

Quality Assurance Project Plan

Morro Bay National Estuary Program's
Volunteer Monitoring Program

Prepared for
Central Coast Regional Water Quality Control Board
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401

and

United States Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, CA 94105

Prepared by
Morro Bay National Estuary Program

August 7, 2012
Version 7, Draft 1

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: August 7, 2012

NAME OF RESPONSIBLE ORGANIZATION : Morro Bay National Estuary Program

APPROVAL SIGNATURES
(Add or delete signature lines as needed)

GRANT ORGANIZATION:

<u>Title:</u>	<u>Name:</u>	<u>Signature:</u>	<u>Date:</u>
MBNEP Program Director	Adrienne Harris		
MBNEP Program Manager	Ann Kitajima		
QA Officer	Ann Kitajima		

REGIONAL BOARD:

<u>Title:</u>	<u>Name:</u>	<u>Signature:</u>	<u>Date:</u>
QA Officer	Karen Worcester		

STATE WATER RESOURCES CONTROL BOARD:

<u>Title:</u>	<u>Name:</u>	<u>Signature:</u>	<u>Date:</u>

US Environmental Protection Agency:

<u>Title:</u>	<u>Name:</u>	<u>Signature:</u>	<u>Date:</u>
USEPA Project Manager	Suzanne Marr		
USEPA QA Officer	Eugenia McNaughton, Ph.D.		

HISTORY OF REVISIONS

Version Number	Date	Revision Details
1.0	May 15, 2002	Final approval from EPA
1.1	June 30, 2003	See table with summary of revisions
	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.
2.1	April 28, 2006	Incorporated SWAMP QA Team comments into this version.
2.2	July 9, 2006	Incorporated final revisions and comments into this version.
2.3	January 29, 2007	Incorporated EPA comments and awaiting approval before finalizing.
	March 30, 2007	EPA approval of response to comments. Document finalized to be submitted to EPA for signatures.
3.1	August 7, 2007	Annual update submitted to RWQCB for approval.
3.2	August 28, 2007	Responded to RWQCB comments and resubmitted for approval.
3.3	October 9, 2007	Received RWQCB approval of response to comments and generated final document.
4.1	March 26, 2008	Annual update to document for EPA approval.
4.2	October 10, 2008	Responded to EPA comments and resubmitted for approval.
4.3	October 30, 2008	Received final approval from EPA and finalized document for signatures.
5.1	October 30, 2009	Annual update submitted to EPA for approval.
5.2	January 12, 2010	Received conditional approval from EPA and finalized document for signatures, incorporating comments from Mark Kutnink in his email dated December 29, 2009.
6.1	January 12, 2011	Annual updates submitted to EPA for approval.
6.1	August 16, 2011	Received approval from EPA's Office of Quality Assurance.
6.1	August 31, 2011	Received approval from the QA Officer of the CCRWQCB.
6.1	September 12, 2011	Finalized Version 6.1 of the document.
7.1	August 7, 2012	Annual updates submitted to EPA for approval.
7.1	August 21, 2012	Received approval from EPA's Office of Quality Assurance.
7.1	December 10, 2012	Received approval from the QA Officer of the CCRWQCB.

2. TABLE OF CONTENTS

	Page:
Group A Elements: Project Management	2
1. Title and Approval Sheets.....	2
2. Table of Contents.....	5
3. Distribution List.....	8
4. Project/Task Organization.....	9
4.1 Involved parties and roles.....	9
4.2 Quality Assurance Officer role	10
4.3 Persons responsible for QAPP update and maintenance.....	10
4.4 Organizational chart and responsibilities	11
5. Problem Definition/Background	12
5.1 Problem statement	12
5.2 Decisions or outcomes.....	12
5.3 Water quality or regulatory criteria.....	13
6. Project/Task Description.....	15
6.1 Work statement and produced products.....	15
6.2. Constituents to be monitored and measurement techniques	17
6.3 Project schedule.....	18
6.4 Geographical setting	19
6.5 Constraints.....	20
7. Quality Objectives and Criteria for Measurement Data.....	37
7.1 Measurement quality objectives	37
8. Special Training Needs/Certification	46
8.1 Specialized training or certifications	46
8.2 Training and certification documentation	47
8.3 Training personnel.....	47
9. Documents And Records	47
Group B: Data Generation and Acquisition.....	48
10. Sampling Process Design.....	48
11. Sampling Methods	51
12. Sample Handling and Custody	58
12.1 Sample handling and transport	58
12.2 Chain of custody procedure	60
13. Analytical Methods.....	60
13.1 Analytical methods.....	60
14. Quality Control.....	68
14.1 Water quality monitoring.....	68
14.2 Bacteria monitoring	73
14.3 Macroinvertebrate monitoring	75
14.4 Flow monitoring	75
15. Instrument/Equipment Testing, Inspection, and Maintenance	76
15.1 Equipment testing, inspection and maintenance	76
16. Instrument/Equipment Calibration and Frequency.....	78
16.1 Field instruments.....	78
16.2 Laboratory analytical equipment	80
17. Inspection/Acceptance of supplies and Consumables.....	82
18. Non-Direct Measurements (Existing Data)	82
19. Data Management.....	83
Group C: Assessment and Oversight.....	84
20. Assessments & Response Actions	84
21. Reports to Management	84
Group D: Data Validation and Usability.....	85

22. Data Review, Verification, and Validation Requirements	85
23. Verification and Validation Methods.....	85
24. Reconciliation with User Requirements.....	86
References	86

List of Appendices:

Appendix A. Morro Bay Volunteer Monitoring Program Bacteria Monitoring Protocol	89
Appendix B. Morro Bay Volunteer Monitoring Program Water Quality Monitoring Protocols and Field Guide.....	105
Appendix C. Morro Bay Volunteer Monitoring Program Back Bay Nitrate Monitoring Protocol	132
Appendix D. Morro Bay Volunteer Monitoring Program Dissolved Oxygen in the Bay	139
Appendix E. Morro Bay Volunteer Monitoring Program Stormwater Monitoring (“First Flush”) Protocol	143
Appendix F. Morro Bay Volunteer Monitoring Program Urban Watch Monitoring Protocol.....	152
Appendix G. Morro Bay Volunteer Monitoring Program Stream Profiling Protocol	178
Appendix H. Morro Bay National Estuary Program Surface Elevation Table Monitoring for Measuring Sediment Accretion in Morro Bay Estuary	190
Appendix I. Morro Bay Volunteer Monitoring Program Macroinvertebrate Monitoring Protocol.....	195
Appendix J. Morro Bay National Estuary Program Eelgrass Monitoring Standard Operating Protocol	197
Appendix L. Morro Bay Volunteer Monitoring Program Shorebird Survey Protocol.....	206
Appendix M. Morro Bay Volunteer Monitoring Program Phytoplankton Monitoring Protocol	213
Appendix N. Morro Bay National Estuary Program’s Suspended Sediment Monitoring Protocol.....	217
Appendix O. Morro Bay Volunteer Monitoring Program Equipment Calibration Protocols.....	236
Appendix P. Morro Bay Volunteer Monitoring Program Data Management Protocols	253

Table of Figures:

Figure 4.4.1. Organizational chart	11
Figure 6.4.1. Location of Morro Bay Watershed and Tributaries	21
Figure 6.4.2. MBNEP Flow Monitoring Locations	22
Figure 6.4.3. MBNEP Creek and Bay Bacteria Monitoring Locations.....	23
Figure 6.4.4. MBNEP Creek Water Quality Monitoring Locations.....	24
Figure 6.4.5. MBNEP Bay Nutrients Monitoring Locations.....	25
Figure 6.4.6. MBNEP Bay Dissolved Oxygen Monitoring Locations.....	26
Figure 6.4.7. MBNEP First Flush Stormwater Monitoring Locations.....	27
Figure 6.4.8. MBNEP Urban Watch Runoff Monitoring Locations for Los Osos	28
Figure 6.4.9. MBNEP Urban Watch Runoff Monitoring Locations in Morro Bay	29
Figure 6.4.10. MBNEP Stream Profiling Monitoring Locations	30
Figure 6.4.11. MBNEP SET Monitoring Locations	31
Figure 6.4.12. MBNEP Macroinvertebrate Monitoring Locations	32
Figure 6.4.13. MBNEP Eelgrass Monitoring Locations	33
Figure 6.4.14. MBNEP Algae Monitoring Locations.....	34
Figure 6.4.15. MBNEP Shorebird Monitoring Locations	34
Figure 6.4.16. MBNEP Phytoplankton Monitoring Locations	35
Figure 6.4.16. MBNEP Phytoplankton Monitoring Locations	36

Table of Tables:

Table 4.1.1. Personnel responsibilities	9
Table 5.3.1. MBNEP screening levels for monitoring data	13
Table 6.2.1 Constituents monitored and measurement techniques	17
Table 6.3.1. Project schedule timeline.....	19
Table 7.1.1. Measurement quality objectives	37
Table 7.1.2. Measurement quality objectives for field measurements	41

Table 7.1.3. Measurement quality objectives for laboratory measurements.....	44
Table 11.1.1. Sampling locations and sampling methods.	53
Table 12.1.1. Sample handling and custody	58
Table 13.1.1. Field analytical methods.....	60
Table 13.1.2. Field equipment features	62
Table 13.1.3. Laboratory analytical methods.....	63
Table 14.1.1. Field QC for water quality monitoring	70
Table 14.1.2. Analytical QC for water quality and stormwater monitoring	71
Table 14.2.1. Field QC for bacteria monitoring.....	73
Table 14.2.2. Analytical QC for bacteria monitoring.....	74
Table 14.3.1. Analytical QC for macroinvertebrate monitoring	75
Table 15.1.1. Testing, inspection, maintenance of sampling equipment and analytical instruments	76
Table 16.1.1. Testing, inspection, maintenance of field sampling equipment and analytical instruments.....	78
Table 16.2.1. Testing, inspection, maintenance of analytical laboratory instruments.....	80
Table 21.1. QA management reports	84

3. DISTRIBUTION LIST

<u>Title:</u>	<u>Name (Affiliation):</u>	<u>Tel. No.:</u>	<u>QAPP No*:</u>
Contractor Program Director	Adrienne Harris (MBNEP)	805-772-3834	1
Contractor Program Manager/QA Officer /VMP staff	Ann Kitajima (MBNEP)	805-772-3834	ORIGINAL
Regional Board QA Officer	Karen Worcester (RWQCB)	805-549-3333	1
USEPA Project Manager	Suzanne Marr(USEPA)	415-972-3468	1
USEPA QA Officer	Eugenia McNaughton, Ph.D.(USEPA)	415-972-3798	1
MBNEP Technical Working Group	Yarrow Nelson	805-756-1347	1

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 and analysis of stormwater samples. 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 bacteria 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.

Table 4.1.1. Personnel responsibilities

Name	Organizational Affiliation	Title	Contact Information (Telephone number, fax number, email address.)
Ann Kitajima	MBNEP Volunteer Monitoring Program	Program Manager/QA Officer	805-772-3834, (f) 805-772-4162, annk@mbnep.org
Adrienne Harris	MBNEP	Program Director	805-772-3834, (f) 805-772-4162, aharris@mbnep.org
Stuart Buttram	BC Laboratories	Technical Director	800-878-4911, ex. 240, stuart@bclabs.com
Sharon Beccaccio	San Luis Obispo County Public Health Agency	Supervising Health Officer	805-781-5507, (f) 805-781-1023
Gary Lester	Ecoanalysts, Inc.	President	208-882-2588, glister@ecoanalysts.com

Name	Organizational Affiliation	Title	Contact Information (Telephone number, fax number, email address.)
John Callaway	University of San Francisco	Project Manager for SET project	(415) 422-5702, callaway@usfca.edu

4.2 Quality Assurance Officer role

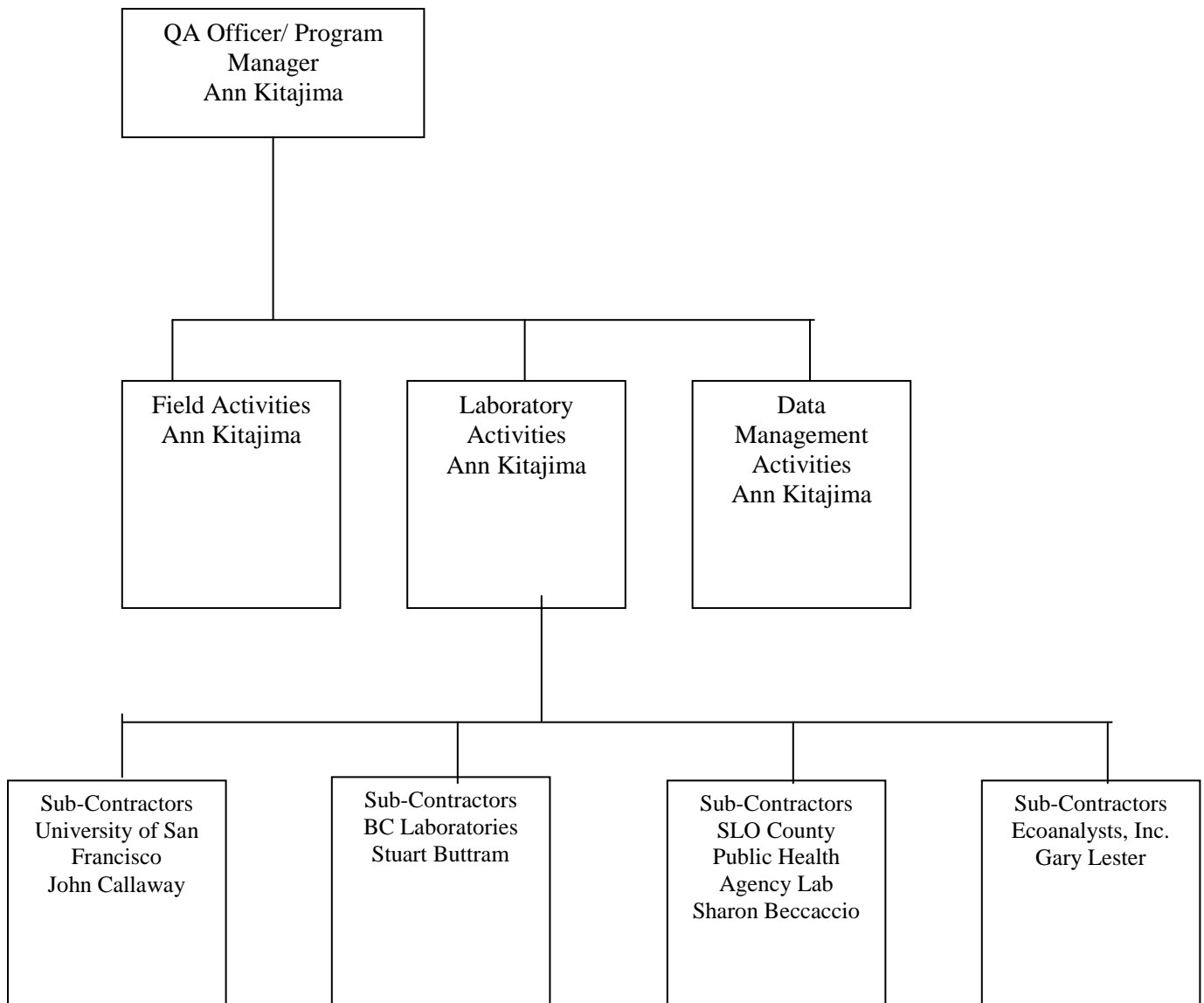
The MBNEP Program Manager is responsible for general oversight of the program including grant management, volunteer recruitment and training, protocol development, data management, data analysis and report writing. The Program Manager also serves as the MBNEP QA Officer for this small program. However, 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. While they receive training and oversight from the Program Manager, the data collection is conducted independently of VMP staff members. 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 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. Increased Bacteria Concentrations
3. Increased Nutrients Concentrations
4. Reduction of Freshwater Flow
5. Increased Heavy Metals and Toxics
6. Habitat Loss
7. Loss of Steelhead

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.

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, eelgrass, and algal cover 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
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 (estuarine)	< 5.0 mg/L, median % saturation > 85% (ocean waters)	CCRWQCB Basin Plan standard	General objective for ocean waters.
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 ₄ (for Water Quality)	> 0.36 mg/L	Guideline value	Value developed specifically for Pajaro River but being used for

Parameter	Criteria	Source	Comments
			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 ₃ -N as unionized ammonia	CCRWQCB Basin Plan Standard	General objectives, toxicity criteria.
Total dissolved solids (TDS) – FF stormwater	NA	NA	Standards exist for receiving waters, but the MBNEP is analyzing stormwater flows.
Total suspended solids (TSS) – FF stormwater	NA	NA	Standards exist for receiving waters, but the MBNEP is analyzing stormwater flows.
Oil & grease – FF stormwater	NA	NA	Standards exist for receiving waters, but the MBNEP is analyzing stormwater flows.
Dissolved metals – FF stormwater	NA	NA	Standards exist for receiving waters, but the MBNEP is analyzing stormwater flows.
Turbidity – FF stormwater	NA	NA	Standards exist for receiving waters, but the MBNEP is analyzing stormwater flows.
Urban Watch: Ammonia, Total Residual Chlorine, Turbidity, pH, Temperature, Conductivity, Orthophosphates	NA	NA	Standards exist for receiving waters, but the MBNEP is analyzing dry season runoff flows.
Urban Watch: nitrates	> 2.6 mg/L	Guideline value	Value developed for the Salinas Stormwater permit and adapted for the Morro Bay area.
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.

Water quality monitoring by program volunteers 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 PO₄. 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 twice 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.

Bay water quality monitoring by program volunteers includes monthly sampling at shoreline and bay sites. Water at the shoreline sites is analyzed for temperature, salinity and nitrates as nitrogen. The bay sites are analyzed for DO, temperature and salinity. The shoreline data and the bay data are stored in an Excel database. Deliverables include a consistent bay water quality data set in an electronic format. All data is analyzed in an annual data summary report.

For stormwater monitoring, program volunteers collect samples from local storm drains, culverts and other collection points within the first hour of the first major rain of the season, which is called First Flush monitoring. Samples are analyzed by the laboratory for nitrates, orthophosphates, pH, temperature, turbidity, *E. coli*, total coliform, TDS, TSS, oil & grease, and dissolved metals. Data is stored in an Excel database. Deliverables include a consistent stormwater data set in an electronic format and an annual stormwater monitoring report.

For Urban Watch (UW) monitoring, program volunteers collect samples and record observations of storm drain flows during the dry season. Samples are analyzed by the volunteers using test kits and meters. Samples are analyzed for pH, temperature, conductivity, turbidity, chlorine, ammonia, nitrates,

orthophosphates, turbidity and bacteria. Data is stored in an Access database. Deliverables include a consistent dry season runoff data set in an electronic format and an annual stormwater monitoring report.

For bioassessment monitoring, program 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 following EPA's Western EMAP method with counts to the genus/species level, including the midges, with worms left at Class Oligochaeta, to a 500 count subsample. 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 six sites in the salt marsh area 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 on four detailed 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 California Department of Public Health (DPH) track toxic algal blooms. Samples are analyzed under a microscope, and cell counts and samples are sent to DPH 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 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

Parameter	Monitoring Frequency	Primary or Secondary	Method
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	Primary	Meter
Dissolved oxygen (marine and freshwater)	Monthly	Primary	Meter
Nitrate as nitrogen (marine, freshwater and dry season runoff)	Monthly for marine and freshwater, weekly for dry season runoff	Primary	Test kit
Orthophosphate as PO ₄ (freshwater and dry season runoff)	Monthly for freshwater, weekly for dry season runoff	Primary	Meter
pH (freshwater)	Monthly	Primary	Meter
pH (dry season runoff)	Weekly	Primary	pH paper
Flow (freshwater)	Monthly	Primary	Meter
Temperature (marine and freshwater)	Monthly	Primary	Meter
Turbidity (freshwater and dry season runoff)	Monthly for freshwater, weekly for dry season runoff	Primary	Meter
Laboratory analysis - Nitrate as nitrogen (freshwater and FF stormwater)	Monthly for freshwater, annually for stormwater	Primary	EPA Method 300.0
Laboratory analysis - Orthophosphate as P (freshwater and FF stormwater)	Monthly for freshwater, annually for stormwater	Primary	SM 4500-P E
Laboratory analysis - Total nitrogen (freshwater)	Twice monthly for Ag Monitoring Sites	Primary	Calculated
Laboratory analysis - Organic nitrogen (freshwater)	Twice monthly for Ag Monitoring Sites	Primary	Calculated
Laboratory analysis - Nitrite as NO ₂ (freshwater)	Twice monthly for Ag Monitoring Sites	Primary	EPA 353.2
Laboratory analysis -	Twice monthly for Ag	Primary	SM4500-NH ₃ D

Parameter	Monitoring Frequency	Primary or Secondary	Method
Ammonia (freshwater)	Monitoring Sites		
Laboratory analysis - Total Kjeldahl Nitrogen (freshwater)	Twice monthly for Ag Monitoring Sites	Primary	EPA 351.2
Laboratory analysis - Total Phosphorus (freshwater)	Twice monthly for Ag Monitoring Sites	Primary	EPA 365.4
Laboratory analysis - Total dissolved solids (TDS) (FF stormwater)	Annually	Primary	SM 2540C
Laboratory analysis - Total suspended solids (TSS) (FF stormwater)	Annually	Primary	SM 2540D
Laboratory analysis - Oil & grease (FF stormwater)	Annually	Primary	EPA 1664
Laboratory analysis - Dissolved metals (FF stormwater)	Annually	Primary	EPA 200.8
Laboratory analysis – Turbidity (FF stormwater)	Annually	Primary	SM 2130B
Laboratory analysis - Bioassessment Macroinvertebrates	Annually	Primary	EPA's Western EMAP method with counts to genus/species level to a 500 count subsample
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. 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		Annual data summary report	September of each year of grant
Stormwater	Ongoing		Annual data summary report	June of each year
Sedimentation: SETs, suspended sediment concentrations	Ongoing		Annual data summary report	September 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 28,000-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.

In the following figures, the source data for the roads was the TIGER dataset produced by the US Census. In the legend for the figures, this was designated as “tiger_roads.”

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 nutrients monitoring locations
- Figure 6.4.6: MBNEP bay dissolved oxygen monitoring locations
- Figure 6.4.7: MBNEP First Flush stormwater monitoring locations
- Figure 6.4.8: MBNEP Urban Watch runoff monitoring locations in Los Osos
- Figure 6.4.9: MBNEP Urban Watch runoff monitoring locations in Morro Bay
- Figure 6.4.10: MBNEP stream profiling monitoring locations
- Figure 6.4.11: MBNEP SET monitoring locations
- Figure 6.4.12: MBNEP bioassessment and algae monitoring locations
- Figure 6.4.13: MBNEP eelgrass monitoring locations
- Figure 6.4.14: MBNEP shorebird monitoring locations
- Figure 6.4.15: MBNEP phytoplankton monitoring locations

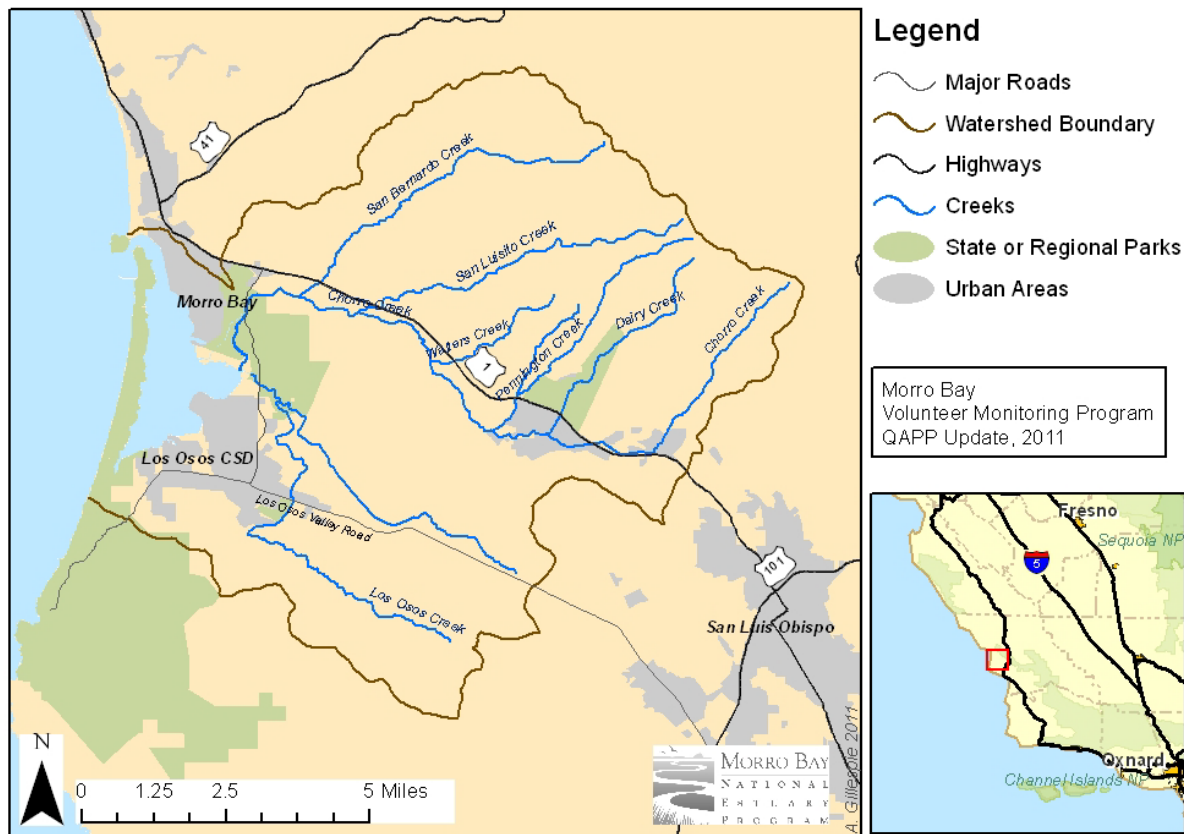
- Figure 6.4.16: MBNEP suspended sediment monitoring locations

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 both 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



MBNEP QAPP

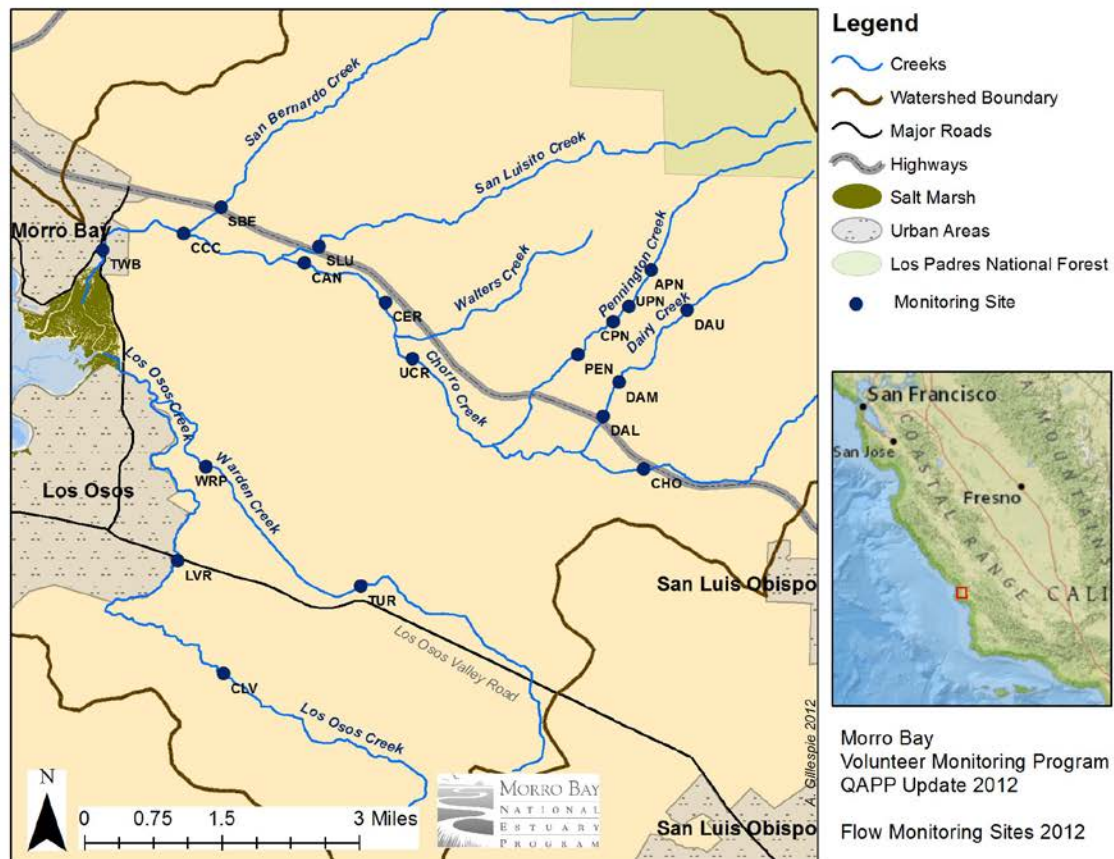


Figure 6.4.3. MBNEP Creek and Bay Bacteria Monitoring Locations

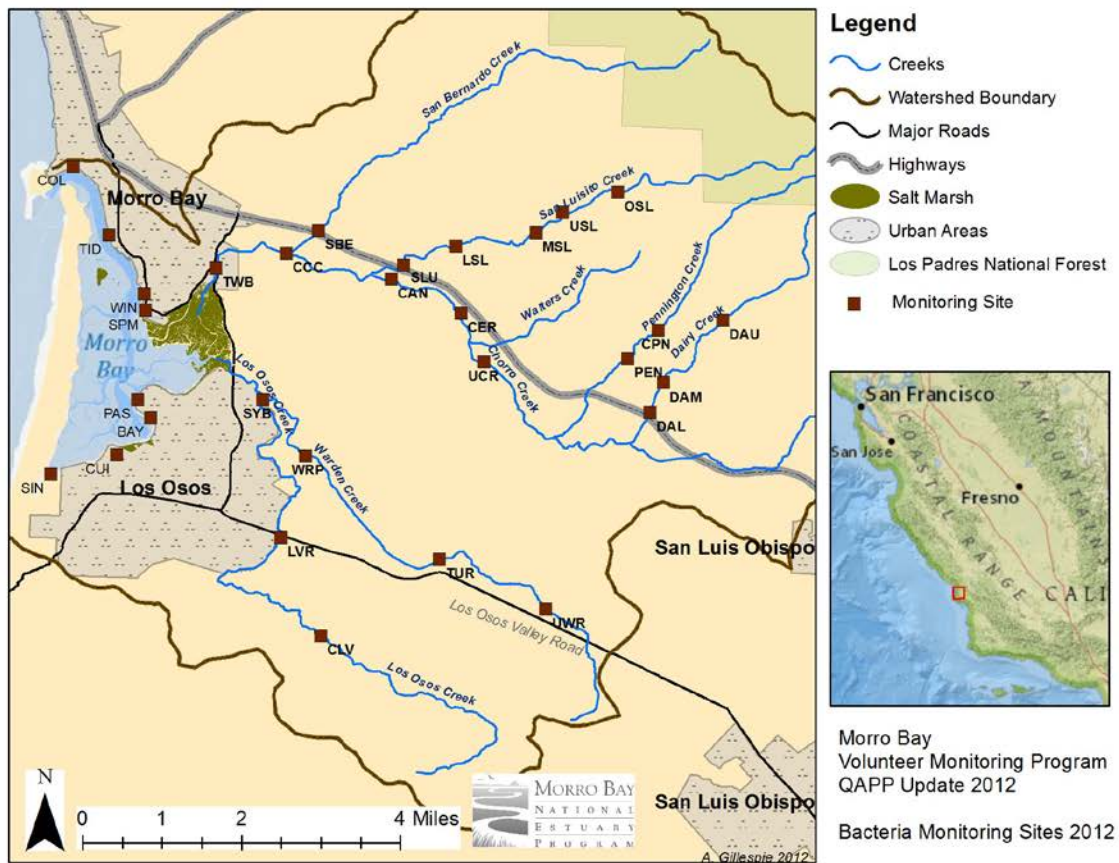
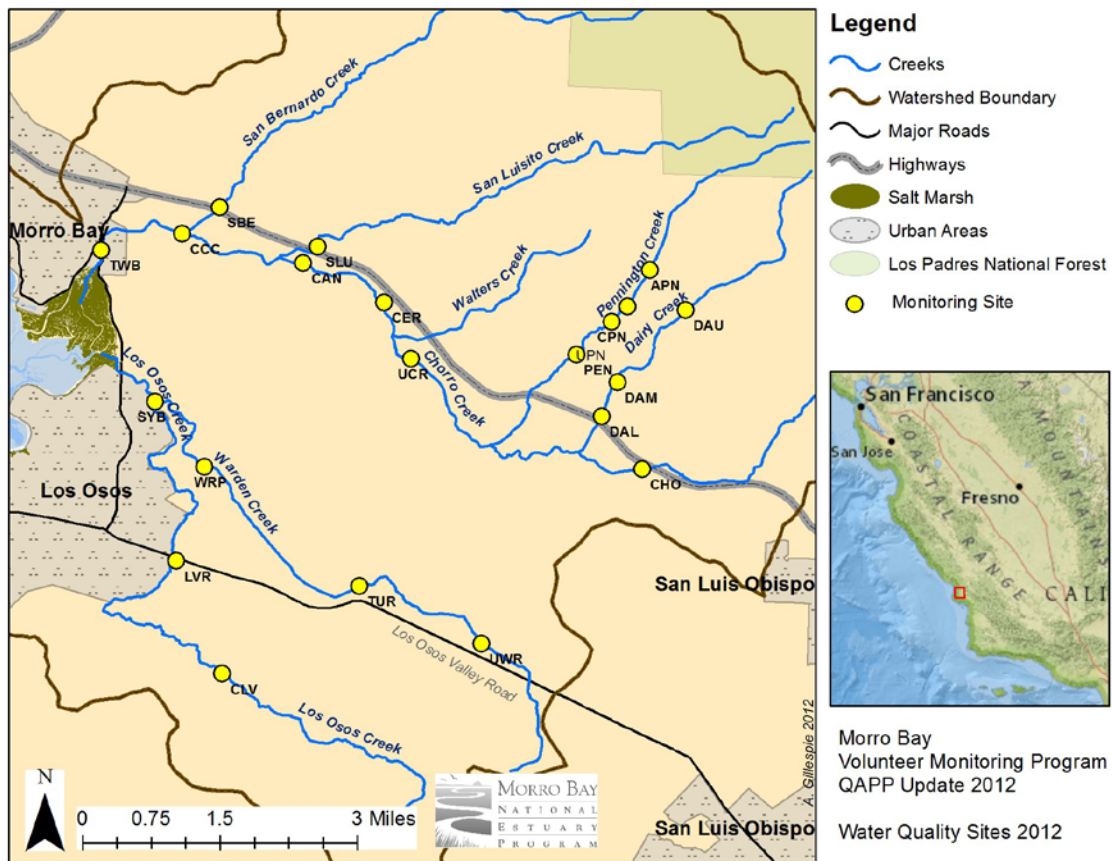


Figure 6.4.4. MBNEP Creek Water Quality Monitoring Locations



MBNEP QAPP



Figure 6.4.6. MBNEP Bay Dissolved Oxygen Monitoring Locations

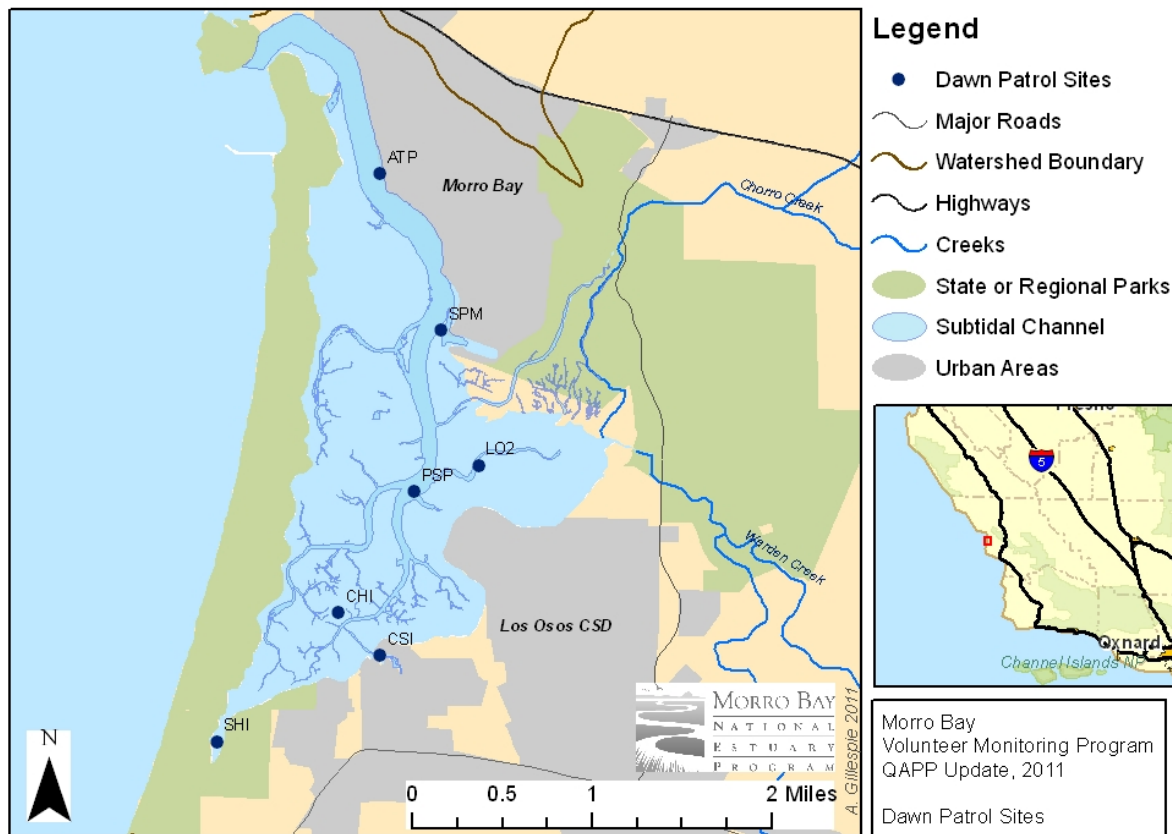


Figure 6.4.7. MBNEP First Flush Stormwater Monitoring Locations



Figure 6.4.8. MBNEP Urban Watch Runoff Monitoring Locations in Los Osos

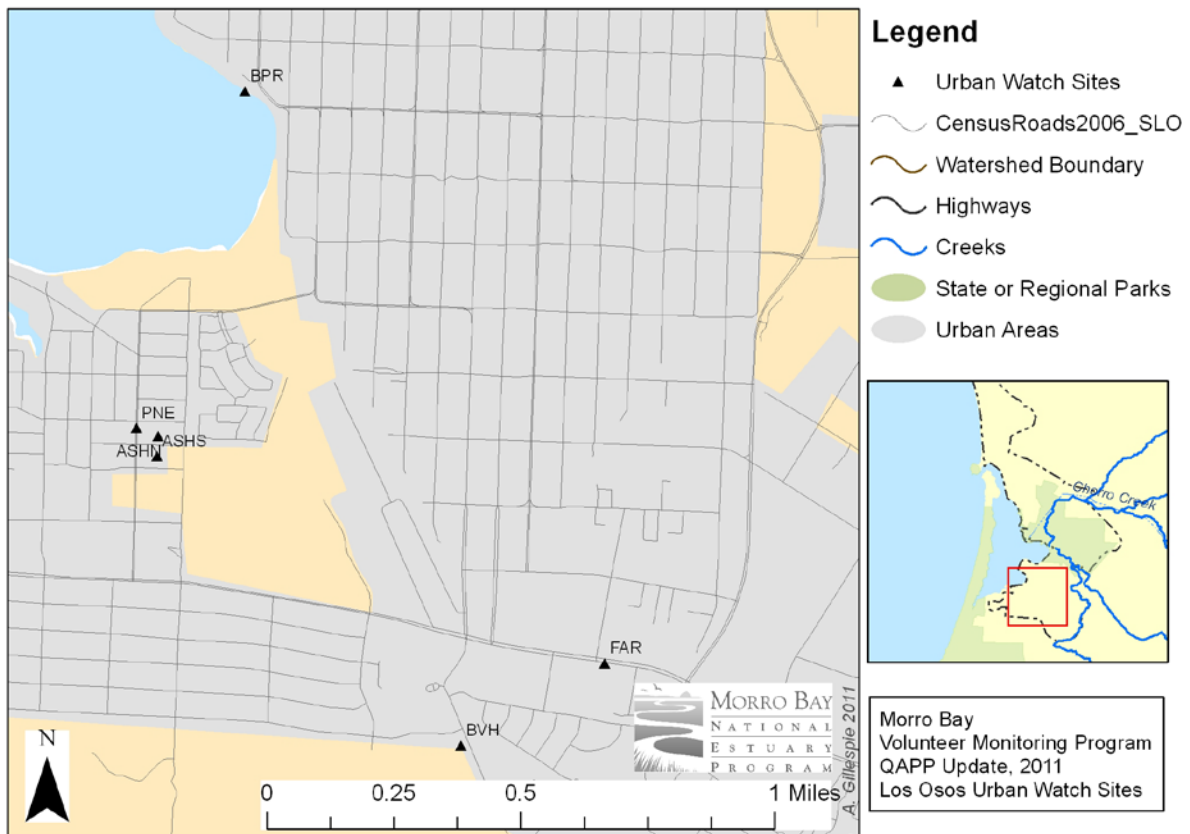


Figure 6.4.9. MBNEP Urban Watch Runoff Monitoring Locations in Morro Bay



Figure 6.4.10. MBNEP Stream Profiling Monitoring Locations

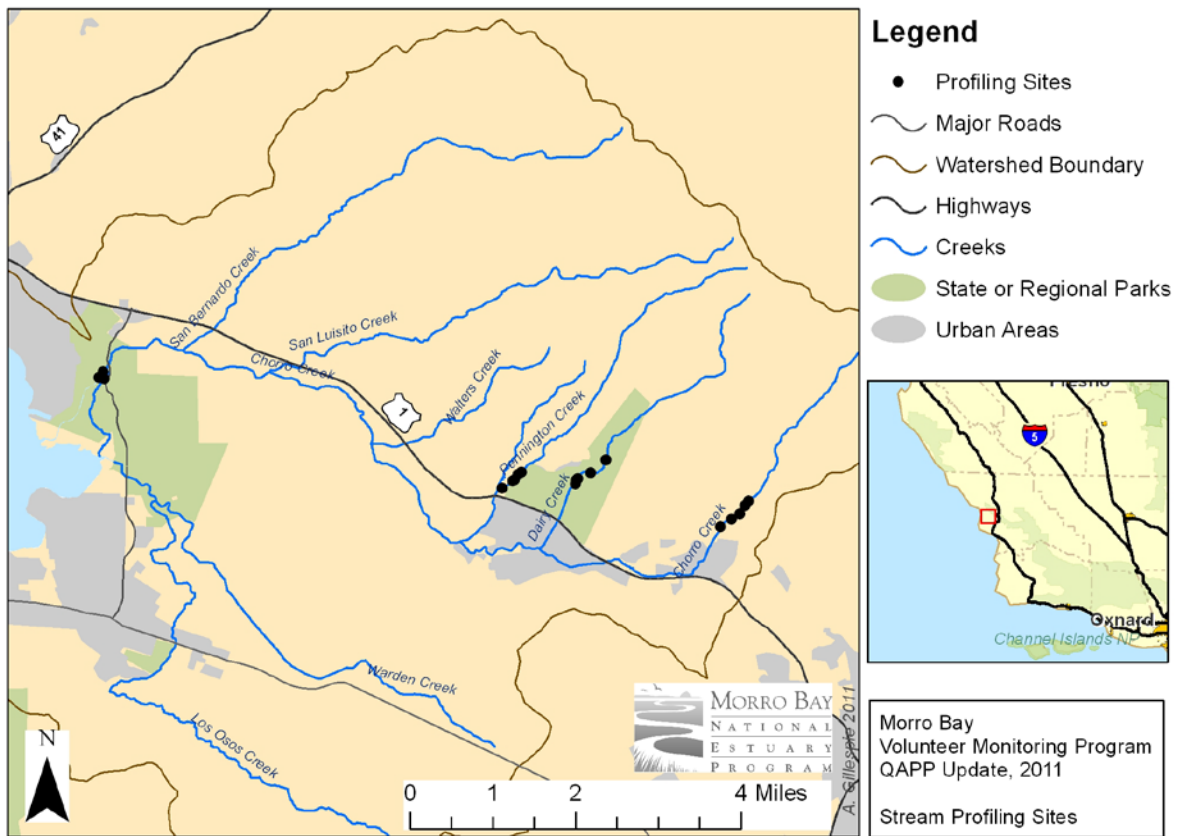


Figure 6.4.11. MBNEP SET Monitoring Locations

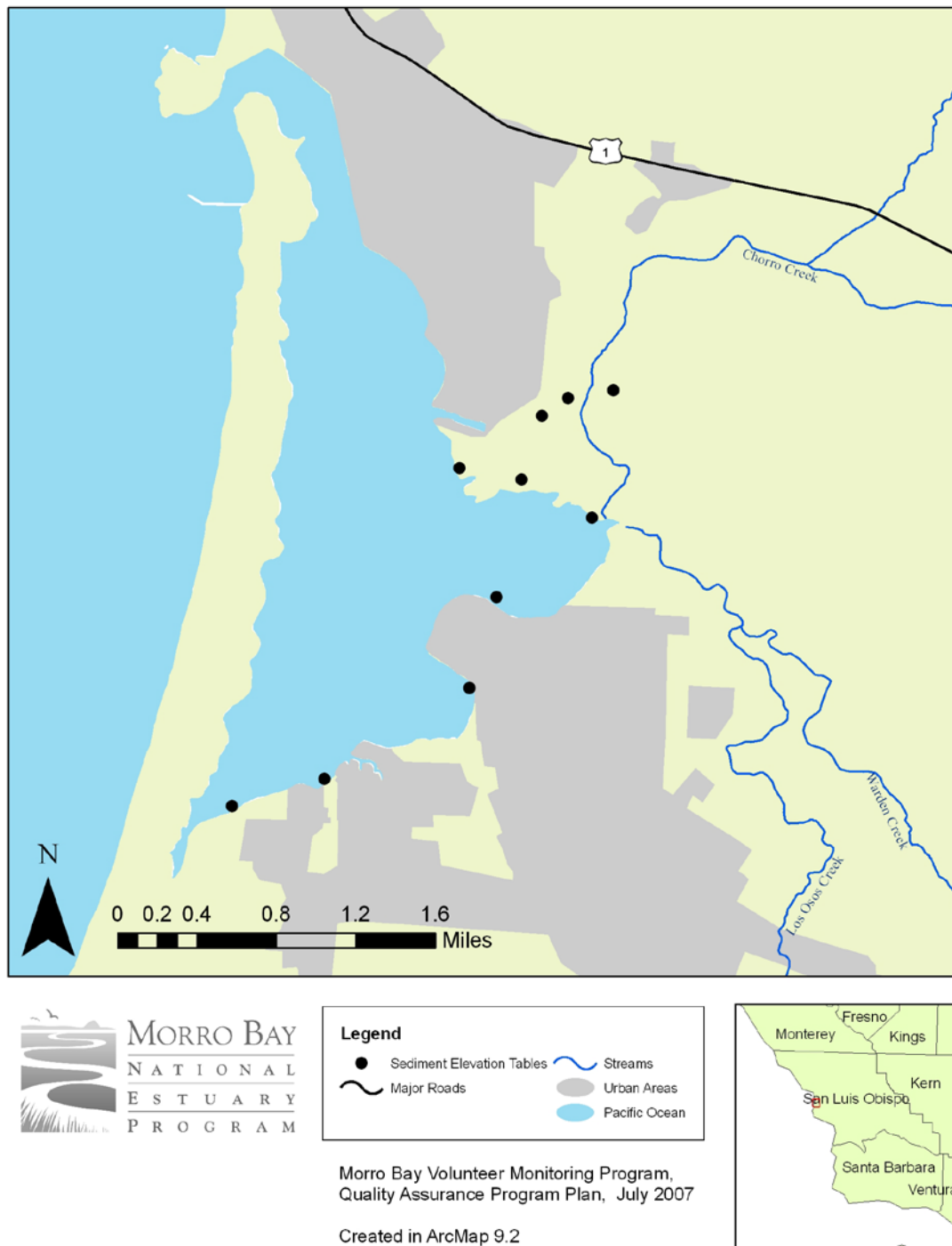


Figure 6.4.12. MBNEP Bioassessment and Algae Monitoring Locations

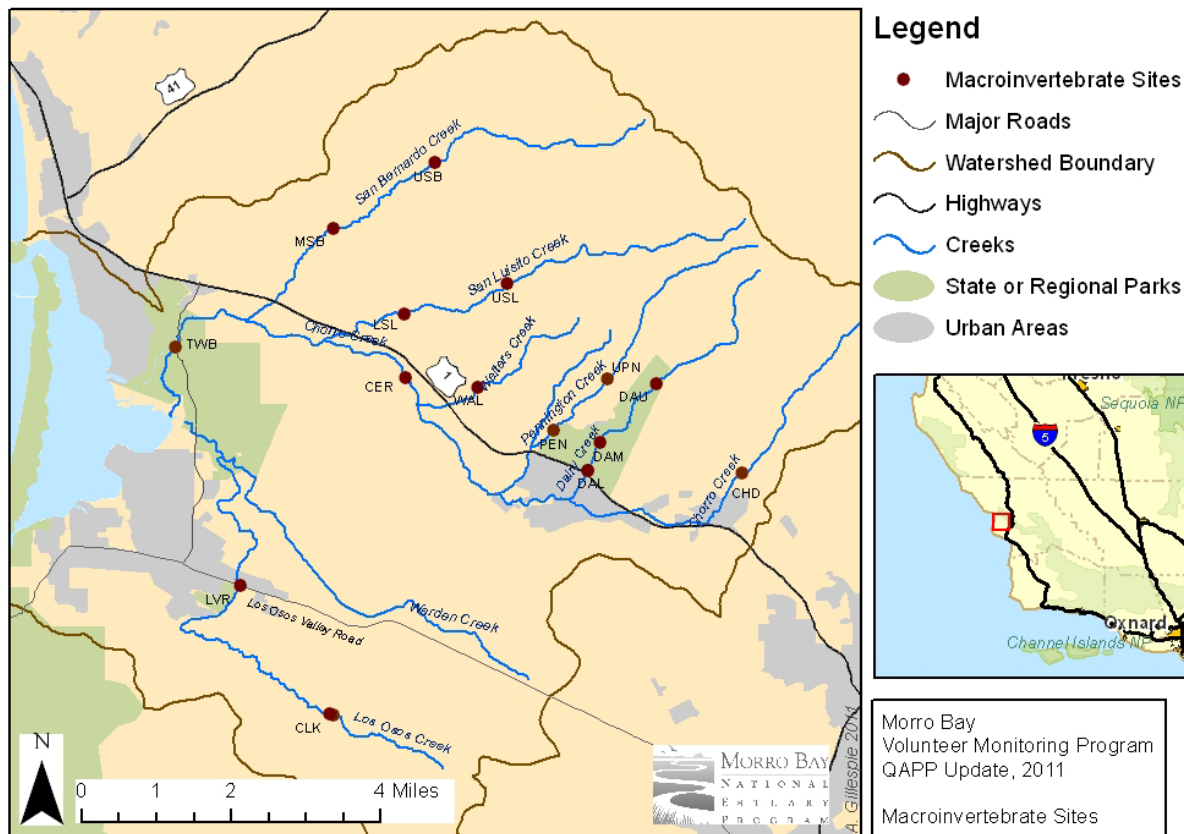


Figure 6.4.13. MBNEP Eelgrass Monitoring Locations

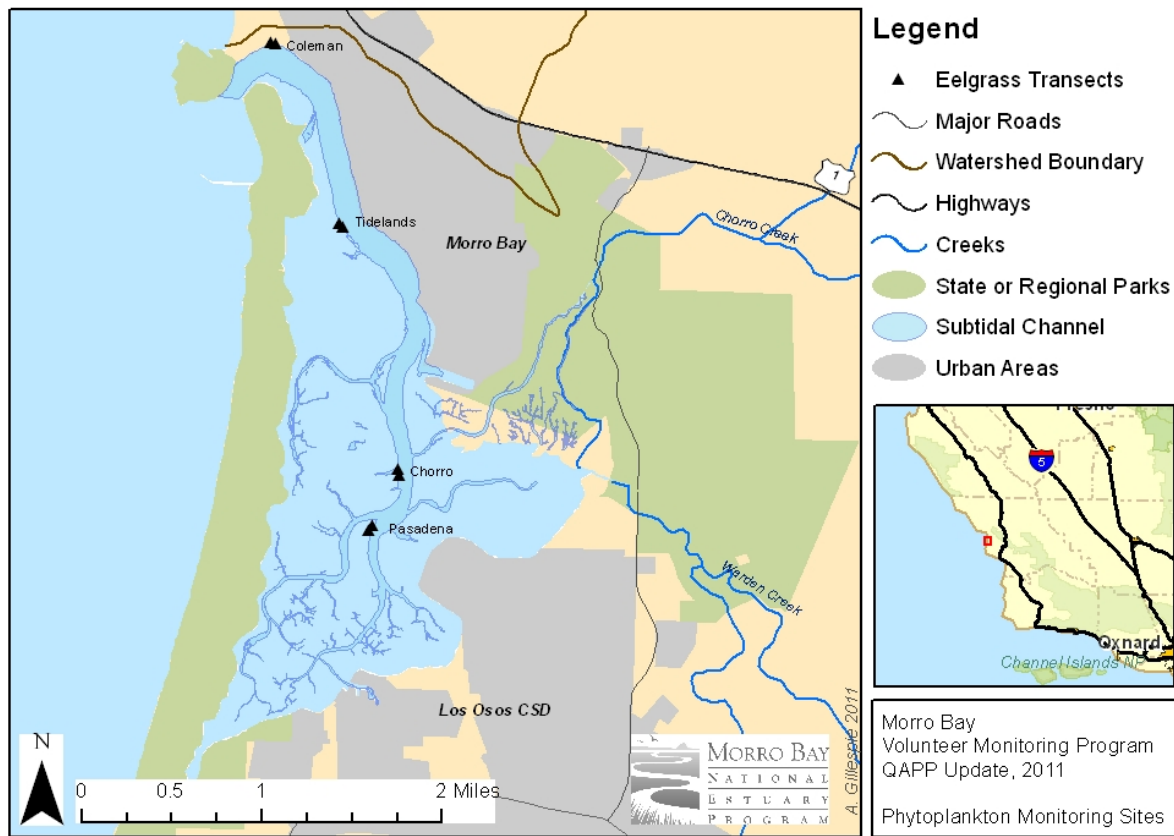


Figure 6.4.14. MBNEP Shorebird Monitoring Locations

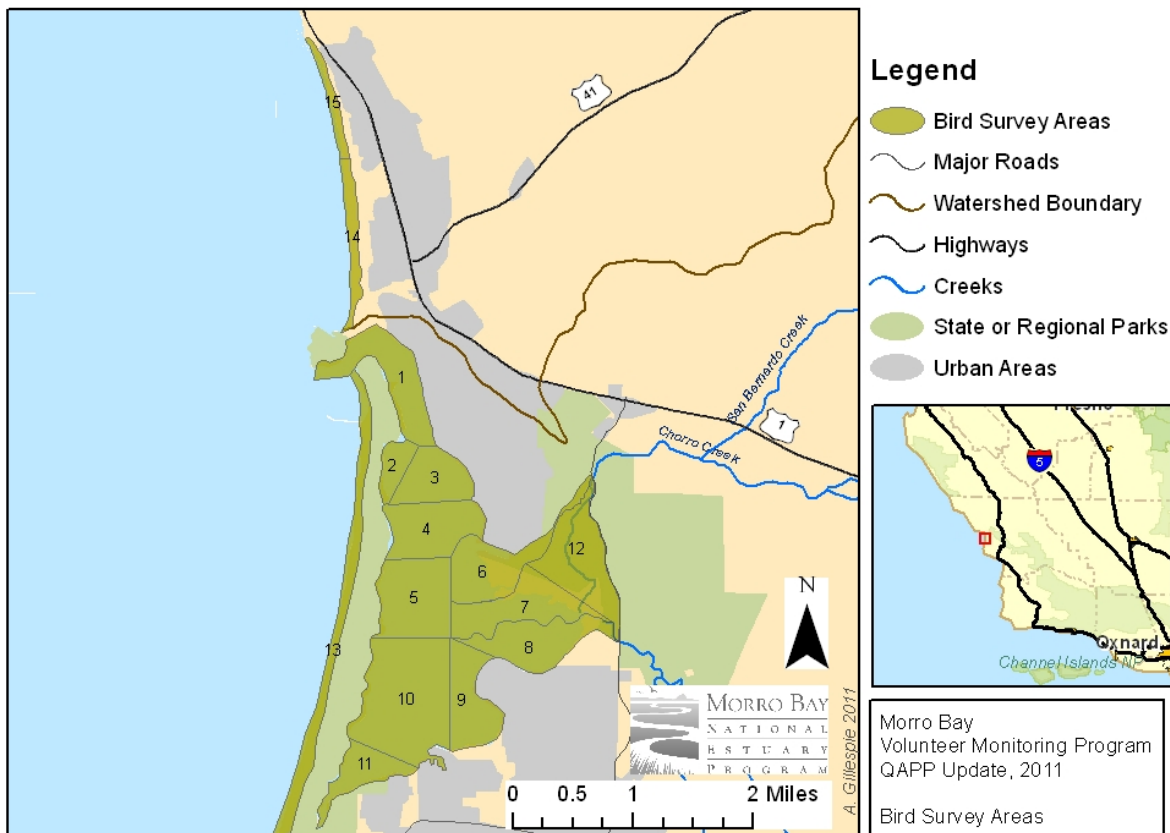


Figure 6.4.15. MBNEP Phytoplankton Monitoring Locations

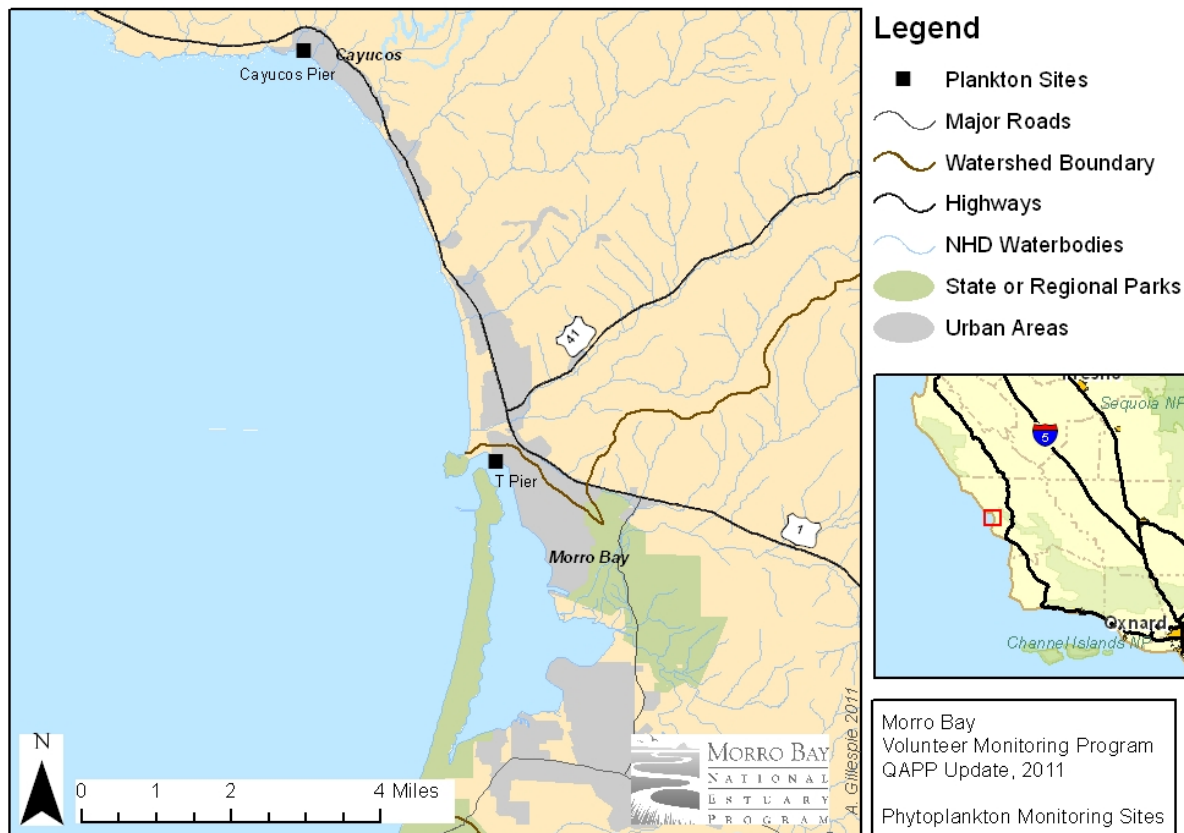
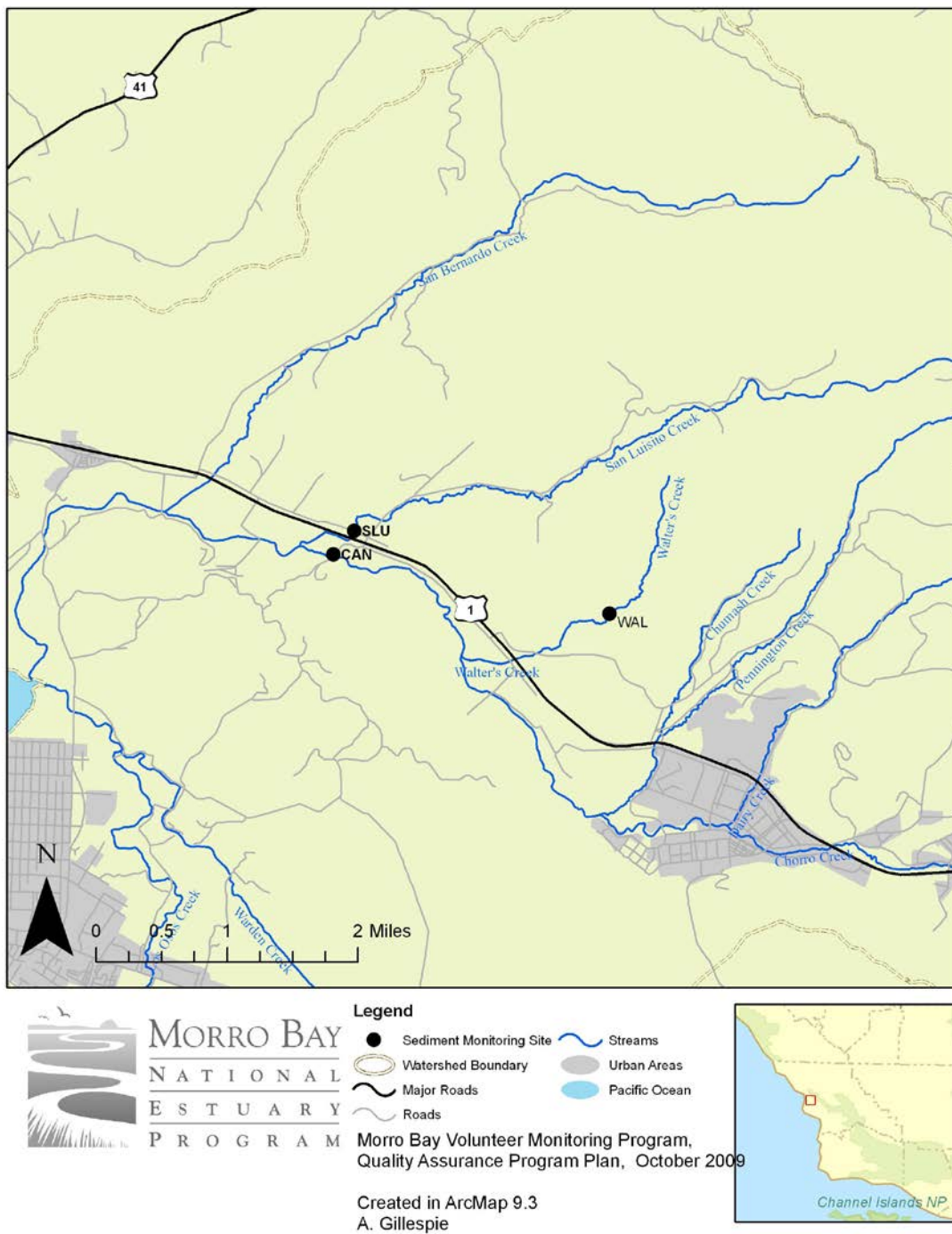


Figure 6.4.16. MBNEP Suspended Sediment Monitoring Locations



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
Laborat ory	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
Laborat	Water quality	NA	Yes. See Table 7.1.2.	Yes. See Table 7.1.2.	Yes. See Table 7.1.2.	Yes. See Table	Yes. See Table

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Completeness	Sensitivity
ory						7.1.2.	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 to maximize spatial variability. All monitoring takes place periodically during the dry season. It was determined to be an adequate frequency.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
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	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Completeness	Sensitivity
		be an adequate frequency for statistical analysis.					
Laboratory	Macroinvertebrates	NA	NA	Yes. Lab re-sorts 20 to 25% of all samples and 10% of the samples are re-identified by a second taxonomist.	Yes. Lab re-sorts 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 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.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA
Field	Phytoplankton	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place monthly	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 7.1.2.	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Completeness	Sensitivity
		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.					
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	Dry season runoff (Urban Watch)	Yes. Monitoring sites were selected to maximize spatial variability and provide safe access. Monitoring takes place weekly in the dry season, which was determined to be an adequate frequency.	Yes. Training in field techniques minimizes bias.	NA. Data collected is screening-level data. Inadequate sample sizes prohibit splits and duplicates of samples, in many cases.	NA	NA	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 work. Monitoring takes place during storms of various amounts of rainfall to represent varying flow conditions.	Yes. Training in field techniques minimizes bias.	NA	NA	NA	NA
Laborat	Suspended	NA	NA	Yes. SLQA	Due to the	NA	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity
ory	sediment concentrati on			provides replicate samples for analysis. Results must be within +/- 1 mg.	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.		

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	± 0.3 mg/L	± 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 and Urban Watch	Conductivity	$\pm 1\%$ of range	± 5 or 10%	NA	200 uS for low range meter and 0.1 uS for high range meter	90%
Water quality	pH electrode	$\pm 20\%$	$\pm 20\%$	NA	0.01 pH	90%
Urban Watch	pH paper	± 0.5 units	± 0.5	NA	4.5 units	90%
Water quality and Urban	Turbidity	See	See	NA	0.01 NTU	90%

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limit	Completeness
Watch		below.	below.			
Water quality	Nitrate as N	$\pm 20\%$	$\pm 20\%$	NA	0.3 mg/L	90%
Urban Watch	Nitrate as N	$\pm 20\%$	$\pm 20\%$	NA	1.0 mg/L	90%
Water quality and Urban Watch	Orthophosphate as PO ₄	$\pm 20\%$	$\pm 20\%$	NA	0.3 mg/L	90%
Flow	Flow (cubic feet per second)	± 0.25 ft ³ /sec	$\pm 25\%$	NA	NA	90%
Stream profiling	Elevation along profile	± 0.05 ft	NA	NA	NA	90%
SETs	Elevation change	± 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%
Dry season runoff – Urban Watch	Ammonia (Nitrogen)	$\pm 20\%$	$\pm 20\%$	NA	0.25 ppm	90%
Dry season runoff – Urban Watch	Total Residual Chlorine	NA	$\pm 20\%$	NA	0.20 ppm	90%
Suspended sediment monitoring	Suspended sediment concentration	NA	± 1 mg	Single blind samples from USGS sediment lab.	2 mg	NA

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limit	Completeness
				Analyzed twice annually. Results must be within ± 1 mg.		

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

Urban Watch dry season runoff data is considered to be screening-level data to aid local agencies and city governments in identifying areas and analytes meriting further investigation. Methods for analysis were selected to be inexpensive, simple and easy to conduct in the field, so test strips and other simple test kits were chosen. Additionally, volunteers can only collect minimal amounts of water at many sites due to the transient nature of storm drain flows. Often there is not adequate water to allow for duplicates and replicates. When possible, duplicates and replicate samples will be run for up to 5% of the samples collected during a monitoring season. In the case of chlorine, analysis for accuracy will only be run on a sample where the test kit yielded a positive result as a verification of the ability of the test kit to detect the presence or absence of chlorine.

The Urban Watch analysis methods for many of the parameters are identical to the methods used for creek water quality monitoring except for two additional parameters. The chlorine test kit involves comparing a reaction to a color chart. The color chart provides the following corresponding readings for total residual chlorine: 0.2, 0.4, 0.6, 0.8, 1.0, 1.5, 2.0 and 3.0 ppm. The ammonia nitrate test strips involve comparing a test strip to a color chart, which provides the following corresponding readings: 0, 0.25, 0.5, 1, 3 and 6 ppm.

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%
Stormwater quality – First Flush	Total dissolved solids	NA	± 10%	90-110%	10 mg/L	90%
Stormwater quality – First Flush	Total suspended solids	NA	± 10%	NA	0.5 mg/L	90%
Stormwater quality – First Flush	Dissolved Metals (Cu, Ni, Pb, Zn)	70-130%	± 20%	85-115%	Cu, Ni, Pb: 0.001 mg/L Zn: 0.005 mg/L	85%
Stormwater quality – First Flush	Oil & Grease	78 – 114%	± 18%	78 – 114%	5 mg/L	80%
Water quality and stormwater quality – First Flush, Urban Watch	Nitrates as N	80 – 120%	± 10%	90-110%	0.1 mg/L	90%
Water quality and stormwater quality – First Flush, Urban Watch	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

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Completeness
Water quality - Ag Monitoring Sites	Organic Nitrogen	NA	NA	NA	NA	Calculation
Water quality - Ag Monitoring Sites	Ammonia-Nitrogen	90 - 110%	$\pm 10\%$	90 - 110%	0.05 mg/L	90%
Water quality - Ag Monitoring Sites	Total Kjeldahl Nitrogen	80 - 120%	$\pm 20\%$	80 - 120%	0.2 mg/L	80%
Water quality - Ag Monitoring Sites	Nitrite as NO ₂	90 - 110%	$\pm 10\%$	90 - 110%	0.17 mg/L	90%
Water quality - Ag Monitoring Sites	Total Phosphorus	80 - 120%	$\pm 20\%$	80 - 120%	0.05 mg/L	80%
Water quality and stormwater quality – First Flush, Urban Watch	Turbidity	NA	NA	NA	0.1 NTU	90%
Urban Watch	Total Residual Chlorine	NA	$\pm 10\%$	NA	0.1 mg/L	90%
Urban Watch	Ammonia (nitrogen)	90-110%	$\pm 10\%$	90-110%	0.05 mg/L	90%
Bioassessment	Benthic invertebrates	$\leq 10\%$ difference in sorting efficacy, 0% difference in identification.	$\leq 10\%$ 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. This training also covers Urban Watch monitoring. Water quality training will be split into estuarine, freshwater and Urban Watch monitoring training. Documentation of training attendees will be recorded and maintained in a training log.

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 a refresher training from CCRWQCB staff, who are trained annually by CDFG 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.

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:

VMP staff and 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 DPH Marine Biotoxin Monitoring staff. Documentation of training attendees will be recorded and maintained in a training log.

Stormwater Monitoring Training:

VMP staff train program volunteers in the techniques for collecting and, where applicable, analyzing samples for stormwater monitoring. Site locations and safety are emphasized. 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.

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.

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.

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 this first and 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. The eelgrass sites 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 a portion of the bay where the most change due to sedimentation could be expected. Stormwater monitoring sites were established to represent multiple land use types and to include historical sites, where applicable. 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. Phytoplankton pulls are conducted on a monthly basis. Stream profiling, bioassessment, algae, and First Flush stormwater monitoring are conducted once a year in the appropriate season. Eelgrass monitoring is typically monitored every other year, depending on funding. SET monitoring takes place every several years due to the long-term nature of the sediment measurements.

Urban Watch stormwater monitoring is conducted weekly from June through the first significant fall rain of the season, typically in October or November. 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 22 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 20 creek sites and at three shoreline 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 H₂SO₄ preservative. Flow data is collected at 19 creek sites during times of measurable flow. Stormwater monitoring for First Flush is conducted at eight sites with water samples collected for analysis. Urban Watch stormwater monitoring is conducted at eight sites in Morro Bay and six sites in Los Osos. 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 once each month. For eelgrass, 30 shoots are collected from each of four transects. The samples are dried and weighed to make a biomass determination. For 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, stormwater, 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. Creek algae documenting takes place once a year in the spring during bioassessment monitoring. Urban Watch stormwater monitoring is conducted twice a month during the dry months, typically from June through October or November. Bay samples must be collected at the appropriate tidal cycle and thus this monitoring schedule is dictated by the tides. Bay nutrient monitoring to be conducted from the shoreline can take place during a tide that allows adequate access. In-bay monitoring for DO must be conducted within two hours after sunrise on a tide to allow adequate 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. 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. First Flush stormwater monitoring, stream profiling eelgrass transects and bioassessment are monitored once a year. First Flush stormwater and nutrient QA samples are delivered to the lab within 48 hours for analysis. 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. Due to heavy rainfall years, more frequent monitoring may take place. 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 once 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, First Flush stormwater 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, water quality and Urban Watch monitoring, a potential source of bias is in the interpretation of test kit results. Volunteers must interpret a color change to read the results. This bias is addressed by periodically splitting samples for all analysis except Urban Watch. 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 Urban Watch, the screening-level monitoring techniques and the lack of adequate flow prohibit the splitting of samples. 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 present at some sampling 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 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.

For Urban Watch monitoring, samples are collected from storm drains and curb inlets while avoiding stirring up of any sediment in the bottom of the drain. All sampling equipment is triple rinsed with deionized water upon completion of the monitoring. Temperature, conductivity, pH, ammonia as nitrate and chlorine are monitored in the field and analysis is conducted immediately. Analysis for nitrates, orthophosphates, turbidity and total coliform are conducted in the office, and the samples can be held for 24-hours. If excess sample is available and water samples can be collected for quality assurance purposes, a large, clean container is used to collect a single sample. The sample is gently mixed and then split. A portion is used for the volunteer's analysis, and a portion stored in clean containers with appropriate preservative provided by the laboratory for one-time use. All samples are aqueous samples. Samples for Urban Watch are collected in sterile Whirl-Pak bags and analyzed within 24 hours of collection. Excess sample is disposed of down the drain. 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.

For stormwater monitoring, water samples are collected from storm drains, culvert outfalls, pooling areas or drainage gutters. Samples for First Flush are collected in clean containers provided by the laboratory

for one-time use. The sample for dissolved metals is filtered within two hours and delivered to the lab who then conducts the acidification. The containers for oil and grease contain an H₂SO₄ preservative. Excess sample is disposed of by the lab.

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% ethyl 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 DPH for their analysis. The net is rinsed with freshwater and hung to dry. Excess sample is disposed of down the drain.

For eelgrass, 30 eelgrass shoots are collected at each of the four transects and 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.

Sampling Location	Location ID Number	Matrix	Depth (units)	Analytical Parameter	# Samples (include field duplicates)	Sampling SOP #	Sample Volume	Containers #, size, type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/ analysis
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	120 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	120 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.
Water Quality - All creek sites	See Fig 6.4.6	Water	Below surface	Nitrates as N and orthophosphates as PO ₄	1 per site per month	MBVMP Water Quality Monitoring Protocol	4 oz.	Sterile 4 oz. Whirl-pak bag	None	48 hours at 4 °C, dark
Water Quality - All creek sites and Ag	See Fig 6.4.6	Water	Below surface	Nitrates as N, Orthophosphates as P,	For QA, split samples at 10% of sites per	MBVMP Water Quality Monitoring	250 mL	250 mL container/ site, clean plastic container	None	48 hours at 4 °C, dark

Sampling Location	Location ID Number	Matrix	Depth (units)	Analytical Parameter	# Samples (include field duplicates)	Sampling SOP #	Sample Volume	Containers #, size, type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/analysis
Monitoring Sites				Turbidity	month, sent to lab for analysis. For Ag Sites, 2 sets per month sent to lab.	Protocol		provided by lab		
Water Quality - Ag Monitoring Sites	See Fig. 6.4.3	Water	Surface	Total Nitrogen, Nitrite as NO ₂	One per site, twice a month	BCGEN05 5	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, twice a month	Calculated	8 oz.	Jar, plastic	None	48 hours at 4°C, dark
Water Quality - Ag Monitoring Sites	See Fig. 6.4.3	Water	Surface	Ammonia as Nitrogen	One per site, twice a month	BCGEN06 1	8 oz.	Jar, plastic	H ₂ SO ₄	28 days at 4°C, dark
Water Quality - Ag Monitoring	See Fig. 6.4.3	Water	Surface	Total Kjeldahl Nitrogen	One per site, twice a month	BCGEN05 9	8 oz.	Jar, plastic	H ₂ SO ₄	28 days at 4°C, dark

Sampling Location	Location ID Number	Matrix	Depth (units)	Analytical Parameter	# Samples (include field duplicates)	Sampling SOP #	Sample Volume	Containers #, size, type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/analysis
Sites										
Water Quality - Ag Monitoring Sites	See Fig. 6.4.3	Water	Surface	Total Phosphorus	One per site, twice a month	BCGEN060	8 oz.	Jar, plastic	H ₂ SO ₄	28 days at 4°C, dark
Water Quality – bay nutrient sites	See Fig 6.4.5	Water	Below surface	Salinity, temperature, NO ₃ -N	1 sample per month at each site, duplicate collected for 10% of samples and sent to lab for analysis	MBVMP Back Bay Nitrate Monitoring Protocol	120 mL	120 mL container/site	None	48 hours 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
Stormwater quality – First Flush	See Fig 6.4.7	Water	Surface	Total dissolved solids/total suspended	One per site	MBVMP Stormwater Monitoring Protocol	0.5 gal	Plastic container	None	7 days at 4 °C, dark

Sampling Location	Location ID Number	Matrix	Depth (units)	Analytical Parameter	# Samples (include field duplicates)	Sampling SOP #	Sample Volume	Containers #, size, type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/analysis
				solids						
Stormwater quality – First Flush	See Fig 6.4.7	Water	Surface	Turbidity	One per site	MBVMP Stormwater Monitoring Protocol	8 oz.	Plastic bottle	None	48 hours at 4 °C, dark
Stormwater quality – First Flush	See Fig 6.4.7	Water	Surface	Dissolved metals: Pb, Zn, Cu, Ni	One per site	MBVMP Stormwater Monitoring Protocol	8 oz.	Plastic bottle	None	Filtered by lab within 24 hours, preserve with HNO ₃ . Holds for 6 months.
Stormwater quality – First Flush	See Fig 6.4.7	Water	Surface	Oil & grease	One per site	MBVMP Stormwater Monitoring Protocol	1 quart	Amber glass	HCl, light protected	28 days
Urban Watch (for field analysis)	See Fig. 6.4.8 and 6.4.9	Water	Surface	Various	One per site	MBVMP Urban Watch Monitoring Protocol	100 mL	Whirl-Pak bags	None	24 hours
Urban Watch	See Fig. 6.4.8 and 6.4.9	Water	Surface	Ammonia-nitrogen	5% of samples split	MBVMP Urban Watch Monitoring Protocol	8 oz.	Plastic bottle	H ₂ SO ₄ preservative, light protected, 4° C	28 days

Sampling Location	Location ID Number	Matrix	Depth (units)	Analytical Parameter	# Samples (include field duplicates)	Sampling SOP #	Sample Volume	Containers #, size, type	Preservation (chemical, temperature, light protected)	Maximum Holding Time: Preparation/ analysis
Urban Watch	See Fig. 6.4.8 and 6.4.9	Water	Surface	Total residual chlorine	5% of samples split	MBVMP Urban Watch Monitoring Protocol	8 oz.	Plastic	Fill vial without headspace, light protected, 6° C	As soon as possible (deliver to lab within 3 hours)
Suspended sediment	See Fig. 6.4.17	Water	Surface	Suspended sediment concentration	Depends on number of storms and frequency of sample collection	MBVMP Suspended Sediment Monitoring Protocol	350 mL	1 L plastic sampler bottles	None, light protected	No holding time limit
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% ethyl 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	MBNEP Eelgrass Monitoring Protocols	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% ethanol 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, stormwater, bacteria or phytoplankton analysis will be analyzed immediately or transferred to the laboratory refrigerator.

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 and stormwater 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, 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> , enterococcus, total coliform	Sterile, sealed plastic jar purchased from IDEXX	120 mL	Sodium thiosulfate, cool to 4°C; dark.	6 hour at 4°C, dark. If not possible to analyze within 6 hours, then analyze

Parameter	Container	Volume	Initial Preservation	Holding Time
	Laboratories			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 ₂ , Total Nitrogen, Organic Nitrogen, analysis by laboratory	Plastic jar provided by BC Laboratories	250 mL	None	48 hour at 4°C, dark.
TDS and TSS	Plastic bottle provided by BC Laboratories	64 oz.	None	7 days at 4°C
Oil & Grease	Amber glass bottle provided by BC Laboratories	32 oz.	Hydrochloric acid preservative	28 days at 4°C
Dissolved metals	Plastic bottle provided by BC Laboratories	8 oz.	None	24 hours at 4°C. Filtered within 2 hours of collection Preserved with HNO ₃ by the lab within 48 hours. Can hold for 6 months after filtered and acidified.
Turbidity	Plastic bottle provided by BC Laboratories	8 oz.	None	48 hours at 4°C
Total residual chlorine	Glass VOA vial provided by BC Laboratories	40 mL	None	Analyze immediately, transport at 4°C in the dark.
Ammonia-nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus	Plastic bottle provided by BC Laboratories	8 oz.	H ₂ SO ₄ preservative	28 days, at 4°C in the dark.

Parameter	Container	Volume	Initial Preservation	Holding Time
Benthic invertebrates	Widemouth plastic jar	16 oz.	95% ethanol	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 shall have custody of samples during field sampling. Chain of custody forms will accompany all samples during shipment 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 (for Water Quality only)	-1.0 pH	MBVMP Water Quality Monitoring Protocols	No	NA	NA
pH (Urban)	Field monitoring	NA	4.5 units	MBVMP Water	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)
Watch)	g by MBNEP volunteers			Quality Monitoring Protocols			
Conductivity (Water Quality and Urban Watch)	Field monitoring by MBNEP volunteers	> 3,000 uS (for Water Quality only)	200 uS for low range meter and 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 Quality and Urban Watch)	Field monitoring by MBNEP volunteers	> 25 NTU (for Water Quality only)	0.01 NTU	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Nitrate as N (Urban Watch)	Field monitoring by MBNEP volunteers	2.6 mg/L	1.0 mg/L	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Nitrate as N (Water Quality)	Field monitoring by MBNEP volunteers	> 10 mg/L (for Water Quality only)	0.3 mg/L	MBVMP Water Quality Monitoring Protocols	No	NA	NA
Orthophosphates as PO ₄ (Water	Field monitoring by MBNEP	> 0.36 mg/L (for Water Quality only)	0.3 mg/L	MBVMP Water Quality Monitoring	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 and Urban Watch)	volunteers			Protocols			
Ammonia Nitrogen (Urban Watch)	Field monitoring by MBNEP volunteers	NA	0.25 ppm	MBVMP Urban Watch Monitoring Protocol	No	NA	NA
Total Residual Chlorine (Urban Watch)	Field monitoring by MBNEP volunteers	NA	0.2 ppm	MBVMP Urban Watch Monitoring Protocol	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 (Urban Watch)	pH paper	pH paper	
pH (Water Quality)	pH meter	Ion-selective electrode	Temperature compensation
Conductivity (Water Quality and Urban Watch)	Oakton ECTestr Low range and ECTestr 11 Plus	Voltage drop	Temperature correction
	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

Monitoring Effort	Equipment Description	Measurement Principle	Major Attributes
Temperature (Water Quality and Dawn Patrol)	YSI Model 55 and 85	Thermistor	
Turbidity (Water Quality and Urban Watch)	HACH 2100P Turbidimeter	Nephelometric	Auto ranging
Nitrate as N (Water Quality)	HACH DR/890 meter	Chromatropic acid reaction, colorimeter	
Nitrate as N (Urban Watch)	LaMotte Test No. 3354 Nitrate-Nitrogen	Zinc reduction reaction	
Orthophosphates as PO ₄ (Water Quality and Urban Watch)	Hanna Low Range Phosphate Meter, Model 93713	Ascorbic acid reduction reaction, colorimeter	
Ammonia Nitrogen (Urban Watch)	HACH Test Strips, No. 2755325	Ammonia salicylate test strip	
Total Residual Chlorine (Urban Watch)	LaMotte Test No.3308 Total and Combined Chlorine Test Kit	N,N diethyl-p-phenylenediamine sulfate and potassium iodide reaction	

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/ 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)
Colilert-18)		water, 61 MPN/100 mL for fresh water	sample	Protocols		sample	
Nitrate as N (Dionex DX-100 IC) for First Flush, Water Quality and Urban Watch	BC Laboratories	10 mg/L for Water Quality; NA for FF	0.1 mg/L	EPA Method 300.0	No	0.014 mg/L	0.1 mg/L
Orthophosphates as P (Kone 1)) for First Flush, Water Quality and Urban Watch	BC Laboratories	> 0.12 mg/L for Water Quality; NA for FF	0.02 mg/L	SM 4500-P E	No	0.0041 mg/L	0.02 mg/L
Total Kjeldahl Nitrogen	BC Laboratories	NA	0.2 mg/L	EPA 351.2	No	0.056 mg/L	0.2 mg/L
Total nitrogen	BC Laboratories	NA	NA	NA	NA	Calculated	Calculated
Organic Nitrogen	BC Laboratories	NA	NA	NA	NA	Calculated	Calculated
Nitrite as NO ₂	BC Laboratories	NA	0.17 mg/L	EPA 353.2	No	0.0048 mg/L	0.17 mg/L
Total Phosphorus	BC Laboratories	NA	0.05 mg/L	EPA 365.4	No	0.016 mg/L	0.05 mg/L
Ammonia-nitrogen	BC Laboratories	NA	0.05 mg/L	SM 4500-NH ₃ D	No	0.025 mg/L	0.05 mg/L

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)
(Smart Chem) for Urban Watch and Ag Monitorin g Sites	es Laboratori es						
Total residual chlorine for Urban Watch	BC Laboratori es Laboratori es	NA	0.1 mg/L	SM 4500- C/G	Yes. Due to logistics of sampling, it is not possible to analyze the sample within 15 minutes of collection. The sample will be analyzed as soon as possible upon arrival at lab.	0.1 mg/L	0.1 mg/L
Total dissolved solids (gravi- metric) for First Flush	BC Laboratori es Laboratori es	NA	10 mg/L	SM 2540C	No	10 mg/L	10 mg/L
Total suspended solids (gravi- metric) for First Flush	BC Laboratori es Laboratori es	NA	0.5 mg/L	SM 2540D	No	0.5 mg/L	0.5 mg/L
Oil & Grease (gravi- metric) for First Flush	BC Laboratori es Laboratori es	75 mg/L	5 mg/L	EPA 1664	No	1.4 mg/L	5 mg/L
Dissolved	BC Laboratori	Pb: 20 ug/L	Ni,Pb, Cu: 1	EPA 200.8	Yes. Due to	Cu: 0.35	Cu: 2.0

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)
metals: Cu, Ni, Zn, Pb (ICP_MS) for First Flush	es Laboratori es	Ni: 50 ug/L Zn: 7 ug/L Cu: 30 ug/L (for receiving waters, not for runoff)	ug/L Zn: 5 ug/L		logistics of sampling, it is not possible to filter the sample within 15 minutes of collection. The sample will be filtered and then acidified as soon as possible after collection, typically within 2 hour of collection.	ug/L Ni: 0.14 ug/L Pb: 0.16 ug/L Zn: 1.6 ug/L	ug/L Ni: 2.0 ug/L Pb: 1.0 ug/L Zn: 5.0 ug/L
Turbidity for Water Quality	BC Laboratori es Laboratori es	25 NTU	0.1 NTU	SM 2130B	No	0.1 NTU	0.1 NTU
Turbidity for First Flush and Urban Watch	BC Laboratori es Laboratori es	NA	0.1 NTU	SM 2130B	No	0.1 NTU	0.1 NTU
Total coliform (IDEXX Colilert- 18)	SLO County Public Health Agency Labora- tory	> 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
<i>E. coli</i> (IDEXX Colilert- 18)	SLO County Public Health Agency Labora-	> 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

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)
	tory						
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
Benthic macroin- vertebrates for Bioassess- ment	Ecoanalys- ts, Inc.	NA	0 to 500 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

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 using the field test kits 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 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

For FF stormwater sampling, quality assurance and quality control activities for sampling processes include the collection of field replicates and the preparation of field blanks. For field replicates, the volunteers split samples for analysis by the laboratory. The laboratory will run both the original sample and the replicates samples to assess the accuracy and bias criteria. See Table 7.1.3 for the accuracy criteria. The RPD is calculated as above. This splitting of samples will take place for one site during each annual sampling run. 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 samples are handled. The blank is compared to the MDL, as above. The laboratory will analyze the field blank for nutrients. One blank will be submitted each year. 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. Outlier calculations will not be applied to stormwater data because the data is by its nature highly variable.

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		
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, one sample per year for stormwater analysis	< 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 ≤ 5 NTU (± 2 NTU), for ≤ 25 NTU (± 5 NTU), for ≤ 100 NTU (± 20 NTU), for ≤ 500 NTU (± 50 NTU), for $\leq 1,000$ NTU (± 100 NTU), for $\leq 10,000$ NTU (± 200 NTU), for $\leq 100,000$ NTU (± 300 NTU)
Field Splits: pH	One sample per month	RPD < 20%

	analyzed by MBNEP equipment and a certified lab.	
Field Splits: DO	One sample per month analyzed both by MBNEP equipment and Winkler titration	± 1 mg/L
Field Matrix Spikes		
Other:		

Table 14.1.2. Analytical QC for water quality, stormwater and Urban Watch monitoring

Matrix: Water		
Sampling SOP: MBVMP First Flush Monitoring Protocols, MBVMP Water Quality Monitoring Protocols, MBVMP Urban Watch 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 ₂ , Total Phosphorus, TDS, TSS, oil & grease, dissolved metals, turbidity, residual chlorine, ammonia-nitrogen		
Analytical Method/SOP Reference: Nitrates (EPA 300.0), Orthophosphates (SM 4500-P E), TDS (SM 2540C), TSS (SM 2540D), oil & grease (EPA 1664), Dissolved metals (EPA 200.8), Turbidity (SM 2130B), Residual Chlorine (SM 4500-C/G), Ammonia-Nitrogen (SM 4500-NH ₃ D), TKN (EPA 351.2), Total Phosphorus (EPA 365.4), Nitrite as NO ₂ (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: Dissolved metals	One per day of analysis	< TRL

Lab. Duplicate	One per batch or one per 20 samples	Dissolved metals: $RPD \leq 20\%$ Orthophosphates: $RPD \leq 10\%$ Nitrates: $RPD \leq 10\%$ TDS: $RPD \leq 10\%$ TSS: $RPD \leq 10\%$ Oil & grease: $RPD \leq 18\%$ Turbidity: $\leq 10\%$ Total Residual Chlorine: $RPD \leq 10\%$ Ammonia-Nitrogen: $RPD \leq 10\%$ TKN: $RPD \leq 20\%$ Total Phosphorus: $RPD \leq 10\%$ Nitrite as NO_2 : $RPD \leq 20\%$
Lab. Matrix Spike	One per batch or one per 20 samples	Dissolved metals: recovery 70-130% Orthophosphates: recovery 90-110% Nitrates: recovery 80-120% TDS: NA TSS: NA Oil & grease: recovery 78-114%, $RPD < 18\%$ Turbidity: NA Total Residual Chlorine: NA Ammonia-Nitrogen: recovery 90-110% TKN: recovery 90-110% Total Phosphorus: recovery 90-110% Nitrite as NO_2 : recovery 80-120%
Matrix Spike Duplicate	One per batch or one per 20 samples	Dissolved metals: 70-130%, $RPD \leq \%$ Orthophosphates: 90-110%, $RPD \leq 10\%$ Nitrates: 80-120%, $RPD \leq 10\%$ TDS: NA TSS: NA Oil & grease: 78-114%, $RPD \leq 18\%$ Turbidity: NA Total Residual Chlorine: NA Ammonia-Nitrogen: 90-110%, $RPD \leq 10\%$ TKN: recovery ≤ 80 -120% Total Phosphorus: recovery ≤ 90 -110% Nitrite as NO_2 : recovery ≤ 80 -120%
Lab. Control sample	One per batch	Dissolved metals: 85-115% Orthophosphates: 90-110% Nitrates: 90-110% TDS: 90-110% TSS: NA Oil & grease: 78-114% Turbidity: NA Total Residual Chlorine: NA Ammonia-Nitrogen: 90-110% TKN: recovery < 80 -120% Total Phosphorus: recovery < 90 -110%

		Nitrite as NO ₂ : 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		
Analytical Parameter(s): <i>E. coli</i> , total coliform, enterococcus		
Analytical Method/SOP Reference: IDEXX Colilert-18 and Enterolert		
# 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	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		
Analytical Method/SOP Reference: Enterolert – ASTM D6503.99, Colilert-18 – Standard Methods 9223		
# Sample locations: Various (See Section 6.4)		
Laboratory QC	Frequency/Number	Acceptance Limits
Method Blank	NA	
Reagent Blank	For each new lot of reagent, run a presence/absence test for <i>E. coli</i> , <i>Klebsiella pneumoniae</i> and <i>Pseudomonas aeruginosa</i>	Presence/absence
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	No contamination

	containers. Run a presence/absence test with sterile DI water.	
--	--	--

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 Game 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 the comparison of volunteer-collected flow data with established gauges at San Luisito and Chorro Creeks. Flows calculated with volunteer-collected data will be compared to flow data from these gauges. 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 ± 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

Equipment / Instrument	Maintenance Activity, Testing Activity or Inspection Activity	Responsible Person	Frequency	SOP Reference
YSI 55 and YSI 85 DO Meters	Inspected periodically throughout monitoring time period	VMP staff	Weekly during water quality monitoring effort	Operator manual
YSI 55 and 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	Weekly during water quality monitoring effort	Operator manual
Oakton ECTestr and YSI Model 30 Meter	Inspected periodically throughout monitoring time period	VMP staff	Weekly during water quality monitoring effort	Operator manual
Oakton pH Testr 30 pH meter	Inspected periodically throughout	VMP staff	Weekly during water quality monitoring effort	Operator manual

Equipment / Instrument	Maintenance Activity, Testing Activity or Inspection Activity	Responsible Person	Frequency	SOP Reference
	monitoring time period			
HACH DR/890 for Nitrates as N for Water Quality	Inspected periodically throughout monitoring time period. Quarterly, run a sample of reagent of a known NO ₃ concentration to test the meter results.	VMP staff	Weekly during water quality monitoring effort	Operator manual
LaMotte Nitrate as N test kit for Urban Watch	Inspected periodically throughout monitoring time period	VMP staff	Weekly during water quality monitoring effort	Operator manual
Hanna PO ₄ meter	Inspected periodically throughout monitoring time period. Quarterly, run a sample of reagent of a known PO ₄ concentration to test the meter results.	VMP staff	Inspected weekly during water quality monitoring effort	Operator manual
Incubators and thermometers for bacteria monitoring	Inspected periodically throughout monitoring time period	VMP staff	Monthly	Operator manual
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 and Urban Watch 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, the following corrective actions will be taken immediately. All affected sample vials and syringes will be replaced with new ones

immediately. The split sample procedure will be repeated quarterly. Volunteers will be re-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

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person and Corrective Action
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 ≤ 5 NTU (± 2 NTU), for ≤ 25 NTU (± 5 NTU), for ≤ 100 NTU (± 20 NTU), for ≤ 500 NTU (± 50 NTU), for $\leq 1,000$ NTU (± 100 NTU), for $\leq 10,000$ NTU (± 200 NTU), for $\leq 100,000$ NTU (± 300 NTU)	Monthly	VMP staff. Recalibrate. If cannot be corrected, return to manufacturer for servicing.
Oakton ECTestr, ECTestr 11 Plus and 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.
LaMotte Nitrate as N test kit and HACH	MBVMP Equipment Calibration Protocols	Run a known calibration standard and DI water to ensure accuracy. Kits and meter cannot be	Quarterly	VMP staff. Kits and meter cannot be recalibrated. Split samples are sent to laboratory for analysis.

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person and Corrective Action
DR/890 meter		calibrated.		See Table 7.1.2 for criteria.
Hanna PO ₄ 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.
Bacteria Lab: Incubator and thermometer	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 ± 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 sediment)	MBVMP Suspended Sediment Monitoring Protocol	Verify the volume of sample collected by the sampler	Annually	VMP staff. Adjust sampler programming as needed.
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 ± 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 ± 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 +/- 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 annually	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	Once for each new lot of trays	Keya Bergman
SLO County Public Health Agency Lab: incubators	QA Manual for Water and Shellfish Testing	Place inoculated plate in the incubator to test incubator temperature	Each time incubator is used	Keya 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 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 ≥ 0.995 . Calibration verification every 10 samples after initial	90 – 110% Daily	SDU

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person
		calibration. Standard source different than used for initial calibration. Recovery 90 – 110%.		
BC Labs: Dissolved Metals	BC Labs SOP	External calibration with 3 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the MDL. Linear regression ≥ 0.995 . Calibration verification every 10 samples after initial calibration. Standard source different than used for initial calibration. Recovery 90 – 110%.	90-110%	PPS
BC Labs: Oil & Grease	BC Labs SOP	Sample QA (MS/MSD, LCS & MB) analyzed every 20 samples to confirm instrument is in control.	1 per 20 samples	JAK
BC Labs: TDS and TSS	BC Labs SOP	Sample Duplicate and Laboratory Control analyzed every 10 samples to confirm system is in control.	90 – 110% for TDS, 10% for TSS	RML
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 geobacillus 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 Treatment Plant Lab: autoclave timer	Morro Bay-Cayucos Wastewater Treatment Plant Laboratory QA Manual	Run batch with two timers, one certified, to ensure accuracy.	Quarterly	Bruce Keogh
Morro Bay-Cayucos Wastewater	Morro Bay-Cayucos Wastewater	Run batch with two thermometers, one which holds the maximum	Each batch	Bruce Keogh

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person
Treatment Plant Lab: autoclave thermometer	Treatment Plant Laboratory QA Manual	temperature reached during the autoclave run.		

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 the CCAMP 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 Mens 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
- Los Osos Community Services District
- Surfrider
- California Department of Fish and Game
- California Department of Parks and Recreation
- US Fish and Wildlife
- California Native Plant Society
- San Luis Obispo Science and Ecosystem Alliance (SLOSEA)

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.

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 either 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 CCAMP database, VMP staff relies on guidance from CCAMP staff to inform us of the requirements of both hardware and software for properly maintaining the CCAMP 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 are 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 both the VMP staff and 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

Type of Report	Frequency (daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Dates(s)	Person(s) Responsible for Report Preparation	Report Recipients
Data Summary Report, including QA Report	Annually	January 31	MBNEP Program Manager	RWQCB QA Officer
Calibration Log	Annually	December 31	MBNEP	RWQCB QA Officer

Type of Report	Frequency (daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Dates(s)	Person(s) Responsible for Report Preparation	Report Recipients
			Program Manager	
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. First Flush analysis for dissolved metals will be flagged because they will not comply with the Standard Methods since they cannot be filtered immediately after sample collection. 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.

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. 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 indicates whether this data will be adequate. The completeness criteria is 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 we receive requests for our data or if we conduct any data 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 RWQCB Contract 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.

References

Black, R. 2010. Response of algal metrics to nutrients and physical factors and identification of nutrient thresholds in agricultural streams. Environmental Monitoring Assessment, doi: 10.1007/s10661-010-1539-8.

Central Coast Regional Water Quality Control Board. 1994. Water Quality Control Plan, Central Coast Region (Basin Plan).

Central Coast Regional Water Quality Control Board. 1995. Quality Assurance Project Plan for Non-Point Source Pollution and Treatment Measure Evaluation for the Morro Bay Watershed.

Central Coast Regional Water Quality Control Board. Central Coast Ambient Monitoring Program (CCAMP), Tentative Attention Levels.

EPA. 1986. Ambient Water Quality Criteria for Bacteria.

Morro Bay National Estuary Program. 2000. Comprehensive Conservation and Management Plan. Morro Bay National Estuary Program, Morro Bay, California.

Morro Bay National Estuary Program. 2000. Comprehensive Conservation and Management Plan. Vol. II Environmental Monitoring Plan. Morro Bay National Estuary Program, Morro Bay, California.

Moyle, Peter. 2002. Inland Fishes of California. University of California Press.

Shoup, D.E. and D.H. Wahl. 2009. The effect of turbidity on prey selection by piscivorous largemouth bass. Transactions of the American Fisheries Society, 138:1018-1027.

Sigler et al. 1984. Effects of chronic turbidity on density and growth of steelhead and coho salmon. Transactions of the American Fisheries Society, 113:142-150.

Spratt, J.D. 1989. The distribution and density of eelgrass, *Zostera marina*, in Tomales Bay, California. *California Fish and Game* **75**(4), 204-12.

Thom, R.M., 1990. A review of eelgrass transplanting projects in the Pacific Northwest. Northwest Environ. Jour., 6:121-137.

Thorne-Miller, B., M.M. Harlin, G. B. Thursby, M. M. Brady-Campbell, and B. A. Dworetzky. 1983. Variations in the distribution and biomass of submerged macrophytes in five coastal lagoons in Rhode Island, USA. Bot. Mar. **26**: 231-242.

Standard Test Methods for Determining Sediment Concentration in Water Samples. ASTM D- 3977-97. Re-Approved in 2002.

Williamson, R.1994. The Establishment of Nutrient Objectives, Sources, Impacts, and Best Management Practices for the Pajaro River and Llagas Creek. San Jose State University.

Appendices

List of Appendices:

Appendix A. Morro Bay Volunteer Monitoring Program Bacteria Monitoring Protocol	89
Appendix B. Morro Bay Volunteer Monitoring Program Water Quality Monitoring Protocols and Field Guide.....	105
Appendix C. Morro Bay Volunteer Monitoring Program Back Bay Nitrate Monitoring Protocol	132
Appendix D. Morro Bay Volunteer Monitoring Program Dissolved Oxygen in the Bay	139
Appendix E. Morro Bay Volunteer Monitoring Program Stormwater Monitoring (“First Flush”) Protocol	143
Appendix F. Morro Bay Volunteer Monitoring Program Urban Watch Monitoring Protocol.....	152
Appendix G. Morro Bay Volunteer Monitoring Program Stream Profiling Protocol	178
Appendix H. Morro Bay National Estuary Program Surface Elevation Table Monitoring for Measuring Sediment Accretion in Morro Bay Estuary	190
Appendix I. Morro Bay Volunteer Monitoring Program Macroinvertebrate Monitoring Protocol.....	195
Appendix J. Morro Bay National Estuary Program Eelgrass Monitoring Standard Operating Protocol	197
Appendix L. Morro Bay Volunteer Monitoring Program Shorebird Survey Protocol.....	206
Appendix M. Morro Bay Volunteer Monitoring Program Phytoplankton Monitoring Protocol	213
Appendix N. Morro Bay National Estuary Program’s Suspended Sediment Monitoring Protocol.....	217
Appendix O. Morro Bay Volunteer Monitoring Program Equipment Calibration Protocols.....	236
Appendix P. Morro Bay Volunteer Monitoring Program Data Management Protocols	253

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)
- Latex 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 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 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 an outgoing tide.
- Ideally, samples will arrive at the lab within six hours of collection, and must be maintained at 10 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 10 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 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 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 rubber 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.
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)

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

Table of Contents

Field Hazards and Precautions.....	2
Emergency Phone Numbers and Contacts.....	5
Collection Permit.....	6
Right of Way Permit.....	7
Material Safety Sheets.....	8
Site Codes and Gate Codes.....	10
Measurement Instructions.....	
Measurement location and pH Paper.....	11
Nitrate Kit.....	12
Phosphate Kit.....	13
Turbidity Meter.....	15
Conductivity Probe.....	16
Dissolved Oxygen Meter.....	18
Dissolved Oxygen Meter <i>for Bay and SYB</i>	20
FLOW Mate Meter.....	21
Flow Measurement Protocol.....	23
Equipment Malfunction Guide.....	25
Quality Assurance (QA) Instructions.....	27
Instructions for Collecting QA Samples.....	28

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. See the following page for additional information.

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 μS or mS .

The $^{\circ}\text{C}$ 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 $^{\circ}\text{C}$ 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 in case 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 H₂SO₄ 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.
- Open the container underwater at 1/3 the depth and fill. The container does not need to be completely full. It is all right to leave an 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.

- 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.
- 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

This lock is on a rotating combination based on the month and year.

	<u>Even</u>	<u>Odd</u>
JAN	3288	5431
FEB	1302	6797
MAR	3110	1006
APR	8129	2083
MAY	5014	4132
JUN	6722	9465
JUL	1813	8649
AUG	7522	1981
SEP	2304	7057
OCT	7602	2146
NOV	4498	8081
DEC	1112	5503

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:**
These meters take 6 AA batteries which are in the small Tupperware container in the kit. Unscrew the knob at the base of the meter by the cord and replace the batteries. Re-screw tightly!

Nitrate Meter:

- **Meter will not turn on:**
 - This meter takes a nine volt battery. There should be a replacement battery in the Tupperware container in the kit.

Phosphate Meter:

- **Screen displays a strange message, or won't zero:**
There is a full guide to display codes for this meter in the Phosphate Meter directions in this guide.
 - If the meter repeatedly displays 'LO' bring back to the office and we'll fix it.
- **Meter will not turn on:**
This meter takes a nine volt battery. There should be a replacement battery in the Tupperware container in the kit.

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:**

A nutrient blank is sterile water that is refrigerated and transported to the water quality site for testing. AFTER you test the creek water, rinse the Nitrate and Phosphate kit vials as you normally would, then run the test the water from the Nutrient Blank bottle that you took from the fridge in the equipment room. 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 please see the next page.

- **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	Units (circle)	Notes/Field Observations
Water Temperature	DOE-MBV- <input style="width: 40px;" type="text"/>		C	<i>Algae Present?</i> YES or NO
Dissolved Oxygen	DOE-MBV- <input style="width: 40px;" type="text"/>		mg/L	If YES, please describe below. (Dense or patchy, color, stringy or mats)
Dissolved Oxygen	DOE-MBV- <input style="width: 40px;" type="text"/>		%	
Turbidity	TUN-MBV- <input style="width: 40px;" type="text"/>		NTU	
Conductivity	DOE-MBV- <input style="width: 40px;" type="text"/>		uS or mS	
pH & pH Temperature	PHEL-MBV- <input style="width: 40px;" type="text"/>		pH, Temp	
Nutrient Sample	Time collected:		-	

Flow Volume Measurement			Total Width of Stream (ft): <input style="width: 100px;" type="text"/>
Distance from Bank	Depth (0.00)	Velocity (ft/s)	<small>If your site is <5' wide take at least 6 measurements. If your site is >5' wide take at least 12 measurements.</small>
1)			Flow Mate Equipment ID:
2)			FLO-MBV- <input style="width: 60px;" type="text"/>
3)			Notes/Field Observations Trash/ Litter Present: YES or NO Oily Sheen or scum on Surface? YES or NO Odor detected? YES or NO Fish present? YES or NO
4)			
5)			
6)			
7)			
8)			
9)			
10)			
11)			
12)			
13)			
14)			
15)			
16)			
17)			
18)			
19)			

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

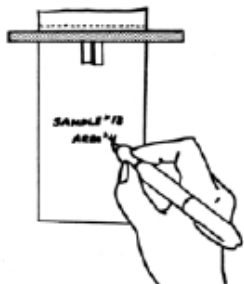
Equipment:

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

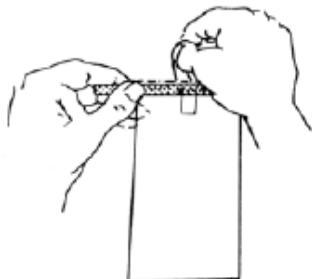
Sample Collection Procedure:

1. Collect the sample when you first arrive at the site.
2. Label the container 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



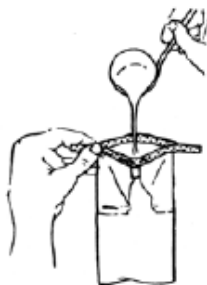
1. Label the bag with sample information if necessary.



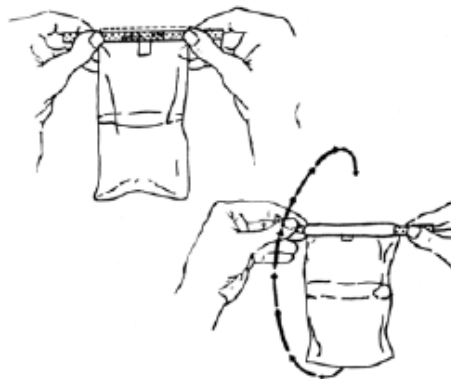
2. Tear off the top of the bag along the perforation.



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:

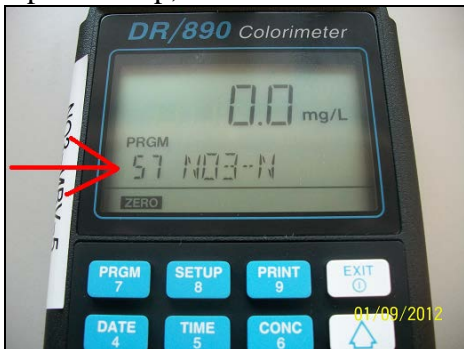
- HACH DR/890 meter with back plastic test tube adapter and meter cap
- Nitrate reagent vial (glass with plastic cap)
- Nitrate reagent powder (silver packets)
- Kim Wipes
- Pipetter labeled ‘NITRATE’
- Pipette tips
- Blue test tube rack
- Sharpie
- Scissors
- Lab coat
- Safety glasses
- Lab gloves



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
- PO4 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

	This indicates that the meter is in a ready state and zeroing can be performed.
	Sampling in Progress. This prompt appears each time the meter is performing a measurement.
	This indicates that the meter is in a zeroed state and measurement can be performed.
	A zero reading was not taken. Insert a sample before adding reagent and press ZERO.
	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.
	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.
	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.
	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.
	The "V" indicates that the battery voltage is getting low and the battery needs to be replaced.
	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. Morro Bay Volunteer Monitoring Program
Back Bay Nitrate Monitoring Protocol

Morro Bay Volunteer Monitoring Program Back Bay Nitrate Monitoring Protocol

Background

Nitrate is the most oxidized form of nitrogen, and is the primary form of biologically available nitrogen. We are measuring Nitrate as a concentration of Nitrogen ($\text{NO}_3\text{-N}$). When expressed in this form, concentrations are approximately 4.5 times lower than when processed as Nitrate (NO_3).

Concentrations $>2.25 \text{ mg/l } (\text{NO}_3\text{-N})$ ($>10 \text{ mg/L of } \text{NO}_3$) can cause Methemoglobinemia (Blue Baby Syndrome) in infants. Toxicity is the result of reduction of NO_3 to Nitrite (NO_2), which reacts with hemoglobin and prevents the blood cells from transporting oxygen to tissues. Relationships with other health effects, including bladder cancer and non Hodgkins Lymphoma, have been documented.

Excessive nitrate and resulting nitrite concentrations have been shown to be toxic to aquatic life such as frogs and marine invertebrates. Excessive concentrations stimulate growth of algae and aquatic plants, which can negatively affect water quality. Extensive growth of algae increases decaying vegetative material, resulting in low or fluctuating dissolved oxygen levels. Low dissolved oxygen can be lethal to fish and other aquatic species.

Excessive nitrate can originate from direct discharge from treated wastewater and sewer overflows, and non-point sources such as agriculture and urban runoff. Specific sources include fertilizers, confined livestock/animal wastes, septic systems and sewage treatment systems, and atmospheric deposition. Nitrate does not adhere readily to sediments and is transported primarily in the dissolved phase in surface runoff and through the substrate into ground water.

Source: Federal Interagency Stream Restoration Working Group. 1998. Stream Corridor Restoration: Principals, Processes and Practices.

#	ID	DESCRIPTION
3	BPR	Baywood Pier
4	SW T	Sweet Springs - sample from second bridge
6	CUI	Cuesta Inlet - sample from launch

Sites



Site Photos



Site 4 – Trail at Sweet Springs and Site Near Second Bridge



Site 6 –Site at Cuesta Inlet

Testing

Safety:

- **Your safety is more important than collecting the sample, so never put yourself in a situation that makes you feel uncomfortable.**
- Always go with a partner.
- Carry a cell phone. VMP Office: 772-3834 Police, Los Osos (Non-Emergency): 528-6083
Harbor Patrol: 772-6254
- Be sure to wear gloves. This protects both you and the sample from contamination.
- Wear rubber boots. The shoreline is often muddy so step carefully to avoid slips and sinking in the mud.
- Begin sampling just after a high tide, preferably a +5 tide or greater, but no less than +4 tide.

Field Equipment:

- 2 pairs of rubber boots (both people)
- 3 sample bottles (labeled 1-3)
- 1 “blank” bottle (filled with DI)
- 1 box of gloves
- 1 salinity/temp meter
- 1 bottle DI water
- 1 extendable sampling rod
- 1 cooler with ice
- datasheet

Test Equipment:

- 2 Nitrate test kits
- 2 QA bottles
- timers
- DI water
- waste collection container

Procedure:

- Gather field equipment from office.
- Fill “Blank” with DI water and place in cooler before leaving.
- Collect samples (see instructions below).
- Return to office.
- Gather test equipment.
- Run tests (See instructions below).

Collecting a Sample:

- Each site will have a sample bottle that is labeled with the site number.
- Remove lid then slide the neck of the bottle between the prongs of the extendable sampling rod.
- Carefully walk to water’s edge and fully extend rod.
- Turn bottle upside down, dip underwater, turn right side up, and lift out of water.
- Carefully bring bottle back to you and cap.
- Place in cooler.
- Record time of collection on data sheet.

Measure the salinity at the site:

- Turn on the salinity meter and if necessary press the ‘Mode’ button until the units are ‘ppt’.
- Wrap the end of the cable around the prongs of the extendable sampling rod so the probe hangs down about 6 inches, then extend the rod.
- 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 fully submerged for the readings to be accurate.
- Wait for the reading to stabilize.
- Record the salinity and temperature values on the datasheet.
- Rinse the probe with DI water and return to the chamber in the side of the meter.

Running a Test:

- See attached pages for test procedures.

Notes:

- Shake samples before running them to mix water.
- Run samples in the same order as they were collected, but include blank randomly (i.e. some months run the blank first, some second, some third, etc.)
- When reading results from the nutrient test kits, if the color from your test looks like it's between two different values on the color chart, it's OK to interpolate a value. For instance, if the color of your nitrate test looks like it's between 2 mg/L and 4 mg/L, it's fine to put 3 mg/L on the data sheet.
- Dump test waste into a plastic bottle that is labeled "NITRATE TEST KIT WASTE".
- Rinse test tubes with DI water at least three times before running next sample, pour rinse water into test waste bottle, shake out excess to dry tube.

Names:			High & Low Tide (Time & Height):			Current Weather - Rain Last Week:		
Date:				Notes:				

Site #	GPS		Time of Sample	Temp (°C)	Salinity (ppt)	Equip ID	Nitrate (ppm)	Kit ID	Site Notes
3 BAY	Latitude	35°19.62' N				SAL-MBV-1		NO3-MBV-	
	Longitude	120°50.51' W							
4 SWT	Latitude	35°19.33' N				SAL-MBV-1		NO3-MBV-	
	Longitude	120°50.50' W							
6 CUI	Latitude	35°19.18' N				SAL-MBV-1		NO3-MBV-	
	Longitude	120°50.92' W							
Site Codes: BAY = Baywood Pier, SWT = Sweet Springs, CUI = Cuesta Inlet									

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.

Dawn Patrol	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 Stormwater Monitoring (“First Flush”) Protocol

Morro Bay Volunteer Monitoring Program Stormwater Monitoring (“First Flush”) Protocol

Pre-Flush Preparations

1. Note all coolers and sample bottles labeled with Site and Sample ID codes.
2. Note site locations, site codes, and site monitoring route for specified city.
3. Visit sites during daylight to become familiar with monitoring locations and site needs.

First Flush Event

1. Designate a data recorder from the team of volunteers assembled. This person will be responsible for recording all data for the four sites.

2. Assemble all equipment:

Coolers for designated sites	Rainjackets and boots
Gloves	Sampling Pole
Bucket and Cup	Headlamps / Flashlights
Site Maps and Descriptions	DI Water
Datasheets and Pencils	

3. Upon arrival at each site data recorder fills out top half of the *Field Datasheet*.
4. At the site, rinse the bucket or sampling cup 2-3 times in the outflow before collecting samples.
5. Collect outflow and use cup to pour water into sample bottles. **DO NOT RINSE SAMPLE BOTTLES!** Sample bottles have been sterilized and contain preservatives!
6. Data recorder notes time each sample is collected, and who completes the collection on the ‘Sample Collection’ area of the datasheet.
7. Data recorder notes all measurements and time taken under the ‘Field Measurements’ portion of the *Field Datasheet*.
8. Bucket and cup are rinsed 2-3 times with outflow at next site.
10. Data recorder notes departure time at the top of the datasheet.

**Morro Bay National Estuary Program
Volunteer Monitoring Program**

Stormwater (“First Flush”) Sampling Bottles and Kit Supplies

Oil and Grease:

- BC Laboratory Analysis
- 1 quart glass bottle, sulfuric acid preservative
- 28 day hold time

Metals (dissolved metals):

- BC Laboratory Analysis
- 8 oz. plastic bottle, no preservative.
- We conduct filtration ASAP after sample collection.

Nutrients (orthophosphates and nitrates), TDS and TSS

- BC Laboratory Analysis
- ½ gallon plastic bottle, no preservative.
- 48 hour hold time for nutrients, 7 day hold time for TDS and TSS.

Bacteria (*E. coli*, Total Coliform)

- San Luis Obispo County Public Health Agency
- 1 sealed IDEXX bottle with sodium thiosulfate
- 24 hour hold time.

pH

- VMP analysis
- 8 oz. sterile plastic bottle.
- Check pH ASAP.

Additional Supplies

De-Ionized water

Headlamps and Flashlights

Rain jackets

Sampling pole, bucket.

Maps and Datasheets (Rite-in-Rain)

Coolers and Icepacks, all samples must be chilled to 4 degrees Celsius!!

Stormwater (“First Flush”) Timeline of Events

Today:	Review of site locations and protocol. Designation of Los Osos Team Captain.
24-48 hours prior:	Team captains notify volunteers of incoming weather and potential for first flush monitoring.
1-4 hours prior:	Team captains watch local weather conditions, look for potential sheet flow from the streets.
Minutes Prior / Start Time:	Team captains observe sheet flow, mobilize volunteers.

Sheet Flow Observed:

Volunteers need to mobilize as quickly as possible, all water must be collected during first hour after sheet flow is observed!

20 Minutes of SF	Volunteers meet at designated meeting points: Baywood Pier Parking Lot in Los Osos MBNEP Office in Morro Bay
30 Minutes of SF	Volunteers leave from meeting points, begin site routes.
1 Hour after SF	All water is collected, stored in coolers. Coolers brought to MBNEP office. Samples analyzed for pH.

MBNEP staff will conduct analysis of selected water quality parameters.
Remaining samples will be prepared for laboratory analysis.



**Morro Bay National Estuary Program
Volunteer Monitoring Program
First Flush Monitoring**

Monitoring Route:

Date:

Team Captain:

Captain's Phone Number:

Team Members:

<u>Sample ID</u>	<u>Time Collected</u>	<u>Collected By</u>	<u>Container Type</u>
310-			Large ½ gallon plastic
			Amber glass bottle
			Medium plastic unsealed
			Small sealed plastic

Captain Signature

VMP Staff Signature

Time Relinquished to MBNEP

Morro Bay National Estuary Program

Date:

Site Code:

--	--

Arrival Time at Site:

Departure Time at Site:

--	--

Site Conditions: (please circle one)

Precipitation: Mist Drizzle Rain Downpour

Water Clarity: Clear Cloudy Murky Muddy Dark/Black

Wind: Calm Light Medium Strong

Flow: 5 gal/min 10 gal/min 25 gal/min 50 gal/min

Observations: **Description and Notes:** (eg. kinds of trash seen)

Oily Sheen? Y/N _____

Odor Y/N _____

Floating Trash Y/N _____

Bubbles/Foam Plume
at outlet? Y/N _____

Dark Plume at outlet?
Y/N _____

Other Observations and Notes:

Sample Chain-of-Custody for First Flush

Morro Bay National Estuary Program's Volunteer Monitoring Program First Flush Dissolved Metal Sample Filtration Procedure

Equipment:

Stormwater samples

10 mL syringes (one per sample)

Syringe filters, 40 um pore size with 1um pre-filter (three per sample)

Clean 8 oz. plastic bottles (one per sample)

Sharpie

Gloves

Waste container

Procedure for Filtering Dissolved Metal Samples:

1. Wear gloves.
2. Allow metals stormwater samples to sit, undisturbed, for approximately 10 minutes before filtering.
3. Label all sample containers with site names.
4. Remove a sterile syringe from its packaging.
5. Draw 10 mL of stormwater sample into the syringe.
6. Remove a syringe filter from the container.
7. Attach the syringe filter to the end of the syringe.
8. Press the plunger of the syringe and filter approximately 2 mL of sample into the waste container.
9. Filter the remaining volume in the syringe into the sample container.
10. Remove the filter and draw up 10 mL into the syringe.
11. If the filter was beginning to offer resistance during the filtration, then put a new filter on the syringe. If a new filter is used, be sure to discard the first few mL of filtered sample into the waste container. If it was not yet clogged, then re-attach the same filter.
12. Filter the water into the sample container.
13. Repeat until you have approximately 30 to 50 mL of filtered sample.
14. Note the time of filtration on the datasheet for the site.

Appendix F. Morro Bay Volunteer Monitoring Program Urban Watch Monitoring Protocol

Morro Bay Volunteer Monitoring Program Urban Watch Monitoring Protocol

Urban Watch Goals: To provide regular monitoring of storm drains in the communities bordering Morro Bay estuary to document the types and frequency of urban contamination reaching the bay. To generate data to educate residents and to help identify illicit discharges to assist local communities in remedying problems associated with these discharges.

Volunteer Commitment: Volunteer will monitor once a week during their assigned week. Each volunteer will be assigned two weeks per month. Each monitoring trip will take approximately two hours.

Overview of the Monitoring: Volunteers will observe their sites and fill out a site checklist indicating whether the drain is flowing or not. If a drain is flowing, the volunteer will fill out a more detailed 'Dry Weather Flow Datasheet' and provide more observations of the flow. Some simple analysis will be conducted at the site, and samples will be collected to be taken back to the office. More detailed analysis will be conducted by the volunteer at the office. The volunteer must return in 24 to 48 hours to interpret the bacteria results or coordinate with VMP staff to read the results.

Equipment Checklist

- Cooler
- Ice packs in a clean zipped plastic bag
- Gloves
- Deionized (DI) water
- Whirl-pak bags
- Coli-Test Whirl-pak bags (containing white pills)
- Conductivity meter
- pH paper
- Ammonia test strips
- Camera
- Datasheets, 2 types: Site Checklist and Dry Weather Flow Datasheet
- Clipboard and pen
- Sharpie
- Safety glasses
- Bucket on rope
- Timer

Scheduling UW Monitoring

Do not conduct monitoring if there has been significant rainfall in the previous 72 hours.

Try to schedule your monitoring trips at random times. If possible, conduct one set of observations on a weekday and one set on a weekend.

Completing the Site Checklist

1. Collect your equipment and proceed to your first storm drain.
2. Complete the general information on the Site Checklist: Name, date, weather, and tide information.
3. At each site, enter the three letter site code on the checklist.
4. Enter the time you are at the site making the observation.
5. Check whether the site is flowing, ponded, dry or tidally influenced. The tidal category would apply if the storm drain appears to have been recently inundated by the tide.
6. If a site has flow that is not tidal, then fill out a Dry Weather Flow Datasheet for the site.
7. Complete the checklist for all sites. If you've collected flow samples for some of your sites, return to the office to analyze the samples. If none of the sites were flowing, then Urban Watch monitoring is complete.

What To Do If a Site Has Flow

- First you should collect your sample, because the flow could end quite quickly.
- If the runoff is particularly egregious (i.e., clearly polluted), contact the authorities that can respond. Some clues to look for include a solvent smell, a hydrocarbon smell, large amounts of dirt or paint, etc.
- For Morro Bay:
 - During the week: if you suspect that the source is from a construction site, call Damaris Hanson at the city offices at 805-772-6165. If she is not available, call the city offices at their general number 805-772-6162 and ask for Rob Livick or Dan Doris. If none of them are available, be sure to leave a message with the front office staff rather than leaving a voice mail. If it is not a construction site or if none of the City of Morro Bay staff are available, call the police department at 805-772-6237 and ask for Commander Tim Olivas.
 - During the weekend and after hours: call the police department at 805-772-6237.
- For Los Osos:
 - During the week: Call SLO County Environmental Health Department at 805-781-5544 and tell the receptionist that you would like to report a potentially illegal discharge.
 - During the weekends and after hours: Call 911 and tell the Sheriff's Dispatch that you have a non-emergency call and would like to report a potentially illegal discharge that the County Environmental Health Department might need to respond to.
- If you can't get a response and the runoff is particularly nasty, then call 911.
- If you can determine that the runoff is from a private citizen (i.e., irrigation or car washing, oil, foam, gasoline), note the address or general neighborhood of the source. Local agencies will use that information to determine where to target their education and outreach efforts. In the future, a mailer might be distributed in the area to educate local residents.
- If you can clearly identify that the runoff is from a business, make a note of the business name and location. Take pictures if possible to document the amount and condition of the runoff.

- **It is NOT the role of program volunteers to confront or educate either the public or local businesses about runoff regulations.** The volunteer role is to collect as much documentation as possible about a discharge incident so that local authorities can use it to target their efforts.

Collecting a Runoff Sample

1. When a site is flowing, the first thing you should do is collect a sample. Flows are often short in duration and you don't want to miss it.
2. **Put on gloves and safety glasses.**
3. Label two Whirl-Pak bags and one Coli-Test Whirl-Pak bag (contains white pills) with the site code BEFORE you collect the sample. One Whirl-Pak bag is for the analysis conducted in the field, and one is for the analysis to be conducted at the office. The Coli-test Whirl-Pak bag is for bacteria analysis, which will be conducted at the office.
4. Open each Whirl-Pak bag by tearing off the strip across the top. Pull open the bag using the paper tabs and hold by the wires. The bags are sterile and so to avoid contaminating the sample, you should not touch the inside of the bag.
5. Try to collect the flow without disturbing the sediment at the bottom of the storm drain. Fill the bags up to about 4 cm from the top.
6. Seal the Whirl-Pak bags by rolling the top edges down three times and then twisting the wire edges together. Check for leaks by upending the bag and giving it a gentle squeeze.
7. Store the Coli-Test bag and one of the Whirl-Pak bags in the clean plastic bag with the ice packs in the cooler for analysis at the office.
8. Conduct your field measurements (temperature, conductivity, total residual chlorine, ammonia and pH) on the remaining Whirl-Pak bag.

Conducting Field Analysis

- Use your collected water in the Whirl-Pak bag for field measurements.
- Record the Urban Watch Kit # on the datasheet (written on the lid of the cooler).
- Be sure to conduct analysis for pH last.

Water Temperature and Conductivity



1. Uncap the meter and press the ON/OFF button to turn on the meter. Check that the temperature readout is in Celsius
2. Triple rinse the metal probes with DI water to ensure that they're clean.
3. Hold the Whirl-Pak bag by the wire on top to avoid heating the water sample with the heat from your hand
4. Insert probes into the Whirl-Pak bag.
5. Make sure the electrodes are fully submerged but are not near the bottom or sides of the Whirl-Pak bag.
6. Once the reading stabilizes, press the HOLD button and remove the meter from the water to read the result. (This holds the latest reading from the meter.)
7. Record the temperature reading on the datasheet, which is the number at the bottom of the meter's screen. Make sure the reading is in Celsius.
8. Record the conductivity reading on the datasheet, which is the value at the top of the screen. Circle the correct units, either uS or mS. If the meter reads 'OR', this means the reading is out of range for the meter. Record 'OR' on the datasheet.

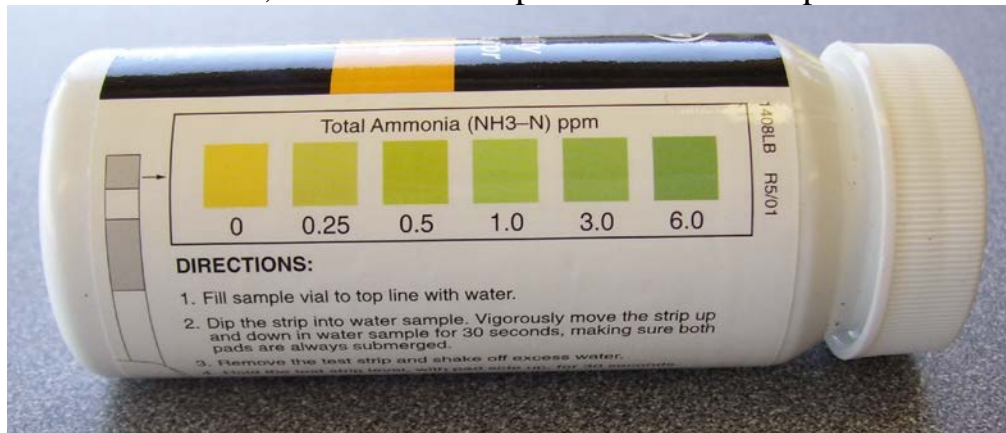


9. Turn the meter off.
10. Triple rinse the electrodes with DI water and recap the meter.
11. Record the meter's Equipment ID# on the datasheet.

Ammonia Nitrogen



1. Rinse sample vial twice with DI water.
2. Fill with sample water and then discard into the Nontoxic Waste Container.
3. Fill with sample water to top line.
4. Remove a strip from the container and recap tightly. Be careful to not touch the pads on the test strip to avoid contaminating it.
5. Dip the strip into the water sample. Vigorously move the strip up and down in the water for 30 seconds, making sure both pads are always submerged. Use the timer to track the time.
6. Remove the test strip and shake off excess water.
7. Hold the test strip level, with pad side up, for 30 seconds.
8. To read result, turn the test strip over so that both pads are facing away from you.



9. Compare the color of the small pad to the color chart on the bottle. Read the result through the clear plastic of the test strip. Record the corresponding value on the datasheet. Remove your sunglasses before reading. If the color seems to fall between two different levels, do NOT interpolate the results. Choose the closest value and record that on the datasheet.
10. Discard the test strip in the trash bag in the kit.
11. Rinse the sample vial with DI water twice and discard in Nontoxic Waste Container.
12. Keep the test strip container tightly sealed and out of the sun.

Total Residual Chlorine

Sample should be analyzed as soon as possible after collection.



1. Use the same syringe used for previous tests.
2. Rinse the sample tube twice with DI water.
3. Rinse sample tube once with water to be tested and discard into Nontoxic Waste Container.
4. Use the syringe to fill the tube to the 10 mL line with the sample water.
5. Add one DPD #1R tablet, cap and shake to dissolve.
6. Add one DPD #3R tablet, cap and shake to dissolve.



7. Immediately insert tube into Octa-Slide Viewer and match sample color with the Octa-Slide. You must pick a number from the color bar. Do not estimate between numbers. If the color is lighter than the lightest color on the bar, record <0.2 mg/L on the datasheet.
8. Dispose of sample into Nontoxic Waste Container.
9. Rinse the tube twice with DI water, dumping the water into the Nontoxic Waste Container. Store the tube, uncapped, in the kit.

pH



1. Remove one pH strip from the package and re-cap the package.
2. Insert the pH paper into the bag (be sure to hold the bag by the wire on the top).
3. Submerge all three bars and immediately remove from the water.
4. Flick to remove surface water.
5. Read within 10 seconds. Compare it to the color bars on the package and record the data. Be sure to choose the best match for all three color bars. Read in the shade, not the sun for more accurate color. Remove your sunglasses before reading for a more accurate interpretation.
6. Record the pH package ID# on the datasheet under Equipment ID#.
7. Discard the used test strip in the trash bag in the kit.

Once all of these readings are complete, you can use the same water for the Runoff Characteristics (odor, color, etc.).

Completing the Urban Watch Flow Datasheet

1. Complete the general information including date, time of observation, your name and the three letter site code.
2. **Odor:** Hold the open Whirl-Pak bag about six inches from your nose. Use your free hand to fan the scent toward your nose. Never inhale the air directly off the top of the sample. Record your observations.
3. **Color:** Under natural light and not in direct sunlight, hold the Whirl-Pak bag against a white background and observe the color.
4. **Clarity:** Hold up the Whirl-Pak bag to the light and observe the sample clarity. Record your observations.
5. **Floatables:** Observe the flow from the storm drain and note any floatables including trash, cigarette butts, food wrappers, bubbles or foam, oily sheen, fecal matter or Other. For the category “Other”, please provide a brief explanation.
6. **Deposits in pipe:** Look into the storm drain pipe and note any sediment or gravel, fine particulates, stains, oily deposits or Other. For the category “Other”, please provide a brief explanation.
7. **Water Flow:** Estimate the water flow from the storm drain. The best way to do this is to imagine how long it would take for the flow from the drain to fill a one quart bottle or a gallon-sized bottle.
8. **Does the flow reach the receiving water?** Note whether or not the flow is reaching the bay or whether it appears to be absorbed by vegetation, evaporating, etc.
9. **Evidence of Overland flow?** Note any obvious sources of flow, including irrigation runoff and vehicle washing that are visible from the outfall.
10. **Location of source:** Make notes about the source including an address or business name.
11. **Photos:** If you take photos of the site, provide notes and details to help understand the photo. Examples of things to photograph: unusual water colors or flows, unusual amounts of trash, pollution sources.

Conducting Lab Analysis

- If samples were collected, return to the office to conduct further analysis.
- Analysis must take place at the office when the building is open. Building hours are typically 8 a.m. to 5 p.m. on weekdays and 10 a.m. to 5 p.m. on weekends.
- All analysis will take place in the VMP Equipment Room, located in the Estuary Nature Center in the Marina Square Building.
- If you cannot get into the building to conduct your analysis, you must store your samples properly until the next day when they can be analyzed. Place the Whirl-Pak bags into a clean zipped plastic bag and store in a refrigerator or store on ice in a cooler. Do not freeze samples. The samples must be analyzed within 24 hours after collection. Chlorine sample should be analyzed as soon as possible after collection because the sample rapidly degrades over time.
- **You must wear gloves and safety glasses** when conducting all laboratory analysis.
- For each piece of equipment, record the Equipment ID# on the datasheet. If a data reading ever seems suspect, VMP staff can test the meter to determine whether it is due to an equipment malfunction.
- Waste from the Orthophosphate and Nitrate tests each have a separate container. All other water waste can go into a single Nontoxic Waste Container.
- All equipment you need for your analysis is contained in the white cabinet in Water Quality Kit #2 and in a bin in the cabinet marked 'Nutrient Analysis.'

Turbidity

1. Using the same syringe from the previous test (total residual chlorine), fill it with sample water and fill glass sample cell to the 10 mL mark (white band/arrow). Hold the glass cell by the top, not the sides.



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



7. Close lid.
8. Press READ.
9. Record value after light bulb icon turns off.
10. Push the POWER button to turn the instrument off.
11. Empty cell. Rinse cell and syringe with DI and discard into Nontoxic Waste Container. Store in the case with the cap off so cell can air dry.
12. Return cloth to its plastic bag to keep it clean.

Orthophosphate



1. Sample must be between 18 and 25° C at the time of analysis.
2. Turn the meter on by pressing the ON/OFF button.
3. When the meter displays '---' it is ready for use.
4. Use the syringe to fill the vial with sample water and then discard the water into the Nontoxic Waste Container.
5. Use the syringe to fill the vial to the 10mL line marking and screw on the cap.
6. Use lens paper to dry off the vial.
7. Place the vial in the chamber making sure that the notch in the cap is positioned securely into the groove.
8. Press the 'ZERO' button, a '5IP' message will appear, and will change to 0.0 in a few seconds.

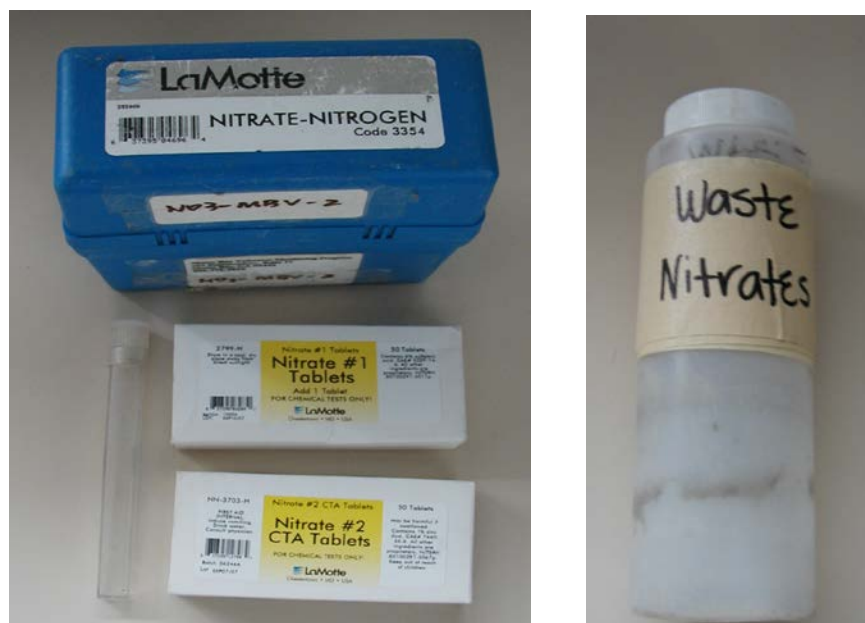


9. Once zeroed, remove the vial and carefully add one packet of reagent manufactured by HACH.



10. Replace the cap and swirl gently for **THIRTY SECONDS** until most of the crystals are dissolved. Use the timer. Do not vigorously shake the vial or it will leak.
11. Place the vial back into the meter and set a timer for two minutes.
12. When the timer goes off, hit the **READ DIRECT** button. Record the value on the datasheet.
13. Store waste in a container labeled Orthophosphate Waste. **DO NOT MIX WASTES FROM THE DIFFERENT TYPES OF TESTS.**
14. Rinse the vial and cap out twice with DI water and pour the rinse water into the Orthophosphate Waste Container.
15. Store vial in the kit with the cap off so that it can dry.

Nitrates



1. Sample must be between 18 and 25° C at the time of analysis.
2. Fill the plastic sample tube with DI water, cap, shake to rinse, and then discard water into the Nontoxic Waste Container. Repeat again.
3. Use the same syringe to fill plastic sample tube with water from Whirl-Pak bag. Swirl and discard into the Nontoxic Waste Container.
4. Refill the tube to the 5 mL line with the sample water.
5. Add one Nitrate # 1 Tablet, cap and mix until the tablet dissolves.
6. Add one Nitrate # 2 Tablet, cap and mix until the tablet dissolves.
7. Begin timing for 5 minutes once the tablet has dissolved.
8. At the end of 5 minutes, place the test tube into the color comparison slide viewer.

9. Match the sample color to the most appropriate color standard.
10. If the color from your test looks like it's between two different values on the color chart, it's OK to interpolate a value. For instance, if the color of your nitrate test looks like it's between 2 mg/L and 4 mg/L, enter 3 mg/L on the data sheet.
11. Store waste in the container labeled Nitrate Waste. DO NOT MIX WASTES FROM THE DIFFERENT TYPES OF TESTS.
12. Rinse the plastic vial and cap twice with DI water, discarding it into the Nitrate Waste Container.
13. Store vials with caps off so that they can dry properly.

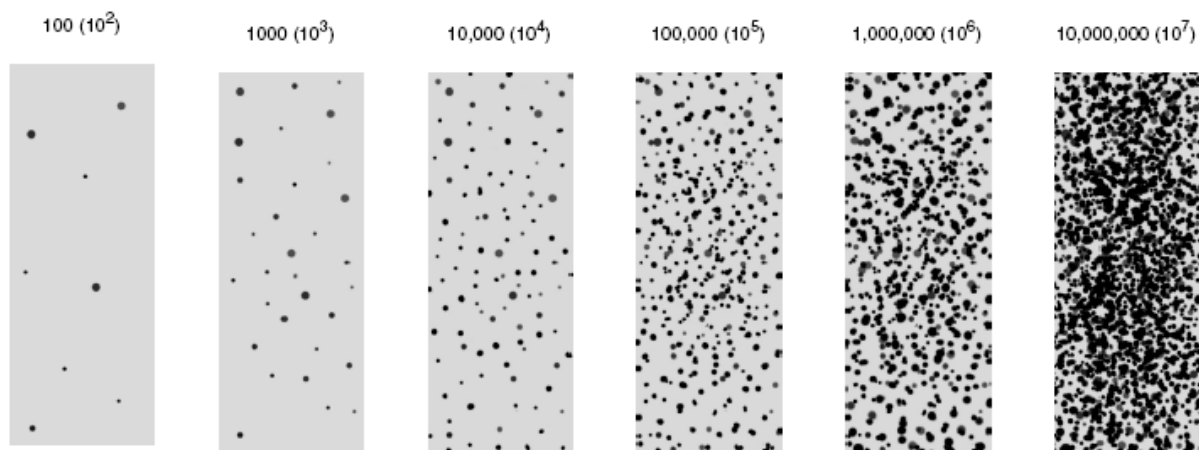


Bacteria

1. Remove a paddle tester from the box in the equipment room refrigerator.
2. Remove the paddle from the vial. Do not touch the media.
3. Immerse the entire paddle into the Coli-Test Whirl-Pak bag.
4. Remove the paddle from the liquid and allow the excess liquid to drip off. Do not shake.
5. Return the paddle to the vial and screw on the cap. Label vial with site code.
6. Place the paddle tester in the incubator in an upright position.
7. Note the time that incubation started on the datasheet.
8. Read the thermometer inside the incubator, and record on the datasheet the temperature inside the incubator.
9. Results must be read in 24 hours. Notify VMP staff of start time of incubation so that they can read the results at the correct time. [If monitoring is taking place on a Friday or Saturday, VMP staff will not be available to read the results. If you cannot return 24 hours later to read the results, then do NOT run a bacteria test for the sample.]
10. Observe the red side of the paddle under direct light.
11. If no colonies are present, return the vial to the incubator and re-read after an additional 24 hours of incubation.

12.If pink colonies are present, count them and match the results to the chart below. Do not count colonies on the yellow side of the paddle. Record the value on the datasheet.

Interpreting the Level of Contamination for Total Bacteria or Total Coliform Bacteria



13.If clear or grey colonies are present, then the sample is negative for total coliform. Record '< 100' on the datasheet.

14.Sterilize the paddle tester prior to disposal. Remove the cap and add 10% bleach solution to the paddle tester as recommended by the manufacturer. Replace the cap. Dispose of in trash.

Upon Completion of Monitoring

- Pour extra water from Whirl-Pak bags into the Nontoxic Waste Container. Pour Nontoxic Waste Container down the drain and rinse with tap water.
- Rinse out the syringe so it is ready for the next volunteer.
- Make sure kit is clean and ready for the next volunteer.
- If any supplies are needed, notify VMP staff.
- Deliver datasheets and photos to the office.
- Sign-in on the clipboard in the equipment room with your name and the total time monitoring, including travel time to the sites.

Urban Watch Site Checklist

[illegible]

Urban Watch Flow Datasheet

Date						
Time of observation						
Observer name						
Site ID						
Runoff Characteristics (check all that apply)						
Odor	<input type="checkbox"/> None <input type="checkbox"/> Petroleum	<input type="checkbox"/> Musty <input type="checkbox"/> Chlorine	<input type="checkbox"/> Rotten Egg <input type="checkbox"/> Ammonia	<input type="checkbox"/> Chemical <input type="checkbox"/> Sewage	Other:	
Color	<input type="checkbox"/> None <input type="checkbox"/> Unknown	<input type="checkbox"/> Yellow	<input type="checkbox"/> Brown	<input type="checkbox"/> White	<input type="checkbox"/> Gray	Other:
Clarity	<input type="checkbox"/> Clear	<input type="checkbox"/> Slightly Cloudy	<input type="checkbox"/> Opaque	Other:		
Floatables	<input type="checkbox"/> None <input type="checkbox"/> Cigarettes	<input type="checkbox"/> Trash <input type="checkbox"/> Food wrappers	<input type="checkbox"/> Bubbles/foam	<input type="checkbox"/> Oily Sheen	<input type="checkbox"/> Fecal Matter	Other:
Deposits in pipe	<input type="checkbox"/> None	<input type="checkbox"/> Sediment/Gravel	<input type="checkbox"/> Fine particulates	<input type="checkbox"/> Stains	<input type="checkbox"/> Oily Deposits	Other:
Water Flow	<input type="checkbox"/> Stagnant/ponded	<input type="checkbox"/> Trickle (<1 qt/min)	<input type="checkbox"/> Moderate (<1 gal/min)	<input type="checkbox"/> High (> 1 gal/min)		
Does the flow reach the receiving water?	<input type="checkbox"/> Yes		<input type="checkbox"/> No	<input type="checkbox"/> N/A		
Evidence of Overland flow?	<input type="checkbox"/> None	<input type="checkbox"/> Irrigation Runoff	<input type="checkbox"/> Vehicle Washing	Other:		
Location of source (address, business name, etc.):						
Photo taken	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Photo #			
Runoff Sample Analysis						
Urban Watch Kit #:						
Field Analysis	Equipment ID#	Result	Notes and Observations:			
Water temperature (°C)						
Conductivity (uS or mS)						
pH						
Ammonia Nitrogen (ppm)						
Total Chlorine (mg/L)						
Lab Analysis	Equipment ID#	Result	Time of Start of Lab Analysis:			
Turbidity (NTU)						
Orthophosphate as PO ₄ (mg/L)						
Nitrate as N (mg/L)						
Total coliform (CFU)	-		Incubation start time:	Incubator temp:	Time read results:	

Appendix G. Morro Bay Volunteer Monitoring Program
Stream Profiling Protocol

Morro Bay Volunteer Monitoring Program Stream Profiling Protocol

Equipment List

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

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

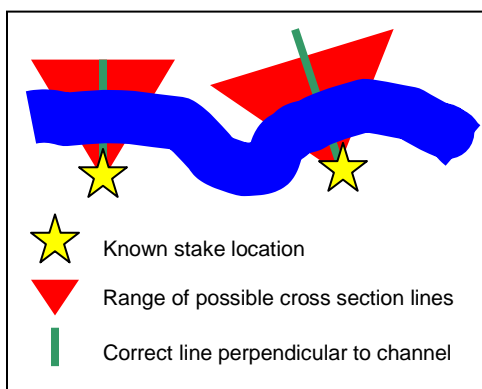


Figure 2 – Cross sections perpendicular to channel

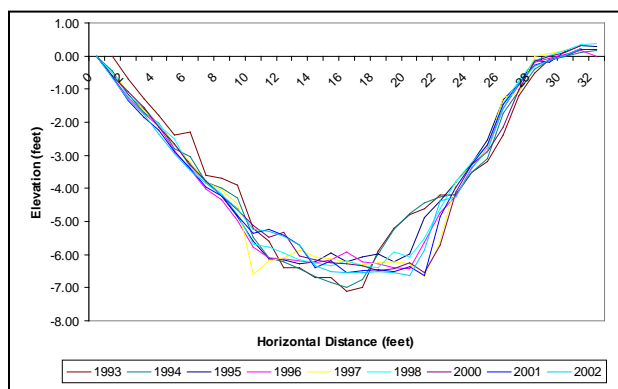


Figure 3 – Cross section plot showing 32 feet between stakes

- 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.

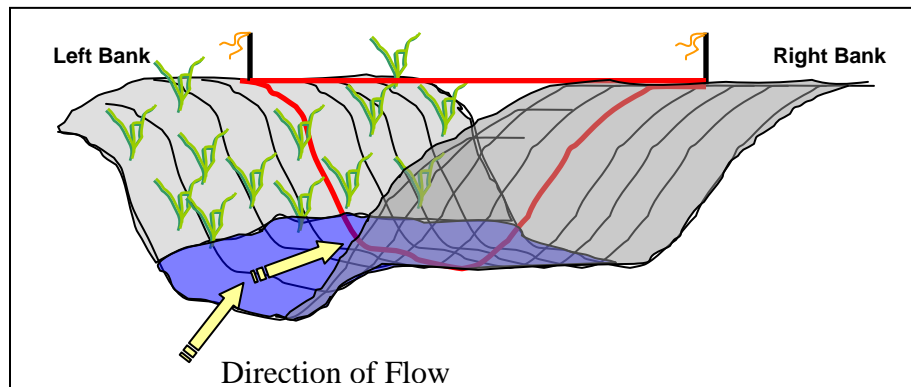


Figure 5 – The left and right banks are determined by facing downstream

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).

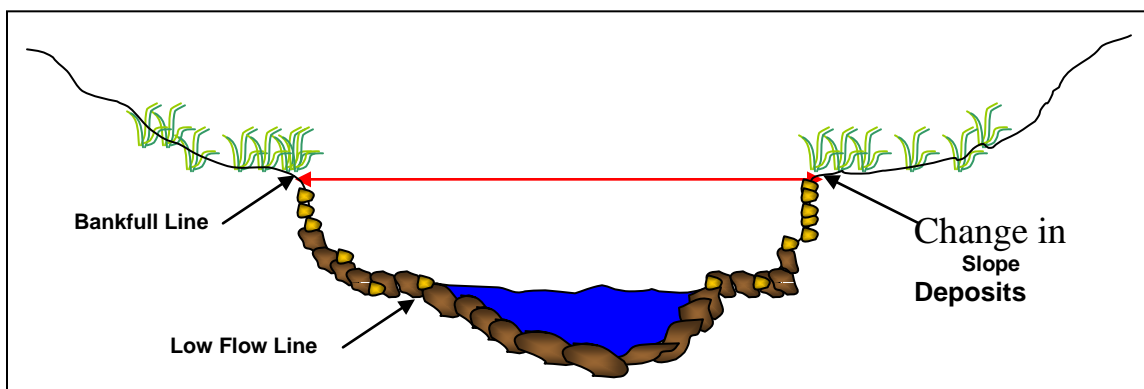


Figure 6 – Cross section depicting bankfull line

- 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.

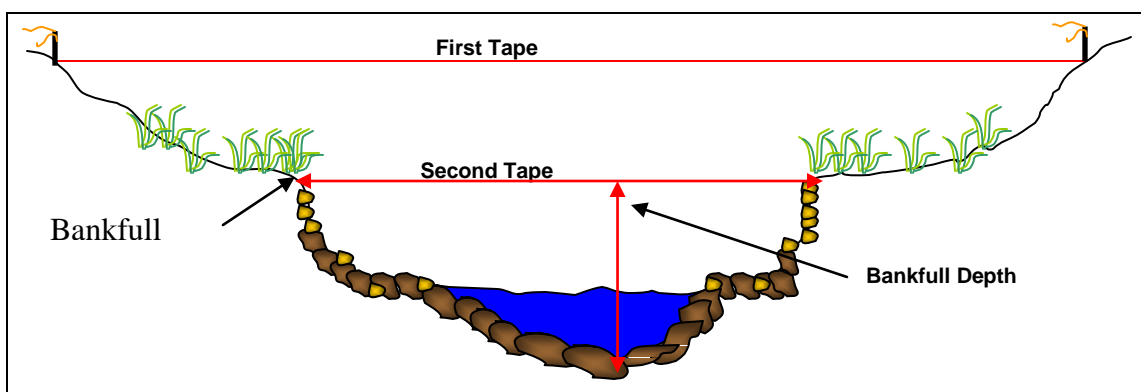


Figure 7 – Locating bankfull width and bankfull depth

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).

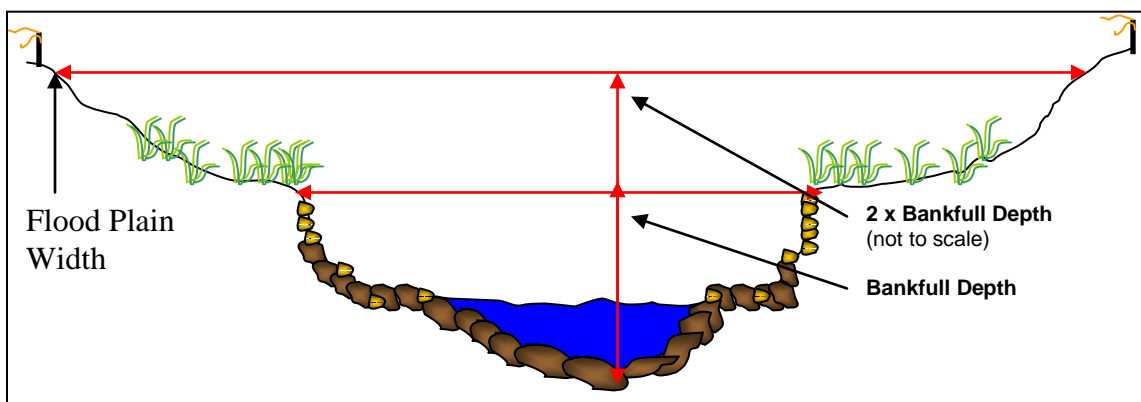


Figure 8 – Locating floodplain width

- 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.

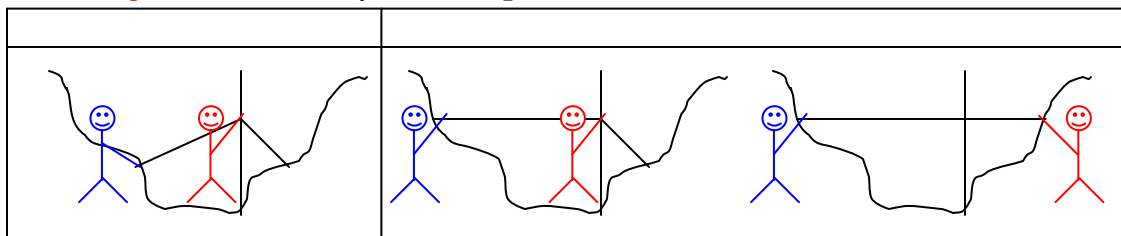


Figure 9 – Measuring floodplain width with two people

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.

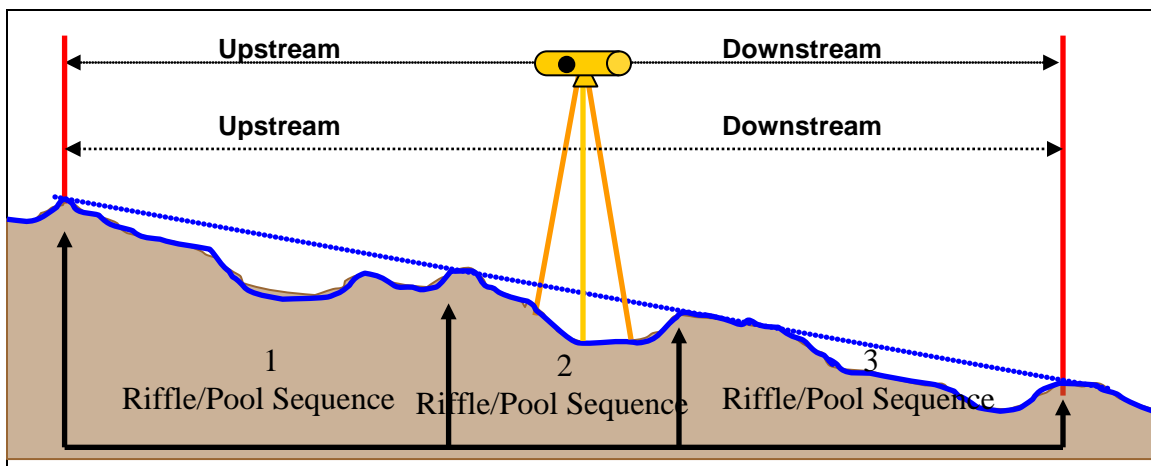


Figure 10 – Measuring slope

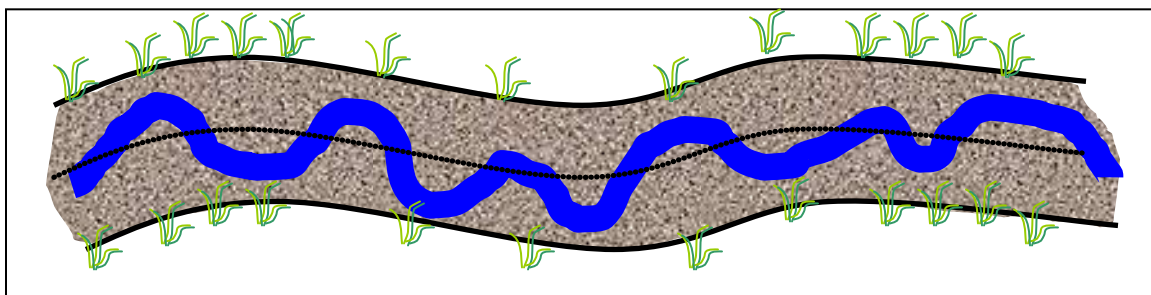


Figure 11 – Dotted line represents centerline of the bankfull channel; blue line represents a summer low flow channel

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.

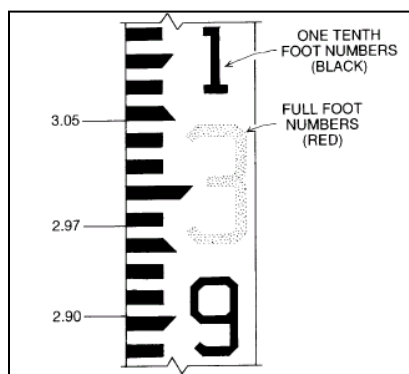


Figure 12 – Reading stadia rod

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

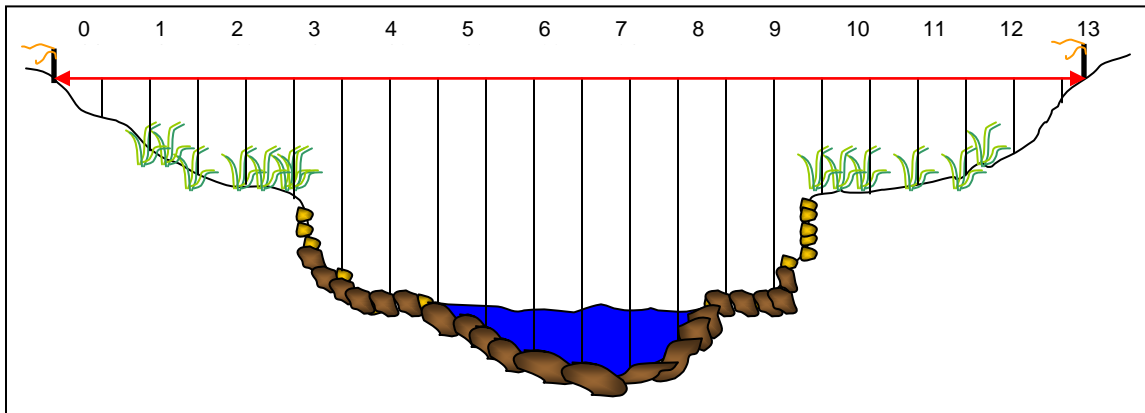


Figure 13 – Survey the cross section by taking a reading at every foot

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

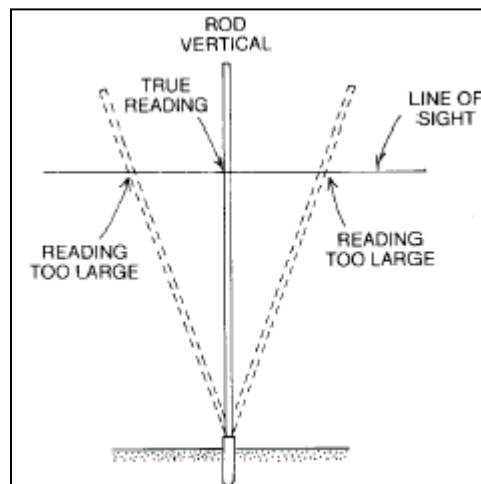


Figure 14 – Leaning the rod results in incorrect readings

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.

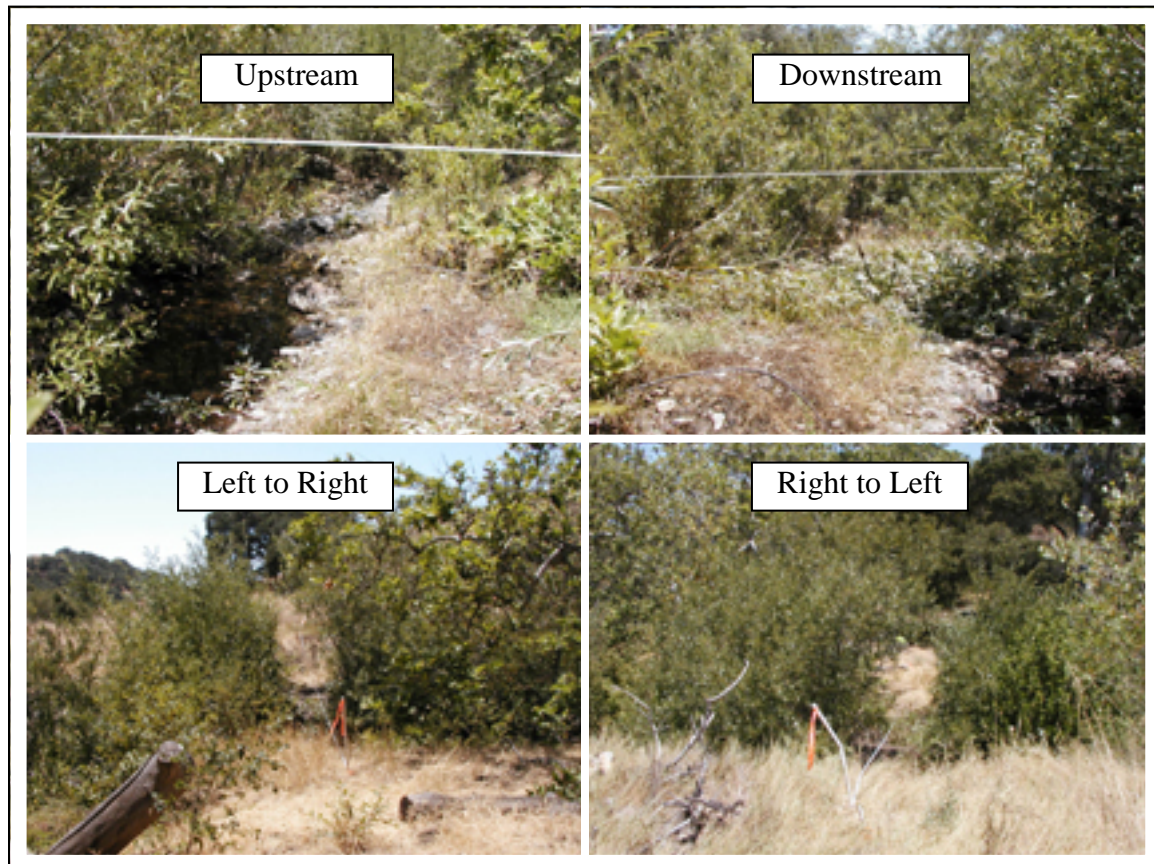


Figure 15 – Example photos

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 $6.81 - 5.19 = 1.62$

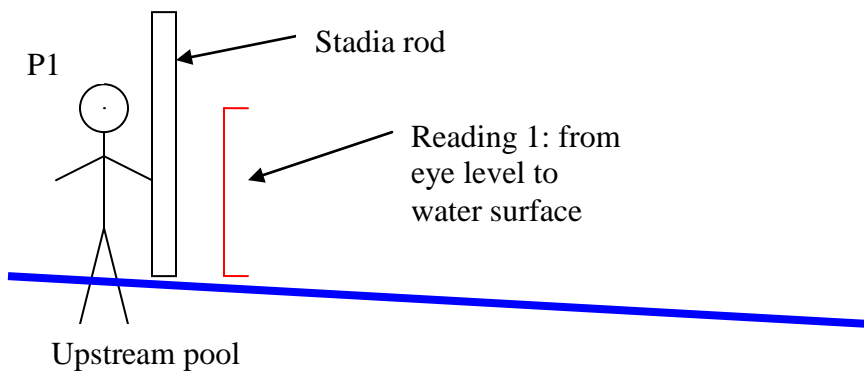
Run: using tape measure = 73

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

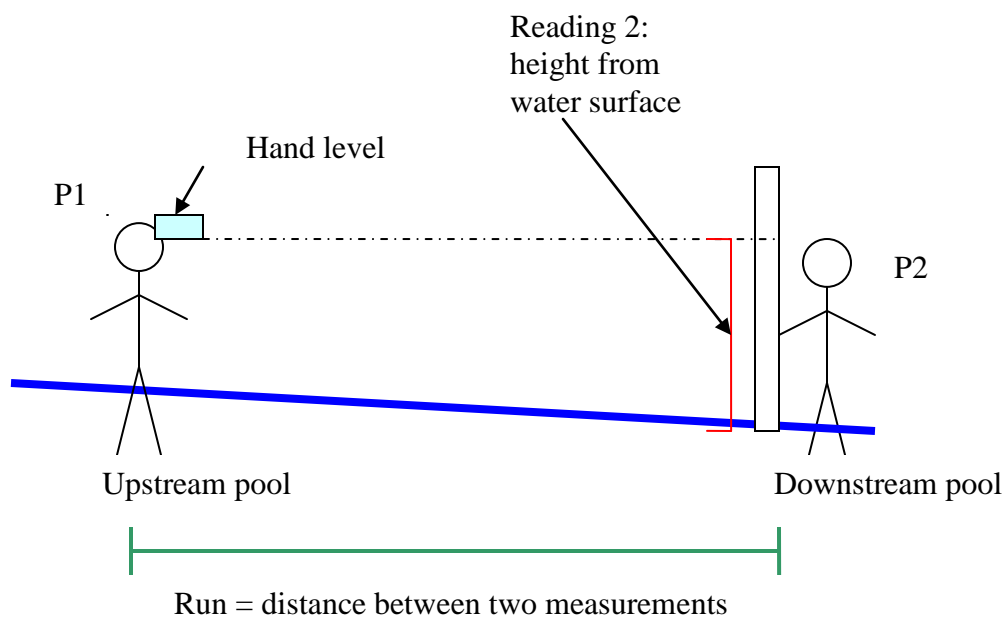
Note:

- 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		Slope Measurements
4		39		74		Upstream Distance:
5		40		75		Upstream Reading:
6		41		76		Downstream Distance:
7		42		77		Downstream Reading:
8		43		78		Notes
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 H. Morro Bay National Estuary Program
Surface Elevation Table Monitoring for
Measuring Sediment Accretion in Morro Bay Estuary

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).

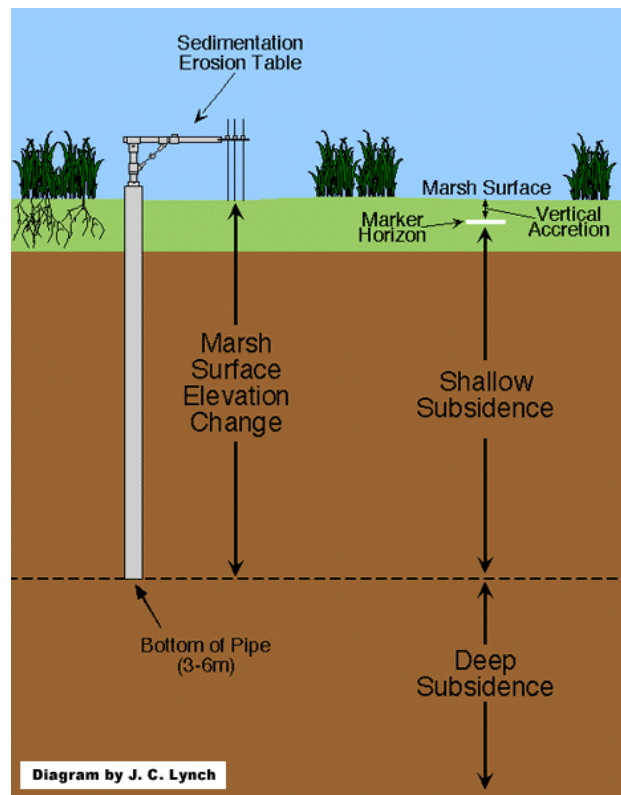
The SET is attached to a stable benchmark on the marsh surface (Figure 1). The benchmark is a 3'' aluminum pipe driven into the sediment as far as possible (until refusal). The benchmarks are driven by hand, and extend 6 to 8 inches above the sediment surface. In order to take measurements, the SET is 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 ± 0.4 mm to ± 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 I. 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.

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

Morro Bay National Estuary Program

Eelgrass Monitoring Standard Operating Protocol

Equipment List

- Motorized boat
- Lifejackets, orange safety vests, mudders, hip waders
- Digital Camera and cell phone
- Differential GPS unit and data logger
- PVC 0.25 meter quadrat
- 100 meter tape
- Ziploc Freezer Bags
- Clipboard with Rite in rain data sheets, map and protocol
- Pencils and sharpies
- Large backpack and water bottles
- Algae Guide (optional)

Transect Locations and Transport

Coleman Transect

In 2006 a new transect was established at Coleman beach near the Power Plant. This area was selected due to the permanent and dense eelgrass bed that has been documented in that location for several years. This site can be accessed from Coleman beach near the power plant, no boat is necessary for transport. The substrate for this eelgrass bed is sandy, mudders are not necessary. Short PVC markers are visible at low tide marking the transect which runs parallel to the shore and adjacent to the rock road embankment. This transect was monitored on 11/4/06 at 1:56 PM on a -0.9' low tide turning at 3:15 PM

Tidelands Transect

This transect just north and across the channel from the Tidelands boat launch. The transect poles can be easily sighted at low tide conditions. This transect was monitored on 11/15/2005 at 1:30 PM on a -0.90' low tide turning at 3:56 PM, and on 11/04/06 at 3:56 on a -0.90' tide turning at 3:15pm. This transect was monitored while still submerged, and has sandy substrate that does not require the use of mudders. Eelgrass blades are quite long and dense at this site. This transect can be quickly reached by boat, and can be accessed by kayak if necessary.

Chorro Transect

The original Chorro transect was established on an unusually low tide. In 2005 a new site was established where it could be accessed but in the same immediate region. Specifically, this second transect was established in a westerly direction from the southwest marker pole of the oyster bed, approximately 200 ft from the main channel. In 2006, the transect was again moved to provide better access and reduce trampling of eelgrass on the mudflats. The new 2006 transect runs perpendicular to the main channel and is located slightly north of the oyster beds. White PVC marking poles at each end of the transect are permanent and easy to locate during low tide conditions. The second transect was monitored on 11/15/2005 at 3:15 PM on a -0.90' low tide

turning at 3:56pm. The newest 2006 transect was monitored on 11/05/06 at 2:57 PM on a -1.2 tide turning at 4:02pm. The eelgrass at this site is best described as medium density, with heavy algae coverage at the base near the shoots. Mudders are necessary at this site. This site must be reached by boat.

Pasadena Transect

The Pasadena transect was established with transport to the site in mind. This region is midway between Cuesta Inlet and State Park Marina, thus kayaking or hiking to the site is not feasible. Harbor patrol provided transport to this site, which was monitored on 12/12/05 at 2:00 PM on a -0.50' low tide, turning at 2:33 PM and on 11/5/06 at 4:41 pm on a -1.2' low tide turning at 4:02 pm. This transect was established with the northernmost point approximately 30 feet from the channel edge and was staked during the 2006 visit. This area is where depth limits transport by most boats, thus the transect is at the northern end of this region. The eelgrass at this site can be described as patchy with a good deal of algae cover and substrate exposed.

Field Team

Three people are necessary for efficient monitoring of each transect. Two members conduct the transect survey and collect the samples while a third records data and photographs the site. All members should be supplied with hip or chest waders, mudders, lifejackets and orange safety vests. A backpack should be used to transport smaller items to the site. During the Fall 2005 survey it was found that the quadrat could be operated more easily if the division wires were removed to prevent grass from tangling and tearing along the transect.

Survey Methods

- 1.) Using the GPS unit and maps, navigate to the transect sites.
- 2.) At the site, secure the tape starting at the northern end of the transect.

3.) Transect Instructions

Begin the survey by placing the center of the quadrat at the 1 meter mark. Readings are conducted every 2.5 meters as indicated by the 'Position' column on the datasheet. For each quadrat determine the following:

- a.) **Eelgrass % coverage and Density.**
Percent coverage is determined in increments of 5%. Density is the total number of shoots within the 0.25 meter square, counted at the surface of the mud.
- b.) **Substrate % coverage and Type.**
Percent coverage is determined in increments of 5%, this is the amount of substrate visibly exposed before the eelgrass or algae are moved in any way. Type of substrate can be classified as mixed fines (MF), mud (MD), or sand (SD).
- c.) **Macroalgae % coverage and Type.**
Percent coverage is determined in increments of 5%. Type of algae is classified as Ulva (ULV), green enteromorpha (GENT), Chaetomorpha (GC), gracilaria (GRC) and Gelidium (GEL). In 2005 red enteromorpha (RENT) was classified, however

this was a misclassification. The Algae Guide which includes photographs of these algae types should be reviewed prior to monitoring and brought into the field if necessary.

Notes:

The cumulative % coverage may exceed 100% for macroalgae, substrate and eelgrass. A quadrat with 100% eelgrass overstory may have a significant amount of algae in the understory among the shoots.

d.) Water Coverage

The two classifications submerged [(SUB) and exposed (EXP)], refer to the conditions of the shoots, not the entire length of the blades. For example, the shoots may be submerged at the base with 3 in. of water while the blades are still exposed. If the shoots and substrate are submerged, record the depth of the water (in tenths of feet) using the stadia rod.

e.) Grazing

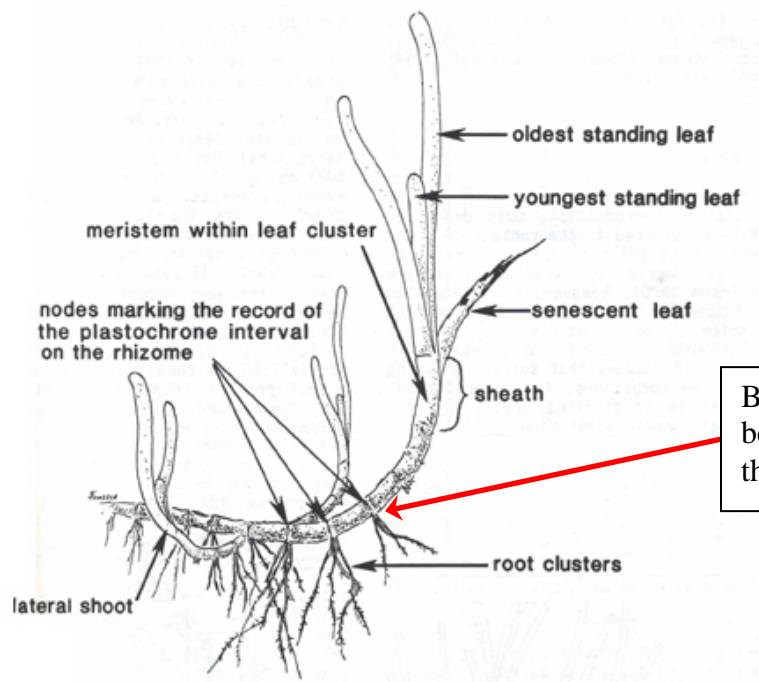
There are three categories of grazing impact: heavy (HG), medium (MG), and light(LG). This column only needs to be filled if the grass has obviously been grazed, it can be left blank if no grazing is apparent.

f.) Notes

In this section record information on epiphyte coverage and other transect details that might be useful for future work. Additionally, presence of flowering shoots should be recorded here.

5.) Sample Collection

30-40 samples should be randomly collected throughout the area parallel to the transect. It is important that shoot collection be randomized, so that there is no bias to collect the longest and healthiest shoots. Shoots should be collected as close to the rhizome as possible, and removed without damaging the leaves. The entire lengths of eelgrass should be placed in a large Ziploc bag. Label the outside of the Ziploc bag and record the sample label on the datasheet. All samples from the same transect site can be stored in the same bag. However, if blades seem particularly long and prone to breakage, it may be preferable to place 5-10 shoots in several bags.



Biomass shoots should be collected at or below this node.

6.) Photographic Documentation

General site photos were taken during the fall 2005 monitoring. Photos of the mudflat conditions in the area near the transect are useful to convey the degree of algae or eelgrass coverage and substrate exposure. Additionally, this is a good opportunity to take file photos of eelgrass, algae and marine life for the NEP. When using a digital camera record which photo numbers correspond to the site. In 2006 more site photos, stock photos of algae and eelgrass were taken and can be viewed in the 2006 eelgrass/site photos folder.

**Morro Bay National Estuary Program
Eelgrass Monitoring Field Datasheet**

DATE:					RECORDER:				
SITE:					SAMPLERS:				
LAT., LONG.:					Tide:				
Time Survey Completed:					QUAD SIZE: 0.25 meters				

Position	Eelgrass		Substrate		Macroalgae		Water Coverage		Grazing
X, Y	% COVER	DENSITY	% COVER	TYPE	% of : ULV, GENT, RENT, GRC		Depth	Exposed	Degree
	%	# shoots	%	MF, MD, SD	%	ULV, GENT, RENT...	if SUB, in ft.	SUB, EXP	MG, LG, HG
1.0									
3.5									
6.0									
8.5									
11.0									
13.5									
16.0									
18.5									
21.0									
23.5									
26.0									
28.5									
31.0									
33.5									
36.0									
38.5									
41.0									
43.5									
46.0									
48.5									

KEY: MG=Medium Grazing, HG= Heavy Grazing, LG= Light Grazing
 SUB= Submerged, EXP= Exposed. MF= Mixed Fines, MD=mud, SD= Sand
 GRC= Gracilaria, GENT= Green Enteromorpha, RENT=Red Enteromorpha, ULV= Ulva

Photo Numbers: _____ Samples: _____

Clinometer Reading: _____ Eye Line: _____ Distance: _____

NOTES:

Morro Bay National Estuary Program

Eelgrass Biomass Measurements Protocol

Sample Collection

Randomly collect 30-40 shoot samples from the area immediately adjacent to the transect line. It is important that shoots be collected from an area outside the transect that has not been disturbed by mudders.

To collect shoots, break off the shoot at the node closest to the surface of the mud. If easier, expose the entire rhizome to determine where the blade should be broken off. Hold the shoots together in long strands while collecting (so it looks like a mop) and wind the whole group in a loose coil. This helps prevent breakage or tangling of the leaves. Thirty shoots are needed for biomass measurements, it is a good idea to collect up to ten extra shoots in case of breakage.

Sample Storage

Carefully place the shoots into a labeled Ziploc Gallon size freezer bag. Samples can be stored in sealed Ziploc bags in a refrigerator for up to five days following collection.

Equipment Needed:

Drying oven (80-90 degrees C)
Thermometer
Tin foil
Electronic scale (to hundredth gram)
Sharpie permanent marker
Masking tape
Eelgrass Biomass Datasheets
Desiccator

Sample Preparation Procedures

Drying and weighing operations are conducted at the Morro Bay Water Lab located at Cuesta Community college.

1. Carefully remove individual shoots from the bag and wash gently under cool tap water.
2. If a shoot has been removed with multiple nodes or its rhizome intact, break the shoot off at the uppermost node.
3. If there are excessive amounts of epiphytes growing on the eelgrass blades, carefully scrape them into a separate bowl. Rinse epiphytes onto 2mm mesh screen, dry and weigh to nearest milligram.
4. Randomly select ten shoots of eelgrass and measure the total length from the base to the tip of the longest blade. Note on the datasheet if the longest blade has been torn or if the rounded tip is intact.
5. Cut off six to eight squares of foil and use masking tape and a sharpie to number each square.
6. Weigh each foil square individually and record mass (to nearest milligram) for each square.
7. Carefully wrap five blades of eelgrass into each square, leaving the foil open slightly for venting.

8. Place in oven to dry. Temperature and time may vary, oven temperature should be between 80-90 C. Do not fill the oven too full to ensure adequate air movement.
9. For each monitoring season, determine the amount of drying time needed. After 48 hours in the oven, remove the three largest samples from oven place in desiccator. Allow to come to room temperature and then weigh in foil. Record weight of eelgrass and foil.
10. Return the three samples to the oven for four additional hours and then place in the desiccator to cool and re-weigh. If the difference in weight is greater than 1%, then the samples should be returned to the oven and the procedure repeated until a constant weight is achieved. The total time the samples are placed 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.
11. Once all samples have been dried, cooled and weighed, subtract weight of foil to determine weight of dried eelgrass.
12. Calculate average shoot weight for each transect site.
13. Calculate above ground biomass for each transect by multiplying mean shoot density by mean shoot weight.
14. Enter data into a new excel sheet in the U:\Monitoring\vmp\VMP Data\Eelgrass\Data - Summaries\VMP BIOMASS DATA.

[illegible]

Appendix K. 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 13th 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 L. Morro Bay Volunteer Monitoring Program Phytoplankton Monitoring Protocol

Morro Bay Volunteer Monitoring Program Phytoplankton Monitoring Protocol

Equipment:

- plankton net
- bucket
- sample container with weight

Sampling sites:

1. 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.
2. Cayucos Pier: This site is at the Cayucos Pier in the city of Cayucos. Drive north on Highway 1 and take the main exit for the city of Cayucos. Head northwest on south Ocean Avenue. The pier is approximately 1 mile north at the intersection of Cayucos Drive and North Ocean Avenue. The pull should be done from the pier at the point where the pier begins an upward slope.

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. For the Cayucos pulls, they can be conducted on any tide.
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.
$$\text{Tow length} = \text{length of rope dropped} \times \text{number of times net is dropped}$$
$$= 10 \text{ feet} \times 5 \text{ drops} = 50 \text{ foot tow length}$$
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. Use the public shower or rest rooms at Cayucos Pier.
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 DHS 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. Turn on the TV.
7. Make sure that the video feed in the TV is coming from the microscope. (The cord is a yellow video signal cable. Sometimes the VCR is connected to the TV instead of the microscope.) You may need to use the TV remote to switch the signal from the TV to the external output by pushing the 'TV/VCR' button on the remote. The remote is usually located in the top right hand drawer of the desk.
8. 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
9. 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.
10. Make three complete passes through the slide. Estimate population counts for each type of phytoplankton in each pass to complete the DPH data sheet, which is available in the NEP equipment room.
11. Don't fill out the relative abundance scale or the percentage. We will calculate it.
12. 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!
13. Put the sample for DPH into the sample container and pack in the plastic bag with the absorbent cotton.
14. 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.
15. Drop the sample container into the mailbox.
16. Turn off microscope and replace the cover.
17. Wipe the slides and slide covers clean. Rinse out the eye droppers and return equipment to the shelf.

18. Please pour out the remaining sample and rinse the sample containers for the next use. That's probably easiest to do in the restroom.
19. Please report any problems with equipment to VMP staff. Also let them know if any additional supplies are needed before the next pull.

Appendix M. 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 at a certain time and 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 nearby 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). 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. Fasten the round bottle plate to the base with the three elastic bands.
7. Lightly screw caps onto each bottle.

2. Battery Charging and Installation

There are two types of batteries used in the field to power the ISCO samplers. The small black batteries are used primarily for field testing, the large batteries are deployed for continuous sampling.

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. Date and time of site visit.

2. Staff gauge height (recorded off the staff gauge on the bridge wall)
3. Code for the bottle set being removed (i.e., CAN-A for the A set of bottles from the Canet site)
4. Description of samples collected in bottle set being removed. Note if any bottles failed to fill, overtopped, or drew a varying volume.
5. If battery required changing out
6. Code for new bottle set being installed
7. Code for new battery being installed
8. Program start date and start time
9. Program sampling frequency
10. Program sampling volume

4. Programming the Sampler

Sampling report data should be downloaded from the sampler monthly.

1. Unscrew the cap on the back of the sampler for the port with the computer icon sticker.
2. Connect the RTD device to the port.
3. Wait for data download to complete.
 - a. The orange light on the RTD should light up.
 - b. The green light on the RTD will blink while data is being downloaded.
 - c. The green light on the RTD will become solid when data downloading is complete.
4. Disconnect the RTD from the port when the green light has become solid.
5. Screw the cap back onto the port.

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 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 have been made to the sampler intake.

Sampling at One-Hour Intervals with a Manual Start

1. Press the power button to turn the sampler on.
2. If the first screen shows 'Standard Programming' proceed to step 7. If the first screen shows 'Extended Programming' continue to step 3.
3. Before changing the programming setting, connect the RTD device and download all data.
4. Remove the RTD and use the number keypad to type in **6712.1**. This number sequence will change back to standard programming.
5. A message will flash on the screen warning that all data will be lost. Press **Enter** to continue.

6. The next screen will show 'Standard Programming'.
7. Go to the main menu.
8. Go to **Program**, press **Enter**
9. At "Site description change?" scroll to **No**, and press **Enter**.
10. At "Number of Bottles," scroll to **24**, and press **Enter**.
11. At "Bottle Volume," type in **1000** mL, and press **Enter**.
12. At "Suction Line Length," check that lengths are the same as shown below, press **Enter**.
(Should not need to be changed)
13. Line lengths by site are:
CANET: 99
SAN LUISITO: 35
14. WALTERS: 55At "Time Paced or Flow Paced" sampling, select **Time Paced**, and press **Enter**.
15. At "Time Between Sample Events," **type** in the **Number of Hours and Minutes**, and press **Enter**.
16. At "Sequential, Bottles/Sample, Samples/Bottle" select **Sequential**, and press **Enter**.
17. At "Run Continuously?" select **No**, and press **Enter**.
18. At "Sample Volume" type in **300** ml, and press **Enter**.
19. At the next menu "No Delay to Start, Delayed Start, or Clock Time" scroll to **Clock Time**, and press **Enter**.
20. At "First Sample at --:--", type in the start time, and press **Enter**. Time should be entered as time on a 24-hour clock.
21. At "Select Days" scroll through days, press **Enter** to select or un-select. Scroll to **Done**, press **Enter**.
22. 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 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**. Enter **Months**, and press **Enter**. Enter **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 any bottles where the volume 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 (if different from bottle set assigned)
 - e. Be sure to leave room for recording Tare 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 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.
10. Continue with login for sample processing.

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. Do not pre-rinse the bottle! Bottles have been washed and treated in the same manner as the field ISCO bottles.
3. Fill the bottle approximately halfway with DI water.
4. Weigh the un-capped bottle on the high capacity scale.
5. Create a RITR label noting the QA Blank sample, and the date it was prepared.
6. Record the weight of the sample on a RITR label.
7. Re-cap bottle tightly and remove from scale.
8. Apply the RITR label(s) to the bottle.
9. Place bottle into storage with the appropriate field bottle set, or continue with login for sample processing.

Sample Storage at the Lab

If samples will not be processed immediately:

1. Make sure sample is completely and clearly labeled and weighed in. Note: 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 back in base, or other storage container.
3. Samples stored in the water lab should be covered with a tarp.
4. Samples with a high sediment/solids concentration should be stored in the refrigerator in the Geology Prep Room.

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.

DI Water

DI water should be checked for conductivity before filling the DI squeeze bottles.

1. Run the DI tap for a full minute.
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. Record time, date, and conductivity in the DI logbook.
6. If DI water conductivity is over 10 uS/cm, run the tap an additional 1-2 minutes, collect and test a new sample.
7. Once DI water is reading below 10 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 come on.
5. When the orange indicator light has gone off, open the oven door and record the temperature on the internal thermometer.
6. In the logbook record the date, time and temperature.
7. Oven temperature should be between 103° and 110° Celsius.
8. 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 resuspend 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.

High Capacity Balance

The high capacity balance should be checked for accuracy before weighing in each round of samples.

1. Make sure the bubble level in the back left corner of the scale is centered. If it isn't, use the dials located on sides of the scale to level the scale.
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. When the scale is stable, press the CAL button to begin calibration.
6. Place the indicated calibration weight on the scale (500 grams).
7. After calibration, the calibration weight is displayed with weight units.
8. Remove the calibration weight.
9. Perform several weight checks with the smaller weights in the calibration weight set. Perform weight checks with the 200, 300, and 500 gram weights in the set.
10. The scale capacity is 810 grams, do not exceed this capacity when performing weight checks.

11. 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.

Fine Scale Balance

The fine scale balance should be checked for accuracy before weighing in any filters. It is also important to watch the scale for signs of drift when weighing 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 sides are closed.
4. Tare the balance by pressing the 'ZERO' button. The scale will beep when zeroing is complete.
5. When the scale is stable, press the CAL button to begin calibration.
6. Place the indicated calibration weight on the scale (50 grams) and close the doors.
7. After calibration, the calibration weight is displayed with weight units.
8. Remove the calibration weight.
9. Perform several weight checks with the smaller weights in the calibration weight set. Perform weight checks with the 1.0000, 2.0000, and 3.0000 gram weights in the set.
10. 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 begin to drift. To check for scale drift, follow the steps below.

1. Close all of the doors and wait for the scale to stabilize. If the scale does not stabilize at 0.0000 it may be drifting.
2. Test the scale with the low weight calibration weights.
3. If the scale drifts between more than +/- 0.0002 it should be re-zeroed and re-calibrated.

Annual Scale Maintenance and Calibration

The High Capacity Balance and Fine Scale balance will be 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 needs to be re-charged in the oven if more than 20% of the crystals have changed color from blue to pink. To recharge the desiccant, spread it into baking pans and heat according to instructions below.

- Dark blue desiccant beads should be heated to 120°C (248° F) for one to two hours.
- Light blue desiccant crystals should be spread into a single layer and heated to 230°C (450° F) for one to two hours.

Upon removal from the oven, desiccant should be placed immediately into the cabinets. Record the date of recharge in the desiccant log book.

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. Turn on the pump and let it run for one to two minutes.
5. Disconnect the tubing from the 'Pressure' side, and re-attach to the 'Vacuum' side.
6. 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 following all sample and battery handling.

Filter Contamination Prevention

Filter weights and subsequent sediment concentration data can be influenced by lab 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. 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.
4. 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 door of the lab.

Potentially hazardous materials in the lab include:

NiCd batteries (4)
AGM Batteries (1)
Turbidimeter calibration standards
Winkler DO kit solutions and reagents
Compressed air

3. Filter Preparation and Storage

Important: Filters must always be handled with forceps.

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. With valves closed, place filters on all six manifold stages.
5. Turn on vacuum and open valves.
6. Rinse filters with DI water to remove any loose fibers or dust.
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 at 17 in. Hg)
9. Close valves and carefully remove filters with forceps.
10. Place each filter into a clean, numbered foil tray.
11. Place foil trays on clean baking sheet and allow to air dry.
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 before being used for filtration.

4. Crucible Preparation and Storage

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

1. Glass crucibles are permanently numbered beginning with crucible number 901.
2. Clean crucibles may be stored in the Clean Filter Desiccator between uses.
3. Crucibles 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 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. 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.

6. Sample Filter or Crucible Assignment and Log in

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.

Samples : Form

Sediment Sample Login Page

Record Created: 3/3/2008 1:55:30 PM
Record Edited: 3/3/2008 3:24:41 PM

These fields are locked and cannot be edited. They are updated automatically when records are created or changed.

Date Sample Collected:
Site Code:
Bottle ID:
Incoming Weight (grams): *Enter whole number, no units.*
Date Sample Processed: *Enter date of laboratory analysis.*
Remarks:
Sample Quality Control:
Turbidity: 0
Stage Height: 0

True Wet Weight (grams):
Sediment Weight (grams): 0
Sediment Concentration:
Final Sediment Weight:

These fields are calculated automatically, do not enter values in these fields.

Filter Records

Filter Tare Weight: Remark:
Filter with Sample:
Dish Number: Invalid: ☐

Record: 1 of 262

Field Title	Purpose	Entry Instructions
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.
Date Sample Collected	Records when samples are collected.	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 or 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.
Incoming Weight	Records weight of bottle with sample. Should not include weight of cap.	Enter incoming wet weight, as written on bottle label.
Date Sample Processed	Tracks when samples and filters are processed.	Enter date that sample processing starts.
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 reading is available.
Stage Height	Identifies creek stage when sample was collected.	Enter the most recent stage reading, downloaded from the County datalogger.
True Wet Weight	Calculates the weight of the sample.	This field is locked, and is

Field Title	Purpose	Entry Instructions
(grams)	Automatically subtracts the tare weight of the bottle containing the sample.	shown only to reference the weight of the sample being analyzed.
Sediment Weight (grams)	Calculates the net weight of sediment collected on filters or crucibles.	This field is locked, and is only shown to reference the raw sediment weight of the sample.
Sediment Concentration (ppm)	Uses the 'True Wet Weight' and 'Sediment Weight' fields to calculate the 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.
Final Sediment Weight (mg/L)	Uses the 'Sediment Concentration' field and a numeric equation to calculate the final sediment concentration in milligrams per liter.	This field is locked, and is only shown to display the sediment concentration of the sample.
Filter Tare Weight (grams)	Records the weight of the clean 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.
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.

5. Sample Login

1. Remove samples from long term storage and inspect visually.
 - a. Bottles should be dry, with roughly equal volume samples. Set aside any bottles that are wet or have suspect volumes (might indicate a leaky bottle.)
2. In the 'Suspended Sediment' master database, open the form called 'Samples'.
3. Enter the following fields in order:
 - a. Date Sample Collected. (Includes Time entered as 24 hour clock.)
 - b. Site Code
 - c. Bottle ID (An error message will pop up if your bottle is not identified in the database.)
 - d. Incoming Wet Weight
 - e. Date Sample Processed
 - f. Turbidity

- i. Enter turbidity measurement indicated on bottle if available.
- g. Stage Height
 - i. Enter stage height measurement indicated on bottle if available.
- h. Remarks
 - i. Use this field to note any suspect sample volumes, floating debris, or macroinvertebrates in the sample.

Activate the 'Filters' sub-form of the Samples form to assign filters to the sample.

6. Assigning Filters or Crucibles

Depending on the sediment content of samples, they may require from one to ten 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.
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 on the foil tab or crucible into the 'Dish Number' field.
6. To assign an additional filter, press the new record form located at the bottom of the form. (Indicated by the right pointing arrow and star symbol)

7. Filtering Samples

It is important to note the vacuum pressure 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 if needed.

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 place 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 dish should be the side 'face-up' on the manifold.
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 check the filter for contamination or tears.
6. Replace the magnetic cup on top of the manifold station.

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. It is important not to tilt or flip the wet filter as sands or other large particles may fall off.
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 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 place 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.
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.
9. Watch the vacuum pressure as each of the manifolds begin to pull water through the filters. 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.
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 filter, rinse down the inside of the magnetic cup 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.
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 require a crucible and 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 one of the magnetic cups and place 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 dish should be the side 'face-up' on the manifold.
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 check the filter for contamination or tears.
6. Replace the magnetic cup on top of the manifold station.
7. Slowly pour the clear sample water into the magnetic cup, being careful not to splash water out of the cup.
8. Pour the majority of the sample through the filter, maintaining approximately 100ml to suspend the settled sediment within the sample.
9. Re-cap the sample bottle, and swirl vigorously to suspend settled sediment.
10. Place the crucible in a small tray, and slowly pour the remaining sample into the crucible.
11. Hold the sample bottle cap over the magnetic cup and filter. Rinse down the cap with DI water.
12. Hold the sample bottle over the magnetic cup and filter, 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.
13. When all of the sample and rinse water has filtered through the filter, rinse down the inside of the magnetic cup with DI water.
14. Watch the filter carefully to see that all water drains through the filter.
15. Switch off the suction to the station and remove the magnetic cup.
16. Using forceps, carefully slide the filter back into the assigned foil tray. It is important not to tilt or flip the wet filter as sands or other large particles may fall off.
17. Place the foil tray with filter onto a large baking sheet.
18. Place the crucible into one of the deep metal pans for drying.
19. 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.

8. Drying Samples

Used filters 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 should be placed into one of the square or rectangular baking pans.

1. Turn on the oven.
2. Set the thermostat to 225° F
3. Place baking sheets with filters, or pans with crucibles into oven.
4. Bake from three to 24 hours. Minimum drying time for processed filters is 3 hours.
5. Crucibles must be baked for 1 hour after all visible water has evaporated. Minimum drying time for crucibles is around 8 hours.
6. Remove baking sheets from oven.
7. Using tongs, carefully transfer foil trays with filters and crucibles into the 'Sediment Sample Desiccator'.
8. 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.

9. 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 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 sides 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.
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 should be given a sequential number to identify the most recent version. 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 N. Morro Bay Volunteer Monitoring Program Equipment Calibration Protocols

Morro Bay Volunteer Monitoring Program

Equipment Calibration Protocols

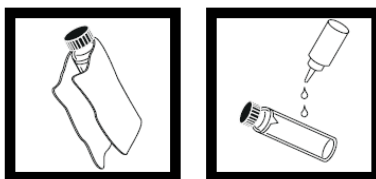
Hach 2100 Turbidimeter

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.

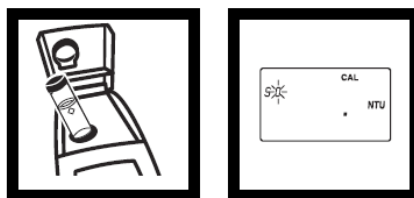
The formazin calibration standards have a long shelf life, but must be stored properly. Standards should be stored in their respective kit with cover in place, out of direct sunlight. For long term storage, refrigeration at 5° C is recommended, do not store above 25° C.

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.

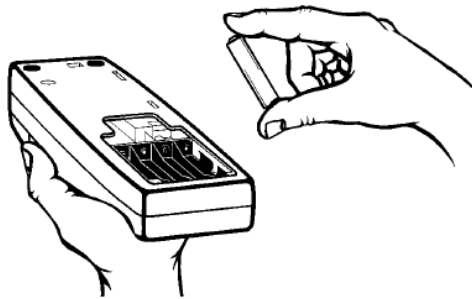


- The display will show the 20.00 ntu value on the screen. Insert the 20.00 ntu standard with correct alignment and press the **READ** button.

- 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:

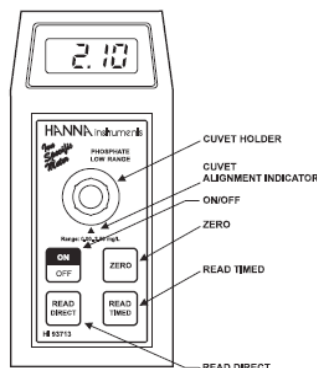
- This meter works on 4 AA-size alkaline batteries. Brand name 'digital' batteries are recommended for best performance.
- Remove the battery compartment cover on the bottom of the meter to install new batteries.
- Check the polarity diagram on the inside of the panel to ensure correct installation.



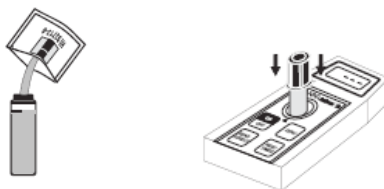
Hanna Phosphate Meter Calibration Protocol

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 PO₄ calibration standard.

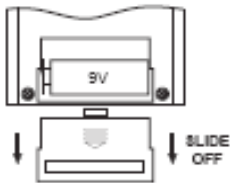
Battery Replacement:

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.

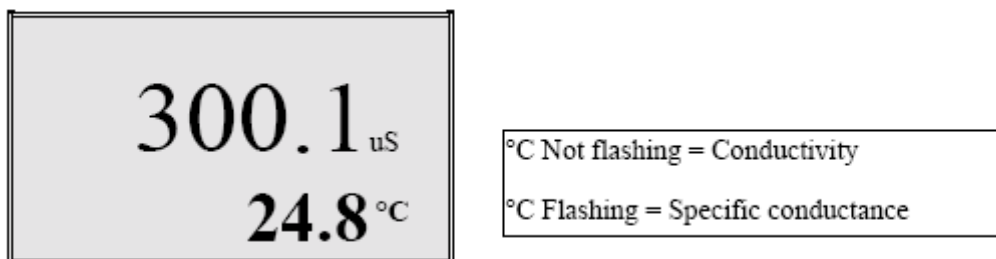


YSI 30 and 85 Salinity Meter Calibration Protocol

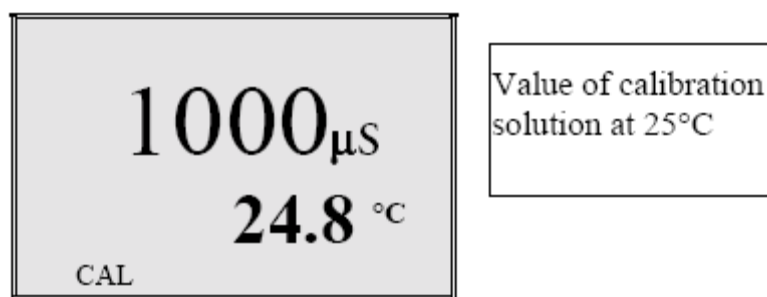
Calibration:

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 μ S or 50,000 μ 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.



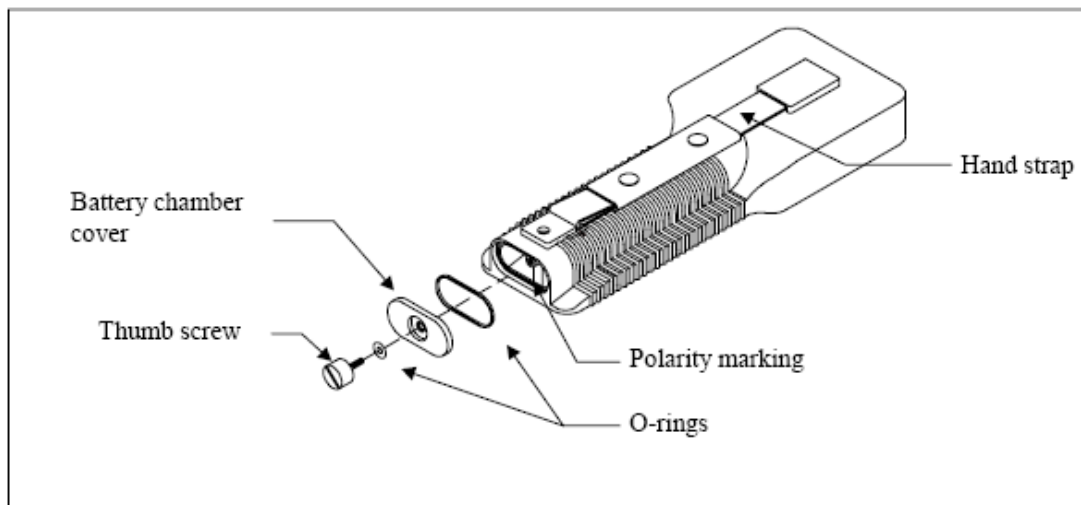
- Use the UP ARROW or DOWN ARROW key to adjust the reading on the display until it matches the value of the calibration solution you are using.
- Once the display reads the exact value of the calibration solution being used (the meter will make the compensation for temperature variation) press the ENTER 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

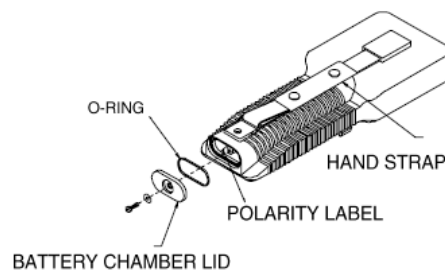
Before calibrating, determine if meter is being calibrated for fresh water (creeks) or salt water (bay) monitoring. Determine the approximate altitude of the area where the meter will be used.

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 no 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.
- Model 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.

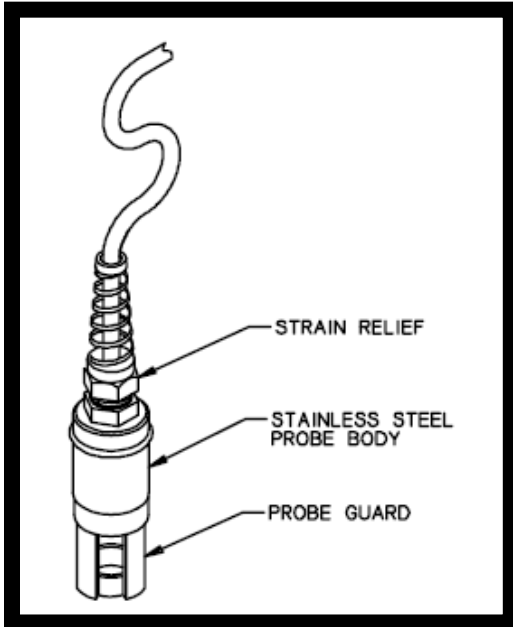
Battery Replacement:

- 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				Standard		
	20 NTU				20 NTU		
	Standard				Standard		
	100 NTU				100 NTU		
	Standard				Standard		
	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 O. Morro Bay Volunteer Monitoring Program Data Management Protocols

Morro Bay Volunteer Monitoring Program Data Management Protocols

Revised March 2008

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.
First Flush	...monitoring\data management\MBVMP database\MBVMP_Vers_**.xlsx
Urban Watch	...VMP DATA\STORMWATER\URBAN WATCH\URBAN WATCH.MDB
Suspended Sediment Data	...VMP DATA\SEDIMENT\SUSPENDED SEDIMENT.MDB
Eelgrass	...VMP DATA\EELGRASS\DATA-SUMMARIES\ VMP FIELD DATA or 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 or SUBSTRATE DATA
Back Bay Nutrients	...monitoring\data management\MBVMP database\MBVMP_Vers_**.xlsx

Project	Data Entry File
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
Bay Nutrients Data	Nitrate data for bay sites
MINI	Continuous water quality meter data
FFLUSH	First Flush stormwater monitoring 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 date 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
- 2.

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*, iff 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 μ 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.

Stormwater (First Flush)

1. The data is entered in the FFLUSH worksheet in MBVMP_Vers_##. The best thing to do is find the data entry for sites tested the previous year so that the appropriate analyte fields are filled.
2. If duplicate readings are taken for any of the analytes (e.g. turbidity) check and see that they are similar then enter the first set of the numbers.
3. To enter the QA data, copy the volunteer's row of data then insert the copied row just below, and in the Purpose column type 'QA'. Delete all of the data from the row then enter only the lab results.
4. In the notes column enter the total rainfall from the storm as given by the Morro Bay NOAA rain gauge, the dilutions used for bacteria analysis, and the qualitative descriptions of the stormwater given by the volunteers.
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.

Dry Season Runoff (Urban Watch)

1. The data is entered in the UrbanWatch.mdb Access database.
2. 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. Fax this datasheet to Gregg Langlois at the Dept. of Public Health– fax # (510) 412-4637.
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. There is currently no electronic data entry system for macroinvertebrate data. We are awaiting development of a system by the RWQCB. Data is received from the analytical lab in Excel format containing the taxa counts and the metric calculations.

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.

Back Bay Nutrients

1. This data is entered in Bay Nutrients Data in MBVMP_Vers_##.
2. Enter the Date and Time, Site ID#, water temperature, salinity, nitrate, sampler name, high tide height, low tide height, and weather.
3. For the nutrients, if there were not any levels detected then the number entered would be entered as 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.
4. To enter the nutrient QA data, copy the volunteer's row of data then insert the copied row just below, in the Site column type the site number followed by 'QA', and then enter the lab results.
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.

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.