Surface Water Ambient Monitoring Program (SWAMP)

Tomales Bay Water Quality Monitoring

Quality Assurance Project Plan

Prepared by

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in collaboration with

A. Marc Commandatore, California Department of Health Services

For the

STATE WATER RESOURCES CONTROL BOARD

December 2007

Phillip D. Smith, Project Manager
David Yong Ph.D, Laboratory QA Officer
Farhad Ghodrati, Contract Manager
Wil Bruhns, Regional Water Quality Control Board QA Officer

1. Approval Signatures

MARIN COUNTY ENVIRONMENTAL HEALTH SERVICES :

Title:	Name:	Signature:	Date:
Project Director and Grant Contact	Philip D. Smith		

REGIONAL WATER QUALITY CONTROL BOARD (WATER BOARD):

Title:	Name:	Signature:	Date:
QA Officer	Wil Bruhns		
Grant Manager	Farhad Ghodrati		

STATE WATER RESOURCES CONTROL BOARD (SWRCB):

Title:	Name:	Signature:	Date:
QA Program Manager	Bill Ray		

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3. Distribution List

Title:	Name (Affiliation):	Tel. No.:	No. of copies:
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Monitoring Leader	A. Marc Commandatore (CDPH)	510-412-4631	1
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RWQCB QA Officer	Wil Bruhns,	510-622-2357	1
Laboratory Director & QA Officer	Dr. David Yong Sonoma County Public Health Laboratory	707-565-4711	1
Preharvest Shellfish & Marine Biotoxin Monitoring Program Supervisor, CDPH	Gregg Langlois, CDPH	510-540-2716	1

4. Project/Task Organization

4.1 Involved parties and roles.

County of Marin, Environmental Health Services (EHS), has received a Prop 13 grant for the East Shore Wastewater Project (03-119-552-0). Among other things, EHS oversees the permitting and installation of onsite wastewater (septic) systems in the County of Marin. The goal of this Prop 13 project is to upgrade/repair the faulty septic systems currently located in existing homes along the shoreline of Tomales Bay in the town of Marshall, CA

The California Department of Public Health (CDPH) oversees compliance with the classification and certification of shellfish growing areas in California. The shellfish areas located in Tomales Bay are immediately offshore of many of the septic systems proposed for repair/upgrade in the East Shore Wastewater Project. A. Marc Commandatore is the CDPH staff responsible for certifying compliance with the provisions of the Shellfish Growing Area certification for Tomales Bay. He is responsible for training the sampling volunteers and reporting the results in accordance with the Monitoring Plan and QAPP.

4.2 Quality Assurance

Mr. Gregg Langlois, CA DPH, will assist with Quality Assurance matters. Mr. Langlois' role is to establish the quality assurance and quality control procedures found in this QAPP as part of the sampling and field analysis. Mr. Langlois will not work with the Quality Assurance Officer for the Sonoma County Public Health Laboratory because the lab is following strict quality assurance procedures in accordance with internal and external quality controls including EPA methods & policy.

Mr. Langlois will also review and assess all procedures during the life of the contract against QAPP sampling requirements. Mr. Langlois will report all findings to A. Marc Commandatore, including all requests for corrective action. Mr. Langlois may stop all actions if there are significant deviations from required practices or if there is evidence of a systematic failure.

4.3 Persons responsible for QAPP update and maintenance.

Changes and updates to this QAPP may be made after a review of the evidence for change by EHS's Project Manager and DHS Coordinator, and with the concurrence of both the Regional Board's Contract Manager and Quality Assurance Officer.

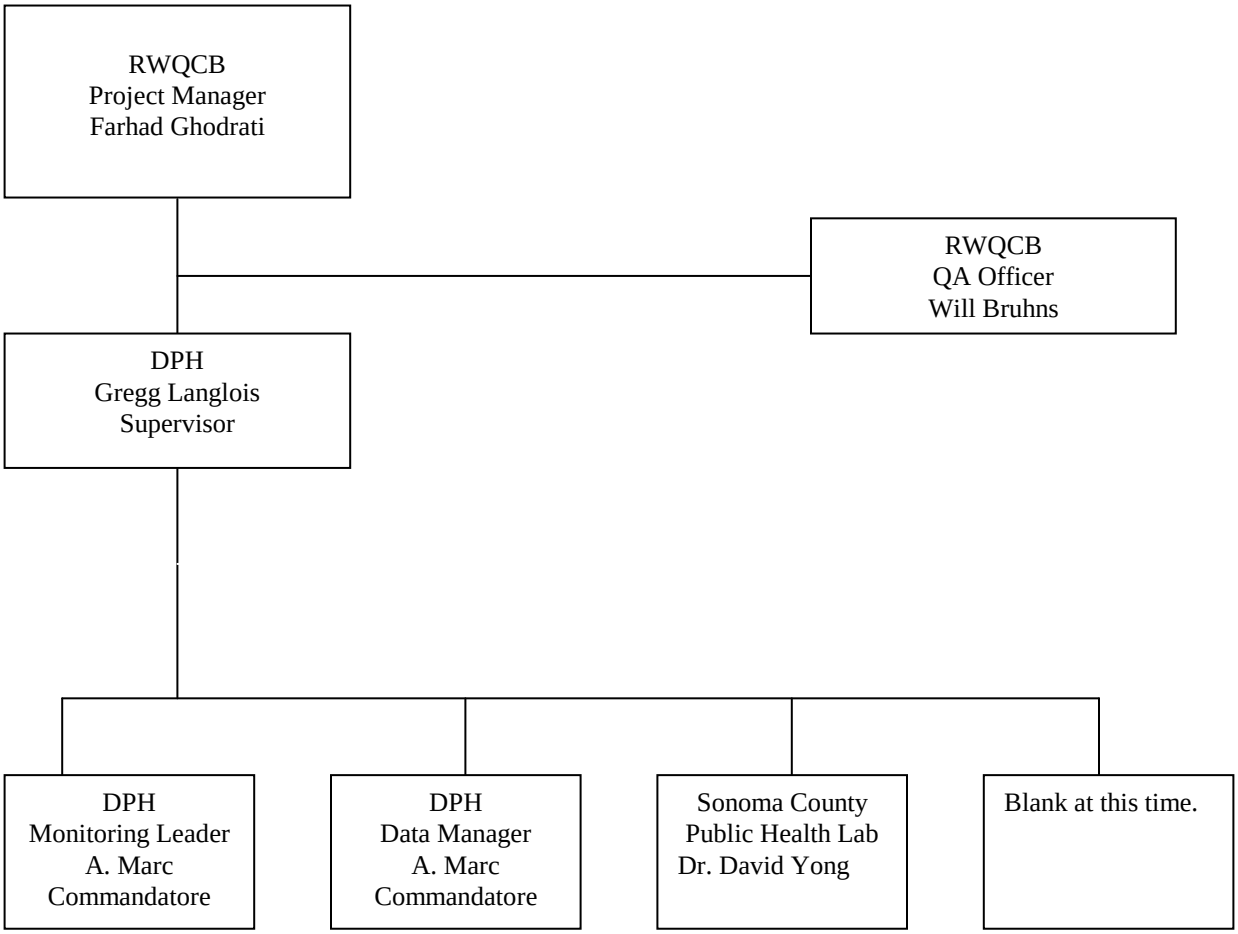
The Project Manager will be responsible for making the changes, submitting drafts for review, preparing a final copy, and submitting the final for signature.

Table 1. Personnel responsibilities.

Name	**Organizational Affiliation**	**Title**	**Contact Information (Telephone number, fax number, email address.)**
Philip Smith	Marin County EHS	Project Manager	415-499-6907 Fax: 415-507-4120 PSmith@co.marin.ca.us
A. Marc Commandatore	CDPH	Coordinator	510-412-4631 Fax: 510-412-4637
Gregg Langlois	CDPH Preharvest Shellfish Protection and Marine Biotoxin Monitoring Program	Program Supervisor	510-412-4631 Fax: 510-412-4637

4.4 Organizational chart and responsibilities

Figure 1. Organizational chart.



5. Problem Definition/Background

5.1 Problem statement.

Tomales Bay, an estuary located in Marin County, supports a variety of threatened and endangered species and sensitive ecosystems including Coho salmon and steelhead habitat and estuarine migration and feeding and resting areas for waterfowl and marine mammals. The Bay also supports active human recreational uses including boating, kayaking and fishing. Tomales Bay supports seven active commercial shellfishing operations (six along the East Shore) and is the State's third largest growing area for commercial shellfishing operation.

The San Francisco Bay Regional Water Quality Control Board (RWQCB) formed the Tomales Bay Shellfish Technical Advisory Committee (TAC) and conducted an “Investigation of Pollution Sources Impacting Shellfish Growing Areas in Tomales Bay” during the 1995-1996 water years. Of the sources of pathogen, human waste carries the highest risk of viral contamination. The most likely source of human pathogens has been identified as faulty sewage and on-site disposal systems (septic systems) from near shore homes along Tomales Bay.

The Shellfish TAC 1995-6 study and the Final Report (2001), and the RWQCB’s Total Maximum Daily Load (TMDL) for Pathogens in Tomales Bay (September 2005), both concluded that fecal coliform levels in all of the Tomales Bay and Watershed sampling stations exceeded the designated water quality objective for Shellfish Harvesting Waters (14 MPN) and, in most cases, exceeded the water quality objective for Non-Contact Water Recreation (200 MPN). Onsite wastewater systems or septic systems have been identified as one of the primary sources contributing to the exceedances of bacteria.

County of Marin, EHS, received a grant from the State Board to update and repair septic systems along the shoreline of Tomales Bay. EHS will use water quality data to help assess the baseline water quality before the septic repairs and after completion of the repairs.

Bay water samples collected by oyster growers (through oversight of DHS) and analyzed by County of Sonoma Public Health Laboratory show that water quality in Tomales Bay have levels of fecal coliform that exceed the safe levels for shellfish harvesting an average of 70 days per year. These exceedances typically occur during storm events.

5.2 Decisions or outcomes.

This project will provide information about the Bay's bacteria levels through field monitoring of fecal coliform levels at 17 stations in Tomales Bay. This information will be integrated with previously collected information and used for trend analysis.

Monitoring fecal coliform levels before and after the project implementation will provide preliminary information about the project's success in reducing bacteria contamination of Tomales Bay and to determine if the Bay is safe for shellfish harvesting.

5.3 Water quality or regulatory criteria

- The Regional Board's Basin Plan designates the beneficial uses of Tomales Bay to include shellfish harvesting and recreation.

Bacteria

The project will use the ambient standards for fecal coliform of 43 MPN/100ml, the shellfishing harvest limit.

Beneficial Use	**Fecal Coliform (MPN/100ml)**
Water Contact Recreation	Geometric mean < 200 90th percentile < 400
Shellfish Harvesting	Median < 14 [a] and 90th percentile < 43

Notes:

a. Based on a minimum of five consecutive samples equally spaced over a 30-day period.

6. Project/Task Description

6.1 Work statement and produced products

The project will measure fecal coliform at 17 shellfishing locations in Tomales Bay. DHS (in coordination with the oyster growers) will monitor water quality at the following sites (see table and maps)

STATION #	LOCATION
WQ Station 2	Lease M-430-10 + M-430-11, Near Walker Cr. delta
WQ Station 7	Lease M-430-12, M-430-13, MOC M-430-19 area of M-430-05 N of Tomasini Pt.
WQ Station 12	Wet storage intake, Marshall
WQ Station 31	Lease M-430-15, West end off Toms PT
WQ Station 32	Lease M-430-15, N side, central
WQ Station 33	Unclassified area of Lease M-430-15

STATION #	LOCATION
WQ Station 8	Lease M-430-05, s of Tomasini Point
WQ Station 9	Lease M-430-05, wet storage intake
WQ Station 10	Lease M-430-05, cove north of Millerton Point
WQ Station 11	Lease M-430-05, S end near Millerton Point

STATION #	LOCATION
WQ Station 40	Lease M-430-04, NW side Center, Walker Creek delta
WQ Station 41	Lease M-430-04, SW side closest to M-430-17, and M-430-02, Walker Creek delta
WQ Station 47	Lease M-430-04, NE side closest to M-430-17, Walker Creek delta

STATION #	LOCATION
WQ Station 6	Lease M-430-06 Marconi Cove

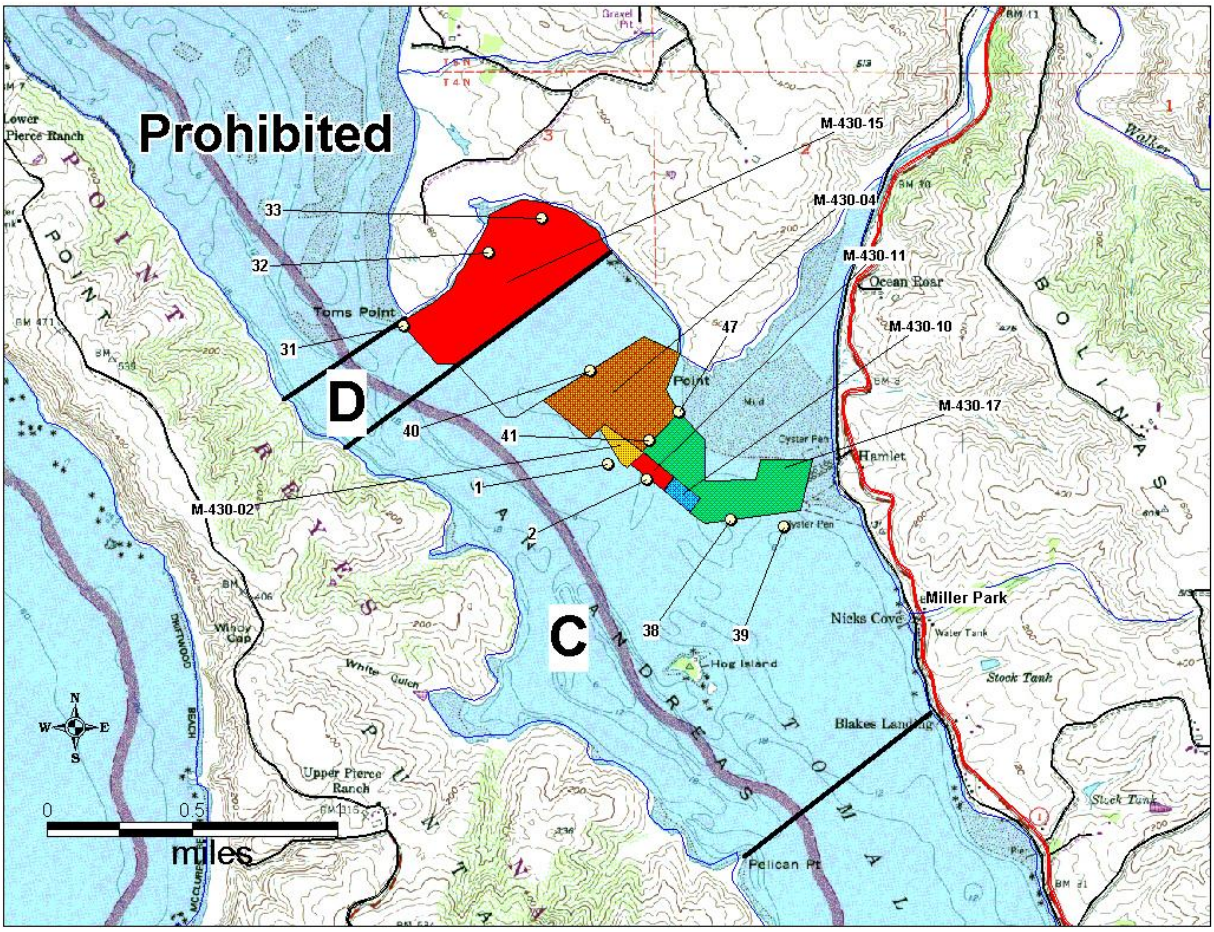


Figure 1A. Outer Tomales Bay Leases and Water Quality Sampling Sites.

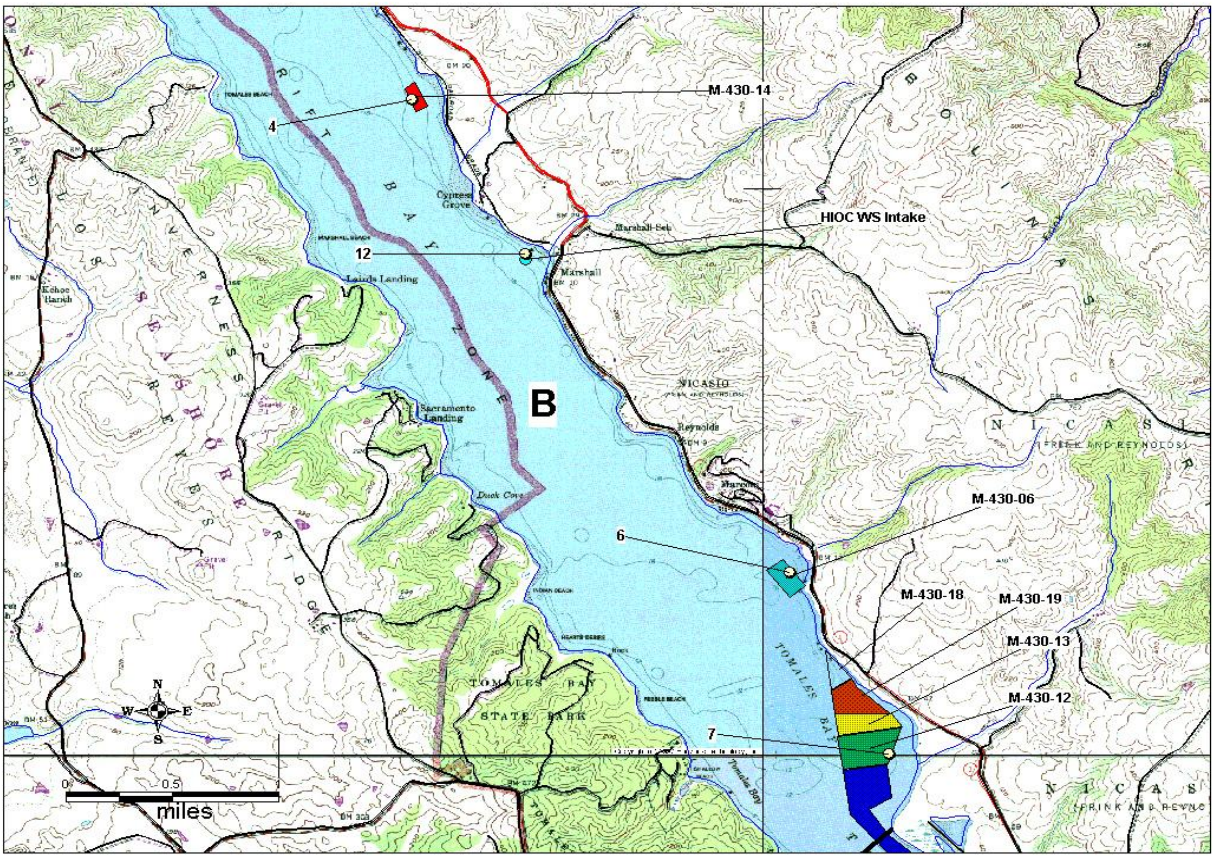


Figure 1B. Mid Tomales Bay Leases and Water Quality Sampling Sites.

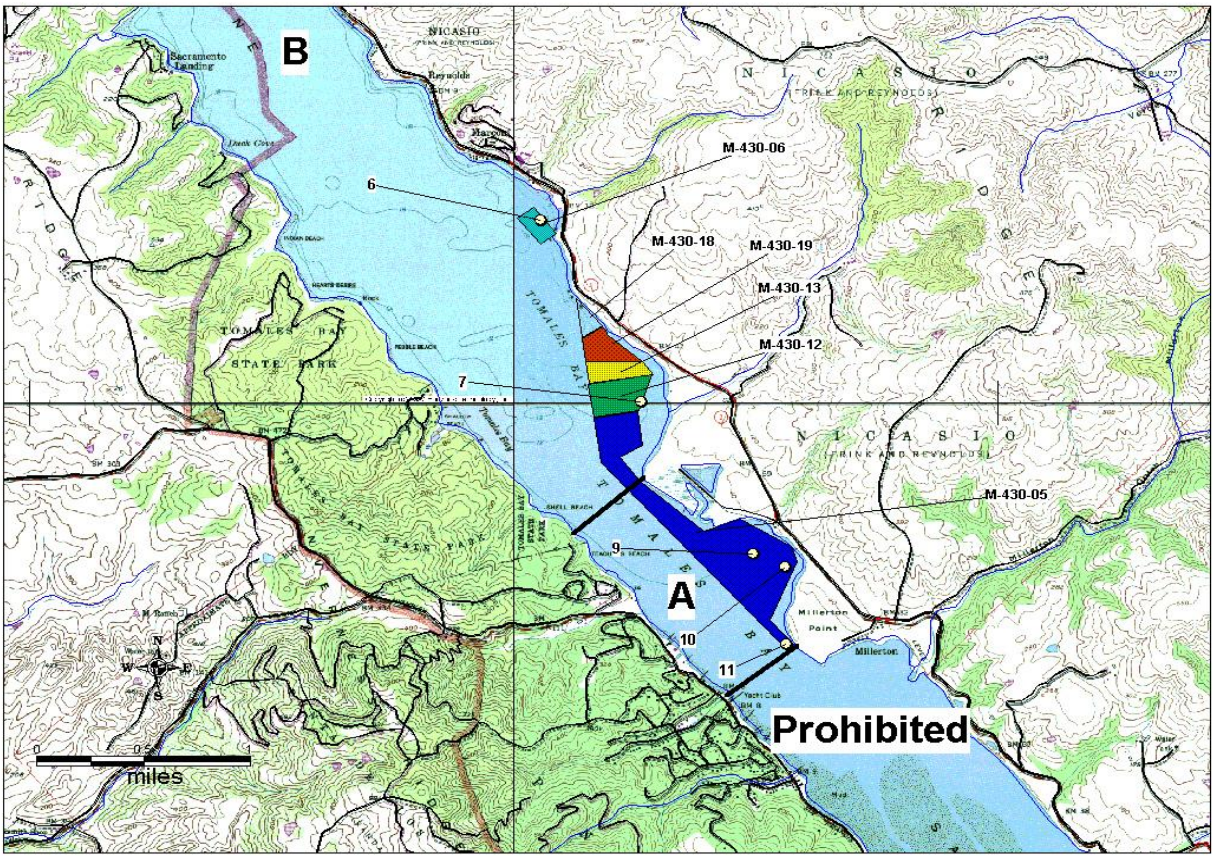


Figure 1C. Inner Tomales Bay Leases and Water Quality Sampling Sites.

See Appendix A for a description of monitoring frequency and sampling schedule.

As required in the grant agreement, EHS will provide semiannual progress reports, including collected data, during the life of the project. At the end of the project, EHS will provide a full listing and summary of the data collected including a trend analysis using all data collected.

6.2. Constituents to be monitored and measurement techniques.

Monitoring will consist of field samples taken for analysis of fecal coliform content, which will be determined using the MPN method. Sonoma County Public Health Laboratory will perform all analyses in the course of this project.

6.3 Project schedule

Table 2. (Element 6) Project schedule timeline.

Activity	Date (MM/DD/YY)		Deliverable	Deliverable Due Date
	Anticipated Date of Initiation	Anticipated Date of Completion		
Recruit and train volunteers	done	Done	NA	NA
Monitoring at 17 sites on Tomales Bay	ongoing	4/1/09	Semiannual report	By 30 days after the completion of each monitoring series
Summarize data	4/15/09	5/1/09	Complete data set and summary	In progress
Final Report	6/1/09	6/1/09	Report	6/1/09

6.4 Geographical setting

Tomales Bay is an estuary located in the unincorporated area of Marin County. Surrounding land uses include Point Reyes National Seashore, unincorporated agricultural land, and the communities of Nicasio, San Geronimo, Inverness and Point Reyes Station.

A GIS map showing the locations of the sites in the watershed is provided above.

6.5 Constraints

Monitoring frequency will be done monthly systematic random sampling design for compliance monitoring of growing area water quality. Major storm events may delay accessibility to the water sample sites.

7. Quality Objectives and Criteria for Measurement Data

Measurement Quality Objectives

This section identifies how accurate, precise, complete, comparable, sensitive and representative our measurements will be.

Measurement quality objectives for conventional water quality parameters are summarized in Table 7-1. This project is not set up or required to input into the SWAMP database, therefore the MQOs may differ from MQOs specified in Appendix C of the QAMP. For this project, the MQOs are bacteria. Whenever possible the methods with the greatest sensitivity and lowest detection limit will be employed as the primary methods. Methods with lesser sensitivity and higher detection limits will be used for field confirmations or as back-up methods in the case that the primary methods are not available or functioning properly for a particular sampling event.

Table 7.1. Measurement Quality Objectives for Conventional Water Quality Parameters

Parameter	Method/Range	Units	Detection Limit	Sensitivity*	Precision	Accuracy	Complete-ness
Temperature	Electronic meter/probe	^{o} C	-5	0.1 ^{o} C	$\pm$ 0.5 ^{o} C	$\pm$ 0.5 ^{o} C	90%

CDPH will monitor coliform bacteria in partnership with the oyster growers in Tomales Bay.

7.1. Accuracy

Accuracy describes how close the measurement is to its true value. Accuracy is the measurement of a sample of known concentration and comparing the known value against the measured value. The accuracy of chemical measurements will be checked by performing tests on standards at the quality control sessions held twice a year. A standard is a known concentration of a certain solution. Standards can be purchased from chemical or scientific supply companies. Standards might also be prepared by a professional partner, e.g. a commercial or research laboratory. The concentration of the standards, known to the volunteer leader, will be unknown to the monitors until after measurements are determined. The concentration of the standards should be within the mid-range of the equipment.

7. 2. Comparability

Comparability is the degree to which data can be compared directly to similar studies. In preparing their final report, EHS will use the methods described in the following resource documents to ensure that their data can be compared to others:

- SWRCB's SWAMP QAPP Template,
- SWRCB Clean Water Team Compendium for Water Quality Monitoring and Assessment,
- U.S. EPA's Volunteer Monitoring Manuals for Streams, Lakes or Estuaries, and
- San Francisco Estuary Institute's Volunteer Monitoring Protocols.

Before modifying these methods, or developing alternative or additional methods, technical advisors will evaluate and review the effects of the potential modification. It will be important to address their concerns about data quality before proceeding with the monitoring program.

7. 3. Completeness

Completeness is the fraction of planned data that must be collected in order to fulfill the statistical criteria of the project. There are no statistical criteria that require a certain percentage of data. However, it is expected that 80% of all measurements could be taken when anticipated. This accounts for adverse weather conditions, safety concerns, and equipment problems.

We will determine completeness by comparing the number of measurements we planned to collect compared to the number of measurements we actually collected that were also deemed valid. An invalid measurement would be one that does not meet the sampling methods requirements and the data quality objectives. Completeness results will be checked quarterly. This will allow us to identify and correct problems.

7. 4. Precision

The precision objectives apply to duplicate and split samples taken as part of a QC session or as part of periodic in-field QC checks. Precision describes how well repeated measurements agree. The evaluation of precision described here relates to repeated measurements taken by either different volunteers on the same sample (at quality control sessions) or the same volunteer analyzing replicate samples (in the field). Sampling variability will not be covered in this section.

7. 5. Representativeness

Representativeness describes how relevant the data are to the actual environmental condition. Problems can occur if:

- Samples are taken in a stream reach that does not describe the area of interest (e.g. a headwaters sample should not be taken downstream of a point source),
- Samples are taken in an unusual habitat type (e.g. a stagnant backwater instead of in the flowing portion of the creek),
- Samples are not analyzed or processed appropriately; causing conditions in the sample to change (e.g. water chemistry measurements are not taken immediately).

Representativeness will be ensured by processing the samples in accordance with Section 10, 11 and 12, by following the established methods, and by obtaining approval of this document.

7. 6. Method Detection Limit and Sensitivity

The Method Detection Limit is the lowest possible concentration the instrument or equipment can detect. This is important to record because we can never determine that a pollutant was not present, only that we could not detect it. Sensitivity is the ability of the instrument to detect one concentration from the next. Detection Limits and Sensitivities are noted in Table 7.1.

8. Training Requirements

Training will be overseen and administered by the project manager (Philip Smith) and Marc Commandatore. All training materials will be sent to the QA officer for prior review and approval.

Marc Commandatore, the CDPH staff person responsible for overseeing the monitoring efforts has been nationally certified in the Shellfish Sanitation Program and has participated in numerous trainings in water quality monitoring. He continues to participate in monitoring training programs as appropriate.

CDPH staff will provide training assistance to persons designated by the Company in the correct collection and handling techniques for shellfish and shellfish growing water samples, as outlined in attached sampling protocol. CDPH will conduct periodic site visits to verify that the grower is complying with the requirements of this sampling plan.

Mr. Commandatore has personally trained the oyster operators and evaluated their performance of analytical and sampling techniques, by comparing their results to known values, and to results obtained by trainers and other trainees. He has identified specific qualified volunteers for each of the oyster lease areas.

Training records for laboratory technicians will be kept at any of these three locations:

Sonoma County Public Health Laboratory
Contact: Dr. David Yong, Director of Laboratory Services

California Department of Health Care Services & California Dept. of Public Health, Microbial Diseases Laboratory, Environmental Microbial Diseases Laboratory Section. 850 Marina Bay Parkway, Richmond, CA 94804
Contact: Rita Brenden, Ph.D, Chief
Voicemail: (510) 412-3756 email: rbrenden@dhs.ca.gov

FDA Food Pathogens Laboratory
Contact: Gary Hartman, Lab Services Director

Staff training records for field sampling staff will be kept at the CDPH offices in Richmond, CA. Contact: A Marc Commandatore.

9. Documentation and Records

All field results will be recorded at the time of completion, using the field data sheets (see Appendix 2). Data sheets will be reviewed for outliers and omissions before leaving the sample site. Data sheets will be signed after review by the CDPH staff. Data sheets will be stored in hard copy form at CDPH's home office. Field data sheets will be archived for three years from the time they were collected.

All voucher collections, completed data quality control forms and maintenance logs will also be kept at the CDPH home office. All project records will be kept in a hard copy format in addition to electronic as a backup.

Any revisions or updates to the QAPP will be incorporated into the document as underline/strikethrough. The edited version will be sent by email to all of those on the distribution list by the project manager's assistant.

The California Department of Public Health, Division of Drinking Water and Environmental Management, Environmental Management Branch, Environmental Health Services Section, Preharvest Shellfish Protection and Marine Biotoxin Monitoring Program hereinafter abbreviated to CDPH, will retain records of sample collection, field analyses, and laboratory analyses. Samples sent to the Sonoma County Public Health Laboratory will include a Chain of Custody (COC) form. CDPH generates records for sample receipt and storage, analyses, and reporting.

CDPH has an existing database of field measurements from previous studies. Environmental Scientist Marc Commandatore maintains this database. Mr. Commandatore will also maintain the database of water quality information collected during this project.

CDPH records pertinent to this project will be maintained at CDPH's Richmond office. Copies of all records held by CDFG will be provided to CDPH and stored in the project file.

Copies of this QAPP will be distributed to all parties whose names appear in the distribution list in Element 3 of this QAPP. Any future amended QAPPs will be held and distributed in the same fashion. All originals, and subsequent amended QAPPs, will be held at Marin County Environmental Health Services Office. Copies of versions, other than the most current, will be discarded so as not to create confusion.

Persons responsible for maintaining records for this project are as follows. Marc Commandatore of CDPH Shellfish Unit will maintain all sample collection, sample transport, chain of custody, and any field analysis forms. Dr David Yong, Sonoma County Public Health Laboratory Director, or his designee will maintain all records associated with the receipt and analysis of samples analyzed for bacteria. A. Marc Commandatore will maintain the database at CDPH's Richmond office; data management procedures including back-up plans for data stored electronically are outlined in Element 19 of this QAPP. Project Director Philip Smith will oversee the actions of these persons and will arbitrate any issues relative to records retention and any decisions to discard records.

All records will be passed to the Regional Board Project Manager, Farhad Ghodrati, at project completion. Copies of the records will be maintained at Marin County Environmental Health Services and CDPH for five years after project completion then discarded, except for the database, which will be maintained for a period of more than five years.

One data report will be produced. The final data report will summarize the activities conducted to generate that data, including sample collection, storage and analysis. The data report will contain, as an appendix, a CD containing, in tabular format, all data generated during this project. The report will also include the results of the analysis of QC samples and an assessment of the overall quality of the data generated in comparison to the goals described in the QAPP. A preliminary draft of the data report should be submitted to Farhad Ghodrati at the RWQCB by May 1st, 2009. Following a review period of no longer than two weeks, Regional Board staff will submit any comments they have on the preliminary draft. The monitoring report will be finalized by June 30th, 2009.
Electronic records on all servers at the Sonoma County Public Health Laboratory are incrementally backed up on a daily basis by professional Information Technology staff. A full backup is performed each week on all servers. The weekly backup is kept on site for 2 weeks and then rotated to an offsite storage service.

10. Sampling Process Design

10.1. Rationale for Selection of Sampling Sites

Sampling sites are indicated on the maps provided above:

- access is safe,
- sample can be taken in main river current or where homogeneous mixing of water occurs,
- sample is representative of the part of the water body of interest,
- location complements or supplements historical data,
- location represents an area that possesses unique value for fish and wildlife or recreational use.

Any reference sites are chosen upstream of any potential impact. A site chosen to reflect the impact of a particular discharge, tributary or land use is located downstream of the impact where the impact is completely integrated with the water, but upstream of any secondary discharge or disturbance.

Sampling sites may become temporarily inaccessible, usually because of storm events. If a sampling site should become inaccessible, resampling will take place as soon as the weather permits or during the next monthly sampling period, whichever is sooner.

10.2. Sample Design Logistics

Volunteers are instructed to work in teams of at least two people.

Safety measures will be discussed with all volunteers. Safety issues are included in the U.S. EPA Volunteer Stream Monitoring Manual (1997).

10.3 Sample Numbers

The expected number of samples over the duration of the project will be 864, which is the total number of monthly sampling of 18 sites over four years (12 X 18 X 4 = 864).

11.0 SAMPLING METHOD REQUIREMENTS

Table 11.1 describes the sample holding container, sample preservation method, and maximum holding time for each parameter.

Table 11.1 Sampling Method Requirements

Parameter	Sample Container	Preferred / Maximum Holding Times
Biological Samples		
Bacteria	sterile plastic sampling bottle or whirl-pak	Refrigerate to 4 degrees C in the dark; delivered to the lab within 4 hours, start analysis within 6 hours

Rejection of samples

If a violation of holding time or temperature occurs, the affected samples are rejected. Samplers are advised that seawater samples must be submitted to the lab as soon as possible and in all cases the testing must be completed within 30 hours after the sample collection. These requirements are documented In the Sonoma County Public Health Laboratory SOP # WA 012.00, which is excerpted here. If the sample holding time has been exceeded, or will be exceeded before the test can be

completed, the rejection is documented as follows: The client is immediately notified and a report with the result “Unacceptable” is issued with the phrase “Please resubmit sample because maximum holding time is exceeded.”

12.0 SAMPLE HANDLING AND CUSTODY PROCEDURES

12.1. Sample Handling

Identification information for each sample will be recorded on the field data sheets (see Appendix 2) when the sample is collected. Samples that are not processed immediately, like water samples for bacteria analysis, will be labeled with the water body name, sample location, sample number, date and time of collection, and sampler's name.

12.2. Custody Procedures

When samples are transferred from one volunteer to another member of the same organization for analysis, or from the citizen monitoring group to an outside professional laboratory, then a Chain of Custody (COC) form should be used. This form identifies the water body name, sample location, sample number, date and time of collection, sampler's name, and method used to preserve sample (if any). It also indicates the date and time of transfer, and the name and signature of the sampler and the sample recipient. The original COC will always be kept with the sample. Once the sample has processed, analyzed and the appropriate QA/QC has been completed, a copy of the Chain of Custody form will be kept on file at the CDPH home office.

12.3. Disposal

Field data sheets (in hard copy and electronic form) will be kept for 5 years before disposal or archiving to another location.

13.0 ANALYTICAL METHODS REQUIREMENTS

Bacterial analysis is performed at the Sonoma County Health Laboratory using the CDPH Environmental Laboratory Accreditation Program (ELAP) standard methods.

Table 13.1 Analytical Methods for Water Quality Parameters

Parameter	Method	Modification	Reference (a)
Fecal Coliform Bacteria	MPN	None	9223/SOP1103

14.0 QUALITY CONTROL REQUIREMENTS

Quality control samples will be taken to ensure valid data are collected. Depending on the parameter, quality control samples will consist of blanks, replicate samples, and split samples. In addition, quality control sessions (a.k.a. intercalibration exercises) will be held twice a year to verify the proper working order of equipment, refresh volunteers in monitoring techniques and determine whether the data quality objectives are being met.

14.1 Blanks, Replicates, Split Samples, and Standardization

Bacteria Analysis: CDPH will monitor coliform bacteria in conformance with the standards and guidelines in the National Shellfish Sanitation Program (NSSP) Model Ordinance (1999). The quality control program for bacteria analysis consists of a demonstration of capability, media quality control, and the analysis of duplicates as a continuing check on performance. The laboratory is required to maintain performance records that define the quality of the data that are generated.

The laboratory will run quality control with every batch of testing. If analytical control limits are exceeded, and the sample is not expired, the test is repeated. Otherwise, new samples are necessary and staff must, investigate the problem, correct and document according to ELAP procedures. If there is a violation of holding time or temperature, the sample is rejected.

Internal quality control (QC) is achieved by analyzing a series of duplicate, blank, matrix spike, and matrix spike duplicate samples to ensure that analytical results are within the specified QC objectives. The QC sample results are used to quantify precision and accuracy and identify any problem or limitation in the associated sample results. The internal QC components of a sampling and analyses program will ensure that data of known quality are produced and documented. The quality control assessments used in the water quality monitoring program are discussed below. Quality control acceptance limits and frequencies are summarized in Tables 11 and 12 and Appendix 2. Detailed procedures for preparation and analysis of quality control samples are provided in the analytical method documents in Appendices 5-9.

14.1 Measurement Quality Objectives and Quality Assurance Objectives

Measurement Quality Objectives (MQOs) and Quality Assurance Objectives (QAOs) are related data quality planning and evaluation tools for all sampling and analysis activities. A consistent approach for developing and using these tools is necessary to ensure that enough measurements are produced and are of sufficient quality to make decisions for this study.

MQOs and Data Use Planning

MQOs specify the underlying reason for collection of data, data type, quality, quantity, and uses of data collection. For this program, data is needed for identification of sources and evaluation of management practices effectiveness.

Measurement Quality Category

Measurements will be analyzed using standard US Environmental Protection Agency (EPA) methods, or other reference methods approved by Regional Board or CDPH staff. Measurements are analyte-specific. Each method has standardized Quality Control and documentation requirements that provide supporting information necessary to verify all reported results.

14.3 Precision Accuracy Representativeness Completeness (PARC) Definitions and Calculations

Precision

Precision measures the reproducibility of repetitive measurements. Precision is evaluated by calculating the RPD between duplicate spikes, duplicate sample analyses or field duplicate samples and comparing it with appropriate precision objectives established in this QAPP. Analytical precision is developed using repeated analyses of identically prepared control samples. Field duplicate samples analyses results are used to measure the field QA and matrix precision. Interpretation of precision data must include all possible sources of variability. The precision objectives for this QAPP are listed in Table 4.

Accuracy

Accuracy measures correctness, or how close a measurement is to the true or expected value. Accuracy is measured by determining the percent recovery of known concentrations of analytes spiked into field sample or reagent water before

extraction. The stated accuracy objectives for Laboratory control spikes or matrix spikes should reflect the Qualitative Objectives anticipated concentrations and/ or middle of the calibration range. The accuracy objectives for this QAPP are listed in Table 4. Accuracy can be calculated with the following formula:

Representativeness

Representativeness is obtained by using standard sampling and analytical procedures listed and referenced in this QAPP to generate data that are representative of the sites.

Comparability

The comparability of data produced by and for this program is predetermined by the commitment of its staff and laboratory to use standardized methods, including EPA-approved analytical methods, or documented modifications thereof, which provide equal or better results. These methods have specified units in which the results are to be reported.

Measurements are made according to standard procedure, or documented modifications thereof which provide equal or better results, using common units such as Celsius, feet, feet/sec, mg/L, µg/L, mg/kg, etc. Analytical procedures are set by the USEPA approval list published in 40 CFR 136 (USEPA 2004(a)).

Completeness

Completeness is calculated for each method and matrix for an assigned group of samples. Completeness for a data set is defined as the percentage of unqualified and estimated results divided by the total number of the data points. This represents the usable data for data interpretation and decision-making. Completeness does not use results that are qualified as rejected or unusable, or that were not reported as sample loss or breakage. The overall objective for completeness is 90% for this project (Table 4). Completeness can be calculated with the following formula:

$$\%C = \left[1 + \left(\frac{Y - X}{X}\right)\right] x100$$

Where: %C = Percent completeness
Y = The number of valid data points
X = The total possible number of data points.

14.4 Field Quality Control

Field QC samples are used to assess the influence of sampling procedures and equipment used in sampling. They are also used to characterize matrix heterogeneity. For basic water quality analyses, quality control samples to be prepared in the field will consist of field blanks, field duplicates and matrix spikes. The number quality control samples are set to achieve an overall rate of at least 12% of all analyses for a particular parameter. The external QA samples are rotated among sites and events to achieve the overall rate of 4% each of field duplicate samples, field blanks, and matrix spikes. The frequency and acceptance limits of field quality control samples for this project are listed in Table 11.

14.5 Laboratory Quality Control

Laboratory QC is necessary to control the analytical process within method and project specifications, and to assess the accuracy and precision of analytical results

Quality control for the fecal coliform test using A-1 medium tests the selectiveness, the nutritive capacity, and the sterility of the media. Escherichia coli (ATCC# 25922) and Enterobacter aerogenes are the quality control organisms used for this test. E. coli is the positive control; Enterobacter aerogenes is the negative control. There is also an uninoculated sterile control to check the sterility of the media. Controls are run with every set of samples received regardless of whether the batch of media has already passed quality control.

Detailed procedures and criteria for acceptance of QA test results are listed on page 4 of 6 on SOP WA008.00 in Appendix 3.

Table 9. Measurement Quality Objectives for fecal coliform analysis.

QA Procedure	Parameter	Frequency	Criterion	Corrective Action
Method Blanks (Sterility Checks)	Contamination	1 per batch	< RL	Identify contamination source. Clean equipment and slides. Check reagents. Re-analyzed blank.
Negative Control Samples	Contamination	1 per culture medium or reagent lot	< RL	Identify source. Clean equipment and prepare new media. Re-examine negative control.
Positive Control Samples	Assay function	1 per culture medium or reagent lot	≥ RL	Identify and correct problem. Re-examine negative control.
Assess percent of data successfully collected	Data Completeness	1 per planned sample event	90%	Reschedule sample events as necessary or appropriate.

15.0 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

A maintenance log is kept by the monitoring volunteers. This log details the dates of instrument and sampling gear inspection, calibrations performed in the laboratory, battery replacement, the dates reagents and standards are replaced, and any problems noted with instruments, samplers, or reagents.

Lab equipment is monitored either daily or twice a day for temperature; corrective action is to repair the instrument and document actions according to ELAP requirements. Responsible party is Lisa Critchett, Microbiologist II or Dr. David Yong, Laboratory Director.

Equipment Requiring Maintenance or Testing

1. Autoclave

2. Incubator and Water Bath

Detailed preventive maintenance and corrective actions for the equipment listed above is contained in Appendix 5.

A full complement of spare parts for equipment is kept on hand at the laboratory.

Instrument / Equipment Testing, Inspection and Maintenance

Field measurement equipment will be checked for operation in accordance with the manufacturer's specifications. This includes battery checks, routine replacement of membranes and cleaning of conductivity electrodes. Equipment will be inspected when first handed out and when returned from use for damage. Sonoma County Public Health Lab maintains its equipment in accordance with its SOPs, which include those specified by the manufacturer and those specified by the method

16.0 INSTRUMENT CALIBRATION / STANDARDIZATION AND FREQUENCY

No instruments will be used in the field – only water samples drawn.

17.0 INSPECTION/ACCEPTANCE REQUIREMENTS

All sampling materials will be managed in the manner provided in Appendix A. All supplies (including boat trays, bottles and pipettes) will be inspected upon receipt by the laboratory staff.

Gloves, sample containers, and any other consumable equipment used for sampling will be inspected by the sampling crew on receipt and will be rejected and/or returned if any obvious signs of contamination (torn packages, etc.) are observed. Inspection protocols and acceptance criteria for laboratory analytical reagents and other consumables are documented in the SCPH Lab Quality Assurance Manual. The laboratory QA Manual is available for review at the laboratory.

At the laboratory, the following individuals are assigned to inspect and accept or reject supplies and consumables: Frances Summers, Carol DuBay and Russell Thompson.

18.0 DATA ACQUISITION REQUIREMENTS

18.1. Professional Analytical Data

Only certified analytical laboratories or academic laboratories (with approval of State and/or Regional Board staff) will be used for quality assurance checks and analysis of field samples. Technical advisors will review all data collected by citizen monitors and analyzed by these laboratories. Technical advisors may also chose to evaluate the laboratories own quality control data to ensure data validity.

18.2. Non-Direct Measurements

There are no non-direct measurements as part of this sampling effort.

19.0 DATA MANAGEMENT

19.1 Data Production, Storage and Analysis

Field data sheets are checked in the field by the CDPH staff. The CDPH Staff will identify any results where holding times have been exceeded, sample identification information is incorrect, samples were inappropriately handled, or calibration information is missing or inadequate. Such data will be marked as unacceptable by the CDPH staff and will not be entered into the electronic data base.

Independent laboratories will report their results to the CDPH Staff. The coordinator will verify sample identification information, review the chain-of-custody forms, and identify the data appropriately in the database. These data are also reviewed by the Quality Assurance Officer and technical advisors quarterly.

The data manager will review the field sheets and enter the data deemed acceptable by the CDPH staff and the technical advisors. Upon entering the data, the data manager will initial, date, and archive the field data sheets. Data will be entered into a spreadsheet (MS Excel) or a database (MS Access). Following initial data entry the data manager will review electronic data, compare to the original data sheets and correct entry errors. After performing data checks, and ensuring that data quality objectives have been met, data analysis will be performed. This analytic data will not be uploaded into the SWAMP database.

Raw data will be provided to the Regional Board Contract Manager in electronic format once every six months as required per the grant agreement. Appropriate quality assurance information may be provided upon request.

20.0 ASSESSMENT AND RESPONSE ACTIONS

Review of all field and data activities is the responsibility of the CDPH staff, with the assistance of technical advisors. The CDPH staff or a technical advisor will accompany the oyster growers' monitors on at least one of their first 5 sampling trips. If errors in sampling technique are consistently identified, retraining may be scheduled more frequently.

All field and laboratory activities, and records may be reviewed by State and EPA quality assurance officers as requested.

The individuals listed in Element 8 are responsible for internal laboratory assessments. CCDPH receives project assessment findings as annual and triennial sanitary surveys of shellfish growing areas.

Measurement data must be consistently assessed and documented to determine whether project quality assurance objectives (QAOs) have been met, quantitatively assess data quality and identify potential limitations on data use. Assessment and compliance with quality control procedures will be undertaken during the data collection phase of the project:
The laboratory is responsible for following the procedures and operating the analytical systems within the statistical control limits. These procedures include proper instrument maintenance, calibration of the instruments, and the laboratory QC

sample analyses at the required frequency (i.e., method blanks, laboratory control samples, etc.). Associated QC sample results are reported with all sample results so the project staff can evaluate the analytical process performance.
All project data must be reviewed as part of the data assessment. Review is conducted on a preparation batch basis by assessing QC samples and all associated field sample results.
Project data review established for this project includes the following steps:
Initial review of analytical and field data for complete and accurate documentation, chain of custody procedures, analytical holding times compliance, and required frequency of field and laboratory QC samples;
Evaluation of analytical results to identify random and systematic contamination;
Comparison of all duplicate results with project objectives for precision and accuracy;
Calculating completeness by matrix and analytical method.

Corrective Actions
During the course of sample collection and analysis in this study, the laboratory supervisors, analysts, and contractor project supervisor and team members will make sure that all measurements and procedures are followed as specified in this QAPP, and measurements meet the prescribed and acceptance criteria. If a problem arises, prompt action to correct the immediate problem and identify its root causes is imperative. Any related systematic problems must also be identified.

Problems about analytical data quality that require corrective action are documented in the laboratories' QA/QC Guidance. The following is excerpted from the Sonoma County Public Health Laboratory Shellfish Quality Assurance Manual (Appendix 5):
Corrective action is taken any time that there is a deviation from protocol or SOP. If there is any problem or error, immediate action must be taken to find out the core cause. The problem should be fixed as soon as possible. The problem should also be evaluated to determine if further action has to be taken over time to definitively fix the problem. Corrective actions must be documented in writing. This written summary must include a critique as to whether the corrective action was effective or not.

21.0 REPORTS

The technical advisors will review draft reports to ensure the accuracy of data analysis and data interpretation. Raw data will be made available to data users per their request. Every six months, the project manager will send an electronic copy of the raw data to the grant manager at the Regional Water Board. The QA status report will be written by the project manager and sent to the grant contract manager at the Regional Board as needed.

Final Report
Marin County EHS will prepare a final report. The elements described below will be addressed and included in the report:

- Description of the project including the number of samples, analyses, completeness and any significant problems or occurrences that influence data use
- The QA/QC activities performed during this project
- QC sample results, type and number of samples including the results that did not meet the project objectives and the impact on usability
- Tables of analytical results

22.0 DATA REVIEW, VALIDATION AND VERIFICATION

Data sheets or data files are reviewed quarterly by the technical advisors to determine if the data meet the Quality Assurance Project Plan objectives. They will identify outliers, spurious results or omissions to the citizen monitoring leader. They will also evaluate compliance with the data quality objectives. They will suggest corrective action that will be implemented by the Monitoring Leader. Problems with data quality and corrective action will be reported in final reports.

23.0 VALIDATION AND VERIFICATION METHODS

As part of standard field protocols, any sample readings out of the expected range will be reported to the CDPH staff. A second sample will be taken as soon as possible to verify the condition. If the data is invalid, then the data will be noted

(flagged) on the data sheet. We will take further actions to trace the sources of error, and to correct those problems. If the error is a result of improper monitoring procedures, then we may re-train monitors until their performance is acceptable. It is the responsibility of the Coordinator to re-train volunteers until performance is acceptable.

24.0 RECONCILIATION WITH MQOS

Technical Advisors working with the CDPH will review data quarterly to determine if the measurement quality objectives (MQOs) have been met. This data will not be entered into the SWAMP database, nor is it required to be included in the database. If data do not meet the project's specifications, the following actions will be taken. First, the technical advisors working with the Monitoring Leader will review the errors and determine if the problem is equipment failure, calibration/maintenance techniques, or monitoring/sampling techniques. They will suggest corrective action. If the problem cannot be corrected by training, revision of techniques, or replacement of supplies/equipment, then the technical advisors will review the MQOs and determine if the MQOs are feasible. If the specific MQOs are not achievable, they will determine whether the specific MQO can be relaxed, or if the parameter should be eliminated from the monitoring program. Any revisions to MQOs will be appended to this QA plan with the revision date and the reason for modification. The appended QAPP will be sent to the quality assurance panel that approved and signed this plan. When the appended QAPP is approved, the Monitoring Leader will work with the data coordinator to ensure that all data meeting the new MQOs are entered into the database. Archived data can also be entered.

The uncertainty of validated data will be evaluated by the sampling manager and training officer as needed. The determination will then be made if replicate samples should to be taken and/or analytic laboratory tests re-run as corrective actions.

APPENDIX 1. SAMPLING PROTOCOL & S.O.P.

SAMPLING PROTOCOL
FOR
SHELLFISH GROWING AREA WATER QUALITY MONITORING
(Example from instructions provided to Hog Island Oyster Company.

A. EQUIPMENT AND SUPPLIES NEEDED BY SAMPLER:

1. Sterile water sample bottles (approximately 110 mL or larger size), with numbered labels, 1 per sample plus several extras.
2. Sample examination forms (i.e., lab slips, see Figure 3), 1 per sample, or other appropriate form. [NOTE: Appropriate sample bottles and lab slips may be obtained from the certified shellfish laboratory at which Grower has established an account.]
3. Water sampling wand (a broom handle with a radiator hose clamp bolted to one end to hold a sample bottle is sufficient).
4. Water thermometer, Celsius, capable of reading to nearest 1/2 degree.
5. Water bucket (optional).
6. Cooler or insulated shipping container with frozen gel packs.
7. Clipboard or other writing surface.
8. Pen or pencil.
9. Watch.
10. Sample station map (Figure 1).
11. Appropriate data field sheet (Figure 2).
12. Utility boat in safe operating condition with required safety and personal flotation equipment.

B. WATER SAMPLING PROCEDURES (INSTRUCTIONS TO SAMPLER)

1. General Requirements
   a. Under a systematic random sampling design for compliance monitoring of growing area water quality, collect samples at the primary sampling stations according to the schedule in Appendix B.

   b. Collect one sample from the following primary sampling stations (Figures 1A,1B,1C):

STATION #	LOCATION
WQ Station 2	Lease M-430-10 + M-430-11, Near Walker Cr. delta
WQ Station 7	Lease M-430-12, M-430-13, MOC M-430-19 area of M-430-05 N of Tomasini Pt.
WQ Station 12	Wet storage intake, Marshall
WQ Station 31	Lease M-430-15, West end off Toms PT
WQ Station 32	Lease M-430-15, N side, central
WQ Station 33	Unclassified area of Lease M-430-15

   A list of all sampling locations is provided in Element 6.

   c. If a scheduled sampling date occurs during a harvest closure, the first available day (i.e., the day of reopening) shall be sampled instead.

   d. All samples shall be collected on an outgoing tide.

e. Provide ample notification to Sonoma County Public Health Laboratory Services, tel. (707) 565-4711, to ensure that the scheduled sample(s) will be analyzed. Provide the following information: type (shellfish growing water) and number of samples you will send, date, and approximate time of delivery to lab.

f. Ensure that enough sterile sample bottles and laboratory sample submission forms (lab slips) are on hand. [NOTE: Any sample bottles on hand must be stored in a clean, dry place free of vermin or other possible source of contamination.]

g. If weather or other conditions are hazardous, postpone sampling until the next safe opportunity (appropriate tide when growing area is open). If a sampling is postponed, notify the laboratory as soon as possible by telephone. CDPH must be notified of any changes to the sampling schedule (Appendix B) prior to the scheduled sampling date.

2. Sample Collection Procedures

a. Insert empty sample bottle into holder of sampling wand.

b. Carefully remove cap and hold in one hand so inside surfaces of cap and bottle are not touched or otherwise contaminated.

c. Avoiding visible debris or floating material, dip bottle underwater, mouth down, and with a slow sweeping motion to one side, turn bottle right side up to fill. Take sample beneath the surface about six inches and no deeper than one foot.

d. Bring bottle to surface and tip out a little water to produce a small, about one-quarter inch, air space.

e. Carefully replace cap, without contaminating the sample, and screw on tight. [NOTE: If a sample bottle accidentally becomes contaminated, do not use; sample with another bottle and return contaminated bottle to lab to be re-sterilized.]

f. Record on field sheet (Figure 2) the station number, sampling time, and bottle cap number.

g. Place sample bottle in cooler. [NOTE: Use frozen gel packs in cooler, not wet ice, to avoid possible contamination of sample from contact with melt water.]

h. Collect an additional sample at the first station and label it “Temperature Blank”. This sample should be handled identically to all other samples. Upon receipt of the samples, the laboratory will check the temperature of the Temperature Blank to ensure it is within the proper temperature range.

i. Record water temperature at each station, to the nearest 1/2 degree Celsius. Take temperature of water collected in a bucket or alongside boat; do not insert thermometer or anything else into sterile sample bottle.

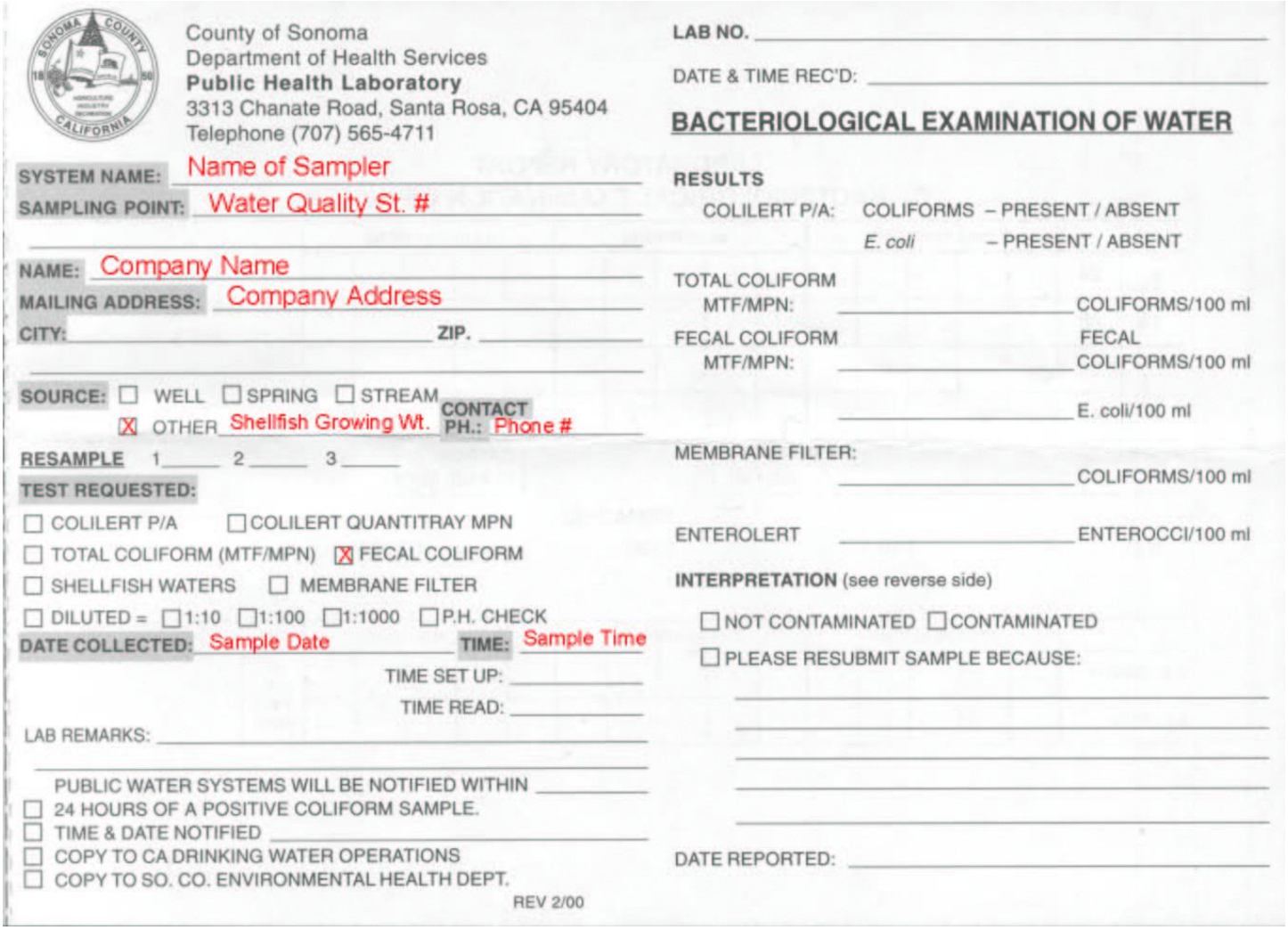
j. Complete one lab slip for each sample, as the example shown (Figure 3). Print clearly with a ballpoint pen and press hard enough so bottom sheet is readable. Request fecal coliform and salinity; the latter may be omitted if the Company can make reliable measurements of salinity in the field.

k. Transport or ship samples so they are delivered to the laboratory as soon as possible, and no more than 24 hours after first sample was collected. Samples should be kept in a cooler with frozen gel packs or placed in a refrigerator adjusted to a temperature of 4° Celsius (39° F). Samples must be held at 1° - 10° C (Do not use wet or dry ice).

l. In cases where the elapsed time between sample collection and delivery to the laboratory is minimal, the sample temperature must be at or below the ambient water temperature measured in step 2.i. Under this circumstance there is inadequate time for the sample to chill to the proper temperature range. However, the sample(s) must be handled in accordance with step 2.g. such that an increase in temperature does not occur.

Mail or fax a copy of completed field data sheet to A. Marc Commandatore, California Department of Health Services, 2151 Berkeley Way, Room 102, Berkeley, CA 94704 (fax: 510-540-2716).

APPENDIX 2. Data and Observation Sheets



County of Sonoma
Department of Health Services
Public Health Laboratory
3313 Chanate Road, Santa Rosa, CA 95404
Telephone (707) 565-4711

SYSTEM NAME: Name of Sampler
SAMPLING POINT: Water Quality St. #

NAME: Company Name
MAILING ADDRESS: Company Address
CITY: _____ **ZIP.** _____

SOURCE: ☐ WELL ☐ SPRING ☐ STREAM
☒ OTHER Shellfish Growing Wt. **CONTACT PH.:** Phone #

RESAMPLE 1_____ 2_____ 3_____

TEST REQUESTED:

☐ COLILERT P/A ☐ COLILERT QUANTITRAY MPN
☐ TOTAL COLIFORM (MTF/MPN) ☒ FECAL COLIFORM
☐ SHELLFISH WATERS ☐ MEMBRANE FILTER
☐ DILUTED = ☐ 1:10 ☐ 1:100 ☐ 1:1000 ☐ P.H. CHECK

DATE COLLECTED: Sample Date **TIME:** Sample Time
TIME SET UP: _____
TIME READ: _____

LAB REMARKS: _____

PUBLIC WATER SYSTEMS WILL BE NOTIFIED WITHIN _____
☐ 24 HOURS OF A POSITIVE COLIFORM SAMPLE.
☐ TIME & DATE NOTIFIED _____
☐ COPY TO CA DRINKING WATER OPERATIONS
☐ COPY TO SO. CO. ENVIRONMENTAL HEALTH DEPT.

REV 2/00

LAB NO. _____

DATE & TIME REC'D: _____

BACTERIOLOGICAL EXAMINATION OF WATER

RESULTS

COLILERT P/A: COLIFORMS – PRESENT / ABSENT
E. coli – PRESENT / ABSENT

TOTAL COLIFORM
MTF/MPN: _____ COLIFORMS/100 ml

FECAL COLIFORM FECAL
MTF/MPN: _____ COLIFORMS/100 ml

_____ E. coli/100 ml

MEMBRANE FILTER:
_____ COLIFORMS/100 ml

ENTEROLERT _____ ENTEROCCI/100 ml

INTERPRETATION (see reverse side)

☐ NOT CONTAMINATED ☐ CONTAMINATED
☐ PLEASE RESUBMIT SAMPLE BECAUSE:

_____
_____
_____
_____
_____

DATE REPORTED: _____