

QUALITY ASSURANCE PROJECT PLAN

for

FRIENDS OF CASCO BAY

**CITIZEN STEWARDS WATER QUALITY
MONITORING PROGRAM**

Revision 4
RFA No. 11103

March 28, 2011

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for

THE FRIENDS OF CASCO BAY
CITIZENS WATER QUALITY MONITORING PROGRAM

Prepared by

FRIENDS OF CASCO BAY
43 SLOCUM DRIVE
SOUTH PORTLAND, ME 04106

Prepared for

CASCO BAY ESTUARY PARTNERSHIP

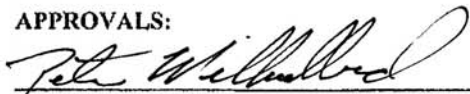
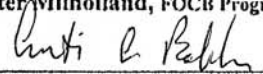
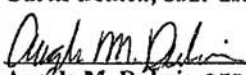
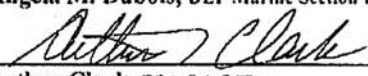
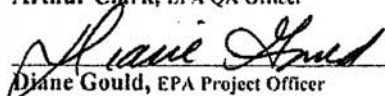
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U. S. ENVIRONMENTAL PROTECTION AGENCY
REGION 1

REVISION 4
March 28, 2011

(This document is valid for five years from the date of approval)

APPROVALS:

	5/5/11
Peter Milholland, FOCB Program Coordinator	Date
	5/12/2011
Curtis Bohlen, CBEP Executive Director	Date
	4-27-2011
Angela M. Dubois, DEP Marine Section Leader	Date
	4-15-2011
Arthur Clark, EPA QA Officer	Date
	4-26-2011
Diane Gould, EPA Project Officer	Date

ACKNOWLEDGMENTS

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The development of this plan was made possible by funding from the Casco Bay Estuary Partnership.

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A.3. Distribution List

Curtis C. Bohlen
Director, Casco Bay Estuary Partnership
USM Muskie School of Public Service
P.O. Box 9300
228 Wishcamper Center
Portland, ME 04104-9300
p. (207)780-4820
f. (207)780-4317
cbohlen@usm.maine.edu

Diane Switzer
New England Regional Laboratory
11 Technology Drive
North Chelmsford, MA 01863-2431
p. (617) 918-8377
Switzer.diane@epa.gov

Arthur Clark
New England Regional Laboratory
11 Technology Drive
North Chelmsford, MA 01863-2431
p. (617) 918-8374
f. (617) 918-8274
clark.arthur@epa.gov

Diane Myrick Gould, Ph.D.
USEPA REGION 1 - New England
5 Post Office Square
Mail Code: OEP06-1
Boston, MA 02109-3912
p. (617) 918-1569
f. (617) 918-0569
gould.diane@epa.gov

Angela M. Dubois
Section Leader, Marine Unit
Division of Environmental Assessment
Bureau of Land and Water Quality
Maine Department of Environmental Protection
Station #17
Augusta, ME 04333
p. (207) 287-7666
f. (207) 287-7826
c. (207) 592-2352
Angela.M.Dubois@maine.gov

Anna Bourakovsky
Department of Marine Resources
P.O. Box 8
West Boothbay Harbor, ME 04575
p. (207) 633-9501
f. (207) 633-9579
c. (207) 592-4404
anna.bourakovsky@maine.gov

Official copies of the plan and any subsequent revisions will be sent to Angela M. Dubois, Diane Switzer, Arthur Clark, and Diane Gould. Notification of any revisions will be sent to all members of the Water Quality Advisory Committee as listed in Appendix I. Copies of the revised plan will be available to Committee members and other interested parties on request.

A.4. Project / Task Organization

The Citizen Stewards Water Quality Monitoring program for Casco Bay is being coordinated by Friends of Casco Bay. The program is approximately 30% funded by the Casco Bay Estuary Partnership.

The organization of the CSWQM program is shown in Figure 1.

Peter Milholland, FOCB's Citizen Steward Coordinator, is the Program Coordinator. He will be directly responsible to the Casco Bay Estuary Partnership. Responsibilities of the Program Coordinator will include working with the committees, conducting volunteer training and QA sessions, conducting sampling from the BayKeeper boat, reviewing collected data, and overseeing the selection and maintenance of equipment for the CSWQM program. The Program Coordinator will also network with other water quality monitoring programs and work to raise awareness of water quality issues within the community.

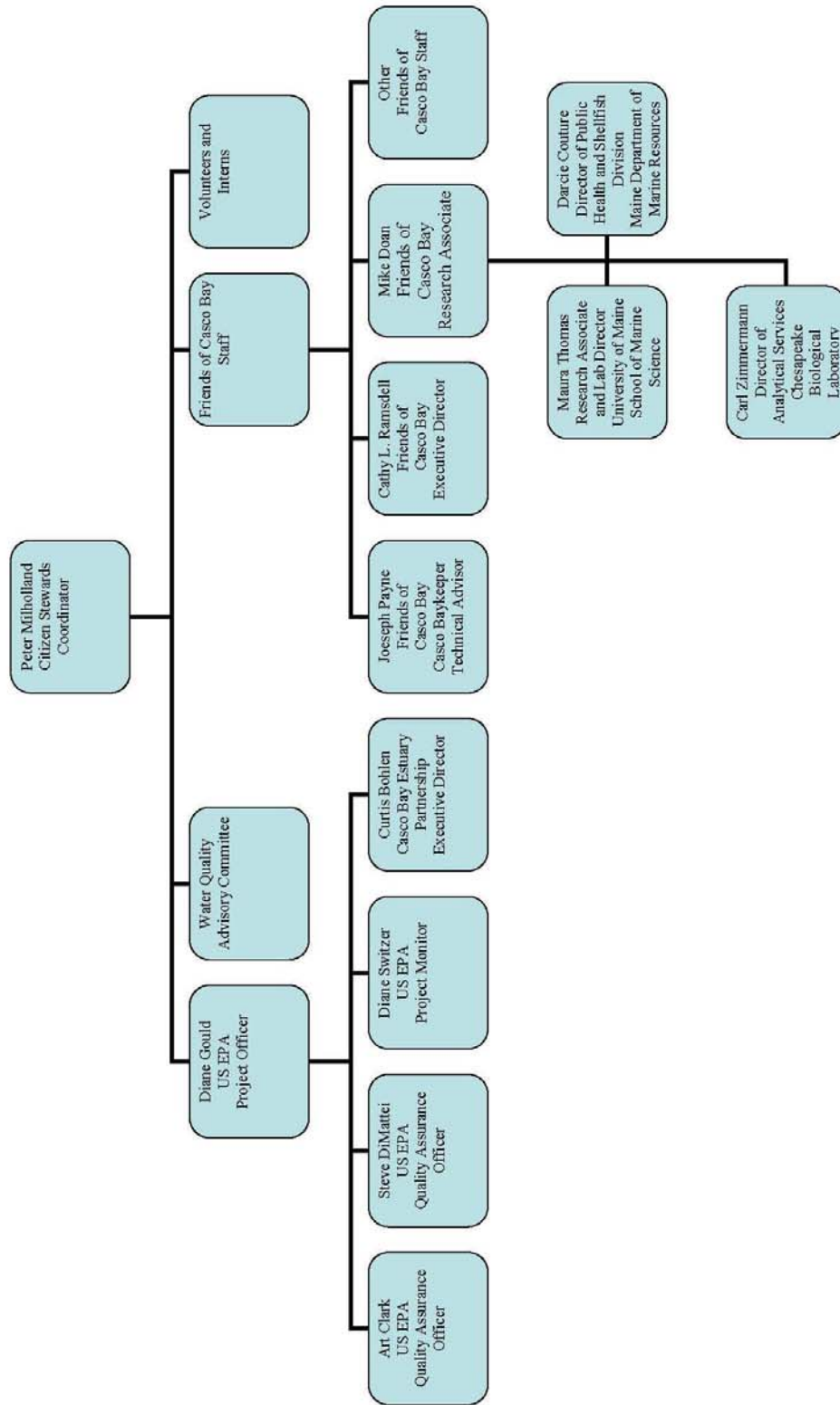
Robert Michael Doan is FOCB's Research Associate. Responsibilities of the Program Research Associate include assisting in the design and execution of volunteer training and QA sessions, assisting in the selection and maintenance of equipment for the CSWQM program, assist in revisions of the QAPP and Training Manual as necessary, writing data analysis reports as required for submission to CBEP and the DEP and serving as first mate on the BayKeeper boat.

Joseph Payne, the Casco BayKeeper, will be available as Technical Advisor. Other FOCB staff will participate in the CSWQM program as necessary.

The Water Quality Advisory Committee is composed of representatives of academic institutions, state and federal agencies, and independent scientists and water quality experts. This committee will provide technical advice on volunteer training, QA/QC, data analysis, and additional testing protocols.

All status reports and final reports will be directed to the Director of the Casco Bay Estuary Partnership.

FIGURE 1. CSWQM PROGRAM ORGANIZATION



A.5. Project Identification / Background

A. Objective and Scope Statement

Casco Bay became part of the U. S. Environmental Protection Agency's National Estuary Program in April, 1990. Casco Bay was nominated because of public concern about environmental degradation in the Bay. Casco Bay provides a major link between open ocean, fresh water, and the land. It has over 700 islands and exposed ledges and over 500 miles of coast. The Bay is extremely productive and provides essential food, cover, migratory corridors, and breeding and nursery areas for a wide variety of animals. Its rocky ledges, deep waters, mudflats, and wetlands provide habitats for birds, seals, whales, harbor porpoises, and many other species which contribute to a rich fishery. Portland is the second largest fishing port in New England. Casco Bay is an excellent area for both sail and power boating, for sea kayaking and wind surfing, and for bird watching, recreational fishing, and hunting.

Over the years, Casco Bay has been adversely impacted by human activities. Although many sources of pollution are now treated, questions remain about the ecological integrity of the Bay and about whether enough effort is being undertaken to protect that integrity. With the help of local governments and the public, the Casco Bay Estuary Partnership (CBEP) intends to explore and recommend management strategies designed to ensure protection of the Bay. The Project is also working to develop a sense of stewardship among the citizens of the Casco Bay watershed that will extend beyond the life of the project, now in its four-year implementation phase.

As a part of this effort, the Casco Bay Estuary Partnership has assisted in funding the Citizen Stewards Water Quality Monitoring (CSWQM) program. This program has been organized and implemented by Friends of Casco Bay (FOCB) with technical and facilities support from Southern Maine Community College (SMCC). The planning and design of the program is done in conjunction with a Water Quality Advisory Committee (WQAC) made up of representatives of academic institutions, state and federal agencies, and independent scientists and water quality experts (Appendix I). Volunteers form a large network of "bay watchers" who, by taking samples and making observations, can provide an ongoing assessment of water quality.

Friends of Casco Bay has organized a program that involves sampling around the Bay, in coastal waters. The parameters measured are five standard field data items: dissolved oxygen, pH, temperature, specific gravity (to determine salinity), and water clarity (limit of visibility). In addition, fecal coliforms are monitored at stations selected by the Maine Department of Marine Resources (DMR) from their existing stations. Sampling of river mouth stations has been coordinated with existing river and stream groups. The Maine Department of Environmental Protection (DEP) continues to work with the existing river and lake groups and is the repository of data from all groups. The ultimate goal of the Casco Bay Estuary Partnership, the DEP, and Friends of Casco Bay is to have a coordinated and comprehensive citizen monitoring program for the Bay and watershed. Through this program, accurate data of known quality can be collected at a scope and frequency attainable only with volunteers.

B. Data Usage

The data collected in the CSWQM program can aid environmental managers in:

- Establishing baseline water quality conditions.
- Determining long-term water quality trends.
- Documenting some effects of water quality improvement programs, e.g. CSO abatement, overboard discharge elimination, implementation of storm water and Boatyards & Marinas Best Management Practices.
- Screening for sources of pollution by identifying current problems.
- Making decisions on shoreland planning and zoning.

The data gathered by the program is supplied to the Department of Environmental Protection and the Casco Bay Estuary Partnership in digital form to help with the assessment and management of water quality.

A.6. PROJECT/TASK DESCRIPTION

A. TASKS

Since its inception, the Friends of Casco Bays' Citizen Stewards Water Quality Monitoring Program has been collecting data under the guidance of its first QAPP approved March 3, 1993 and subsequent revisions (Revision 1, approved May 1, 1997; Revision 2, approved July 12, 2001; Revision 3, approved September 15, 2006). Tasks outlined in this revision generally correlate with previously approved QAPP's and are designed to maintain the program. A schedule of tasks and products (Table 1) will be revised as necessary and submitted for approval as outlined in annual Scope of Work contracts between Friends of Casco Bay and the Casco Bay Estuary Partnership. This document is valid for five years from the date of approval.

B. DESCRIPTION

The Friends of Casco Bay CSWQM program maintains approximately 80-100 citizen volunteers to monitor water quality at roughly 40 selected sites, and 10 "profile" sites annually. Since the inception of the program in 1992 roughly 101 sites have been monitored by volunteers and staff creating the most comprehensive data set for Casco Bay. Volunteers and staff monitor water quality for basic oceanographic parameters: dissolved oxygen, temperature, salinity, pH, water clarity, and dissolved inorganic nutrients. Samples are collected once a month, April, May, June, and October, as well as twice a month in July, August, and September. Samples are collected at 07:00 AM (\pm ½ hour) & 15:00 PM (\pm ½ hour) with the exception of special projects.

Specifics of sampling procedures are described in more detail in section B, Element #10 & 11, pp: 22 - 39.

TABLE 1. SCHEDULE OF TASKS AND PRODUCTS

	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Program Planning	<----->												
Conduct Annual QA Checks on Veteran Monitors			group *-----*		-----*	-----*	-----*						
Train New Monitors				*-----			-----*						
Conduct Year-Round Sampling by FOCB Staff	<----->												
Conduct Sampling by Volunteer Monitors					*-----						-----*		
Conduct Site Visits with Volunteers					*-----						-----*		
Maintain Database	<----->												
Submit Data on Disk to CBEP & MEDEP								*					
Submit Reports to CBEP as Outlined in Work Scope	*	*	*	*	*	*	*	*	*	*	*	*	*

A.7. DATA QUALITY OBJECTIVES FOR MEASUREMENT DATA

Table 2 summarizes the data quality objectives (DQO) defined by FOCB for data collected in the CSWQM program. These data quality objectives are subject to change if deemed necessary by the Water Quality Advisory Committee and upon approval by the EPA.

Guidelines for monitoring precision, accuracy, representativeness, comparability, and completeness will be as follows:

A. Precision

Monitors will be asked to collect and titrate duplicate dissolved oxygen samples at QA sessions and during each sampling event. On the basis of statistical analyses and a control sheet, monitors will be instructed to do a third titration if the difference between the first two is greater than 0.6 mg/l (upper warning limit). The average of the two closer values is recorded. If the difference between the two titrations is greater than 0.9 mg/l (upper control limit) and no third titration is done, the results will not be entered into the CSWQM program data file. If a volunteer reports values differing by greater than 0.6 mg/l two weeks in a row, the volunteer will be called to determine the cause of the problem. A site visit may be deemed necessary.

Duplicate samples for DO by YSI probe have been part of FOCB's SOP for "winter profile procedures", usually conducted when the water temp, salinity and DO are homogenous throughout the profile. Samples are collected at the surface, one meter, two meters and then at the bottom. If temperature is within one degree C, the salinity within one part per thousand or DO within one milligram per liter then the sample is considered homogenous. As the meter is pulled up to the surface a second sample will be collected at a randomly selected depth for comparison to the first one sampled.

In the case of fecal coliforms, when samples are analyzed by volunteers, replicate sample analyses will be performed monthly by splitting samples and having analyses performed by CSWQM program personnel, by an outside laboratory, and by the Department of Marine Resources.

Duplicate samples for DIN will be conducted once per "profile trip" by FOCB staff at a randomly selected station and depth. Random selection will be determined by means of drawing a coin (poker chip) with a station number written on it, and a separate coin with either "*surface, bottom, above thermocline or below thermocline*" written. The duplicate sample will be identified to only FOCB staff and not the analytical lab performing the analysis. The duplicate will be performed to provide a measure of precision between field collection and lab analysis.

For Citizen Stewards collecting DIN a randomly selected date will be determined for them to collect a duplicate sample. The duplicate sample will be identified to FOCB staff and the volunteer collecting the sample but not the analytical lab performing the analysis.

TABLE 2. DATA QUALITY OBJECTIVES

Parameter	Method/Range	Units	Sensitivity (a)	Precision	Accuracy	Calibration Method
Temperature	Thermometer -5.0 to +45.0°C	degrees Celsius (°C)	0.5°C	±1.0°C (b)	±0.5°C (b)	NIST Certified Thermometer
	YSI 556 Multiparameter System -5.0 to +45.0°C	degrees Celsius (°C)	0.01°C	±0.25°C (p)	±0.5°C (d)	NIST Certified Thermometer
	YSI 6600 Sonde -5.0 to +45.0°C	degrees Celsius (°C)	0.01°C	±0.25 (h)	±0.5°C (h)	NIST Certified Thermometer
	Hanna Waterproof pH meter Mod # HI 98128	degrees Celsius (°C)	0.1°C	±0.2°C (q)	±0.5°C (h)	NIST Certified Thermometer
pH	pH Octet Comparator (Wide-Range) 3.0 to 10.0 units	standard pH units	0.5 units	±0.6 units (b)	{±0.4 units} (b)	pH Meter
	pH Octet Comparator (Narrow-Range) 7.2 to 8.6 units	standard pH units	0.1 units	±0.3 units (c)	±0.2 units (b)	pH Meter
	Oakton Waterproof pHTestr 2 -1.0 to 15.0 units	standard pH units	0.1 units	±0.1 units (g)	±0.2 units (g)	pH Buffer Reference Standards
	Hanna Waterproof pH meter Mod # HI 98128	standard pH units	0.01 units	±0.03 units (o)	±0.05 units	pH Buffer Reference Standards
	YSI 556 Multiparameter System 0.0 to 14.0 units	standard pH units	0.01 units	±0.13 units (p)	±0.2 units	pH Buffer Reference Standards
	YSI 6600 Sonde 0.0 to 14.0 units	standard pH units	0.01 units	±0.1 units (h)	±0.2 units (h)	pH Buffer Reference Standards
Dissolved Oxygen	Micro Winkler Titration 0 to 20 mg/l	milligrams per liter (mg/l)	0.1 mg/l	±0.9 mg/l (b)	±0.3 mg/l (b)	Standard Winkler
	YSI 556 Meter 0 to 50 mg/l	milligrams per liter (mg/l)	0.01 mg/l	±0.4 mg/l (p)	±0.2mg/l of rdg up to 20mg/l (h)	Standard Winkler
	YSI 6150 ROX Optical DO Sensor	milligrams per liter (mg/l)	0.01 mg/l	±0.2 mg/l (n)	±0.1mg/l of rdg up to 20mg/l (h)	Standard Winkler
	YSI 6600 Sonde 0 to 50 mg/l	milligrams per liter (mg/l)	0.01 mg/l	±0.4 mg/l (g & h)	±0.2mg/l of rdg up to 20mg/l	Standard Winkler

Dissolved Oxygen (pre- & post-checks)	YSI 556 Meter 0% to 500% saturation	percent air saturation (% sat)	0.1% sat	±0.4 mg/l (p)	±5% sat (p)	Barometric Pressure
Dissolved Oxygen (pre- & post-checks) continued	YSI 6150 ROX Optical DO Sensor	percent air saturation (% sat)	0.1% sat	10% RPD {±3% sat} (p)	0 to 200%: ±1% of reading or 1% air saturation, whichever is greater; 200 to 500%: ±15% of reading	Barometric Pressure
	YSI 6600 Sonde 0% to 500% saturation	percent air saturation (% sat)	0.1% sat	10% RPD {±3% sat} (p)	0 to 200%: ±2% of reading or 2% air saturation, whichever is greater; 200 to 500%: ±6% of reading	Barometric Pressure
Salinity	Hydrometer 0 to 42 ppt (1.0000 to 1.0700 specific gravity)	parts per thousand (ppt)	0.1 ppt (0.0005 specific gravity)	±1.0 ppt (b)	±0.82 ppt (b)	Orion 140 S-C-T Meter (ck'd vs. NIST Certified Conductivity Standards)
	YSI 556 Multiparameter System 0.0 to 14.0 ppt	parts per thousand (ppt)	0.01 ppt	±0.5 ppt (h)	±1.6 ppt at 33 ppt; ±0.7 ppt at 10 ppt (h)	NIST Certified Conductivity Standards
	YSI 6600 Sonde 0 to 70 ppt	parts per thousand (ppt)	0.01 ppt	±0.5 ppt (h)	±1.0% of reading or 0.1 ppt, whichever is greater	NIST Certified Conductivity Standards
Conductivity (pre- & post-measurement checks)	YSI 556 Multiparameter System 0 to 100 mS/cm	milliSiemens per centimeter (mS/cm)	0.001 mS/cm to 0.1 mS/cm (range dependent)	±100 µmhos/cm (h)	±0.5% of reading +0.001 mS/cm	NIST Certified Conductivity Standards
	YSI 6600 Sonde 0 to 100 mS/cm	milliSiemens per centimeter (mS/cm)	0.001 mS/cm to 0.1 mS/cm (range dependent)	±100 µmhos/cm (h)	±0.5% of reading +0.001 mS/cm	NIST Certified Conductivity Standards
Limit of Visibility	Secchi Disk Depth 0 to 20 m	meters (m)	0.1 m	NA	NA	NA
Sample Depth	Marked Line 0 to 36 m	meters (m)	1 m	10% RPD	NA	NA
	YSI 6600 Sonde 0 to 200 m	meters (m)	0.001 m	NA	NA	barometric pressure

Parameter	Method/Range	Units	Sensitivity	Precision	Accuracy	Calibration Method
Fecal Coliforms	Membrane Filtration 20 to 60 CFU	number of colony forming units (CFU) per 100 ml	1 CFU	10% RPD	NA	NA
Chlorophyll Fluorescence (j)	YSI 6600 Sonde 0-400 µg/L Chl (k)	micrograms per liter (µg/L)	0.1 µg/L	±0.3 µg/L (l)	NA	NIST Certified Rhodamine B
Turbidity	YSI 6600 Sonde 0 to 1000 NTU	nephelometric turbidity units (NTU)	0.1 NTU	NA	+ 2 % of reading or 0.3 NTU, whichever is greater	NIST Certified Turbidity Standards
Dissolved Inorganic Nutrients	NO ₃ +NO ₂ , NH ₄ , SiO ₄ , PO ₄ Membrane Filtration	micromoles (µM)	0.01µM	< 20 µM, < 25 µM, < 30 µM, < 4 µM (m)	NA	NA
Total Nitrogen	Persulfate Method Whole Water Sample	(mg N/L)	0.01 mg N/L	NA	NA	NA

NA = Not Available

Note: Precision values shown within { } are values obtained from calibration records and/or annual QA sessions.

- (a) Determined by the increments measurable with the stated method reflecting estimation where allowed.
- (b) Data taken from EPA Volunteer Water Monitoring: A Guide for State Managers, 1990, EPA 440/4-90-010, p. 39; based on data provided by the Chesapeake Bay Citizen Monitoring Program.
- (c) Data taken from the Quality Assurance Project Plan for the Chesapeake Bay Citizen Monitoring Program, Section 5, p. 2.
- (d) Data taken from FOCB1995 Water Column Profile Data Report, 1996, Friends of Casco Bay Citizen Stewards Water Quality Monitoring Program, Volume I, pp. 28-29.
- (e) Data taken from FOCB 1995 Water Column Profile Data Report, 1996, FOCB CSWQM Program, Volume I, pp. 28-29. The salinity accuracy figures are for +4° to +45°C. For -2 to +4°C, the meter should be accurate to ±1.9 ppt at 33 ppt and ±0.7 ppt at 10 ppt.

- (f) Data taken from FOCB 1995 Water Column Profile Data Report, 1996, FOCB CSWQM Program, Volume I, pp. 28-29. The post-calibration errors actually errors actually observed in 1995 ranged from -296 to +320 $\mu\text{mhos/cm}$ (after correction to 25°C).
- (g) Data taken from 1995 Water Column Profile Data Report, 1996, FOCB CSWQM Program, Volume I, pp. 28-29.
- (h) Data derived from 1999 - 2000 calibration records.
- (i) methods approved for QAPP by Steve DiMattei
- (j) Determination of chlorophyll with YSI 6025 probe can only be considered qualitative and are an estimate of chlorophyll concentrations *in situ*.
- (k) YSI Chlorophyll sensor range: 0-400 $\mu\text{g/L}$ Chl; 0-100 Percent Full Scale (%FS) Fluorescence Units
- (l) Precision calculated from 2001 – 2005 pre & post calibration records
- (m) Data taken from FOCB/CBEP *Twelve-Year Water Quality Data Analysis: 1993 – 2004*, section 2.2 p.6
- (n) Precision calculated from 2009 – 2010 pre & post calibration records
- (o) Precision calculated based on methods comparative study conducted 2/2011
- (p) Data derived from 2007 - 2010 calibration records.
- (q) Precision calculated based on comparative study of meters vs. NIST certified thermometer, conducted 2/2011

B. Accuracy

Accuracy of procedures and equipment used in the CSWQM program will be verified using standard reference materials. A detailed description of calibration procedures is given in Section B15 & B16.

C. Representativeness

Representativeness of the data collected in monitoring projects is considered and discussed in the project design and field plan, especially in sampling site selection. It will not be routinely monitored throughout the project, but will need to be considered when interpreting the data.

It is obvious that water flowing past a given location on land is constantly changing in response to inflow, tidal cycle, weather, etc. Periodic collection of data can help develop a better understanding of the variance associated with time series measurements of selected environmental variables. Such data collection can also provide increased resolution and sensitivity to localized and short term effects of events along tributary margins and in embayments.

During the first four years of the project, from 1993 to 1996, a dense network of sampling stations was established across Casco Bay. Samples were taken at Citizens Monitoring stations biweekly April through October. Stations monitored from the BayKeeper boat were sampled biweekly March through November (as allowed by weather conditions) and monthly December through February. The four years' worth of data demonstrated that conditions across the Bay were generally healthy, were relatively homogenous geographically, and changed fairly smoothly throughout the monitoring season.

On the basis of the previous data and after consultation with the Water Quality Advisory Committee, in February, 1997 the sampling frequency was changed to monthly for all stations. Monthly sampling allowed us to keep a close watch on what's going on in the Bay while making efficient use of our resources, especially staff and volunteer time.

In the spring of 2001 through 2005, FOCB staff began a series of internal program meetings to discuss data results and the future of the Citizen Stewards Monitoring Program. These meetings also coincided with two peer reviewed analytical reports *Friends of Casco Bay and Casco Bay Estuary Project ~ Six – Year Water Quality Data Analysis; 1993 – 1998* and *Friends of Casco Bay ~ Twelve – Year Water Quality Data Analysis: 1993 – 2004*, both authored by P. Scott Libby from Battelle - Applied Coastal and Environmental Services. Based on recommendations from these peer reviewed reports, FOCB has implemented the following recommendations:

- Collect samples early in the morning to document worst case water quality
- Increase sampling during months of concern – July – September
- Add nutrients and biomass measurements to quantify loading and ambient conditions – suite of nitrogen parameters and chlorophyll concentration

Beginning April 2005 FOCB staff and volunteers implemented the above recommendations with the addition of all CSWQM sites to be monitored synoptically at 07:00 hrs and again at 15:00 hrs (± 30 min).

D. Comparability

Efforts will be made to use methods that are EPA-approved and comparable to those employed by other water quality monitoring programs. Where the methods are necessarily different, either method comparison tests will be performed using EPA-approved methods and the degree of comparability will be determined and reported, or comparison tests in the literature will be referenced. Comparisons will be necessary for the parameters of pH, specific gravity and DIN when these parameters are not measured using EPA-approved methods.

pH will be measured using narrow-range and wide-range pH octet comparators. To determine the comparability of pH values measured using this method, comparison measurements will be made during QA sessions with a pH meter using EPA method 150.1. The narrow-range comparator uses a cresol red indicator. Interferences with cresol red at medium to high salinities are well documented in the literature. At 14 ppt salinity, cresol red gives an apparent pH reading which is too high by 0.21 units. At 32 ppt salinity, the error increases to 0.27 units. To compensate for these known errors, the pH data submitted by the monitors will be adjusted by the CSWQM database program MURPHY version 2.12, as described in Section B19.

Salinity will be measured using a hydrometer (Standard Methods, 16th Edition, Method 210B). From the actual specific gravity and temperature measurements of the water sample, a table will be used to calculate the water density and the corresponding salinity. To determine the comparability of salinity values measured by this method, comparison measurements will be made during QA sessions with a YSI model 6600 data Sonde using EPA method 120.1. The meter will be calibrated according to manufacturer's specifications using NIST certified conductivity standards.

E. Completeness

Completeness will be measured as the percentage of total samples collected that were analyzed as a whole and for individual parameters and sites. Volunteer monitors in the CSWQM program will be requested to collect data monthly April, May, June, October, and bi-monthly July, August, September. Observations will be made 20 times per site per year at all sites monitored by volunteers. However, it is assumed that some weeks may be missed due to vacations, illness, and severe weather. A complete data set has been initially set as 16 sampling events during the seven-month sampling period.

Fecal coliform samples will be collected monthly April through November for analysis by the DMR. Because samples are collected by boat and must be submitted for analysis on a specific day each month, there is the possibility that a collection day may be missed due to inclement weather. The DMR requires that six out of eight samples be taken per year at each site for random sampling. However, every effort will be made to take all eight samples.

Stations monitored from the BayKeeper boat will be sampled monthly year-round. Observations will be made 12 times per site per year. However, due to the possibility of severe weather, a complete data set has been initially set as 10 complete sampling events per year. During the period from April through October, the maximum interval between events will be 49 days and the minimum will be 14 days. During the period from November through March, a monthly schedule will be followed as closely as weather allows, with a minimum interval between sampling events of 14 days. When weather conditions do not allow us to sample all the BayKeeper boat stations within the maximum sampling interval, we will sample at a subset of sites which can be reached in almost any weather. This subset has been selected to represent both deep-water and shallow-water sites.

Sample collection for Total Nitrogen will occur monthly at the ten existing water column profile sites and May, July and September (summer) at 15 selected sites. At the monthly profile sites, samples for TN will be collected at the surface at all ten sites and also at the bottom at four of the ten sites (P1, P2, P3, and P6) year-round. For the summer sites, only surface water will be collected.

A.8. TRAINING REQUIREMENTS/CERTIFICATION

The most important step in ensuring that volunteer monitors are successful in collecting reliable data is the provision of a well-planned monitor training program. Training for the CSWQM program will be conducted by FOCB. If necessary, SMCC faculty or DEP staff will be asked for assistance. Training will involve three phases. During phase I, volunteers will be given extensive instructions on the protocols for measuring temperature, specific gravity, pH, dissolved oxygen and dissolved inorganic nutrients. In phase II, volunteers will practice all sampling, testing, and safety procedures. Phase III of the training will be conducted for each volunteer at his/her monitoring site, allowing the volunteers to further practice the testing procedures. Additional on-site training sessions may be necessary before monitors are allowed to proceed alone. Only trained volunteers will participate in monitoring activities.

Volunteers involved in the sampling of fecal coliforms at DMR stations will be certified by the DMR. Training will be conducted in the field. Phase I will allow the volunteers to practice sampling procedures. In phase II, the volunteers will demonstrate their ability to perform these procedures to a representative of the DMR. If sampling is initiated at non-DMR stations, volunteers will go through a similar two-phase training program but need not be certified by the DMR.

If FOCB implements its own fecal coliform analyses, training of volunteers involved in the analyses will be conducted in the laboratory. The analytical procedures for fecal coliform analyses are more complicated than for the other parameters being monitored in the CSWQM program. During phase I of training, volunteers involved in fecal coliform analyses will observe a demonstration of these procedures, have a chance to ask questions, and get hands-on practice in laboratory techniques. During phase II, each volunteer will perform a fecal coliform analysis under the observation of a trainer and will be able to practice specific techniques.

In addition to the training program, monitors will be provided with a copy of the FOCB Citizen Stewards Water Quality Monitoring Training Manual. This manual describes in detail the test procedures, proper care and handling of equipment, safety precautions, and data reporting procedures.

A.9. DOCUMENTATION AND RECORDS

Both volunteer monitors and FOCB staff will collect and report data on the Data Collection Forms supplied by the CSWQM program. All field measurements and observational data except profile data will be recorded on Side 1 of this form (Figure 2). Data requiring more notation and validation/verification by FOCB staff will be recorded on Side 2 (Figure 4). All observational data and DIN scintillation vial number & depth, collected during profile trips, are recorded on Side 1 (Figure 3) of the Profile Data Collection Forms. Actual profile data and validation/verification records are recorded on Side 2 (Figure 4).

Each monitor will be asked to make a copy of the data form and to send the original to the Program Coordinator of the CSWQM program monthly for review and data entry. The Program Coordinator will file the original in the program data file.

The copy of the data form will be retained by the volunteer in an accordion file provided by FOCB for the storage of water quality data and other program information. The purpose of these volunteer data files is to guard against loss and to facilitate discussion of any questions later about data reported. Volunteer data files will be reviewed for completeness during site visits.

FIGURE 2. CSWQM 2011 DATA COLLECTION FORM, SIDE 1

THE FRIENDS OF CASCO BAY CITIZENS' MONITORING PROGRAM
 WATER QUALITY DATA SHEET (SIDE 1 OF 2)

□

1
I.D.

Site name: _____	Collection date (mo/dy/yr): ___/___/___
Monitor name(s): _____	Time (24-hour time): _____ hours

2
WEATHER
CONDITIONS

Air temperature: _____.____ °C	Wind direction: _____ (N,NE,E,SE,S,SW,W,NW)
	Wind speed: _____ mph
Weather (check one)	<input type="checkbox"/> clear <input type="checkbox"/> snow <input type="checkbox"/> overcast <input type="checkbox"/> fog/haze <input type="checkbox"/> drizzle <input type="checkbox"/> downpour <input type="checkbox"/> partly cloudy
Rainfall in previous 24 hours (check one):	<input type="checkbox"/> none <input type="checkbox"/> light (___ inches) <input type="checkbox"/> heavy (___ inches)
Number of days with similar weather (including today): _____ days (must be >0)	

3
SITE
OBSERVATIONS

Tidal stage (check one):	<input type="checkbox"/> high <input type="checkbox"/> low <input type="checkbox"/> high ebb <input type="checkbox"/> low flood <input type="checkbox"/> ebb <input type="checkbox"/> flood <input type="checkbox"/> low ebb <input type="checkbox"/> high flood
High tide: _____ hours	
Low tide: _____ hours	
Water surface (check one):	<input type="checkbox"/> calm <input type="checkbox"/> ripple <input type="checkbox"/> waves <input type="checkbox"/> whitecaps
Indicators (check all that apply):	
<input type="checkbox"/> fishkills <input type="checkbox"/> dead crabs <input type="checkbox"/> oil on surface <input type="checkbox"/> debris <input type="checkbox"/> erosion <input type="checkbox"/> foam <input type="checkbox"/> bubbles <input type="checkbox"/> odors <input type="checkbox"/> abnormal color <input type="checkbox"/> birds <input type="checkbox"/> animals <input type="checkbox"/> other	
Please elaborate on the above: _____	

	PH calibration results: pH 7.01 _____.____ pH 10.01 _____.____

4
FIELD
MEASUREMENTS

Secchi depth: _____.____ meters	Water depth: _____.____ meters
Water temperature: _____.____ °C	pH: _____.____ N, W, O, mtr (circle one)
Specific gravity: _____.____ read at temp of _____.____ °C	
Salinity: _____.____ ppt	
Dissolved oxygen: Test 1: _____.____ mg/l	Test 2: _____.____ mg/l
Test 3: _____.____ mg/l	Avg: _____.____ mg/l

Monitor signature(s): _____

FIGURE 4. CSWQM PROFILE DATA COLLECTION FORM, SIDE 1

THE FRIENDS OF CASCO BAY CITIZENS' MONITORING PROGRAM
 WATER QUALITY DATA SHEET (SIDE 1 OF 2)

1
I.D.

Site name: _____ Collection date (mo/dy/yr): ___/___/___
 Monitor name(s): _____ Time (24-hour time): _____ hours

2
WEATHER
CONDITIONS

Air temperature: _____.____ °C Wind direction: _____ (N,NE,E,SE,S,SW,W,NW)
 Wind speed: _____ mph
 Weather (check one) clear snow overcast fog/haze
 drizzle downpour partly cloudy
 Rainfall in previous 24 hours (check one): none
 light (___ inches)
 heavy (___ inches)
 Number of days with similar weather (including today): _____ days (must be >0)

3
SITE
OBSERVATIONS

Tidal stage (check one): high low
 high ebb low flood
 High tide: _____ hours ebb flood
 Low tide: _____ hours low ebb high flood
 Water surface (check one): calm ripple waves whitecaps
 Indicators (check all that apply):
 fishkills dead crabs oil on surface debris
 erosion foam bubbles odors
 abnormal color birds animals other
 Please elaborate on the above: _____

4
FIELD
MEASUREMENTS

Secchi depth: _____.____ meters Water depth: _____.____ meters
 GoMOOS Nutrient Sampling

Bottle #	1	2	3	4	5	6
Depth (m)						
DIN Vial #						

Monitor signature(s): _____

FIGURE 5. CSWQM & PROFILE DATA COLLECTION FORM, SIDE 2

THE FRIENDS OF CASCO BAY CITIZENS' MONITORING PROGRAM
WATER QUALITY DATA SHEET (SIDE 2 OF 2)

WATER COLUMN PROFILE DATA	TEMPERATURE (°C)	SALINITY (ppt)	DISSOLVED OXYGEN (mg/l)
Model number of meter			
Serial number of meter			
Depth (m): 0	.	.	.
1	.	.	.
2	.	.	.
4	.	.	.
6	.	.	.
8	.	.	.
10	.	.	.
12	.	.	.
14	.	.	.
16	.	.	.
18	.	.	.
20	.	.	.
22	.	.	.
24	.	.	.
26	.	.	.
28	.	.	.
30	.	.	.
32	.	.	.
34	.	.	.
36	.	.	.
38	.	.	.

REMARKS :

Staff use ONLY	Date	Initials
Sheet rec'd		
Data ck'd		
Data entered into database		
Entry ck'd vs sheet		

F:\Data\PMilhollandCommon\WPDOCS\WQ\DTSHT01pr2.wpd

Nutrient Monitoring Project Data Sheet

Date:

Site:	Water temperature:
Time:	Salinity:
Secchi Depth:	Dissolved Oxygen (mg/l):
DIN Vial Number:	pH:
TN Jar ID:	Chlorophyll:

Site:	Water temperature:
Time:	Salinity:
Secchi Depth:	Dissolved Oxygen (mg/l):
DIN Vial Number:	pH:
TN Jar ID:	Chlorophyll:

Site:	Water temperature:
Time:	Salinity:
Secchi Depth:	Dissolved Oxygen (mg/l):
DIN Vial Number:	pH:
TN Jar ID:	Chlorophyll:

Site:	Water temperature:
Time:	Salinity:
Secchi Depth:	Dissolved Oxygen (mg/l):
DIN Vial Number:	pH:
TN Jar ID:	Chlorophyll:

Site:	Water temperature:
Time:	Salinity:
Secchi Depth:	Dissolved Oxygen (mg/l):
DIN Vial Number:	pH:
TN Jar ID:	Chlorophyll:

Site:	Water temperature:
Time:	Salinity:
Secchi Depth:	Dissolved Oxygen (mg/l):
DIN Vial Number:	pH:
TN Jar ID:	Chlorophyll:

Current weather:

Weather, previous 24 hours:

Days with similar weather:

Field Notes/Observations (changes in weather during data collection, etc):

B.10. SAMPLING PROCESS DESIGN

The goal of the FOCB Citizen Stewards Water Quality Monitoring program is to coordinate a baywide citizen monitoring program which provides quality data to assist in the monitoring and protection of the waters of Casco Bay and its watershed. To meet this goal, quality assurance and quality control must be paramount in the program. These concepts are emphasized in volunteer training and in the development of sampling and analytical procedures.

1. General Procedures for Sampling by Citizen Monitors

All regular sampling in the CSWQM program will involve ambient measurements collected and processed in the field. A few stations will be sampled from volunteers' boats, but most monitors will sample nearshore stations referenced to nearby fixed structures (e.g. end of pier). Preferably they will sample from bridges, piers, bulkheads, floats, jetties, docks, etc. where there is at least ten feet of water at low tide. This minimum water depth requirement would allow a Secchi disk reading to be taken at almost any tide stage. Unfortunately, requiring a strict minimum depth is not feasible. Because of the limited number of ideal spots and because consistency is related to convenience, a number of stations will be sampled by wading-in from shore. The disadvantage is that Secchi disk readings won't be taken, and that intertidal areas can be more dynamic than sub-littoral areas and thus harder to characterize. The advantage is that nearshore stations both intertidal and sub-littoral can be close to important nursery areas as well as providing habitat and a food source for adult marine organisms. These areas are also more likely to show the effects or presence of pollution from shoreline point and non-point sources.

Citizen monitors in the CSWQM program currently sample about forty stations, and this number is expected to remain fairly stable. All stations are visited by FOCB staff or volunteer regional coordinators to measure latitude and longitude using a GPS unit, to take a reference photo, and to establish a point at the station from which sampling can be done both safely and consistently. A list of all FOCB sites are noted in table 3.

All samples will be of surface water and will be collected by 5-gallon bucket. Monitors will be instructed to rinse the buckets three times before filling them for sampling. Sampling will be monthly from April through October except in July, August, and September when samples will be collected bi-weekly. Sampling will be conducted on a designated Saturday at 07:00 (7:00 AM) and 15:00 (3:00 PM) plus or minus ½ hour.

2. Procedures for Sampling from the BayKeeper Boat

In addition to the stations sampled by citizen monitors, approximately ten stations will be sampled from the BayKeeper boat by the Program Coordinator and other FOCB staff. (Volunteers are invited and encouraged to participate in boat sampling.) These ten stations will be either deep water, mid-channel, off a submerged discharge, or some other area only accessible by boat. At these stations, water column profiles will be taken for dissolved oxygen, temperature, salinity, pH, chlorophyll fluorescence, and dissolved inorganic nutrients. Limit of visibility will also be measured. Sampling from the BayKeeper boat will be conducted monthly year-round except in July, August, and September when samples will be collected bi-weekly.

3. Procedures for Fecal Coliform Sampling

Fecal coliforms will be sampled at selected stations with one or two boat crews sampling all stations and transporting samples to one or two sites where labs have been set up. The fecal stations will be at or near closed clam flats and will be selected in conjunction with the Maine Department of Marine Resources. Approximately fifteen to twenty stations will be sampled monthly April through November.

Fecal coliform samples will be collected in sterile plastic bags with the aid of sampling tongs. The sampling procedure is as follows:

1. The pre-labeled bag is held with one hand and the alligator clips of the tongs are placed on the tabs of the bag with the other. The top of the bag is torn off at the perforation; care is taken that the opening of the bag is not touched.
2. With the tongs squeezed together, the bag is plunged 6 to 8 inches below the water surface. The bag is pointed into any apparent current and opened.
3. The bag is brought to the surface, and the opening is closed by bringing the tongs together. To facilitate shaking the sample in the lab, excess water is squeezed out so that the bag is only 2/3 full.
4. The bag is held by the paper-covered wire closures at the top and twirled around them. The closures are then twisted together over the top of the bag.
5. The bag is placed upright in a cooler kept between +4 and +10°C.

4. Procedures for collecting dissolved inorganic nutrients (DIN)

DIN samples will be collected with a 60 ml syringe (from the sampling bucket), filtered through a 0.45 µm Acrodisc* Premium syringe filter, into a high-density polyethylene liquid scintillation vial. Samples will then be kept insulated and out of direct sunlight, and frozen ASAP (no more than two (2) hours from collection). The sampling procedure are as follows:

Dissolved Inorganic Nutrients Step-By-Step Field Procedures for Volunteers

NOTE: On page 45 of the field manual, the following procedure will occur between steps 4 and 5.
DIN SAMPLES ARE TO BE COLLECTED BEFORE FILLING DO BOTTLES.

- 1) Rinse the outside of the 60 ml syringe with the sample water.
- 2) Draw up a small amount of the sample water (10 ml \pm) into the syringe, remove from bucket, pull plunger back, and shake to rinse
- 3) Expel the rinse water away from bucket
- 4) Repeat this three times
- 5) Fill the syringe with sample water (from the bucket), attach the filter, and rinse the (DIN) scintillation vial (and cap) three times.
- 6) Fill the DIN vial 2/3 full, leaving plenty of room for expansion upon freezing
- 7) Cap and place in foam (out of direct sunlight) in your kit.
- 8) Record DIN vial # on datasheet. When you return home, place vial in freezer bag, and in freezer ASAP. Be sure to record the time on your data sheet that the vial was put in the freezer.

After completing steps 1-7 continue collecting samples for Temp, salinity, DO etc.

Dissolved Inorganic Nutrient and Total Nitrogen, Step-By-Step Field Procedures for sampling from the Baykeeper Boat

NOTE All DIN and TN samples obtained by staff from the Baykeeper boat will be collected by means of a Kemmerer water sampler, deployed at the proper depth in accordance with YSI pressure transducer reading.

- 1) Set Sonde at surface of water (6" below surface is considered surface) to equilibrate with local conditions.
- 2) Set trigger on Kemmerer water sampler and rinse with surface water
- 3) Deploy sampler to the same water depth as noted by YSI 6600 pressure transducer, send messenger and retrieve sample.
- 4) Dispense sample into a 500 ml amber Nalgene bottle a minimum of $\frac{3}{4}$ full, cap and set in cooler
- 5) Continue profile until a thermocline or halocline are observed
- 6) Hold Sonde above identified thermocline or halocline, and repeat steps 2-4
- 7) Continue profile until Sonde is below thermocline or halocline, repeat steps 2-4
- 8) Continue profile until Sonde reaches bottom, repeat steps 2-4
- 9) Once profile is complete, remove amber Nalgene bottles from cooler and process samples following steps 1-8 of CSWQM Volunteer field procedures
- 10) Place scintillation vials on ice in cooler
- 11) Immediately place vials in freezer at FOCB lab upon return

B.11. SAMPLING METHODS REQUIREMENTS

A. Monitoring Parameters and Collection Frequency

Table 3 summarizes the water quality parameters monitored in the CSWQM program. Samples will be taken at all Citizens' Monitoring stations monthly April through October except in July, August, and September when samples will be collected bi-weekly. All measurements will be made by the monitors on-site, with the possible exception of dissolved oxygen (DO) and dissolved inorganic nutrients (DIN). When necessary, DO samples may be collected and fixed on-site, then titrated within eight hours after collection. DIN samples are to be collected and filtered on site and stored in kit (out of direct sunlight) until placed in freezer (no longer than 2 hrs from collection).

Stations monitored from the BayKeeper boat will be sampled monthly year-round except in July, August, and September when samples will be collected bi-weekly. Measurements for Secchi depth, DIN and water column profiles of water temperature, salinity, pH, dissolved oxygen, and chlorophyll fluorescence will be taken at these stations.

Fecal coliforms will be sampled at stations selected by the Maine Department of Marine Resources (DMR) from their existing stations upon request. The samples will be delivered to the DMR laboratory in Boothbay for analysis.

Table 3. Site Locations for Friends of Casco Bay Water Quality Monitoring

Site Name	Site Number	Water Body Name	Water Body Code	Town	DIN & TN Sites	Water Class
Anthoine Creek	ANT01	Portland Harbor	PH	South Portland	*	SC
B&M Railroad Trestle	BMR02	Portland Coast	PC	Portland		SC
Bartol Island Causeway	BAR48	Harraseeket River	HR	Freeport		SB
Bear Island1	P4BRI	Eastern Coast	EC	Phippsburg	*	SB
Ben Island	BEN03	Quahog Bay	QB	Harpswell		SB
Bethel Point	BTH04	Quahog Bay	QB	Harpswell		SB
Birch Point (East of)	BIR05	New Meadows River	NMR	West Bath		SB
Boat Cove, Cliff Island	CLF71	Western Bay	WB	Portland		SB
Broad Cove, Cumberland	BCC06	Foresides	FS	Cumberland		SB
Broad Sound1	P5BSD	Eastern Bay	EB	Cumberland	*	SB
Cape Small Harbor2	CSH07	Eastern Coast	EC	Phippsburg		SB
Cat Cove, West Point	CAT69	Eastern Coast	EC	Phippsburg		SB
Channel Crossing	CHX09	Portland Harbor	PH	South Portland		SC
Chebeague Island, Johnson Cove	CIJ72	Western Bay	WB	Cumberland		SB
Chebeague Island, Stone Pier	CHB10	Western Bay	WB	Cumberland		SB
Cousins Island Wharf	CIW85	Western Bay	WB	Yarmouth		SB
Clapboard Island	CLP11	Western Bay	WB	Falmouth		SB
Clapboard Island1	P7CBI	Western Bay	WB	Falmouth	*	SB
Clark Cove	CLK12	Harpswell Sound	HS	Harpswell		SB
Cliff Island Public Landing	CLF13	Western Bay	WB	Portland		SB
CMP Dock	CMP61	Western Bay	WB	Yarmouth		SB
Cousins River, Muddy Rudder	CRV63	Royal River	RR	Yarmouth	*	SB
Cushing Island	CUS14	Western Bay	WB	Portland		SB
Custom House Wharf	CST15	Portland Harbor	PH	Portland	*	SC
Diamond Cove, Great Diamond Island	GRD21	Western Bay	WB	Portland		SB
Dyer Cove, Cape Elizabeth	DYR16	Cape Elizabeth	CE	Cape Elizabeth		SB
Dyers Cove, Quahog Bay	DYQ17	Quahog Bay	QB	Harpswell		SB
East End Beach	EEB18	Portland Coast	PC	Portland	*	SC
Ewin Narrows	EWN77	Harpswell Sound	HS	N. Harpswell		SB
Fort Gorges1	P6FGG	Portland Coast	PC	Portland		SC
Googins Ledge	GGL20	Eastern Bay	EB	Freeport		SB
Goslings	GOS19	Eastern Bay	EB	Harpswell		SB
Gun Point	GUN65	Quahog Bay	QB	Harpswell		SB
Halfway Rock1	P2HWR	Offshore	OFF	Harpswell	*	SA
High Head Yacht Club2	HHY22	Harpswell Sound	HS	Harpswell		SB
Indian Rest	IND66	New Meadows	NMR	Harpswell		SB

Site Name	Site Number	Water Body Name	Water Body Code	Town	DIN & TN Sites	Water Class
		River				
International Ferry Terminal ²	INT23	Portland Harbor	PH	Portland		SC
Jordan Point, Harpswell	JOR24	Middle Bay	MB	Harpswell		SB
Knightville Landing	KVL84	Portland Harbor	PH	South Portland	*	SC
Little Bustins Island ¹	P8LBI	Eastern Bay	EB	Freeport		SB
Little Chebeague	LCH25	Western Bay	WB	Portland		SB
Little Diamond Island	LTD60	Western Bay	WB	Portland		SB3
Little Flying Point	LFP26	Maquoit Bay	MQ	Freeport		SB
Little Flying Point ¹	P9LFP	Maquoit Bay	MQ	Freeport		SB
Little Iron Island ¹	P10LI	Middle Bay	MB	Harpswell		SB
Littlejohn Island	LJN27	Western Bay	WB	Yarmouth		SB
Long Island, New Meadows	LNM75	New Meadows River	NMR	Harpswell		SB
Lookout Point	LPT74	Middle Bay	MB	Harpswell		SB
Lowells Cove, Orrs Island	LWC28	Harpswell Sound	HS	Harpswell		SB
Mackerel Cove Bailey	MCV29	Harpswell Sound	HS	Harpswell		SB
Mackworth Causeway	MAC30	Foresides	FS	Falmouth		SC
Mackworth Stone Pier	MSP31	Foresides	FS	Falmouth		SB
Maquoit Bay, Haible	MQH32	Maquoit Bay	MQ	Brunswick		SB
Maquoit Bay, Wallace	MQW33	Maquoit Bay	MQ	Brunswick		SB
Marine East	MRE64	Portland Harbor	PH	South Portland		SC
Mill Cove, Harpswell ²	MIL34	Harpswell Sound	HS	Harpswell		SB
New Meadows Causeway	NMC84	New Meadows River	NMR	Brunswick		SB
New Meadows Lake (Upper)	NML	New Meadows River	NMR	Brunswick/West Bath		SB
New Meadows Marina	NMM79	New Meadows River	NMR	Brunswick	*	SB
Orrs & Bailey Island Yacht Club	OBY35	Harpswell Sound	HS	Harpswell		SB
Peabbles Cove	PBL36	Cape Elizabeth	CE	Cape Elizabeth		SB
Peaks Island, Public Landing	PKP38	Western Bay	WB	Portland		SB3
Peaks Island, East	PKE37	Western Bay	WB	Portland		SB
Peaks Island, South	PKS39	Western Bay	WB	Portland		SB3
Pennellville, Middle Bay	PEN40	Middle Bay	MB	Brunswick		SB
Perry's Landing	PRY41	Quahog Bay	QB	Harpswell		SB
Phippsburg Town Pier	PTP76	Eastern Coast	EC	Phippsburg		SB
Pinkham Point, Quahog Bay	PKT42	Quahog Bay	QB	Harpswell		SB
Portland Headlight ²	PTH59	Cape Elizabeth	CE	Cape Elizabeth		SB3
Portland Yacht Club	PYC43	Foresides	FS	Falmouth		SB
Portland Yacht Services	PYS44	Portland Harbor	PH	Portland		SC
Princes Point, Yarmouth	PPT45	Foresides	FS	Yarmouth		SB

Site Name	Site Number	Water Body Name	Water Body Code	Town	DIN & TN Sites	Water Class
Quahog Bay1	P11QB	Quahog Bay	QB	Harpswell	*	SB
Ram Island Ledge1	P1RIL	Offshore	OFF	Portland	*	SB
Royal River C5	RRC46	Royal River	RR	Yarmouth		SB
Royal Yankee Marina	RRY47	Royal River	RR	Yarmouth	*	SB
RT9 Presumpscot Bridge	PRV70	Presumpscot River	PR	Falmouth	*	SC
Seaborne, Yarmouth	SEA62	Foresides	FS	Yarmouth		SB
Seameadows	SEA73	Western Bay	WB	Yarmouth		SB
Sebasco Estates	SEB49	Eastern Coast	EC	Phippsburg		SB
Small Point1	P3SMP	Offshore	OFF	Phippsburg	*	SB
SMCC Pier	SMT50	Portland Coast	PC	South Portland	*	SC
South Freeport Town Landing	SFP51	Harraseeket River	HR	Freeport		SB
Stockbridge Point	STK52	Harraseeket River	HR	Freeport		SB
Stovers Point	STV53	Harpswell Sound	HS	Harpswell		SB
Stroudwater Bridge	STR54	Portland Harbor	PH	Portland	*	SC
The Basin	BAS68	New Meadows River	NMR	Phippsburg		SB
Two Lights, Cape Elizabeth	TWO55	Cape Elizabeth	CE	Cape Elizabeth		SB
Waites Landing	WAI56	Foresides	FS	Falmouth		SB
Whartons Point	WPT78	Maquoit Bay	MQ	Brunswick		SB
Willard Beach	WIL57	Portland Coast	PC	South Portland		SB3
Winter Point	WIN82	New Meadows River	NMR	West Bath		SB
Wolf Neck State Park	WLF58	Eastern Bay	EB	Freeport		SB
York Landing, Falmouth	YOL66	Foresides	FS	Falmouth		SB

¹The eleven profile sites, note: P8LBI was discontinued in 2001, and replaced with P11QB

² these five surface sites are also sampled year-round.

³These five sites were reclassified from SC to SB waters based on FOCB data.

NOTE: A map of all 2011 site locations has been provided in APPENDIX 3.

TABLE 4. MONITORING PARAMETERS

Parameter	Method	Units	Field Measurement or Processing
Temperature	Thermometric	degrees Celsius (°C)	Record to nearest 0.5°C
	Electrometric*	degrees Celsius (°C)	Record to nearest 0.1°C
pH	Colorimetric (Narrow & Wide-Range Octet Comparators)	standard units	Record to nearest 0.1 units (0.5 if using wide-range comparator)
	Electrometric*	standard units	Record to nearest 0.1 units
Dissolved Oxygen	Modified Winkler Titration	milligrams per liter (mg/l)	Record to nearest 0.1 mg/l
	Electrometric*	milligrams per liter (mg/l)	Record to nearest 0.1 mg/l
	Luminescent*	milligrams per liter (mg/l)	Record to nearest 0.1 mg/l
Salinity	Gravimetric	specific gravity (converted to ppt salinity)	Record to nearest 0.0005 specific gravity
	Electrometric*	parts per thousand (ppt)	Record to nearest 0.1 ppt
Limit of Visibility	Secchi Disk Depth	meters (m)	Record to nearest 0.1 m
Sample Depth	Marked Line	meters (m)	Record to nearest 0.1 m
	Pressure transducer*	meters (m)	Record to nearest 0.1 m
Observations	----	----	Record descriptions of water, weather, etc.
Total Nitrogen	Whole Water	milligrams per liter (mg/l)	Collect samples in plastic 30 ml Nalgene vial, store in cooler on ice and away from direct sunlight
Dissolved Inorganic Nutrients	Filtration	micromole (µm)	Collect samples in plastic 20 ml scintillation vial, store in kit away from direct sunlight
Fecal Coliforms	Membrane Filtration	number of colony forming units (CFU) per 100 ml	Collect samples in sterile plastic bags; store at 4-10°C

* Methods to be used at stations monitored from BayKeeper boat.

Detailed procedures for measuring pH, salinity, chlorophyll fluorescence, and water clarity are described in sub-chapter D since the methods being used are not EPA-approved. For pH, a Hanna electrometric meter will be employed. For salinity, a gravimetric procedure using a hydrometer will be employed rather than the electrometric method. For salinity the non-electrometric methods are more appropriate for the CSWQM program. These methods have been approved for use by citizen programs in other EPA regions, i.e. Region 3, Chesapeake Bay Citizen Monitoring Program and Region 6, Galveston Bay Foundation TEST Program.

The methods used to measure dissolved oxygen and water temperature are EPA-approved methods and are described below.

Dissolved Oxygen (DO)

Dissolved oxygen is measured with a Dissolved Oxygen test kit using the azide-modified Winkler Titration method.

Collection and Fixation:

1. In order to avoid contamination, a 60-ml water bottle is thoroughly rinsed with the water from the sampling bucket three times. The rinse water is discarded.
2. The bottle is tightly capped and submerged in the sampling bucket. The cap is removed, and the bottle is allowed to fill. Any air bubbles clinging to the sides of the submerged bottle are removed by tapping. The cap is replaced while the bottle is still submerged. After retrieval, the bottle is examined to make sure that no air bubbles are trapped inside. Once a sample without any air bubbles has been collected, Steps 3 & 4 are performed immediately.
3. 8 drops of Manganous Sulfate Solution and 8 drops of Alkaline Potassium Iodide Azide are added to the sample. The bottle is capped and inverted gently several times to mix. A precipitate forms. After the precipitate has settled below the shoulder of the bottle, the bottle is inverted again. The precipitate is allowed to settle again.

Titration: The titration should be completed no longer than 8 hours following fixation. When necessary, samples may be collected and fixed in the field for later titration. Samples should be protected from light and excess heat.

4. 8 drops of Sulfuric Acid (1:1) are added to the sampling bottle. The sample is mixed by gently shaking until both the reagent and the precipitate have dissolved. A clear-yellow to brown-orange color develops, depending on the oxygen content of the sample. After the addition of the acid, the analysis must be completed within 45 minutes.

5. A 25-ml graduated cylinder is filled to the 20 ml line with the sample solution. The solution is then transferred to the titration tube.
6. The plunger of a direct-reading titrator, a small syringe, is depressed to expel air. The titrator is inserted into the plastic fitting of a bottle of Standard Sodium Thiosulfate Solution (0.025N). The bottle is inverted, and the plunger of the titrator is slowly withdrawn until the bottom of the plunger is past the zero mark on the titrator scale. A plastic tip is then attached to the titrator. The plunger is pressed slowly until the plastic tip is full and the lowermost rim of the black rubber shoulder of the plunger is opposite the zero mark.

If air bubbles appear in the titrator barrel during the filling process, the titrator is removed from the reagent bottle. The plunger is pressed until the bubbles are expelled. The titrator is then reattached to the reagent bottle. Any solution expelled during this process is discarded.

Occasionally air bubbles appear on the tip of the plunger which can not be removed by the above process. If this process has been repeated three times and air bubbles remain, they may be removed by drawing about a centimeter of solution into the titrator and then forcibly expelling the solution back into the reagent bottle. This step is repeated until there are no more air bubbles.

7. 1 drop of Sodium Thiosulfate is added to the titration tube and mixed by swirling the tube. Another drop of the Sodium Thiosulfate is added and swirled again. The titration process is continued, adding one drop at a time, until the yellow-brown solution in the titration tube just begins to fade or get lighter. The color of the solution at this point should be about the shade of pale straw.
8. 8 drops of Starch Indicator Solution are added to the titration tube, which is mixed by swirling. The solution turns from light yellow to dark blue.
9. The titration process is continued (as described in Step 7) with the remaining Sodium Thiosulfate, until the test solution turns from blue to clear. No more Sodium Thiosulfate is added than is necessary to produce the color change.

If 10 units of Sodium Thiosulfate are added without accomplishing the final color change, the titrator is refilled as described in Step 6 and the titration is continued.

10. The scale on the side of the titrator is used to count the total number of units of Sodium Thiosulfate used in the experiment. If it is necessary to refill the titrator, the total is 10 units plus whatever units were used from the second filling. The number of units equals the milligrams per liter (mg/l) of oxygen dissolved in the sample.

Air Temperature

Air temperature is measured thermometrically using an alcohol-filled thermometer.

1. The LaMotte shielded thermometer must be hung in the shade and not touching anything. It must be protected from direct sunlight and/or wind as much as possible.
2. At least 3 minutes, no more than 5 minutes, are allowed for the thermometer reading to stabilize.
3. The temperature is read while the thermometer is still in the shade, and the temperature is recorded to the nearest 0.5°C.

Water Temperature

Water temperature is measured electrometrically using a Hanna pH meter with temperature thermister.

1. The Hanna meter is hung (submerged) in the center of the bucket (water sample) immediately after it is collected. The bucket is protected from direct sunlight and/or wind as much as possible.
2. At least 3 minutes are allowed for the thermometer reading to stabilize.
3. The temperature is read while the thermometer is immersed in the water sample, and the temperature is recorded to the nearest 0.1°C.

B. Methodology for Stations Monitored from BayKeeper Boat

For stations monitored year-round from the BayKeeper boat, water temperature, salinity, dissolved oxygen, pH and chlorophyll fluorescence will be measured electrometrically. The procedures are described below. Although electrometric methods of measuring temperature are not EPA-approved, the procedure is included here because it is part of the salinity and dissolved oxygen measurements. For simplicity, the procedure for measuring salinity is described separately from those for measuring water temperature and dissolved oxygen. In practice, all five parameters are measured at each profile depth before moving the probes to the next depth.

Water Temperature & Dissolved Oxygen

Water temperature and dissolved oxygen are measured electrometrically using a YSI Model 6600 Data Sonde with a digital display.

All calibrations performed on the YSI Mod. #6600 Data Sonde are executed with the use of a field lap-top computer and with Interactive Oceanographic, Streamline ENV, YSI PC6000 software, or YSI Ecowatch software.

Data collected by use of YSI 6600 Data Sonde is recorded by the use of YSI PC6000 software and will log the following parameters simultaneously:

Date	Time	Depth	Temp	Salinity	DO Conc	DO%	DO Charge	pH	Chlorophyll	ODO	Turbidity	Battery
M/D/Y	hh:mm:ss	m	C	ppt	mg/L	%			µg/l	mg/L	NTU	Volts

Methods for Capturing Data Are as Follows:

1. Visually inspect the dissolve oxygen (DO) probe for any obvious damage. Also check membrane for surface flaws, nicks, or KCL discoloration.
2. At each station the probe is lowered to the first depth to be measured. PC 6000 software is initialized and mode of data acquisition is selected to "Sonde". All data captured at this time will be logged within the Data Sonde minimizing battery power required by the laptop. At the "#" prompt, type MENU and ENTER. Main menu will appear.
3. At the prompt select OPTION #1, the RUN category.
4. At the prompt select OPTION #1, DISCRETE SAMPLE.
5. At the prompt select OPTION #1, START SAMPLING.
6. Sonde will prompt with a message indicating probes stabilizing in 4..3..2..1..
7. The probes will take a few seconds to equilibrate to all parameters selected.
8. Logging for all 12 parameters will occur once every 4 seconds simultaneously but no data will be captured until the operator has observed three or more continuous lines of parallel data. Once the operator has determined that this objective has been met the operator must select key stroke #1 on the key pad. This command will capture the last set of data logged ONLY for that specific second and store the data in a pre-assigned file.
9. Sonde is then lowered to the next desired depth and the same capturing procedures are used until all desired data has been collected.
10. Duplicate samples will be collected and noted on data sheet at a preselected depth determined by random selection. Data collected at that depth for the first sample as well as the duplicate must be within DQO criteria as stated on pages 8-10.
11. Before moving from sampling site, the data file is viewed for completeness. Any data

missed will constitute the execution of a second attempt to capture data at that specific site.

12. Upon satisfaction of successfully completing data collection at a station, operator will inspect Sonde for any damage, create a new file for the next station and will exit PC6000 software to minimize battery usage.

Note: Pre-calibration of Sonde is not compromised by exiting PC6000 software. Sonde will be checked during post-calibration procedures for any faulty data acquisitions.

C. Methodology for Fecal Coliform Analyses

Fecal coliform analyses will be conducted using the Membrane Filtration technique pioneered and perfected for citizen use in mid-coast Maine by Esperanza Stancioff, then a Marine Program Assistant in the Cooperative Extension Service at the University of Maine. This method is approved by the EPA. It was chosen for the CSWQM program because of the relative ease of the test procedure, inexpensive long-term cost, and less risk of contamination.

Fecal Coliform Analyses

Fecal coliform analyses will be done using the Membrane Filtration technique with M-FC medium. The filtering system consists of a glass or plastic microanalysis filter assembly held by a rubber stopper in a side-arm flask, which is connected with plastic tubing to another flask and then to a vacuum pump.

1. The filter apparatus and glass petri dishes are sterilized in an autoclave or placed under UV light for at least 3 minutes. The apparatus and dishes are resterilized between samples, and care is taken that the dishes are separated so that the UV can get to all surfaces.
2. The working surface is sterilized with alcohol.
3. The cover and the bottom of a petri dish are marked in indelible marker with the sample number. A sterile absorbent pad is placed in the dish. The contents of a 2-ml glass ampule of M-FC medium are tapped into the larger part of the ampule. The narrow part of the ampule is sterilized by wiping it with alcohol. A plastic ampule breaker is used to break open the ampule at the narrow part. The medium is tapped onto the absorbent pad in the petri dish, and the petri dish cover is replaced. The dish is then placed in front of the filter apparatus.
4. The bottom half of the filter apparatus is placed on the vacuum flask.

5. The forceps are sterilized by dipping them in alcohol and flaming. Using the forceps, a sterile filter is placed with the grid side up on the stainless steel mesh support screen of the filter apparatus.
6. A filter funnel is placed over the screen. The funnel is clamped with a metal clamp if a glass filter apparatus is being used. The plastic apparatus is magnetized and doesn't need a clamp.

Note: The first and last samples run are 100 ml of a sterile pH 7.0 phosphate buffer to check for sterilization, providing a negative control. A sample of known *E. coli* is also run as a positive control. The *E. coli* culture is prepared on a slant by personnel at the Maine Department of Marine Resources (DMR) laboratory.

7. The sample is shaken vigorously approximately 100 times to facilitate even distribution of bacteria. Then, 100 ml of the sample is poured from the sample bag into the graduated filter funnel, making sure that neither the pouring surface of the bag nor the funnel is touched. The exact volume can be more or less than 100 ml, but it must be recorded. The time is also noted and recorded at this point.
8. The vacuum pump is turned on to 15 lbs of pressure. After the sample has run completely through the filter funnel, the sides of the funnel are rinsed three times with sterile pH 7.0 phosphate buffer to pick up any bacteria clinging there. The vacuum pump is turned off.
10. The filter funnel is removed. The filter is removed from the mesh support screen and placed in the labeled petri dish. Care is taken to handle the filter only by the edges. It is also important not to trap air bubbles underneath the filter. If air bubbles do get trapped, the filter is carefully picked up and placed in the dish again. If this fails, another 100 ml of the sample is run; the new filter is placed in a fresh petri dish. All petri dishes are checked for air bubbles before being placed in the incubator.
11. Two covered petri dishes containing filters are placed upside down in a sterile plastic bag. As much air is expelled as possible. The bag is rolled at least 7 times and sealed to prevent leakage, then placed in a rack in the water-bath incubator. **The petri dishes must be placed in the incubator within 20 minutes of filtering.**
12. The petri dishes are incubated for 24 ± 2 hours at $44.5 \pm 0.2^{\circ}\text{C}$. In order to ensure that the temperature is stable within the incubator, the temperature is recorded in the Incubator Temperature Log before placing the dishes in and before removing them. The temperature is also checked once during the 24 hour period.

13. After 24 hours, the petri dishes are removed from the incubator. A binocular microscope is used to count the number of colony forming units with a blue metallic sheen on the filter paper. Each filter should have between 20 and 60 colony forming units for an accurate count. If the number of CFU's is outside this range, the actual number is recorded if possible; if the colonies are too numerous to count, TNTC will be entered on the data form.

Because the maximum holding period between collection and analysis is 24 hours, further analyses of the same sample can not be done at this point. However, when water collected from the same site in the next monthly sampling event is analyzed, two petri dishes will be prepared. One preparation will use 100 ml of the sample. The other will use an adjusted sample volume based on the previous out-of-range results.

D. Detailed Procedures for pH, Salinity & Water Clarity Not EPA Approved

pH Oakton Waterproof pHTestr 2, Hanna Waterproof pH tester, HI 98128 or YSI 6600 and 556 meters are measured electrometrically with automatic temperature compensation.

Oakton procedures:

1. The pHTestr cap is removed. The electrode is rinsed with tap water and dried with a Kim-Wipe. The meter is powered on by pressing the “ON/OFF” button.
2. The electrode is immersed into a container of pH 7.0 buffer at least 1 cm deep and used to stir the buffer.
3. The “CAL” button is pressed to enter the calibration mode. The abbreviation “CA” flashes while the current pH reading shows on the display. At least 30 seconds are allowed while the display flashes to get a stable sample reading.
4. The “HOLD/CON” button is pressed to confirm the calibration. “CO” and a pH reading of 7.0 are displayed.
5. The electrode is rinsed in distilled water and dried with a Kim-Wipe.
6. Steps 2 through 5 are repeated for pH 4.0 and 10.0 buffers. When the “HOLD/CON” button is pressed, the display reads 4.0 and 10.0 respectively.
7. At each station, the pHTestr cap is removed. The meter is powered on by pressing the “ON/OFF” button. (This instrument has an automatic shutoff that turns the instrument off after 8.5 minutes.)
8. The electrode is immersed 1-2 cm into the sample and used to stir the sample once. The display is allowed 2-3 minutes to stabilize.
9. The pH reading is recorded to the nearest 0.1 units. The meter is turned off by pressing the “ON/OFF” button.

Hanna procedures:

1. From normal measuring mode, press and hold the /MODE button until OFF on the secondary LCD is replaced by CAL.
2. Release the button. The LCD enters the calibration mode displaying “pH 7.01 USE” (or “pH 6.86 USE” if the NIST buffer set was selected).
3. After 1 second the meter activates the automatic buffer recognition feature. If a valid buffer is detected then its value is shown on the primary display and REC appears on the secondary LCD. If no valid buffer is detected, the meter keeps the USE indication active for 12 seconds, and then it replaces it with WRNG, indicating the sample being measured is not a valid buffer.
4. For a single-point calibration with buffers pH 4.01, 9.18 or 10.01, the meter automatically accepts the calibration when the reading is stable; the meter displays the accepted buffer, with the message “OK 1”. After 1 second the meter automatically returns to the normal measuring mode.
5. If a single-point calibration with buffer pH 7.01 (or pH 6.86) is desired, then after the calibration point has been accepted the /MODE button must be pressed in order to return to normal mode. After the button is pressed, the meter shows “7.01” (or “6.86”) - “OK 1” and, after 1 second, it automatically returns to the normal measuring mode.

pH Colorimetric Method

pH will be measured by a colorimetric method using a narrow-range pH octet comparator and/or a wide-range comparator as appropriate.

1. The sample test tube and cap supplied with the test kit is rinsed three times with water from the sampling bucket.
2. The sample test tube is filled to the mark with water from the bucket.
3. The number of drops of pH indicator specified on the comparator label are added, and the sample is mixed thoroughly.
4. The test tube is put in the comparator slot and the sample color is matched to the closest color in the comparator.
5. The value is reported to 0.1 pH units with the narrow-range comparator, to 0.5 units with the wide-range.

Specific Gravity

Specific gravity will be measured using a hydrometer (Standard Methods, 16th Edition, Method 210B).

1. A clean hydrometer jar is rinsed three times with water from the sampling bucket, and then filled about 3/4 full with the sample to be measured.
2. The thermometer is hung in the jar so that it is totally immersed.
3. The hydrometer is inserted into the jar with a twisting motion. Care is taken that it will not hit the bottom hard and break, and that drops are not splashed on to the hydrometer stem above water level. The hydrometer is allowed to float freely.
4. The temperature of the water sample in the jar is read and recorded to the nearest 0.1°C. The thermometer is removed.
5. The specific gravity is read and recorded to the nearest 0.0005 using the lines printed between the labeled graduations. The reading is taken at the point where the scale crosses the surface of the water sample in the jar, not the top of the meniscus. The reading is taken at eye level since viewing up or down at an angle can give an incorrect reading.
6. A table is used to convert the hydrometer reading at the measured temperature to salinity. (This conversion is verified by computer calculation upon entry into the database.)

Secchi Depth: Water Clarity Determination

An indication of water clarity will be obtained using a Secchi disk.

1. The reading is taken while the monitor is standing with the sun to her or his back and is not wearing sunglasses.
2. The Secchi disk is lowered into the water until the disk barely disappears from sight. The depth reading, in meters, is noted based on the length of suspension line that is submerged.
3. The disk is lowered further, then slowly raised. The depth at which it reappears (barely perceptibly) is noted.
4. An average is calculated from the two depth readings obtained above. The average of the two readings is considered to be the limit of visibility or index of transparency. The reading is recorded to the nearest 0.1 m.

B.12. SAMPLE HANDLING AND CUSTODY REQUIREMENTS

This section currently applies to fecal coliform, dissolved inorganic nutrients, and total nitrogen. At this time, all other monitoring procedures are conducted by the monitors in the field. The CSWQM program commitment includes the investigation of additional testing. If other tests are identified which require sample custody procedures, they will be developed and added to this section.

As a minimum, the sample custody form shown in Figure 5 will be used.

For fecal coliform, all samples along with a chain of custody form will be transferred from FOCB staff to a locked cooler (equipped with ice packs and thermometer), and deposited at a predetermined location. Samples and chain of custody form will be retrieved by the regional DMR representative, Laura Livingston, for processing and analysis at their lab in West Boothbay Harbor, ME.

For dissolved inorganic nutrients (DIN), volunteers samples will be required to be stored in volunteers kits (out of direct sunlight) for no more than two hours after sample collection. Samples must be frozen ASAP and kept frozen until the end of season when samples are to be transferred to FOCB staff. One half page of the *DIN Chain of Custody Form* (Figure 6.) will be supplied to all volunteers collecting DIN. The form must be filled out and included with all frozen vials upon transfer from volunteer to FOCB staff. All samples will be packed and shipped in dry ice via FedEx and relinquished to Maura Thomas at the University of Maine School of Marine Sciences Lab.

Samples collected by FOCB staff on the Baykeeper boat during profile trips will be placed immediately on ice. Upon return from field sampling, all vials will be frozen and stay frozen until relinquished to U Maine lab personnel as stated above.

Staff will continue to collect Total Nitrogen (TN) all around Casco Bay. This effort, previously referred to as the “Grand Slam” and then the “Dirty Dozen,” is entering its fifth year. In 2011, sampling will expand to include 15 sites, samples will be collected in May, July and September, and the effort will be renamed SWAN for “Surface Water Ambient Nitrogen.” Other parameters to be measured, as usual, include: water temperature, salinity, Secchi depth, dissolved oxygen (DO), and pH.

Data collected through this effort is combined with data collected during the profiles of the water column; together, these present the largest and most complete Nitrogen dataset in the state. This dataset will be used by the state of Maine in the effort to produce a nitrogen standard.

Samples will be collected in 30ml nalgene jars and frozen until delivery to the lab. Samples will be stored for no more than 25 days prior to delivery to the lab.

1. Sample Transfer Requirements from FOCB to Lab(s)

Fecal coliform samples collected in the field must be stored on ice in a cooler, provided by the Department of Marine Resources Lab, during the scheduled cruise. Upon completion of the scheduled cruise a chain of custody form must be completed noting the time of completion, ambient internal temperature of cooler, date and time of day of relinquishment, and the name of personnel

relinquishing samples. A photo copy of the chain of custody is to be made, and the original included in cooler with samples. A padlock will be attached to the cooler and left in the main office of Handy Boat Boatyard, Falmouth, ME for pick up by Maine Department of Marine Resources (DMR) Shellfish Growing Staff. DMR staff picks up samples from Handy Boat and transfer them to their own cooler along with chain of custody form later the same day and transport to their lab in West Boothbay Harbor.

Dissolved Inorganic Nitrogen samples are collected in the field by FOCB volunteers and are required to put on ice within two hours of collection. Samples stay in volunteer's freezer until they can be relinquished to FOCB staff on designated pick up days in early November. Once samples and chain of custody forms (figure 6) are collected samples are then transported to FOCB lab. Once at FOCB, samples are then collated by ID code and checked for completeness. Once FOCB staff has amassed 90% of expected samples from volunteers, all sample ID's and data are checked again prior to shipment to U Maine School of Marine Science Lab. For shipment all samples are packed on ice in a cooler along with chain of custody forms and driven to U Maine lab for relinquishment with Maura Thomas, Research Associate and Director of the Lab.

Total Nitrogen samples are collected in the field and stored in a cooler on ice during research cruises. Upon completion of cruise, samples are stored in FOCB freezer. Samples are shipped on ice quarterly via FedEx in small Styrofoam shipping boxes, with a chain of custody form, to Carl Zimmermann at the Chesapeake Biological Laboratory (CBL) in Solomons, MD.

FIGURE 5. CSWQM SAMPLE CUSTODY FORM

FRIENDS OF CASCO BAY							CHAIN OF CUSTODY RECORD				Page ___ of ___		
PROJECT:							COLLECTOR(S): <i>(Signature)</i>						
LOCATION:													
DISTRIBUTION: • ORIGINAL - To accompany samples							• COPY - To Program Coordinator						
Station Number	Replicate	Date	Time	Sample Type	Container		Preservative	Analysis Required	Due Date	Remarks	No. of CFU's		
					Vol.	Type							
Relinquished by: <i>(Signature)</i>				Received by: <i>(Signature)</i>				Date	Time	Method of Shipment:			
Relinquished by: <i>(Signature)</i>				Received by: <i>(Signature)</i>				Date	Time	Destination:			
Relinquished by: <i>(Signature)</i>				Received by: <i>(Signature)</i>				Date	Time	Destination:			
Dispatched by: <i>(Signature)</i>				Date	Time	Received for Laboratory by: <i>(Signature)</i>				Date	Time		

B.13. ANALYTICAL METHODS REQUIREMENTS

Procedures for measuring dissolved oxygen, water temperature, and fecal coliforms are EPA-approved and are described in Section B11. For pH and salinity, EPA sampling procedures were not appropriate for widespread use in the CSWQM program. The alternative methods used for these parameters and for the Secchi disk procedure are outlined in section B11:

TABLE 5. LABORATORY METHODS AND FIELD ANALYSIS PARAMETER TABLE

Parameter	Method	Reference (a)	Modification
Temperature	Thermometric	Std. Methods 2550 B	Alcohol-filled thermometer
	Electrometric	Std. Methods 2550 B	Hanna Waterproof pH meter Mod # HI 98128
	Electrometric	Std. Methods 2550 B	YSI 556 Multiparameter System YSI Model 6600 Sonde
pH	Colorimetric	(c)	
	Electrometric	Std. Methods 4500-H B	Oakton Waterproof pHTestr 2 Hanna Waterproof pH meter Mod # HI 98128 YSI Model 6600 Sonde YSI 556 Multiparameter System
Dissolved Oxygen	Modified Winkler Titration	Std. Methods 4500-OC	Micro method; 60 ml bottle
	Electrometric	Std. Methods 4500-OG	YSI 556 Multiparameter System YSI Model 6600 Sonde
Salinity	Gravimetric	(c)	
	Electrometric	Std. Methods 2510 B	YSI 556 Multiparameter System YSI Model 6600 Sonde
Turbidity	Nephelometric	Std. Methods 2130 B	YSI Model 6136
Chlorophyll	fluorometric	(g)	YSI Model 6025

Limit of Visibility	Secchi Disk Depth	(c)	
Sample Depth	Marked Line	NA	
	Electrometric Transducer	(e)	
Fecal Coliforms (d)	Membrane Filtration	(b)	
Dissolved Inorganic Nutrients (DIN)	Membrane Filtration	(f)	
Total Nitrogen (TN)	Whole Water Sample	(f)	

NA = not available.

- (a) Methods referenced are from 40 CFR 136.3
- (b) U. S. Environmental Protection Agency. 1978. Microbiological Methods for Monitoring the Environment, Water and Waste, p. 124. EPA-600/8-78-017. Environmental Monitoring and Support Laboratory, Cincinnati, OH.
- (c) The EPA-approved method is not appropriate for all purposes of the CSWQM program. Comparative measurements will be made with EPA-approved methods during QA sessions where possible.
- (d) Samples will be stored at +4 to +10°C. The **maximum** holding time for fecal coliform samples will be 6 hours. Holding time will be recorded for all samples; data from samples with a holding time of greater than 6 hours will not be compared with data from samples held for less than 6 hours.
- (e) Sample Depth is also recorded by use of a pressure transducer integral to YSI 6600 Sonde.
- (f) Analysis of dissolved inorganic nutrients is done at the University of Maine School of Marine Sciences Townsend Lab. The method is described in: Whitley TE, Veidt DM, Mallow SC, Patton CJ, Wirick CD (1986) Automated nutrient analyses in seawater. Publ Brookhaven Natl Lab (BNL) NY 38990.
- (g) YSI Environmental Operations Manual – 6 Series, (2000)

TABLE 6, LIST OF LABORATORIES CONTRACTED BY FOCB

Total Nitrogen Analysis performed by:

University of Maryland Center for Environmental Science
Chesapeake Biological Laboratory
P.O. Box 38
Solomons, MD 20688
Contact: Carol Zimmermann
(410) 326-7252
carlz@umces.edu

Dissolved Inorganic Nutrient Analysis performed by:

University of Maine
School of Marine Sciences
5706 Aubert Hall
University of Maine
Orono, ME 04469
Contact: Maura Thomas
(207) 581-4314
mthomas@maine.edu

Fecal Coliform Analysis performed by:

Maine Department of Marine Resources
Shellfish Sanitation Laboratory
P.O. Box 8
West Boothbay Harbor, ME 04575
Contact: Darcie Couture
(207) 633-9570
darcie.couture@maine.gov

B.14. QUALITY CONTROL REQUIREMENTS

The CSWQM program will be constantly evaluated to determine the major causes of missed observations and data quality deficiencies. Based on the experience of our program, the most common causes of monitoring deficiencies are:

- Failure of monitors to sample at scheduled times.
- Failure of monitors to return data and/or chain of custody forms to the Program Coordinator.

Occasional problems have also arisen due to:

- Failure of monitors to clearly identify sites, sampling dates, and times on data forms.
- Failure of equipment.
- Unsafe weather conditions

Monitoring deficiencies due to a lack of sufficient chemical reagents, sometimes reported by other programs, have not been observed in the CSWQM program. Monitors are given a fresh supply of reagents at the beginning of each season in quantities that should be sufficient to last through the season. Monitors have demonstrated an extremely responsible attitude in reporting reagent shortages on a timely basis.

The following protocols have been proposed to eliminate as many problems as possible.

We have assumed that all monitors may miss a few weeks during the year due to vacation, illness and emergency situations, or severe weather. In order that as few sampling events will be missed as possible, alternate, and/or teams of monitors will be trained and identified to the monitors who have primary responsibility for sampling the sites. In addition, a few monitors will be asked to volunteer as regional coordinators for their section of the Bay. If a primary monitor anticipates missing a sampling event, it is the monitor's responsibility to contact the alternate(s) assigned to that site. If an alternate is not available, the primary monitor will contact the regional coordinator for that region. Only if the regional coordinator can not find a trained monitor to cover the site will the Program Coordinator be contacted to find a replacement.

Monitors will be requested to return their data forms to the Program Coordinator as soon as possible after sampling in pre-addressed envelopes supplied by FOCB. (More detail on the handling of data forms is given in Section D.23) The Program Coordinator will contact monitors who are not sending in their data forms on a timely basis.

Each primary monitor will be supplied at the beginning of the season with a supply of preprinted labels for the site to which the monitor is assigned. The labels will be preprinted with the site code and site name, and with the codes and names of the primary and alternate monitors for

that site. The monitors will be instructed that when sampling the site, they should attach a label to the data form and circle their name. If an alternate monitor is going to sample the site, they should receive the supply of labels along with the kit from the primary monitor. If a monitor other than the regular primary or alternate is going to sample the site, they should receive the supply of labels from the primary monitor and write their name in. This should ensure that the site will always be referred to by a consistent name which does not duplicate the name of another site.

Upon receipt of the data forms, the Program Coordinator will check them for missing or obviously incorrect data, including the sampling date and time. As described in Section A9, monitors will be contacted by phone (or e mail) to answer questions about data that appear to be in error.

All equipment, meters, and kits will be checked by the Program Coordinator to ensure that operations are within technical specifications before being issued. Thereafter, equipment will be evaluated at QA sessions, and any faulty kits and equipment will be replaced. All records on the equipment checks, maintenance, and replacement will be kept on file by the Program Coordinator. The Program Coordinator should keep replacement equipment and reagents on hand at all times, and will also distribute equipment and reagents to the regional coordinators to establish local depots.

The FOCB Citizens Water Quality Monitoring Training Manual describes the proper handling and maintenance of equipment. These aspects will be emphasized during the training and annual QA sessions. Monitors will be asked to contact their regional coordinator if any equipment fails to operate properly. The regional coordinator will arrange for delivery or pickup, or send requested replacements by return mail immediately. If the regional coordinator does not have the required supplies, the Program Coordinator will be contacted and will then be responsible for getting the supplies to the monitor.

The activities to be included in the QA exercises constitute performance and system audits. All of the performance and system audits described in this plan, including training sessions, QA sessions, and field site visits will be performed.

Volunteer monitors will be required to attend the CSWQM training program and complete minimum training requirements before monitoring. The minimum training requirements include the following:

- Demonstrations with detailed instructions of the temperature, pH, dissolved oxygen, salinity, dissolved inorganic nutrients, and Secchi depth procedures.
- Hands-on practice of all sampling, testing, and safety procedures.
- On-site training session with each monitor covering monitoring and safety procedures.

Volunteers involved in fecal coliform analyses will attend a minimum of two lab sessions. During the first, they will observe a demonstration of the analytical procedures, have a chance to ask questions, and get hands-on practice in laboratory techniques. During the second, each volunteer

will perform an analysis under the observation of a trainer . Volunteers involved in fecal coliform sampling will practice sampling techniques during a field training session and will demonstrate their proficiency in these techniques during the training session.

With each batch of fecal coliform samples collected on a given sampling trip two “field blanks” will be collected at a randomly selected time and added to the batch. Each blank will be given a station ID number and time so as to preserve their anonymity. All blanks will be made from distilled water and decanted into a whirlpack bag. The location and status of blanks will be left unknown to lab personnel until all samples have been completely processed. In addition, positive and negative samples will be added to lab analysis on a frequency of 5% per sampling season. Split samples (of positive and negative plates) will be conducted by FOCB lab personnel and by The Portland Water District lab personnel to measure interlab precision.

Additional on-site sessions will be conducted, if necessary, until proficiency in all required techniques is demonstrated by the monitor. Training will be conducted by FOCB trainers with input and help from the DEP and from SMTC faculty. A training checklist (Figures 5 and 6) will be completed for each volunteer trainee, and these checklists will become a part of the training certification and maintained in the volunteer's records.

Group QA sessions will be held before the start of each seven-month monitoring season by the Program Coordinator. Monitors will be required to attend one session per year. (Due to the relatively short length of the sampling season in Maine, it is impractical to hold semiannual QA sessions as some more southerly groups do.) Monitors are sometimes unable to attend one of the group QA sessions due to scheduling conflicts or to residence out of the area during the winter. For these monitors, the Program Coordinator will arrange for an individualized “on-the-road” QA session at the monitor’s site or home using a QA kit developed by FOCB to duplicate the exercises performed in the group QA sessions.

The results of the group and individual QA exercises will provide a measure of how well monitors perform individually and as a group. Data collected at the QA sessions will be used to assess the accuracy and precision of the data collected in this program (see Section B16 for more details). Results and analysis from the QA sessions will be kept on file by the Program Coordinator.

The Water Quality Advisory Committee will review and suggest additional testing procedures to be evaluated in the program. This may include new parameters to be measured or changes to any existing procedures being used.

The project will be open to EPA system audits at their discretion.

FIGURE 7. CSWQM MONITOR TRAINING RECORD, SIDE 1

**FRIENDS OF CASCO BAY - CITIZENS WATER QUALITY MONITORING PROGRAM
MONITOR TRAINING RECORD, SIDE 1**

NAME: _____ MONITOR #:

ADDRESS: _____

TOWN, STATE: _____ ZIP: _____

TELEPHONE #'S: HOME: _____ WORK: _____

E MAIL ADDRESS: _____

INFORMATION ON ASSIGNED SITE

SITE NAME: _____ SITE #:

AKA: _____ KIT #:

INITIAL TRAINING SESSION

TRAINER(S): _____ DATE: / /

	Demonstrated by Trainer (Y/N)	Performed by Monitor (Y/N)	Comments
Observations:			
Weather			
Wind Direction & Speed			
Water Surface			
Tide Stage (calculation of)			
General			
Test Procedures:			
Air Temperature			
Water Temperature			
pH			
DO Sampling			
DO Titration			
Salinity			
Secchi Depth			
Fecal Sampling			
Fecal Analysis			

Additional Information: _____

FIGURE 8. CSWQM MONITOR TRAINING RECORD, SIDE 2

NAME: _____ MONITOR #: _____

ADDRESS: _____

TOWN, STATE: _____ ZIP: _____

TELEPHONE #'S: HOME: _____ WORK: _____

E MAIL ADDRESS: _____

INFORMATION ON ASSIGNED SITE

SITE NAME: _____ SITE #: _____

AKA: _____ KIT #: _____

INITIAL TRAINING SESSION DATE: _____

TRAINER(S): _____

	Demonstrated by Trainer (Y/N)	Performed by Monitor (Y/N)	Comments
<u>Observations:</u>	=====	=====	=====
Weather			
Wind Direction & Speed			
Water Surface			
Tide Stage (calculation of)			
General			
<u>Test Procedures:</u>	=====	=====	=====
Air Temperature			
Water Temperature			
pH			
DO Sampling			
DO Titration			
Salinity			
Secchi Depth			
Fecal Sampling			
Fecal Analysis			
Dissolved Inorganic Nutrients			

Additional Information: _____

B.15. & B.16. INSTRUMENT CALIBRATION, MAINTENANCE AND FREQUENCY

The calibration equipment used for comparison measurements during QA sessions will be available from FOCB. FOCB will maintain and calibrate the YSI Model 58 Dissolved Oxygen meter, the YSI Model 33 Salinity-Conductivity-Temperature meter, YSI Model 556 multi parameter system (MPS), Orion Model 140 Salinity-Conductivity-Temperature meter and the more precise YSI Model 6600 Data Sonde. FOCB will also provide the NIST certified thermometer and portable pH meter. Backups for all of the above equipment can be provided, as availability allows by SMCC, Bowdoin College, Normandeau Associates, Pine Environmental Services or MER Consulting.

Calibration and maintenance procedures will be as follows:

Temperature

Monitored with:

- Armored, alcohol-filled thermometer; Model 545; range -5.0 to +45.0°C in 0.5°C increments. LaMotte Company; Cat. No. 1066.
- Hanna Waterproof pH Tester, Model HI 98128; range -5.0 to +50.0°C in 0.1°C increments. Ben Meadows Co; Cat. No. 78289

Monitored from BayKeeper boat with:

- YSI Model 6600 Data Sonde with YSI Model 6560 Conductivity/Temperature probe; temperature range -5.0 to + 45.0°C in 0.01°C in 0.01°C increments; accuracy ±0.15°C.

Calibrated with:

- Thermometer factory-certified against National Institute of Standards and Technology (NIST) standards and traceable to NIST; range -10.0 to +55.0°C in 0.1°C increments. Brooklyn Thermometer Company Inc.; Cat. No. 3231RM-A-FC.

Or: ANSI/SAMA accuracy thermometer calibrated and certified against equipment whose calibration is traceable to NIST; range -1.0 to +51.0°C in 0.1°C increments. VWR Scientific Products; Cat No. 61027-205.

The monitors' thermometers will be calibrated before initial use and during QA sessions thereafter. Comparisons will be made with a calibration thermometer for two different temperature solutions within the -5 to +45°C range. The YSI DO meter will be calibrated on each day of use with a calibration thermometer for one solution within the -5 to +45°C range. The ANSI/SAMA thermometers will be calibrated annually with the NIST thermometer for two different temperature solutions within the -5 to +45°C range.

Monitors will be instructed to visually inspect the armored alcohol filled thermometers and thermistors on the Hanna waterproof meters for separation of red or green fluid before entering the field, to handle thermometers carefully, to avoid storing them in hot places, and to rinse them with fresh water after use.

pH

Monitored with:

- Octet comparator test kits; wide range 3.0 to 10.0 pH units in 1.0 unit increments; narrow range 7.2 to 8.6 pH units in 0.2 unit increments; Thymol Blue range 8.0 to 9.4 pH units in 0.1 unit increments. LaMotte Company; Cat. Nos. 2192 (3.0 to 10.0 units), 2186 (7.2 to 8.6 units) and 2187 (8.0 to 9.4).

Monitored from BayKeeper boat with:

- YSI Model 6600 Data Sonde with YSI Model # 6561 pH Probe; range 0.0 to 14.0 units. pH units in 0.01 unit increments, accuracy ± 0.2 units.
- Hanna Waterproof pH Tester, Model HI 98128; range -5.0 to +50.0°C in 0.1°C increments. Ben Meadows Co; Cat. No. 78289
- Oakton Waterproof pHTestr 2; range -1.0 to 15.0 pH units in 0.1 unit increments; accuracy ± 0.2 units. LaMotte Company; Cat. No. 5-0010.

Comparator test kits calibrated with:

- Hanna Waterproof pH Tester, Model HI 98128; range -5.0 to +50.0°C in 0.1°C increments. Ben Meadows Co; Cat. No. 78289

Oakton Waterproof pHTestr 2 & Waterproof pH Tester, Model HI 98128 Calibrated with:

- pH buffer reference standards calibrated against NIST certified solutions by manufacturer, 4.0, 7.0, and 10.0 pH units; accurate to ± 0.01 units at 25°C. VWR Scientific Products; Cat Nos. 34170-106 (pH 4.0), 34170-115 (pH 7.0), and 34170-124 (pH 10.0).

The Hanna pH meters will be calibrated during QA sessions by comparative measurements using a portable pH meter and a seawater sample. The Oakton, Hanna & YSI pH meters will be calibrated on each day of use using three pH buffer reference standards.

Monitors will be evaluated during QA sessions for their ability to accurately interpret pH readings. pH levels outside the range of the narrow-range octet comparator are identifiable in that their colors don't match any in the comparator and are more intense than the colors of the lowest and highest comparator readings. This will be demonstrated to monitors using pH 4.0 and 10.0 buffers.

Monitors will be given instructions on how to take care of the indicator solutions so that they will give reliable results. The shelf-life of the indicators will exceed the amount of solutions supplied. Nonetheless, monitors will be asked to check the solutions for formation of a precipitate. They will be supplied with new indicator solutions annually.

Salinity

Monitored with:

- LaMotte hydrometer with 500-ml hydrometer jar; range 1.0000 to 1.0700 specific gravity in 0.0005 increments (0 to 42 ppt salinity). LaMotte Company; Cat. Nos. 3-0011 (hydrometer) and 3-0024 (jar).

Monitored from BayKeeper boat with:

- YSI Model 6600 Data Sonde with YSI Model 6560 Conductivity/Temperature probe; Salinity range 0 to 70 ppt; accuracy $\pm 1.0\%$ of reading or 0.1 ppt, whichever is greater.

Hydrometer calibrated with:

- Orion Model 140 Salinity-Conductivity-Temperature meter with Model 014010 4-electrode cell; salinity range 0.0 to 70.0 ppt; accuracy (at 5 to 25°C) ± 0.1 ppt. VWR Scientific Products; Cat. Nos. 23197-953 (meter) and 23197-955 (cell).

YSI and Orion S-C-T meters calibrated with:

- NIST certified conductivity standard, 10,000 & 50,000 μmhos , YSI No. 3163 & 3169 respectively. VWR Scientific Products; Cat. No. 23202-285.

The hydrometers will be calibrated using three different saline solutions within the 0 to 35 ppt range. Calibrations will be performed before initial use and at QA reviews. The YSI and Orion S-C-T meters will be calibrated on each day of use using NIST certified conductivity standards.

Monitors will be evaluated for their ability to correctly read the hydrometer. They will be shown how to calculate the salinity from the specific gravity measurement using the conversion table. Monitors will be instructed to record the specific gravity from the scale in the hydrometer stem at the point where the scale crosses the level of the water sample in the jar, not at the top of the meniscus. Monitors will also be instructed to read the hydrometer with their eyes level with the water surface in the hydrometer jar; viewing up or down at an angle can give an incorrect reading.

Hydrometers are fragile instruments and are subject to breakage. The hydrometers will be carefully packaged when distributed to the monitors - they will be enclosed in the plastic cylinder in which they are shipped and secured in a foam insert in the supplied carrying case. Monitors will be instructed to use care when handling the hydrometer and to return it directly to its protective case immediately after use. The hydrometer and hydrometer jar should be rinsed with fresh water and dried after use.

Dissolved Oxygen

Monitored with:

- Precision Dissolved Oxygen test kit, azide modification of Winkler titration method; range 0.0 to 20.0 mg/l in 0.1 mg/l increments. Reagents sufficient for 25 tests at 0.0 to 20.0 mg/l range. LaMotte Company; Cat. No. 5856/XDO.

Monitored from BayKeeper boat with:

- YSI Model 6600 Data Sonde with YSI Model 6562 Rapid Pulse DO Probe; DO range 0 to 50 mg/l; accuracy $\pm 2\%$ of reading or 0.2 mg/l of reading (whichever is greater) up to 20 mg/l; $\pm 6\%$ of reading from 20 mg/l to 50 mg/l.

Calibrated with:

- Standard Winkler titration with azide modification. EPA-approved method 360.2.

The test kits and the YSI Model 6600 Data Sonde will be calibrated against each other during QA sessions. The YSI Model 556 & 6600 will also be calibrated semiannually against the standard Winkler titration. One of these calibrations will be done shortly before the first QA session of the year. On each day of use the DO meter will also be calibrated with water-saturated air.

To ensure the reliability of the results obtained using the LaMotte Dissolved Oxygen kit under conditions that preclude measuring against a standard each time a test is conducted, monitors will be trained on certain precautions to be followed. Monitors will be instructed to perform duplicate measurements each sampling time. They will be told to store the reagents in a dark, cool place. They will be cautioned about possible contamination and instructed in how to prevent it: never return any unused titrant to the reagent bottle, check for particulate matter in the reagent bottle, and thoroughly rinse all equipment after each use.

Water Clarity

Monitored with:

- Secchi disk, 20 cm diameter, stretch-resistant line. LaMotte Chemical Products; Cat No. 0171-CL.

Secchi disks with black and white quadrants are used to determine the limit of visibility. The lines supplied by LaMotte are marked at 0.5 meter intervals up to 20 meters. Additional markings at 0.1 meter intervals (of a different color from the 1.0 meter marks) will be added by FOCB up to seven meters before the disks are distributed to the monitors. Few stations require more than seven meters of line for measuring either water depth or Secchi depth. If a monitor reports that they are using more than seven meters of line, markings at 0.1 meter intervals will be added for the required length. The accuracy of the depth markings will be checked before initial use and during QA sessions thereafter.

Fecal Coliform Analyses

Monitored with:

- Membrane Filtration Technique; see Table 7 for monitoring equipment.

All personnel involved in sampling fecal coliforms should be aware of the concept of "aseptic technique" and the integrity of sterile systems. It is imperative, especially under primitive field conditions, that precautions be taken against bacterial contamination or cross-contamination of containers and samples. Protection against contamination of the sample and container before, during, and after collection will be emphasized in training. The use of aseptic techniques in collecting samples and in handling the sterile nylon membranes during analysis will be practiced during QA sessions by all monitors who will be sampling or analyzing for fecal coliforms.

Another important factor in fecal coliform analyses is the incubation temperature. Too low a temperature allows nonindicators to grow; too high a temperature prohibits fecal coliform growth.

The incubator temperature will be recorded in an Incubator Temperature Log before petri dishes are placed in the incubator and before they are removed. The log will be kept on file at the laboratory.

Vendors of Monitoring and Calibration Equipment

Albert Mojonier Inc., P.O. Box 473, Eaton, Indiana 47338. (317) 396-3351.

Brooklyn Thermometer Company Inc., 90 Verdi Street, Farmingdale, New York 11735. (516) 694-7610.

LaMotte Company, 802 Washington Avenue, P.O. Box 329, Chestertown, Maryland 21620-0329. (410) 778-3100.

Nasco, 901 Janesville Avenue, Fort Atkinson, Wisconsin 53538. (414) 563-2446.

VWR Scientific Products, P.O. Box 483, 501 Heron Drive, Bridgeport, New Jersey 08014. (609) 467-2605.

YSI Incorporated, 1700/1725 Brannum Lane, Yellow Springs, Ohio 45387 USA. (800) 765-4974.

Ben Meadows, P.O. Box 5277 Janesville, WI 53547-5277 (800) 241-6401.

Hanna Instruments Inc., 584 Park East Dr. Woonsocket, RI 02895 (800) 426-6287

TABLE 7. MEMBRANE FILTRATION EQUIPMENT & SUPPLIES FOR FECAL COLIFORM BACTERIA ANALYSES

ITEM	VWR CATALOG #
Precision coliform water-bath incubator, small capacity	13307-064
Petri dish rack for incubator	13307-505
Thermometer for incubator, 34.5 to 46.0°C in 0.1°C increments	61069-941
Bath cover for coliform incubator	13307-196
Gelman magnetic filter funnel apparatus (polysulfone funnel) with stainless steel mesh support screen or	28144-832
Glass microanalysis filter apparatus with stainless steel mesh support screen	KT953805-0000
Gelman filters (GN6, 47 mm, grid style)	28148-733
Gelman absorbent pad kit with dispenser	28150-677
Glass fecal coliform ampules containing premeasured M-FC broth	28145-655
Petri dishes, 60 x 15 mm	25384-060
Filter forceps	28198-975
Glass alcohol burner	17805-005
Sterile plastic sample bags, 4 1/2 x 9" (522 ml), 4 1/2 mil, flat wire closure	(a)
Stainless steel tongs	(b)
pH 7.0 buffer	34170-115
Side-arm 1 liter filtering flask	29415-121
#8 one-hole stoppers	59581-367
Vacuum pump	54908-035
3/8" ID vacuum tubing	62994-241
Autoclavable wash bottles, 500 ml	16651-904
Kimwipes, 4.5 x 8.5 in	21905-026

(a) Obtained from Albert Mojonier Inc., Cat. No. 459FSW.

(b) Obtained from Nasco, Cat. No. B1079WA.

B.17. INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES

In 1992 and 1993 FOCB staff worked extensively with vendors to find equipment appropriate for CSWQM program that met the QA/QC requirements as outlined in Section A.7.

In collaboration with technical support personnel from LaMotte Co. and the Friends of Casco Bay, the Casco Bay Tidal Water Monitoring Kits, Mod.# XX00143 & Mod.# XX00144, were established and put into circulation. Each kit is supplied with the necessary equipment to perform tests for dissolved oxygen, temperature, salinity, pH, & water clarity.

All equipment and chemical reagents for the Casco Bay Tidal Water Monitoring Kits are inspected annually during QA training, immediately upon return from any volunteers leaving the program, and at the end of the season. Any equipment determined to have failed will be replaced prior to use in the field.

All chemical reagents for the kits are inspected for expiration dates when purchased and will be used only if they are within the recommended shelf life. All reagents will be replaced annually to insure the best quality obtainable. At annual QA sessions with volunteers, lot numbers and expiration dates are recorded on special QA data sheets. If a vendor reports any reagent to be defective, it will be removed from those kits.

All supplies for DIN sampling are purchased through VWR scientific. Each vial supplied to staff and volunteers are pre-labeled with a unique identifiable code. Each volunteer will be supplied with (20) 20 ml scintillation vials, (20) Pall Life Sciences *Acrodisc*, single use 0.45 µm filters, (2) 60 ml B&D syringes and 1 Large Zip Loc freezer bag for sample storage in freezer. Also included in DIN supply kit is a chain of custody form.

Sample supplies needed for TN collection are furnished by The Chesapeake Biological Laboratory (CBL) and consist of a 30 ml Nalgene jar per site. Samples are stored in a cooler when in the field and are then frozen at FOCB lab prior to relinquishment to CBL.

B.18. DATA ACQUISITION REQUIREMENTS

For the CSWQM Program U.S.G.S. topographic maps and/or NOAA Navigational charts No. 13290 & 13292, or approved chart reproductions "Water Proof Chart" # 101E are used to identify site locations. Printed copies with marked site ID's are provided to each volunteer and will be filed in a site folder containing further descriptive information pertaining to that specific site.

B.19. DATA MANAGEMENT

The data will be reviewed by the Program Coordinator for decimal point errors, missing site and/or monitor numbers, apparently anomalous data, and general problems. Monitors will be contacted by phone to answer questions about data that appear to be in error or missing. Contact with the volunteers regarding data problems is the responsibility of the Program Coordinator.

After adjustment and review, the data will be entered into the MURPHY 2.12 database program, a computer program developed by FOCB under contract to the Estuary Project. Among other checks and calculations, MURPHY adjusts pH data measured using the narrow-range, cresol red indicator to compensate for known errors resulting from interferences with cresol red at medium to high salinities. The raw data is decreased by factors ranging from 0.21 units at 14 ppt salinity to 0.27 units at 32 ppt salinity. Both the raw and corrected data are stored in the database.

Where salinity data have been measured using a hydrometer, MURPHY uses the specific gravity and temperature readings to calculate salinity values which can be used to confirm the salinity values calculated by the monitors. MURPHY also uses temperature, salinity, and dissolved oxygen concentration data to calculate values for percent saturation dissolved oxygen.

Checks will be made by FOCB between the data listing and the raw data whether the data were entered by FOCB or by the monitor. The data will be evaluated for the mean, minimum, and maximum values for each parameter with site and time series plots of data every three months. A data documentation file will be kept current. Data will be presented using the graph and report formats being developed for the MURPHY program. Copies of the data printouts will be sent to the monitors so that they may review them and report any errors to the Program Coordinator.

All data generated by the CSWQM program will be sent to Maine DEP on disk by the Program Coordinator. The data disk will also be sent to the CBEP Director for possible entry into the Estuary Project GIS.

C.20. ASSESSMENT AND RESPONSE ACTIONS

All data reported for the CSWQM program will be subject to checks by the CSWQM Program Coordinator for errors in transcription, calculation, or computer input. Additionally, all data forms will be reviewed to ensure that they are complete and signed by the volunteers. All data forms must be signed and dated on the back of the original data form by the reviewer. Any changes made to the data form must be initialed, and any action taken as a result of the data review must be recorded on the data form below the reviewer's signature.

Only data that meets the following conditions will be accepted and entered into the CSWQM Data File:

- Monitors have appropriate levels of training for the tests being conducted.
- Monitors have successfully participated in required training or QA reviews.
- Equipment has been checked and approved prior to or during an annual QA review.
- Data forms are signed by monitors, and date, time, station number, and station description are recorded.
- All required equipment calibrations have been completed and recorded.
- Data entries are legible.

C.21. REPORTS

Status reports will be submitted monthly by the Program Coordinator to the Director of the Casco Bay Estuary Partnership. The content of these reports will be determined by the workscope amended yearly and approved by CBEP. The reports will include any significant progress or changes for the following QA elements:

- Status of the monitoring program including the stage of planning and implementation.
- Results of any performance checks.
- Identification of significant QA/QC problems and recommended solutions.
- Outcome of corrective actions.
- Completeness of CSWQM data set to date.
- Updated list of trained monitors and monitoring sites.

D.22. DATA REVIEW, VALIDATION AND VERIFICATION REQUIREMENTS

As part of the data review and validation, all field and lab data will be reviewed and discussed by the Program Coordinator and Program Associate to determine if the data meet the objectives as outlined in the QAPP. Decisions will be made to accept or reject the data before presenting the information in any publications or reports. Errors in data entry will be corrected and any outliers will be flagged for further review. Any data deemed to be not acceptable will be noted in the “comments” fields of the CSWQM database and will be removed from any statistical calculations.

The data will be used by Friends of Casco Bay to support its mission; *“to improve and protect the environmental health of Casco Bay”*. Data will also be provided to support the efforts of the Casco Bay Estuary Partnership under the guidance of the Casco Bay Plan - Public Education Action Item #9, Technical Assistance Action Item # 7, and Planning and Assessment Action Item # 6. Data will also be provided to the Maine Department of Environmental Protection for use in state 305B reports.

D.23. VALIDATION AND VERIFICATION METHODS

Data validation and verification is a multi-step process performed by two or more people. Data will be reviewed by the Program Coordinator before being entered by volunteers, student interns or FOCB staff into the CSWQM MURPHY 2.12 database. After being entered, the data sheets will then be checked against the data entry in the database by someone other than the person who initially entered the data. If entry errors are found, edits will be made and the data sheet will be re-checked (by someone other than the entry person) vs the database. If entry checked vs the database are parallel the data sheet will then be filed in a site specific folder for future data queries. All data entry procedures require signoff by the data entry personnel as illustrated in table 8.

TABLE 8. VALIDATION & VERIFICATION SIGN-OFF

Staff use ONLY	Date	Initials
Sheet rec'd		
Data ck'd		
Data entered into database		
Entry ck'd vs sheet		

D.24. RECONCILIATION WITH DATA QUALITY OBJECTIVES

Data quality objectives and validation procedures for this program have been designed to ensure that volunteers and/or the Program Coordinator will be able to identify and correct problems in data collection and reporting. Should the results of data validation measures or quality assurance reviews indicate that the integrity of data is questionable and data quality objectives are not being met, the data set (or that portion which is deficient) must be flagged as unacceptable for inclusion in the CSWQM Data File.

Quality assurance and control reviews are part of this monitoring program and are designed to ensure that work is performed by volunteers who are well trained and understand the objectives and methods being used. QA sessions will be conducted by FOCB trainers and reviewed by the Program Coordinator. Results recorded at QA reviews will be discussed with the monitors during each session, and any difficulties or differences in technique can be corrected immediately. If a monitor's performance fails to meet the data quality objectives or demonstrates a lack of safety

measures, the monitor will be required to have additional training. Also, defective equipment or outdated reagents detected during QA sessions will be replaced.

The responsibility for deciding to take any corrective action rests with the Program Coordinator. The Program Coordinator is responsible for ensuring that all corrective measures recommended from QA reviews are implemented by monitors. The Program Coordinator has the authority to question data, call for re-training, and recommend replacement of monitors when necessary.

APPENDIX I

FRIENDS OF CASCO BAY CITIZENS WATER QUALITY MONITORING PROGRAM WATER QUALITY ADVISORY COMMITTEE

Diane Myrick Gould, Ph.D.
USEPA
1 Congress Street, Suite 1100 COP
Boston, MA 02114
p. (617) 918-1569
f. (617) 918-0569
gould.diane@epa.gov

Angela M. Dubois
Section Leader, Marine Unit
Division of Environmental Assessment
Bureau of Land and Water Quality
Maine Department of Environmental Protection
Station #17
Augusta, ME 04333
p. (207) 287-7666
f. (207) 287-7826
c. (207) 592-2352
Angela.M.Dubois@maine.gov

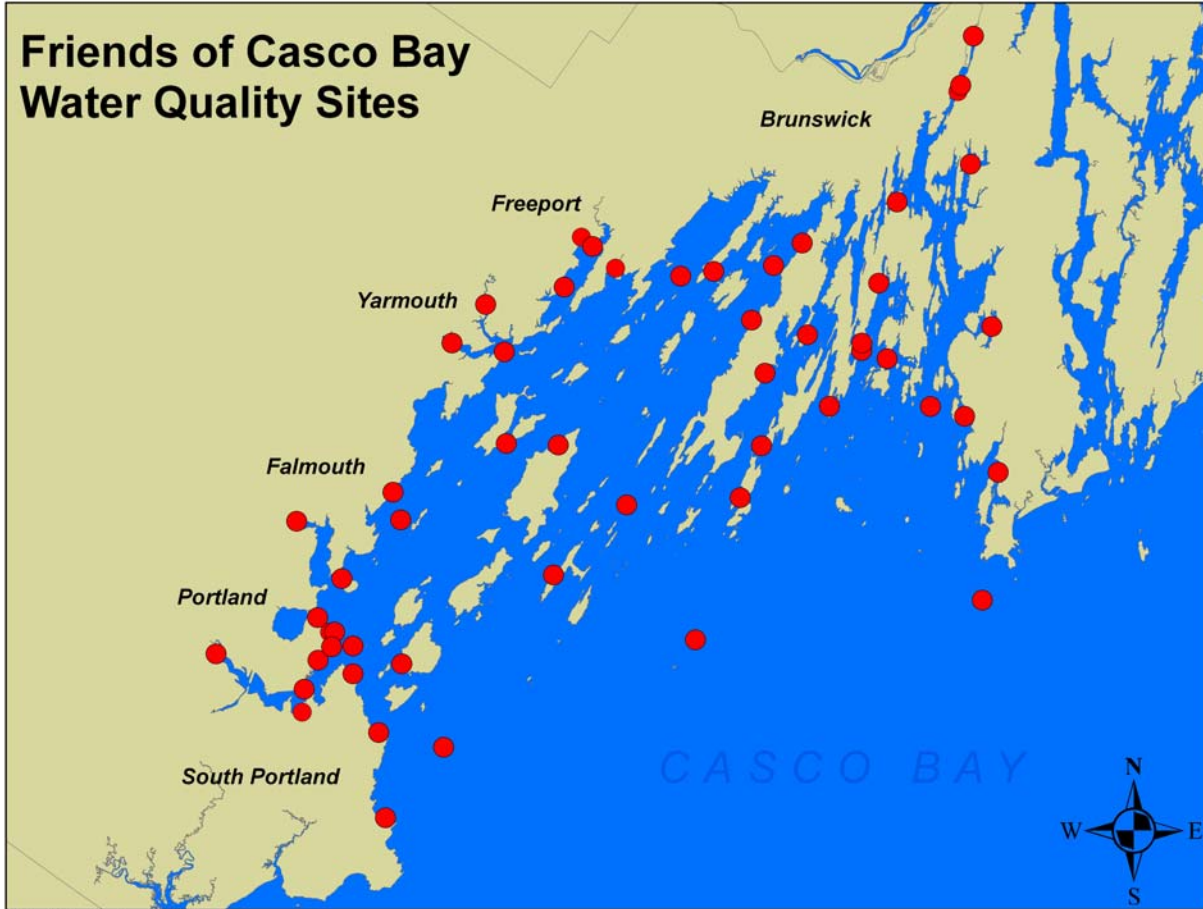
Charles J. Gregory
Professor of Marine Sciences & Allied Health
Southern Maine Community College
2 Fort Road
South Portland, ME 04106
p.(207) 741-5643
f. (207) 741-5645
CGregory@smccme.edu

Christopher Heinig
President, MER Assessment Corporation
RFD #2 Box 109
South Harpswell, ME 04079
p.(207) 729-4245
f.(207)-729-4706
mer@maine.com

Kathleen Leyden
Director, Maine Coastal Program
Maine State Planning Office
State House Station 38
Augusta, Maine 04333-0038
p. 207-287-3144
f. 207-287-8059
kathleen.leyden@maine.gov

Dr. David W. Townsend
Professor of Oceanography, and
Director, School of Marine Sciences
5706 Aubert Hall, Rm 341
University of Maine
Orono, ME 04469
p. (207) 581-4367
f. (207) 581-4388
davidt@maine.edu

APPENDIX 2



Created by Mike Doan, 2/14/11

FOCB Water Quality Monitoring Sites as of 3/2011

APPENDIX 3

Reference for the University of Maine Dissolved Inorganic Nutrients Standard Operating Procedures

Whitledge TE, Veidt DM, Mallow SC, Patton CJ, Wirick CD (1986) Automated nutrient analyses in seawater. Publ Brookhaven Natl Lab (BNL) NY 38990.

Note: An electronic version of this document does not exist. Hard copies can be furnished by FOCB staff upon request.

APPENDIX 4
Reference for the University of Maryland
Center for Environmental Science
Chesapeake Biological Laboratory
Total Nitrogen Analysis

Analysis will be conducted by the Nutrient Analytical Services of the Chesapeake Biological Laboratory in Solomons, MD.

Total Nitrogen will be determined through the persulfate method, a persulfate oxidation technique for nitrogen where, under initially alkaline conditions, nitrate is the sole nitrogen product. Digested samples are passed through a granulated copper-cadmium column to reduce nitrate to nitrite. The nitrite then is determined by diazotizing with sulfanilamide and coupling with N-1-naphthylethylenediamine dihydrochloride to form a colored azo dye. Color is proportional to nitrogen concentration.

D'Elia, C.F., P.A. Steudler, and N. Corwin. 1977. Determination of total nitrogen in aqueous samples using persulfate digestion. *Limnol. Oceanogr.* 22: 760-764.

Valderrama, J.C. 1981. The simultaneous analysis of total nitrogen and total phosphorus in natural waters. *Mar. Chem.* 10: 109-122.

The results are presented as mg N/L, and the analysis is sensitive to 0.01.