WATER QUALITY MONITORING QUALITY ASSURANCE WORKSHOP

WORCESTER, MA

MAY 2, 2019

MassDEP

Massachusetts Rivers Alliance

Water Resources Research Center

TERMINOLOGY

- STUDY DESIGN
- QAPP QUALITY ASSURANCE PROJECT PLAN
- SAP SAMPLING AND ANALYSIS PLAN
- SOP STANDARD OPERATING PROCEDURES
- DQO DATA QUALITY OBJECTIVES

STUDY DESIGN

"A document that outlines the monitoring program, including how it fits within your organization's objectives and goals " - *ALLARM*

QAPP

The Quality Assurance Project Plan is “a document that outlines the procedures and measures used to ensure the quality of the data when collecting and analyzing the samples and managing the data “ - *ALLARM*

SAMPLING AND ANALYSIS PLAN

A document that outlines the field and lab procedures followed in the monitoring program. Usually specific to a monitoring year.

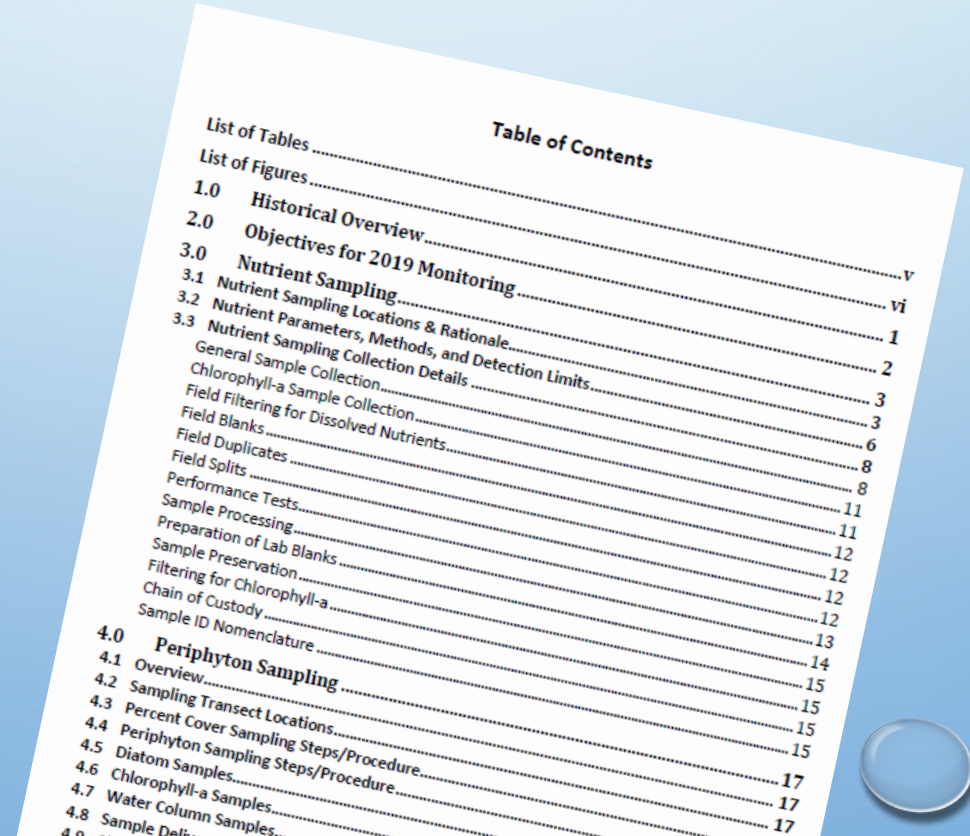
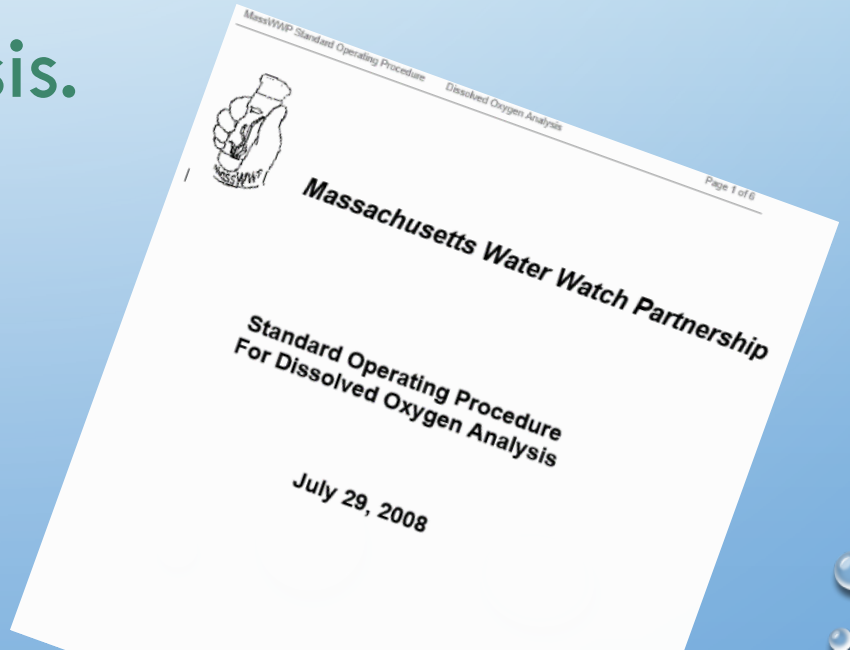


Table of Contents

STANDARD OPERATING PROCEDURES

An SOP is a document that describes in detail how to take samples or measurements in the field or how to perform a laboratory analysis.



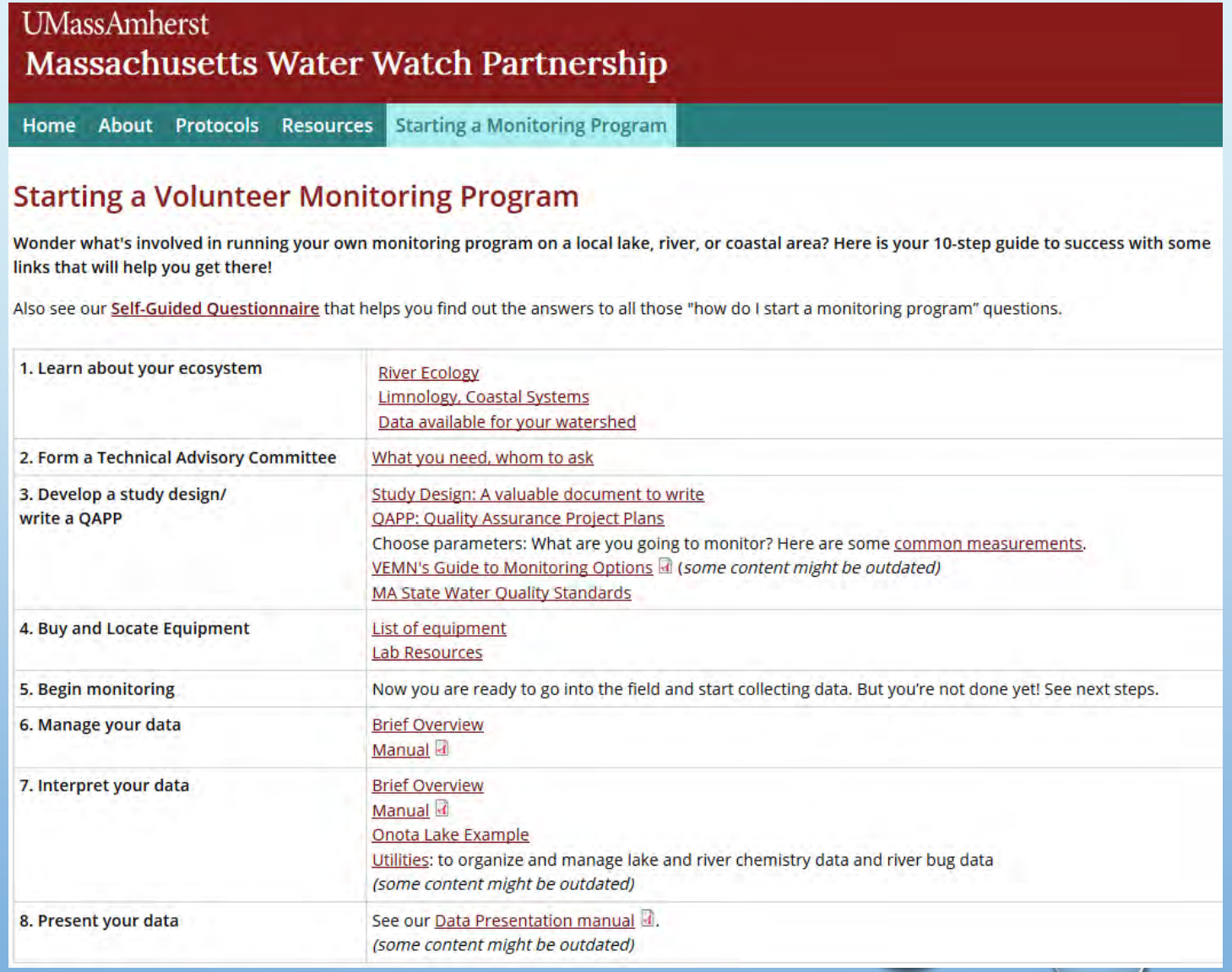
DATA QUALITY OBJECTIVES

DQOs are the qualitative and quantitative terms used to describe how good your data needs to be to meet project objectives.

"Collect water quality data to determine the likelihood that waterbodies in the Blackstone River Watershed meet state water quality standards"

Parameter	Field Precision (%RPD)	Lab Precision (%RPD)	Accuracy (%R)	Field Blank Cleanliness
Water Column				
Total Phosphorus	≤ 30%	≤ 20%	80-120%	< RL

WATER QUALITY MONITORING PLANNING PROCESS



UMassAmherst
Massachusetts Water Watch Partnership

Home | About | Protocols | Resources | Starting a Monitoring Program

Starting a Volunteer Monitoring Program

Wonder what's involved in running your own monitoring program on a local lake, river, or coastal area? Here is your 10-step guide to success with some links that will help you get there!

Also see our Self-Guided Questionnaire that helps you find out the answers to all those "how do I start a monitoring program" questions.

1. Learn about your ecosystem	River Ecology Limnology, Coastal Systems Data available for your watershed
2. Form a Technical Advisory Committee	What you need, whom to ask
3. Develop a study design/ write a QAPP	Study Design: A valuable document to write QAPP: Quality Assurance Project Plans Choose parameters: What are you going to monitor? Here are some common measurements. VEMN's Guide to Monitoring Options *(some content might be outdated)* MA State Water Quality Standards
4. Buy and Locate Equipment	List of equipment Lab Resources
5. Begin monitoring	Now you are ready to go into the field and start collecting data. But you're not done yet! See next steps.
6. Manage your data	Brief Overview Manual
7. Interpret your data	Brief Overview Manual Onota Lake Example Utilities: to organize and manage lake and river chemistry data and river bug data *(some content might be outdated)*
8. Present your data	See our Data Presentation manual. *(some content might be outdated)*

MONITORING PROGRAM ACTIVITIES

- **BEFORE SAMPLING BEGINS**
  - Study Design
  - QAPP
  - Training

- **DURING/IMMEDIATELY AFTER SAMPLING**
  - Sample Collection
  - Lab Analysis

- **AFTER SAMPLING & ANALYSIS**
  - Data Management
  - Data Analysis
  - Data Review, Validation & Verification
  - Data Submission (optional)
  - Data Presentation
  - Program Evaluation

WHY DO YOU NEED (WHO GIVES?) A QAPP?

- As a guidance document to clearly outline monitoring objectives, how data will be used, what steps are needed to meet your goals and Data Quality Objectives.
- Regardless of what your goals are, developing a QAPP ensures you will collect data that can be used for its intended purpose.
- If want data to be used by DEP, having an approved QAPP is a requirement.
- May be required to have a QAPP to obtain monitoring grants from the State of Massachusetts or from EPA.

Up-front time spent writing a QAPP will save a great deal of time and headaches throughout the sampling year!

STEPS TO QAPP DEVELOPMENT

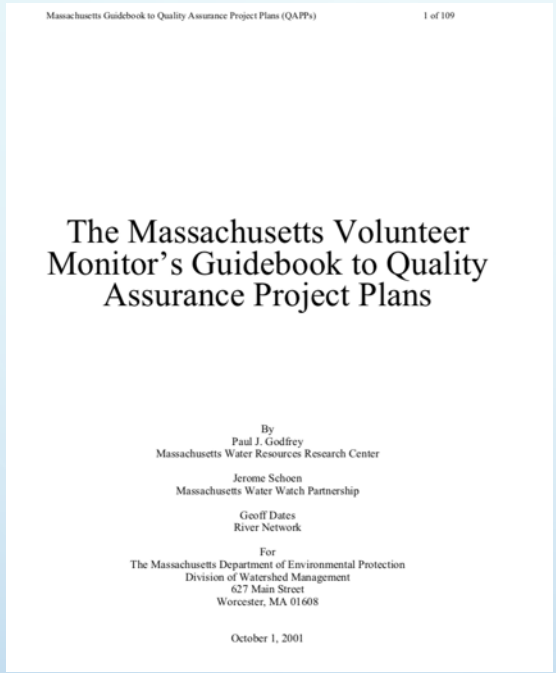
<u>This session will cover:</u>

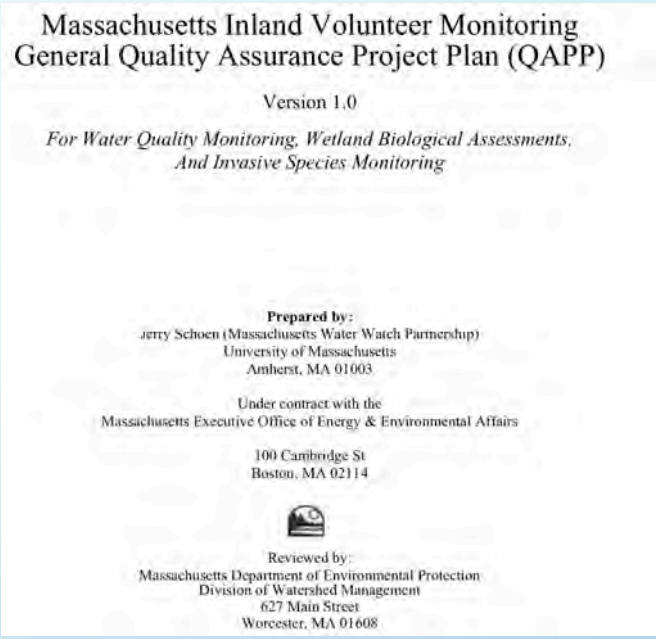
The process of writing a QAPP

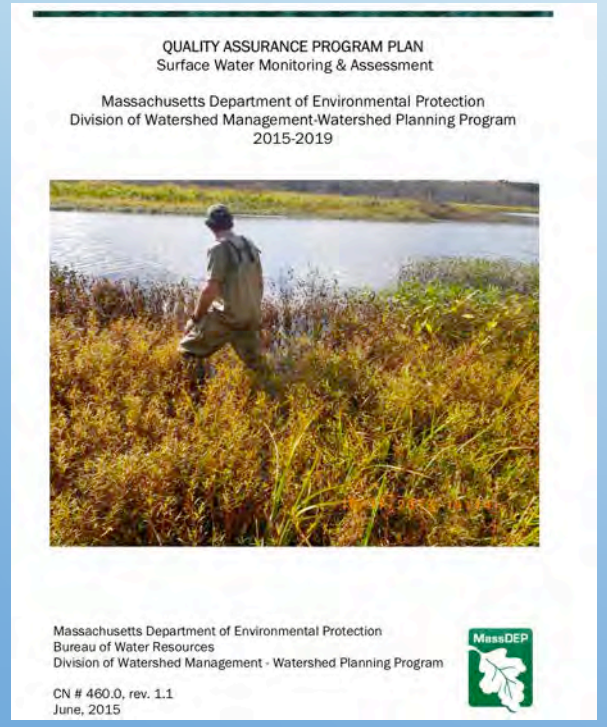
Details on major elements or sections of QAPP:

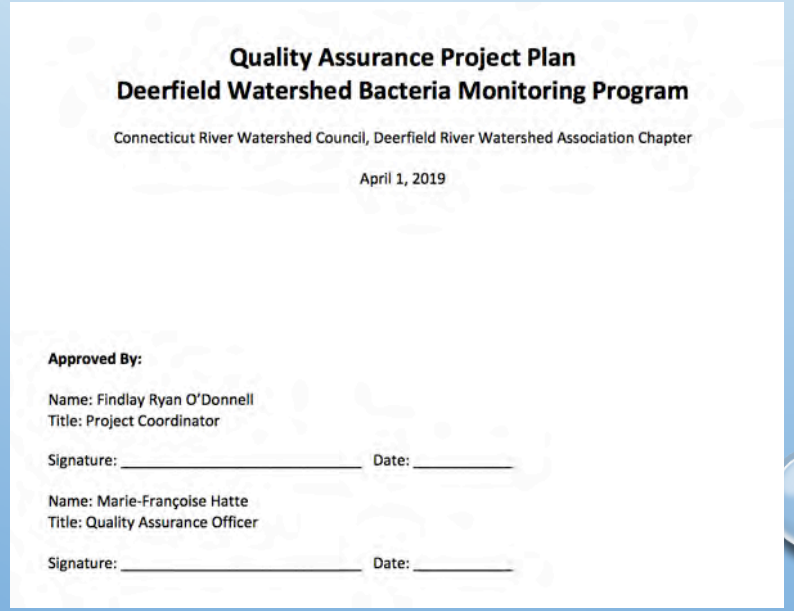
- What each means
- What to include
- Where to obtain needed information/ how to decide what to write

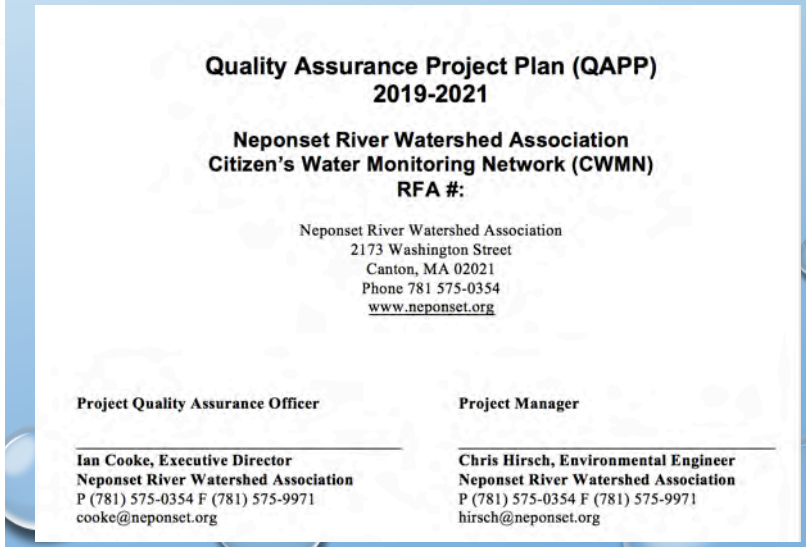
Supporting Documents











STEPS TO DEVELOPING A QAPP

1. ESTABLISH A QAPP TEAM
2. DETERMINE THE GOALS AND OBJECTIVES OF YOUR PROJECT
3. COLLECT BACKGROUND INFORMATION
4. REFINE YOUR PROJECT
5. DESIGN YOUR SAMPLING, ANALYTICAL AND DATA REQUIREMENTS
6. DEVELOP AN IMPLEMENTATION PLAN
7. DRAFT SOPS AND QAPP
8. SOLICIT FEEDBACK ON SOPS AND QAPP
9. REVISE AS NEEDED, SUBMIT FOR FINAL APPROVAL
10. BEGIN YOUR MONITORING PROJECT
11. EVALUATE AND REFINE YOUR QAPP

Comparison of Guidance Documents

1993 EPA "The Volunteer Monitor's Guide to Quality Assurance Project Plans"	2019 EPA "Citizen Scient Quality Assurance and Documentation Handbook" and templates	2001 EPA "EPA Requirements for Quality Assurance Project Plans" EPA QA/R-5 and companion "Guidance for Quality Assurance Project Plans" EPA QA/G-5
Chapters 1-3 Introduction on how to develop a QAPP and definitions / explanations of terms and concepts	Pages 1-9 Introduction and emphasis on tiered approach to QAPP development	Chapter 1 -2 provides overview
PROJECT MANAGEMENT	**MANAGING THE PROJECT**	**GROUP A: PROJECT MANAGEMENT ELEMENTS**
1. Title and Approval	1. Title and Approval	A1 Title and Approval Sheet
2. Table of Contents	2. Table of Contents (optional for Education/Understanding QAPPs)	A2 Table of Contents
3. Distribution List	19. Distribution List (optional for Education/Understanding QAPPs)	A3 Distribution List
4. Project/Task Organization	17. Organization Chart (optional for Education/Understanding QAPPs)	A4 Project/Task Organization
5. Problem Identification	3(A) Problem Definition and 3(B) Background	A5 Problem Definition/ Background
6. Project/Task Description (including project schedule)	3(C) Project Description and 5 Project Schedule	A6 Project/Task Description
7. Data Quality Objectives for Measurement Data	4. Data Quality Objectives and Indicators (with clear table of DQIs)	A7 Quality Objectives and Criteria
8. Training Requirements	6. Training and Specialized Experience	A8 Special Training/Certification
9. Documentation and Records	7. Documents and Records	A9 Documents and Records
MEASUREMENT/DATA ACQUISITION	**COLLECTING THE DATA**	**GROUP B: DATA GENERATION AND ACQUISITION ELEMENTS**
10. Sampling Process Design (including SOP citations, sampling locations)	9(A) Sampling Methods (including methods, locations, sampling frequency, quality control measures broken out by sample/monitoring type)	B1 Sampling Process Design (Experimental Design)
11. Sampling Methods Requirements (includes equipment, containers, preservation, hold times, sample type, any decontamination)	9(B) Sampling Methods – Data Collection Methods (including parameters, locations, type of QC, number of samples, SOPs, rationale	B2 Sampling Methods
12. Sampling Handling and Custody	9. Sampling Handling (includes sample ID process)	B3 Sample Handling and Custody
13. Analytical Methods Requirements	12. Analytical Methods (includes containers and preservation)	B4 Analytical Methods
14. Quality Control Requirements	13. Field and Laboratory Quality Control	B5 Quality Control

Comparison of Guidance Documents - Continued

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MEASUREMENT/DATA ACQUISITION	**COLLECTING THE DATA**	**GROUP B: DATA GENERATION AND ACQUISITION ELEMENTS**
15. Instrument/Equipment Testing, Inspection, and Maintenance Requirements	11. Equipment/Instrument Maintenance, Testing, Inspection and Calibration	B6 Instrument/Equipment Testing, Inspection, and Maintenance
16. Instrument Calibration and Frequency		B7 Instrument/Equipment Calibration and Frequency
17. Inspection/Acceptance Requirements for Supplies		B8 Inspection /Acceptance of Supplies and Consumables
18. Data Acquisition Requirements	8. Existing Data	B9 Non-Direct Measurements
19. Data Management	14. Data Management	B10 Data Management
ASSESSMENT AND OVERSIGHT	ASSESSING THE DATA	GROUP C: ASSESSMENT AND OVERSIGHT ELEMENTS
20. Assessment and Response Actions	15. Reporting, Oversight and Assessments and some of 14	C1 Assessments and Response Actions
21. Reports		C2 Reports to Management
DATA VALIDATION AND USABILITY	**REVIEWING THE DATA**	**GROUP D: DATA VALIDATION AND USABILITY ELEMENTS**
22. Data Review, Verification, and Validation	16. Data Review and Usability (more sensibly described!)	D1 Data Review, Verification, and Validation
23. Verification and Validation Methods		D2 Verification and Validation Methods
24. Reconciliation with User Requirements		D3 Reconciliation with User Requirements

Elements of a QAPP

Project Management

1. Title and Approval Page
2. Table of Contents
3. Distribution List
4. Project/Task Organization
5. Problem Identification/ Background

6 Project/Task Description

7 Data Quality Objectives for Measurement Data

8 Training Requirements/Certification

9 Documentation and Records

Measurement/Data Acquisition

10. Sampling Process Design
11. Sampling Methods Requirements
12. Sample Handling and Custody
13. Analytical Methods Requirements
14. Quality Control Requirements
15. Instrument/Equipment Testing, Inspection, and Maintenance Requirements
16. Instrument Calibration and Frequency
17. Inspection/Acceptance Requirements for Supplies
18. Data Acquisition Requirements
19. Data Management

Assessment and Oversight

20. Assessment and Response Actions
21. Reports

Data Validation and Usability

22. Data Review, Validation and Verification
23. Validation and Verification Methods
24. Reconciliation with Data Quality Objectives

STEPS TO DEVELOPING A QAPP

1. ESTABLISH A QAPP TEAM
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3. COLLECT BACKGROUND INFORMATION
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8 Training Requirements/Certification

9 Documentation and Records

Measurement/Data Acquisition

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18. Data Acquisition Requirements
19. Data Management

Assessment and Oversight

20. Assessment and Response Actions
21. Reports

Data Validation and Usability

22. Data Review, Validation and Verification
23. Validation and Verification Methods
24. Reconciliation with Data Quality Objectives

Elements of a QAPP – Suggested completion order

Project / Task Organization (#4. draft… finish later)
Problem Identification / Background (#5)
Project / Task Description (#6)

Data Quality Objectives for Measurement Data (#7)
Sampling Process Design (#10)
Sampling Methods Requirements (#11)
Sample Handling and custody Requirement (#12)
Analytical Methods Requirements (#13)
Quality Control Requirements (#14)

Instruments/Equipment Testing, Inspections, and Maintenance Requirements (#15)
Instrument Calibration and Frequency (#16)
Inspection / Acceptance Requirements for Supplies (#17)
Training Requirements / Certification (#8)

Elements of a QAPP – Suggested completion order, continued

Documentation and Records (#9)
Data Management (#19)
Data Acquisitions Requirements (#18)

Data Review, Validation, and Verification Requirements (#22)
Validation and Verification Methods (#23)
Reconciliation with Data Quality Objectives (#24)

Reports (#21)

Assessment and Response Actions (#20)

Project / Task Organization (#4. final version)
Distribution List (#3)
Title and Approval Page (#1)
Table of Contents (#2)

Problem Identification / Background

EPA Element # 5

A. Problem Definition

"This section describes the environmental problem, question or threat to be addressed, explains why this work needs to be done, and provides a framework for determining the project purpose, the use of the data, and the project objectives."

B. Background

"This is an opportunity to describe the history of the project (or environmental problem), relevant previous studies, and how this project fills in a data gap (including from existing data) or complements existing information."

- Citizen Science Quality Assurance and Documentation. EPA, 2019

Problem Identification / Background

EPA Element # 5

From MA VM QAPP Guidebook

- Describe your organization
- Describe your watershed and waters of interest
- Describe the current status of your waters of interest
- State water quality issues of concern
- Describe information needed to address the concern
- List your monitoring questions
- What are your monitoring purposes?
- List intended users, uses of information you collect

5. Background of DRWA Volunteer Bacteria Monitoring Program

Deerfield River Watershed Association QAPP 2019

The Deerfield River Watershed encompasses approximately ***665 square miles...*** The… River is widely regarded as one of the ***coldest and cleanest rivers in Massachusetts*** and attracts many ***sport-fishermen and whitewater enthusiasts.*** However, ***nonpoint source pollution*** has degraded segments … and poses a threat to other tributaries ... The ***DRWA has intermittently monitored*** the water quality … since 1990 to document the current quality of the watershed.

… DRWA started ***monitoring fecal coliform bacteria at popular recreation sites*** to provide data in the intervening years [between DEP monitoring schedules] … In 1999 DRWA monitored bacteria above and below … WWTPs and at a few recreational sites… ***high counts of bacteria*** were recorded from at least one … site, ***exceeding the Massachusetts Surface Water Quality Standards*** Class B standards... This finding prompted a ***focused examination of bacteria levels in 2003***... However, concerns of impairment … persist. According to the Massachusetts Year ***2016 Draft Integrated List of Waters***, the lower nineteen miles of the mainstem and four important tributaries of the Deerfield are assigned to ***Category 5 Waters for pathogens***…

5. Background of DRWA Volunteer Bacteria Monitoring Program

Deerfield River Watershed Association QAPP 2019 – continued

DRWA ***resumed monitoring*** of bacteria in the Deerfield watershed in 2017. …the ***Connecticut River Conservancy (CRC) provides [lab services].*** Through [this] support, DRWA has been able to test bacteria in …and include testing parameters besides bacteria in Massachusetts. In 2019, CRC received the ***bacteria grant from MA DEP that will help cover the costs of testing bacteria*** in the Massachusetts portion of the watershed.

Problem Statement

…MassDEP and … VT DEC have identified several potential sources of nonpoint pollution in the Deerfield Watershed, including ***failing septic systems, stormwater runoff, road runoff from paved and unpaved roads …and agricultural activities*** in close proximity to rivers and streams.

In Massachusetts, approximately nineteen (19) river miles … have been assigned to Category 5 (waters that require a … (TMDL calculation)…other river segments remained unassessed for recreation.

In Vermont, there is a bacteria TMDL … Monitoring over the past 2 years suggests that the TMDL area ***may need to be extended…*** Vermont is on a 5-year watershed basin planning cycle. The Deerfield Watershed is currently undergoing its basin planning process.

Problem Identification / Background

Neponset RWA QAPP 2019

A5-1 Watershed Description

The Neponset River Watershed covers 117 square miles…

A5-2 Organizational Background

The Neponset River Watershed Association (NepRWA) is …

A5-3 Sources of Impairment and Pollutants of Concern

Remaining water quality problems in the watershed include …

Current pollutants of concern in the Neponset Watershed include…

A5-4 Past Sampling Efforts

The Massachusetts DEP completed a very comprehensive water quality assessment …

The CWMN program has been working to fill water quality information gaps and facilitate water quality improvement for more than 20 years…

Sources of Information About Massachusetts Waters

1. Mass Water Quality Standards: http://www.mass.gov/eea/agencies/massdep/water/regulations/314-cmr-4-00-mass-surface-water-quality-standards.html
2. Massachusetts Water Quality Assessments. "Look here for reports on the condition of watersheds in Massachusetts": http://www.mass.gov/eea/agencies/massdep/water/watersheds/water-quality-assessments.html#3
3. Integrated List of Waters: https://www.mass.gov/lists/integrated-lists-of-waters-related-reports
4. TMDLs: http://www.mass.gov/eea/agencies/massdep/water/watersheds/total-maximum-daily-loads-tmdls.html#2
5. Older Water Quality Assessment Reports: http://www.mass.gov/eea/agencies/massdep/water/watersheds/water-quality-assessments.html#3

Deerfield River Basin

Category 5 waters listed alphabetically by major watershed
The 303(d) List – "Waters requiring a TMDL"

WATER BODY	SEGMENT ID	DESCRIPTION	SIZE	UNITS	IMPAIRMENT	EPA TMDL NO.
Upper Van Horn Park Pond	MA34128	Springfield (Changed from MA36158 to 34128 on 6/21/02, TRD).	8	ACRES	Nutrient/Eutrophication Biological Indicators	
					Phosphorus (Total)	
Venture Pond	MA34096	Springfield.	7	ACRES	Nutrient/Eutrophication Biological Indicators	
					Oxygen, Dissolved	
					Phosphorus (Total)	
Watershops Pond	MA34099	Springfield.	161	ACRES	Nutrient/Eutrophication Biological Indicators	
Weston Brook	MA34-23	Headwaters, south of State Street (Route 202), Belchertown to mouth at inlet Forge Pond, Granby (WWF applies from the confluence of Lampson Brook in Belchertown to the mouth).	2.7	MILES	Phosphorus (Total)	
Wilton Brook	MA34-15	Headwaters, perennial portion, Easthampton to outlet RubberThread Pond (formerly segment MA34105) , Easthampton.	1.1	MILES	(Non-Native Aquatic Plants*)	
					Aquatic Plants (Macrophytes)	
Deerfield						
Bear River	MA33-17	Headwaters west of Barnes Road, Ashfield to confluence with Deerfield River, Conway.	6.9	MILES	Temperature, water	
CHERRY RUM BROOK	MA33-97	Headwaters, northeast of Stoneleigh Burnham Drive, Greenfield to confluence with Green River, Greenfield.	2.1	MILES	Aquatic Macroinvertebrate Bioassessments	
Davis Mine Brook	MA33-18	Headwaters, south of Dell Road, Rowe to confluence with Mill Brook, Charlemont.	3.3	MILES	Fishes Bioassessments	
					pH, Low	
Deerfield River	MA33-03	Confluence with North River, Charlemont/Shelburne to confluence with Green River, Greenfield.	16.8	MILES	Escherichia coli	
Deerfield River	MA33-04	Confluence with Green River, Greenfield to confluence with Connecticut River, Greenfield/Deerfield.	2	MILES	Escherichia coli	
Dragon Brook	MA33-20	Headwaters, perennial portion north of Patten Road, Shelburne to confluence with the Deerfield River, Shelburne.	4.4	MILES	Temperature, water	
East Branch North River	MA33-19	Vermont line, Colrain to confluence with West Branch North River, Colrain.	7.5	MILES	Escherichia coli	
Green River	MA33-30	From Swimming Pool #2 Dam (National Dam ID MA02321) northwest of Nashs Mill Road, Greenfield to confluence with the Deerfield River, Greenfield (formerly segment MA33-10 and part of segment MA33-09) (HQW applies upstream of former Greenfield WWTF discharge (NPDES# MA0101214), from approximately 0.5 mile upstream of mouth).	3.7	MILES	Escherichia coli	
					Fecal Coliform	
					Turbidity	
Hinsdale Brook	MA33-21	Headwaters east of Fiske Mill Road, Shelburne to confluence with Punch Brook, Greenfield.	2.8	MILES	Escherichia coli	
MILL BROOK	MA33-70	Headwaters, north of West Mountain Road, Bernardston to confluence with Cherry Rum Brook, Greenfield.	8.4	MILES	Aquatic Macroinvertebrate Bioassessments	
Pelham Lake	MA33016	Rowe.	80	ACRES	Mercury in Fish Tissue	
Sherman Reservoir	MA33018	Massachusetts portion only. Rowe/Monroe.	72	ACRES	Mercury in Fish Tissue	
South River	MA33-07	Headwaters, outlet Ashfield Pond, Ashfield to Emments Road, Ashfield.	2.3	MILES	Temperature, water	
SOUTH RIVER	MA33-101	Emments Road, Ashfield to confluence with Johnny Bean Brook, Conway (formerly part of MA33-08).	6.1	MILES	Escherichia coli	
					Fecal Coliform	

Program Goals and Objectives
Part 2 of EPA Element #5

A5 Program Goals and Objectives - DEP

* For "assessment" (reported in "Integrated List" to EPA)
* TMDL-support
* Other objectives
  * Pollutant source ID
  * Establish baseline conditions
  * Long-term trends
  * Post-restoration monitoring

Project Purpose- DRWA

Objectives of Project

The principal objectives of projects under this QAPP are to 1) provide a perspective on the range of ***water quality conditions for recreation*** in the Deerfield River watershed across Vermont and Massachusetts; 2) describe water quality conditions of individual ***tributaries and the mainstem;*** 3) ***establish a database*** for use in documenting ***future changes in water quality;*** and, 4) educate and involve residents in waterbody protection.

Toward those objectives, DRWA will monitor 29 sites for *E. coli* sampling during the recreation season, June through September. This project includes conducting a water quality monitoring program for *E. coli* in the Vermont and the Massachusetts portions of the watershed ***where pathogens have been detected*** during previous sampling efforts undertaken ***by MassDEP and VT DEC***.

Project Purpose- DRWA

B. Intended Uses of Data

The data generated under this QAPP will serve the following uses:

- Use in the ***MassDEP CWA Integrated Report***
- ***Document the presence and severity of bacteria*** as pathogen indicators
- ***Educate school children*** and local communities about water quality, and any problems and improvements.
- ***Evaluate the effectiveness of restoration projects*** and other management activities

A5.6 Program Goals and Objectives – NepRWA

NepRWA's CWMN program seeks to accomplish the following during the period 2019-2021:

- ***Regularly collect in-stream water quality samples*** at a handful of ***"indicator sites"*** that ***represent overall water quality conditions and trends***.
- Regularly collect in-stream water quality samples at a larger number of ***"subwatershed sites"*** that ***target known or suspected problem areas***.
- Conduct ***"follow up" and "special study"*** investigations and sampling as needed to confirm and further specify suspected problem or opportunity areas identified through the regular sampling program.
- …
- Collect in-stream samples ***during rainfall events***.
- ***Distribute results promptly to municipal officials, state and federal regulators*** and the general public as a means to increase understanding of water pollution issues.
- Using fully sterile methods, collect data needed to help implement recommendations of the ***Total Maximum Daily Load (TMDL)*** for bacteria.
- Generate data to help enhance the ***effectiveness of municipal, state, federal and private efforts*** to improve water quality.

Monitoring Objectives & DWM-DEP Data Levels

Educational/Stewardship-level

- Objective is to engage volunteers in monitoring to develop better understanding of the importance of water resources and to encourage their fellow citizens to take an active role in the preservation and restoration of their local water bodies and watersheds.

Screening-level

- Typically used to direct future sampling efforts and as supporting evidence only.

Regulatory/Assessment-level

- Directly usable for 305(b) and 303(d) decision-making.
- Scientifically sound and legally-defensible.
- Contingent on review and approval, these data can help determine if a water body is meeting water quality standards or is impaired.

Monitoring Objectives & DWM-DEP Data Levels

DATA QC REQUIREMENTS	DATA LEVEL		
	Level 1	*Level 2*	*Level 3*
	Educational/Stewardship	**Screening**	**Regulatory/Assessment**
Agency-approved QAPP	No	Yes	Yes
State-certified (or otherwise acceptable) laboratory analysis (parameter-specific)	No	Yes	Yes
Documented QA/QC activities and data quality assessment	No	**Yes/No**	**Yes**
Number of valid results (vs. required sample "N" for decision)	No	**Yes/No**	**Yes**
Representative, documented, and accurately-described sampling locations	No	Yes	Yes
Training	No	**Yes/No**	**Yes**
Data Validation and verification	No	**Yes/No**	**Yes**
Internal field and/or lab audit(s)	No	Yes/No	Yes/No
Project organization	No	**Yes/No**	**Yes**
Data Quality Objectives (relatively stringent and comparable to DWM-WPP's)	No	**Yes/No**	**Yes**
Use of lab(s) and/or calibrated instruments (vs. kit use)	No	**Yes/No**	**Yes**
Documented QC (e.g., instrument calibration) and methods	No	**Yes/No**	**Yes**
External field and/or lab audit(s) by agency/other	No	**No**	**Yes/No**
Calibration of instruments prior to use	No	**Yes/No**	**Yes**
Inspection/maintenance activities (as needed)	No	**Yes/No**	**Yes**
Sufficient metadata documentation (e.g., fieldsheets)	No	**Yes/No**	**Yes**
Voucher sample verification (biological)	No	**Yes/No**	**Yes**

Project /Task Description – EPA Element #6

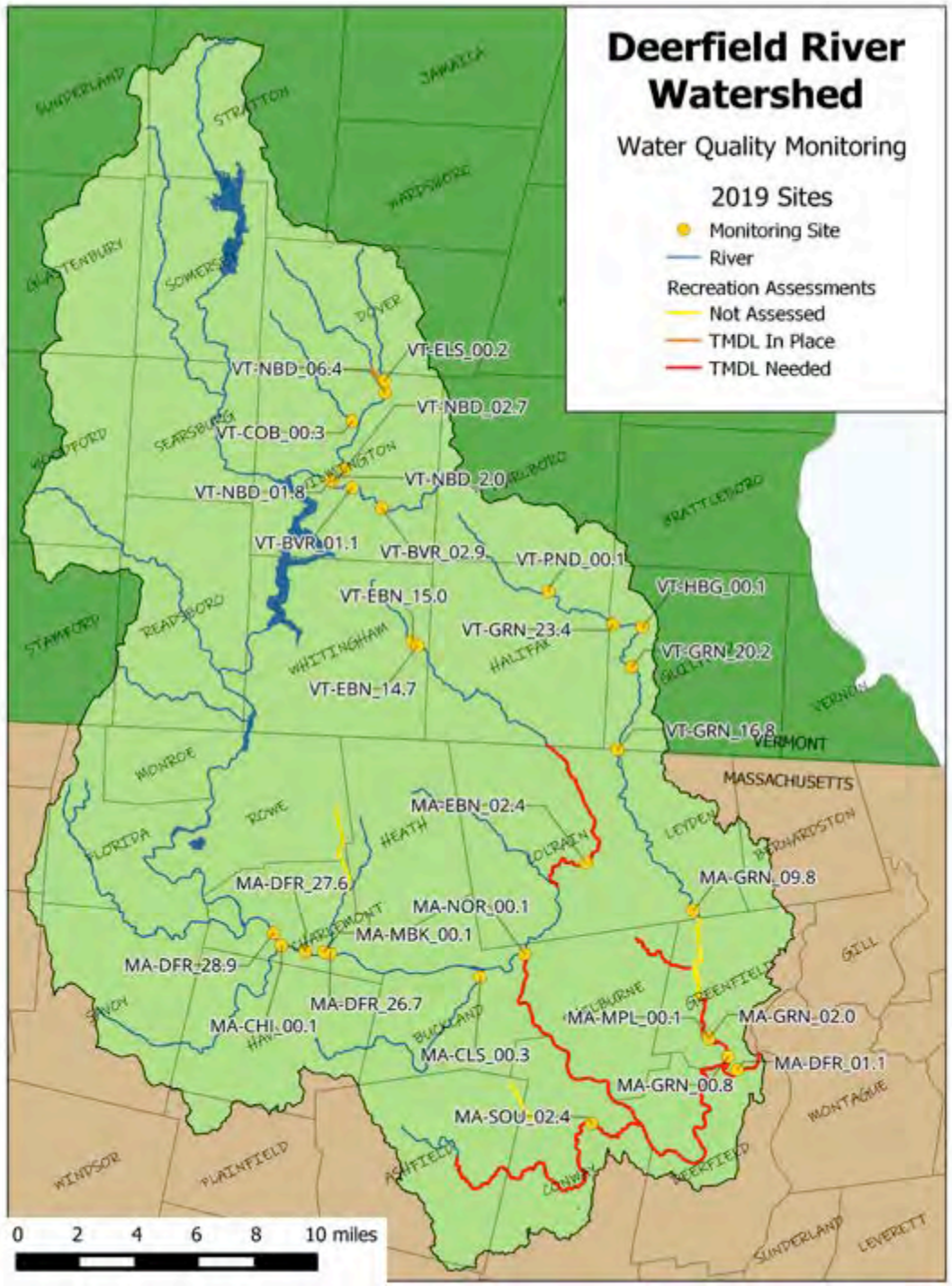
In general terms, describe

- The work your staff/volunteers will perform
- Where it will take place
- What kinds of samples will be taken
- What kinds of conditions will be measured
- How you will evaluate results

DRWA Project Purpose/Task Description

C. Brief Description of Project

- There will be a training and orientation meeting held in March organized by VTDEC but held at VAEL.
- Volunteers will be trained annually prior to the start of the sampling season.
- River water samples will be collected at 29 sites, 6 times between June and September.
- The project will employ the Colilert System developed by IDEXX laboratories, Inc. to assay *E. coli* bacteria. Samples will be analyzed at the CRC laboratory.
- Data will be analyzed and reviewed for quality assurance, summarized and interpreted on an annual basis.
- Data that meet project quality objectives will be submitted to MassDEP and entered in the VTDEC's Water Quality data management system as well as the EPA's national water quality data storage system known as STORET.
- Information will be presented to the local community in a suitable format, be it a press release, public meeting, or another event.
- A report will be prepared and shared with the distribution list in this QAPP and published on the DRWA website (deerfieldriver.org)


Deerfield River Watershed
Water Quality Monitoring
2019 Sites
Monitoring Site
River
Recreation Assessments
Not Assessed
TMDL In Place
TMDL Needed
VT-ELS_00.2
VT-NBD_06.4
VT-NBD_02.7
VT-COB_00.3
VT-NBD_01.8
VT-NBD_2.0
VT-BVR_01.1
VT-BVR_02.9
VT-PND_00.1
VT-HBG_00.1
VT-EBN_15.0
VT-GRN_23.4
VT-GRN_20.2
VT-EBN_14.7
VT-GRN_16.8
VERMONT
MASSACHUSETTS
MA-EBN_02.4
MA-GRN_09.8
MA-DFR_27.6
MA-NOR_00.1
MA-MBK_00.1
MA-DFR_28.9
MA-DFR_26.7
MA-CHI_00.1
MA-MPL_00.1
MA-GRN_02.0
MA-CLS_00.3
MA-DFR_01.1
MA-GRN_00.8
MA-SOU_02.4
0 2 4 6 8 10 miles

Site ID	Site Name	Town	Rationale	Lat	Lon
Deerfield River Mainstem and Branches					
VT-NBD_06.4	East Dover Rd	Wilmington	Monitor above most ag and below golf course	42.91431	-72.8376
VT-NBD_02.7	Above Wilmington Center	Wilmington	Monitor within ag and above village center	42.87452	-72.864
VT-NBD_02.0	Wilmington Center above confl w Beaver Brk	Wilmington	Monitor for high bacteria/nutrients and Beaver Brk contribution	42.86816	-72.8721
VT-NBD_01.8	Wilmington Center below confl w Beaver Brk	Wilmington	Swim hole/high bacteria/nutrients	42.86875	-72.8738
MA-DFR_28.9	Shunpike Rest Area	Charlemont	Monitor Deerfield River coming from VT	42.6363	-72.9071
MA-DFR_27.6	Above Charlemont Center	Charlemont	Bracket WWTF, Mill Brk	42.6271	-72.8853
MA-DFR_26.7	Charlemont Center	Charlemont	Bracket WWTF, Mill Brk	42.6262	-72.8685
MA-DFR_01.1	5 & 10 Bridge	Greenfield	Monitor Deerfield contributions to CT River	42.56975	-72.5922
North River					
VT-EBN_15.0	Above Jacksonville WWTF	Whitingham	Bracket WWTF	42.787	-72.8163
VT-EBN_14.7	Below Jacksonville WWTF	Whitingham	Bracket WWTF	42.78456	-72.8128
MA-EBN_02.4	Foundry Village Rd Ballfields	Colrain	Swim hole	42.67478	-72.6966
MA-NOR_00.1	Formerly Sunburn Beach	Colrain	Mouth of North River	42.65286	-72.7141
Green River Watershed					
VT-PND_00.1	Mouth of Pond Brook	Halifax	Green River reclassification in support of Green River Watershed Alliance grant	42.8135	-72.7243
VT-GRN_23.4	Hinesburg Rd	Guilford	Green River reclassification in support of Green River Watershed Alliance grant	42.79717	-72.6804
VT-HBG_00.1	Mouth of Hinesburg Brook	Guilford	Green River reclassification in support of Green River Watershed Alliance grant	42.79582	-72.6605
VT-GRN_20.2	Green River Timber Crib Dam swim hole	Guilford	Swim Hole/Green River reclassification in support of Green River Watershed Alliance grant	42.77555	-72.6673
VT-GRN_16.8	MA/VT State Line	Guilford	Green River reclassification in support of Green River Watershed Alliance grant	42.73299	-72.6761
MA-GRN_09.8	Bare Ass Beach	Greenfield	Swim Hole	42.65102	-72.6235
MA-MPL_00.1	Mouth of Maple Brook	Greenfield	ID source of bacteria/nutrients	42.58667	-72.6124
MA-GRN_02.0	Mohawk Trail Bridge	Greenfield	ID source of bacteria/nutrients	42.58554	-72.6117

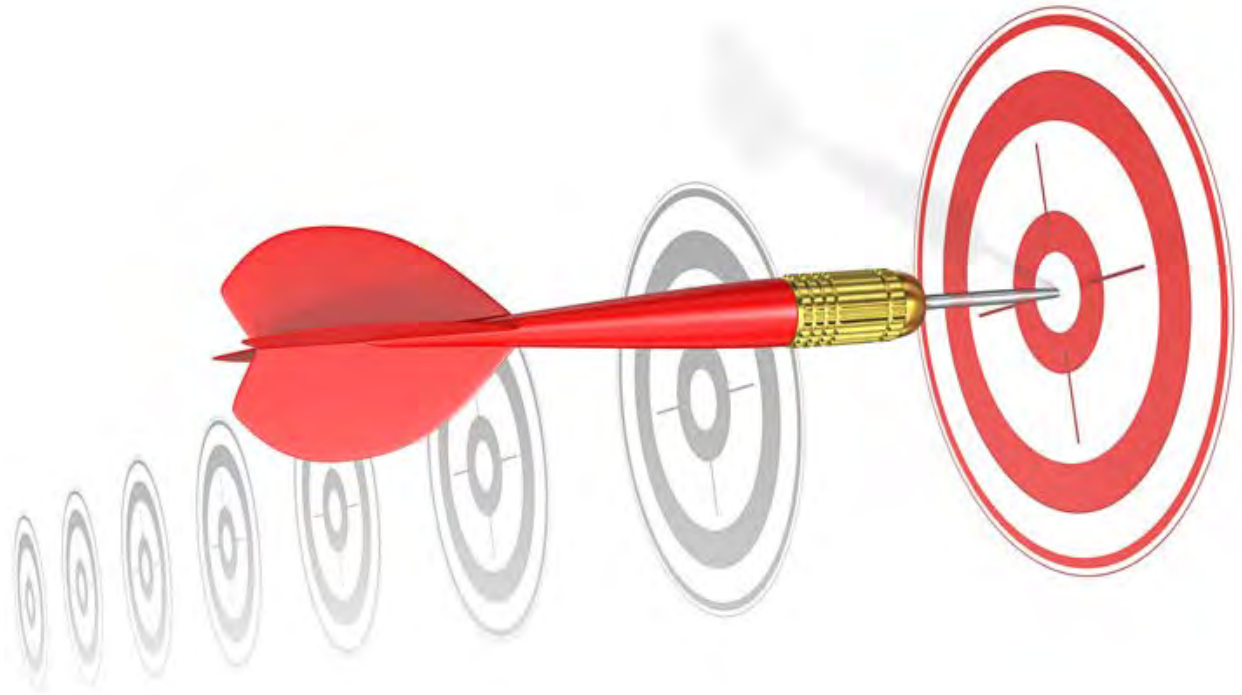
Deerfield River Watershed Association Project / Task Description

Table 3: Project Tmetable

Activity	Projected Start Date	Anticipated Completion Date
Project Planning Meeting	January 2019	Late March 2019
Fill out and submit this QAPP to MADEP	April 2019	April 2019
QAPP Approved by MADEP	May 2019	May 2019
Training Volunteers/Samplers	June 2019	June 2019
Sampling Begins	June 26, 2019	June 26, 2019
Sampling Ends	September 4, 2019	September 4, 2019
Analytical Results Evaluated * Check/Correct Errors Due to Math Miscalculations or Transferring Data from Field/Lab Forms * Confirm Useable/Unusable Data	June 2019	October 2019
Data Entered into spreadsheet and entered in ctriver.us	After receipt of lab results	1-2 weeks after database is opened for review
QC Review of Data entry	November 2019	November 2019
Data Summarized	December 2019	December 2019
Submit Final Report	January 2019	January 2019
Presentation(s) of Information at Local Meeting (s) or other venue(s)	E. Coli results published immediately	Report January 2020

Data Quality Objectives - EPA Element # 7

- **Precision**
- **Accuracy**
- **Representativeness**
- **Comparability**
- **Completeness**



Precision

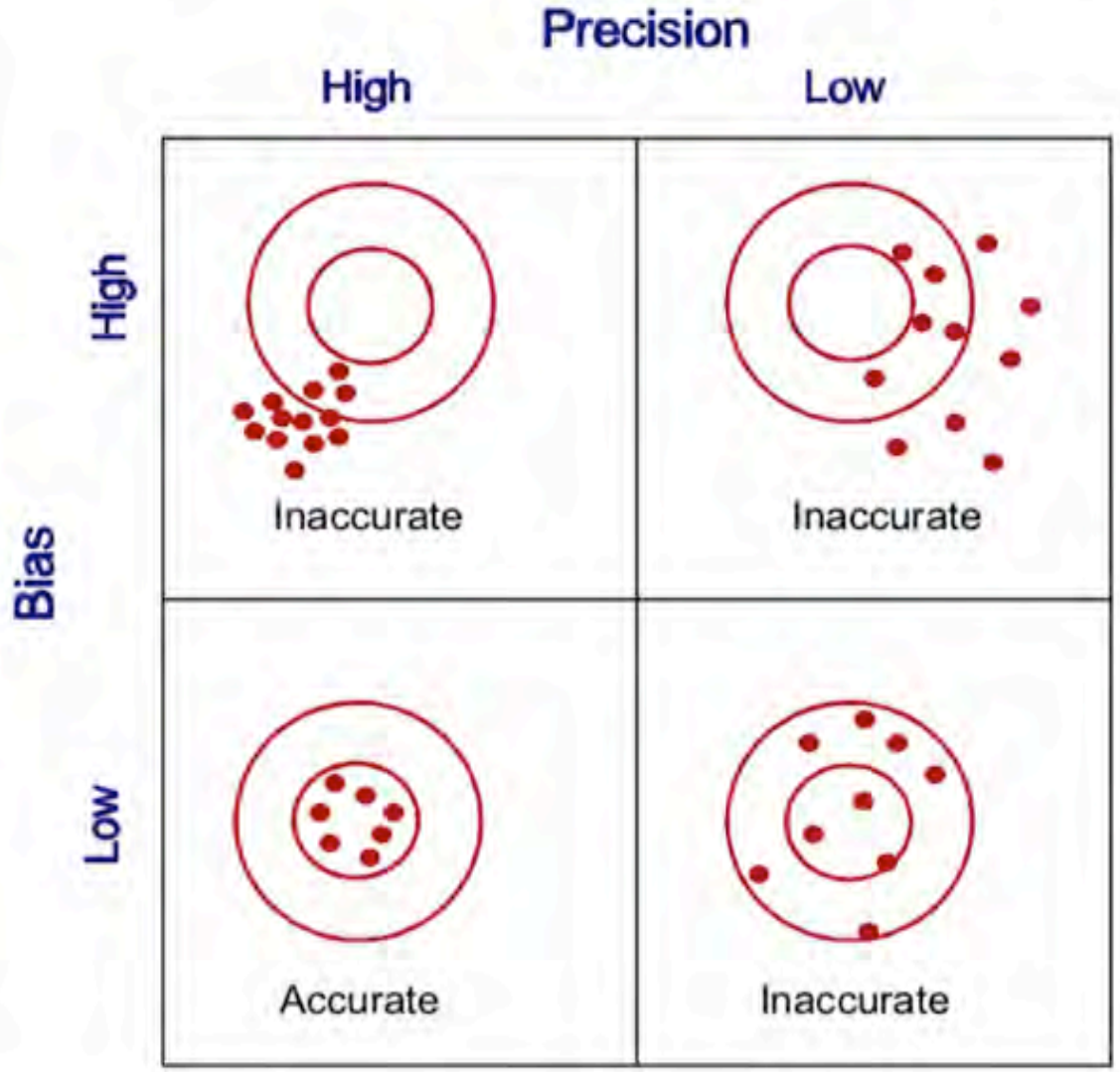
The degree of agreement among repeated measurements of an indicator on separate samples collected as close as possible in time and place.

It does not mean that the sample actually reflects the "true" value, but rather that your sampling and analysis are giving consistent results under similar conditions.

Accuracy

Accuracy *or* Bias is a measure of confidence that describes how close a measurement is to its "true" value.

PRECISION, BIAS, AND ACCURACY




WEIGHT
LIMIT
ON BRIDGE
5
TONS

Indicator	Units	Minimum Detection Limit	Accuracy/Bias[1,2]	Overall Precision[3]	Approx. Potential Range[4]
DO	mg/l	0.0	+0.5 for zero standard	<0.5 difference between dups	0.0-15.0
BOD	mg/l	0.0	Within lab control limits for glucose-glutamic acid and dilution water blank checks	<1.0 difference between dups	0.0-10.0
Temperature	°C	0.0	±0.5 °C in comparison to NIST-traceable thermometer	+/- 0.5 °C	0.0-30.0
Conductivity	µS/cm	25	±5% of known QC std.	10% RPD	10-2000 (freshwater)
pH	pH units	NA	±0.2 of QC standard	± 0.2	4.0-10.0
TP (water)	mg/l P	0.005	80-120 % recovery for QC std. and lab fortified matrix	± 0.005 mg/l if less than 0.050 mg/l or 20% RPD if more than 0.050 mg/l	0.000-0.500
Alkalinity	mg/l CaCO3	-5.0	80-120 % recovery for QC std. and lab fortified matrix	± 2.0 mg/l if less than 20 mg/l or or 20% RPD if more than 20 mg/l	-5.0 to 150.0
Ammonia Nitrogen	mg/l N	.010	80-120 % recovery for QC std. and lab fortified matrix	± 0.01 if less than 0.1 mg/l or 20% RPD if more than 0.1 mg/l	0.00-1.0
Nitrate Nitrogen	mg/l N	.010	80-120 % recovery for QC std. and lab fortified matrix	± 0.02 if less than 0.1 mg/l or 20% RPD if more than 0.1 mg/l	0.00-2.0
Kjehldahl Nitrogen	mg/l N	.025	80-120 % recovery for QC std. and lab fortified matrix	± 0.20 if less than 0.5 mg/l or 20% RPD if more than 0.5 mg/l	0.00-2.0
Secchi disk Transparency	m	0.2	NA	± 0.2 m for duplicate readings by the same monitor, as well as	0.0-10.0

DRWA Data Precision and Accuracy

Table 4: Measurement Quality Goals

Parameter	Reporting Limit	Accuracy (% Recovery)	Field Precision (RPD)	Expected Range
E. coli	1 MPN /100ml	Blanks and negatives show no colonies, positives show colonies	30% of log10 transformed MPN	0-2420 MPN

DRWA Data Precision and Accuracy

These objectives will be measured as follows:

Field Specific Quality Controls:

10% of samples collected (3 per event in 2019) will be field blanks. Sterile water poured into sterile sample bottle in the field. These must register <1 for total coliform and *E. coli*.

10% of samples collected (3 per event in 2019) will be field duplicates. A second sample will be collected at the same location by the volunteer. These will have a Relative Percent Difference of ≤ 30% for log transformed e values.

Laboratory Sample Batch-Specific Quality Control Samples: With each new batch of samples run, CRC will perform the following QC sample analysis:

1 Lab Blank - Sterile water
1 Positive Culture Control -sterile buffer dilution water inoculated with *E. coli* (i.e., total coliform & *E. coli* positive)
1 Negative culture Control -sterile buffer dilution water inoculated with non-fluorescent *Pseudomonas* sp. (i.e., total coliform & *E. coli* negative).
1 Lab Duplicate – 250 mL sample split into 2 100 mL samples in the lab

REPRESENTATIVENESS

Representativeness is the extent to which measurements actually represent the true environmental condition.

You will state that

- Sampling sites were selected to appropriately capture:
  - the general characteristics of the water body
  - or specific impacts, if you are conducting an impact assessment (e.g. above & below suspected pollution sources…)
- The sample collection point is appropriate: e.g. mid-stream, mid-lake, etc., what sampling depth,
- Number of sites is adequate to answer study question
- The parameters monitored are relevant to the type of impact, or to a general WQ assessment.
- Sample collection timing and frequency are selected to capture data that are representative of target conditions (e.g. various water levels, weather, seasons).

MassDEP - RECOMMENDED MINIMUM SAMPLE NUMBER, FREQUENCY AND TIMING FOR EXAMPLE PARAMETERS

Parameter	Streams		Lakes	
	Min. Sample Number and Frequency	Sampling Period **	Min. Sample Number and Frequency	Sampling Period **
D.O. (discrete)	5 results, pre-dawn	June - September	3 results (epilimnetic)	June - September
D.O. (continuous)	30 days	June - September	30 days	June - September
pH	5 results	June - September	3 results (epilimnetic)	June - September
Temperature (discrete)	5 results, afternoon	June - September	3 results (epilimnetic)	June - September
Temperature (continuous)	30 days	June - September	30 days	June - September
Bacteria (e.g., *E. coli*)	3-5 results (in 30-90 days)*	April 1-October 15	3-5 results (in 30-90 days)*	April 1-October 15
Nutrients (inc. chl a for lakes)	5 results	June- September	3 results	June - September
Secchi depth	---	---	3 results	June - September
Chloride	3 results	4 day period (yr-round)	---	---
"Clean" metals	3 results	4 day period (summer)	---	---
Misc. toxics/ emerging contam.	3 results	30 day period (summer)	3 results (epilimnetic)	30 day period (summer)
Fish community	1 survey	April 1-October 15	1 survey	April 1-October 15
Fish tissue contaminants (e.g., Hg, PCBs, pesticides)	1 survey	Any	1 survey	Any
Benthic invertebrates (RBP3)	1 survey	July – October	---	---
Weed surveys	1 survey	June- September	1 survey	June- September
Aesthetics	1 survey	April 1-October 15	1 survey	April 1-October 15

* 30 days (bathing); 90 days (non-bathing) ** "worst-case" typ. July-Aug

REPRESENTATIVENESS

DRWA:

B. Data Representativeness

Samples collected at locations and depths described in this QAPP will reflect conditions of individual water bodies and tributaries in Vermont and Massachusetts. To ensure representativeness all samples will be collected, preserved and analyzed according to the procedures in this QAPP, and within the specified holding times.

NepRWA

A7-5 Data Representativeness

Sampling points will be chosen to represent the water quality within the applicable geographic area of interest. Staff experienced and knowledgeable in the factors affecting water quality will choose sample points that will be representative of conditions within the area of concern.

COMPARABILITY

Comparability is the degree to which data can be compared directly to similar studies. There are two things to consider: future studies someone might undertake and past studies you (or others) will want to compare your data with.

State that you will use and document standardized

- sampling & analytical methods and units of reporting,
- sampling sites, times and dates,
- sample storage and transfer;

Comparability

Deerfield River Watershed Association

C. Data Comparability

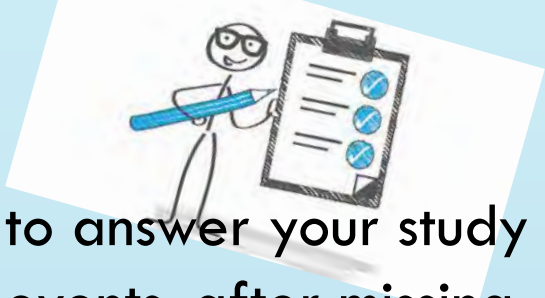
All samples for each specific parameter will be collected and analyzed using the respective procedures described in this QAPP to ensure that comparisons between different sample sites, sample dates, depths and projects can be appropriately made. Procedures are unchanged from previous years.

Neponset River Watershed Association

A7-6 Comparability

Comparability is ensured by the utilization of established sampling and monitoring protocols from Massachusetts DEP, MWRA, Massachusetts Water Watch Partnership, the Boston Water and Sewer Commission, and NepRWA, and by the use of standard test methods and procedures as outlined in Appendices 6, 7, and 8.

Completeness



Completeness is an estimate of the amount of data you will need to answer your study question. Usually expressed as a % of originally planned sample events, after missing sample events and data no meeting DQOs are subtracted from the planned number.

DRWA:

D. Data Completeness

At least 80% of the anticipated number of samples will be collected at each site, analyzed and determined to meet data quality objectives for the project to be considered successful. A report detailing the number of anticipated samples, number of valid results, and percent completion (number of valid samples/number of anticipated samples) will be produced.

NepRWA:

A7-8 Completeness

In order to obtain the best picture of the watershed, NepRWA expects 90% of the routine sampling and follow up sampling samples to be collected and analyzed during each scheduled sampling event. In the routine sampling program uncertainties such as weather, volunteer scheduling, and illness sometimes result in unavoidable omissions, but every effort is made to assign backup samplers when possible.

Sampling Process Design - EPA Element #10

From MassWWP QAPP Guide

Purpose: To describe in greater detail the design of the sampling part of your monitoring program.

In Section 6, you briefly outlined the sample process design. In this section, you should elaborate on the rationales for those choices. When you complete this section, you should revisit Section 6 and revise as necessary. The two sections should be in agreement.

What To Include

- Indicators or measures
- Types of samples
- Sampling frequency
- Sampling period
- How you will select sample sites and identify them over time
- Site safety plans

MADEP - RECOMMENDED MINIMUM SAMPLE NUMBER, FREQUENCY AND TIMING FOR EXAMPLE PARAMETERS

Parameter	Streams		Lakes	
	Min. Sample Number and Frequency	Sampling Period **	Min. Sample Number and Frequency	Sampling Period **
D.O. (discrete)	5 results, pre-dawn	June - September	3 results (epilimnetic)	June - September
D.O. (continuous)	30 days	June - September	30 days	June - September
pH	5 results	June - September	3 results (epilimnetic)	June - September
Temperature (discrete)	5 results, afternoon	June - September	3 results (epilimnetic)	June - September
Temperature (continuous)	30 days	June - September	30 days	June - September
Bacteria (e.g., *E. coli*)	3-5 results (in 30-90 days)*	April 1-October 15	3-5 results (in 30-90 days)*	April 1-October 15
Nutrients (inc. chl a for lakes)	5 results	June- September	3 results	June - September
Secchi depth	---	---	3 results	June - September
Chloride	3 results	4 day period (yr-round)	---	---
"Clean" metals	3 results	4 day period (summer)	---	---
Misc. toxics/ emerging contam.	3 results	30 day period (summer)	3 results (epilimnetic)	30 day period (summer)
Fish community	1 survey	April 1-October 15	1 survey	April 1-October 15
Fish tissue contaminants (e.g., Hg, PCBs, pesticides)	1 survey	Any	1 survey	Any
Benthic invertebrates (RBP3)	1 survey	July – October	---	---
Weed surveys	1 survey	June- September	1 survey	June- September
Aesthetics	1 survey	April 1-October 15	1 survey	April 1-October 15

* 30 days (bathing); 90 days (non-bathing) ** "worst-case" typ. July-Aug

Deerfield River Watershed Association

10. Sampling Process Design

Sampling sites were selected to represent ***locations that receive heavy human use*** from swimmers, boaters, anglers, and other contact recreational users.

Samples will be collected ***bi-weekly*** from late ***June through early September*** (prime recreation period) between ***10 A.M. and 1 P.M. Samplers will first*** fill out their field data sheet. They will then collect a water sample away from the edge of the stream, near the center of the stream (centroid of flow) and just below the surface, ***following the MWWP protocol*** (available in the Appendix).

Samplers will ***place their samples immediately in a cooler*** with ice or frozen ice packs, making sure the temperature in the cooler is at 4°C or lower. Each sample bottle will be ***placed in an individual clean Ziploc*** bag to ***avoid cross contamination.***

Neponset River Watershed Association

B1 Sampling Process Design

The CWMN program is designed to develop and maintain ***a record of general water quality*** throughout the watershed. Project goals include both ***evaluation of long-term changes over time*** across the watershed as a whole and the ***identification of pollution hotspots*** at a low order subwatershed scale.

Routine sampling activities consist of collecting in-stream samples. As discussed above, ***routine sampling sites are divided among "indicator" sites and "subwatershed sites***" in order to meet the dual objectives of the program. ***Indicator sites are selected to be representative of overall water quality and are relatively unchanging over time*** to allow ***comparison to past and future investigations.*** Sites have generally been selected at the ***downstream ends or key segmentation points of major subwatersheds and at or near locations where there is a longstanding data record.***

Neponset River Watershed Association

B1 Sampling Process Design – continued

Subwatershed sites are selected to provide higher spatial resolution along individual streams in an effort ***to bracket pollution sources*** and facilitate their identification and remediation. Subwatershed sites make up roughly 60% of the overall number of sites, and are more likely to change from year to year. Subwatershed sites ***may be rotated through different watersheds*** over the course of several sampling seasons to provide detailed data on different subwatersheds over a period of years. Specific ***sites are selected*** by the project manager ***on the basis of known or suspected problems*** or opportunities, or to fill in a lack of detailed data in a specific area.

Neponset River Watershed Association

B1 Sampling Process Design – continued

In addition to the routine sampling activities, CWMN ***also encompasses follow up and special study sampling*** activities. These are ***generally "one-time" investigations*** intended to zero in on pollution sources in a known or suspected problem area…Specific sampling stations may be planned in advance, or may be chosen opportunistically by samplers while in the field.

The mix of ***parameters*** sampled at each site ***depends on its status as an indicator, subwatershed or follow up station,*** the relative location of the station in the watershed, and the ***specific pollutant(s) of concern*** at that specific location. ***Indicator sites are tested for bacteria, nutrients, ammonia and field measured parameters… Subwatershed sites are generally tested for bacteria, total phosphorus and field measured parameter***s. ***At some subwatershed sites … Follow up sampling stations will generally be tested for a very narrow set of parameters*** based on the ***specific pollutant of concern.*** A listing of current routine ***sampling stations and the parameters*** sampled is ***provided in the Appendix*** 1e.

Table 10.2. Example of a Table of Sampling Frequency, Period and Time of Day

Measure(s) or Indicator(s)	Sites	Brief Description of Location	Type of Site	Frequency	Type of Sample Collected	Time of Day Sampled	Special Weather Conditions
pH, alkalinity, DO	#25	100 yards upstream of Rte. 15 crossing (town)	Control	Semi-monthly from June-September	Water: grab sample Benthics: grab sample before leaf fall.	6-8 a.m,	None
Benthic macroinvert-ebrates	#25	Nearest riffle to chemical site #25	Control	Once in April Once in September	Water: grab sample at surface Benthics: grab sample before leaf fall.	N/A	Avoid high flows

Sampling Methods Requirements - EPA Element # 11

This section describes your field measurement/sample collection methods.
It can be stated in table form, with narrative descriptions if you choose.

Include:

- What parameters are being sampled
- Sampling containers/devices, sample preservation steps. Maximum holding time.
- Amount of sample to be collected
- Summarize steps taken by field samplers
- Reference to the method followed (cite specific SOPS, include in appendices)
- Can also include sampling considerations (e.g. time of day, steps taken to avoid stirring up sediments, sample collection depth, etc.). These will be detailed in SOPs.

Deerfield River Watershed Association

Parameter/Measure	Container	Field Rinse	Preservation	Hold Time
E. coli	120 mL IDEXX plastic round sealed or 290ml sterile plastic round (for lab dup)	**NO RINSE**	Cool to <4°C	6 hours to lab 8 hours to processing

Neponset River Watershed Association

B2 Sampling Methods

B2-2 Visual Observations
B2-3 Fecal Coliform, E. coli, and Enterococcus
B2-5 Nutrients
B2-6 Specific Conductance, and Salinity
B2-7 Temperature
B2-8 pH
B2-9 Dissolved Oxygen
B2-10 Surfactants
B2-11 Depth and Flow
B2-12 Optical Brighteners
B2-13 Qualitative Ammonia Nitrogen

Table 2: Sample Collection Requirements

	Type	Minimum Quantity (mL)	Bottle Type	Preservative	Maximum hold time
Bacteria					
E. Coli	**Grab**	**100**	**Sterile sealed plastic, 125-250 mL**	**Cool to 4 ° C**	**6 hours delivery plus 2 hours lab**
Enterococcus	Grab	100	Sterile sealed plastic, 125-250 mL	Cool to 4 ° C	6 hours delivery plus 2 hours lab
Fecal coliform	Grab	100	Sterile sealed plastic, 125-250 mL	Cool to 4 ° C	6 hours delivery plus 2 hours lab
Total Coliform	Grab	100	Sterile sealed plastic, 125-250 mL	Cool to 4 ° C	6 hours delivery plus 2 hours lab
Nutrients*					
Ammonia non-reg preserve	**Grab**	**50**	**HDPE 1000 mL**	**Cool to 4 ° C**	**filter within 6 hrs and freeze up to 3 months**
Ammonia reg preserve	Grab	50	HDPE 1000 mL	Cool to 4 ° C or h2so4 to pH<2 and cool to 4 ° C	48 hours (no acid) or 28 days (acid)
Nitrate plus nitrite non-reg preserve	Grab	50	HDPE 1000 mL	Cool to 4 ° C	filter within 6 hrs and freeze up to 3 months
Nitrate plus nitrite reg preserve	Grab	50	HDPE 1000 mL	Cool to 4 ° C or h2so4 to pH<2 and cool to 4 ° C	48 hours (no acid) or 28 days (acid)
Nitrogen, Total (not TKN) non-reg preserve	**Grab**	**100**	**HDPE 1000 mL**	Cool to 4 ° C	**Freeze within 24 hours for up to 28 days**
Total Phosphorus non-reg preserve	**Grab**	**100**	**HDPE 1000 mL**	Cool to 4 ° C	**Freeze within 24 hours for up to 28 days**
Orthophosphate non-reg preserve	**Grab**	**50**	**HDPE 1000 mL**	**Cool to 4° C**	**filter within 6 hours and freeze up to 3 months**
Orthophosphate EPA reg preserve	Grab	50	HDPE 1000 mL	Field Filter immediately Cool to 4° C	analyze within 48 hours

- Nutrient preservation methods in bold are those used for CWMN routine sampling activities
- Non bold are for follow up and special studies sampling (critical parameters)

Sample Handling and Custody Requirements - EPA Element # 12

Demonstrate that your sampling handling and storage techniques will retain/safeguard the integrity of your samples and data records.

Deerfield River Watershed Association

12. Sample Handling and Custody Procedures

Samples will be collected between 7 A.M. and 10 A.M. on sampling days. The samples will be kept on ice inside a cooler during transport. Wilmington, VT area samples will be picked up by the monitoring assistant in the Main Street parking lots or other agreed upon meeting location by 9 A.M.. Green River, VT samples will be picked up by the transporting volunteer at the Green River covered bridge or other agreed upon meeting location by 9:30 A.M. The remaining samples will be delivered directly to the CRC water quality lab by 10 A.M. Any exchange of possession in the samples will be documented on the Chain of Custody (CoC) form, which will be completed and signed by the Lab Analyst upon receipt at the lab. The CoC form will be checked by the program coordinator. See Appendix for the CoC.

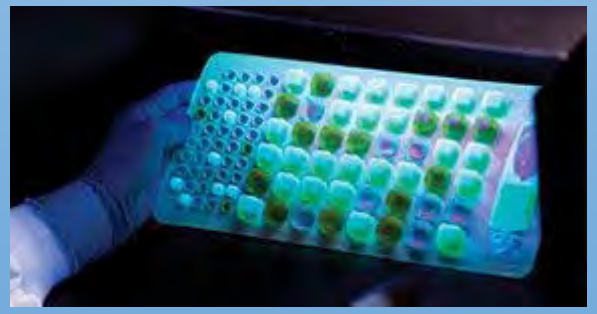
Analytical Methods Requirements - EPA Element # 13

Deerfield River Watershed Association

13. Analytical Methods Requirements

All analytical determinations will be performed at the CRC lab in Greenfield by the Lab Director Gabriel Chevalier.

Indicator	Method Number	Source	Reporting Units	Modifications or Options
E. coli	United water laboratory 1603 Bacteria Colilert SOP 604b CRWC 03-11-10	EPA 1603 (Modified m-TEC)	1 MPN	Sodium Thiosulfate used in all containers



Neponset River Watershed Association

Table 3: Analytical Methods

Analyte	Units	Method	Lab
Bacteria			
E. coli	MPN cfu/100 mL or cfu/100 mL	SM 9223B (Colilert) or SM 9222D or MWRA 1167.4*	MWRA Umass NepRWA
Enterococcus	MPN cfu/100 mL or cfu/100 mL	SM 9223 (Enterolert) or SM 9230C or MWRA 1217.3*	MWRA
Fecal Coliform	cfu/100 mL	SM 9222D**	MWRA
Total Coliform (Colilert)	MPN cfu/100 mL	SM 9222 (Colilert)***	MWRA
Nutrients			
Ammonia	Reported by lab in uM, converted to mg/L	MWRA 1005.9	MWRA NepRWA
Nitrate plus Nitrite	Reported by lab as uM, converted to mg/L	MWRA 1007.7	MWRA
Nitrogen, Total	Reported by lab as uM, converted to mg/L	MWRA 1072.4	MWRA
Orthophosphate	Reported by lab as uM, converted to mg/L	MWRA 1006.7	MWRA
Total Phosphorous	Reported by lab as uM, converted to mg/L	MWRA 1072.4	MWRA
Other			
Chlorophyll and phaeophytin	ug/L	MWRA 1108.4	MWRA
Specific conductance	uS/cm	EPA 120.1	NepRWA
Dissolved Oxygen	mg/L	SM 4500-O D	NepRWA
pH	SU	EPA VMH 5.4 or EPA Method 150.1	NepRWA
Salinity	ppt	SM 2520B	NepRWA
Surfactants	mg/L	EPA 425.1 (by CHEMets R-9400)	NepRWA
Temperature	°C	SM 2550B	NepRWA
TSS	mg/L	MWRA 1012.1	MWRA
Optical Brighteners	Positive, Negative, or Retest	NepRWA Sampling and Analysis SOP	NepRWA
Qualitative Ammonia	mg/L	CHEMetrics V-2000 CHEMetrics K-1403	NepRWA

Massachusetts Volunteer Monitor's Guide to QAPP Development

Here are some things to consider in **choosing a method:**

Scientific Considerations:

* Does it meet your data quality objectives?
    - How accurate is it?
    - How precise (reproducible) is it?
    - What is its detection limit?

* Will it measure the indicator in the range that you need?
* What lab facilities are required?
* What equipment is required?
* Does it yield samples that are representative?
* Is it comparable to methods used by agencies collecting similar information?

Practical and Program Considerations:

- Do you have the human and financial resources to do it?
- How difficult is it?
- How time-consuming is it?
- Will it produce data useful to the target audience?

Quality Control – EPA Element # 14

This section documents that the specific quality control measures you will take will allow you to determine whether you meet your data quality objectives.

What To Include

Section 7 stated your DQOs. Here you describe how you are going to meet them.

For each indicator, include the following information:

- Accuracy, Precision checks: list what checks you will perform.
- List the % of your samples upon which you will perform quality checks that will represent the quality of all your samples.

Quality Control

Accuracy checks

There are a variety of ways to check the accuracy of your sampling and analysis.

Checks can be done internally (done totally within your project lab) or externally (done with the assistance of an independent lab).

Known Samples: This is an internal check that compares your results against another analyst or a "known". An example of a known is a quality assurance sample that UMass WRRC sends to VM groups for pH, DO, or alkalinity – with the expected value communicated when sample is sent.

Proficiency Testing (Unknown) Samples: In some cases, there are programs that provide proficiency testing samples for laboratory performance evaluation, the concentrations of which are known to the auditor but not to the lab being tested. This is relatively common for most water chemistry indicators. An example of an unknown would when WRRC sends a quality assurance sample without communicating the expected value in advance.

Quality Control

Accuracy checks - continued

Blank and Positive Plates: Bacteriological samples should be checked using the blank and positive plate procedure. The blank plate uses the rinse water, media and equipment in the analysis to determine if there is contamination in the laboratory materials. The result should be 0. The positive plate procedure uses a sample known to contain bacteria (e.g. waste- water treatment plant influent) to determine if a procedural error in the lab causes inhibition of bacterial growth. Results should be "Too Numerous To Count". Each batch of samples should include at least one blank and one positive check sample. This is an internal check.

Spiked Samples: Spikes are additions of a known amount of the indicator with the expectation that subsequent analysis will measure exactly that much increase over the un- spiked sample. This procedure is described in Section 1020 B of Standard Methods. This is an internal check.

Voucher and Reference Collections: For macroinvertebrates and aquatic plants, maintenance of a voucher and/or a working reference collection is recommended. A voucher collection is a preserved collection of the *type* specimens, i.e. an example of each of the individual taxa that you have given a name. It should be maintained in archival condition by a trained curator, typically found at a university. A reference collection is an exact duplicate of the voucher collection but is the one that you will regularly use as a reference when identifying new specimens. Both voucher and reference collections should be verified by an expert. This is an external check. Alternatively, have an expert review IDs made by volunteers of at least 10% of specimens collected. 90% accuracy is recommended.

Quality Control

Precision Checks

Precision checks are primarily accomplished through replicate sampling & analysis in the field and lab.

Field Replication: Replication can be done by the same field collectors but some replication by other collectors is good: e.g. a pair of field collectors swapping roles, or have different team collect the replicate. This is an internal check.

Lab Replication: Additional replication should occur in the lab. Lab replication is done by dividing a well-mixed sample into two or more aliquots and conducting analysis on each aliquot. This is an internal check.

Split Samples: Split samples (a sample that is split into two sub-samples) can be done in the field or the lab.

Relative Percent Difference

A measure of precision used for duplicate sample results. It is calculated by dividing the difference between the two results by the mean of the two results, expressed as a percentage. Used when sample number equals two.

$$RPD = \frac{(S - D) \times 100}{(S + D)/2}$$

e.g. ((9.8-9.2) *100) /((9.8+9.2))/2 = 6.3%

Deerfield River Watershed Association

14. Quality Control Requirements

A. Volunteers Check - Field Audit

Either the QC Officer, the Project Coordinator, or both will accompany a crew of volunteers (each) to their site each collection. The trainers will observe the volunteers' performance and check their sampling technique and field data sheets for accuracy.

B. Field QC Checks

At least one Field Duplicate and one Field Blank will be submitted for every ten samples collected.

Field Duplicate – a check on water quality, sampling & analysis consistency. This is a replicated sample collected at the same point in time and space, side by side with the first sampling and given a separate Sample ID number.

Field Blanks – a check for contamination (Accuracy/Bias) in the field by processing laboratory-supplied deionized water through the sampling train. This checks for contamination introduced from the sample container(s) or from field contamination. A Field Blank will be taken by one volunteer at one site per sampling day for bacteria. A container of DI water will be given to the volunteer, who will pour this DI water into the sample bottle at the site.

We will rotate the field duplicate and field blank samples among the volunteers throughout the sampling season so a maximum of collectors can be checked.

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14. Quality Control Requirements – continued

C. Laboratory QC Checks
A **Lab Duplicate** will be analyzed each sampling day: The lab will split a randomly chosen sample and analyze both subsamples.

The lab will run a **Lab Blank** and a **Positive Sample** for bacteria each collection (see section 7).

D. ***Data Analysis*** QC Checks
River data and QC data will be reviewed by the QC Officer as soon as they come in from the lab after each collection. QC data will be compared to the quality objectives (e.g. blanks should have zero colonies, sample duplicates should be within 3 standard deviations of the mean, positives should show bacterial growth, etc.). River data will be reviewed as well to ensure that no field or lab contamination has occurred (data will be compared to those of other sites and of previous collections).

Bacteria computations will be checked and validated. If discrepancies are found, the Lab Director will be called to resolve the discrepancy and corrections will be made by the QC Officer.

Field data sheets will be also reviewed the day of collection by the Project Coordinator, and later by the QC Officer to ensure that samples were taken at the right times and that all the required information has been filled out. The Project Coordinator or collectors will be called if omissions or errors are detected. If needed, corrections will be made (signed and dated) on the field sheet by the QC Officer.

Neponset River Watershed Association

Table 4: QC Samples and Acceptance Criteria

Analyte	Number of QC Samples	Acceptance Criteria
Bacteria: E. coli		
Field Duplicates	10%	<=30% RPD Log10 transformed
Lab Splits	1 per batch[1]	<=30% RPD Log10 transformed
Lab Blanks	1 per batch	Not exceeding lab MDLs
Positive Control	1 per day	Too numerous to count (MF) or fluorescence (Colilert)
Bacteria: Enterococcus		
Field Duplicates	10%	<=30% RPD Log10 transformed
Lab Splits	1 per batch	<=30% RPD Log10 transformed
Lab Blanks	1 per day	Not exceeding lab MDLs
Positive Control	1 per day	Too numerous to count (MF) or fluorescence (Colilert)
Bacteria: Fecal Coliform		
Field Duplicates	10%	<=30% RPD Log10 transformed
Lab Splits	10% or 1 per batch	<=30% RPD Log10 transformed
Lab Blanks	1 per day	Not exceeding lab MDLs
Positive Control	1 per day	Too numerous to count
Bacteria: Total Coliform		
Field Duplicates	10%	<=30% RPD Log10 transformed
Lab Splits	1 per batch	<=30% RPD Log10 transformed
Lab Blanks	1 per batch	Not exceeding lab MDLs
Positive Control	1 per day	All cells yellow

PRECISION DQOS
DEALING WITH LOW-LEVEL CONCENTRATIONS

Source	Analyte	Units	Precision
MassDEP WPP Monitoring QAPP	Total Phosphorus	mg/L	< 50 ppb: 5ppb > 50 ppb: 10% RPD
MRWA lab, for NepRWA QAPP	Total Phosphorus	mg/L	< 0.5 mg/L: 50% RPD > 0.5 mg/L: 25% RPD

Training Requirements / Certification – EPA Element # 8

In Narrative or Table Format:

- List type of training (e.g. Field WQ, lab analysis, visual observation, data mgt, data entry etc.)
- Who is training, who receives training
- How often training done

If training records are kept (they should be), include that in section 9 on documentation and records.

Neponset River Watershed Association

A8 Training - *Excerpt*

To ensure the high quality and usability of the data that is generated by the CWMN program, ***all participants receive training appropriate to the tasks*** for which they will be responsible. NepRWA staff that are involved in the program are professionals with extensive training in water quality, chemistry, biology, and field sampling. NepRWA has established a program of training for volunteers that includes initial training, follow-up, and refresher classes. These ***classes are given by NepRWA staff that are qualified not only in the technical matter covered, but in training and education***.

The initial training for volunteer monitors is primarily instruction and demonstration by the trainer, with ***repetition by the volunteer***. This training includes an overview of the entire project and detailed instruction in sampling procedures. ***All monitors receive and review a copy of NepRWA's Water Monitoring and Sampling Manual*** (see Appendix 3a).

After their initial training, all volunteers participate in a mandatory annual group and/or individual training session. These sessions are designed to update the volunteers on changes in the program, further train them in equipment calibration and field-testing procedures and evaluate each volunteer's performance…

Table 8.2. Example of Training Records

Project Function	Training Course Title	Provided by	Training Date	Personnel Trained	Personnel Function	Training Record Location
General Water Quality Field Sampling	Water Quality Field Sampling	MWWP	April, 14, 2000	John Smith	Field Collection Volunteers	Organization office
Lab Analysis	Water Quality Lab Analysis	Project QA Officer	April 20, 2000	Jane Doe	Lab Analysis	Project Headquarters

Instrument/Equipment Testing, Inspection, and Maintenance Requirements – EPA Element # 15

Instrument Calibration and Frequency – EPA Element # 16

Inspection/Acceptance Requirements for Supplies – EPA Element # 17

Table 15.1. Recommended Equipment Inspection and Maintenance. Maintenance and corrective action procedures should be described in your QAPP. These will either be part of the method description or manufacturer's recommendations.

Equipment Type	Inspection Frequency	Type of Inspection	Available Parts	Maintenance, Corrective Action & Recordkeeping
Wisconsin Sampler	Before each sampling date	No leaks Proper operation of trip mechanism	Spare sampler	Annually or as needed Logbook notation
Secchi Disk	Before each sampling date	Visual	Spare disk	
Calibrated Line	Before each sampling date	Integrity of line and clips		Annually or as needed Logbook notation
D.O. Meter	Before each sampling date	Battery life, electrical connections, membrane condition	Spare membranes, batteries	Annually or as needed Logbook notation
Thermistor	Before each sampling date	Battery life	Spare batteries	Annually or as needed Logbook notation
Turbidometer	Before each sampling date	Battery life	Spare batteries	Annually or as needed Logbook notation
pH Meter	Before each sampling date	Battery life, level of electrolyte, integrity of probe	Spare batteries, electrolyte	Annually or as needed Logbook notation
Digital Titrator	Before each sampling date	Proper installation of cartridge, zero reset	Spare cartridges, dispensing tubes	Annually or as needed Logbook notation

DOCUMENTATION AND RECORDS – EPA ELEMENT #9

Document that your recordkeeping procedures preserve your data record.

In this section, you describe the documentation that will accompany your samples from collection through analysis and archiving:

- Field data sheets
- Sample container labels
- Chain of custody forms
- Lab data sheets (including inspection and calibration logs)
- Sample archives and / or voucher collections

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A9 Documents and Records

A9-1 Data Sheets

Field data sheets include information about the site location (NepRWA ID number), which specific equipment was used to make measurements (thermometer number), the sampling method used (direct fill, pole, or Bridge Buddy) and equipment calibration results. The field data sheets are also used to record temperature, velocity, depth, color, odor, and turbidity information (Appendix 4e)…

… See Appendix 4 for copies of the various data sheets used in the CWMN program.

A9-2 Chain of Custody Forms

A9-3 Sample Labeling

A9-4 Equipment Custody Form

A9-5 Training and Evaluation Form

Data Acquisition Requirements - EPA Element # 18

Purpose: To ensure that any data you use but don't collect yourself has a known data quality and is consistent with your data quality objectives, that others can access these data, and that your use of the data is appropriate.

Describe any external data you use, such as GPS coordinates for site locations, weather station rainfall amounts, etc.

Include:

- The title of the document or name of the information
- Where you obtained it and where others may find it
- Notes on the quality of the outside information such as uncertainties and caveats

Preamble to Elements 19 through 24

Consider the four separate objectives of these chapters:

1) Producing a good data set.

- 19 covers the normal data mgt. routines you do to *prevent* data mistakes in the first place.
- 22 &23 describe how you review the resulting data sets - how you find and correct missing or erroneous data.
- 19, 22 and 23 should produce as complete & accurate a data set as possible.

2) ***Ensuring that any use you make of your data is justified.***

In # 24, you decide how usable your data are. Review the *final* data set that the above efforts have produced. Compare it with your DQOs to determine whether you have to discard or qualify any data, what conclusions you can draw from your data, or what changes you might need to make in your DQOs.

3) ***Improve overall project performance***. # 20 deals with how well volunteers, laboratories, and equipment are operating. It looks at ***function***, not outcomes. Who evaluates the various components of your program; when problems are found, what corrections are made to make your program run better?

4) ***Report your results***. After you've run these various checks, you are ready to release your data. In Chapter 21 you describe the reports you will issue.

EPA Elements 19 – 24

- **Data Management** (#19)
- **Assessment and Response Actions** (#20)
- **Reports** (#21)
- **Data Review, Validation, and Verification Requirements** (#22)
- **(Data) Validation and Verification Methods** (#23)
- **Reconciliation with Data Quality Objectives** (#24)

Suggested order:

- **Data Management** (#19)
- **Data Review, Validation, and Verification Requirements** (#22)
- **(Data) Validation and Verification Methods** (#23)
- **Reconciliation with Data Quality Objectives** (#24)
- **Assessment and Response Actions** (#20)
- **Reports** (#21)

Data Management – EPA Element # 19

Follow the data from the moment it's recorded through every step to final report / database. Intent is to *prevent* errors or loss of data, or be able to correct in timely manner.

- ***Before*** each activity/step is conducted: well-designed field sheets, checklists, COC forms, data entry software, auto-QC calculations, out-of-bounds highlights, etc.
- ***During*** each step: sheets filled completely, checklist reviewed before leaving site, etc.
- ***Immediately after***: Computer-entered data compared with field sheets, etc.
- ***Long term preservation***: Data storage.

Neponset River Watershed Association

B9 Data Management

The ***Project Manager is responsible*** for overseeing all data management activities. Refer also to section D below for additional discussion of data review, verification and validation practices.

B9-1 Raw Data

Field data sheets are collected with the samples. The sheets are turned into the NepRWA office by the site coordinators. The ***forms are then reviewed for illegible answers, errors*** or questionable values, and checked for ***consistency with the COC and bottle labels*** as described in Appendix 3I. Any questions are referred to the volunteer for clarification. ***NepRWA staff makes corrections by crossing out the errors*** and writing in the correct answer. All corrections must be ***initialed.***

B9-2 Data Entry and Validation

Once the information has undergone a preliminary check, it is entered into a ***Filemaker database.*** The software has been customized to the data sheet. ***Fields within the worksheet have been set-up with limits based on expected results.*** This helps to minimize entry errors. Entered data is then checked against the data sheets by another volunteer or staff person.

B9-3 Data Storage

The ***original data sheets*** are filed into an event file and ***stored in NepRWA's permanent files.*** Electronic copies of data are maintained on a secure Filemaker server. ***Data files are kept in perpetuity, along with hard copies*** of volunteer data sheets. All ***electronic data is backed-up daily*** on to a password-protected hard drive.

Data Review, Validation, and Verification– EPA Element # 22

(Data) Validation and Verification Methods – EPA Element # 23

Deerfield River Watershed Association

22. Data Review, Validation, and Verification – *Summarized bullet list*

All data reviewed by the Project Coordinator and QA Coordinator

Data Analysis QC Checks will include:

- Data entry checks by a second person
- Computer entries compared with field/lab sheets
- Checks on graphs & all other data representations
- Calculation of measures of data quality, including % completeness

Corrective actions

- Data entry errors corrected.
- Data outside expected range flagged or rejected.
- 2nd field sample and/or laboratory aliquot taken when possible
- Data quality problems discussed in draft and final reports.

(Data) Validation and Verification Methods – EPA Element #23

From Inland QAPP

Validation and Verification Methods will include checks on:

- Completion of all fields on data sheets; missing data sheets
- Completeness of sampling runs (e.g. number of sites visited/samples taken vs. number proposed, were all parameters sampled/analyzed)
- Completeness of QC checks (e.g. number and type of QC checks performed vs. number/type proposed)
- Accuracy and precision compared to data quality objectives
- Representativeness of samples and resulting data by examining survey metadata for unusual conditions and occurrences that may have impacted the validity of results.

Deerfield River Watershed Association – *Excerpt, summarized*

23. Validation and Verification Methods

The following simple measures of data quality will be calculated and included in the final report:

1) To screen for contamination, the ***average blank concentration … will be calculated.*** This average value should be as close as practical to the Reporting Limit listed in Table 4.

2) To assess the precision of results, the "***Mean Relative Percent Difference***" between field duplicate samples should be calculated. The ***average RPD should be less than or equal to the Estimated Precision*** listed in Table 4. This simple measure is calculated as follows:

RPD formula used: …

Reconciliation With Data Quality Objectives – EPA Element #24

MassWWP guide to QAPP development

<u>What to Include:</u>

- List who will evaluate your actual data vs. your data quality goals.
- State how and when this will be done.
- Describe the process for determining what to do if goals are not met.

Neponset River Watershed Association

D2 Reconciliation with User Requirements ***- Summarized, bulleted***

- ***Following each sampling event***, and prior to the subsequent event, ***calculations and determinations for precision, completeness, and accuracy*** will be made.
- Any ***corrective action will be implemented***, noted, and initialized ***by the project manager***.
- If ***data quality indicators do not meet the project's specifications*** then ***data may be discarded, may be flagged or re-sampling may occur***.
- ***Investigation of problems*** will take place and corrections will be documented. If equipment failure is found to be the cause, calibration and maintenance techniques will be reassessed. Field duplicate testing may occur during the next sampling event to ensure confidence in the results.
- Any ***limitations on the data will be noted***.
- Any ***revisions to the project will be submitted to EPA and DEP quality assurance officers for approval***.

Assessment and Response Actions - EPA Element #20

From Inland QAPP

Document that ***the progress and quality of the monitoring program will be continuously assessed*** to ensure that its objectives are being accomplished.

The Monitoring Coordinator will periodically check to see the following:

- Monitoring is occurring as planned;
- Sufficient written commentary and supporting photographs exist;
- Sufficient volunteers are available;
- Volunteers have been observed as they sample their sites;
- Samplers are collecting in accordance with project schedules;
- Data sheets and custody control sheets are being properly completed and signed;
- Data are properly interpreted;
- Plans for dealing with adverse weather are in place;

Assessment and Response Actions - EPA Element #20

From Inland QAPP – continued

The Monitoring Coordinator will periodically check to see the following:

- Retraining or other corrective action is implemented at the first hint of non compliance with the QAPP or SOPs;
- Labs are adhering to the requirements of their QAPP, in terms of work performed, accuracy, acceptable holding times, timely and understandable results and delivery process;
- Data management is being handled properly, i.e. data are entered on a timely basis, is properly backed up, is easily accessed, and raw data are properly stored in a safe place;
- Procedure for developing and reporting the results exists.

Assessment and Response Actions - EPA Element #20

From Inland QAPP – continued

The Monitoring Coordinator will confer with the QA Officer as necessary to discuss any problems that occur and what corrective actions are needed to maintain program integrity. In addition, the Monitoring Coordinator and QA Officer will meet at the end of the sampling season, to review the draft report and discuss all aspects of the program and identify necessary program modifications for future sampling activities. [If the program includes a technical advisory committee, the TAC will be included in these discussions.] Corrections may include retraining volunteers; rewriting sampling instructions; replacement of volunteers; alteration of sampling schedules, sites or methods; or other actions deemed necessary. All problems discovered and program modifications made will be documented in the final version of the project report. If modifications require changes in the Quality Assurance Project Plan, these changes will be submitted MassDEP for review.

Deerfield River Watershed Association

20. Assessment and Response Actions – *Summarized, bullet list*

- There will be an on-site visit by the Quality Control Officer to observe field sampling and field analysis procedures. Generally, this will be done near the beginning of the project.
- A written checklist will be used for the assessments, maintained by the Project Coordinator, and copies will be provided with the data report.
- The Project Coordinator and QC Officer will determine if field work follows the written procedures or if there needs to be corrections by additional training or revising protocols.
- Please refer to Section 22 for additional evaluations and response actions regarding data evaluations.

Reports – EPA Element # 21

Project / Task Organization – EPA Element #4 *Review/revise early choices*

Distribution List – EPA Element #3

Title and Approval Page - EPA Element #1

Table of Contents – EPA Element #2

You can figure these ones out