

# Quality Assurance Project Plan

Morro Bay National Estuary Program's  
Volunteer Monitoring Program

**Prepared for**  
**Central Coast Regional Water Quality Control Board**  
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**and**

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**Prepared by**  
**Morro Bay National Estuary Program**

September 23, 2013  
Version 8, Draft 2

# GROUP A ELEMENTS: PROJECT MANAGEMENT

## 1. TITLE AND APPROVAL SHEETS

Quality Assurance Project Plan

For

PROJECT NAME: Morro Bay National Estuary Program's Volunteer  
Monitoring Program

Proposal Identification Number: \_\_\_\_\_

Date: September 23, 2013

NAME OF RESPONSIBLE ORGANIZATION : Morro Bay National Estuary Program

**APPROVAL SIGNATURES**  
(Add or delete signature lines as needed)

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## **HISTORY OF REVISIONS**

<b>Version Number</b>	<b>Date</b>	<b>Revision Details</b>
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	October 27, 2003	See table with summary of revisions. EPA approval of update.
1.2	October 1, 2004	See table with summary of revisions.
	January 25, 2005	EPA approval of update.
2.0	March 31, 2006	Updated to SWAMP compatible.
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2.2	July 9, 2006	Incorporated final revisions and comments into this version.
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7.1	December 10, 2012	Received approval from the QA Officer of the CCRWQCB.



<b>Version Number</b>	<b>Date</b>	<b>Revision Details</b>
8.1	August 21, 2013	Annual updates submitted to EPA for approval.
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### 3. DISTRIBUTION LIST

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## 4. PROJECT/TASK ORGANIZATION

### 4.1 Involved parties and roles.

The Morro Bay National Estuary Program (MBNEP) is a collaborative organization that brings local citizens, local government, non-profits, agencies and landowners together to protect and restore the physical, biological, economic and recreational values of the Morro Bay estuary.

Adrienne Harris is the program director of the MBNEP. She approves the contract invoices developed by the program manager. The program manager reports directly to the program director.

Ann Kitajima is the MBNEP Volunteer Monitoring Program (VMP) manager and is referred to as the MBNEP Program Manager throughout this document. She also serves as the MBNEP Quality Assurance (QA) Officer for the project. She is responsible for all aspects of the project including organizing VMP staff, scheduling of monitoring, selection and maintenance of monitoring equipment, field and in-house analysis of samples, and contact with the labs used for quality assurance purposes. She is responsible for all contract submittals. She is responsible for the activities of all VMP staff and volunteers.

BC Laboratories, Inc. is the lab that conducts QA analysis of nutrient samples for the MBNEP. This contract laboratory is not directly responsible for delivery of any contract submittals. The San Luis Obispo County Public Health Agency Laboratory conducts the QA analysis of VMP-run bacteria samples and analysis of fecal coliform samples. This contract laboratory is not directly responsible for delivery of any contract submittals. Both labs will analyze submitted samples in accordance with all method and quality assurance requirements found in this Quality Assurance Project Plan (QAPP).

Ecoanalysts, Inc. conducts the analysis of macroinvertebrate samples. The lab will analyze submitted samples in accordance with all method and quality assurance requirements found in this QAPP. This contract laboratory is not directly responsible for delivery of any contract submittals.

The California Department of Public Health (CDPH) is responsible for the fecal coliform monitoring effort in the bay and creeks. CDPH staff determine the monitoring sites and the schedule of monitoring, collect the samples, deliver them to the lab, oversee data management and conduct data analysis.

**Table 4.1.1. Personnel responsibilities**

<b>Name</b>	<b>Organizational Affiliation</b>	<b>Title</b>	<b>Contact Information (Telephone number, fax number, email address.)</b>
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#### 4.2 Quality Assurance Officer role

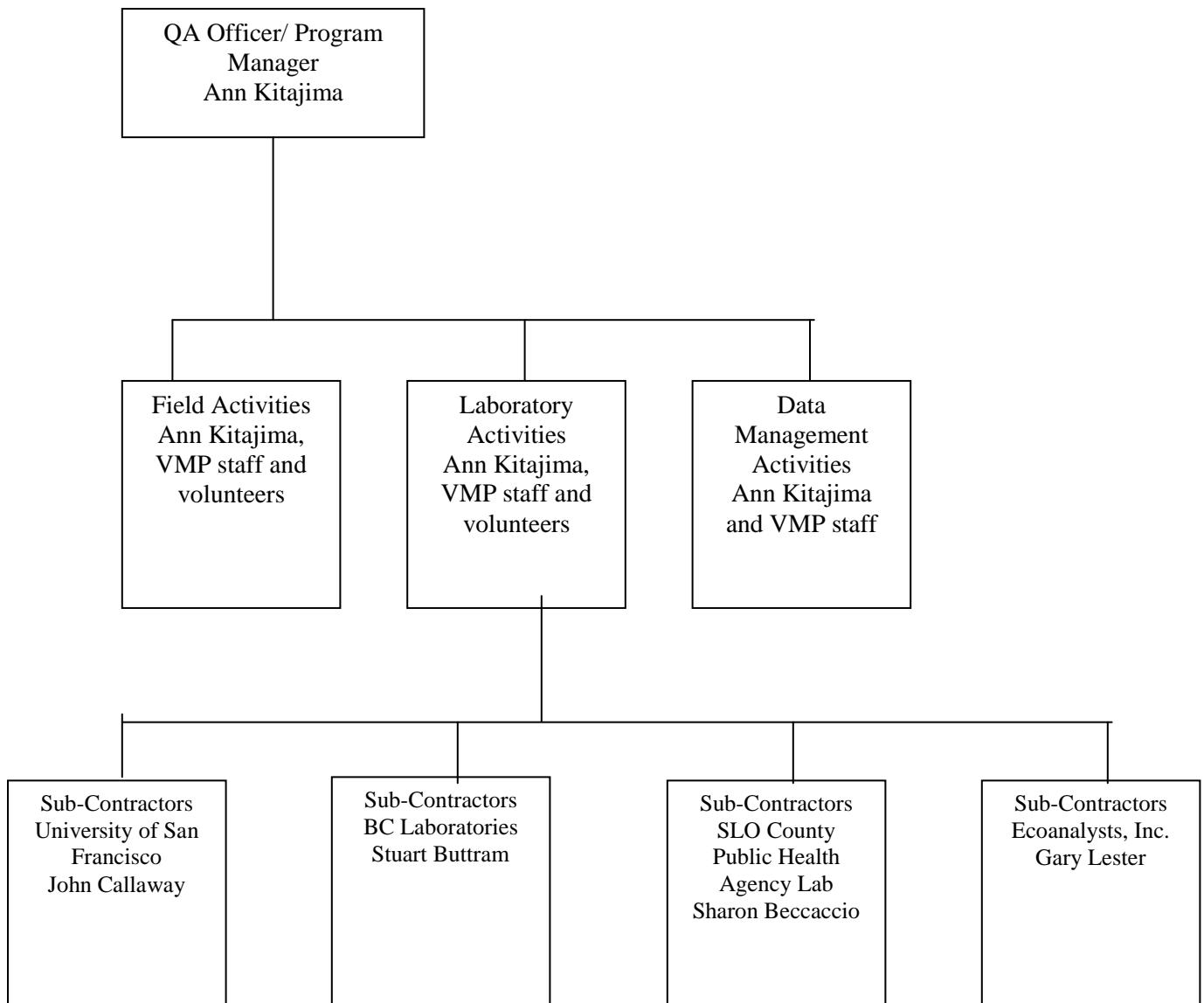
The MBNEP Program Manager is responsible for general oversight of the program including grant management, volunteer recruitment and training, protocol development, data management, data analysis and report writing. The Program Manager also serves as the MBNEP QA Officer for this small program. While the Program Manager oversees the operations of the program, this person is not actually generating the project data. Data collection is conducted by program volunteers and staff. While they receive training and oversight from the Program Manager, their data collection is conducted independent of the Program Manager. Data management and reporting, while overseen the Program Manager, are conducted by a VMP staff member. So while both the MBNEP Program Manager and QA Officer roles are fulfilled by the same individual, there is no bias in the generating of project data.

#### 4.3 Persons responsible for QAPP update and maintenance.

The MBNEP Program Manager is the person responsible for updates to this QAPP. Changes and updates may be made after a review of the changes by the MBNEP Program Manager and QA Officer. The MBNEP Program Manager will be responsible for making the changes, submitting the drafts for review, preparing a final copy, and submitting the final for signature.

#### 4.4 Organizational chart and responsibilities

**Figure 4.4.1. Organizational chart**



## **5. PROBLEM DEFINITION/BACKGROUND**

### **5.1 Problem statement**

The National Estuary Program was established in 1987 under Section 320 of the Clean Water Act to address long-term planning and management in nationally significant estuaries. In 1995, Morro Bay was accepted into the program. As part of the formation of the Morro Bay National Estuary Program (MBNEP), seven priority problems were identified as major impacts to the estuary. These priority problems are:

1. Accelerated Sedimentation
2. Bacterial Contamination
3. Elevated Nutrients Concentrations
4. Scarce Freshwater Resources
5. Toxic Pollutants
6. Preserving Biodiversity
7. Environmentally Balanced Uses

The threats to the estuary as well as proposed actions to address these threats are outlined in a Comprehensive Conservation and Management Plan for Morro Bay (CCMP). Effectiveness of these implemented actions is tracked by monitoring. The data will help assess effectiveness of implementation actions and guide future actions. The MBNEP helped to establish the Morro Bay Volunteer Monitoring Program (VMP) in the early 1990s both to provide data to guide CCMP actions and to increase public involvement and stewardship in protection of a unique natural resource. The goal of the program is to track long-term trends in the Morro Bay estuary and its watershed, as well as understand the effectiveness of implementation efforts.

### **5.2 Decisions or outcomes**

The MBNEP QAPP is based upon the following goal and seven objectives that are consistent with overall program goals. The objectives listed are in reference to evaluation and research needs of the CCMP. These public concerns, targets and methods of measurement are described in Chapters 5-13 of the MBNEP's Environmental Monitoring Plan (EMP). Further information on targets can be found in the Central Coast Regional Water Quality Control Board's (CCRWQCB) Basin Plan and in the Total Maximum Daily Load (TMDL) regulations for the Morro Bay watershed.

The primary goal of the program is to track the implementation of CCMP actions and monitor the health of the Morro Bay ecosystem.

In addition to identifying priority problems, the CCMP identified objectives for the program, as follows:

#### **Geomorphological Objective**

- ✓ Slow sedimentation by implementing management measures that address erosion and sediment transport

#### **Human Use Objectives**

- ✓ Ensure that bay water remains of sufficient quality to support a viable commercial shellfish industry, and safe recreational uses
- ✓ Protect social, economic, and environmental benefits provided by the bay and watershed through comprehensive resource management planning
- ✓ Promote public awareness and involvement in estuarine management issues through education,



outreach and use of volunteers

### Water Quality Objectives

- ✓ Ensure that bay water remains of sufficient quality to support a viable commercial shellfish industry, safe recreational uses, healthy eelgrass beds, habitats for listed species, cold water aquatic habitat, and thriving fish and shellfish populations

### Living Resources Objectives

- ✓ Ensure integrity of the broad diversity of natural habitats and associated native wildlife species in the bay and watershed
- ✓ Reestablish healthy steelhead trout habitat in Chorro and Los Osos Creeks

## 5.3 Water quality or regulatory criteria

Criteria for MBNEP monitoring include Basin Plan standards, Central Coast Ambient Monitoring Program (CCAMP) Attention Levels and other applicable regulatory criteria. Some monitoring methods including stream profiling, shorebird surveying, surface elevation tables (SETs), stream flow, macroinvertebrates, and eelgrass do not have specific criteria for comparison.

**Table 5.3.1. MBNEP screening levels for monitoring data**

Parameter	Criteria	Source	Comments
Total coliform (freshwater, estuarine)	> 10,000 MPN/100 mL	AB411 State Regulation of Beaches & Recreational Waters	If the ratio of fecal/total coliform bacteria exceeds 0.1, then the criteria is 1,000 MPN/100 mL
<i>E. coli</i> (freshwater)*	> 235 MPN/100 mL	Recommended standard from EPA Guidance, Ambient Water Quality Criteria for Bacteria, 1986	This value is not currently part of the CCRWQCB Basin Plan
<i>Enterococcus spp.</i> (estuarine)	> 104 MPN/100 mL	Recommended standard from EPA Guidance, Ambient Water Quality Criteria for Bacteria, 1986	This value is not currently part of the CCRWQCB Basin Plan
Fecal coliform (estuarine)	> 43 MPN/100 mL	USFDA National Shellfish Sanitation Program Guide for the Control of Molluscan Shellfish, Section II Model Ordinance, Chapter IV	Standard by which shellfish growing waters are regulated
Conductivity (for Water Quality)	> 3,000 uS/cm (AGR beneficial use)	CCRWQCB Basin Plan standard	Protects water for use as irrigation water
Dissolved oxygen (freshwater)	< 7.0 mg/L (COLD) < 5.0 mg/L (WARM)	CCRWQCB Basin Plan standards	Protection of aquatic life for cold and warm freshwater
Dissolved oxygen	< 7.0 mg/L, median %	CCRWQCB Basin Plan	Protection of cold water

Parameter	Criteria	Source	Comments
(estuarine)	saturation > 85% (ocean waters) (COLD, SPWN)	standard	species in estuarine environment
Nitrate as nitrogen (for Water Quality)	> 1.0 mg/L with supporting evidence	CCRWQCB 303(d) Listing Guidance Value	Evidence includes DO < 7.0 or > 13.0 mg/L, extensive algae, etc. (Black, 2010)
Orthophosphate as PO <sub>4</sub> (for Water Quality)	> 0.36 mg/L	Guideline value	Value developed specifically for Pajaro River but being used for Morro Bay. (Williamson, 1994.; Black, 2010)
pH (for Water Quality)	< 7.0 and > 8.5 (COLD, WARM, estuarine)	CCRWQCB Basin Plan Standard	
Temperature (for Water Quality)	> 21 °C	CCRWQCB 303(d) Listing Guidance Value	Optimum range for steelhead of 13 to 21 °C (Moyle, 2002)
Turbidity (for Water Quality)	> 25 NTU (COLD) > 40 NTU (WARM)	CCRWQCB 303(d) Listing Guidance Value	COLD criteria (Sigler, 1984). WARM criteria (Shoup, 2009)
Ammonia (for Water Quality)	0.025 mg/L NH <sub>3</sub> -N as unionized ammonia	CCRWQCB Basin Plan Standard	General objectives, toxicity criteria
Suspended sediment concentration of creek storm flows	NA	NA	No standards exist either in the Basin Plan or as part of CCAMP

\* As there is no recommended EPA standard for analysis of *E. coli* in marine waters, there is no corresponding value in Table 5.3.1 for comparison of *E. coli* results in marine waters. However, this analysis is conducted by the program for marine samples because the shellfish regulations and the current Basin Plan regulations are written for fecal coliform. Because fecal coliform data is more closely comparable to *E. coli* data than enterococcus results, the program will continue to monitor for both *E. coli* and enterococcus in marine waters.

## 6. PROJECT/TASK DESCRIPTION

### 6.1 Work statement and produced products

Bacteria monitoring conducted by program volunteers includes monthly sampling at sites on local creeks and in Morro Bay. All freshwater samples are analyzed for total coliform and *E. coli*, and the marine samples are analyzed for *E. coli* and enterococcus. Split samples are sent to a local laboratory for analysis. Each month, results for sites with levels of concern are forwarded to various landowners and agencies so that any potential public health threat can be addressed. Data is stored in an Excel database. Deliverables include a consistent bacteria data set in electronic format and monthly notifications. All data is analyzed in an annual data summary report.

Bay fecal coliform samples are collected by California Department of Public Health (CDPH) staff and VMP staff on a monthly, bi-monthly or quarterly basis, depending on the monitoring site. Samples are analyzed for fecal coliform by the San Luis Obispo County Public Health Agency Laboratory. Results are retained by CDPH for management of shellfish growing waters within the bay. Data is stored in a Paradox database. Deliverables include a consistent bacteria data set in electronic format. Data will be analyzed in the data summary report.

Water quality monitoring by program volunteers and staff includes monthly sampling at local creek sites throughout the Morro Bay watershed. Samples are analyzed for pH, temperature, turbidity, conductivity, dissolved oxygen (DO), nitrates as nitrogen and orthophosphates as PO<sub>4</sub>. Split samples are sent to a laboratory for nutrient QA analysis. Four of the water quality monitoring sites have been designated as 'Agricultural Monitoring Sites'. All of the same analysis takes place at these sites as at the other water quality sites, with the addition of samples of collected for laboratory analysis for the following analytes: nitrates as nitrogen, total nitrogen, organic nitrogen, Total Kjeldahl nitrogen, ammonia, nitrite, total phosphorus and orthophosphates as P. Monitoring takes place three times a month. Data is stored in an Excel database. Deliverables include a consistent water quality data set in an electronic format. All data is analyzed in an annual data summary report.

Flow monitoring by program volunteers includes monthly monitoring at local creek sites throughout the watershed. Volunteers estimate creek depth and velocity, and an instantaneous flow rate is estimated from this information. Data is stored in an Excel database. Deliverables include a consistent flow data set in an electronic format. All data is analyzed in an annual data summary report.

Continuous water quality data is collected by program staff on a quarterly basis at local creek sites throughout the watershed. The continuous monitoring equipment is deployed for at least a 24-hour time period to collect the following parameters: DO, temperature, conductivity, turbidity and pH. Data is stored in an Excel database. Deliverables include a consistent water quality data set in an electronic format. All data is analyzed in an annual data summary report.

For bioassessment monitoring, program staff and volunteers collect samples on local creeks each year. Algae documenting is conducted in conjunction with bioassessment monitoring. Macroinvertebrate samples are sent to a lab for analysis. The lab analyzes the sample according to SWAMP SAFIT Level 2 taxonomy protocols, with counts to 600. The lab provides the counts as well as various calculated metrics. Data is provided in Excel format. Deliverables include a consistent macroinvertebrate data set in electronic format. All data is analyzed in an annual data summary report.

For stream profiling, program volunteers monitor sites as needed throughout the watershed. The data is maintained in an Excel spreadsheet and is shared periodically with CCRWQCB staff. Deliverables include a consistent stream profiling data set in electronic format. Select data is analyzed in an annual data summary report.

For SET monitoring, sites are currently monitored approximately every five years, and more frequently if large storm events occur. During the dry season, a complete set of measurements is taken by University of San Francisco personnel at ten sites in the salt marsh and other shoreline areas of the bay. The results are presented in an annual sediment monitoring report.

For eelgrass monitoring, a contractor collects and analyzes bay-wide aerial imagery and creates a bay-wide map showing eelgrass location and density. The aerial imagery is typically collected every other fall with a digital aerial sensor with four channels. The spectral wavelength of each channel is customizable with the use of narrow-band interference filters. The digital image frames are used to generate a GIS-ready, georegistered, mosaiced false color imagery. National Marine Fisheries Service staff collect data on bay-wide eelgrass using a Biosonics DE-X #03005 single-beam acoustic unit and Biosonics EcoSAVE software to analyze the data. Their survey covers the transects historically monitored by VMP staff and volunteers, as well as submerged eelgrass that is not captured by other monitoring efforts. VMP staff conducts fieldwork in five areas of the bay along transects to collect shoot density, biomass samples and other measurements. The data is stored electronically in Excel spreadsheets. An annual eelgrass report is created summarizing the effort and results for the year.

For bird monitoring, volunteers participate in shorebird monitoring events each fall to conduct bay-wide counts. The data is shared with local birding organizations and stored in electronic Excel format. It is also entered into a data portal developed by the Point Reyes Bird Observatory. The data is included in an annual data summary report.

For phytoplankton monitoring, program volunteers collect samples twice monthly from bay and ocean sites to help the CDPH track toxic algal blooms. Samples are analyzed under a microscope, and cell counts and samples are sent to CDPH for analysis. The results are stored in an Excel database. The data is included in an annual data summary report.

For suspended sediment concentration monitoring, samples are collected from three creek sites during storm flows using automated samplers. Lab analysis is conducted by VMP staff to analyze the samples for their suspended sediment concentration. Data is stored in an Access database. Deliverables include a consistent suspended sediment concentration dataset stored in an electronic format and an annual sediment monitoring report summarizing the results.

## 6.2. Constituents to be monitored and measurement techniques

Table 6.2.1 summarizes the constituents to be measured for each of the monitoring efforts described in Section 6.1.

**Table 6.2.1 Constituents monitored and measurement techniques**

<b>Parameter</b>	<b>Monitoring Frequency</b>	<b>Primary or Secondary</b>	<b>Method</b>
Total coliform (freshwater)	Monthly	Primary	IDEXX Colilert-18 analysis
<i>E. coli</i> (marine and freshwater)	Monthly	Primary	IDEXX Colilert-18 analysis
<i>Enterococcus spp.</i> (marine)	Monthly	Primary	IDEXX Enterolert analysis
Conductivity (freshwater)	Monthly, three times a month for ag sites	Primary	Meter
Dissolved oxygen (marine and freshwater)	Monthly, three times a month for ag sites	Primary	Meter
Nitrate as nitrogen (freshwater)	Monthly freshwater	Primary	Meter
Orthophosphate as PO <sub>4</sub> (freshwater)	Monthly	Primary	Meter
pH (freshwater)	Monthly, three times a month for ag sites	Primary	Meter
Flow (freshwater)	Monthly, three times a month for ag sites	Primary	Meter
Temperature (marine and freshwater)	Monthly, three times a month for ag sites	Primary	Meter
Turbidity (freshwater)	Monthly, three times a month for ag sites	Primary	Meter
Laboratory analysis – fecal coliform (estuarine)	Monthly, bimonthly or quarterly, depending on the site	Primary	Standard Method 9221 E.2.A-1
Laboratory analysis -	Three times a month for	Primary	EPA Method 300.0

<b>Parameter</b>	<b>Monitoring Frequency</b>	<b>Primary or Secondary</b>	<b>Method</b>
Nitrate as nitrogen (freshwater)	Ag Monitoring Sites		
Laboratory analysis - Orthophosphate as P (freshwater)	Three times a month for Ag Monitoring Sites	Primary	SM 4500-P E
Laboratory analysis - Total nitrogen (freshwater)	Three times a month for Ag Monitoring Sites	Primary	Calculated
Laboratory analysis - Organic nitrogen (freshwater)	Three times a month for Ag Monitoring Sites	Primary	Calculated
Laboratory analysis - Nitrite as NO <sub>2</sub> (freshwater)	Three times a month for Ag Monitoring Sites	Primary	EPA 353.2
Laboratory analysis - Ammonia (freshwater)	Three times a month for Ag Monitoring Sites	Primary	SM4500-NH <sub>3</sub> D
Laboratory analysis - Total Kjeldahl Nitrogen (freshwater)	Three times a month for Ag Monitoring Sites	Primary	EPA 351.2
Laboratory analysis - Total Phosphorus (freshwater)	Three times a month for Ag Monitoring Sites	Primary	EPA 365.4
Laboratory analysis - Bioassessment Macroinvertebrates	Annually	Primary	SWAMP SAFIT Level 2 protocol
Stream profiling	As Needed	Primary	NA
SETs	As Needed	Primary	NA
Eelgrass	Biennially	Primary	NA
Algae documenting	Annually with bioassessment monitoring	Primary	NA
Bird surveys	Annually	Primary	NA
Phytoplankton	Bimonthly	Primary	NA
Suspended sediment concentration	As needed, during storms	Primary	ASTM D 3977

### 6.3 Project schedule

All monitoring efforts are ongoing with the goal of tracking long-term trends and assessing project effectiveness. Monitoring efforts were conducted under a 319(h) grant from 2001 through 2003, a Proposition 13 Coastal Nonpoint Source Control Program grant from 2004 through 2007, and a Proposition 50 Coastal Nonpoint Source Pollution Control Program grant from 2007 through 2008. Upon suspension of proposition-funded grants in December 2008, the program received ARRA funding starting in May of 2009 that continued through the end of 2010. For each monitoring effort, the results are summarized in an annual data summary report. This monitoring is expected to continue, assuming adequate funding is available, beyond the conclusion of the current funding source. Data analysis and review is conducted at a minimum on an annual basis.

**Table 6.3.1. Project schedule timeline**

Activity	Date (MM/DD/YY)		Deliverable	Deliverable Due Date
	Anticipated Date of Initiation	Anticipated Date of Completion		
Water quality, flow, bacteria, bioassessment, stream profiling, eelgrass, algae documenting, shorebird surveys, phytoplankton	Ongoing	Variable	Annual data summary report	Variable
Stormwater	Ongoing	Variable	Annual data summary report	September of each year
Sedimentation: SETs, suspended sediment concentrations	Ongoing	Variable	Annual data summary report	October of each year
Bacteria	Ongoing		Data summary for sites of concern	Monthly

#### 6.4 Geographical setting

The Morro Bay estuary is a 2,300 acre semi-enclosed body of water where freshwater flowing from land mixes with the saltwater of the sea. Morro Bay opens into Estero Bay. Morro Bay is fed by a 48,000-acre watershed containing two major creeks, Chorro and Los Osos. Figure 6.4.1 shows the location of the bay, its watershed and the major creeks.

This section includes maps showing monitoring sites as follows:

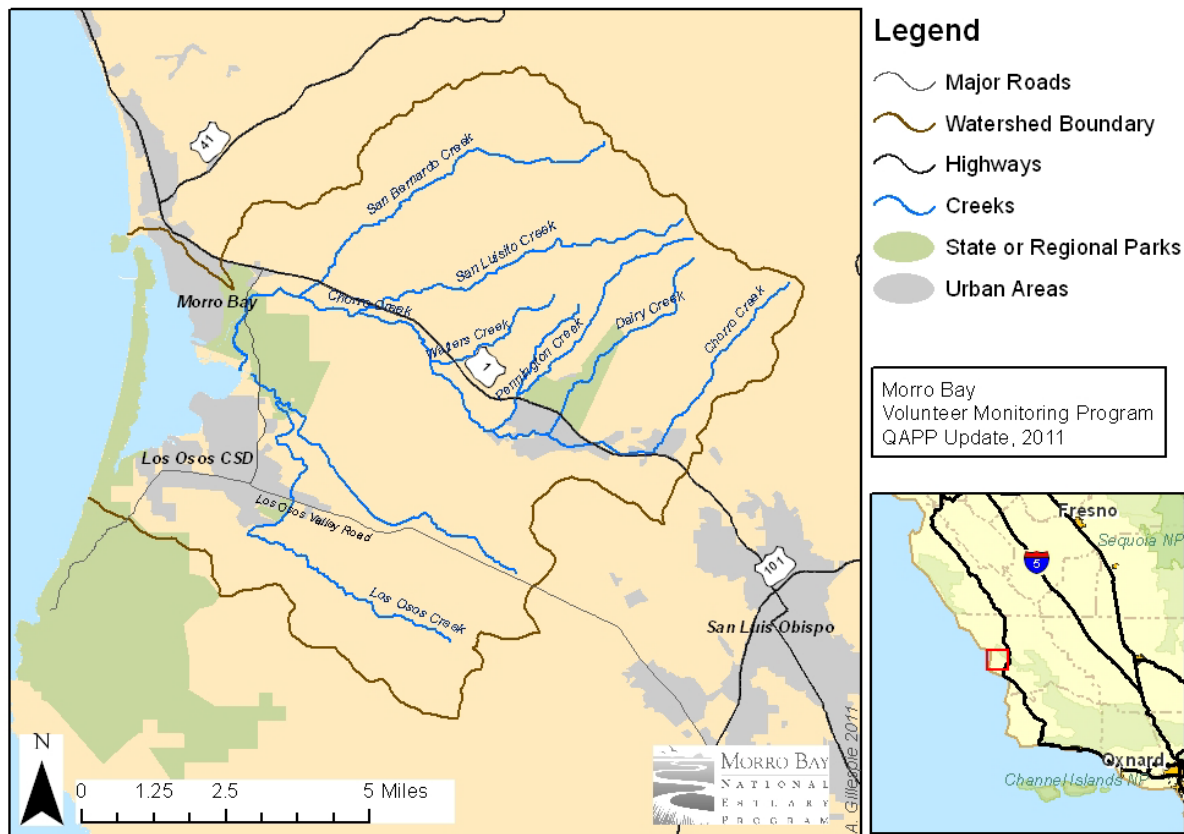
- Figure 6.4.2: MBNEP flow monitoring locations
- Figure 6.4.3: MBNEP creek and bay bacteria monitoring locations
- Figure 6.4.4: MBNEP creek water quality monitoring locations
- Figure 6.4.5: MBNEP bay dissolved oxygen monitoring locations
- Figure 6.4.6: MBNEP stream profiling monitoring locations
- Figure 6.4.7: MBNEP SET monitoring locations
- Figure 6.4.8: MBNEP bioassessment and algae monitoring locations
- Figure 6.4.9: MBNEP eelgrass monitoring locations
- Figure 6.4.10: MBNEP shorebird monitoring locations
- Figure 6.4.11: MBNEP phytoplankton monitoring locations
- Figure 6.4.12: MBNEP suspended sediment monitoring locations
- Figure 6.4.13: CDPH fecal coliform monitoring locations

#### 6.5 Constraints

Low creek flow conditions can impact water quality, bacteria, flow and bioassessment monitoring. For bay monitoring, tides must be high enough to avoid stranding in the soft mud.

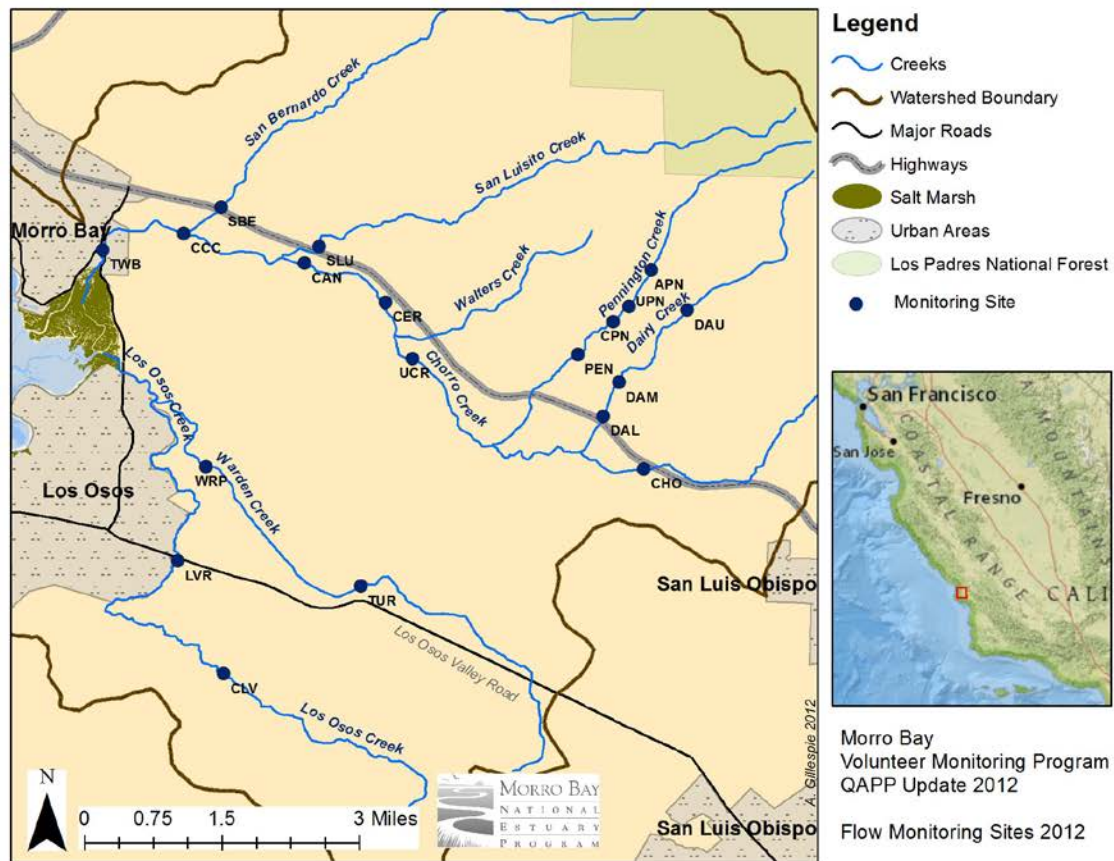
Possible constraints for monitoring include funding for SET, eelgrass and macroinvertebrate monitoring, which involve costly consultants or laboratories. If funding is inadequate in the future, bay-wide aerial eelgrass maps, SETs and detailed bioassessment sample analysis may not be conducted.

**Figure 6.4.1. Location of Morro Bay Watershed and Tributaries**

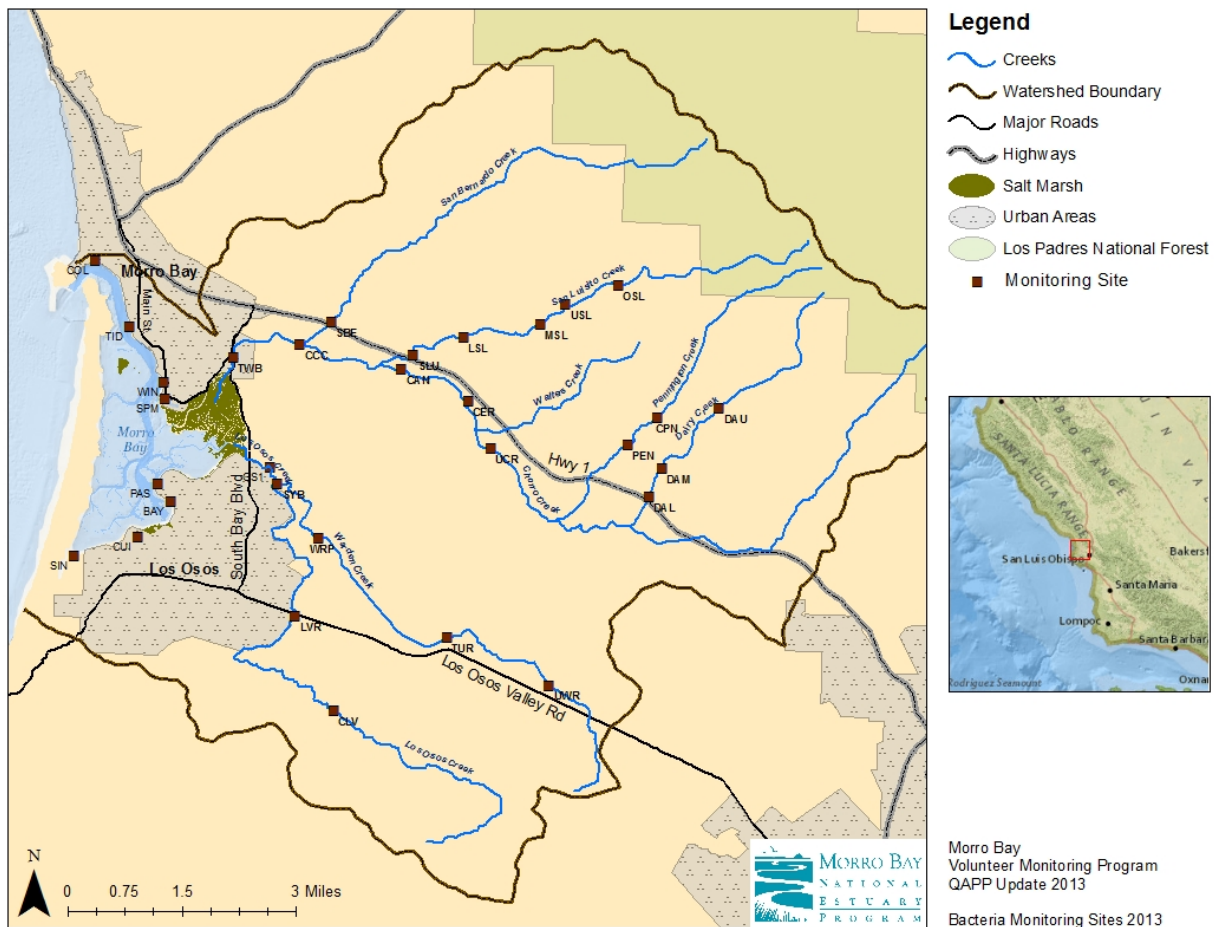




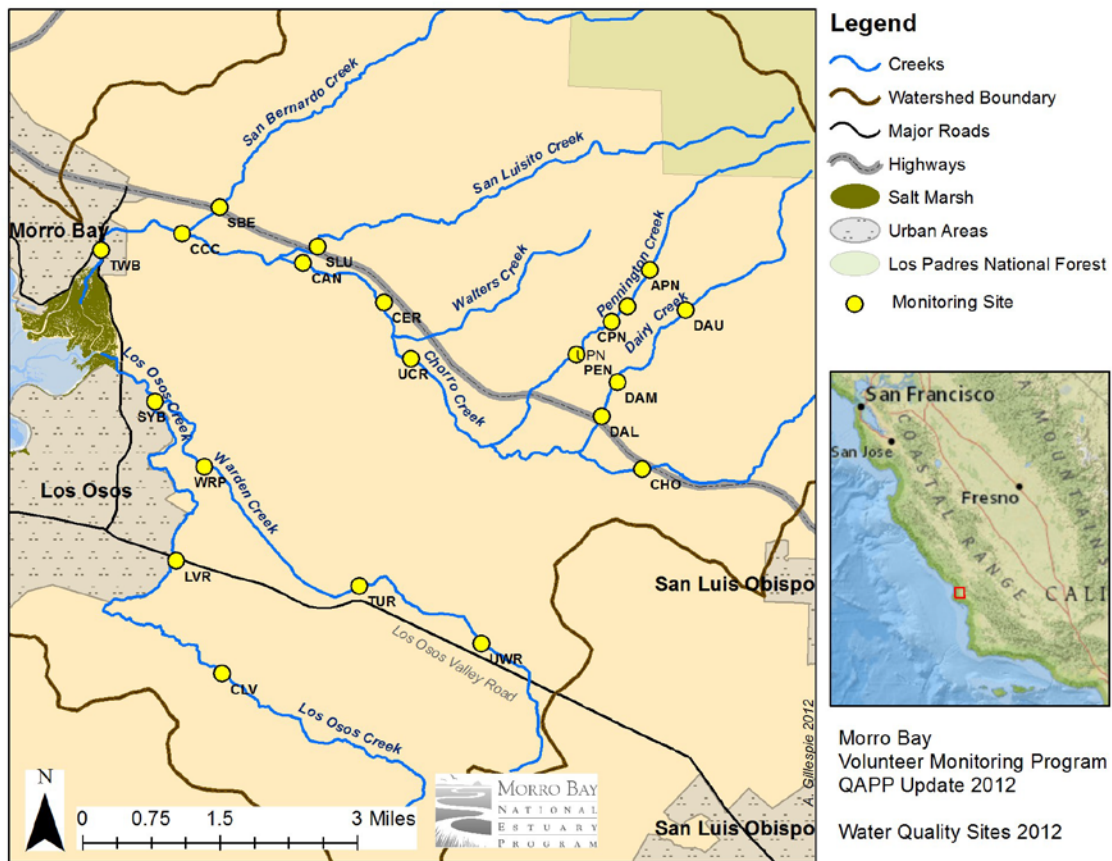
**Figure 6.4.2. MBNEP Flow Monitoring Locations**



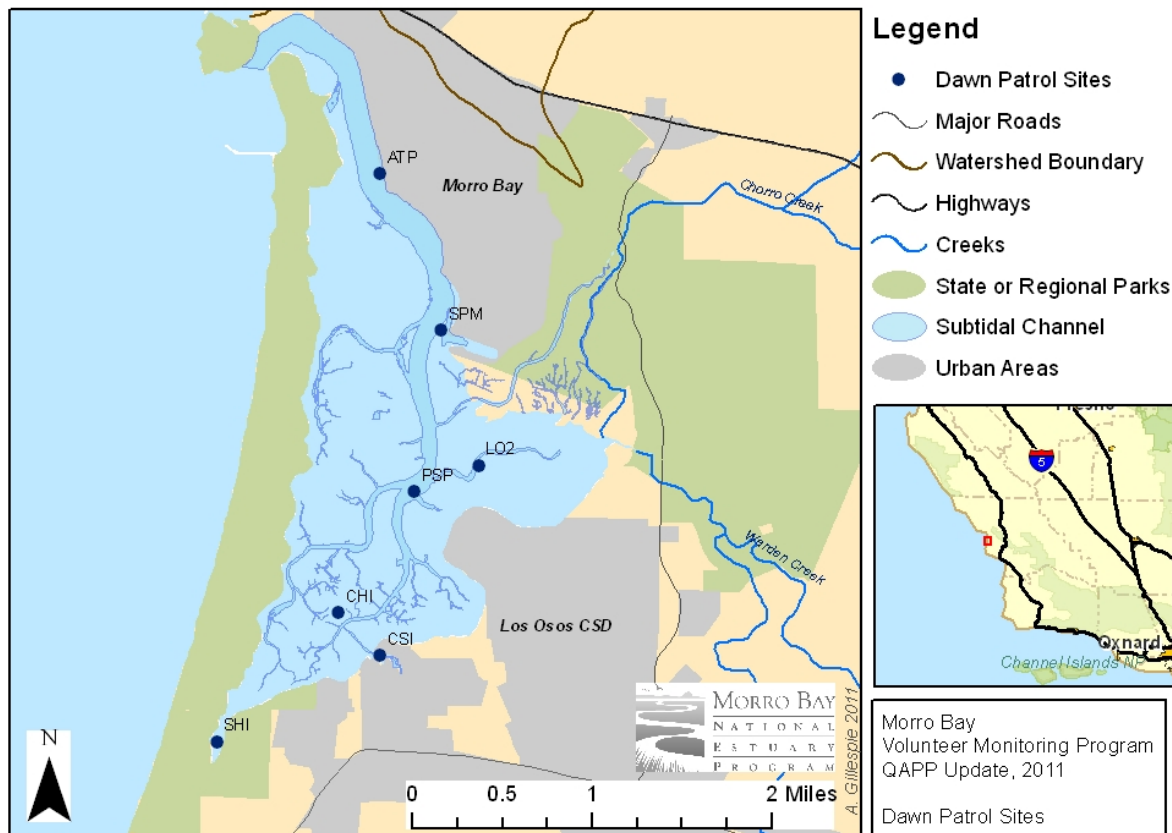
**Figure 6.4.3. MBNEP Creek and Bay Bacteria Monitoring Locations**



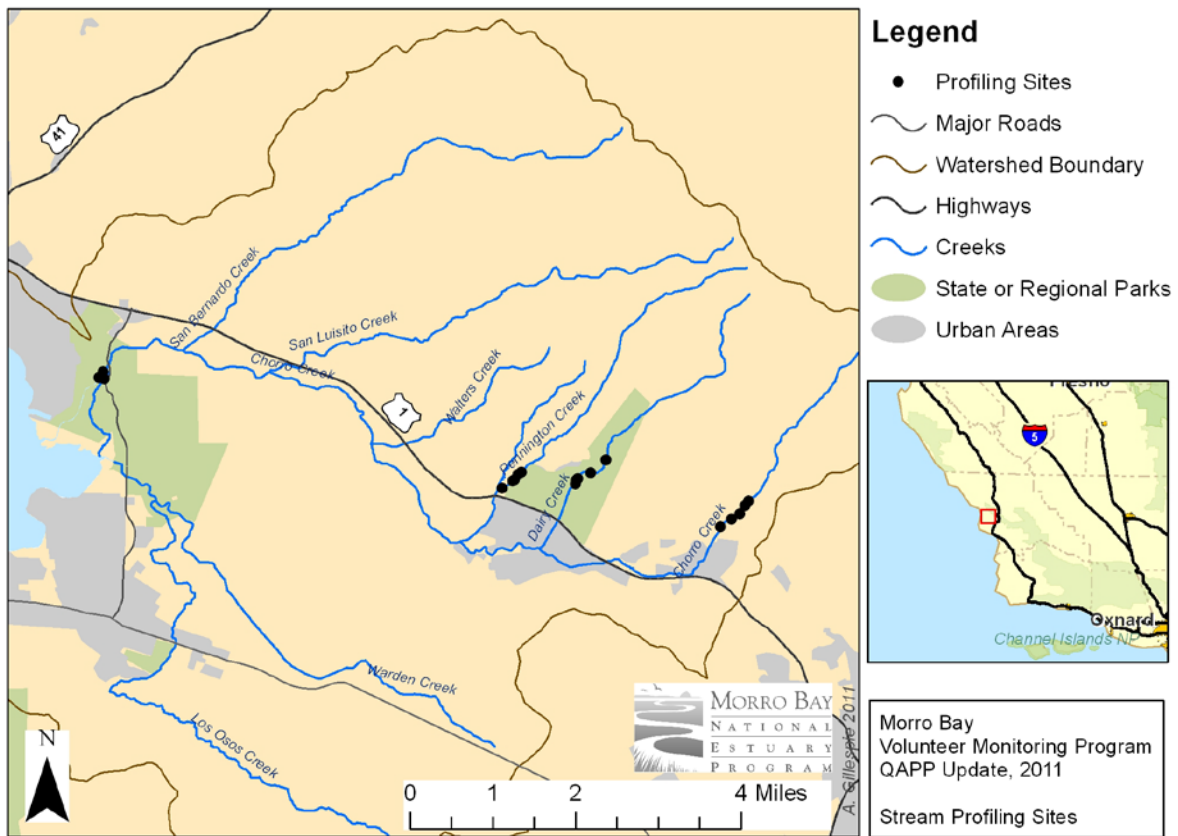
**Figure 6.4.4. MBNEP Creek Water Quality Monitoring Locations**



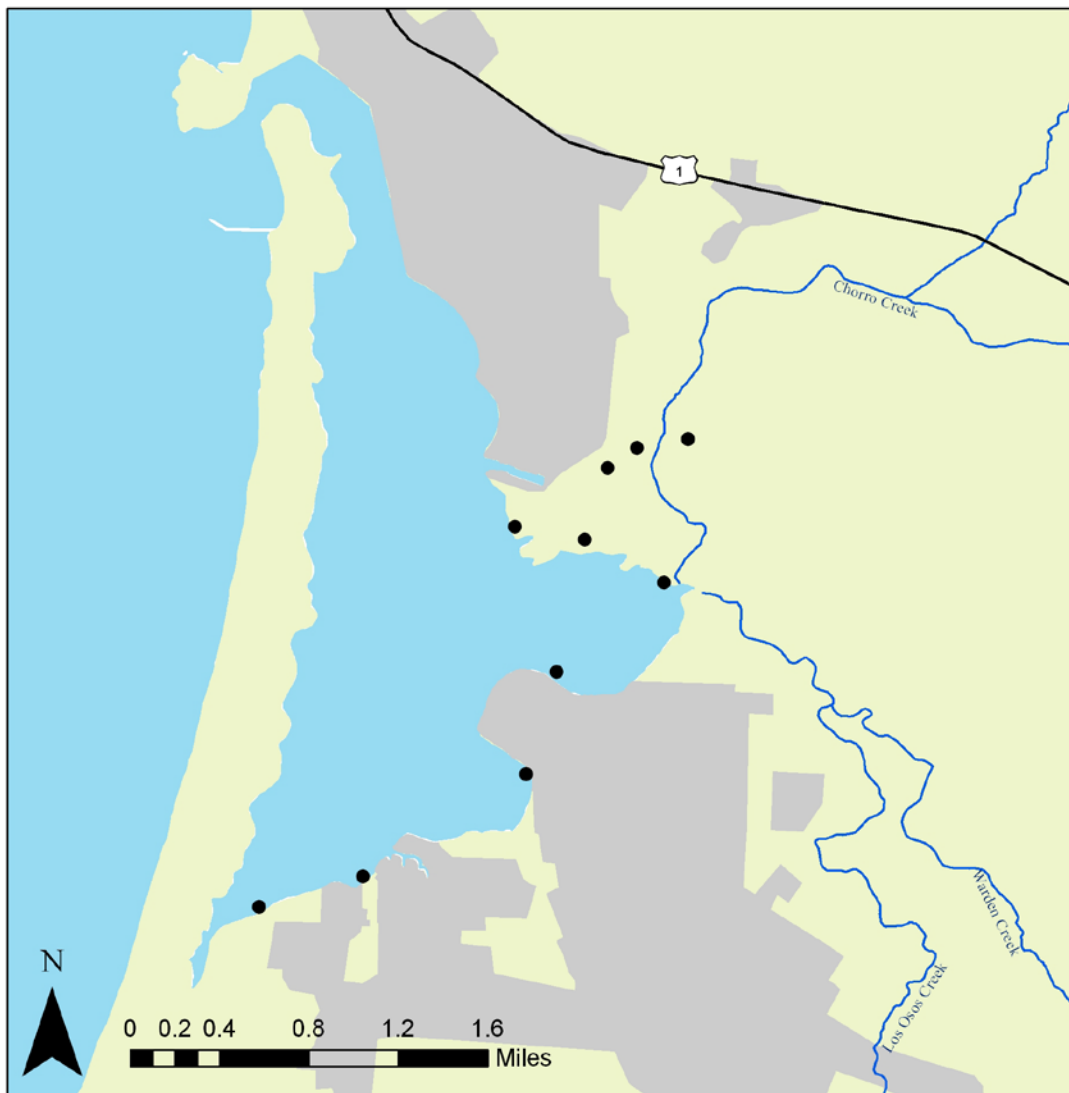
**Figure 6.4.5. MBNEP Bay Dissolved Oxygen Monitoring Locations**



**Figure 6.4.6. MBNEP Stream Profiling Monitoring Locations**



**Figure 6.4.7. MBNEP SET Monitoring Locations**



**Legend**

- Sediment Elevation Tables
- ~ Major Roads
- ~ Streams
- Urban Areas
- Pacific Ocean

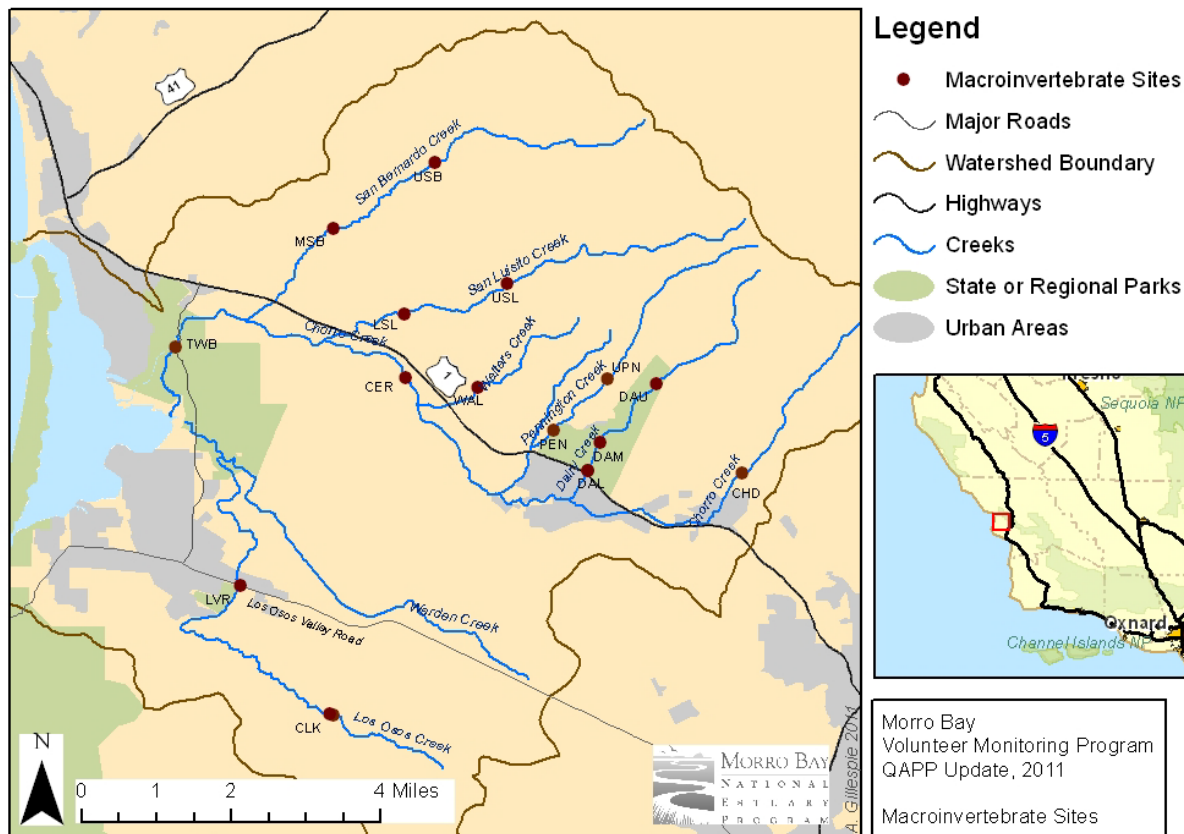
Morro Bay Volunteer Monitoring Program,  
Quality Assurance Program Plan, July 2007

Created in ArcMap 9.2

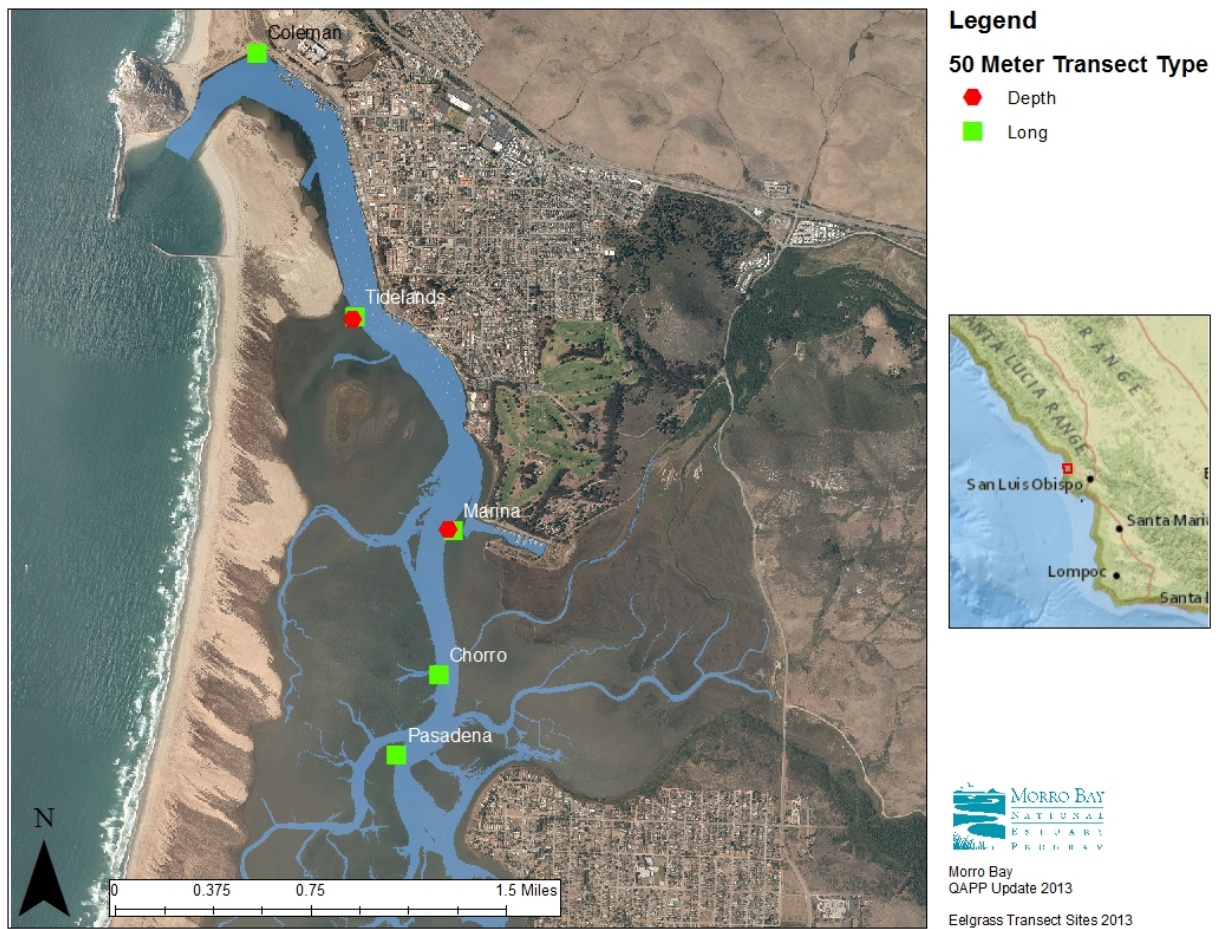




**Figure 6.4.8. MBNEP Bioassessment and Algae Monitoring Locations**

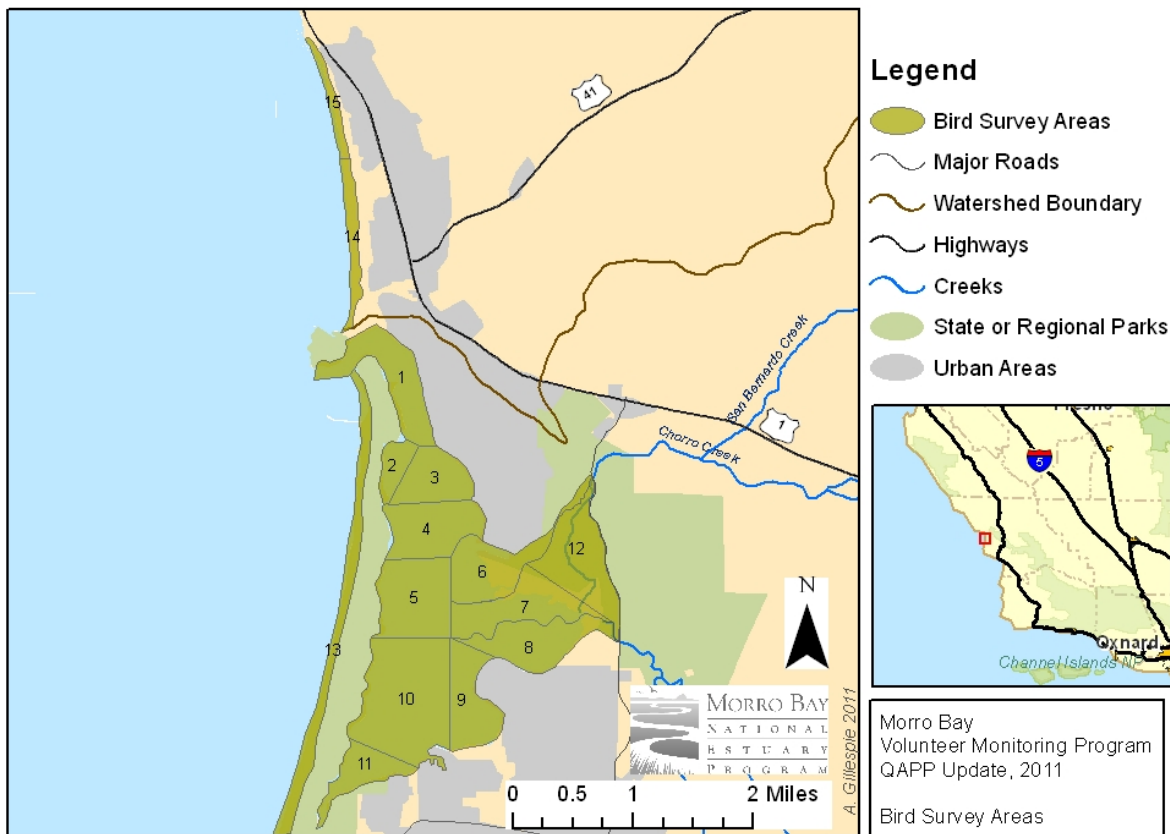


**Figure 6.4.9. MBNEP Eelgrass Monitoring Locations**

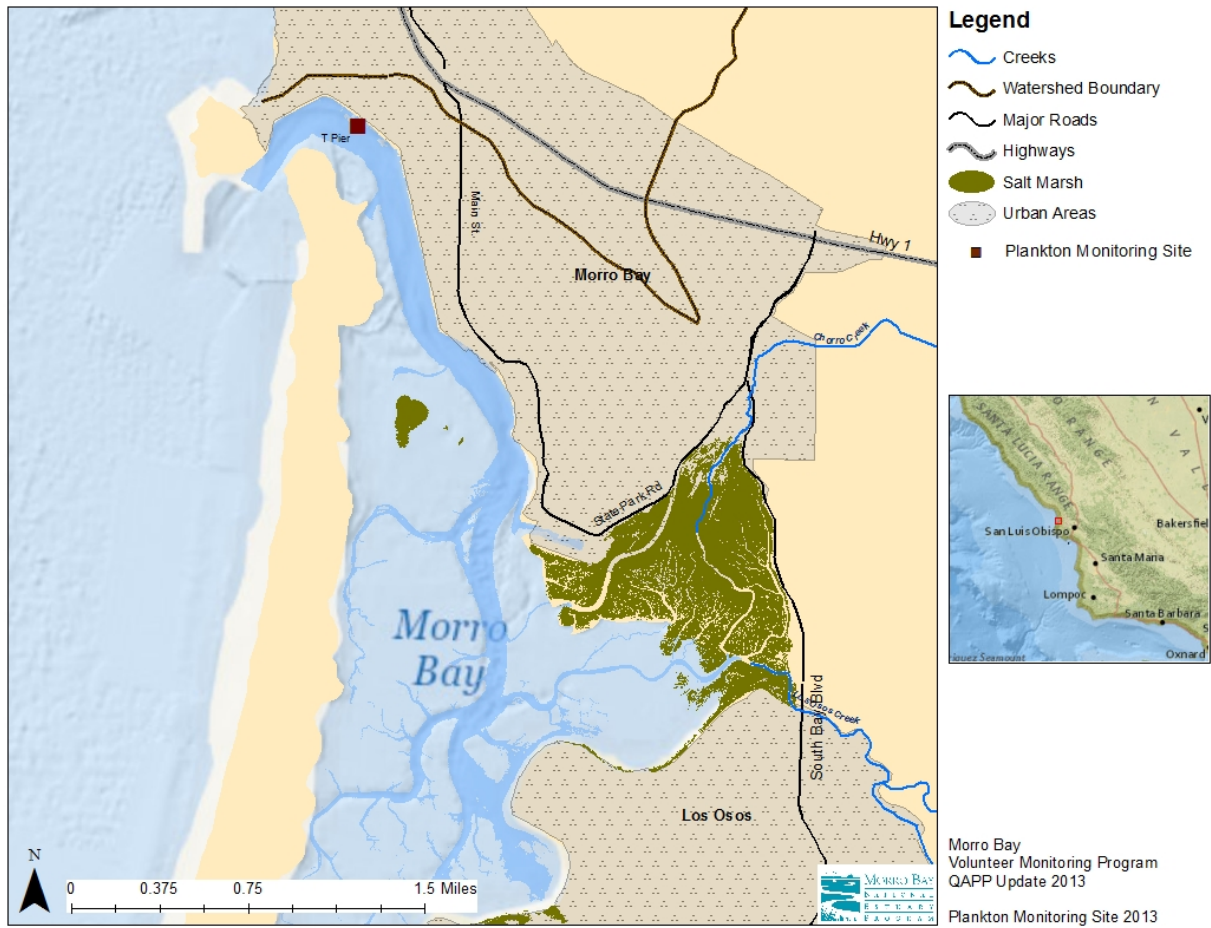




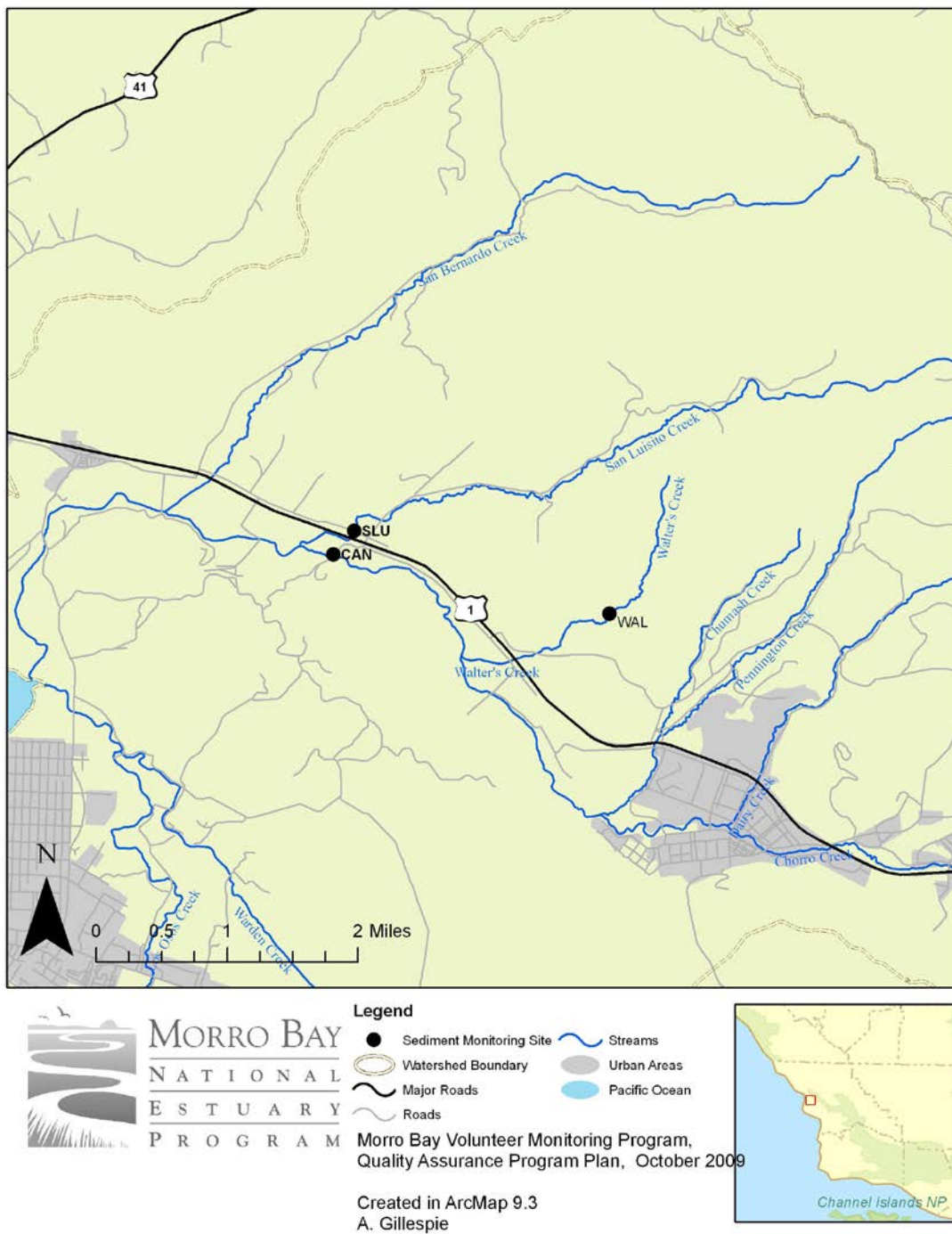
**Figure 6.4.10. MBNEP Shorebird Monitoring Locations**



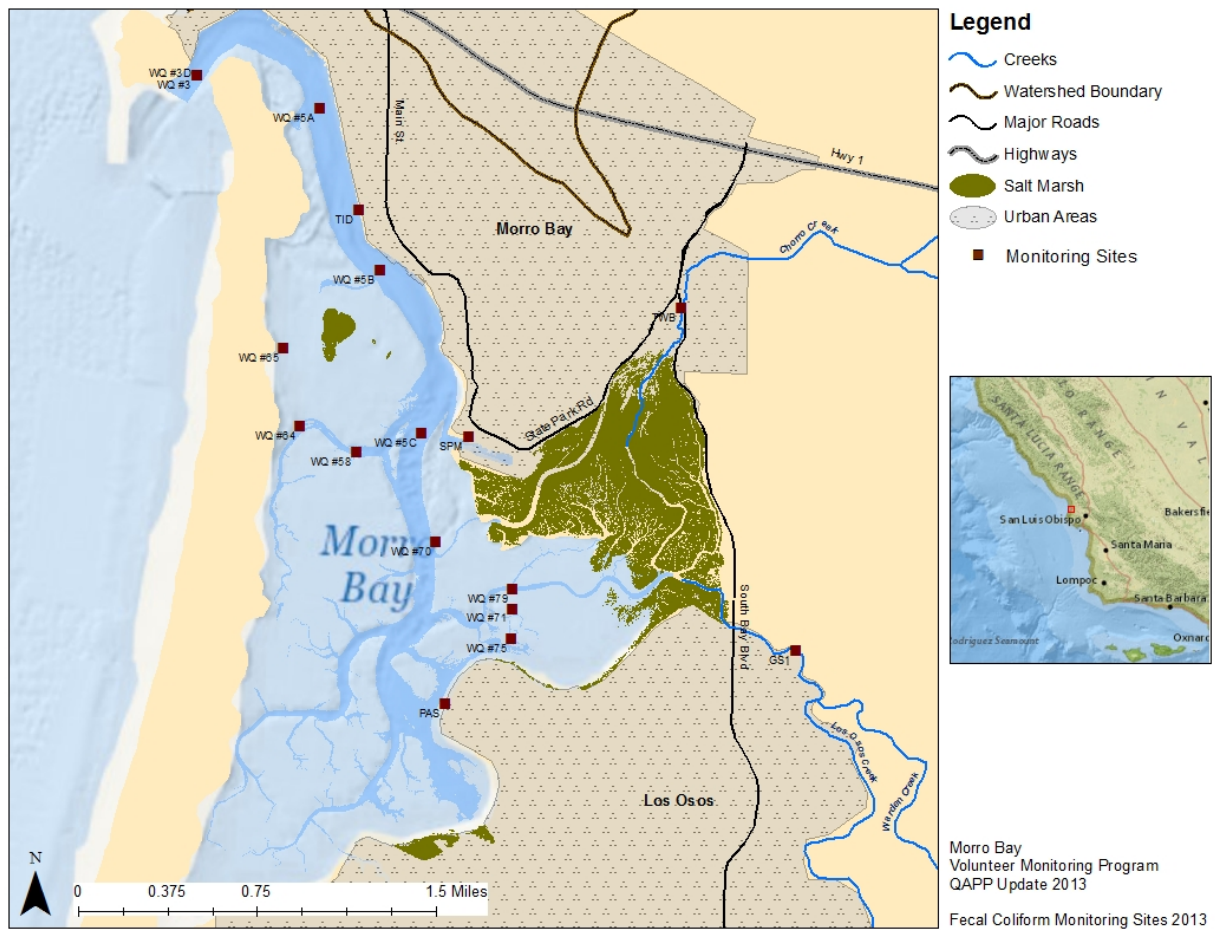
**Figure 6.4.11. MBNEP Phytoplankton Monitoring Locations**



**Figure 6.4.12. MBNEP Suspended Sediment Monitoring Locations**



**Figure 6.4.13. CDPH Fecal Coliform Monitoring Locations**



## 7. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

### 7.1 Measurement quality objectives

This section contains the measurement quality objectives for the program monitoring. This includes analysis both in the field and the laboratory.

**Table 7.1.1. Measurement quality objectives**

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity
Field	Bacteria	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place monthly throughout the year, which was determined to be an adequate level of seasonality. End users of the data determined this frequency to be adequate for statistical analysis.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
Laboratory	Bacteria	NA	Yes. Samples split and analyzed by volunteers and lab. Results must be within 95% confidence interval.	Yes. Two laboratory replicates per year.	Yes. Presence/absence.	Yes. See Table 7.1.2.	NA
Field	Water quality	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place monthly throughout the year, which was determined to be an adequate level of seasonality. End users of the data determined this frequency to be adequate for statistical analysis.	NA	Yes. Monthly replicate readings taken for all meters and kits.	Yes. Pre and post-calibration of equipment.	Yes. See Table 7.1.2.	NA
Field	Water quality	Yes. Monitoring sites were selected	NA	Yes. Side-by-side	Yes. Pre and post-	Yes. See Table	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Completeness	Sensitivity
	(Continuous Monitoring)	in areas where changes due to project implementation were of interest. All monitoring takes place quarterly throughout the year, which was determined to be an adequate level of seasonality. End users of the data determined this frequency to be adequate for statistical analysis.		deployment of two units.	calibration of equipment with each deployment event.	7.1.2.	
Laboratory	Water quality	NA	Yes. See Table 7.1.2.	Yes. See Table 7.1.2.	Yes. See Table 7.1.2.	Yes. See Table 7.1.2.	Yes. See Table 7.1.2.
Field	Flow	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place monthly throughout the year, which was determined to be an adequate level of seasonality. End users of the data determined this frequency to be adequate for statistical analysis.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
Field	Stream Profiling	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place annually during the dry season. This frequency provides an adequate level of seasonality. It was determined to be an adequate frequency for statistical analysis.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
Field	SETs	Yes. Monitoring sites were selected	Yes. Training in field	NA	NA	Yes. See Table	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Completeness	Sensitivity
		to maximize spatial variability. All monitoring takes place periodically during the dry season. It was determined to be an adequate frequency.	techniques minimizes bias.			7.1.2.	
Field	Macroinvertebrates	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place annually each spring. This frequency provides an adequate level of seasonality. It was determined to be an adequate frequency for statistical analysis.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
Laboratory	Macroinvertebrates	NA	NA	Yes. Lab resorts 20 to 25% of all samples and 10% of the samples are re-identified by a second taxonomist.	Yes. Lab resorts 20 to 25% of all samples and 10% of the samples are re-identified by a second taxonomist.	Yes. See Table 7.1.2.	NA
Field	Eelgrass	Yes. Monitoring sites were selected to maximize spatial variability. Transect and biomass monitoring takes place annually each fall. Aerial mapping takes place biennially. This frequency provides an adequate level of seasonality. It was determined to be an adequate frequency for statistical analysis.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
Field	Algae	Yes. Monitoring sites were selected to maximize spatial	Yes. Training in field techniques	NA	NA	Yes. See Table 7.1.2.	NA

Group	Parameter	Representative- ness	Bias	Precision	Accuracy	Complete- ness	Sensiti- vity
		variability. All monitoring takes place annually during bioassessment, which was determined to be an adequate level of seasonality. End users of the data determined this frequency to be adequate for statistical analysis.	minimizes bias.				
Field	Phytoplankton	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place monthly throughout the year, which was determined to be an adequate level of seasonality. End users of the data determined this frequency to be adequate for statistical analysis.	Yes. Training in field techniques minimizes bias.	NA	All samples are re-analyzed by CDPH staff.	Yes. See Table 7.1.2.	NA
Field	Shorebird surveys	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place annually each fall. This frequency provides an adequate level of seasonality. It was determined to be an adequate frequency for statistical analysis.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
Field	Suspended sediment concentration	Yes. Monitoring sites were selected based on safety considerations, existing infrastructure, and to target sediment loads in relation to on-going and future restoration	Yes. Training in field techniques minimizes bias.	NA	NA	NA	NA



Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity
		work. Monitoring takes place during storms of various amounts of rainfall to represent varying flow conditions.					
Laboratory	Suspended sediment concentration	NA	NA	Yes. SLQA provides replicate samples for analysis. Results must be within +/- 1 mg.	Due to the nature of the analysis, samples cannot be split for analysis by an independent laboratory. However, single blind samples are obtained from the USGS Sediment Lab for analysis. Sample results must be within +/- 1 mg.	NA	NA

Representativeness indicates how well the data represents environmental conditions. This is addressed through the overall sampling design. Sites were selected to maximize spatial variability and are typically located at the bottoms of tributaries. The sample schedule was designed to maximize representativeness by optimizing the sampling frequency and location. Often, data end users were involved in these decisions to ensure that the data generated would be adequate for their analytical needs.

See Table 7.1.2 for a description of how each measurement quality objective will be determined.

**Table 7.1.2. Measurement quality objectives for field measurements**

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limit	Complete-ness
Water quality	Dissolved oxygen	$\pm 0.3$ mg/L	$\pm 0.75$ mg/L or 15%	NA	0.01 mg/L	90%
Water quality	Temperature	$\pm 0.1^{\circ}\text{C}$	$\pm 0.5^{\circ}\text{C}$ or 10%	NA	0.1 $^{\circ}\text{C}$	90%
Water quality	Conductivity	$\pm 1\%$ of range	$\pm 5$ or 10%	NA	0.1 uS for high range meter	90%
Water quality	pH electrode	$\pm 20\%$	$\pm 20\%$	NA	0.01 pH	90%

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limit	Completeness
Water quality	Turbidity	See below.	See below.	NA	0.01 NTU	90%
Water quality	Nitrate as N	$\pm 20\%$	$\pm 20\%$	NA	0.3 mg/L	90%
Water quality	Orthophosphate as PO <sub>4</sub>	$\pm 20\%$	$\pm 20\%$	NA	0.3 mg/L	90%
Flow	Flow (cubic feet per second)	$\pm 0.25$ ft <sup>3</sup> /sec	$\pm 25\%$	NA	NA	90%
Water quality (Continuous Monitoring)	DO	$\pm 0.1$ mg/L when $< 8$ mg/L $+0.2$ mg/L when $> 8$ mg/L $\pm 10\%$ reading when $> 20$ mg/L	$\pm 0.75$ mg/L or 15%	NA	0.01 mg/L	90%
Water quality (Continuous Monitoring)	Conductivity	$\pm (0.5\%$ of reading + 0.001 mS/cm)	$\pm 5$ or 10%	NA	0.1 uS/cm for high range meter	90%
Water quality (Continuous Monitoring)	pH	$\pm 0.2$ units	$\pm 20\%$	NA	0.01 pH	90%
Water quality (Continuous Monitoring)	Turbidity	$\pm 1\%$ up to 100 NTU $\pm 3\%$ from 100 - 400 NTU $\pm 5\%$ from 400 - 3000 NTU	$\pm 1\%$ up to 100 NTU $\pm 3\%$ from 100 - 400 NTU $\pm 5\%$ from 400 - 3000 NTU	NA	0.1 NTU from 0 – 400 NTU 1 NTU > 400 NTU	90%

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limit	Completeness
Water quality (Continuous Monitoring)	Temperature	$\pm 0.10^{\circ}\text{C}$	$\pm 0.5^{\circ}\text{C}$ or 10%	NA	$0.1^{\circ}\text{C}$	90%
Stream profiling	Elevation along profile	$\pm 0.05$ ft	NA	NA	NA	90%
SETs	Elevation change	$\pm 1.5$ mm	NA	NA	NA	90%
Eelgrass	Shoot density, biomass, etc.	NA	NA	NA	NA	90%
Algae documenting	Photo documenting	NA	NA	NA	NA	90%
Phyto-plankton	Cell counts	NA	NA	NA	NA	90%
Shorebirds	Bird counts	NA	NA	NA	NA	90%
Suspended sediment monitoring	Suspended sediment concentration	NA	$\pm 1$ mg	Single blind samples from USGS sediment lab. Analyzed twice annually. Results must be within $\pm 1$ mg.	2 mg	NA

The acceptable difference between the two readings for turbidity are for  $\leq 5$  NTU ( $\pm 2$  NTU), for  $\leq 25$  NTU ( $\pm 5$  NTU), for  $\leq 100$  NTU ( $\pm 20$  NTU), for  $\leq 500$  NTU ( $\pm 50$  NTU), for  $\leq 1,000$  NTU ( $\pm 100$  NTU), for  $\leq 10,000$  NTU ( $\pm 200$  NTU), for  $\leq 100,000$  NTU ( $\pm 300$  NTU).

Completeness is the percentage of how much of the data are available for use versus the total amount of data collected. Data may be unavailable for use due to unavoidable circumstances such as laboratory error, samples lost or contaminated, etc. Because this monitoring program is a long-term program, any missed data at a specific site or time period can generally be collected during a later monitoring event.

Completeness percentages were determined to help assess the effectiveness of this monitoring program and are provided in Tables 7.1.2 and 7.1.3.

The suspended sediment monitoring methods were selected in consultation with USGS's Sediment Monitoring Laboratory in Marina, CA as well as staff in the Santa Maria office. The method of monitoring does not allow for splitting of samples for analysis to determine accuracy, precision or completeness. Analysis will be conducted to assess recovery. The monitoring program will participate in the USGS SLQA program which produces single blind samples which will be analyzed in our laboratory at least annually. Based on this analysis, we will be able to assess our recovery rate.

**Table 7.1.3. Measurement quality objectives for laboratory measurements**

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Completeness
Bacteria	<i>E. coli</i>	Presence/absence	95% confidence interval	NA	2 MPN/100 mL	90%
Bacteria	Total coliform	Presence/absence	95% confidence interval	NA	2 MPN/100 mL	90%
Bacteria	Enterococcus	Presence/absence	95% confidence interval	NA	2 MPN/100 mL	90%
Bacteria	Fecal coliform	Presence/absence	95% confidence interval	NA	2 MPN/100 mL	90%
Water quality	Nitrates as N	80 – 120%	± 10%	90-110%	0.1 mg/L	90%
Water quality	Ortho-phosphate as P	90-110%	±10%	90-110%	0.02 mg/L	90%
Water quality - Ag Monitoring Sites	Total Nitrogen	NA	NA	NA	NA	Calculation
Water quality - Ag Monitoring Sites	Organic Nitrogen	NA	NA	NA	NA	Calculation
Water quality - Ag Monitoring Sites	Ammonia-Nitrogen	90 - 110%	± 10%	90 - 110%	0.05 mg/L	90%
Water quality -	Total	80 - 120%	± 20%	80 - 120%	0.2 mg/L	80%

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Completeness
Ag Monitoring Sites	Kjeldahl Nitrogen					
Water quality - Ag Monitoring Sites	Nitrite as NO <sub>2</sub>	90 - 110%	± 10%	90 - 110%	0.17 mg/L	90%
Water quality - Ag Monitoring Sites	Total Phosphorus	80 - 120%	± 20%	80 - 120%	0.05 mg/L	80%
Water quality	Turbidity	NA	NA	NA	0.1 NTU	90%
Bioassessment	Benthic invertebrates	≤ 10% difference in sorting efficacy, 0% difference in identification.	≤ 10% difference in sorting efficacy, 0% difference in identification.	NA	NA	80%

## 8. SPECIAL TRAINING NEEDS/CERTIFICATION

### 8.1 Specialized training or certifications

Each of the trainings sessions is to prepare program volunteers for MBNEP volunteer monitoring efforts. All are offered on an as-needed basis. All trainees receive information on safety in the field. After training, volunteers will “shadow” a qualified volunteer monitor in that given protocol. Shadowing is defined as performing the given protocol, but with supervision to remind the trainee of safety and quality assurance guidelines. All staff and volunteers receive training prior to the start of a monitoring effort. No special training or certifications are required for this project.

The MBNEP QA Officer is responsible for overseeing training of all VMP staff and volunteers. The MBNEP QA Officer provides training to VMP staff. Volunteers are trained by VMP staff under supervision of the QA Officer.

Following is a brief discussion of training pertinent to each monitoring task. Volunteer monitors will carry out all protocols in the field, except bacteriological testing.

#### Water Quality Monitoring Training:

This training, conducted by VMP staff, emphasizes water sampling safety protocols. Training includes instruction on how to calibrate and properly operate field meters to monitor nutrients, DO, turbidity, temperature, pH, and conductivity. Water quality training will be split into estuarine and freshwater monitoring training. Documentation of training attendees will be recorded and maintained in a training log.

Continuous monitoring water quality meters are deployed by VMP staff. New staff receive training from VMP staff per the monitoring protocol.

#### **Flow Monitoring Training:**

A training conducted by VMP staff demonstrates the use of the flow meter, while emphasizing water safety precautions. Documentation of training attendees will be recorded and maintained in a training log.

#### **Bioassessment and Algae Monitoring Training:**

VMP staff train program volunteers in the techniques for collection of bioassessment samples. All samples are analyzed by a laboratory, and thus sample identification is not emphasized. All monitoring is conducted under the direct guidance of a VMP staff member. VMP staff receive an annual refresher training from CCRWQCB or California Department of Fish & Wildlife staff. Documentation of training attendees will be recorded and maintained in a training log.

#### **Bacteria Monitoring Training:**

VMP staff trains program volunteers in proper technique for sample collection in the field, including sterile technique. Volunteers are then trained in the lab by VMP staff in sample analysis techniques using IDEXX methodologies. The lab protocols include sample dilution, sample preparation, and reading and documenting lab results. Documentation of training attendees will be recorded and maintained in a training log. For bay fecal coliform sampling, CDPH staff sample according to their protocol. CDPH staff must be certified in the sampling procedures, and CDPH staff provide training for any new sampling staff.

#### **Stream Profiling Training:**

VMP staff train program volunteers in the techniques for plotting stream cross-sections at established points throughout the watershed. All monitoring is conducted under the direct guidance of a VMP staff member. Documentation of training attendees will be recorded and maintained in a training log.

#### **Shorebird Monitoring Training:**

Local birding experts train program volunteers in the protocol for conducting bay-wide shorebird counts. Bird identification is not included in the training because only birders of sufficient expertise participate in the effort.

#### **Phytoplankton Monitoring Training:**

VMP staff train program volunteers in the techniques for collecting and identifying phytoplankton samples. Periodic refresher training is provided for both VMP staff and program volunteers by the CDPH Marine Biotoxin Monitoring staff. Documentation of training attendees will be recorded and maintained in a training log.

### **8.2 Training and certification documentation**

All training is documented in a training log where program staff record the volunteer trained, type of training, and staff conducting the training. When monitoring protocols are updated, volunteers are re-trained, and this is also documented in the training log. Upon starting with the program, VMP staff receive training in all areas of the program as part of their basic orientation. All training documentation is overseen by the MBNEP QA Officer.

For CDPH fecal coliform sampling, CDPH staff conduct training per their water sampling protocol. All CDPH staff and volunteers who collect samples must undergo the CDPH certification process.

### 8.3 Training personnel

All VMP staff training is provided by the MBNEP QA Officer who ensures that all necessary training has been completed. All volunteer training is overseen by the MBNEP QA Officer and provided by VMP staff who ensure that all appropriate volunteer training has been completed. Analytical laboratories are responsible for providing training to their own personnel. CDPH personnel provide their own training for fecal coliform sampling.

## 9. DOCUMENTS AND RECORDS

The MBNEP will maintain records for sample collection and laboratory testing. Samples sent to a laboratory for analysis will include a chain of custody form. The laboratories generate records for sample receipt and storage, analyses, and reporting. Sampling collection records contain a unique site ID, date, time, monitor's name, equipment used, data recorded, weather and rainfall information, and tidal information (if applicable).

The MBNEP has an existing database of field measurements. The program uses an Excel-based database to store all program data. The Data Manager, a VMP staff member, maintains this electronic data with oversight by the MBNEP QA Officer. The database is backed up on a mirror copy of the server on an external hard drive that is written over every other week and stored off site in a safety deposit box.

All monitoring records generated are stored at the MBNEP office, both paper and electronic copies. The analytical laboratories records pertinent to this project will be maintained at the lab locations. Copies of all laboratory results will be sent to the MBNEP via mail, email or electronic data retrieval system and stored in the project file. All records contain the unique sample ID, date of sample receipt, date of analysis, analytical methods, method detection limit (if applicable), reporting limit (if applicable) and measured value.

For CDPH fecal coliform monitoring, the lab report results and chain-of-custody forms are maintained by the VMP. Copies are sent to CDPH, who manages the data electronically.

All data records, both volunteer-generated and laboratory-generated, that do not meet the objectives outlined in the approved QAPP will be flagged as acceptable or unacceptable.

Copies of this QAPP will be distributed to all parties involved with the project and made available to VMP staff. Copies of relevant sections will be sent to the analytical laboratories for distribution within the labs. Any future amended QAPPs will be held and distributed in the same fashion. All originals of subsequent amended QAPPs will be held at the MBNEP. Copies of versions, other than the most current, will be labeled as such so as not to create confusion.

Persons responsible for maintaining records for this project are as follows. VMP staff will maintain all sample collection, sample transport, chain of custody, and laboratory analyses forms at the MBNEP office. VMP staff will also maintain at the MBNEP office all records associated with the receipt and analysis of samples, and all records submitted by the laboratory. VMP staff will maintain the database permanently. Each individual laboratory will maintain records in accordance with its own QAPP requirements. The MBNEP Program Manager will oversee the actions of these persons and will arbitrate any issues relative to records retention and any decisions to discard records.

Copies of the records will be maintained at the MBNEP office and the analytical laboratories for at least five years after project completion. The database will be maintained without discarding. The QAPP will be maintained without discarding.

Other documents generated during the course of this project include monthly status reports, annual data summary reports, an annual training log, and an annual database submittal.

## **GROUP B: DATA GENERATION AND ACQUISITION**

### **10. SAMPLING PROCESS DESIGN**

Size of study area: Water quality, bacteria, flow, stream profiling and bioassessment monitoring sites were selected to monitor as much of the watershed as possible. Thus, sites tend to be at the downstream locations of tributaries or near potential significant impacts. Additionally, many sites were selected based on historical monitoring efforts in the area such as the National Monitoring Program. Safe access and landowner permission are other major factors in site selection. Sites for continuous monitoring of water quality parameters are typically selected to be upstream and downstream of improvement projects or other features of interest such as point sources. Sites for fecal coliform monitoring by CDPH were selected based on historical sites as well as the locations of the shellfish growing lease areas. The eelgrass transects were distributed throughout the bay to look at the influence from different factors present in each region of the bay. Eelgrass mapping covers the entire bay. The shorebird study area follows the historical sites established in historical studies. Phytoplankton sites were established to be easily accessible but provide adequate information with a minimal amount of sampling. The SETs were established in portions of the bay where the most change due to sedimentation could be expected. Suspended sediment concentration sites were established to help characterize the effects of on-going and future restoration work as well as to track overall suspended sediment load from the Chorro watershed.

Volume or time period represented by a sample: Water quality, bacteria and flow monitoring are conducted on a monthly basis. Agricultural Monitoring water quality sites are monitored three times per month during times of adequate surface flows. Continuous Monitoring of water quality parameters is conducted on a quarterly basis. Monitoring by CDPH for fecal coliform is conducted on a monthly basis at nine sites, bimonthly at five sites, and quarterly at three sites. Phytoplankton pulls are conducted on a twice monthly basis. Bioassessment and algae monitoring are conducted once a year in the appropriate season. Eelgrass imagery collection is typically monitored every other year, depending on funding. Eelgrass transects are monitored annually for shoot density, biomass and other measurements. Stream profiling and SET monitoring takes place every several years due to the long-term nature of the sediment measurements. Shorebird monitoring events are conducted each fall. Suspended sediment monitoring data is collected during storms which generate flow above base-flow conditions.

Type and total number of samples needed: Water samples for bacteria analysis are collected at 23 creek sites and eight bay sites. One 120-mL water sample is collected at each site where 1:10 dilutions are run, and two 120-mL samples are collected at each site where an undiluted and 1:10 sample are run or a quality assurance analysis is being conducted for that site, in which case larger volumes of water may be required. Water quality monitoring is conducted at 21 creek sites and seven bay sites. Water samples are collected in sterile 4 oz. Whirl-pak bags for nutrient analysis or in 8 oz. plastic bottles if quality assurance is being conducted and a sample is needed for laboratory analysis. Samples for analysis for ammonia, total Kjeldahl nitrogen, total phosphorus are collected in 8 oz. bottles containing H<sub>2</sub>SO<sub>4</sub> preservative. Flow data is collected at 19 creek sites during times of measurable flow. For fecal coliform monitoring conducted by CDPH, water samples are collected at 15 bay and two creek sites. One 120-mL water sample is collected at each site using a sterile container. Bioassessment samples include insects and debris collected from creek beds. The total number of bioassessment monitoring sites is 12, but the number monitored varies from year to year based on water levels, funding, staff availability and other factors. For phytoplankton, a water sample is collected from the site twice each month. For eelgrass, shoots are



collected from transects located at five sites. At eelgrass beds that are dense, 30 shoots are collected. At beds where the eelgrass is sparse, 15 shoots are collected. The samples are dried and weighed to make a biomass determination. For continuous monitoring of water quality, stream profiling, SETs, algae documenting and bird surveys, no samples are collected. For suspended sediment concentration monitoring, creek water samples are collected at three sites. Each sample bottle is filled to 350 mL by an automated sampler, and 24 bottles can be collected during a sampler run. The sampler must then have the bottles swapped out and the timer re-set for additional sample collection.

Where samples are taken: See maps from Section 6.4. Sites are identified in various ways. While all are identified through GPS, volunteers in the field for bacteria, water quality, flow, bioassessment, algae, shorebirds and phytoplankton monitoring identify sites through the use of landmarks. For monitoring of suspended sediment, eelgrass, SETs and stream profiling, permanent benchmarks are established at each of the monitoring sites, and they are located with the aid of GPS. Either VMP staff or contractors conduct these monitoring efforts and are trained in the use of GPS.

If sites become inaccessible: Samples can be collected within the same reach or immediate area at a more accessible location. Volunteers are trained in site selection so they have the knowledge to identify a new site location if a new one becomes inaccessible. If conditions are unsafe, volunteers will delay sample collection until access becomes safe.

Project activity schedules: Monitoring for water quality, bacteria and flow is conducted on a monthly basis, year-round. Agricultural Monitoring water quality sites are monitored three times per month. Fecal coliform monitoring by CDPH staff is conducted monthly, bi-monthly and quarterly, depending on the site. Continuous monitoring of water quality parameters takes place quarterly. Creek algae documenting takes place once a year in the spring during bioassessment monitoring. Bay samples must be collected at the appropriate tidal cycle and thus this monitoring schedule is dictated by the tides. In-bay monitoring for DO must be conducted within two hours after sunrise on a tide to allow safe access via kayak. This allows the volunteers to capture the lowest DO levels of the diurnal cycle. All QA samples will be delivered to the lab by VMP staff or lab courier pick-up. Staff will make every effort to deliver the bacteria samples to the lab in time for them to be analyzed within six hours of collection. If this is not possible, they will be delivered for analysis within 24 hours of collection. Eelgrass transects and bioassessment are monitored once a year. Bioassessment samples are typically delivered to the lab within six months, although they can be held for up to five years. Eelgrass biomass samples are collected and refrigerated until they can be analyzed, typically within 72 hours. Eelgrass imagery is collected biennially, depending on funding availability and the amount of rainfall. In heavy rainfall years, more frequent monitoring may take place. Stream profiling and SET monitoring takes place on a frequency of several years since the monitoring is intended for long-term tracking of sedimentation in the bay. Phytoplankton is monitored twice a month. Tidally-influenced monitoring such as bay water quality, bacteria, eelgrass, SETs, shorebirds and phytoplankton are scheduled upon review of a tide table to ensure adequate access and optimal conditions. Suspended sediment monitoring is conducted during storms taking place during the rainy season. Samples are delivered within 48 hours of collection to the sediment laboratory. Samples do not have a hold time requirement but are kept either in a refrigerator or at room temperature in the dark.

Critical vs. informational data: All data collected for this effort is considered to be critical data.

Sources and reconciliation of variability: For water quality and bacteria monitoring, potential sources of variability include improper sample handling or lab techniques and environmental variability. Samples are split for 10% of samples collected. If split samples sent to the laboratory for analysis differ consistently from volunteer conducted analysis, additional quality assurance will be conducted and training refreshers will be conducted to remedy the problem and minimize operator-introduced sources of

variability. Data should be within the measurement quality objectives listed in Table 7.1.3. If these objectives are not met, the data are flagged in the database and are not included in any data analysis. Other measures to address variability include wearing gloves during sample collection and analysis, use of clean or sterile containers for sample collection and analysis, and intense training for volunteers in proper sampling technique. For flow monitoring and bioassessment sampling, proper site selection is the largest source of variability and is addressed through volunteer training. For algae documenting, eelgrass, shorebird monitoring and phytoplankton, the greatest sources of variability are the individual making the assessment, and this can only be addressed through training. For stream profiling, proper site identification is likely the greatest source of variability and can only be addressed through training. For suspended sediment monitoring, the largest sources of variability include malfunctioning of the automated sampler, sample bottles that are not clean, and contamination during the laboratory analysis process. These are addressed through training and use of detailed protocols.

Sources of bias or misrepresentation: For bacteria and water quality monitoring, a potential source of bias is in the interpretation of testing results. Volunteers must interpret a color change to read the results. This bias is addressed by periodically splitting samples for all analysis. The volunteer analyzes half of it and the QA lab analyzes the other half. The compared results must be within the measurement quality objectives outlined in Table 7.1.3. If they are not, then the volunteer's sample collection and laboratory techniques will be reviewed to eliminate any potential source of bias and the data will be flagged in the database. For flow monitoring and macroinvertebrate sampling, proper site selection is the largest source of bias and is addressed through volunteer training. For algae documenting, eelgrass, shorebird monitoring and phytoplankton, the greatest sources of bias are the individual making the assessment and this can only be addressed through training. For stream profiling, a potential source of bias is improper use of the monitoring equipment, which can only be addressed through training. For suspended sediment monitoring, the method of analysis does not allow for splits or duplicates to be analyzed for comparison. The largest source of bias would be improper laboratory techniques such as inadequate drying of filters and improperly calibrated lab equipment such as scales. This is addressed through training in laboratory techniques as well as detailed calibration procedures.

## **11. SAMPLING METHODS**

All bacteria samples are aquatic samples. They will be collected as grab samples using sterile jars from approximately mid-stream and from just below the water's surface. The sterile sample jars hold 120-mL and are made from high density plastic. They are purchased from IDEXX Laboratories for use with the IDEXX testing system. The sealed, sterile jars contain sodium thiosulfate to neutralize chlorine which may be present at some sites. These bottles are used once and then disposed of. When samples are collected, the volunteer makes sure to leave some headspace in the jar. To collect samples to be split, a larger volume of water is required. Larger, 250-mL autoclavable bottles are used for sample collection. The bottles are autoclaved between uses to ensure that they are sterile. Samples are inverted 25 times and then 100 mL is decanted into each of two IDEXX 120-mL jars prior to analysis. Excess sample can be disposed of down the drain. Bacteria monitoring requires a wet lab with an autoclave, incubators and a source of sterile deionized water. MBNEP bacterial analysis by program volunteers is conducted at the Morro Bay-Cayucos Wastewater Treatment Plant Laboratory. Plant personnel operate the facility's autoclave to provide the sterilized glassware and deionized water needed for analysis. If it is determined that the sample collection method is introducing error into the results, the MBNEP QA Officer will reassess both the monitoring protocol and how the volunteers follow the protocol. If a source of error is identified, the protocol will be revised and volunteers will be re-trained.

For water quality monitoring, measurements are taken from approximately mid-stream and from just below the water's surface. All sampling equipment is rinsed with deionized water upon completion of the monitoring. pH meters are rinsed with tap water. All monitoring and analysis except for nutrient analysis

is conducted in the field. Water samples for quality assurance purposes and nutrient analysis are collected from mid-stream, just below the water's surface. A large, clean container is used to collect a single sample. The sample is gently mixed and then split. A portion is used to fill a sterile 4 oz. Whirl-pak bag for the volunteer's analysis and a portion stored in a clean container provided by the laboratory for one-time use. All samples are aqueous samples. Excess sample is disposed of by the lab. Other than the field equipment, no special equipment or facilities are required for analysis. If it is determined that the sample collection method is introducing error into the results, the MBNEP QA Officer will reassess both the monitoring protocol and how the volunteers follow the protocol. If a source of error is identified, the protocol will be revised and volunteers will be re-trained.

Macroinvertebrate samples for bioassessment are stored in clean 16-oz plastic containers. The samples contain creek substrate and macroinvertebrates. Every attempt is made to remove all plant matter. The D-ring sampling net, bucket and sieves are rinsed between monitoring sites to minimize contamination. Excess samples are disposed of by the lab. No additional equipment or facilities are required for the sampling. All analysis is conducted by the laboratory. If samples are too large to fit in the 16-oz collection jar, larger debris is rinsed and removed until the sample is small enough. A 95% isopropyl alcohol preservative is added to each jar as soon as possible after collection. If it is determined that the sample collection method is introducing error into the results, the MBNEP QA Officer will reassess both the monitoring protocol and how the volunteers follow the protocol. If a source of error is identified, the protocol will be revised and volunteers will be re-trained.

For phytoplankton, water samples are filtered using a fine mesh net and stored in a clean plastic container for transport to the MBNEP office. Once at the office, the sample is studied under a microscope and a portion of the sample is mailed to CDPH for their analysis. The net is rinsed with freshwater and hung to dry. Excess sample is disposed of down the drain.

For eelgrass, shoots are collected from transects located at five sites. If the bed has dense eelgrass coverage, 30 shoots are collected. If the eelgrass bed is sparse, then 15 shoots are collected. Shoots are stored in plastic bags. They are stored in the refrigerator until they are dried and weighed to make a biomass determination. Excess sample is disposed of in the trash. The drying ovens and balances required for the sample analysis are the same equipment used for suspended sediment analysis.

For flow, SETs, stream profiling, algae documenting and shorebird monitoring, no samples are collected.

For suspended sediment monitoring, samples are collected from creeks during storms using automated samplers which draw water through an intake in the creek and up into a sampler housing which contains 24 bottles. The intake is located in an area in the creek where it will remain submerged but is not at risk of becoming buried by sediment or crushed in a debris jam. All samples are aqueous samples. The samplers are programmed to draw a certain volume of water at a certain frequency. Each sample is 350 mL, leaving headspace at the top of the bottles. These samples do not require any refrigeration. Following filtration, sample supernate water is disposed of down the drain. Sample bottles are rinsed with DI water and allowed to dry completely before being re-deployed in the field. If it is determined that the method of sample collection is introducing bias into the results, the protocol will be revised and monitoring personnel will be retrained.

In all of these monitoring efforts, any problems are identified by VMP staff in conjunction with the MBNEP QA Officer. Protocols will be revisited and any appropriate volunteer re-training will take place to correct the problem. These corrections will be documented in the updated monitoring SOPs as well as the volunteer training log.

See Appendices for copies of all monitoring SOPs.

**Table 11.1.1. Sampling locations and sampling methods.**

<b>Sampling Location</b>	<b>Location ID Number</b>	<b>Matrix</b>	<b>Depth (units)</b>	<b>Analytical Parameter</b>	<b># Samples (include field duplicates)</b>	<b>Sampling SOP #</b>	<b>Sample Volume</b>	<b>Containers #, size, type</b>	<b>Preservation (chemical, temperature, light protected)</b>	<b>Maximum Holding Time: Preparation/ analysis</b>
Bacteria - All creek sites	See Fig 6.4.3	Water	Below surface	<i>E. coli</i> , total coliform	1 per month at each site plus one split per month	MBVMP Bacteria Monitoring Protocol	100 mL	1-120 mL container/ site, sterile IDEXX bottle	Sodium thiosulfate, stored on ice at 4 °C, dark	Optimal hold time: 6 hours. If not possible to analyze within 6 hrs: 24 hours.
Bacteria - All bay sites	See Fig 6.4.3	Water	Below surface	<i>E. coli</i> and entero-coccus	1 per month at each site plus one split per month	MBVMP Bacteria Monitoring Protocol	100 mL	1-120 mL container/ site, sterile IDEXX bottle	Sodium thiosulfate, stored on ice at 4 °C, dark	Optimal hold time: 6 hours. If not possible to analyze within 6 hrs: 24 hours.
Bacteria – CDPH bay sites	See Fig.6.4.13.	Water	Below surface	Fecal coliform	Monthly, bi-monthly, and quarterly, depending on the site	2013 Sampling Protocol for Shellfish Growing Area Water Quality Monitoring	100 mL	1-120 mL container/site, sterile bottle	Sodium thiosulfate, stored on ice at 4 °C, dark	Optimal hold time: 6 hours. If not possible to analyze within 6 hrs: 24 hours.
Water Quality -	See Fig	Water	Below	Nitrates as N and	1 per site	MBVMP Water	4 oz.	Sterile 4 oz. Whirl-	None	48 hours at 4

<b>Sampling Location</b>	<b>Location ID Number</b>	<b>Matrix</b>	<b>Depth (units)</b>	<b>Analytical Parameter</b>	<b># Samples (include field duplicates)</b>	<b>Sampling SOP #</b>	<b>Sample Volume</b>	<b>Containers #, size, type</b>	<b>Preservation (chemical, temperature, light protected)</b>	<b>Maximum Holding Time: Preparation/analysis</b>
All creek sites	6.4.6		surface	orthophosphates as PO <sub>4</sub>	per month	Quality Monitoring Protocol		pak bag		°C, dark
Water Quality - All creek sites and Ag Monitoring Sites	See Fig 6.4.6	Water	Below surface	Nitrates as N, Orthophosphates as P, Turbidity, pH	For QA, split samples at 10% of sites per month, sent to lab for analysis. For Ag Sites, 3 sets per month sent to lab.	MBVMP Water Quality Monitoring Protocol	250 mL	250 mL container/site, clean plastic container provided by lab	None	48 hours at 4 °C, dark
Water Quality - Ag Monitoring Sites	See Fig. 6.4.3	Water	Surface	Total Nitrogen, Nitrite as NO <sub>2</sub>	One per site, three times a month	BCGEN055	8 oz.	Jar, plastic	None	48 hours at 4°C, dark
Water Quality - Ag Monitoring Sites	See Fig. 6.4.3	Water	Surface	Organic Nitrogen	One per site, three times a month	Calculated	8 oz.	Jar, plastic	None	48 hours at 4°C, dark
Water	See Fig.	Water	Surface	Ammonia	One per	BCGEN06	8 oz.	Jar, plastic	H <sub>2</sub> SO <sub>4</sub>	28 days at

<b>Sampling Location</b>	<b>Location ID Number</b>	<b>Matrix</b>	<b>Depth (units)</b>	<b>Analytical Parameter</b>	<b># Samples (include field duplicates)</b>	<b>Sampling SOP #</b>	<b>Sample Volume</b>	<b>Containers #, size, type</b>	<b>Preservation (chemical, temperature, light protected)</b>	<b>Maximum Holding Time: Preparation/analysis</b>
Quality - Ag Monitoring Sites	6.4.3			as Nitrogen	site, three times a month	1				4°C, dark
Water Quality - Ag Monitoring Sites	See Fig. 6.4.3	Water	Surface	Total Kjeldahl Nitrogen	One per site, three times a month	BCGEN059	8 oz.	Jar, plastic	H <sub>2</sub> SO <sub>4</sub>	28 days at 4°C, dark
Water Quality - Ag Monitoring Sites	See Fig. 6.4.3	Water	Surface	Total Phosphorus	One per site, three times a month	BCGEN060	8 oz.	Jar, plastic	H <sub>2</sub> SO <sub>4</sub>	28 days at 4°C, dark
Water Quality – bay dissolved oxygen sites	See Fig 6.4.6	Water	Below surface	Salinity, temperature, DO	1 sample per month at each site	MBVMP DO in the Bay Protocol	NA	NA	NA	NA
Suspended sediment	See Fig. 6.4.17	Water	Surface	Suspended sediment concentration	Depends on number of storms and frequency of sample	MBVMP Suspended Sediment Monitoring Protocol	350 mL	1 L plastic sampler bottles	None, light protected	No holding time limit

<b>Sampling Location</b>	<b>Location ID Number</b>	<b>Matrix</b>	<b>Depth (units)</b>	<b>Analytical Parameter</b>	<b># Samples (include field duplicates)</b>	<b>Sampling SOP #</b>	<b>Sample Volume</b>	<b>Containers #, size, type</b>	<b>Preservation (chemical, temperature, light protected)</b>	<b>Maximum Holding Time: Preparation/analysis</b>
					collection					
Macroinvertebrates - All sites	See Fig 6.4.12	Macroinvertebrate samples	Creek bottom	Benthic invertebrates	1 composited sample per site	MBVMP Macroinvertebrate Sampling and Rapid Bioassessment Protocol	16-oz	16-oz widemouth plastic jars	95% isopropyl alcohol	5 years, store in dark away from extreme temperatures
Eelgrass – All Sites	See Fig 6.4.13	Eelgrass biomass samples	Eelgrass exposed at low tides	Eelgrass plant biomass	30 shoots per transect for dense beds, 15 shoots per transect for sparse beds	MBNEP Eelgrass Monitoring Protocols	15 or 30 shoots	Plastic bag	Refrigerated	7 days, refrigerated

## 12. SAMPLE HANDLING AND CUSTODY

### 12.1 Sample handling and transport

The field sampler is personally responsible for the care and custody of the samples collected until they are transferred or dispatched properly. Samples to be analyzed in the field or by a lab should include the date and time of collection, sample location, sample identification, sampler, and analysis to be performed.

When sampling water, collected samples will be kept in an ice chest (4°C) with ice or ice packs.

Volunteers conducting the sample collection and analysis are required to complete field datasheets. These include the following information: time of sample collection; sample ID numbers, including unique IDs for any replicate or blank samples; the results of any field measurements (e.g., temperature, DO, pH, conductivity, turbidity) and the time that measurements were made; qualitative descriptions of relevant water conditions (e.g., color, flow level, clarity) or weather (e.g., wind, rain) at the time of sample collection; and a description of any unusual occurrences associated with the sampling event, particularly those that may affect sample or data quality. Samples will be clearly labeled with an indelible marker and include the site ID, sampling date and time, and parameter to be analyzed for.

For bioassessment samples, 95% isopropyl alcohol should be added to the sample as soon as possible.

Eelgrass samples should be stored in a refrigerator or freezer as soon as possible after collection.

After returning from the field, all water samples for water quality, bacteria or phytoplankton analysis will be analyzed immediately, transferred to the laboratory refrigerator, or delivered to the analytical laboratory or its courier.

Upon completion of sample collection, suspended sediment samples should be capped and transported to the sediment lab. Each bottle will be labeled with the date and time of sample collection and then weighed, without the cap, to determine the total sample weight. Bottles have been pre-weighed and the tare weights are stored in the sediment monitoring database. Samples can then be stored either in the refrigerator or in a dark, cool location until they are processed.

All bacteria samples are hand delivered to the labs. Water quality samples to be analyzed by the lab are picked up with a lab courier and delivered to the lab. Pick-ups are scheduled to comply with all hold time requirements.

Bioassessment samples are drained of alcohol preservative, double-bagged and overnight shipped to the lab. Lab personnel immediately refill the samples with alcohol.

Contract laboratories will follow sample custody procedures outlined in their QA plans. Contract laboratory QA plans are on file with the respective laboratory.

All samples remaining after successful completion of analyses will be disposed of properly. It is the responsibility of the personnel of each analytical laboratory to ensure that all applicable regulations are followed in the disposal of samples or related chemicals.

Laboratories shall maintain custody logs sufficient to track each sample submitted and to analyze or preserve each sample within specified holding times.

**Table 12.1.1. Sample handling and custody**

Parameter	Container	Volume	Initial Preservation	Holding Time
<i>E. coli</i> ,	Sterile, sealed	120 mL	Sodium thiosulfate, cool	6 hour at 4°C, dark. If



Parameter	Container	Volume	Initial Preservation	Holding Time
enterococcus, total coliform, fecal coliform	plastic jar purchased from IDEXX Laboratories		to 4°C; dark.	not possible to analyze within 6 hours, then analyze within 24 hours.
Nitrates as N and Orthophosphate as P, analysis by volunteer	Whirl-pak bag	4 oz.	None	48 hour at 4°C, dark.
Nitrates as N and Orthophosphate as P, Nitrite as NO <sub>2</sub> , Total Nitrogen, Organic Nitrogen, analysis by laboratory	Plastic jar provided by BC Laboratories	250 mL	None	48 hour at 4°C, dark.
Turbidity, analysis by lab	Plastic bottle provided by BC Laboratories	8 oz.	None	48 hours at 4°C
Ammonia-nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, analysis by lab	Plastic bottle provided by BC Laboratories	8 oz.	H <sub>2</sub> SO <sub>4</sub> preservative	28 days, at 4°C in the dark.
Benthic invertebrates	Widemouth plastic jar	16 oz.	95% isopropyl alcohol	5 years
Eelgrass	Plastic bag	Various	None	7 days, refrigerate or freeze.
Suspended sediment	Plastic bottle with cap	350 mL	None	Unlimited hold time, in dark cool location.

## 12.2 Chain of custody procedure

The volunteers and staff shall have custody of samples during field sampling. Chain of custody forms will accompany all samples during transport to contract laboratories. These are completed by VMP staff. Forms are signed by the lab and the person relinquishing the sample. Copies of these forms are maintained by VMP staff. All bacteria and water quality samples will be transported to the analytical laboratory directly by volunteers, VMP staff or by laboratory or overnight courier.

See Appendix for a sample chain of custody form.

### 13. ANALYTICAL METHODS

#### 13.1 Analytical methods

The data in Table 13.1.1 and 13.1.3 do not apply to stream profiling, SETs, eelgrass, algae, shorebirds, or phytoplankton monitoring. In the following tables, the term MDL refers to the Method Detection Limit which is the lowest concentration an instrument can distinguish from zero but cannot quantify. This is generally established by the lab conducting the analysis. The term Method refers to when an MDL is specified by the method itself. These terms do not apply to the activities listed in Table 13.1.1, which covers field analysis.

**Table 13.1.1. Field analytical methods**

Analyte	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (1)
Flow	Field monitoring by MBNEP volunteers	NA	Depth = 0.2 ft, Velocity = 0.01 ft/sec	MBVMP Water Quality Monitoring Protocols	No	NA	NA
pH (Water Quality)	Field monitoring by MBNEP volunteers	< 6.5 or > 8.3 pH units	-1.0 pH	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Conductivity (Water Quality)	Field monitoring by MBNEP volunteers	> 3,000 uS (for Water Quality only)	0.10 uS for high range meter	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Dissolved oxygen (Water Quality and Dawn Patrol)	Field monitoring by MBNEP volunteers	< 7.0 mg/L	0.01 mg/L	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Temperature (Water Quality and Dawn Patrol)	Field monitoring by MBNEP volunteers	> 21°C	0.1°C	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Turbidity (Water)	Field monitoring by	> 25 NTU	0.01 NTU	MBVMP Water Quality	No	NA	NA

Analyte	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (1)
Quality)	MBNEP volunteers			Monitoring Protocols			
Nitrate as N (Water Quality)	Field monitoring by MBNEP volunteers	> 10 mg/L	0.3 mg/L	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Orthophosphates as PO <sub>4</sub> (Water Quality)	Field monitoring by MBNEP volunteers	> 0.36 mg/L	0.3 mg/L	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Dissolved Oxygen (Continuous Water Quality Monitoring)	Continuous monitoring with deployment by MBNEP staff	< 7.0 mg/L	0.01 mg/L	MBVMP Minisonde MS5 Calibration and Deployment Protocols	No	NA	NA
pH (Continuous Water Quality Monitoring)	Continuous monitoring with deployment by MBNEP staff	< 6.5 or > 8.3 pH units	-1.0 pH	MBVMP Minisonde MS5 Calibration and Deployment Protocols	No	NA	NA
Conductivity (Continuous Water Quality Monitoring)	Continuous monitoring with deployment by MBNEP staff	> 3,000 uS/cm	0.01 uS/cm	MBVMP Minisonde MS5 Calibration and Deployment Protocols	No	NA	NA
Temperature (Continuous Water Quality Monitoring)	Continuous monitoring with	> 21°C	0.1°C	MBVMP Minisonde MS5 Calibration	No	NA	NA

Analyte	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (1)
Quality Monitoring)	deployment by MBNEP staff			and Deployment Protocols			
Turbidity (Continuous Water Quality Monitoring)	Continuous monitoring with deployment by MBNEP staff	>25 NTU	0.01 NTU	MBVMP Minisonde MS5 Calibration and Deployment Protocols	No	NA	NA
Suspended sediment concentration	Sample collection and analysis by VMP staff	NA	NA	MBVMP Suspended Sediment Monitoring Protocol	No	NA	NA

**Table 13.1.2. Field equipment features**

Monitoring Effort	Equipment Description	Measurement Principle	Major Attributes
Flow	Marsh-McBirney Flo-Mate 2000	electromagnetic	Velocity averaging
pH (Water Quality)	pH meter	Ion-selective electrode	Temperature compensation
Conductivity (Water Quality)	YSI Model 30 and 85	Voltage drop	Temperature correction
Dissolved oxygen (Water Quality and Dawn Patrol)	YSI Model 55 and 85	membrane covered polarographic	Self-calibrating
Temperature (Water Quality and Dawn Patrol)	YSI Model 55 and 85	Thermistor	
Turbidity (Water Quality)	HACH 2100P Turbidimeter	Nephelometric	Auto ranging

Monitoring Effort	Equipment Description	Measurement Principle	Major Attributes
Nitrate as N (Water Quality)	HACH DR/890 meter	Chromatropic acid reaction, colorimeter	
Orthophosphates as PO <sub>4</sub> (Water Quality)	Hanna Low Range Phosphate Meter, Model 93713	Ascorbic acid reduction reaction, colorimeter	
Dissolved Oxygen (Water Quality Continuous Monitoring)	HACH Minisonde 5	Luminescent dissolved oxygen sensor optical probe	
Conductivity (Water Quality Continuous Monitoring)	HACH Minisonde 5	Voltage drop across graphite electrodes	Temperature correction
pH (Water Quality Continuous Monitoring)	HACH Minisonde 5	Ion selective electrode	Temperature correction
Turbidity (Water Quality Continuous Monitoring)	HACH Minisonde 5	Nephelometric	Self-cleaning sensor
Temperature (Water Quality Continuous Monitoring)	HACH Minisonde 5	Thermistor	Provides compensation for DO, conductivity and pH sensors

**Table 13.1.3. Laboratory analytical methods**

Analyte/ Instrumentation	Laboratory / Organization	Project Action Limit (units, wet or dry weight)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (1)
Total coliform (IDEXX Colilert-18)	MBNEP In-house laboratory	> 10,000 MPN/100mL	2 MPN/100mL for an undiluted sample	MBVMP Bacteria Monitoring Protocols	No	1 MPN/100 mL for an undiluted sample	Not applicable
<i>E. coli</i> (IDEXX Colilert-18)	MBNEP In-house laboratory	> 235 MPN/100 mL	2 MPN/100mL for an undiluted sample	MBVMP Bacteria Monitoring Protocols	No	1 MPN/100 mL for an undiluted sample	Not applicable
Enterococcus (IDEXX)	MBNEP In-house laboratory	> 104 MPN/100 mL for salt	2 MPN/100mL for an undiluted	MBVMP Bacteria Monitoring	No	1 MPN/100 mL for an undiluted	Not applicable

Analyte/ Instru- mentation	Labora- tory / Organiza- tion	Project Action Limit (units, wet or dry weight)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (1)
Enterolert)		water, 61 MPN/100 mL for fresh water	sample	Protocols		sample	
Nitrate as N (Dionex DX-100 IC	BC Laboratori es	10 mg/L for Water Quality	0.1 mg/L	EPA Method 300.0	No	0.014 mg/L	0.1 mg/L
Orthophos phates as P (Kone 1)	BC Laboratori es	> 0.12 mg/L for Water Quality	0.02 mg/L	SM 4500-P E	No	0.0041 mg/L	0.02 mg/L
Total Kjeldahl Nitrogen	BC Laboratori es	NA	0.2 mg/L	EPA 351.2	No	0.056 mg/L	0.2 mg/L
Total nitrogen	BC Laboratori es	NA	NA	NA	NA	Calculated	Calculated
Organic Nitrogen	BC Laboratori es	NA	NA	NA	NA	Calculated	Calculated
Nitrite as NO <sub>2</sub>	BC Laboratori es	NA	0.17 mg/L	EPA 353.2	No	0.0048 mg/L	0.17 mg/L
Total Phosphoru s	BC Laboratori es	NA	0.05 mg/L	EPA 365.4	No	0.016 mg/L	0.05 mg/L
Ammonia- nitrogen (Smart Chem)	BC Laboratori es	NA	0.05 mg/L	SM 4500- NH3 D	No	0.025 mg/L	0.05 mg/L
Turbidity for Water Quality	BC Laboratori es Laboratori es	25 NTU	0.1 NTU	SM 2130B	No	0.1 NTU	0.1 NTU
Total coliform (IDEXX Colilert-	SLO County Public Health	> 10,000 MPN/100 mL	2 MPN/100mL for an undiluted sample	Standard Methods 9223	No	1 MPN/100 mL for an undiluted sample	Not applicable

Analyte/ Instru- mentation	Labora- tory / Organiza- tion	Project Action Limit (units, wet or dry weight)	Project Quantitation Limit (units, wet or dry weight)	Analytical Method		Achievable Laboratory Limits	
				Analytical Method/ SOP	Modified for Method yes/no	MDLs (1)	Method (1)
18)	Agency Labora- tory						
<i>E. coli</i> (IDEXX Colilert- 18)	SLO County Public Health Agency Labora- tory	> 235 MPN/100 mL	2 MPN/100mL for an undiluted sample	Standard Methods 9223	No	1 MPN/100 mL for an undiluted sample	Not applicable
Enterococ- cus (IDEXX Enterolert)	SLO County Public Health Agency Labora- tory	> 104 MPN/100 mL for salt water, > 61 MPN/100 mL for fresh water	2 MPN/100mL for an undiluted sample	ASTM D6503.99	No	1 MPN/100 mL for an undiluted sample	Not applicable
Fecal coliform (MTF, A1 Method)	SLO County Public Health Agency Laborator- y	> 43 MPN/100 mL for shellfish growing waters	2 MPN/100 mL for an undiluted sample	SM 9221 E.2.A-1	No	1 MPN/100 mL for an undiluted sample	Not applicable
Benthic macroin- vertebrates	Ecoanalys- ts, Inc.	NA	600 ± 10% individuals	Ecoanalyst s Laboratory SOP/QA Plan 2007*	No	NA	NA
Suspended sediment concentrat- ion	MBNEP Sediment Laborator- y by VMP staff	NA	2 mg	MBVMP Suspended Sediment Monitoring Protocol (Derived from ASTM D 3977)	No	NA	NA

\*Bioassessment sample analysis is conducted per the following SWAMP SOP:

[http://www.waterboards.ca.gov/water\\_issues/programs/swamp/docs/bmi\\_lab\\_sop\\_final.pdf](http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/bmi_lab_sop_final.pdf)

If failures occur, the appropriate laboratory personnel will address the problem and contact the MBNEP QA Officer with any proposed solutions or resolutions.

All excess samples will be disposed of properly by laboratory personnel following their own documented SOPs.

Analytical results are typically available for bacteria and water quality samples within two weeks. If a rush is needed on the analysis, results can be transmitted via phone or fax in a more timely manner. Macroinvertebrate samples for bioassessment typically take six months for analysis and reporting.

## **14. QUALITY CONTROL**

### **14.1 Water quality monitoring**

Quality assurance and quality control activities for sampling processes include the collection of field splits for nutrient testing and the preparation of field blanks. For field splits, the volunteers collect a sample and split it. Half is analyzed by the volunteer and half is sent to the laboratory for analysis. The laboratory will analyze the split samples to assess the accuracy and bias criteria.

Blanks will be prepared by pouring deionized water into a clean sample collection container provided by the laboratory. This blank is carried in the field in a cooler with ice packs, to simulate as closely as possible how the nutrient samples are handled. The laboratory will analyze the field blanks submitted.

In order to monitor the sampling process, the MBNEP QA Officer will randomly observe sampling processes and compare the actual actions against the sampling SOP.

Volunteers will split water quality samples and analyze both samples to determine precision. The relative percent difference (RPD) between the two results should be within 20%. This analysis is conducted for 10% of samples analyzed by volunteers.

The RPD is calculated as follows:

$$RPD = (X1 - X2) * 100 / [(X1 + X2) / 2] \quad \text{where } X1 \text{ is the larger value}$$

The volunteers will periodically analyze deionized water using the water quality nutrient field test kits to assess their sample handling and laboratory techniques. The result should be less than the method detection limit. This analysis is conducted for 10% of samples analyzed by volunteers. This also ensures the quality of each batch of reagents. The results are analyzed as follows:

$X1 < MDL$  where  $X1$  is the analysis result by the volunteers and the MDL is the method detection limit for the method of analysis.

Water quality data will also be tested for outliers. During data reviews, data is plotted and any values that are out of range with the majority of the data at a given site are revisited and checked for possible equipment malfunction, operator error and other possible explanations for out of range results. If the results appear to be valid given the circumstances (i.e., weather-related) then the data remains in the database as valid. If a determination cannot be made as to whether or not the data is valid, then the Grubbs outlier test is applied. The ratio  $Z$  is calculated as follows:

$Z = \text{absolute value (mean - value)} / SD$  where the mean is the mean value of all results analyzed, the value refers to the reading in question, and SD is the standard deviation of all results analyzed

If the  $Z$  ratio exceeds the ratios in the table below, then the  $P$  value is less than 0.05, which means that there is a less than 5% chance that this outlier was obtained by chance alone if all of the data were from a MBNEP QAPP



single Gaussian distribution. If this is the case, then the data is flagged and excluded from future analysis.

Critical Values for Z: N is the number of values in the group

N	Critical Z	N	Critical Z
3	1.15	27	2.86
4	1.48	28	2.88
5	1.71	29	2.89
6	1.89	30	2.91
7	2.02	31	2.92
8	2.13	32	2.94
9	2.21	33	2.95
10	2.29	34	2.97
11	2.34	35	2.98
12	2.41	36	2.99
13	2.46	37	3.00
14	2.51	38	3.01
15	2.55	39	3.03
16	2.59	40	3.04
17	2.62	50	3.13
18	2.65	60	3.20
19	2.68	70	3.26
20	2.71	80	3.31
21	2.73	90	3.35
22	2.76	100	3.38
23	2.78	110	3.42
24	2.80	120	3.44
25	2.82	130	3.47
26	2.84	140	3.49

The QA laboratory, BC Laboratories, is an ELAP-certified lab that undergoes the annual inspection and recertification process. Any data that fails to meet the lab's own measurement quality objectives will be addressed by the laboratory following its own SOPs. The accuracy, precision, completeness and recovery criteria are laid out in Table 7.1.3. Precision is determined by calculating the RPD (as shown above). Accuracy, recovery and completeness are calculated as follows:

Accuracy % difference =  $[(X1 - X2) * 100] / (X1)$  where X1 is the known value

% Recovery =  $[(\text{matrix plus spike result} - \text{matrix result}) / (\text{expected matrix plus spike result})] * 100$

% Completeness =  $[\# \text{ valid samples} / \# \text{ total planned samples}] * 100$

Data that fails to meet the data quality objective will be flagged as such in the database and will not be used in subsequent analysis. If this occurs, volunteer protocols and technique will be reviewed. If necessary, protocols will be revised and volunteers will be re-trained.

In the following tables, TRL stands for Target Reporting Limit.

**Table 14.1.1. Field QC for water quality monitoring**

Matrix: Water		
Sampling SOP: MBVMP Water Quality Monitoring Protocols, Minisonde MS5 Calibration and Deployment Protocols		
Analytical Parameter(s): Nitrates, orthophosphates, turbidity, pH		
Analytical Method/SOP Reference: See Table 14.1.2.		
# Sample locations: Various. (See Section 6.4).		
Field QC	Frequency/Number per sampling event	Acceptance Limits
Equipment Blanks		
Field Blanks: nutrients	One sample per year for water quality monitoring	< MDL for target analyte
Trip Blanks		
Cooler Temperature		
Field Duplicate Pairs		
Field Splits: nutrients	10% of total samples for water quality nutrient analysis	RPD < 20%
Field Splits: turbidity	One sample per month analyzed both by MBNEP equipment and a certified lab.	The acceptable difference between the two readings are: for $\leq 5$ NTU ( $\pm 2$ NTU), for $\leq 25$ NTU ( $\pm 5$ NTU), for $\leq 100$ NTU ( $\pm 20$ NTU), for $\leq 500$ NTU ( $\pm 50$ NTU), for $\leq 1,000$ NTU ( $\pm 100$ NTU), for $\leq 10,000$ NTU ( $\pm 200$ NTU), for $\leq 100,000$ NTU ( $\pm 300$ NTU)
Field Splits: pH	One sample per month analyzed by MBNEP equipment and a certified lab.	RPD < 20%
Field Splits: DO	One sample per month	$\pm 1$ mg/L

	analyzed both by MBNEP equipment and Winkler titration	
Field Matrix Spikes		
Other:		

**Table 14.1.2. Analytical QC for water quality monitoring**

Matrix: Water		
Sampling SOP: MBVMP Water Quality Monitoring Protocols, BCGEN048, BCGEN051, BCGEN014, BCGEN061, BCMET037, BCGEN013, BCGEN022, BCGEN010, BCORG026, BCGEN059, BCGEN060, BCGEN058		
Analytical Parameter(s): Nitrates as N, orthophosphates as P, TKN, Nitrite as NO <sub>2</sub> , Total Phosphorus, , turbidity, ammonia-nitrogen		
Analytical Method/SOP Reference: Nitrates (EPA 300.0), Orthophosphates (SM 4500-P E), Turbidity (SM 2130B), Ammonia-Nitrogen (SM 4500-NH <sub>3</sub> D), TKN (EPA 351.2), Total Phosphorus (EPA 365.4), Nitrite as NO <sub>2</sub> (EPA 353.2)		
# Sample locations: Various (See Section 6.4)		
Laboratory QC	Frequency/Number	Acceptance Limits
Method Blank	One per batch	< TRL
Reagent Blank	One per new lot	< TRL
Storage Blank	NA	
Instrument Blank		
Lab. Duplicate	One per batch or one per 20 samples	Orthophosphates: RPD ≤ 10% Nitrates: RPD ≤ 10% Turbidity: ≤ 10% Ammonia-Nitrogen: RPD ≤ 10% TKN: RPD ≤ 20% Total Phosphorus: RPD ≤ 10% Nitrite as NO <sub>2</sub> : RPD ≤ 20%
Lab. Matrix Spike	One per batch or one per 20 samples	Orthophosphates: recovery 90-110% Nitrates: recovery 80-120% Turbidity: NA Ammonia-Nitrogen: recovery 90-110%

		TKN: recovery 90-110% Total Phosphorus: recovery 90-110% Nitrite as NO <sub>2</sub> : recovery 80-120%
Matrix Spike Duplicate	One per batch or one per 20 samples	Orthophosphates: 90-110%, RPD ≤ 10% Nitrates: 80-120%, RPD ≤ 10% Turbidity: NA Ammonia-Nitrogen: 90-110%, RPD ≤ 10% TKN: recovery ≤ 80-120% Total Phosphorus: recovery ≤ 90-110% Nitrite as NO <sub>2</sub> : recovery ≤ 80-120%
Lab. Control sample	One per batch	Orthophosphates: 90-110% Nitrates: 90-110% Turbidity: NA Ammonia-Nitrogen: 90-110% TKN: recovery < 80-120% Total Phosphorus: recovery < 90-110% Nitrite as NO <sub>2</sub> : recovery < 80-120%
Surrogates	NA	
Internal Standards	NA	
Others:	NA	

## 14.2 Bacteria monitoring

Quality assurance and quality control activities for sampling processes include the collection of field splits for bacterial testing and the preparation of field blanks. Split samples are prepared by collecting a sample in a large, sterile container and then dividing it into multiple samples for analysis by the volunteer and by the QA laboratory. The precision criterion is that the lab-generated result must be within the 95% confidence interval of the volunteer-generated result. Confidence interval charts are provided by IDEXX, the manufacturer of the bacterial testing methodology.

Blanks will be prepared by pouring sterile deionized water into a sterile sample collection container, then subsampling into the appropriate number of replicate sample containers. This is to test both the volunteer sample handling and lab analysis as well as testing for contamination from each new batch of reagent. The result of the analysis from both the volunteer and the lab must be within the MDL for the method of analysis. See Section 14.1 for calculation.

In order to monitor the sampling process, the MBNEP QA Officer will randomly observe sampling processes and compare the actual actions against the sampling SOP.

The QA laboratory, the SLO County Public Health Agency Laboratory, is ELAP-certified and undergoes an annual inspection and recertification process. Any data that fails to meet the lab's own measurement quality objectives will be addressed by the laboratory following its own SOPs.

The completeness calculation is as above.

Data that is outside the 95% confidence interval for both types of analysis will be flagged as such in the database and will not be used in subsequent analysis. If this occurs on a consistent basis, volunteer protocols and technique will be reviewed. If necessary, protocols will be revised and volunteers will be

re-trained.

**Table 14.2.1. Field QC for bacteria monitoring**

Matrix: Water		
Sampling SOP: MBVMP Bacteria Monitoring Protocols, 2013 Sampling Protocol for Shellfish Growing Area Water Quality Monitoring		
Analytical Parameter(s): <i>E. coli</i> , total coliform, enterococcus, fecal coliform		
Analytical Method/SOP Reference: IDEXX Colilert-18 and Enterolert, Standard Methods 9221 E.2.A-1		
# Sample locations: Various. (See Section 6.4)		
Field QC	Frequency/Number per sampling event	Acceptance Limits
Equipment Blanks		
Field Blanks: total coliform, <i>E. coli</i> , enterococcus, fecal coliform	One per year	< MDL for target analyte
Trip Blanks		
Cooler Temperature		
Field Duplicate Pairs		
Collocated Samples		
Field Splits: total coliform, <i>E. coli</i> , enterococcus	10% of total samples	95% confidence interval
Field Matrix Spikes		
Other:		

**Table 14.2.2. Analytical QC for bacteria monitoring**

Matrix: Water		
Sampling SOP: Water Quality Sample Collection and Laboratory Procedure		
Analytical Parameter(s): <i>E. coli</i> , total coliform, enterococcus, fecal coliform		
Analytical Method/SOP Reference: Enterolert – ASTM D6503.99, Colilert-18 – Standard Methods 9223, Fecal coliform – Standard Methods 9221 E.2.A-1		
# Sample locations: Various (See Section 6.4)		
Laboratory QC	Frequency/Number	Acceptance Limits
Method Blank	NA	
Reagent Blank	For each new lot of reagent,	Presence/absence

	run a presence/absence test for <i>E. coli</i> , <i>Klebsiella pneumoniae</i> and <i>Pseudomonas aeruginosa</i>	
Storage Blank	NA	
Instrument Blank	NA	
Lab. Duplicate	Upon request from clients	95% confidence interval
Lab. Matrix Spike	NA	
Matrix Spike Duplicate	NA	
Lab. Control sample	NA	
Surrogates	NA	
Internal Standards	NA	
Others:	Sterility check on new lots of sterile sample collection containers. Run a presence/absence test with sterile DI water.	No contamination

### 14.3 Bioassessment monitoring

VMP staff accompany volunteers on all sample collection field trips. VMP staff receive biennial refresher training from CCRWQB staff or the California Department of Fish and Wildlife's Aquatic Bioassessment Lab to ensure that all collection methods are correct and up-to-date.

The macroinvertebrate analysis laboratory conducts QA measures for sorting and identifying the sample. Following initial sorting of the sample, 20 to 25% of *every* submitted sample is re-sorted by a specially trained sorting QC technician who is never the technician who originally sorted the sample. The QC technician re-sorts the sample until the percent sorting efficacy is 90% or greater. For QA of the identification process, a second taxonomist re-identifies 10% of the samples. A percent similarity is calculated to compare both sets of data. Any discrepancies are discussed by both taxonomists until a consensus is reached. Any data that fails to meet the lab's own measurement quality objectives will be addressed by the laboratory following its own SOPs.

**Table 14.3.1. Analytical QC for bioassessment monitoring**

Matrix: Benthic invertebrates
Sampling SOP: Standard Operating Procedure for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California, 2007

Analytical Parameter(s): Benthic invertebrates
Analytical Method/SOP Reference: Ecoanalysts Laboratory SOP/QA Plan 2007
# Sample locations: Various (See Section 6.4)

#### 14.4 Flow monitoring

Quality assurance and quality control activities for flow monitoring include replicate measurements of flow velocity. RPD values should be within  $\pm 25\%$ . See above for method of calculation.

In order to monitor the process, the MBNEP QA Officer will randomly observe sampling processes and compare the actual actions against the sampling SOP.

Data that fails to meet the data quality objective will be flagged as such in the database and will not be used in subsequent analysis. If this occurs, volunteer protocols and techniques will be reviewed. If necessary, protocols will be revised and volunteers will be re-trained.

#### 14.5 Suspended sediment monitoring

For suspended sediment monitoring, samples cannot be split, and replicate samples would not provide any meaningful information. Instead, single-blind samples prepared by the USGS Branch of Quality Systems will be analyzed by VMP staff in our laboratory at the minimum on a biannual basis to assess the accuracy and precision of our procedures and equipment. Values should be within  $\pm 1$  mg. In addition, blank samples of DI water will be analyzed to ensure that proper sample handling techniques are being used.

### 15. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

#### 15.1 Equipment testing, inspection and maintenance

Field measurement equipment will be checked in accordance with the manufacturer's specifications. This includes battery checks, routine replacement of membranes, and cleaning of conductivity electrodes. All equipment will be inspected when first handed out and when returned from use for damage.

All laboratories maintain their equipment in accordance with its SOPs, which include those specified by the manufacturer and those specified by the method.

VMP staff are responsible for equipment inspection, testing and maintenance. Field equipment inspection is carried out prior to each trip in the field. Testing is conducted if equipment appears visibly worn or if volunteers report problems with the equipment upon returning from the field. If deficiencies are found, VMP staff will perform the needed maintenance and then re-calibrate and re-inspect the equipment. A pre- and post-calibration will be run to determine if the problem has been fixed. If it has not, maintenance and re-calibration will be conducted. If this does not correct the problem, then the equipment will be taken out of use and sent to the manufacturer for servicing.

**Table 15.1.1. Testing, inspection, maintenance of sampling equipment and analytical instruments**

<b>Equipment / Instrument</b>	<b>Maintenance Activity, Testing Activity or Inspection Activity</b>	<b>Responsible Person</b>	<b>Frequency</b>	<b>SOP Reference</b>
YSI 85 DO Meters	Inspected periodically throughout monitoring time period	VMP staff	Weekly during water quality monitoring effort	Operator manual
YSI 85 DO Meters	Change membrane	VMP staff	As needed, approximately 4 times/year	Operator manual
HACH 2100P Turbidimeter	Inspected periodically throughout monitoring time period.	VMP staff	Inspected weekly during water quality monitoring effort.	Operator manual
HACH Minisonde MS5	Pre-calibration prior to deployment. Post-calibration following deployment.	VMP staff	Each time deployed	Operator manual
Oakton pH Testr 30 pH meter	Inspected periodically throughout monitoring time period.	VMP staff	Inspected weekly during water quality monitoring effort.	Operator manual
HACH DR/890 for Nitrates as N for Water Quality	Inspected periodically throughout monitoring time period. Monthly, run a sample of reagent of a known NO <sub>3</sub> concentration and a blank to test the meter results.	VMP staff	Inspected weekly during water quality monitoring effort. Monthly analysis of known reagent and blank.	Operator manual
Hanna PO <sub>4</sub> meter	Inspected periodically throughout monitoring time period. Quarterly, run a sample of reagent of a known PO <sub>4</sub> concentration and a blank to test the meter results.	VMP staff	Inspected weekly during water quality monitoring effort. Monthly analysis of known reagent and blank.	Operator manual
Incubators and thermometers for bacteria monitoring	Inspected periodically throughout monitoring time	VMP staff	Monthly	Operator manual



<b>Equipment / Instrument</b>	<b>Maintenance Activity, Testing Activity or Inspection Activity</b>	<b>Responsible Person</b>	<b>Frequency</b>	<b>SOP Reference</b>
	period			
ISCO Model 6712 Automated sampler (suspended sediment)	Inspected periodically throughout monitoring time period	VMP staff	Each time sampler is deployed.	Operator manual

All spare parts, reagents and calibration standards are maintained in the MBNEP equipment room, located adjacent to the MBNEP office. All necessary parts and standards are kept on hand so that equipment can be kept in good repair and properly calibrated.

To ensure that there is no carry-over contamination in the vials and syringes used for water quality analysis, VMP staff conducts split analysis for precision on a quarterly basis. Samples are split and analyzed in a new vial and in a vial that has been in use and undergone the regular procedure of rinsing with DI water and with sample water prior to use. The acceptability criteria for the two results are the precision criteria described in Table 7.1.2. If the criteria are not met, all affected sample vials and syringes will be replaced with new ones immediately. The split sample procedure will be repeated quarterly. Volunteers are trained to emphasize the importance of the cleaning procedures. All glassware, vials and syringes are replaced on a biannual basis.

## **16. INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY**

### **16.1 Field instruments**

Water quality field monitoring uses instruments requiring regular calibration. Each calibration is documented and kept in the calibration log.

**Table 16.1.1. Testing, inspection, maintenance of field sampling equipment and analytical instruments**

<b>Equipment / Instrument</b>	<b>SOP reference</b>	<b>Calibration Description and Criteria</b>	<b>Frequency of Calibration</b>	<b>Responsible Person and Corrective Action</b>
Marsh McBirney Flow Meters	MBVMP Equipment Calibration Protocols	Sent to manufacturer for calibration and conditioning	Annually	VMP staff. Manufacturer will continue to repair meter until problems are corrected or meter needs to be replaced.
YSI 85 DO Meters	MBVMP Equipment Calibration Protocols	Internal calibration, verification against Winkler titration. Two readings must be within $\pm 20\%$ .	Monthly	VMP staff. Replace membrane and recondition probe. If this fails, send equipment in for servicing.
HACH 2100P Turbidimeter	MBVMP Equipment Calibration Protocols	Formazin calibration standards. The acceptable difference between the two readings are: for $\leq 5$ NTU ( $\pm 2$ NTU), for $\leq 25$	Twice monthly	VMP staff. Recalibrate. If cannot be corrected, return to manufacturer for servicing.

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person and Corrective Action
		NTU ( $\pm 5$ NTU), for $\leq 100$ NTU ( $\pm 20$ NTU), for $\leq 500$ NTU ( $\pm 50$ NTU), for $\leq 1,000$ NTU ( $\pm 100$ NTU), for $\leq 10,000$ NTU ( $\pm 200$ NTU), for $\leq 100,000$ NTU ( $\pm 300$ NTU)		
YSI Model 30 Meter	MBVMP Equipment Calibration Protocols	Calibration standards. Reading must be within $\pm 10\%$ of calibration standard.	Monthly	VMP staff. Recalibrate. If cannot be corrected, return to manufacturer for servicing.
Oakton pH Testr 30 pH meter	MBVMP Equipment Calibration Protocols	Calibration standards. Reading must be within $\pm 10\%$ of calibration standard.	Weekly	VMP staff. Recalibrate. If cannot be corrected, replace electrode and recalibrate.
HACH Minisonde MS5	Minisonde MS5 Calibration & Deployment Protocols	Run known calibration standards for conductivity, turbidity, pH and DO.	Each time deployed, pre- and post-calibration	VMP staff. Recalibrate. If cannot be corrected, send meter out for service.
HACH DR/890 meter	MBVMP Equipment Calibration Protocols	Run a known calibration standard and DI water to ensure accuracy. Meter cannot be calibrated.	Quarterly	VMP staff. Meter cannot be recalibrated. Split samples are sent to laboratory for analysis. See Table 7.1.2 for criteria.
Hanna PO <sub>4</sub> meter	MBVMP Equipment Calibration Protocols	Run a known calibration standard and DI water to ensure accuracy. Meters cannot be calibrated.	Quarterly	VMP staff. Meter cannot be recalibrated. Split samples are sent to laboratory for analysis. See Table 7.1.2 for criteria.
Incubator and thermometer (Bacteria Lab)	MBVMP Equipment Calibration Protocols	Log incubator temperature each time remove a batch of trays. Incubator must be from 34.5 to 37 °C for the Colilert-18 incubator and $41 \pm 0.5$ °C for the Enterolert incubator.	Each batch	Volunteers record values. Reviewed by QA Officer. Adjust incubator temperature as needed.
Incubator and thermometers (Bacteria lab)	MBVMP Equipment Calibration Protocols	Replace the certified thermometer in the incubators.	Annually	VMP staff.
ISCO Model 6712, automated sampler (suspended	MBVMP Suspended Sediment Monitoring Protocol	Verify the volume of sample collected by the sampler	Annually	VMP staff. Adjust sampler programming as needed.

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person and Corrective Action
sediment)				
Fine scale (sediment lab)	MBVMP Suspended Sediment Monitoring Protocol	Verify accuracy of scale using calibration weights. Certification and calibration of scale, as needed.	Each time scale is used or if drift becomes greater than $\pm 0.0002$ g.	VMP staff. Re-calibrate scale. If problem cannot be corrected, scale must be sent to the manufacturer for service.
Gross scale (sediment lab)	MBVMP Suspended Sediment Monitoring Protocol	Verify accuracy of scale using calibration weights. Certification and calibration of scale, as needed.	Each time scale is used and if drift becomes greater than $\pm 0.02$ g.	VMP staff. Re-calibrate scale. If problem cannot be corrected, scale must be sent to the manufacturer for service.
Oven (sediment lab)	MBVMP Suspended Sediment Monitoring Protocol	Verify accuracy of temperature adjustment using certified thermometer.	Each time oven is started.	VMP staff. Adjust oven thermostat so that temperature remains within $\pm 10$ of the desired temperature.
Dessicators (sediment lab)	MBVMP Suspended Sediment Monitoring Protocol	Ensure desiccant is dry.	As begin processing each batch of samples.	VMP staff. Bake desiccant in oven at designated temperature for desired time and cool before re-using in desiccator.

A calibration log is maintained. See Appendix for a sample. Pre-calibration levels and post-calibration levels are recorded, as well as the name of the person conducting the analysis and the date of calibration. Each piece of equipment is assigned a unique ID number. This number is also recorded in the calibration log, allowing for tracking of performance history for each individual piece of equipment. All equipment maintenance is recorded in a log book to document the date and nature of the maintenance required.

If equipment is not meeting the criteria, it is the responsibility of the MBNEP QA Officer to address the problem. This may include repair or replacement of equipment. All corrective actions are documented in the Calibration Log and the Equipment Maintenance Log.

## 16.2 Laboratory analytical equipment

Calibration of analytical equipment used by each laboratory is outlined in each laboratory's standard operating procedures and quality assurance documentation. Any deficiencies are addressed by the individual laboratory's QA plan. Laboratories comply with the procedures listed below.

**Table 16.2.1. Testing, inspection, maintenance of analytical laboratory instruments**

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person
SLO County Public Health Agency Lab: incubators	QA Manual for Water and Shellfish Testing	Read and record temperature in incubators twice a day. Thermometers are certified and ASTM calibrated.	Certified biannually	Keya Bergman
SLO County Public Health Agency Lab: tray sealer	QA Manual for Water and Shellfish Testing	Run a tray through the sealer containing water with dye to check for leaks.	Monthly	Keya Bergman
SLO County Public	QA Manual for	Place inoculated plate in the	Each time	Keya

<b>Equipment / Instrument</b>	<b>SOP reference</b>	<b>Calibration Description and Criteria</b>	<b>Frequency of Calibration</b>	<b>Responsible Person</b>
Health Agency Lab: incubators	Water and Shellfish Testing	incubator to test incubator temperature.	incubator is used	Bergman
Ecoanalysts: Benthic invertebrates	NA	NA	NA	Gary Lester
BC Labs: Nitrate as N, Orthophosphate as P	BC Labs SOP	External calibration with 6 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the MDL. Linear regression $r^2 \geq 0.995$ . Calibration verification every 10 samples after initial calibration. Standard source different than that used for initial calibration. Recover 90 - 110%.	Nitrate as N: Daily  Ortho-phosphate: Once per batch	LDI  TDC
BC Labs: Ammonia as N, Total Nitrogen, Organic Nitrogen, Nitrite as $\text{NO}_2$ , Total Kjeldahl Nitrogen, Total Phosphorus	BC Labs SOP	External calibration with 6 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the MDL. Linear regression $\geq 0.995$ . Calibration verification every 10 samples after initial calibration. Standard source different than used for initial calibration. Recovery 90 - 110%.	90 - 110% Daily	SDU
BC Labs: Turbidity	BC Labs SOP	NA	NA	
Morro Bay-Cayucos Wastewater Treatment Plant Lab: autoclave	Morro Bay-Cayucos Wastewater Treatment Plant Laboratory QA Manual	Run a vial of geobascillus stereothermophilus spores through an autoclave cycle. Place in incubator along with an unautoclaved vial. The unautoclaved vial should change color due to cell growth and the autoclaved one should not.	Monthly	Bruce Keogh
Morro Bay-Cayucos Wastewater Treatment Plant Lab: autoclave	Morro Bay-Cayucos Wastewater Treatment Plant Laboratory QA Manual	Place autoclave tape on items to be treated. Tape should change color if temperature reaches 121 °C.	Each batch	Bruce Keogh
Morro Bay-Cayucos Wastewater	Morro Bay-Cayucos Wastewater	Run batch with two timers, one certified, to ensure accuracy.	Quarterly	Bruce Keogh

<b>Equipment / Instrument</b>	<b>SOP reference</b>	<b>Calibration Description and Criteria</b>	<b>Frequency of Calibration</b>	<b>Responsible Person</b>
Treatment Plant Lab: autoclave timer	Treatment Plant Laboratory QA Manual			
Morro Bay-Cayucos Wastewater Treatment Plant Lab: autoclave thermometer	Morro Bay-Cayucos Wastewater Treatment Plant Laboratory QA Manual	Run batch with two thermometers, one which holds the maximum temperature reached during the autoclave run.	Each batch	Bruce Keogh

## **17. INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES**

Supplies will be examined for damage as they are received. The following supplies will receive additional checks as follows.

Conductivity and turbidity standards will be checked by comparing their readings with those generated by the current lot of standards. Standards must agree exactly.

Bacterial media will be checked with a sterility check. New batches of media will be used to run a bacteria test using sterile DI water as the sample. The results should be below the method detection limit.

Each new batch of nutrient and bacteria media will be tested using DI water as the sample. The results should be below the method detection limit.

All analytical laboratories used by the program maintain a supply inspection and acceptance SOP, which are available from the laboratories upon request.

VMP staff, overseen by the MBNEP QA Officer, are responsible for receipt of all consumables and supplies. All supplies are stored in the MBNEP equipment room adjacent to the office. VMP staff track supplies and ensure that they are reordered in a timely fashion. All supplies are stored per the manufacturer's recommendations.

## **18. NON-DIRECT MEASUREMENTS (EXISTING DATA)**

The primary source of non-direct data to this project is the CCRWQCB, which collects data under a SWAMP-approved QAPP, and thus its validity is well-documented. Only data that had undergone CCRWQCB's own approval process would be used. Data is typically provided in a CEDEN-compatible database format. This data would be used in combination with MBNEP data. For details see the MBNEP EMP. The data would need to meet the data quality objectives laid out in Section 7.

The other potential sources of data listed below provide data that would be used anecdotally. If data was to be used for program decision-making, it would be considered based on details provided in data collection protocols. The MBNEP QA Officer would conduct internal audits of the precision, accuracy, bias and completeness to determine if the data would be acceptable for incorporation into its own Excel database format. Methods of data collection and analysis would be analyzed to ensure that they met the MBNEP's acceptability criteria. Data that did not meet the MBNEP's own criteria laid out in Section 7 would not be included in the Excel database and would be analyzed separately so that it did not become intermixed with data that had met acceptance criteria.

If that data had confidentiality constraints on it, it would be used without revealing the exact location of sample collection.

These other sources include (but are not limited to):

- California Men's Colony Wastewater Treatment Plant
- Morro Bay Power Plant
- California Polytechnic State University, San Luis Obispo student project data
- Resource Conservation District maintenance and monitoring records
- Point Reyes Bird Observatory
- Applicable Environmental Impact Report data
- County of San Luis Obispo Environmental Health Department and Department of Public Works
- Los Osos Community Services District
- Surfrider
- California Department of Fish and Wildlife
- California Department of Parks and Recreation
- US Fish and Wildlife Service
- California Native Plant Society
- San Luis Obispo Science and Ecosystem Alliance (SLOSEA)
- California Department of Public Health
- City of Morro Bay

## **19. DATA MANAGEMENT**

Upon completion of fieldwork, volunteers or VMP staff check over datasheets for completeness and any obvious errors. As datasheets come in from the field, VMP staff will review them for any obvious omissions or errors. Data is then entered into the appropriate computerized system, either the Excel or Access database. Upon completion of data entry, the MBNEP QA Officer reviews all entered data to ensure its accuracy and completeness. Once this is complete, the original paper copy datasheets are filed. The database and other electronic data records are backed up on an external server hard drive twice a week and stored off-site in a safety deposit box. In addition to these procedures, CDPH fecal coliform data is entered into a Paradox database by CDPH staff. Data entry is checked by CDPH staff and the data is not released until it has been verified.

Suspended sediment data is stored in an Access database which is maintained at the Sediment Laboratory located at Cuesta College. All sample-related data is stored in the database. Twice monthly during times of sample processing, an Access query is run to generate a paper copy of all relevant data to provide a hard copy. The database is backed up twice a month during periods when samples are being processed and stored off-site.

When data is received from the analytical laboratories, VMP staff reviews the data and then enters it into the appropriate electronic data management system. Upon completion of the data entry, the MBNEP QA Officer reviews all entered data to ensure its accuracy and completeness. Once this is completed, the paper copy report is filed. The database and other electronic data records are backed up on an external server hard drive twice a week and stored off-site in a safety deposit box.

The data management protocols are outlined in an SOP titled MBVMP Data Management Protocols (see Appendices).

As SOPs are updated, the date of the update is inserted in the document footer so that users can be sure that they are using the most recent version.

Data is analyzed periodically for various reports or data summaries generated for agencies, non-profits and other users of the data. The majority of this analysis is conducted with Excel and ESRI ArcGIS. The

database is forwarded regularly to CCRWQCB CCAMP staff. This analysis is conducted by VMP staff and is overseen by the MBNEP QA Officer. The Excel database is CEDEN-compatible, and data should be easily uploaded into a SWAMP database if needed.

The MBNEP contracts with an independent contractor to provide server maintenance and upkeep. As our primary data management system is a CEDEN-compatible database, VMP staff relies on guidance from CEDEN staff to inform us of the requirements of both hardware and software for properly maintaining the CEDEN-compatible database.

## **GROUP C: ASSESSMENT AND OVERSIGHT**

### **20. ASSESSMENTS & RESPONSE ACTIONS**

To ensure that the QAPP is being implemented as approved, the QC procedures outlined in Section 14 are conducted. The MBNEP QA Officer is responsible for this assessment. Progress or problems are reported to the RWQCB QA Officer. These assessments include review of calibration logs, review of QA data from the laboratories, audits of field and laboratory activities, and review of all data management activities. These activities are all on-going and happen at least on a quarterly basis. The approximate schedule for these activities is in March, June, September and December of each year.

While no formal external assessments are planned, any problems or issues are shared with the RWQCB QA Officer and advice is sought to correct the problem.

Corrective actions noted during a field or laboratory audit would be addressed through a review of the SOP and re-training of staff or volunteers. Actions to address calibration problems or QA data from the laboratories would be addressed by the MBNEP QA Officer and might include repair or maintenance to a piece of equipment, review of SOPs, re-training of staff or volunteers, or replacement of a problematic piece of equipment. Corrective actions for data management issues would include review of SOPs and retraining of VMP staff to correct any problems.

Laboratory personnel are responsible for assessing laboratory QC results and implementing any necessary corrective actions.

The MBNEP QA Officer has the authority to halt all sampling and analytical work by the VMP staff or volunteers as well as any of the analytical laboratories with which it contracts.

### **21. REPORTS TO MANAGEMENT**

VMP staff and volunteers are in constant communication with the MBNEP QA Officer and any issues, discrepancies or problems would immediately be reported.

The VMP staff and MBNEP QA Officer create an annual detailed QA report to accompany their annual data summary report. This QA report will outline any results that did not meet the QC objectives. These reports are submitted in writing to the RWQCB QA Officer.

SOPs are updated continuously throughout the year. Once a year, a QAPP update will be submitted to the RWQCB and EPA QA Officers for their review and approval. It will include all of the updates to SOPs and QA procedures.

**Table 21.1. QA management reports**

<b>Type of Report</b>	<b>Frequency (daily, weekly, monthly, quarterly, annually, etc.)</b>	<b>Projected Delivery Dates(s)</b>	<b>Person(s) Responsible for Report Preparation</b>	<b>Report Recipients</b>
Data Summary Report, including QA Report	Annually	October 31	MBNEP Program Manager	SWRCB project manager
Calibration Log	Annually	December 31	MBNEP Program Manager	RWQCB QA Officer
QAPP Update	Annually	Variable	MBNEP QA Officer	RWQCB QA Officer, EPA QA Officer

## **GROUP D: DATA VALIDATION AND USABILITY**

### **22. DATA REVIEW, VERIFICATION, AND VALIDATION REQUIREMENTS**

All raw data, data entry, calculations, and data analysis are reviewed and verified by the MBNEP QA Officer. All data received by laboratories are also reviewed by the MBNEP QA Officer. Information such as chain of custody forms are also reviewed to ensure that all hold times, sample preservation requirements, etc. have been met.

Data will be reviewed against the measurement quality objectives in Section 7 and separated into one of the following categories: data meeting all MQOs, data failing precision criteria, or data failing to meet accuracy criteria. Data meeting all MQOs is usable for future analysis. Data in the last category is not usable. For data failing the precision category, the following actions will be taken based on the type of data. For bacteria, data failing the 95% confidence interval will not be used. For nitrates, readings of 0.3 mg/L or less that fail the criteria will be retained. Higher readings that fail the criteria will be rejected. For orthophosphates, readings of 0.3 mg/L or less that fail the criteria will be retained. Higher readings that fail will be rejected. Orthophosphate data that falls below the project quantitation limit (PQL) of 0.3 mg/L will be flagged in the database in the QAComments field as being less than the PQL. All other water quality parameters will follow the precision criteria listed in Table 7.1.2 and if they are not met, the data are rejected. Each failing value will be flagged as such in the database so it can easily be excluded from all data analysis. For suspended sediment data, sample results that are invalid due to errors during processing or data management will be removed from the sediment monitoring database and will not be used in any data analysis. All decisions regarding data validation will be performed by the MBNEP QA Officer.

### **23. VERIFICATION AND VALIDATION METHODS**

All data records will be checked visually prior to data entry into either the Excel database or other electronic formats. Any corrections will be written directly on the datasheet. VMP staff will conduct all reviews and the MBNEP's QA Officer will review all datasheets and all data entry into Excel and other electronic formats. Laboratory QA Officers will perform checks of all of their records. All submittals by laboratories will be reviewed by the MBNEP Program Manager. Any questions with the data submitted by the laboratories will be addressed with the appropriate laboratory personnel who verify the data. Once any issues have been resolved, the data can be loaded into the Excel database and other electronic



formats.

Data validation is conducted by the MBNEP QA Officer and is done by a manual review of the data. The MBNEP QA Officer is responsible for verifying and validating all datasheets, chain of custody forms, maintenance logs and calibration logs. The MBNEP QA Officer also validates the data entry into the CCAMP database and other electronic formats, as well as any calculations.

All fecal coliform data is managed by CDPH. The staff member who manages a lease area is responsible for entering and confirming all data entry. The data entry is checked against hard copy datasheets from the lab and field. The reviewer signs off on the lab results once they have been confirmed. The lease area manager must verify that data has been checked before using the results for growing area classification or before distributing the data.

Issues will be noted. Reconciliation and correction will be done by a committee composed of the MBNEP QA Officer and VMP staff with input, if applicable, from laboratory directors and from the RWQCB QA Officer. Any special notes on decisions regarding data usability will be entered in the 'Notes' column of the Excel database. If it has been determined that the data should not be used in future calculations, it will be flagged as such in the electronic format.

## **24. RECONCILIATION WITH USER REQUIREMENTS**

The overall goal of this monitoring effort is to track long-term trends in the Morro Bay estuary and its watershed, as well as assess effectiveness of implementation efforts. The specific goals of the monitoring are laid out in Section 5.2. The monitoring was designed to include sampling locations, methods and frequency to assist in addressing these goals. However, MBNEP-generated data will not be adequate for completely addressing all of these goals and is expected to be supplemented by other sources.

Uncertainty regarding the data will be assessed with data verification and validation procedures as outlined in Sections 22 and 23. The project requires adequate data to address its goals, and the completeness criteria indicate whether this data will be adequate. The completeness criteria are the most essential in determining whether the collected data provide enough information to answer the original questions asked. Long-term trend data is required, with no gaps in the data collection and consistent sample collection and handling.

All data with limitations on its data use are flagged in our database. If requests are received for program data or analysis, those questionable data records will not be included.

All data will be analyzed for outliers and trends. Data is summarized in graphs and charts and presented on an annual basis in a data summary report that is submitted to the SWRCB Program Manager. All trends, anomalies and relationships are discussed in the report. Adequate information on sample design will be provided to inform users of limitations in data use.

All data is collected, managed and maintained in a SWAMP-compatible manner. While not currently part of the SWAMP umbrella, it could easily be incorporated at any time.

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Appendix A. Morro Bay Volunteer Monitoring Program  
Bacteria Monitoring Protocols

# **Morro Bay Volunteer Monitoring Program**

## **Bacteria Monitoring Protocols**

### **Total Coliform and *E. coli* Monitoring Protocol**

#### **Background:**

- Pathogens, consisting of viruses, bacteria and protozoans, can cause disease.
- Sources include fecal contamination from sewage, leaking septic systems, urban runoff, boat and marina waste, and waste from pets, farm animals and wildlife.
- Direct testing is very expensive and impractical since pathogens are rarely found in water bodies. Also, there are no existing regulatory standards for all of the individual pathogens.
- Instead, monitor for pathogens by testing for “indicator” species. Their presence indicates that fecal contamination may have occurred.
- Four common indicators: total coliforms, fecal coliforms, *E. coli*, and enterococci. These bacteria are prevalent in the intestines and feces of warm-blooded animals. The indicators themselves are usually not pathogenic.

#### **Types of Indicators:**

- Coliform bacteria live in the lower intestines of warm-blooded animals and may constitute as much as 50% of fecal waste. Not pathogenic themselves typically, but their presence indicates sewage contamination, perhaps accompanied by disease-causing pathogens.
- Total Coliforms are a group of closely related bacterial genera that all share the ability to ferment lactose. Total coliform standards exist for recreational or shellfish waters, although some species are found naturally in plant material or soil. More useful for testing drinking water where plant or soil material would be of concern.
- Fecal coliforms: Subgroup of total coliform. Widely used to test recreational waters and shellfish waters. Generally considered the best available indicators of contamination at this time. The current regulations are written for this indicator.
- *Escherichia coli*: Occurs only in the feces of warm-blooded mammals, making it a good fecal-specific indicator. Can provide better correlation with swimming-associated gastrointestinal illness than fecal coliforms. However not widely used, despite EPA recommendations, due to continuity with previous data and cheaper analytical costs. This indicator is valid in marine and freshwater, although there is no regulatory standard for comparison in marine waters. Our program continues to monitor for *E. coli* in marine waters because it is more closely comparable to fecal coliform data than is Enterococcus data. Since shellfish regulations and the current Basin Plan standard are for fecal coliform, this *E. coli* monitoring will continue until the regulatory standards are changed.
- Enterococci: Group of bacteria found primarily in the intestinal tract of warm-blooded animals. Unrelated to coliforms, they are a subgroup of the fecal streptococci group. But expensive to monitor, despite EPA recommendations that it is a better indicator of harmful recreational contact in salt water environments. This indicator is valid in marine and freshwater, although there is no regulatory standard for comparison at this time. Our program monitors for Enterococcus in marine samples and at a tidally-influenced creek.

#### **Background on Colilert-18 Tests:**

- These tests are for freshwater or marine waters.

- Based on the Most Probable Number (MPN) technique, which uses multiple tubes with broth that are inoculated with the sample at different dilutions. After incubation, the tubes show a positive or negative reaction for the target organism. The number of positive tubes corresponds to a statistical probability that the sample contained a certain number of bacteria.
- Kits are approved by EPA for monitoring drinking water.
- Based on a color change in the wells after incubation, total coliform and *E. coli* can be detected in freshwater samples. Only *E. coli* can be detected in marine samples.
- Cost: Approximately \$5/test.

## Procedure for Sample Collection

### Equipment:

- 120-mL sealed sterile sample jars containing sodium thiosulfate (2 per site for creeks, 1 per site for bay))
- 250-mL sterile Nalgene sampling jars (1 per site for creeks)
- Disposable vinyl gloves
- Data collection sheet
- Pen
- Clipboard
- Sharpie pen for labeling sample containers
- Ice chest
- Ice packs
- Tide book

### Bay Sites (land-based):

- Cuesta Inlet (CIN)
- Baywood Park (BAY)
- Pasadena Point (PAS)
- Windy Cove (WIN)
- Public Boat Ramp at Tidelands Park (TID)
- State Park Marina (SPM)
- Coleman Park (COL)
- Sharks Inlet (SIN)

### Creek Sites:

- Los Osos Creek at Turri Road near South Bay Blvd (SYB)
- Los Osos Creek at Turri Rd, downstream from SYB (GS1)
- Los Osos Creek at Clark Valley (CLV)
- Warden Creek, upper (UWR)
- Warden Creek off Turri Road near Los Osos Valley Road (TUR)
- Warden Creek, lower (WRP)
- Chorro Creek above the Ecological Reserve (UCR)
- Chorro Creek at Canet Road bridge (CAN)
- Chorro Creek at the Chorro Creek Ecological Reserve (CER)
- Chorro Creek at Chorro Creek Road (CCC)
- Chorro Creek at South Bay Boulevard Bridge (TWB)
- Pennington Creek on Cal Poly property (CPN)
- Pennington Creek on Rancho El Chorro property (PEN)
- Dairy Creek, lower (DAL)
- Dairy Creek, middle (DAM)
- Dairy Creek, upper (DAU)
- San Luisito Creek (SLU)
- San Luisito Creek, upper (USL)
- San Luisito Creek, middle (MSL)
- San Luisito Creek, lower (LSL)
- San Bernardo Creek (SBE)

#### Sample Collection in Creeks:

- Fill out data collection form with date, sampler names, weather in past 24 hours, current weather, (SYB and GS1 only). There is a tide book in the equipment room.
- Record the three letter site code and the time the sample was taken. In the notes section, note things such as presence of animals and birds, abundant leaf matter, any strange debris, any unusual smells, etc.
- Label two sterile 120 mL sample bottles with site ID.
- Wear gloves to protect both you and the sample.
- Site should be free of algal blooms, surface debris, oil slicks and congregations of water fowl. Avoid agitating the bottom sediment. Avoid splashing water. Choose site with good mixing and no stagnant pools.
- If entering the water to take the sample, be careful to not stir up sediment. Face upstream to take the sample, so that you do not affect the sample.
- Submerge sterile 250 mL bottle underwater and remove cap from sample bottle, being careful not to touch the rim or inside the lid. Try to collect the sample 12" underwater or at 1/3 of the depth below the surface.
- Fill the sample bottle with water, with the bottle facing into the current. Recap underwater.
- Fill the bottle to the shoulder, leaving headspace in the container.
- Gently invert bottle 25 times.
- Pour 100 mL into each of the two labeled 120 mL bottles.
- Store in the ice chest.
- Are your next site, **do not reuse the large bottle**. You must use a new sterile 250-mL bottle at each site.
- At the lab, process your samples as usual, **using one jar for the undiluted sample and one jar for the 1:10 sample at each site**.
- Rinse out the large 250-mL bottles in the sink and leave them in the Dirty Glassware bin to be reautoclaved along with the rest of your glassware.
- Change gloves at each site.
- If sampling on a beach, collect it on an incoming wave.
- For SYB, sample on a high tide. For GS1, sample at low tide.
- Ideally, samples will arrive at the lab within six hours of collection, and must be maintained at 4 degrees C or lower. If they can't be tested within six hours, they must be tested within 24 hours of collection.

#### Sample Collection in Bay:

- Fill out data collection form with date, sampler names, weather in past 24 hours, current weather, time of high tide and height of high tide. There is a tide book in the equipment room.
- Record the three letter site code and the time the sample was taken. In the notes section, note things such as presence of animals and birds, abundant leaf matter, any strange debris, any unusual smells, etc.
- Use sterile sample bottles, labeled with site ID.
- Wear gloves to protect both you and the sample.
- Site should be free of algal blooms, surface debris, oil slicks and congregations of water fowl. Avoid agitating the bottom sediment. Avoid splashing water. Choose site with good mixing and no stagnant pools.
- If entering the water to take the sample, be careful to not stir up sediment. Face upstream to take the sample, so that you do not affect the sample.



- Submerge bottle underwater and remove cap from sample bottle, being careful not to touch the rim or inside the lid. Try to collect the sample 12" underwater or at 1/3 of the depth below the surface.
- Fill the sample bottle with water, with the bottle facing into the current. Recap underwater.
- Fill the bottle to the shoulder, leaving headspace in the container.
- Store in the ice chest.
- Change gloves at each site.
- If sampling on a beach, collect it on an incoming wave.
- For bay sites, sample on a high tide to avoid getting stuck in the mud.

Ideally, samples will arrive at the lab within six hours of collection, and must be maintained at 4 degrees C or lower. If they can't be tested within six hours, they must be tested within 24 hours of collection.

### **Procedure for Sample Analysis at the Morro Bay-Cayucos Wastewater Treatment Plant**

Directions to the lab:

From Hwy 1, exit at the Hwy 41 exit and head west, toward Morro Bay High School. Pass the high school on your right. Pass the first gate on your left (the city maintenance yard). The second gate on the left is unlabeled – this is the WWTP. Turn left into the gate and take the first right. There is a small parking area on the right and the building to your right contains the WWTP operations center and lab. If you have more than one car, please park outside the facility and walk in.

**Lab hours are as follows:**

**Monday – Friday: 8 a.m. to 4:30 p.m.**

**Saturday: 7:30 a.m. to 3:30 p.m.**

**Sunday: 7 a.m. to 3 p.m.**

**But you must be out of the lab a half an hour before closing time.**

Equipment:

- Sterile deionized water
- Sterile pipette tips
- Pipetter
- Disposable gloves
- Safety glasses
- Colilert-18 reagent packet
- Quanti-Tray/2000 foil tray
- Incubator
- Quanti-Tray sealer and rubber insert

1. Upon arrival at the lab, notify plant staff that you are at the facility and are going to be doing lab analysis for the VMP. It is crucial to let someone know you are there, in case there is a plant emergency. Plant personnel will be notified in advance of the date and approximate time of VMP use of the lab.
2. Wash your hands, using the anti-bacterial soap mounted above the sink.
3. Put on disposable gloves and safety glasses.

4. Turn on the Quanti-Tray sealer (power switch on back, right hand side) so it has time to pre-heat. The amber light goes on. The sealer is ready when the green light also goes on. **Make sure there is nothing behind the sealer that would block trays from exiting after they are sealed.**
5. Collect your sterile bottles.
6. For bay water quality samples:
  - a. First you must dilute the sample 1:10 due to interference from marine samples.
  - b. Invert sample bottle 25 times to mix.
  - c. Put sterile tip onto pipetter. Dial pipetter to read 10 mL. Use a pipetter to remove 10 mL from the sample container. Be careful to not tip the pipette once you have filled it – you must keep the pipette upright so that the sample does not contaminate the paper plug in the pipetter.
  - d. Add sample to a sterile plastic bottle.
  - e. Add Colilert-18 reagent.
  - f. Add 90 mL of sterile DI water from squeeze bottle labeled ‘sterile DI water’ into graduated cylinder. Add to the 10 mL of sample in the plastic bottle.
  - g. Swirl to dissolve powder. (Avoid shaking vigorously, which adds bubbles and foam to the sample.)
  - h. If sample is foamy, let sit for a few minutes to let foam settle.
  - i. Sample is ready to add to Quanti-Tray
7. For undiluted freshwater samples:
  - a. Invert sample bottle to mix. Open sample container. Pour out or pipette out excess sample so that have a 100 mL sample remaining. Suggest pouring into sterile jar in case you accidentally pour out too much.
  - b. Add Colilert-18 reagent.
  - c. Re-cap container.
  - d. Swirl to dissolve reagent.
  - e. If sample is foamy, let sit for a few minutes to let foam settle.
  - f. Sample is ready to add to Quanti-Tray.
8. If a 1:10 dilution is required for freshwater samples, see Step 6.
9. If a 1:100 dilution is required:
  - a. Invert sample bottle 25 times to mix. Open sample container.
  - b. Insert clean, sterile tip into pipetter. Dial pipetter to read ‘1 mL.’
  - c. Place 1 mL of sample in sterile plastic bottle.
  - d. Add 99 mL of sterile DI water from squeeze bottle into plastic bottle using the graduated cylinder.
  - e. Add Colilert-18 reagent and swirl to dissolve.
  - f. If sample is foamy, let sit for a few minutes to let foam settle.
  - g. Sample is ready to add to Quanti-Tray.
10. Must use new sterile equipment (flasks, pipettes, plastic containers, etc.) for each site and each dilution.
11. If a blue flash occurs upon addition of Colilert-18 reagent, the sample is considered invalid due to excessive chlorine and testing should be discontinued.
12. To put sample in Quanti-Tray:
  - a. Look over the tray and make sure it has no tears or wrinkles in the seals.
  - b. First label the back of the Quanti-Tray with a Sharpie marker. Mark the site code, date, time of testing and dilution. **Label the back of the tray as ‘E. coli’ if you are also running Enterococcus samples to avoid confusion.**
  - c. Use one hand to hold the Quanti-Tray upright with the well side facing the palm.

- d. Squeeze the upper part of the Quanti-Tray so that the tray bends toward the palm.
- e. Gently pull foil tab to separate foil from the tray. **Avoid touching the inside of the foil or tray.**
- f. Pour the sample directly into the tray, avoiding contact with the foil. Tap the small wells 2-3 times to release any air bubbles. Allow foam to settle.
13. To seal the Tray:
  - a. Wait until both the amber and green lights are lit, indicating sealer is pre-heated.
  - b. Check behind the sealer to ensure that nothing is blocking the slot where trays exit the sealer.
  - c. Place the empty sealer rubber insert on the input shelf with the large cutout facing away from the sealer.
  - d. Place the tray filled with sample onto the rubber insert, making sure that the tray is properly seated on the rubber insert, with each well of the tray in its corresponding hole in the rubber insert.
  - e. Slide the insert into the sealer until the motor grabs it and draws it into the sealer.
  - f. In approximately 5 seconds, the tray will be sealed and partially ejected from the rear of the sealer. Remove the rubber insert and tray from the rear of the sealer.
  - g. If you wish to reverse the motor drawing the rubber tray into the sealer (if a misaligned tray is accidentally fed into the sealer), press and hold the reverse button on the front of the sealer. However, do NOT reverse the motor once the rubber insert has been drawn fully into the sealer.
14. When done sealing all trays, turn the sealer off.
15. As you finish sealing each tray, stack in the incubator.
16. The incubator does not need to be pre-heated before the samples are incubated. The incubator temperature should be between 34.5 and 37 degrees C during the incubation period.
17. On the data sheet, note the time the samples were put into the incubator.
18. Triple rinse all autoclavable bottles with hot tap water. Do not use soap. Once washed, place them in the bin that is labeled 'DIRTY'. Put caps on the bottles but don't tighten.
19. Place the pipette tips in the autoclavable tray and place in bin.
20. Refill empty squeeze bottles with DI water from our large carboy sitting on the bench top. Put the tops on loosely, and do not put foil over the tip. Put those in the bin to be autoclaved. Be sure to refill them so there's enough sterile DI water for the next volunteer!
21. Put the graduated cylinder in the 'DIRTY' bin. Be sure to cover the top with foil, located in the drawer.
22. Lab personnel will sterilize the equipment before your next visit to the lab and place them under the counter.
23. Discard the sample collection bottles in the recycle bin and the caps in the garbage. These are not re-usable.
24. Wipe down the bench top.
25. Dispose of gloves in the trash. Wash hands with anti-bacterial soap.
26. Let plant personnel know that you are leaving.

## Collecting Samples for QA Purposes:

Occasionally we will request that you collect a split sample for QA purposes. One sample will be analyzed by the VMP using our testing method, and the other will be analyzed by a certified laboratory as a QA of our methodology.

In order to increase the success with which the QA results are similar to those we obtain in the lab, we will collect a single sample from the site that is *later* split between two separate bottles, rather than *initially* collecting two separate samples in separate bottles.

Two separate samples, despite being collected simultaneously, can have very different concentrations of bacteria because bacteria are not dispersed equally throughout the water column. By collecting one sample, mixing it, then splitting that sample into two bottles, we hope to increase the likelihood that both the sample we test and that tested for QA will return similar results.

- We have designated autoclavable 250 ml bottles to use for collecting samples that will be split for QA purposes.
- For each site that you need to collect a QA sample from, bring a QA bottle along with two of the IDEXX bottles (one for your sample, one for the QA sample) for bay sites and three IDEXX bottles for creek sites (two for your samples, one for the QA sample).
- Collect a sample from your site using one of the QA bottles in the same manner with which you collected your samples using the IDEXX bottles.
  1. Wear gloves to prevent contamination from your hands
  2. Submerge bottle and remove cap, do not touch the rim or inside the lid
  3. Fill the sample bottle with water, with the bottle facing into the current
  4. Recap underwater
- Split the sample. Wearing clean gloves, open the IDEXX bottles, and then shake the QA bottle 25 times to mix the sample well.
- Label the three IDEXX bottles with the site code.
- If you run diluted samples you can pour 100 ml of the sample into each of the IDEXX bottles.
- If you run an undiluted sample along with a diluted sample, fill one IDEXX bottles to the 100 ml mark for your undiluted sample, fill another bottle to the 100 ml line for the QA sample, and then pour the remaining sample into a third bottle for the diluted sample. This should allow 100 ml for your undiluted sample, 100 ml for the QA sample, and nearly 100 ml for the diluted sample .
- The bottle that goes to QA should not always be the first, or always the second, bottle that the sample is poured into. So, vary which bottle you fill first. Set the QA bottle aside in the ice chest to place in fridge when you return to the office.

- To proceed with the lab test, begin by shaking the IDEXX bottle with your sample in it to dissolve all the granules that neutralize any chlorine that may be present in the sample, and to ensure a well mixed sample. Then, run the test as usual.

## Reading the Sample Trays

The trays must incubate between 18 and 22 hours at 34.5 to 37 degrees C before reading. **If you read the trays later than the 22 hour incubation time period, the results are not valid.**

There are a total of 49 large wells and 48 small wells per tray. The large, rectangular well at the top of the tray is counted as a large well.

Fill out the bottom section of the data collection form with your name, the incubator temperature and the date and time the results were read.

### **For total coliform results (for freshwater only):**

1. Pull out the color comparator from the drawer.
2. Face the doorway to the lab, with your back to the room, and hold the tray and comparator out at arms length and below eye level. This seems to facilitate detection of the color change.
3. Count the number of large wells (including the large rectangular well at the top of the tray) and small wells that are **more** yellow than the comparator tray. These wells as positive for total coliforms. All wells that are less yellow than the comparator are negative for total coliforms.
4. Record these values on the data sheet.
5. Use the MPN chart and based on the number of large and small wells that changed color, record the MPN value on the data sheet.
6. If your sample was diluted, then you must multiply the MPN value by the dilution factor (i.e., multiply by a factor of 10 if diluted original sample 1:10) to get the MPN value for the original, undiluted sample.
7. Return the color comparator to its red bag in the drawer. Do NOT autoclave it!

If a different bacteria, other than coliform bacteria, were present in the sample and caused a color change other than yellow or fluorescing, do not record these as positive wells.

This gives an MPN value for total coliform. Note that the test kits can't be used to monitor for total coliforms in marine samples.

### **For *E. coli* results (both freshwater and marine samples):**

1. Put the tray into the UV cabinet and plug in the UV light. Push the red button and look through the viewing screen on the cabinet.
2. Count the number of large and small wells that are both fluorescing AND yellow. These are positive wells for *E. coli*. Record on the data sheet. All wells that fluoresce more than the comparator **and** are yellow are positive for *E. coli*.
3. If it is difficult to distinguish whether the well is both yellow and fluorescing when it is in the cabinet, use a Sharpie to make each of the fluorescing wells while it is in the cabinet. Then pull the tray out of the cabinet and verify that all of those fluorescing wells also have the yellow color change. Only the wells with BOTH fluorescence and a yellow color change are positive for *E. coli*.
4. Look up the MPN value from the chart and record on the data sheet.

5. If your sample was diluted (all marine samples are diluted to at least 1:10), then you must multiply the MPN value by the dilution factor (i.e., multiply by a factor of 10 if diluted original sample 1:10) to get the MPN value for the original, undiluted sample.
6. Be sure to turn off the UV light when you are done.

If a different bacteria, other than coliform bacteria, were present in the sample and caused a color change other than fluorescing (i.e., a bright blue fluorescence), do not record these as positive wells. If the tray fluoresces but did not turn yellow, this is not a positive result for *E. coli* but rather some other undetermined organism.

This gives the MPN value for *E. coli*.

**Once the readings are complete:**

1. The trays must be autoclaved before they can be thrown out. Mark the back 'Destroy' and double bag it in **two** autoclave bags and place in the 'To be autoclaved' bin. Bags are located in the drawers under our lab space. Lab personnel will autoclave and then dispose of the tray. Do not fold the bags closed too tightly since steam must be able to escape during autoclaving.
2. Don't turn off the incubator since someone else may be coming in to use it.

Positives observed before 18 hours are valid, and negatives after 22 hours are valid.

**Suggested Dilutions for Bacteria Testing:**

Creek Sites: Due to variance in *E. coli* and total coliform levels, undiluted and 1:10 dilutions are run at each creek site. For Walters Creek (WAL) it is recommended to run a 1:10 and 1:100 dilution.

Bay Sites: All sites are tested with a 1:10 dilution.

# Enterococcus Monitoring Protocol

## Background:

- Enterococci: Group of bacteria found primarily in the intestinal tract of warm-blooded animals. Unrelated to coliforms, they are a subgroup of the fecal streptococci group. Enterococcus is less sensitive to salt than *E. coli* and is thus considered a better indicator in marine environments.

## Background on Enterolert Tests:

- These tests are valid for freshwater or marine waters. We will continue to monitor total coliforms and *E. coli* in freshwater. We will monitor *E. coli* as well as enterococcus in marine waters. The reason for continuing to monitor *E. coli* in the bay is that regulatory agencies use the levels of the coliform family of bacteria (which includes *E. coli*) to determine if the shellfish that grow in the water are safe for consumption. Since we are collecting data that may be used to assess the safety of bay waters for shellfish growing, we need to continue collecting *E. coli* data.
- Based on the Most Probable Number (MPN) technique, which uses multiple tubes with broth that are inoculated with the sample at different dilutions. After incubation, the tubes show a positive or negative reaction for the target organism. The number of positive tubes corresponds to a statistical probability that the sample contained a certain number of bacteria.
- Based on a color change in the wells after incubation, enterococcus can be detected in samples.
- Cost: Approximately \$6/test.

## Notes on Sample Collection

Sample collection procedure is the same as for Colilert-18 testing. Since only 10 mL of sample are needed for each test, you only need to collect one sample jar at each site in order to conduct both enterococcus and *E. coli* testing.

We will conduct enterococcus monitoring at the following sites:

### Bay Sites:

- Cuesta Inlet (CIN)
- Baywood Park (BAY)
- Pasadena Point (PAS)
- Sharks Inlet (SIN)
- Windy Cove (WIN)
- Public Boat Ramp at Tidelands Park (TID)
- State Park Marina (SPM)
- Coleman Park (COL)

### Creek Sites:

- Los Osos Creek at Turri Road near South Bay Blvd (SYB)
- Los Osos Creek near Turri Road, downstream of SYB (GS1)



Note: At SYB, we might want to bring along the salinity meter and take a reading at the time of sample collection.

### Notes on Sample Analysis

Enterolert samples are processed identically to Colilert-18 samples (same process, same Quanti-trays, etc.). The only differences are as follows:

- A different packet of reagent is used. The Colilert-18 reagent packets are labeled in red, and the Enterolert reagent packets are labeled in purple.
- The samples incubate at 41 +/- 0.5 degrees C (versus 34.5 to 37 degrees C for Colilert-18)
- The incubation time is 24 to 28 hours (versus 18 to 22 hours for Colilert-18)

Some information for the lab analysis:

- All samples must be diluted 1:10.
- **Label the back of each tray with either “*E. coli*” or “Enterolert” to help keep them straight.** Once the reagent is added to the water sample, it is difficult to distinguish whether you have a Colilert-18 or an Enterolert sample. The Enterolert samples appear to be a slightly darker shade of yellow than the Colilert-18 samples.
- Be careful to place your enterococcus samples in the incubator labeled ‘Enterolert’. The incubator for the *E. coli* samples is labeled ‘Colilert-18.’ The enterococcus incubator is set for 41 +/- 0.5 degrees C, and the *E. coli* incubator is set for 34.5 to 37 degrees C.

### Reading the Enterolert Trays

The trays must incubate between **24 and 28 hours** at 41 +/- 0.5 degrees C before reading. **If you read the trays later than the 28 hour incubation time period, the results are not valid.**

Fill out the bottom section of the data collection form with your name, the incubator temperature and the date and time the results were read.

#### For enterococcus results:

1. Put the tray into the UV cabinet and plug in the UV light. Push the red button and look through the viewing screen on the cabinet.
2. Count the number of large and small wells that are fluorescing blue. These wells are positive for enterococcus. Any amount of fluorescing is considered to be a positive result. Record on the data sheet. If the wells fluoresce a color other than blue, do not record these as positive wells.
3. Look up the MPN value from the chart (the same chart as for the Colilert-18 results) and record on the data sheet.
4. Multiply the result by the dilution factor. All samples are diluted at least 1:10.
5. Be sure to turn off and unplug the UV light when you are done.
6. Once the readings are complete, treat them the same way as the Colilert-18 trays. Double bag in autoclave bags and put in the ‘To be autoclaved’ bin.

## Morro Bay Volunteer Monitoring Program Bacteria Monitoring Datasheet

Date:
Samplers:
Weather, past 24 hrs:
Weather currently:

High Tide Time:	
High Tide Height:	
Rainfall in past week:	

Site ID	Collection Time	Parameter	Dilution Factor	# Large Wells	# Small Wells	MPN/100 mL	Notes
		Total coliforms					
		E.coli					
		Enterococcus					
		Total coliforms					
		E.coli					
		Enterococcus					
		Total coliforms					
		E.coli					
		Enterococcus					
		Total coliforms					
		E.coli					
		Enterococcus					

Test	<b>Colilert-18</b>	<b>Enterolert</b>	<b>Site Codes</b> <b>BAY SITES:</b> Cuesta Inlet ( <b>CIN</b> ), Baywood Park ( <b>BAY</b> ), Pasadena Pt. ( <b>PAS</b> ), Windy Cove ( <b>WIN</b> ), State Park Marina ( <b>SPM</b> ), Coleman Beach ( <b>COL</b> ), Tidelands Park ( <b>TID</b> ), Santa Lucia Seep ( <b>SLS</b> ), 3rd Street Dock, North/South ( <b>TRN, TRS</b> ), Pismo Seep ( <b>PSS</b> ) Midway Seep ( <b>MID</b> ) <b>CREEK SITES:</b> Los Osos Crk at Turri ( <b>SYB</b> ), Walters Crk near Hwy 1 ( <b>WAL</b> ) Pennington Crk near REC school ( <b>PEN</b> ), Warden Crk at Turri ( <b>TUR</b> ), Chumash Crk at flume ( <b>CHU</b> ) San Bernardo Crk at culvert ( <b>SBE</b> ), San Luisito Crk at bridge ( <b>SLU</b> ) Chorro Crk at Canet Rd ( <b>CAN</b> ), Chorro Crk at Ecological Reserve ( <b>CER</b> ), Chorro Creek at South Bay Blvd ( <b>TWB</b> ) Dairy Crk at culvert ( <b>DAL</b> ), Dairy Crk at gate ( <b>DAM</b> ), Dairy Creek at crossing ( <b>DAU</b> )
Time incubation started:			
Name of sample reader:			
Incubator temp when read:			
Date samples read:			
Time samples read:			

**Colilert-18 samples: read after 18-22 hours    Enterolert: read after 24-28 hours**

If multiple dilutions were run, report results that have between 48 and 78 positive wells (50-80% of the 97 wells). This might be separate dilutions for the different bacteria types.

Appendix B. Morro Bay Volunteer Monitoring Program  
Water Quality Monitoring Protocols and Field Guide



## **Morro Bay Volunteer Monitoring Program Water Quality Monitoring Protocols and Field Guide**

# Morro Bay Volunteer Monitoring Program Water Quality Monitoring Protocols

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## **Field Hazards and Precautions**

Poison Oak and Stinging Nettle are two noxious plants that grow along side many creeks throughout the watershed. If you need to move your sampling location upstream or downstream slightly to avoid contact with these plants please do so!

If you do brush up against poison oak, wash the affected area with Technu and Cala gel which are available in our office.

If you brush up against stinging nettle, it is best to soak the affected area in cold water and apply a Benadryl gel to block the antihistamine response.

**Poison Oak:**

Identify by shiny 'leaves of three' and lack of thorns on branches. Leaves turn red and orange seasonally.

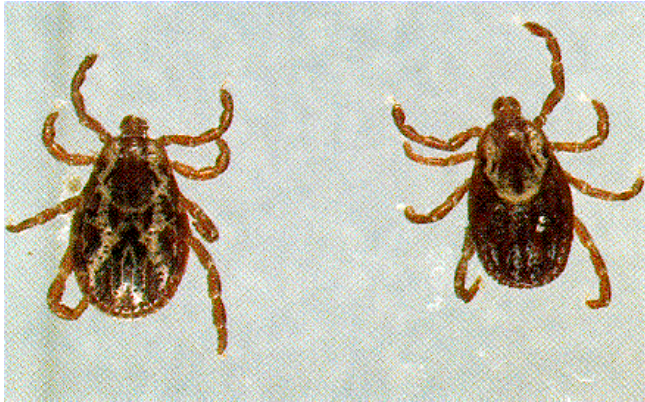
**Stinging Nettle:**

Leaves have jagged edges, and small grainy flowers hanging from where leaves meet the stem. These plants

## Field Hazards and Precautions

**Ticks are often found in cool riparian areas during the spring and summer. They will climb onto clothing and then onto skin where they bite and attach. They are known to transmit diseases, and should be avoided and removed immediately.**

Rattlesnakes are also occasionally encountered in the watershed. They can be identified for the dark diamond pattern and characteristic rattle. If you see a rattlesnake, leave the area immediately.



Two common varieties of ticks in the Morro Bay area.



Rattlesnakes: Identify by diamond patterning and rattle at the tail.



## Emergency Phone Numbers and Contacts

### EMERGENCY: 911

Morro Bay Police: (805) 772-6225

Morro Bay Fire: (805) 772-6242

County Sheriff: (805) 781-4550

California Highway Patrol: (805) 593-3333

National Estuary Program Office: (805) 772-3834

### **Wildlife:**

Marine Mammal Rescue Center: (415) 289-7327  
Injured or sick marine mammals.

Pacific Wildlife Care: (805) 543-9453  
Injured or orphaned wildlife (fawns, birds of prey, other animals)

## Water Quality Monitoring for the Morro Bay Volunteer Monitoring Program

### **Where to Take Measurements:**

- Optimum location: center of creek at 1/3 of water depth
- Try to sample in part of creek with mixing, do not sample in stagnant pools.
- Don't stir up water when taking measurements.
- Face upstream when taking sample – stay downstream of the equipment/sample.

### **Measuring pH with the pH Sensor**



- Fill the measuring cup halfway with a water sample from the creek
- Press the ON/OFF button to switch the sensor ON and remove the cap from the end of the electrode.
- Place the electrode into the measuring cup. Wait for temperature reading to stabilize. This may take a few minutes. **It should come within 1 degree of the temperature reading from the DO Meter.**
- Record the temperature and pH readings on the datasheet.
- Press the ON/OFF button to switch the sensor OFF.
- Rinse the electrode with **TAP WATER** from the small squirt bottle. Squirt a small amount into the yellow sponge in the electrode cap.

- Replace the electrode cap on the end of the sensor, and place the sensor back in the case.

### **Dissolved Oxygen, Temperature, and Conductivity** **with YSI Model 85 Meter**

These YSI meters can measure DO, temperature, salinity, conductivity and specific conductance, which is a temperature-adjusted conductivity value.

- Turn on meter upon arriving at the site by hitting the ON/OFF button. The meter requires ten to 15 minutes to stabilize before you can take readings.



- To collect Dissolved Oxygen (DO) readings:
  - Place probe in water. The entire probe **up to the cable** must be submerged to ensure that all necessary instrumentation is in contact with the water.
  - Gently move the probe while measuring. The instrument requires a minimum of 1 ft/sec of flow across the probe for an accurate reading to be taken.
  - Press the mode button until DO percent saturation is displayed. This is indicated by a small '%' sign in the upper right corner of the screen.
  - Once the value has stabilized, record it on the datasheet as Dissolved Oxygen, %.
  - Next, hit the MODE button. The screen will display the DO value in mg/L. This will be indicated by a 'mg/L' on the screen to the right of the value.
  - Once the value has stabilized, record it on the datasheet as Dissolved Oxygen, mg/L.
  - Record the temperature in °C from the bottom right corner of the screen.



The units will be in uS or mS.

The ° C symbol will be flashing when you are in the correct mode.

- Take a Specific Conductance reading:
  - Hit the mode button one more time and you will see a value with either a **μS** or **mS** as the units. This value is a conductivity reading without any temperature correction. This is NOT the value we want from this meter.
  - Hit the mode button again and you will see a value with either **μS** or **mS**, and the °C will be **flashing on and off**. This is the **Specific Conductance** mode, which is the value we want. It is also known as a temperature compensated conductivity value, which means that the meter has adjusted the reading to the calculated value which would have been read if the sample had been at 25 °C.
  - Record the specific conductance value in the Conductivity column on the datasheet.
  - The meter will indicate the units as either **μS** or **mS**. Circle the correct units on the datasheet.
- When finished monitoring:
  - Rinse the probe thoroughly with DI water.
  - Store the probe in the chamber on the side of the meter
  - Only push the probe in until the black o-ring enters the chamber, do not shove it in all the way.
  - Leave the meter on as you travel to the next site, or turn it off when done sampling.

## Turbidity with HACH 2100P Portable Turbidimeter

- Triple rinse the syringe with creek water.
- Use syringe to fill glass sample cell to the mark (white band/arrow). Handle cell by the top, not the sides.



- If outside of cell gets wet, wipe off cell with a Kim-wipe – do not use your shirt or a paper towel since it could scratch the cell.
- Place a small drop of silicone on the cell then rub in with a Kim-wipe to reduce the effect of scratches in the glass on the reading.
- Turn instrument on.
- At the bottom of the screen it should say 'Auto Rng'. If it doesn't, press the RANGE button until the words appear.
- Insert sample cell with diamond on cell lined up with the notch on meter.



- Close lid.
- Press READ.
- Record value after light bulb icon turns off. Units in NTU.
- Turn instrument off.

- Empty cell. Rinse cell and syringe with DI. Leave cap off so cell can air dry.

### Collecting Nutrient QA Sample and Agricultural Monitoring Samples

- Collect equipment: sample container, cooler and ice packs. They are all available in the back of the storeroom near our refrigerator.
- For each Ag Monitoring Site, you will need one 8 oz. plastic bottle without preservative and one 8 oz. plastic bottle with H<sub>2</sub>SO<sub>4</sub> preservative.
- Label sample container as follows:
  - Client: Morro Bay Volunteer Monitoring Program
  - Location: Code for your site
  - Project: MBNEP
  - Sampler: Your name
  - Date
  - Time **[NOTE: It's very important to note the time because we need to get the sample analyzed by the lab before the holding time is exceeded.]**
  - Sample#: Code for site and date



- At site, wade into stream at sampling location, taking care to not stir up water. Stay downstream of the area where you will be collecting the sample.
- For the non-acidified bottle: Open the container underwater at 1/3 the depth and fill. Dump out the water. Repeat two additional times so that the bottle has been triple rinsed. Then fill the container. Leave air space at the top.
- For the acidified bottle: Open the container underwater at 1/3 the depth and fill. Leave air space at the top.
- Cap the container.
- Store in cooler and return to NEP office.
- Put sample bottle in the refrigerator. Return the ice packs to the freezer.



- Let VMP staff know that you've left samples in the fridge.
- Samples will be picked up by the lab courier such that the appropriate hold time will be met.

### Flow Measurement Protocol with Flo-Mate

- Choose a point on the creek with the following characteristics:
  - Wadeable (less than 3 feet deep) and not moving so swiftly as to be unsafe;
  - Lacks obstructions within 15 ft up or downstream of site;
  - Depth greater than 0.1 feet;
  - Bottom of the creek should be relatively flat and even;
  - Bottom of the creek should be solid so you won't sink;
  - Site at the beginning of a riffle, not a pool.



- Extend the tape measure across the section of the creek to be measured. When you are facing upstream, the zero end of the tape should be on the left bank. Make sure you use the side of the tape that measures feet in tenths, not inches. The tape must be held in place firmly during all measurements and not moved.
- Measure the total width of the creek.
- Record the creek length in the 'Total length' spot on the data collection form.
- Divide the total length into segments following these guidelines:
  - If your site is <5 feet wide – take at least 6 readings
  - If your site is >5 feet wide – take at least 12 readings

- If the creek length is not easily divided into segments of even length, it is fine to have shorter or longer segments at either end.
- Begin by sliding the sensor onto the mounting shaft of the top-setting rod and securing by tightening the thumbscrew. Be sure to mount the sensor so that the cable is coming straight up. Turn only till snug, do not over tighten.
- **Start on the left bank when facing upstream.** Place the top-setting rod in the water so that the sensor faces upstream, directly into the current. Stand downstream of the meter and tape so that you do not interfere with the flow. Do not stand directly behind the flow meter or you might create eddies – try to stand off to the side. Make sure the rod sits flat on the bottom, stands upright, and that there are no rocks, sticks, algae, etc. interfering with the sensor.
- Take the first reading at the edge of the wetted width.
- Under ‘Distance from Bank’, record the distance from the point on the left bank where the water begins to the point where the flow measurement is being taken.
- Visually measure the depth of the creek using the graduation lines on the hexagonal rod. Single line = 0.1 feet, double lines = 0.5 feet, triple lines = 1.0 feet. Record the depth on the data collection sheet.
- Adjust the rod so the sensor is raised above the bottom of the channel by setting the gauge on the top of the rod to the depth of the channel. To set the sensor at the correct depth, press the trigger to slide the smaller rod up or down. The smaller rod has graduations marked in feet starting with ‘0’ for depths less than 1 foot. For example, if the creek depth is 1 foot, move the small rod so that the 1 foot graduation lines up with the “0” on the large rod. If the creek depth is 1.4 feet, raise the small rod so the 1 foot graduation is aligned with the “4” on the large rod.
- Be sure the electrodes on the sensors are submerged. They are two shaded areas on the front of the sensor. If they are not submerged, there is insufficient depth to take a reading and you can record ‘0’ flow in the fps column on the datasheet. (Typically 0.2 feet or less.) Make sure the electrodes on the sensor are facing directly into the flow.
- Once the rod is set, press the ‘ON/C’ button on the box to start your first measurement.



- The meter will take readings for 30 seconds as indicated by the ‘Period ■■■■...’ counter. You will see the reading fluctuate as the meter calculates an average. After 30 seconds, an average value in feet per second (ft/s) will be displayed on the readout. Record this value in the fps column of the datasheet. The counter will start over and give an average value after 30 more seconds. Note: If the sensor gives a negative number, record ‘0’.
- Repeat measurements across the channel. At each segment, measure the depth, set the rod, press the ‘ON/C’ button, wait thirty seconds, then record the ft/s value.
- Take the last reading at the edge of the wetted width.
- When you are done, turn off the meter by pressing the ‘OFF’ button.
- Disconnect the sensor from the rod, coil the cable, and place in mesh pocket.



- If a Low Battery warning ('Low Bat') is displayed on the screen, please notify the VMP staff so we can change the batteries.
- Use the 'Notes/Field Observations' portion of the datasheet to record any changes at the site (i.e., algal growth, wildlife, etc.). If you have had to move the site due to obstructions, note that on the datasheet.
- Report any problems with equipment to VMP staff.

## **Site and Gate Codes**

### **Site ID Codes:**

San Bernardo Creek: SBE  
Pennington Creek, Cal Poly, upper: APN  
Pennington Creek, Cal Poly, lower: UPN  
Pennington Creek, upper: CPN  
Pennington Creek, lower: PEN  
Dairy Creek, lower: DAL  
Dairy Creek, middle: DAM  
Dairy Creek, upper: DAU  
Los Osos Creek near S.Bay Blvd: SYB  
Los Osos Creek at Clark Valley: CLV  
Los Osos Creek at Los Osos Valley Rd: LVR  
Walters Creek: WAL  
San Luisito Creek: SLU  
Warden Creek, upper: UWR  
Warden Creek at Turri Road, near Los Osos Valley Road: TUR  
Warden Creek, lower: WRP  
Chorro Creek at Camp San Luis: CHO  
Chorro Creek at Upper Chorro Reserve: UCR  
Chorro Creek Ecological Reserve: CER  
Chorro Creek at Canet Road: CAN  
Chorro Creek at Chorro Creek Road: CCC  
Chorro Creek at Twin Bridges: TWB  
Coon Creek at Montana de Oro: COO

### **Gate Codes:**

#### **CER: 2855**

**(Please note that we are occasionally asked to use either the south or north gate depending on where animals are grazing.)**

#### **DAM and DAU**

Our lock has “MBNEP” engraved on it and the combination is ‘3834.’ Be sure to lock the gate behind you.

## **Equipment Malfunctions and Common Mistakes**

### **DO Meter:**

- **Won't Stabilize:**

This meter can jump back and forth between a few values for a long time. Pick a mid range value of those that are being repeatedly displayed and record on datasheet.

- **Displays LO BAT or will not turn on:**

You will not be able to collect data. Be sure to notify staff of the problem so that it can be corrected.

### **FLOW Mate:**

- **Meter blinks on and turns off immediately:**

This meter takes size DD batteries, and has to be unscrewed in order to replace them. You do not need to attempt this replacement in the field. Notify the office when you return so that staff can fix the meter and make the measurements later in the day.

- **Meter displays negative numbers:**

This may be due to very low depth (less than 0.2) so the meter is unable to take a good reading. (If this is the case, record 0 on the datasheet.)

If the meter is entirely submerged, check for obstacles in front of the bulb (rocks, large tree roots.) These large obstacles may be creating turbulence near the meter and resulting negative numbers. You can often correct this problem by raising the bulb higher up in the water and re-starting the reading.

## **Quality Assurance Instructions**

- The data for QA is recorded on a separate form, the 'Replicate and QA Datasheet.' This form will be provided for you and is always on blue paper to distinguish it from the regular datasheets.
- **Collect replicate readings with the meters:**
  - **Dissolved Oxygen and Temperature:**  
After your initial readings have been recorded, remove the probe. Wait 10 seconds, then place the probe back into the water and allow it to stabilize. Record these readings.
  - **Turbidity:**  
After the initial reading has been recorded on the datasheet, remove the vial from the chamber and invert it a few times. Place the vial back into the meter and press 'READ.' The result is your replicate value.
  - **Conductivity:**  
Remove the probe from the water and allow the reading to drop back to zero. Place back into the water and record the reading.
  - **pH:**  
After your initial readings have been recorded, remove the probe. Wait 10 seconds, then place the probe back into the water and allow it to stabilize. Record these readings.
- **Nutrient Blanks:**  
Run the test as normal, but use DI water rather than sample water. The goal is to get a zero value for both tests.
- **Sample for QA**  
Please record the samplers name, sample ID and time on the datasheet. For instructions on collecting the sample see the Collecting a Nutrient QA Sample and Agricultural Monitoring Sample portion of the protocol.
- **Flow Measurement Replicates:**  
Randomly select three points in the creek with high velocity where you are measuring flow. After the first measurement, re-start the meter to count for another 30 second period. Record the second velocity, as well as the distance from the bank on the Replicate Datasheet.

## Water Quality Monitoring Data for the Morro Bay Volunteer Monitoring Program

Date:	Time:	Site ID:
Team names:		
Current weather:	Rainfall in past week:	

Parameter	Equipment ID (fill in number)	Data	Notes/Field Observations
Water Temperature	DOE-MBV- <input type="text"/>	<input type="text"/> °C	Algae Present? YES or NO
Dissolved Oxygen	DOE-MBV- <input type="text"/>	<input type="text"/> mg/L	Approx. % Algae Cover: <input type="text"/>
Dissolved Oxygen	DOE-MBV- <input type="text"/>	<input type="text"/> %	Trash/Litter Present? YES or NO
Turbidity	TUN-MBV- <input type="text"/>	<input type="text"/> NTU	Oily sheen or scum? YES or NO
Conductivity	DOE-MBV- <input type="text"/>	<input type="text"/> uS or mS	Odor detected? YES or NO
pH Electrode	PHSL-MBV- <input type="text"/>	<input type="text"/> °C	Fish present? YES or NO
Temperature & pH		<input type="text"/> pH	Other Notes:
pH Paper	PHST-MBV- <input type="text"/>	<input type="text"/> pH	
Nutrient Sample	Time collected:	<input type="text"/>	

## Flow Volume Measurement

[illegible]

## **Morro Bay NEP's Volunteer Monitoring Program Creek Nutrient Monitoring Protocol**

This protocol describes the procedure for processing nutrient samples for creek water quality monitoring.

Samples are collected at the creek by the volunteers. They return to the office with the sample and conduct the analysis at the office.

This protocol is for all creek water quality sites.

### **Field Sample Collection**

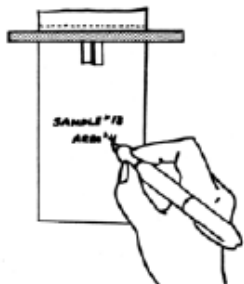
#### **Equipment:**

- Clean Whirl-pak bag, 1 per site
- Gloves
- Sharpie
- Pen
- Datasheet
- Clipboard
- Sampling pole (if necessary)

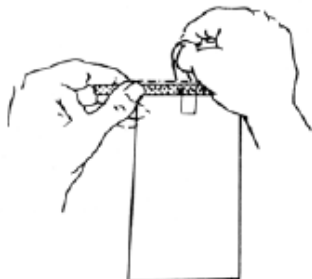
#### **Sample Collection Procedure:**

1. Collect the sample when you first arrive at the site.
2. Label the Whirl-pak with the site code, date of collection and time of collection.
3. Wear gloves for collecting the sample.
4. Be careful to not stir up sediment
5. Fill the Whirl-pak bag as follows:

## INSTRUCTION SHEET FOR **WHIRL-PAK** SAMPLE BAGS



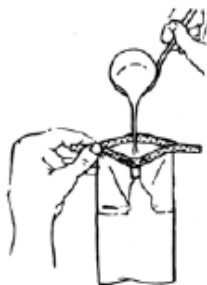
1. Label the bag with sample information if necessary.



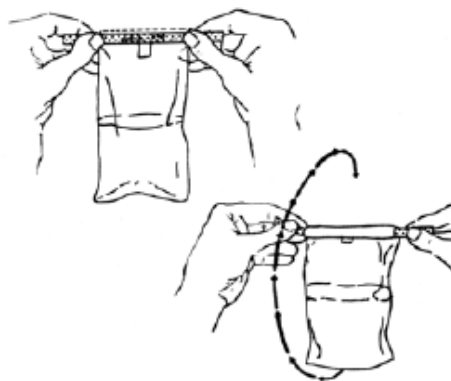
2. Tear off the top of the bag along the perforation.



3. Use pull tabs on each side to open the bag. Sometimes a little pull on the bottom of the bag helps open it completely.



4. Put sample, liquid or solid, into bag. Leave enough space at the top for closing and mixing if needed.



5. Pull the ends of the wire to close the bag. Holding the bag by the wire ends, whirl the bag three complete revolutions to form a leakproof seal. Whirling the bag will form the tightest seal. Larger bags can be closed by "folding" the tab over as tightly as possible.



6. Bend the wire ends over onto the bag to complete the closing.

Note from VMP Staff: We recommend folding the bag down, rather than whirling it. Otherwise you might end up wearing your sample.

6. Do not store the sample on ice. Bring sample to the office to conduct the analysis.

**Note:** Occasionally we will request that you collect a quality assurance sample to be sent to a laboratory for analysis. If that is the case, you must also bring with you 8 oz. bottles from BC Laboratories, one per site, as well as a cooler and ice packs. Collect the QA samples in the same manner as the other samples and store in a cooler with ice packs.

## In-Office Sample Analysis

Return to the office with the sample. All equipment for analysis is contained in the bin in the white cupboards. The bin is labeled “Nutrient Analysis Equipment.”

## Sample Analysis for Nitrate

### Equipment:

- HACH DR/890 meter with back plastic test tube adapter and meter cap
- Nitrate reagent vial (glass with plastic cap)
- Nitrate reagent powder (silver packets)
- Kim Wipes
- Pipetter labeled ‘NITRATE’
- Pipette tips
- Blue test tube rack
- Sharpie
- Scissors
- Lab coat
- Safety glasses
- Lab gloves

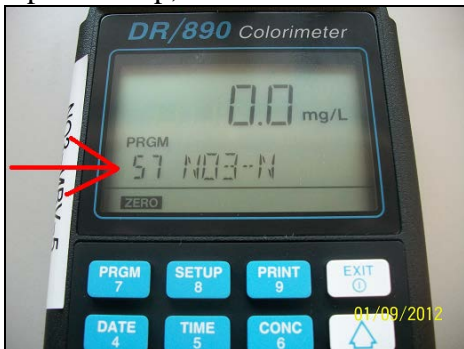


## Sample Analysis Procedure

1. Please wear protective safety gear: safety glasses, lab coat and gloves.



2. Record the meter ID# and date and time of analysis on the datasheet.
3. Turn on meter by pressing the **EXIT** button on the upper right hand corner of keypad.
4. Upon startup, “57 NO3-N” should be displayed on the bottom left hand corner of the screen.



5. If “PRGM 57” is not displayed, press the **PRGM** button. The display will show: “PRGM?” Then enter “57” and push the **ENTER** button on the bottom right hand corner of the keypad. “57 NO3-N” should now be on the bottom left hand corner of the meter display.
6. Insert the test tube adapter into the cell holder by rotating the adapter until it drops into place. Push down to fully insert it.



7. Place the nitrate reagent vial in the test tube rack. Remove cap on vial.
8. Use pipetter labeled ‘NITRATE’. Pipette in 1 mL of sample. (Make sure pipette reads 1 mL.)
9. Cap the vial and invert gently 10 times to mix. (Do not worry if vial heats up, this is normal.)
  - a. Hold vial with cap pointing up.
  - b. Turn vial upside-down.
  - c. Wait for all of solution to flow down to cap.
  - d. Pause.
  - e. Return vial to upright position and wait for all solution to flow to the bottom.
  - f. This process equals one inversion.
10. Clean outside of vial with a Kim Wipe.
11. Place the vial into the test tube adapter with the HACH logo facing the front of the meter.



12. Cover the vial with the meter cap.



13. Press **ZERO** button on the bottom left hand corner of the key pad. The display should read "0.0 mg/L".
14. Remove the vial from the meter and place it in the test tube rack. Remove cap. Use scissors to open silver reagent packet and add powder to the vial.
15. Replace cap and invert gently 10 times. Not all of the reagent will dissolve.
16. Clean vial with Kim Wipe and then place back into test tube adapter with HACH logo facing the front of the meter.
17. Cover vial with the meter cap.
18. Press **TIMER** and then **ENTER** which are both on the bottom right hand corner of the meter keypad. This starts the timer for the five minute reaction time.
19. After the meter beeps, press the **READ** button at the bottom of the keypad. Do not push the **READ** button **BEFORE** the beeps finish, or you will get a zero reading.
20. The result in "mg/L" will be displayed. Record value on datasheet. (Note: Meter range is up to 30 mg/L.)
21. Press the **EXIT** button to turn off meter.
22. Use a Sharpie to write an X on the top of the vial cap, and place it with the other used vials in the plastic bin labeled "USED VIALS."

## Sample Analysis for Orthophosphates

Samples should be near room temperature (approximately 18 to 25°C) at the time of analysis.

### Equipment:

- Hanna orthophosphate meter with glass cuvetts and black plastic caps
- Orthophosphate reagent made by HACH (Phos Ver 3)
- Kim Wipes
- DI water
- Pipetter and tips
- Timer
- Scissors
- PO<sub>4</sub> Waste Container

### Sample Analysis Procedure

1. You may use the same gloves from the nitrate analysis.
2. Record the meter ID# on the datasheet.
3. Record the time of analysis on the datasheet.
4. Triple rinse the glass cuvet and plastic cap with DI water.
5. You may reuse the same pipette tip from the nitrate analysis.
6. Analyze the sample:
  - a. Pipette up 10 mL of sample water.
  - b. Fill the cuvet about halfway, put on the cap, shake, and then discard the water.
  - c. Fill the pipette again with sample water.
  - d. Fill the glass cuvet to the 10 mL line, cap the cuvet, and clean the outside of the cuvet with a Kim Wipe.
  - e. Turn on the meter, insert the glass cuvet and press the 'Zero' button to take a zero reading.
  - f. Set the timer for 30 seconds.
  - g. Use scissors to cut the reagent packet open.
  - h. Remove the cuvet from the meter, remove the cap and add the reagent packet.
  - i. Replace the cap on the cuvet.
  - j. Start the timer and swirl the cuvet for 30 seconds to dissolve the reagent.
  - k. Set the timer for two minutes and wait for the reaction to complete. You may need to re-clean the outside of the cuvet with an additional Kim Wipe. The caps sometimes leak and leave liquid on the outside of the cuvet.
  - l. Insert the cuvet in the meter.
  - m. When the timer rings, push the 'Read Direct' button.
7. The meter screen will show the result.
  - a. If the resulting orthophosphate value is less than 2.50 mg/L, record the value on the datasheet.
  - b. If the value is greater than 2.50 mg/L, then the sample must be diluted and the analysis run again. Save the sample in the fridge. **Notify staff that additional dilutions must be run before the 48-hour hold time expires.**

8. Clean up:
  - a. Empty the glass cuvet in the waste container labeled 'PO4 Waste'.
  - b. Triple rinse the cuvet and cap with DI water and discard into the PO4 waste container.
9. Place the used syringe and Whirl-pak bag in the bin labeled 'Dirty Glassware'.
10. Return equipment to bin and return to shelf.
11. Leave datasheet by sign-in sheet.

## **Procedure for Dilutions of Orthophosphate Samples To be Conducted by VMP Staff Only**

If orthophosphate results are greater than 2.50 mg/L, then the sample requires a dilution to obtain an accurate result. VMP staff check the sample fridge at the start of each day to determine if samples are present that require further dilutions.

### **Equipment:**

- Hanna orthophosphate meter with glass cuvetts and black plastic caps
- Orthophosphate reagent made by HACH (Phos Ver 3)
- Kim Wipes
- DI water in a bottle
- Adjustable pipetter
- Pipette tip
- Timer
- Scissors
- PO4 Waste Container

### **Sample Analysis Procedure:**

1. Put on gloves.
2. Record the date and time of analysis on the datasheet.
3. Triple rinse the glass cuvet and plastic cap with DI water.
4. Triple rinse the pipette tip, inside and out.
5. Place a pipette tip on the pipetter.
6. Dial the pipetter to 5 mL.
7. Dispense 5 mL of DI water from the bottle into the glass cuvet.
8. Dispense 5 mL of sample water into the glass cuvet.
9. Clean the outside of the cuvet with a Kim Wipe.
10. Turn on the meter, insert the glass cuvet and press the 'Zero' button to take a zero reading.
11. Set the timer for 30 seconds.
12. Use scissors to cut the reagent packet open.
13. Remove the cuvet from the meter, remove the cap and add the reagent packet.
14. Replace the cap on the cuvet.
15. Start the timer and swirl the cuvet for 30 seconds to dissolve the reagent.
16. Set the timer for two minutes and wait for the reaction to complete. Re-clean the outside of the cuvet with an additional Kim Wipe.
17. Insert the cuvet in the meter.
18. When the timer rings, push the 'Read Direct' button.
19. The meter screen will show the result. Record the value times a factor of two on the datasheet. Record the dilution factor of 50% on the datasheet.
20. Clean up: Empty the glass cuvet in the waste container labeled 'PO4 Waste'. Triple rinse the cuvet and cap with DI water and discard into the PO4 waste container. Place the used pipette tip and Whirl-pak bag in the bin labeled 'Dirty Glassware'.

## Orthophosphate Meter Error Codes:

### *Display Code Guide*

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This indicates that the meter is in a ready state and zeroing can be performed.

SIP

Sampling in Progress. This prompt appears each time the meter is performing a measurement.

-00-

This indicates that the meter is in a zeroed state and measurement can be performed.

2EAO

A zero reading was not taken. Insert a sample before adding reagent and press ZERO.

0.00

Under range. A blinking "0.00" indicates that the sample absorbs less light than the zero reference. Check the procedure and make sure you use the same cuvet for reference (zero) and measurement.

-2.74

Over range. A flashing value higher than the maximum concentration readable (see specifications) indicates that the sample absorbs too much light, meaning that the concentration is too high. Dilute the sample.

LAP

Light over range. The cuvet is not inserted correctly and an excess ambient light is reaching the detector. If the cover is properly installed, then contact your dealer or the nearest Hanna Customer Service Center.

LO

Light under range. The zero sample is too dark for proper zeroing. If this is not the case, contact your dealer or the nearest Hanna Customer Service Center.

V 2.50

The "V" indicates that the battery voltage is getting low and the battery needs to be replaced.

-BA-

This indicates that the battery is dead and must be replaced.

Note: once this indication is displayed, the meter will lockup. Change the battery to restart.

## Appendix C. Minisonde MS5 Calibration and Deployment Protocols

## **Morro Bay National Estuary Program**

### **HACH Minisonde MS5 Calibration and Deployment Protocols**

The HACH MS5 sonde probe measures dissolved oxygen (DO), turbidity, conductivity, pH and temperature. Each parameter except temperature requires regular calibration and maintenance before and after deployment.

#### **Storage**

The MS5 needs to be stored wet to maintain the integrity of the probes. If storing the probe for longer than 24 hours, follow the protocol below.

1. Clean off the sensors using a diluted Simple Green solution and a toothbrush. Rinse off all of the soap with deionized water.
2. Wash and rinse the calibration cup, and remove all debris.
3. Fill the calibration cup up between a third to halfway full with pH 7.0 buffer or tap water. (NOTE: The probe should NOT be stored with deionized water as the pH is unstable and algae may begin to grow in the water.)
4. Screw the cap on tightly.
5. Remove batteries from battery chamber if the MS5 will not be used within the next 10 days.

#### **Deployment**

The Minisonde can be deployed either horizontal or vertical to the flow. It is important that all of the probes stay submerged throughout the deployment period.

1. The MS5 should travel to and from sites with the clear plastic calibration cup attached.
2. At the field site, remove the calibration cup and screw on the weighted black vented cap.
3. Use the chisel to remove the cap from the 4" PVC housing
4. Place the MS5 into the housing and align the venting holes of the weighted cap. Align the paint on the PCV cap to the housing and use the chisel to replace the cap on the housing.
5. Thread one cable loop through the U lock, and thread the U lock through the housing.
6. Position the MS5 in the water so that all of the vents are fully submerged. The MS5 can be deployed vertically or horizontally in the water column.
7. Gently shake the MS5 housing underwater to release any air bubbles that may be trapped in the housing and near the sensors. Secure the cable around a secure anchor such as a piling or tree trunk. Lock the other cable loop into the U lock.

#### **Retrieval and Cleaning MS5s**

The MS5 should travel to and from sites with the clear plastic calibration cup attached.

Remember to bring : keys, chisel, and clear calibration cup to the site when retrieving an MS5.

1. Unlock the cable and U lock and remove the MS5 from the PVC housing.



2. Remove the weighted sensor guard and remove any debris that may have become attached to the sensors.
3. Fill the calibration cup at least halfway with creek water. Alternatively, bring a 1-gallon carboy of tap or deionized water to the site to fill the calibration cup.
4. At the lab, fill a beaker with diluted Simple Green soap and warm water.
5. Gently scrub the sensors with the diluted solution using a soft-bristled brush (toothbrush) to remove any films or foulants. *Hard scrubbing will damage probe coatings. Organic solvents like acetone or methanol will also damage the sensors.*
6. Be sure to very carefully clean the turbidity probe following marine deployment to prevent rusting.
7. Rinse the sensors with clean tap water.
8. Replace the calibration cup and wash the outside of the MS5 and weighted sensor caps with diluted Simple Green Solution.
9. Rinse black PVC housings with hot tap water and scrub with stiff bottle brushes to remove any debris that may have accumulated inside them.
10. Allow housings to dry fully before re-deploying in the field.

## Power

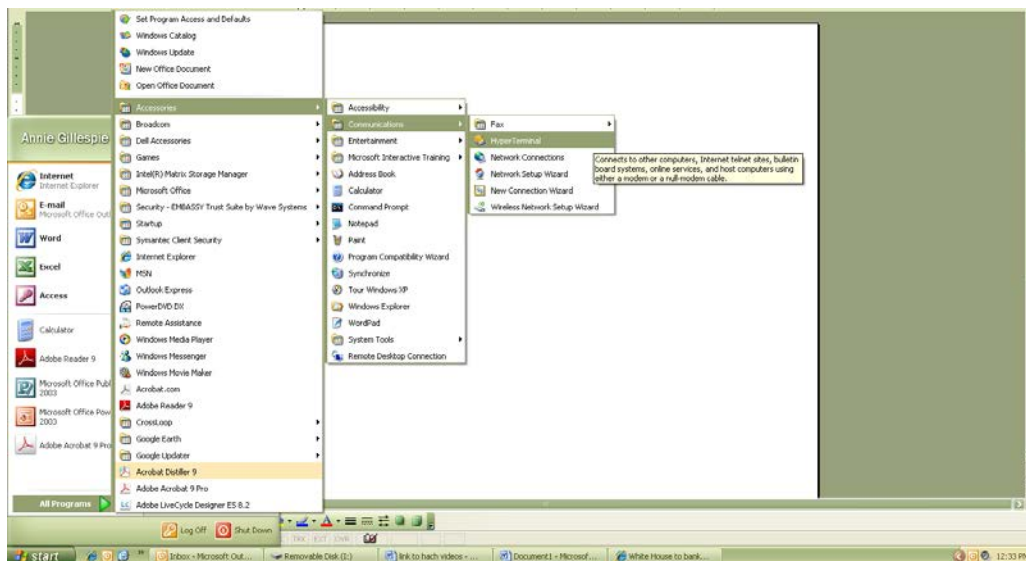
The MS5 sonde requires (8) internal AA batteries for power. The MS5 will display the remaining voltage of the batteries when connected through Hyperterminal. To replace the batteries:

1. Unscrew the white cap below the connection prongs.
2. Remove the black bands holding the batteries in place
3. Replace the batteries, carefully observing the polarity markings.
4. Replace the black bands into the indented rings.
5. Coat the battery sleeve O-rings sparingly with silicone grease if needed.
6. Screw the white cap back on to the sensor, taking care not to overtighten. If the cap is overtightened, it may crack and allow water into the battery compartment!
7. Batteries should be removed from the MS5 if it will not be used within 10 days.

## MS5 Connection to Computer

The Water Science Lab computer is configured to connect to the MS5 through a program called Hyperterminal. Plug the MS5 into the connection cable before opening Hyperterminal.

1. Open the Start Menu
2. Select “**Accessories**”
3. Select ‘**Communications**’
4. Open ‘**Hyperterminal**’



5. Hyperterminal defaults to creating a new connection, close the popup box, and select the 'open file' icon to open an existing connection file.

6. The connection settings to the Minsonde are saved as a connection named MS5. If the connection is not found, create a new connection with the following settings:

**Connect Using: COM 1 Bits Per Second: 19200**

**Data Bits: 8**

**Parity: None**

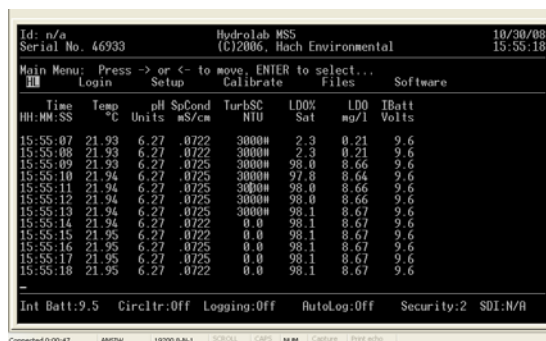
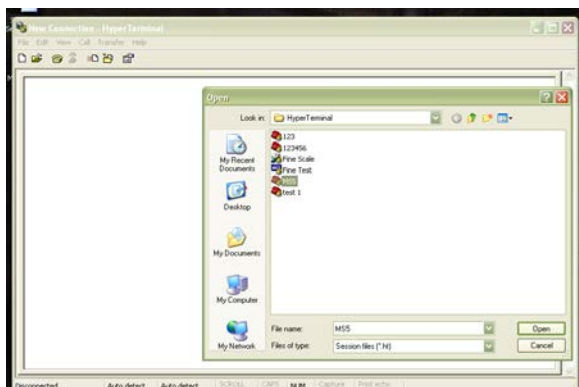
**Stop Bits: 1**

**Flow Control: X on X off**

3. When connected, the screen will turn black or potentially turn blank.

If data does not start streaming automatically, press the space bar. The MS5 should beep and the screen should go black and begin streaming data from the MS5.

5. If the connection is not established and the black screen does not appear, disconnect the MS5 cable, and restart the connection process.



## Calibration Procedures

Calibration must be done within 24-48 hours prior to each sampling event as well as within 24-48 hours after each sampling event.

For all parameters except dissolved oxygen and temperature, conduct a two-point calibration. The goal is to calibrate to known standards that will bracket the values you expect the equipment to encounter in the field.

Prior to calibration with each solution, ALWAYS rinse all probes and calibration cup thoroughly with a small amount of standard solution you will be using to calibrate.

### *Calibration Supplies*

Calibration Access Database

Calibration cord to connect to computer

De-ionized water

(2) pH Buffer solutions (Usually 7.0 and 10.0)

(2) Turbidity standards (Usually deionized water 0 NTU and 20.00 NTU)

(2) Conductivity Standards (Usually 447 uS and 1413 uS for creeks)

Lint free, microfiber drying cloth.

Tap water

The calibration log is maintained electronically in an Access database. All calibration and repairs should be recorded in this log.

1. Open the Access database file on the desktop named '**Minisonde Calibration**'.
2. On the left menu bar double click the row for '**Calibration Data Entry**' to open the data entry form seen below. Look for the FORM, not the TABLE. Create a new record and fill in all of the rows for each calibration solution used.
3. Fill in the 'Repairs Made' box when physical maintenance is performed on any of the probes. Repairs include changing out the wiper on the turbidity probe, replacing the LDO cap, or maintaining the pH probe.

Minisonde Calibration Log

Date and Time: 11/3/2008 2:52:00 PM

Meter ID: SO-MBV-1

Analyte: DO % Sat

Calibration Standard: Deionized Water

Pre-Calibration Measurement: 90.4

Post-Calibration Measurement: 99.7

Barometric Pressure: 761.99

DO Scale Factor: 0.851

Calibration technician: Annme Gillespie

Repairs made:

### **Logging in New Calibration Standards**

1. All calibration standards should appear in the drop down list on the electronic calibration form
2. Calibration standards not in the list need to be entered into the Calibration Standards table. Once they are entered in this table, they will appear in the drop down list on the main calibration form.

ID	Supplier	Standard
1	Hach	0.506 mS
2	Hach	1.412 mS
3	Hach	100 NTU
4	LabChem	1.506 mS
5	LabChem	10.00 psi
6	LabChem	7.00 psi
7	LabChem	4.00 psi
8	None	Deionized Wat
[New]		

### **pH Calibration**

1. Rinse the calibration cup and sensor with DI water.
2. Pour a small amount (~50ml) of pH 7.0 solution into the calibration cup.
3. Screw on the calibration cup and invert to rinse the probes in pH 7.0 solution. Empty the rinse solution into the sink.
4. Fill the cup with ~100 ml of fresh 7.0 pH buffer solution. Invert the MS5 so that the solution covers the measurement probes.

5. Gently tap the calibration cup to release bubbles that are around the probes. Watch the recording values stabilize in the scrolling dataframe. When a full frame of stable values has appeared, record “pre cal” value in the calibration log.
6. Calibrate the pH probe to 7.00 using the using arrow keys.
  - a. Arrow to select **‘Calibrate’** and press <Enter>.
  - b. Arrow to select **‘pH’** and press <Enter>.
  - c. Arrow to select **‘pH units’** and press <Enter>.
  - d. Type in **‘7.00’** and press <Enter>.
7. This will return Hyperterminal to the main screen with scrolling values. When a full frame of stable values has appeared, record the “post cal” value in the calibration log (which should be 7.00).
8. Discard the pH 7.00 solution, or place in a clean beaker if calibrating a second MS5.
9. Rinse the calibration cup and probes with DI water.
10. Create a new record to calibrate using pH solution 10.0
11. Repeat calibration steps 1 through 9 using pH 10.0 buffer solution.

### **Conductivity Calibration**

1. Rinse the calibration cup and probes with DI water.
2. Pour a small amount (~50ml) of conductivity solution into the calibration cup.
3. Screw on the calibration cup and invert to rinse the probes in calibration solution. Empty the rinse solution into the sink.
4. Fill the cup with ~100 ml of fresh conductivity solution. Invert the MS5 so that the solution covers the measurement probes.
5. Gently tap the calibration cup to release bubbles that are around the probes.
6. Watch the recording values stabilize in the scrolling dataframe. When a full frame of stable values has appeared, record “pre cal” value in the calibration log.
7. To Calibrate conductivity using the arrow keys:
  - a. Arrow to select **‘Calibrate’** and press <Enter>.
  - b. Arrow to select **‘Cond’** and press <Enter>.
  - c. Arrow to select **‘Cond uS/cm’** and press <Enter>.
  - d. Type in value **‘447’ or ‘1413’** and press <Enter>.
8. This will return Hyperterminal to the main screen with scrolling values. When a full frame of stable values has appeared, record the “post cal” value in the calibration log (which should be very near to the calibration standard value. Repeat steps 1 through 9 with a second conductivity standard with a calibration standard other than DI water to complete the two point calibration.
  - a. For marine deployment, use 12,880uS or 15,000 uS/cm calibration standard as the low calibration point. Use 100,000 uS/cm calibration standard as the high point.
  - b. For creek deployment use 447 uS/cm as the low point and 1413 uS/cm calibration standard for the high point.

### Dissolved Oxygen Calibration

The LDO sensor compensates for the temperature of the water, so it is important that the water used for calibration maintain a constant temperature. Use the squirt bottles of DI water that have been stored in the cupboard at room temperature.

Calibrating the Dissolved Oxygen percent saturation requires an up-to-date, localized measurement of barometric pressure. Look up barometric pressure on one of two websites: the DCPD Forecast from Diablo Canyon, or the National Weather Service forecast for San Luis Obispo or Morro Bay. Both websites are bookmarked on the Sed Lab computer.

Determine the current local barometric pressure in either millibars or in/Hg. Convert the value to millimeters Hg via the Online Conversion website.

(Both weather websites, and Online Conversion are bookmarked in the Favorites Bar on the Sed Lab computer.) Record the converted barometric pressure measurement for use in calibration. (Range is generally 740-780 mm/Hg)

1. Remove a bottle of DI water from the cupboard above the counter.
2. Pour 500ml of DI water into a clean 1liter nalgene bottle.
3. Cap the Nalgene bottle and vigorously shake the bottle for at least 60 seconds to aerate the water.
4. Stand the MS5 so that the sensors are pointed upwards with storage cup attached.
5. Fill the storage cup to the bottom of the cap threads.
6. Place the storage cap on upside-down. Do not fully screw the cap on.
7. To calibrate Dissolved Oxygen using the arrow keys:
  - a. Arrow to select '**Calibrate**' and press <Enter>.
  - b. Arrow to select '**LDO**' and press <Enter>.
  - c. Arrow to select '**LDO % SAT**' and press <Enter>.
  - d. Once the readings have stabilized, enter the current barometric pressure (as mm/Hg) and press <Enter>

Verify the accuracy of calibration by checking the Scale Factor.

1. Using the arrow keys, highlight '**Login**' and press <Enter>.
2. Highlight '**Level 3**', and press <Enter>.
3. Type in the password: **Hydrolab** and press <Enter>. The password is case sensitive.
4. Select '**Setup**' and press <Enter>.
5. Select '**Sensors**' and press <Enter>.
6. Select '**LDO**' and press <Enter>.
7. Select '**LDO % SAT**' and press <Enter>.
8. Read the scale factor, record in the calibration database. A valid calibration will produce a scale factor between 0.5 and 1.5. Values outside of this range may indicate a problem with the sensor or electronics.
- 9.
10. DO NOT type in a new value for the scale factor!
11. Press <Esc> to exit once you have verified the scale factor.
12. Record the barometric pressure used for calibration in the calibration database.

## **Turbidity Calibration**

The turbidity sensor uses scattered light to report the concentration of suspended particles in water, so it is important to clean the instrument thoroughly and carefully before calibration and deployment. Use a soft brush and mild soap to remove dirt and debris from all of the sensors and inside the calibration cup. Rinse the storage cup and sensors with DI water and dry with lint free towels.

The turbidity probe can be calibrated using several standards. Ideally, the standards used for calibration should bracket the conditions expected during deployment. If environmental conditions are generally very clear, use DI water (0 NTU) and a calibration standard of either 20NTU or 40 NTU. If you are expecting higher turbidity during deployment, calibrate using 0 NTU, 100 NTU and 200 NTU. The high end calibration point should be a value higher than the highest value anticipated at the deployment site.

StablCal turbidity solutions are very expensive, so it is preferable to use only the smallest volume needed to conduct the calibration.

### ***Low Point Calibration for Turbidity using DI water***

1. Rinse the probes with DI water to remove any residual calibration standards.
2. Slowly fill the calibration cup with DI water.
  - a. Avoid creating bubbles when filling the cup. Bubbles can affect turbidity readings/
3. Arrow to select '**Calibrate**' and press <Enter>.
4. Arrow to select '**Turbidity**' and press <Enter>.
5. Arrow to select '**CleanRev**' and press <Enter>.
6. The next screen will ask for test rotations, type in '**2**' and press <Enter>. This activates the automatic wiper that will clean off the turbidity probe.
7. The display screen will show **3000#** for the turbidity reading until the probe has completed wiping the sensor. Proceed with step 8 when the turbidity probe begins generating numeric measurements.
8. Record the pre-calibration reading for turbidity in the calibration log.
9. Arrow to select '**Calibrate**' and press <Enter>.
10. Arrow to select '**Turbidity**' and press <Enter>.
11. Arrow to select "**TurbSC: NTU**" and press <Enter>.
12. The next screen will ask for a calibration point. Type in '**1.0**' and press <Enter>.
13. Enter the calibration standard value at the next screen. Type in '**0.0**' and press <Enter>.
14. Record the post-calibration reading for turbidity in the calibration log.

### ***Turbidity calibration using StablCal standards***

1. Gently swirl or invert the bottle of 100 NTU or 400 NTU StablCal standard for two to three minutes to mix the suspension.
  - a. Do not shake the bottle, which can suspend air bubbles in the solution and changes the turbidity.
2. Make sure that the probes are clean and dry, so that they will not drip contaminants into the StablCal standards.

3. Use a small syringe to draw 20 mL of calibration standard.
4. Use the syringe to rinse ONLY the turbidity probe with the calibration standard.
5. Slowly fill the calibration cup with a small amount of turbidity standard. The sensors should be pointing downwards for this calibration, with only the turbidity probe immersed in the solution.
6. Arrow to select '**Calibrate**' and press <Enter>.
7. Arrow to select '**Turbidity**' and press <Enter>.
8. Arrow to select '**CleanRev**' and press <Enter>.
9. The next screen will ask for test rotations, type in '**2**' and press <Enter>. This activates the automatic wiper that will clean off the turbidity probe.
10. The display screen will show **3000#** for the turbidity reading until the probe has completed wiping the sensor. Proceed with step 12 when the turbidity probe begins generating numeric measurements.
11. Record the pre-calibration reading for turbidity in the calibration log.
12. Arrow to select '**Calibrate**' and press <Enter>.
13. Arrow to select '**Turbidity**' and press <Enter>.
14. Arrow to select '**TurbSC: NTU**' and press <Enter>.
15. The next screen will ask for a calibration point. Type in '**2.0**' and press <Enter>.
16. Enter the calibration standard value at the next screen and press <Enter>.
17. Record the post-calibration reading for turbidity in the calibration log.

If all plastic calibration cups are in use during calibration, trimmed plastic bottles can be used to calibrate the turbidity probe. Secure the probe (oriented downward) using the three pronged stand. The sensor requires an unobstructed view of the water to the depth of one inch. Pour one inch of calibration standard into the trimmed plastic cup, and carefully position the sensor using the three pronged stand.

Calibration standards that have been dispensed from the purchased solution bottle can be re-used for up to 2 weeks if stored correctly. Once calibration is completed, pour remaining calibration solution into a new, clean storage bottle. Cap the bottle, and label with the date and time it was dispensed, and with information identifying the StablCal standard. Used and expired solutions should be collected in the Turbidity Waste storage container for disposal at the Landfill.

### **New Logging File Set up**

Before creating a new file for the monitoring period, it is likely that an old file will need to be deleted to create memory space. Using the black Hyperterminal interface, use the arrow keys to select the following options:

1. Arrow to select '**Files**' and press <Enter>.
2. Arrow to select '**Delete**' and press <Enter>.
3. Type in number (1 through 4) corresponding to the file you want to delete and press <Enter>.
4. At the prompt, type '**y**' for yes and press <Enter> to delete the file.
5. Hyperterminal will tell you file was successfully deleted and direct back to the mainframe menu.

To create a new file for your monitoring period:



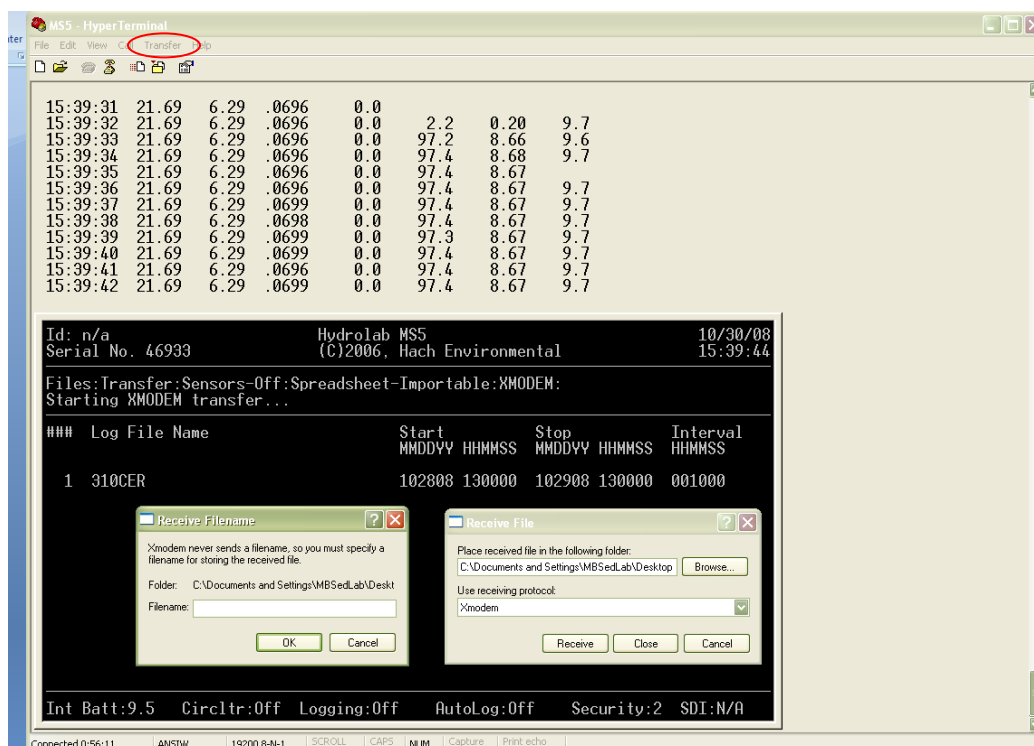
1. Arrow to select '**Files**' and press <Enter>.
2. Arrow to select '**Create**' and press <Enter>.
3. Name your file with three letter site name and 6-digit start date (the date that logging will begin).
4. Enter the following fields as they appear using the appropriate formats:
  - Start date- January 6, 2013 would appear: 010613
  - Start time- 6:30PM would appear: 183000
  - End date- January 15, 2013 would appear: 011513
  - End time- 3:45 PM would appear as: 154500
  - Logging Interval (how often you want the meter to record readings)- 30 minutes would appear as: 003000, one hour as: 010000
  - Sensor warm up time should be set to two minutes: 000200
  - The MS5 sensors are NOT configured with circulators, this prompt is a remnant from prior equipment configurations. Enter 30 seconds at this prompt: 000030
  - Enable Audio: 'n'

For example, if you want to start on August 20, 2013 at 12:15PM and log every 15 minutes with a 2 minute sensor warm up and a 30 second minute circulator warm up until 5:45 PM on August 23, 2013, the series of numbers would be as follows:

Start Date: 082013  
 Start Time: 121500  
 End Date: 082313  
 End Time: 174500  
 Logging Interval: 150000  
 Sensor Warmup: 000200  
 Circulator Warmup: 000030  
 Enable Audio: n

To download a file that has finished logging: Select '**Files**' and press <Enter>.

1. Arrow to select '**Transfer**' and press <Enter>.
2. Arrow to select '**Sensors Off**' and press <Enter>.
3. Arrow to select '**Spread Sheet Importable**' and press <Enter>.
4. Arrow to select '**XModem**' and press <Enter>.
5. Type in the number corresponding to the file (1 through 4) you want to download and press enter.
6. Go to '**Transfer**' on the Hyperterminal menu bar (outside the black mainframe- within Hyperterminal) in the drop down menu select '**Receive**'.

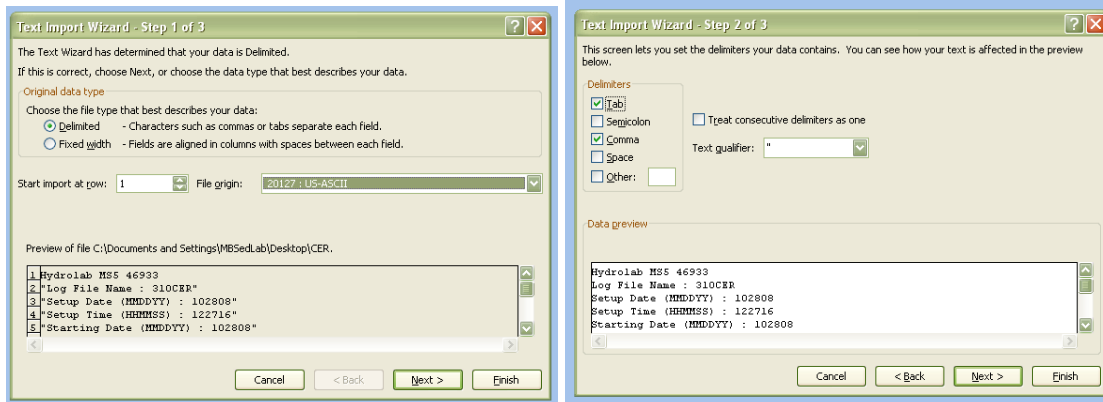


7. In the “Receive File” pop up box browse to the location for the file you are going to download.
8. Double check that the receiving protocol is “**XModem**”.
9. In the “**Receive Filename**” pop up box enter a name for the file. The downloaded csv file being created should be given the same name as the logfile that was created for the MS5. (As shown above, it would be 310CER)
10. Click “**Receive**” and “**OK**” where prompted, and the file will begin to download as packets.

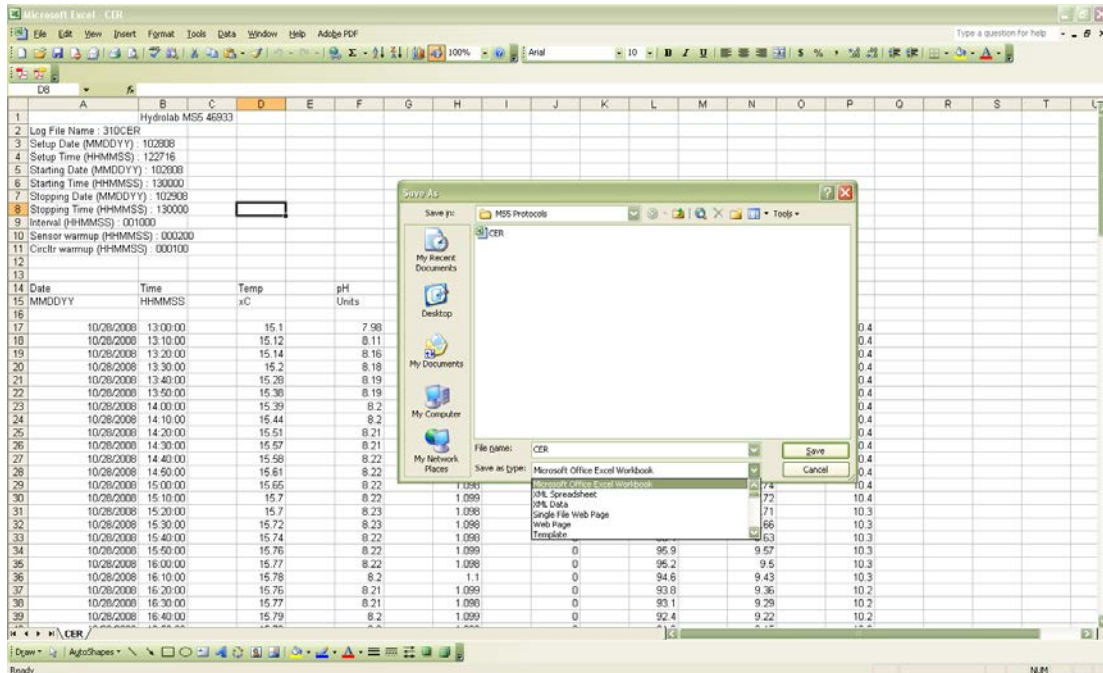
**Importing Data to Excel** The data file from the download needs to be imported into Excel for analysis. It is important to follow these steps in order to create an Excel workbook file.

1. Open Microsoft Excel.
2. Select “**File**”.
3. Select “**Open**”.
4. In the pop up box change the file type to include **All Files** since the imported file is not an excel workbook format file.
5. Select the file that you downloaded.
6. Select “**OK**”.
7. A window will appear with importing options.
  - Select the language option **US-ASCII**.
  - Check that the file is “**delimited**”.
  - Press “**Next**”.
8. In the next Text Import window:
  - Check the box for “**Tab Delimiters**”.
  - Check the box for “**Comma Delimiters**”.

- Press “Next”.



9. In the third window press “Finish”.
10. Data should appear in a columnar arrangement in a new Excel workbook.
11. To save the data file in an Excel workbook format:
  - Select “Save As”.
  - Enter a file name.
  - Open the drop down menu for “Save As Type”.
  - Select “Microsoft Office Excel Workbook”.



Appendix D. Morro Bay Volunteer Monitoring Program Dissolved Oxygen in the Bay  
("Dawn Patrol") Protocol

## **Morro Bay Volunteer Monitoring Program Dissolved Oxygen in the Bay ("Dawn Patrol") Protocol**

### NEP Provided Equipment

- DO meter with safety leash
- Temp/Salinity meter with safety leash
- Clipboard
- Laminated data sheet and grease pencil
- DI water to rinse probes
- Headlamp
- Kayak
- Paddles
- Lifejacket
- Anchor

### Recommended Personal Equipment

Heavy nylon or water repellant jacket and pants (rubberized clothing or wetsuits can get hot) under layers of fleece. Use neoprene or rubber gloves and booties and wool cap or bandana to cover head.

**Preferred optimal tides for monitoring lowest level of oxygen in the bay would be at minimum tides. The tricky part is to account for sufficient tides to avoid getting stuck! General amount of time necessary for collection is 30 minutes.**

### **MINIMUM TIDES NECESSARY TO GET IN AND OUT:**

**At least 3ft+ for an incoming tide**

**At least 4ft + for an outgoing tide**

### PROCEDURE

1. Always go out with a partner. Choose a day that has an early morning high tide. You'll need three+ feet or more of water when you're taking your measurements. Field work should be conducted within two hours after sunrise. Choose a tide that allows enough water to get back safely without getting stuck in the mud (see above).
2. The most efficient route for upper bay sites (ATP, STP, LO2 and PSP), is to check ATP (Tidelands Park boat launch) from dock then drive to STP (State Marina) and launch there to get other three sites. The three backbay sites (CSI, SHI, and CHI) can be accessed by launching from Cuesta Inlet.
3. Before setting out, turn on the DO meter to give it time to warm up. It's a good idea to turn on the meter as you start out so it has adequate time to stabilize before you start taking measurements.

4. Use the safety leashes to clip the meters to either yourself or your kayak. We've lost many meters at the bottom of the bay!
5. For safety, and to help fill out the data sheets, use the headlamps. Don't forget to wear a lifejacket.
6. On the data sheet record the date, time, dawn time, sunrise time, height of tide, whether it is in or out going, and the current weather (especially wind, clear, foggy or rain).
7. Paddle to the site. Approximate your location based on landmarks.
8. Measure the DO at the site.
  - a. Remove the probe from the chamber.
  - b. Hit the Mode button so that the units shown for the reading is '%'.
  - c. Place probe in the water just below the surface and move the probe slowly. You want to move the probe at an even pace, about 2 feet per second, either back and forth or in a circle. Alternatively, you could use faster and shorter strokes in an up and down motion. You'll know when you're moving the probe correctly because the meter reading will stabilize.
  - d. Wait until the meter reading stabilizes.
  - e. Record DO value at the surface (or a depth value of '0') in %.
  - f. Hit the Mode button to switch the units to mg/L. Wait for the reading to stabilize and record the value.
  - g. Record the temperature.
9. Measure salinity at the site.
  - a. Insert the probe just below the surface of the water and bob it up and down so that all air bubbles are forced out of the holes in the probe. The probe must be submerged in the water beneath the vent holes on the top of the probe. If not adequately submerged, the water won't come in contact with the probe and the reading will be inaccurate.
  - b. Hit the Mode button until the units for the reading are 'ppt.'
  - c. Wait for the reading to stabilize. (The range message must complete.)
  - d. Record the salinity value on the datasheet.
  - e. Rinse the probe with DI water and return to the storage chamber on the side of the meter.
10. Paddle to the next site and continue monitoring.
11. Upon completion of data collection, return equipment and datasheet to the NEP office. Let NEP staff know if there are any problems with the equipment.

<b>Dawn Patrol</b>	Date:	Time:	Sunrise:
Samplers:		Weather:	
Tide (height & time):		Incoming / Outgoing (circle)	Equipment ID:

Readings at the Surface						
Site	Time	Salinity (ppt)	Temp (C)	DO (mg/L)	DO, %	Description
CSI						1/2 way between sign board on shore at boat launch & the other side of inlet
SHI						mouth of shark's inlet - end of golf course and across from last houses
CHI						next to 'no hunting' sign, water stick marker, south of private pier, north of cuesta inlet mouth
PSP						across from big brown house up on point, water marker to the west
LO2						midway between red tube bouy and black water marker 100 yds apart
SPM						directly out from museum of natural history
ATP						just off boat tie-up at tidelands

Appendix E. Morro Bay Volunteer Monitoring Program  
Stream Profiling Protocol



# **Morro Bay Volunteer Monitoring Program Stream Profiling Protocol**

## **Equipment List**

- |                                 |   |
|---------------------------------|---|
| 1. Tripod                       | 7. GPS (if needed)                                    |
| 2. Level                        | 8. Rebar, PVC Pipe (if needed)                        |
| 3. Stadia Rod                   | 9. Hammer (if needed)                                 |
| 4. Survey Tapes (100' and 200') | 10. Gloves, Machete (if needed)                       |
| 5. Clipboard, datasheet, pencil | 11. Tecnu and Alcohol Wipes                           |
| 6. Digital Camera               | 12. Pants, Long Sleeves, Boots, <a href="#">Water</a> |

## **Main Steps**

1. Locate Site
2. Define Cross Section
3. Measure Bankfull Width
4. Measure Bankfull Depth
5. Measure Floodplain Width
6. Set Up the Level
7. Measure Water Surface Slope  
(Option 1)
8. Conduct Cross Section  
Survey
9. Measure Water Surface Slope  
(Option 2)
10. Take Digital Photos
11. Clean-Up

## Procedure

### 1. Locate Site

- GPS points, maps, photos, and descriptions should illustrate site locations. Additionally, sites should be marked with orange flagging and PVC pipes that stick out of the ground about 2 feet on each side of the stream (Figure 1). These pipes sit over rebar stakes that also mark the cross section.
- The cross section number should be written on the pipe, the flagging, and a brass tag that is tied to one of the rebar stakes. If only one pipe/rebar can be found, focus your search for the other stake at an angle that is perpendicular to the channel (Figure 2), and use a plot of the cross section from previous surveys to measure the distance from the known stake to where the unknown stake should be located (Figure 3).



Figure 1 - Stake

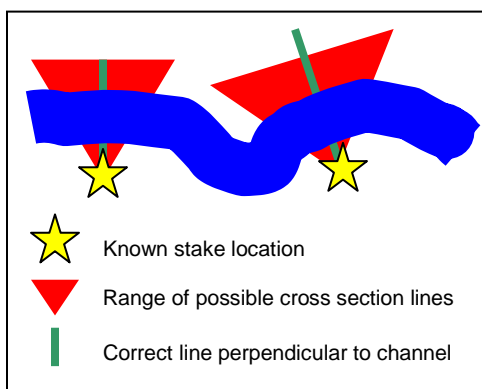


Figure 2 – Cross sections perpendicular to channel

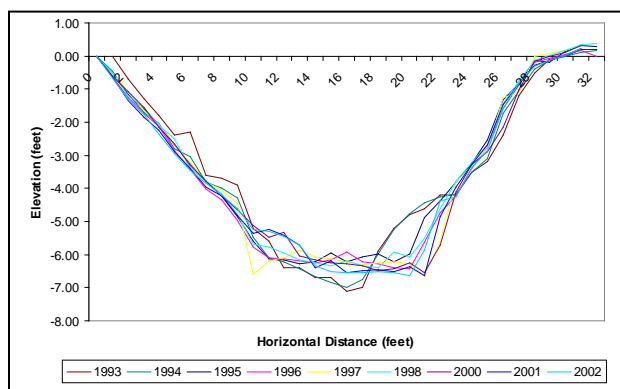


Figure 3 – Cross section plot showing 32 feet between stakes

- On data form, fill out **Creek Name**, **Site ID**, **Date**, and names of **Samplers** (Figure 4).

Creek: Chorro (upper)	Site ID: CU #5	Date: 7/1/03	Samplers: Sandy Smith, Dan Scott
-----------------------	----------------	--------------	----------------------------------

Figure 4 – Example of general survey information

## 2. Define Cross Section

- Remove PVC pipes to reveal rebar benchmarks, then attach the measuring tape's metal hook to the rebar benchmark on the left bank (determine left bank by looking downstream) (Figure 5), stretch the tape tight across to the rebar benchmark on the right bank, and fasten by wrapping the tape around the rebar then knotting.

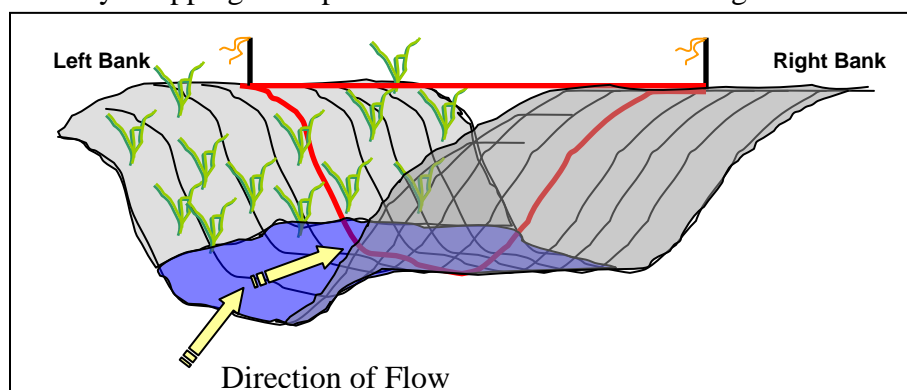


Figure 5 – The left and right banks are determined by facing downstream

## 3. Measure Bankfull Width

- Imagine you were standing in the stream during a large rainstorm and the channel was full of water from bank to bank. How deep would the water be? Looking both upstream and downstream try to identify combinations of clues on both banks that indicate a high water (“bankfull”) line. Note that this is not the flood line, but rather a line of flow that occurs approximately every couple years from extra large storms. Things to look for: a) obvious scour/stain lines, b) breaks in slope, c) changes in vegetation, d) changes in deposits, e) undercut banks, and f) the tops of point bars (Figure 6).

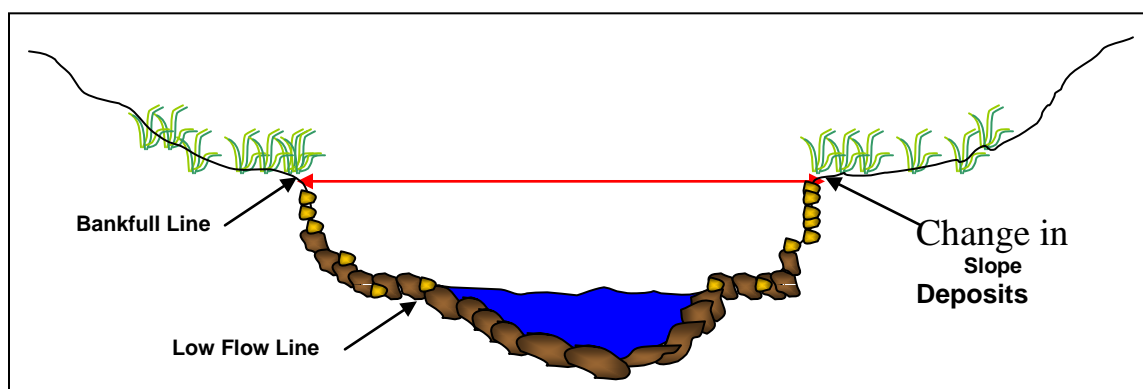


Figure 6 – Cross section depicting bankfull line

- Directly under the first tape you secured, stretch a second tape from the bankfull line on one bank, across the channel to the bankfull line on the other bank (Figure 7). This is your **Bankfull Width** — record it on the data sheet.

#### 4. Measure Bankfull Depth

- While keeping the tape stretched across the bankfull channel, now imagine there was only a thin trickle of water in the stream. It would follow a path that would wound through the deepest part of the channel bottom; this path is called the thalweg.
- To find the thalweg, use the stadia rod to locate the deepest point in the channel. Once this is established, measure the distance from the channel bottom up to the tape that represents a bankfull flow (Figure 7). This is your **Bankfull Depth** — record it on the data sheet.

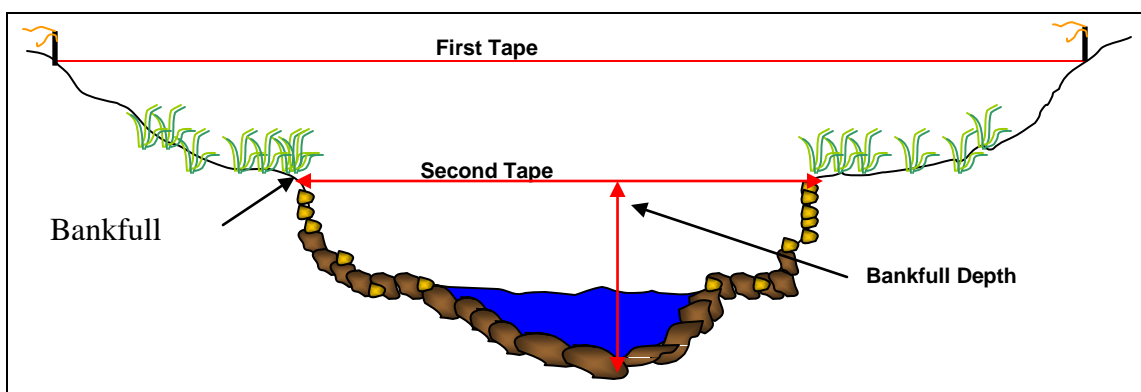


Figure 7 – Locating bankfull width and bankfull depth

#### 5. Measure Floodplain Width

- The width of the floodplain is measured at a height above the thalweg equal to 2 times the bankfull depth (Figure 8).

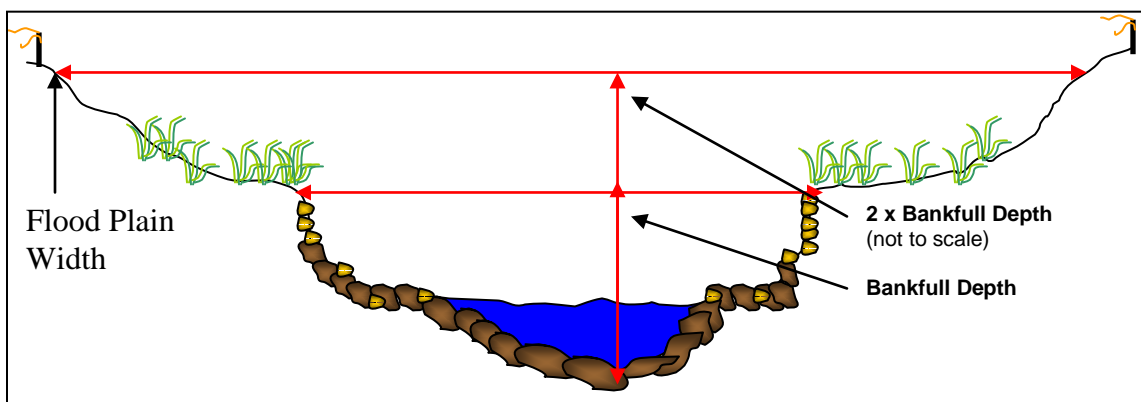


Figure 8 – Locating floodplain width

- While holding the rod in the thalweg, lift the tape to a height above the thalweg equal to 2 times the bankfull depth (e.g. if bankfull depth equals 2 feet, raise the tape to 4 feet) (Figure 9A), then raise both ends of the tape level and extend so the tape reaches both banks (Figure 9B). This is your **Floodplain Width** — record it on the data sheet.

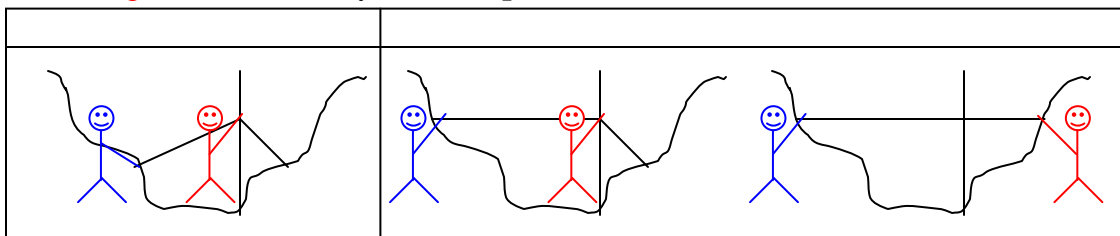


Figure 9 – Measuring floodplain width with two people

## 6. Set Up the Level

- Ideally, you want to be able to survey the cross section without moving the level, so try to locate the level so that it is above the entire line of measuring tape, although not above the extent the rod will extend, and not somewhere blocked by trees or other vegetation.
- When setting up the tripod, set it up in sturdy ground with the legs of the tripod spread sufficiently to keep it steady. Attach the level to the screw in the middle of the base on top of the tripod, tighten, and then adjust level until the bubble is centered in the middle of the circle.

## 7. Measure Water Surface Slope (Option 1)

- **Note:** Ideally the distance between the two readings would include at least two riffle pool sequences (Figure 10). If this cannot be achieved from the location on the bank where the level is set to read the cross section (e.g. brush obscures line of sight, creek bends, etc.), wait until you've completed surveying the cross section then move the level to a location that allows a better view both up and downstream - this may be in the channel itself rather than on the banks (**Option 2**).
- Locate the furthest riffle upstream of the cross section that is within your line of sight. Measure, along the centerline of the bankfull channel\*, the distance from the cross section to the beginning of that riffle (Figure 10). This is your **Upstream Distance** — record it on the data sheet.
- At the beginning of the riffle, have one person hold the stadia rod right on top of the water's surface (use a rock or the toe of your boot to set it at this level), while the other person takes a reading of the stadia rod with the level (Figure 10). This is your **Upstream Reading** — record it on the data sheet.

\* This can be interpreted as the centerline of the creek if water was filled from bank to bank, which may be different than the centerline of the creek during the low flow summer months (Figure 11).

- Similarly, locate the furthest riffle downstream of the cross section that is within your line of sight, and repeat the same steps to measure your **Downstream Distance** and **Downstream Reading (Figure 10)** — record those on the data sheet.

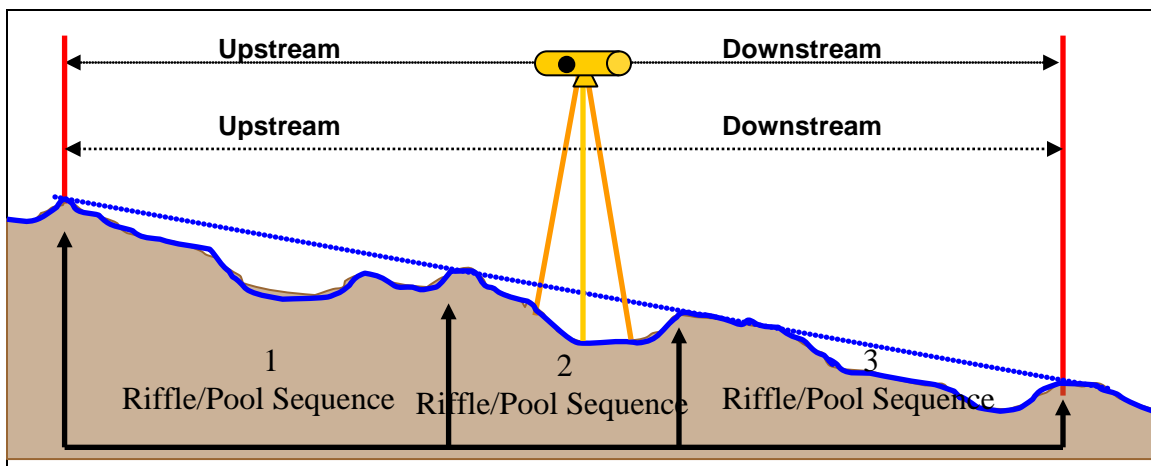


Figure 10 – Measuring slope

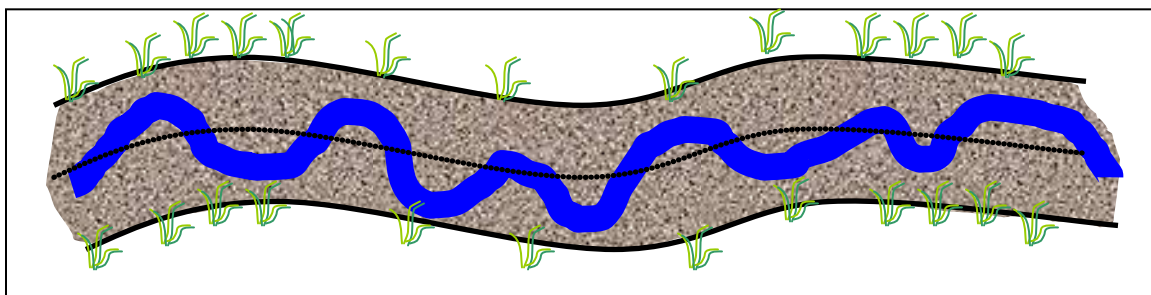


Figure 11 – Dotted line represents centerline of the bankfull channel; blue line represents a summer low flow channel

## 8. Conduct Cross Section Survey

- Place the rod at 0 feet (should be at the left-bank benchmark) then use the level to view where the cross hairs intersect the rod (Figure 12). This is your **Stadia Reading** — record it on the data sheet.

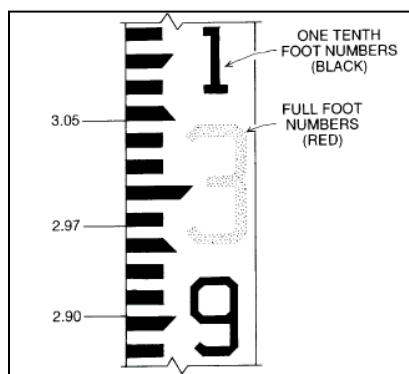


Figure 12 – Reading stadia rod

- Continue, taking a reading every horizontal foot, until you reach the right-bank benchmark (Figure 13).

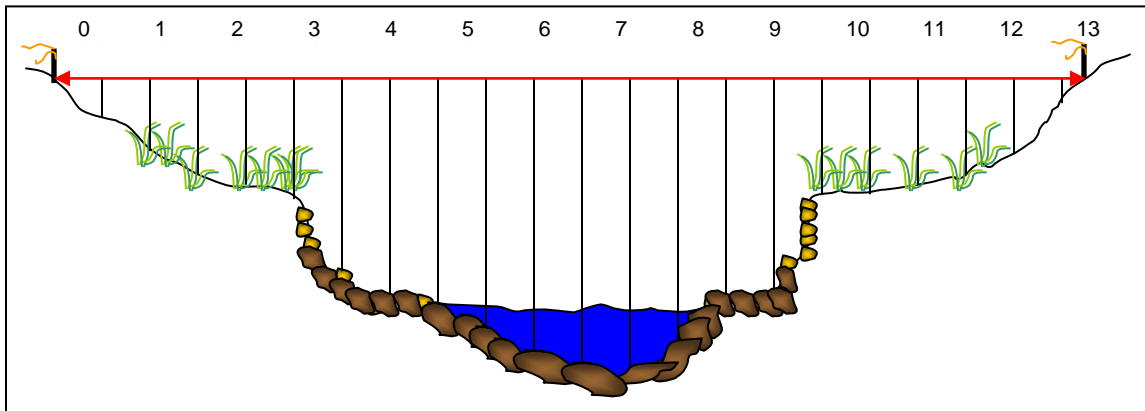


Figure 13 – Survey the cross section by taking a reading at every foot

- **Note:** It is very important that the rod be held vertically (Figure 14).

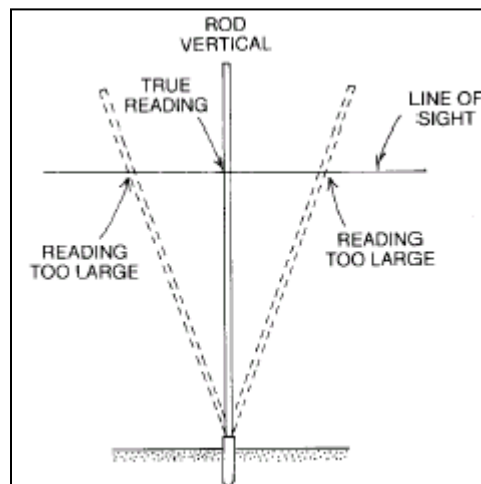


Figure 14 – Leaning the rod results in incorrect readings

## 9. Measure Water Surface Slope (Option 2)

- If your view upstream and downstream of the cross section was impaired from your location on top of the banks, relocate the level at this time, then take the water surface slope measurements.

## 10. Take Digital Photos

- Before removing the tape that stretches between the rebar, replace the PVC markers then take four digital photos to document site: 1) standing in the channel facing upstream 2)



standing in the channel facing downstream 3) standing on the left bank facing the right bank, and 4) standing on the right bank facing the left bank (Figure 15).

- If possible, include the tape and markers in the view to clarify the location of the cross section within the photos. Also, if you feel that any additional photos are needed to clearly portray the cross section, feel free to take more than the primary four.

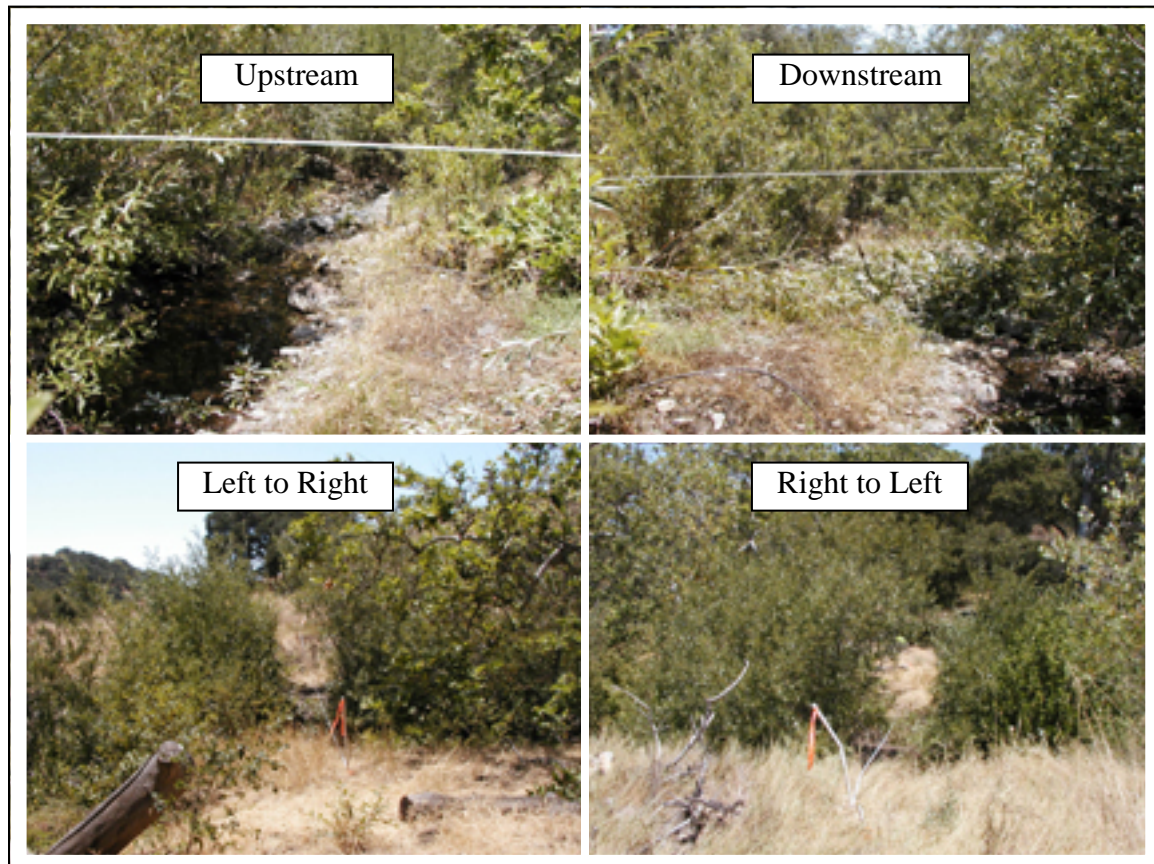


Figure 15 – Example photos

## 11. Clean-Up

- Remove measuring tape from rebar benchmarks, replace PVC pipes over rebar, and apply fresh flagging if needed to assist in relocating site for subsequent surveys.
- Use alcohol wipes to clean off all equipment that might have come into contact with poison oak. Then, clean any poison oak off your own skin with the alcohol wipes in the field, and wash with Tecnu when you return to the office. Also, thoroughly check yourself and your partner(s) for ticks.
- Finally, report your successful completion of the survey or any problems you encountered to the VMP staff.



## Measuring Stream Gradients Using a Hand Level

### Equipment:

- Stadia rod
- Hand level
- Tape measure

1. Person one (P1) stands in the upstream pool with the hand level. Stand so you have an unobstructed view of the downstream pool.
2. Person two (P2) holds the stadia rod at the water surface and takes a stadia reading of the eye level of P1.
3. P2 stands in the downstream pool and holds the stadia rod at the water surface.
4. P1 uses the hand level to take a stadia rod reading of the downstream pool.
5. Calculate the difference between the two elevation readings. This value is the rise.
6. Use the tape measure to measure the distance between P1 and P2. This value is the run.
7. Calculate the % Slope =  $(\text{Rise} / \text{Run}) \times 100$

For example:

Rise: Downstream reading = 6.81; Upstream reading = 5.19 - therefore  $6.81 - 5.19 = 1.62$

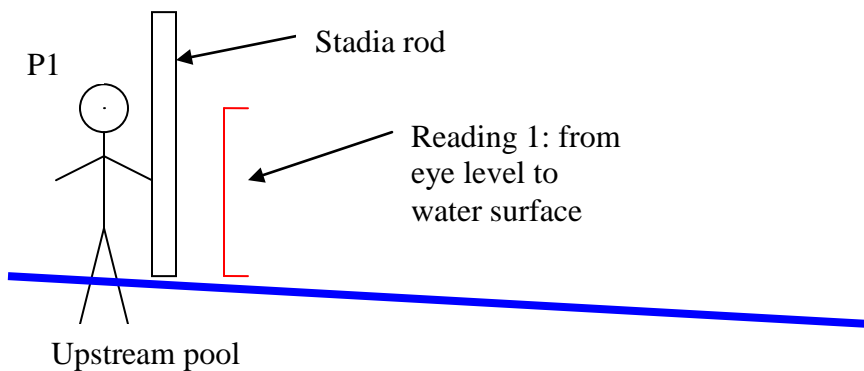
Run: using tape measure = 73

% Slope =  $(\text{Rise} / \text{Run}) \times 100 = (1.62 / 73) \times 100 = 2.2 \%$

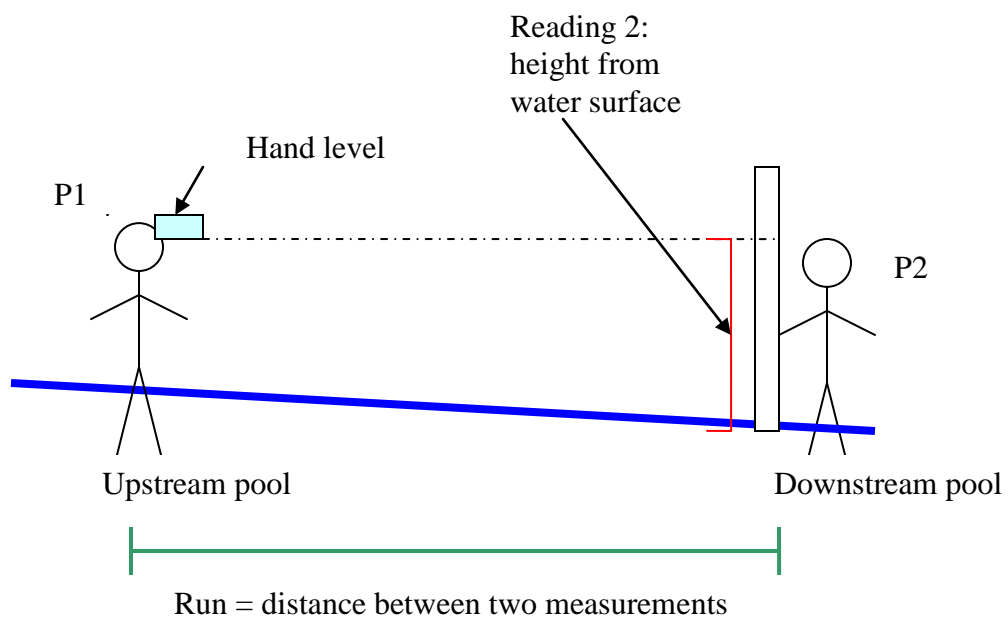
Note:

- The hand level does not magnify as much as the bigger level. To make a more accurate stadia rod reading, it helps to have the person holding the rod place their finger at different points on the rod. The person with the level can call out 'higher' or 'lower' until the rod holder's finger is at the correct reading.

### Step 2.



### Step 3.



## Stream Profiling Datasheet

Creek:		Site ID:		Date:		VMP Staff:
Volunteers:						
Foot #	Stadia Reading	Foot #	Stadia Reading	Foot #	Stadia Reading	Bankfull and Floodplain Dimensions
0		35		70		Bankfull Width:
1		36		71		Bankfull Depth:
2		37		72		Flood-Prone Width:
3		38		73		<b>Slope Measurements</b>
4		39		74		Upstream Distance:
5		40		75		Upstream Reading:
6		41		76		Downstream Distance:
7		42		77		Downstream Reading:
8		43		78		<b>Notes</b>
9		44		79		
10		45		80		
11		46		81		
12		47		82		
13		48		83		
14		49		84		
15		50		85		
16		51		86		
17		52		87		
18		53		88		
19		54		89		
20		55		90		
21		56		91		
22		57		92		
23		58		93		
24		59		94		
25		60		95		
26		61		96		
27		62		97		
28		63		98		
29		64		99		
30		65		100		
31		66		101		
32		67		102		
33		68		103		
34		69		104		

Appendix F. Morro Bay National Estuary Program  
Surface Elevation Table Monitoring

# **Morro Bay National Estuary Program Surface Elevation Table Monitoring for Measuring Sediment Accretion in Morro Bay Estuary**

## **Purpose and Methods**

The surface elevation table (SET) –also referred to as a sedimentation erosion table - is used to measure the sediment accumulation on the surface of a marsh or mudflat over time. In conjunction, a thin layer of feldspar can be placed around the SET as a marker horizon to measure shallow subsidence of the surface caused by compaction, desiccation, or other processes (Figure 1).

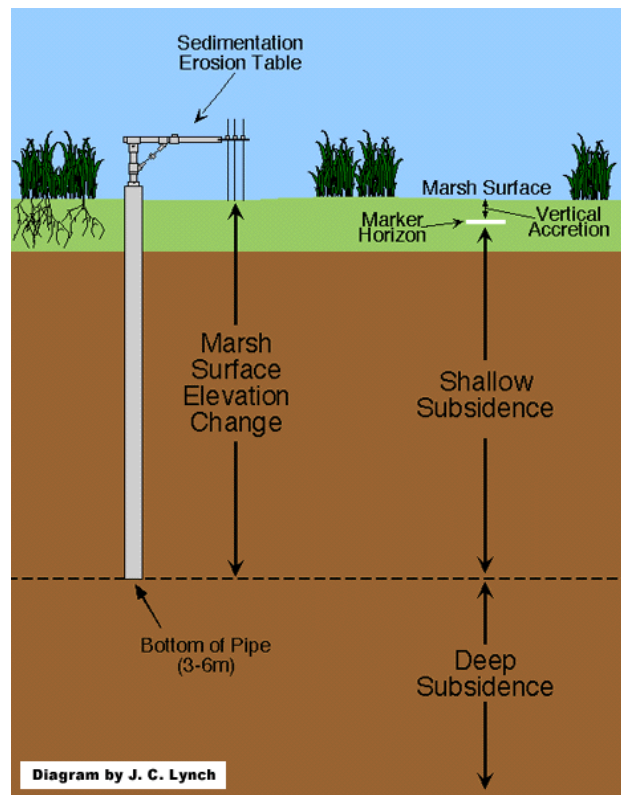
The SET is attached to a stable benchmark on the marsh surface (Figure 1). The benchmark is a 3'' aluminum pipe driven into the sediment as far as possible (until refusal). The benchmarks are driven by hand, and extend 6 to 8 inches above the sediment surface. In order to take measurements, the SET is placed over the benchmark and the surface elevation is measured relative to the benchmark at radial points around the station. Since a footprint in the measurement area can contaminate the readings for years, a platform or walkway, which serves as a working surface can also be constructed (Figure 2). We anticipate using these platforms in the salt marsh as needed, but not in the mud flats.

The plan for Morro Bay is to use the SET devices mainly in and adjacent to the salt marsh, and to use marker horizons and some PVC benchmarks elsewhere in the estuary. The final site locations, will be determined based on field conditions, site access, and the expertise of the Battelle consultants. A final map showing exact locations will be made available to you upon installation. Both salt marsh and intertidal mudflats will be represented.

Recording measurements after the initial installation consists of walking to the benchmark, attaching the SET device, and measuring the elevation. The precision of measurements at the 95% confidence interval for the SET technique ranges from  $\pm 0.4$  mm to  $\pm 1.5$  mm, depending on substrate characteristics. For the horizon markers, a small core is taken and the amount of sediment that has accumulated above the horizon marker is measured from the core. The direct measurements of elevation change can be used to measure overall sediment deposition or erosion, to compare rates of sediment deposition in different regions of the estuary, and to provide data to 'ground-truth' the numerous sediment models of the estuary. Elevation change can be compared to the local rate of sea-level rise to determine the potential for submergence or elevation of the wetland.

We plan to take measurements pre and post wet season in the first year, and annually thereafter. We will adjust the sampling frequency depending on results, and in response to extreme events such as major storms. The time required to collect data, once on site, is relatively short (less than an hour for an experienced operator) and so man-hours depend on ease of access to the site. Our data collection program should extend for at least five years; probably longer assuming the method proves effective. Additional information on the SET methodology can be found at: <http://www.pwrc.usgs.gov/resshow/cahoon/>

## Layout of Surface Elevation Tables



# Surface Elevation Tables Data Collection Form

## SET DATASHEET

Date \_\_\_\_\_  
 Location Morro Bay  
 Transect A B C  
 Station low high

direction	pin	reading (mm)	notes
_____	1	_____	_____
	2	_____	_____
	3	_____	_____
	4	_____	_____
	5	_____	_____
	6	_____	_____
	7	_____	_____
	8	_____	_____
	9	_____	_____
_____	1	_____	_____
	2	_____	_____
	3	_____	_____
	4	_____	_____
	5	_____	_____
	6	_____	_____
	7	_____	_____
	8	_____	_____
	9	_____	_____
_____	1	_____	_____
	2	_____	_____
	3	_____	_____
	4	_____	_____
	5	_____	_____
	6	_____	_____
	7	_____	_____
	8	_____	_____
	9	_____	_____
_____	1	_____	_____
	2	_____	_____
	3	_____	_____
	4	_____	_____
	5	_____	_____
	6	_____	_____
	7	_____	_____
	8	_____	_____
	9	_____	_____

Surface Elevation Table Data Collection Form

**MARKER HORIZON DATASHEET: SALT MARSH SAMPLING LOCATIONS**

Date: \_\_\_\_\_  
 Observers: \_\_\_\_\_  
 Location: Morro Bay  
 Transect: A      B      C  
 Station: low      high

<u>plot location</u>	<u>repl.</u>	<u>random</u> <u>x</u>	<u>random</u> <u>y</u>	<u>readings</u> 3 per core	<u>notes</u>
_____	1	29	29	_____	_____
	2	16	19	_____	_____
	_____	18	14	_____	_____
	_____	38	18	_____	_____
_____	1	20	12	_____	_____
	2	36	18	_____	_____
	_____	14	38	_____	_____
	_____	8	11	_____	_____
_____	1	44	10	_____	_____
	2	27	11	_____	_____
	_____	18	36	_____	_____
	_____	40	28	_____	_____
_____	1	15	17	_____	_____
	2	45	29	_____	_____
	_____	43	12	_____	_____
	_____	19	14	_____	_____



Appendix G. Morro Bay Volunteer Monitoring Program  
Bioassessment and Algae Monitoring Protocol

## **Morro Bay Volunteer Monitoring Program Bioassessment Monitoring Protocol**

Refer to the ‘*Standard Operating Procedure for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California*,’ February 2007, prepared by the California Department of Fish and Game, Aquatic Bioassessment Laboratory.

For algae monitoring, refer to the "*Standard Operating Procedure for Collecting Stream Algae Samples and Associated Physical Habitat and Chemical Data for Ambient Bioassessments in California*," June 2009, prepared by the California Department of Fish and Game, Aquatic Bioassessment Laboratory. NOTE: Sections 4 and 5 of the protocol, involving collecting and preparing algal samples, are not conducted by our organization due to lack of lab facilities and inadequate budget.

While conducting bioassessment monitoring, staff and volunteers must follow the California Department of Fish and Game Aquatic Invasive Species (AIS) Decontamination Protocols, as follows.



## California Department of Fish and Game Aquatic Invasive Species Decontamination Protocol

The California Department of Fish and Game (DFG) is committed to protecting the state's diverse fish, wildlife, and plant resources, and the habitats upon which they depend. Preventing the spread of aquatic invasive species (AIS) in both DFG's activities, as well as those activities DFG permits others to conduct is important to achieving this goal. The protocols outlined below are a mandatory condition of your DFG authorization to work in aquatic habitats. They are intended to prevent the spread of AIS, including New Zealand mudsnail (*Potamopyrgus antipodarum*), quagga mussel (*Dreissena rostriformis bugensis*) and zebra mussel (*Dreissena polymorpha*). Information about New Zealand mudsnails and quagga and zebra mussels is summarized in Attachments A and B. For complete information on the threats of AIS and aids to their identification, please visit the Department's Invasive Species Program webpage at [www.dfg.ca.gov/invasives](http://www.dfg.ca.gov/invasives) or call (866) 440-9530.

Many AIS are difficult, if not impossible to see in the environment and can be unknowingly transported to new locations on equipment. Therefore, decontamination is necessary to prevent the spread of AIS between collection locations. Equipment shall be decontaminated between each use in different waterbodies. All equipment, including but not limited to, wading equipment, dive equipment, sampling equipment (e.g., water quality probes, nets, substrate samples, etc.), and watercraft, must be decontaminated using one or more of the protocols listed below. As an alternative to decontaminating on-site, you may wish to have separate equipment for each site and to decontaminate it all at the end of the day. Listed below are three options for equipment decontamination. Use your judgment and field sampling needs to select the method(s) that are appropriate for your equipment and schedule. **Because there are currently no molluscicides registered with the California Department of Pesticide Regulation that have been demonstrated to be effective for these three species, DFG cannot recommend chemical decontamination.** If you would like training on implementing these protocols please contact the Invasive Species Hotline at (866) 440-9530 or e-mail [invasives@dfg.ca.gov](mailto:invasives@dfg.ca.gov)

General field procedures to prevent the spread of AIS:

- If decontamination is not done on site, transport contaminated equipment in sealed plastic bags and keep separate from clean gear.
- When practical, in flowing water begin work upstream and work downstream. This avoids transporting AIS to non-infested upstream areas.
- For locations known to be infested with AIS, use dedicated equipment that is only used in infested waters. Store this equipment separately.

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January 24, 2012

## **Equipment Decontamination Methods**

### **Option 1: Dry**

- Scrub gear with a stiff-bristled brush to remove all organisms. Thoroughly brush small crevices such as boot laces, seams, net corners, etc.
- Allow equipment to thoroughly dry (i.e., until there is complete absence of moisture), preferably in the sun. Keep dry for a minimum of 48 hours to ensure any organisms are desiccated.

### **Option 2: Hot water soak**

- Scrub gear with a stiff-bristled brush to remove all organisms. Thoroughly brush small crevices such as boot laces, seams, net corners, etc.
- Immerse equipment in 140° F or hotter water. If necessary, weigh it down to ensure it remains immersed.
- Soak in 140° F or hotter water for a minimum of five minutes.

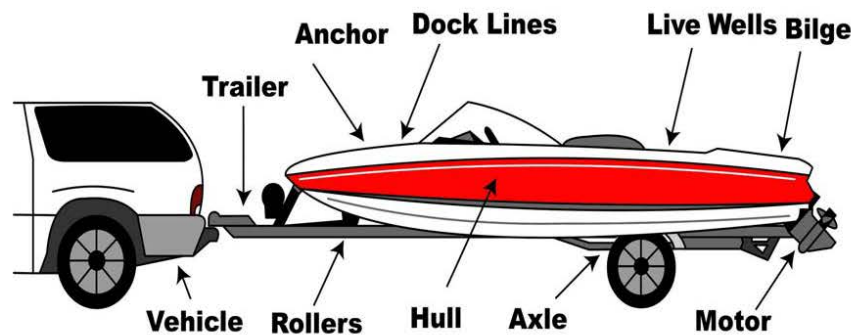
### **Option 3: Freeze**

- Scrub gear with a stiff-bristled brush to remove all organisms. Thoroughly brush small crevices such as boot laces, seams, net corners, etc.
- Place in a freezer 32°F or colder for a minimum of eight hours.

## **Watercraft Decontamination**

- Prior to leaving the launch area, remove all plants and mud from your watercraft, trailer, and equipment. Dispose of all material in the trash.
- Prior to leaving the launch area drain all water from your watercraft and dry all areas, including motor, motor cooling system, live wells, bilges, and lower end unit.
- Upon return to base facilities, pressure wash the watercraft and trailer with 140° F water\*, including all of the boat equipment (i.e. ropes, anchors, etc.) that came into contact with the water.
- Flush the engine with 140° F water for at least 10 minutes and run 140° F water through the live wells, bilges, and all other areas that could contain water.

\*To ensure 100% mortality the water needs to be 140° F at the point of contact or 155° F at the nozzle.



### Reporting Aquatic Invasive Species

If you suspect you have found New Zealand mudsnail, quagga and zebra mussels, or other AIS, please immediately notify the DFG Invasive Species Program at (866) 440-9530 or e-mail [invasives@dfg.ca.gov](mailto:invasives@dfg.ca.gov). Please provide your contact information, specific location of discovery, and digital photographs of the organisms (if possible).

## Attachment A

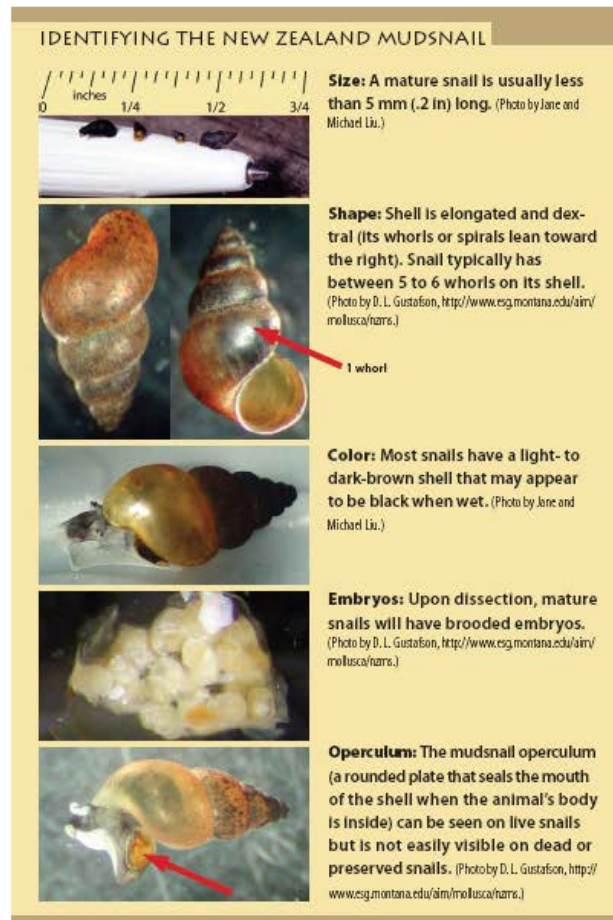
### New Zealand Mudsnaill

The threat posed by New Zealand mudsnails (NZMS):

- NZMS reproduce asexually therefore it only takes a single NZMS to colonize a new location.
- NZMS are prolific, and a single NZMS can give rise to 40 million snails in one year.
- Densities of over 750,000 NZMS per square meter have been documented.
- NZMS out-compete and replace native invertebrates that are the preferred foods of many fish species and alter the food web of streams and lakes.

Identifying NZMS:

- NZMS average 1/8 inch in length, but young snails may be as small as a grain of sand. Adults bear live young.
- See the photos, below, for assistance identifying NZMS. Expert identification will be necessary to confirm identification.



**NZMS Habitat:**

- NZMS can live in most aquatic habitats, including silted river bottoms, clear mountain streams, reservoirs, lakes and estuaries.
- NZMS have a temperature tolerance of 32-77° F.
- NZMS can survive out of water for more than 25 days in cool, moist environments, and have been found over 40 feet from water.

Current known locations of NZMS in California can be found at <http://nas.er.usgs.gov/taxgroup/mollusks/newzealandmudsnaildistribution.aspx>



## Attachment B

### Quagga and Zebra Mussels

The threat posed by quagga and zebra mussels (Dreissenid mussels):

- Dreissenid mussels multiply quickly and out-compete other species for food and space.
- Their presence can alter food webs and alter environments, negatively affecting native and game fish species.
- Dreissenid mussels attach to hard and soft surfaces, and negatively impact water delivery systems, hydroelectric facilities, agriculture, recreational boating and fishing.
- Adults can survive up to 30 days out of water in cool, humid conditions.
- Produce microscopic larvae that can be unknowingly transported in water, including live-wells, bilges, and motors.

Identifying Dreissenid mussels:

- Typically the same size as a fingernail but can grow up to about 2 inches long.
- Variable, usually dark and light alternating stripes. May also be solid cream, brown, or black.

Dreissenid mussel habitat:

- Variable, including both hard and soft surfaces in freshwater.
- From surface depth to more than 400 feet in depth.



Current known locations of Dreissenid mussels in California can be found <http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/maps/CaliforniaDreissenaMap.jpg>



## DECONTAMINATION Protocols for Field Activities

### REMEMBER:

To reduce the potential of spreading aquatic invasives by our activities, it is important to decontaminate *between* watersheds. Thus, if moving to more than one watershed in a day, you must decontaminate *before* moving to the next site. At the end of the field day, also, decontaminate before leaving the last water feature visited or properly seal equipment in a bag or container for later decontamination at a facility.

*2 sets of field gear may be rotated in and out of the field per cleaning cycle.*

The following procedures should be used to decontaminate field gear (e.g. waders, wading boots, boot soles, nets or any gear that comes into contact with the water):

### Freezing plus Drying Procedure \*Use this procedure in combination.

Brush off any debris and then place gear into a new large plastic trash bag/s. Seal for containment before leaving the field location and prior to placement into a vehicle.

- Upon return to facility, place the plastic bag with the gear into a suitable freezer (<32deg F) for a minimum of 8 hours. Follow by drying completely ( $\geq 90$ degF).

### Chemical Procedure

- If field gear is to be transported prior to decontamination, first brush off any debris, place in a suitable large trash bag and seal for containment.
- Prepare decontamination solution by diluting concentrate containing quat (quaternary ammonium)\* in a well-ventilated space using gloves and eye protection. Exposure to concentrated solution may be toxic and corrosive (see MSDS of specific quat source).
- Pour decontamination solution into a suitable holding container and submerge gear for at least 10 minutes. Gear may need to be weighed-down and/or rotated for complete and sustained immersion.

Note: *We will be using higher concentrations of quat solutions than recommended by the manufacturer.*

#### *Dilution example for quat sources:*

Quat 128 or HDQ concentrate (oz)	Green Solutions (GS) HD 256 concentrate (oz)	Super HDQ	Water (gal)
6.5	2.5	3.5	1
34	13	17	5

- Remove field gear from decontamination solution and inspect it to make sure all surfaces have been wetted. (*continued on next page*)

- Rinse treated field gear with *fresh* water (**not water from previous waterbody to avoid further contamination**). Dispose of *rinse water* at least 100 ft. from any surface water.
- Do not re-use decontamination solution after one week or after it looks dirty and is contaminated with organic matter. Test with strips. Readings should be at least 600ppm.
- **Decontamination solution** should be collected to be disposed of in a **wastewater sewer facility only** (not in a septic system). If this is not possible, dispose of it in the least biologically sensitive place.

#### Alternative Spray Bottle Procedure

- Increase concentration of working solution by 1oz. So to make up 1 quart, divide the amount of concentrate for 1gal by 4 then add 1 oz. concentrate and dilute to a total of 1 quart.
- Make up diluted decontamination concentrate solution in a well-ventilated space using gloves and eye protection. *Exposure to concentrated solution may be hazardous (see MSDS).*
- Saturate field gear making sure all areas are wetted thoroughly.
- Let treated gear stand for at least 15 minutes.
- Rinse treated gear with *fresh* water. Do not use water from previous waterbody to avoid contamination.
- Dispose of *rinse water* at least 100 ft. from any surface water.
- Dispose of decontamination solution to a **wastewater sewer facility only** (not in a septic system).
- Do not re-use decontamination solution after one week or if contaminated with organic debris.

The spray bottle technique is not as reliable as freezing (followed by drying) or immersion methods, as complete wetting and adequate exposure times are difficult to control, and should be used only in cases where the other methods are impractical.

#### **Watercraft Decontamination Procedure**

- Prior to leaving a waterbody locale, 1) clean all mud and other debris from the watercraft, trailer and equipment 2) drain all water from the watercraft (i.e. motor, cooling system, live-wells, bilge and lower end unit) and allow to dry thoroughly.
- Dry in storage for a week to thirty days (depending on ambient conditions) before using the watercraft again (unless dedicated to a specific water body, only).
- **Or--**Pressure wash all wetted surfaces with hot ( $\geq 140$  deg F) water after each use at a different water body.

\*Sources of quat (ADBAC or DDAC) include: Green Solutions (GS) HD 256, Quat 128, HDQ, Super HDQ. These are janitorial disinfectants and can be found at appropriate supply stores.

**For questions or sources contact :**

L. Breck McAlexander, Region 1 Aquatic Invasive Species Coordinator [LMCALEXANDER@dfg.ca.gov](mailto:LMCALEXANDER@dfg.ca.gov) ;  
off.: (530) 225-2317; mobile: (530) 510-2014.

Appendix H. Morro Bay National Estuary Program  
Eelgrass Monitoring Standard Operating Protocol

# Morro Bay National Estuary Program

## Eelgrass & Algae Field Transect Protocol

Monitoring takes place at five permanent stations located throughout Morro Bay. Each station has one to three permanent transect locations for monitoring. All transects are 50 meters long. At each site there is one 'Long' transect and two 'Depth' transects.

**Long** transects are 50 meter transects that are monitored at 20 distinct quadrat locations.

**Depth** transects are 50 meter transects that are parallel to the Long transect and are monitored at only 12 distinct quadrat locations.

### Monitoring Locations

Site	Type of Transect	Latitude	Longitude
Coleman	Long	35.37208	-120.86
Tidelands	Long	35.35753	-120.853
Tidelands	Depth	35.35742	-120.853
Marina	Long	35.34579	-120.846
Marina	Depth	35.34587	-120.846
Chorro	Long	35.33774	-120.847
Pasadena	Long	35.33323	-120.849

**Coleman** and **Marina** stations are located on the East side of the navigation channel.

**Tidelands**, **Pasadena** and **Chorro** stations are located on the West side of the navigation channel.

The procedure differs depending on the density of eelgrass present at the transect. In areas with dense eelgrass coverage, 30 shoots can be collected from each site for biomass analysis. For areas with sparse eelgrass coverage, adequate shoots may not be present. In this case, five shoots are collected from the monitoring site. The protocol is divided into steps for Dense Sites and Sparse Sites.



### Legend

#### 50 Meter Transect Type

- Depth
- Long



Morro Bay  
QAPP Update 2013  
Eelgrass Transect Sites 2013

## Supplies Checklist

- waterproof datasheets (up to 3 per site)
- (2) 300ft standard and metric Keson Transect Tapes
- (1) 15 meter metric Keson Transect Tape
- (1) photo whiteboard
- Dry erase markers
- (2) Plastic rulers (metric)
- (4) temporary transect end stakes
- GPS unit
- Plastic clipboards & pencils
- Ziploc Bags (1 gallon)
- Waterproof biomass sample labels
- Waterproof camera
- PVC 0.25 m<sup>2</sup> meter quadrat
- PVC 0.0625m<sup>2</sup> quadrat

## Setting up Transects and Quadrats

1. Review site maps for the site and determine which transect is being monitored (A, B or C).
2. Select the appropriate datasheet for which quadrats must be counted.
3. Fasten the Keson tape with the 0 end at the northern stake. (Reference site maps if needed.)
4. Take photos of the transect from each end of the transect looking in towards the area to be assessed.
5. All quadrat measurements are completed on the shallow side of the transect tape.
6. Place a sampling quadrat (using the distances provided on the datasheet) on the shallow side of the transect. Position the quadrat so that the center mark of the quadrat is on the specified Keson tape distance mark.

## Monitoring Protocol for Dense Sites

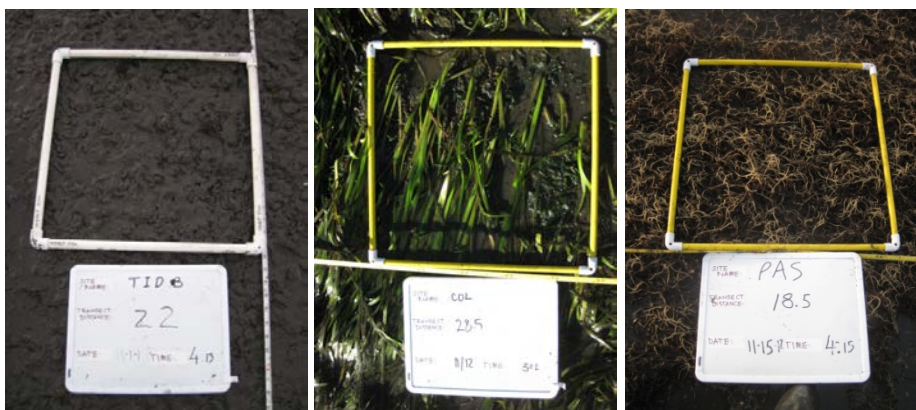
### **Photo Documenting Quadrats**

Take photos before disturbing any of the vegetation in the quadrat.

1. Fill out the whiteboard with the transect and quadrat information for the quadrat picture:
  - a. Site Name
  - b. Transect Name (A,B or C)
  - c. Quadrat Number (location on tape)
  - d. Date
  - e. Time
2. Place the whiteboard outside the quadrat frame, within the area captured in the photo.
3. Take a photograph of the quadrat. Take the photograph as vertical as possible, including the entire quadrat frame, the whiteboard photo label, and the Keson tape measure. Try to avoid shadows and reflections in the photograph.

Example photos:





### **Measuring Quadrat Percent Coverage and Canopy Height**

1. Identify the seagrass and algae species present in the quadrat.
2. Estimate % cover of each species (seagrass and algae) in the quadrat. Minimum % cover increments are 5%. Record the percent coverage for each vegetation type in the ***Coverage %*** columns on the datasheet.
3. Randomly select a clump of eelgrass blades from within the quadrat. Extend the leaves sideways to their maximum length without uprooting.
4. Use the 15-meter Keson tape to measure the length in centimeters from the substrate to the leaf tips. Ignore the longest 25% of the eelgrass leaves in the clump.
5. If grass density is very low and a clump of blades cannot be grouped, make measurements on 5 individual shoots within the quadrat. Record the 5 separate measurements in the ***Canopy Height (cm)*** column.
6. If the quadrat contains algae but no eelgrass, use a ruler to measure the depth of the algae mat (in centimeters) from the surface of the mud.
7. Record the measurements in the ***Canopy Height (cm)*** column on the datasheet.
8. Note whether the canopy height measurements were taken for algae or eelgrass.

### Counting Eelgrass Shoots, Measuring Water Depth

1. Carefully separate eelgrass shoots around the outside of the transect frame to determine which shoots are rooted within the frame. Shoots that are lying down into the frame should be folded back out of the frame to avoid confusion.



2. If the frame is very dense with evenly distributed shoots, count 25% or 50% of the quadrat. Use the small white quarter squares to mark off which portions of the quadrat will be counted.
3. Fill in the % area counted (25%, 50%, 100%) in the ***Quad Area*** column on the datasheet.
4. Count shoots individually, feeling down to the base of the shoot at the sediment. Where possible, count all shoots in the quadrat (100% of the quadrat).
5. Record the total number of shoots for the area counted in the ***EG Shoot Count*** column.
6. If the majority of the quadrat is submerged in water, use the plastic ruler to measure water depth in centimeters. Record the water depth in the ***Water Depth (cm)*** column on the datasheet.
7. Do not record water depth if less than 50% of the quadrat is submerged. Record zero if water depth is less than 1cm.

### Collecting Eelgrass and Algae Biomass Samples from "Dense" Sites

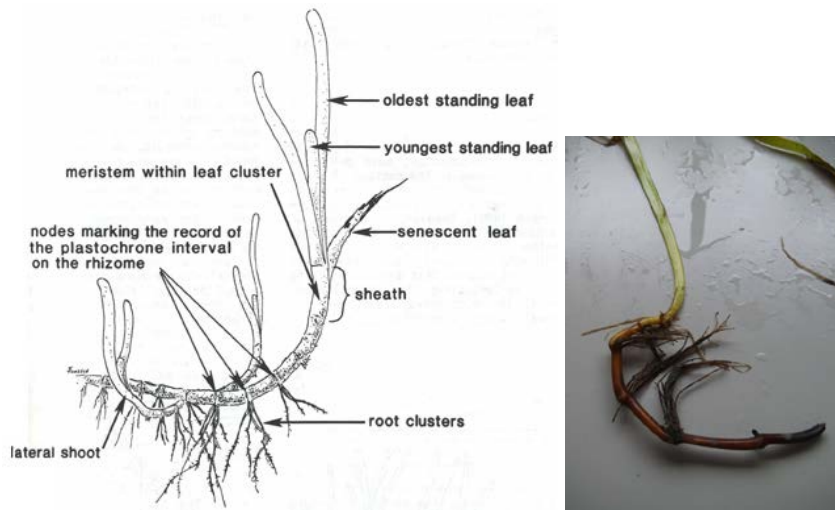
1. Fill out the labels for each bag:
  - a. Site code (circle one)
  - b. Biomass Quadrat number (circle number)
  - c. Eelgrass or Algae
  - d. Date
  - e. Time
2. Collect biomass samples from each site on the “deep” side of the transect tape where quadrats are not being measured.

#### ***Eelgrass Biomass Samples:***

1. Eelgrass biomass samples will be collected from three random quadrat placements within the eelgrass bed adjacent to the quadrats being monitored.
3. Use the small 0.0625 m<sup>2</sup> quadrat to demarcate the biomass collection area. Once the quadrat is placed, fill out the biomass sample label and take a photo of the quadrat with the label.
4. Place the quadrat label into a 1-gallon Ziploc bag.

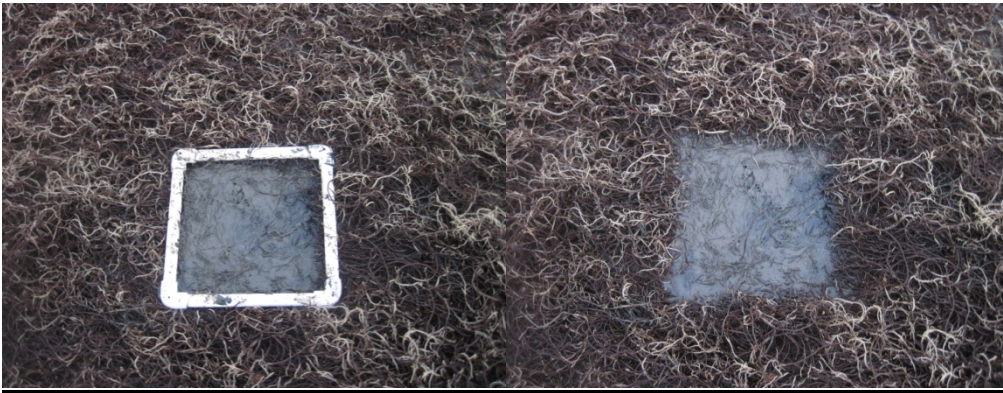


5. Remove 10 eelgrass shoots from the quadrat area. Where possible, remove 2 nodes of the underground rhizome connected to the shoot.
6. Carefully wrap eelgrass blades in a loose loop and place eelgrass shoots in the large Ziploc bag. There should be no more than 10 shoots per bag.
7. Once the 10 shoots have been collected, seal the bag. Gently shake the bag to increase the humidity around the samples. Do not add any seawater to the bag.
8. Place the labeled and sealed Ziploc bag in the cooler for transport to the lab.



#### ***Algae Biomass Sample Collection:***

1. Algae biomass samples will be collected from five randomly selected quadrat placements adjacent to the quadrats being monitored for the transect.
2. Algae biomass samples should be collected adjacent to the distances marked on the transect tape at a subset of the locations specified below:  
2m, 7m, 9m, 19m, 21m, 27m, 33m, 38m, 41m
3. Use the small 0.0625 m<sup>2</sup> quadrat to demarcate the biomass collection area. Once the quadrat is placed, fill out the biomass sample label and take a photo of the quadrat with the label.
4. Label the outside of the 1-gallon Ziploc bag with identical information to what is on the label. Place the label inside the bag.
5. Using floral shears, cut algae around the inner margins of the PVC quadrat. Point the scissors downward so that the tips penetrate the surface of the mud while cutting algae.
6. Carefully remove all algae from the inside of the quadrat and place in the Ziploc bag. Do not excavate any algae that is beneath the surface of the mud. (The goal is to measure above-ground biomass.)



9. Once all of the algae has been collected, seal the bag. Gently shake the bag to increase the humidity around the samples. **Do not add any seawater to the bag.**
10. Place the labeled and sealed Ziploc bag in the cooler for transport to the lab.

## Monitoring Protocol for Sparse Sites

**Use the Sparse Sites Biomass Datasheet for recording measurements!**

### Photo Documenting Quadrats

1. Once the quadrat is placed, fill out the whiteboard with the following information:
  - a. Site Name
  - b. Transect Name (A,B or C)
  - c. Quadrat Number (location on tape)
  - d. Date
  - e. Time
2. Take a photo of the quadrat.

### Collecting Eelgrass Samples for Sparse Sites

1. Fill out the label for the bag:
  - a. Site code
  - b. Biomass Quadrat number (1,2 or 3)
  - c. Eelgrass or Algae (circle one)
  - d. Date
  - e. Time

2. Collect biomass samples from each site on the “deep” side of the transect tape where quadrats are not being measured. Samples will be collected from three random quadrat placements within the eelgrass bed adjacent to the transects being monitored.
3. Remove up to five eelgrass shoots from the quadrat area, without removing any rhizome area.
4. Carefully place eelgrass shoots in a separate large Ziploc bag. There should be no more than five shoots per bag.

## **General Lab Processing Protocol**

All eelgrass biomass samples will be stored in Ziploc bags refrigerated at 4° C until lab processing. Processing will occur within three days (72 hours) of collection.

### **Lab Processing Equipment List**

- Waterproof datasheets (at least 30 per site)
- Pencils & sharpies
- Clothes pins
- Plastic trays
- Measuring calipers
- Meter stick
- Clear plastic rulers
- Glass slides
- Pre-weighed and labeled foil sheets
- 1-gallon Ziploc bags
- Waterproof labels
- Coolers with ice for transport
- Refrigerator for sample storage
- Nylon stockings
- Salad spinner
- Timer
- Freshwater and Saltwater

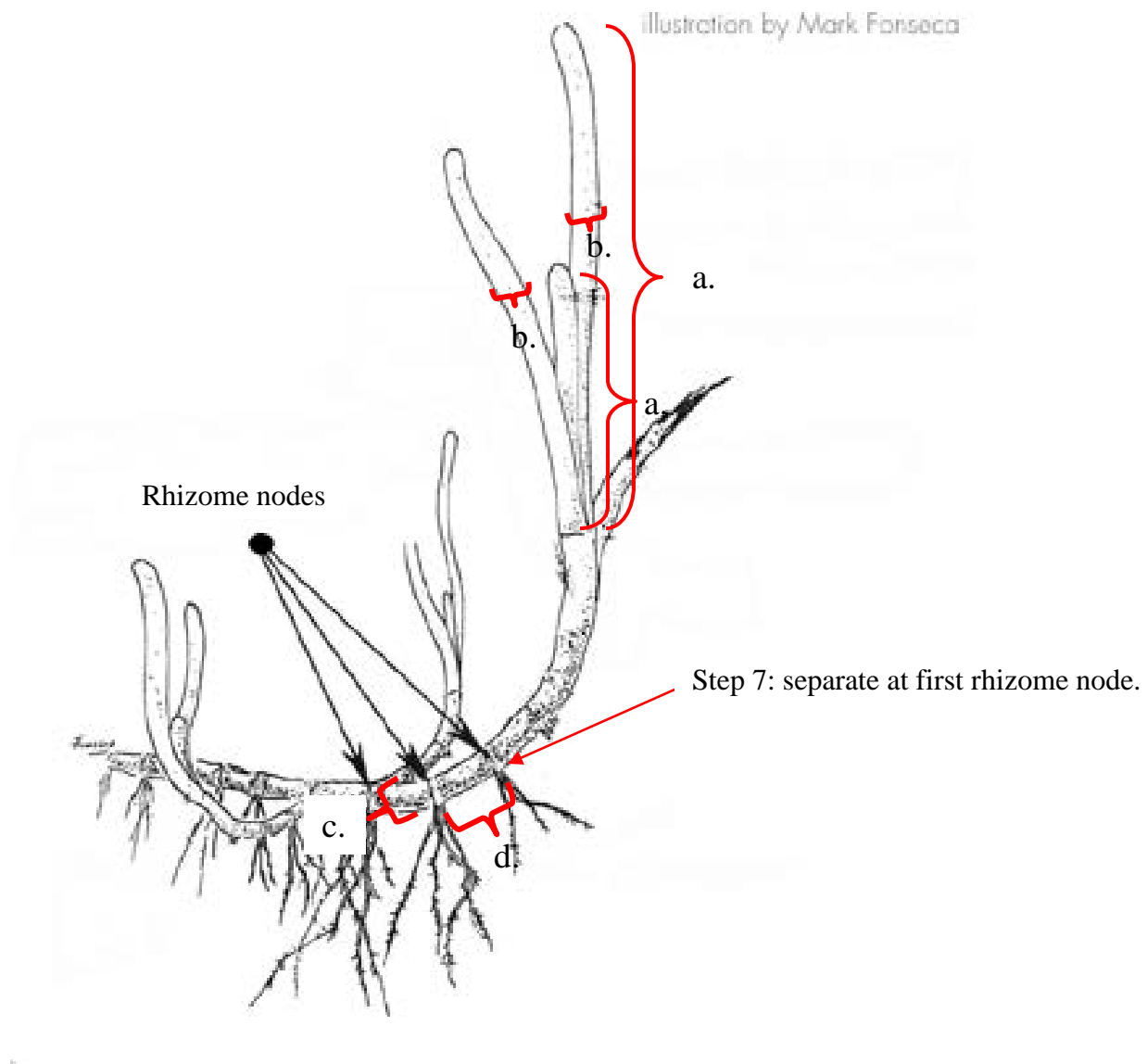
### **Preparing to Process Samples**

1. Turn on the heat circulator and set the oven temperature to 140°F (60° C)
2. Place the foils on the large baking sheets, leaving room between the foils to allow for air circulation.
3. Make sure that the tops of the foils are vented open so that steam can escape from the wrapped samples.
4. Dry samples at 60°Celsius for 48 to 72 hours.
5. Remove samples from oven and place in sealed desiccator cabinets
6. Allow samples to cool in desiccator cabinet for one hour before weighing.

### **Processing Biomass Samples**

1. Remove shoots from labeled bags, ensuring that shoots stay grouped by bag. Do not open any additional bags until all shoots are processed.
2. Carefully separate shoots, avoid breaking any fragile long blades. Place shoots into separate trays for processing.
3. Rinse single shoot gently with freshwater, taking care to not remove epiphytes.
4. Use one eelgrass biomass lab form per shoot. Fill out the site code, quad # and assign a shoot number (1-10).
5. Remove the shoot from the tray, separate and extend the leaves.
6. Collect measurements:

- a. Measure the three longest and most intact leaves, starting from the end of the leaf sheath (see A on diagram next page). Record measurements in cm. (Intact leaves have rounded tips.)
  - b. Measure the width of each leaf for which you have measured the length (see B on diagram on next page). Use the calipers to determine the width. Record measurement in mm.
  - c. If there is any rhizome attached to the leaf, use the calipers to measure the diameter of the rhizome (see C on diagram on next page). Record measurement in mm.
  - d. Measure the distance between rhizome nodes using the calipers (see D on diagram on next page). Record measurement in mm.
7. Once the eelgrass shoot and rhizome measurements are complete, separate the shoot from the rhizome at the uppermost node. (Diagram next page.)
8. If the eelgrass shoot has a heavy visible load of epiphytes, they must be removed and weighed separately.
  - a. Use a glass slide to scrape epiphytes off of the leaves and into a pre-weighed foil.
  - b. Record the site, quadrat and shoot number on the foil label.
  - c. Record the foil information on the datasheet.
9. Carefully wrap the eelgrass shoot in the pre-weighed and labeled foil.
10. Place the foil in a clean Ziploc bag if transporting to another location for drying.
11. Place the bag in the cooler or refrigerator until ready to dry.
12. Place in oven to dry. Temperature and time may vary. Oven temperature should be between 80 to 90°C. Do not fill the oven too full to ensure adequate air circulation.
13. Determine the amount of drying time needed. After 48 hours in the oven, remove the three largest samples from the oven and place in the desiccator to cool. After it reaches room temperature, weigh the sample in the foil. Return the sample to the oven for four additional hours, cool in the desiccator and re-weigh. If the two weights differ by more than 1%, then the samples should be returned to the oven and the process continued until constant weight is achieved. The total time the samples require in the oven will be used as a guide to determine the total amount of time to dry all of the samples to a constant weight.
14. Once all of the samples have been dried, cooled and weighed, subtract weight of foil to determine weight of dried eelgrass.
15. Calculate average shoot weight for each transect site.
16. Calculate above ground biomass for each transect by multiplying mean shoot density by mean shoot weight.



#### Eelgrass Monitoring Datasheets:

- Long Transect Datasheet
- Depth (Shallow) Transect Datasheet
- Depth (Mid) Transect Datasheet
- Depth (Deep) Transect Datasheet
- Biomass Sampling Datasheet

## A (Shallow Transect)

Revised Dec. 2012

Date: \_\_\_\_\_ Time Arrived: \_\_\_\_\_ Monitor Names: \_\_\_\_\_

Station Name: \_\_\_\_\_ Transect Letter: \_\_\_\_\_

Coleman = COL Tidelands = TID Marina = MAR  
Chorro = CHO Pasadena = PAS

Algae Biomass Collected: \_\_\_\_\_ Y or N \_\_\_\_\_ # Samples \_\_\_\_\_

Eelgrass Biomass Collected: \_\_\_\_\_ Y or N \_\_\_\_\_ # Shoots \_\_\_\_\_

South facing: \_\_\_\_\_ North facing: \_\_\_\_\_

Trans Name	Trans Letter	Quad Position	Coverage %					Canopy Height (cm)	Canopy Notes	EG Shoot Count	Water Depth (cm)	Additional Notes
			Eelgrass	Ulva	Gracilaria	Other	Bare	explain OTHER				
		2										
		7										
		8										
		16										
		18										
		25										
		26										
		33										
		38										
		40										
		44										
		46										

## Revised Dec. 2012

Date:	Time Arrived:	Monitor Names:
<b>Station Name:</b> Coleman =COL Tridlandá = TID Marina= MAR Chorro =CHO Pasadena = PAS	<b>Transect Letter:</b> A= Shallow B= Middle C=deep	<b>Algae Biomass Collected:</b> Y or N # Samples
<b>Transect Site Photos:</b>	<b>North facing:</b>	<b>Eelgrass Biomass Collected:</b> Y or N # Shoots

[illegible]



**B (Middle Transect)**

Date: \_\_\_\_\_ Time Arrived: \_\_\_\_\_ Monitor Names: \_\_\_\_\_

Station Name: \_\_\_\_\_ Transect Letter: \_\_\_\_\_  
 Coleman =COL Tidelands = TID Marine= MAR  
 Chorro =CHO Pasadena = PAS

Y or N # Samples

Algae Biomass Collected:

Y or N # Shoots

Eelgrass Biomass Collected:

South facing:

Transect Site Photos: North facing:

Trans Name	Trans Letter	Quad Position	Coverage %				Canopy Height (cm)	Canopy Notes	EG Shoot Count	Water Depth (cm)	Additional Notes
			Eelgrass	Ulva	Gracilaria	Other	Bare	explain OTHER			
		9									
		10									
		15									
		17									
		22									
		25									
		28									
		31									
		35									
		37									
		39									
		45									

**C DEEP**

## Transect Datasheet

Station Name: \_\_\_\_\_ Staff Names: \_\_\_\_\_

Date & Time Arrived: \_\_\_\_\_ Time Departed: \_\_\_\_\_ Tide Height & Time: \_\_\_\_\_

Trans Name	Trans Letter	Quad Position	Photo	Coverage %				Canopy Height (cm)	Quad Area	EG Shoot Count	Water Depth (cm)	Flowering/ Grazing
				Eelgrass	Ulva	Gracilaria	Other					
		5										
		7										
		10										
		18										
		19										
		22										
		26										
		34										
		35										
		38										
		43										
		44										

**Transect Codes:**  
A = Shallow  
B = Middle  
C = Deep

**Station Names:**  
Coleman  
Tidelands  
Pasadena

**COL**   **TID**   **PAS**

**Chorro**   **Marina**

**CHO**   **MAR**

**Substrate Type:**  
Sand  
Fines  
Mixed

**WQ Measures:**  
Temp:  
Salinity :

*Eelgrass Biomass*  
*Lab Form*  
*Use (1) form per eelgrass shoot.*

Staff Names: \_\_\_\_\_

Site Name: \_\_\_\_\_

Date & Time Samples Collected: \_\_\_\_\_

Date & Time Samples Processed: \_\_\_\_\_

Label Information	Site Code	Quad #	Shoot #

Examples: COL\_1\_5\_EG Coleman, Quad 1, shoot 5, eelgrass

Leaf Length (cm)			
Leaf Length 1	Leaf Length 2	Leaf Length 3	Leaf Length 4

Leaf Width (mm)			
Leaf Width 1	Leaf Width 2	Leaf Width 3	Leaf Width 4

Rhizome Measures (mm)			
Rhiz. Present (y/n)	Rhizome Diam. 1	Rhizome Diam. 2	Rhizome Diam 3
Y or N			

Node length 1	Node length 2	Node length 3

Eelgrass Drying Foil		
Eelgrass Foil Label	Foil Pre weight (g)	Post weight (g)

Drying Start and End			
Start Date		End Date	
Start Time		End Time	

## Appendix I. Morro Bay Volunteer Monitoring Program Shorebird Survey Protocol

# **Morro Bay Volunteer Monitoring Program**

## **Shorebird Survey Protocol**

(from Point Reyes Bird Observatory – Pacific Flyway Project)

Shorebirds can be counted more easily than many birds due to their use of tidal flats and other open habitats. Further, shorebirds generally move shoreward as the tide rises, affording land-based observers an improving view until the flood tide forces the birds to alternative high tide habitat. However, due to their habits of aggregating, sometimes in very large, mixed-species flocks, and flying (often unexpectedly during a count!), skill and experience are necessary to obtain accurate counts.

### **COUNTING METHODS**

Counting methods vary, depending on the number of birds, their edginess, and census conditions. The number of birds in a flock can be obtained by:

1. Counting birds individually.
2. Counting birds in groups of some number
3. Estimating the number of birds in a flock without actually counting them.

The first two methods are always more accurate and preferred over the third, which should be used only for preliminary observations of flocks or to salvage an interrupted count.

**Counting birds individually:** If there are only a few birds in an area, (less than 100 total), they should be counted individually.

***Counting birds in groups of some number:** If you are counting larger flocks, say 200 birds, begin at one end of the flock - count the first 10 birds, then the second 10 birds, continuing until you can easily see the birds in groups of 10. At that point, start counting by 10-bird groups. This method can be generalized to counting by 20-bird, 25-bird, 50-bird, or even larger groups, for larger flock sizes. This method can also be used for counting birds in flight.*

**Estimating the number of birds:** It is wise to initially estimate numbers of all the birds quickly, to determine the relative proportions of the most common species, to roughly determine the numbers of the less common species, and to determine whether the species are segregated or homogeneously mixed throughout the flock. Then, if the actual count is interrupted, some reasonable estimates of numbers will be possible. Making a rapid estimate of the number of birds may be the only way to salvage a count in which birds fly away before they are counted.

### **SPECIES IDENTIFICATION**

1. Try to identify all the birds (except dowitchers) to species.
2. Whenever possible, allocate unidentified shorebirds to species groups (such as Least Sandpiper or Western Sandpiper) rather than just listing them as unidentified large or small shorebirds.

On the census form we have provided species categories that might commonly be used. Four groupings: yellowlegs spp., dowitcher spp., phalarope spp., and Least or Western sandpiper are self-explanatory. The plover species would include Semipalmated Plover, Snowy Plover, and Killdeer. The large sandpiper grouping could include any combination of Willet, Marbled Godwit,

Greater Yellowlegs, Long-billed Curlew, or Whimbrel. If you use any of these categories please indicate which species you believe could have been involved. Write in any species not on the census sheet in one of the empty columns at the bottom of the census form and provide details on the sightings.

### **APPORTIONING THE COUNT OVER SEVERAL SPECIES**

1. Count out each species separately.
2. Count all species together.
3. Count several species together.

**Counting each species separately:** Counting each species separately is time consuming if there are many species to count but can be the least confusing method if there are few abundant species per counter.

**Counting all species together:** If the group of shorebirds comprises primarily one species, with a few individuals of other species, it is often easiest to count the total number of birds, then to count out the rarer species and subtract their numbers from the total, to get the number of the common species. An assistant, recording for the counter, can aid in this process by either counting the rarer species in the flock or by making the subtractions on the recording form. In cases where there are tens of thousands of shorebirds and several species are very abundant, it may be necessary to count all species together and to sample species composition at many places in the flock in order to determine the proportion of the total made up by each species.

**Counting several species simultaneously:** In a mixed flock, it is often fastest to make a combined count of similarly sized species. For example, say there are six species present: Dunlin, Western Sandpiper, Least Sandpiper, Willet, Marbled Godwit, and Long-billed Curlew. It might be easiest to count the first three species together, by writing down the number of the less common species as they are encountered and keeping a running tally of the most common species in your head until the flock has been scanned completely. Similarly, the Willet, Marbled Godwit, and Long-billed Curlew could be counted together. Counting several species simultaneously can often be done most effectively if there is both a counter and a recorder. The counter can give the recorder the counts of the less common species as they are seen but accumulate the count for the most common species until the flock is completely counted.

### **WHAT TO DO WHEN BIRDS FLY DURING A CENSUS**

*Movement of birds during a census creates some particularly troublesome problems. Our basic strategy is to count the birds before they move from tidal flat areas. Counts at shoreline segments should not take longer than about 1 hour so that the overall amount of bird movement is minimized. It is also important that counters in the same general area of the Bay are counting at the same time. Using the guidelines below, we hope that you will be able to best judge whether or not you should count certain birds.*

1. **If you are covering a shoreline segment:** Count birds that fly into and stay in your area during the first hour of your count. You should count birds that fly out of your area only if they are leaving for non-tidal, high tide roosts (such as salt ponds). If a bird (or flock) moves to another tidal flat area and it is less than an hour since your starting time for that area and there is still a counter visible to you in the area into which the bird(s) moved, you should not count the bird(s) for your area. Alternatively, if a bird (or flock) moves into your area in the first hour of your count, you should count them, unless it is apparent to you that they have been counted by an observer in an adjacent area and the observer did not see them move to your area.
2. **If you are covering a non-tidal area at the same time that shoreline segments are being covered:** Only count flying birds in your area that leave for other tidal areas. If birds leave your area for the tidal flats (this shouldn't happen too often) do not count them if it is less than an hour since tidal flat counts have begun. Do not count birds that fly into your area once the shoreline segment counts have begun.
3. **For both tidal and non-tidal sites:** If you do not know where departing birds go, note them separately on your form with the time they leave and general direction that they go. Make similar notes on arriving birds. If birds fly by your area without stopping, note them separately with the time and direction of flight, if possible. Do not include any of the birds noted separately in the totals for your area; we will decide after the census if they have been counted by any other team. However, the best decisions on whether or not a flock should be counted are often most easily made in the field.

#### **FOR FIRST TIME CENSUSERS: WHAT YOU 'LL WANT TO REMEMBER TO BRING**

- Binoculars
- Telescope (if you have one)
- Wrist watch
- Letter or card indicating permission to restricted land (if applicable)
- Recording pad (use census form for final tally only)
- Pencils (mechanical pencils don't need to be sharpened if they break)
- Rubber boots (your letter will indicate if needed for your area)
- Warm layers of clothes, water, sunscreen
- These forms and instructions
- A field guide (although there usually isn't time to refer to it during the census)

## **Morro Bay Volunteer Monitoring Program Shorebird Census Location Information**

See Map for reference. All boat sections concentrate the on the main body of the bay excluding the salt marsh and Chorro/Los Osos creek outlets. Those areas will be covered from the shore.

1. Section 1: Land Section. Use scope near Morro Rock, T-Piers, and several street-end viewing docks along the Embarcadero.
2. Section 2 & 3: Boat Section. Depart from embarcadero. Sections 2 & 3 are usually completed together. Concentrate on Grassy Island & the shore of sand spit. The boundary of Section 4 starts at the southern tip of Grassy Island and runs from the sandspit east to Fairbanks Point.
3. Section 4: Boat Section. Depart from State Park Marina. South of Grassy Island. Concentrate on shore of sandspit and any exposed mudflats. The southern boundary of Section 4 runs east to west from just north of the Marina to the sandspit.
4. Section 5: Boat Section. Depart from State Park Marina. Concentrate on sand spit and any exposed mudflats south of the Marina to approximately the northern tip of Pasadena Point. The southern boundary of Section 10 runs east to west from Cuesta Inlet to the sandspit.
5. Section 6: Land Section. Use scope around State Park Marina (to the south side) and east along the Salicornia (pickle weed) as far as necessary.
6. Section 7. Land Section. Can be done with Section 6 from the same vantage points. Boundary between Sections 6 & 7 is approximately along the Chorro Creek channel.
7. Section 8. Land Section. Use scope from Bush Lupine Point in Elfin Forest. Park at north end of 13<sup>th</sup> Street in Los Osos. If vantage point further east is necessary, go along boardwalk to Siena's View, the next point at which the boardwalk affords a bay view.
8. Section 9. Land Section. Use scope (if needed) from pullout on Pasadena Drive, from Baywood Pier, Sweet Springs Nature Preserve (enter at Broderson St.), & further west at public access near intersections of Mitchell Dr. & Doris St.
9. Section 10: Boat Section. Depart from Cuesta Inlet. Concentrate on sand spit and any exposed mudflats south to approximately Cuesta Inlet. The southern boundary of Section 10 runs east to west from Cuesta Inlet to the sandspit.
10. Section 11. Land Section. Starting from west end of Butte Dr. checking near shore, then when closer to Shark's Inlet (back corner of bay), look across to shore of sand spit. Boundary with Section 10 is north end of a large bare dune.  
Note: If sand spit side of Section 10 is done on foot, the Section 11 team can do the portion of Section of 10 that is Cuesta by the sea shoreline.
11. Section 12. Land Section. Use scope from bay side of South Bay Blvd. across from Turri Rd. Further north access is available just south of Chorro Cr. Bridge.



12. Section 13. Land Section. Ocean side of sandspit. Use Montana de Oro access. Census the beach while walking north, then walk back.

Note: Can arrange pick up with boat on north sandspit rather than walking back.

13. Sections 14/15. Land Section. Walk from Morro Rock to North Point (or vice versa). To avoid wading Morro Creek, walk north from Morro Rock to the creek, walk back and drive to north side of creek (Highway 41 west to the end). Park and walk from north side of Morro Creek to North Point. With two people & a desire to walk less, a car can be dropped off at North Point, return to Morro Rock to begin survey, census and finish at North Point and awaiting car.

We need at least 11 bird survey leaders.

## Morro Bay Volunteer Monitoring Program Shorebird Monitoring Datasheet

Location \_\_\_\_\_ Date \_\_\_\_\_

Team Members (first, last names) \_\_\_\_\_

Area \_\_\_\_\_

Start Time \_\_\_\_\_ End Time \_\_\_\_\_

Black Bellied Plover		Western Sandpiper		Great Blue Heron	
Snowy Plover		Least Sandpiper		Great Egret	
Semipalmated Plover		Least/Western sandpip.		Snowy Egret	
Killdeer		(*) Ratio >>		Cattle Egret	
Am. Black Oystercatcher		Dunlin		Green Heron	
American Avocet		Least/West/ Dunlin		Blck-cr. Night Heron	
Greater Yellowlegs		(*) Ratio >>		Virginia Rail	
Lesser Yellowlegs		Baird's Sandpiper		White Pelican	
yellowlegs spp.		Short-bill. Dowitcher		Brown Pelican	
Willet		Long-bill. Dowitcher		Turkey Vulture	
Wandering Tattler		dowitcher spp.		Osprey	
Spotted Sandpiper		Wilson's (common) Snipe		White-tailed Kite	
Whimbrel		Wilson's Phalarope (u)		Northern Harrier	
Long-billed Curlew		Red-necked Phalarope		Red-tailed Hawk	
Marbled Godwit		Red Phalarope (u)		American Kestrel	
Ruddy Turnstone		phalarope spp.		Merlin	
Black Turnstone		Brant		Peregrine Falcon	
Surfbird		Other species (d)		Red-shouldered Hawk	
Red Knot					
Sanderling					

(u) indicates species we suspect will be very uncommon or local

**Dowitchers**--We suggest the censusers count all dowitchers as **dowitcher spp.** If dowitchers are identified to species we would like some information on how the determination was made.

**Mixed Species Groups** -- Indicate the possible species and number. For example, if you saw a mixed flock of 155 Willet and Marbled Godwit, you would write Willet/Marbled Godwit and 155. **Whenever possible, indicate proportions of mixed species groups.**

(\*) Use these spaces only to record numbers of sandpipers that you are able to separate into Least or Western sandpipers. Count the species together and record the total number. **If possible, list the ratio of the unseparated species.**

## Appendix J. Morro Bay Volunteer Monitoring Program Phytoplankton Monitoring Protocol

## **Morro Bay Volunteer Monitoring Program Phytoplankton Monitoring Protocol**

### Equipment:

- plankton net
- bucket
- sample container with weight
- sample jar

### Sampling site:

Morro Bay T-pier: The T-pier near the Coast Guard/Harbor Patrol offices at the northern end of Embarcadero in Morro Bay (near the power plant). Sample on an incoming tide. It is best to sample from the southern portion of the 'T' so that the current will pull the net away from the pier pilings to avoid snags.

### Sample collection procedure:

1. Sampling should occur on an incoming tide, preferable at the mid-point between the low tide and the high tide. This is crucial for the Morro Bay pulls.
2. Secure the rope that is attached to the net to a fixed object (i.e., railing).
3. Do not place sample cup on railing where it can be easily knocked into the water.
4. Attach the sample cup to the net and make sure that it is secure.
5. Drop the net into the water down to the flagging tape, which is a 10 ft length.
6. Pull the net up until it clears the surface of the water and allow water to drain out.
7. Be careful not to snag the net on the pier or pilings.
8. Repeat the dropping and pulling up of the net until the total tow length equals 50 feet.  
Tow length = length of rope dropped x number of times net is dropped  
= 10 feet x 5 drops = 50 foot tow length
9. When completed towing, pull up the net and pour sample into sample container.
10. Label the sample container. Avoid violently shaking or jostling the sample jar to help preserve the sample.
11. Rinse net in freshwater using the bucket. There are hoses on the boat slips on Marina Square that you can use.
12. Soak net in a bucket of freshwater for a few hours.
13. Rinse net and hang net to dry in the NEP storage room. Be careful, the fabric of the net can snag or tear.
14. Fill out the top of the DPH data sheet with the date, your name, sample location, sample time, tow type (vertical for land-based sites), tow depth (10 ft if that's how deep you let the net drop each time), and tow length (see above for calculation). You do not need to provide the water temperature or salinity.

## Analyzing the Sample

### Equipment:

- microscope
- TV
- droppers
- slides
- slide covers
- DPH worksheet
- DPH sample container

1. Bring samples back to the NEP equipment room to use the microscope. The equipment is in a box labeled 'Phytoplankton Supplies' in the white cabinets in the equipment room.
2. Gently invert the sample container to re-suspend the sample.
3. Use the dropper to place a few drops of sample onto a glass slide.
4. Place the cover slip on the sample and try to avoid trapping air bubbles under the slide cover.
5. Turn on the microscope by pushing the red button and green switch on the back of the microscope. They should light up.
6. The silver lever on the top of the microscope has three positions:
  - Pulled all of the way out: image on TV and microscope
  - Pulled halfway out: image on TV only
  - Pushed all of the way in: image in microscope only
7. Using the 10X magnification, scan the entire slide to ensure that the slide is fairly uniform (i.e., phytoplankton is fairly evenly distributed throughout the slide). If the slide is not uniform, create a new slide and try again.
8. Make three complete passes through the slide. Estimate population counts for each type of phytoplankton in each pass to complete the DPH data sheet.
9. Don't fill out the relative abundance scale or the percentage. We will calculate it.
10. Complete data sheet. Leave a copy in the NEP office or equipment room to be faxed to DPH. Do NOT mail the data sheet with the sample or we won't get a copy of it!
11. Put the sample for DPH into the sample container and pack in the plastic bag with the absorbent cotton.
12. Complete the slip of paper contained in the mailing tube to help identify the sample. If there is no slip of paper in the tube, extras are in an envelope in the phytoplankton supply bin.
13. Drop the sample container into the mailbox.
14. Turn off microscope and replace the cover.
15. Wipe the slides and slide covers clean. Rinse out the eye droppers and return equipment to the shelf.
16. Store extra sample in the fridge.
17. Please report any problems with equipment to VMP staff. Also let them know if any additional supplies are needed before the next pull.

## Appendix K. Morro Bay National Estuary Program's Suspended Sediment Monitoring Protocol

# **Morro Bay National Estuary Program's Suspended Sediment Monitoring Protocol**

## **Background**

As the main entity conducting monitoring for the Morro Bay Sediment TMDL, the MBNEP recognizes the importance of tracking sediment loads as best management practices and restoration projects are installed throughout the watershed. This monitoring effort is intended to supplement existing ambient turbidity monitoring (captured via the Water Quality Monitoring effort) by collecting near continuous monitoring data during large storm events. The goals are to monitor suspended sediment concentration, nephelometric turbidity and stream discharge to allow for better calculations of suspended sediment load. This effort employs automated samplers for sample collection at a higher frequency than could be attained by field visits.

## **Overview**

Automated samplers are deployed in the field to collect water samples during storm flows. Permanent equipment shelters have been installed at creek sites to house automated samplers. If a storm is forecasted, the samplers are stocked with empty bottles and programmed to begin sampling to collect samples of a specified volume on a determined frequency. Once all 24 sampler bottles have been filled VMP staff return to the site to swap out the bottles and re-program the sampler if further sampling is desired. Samples are processed in our Water Science Lab located at Cuesta College. Samples are weighed and then poured onto pre-weighed filter. The dried filters provide the mass of sediment contained in the sample and based on the volume of water originally collected, a suspended sediment concentration can be obtained corresponding to various flow levels in the creek.

## **A. Field Sampling Protocol**

### **1. Bottle Preparation for Sampling**

Each site has four assigned bottle sets (A, B, C, or D). Bottles are individually labeled with the site code (three letters), set code (A, B, C or D) and bottle number (1 through 24). For example, each bottle has a unique three part ID: CAN-A-13. Each bottle has a unique tare weight, written on both sides of the bottle. There are two extra sets of bottles (site code EXT) that may be used at any of the stations if needed. To prepare bottles for field sampling, follow the method below.

1. Rinse bottles thoroughly with DI water.
2. Fill halfway with DI water, cap, shake vigorously, and pour out DI water.
3. Bottles from especially dirty or contaminated bottle sets should be washed with dishwashing soap and the bottle brush, and rinsed thoroughly with DI water.
4. Place bottles on drying rack over sink.
5. After bottles have rested for 20 minutes, tip forward to pour out water settled in the bottle neck.
6. Place bottles back on rack until completely dried.
7. Place caps into 500 mL beaker, and then fill with DI water and pour out several times.

Once bottles have dried completely:

1. Wipe out sampler base to remove any debris, dirt or water.
2. Gather bottles into matching sets of 24. (Sets are A, B or C for each site).
3. Inspect bottles to ensure that the bottle ID number, tare weight, etc. are legible. If needed, use a Sharpie to refresh these labels.
4. Remove any remaining stickers with prior sampling information.
5. Install bottles in numeric order, with bottle numbers matching numbers stamped on the sampler base.
6. Double check that bottles 3, 15 and 21 are notched into the molds of the base.
7. Fasten the round bottle plate to the base with the three elastic bands.
8. Lightly screw caps onto each bottle.

## **2. Battery Charging and Installation**

There are numerous 12 volt, 32amp hour batteries available for use in the field to power the ISCO samplers. Charging the 32 amp Battery:

- NEVER charge a frozen battery
  - NEVER set battery on top of charger
  - Never place charger directly above battery being charged. The gases from the battery will corrode and damage the charger
1. Be sure to set the charger to the 12V setting
  2. Place the battery on top of the Styrofoam or wooden block.
  3. Note the polarity of the battery posts by checking the identification marks.
  4. Connect the POSITIVE (red) output clamp from the charger to the POSITIVE (red) post on the battery.
  5. Position yourself as far away from the battery as possible, and then connect the NEGATIVE (black) output clamp from the charger to the free end of the cable (black).
  6. Plug in charger power cord.
  7. Select the appropriate charge rate and battery voltage. The yellow LED light labeled "CHARGING" should light up and the charging process should start.
  8. Check to make sure the charging is on the lowest 2V setting for trickle charging.
  9. Battery charging takes approximately 6 hours.
  10. After charging is done, disconnect the charger using the following steps. First, unplug the charger power cord. Second, remove the output clamp from the NEGATIVE (black) post. Third remove the POSITIVE (red) output clamp from the positive (red) post.
  11. Wash hands each time you finish handling the battery and charger.

## **3. Filling out the Field Logbook**

Upon arrival at the site, start a new record in the field logbook. Each field record should include the following:

1. Current date and time.



2. Staff gauge height (recorded off the staff gauge on the bridge wall)
3. Code for the bottle set being removed Description of samples collected in bottle set being removed. Note if any bottles failed to fill, overtopped, or drew an incorrect volume.
4. If battery required changing out
5. Code for new bottle set being installed
6. Code for new battery being installed
7. Program start date and start time
8. Program sampling frequency (typically 30 or 60 minutes.) Program sampling volume (typically 400ml.)

## 4. Programming the Sampler

### Standard Programming

With standard programming, the sampler purges the sampling line, draws a sample, and then purges the line again after sampling. Only in the extended programming mode does the sampler rinse the line before sampling or conduct retries for sampling.

Each sampler has been pre-programmed (initialized) with a site description, which does not need to be changed. Suction line length has also been entered and should not be changed unless changes are made to the sampler intake.

When setting a program it is important to keep in mind the duration of the sampling period that can be accommodated by the 24 available bottles and the timing of the anticipated storm flow event. A 30-minute sampling interval will capture a period of about 11.5 hours. A 1-hour sampling interval will capture a period of 24 hours.

### Sampling Intervals with a Manual Start

1. Press the power button to turn the sampler on.
2. .
3. Arrow to **Program**, press **Enter**
  - a. **(Selected options will begin blinking when they are selected.)**
4. At “Site description change?” arrow to **No**, and press **Enter**.
5. At “Number of Bottles,” arrow to **24**, and press **Enter**.
6. At “Bottle Volume,” type in **1000** mL, and press **Enter**.
7. At “Suction Line Length,” check that lengths are the same as shown below, press **Enter**.  
(Should not need to be changed except in special circumstances)
8. Line lengths by site are:  
CANET: 99  
SAN LUISITO: 35  
WALTERS: 55
9. At the screen for “Time Paced or Flow Paced” sampling, select **Time Paced**, and press **Enter**.
10. At “Time Between Sample Events,” type in the **Number of Hours and Minutes**, and press **Enter**.
11. At “Sequential, Bottles/Sample, Samples/Bottle” select **Sequential**, and press **Enter**.

12. At “Run Continuously?” select **No**, and press **Enter**.
13. At “Sample Volume” type in **400** ml, and press **Enter**.
14. At the next menu “No Delay to Start, Delayed Start, or Clock Time” scroll to **Clock Time**, and press **Enter**.
15. At “First Sample at --:--”, type in the start time, and press **Enter**. Time should be entered as time on a 24-hour clock. (Take note of the clock time displayed on the sampler, the sampler cannot begin sampling in the past!)
16. At “Select Days” scroll through days, press **Enter** to select or un-select. Scroll to **Done**, press **Enter**.
17. The final screen should show the time the program is scheduled to start (top line) and the countdown to the first sample (bottom line). Double check that the start time is consistent with when you want to begin sampling, and that the countdown is accurate.

## Setting the Clock

1. Synchronize sampler clock to time and date on a cell phone. Remember to change clocks with daylight savings time.
2. Go to **Other Functions**, and press **Enter**.
3. Go to **Maintenance**, and press **Enter**.
4. Press **Enter** again to select **Set Clock**.
5. Enter **Hour**, and press **Enter**. Enter **Minutes**, and press **Enter**. Enter **Day**, and press **Enter**. Type in Months, and press **Enter**. Type in the **Year**, and press **Enter**.
  - a. Hours must be set using the 24 hour clock. If it is after 12pm, add 12 to the standard time to get the 24 hour time. (4:00PM + 12 = 16:00)
6. Press **Stop** to return to the main menu.

## 5. Sample Preparation and Handling

### In the field:

1. Immediately upon removing sampler base, cap bottles tightly.
2. Note in the field log any bottles where the volume collected appears to be inaccurate.
3. Fill out RITR labels for each bottle. Labels should include:
  - a. Bottle ID
  - b. Time of Sample Collection
  - c. Date of Sample Collection
  - d. Sampling Site (only if different from bottle set code or if EXT bottles are being used)
  - e. Be sure to leave room on the label for recording sample weight.
4. Bottles should be transported to the lab the same day they are removed from the field.

### At the lab:

1. Remove capped bottles from the sample base.
2. Check the water level of each bottle, note bottles with suspect volumes.

3. **Clean and dry outside of each bottle**, and look for floating debris (leaves, sticks or algae).
4. Remove the bottle cap.
5. Set bottle on high capacity scale.
6. Record the weight of the sample on the appropriate RITR label.
7. Re-cap bottle tightly and remove from scale.
8. Apply the RITR label(s) to the bottle.
9. Bottle is ready for storage. Bottles may be stored in the refrigerator, or in one of the grey storage bins in the lab.

### **Sample Storage at the Lab**

If samples will not be processed immediately:

1. Make sure sample is completely and clearly labeled and weighed in. Do NOT enter the information for the bottle into the Sediment Data Management System until you begin filtering the samples.
2. Re-cap tightly and place in the refrigerator or storage container.
3. Samples with a high sediment/solids concentration should preferably be stored in the refrigerator.

### **Sample Handling QA**

To ensure sterility and accuracy, one blank sample should be run for each bottle set that comes in from the field. The blank bottle is filled with DI water, stored at the lab, and filtered alongside samples in the field bottle set.

To prepare a QA Blank:

1. Locate one-liter Nalgene bottles from the BLK bottle set at the lab.
2. Fill the bottle approximately halfway with DI water.
3. Weigh the un-capped bottle on the high capacity scale.
4. Create a RITR label noting the QA Blank sample, and the date it was prepared.
5. Record the weight of the sample on a RITR label.
6. Re-cap bottle tightly and remove from scale.
7. Apply the RITR label(s) to the bottle.
8. Place bottle into storage with the appropriate field bottle set, or continue with login for sample processing.

## **B. Laboratory Protocol**

### **1. Equipment Accuracy and Calibration Checks**

At the beginning of each major lab session, all equipment should be checked and re-calibrated if necessary.

1. DI WaterThe deionizing filter for the building needs to be replaced periodically. Check the conductivity of the deionized water monthly to ensure that the filter is working correctly..
2. Rinse a 500 mL beaker with DI water and pour out.
3. Fill a 500 mL beaker with DI water.
4. Insert the conductivity probe, and allow reading to settle.
5. If DI water conductivity is over 100 uS/cm, run the tap an additional 1-2 minutes, collect and test a new sample.
6. Once DI water is reading below 100 uS/cm, fill all squeeze bottles that will be used during sample processing.

#### **Oven Temperature**

1. Flip the middle switch to 'Power' to turn on the oven.
2. Flip the lower switch upwards to 'Heat'.
3. Set the dial thermostat to 225° F.
4. The red (Power) and orange (Heating) indicator lights on the front of the oven should illuminate.
5. When the orange indicator light has gone off, open the oven door and record the temperature on the internal thermometer.
6. Oven temperature should be between 103°and 110° Celsius.
7. Make adjustments to thermostat dial as needed.

#### **Hach 2100AN Turbidity Meter**

This instrument is designed for long-term stability and minimal need for recalibration. It is recommended that recalibration be performed at least once every three months, or more often if experience indicates a need. To guarantee accurate calibration, use only the formazin standards issued by Hach.

The formazin calibration standards have a long shelf life, but must be stored properly. Standards should be stored in their respective kit with cover in place, out of direct sunlight. For long term storage, refrigeration at 5° C is recommended, do not store above 25° C.

- Shake the standard vigorously for 2-3 minutes to re-suspend particles. Do NOT shake the < 0.1 NTU standard, only the 20 NTU, 200 NTU, 1000 NTU, 4000NTU, and the 800 NTU standards.
- Allow standard to stand undisturbed for 5 minutes.
- Gently invert the cells 5 to 7 times.

- Prepare the sample cell for measurement by applying a thin film of silicon oil and wiping with the velvet cloth.
- Let the cell stand for one minute after oiling.
- Press the **CAL/Zero** button. The small green LED digits in the mode display will flash “00”.
- Insert the <0.1 ntu standard cell, align the orientation marks on the cell and chamber. Close the lid and press the **ENTER** button to begin calibration.
- The meter will count down from 60 to 0, read the sample and calculate the correction factor.
- The display will show the 20.00 NTU value on the screen. Insert the 20.00 NTU standard with correct alignment and press the **ENTER** button.
- The meter will count down from 60 to 0, and display the will show the value of the next standard required.
- Repeat these procedures sequentially for the remaining standards as the meter prompts.
- After reading the final standard (7500 NTU), press the **CAL/ZERO** to accept the calibration.

### Fine Scale Balance

The fine scale balance should be checked for accuracy before weighing in any filters (new or used). The scale should be calibrated when the temperature in the room has stabilized. If the oven will be used concurrent with the scale, allow the oven to warm the room for 15 minutes before calibrating the scale. It is also important to watch the scale for signs of drift when weighing for an extended period of time. If the weight of the scale drifts more than 0.0002 grams when closed and stabilized, recalibration may be necessary.

1. Position the scale so that the glass doors will open fully to enable weighing the samples.
2. Make sure the bubble level in the back left corner of the scale is centered. If it isn't, use the dials located on the front sides of the scale to level the scale.
3. Turn the scale on. The scale display should fill in completely to indicate a self-check.
4. Make sure the surface of the scale is clean and all of the glass sides are closed.
5. Tare the balance by pressing the '**ZERO**' button. The scale will beep when zeroing is complete.
6. Remove the 'Fine Balance Weights' (in the grey box) and scale calibration log book from the drawer underneath the scales.
7. Scale calibration weights should only be handled with gloves. It is preferable to use the plastic tongs to transfer the fine calibration weights from the box to the scale.
8. When the scale has zeroed and stabilized, press the **CAL** button to begin calibration.
9. Place the indicated calibration weight in the center of the scale and gently close the glass doorse (50.0000 grams).
10. When the scale has stabilized it will beep and display the calibration weight with weight units.
11. Remove the calibration weight and replace it in the grey box. Perform several weight checks with the smaller weights in the calibration weight set. Perform weight checks with the 30.0000, 20.0000, 5.0000, 2.0000 gram weights in the set.

12. While testing with calibration weights, record the time and date of the test, weight of the calibration weight, and scale reading in the scale logbook.

**The scale capacity is 70.0000 grams, do not exceed this capacity when performing weight checks.**

### **High Capacity Balance**

The high capacity balance should be checked for accuracy before weighing in each round of samples. The calibration weights are kept in three separate black plastic boxes in the drawer underneath the scales.

1. Make sure the bubble level in the back left corner of the scale is centered. Adjust the front feet of the scale to level if needed.
2. Turn the scale on. The scale display should fill in completely to indicate a self-check.
3. Make sure the surface of the scale is clean and that there is no water on the metal plate.
4. Tare the balance by pressing the 'ZERO' button. The scale will beep when zeroing is complete.
5. Remove the Gross Scale Weights from the drawer. There are separate black boxes for calibration weights of 200.00g, 300.00g and 500.00 g.
6. Wear gloves for moving the calibration weights from the storage boxes to the scale.
7. When the scale is stable, press the CAL button to begin calibration.
8. Place the indicated calibration weight on the center of the scale (500.00 grams)
9. After calibration, the calibration weight is displayed with weight units.
10. Remove the calibration weight.
11. Perform weight checks with the smaller weights in the calibration weight set. Perform weight checks with the 200.00 and 300.00 gram weights. Do not exceed the capacity of the scale: 810grams.
12. When testing with calibration weights, record the time and date of the test, weight of the calibration weight, and scale reading in the scale logbook.

If the scale is left on for an extended period or bumped off balance, it may drift. If the scale drifts by 0.02 or more, clean and recalibrate the scale.

### **Annual Scale Maintenance and Calibration**

The High Capacity Balance and Fine Scale balance are checked and calibrated annually by an independent calibration firm.

### **Desiccator Cabinet**

At the beginning of each lab session, check the desiccant in each desiccator. Desiccant may need to be re-charged in the oven if the ambient humidity exceeds 15%. (Alternatively, more fresh desiccant can be added to the cabinet for a short-term fix.)

Check the humidity indicator card in both desiccators at the beginning of each lab session. The indicator circles will change from blue to pink if the humidity of the cabinets increases. To recharge Drie-Rite desiccant crystals, spread the desiccant into baking pans and heat to 230°C (450° F) for one to two hours .

Upon removal from the oven, desiccant should be placed immediately into the cabinets or storage containers. Loosely cap storage containers until desiccant has cooled (15-minutes) then screw the cap onto the container.

### **Vacuum Carboy**

1. Empty the vacuum carboy frequently when processing samples.
2. The carboy should be emptied when the water depth in the carboy reaches the label marked on the side.
3. Unscrew the white cap on the top of the carboy, being careful not to disconnect tubing from the cap.
4. Pour carboy contents into the sink.
5. Replace white cap on carboy and screw on tightly.

Inspect the tubing that runs from the vacuum to the carboy, there should not be any moisture in the tubing. To remove moisture from the tubing:

1. Loosen the white plastic cap on the carboy so that air can circulate out of the carboy.
2. Disconnect the clear tubing line at the 'Vacuum' side of the pump.
3. Attach the tubing to the nozzle on the 'Pressure' side of the pump.
4. Open the valves on the filtration manifold to allow pressure to escape.
5. Turn on the pump and let it run for one to two minutes. This will push accumulated moisture away from the pump, and back towards the storage carboy.
6. When you cannot see any more water droplets in the clear suction line, or the pump has run for about 2 minutes, turn off the pump.
7. Disconnect the tubing from the 'Pressure' side, and re-attach to the 'Vacuum' side.
8. Replace white cap on carboy and screw on tightly.

## **2. Lab Safety Equipment and Procedures**

Water samples should be considered and handled as samples containing pathogenic material. Historic water quality data from sediment monitoring sites has shown high levels of pathogenic bacteria, thus safety precautions are necessary for sample handling.

### **Sample Handling Safety Procedures**

1. Powderless gloves should be worn at all times when samples are being weighed or filtered.
2. In isolated instances, face shields should be worn when filtering to avoid potentially hazardous splashing.
3. Lab personnel should wash hands with anti-bacterial soap before and after all sample and battery handling.

### **Filter Contamination Prevention**

Filter weights and subsequent sediment concentration data can be influenced by contamination. The following steps should be taken to prevent filter contamination.

1. Lab personnel should wash hands prior to commencing any work in the lab.
2. Lab personnel should put on powderless gloves before handling any filters.
3. Lab personnel should not conduct lab work while wearing wet clothing, or with wet hair.
4. Filters should be transported to the manifold and into foil trays using clean forceps. Following rinsing on the manifold, filters should not be touched with bare hands.
5. Filters that have been rinsed and dried for one hour should be moved into the 'clean dessicator' using clean tongs immediately upon removal from the oven.

### **General Lab Safety**

A First Aid kit is mounted on the wall near the sink of the lab. An updated red folder of MSDS forms is available in the file holder near the desiccator cabinets.

Potentially hazardous materials in the lab include:

NiCd batteries (4)  
 AGM Batteries (1)  
 Turbidimeter calibration standards  
 Contaminated water samples  
 Compressed air

### **3. Filter Preparation and Storage**

**Important: Filters must always be handled with forceps, and gloves must be worn during filter preparation and use.**

1. Using forceps, remove filters from the box and separate carefully.
2. Visually inspect filters for holes or tears. Discard defective filters.
3. Rinse manifold platforms and filter funnels with DI water.
4. Remove the magnetic filtration cups from the six manifold stages.
5. Place new filters on all six manifold stages, rinse with DI water to create adherence to the manifold stages.
6. Open the pressure valves to pull DI rinse water down through the filters.
7. Check filters for holes by listening for a whistling sound, emitted as air passes through a hole in the filter.
8. Watch for filter centers to change from transparent to white, indicating that most of the moisture has been removed. (Pressure on the vacuum valve will be between 14- 17 in. Hg)
9. Carefully remove filters with forceps.
  - o When removing filters, grasp with forceps at the most outer edges of the filters, never grasp from the center of the filter.
10. Place each filter into a clean, numbered foil tray.
11. Place foil trays on clean baking sheet and allow to air dry until the full sheet of foils is filled.
12. Place baking sheet into oven and heat at 103° to 105°C for 30 minutes.
13. Remove baking sheet from oven.
14. Using tongs, place foil trays into Clean Filter Desiccator for cooling and storage.



15. Foil trays must cool in desiccator for at least 30 minutes (to reach room temperature) before being used for filtration.

#### 4. Crucible Preparation and Storage

Samples with a visibly elevated sediment content may be evaporated in glass crucibles or larger foil trays to reduce processing time and error.

1. Glass crucibles and foil trays are permanently numbered beginning with crucible number 901.
2. Clean crucibles and trays may be stored in the Clean Filter Desiccator between uses.
3. Crucibles and trays are washed with soap, rinsed with DI water after each use.
4. Place crucibles on a baking sheet and dried in the at 103° to 105°C for 30 minutes.
5. Remove baking sheet from oven.
6. Visually inspect crucibles for cracks, chips, or dirt.
7. Using tongs, place crucibles into Clean Filter Desiccator for cooling and storage.
8. Crucibles must cool in desiccator for at least 60 minutes before being used for sample processing.

#### 5. Turbidity Measurements

Selected samples may be measured for turbidity. Measurements are typically conducted on 12 bottles in a 24 bottle set. Turbidity measurements can only be conducted on samples that have already been weighed in, and have been brought to room temperature to avoid error due to condensation. Gloves should be worn at all times when measurements are being conducted.

1. Check to make sure the instrument is in Automatic range by pressing the RANGE button.
2. Check to make sure that Signal averaging is turned on by pressing the SIGNAL AVG button.
3. Make sure sample bottle is tightly capped.
4. Vigorously shake sample bottle to re-suspend sediment. Allow sample to rest for 30 seconds after mixing.
5. Over a clean glass beaker, pour 30ml of sample into the sample cell to the line indicated on the glass sample cell. Take care to handle the sample cell by the top.
6. Cap the sample cell, wipe off any water spots or smudges with KimWipes.
7. Apply a thin bead of silicone oil, and use the velvet oiling cloth to wipe the oil over the cell.
8. Place the sample cell in the instrument, aligning the arrow on the cell to the notch in the instrument compartment.
9. Close the lid of the compartment.
10. The unit will begin measurements immediately, record the result indicated within the first 10 seconds of measurement. Turbidity readings will decline as the sediment settles out of the sample over time.
11. Record the result on a new RITR label, and place on the bottle next to the sample information label.
12. Pour the water from the sample cell back into the sample bottle. Rinse the sample cell with DI water, and pour the rinse into the sample bottle. (Note: It is important to recapture all of the suspended sediment from the original sample for processing. It is also important not to add any weight (DI water rinse) to the bottle unless it has

- already been weighed in. Water weight is important- but once the sample has been weighed in, extra weight from DI rinseate water won't be factored into the lab record. (So don't re-weigh after putting the rinseate DI water into the bottle.))
13. Recap the bottle and place into storage container.

## 6. Sample Log in and Filter Assingment.

Samples are not logged in to the computer until they are ready to be filtered and processed. All samples are logged in using the 'Samples' form in the Suspended Sediment Database, seen below.

Before the sample login information is entered, it is important to determine whether the sample should be analyzed separately for sand and fine particles, or just fine particles. Samples with high levels of turbidity (>100NTU) are good candidates for separate sands/fines analysis.

If the sample will only be processed for 'fines', only one sample login is recorded. If the sample will be processed separately for sands and fines, two different records will need to be created for the same sample.

Sediment Sample Login Page			
Record Created	<input type="text"/>	<i>These fields are locked and cannot be edited. They are updated automatically when records are created or changed.</i>	
Record Edited	<input type="text"/>		
<b>Data Entry Tech</b>	<input type="text"/>		
Date Sample Collected	<input type="text"/>	Example 01/01/2011 01:00 AM	
Site Code	<input type="text"/>		
Bottle ID	<input type="text"/>		
Incoming Weight (grams)	<input type="text"/>	Enter whole number, no units.	
<b>Sample Analysis Tech</b>	<input type="text"/>		
Date Sample Processed	<input type="text"/>	Enter date of laboratory analysis.	
<b>Sample Type</b>	Fines		
Turbidity (NTU)	0		
Remarks	<input type="text"/>		
Stage Height (ft)	0		
<div> <div>Filter Records</div> <div> <div>Filter Tare Weight <input type="text"/></div> <div>Dish Number <input type="text"/></div> <div>Filter with Sample <input type="text"/></div> </div> <div> <div>Remark <input type="text"/></div> <div>Invalid <input type="checkbox"/></div> </div> </div>			
Record: 1 of 1    No Filter    Search			
True Wet Weight (grams)	<input type="text"/>	<i>These fields are calculated automatically, do not enter values in these fields.</i>	
Sediment Weight (grams)	<input type="text"/>		
Coarse Fraction mg/L	<input type="text"/>		
Fines Fraction mg/L	<input type="text"/>		

<b>Field Title</b>	<b>Purpose</b>	<b>Entry Instructions</b>
Record Created	Tracks when records are created.	Locked field, no entry permitted.
Record Edited	Tracks when records are changed or updated.	Locked field, no entry permitted.
Data Entry Tech	Records the name of staff person logging sample data into the database	Enter the name of the staff person logging sample information and assigning filters to samples.
Date Sample Collected	Records date and time when samples are collected in the field	Enter date and time on bottle label, using 24-hour clock. For midnight enter 00:00:01.
Site Code	Records which site samples are from.	Enter 3 letter site code, SLU, WAL CAN. For blanks enter BLK.
Bottle ID	Records which bottle is being used, subtracts tare weight	Enter 3 letter site code, bottle set letter, bottle number. Only bottles already logged into the system will be permitted for entry in this field.
Incoming Weight	Records weight of bottle with sample. Should not include weight of cap.	Enter incoming wet weight, in grams, as written on bottle label.
Sample Analysis Tech	Records name of staff person filtering the sample through the manifold.	Enter the name of the staff person filtering the sample on the manifold.
Date Sample Processed	Tracks when samples and filters are processed.	Enter date that sample processing starts.
Sample Type	Denotes whether the processing is for sand sized particles or fine sized particles.	Choose either sands or fines from the drop-down menu.
Remarks	Notes anything unusual about the sample.	Note low sample volume, if sample has spilled, if there is algal growing in the bottle.
Turbidity (NTU)	Record turbidity reading for the sample.	Enter this value if a turbidity measurement has been conducted on the sample.
Stage Height	Identifies creek stage when sample was collected.	Enter the corresponding stage height if available.
True Wet Weight (grams)	Calculates the weight of the sample. Automatically subtracts the tare weight of the bottle containing the sample.	This field is locked and calculates results automatically. It is shown only to reference the weight of the sample being analyzed.
Sediment Weight (grams)	Calculates the net weight of sediment collected on all assigned filters or crucibles by subtracting the tare weight of all assigned crucibles and filters.	This field is locked, and is shown to indicate the raw net sediment weight of the sample.

Field Title	Purpose	Entry Instructions
Coarse Fraction (mg/L)	Uses the 'True Wet Weight' and 'Sediment Weight' fields to calculate the fine sediment concentration of the sample in parts per million.	This field is locked, and is only shown to display the sediment concentration of the sample.
Fine Fraction (mg/L)	Uses the 'True Wet Weight' and 'Sediment Weight' fields to calculate the coarse/sands concentration of the sample in parts per million.	This field is locked, and is only shown to display the sediment concentration of the sample.

The filters assigned to each sample are recorded in a sub-form of the sample login form. The Filter Records form functions independently from the sample login form, but is electronically linked to the information in the sample login form. This form allows the data entry tech to assign unlimited filters to a single sample.

Filter weights are transferred directly to the sub-form electronically. To enable the transfer of weights to the database the CPS Plus software must be opened and running concurrent with the Access database. This will allow for automatic transmission of weights to the database.

To transfer weights to the database- point the cursor to the desired cell block and click to activate the cursor. Press 'PRINT' on the scale to transmit the weight to the cell block. (Note: The software does not automatically transfer the digit for the tens place from the scale to the database. The value must be manually entered.)

Field Title	Purpose	Entry Instructions
Filter Tare Weight (grams)	Records the weight of the clean filter and dish, or crucible, assigned to the sample.	When the filter has been placed on the fine balance and the weight has stabilized, press 'Print' on the balance to transmit data to this field directly.
Filter With Sample (grams)	Records the weight of the used filter and dish, or crucible, assigned to the sample.	When the fine balance has stabilized, press 'Print' on the balance to transmit data to this field directly.
Dish Number	Tracks the dishes or crucibles assigned to the sample.	Type in the three digit number of the filter, written on the tab of the foil dish.
Remarks	Notes any problems with the filter or crucible during processing.	Enter notes as needed.
Invalid	Checkbox used to invalidate filters or crucibles that have been incorrectly assigned or damaged. Checking this box halts all automatic data calculations for the sample.	Check this box when filters have been damaged or contaminated. Checking this box will cancel the calculation of the fines or coarse fraction for the whole sample.

## 7. Basic (Fines) Sample Login

1. Remove samples from long term storage and inspect visually.
2. Bottles from each set should be dry, with roughly equal volume samples.
3. In the 'Suspended Sediment' master database, open the form called 'Samples'.
4. Enter the following fields in order:
  - a. Data entry tech (the staff person logging samples into the database)
  - b. Date sample collected. (Time entered as 24 hour clock.)
  - c. Site code
  - d. Bottle ID (An error message will pop up if your bottle is not identified in the database.)
  - e. Incoming Wet Weight
  - f. Sample analysis tech (the staff person performing the filtration on the sample)
  - g. Date Sample Processed
  - h. Sample Type (Fines)
  - i. Turbidity
    - i. Enter turbidity measurement indicated on bottle if available.
  - j. Stage Height
    - i. Enter stage height measurement indicated on bottle if available.
  - k. Remarks
    - i. Use this field to note unusual sample volumes (bottles that may have underfilled), floating debris, or macroinvertebrates in the sample.

Activate the 'Filters' sub-form of the Samples form to assign filters to the sample in accordance with protocol below.

## 8. Assigning Filters or Crucibles

Depending on the sediment content of samples, they may require from one to six or more filters to process the entire sample. Samples with substantial sediment content may be processed in crucibles as well as filters. Reviewing the stage data and processing samples in the order they were taken in the field will help determine the number of filters needed for each sample.

1. Use tongs to remove clean and dry filters from 'Clean Filter Desiccator'.
  - a. Only remove as many filters as you can use in a ten-minute period. Filters will pull moisture from the air which will result in an artificially high tare weight.
2. Place one filter or crucible on the fine scale balance and close all of the glass doors.
  - a. Close glass doors gently! Pulling doors closed with force can upset the balance of the scale, and produces an immediate effect on the weight of the filter. The weight of the filter will take longer to stabilize if the door is not closed gently.
3. Place the mouse pointer into the 'Filter Tare Weight' field and activate the field.
4. When the weight has stabilized on the balance, press 'Print' on the balance to transmit data to the field.
5. Enter the three digit number written on the foil tab or crucible into the 'Dish Number' field.
6. To assign an additional filter, press the new record form located within the subform. (Indicated by the right pointing arrow and yellow star symbol)

## 9. Sands/Fines Sample Login

1. Create a full record for 'Fines' processing for the sample. Assign filters as needed to collect fine particles.
2. Create a second Sample record for the 'Sands' information. Enter the identical sample information from the bottle as noted in Step 4 of the Basic Sample Login. Make sure that the new record specifies 'Sands' as the sample type.
3. Assign a separate series of crucibles or filters to the sample record for 'Sands' using the filters subform in the database.
  - a. Typically, this will involve a glass crucible, or large foil dish for collecting the sands.
4. Proceed with sample filtration only when BOTH the sands and fines login records have been created for the sample.

## 10. Filtering Samples

It is important to observe the vacuum pressure exerted on the manifold when filtering samples. Pressure applied to the filters should not exceed 20 in. Hg. If filtering on several stations concurrently, leave one station clear so that vacuum pressure can be relieved.

### **For samples that require a single filter:**

1. Turn on the vacuum pump and open all of the valves on the manifold.
2. Rinse down all stations on the manifold to clear any debris or dust that might have settled on the surface.
3. Remove one of the magnetic cups and center the filter on top of the black filtering surface.
  - a. Filters should be handled with forceps and should not be 'flipped'. The side of the filter 'face-up' in the foil dish should be the side 'face-up' on the manifold.
  - b. If filters are not carefully centered on the manifold they may prevent the magnetic cup from sealing properly, and the sample may leak out of the cup.
4. Place the empty foil dish directly beneath the filter station. Filters and dishes are not transferable! It is important to keep the filter with the assigned dish throughout the process.
5. Wet down the filter with DI water and inspect the filter for contamination or tears.
6. Replace the magnetic cup on top of the manifold station over the wet filter.
7. Slowly pour the sample into the magnetic cup, being careful not to splash water out of the cup.
8. Hold the sample bottle cap over the magnetic cup and rinse down the cap with DI water.
9. Hold the sample bottle over the magnetic cup and rinse down the inside of the bottle with DI water. Tilt the bottle at an angle to flush out any particles trapped in the neck of the bottle.
10. When all of the sample and rinse water has filtered through the filter, rinse down the inside of the magnetic cup with DI water.
11. Watch the filter carefully to see that all water drains through the filter.
12. Switch off the suction to the station and remove the magnetic cup.
13. Using forceps, carefully slide the filter back into the assigned foil tray.
  - a. Handle the filter along the edges only to avoid removing any particles that are accumulated on the center of the filter.

- b. It is important not to tilt or flip the wet filter as sands or other large particles may fall off of the filter.
- 14. Place the foil tray with filter onto a large baking sheet.
- 15. Allow wet filters to air dry on baking sheet until the baking sheet is full.

\*Process the blank sample using the protocols for filtering with a single filter. One blank sample should be run for each bottle set (24 bottles) that comes in from the field.

**For Fines samples that require multiple filters:**

1. Turn on the vacuum pump and open all of the valves on the manifold.
2. Rinse down all stations on the manifold to clear any debris or dust that might have settled on the surface.
3. Remove the magnetic cups and center the filters on top of the black filtering surface.
  - a. Filters should be handled with forceps and should not be 'flipped'. The side of the filter 'face-up' in the dish should be the side 'face-up' on the manifold.
  - b. Do not place filters on more than 5 stations at the same time. One station must remain open to relieve pressure to the vacuum.
4. Place the empty foil dish directly beneath the filter station. Filters and dishes are not transferable! It is important to keep the filter with the assigned dish throughout the process.
5. Wet down the filters with DI water and check the filter for contamination or tears.
6. Replace the magnetic cup on top of the manifold station.
7. Place filters on up to 5 stations. Leave the sixth station clear so that vacuum pressure can be relieved if needed.
8. Slowly pour between 50 to 100ml of the sample onto each of the filters in turn.
  - a. While pouring, a white cross will appear across the center of the filter. The disappearance of this cross (filter turning uniformly brown) is an indication that the filter may be nearing capacity for filtering water.
9. Watch the vacuum pressure as each of the manifolds begin to pull water through the filters.
  - a. If the draw down of water is initially quick, but then slows, purge the vacuum line of water by opening the valve on the empty station. Allow the empty station to draw air into the suction line and push the filtered water towards the carboy.
  - b. If vacuum pressure rises to 19 in. Hg, open the valve on the empty station to relieve the pressure.
10. Close the valve at the empty station to increase the pressure on the filtering stations.
11. Open and close the valve at the empty station as needed to continue filtering without exceeding 19in Hg pressure.
12. When the majority of the sample volume has been poured out, carefully use DI water to dislodge remaining particles in the bottom of the bottle.
13. Distribute the remaining sample among the filters.
14. Hold the sample bottle over one of the magnetic cup and rinse down the inside of the bottle with DI water. Tilt the bottle at an angle to flush out any particles trapped in the neck of the bottle.
15. Hold the sample bottle cap over one of the magnetic cups and rinse down the cap with DI water.

16. When all of the sample and rinse water has filtered through the filters, rinse down the inside of the magnetic cups with DI water.
17. Watch the filters carefully to see that all water drains through the filters.
18. Switch off the suction to the station and remove the magnetic cup.
  - a. Particles may stick to the inner rim of the magnetic cup if a sample with particularly heavy sediment content is filtered on a single sample.
  - b. Once the magnetic cup has been removed from the completed sample, place the magnetic cup inside the cup of another filter that has been assigned to the same sample.
  - c. Rinse the inner edges of the nested magnetic cup into the cup that still contains a filter. This will capture any sediment in the sample that may have been lodged to the inside of the sample cup.
19. Using forceps, carefully slide the filters back into their assigned foil trays. It is important not to tilt or flip the wet filter as sands or other large particles may fall off.
20. Place the foil trays with filters onto a large baking sheet.
21. Allow wet filters to air dry on baking sheet until the baking sheet is full.

**For samples that are processed for Sands and Fines separately:**

1. Separate the filters and crucibles that have been assigned to the Fines record from those that have been assigned to the Sands record.
2. Filtration for **Fines** takes place first, followed by **Sands**. Group and set aside the filters and dishes that have been assigned to the **Sands** record.
3. Rinse down all stations on the manifold to clear any debris or dust that might have settled on the surface.
4. Remove the magnetic cups and center filters on top of the black filtering surface.
  - a. Filters should be handled with forceps and should not be 'flipped'. The side of the filter 'face-up' in the dish should be the side 'face-up' on the manifold.
  - b. Do not place filters on more than 5 stations at the same time. One station must remain open to relieve pressure to the vacuum.
5. Place the empty foil dishes directly beneath the filter stations.
  - a. Filters and dishes are not transferable! It is important to keep the filter with the assigned dish throughout the process.
6. Wet down the filters with DI water and check the filter for contamination or tears.
7. Replace the magnetic cup on top of each manifold station.
8. Place the metal sands filter in the top of one of the magnetic cups that overlies a filter.
9. Slowly pour sample water through the sands filter into the magnetic cup.
10. Pour slowly and evenly, avoid suspending or mixing particles that have settled to the bottom of the sample. While pouring, a white cross will appear across the center of the filter. The disappearance of this cross (filter turning uniformly brown) is an indication that the filter may be nearing capacity for filtering water.
11. When the first filter has reached capacity, carefully move the sands filter to the magnetic cup of a second filter. Proceed with pouring the sample through the sands filter and into the cup until the second filter has reached capacity.
  - a.
12. Once the majority of the sample has been poured through the sands filter and onto the fines filters, swirl the remaining liquid (50-100ml) to resuspend the settled sediment within the sample.



13. While suspended, pour the remaining sample into the sands filter while overlying a clean fines filter.
14. Thoroughly rinse the sand particles in the sands filter to flush any fine sediments down into the magnetic cup.
  - a. The rinse water from the sands filter should be running clear to ensure that all fine particles have been flushed onto the fines filters.
15. When all of the sample and rinse water has been poured from the ISCO bottle and filtered through the sands filter and onto the fines filters, rinse down the inside of the magnetic cups with DI water.
16. Watch the filters carefully to see that all water drains through the filters.
17. Switch off the suction to the station and remove the magnetic cup.
  - a. Particles may stick to the inner rim of the magnetic cups if a sample with particularly heavy sediment content is filtered on a single sample.
  - b. Once the magnetic cup has been removed from the completed sample, place the magnetic cup inside the cup of another filter that has been assigned to the same sample.
  - c. Rinse the inner edges of the nested magnetic cup into the cup that still contains a filter. This will capture any sediment in the sample that may have been lodged to the inside of the sample cup.
18. Using forceps, carefully slide the filters back into their assigned foil trays. It is important not to tilt or flip the wet filter as sands or other large particles may fall off.
19. Place the foil trays with filters onto a large baking sheet.
20. Once all of the fines have been flushed onto assigned filters the sands can be transferred to the assigned crucible or foil dish.
21. Use DI water to rinse all of the sand into one corner of the sands filter
  - a. It is permissible to rinse the sands in the filter over the sink, using as much DI water as needed to accumulate all the particles into one mass. All of the fines should already have been flushed onto filters, so capturing rinsewater is not necessary at this stage.
  - b. Take care not to rinse any sands OUT of the filter.
22. Hold the sands filter over the assigned crucible or foil tray and use DI water to flush all of the sands into the crucible.
  - a. All of the sand particles and a small volume of DI water (~100ml) should be captured in the dish.

\*Process the blank sample using the protocols for filtering with a single filter. One blank sample should be run for each bottle set (24 bottles) that comes in from the field.

## 11. Drying Samples

Used filters and crucibles should be placed on a baking sheet in preparation for drying. Once the baking sheet is full, place baking sheet into the oven to dry samples. Crucibles can also be placed into one of the square or rectangular baking pans.

1. If not already on, turn on the oven. and set the thermostat to 225° F
  1. Place baking sheets with filters, or pans with crucibles into oven.
    - a. Never mix 'clean filters' and 'used filters' on the same baking sheet.
  2. Bake from three to 24 hours. Minimum drying time for processed filters is 3 hours.

3. Crucibles must be baked for 1 hour after all visible water has evaporated. Minimum drying time for crucibles is around 8 hours.
4. Remove baking sheets from oven.
5. Using tongs, carefully transfer foil trays with filters and crucibles into the 'Sediment Sample Desiccator'.
6. Filtered samples should cool in the desiccator for 30 minutes before they are weighed. Glass crucibles should cool in the desiccators for 60 minutes before they are weighed.

## 12. Final Filter and Crucible Weights

The fine scale balance should be checked for accuracy before weighing in any filters or crucibles. It is also important to watch the scale for signs of drift when weighing filters for an extended period of time.

1. Make sure the bubble level in the back left corner of the scale is centered.
2. Turn the scale on. The scale display should fill in completely to indicate a self-check.
3. Make sure the surface of the scale is clean and all of the glass doors are closed.
4. Complete the scale calibration and weight checks described in the Equipment Accuracy and Calibration section of this protocol.
5. Open the form called 'Final Weights'.
6. Locate the dish number that corresponds to the dish being weighed. Dishes are listed in ascending order.
7. Using the tongs, place the dish with filter or crucible onto the fine scale balance and close the glass doors.
8. Place the mouse pointer into the 'Filter With Sample' field and activate the field.
9. When the weight has stabilized on the balance, press 'Print' on the balance to transmit data to the field.
10. After weighing several dishes, save changes and close the form. Re-opening the form will limit the display to only the filters that are missing a final weight.

## **C. Data Management**

The database should be copied and saved to a USB data transfer device twice each month. The database is then downloaded from the USB device to a staff computer at the MBNEP office and saved to a specified folder on the server. The back-up of the server created weekly and stored in a fireproof box.

Database copies can be made and transferred more frequently when a high volume of samples is being processed at the lab.

A query has been developed so that a hard copy of all sample results can be created. The query is run twice a month during times of sample processing. These paper records are stored at the lab.

## Appendix L. Department of Public Health Protocol for Fecal Coliform Sampling

## **APPENDIX A**

### **2013 SAMPLING PROTOCOL FOR SHELLFISH GROWING AREA WATER QUALITY MONITORING BY: GRASSY BAR OYSTER COMPANY, MORRO BAY 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 1 per sample, or other appropriate form (Chain of Custody).
3. Water sampling pole (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 or instrument.
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.
11. Appropriate data field sheet.
12. Utility boat in safe operating condition with required safety and personal flotation equipment.

#### **B. WATER SAMPLING 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 B-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 (see 2.k. for discussion of holding temperature exceptions).
- i. Record water temperature and salinity at each station. Take temperature of water collected in a bucket or alongside boat; do not insert thermometer or anything else into sterile sample bottle.
- j. 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).
- k. 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 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 g. such that an increase in temperature does not occur.

This monitoring protocol is being conducted at the following sites in Morro Bay.

Site Code	Latitude	Longitude
WQ #3	35.36771	-120.8642
WQ #3D	35.36771	-120.8642
WQ #5A	35.36590	-120.8550
WQ #5B	35.35620	-120.8502
WQ #5C	35.34640	-120.8468
WQ #58	35.34510	-120.8516
WQ #65	35.35130	-120.8572
WQ #64	35.34660	-120.8558
WQ #70	35.33980	-120.8455
WQ #71	35.33590	-120.8397
WQ #75	35.33410	-120.8397
WQ #79	35.33710	-120.8397
GS1	35.33384	-120.8186
PAS	35.32999	-120.8445
TWB	35.35444	-120.8278
TID	35.35982	-120.8519
SPM	35.34627	-120.8433

## Appendix M. Morro Bay Volunteer Monitoring Program Equipment Calibration Protocols

# Morro Bay Volunteer Monitoring Program

## Equipment Calibration Protocols

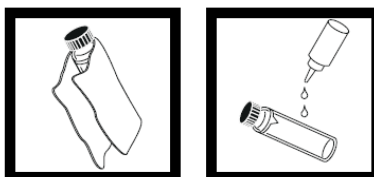
### Hach 2100 Turbidimeter

This instrument is designed for long-term stability and minimal need for recalibration. It is recommended that recalibration be performed at least once every three months, or more often if experience indicates a need. To guarantee accurate calibration, use only the formazin standards issued by Hach.

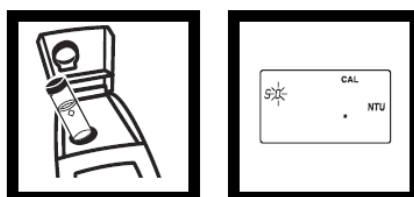
The formazin calibration standards have a long shelf life, but must be stored properly. Standards should be stored in their respective kit with cover in place, out of direct sunlight. For long term storage, refrigeration at 5° C is recommended, do not store above 25° C.

#### Calibration:

- Shake the standard vigorously for 2-3 minutes to resuspend particles. Do NOT shake the < 0.1 NTU standard, only the 20 NTU, the 100 NTU and the 800 NTU standards.
- Allow standard to stand undisturbed for 5 minutes.
- Gently invert the bottle 5 to 7 times.
- Prepare the sample cell for measurement using traditional preparation techniques. (Oil the sample cell and wipe with velvet cloth).



- Let the cell stand for one minute after oiling.
- Insert the <0.1 ntu standard cell, align the orientation marks on the cell and chamber. Close the lid and press the **I/O** button to turn on the meter.
- Press the **CAL** button, both the **SO** and **CAL** buttons will be displayed and the '0' will flash.



- Press **READ** and the meter will count down from 60 to 0, read the sample and calculate the correction factor.



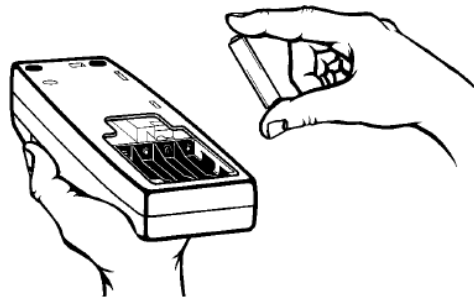
- The display will show the 20.00 ntu value on the screen. Insert the 20.00 ntu standard with correct alignment and press the **READ** button.



- Repeat these procedures sequentially for the remaining standards as the meter prompts.
- After reading the final standard (800 ntu), the meter will re-display the **S0** screen from the beginning of the calibration.
- Remove the 800 ntu standard and press **CAL** to accept the calibration.

#### **Battery Replacement:**

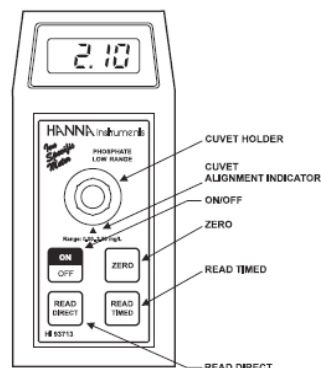
- This meter works on 4 AA-size alkaline batteries. Brand name 'digital' batteries are recommended for best performance.
- Remove the battery compartment cover on the bottom of the meter to install new batteries.
- Check the polarity diagram on the inside of the panel to ensure correct installation.



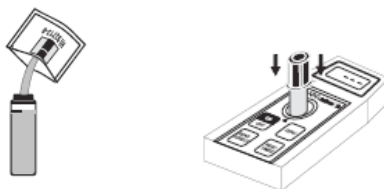
## Hanna Phosphate Meter Calibration Protocol

This instrument is designed for long-term stability and minimal need for recalibration. This meter cannot be calibrated in house, however, due to variations in accuracy against quality assurance tests this meter is given a two point test on a quarterly basis.

### Calibration:



- Remove the cap of a glass cuvet and rinse thoroughly with DI water.
- Using a syringe, fill the cuvet up to the 10ml line with DI water as the 0.0mg/L standard and replace the cap.
- Record the calibration standard value in the calibration log.
- Turn the meter on by pressing the **ON/OFF** button. When the meter displays --- it is ready to take measurements.
- Remove the travel cap and place the cuvet into the holder. Ensure that the notch on the cap is positioned securely in the groove.
- Press the **ZERO** button and **SIP** will appear on the screen. Wait a few seconds for the '0.0' reading to appear on the screen indicating that the sample has been zeroed effectively.
- Remove the cuvet and add a packet of the reagent. Swirl gently for thirty seconds.



- Reinsert the cuvet into the holder and wait two minutes for the reaction to complete. Press the **READ DIRECT** button..
- 
- Record the result in the post-calibration area on the calibration log.
- Repeat above procedures with the 1.0 mg/L PO<sub>4</sub> calibration standard.

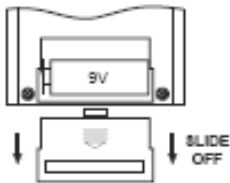
### Battery Replacement:

The meter can signal a need for battery replacement in two ways. A small ‘V’ appears in the upper right corner of the display to indicate low remaining voltage.

The meter signals that batteries have died by displaying a **-BA-** warning when the meter is turned on. (See displays below.)



This meter requires one alkaline 9-volt battery that can be installed by sliding open the panel on the bottom of the meter.

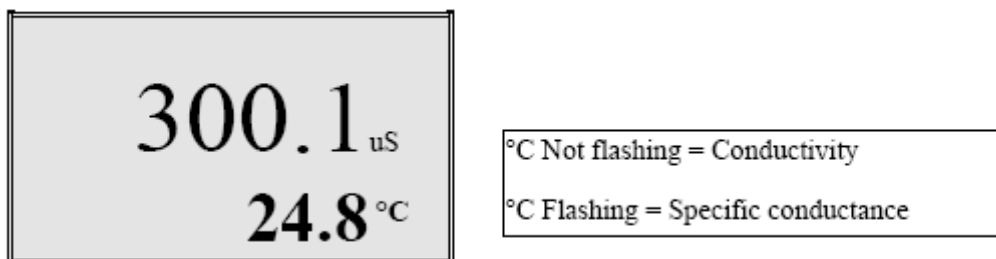


## YSI 30 and 85 Salinity Meter Calibration Protocol

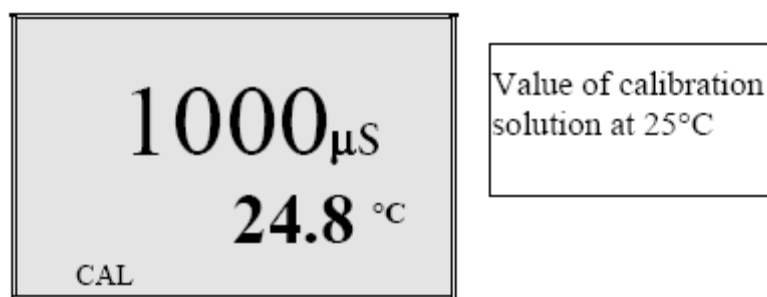
### **Calibration:**

The YSI 30 meter requires only a single point calibration to adjust the meter for all parameters. As the VMP uses these meters in brackish and saline waters, a 15,000 $\mu$ S or 50,000  $\mu$ S standard is suitable for most testing.

- Turn the instrument on and allow it to complete its self test procedure.
- Select a calibration solution most similar to the sample the meter will be measuring.
- Pour at least 3 inches of solution into a clean glass calibration jar.
- Insert the probe into the beaker deep enough to completely submerge the oval shaped hole on the side of the probe. Do not rest the probe on the bottom of the container, suspend it above the bottom by at least ¼ inch.
- Press the mode key until the instrument is reading conductivity or specific conductance. (Indicated by the display below).



- Allow at least 60 seconds for the temperature reading to become stable.
- Move the probe vigorously from side to side to dislodge any air bubbles from the electrodes.
- Press both the UP ARROW and DOWN ARROW keys at the same time. The CAL symbol will appear on the bottom left of the display to indicate the meter is now in calibration mode.



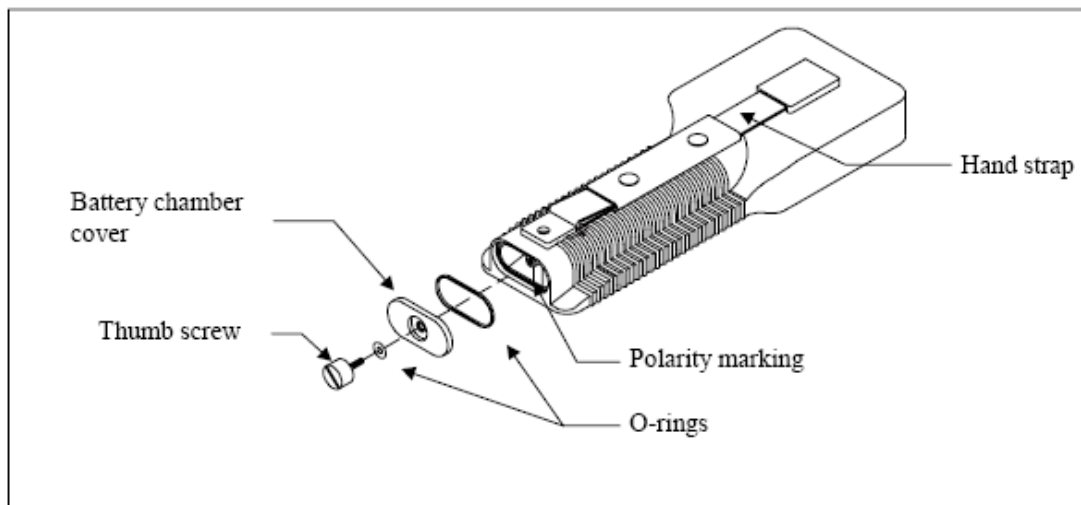
- Use the UP ARROW or DOWN ARROW key to adjust the reading on the display until it matches the value of the calibration solution you are using.
- Once the display reads the exact value of the calibration solution being used (the meter will make the compensation for temperature variation) press the ENTER key.

- The word SAVE will flash across the display for a second indicating that the calibration has been accepted.



### **Battery Replacement:**

- This meter works on 6 AA-size alkaline batteries. Brand name 'digital' batteries are recommended for best performance.
- Use a screwdriver or small coin to remove the thumbscrew on the bottom of the instrument and open the battery chamber.
- The battery chamber is marked with the words OPEN and CLOSE to guide you.
- Check the labels inside the two battery chambers that illustrate the correct polarity of the batteries



## YSI 85 Dissolved Oxygen Meter Calibration Protocol

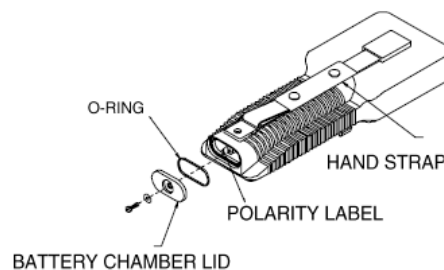
Before calibrating, determine if meter is being calibrated for fresh water (creeks) or salt water (bay) monitoring. Determine the approximate altitude of the area where the meter will be used.

### **Calibration:**

- Ensure that the sponge inside the instrument's calibration chamber is saturated with de-ionized water.
- Rinse the probe with de-ionized water.
- Insert the probe into the calibration chamber.
- Turn the instrument on by pressing the ON/OFF button.
- Wait for the dissolved oxygen and temperature readings to stabilize, approximately 15 minutes.
- To enter calibration menu, press both the UP ARROW and DOWN ARROW keys at the same time.
- The screen will prompt you to enter the local altitude in hundreds of feet, use arrow keys to increase or decrease the altitude.
- When the proper altitude appears on the screen press the ENTER key.
- Model should now display CAL in lower left of display, the calibration value is displayed in the lower right of the display and the current DO reading should be on the main display.
- Make sure that the DO reading on the main display is stable, press ENTER.
- For Model 30, Screen will prompt you to enter salinity of water being analyzed use UP ARROW and DOWN ARROW to adjust to the following:
  - For freshwater enter 0.0 ppt
  - For saltwater enter reading taken using YSI 30 Salinity meter, up to 40.0 ppt.
- Once calibration is complete only the MODE and ON/OFF keys will remain operational.

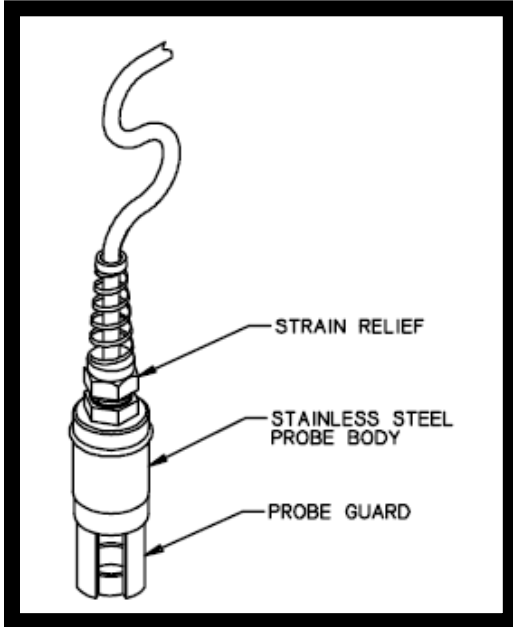
### **Battery Replacement:**

- This meter works on 6 AA-size alkaline batteries. Brand name 'digital' batteries are recommended for best performance.
- Use a screwdriver or small coin to remove the thumbscrew on the bottom of the instrument and open the battery chamber.
- The battery chamber is marked with the words OPEN and CLOSE to guide you.
- Check the labels inside the two battery chambers that illustrate the correct polarity of the batteries.



### **Probe Conditioning:**

- For the Model 85's, unscrew the membrane cap.
- If triangular silver anode appears tarnished,(it should appear white) soak in 3% ammonium hydroxide, and rinse with DI water.
- If gold cathode appears tarnished, clean using the probe reconditioning kit. Rub the gold cathode ring gently with tarnish cloth until shine is restored.
- To install new membrane on the Mode 85s, add electrolyte solution and then screw on a new membrane cap.
- Rinse with de-ionized water and reinstall sensor guard.
- Allow meter to stabilize in humid calibration chamber overnight before re-calibration.



## Oakton pH Testr 30 pH meter

### Calibration:

This meter must be rinsed with tap water and not with deionized water.

- Ensure that the sponge in the cap of the meter is damp.
- Remove the cap and rinse the meter with tap water.
- Turn the meter on and insert into the first calibration solution. We will be using 7.0 and 10.0 solution.
- Wait two minutes for the reading to stabilize, and record value as the pre-calibration reading on the calibration sheet.
- Remove the meter from the solution. Rinse the probe and dry with a Kim Wipe. Place in the second calibration solution.
- Wait two minutes. Record the value as the pre-calibration reading on the calibration sheet.
- Push the CAL button to enter the calibration mode. The CAL indicator will be displayed. The upper display will show the measured reading based on the last calibration while the lower value is the pH standard solution.
- Place the meter in the first calibration solution. Allow two minutes for the meter to stabilize.
- Press the HOLD/ENT button to accept the first calibration point. The upper display will be calibrated to the pH calibration standard and the lower will be toggling between the readings of the next pH standards.
- Rinse the probe with tap water, dry with a Kim Wipe and insert in the next calibration solution.
- Wait two minutes and then push the HOLD/ENT button to accept the second calibration point.
- The meter is now flashing to be calibrated in a third calibration standard, but we do not use a third standard. Push CAL to skip the remaining calibration point and exit to the measurement mode.
- Place the now calibrated meter in one of the calibration solutions. Wait two minutes for the meter to stabilize, and then record a post-calibration reading.
- Rinse the probe, dry and then take a post-calibration reading in the other calibration standard and record on the datasheet.
- Rinse meter and replace cap. Store in plastic box.

The pH meters must be calibrated on a weekly basis.



## **Protocol for Winkler Titration to Verify DO Meter Accuracy To be Conducted by VMP Staff Only**

### **Equipment:**

- 1 L beaker
- Magnetic stirrer
- Stirring plate
- DI water
- Dissolved Oxygen Test Kit (HACH, Cat. No. 1469-33)

### **Procedure:**

1. Rinse all testing materials with DI water.
2. Conduct the High Range Test (1-20 mg/L)
3. Fill the beaker with DI water.
4. Place a stirrer in the water and place the beaker on the stirring plate.
5. Set the stirrer to the maximum rate and allow the water to mix for 2 minutes.
6. Turn off the stirrer and use the beaker to fill the DO bottle (round bottle with glass stopper). Allow sample water to overflow the bottle and avoid turbulence and bubbles in the sample while filling.
7. Replace the beaker on the stirring plate and turn the stirrer on to the maximum.
8. Place the DO meter probes into the beaker, making sure that they are fully submerged.
9. Conduct the Winkler DO test on the sample. Incline the bottle slightly and insert the stopper with a quick thrust to avoid trapping air bubbles. If bubbles become trapped, discard the sample and repeat the test.
10. Remove the stopper and add the contents of one Dissolved Oxygen 1 Reagent Powder Pillow and one Dissolved Oxygen 2 Reagent Powder Pillow. Stopper the bottle carefully to avoid trapping air bubbles. If bubbles become trapped, discard the sample and repeat the test.
11. Shake the bottle vigorously to mix. Flocculant (floc) precipitate will form. Brownish-orange precipitate indicates oxygen is present.
12. Wait for floc to settle to approximately half the bottle volume.
13. Shake the bottle vigorously.
14. Wait for floc to settle halfway.
15. Remove the stopper and add the contents of one Dissolved Oxygen 3 Reagent Powder Pillow. Stopper the bottle carefully to avoid trapping air bubbles. If bubbles become trapped, discard the sample and repeat the test.
16. Shake the bottle vigorously to mix. Floc will dissolve and the sample will turn yellow if oxygen is present.
17. Fill plastic tube full (to the top) with prepared sample.
18. Pour the contents of the tube into a square mixing bottle.
19. Add Sodium Thiosulfate Standard Solution one drop at a time to the mixing bottle. Count each drop. Swirl to mix after each drop. Add drops until the sample becomes colorless.
20. The total number of drops of titrant equals the total mg/L Dissolved Oxygen. Compare to the read-outs on the DO meters.
21. Record all values on the Equipment Calibration Log Sheet.
22. Discard waste in bottle labeled "Winkler Titration Waste Container."
23. Triple rinse all DO testing bottles with DI water.

# Equipment Calibration Log

## Morro Bay Volunteer Monitoring Program Equipment Calibration Log

Date	Name
------	------

**Turbidimeter: HACH 2100P**

Time of Calibration:

New Battery?

ID#	Standard	Pre-cal	Post-Cal	ID#	Standard	Pre-cal	Post-Cal
	< 0.1 NTU				< 0.1 NTU		
	Standard	Pre-cal	Post-Cal		Standard	Pre-cal	Post-Cal
	20 NTU				20 NTU		
	Standard	Pre-cal	Post-Cal		Standard	Pre-cal	Post-Cal
	100 NTU				100 NTU		
	Standard	Pre-cal	Post-Cal		Standard	Pre-cal	Post-Cal
	800 NTU				800 NTU		

**DO Meter: YSI 85**

Meter ID#	Winkler Titration Result (mg/L)	Meter Result (mg/L)	Time of Calibration	Battery Replaced?
DOE-MBV-4				
DOE-MBV-5				
DOE-MBV-6				
DOE-MBV-7				

**Salinity Meter: YSI 30**

ID#	Standard	Pre-cal	Post-Cal	Time of Calibration	Battery Replaced?
SAL-MBV-2					

**Conductivity: YSI 85**

**Morro Bay Volunteer Monitoring Program  
Equipment Calibration Log**

ID#	Standard	Pre-cal	Post-Cal	Time of Calibration	Battery Replaced?
DOE-MBV-4					
DOE-MBV-5					
DOE-MBV-6					
DOE-MBV-7					

**Conductivity: ECTestr 11+ Multi-Range, and Hanna HI 98312**

ID#	Manufacturer/ Model#	Standard	Pre-cal	Post-Cal	Standard	Pre-cal	Post-Cal	Time of Calibration
EC-MBV-3	Oakton/ECTestr11+							
EC-MBV-4	Hanna/HI98312							
EC-MBV-6	Hanna/HI98312							
EC-MBV-7	Hanna/HI98312							
EC-MBV-8	Hanna/HI98312							

Battery replaced?

ID#:

**DO Meter Maintenance**

Date:

Meter ID #:	Meter model #:	Membrane replaced:

pH Meter Calibration Logsheet

Date of Calibration	Time of Calibration	Meter ID#	Standard	Pre-cal	Post-cal	Changed Calibration Solution?	Initials
		PHEL-MBV-_____	7.0				
			10.0				
		PHEL-MBV-_____	7.0				
			10.0				
		PHEL-MBV-_____	7.0				
			10.0				
		PHEL-MBV-_____	7.0				
			10.0				
		PHEL-MBV-_____	7.0				
			10.0				
		PHEL-MBV-_____	7.0				
			10.0				
		PHEL-MBV-_____	7.0				
			10.0				
		PHEL-MBV-_____	7.0				
			10.0				
		PHEL-MBV-_____	7.0				
			10.0				
		PHEL-MBV-_____	7.0				
			10.0				
		PHEL-MBV-_____	7.0				
			10.0				
		PHEL-MBV-_____	7.0				
			10.0				

## **Bacteria Laboratory Equipment**

### **Thelco Model 2DG and Model #DM Incubators and Thermometers**

This instrument is to provide a controlled dry heat environment from 5°C to 70°C  $\pm$  0.5 °C for culture tubes or Petri dish incubations.

Each time a volunteer or staff member places samples in the incubator or removes samples, the temperature on the certified thermometer inside the incubator is recorded on a log sheet. The temperature on the certified thermometer should be at 34°C  $\pm$  0.5°C for IDEXX Colilert-18 incubation and 41°C  $\pm$  0.5°C for IDEXX Enterolert incubation. If the incubator is not at the desired temperature, the temperature control will be adjusted until the temperature is correct.

If the incubator thermometer is not within  $\pm$  0.5°C of the certified thermometer, the temperature difference will be recorded and the incubator temperature will be adjusted accordingly.

## Morro Bay Volunteer Monitoring Program Bacteria Laboratory Equipment Calibration Log

[illegible]

## Appendix N. Morro Bay Volunteer Monitoring Program Data Management Protocols

# Morro Bay Volunteer Monitoring Program

## Data Management Protocols

Revised August 2013

### Overview

All of the data that is collected for the volunteer monitoring program (except debris monitoring) is entered into an Excel database. Some of the projects are included in the CCAMP (Central Coast Ambient Monitoring Program) database, which is maintained by the Regional Board. The remaining projects have separate datasheets that were created by the VMP specifically for each project. Following is a list of the data that is collected and the file where it is entered.

Project	Data Entry File
Bacteria	...monitoring\data management\MBVMP database\MBVMP_Vers_**.xlsx
Water Quality and Flow	...monitoring\data management\MBVMP database\MBVMP_Vers_**.xlsx
Water Quality and Bacteria QA	...monitoring\data management\QA database.mdb
Dawn Patrol	...monitoring\data management\MBVMP database\MBVMP_Vers_**.xlsx
Phytoplankton	...monitoring\data management\MBVMP database\MBVMP_Vers_**.xlsx
Bioassessment and algae	Not applicable.
Suspended Sediment Data	...VMP DATA\SEDIMENT\SUSPENDED SEDIMENT.MDB
Eelgrass	...VMP DATA\EELGRASS\DATA-SUMMARIES\ VMP FIELD DATA <b>or</b> VMP BIOMASS DATA
Bird Survey	...VMP DATA\ BIRD SURVEYS \ DATA-SUMMARIES \ BIRD SURVEY DATA.xls
Stream Profiles	...VMP DATA\ STREAM PROFILES \ DATA-SUMMARIES \ PROFILE DATA <b>or</b> SUBSTRATE DATA
Volunteer Hours	...VMP ADMIN \ RECOGNITION \ VOLUNTEER HOURS \ VOLUNTEER HOURS.xls
New Volunteers	...DATABASE\NEW DATABASE\MBNEP.MDB



## CEDEN

The California Environmental Data Exchange Network (CEDEN) is a cooperative effort by many partners, including the Surface Water Ambient Monitoring Program and the Water Boards to exchange environmental data and make it accessible to the public. In order to load data into CEDEN, it must be entered into a series of upload templates. The VMP's data management system was reorganized to fit these CEDEN templates and organized into an Excel database named MBVMP\_Vers##.xlsx.

The ## refers to the version of the file. After entering a month's worth of data, new versions of the file are saved and numbered consecutively. Following is a general explanation of the worksheets that the VMP regularly uses:

The following is a list of the tabs contained in the database and what type of data they are used to manage.

Tab Name	Description of Data
WQUAL	Water quality monitoring data for creeks
FLOW	Flow data for creeks
Chorro Nutrients	Nitrate and orthophosphate data from targeted monitoring on Chorro Creek
BAC	Bacteria data for creeks and bay
San Luisito Bacteria	Bacteria data from San Luisito Creek
DAWN	Water quality data from early morning bay monitoring
Plankton Data	Phytoplankton pull data
MINI	Continuous water quality meter data
SITES	Monitoring site information
EQUIP	Monitoring equipment information
Sample Types	Codes for different types of samples
EquipCalData	Results for equipment calibration
Allowed Analytes	List of analytes

## **Sites**

1. Each of the locations where data is collected has to be entered into the Sites page.
2. To enter a new site, use the existing entries as a guide and enter the 'Site Tag' and 'Site Name'.
3. Provide a brief site description.
4. Enter the SiteType.
5. Enter the latitude and longitude.
6. Enter the waterbody type.

## **Equip**

1. Enter the unique identification number for each piece of equipment in the FieldEquipID column.
2. Enter a brief description of the equipment including the model and serial numbers, in the CollectionDeviceName column.
3. Enter the name of the analyte being measured in the AnalyteName column.
4. Enter the name of the organization, MBNEP, in the Org\_id column.
5. Enter the corresponding code for the analyte name from the CCAMP database in the CCAMPID column.

## **Sample Type**

1. Each type of sample is listed in the SampleTypeCode column.
2. No changes should be required to this worksheet.

## **EquipCalData**

1. Enter the unique identification number for each piece of equipment in the Equip\_ID column.
2. Enter the data and time of calibration in the CalDate and CalTime columns.
3. Enter the type of calibration operation in the Operation column.
4. Enter the type of analyte being calibrated for in the Analyte column.
5. Enter the precalibration value in the PreCalMeasurement column and the post calibration value in the PostCalMeasurement column.
6. Enter the expected value (i.e., the concentration of the calibration standard) in the Expected\_Value column.
7. Enter the calibration method in the CalMethod column.
8. Enter the name of the person conducting the calibration in the Person column.
9. Enter whether or not the battery was replaced in the Battery\_New column.
10. Enter whether or not the equipment was repaired in the Repair column and describe the actions taken in the Repair\_Comment column.

## **Allowed Analytes**

To enter a new analyte, use the existing entries as a guide and enter the 'Analyte', 'CCAMPID', etc.

Additionally, a few other notes about data entry.

1. With each data row there is a watershed code ('Shed' column), so if you are copying a row of data from one site then inserting it to be used for data entry of a different site, or if adding a new site, be sure to check that the 'Shed' code correctly refers to the watershed where the site is located.
  - a. Bay Sites = 31020
  - b. Los Osos Sites = 31022
  - c. Chorro Sites = 31023
  - d. Coon Creek = 31025

## **Bacteria / Bacteria QA**

1. Use the printed IDEXX table, or the IDEXX MPN Generator (in the Start Menu), to verify that the volunteer correctly identified the MPN.
2. If the sample was diluted, verify that the MPN was multiplied by the dilution factor.
3. For *E. coli*, if multiple dilutions were run, enter data from the results that are closest to 80% positive wells (77 of 97 wells). This may be from separate dilutions for the separate types of bacteria. Indicate on the datasheet and in the Notes column of the database what dilution, for each type of bacteria, was used on the data entered.
4. For total coliform, always enter the result for the dilution that is less than 80% positive wells. This may not be the result that is closest to 80% positive wells.
5. If the results for a site are above this range then increase the dilution factor the following month, and likewise, if the results for a site are below this range, decrease the dilution the following month.
6. The data is entered in the BAC worksheet in MBVMP\_Vers\_\*\*.xlsx. The best thing to do is find the data entry for that site from the previous month, copy the row, then insert the row at the end of the BAC dataset and make appropriate changes by entering the current data in the appropriate columns.
7. For entering the QA data:
  - a. Open the file U:\Monitoring\vmp\VMP Data\Bacteria\Data – Summaries\95% CI for QA.xls, or the IDEXX MPN Generator, and write down on the datasheet the upper and lower limits of the 95% confidence interval.
  - b. To enter the QA data, open the file u:\Monitoring\Data Management\QA Database.mdb. Enter the date of monitoring, site code, volunteer name, analyte, dilution factor, QA purpose (accuracy, precision or sterility), the results, whether or not the 95% confidence interval was met, and whether the sample passed or failed.
  - c. Note that the Lab runs the QA samples at a 1:10 dilution so the QA results need to be compared to the volunteer's 1:10 dilution even if the volunteer did a different dilution that returned results that are closer to the target number of positive wells.
  - d. When finished entering data, initial the datasheet in the upper right hand corner then file in the folder 'Data Entered – Needs QA'. The program manager will then double check the data, initial it, then either file it into the 'Need to File' folder or the appropriate project folder.

## **Dawn Patrol**

1. The data is entered in the MBVMP\_Vers\_##.xlsx database under the 'DAWN' worksheet tab. The best thing to do is find the data entry for that site from the previous month, copy the row, then insert the row at the end of the dawn patrol dataset and make appropriate changes.
2. Be sure to describe tide and weather information in the Notes column.
3. When finished entering data, initial the datasheet in the upper right hand corner then file in the folder 'Data Entered – Needs QA'. The program manager will then double check the data, initial it, then either file it into the 'Need to File' folder or the appropriate project folder.

## **Water Quality**

1. The data is entered in the WQUAL worksheet in MBVMP\_Vers\_##.xlsx. The best thing to do is find the data entry for that site from the previous month, copy the row, then insert the row at the end of the water quality dataset and make appropriate changes.
2. In the Notes column, enter observations about the site regarding algae, flow conditions, etc. Also enter any notes about equipment problems or any data that was discarded due to failure of QA criteria. If a dilution was required for the nutrient analysis, enter that information here.
3. If duplicate readings are taken for any of the analytes (e.g. dissolved oxygen) check and see that they are similar then enter the first set of the numbers.
4. For conductivity at SYB the meter will read in ms. All of the other site's data is collected in  $\mu$ s. Therefore, the value that the volunteer records needs to first be converted (multiply by 1000) before being entered.
5. For the nutrients, if there were not any levels detected then the number entered would be equivalent to one half the detection limit. For example, the lower detection limit for our nitrate kits is 1, so if there were not any levels detected then 0.5 would be the value entered.
6. For QA data entry:
  - i) Go to u:\monitoring\Data Management\QA Database.mdb. Open the Water Quality table.
  - ii) To enter the precision data (replicate meter readings), enter the date, site code, volunteer name, analyte, measurement type (replicate), QA purpose (Volunteer precision), the two meter readings, the relative percent difference, and whether or not the replicate reading passed the QA standard.
  - iii) To enter accuracy data (split samples), enter the date, site code, volunteer name, analyte, measurement type (split), QA purpose (Volunteer Accuracy), the volunteer-generated result, the lab-generated result, the relatively percent difference, and whether or not the split sample passed the accuracy criteria.
  - iv) For results from blanks, enter the date, enter BLANK for the site code, the volunteer name, analyte, measurement type (Blank), QA Purpose (sterility), the result, and whether or not the sample passed the criteria.
7. Flow data is entered in the FLOW worksheet. Again, copy a previous entry for that site then paste it at the bottom of the entries for that particular monitoring site.
8. Change the date, enter any appropriate notes, clear the old values in the 'W\_D\_F' column (Width\_Depth\_Flow), then enter the new transect info.

9. The 'Position' always starts at zero and ends with the total length of the transect. 'Depth' and 'Velocity' at each end is always zero.
10. Return to the WQUAL page and manually enter the flow value by typing it into the 'Flow' column. Write the flow value on the datasheet.
11. When finished entering data, initial the datasheet in the upper right hand corner then file in the folder 'Data Entered – Needs QA'. The program manager will then double check the data, initial it, then either file it into the 'Need to File' folder or the appropriate project folder.

## **Suspended Sediment**

1. All data is entered directly into the suspended sediment database. No worksheets or paper copies are generated from the sample collection or analysis.

## **Phytoplankton**

1. On the datasheet, multiply each of the organism counts by 4 and write that value in the square with the picture. This is the number that you will enter into the database.
2. Sum up all of these new counts and write down the total number of species on the bottom of the datasheet, then for each species counted figure what percentage of the total count that number was.
3. Finally, indicate the Relative Abundance – Rare =  $\leq 1\%$ , Present =  $1\% - 10\%$ , Common  $\geq 10\% - \leq 50\%$ , Abundant  $> 50\%$ .
4. Scan and email the datasheet to DPH staff.
5. The count data is entered in the Plankton Data worksheet in MBVMP\_Vers\_##. Relative abundance calculations are not entered in the database.
6. Simply enter the descriptive data and organism counts in the appropriate columns.
7. When finished entering data, initial the datasheet in the upper right hand corner then file in the folder 'Data Entered – Needs QA'. The program manager will then double check the data, initial it, then either file it into the 'Need to File' folder or the appropriate project folder.

## **Bioassessment**

1. Bioassessment data is entered into CEDEN, per the protocol provided by SWAMP. The protocols are available at:
  - a. <http://swamp.mpsl.mlml.calstate.edu/resources-and-downloads/database-management-systems/swamp-25-database/documentation-25/swamp-data-management-plan>
  - b. <http://swamp.mpsl.mlml.calstate.edu/resources-and-downloads/database-management-systems/swamp-22-database/documentation-22>

## **Eelgrass**

1. Eelgrass field data is entered in files separate from biomass data from each site. For each year of monitoring, create a new file in each folder
2. ..\..\..\Monitoring\vmp\VMP Data\Eelgrass\Data - Summaries\VMP BIOMASS DATA  
or ..\..\..\Monitoring\vmp\VMP Data\Eelgrass\Data - Summaries\VMP FIELD DATA

3. Create separate worksheets within the spreadsheet for each site and label with site code and year.
4. Enter all data as shown on the datasheet, calculate average coverage and biomass for each site.
5. When finished entering data, initial the datasheet in the upper right hand corner then file in the folder 'Data Entered – Needs QA'. The program manager will then double check the data, initial it, then either file it into the 'Need to File' folder or the appropriate project folder.

### **Bird Survey**

1. The bird survey data is entered in a separate excel database U:\Monitoring\vmp\VMP Data\Bird Surveys\Data – Summaries\Bird Survey Data.xls
2. Data is entered by survey area and species. There are a total of 15 survey areas, and 30 'original species'. The list of 'original' species corresponds to a list that has been used for data collection in the area since the 80's. When looking at long term trend data for the number of birds counted and the number of species counted then only data corresponding to this 'original' list is used. Do not add birds to this list.
3. With the surveys that the VMP oversaw in 2003, an 'other' bird category was added. The additional 'other' birds are listed following the 'original' birds, and are counted separately. If new species are sighted during a survey, add the names to this additional 'other' birds list.
4. If the volunteers count birds in their area, and those birds later fly into another area, then they indicate in the notes the number of birds that flew away and into what area they flew.
5. For the species Least/Western Sandpip., which is used when there is a mixed group of both least sandpipers and western sandpipers, the volunteers should indicate in the notes an estimate of the ratio of least to western sandpipers.
6. A summary of the total number of 'original' birds counted and the total number of 'original' species that were seen is located in U:\Monitoring\vmp\VMP Data\Bird Surveys\Data – Summaries\Bird Survey Summary.xls
7. Each time a new survey is completed, add the totals onto this summary page to allow comparisons to the historic data.
8. When finished entering data, initial the datasheet in the upper right hand corner then file in the folder 'Data Entered – Needs QA'. The program manager will then double check the data, initial it, then either file it into the 'Need to File' folder or the appropriate project folder.
9. FYI – We have hard copies of the historic data that is in the Bird Survey Summary file, but none of the individual species counts have ever been entered into a database.

### **Stream Profiles**

1. The stream profile data is entered in a separate excel database for each site. These files are located in the folder U:\Monitoring\vmp\VMP Data\Stream Profiles\Data - Summaries\Profile Data
2. The file All Sites – Channel Data.xls is where all of the descriptive channel data is entered. This includes bankfull measurements and calculations of slope and entrenchment for all of the sites.

3. For each of the profile sites, open the file corresponding to that site's name. Under the 'Stadia Reading' heading, create a column that corresponds to the current year and enter the stadia reading data.
4. Under the 'Elevation' heading, also create a column that corresponds to the current year then enter the formula to compute the elevation data from the stadia data. Drag the formula down through all of the cells.
5. Open the profile plot worksheet. Update the source data by adding a new series in order to display the new data. Then remember to update the heading on the plot to reflect the correct time frame.
6. There is also a file, U:\Monitoring\vmp\VMP Data\Stream Profiles\Data – Summaries\Dates Sites Surveyed.xls, which shows a table that indicates which of the sites were measured in a given year. Update this file as well as sites are revisited.
7. When finished entering data, initial the datasheet in the upper right hand corner then file in the folder 'Data Entered – Needs QA'. The program manager will then double check the data, initial it, then either file it into the 'Need to File' folder or the appropriate project folder.
8. FYI – in the past, veg and substrate data was collected in conjunction with the stream profiling data. This data is saved in CCAMP ## in the TransData2 worksheet.

### **Volunteer Hours**

1. There is a separate worksheet for each year, which has listed only the volunteers that participated during that year, and shows both monthly and annual participation hours.
2. The 'All Volunteer Hours' worksheet lists the names of all the volunteers that have ever participated, their annual participation hours and overall total for all years. This worksheet should be manually updated each December.
3. The volunteer list is sorted by last name so search for the appropriate location to add the volunteer.
4. Insert a row then in the first cell, type in the volunteer's last name. In the second cell, type in the volunteer's first name.
5. Now monthly hours can be added for that volunteer.
6. The previous worksheets have been protected to prevent accidental data loss from those years.
7. Should these sheets need to be edited, the protection can be removed by clicking on the pull down menu 'Tools', selecting 'Protection', and 'Unprotect Sheet'.
8. Similarly, to protect a sheet once data has been entered click on the pull down menu 'Tools', select 'Protection', and 'Protect Sheet'.
9. You will be prompted for a password which, in this case, should be left blank.

### **New Volunteers**

1. All participants in program activities need to fill out a contact information/liability release form.
2. If the volunteer is interested in receiving monthly emails with program updates, enter their contact information into the Access database. Open the database and choose Data Input/Lookup.
3. Enter contact info into appropriate cells.
4. Give the release form to Ann so she can add their email address to the active mailing list. She will return the sheet to you to file in the volunteer info binder.

5. If someone only participates in a one-time event and is not interested in getting email updates, do not enter their contact info into the database. Simply file their sheet in the brown Pendaflex folder.
6. Enter completed volunteer training in the Volunteer Training Log Sheet located at u:\monitoring\vmp\vmp admin\recognition\volunteer hours.xls. Enter the volunteer name, hours of training, type of training, location of training, and staff member conducting training.