Maine Volunteer River Monitoring Program (VRMP) Quality Assurance Project Plan (2019-2024)

Maine Department of Environmental Protection
Bureau of Water Quality
Division of Environmental Assessment

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[A2. (Element 2)]

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I. Acknowledgements

This QAPP and the related SOPs build off the work of the original authors at the Maine Department of Environmental Protection (MDEP, Jeff Varricchione and Lisa Vickers, 2009). A number of environmental monitoring programs were researched to help design this document, and a number of organizations and individuals were asked to provide advice or help review this document, including the MDEP Division of Environmental Assessment, Maine Volunteer Lake Monitoring Program (VLMP) and New Hampshire Department of Environmental Services (NHDES) - Volunteer River Assessment Program. Primary contributors to the original QAPP were Mary Ellen Dennis, Melissa Evers and Mark Whiting, MDEP.

II. List of Acronyms Commonly Used in this Document

BWQ-	Bureau of Water Quality (of MDEP)
DEA -	Division of Environmental Assessment (of MDEP)
DQO -	Data Quality Objective(s)
EGAD -	Maine Environmental and Geographic Analysis Database (Maine DEP)
USEPA-NE -	U.S Environmental Protection Agency Region 1 (formerly USEPA New England)
GPS -	Global Positioning System
HETL -	Health and Environmental Testing Laboratory (under Maine Department of Health and Human Services)
HUC -	Hydrologic Unit Code (a.k.a. Watershed Boundary Dataset) from USGS
LSM -	Lake Stewards of Maine-Volunteer Lake Monitoring Program
MDEP/DEP -	Maine Department of Environmental Protection
MDIFW -	Maine Department of Inland Fisheries & Wildlife
NHDES -	New Hampshire Department of Environmental Services
Lakes of Maine -	A publicly accessible online database of Maine lake water quality monitoring data and other lake-related information
QAPP -	Quality Assurance Project Plan
QA/QC -	Quality Assurance/Quality Control
SAP -	Sampling and Analysis Plan
SOP -	Standard Operating Procedure
STORET -	“STOrage and RETrieval”; one of USEPA's environmental database systems
TMDL -	Total Maximum Daily Load
USEPA -	United States Environmental Protection Agency
USGS -	United States Geological Survey
VRAP -	Volunteer River Assessment Program (of NHDES)
VRMP -	(Maine) Volunteer River Monitoring Program

1. General Background

TOPICS

- Need for a QAPP (Quality Assurance Project Plan)
- Type of QAPP being developed for the Volunteer River Monitoring Program
- Need for SAPs (Sampling and Analysis Plans)
- Usage of the terms "stream" and "river" in this document

The U. S. Environmental Protection Agency (USEPA) requires that all environmental data used in the decision-making process are implemented and thus supported by an approved Quality Assurance Project Plan (QAPP). QAPPs are intended to document all the various aspects of a project. QAPPs will, at minimum, contain information about four basic elements of the project: A. Project Management, B. Data Generation and Acquisition, C. Assessment and Oversight, and, D. Data Validation and Usability.

USEPA has allowed two approaches to QAPP development. The first is a project-specific approach where all four basic elements are addressed in detail. The second is a generic program approach, or "umbrella level" QAPP, where detail is given for elements that all projects share. Elements not shared, including project-specific Standard Operating Procedure (SOP) versions followed by certain individual groups, are documented in project specific Sampling and Analysis Plans (SAPs), which reference the Program QAPP. This document represents a generic QAPP for the statewide Maine Volunteer River Monitoring Program (VRMP). (*Note*: Detailed background information about the history of VRMP development is provided in Section 4.2 "Problem Definition / Background" of this document.)

For this program, any number of volunteer groups may generate SAPs as companions to this QAPP document (see Appendix 3 for a SAP template). Volunteer groups wishing to become a part of the VRMP, to store their data in the official VRMP database (as part of MDEP's Environmental and Geographic Analysis Database [EGAD]), and to have their data potentially be used in official business by water quality organizations, such as the VRMP, the Maine Department of Environmental Protection (MDEP), and the USEPA, will be required to write and abide by a SAP document that has been reviewed and approved by the VRMP and associated quality assurance staff. Some volunteer-group specific SAPs may possibly require external review (e.g., by the USEPA's New England regional office), but final approval will reside with the MDEP. Revisions or updates, along with the required approvals, will be made as necessary.

Usage of the Terms "Stream" and "River" in this Document

Although the terms "stream" and "river" sometimes are used by the public to distinguish between small and large bodies of flowing water, they will be used interchangeably in this document for the sake of simplicity. In this QAPP an emphasis will be placed upon freshwater rivers and streams. Tidal sections of rivers and streams also may be included, but they will be considered on a case-by-case basis, due to their different ecological nature and to ensure that the appropriate parameters and methods are employed. An effort will be made to coordinate review of methods with tidal water monitoring groups such as Maine Department of Marine Resources, Friends of Casco Bay, Maine Coastal Observing Alliance and other similar organizations.

2. Purpose

TOPICS

- Why was the VRMP created?
- The purpose of QAPPs and SAPs
- Overview of the roles of the VRMP Management Team
- Why volunteer river and stream monitors are needed in Maine

Creating a full-scale QAPP is a very complicated and time-consuming process, and many volunteer stream and river groups in the State of Maine lack the resources or time to generate one on their own. Of the handful of volunteer groups that have developed QAPPs, data comparability is challenging due to (among other things) different sampling or analysis methods, data-management procedures, and accuracy requirements. Also, for the general public, centralized access to the results of most volunteer sampling of flowing fresh waters has not been readily available in the State of Maine to date.

The Volunteer River Monitoring Program (VRMP) was created within the MDEP Bureau of Water Quality (BWQ), Division of Environmental Assessment (DEA) as an organization to address these problems. The VRMP is a network of volunteer groups participating in quality-assured volunteer sampling as governed by:

1. This program-level Quality Assurance Project Plan (QAPP), which is created and maintained by VRMP staff, and;
2. Individual Sampling and Analysis Plans (SAPs), which are created by each volunteer group to tailor the program-level QAPP to their specific project situation and which are reviewed/approved by VRMP staff.

The purpose of the QAPP is to assure that all participating groups, regardless of funding sources or volunteer types, will conduct water quality monitoring in a scientifically-defensible manner supported by the VRMP of the MDEP. (Other organizations such as the USEPA, the University of Maine, Bowdoin College, other state and federal agencies, local nonprofit organizations, etc., may play a supportive role for some groups at some level as well.) The generic nature of the QAPP is designed to provide the backbone for the VRMP and for each individual volunteer-group monitoring project. It helps to standardize basic sampling and monitoring procedures, accuracy/precision criteria, and data management protocols, and will encourage new groups to adopt pre-approved VRMP standard operating procedures (SOPs) whenever possible. Table 1 summarizes the specific QAPP development details required by USEPA.

Each volunteer group (with assistance from VRMP staff) will be responsible for writing a SAP that includes project-specific information, including goals and objectives of the volunteer group (e.g., baseline data collection) and any project details deviating from the contents of this QAPP. Project-specific details include items such as detailed site location information, sampling frequency and season. They also include the parameters being monitored, the types of equipment being used, lab sampling logistics and specific SOPs being referenced. Individual SAPs also allow the flexibility for groups to adapt the design of this program to local situations, conditions, and available resources. A SAP “template” can be found in Appendix 3.

Each parameter shall be sampled by following an SOP. Groups will use (and reference) one of the VRMP-developed SOPs included in this QAPP (see Appendix 2). The VRMP will add new

SOPs for new equipment and/or parameters annually, as needed. Newly developed SOPs shall meet Quality Assurance/Quality Control (QA/QC) criteria of precision, accuracy, etc. as presented in this QAPP [Table 3a; Sections 4.4 and 5.2] and also shall be approved by VRMP Staff.

Following established procedures and creating a hierarchy of decision-making will be essential to maintaining consistency, comparability, and valid analyses of data collected. As such, a VRMP Management Team (sometimes referred to as "VRMP Staff"), comprised of a VRMP coordinator (a MDEP biologist) and other qualified MDEP water resource scientists and managers who will lend their (part-time) assistance towards the success of the project, was created to oversee the operations of the VRMP. (Figure 1 in Section 4.1 illustrates the VRMP organizational chart.) The VRMP Management Team will update and maintain the QAPP, facilitate the SAP creation process for individual groups, govern SAP approval, direct appropriate training sessions, and review and compile data generated through the VRMP, and make it available to the general public. As the VRMP grows, we may consider having an Advisory Board to include river/stream professionals outside of MDEP.

Volunteer groups participating in the VRMP will need to dedicate time to designing SAPs, receiving training and certifications, monitoring waterways, and managing data (with assistance from the VRMP). As a result of this hard work, VRMP participants will generate high quality water quality data for some of Maine's approximately 55,000 miles of streams and rivers. These data will supplement work done by Maine's natural resource agencies, leading to an increased ability to focus the State's limited assessment, restoration, and conservation resources on the most impacted and pristine waters within the state, respectively. This work has the added important benefit of engaging citizens in learning about and protecting the ecological integrity of Maine's rivers and streams through the hands-on experience of volunteer water quality monitoring.

Table 1. QAPP development details required by USEPA.

1. Guidance Used to Prepare QAPP	EPA New England Quality Assurance Project Plan Program Guidance (April 2003)
	EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5 (March 2001)
	Review of QAPPs and programs of other states and volunteer monitoring groups (see Acknowledgements and References sections of this document)
2. EPA & State Programs	Federal Clean Water Act
	Maine Revised Statutes, Title 38, Water Classification Program
3. Approval Entities	USEPA-Region 1
	MDEP
4. QAPP Type	Generic Volunteer River Monitoring Program QAPP
5. Dates (Month & Year) of Scoping Meetings	April, August, and October 2004; February 2005; March, July, and December 2006; January 2007; September, November, and December 2008; January 2009; personal communication in person or via email with various 'stakeholders'. Also: Citizen Stewardship and Monitoring for Clean Water in Maine: A Needs Assessment Report for the Development of a Citizen-Based Maine Volunteer River Monitoring Program; October, 2007; prepared for MDEP by Barbara S. Arter.
6. Previous QAPP documents	June 10, 2009-1st Edition; April 4, 2014-Update
7. Organizational Partners	USEPA; Maine Dept. of Inland Fisheries & Wildlife; Maine Atlantic Salmon Commission; Maine Department of Marine Resources; Maine Rural Water Association; Maine Rivers; Project SHARE; Regional Watershed Organizations; Municipalities; Trout Unlimited; Others
8. Data Users	MDEP: BWQ / DEA; Maine Dept. of Inland Fisheries & Wildlife; Maine Atlantic Salmon Commission; USEPA - STORET; volunteer monitoring groups; watershed councils; local municipal and county governments and conservation commissions; land trusts; stream/river researchers at various Maine universities/colleges; conservation organizations; LSM-VLMP; students; citizens

3. Applicability

TOPICS

- Scope and review of the QAPP and SAPs
- Types of volunteer data that will be accepted into the VRMP database
- MDEP use of VRMP data
- Possible databases for volunteer data lacking quality assurance measures
- QAPP distribution list

The VRMP QAPP is intended to serve as an "umbrella" document under which specific citizen river/stream project SAPs may be developed. The VRMP will only accept volunteer-gathered data into its official database if the group has a SAP that has been approved by VRMP staff and is on file at the VRMP office.

Project-specific SAPs from individual volunteer groups will document any and all deviations from the 24 elements included in this QAPP. Typical deviations include names of personnel involved with a project, scope and intensity of project sampling plans, particular water bodies and site locations being monitored, specific equipment and/or methods and laboratories being used, etc. Project-specific SAPs shall meet minimum QA/QC criteria (e.g., precision, accuracy) as presented in this QAPP (e.g., Table 3a, Sections 4.4 & 5.2), and will need to be submitted to VRMP for review in order to be approved prior to the start of sampling. SAPs do not need to be updated annually but do when changes are needed. VRMP staff will assist interested citizen groups in preparing SAPs whenever possible. VRMP staff, and any other professional personnel involved with overseeing VRMP activities, will receive a copy of, and any updates to a SAP. The list of these staff is included in the Distribution List found in Table 2, and may be updated at any time. Table 2 also lists VRMP, MDEP, and other organizations' staff who will review and approve SAPs submitted by individual citizen monitoring groups.

Maine DEP Use of VRMP Data

The VRMP is designed to guide and train volunteer groups to collect high quality data that will be useful to various agencies within the State of Maine and beyond. Volunteers will be able to sample and monitor parts of rivers or streams that state agencies may not have the resources to monitor on a regular basis and become advocates for water quality protection and improvement. Volunteer groups will be able to identify parts of rivers or streams which may have degraded water quality, thus helping organizations such as MDEP, MDIFW, Maine Department of Marine Resources, non-profits, conservation districts, and towns prioritize where to investigate conditions further and where to focus best management practice (BMP) implementation efforts. These data can also be used to gather baseline information and track trends over time.

While the data that VRMP-affiliated groups gather will be of high quality, MDEP reserves the right to use discretion as to how to use the information and whether the data will be used in decisions related to laws, enforcement, and other regulatory issues. In some cases, VRMP-collected data will be viewed as primarily "advisory-level data" since it may be difficult for MDEP to defend the validity of volunteer-collected data, regardless of the quality assurance steps that are in place. In other cases, MDEP may use the VRMP data in decisions related to certain regulatory issues.

Non-QAPP/SAP Volunteer River and Stream Data

The VRMP recognizes that there likely will be a number of volunteer and school groups who wish to collect water quality data and share their findings with other volunteers and agency staff in the State of Maine without going through the trouble of writing and meeting the rigorous standards and protocols of this QAPP, a personalized SAP, and training/certification requirements. Because of this constituency, the VRMP will review user-friendly, well-organized online databases for this non-QAPP/SAP level of information and refer groups to these resources. Possible databases currently available for further exploration include, among other possible sites:

- Gulf of Maine Aquarium "Vital Signs" https:www.gmri.org/our-work/science-education/vital-signs
- Maine Watershed Web learn.bowdoin.edu/apps/hydrology/watersheds/
- EarthEcho Water Challenge World Water Monitoring Day https://www.monitorwater.org/
- The GLOBE Program www.globe.gov
- Earth Force www.earthforce.org
- Anec Data www.anecdata.org
- DEP Environmental Education www.maine.gov/dep/schools/lessons/index.html

Table 2: Maine Volunteer River Monitoring Program (VRMP) Quality Assurance Project Plan Distribution List. "BWQ" stands for Bureau of Water Quality and "DEA" stands for Division of Environmental Assessment. [A3. (Element 3)]

QAPP Recipient	Title	Organization	Telephone #
Primary Reviewers			
Kristin Feindel	Biologist II	VRMP Program Director, BWQ, MDEP	207-215-3461
Bill Longfellow	DEP QAPP Review Coordinator	Commissioner's Office, MDEP	207-287-7047
Susanne Meidel	Biologist III, DEA	Technical Reviewer, BWQ, MDEP	207-441-3612
Secondary Reviewers (as necessary)			
Angela Brewer	Biologist III, DEA	BWQ, MDEP	207-592-2352
Tom Danielson	Biologist II, DEA	BWQ, MDEP	207-441-7430
Wendy Garland	NPS Coordinator, DEA	BWQ, MDEP	207-215-6277
Robert Mohlar	Senior Environmental Engineer, DEA	BWQ, MDEP	207-592-2352
Barry Mower	Biologist III, DEA	BWQ, MDEP	207-215-0291
Don Witherill	Director, DEA	BWQ, MDEP	207-215-9751

4. Additional Program/Project Management Elements

4.1 Program Organization.

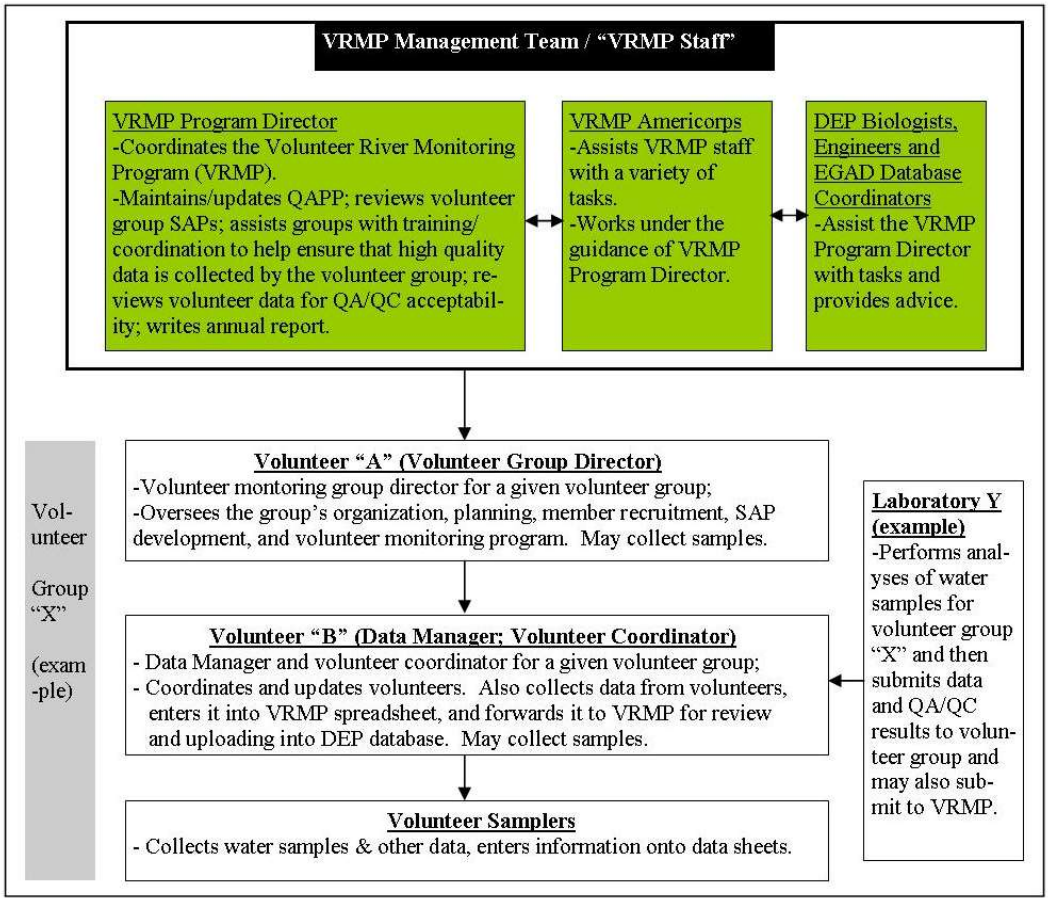
[A4. Project/Task Organization (Element 4)]

TOPICS

- Program organization

Figure 1 illustrates the organizational structure of the Maine VRMP, and other key partners as they relate to this QAPP.

Figure 1: Organizational chart of the Maine Volunteer River Monitoring Program (VRMP) and its key partners as they relate to this Quality Assurance Project Plan.



4.2 Problem Definition/Background.

[A5. (Element 5)]

TOPICS

- History of the Volunteer River Monitoring Program
- Need for QAPPs and SAPs
- Benefits associated with a single generic QAPP

Over the past couple of decades, various attempts by different entities were made to try to establish a formal, statewide volunteer stream monitoring program for Maine. One of the more promising opportunities occurred when CEMA (the Council for Environmental Monitoring and Assessment) was established in 1997 by Executive Order of then-governor Angus King. Those efforts had some positive impacts, but did not result in the creation of a volunteer stream monitoring program. In the following years, namely, after a few meetings of potential advisory committee members in 2004 and 2005, momentum for a volunteer stream monitoring program began to build in 2006. This program is now called the Maine Volunteer River Monitoring Program (VRMP). A QAPP and other major components of the program were drafted, revised, and completed between 2006 and 2008 while other aspects of the VRMP were explored and developed.

The creation of an approved generic QAPP and the provision of support by VRMP staff will help to make it easier for interested groups to tackle the rigors of water quality monitoring, with reduced difficulty and time associated with the development of QAPPs, SAPs, and SOPs. If volunteer-collected data are to be useful at any level beyond the local planning or statewide screening levels, they need to be collected under an approved QAPP along with a SAP specific to each volunteer group (see Appendix 3 for a SAP template).

Several volunteer groups in Maine already have approved QAPPs. These groups may use different monitoring methods, labs, QA/QC criteria, etc., than those contained in this VRMP QAPP. Groups that already have approved QAPPs will be encouraged to review this QAPP and then submit SAPs for approval by the VRMP. This should be a relatively straightforward process since much of the necessary information likely will already be contained in their existing QAPP (assuming they meet the minimum QA/QC criteria listed in this document). (Volunteer groups may contact the VRMP for assistance with this process, time and availability permitting.)

By having a single generic QAPP, with a number of approved SAPs specific to each volunteer group, the VRMP aims to uphold basic, required minimum QA/QC criteria and minimize the number of varying monitoring techniques used around the state, thereby increasing the consistency and comparability of sampling methods and data. Improved consistency and comparability should benefit data users such as regional and local organizations, MDEP, USEPA, etc.

4.3 Project/Task Descriptions

[A6. (Element6)]

TOPICS

- Initial target groups and timeline
- SAP development and approval
- How announcements and news regarding the VRMP will be shared with the public

Initial Target Groups and Timeline

The VRMP was created to assist citizen volunteer groups, comprised of adults and/or teachers and students who are committed and willing to put an earnest effort into SAP design, training, certification, and data management, with the design and implementation of study plans aimed at gathering high quality water-quality data from rivers and streams around the State of Maine. The VRMP QAPP is being modeled after those of Maine's Volunteer Lake Monitoring Program (VLMP, now Lake Stewards of Maine) (MDEP, 2004), the New Hampshire Department of Environmental Services (NHDES) Volunteer River Assessment Program (VRAP) (NHDES, 2003), some local volunteer river monitoring groups, some MDEP QAPPs from other programs, and other groups/agencies.

Sampling & Analysis Plan (SAP) - Development and Approval

In order for volunteer water quality data to be received by the VRMP and entered into the official VRMP database, a) volunteer groups shall have already submitted a SAP for review and approval by the VRMP and b) their data shall pass quality assurance review procedures as detailed in later parts of this QAPP. A discussion of the official VRMP water quality database and its "parent" database, "EGAD" [Environmental and Geographic Analysis Database], can be found in section 5.10.

Revised and approved SAPs will be required of volunteer groups whenever they make changes to monitoring protocols, site locations, QA/QC requirements, laboratory locations, etc. Groups should contact the VRMP Program Director to determine if desired changes require a revised SAP. Each group is required to keep an electronic copy of their most recent SAP so that updates and edits will be relatively fast and easy.

SAP and Volunteers

It will be the responsibility of the VRMP groups' leader(s) to ensure that volunteers working under a SAP are aware that a SAP exists. Leadership should either review it with volunteers or make it available for volunteers to review. Copies (hard copy or electronic) may be provided or a SAP will be available on the group's website. Group leaders will be required to sign the "Project Oversight Certification" (Appendix C of Appendix 3,) that states that they have read and understand the SAP/Annual Project Plan and will ensure volunteers are familiar with the SAP.

Volunteer Field Monitoring and Sample Collection

The SAPs of individual groups, which fall under the umbrella of this VRMP generic QAPP, will detail their own field monitoring and sample collection protocols.

Laboratory Analyses

The SAPs of individual groups will detail the laboratories that will analyze the water quality samples that the groups will not be analyzing themselves. See section 4.5 and Appendix 10 for information related to which laboratories can be used by volunteer groups interested in having their data entered into the VRMP database.

Data Management by the Volunteer Groups and the VRMP

A summary of data management procedures is presented in Section 5.10.

(Note: More detailed descriptions regarding SAPs, data collection and analyses, and data management are provided in Sections 4.4 through 5.10.)

Education & Outreach; VRMP Updates Notification

VRMP groups receive periodic updates, reminders and news informally via email through the group's project coordinators. Eventually an e-newsletter may be created to include information about VRMP groups and other information of interest.

4.4 Data Quality Objectives and Criteria.

[A7. (Element 7)]

TOPICS

- Introduction to QA/QC concepts such as precision, accuracy, representativeness, completeness, and comparability
- Minimum data quality objectives for various water quality parameters
- VRMP prioritization of water quality parameters that volunteer groups are encouraged to sample (with sources of basic information about those parameters)
- Frequency of precision (field duplicate) measurements or samples required of volunteer samplers

[Note: Tables 3a and 3c currently exist as documents/files that are physically separate from this document/file. To obtain these QAPP tables, if they are not already attached to this document, please visit the VRMP website at
< www.maine.gov/dep/water/monitoring/rivers_and_streams/vrmp/qapp/index.htm >.

The parameters listed in Table 3a are the parameters for which the VRMP has produced recommended SOPs. Table 3a lists the water quality parameters, along with their respective minimum VRMP quality objectives and measurement performance criteria, for which the VRMP currently will train/certify volunteers to sample.

Appendix 1 contains definitions and information regarding the importance and relevance of these various quality objectives (i.e., precision, accuracy) plus other criteria (i.e., representativeness, completeness, comparability) which will need to be considered in volunteer group SAPs as groups design their overall monitoring plan. Table 3a of this QAPP is expected to aid volunteer groups

in discussing quality objectives in their SAPs because it spells out the VRMP's minimum standards.

The parameters in Table 3a are listed in order of rank in which the VRMP would like to see that particular parameter incorporated into a volunteer group's study design. Factors that typically influence choice of parameters to measure include: perceived (or known) threats to water quality, interests/goals/skills of the volunteers, and funding.

- The primary (Priority 1) parameters are core water quality criteria (dissolved oxygen [DO], temperature, specific conductance [SPC], bacteria). These parameters are important because the primary goal of data collection by the MDEP and volunteers is to evaluate attainment of Maine's Water Quality Standards. These parameters are also relatively inexpensive and easy to monitor (given the proper training) and commonly collected by government agency to assess the status of a given stream/river, and therefore are seen to be of the most interest to the VRMP. DO, temperature, SPC and bacteria are also parameters where repeat measurements are required and therefore a task more efficiently provided by volunteers who are local.

- Secondary (Priority 2) parameters are water quality characteristics which also are very important, but given their additional costs and/or increased difficulty of measurement or limited applicability, are usually measured less frequently than Priority 1 parameters, and therefore are a lower priority of the VRMP. These parameters are often best collected during specific flow events that can more readily be acquired by volunteers. Secondary parameters include pH, salinity, turbidity and suspended sediment.

- Tertiary (Priority 3) parameters are water quality characteristics which also are very important, but typically can either be relatively expensive to monitor or require more rigorous and complex training or sample handling. Tertiary parameters include total dissolved solids, chloride and total phosphorus.

- Finally, quaternary (Priority 4) parameters are important indicators, but they may be parameters/techniques that are required more for special studies and a) considered too complicated or expensive, or b) regarded as probably not yet having volunteer-oriented methods that would provide a high level of data reliability for legal decision-making. Quaternary parameters include nitrogen constituents, ortho phosphate, hardness, alkalinity and total suspended solids.

All types of river/stream water quality data are important, and different groups will have different interests. This ranking is merely a way to guide volunteer groups towards the monitoring of parameters that can most easily and efficiently be put to use by the VRMP. Maine DEP's *Stream Survey Manual (Volume 2): A Citizen's Primer on Stream Ecology, Water Quality, Hydrology, and Fluvial Geomorphology* (October 2010; http://www.maine.gov/dep/water/monitoring/rivers_and_streams/vrmp/stream-survey-manual/index.html) contains a lot of useful information regarding many of the water quality parameters (e.g., DO, specific conductance) listed in Table 3a along with the unique types of information each type of parameter provides. This information should further assist groups with deciding which parameters they want to sample.

Determination of whether a river or stream attains it statutory classification, will be made by follow-up investigations and analyses, or review of QA/QC'd VRMP data, by MDEP's Division of Environmental Assessment or a delegated authority.

Volunteer Groups' Quality Objectives and Measurement Performance Criteria

All VRMP volunteer groups, at a minimum, need to be able to meet the data quality objectives and measurement performance criteria (e.g., precision, accuracy, measurement range, the collection and use of quality control samples) listed in Table 3a of this QAPP for the parameters they will be sampling in their river. In fact, groups will be required to include a copy of this table in their SAP for the benefit of their volunteers. If volunteer groups choose to use more stringent standards than those listed in Table 3a, for certain parameters, those differences shall be noted in their SAP. Volunteer groups will also need to address measurement performance criteria such as representativeness, completeness, and comparability in their SAPs. This is a critical step for volunteer groups to complete before they become a part of the VRMP.

Brief summary of selected data quality objective criteria described and explained in Appendix 1.

Precision
Precision is the degree of agreement among repeated measurements of the same characteristic on the same sample or on separate samples collected as close as possible in time and place. It tells you how consistent and reproducible your field or laboratory methods are by showing you how close your measurements are to each other. It does not mean that the sample results actually reflect the "true" value, but rather that your sampling and analysis are giving consistent results under similar conditions.

Accuracy
Accuracy is a measure of confidence in a measurement. The smaller the difference between the measurement of a parameter and its "true" or expected value, the more accurate the measurement.

Other topics covered in Appendix 1
- quality assurance (QA)
- quality control (QC)
- representativeness
- completeness
- comparability
- detection limit
- measurement range
- quality control (QC) samples - field blanks, equipment or rinsate blank, split sample, blind sample, replicate samples, duplicate samples, spiked samples

Volunteer groups are referred to Appendix 1 of this QAPP to obtain definitions and background information on these measurement performance criteria.

By ensuring that objectives such as precision and accuracy are met, and that quality control samples are collected/analyzed, groups will understand the amount of attention that will be required to obtain useful data, and also the limits to which their sampling will be able to detect problems in a reliable manner. Data or particular water quality parameters/methods which do not

meet the minimum standards in Table 3a will not be permitted to be entered into the official VRMP database (i.e., EGAD). (If rare exceptions do exist, caveats and disclaimers shall be clearly visible and associated with those particular data. These exceptions will be handled on an individual basis and reviewed/approved by VRMP staff.)

The objectives of representativeness, completeness, and comparability allow groups to better understand the limits of their data. For example, while sampling in fall, winter or spring may be interesting, it does not represent summer conditions when low flow and high temperatures create the most critical conditions and poorest water quality that need to be evaluated to assess compliance with Maine's Water Quality Standards. Additional parameters not covered in Table 3a but required for specific assessment goals of individual projects will need to be included in that group's SAP, following review and (potentially) approval by the VRMP.

Field Duplicates

Field duplicates will be collected or measured to assess the precision of volunteer equipment and techniques. A "field duplicate" for a water grab sample will be a second water grab sample collected, in a separate sample container, in the same location within a minute after the first water grab sample was collected. A "field duplicate" for a water quality meter (or thermometer) will be collected as follows: after the first reading/measurement has been made and recorded, the probe/thermometer will be left in the stream for approximately 5 minutes and then a second reading/measurement recorded. For profile data, a "field duplicate" will be collected as follows: profile readings/measurements are recorded; as the probe is returned to the surface a duplicate reading/measurement will be recorded at any one given depth.

Table 3b lists the frequency of precision (field duplicate) measurements or samples required of volunteer samplers, as well as for laboratories performing analyses for volunteer groups. A field duplicate will be obtained by each volunteer for at least 10% (1 duplicate per 10 samples collected or monitored) of their own sampling efforts for any given parameter per year, or at least once per sampling season. As an example, Volunteer "X" collects dissolved oxygen, temperature and bacteria samples at their assigned sample site. The volunteer will collect 10 samples (or fewer) during the field season. In order to meet the minimum number of precision measurements, the volunteer shall collect at least 1 duplicate for each parameter sampled. Even if the volunteer were to only collect 5 total samples that year, they would still be required to collect at least 1 duplicate during the year. The volunteer or group leader can determine when the duplicate should be collected (e.g. on the 10th and/or last sample) and this information should be included in the SAP.

Table 3b. Frequency of precision measurements or samples required of volunteer samplers and/or laboratories performing analyses for volunteer groups.

Total Number of Samples (of a Given Parameter) Collected by a Single Volunteer (or Analyzed by a Laboratory) Over the Course of a Year	Number of Required Duplicates
1-10	1
11-20	2
21-30	3
31-40	4
41-50	5
Etc.	Etc.

4.5 Special Training/Certification.

[A8. (Element 8)]

TOPICS

- Minimum experience/training/certification requirements of the:
  - VRMP Director
  - MDEP staff supporting the VRMP
  - Volunteer groups
  - Volunteer Group - Data Managers and Re-Certification of the Organizations
  - Laboratories
- Safety considerations

Volunteer River Monitoring Program Staff and Associates

VRMP Program Director

The VRMP Program Director position will require someone with experience in collecting, interpreting, and managing water quality data. Experience working with volunteers is another important trait needed by the Program Director. Additionally, multiple years of experience in the discipline of limnology, stream ecology, water chemistry, watershed management, or a closely-related field, will be viewed as an asset. The Director will have a minimum of a Bachelor's degree in one of the natural/environmental sciences, chemistry, or a closely-related field.

Maine DEP Staff Providing QA/QC, Data Review, and Other Support Services to the VRMP

The State of Maine job classification system has established minimum qualifications required for all levels of state employment. Most of the individuals working directly with the VRMP are in the "Biologist" classification ladder. Usually, at least one individual will be an Environmental Specialist (classified as a MDEP "Environmental Specialist III" (ES-III) position). Their qualifications range from a Bachelor's degree to a Ph.D. in one of the natural sciences, and they generally have a number of years of experience in the field of limnology, stream ecology, water chemistry, watershed management, or a closely related field. Because the State hiring process establishes training and experience levels required to be employed by the BWQ Division of Environmental Assessment, there is no need to include resumes for each individual in this group. The minimum requirement for the annual AmeriCorps volunteer staff position assisting the VRMP is at least a Bachelor's degree, typically in one of the natural sciences, natural resource management, environmental engineering, or environmental education.

In addition to volunteer training, data review/management, and administration responsibilities, MDEP biologists or Environmental Specialists affiliated with the VRMP shall maintain current First-Aid and CPR Training. In addition, the staff will be required to attend an annual Field Support Area Training that reviews lab safety protocols (e.g. chemical storage and disposal, spill cleanup, lab evacuation).

Volunteer Groups

Initial Meetings

Leaders of volunteer groups that are new to the VRMP program will meet, in person (ideally) or over the phone, with VRMP staff to discuss the goals and objectives of the group, the parameters of interest, potential monitoring locations, equipment/volunteer sampling certification procedures, data management, typical planning/training/certification requirements, and other important concerns. The VRMP Reports, QAPP, a SAP template, links to water quality data and publications, and other useful information related to the VRMP, are posted on the VRMP website (https://www.maine.gov/dep/water/monitoring/rivers_and_streams/vrmp/) to educate and inform new groups who are exploring the possibility of becoming a part of the VRMP. These materials also can be mailed to groups requesting them in hardcopy form.

Volunteer Training/Certification/Re-Certification

Each year, all volunteers, plus their monitoring equipment, will need to be certified/re-certified. The certification workshops will happen as follows (also see Appendix 4):

a. VRMP staff will hold volunteer certification/re-certification workshops for volunteer groups around the state during the spring and early summer (May - June). Some workshops may be scheduled on Saturdays, while others may be on weekdays (depending on volunteers' availability).

b. These workshops will teach/review the basic objectives and status of the VRMP, an overview of Maine's water classification system, safety, the importance of QA/QC, procedures for monitoring / sample collection, and data management. (The methods taught at each workshop will be specific to the parameters, protocols, and equipment described in the approved SAP[s] of the local group[s] that are attending a given training/re-certification workshop.)

c. Later in the workshop, the sampling techniques of volunteers will be evaluated for accuracy (Table 3a) by VRMP staff with the VRMP reference ("benchmark") set of chemical kits and water quality meters. (VRMP "**benchmark**" equipment is also discussed in Tables 3a and section 6.1.) Volunteer groups using dissolved oxygen kits are responsible for purchasing new supplies each year as needed, prior to training.

d. Most of the equipment (e.g. meters) used by volunteers are provided by the VRMP through its equipment loan program. This equipment is maintained and calibrated by VRMP and MDEP staff. Some VRMP volunteer groups may obtain equipment from other sources (e.g. Casco Bay Estuary Program, USEPA, NH VRAP). Equipment from other sources will be checked against VRMP benchmark equipment (if not done prior to the training session).

e. Volunteers will be taken out to a nearby river or stream where they will receive "hands-on" training from an experienced VRMP staff member, along with the group's leader, using the techniques spelled out in the volunteer group's SAP. In case of bad weather, this portion of the training will be conducted indoors using a clean bucket filled with fresh stream or river water. Volunteers will be shown how to calibrate and use their equipment and, if applicable, how to collect surface grab samples, label containers, preserve and store samples, fill out chain of custody forms, and submit samples to the appropriate laboratory. All volunteers will then need to demonstrate data collection techniques for each of the group's chosen parameters (e.g., temperature, DO) until they are comfortable

with the procedure and getting measurements within the predefined accuracy limits stated in this QAPP and the group's SAP. Following successful completion of these evaluations, volunteers will become "certified" volunteer monitors.

During the certification evaluation process, the measurements obtained by both the volunteer and the VRMP staff person, along with other pertinent information, will be recorded in a certification tracking spreadsheet (Appendix 4d). This spreadsheet will be stored in the electronic VRMP files (by year).

At certification/re-certification workshops, volunteers who repeatedly fail to use proper techniques or obtain data that fall outside the acceptability limits listed in Table 3a, when compared the VRMP's benchmark equipment, will not be certified. Suggested remedies to this denial of certification may include: 1) having a qualified technician examine the equipment for problems or 2) pairing up these volunteers with other volunteers who have demonstrated sampling proficiency, or VRMP staff, until they can demonstrate their own proficiency.

Volunteer Group - Data Managers

Each volunteer group will need to have their own "data manager" – a person who is responsible for collecting the data sheets from volunteers, entering the data into VRMP spreadsheets, and then forwarding the electronic data and hard copies data to the VRMP. In some cases, a volunteer group may have more than one person who works on data management. If that is the case, it is crucial that those data managers stay coordinated in order to minimize the chance for errors or duplicative efforts. QA/QC steps are outlined in Section 5.10 (Data Management). VRMP staff will make themselves available to volunteer group data managers who have any questions.

Volunteer Groups – Re-Certification of the Organizations

If the VRMP Director determines it is necessary, VRMP staff will work with a volunteer group (group director, group volunteer coordinator or all volunteers, as necessary based on the issues encountered) to discuss and evaluate any organizational or performance issues. Discussions will seek to identify important steps that can be taken to address any issues that are raised. If a satisfactory resolution of any problems cannot be reached, the group will not be "re-certified" and thus potentially not allowed to continue to participate in the VRMP; any such decision is at the discretion of VRMP and other MDEP staff.

Laboratories

The (approved) SAPs of individual groups will detail the laboratories and methods that will be performed to analyze the water quality samples the group will not be analyzing themselves. In order for a laboratory to be acceptable for inclusion of data in the VRMP database, it shall meet at least one of the criteria listed in Appendix 8 Volunteer groups will consult with the VRMP if they have any questions regarding this certification or need a list of labs that are currently certified.

Safety Considerations

Volunteers will be encouraged to work in teams, whenever possible, to increase safety during sample collection visits. If this is not feasible, volunteers will at least be cautioned about the dangers of working around streams and rivers (slippery/steep banks and stream bottoms, swift/strong moving waters [especially after rain events], sharp objects, insect bites, poison ivy, ticks). The practices of informing friends/family/group-leaders about one's sampling plans, checking in after sampling, carrying a cell phone, carrying a small first aid kit, and avoiding sampling during lightning events, will be strongly encouraged. Safety tip sheets (from Appendix 4) will be handed out to volunteers at annual training sessions. Table 4 provides a general outline of safety recommendations. The VRMP's liability waiver form for volunteers is contained in Appendix 4.

Table 4. Basic safety tips.

BASIC SAFETY TIPS
Volunteers are encouraged to: • not enter water that goes above their thighs; • wear an appropriate personal floatation device (PFD) when working in or near the water • not enter water if there is any concern for one's safety (e.g., high, fast flows); • be careful walking on slippery surfaces such as streambanks and stream bottoms; • work in teams of at least two whenever feasible; • let a friend or family member know where they are going and when they are expected to return; • bring a first aid kit and cell phone; • dress appropriately for the field conditions; • watch out for poison ivy, oak, or sumac; • do a tick check after being in the field; • bring water and snacks (if you plan to be out for more than a short period); • wash or disinfect hands before eating, especially if they have been in the water.

4.6 Documentation and Records. [A9. (Element 9)]

TOPICS

- Documentation of modifications to QAPPs, SAPs, and SOPs
- Archiving of data and QA/QC records

QAPP and SOP Modifications and Archiving (MDEP and VRMP Duties)

Programmatic changes to the QAPP or any SOP will include reference to the section(s) of text being modified or added to, the reason why the modification is necessary, and the actual

replacement/additional language. Modification documents will need at least two signatures: that of the BWQ Technical Reviewer and the VRMP Program Director (Table 2). Other MDEP staff may need to be involved on occasion. If the modification is extensive, it will be the responsibility of the MDEP QAPP Review Coordinator to determine if it is necessary to request additional review from others within the agency, from USEPA, and/or a technical expert from outside of the Department. Significant alterations and updates (those affecting data quality) of this QAPP and any SOPs contained within the auspices of this QAPP will be documented in Addendum format and saved in the same folder as the QAPP. MDEP SOPs under development will be included as part of this QAPP as soon as practicable and will be designated as drafts during review periods. Documentation regarding QAPP and SAP modifications will be placed in the VRMP Program Director's file cabinet and retained indefinitely. Electronic versions will be archived on the MDEP computer server, which is backed-up according to established State of Maine back-up schedules. Updated documents are distributed to individuals identified in Table 2 by the VRMP Program Director as soon as they are finalized.

SAP/SOP Modifications and Archiving (Volunteer Group and VRMP Duties)

VRMP staff will prompt individual volunteer groups to review their SAPs annually to determine if any changes are necessary (e.g., changes in SOPs, additions/deletions/re-location of sampling sites, additions/deletions of parameters that are sampled). Modifications to SAPs will be made at the discretion of the group's leader (assuming he/she has approval of its members) and VRMP Program Director and then submitted to the VRMP for review and approval. Approved SAPs will be retained by each volunteer group for 5 years.

It is important to note that the purpose of maintaining a record of every volunteer group's past and current SAPs is to maintain metadata (data about data; background information) associated with every data point that is collected and stored. Individual group SAPs will remain in the possession of the VRMP indefinitely, for archiving purposes. Files associated with such plans will be organized such that persons requesting information about VRMP data can follow the paper trail from planning through reporting phases in a logical progression. These files, both ongoing and historical, will be placed in the VRMP Program Director's file cabinet or scanned and retained indefinitely. Electronic versions will be archived on the MDEP computer server, which is backed-up according to established State of Maine back-up schedules.

Datasheet Archiving (Volunteer Group, MDEP/VRMP, and Laboratory Duties)

Clean, readable scanned versions or paper copies of the original datasheets will be submitted to the VRMP to accompany the electronic files. These copies will eventually be archived in the VRMP electronic files. Datasheets are retained by individual volunteer groups for 5 years.

QA and Certification Records

The VRMP will maintain quality assurance records in either paper and/or electronic file format. Electronic files will automatically be backed up according to established State of Maine back-up schedules. This information will include measurement comparisons (QA/QC) between VRMP staff and volunteers for the parameters of interest (e.g., DO, temperature, specific

conductance), other certification/recertification/training results (see Appendix 4), and volunteer contact information obtained during spring and summer volunteer certification/re-certification workshops. This information becomes part of the metadata (data about data) associated with each volunteer monitor. This information will be kept indefinitely as it may be needed to assist in the interpretation of anomalous historic data.

Electronic or paper copies of lab QA data, if applicable, will be kept by both the individual monitoring group and the VRMP for 5 years.

5. Data Generation and Acquisition

Elements in this section address aspects of data generation and acquisition. Some of these aspects apply to all projects and will be documented as such; other aspects will be project-specific; thus it is necessary to address them at the project level in individual SAPs.

5.1 Sampling Process Design (Experimental Design). [B1. (Element 10)]

TOPICS

- Need to write and submit a Sampling and Analysis Plan (SAP)
- Improving consistency while retaining flexibility
- Site location descriptions
- Recommended areas within channels for sampling
- Useful references and resources

Need for SAPs

Specific sampling plans will need to be created by each individual volunteer monitoring group participating in the VRMP. Each group will need to decide upon their goals and objectives and then write up a sampling and analysis plan (SAP) that addresses those goals and objectives.

SAPs should be carefully thought out so as to maximize:

- the gathering of useful, credible data and
- the sense of accomplishment for volunteers

and minimize:

- volunteer time commitments,
- organizational expenses,
- and redundancy with MDEP monitoring efforts.

VRMP staff are available to help new and existing groups that need assistance with writing or updating a SAP. The SAPs are reviewed and approved by VRMP staff prior to the start of sampling. As time permits, VRMP staff will also schedule meetings with leading members of an individual group in order to facilitate preparation of a group's SAP.

Improving Consistency

Sampling Season and Sampling Frequency

SAPs will vary by individual groups, resulting from factors such as different objectives, interests, volunteer time availability, funding, etc. To improve consistency and comparability, however, groups will be encouraged to consider sampling at least once every 2 weeks between the months of May and September. In many stream and river systems in Maine, these warm months can be the most stressful for biological communities due to (typically) elevated water temperatures, decreased dissolved oxygen concentrations, and lower water volumes (decreased habitat availability). Also, warm, drier months typically are safer for volunteer sampling since water levels typically are lower.

Some groups may desire to characterize the impact of other stressful periods for aquatic organisms. Examples of these periods include months when rain/flooding events are more frequent (spring and fall) or when (typically acidic) snowmelt is prevalent (late winter/spring). Sampling periods for these groups might be from March through October. Also, some groups may choose to sample during or immediately following storm events.

Promotion of Certain SOPs

Another way the VRMP will attempt to improve consistency will be through the promotion of a limited number of SOPs for the monitoring of various water quality parameters. For example, dissolved oxygen concentrations could possibly be measured using a number of different chemical kits or meters (of various manufacturers and specifications). The VRMP will try to limit the number of different methods or brands of equipment used by recommending the use of about 2 or 3 pre-written SOPs contained in the "cookbook" (Appendix 2) of this VRMP QAPP. (The term SOP "cookbook" refers to the manner in which volunteer groups can look through a series of recommended SOPs and select the one[s] that would work well for their group.) Not all volunteer groups will opt to use the SOPs contained in this QAPP, whether because they already have their own equipment, or because they lack the financial resources to obtain a particular meter or kit. This QAPP will enable these groups to create their own SOPs, relying on VRMP minimum QA/QC standards (e.g., precision, accuracy, measurement range) outlined in Table 3a, in order to establish a basic level of confidence in volunteer-collected data and maintain consistency among groups.

A third way to improve consistency within the VRMP will be to educate volunteer groups about the value of long-term monitoring. This will not be an important point for groups just starting out, since they will be mainly focused on the recruitment of volunteers, gaining experience monitoring streams and rivers, and determining the long-term goals of their program. However, as groups begin to mature and become established, they will be shown the value of long-term data collection via data reports, figures, and tables covering multiple years as well as discussions with them about possible trends and inter-annual variability in the data.

Site Location Descriptions

When submitting SAPs for review and approval, volunteer groups will provide a list of sampling/monitoring sites. This list should include, at a minimum, a list or table that states the

geographic coordinate locations (e.g., UTM [Universal Transverse Mercator] or latitude/longitude - using either a NAD83 or WGS84 datum) of sampling/monitoring sites, along with site "names" or "codes". Monitoring site names/codes shall end with "-VRMP" within the EGAD database in order to distinguish their sample data from that collected by MDEP staff in the same area. A map showing site locations based upon geographic coordinates should be included with the SAP (VRMP staff can assist groups with the creation of these maps). Also, if possible, driving directions to individual sampling locations should be provided in the sampling site table.

VRMP staff will provide assistance with GPS (Global Positioning System) geographic coordinate data collection and GIS map-making to volunteer groups as needed and as time allows. The VRMP will loan a GPS unit to a volunteer group when they need to document sampling sites (as equipment is available).

Site location data are expected to be gathered by using a handheld GPS unit. If they are collected by any other method, those methods will be recorded in the volunteer group's SAP. Site location (GPS) data will only be recorded after at least 3-4 satellites have been acquired by the GPS unit, and GPS location data will include a measure of expected or measured GPS error. (The VRMP's preferred geographic coordinate system is the UTM coordinate system.)

Groups will be asked to be very specific as to where the sampling/monitoring will occur at each site (e.g., mid-channel [by wading, boat, or from bridge], from edge of stream on outside of a stream bend; mid-depth of channel, 1 - 1 ½ feet below the surface, or at 1-m depth-profile increments of the water). See Appendix 6 for background information about locations within streams and for advice on in-stream site selection. Regardless of where the samples are collected, ensuring that they are collected from essentially the same location time after time (whenever feasible and safe) is critical because it helps ensure comparability of data at that particular site. If a volunteer needs to deviate from the standard sampling location for example for safety reasons, careful note of this will need to be made on the field sheet (e.g. 'sampled 20 feet upstream of regular location for safety reasons').

Volunteer groups will use the sampling site description form in Appendix 6 to document the addition of each sampling site. This form includes site location (GPS) information, local in-stream and terrestrial habitat characteristics, position in the channel where the sample is being collected and vertical depth, and directions to the site.

For new groups, VRMP will visit the sites with the volunteer group's leadership, document sites and advise on specific sampling location. Sites added subsequently may also be visited by VRMP staff if needed.

The VRMP will use the EGAD standardized site coding system which includes river basin and river mile, and is determined by the MDEP (e.g. SKE11-VRMP). Volunteer groups also have their own naming system referred to as "alias names" (e.g. KB-1). In larger river systems, volunteer groups will be encouraged to adopt a river mile naming system (or use EGAD names). This is less confusing when subsequent sites are added, and it is easier for report writing and interpretation.

Useful References and Resources

Refer to the Maine DEP (2009) stream manual series for basic information about basic stream ecology, water quality, pollution, stream morphology, GIS/GPS mapping, and other useful concepts and terminology. It can be found on the VRMP website < http://www.maine.gov/dep/water/monitoring/rivers_and_streams/vrmp/stream-survey-manual/index.html >. Those manual titles are:

- Stream Survey Manual (Volume 1): A Citizen's Guide to Stream Watershed Surveys and Stream Corridor Surveys. (Maine Department of Environmental Protection, 2009, Portland, ME).

- Stream Survey Manual (Volume 2): A Citizen's Primer on Stream Ecology, Water Quality, Hydrology, and Fluvial Geomorphology. (Maine Department of Environmental Protection, October 2010, Portland, ME).

5.2 Sampling Methods.

[B2. (Element 11)]

TOPICS

- VRMP "cookbook" of optional SOPs
- Water sampling / measurement techniques:
  - Water quality meters/probes
  - Water grab samples
- Preventing sample contamination

VRMP "Cookbook" of Optional SOPs

The VRMP will maintain a "cookbook" appendix of acceptable SOPs from which its participating volunteer groups can select acceptable, VRMP-endorsed, SOPs for their individual SAPs (see Appendix 2). As discussed in section 5.1, the VRMP does recognize, however, that each group may have different preferences or financial resources, or groups might already be using equipment or methods that differ from VRMP recommended SOPs. Therefore, the VRMP will review and consider any new variant SOP for integration into the VRMP program's SOP "cookbook". Critical criteria used in this review will include 1) a general, proven acceptance of the method by the scientific community (e.g., it is an approved method that meets guidelines or criteria set forth by the USEPA or the American Public Health Association et al. [1995 or later]) ["Standard Methods"] and 2) it meets minimum QA/QC standards (e.g., precision, accuracy, measurement range) outlined in Table 3a of this QAPP. Volunteer data will not be accepted into the VRMP water quality database unless the volunteer group has an approved SAP on file at the VRMP's office.

New SOPs will be developed and appended as necessary. SAPs will list the SOPs for various parameters being followed by a given volunteer group, including the revision date. Deviations from or amendments to existing SOPs will be identified along with justification(s) for these changes. Any after–the-fact deviations from the QAPP/SOPs/SAP shall be appended to the SAP with an explanation of the reason(s) why the deviation was necessary. SAPs will remain in the possession of each individual group manager until a volunteer group's project is complete, at which time the document will be filed with the VRMP group with copies of results, correspondence,

and reports produced. The VRMP will maintain copies of these materials indefinitely.

Water Sampling / Measurement Techniques

VRMP-approved water sampling and measurement equipment and monitoring procedures are described in Appendix 2 of the VRMP QAPP.

- Water Quality Meters
  SOPs exist in Appendix 2 for the use of a number of water quality meters/probes for a variety of water quality parameters.
- Water Grab Samples
  For any parameters that are not to be measured directly with a meter/probe setup, but rather via water "grab" samples and subsequent laboratory analyses or measurements of grab samples using meters/probes, refer to "Standard Operating Procedure - Methods for Collecting Water Grab Samples in Rivers and Streams" (a.k.a. "Water Grab SOP") in Appendix 2 of this QAPP.

Preventing Sample Contamination

Volunteers will be shown proper techniques for collecting water samples with guidelines on how to avoid sample contamination at the annual certification/re-certification workshops. These techniques are detailed in the SOP entitled "(VRMP) Standard Operating Procedure - Methods for Collecting Water Grab Samples in Rivers and Streams" (Appendix 2).

5.3 Sample Handling and Custody. [B3. (Element 12)]

TOPICS

- Sample handling, labeling and custody protocols

[Note: Tables 3a and 3c currently exist as documents/files that are physically separate from this document/file. To obtain these QAPP tables, if they are not already attached to this document, please visit the VRMP website at < http://www.maine.gov/dep/water/rivers_and_streams/vrmp/qapp/index.htm >.]

Water quality samples collected by volunteer groups will be labeled, preserved, stored and transported according to storage and holding time needs identified in their individual SAPs and appropriate SOPs (Appendix 2). (Be aware that in addition to any preservatives that may be required, many types of water samples need to be stored at approximately 4°C [on ice in a cooler or in a refrigerator].) Table 3c presents minimum sample preservation and storage methods required for various water quality parameters required by the VRMP. If volunteer groups believe they have preservation or storage methods that are credible, but differ from Table 3c, then VRMP staff will review the methods and determine whether they should be added to Table 3c.

If any water samples are collected by the volunteer group for later analyses at a laboratory, the minimum information that should be contained on bottle labels is as follows:

a) Volunteer group / organization name (or at least initials)

b) Name of the volunteer who collected the sample, or volunteer identification number (or at least initials)
c) Date & time of sample collection
d) Site name and/or ID number[1]
e) Type of analysis to be performed on the sample (e.g., total phosphorus)
f) For duplicate samples, the indicator 'Dup' or 'Duplicate'.

Volunteer groups will be encouraged, but not required, to pre-label sample containers (under warm, dry conditions) in advance of the sampling event, so that ink markings will be less apt to be smudged. Obviously, sample collection time will need to be recorded on the label after the sample has been collected, or immediately before sampling when the bottle is still dry. Rubber bands are useful to have in the field to help keep labels on sample bottles.

Either Chain of Custody (COC) forms (Appendix 7 shows an example) or Sample Submission forms will need to be completed and submitted with samples to be processed by an approved laboratory (see Appendix 10), as detailed in the approved SAPs of individual groups. Volunteer groups will consult with the VRMP if they have any questions regarding this certification or need a list of labs that are currently certified. Volunteer groups should add their laboratory's COC or Sample Submission form to their SAP if different than the HETL sample in Appendix 7.

5.4 Analytical Methods.

[B4. (Element 13)]

TOPICS

- Analytical methods and documentation requirements

Many water quality parameters are measured by meters, chemical test kits, or other types of field equipment. Other parameters are measured by collecting water samples in the field and then turning them over to a laboratory for analysis. Analytical methods, regardless of being measured in the field or laboratory, will meet or exceed quality objectives outlined in Table 3a (Section 4.4) if they are listed for a particular parameter. (The frequency of precision measurements or samples required of volunteer samplers and/or laboratories performing analyses for volunteer groups is listed in Table 3b.)

. SAPs will reference specific laboratory analytical VRMP "cookbook" SOPs used for each parameter, as applicable. Copies of analytical SOPs will be either included within individual group SAPs to facilitate referencing or cited within SAPs. If SOPs have not been established for a particular analyte, project plans will reference the starting point for draft procedure development (Standard Methods or other citation) and maintain copies of quality trials while the method is under development.

[1] Monitoring site names/codes shall end with "-VRMP" within the EGAD database in order to distinguish their sample data from that collected by MDEP staff in the same area.

5.5 Quality Control.

[B5. (Element 14)]

[Note: Tables 3a and 3c currently exist as documents/files that are physically separate from this document/file. To obtain these QAPP tables, if they are not already attached to this document, please visit the VRMP website at < http:www.maine.gov/dep/water/rivers_and_streams/vrmp/qapp/index.htm >.]

TOPICS

- Quality control steps

SAPs and SOPs are a part of the VRMP's quality assurance foundation. Within each SAP and SOP, there may be specific quality control measures that are recommended. While detailed information about QA/QC procedures can be found in sections 4.4, 4.5, and 5.10, the following bullets summarize the various QA/QC measures that will be a part of the VRMP program:

- Individual volunteers will be evaluated for the adequacy of their sampling techniques and the measurement abilities of their monitoring/sampling equipment at annual volunteer certification/re-certification workshops.

- To the extent possible, VRMP staff and/or AmeriCorps volunteers will observe new volunteers in the field once during the field season. The VRMP Director and group Volunteer Coordinator will also identify any returning volunteers that need to be checked.

- The accuracy of monitoring equipment or techniques will be tested as described in Table 3a.

- Monitors will follow an approved SOP for each parameter monitored. Additionally, field calibration and/or accuracy-determination procedures will be performed for those parameters that require it, as listed in Table 3a or in the parameter's specific SOP.

- A field duplicate will be obtained by each volunteer for at least 10% (1 duplicate per 10 samples collected or monitored) annually of their own sampling efforts for all parameters (see section 4.4 and Table 3b for more details). If discrepancies are detected in volunteer-collected data (e.g., some results fall outside of the acceptable limits for a parameter's measurement range, accuracy, or precision as listed in Table 3a), then operator technique and equipment will both be checked by the volunteer group's leader or a qualified technician or, if necessary, VRMP staff as soon as possible. The problem shall be corrected before any new sampling is conducted; sampling will be suspended temporarily until the problem is resolved.

- For water samples requiring laboratory analyses, duplicate samples will be obtained for at least 10% of samples (i.e., 1 duplicate per 10 samples) collected per parameter (Table 3c). This set of samples will be designated as a set of duplicates for that particular sampling event on the label (i.e., "Duplicate" or "Dup."). Comparisons of duplicate results versus "original sample" results will be expected to meet the criteria listed in Table 3a.

- Sample bottles or containers, if used, will need to be appropriately prepared (e.g., rinsed, sterilized) prior to sampling, by either a laboratory or the volunteer group according to approved SOPs.

- Laboratories that are used by member organizations shall meet the criteria listed in Appendix 10. (Groups may contact the VRMP for the latest list of approved labs.) Also, they are expected to provide their own internal approach to quality control for each parameter being analyzed, and their testing shall meet VRMP criteria outlined in Table 3a if the data are to be included in the VRMP's water quality database. Quality control data will be submitted by each laboratory as soon as possible to their patron volunteer monitoring groups who will, in turn, submit electronic copies of this information to the VRMP. The volunteer group will review the lab QA/QC data for potential problems first and inform the VRMP of any problems. The VRMP will perform a secondary check to confirm the absence of problems.

- Water quality data will be reviewed according to procedures outlined in section 5.10.

- VRMP staff will keep in mind scenarios that might produce unexpected data or QA/QC findings and cause data managers to suspect sampling or analytical error including samples collected from:
    - *pristine* or *oligotrophic* (nutrient-poor) waters, where parameter levels are extremely low (except for DO and pH), or
    - *extremely polluted* or *productive* (nutrient-rich) waters that might yield results for duplicate samples that are highly variable due to the patchy nature of pollutant loadings or bacteria distribution within the water column.

    ➢ These circumstances may require follow-up field visits by VRMP staff to evaluate the environmental conditions and use "best professional judgment" and additional sampling to determine potential causes for the questionable data.

5.6 Instrument/Equipment Testing, Inspection, and Maintenance. [B6. (Element 15)]

TOPICS

- Instrument/equipment testing, inspection, and maintenance

VRMP "master"/"benchmark" equipment will serve as the basis against which volunteer equipment will be compared to determine whether it is in acceptable condition or not. The benchmark equipment is listed in Table 5a. All kits will be examined, prior to volunteer certification workshops, by the VRMP Program Director for problems (e.g., mold in the starch dissolved oxygen solution, expired chemicals, other signs of solution defects). When VRMP benchmark equipment is in unacceptable condition, it will either be replaced with new equipment or serviced by technicians such as "L.A.W. Calibration" [Saco, ME].

Volunteer monitoring instruments and test kits will be tested annually against VRMP "master"/"benchmark" equipment prior to or at certification/re-certification workshops as described in section 4.5.

Table 5a. VRMP "benchmark equipment". Volunteer equipment will be compared against VRMP benchmark equipment in order to determine whether volunteer equipment is in good working order.

Parameter	VRMP Benchmark Equipment
Dissolved Oxygen	Optical dissolved oxygen meter that has been checked against the MDEP aquarium setup
Temperature	NIST-certified thermometer
pH	Buffer solutions of 4.0, 7.0, and 10.0; also distilled water has a pH of approx. 5.5 - 5.9
Specific Conductance	Conductivity standard(s) (standards recommended by the manufacturer)
Turbidity (meter)	Turbidity standard cells: ▪ For LaMotte 2020e turbidity meter: AMCO™ standards of 0 NTU, 1 NTU, and 10 NTU; ▪ For Hach 2100P turbidimeter: StablCal Stabilized Formazin sealed-vial standards of <0.1 NTU, 20 NTU, 100 NTU, and 800 NTU).
Total Dissolved Solids (TDS)	TDS standard (30 mg/L)

Inspection of sampling/monitoring equipment for defects or damage by volunteers will be performed at each time of use in most cases. Test kits will be checked for chemical expiration date exceedances. Equipment maintenance will be performed by a qualified member of the volunteer group, or by VRMP staff, as needed [following inspection or when QC tolerances are exceeded]. Maintenance will occur under the guidance of SOPs contained in this document and/or volunteer group SAPs. See Table 5b for a list of generic maintenance, testing, and inspection procedures for field meters, test kits, and other equipment that should be considered in volunteer group SAPs. Individual groups should explain any deviations from these procedures in their own SAPs and SOPs, if any exist, and cite the equipment manufacturer owner's manuals as appropriate.

Devices used to obtain samples are tested at the beginning of the sampling season and repaired or replaced as necessary. Maintenance and storage details for equipment will be found in SOPs that address use of these pieces of equipment. SAPs should be careful to document equipment cleaning and decontamination procedures (refer to Appendix 2 for example protocols).

Laboratories are expected to perform their own testing, inspections and maintenance as necessary to achieve quality objectives outlined in Table 3a (Section 4.4). Volunteer-collected sample field "blanks" will be collected using lab-supplied sampling containers and analyzed to see if they meet criteria listed in Table 3a. This step checks the cleanliness of lab-supplied sample containers and also the ability of volunteers to prevent sampling contamination.

5.7 Instrument/Equipment Calibration and Frequency. [B7. (Element 16)]

TOPICS

- Instrument/equipment calibration and frequency

Volunteer monitor instruments will be calibrated and checked against VRMP reference/ benchmark instruments and standards prior to or during annual VRMP volunteer certification/recertification workshops and, also, often before each use (see Table 5b). For

example, most dissolved oxygen meters need to be calibrated each day that they are used to make measurements. Instruments / pieces of equipment that fail to calibrate or hold calibration will not be used until the problem is corrected, i.e. successful calibration can be achieved.

Table 5b. General maintenance, testing, and inspection procedures for field meters, test kits, and other equipment that should be considered in volunteer group SAPs and VRMP SOPs. Individual groups will explain any deviations from these procedures, if any exist, in their own SAPs and SOPs. *Additionally, annual calibration and testing will occur prior to or at annual at volunteer certification workshops.

Parameter/ Equipment	Inspection[2]	Maintenance	Testing	Calibration Method	Calibration Frequency*
Dissolved Oxygen (meter)	Full inspection of meter prior to beginning of field season; simple visual inspection at beginning of each day of use (includes an inspection of the condition of the probe membrane or membrane cap sensor)	Once a year at beginning of field season and as required Clean probe if needed	Check battery status prior to each use Zero D.O. check in mid-season (VRMP group) and end of season (VRMP)	Typically a "water-saturated air calibration" done within a protective sheath or a cell/hole within the meter's body	• Each time meter is turned on; • Also, most meters need to be turned on for a period of time before calibration or use (refer to your meter's user manual for details)
Dissolved Oxygen (kit)	Full inspection of chemicals (e.g., expiration dates) prior to beginning of field season; simple visual inspection at beginning of each day of use	Once a year at beginning of field season and as required	Kits require sodium thiosulfate check monthly	--	n/a
Temperature (instantaneous)	Full inspection of thermometer or meter prior to beginning of field season; simple visual inspection at beginning of each day of use	As required	--	(Checked for accuracy at a VRMP certification workshop using an NIST-certified thermometer)	Before beginning of field season
Temperature (continuous; data logger)	Full inspection of logger prior to beginning of field season; simple visual inspection at beginning of each day of use	As required	--	(Controlled test of multiple loggers using a VRMP-accepted SOP)	Before beginning of field season
Specific Conductance (pen or meter)	Full inspection of pen/meter prior to beginning of field season; simple visual inspection at beginning of each day of use	As required	Check battery status prior to each use	Calibrate against standard solution(s) (recommended by manufacturer)	Before beginning of field season

[2] Meters that give readings that are consistently high or low as compared to the mean will be further examined for air bubbles, old membranes, dirty anode or cathode and/or weak batteries. After repairs are made the meter/probe assembly will be tested again. Meters that fail will not be not taken into the field or used at certification/recertification workshops. Repairable meters will be returned to their manufacturer or a qualified repair person (e.g., L.A.W. Calibration – Saco, ME) for service.

Parameter/ Equipment	Inspection[2]	Maintenance	Testing	Calibration Method	Calibration Frequency*
Salinity (refractometer or meter)	Full inspection of refractometer/meter prior to beginning of field season; simple visual inspection at beginning of each day of use	As required	Meter - Check battery status prior to each use	Refractometer calibrated using DI water Meter calibrated when Conductivity/SPC calibrated	Refractometer – each time used Meter – before beginning of field season
pH (meter)	Full inspection of meter prior to beginning of field season; simple visual inspection at beginning of each day of use	As required	Check battery status prior to each use	Calibrate against two standard buffers – either pH 4 & 7 or 7 & 10	At beginning of each day of use (or more as needed)
Turbidity (meter)	Full inspection of meter prior to beginning of field season; simple visual inspection at beginning of each day of use	As required	Check battery status prior to each use; checking against standards once at beginning of each sampling day; if bad readings, then recalibrate; or as needed	Calibrate against the standard(s) which came with the unit	Before beginning of field season and at beginning of each day of use
Turbidity (tube)	Full inspection of tube prior to beginning of field season; simple visual inspection at beginning of each day of use	As required	--	--	--
Total Dissolved Solids (meter)	Full inspection of meter prior to beginning of field season; simple visual inspection at beginning of each day of use	As required	Check battery status prior to each use	Calibrate against a standard TDS solution of 30 ppm	Before beginning of field season

5.8 Inspection/Acceptance of Supplies and Consumables. [B8. (Element 17)]

TOPICS

- Inspection/acceptance of supplies and consumables

Supplies and consumables (as listed in individual SOPs) are inspected upon receipt by the individual volunteer groups or VRMP. In the event that these are found to be unacceptable, they will be returned to the supplier or manufacturer. Once accepted, if an item appears to be damaged or soiled, the item is not used but discarded or returned to the provider, as appropriate. Also, chemical expiration dates will be checked at least annually, and expired chemicals will be disposed of as directed on label instructions (Table 5b). Local laboratories or the VRMP staff may be able to assist volunteer groups with the disposal of these chemicals.

5.9 Non-Direct Measurements / Data Acquisition Requirements. [B9. (Element 18)]

TOPICS

- Non-direct measurements / data acquisition requirements

The VRMP will use geographic data derived from USGS maps and State of Maine Office of GIS (geographic information system) coverages for tasks such as organizing volunteer groups and data by HUC watershed, data visualization, map-making tools, learning about local watershed land-uses, etc. The State of Maine GIS data layers typically have metadata (data used to describe other data) associated with them explaining any background information or limitations it may have. Volunteer groups may obtain precipitation data from various sources including Weather Underground <www.wunderground.com> or the National Weather Service <www.weather.gov>. Any other types of non-direct measurements or externally-sourced data and their limitations will need to be explained in individual volunteer group's SAPs. GPS units will also be used to document site locations as described in Section 5.1 (Site Location Description and Appendix 6 [Sampling Site Description Form].

5.10 Data Management. [B10. (Element 19)]

TOPICS

- Data collection / forms
- Data entry and submission
- Data review by volunteer group managers and VRMP staff
- Data availability via the Internet

Each group will need to include in their SAPs detailed explanations about their handling of datasheets and chain-of-custody/sample-submission forms as well as protocols for datasheet and data file proofing/checking. Examples of datasheets can be found in Appendix 5 and one example of a chain-of-custody in Appendix 7. At a minimum, volunteer groups belonging to the VRMP will be required to take some basic steps to ensure proper datasheet handling and data entry. Those minimum requirements are presented later in this section.

An overview of assistance that will be provided by EGAD staff to the VRMP is listed in Table 5c. (EGAD stands for MDEP's Environmental and Geographic Analysis Database.)

Table 5c. EGAD Staff Support for the VRMP.

MDEP-EGAD staff, with the help of programming staff from the Maine Office of Information Technology (OIT), have created a process to assist VRMP staff with reviewing, validating, and uploading volunteer-group water quality data into the EGAD database.

Key data management and QA/QC support that will be provided to the VRMP by MDEP and OIT EGAD staff includes:

i. Design and maintain or update as needed a standardized water quality data import spreadsheet template for VRMP volunteer groups;
ii. Facilitate the importing of volunteer data, via "pre-EDD" (pre-Electronic Data Deliverable) spreadsheets, forwarded to and reviewed by VRMP staff;
iii. Assist VRMP staff with some aspects of electronic QA checks of data being uploaded to EGAD (e.g., data validation procedures utilizing computer database scripts programmed by OIT staff); and
iv. Create a standardized format and scripts for output of VRMP river data (e.g., Excel tables, graphs, selected analysis)

A. Forms for Data Collection and Chain of Custody (Lab Sample Submission)

VRMP volunteer water quality data will be entered onto standard field forms (which will be updated periodically) (Appendix 5). (The VRMP has obtained input from some existing volunteer groups to gather feedback so that the VRMP datasheets will meet the needs of as many volunteer groups as possible. Alternatively, groups that choose to use their own style of datasheets shall also fill out standardized VRMP forms in addition to their own datasheets.) These VRMP datasheet forms will include space for data elements that will be entered into the VRMP database; specific locations for QA/QC data collected by the volunteers; areas to record which parameters were sampled along with specific methods, equipment, and calibration types; and any other important notes or observations.

At volunteer training sessions (see section 4.5) volunteers will be encouraged to take the time to carefully enter and double-check data on the forms because this information could play a role in waterbody assessment and management actions. The Maine Lakes Program (MDEP and LSM/VLMP) has found that most individuals are more likely to double-check their form prior to submitting if their signature is required, thus VRMP forms will include a required signature line at the bottom.

Original datasheets, along with chain-of-custody or sample-submission forms for (approved) laboratory analyses (if applicable), will be completed by members of the individual volunteer groups and will eventually reside as archives within the group's project files that are maintained by the group's leader or designee. Additionally, copies of the datasheets will be sent to and maintained by the VRMP at VRMP headquarters.

B-1-a. Data Input and Review – Volunteer Group Phase

- Data will be input by the volunteer group's data management designee ("data manager") into a standardized, EGAD/VRMP-created water quality data import spreadsheet template called a "pre-EDD" (pre-Electronic Data Deliverable) spreadsheet. These simple spreadsheet templates will be in MS Excel format. The use of a template by VRMP groups will facilitate, speed up, and standardize the importing of volunteer data into EGAD.

- A review of field duplicate data and laboratory quality assurance information will also be conducted (this step can be done by the "data manager"). Any easily-fixed problems (e.g.,

"typos") will be corrected in the electronic files. More complicated problems will be documented in the "pre-EDD" datasheet in a location designated on the spreadsheet.

- Data identified as problematic or incorrect will either be corrected (based upon writings on the data sheet), deleted, or flagged as "problematic" on the data spreadsheet so that VRMP staff can delete those specific data (or take other corrective steps) before the spreadsheet is uploaded into EGAD.

- The volunteer group's data manager will then sign the Chain of Custody portion of the VRMP field data sheet (Appendix 5) indicating that the data (quality assurance) review has been completed before passing on the data spreadsheet to the VRMP electronically.

- Clean, readable scanned versions or hardcopies of the original datasheets will be passed along to the VRMP (item B-2) to accompany the electronic files. These copies will eventually be archived in the VRMP electronic files.

OPTIONAL – ITEM FOR FUTURE CONSIDERATION

B-1-b. Data Review – Regional Data Coordinator *or* Volunteer Group "Data Swap" Phase

NOTE:

- ***This step currently is considered optional*** *under this version of the VRMP QAPP because it is expected that few, if any, people will volunteer to be regional data coordinators for the VRMP. Volunteer watershed groups and their members are expected to be the only volunteers participating in the VRMP during its early years.*
- *This data review step (B-1b) may become implemented* ***as the VRMP grows beyond 10-12 groups, in order*** *to keep data review by VRMP staff (described in item B-2) manageable.*
- *This data review step could potentially substitute for task B-1 for some volunteer groups in the future.*

- Prior to a volunteer group's submission of electronic water quality data spreadsheet to the VRMP, either a (volunteer) regional data coordinator or another volunteer group's data management designee will compare the group's data sheets and electronic data files to the best of their ability, as documented in their SAP, to see if the records match. A review of field duplicate data and laboratory quality assurance information will also be conducted. The data reviewer will compare 100% of the group's original data sheets to the data entered electronically into the "pre-EDD" datasheet template, to see if the records match.

- Data identified as problematic or incorrect will either be corrected (based upon writings on the data sheet), deleted, or flagged as "problematic" on the data spreadsheet so that VRMP staff can delete those specific data (or take other corrective steps) before the spreadsheet is uploaded into EGAD. This reviewer will document any data deletions and why they occurred, and then pass that documentation on to the VRMP.

- This data reviewer will then sign the Chain of Custody portion of the VRMP field data sheet (Appendix 5) indicating that the data review has been completed before submitting the data spreadsheet to the VRMP.

- Copies of the original datasheet hardcopies or scanned copies will be passed along to the VRMP to accompany the electronic files. Hardcopies will be archived in a VRMP file cabinet at VRMP headquarters and scanned copies saved on the MDEP server. Data spreadsheets may be submitted electronically.

B-2. Data Review – MDEP (VRMP, EGAD) Phase

[Some of the procedures related to data validation are also mentioned in sections 7.1 and 7.2.]

- After a water quality datasheet has gone through the data review processes outlined in item B-1, the VRMP will then review the data. VRMP staff will compare the group's data sheets and electronic data files to see if the records match. A review of field duplicate data and laboratory quality assurance information will also be conducted. The data reviewer will compare 100% of the group's original data sheets to the data entered electronically into the "pre-EDD" datasheet template, to see if the records match. (As the VRMP grows beyond 10-12 groups, it may begin using the steps outlined in item B-1b instead, and then perhaps scale back the proportion of hardcopy and electronic data records that it reviews.)

- A summary of techniques that VRMP staff will use to identify possible data problems, as well as protocols for resolving problematic ("flagged") data, is provided in Table 5d.

- Data identified as problematic or incorrect will either be corrected (based upon writings on the data sheet and after checking with the volunteer group data manager) or excluded from uploading into EGAD. Details about dealing with problematic data are provided in section 7.2.
    - The VRMP will document any data exclusions and why they occurred, and then save that documentation in the group's electronic file.

- VRMP staff will then sign the Chain of Custody portion of the VRMP field data sheet (Appendix 5) and archive it in VRMP files, indicating that the data review has been completed.

- Copies of the original datasheet hardcopies will be archived in the VRMP electronic files.

C. Data Review Tracking

- The Chain of Custody portion of the VRMP field data sheet (Appendix 5) will be the process used to track the various levels of data review discussed above. These Chains of Custody/field-sheets will be archived in a VRMP file cabinet.

Table 5d. Techniques VRMP staff will use to identify and deal with possibly problematic or "flagged" data problems. *See also section 7.2.*

VRMP staff will exclude data records or data sets that fail to meet QA/QC criteria (e.g., precision, accuracy) for the various parameters outlined in Table 3a. Also, if calibration checks are not recorded or fall outside the acceptable range, the data will be excluded).
Automated data validation techniques (described in sections 7.1 and 7.2) also will be employed by VRMP staff to identify problematic data and reduce the chance of human error. For example, EGAD staff have implemented scripts to identify data that fall outside of expected ranges for particular water quality parameters. Data that fall a great distance outside of expected ranges may have been entered with incorrectly placed decimal points.
Best professional judgment will be used to decide whether to exclude data from the dataset. Notes and local knowledge about conditions will be considered.
Data including duplicates samples will be entered in a data tracking spreadsheet. The purpose of this spreadsheet is to provide an overall review of the data and to track duplicate field and lab samples (i.e. determine whether duplicate sampling is performed and values are meeting quality objectives).
VRMP staff will contact the volunteer groups to gather more background information and other details that might help resolve the status of questionable data. Field visits to potential problem sites may also occur.

D. Data Uploading Into EGAD

Once data has been subjected to the various review steps outlined in section 5.10 (items B-1 through B-2) and data validation steps described in sections 7.1 and 7.2, it will be uploaded into EGAD by VRMP staff.

E. Data Availability Via the Internet

The water quality data submitted by VRMP staff to EGAD are periodically uploaded to Internet-accessible databases (i.e. DEP's own website (bacteria data), USEPA-STORET) by MDEP EGAD and GIS staff.

6. Assessment and Oversight

6.1 Assessments and Response Actions.

[C1. (Element 20)]

TOPICS

- VRMP "benchmark" equipment
- VRMP volunteer re-certification workshops
- Lab QA/QC data
- Response actions to problems

MDEP-VRMP Benchmark Equipment

VRMP "master"/"benchmark" equipment will serve as the basis against which volunteer equipment will be compared to determine whether it is in acceptable condition or not. The benchmark equipment is listed in Table 5a. Volunteer groups using LaMotte/Hach dissolved oxygen kits are responsible for ordering new chemicals prior to field season. When VRMP benchmark equipment is in unacceptable condition, it will either be replaced with new equipment or sent out to be serviced.

VRMP Volunteer Re-Certification Workshops

Certification/re-certification workshops will be held across the State of Maine annually so that volunteers may be re-certified for the parameters they monitor/collect. Parameter certifications expire after one year. At record of volunteer certifications will be kept by VRMP either electronically or in hardcopy. For those volunteers collecting dissolved oxygen data, it is necessary to check expiration dates on chemicals in kits, check accuracy of meters, perform frequent basic meter maintenance as well as check calibration procedures. A meter/probe check will be performed in the field as often as possible but may be moved indoors due to poor weather conditions. Meters or kits that do not pass checks shall be serviced before use or replaced. VRMP staff will travel to workshops with copies of their own dissolved oxygen manuals (and those provided to them in volunteer group SAPs), a dissolved oxygen meter, and other items as appropriate. Staff will also have a QA/QC Checklist for Volunteers which they can use as a self-checklist during the sampling season (Appendix 4e). More details regarding volunteer training and certification/re-certification can be found in section 4.5.

Lab QA/QC Data

Quality assessment and quality control data (i.e. duplicate field and lab results, blanks and spikes as appropriate) will be sent to volunteer groups as soon as possible, and (copies) to the VRMP at least annually.

Response Actions to Problems

When field data quality objectives are not being met (Table 3a), and best professional judgment suspects sampling or equipment error, procedures and equipment will be examined to determine which steps are critical for resolving the problem and getting the volunteer to the point where he/she can sample properly. When laboratory quality objectives are not met, and best professional judgment suspects analytical error, the lab will be contacted and some resolution to the problem will be sought. Circumstances where best professional judgment might not indicate evidence of sampling error or analytical error include results obtained from extremely clean or oligotrophic waters, where parameter levels are extremely low. Similarly, extremely polluted or productive waters may yield results for duplicate samples that are highly variable due to the patchy nature of pollutants or distribution of bacteria within the water column.

These problem detection/assessment/response processes need to be done both by the VRMP and the volunteer group's project leader or data manager. Volunteer group activities will be monitored by the above-mentioned people and problems will either be resolved internally or VRMP staff will need to be contacted for assistance. In any case, problem detection and resolution activities need to be well-documented and kept on file by both the local group and the VRMP. The local volunteer group and the VRMP will communicate and a resolution to the problem will be sought. Further details may be added or modifications made to the SOP and/or SAP, and emphasis will be placed on these changes at future workshops.

6.2 Reports

[C2. (Element 21)]

Annual summaries of training activities, data quality objective (DQO) attainment, and corrective actions (if any) are compiled by VRMP staff and will reside in VRMP files. Reporting out of the collected data can be done via the EGAD module. VRMP staff provide an annual summary report of the data for each volunteer group. See Section 7.3 for more information about the availability of the data to the public. The format and content of reports to volunteer groups will be assessed as the program becomes more electronically based.

7. Data Validation and Usability

7.1 Data Review, Verification, and Validation Requirements.

[D1. (Element 22)]

TOPICS

- Responsibilities for review and validation of data
- Dealing with questionable data

Each volunteer should check their datasheets the same day after sampling is complete, to make sure the datasheet is complete and correct. The volunteer group's data manager will conduct data review on all volunteer data as detailed in Section 5.10, B-1-a. The reviewed data will be forwarded to the VRMP Program Director electronically and copies of field sheets in hardcopy or electronically.

VRMP staff will perform quality control on the electronic data, using the field sheets and following the steps and criteria outlined in Section 5.10, B-2 and Section 7.2. VRMP staff can remove questionable data (or make notes as appropriate) as needed before the spreadsheet is uploaded into EGAD, or determine if a pre-EDD should not be uploaded to EGAD due to quality control concerns.

7.2 Verification and Validation Methods.

[D2. (Element 23)]

TOPICS

- Data verification and validation methods
- Dealing with problematic data

Methods for verification and validation of data, including chain-of-custody and data review/proofing procedures, are detailed in sections 5.10 (Data Management) and 7.1 (Data

Review, Verification, and Validation Requirements). Validation issues involve application of criteria listed in Tables 5d and 6 as well as the analysis of laboratory results for duplicate samples and, if applicable to the analysis, blanks and spikes (using criteria in Table 3a). Best professional judgment may override these criteria when supporting data or information suggests a valid anomaly; anything out of the ordinary will be documented in VRMP archives and EGAD where appropriate. Data evaluations will be performed during the data proofing stage as outlined in section 5.10. "Problematic" data records will be handled as described below. All validated data will be included in the EGAD water quality database.

Table 6. Criteria used to review/validate data. Data that exceed these minimum or maximum criteria will be highlighted by the EGAD database during the data loading process and evaluated by VRMP staff for inclusion in the EGAD database based upon best professional judgment and, sometimes, follow-up monitoring. Field and lab duplicates will be used by VRMP staff to help with decision-making. Notes will be added within the database record to detail important facts about any unusual data. The computer validation acts as a secondary check on the data in the unlikely case that VRMP staff miss an error outside of the data validation range.

Parameter	Visual Check By VRMP Staff		Computer Validation Program		Notes
	Min. Value	Max. Value	Min. Value	Max. Value	
Dissolved Oxygen (conc.)	2.0 mg/l	18.0 ppm	1.0 ppm	20.0 ppm	
Dissolved Oxygen (% sat.)	10 %	125 %	10 %	130 %	
Water Temperature	-0.5 °C	30 °C	-0.5 °C	35 °C	
Bacteria	0 / 100 ml	15,000 / 100 ml	0 / 100 ml	20,000 / 100 ml	Some bacteria procedures, such as the IDEXX method have an upper maximum of TNTC (too numerous to count). These will neither be flagged or deleted.
pH	4.0 *	9.0	3.0 *	11.0	* can be exceeded during snowmelt events and outliers will be treated with best professional judgment given methodology used to obtain reading
Salinity	0 ppt	35 ppt	N/A	N/A	Newer parameter being collected by VRMP, was not included when computer validation program was developed
Specific Conductance	10 µS/cm	1000 µS/cm **	5 µS/cm	1200 µS/cm	** most Maine streams are < 100; > 300 indicates possible salt water influence, intrusion, or urban watershed runoff
Turbidity	2 NTU	1000 NTU	1 NTU	1000 NTU	
Total Dissolved Solids (TDS)	10 mg/L	1000 mg/L	5 mg/L	1000 mg/L	
Suspended Sediment	2 mg/L	200 mg/L	2 mg/L	300 mg/L	

Parameter	Visual Check By VRMP Staff		Computer Validation Program		Notes
	Min. Value	Max. Value	Min. Value	Max. Value	
Concentration (SSC)					
Total Suspended Solids (TSS)	2 mg/L	200 mg/L	2 mg/L	300 mg/L	
Total Phosphorus	5 ppb	75 ppb	1 ppb	100 ppb	
Ortho-Phosphorus	3 ppb	10 ppb	1 ppb	20 ppb	
Alkalinity	3 mg/L CaCO3	200 mg/L CaCO3	1 mg/L CaCO3	200 mg/L CaCO3	
Hardness	3 mg/L CaCO3	200 mg/L CaCO3	1 mg/L CaCO3	200 mg/L CaCO3	
Total Kjeldahl Nitrogen (TKN)	50 ppb	2000 ppb	40 ppb	2500 ppb	
Nitrate (NO3) + Nitrite (NO2)	10 ppb	1000 ppb	5 ppb	1500 ppb	
Chloride	3 mg/L	300 mg/L	2 mg/L	350 mg/L	
Date	2009 *	current year	2009 *	N/A	Most dates will reflect data obtained in previous season. * These values may change if historical data is entered into EGAD.

Dealing with Problematic Data

In all cases, “problematic” data (data which fail VRMP QA/QC standards [Table 3a] in any of the steps mentioned above) or data collected by volunteers who are not currently certified will NOT be included in the official VRMP water quality database (i.e., EGAD).

These “problematic” data may, however, be archived by the individual volunteer group in their own databases or records if they so choose. (The VRMP will archive all volunteer groups’ original data file submissions on DEP’s computer server.) Volunteer groups will be notified by the VRMP about any “problematic” data for their records and there will be discussion about how to prevent the problem from occurring in the future.

7.3 Reconciliation with User Requirements.

[D3. (Element 24)]

TOPICS

- Determining how well data quality objectives for groups have been met
- Making water quality data available to the public
- Expected uses of VRMP data

The VRMP will work with each leader of a certified volunteer group that has submitted data to the VRMP to determine how well the data quality objectives (DQOs) outlined in Table 3a of this QAPP

and any objectives in their own SAP were met (e.g., 90% of the total phosphorus replicates met the DQO). For the parameters requiring laboratory analysis, we expect that 80% of the duplicates will meet the DQO. This is a conservative level but reasonable to achieve given the analytes of concern.

VRMP staff compile the data acquired by VRMP participants and produce an annual report that is posted on the MDEP VRMP website. The format and content of reports to volunteer groups will be assessed as the program becomes more electronically based. An MDEP webpage is also available that displays bacteria results from VRMP monitoring, follow-up on the Statewide Bacteria TMDL and Healthy Maine Beaches. Data are also expected to eventually be available to the public through links or actual databases via VRMP, Lakes of Maine, and USEPA's WQX websites in addition to online access to portions of DEP's EGAD database. River/stream data may be used by MDEP staff for various purposes including for Integrated Water Quality Monitoring and Assessment Reports and to identify streams that need further assessment. They may also be used by river and stream councils/groups for planning purposes, towns for comprehensive planning and river/stream protection activities (zoning, ordinance development). Individuals requesting information about a particular river or stream will be referred to these websites. If the individual requesting information does not have access to the Internet, then VRMP staff will provide information in hardcopy or over the phone as time allows.

River and stream data collected through the VRMP are not intended to be used for issuing stop-work orders or enforcement relating to a particular activity. Rather, this data will be used to evaluate the condition of a stream/river's general integrity or "health", which is a result of natural features unique to the stream (slope, geology, drainage area, volume, duration since last rain event, etc.) and human land uses (past and present) in its direct and indirect watershed. It is used to answer questions like:

- Do the data indicate attainment of water classification?
- How clear is the water?
- Are oxygen levels and temperatures adequate, and are pollutant levels low enough, to support a coldwater fishery and other biota?
- Do we expect to see large algae blooms in this waterbody?
- Do we expect the stream or river to export large amounts of sediment and nutrients to downstream receiving waters?
- Do there appear to be above-normal levels of dissolved materials in the water?
- Are there seasonal or weather-related patterns in water quality in a given stream or river?
- Is it desirable to swim in this stream?

If the data used to answer these questions indicate that a waterbody is in possible violation of its classification, then steps will be taken by VRMP staff to request further investigation and analysis by MDEP's Division of Environmental Assessment staff for final determination based upon data and best professional judgment. As an example, volunteer data may consistently find that a sampling location in a river may have dissolved oxygen concentrations between 4.0 and 4.5 mg/L under early morning conditions, which often is considered an "impaired" condition when related to human activities or land uses. Low dissolved oxygen conditions may, however, be due to natural conditions such as the presence of numerous wetlands upstream of the sampling site, and hence a significant natural contribution of wetland water. The purpose of this volunteer monitoring program is to obtain basic water quality data, not seek opportunities for enforcement actions. Generally, volunteer monitoring is designed to be on friendly terms. If any problems appear to be found, then the proper authorities can be contacted.

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Table 3a. Quality objectives for commonly measured stream assessment parameters under the umbrella of the VRMP.

See Table 3b for an explanation of frequency of precision measurements. Accuracy assessments will be made at the annual volunteer certification workshops. Laboratories will be responsible for providing accuracy and precision information to volunteer organizations. Refer to Appendix 1 for background information about various quality assurance critieria such as "precision" (including RPD), "accuracy", etc. Also see footnotes at bottom of table.

Priority	Parameter	Parameter Subgroup	Sampling & Analysis Method	Analysis Location	Measurement Range (Detection Limits)		Duplicate Precision	Accuracy	Reso-lution	Notes
		[or additional parameter information]			Minimum*	Maximum*	[Relative % Difference (RPD)] [4]	(Assessed at annual trainings and in field (after calibration), or in lab via % recovery [spiked samples].)	**	(In addition to the notes in this table, most water quality meters require calibration at least at the beginning of each sampling day if not more. Refer to appropriate SAP.)
INSTANTANEOUS MEASUREMENTS										
1	Dissolved Oxygen (D. O.)	Instantaneous	field meter or Winkler-style test (See footnote *** for guidance regarding time-of-day for dissolved oxygen measurements.)	field or field & lab	1 mg/L	15 mg/L (20 mg/L is re-commended)	Field dup.: ± 0.3 mg/L	Annual certification by VRMP ± 0.3 mg/L Measured against VRMP "benchmark" optical D. O. meter	0.2 mg/L	• Simultaneous temperature measurement is mandatory. • D. O. meter membranes should be inspected for problems prior to use. • Most meters require continuous movement of water across their membranes in order to function properly. • VRMP "benchmark" D. O. meter accuracy must be ± 0.2 mg/L against DEP's lab-grade Winkler titration set-up in Augusta. • Volunteers using meters also perform "zero oxygen" standard (accuracy) check at beginning of field season, mid-season and end of season using the same accuracy criteria. • See Table 4a of VRMP QAPP for guidance regarding depth profiles of D. O. and temperature for Tier 1.
1	Temperature	Instantaneous	field thermometer or meter	field	0° C	35° C	Field dup.: ± 1° C	Annual certification by VRMP ± 1° C	0.5° C	• Thermometers (or meters with ability to record temp.) will have their accuracy checked against an NIST-certified thermometer prior to or at annual VRMP certification workshop. (VRMP will purchase thermometers for groups not using meters, if they do not have thermometers having a resolution of 0.5 °C. Any NIST-certificates which accompany thermometers will be archived at VRMP headquarters.)

Priority	Parameter	Parameter Subgroup	Sampling & Analysis Method	Analysis Location	Measurement Range (Detection Limits)		Duplicate Precision	Accuracy	Reso-lution	Notes
		[or additional parameter information]			Minimum*	Maximum*	[Relative % Difference (RPD)] [4]	(Assessed at annual trainings and in field (after calibration), or in lab via % recovery [spiked samples].)	**	(In addition to the notes in this table, most water quality meters require calibration at least at the beginning of each sampling day if not more. Refer to appropriate SAP.)
1	Specific Conductance	Specific Conductance	field meter	field	1 µS/cm	2000 µS/cm	Field dup.: ± 15% (0 - 499 µS/cm); ± 10% (≥ 500 µS/cm)	Annual certification by VRMP ± 10% (against VRMP "benchmark": either 47 or 84 µS/cm [5] standard set)	1 µS/cm	• Make sure that data are expressed in units of µS/cm and not mS/cm. (1000 µS = 1 mS) • Make sure to measure & report specific conductance (which is conductance that has been corrected / adjusted to a temperature of 25 °C). Most modern meters can do this automatically -- refer to your owner's manual.
1	Bacteria	*E. coli*	field: grab sample lab: glass millipore filter method	Must use a VRMP approved lab.	0/ 100 mL	TNTC (TNTC = Too Numerous To Count)	Field dup.: ± 30% [for log 10 transformed duplicate data]	Prior to each day of lab analyses "Blank" (see notes)	1/ 100mL	• [Accuracy] A lab blank, using distilled water, must be performed (run) for each batch of samples and result in "0/100 mL" for the sample batch to be valid.
1	Bacteria	*E. coli*	field: grab sample lab: IDEXX Colilert method	lab	1 / 100 mL	>2419 / 100 mL	Field dup.: ± 30% [for log 10 transformed duplicate data]	Prior to each day of lab analyses Use either method "1" or "2": 1) "Blank" (see notes); 2) Need to be TNTC on positive control.	1/ 100mL	• [Accuracy method # 1] A lab blank, using distilled water, must be performed (run) for each batch of samples and result in "0 MPN" for the sample batch to be valid. • [Accuracy method # 2] >2419 /100 mL on positive control (a spiked sample {e.g., raw sewage sample from wastewater treatment plant}.) --> NOT a recommended method for safety reasons.
1	Bacteria (in tidal sections of coastal streams)	*Enterococcus*	field: grab sample lab: glass millipore filter method	Must use a VRMP approved lab.	0/ 100 mL	TNTC (TNTC = Too Numerous To Count)	Field dup.: ± 30% [for log 10 transformed duplicate data]	Prior to each day of lab analyses "Blank" (see notes)	1/ 100mL	• A lab blank, using distilled water, must be performed (run) for each batch of samples and result in "0/100 mL" for the sample batch to be valid. [[Accuracy]]

Priority	Parameter	Parameter Subgroup	Sampling & Analysis Method	Analysis Location	Measurement Range (Detection Limits)		Duplicate Precision	Accuracy	Reso-lution	Notes
		[or additional parameter information]			Minimum*	Maximum*	[Relative % Difference (RPD)] [4]	(Assessed at annual trainings and in field (after calibration), or in lab via % recovery [spiked samples].)	**	(In addition to the notes in this table, most water quality meters require calibration at least at the beginning of each sampling day if not more. Refer to appropriate SAP.)
1	Bacteria	*Enterococcus*	field: grab sample lab: IDEXX Enterolert method	lab	1 / 100 mL	>2419 / 100 mL	Field dup.: ± 30% [for log 10 transformed duplicate data]	Prior to each day of lab analyses Use either method "1" or "2": 1) "Blank" (see notes); 2) Need to be TNTC on positive control.	1/ 100mL	• [Accuracy method # 1] A lab blank, using distilled water, must be performed (run) for each batch of samples and result in "0 MPN" for the sample batch to be valid. • [Accuracy method # 2] >2419 on positive control (a spiked sample {e.g., raw sewage sample from wastewater treatment plant}.) --> NOT a recommended method for safety reasons.
2	pH	pH	field meter	field	1	14	Field dup.: ± 0.4 pH units	Annual Certification by VRMP ± 0.2 pH units against two buffers of (4 and 7) or (7 and 10)	0.1	• Buffer solutions should be brought to stream water temperature before performing calibration or determining accuracy.
2	Salinity	Salinity	refractometer	field	0	100 ppt	Field dup.: ± 10%	N/A	1 ppt	Calibrated with deionized water
2	Salinity	Salinity	field meter	field	0	70 ppt	Field dup.: ± 10%	Annual certification by VRMP ± 10% (against VRMP "benchmark")	0.1 ppt	
2	Turbidity	Turbidity (tier 1)	field: grab sample field or lab: meter	field	0	1000 NTUs	Field dup.: ± 20%	Annual Certification by VRMP ± 2 NTUs (checked against VRMP "benchmark" standards)	1 NTU	Checked against turbidity standards.
2	Turbidity	Turbidity (tier 1)	field: grab sample lab: 2130 B (APHA, 1995)	VRMP certified lab	0	1000 NTUs	Field dup.: ± 20% Lab split: ± 10%	N/A	1 NTU	Checked against turbidity standards.

Priority	Parameter	Parameter Subgroup	Sampling & Analysis Method	Analysis Location	Measurement Range (Detection Limits)		Duplicate Precision	Accuracy	Reso-lution	Notes
		[or additional parameter information]			Minimum*	Maximum*	[Relative % Difference (RPD)] [4]	(Assessed at annual trainings and in field (after calibration), or in lab via % recovery [spiked samples].)	**	(In addition to the notes in this table, most water quality meters require calibration at least at the beginning of each sampling day if not more. Refer to appropriate SAP.)
2	Suspended Sediment Concentration (SSC)	SSC	field: grab sample lab: ASTM[1] Method D 3977-97	VRMP certified lab	5 mg/L	200 mg/L	Field dup.: ± 30% Lab split: ± 20%	N/A	1 mg/L	Due to the sub-sampling procedures that typically are used with the TSS method, and associated error problems[2], MDEP recommends that SSC be measured instead of total suspended solids (TSS). The reason that TSS is included in this table at all is because some groups may have historical TSS data.
3	Turbidity	Turbidity (tier 2)	field: turbidity tube	field	0 cm	60 cm	Field dup.: ± 5 cm	Annual Certification by VRMP ± 5 cm between experienced staff and trainees	1 cm	If turbidity is to be monitored primarily under stormflow conditions, then a 60 cm tube may be adequate. If turbidity is to be monitored primarily under low flow conditions, then a 120 cm tube is recommended.
3	Total Dissolved Solids (TDS)	TDS	field: meter *-or-* field: grab sample with laboratory analysis; Method 2540C (APHA et al., 1995)	field or VRMP certified lab	1 mg/L	2000 mg/L	Field dup.: ± 15% Lab split: ± 10%	Annual certification by VRMP ± 10% (against VRMP "benchmark" 30 ppm [5] standard set)	1 mg/L	• (The TDS concentration in mg/L is approximately 65 % [range 55 - 75%] of the specific conductivity value in µS/cm. {Allan and Castillo 2007}[3]
3	Chloride	Chloride	field: grab sample: lab: Method 4500 CL^- (B or C) (APHA et al, 1995)	VRMP certified lab	3 mg/L	300 mg/L	Field dup.: ±30% Lab split: ±10%	On each day of lab analyses Lab ±10%	1 mg/L	
3	Phosphorus	Total Phosphorus	field: grab sample lab: EPA 365.1; Lachat 10-115-01-1-F	Only HETL or SECRL labs	1 ppb	200 ppb (> 200 ppb by dilution)	Field dup.: ±30% Lab split: ±10%	On each day of lab analyses Lab ±30%	1 ppb	HETL = State of Maine Health & Environmental Testing Laboratory (Augusta) SECRL = Sawyer Environmental Chemistry Research Laboratory (University of Maine)
4	Phosphorus	Ortho Phosphate	field: grab sample lab: EPA 365.1; Lachat 10-115-01-1-B	Only HETL or SECRL labs	1 ppb	200 ppb (> 200 ppb by dilution)	Field dup.: ±30% Lab split: ±10%	On each day of lab analyses Lab ±30%	1 ppb	HETL = State of Maine Health & Environmental Testing Laboratory (Augusta), SWRL = Sawyer Water Research Laboratory (University of Maine), Clearwater Lab (Newport)

Priority	Parameter	Parameter Subgroup	Sampling & Analysis Method	Analysis Location	Measurement Range (Detection Limits)		Duplicate Precision	Accuracy	Reso-lution	Notes
		[or additional parameter information]			Minimum*	Maximum*	[Relative % Difference (RPD)] [4]	(Assessed at annual trainings and in field (after calibration), or in lab via % recovery [spiked samples].)	**	(In addition to the notes in this table, most water quality meters require calibration at least at the beginning of each sampling day if not more. Refer to appropriate SAP.)
4	Nitrogen	Nitrate (NO_3) and Nitrite (NO_2)	field: grab sample lab: EPA 353.2; Lachat 10-107-04-1-C	VRMP certified lab	1 ppb	2000 ppb	Field dup.: ±30% Lab split: ±10%	On each day of lab analyses Lab ±10%	1 ppb	Usually reported as 1 value
4	Nitrogen	Total Kjeldahl Nitrogen (TKN)	field: grab sample lab: EPA 351.2; Lachat 10-107-06-2-E	VRMP certified lab	40 ppb	5000 ppb	Field dup.: ±30% Lab split: ±10%	On each day of lab analyses Lab ±30%	10 ppb	
4	Hardness	Hardness	field: grab sample lab: Method 2340 B (APHA et al, 1995)	VRMP certified lab	3 mg/L	400 mg/L	Field dup.: ±30% Lab split: ±10%	On each day of lab analyses ± 10%	1 mg/L	Expressed in terms of $CaCO_3$/L
4	Alkalinity	Alkalinity	field: grab sample lab: EPA 310.1; Method 2320 B (APHA, 1995)	VRMP certified lab	5 mg/L	400 mg/L	Field dup.: ±30% Lab split: ±10%	On each day of lab analyses ± 10%	1 mg/L	Expressed in terms of $CaCO_3$/L
4	Total Suspended Solids (TSS)	TSS	field: grab sample lab: EPA Method 160.2; method 2540 D (APHA et al., 1995)	VRMP certified lab	5 mg/L	200 mg/L	Field dup.: ± 30% Lab split: ± 20%	N/A	1 mg/L	Due to the sub-sampling procedures that typically are used with the TSS method, and associated error problems, MDEP generally recommends that suspended sediment concentration (SSC) be measured instead of TSS. The reason that TSS is included in this table at all is because some groups may have historical TSS data or a specific use for TSS data.
4	Bacteria (in tidal sections of coastal streams))	Fecal Coliform	field: grab sample lab: glass millipore filter method	Must use a VRMP approved lab.	0/ 100 mL	2400/ 100mL	Field dup.: ± 30% [for log 10 transformed duplicate data]	Prior to each day of lab analyses "Blank" (see notes)	1/ 100mL	• A lab blank, using distilled water, must be performed (run) for each batch of samples and result in "0/100 mL" for the sample batch to be valid. [[Accuracy]]

Priority	Parameter	Parameter Subgroup	Sampling & Analysis Method	Analysis Location	Measurement Range (Detection Limits)		Duplicate Precision	Accuracy	Reso-lution	Notes
		[or additional parameter information]			Minimum*	Maximum*	[Relative % Difference (RPD)] [4]	(Assessed at annual trainings and in field (after calibration), or in lab via % recovery [spiked samples].)	**	(In addition to the notes in this table, most water quality meters require calibration at least at the beginning of each sampling day if not more. Refer to appropriate SAP.)
CONTINUOUS MEASUREMENTS (DATA LOGGERS, SONDES, ETC.)										
1	Temperature	continuous	datalogger	field	0˚C	35˚C	See notes.	0.2˚C	0.02^{o} C	• Data logger precision checked annually following VRMP-approved SOP. Basically, this consists of placing all of a group's loggers in a fume hood or ice bath for 2 hours and then comparing to determine whether the mean temperature of any of the loggers falls outside ± 0.5 ^{o}C of the grand mean temperature (mean of the means) of all the loggers.

Footnotes

*: VRMP and VRMP volunteer group equipment must be able to make measurements, for a given parameter, at least down to the minimum detection limit and at least up to the maximum detection limits shown in the "Measurement Range" column for the equipment and data to be considered valid for the program.

**: Resolution values indicate minimum resolution values [but not necessarily minimum detection limits] that must be attained by field or lab equipment for it to be considered valid by the VRMP. Equipment that has better resolution than required minimum standards is acceptable.

***: Dissolved oxygen (D.O.) data collected between dawn and 8:00 AM are important for assessment of attainment of D.O. criteria within Maine's Water Quality Standards. But, except as naturally occurs, D.O. concentrations below the applicable D.O. criteria at any time of day signal non-attainment. If there are no D.O. concentrations below the criteria after 8:00 AM, then data between dawn and 8:00 AM must be collected to assess attainment of the criteria.

1: American Society for Testing and Materials (ASTM), 2000, Standard test methods for determining sediment concentration in water samples: Method D 3977-97, vol. 11.02, Water (II), 395-400.

2: Gray, J. R, G. D. Glysson, L. M. Turcios, and G. E. Schwarz. 2000. Comparability of Suspended-Sediment Concentration and Total Suspended Solids Data. U. S. Geological Survey. Water-Resources Investigations Report 00-4191. Reston, Virginia. 14 pp.

3: Allan, J. D. and M. M. Castillo. 2007. Stream ecology: structure and function of running waters. Springer, Dordrecht, Netherlands, 436 pp., 2nd edition.

4: "Field duplicates" are extra samples or monitoring replicates that are collected immediately after the initial sample was collected so that precision can be estimated. For water grab samples, this involves collecting a duplicate grab sample after collecting an initial grab sample for a given parameter. For water quality meters, thermometers, or similar field equipment, the field duplicate consists of lowering the meter's probe back into the water immediately after the initial reading was taken. "Lab split" refers to a precision estimation technique used by laboratories in which they take the initial water grab sample, mix well, and split into two samples. Then analyses are made on the two new samples to see how close they were to each other.

5: Some possible standard solutions:
- Myron L Company; Total Dissolved Solids/Conductivity Standard Solution 442™ Standard Solution (30ppm / 46.7µS); (formula 442 is intended for lakes, streams, etc.)
- Oakton; Conductivity Standard Solution, 84 µS

Table 3c. Typical sampling techniques and sample preservation methods for common water quality parameters of the VRMP.

* Reference for sample container type and holding time (except bacteria and salinity): USEPA. 1983. Methods for Chemical Analysis of Water and Wastes. VRMP-approved laboratories (see section 4.5 and Appendix 11 of QAPP) shall be consulted regarding container types/volumes that should be used for specific projects.

Parameter	Sampling Techniques	Typical Sample Volume*	Sample Container Type* / Preparation	Sample Preservation / Maximum Holding Time*	Analysis Location
Dissolved Oxygen	Place field meter in channel; *or* use Winkler-style chemical kit	--	Kit: Glass sample collection bottle	For kits: (*Preservation*): Fix immediately, store in the dark. (*Sample Temperature*): Store (a) at the temperature of the collected water or (b) water-sealed and kept 10°C - 20°C. (*Max. Hold. Time*): 8 hrs.	Field (or lab for kit)
Salinity	*Usually measured in the field with a meter* (however, when salinity, spec. cond. or TDS can't be measured in the field, they can be analyzed in a lab)	--	Plastic or Glass	Cool, 4 ^{o}C; 28 days	Field (or lab for conductance and TDS)
Specific Conductance			Plastic or Glass	Cool, 4 ^{o}C; 28 days	
Total Dissolved Solids			Plastic or Glass	Cool, 4 ^{o}C; 7 days	
Temperature (instantaneous)					
pH					
Temperature (continuous)	Optic Stowaway data logger	--	--	--	Record in field; download onto office computer using appropriate logger software
Total Kjeldahl Nitrogen	Grab sample	250 ml	Plastic or Glass	Cool, 4^{o}C; H_2SO_4 to pH<2; 28 days (speak with lab about the H_2SO_4 & safety; they may add the acid)	VRMP certified lab
Nitrate or Nitrite	Grab sample	250 ml	Plastic or Glass	Cool, 4^{o}C; 48 hr	VRMP certified lab
Total Phosphorus	Grab sample	55 ml	Plastic or Glass	Cool, 4^{o}C; H_2SO_4 to pH<2; 28 days (speak with lab about the H_2SO_4 & safety; they may add the acid)	VRMP certified lab
Ortho-Phosphate	Grab sample	250 ml	Plastic or Glass	Cool, 4^{o}C; 48 hr	VRMP certified lab
Chloride	Grab sample	250 ml	Plastic or Glass	(Cooling not required); 28 days	VRMP certified lab
Total Suspended Solids	Grab sample	500 ml	Plastic or Glass	Cool, 4^{o}C; 7 days	VRMP certified lab
Suspended Sediment Concentration	Grab sample	500 ml	Plastic or Glass	Cool, 4^{o}C; 7 days	VRMP certified lab
Turbidity	Grab sample	500 ml	Plastic or Glass	Cool, 4^{o}C; 48 hr	VRMP certified lab
Hardness	Grab sample	250 ml (x 2)	Plastic or Glass	Cool, 4^{o}C; HNO_3 to pH<2; 6 months (speak with lab about the HNO_3 & safety)	VRMP certified lab
Alkalinity	Grab sample	250 ml (x 2)	Plastic or Glass	Cool, 4^{o}C; 14 days	VRMP certified lab
Bacteria	Grab sample	100 ml	Sterile Plastic or Glass (e.g., Whirl-pak or new cubitainer)	Cool, < 10^{o}C; 6 hr (Samples must processed within 2 hr of arriving at laboratory.)	VRMP certified lab