QUALITY ASSURANCE PROJECT PLAN (QAPP)

VERSION 19.2

Morro Bay National Estuary Program's

Monitoring Program

July 6, 2026

GROUP A: PROJECT MANAGEMENT & DATA QUALITY OBJECTIVES

A1. Title Page

Project Title: Morro Bay National Estuary Program's Monitoring Program

Lead Organization: Morro Bay National Estuary Program

Primary Contact: Ann Kitajima, Executive Director, annk@mbnep.org

Prepared for:

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

State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

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

Effective Date: This QAPP is effective from 2026 to 2027.

Preface: This QAPP document defines procedures and criteria for the Morro Bay National Estuary Program's Monitoring Program. The Monitoring Program started in 2002 to assess long-term trends in the Morro Bay watershed. Data is submitted to the Regional Water Board to inform management decisions.

Cite as: Morro Bay National Estuary Program. 2026. Quality Assurance Project Plan. Morro Bay, CA.

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreements CE-98T25101 and 4T-98T47301 to the Bay Foundation of Morro Bay. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

Table 1. History of revisions

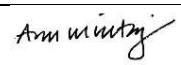
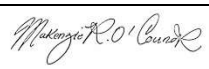
Version Number	Date	Revision Details
1.0	May 15, 2002	Final approval from EPA.
1.1	June 30, 2003 October 27, 2003	See table with summary of revisions. See table with summary of revisions. EPA approval of update.
1.2	October 1, 2004 January 25, 2005	See table with summary of revisions. EPA approval of 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 March 30, 2007	Incorporated EPA comments and awaiting approval before finalizing. 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 August 16, 2011 August 31, 2011 September 12, 2011	Annual updates submitted to EPA for approval. Received approval from EPA's Office of Quality Assurance. Received approval from the QA Officer of the CCRWQCB. Finalized Version 6.1 of the document.

Version Number	Date	Revision Details
7.1	August 7, 2012 August 21, 2012 December 10, 2012	Annual updates submitted to EPA for approval. Received approval from EPA's Office of Quality Assurance. Received approval from the QA Officer of the CCRWQCB.
8.1	August 21, 2013	Annual updates submitted to EPA for approval.
8.2	September 18, 2013	Received approval from EPA's Office of Quality Assurance.
9.1	September 15, 2014 December 30, 2014	Annual updates submitted to EPA for approval. Received approval from EPA's Office of Quality Assurance.
10.1	December 14, 2015 February 9, 2016	Annual updates submitted to EPA for approval. Received approval from EPA's office of Quality Assurance.
11.1	February 7, 2017 February 14, 2017	Annual updates submitted to EPA for approval Received approval from EPA's office of Quality Assurance
12.1	March 22, 2018 March 30, 2018	Annual updates submitted to EPA for approval. Received approval from EPA's office of Quality Assurance
12.2	September 26, 2018	Received approval from SWRCB Office of QA.
13.1	March 22, 2019 April 30, 2019 June 17, 2019 July 10, 2019	Annual updates submitted to EPA for approval. Annual updated version revised with additional information for ocean acidification monitoring. Received approval from EPA's Office of Quality Assurance. Received approval from SWRCB Office of QA.
14.1	August 4, 2020 September 24, 2020 December 7, 2020	Annual updates submitted to EPA for approval. Received approval from EPA's Office of Quality Assurance. Received approval from SWRCB Office of QA
15.1	September 14, 2021 October 26, 2021 November 17, 2021	Annual updates submitted to EPA for approval Received approval from EPA's Office of Quality Assurance. Annual updates submitted to SWRCB Office of QA.
16.1	December 21, 2022 January 31, 2023 April 27, 2023	Annual updates submitted to EPA for approval. Received approval from EPA's Office of Quality Assurance. Annual updates submitted to SWRCB Office of QA.

Version Number	Date	Revision Details
17.1	January 31, 2024 February 27, 2024 February 29, 2024	Annual updates submitted to EPA for approval. Received approval from EPA's Office of Quality Assurance. Annual updates submitted to SWRCB Office of QA.
18.1	March 28, 2025 April 22, 2025 April 23, 2025	Annual updates submitted to EPA for approval. Received approval from EPA's Office of Quality Assurance. Annual updates submitted to SWRCB Office of QA.
19.1	April 3, 2026	Annual updates submitted to EPA for approval.
19.2	June 8, 2026 July 6, 2026	Incorporated EPA comments and resubmitted for approval. Received approval from EPA's Office of Quality Assurance.

A2. Approval Page

Grant Organization:

Title	Name	Signature	Date
MBNEP Program Director	Ann Kitajima		7/6/2026
MBNEP Program Manager	Ann Kitajima		7/6/2026
QA Officer	Makenzie O'Connor		7/6/2026

Regional Board:

Title	Name	Signature	Date
QA Officer *			

State Water Resources Control Board:

Title	Name	Signature	Date
QA Officer	Ranita Prasad		10/12/2026

U.S. Environmental Protection Agency:

Title	Name	Signature	Date
USEPA Project Manager	Vivian Lopez	ERICA YELENSKY Digitally signed by ERICA YELENSKY Date: 2026.07.08 13:24:53 -07'00'	
USEPA QA Manager	Audrey L. Johnson	Audrey L Johnson Digitally signed by Audrey L Johnson Date: 2026.07.07 08:44:13 -07'00'	

**No signature obtained since this position is vacant. The Regional Board will defer to the State Water Board QA Officer for approval of this and future QAPP documents.*

A3. Table of Contents

GROUP A: PROJECT MANAGEMENT & DATA QUALITY OBJECTIVES 2
A1. Title Page 2
A2. Approval Page 6
A3. Table of Contents 7
A4. Project Purpose, Problem Definition & Background 10
A5. Project Task Description 13
A6. Data Quality Objectives & Acceptance Criteria 39
A7. Distribution List 50
A8. Project Organization 51
A9. Quality Assurance Manager Independence 53
A10. Project Organizational Chart 54
A11. Personnel Training & Certification 55
A12. Documents & Records 56
GROUP B: DATA GENERATION & ACQUISITION 58
B1. Sampling Process Design 58
B2. Methods for Data Acquisition 61
B3. Sample Handling & Custody 72
B4. Quality Control 75
B5. Instrument/Equipment Calibration, Testing, Inspection & Maintenance 83
B6. Inspection/Acceptance of Supplies & Consumables 90
B7. Data Management 91
GROUP C: ASSESSMENT & OVERSIGHT 93
C1. Assessments & Response Actions 93
C2. Oversight & Reports to Management 93
GROUP D: DATA VALIDATION & USABILITY 95
D1. Data Review & Validation 95
D2. Usability Determination 96
REFERENCES 97

TABLE OF TABLES:

Table 1. History of revisions 3
Table 2. MBNEP screening levels for monitoring data 11
Table 3. Project schedule timeline 16
Table 4. Data quality indicators 40
Table 5. Measurement quality objectives for field measurements 47
Table 6. Measurement quality objectives for laboratory measurements 48
Table 7. Personnel responsibilities 52
Table 8. Constituents monitored and measurement techniques 58
Table 9. Sampling methods. 63
Table 10. Field analytical methods 65
Table 11. Field equipment features 67
Table 12. Laboratory analytical methods 69
Table 13. Sample handling 73

Table 14. Field QC for water quality monitoring 77
Table 15. Analytical QC for water quality monitoring 77
Table 16. Field QC for bacteria monitoring 79
Table 17. Analytical QC for bacteria monitoring 79
Table 18. Field QC for bay nutrient monitoring 81
Table 19. Analytical QC for bay nutrient monitoring 81
Table 20. Field QC for continuous bay water quality monitoring 82
Table 21. Analytical QC for toxicity 82
Table 22. Testing, inspection, maintenance, and calibration of field instruments 84
Table 23. Testing, inspection, maintenance of analytical laboratory instruments 87
Table 24. MBNEP QA management reports 94

TABLE OF FIGURES:

Figure 1. Location of Morro Bay watershed and tributaries 18
Figure 2. MBNEP Flow Monitoring Locations 19
Figure 3. MBNEP Creek and Bay Bacteria Monitoring Locations 20
Figure 4. MBNEP Monthly Creek Water Quality Monitoring Locations 21
Figure 5. MBNEP Creek Bimonthly Nutrient Monitoring Locations 22
Figure 6. MBNEP Bay Dissolved Oxygen Dawn Patrol Monitoring Locations 23
Figure 7. MBNEP Stream Profiling Monitoring Locations 24
Figure 8. MBNEP Sediment Elevation Monitoring Locations 25
Figure 9. MBNEP Bioassessment and Algae Monitoring Locations 26
Figure 10. MBNEP Eelgrass - Permanent Transect Monitoring Locations 27
Figure 11. MBNEP Eelgrass - Bed Condition Monitoring Locations 28
Figure 12. MBNEP Toxicity Monitoring Locations 29
Figure 13. MBNEP Bay Macroalgae and Biomass Monitoring Locations 30
Figure 14. MBNEP Shorebird Monitoring Locations 31
Figure 15. MBNEP Pressure Transducer Monitoring Locations 32
Figure 16. MBNEP Continuous Temperature Monitoring Locations 33
Figure 17. MBNEP Seeps Monitoring Locations 34
Figure 18. Cal Poly Continuous Bay Water Quality Monitoring Locations 36
Figure 19. Cal Poly Shoreline Nutrient Monitoring Locations 37
Figure 20. MBNEP Recreational Use Monitoring Locations 38

LIST OF APPENDICES:

APPENDIX A. MORRO BAY NATIONAL ESTUARY PROGRAM BACTERIA MONITORING PROTOCOLS 102
APPENDIX B. MORRO BAY NATIONAL ESTUARY PROGRAM WATER QUALITY PROTOCOLS 126
APPENDIX C. MORRO BAY NATIONAL ESTUARY PROGRAM YSI EXO3 PROTOCOLS..... 158
APPENDIX D. MORRO BAY NATIONAL ESTUARY PROGRAM DISSOLVED OXYGEN IN THE BAY PROTOCOL 167
APPENDIX E. MORRO BAY MONITORING PROGRAM STREAM PROFILING PROTOCOL..... 171
APPENDIX F. MORRO BAY NATIONAL ESTUARY PROGRAM SURFACE ELEVATION TABLE MONITORING... 181
APPENDIX G. MORRO BAY NATIONAL ESTUARY PROGRAM BIOASSESSMENT PROTOCOL 186
APPENDIX H. MORRO BAY NATIONAL ESTUARY PROGRAM AGRICULTURAL MONITORING PROTOCOL .. 192
APPENDIX I. MORRO BAY NATIONAL ESTUARY PROGRAM EELGRASS PERMANENT TRANSECT MONITORING PROTOCOL..... 195
APPENDIX J. MORRO BAY NATIONAL ESTUARY PROGRAM EELGRASS INTERTIDAL BED CONDITION MONITORING PROTOCOLS..... 200
APPENDIX K. MORRO BAY NATIONAL ESTUARY PROGRAM EELGRASS MAPPING GROUNDTRUTHING ... 209
APPENDIX L. MORRO BAY NATIONAL ESTUARY PROGRAM SHOREBIRD SURVEY PROTOCOL..... 211
APPENDIX M. MORRO BAY NATIONAL ESTUARY PROGRAM MACROALGAE MONITORING PROTOCOL... 218
APPENDIX N. MORRO BAY NATIONAL ESTUARY PROGRAM EQUIPMENT CALIBRATION PROTOCOLS..... 225
APPENDIX O. MORRO BAY NATIONAL ESTUARY PROGRAM DATA MANAGEMENT PROTOCOLS 237
APPENDIX P. MORRO BAY NATIONAL ESTUARY PROGRAM PRESSURE TRANSDUCER PROTOCOL..... 244
APPENDIX Q. MORRO BAY NATIONAL ESTUARY PROGRAM RECREATIONAL USE PROTOCOL 253
APPENDIX R. MORRO BAY NATIONAL ESTUARY PROGRAM CONTINUOUS TEMPERATURE PROTOCOL ... 258
APPENDIX S. MORRO BAY NATIONAL ESTUARY PROGRAM STORMWATER MONITORING PROTOCOL 262
APPENDIX T. CAL POLY HYDROCAT STANDARD OPERATING PROCEDURE..... 268
APPENDIX U. CAL POLY SEABIRD SEAFET PH SENSOR DEPLOYMENT AND CALIBRATION PROTOCOLS..... 270
APPENDIX V. CAL POLY SHORELINE NUTRIENT MONITORING PROTOCOL..... 281
APPENDIX W. MORRO BAY NATIONAL ESTUARY PROGRAM FRESHWATER SEEPS MONITORING..... 283
APPENDIX X. MORRO BAY NATIONAL ESTUARY PROGRAM TOXICITY MONITORING PROTOCOL..... 285
APPENDIX Y. MORRO BAY NATIONAL ESTUARY PROGRAM MASTER SITE LIST 291

A4. Project Purpose, Problem Definition & Background

A4.1. Problem Definition

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

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

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

A4.2. Project Background

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 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 (WQ) 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

A4.3. 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 do not have specific criteria for comparison including stream profiling, shorebird surveying, surface elevation tables (SETs), feldspar marker horizons, stream flow, macroinvertebrates, macroalgae, and eelgrass monitoring.

Table 2. MBNEP screening levels for monitoring data

Parameter	Criteria[1]	Source	Comments
E. coli (freshwater)	Statistical Threshold Value: 320 MPN/100 mL (90th percentile of data) Geomean: 100 MPN/100 mL	SWRCB, Part 3 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays and Estuaries of California, Bacteria Provisions and a Water Quality Standards Variance Provision	REC-1 Bacteria Water Quality Objectives
Enterococcus spp. (estuarine)	Statistical Threshold Value: 110 MPN/100 mL (90th percentile of data) Geomean: 30 MPN/100 mL	SWRCB, Part 3 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays and Estuaries of California, Bacteria Provisions and a Water Quality Standards Variance Provision	REC-1 Bacteria Water Quality Objectives
Conductivity (for Water Quality)	> 3,000 µS/cm (AGR beneficial use)	CCRWQCB Basin Plan standard	Protects water for use as irrigation water

[1] The criteria in this table indicate the range of concentrations that would be of concern. For example, for dissolved oxygen in freshwater, concentrations less than 7 mg/L are not protective of the COLD beneficial use. Thus, the criterion in the table is indicated as "< 7 mg/L."

Parameter	Criteria[1]	Source	Comments
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)	< 7.0 mg/L, median % saturation < 85% (ocean waters) (COLD, SPWN)	CCRWQCB Basin Plan standard	Protection of cold water species in estuarine environment
Nitrate as nitrogen (for Water Quality)	> 1.0 mg/L with supporting evidence, > 10 mg/L (drinking water standard)	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 Morro Bay (Williamson, 1994; Black, 2010).
pH (for Water Quality)	< 7.0 and > 8.5(COLD, WARM, estuarine)	CCRWQCB Basin Plan Standard	Changes in normal ambient pH levels shall not exceed 0.5 in fresh waters (COLD, WARM)
Chlorophyll *a* (for Water Quality)	> 15 µg/L	CCRWQCB Basin Plan Guideline	Value developed for Lower Salinas River Watersheds but being used for Morro Bay (CCRWQCB Basin Plan, 2019).
Ammonia (for Water Quality)	> 0.025 mg/L NH_3-N as unionized ammonia	CCRWQCB Basin Plan Standard	General objectives, toxicity criteria
Temperature (for Water Quality)	> 21ºC	CCRWQCB 303(d) Listing Guidance Value	Optimum range for steelhead of 13 to 21 ºC (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)
Aquatic Toxicity (for Water Toxicity)	< 6-day *Ceriodaphnia* survival and reproduction	CCRWQCB Basin Plan Guideline	Value developed for Santa Maria watershed but being used for Morro Bay (CCRWQCB Basin Plan, 2019).
Aquatic Toxicity (for Sediment Toxicity)	< 10-day *Hyalella azteca* survival	CCRWQCB Basin Plan Guideline	Guidance developed for Santa Maria watershed but being used for Morro Bay (CCRWQCB Basin Plan, 2019).

A4.4. Non-Direct Measurements

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

EMP. The data would need to meet the data quality objectives laid out in Section A6 (Data Quality Objectives & Acceptance Criteria).

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 analysis. Outside data is not incorporated into the Access database. 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 be analyzed separately so that it did not become intermixed with data that had met acceptance criteria.

If that data had confidentiality constraints on it, it would be used without revealing the exact location of sample collection. These other sources include but are not limited to:

- California Men's Colony Wastewater Treatment Plant
- California Polytechnic State University, San Luis Obispo student project data
- California Polytechnic State University, San Luis Obispo research data
- Resource Conservation District maintenance and monitoring records
- Point Blue Conservation Science
- Applicable Environmental Impact Report data
- County of San Luis Obispo Environmental Health Department and Department of Public Works
- Los Osos Community Services District
- Surfrider Foundation
- California Department of Fish and Wildlife
- California Department of Parks and Recreation
- US Fish and Wildlife Service
- California Native Plant Society
- California Department of Public Health
- City of Morro Bay
- Central and Northern California Ocean Observing System (CeNCOOS)

A5. Project Task Description

A5.1. Work Statement & Products

- *Bacteria monitoring:* Bacteria monitoring conducted by program staff and 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 enterococcus. Volunteers and staff analyze duplicate samples, run sterility blanks, and analyze certified reference materials. Occasionally samples are processed by the San Luis Obispo County Public Health Agency Lab due to logistics which do not allow them to be processed by MBNEP volunteers or staff. Each month, results are forwarded to various landowners and agencies so that any potential public health threats can be addressed. Data is stored in an MBNEP-maintained Access database. Deliverables include a consistent bacteria data set in electronic format and monthly notifications. All data is analyzed in monthly memos and in an annual data summary memo.
- *Water quality monitoring:* Water quality monitoring by program volunteers and staff includes

monthly sampling at local creek and bay sites throughout the Morro Bay watershed. Samples are analyzed for temperature, turbidity, conductivity, dissolved oxygen (DO), and orthophosphates as PO4. Split samples are sent to an Environmental Laboratory Accredited Program (ELAP) accredited laboratory for turbidity, pH and nutrient QA analysis. Three of the water quality monitoring sites have been designated as 'Agricultural Monitoring Sites.' All of the same analyses takes place at these sites as at the other water quality sites, with the addition of a field measurement for chlorophyll and total dissolved solids (TDS). Samples are analyzed by an ELAP accredited laboratory for the following analytes: nitrates as nitrogen, total nitrogen, organic nitrogen, Total Kjeldahl nitrogen, ammonia, nitrite, total phosphorus, orthophosphates as P, and total suspended solids (TSS). Monitoring takes place monthly. A subset of water quality monitoring sites is designated as 'Bimonthly Nutrient Monitoring Sites.' Every other month, samples are analyzed for nitrates as nitrogen and orthophosphate as phosphorus by an ELAP accredited laboratory. Data is stored in an MBNEP-maintained Access database. Deliverables include a consistent water quality data set in an electronic format. All data is analyzed in an annual data summary memo.

- *Freshwater seeps monitoring:* Seeps monitoring is conducted by program staff and includes every other month collection of samples at up to five freshwater seeps along the back bay shoreline. The flow varies depending on time of year and rainfall. Staff measures the conductivity and salinity of the seep and collects a sample for nitrate as nitrogen analysis by a certified laboratory. Data is stored in an MBNEP-maintained Access database. Deliverables include a consistent water quality data set in an electronic format. All data is analyzed in a data summary memo.
- *Streamflow monitoring:* Flow monitoring by staff and program volunteers includes monthly monitoring at local creek sites throughout the watershed. Staff and volunteers measure creek depth and velocity, and an instantaneous flow rate is estimated from this information. Data is stored in an MBNEP-maintained Access database. Deliverables include a consistent flow data set in an electronic format. Data is provided to partners upon request to support project implementation.
- *Continuous water quality monitoring:* Continuous water quality data is collected by program staff monthly at local creek sites throughout the watershed. The continuous monitoring equipment is deployed for a week-long period to collect temperature, DO (concentration and percent saturation), conductivity, pH, and chlorophyll concentrations at 30- minute intervals. Data is stored in an MBNEP-maintained Excel database. Temperature data is collected year-round with data collected at 30-minute intervals. Data is stored in an MBNEP-maintained Excel database. Deliverables include a consistent water quality data set in an electronic format. Data is analyzed in an annual data summary memo.
- *Stage data collection:* Continuous water depth measurements are collected by program staff at local creek sites throughout the watershed. The equipment is deployed permanently at the sites and collects stage height data on 15-minute increments. Data is downloaded from the equipment monthly and stored in an MBNEP-maintained Excel database. Deliverables include a consistent water depth data set in an electronic format. Data is provided to partners upon request to support project implementation.
- *Freshwater bioassessment monitoring:* For bioassessment monitoring, program staff and volunteers collect samples on local creeks each year. Algae documenting is conducted in conjunction with bioassessment monitoring. Macroinvertebrate samples are sent to a contract laboratory for analysis. The lab analyzes the sample according to SWAMP SAFIT Level 2

taxonomy protocols, with counts to at least 600. The lab provides the counts as well as various calculated metrics. Data is provided in Excel format. Deliverables include a consistent bioassessment data set in electronic format. All data is analyzed in an annual data summary memo.

- *Stream profiling:* For stream profiling, program staff and 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. Data is included in sediment reports.
- *Toxicity:* For toxicity, samples are collected from four sites throughout the watershed and analyzed at a contract laboratory. Water samples are collected once during the dry season and once during the wet season. Sediment samples are collected once during the dry season. Deliverables include a toxicity data set in an electronic format. Data is stored in an MBNEP-maintained Excel database.
- *Recreational use monitoring:* For recreational use monitoring, program staff and volunteers track the visitation of eight shoreline sites across near the Morro Bay estuary to establish a time series of use. Vehicle and visitor counts are collected approximately bimonthly, along with water quality measurements including water temperature, dissolved oxygen, pH, salinity, conductivity, and chlorophyll. Deliverables include a recreational use data set in an electronic format. Data is stored in an MBNEP-maintained Excel database.
- *Continuous water quality (estuarine):* Continuous water quality measurements are collected in the estuary by Cal Poly faculty, students, as part of the Central & Northern California Ocean Observing System (CeNCOOS). Equipment is deployed at the Morro Bay T-pier and a back bay location with a third sensor on standby to prevent data loss due to equipment issues. Continuous dissolved oxygen, temperature, pressure, chlorophyll, turbidity, and pH data is available to the public via the CeNCOOS data portal. Deliverables include consistent estuary water quality data in an electronic format.
- *Nutrient monitoring (estuarine):* For bay nutrient monitoring, Cal Poly staff and volunteers collect discrete samples from shoreline locations each month. Data is stored in a Cal Poly-maintained database. Deliverables include an estuarine water quality data set in an electronic format. Data will be analyzed in a report after a year of data collection and will also be used to support other Cal Poly research efforts.
- *Sediment elevation monitoring (estuarine):* For sediment elevation monitoring, the MBNEP works with U.S. Geological Survey (USGS) to monitor surface elevation tables (SETs) and feldspar marker horizons. For SET monitoring, sites are monitored at ten locations in the salt marsh, including four sites established by USGS and six historic sites established by the University of San Francisco, approximately every five years and more frequently if large storm events occur. For feldspar marker horizons, eight plots are established throughout the bay. Marker horizons are monitored approximately twice per year. Data is stored in a shared drive with USGS. The results are presented in sediment monitoring reports.
- *Intertidal eelgrass and macroalgae monitoring (estuarine):* 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 approximately every other year with a drone or digital aerial sensor with four channels. For the aerial sensor, 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. For the drone, aerial RGB images taken at extreme low tides are georectified into orthomosaic images. A technician uses manual classification to distinguish eelgrass location and density. When flights take place, MBNEP staff conducts groundtruthing to collect data to support the classification conducted by the contractor. To track the health of eelgrass, MBNEP staff conducts separate monitoring efforts on eelgrass in the bay: 1) Permanent transect monitoring in six areas of the bay along transects to collect shoot density and other measurements; 2) Intertidal bed condition monitoring to determine eelgrass bed conditions through density, patchiness, and observational data; 3) Restoration bed monitoring to track the success of planting methods, locations, and seasonality; and 4) Biannual macroalgae and biomass monitoring to assess competition with eelgrass. The data is stored electronically in MBNEP-maintained Excel spreadsheets. An eelgrass report is created summarizing the effort and results for the year.

- *Bathymetry:* Periodically the MBNEP works with a contractor to conduct bay-wide bathymetry surveys. Interferometric side scan sonar will be used in the deeper waters of the bay and LiDAR measurements will be used for the shallower areas to collect topo-bathymetric elevation point data. The contractor will seam together the data sets and conduct the classification to create the bathymetry data layer. All standard accuracy validations will be conducted to ensure data quality. The results will be shared widely with project partners and researchers. The analysis is likely to be conducted at approximately a ten-year frequency.
- *Shorebird monitoring:* For bird monitoring, volunteers participate in shorebird monitoring events each fall in partnership with the Morro Coast Audubon Society 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 Point Blue, who shares the survey results.

A5.2. Project Schedule

All monitoring efforts are ongoing with the goal of tracking long-term trends and assessing project effectiveness. For each monitoring effort, the results are summarized in memos and reports. This monitoring is expected to continue, assuming adequate funding is available, beyond the conclusion of the current funding source. The monitoring program is supported by Clean Water Act (CWA) Section 320 funding. Data analysis and review are conducted at a minimum on an annual basis.

Table 3. Project schedule timeline

Activity	Timeframe[2]		Deliverable	Deliverable Due Date
	Anticipated Date of Initiation	Anticipated Date of Completion		
Water quality	Winter 2026	Summer 2027	Annual data summary memos	None
Bioassessment	Spring 2026	Fall 2026	Annual data summary memo	None

[2] These initiation and completion dates are estimated target dates. The timing of these activities depends on numerous factors beyond our control including staffing availability, seasonal factors (i.e., how much rain we received and when), and others.

Intertidal eelgrass and macroalgae monitoring	Winter 2026	Summer 2027	Annual data summary report	None
Sedimentation: SETs, feldspar marker horizons, stream profiling, bathymetry	Summer 2026	Fall 2027	Annual data summary report	None
Bacteria	Winter 2026	Spring 2026	Monthly memo, Annual data summary memo[3]	None

A5.3. Geographical Setting

The Morro Bay estuary is a 2,300-acre semi-enclosed body of water where freshwater flowing from land mixes with the saltwater of the sea. Morro Bay opens into Estero Bay. Morro Bay is fed by a 48,000-acre watershed containing two major creeks, Chorro and Los Osos. Figure 1 shows the location of the bay, its watershed and the major creeks.

This section includes maps showing monitoring sites as follows:

- Figure 1. Location of Morro Bay Watershed and Tributaries
- Figure 2. MBNEP Flow Monitoring Locations
- Figure 3. MBNEP Creek and Bay Bacteria Monitoring Locations
- Figure 4. MBNEP Monthly Creek Water Quality Monitoring Locations
- Figure 5. MBNEP Creek Bimonthly Nutrient Monitoring Locations
- Figure 6. MBNEP Bay Dissolved Oxygen Dawn Patrol Monitoring Locations
- Figure 7. MBNEP Stream Profiling Monitoring Locations
- Figure 8. MBNEP Sediment Elevation Monitoring Locations
- Figure 9. MBNEP Bioassessment and Algae Monitoring Locations
- Figure 10. MBNEP Eelgrass – Permanent Transect Monitoring Locations
- Figure 11. MBNEP Eelgrass – Bed Condition Monitoring Locations
- Figure 12. MBNEP Toxicity Monitoring Locations
- Figure 13. MBNEP Bay Macroalgae and Biomass Monitoring Locations
- Figure 14. MBNEP Shorebird Monitoring Locations
- Figure 15. MBNEP Pressure Transducer Monitoring Locations
- Figure 16. MBNEP Continuous Temperature Monitoring Locations
- Figure 17. MBNEP Seeps Monitoring Locations
- Figure 18. Cal Poly Continuous Bay Water Quality Monitoring
- Figure 19. Cal Poly Shoreline Nutrient Monitoring Locations
- Figure 20. MBNEP Recreational Use Monitoring Locations

Note that coordinates for each monitoring site in the maps are listed in Appendix W.

[3] A monthly memo is issued containing the results of the monthly monitoring as well as summary statistics. The focus of the memo is on data that exceeds the SWRCB Bacteria Provisions. We also compile an annual memo summarizing data for the past water year.

Figure 1. Location of Morro Bay watershed and tributaries

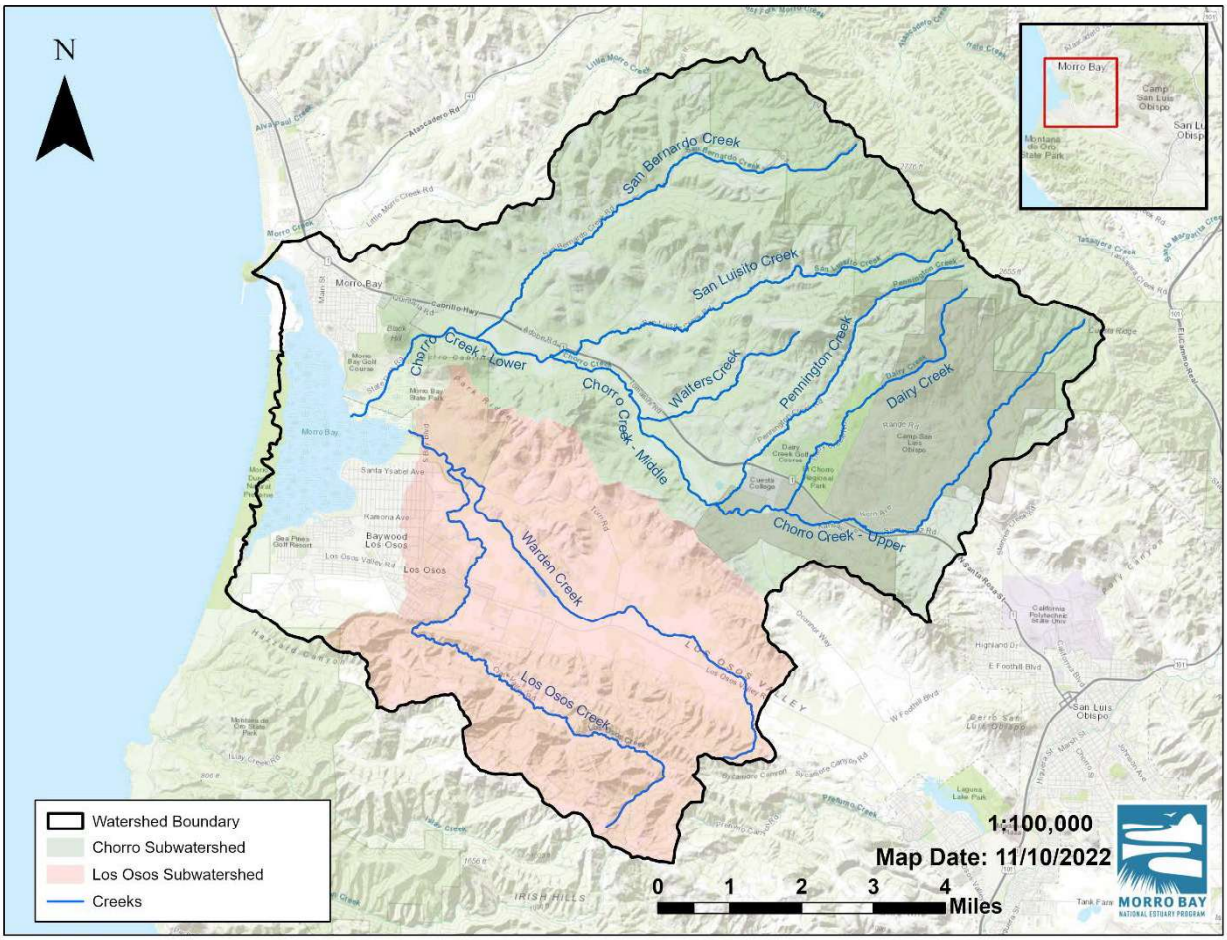


Figure 2. MBNEP Flow Monitoring Locations

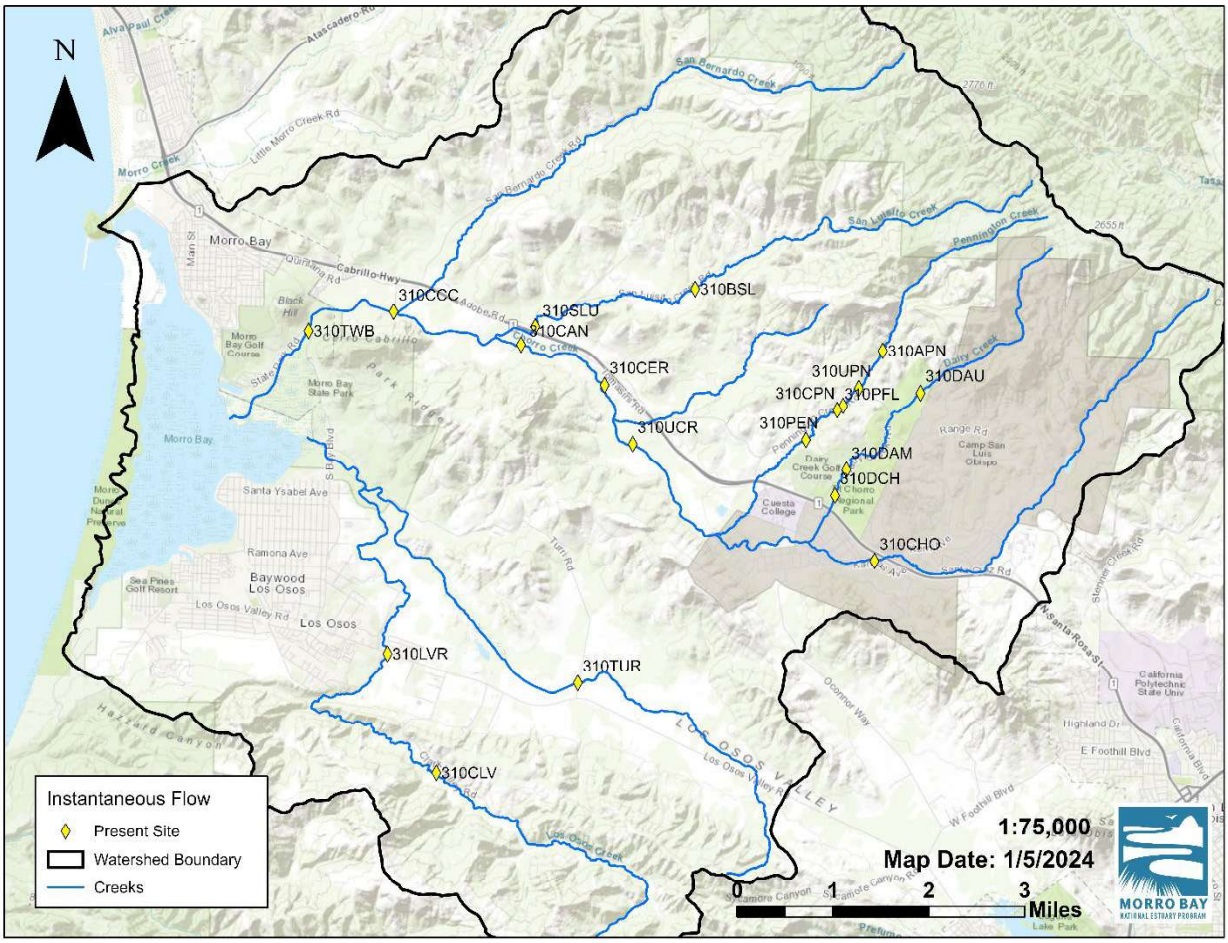


Figure 3. MBNEP Creek and Bay Bacteria Monitoring Locations

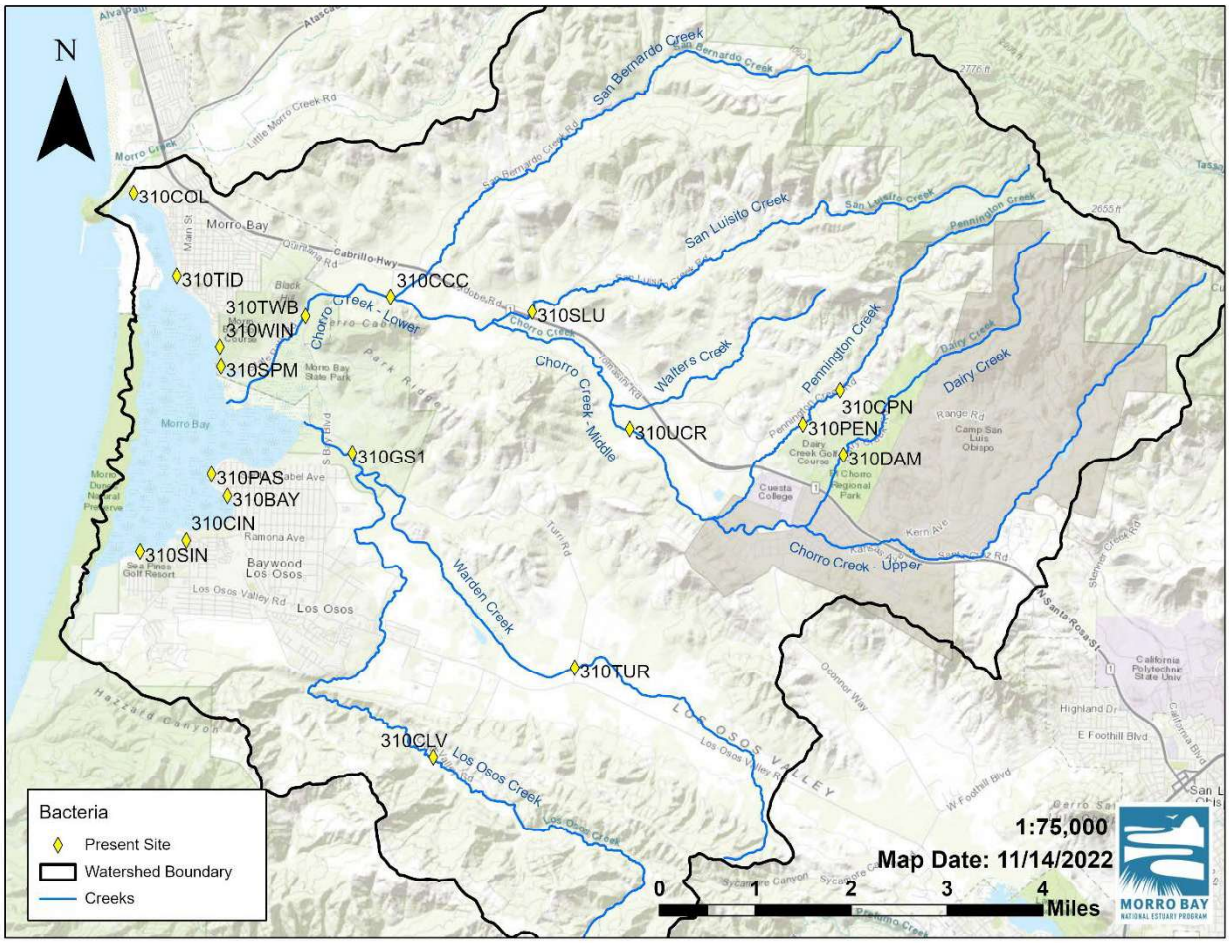


Figure 4. MBNEP Monthly Creek Water Quality Monitoring Locations

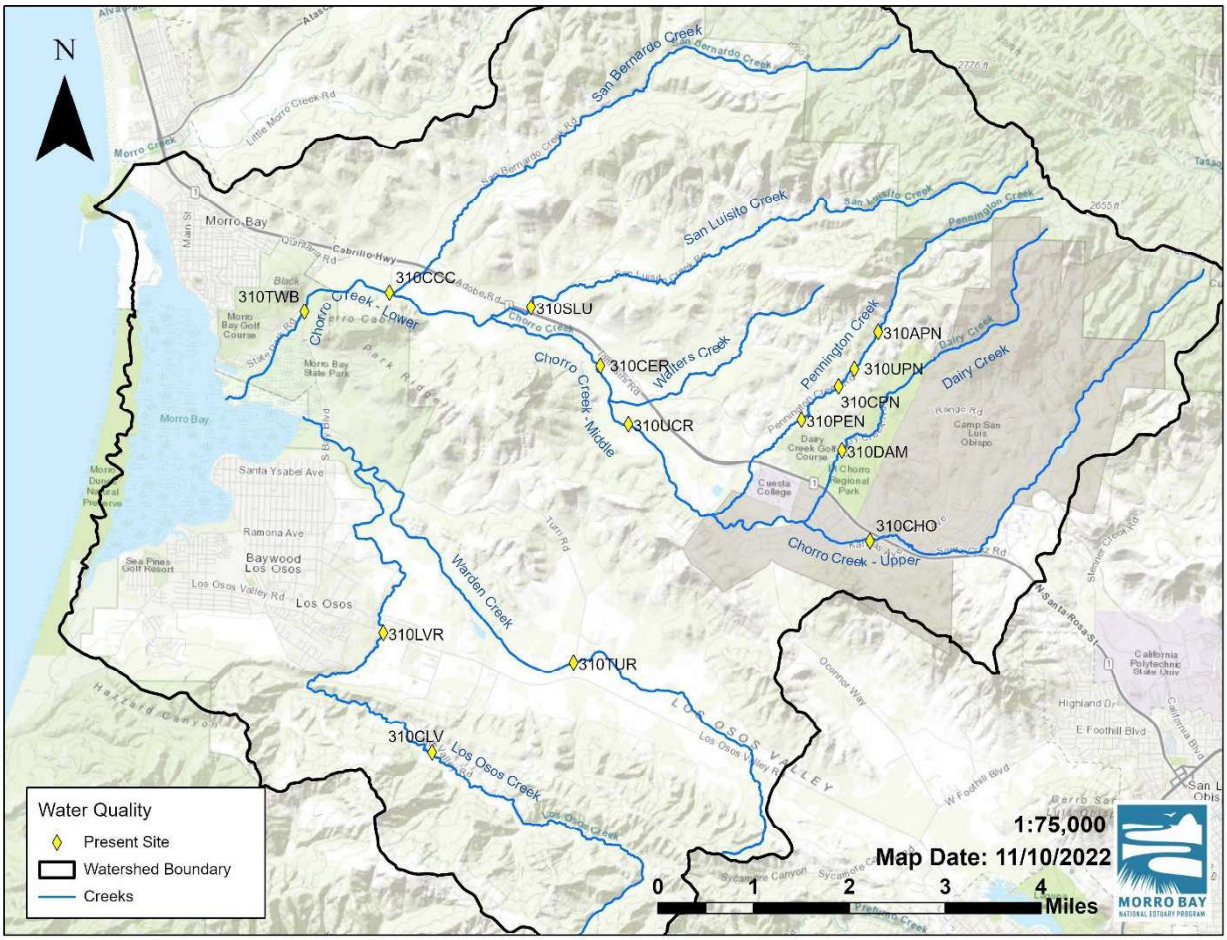


Figure 5. MBNEP Creek Bimonthly Nutrient Monitoring Locations

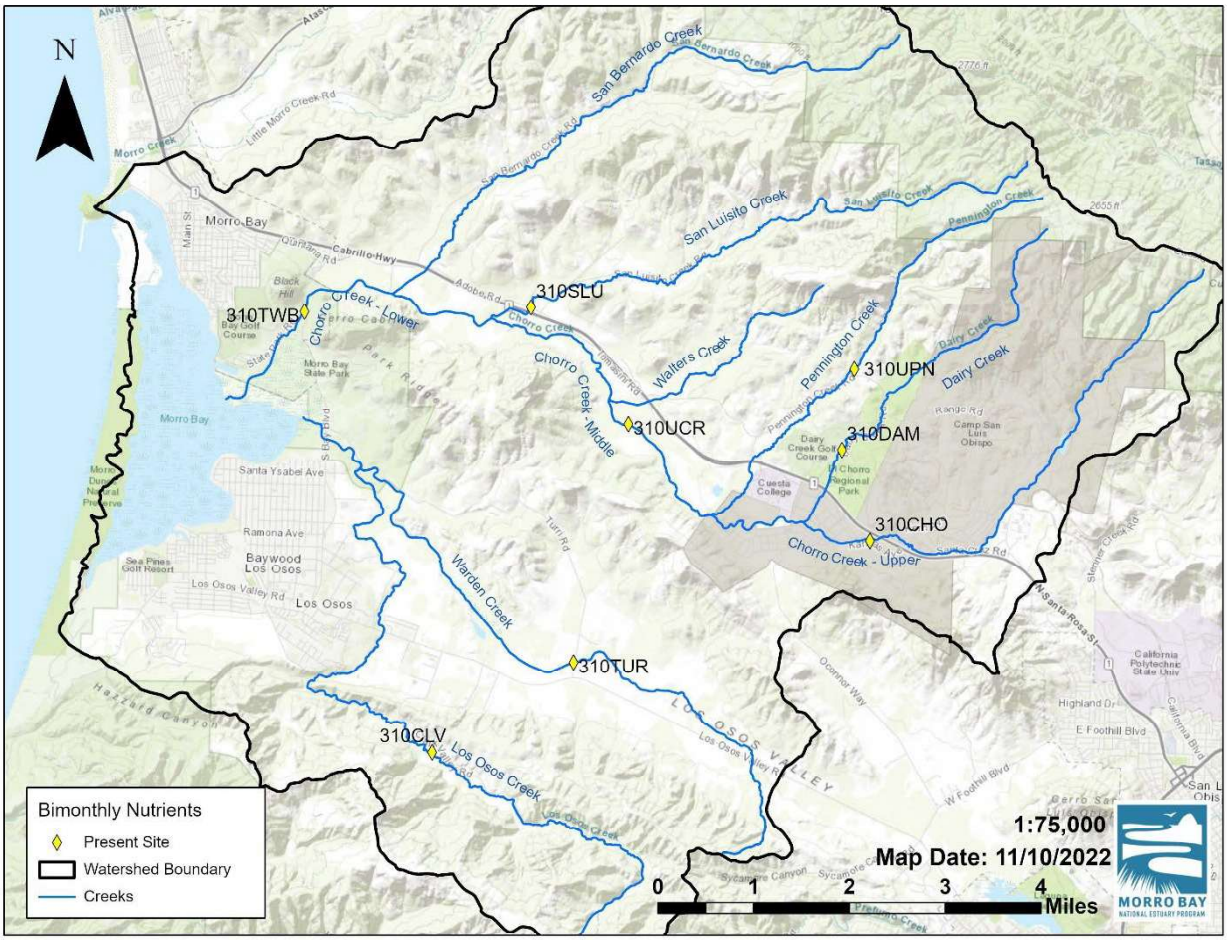


Figure 6. MBNEP Bay Dissolved Oxygen Dawn Patrol Monitoring Locations

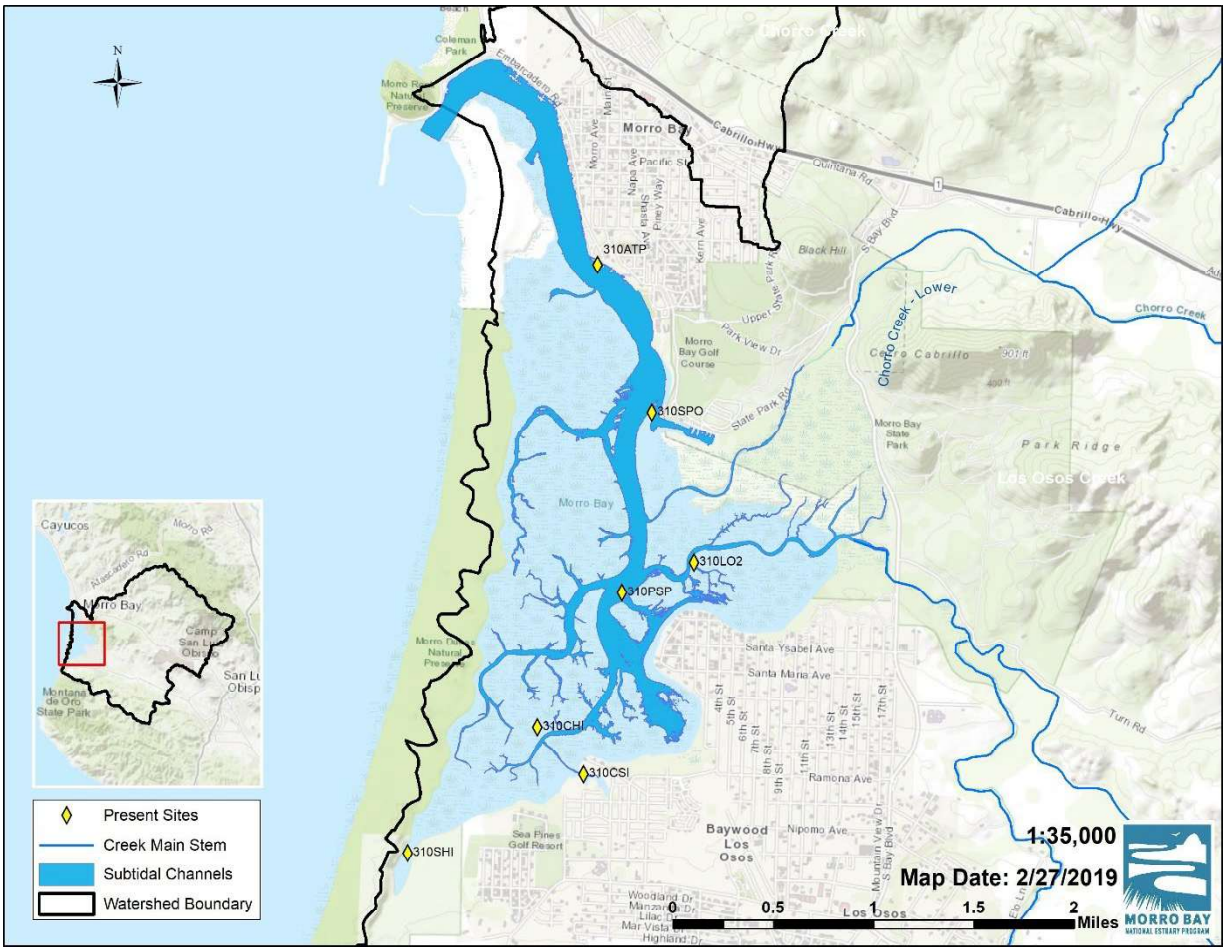


Figure 7. MBNEP Stream Profiling Monitoring Locations

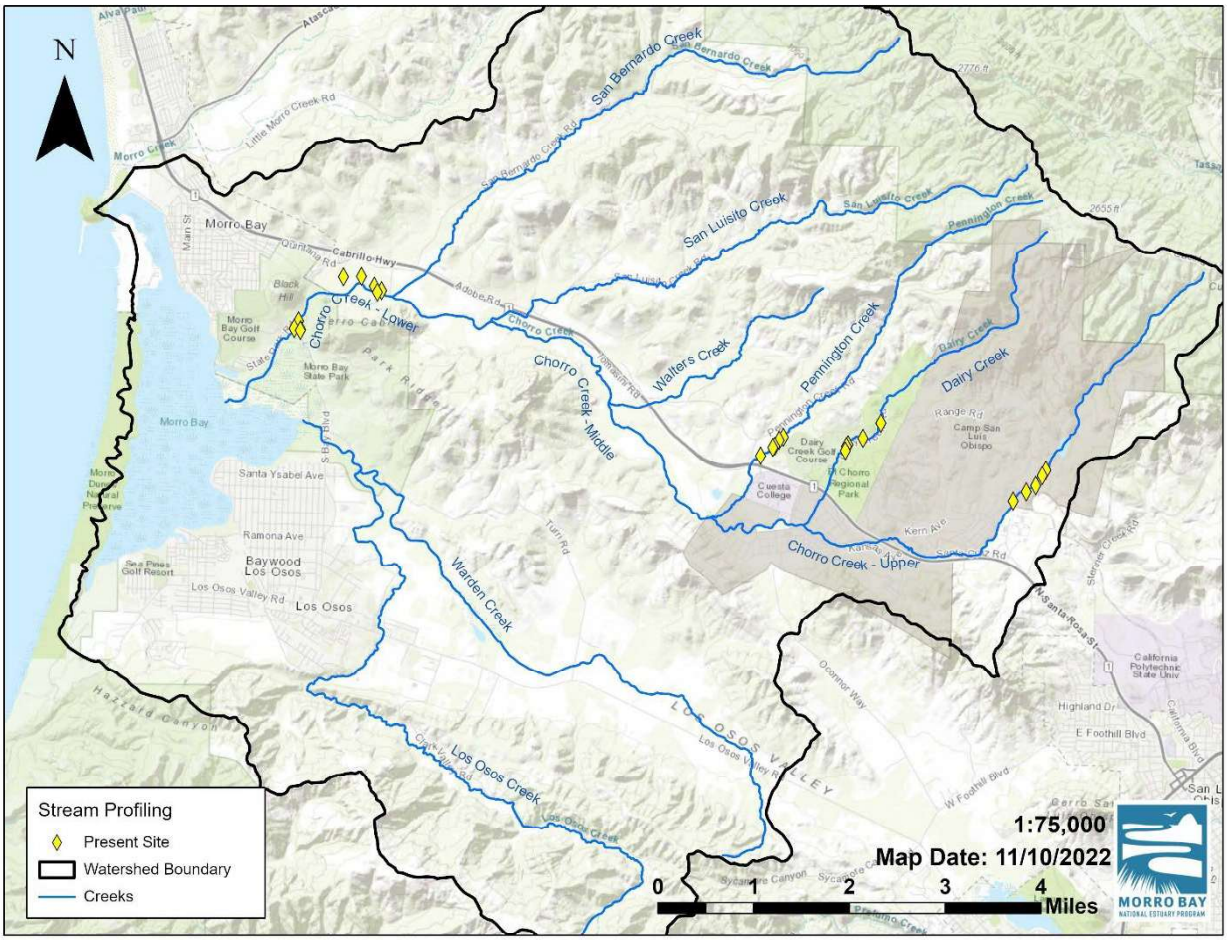


Figure 8. MBNEP Sediment Elevation Monitoring Locations

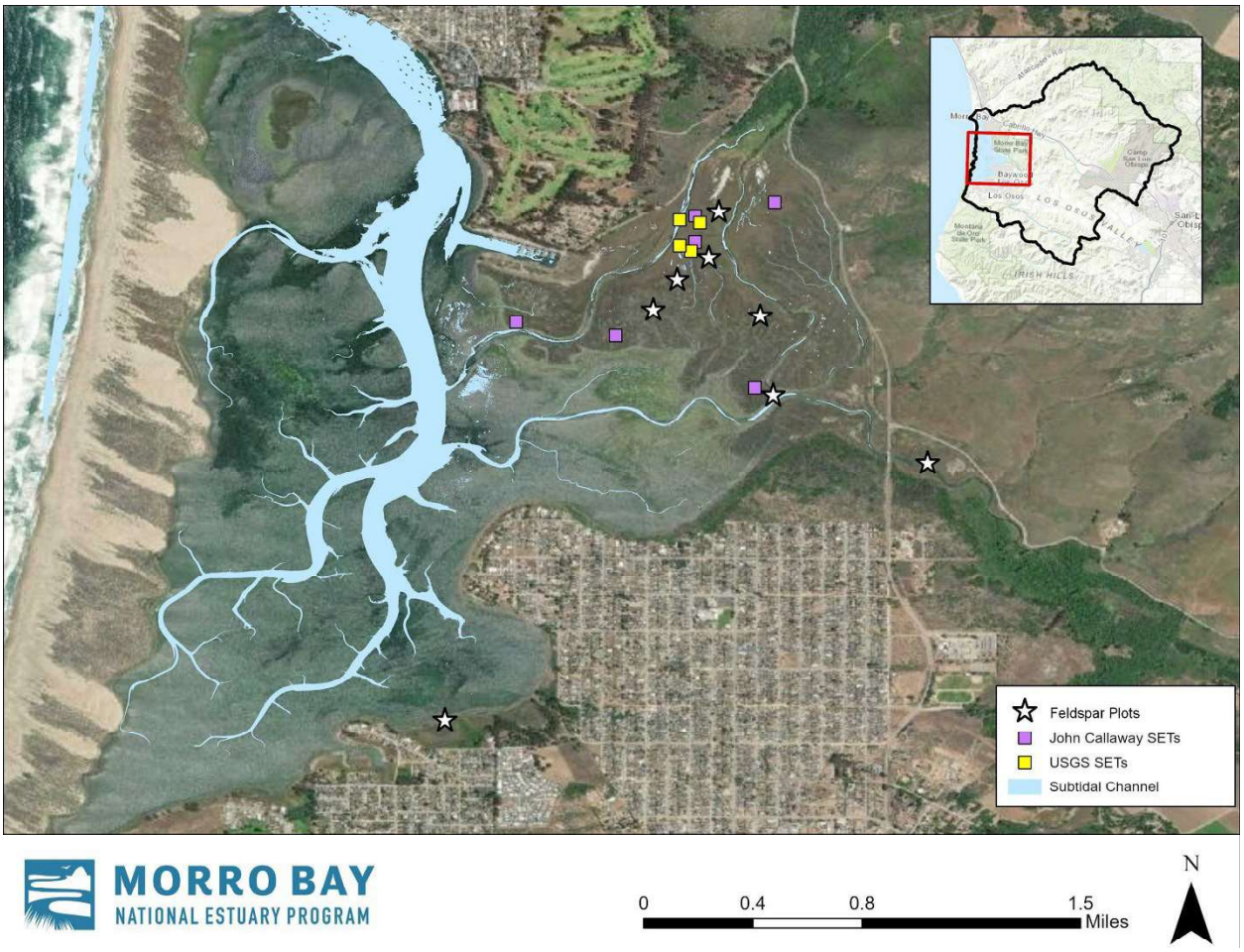


Figure 9. MBNEP Bioassessment and Algae Monitoring Locations

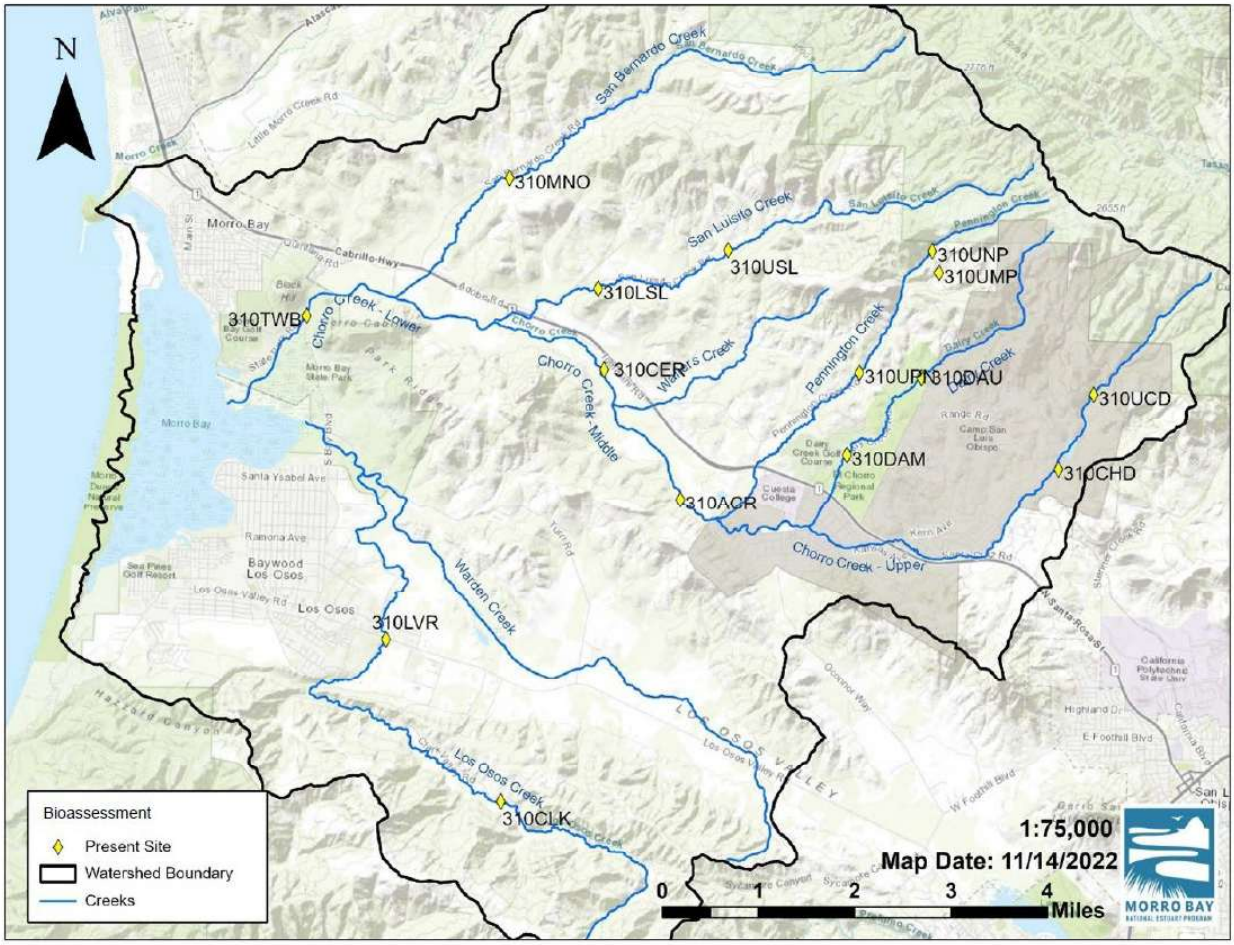


Figure 10. MBNEP Eelgrass - Permanent Transect Monitoring Locations



Figure 11. MBNEP Eelgrass - Bed Condition Monitoring Locations



Figure 12. MBNEP Toxicity Monitoring Locations

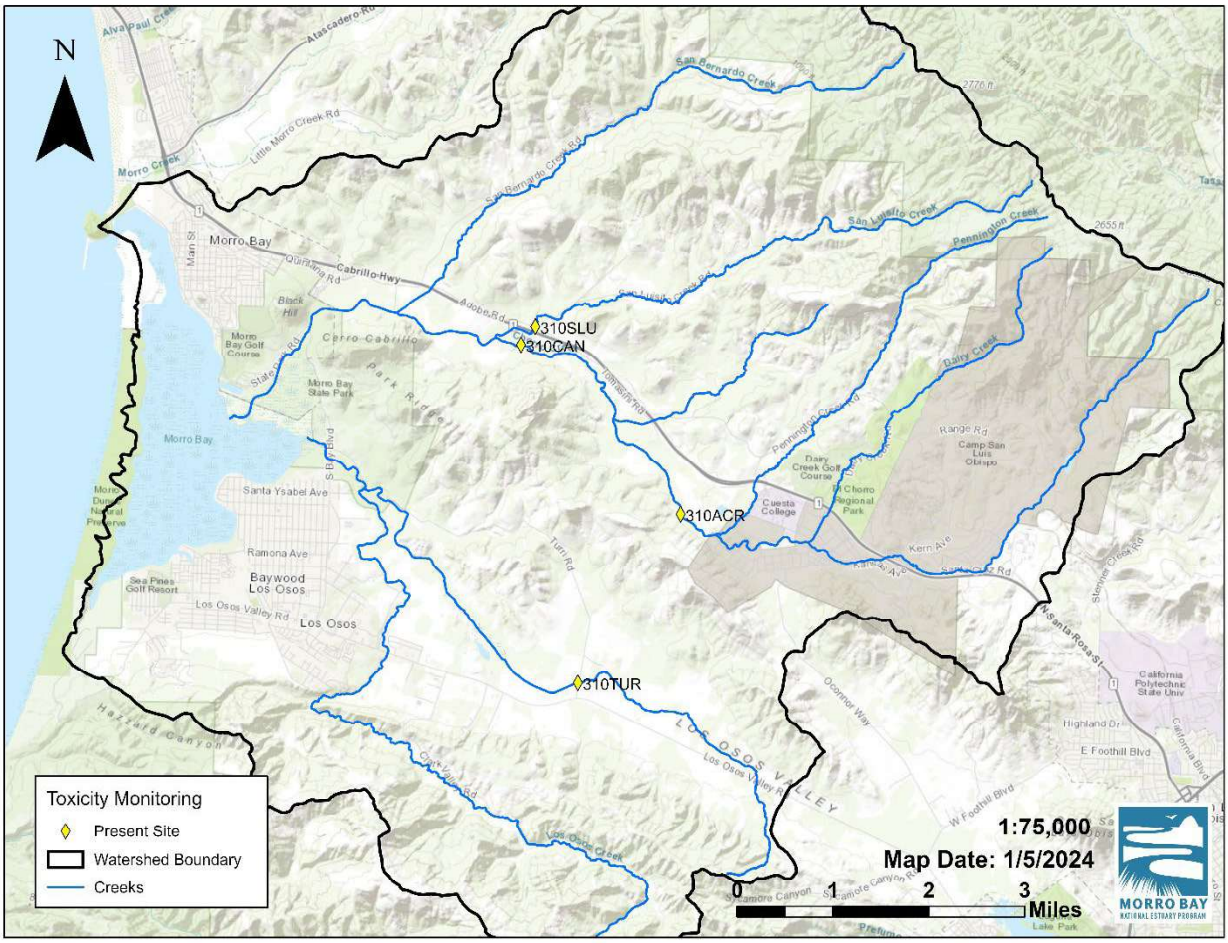


Figure 13. MBNEP Bay Macroalgae and Biomass Monitoring Locations



Figure 14. MBNEP Shorebird Monitoring Locations

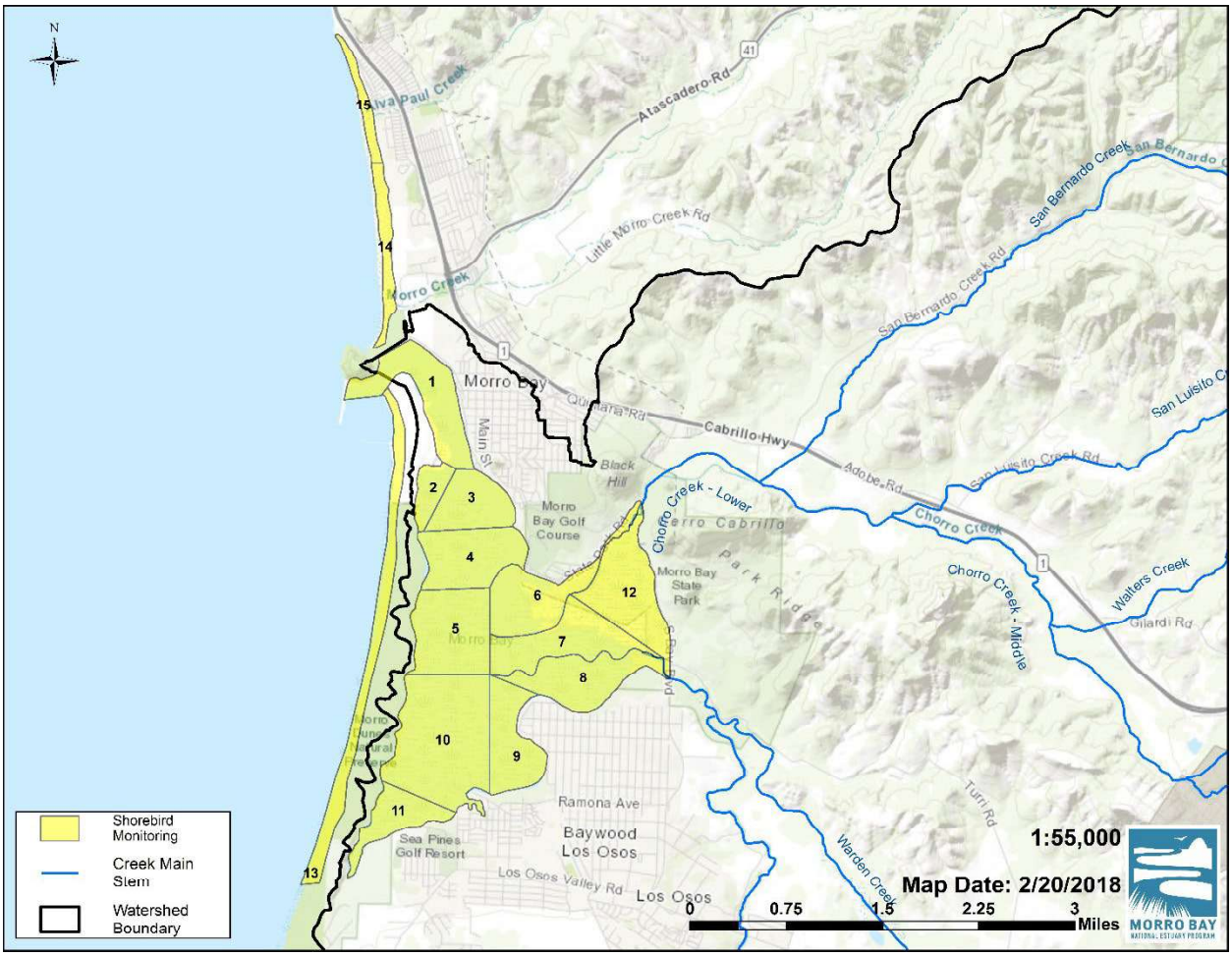


Figure 15. MBNEP Pressure Transducer Monitoring Locations

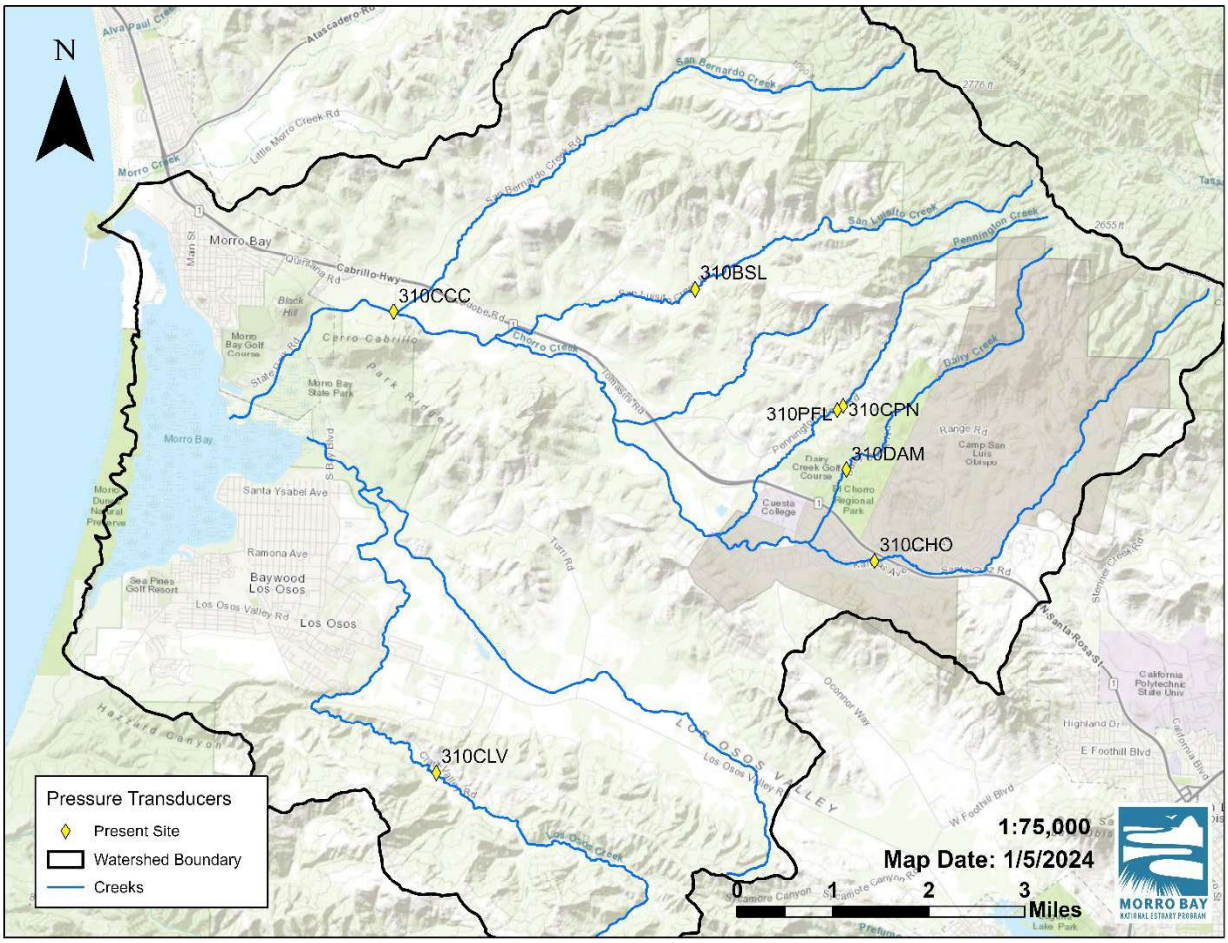


Figure 16. MBNEP Continuous Temperature Monitoring Locations

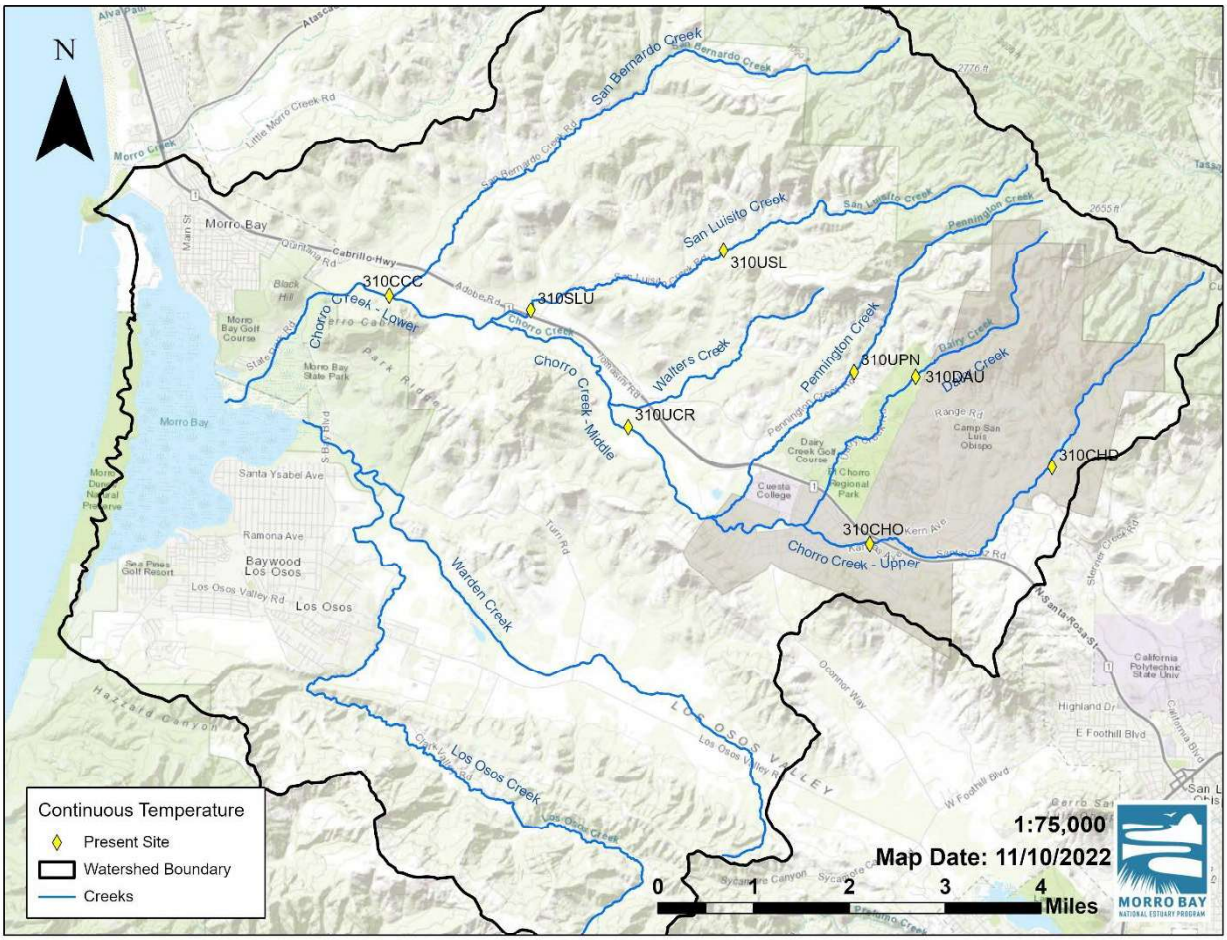
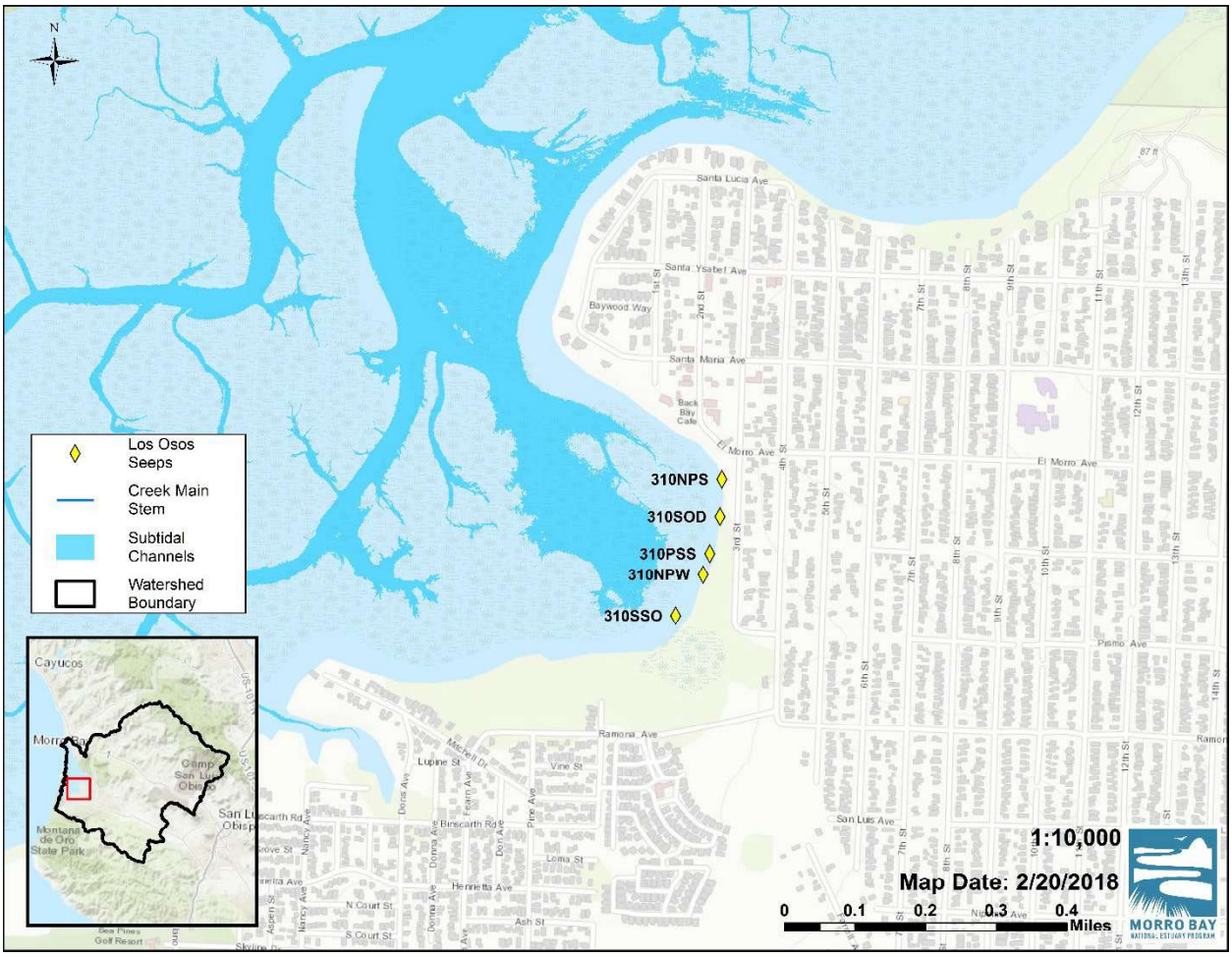


Figure 17. MBNEP Seeps Monitoring Locations



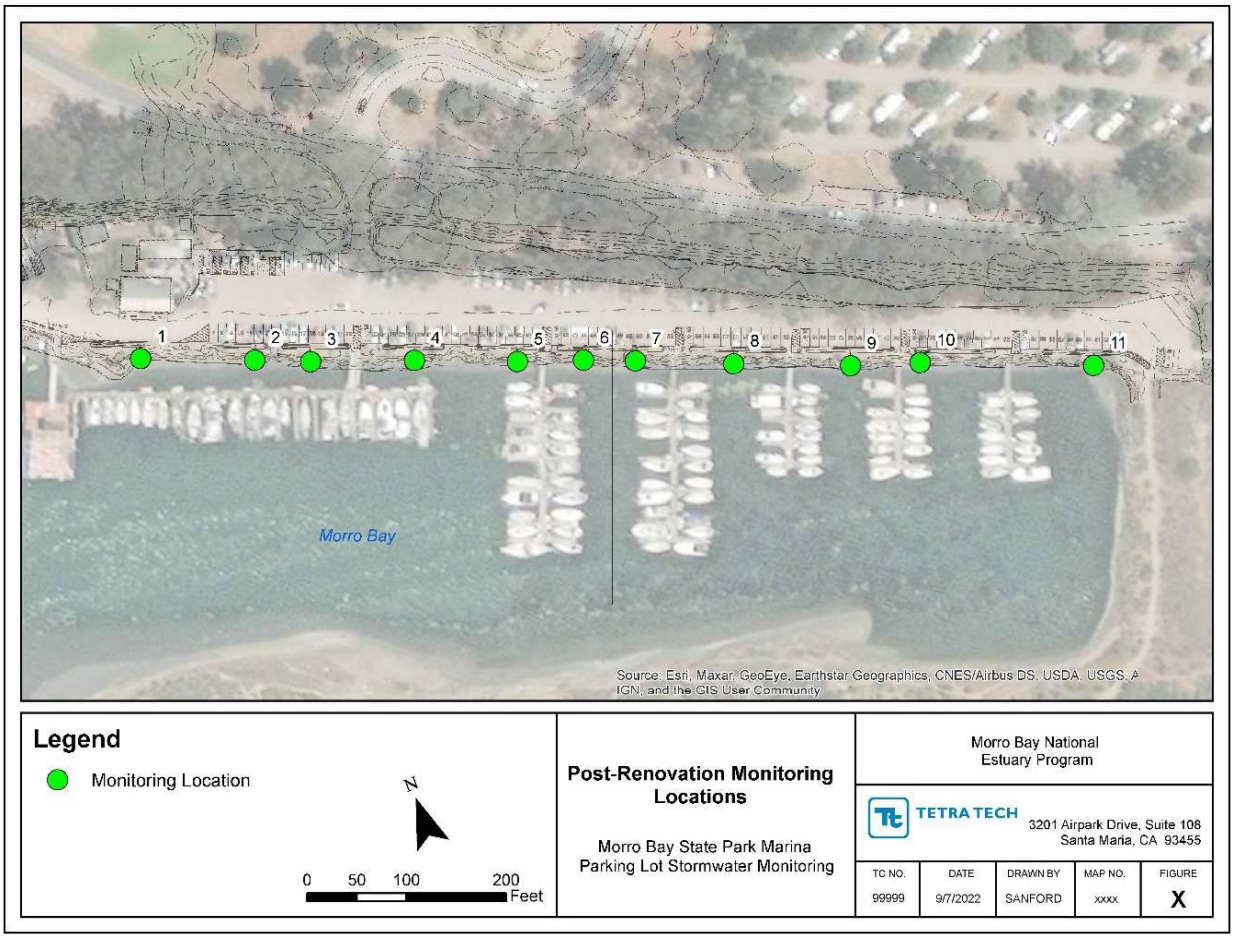

1
2
3
4
5
6
7
8
9
10
11
Morro Bay
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, A
IGN, and the GIS User Community
Legend
Monitoring Location
N
0 50 100 200
Feet
Post-Renovation Monitoring Locations
Morro Bay State Park Marina
Parking Lot Stormwater Monitoring
Morro Bay National
Estuary Program
TETRA TECH
3201 Airpark Drive, Suite 108
Santa Maria, CA 93455
TC NO.
99999
DATE
9/7/2022
DRAWN BY
SANFORD
MAP NO.
xxxx
FIGURE
X

Figure 18. Cal Poly Continuous Bay Water Quality Monitoring Locations

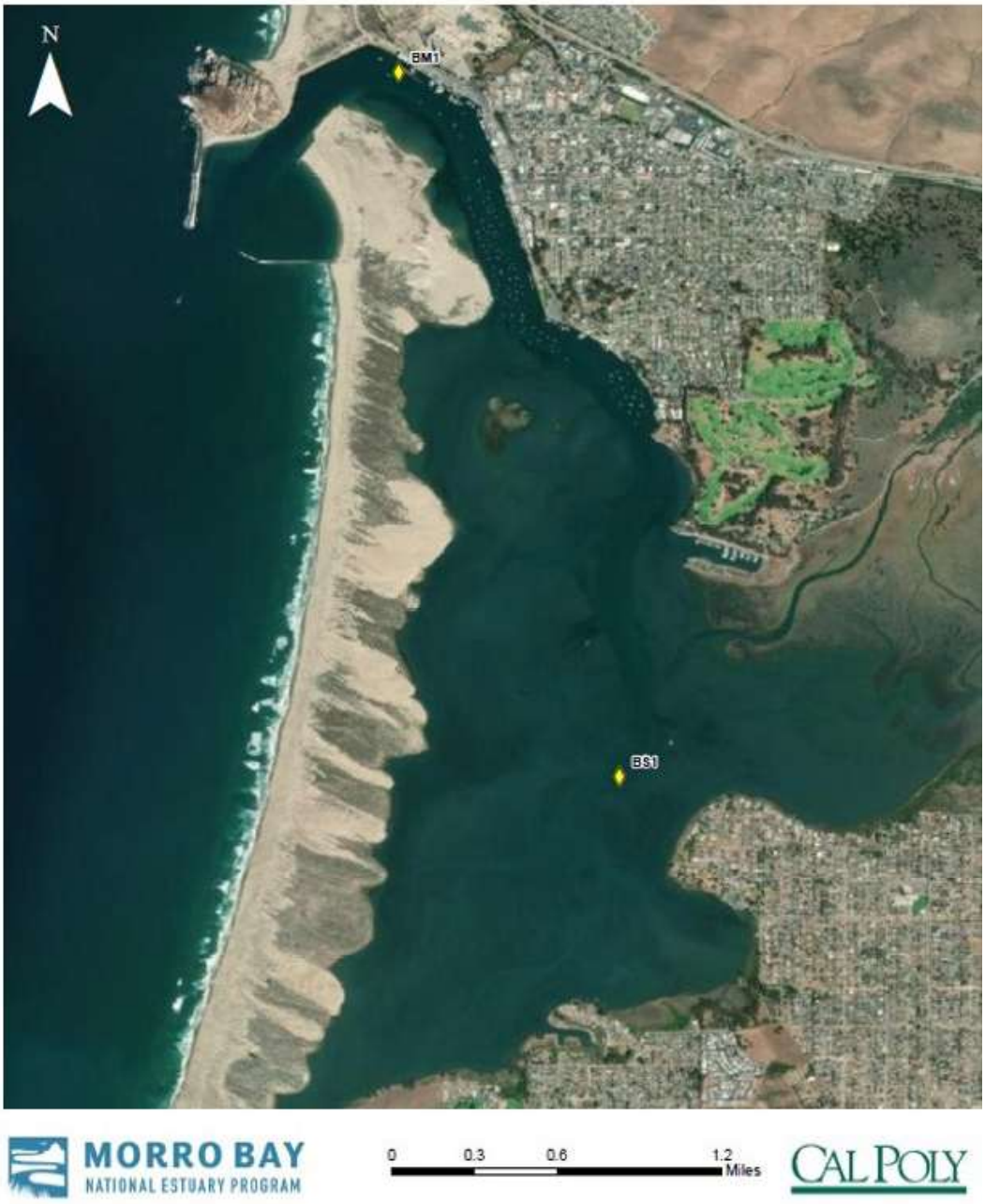
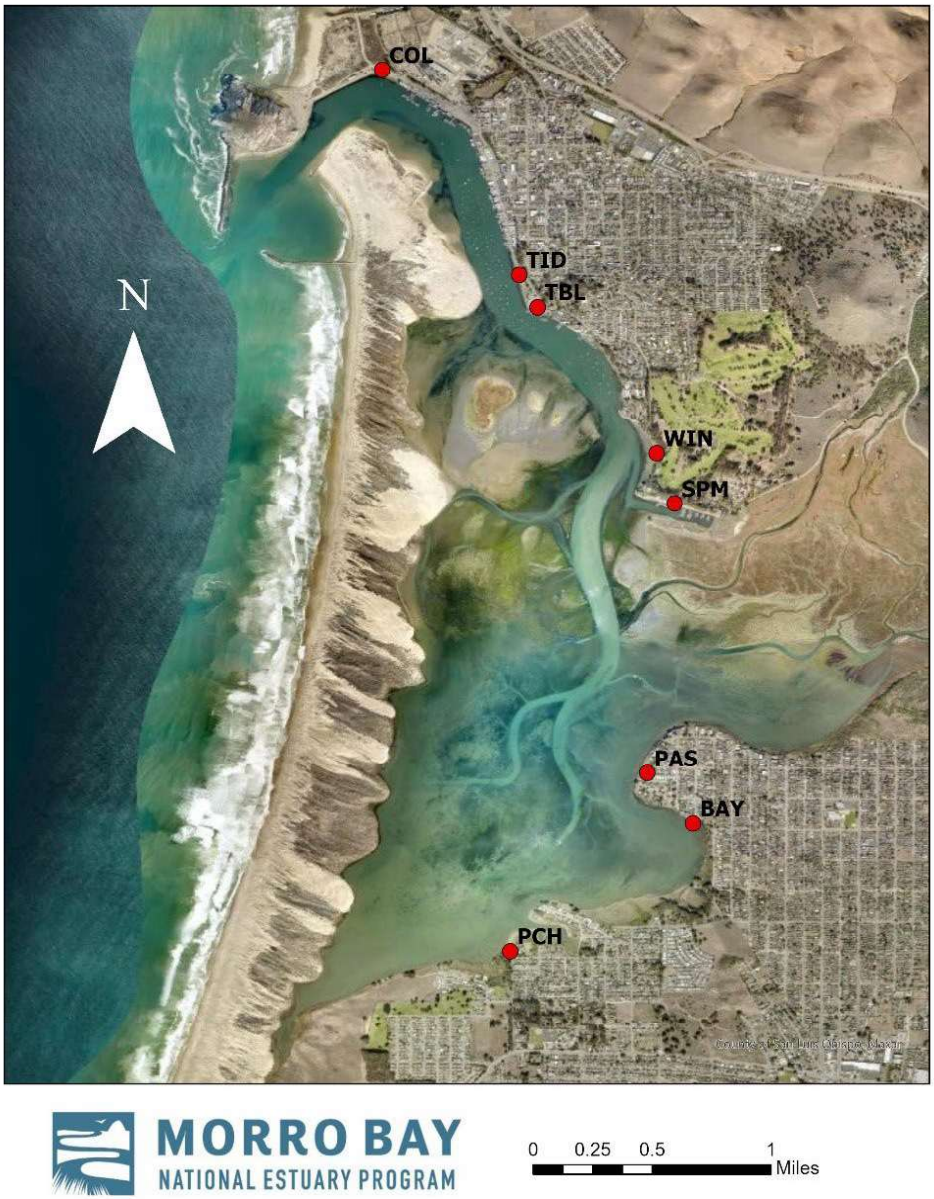


Figure 19. Cal Poly Shoreline Nutrient Monitoring Locations



Figure 20. MBNEP Recreational Use Monitoring Locations



A5.4. Constraints

Low creek flow conditions can impact water quality, bacteria, flow and bioassessment monitoring. Conversely, extremely high stream flow can impact site safety. If conditions are unsafe, staff and volunteers will delay sample collection until access becomes safe. For sediment toxicity, lack of sediment of adequate grain size may be a limiting factor. For bay water quality monitoring, tides must be high enough to avoid stranding in the soft mud.

Funding is a primary constraint for SET monitoring, feldspar marker horizons, eelgrass mapping, bathymetry, toxicity, bioassessment, and continuous bay water quality monitoring, which involve costly consultants, laboratories, and/or equipment. If funding is inadequate in the future, these monitoring efforts may be limited in scope or not conducted.

The timeline for creating the products listed in Section A5.2 (Project Schedule) are influenced by numerous factors, including organizational capacity, staff availability, the timing of rainfall, etc. If the proposed timelines in the table cannot be met, staff will assess capacity and reschedule the completion of these products.

A6. Data Quality Objectives & Acceptance Criteria

Data Quality Objectives (DQOs) are essential because they set limits of allowable error to ensure that data are useable and support project goals. Data Quality Indicators (DQIs) are the quantitative statistics and qualitative descriptors used to interpret the degree of acceptability or utility of data to a user. Measurement Quality Objectives (MQOs) lay out the numeric targets associated with the DQIs that must be met to meet the project DQOs.

A6.1. Data Quality Indicators

DQIs are the quantitative measures and qualitative descriptors used to set limits of acceptable levels of data error. The principal data quality indicators are representativeness, sensitivity, completeness, accuracy, precision, bias, and comparability.

- ***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.
- ***Sensitivity*** for chemistry analysis is the lowest value an instrument or method can measure with reasonable statistical certainty. The contract laboratories selected for this project utilize analytical methods with laboratory-determined method detection limits (MDL) and reporting limits (RL) that meet the level of sensitivity required to meet the MQOs for this project.
- ***Completeness*** is the percentage of data 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 5 and 6.
- ***Accuracy*** is the closeness of agreement between a measured value and the true value. For field quality assurance, various methods are employed to measure data accuracy. For water quality

field measurements, accuracy is ensured through regular calibration of monitoring equipment. See Section B5 (Instruments/Equipment Calibration, Testing, Inspection, and Maintenance) for more details. For orthophosphates and turbidity field measurements, a monthly QA sample is collected at the time measurements are taken and sent to a contract laboratory as an accuracy check. Blanks are run monthly. Samples submitted to the contract laboratory for analysis are run for a spiked lab control sample, matrix spikes, matrix spike duplicates, blanks, and laboratory control samples. For bacteria analysis both internally and by contract laboratories, blanks and certified reference materials are run to ensure accuracy. Each year the MBNEP submits blank blind samples to the contract laboratories for analysis. Accuracy checks are conducted for 10% of the project's total samples, and each must have a relative percent difference (RPD) less than 25%.

- ***Precision*** of a measurement describes how close the agreement is between multiple measurements. For field measurements, duplicate measurements are collected monthly and reviewed to ensure that they meet the MQOs. Analytical laboratories conduct duplicate and matrix spike duplicate analysis to ensure precision. Duplicates are run for 10% of the project's total samples, and each must have an RPD less than 25%. At least one laboratory duplicate per analytical batch (defined as 20 samples or less) is required. The RPD between the two replicate samples will be less than the MQOs defined in the QAPP. For bacteria replicates analysis, a single sample is collected in the field, mixed, and split into two samples for analysis. For the analysis method, the duplicate sample MPN must be within the 95% confidence interval. Each month, an analyst runs both portions of a split sample. To meet the precision criteria, the results must be within the 95% confidence interval criteria. Each year the MBNEP submits split samples blind to the contract laboratories for analysis.
- ***Bias*** is a systemic error that can cause measurements to be skewed in one direction or the other. Bias can be unintentionally introduced through improper timing, reach selection, sample contamination, and site selection. These biases are controlled by ensuring field staff and volunteers are trained in proper site selection. Field blanks are also used to measure any contamination introduced during the process. QA samples are randomly distributed among all sites and samplers throughout the year to identify and eliminate bias.
- ***Comparability*** is the measure of confidence that a dataset can be compared to and combined with another for decision-making purposes. MBNEP site selection and sampling design were developed in conjunction with the CCRWQCB and other local experts to ensure data comparability over the years.

Table 4 details the activities undertaken to ensure data quality, both for field and lab activities, as described generally above.

Table 4. Data quality indicators

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[4]
Field	Bacteria (sample	Yes. Monitoring sites were selected to	Yes. Training in field	Yes. Monthly, a volunteer or staff	NA	Yes. See Table 5.	NA

[4] All analytical methods were selected to ensure that the results were of adequate sensitivity for comparison to the screening levels for monitoring data laid out in Section A4.3 (Water Quality or Regulatory Criteria).

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[4]
	collection in the field)	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.	techniques minimizes bias.	member analyzes a split sample for comparison to precision criteria.			
Laboratory	Bacteria (sample analysis in the lab)	NA	Yes. Training in lab techniques minimizes bias.	Yes. Monthly, a volunteer or staff member analyzes a split sample for comparison to precision criteria.	Yes. Certified reference material.	Yes. See Table 6.	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 5.	NA
Field	Water quality (Continuous Monitoring)	Yes. Monitoring sites were selected in areas where changes due to project implementation were of interest.	NA	Yes. Side-by-side deployment of two units.	Yes. Pre and post-calibration of equipment with each	Yes. See Table 5.	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[4]
		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.			deployment event.		
Laboratory	Water quality	NA	Yes. See Table 15.	Yes. See Table 6.	Yes. See Table 6.	Yes. See Table 6.	Yes. See Table 8.
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.	Duplicate velocity measurements are collected at multiple points in the transect once a month.	NA	Yes. See Table 5.	NA
Field	Water depth	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place continuously throughout the year, which was determined to be an adequate level of seasonality. End users of the data determined this frequency to	Yes. Advice and review by experts minimize bias. Comparison of water depth data with flow measurement.	Duplicate depth measurements are collected at multiple points in the transect once a month.	NA	NA	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[4]
		be adequate for statistical analysis.					
Field	Continuous bay water quality	Yes. Monitoring sites were selected to maximize spatial variability. Monitoring takes place continuously throughout the year to provide an adequate level of seasonality.	Yes. Training in the field and review by experts minimizes bias.	Yes. See Table 5.	Yes. See Table 5.	Yes. See Table 5.	NA
Field	Stream Profiling	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place approximately every five years, during the dry season. It was determined to be an adequate frequency for statistical analysis.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 5.	NA
Field	Recreational use	Yes. Monitoring sites were selected to maximize spatial variability.	Yes. Training techniques minimize bias.	NA	NA	Yes. See Table 5.	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 5.	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[4]
Field	Feldspar marker horizons	Yes. Monitoring sites were selected to maximize spatial variability. Marker horizons are monitored approximately biennially. It was determined to be an adequate frequency.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 5.	NA
Field	Macroinvert ebrates	Yes. Monitoring sites were selected to maximize spatial variability. All monitoring takes place annually each spring. This frequency provides an adequate level of seasonality. It was determined to be an adequate frequency for statistical analysis.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 5.	NA
Laboratory	Macroinvert ebrates	NA	NA	Yes. Lab re-sorts 100% of all samples and 10% of the samples are re-identified by a second taxonomist.	Yes. Lab re-sorts 100% of all samples and 10% of the samples are re-identified by a second taxonomist.	Yes. See Table 6.	NA
Field	Eelgrass mapping	Yes. Monitoring sites were selected to maximize spatial variability. Transect monitoring takes place annually	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 6.	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[4]
		each fall. Aerial mapping takes place biennially. This frequency provides an adequate level of seasonality. It is unknown if/when sonar mapping would be repeated.					
Field	Eelgrass monitoring	Yes. Monitoring sites were selected to maximize spatial variability. Monitoring takes place seasonally.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 5.	NA
Field	Bay Macroalgae Monitoring	Yes. Monitoring sites were selected to maximize spatial variability. Monitoring takes place biannually.	Yes. Training in field techniques minimizes bias.	NA	NA	Yes. See Table 5.	NA
Laboratory	Bay Macroalgae Biomass	NA	NA	Yes. Replicate weights are taken. Results must be within +/- 1 mg.	Yes.	Yes. See Table 6.	NA
Field	Baywide Bathymetry	Decadal frequency was determined to be appropriate.	NA	NA	One cross line will be required within the survey. Position accuracy and classificatio n accuracy will be verified.	NA	NA
Field	Algae (freshwater)	Yes. Monitoring sites were selected to maximize spatial	Yes. Training in field techniques	NA	NA	Yes. See Table 5.	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[4]
		variability. All monitoring takes place annually during bioassessment, which was determined to be an adequate level of seasonality. End users of the data determined this frequency to be adequate for statistical analysis.	minimizes bias.				
Field	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 5.	NA
Field	Water toxicity	Yes. Monitoring sites were selected to maximize spatial variability. Monitoring takes place once during the dry season and once during the wet season.	Yes. Training in field techniques minimizes bias.	NA	NA	NA	NA
Field	Sediment toxicity	Yes. Monitoring sites were selected to maximize spatial variability. Monitoring takes place annually	Yes. Training in field techniques minimizes bias.	NA	NA	NA	NA

Group	Parameter	Representative-ness	Bias	Precision	Accuracy	Complete-ness	Sensiti-vity[4]
		during the dry season.					
Laboratory	Water toxicity, sediment toxicity	NA	Yes. See SPoT QAPP (SWRCB, 2023).	Yes. See SPoT QAPP, (SWRCB, 2023).	Yes. See SPoT QAPP (SWRCB, 2023).	Yes. See SPoT QAPP (SWRCB, 2023).	Yes. See SPoT QAPP (SWRCB, 2023).

A6.2. Measurement Quality Objectives

Measurement quality objectives (MQOs) are the acceptance criteria for the quality control samples that are used to assess the data quality indicators (DQIs). Table 5 describes MQOs for field measurements collected by Estuary Program staff and volunteers. These values represent acceptance criteria to determine usability, not sensor specifications. Table 6 describes MQOs for laboratory measurements. For definitions of all quality control terms, please see Section A6.1.

Table 5. Measurement quality objectives for field measurements

Group	Parameter	Accuracy	Precision[5]	Target Reporting Limit	Completeness
Water quality	Dissolved oxygen (discrete)	± 0.2 mg/L	± 0.75 mg/L or 25%	0.01 mg/L	90%
	Dissolved oxygen (continuous)	± 0.1 mg/L	± 0.75 mg/L or 25%	0.01 mg/L	90%
Water quality	Temperature (discrete, continuous)	± 0.1°C	± 0.5 °C or 25%	NA	90%
Water quality	Conductivity (discrete, continuous)	± 1% of range	± 5 or 25%	0.1 µS for high range meter	90%
Water quality	pH (discrete, continuous)	± 0.05 pH units	< 0.001 pH units	0.05 pH units	90%
Water quality	Turbidity (discrete)	See below[6].	See below[6].	0.01 NTU	90%
	Turbidity	± 2% of	± 2% of reading	0.01 NTU	90%

[5] The precision criteria will be based on whichever value is greater.

[6] 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 ≤ 1,000 NTU (± 100 NTU), for ≤ 10,000 NTU (± 200 NTU), for ≤ 100,000 NTU (± 300 NTU). These criteria assess precision by comparing two in-house replicate samples. Accuracy is evaluated by comparing an in-house replicate to a certified laboratory result using the same criteria.

Group	Parameter	Accuracy	Precision[5]	Target Reporting Limit	Completeness
	(continuous)	reading			
Water quality	Orthophosphate as PO_4	± 25%	± 25%	0.33 mg/L	90%
Flow	Flow (cubic feet per second)	± 0.25 ft^3/sec	± 25%	NA	90%
Water quality	Chlorophyll (discrete, continuous)	± 0.1 µg/L of pigment	25%	0.1 µg/L	90%
Stream profiling	Elevation along profile	± 0.05 ft	NA	NA	90%
Water depth	Water depth	± 0.1% full scale	NA	NA	90%
Recreational use	Car counts, visitor counts	NA	NA	NA	90%
SETs	Elevation change	± 1.5 mm	NA	NA	90%
Eelgrass	Shoot density, blade length etc.	NA	NA	NA	90%
Algae documenting	Photo documenting	NA	NA	NA	90%
Macroalgae biomass	Biomass (wet/dry weights)	± 0.02 g	± 0.05 g for repeated measurements	0.01 g	90%
Shorebirds	Bird counts	NA	NA	NA	90%

Table 6. Measurement quality objectives for laboratory measurements

Group	Parameter	Organization	Accuracy[7]	Precision	Recovery[8]	Target Reporting Limits	Completeness
Bacteria	*E. coli*	MBNEP, County of San Luis Obispo	Within range of	Replicate must be within the 95%	NA	2 MPN/100 mL	90%

[7] Accuracy is measured by comparing the measured value to the true value. Accuracy is assessed with a matrix spike and matrix spike duplicate, using a known amount of a certified reference material (CRM). Accuracy is calculated within established limits.

[8] Recovery is measured by comparing the measured value to an expected value. Recovery is assessed with a blank spike and a blank spike duplicate, using a known amount of CRM. Recovery is calculated within established limits.

Group	Parameter	Organization	Accuracy[7]	Precision	Recovery[8]	Target Reporting Limits	Completeness
		Public Health Laboratory	CRM	confidence interval.			
Bacteria	Entero-coccus	MBNEP, County of San Luis Obispo Public Health Laboratory	Within range of CRM	Replicate must be within the 95% confidence interval.	NA	2 MPN/100 mL	90%
Water quality	Nitrates as N	Fruit Growers Laboratory	86-112%	± 7%	90-110%	0.10 mg/L	90%
Water quality	Orthophos-phate as Phophorus	Fruit Growers Laboratory	89-115%	±8%	90-110%	0.1 mg/L	90%
Water quality - Ag Monitoring	Ammonia-Nitrogen	Fruit Growers Laboratory	46-139%	± 20%	90 - 110%	0.2 mg/L	90%
Water quality - Ag Monitoring	Total Kjeldahl Nitrogen	Fruit Growers Laboratory	90 - 110%	± 20%	90 - 110%	0.50 mg/L	80%
Water quality - Ag Monitoring	Nitrite as N	Fruit Growers Laboratory	88-111%	± 8%	90 - 110%	0.1 mg/L	90%
Water quality - Ag Monitoring	Total Phosphorus	Fruit Growers Laboratory	75-125%	± 20%	85 – 115%	0.1 mg/L	80%
Water quality - Ag Monitoring	Total Suspended Solids	Fruit Growers Laboratory	70-115% (LCS)	± 20%	70-115%	1 mg/L	90%
Water quality	Turbidity	Fruit Growers Laboratory	NA	± 20%	NA	0.1 NTU	90%
Bioassessment	Benthic macroinvertebrates	Spheros Envrionmental	≤ 10% difference in sorting efficacy with identification differences resolved through taxonomist consensus.	≥ 90% percent standard completion (PSC) with identification and enumeration differences resolved through taxonomist consensus.	NA	NA	80%

Group	Parameter	Organization	Accuracy[7]	Precision	Recovery[8]	Target Reporting Limits	Completeness
Bay Nutrient Sampling (shoreline locations)	Nitrate + Nitrite	UCSB Marine Science Institute Lab	90 - 110%	± 5%	90 - 110%	2.8 µg/L	90%
Bay Nutrient Sampling (shoreline locations)	Nitrite	UCSB Marine Science Institute Lab	90 - 110%	± 5%	90 - 110%	1.4 µg/L	90%
Bay Nutrient Sampling (shoreline locations)	Phosphate	UCSB Marine Science Institute Lab	90 - 110%	± 5%	90 - 110%	3.1 µg/L	90%
Bay Nutrient Sampling (shoreline locations)	Silicic Acid	UCSB Marine Science Institute Lab	90 - 110%	± 5%	90 - 110%	28 µg/L	90%
Bay Nutrient Sampling (shoreline locations)	Ammonium	UCSB Marine Science Institute Lab	90 - 110%	± 5%	90 - 110%	2.8 µg/L	90%
Toxicity	Water toxicity	UC Davis Granite Canyon Lab	NA	At least 5% of the total count. Each must have a RPD of <30%. One duplicate per batch of 20 samples.	NA	NA	90%
Toxicity	Sediment toxicity	UC Davis Granite Canyon Lab	NA	At least 5% of the total count. Each must have a RPD of <30%. One duplicate per batch of 20 samples.	NA	NA	90%

A7. Distribution List

Title	Name	Affiliation	Phone	QAPP #
Program Director	Ann Kitajima	MBNEP	805-772-3834	1
QA Officer	Makenzie O'Connor	MBNEP	805-772-3834	ORIGINAL
Regional Board QA Officer	Mary Hamilton	CCWQRCB	805-542-4768	1
USEPA Project Manager	Vivian Lopez	USEPA	415-972-3076	1
USEPA QA Officer	Audrey L. Johnson	USEPA	415-972-3431	1
MBNEP Technical Working Group	Yarrow Nelson	MBNEP	805-756-1347	1

A8. Project Organization

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.

Ann Kitajima is the program director of the MBNEP, as well as the MBNEP Volunteer Monitoring Program (VMP) manager and is referred to as the MBNEP Program Manager throughout this document. Makenzie O'Connor 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 and for the activities of all VMP staff and volunteers. Additionally, she is responsible for planning, coordinating, documenting, and evaluating all activities associated with the Quality Assurance Project Plan (QAPP). Tasks include maintaining the QAPP, coordinating with partners and laboratories, and ensuring procedures are consistently implemented by staff, volunteers, and contractors. If quality-related issues are identified, the QA Officer responds to them with guidance and support from the Program Manager. Additional information may be sought from laboratory personnel, other organizations conducting monitoring, regulatory agencies, etc. to provide guidance or clarification.

The State Water Board QA Officer is responsible for ensuring that the QAPP adheres to the QA principles of the State Water Board. The EPA QA Officer is responsible for ensuring that the QAPP adheres to the QA principles of EPA. The Central Coast Regional Water Quality Control Board (CCRWQCB) QA Officer is responsible for ensuring that the QAPP adheres to the QA principles of the Regional Board.

Fruit Growers Laboratory, Inc. (FGL) is the lab that conducts nutrient and QA analysis for the MBNEP. The San Luis Obispo County Public Health Agency Laboratory occasionally conducts the analysis of *E. coli* and enterococcus samples. Contract laboratories are not directly responsible for delivery of any contract submittals. All labs will analyze submitted samples in accordance with all method and quality assurance requirements found in this QAPP.

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

The University of California, Santa Barbara (UCSB) Marine Science Institute Laboratory is the lab that conducts nutrient analysis of bay waters for the MBNEP. This includes nitrates + nitrites, nitrites, orthophosphates, silicic acid, and ammonium. 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 project submittals.

California Polytechnic University (Cal Poly) provides support for the MBNEP through maintenance of continuous water quality sensors in Morro Bay as part of the Central & Northern California Ocean Observing System (CeNCOOS). CeNCOOS is a regional source of high-quality data and works with researchers, students, institutions, and others to collect a diverse set of data from the Central Coast region. Data are used by scientists, decision-makers, students, communities, and resource managers including the MBNEP.

The University of California, Davis Marine Pollution Studies Laboratory at Granite Canyon (UCD-GC) is the lab that conducts water and sediment toxicity analysis for the MBNEP. 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 7. Personnel responsibilities

Name	Organizational Affiliation	Title	Contact Information
Ann Kitajima	MBNEP	Program Director, Program Manager	805-772-3834, annk@mbnep.org
Makenzie O'Connor	MBNEP	Monitoring Projects Manager, QA Officer	805-772-3834, moconnor@mbnep.org
David Terz	Fruit Growers Laboratory, Inc.	QA Director	805-392-2024, davidt@fglinc.com
Dr. Glen Miller	San Luis Obispo County Public Health Agency	Laboratory Director	805-781-5512, gmmiller@co.slo.ca.us
Gary Lester	Spheros Environmental	Principal, Aquatic Sciences Lead	208-882-2588, glester@spherosenvironmental.com
Dr. Emily Bockmon	California Polytechnic University, Chemistry Department	Assistant Professor, Project Lead for Estuarine Nutrients Project	805-756-1636, ebockmon@calpoly.edu
Dr. Ryan Walter	California Polytechnic University, Physics Department	Associate Professor, Project Lead for CeNCOOS Project	805-756-1357, rkwalter@calpoly.edu
Karen Thorne	USGS Western Ecological Research Center	Project Manager for SET Project	916-502-2996, kthorne@usgs.gov

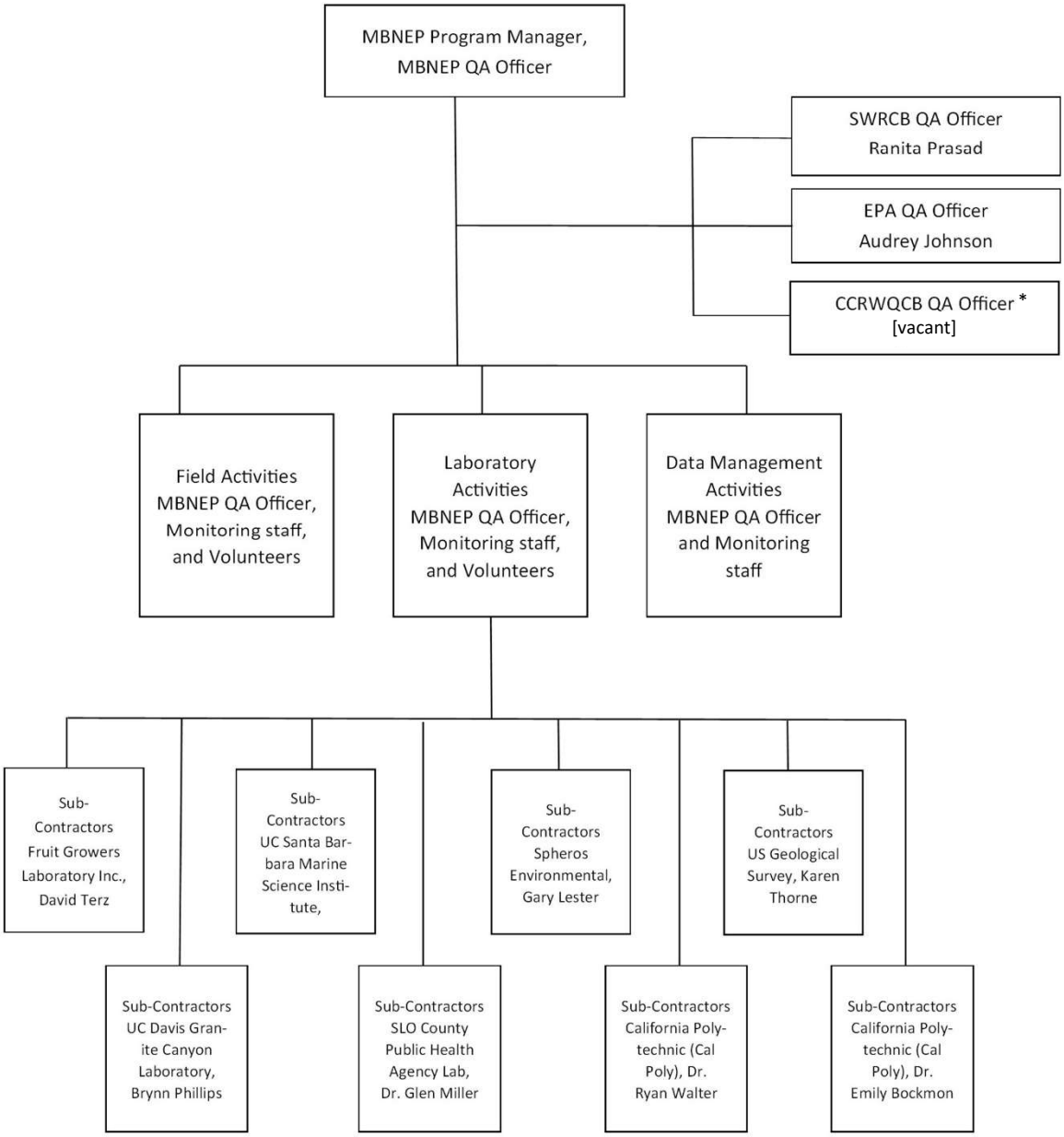
Name	Organizational Affiliation	Title	Contact Information
Ken Marchus	UCSB Marine Science Institute Laboratory	Lab Director	805-893-3802, k_a_m@ucsb.edu
Bryn Phillips	UC Davis Marine Pollution Studies Laboratory at Granite Canyon	Laboratory Director, QA Officer	831-624-0947, bmphillips@ucdavis.edu

A9. Quality Assurance Manager Independence

The MBNEP Program Manager is responsible for general oversight of the program and coordination with EPA and State Water Board QA Officers. The MBNEP QA Officer is responsible for staff and volunteer training, protocol development, data management, data analysis and report writing. Data collection is conducted by program staff and volunteers. Data management and reporting are conducted by MBNEP staff members, and overseen by the Program Manager.

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

A10. Project Organizational Chart



A10.1. Project Communications

MBNEP staff, volunteers, and contractors communicate data quality concerns and discrepancies promptly to the QA Officer. The QA Officer communicates and addresses any QAPP non-conformances to the MBNEP Program Manager. The MBNEP Program Manager shares significant issues with EPA, SWRCB, and CCRWQCB QA staff as necessary. The QA Officer works with project personnel and contractors to ensure consistency with the QAPP and develop process improvements where possible.

A11. Personnel Training & Certification

A11.1. Specialized Training or Certifications

Training prepares program volunteers and staff for MBNEP monitoring efforts. Training is required for new staff and volunteers and is offered throughout the year on an as-needed basis. All trainees receive information on field equipment and safety. 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. Bioassessment monitoring requires specialized training provided by the California Department of Fish and Wildlife Aquatic Bioassessment Laboratory (ABL) or CCRWQCB staff. Due to the infrequency of training opportunities, MBNEP staff attend bioassessment trainings whenever they are offered.

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

Laboratory accreditation from the State Water Board's Environmental Lab Accreditation Program (ELAP) is not required because MBNEP data is not utilized for compliance assessment. However, to ensure data of known and documented quality, all laboratories are appropriately accredited. The water quality laboratories are ELAP certified or provide adequate information to assess lab performance and data quality. The bioassessment lab meets the certification requirements for taxonomy work.

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

- *Water Quality Monitoring:* This training, conducted by MBNEP staff, emphasizes quality data collection and field safety protocols. Training includes instruction on how to properly operate field meters which collect temperature, dissolved oxygen, conductivity/salinity, and pH (freshwater meters only). Water quality training is split into estuarine and freshwater monitoring training. Volunteers for freshwater monitoring receive additional training by MBNEP staff that demonstrate the use of the flow meter and emphasize water safety precautions. Documentation of training attendees is recorded and maintained in a training log.

  Continuous monitoring water quality meters and continuous water depth equipment are deployed by MBNEP staff. New staff receive training from MBNEP staff per the monitoring protocol. Estuarine pH sensors are deployed by Cal Poly staff, who handle all staff training per the monitoring protocol.

  Bimonthly nutrient monitoring, Agricultural monitoring, seeps monitoring, and toxicity monitoring are carried out by MBNEP staff. New staff receive training from MBNEP staff per monitoring protocols (see Appendices).

- *Bioassessment Monitoring*: MBNEP 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 an MBNEP staff member. MBNEP staff receive training from CCRWQCB or California Department of Fish & Wildlife staff. Documentation of training attendees will be recorded and maintained in a training log.

- *Bacteria Monitoring:* MBNEP staff trains program volunteers in proper technique for sample collection in the field, including sterile technique. Volunteers are then trained in the lab by MBNEP 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*: MBNEP 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 an MBNEP staff member. Documentation of training attendees will be recorded and maintained in a training log.
- *Shorebird Monitoring:* 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.
- *Eelgrass and Macroalgae:* Eelgrass and macroalgae monitoring are completed primarily by MBNEP staff with occasional support by contractors. Prior to each field season, MBNEP staff hold a training session for new staff and contractors with guidance and oversight from an experienced staff member. Documentation of training attendees will be recorded and maintained in a training log.

A11.2. Training & 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, MBNEP 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.

A11.3. Training Personnel

All MBNEP staff training is provided by the MBNEP QA Officer and/or experienced staff who ensure that all necessary training has been completed. Training for Cal Poly students is provided by Cal Poly staff with support from experienced MBNEP staff. All volunteer training is overseen by the MBNEP QA Officer and provided by MBNEP staff who ensure that all appropriate volunteer training has been completed. Analytical laboratories are responsible for providing training to their own personnel.

A12. Documents & 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 program uses an Access database and Excel spreadsheets to store all program data. The Data Manager, an MBNEP staff member, maintains this electronic data with oversight by the MBNEP QA Officer. The files are saved to MBNEP's cloud storage with regular backup on an external hard drive. Cal Poly will store files (typically in Excel and MATLAB format) in the Cal Poly OneDrive, which is backed up via cloud storage.

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 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 and excluded from any future analysis or reporting. QA Officer will work with staff, volunteers, or contract laboratories to develop corrective actions. Any necessary retraining will be conducted.

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

Persons responsible for maintaining records for this project are as follows. MBNEP staff will maintain all sample collection, sample transport, chain of custody, and laboratory analyses forms at the MBNEP office. MBNEP 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. MBNEP 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 memos, an annual training log, and quarterly database submittals.

GROUP B: DATA GENERATION & ACQUISITION

B1. Sampling Process Design

Monitoring efforts occur at various times of the year. Data collection frequency is determined based on staffing capacity, site accessibility, and the amount of information needed for analysis. For more information, see Section A5 (Project Description).

Water quality, bacteria, flow, stream profiling, water depth, toxicity, 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 potentially significant impacts. Additionally, many sites were selected based on historical monitoring efforts in the area such as the National Monitoring Program. Safe access and landowner permission are other major factors in site selection. Sites for continuous monitoring of water quality parameters are selected to be upstream and downstream of features of interest such as point sources or past, present, or future enhancement projects. Continuous water depth measurement sites were established to help characterize surface flows to develop a water balance for the Chorro Valley, to track the impact of water conservation efforts, and to identify future project locations.

In the estuary, eelgrass and macroalgae monitoring transects were established throughout the bay to evaluate regional influences, while eelgrass mapping and bathymetry mapping covers the entire bay. The shorebird study area follows the historical sites established in historical studies. The SETs and feldspar marker horizons were established in portions of the bay where the most change due to sedimentation could be expected. The bay water quality sensors are deployed in locations with other water quality sensor infrastructure already in place so that the data supports ongoing monitoring efforts. Bay nutrient sampling is conducted at easily accessible shoreline sites located throughout the bay.

Sites are identified using landmarks, maps, and GPS coordinates. For more information on sampling locations, see Section A5.3 (Geographical Setting).

Table 8. Constituents monitored and measurement techniques

Parameter	Laboratory / Organization	Monitoring Frequency	Primary or Secondary	Method
E. coli (freshwater)	MBNEP	Monthly	Primary	IDEXX Colilert analysis
Enterococcus spp. (marine)	MBNEP	Monthly	Primary	IDEXX Enterolert analysis
Temperature (freshwater, marine)	MBNEP	Monthly	Primary	Meter
Dissolved oxygen (freshwater, marine)	MBNEP	Monthly	Primary	Meter
Conductivity (freshwater), Salinity (marine)	MBNEP	Monthly	Primary	Meter
pH (freshwater)	MBNEP	Monthly	Primary	Meter

Parameter	Laboratory / Organization	Monitoring Frequency	Primary or Secondary	Method
Orthophosphate as PO_4 (freshwater)[9]	MBNEP	Monthly	Primary	Meter
Flow (freshwater)	MBNEP	Monthly	Primary	Meter
Water depth (freshwater)	MBNEP	Continuously	Primary	Meter
Temperature (freshwater)	MBNEP	Continuously	Primary	Meter
Turbidity (freshwater)[10]	MBNEP	Monthly	Primary	Meter
Chlorophyll (freshwater)	MBNEP	Monthly at Ag Monitoring Sites	Primary	Meter
Total dissolved solids (freshwater)	MBNEP	Monthly at Ag Monitoring Sites	Primary	Calculated
Dissolved oxygen (marine)	Cal Poly	Continuously	Primary	Meter
pH (marine)	Cal Poly	Continuously	Primary	Meter
Temperature (marine)	Cal Poly	Continuously	Primary	Meter
Conductivity, salinity (marine)	Cal Poly	Continuously	Primary	Meter
Turbidity (marine)	Cal Poly	Continuously	Primary	Meter
Water depth (marine)	Cal Poly	Continuously	Primary	Meter
Chlorophyll (marine)	Cal Poly	Continuously	Primary	Meter
Nitrate as Nitrogen (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites and seeps, every other month for Water Quality (WQ) sites	Primary	EPA 300.0
Orthophosphate as P (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites, every other month for WQ sites	Primary	EPA 300.0
Total Nitrogen (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	Calculated
Organic Nitrogen (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	Calculated
Nitrite as N (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	EPA 300.0
Total Ammonia (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	SM4500-NH_3D
Total Kjeldahl Nitrogen (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	EPA 351.2

[9] Orthophosphate as phosphorus (PO_4-P) analysis is conducted in-house by staff and volunteers. Although analysis is conducted in the office, measurements are considered field measurements since they are analyzed using a field meter.
[10] Turbidity analysis is conducted in-house by staff and volunteers. Although analysis is conducted in the office, measurements are considered field measurements since they are analyzed using a field meter.

Parameter	Laboratory / Organization	Monitoring Frequency	Primary or Secondary	Method
Total Phosphorus (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	EPA 200.7
Total Suspended Solids (freshwater)	Fruit Growers Laboratory	Once a month for Ag Monitoring Sites	Primary	SM2540D
Total Alkalinity (marine)	Cal Poly	Monthly at shoreline locations	Primary	Dickson et al. 2009. Guide to Best Practices for Ocean CO_2 Measurements
Dissolved Inorganic Carbon (marine)	Cal Poly	Monthly at shoreline locations	Primary	Dickson et al. 2009. Guide to Best Practices for Ocean CO_2 Measurements
Nitrite + Nitrate (marine)	UCSB Marine Science Institute Lab	Monthly at shoreline sites	Primary	Lachat Instruments, QuickChem Method 31-107-04-1-A
Nitrite (marine)	UCSB Marine Science Institute Lab	Monthly at shoreline sites	Primary	Lachat Instruments, QuickChem Method 31-107-05-1-A
Orthophosphate (marine)	UCSB Marine Science Institute Lab	Monthly at shoreline sites	Primary	Lachat Instruments, QuickChem Method 31-115-01-3-A
Silicic Acid (marine)	UCSB Marine Science Institute Lab	Monthly at shoreline sites	Primary	Lachat Instruments, QuickChem Method 31-114-27-1-B
Ammonium (marine)	UCSB Marine Science Institute Lab	Monthly at shoreline sites	Primary	Lachat Instruments, QuickChem Method 31-107-06-5-A
Macroinvertebrates	Spheros Envrionmental	Annually	Primary	SWAMP SAFIT Level 2 protocol
Stream Profiling	MBNEP	As Needed	Primary	NA
SETs	MBNEP	As Needed	Primary	NA
Eelgrass monitoring	MBNEP	Annually	Primary	NA
Eelgrass – Baywide map	MBNEP	Biennially, approximately	Primary	NA
Bathymetry – Baywide data set	MBNEP	Approximately every ten years	Primary	NA
Algae documenting (freshwater)	MBNEP	Annually with bioassessment monitoring	Primary	NA
Macroalgae and biomass monitoring (estuarine)	MBNEP	Biannually	Primary	NA

Parameter	Laboratory / Organization	Monitoring Frequency	Primary or Secondary	Method
Recreational use monitoring	MBNEP	Bimonthly	Primary	Vehicle count and visitor count
Bird surveys	MBNEP	Annually	Primary	NA
Water toxicity	UC Davis Granite Canyon Laboratory	Once per year in the dry season Once per year in the wet season	Primary	*Ceriodaphnia dubia* (7-day), *Chironomus dilutus* (10-day), *Hyalella azteca* (96-hour) *Chironomus dilutus* (10-day), *Hyalella azteca* (96-hour)
Sediment toxicity	UC Davis Granite Canyon Laboratory	Once per year in the dry season	Primary	*Chironomus dilutus* (10-day), *Hyalella azteca* (10-day)

B2. Methods for Data Acquisition

B2.1. Sampling Methods

- *Bacteria monitoring:* All bacteria samples are aquatic samples. They will be collected as grab samples using sterile containers from approximately mid-stream and from just below the water's surface. The sterile sample containers 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 containers contain sodium thiosulfate to neutralize chlorine which may be present at some sites. These bottles are used once and then disposed of. When samples are collected, the collector makes sure to leave some headspace in the jar. To collect samples to be split, a larger volume of water is required. Larger, 250-mL autoclavable bottles are used for sample collection. The bottles are autoclaved between uses to ensure that they are sterile. Samples are inverted 25 times and then 100 mL is decanted into each of two IDEXX 120-mL jars prior to analysis. Excess sample can be disposed of down the drain. Bacteria monitoring requires a wet lab with an autoclave, incubators and a source of sterile distilled water. MBNEP bacterial analysis is conducted at Cuesta College by program staff and volunteers. MBNEP and Cuesta College staff operate the facility's two autoclaves to provide the sterilized glassware and distilled water needed for analysis and to sterilize waste before disposal. Separate autoclaves are used for sterilizing equipment and for sterilizing waste. 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 and staff will be re-trained.
- *Water quality monitoring:* 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. All monitoring is conducted in the field using field meters. Water samples for quality assurance purposes 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 16 oz. Whirl-Pak bag for the volunteer's analysis and a portion is used to triple rinse and then fill a clean

container provided by the laboratory for one-time use. For Bimonthly Nutrient Monitoring, Seeps monitoring, and Agricultural Monitoring, water samples are collected in one-time use bottles provided by the contract laboratory. 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 and staff follow the protocol. If a source of error is identified, the protocol will be revised and volunteers and staff will be re-trained.

- *Freshwater bioassessment monitoring:* 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-frame sampling net, bucket and sieves are rinsed between monitoring sites to minimize contamination. Excess samples are disposed of by the lab. No additional equipment or facilities are required for the sampling. All analysis is conducted by the laboratory. If samples are too large to fit in the 16-oz collection jar, larger debris is rinsed and removed until the sample is small enough. A 95% isopropyl alcohol preservative is added to each jar as soon as possible after collection. If it is determined that the sample collection method is introducing error into the results, the MBNEP QA Officer will reassess both the monitoring protocol and how the volunteers and staff follow the protocol. If a source of error is identified, the protocol will be revised and volunteers and staff will be re-trained.
- *Sediment toxicity*: For sediment toxicity, samples will be taken from depositional areas with low hydrologic energy, such as the inner side of bends or eddies where the water movement may be slower. Samples are collected along a 100-meter reach, with subsamples collected from up to 10 depositional areas, depending on the location of fine sediment deposits. Subsamples are homogenized to address variability and create a sample representative of depositional sediment mobilized within the watershed. Care is taken to sample recent sediment deposits in active areas of the streambed by avoiding banks, beaches, and other areas where sediment may have been deposited more than one year previously. Sediment is sampled to a depth of up to five centimeters and placed in a 4-L amber glass compositing/homogenizing container. This container is filled approximately 75% full with depositional sediment.
- *Water toxicity*: For water toxicity, samples will be taken from the centroid of the stream, where a 2.25-L bottle can be submerged. If there is no sampling point deep enough to submerge the 2.25-L bottle, a clean 1-L glass amber bottle will be used. In all these monitoring efforts, any problems are identified by MBNEP 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.
- *Continuous pH (estuarine):* For bay pH, discrete samples are collected as needed and preserved with mercury chloride to be a pH calibrant for the field sensors. Samples of 500 mL are collected with a trigger-deployed Niskin sampler. They are analyzed using a Dissolved Inorganic Carbon instrument with a Licor 7000 NDIR analyzer, a Total Alkalinity titrator, or a custom automated spectrophotometric pH instrument using m-cresol purple indicator dye. The preserved samples may be stored in the laboratory for up to six months before analyzing.

- *Nutrient monitoring (estuarine):* For bay nutrient monitoring, a sample is collected with a trigger-deployed Niskin sampler and decanted into 100 mL plastic HDPE with a plastic-lined cap. Samples are stored on ice and immediately transported to a lab to be frozen. Samples can be held for up to a year before analysis.
- *Macroalgae biomass (estuarine):* For intertidal macroalgae monitoring, a subsample of algae is collected from a 0.25m^2 area. Depending on algae density and cover, scissors may be used to collect algae only from the pre-defined collection area. The collected algae is rinsed, bagged, then stored in a refrigerator before weighing. Macroalgae wet weights are measured using a tared gross scale. For dry weights, samples are oven-dried at 90°C. After the first 48 hours, samples are weighed and returned to the oven for an additional hour. If the change in weight is less than 0.05 g after the second weighing, the sample is considered fully dry and recorded as the final dry weight. A second or third drying period may be necessary for a final dry weight. Calibration weights (200.00 g, 300.00 g, 500.00 g) are used regularly to ensure scale accuracy, with recalibration performed if drift exceeds 0.02 g.

The table below outlines all sampling methods and relevant standard operating procedures (SOPs). SOPs are updated on as needed basis by the project lead, and are documented in the QAPP Appendices by the MBNEP QA Officer. For sampling locations, please see Section A5.3 (Geographical Setting). For sample handling, please see Section B3 (Sample Handling and Custody). Note that no samples are collected for continuous water quality, streamflow, SETs, stream profiling, recreational use, or shorebird monitoring.

Table 9. Sampling methods.

Sampling Location	Organization	Matrix	Depth	Analytical Parameter	Number of Samples	Sampling SOP #
Bacteria (all creek sites)	MBNEP	Water	Below surface	*E. coli*	1 per month at each site plus one split per month	MBVMP Bacteria Monitoring Protocol
Bacteria (all bay sites)	MBNEP	Water	Below surface	Enterococcus	1 per month at each site plus one split per month	MBVMP Bacteria Monitoring Protocol
Water Quality (all creek sites)	MBNEP	Water	Below surface	Orthophosphates as PO_4, Turbidity	1 per site per month	MBVMP Water Quality Monitoring Protocol
Water Quality (all creek sites)	MBNEP	Water	Below surface	Orthophosphates as P, Nitrate as N, Turbidity	For QA, split samples at 10% of sites per month, sent to lab for analysis.	MBVMP Water Quality Monitoring Protocol
Water Quality – Bimonthly Nutrient Monitoring Sites	MBNEP	Water	Below surface	Nitrates as N, Orthophosphates as P	For Bimonthly Nutrient sites, samples sent to lab four times per year.	MBVMP Water Quality Monitoring Protocol

Sampling Location	Organization	Matrix	Depth	Analytical Parameter	Number of Samples	Sampling SOP #
Water Quality - Ag Monitoring Sites	MBNEP	Water	Below surface	Nitrates as N, Orthophosphates as P	For Ag Sites, 1 set per month sent to lab.	MBVMP Water Quality Monitoring Protocol
Water Quality - Ag Monitoring Sites	MBNEP	Water	Surface	Total Nitrogen, Nitrite as N, Organic N	1 per site, once a month	MBNEP Ag Monitoring Protocol
Water Quality - Ag Monitoring Sites	MBNEP	Water	Surface	Ammonia as Nitrogen	1 per site, once a month	MBNEP Ag Monitoring Protocol
Water Quality - Ag Monitoring Sites	MBNEP	Water	Surface	Total Kjeldahl Nitrogen	1 per site, once a month	MBNEP Ag Monitoring Protocol
Water Quality - Ag Monitoring Sites	MBNEP	Water	Surface	Total Phosphorus	1 per site, once a month	MBNEP Ag Monitoring Protocol
Water Quality - Ag Monitoring Sites	MBNEP	Water	Surface	Total Suspended Solids	1 per site, once a month	MBNEP Ag Monitoring Protocol
Toxicity Monitoring Sites	MBNEP	Water	Below Surface	Freshwater water toxicity	1 sample per site, once during the dry season. 1sample per site, once during the wet season.	Stream Pollution Trends (SPoT) Monitoring Program QAPP (SWRCB, 2023)
Toxicity Monitoring Sites	MBNEP	Sediment	1-5 cm depositional sediment	Freshwater sediment toxicity	1 sample per site, once during the dry season	Stream Pollution Trends (SPoT) Monitoring Program QAPP (SWRCB, 2023)
Bay pH (calibration for sensors)	Cal Poly	Water	1 m below the surface	pH	1 sample per sensor per deployment	SeaBird SeaFET pH Sensor Deployment and Calibration Procedures
Bay Nutrient Monitoring Sites	Cal Poly	Water	1 m below the surface	Nitrate + Nitrite, Nitrite, Orthophosphate, Silicic Acid, Ammonium	1 sample per site, once a month	Cal Poly Nutrient Monitoring Sample Collection Protocol

Sampling Location	Organization	Matrix	Depth	Analytical Parameter	Number of Samples	Sampling SOP #
Bay Macroalgae Biomass Sites	MBNEP	Algae	Surface	Algae biomass dry weight	9 unique samples per transect	MBNEP Bay Macroalgae Monitoring Protocol
Bioassessment Monitoring Sites	MBNEP	Macroinvertebrate samples	Creek bottom	Benthic invertebrates	1 composited sample per site	MBVMP Bioassessment Protocol

B2.2. Field Analytical Methods

Field measurements are collected by MBNEP staff and trained volunteers for all MBNEP projects. Trained Cal Poly students and faculty are responsible for all Cal Poly measurements. Continuous monitoring data is collected autonomously by stationary equipment. Table 10 outlines methods for field measurements and field analyses, while Table 11 describes the measurement principles for field equipment.

Table 10. Field analytical methods

Analyte	Organization	Project Action Limit	Target Reporting Limit	Standard Operating Procedure (SOP)
Flow	Field monitoring by MBNEP staff and volunteers	NA	Depth = 0.15 ft, Velocity = 0.01 ft/sec	MBVMP Water Quality Monitoring Protocols
Conductivity (Water Quality)	Field monitoring by MBNEP staff and volunteers, Continuous monitoring deployment by MBNEP staff	> 3,000 uS	0.10 uS for high range meter	MBVMP Water Quality Monitoring Protocols, MBVMP EXO3 Sonde Protocol
Dissolved oxygen (Water Quality and Dawn Patrol)	Field monitoring by MBNEP staff and volunteers, Continuous monitoring deployment by MBNEP staff	< 7.0 mg/L	0.01 mg/L	MBVMP Water Quality Monitoring Protocols, MBVMP EXO3 Sonde Protocol
pH (Water Quality)	Field monitoring by MBNEP staff and volunteers, Continuous monitoring deployment by	< 7.0 or > 8.5 pH units	1.0 pH	MBVMP Water Quality Monitoring Protocols, MBVMP EXO3 Sonde Protocol

Analyte	Organization	Project Action Limit	Target Reporting Limit	Standard Operating Procedure (SOP)
	MBNEP staff			
Chlorophyll (Water Quality, Ag)	Field monitoring and continuous deployment by MBNEP staff	NA	NA	MBNEP Agricultural Monitoring Protocol, MBVMP EXO3 Sonde Protocol
Total Dissolved Solids (Water Quality, Ag)	Field monitoring by MBNEP staff	Annual mean > 500 mg/L[11]	NA	MBNEP Agricultural Monitoring Protocol, MBVMP EXO3 Sonde Protocol
Temperature (Water Quality)	Field monitoring by MBNEP staff and volunteers, Continuous monitoring deployment by MBNEP staff	> 21°C	0.1°C	MBVMP Water Quality Monitoring Protocols, MBNEP Continuous Temperature Logger Protocol, MBVMP EXO3 Sonde Protocol
Turbidity (Water Quality)	Field monitoring by MBNEP staff and volunteers	> 25 NTU	0.01 NTU	MBVMP Water Quality Monitoring Protocols
Orthophosphates as PO_4 (Water Quality)	Field monitoring by MBNEP staff and volunteers	> 0.36 mg/L	0.33 mg/L	MBVMP Water Quality Monitoring Protocols
Bay pH	Continuous monitoring deployment by Cal Poly	< 7.0 and > 8.5 pH units	6.5 pH units	SeaBird SeaFET pH Sensor Deployment and Calibration Procedure
Bay Temperature	Field monitoring by MBNEP staff and volunteers, Continuous monitoring deployment by Cal Poly	NA	NA	MBNEP Dawn Patrol Protocol, Cal Poly HydroCAT Standard Operating Procedure
Bay Dissolved Oxygen	Continuous monitoring deployment by Cal	< 5 mg/L	0% saturation of 0 ml/L	Cal Poly HydroCAT Standard Operating Procedure

[11] The CCRWQCB Basin Plan calls for annual mean total dissolved solids (TDS) levels not to exceed 500 mg/L in Chorro Creek surface waters.

Analyte	Organization	Project Action Limit	Target Reporting Limit	Standard Operating Procedure (SOP)
	Poly			
Bay Water Pressure (depth)	Continuous monitoring deployment by Cal Poly	NA	0 mS/cm	Cal Poly HydroCAT Standard Operating Procedure
Bay Turbidity	Continuous monitoring deployment by Cal Poly	NA	0.01 NTU	Cal Poly HydroCAT Standard Operating Procedure
Chlorophyll	Continuous monitoring deployment by Cal Poly	NA	0.1 µg/L	Cal Poly HydroCAT Standard Operating Procedure
Macroalgae Biomass	Sample collection and analysis by MBNEP staff and contractor	NA	NA	MBNEP Bay Macroalgae Monitoring Protocol

Table 11. Field equipment features

Monitoring Effort	Equipment	Measurement Principle	Major Attributes
Flow	HACH FH950	Electromagnetic	Velocity averaging
Water depth	In-Situ Inc., Level TROLL 500, Level TROLL 700	Piezoresistive transducer	Automatic barometric pressure compensation
Conductivity (Water Quality, Water Quality Continuous)	YSI ProQuatro. YSI Pro 2030, YSI EXO3 Multi-Parameter Water Quality Sonde	Voltage drop	Temperature correction
Dissolved oxygen (Water Quality, Dawn Patrol, Ag)	YSI ProQuatro, YSI Pro 2030	Membrane covered polarographic	Self-calibrating
Temperature (Water Quality and Dawn Patrol)	YSI ProQuatro, YSI Pro 2030	Thermistor	
pH (Water Quality)	YSI ProQuatro, YSI EXO3 Multi-Parameter Water Quality Sonde	Glass combination electrode	Temperature compensation

Monitoring Effort	Equipment	Measurement Principle	Major Attributes
Turbidity (Water Quality)	HACH 2100Q Turbidimeters	Nephelometric	Auto ranging
Orthophosphates as PO_4 (Water Quality)	HACH DR/890, HACH DR/900	Ascorbic acid reduction reaction, colorimeter	
Chlorophyll (Water Quality, Ag)	YSI EXO3 Multi-Parameter Water Quality Sonde	Optical (fluorescence)	
Total Dissolved Solids (Ag)	YSI EXO3 Multi-Parameter Water Quality Sonde	Calculated from specific conductance with a TDS conversion factor of 0.65.	
Dissolved Oxygen (Water Quality Continuous)	YSI EXO3 Multi-Parameter Water Quality Sonde	Optical (dynamic luminescence quenching)	No flow required
Temperature (Water Quality Continuous)	YSI EXO3 Multi-Parameter Water Quality Sonde	Thermocouple	
Temperature (Water Quality Continuous)	HOBO MX2203 TidbiT	Thermistor	Detects when water is present, Bluetooth connectivity for download
Bay Dissolved Oxygen (Continuous)	SeaBird HydroCAT-EP V2 Multiparameter CTD	Optical	Designed for long duration deployments (antifouling)
Bay pH (Continuous)	SeaBird SeaFET V2 pH sensor SeaBird HydroCAT-EP V2 Multiparameter CTD	Ion sensitive field effect transistor Glass electrode	
Bay Temperature (Continuous)	SeaBird HydroCAT-EP V2 Multiparameter CTD	Thermistor	
Bay Conductivity (Continuous)	SeaBird HydroCAT-EP V2 Multiparameter CTD	Conductivity cell (inductive)	Pumped through anti bio-fouling cell and designed for long duration deployments.

Monitoring Effort	Equipment	Measurement Principle	Major Attributes
Bay Pressure/Depth (Continuous)	SeaBird HydroCAT-EP V2 Multiparameter CTD	Strain gauge pressure sensor	
Bay Chlorophyll (Continuous)	SeaBird HydroCAT-EP V2 Multiparameter CTD	Optical (fluorescence)	
Bay Turbidity (Continuous)	SeaBird HydroCAT-EP V2 Multiparameter CTD	Optical (backscatter)	
Drone-based Eelgrass Monitoring	DJI Phantom 4 Pro	True color imagery collection	20-megapixel camera

B2.3. Laboratory Analytical Methods

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 established by the lab conducting the analysis.

Table 12. Laboratory analytical methods

Analyte	Organization	Project Action Limit	Target Reporting Limit	Analytical Method or SOP	Method Detection Limit
Total coliform	MBNEP In-house laboratory	> 10,000 MPN/100mL	2 MPN/100mL for an undiluted sample	MBVMP Bacteria Monitoring Protocols, IDEXX Colilert	1 MPN/100 mL for an undiluted sample
E. coli	MBNEP In-house laboratory	Statistical Threshold Value: 320 MPN/100 mL (90th percentile of data) Geomean: 100 MPN/100 mL	2 MPN/100mL for an undiluted sample	MBVMP Bacteria Monitoring Protocols, IDEXX Colilert	1 MPN/100 mL for an undiluted sample
	County of San Luis Obispo Public Health Laboratory	See above	See above	Standard Methods 9223 B	See above
Enterococcus	MBNEP In-house laboratory	Statistical Threshold Value: 110 MPN/100 mL (90th percentile of	2 MPN/100mL for an undiluted	MBVMP Bacteria Monitoring Protocols,	1 MPN/100 mL for an undiluted

Analyte	Organization	Project Action Limit	Target Reporting Limit	Analytical Method or SOP	Method Detection Limit
	County of San Luis Obispo Public Health Laboratory	data) Geomean: 30 MPN/100 mL See above	sample See above	IDEXX Enterolert Standard Methods 9230	sample See above
Bay pH (spectrophotometer)	Cal Poly	< 7.5 pH units	6.5 pH units	Carter et al. 2013 DOI 10.4319/lom.2013.11.16	NA
Bay Nitrates + Nitrites	UCSB Marine Science Institute Lab	NA	2.8 µg/L	31-107-04-1-A	0.13 µg/L
Bay Nitrite	UCSB Marine Science Institute Lab	NA	1.4 µg/L	31-107-05-1-A	0.30 µg/L
Bay Phosphate	UCSB Marine Science Institute Lab	0.13 mg/L	3.1 µg/L	31-115-01-3-A	0.31 µg/L
Bay Silicic Acid	UCSB Marine Science Institute Lab	NA	28 µg/L	31-114-27-1-B	0.84 µg/L
Bay Ammonium	UCSB Marine Science Institute Lab	0.1 mg/L as ammonia	2.8 µg/L	31-107-06-5-A	0.10 µg/L
Nitrate as N	Fruit Growers Laboratory	10 mg/L	0.1 mg/L	EPA 300.0	0.0066 mg/L
Orthophosphate as P	Fruit Growers Laboratory	> 0.12 mg/L	0.05 mg/L	EPA 300.0	0.01 mg/L
Total Kjeldahl Nitrogen	Fruit Growers Laboratory	NA	0.5 mg/L	EPA 351.2	0.013 mg/L
Nitrite as N	Fruit Growers Laboratory	NA	0.17 mg/L	EPA 300.0	0.0015 mg/L

Analyte	Organization	Project Action Limit	Target Reporting Limit	Analytical Method or SOP	Method Detection Limit
Total Phosphorus	Fruit Growers Laboratory	NA	0.10 mg/L	EPA 200.7	0.061 mg/L
Ammonia as N	Fruit Growers Laboratory	NA	0.8 mg/L	SM 4500-NH3 G	0.066 mg/L
Turbidity for Water Quality (for QA)	Fruit Growers Laboratory	> 25 NTU	0.1 NTU	SM 2130B	0.033 NTU
Fecal/thermotolerant coliform (multiple tube fermentation – MTF)	County of San Luis Obispo Public Health Laboratory	> 43 MPN/100 mL	2 MPN/100 mL for an undiluted sample	Standard Methods 9221E+C	Lower: 1.8 MPN/100 mL Upper: >1600 MPN/100 mL Upper with extra dilution: >16000 MPN/100 mL
Benthic macroinvertebrates[12]	Spheros Environmental	NA	600 minimum individuals	Spheros Benthic Macroinvertebrate Sorting and Taxonomy SOP 2026	NA
Total Suspended Solids	Fruit Growers Laboratory	NA	3.2 mg/L	SM2540D	0.55 mg/L
Freshwater Sediment Toxicity	UC Davis Granite Canyon	NA	NA	EPA 600/R-99/064; *Hyalella azteca* - SOP 2.7	NA
Freshwater Sediment	UC Davis Granite Canyon	NA	NA	EPA 600/R-99/064;	NA

[12] Bioassessment sample analysis is conducted per the following SWAMP SOP, with customization or modifications per the QA Officer's request: http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/bmi_lab_sop_final.pdf

Analyte	Organization	Project Action Limit	Target Reporting Limit	Analytical Method or SOP	Method Detection Limit
Toxicity				*Chironomus dilutus* - SOP 2.8	
Freshwater Water Toxicity	UC Davis Granite Canyon	NA	NA	EPA 821/R-02/012M; *Hyalella azteca* - SOP 2.20	NA
Freshwater Water Toxicity	UC Davis Granite Canyon	NA	NA	Ingersoll et al. 2013; Kunz et al. 2017; *Chironomus dilutus* - SOP 2.26	NA
Freshwater Water Toxicity	UC Davis Granite Canyon	NA	NA	EPA /R-02/013; *Ceriodaphnia dubia*	NA

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 email in a more timely manner. Macroinvertebrate samples for bioassessment typically take three months for analysis and reporting by the analytical lab.

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.

B3. Sample Handling & Custody

B3.1. Sample Handing & Transport

The field sampler is personally responsible for the care and custody of the samples collected until they are transferred or dispatched properly. Samples should include the date and time of collection, sample location, sampler name, and analysis to be performed. Collected samples will be kept in an ice chest 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, 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, sampler name, and parameter to be analyzed for.

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

For bioassessment samples, 95% isopropyl alcohol is added immediately after collection. Samples are stored in a refrigerator for approximately one month. Prior to overnight shipment to a contract laboratory, samples are drained of alcohol preservative, double-bagged, and packed in a shipping container. Lab personnel immediately refill the samples with alcohol upon sample arrival.

For discrete grab samples for calibrating bay pH equipment, the sample is transferred into a 500-mL glass sample bottle through tubing and allowed to overflow to remove all bubbles and headspace. Use syringe to remove water to create headspace. Add 120 uL of 100% saturated Mercury II Chloride via pipette. Insert the greased glass stopper and use band and clip to secure stopper. Invert bottle several times to fix thoroughly. Sample can be stored for up to six months in the laboratory. For bay nutrient monitoring, samples are filtered using a 0.5 um polycarbonate filter then stored on ice. Upon returning to the lab, samples are frozen. Frozen samples are stored for six months.

All bacteria samples are hand delivered to the labs. Water quality samples to be analyzed by the lab are picked up by a lab courier for delivery to the lab or shipped via an overnight courier service. Pick-ups and deliveries are scheduled to comply with all hold time requirements. Contract laboratories will follow sample custody procedures outlined in their QA plans. Contract laboratory QA plans are on file with the respective laboratory. Laboratories shall maintain custody logs sufficient to track each sample submitted and to analyze or preserve each sample within specified holding times.

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.

Table 13. Sample handling

Parameter	Organization	Container	Volume	Matrix	Initial Preservation	Holding Time
E. coli	MBNEP	Sterile, sealed plastic jar purchased from IDEXX Laboratories	120 mL	Water	Sodium thiosulfate, cool to 4°C; dark.	24-hour hold time, but 8 hour if conditions allow, at 4°C, dark.
	County of San Luis Obispo Public Health	Sterile sample contained provided by	See above.	See above.	None, cool to 4°C; dark.	See above.

Parameter	Organization	Container	Volume	Matrix	Initial Preservation	Holding Time
	Laboratory	laboratory				
Enterococcus	MBNEP	Sterile, sealed plastic jar purchased from IDEXX Laboratories	120 mL	Water	Sodium thiosulfate, cool to 4°C; dark.	24-hour hold time, but 8 hour if conditions allow, at 4°C, dark.
	County of San Luis Obispo Public Health Laboratory	Sterile sample contained provided by laboratory	See above.	See above.	None, cool to 4°C; dark.	
Orthophosphate as P, Turbidity	MBNEP	Whirl-Pak bag	4 oz	Water	None	48 hour at ≤ 6 °C, dark.
Orthophosphate as P	Fruit Growers Laboratory	Glass vial and 0.45 µm filter provided by laboratory	(2) 40 mL	Water	Field filtered.	48 hour at ≤ 6 °C, dark.
Nitrates as N, Nitrite as N, Total Nitrogen, Organic Nitrogen	Fruit Growers Laboratory	Plastic jar provided by laboratory	16 oz	Water	None	48 hour at ≤ 6 °C, dark.
Turbidity	Fruit Growers Laboratory	Plastic bottle provided by laboratory	16 oz	Water	None	48 hours at ≤ 6 °C, dark.
Ammonia-nitrogen, Total Kjeldahl Nitrogen	Fruit Growers Laboratory	Plastic bottle provided by laboratory	(2) 16 oz	Water	H_2SO_4 preservative	28 days, at ≤ 6 °C, dark.
Total Phosphorus	Fruit Growers Laboratory	Plastic bottle provided by laboratory	250 mL	Water	HNO_3 preservative	6 months, at ≤ 6 °C, dark
Bay pH	Cal Poly	Glass bottle	500 mL	Water	100% saturated Mercury II Chloride	6 months after being fixed
Benthic invertebrates	Spheros Envrionmental	Wide mouth plastic jar	16 oz	NA	95% isopropyl alcohol	5 years

Parameter	Organization	Container	Volume	Matrix	Initial Preservation	Holding Time
Bay Nutrient Monitoring	UCSB Marine Science Institute Lab	Plastic HDPE Falcon flask with plastic lined cap	14 mL	Water	Store on ice. Upon return to the lab, filter through a 0.2 µm polycarbonate filter and freeze.	6 months, samples frozen
Total Suspended Solids	Fruit Growers Laboratory	Plastic bottle with cap provided by laboratory	32 oz	Water	Cool to ≤ 6	7 days at < 6°C in the dark.
Freshwater Water Toxicity	UC Davis Granite Canyon	Amber glass bottle provided by laboratory	500 mL	Water	None	48 hours at 4°C in dark.
Freshwater Sediment Toxicity	UC Davis Granite Canyon	Amber glass bottle provided by laboratory	500 mL	Sediment	None	56 days at ≤ 6°C in the dark.

B3.2. Chain of Custody Procedure

Chain of custody (COC) forms will accompany all samples during transport to contract laboratories. These are completed by MBNEP staff. Forms are signed by the lab and the person relinquishing the sample. Copies of these forms are maintained by MBNEP staff. All bacteria and water quality samples will be transported to the analytical laboratory directly by volunteers, MBNEP staff or by laboratory or overnight courier. Sample chain of custody forms can be found in the MBNEP's QAPP Appendices document, alongside the related project's SOPs.

B4. Quality Control

Quality control (QC) measures are necessary for field and laboratory results to evaluate precision and accuracy, and to identify potential contamination, matrix interference, or other procedural errors. The results of QC sample analyses are compared to MQOs outlined in Section A6 (Data Quality Objectives) to ensure compliance. If the method being used specifies more stringent requirements, the method requirements must be followed.

B4.1. Water quality monitoring QC

Quality assurance and quality control activities for water quality monitoring include the collection of field splits and the preparation of field blanks. 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.

For field splits, volunteers or staff collect a sample, homogenize it, then split it. Half is analyzed by the sampler and the other half is sent to the laboratory for accuracy and bias assessment. Field blanks are prepared by pouring deionized water into a clean sample collection container provided by the laboratory (Section B3). This blank is carried in the field in a cooler with ice packs, to simulate as closely as possible how the field samples are handled. To assess precision, staff and volunteers homogenize and split a sample. Both samples are analyzed by staff or volunteers, and the relative percent difference (RPD) between the two results should be within 25%. This analysis is conducted once per month by staff or volunteers.

The RPD is calculated as follows:

RPD = (X1 – X2)*100/[(X1 + X2)/2], where X1 is the larger value

Staff and 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 monthly by staff and 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 when the data is analyzed with box plots, the outliers are identified and are not included in the calculation of medians, interquartile ranges, etc. The criterion for an outlier is values that are at least 1.5 times the interquartile range (Q3 – Q1) from the edge of the box.

The Estuary Program's contract laboratory, Fruit Growers Laboratory, is ELAP-certified (Certification #1573) and undergoes annual inspection and recertification processes. 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 Section A6. 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 = [(matrix + spike result – matrix result) / (expected matrix + spike result)] * 100

% Completeness = [# valid samples / # 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.

Table 14. Field QC for water quality monitoring

Analytical Parameter(s)	Organization	Quality Control	Frequency
Orthophosphate as P	MBNEP staff and volunteers	Field blanks	One sample per year
		Field duplicate pairs	One sample per month, analyzed by MBNEP and certified laboratory.
Turbidity	MBNEP staff and volunteers	Field blanks	One sample per year
		Field duplicate pairs	One sample per month, analyzed by MBNEP and certified laboratory.
pH	MBNEP staff and volunteers	Field blanks	One sample per year
		Field duplicate pairs	One sample per month, analyzed by MBNEP and certified laboratory.
Dissolved oxygen	MBNEP staff and volunteers	Field duplicate pairs	One sample per month analyzed by secondary meter with a different measurement principle (optical or polarographic).
Continuous water temperature	MBNEP staff	Field duplicate pairs	At time of deployment and retrieval, take a second reading with a calibrated temperature meter.

Table 15. Analytical QC for water quality monitoring

Analytical Parameter(s)	Organization	Quality Control	Frequency
Nitrates as N, Orthophosphates as P, TKN, Nitrite as N, Total Phosphorus, Turbidity, Total Ammonia-Nitrogen, Total Suspended Solids	Fruit Growers Laboratory	Method Blank	One per batch
		Instrument Blank	One per day
		Lab Duplicate	One per batch[13]

[13] The matrix spike duplicate may serve as the lab duplicate in some cases.

Analytical Parameter(s)	Organization	Quality Control	Frequency
		Lab Matrix Spike	One per batch
		Matrix Spike Duplicate	One per batch
		Lab Control Sample	One per batch

B4.2. Flow monitoring QC

Quality assurance and quality control activities for flow monitoring include replicate measurements of flow velocity. RPD values should be within ± 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.

B4.3. Bacteria monitoring QC

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. The precision criterion is that the two volunteer-generated results must be within the 95% confidence interval criteria. To verify volunteer accuracy, *E. coli* and enterococcus samples of a known range of concentration are obtained from IDEXX Laboratories. Volunteers analyze the sample and the results should be within the acceptable range.

Blanks will be prepared by pouring sterile distilled 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. 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 County of San Luis Obispo Public Health Laboratory is certified by Environmental Laboratory Accreditation Program (ELAP) (Certification # 2114) and the National Environmental Laboratories Accreditation Conference (NELAC/TNI). The lab undergoes an annual recertification process and biennial inspection. 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 QC criteria 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 16. Field QC for bacteria monitoring

Analytical Parameter(s)	Organization	Quality Control	Frequency
Total coliform, *E. coli*, enterococcus	MBNEP	Field blanks	One per month
		Field duplicate pairs	One per month

Table 17. Analytical QC for bacteria monitoring

Analytical Parameter(s)	Organization	Quality Control	Frequency
E. coli, enterococcus	MBNEP	IDEXX certified reference material	One per month within IDEXX accuracy range
Total coliform, *E. coli* (Colilert-18/24)	County of San Luis Obispo Public Health Laboratory	Reagent blanks	For each new lot of reagent, run a presence/absence test for Colilert 18/24 strains: *Escherichia coli* ATCC 25922, *Klebsiella variicola* ATCC 31488, and *Pseudomanas aeruginosa* ATCC 27853.
Enterococcus	County of San Luis Obispo Public Health Laboratory	Reagent blanks	For each new lot of reagent, run a presence/absence test for Enterolert Strains: *Enterococcus faecium* ATCC 35667, *Serratia marcescens* ATCC 43862, and *Aerococcus viridans* ATCC 10400
Fecal / thermotolerant coliform	County of San Luis Obispo Public Health Laboratory	Negative control	For every test, run a negative control for *K.aerogenes* (ATCC # 13048)
		Positive control	For every test, run a positive control for *E.coli* (ATCC # 25992)
		pH	pH is taken and recorded for reach new batch of prepared media.
All analyses (*E. coli*,	County of San Luis	Media sterility test	Each new batch of prepared media

Analytical Parameter(s)	Organization	Quality Control	Frequency
total coliform, enterococcus, fecal / thermotolerant coliform)	Obispo Public Health Laboratory		or each new lot of purchased media.
		Additional sterility checks	On each new lot of sterile sample collection containers, dilution blanks, and graduated pipettes (growth test with Tryptic Soy Broth)
		Volume checks	On each new lot of dilution blanks, IDEXX sample bottles, and graduated pipettes. Volume check pipettor quarterly. QC scale each use with weights calibrated every 5 years.

B4.4. Bioassessment monitoring QC

MBNEP staff accompany volunteers on all sample collection field trips. MBNEP staff and volunteers receive annual training from seasoned staff prior to each sampling season. When provided, MBNEP staff attend refresher training provided by CCRWQCB staff or the California Department of Fish and Wildlife's Aquatic Bioassessment Lab to ensure that all collection methods are correct and up to date.

The macroinvertebrate analysis laboratory conducts QA measures for sorting and identifying the sample. Following initial sorting of the sample, 100% of the sorted material 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. 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.

B4.5. Bay nutrient monitoring QC

Quality assurance and quality control activities for sampling processes include the collection of field splits for bay nutrient testing and the preparation of field blanks. For field blanks, two samples are run using > 10 megohm-cm deionized (DI) water. Seawater blanks are also run using low nutrient seawater samples that are aged for months. This DI water is also used for all reagents, carriers, standards, and probe rinsing. For field duplicate pairs, the sample is split, with half analyzed by Cal Poly and half sent to the laboratory for analysis. The relative percent difference (RPD) between the two results should be within 25%. This analysis is conducted for 10% of samples analyzed. The laboratory will analyze the split samples to assess the accuracy and bias criteria.

In order to monitor the sampling process, the Cal Poly staff will randomly observe sampling processes and compare the actual actions against the sampling SOP.

Table 18. Field QC for bay nutrient monitoring

Analytical Parameter(s)	Organization	Quality Control	Frequency
Nitrates + Nitrites, Nitrites, Phosphate, Silicic Acid, Ammonium	Cal Poly	Field blanks	One per quarter
		Field duplicate pairs	One per quarter

Table 19. Analytical QC for bay nutrient monitoring

Analytical Parameter(s)	Organization	Quality Control	Frequency
Nitrates + Nitrites, Nitrites, Phosphate, Silicic Acid, Ammonium	UCSB Marine Science Institute Lab	Method blank	Two at the beginning of each run.
		Storage blank	One per quarter.
		Instrument blank	One every 20 samples.
		Lab duplicate	One in DI and one in SW at the beginning of analytical batch and one (DI or seawater) every 20 samples.
		Lab matrix spike, matrix spike duplicate	One every 20 samples, spike sample aliquots.
		Lab control sample	Seawater spike and DI spike, one in every 20 samples, one at end of run at concentration above highest measured result.
		External standards	12 standards run in duplicate at the beginning of the analytical batch to establish calibration curves for each analyte.

B4.6. Continuous bay water quality QC

As it is collected, the SeaBird sensor data undergoes automated analysis where QC flags are applied to suspect data. Prior to utilizing the data for analysis, Cal Poly will develop scripts to check the data by

applying site-specific criteria such as season, location, biofouling and cleaning schedule. These will be developed to align with the CeNCOOS QC standards but adapted to be more robust for Morro Bay.

Table 20. Field QC for continuous bay water quality monitoring

Analytical Parameter(s)	Organization	Quality Control	Frequency
Continuous bay pH	Cal Poly	Equipment blanks	Prior to deployment
		Field duplicate pairs	One sample per sensor per month.

B4.7. Toxicity monitoring QC

Quality control (QC) for analytical parameters is outlined in the SPoT QAPP (SWRCB, 2023).

Table 21. Analytical QC for toxicity

Analytical Parameter(s)	Organization	Quality Control	Frequency
Water toxicity	UC Davis Granite Canyon	Method blank	One per batch
		Conductivity/salinity control	A conductivity or salinity control must be tested when these parameters are above or below the species tolerance.
		Additional method blanks	Additional method blanks are required whenever manipulations are performed on one or more of the ambient samples within each analytical batch.
Sediment toxicity	UC Davis Granite Canyon	Method blank	One per batch
		Sediment control	One per batch
		Conductivity/salinity control	A conductivity or salinity control must be tested when these parameters are above or below the species tolerance.
		Additional method	Additional method blanks are required whenever manipulations

Analytical Parameter(s)	Organization	Quality Control	Frequency
		blanks	are performed on one or more of the ambient samples within each analytical batch.

B4.8. Macroalgae biomass QC

Quality control for macroalgae biomass including daily scale verification, standardized sorting and drying procedures, and duplicate measurements. The high-capacity scale is verified daily using 500 g, 300 g, and 200 g calibration weights, with recalibration performed if drift exceeds 0.02 g The scale remains on throughout drying and weighing to ensure consistency. For dry weights, samples are dried for 48-hours at 90°C then weighed. Samples are returned to the oven for one hour, then reweighed until the change in weight is less than 0.05 g. Algae samples are sorted by genus, with unknown species identified using reference materials or expert consultation. All weights are recorded to the nearest 0.01 g, and drying conditions are routinely monitored to maintain consistency across samples.

B5. Instrument/Equipment Calibration, Testing, Inspection & Maintenance

Field equipment inspection is carried out prior to each trip in the field. Testing is conducted routinely regardless of equipment condition, as well as if equipment appears visibly worn or if volunteers report problems with the equipment upon returning from the field. If deficiencies are found, staff will perform the needed maintenance and then re-calibrate and/or re-inspect the equipment. A pre- and post-calibration may 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. For more information on instrument calibration and documentation, see Section B5.1.

The MBNEP keeps spare parts, reagents and calibration standards 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. Cal Poly maintains all parts, reagents, and other equipment necessary for operating the SeaBird SeaFET pH sensors, and the SeaBird HydroCAT-EP V2 Multiparameter CTD.

To ensure that there is no carry-over contamination in the vials and syringes used for water quality analysis, MBNEP staff conducts split analysis for precision on a biannual 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 Section A6.2 (Measurement Quality Objectives). If the criteria are not met, all affected sample vials and syringes will be replaced with new ones immediately. The split sample procedure will be repeated biannually. Volunteers are trained to emphasize the importance of cleaning procedures. All glassware, vials and syringes are replaced on a biannual basis.

B5.1. Field analytical instruments

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.

For all calibrated instruments, a calibration log is maintained. 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 and Excel database to document the date and nature of the maintenance required. Cal Poly maintains all calibration results in a calibration log.

If equipment does not meet the criteria, it is the responsibility of the 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.

Table 22. Testing, inspection, maintenance, and calibration of field instruments

Organization	Equipment / Instrument	SOP Reference	Calibration, Testing, Inspection and/or Maintenance Description	Frequency	Responsible Person and Corrective Action
MBNEP	HACH FH950 Flow Meters	MBVMP Equipment Calibration Protocols	Bucket test the meters and zero them Send to manufacturer for repair and calibration	Weekly As needed	MBNEP staff. If meter won't zero properly, sensor is cleaned and meter is re-zeroed. Manufacturer will continue to repair meter until problems are corrected or meter needs to be replaced.
MBNEP	YSI ProQuatro, YSI Pro 2030 DO Meters	MBVMP Equipment Calibration Protocols	Visually inspected for overall condition. Internal calibration, verification against secondary meter. Two readings must be within ± 20%. Replace membrane and recondition probe.	Weekly Monthly Bimonthly, or as needed.	MBNEP staff. Sent to manufacturer for servicing if issues persist.

Organization	Equipment / Instrument	SOP Reference	Calibration, Testing, Inspection and/or Maintenance Description	Frequency	Responsible Person and Corrective Action
MBNEP	YSI ProQuatro, YSI Pro 2030 Conductivity Sensors	MBVMP Equipment Calibration Protocols	Calibration standards. Reading must be within ± 10% of calibration standard.	Biweekly	MBNEP staff. Sent to manufacturer for servicing if issues persist.
MBNEP	YSI ProQuatro pH Sensors	MBVMP Equipment Calibration Protocols	Calibration standards. Reading must be within ± 10% of calibration standard.	Biweekly	MBNEP staff. Sent to manufacturer for servicing if issues persist.
MBNEP	HACH 2100Q Turbidimeters	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 ≤ 1,000 NTU (± 100 NTU), for ≤ 10,000 NTU (± 200 NTU), for ≤ 100,000 NTU (± 300 NTU) Split samples with a certified laboratory.	Biweekly Monthly	MBNEP staff. Recalibrate. If cannot be corrected, return to manufacturer for serving.
MBNEP	HACH DR/890 and DR/900 meters	MBVMP Equipment Calibration Protocols	Run a known calibration standard and DI water to ensure accuracy. Apply reagent correct factor. Split samples with a certified laboratory. Assess instrument performance against secondary absorbance standards at 420nm, 520nm, and 560 nm.	Monthly Monthly Twice per year	MBNEP staff. Sent to manufacturer for servicing if issues persist.
MBNEP	YSI EXO3 Water Quality Sonde DO Sensor	MBVMP EXO3 Sonde Protocol	Internal calibration, verification against Winkler titration and/or YSI Pro 2030 meters.	Prior to each deployment	MBNEP staff

Organization	Equipment / Instrument	SOP Reference	Calibration, Testing, Inspection and/or Maintenance Description	Frequency	Responsible Person and Corrective Action
			Compared readings must be within ± 20%.		
MBNEP	YSI EXO3 Water Quality Sonde pH Sensor	MBVMP EXO3 Sonde Protocol	Calibration standards. Reading must be within ± 10% of calibration standard.	Prior to each deployment	MBNEP staff
MBNEP	YSI EXO3 Water Quality Sonde Conductivity Sensor	MBVMP EXO3 Sonde Protocol	Conductivity calibration standard. Reading must be within ± 10% of calibration standard.	Prior to each deployment	MBNEP staff
MBNEP	YSI EXO3 Water Quality Sonde Chlorophyll Sensor	MBVMP EXO3 Sonde Protocol	Prepare 0.625 mg/L Rhodamine calibration solution. Reading must be within ± 10% of calibration solution.	Prior to each deployment	MBNEP staff
MBNEP	In-Situ Level TROLL 500, 700 for Water Depth	MBNEP Pressure Transducer Protocol	Inspected during data downloads. Compare water depth readings to staff gauge reading. Analyze downloaded data for equipment issues.	Monthly	MBNEP staff. Sent to manufacturer if error is detected.
MBNEP	HOBO MX2203 Temperature Sensor	MBVMP Continuous Temperature Logger Protocol	Readings verified with a second HOBO MX2203 Temperature Sensor or a calibrated YSI 2030 Pro. Visually inspected for overall condition. Retrieve all sensors and place inside a large bucket with a known temperature. Verify readings of ± 0.2°C	Monthly at one site Monthly during data downloads. Annually	MBNEP staff or volunteer. MBNEP staff or volunteer. MBNEP staff. Sent to manufacturer if error is detected.
Cal Poly	SeaBird SeaFET pH sensor	SeaBird SeaFET Sensor Deployment and Calibration Procedures	Discrete sample calibration and unit inspection. Compare results to sample analyzed on a spectrophotometric pH instrument	Quarterly Prior to deployment	Cal Poly. Sent to manufacturer if errors are detected.

Organization	Equipment / Instrument	SOP Reference	Calibration, Testing, Inspection and/or Maintenance Description	Frequency	Responsible Person and Corrective Action
			Gel cap replacement, external reference electrode replacement	Annually	
Cal Poly	SeaBird HydroCAT-EP V2 Multiparameter CTD	Operator manual	Factory calibration by manufacturer prior to deployment. Complete external inspection. Test all functions and input channel responses. Replace O-rings and conduct a hydrostatic pressure test if necessary.	Prior to deployment	Cal Poly. Factory calibration by manufacturer.

B5.2. Laboratory analytical equipment

All laboratories maintain their equipment in accordance with SOPs, which include those specified by the manufacturer and those specified by the method. Calibration of analytical equipment used by each laboratory is outlined in each laboratory's SOPs and quality assurance documentation. Any deficiencies are addressed by the individual laboratory's QA plan. Laboratories comply with the procedures listed below.

Table 23. Testing, inspection, maintenance of analytical laboratory instruments

Organization / Laboratory	Equipment / Instrument	SOP Reference	Testing, Inspection and/or Maintenance Description	Frequency	Responsible Person
MBNEP Bacteria Lab	Incubator and thermometer	MBVMP Bacteria Quality Assurance Protocol	Log incubator temperature each time remove a batch of trays. Incubator must be from 35 $\pm$ 0.5ºC for the Colilert incubator and 41 $\pm$ 0.5 ºC for the Enterolert incubator. Replace the certified thermometer in the incubators.	Each batch Annually	Volunteers record values. Reviewed by QA Officer. Adjust incubator temperature as needed. MBNEP staff
MBNEP Bacteria Lab	Autoclave thermometer	MBVMP Bacteria Quality Assurance Protocol	Place certified Maximum Registering Thermometer (MRT) inside autoclave for each sterilization. MRT should reach at least 121˚C.	Each batch	MBNEP staff

Organization / Laboratory	Equipment / Instrument	SOP Reference	Testing, Inspection and/or Maintenance Description	Frequency	Responsible Person
			Place autoclave tape on items to be processed. Tape should change color if the temperature reaches 121°C.		
MBNEP Bacteria Lab	Autoclave	MBVMP Bacteria Quality Assurance Protocol	Run a vial of geobascillus stereothermophillus 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	MBNEP staff
MBNEP Bacteria Lab	Autoclave timer	MBVMP Bacteria Quality Assurance Protocol	Run autoclave cycle and verify internal timer results using exact National Time Standard (NIST) website time.	Quarterly	MBNEP staff
MBNEP Bacteria Lab	Pipettors	MBVMP Bacteria Quality Assurance Protocol	Pipettors are checked gravimetrically at 1 mL, 5 mL, and 10 mL using a fine scale. Sent in for service by accredited provider.	Quarterly Annually or as needed if acceptance criteria are not met.	MBNEP staff ISO/IEC 17025-accredited service provider.
MBNEP Macroalgae Biomass Lab	Fine scale	MBNEP Bay Macroalgae Monitoring Protocol	Verify accuracy of scale using calibration weights. Certification and calibration of scale.	Each time scale is used or if drift becomes greater than $\pm$ 0.0002 g. As needed, approximately annually.	MBNEP staff. If problem cannot be corrected, scale must be sent to the manufacturer for service.
MBNEP Macroalgae Biomass Lab	Gross scale	MBNEP Bay Macroalgae Monitoring Protocol	Verify accuracy of scale using calibration weights.	Each time scale is used and if drift becomes	MBNEP staff. If problem cannot be corrected, scale must be

Organization / Laboratory	Equipment / Instrument	SOP Reference	Testing, Inspection and/or Maintenance Description	Frequency	Responsible Person
			Certification and calibration of scale.	greater than ± 0.02 g. As needed.	sent to the manufacturer for service.
MBNEP Macroalgae Biomass Lab	Oven	MBNEP Bay Macroalgae Monitoring Protocol	Verify accuracy of temperature adjustment using certified thermometer.	Each time oven is started.	MBNEP staff. Adjust oven thermostat so that temperature remains within +/- 10° of the desired temperature.
MBNEP Macroalgae Biomass Lab	Desiccators	MBNEP Bay Macroalgae Monitoring Protocol	Ensure desiccant is dry.	As begin processing each batch of samples.	MBNEP staff. Bake desiccant in oven at designated temperature for desired time and cool before re-using in desiccator.
County of San Luis Obispo Public Health Laboratory	Incubators, water baths	County of SLO Public Health Lab QA Manual	Read and record temperature in incubators twice a day. Thermometers are certified and ASTM calibrated.	Calibrated annually	All Analysts
County of San Luis Obispo Public Health Laboratory	Tray sealer	County of SLO Public Health Lab QA Manual	Run a tray through the sealer containing water with dye to check for leaks.	Monthly	All Analysts
County of San Luis Obispo Public Health Laboratory	Refrigerator, room temperature	County of SLO Public Health Lab QA Manual	Read and record temperature once a day. Thermometers are certified and ASTM calibrated.	Calibrated annually	All Analysts
Spheros Environmental	Benthic invertebrates	NA	NA	NA	Gary Lester
Fruit Growers Laboratory	Nitrate as N, Nitrite as N, Orthophosphate as P	FGL SOP 2D0900256	External calibration with minimum 5 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the RL. Linear regression r2	As needed	LDM

Organization / Laboratory	Equipment / Instrument	SOP Reference	Testing, Inspection and/or Maintenance Description	Frequency	Responsible Person
			≥ 0.995. Calibration verification every 10 samples after initial calibration. Standard source different than that used for initial calibration. Recover 90 - 110%.		
Fruit Growers Laboratory	Ammonia as N, Total Nitrogen, Organic Nitrogen, Total Kjeldahl Nitrogen Total Phosphorus	FGL SOPs 2D0900022, 2D0900023, 2D0900089	External calibration with minimum 5 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard at or near the RL. Linear regression ≥ 0.995. Calibration verification every 10 samples after initial calibration. Standard source different than used for initial calibration. Recovery 90 to 110%.	Daily	LCR AC
Fruit Growers Laboratory	Total Suspended Solids	FGL SOP 2D0900047	Balance calibration verification performed at two levels	Daily	SJA
Fruit Growers Laboratory	Turbidity (for QA)	FGL SOP 2D0900019	Calibration performed Secondary standard check	Daily	MCT
UCSB	Lachat Instruments QuickChem 8500 Series 2	QA Manual MSIAL	Blanks, certified reference materials, calibration curve with 12 concentrations, control spikes, check standards, and final checks.	Daily	Ken Marchus

B6. Inspection/Acceptance of Supplies & Consumables

MBNEP 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. MBNEP staff track supplies and ensure that they are reordered in a timely fashion. All supplies are stored per the manufacturer's recommendations. Cal Poly inspects and stores all supplies and standards pertaining to continuous bay water quality and nutrient monitoring.

Supplies will be examined for damage as they are received. The following supplies will receive additional checks as follows. Records related to conductivity, turbidity and nutrients are maintained in the Calibration Log, and records related to bacteria media are maintained in an Access database.

- 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 distilled 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 distilled 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. Bottles supplied by contract laboratories are visually inspected prior to use, and the expiration dates are noted. The MBNEP assesses contamination using field blanks and duplicates annually. For more information, see Section B4.1.

B7. Data Management

Upon completion of fieldwork, volunteers or MBNEP staff check over datasheets for completeness and any obvious errors. As datasheets come in from the field, MBNEP 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, a different MBNEP staff member than the one who originally entered that data reviews all entered data to ensure its accuracy and completeness. Once this is complete, the original paper copy datasheets are filed. The database is backed up on an external hard drive and uploaded to cloud storage each night.

When data is received from the analytical laboratories, MBNEP staff reviews the data and then enters it into the appropriate electronic data management system or uploads the electronic data delivery report from the lab. Upon completion of the data entry, an MBNEP staff member reviews all entered data to ensure its accuracy and completeness. Once this is completed, the paper copy report is filed. The database is backed up on an external hard drive and uploaded to cloud storage each night. Data management protocols are outlined in the MBVMP Data Management Protocols SOP (see Appendices).

Data that are submitted to the California Environmental Data Exchange Network (CEDEN) are reviewed by the MBNEP QA Officer and an automated data checker, which is maintained by CEDEN. If data fails the automated check criteria, data will be returned to the QA Officer for edits. Successfully submitted data are available for download by CCRWQCB, CCAMP staff, and others.

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

Data is analyzed periodically for various reports or data summaries generated for agencies, non-profits and other users of the data. The majority of this analysis is conducted with Access, Excel and ESRI ArcGIS. This analysis is conducted by MBNEP staff and is overseen by the MBNEP QA Officer.

All Cal Poly-generated data is stored on the Cal Poly OneDrive cloud server. Continuous bay water quality data is stored on both local and remote servers, including archiving by CeNCOOS. Cal Poly is responsible for serving data streams to be archived by CeNCOOS.

GROUP C: ASSESSMENT & OVERSIGHT

C1. Assessments & Response Actions

To ensure that the QAPP is being implemented as approved, the QC procedures outlined in Section B4 (Quality Control) are conducted. The MBNEP QA Officer is responsible for this assessment and any necessary response actions. 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. Assessments are documented in monthly internal-use memos. These activities are all on-going and happen at least on a quarterly basis. The approximate schedule for these activities is in March, June, September, and December of each year. While no formal external assessments are planned, any problems or issues are shared with the RWQCB QA Officer and advice is sought to correct the problem. Any issues and necessary corrective actions are documented, then shared with staff.

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

Cal Poly is responsible for all QA issues related to continuous bay water quality and nutrient monitoring, including review of calibration logs, review of QA data, audits of field and lab activities, and review of data. Laboratory personnel are responsible for assessing laboratory QC results and implementing any necessary corrective actions.

C2. Oversight & Reports to Management

MBNEP staff and volunteers are in constant communication with the MBNEP QA Officer and any issues, discrepancies or problems would immediately be reported. The MBNEP staff and MBNEP QA Officer create an annual detailed QA analysis. This QA analysis will outline any results that did not meet the QC objectives. Any outstanding issues are discussed with 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.

For continuous bay water quality and nutrient monitoring, Cal Poly will produce a report which will include all applicable QA information like accuracy and precision estimates. Any issues, discrepancies, or problems are immediately addressed by Cal Poly staff, in conjunction with the manufacturer.

Table 24. MBNEP QA management reports

Type of Report	Frequency	Projected Delivery Dates	Person(s) Responsible for Report Preparation	Report Recipients
Data Summary Report and Memos	Annually	Variable	MBNEP Program Manager	Project partners
Calibration Log	Annually	Variable	MBNEP Program Manager	Maintained on-site
QAPP Update	Annually	Variable	MBNEP QA Officer	RWQCB QA Officer, EPA QA Officer

GROUP D: DATA VALIDATION & USABILITY

D1. Data Review & Validation

D1.1. Data Review

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 or a trained staff person. Information such as chain of custody forms are also reviewed to ensure that all hold times and sample preservation requirements have been met.

Data will be reviewed against the measurement quality objectives in Section A6 (Quality Objectives) 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 validated and is considered usable for future analysis. Data failing to meet accuracy criteria are documented but excluded from future analysis.

For any data that do not meet the precision criteria listed in Section A6, 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. All decisions regarding data validation will be performed by the MBNEP QA Officer. For bacteria, data failing the 95% confidence interval criteria will not be used. For in-house analysis of orthophosphate, the meter has a practical quantitation limit (PQL) of 0.33 mg/L as PO4. When assessing the orthophosphates precision criteria and the replicate readings are less than the PQL, then regardless of the relative percent difference (RPD) between the two readings the results pass the acceptance criteria and data will be retained. If the replicate readings are greater than the PQL and the RPD is greater than 25%, then the replicate criteria has not been met and the data will be rejected.

Cal Poly is responsible for the review, verification, and validation of continuous bay water quality data. Field and analytical QA standards will be assessed to ensure that they meet the measurement quality objectives. Discrete pH samples will be used to assess error by establishing an error envelope for the sensor time-series calculated as a function of the discrete pH error. The data will be used to create time series anomaly plots to identify periods of sensor conditioning, drift, fouling, and failure. It will also be used to create property-property plots to examine the agreement between the sensor pH and independent reference pH values from the discrete samples. For absolute differences in sensor and discrete sample results of greater than 0.1 pH units, the data would be discarded from further analysis.

D1.2. Data Validation

All data records will be checked visually prior to data entry into either the Access database, the Excel files or other electronic formats. Any corrections will be written directly on the datasheet. MBNEP staff will conduct all reviews and a different MBNEP staff member will review all datasheets and all data entry into Access, Excel and other electronic formats. Laboratory QA Officers will perform checks of all of their records. All submittals by laboratories will be reviewed by MBNEP staff. 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 Access database, 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 MBNEP staff with input, if applicable, from laboratory directors and from the RWQCB QA Officer. Any special notes or decisions regarding data usability will be entered in the 'Notes' column of the Access or 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.

Data validation is conducted by Cal Poly for the bay pH and nutrient data, per analysis described in the Section D1 (Data Review, Validation, and Usability). Issues are noted, reconciled, and corrected by Cal Poly.

D2. Usability Determination

The overall goal of this monitoring effort is to track long-term trends in the Morro Bay estuary and its watershed, as well as assess effectiveness of implementation efforts. The specific goals of the monitoring are laid out in Section A4.1 (Problem Definition). 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 Group C (Assessment & Oversight). The project requires adequate data to address its goals, and the completeness criteria indicate whether this data will be adequate. The completeness criteria are the most essential in determining whether the collected data provide enough information to answer the original questions asked.

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

All data will be analyzed for outliers and trends. Data is summarized in graphs and charts and presented on an annual basis in data summary memos that are made publicly available. 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. All historic data for water quality, flow, bacteria and bioassessment has been submitted to CEDEN via the Regional Data Center. Data is submitted to CEDEN on a quarterly basis.

Continuous bay water quality data is uploaded to the CeNCOOS data portal. Only data that meets QA criteria will be uploaded.

REFERENCES

Ammerman, J. and Bogren, K. 2001. Determination of ammonia by flow injection analysis. QuickChem Method 31-107-06-5-A. Lachat Instruments, Loveland, CO.N

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.

Bresnahan, P. J. J., Martz, T. R., Takeshita, Y., Johnson, K. S., and LaShomb, M. (2014). Best practices for autonomous measurement of seawater pH with the Honeywell Durafet. Methods Oceanogr. 9, 44–60. doi: 10.1016/j.mio.2014.08.003

California Department of Pesticide Regulation Environmental Management Branch. 2021. Standard Operating Procedures for Collecting Water and Sediment Samples for Pesticide Analysis. Sacramento, CA. https://www.cdpr.ca.gov/docs/emon/pubs/sops/fswa017.pdf

CDFW. California Department of Fish and Wildlife Aquatic Invasive Species Decontamination Protocol. October 3, 2022.

Central Coast Regional Water Quality Control Board. 2019. Water Quality Control Plan, Region (Basin Plan).

Central Coast Water Quality Control Board. 2017. Order No. R3-2017-0042. Waste Discharge Requirements, National Pollutant discharge Elimination System (NPDES) General Permit for Discharges with Low Threat to Water Quality.

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 and Northern California Ocean Observing System (CeNCOOS). 2018. CeNCOOS Data Management and Communications System Plan. July 2018.

Diamond, D. 2008. Determination of nitrate/nitrite in brackish or seawater by flow injection analysis. QuickChem Method 31-107-04-1-A. Lachat Instruments, Loveland, CO.

EPA. 2012. Recreational Water Quality Criteria. EPA 820-F-12-058.

EPA. 1999. 1999 Update of Ambient Water Quality Criteria for Ammonia. Office of Water 4304, EPA/822/R-99/014.

Herbst, David, et al. Sediment Deposition Relations to Watershed Land Use and Sediment Load Models Using a Reference Stream Approach to Develop Sediment TMDL Numeric Targets for the San Lorenzo River and Central Coast California Streams. January 2011.

Huberty, H. and Diamond, D. 1996. Determination of silicate in brackish or seawater by flow injection analysis. QuickChem Method 31-114-27-1-B. Lachat Instruments, Loveland, CO.

Integrated Ocean Observing System. 2020. Quality Control/Quality Assurance of Real-Time Oceanographic Data.

Kapsenberg L, Bockmon EE, Bresnahan PJ, Kroeker KJ, Gattuso J-P and Martz TR (2017) Advancing Ocean Acidification Biology Using Durafet® pH Electrodes. Front. Mar. Sci. 4:321. doi: 10.3389/fmars.2017.00321

Merkel and Associates, Inc., 2017. 2017 Morro Bay Comprehensive Baywide Eelgrass Inventory. August 2017.

Morro Bay National Estuary Program. 2022. Comprehensive Conservation and Management Plan, 2022 Update. 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.

Mulvaney, K. K., Atkinson, S. F., Merrill, N. H., Twichell, J. H., Mazzotta, M. J., (2020). Quantifying Recreational Use of an Estuary: A Case Study of Three Bays, Cape Cod, USA. *Estuaries and Coasts.* doi.org/10.1007/s12237-019-00645-8.

Ode, P.R., A.E., et al. 2025. Standard Operating Procedures for the Collection of Field Data for Bioassessments of California Wadeable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat. California State Water Resources Control Board Surface Water Ambient Monitoring Program (SWAMP) SOP-SB-2025-0001

Schroeder, S. 1997. Determination of nitrite in brackish or seawater by flow injection analysis. QuickChem Method 31-107-05-1-A. Lachat Instruments, Loveland, CO.

Sea-Bird Scientific (2023). User manual: HydroCAT-EP V2 CTD.

Sea-Bird Scientific (2018). User manual: SeaFET sensor, pH and optional CTD-DO. Document No. SeaFET170601

Sea-Bird Scientific (2018). Technical Note: Best Practices for the SeaFETTM V2: Optimizing pH Data Quality.

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.

SWAMP. Standard Operating Procedures for Laboratory Processing and Identification of Benthic Macroinvertebrates in California. October 2012.

SWRCB. California Environmental Data Exchange Network Field Data Submission Guidance Document. August 2013.

SWRCB. California Environmental Data Exchange Network Chemistry Data Submission Guidance Document. August 2013.

SWRCB. 2023. Statewide Stream Pollution Trends Monitoring Program: Quality Assurance Project Plan. Sacramento, CA: Surface Water Ambient Monitoring Program.

SWRCB. Surface Water Ambient Monitoring Program Measurement Quality Objectives: Field Mesaurements in Fresh and Marine Waters. January 2013.

SWRCB. Surface Water Ambient Monitoring Program Measurement Quality Objectives: Nutrients in Fresh and Marine Waters. January 2013.

SWRCB. Surface Water Ambient Monitoring Program Measurement Quality Objectives: Indicator Bacteria in Fresh Water. January 2013.

2005. Standard Methods for the Examination of Water and Wastewater. Microbiology precision of quantitative methods.

Schroeder, S. 1997. Determination of nitrite in brackish or seawater by flow injection analysis. QuickChem Method 31-107-05-1-A. Lachat Instruments, Loveland, CO.

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.

Worcester, K., D. Paradies, M. Adams. 2010. Interpreting Narrative Objectives for Biostimulatory Substances for California Central Coast Waters. Technical Report.

Xylem, YSI Incorporated. EXO User Manual, Item # 603789REF, Revision F. January 2019.

Xylem YSI Incorporated. ProQuatro User Manual. March 2020.

YSI Incorporated. Pro 2030 User Manual. November 2010.

Acronym list

Acronym	Definition
CCAMP	Central Coast Ambient Monitoring Program
CCMP	Comprehensive Conservation & Management Plan
CCRWQCB	Central Coast Regional Water Quality Control Board
CDPH	California Department of Public Health
CEDEN	California Environmental Data Exchange Network
CWA	Clean Water Act
DI	Deionized
DO	Dissolved oxygen
ELAP	Environmental Laboratory Accreditation Program
EMP	Environmental Monitoring Plan
EPA	Environmental Protection Agency
GPS	Global Positioning System
ISS	Inferometric sidescan sonar
MBNEP	Morro Bay National Estuary Program
MBVMP	Morro Bay Volunteer Monitoring Program
MDL	Minimum Detection Limit
MPN	Most Probable Number
MQO	Measurement Quality Objective
MTF	Multiple Tube Fermentation
NTU	Nephelometric turbidity units
PQL	Project Quantitation Limit
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
RWQCB	Regional Water Quality Control Board
SET	Surface elevation table
SM	Standard Method
SOP	Standard Operating Procedure
SPoT	Stream Pollution Trends
SWAMP	Surface Water Ambient Monitoring Program
TMDL	Total Maximum Daily Load
UAV	Unmanned aerial vehicle
UCD-GC	UC Davis Granite Canyon
USGS	United States Geological Survey
VMP	Volunteer Monitoring Program