I PROJECT MANAGEMENT

1.0 Title and Approval Page

Quality Assurance Project Plan for
Rhode Island Ambient River Monitoring Program
State of Rhode Island
Rhode Island Department of Environmental Management (DEM)
Office of Water Resources

Approval Signatures

Jane Sawyers — Digitally signed by Jane Sawyers Date: 2024.03.25 08:41:34 -04'00'
Jane Sawyers, RIDEM/OWR Program Manager — Date

Colin Millar — 3/14/24
Colin Millar, RIDEM/OWR Project QA Officer — Date

Kelsey E Mudry — 3/13/24
Kelsey Mudry, RIDEM/OWR Project Manager — Date

Richard Enander — 3/18/24
Richard Enander, RIDEM QA Manager — Date

Hilary Snook — Digitally signed by Hilary Snook Date: 2024.03.26 09:58:28 -04'00'
Hilary Snook, USEPA Technical Lead — Date

ZACHARY DEGLER — Digitally signed by ZACHARY DEGLER Date: 2024.03.26 12:53:36 -04'00'
Jennifer Brady, USEPA PPG Project Officer — Date

ANTHONY PEPE — Digitally signed by ANTHONY PEPE Date: 2024.03.26 09:26:19 -04'00'
Anthony Pepe, USEPA QA Officer — Date

Rajendra Kothavade — 3/19/24
Rajendra Kothavade, Ph.D., Chemical Analysis Project Lead — Date

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QAPP Recipient	Responsibilities	Organization
Anthony Pepe	EPA Quality Assurance Officer	United States Environmental Protection Agency New England Region 1 Laboratory 11 Technology Drive N. Chelmsford, MA 01863 Phone: 617-918-8335 pepe.anthony@epa.gov
Hilary Snook	USEPA Technical Lead	United States Environmental Protection Agency New England Region 1 Laboratory 11 Technology Drive N. Chelmsford, MA 01863 Phone: 617-918-8309 snook.hilary@epa.gov
Jane Sawyers	RIDEM Program Manager	RI Department of Environmental Management Office of Water Resources 235 Promenade St. Providence, RI 02908 Phone: 401-222-4700 Ext. 2777300 jane.sawyers@dem.ri.gov
Kelsey Mudry	RIDEM Project Manager	RI Department of Environmental Management Office of Water Resources 235 Promenade St. Providence, RI 02908 Phone: 401-222-4700 Ext. 27772032 kelsey.mudry.ctr@dem.ri.gov
Colin Millar	RIDEM Quality Assurance Manager	RI Department of Environmental Management Office of Water Resources 235 Promenade St. Providence, RI 02908 Phone: 401-222-4700 Ext. 2777239 colin.millar@dem.ri.gov
Rajendra Kothavade, Ph.D.	Chemical Analysis Project Lead	RI State Health Laboratories 50 Orms Street Providence, RI 02904 Phone: 401-222-5578 Rajendra.kothavade@health.ri.gov
Richard Enander	RIDEM Quality Assurance Manager	RI Department of Environmental Management Office of Customer and Technical Assistance 235 Promenade Street Providence, RI 02908 Phone: 401-2224700 Ext 2774411 Fax: (401) 222-6802 richard.enander@dem.ri.gov

QAPP Recipient	Responsibilities	Organization
Jennifer Brady	EPA PPG Project Officer	United States Environmental Protection Agency Region 1 5 Post Office Square – Suite 100 (6-WO) Boston, MA 02109-3912 Phone: 617-918-1698 brady.jenniferL@epa.gov

4.0 Project/Task Organization

The Rhode Island Department of Environmental Management, Office of Water Resources (RIDEM/OWR) will conduct water quality monitoring of rivers and streams as part of the ongoing Ambient River Monitoring (ARM) Program in Rhode Island during a five-year period following signature of this QAPP. RIDEM/OWR will collect water samples and field data and will contract with the Rhode Island Department of Health (RIDOH) to conduct laboratory analyses during a five-year period following signature of this QAPP. The organizational chart shown in Figure 1 describes the principal officials from RIDEM, RIDOH, and the United States Environmental Protection Agency (USEPA) associated with the program during the period following signature of this QAPP.

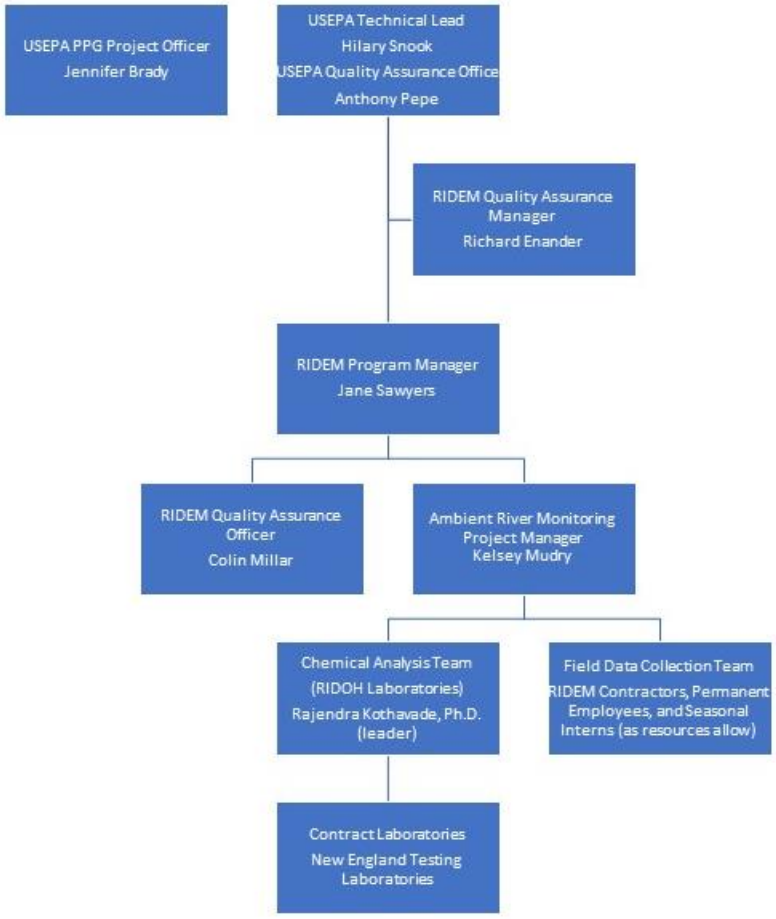


Figure 1 Organizational Chart for RIDEM Ambient River Monitoring Program.

Jane Sawyers of RIDEM/OWR will serve as the RIDEM Program Manager, and will:

- Develop cost estimates for contractual agreements between RIDEM/OWR and RIDOH.
- Provide guidance on program direction.
- Supervise general progress of the program.

Colin Millar of RIDEM/OWR will serve as Quality Assurance Manager (QA Manager) and will ensure that:

- Procedures and protocols outlined in the QAPP are followed.
- Data are correctly reported and are finalized and delivered on time by self or by designee.

Kelsey Mudry of RIDEM/OWR Ambient River Monitoring Project Manager duties will include:

- Field personnel are properly trained.
- Acting as the primary point of contact for the program.
- Organizing field data collection.
- Ensuring that equipment is in good working order, and that supplies are ordered.
- Ensuring that the QAPP outlined procedures are followed and resolving any problems that arise.
- Ensuring that correct laboratory analyses are done.
- Reviewing field and laboratory data.
- Providing written or verbal updates to the RIDEM Program Manager.
- Updating or modifying the QAPP as needed.
- Ensuring field SOPs meet DQO stated in this QAPP

Seasonal technicians and other personnel from RIDEM/OWR will:

- Assisting with the collection of field data and water samples as needed.

Rajendra Kothavade, Ph. D. (RIDOH) will:

- Serve as the Chemical Analysis Project Lead.
- Ensure all involved RIDOH personnel are properly trained in protocols associated with the laboratory analyses.
- Ensure that RIDOH and contract lab SOPs meet the Data Quality Objectives (DQOs) stated in this QAPP as communicated by the Project Manager.

All laboratory chemical analyses will be performed by RIDOH with a few exceptions. RIDOH with subcontract with an authorized state vendor for Total ammonia (NH_3-N), total Kjeldahl nitrogen (TKN), and dissolved organic carbon (DOC). The vendor is currently New England Testing Laboratories (NETL) located in Warwick, RI. Results from NETL will be communicated to RIDEM/OWR directly and via RIDOH.

5.0 Problem Definition/Background

A. Goals of RIDEM/OWR Ambient River Monitoring Program

The objective of the RIDEM/OWR Ambient River Monitoring Program is to characterize the water quality conditions in rivers and streams in Rhode Island by measuring physical and chemical parameters. The data represent the state of rivers during dry weather. The data collected by this program will provide information for the RIDEM/OWR Water Quality Standards and Assessment Programs and for other management decisions. The physical and chemical data are primarily used with biological data, when available, to assess and report on the water quality status of rivers and streams as required under Sections 305(b) and 303(d) of the Clean Water Act (CWA). These assessments are published in the Integrated Water Quality Monitoring and Assessment Report (Integrated Report) that is issued biennially by RIDEM to USEPA. The process for making assessment decisions is explained in the State's Consolidated Assessment and Listing Methodology (CALM) (RIDEM 2023). The Water Quality Standards Program may also use monitoring data to refine water quality criteria and update regulations. Data are also used to support permitting programs, TMDL development, and to assess progress toward water quality restoration goals.

B. Background and Historical Context of Water Quality Monitoring in RI Rivers

RIDEM/OWR is charged by the Federal Clean Water Act with comprehensively monitoring and assessing the water quality of the State's waters. The development of water quality monitoring in Rhode Island's rivers occurred in several stages between 1978 and 2016. This is described in detail in the earlier version of this program's QAPP (RIDEM 2010), which covers the history of the program from 1991-2009. In 1991, RIDEM began to supplement the limited number of rivers being sampled by USGS with a baseline monitoring program. The ARM program evolved from baseline monitoring at selected stations to a targeted rotating basin approach to cover more areas of the State. For each year in the rotation, program changes are documented in addenda to the QAPP. The addenda also include lists of stations, maps, and which chemical and physical analyses were performed at each station. Table 1 summarizes the timeline to the present.

Table 1 Summary of Water Quality Monitoring in RI Rivers from 1991.

Years	Collecting Agency	Analysis Agency	Sampling Approach	Number of Stations	Area Sampled
1991-2003	URI-CVE	URI-CVE	Fixed Stations	25	Statewide Baseline Stations
2004-2005	URI-CVE	URI-CVE	Geometric Rotating Basin	32	Wood River
2005-2006	URI-CVE	URI-CVE	Geometric Rotating Basin	46	Beaver, Chipuxet, Pawcatuck Mainstem Rivers
2006-2007	URI-CVE	RIDOH	Geometric Rotating Basin	51	South Branch Pawtuxet, Big Queen, Flat, Adamsville Rivers

Years	Collecting Agency	Analysis Agency	Sampling Approach	Number of Stations	Area Sampled
2007-2008	RIDEM	RIDOH	Geometric Rotating Basin; >5 mi^2 Drainage Area	36	North Branch Pawtuxet, Pocasset Rivers
2008-2009	RIDEM	RIDOH	Geometric Rotating Basin; >5 mi^2 Drainage Area	64	Branch, Clear, Millers, Moshassuck, Saugatucket, Woonasquatucket, Moosup Rivers
2010	NA	NA	NA	0	Program was reevaluated
2011	RIDEM	RIDOH	Refined Rotating Basin	60	Pawcatuck/Wood Rivers
2012	RIDEM	RIDOH	Refined Rotating Basin	66	Pawtuxet, Hunt, Moosup Rivers
2013	RIDEM	RIDOH	Refined Rotating Basin	60	Blackstone, Clear, Branch, Moshassuck Rivers
2014	RIDEM	RIDOH	Refined Rotating Basin	42	Woonasquatucket, Ten Mile, Saugatucket Rivers; Tiverton/Little Compton, Aquidneck Island
2015	RIDEM	RIDOH	Refined Rotating Basin	63	Pawcatuck/Wood Rivers
2016	RIDEM	RIDOH	Refined Rotating Basin	66	Pawtuxet, Hunt, Moosup Rivers
2017	NA	NA	NA	0	Program was reevaluated
2018	RIDEM	RIDOH	Targeted Supplemental Sampling	9	Sites with potential for removal of impairment were targeted for further data collection
2019	RIDEM	RIDOH	Refined Rotating Basin	44	Blackstone, Clear, Branch, Moshassuck, West, Woonasquatucket, Ten Mile, and Upper Five Mile and Lower Five Mile Rivers
2020	NA	NA	NA	0	Global Pandemic
2021	RIDEM	RIDOH	Refined Rotating Basin	49	Coastal drainage to Narragansett Bay (including Aquidneck Island, Tiverton/Little Compton)

Years	Collecting Agency	Analysis Agency	Sampling Approach	Number of Stations	Area Sampled
2022	RIDEM	RIDOH	Refined Rotating Basin	57	Pawcatuck/Wood, Queen, Chipuxet, Beaver, Tomaquag, Ashaway, and Saugatucket Rivers
2023	RIDEM	RIDOH	Refined Rotating Basin	51	Pawtuxet, Hunt, Moosup, Pocasset, Scituate, and Flat Rivers
2024*	RIDEM	RIDOH	Refined Rotating Basin	TBD*	Blackstone, Clear, Branch, Moshassuck, West, Woonasquatucket, Ten Mile, Upper Five Mile, and Lower Five Mile Rivers*
2025*	RIDEM	RIDOH	Refined Rotating Basin	TBD*	Coastal drainage to Narragansett Bay (including Aquidneck Island, Tiverton/Little Compton)*
2026*	RIDEM	RIDOH	Refined Rotating Basin	TBD*	Pawcatuck/Wood, Queen, Chipuxet, Beaver, Tomaquag, Ashaway, and Saugatucket Rivers*
2027*	RIDEM	RIDOH	Refined Rotating Basin	TBD*	Pawtuxet, Hunt, Moosup, Pocasset, Scituate, and Flat Rivers*

**Future rotations are projected and final station design will be documented in an annual addenda*

6.0 Project Description

A. Objectives

RIDEM/OWR will conduct dry-weather water sampling in rivers and streams according to a rotating basin schedule. Additional targeted sampling stations may be added to address specific concerns by stakeholders or other programs in the RIDEM/OWR. The number of stations sampled annually is determined annually. During a full rotating basin cycle, approximately 50 river stations are expected to be sampled each year. During each sampling season, most stations will be sampled a total of five times over the course of 6 months between May and October: three sampling events with chemistry and pathogen samples collected and two sampling events with only pathogens samples collected. First order streams with no bacteria impairments will be sampled three times for water chemistry June through October. Deviations from the full rotating basin schedule will be documented in the annual addendum.

RIDEM/OWR, with permanent, seasonal, and contractual employees, will perform all fieldwork, and laboratory analyses will be conducted by RIDOH labs in Providence, Rhode Island. RIDOH will contract with an authorized state vendor for analytical laboratory services to conduct analyses of total Kjeldahl-nitrogen (TKN) and total ammonia (NH_3-N).

B. Specific Task Descriptions

A targeted timeline for key project milestones is included in (Table 2). The Ambient River Monitoring Project Manager will develop a sampling plan prior to each year's data collection. The plan will identify the stream locations to be sampled and which chemical and physical properties will be analyzed for each location. Samples will be collected from all stream locations and analyzed for a suite of common chemical constituents and, in some cases, pathogens. Water samples may also be collected and analyzed for dissolved or total metals, dependent upon applicable water quality criteria. Additional sites may be added if there are known or suspected sources of contamination near the station. Input from TMDL and permitting programs will be incorporated during the development of the sampling plan. Changes to the sampling plan or station lists will be added as addenda to this program QAPP.

Stations may be visited prior to each year's sampling to identify any changes or obstacles to sampling and to refine descriptions for each site. Other preparations prior to starting fieldwork will include the purchase and organization of field gear, data sheets, labels, and Chain of Custody forms. Bottles will be ordered from RIDOH and contract labs and picked up and organized in advance of sampling.

For all sampling events, stations will be sampled if rainfall in the previous 24 hours is less than 0.25". If more than 0.25 inch of rain fell, sampling was rescheduled. In 2013-2018, for the three chemistry collection events, stations were only sampled if there was an antecedent dry period where total precipitation was less than 0.25 inch during the previous 48 hours. For the two pathogen sampling events in 2013-2018, a different antecedent dry period rule applied:

precipitation was less than 0.25 inches in the previous 48 hours. Rotations prior to 2013 used 0.1 inch during the previous 48 hours for all sampling events.

Field data will be collected using a handheld multi-parameter meter as described in the Standard Operating Procedure (SOP) manual for the instrument (RIDEM 2022b). All data will be recorded on the form shown in that manual. The data collection sheet is shown in Figure 4. Site conditions will be documented with digital photos during each site visit, and pictures will be maintained in accordance with the RIDEM Digital Photography Record Collection and Storage SOP (RIDEM 2008). Samples will be collected according to the water quality sampling SOP manual (RIDEM 2022a). All samples will be kept on ice during the sampling event and prior to delivery to the State Health Laboratories.

Water samples will be delivered to the State Health Laboratories. Upon arrival, a Chain of Custody form (Figure 2) will be signed by the sample collecting scientists and by the receiving lab personnel to indicate who is holding the samples each time they change hands. The State Health Laboratories will analyze the water samples for the parameters specified by RIDEM/OWR in accordance with EPA-approved Standard Methods. Any changes in laboratory analysis procedures will be documented in a QAPP addendum. All data generated in this project will be managed as described in Sections I.9 and II.10 of this document.

Table 2 Targeted Project Timetable.

Task	February	March	April	May	June	July	August	September	October	November - January
Sampling Plan	Develop	Final								
Sample Collection Large River				Pathogens	Pathogens Chemistry	Pathogens	Pathogens Chemistry	Pathogens Chemistry		
Sample Collection Small River/Streams				Pathogens	Pathogens Chemistry	Pathogens	Pathogens Chemistry	Pathogens Chemistry		
Lab Analyses				Pathogens	Pathogens Chemistry	Pathogens	Pathogens Chemistry	Pathogens Chemistry		
Data Review				Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Review and Approve Final Data Set
Submission of Annual Addenda		Develop	Final							

Chemistry: Water Chemistry

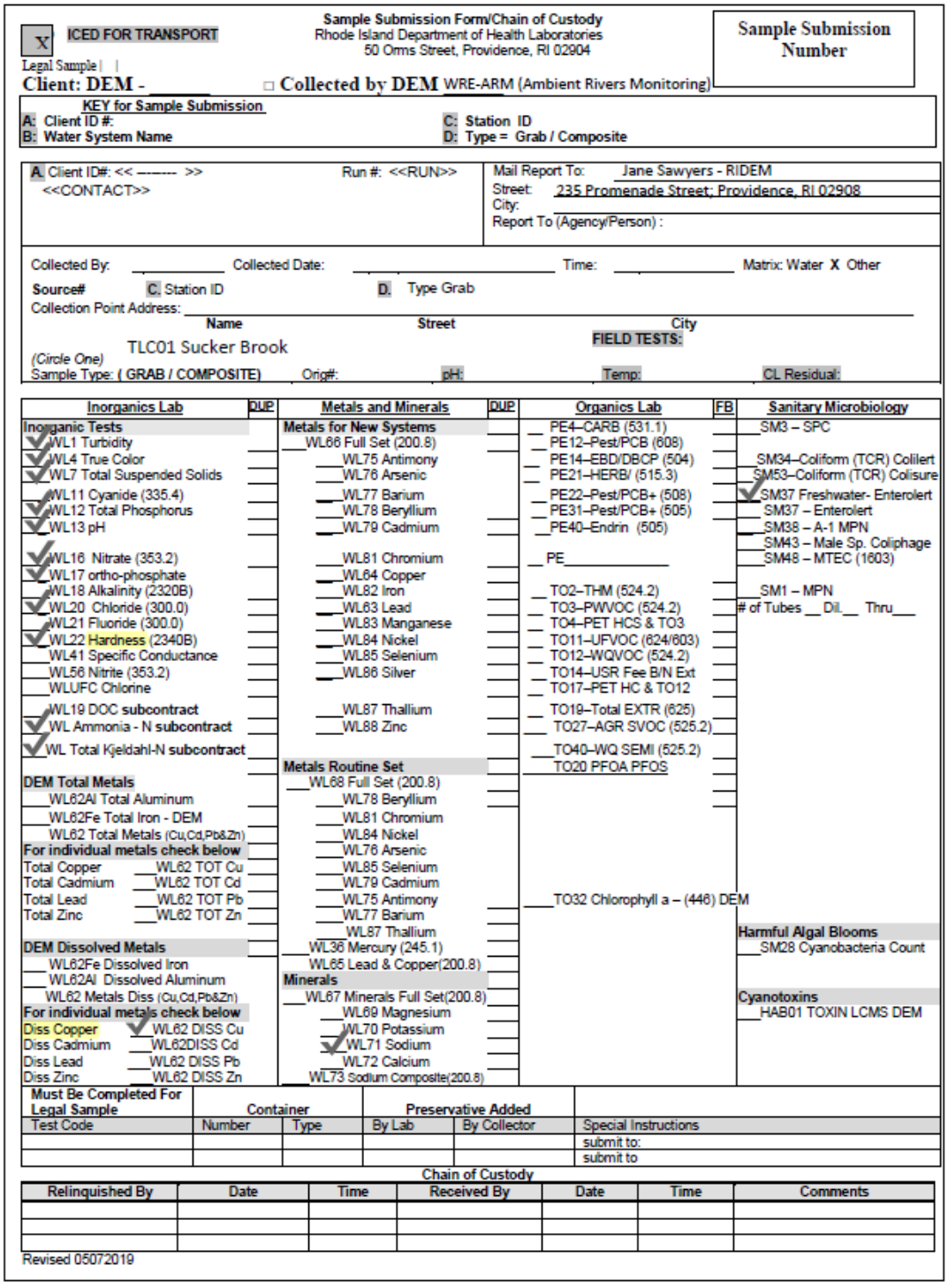
Table 3 Chemical Parameters, Analytical Methods, and SOPs followed by RI State Health Laboratories to Analyze Water Samples.

Parameter	Abbreviation	Units	Method	SOP Document
Conventionals				
Chloride	Cl	mg/L	EPA 300.0 Rev. 2.1 Ion Chromatography Lachet	RIDOH SOP WL20 Chloride ID No.: 1330 rev. 4
Dissolved Organic Carbon	DOC	mg/L	Standard Methods 5310C	NETL SOP 429
Hardness	--	mg/L	Standard Method 2340B Hardness by Calculation	RIDOH SOP WL22 Hardness ID No.: 1331 rev. 5
pH	pH	pH units	SM 4500-H+ B Electrode Orion Instrument model 720 A	RIDOH SOP WL13 pH ID No.: 4421 rev. 4
Sodium	Na	mg/L	EPA 200.8 ICP-MS	RIDOH SOP WL ICPMS ID No.: 7364 rev. 3
Total Suspended Solids	TSS	mg/L	SM2540 D Gravimetric	RIDOH SOP WL 7 TSS ID No.: 2450 rev. 5
True Color	--	CU	Observation relative to standard	RIDOH SOP WL04 Color ID No.: 1317 rev. 6
Turbidity	--	NTU	EPA 180.1 Nephelometric Turbidimeter	RIDOH SOP WL1 Turbidity ID No.: 1316 rev. 4
Nutrients				
Total ammonia [A]	NH_3-N (total)	mg/L	EPA 350.1 Rev. 2.0 Semi-automated Colorimetry	NETL SOP 40_0024L
Total Kjeldahl Nitrogen [A]	TKN	mg/L	EPA 351.2 Semi-automated Colorimetry	NETL SOP 40_0019B Total Kjeldahl Nitrogen
Nitrate-Nitrite as Nitrogen, Dissolved	NO_2 + NO_3-N	mg/L	EPA 353.2 Rev. 2.0 Autoanalyzer – Lachet	RIDOH SOP WL16 Nitrate ID No.: 1322 rev. 5 & RIDOH SOP WL56 Nitrite rev. 4
Ortho-phosphate	PO4-P	mg/L	Lachat method 10-115-01-1-F plus EPA 365.3	
Total Phosphorus	TP	mg/L	SM 4500 P B.5 & E Persulfate Digestion and Ascorbic Acid Method	RIDOH SOP WL12 Total Phosphorus ID No.: 1328 rev. 6
Chlorophyll *a*	Chl *a*	mg/L	EPA 446.0 Rev. 1.2 Spectrophotometry	RIDOH SOP TO32 Chlorophyll a ID No.: 1079 rev. 5
Pathogens				
Enterococci	Entero	MPN/100 mL	EPA/821/R-97-004	RIDOH SOP SM 37 Enterolert ID No.: 1832 rev. 4
Fecal	Fecal	CFU/100ml	EPA/821/R-97-004	RIDOH SOP SM48 Modified mTEC ID No.: 1838 rev. 4
Bacteriophage	Coliphage	PFU/100ml	USEPA, Method 1601 EPA 821-R-01-030, April 2001.	RIDOH SOP SM 43 Male-specific Bacteriophage Determination for Soft Shell Clams, Hard Clams and American Oysters ID No.:5803 rev. 1
Metals				
Cadmium	Cd (dissolved)	µg/L	EPA 200.8 ICP-MS	RIDOH SOP WL ICPMS rev. 1
Copper	Cu (dissolved)	µg/L	EPA 200.8 ICP-MS	RIDOH SOP WL ICPMS rev. 1
Lead	Pb (dissolved)	µg/L	EPA 200.8 ICP-MS	RIDOH SOP WL ICPMS rev. 1
Zinc	Zn (dissolved)	µg/L	EPA 200.8 ICP-MS	RIDOH SOP WL ICPMS rev. 1
Total Aluminum	Al (total)	µg/L	EPA 200.8 ICP-MS	RIDOH SOP WL ICPMS rev. 2

Parameter	Abbreviation	Units	Method	SOP Document
Total Iron	Fe (total)	µg/L	EPA 200.8 ICP-MS	RIDOH SOP WL ICPMS rev. 1

[A] Samples are analyzed by a laboratory certified in RI to test these parameters in non-potable water.

Note: Dissolved Oxygen, water temperature, conductivity, specific conductance, and salinity are measured in the field using YSI instrumentation. Total Nitrogen is reported as the addition of the following fractions: (NO_3-N) + (TKN)



Sample Submission Form/Chain of Custody
Rhode Island Department of Health Laboratories
50 Orms Street, Providence, RI 02904

X ICED FOR TRANSPORT
Legal Sample | |
Client: DEM - □ **Collected by DEM** WRE-ARM (Ambient Rivers Monitoring)

Sample Submission Number

KEY for Sample Submission
A: Client ID #:
B: Water System Name
C: Station ID
D: Type = Grab / Composite

A Client ID#: << ------- >>
<<CONTACT>>
Run #: <<RUN>>

Mail Report To: Jane Sawyers - RIDEM
Street: 235 Promenade Street; Providence, RI 02908
City:
Report To (Agency/Person) :

Collected By: _____ Collected Date: _____ Time: _____ Matrix: Water X Other
Source# C Station ID D Type Grab
Collection Point Address: _____
Name Street City
TLC01 Sucker Brook
(Circle One)
Sample Type: (GRAB / COMPOSITE) Orig#: pH: Temp: CL Residual:
FIELD TESTS:

Inorganics Lab	DUP	Metals and Minerals	DUP	Organics Lab	FB	Sanitary Microbiology
Inorganic Tests		**Metals for New Systems**				
✓WL1 Turbidity		___WL66 Full Set (200.8)		__ PE4–CARB (531.1)		___SM3 – SPC
✓WL4 True Color		___WL75 Antimony		__ PE12–Pest/PCB (608)		
✓WL7 Total Suspended Solids		___WL76 Arsenic		__ PE14–EBD/DBCP (504)		___SM34–Coliform (TCR) Colilert
___WL11 Cyanide (335.4)		___WL77 Barium		__ PE21–HERB/ (515.3)		___SM53–Coliform (TCR) Colisure
✓WL12 Total Phosphorus		___WL78 Beryllium		__ PE22–Pest/PCB+ (508)		✓SM37 Freshwater- Enterolert
✓WL13 pH		___WL79 Cadmium		__ PE31–Pest/PCB+ (505)		___SM37 – Enterolert
				__PE40–Endrin (505)		___SM38 – A-1 MPN
✓WL16 Nitrate (353.2)		___WL81 Chromium				___SM43 – Male Sp. Coliphage
✓WL17 ortho-phosphate		___WL64 Copper		__ PE_____		___SM48 – MTEC (1603)
___WL18 Alkalinity (2320B)		___WL82 Iron				
✓WL20 Chloride (300.0)		___WL63 Lead		__ TO2–THM (524.2)		___SM1 – MPN
___WL21 Fluoride (300.0)		___WL83 Manganese		__ TO3–PWVOC (524.2)		# of Tubes __ Dil.__ Thru___
✓WL22 Hardness (2340B)		___WL84 Nickel		__ TO4–PET HCS & TO3		
___WL41 Specific Conductance		___WL85 Selenium		__ TO11–UFVOC (624/603)		
___WL56 Nitrite (353.2)		___WL86 Silver		__ TO12–WQVOC (524.2)		
___WLUFC Chlorine				__ TO14–USR Fee B/N Ext		
				__ TO17–PET HC & TO12		
___WL19 DOC **subcontract**		___WL87 Thallium		__ TO19–Total EXTR (625)		
✓WL Ammonia - N **subcontract**		___WL88 Zinc		___ TO27–AGR SVOC (525.2)		
✓WL Total Kjeldahl-N **subcontract**				___TO40–WQ SEMI (525.2)		
		Metals Routine Set		___TO20 PFOA PFOS		
DEM Total Metals		___WL68 Full Set (200.8)				
___WL62Al Total Aluminum		___WL78 Beryllium				
___WL62Fe Total Iron - DEM		___WL81 Chromium				
___WL62 Total Metals (Cu,Cd,Pb&Zn)		___WL84 Nickel				
For individual metals check below		___WL76 Arsenic				
Total Copper ___WL62 TOT Cu		___WL85 Selenium				
Total Cadmium ___WL62 TOT Cd		___WL79 Cadmium				
Total Lead ___WL62 TOT Pb		___WL75 Antimony		___TO32 Chlorophyll a – (446) DEM		
Total Zinc ___WL62 TOT Zn		___WL77 Barium				**Harmful Algal Blooms**
		___WL87 Thallium				___SM28 Cyanobacteria Count
DEM Dissolved Metals		___WL36 Mercury (245.1)				
___WL62Fe Dissolved Iron		___WL65 Lead & Copper(200.8)				
___WL62Al Dissolved Aluminum		**Minerals**				
___WL62 Metals Diss (Cu,Cd,Pb&Zn)		___WL67 Minerals Full Set(200.8)				**Cyanotoxins**
For individual metals check below		___WL69 Magnesium				___HAB01 TOXIN LCMS DEM
Diss Copper ✓WL62 DISS Cu		___WL70 Potassium				
Diss Cadmium ___WL62DISS Cd		✓WL71 Sodium				
Diss Lead ___WL62 DISS Pb		___WL72 Calcium				
Diss Zinc ___WL62 DISS Zn		___WL73 Sodium Composite(200.8)				

Must Be Completed For Legal Sample	Container		Preservative Added		
Test Code	Number	Type	By Lab	By Collector	Special Instructions
					submit to:
					submit to

Chain of Custody

Relinquished By	Date	Time	Received By	Date	Time	Comments

Revised 05072019

Figure 2 Chain of Custody Form (Updated Annually by RIDOH).

C. Rotating Basin Schedule and Sampling Station Locations

The initial five-year rotating basin rotation schedule began in 2004 and was completed at the end of the 2009 sampling cycle. The second rotation began in 2011 and was completed in 2014. The third rotation began in 2015 and was completed in 2021. The fourth rotation is currently underway. The areas sampled during 2011 through 2021 are listed in Table 1. The watersheds that were sampled in 2019 through 2023 and those that are targeted for sampling 2024-2028 are shown in Figure 3. Sampling locations will be described in each year's addendum to the QAPP. A station list with parameters noted and a map of stations will be provided in the addendum.

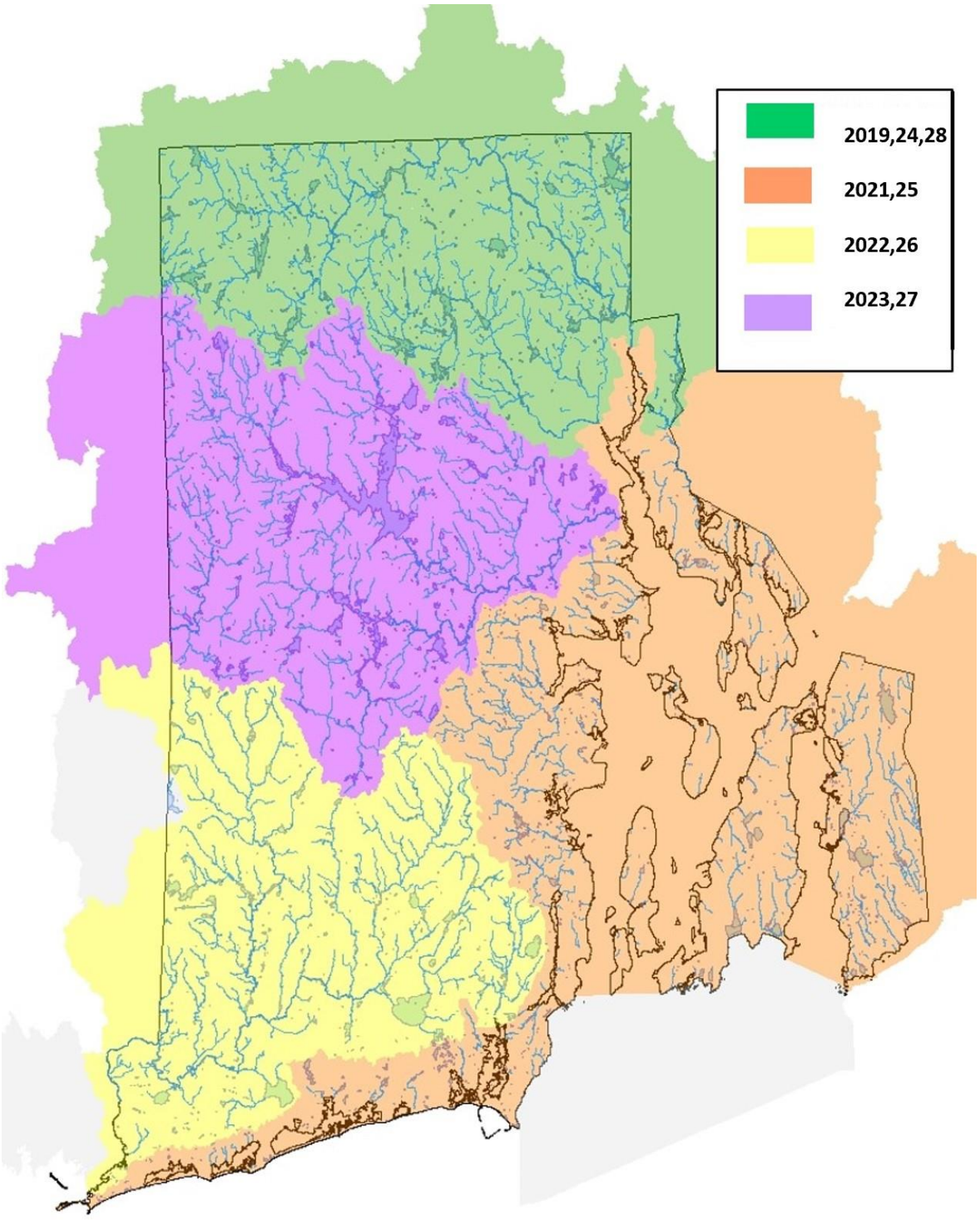


Figure 3 Ambient River Monitoring Program Basin Rotation 2019-2028.

7.0 Data Quality Objectives and Measurement Performance Criteria

A. Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements that clarify the intended use of the data, define which purposes the data may be used for, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions. DQOs delineate the type of data needed to support decisions, identify the conditions under which the data should be collected, and state what requirements must be met to use the data for its intended purpose. If applicable, the DQOs should specify the tolerable limits of the probability of making a decision error because of uncertainty in the data. The QA Lead, or their designee, will review field and analytical results to identify data that do not meet the DQOs.

This QAPP and associated SOP documents outline the proper data collection methods, procedures, and measurements to be utilized to reduce sources, magnitude, and frequency of errors during data generation. By outlining and following these steps, uncertainties in the data will be reduced and data quality will be assured for proper use and interpretation of the data. To meet the data quality objectives, the following quality assurance measures will be employed to verify the use of proper, consistent field procedures, handling measures, and laboratory analyses.

- Standard Operating Procedures (SOPs) will be implemented during sampling and field data collection.
- EPA-approved, standardized methods will be adhered to for all chemical analysis procedures.
- Qualified, trained scientists will perform the sample collection and laboratory analyses.
- Chain of Custody forms will be completed when handling samples and transferring custody from field crew to the State Health Laboratories as well as the authorized state vendors for analytical laboratory services (Figure 2).
- Duplicate samples will be collected at 10% or more of the sampling stations to ensure precise, reproducible results. Sampling stations for duplicate sample collections will be chosen randomly or in such a manner that ensures the same station is not always selected for a duplicate sample. In cases where a parameter is only sampled at a small subset of the total stations, the number of duplicate samples will be collected based on the total number of samples per sampling round.
- Field blanks will be collected at 10% or more of the sampling stations to ensure there is not contamination introduced in the field sampling procedures. Field blanks will be collected at duplicate stations.

B. Data Quality Indicators

Data quality indicators (DQI) are the quantitative statistics and qualitative descriptors used to evaluate data quality and determine if the data are acceptable to the user. The principal data quality indicators are precision, accuracy, sensitivity, bias, representativeness, completeness,

and comparability. To determine that the data meet quality objectives, the data quality indicators are compared against predetermined standards or *measurement performance criteria* as discussed below for each DQI.

Precision

Precision is the measure of agreement among repeated measurements of the same property under similar conditions. This is often expressed as the standard deviation. To ensure precise sampling, a duplicate sample will be collected at a minimum of 10% of stations. Duplicate sample analyses are run in the laboratory and the relative percent difference (RPD) is calculated. If the data results from the duplicate samples are not within the acceptable range, either an acceptable explanation must be found, or the data will not be used from these samples. Laboratory duplicates are considered part of the Lab QA/QC protocols and are described in the RIDOH QAPP. Sequential field duplicates are collected at 10% of stations each round of sampling event as described in the Field Sampling SOP (RIDEM 2022a). An RPD is calculated from the field duplicates, and an RPD of <20% is indicates that the samples are meeting the precision DQI.

Accuracy (Method Sensitivity)

Accuracy is the agreement of a measurement to a known value, and standard methods of measurement have a known accuracy. Use of EPA-approved, standardized, repeatable sample collection methods and chemical analysis procedures will be used to ensure accuracy. The accuracy of each method is established by laboratory studies and is reported as the method detection limit (MDL) and the quantitation level (QL) (Table 5). A quantitation limit is the minimum concentration of a substance that can be reliably identified, measured, and reported with confidence that it is accurate. The method detection limit is the lowest concentration of a substance that can reliably be measured and reported with a degree of confidence that the substance is greater than zero. Field blanks will measure the accuracy of the field methods. Field blanks should not be different than 0 or less than the method detection limit to meet the accuracy DQOs set out in the QAPP.

Bias

Bias is the persistent distortion of a measurement process that causes errors in one direction, either over-estimating or under-estimating the true value. EPA-approved, standardized, repeatable sample collection methods and chemical analysis procedures will be used for each sample to avoid bias. Quality assurance data will also be used to determine whether sampling or analytical bias exists. These data will be reported with the data results.

Data Representativeness

Representativeness is the degree to which data accurately and precisely represent an environmental condition. Stream locations are chosen so that the samples collected will be representative of the site conditions on the day and time of collection and will reflect the ambient conditions of the watershed. RIDEM will exclude sites that are not representative of flowing rivers during ambient conditions, including those dominated by withdrawals or

discharges of water, stagnant or backwater conditions, or impoundments. If the site does not meet the conditions for ambient river monitoring as defined in this document, an alternate sampling date or location will be chosen. The representativeness of the study can be measured by the percentage of samples collected during the period of record that meet the criteria of ambient conditions. A minimum of 90% of samples must meet these conditions to accurately report the results as representative of ambient water quality conditions.

Sampling completeness

Completeness is the measure of the amount of valid data collected compared to the total amount of data that was planned to be collected. On occasion, water samples may be lost, broken or contaminated. If a stream is dry, construction prohibits access, or it is unsafe to collect a sample then a sample cannot be collected. It may be necessary to collect a sample on an alternate date and effort will be made to collect missed samples until November 30th. Data may be invalid if the sample cannot be analyzed due to a laboratory error, equipment malfunction, or failure to meet measurement performance criteria. The completeness of the study will be measured as the percentage of all samples collected that produced usable data. A minimum of 90% of samples should be collected, analyzed and judged valid to be considered an effective data collection program. If this completeness requirement is not met, statistical procedures and best professional judgment will be applied to decide whether the remaining data will produce correct data interpretations and conclusions.

Data Comparability

Data comparability refers to how well one data set matches up to another, in terms of data collection techniques, sample preparation and handling, and analytical methods used. Depending on how closely various methodologies match, it can be appropriate to use the data in a way that combines it all quantitatively. If the data are not very comparable, it should be used separately in a weight of evidence approach. It is important that the ARM program both document its methodologies carefully, and follow the documented methods, because this allows comparability with other data sets to be more accurately assessed.

Data collected during previous rotations in similar areas, and by the earlier baseline monitoring program should be very comparable, and any changes in procedures are described in detailed QAPP and SOP documents. If data are available for comparison, they can be used to identify any outlying data points or relative data variability. Data collected at the same stream locations can be used to document any changes that have occurred over time at these sites.

8.0 Training Arrangements and Responsibilities

All fieldwork will be performed by the Field Data Collection Team under the training and supervision of the ARM Project Manager (or other qualified individual). The ARM program has a training program called the “Training Passport” (Appendix A). This document provides a list of self-directed and instructor-led training for each new employee to cover and initial when completed. Because the Field Data Collection Team may include new seasonal or contractual

employees, the training process each sampling season includes in-field training and observation by the QA Manager prior to the Field Data Collection Team sampling. The Training Passport will provide documentation of training that will be kept on file by the QA manager. The ARM Project Manager will train RIDEM scientists who perform sample collection in clean hands methods as outlined in the SOP document (RIDEM, 2022a). Other than previous academic study in an environmental science related field, the Field Data Collection Team will require no additional training or certification courses in preparation for this project.

All laboratory work will be performed under the supervision of the Chemical Analysis Project Lead at Rhode Island Department of Health State Health Laboratories. Laboratory workers will receive training supervised by the Chemical Analysis Project Lead or a qualified trainer prior to work being performed. A qualification record is kept on site to track the training and performance of those personnel assigned to laboratory tasks.

9.0 Documentation and Records

The ARM Project Manager will be responsible for all data collected on site and sample data reported by the State Health Laboratories. Electronic or paper copies of original field notes, YSI data sheets, Chain of Custody forms, and laboratory results will be maintained. Each sampling location will have a folder for data collected at that site. Forms that have multiple sites recorded on the same form, such as YSI data, will be placed into one folder for each year. All electronic data will be formatted in Microsoft Excel. The ARM Project Manager will ensure these documents and electronic data are permanently retained to allow future comparisons and trend analysis. All electronic data and metadata are saved in folders on digital storage drive which is backed up by the Rhode Island Department of Information Technology (RI DOIT) department.

The ARM Project Manager or their designee will be responsible for future updates to this QAPP and any required addenda. Individuals involved in the project will receive a current copy of the approved QAPP.

II DATA GENERATION AND ACQUISITION

1.0 Sampling Design Process

A. Rationale for Selection of Sampling Sites

Sampling sites will be selected as described in Section I.6.B Specific Task Descriptions. Several targeted stations may be added to address specific concerns of other RIDEM programs and stakeholders. All sample locations will be representative of the site conditions on the day and time of collection and will reflect ambient conditions in the watershed. Most stations will be near road crossings, or easily accessible by foot via public property or, with permission, private property. If a sampling station is inaccessible, field crews will contact the Field Data Collection Team Leader, and they will schedule a return visit to the station when conditions allow access or select an accessible location.

B. Sampling Schedule and Logistics

The first rotating basin monitoring cycle ran from 2004-2009. The second rotation from 2011 through 2014, the third rotation began in 2015 through 2021, and the fourth rotation began in 2022 (Table 1). Any revisions to the sampling plan will be addressed in addenda to this QAPP. The sampling stations will vary by year according to the rotating basin schedule and will be finalized by RIDEM before the beginning of each sampling season. Each year, full sampling water chemistry suites and metals and pathogens (as applicable) will be collected in June, August, and September, as weather conditions allow. Two additional sampling events in May and July will collect pathogen data only.

For each year in the rotation cycle there will be approximately 50 stations, with additional QA/QC samples also collected as described in Section I.7.A. The number of QA/QC samples will vary depending on how many sampling days are required to finish each round and the distribution of parameters measured at each sampling station. The sampling schedule will consider precipitation thresholds and sampling time constraints to satisfy RIDOH sample receiving policies. RIDOH will not accept any samples received Fridays after noon, so sampling will not take place on Fridays, unless circumstances require a Friday sampling with previous arrangement with RIDOH. All samples submitted to the State Health Laboratories will be delivered to the receiving area by 3:00 PM Monday through Thursday. Water chemistry samples and YSI data are critical information, while the photographs of the site during each sampling event are for informational purposes to document site conditions. The Project Manager in consultation with the Program Manager will be responsible for deciding any seasonal factor to either avoid or capture through the sampling effort (i.e. phytoplankton growing season, spawning, high or low precipitation beyond the dry weather conditions mentioned prior). No sampling will take place during dangerous weather conditions (i.e. lightning, high wind advisories). Other sources of variability specific to the project will be addressed in the project-specific addendum.

2.0 Sampling Methods

Prior to each field day, materials will be compiled and prepared in the RIDEM/OWR Sampling Center. Environmental conditions will be noted, and the number and type of samples planned may be recorded on a standard form. While the checklists on the Sampling Event form (Figure 4) will be consulted before each sampling day, the Project Manager may opt to not fill out the Sampling Event form out each day. If the form is not filled out, the amount of antecedent rainfall must be tracked in an excel file. This form is to act as a guide to ensure all necessary materials are brought for sampling. It can be used as such by the Project Manager without daily completion so long as it is always referenced, and rainfall data is recorded as stated above.

As previously described in Section I.6.B Specific Task Descriptions, samples will be collected following a 24-hour antecedent dry period with precipitation not to meet or exceed 0.25 inches. Any deviations from the antecedent dry period will be addressed in the annual addendum. Other than metal samples, all water chemistry samples will be collected as grab samples from a representative location in the stream. A pole with bottle attachment may be used in sampling locations where access to a representative section of the stream is not possible. Clean hands-dirty hands sampling techniques will be used for metals samples, as described in the SOP: Standard Operating Procedure for the Collection of Ambient Water Samples from Streams (RIDEM 2022a).

Sample containers are obtained from RIDOH. The collected sample volume required for each container is specified by RIDOH. The sample containers are provided cleaned and ready for sample collection, including any preservatives required. Single-use containers are disposed of by RIDOH, and multi-use containers are cleaned and reused by RIDOH under their protocols. All bottles and their contents are inspected by the Field Crew prior to and after use. Any problems are reported to the Project Manager, who will communicate issues to RIDOH.

All sampling bottles will either have a pre-printed label attached, or will have the date and time collected, Station ID, River Name, and RIDEM written with indelible marker on a label attached to the bottle. The naming conventions for Station ID for QA/QC samples are as follows:

Table 4 Naming Conventions for QA/QC Samples.

Sample Type	Naming Convention
Field Equipment Blank	FStationID (Example: FBNC01 is the Field Equipment Blank for BNC01)
Duplicate	DStationID (Example: DBNC01 is the Duplicate for BNC01)

1 Sampling Event Information General Area: Date:

- ☐ Sent email notification to DOH?
- ☐ Label Blank bottles and put in cooler
- ☐ Posted Float Plan at Project Manager's cube (note: Who / Where / Why / Which vehicle)

2 Weather

Current Conditions *Temp:* *Barometric Pressure:* *(online or measured?)*

% Chance of Rain forecasted today: Circle one: Overcast Clear Scattered Clouds

_____ % @ Providence Airport -- Warwick (NOAA): Time of Departure from Foundry: _____
_____ % @ Smithfield (NOAA):
_____ % @ Westerly (NOAA): Time of Arrival at HEALTH: _____
_____ % @ Weather.com zipcode:
_____ % @ weatherunderground.com zipcode: Time of Arrival at Foundry: _____

2-day Weather History (amount of precipitation in the last 48 hours must be ≤ 0.10 inches)

_____ in. @ Providence Airport (Warwick) between (days/times) _____
_____ in. @ Smithfield between (day/times)_____
_____ in. @ Westerly between (days/times)_____

3 Required Sample Bottle Sets:

_____ =Total Number of Stations Sampling Today (****note number of DUPS and BLANKS)
_____ = Number of Sets of *"Suite 1"* (5 bottles: conventionals, nutrients, entero)
_____ = Number of Sets of *"Suite 1 + metals"* (6 bottles: conventionals, nutrients, entero)
_____ = Number of Sets of *"Suite 1 + Metals + Fe(or Cu)"* (6 bottles: conventionals, nutrients, metals)
_____ = Number entero only bottles:

Other data to collect today: (circle) **habitat data** **shade** **flow** **periphyton**
measured or USGS gage?

4 Field Gear Inventory (check box when packed and write a note if we need to order more or resolve any problems)

☐ Coolers with Ice	☐ YSI meter # _____	☐ Orange Vests
☐ Sample Bottles	☐ Extra YSI batteries	☐ POWDER FREE gloves
☐ Sampling basket/bucket & rope	☐ Camera w/ charged battery	☐ First Aid Kit
☐ Waders or Hip boots	☐ Sprayer for waders	☐ Safety Hats
☐ Safety Cones	☐ meter measuring tape	☐ Hand sanitizer/wipes
☐ Sampling Wand	☐ bottled DI water for FEB	☐ flow meter/staff

5 Paperwork to bring (in metal clipboard)

☐ Chain of Custody Forms	☐ Directions (list of station order)	☐ YSI data Collection Sheets
☐ Labels for Sample Bottles	☐ site specific plans	☐ ICE emergency sheets
☐ List of carwashes/gas stations	☐ Pens/Pencil/sharpies	☐ Map/atlas

6 Helpful things to bring (but not required)

☐ Sunscreen	☐ Lunch	☐ cell phone
☐ Bugspray	☐ Sunglasses/hat	☐ Towel/dry clothes
☐ Technu	☐ Garbage bag/sample bags	☐ Clippers

END OF THE DAY REMINDERS (please initial who will do this and check off when completed, cross out if NA)

___ Re-fuel Vehicle	___ Return Car Keys	___ Restock Ice in Freezer
___ Pick up bottles at HEALTH	___ Charge Camera Battery	___ Email New Bottle Order
___ Refill Blue Distilled Water at HEALTH		___ Enter YSI 85 Data
___ Download Pictures from Camera		___ Download ProPlus Data

Figure 4 Sampling Event Form.

Field measurements will be made using a Handheld Multi-parameter Meter according to the procedures outlined in the Standard Operating Procedures Manual (RIDEM, 2022b). All field data will be recorded on the Field Data Collection Sheet (RIDEM, 2022a) shown in Figure 5. Written mistakes will be crossed out using a single line and initialed. Duplicate field measurements will be collected whenever duplicate samples are collected. A digital camera will be used to document site conditions at each station, and pictures will be maintained according to the RIDEM Digital Photography Record Collection and Storage SOP (RIDEM, 2008).

Samping Round _____ ARM 2021 - Coastal Rotation Page ____ of ___

Sampling Day _____

Field Crew:	Weather Conditions:
YSI Instrument (circle one): ProPlus 2030	YSI Serial Number

Site ID												
Location Name												
Date												
Time												
DO (mg/L)												
Saturation (%)												
SPC (µS/cm)												
Temp (°C)												
B. Pres. (mmHg)												
pH												
Nitrate (mg/L)												
Photographs												
O.G.												
Flow												
Sample Method												
Comments												

Rhode Island DEM - Office of Water Resources

Figure 5 Field Data Collection Sheet for Monitoring Section Sampling Events

Figure 6 Using YSI Multi-Parameter Meter in Stream.

3.0 Sampling Handling and Custody

All samples will be collected in the field and transported on ice in a cooler under the supervision of the ARM Project Manager or a person with proper training. All samples will be delivered to the RIDOH State Health Laboratories in Providence accompanied by a complete, signed Chain of Custody form (Figure 2). The RIDEM OWR employee who drops off the samples and the RIDOH receiving personnel will sign the Chain of Custody form to verify the bottle exchange. RIDOH will retain the original Chain of Custody forms, and RIDEM will take copies. Samples will be logged into the RIDOH tracking system. Sample maximum holding times prior to analysis are noted in Table 5. At the end of the sampling day, all equipment (coolers, waders, bucket etc.) will be rinsed and left to dry in the RIDEM OWR Sampling Center. Other materials will be put away, paperwork will be filed, and digital photographs will be downloaded, renamed and organized into folders at the end of the sampling day, or soon thereafter.

4.0 Analytical Methods

RIDOH will conduct all laboratory analyses using standard EPA-approved methods and the associated RIDOH SOP and QAPP. Standard operating procedures will be used by the authorized

state vendor for analytical laboratory services to run TKN and total ammonia analyses with the SOP document number and EPA method. RIDOH documents the procedures to follow for failures and the personnel responsible for corrective action and documentation. As this information is typically used biennially under the assessment program, no turn-around time for the final approved electronic data package is specified; however, DOH sends Certificates of Analysis (COAs) as soon as they are available following submission and analysis of the sample, typically within a week of submission. These COAs arrive prior to the next sampling round and are reviewed for adherence to the DQOs of this QAPP. RIDOH QAPP and SOPs are available upon request.

5.0 Quality Control

To meet our data quality objectives, the following quality assurance measures will be employed to verify the use of proper, consistent field procedures, handling measures, laboratory analyses and database management activities:

- Standard Operating Procedures (SOPs) will be carefully followed and refined when necessary, during sampling and field data collection.
- EPA-approved, standardized methods will be adhered to for all chemical analysis procedures (Table 3).
- Samples will not exceed recommended holding times (Table 5).
- Qualified, trained scientists will perform the sample collection and laboratory analyses.
- Chain of Custody forms will be completed when handling samples and transferring custody from field crew to both the RIDOH Laboratories as well as the authorized state vendor for analytical laboratory services. (Figure 2).
- Other quality assurance samples, either duplicates or field equipment blanks, will be collected daily, for at least 10% of the total samples collected for each sampling round. This will help to ensure precise, reproducible results. Stations for duplicate sample collections will be chosen randomly or in such a manner that ensures the same station is not always selected for a duplicate sample.

The RIDOH laboratories will conduct QA/QC procedures according to the QAPP and SOP documents for that program (RIDOH, 2018). Sample holding times, handling procedures, and standard methods will be followed, otherwise data will be flagged, and an explanation will be provided to help determine if data are still usable.

Table 5. Holding Times, Lab Quantitation and Method Detection Limits for Each Parameter Analyzed by RIDOH Laboratory[1].

Parameter	Abbreviation	Units	Max holding time	Quantitation Limit (QL)	Method Detection Limit (MDL)
Conventionals					
Chloride	Cl	mg/L	28 days	0.2	0.02
Hardness	--	mg/L	6 months	–	–
pH	pH	pH units	immediately	–	–
Sodium	Na	mg/L	6 months	1	0.05
Total Suspended Solids	TSS	mg/L	7 days	1.0	–
True Color		CU	48 hours	–	–
Turbidity	–	NTU	48 hours	0.2	–
Nutrients					
Total ammonia	NH_3-N (total)	mg/L	7 days	0.05	0.02
Total Kjehldahl Nitrogen	TKN	mg/L	28 days	0.2	–
Nitrate-Nitrite as Nitrogen, Dissolved	NO3-N	mg/L	2 days	0.05	0.01
Ortho-phosphate	PO4-P	mg/L	48 hours	0.02	0.01
Total Phosphorus	TP	mg/L	28 days	0.02	0.01
Chlorophyll *a*	Chl *a*	mg/l	24 hours (unfiltered) 21 days (filtered)	0.1	0.046
Pathogens					
Enterococci	Entero	Entercocci per 100 mL	6 hours	< 1	–
Fecal Coliform	Fecal	CFU/100ml	6 hours	< 1	–
Bacteriophage	Coliphage	PFU/100ml	6 hours	< 1	–
Metals					
Cadmium	Cd	µg/L	6 months	1.0	0.17
Copper	Cu	µg/L	6 months	1.0	0.13
Lead	Pb	µg/L	6 months	1.0	0.11
Zinc	Zn	µg/L	6 months	20	3.58
Total Aluminum	Al (total)	µg/L	6 months	10	2.38
Total Iron	Fe (total)	µg/L	6 months	20	8.18

[1]Total ammonia and Total Kjehldahl Nitrogen are analyzed at sub-contracted laboratory.

6.0 Instrument/Equipment Testing, Inspection, and Maintenance

Inspection, testing, and maintenance of field equipment is the responsibility of the ARM Project Manager. Any necessary field equipment should be checked, before heading into the field, including the items on the sampling event form (Figure 4).

All sampling bottles will either have pre-printed label attached, or will have the date and time collected, Station ID, River Name, and RIDEM written with indelible marker on a label attached to the bottle.

The following inspection tasks should be done at least daily:

- Checking waders for holes, leaks, and repairing if necessary.
- Checking the ice maker, and stocking freezer with ice during high demand months.
- Spare batteries for hand-held meter and a screwdriver to open the battery compartment should be kept in the meter case.
- Ensuring that sufficient safety vests are available and in good shape.
- Ensuring that sufficient traffic cones are available.
- Ensuring that sprayers are full and in good working order.
- Checking the camera and/or iPad battery charge and downloading and deleting old pictures.
- Ensuring that the sampling wand is in working order.

The RIDOH laboratories will conduct QA/QC procedures according to the QAPP and SOP documents for that program (RIDOH, 2018). Maintenance logs for the equipment and analysis instruments will be maintained in the RIDOH State Health Laboratories as detailed in the RIDOH Quality Assurance Plan.

7.0 Instrument Calibration

To ensure that the field data are correct, the hand-held meter will be calibrated for dissolved oxygen each day as described in the SOP (RIDEM, 2022b). This will be done prior to sampling as well as at the end of the day after sampling has been completed. Specific conductivity and temperature with be verified once per month during the field season. If any calibration/verification value falls outside of an acceptable range, the instrument will be re-calibrated. If re-calibration is not successful, then the instrument will be sent to the manufacturer or an authorized repair facility for further repair. All calibration and verification data will be recorded in a log sheet located in the sampling center. Calibration data should be kept with the same retention schedule as the field data. Any information on service, repairs, or routine maintenance, including new probes, membranes, factory calibrations, batteries, etc. should be recorded in the instrument's logbook.

RIDEM Calibration Log **YSI 2030** **Circle: Meter #1(18H108152)** **Meter #2 (18H108153)**

	Date	Time
DO Membrane Change		
Specific Conductivity Verification		
Temperature Verification		

Complete once per month or as needed. See SOP and lab book.

	1 Date	2 Time	3 Date DO Membrane Changed	4 Initial DO Reading mg/L	5 Temp Reading °C	6 Barometric Pressure mm Mg	7 Ideal DO (from Table) mg/L	8 DO Reading after Calibration mg/L	9 Difference: Reading and Ideal Value mg/L	10 Is Col 9 Difference ±0.5 mg/L? Y or N	11 Initial	12 Notes
1 Pre												
2 Post												
3 Pre												
4 Post												
5 Pre												
6 Post												
7 Pre												
8 Post												
9 Pre												
10 Post												

Col 9 Calibration before field work: subtract Col 8 (Post Calibration) and Col 7 (Ideal).
Post field work check: subtract Col 4 (Initial) and Col 7 (Ideal).
Note when batteries have been changed in NOTES column

Figure 7 RIDEM YSI 2030 Calibration Log Sheet.

RIDEM Log YSI 2030 Circle: Meter #1(18H108152) Meter #2 (18H108153)

Specific Conductivity (SC) Verification: Once per Month

Date	Time	Standard µS/cm	Lot Nunber	Expiration	Initial SC Reading µS/cm		Difference: Initial Reading and Standard µS/cm	Is Difference ±5 µS/cm? Y or N*	Initial	Notes

* If yes, complete steps detailed in Section 6.3.2 from SOP. This includes rinsing the probe and repeating verification before calibrating.

Temperature Verification: Once per Month

Date	Time	NIST Serial Number	NIST Tempertaure Reading	Meter Temperature Reading	Difference: NIST and Meter	Is Difference ±1°C?	Initial	Notes

Specific Conductivity (SC) Calibration: If Needed

Date	Time	Standard µS/cm	Lot Nunber	Expiration	Initial SC Reading µS/cm	SC Reading after Calibration µS/cm	Difference: After Calibration and Standard µS/cm	Is Difference ± 5 µS/cm? Y or N	Initial	Notes

Figure 8 RIDEM YSI 2030 Specific Conductivity and Temperature Verification Log Sheet.

The instrument calibration procedures and frequency for RIDOH equipment will be documented in the standard operating procedures maintained at the RIDOH State Health Laboratories as detailed in the RIDOH Quality Assurance Plan (RIDOH, 2018).

8.0 Inspection for Supplies and Consumables

All sample bottles with preservative received from the State Health Laboratories will be checked by members of the Field Data Collection Team to verify if the bottle cap is securely fastened to prevent leaking of the preservative prior to sample collection. Sample bottles will be stored in the OWR Sampling Center until needed. Field supplies stored in the OWR Sampling Center will be inventoried before the start of each sampling day, and problems will be reported to the ARM Program Manager. At the end of each field day, supplies and gear will be rinsed or washed as needed, allowed to dry, and stored in the OWR Sampling Center.

At least annually, the ARM Project Manager and Field Data Collection Team Leader will take stock of all consumable supplies, and re-order as necessary. These will include:

- Gloves
- Ice
- Standards
- Kimwipes
- Paper towels
- Deionized water
- First aid supplies
- Sunscreen
- Hand sanitizer
- Bug spray
- Traffic cones
- Hunting vests (Bright orange)
- Waders

Certificates of Analysis for reagent chemicals and standards are maintained by RIDOH State Health Laboratories and checked by the Laboratory Chemical Analysis Lead or qualified designee.

9.0 Non-direct Measurements

The decision to sample on a given day following scattered rain or possible showers will be based on data retrieved online from the NOAA National Weather Service (NWS). The NWS provides near real-time access to a selection of official weather observations and forecasts from U.S. government sources for use by the national and international community. These data are available on the NOAA website. NOAA maintains its own documentation on their procedures to collect, inspect and validate the data.

Each day before fieldwork commences, a member of the Field Data Collection Team will check the three-day weather histories at stations in Smithfield, RI (http://www.weather.gov/data/obhistory/KSFZ.html), at the Providence, Green State Airport station (http://www.weather.gov/data/obhistory/KPVD.html) and Westerly State Airport (http://www.weather.gov/data/obhistory/KWST.html). For chemistry sampling, precipitation accumulating greater than or equal to 0.25 inches in the area of sampling locations will result in postponement of the sampling day until 24 hours have passed since the rain stopped. Any deviations from the antecedent dry period will be addressed in the annual addendum.

10.0 Data Management

The ARM Project Manager will be responsible for the proper compilation of data analyses, preparation, review, and transmission of results. The ARM QA Manager or designee will review all analytical data for accuracy and will maintain hardcopies of the data in the project file at

RIDEM/OWR as noted in Section I.9 of this document. The hard copies will be kept under the RIDEM Records Retention Policy. The electronic copy will be uploaded to the State Water Information Management System (SWIMS) for indefinite storage by the RIDEM QA Manager.

III DATA VALIDATION AND USABILITY

1.0 Data Review, Verification and Validation

The ARM Project Manager or designee will review all data for completeness and accuracy. Field notes and Chain of Custody forms must be reviewed, and data entry must be checked for any errors, corrected as necessary. Outliers and inconsistencies will be flagged for further review with the RIDEM/OWR QA Manager. Laboratory results will be reviewed by RIDOH using their own procedures to verify that values and data quality indicators meet criteria and are within the acceptable ranges for each parameter. MDLs are statistically derived values. New MDL studies are conducted annually by the RIDOH State Health Laboratories to demonstrate the statistical limits of detection. The MDLs are updated annually based on the studies.

2.0 Verification and Validation Methods

Analytical data provided by State Health Laboratories will be reviewed and validated internally to provide information on whether data are acceptable or should be rejected. The ARM Project Manager or designee will be responsible for reviewing the laboratory reports and data packages, as well as data entries and transmittals, for completeness and adherence to QA requirements. Data packages will include sample receipt and tracking information, Chain of Custody forms, tabulated data summary forms, and raw analytical data for all field samples, standards, QC checks, and other project specific documents. Along with the procedures set forth in the RIDEM environmental data review SOP (RIDEM, 2007), data quality will be assessed by comparing entered data to original data decisions to qualify, accept or reject data will be discussed by the ARM Program Manager and the QA Manager. The RIDEM Program Manager will make the final determination to reject data and remove any unusable data. If fewer than 90% of the data are judged valid, statistical procedures and best professional judgment will be applied to decide whether use of the remaining data will produce correct data interpretations and conclusions. Assumptions of the project design and limitations in the data set will be documented for future communication to data users and water quality managers.

3.0 Reconciliation with Project Goals

The RIDEM/OWR Quality Assurance Manager or designee will decide if the data collected meet the measurement performance criteria and verify that all the SOPs have been followed to determine if the data meet the project quality objectives. If data collected meet the data quality objectives for the project, the data are considered accepted. Data that do not meet data quality objectives will be rejected. The project team will determine if additional data need to be collected and will specify and document limitations on the use of rejected data.

IV ASSESSMENT AND OVERSIGHT

1.0 Assessment and Response Actions

The Quality Assurance Manager will annually assess field data collection efforts, field notes, laboratory data, and maps generated as part of this project to ensure that data collected is useable for the purposes of the study. They will also provide oversight to ensure that protocols described in the QAPP are being followed.

Oversight will include ensuring that:

- Field equipment is routinely and properly calibrated.
- Calibrations are properly documented.
- Data are recorded in a consistent manner.
- Samples are collected as directed in standard operating procedures.
- Samples are properly stored prior to transfer to custody of the State Health Laboratories.
- All documentation must be properly stored.

The Quality Assurance Manager or designee will review field and laboratory data, including data collected on site, water quality parameter measurements, quality assurance sample measurements, and other data quality indicators to ensure that data are within the accepted range for each parameter. If inconsistencies are noted, the Quality Assurance Manager will discuss field instrument calibration and data collection procedures with field personnel, and chemical analysis with the Chemical Analysis Project Lead and the ARM Project Manager. Any questionable data discovered will be reported and will be re-collected or re-analyzed if possible. Potential sources of error will be considered, described and carefully documented in order to flag results for data users or decision makers.

2.0 Reports to Management

Periodic quality management reports serve as confirmation that data are of sufficient quality to meet project goals. To ensure that all members of the project are notified of the project status, the ARM Project Manager will document project milestones and will update the RIDEM Program Manager and Quality Assurance Manager on progress. Reports will include start and finish of data collection, status of data transfer, or significant QA problems and recommended solutions. The QA Manager may require that actions be taken to ensure data quality objectives are met. If a sample needs to be re-collected or re-analyzed because of data quality concerns, this will be discussed by the ARM Project Manager and/or Chemical Analysis Project Lead, RIDEM Program Manager and QA Manager. Copies of communications regarding data concerns will be retained in the same folders as the data that is being discussed.

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APPENDIX A

SOP for the Measurement of Dissolved Oxygen, Temperature, Specific Conductance, pH, and Nitrate Using a Handheld YSI Professional Plus Instrument

Rhode Island Department of Environmental Management
Office of Water Resources
Standard Operating Procedure (SOP) Review Page

SOP No.	SOP Name	Review Date	What changes, if any?	Reviewed By	Revision/ Renewal Date
WR-W 34	SOP For measurement of DO, Temp, Sp Cond, pH, and Nitrate using a handheld YSI Pro Plus Instrument	5/28/21	NONE	Brian Zalewsky	5/28/21

APPROVALS: I certify that the SOP has been reviewed, revised (if necessary), and verify that the SOP accurately reflects the current needs of the program:

Program Quality Assurance Manager:

Printed Name	Signature	Date
Jane Sawyers	Jane Sawyers	5/28/21

Division/Office Administrator:

Printed Name	Signature	Date
Angelo S. Liberti	Angelo S. Liberti Digitally signed by Angelo S. Liberti Date: 2021.06.03 08:17:04 -04'00'	

OCTA Quality Assurance Staff:

Printed Name	Signature	Date
	Richard T. Enander Digitally signed by Richard T. Enander Date: 2021.06.07 13:36:32 -04'00'	

DISTRIBUTION

(x) Program QA Manager

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Rhode Island Department of Environmental Management
Office of Water Resources
235 Promenade Street, Providence RI 02908

Standard Operating Procedure for the Measurement of Dissolved Oxygen, Temperature, Specific Conductance, pH and Nitrate Using a Handheld YSI Professional Plus Instrument

SOP No.: WR-W-34
Revision No.: 0
Originator Name: Mark Nimiroski

APPROVALS:

Deputy Chief of Water Quality & Standards:

Sue Kiernan	Sue Kiernan	10/16/12
Printed Name	Signature	Date

RIDEM Quality Assurance Manager:

Terry Gray	Terrence Gray	10/7/12
Printed Name	Signature	Date

Surface Water Monitoring and Assessment QA Manager

Connie Carey	Connie Carey	10/16/12
Printed Name	Signature	Date

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(x) Surface Water Monitoring & Assessment (Connie Carey) By: cgc Date : 10/16/12

(x) TMDL Program (Elizabeth Scott) By: ES Date : 10/7/12

(x) Quality Assurance Manager, RIDEM (Terry Gray) By:_____ Date :_____

Rhode Island Department of Environmental Management
Office of Water Resources
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_____	_____	_____
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Surface Water Monitoring and Assessment QA Manager

Connie Carey

_____	_____	_____
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(x) TMDL Program (Elizabeth Scott) By:_____Date :_____

(x) Quality Assurance Manager, RIDEM (Terry Gray) By:_____Date :_____

TABLE OF CONTENTS

Standard Operating Procedure for the Measurement of Dissolved Oxygen, Temperature, Specific Conductance, pH, and Nitrate Using a Handheld YSI Pro Plus Instrument

1.0 APPLICABILITY

This SOP applies to all Office of Water Resources (OWR) staff involved in routine calibration and operation of a Handheld YSI Model Professional Plus Instrument (YSI Pro Plus) to collect environmental monitoring data on behalf of the Rhode Island Department of Environmental Management (RIDEM). Any specific exemptions from the use of this SOP for project work shall be predetermined by management discretion, noted in project specific QAPPs and communicated to the analysts by the project manager.

2.0 PURPOSE

This SOP establishes a standardized method for performing water quality measurements in the field using a YSI Pro Plus. The YSI Pro Plus instrument is used to analyze water in situ for dissolved oxygen, specific conductance (temperature compensated conductivity), temperature, nitrate, pH, barometric pressure. This SOP is intended to set a consistent protocol to ensure the quality of RIDEM's data collection—resulting in improved uniformity, reproducibility, verifiability, and defensibility of the data, as well as increased program credibility. This document describes the RIDEM OWR procedure for calibrating and maintaining the YSI Pro Plus instrument, details how measurements should be taken, and how data should be recorded. This SOP is not intended to provide guidance for use of the meter in effluent discharges, brackish or saline waters, or for contaminant specific measurements such as spills. If the intended use of the meter is for the above situations, or any situations other than ambient freshwaters, a project specific QAPP or SOP should be developed.

3.0 DEFINITIONS

3.1 ANALYST: Any RIDEM employee, intern, or contractor who is collecting environmental data on behalf of the State of Rhode Island for the purposes of water quality monitoring.

3.2 ACCURACY: The degree of agreement between a measured value and the accepted reference value.

3.3 CALIBRATION: A procedure used to establish a relationship between the value measured by the YSI Pro Plus (value the device produces) and the actual value of a traceable standard. This process ensures that the YSI Pro Plus takes an accurate measurement within the specified limits.

3.4 OWR: RIDEM Office of Water Resources

3.5 PROJECT: A set amount and duration of work with explicitly stated tasks and procedures for completion of that work.

3.6 PROJECT MANAGER: The RIDEM employee or contractor who has primary and supervisory responsibility for the timely completion of an individual project according to the procedures detailed in any Quality Assurance Project Plans and Standard Operating Procedures.

3.7 QA (QUALITY ASSURANCE): Systematic processes used to ensure RIDEM OWR produces valuable, accurate, reliable, reproducible, and defensible environmental data.

3.8 QC (QUALITY CONTROL): Activities performed to produce valuable, accurate, reliable, reproducible, and defensible environmental data.

3.9 QI (QUALITY IMPROVEMENT): Any act or process performed to enhance the value, accuracy, reliability, reproducibility, or defensibility of environmental data collected by RIDEM OWR.

3.10 RIDEM: Rhode Island Department of Environmental Management

3.11 SOP: Standard Operating Procedure

3.12 VERIFICATION: A process used to document and assure the accuracy and consistency of the YSI Pro Plus instrument, by comparing a value measured by the YSI Pro Plus to a traceable standard measurement. The instrument is considered accurate and consistent if the measured value falls within a specified, acceptable range of the traceable standard.

3.13 YSI PROFESSIONAL PLUS (YSI PRO PLUS): Handheld YSI Pro Plus Instrument that measures dissolved oxygen, specific conductance (temperature compensated conductivity), temperature, nitrate, pH, barometric pressure.

4.0 RESPONSIBILITIES

4.1 TRAINING

Anyone operating the YSI Pro Plus to collect data for a RIDEM project or program should have completed RIDEM's Quality System Awareness Training Program with appropriate documentation from the Quality Assurance Manager. This training ensures the analyst recognizes the importance of proper data collection and management, and comprehends the significance of the environmental decisions that may be made with the data. It is suggested that analysts have also completed the USEPA Water Quality Standards Academy Basic Course and Supplemental Topic Modules online (or on location). To properly operate the YSI Pro Plus, the analyst must be familiar with and comply with the calibration and measurement techniques stated in this SOP. The Project Manager will ensure that any analyst not familiar with the operation of the YSI Pro Plus will be properly trained by personnel that are

familiar with the instrument. Training will take place before the start of fieldwork, and documentation of training, including date and training personnel will be kept on file. Periodic refreshers of training, if deemed necessary, should be arranged for and documented by the Project Manager. In addition field, verification of proper techniques should be done at least quarterly, or more often if necessary to achieve project goals.

4.2 RESPONSIBILITIES OF ANALYST

The analyst is responsible for verifying that the YSI Pro Plus is in proper operating condition and maintaining it in proper working order. The analyst is responsible for checking the proper function and calibrating the instrument in the Sampling Center at the beginning of the sampling event (before taking measurements in the field) and again at the end of the day (after the last measurement), in accordance with Sections 6.2-6.9 of this document. The analyst is accountable for employing proper measurement procedures and data recording in accordance with Section 6.10 of this document. When indicated in the *YSI Pro Plus Meters Maintenance Records and Log Book* located in the Sampling Center the analyst must comply with QA/QC requirements (Section 5.0) and verify the system calibration or, when applicable, change the membrane cap, probes, or batteries (Section 6.1.8).

4.3 RESPONSIBILITIES OF THE PROJECT MANAGER

The project manager is responsible for providing the materials, resources, and/or guidance necessary to perform the calibration and measurements in accordance with this SOP. The project manager is responsible for ensuring that the analyst or technician operates the YSI Pro Plus correctly in accordance with this SOP. The project or program manager is responsible for ensuring that the YSI Pro Plus is maintained in proper operating condition. This includes ensuring that the membrane cap and batteries are changed at appropriate times, the system calibration is verified, the instrument is sent out for service when necessary, and that any additional project-specific requirements are communicated to the project team. Further, the project or program manager shall ensure annual renewal and periodic revisions to this SOP to reflect current needs and standards, as well as renew this document every five years.

5.0 QUALITY CONTROL

5.1 QUALITY ASSURANCE PLANNING CONSIDERATIONS

The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. Unless specified otherwise, in a site or project-specific work plan, Quality Assurance Project (or Program) Plan (QAPP), or laboratory Quality Assurance Manual (QAM), all data collected following

the protocols set forth in this document will be done in accordance with the minimum QA/QC requirements. Further quality assurance requirements will be defined in project specific work plans and/or QAPPs, and may include duplicate or replicate measurements or confirmatory analyses.

5.2 CALIBRATION AND VERIFICATION OF FIELD PARAMETERS

Calibrating the YSI Pro Plus establishes a relationship between the actual value of a traceable standard and value reported by the instrument (number the device produces). Calibrations set the YSI Pro Plus to take an accurate measurement within the specified limits of the instrument. Calibration of dissolved oxygen, pH, barometric pressure, specific conductance, and nitrate should be completed according to the procedures detailed in Sections 6.2-6.6. Saturation values for dissolved oxygen will be different under varying environmental conditions and (i.e. barometric pressure and temperature) requires calibration at the beginning and end of each sampling day, and that the analyst leave the meter turned on once it has been calibrated. If the end of the day calibration fails, values of dissolved oxygen collected during that day are questionable, and field sheets and database entries should be flagged. Temperature verification should be completed according to proper procedures (Section 6.8 and 6.9). Because specific conductance and dissolved oxygen are both temperature compensated, when temperature verification fails these values are questionable, and should not be used in data analysis or reporting.

5.3 DUPLICATE MEASUREMENTS

Duplicate measurements will be performed at a frequency of 10% of the environmental measurements recorded. This measurement, made once every 10 measurements, will consist of a sequential duplicate set of field parameters collected at the same site under similar conditions. The error in these duplicates is the sum of the error in the instrument, and the variability in the natural waters being measured. In the absence of project-specific criteria, duplicate measurements should have a Relative Percent Difference (RPD) of less than five percent, unless field conditions are such that the analyst would expect larger differences in the data. Examples of such conditions include, but are not limited to: storm or snowmelt events, spills or other accidental releases of contaminants, or presence of wildlife. Once per year, the meter should be checked side-by side in the field with an independent meter in as near to possible identical environmental conditions. This measurement will help quantify the variation between instruments and help to isolate the instrument variability from the environmental variability. As with the sequential duplicates, in the absence of project-specific criteria, duplicate measurements should have an RPD of

less than five percent, unless field conditions are such that the analyst would expect larger differences in the data.

5.4 PERFORMANCE PROBLEMS

If there are any performance problems with the YSI Pro Plus meter that result in an inability to achieve the acceptance criteria, the appropriate section of the meter instruction manual for self-test procedures should be consulted. If the problem persists, the manufacturer's customer service department should be contacted immediately for further information (Section 6.12).

6.0 GUIDELINES AND PROCEDURES

6.1 PROPER USE AND MAINTENANCE OF YSI PRO PLUS

6.1.1 Required Materials

The following materials are required

Field Items:

- YSI Pro Plus meter (Serial Numbers 11F100644 and 11F100645)
- YSI Pro Plus carrying case
- YSI Pro Plus manufacturer's Instruction Manual (in carrying case)
- Two C batteries (located in Sampling Center at A)
- YSI Pro Plus replacement membrane cap kit (part #YSI 5906)

Sampling Center items: (See Figure 1: Map of Sampling Center)

- Lint-free tissues (Kimwipes brand located in Sampling Center at A)
- Specific conductance standard 1000 uS/cm (YSI 3167 located in Sampling Center at A)
- pH standards 4, 7, and 10 (Wilkem Cat # 2129704, 2129717, 21209720 located in Sampling Center at A)
- NIST traceable thermometer (Control company brand model 4038 serial # 102162086, located in sampling center at A)
- NIST traceable barometer (Control Company S/N: 122006218 located in sampling center at A)
- De-ionized or distilled water from carboy in sampling center (located at J; filled at RIDOH)
- YSI Field Data Collection Sheet for Monitoring Sampling Events (Datasheet 1)

- Conductivity probe cleaning solution (foaming tile cleaner located in sampling center at E)
- 1:1 isopropyl alcohol and 10N HCl
- Nylon brush (located in the Sampling Center at A)
- *YSI Pro Plus Meters Maintenance Records and Log Book* (located in the Sampling Center at A)
- YSI 5908 dissolved oxygen probe reconditioning kit (located in the Sampling Center at A)
- Full and daily calibration log sheets for RIDEM YSI Pro Plus (Datasheets 2, 3)
- RIDEM YSI Pro Plus Thermometer Calibration Log Sheet (Datasheet 4)

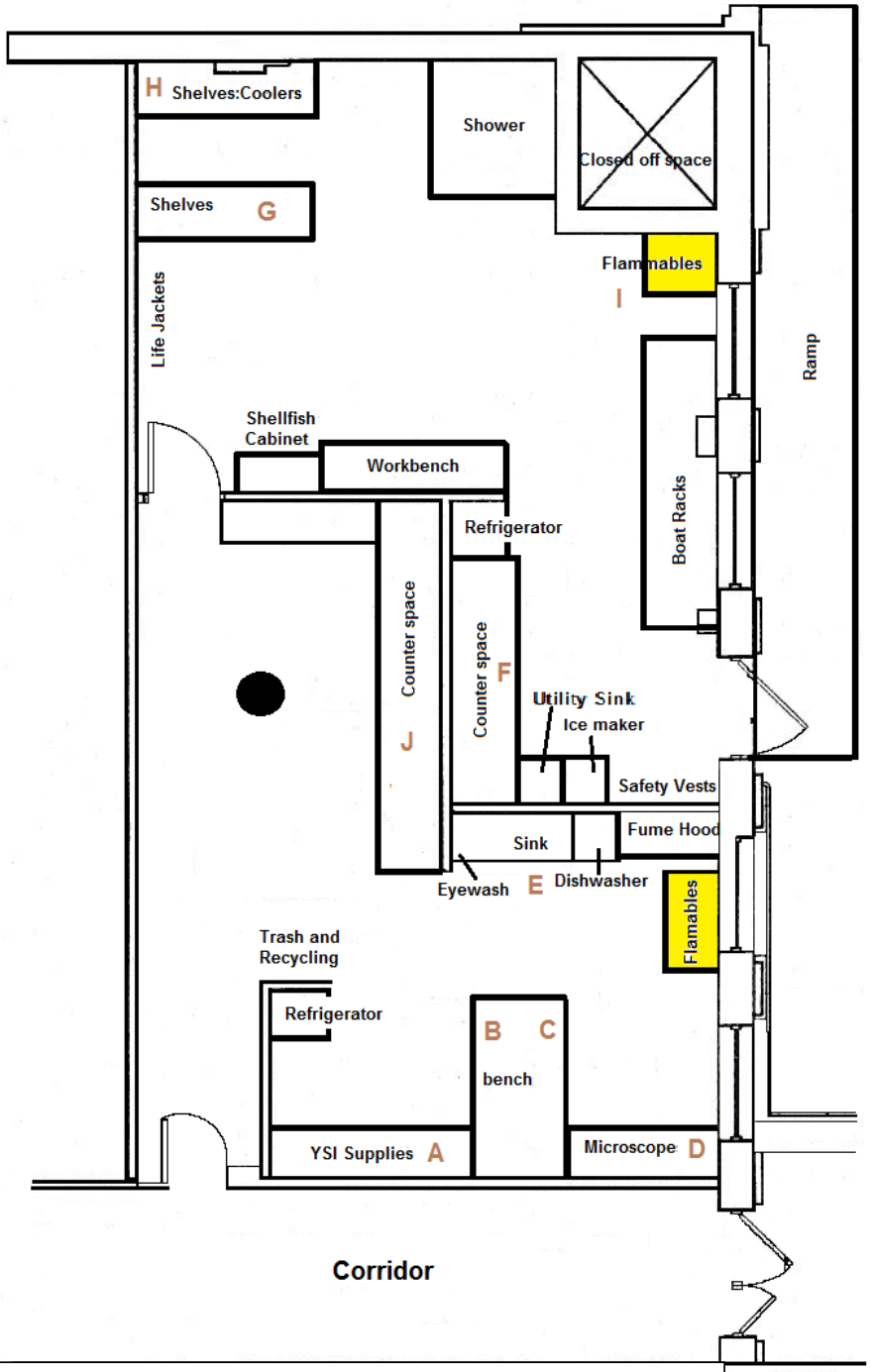

Figure 1. Map of sampling center.

6.1.2 Use of the YSI Pro Plus

For most purposes the YSI Pro Plus is used specifically for in situ water quality measurements directly taken in the field, in lotic or lentic surface waters at temperatures between -5.0°C and 65.0°C. This method does not require sample containers or preservation. The meter should be transported from the Sampling Center to vehicles and from site to site in the carrying case (Figure 2) to prevent damage to the meter. This case is waterproof and will float, so it is particularly important to utilize the case when sampling from a boat. See section 6.10 for details on use of meter in the field.

Figure 2. The carrying case for the the YSI Pro Plus.

6.1.3 Field Parameter Units

The following units should be used when recording measurements taken with the YSI Pro Plus:

Dissolved Oxygen %……..	% saturation
Dissolved Oxygen……..	mg/L
Specific Conductance…….	uS/cm
pH …….....	Standard Units
Temperature……..……..	°C

Barometric Pressure…… mm Hg

Nitrate……..……. mg/L

Instrument, probe, battery and dissolved oxygen membrane maintenance should be performed according to the procedures and frequencies required by the manufacturer at a minimum.

6.1.4 Cleaning and Storage of the Dissolved Oxygen Probe

Cleaning of the probe will typically take place when the membrane is replaced (Section 6.1.8). The probe should be stored in the calibration chamber with a small volume of water to keep the electrolyte from drying out. Should the electrolytic cell (located inside the membrane cap) begin to tarnish or turn black, lightly buff the surface with wet sandpaper from the YSI 5238 Probe Reconditioning Kit, or 400 grit wet/dry sandpaper. This procedure should remove any oxidation.

6.1.5 Cleaning and Storage of the Specific Conductance Probe

The conductivity cell should be rinsed with clean water after each use. If the conductivity cell becomes fouled and rinsing is not sufficient, the cell should be dipped in cleaning solution and agitated for two to three minutes. Any standard foaming acid tile cleaner and a soft bristled brush will clean the cell adequately. If a stronger solution is required, a solution of 1:1 isopropyl alcohol and 10N HCL can be used. Use a nylon brush to dislodge contaminants from the inside of the electrode chamber and rinse thoroughly. The probe should be stored in the calibration chamber.

6.1.6 Cleaning and Storage of the pH Probe

The life of the pH probe is typically between twelve to twenty-four months, depending on whether it has been stored properly. The longevity of the probe relies on appropriate storage, and should be done with the utmost thoroughness. The pH probe should be rinsed with clean water and stored in the calibration cup with a small volume of water in between uses. It should be cleaned before long-term storage. The probe should be uninstalled for ease of cleaning, and a port lug placed into the probe housing. Depending on the severity and type of fouling, the probe should be gently cleaned with a cotton swab and fresh tap water, or, if more severe fouling is present, soaked in water with a few drops of detergent for ten to fifteen minutes. If the fouling is biological, the probe should be soaked for one hour in a 1:1 bleach/tap water solution. Immediately afterwards, the probe should be soaked for an additional hour in fresh tap water, with occasional

stirring to remove bleach residue. There will be periods where the meter is not regularly used and it will need to be stored for the long-term (Section 6.11).

6.1.7 Changing the Batteries of the YSI Pro Plus

The YSI Pro Plus batteries should not be changed in the field. After 100 hours of operation (approximately fourteen field days; or when the LCD screen indicates low battery) the batteries should be changed in the Sampling Center before departing for a sampling event (Figure 3).

Figure 3. The battery compartment of the YSI Pro Plus, accessed using Philips head screwdriver.

The date batteries were last changed should be written on a piece of labeled tape affixed to the YSI Pro Plus, and noted in the RIDEM *YSI Pro Plus Meters Maintenance Records and Log Book* located in the Sampling Center at A (figure 1). After the batteries have been changed, the instrument must be calibrated (Sections 6.2-6.8).

6.1.8 Changing the Dissolved Oxygen Membrane

Dissolved oxygen membranes should be changed approximately every two weeks during the field season. Evidence of damage, such as a loose, wrinkled, or fouled membrane, or large bubbles in the reservoir, are also sufficient reasons to replace the membrane. This procedure requires YSI Pro Plus replacement membrane cap kit (part #YSI 5908).

To install a new membrane on the YSI Pro Plus:

- The probe sensor guard should be unscrewed and removed (Figure 4a).
- The old membrane cap should be unscrewed, removed, and discarded (Figure 4b).

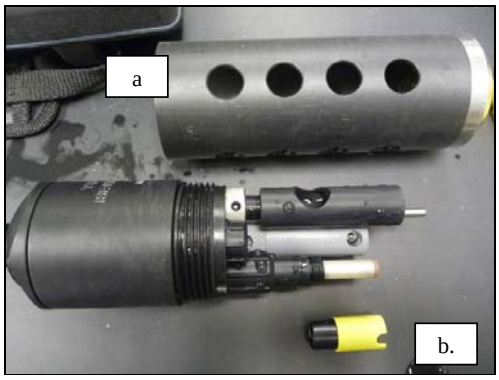

Figure 4. YSI Pro Plus probe with (a) sensor guard and (b) yellow membrane cap removed.

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- The sensor tip should be thoroughly rinsed with de-ionized or distilled water.
- The electrolyte solution should be prepared in accordance to the directions on the KCl solution bottle included in the kit. It is best to have the solution prepared well in advance of calibration, and the bottle should not be shaken too vigorously, because this will dissolve oxygen into the KCl solution, and affect the accuracy of the calibration.
- The new membrane cap should be filled it at least half full with KCl electrolyte solution (Figure 5).

Figure 5. New membrane cap being filled with KCl solution.

- While the probe is at a 45 degree angle, the membrane cap should be screwed onto the probe moderately tightly; a small amount of electrolyte should overflow.
- The analyst should look carefully at the membrane from several different angles to make sure that no air bubbles are caught under the membrane.

If air bubbles are observed, the membrane cap should be removed, refilled, tapped to eliminate any air bubbles, and reinstalled.

- There is no stretch period required for the membrane, once the membrane has been installed, the meter can be used to measure dissolved oxygen right away.

6.2 CALIBRATION ORDER AND ACCEPTANCE CRITERIA

6.2.1 Calibration of the YSI Pro Plus should be done in the following order, with acceptance criteria as stated.

Parameter	**Acceptance Criteria**
Barometric Pressure	3 mm Hg (within 10 degrees of calibration point)
Dissolved Oxygen	+-2% (between 0 and 200% saturated)
Specific Conductance	+-0.5% or 1 microsiemen (whichever is greater)
pH	+-0.1 Standard units (Standard values may need to be adjusted for temperature)
Nitrate	+- 10% or 2 mg/l (whichever is greater)
Temperature	+- 1.0 Degrees Celsius

Table 1. Order of calibrations and acceptance criteria for each parameter.

6.3 BAROMETRIC PRESSURE CALIBRATION PROCEDURES

The following sections describe the barometric pressure calibration procedure.

6.3.1 Required Frequency of Barometric Pressure Calibrations

The barometric pressure on the YSI Pro Plus can drift over time, and must occasionally be calibrated. At a minimum, the calibration should be done twice a year- at the beginning and end of summer field work. The barometric pressure value on the YSI Pro Plus must be calibrated using a NIST traceable barometer. Typically barometers (like the model in Figure 6), have several different units of measurement on concentric rings. The RIDEM ARM program records barometric pressure in millimeters of mercury (mm Hg). The middle ring shows these values increasing from left to right. The black needle (a), points to the current pressure which is 770.5 mm Hg. The silver indicator (b) is adjustable and allows the user to track changes in pressure. It is not generally used for RIDEM programs.

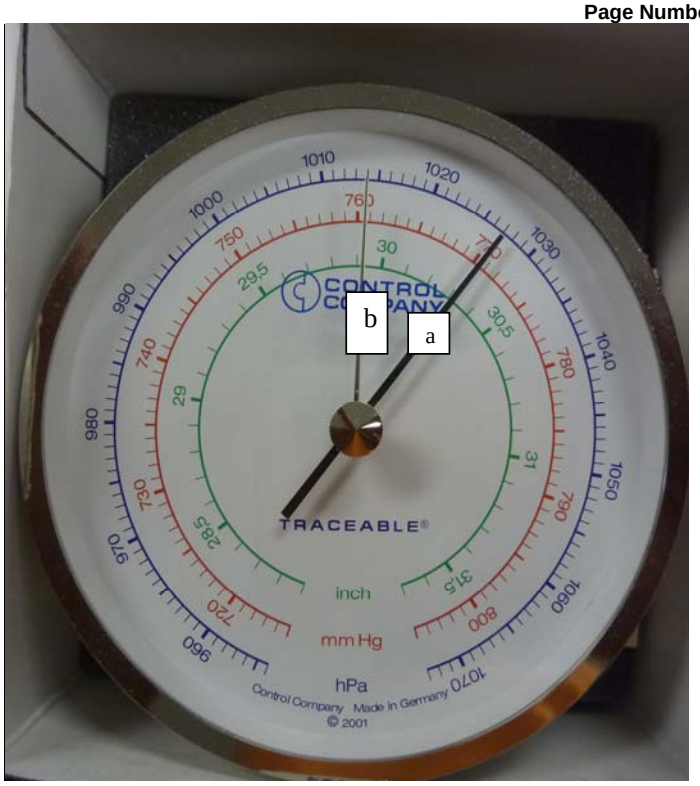


Figure 6. NIST traceable barometer The black indicator arrow is located at (a) and the adjustable silver indicator is located at (b).

6.3.2 Preparing YSI Pro Plus for Barometric Pressure Calibration

The **Cal** button (Figure 7), when pressed, will open the menu for calibrating all the parameters measured by the YSI Pro Plus. Pressing the down arrow four times will highlight "**Barometer"** in the **Calibrate** menu, which will allow the analyst to calibrate the barometric pressure (Figure 8a).

Figure 7. YSI Pro Plus instrument panel.

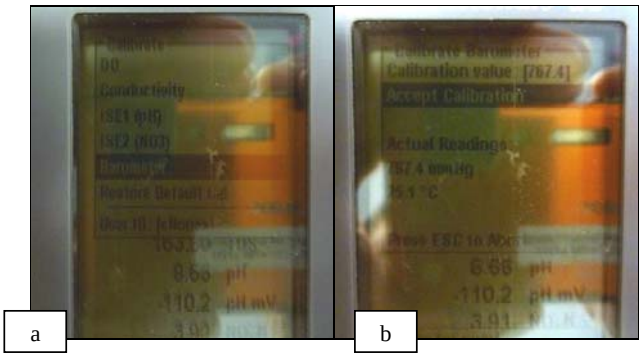


Figure 8. YSI Pro Plus Barometer calibration sequence: a) **Calibrate** menu with "**Barometer**" selected; b) **Calibrate Barometer** menu with "**Accept Calibration"** selected.

6.3.3 Calibrating Barometric Pressure

The **ENTER** button, when pressed with "**Barometer"** selected, will begin the calibration procedure (Figure 8a). It will take several minutes for the meter to stabilize. Once value is stable, the analyst should press the **ENTER** button while the "**Calibration value"** is selected to adjust the calibration value on the YSI Pro Plus to match the value on the barometer. Pressing the **ENTER** button with "**Accept Calibration"** selected will complete the calibration procedure (Figure 8b). Initial barometric pressure and instrument readings should be recorded on a Calibration Log Sheet for RIDEM YSI Pro Plus (Datasheet 3).

6.3.4 Barometric Pressure Acceptance Criteria

Barometric pressure measured with the YSI Pro Plus is accurate to within +/- three mm Hg within ten degrees Celsius of calibration point. If the reading is

within three mm Hg of the NIST barometer reading, the meter is within acceptance criteria.

6.4 DISSOLVED OXYGEN CALIBRATION PROCEDURES

The following sections describe the dissolved oxygen calibration procedure.

6.4.1 Required Frequency of Dissolved Oxygen Calibrations

The YSI Pro Plus must be calibrated for dissolved oxygen measurements at the beginning of each sample day and after the last measurement of the day. During long sampling events it must be recalibrated every twelve hours, in addition to the beginning and end of the day. The end of the day calibration ensures that the instrument was operating correctly while collecting measurements. If the calibrated value of dissolved oxygen (mg/L) falls within the acceptance criteria (Section 6.4.8), the calibration will be recorded on a YSI Field Data Collection Sheets (Datasheet 1) and a Calibration Log Sheet for RIDEM YSI Pro Plus (Datasheet 2) in the *YSI Pro Plus Meters Maintenance Records and Log Book* located in the Sampling Center at A (figure 1). If the calibrated dissolved oxygen value falls outside of the acceptance criteria, the instrument should be re-calibrated. If recalibration fails, it is possible that there is a problem with the DO probe itself. Refer to sections 6.1.4 Cleaning and Storage of the Dissolved Oxygen Probe and 6.1.8 Changing the Dissolved Oxygen Membrane. If the instrument does not calibrate correctly at the end of the day, data collected that day is unreliable. Unacceptable data that do not meet the quality assurance criteria should not be used in analyses or assessments. When data do not meet acceptance criteria this should be noted on a YSI Field Data Collection Sheets (Datasheet 1) and a Calibration Log Sheet for RIDEM YSI Pro Plus (Datasheet 2) in the *YSI Pro Plus Meters Maintenance Records and Log Book* located in the Sampling Center. It is recommended that those affected sampling stations be re-sampled on a different day, after the instrument has been repaired or is properly calibrated.

6.4.2 Preparing the YSI Pro Plus Probe for Dissolved Oxygen Calibration

The probe should be inserted into the calibration cup, with water filled just below the yellow tipped dissolved oxygen probe (Figure 9). A stand makes this procedure easier. There should be no water present on the clear membrane part of the probe, if there is, it should be removed by lightly dabbing a lint-free tissue on the area. The calibration cup cap should be inversely placed on the cup, and not screwed on.

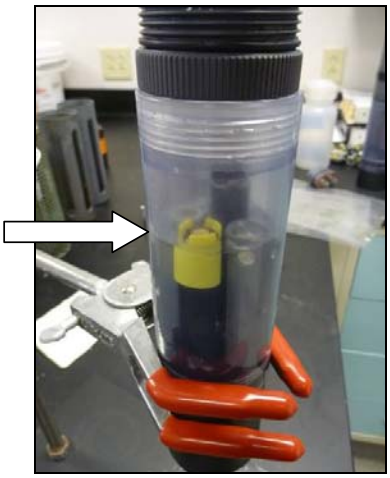


Figure 9. YSI Pro Plus with the proper set-up for calibrating dissolved oxygen; the cap unscrewed and placed inverted on top of the unit, and the water filled to the correct level (see arrow).

6.4.3 Power On and Self-Test

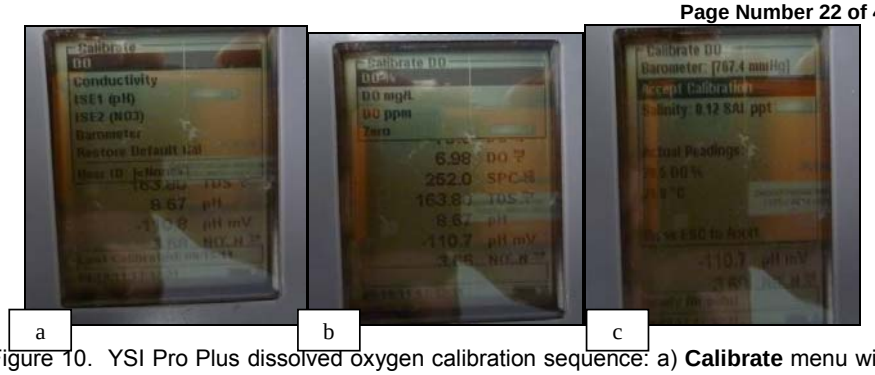
The **power** button (Figure 7) will turn the YSI Pro Plus on, and the instrument will activate all segments of the display for a few seconds. This will be followed by a self-test procedure that lasts for several more seconds. During this power on and self-test sequence, the instrument's microprocessor is verifying that the instrument is working properly.

6.4.4 Recording Initial Reading

At least fifteen minutes is required for the dissolved oxygen and temperature readings to stabilize. The analyst should record initial dissolved oxygen reading on a Calibration Log Sheet for RIDEM YSI Pro Plus (Datasheet 2).

6.4.5 Initiating Dissolved Oxygen Calibration

The analyst should press and release the **Cal** button (Figure 7), and select "**DO"** from the **Calibrate** menu, by pressing the **ENTER** button when "**DO"** is highlighted (Figure 10a). This will be the first item on the list when the **Cal** button is pushed.



a b c

Figure 10. YSI Pro Plus dissolved oxygen calibration sequence: a) **Calibrate** menu with "**DO**" selected; b) **Calibrate DO** menu with "**DO%**" selected; c) **Calibrate DO** menu with "**Accept Calibration"** selected.

6.4.6 Calibrating Dissolved Oxygen

There are several choices of how to calibrate dissolved oxygen, RIDEM uses the percent dissolved oxygen ("**DO%"**) method, by placing the probe in air saturated with water in the calibration cup (figure 9). The user places the probe in the 100% oxygen saturated environment, and the instrument adjusts the reading to this value. "**DO%**" should be selected from the **Calibrate** Menu (Figure 10b).

6.4.7 Recording calibrated Dissolved Oxygen

When the dissolved oxygen reading is no longer variable, the values for dissolved oxygen (mg/L and % saturation), temperature (degrees Celsius), and barometric pressure (mm Hg) should be recorded on a Calibration Log Sheet for RIDEM YSI Pro Plus Datasheet 2), with the date, time, and analyst performing the calibration. Sheets should be placed in the *YSI Pro Plus Meters Maintenance Records and Log Book* located in the Sampling Center at A (figure 1). To accept the calibration, the analyst should press the **ENTER** button when "**Accept Calibration"** is highlighted (Figure 10c).

6.4.8 Dissolved Oxygen Acceptance Criteria

Dissolved oxygen measured with the YSI Pro Plus is accurate to within +/- two percent of reading, or two percent of air saturation (whichever is greater), between zero and two-hundred percent saturated. If the meter is within two percent of the saturation at the given temperature and barometric pressure, then the meter is within acceptance criteria. Charts like the one in Lewis, 2006 show the saturation value for dissolved oxygen at various temperatures and pressures. When the meter has stabilized, the saturation value (in mg/l) should be recorded on the log sheet. If the calibrated value for dissolved oxygen is within two percent of the chart, then the meter is within acceptance criteria

Table 6.2–6. Solubility of oxygen in water at various temperatures and pressures—Continued

Temp	Atmospheric pressure, in millimeters of mercury																		
°C	795	790	785	780	775	770	765	760	755	750	745	740	735	730	725	720	715	710	705	700
15.0	10.5	10.5	10.4	10.3	10.3	10.2	10.1	10.1	10.0	9.9	9.9	9.8	9.7	9.7	9.6	9.6	9.5	9.4	9.3	9.3
15.5	10.4	10.4	10.3	10.2	10.2	10.1	10.0	10.0	9.9	9.8	9.8	9.7	9.6	9.6	9.5	9.4	9.4	9.3	9.2	9.2
16.0	10.3	10.2	10.2	10.1	10.0	10.0	9.9	9.8	9.8	9.7	9.7	9.6	9.5	9.5	9.4	9.3	9.3	9.2	9.1	9.1
16.5	10.2	10.1	10.1	10.0	9.9	9.9	9.8	9.7	9.7	9.6	9.5	9.5	9.4	9.4	9.3	9.2	9.2	9.1	9.0	9.0
17.0	10.1	10.0	10.0	9.9	9.8	9.8	9.7	9.6	9.6	9.5	9.4	9.4	9.3	9.3	9.2	9.1	9.1	9.0	8.9	8.9
17.5	10.0	9.9	9.9	9.8	9.7	9.7	9.6	9.6	9.5	9.4	9.3	9.3	9.2	9.2	9.1	9.0	9.0	8.9	8.8	8.8
18.0	9.9	9.8	9.8	9.7	9.6	9.6	9.5	9.4	9.4	9.3	9.3	9.2	9.1	9.1	9.0	8.9	8.9	8.8	8.7	8.7
18.5	9.8	9.7	9.7	9.6	9.5	9.5	9.4	9.3	9.3	9.2	9.2	9.1	9.0	9.0	8.9	8.8	8.8	8.7	8.7	8.6
19.0	9.7	9.6	9.6	9.5	9.4	9.4	9.3	9.3	9.2	9.1	9.1	9.0	8.9	8.9	8.8	8.8	8.7	8.6	8.6	8.5
19.5	9.6	9.5	9.5	9.4	9.3	9.3	9.2	9.2	9.1	9.0	9.0	8.9	8.9	8.8	8.7	8.7	8.6	8.5	8.5	8.4
20.0	9.5	9.4	9.4	9.3	9.3	9.2	9.1	9.1	9.0	8.9	8.9	8.8	8.8	8.7	8.6	8.6	8.5	8.5	8.4	8.3
20.5	9.4	9.3	9.3	9.2	9.2	9.1	9.0	9.0	8.9	8.9	8.8	8.7	8.7	8.6	8.6	8.5	8.4	8.4	8.3	8.3
21.0	9.3	9.2	9.2	9.1	9.1	9.0	8.9	8.9	8.9	8.8	8.7	8.6	8.6	8.5	8.5	8.4	8.4	8.3	8.2	8.2
21.5	9.2	9.2	9.1	9.0	9.0	8.9	8.9	8.8	8.7	8.7	8.6	8.6	8.5	8.4	8.4	8.3	8.3	8.2	8.1	8.1
22.0	9.1	9.1	9.0	9.0	8.9	8.8	8.8	8.7	8.7	8.6	8.5	8.5	8.4	8.4	8.3	8.2	8.2	8.1	8.1	8.0
22.5	9.0	9.0	8.9	8.9	8.8	8.8	8.7	8.6	8.6	8.5	8.5	8.4	8.3	8.3	8.2	8.2	8.1	8.0	8.0	7.9
23.0	9.0	8.9	8.8	8.8	8.7	8.7	8.6	8.6	8.5	8.4	8.4	8.3	8.3	8.2	8.1	8.1	8.0	8.0	7.9	7.9
23.5	8.9	8.8	8.8	8.7	8.6	8.6	8.5	8.5	8.4	8.4	8.3	8.2	8.2	8.1	8.1	8.0	8.0	7.9	7.8	7.8
24.0	8.8	8.7	8.7	8.6	8.6	8.5	8.4	8.4	8.3	8.3	8.2	8.2	8.1	8.0	8.0	7.9	7.9	7.8	7.8	7.7
24.5	8.7	8.7	8.6	8.5	8.5	8.4	8.4	8.3	8.3	8.2	8.1	8.1	8.0	8.0	7.9	7.9	7.8	7.7	7.7	7.6
25.0	8.6	8.6	8.5	8.5	8.4	8.3	8.3	8.2	8.2	8.1	8.1	8.0	8.0	7.9	7.8	7.8	7.7	7.7	7.6	7.6
25.5	8.5	8.5	8.4	8.4	8.3	8.3	8.2	8.2	8.1	8.0	8.0	7.9	7.9	7.8	7.8	7.7	7.7	7.6	7.6	7.5
26.0	8.5	8.4	8.4	8.3	8.3	8.2	8.1	8.1	8.0	8.0	7.9	7.9	7.8	7.8	7.7	7.6	7.6	7.5	7.5	7.4
26.5	8.4	8.3	8.3	8.2	8.2	8.1	8.1	8.0	8.0	7.9	7.8	7.8	7.7	7.7	7.6	7.6	7.5	7.5	7.4	7.4
27.0	8.3	8.3	8.2	8.2	8.1	8.0	8.0	7.9	7.9	7.8	7.8	7.7	7.7	7.6	7.6	7.5	7.5	7.4	7.3	7.3
27.5	8.2	8.2	8.1	8.1	8.0	8.0	7.9	7.9	7.8	7.8	7.7	7.7	7.6	7.5	7.5	7.4	7.4	7.3	7.3	7.2
28.0	8.2	8.1	8.1	8.0	8.0	7.9	7.9	7.8	7.7	7.7	7.6	7.6	7.5	7.5	7.4	7.4	7.3	7.3	7.2	7.2
28.5	8.1	8.0	8.0	7.9	7.9	7.8	7.8	7.7	7.7	7.6	7.6	7.5	7.5	7.4	7.4	7.3	7.3	7.2	7.1	7.1
29.0	8.0	8.0	7.9	7.9	7.8	7.8	7.7	7.7	7.6	7.6	7.5	7.5	7.4	7.3	7.3	7.2	7.2	7.1	7.1	7.0
29.5	8.0	7.9	7.9	7.8	7.8	7.7	7.6	7.6	7.5	7.5	7.4	7.4	7.3	7.3	7.2	7.2	7.1	7.1	7.0	7.0

Figure 11. Chart showing solubility of oxygen in water and various temperatures and pressures (Lewis, 2006)

6.4.9 Calibration in the Field

Occasionally it may become necessary to calibrate the YSI Pro Plus in the field. Questionable readings on the meter or suspicion of damage to the probe or membrane are factors that would lead the analyst to want to confirm the accuracy of the calibration before making additional measurements or returning to the Sampling Center. Field calibration can be problematic due to lack of access to clean facilities to change the membrane, and unpredictability of temperature and barometric pressure shifts. Membrane cap kits should be carried as spares in case of damage, and field vehicles should be kept clean to act as alternative lab area for such situations. The same procedures should be followed as for a normal calibration for dissolved oxygen (Sections 6.4.2-6.4.8), and any such calibrations should be documented on field sheets and transcribed to log books upon return to the Sampling Center.

6.5 SPECIFIC CONDUCTANCE VERIFICATION PROCEDURES

According to the YSI Pro Plus Manual (YSI incorporated, 2009), calibrating specific conductance is rarely required because the calibration done at the factory should be adequate. In order to ensure that the data collected are of the highest quality, specific conductance verifications will be performed at fixed intervals. More frequent intervals may be necessary to meet data objectives. If

the specific conductance verification does not meet acceptance criteria (Section 6.5.7), it should be calibrated.

6.5.1 Required Frequency of Calibration and Verification

Specific conductance readings will be verified in accordance with proper procedures (Sections 6.5.2-6.5.10) at a frequency of ten percent of the dissolved oxygen calibrations. For every ten dissolved oxygen calibrations a one-point temperature verification, and a barometric pressure, specific conductance, pH, and nitrate calibration should be performed. Verifications and calibrations will be recorded on a Calibration Log Sheet for RIDEM YSI Pro Plus (Datasheet 3).

6.5.2 Preparing the YSI Pro Plus Probe for Specific Conductance Verification

Rinsing the container and the probe ensures that there is no dust or residue that would interfere with accurate measurement of readings by contaminating the solution. The receptacle and probe should be rinsed twice with de-ionized or distilled water. The receptacle should then be rinsed twice with the 1000 µS standard.

6.5.3 Verifying Specific Conductance

The calibration cup should be filled with enough 1000 µS standard solution to completely cover the cluster of probes (Figure 12). A gentle tap on the edge of the cup will ensure that there are no air bubbles present in the probe.

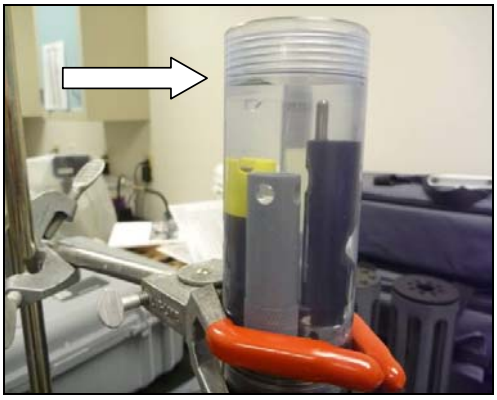


Figure 12. YSI Pro Plus with the proper set-up for calibrating specific conductance; the cap unscrewed and water filled to the correct level (see arrow).

6.5.4 Allowing Specific Conductance Value to Stabilize

The analyst should wait about one minute for the probe to adjust to the conductance of the 1000 µS standard solution.

6.5.5 Recording Specific Conductance Value on Log Sheet

Values, date, time, and name of analyst should be recorded on a Calibration Log Sheet for RIDEM YSI Pro Plus (Datasheet 3). Each meter has a section in the *YSI Pro Plus Meters Maintenance Records and Log Book* located in the Sampling Center, with the meter number at the top of the sheet.

6.5.6 Specific Conductance Acceptance Criteria

The YSI Pro Plus meter is accurate to within +/- 0.5 percent of the value of specific conductance of a liquid. If the meter is off by more than +/- 0.5 percent of the standard solution value, then it will need to be calibrated (Section 6.5.7). The analyst should record the value that the meter is reading on the part of the log sheet that requires "initial reading".

6.5.7 Calibrating Specific Conductance, if Necessary

The analyst should press the **CAL** Button (Figure 7), and select "**Conductivity"** from the **Calibrate** menu (Figure 13a). Next, "**SPC-uS/cm"** should be selected from the **Calibrate Sp. Conductance** menu (Figure 13b). When the reading on the meter has stabilized, the analyst should select "**Accept Calibration"** from the **Calibrate Sp. Conductance** menu (Figure 13c).

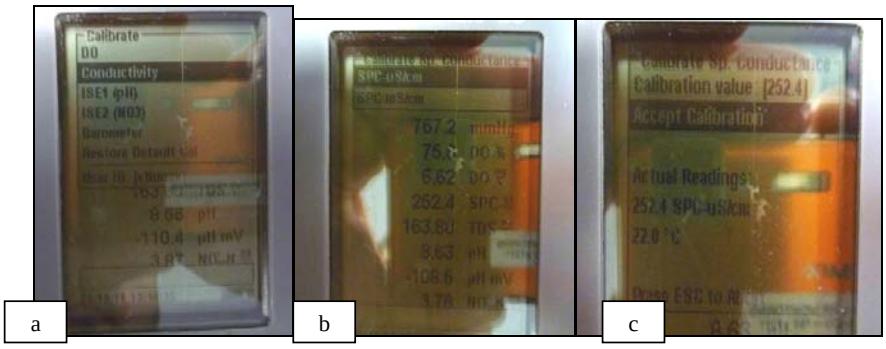


Figure 13. YSI Pro Plus Specific Conductance calibration sequence: a) **Calibrate** menu with "**Conductivity"** selected; b) **Calibrate Sp. Conductance** menu with "**SPC-uS/cm"** selected; c) **Calibrate Sp. Conductance** menu with "**Accept Calibration"** selected.

6.5.8 Additional Standards

If the meter is checked against several standard solutions, the solution with the lowest specific conductance value should be checked first, followed by standard solutions with higher values. De-ionized or distilled water should *not* be used to rinse the meter between standards. Such water is effectively a zero conductance solution and has a greater probability of contaminating the standard solution more than a solution with a specific conductance higher than zero. Rinsing the probe several times with each standard solution will reduce the probability of contaminating them and the probe during calibration.

6.5.9 Calibrating Specific Conductance with Additional Standards, if Necessary

Specific conductance should be adjusted following the proper procedure (Section 6.5.8).

6.5.10 Failure of Calibration

Contact customer service if calibration fails, see section 6.12

6.6 PH CALIBRATION AND VERIFICATION PROCEDURES

The following sections describe the calibration and verification procedures for pH. Project specific procedures may be adopted if data quality objectives require more stringent protocols. The process described below (6.6.3 through 6.6.9) is a 3-point pH calibration.

6.6.1 Required Frequency of pH Verification

Verification of pH will be done in accordance with proper procedures (Sections 6.6.3-6.6.9) at a frequency of ten percent of the dissolved oxygen calibrations. For every ten dissolved oxygen calibrations a one-point temperature verification, and a barometric pressure, specific conductance, pH, and nitrate calibration should be performed. Verifications and calibrations will be recorded on a Calibration Log Sheet for RIDEM YSI Pro Plus (Datasheet 3).

6.6.2 Uninstalling Nitrate Probe to the YSI Pro Plus

The nitrate probe is negatively affected by pH standards. Calibration for pH must be executed with the nitrate probe uninstalled (Figure 14).

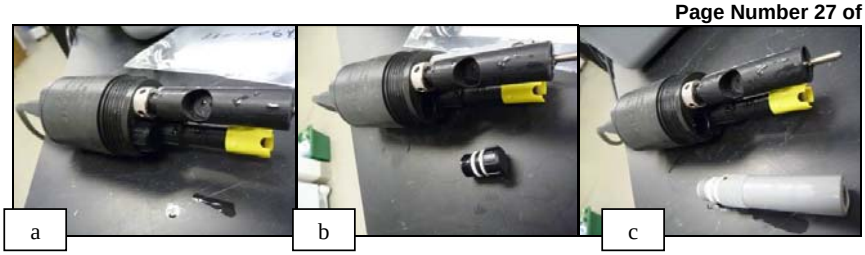


Figure 14. a) YSI Pro Plus probe housing with port plug in ISE2-receptacle for Nitrate or other ISE probes; b) ISE2 port plug removed; c) port plug removed and nitrate probe ready to install.

6.6.3 pH 7 Buffer Calibration

The probe should be placed on the stand and the calibration cup should be filled with a sufficient volume of pH 7 buffer solution to cover the pH probe and the temperature probe as well (Figure 15b). Note that the pH 7 buffer solution is typically yellow in color (Figure 15a).

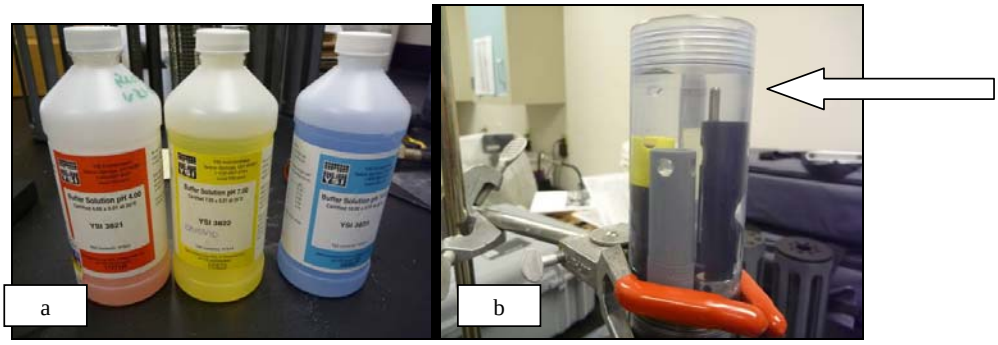


Figure 15. a) pH standards 4, 7, and 10 from left to right, respectively and b) calibration cup filled with the correct amount of pH 7 buffer so that the temperature probe (silver, indicated by arrow) is covered.

6.6.4 Calibrating the pH with pH 7 Buffer

The analyst should press the **Cal** button, and select "**ISE1 (pH**)" from the **Calibrate** Menu by pressing the **ENTER** button when it is highlighted on the screen (Figure 16a).

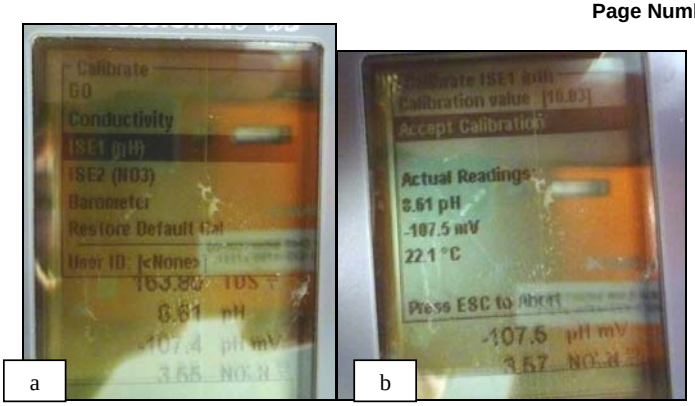


Figure 16. YSI Pro Plus pH calibration sequence: a) **Calibrate** menu with "**ISE1 (pH)"** selected; b) **Calibrate ISE1 (pH)** menu with "**Accept Calibration"** selected.

6.6.5 Allowing Value to Stabilize and Accepting Calibration

The meter will automatically recognize the buffer value, and will display it on the **Calibrate** screen as "**Calibration Value [7.00]**". "**Actual Readings**" will need a few minutes to stabilize. When the "**Actual Readings**" value has stabilized, the analyst should press the **ENTER** button with "**Accept Calibration**" selected (Figure 16b). The meter is now ready for a second calibration point.

6.6.6 pH 4 Buffer Calibration

The calibration cup should be rinsed twice with pH 4 buffer solution and filled with a sufficient volume of solution to cover the pH probe (Figure 15b). Note that the pH 4 buffer solution is typically red in color (Figure 15a).

6.6.7 Allowing Value to Stabilize and Accepting Calibration

The meter will automatically recognize the buffer value, and will display it on the **Calibrate** screen as "**Calibration Value [4.00]**". "**Actual Readings**" will need a few minutes to stabilize. When the "**Actual Readings**" value has stabilized, the analyst should press the **ENTER** button with "**Accept Calibration**" selected (Figure 16b). The meter is now ready for a third calibration point.

6.6.8 pH 10 Buffer Calibration

The calibration cup should be rinsed twice with pH 10 buffer solution and filled with a sufficient volume of solution to cover the pH probe (Figure 16b). Note that pH 10 buffer solution is typically blue in color (Figure 16a).

6.6.9 Allowing Value to Stabilize and Completing Calibration Sequence

The meter will automatically recognize the buffer value, and will display it on the **Calibrate** screen as "**Calibration Value [10.00]**". "**Actual Readings**" will need a minute to stabilize. When the "**Actual Readings**" value has stabilized, the analyst should press the **ENTER** button with "**Accept Calibration**" selected (Figure 16b). Press the **Cal** button to complete the calibration.

6.6.10 pH Acceptance Criteria

The YSI Pro Plus meter is accurate to within +/- 0.1 units of the value of pH. If the reading on the meter is within +/- 0.1 units from the value of the standard (corrected for temperature), the meter is within acceptance criteria.

6.7 NITRATE PROBE CALIBRATION PROCEDURES

6.7.1 Required Frequency of Nitrate Probe Calibration

Nitrate will be verified in accordance with proper procedures (Sections 6.7.2-6.7.10) at a frequency of ten percent of the dissolved oxygen calibrations. For every ten dissolved oxygen calibrations, a one-point temperature verification, and a barometric pressure, specific conductance, pH, and nitrate calibration should be performed. Verifications and calibrations will be recorded on a Calibration Log Sheet for RIDEM YSI Pro Plus (Datasheet 3).

6.7.2 Installing Nitrate Probe to the YSI Pro Plus

The nitrate probe is negatively affected by pH standards and should be removed before pH is calibrated (6.6.2). Once pH has been calibrated, the nitrate probe can be reinstalled for the nitrate calibration (Figure 14).

6.7.3 Accepting Nitrate Probe Values

The meter needs to be set up to accept and interpret the values that it receives from the nitrate probe. The **Probe** button should be pressed to begin this process (Figure 7).

6.7.4 Preparing the YSI Pro Plus Nitrate Probe

The user should go to the **Sensors** menu and press the **ENTER** button when "**Setup**" is highlighted (Figure 17a). Next, the user should select "**ISE2 [NO3]"** when it is highlighted in the **Sensors** menu (Figure 17b) to ensure that the correct nitrate probe feature is being calibrated.

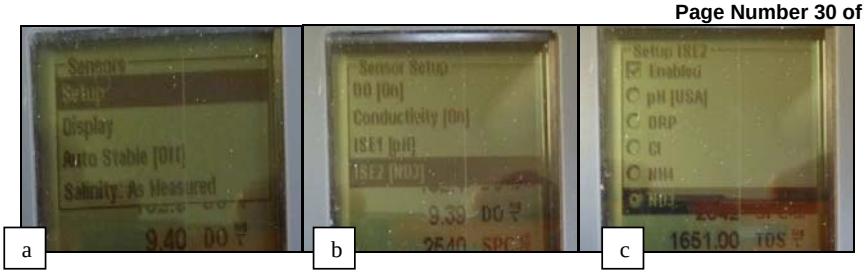


Figure 17. YSI Pro Plus nitrate calibration sequence: a) **Sensors** menu with "**Setup"** selected; b) **Sensors** menu with "**ISE2 [NO3]**" selected; c) **Setup ISE2** menu with "**Enabled**" checked off and "**NO3**" selected.

6.7.5 Enabling the Nitrate Probe

The user should select "**Enabled**" from the **Setup ISE2** menu and press the **ENTER** button to enable the ISE2 port (Figure 17c). Next the user should select "**NO3**" and press the **ENTER** button to set the port to recognize the probe as a Nitrate probe (Figure 17c). The same procedure can be followed to enable other probes utilized by this instrument.

6.7.6 Preparing the YSI Pro Plus for the 1.0 MG/L Nitrate Standard Calibration

Typically a two-point calibration should be done for the nitrate probe as described in the YSI Pro Plus manual (YSI incorporated, 2009). The first standard to be used is a 1.0 mg/L standard solution. The calibration cup and probe should be rinsed two times with this standard, and then filled with a sufficient volume of solution to cover the nitrate probe (Figure 18).

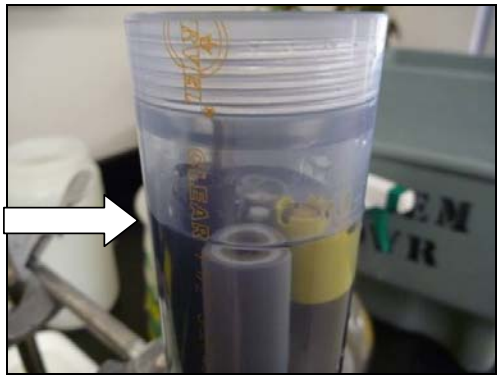


Figure 18. YSI Pro Plus probe submerged with the proper amount of Nitrate standard solution (see arrow).

6.7.7 Calibrating Nitrate

The **CAL** button should be pressed and "**Nitrate"** selected from the **Calibrate** menu. The meter will automatically recognize the standard.

6.7.8 Allowing the Meter to Stabilize and Accept Calibration

The analyst should wait at least five minutes for the value to stabilize, select "**Accept Calibration**", and press the **ENTER** button to accept the first calibration.

6.7.9 Preparing the YSI Pro Plus for the 100.0mg/L Nitrate Standard Calibration

The second standard to be used is a 100.0 mg/L standard solution. The calibration cup and probe should be rinsed two times with this standard, and then filled with a sufficient volume of solution to cover the nitrate probe (Figure 18). Once the cup is filled, the **Cal** button should be pressed.

6.7.10 Completing the Calibration

The analyst should wait at least five minutes for the value to stabilize, before selecting "**Accept Calibration**" and pressing the **ENTER** button to accept the second calibration. Once accepted, the **Cal** button should be pressed to accept the nitrate calibration sequence.

6.7.11 Nitrate Acceptance Criteria

The Nitrate probe with the YSI Pro Plus meter is accurate to within +/- ten percent or two mg/L, whichever is greater. If the reading on the meter is within +/- ten percent or two mg/L, then the meter is within acceptance criteria.

6.8 ONE-POINT TEMPERATURE VERIFICATION PROCEDURES

This verification is intended to assure that the meter is accurately measuring temperature. The meter should be returned to YSI for service if verification fails.

6.8.1 Required Frequency of One-Point Temperature Verification

Temperature readings will be verified using an NIST traceable thermometer. This thermometer is a Control Company brand model 4038 and is located in the sampling center (Figure 1, at A). Verifications will be done in accordance with proper procedures (Sections 6.8.2-6.8.5) at a frequency of ten percent of the dissolved oxygen calibrations (every ten dissolved oxygen calibrations) temperature should be verified.

6.8.2 Preparing YSI Pro Plus Probe and NIST Traceable Thermometer

The probe and thermometer should be lowered into a rinsed container with a sufficient volume of room temperature water to cover them. Cold tap water will slowly warm, making it difficult to get a stable temperature reading on both the probe and the thermometer, so it is best to use room temperature water.

6.8.3 Allowing Temperature to Stabilize

The analyst should wait about five minutes for the YSI Pro Plus probe and NIST traceable thermometer to adjust to the temperature of the water. The thermometers should not rest on the bottom or sides of the container.

6.8.4 Recording Temperature of YSI Pro Plus and NIST Traceable Thermometer

Values, date, time, and name of analyst should be recorded on a YSI Calibration Log Sheet for RIDEM YSI Pro Plus (Datasheet 3). Each meter has a log book located in the Sampling Center at A (figure 1), with the meter number on the cover of the book.

6.8.5 Temperature Acceptance Criteria

The YSI Pro Plus meter is accurate to within +/-0.35 degrees Celsius. The NIST traceable thermometer is accurate to within +/-1.0 degrees Celsius. If the reading on the meter is different from the reading on the thermometer by more than +/-1.0 degrees Celsius, then the meter is not within acceptance criteria. The thermometer and probe should be removed from the water and inspected to verify that the thermometer probe and the YSI Pro Plus probe are clean and not in disrepair. The probes should be placed back in the water for a second test. Once again, the analyst should wait five minutes for the temperatures to stabilize and monitor that the temperature of the water stays constant If the meter is still different from the thermometer by more than +/-1.0 degrees Celsius, the meter will need to be sent in for service, and the temperature probe will likely have to be replaced. See Section 6.12 for contact information.

6.9 THREE-POINT TEMPERATURE VERIFICATION PROCEDURE

This methodology is adapted from Radtke et. al 1998.

6.9.1 Required Frequency of Three-Point Temperature Verification

Temperature readings will be verified using the NIST traceable thermometer in accordance with proper procedures (Sections 6.9.2-6.9.14) at a frequency of three times per year, or every four months.

6.9.2 Documentation for Three-Point Temperature Verification

RIDEM YSI Pro Plus Three-Point Temperature Verification Log Sheets (Datasheet 4) should be used for this procedure. These forms are kept in the *YSI Pro Plus Meters Maintenance Records and Log Book* located in the Sampling Center at A (figure 1).

6.9.3 Preparing for Temperature Verification I

A container large enough to fit the YSI Pro Plus probe and the NIST traceable thermometer should be filled with a mixture of tap water and ice. Ice from the machine located in the Sampling Center is sufficient for this procedure (near F figure 1).

6.9.4 Temperature Verification I: Ice Water

Both the YSI Pro Plus probe and the NIST traceable thermometer should be immersed into the ice water (Figure 19). It will take at least two minutes to stabilize. The ice-water mixture should be stirred periodically to ensure that the temperature is uniform. Both the YSI Pro Plus probe and the NIST traceable thermometer need to be completely covered for a proper temperature reading.

Figure 19. YSI Pro Plus meter in ice/water bath with NIST traceable thermometer.

6.9.5 Recording Temperatures

The display for both meters should be easily readable. After a five minute stabilization period, three temperatures for both the YSI Pro Plus and the NIST traceable thermometer should be recorded on a RIDEM YSI Pro Plus Three-Point Temperature Verification Log Sheets (Datasheet 4).

6.9.6 Calculating and Comparing the Mean Temperatures

The mean temperature values of the three values read from the YSI Pro Plus and the NIST traceable thermometer should be calculated for each device and compared. The mean values should be within +/-1.0 degrees Celsius of each other.

6.9.7 Preparing for Temperature Verification II

The water should be set aside for at least one half hour to equilibrate to the temperature in the Sampling Center. The temperature should be near 25 degrees Celsius.

6.9.8 Temperature Verification II: Room Temperature Water

Both the YSI Pro Plus probe and NIST traceable thermometer should be immersed into the water. It will take at least two minutes to stabilize. The water should be stirred periodically to ensure that the temperature is uniform. Both the YSI Pro Plus probe and the NIST traceable thermometer need to be completely covered for a proper temperature reading.

6.9.9 Recording Temperatures

The display for both meters should be easily readable. After a five minute stabilization period, three temperatures for both the YSI Pro Plus and the NIST traceable thermometer should be recorded on the RIDEM YSI Pro Plus Three-Point Temperature Verification Log Sheets (Datasheet 4).

6.9.10 Calculating and Comparing the Mean Temperatures

The mean temperature values of the three values read from the YSI Pro Plus and the NIST traceable thermometer should be calculated for each device and compared. The mean values should be within +/- 1.0 degrees Celsius of each other.

6.9.11 Preparing for Temperature Verification III

Hot tap water should be used for this verification, with an aim for a temperature near 40 degrees Celsius. The water will slowly equilibrate to the temperature in the Sampling Center. To mitigate this effect, thermal protection, such as putting the water container into a cooler partially filled with packing material is helpful (figure 19).

6.9.12 Temperature Verification III: Hot Water

Both the YSI Pro Plus probe and NIST traceable thermometer should be immersed into the water. It will take at least two minutes to stabilize. The water should be stirred periodically to ensure that the temperature is uniform. Both the YSI Pro Plus probe and the NIST traceable thermometer need to be completely covered for a proper temperature reading.

6.9.13 Recording Temperatures

The display for both meters should be easily readable. After a five minute stabilization period, three temperatures for both the YSI Pro Plus and the NIST traceable thermometer should be recorded on a RIDEM YSI Pro Plus Three-Point Temperature Verification Log Sheets (Datasheet 4).

6.9.14 Calculating and Comparing the Mean Temperatures

The mean temperature values of the three values read from the YSI Pro Plus and the NIST traceable thermometer should be calculated for each device and compared. The mean values should be within +/- 1.0 degrees Celsius of each other.

6.10 FIELD MEASUREMENT PROCEDURES

The following sections describe the use of the YSI Pro Plus in the field to make measurements of field parameters. The procedures below should be followed unless project specific requirements require different methods.

6.10.1 Preparing YSI Pro Plus Probe for the Field

The meter should be transported using the carrying case (Figure 2). The sensor guard should always be used when taking field measurements because probes are easily damaged. The guard is screwed on to threaded area (Figure 20).

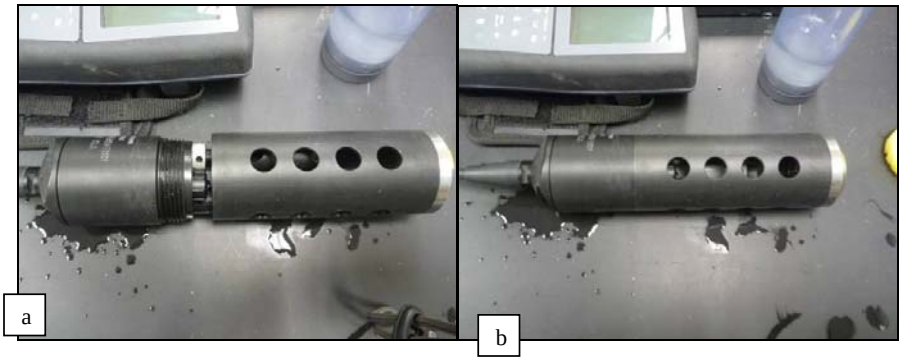


Figure 20. YSI Pro Plus sensor guard a) off and b) on.

6.10.2 Taking a Measurement in the Field

The YSI Pro Plus probe, with sensor guard on, should be lowered to a desired depth (surface, middle, or bottom of the water column). When recording the bottom measurement, the analyst should keep the electrode at least 0.5 feet above the bottom, unless shallow depths do not allow. The bottom substrate should not be disturbed prior to or during measurement. Because the electrolytic cell (for dissolved oxygen) consumes oxygen in the water during measurement, it may be necessary to agitate the probe up and down in the water column to ensure that water is actively passing across the membrane. This is particularly important when the probe is immersed in stagnant water. It is evident when this occurs because the dissolved oxygen value will slowly decrease. Once the probe is agitated, the value of dissolved oxygen will slowly increase to a steady maximum; this value should be recorded.

6.10.3 Recording Field Measurements

The YSI Pro Plus can be set to display a number of parameters on the screen at one time. Depending on project needs, it may be desirable to only display necessary parameters and hide others. The screen has the capacity to display no more than nine parameters, so the down arrow must be pressed to see additional values. The YSI Pro Plus has an “Auto-Range” function that automatically calculates the average of the values being measured by the probe and only displays that value. The YSI Pro Plus manual should be consulted on how to change the units that the meter displays.

6.10.4 Storing Values on the Internal Memory of the YSI Pro Plus

In certain circumstances it will be valuable to store values electronically on the internal memory of the YSI Pro Plus. This should not be a replacement for good field notes. The YSI Pro Plus can be programmed to store site names using the YSI Data Manager software. Instructions for the software package for this unit should be consulted, if the user wishes to store site names. In addition, cross-sectional data can be stored on the unit internally, and median values reported for field parameters in the database.

6.10.5 Storing YSI Pro Plus between Sites

The probe should be retracted from the water and shaken to remove excess sample water. Distilled or de-ionized water should be poured over the probe to rinse it, and excess water can be blotted away with a clean lint-free tissue. To minimize contamination of the storage water in the calibration cup and prevent

damage to the probes, the whole sensor end with sensor guard attached can slide into the grey rubber storage sleeve (Figure 21). This sleeve has a small round piece of sponge that should be damp to keep the probes from desiccating. The sponge should be changed periodically.

Figure 21. YSI Pro Plus with sensor guard and storage sleeve.

6.11 LONG-TERM OR WINTER STORAGE OF YSI PRO PLUS METER

RIDEM OWR ambient monitoring program measures water quality parameters using the YSI Pro Plus typically from April to October. Long term storage of the YSI Pro Plus during extended periods of disuse is vital to the operational life of the unit.

6.11.1 Uninstalling the Nitrate Probe

When uninstalling the Nitrate probe, the analyst should unscrew the probe from the sensor housing and place it in its original shipping container. In this shipping container there will be a bottle in KCl with a sponge, and a rubber cap that should be placed over the threaded end of the probe. (Figure 22).

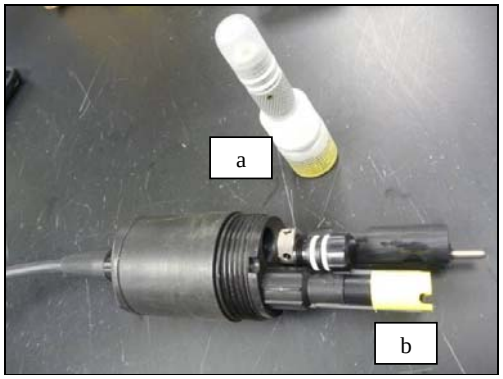


Figure 22. Sensor housing with a) Nitrate probe removed, and b) port plug ready to be uninstalled.

6.11.2 Uninstalling the pH Probe

When uninstalling the pH probe, the analyst should unscrew the probe from the sensor housing. O-rings should be coated with a small amount of grease, and the probe should be stored in pH 4 buffer in the container it was shipped in. (Figure 23).

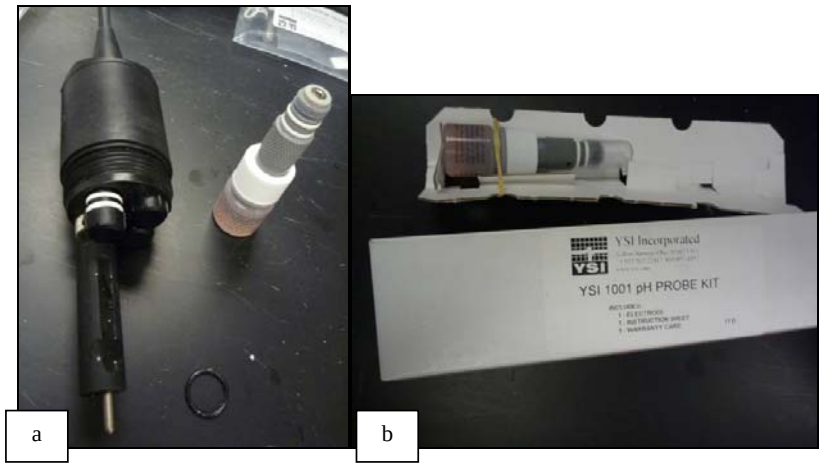


Figure 23. a) pH probe uninstalled from sensor housing and port plug partly installed, and b) pH probe attached to cardboard and ready to be stored in box.

6.11.3 Uninstalling the Dissolved Oxygen Probe

When uninstalling the dissolved oxygen probe, the analyst should unscrew the membrane cap from the dissolved oxygen probe, drain the probe's electrolyte, rinse it with de-ionized or distilled water, and allow it to dry (Figure 24). This procedure can be done with the probe installed or uninstalled from the sensor housing.

Figure 24. Dissolved oxygen probe uninstalled emptied, rinsed, and drying on a Kimwipe.

6.11.4 Storing the Calibration Cup

The calibration cup should be cleaned, dried, and screwed back on to the sensor housing (Figure 25).

Figure 25. Sensor housing with Nitrate and pH probes uninstalled and stored for the winter. Dissolved oxygen and temperature/conductance probe are installed and stored dry in the calibration cup.

6.12 ISSUES THAT CANNOT BE FIXED BY ANALYST

Occasionally issues will arise that cannot be fixed locally. In the case of meter malfunction, the manufacturer's customer service department should be consulted immediately for further information. Contact: Q.C. Services, Inc. P.O. Box 68, Harrison, Maine, 04040; telephone: (207)583-2980; website: www.qcservices.com; email: qcservices@gwi.net; shipping address: Q.C. Services, Inc. 8 Smith St, Harrison, Maine, 04040.

7.0 DOCUMENTATION

7.1 FIELD MEASUREMENTS

All calibration and field measurements will be recorded on the RIDEM YSI Field Data Collection Sheet for Monitoring Sampling Events (Datasheet 1).

7.2 CALIBRATION

Calibration documentation must be maintained in a thorough and consistent manner. Documentation of all calibration and maintenance operations shall be filled out on a Calibration Log Sheet for RIDEM YSI Pro Plus (Datasheet 2) in entirety and kept in the *YSI Pro Plus Meters Maintenance Records and Log Book* located in the Sampling Center.

8.0 DOWNLOADING FIELD DATA TO PC

The following instructions assume that the YSI data manager and cradle have already been installed on the user's personal computer. The instruction manual should be consulted to properly install software.

8.1 CONNECT YSI PRO PLUS TO CRADLE

The YSI Pro Plus should be slid onto cradle (Figure 26).

Figure 26. YSI Pro Plus and cradle.

8.2 OPEN YSI DATA MANAGER

YSI data manager can be activated by double clicking the desktop icon. The manual and online support documentation should be consulted for proper use of this software package.

9.0 REFERENCES

Lewis, M.E., 2006. Dissolved Oxygen. United States Geological Survey Techniques of Water Resources Investigations. Book 9, Chapter 6.1. Accessed 09/10/2012:

http://water.usgs.gov/owq/FieldManual/Chapter6/6.2_contents.html

Radtke, J.D., Kurklin, J.K., and Wilde, F.D., 1998. Temperature. United States Geological Survey Techniques of Water Resources Investigations. Book 9, Chapter 6.1. Accessed 08/23/2011:
http://www.commtec.com/Library/technical_papers/USGS/Section6.1.pdf.

YSI incorporated. 2009. YSI Professional Plus: User Manual. Yellow Springs Ohio, USA. http://www.ysi.com/media/pdfs/605596-YSI-ProPlus-User-Manual-RevD.pdf

Field Crew:	**Weather Conditions:**
YSI Instrument (circle one): #1 #2 #3 ProPlus	

Site ID												
Location Name												
Date												
Time												
Temp (°C)												
B. Pres. (mmHg)												
Saturation (%)												
DO (mg/L)												
SPC (µS/cm)												
pH												
Nitrate (mg/L)												
Photographs												
O.G.												
Flow												
Sample Method												
Comments												

Datasheet 1. RIDEM YSI Field Data Collection Sheet for Monitoring Sampling Events.

Meter Seria

Number

	D
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

*

Calibration Log For RIDEM YSI-85

	Date	Time	membrane changed (yes / no)	Temperature reading (oC)	INITIAL D.O. reading %	INITIAL D.O. reading mg/L	Calibrated D.O. reading %	Calibrated D.O. reading mg/L	Ideal DO value mg/L (see table)	Difference between calibration reading and ideal value (100%) %	Difference between calibration reading and ideal value (100%) mg/L	Difference is within + 0.5 mg/L ? (yes/no)	Acceptable Calibration (Y/N, intials)
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													

QAQC			Temperature reading (oC)	Distilled water reading	Difference between reading and 0	1000 µS Standard Reading	Difference between reading and 1000	Ideal value (thermometer or standard)	Difference between reading and ideal value		Differences are within + 5 % Ideal Values ? (yes/no)	Acceptable Verification (Y/N, intials)
Verify temperature												
Verify conductivity												

* batteries should be changed every 12 field days; please note when batteries have been changed.

Datasheet 2. Daily Calibration Log Sheet for RIDEM YSI Pro Plus.

ProPlus Calibration Log

Date:	Analyst:		
Meter Serial Number:	Long Cord Meter: 11F100644		Short Cord Meter: 11F100645
Barometric Pressure (S/N 122006218)		**Specific Conductance**	
Temperature (°C)		Temperature (°C)	
Initial Reading (mmHg)		Standard (µS/L)	
Barometer Reading (mmHg)		Lot Number	
Reading after Calibration (mmHg)		Initial SPC Reading (µS/L)	
Dissolved Oxygen		Reading after Calibration (µS/L)	
Temperature (°C)		**Nitrate**	
B. Pres. (mmHg)		Temperature (°C)	
100% Saturated (chart)		1.0 mg/l Standard	
Initial DO Reading (mg/L)		Lot Number	
Reading after Calibration (mg/L)		Initial Reading (mg/L)	
Temperature (verification only S/N 102162086)		Reading after Calibration (mg/L)	
Meter Reading (°C)		Temperature (°C)	
NIST Thermistor Reading (°C)		10.0 mg/l Standard	
Difference (°C)		Lot Number	
Acceptable Calibration		Initial Reading (mg/L)	
pH (Uninstall nitrate probe before calibration!)		Reading after Calibration (mg/L)	
Temperature (°C)		Temperature (°C)	
4.0 Standard (pH)		100.0 mg/l Standard	
Lot Number		Lot Number	
Initial Reading (pH)		Initial Reading (mg/L)	
Reading after Calibration (pH)		Reading after Calibration (mg/L)	
Temperature (°C)			
7.0 Standard (pH)			
Lot Number			
Initial Reading (pH)			
Reading after Calibration (pH)			
Temperature (°C)			
10.0 Standard (pH)			
Lot Number			
Initial Reading (pH)			
Reading after Calibration (pH)			

Datasheet 3. Full Calibration Log Sheet for RIDEM YSI Pro Plus.

RIDEM OWR Thermometer Calibration Log Sheet

Date/Time: NIST Serial #:

Calibrator's Initials: YSI Meter #:

Ice Bath (0°C)	YSI Field Thermometer Temperature (°C)	NIST Thermometer Temperature (°C)	Comments
Reading #1			
Reading #2			
Reading #3			
Mean			
Difference Between Means			
Within 1.0°C? (Y/N)			

Room Temp Bath (25°C)	YSI Field Thermometer Temperature (°C)	NIST Thermometer Temperature (°C)	Comments
Reading #1			
Reading #2			
Reading #3			
Mean			
Difference Between Means			
Within 1.0°C? (Y/N)			

Warm Bath (40°C)	YSI Field Thermometer Temperature (°C)	NIST Thermometer Temperature (°C)	Comments
Reading #1			
Reading #2			
Reading #3			
Mean			
Difference Between Means			
Within 1.0°C? (Y/N)			

Datasheet 4. RIDEM YSI Pro Plus Thermometer Verification Log Sheet.

APPENDIX B

Digital Photographic Record Collection and Storage SOP

Digital Photograph Record Collection and Storage SOP
SOP-OD-QM-4

1. APPLICABILITY. This SOP applies to all DEM programs where staff utilizes digital photography, including but not limited to, licensed facility inspections, shoreline surveys, environmental restoration or protection projects or any other photo-documentation purposes. Exemption from the use of this SOP for project work shall be allowed for reasons of inapplicability determined by management discretion. It is anticipated that individual programs will modify the SOP, as necessary, to account for differences in digital camera protocols.

2. PURPOSE. Photography that has a reasonable probability to be considered for use as legal evidence, historic record or other value to the State must be protected from loss or destruction. This SOP provides a method to collect and store digital photographs and associated documentation data. The use of digital photography for documentation has resulted in a proliferation of data files that can be lost or easily destroyed, since unlike traditional printed-paper, they may not physically exist except in the form of magnetic or optically read media. There are many types of digital cameras, photographic processing software and operating systems in use currently at DEM, however certain common elements can be used as a framework to establish a standard method to assist in preservation of these records for easy retrieval and future use.

3. DEFINITIONS

3.1. WWW - World Wide Web

3.2. JPG - is a commonly used image file format for photographic images. The acronym JPEG (usually pronounced JAY-pehg) stands for the group that invented the format (Joint Photographic Experts Group). Usually with the file suffix of .jpg[1]. When you create a JPEG or convert an image from another format to a JPEG, you are asked to specify the quality of image you want. Since the highest quality results in the largest file, you can make a trade-off between image quality and file size.

3.3. GIF- Graphic Interchange Format [2] usually with the file suffix of .gif

3.4. PNG - Image file format supported on the WWW, usually with the file suffix of .png[3]

3.5. BLUETOOTH - a telecommunications industry specification that describes how cameras, mobile phones, computers, and personal digital assistants (PDAs) can be easily interconnected using a short-range wireless connection.

3.6. THUMBNAIL - A reduced file size version of a photographic record used for indexing and previewing of images.

3.7. GPS - The GPS (Global Positioning System) is a "constellation" of 24 well-spaced satellites that orbit the Earth and make it possible for people with ground receivers to pinpoint their geographic location. A basic GPS receiver provides geographic position - longitude and latitude, within 100 meters. Some receivers are equipped with a display screen that shows a map of the position.[4]

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[1] http://searchwebservices.techtarget.com/sDefinition/0,,sid26_gci212425,00.html
[2] ibid.
[3] ibid
[4] http://searchmobilecomputing.techtarget.com/sDefinition/0,,sid40_gci213986,00.html

3.8. MEDIA - Electronic devise that is designed to store of storing electronic records such as magnetic and optical disks, cards containing microchips etc.

4. RESPONSIBILITIES

4.1. COMPLIANCE - All staff engaged in collecting DEM digital photographic records are responsible to determine applicability of this SOP to their work. See Section 1 above. Supervisors are responsible for ensuring that staff is familiar with and adhere to any SOPs affecting their program functions.

5. GUIDELINES AND PROCEDURES

5.1. CAMERA AND FIELD NOTES

5.1.1. Verify that the date and time on the camera is accurate.

5.1.2. Activate the visible date and time option such that the recorded image will be imprinted with the date and time of the photo.

5.1.3. Select appropriate resolution quality. The higher the resolution the fewer the images that can be recorded for a given media.

5.1.4. Descriptive documentation should be recorded in sequentially numbered field notes immediately after the images are collected for specific photograph detail recall. (See 5.5.1)

5.2. COMPUTER SUBDIRECTORY CREATION AND FILE NAMING CONVENTIONS

5.2.1. Create a subdirectory on the computer to store the image files.

(A) File name conventions for subdirectory folders should be established to facilitate organization of records by Project, Station or Location.

(B) Multiple photo documentation sessions at a particular station or location should have date coding in the subdirectory name convention.

(C) Create a print image or report subdirectory to store the print versions of select images.

5.2.2. File name conventions for image files should be established to facilitate organization of records, for example, by: Project, Station or Location, Date, and a unique identifier, if necessary. (i.e. Project_Station_Date_ UniqueIdentifier.jpg. An image taken for the Wood River Basin Monitoring Project at Station #2 on 19 August 2006 could be named "WRB_Station2_19AUG2006.jpg". If multiple pictures were taken at this station on this date, each file name should include a unique identifier (e.g. WRB_Station2_19AUG2006_Looking_Downstream.jpg".)

5.3. COMPUTER IMAGE TRANSFER AND THUMBNAIL PRINT

5.3.1. Transfer the image files to the computer by various methods below:

(A) Connect camera directly to the computer with the supplied cable.

(B) Remove the memory card from the camera and use a card-reading device connected to the computer.

(C) Use of Bluetooth or other wireless transfer protocol.

5.3.2. When the device connection is recognized by the computer you will

typically be given the option of storage file location and whether to delete the image files after transfer.

(A) Do not select “delete after transfer” option until you are experienced with successful location and retrieval of your images from a previous photo transfer procedure.

(B) Select the appropriate subdirectory for transfer of the photos..

5.3.3. Validate the transfer of images to the new directory by viewing the directory and comparing file sizes to originals.

5.3.4. Deleting images from the camera or camera media.

(A) If you are confident that the transfer was successful, avoid selecting and deleting the camera image processing files and delete only the camera image files with suffixes .jpg, .gif, or .png.

5.3.5. Print out a thumbnail sheet of photographs transferred to the file.

5.4. IMAGE ENHANCEMENT

5.4.1. Typical digital photography processing software enables simple improvement of images with respect to contrast, brightness and level of detail though special effects. Any image-modified versions must not result in the replacement of the original image. Any modified image should be saved as a new file name encoded in a convention that clearly discloses image enhancement.

5.5. CREATE REPORT OR PRINT IMAGE FROM TEMPLATE

5.5.1. Templates for print out of photographic documentation should include at minimum:

(A) Date of photo record.

(B) Originating DEM Office.

(C) Photographer name.

(D) Other DEM staff witnesses to photograph conditions.

(E) Image sequence number.

(F) Location or site of photography, GPS coordinates if available.

(G) Photo description or caption.

5.5.2. Load the template file and “Save–as” a new report name.

5.5.3. Select the best representative images for print out to a template appropriate in size to the level of detail required and copy them into the template.

5.5.4. Fill out section 5.5.1 details in the template from memory and/or field notes.

5.5.5. Print the report and file it with the other project records including the above said thumbnail sheet.

5.6. CREATE DUPLICATE ELECTRONIC RECORD (BACKUP)

5.6.1. To maintain a permanent record and to create an electronic backup of the original photos, programs shall adopt some of the mechanisms including but not limited to the following:

- burn a CD of the project work,
- copy to other internal drives,
- emailing them to storage areas,
- use of jump drives, or
- other available storage technology.

5.6.2. If available and network storage capacity allows, utilize DEM network to archive image files.

6. REFERENCES

6.1. See Footnotes.

DIGITAL PHOTOGRAPH RECORD COLLECTION AND STORAGE SOP
SOP-OD-QM-4

Originator:

R.P. Schmidt _____ _____ Date: 7/27/07
Print Name Signature

APPROVALS:

Quality Team Chair:

Tom Getz _____ _____ Date: 7/25/07
Print Name Signature

Assistant Director of Water Resources

Alicia Good _____ _____ Date: 8/15/07
Print Name Signature

Assistant Director of Air, Waste and Compliance

Terry Gray _____ _____ Date: 8/1/07
Print Name Signature

Associate Director of Natural Resources

Larry Mouradjian _____ _____ Date: 8/6/07
Print Name Signature

DISTRIBUTION:

(x) Office of Air Resources ..... By: mcc Date: 8/20/07
(x) Division of Agriculture ..... By: mcc Date: 8/20/07
(x) Office of Waste Management..... By: mcc Date: 8/20/07
(x) Office of Compliance and Inspection..... By: mcc Date: 8/20/07
(x) Office of Technical and Customer Assistance ..... By: mcc Date: 8/20/07
(x) Groundwater and Wetlands Protection..... By: mcc Date: 8/20/07
(x) Surface Water Protection ..... By: mcc Date: 8/20/07
(x) Water Quality and Standards ..... By: mcc Date: 8/20/07
(x) Office of the Director ..... By: mcc Date: 8/20/07
(x) Quality Management Team..... By: e-mail Date: 8/20/07
(X) DOA MIS Liaison .....By: mcc Date: 8/20/07

APPENDIX C

Standard Operating Procedure for the Collection of Ambient Water Samples from Streams

Rhode Island Department of Environmental Management
Office of Water Resources
235 Promenade Street, Providence RI 02908

TITLE AND APPROVAL PAGE

Standard Operating Procedure for the Collection of Ambient Water Samples From Streams

SOP No.: WR-W-38
Revision No.: 0
Originator Name: Jane Sawyers

APPROVALS:

Administrator, Office of Water Resources

Joseph Haberek, P.E.

Printed Name	Signature	Date

Supervisor of Monitoring, Assessment, Water Quality Standards and TMDLs:

Jane Sawyers

Printed Name	Signature	Date

RIDEM Quality Assurance Manager:

Richard Enander	*Richard T. Enander*	2-14-2024
Printed Name	Signature	Date

DISTRIBUTION

(x) Surface Water Monitoring & Assessment (Jane Sawyers) By:_____Date :_____

(x) Quality Assurance Manager, RIDEM (Richard Enander) By:_____Date :_____

Standard Operating Procedure for the
Collection of Ambient Water Samples From Streams

1.0 APPLICABILITY

1.1 IDENTIFYING THE PROGRAMS AFFECTED BY THIS SOP

This Standard Operating Procedure (SOP) provides basic instructions for the field sampling collection of ambient water from streams. Exemption from the use of this SOP for project work shall be allowed for reasons of inapplicability determined by management discretion.

2.0 PURPOSE

2.1 OBJECTIVE OF THIS SOP

This SOP establishes a standardized method for collection of ambient water for water quality analysis. It sets a consistent protocol to ensure the quality of RIDEM's data collection—resulting in improved uniformity, reproducibility, verifiability, and defensibility of the data, as well as increased program credibility. This SOP advances our ability to attain the highest levels of Quality Assurance, Quality Control and Quality Improvement (QA/QC/QI).

3.0 DEFINITIONS

3.1 RIDEM – Rhode Island Department of Environmental Management
3.2 OWR – RIDEM Office of Water Resources
3.3 SOP – Standard Operating Procedure
3.4 Quality Assurance (QA) refers to a systematic process to ensure RIDEM OWR produces valuable, accurate, reliable, reproducible and defensible environmental data.
3.5 Quality Control (QC) refers to the activities performed to affirm RIDEM OWR produces valuable, accurate, reliable, reproducible and defensible environmental data.
3.6 Quality Improvement (QI) refers to any act or process performed to enhance the value, accuracy, reliability, reproducibility or defensibility of environmental data collected by RIDEM OWR.

4.0 RESPONSIBILITIES

4.1 TRAINING

Anyone collecting ambient water for water quality analyses for a RIDEM/OWR project or program should have completed RIDEM's Quality System Awareness Training Program with appropriate documentation from the Quality Assurance Manager. This training ensures the analyst recognizes the importance of proper data collection and management and he/she comprehends the significance of the

environmental decisions that may be made with the data. It is suggested that analysts have also completed the USEPA Water Quality Standards Academy Basic Course and Supplemental Topic Modules online, but this type of sampling does not require any additional special training or certification.

To properly collect ambient water for water quality analyses, the analyst must be familiar with and comply with the techniques stated in this SOP. Any technician not familiar with collecting ambient water for water quality analysis should be assisted by OWR staff who are accustomed to collecting these samples. The Ambient River Monitoring (ARM) program has a training program called the “Training Passport”, which incorporates all of the above training with additional modules.

4.2 RESPONSIBILITIES OF THE ANALYST

The analyst is responsible for verifying that field equipment is in proper operating condition prior to use. The analyst is responsible for bringing the proper equipment to the site where samples are going to be taken. The analyst is accountable for employing proper sampling procedures and data recording (Section 6.0 and 7.0). The analyst must comply with QA/QC requirements (Section 5.0) and verify that the data collected is within acceptance criteria when applicable.

4.3 RESPONSIBILITIES OF THE PROJECT MANAGER

The project manager is responsible for providing the materials, resources, and/or guidance necessary to perform sampling in accordance with this SOP. The project manager is responsible for ensuring that the analyst or technician conducts sampling in accordance with this SOP, and that any additional, project-specific requirements are communicated to the project team. The project manager is responsible for ensuring that necessary equipment is repaired when necessary or if found deficient by the analyst(s) and ensuring that necessary supplies are provided in a timely fashion. Further, the project manager shall ensure annual renewal and periodic revisions to this SOP to reflect current needs and standards and will renew this SOP every five years.

5.0 QUALITY CONTROL

5.1 QUALITY ASSURANCE PLANNING CONSIDERATIONS

The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. Unless specified otherwise in a site or project-specific workplan, Quality Assurance Project Plan (QAPP), Quality Assurance Program Plan (QAPP) or laboratory Quality Assurance Manual (QAM), all data collected following the protocols set forth in this document will be collected in accordance with the minimum QA/QC requirements (Section 5.0). Further quality assurance requirements will be defined in project specific work plans and may include duplicate or replicate measurements or confirmatory analyses.

5.2 FIELD PARAMETERS

When collecting water quality samples, it is generally associated with measurement of conventional parameters in the field, including but not limited to: dissolved oxygen, specific conductance, pH, and temperature (Figure 1). Calibration and verification of these parameters will be done according to the procedures in the SOPs for the YSI-85 (SOP-WR-W39), YSI Pro Plus (SOP-WR-W34), or YSI 2030 (WR-W-48). If calibration and verification fails and basic troubleshooting does not rectify the issue, the parameter needs to be flagged on field sheets and will not be included in the RIDEM/OWR water quality database. If temperature verification indicates that the probe is malfunctioning, any samples taken previous to that verification, back to the previous successful verification should be flagged as having a faulty reading of field parameters. Because specific conductance and dissolved oxygen are both temperature compensated, these values are questionable as well, and it is recommended that they not be used in data analysis or reporting. Specific conductance will need to be calibrated at the frequency specified in project documentation. If other guidance is unavailable, once weekly calibration should be sufficient for this parameter. Dissolved oxygen will be different under varying environmental conditions (barometric pressure and temperature) requiring twice daily calibration (before leaving and upon return to RIDEM office) and also requiring that the analyst leave the meter turned on during the entire sampling event. If at the end of the day a dissolved oxygen reading fails verification, values of dissolved oxygen collected during that day are questionable, and field sheets entries should be flagged and will not be included in the RIDEM/OWR water quality database.

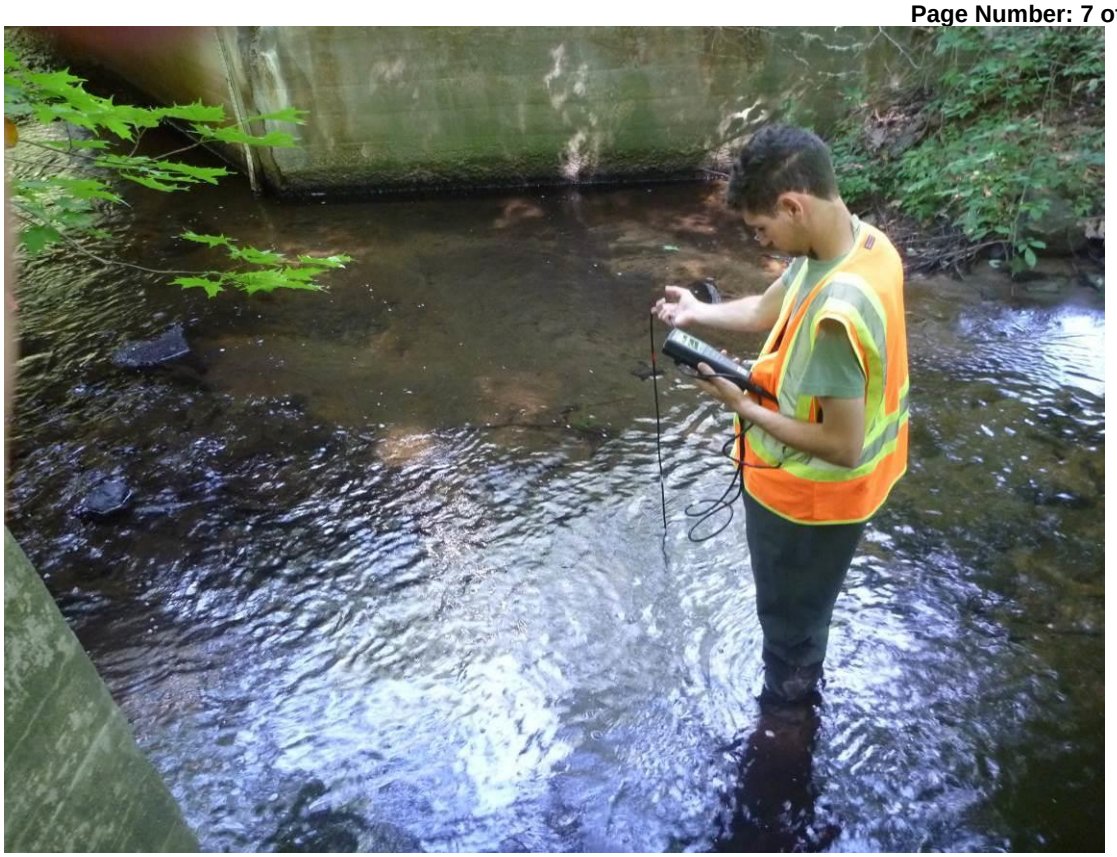


Figure 1 Analyst collecting field parameters in a stream.

5.3 DUPLICATE SAMPLES

Duplicate samples are collected to ensure the reproducibility of results. If two samples are taken of the same water, under the same conditions, the data generated from those two samples should theoretically be the same within a designated margin of error. Duplicates allow the analyst to quantify the error involved in sample collection. Duplicates will be collected at the frequency specified in the project plan. In the absence of project-specific criteria, duplicate analysis of samples should agree within five percent of relative percent difference.

5.3.1 SEQUENTIAL DUPLICATES (REPLICATES)

When a sample is taken and then another is taken from the same water immediately after, the sample is referred to as a sequential duplicate. These samples do not gather data under the exact same sampling conditions; therefore, there may be a difference in the values. Analysis of sequential samples allows the analyst to quantify the error involved in filling bottles one after another from the same source water. A sequential duplicate can also give information on the heterogeneity of the waterbody sampled.

5.4 BLANK SAMPLES

Blank samples are water samples of de-ionized or distilled water that should be free of analyte. Depending on the timing and conditions of when these sample bottles are filled, various parts of the sampling operation can be verified. Blank samples will be collected at the frequency specified in the project plan. In the absence of project-specific criteria, blank water should be free of analyte to the detection limit of the analytical procedure, and all components of the sampling procedures must be verified at least once.

5.4.1 FIELD EQUIPMENT BLANK

Field equipment blank refers to blank water that is processed through specific components of the equipment used for collecting and processing environmental samples. Field equipment blanks refer to blank water that is passed through all the equipment used for collecting and processing samples in the field after samples are collected and the equipment is decontaminated. These samples are to verify that the decontamination of equipment in the field is adequate.

Figure 2. Analyst filling a1 liter bottle with DIW for a field blank sample.

5.4.3 TRIP BLANKS

Trip blanks refer to distilled water poured into sample bottles in the controlled environment of the sampling center or the RIDOH lab. These samples then travel with the field team during data collection. Trip blanks are stored and shipped with

environmental samples. These samples verify that there is no contamination during the shipping, storage, or transport of samples.

6.0 GUIDELINES AND PROCEDURES

The sections below describe in detail the procedures for taking a grab sample at a flowing stream. It is generally understood that a grab sample at a single point is sufficient in cases where the stream is determined to be well mixed. Clean-hands protocols are described in addition to sampling that does not require clean hands protocols. Procedures for collecting a sample using a sampling wand are also described.

6.1 REQUIRED MATERIALS

- YSI meter
- Lint-free tissues
- One pair of "powder free" gloves and a sampling bottle in a separate sealed Zip-Lock plastic bag prepared in the sampling center ahead of time by an analyst wearing gloves (for metals samples).
- A box of regular powder-free gloves
- Chest waders with belt or hip boots (if necessary)
- Sampling wand
- Indelible marker
- RIDEM YSI Field Data Collection Sheet (Datasheet 1)
- Waterproof pen or pencil
- Site descriptions
- Other field data sheets
- Chain of custody forms
- Site specific bottle label stickers

6.2 SPECIFIC BOTTLE REQUIREMENTS

Depending on what analysis will be done on the sample, there are different requirements for bottle size and composition. This ensures that there is enough water for analysis, and that the material the bottle is made of such as plastic, clear glass, or amber glass, will protect the sample from degradation or reaction. Specific

project documentation should supersede any general guidelines presented in this SOP (Table 1).

6.2.1 BOTTLE PREPARATION

Analytes that require sample preservation are pre-acidified by RIDOH lab personnel. The specific preservative will be marked on the label and detailed extensively by the RIDOH quality assurance plan (RIDOH 2018).

6.2.2 AVOIDING CONTAMINATION

Care should be used when filling bottles that contain preservatives. Bottles should be filled in the proper order to minimize contact with preservatives that may possibly be analytes in bottles filled subsequently.

6.2.3 FILLING THE BOTTLE

Different analytical techniques require filling the bottle to different degrees. Unless otherwise stated, the bottles for most RIDEM programs will be filled to the shoulder by the collection protocol stated in the following sections by analyte and bottle type. This refers to the part of the bottle where it begins to narrow before reaching the neck (Figure 4).

Figure 3 Orange lines are at the shoulder of the various bottles used for the ARM program. Samples should be filled to this level unless program specific instructions are provided.

6.3 ENTERING THE SAMPLING LOCATION

6.3.1 PUTTING ON WADERS

The analyst should put on waders in the vehicle before entering stream. Care should always be taken because there can be a number of hazards associated with stream sampling.

6.3.2 APPROACHING SAMPLING LOCATION

Where there is flow or current, the analyst should always approach the sampling location slowly from the downstream, as long as it is safe to do so. Once the sampling location is reached, the streambed and water will need time to return to a pre-disturbed condition. Bottles should not make contact with the bottom or adjacent rocks and stream debris. If the water depth is less than one foot (30.5 cm), this condition should be recorded and the sample taken at mid depth.

Figure 4 Analyst collecting a sample in shallow water (depth less than 1 foot). This condition should be noted on field sheets.

6.4 SAMPLE COLLECTION PROTOCOLS

The method of collection is dependent upon the analyte and preservation of the bottle. Each section below describes a specific method of removal of a water sample from the stream location. The order of the collection is dependent upon the analyte(s) being sampled that the sampling location. Any sampling event that includes metal sample(s) should collect the metal first due to the high potential for contamination.

6.4.1 COLLECTING A **METALS** SAMPLE USING CLEAN HANDS PROTOCOLS

The following steps describe the procedures for rinsing and filling the non-preserved metals sample bottle with water. This procedure must be done in teams of two people. Clean hands protocols separate field duties and dedicate one individual as the “clean hands” person (CHP) to tasks related to direct contact with the sample. The assistant is designated the "dirty hands" person (DHP). The CHP should not to touch anything but the sample bottle until sampling is complete. The DHP is responsible for all other equipment until sampling is complete. RIDEM ARM program uses clean hands protocols only for metals sampling. The detection limit is very low on this set of tests, so having a clean hands sampler helps to reduce the chances of contamination.

Figure 5 Clean hands person on the left of picture only handles bottles with clean gloves after entering water.

(A) PUTTING ON GLOVES

After the CHP has entered the water, and immediately before collecting the sample, the DHP should put on regular powder-free gloves. Next the DHP should open the bag containing a second set of clean gloves and sample bottle, and hold it open for the CHP to take out and put on the gloves without touching the bag.

(B) FILLING THE BOTTLE WITH WATER

The CHP should remove the sample bottle from the bag and remove the cap. Reaching upstream or up current, the CHP will submerge the container 25 cm into water and allow the container to fill. The analyst should avoid contacting the sample bottle with the bottom or adjacent rocks and stream debris, because this could possibly re-suspend sediment or other bottom materials, biasing the sample. If there is significant residue on the surface, this should be recorded in the field notes.

(C) TRIPLE RINSING THE SAMPLE BOTTLES

The CHP will bring the bottle up and immediately cap the container. Once capped, the bottle is gently shaken and all water is poured out downstream of sampling area or on the riverbank. This is repeated three times to ensure that the bottle contains only an environmental sample with no residue from cleaning or manufacture of the sample bottle.

(D) FILLING THE SAMPLE BOTTLE

The CHP will submerge the container 25 cm into water and allow the container to fill. Unless stated by other project documentation, sample bottle should be filled to the shoulder as described in 6.2.3.

6.4.2 SAMPLE COLLECTION PROCEDURE FOR **NON-PRESERVED AND NON-BACTERIA** WATER QUALITY SAMPLES

The sampling procedure outlined below is for taking samples of water that do not require preservative and are not samples that will be analyzed for bacteria. This method includes rinsing the sample bottle three times with sample water. Because preserved samples are pre-acidified, rinsing the bottle would result in rinsing the preservative away. Bacteria samples are not rinsed, because bacteria can cling to the sides of sample bottles during the rinsing procedure, lending a positive bias to the bacteria sample.

Figure 6 Analyst collecting water using a bottle that is non-preserved, and not a bacteria sample.

(A) PUTTING ON GLOVES

Immediately before collecting the sample, the analyst should put on regular powder-free gloves.

(B) FILLING THE BOTTLE WITH WATER

The analyst should remove the sample bottle cap. Reaching upstream or up current, the analyst will submerge the container 25 cm into water and allow the container to fill. The analyst should avoid contacting the sample bottle with the bottom or adjacent rocks

and stream debris, because this could possibly re-suspend sediment or other bottom materials, biasing the sample. If there is significant residue on the surface, this should be recorded in the field notes.

(C) TRIPLE RINSING THE SAMPLE BOTTLES
The analyst will bring the bottle up and immediately cap the container. Once capped, the bottle is gently shaken and all water is poured out downstream of sampling area or on the riverbank. This is repeated three times to ensure that the bottle contains only an environmental sample with no residue from cleaning or manufacture of the sample bottle.

(D) FILLING THE SAMPLE BOTTLE
The analyst will submerge the container 25 cm into water and allow the container to fill. Unless stated by other project documentation, sample bottle should be filled to the shoulder as described in 6.2.3.

6.4.4 SAMPLE COLLECTION PROCEDURE FOR **BACTERIA** WATER QUALITY SAMPLES
The sampling procedure outlined is the same procedure as that outlined in Section 6.4.2, with the exceptions that bottles are *not* triple rinsed. **Steps 6.3.1 through 6.3.2 must be followed prior to taking the sample.**

(A) PUTTING ON GLOVES
Immediately before collecting the sample, the analyst should put on regular powder-free gloves.

(B) READYING THE SAMPLE BOTTLE
Reaching upstream or up current, the analyst should hold the container with the opening facing directly toward the water, quickly plunging though the water surface to avoid collecting surface residue. If there is significant residue on the surface, this should be recorded in the field notes.

(C) TAKING A SAMPLE
The analyst will submerge the container 25 cm into water and turn the container, allowing it to fill. If the water depth is less than one foot (30.5 cm), it should be recorded and the sample taken at mid depth. The analyst should avoid contacting the sample bottle with the bottom or adjacent rocks and stream debris, because this could possibly re-suspend sediment or other bottom materials, biasing the sample.

(D) FILLING THE BOTTLE
Unless stated by other project documentation, the bottle should be filled to the shoulder as described in 6.2.3.

(E) FINISHING COLLECTION
The analyst will bring the bottle up and immediately cap it. The bottle should be placed in a secure spot and brought to the cooler as soon as possible.

6.5 ALTERNATIVE SAMPLE COLLECTION PROCEDURE FOR **NON-PRESERVED AND NON-BACTERIA** WATER QUALITY SAMPLES TAKEN WITH A SAMPLING WAND FROM THE SHORE OR BRIDGE

The sampling wand is extendable and useful in situations where an extra reach is needed. The necessity of using this altered procedure will be determined by the field analyst based on safety and collection of high quality samples. It enhances the clean hands protocol, by limiting direct contact with the sample bottles. Wand sampling is the preferred method of obtaining a representative sample from larger streams and rivers. This is because the wand method eliminates disturbing the substrate by wading.

Figure 7 Sampling wand with bottle inserted in small clip.

6.7.1 PREPARING TO TAKE A SAMPLING WAND SAMPLE

The analyst should always try to sample where there is flow or current. Typically, the analyst will not need to put on waders, because the wand will provide the extra length needed to reach the ideal sampling spot from the bank or bridge.

Figure 8 Analyst collecting a water sample from the streambank using the sampling wand.

(A) A REPRESENTATIVE SAMPLE

Bottles should not make contact with the bottom or adjacent rocks and stream debris. Water should be flowing, and the sample should be collected close to the center of the stream if depth will allow. Water that is not moving should not be sampled. If the water depth is less than one foot (30.5 cm), it should be recorded and the sample taken at mid depth.

6.7.2 TAKING A **METALS** SAMPLE

The following steps describe the procedures for rinsing and filling the bottle with water. **Step 6.7.1 must be followed prior to taking the sample.**

(A) CLEAN HANDS PROTOCOL

The same analysts' responsibilities that are outlined in Section 6.4.1 apply to this section. The CHP is the "clean-hands" person, and the DHP is the "dirty-hands" person.

(B) PUTTING ON GLOVES

Immediately before collecting the sample, the DHP should put on regular powder-free gloves. Then they should open the sample kit, take out the bag containing gloves, and hold it open for the CHP to take and put on the gloves without touching the bag.

(C) READYING THE SAMPLE BOTTLE

The wand has a large and small clip for holding sample bottles. The CHP should hold the sample bottle in the center of the appropriately sized clip, while the DHP holds the wand steady and secures the clip around the middle of the bottle. The CHP should check that the bottle is in a fixed position before removing the cap. Reaching the wand upstream or up current, the DHP will plunge the wand, with the container opening facing directly toward the water, quickly though the water surface to avoid collecting surface residue. If there is significant residue on the surface, this should be recorded in the field notes.

(D) TAKING A SAMPLE

The DHP will submerge the container 25 cm into water and allow the container to fill. The analyst should avoid contacting the sample bottle with the bottom or adjacent rocks and stream debris, because this could possibly re-suspend sediment or other bottom materials, biasing the sample.

(E) RINSING THE SAMPLE BOTTLES

When the DHP brings the bottle up, the CHP should immediately cap the container. Once the bottle is capped, the wand is gently shaken, the cap removed by the CHP, and all the water in the bottle poured out downstream of sampling area or on the riverbank. This is repeated three times to ensure that the bottle contains only an environmental sample.

(F) FILLING THE BOTTLE

Unless stated by other project documentation, the bottle should be filled to the shoulder as described in 6.2.3.

6.7.3 SAMPLE COLLECTION PROCEDURE FOR **PRESERVED** WATER QUALITY SAMPLES TAKEN WITH A SAMPLING WAND FROM THE SHORE

The sampling procedure outlined is the same procedure as that outlined in Section 6.7, with the exceptions that bottles are *not* triple rinsed or inserted into the water with the opening of the bottle directly towards the water. Because preserved samples are pre-acidified, a clean bottle will be filled, referred to the collection bottle in this section, as directed in sections 6.7.1 through 6.7.2. The pre acidified bottle that will receive sample, referred to in this section as the sample bottle.

(A) FILLING THE BOTTLE

Unless stated by other project documentation, the sample bottle should be filled from the collection bottle to the shoulder as described in 6.2.3.

(B) FINISHING COLLECTION

The analyst will bring the bottle up and will immediately cap it. The bottle should be placed in a secure spot and brought to the cooler as soon as possible.

6.7.4 PROCEDURE FOR COLLECTION OF **BACTERIA** SAMPLES USING A SAMPLING WAND FROM THE SHORE OR BRIDGE

The sampling procedure outlined is the same procedure as that outlined in Section 6.7, with the exceptions that bottles are *not* triple rinsed. **Step 6.7.1 must be followed prior to taking the sample.**

(A) PUTTING ON GLOVES

Immediately before collecting the sample, the analyst should put on regular powder-free gloves.

(B) READYING THE SAMPLE BOTTLE

The wand has a large and small clip for holding sample bottles. The analyst should hold the sample bottle in the center of the appropriately sized clip and secure the clip around the middle of the bottle. Reaching the wand upstream or up current, the analyst should plunge the wand, with the container opening facing directly toward the water, quickly though the water surface to avoid collecting surface residue. If there is significant residue on the surface, this should be recorded in the field notes.

(C) TAKING A SAMPLE

The analyst will submerge the container 25 cm into water and allow the container to fill. If the water depth is less than one foot (30.5 cm), it should be recorded and the sample taken at mid depth. The

analyst should avoid contacting the sample bottle with the bottom or adjacent rocks and stream debris, because this could possibly re-suspend sediment or other bottom materials, biasing the sample.

(E) FILLING THE BOTTLE
Unless stated by other project documentation, the bottle should be filled to the shoulder as described in 6.2.3.

(F) FINISHING COLLECTION
The analyst will bring the bottle up and immediately cap it. The bottle should be placed in a secure spot and brought to the cooler as soon as possible.

6.8 ALTERNATIVE FOR CONDITIONS WHERE ATMOSPHERIC DEPOSITION IS A CONCERN

There may be days where conditions cause the analyst to be concerned with the deposition of contaminating materials into the sample container. Conditions would include: very windy days, sites where there is an unusual amount of dust or dirt in the air, or other air quality concerns. In these cases the capped container should be submerged 25 cm into the water and the cap should be removed while in the water. Once the container is filled, the bottle should be recapped under the water. The bottle can then be emptied, refilled, and rinsed as required. In cases of preserved samples, the sample collection bottle can be submerged, uncapped and filled while underwater, then emptied, refilled, and rinsed as required. The preserved sample bottle can be filled either by shielding the bottle from the source of atmospheric deposition or by filling the bottle in a vehicle if necessary.

6.9 HANDLING OF WATER QUALITY SAMPLES AFTER COLLECTION

Depending on the analyses to be conducted on the samples, there are different requirements for storage of the samples (Table 1). Unless project specific guidance is provided, samples should be stored in a cooler with sufficient ice enclosed in a plastic bag to keep the samples cool and dark during the entire sampling day. Bagging the ice helps prevent the outside of the sample container from being contaminated with melted ice water and helps keep bottle labels intact. According to EPA Policy, all drinking water samples must be submitted at 4˚ Celsius. However, due to the small size of Rhode Island, samples that are collected and put on ice are not always in transit long enough to reach the 4˚ Celsius requirement. As noted on the RIDOH laboratory sample submission form, all drinking water samples must be received on ice. If samples are received without ice, the drinking water quality program is notified and samples are flagged. Once received, all samples are immediately stored in a refrigerator at 4˚ Celsius (RIDOH 2010).

6.9.1 SAMPLE HOLDING TIMES

Samples generally need to be brought to the RIDOH lab by 1445 or earlier on the day that they are collected (the lab closes at 1500); however, if the samples cannot be delivered, the appropriate holding time and procedures should be implemented (Table 1). Samples should never be delivered to the lab that cannot be accepted within this period.

7.0 DOCUMENTATION

7.1 FIELD MEASUREMENTS

Unless project specific guidelines direct otherwise, all calibration and field measurements will be recorded on a RIDEM YSI Data Collection Sheet or in the appropriate field notebook (Figure 2).

7.2 CHAIN OF CUSTODY FORMS

Depending upon the lab that is used, each project will have different chain of custody forms. An example of a filled chain of custody form from RIDOH is provided (Figure 8).

7.3 LABELS

Depending upon the lab that is used, each project will have different sets of labels. An example of a filled label form that is acceptable to the RIDOH lab is provided (Figure 9).

8.0 REFERENCES

Franke, O.L. and the Ground Water Focus Group of the Intergovernmental Task Force on Monitoring Water Quality. 1997. Conceptual Frameworks for Groundwater Quality Monitoring. 112 p.

Lurry, D.L. and Kolbe, C.M. 2000. Interagency Field Manual for the Collection of Water-Quality Data. U.S.Geological Survey, Open File Report 00-213. 85 p.

Nimiroski M. 2012. Standard Operating Procedure for the Measurement of Dissolved Oxygen, Temperature, Specific Conductance, pH and Nitrate Using a Handheld YSI Professional Plus Instrument RIDEM SOP, WR-W-34. 44 p.

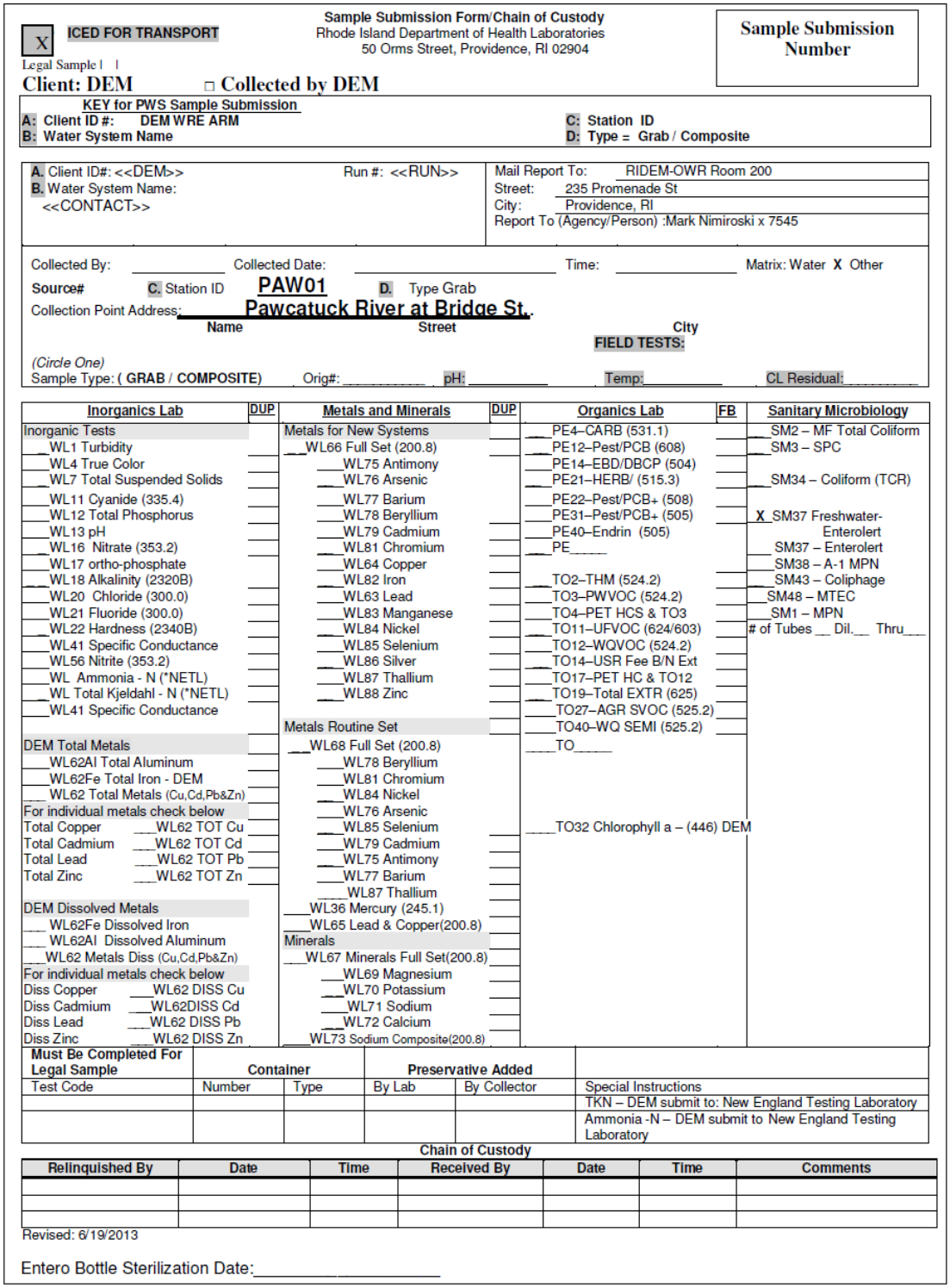
Nimiroski M. and DeGoosh K. 2011. Standard Operating Procedure for the Measurement of Dissolved Oxygen, Temperature, Specific Conductance, and Salinity Using a Handheld YSI Model 85 Instrument. RIDEM SOP, WR-W-39. 21 p.

Rhode Island Department of Health Laboratory. 2010. Quality Assurance Plan for the Rhode Island Department of Health Laboratories In Support of Drinking Water Quality and Water Pollution Programs, Revision 12.0. Section 4. 110 p.

YSI Model 85: Handheld Oxygen, Conductivity, Salinity, and Temperature System Operations Manual. YSI incorporated. Yellow Springs Ohio, USA.

Field Crew:						**Weather Conditions:**						
YSI Instrument (circle one):	**#1**	**#2**	**#3**	**ProPlus**								
Site ID												
Location Name												
Date												
Time												
Temp (°C)												
B. Pres. (mmHg)												
Saturation (%)												
DO (mg/L)												
SPC (µS/cm)												
pH												
Nitrate (mg/L)												
Photographs												
O.G.												
Flow												
Sample Method												
Comments												

Datasheet 1. RIDEM YSI Field Data Collection Sheet



X ICED FOR TRANSPORT

Legal Sample I I

Sample Submission Form/Chain of Custody
Rhode Island Department of Health Laboratories
50 Orms Street, Providence, RI 02904

Sample Submission Number

Client: DEM □ **Collected by DEM**

KEY for PWS Sample Submission
A: Client ID #: DEM WRE ARM
B: Water System Name
C: Station ID
D: Type = Grab / Composite

A. Client ID#: <<DEM>> Run #: <<RUN>>
B. Water System Name:
<<CONTACT>>

Mail Report To: RIDEM-OWR Room 200
Street: 235 Promenade St
City: Providence, RI
Report To (Agency/Person) :Mark Nimiroski x 7545

Collected By: _____ Collected Date: _____ Time: _____ Matrix: Water X Other
Source# C. Station ID PAW01 D. Type Grab
Collection Point Address: Pawcatuck River at Bridge St.
Name Street City
FIELD TESTS:
(Circle One)
Sample Type: (GRAB / COMPOSITE) Orig#: _____ pH: _____ Temp: _____ CL Residual: _____

Inorganics Lab	DUP	Metals and Minerals	DUP	Organics Lab	FB	Sanitary Microbiology
Inorganic Tests		Metals for New Systems		___PE4–CARB (531.1)		___SM2 – MF Total Coliform
___WL1 Turbidity		___WL66 Full Set (200.8)		___PE12–Pest/PCB (608)		___SM3 – SPC
___WL4 True Color		____WL75 Antimony		___PE14–EBD/DBCP (504)		
___WL7 Total Suspended Solids		____WL76 Arsenic		___PE21–HERB/ (515.3)		___SM34 – Coliform (TCR)
___WL11 Cyanide (335.4)		____WL77 Barium		___PE22–Pest/PCB+ (508)		
___WL12 Total Phosphorus		____WL78 Beryllium		___PE31–Pest/PCB+ (505)		X SM37 Freshwater-Enterolert
___WL13 pH		____WL79 Cadmium		___PE40–Endrin (505)		___ SM37 – Enterolert
___WL16 Nitrate (353.2)		____WL81 Chromium		___PE_____		___SM38 – A-1 MPN
___WL17 ortho-phosphate		____WL64 Copper				___SM43 – Coliphage
___WL18 Alkalinity (2320B)		____WL82 Iron		___TO2–THM (524.2)		___SM48 – MTEC
___WL20 Chloride (300.0)		____WL63 Lead		___TO3–PWVOC (524.2)		___SM1 – MPN
___WL21 Fluoride (300.0)		____WL83 Manganese		___TO4–PET HCS & TO3		# of Tubes __ Dil.__ Thru___
___WL22 Hardness (2340B)		____WL84 Nickel		___TO11–UFVOC (624/603)		
___WL41 Specific Conductance		____WL85 Selenium		___TO12–WQVOC (524.2)		
___WL56 Nitrite (353.2)		____WL86 Silver		___TO14–USR Fee B/N Ext		
___WL Ammonia - N (*NETL)		____WL87 Thallium		___TO17–PET HC & TO12		
___WL Total Kjeldahl - N (*NETL)		____WL88 Zinc		___TO19–Total EXTR (625)		
___WL41 Specific Conductance				___TO27–AGR SVOC (525.2)		
		Metals Routine Set		___TO40–WQ SEMI (525.2)		
DEM Total Metals		___WL68 Full Set (200.8)		____TO_____		
___WL62Al Total Aluminum		____WL78 Beryllium				
___WL62Fe Total Iron - DEM		____WL81 Chromium				
___ WL62 Total Metals (Cu,Cd,Pb&Zn)		____WL84 Nickel				
For individual metals check below		____WL76 Arsenic				
Total Copper ___WL62 TOT Cu		____WL85 Selenium		____TO32 Chlorophyll a – (446) DEM		
Total Cadmium ___WL62 TOT Cd		____WL79 Cadmium				
Total Lead ___WL62 TOT Pb		____WL75 Antimony				
Total Zinc ___WL62 TOT Zn		____WL77 Barium				
		____WL87 Thallium				
DEM Dissolved Metals		___WL36 Mercury (245.1)				
___ WL62Fe Dissolved Iron		___WL65 Lead & Copper(200.8)				
___ WL62Al Dissolved Aluminum		Minerals				
___WL62 Metals Diss (Cu,Cd,Pb&Zn)		___WL67 Minerals Full Set(200.8)				
For individual metals check below		____WL69 Magnesium				
Diss Copper ___WL62 DISS Cu		____WL70 Potassium				
Diss Cadmium ___WL62DISS Cd		____WL71 Sodium				
Diss Lead ___WL62 DISS Pb		____WL72 Calcium				
Diss Zinc ___WL62 DISS Zn		___WL73 Sodium Composite(200.8)				

Must Be Completed For Legal Sample	Container		Preservative Added		
Test Code	Number	Type	By Lab	By Collector	Special Instructions
					TKN – DEM submit to: New England Testing Laboratory
					Ammonia -N – DEM submit to New England Testing Laboratory

Chain of Custody

Relinquished By	Date	Time	Received By	Date	Time	Comments

Revised: 6/19/2013

Entero Bottle Sterilization Date:_____

Figure 9 Example of chain of custody form used by Rhode Island Department of Health as filled out by Ambient River Monitoring Program.

RI HEALTH MICRO SM37 250ml sterile
LPK01 Spring Brook
DATE: TIME:

RI HEALTH MICRO SM37 250ml sterile
LPK03 Mastuxet Brook
DATE: TIME:

RI HEALTH MICRO SM37 250ml sterile
PAW01 Pawcatuck R. at Bridge St.
DATE: TIME:

RI HEALTH MICRO SM37 250ml sterile
PAW05 Chipuxet at Wolf Rocks Rd.
DATE: TIME:

RI HEALTH MICRO SM37 250ml sterile
PAW09 Chickasheen Brook at Waites Corner Rd.
DATE: TIME:

RI HEALTH MICRO SM37 250ml sterile
PAW11 Mile Brook at Main St.
DATE: TIME:

RI HEALTH MICRO SM37 250ml sterile
PAW12a Ashaway River at Ashaway Rd.
DATE: TIME:

RI HEALTH MICRO SM37 250ml sterile
PAW13 Parmenter Brook at Wich Way
DATE: TIME:

RI HEALTH MICRO SM37 250ml sterile
PAW15 Tomaquag Brook at Collins Rd.
DATE: TIME:

RI HEALTH MICRO SM37 250ml sterile
PAW17 Perry Healy Brook at Klondike Rd.
DATE: TIME:

Figure 10 Example of a sheet of labels to be printed for sample bottles

Table 1. Modified requirements table of the one detailed in Section 4 of the RIDOH QAPP (RIDOH 2010). These are possible parameters sampled for in this program with their corresponding minimum volume, container, preservative, and holding time.

Parameter	Minimum Volume	Container	Preservative	Holding Time
Metals (except Hg)	1 L	Plastic or Glass	HNO3 to pH<2	6 months
Mercury	100 mL	Plastic or Glass	HNO3 to pH<2	28 days
Alkalinity	100 mL	Plastic or Glass	Cool, 4°C	14 days
Chloride	50 mL	Plastic or Glass	None	28 days
Color	50 mL	Plastic or Glass	Cool, 4°C	48 hours
Conductivity	100 mL	Plastic or Glass	Cool, 4°C	28 days
Cyanide	1 L	Plastic or Glass	Cool, 4°C, Ascorbic Acid (if chlorinated), NaOH to pH>12	14 days
Fluoride	300 mL	Plastic or Glass	None	28 days
Nitrate/Nitrite	100 mL	Plastic or Glass	Cool, 4°C	48 hrs
Physicals (Odor, Turbidity, Sediment, Foam Screen)	200 mL	Glass or Plastic	Cool, 4°C	24 hrs
pH	25 mL	Plastic or Glass	None	Immediately
Orthophosphate	50 mL	Plastic or Glass	Cool, 4°C	48 hours
Solids (TDS)	100 mL	Plastic or Glass	Cool, 4°C	7 days
Sulfate	50 mL	Plastic or Glass	Cool, 4°C	28 days
Turbidity	100 mL	Plastic or Glass	Cool, 4°C	48 hours
Trihalomethanes	40 mL	Glass, teflon lined septum	Sodium Thiosulfate Cool, 4°C	14 days
Volatile Organics	40 mL	Glass, teflon lined septum	(1) Ascorbic Acid (2) HCl to pH<2 (3) Cool, 4°C	14 days

Volatile Organics	40 mL	Glass, teflon lined septum	(1) Sodium Thiosulfate. (2) HCl to pH<2 (3) Cool, 4°C	14 days
Semivolatiles	1 L	Amber glass, teflon lined septum	Sodium Sulfite if chlorinated HCl to pH<2 Dark, cool, 4°C	14 days
EDB/DBCP	40 mL	Glass, teflon lined septum	Sodium Thiosulfate, Cool, 4°C	14 days
Pesticides	1 L	Amber glass, teflon lined caps	Sodium Thiosulfate, Cool, Dark, 4°C	7 days
Acid Herbicides	60 mL	Amber glass, teflon lined caps	Sodium Thiosulfate, Cool, 4°C	14 days
Carbamates	60 mL	Amber glass, teflon lines caps	Monochloroacetic Acid to pH<3, Cool, 4°C	28 days
Total and Fecal Coliform	100 mL	Glass or plastic, sterile	Sodium Thiosulfate Cool, 4°C	30 hours for potable water (8 hrs in source water); 6 hours for non-potable waters

APPENDIX D

Summary Guidance for Reviewing Environmental Monitoring Data

Summary Guidance for Reviewing Environmental Monitoring Data

Standard Operating Procedure # - BEP-WR-1

1. **APPLICABILITY.** This SOP applies to all DEM programs where staff review environmental monitoring data for use in various environmental regulatory decisions. This summary guidance can be applied to the review of environmental data generated by the Department or by entities in fulfillment of environmental regulatory requirements, as well as to secondary data. It is anticipated that individual programs will modify the checklist (Appendix A) as necessary to meet their DQOs. Appendix C is an example of a checklist that focuses on data verification / validation issues.

2. **PURPOSE.** This SOP is intended to serve as a primer on the procedures for reviewing environmental data and data reports for DEM programs. Depending on the needs of the project, the intended use of the final data and the degree of confidence required in the quality of the results, data review can be conducted at many levels. This document provides general guidance on verification and validation procedures and usability assessments and informs staff of available references to utilize. Data verification ensures that reported results accurately depict work performed. Data validation confirms that these verified results meet the overall quality requirements of the project. Usability assessments define acceptance criteria by which environmental data are evaluated for ultimate use in decision-making.

3. **DEFINITIONS.**

Data Quality Objectives (DQOs) – Description of the intended use of the data and some of the requirements that must be attained (quality and quantity) to meet the intended use.

Data Validation – A technical review performed to compare data with established quality criteria to ensure that data are adequate for the intended use. Data validation confirms that the verified results meet the overall quality requirements of the intended use.

Data Verification – The first step in data review, data verification entails an evaluation of the completeness, correctness, consistency and conformance/compliance of a data set against pre-determined requirements given in a document such as the Quality Assurance Project Plan (QAPP), and to ensure that the records associated with a specific dataset actually reflect what was conducted.

Detection Limit (DL)/Method Detection Limit (MDL) – the lowest concentration of a substance that can be measured with 99% confidence that the substance is present in the sample, i.e., greater than zero.

Metadata – Informational data about the data.

Quality Control (QC) –technical activities intended primarily to control errors. The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the established requirements.

Quantitation Level (QL) – (quantification level, practical quantitation level) – the lowest concentration of a substance that can be reliably measured and reported with some degree of confidence.

Secondary Data – Data collected for purposes other than the current intended use.

4. RESPONSIBILITY.

All staff involved in reviewing environmental data are responsible to determine the applicability of this SOP to their work. Supervisors are responsible for ensuring that staff are familiar with and adhere to any SOPs affecting their project or program functions.

5. GUIDELINES AND PROCEDURES

5.1 General

A primary goal of DEM is to ensure that environmental decisions are supported by data of the type and quality needed and expected for their intended use. Data review is the process by which data are examined and evaluated to varying levels of detail and specificity to ensure that only sound data that are of known and documented quality and meet project quality objectives are used in making environmental regulatory decisions. Although a certain level of verification and validation occur during field sampling and analytical procedures in the laboratory prior to data/report submittal to DEM staff, there is an internal need to review submitted data/reports which will ultimately be used to make environmental regulatory decisions.

The review of environmental data occurs in two phases. The first phase consists of 2 steps in reviewing and determining the validity of the analytical data (data verification and validation). The second phase consists of interpreting the data to determine its applicability for an intended use (usability assessment). Generally, the data verification and validation procedures are outlined in the project's QAPP or Quality Assurance (QA) documentation. Details regarding data verification and validation procedures can be found in EPA's *Guidance on Environmental Data Verification and Data Validation* (EPA 2002). Data verification and validation can be conducted using a checklist or other systematic approach (see Appendix A checklist adapted from EPA's *Requirements for Quality Assurance Project Plans, EPA QA/R-5).* (EPA 2001).

When considering the use of secondary data, the metadata associated with the secondary data should be evaluated for consistency with the Data Quality Objectives and quality criteria of the current intended use similarly to the steps outlined below.

5.2 Data Verification

Data verification is the process of evaluating the completeness, correctness, and consistency of a laboratory data package or final data/project report, against specified requirements usually outlined in project/program QAPPs. This completeness check is performed first to determine whether the required information (the complete data package) is available for further review. The process verifies the information for consistency with project/program specifications, including but not limited to:

- Completeness of the data package as prescribed in the QAPP or other QA documentation;
- Inclusion of sample collection records including field logs;
- Sample collection methods, location(s) and list of analytes are reported in accordance with QAPP or other QA documentation requirements, or documentation of deviations;
- Integrity of samples as determined by complete and proper sample chain-of-custody documentation;
- Adherence to appropriate holding times, preservation, transport or handling protocols;
- Proper sample preparation and documentation such as instrument logs, bench notes, calculation worksheets;

- Sample analysis documentation such as methods and instruments utilized;
- Proper and sufficient documentation of quality control measures and criteria including calibration standards, method blanks, duplicate and replicate samples, spiked samples and blanks, precision, accuracy and data qualifier codes;
- Documentation of Detection Limits and Quantification (reporting) Levels including methods of calculation;
- Documentation of all generated data

5.3 **Data Validation**

The primary focus of data validation is the accuracy and integrity of individual data values so that the numbers can be trusted. Data validation is an analyte- and sample-specific process that extends the evaluation of data beyond method, procedural or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set. The intensity of the data validation effort can vary depending on the needs of the project, program, and/or use of the data.

Data validation should:

- Establish that required sampling methods were used and that any deviations were noted;
- Ensure that the sampling procedures and field measurements met performance criteria and that any deviations were documented;
- Establish that required analytical methods were used and that any deviations were noted.
- Verify attainment of required QC measures and criteria, and that deviations were documented.
- Review data for the level of precision, accuracy, representativeness, comparability and completeness;
- Determine that the laboratory data qualifiers are defined and applied as specified in methods, procedures, or the QAPP;
- Verify attainment of required DLs and QLs;
- Identify any deviations from procedures and methods that may require corrective actions or limit the use of the data collected.

5.4 Data Usability Assessment

Data Usability Assessments determine the adequacy of the verified and validated data as related to the data quality objectives (DQO) outlined in the QAPP or for the intended use of the data. Many aspects of a project affect data quality, therefore, all types of data and associated information (e.g., sampling design, sampling technique, analytical methodologies) are evaluated to determine if the data appears to be appropriate and sufficient to support decision-making based upon the original project needs.

A Data Usability Assessment has an analytical and a field component. An Analytical Data Usability Assessment is used to evaluate whether analytical data points are scientifically valid and defensible, and of a sufficient level of precision, accuracy, and sensitivity to support the DQOs. The Field Data Usability Assessment evaluates whether the sampling procedure (e.g., sampling method, sample preservation and hold times) ensures that the sample that is collected and delivered to the laboratory is representative of the sampling point.

Verification and validation processes may result in identifying data that do not meet predetermined QC measures or criteria (e.g., flagging quantitative data that must be considered qualitative only) or in the ultimate rejection of data from its intended use. The Data Usability Assessment considers whether all aspects of the final data meet project/program quality objectives as they relate to the decision to be made, and evaluates whether verified and validated data are suitable for making that decision. Usability of verified and validated data for environmental regulatory decisions is project/program specific and details of the usability criteria may be outlined in the project/program QAPP. Appendix B of this SOP contains the Office of Water Resource's data use rules for water quality assessments.

6. REFERENCES

U.S. EPA, 2001. *EPA Requirements for Quality Assurance Project Plans,* (EPA QA/R-5) EPA/240/B-01/003, March 2001, Office of Environmental Information. (http://www.epa.gov/quality/qs-docs/r5-final.pdf)

U.S. EPA, 2002. *Guidance on Environmental Data Verification and Data Validation*, (EPA QA/G-8), EPA/240/R-02/004, November 2002, Office of Environmental Information. (http://www.epa.gov/quality/qs-docs/g8-final.pdf)

Appendix A

Checklist for Review of Environmental Data and Data Reports

This checklist is based on the elements in *EPA Requirements for QA Project Plans* (QA/R-5) (EPA, 2001). This checklist can be used to review a final data report developed in accordance with a QAPP or other QA documentation.

PROJECT TITLE: _____

Date Submitted for Review: _____ **Date of Review:** _____

Preparer: _____ **Organization:** _____

Reviewer: _____ **Organization:** _____

☐ Accepted as is	☐ Accepted, if minor issues addressed	☐ Major revision needed

Reviewer Signature _____

Note: A = Acceptable U = Unacceptable NI = Not Included NA = Not Applicable

Element	A	U	NI	NA	Page #/ Section #	Comments
A1. Title and Approval Sheet						
Contains project title						
Indicates revision number, if applicable						
Indicates Organization's name						
Dated signature of organization's project manager						
Dated signature of organization's QA manager						
Other signatures as needed						
A.2. Table of Contents						
Lists QA Project Plan information sections						
Document Control Information indicated						
A.3. Distribution List						
Includes all individuals who are to receive a copy of the QA Project Plan and identifies their organization						

Element	A	U	NI	NA	Page #/ Section #	Comments
A.4. Project/Task Organization						
Identifies key individuals involved in all major aspects of the project, including contractors						
Discusses their responsibilities						
Project QA Manager position indicates independence from unit generating data						
Identifies individual responsible for maintaining the official, approved QA Project Plan						
Organizational chart shows lines of authority and reporting responsibilities						
A.5. Problem Definition/Background						
States decision(s) to be made, actions to be taken, or outcomes expected from the information to be obtained						
Clearly explains the reason (site background or historical context) for initiating this project						
Identifies regulatory information, applicable criteria, action limits, etc., necessary to the project						
A.6. Project/Task Description						
Summarizes work to be performed, for example, measurement to be made, data files to be obtained, etc., that support the project's goals						
Provides work schedule indicating critical project points, e.g., start and completion dates for activities such as sampling, analysis, data or file reviews, and assessments						
Details geographical locations studied/sampled, including maps where possible						
A.7. Quality Objectives and Criteria						
Identifies performance/ measurement criteria for all information collected and acceptance criteria for information obtained from previous studies, including project action limits and lab detection limits and range of anticipated concentrations of each parameter of interest						
Discusses precision						

Element	A	U	NI	NA	Page #/ Section #	Comments
Addresses bias						
Discusses representativeness						
Identifies the need for completeness						
Describes the need for comparability						
Discusses desired and achieved method sensitivity						
A.8. Special Training/Certifications						
Identifies any project personnel specialized training or certifications						
Discusses how and if this training was provided						
Indicates personnel responsible for assuring these are satisfied						
Identifies where this information is documented						
A.9. Documentation and Records						
Identifies report format and summarizes all data report package information						
Lists all other project documents, records, and electronic files that will be produced						
Identifies where project information is kept and for how long						
Discusses back up plans for records stored electronically						
States how individuals identified in A3 will receive the most current copy of the approved QAPP, identifying the individual responsible for this						
B.1. Sampling Process Design (Experimental Design)						
Describes and justifies design strategy, indicating size of the area, volume, or time period to be represented by a sample						
Details the type and total number of sample types/matrix or test runs/trials expected and needed						
Indicates where samples should be taken, how sites will be identified/located						
Discusses what to do if sampling sites become inaccessible						
Identifies project activity schedules such as each sampling event, times samples should be sent to the lab, etc.						

Element	A	U	NI	NA	Page #/ Section #	Comments
Specifies what information is critical and what is for informational purposes only						
Identifies sources of variability and how this variability should be reconciled with project information						
B.2. Sampling Methods						
Identifies all sampling SOPs by number, date, and regulatory citation, indicating sampling options or modifications to be taken						
Indicates how each sample/matrix type should be collected						
If *in situ* monitoring, indicates how instruments should be deployed and operated to avoid contamination and ensure maintenance of proper data						
If continuous monitoring, indicates averaging time and how instruments should store and maintain raw data, or data averages						
Indicates how samples are to be homogenized, composited, split, or filtered, if needed						
Indicates what sample containers and sample volumes should be used						
Identifies whether samples should be preserved and indicates methods that should be followed						
Indicates whether sampling equipment and samplers should be cleaned and/or decontaminated, identifying how this should be done and by-products disposed of						
Identifies any equipment and support facilities needed						
Addresses actions to be taken when problems occur, identifying individual(s) responsible for corrective action and how this should be documented						
B.3. Sample Handling and Custody						
States maximum holding times allowed from sample collection to extraction and/or analysis for each sample type and, for *in situ* or continuous monitoring, the maximum time before retrieval of information						

Element	A	U	NI	NA	Page #/ Section #	Comments
Identifies how samples or information should be physically handled, transported, and then received and held in the laboratory or office (including temperature upon receipt)						
Indicates how sample or information handling and custody information should be documented, such as in field notebooks and forms, identifying individual responsible						
Discusses system for identifying samples, for example, numbering system, sample tags and labels, and attaches forms to the plan						
Identifies chain-of-custody procedures and includes form to track custody						
B.4. Analytical Methods						
Identifies all analytical SOPs (field, lab and/or office) that should be followed by number, data, and regulatory citation, indicating options or modifications to be taken, such as sub-sampling and extraction procedures						
Identifies all analytical SOPs (field, laboratory and /or office) that should be followed by number, date, and regulatory citation, indicating options or modifications to be taken, such as sub-sampling and extraction procedures						
Identifies equipment or instrumentation needed						
Specifies any specific method performance criteria						
Identifies procedures to follow when failures occur, identifying individual responsible for corrective action and appropriate documentation						
Identifies sample disposal procedures						
Specifies laboratory turnaround times needed						
Provides method validation information and SOPs for nonstandard methods						

Element	A	U	NI	NA	Page #/ Section #	Comments
B.5. Quality Control						
For each type of sampling, analysis, or measurement technique, identifies QC activities which should be used, for example, blanks, spikes, duplicates, etc., and at what frequency						
Details what should be done when control limits are exceeded, and how effectiveness of control actions will be determined and documented						
Identifies procedures and formulas for calculating applicable QC statistics, for example, for precision, bias, outliers and missing data						
B.6. Instrument/Equipment Testing, Inspection, and Maintenance						
Identifies field and laboratory equipment needing periodic maintenance, and the schedule for this						
Identifies testing criteria						
Notes availability and location of spare parts						
Indicates procedures in place for inspecting equipment before usage						
Identifies individual(s) responsible for testing, inspection and maintenance						
Indicates how deficiencies found should be resolved, re-inspections performed, and effectiveness of corrective action determined and documented						
B.7. Instrument/Equipment Calibration and Frequency						
Identifies equipment, tools, and instruments that should be calibrated and the frequency for this calibration						
Describes how calibrations should be performed and documented, indicating test criteria and standards or certified equipment						
Identifies how deficiencies should be resolved and documented						

Element	A	U	NI	NA	Page #/ Section #	Comments
B.8. Inspection/Acceptance for Supplies and Consumables						
Identifies critical supplies and consumables for field and laboratory, noting supply source, acceptance criteria, and procedures for tracking, storing and retrieving these materials						
Identifies the individual(s) responsible for this						
B.9. Non-direct Measurements						
Identifies data sources, for example, computer databases or literature files, or models that should be accessed and used						
Describes the intended use of this information and the rationale for their selection, i.e., its relevance to project						
Indicates the acceptance criteria for these data sources and/or models						
Identifies key resources/support facilities needed						
Describes how limits to validity and operating conditions should be determined, for example, internal checks of the program and Beta testing						
B.10. Data Management						
Describes data management scheme from field to final use and storage						
Discusses standard record-keeping and tracking practices, and the document control system or cites other written documentation such as SOPs						
Identifies data handling equipment/procedures that should be used to process, compile, analyze, and transmit data reliably and accurately						
Identifies individual(s) responsible for this						
Describes the process for data archival and retrieval						
Describes procedures to demonstrate acceptability of hardware and software configurations						
Attaches checklists and forms that should be used						

Element	A	U	NI	NA	Page #/ Section #	Comments
C.1. Assessments and Response Actions						
Lists the number, frequency, and type of assessment activities that should be conducted, with the approximate dates						
Identifies individual(s) responsible for conducting assessments, indicating their authority to issue stop work orders, and any other possible participants in the assessment process						
Describes how and to whom assessment information should be reported						
Identifies how corrective actions should be addressed and by whom, and how they should e verified and documented						
C.2. Reports to Management						
Identifies what project QA status reports are needed and how frequently						
Identifies who should write these reports and who should receive this information						
D.1. Data Review, Verification, and Validation						
Describes criteria that should be used for accepting, rejecting, or qualifying project data						
D.2. Verification and Validation Methods						
Describes process for data verification and validation, providing SOPs and indicating what data validation software should be used, if any						
Identifies who is responsible for verifying and validating different components of the project data/information, for example, chain-of-custody forms, receipt logs, calibration information, etc.						
Identifies issue resolution process, and methods and individual responsible for conveying these results to data users						
Attaches checklists, forms, and calculations						

D.3. Reconciliation with User Requirements						
Describes procedures to evaluate the uncertainty of the validated data						
Describes how limitations on data use should be reported to the data users						

Appendix B

Final Decisions on Use of Low Level Ambient Data for Water Quality Assessments

January 24, 2007

Definitions

- Ambient data result/value – analytical results as determined by the laboratory with data qualifiers (ie, additional associated information that must be taken into account during any interpretation of the result).
- Reported value – final data results/values after consideration of DLs and QLs as described below. Reported values are to be used for assessments, TMDLs and other analyses by OWR.
- DL/MDL – detection limit/method detection limit – the lowest concentration of a substance that can be measured with 99% confidence that the substance is present in the sample, i.e., greater than zero. The MDL is determined through analyses of at least seven replicate samples containing the target analyte(s) at a concentration near the estimated detection capabilities of the method. To calculate the MDL value, the standard deviation of the replicate measurements is multiplied by critical values from the Student t-statistic table for the 99 percent confidence level (1-tailed) with n-1 degrees of freedom. For example, in the case of 7 replicates, the critical value for the 99% confidence level with 6 degrees of freedom (n-1), is 3.143.
- QL – quantitation level – the lowest concentration of a substance that can be reliably measured and reported with some degree of confidence. (EPA's current working definition - The smallest detectable concentration of an analyte greater than the detection limit where the required accuracy (precision & bias) is achieved for the intended purpose.) No standard methodology for QL determination exists but most current approaches follow a calibration procedure similar to, or even based upon, the MDL determination.

Environmental Data Review for Water Quality Assessments:

1. QAPPs will describe: the analytical method to be used for each parameter; the MDL for each parameter (preferably generated through a minimum of 7 replicate samples as noted above), including results of the MDL calibration determination; the QL for each parameter, including how the QL was determined (Because a standardized methodology for determination of the QL does not exist, a complete description of the approach followed should be submitted.)

2. QAPPs should ensure that adequately sensitive analytical techniques are utilized to meet a project's data quality objectives. The analytical method implemented and MDLs and QLs which must be achieved will be driven by the criteria for each parameter analyzed. In other words, OWR staff should ensure that every attempt is made to choose and utilize the analytical method and the lowest detection limit needed to evaluate results relative to criteria. In addition, the lab should achieve quantitation levels as low as possible and as low as necessary to evaluate results relative to criteria. The MDLs and QLs should be routinely achievable by HEALTH certified laboratories to assure the reliability of the measurements and be cost effective for the OWR project.

3. Due to the low hardness of many RI freshwaters, metals criteria may be extremely low in some waterbodies. To account for this issue and implement consistency in metals data review, QLs of at least the following values should be achieved for the listed metals of concern:

Metal	Required QL
a. Dissolved Cd	1.0 ug/l
b. Dissolved Pb	1.0 ug/l
c. Dissolved Cu	1.0 ug/l
d. Dissolved Zn	2.5 ug/l

4. Ambient data resulting in a value below detection limit (i.e. <DL), will be reported as zero. This guideline is in accordance with the determination of the MDL/DL as defined above, where the variance associated with results observed at these levels is such that the concentration cannot be distinguished as different from zero.

5. Ambient data resulting in values which are equal to or greater than the DL but less than the QL, constitute uncertain values. Such data will be deemed invalid and excluded from analyses (e.g. assessments) because the measured concentrations do not meet the required accuracy for the intended purpose(s)/data quality objectives.

6. All ambient data results/values will be submitted to OWR (along with the DL and QL). OWR staff will be responsible for determining the reported values including the validity of the data as described above. OWR staff will maintain both the ambient data value and the reported value within RISWIMS.

7. The aquatic life criteria were developed by reliable EPA laboratories and will be used to evaluate all valid ambient data results even if the criteria is less than DL or less than QL for a given parameter.

Appendix C

Checklist for Review of Environmental Data & Data Reports

Project Title: Date Submitted for Review: Date of Review:

Preparer: Organization:
Reviewer: Organization:

☐ Accepted as is ☐ Accepted with minor revisions ☐ Major revision required

Please respond to each question. Indicate if any question is not applicable to this set of environmental data being reviewed.

Checklist for Review of Data Verification Issues in Environmental Data & Data Reports				
	Data Verification Issues			
No.	Question	Comment	Yes	No
1	Was all the information/data included in data package?			
1a	If no, identify any missing data.			
2	Were sample collection records/chain of custody /sample loss included in data package?			
2a	If no, identify any missing data.			
3	Were all samples collected and analyzed?			
3a	If no, identify any missing samples.			
4	Were holding times and preservation of samples and transportation and handling protocols met?			
4a	If no, identify any nonconformance.			
5	Is all analytical documentation included in the data package?			
5a	If no, identify any missing documentation.			
6	Were the correct analyses performed and were the correct reporting limits (quantitation and detection) reported?			
6a	If no, identify any nonconformance.			
7	Is QC information provided (i.e. duplicates, spikes, blanks, surrogates) with acceptance criteria?			
7a	If no, identify any nonconformance.			
8	Can the decisions be made for the project DQOs based on this environmental data report?			
8a	If no, have the field and/or lab personnel been contacted to obtain any missing information or data.			
9	Has a data usability report/narrative been completed? (i.e., can you complete/close this project?)			
9a	If no, should any missing data be collected in order to complete the report?			

Checklist for Review of Data Validation Issues in Environmental Data & Data Reports

	Data Validation Issues			
No.	Question	Comment	Yes	No
1	Were required sampling methods used?			
1a	If no, note deviations from sampling methods used.			
2	Were there any deviations noted in the sampling methods used?			
2a	If yes, note deviations from the sampling methods.			
3	Did the sampling procedures and field measurements meet performance criteria?			
3a	If no, document any deviations from the performance criteria.			
4	Were the required analytical methods used on the samples?			
4a	If no, note deviations from the analytical methods.			
5	Were attainment of required QC measures and criteria verified?			
5a	If no, document any deviations from the required QC measures and criteria.			
6	Did the data review indicate the level of precision, accuracy, representativeness, comparability and completeness were met?			
6a	If no, note deviations found in the review.			
7	Were the laboratory data qualifiers defined and applied as specified in methods, procedures, or in the QAPP?			
7a	If no, explain why they were not defined and applied as specified in methods, procedures, or in the QAPP			
8	Was attainment of the required detection limits and quantification limits verified?			
8a	If no, indicate problems found in the review of the data.			
9	Were there any deviations from procedures and methods that may require corrective actions or limit the use of the data collected?			
9a	If yes, indicate corrective actions conditions that limit the use of the data collected.			

Summary Guidance for Reviewing Environmental Monitoring Data

Standard Operating Procedure # - BEP-WR-1

Originator:

Connie Carey _____ Connie Carey _____ Date: 7/27/07
Print Name Signature

APPROVALS:

Quality Team Chair:

Tom Getz _____ _____ Date: 7/27/07
Print Name Signature

Assistant Director of Water Resources

Alicia Good _____ _____ Date: 8/15/07
Print Name Signature

Assistant Director of Air, Waste and Compliance

Terry Gray _____ _____ Date: 8/1/07
Print Name Signature

Associate Director of Natural Resources

Larry Mouradjian _____ _____ Date: 8/6/07
Print Name Signature

DISTRIBUTION:

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(x) Quality Management Team ..... By: [illegible] Date: 8/20/07
(X) DOA MIS Liaison .....By: mcc Date: 8-20-07

APPENDIX E

Rhode Island Department of Health Quality Assurance Plan

Quality Assurance Project Plan for
Rhode Island Ambient River Monitoring Program

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Lab analysts are trained in protocols associated with the laboratory analysis.

Wernquest, Ruth
Supervising Registered Environmental Lab Scientist
RO State Public Health Laboratory

The RIDOH and contract lab SOPs meet the Data Quality Objectives (DQOs) stated in the QAPP as communicated by the Project Manager.

Nicole Duffy
QA Officer
RI State Public Health Laboratory

Certified that the information provided is accurate.

Rajendra Kothavade (Ph.D.)
Chief Environmental Science Center
Division of State Laboratories
Rhode Island Department of Health

1.0 Introduction

The Environmental Testing Laboratories (ETL) are laboratories located within the Rhode Island State Health Laboratories at 50 Orms Street, Providence, Rhode Island, 02904 whose functions include analysis of drinking water, wastewater and other non-potable water. The Rhode Island State Health Laboratories is a Division of the Rhode Island Department of Health. The Environmental Sciences Section is comprised of four labs – Water and Dairy/Shellfish Microbiology, Air Pollution, Organic Chemistry, and Inorganic Chemistry. The quality assurance policies and procedures specified in this document apply to the water testing programs conducted in the following laboratories: Water Microbiology, Organic Chemistry (water) and Inorganic Chemistry (water).

The RI State Health Laboratories is the Principal State Laboratory under the State Primary Drinking Water Regulations and is certified by EPA Region I for all drinking water tests performed for compliance purposes. These laboratory analyses support the functions of the RI Department of Health's Center for Drinking Water Quality and the RI Department of Environmental Management's Division of Water Resources. The laboratories listed above also test private well drinking water on a fee-for-service basis. In order to ensure that water testing results are accurate, precise, representative and legally defensible, a comprehensive Quality Management System (Quality System) must be in place.

The Quality Management System describes the overall direction of the laboratory as decided by the top management in accordance with its vision and mission. Its goal is to document and improve the performance of the laboratory. The documents making up the Quality Management include, but are not limited to, the Environmental Quality Assurance Plan (a description of the organization's quality policies and procedures), the Standard Operating Procedures, or SOPs, (a description of the activities needed to implement the policies and the detailed work instructions specific to each of the tests within the labs), and the supporting documents, such as forms. All documents included in the Quality Management System help ensure uniformity in processes, training and auditing actions.

Changes to this document require approval by the Quality Assurance Officer, Section Chief and Laboratory Director. Changes to SOPs require approval by the Lab Supervisor, Quality Assurance Officer and the Section Chief.

2.0 Mission

The mission of the Environmental Testing Laboratories is to support the RI Department of Health Center for Drinking Water Quality and the RI Department of Environmental Management Division of Water Resources by providing accurate and prompt water testing capabilities. This enables ongoing monitoring and prompt investigation of problems identified in the Rhode Island public and private water supply.

3.0 Quality Policy

It is the policy of ETL to provide the highest quality service available to our customers. To accomplish this, a quality management system has been established. This quality management system has two interrelated aspects: the needs and interests of the laboratory and the needs and interests of its customers.

The laboratory must maintain quality through the utilization of the staff and material resources available. The laboratory customers must be confident in the ability of the laboratory to deliver high quality services. To promote confidence, the laboratory must provide prompt, accurate, and thorough responses to all requests. This is accomplished through training of staff and review of laboratory processes.

An integral part of the Quality Management System is quality assurance, the confidence that testing is accurate, precise and appropriate for the intended purpose. The responsibility for quality assurance resides with every laboratory staff member. Quality assurance and

improvement is an on-going endeavor that requires the commitment of all staff involved. By creating a work environment that fosters communication, initiative, personal achievement and teamwork, the goal of providing the highest quality services can be achieved.

Objectives

1. Maintain Laboratory Certification- Assure that the laboratory is operated in a manner that is consistent with the best scientific principles and practices. Assure that all analyses are technically correct and that all analysts are properly trained. Assure that analytical data generated by the laboratory are technically accurate, scientifically meaningful and legally defensible.

2. Improve quality of laboratory services through customer feedback: the Rhode Island State Health Laboratories utilizes a customer satisfaction survey annually to assess the needs of the customer and define improvements necessary by the laboratory.

3. Bring new technology to the Rhode Island State Health Laboratories.

4.0 General Requirements

4.1 Impartiality

The laboratory is committed to impartiality of its activities. To ensure this, all employees must attest to reading the Ethics and Integrity Policy annually, as well as take part in ethics training. Risks to impartiality shall be identified and evaluated on an on-going basis. In those cases where risks are identified, actions will be taken to eliminate or minimize those risks.

4.2 Confidentiality

The State Health Laboratories ensure the protection of its customers' confidential information and proprietary rights. Only authorized individuals may access laboratory records and related information. Employees are required to keep all information obtained in their official capacities confidential. All documents and records dealing with samples and/or sensitive information are considered confidential. The laboratory shall ensure the protection of confidential information including sample submissions, results and associated information in accordance with the RI DOH policies described in the Employee Handbook, as well as PRO-FTL Security.

5.0 Structural Requirements

5.1

The Rhode Island State Health Laboratories is a Division of the Rhode Island Department of Health and is therefore a legal entity that is legally responsible for its laboratory activities.

5.2

The Rhode Island State Legislature appropriates the annual budget for state agencies. As part of the agency budget, the RI Department of Health requests funds for the RI State Health Laboratories based on planning needs. The following members of RI Department of Health management have a role in planning, requesting and operating the State Health Laboratories budget:

- Director, Department of Health – appoints the director of Health Laboratories and submits the budget request for RI Department of Health.

- The Director of Health Laboratories is responsible for planning, administering and directing the activities of the state's public health laboratories.

5.3

The quality assurance policies and procedures specified in this document apply to the water testing programs conducted in the following laboratories: Water Microbiology, Organic Chemistry (water) and Inorganic Chemistry (water).

5.4

Laboratory activities shall conform to this document, as well as any additional requirements set forth by the EPA, our state Laboratory Certification program, and our customers. Quality assurance criteria and testing methods are based on EPA's Manual for the Certification of Laboratories Analyzing Drinking Water.

5.5

(a)
The Rhode Island State Health Laboratories is a Division of the Rhode Island Department of Health. The organizational structure of the State Health Laboratories is depicted in these 2 organizational charts:

State Health Laboratories Organizational Chart, Doc ID#2056
Environmental Sciences Organizational Chart, Doc ID#2239

Water Microbiology: performs microbial analysis of waters, including detection and enumeration of total and fecal coliforms. In addition, this laboratory performs Dairy and Shellfish analysis. Refer to QA Manual for FDA Programs, Doc ID# 10052.

Organic Chemistry: performs water analyses for pesticides, herbicides, volatiles, semi-volatiles and other organic chemicals and toxins by EPA methods. In addition, this laboratory is involved in select food testing activities. Refer to Food Testing Laboratories Quality Policy Manual, Doc ID# 2474.

Inorganic Chemistry: performs water analyses for environmental contaminants by EPA and Standard Methods. In addition, this laboratory is involved in select food testing activities. Refer to Food Testing Laboratories Quality Policy Manual, Doc ID# 2474.

(b)
The following list describes the structure and function of staff:

- Chief of Environmental Science – Reports to the Director of the RI State Health Laboratories and is responsible for the operation of all labs within the Environmental Science Section. The Chief also assumes the role of Quality Assurance Officer in his/her absence. In conjunction with the QAO and Laboratory Supervisors, the Chief is responsible for ensuring compliance with EPA laboratory certification requirements. The Chief also performs a review at least 10% of completed data packs.

- Quality Assurance Officer (QAO) – The Quality Assurance Officer, with assistance from the Chief of the section, has the responsibility and authority for ensuring that the quality management system is implemented and followed at all times. The QAO has direct access to the highest level of management at which decisions are made on laboratory policy or resources and reports to the Section Chief. The QAO submits quarterly reports to the laboratory director. This report contains detailed information on QA activities during the previous three months, including:
    - Status and summary of external and internal audits
    - Status and results of external proficiency testing

- QA problems in the laboratory (if applicable)
- Discussion of corrective action program issues
- New QA program initiatives.

This individual also maintains the quality assurance document management system, writes and updates the Quality Assurance Plan, chairs quality assurance meetings, performs or assigns individuals to perform internal audits, reviews the quality management system meeting outcomes and works with external accrediting agencies. The QAO also performs a review at least 10% of completed data packs.

- Supervising Environmental Laboratory Scientist – Reports to the Section Chief and is the technical leader responsible for all technical aspects of the Lab including quality control, evaluation and implementation of methods used to perform testing, identification and isolation of problems related to analytical methods, training, safety compliance, proficiency testing and the assignment and review of the work of subordinates. In the absence of the Chief, responsibility and authority rests with the Lab Supervisor in conjunction with the Quality Assurance Officer.

- Principal Environmental Laboratory Scientist – Reports to the Lab Supervisor and is responsible for performing laboratory analyses, coordinating assignments and reviewing work of subordinates. In the absence of the Lab Supervisor the Principle will report to the Section Chief.

- Senior Environmental Laboratory Scientist – Reports to the Lab Supervisor and is responsible for performing laboratory analyses and reviewing work of subordinates.

- Environmental Laboratory Scientist – Reports to the Lab Supervisor and is responsible for performing laboratory analyses in the Environmental Testing Laboratory.

(c)
The Quality Documents within the Quality Management System serve to delineate, formalize and standardize quality assurance policies and laboratory practices such that the objectives of the Quality Management System are met.

5.6

ETL personnel have the authority and resources to prevent nonconformities related to analytical procedures, reporting and operations and to be proactive in the identification of deviations from the management system, or of areas requiring correction and/or improvement. Information regarding deviations, corrections and improvements are documented in Qualtrax workflows.

5.7

Management shall ensure that appropriate communication processes are followed within the laboratory. Information generally travels from the Director of Laboratories to the Chief of the section then is shared with the Quality Assurance Officer, Supervisor and staff.

The Management staff shall communicate to all staff the effectiveness of the Quality Management System by:

- issuing memoranda to all affected staff when new developments arise within the Environmental Testing Laboratories, the State Health Laboratories, and the Rhode Island Department of Health
- making the results of client surveys, positive feedback, customer complaints and other correspondence from customers available to all ETL staff
- recording and maintaining corrective actions, preventive actions and audit findings to allow staff to view the process and results of management investigations

- using the Qualtrax system to create and modify quality documents, which allows for the automatic (e-mail) notification of the changes made to laboratory policies and procedures

6.0 Resource Requirements

6.1 General

ETL has the personnel, facilities, equipment, systems and support services necessary to implement the quality management system.

6.2 Personnel

6.2.1
All ETL personnel are employed by, or under contract to, the Rhode Island Department of Health and are located at the Rhode Island State Health Laboratories. Management and supervisors will ensure that all staff members are properly trained, supervised, and competent in their duties and adhere to the standards of the quality management system.

6.2.2
To ensure the quality of services provided, laboratory personnel must:

- Satisfy the requirements of job specifications including education, training, experience and skills
- Successfully complete a required training program
- Meet continuing education requirements
- Participate in competency assessments and proficiency testing

Competency requirements for laboratory functions are outlined in PRO-FTL/ETL Training and Employee Development. All staff will participate in an employee training program. The purpose of training is to provide each trainee with the sufficient background, knowledge and skills to perform routine tasks with minimum supervision. Analysts will not be permitted to perform actual sample testing, participate in validation studies, peer review data or report test results until properly and satisfactorily trained, including the successful completion of their competency assessment by the Lab Supervisor.

6.2.3
Once successfully trained, the competency of staff members will be maintained through participation in continuing education programs, competency assessments and proficiency tests. Remedial training will be initiated and directed by management based on one or more observed/documented deficiencies.

The training needs of all employees will be assessed by the Lab Supervisor through the review of proficiency study results and quality control samples. ETL personnel are responsible for identifying and submitting training and education needs to the Chief of the section for budget consideration. Whenever resources permit, continuing education and external training opportunities will be offered to staff to supplement in-house training.

6.2.4
The RI Department of Health Personnel Office maintains the current job descriptions for all classes of FTL employees. Job descriptions can also be referenced online at Job Descriptions. Each description contains the specific education

requirements, job duties and responsibilities of the position. Supervisors are responsible for assigning specific duties to analysts, which may be communicated verbally or as a written document.

6.2.5
(a) Competency is established through the successful completion of the training program and is continuously evaluated with the use of proficiency testing as well as procedure-specific performance criteria.

(b) Procedures and records for personnel selection are maintained by the State of RI Human Resources Department, as well as the Director of Laboratories.

(c) ETL management will develop relevant and comprehensive training programs to meet the goals and objectives of the laboratory. Unit Supervisors will take into consideration laboratory efficiency, compliance with standards and the needs of customers when developing the training program for his/her respective Unit. The RI Department of Health, State of Rhode Island and Chiefs are responsible for the managerial training of Unit Supervisors.

See PRO-FTL/ETL Training and Employee Development for more information.

(d) All ETL personnel are employed by, or under contract to, the RI Department of Health. All ETL employees, contract and support personnel will be assigned an immediate supervisor.

(e) All ETL personnel must be authorized to perform laboratory activities. This authorization may be documented by an Authorization Memo, or similar document (such as a method-specific sign-off sheet). Authorizations may include, but are not limited to:

- the development, modification, verification and validation of methods,
- the analysis, review and reporting of results,
- the operation of method-specific equipment

(f) Unit Supervisors are responsible for establishing a Training File for each employee that includes, but is not limited to:

  - Training records
  - Proficiency test results
  - Competency assessments, including the date competence is confirmed
  - Continuing education records
  - Records of court testimony
  - Required readings (if applicable)
  - Academic and professional qualifications

Each staff member is responsible for keeping his/her Training File current. The training records and successful completion of the required assessments authorize the employee to perform his/her current job.

6.2.6
Refer to 6.2.5 (e).

6.3 Facilities and Environmental Conditions

6.3.1
ETL management will monitor the environmental conditions of the laboratory to ensure that they are suitable for the types of measurements, equipment and testing being performed. The integrity of the quality management system will be maintained through the proper performance and operation of safety, heating/cooling, plumbing and electrical systems.

6.3.2 and 6.3.3
Any testing or laboratory activities that require additional environmental controls to the above will be addressed in the procedures and/or work instructions specific to each Unit or function. If environmental conditions could affect the validity of results, or the successful operation of equipment, those conditions shall be recorded.

All ETL staff members have the responsibility to recognize environmental conditions that may jeopardize the results of testing or the integrity of samples, and immediately notify the appropriate Unit Supervisor. The Unit Supervisor will temporarily halt testing if necessary and notify the Chief if the problem cannot be resolved. The Chief has the authority to suspend operations and initiate an investigation. Refer to Section 7.10 for nonconforming testing policies.

The Lab Supervisor is responsible for enforcing housekeeping and general cleanliness within their respective labs. The Lab Supervisor is also responsible for ensuring that laboratory safety protocols established in the RI State Health Laboratories Safety Manual, Doc ID# 1893, are followed. Janitorial duties and trash removal are provided by the Rhode Island Department of Administration.

6.3.4
(a)
Access to and use of the operational areas of the laboratory is strictly controlled. Refer to PRO-FTL Security. Access to ETL work spaces and use of the equipment required for testing is controlled by the Section Chief and Lab Supervisor.

(b and c)
ETL work space has been designed to account for the type of testing performed and the separation/isolation of any testing procedures that are not compatible. All staff members will be trained in the appropriate procedures related to their job duties to prevent cross contamination.

6.3.5
Not applicable – all laboratory activities take place in our permanent facility.

6.4 Equipment

6.4.1 and 6.4.2
All equipment and instrumentation used in the testing of samples will be included in the quality system. If equipment is used that is outside the control of ETL, management will ensure that the same requirements that ETL places on the use of its own equipment are in place for the borrowed or loaned equipment.

In order to ensure accurate test results, equipment and instruments used in sample testing must be adequate for the procedure used and in good working order. Equipment and instruments will be used according to the manufacturer's directions (intended use). Whenever the actual use is outside of the manufacturer's intended use, validation will be required prior to use for testing.

The Lab Supervisor, Quality Assurance Officer, Section Chief have the responsibility and authority to direct the retesting of samples tested by questionable instrumentation or equipment to ensure the integrity of results.

6.4.3 and 6.4.4
Equipment and software that is used in analytical procedures will be evaluated prior to initial use, after maintenance and periodically thereafter to ensure continued acceptable performance. The frequency and extent of the evaluation and/or calibration have been established in the specific procedures. Whenever any piece of equipment that affects quality leaves the direct control of ETL for any reason (e.g. repair, maintenance, modification), the equipment will be shown to perform correctly prior to its return to service. Acceptability of results from standards and/or controls will be documented in maintenance logs/records.

The Lab Supervisor is responsible for preparing a list of instruments and equipment that require calibration in his/her own laboratory. The Lab Supervisor is also responsible for developing preventive maintenance and calibration schedules and ensuring that they are followed.

Written procedures will include equipment type, detailed instructions for calibrating or performing maintenance, acceptance criteria and the actions to be taken when results are unsatisfactory. The calibration interval will be determined based on manufacturer's guidelines or state/federal regulations.

Current operating and maintenance manuals will be readily accessible for instruments/equipment that can affect quality. Instruments and equipment may only be used by properly trained and authorized individuals.

The accuracy and proper functioning of measuring equipment will be maintained by individuals trained in the proper handling, preservation and storage of the equipment. For further information, see method-specific SOPs.

The staff will be trained in the proper handling, transport, storage and use of reference standards and reference materials. Training will also address measures to protect the integrity of the materials and to prevent contamination and deterioration.

6.4.5
Instruments and equipment used for analysis shall be able to provide the appropriate accuracy to ensure valid results.

6.4.6 and 6.4.7
ETL has established procedures for the calibration of equipment and instruments that have a significant impact on the accuracy/validity of test results. Equipment will be calibrated before being placed into service, after any shut down and following any non-routine service or maintenance. The methods used for calibration will be described in the procedures.

General equipment that is not directly used for making measurements and cannot significantly affect the quality of a test or result (e.g. stirrers, hot plates, non-volumetric glassware) do not require calibration and will be maintained through visual examination and/or performance checks. Volumetric equipment such as pipettes will be calibrated/verified according to established procedures. Performance checks and calibration methods will be described in the procedures.

See PRO-FTL/ETL Calibration and Maintenance for ETL's calibration and maintenance program.

6.4.8

All laboratory balances, thermometers and mass standards will be labeled to indicate the status of calibration. The information on the label will include at a minimum the date of the last calibration.

All other instrumentation (such as GCs, GCMSs, ICPs, etc.) does not receive such labeling at this time as these instruments are calibrated as necessary by their primary operators.

6.4.9
Any instrument or piece of equipment that has failed calibration, gives suspect results, is damaged, defective or has been mishandled will be taken out of service immediately. It shall be isolated to prevent its use or clearly labeled or marked as being out of service until it has been repaired and shown by calibration or test to perform correctly.

6.4.10
Quality control performance checks to test that instruments/equipment are functioning properly will be described in the procedures. When appropriate, control charts will be used to indicate trends to ensure that a process is in control.

6.4.11
If calibrations give rise to any correction factors, all copies will be updated, and the update will be recorded on the appropriate maintenance log/records.

6.4.12
Inspection, measuring and test equipment that have calibration settings that can be adjusted by staff will be safeguarded against unintentional changes using at least one of the following methods:

- positive and negative controls or alternate controls will be run with samples
- dedicated personnel assigned to operate specific equipment
- when constructing a new calibration curve in a method, always saving the method under a new name and incorporating the calibration date into the name

6.4.13
All equipment/instrumentation and software that impacts the quality of testing and/or results will be uniquely identified and recorded on that laboratory's equipment list.

The Lab Supervisor, or designee, will maintain records of all testing equipment and software that can affect quality. The records will include at a minimum:

- equipment name
- manufacturer's name, model and unique identifier
- records of compliance with specifications
- location
- reference to location of manufacturer's instructions and/or user's manuals
- calibration records
- maintenance schedules and records
- documentation of modifications/repairs/malfunctions

Instrument/equipment records will be maintained according to the DOH Records Retention Schedule, Doc ID# 7610.

Calibration and maintenance records shall be maintained in close proximity to the equipment or in a location readily accessible to all personnel who may need to reference such records.

6.5 Metrological Traceability

6.5.1
Metrological traceability of measurement results will be maintained and documented.

External calibration laboratories may be used for the calibration of equipment such as balances, thermometers, pipettes and mass standards. When ETL uses external calibration services, traceability of measurement shall be assured by using calibration services provided by vendors that can demonstrate competence, measurement capability and traceability. Every effort will be made to utilize ISO 17025 compliant vendors, when needed or required, to calibrate equipment.

6.5.2 and 6.5.3
Whenever possible, reference materials will be traceable to SI units of measurement. When traceability is not relevant to SI units, then reference materials will establish traceability by one of the following:

- the use of certified reference materials from an approved supplier
- the use of specified methods, published standards and/or consensus standards
- participation in inter laboratory comparisons

The quality of standards and reagents will be suitable for the procedures used. Standard solutions will be purchased or prepared from chemicals/materials of known purity or composition.

Traceability for standards and reagents prepared in-house
All laboratory preparations must be documented in a Standard Preparation Logbook. At a minimum, the following information must be recorded:

- Manufacturer's lot number (or laboratory identifier)
- Concentration of the purchased solution
- Concentration of the prepared solution
- Unique laboratory identifier associated with the prepared solution
- Date of Preparation
- Expiration Date
- Preparer's initials

6.6 Externally Provided Products and Services

6.6.1
ETL may subcontract analyses for which it is EPA-certified under certain circumstances (such as extended instrument downtime). ETL may also facilitate the delivery of samples to another laboratory on behalf of the customer for those analyses which ETL does not perform (ex. radiochemistry).

If a subcontractor were to be utilized to perform analyses under ETL's scope of certification, ETL will provide documentation, when appropriate, that a subcontractor will be utilized. The customer will be given the opportunity to refuse use of the subcontractor and request the cancellation of services and return of the sample.
ETL is responsible for the proper handling and shipment of samples to subcontract laboratories when appropriate.

The reports issued by the analyzing laboratory can be sent directly to the customer or sent to ETL for distribution to the client. This will be in accordance to the agreement set up prior to testing. Results from testing performed by the subcontract laboratory will be communicated to the Center for Drinking Water Quality.

6.6.2 and 6.6.3
The Lab Supervisor shall maintain any records relating to the use of subcontractors. See PRO-FTL Subcontracting for more information.

7.0 Process Requirements

7.1 Review of Requests, Tenders and Contracts

7.1.1 and 7.1.2
For compliance monitoring under the Safe Drinking Water Act and the Clean Water Act, the laboratories will select methods specifically approved by the U.S. EPA for this purpose. The laboratories will select methods for non-regulatory testing based on customer requests, their intended use and whether they meet the needs of the customer.

ETL personnel will evaluate requests for service prior to testing to ensure that the laboratory has the capability and resources available to meet the needs of the customer. If ETL is unable to fulfill a need/service, or if it becomes necessary to perform different and/or additional services than those requested, the customer will be notified prior to testing.

7.1.3
In those instances when the customer requires a statement of conformity, the decision rule will be clearly defined. However, to date, this has not been requested.

7.1.4
The range of services and test methods provided by ETL has been determined in conjunction with the Rhode Island Department of Health's Office of Drinking Water Quality. All methods employed have been approved for drinking water analysis by the U.S. EPA (National Primary Drinking Water Regulations).

Whenever possible, ETL will attempt to resolve sample receiving issues at the time of submission. Refer to Sample Acceptance and Logging Samples into Element and other unit-specific work instructions for procedures related to sample receiving. Any discrepancies between the services requested and/or the samples submitted will be resolved prior to testing.

7.1.5
The customer will be notified of any deviations from the analysis request(s). A Record of Communication form (maintained in the appropriate batch data) or other record of communication (such as a note in the LIMS or a report narrative) will be used to document notifications.

7.1.6

If the analysis requested needs to be amended after work has commenced, the customer and all affected ETL personnel will be notified as soon as possible.

7.1.7
ETL values and encourages communication and cooperation with its customers. Customers may contact or request to meet with the Director of Laboratories, the Chief of the section, the Quality Assurance Officer, Lab Supervisor and/or staff to discuss testing, future needs and performance issues. Regular meetings are held with the water testing laboratory supervisors, laboratory management and the Office of Drinking Water Quality.

7.1.8
A written test request, typically in the form of a Submission Form, is required when accepting samples for routine or special testing. Documentation shall also be required for changes to requests or deviations from standard methods requested by the customer. The Lab Supervisor or designee will approve or deny changes to testing methods prior to testing. ETL will retain all records related to customer requests.

7.2 Selection, Verification and Validation of Methods

7.2.1 Selection and Verification of Methods

7.2.1.1
ETL has documented procedures that define methods of analysis, calibration of equipment, use of reference materials, quality control measures and other processes related to the handling and testing of samples. These methods are located in the procedure folders in Qualtrax specific to each laboratory.

7.2.1.2
All methods will be approved, kept current through periodic review and made readily available to personnel. In addition, user manuals for laboratory equipment and/or instructions on use and handling of that equipment will be readily available to all appropriate staff.

See Section 8.3 for more information.

7.2.1.3
When published methods are used, the laboratory shall ensure that the most current version of the method is used, when applicable. If changes are made to the published method, ETL test methods will be reviewed and revised.

7.2.1.4
If the method(s) of testing are not indicated by the customer, samples will be processed based on any conversations with the customer, using appropriate methods.

7.2.1.5
Verification of Reference Methods
ETL uses analytical methods approved by EPA for use in Safe Drinking Water Act (40CFR Part 141), Clean Water Act (40CFR Part 136) and beach water quality monitoring.

EPA methods describe the laboratory's Initial Demonstration of Capability (IDC) testing that must be successfully completed before the analysis of samples for compliance purposes. IDCs demonstrate that the laboratory can meet specific precision, accuracy and sensitivity criteria and that the procedure is free from contamination. Refer to specific EPA methods for more information.

Minimum Detection Limit (MDL) studies are also required before implementing quantitative methods. The MDL is defined as the lowest concentration of an analyte that can be detected and reported with 99% confidence that the

concentration is greater than zero. MDL determinations are performed according to Definition and Procedure for the Determination of the MDL Rev2 12-13-2016.

7.2.1.6
Qualified ETL personnel shall be provided the equipment and resources necessary to develop and validate methods in-house. Personnel involved in test method validation shall keep the Lab Supervisor and management informed of their progress. New methods or procedures will not be implemented without the review and approval of the Unit Supervisor.

7.2.1.7
Any deviation from a standard method that changes the overall procedure shall require prior approval from the Lab Supervisor, or designee. Deviations will be fully documented (refer to Deviation from Procedure Request, Doc ID#2506). Deviations will only be approved if they are documented and technically justified.

7.2.2 Validation of Methods

7.2.2.1
All technical procedures used by the ETL shall be validated through objective methods to confirm that the requirements for a specific method meet the intended use of the method.

Validation of New Procedures
All technical procedures used by the ETL will be fully validated prior to use on sample testing and will not be implemented without the review and approval of the Lab Supervisor, Quality Assurance Officer, and Section Chief. The extent of validation will be as extensive as is necessary to confirm that the methods are acceptable for their intended use. Validation records shall include, but are not limited to, the results obtained, procedures used and a statement as to whether the method is acceptable for the intended use.

Methods shall be selected from sources such as Standard Methods, EPA methods, equipment manufacturers and technical organizations, as appropriate. Methods may also be developed and validated in-house.

7.2.2.2
Any changes to currently validated methods will be fully validated so as to demonstrate that the method is still fit for intended use.

7.2.2.3
Validation studies will be performed using known samples. If the new method parallels or supersedes an existing one, the two methods will be compared using split samples. Samples will be selected that represent the reportable and references of the test method and manufacturer specifications for the test.

Results of validation studies are considered acceptable or unacceptable. Acceptable results are defined as expected results. Unacceptable results are defined as unexpected results and require an explanation and/or additional validation testing. Once a method has been approved for use, the Lab Supervisor, or designee, will have staff review it in preparation for training. In validating test methods, the following will be assessed as appropriate:

- accuracy
- precision
- reportable range
- reference ranges/intervals (Normal values)
- calibration and control procedures

- analytic sensitivity
- analytic specificity
- limitations

Validated methods shall be relevant to the customer's needs and consistent with specified requirements, when applicable.

7.2.2.4
Records shall be maintained for all validation studies. These records will include the validation procedure, specification of the requirements, performance characteristics and results. The approval of the associated SOP signifies the method's authorization, allowing for its use in the laboratory.

7.3 Sampling

7.3.1 and 7.3.2
Laboratory personnel do not conduct field sampling. All environmental samples submitted by state agencies or offices are collected by field personnel assigned to these programs. These state agencies are responsible for the preparation of sampling manuals, training of field personnel and the oversight of quality assurance activities in the field. The Center for Drinking Water Quality conducts sampling activities according to RI DOH Sample Collection and Preservation Manual for Drinking Water, which describes sampling procedures for each analytical method along with the required sample containers and preservatives.

Private well owners also conduct field sampling according to the instructions provided to them by the Private Well Program, Center for Drinking Water Quality. For real estate transactions, private well sampling shall be conducted by individuals meeting the requirements outlined in Rules and Regulations Pertaining to Private Drinking Water Systems.

Laboratory sampling plans including the selection of material to be tested are included in all EPA-approved methods. See laboratory SOPs for details. For non-regulatory testing, Lab Supervisors are responsible for establishing sampling plans and incorporating these procedures into SOPs. These plans will be based on a reasonable understanding of detection limits, sensitivity of testing, sample size and availability.

7.3.3
Whenever the customer requests a departure from the standard sampling plan (ie., a deviation from a particular SOP in regards to the volumes/weights used for testing), the Lab Supervisor must be notified in writing prior to testing to approve or reject any deviation. A record detailing any deviation and approval/rejection will be included with the sample request and result.

ETL shall follow standard operating procedures when testing samples. Worksheets specific to the sample testing being performed shall be used to record all relevant data. If any deviations from the standard operating procedure are needed, the deviation must be approved by the Lab Supervisor (refer to Deviation from Procedure Request, Doc ID# 2506).

Information pertaining to sampling is recorded and maintained in the batch files.

7.4 Handling of Test or Calibration Items

7.4.1
ETL has established procedures for the receipt, handling, protection, storage, retention and disposal of specimens received for testing. Refer to Sample Acceptance and Logging Samples into Element, Doc ID# 1476, Samples – Release, Transfer, Destruction and Retention, Doc ID# 2520, and specific analysis procedures.

7.4.2
ETL utilizes a Laboratory Information Management System (Promium Element) to enter samples received for testing. Each sample to be tested is assigned a unique identification number that will allow tracking of the sample through the entire testing process, from submission until release of results. Refer to Sample Acceptance and Logging Samples into Element, Doc ID# 1476.

During testing, individual samples will be labeled for identification with the work order and item number. If the actual sample is not suitable for labeling, it will be tagged or placed in a secondary container that is sufficiently labeled. Sub-items that are sampled from a group of items or larger item shall be uniquely identified so that they can be identified back to the original item.

7.4.3
ETL has established procedures for reviewing requests for testing and receiving samples. Whenever possible, sample receiving discrepancies will be resolved at the time of submission. Requests for testing will be reviewed prior to testing to ensure suitability. All discussions between customers and the ETL related to sample identification, handling or testing will be documented in such a way as to be traceable to the sample. Examples include, but are not limited to, recording the conversation/email in a work order memo in Element or on a Record of Communication, Doc ID# 2809, to be filed with the data pack.

7.4.4
Special handling and storage requirements of test items are described in the analytical procedures specific to each Unit. Most water samples are stored under refrigeration. Temperatures of refrigerators are monitored at least daily on working days.

7.5 Technical Records

7.5.1
The laboratory shall retain all records that support the testing of samples received. There should be sufficient information to establish an audit trail for a defined period of time. See the DOH Records Retention Schedule, Doc ID# 7610 for details. The records shall include the identity of personnel responsible for the sampling, performance of each test and/or calibration and checking of results.

Observations, data and calculations shall be recorded for each sample on worksheets that are identifiable to the specific test and sample number at the time they are made.

Data that is stored electronically will be backed up according to the procedures described in PRO-FTL/ETL Electronic Records Backup.

7.5.2
Changes to hard copy data will be made by crossing out the original data with a single strike-through and placing the initials of the person making the change and the date of the change next to the correction. Changes to LIMS information

are traceable through audit trails. Manual integration of chromatographic peaks will follow the policy described in Appendix A.

7.6 Evaluation of Measurement Uncertainty

ETL does not formally estimate the uncertainty of its measurements at this time since it is not required for regulatory EPA-approved methods.

7.7 Ensuring the Validity of Results

7.7.1
In order to verify test results and to ensure that equipment and reagents are performing as expected, the ETL has established quality control procedures that are required by regulatory methods and are appropriate to the type and frequency of tests conducted. The Lab Supervisor is responsible for incorporating quality controls and acceptance criteria into the procedures for each test. Quality control procedures may include, but are not limited to:

- certified reference materials
- positive and negative controls
- replicate testing, or DUP samples
- spiked matrix samples
- internal standards
- second source standards
- retesting retained samples
- parallel testing

Data Verification

Data verification processes further ensure that only accurate data are reported to the customer. Data verification begins with the analyst following proper data reduction procedures (contained in method SOPs) and reviewing their own data.

Supervisory Data Verification

Following the analyst review, the supervisor, or designee, performs a thorough verification of the data and releases the data if satisfied that all data verification elements are met. These elements include:

- results for the correct samples are being reported
- there are no errors in final result calculations or in transcription of results
- samples were analyzed within holding times
- samples were analyzed within method-required calibration and QC acceptance criteria

If significant QC problems are identified during supervisory data review, specific corrective actions outlined in method SOPs must be taken. Depending upon the nature of the noncompliance, samples may require reanalysis. If corrective action cannot be performed, for example due to holding time or lack of sample volume, sample results are rejected and resampling is requested from the submitter.

Managerial Data Review

In addition to supervisory verification, the section chief and QAO perform periodic reviews of sample batch results and associated QC.

7.7.2
ETL utilizes regular participation in proficiency tests to ensure the continuing performance of staff, methods and quality management system. Successful analysis of all analytes for which the lab is certified in drinking water must occur annually. See PRO-FTL/ETL Proficiency Testing for more information

7.7.3
Results of quality control samples will be documented. The information obtained from quality control samples will be analyzed and used to identify trends, identify opportunities for improvement, isolate deficiencies in the quality system and initiate corrective action.

Quality control charts are used to demonstrate that the analytical process is in statistical control and trends or bias are not present. If trends are detected, they are corrected before an "out of control" situation occurs. The Promium Element LIMS allows users to view percent recovery control charts and trends for selected parameters and date ranges.

7.8 Reporting of Results

7.8.1 General
The final report of ETL analyses is the Certificate of Analysis. The laboratories shall make every effort to assure all information on the report is correct and interpretable. This final report will contain information for the customer to make the necessary interpretation of the result.

The results of all analyses performed by the ETL will be reported clearly, objectively, completely and accurately. All testing will be completed, reviewed and reported according to the policies and procedures of the laboratory. All supporting documentation will be retained in the appropriate Laboratory, in the LIMS or as a hard copy.

7.8.2 Information on Reports
7.8.2.1
All test reports will be labeled with a unique identifier for the sample tested. When necessary, the test report will be clearly identified as amended. Tests reports will include, but are not limited to:

- title (e.g. Certificate of Analysis)
- name and address of RI State Health Laboratories
- unique identification of sample
- page number identification
- name and address of customer
- identification of method used
- description of samples tested
- date work order collected
- date work order received
- date work order completed
- name or initials of submitter
- units of measure
- the initials of the person approving the results

References to standard operating procedures are generally not included on reports, except when necessary to the interpretation of results. Standard operating procedures are available to the customer upon request.

Sample dilutions: Samples that are run at a dilution are typically analyzed at no dilution first, then reanalyzed at a dilution for the analyte(s) with concentrations above the highest concentration of the calibration curve. In the rare instances that ONLY a dilution of a sample is analyzed (no straight run), the reporting limit in Element would be

adjusted accordingly and would appear on the final report. If necessary to aid in interpretation of data, a narrative may be attached to the report, or an email sent to the submitting program.

7.8.2.2
If data that can affect the validity of analytical results is provided by the customer for inclusion on the report (example, field tests), that data is included in the section of the report containing biographical information.

All results apply to samples as received, unless otherwise indicated.

7.8.3 Additional Information on Reports

When applicable, the following may also be included on test reports narratives:

- A statement explaining any nonconformities or deviations from standard test methods such as adverse laboratory environmental conditions that may have impacted the testing
- Any additional information which may be required by ETL, customers or specific methods

7.8.3.2
See Section 7.8.2.1.

7.8.4 Calibration Certificate Requirements
This section does not apply as ETL is not a calibration laboratory.

7.8.5 Reporting Sampling
If deviations from SOPs are made with regards to sampling and those deviations may impact the interpretation of results, those deviations would be listed in a report narrative.

7.8.6 Reporting Statements of Conformity
ETL does not make statements regarding conformity of results to specifications or standards.

7.8.7 Reporting Opinions and Interpretations
If opinions and interpretations are to be included on the test report, they shall be clearly identified as such. In the rare case that it may be appropriate to communicate an opinion or interpretation by direct dialogue with the customer such dialogue would be documented in the sample record. Opinions will only be given, and interpretations will only be made, by an individual authorized to do so.

7.8.8 Amendments to Reports
If an amendment to a test result is necessary, the amended report will be clearly marked as “AMENDED” and the new report shall be issued to the client. Corrections to biographical information do not necessitate report being designated as “AMENDED”.

7.9 Complaints

7.9.1
If an ETL staff member receives any communication (oral or written) about a potential problem from a customer, he/she shall document the complaint by initiating a CA workflow in Qualtrax (see Corrective Action Procedure for additional information).

7.9.2
The QA Officer will determine whether to archive the complaint or route it to the Chief, or designee, for assignment and further investigation and/or corrective action.

7.9.3 and 7.9.4
FTL will make every effort to investigate, validate and resolve customer complaints. Any documentation of correspondence with the customer regarding the complaint will be noted in the Corrective Action workflow instance and will be retained in the appropriate batch record or file.

7.9.5
When applicable, the laboratory will acknowledge receipt of the complaint and provide updates to the complainant on the progress of the investigation and outcome.

7.9.6 and 7.6.7
Outcomes communicated to the complainant must be approved by the Chief and QAO as a function of closing out the Corrective Action Workflow instance that was initiated to investigate the complaint. When the workflow is closed out in Qualtrax, the complaint handling process has ended.

7.10 Nonconforming Work

ETL has established procedures to recognize and respond to a nonconformance that may occur within the quality management system. The purpose of these procedures is to ensure that the authorities, management responsibilities and actions in response to a Nonconformance are well-defined. All ETL staff members have the responsibility and authority to identify and report nonconforming work or problems within the quality management system.

Analysts are responsible for monitoring equipment and instruments used during analytical testing, instrument calibration, quality control and operations. Analysts have the authority to make necessary adjustments as long as they are within the guidelines of the standard operating procedure. Any issues that cannot be resolved within the scope of the standard operating procedure must be brought to the attention of the Lab Supervisor, or designee. In addition, the Lab Supervisor shall be immediately notified of any issue that may have affected or compromised the integrity of the sample.

The Lab Supervisor, or designee, has the responsibility and authority to investigate, evaluate and remedy situations involving analytical procedures. The Lab Supervisor, or designee, has the authority to temporarily suspend analytical testing, processing or delivery of reports that may have been impacted by nonconformities or deficiencies. If a Lab Supervisor, or designee, is able to successfully resolve a situation through his/her investigation, he/she has the authority to authorize resumption of work.

In the event the Lab Supervisor, or designee, is unable to resolve a problem, decides that all operations or an individual procedure or process should be halted, has doubt that policies or procedures were followed and determines that results may have been affected, the Lab Supervisor will notify the Chief or QAO immediately.

Once notified of the problem, the Chief or QAO, will evaluate the significance of the problem and determine whether to halt the procedure/process and inform Lab Supervisor to initiate a corrective action workflow through Qualtrax (see Corrective Action Procedure, Doc ID# 1309). Only the Chief or QAO can authorize the resumption of the procedure/process. The Chief, QAO, and Lab Supervisor will make the decision about the acceptability of the nonconforming work and its impact on past, current and future work and the need to repeat testing.

When necessary, the Chief, QAO, or Lab Supervisor will be responsible for notifying customers of problems, delays or deviations from their requests.

Written procedures must be followed at all times; however it is realized that there may be instances when a deviation from the current policies or SOPs is necessary. Request to deviate from a laboratory procedure must be initiated by way of a Qualtrax Deviation from Procedure Request workflow (see Deviation from Procedure Request, Doc ID# 2506). Deviations shall only be permitted after the review and approval by the proper authority(ies); in most cases, the laboratory supervisor or Chief. Information captured includes:

- the requestor and date of request
- a reference to the applicable policy or SOP
- a description of and the purpose for the requested deviation
- the merits of deviating from the procedure
- the associated risk or impact of deviation
- the duration of the authorization
- the approver and date of approval

If the evaluation process indicates that the nonconforming work could recur or that there is doubt about the compliance of the laboratory staff with their policies and procedures, the corrective action procedure shall promptly be followed. The Chief, QAO, and Lab Supervisor will immediately be notified.

7.11 Control of Data and Information Management

7.11.1
All ETL staff have access to the ETL LIMS, Promium Element and the SOPs, housed in Qualtrax.

7.11.2
Computers and instruments will be maintained to ensure proper functioning. Commercial software will be considered sufficiently validated as long as it is used within its design limitations. Initial method validation will include an evaluation of software. Procedures to troubleshoot and verify the proper functioning of computers and software will be incorporated into the appropriate procedures by the Lab Supervisor, or designee.

Test results are released to the Office of Drinking Water Quality electronically via the Laboratory Information Management System.

Element was validated for proper functioning before implementation and undergoes section-wide testing before significant updates are installed.

7.11.3
User access and privileges within Element are assigned by the ETL Chief. Backups of all system data occur frequently according to PRO-FTL/ETL Electronic Records Backup. Any system failures are reported to the IT division. Records of potential failures may exist as emails or IT Division service tickets.

7.11.4
Element is managed and maintained on DOH servers.

7.11.5
Operation manuals for Element are located under the Help menu in the software, which can be accessed by all ETL personnel.

7.11.6
Manual calculations and data transfers shall be reviewed and verified prior to the issuance of reports by the Lab Supervisor, or designee.

8.0 Management system Requirements

8.1 Options

Not applicable – ETL is not ISO accredited.

8.2 Management System Documentation

8.2.1
ETL has established a quality management system to ensure that quality testing services are provided to its customers. The policies and procedures that have been established and documented conform to the requirements of EPA and all other applicable standards. All testing personnel and support staff have been provided with the Environmental Quality Assurance Plan, SOPs and training necessary to comply with the quality management system. Each staff member is responsible for reading, understanding and adhering to the established standards of quality.

8.2.2 and 8.2.3
All laboratory activities shall be undertaken competently, consistently and with impartiality. See also section 3.0 and 5.7.

8.2.4 and 8.2.5
Refer to Section 8.3

8.3 Control of Management System Documents

8.3.1
ETL quality documents are maintained or referenced in the Qualtrax electronic document control system. In the Qualtrax Browse tree, documents specific to ETL are located in the RI State Health Laboratories/Environmental Sciences folders. The folders are further divided into specific laboratories: Organic Chemistry, Water Chemistry and Water Microbiology. There is also a QA Manual and ENV Procedures folder. Documents pertaining to all the State Health Laboratories are also housed in Qualtrax in such folders as Health/Safety and Security and Lab Support Services. ETL defines quality system documents in the following manner:

- Quality Assurance Plan - communicates the organization's methods for implementing the quality system, training of personnel in the quality system requirements and methods of compliance, and the basis for auditing the quality system

- Quality Documents – refers to all the documents related to quality within the section. These include, but are not limited to, policies, procedures/work instructions and forms
- Procedures/Work Instructions – step by step operational procedures for ETL as a whole or for a specific operation or task
- Safety Manual – includes information related to laboratory safety and environmental compliance policies

Employees will adhere to all policies and procedures. Initiations of new policies and procedures or modifications to existing ones will be in accordance with established guidelines. It is the responsibility of management to ensure that all appropriate personnel are made aware of customer requirements and new or modified protocols as soon as possible. This is accomplished through dissemination and document attestations in Qualtrax.

There are some documents and reference materials that cannot be stored in Qualtrax and/or are not revised by the Health Laboratories (instrument manuals, reference methods, etc). These documents and materials will be referred to in Qualtrax as PROXY documents which may be scanned in to Qualtrax or stored elsewhere in a designated area. Refer to Document Control using Qualtrax, Doc ID# 1917, for procedures related to document control.

8.3.2
(a) Documents shall be reviewed and approved by authorized personnel prior to issue.

(b) Quality documents will be periodically reviewed for suitability and continuing compliance with applicable standards. This review is automatically initiated by Qualtrax according to the expiration date set in the document properties. When the document is due for review, an email is sent to the person designated as the document manager reminding them of the review. SOPs are reviewed annually, so the notification for SOPs in Qualtrax is set to 11 months after the last revision was published. Documents that require revision will be reviewed and approved by the same authority(s) that performed the original review unless the responsibility is otherwise delegated. An annual review that does not require revision of the SOP can be designated in Qualtrax as "Verified". The revision number remains the same and no changes have been made, however the review is captured in the document properties for that SOP.

(c) All amendments to quality documents will be made electronically. Only those Qualtrax users that have been identified as having editing privileges are given Edit Document permissions to a document. Those users will be able to "check out" that particular document and edit it. While a user has a document in Edit, the current (in other words, most recently approved) revision is viewable to all other users. This edited revision does not become published as current until all designated approvers have approved it. In the case of procedures, this is typically the Lab Supervisor, QA Officer and Chief of the section.

Once documents are released as published, Qualtrax alerts the appropriate staff members via automatic emails. The changes, deletions or additions made to the superseded document will be identified in the notification email as well as saved as part of each document's properties in Qualtrax. All analysts in a laboratory must attest to the fact that they have read, understood and agree to follow the SOPs of that laboratory. This is accomplished through what is referred to as an Attestation Test in Qualtrax.

(d) Current quality documents shall be available in paper copy and/or electronically at locations where laboratory operations are performed. Paper copies of current policies, procedures and work instructions have been defined as being uncontrolled. The footer of all documents contains the statement "Printouts of this document should be considered uncontrolled. To accomplish work, the published version of the document should be viewed online".

(e) All ETL's quality documents will be uniquely identified in Qualtrax by a number assigned by the system. Other identifying data include the title of the document, date of publication and/or revision identification, page numbers, the total number of pages or a mark to signify the end of the document, and the approving authority(ies). Refer to Document Control using Qualtrax, Doc ID# 1917, for procedures related to document identification.

(f) Invalid or obsolete documents will be superseded or expired; however, all released versions of a quality document will be retained in Qualtrax for future reference. Once a document is expired, it cannot be edited. Qualtrax prevents accidental use of expired documents by only showing the current revision when that document is selected in the Qualtrax browse tree. Only users with specific permissions (ie. QA officers and system administrators) can view expired documents.

8.4 Control of Records

8.4.1
ETL has established procedures for the control of quality records in accordance with the DOH Records Retention Schedule, Doc ID# 7610. Records will be maintained under strict control and security. Electronically stored information will be stored in such a manner as to prevent loss and unauthorized access.

All records will be retained electronically and/or hard copy. All records will be legible and identifiable to the sample identification number. All supporting documentation will be retained a minimum of two years on site at the Rhode Island State Health Laboratories. Records may then be sent to a secure and environmentally controlled storage facility that has been approved through the Rhode Island Department of Health and the Rhode Island Department of Administration until destruction.

8.4.2
All records shall be held secure and in confidence whether on site at the Rhode Island State Health Laboratories or an off-site storage facility approved through the Rhode Island Department of Health and the Rhode Island Department of Administration Division of Purchases.

Computer access will be available for laboratory personnel who require access to complete their assigned job. The ETL LIMS, Promium Element, will maintain an audit trail that will allow the identification of laboratory personnel that have entered and modified data. Electronic data may only be edited by authorized individuals. If results are modified after final reports have been distributed, a Corrective Action workflow shall be initiated.

Electronic records will be backed-up according to the procedures described in Electronic Records Backup, Doc ID# 2508.

8.5 Actions to Address Risks and Opportunities

8.5.1
ETL shall consider risks and opportunities associated with laboratory activities on an ongoing basis.

8.5.2
When risks or opportunities are identified, the laboratory shall take be action to address them. Actions will be evaluated for effectiveness.

8.5.3

Actions taken will be appropriate in scope and extent to the potential impact, if any, on the validity of laboratory results.

8.6 Improvement

8.6.1
ETL management and technical staff shall continually strive to improve the effectiveness of the quality management system. All ETL staff members are encouraged to take a proactive approach to the quality management system by making suggestions, expressing concerns and contributing new ideas.

ETL annually reviews all quality documents to ensure laboratory improvement and compliance to standards. Staff members attend continuing education and other training events as available. This helps to keep staff current on new technologies available for testing. Annual audits, corrective and preventive action procedures are additional measures taken by management to promote laboratory and staff development.

The laboratory shall continually improve the effectiveness of its quality management system through:

- Annual quality system (internal) audits
- Regular review of all quality documents and procedures
- 10% data pack review by Chief and QAO
- Use of the Preventive Action/Opportunity for Improvement Proposal workflow (refer to Preventive Action - Opportunity for Improvement Proposal Workflow, Doc ID# 2220).

Preventive action is a pro-active process to identify potential problems and opportunities for improvement within the Quality Management System. The Chief or QAO has the responsibility and authority to ensure that preventive actions are properly reviewed, approved, documented, implemented and evaluated for effectiveness. The Chief is also responsible for ensuring that all affected personnel are informed of any changes to policies or procedures that result from preventive actions.

Preventive Action - Opportunity for Improvement Proposal Workflow, Doc ID# 2220 describes the procedure for the digital documentation of a preventive action proposal submitted by an ETL staff member who has identified a potential source of a nonconformity or opportunity for improvement. The approving authority designated in the workflow will assess the risks of any potential problems associated with the recommended improvements to ensure that the actions are reasonable and target the potential problem.

8.6.2
Annually, the Rhode Island State Health Laboratories employs a customer satisfaction survey to seek feedback to improve the quality management system, testing and calibration activities and customer service. The surveys are designed to encourage both positive and negative comments, gauge the future needs of the customers and improve laboratory services. Topics may include, but are not limited to, turnaround time, quality of services, and customer training needs.

8.7 Corrective Action

8.7.1
Corrective Action is defined as an action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence (ISO 8402). ETL has established a corrective action procedure to identify and document nonconformances in the Quality Management System.

(a) FTL has established a corrective action procedure to identify and document departures from the quality management system. Using the Corrective Action workflow (see Corrective Action Procedure, Doc ID# 1309), any staff member may notify the Chief and QAO of a problem. A nonconformance report shall be initiated as a result of analyst observation, customer complaint, internal or external audit findings, proficiency testing or quality management system review. The Chief and QAO have the responsibility and authority to investigate all nonconformities requiring corrective action to determine the significance of the event and the effects on prior work products. The Chief and QAO also have the responsibility and authority to ensure that corrective action plans are fully reviewed and documented, appropriate personnel are informed and that the corrective actions effectively resolve the problem.

Sample Receiving
All instances of problems associated with sample collection, transport or receipt that are uncovered by analysts or receiving personnel must be documented. The laboratory may reject a sample based on a set of criteria described in Sample Acceptance and Logging Samples into Element. The individual rejecting the sample must document each instance of sample rejection.

Laboratory
All non-routine quality-related problems must be documented. Corrective actions for routine laboratory calibrations, instrument performance or method-specific quality control problems are described in the appropriate SOPs.

(b) When the potential exists for the recurrence of a nonconformity, a thorough investigation of the root cause(s) of nonconformity will be conducted by the designated Responsible Party. See PRO Corrective Action Procedure for explanation and specific instructions. The Responsible Party will recommend potential corrective actions based on the results of the root cause investigation. The QAO will assess the risks and magnitude of any potential problems associated with the recommended actions to ensure that the actions are reasonable and effectively target the root cause(s) of the problem.

(c) Once the recommended actions are approved the Lab Supervisor, or designee, is responsible for implementing and documenting all of the corrective action work phases. Once completed, the documents related to the corrective actions will be retained in Qualtrax.

(d) The effectiveness of corrective actions will be monitored through the use of controls and/or internal audits arranged by the QA Officer, or designee. Nonconformance reports and corrective actions will also be reviewed during the annual review of the quality management system as described in Section 8.9.

(e) Any risks or opportunities for improvement will be assessed during the correction action process.

(f) If investigation reveals a need to make changes in the management system, these changes will be implemented and documented.

8.7.2
Upon being notified of a possible corrective action, the QA Officer shall assign a Responsible Party to investigate the root cause and to implement and document corrective action(s). The QA Officer and ETL Chief will assess the risks and magnitude of any potential problems associated with the corrective actions to ensure that the actions are reasonable and effectively target the root cause(s) of the problem.

8.7.3

Documentation related to corrective actions will be retained indefinitely in Qualtrax as closed workflows.

8.8 Audits

8.8.1 and 8.8.2
The Quality Assurance Officer, or designee, is responsible for scheduling audits in accordance with the requirements of the ETL quality system and applicable EPA standards.

External Audits

The RI State Health Laboratories is the Principal State Laboratory and is certified by EPA Region 1 for all drinking water parameters performed for compliance monitoring purposes. EPA auditors perform an inspection of the Water Microbiology, Inorganic and Organic Chemistry laboratories every three years.

All deficiencies and recommendations noted during these triennial inspections must be addressed in a satisfactory manner to maintain current certification status. All deficiencies and subsequent actions taken shall be documented by way of the Corrective Action workflow in Qualtrax. Refer to Corrective Action Procedure, Doc ID# 1309.

Internal Audits

Internal audits shall address all aspects of management and testing to verify compliance with quality system components and to monitor the effectiveness of current laboratory policies and procedures. The QAO or designee schedules and performs annual internal audits of the laboratory quality systems to ensure that laboratories meet the requirements of the EPA and are following their SOPs and other quality procedures. Internal audits will take place no more than 15 months from the last internal audit for any particular laboratory. Custom-designed checklists, based on SOPs and EPA requirements, are used in order to make the auditing process complete and objective. Following a laboratory's audit, a report is compiled and forwarded to the appropriate laboratory supervisor and section chief.

The Chief, Quality Assurance Officer and Lab Supervisor are responsible for initiating and following through on any corrective actions that result from audit findings related to laboratory operations and/or validity of test results. The Chief of the section is responsible for notifying customers in writing if investigations reveal that samples or test results may have been affected.

Records of audit findings and related corrective actions shall be retained in the Qualtrax document control software.

The Quality Assurance Officer shall schedule follow-up audits when necessary to monitor the effectiveness of corrective actions. In addition, during the next internal audit any previous findings shall be reviewed and evaluated to assess whether the discrepancy or nonconformance has been sufficiently resolved.

See PRO-FTL/ETL Laboratory Audits for more information.

8.9 Management Reviews

At this time, management reviews are not performed in the ETL.

Bibliography

1. ISO 17025, General requirements for the competence of testing and calibration laboratories – reference number ISO/IEC 17025:2017.

2. Manual for the Certification of Laboratories Analyzing Drinking Water: Criteria and Procedures Quality Assurance, Fifth Ed. 2005.

3. 40 CFR §141 https://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&tpl=/ecfrbrowse/Title40/40cfr141_main_02.tpl.

4. Safe Drinking Water Act

5. Clean Water Act

6. Rules and Regulations Pertaining to Private Drinking Water Systems.

Appendix A: Manual Integration Policy

Background

Integration is a necessary step for peak identification and quantification of analyte concentration. Integration algorithm, which is part of the data analysis software package, locates the peaks in a signal in a chromatogram and also calculates their size (peak area). Integration parameters within Enviroquant may be adjusted to deal with some, but not all, chromatographic situations.

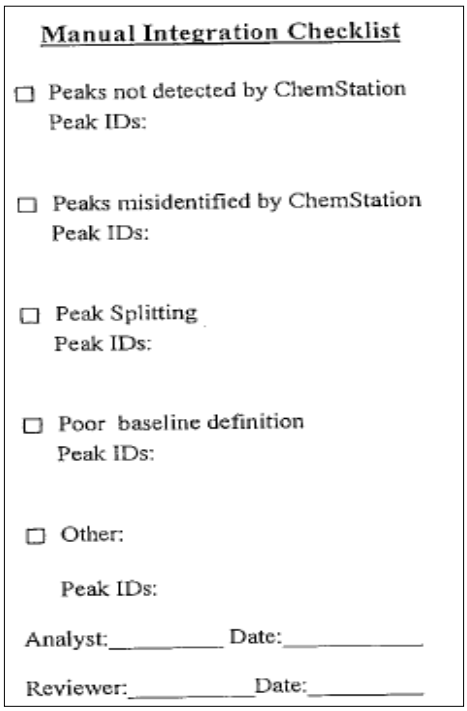
Manual integration occurs when the chromatographer must make the determination where the signal begins and where it ends because the integration algorithm failed to properly integrate a signal.

In the analysis of environmental samples, the data system integrator typically must deal with complicated chromatographic problems. The size of the peaks can vary tremendously within a single run, while the peaks of interest are often present in small concentrations. Interferences such as system noise, drift, and wander can affect the baseline from which the integrator measures peak area and height. Finally, it may not be possible to separate peaks completely with chromatographic process available.

Policy

The following guidelines must be followed in the Organics laboratory for all instances of manual integrations.

1. Optimize the integration parameters so that manual integration is not necessary or held to a minimum. As an example, the data system should be able to correctly integrate peaks at least in a calibration standard chromatogram at mid to high level of the calibration curve.
2. It is recognized that manual assignment of peak beginnings/ends and baseline construction (manual integration) is necessary in some instances to correct the results of automated assignments.
3. All instances of manual integrations must be documented by showing the how the peak was integrated by the data system ("before") and how it was integrated after the manual manipulation ("after"). This can be accomplished by printing before and after pictures from the QEDIT screen in the Enviroquant data analysis screen. Use manual integration stickers (shown, right) on 'before' picture. Check off the appropriate boxes on sticker to explain why the peak integration had to be changed.



Manual Integration Checklist

☐ Peaks not detected by ChemStation
Peak IDs:

☐ Peaks misidentified by ChemStation
Peak IDs:

☐ Peak Splitting
Peak IDs:

☐ Poor baseline definition
Peak IDs:

☐ Other:

Peak IDs:

Analyst:_____ Date:_____

Reviewer:_____Date:_____

APPENDIX F

Seasonal Employee Training Passport

Name

2

Welcome! Quick tour of important offices- Personnel, boat registration, sampling center, copy room, desk. (**<1 hour**)

DATE

Self-guided training

(Complete by end of the month)

3

Online Boating safety.

Self directed at your desk.

http://www.boat-

DATE

4

Online standards academy

http://water.epa.gov/learn/training/standardsacademy/index.cfm

DATE

QAPP

5

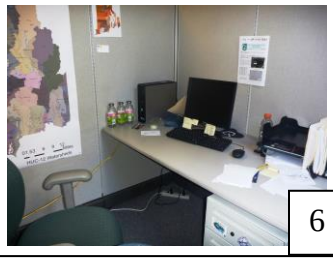
Please read QAPPs :

Biomonitoring:

ARM:

DATE

Formal guided training



6

Virtual Training: Basic Computer setup, email, printers, Common Folders, Google Earth files.

DATE

D·E·M

Agency Overview PowerPoint

DATE

7

(more) Formal guided training

(First week)

Orientation handbook

Review Orientation Handbook with Supervisor

(< **1 hour**)

DATE

QA/QC

Quality assurance/Quality Control Procedures and Quality Management Plan overview Departmental training required yearly (< **1 hour**)

DATE

Introduction to Field Safety Manual

Sampling center

DATE

Chemical Hygiene plan Training

Sampling center

DATE

Brief overview of YSI Pro Plus meter and DAILY calibration

Sampling center

DATE

Quick overview of NLA/ NRSA supplies, equipment, techniques, etc.

In sampling center

DATE

Field training ARM sampling

Gearing up in sampling center and heading to the field

DATE

Invasives identification

Powerpoint

DATE

Nutrients program overview

Powerpoint

DATE

In-Depth Training

Invasive Monitoring/ Practical Boating Training (**1 day**)

DATE

STOP AQUATIC HITCHHIKERS!

Prevent the transport of nuisance species. Clean all recreational equipment.

www.ProtectYourWaters.net

Take Online AIS Training:

http://www.100thmeridian.org/certificate.asp

DATE

(More) In-D

(To be determined)

YSI Pro Plus FULL

DATE

Nutrient Criteria specific training.

DATE

DELIVERABLES:

ARM QAPP signature page	
Boating safety training certificate	
Online standards academy (print out certificate)	
Field Safety Training questionnaire	
Emergency contact information sheets	
Chemical Hygiene training log signed	
RIDEM Quality System email/certificate	