NH Department of Environmental Services
Volunteer Lake Assessment Program
Quality Assurance Project Plan (QAPP)

Prepared by
Sara Steiner, VLAP Coordinator
NH Department of Environmental Services
29 Hazen Drive, PO Box 95
Concord, NH 03302-0095

June, 2014

Project Manager: _____
Signature / Date
David Neils, Director, Jody Connor Limnology Center NHDES

Project Coordinator: _____
Signature / Date
Sara Steiner, VLAP Coordinator, NHDES

Project QA Officer: _____
Signature / Date
Scott Ashley, NHDES

NHDES Quality Assurance Manager _____
Signature / Date
Vincent R. Perelli, NHDES

USEPA NE Project Officer: _____
Signature / Date
Nora Conlon
US EPA Region I
Note: This review is not required since this project receives only state funding and does not receive EPA funding, however, we are requesting EPA review

USEPA RFA Control Number: 14087

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICIES

A3 Distribution List and Project Personnel

A3.1 Distribution List

The approved QAPP, Sampling and Analysis Plans (Appendix F), and any amendments are distributed to people who implement, oversee, and review the progress of the VLAP (Table A3-1).

Table A3-1: Distribution List

QAPP Recipients	Title	Organization	Phone	Email
Sara Steiner	VLAP Coordinator	NHDES	603-271-2658	sara.steiner@des.nh.gov
VLAP Intern	Seasonal VLAP Intern	NHDES	Varies	
David Neils	Director, Jody Connor Limnology Center	NHDES	603-271-8865	david.neils@des.nh.gov
Scott Ashley	QA/QC Officer/Database Coordinator	NHDES	603-271-2968	scott.ashley@des.nh.gov
Vince Perelli	QA Manager	NHDES	603-271-8989	vincent.perelli@des.nh.gov
Nora Conlon	Quality Assurance Officer	US EPA-NE	617-918-8335	conlon.nora@epa.gov
Rachel Rainey	QA/QC Supervisor	NHDHHS	603-271-8501	rachel.rainey@dhhs.state.nh.gov
Melanie Titus	Data Management Specialist	NHDES	603-271-1152	melanie.titus@des.nh.gov
Bonnie Lewis	VLAP Satellite Laboratory Manager	CSC LSPA	603-526-3486	blewis@Colby-sawyer.edu
Aaron Johnson	VLAP Satellite Laboratory Manager	PSU CFE	603-535-3269	ajohns17@plymouth.edu
Volunteer	Volunteer Lake Monitors	Lake Assoc.		

A3.2 Project Personnel

Contact information and title of all VLAP personnel is maintained in the QAPP (Table A3-2).

Table A3-2: Project Personnel

QAPP Recipients	Title	Organization	Phone	Email
Sara Steiner	VLAP Coordinator	NHDES	603-271-2658	sara.steiner@des.nh.gov
VLAP Intern	Seasonal VLAP Intern	NHDES	Varies	
David Neils	Director, Jody Connor Limnology Center	NHDES	603-271-8865	david.neils@des.nh.gov
Scott Ashley	QA/QC Officer/Database Coordinator	NHDES	603-271-2968	scott.ashley@des.nh.gov
Vince Perelli	QA Manager	NHDES	603-271-8989	vincent.perelli@des.nh.gov
Nora Conlon	Quality Assurance Officer	US EPA-NE	617-918-8335	conlon.nora@epa.gov
Rachel Rainey	QA/QC Supervisor	NHDHHS	603-271-8501	rachel.rainey@dhhs.state.nh.gov
Melanie Titus	Data Management Specialist	NHDES	603-271-1152	melanie.titus@des.nh.gov
Bonnie Lewis	VLAP Satellite Laboratory Manager	CSC LSAP	603-526-3486	blewis@Colby-sawyer.edu
Aaron Johnson	VLAP Satellite Laboratory Manager	PSU CFE	603-535-3269	ajohns17@plymouth.edu
Volunteer	Volunteer Lake Monitors	Lake Assoc.		

A4 Project Organization

A4.1 Project Organization Description

The New Hampshire Department of Environmental Services (NHDES) Volunteer Lake Assessment Program (VLAP) requires the participation of a number of partners. The three major partners are the NHDES Biology Section, volunteer monitors located throughout the state, and the VLAP satellite laboratories. The VLAP Coordinator is responsible for QAPP development, program coordination, training and oversight of volunteer monitors, site visits, field audits, water quality sample analysis, data management, analysis and reporting, and supervision and training of VLAP interns. The seasonal VLAP Interns are responsible for training volunteer monitors, site visits, field audits, and water quality sample analysis. Other responsibilities of VLAP personnel include website maintenance, public education and outreach, investigating water quality violations and complaints at lakes and rivers, and watershed management technical assistance. The Director of the Jody Connor Limnology Center is responsible for oversight and management of the VLAP, Program Coordinator, Interns, VLAP data, and communications with US EPA.

Volunteer monitors are responsible for collecting water quality data at lakes, ponds, rivers and streams and transporting samples to VLAP laboratories for analysis. Volunteer monitors communicate water quality and watershed management issues to the VLAP Coordinator, lake associations and watershed residents.

The NHDES Jody Connor Limnology Center (JCLC) QA/QC Officer is responsible for data management, database development, organization and maintenance for the JCLC. The New Hampshire Department of Health and Human Services' (NH DHHS) Division of Public Health Services, Public Health Laboratories-Water Analysis Lab (or PHL WAL) QA/QC Supervisor is responsible data management, database organization and maintenance for PHL WAL. The Colby Sawyer College, Lake Sunapee Satellite Laboratory (CSC LSPA) Manager and Plymouth State University Center for the Environment (PSU CFE) Environmental Research Laboratory Manager are responsible for data management of their designated laboratories. The NHDES Watershed Management Bureau (WMB) Data Specialist is responsible for data management, database development, organization and maintenance for the NHDES Environmental Monitoring Database (EMD).

The VLAP Coordinator is the primary contact for all aspects of lake and tributary water quality monitoring and analysis, VLAP data management and reporting, and VLAP education and outreach. VLAP interns and volunteer monitors communicate all problems with sampling and sample analysis to the VLAP Coordinator. The VLAP Coordinator, interns, and Satellite Laboratory Managers communicate all sample analysis and data quality issues to the JCLC QA/QC Officer. The PHL-WAL QA Supervisor communicates all data quality issues to the VLAP Coordinator. The WMB Data Specialist communicates all data management and transfer issues between the JCLC, PHL-WAL and the WMB EMD. The VLAP Coordinator and JCLC QA/QC Officer are responsible for communicating all laboratory and data issues to the JCLC Director and the NHDES QA Manager.

A4.2 Organization Chart

An organization chart that includes all parties involved is included in Figure A4-1.

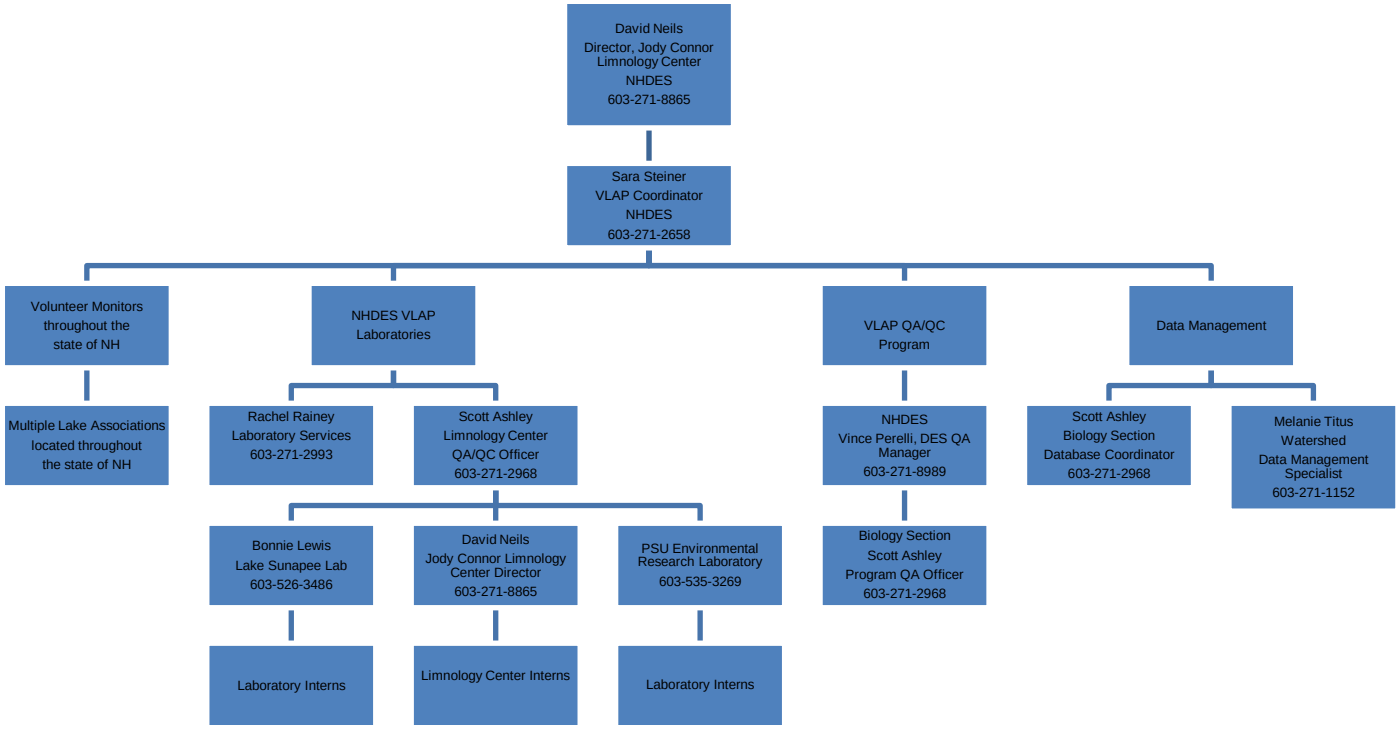

Figure A4-1: Organization Chart for the NHDES Volunteer Lake Assessment Program

A5 Problem (Program) Definition/Background

NHDES has been monitoring lake water quality since the early 1970's through the Lake Trophic Survey (LTS) Program. Through this program, staff biologists assess trophic states of great ponds, those larger than 10 acres in size, throughout the state once every ten to twenty years. Assessing lake trophic states allows NHDES to gather valuable chemical, physical and biological data that provide a comprehensive snapshot of lake health. It also allows NHDES to meet the public's need for information on one of the state's valuable natural resources. However, as population growth increases, so does watershed development which typically leads to an increase in the amount of pollutants entering our water ways, or cultural eutrophication. Increases in pollutant loads, particularly nutrient loading, can lead to a rapid decline in water quality having detrimental effects on aquatic life, aesthetic and recreational resources, and property values.

While the LTS Program provides adequate data to assess trophic states, the large data gaps do not provide NHDES with the ability to track water quality trends, identify pollutants and respond to water quality changes as they occur. The lack of regular water quality data collection to provide current lake health and management information prompted public response for an annual monitoring program. The New Hampshire Volunteer Lake Assessment Program (VLAP) was initiated in 1985 in response to an expressed desire of lake associations to be better informed of current water quality and be involved in lake protection and watershed management in the state. VLAP is a cooperative program between lake residents and the New Hampshire Department of Environmental Services (NHDES). VLAP collects annual lake water quality data in order to assess the chemical and biological characteristics of lakes and ponds to determine overall lake health. VLAP provides NHDES with the ability to assess water quality impairments as well as provide long term water quality trends for individual lakes and on a state-wide basis. VLAP also recognizes the importance in communicating the results of water quality data collection to the volunteer monitors, lake associations, public, local, state and federal governments, commissions, committees, and other organizations. Analyzing and reporting water quality data allows these groups to identify non-point and point sources of pollution and develop strategies to address pollutants to improve or maintain lake health.

A6 Project (Program) Task Description

A6.1 Project (Program) Purpose

The purpose of VLAP is to assess the chemical and biological characteristics of lakes and ponds throughout the state to determine overall health of the system and to make educated decisions regarding lake management (Appendix A). Environmental results are measured by making comparisons to established criteria, means and ranges of water quality for the state of New Hampshire. Data are reported to EPA, NHDES and the volunteer monitors. The data is used by the NHDES for assessment, education, and reporting purposes. The data are used by the volunteer monitors for educational purposes and for guiding local lake management activities.

Approximately 180 lakes and ponds participate in VLAP (Appendix A). The typical season for VLAP monitoring is June through August, after spring turn-over and before fall turn-over, when lakes are most productive. VLAP volunteers collect water quality data from the lake and tributaries entering it once per month. Typical water quality parameters measured include: pH, conductivity, alkalinity, transparency, chlorophyll-a, total phosphorus, turbidity, chloride, *E. coli*, dissolved oxygen, temperature, and phytoplankton. Not only do volunteer monitors collect water quality data, they are also trained to survey and monitor the surrounding watershed, conduct storm event sampling, and collect lake bathymetric data (Appendix C Field SOPs).

Regular sample collection from the lake and tributaries builds a strong set of baseline water quality data. By sampling the lake several times each year, over a period of years, long-term water quality trends can be discerned. Such monitoring results in the early detection of water quality changes. This allows NHDES to trace potential problems to their source before a severe negative impact can take place on the lake. Over time, baseline data are used to determine long-term trends in lake water quality. If a negative water quality trend or impairment in a lake is discerned through VLAP monitoring, then the lake and its watershed may be eligible for more intensive study such as a Total Maximum Daily Load (TMDL) or development of a watershed management plan to identify and quantify pollutant loads.

A6.2 Project (Program) Schedule/Sampling and Analysis Tasks

Sampling Tasks: Water quality samples are collected by the volunteers and/or biologists once per month during the sampling season (typically, June, July, or August) at each lake. Biologists conduct at least one site visit to each lake bi-ennially. Lake names A-M receive a biologist visit in year one and lake names N-Z receive a biologist visit in year two. During the years without a biologist visit, volunteers continue to sample monthly on their own. Sampling events occur at approximately the same time frame each month. For example, if a biologist visit is scheduled in mid-June, then the two remaining sampling events will occur in mid-July and mid-August. Water quality samples are typically collected seasonally from mid-May to mid-September. This encompasses the temperate growing season where biological activity is at its peak. Water quality is evaluated at the deep spot of the lake (maximum depth) and in the major tributaries flowing into the lake. This provides a general description of in-lake water quality as well as what is flowing into the lake. The water quality parameters sampled include: turbidity, conductivity, pH, total phosphorus, chloride (optional), chlorophyll-a, acid neutralizing capacity (ANC), dissolved oxygen, temperature, transparency, phytoplankton (optional), and *E. coli* (optional). Table A6-1 provides a general description of the analytes to be measured, when and where they are collected, and the laboratory responsible for analysis.

Table A6-1: Project Schedule, Sample and Analysis Tasks

Analyte	Description	Collection Dates	Sample Location	Analytical Laboratory
Total Phosphorus	Measure nutrient limiting algal growth.	Seasonal May – September	Deep Spot and Tributaries	PHL-WAL PSU CFE CSC/LSPA
Conductivity	Determine salt and mineral content.	Seasonal May – September	Deep Spot and Tributaries	DES JCLC PSU CFE CSC/LSPA
Turbidity	Determine amount of suspended matter.	Seasonal May – September	Deep Spot and Tributaries	DES JCLC PSU CFE CSC/LSPA
pH	Measure acidity.	Seasonal May – September	Deep Spot and Tributaries	DES JCLC PSU CFE CSC/LSPA
Chloride	Specify contribution to conductivity levels.	Seasonal May – September	Deep Spot and Tributaries	DES JCLC PSU CFE
ANC	Measure buffering capacity.	Seasonal May – September	Deep Spot Epilimnion	DES JCLC PSU CFE CSC/LSPA
Chlorophyll-a	Estimate algal growth.	Seasonal May – September	Deep Spot photic zone.	DES JCLC PSU CFE CSC/LSPA
Phytoplankton	Determine dominant algal genera.	Seasonal May – September	Deep Spot photic zone.	DES JCLC
Dissolved Oxygen	Quantify dissolved oxygen for aquatic life.	Seasonal May – September	Deep Spot	DES JCLC PSU CFE CSC/LSPA
Temperature	Determine stratification and thermal layers.	Seasonal May – September	Deep Spot	DES JCLC PSU CFE CSC/LSPA
E. coli	Assess and estimate bacteria/pathogen levels.	Seasonal May – September	Near-shore and tributaries	PHL-WAL PSU CFE CSC/LSPA

Analytical Tasks: The NHDHHS PHL WAL analyzes all total phosphorus and *E. coli* samples returned to the NHDES JCLC. The NHDES JCLC analyzes pH, ANC, turbidity, conductivity, chloride, chlorophyll-a, and phytoplankton samples. The CSC LSPA and the PSU CFE satellite laboratories analyze pH, ANC, turbidity, conductivity, chloride, chlorophyll-a, total phosphorus, and *E. coli*. Standard operating procedures (SOPs) for all analyses are included in Appendix D. Analyses for transparency, dissolved oxygen/temperature, and bathymetry are conducted in the field by biologists and volunteer monitors. SOPs for field analyses are included in Appendix C. Table A6-2 summarizes information relevant to analytical services.

Table A6-2: Analytical Services Table

Medium/ Matrix	Analytical Parameter	Analytical Method/SOP Reference	Analytical Laboratory
Surface Water (SW)	Total Phosphorus	EPA 365.2 Lachat QuikChem Method 10-115-01-1-F D-6	DHHS PHL WAL, Rachel Rainey, 603-271-8501 CSC LSPA, Bonnie Lewis, 603-526-3486 PSU CFE, Aaron Johnson 603-535-3269
SW	Conductivity	2510B Standard Methods 20th Ed. 1998 D-3	DES JCLC, Scott Ashley, 603-271-2968 CSC LSPA, Bonnie Lewis, 603-526-3486 PSU CFE, Aaron Johnson 603-535-3269
SW	Turbidity	2130B Standard Methods 20th Ed. 1998 D-4	DES JCLC, Scott Ashley, 603-271-2968 CSC LSPA, Bonnie Lewis, 603-526-3486 PSU CFE, Aaron Johnson 603-535-3269
SW	pH	2310B Standard Methods 20th Ed. 1998 D-1	DES JCLC, Scott Ashley, 603-271-2968 CSC LSPA, Bonnie Lewis, 603-526-3486 PSU CFE, Aaron Johnson 603-535-3269
SW	ANC	2320B Standard Methods 20th Ed. 1998 D-2	DES JCLC, Scott Ashley, 603-271-2968 CSC LSPA, Bonnie Lewis, 603-526-3486 PSU CFE, Aaron Johnson 603-535-3269
SW	Chlorophyll-a	EPA 446.0 10200H Standard Methods 20th Ed. 1998 D-5	DES JCLC, Scott Ashley, 603-271-2968 CSC LSPA, Bonnie Lewis, 603-526-3486 PSU CFE, Aaron Johnson 603-535-3269
SW	*E. coli*	9222B Standard Methods 20th Ed. 1998 Hach Method 10029 40 CFR 141 D-7	DHHS PHL WAL, Rachel Rainey, 603-271-8501 CSC LSPA, Bonnie Lewis, 603-526-3486 PSU CFE, Aaron Johnson 603-535-3269
SW	Chloride	Standard Methods for the Examination of Water and Wastewater, 21st Edition, Part D512C D-16	DES JCLC, Scott Ashley, 603-271-2968 PSU CFE, Aaron Johnson 603-535-3269
SW	Phytoplankton	10200 E-F Standard Methods 20th Ed. 1998 D-9	DES JCLC, Scott Ashley, 603-271-2968 CSC LSPA, Bonnie Lewis, 603-526-3486 PSU CFE, Aaron Johnson 603-535-3269
SW	Dissolved Oxygen/Temperature	NHDES JCLC Manual C-3	DES JCLC, Scott Ashley, 603-271-2968 CSC LSPA, Bonnie Lewis, 603-526-3486 PSU CFE, Aaron Johnson 603-535-3269
SW	Transparency	VLAP Field Manual C-2	DES JCLC, Scott Ashley, 603-271-2968 CSC LSPA, Bonnie Lewis, 603-526-3486 PSU CFE, Aaron Johnson 603-535-3269
SW	Bathymetry	VLAP Field Bathymetry Data Collection C-2	DES JCLC, Scott Ashley, 603-271-2968

A6.3 Project (Program) Schedule Timeline

The following tables outline the tasks that NHDES, the satellite laboratories, and the volunteer monitors will conduct through VLAP, which includes an anticipated timeline, (on an annual basis) for completion.

Table A6-3: Project Schedule Timeline (NHDES)

Task	Time (on an annual basis)
Initial QAPP preparation	January – May
QAPP updates	On an ongoing basis during the year
Annual VLAP Refresher Workshop	May
Intern Training	May, and on-going during the sampling season
Volunteer Training	Annual workshop, and once on a bi-ennial basis (May – August*)
Lake and tributary sampling	Sampling season (June - August*).
Sample Analysis	Sampling season (June - August*)
Monthly Data Reporting	Sampling season (June - August*)
Annual Report	Data interpretation and Reporting (October – March)
Satellite Laboratory Assessments	Winter
Provide a monthly program e-newsletter, *The Sampler*	Monthly
VLAP Blog	Weekly/monthly or as necessary
VLAP Training Video	Update as necessary when time allows.
Lake Association Meetings	As requested by the volunteers at any time during the year
Investigate water quality complaints	As requested by the volunteers at any time during the year
Provide technical/educational materials	As requested by the volunteers at any time during the year
Annual Self Audit	January

* Some volunteer monitors choose to extend the sampling season to April - October

Table A6-4: Project Schedule Timeline (VLAP Satellite Laboratories)

Task	Time (on an annual basis)
Intern Training	May, and on-going during the sampling season
Lake and tributary sampling	Sampling season (June - August*).
Sample Analysis	Sampling (June - August*)
Monthly Data Reporting (to volunteers and NHDES JCLC)	Sampling season (June - August*)
Satellite Laboratory Assessments	Winter

* Some volunteer monitors choose to extend the sampling season to April - October

Table A6-5: Project Schedule Timeline (Volunteer Monitors)

Task	Time (on an annual basis)
Annual Workshop	May
View Training Video	Annually or more frequently as needed.
Biennial Biologist Visit	Once every other year or more frequently as requested
Lake and tributary sampling	Monthly during the sampling season (June – August*) (Note: Volunteers are encouraged to collect samples at least once per month from June to July, but some associations choose to sample more or less frequently than this)
Sample transportation to approved laboratory within 24 hours	Sampling season (June - August*)
Financial support for sample analysis	Sampling season (June - August*)
Report water quality violations	As needed during the year
Distribute annual report and educational information	On-going during the year

* Some volunteer monitors choose to extend the sampling season to April - October

A7 Project (Program) Quality Objectives and Measurement Criteria

A7.1 Program Quality Objectives

Water quality samples are collected through VLAP to determine overall lake quality and track water quality trends to determine if conditions are improving, stable or declining. Quantitative and qualitative data for the parameters listed in Table A6-1 are necessary to determine overall water quality conditions for each lake that participates in the program. Project action limits for these parameters need not be established because this is not a regulatory program.

VLAP is a voluntary program; therefore NHDES does not require that the volunteer monitors conduct a specific number of sampling events per season. However, volunteers are encouraged to sample at least once each month over the course of the sampling season (June – August). To assess deep spot water quality, samples are collected from each thermal layer. To assess watershed effects on the lake, water quality samples are collected at the major inlets to the lake, and from the outlet. In addition, samples may be collected along tributaries located throughout the watershed where there is a suspected source of pollution (such as a failing septic system, construction site, roadway crossing, etc.). Data are collected according to the field sampling protocols outlined included in Appendix C-2.

The volunteer monitors are required to schedule a field audit with the NHDES Biologist (the VLAP Coordinator or the VLAP Intern) or Satellite Laboratory Manager once every other sampling season, or biennially. This biennial visit with the biologist provides an opportunity for the biologist to assess and document the volunteer monitors' ability to follow the standard operating procedures for field sample collection (refer to the annual "Sampling Procedures Assessment Audit" provided in Appendix B-3) and provides an annual refresher training for the volunteers. Trained volunteers that decide to sample in addition to the biennial biologist visit sample independently. During the biologist visit, the volunteer monitors collect field duplicate samples. Data are collected on a consistent basis with approximately 10% duplicate samples analyzed. Data are representative of the conditions throughout the lake and watershed. Precision, accuracy/bias, and quantitation limits are included in Table A7-1 and SOPs in Appendix D.

A7.2 Measurement Performance Criteria

Table A7-1 summarizes the measurement performance criteria for each parameter.

PRECISION

Precision in the laboratory is measured by analyzing replicate samples on a 10% basis and determining if those replicates fall within the acceptance range for that testing protocol. If the replicate falls within the acceptance range, the precision is acceptable. If the replicate falls outside of the acceptance range, the sample is analyzed again to determine if there was an analyst error or an equipment error that led to the imprecision. Further detail can be found in the Duplicate Precision SOP in Appendix D-15.

Precision in the field is measured by analyzing field duplicate samples for total phosphorus, pH, chloride, chlorophyll-a, ANC, and conductivity. Water quality samples are analyzed using the relative percent difference (RPD) equation:

$$\text{RelativePercentDifference} = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100\%$$

where x_1 is the original sample concentration

x_2 is the replicate sample concentration

RPDs < 20% will be deemed acceptable.

Field Duplicate precision for turbidity water quality samples is analyzed using critical ranges, as follows:
0-20 NTUs: +/- 2 NTUs
>20 – 100 NTUs: +/- 6 NTUs
>100 NTUs: +/- 20 NTUs.

The acceptance limit for the dissolved oxygen profile field duplicate precision is +/- 2 mg/L.

ACCURACY/BIAS

Accuracy/Bias is determined through the completion of laboratory blanks, instrument calibration, and continuing calibration verification (CCV) checks for sample accuracy within method ranges. CCV's limits and procedures are detailed in Appendix D-15. Accuracy for total phosphorus analysis is determined through the use of spiked samples (Refer to Total Phosphorus SOPs in Appendix D-6).

REPRESENTATIVENESS

Inlet sample locations are located near the mouth of the stream just before it enters into the lake (and where it will not be affected by backflow from the lake) which provides a representation of the overall condition of the stream and the quality of the water entering the lake. When the data show that a particular parameter is elevated in an inlet, the VLAP coordinator would recommend (either during the sampling season or in the annual report) additional sampling locations be established along the stream. These sample locations are chosen to bracket the stream and are representative conditions of the stream, which helps to identify potential areas of pollution or contamination throughout the watershed. A sample location is chosen at the outlet of the lake to provide a representative idea of the quality of the water that is leaving the lake.

The deep spot of the lake is selected as a sampling site so as to be representative of all depth conditions present in the lake. The deep spot is identified using a bathymetric map, and confirmed in the field using triangulation from fixed shoreline points, depth finders, and by conducting a simple depth measurement (lowering a Kemmerer bottle filled with water on a calibrated chain to check the depth). Some volunteer monitors also use fish finders and GPS units, in addition to the previously listed methods, to locate the deep spot. On the annual biologist visit, a dissolved oxygen/temperature profile is conducted at the deep spot to determine the distribution of thermal layers in the water column. Samples are collected at approximately the mid-point of each thermal layer.

COMPARABILITY

Comparability between samples is achieved through maintaining consistency with SOPs, sampling locations, and sampling methods. Samples are collected in the same locations, at approximately the same time of day (typically between 10am and 2pm), and have the same hold times. Since the sample locations each season coincide with the stations sampled in the previous season, data comparisons are made between the data collected each season.

SENSITIVITY (MEASUREMENT RANGE)

Background information on the majority of the inlets and deep spots for the lakes and ponds in the state has been generated since 1975 through the NHDES LTS Program, and the data show that the methods and

instruments are able to detect the analyte of concern and other target compounds at the level of interest. Detectable ranges of the methods and the equipment (as shown in methods and SOPs) are adequate for the purposes of this study design.

COMPLETENESS

Since VLAP only recommends, and does not require that groups collect samples once per month during the summer (June – August), adequate completeness is considered 75% of participating lakes collecting samples more than twice per year.

Table A7-1: Measurement Performance Criteria Table for Surface Water Samples

Analytical Parameter	Method/ SOP Reference	Measurement Performance Criteria			QC Sample and/or Activity Used to Assess Measurement Performance
		Precision	Accuracy	Sensitivity	
Conductivity[1, 3, 4]	D-3	RPD<20%			Field Duplicate
			+/- 10% @ 100 umhos		CCV
				</= 1/3 PQL	Annual MDL Calculation
		+/- 10%			Lab Duplicate
Turbidity [1 &2]	D-4	0-20 NTU +/- 2 >20–100NTU +/- 6 >100 NTU +/- 20			Field Duplicate
			0-20 NTU +/- 1 >20–100NTU +/- 3 >100 NTU +/- 10		CCV
				</= 1/3 PQL	Annual MDL Calculation
		0-20 NTU +/- 1 >20–100NTU +/- 3 >100 NTU +/- 10			Lab Duplicate
pH[1 &2]	D-1	RPD<20%			Field Duplicate
			+/- 0.1 @ 6 pH		CCV
		+/- .5 pH Units			Lab Duplicate
Alkalinity(ANC)[1 &2]	D-2	+/- 1.20			Lab Duplicate
Chlorophyll-a[1 &2]	D-5	RPD <20%			Field Duplicate
			N/A back correction only		Instrument Blank
		+/- 3 ug/L			Lab Duplicate
Total Phosphorus[2,3, 4]	D-6	RPD < 20%			Field Duplicate
		RPD </= 10%[2] +/- 1ug/L if < 20ug/L[4] +/- 5% if > 20 ug/L[4] +/- 0.004[3]			Lab Duplicate
			< MDL		Reagent Blank
				</= 1/3 PQL	Annual MDL Calculation
			82-114%[2,3] 85-115%[4]		Laboratory Matrix Spike
			92-103%		LFB
			91-104%		ICV
			0.004 -0.006mg/L[2] 0.001-0.003mg/L[4]		LCS
			$r^2 > 0.99$		Initial Calibration
			+/-10% of 0.100 mg/L[2,3] +/-10% of 0.010 mg/L[4] +/-10% of 0.025, 0.050, 0.100, and 0.200 mg/L[3]		Calibration Verification Check
			+/- 10% of 0.100mg/L[3] +/- 10% of 0.010 mg/L[4] +/- 10% of 0.050mg/L[2]		Continuing Calibration Verification
E. coli[2,3,4]			0 Counts		Method Blank
		10%			Duplicate Counts
Chloride[1]	D-16	RPD < 20%			Field Duplicate
				< MDL	Instrument Blank
		RPD < 10%			Lab Duplicate
				< MDL	Reagent Blank
				0.23 mg/L	Annual MDL Calculation
			Cal curve R^2 >/= 0.995 RDL 3+/- 20% 100 and High 200 Stds +/-10%		Initial Calibration
			120 +/- 10%		Independent Calibration Verification
			100 +/- 10%		Continuing Calibration Verification

1. NHDES JCLC
2. NHDHHS PHL WAL
3. CSC LSPA
4. PSU CFE

A8 Special Training/Certification

A8.1 Personnel Responsibilities and Qualifications

Table A8-1 details personnel responsibilities and qualifications.

Table A8-1: Personnel Responsibilities and Qualifications

Name	Organization	Responsibilities	Education and Experience
Sara Steiner	NHDES Biology Section	VLAP Coordinator	On file at NHDES
David Neils	NHDES Biology Section	Director, JCLC	On file at NHDES
Scott Ashley	NHDES Biology Section	JCLC QA/QC Officer/Database Coordinator	On file at NHDES
Melanie Titus	NHDES Biology Section	Database Management Specialist	On file at NHDES
Vince Perelli	NHDES	NH DES QA Manager / QAPP Reviewer	On file at NHDES
Rachel Rainey	NHDHHS	Sample analysis and lab QA	On file at NHDHHS
Bonnie Lewis	CSC LSPA	VLAP Satellite Laboratory Manager	On file at CSC LSPA
Aaron Johnson	PSU CFE	VLAP Satellite Laboratory Manager	On file at PSU

A8.2 Special Training Requirements/Certification

Any special training requirements or certifications for the above listed parties are detailed in the supplemental job descriptions or the resume for each person, which are on file at the respective employers. Tables A8-2 and A8-3 summarize the laboratory intern training requirements and certification, and Table A8-4 summarizes volunteer training requirements and certification. Samples are not accepted from any volunteers from a new lake without first being trained by the biologist. All hard copy field data sheets, sampling procedures assessment audit forms, and sample receipt checklists are kept on file at the NHDES JCLC for at least five years.

Table A8-2: Special Training Requirements for NHDES Laboratory Interns

Project function	Description of Training	Trainer	Trainee	Location of Records
Water Sample Collection	Field training of in-lake and tributary water sample and data collection procedures.	VLAP Coordinator	VLAP Intern	NHDES JCLC Appendix B-2 VLAP Intern Field Training and Assessment Form Appendix C Field Sampling SOPs
Water Sample Analysis	Analysis of water samples in the laboratory.	VLAP Coordinator Biology section QA/QC Officer	JCLC Interns Satellite Lab Manager	NHDES JCLC Appendix B-1 Intern Training Form Appendix D Laboratory Analysis SOPs
Data Management	Logging in samples into database and entering sample results into database.	Biology section Database Manager	JCLC Interns Satellite Lab Manager	NHDES JCLC Appendix B-1 Intern Training Form
Data Analysis	Analyzing data.	VLAP Coordinator	VLAP Intern	NHDES JCLC Appendix E

Table A8-3: Special Training Requirements for Satellite Laboratory Interns

Project function	Description of Training	Trainer	Trainee	Location of Records
Water Sample Analysis	Analysis of water samples in the laboratory.	Satellite Lab Managers	Satellite Laboratory Interns	Satellite Laboratory NHDES JCLC Appendix B-1 Intern Training Form
Data Management	Logging in samples and entering sample results into database.	Satellite Lab Managers	Satellite Laboratory Interns	Satellite Laboratory NHDES JCLC Appendix B-1 Intern Training Form

Table A8-4: Special Training Requirements for Volunteer Monitors

Project function	Description of Training	Trainer	Trainee	Location of Training Records
Water Sampling	Annual VLAP Refresher Workshop: water sample collection procedures	NHDES VLAP Coordinator	Volunteer Monitors	NHDES JCLC Appendix C-5 and C-6
Water Sampling	Biennial Biologist Visit: water sample collection procedures in the field	NHDES VLAP Coordinator Satellite Lab Managers	Volunteer Monitors	NHDES JCLC Appendix B-3 Appendix C-5 and C-6
Water Sampling	VLAP Training Video	VLAP Coordinator Satellite Lab Manager	Volunteer Monitors	
Water Sampling	Sample receipt checklist used to “assess” and “re-train” volunteers (if necessary) in proper field sampling collecting procedures	NHDES VLAP Coordinator Satellite Lab Managers	Volunteer Monitors	Satellite Laboratory NHDES JCLC Appendix D-14

A9 Documents and Records

The most current approved version of the Generic Quality Assurance Project Plan (QAPP) for the NHDES VLAP is stored electronically in the NHDES VLAP's database. A hard copy is retained in the VLAP files for the length of the approval period. Any changes to the QAPP are submitted to the NHDES QA Manager and EPA by the VLAP Coordinator for approval. Special projects, other than routine sampling of lakes stated in the Generic QAPP, may require a project specific QAPP to be developed, referred to as Site Specific Project Plans (SSPPs) hereafter. A copy of the SSPP will be retained in the VLAP Program files. A copy of the approved plan will be sent to the NHDES Quality Assurance Manager. The Project Coordinator in conjunction with the VLAP Coordinator is responsible for communicating the SSPP and other QA/QC requirements to the volunteer monitors that may be working on the project (Refer to Appendix F-1). All current and revised versions of the QAPP are distributed to appropriate parties (Table A3-1) by the VLAP Coordinator. The most current approved version of the QAPP is made available on the NHDES VLAP website (http://des.nh.gov/organization/divisions/water/wmb/vlap/index.htm).

Standard operating procedures (SOPs) for laboratory and field methods are stored electronically in the VLAP database and as hard copies in program files and distributed to monitoring and analytical personnel. Hard copies of field data sheets (Appendix C), sample receipt checklists (Appendix D), field sampling procedures checklists (Appendix B), and station identification forms (Appendix C) are stored indefinitely in appropriate folders in VLAP files. Hard copies of intern training documentation (Appendix B) are stored for a minimum of three years in the appropriate folder in VLAP files. Hard copies of analytical bench book data sheets are stored for a minimum of five years in the appropriate folder in the Biology Section and PHL WAL files. Hard copies of laboratory log-in and chain of custody forms are stored for a minimum of five years by PHL WAL. Electronic data generated from analytical runs are backed up nightly and stored indefinitely.

Hard copy analytical results from the PHL WAL are entered into an electronic database and transferred directly into the Watershed Management Bureau's Environmental Monitoring Database (EMD), an Oracle database, on a weekly basis. Results of sample analysis by the DES JCLC are entered into a Microsoft Access database and electronically transferred to the EMD on a weekly basis. The results of sample analysis by the CSC LSPA and PSU CFE are entered into a Microsoft Access database weekly and transferred to the EMD annually in the fall. The EMD is exportable to STORET where all VLAP data resides before export to the EPA STORET Database (http://www.epa.gov/storet/index.html).

Monthly data reports are generated from a Cognos database or Microsoft Access database. Hard copies are mailed to volunteer monitors (Appendix E) and included is a copy of the original data sheet that was submitted with the samples, the completed sample receipt checklist, and a chemical and biological parameter explanation detailing each parameter (Appendix E). After each season, the VLAP Coordinator and intern analyze and interpret the data, and generate a Regional Report for each of seven geographical regions in New Hampshire as well as an Individual Lake Report for each lake that participated in VLAP (Appendix E). Regional and Individual Lake Reports are filed electronically in the VLAP directory and posted on the VLAP website at http://des.nh.gov/organization/divisions/water/wmb/vlap/categories/publications.htm. Volunteer monitoring groups receive a hard copy of the Individual Lake Report and its corresponding Regional Report. The report mailing also contains a How to Read Your VLAP Report (Appendix E) document to assist in interpreting the Individual Lake Reports.

The VLAP Annual Self Audit and QA/QC Workload Report, prepared by the VLAP Coordinator, documents the number of lakes sampled and the number of sample results generated by VLAP each season. The report provides documentation on how the program met or did not meet QA/QC goals. In addition, the report discusses problems encountered during the sampling season, and provides solutions to these problems that are implemented during the next sampling season. Per the NHDES Quality Management Plan, Section 9, this report is provided to the NHDES QA Manager. The NHDES QA Manager compiles all of the Annual QA reports for each program at NHDES and reports to the senior leaders at NHDES (Refer to Section C for a distribution list).

B DATA GENERATION AND ACQUISITION ELEMENTS

B1 Sampling Process Design

B1.1 Types and Number of Samples Required

Samples are collected at the lake deep spot, at the major inlets to the lake, and the outlet. The total number of samples collected will vary per lake depending upon deep spot thermal stratification and the number of inlets to the lake. Sampling locations are established and recorded on the initial biologist visit upon a lake entering the program. The information is then transferred to a file and revised annually as sample stations are added or no longer sampled. When preparing bottles for biologist and volunteer sampling events, staff refers to the "VLAP Accounts and Pickups" file for the number of bottle sets to include for each specific lake (Appendix C-12). All samples collected are aqueous water samples. Samples are collected at least once per summer, and volunteers are encouraged to collect additional samples once per month (June, July and August). Monthly sampling is conducted during the same time frame each month. For example, if samples are collected during the first week of June, samples are collected during the first week of July and August. Samples may be collected during or immediately following a rain event, or during a period of dry weather. To document if samples were collected during a rain event or during a dry event, the volunteer monitors document precipitation conditions, weather conditions, and lake water level conditions on the field data sheet when collecting samples (refer to Appendix C-5, Appendix C-6, and Appendix C-7). In-lake and inlet sampling are conducted as follows.

Each lake is monitored at the deepest spot to be representative of overall lake quality and reflect the result of watershed contributions. This location is determined through pre-exiting bathymetric maps generated by the NHDES LTS Program. The deep spot is found using triangulation from fixed shoreline points, fish finders, GPS units, and hand held depth finders. Deep spot stations are established by completing a sampling station identification form (Appendix C-9). The location is confirmed by conducting a simple depth measurement (lowering a Kemmerer bottle filled with water on a calibrated chain to check the depth), by depth finder, fish finder or GPS unit. On the annual biologist visit, a dissolved oxygen/temperature profile is conducted at the deep spot to determine the location of thermal layers in the water column, and a phytoplankton sample is collected from the photic zone using an 80 µm mesh net at lakes with historical cyanobacteria issues. Volunteers at lakes with historical cyanobacteria issues may be trained to collect phytoplankton samples more frequently. Deep spot samples are collected utilizing a Kemmerer bottle at the mid-point of each thermal layer. Aqueous samples are analyzed for pH, ANC, conductivity, turbidity, total phosphorus, chloride (optional), and *E. coli* (optional). Water clarity is measured at the deep spot utilizing a Secchi disk and viewscope. Chlorophyll-a are collected utilizing an integrated sampler or a composite method.

Inlet stations are selected close to the lake edge to account for the majority of watershed effects on the streams. Stations are established far enough upstream from lake edge so as to prevent lake effects or back-flushing into the stream. Surface grab samples are collected from Inlet stations. Outlet stations are established to provide a representative idea of water quality leaving the lake. Surface grab samples are collected from Outlet stations. Aqueous samples are analyzed for pH, conductivity, turbidity, total phosphorus, chloride (optional), and *E. coli* (optional). All stations are established by completing a sampling station identification form. If volunteers have a GPS unit available, they are encouraged to collect the GPS coordinates and enter those coordinates on the sampling station identification form. If, on a particular scheduled sampling event, a tributary is stagnant or dry, volunteer monitors are instructed to not collect a sample. Since it is not uncommon for tributaries that drain relatively small sub-watersheds to dry up in late-July and August, volunteer monitors are encouraged to collect

at least one set of samples from each tributary in June, a time when tributaries located throughout the state are typically flowing.

When the routine VLAP sampling at an inlet reveals that a particular water quality parameter is elevated (based on the comparison of the data to historical data for that station, and established state means for the data), then it is recommend that the volunteer monitors conduct additional sampling along the inlet. Specifically, it is recommended that the volunteer monitors conduct bracketing sampling to pinpoint potential pollution sources. The samples collected along an established Inlet station are typically named using a two-tiered approach. First, the established station name is used and then followed by a number. As the distance along the stream from the lake increases, the number will increase. For example, the first sample collected on White Brook closest to the lake would be labeled "White Brook1", the second sample collected upstream of the first sample would be named "White Brook2", and so on along the stream. The volunteer monitors provide a description of each station on the VLAP Stream Survey Sheet, complete a VLAP sample station identification form, collect GPS coordinates if possible, and note each sampling location on a map.

All samples along with field data sheets are returned to the NHDES JCLC, PSU CFE, and CSC LSPA within 24 hours of collection to meet sample hold times. If samples exceed hold times, the information is recorded on the VLAP Sample Receipt Checklist (Appendix D-14) under Section 1. Hold Time. E. coli samples that exceed the 24 hour hold time are always rejected. For all other samples that were returned 24-48 hours after collection, the information is recorded on the checklist and in the "Comments" field of the database for each sample logged in. The VLAP Coordinator then flags the sample results in the Environmental Monitoring Database (EMD) and evaluates the data against historical results. Data that do not fall within historical ranges are marked as invalid in the database and this information is recorded in the Annual Program Audit. If samples are returned after 48 hours of collection, all samples are rejected for analysis. Volunteers are notified on-site, by phone or email that samples were past hold time and/or rejected for analysis by the VLAP Coordinator or Satellite Laboratory Manager. During the annual NHDES biologist field audit/visit, duplicate samples are collected by the volunteer monitors according to the outline below.

Duplicate Samples

One duplicate set of samples is collected from the lower layer (hypolimnion or epilimnion if not stratified) and analyzed for the following parameters: total phosphorus, conductivity, turbidity, pH, and chloride (if applicable). The duplicate sample is collected from the lower layer due to the probability that the lower layer sample is most likely to be compromised (due to the bottom being stirred up by improper sampling technique). One duplicate sample is collected at an inlet and analyzed for the following parameters: total phosphorus, conductivity, turbidity, pH, and chloride (if applicable). In addition, duplicate chlorophyll-a samples are collected at the deep spot by both the biologist once per week. A duplicate dissolved oxygen/temperature profile is also measured by both the biologist once per week.

Please note that field duplicate phytoplankton samples are not collected on a routine basis through the program since the NHDES JCLC is not capable of analyzing these additional tests. Also, please note that epilimnetic ANC duplicate samples and total phosphorus duplicate samples are collected for monitoring groups that pay for sample funds to support these additional sample analyses.

B2 Sampling Methods

B2.1 Sample Collection Methods

To maintain consistent sample collection procedures at lakes, the SOPs included in Appendix C are adhered to by all parties involved in lake sampling. Samples are collected in bottles specific to the analytical parameter, and in the event that a sample becomes contaminated, extra samples bottles are provided to volunteers and packed for biologist visits for each sampling event. Once samples are collected they are immediately stored in a refrigerated cooler to initiate the preservation process. Samples are then transported to the NHDES JCLC, LSPA CSC or PSU CFE satellite laboratories within proper hold times. Total phosphorus and *E. coli* samples received in the JCLC are transferred to the NHDHHS PHL WAL within the proper hold times and preservation requirements. Table B2-1 describes in detail the sample location, collection, preservation, and analysis requirements. Deep spot samples are collected utilizing a Kemmerer bottle, a calibrated chain or line, integrated tube, plankton net, and dissolved oxygen/temperature meter. Deep spot samples are collected from a boat securely anchored at the deep spot. Tributary samples are collected utilizing a surface grab method and hard to reach areas may require utilization of a sampling pole. In the event a piece of equipment malfunctions, efforts are made in the field to fix the equipment, otherwise the VLAP Coordinator is notified, samples are not collected, and the event is re-scheduled with the VLAP Coordinator. Sample bottle washing and decontamination follow SOPs listed in Appendix D-10. Field equipment are rinsed free of any attached aquatic life or sediment in the field. Plankton nets are rinsed with hot water in the laboratory and allowed to air dry between sampling events.

Table B2-1: Sample Location, Sampling and Analysis Methods/SOP Requirements

Sampling Location	Matrix	Depth (Units)	Analytical Parameter	No. of Samples per event	Sampling SOP (Appendix)	Containers (Number, size and type)	Preservation Requirements	Maximum Holding Time
Inlets or Outlets	Surface Water	Mid-depth	Total Phosphorus	1	C-2	1-250 mL amber plastic	0.7 mL sulfuric acid, pH<2 Light protected, 4°C	28 Days
	Surface Water	Mid-depth	Turbidity, pH, Conductivity	1	C-2	1-500 mL plastic	4°C	24 Hours
	Surface Water	Mid-depth	Chloride	Optional	C-2	1-500 mL plastic	4°C	28 Days
	Surface Water	Mid-depth	*E. coli*	Optional	C-2	1-250 mL sterile plastic	4°C	24 Hours
Epilimnion	Surface Water	Mid-layer	Total Phosphorus	1	C-2	1- 250 mL amber plastic	0.7 mL sulfuric acid, pH<2 Light Protected, 4°C	28 Days
	Surface Water	Mid-layer	Turbidity, Conductivity, pH	1	C-2	1-500 mL plastic	4°C	24 Hours
	Surface Water	Mid-layer	Chloride	Optional	C-2	1-500 mL plastic	4°C	28 Days
	Surface Water	Mid-layer	ANC	1	C-2	1-500 mL plastic	4°C	24 Hours
Metalimnion	Surface Water	Mid-layer	Turbidity, Conductivity, pH	1	C-2	1-500 mL plastic	4°C	24 Hours
	Surface Water	Mid-layer	Total Phosphorus	1	C-2	1- 250 mL amber plastic	0.7 mL sulfuric acid, pH<2 Light Protected, 4°C	28 Days
Hypolimnion	Surface Water	Mid-layer	Total Phosphorus	1	C-2	1- 250 mL amber plastic	0.7 mL Sulfuric Acid, pH<2 Light Protected, 4°C	28 Days
	Surface Water	Mid-layer	Turbidity, Conductivity, pH	1	C-2	1-500 mL plastic	4°C	24 Hours
Water Column	Surface Water	Photic zone	Phytoplankton	1 w/ biologist Optional	C-4	1-250 mL glass bottle	Lugols, 4°C	Indefinite
Water column	Surface Water	Stratified: mid-metalimnion Unstratified: 2/3 depth to surface	Chl-a	1	C-2	1-1L plastic, amber	light protected 4°C	24 Hours
Water Column	Surface Water	0.5 meters from the bottom to the surface	DO/temp profile	1 w/ biologist Optional	C-3	N/A	N/A	N/A

B2.2 Performance Requirements for Sampling Methods

Upon receipt of samples, the laboratory staff complete an easy to use one-page sample receipt checklist (Refer to Appendix D-14) to assess and document if volunteer monitors followed proper sampling techniques when collecting samples (as outlined in the VLAP Monitor's Field Manual which can be found in Appendix C-2). Volunteers are also required to complete the Volunteer Monitor Field Sampling Procedures Checklist (Appendix C-11) while sampling on their own. Completed checklists are returned with samples and reviewed to make sure volunteers followed proper procedures. If not, volunteers note any deviations from normal sampling protocols on the checklist. Corrective actions (including volunteer monitor re-training and, in certain severe cases, rejection of samples for analysis) are implemented to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques. Table B2-2 supplements the sample receipt checklist and provides additional explanation and guidance for laboratory staff for assessing if proper sampling procedures were followed and what corrective actions, if necessary, should be implemented.

Table B2-2 Performance Requirements for Sampling Methods and Corrective Actions

SOP Appendix Reference	Sample Parameter	Person(s) Responsible	Sample Collection Non-conformance with SOP issue	Corrective action
C-2	Water clarity	Volunteer VLAP Coordinator/ Intern/Sat. Lab Manager	1. Only one depth reading was collected.	A. Reminder to collect at least two readings to average. B. Note on sample receipt checklist.
			2. Depths were reported in feet, not meters.	A. Reminder to use a chain calibrated in meters and record depth in meters.
			3. Depths seem abnormal for this lake based on historical data.	A. Contact volunteer monitors and discuss sampling conditions. C. Note on sample receipt checklist and in log-in system.
C-2	pH Conductivity ANC Turbidity Chloride	Volunteer VLAP Coordinator/ Intern/Sat. Lab Manager	1. Wrong sample bottle used.	A. Reminder on proper sample bottle. B. Document on sample receipt checklist. C. Do not analyze (at discretion of Coordinator and Lab Manager).
			2. Bottle not filled to appropriate volume.	A. Note on sample receipt checklist and in lab log-in system. B. Reminder on appropriate sample volume.
			3. Sediment or debris in bottle, or sample cloudy.	A. Note on sample receipt checklist and in lab log-in system. B. Reminder on proper sample technique.
C-2	Chlorophyll	Volunteer VLAP Coordinator/ Intern/Sat. Lab Manager	1. Wrong sample bottle used.	A. Reminder on proper sample bottle. B. Note on sample receipt checklist and in log-in system. C. Do not analyze (at discretion of Coordinator and Lab Manager).
			2. Bottle not filled to appropriate volume.	A. Note on sample receipt and in lab log-in system. B. Reminder on appropriate sample volume.
C-2	Total Phosphorus	Volunteer VLAP Coordinator/ Intern/Sat. Lab Manager	1. Wrong sample bottle used.	A. Do not analyze sample and remind monitors which bottles to use. B. Note on sample receipt checklist.
			2. Bottle not filled to appropriate volume.	A. Note on VLAP sample receipt checklist and in lab log-in system. B. Reminder on appropriate sample volume.
			3. The pH of the sample is greater than 2 when checked in the laboratory.	A. Add acid immediately. B. Note on VLAP sample receipt checklist and in lab log-in system. C. Remind staff to preserve bottles. D. Reminder not to overfill bottles, and to make a note on the field data sheet if overflow occurs.

SOP Appendix Reference Number	Sample Parameter	Person(s) Responsible	Sample Collection Non-conformance with SOP issue	Corrective action
C-2	*E. coli*	Volunteer VLAP Coordinator/ Intern/Sat. Lab Manager	1. Sterilized sample bottle was not used.	A. Do not analyze sample and remind monitors which bottles to use. B. Note on sample receipt checklist.
			2. Bottle not filled to appropriate volume.	A. Note on sample receipt checklist and in lab log-in system. B. Reminder on appropriate sample volume.
			3. Sediment or debris in bottle, or sample cloudy.	A. Note on sample receipt checklist and in lab log-in system. B. Reminder on proper sample techniques.
			4. Sample returned after 24 hour hold time.	A. Do not analyze sample. B. Reminder on sample hold times.
C-2, C-4	Phyto-plankton	VLAP Coordinator/ Intern/Sat. Lab Manager	1. Iodine (Lugols solution) not added to sample for preservation.	A. Note on sample receipt checklist and in lab log-in system. B. Add iodine immediately.
C-3	Temperature/ DO profile	VLAP Coordinator/ Intern/Sat. Lab Manager	1. Profile results are abnormal for that lake based on historical data. 2. Probe not vertical in water column due to wind/wave action.	A. Calibrate meter immediately prior to use. B. If meter was calibrated, it is possible that meter was not functioning properly. Note on data sheet, inspect meter and check battery. C. If necessary invalidate profile and schedule follow-up data collection.
C-2, C-11	All samples	Volunteer VLAP Coordinator/ Intern/Sat. Lab Manager	1. No attempt was made by volunteer monitor to initiate preservation process.	A. Note on sample receipt checklist. B. Reminder on proper sample preservation procedures.
			2. Samples returned to the lab more than 24 hours after collection and before 48 hours after collection.	A. Note on sample receipt checklist and in lab log-in system. B. Reminder on sample hold times. C. Do not analyze samples (at discretion of Coordinator and Lab Managers).
			3. Samples returned to lab more than 48 hours after collection.	A. Do not analyze samples. B. Note on sample receipt checklist and in log-in system. C. Reminder on sample hold times.
			4. Samples not labeled correctly.	A. Note on sample receipt checklist B. Contact monitors to solve problems. C. Reminder on proper bottle labeling. D. If necessary, discard unknown station samples.
C-2, C-11	In-lake Deep Spot Samples	Volunteer VLAP Coordinator/ Intern/Sat. Lab Manager	1. Samples collected at the wrong depths.	A. Note on sample receipt checklist and in lab log-in system. B. Reminder on appropriate depths.
C-2, C-5, C-6, C-7, C-8, C-11	Sample Field Data Sheets	Volunteer VLAP Coordinator/ Intern/Sat. Lab Manager	1. Field data sheets not returned or not filled out properly.	A. Note on sample receipt checklist. B. Contact monitors for the missing information. C. Reminder to complete all fields of data sheet.

B3 Sample Handling and Custody

B3.1 Sample Collection Documentation

Field observations are collected by the VLAP biologists and the volunteer monitors and recorded on the appropriate field data sheets, checklists and audit forms (Appendix B and C). If more detailed stream survey sampling is conducted, field observations and station specific information are recorded on appropriate data sheets and returned with samples (Appendix C). All data sheets and checklists are returned to the NHDES JCLC or satellite laboratory with samples. The satellite laboratory managers and the VLAP Coordinator are responsible for tracking these field sheets, and making sure that the appropriate data are entered into the JCLC Sample Login database. On a monthly, or more frequent, basis during the sampling season, the Satellite Laboratory Managers send a copy of the field data sheets and the data report to the VLAP Coordinator. The VLAP Coordinator retains all of the field data sheets in the appropriate files at NHDES.

B3.2 Sample Handling and Tracking System

IN THE FIELD

All sample bottles are labeled in the field with the waterbody name, town, sample location/station ID, sample date, and sample time. Tributary stations are typically named using the established local name of the tributary (which is typically listed on a USGS topographic map of the area, or is a local name known to the volunteers). Deep spot stations are named according to the thermal layer (epilimnion, metalimnion, and hypolimnion). Once established, each station is assigned a specific station ID with the following convention: first 3 letters of watebody name, a three letter code for the town (established by DES Data Management), and letter designation specific to the station (established by the VLAP Coordinator). For example the station ID for the Inlet at Ashuelot Pond in Washington would be ASHWASI. The name and station ID of a sampling location generally does not change to ensure consistency for data management and reporting purposes. Duplicate sample bottles are labeled with the established station name/ID and the word "DUP". New sample stations are documented on the field data sheet (Appendix C-5) and a Sample Station Identification Form (Appendix C-9) is completed. Information from the form is entered into the EMD, GIS coverage is created, and the lake sampling station map is updated.

Total phosphorus samples are preserved with 0.7 mL of 9N sulfuric acid in the laboratory prior to sample collection. Volunteers are instructed of the danger of the acid, and various documents such as the field manual, field data sheet, and sampling checklist all reference proper sampling procedures for total phosphorus. Total phosphorus bottles are affixed with a "Danger Acid" sticker to also advise the bottles contain acid. Volunteers are further instructed to utilize gloves and safety glasses when filling the bottles. Phytoplankton samples are preserved with Lugols solution in the field immediately upon collection. All samples are placed on ice and/or ice packs in a cooler immediately after collection and transported to the appropriate satellite laboratory or the JCLC in less than 24 hours after sample collection for analysis. Refer to Table B2-1 for sample volume, preservation and hold times.

IN THE LABORATORY:

VLAP completes a sample receipt checklist when samples are returned to the JCLC or satellite laboratory to ensure that the proper standard field operating procedures were followed (Refer to Appendix D-14). Total phosphorus samples are checked to ensure the pH is < 2 using pH strips, and if the pH is > 2, sulfuric acid is added to the sample to bring the pH to < 2. Once complete, the samples are logged into a Microsoft Access database and assigned a specific number to track the sample. The number is tracked by the JCLC, satellite laboratories and PHL-WAL (Refer to Appendix D-13). These numbers are assigned in consecutive order as samples are logged in, starting with the year, followed by the sample number in the system (e.g., 20XX-XXXX). (Note: In order to avoid confusion with duplicate sample numbers between the JCLC and satellite

laboratory log-in systems the CSC LSPA numbers are assigned as S20XX-XXXX, and the PSU CFE numbers are assigned as P20XX-XXXX.)

Sample labels are printed from the database and contain the sample log-in number, waterbody name, town, sample location, sample date, sample time, collectors' initials, account number, log-in date and time, and the parameters to be run on the sample. An example of the label is shown in Appendix D-13. A log-in sheet is printed out for each lake's samples, as show in Appendix D-12. The temperature of the samples is checked and recorded on the log-in sheet. In the JCLC, custody of total phosphorus and *E. coli* samples are relinquished to the PHL-WAL, the samples are listed on the log-in sheet by station location, sample number, matrix, and analytical parameter. The log-in sheet is signed, dated and time stamped by the individual relinquishing the samples and received by the PHL-WAL. Surface water samples are disposed of down the sink unless otherwise noted in SOPs in Appendix D.

B4 Analytical Methods

B4.1 Field Analytical Methods and Equipment Required

Refer to Appendix C for field method SOPs. Refer to Table B4-1 for Field Analytical Method/SOP Reference.

Table B4-1: Field Analytical Method/SOP Reference Table

SOP Reference Number	Title	Originating Organization	Equipment Identification
C-2, C-3, D-8	Dissolved Oxygen/Temperature	NHDES	YSI Model 52 and 85 Hach LDO Meter YSI ProODO
C-2	Clarity (Secchi Disk Transparency)	NHDES	Secchi Disk and Viewscope
C-10	Conductivity	NHDES	YSI Model 85

B4.2 Fixed Analytical Methods and Equipment Required

Table B4-2 identifies the analytical methods and equipment used to analyze samples in the laboratory, and provides a reference to the appropriate analytical SOP.

Table B4-2: Fixed Laboratory Analysis Analytical Method/SOP Reference Table

Appendix Reference	SOP Title	Equipment Identification
D-6	Total Phosphorus	CSC LSPA – Perkin Elmer, UV/VIS Spec PHL WAL/PSU CFE – Lachat QuickChem Auto Analyzer
D-4	Turbidity	CSC LSPA/NHDES JCLC – HF Scientific Micro 100 PSU CFE– Hach 2100N Turbidimeter
D-3	Conductivity	CSC LSPA – Orion 124 Meter NHDES JCLC – Orion 162A Meter PSU CFE– Accumet AB30 Conductivity Meter
D-1	pH	CSC LSPA – Beckman pH Meter Model 340 NHDES JCLC – Beckman pH Meter Model 360 NHDES JCLC – Corning Meter Model 350 PSU CFE- Orion Star A214 pH/ISE Meter w/ 8102 BNUWP Ross Ultra combination pH electrode
D-2	ANC	CSC LSPA – Beckman pH Model 340 NHDES JCLC – Beckman pH Meter Model 360 NHDES JCLC – Corning Meter Model 350 PSU CFE- Radiometer Analytical TIM860 Titration Manager with SAC80 Sampler Changer
D-5	Chlorophyll-a	CSC LSPA – Perkin Elmer, UV/VIS Spec. CSC LSPA/NHDES JCLC/PSU CFE - Doerr Vacuum Pump (VWR) NHDES JCLC – Varian Cary 50 Spectophotometer PSU CFE– Beckman Spectrophotometer
D-9	Phytoplankton	NHDES JCLC – Olympus BX41TF
D-7	*E. coli*	CSC LSPA and PSU CFE– Hach Method 10029 (40 CFR 141) NHDHHS PHL WAL – Membrane filtration, incubator, stereoscopic microscope
D-16	Chloride	NHDES JCLC – Orion Star ISE Meter PSU CFE - Dionex Ion Chromatography System

B5 Quality Control

B5.1 Field Analytical Quality Controls

Lake and tributary water quality sampling and analyses follow VLAP SOPs listed in Appendix C. Table B5-1 describes the quality control samples collected, frequency and acceptable limits.

B5.2 Fixed Laboratory Quality Controls

Laboratory analyses of water samples are conducted by the NHDES JCLC, NHDHHS PHL WAL, CSC LSPA, and PSU CFE. All laboratories strictly adhere to analytical SOPs described in Appendix D. Table B5-2 describes the quality control conducted, frequency, acceptable limits, and corrective actions. Split samples for total phosphorus are conducted between the NHDHHS PHL WAL and the CSC LSPA and PSU CFE on an annual basis to determine precision between laboratories. The NHDES Biology Section QA Officer and the VLAP Coordinator plan to extend conducting split sample analyses between the NHDES JCLC and the CSC LSPA, and the PSU CFE to include pH, turbidity, conductivity, ANC, and chlorophyll for inter-laboratory comparison purposes.

Table B5-1: Field QC Samples and Frequency Table

Matrix	Analytical Parameter	Field QC	Data Quality Indicators	Acceptable Limits	Corrective Action	Responsible Person	Frequency
Surface Water	TP Conductivity pH Chl-a Chloride	Field Duplicate	Precision	RPD <20%	-Assess laboratory operations and precision -Flag data as questionable in annual report	VLAP Coordinator Satellite Lab Manager	10%
Surface Water	Turbidity	Field Duplicate	Precision	0-20 NTU: +/- 2 >20–100 NTU: +/-6 >100 NTU: +/- 20	-Assess laboratory operations and precision -Flag data as questionable in annual report	VLAP Coordinator Satellite Lab Manager	10%
Surface Water	Dissolved Oxygen	Field Duplicate	Precision	+/- 2 mg/L	-Inspect Meter and probe-determine if inaccurate measurements were made -Repeat Measurements	VLAP Coordinator Satellite Lab Manager	10%

Table B5-2: Laboratory Analytical QC Samples and Frequency

Matrix	Analytical Parameter	Laboratory	Laboratory QC	Data Quality Indicators	Acceptable Limits	Corrective Action	Responsible Person	Frequency
Surface Water	Total Phosphorus	PHL WAL CSC LSPA PSU CFE	Reagent Blank	Accuracy/Bias	< MDL	Samples re-analyzed until QC is acceptable or data flagged.	PHL WAL QA Officer Satellite Lab Manager	1 per run
		PHL WAL	Lab Fortified Blank (LFB)	Accuracy/Bias	+/- 10% of 0.050			1 per run
		PHL WAL CSC LSPA PSU CFE	Lab Matrix Spike	Bias	Recovery 82-114% Recovery 82-114% Recovery 82-115%			10% 1 per run 1 per run
		PHL WAL CSC LSPA PSU CFE	Replicate	Precision	0.0 00 – 0.004 0.0 00 - 0.004 +-/ 1 ug/L if < 20 ug/L +/- 5% if > 20 ug/L			12% 10% 10%
		PHL WAL CSC LSPA PSU CFE	LCS	Accuracy	0.004-0.006 mg/L 0.001-0.003 mg/L			
		CSC LSPA PSU CFE PHL WAL	CV	Accuracy	+/-10% of 0.100 mg/L +/-10% of 0.010 mg/L +/-10% of 0.025, 0.050, 0.100, 0.200 mg/L			
		CSC LSPA PSU CFE PHL WAL	CCV	Accuracy	+/- 10% of 0.100mg/L +/- 10% of 0.010mg/L +/- 10% of 0.050mg/L			
Surface Water	pH	JCLC CSC LSPA PSU CFE	Duplicate	Precision	+/- 0.5	Re-analyze	Analyst	10%
			CV CCV	Accuracy	6.0 +/- 0.1	Re-calibrate Re-calibrate & re-analyze		1 per day 10%
Surface Water	ANC	JCLC CSC LSPA PSU CFE	Duplicate	Precision	+/- 1.20	Re-analyze	Analyst	10%
Surface Water	Conductivity	JCLC CSC LSPA PSU CFE	Duplicate	Precision	RPD < 10%	Re-analyze	Analyst	10%
			CV CCV	Accuracy	100 uMhos/cm +/- 10%	Re-calibrate Re-calibrate & re-analyze		1 per day 10%

Matrix	Analytical Parameter	Laboratory	Laboratory QC	Data Quality Indicators	Acceptable Limits	Corrective Action	Responsible Person	Frequency
Surface Water	Turbidity	JCLC CSC LSPA PSU CFE	Duplicate	Precision	0-20 NTU: +/- 2 >20–100 NTU: +/-6 >100 NTU: +/- 20	Re-analyze	Analyst	10%
			CV CCV	Accuracy	10 NTU +/- 1.0	Re-calibrate Re-calibrate & re-analyze		1 per day 10%
Surface Water	Chlorophyll-a	JCLC CSC LSPA PSU CFE	Method Blank	Accuracy/Bias	n/a	Instrument correction	Instrument	1 per run 1 per week
		JCLC CSC LSPA PSU CFE	Duplicate	Precision	+/- 3.0	Review bench book information	Analyst	10%
Surface Water	Chloride	JCLC PSU CFE	Duplicate	Precision	RPD < 10%	Re-analyze	Analyst	10%
			Inst./Reagent Blanks	Sensitivity	< MDL	Stop run, perform maintenance or re-cal	QA Officer/Lab Manager	1 per run
			Annual MDL Calculation	Sensitivity	0.23 mg/L		QA Officer/Lab Manager	Annually
			CV CCV	Accuracy	100 +/- 10%	Re-calibrate Re-calibrate & re-analyze	Analyst	1 per day 10%
Surface Water	*E. coli*	PHL WAL CSC LSPA PSU CFE	Method Blank	Accuracy/Bias	0 counts	Run data is flagged as questionable	PHL WAL QA Officer Satellite Lab Manager	1 per run
			Duplicate	Precision	10% of count	Recount and inspect plate to determine cause of imprecision		10%

B6 Instrument/Equipment Testing, Inspection, and Maintenance

Field instruments and equipment are inspected annually prior to the sampling season and daily prior to use. Extra batteries for field equipment are carried with staff in the field. Spare parts for field equipment are stored in the appropriate laboratories. Any deficiencies are corrected prior to sampling as noted in Table B6-1. The fixed laboratory instrument and equipment testing and maintenance consist of both internal and external responsibilities (Table B6-2). The JCLC, CSC LSPA and PSU CFE balances and microscopes are inspected and calibrated annually and spectrophotometers are inspected every two years by an outside contractor. PSU CFE replaces the reagent tubing on the total phosphorus analyzer annually or more frequently as necessary. Maintenance records are kept on file with the JCLC QA/QC Officer and Satellite Laboratory Managers, any deficiencies are corrected prior to the sampling season. Less complex bench top meters are inspected by the analysts prior to use during use. Maintenance occurs immediately if a problem is identified and spare parts for bench top meters are stored in the appropriate laboratories. Equipment inspection and maintenance in the NHDHHS PHL WAL are according to the Quality System Manual, Revision 2.5, July 2013, on file at EPA.

Table B6-1: Field Equipment Maintenance, Testing and Inspection

Sampling Equipment	Maintenance Activity	Testing/Inspect Activity	Responsible Person	Frequency	Acceptable Criteria	Corrective Action	SOP
Temp/DO Meter	Change battery and/or membrane	Check battery level. Check membrane for air bubbles or scratches.	Coordinator/Intern Sat. Lab Manager	Prior to use	Calibration	Change battery, membrane, or service	C-2 C-8
GPS Fathometer	Change battery	Check battery level. Check field accuracy.	JCLC QA Officer	Prior to use	Accuracy w/in 30 feet	Manufacturer maintenance or replace unit.	C-2
Plankton Net	Replace Net	Check net for holes	Coordinator/Intern Sat. Lab Manager	Prior to use	No holes	Replace net	C-2
Integrated Sampler	Replace Tube	Check tube for holes or cracks	Coordinator/Intern Sat. Lab Manager	Prior to use	No holes	Replace Tube	C-2
Kemmerer Bottle	Replace worn or broken parts	Field test	Coordinator/Intern Sat. Lab Manager	In use	Works properly, no leakage	Repair/replace broken parts	C-2
Calibrated Chain	Replace depth markers on chains	Check chain for depth markers at every 0.5 meters	Coordinator/Intern Sat. Lab Manager	In use	No missing depth markers	Replace missing markers	C-2

Table B6-2: Fixed Laboratory Equipment Maintenance, Testing and Inspection

Analytical Equipment	Maintenance Activity	Testing/Inspect Activity	Responsible Person	Frequency	Acceptable Criteria	Corrective Action	SOP
pH meter	Change pH probe	Check probe for cracks	Analyst	Prior to use	Calibration	Replace probe	D-1
Turbidity meter	Change sample cell	Inspect cell for scratches	Analyst	Prior to use	Scratch free sample cell	Replace cell	D-4
Conductivity meter	Change conductivity probe	Inspect probe	Analyst	Prior to use	Calibration	Replace probe	D-3
Chloride meter	Change chloride probe	Check probe for leakage and gel level	Analyst	Prior to use	Calibration	Replace Probe	D-16
Spectrophotometer	Annual maintenance	Calibration check	JCLC QA/QC Officer/Sat. Lab Manager	Annual	Calibration w/in tolerances	Per contractor recommendations	N/A
Balances	Annual maintenance	Calibration check	Contractor	Annual	Calibration w/in tolerances	Per contractor recommendations	N/A
Vacuum flask/pump	Pump oil change/empty flask.	Inspect pump oil level & flask water level.	Analyst	Prior to use	Oil level above fill line/¾ full flask	Fill oil/empty flask	N/A
Microscopes	Annual maintenance	Calibration check	Contractor	Annual	Calibration w/in tolerances.	Per contractor recommendations	D-9

B7 Instrument/Equipment Calibration and Frequency

B7.1 Field Equipment Calibration

The SOPs in Appendix C-3 detail field meter calibration methods and Table B7-1 summarizes the field meter calibrations.

Table B7-1: Field Analytical Instrument Maintenance and Calibration Table

Equipment	Procedure	Frequency	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Temp/DO meter	C-3	Each use	100% saturation	- Check battery - Wet sponge - Check for bubbles/scratches in membrane	Coordinator, intern, sat. lab manager, volunteer	C-3
YSI 85 Field Conductivity/ DO Meter	C-3	Each use	100% saturation	Check battery - Wet sponge - Check for bubbles/scratches in membrane	Coordinator, intern, sat. lab manager, volunteer	C-10

B7.2 Laboratory Equipment Calibration

Table B7-2 summarizes the JCLC, CSC LSPA and PSU CFE laboratory equipment calibration and frequency. Meter specific maintenance log books record daily calibration and verification information at the JCLC and Satellite Laboratories. These log books also contains a standards log which tracks the Lot # and expiration dates. Laboratory equipment calibration and frequency in the NHDHHS PHL WAL is in accordance with the Quality Systems Manual, Revision 2.5, July 2013, on file at EPA.

Table B7-2: Fixed Laboratory Analytical Instrument Maintenance and Calibration Table

Instrument	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Method/ SOP Reference
TP	Daily	ICV = +/- 10% of 0.100 ICV[3] = +/- 20% of 0.005 +/- 10% of 0.050, 0.100, 0.200	Check standards, recalibrate	Satellite Lab Managers	D-6
E. coli	Daily	Calibrate to known calibration standards	Check standards, recalibrate	Satellite Lab Managers	D-7
Chloride	Daily and after CCV failure	ICV = +/- 10% of 100 CCV = +/- 10%	Check standards, recalibrate	JCLC or Satellite lab Personnel	D-16
pH	Daily and after CCV failure	ICV = +/1 0.10 pH unit CCV = +/- 0.10 pH unit	Check standards, recalibrate	JCLC or Satellite lab Personnel	D-1
Conductivity	Daily and after CCV failure	ICV = +/- 10% of 100 CCV = +/- 10%	Check standards, recalibrate	JCLC or Satellite lab Personnel	D-3
Turbidity	Daily and after CCV failure	CCV = +/- 10%	Check standards, recalibrate	JCLC or Satellite lab Personnel	D-4
Chlorophyll-a	Quarterly/ Annually	Calibrate to known calibration standards	Check standards, recalibrate	JCLC or Satellite lab Personnel	D-5
Phytoplankton	Annually	Calibrate to known standards	Recalibrate	Outside contractor	D-9

B8 Inspection/Acceptance of Supplies and Consumables

Standard materials, solutions, and reagents ordered by the JCLC and satellite laboratories are inspected by the QA/QC Officer and Lab Managers upon receipt to verify that proper materials were shipped. Lot numbers and expirations dates are recorded in parameter specific bench books. The JCLC reagent water source is a Millipore Milli-RX75 Reverse Osmosis / ELIX system which produces high quality Type II water with resistivity >15 megOhms. The system is maintained under a service contract with Millipore. Standard materials, solutions and reagents prepared in the JCLC, CSC LSPA and PSU CFE satellite laboratories are recorded in log books which contain the chemical lot number, weights, preparer's initials, date prepared, and expiration date. Inspection and acceptance of supplies and consumable in the NHDHHS PHL WAL are in accordance with the QSM on file at EPA.

Sample bottles are examined by JCLC and satellite laboratory staff prior to use. The VLAP Coordinator, the VLAP Intern, and the volunteer monitors bring extra sample bottles in the field in the event that contamination or damage of a sample bottle occurs. Bottle washing occurs according to the NHDES JCLC Laboratory Manual (section V of Appendix D-17), the CSC LSPA Bottle Washing and Care SOP (Section III of Appendix D-18), and the PSU CFE Bottle Washing and Care SOP (Section III of Appendix D-19). Bottle washing, inspection and maintenance in the NHDHHS PHL WAL are in accordance with the QSM on file at EPA.

B9 Non-direct Measurements

VLAP utilizes lake bathymetric map information created by the NHDES LTS Program. Lake bathymetric maps are used to help locate the deep spot of the lake, and the inlets and outlets, so that the biologists and volunteer monitors know where to conduct sampling activities. Specifically, since 1975, the NHDES LTS Program has surveyed the majority of the lakes in the state using fathometers and transect lines to generate bathymetric maps. The VLAP Coordinator assumes that the location of the deepest spot of the lake shown on the bathymetric map is accurate, unless the volunteer monitors can physically prove that there is a deeper spot in the lake during the annual biologist visit. Volunteer monitors are required to complete a field data sheet that requests information on recent precipitation events and how much precipitation occurred. Volunteers typically gather this information from rain gauges or commonly utilized weather websites such as The Weather Channel, the National Weather Service, Accuweather, and the National Climatic Data Center.

B10 Data Management

B10.1 Project Data Management Process

FIELD DATA

Field data sheets (Appendix C) are completed for each sampling event by biologists, interns and volunteer monitors. Field recordings are made in ink. Volunteer monitors also complete and sign the Volunteer Monitor Field Sampling Procedures Checklist (Appendix C-11) when sampling on their own. Field data sheets returned with samples are inspected for completeness upon receipt by laboratory personnel. Dissolved oxygen and temperature profile information are recorded on a field data sheet (Appendix C-8) and also stored in the meter. The VLAP Coordinator, interns or Satellite Laboratory Manager downloads data from the meters into a Microsoft Access database, or hand enter where necessary. The downloaded data are compared to the field data sheet to verify and any necessary corrections made. The VLAP Coordinator, intern, Satellite Laboratory Manager, or volunteer monitor document new sampling stations on the Station Identification Form or the back section of the Field Data Sheet (Appendix C-5). The VLAP Coordinator creates new stations in the Environmental Monitoring Database (EMD), an Oracle application, and station specific data are hand entered. The VLAP Coordinator or intern update GIS coverage in ArcGIS 10.1 software and new station maps are

generated (Appendix A-2). Completed data sheets, checklists and forms are secured in clipboards in the field and filed in year specific folders at NHDES for at least five years.

LABORATORY DATA

Analytical data generated from the JCLC, CSC LSPA and PSU CFE is entered immediately upon analysis into meter-respective bench books utilizing blue or black ink pens. These data are entered weekly into the JCLC Log-In System, a Microsoft Access database, and are cross-referenced with bench book data upon printout by the JCLC QA/QC Officer or designee and Satellite Laboratory Manager or designee. Personnel who enter and QC check data add their initials to the bench book for accountability purposes. Chlorophyll-a sample data are entered into a bench book upon filtering, and analytical data generated by the spectrophotometer are either hand entered into the bench book and log-in database or electronically transferred to meter specific software and the log-in database. Phytoplankton genera counts are recorded on a data sheet, relative percent dominance calculated, and the three dominant genera are recorded on data sheets in the appropriate section of the bench book. The data are entered monthly, or more frequently, into the JCLC Log-In System and cross-referenced with bench book data upon the end of the sample season by the VLAP Coordinator or VLAP Intern. Examples of bench book data sheets are included in Appendix D-11. Once per season, after all data have been analyzed, entered and QC checked, the Satellite Laboratories email an electronic copy of their log-in system, which contains all of the analytical data for the season to the JCLC QA/QC Officer. The data are then uploaded to the NHDES EMD by the WMB Data Management Specialist. This database stores all of the raw data generated for each lake since it joined VLAP. Hard copies of data sheets that contain raw data results are kept on file at the JCLC, CSC LSPA and PSU CFE for at least five years.

Analytical data generated from the NHDHHS PHL WAL are recorded and verified according to the NHDHHS PHL WAL QSM and electronically imported into the NHDES EMD nightly. An error report is generated for data that fails to be exported. The VLAP Coordinator consults with the WMB Data Management Specialist, corrects errors, and the data is re-exported into the EMD.

DATA TRANSFORMATIONS/DATA REDUCTION

Field duplicate data are evaluated at the end of the sampling season to determine whether they meet the quality control criteria. If the criteria are not met, the data are marked as invalid in the EMD and are not utilized for reduction or reporting purposes. For reporting purposes, linear regression analyses are performed utilizing Microsoft Excel according to Appendix E-6. Individual data tables are generated utilizing Cognos software that display current year average values per lake per station. Current year dominant phytoplankton genera as well as dissolved oxygen and temperature profiles are displayed graphically utilizing Microsoft Excel. Historical average annual chlorophyll-a, transparency, and epilimnetic pH, total phosphorus, conductivity, chloride, ANC, and turbidity data are displayed graphically utilizing Sigmot Plot v. 10.0 software and Microsoft Excel. In general, the data for each lake that participated in the current sampling season are analyzed and current year and historical trends are characterized and discussed in an Individual Report for each lake, and a Regional Report for seven geographic regions in NH (Appendix E and Section A 9.0).

DATA TRANSFER/TRANSMITTAL

Data are frequently copied and pasted between various programs depending on the need for various statistical analyses and graphic capabilities of software. Transferred data are cross-referenced with original data. All VLAP data housed in the NHDES EMD are submitted to EPA via WQX on an annual basis.

C ASSESSMENT AND OVERSIGHT

C1 Assessments and Response Actions

FIELD ASSESSMENTS

The VLAP Coordinator is responsible for the training and assessment of the VLAP Intern and Satellite Laboratory Managers to perform field sampling activities according to the SOPs. At the beginning of the sampling season, the VLAP Intern and Satellite Laboratory Managers are trained, or re-trained if necessary, on the proper field sampling SOPs according to the VLAP Intern Field Sampling Procedures Assessment Audit (Appendix B-2). Deviations from sampling protocols are evaluated and corrected immediately with verbal communication and noted on the audit field data sheet. Once the VLAP Intern or Satellite Laboratory Manager successfully completes three sampling audits, they are approved to conduct biologist visits.

Field Sampling Technical Systems Audits (TSA) are conducted biennially during the biologist visit to the participating volunteer monitoring group. Deviations from sampling protocols and project deficiencies are evaluated and corrected immediately with verbal communication and re-training and noted on the annual assessment audit field data sheet (Appendix B-3), copies of which are supplied to the volunteer monitor. Volunteers are also encouraged to attend the Annual VLAP Refresher Workshop and view the VLAP Training Video available on YouTube to refresh sampling skills prior to the start of the sampling season. Revisions to SOPs are made if deemed necessary by the VLAP Coordinator. Field sampling activities are further monitored through field and laboratory checklists to determine continued compliance (Appendix C).

When volunteer monitors sample on their own they are required to complete the Volunteer Monitor Field Sampling Procedures Checklist (Appendix C) to assist with adherence to field sampling SOPs. Upon drop off of samples in the laboratory, staff complete the VLAP Sample Receipt Checklist (Appendix D-14) to identify any deviations from field sampling SOPs. The deviations are noted on the checklist, the sample log-in system, and if necessary samples are rejected for analysis. Corrective actions are communicated to the volunteer monitors in-person or as soon as possible by the VLAP Coordinator, VLAP Intern or Satellite Laboratory Manager in order to minimize, and hopefully eliminate, future sampling deficiencies. If deviations in sampling techniques are consistently identified, retraining of volunteer monitors is scheduled more frequently.

LABORATORY ASSESSMENTS

The VLAP Coordinator, JCLC QA Officer and Satellite Laboratory Managers are responsible for training interns in analytical method SOPs and performing corrective actions if deviations from analytical method SOPs occur. Interns are required to complete the NHDES Limnology Center Intern Training Form (Appendix B-1) prior to performing laboratory analyses on their own. Deviations from analytical method SOPs are identified during training and corrected immediately. Periodically, interns may be re-evaluated and re-trained if inconsistencies are noted in bench book data or questions arise in the laboratory.

NHDES JCLC, CSC LSPA and PSU CFE laboratory assessments are conducted weekly. The JCLC QA Officer and Satellite Laboratory Managers review weekly bench book data reports, calibrations, and quality control data to look for outliers in data points. Duplicate acceptance criteria are monitored and deviations are evaluated to determine error and corrective actions implemented immediately. Analytical data are entered into the JCLC Log-in System weekly and cross-referenced with bench books for accuracy by the JCLC QA Officer and Satellite Laboratory Managers or their designee. Deviations are addressed in both written and verbal formats, and if necessary a TSA will be performed to correct the problem.

The NHDHHS PHL WAL Fixed Laboratory TSA is performed annually and more frequently if a problem arises by the QA/QC Officer. Corrective measures are taken immediately to address deviations or project

deficiencies from the QSM. Replicates and critical range tables are checked with data to determine if sources of error exist. Data are entered into the computer weekly and cross-referenced with bench books for accuracy. Any deviations in results are addressed in both written and verbal formats, and future analyses are monitored to verify that compliance is reached.

COMBINED FIELD & LABORATORY ASSESSMENTS

Field duplicate samples are assessed as part of the fixed laboratory and field TSA on a weekly basis. The TSA occurs prior to the analytical results being sent to the volunteer monitors. Analytical results of field duplicates are compared to project acceptance criteria. Any deviations in results are addressed in both written and verbal formats, and future sampling and analysis is monitored to verify that compliance is reached.

C2 Reports to Management

The VLAP Coordinator completes an annual NHDES QA System Self Audit and submits the report to the NHDES QA Manager on its ability to meet program quality assurance requirements. The VLAP QAPP is reviewed annually through this process. The NHDES also has a Measures Tracking and Reporting System (MTRS), an Oracle application, which allows management to track the progress of certain projects. The VLAP Coordinator updates MTRS quarterly. VLAP also includes the annual audit information in the annual NHDES JCLC QA/QC Report prepared by the JCLC QA Officer. The Annual NHDES JCLC QA/QC Report is provided to JCLC staff, NHDES QA Manager, upper management at NHDES, and representatives of the EPA, as listed in Table C2-1.

Table C2-1: NHDES Jody Connor Limnology Center QA/QC Report Distribution List

Individual/Title	Agency	Contact Information
Thomas Burack Acting Commissioner	NHDES	Thomas.burack@des.nh.gov
Harry Stewart Water Division Director	NHDES	Harry.stewart@des.nh.gov
Ted Diers Watershed Management Bureau Administrator	NHDES	theodore.diers@des.nh.gov
Jim Martin Public Information Center	NHDES	jmartin@des.state.nh.us
Katrina Kipp and Hilary Snook EPA Region 1	EPA	Kipp.katrina@epa.gov Snook.hilary@epa.gov
Vince Perelli DES QA Manager	NHDES	Vincent.perelli@des.nh.gov
Scott Ashley JCLC QA Officer	NHDES	Scott.ashley@des.nh.gov
David Neils JCLC Director	NHDES	David.neils@des.nh.gov
NHDES JCLC Staff	NHDES	various
Sara Steiner VLAP Coordinator	NHDES	Sara.steiner@des.nh.gov

D DATA VALIDATION AND USABILITY

D1 Data Review, Verification, and Validation

The JCLC QA Officer, Satellite Laboratory Managers and PHL WAL QA Officer review analytical data to check for transcription errors, calculation errors and completeness prior to transfer to the EMD. The VLAP Coordinator, Interns and Satellite Laboratory Managers review field data to check for transcription errors, calculation errors and completeness prior to transfer to the EMD. Issues that are identified or arise during the data review process are immediately communicated to the parties involved and corrected where necessary. Once the data are reviewed and transferred to the EMD, the VLAP Coordinator verifies data meet project specifications during the monthly data reporting, annual audit and report writing process. Data that do not meet project specifications and field duplicate data that do not meet stated RPD or acceptance criteria are invalidated in the EMD by the VLAP Coordinator.

D2 Verification and Validation Methods

Verification and validation of data generated from the NHDES JCLC and Satellite Laboratories are compliant with the appropriate laboratory manuals and stated acceptance criteria in A7 Quality Objectives and Measurement Performance Criteria. Verification and validation of data generated from the NHDHHS PHL WAL is compliant with the QSM, revision 2.5, or more current version on file at EPA and stated acceptance criteria in A7 Quality Objectives and Measurement Performance Criteria. Table D2-1 provides a brief overview of the process that will be followed to verify and validate data.

Table D2-1: Data Verification Process

Verification Task	Description	Responsible for Verification
Field Data	Field data sheets are collected at the end of each sampling event and analyzed for completeness and accuracy.	VLAP Coordinator VLAP Intern JCLC Personnel Satellite Lab Managers
NHDES JCLC Data	Applicable data are subject to 10% duplicate analysis and acceptance criteria in the lab. The QA/QC officer checks the accuracy of these samples. Lab personnel conduct data entry and compare to bench book data.	JCLC QA Officer JCLC Personnel
Satellite Laboratories	Applicable data are subject to 10% duplicate analysis and acceptance criteria in the lab. The lab manager checks the accuracy of these samples. The results of these checks are reported to the NHDES JCLC QA Officer. Satellite Lab interns conduct data entry and comparison to bench book data.	Satellite Laboratory Managers Satellite Laboratory Interns
NHDHHS PHL WAL	Data are checked by the laboratory QC personnel and then transferred to the EMD where it is checked by the VLAP Coordinator.	PHL WAL QA Officer VLAP Coordinator
"Regional Reports" and "Individual Lake Reports" Data Analyses and Recommendations	The annual reports for each lake are analyzed for content, accuracy, and recommendations made for sampling activities, QA issues, and water quality problems revealed during each sampling season.	VLAP Coordinator

D3 Reconciliation with User Requirements

Data are generated based on field and analytical SOPs (Appendices C and D) and the quality objectives defined in Section A7 and verified according to sections D1 and D2. Data not meeting acceptable performance criteria are not utilized in evaluating lake water quality. The cause of failure is evaluated. If the cause is found to be sampling error, volunteers are retrained. If the cause is found to be equipment failure, calibration/maintenance techniques are reassessed and improved. If failure to meet program specifications is found to be unrelated to equipment, methods, or sample error, specifications may be revised for the next sampling season. Revisions will be submitted to the EPA Quality Assurance Officer for approval.

Acceptable data are utilized to evaluate lake specific water quality data, identify water quality issues, and make recommendations on addressing the issues. Statistical analyses are performed on in-lake data to determine any significant trends, if no significant trends are detected; the data are evaluated for the degree of variability over time. Any limitations of the data are clearly defined for all users of the reports produced.