Maine Lake Assessment, Quality Assurance Program Plan

State of Maine, Department of Environmental Protection
Bureau of Land and Water Quality
Division of Environmental Assessment
Lake Assessment Section

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Review Signatures:

Maine DEP's Quality Assurance Manager:_____ _____
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Bureau Director, Bureau of Land &Water Quality:_____ _____
Andrew Fisk, Maine DEP Date

Division Director, Div. of Environmental Assessment:_____ _____
David L. Courtemanch, Maine DEP Date

Section Leader, Lake Assessment Section:_____ _____
Roy J. Bouchard, Maine DEP Date

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Linda C. Bacon, Maine DEP Date

External Technical Reviewer:_____ _____
Katherine Webster, PhD, Limnologist, Univ. of Maine Date

Approval Signatures:

Chair, QA Program/Project Plan Review Team:_____ _____
Malcolm C Burson, Maine DEP Date

EPA QA Officer, US EPA, Region I:_____ _____
Alan Peterson, EPA Region I Date

EPA Project Officer, US EPA, Region I:_____ _____
Jennie Bridge, EPA Region I Date

[A1. Title and Approval Sheet (Element1)]

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[A2. Table of Contents (Element2)]

1. Background

Organizations conducting environmental programs such as the State of Maine, Department of Environmental Protection, that are wholly or partially funded by the United States Environmental Protection Agency (EPA), are required to establish, implement and maintain a Quality Management Plan (QMP). An EPA approved QMP is a structured system that describes the policies and procedures for ensuring that work processes, products, and services satisfy previously established specifications. The intent of establishing a quality system is to assure products and decisions forthcoming from the entity are of known quality and are thus scientifically and legally defensible. The State of Maine, Department of Environmental Protection is currently operating under a QMP, entitled "Quality Management Plan", that was EPA approved 5/23/01. This plan outlines a Quality Management System that takes an audit-based approach to water quality management and improvement.

EPA also requires that all environmental data used in the decision making process, are implemented and thus supported by an approved Quality Assurance Project/Program Plan (QAPP). QAPPs are intended to document the various elements of a project from 'A to Z'. QAPPs will, at minimum, contain information about four basic elements of the project: A. Project Management, B. Data Generation and Acquisition, C. Assessment and Oversight, and, D. Data Validation and Usability.

EPA has allowed two approaches to QAPP development. The first is a project-specific approach where all four basic elements are addressed in detail. The second is a generic program approach, where detail is given for elements that all projects share, and, project specific details including specific SOP versions followed, are documented in project specific Sampling and Analysis Plans (SAPs), which reference the Program QAPP. This document represents a generic Quality Assurance Program Plan for the State of Maine, Department of Environmental Protection's Lake Assessment Program. Included in the Appendix are Standard Operating Procedures used by the Lake Assessment Program. Since this document is the first QAPP to be developed for the Lake Assessment Program, but data being used for decision making have been collected since 1970, the appendix includes references to documents that were used as data collection guidelines historically (pg. 32, Section 9.11). Most of these documents have since been retired; this initial program QAPP is the only one that will include copies of the historical guidelines.

Any number of SAPs may be developed as companions to this document. It is anticipated that annual project specific SAPs will be developed for Total Maximum Daily Load (TMDL) related sampling being implemented on 303(d) listed Maine lakes. Specific 319 projects sponsored by DEP cooperators are also likely to refer to the Lake Assessment QAPP and possibly to related project specific SAPs, as necessary.

A Memorandum of Understanding between MEDEP and EPA-NE, dated 2/4/02, outlines the distribution of responsibilities for QAPP approvals. This program QAPP is the first developed under this agreement and as such, requires approval from both MEDEP and EPA-NE. Review of this QAPP will occur annually and will be re-approved or retired no later than five years from

the original approval date. Project specific SAPs developed subsequently, require external review (possibly from EPA-NE), but final approval will reside with the MEDEP. Such SAPs will require annual submission and review. Revisions or updates will be made as necessary.

2. Purpose

The purpose of this document is twofold. First, it is intended to serve as a general QAPP for many of the routine monitoring activities conducted by the Lake Assessment Section of the DEP. Ongoing monitoring activities or projects include the *Volunteer Lake Monitoring Program* (VLMP), *DEP Lake Baseline Sampling*, and *Lake TMDL Sampling*. Special short-term projects may be conducted that will also follow procedures covered in this document. Although much of the monitoring conducted by the section is not supported by EPA funds, this monitoring has and will continue to be done in a scientifically defensible manner. Following established procedures is necessary to maintain consistency, comparability and valid analyses of data collected. Prior to 2002, lake monitoring was conducted in accordance with collections of procedures documented in agency publications or in various editions of Standard Methods for the Analysis of Wastewater. This document is intended to provide a more 'dynamic system' including a collection of procedures (Appendices 9.4 – 9.7) that can be modified or replaced at the individual level, with a traceable trail of archived procedures. This approach will allow future users of the data to see exactly which procedures were used at any given point in the history of data collection.

It is recognized that there are areas where all Maine lake projects overlap and other areas which differ widely. This document provides references that may be used to simplify the development of a project specific Sample and Analysis Plan (SAP). A SAP provides specifics for projects that deviate from the contents of this QAPP. For example, Project Element A, Project Management, is likely to be specific and perhaps unique to each project. Similarly, SOPs followed by a particular project are likely to be a subset of the SOPs included in the Appendix and are more effectively referenced within a project specific SAP. Sampling frequency is also likely to be specific to a project. A SAP Element Template may be found in Section 9.1.

EPA promotes a 'graded approach' to QAPP development. This approach encourages a level of detail that is appropriate for the nature of the work being performed and the intended use of the data. Thus QAPPs vary from a qualitative discussion of the experimental process and its objectives to extensive documentation of a complex environmental program. It is important to clarify that this Lake Assessment Program QAPP fits somewhere in between the extremes of this graded scheme. Lake Assessment activities vary from the statewide screening of trophic related parameters to in-depth data collection for the purposes of completing a TMDL. Screening parameters and sampling regimes are fairly simple in contrast to the in-depth TMDL studies, which measure a considerable number of parameters more frequently. This Program QAPP allows project specific SAPs to reference portions necessary to achieve project goals.

Table 1 summarizes the specific QAPP development details required by EPA.

Table 1. QAPP Development Details.

1. Guidance Used to Prepare QAPP	Region I, EPA Compendium QAPP Guidance (Final: October, 1999)
	EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5 (Interim Final, Nov. 1999)
	The State of Maine, Department of Environmental Protection, Quality Management Plan (5/23/01)
	Memorandum of Understanding between EPA New England and Maine DEP which describes mutual responsibilities pertaining to EPA-required Quality Management Standards (Feb. 4, 200)
	Personal communication with Malcolm Burson, Quality Assurance Manager, ME DEP and Jennie Bridge, EPA Project Officer, EPA-Region 1
2. EPA & State Programs	Federal Clean Water Act: Section 314, Section 319, Section 104(b)3, Section 106, Section 305(b)
	Maine Revised Statutes Annotated, Title 38, Water Classification Program
3. Approval Entities	EPA-NE
	ME DEP
4. QAPP Type	Generic Maine Lake Assessment Program QAPP
5. Dates of Scoping Meetings	July 10, 2001; Oct. 31, 2001; Jan. 10, 2002; Jan 29, 2002; personal communication in person or via email with various 'stakeholders'.
6. Previous QAPP documents	This is the first Lake Assessment Program QAPP. The following project specific QAPPs were developed between section staff and external cooperators, approved by EPA:
	State of Maine Volunteer Lake Monitoring Program (1/2/97)
	Cobbossee Lake Restoration by Reduction of Phosphorus in Jock Stream Watershed (6/16/00)
7. Organizational Partners	N/A (Lake Assessment Staff listed elsewhere; Cooperators identified within project specific QAPPs)
8. Data Users	State of Maine Lake Assessment Staff, Land and Water Bureau, Inland Fisheries and Wildlife Staff, Volunteer Lake Monitoring Staff, Limnological Researchers at Universities/Colleges, County and Municipal Planners, Citizens

3. Applicability

This Lake Assessment Quality Assurance Program Plan is intended to serve as an 'umbrella' document under which specific lake project SAPs may be developed. Project specific SAPs will document any and all deviations from the 24 elements included in this QAPP. Typical deviations include names of personnel involved with a project, scope and intensity of project sampling plans. For example, the Lake Total Maximum Daily Load (TMDL) Program SAP is a project specific SAPs linked to this QAPP that is updated on an annual basis. It is anticipated that all SAPs developed in association with this one will have an agency staff member taking the lead in their development. Agency staff operating under this QAPP, or likely to assist an outside entity in the development of a project specific SAP, receive a hard copy of this document and are listed in the Distribution List found in Table 2. These individuals will receive updates to this document. This list may be added to at any time. Table 3 is an example of the signature page on file for program personnel associated with the Maine Lake Assessment Program. Completion of columns 4 through 6, although typewritten, indicates receipt of signed copy.

Table 2: Maine Lake Assessment Quality Assurance Program Plan Distribution List.

QAPP Recipient	Title	Organization	Telephone Number
Malcolm C Burson	Quality Assurance Officer	Commissioner's Office, Maine DEP	207-287-7755
Andrew Fisk	Director	Bureau of Land & Water Quality, Maine DEP	207-287-7849
David L Courtemanch	Director, Division of Environmental Assessment	Bureau of Land & Water Quality, Maine DEP	207-287-7789
Roy Bouchard	Biologist III, Lake Assessment Section	Bureau of Land & Water Quality, Maine DEP	207-287-7798
Linda C Bacon	Biologist II, Lake Assessment Section	Bureau of Land & Water Quality, Maine DEP	207-287-7749
David Halliwell	Biologist II, Lake Assessment Section	Bureau of Land & Water Quality, Maine DEP	207-287-7649
Judy Potvin	Biologist I, Lake Assessment Section	Bureau of Land & Water Quality, Maine DEP	207-287-7782
Karen Hahnel	Environmental Science Specialist III, Lake Assessment Section	Bureau of Land & Water Quality, Maine DEP	207-287-7732
John McPhedran	Biologist I, Lake Assessment Section	Bureau of Land & Water Quality, Maine DEP	207-287-6110
Scott Williams	Executive Director	Maine Volunteer Lake Monitoring Program	207-783-7733
Norm Marcotte	NPS Coordinator	Bureau of Land & Water Quality, Maine DEP	207-287-7727
Jennie Bridge	EPA Project Officer	US EPA Region I	617-918-1111
Wendy Dennis	Limnologist/Planner	Cobbossee Watershed District	207-377-7111

[A3. Distribution List (Element3)]

Table 3: Maine Lake Assessment Quality Assurance Program Personnel Sign-Off Sheet.

QAPP Recipient	Title	Telephone Number	QAPP Acceptance Date	Signature
Roy Bouchard	Biologist III, Lake Assessment Section	207-287-7798		
Linda Bacon	Biologist II, Lake Assessment Section	207-287-7749		
David Halliwell	Biologist II, Lake Assessment Section	207-287-7649		
Judy Potvin	Biologist I, Lake Assessment Section	207-287-7782		
Karen Hahnel	Environmental Science Specialist III, Lake Assessment Section	207-287-7732		
John McPhedran	Biologist I, Lake Assessment Section	207-287-6110		
Scott Williams	Executive Director, VLMP	207-783-7733		
Norm Marcotte	NPS Coordinator	207-287-7727		

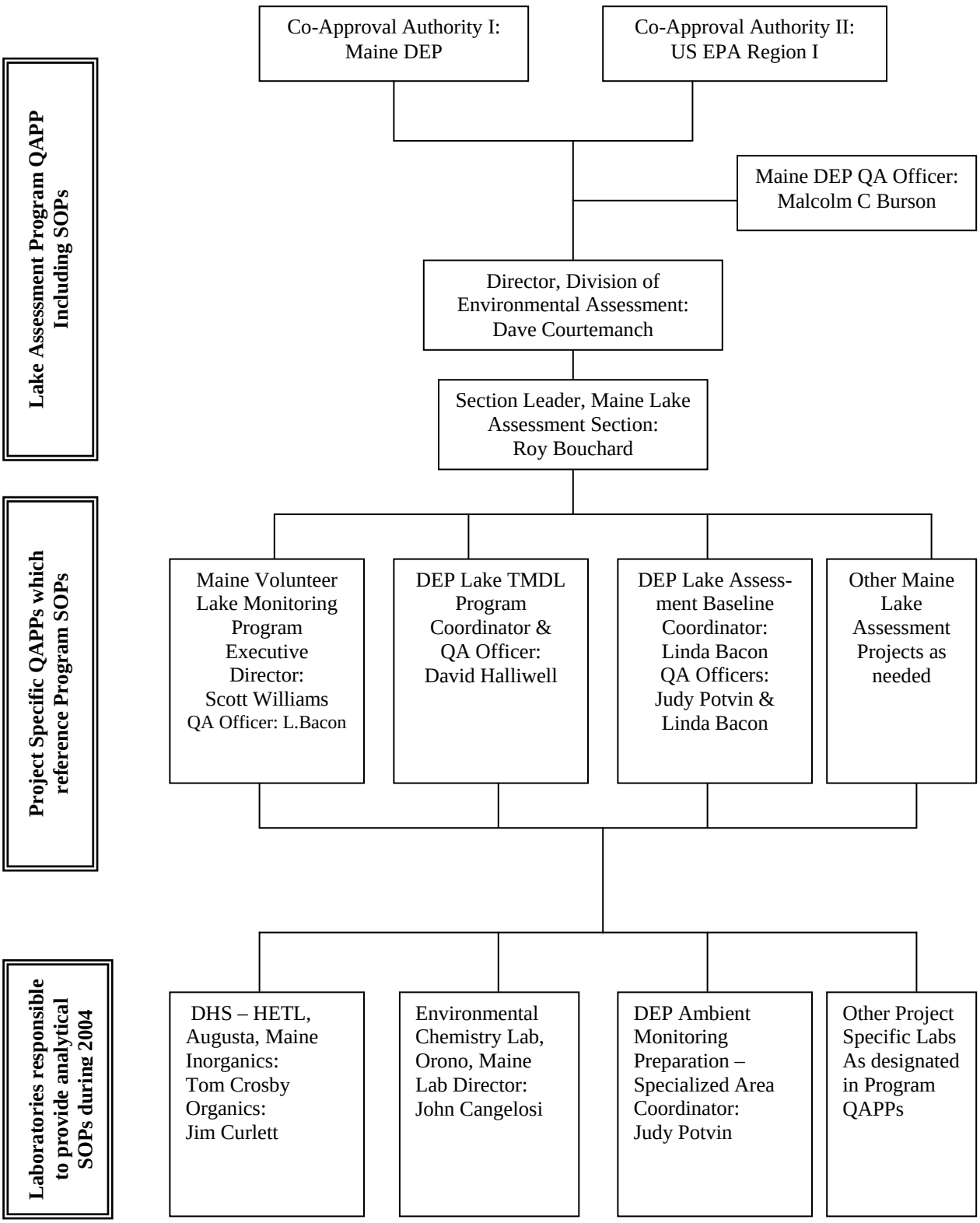
4. Additional Program/Project Management Elements

4.1 Program Organization.

[A4. Project/Task Organization (Element4)]

Figure 1 illustrates the organizational structure of the Lake Assessment Program as it pertains to this Quality Assurance Project Plan.

Figure 1: Organizational Chart.


Lake Assessment Program QAPP Including SOPs
Co-Approval Authority I: Maine DEP
Co-Approval Authority II: US EPA Region I
Maine DEP QA Officer: Malcolm C Burson
Director, Division of Environmental Assessment: Dave Courtemanch
Section Leader, Maine Lake Assessment Section: Roy Bouchard
Project Specific QAPPs which reference Program SOPs
Maine Volunteer Lake Monitoring Program Executive Director: Scott Williams QA Officer: L.Bacon
DEP Lake TMDL Program Coordinator & QA Officer: David Halliwell
DEP Lake Assess-ment Baseline Coordinator: Linda Bacon QA Officers: Judy Potvin & Linda Bacon
Other Maine Lake Assessment Projects as needed
Laboratories responsible to provide analytical SOPs during 2004
DHS – HETL, Augusta, Maine Inorganics: Tom Crosby Organics: Jim Curlett
Environmental Chemistry Lab, Orono, Maine Lab Director: John Cangelosi
DEP Ambient Monitoring Preparation – Specialized Area Coordinator: Judy Potvin
Other Project Specific Labs As designated in Program QAPPs

The Maine Volunteer Lake Monitoring Program (VLMP) is listed under the Lake Assessment Program because of the interdependence that exists between it and the DEP. Although the VLMP is a 'stand alone', non-profit organization, a close working partnership exists between many staff members in the agency and the personnel running day-to-day operations of the VLMP. In addition, they receive approximately one third of their funding from EPA's 319 program, with the Lake Assessment Program's ongoing QA assistance. Technically they are not part of the DEP, but functionally they are an integral part of Maine's lake management program.

Effective communication is necessary to conduct any project under the Lakes Assessment Program. The communication pathways outlined in the following are meant to give a first contact for resolving specific issues. Since the program involves a relatively small number of individuals, most communications are informal.

Two laboratories are generally used for sample analyses in addition to our division's wet lab. The contact for the State of Maine Department of Human Services, Health and Environmental Testing Laboratory inorganics section is Tom Crosby [(207) 287-1710]. The contact for the Environmental Chemistry Lab at the University of Maine in Orono is John Cangelosi [(207) 581-3239]. The contact for the Division of Environmental Assessment field preparation room/lab is Judy Potvin [(207) 287-7782]. These individuals are contacted prior to the sampling season to discuss anticipated analytical needs, cost of analysis or project costs, and specifics about obtaining the proper sample bottles/preservative. During the sampling season, the same individuals are the first contacts for quality assurance issues, reruns and electronic data questions. Project specific SAPs will include any modifications to this list.

Sampling for specific projects is conducted in an organized manner with someone acting as 'Project Manager'. This person will be designated in the project SAPs and is the contact for field issues.

4.2 Problem Definition/Background.

[A5. Problem Definition/Background (Element5)]

The Maine Lake Assessment program is part of the Division of Environmental Assessment, in the Bureau of Land and Water Quality within the Maine Department of Environmental Protection. The 'lakes program' was one of the first established when the Agency was in its infancy as the Environmental Improvement Commission. Lake data were first collected under this program in 1970; volunteer monitors began collecting data under the program shortly thereafter. Most lake monitoring has been related to assessment and management of lake trophic state. Maine statutory classification (Title 38, Section 365-A) of 'Great Ponds' (lakes/ponds > 10 acres in size or if man-made and originally < 10 acres, > 30 acres in size) and natural ponds & lakes less than 10 acres in size is **GPA**. Class GPA specifies:

> A. Class GPA waters shall be of such quality that they are suitable for the designated uses of drinking water after disinfection, recreation in and on the water, fishing, industrial process and cooling water supply, hydroelectric power generation and navigation and as habitat for fish and other aquatic life. The habitat shall be characterized as natural. [1985, c. 698, § 15 (new).]

B. Class GPA waters shall be described by their trophic state based on measures of the chlorophyll "a" content, Secchi disk transparency, total phosphorus content and other appropriate criteria. Class GPA waters shall have a stable or decreasing trophic state, subject only to natural fluctuations and shall be free of culturally induced algal blooms which impair their use and enjoyment. The number of *Escherichia coli* bacteria of human origin in these waters may not exceed a geometric mean of 29 per 100 milliliters or an instantaneous level of 194 per 100 milliliters. [1985, c. 698, § 15 (new).]

C. There may be no new direct discharge of pollutants into Class GPA waters. Aquatic pesticide treatments or chemical treatments for the purpose of restoring water quality approved by the department and storm water discharges that are in compliance with state and local requirements are exempt from the no discharge provision. Discharges into these waters licensed prior to January 1, 1986, are allowed to continue only until practical alternatives exist. No materials may be placed on or removed from the shores or banks of a Class GPA water body in such a manner that materials may fall or be washed into the water or that contaminated drainage therefrom may flow or leach into those waters, except as permitted pursuant to section 480-C. No change of land use in the watershed of a Class GPA water body may, by itself or in combination with other activities, cause water quality degradation that would impair the characteristics and designated uses of downstream GPA waters or cause an increase in the trophic state of those GPA waters. [1999, c. 243, §9 (amd).]

Section B has been the driving force behind much of the lake monitoring done over the past 3+ decades. The program has monitored lakes in varying intensity. General characterizations of trophic state have been made using 'snapshot' data, likely a visit by staff during a lake's period of peak productivity (late summer) when lakes having an abundance of nutrients are most likely to be showing signs of trophic ‘stress’. At this time, warm water temperatures have been sustained for a month or more, some nutrients may be limiting, and plankton populations have reached peak abundance. As plankton cells die and settle into deeper areas of stratified lakes, this organic input can cause populations of decomposers to peak and consume what oxygen remains in the non-epilimnetic volume. Cold-water fish species may experience stress due to diminishing oxygen levels. In some lakes, sediments may release phosphorus into overlaying waters, which due to micro circulation patterns may reach the epilimnetic waters to fuel additional algal growth. Better characterizations have been made using such snapshots in conjunction with volunteer collected data. When trophic state has been determined to fall at the far end of the eutrophic range, volunteer data collected biweekly during the growing season is relied on almost exclusively, to determine whether or not the lake supports nuisance algal blooms.

The group of species generally responsible for nuisance “algal” blooms in Maine lakes is Cyanophyta, commonly known as the “blue-greens”. Originally classified as algae, this group is now classified as bacteria although they function similarly to algae. This group can take advantage of situations where the nutrient phosphorus is abundant but nitrogen becomes limiting, due to their ability to 'fix nitrogen' from the atmosphere. Blue-green populations can reach 'nuisance' conditions in late summer, impairing human use of the lake resource by reducing transparency and emitting odors associated with decomposition. Lakes that support 'culturally induced' algal blooms (more than five in the most recent ten-year period) are considered to be in non-attainment of their water quality standards.

The Lake Assessment Section utilizes various approaches to evaluate attainment status including the ***Volunteer Lake Monitoring Program*** (VLMP), ***Lake Baseline Sampling***, and ***Lake TMDL Sampling***. Each of these will use the SOPs included in the appendix of this document to assure that data is comparable/compatible. The VLMP generates 'screening data' used by DEP as a 'first alert' that a lake may be experiencing attainment issues related to nutrient enrichment. Volunteers predominantly collect transparency data, which the Lake Baseline Sampling program with collection of additional parameters once every five years. When staff are confident that a lake is in non-attainment, it is listed under Section 303(d) and will be put in the queue for TMDL model development. TMDL Sampling begins a few years before the model is developed to help elucidate nutrient sources and nutrient cycling patterns that are contributing to the non-attainment condition. Annual SAPs are produced for TMDL Sampling. In addition, ***Special Projects*** are set up as the need arises. Special projects, wholly or partially funded with federal money, will have a SAP that states the problem to be solved, decision or outcome to be achieved and will include relevant background to provide perspective (historical, scientific and regulatory).

4.3 Project/Task Descriptions

[A6. Problem Definition/Background (Element6)]

The Lake Assessment Section is involved in a number of projects that are ongoing, including the Volunteer Lake Monitoring Program, monitoring of TMDL lakes, and Lake Baseline Sampling. An overview of each project is provided and should be referred to in annual SAPs. Changes to projects and particulars regarding specific lakes and sampling details are to be included in annual SAPs. Special projects wholly or partially funded with federal money are required to have an approved SAP that includes a detailed summary of all work to be performed, products to be produced, and an implementation schedule.

Volunteer Lake Monitoring Program. Use of volunteer collected data began in the early 1970s. The program was set up to assist DEP staff and researchers in acquisition of lake data from lakes of interest. As it expanded, the program also took on the role of educating interested citizens about lake protection. In the mid-1990s, the VLMP became a non-profit entity funded with a mix of Federal, State and private grants. The VLMP assists a variety of entities ranging from individuals to regional organizations with acquisition of various types of lake data. Although most volunteers are primarily interested in tracking biweekly water transparencies, others may desire to collect temperature / dissolved oxygen profiles and/or samples for nutrient or chemical analysis. Approximately 350 lakes are monitored in any given year, by more than 500 trained volunteers. All volunteers collect transparency data and approximately a quarter of these collect data or samples using advanced techniques. Volunteers undergo a certification process that is renewed for transparency every 3-5 years and annually for advanced monitoring, unless professional training and experience indicates that an alternative arrangement will meet program goals.

The program is located at 24 Maple Hill Road, Auburn, Maine, 04210 (207-783-7733). The Executive Director, Scott Williams oversees 2-3 employees and day to day operations of the program. As a non-profit entity [501(c)(3)], the VLMP is required to file annual fiscal reports at both the state and federal levels. It has a board of directors, mission statement, by-laws, and a

periodically updated strategic plan guiding its activities. Additional program insight may be gained by visiting their website at: www.mainevolunteerlakemonitors.org

Volunteers are provided with a packet of information at the beginning of each monitoring season. This packet includes the most recent VLMP Annual Report, monitoring datasheets specific to the type of monitoring done by the volunteer, special announcements, a list of Recertification Workshops, brief procedure review and other appropriate materials (see example of 2004 packet in Appendix 9.2). New monitors also receive a bathymetric map of the lake they have chosen to monitor as well as a view scope and Secchi disk/tape measure. Volunteer monitors are asked to collect data every other week for a 5-month open water period. Those who cannot collect that amount of data are not excluded but are asked to communicate their limitation to VLMP staff or make a notation in the 'Comments' section of the data sheet (illness, only in Maine for 3 months, etc.).

After as series of checks by Regional and Data Coordinators, data collected by volunteers are entered into electronic format and ultimately submitted to DEP. DEP staff performs additional quality checks then the data are uploaded into the Maine Lakes Database. Data summaries are returned to the volunteers for use at the local level (municipality, lake associations). An annual report is also produced and provided to each volunteer. These reports include information about how lakes work, the definitions and distributions of various parameters measured in Maine lakes, program contacts, and articles on current lake topics (e.g., invasive species). The report also includes a data summary for all lakes in the program. Three newsletters are sent to volunteers annually as well. These newsletters provide the volunteers with up-to-date contact information and changes to the program. They also answer frequently asked questions and recognize individuals for outstanding dedication and service.

The VLMP maintains a list of lakes and associated volunteer contact information in an Access database. Lake station locations are indicated on two sets of Maine Department of Inland Fisheries and Wildlife bathymetric maps that are maintained by DEP and VLMP. In addition, electronically scanned depth maps have been electronically annotated with sample station locations and numbers, and are available through the PEARL website (pearl.maine.edu). There is no sure way to determine which lakes will have data submitted by volunteers in any given year. Volunteers are volunteers; many are retired and have health issues that crop up from time to time. Generally 90% of the lakes that were sampled by volunteers last year (2003) are likely to be sampled by a volunteer this year (2004) in addition to some new lakes. The Annual Reports do include a map of Maine that shows the distribution of lakes monitored in that year.

DEP staff uses the volunteer-collected transparency data for attainment screening and trend analysis, when appropriate. When a highly skilled and dedicated volunteer is available, their services may be used in the collection of data under the TMDL sampling program. Annual SAPs are not generally prepared for the Volunteer Lake Monitoring Program unless anticipated activities deviate from this QAPP.

Lake Baseline Sampling. Baseline sampling occurs in August of each year providing that adequate funding exists. In Maine, August is when lakes are most likely to support nuisance

algal blooms that will interfere with lake use. Generally 100-120 lake stations will be visited during a three-week period during this month. Two to four teams of two individuals each will travel statewide to acquire data. Sampling may be accomplished using a canoe, motorized boat or floatplane. In addition to transparency and dissolved oxygen, water samples are collected for chlorophyll a, total phosphorus and basic chemistry (alkalinity, color and specific conductance). SOPs for routine field procedures and sample preparations are located in Appendices 9.4 & 9.5. Additional samples may be collected for major cations, major anions, pH, ANC, DOC, phytoplankton taxonomy, zooplankton taxonomy and/or surface sedimented diatom taxonomy as the budget allows.

Lakes sampled generally include TMDL lakes, 33-50 lakes in the VLMP, lakes of special concern (e.g., anecdotal report of algal bloom), long-term monitoring lakes in ecoreserves and special project lakes. Lake station numbers are determined from a set of annotated bathymetric station maps maintained by DEP and VLMP. Most of the maps are available through the PEARL website (pearl.maine.edu). Station locations have also been added to DEP GIS lake polygons by manually transferring the location from the paper maps. Typically Station 1 is assigned to the deepest spot, Station 2 to the second deepest spot, etc. When two areas of a lake have the same maximum depth, best professional judgement is used to determine which station is most representative of the whole lake. That station is assigned as Station 1. Note that this convention was not followed in some of Maine's larger lakes in the early 1970s so it is always best to examine existing maps.

Samples are analyzed by either the University of Maine Environmental Chemistry Lab (ECL) or the Department of Human Services' Health and Environmental Chemistry Lab (HETL). Analytical SOPs for both labs are included in Appendices 9.6 & 9.7. Annual SAPs are not generally prepared for Baseline sampling. Linda Bacon is the DEP contact for Baseline Sampling.

TMDL Sampling. TMDL stands for Total Maximum Daily Load of a particular pollutant. In Maine lakes, an excess nutrient load (primarily phosphorus) will promote nuisance algae growth/blooms resulting in a violation of water quality standards. A TMDL analyses is prepared to estimate the total amount of dissolved phosphorus that a lake can accept annually without harming water quality. Historically, development of TMDLs was first mandated by the Clean Water Act in 1972, and was applied primarily to point sources of water pollution. As a result of public pressure to further clean-up water bodies, lake and stream TMDLs are now being prepared for Non-Point Sources (NPS) of water pollution. Nutrient enrichment of lakes through excess total phosphorus originating from watershed soil erosion has been generally recognized as the primary source of NPS pollution. Major land use activities contributing to the phosphorus load in lakes include residential-commercial developments, agriculture, roadways, and commercial forestry.

TMDLs are important tools for maintaining and protecting acceptable lake water quality. They are primarily designed to 'get a handle' on the magnitude of the NPS pollution problem and to develop plans for implementing Best Management Practices (BMPs) to address the problem. Development of non-stormwater regulated phosphorus-based lake TMDLs are not intended by

Maine DEP to be used for enforcement purposes. Rather they are intended to provide guidance to landowners and watershed groups that eligible to receive technical and financial assistance from state and federal natural resource agencies to reduce watershed total phosphorus loadings to the lake. The department's lakes TMDL Project Leader is Dave Halliwell.

Statewide, there are approximately 32 lakes which do not meet water quality standards due to excessive amounts of total phosphorus. TMDL reports are based on available water quality data including seasonal (in-lake) measures of total phosphorus, chlorophyll-a, Secchi disk transparencies, and dissolved oxygen-water temperature profiles. Actual reports include: a lake description; watershed GIS assessment and estimation of NPS pollutant sources; identification of a total phosphorus target goal (acceptable amount); allocation of watershed/land-use phosphorus loadings - while addressing 'margin of safety' (uncertainty) concerns and seasonal variation. The process includes a public participation component to allow for public review.

Four basic sampling regimes are in use for monitoring of TMDL lakes. ***Level I,*** often used pre-TMDL development includes monthly monitoring of total phosphorous levels via sub-surface grabs from dam outlets in shallow unstratified lakes and lakes with fall drawdowns. ***Level II,*** used in both pre and post TMDL development includes bi-weekly monitoring of Secchi disk transparencies by volunteers in the VLMP program. ***Level III***, is post-TMDL monthly monitoring of total phosphorus (core and bottom grab samples in deep lakes), dissolved oxygen - temperature profiles, and chlorophyll-a samples (July and August for non-colored waterbodies; monthly for colored waterbodies). The ***Level IV*** regime is most intense and employed in lakes having TMDL reports actively being prepared. This includes bi-weekly monitoring of total phosphorus (every other meter water column profile), dissolved oxygen - temperature profiles, and chlorophyll-a samples (July and August for non-colored waterbodies; monthly for colored waterbodies). As a rule, most 303(d) listed TMDL lakes in Maine are monitored during Maine DEP summer (August) baseline sampling efforts during which water chemistry measures are also collected (e.g., specific conductance, total alkalinity, and color), along with Secchi disk transparency, total phosphorus, Chl-a and dissolved oxygen/temperature profiles. Annual SAPs produced for TMDL Sampling include the lakes to be monitored, frequency and intensity.

Special Projects (Examples). Other projects are conducted from time-to-time, that are intended to characterize a particular aspect of how Maine lakes function. For example, in 1996, the section visited approximately 100 lakes that were deep enough to stratify in areas of the state having minimal human activity. The purpose of this study was to better characterize which lakes were likely to develop natural hypoxia due to morphometric factors. Since these lakes satisfied reference or best possible conditions in their regions, biological samples were also collected to further develop bioassessment metrics. Another targeted study was the Regional EMAP project (1993 - 1995) that assessed fish tissue for mercury and the presence of other toxic substances. A stratified random set of lakes was selected from a list of lakes managed by the Department of Inland Fisheries and Wildlife for a significant sport fishery. The selection process allowed the results to be applied to that entire population of lakes. Future studies are likely to have a similar approach when results are needed to characterize a larger population. Special Projects follow SOPs included in this document and will have a project leader. Special Projects will have a SAP prepared when wholly or partially funded with federal funds.

4.4 Quality Objectives and Criteria. [A7. (Element 7)]

The parameters listed in Table 4 are most frequently used to assess ambient conditions in Maine Lakes. Anticipated ranges of values, accuracy and precision requirements are listed adjacent to each parameter. Additional parameters required for specific assessment goals of projects would be found in SAPs. Sampling frequency and data adequacy issues are determined by the scope of the various projects undertaken by the section and cooperators.

Table 4. Quality objectives commonly measured lake assessment parameters.

PARAMETER	MEASUREMENT RANGE	ACCURACY	PRECISION (10% replication; field dups)
Secchi Transparency	0.1-25.0 meters	Reading comparisons between experienced staff and new staff or volunteer trainees: <6m: +/- 0.3 meters; =or>6m: +/- 5%	For consecutive readings with similar cloud cover conditions in water lacking patchy plankton distributions: <6m: +/- 0.3 meters; =or>6m: +/- 5%
Dissolved Oxygen (meter)	0 - 20 ppm	+/- 0.2 mg/L (ppm) [Winkler or against Winkler verified meter]	+/- 0.1 mg/L (ppm)
Temperature (meter)	-5 to 45 degrees C	+/- 0.4 degrees C [NIST thermometer]	+/- 0.5 degrees C
Dissolved Oxygen (Kit)	0 - 20.0 ppm	+/- 0.4 mg/L (ppm) [Winkler verified meter]	+/- 0.2 mg/L (ppm)
Temperature (thermometer)	-5 to 50 degrees C	+/- 1 degree C [NIST thermometer]	+/- 0.5 degrees C
Total Phosphorus	1 to 200 ppb; > 200 ppb by dilution	100% +/-10% of standard	<10 ppb +/- 1 ppb; =>10 ppb: 10% RPD
Chlorophyll a	Lower limit:1 ppb; No upper limit	N/A (standards unavailable)	<3ppb: +/- 0.3 ppb; = or > 3 ppb: 10%
Hach Color Wheel	0 to 500 SPU	+/- 10% standard	<26: +/- 15%; >25: +/- 10%
Nessler Color Tubes	0 to 100 SPU	With 11 standards: +/- 5 SPU	With 11 stds.: +/- 5 SPUs
Spectrophotometric Color	0 to 500 SPU	<20 SPU: +/- 2 SPU of standard; >20 SPU: +/- 10% of standard	<20 SPU: +/- 2 SPU >20 SPU: +/- 10%
Alkalinity	5 to 400 mg/l as CaCO3/L	<10 mg/l CaCO3: +/- 15% > 10mg/l CaCO3: +/- 10%)	2%
Specific Conductance	0 to 36,000	5% [2% of standard]	2%
ANC	< 5 mg/l as CaCO3 or < 100 ueq/l CaCo3		

4.5 Special Training/Certification. [A8. (Element 8)]

The State of Maine job classification system has established minimum qualifications required for all levels of state employment. The individuals permanently employed in the Lake Assessment Section are either in the 'Environmental Science Specialist' or 'Biologist' classification ladders. Their qualifications range from a Bachelor's degree to a Ph.D. in one of the natural sciences. In addition, most of the individuals had a number of years of experience in the field of Limnology or a closely related field, prior to their employment. Because the state hiring process establishes training and experience levels required to be employed by the Lake Assessment Section, there is no need to include resumes for each individual in the section.

The Executive Director of the Volunteer Lake Monitoring Program has training and experience qualifications similar to those of agency staff. Other VLMP staff have training and experience appropriate for their role within the organization (e.g., Program Development staff have a fundraising and accounts management background, Program Support staff have computer skills in database maintenance and desktop publishing, etc.).

In addition to the job requirements, biologists in the unit must maintain current First-Aid Training, CPR Training, Ergonomics Training, and as available, training for safe boat handling. In addition, unit members are required to attend an annual lab safety workshop and one of two annual lake monitoring training/review workshops held before the start of the sampling season and before August baseline sampling. The Executive Director of the VLMP is a full participant in co-conducting these workshops.

Staff members are encouraged to sample lakes in teams of two for safety purposes. One team member must have attended a lake monitoring workshop within a year of sampling. The training session provides a review of procedures for experienced staff and an introduction or overview for new staff. New staff members do not act as team leaders until they have mentored under experienced staff on 6-10 sampling trips. Experienced staff will determine if/when they are ready to act as team leaders. Trained staff may be involved with lake baseline sampling, TMDL lake sampling and/or special project sampling.

Staff with the Maine Volunteer Lake Monitoring Program (VLMP) also attend annual lake monitoring training workshops and provide mentoring to their seasonal staff in a manner similar to the agency. Volunteers operating under the volunteer monitoring program are certified through training sessions conducted by both VLMP staff and DEP staff..

Volunteer Lake Monitoring Program. Volunteers that are new to the VLMP program attend a 4 hour workshop which introduces them to VLMP staff, including their Regional Coordinators (when possible), objectives of the program, monitoring locations, procedures for obtaining Secchi disk transparency data, and data handling. Volunteers are provided with written background material and procedural references. Volunteers are taken out on a lake where they receive 'hands-on' training from an experienced staff member. The volunteer is encouraged to repeat transparency determinations until they are comfortable with the procedure. At this point, transparency readings are obtained simultaneously by the volunteer and the staff trainer. The readings obtained by each are recorded along with other information that is entered into the VLMP monitor database. This database includes a list of all monitors that have participated in the program since 1996 when the VLMP became a stand-alone, non-profit organization. Records for past monitors are maintained in the system as part as the permanent data record. New volunteers receive a Transparency Certification Card and a QA Certification number that they enter on to their data sheet beside their transparency readings. This allows a link to be made between the transparency data collected and the information in the certification table in the VLMP database. A new monitor is required to attend a Recertification Workshop 3 years from the New Monitor Workshop. A long-term commitment is encouraged. Monitors that continue

past the 3-year Recertification Workshop are required to attend subsequent workshops every 3-5 years thereafter, or take a written recertification test over the internet to verify that procedures are being followed (under development).

There are times when a volunteer is interested in obtaining data in addition to transparency readings. The VLMP encourages monitors to first collect transparency data for one year. This allows them to be familiar with the time obligation and allow a period in which they become familiar with the administrative aspects of the program. Occasionally, a new monitor will be trained to collect data in addition to transparency in their first year of service. This does not happen frequently but has occurred when a previous volunteer has been collecting advanced data on the lake and/or it is a priority for the agency to maintain a continuous dataset for the water (TMDL lakes). In this case, the monitor is required to attend an additional 'advanced' training workshop, often conducted by agency staff. In addition, agency staff often follow up as an observer on the volunteer's maiden voyage. This is highly labor intensive but assures high quality data and that the monitor is comfortable with the routine.

A volunteer that has completed a year of service may be trained to collect additional data by attending an advanced training workshop. The monitor may learn how to obtain temperature and dissolved oxygen profiles using chemical kits or YSI dissolved oxygen meters. Similarly volunteers may receive training on how to collect water samples using an integrated sampling tube, grab samplers or trained in how to collect a surface grab. This training includes a component on how to fill sample bottles for the parameters of interest. Volunteers are instructed regarding sample storage and submissions either directly to a lab or to agency personnel. Each of these advanced techniques requires annual recertification.

Advanced Training is also available under the Certified Volunteer Training (CVT) program, a ‘train-the-trainer’ program under development. Some of the organizations that cooperate with the VLMP (Cobbosee Watershed District, Lakes Environmental Association, Rangeley Lakes Heritage Trust, St. Croix Regional Waterway) have paid staff that are performing tasks generally associated with volunteer coordinators. Most often these individuals have an educational background in resource management and are capable of instructing and assisting volunteers in their organization. The CVT program is designed to provide these individuals with the necessary training and materials to enable them to train and recertify volunteers in their organization. This training would allow these entities to perform recertifications and additional training when working with their volunteers.

4.6 Documents and Records. [A9. (Element 8)]

QAPP Modifications. This section addresses procedures to be followed when modifications are needed to a) this Program QAPP, including associated SOPs, or b) any SAP accepted under this Program QAPP that requires real-time modification to achieve project goals. Examples of such modifications include changes in sampling design, sample collection procedures, sample analysis procedures, data assessment and reporting procedures.

Discussions involving changes to the Program QAPP may be initiated at any level within the Lake Assessment Program. Contact should be made with Roy Bouchard or Linda Bacon to discern whether modification is warranted. The scope of effect of the proposed change will determine whether a discussion is warranted at a regularly scheduled section meeting or if a special meeting is required. Discussion participants will determine if a change to the QAPP is needed. A formal QAPP modification will include reference to the section(s) of text being modified or added to, the reason why the modification is necessary and the actual replacement/additional language. Modification documents will need three signatures, that of the individual proposing the modification, the signature of Roy Bouchard or the individual responsible for the Lake Assessment Section and the DEP Quality Assurance Officer, Malcolm Burson. If the modification is extensive, it will be the responsibility of the DEP Quality Assurance Officer to determine if it is necessary to request additional review from others within the agency, from EPA and/or a technical expert from outside of the Department. Recipients of the original Program QAPP will receive such updates. The electronic files will be updated as proposed using annotation that indicates reference to the formal amendment in a designated part of the appendix (e.g., Update I, Appendix 9.10. QAPP Modifications). SOP modifications, additions and retirements follow the same procedure as modifications to the QAPP. Additionally, SOPs must be organized and formatted according to DEP department-wide guidelines and Bureau of Land and Water Quality guidelines. SOPs under development should be included as part of the QAPP as soon as practicable, as long as they are designated as drafts within the Appendix.

SAP Modifications. Modifications to project specific SAPs will be made at the discretion of the project manager. In general, modifications that refine details in an existing plan may be dated, signed by the project manager and filed with the plan. Modifications that change the focus and or scope of the projects should be discussed with staff in the lake assessment section to determine if any changes are necessary at the program level (e.g., addition or modification of SOPs). If not, the summary of changes should may be dated, signed by the project manager and filed with the plan. It is important to note that the purpose of maintaining a record of each project plan is to maintain metadata associated with every data point collected and stored.

Archiving of SAPs. Lake specific project plans will remain in the possession of the project manager until appropriate reports have been completed. Files associated with such plans will be organized such that persons requesting public information can follow the paper trail from planning through reporting phases in a logical progression. When a project is complete, the original file should be placed in the lake's section of the Land and Water Quality File room, in the alphabetical section of lake folders. Original datasheets need to be filed alphabetically by year among the lake data folders to facilitate error reconciliation.

Datasheet Handling. Datasheets originating under TMDL and special project sampling generally reside with the project leader until results are received from the lab. A Chain of Custody form is completed for samples that are brought to the HETL lab (Appendix 9.7). Either the project leader or designee will hold onto a copy of the Chain of Custody sheet until results are received. All results are sent to the bureau accounts manager, Paul Dutram. Paul or his designee delivers results to the name indicated on the Chain of Custody sheet at the same time verifying account

information. Results are checked by the recipient; questions regarding data validity are directed to the appropriate lab contact as soon as possible. When results are received, they are entered in the appropriate area on the data sheet. The team leader is responsible to check the sheet for completeness then place it in the gray hanging file in the area by Judy Potvin and Linda Bacon. Paper copies of lab results are discarded as the lab maintains the data in an electronic database. Toward the end of the field season, data on these sheets are entered into an Access data entry program by clerical staff within the bureau.

Baseline sampling sheets are handled in a slightly different manner up until they are entered into the Access data entry program. When a field crew returns, they deposit samples in the refrigerator in the field prep area/lab or in the basement by the elevator. They check their data sheets for completeness, clip them together with a properly annotated Lab Processing cover sheet and slip them into an accordion folder attached to the cabinet in the field prep area/lab. The following day, staff on 'lab duty' will inventory all samples taken the previous day. This inventory includes organizing properly labeled sample bottles (ideally into boxes) and filling out Sample Submission Sheets for the Environmental Chemistry Lab (Appendix 9.6). The person completing a sheet will sign it in the designated area. These samples are transported within 2-5 days of collection. When the lab receives the samples, lab staff checks the list against the sample bottles and signs the designated on the sheet. When wet-lab processing is complete (alkalinity, color and specific conductance) and analytical lab results are received (chlorophyll-a and total phosphorus), data are transferred to the field sheets by Judy Potvin or Linda Bacon. Data sheets are submitted for entered into an Access data entry program by clerical staff within the bureau. Appendix 9.7 contains examples of HETL Chain of Custody sheets; Environmental Chemistry lab Sample Submission Sheets can be found in Appendix 9.6; copies of the wet 'Lab Worksheet' and the 'Sample Processing Checklist' may be found in Appendix 9.3.

The top sheet of the carbonless Volunteer Lake Monitoring datasheet is passed from the volunteer monitor to the Regional Coordinator for the region. The Regional Coordinator checks them for completeness then forwards them to the Region's Data Coordinator, who enters the data into electronic format. When complete, the Region's Data Coordinator returns the sheets and diskette or CD to the Regional Coordinator who mails the packet to the VLMP. VLMP retains photocopies of all data sheets then passes the data packet to Judy Potvin or Linda Bacon at the DEP. Alternatively, electronic files may also be emailed directly to both the VLMP and DEP.

Data are printed and proofed against field sheets by Lake Assessment Staff; Judy Potvin or Linda Bacon make corrections to the data files. Corrected data files having the same data structure are merged into larger sets. Judy Potvin conducts 'gross-error checks' on these files before Linda Bacon uploads the data to the master files on the DEP network. Gross-error checks include performing sorts on each field then examining field contents for extreme values (likely to be errors) and appropriate missing data notation. Additional corrections are made as necessary.

From this point forward, nearly all lake datasheets are handled in the same way. Paper VLMP datasheets, TMDL datasheets and Special Project datasheets are filed alphabetically by year. The previous season's sheets are held on 3N for 6-12 months before being transferred to the Land & Water Bureau file room (basement of Ray Building, Augusta). Data sheet files are

organized by alphabetically by year to facilitate error reconciliation. Data sheets are further organized by Midas # (Lake ID #), sample station then sample date. Lake Baseline Field sheets may be stored temporarily in the file cabinet in L. Bacon's cubicle or a separate folder labeled 'Baseline' at the beginning of the year's alphabetic folders before being inter-filed with the other datasheets.

QA and Certification Records. The VLMP and the DEP will maintain quality assurance records in paper and electronic files. This information includes transparency reading comparisons, procedure review checklist and temperature/dissolved oxygen profiles obtained during spring and summer staff monitoring workshops (Excel files, DEP computer network). Similar information is collected by DEP and VLMP staff members at New Monitor and Recertification Workshops in addition to contact information for each volunteer. The latter becomes part of the 'metadata' associated with each volunteer monitor and is transferred from paper to the volunteer monitor database maintained by the VLMP. [Note: From the period of 1970 – circa 1994, this information was stored on 3" x 5" index cards. These cards were discarded before their historical value was known at the time of transfer to electronic format. This information should be kept indefinitely as it may be needed to assist in the interpretation of anomalous historic data.]

Lab QA data from the Environmental Chemistry lab is included in the electronic spreadsheet, copies of which are kept in the baseline ECL lab folder on electronic media and/or on the DEP network. Lab QA data from the Health and Environmental testing lab is directed to Judy Potvin.

5. Data Generation and Acquisition

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

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

Most of the lake sampling conducted in the State of Maine is accomplished through the Volunteer Lake Monitoring Program. Most of this annual lake sampling can be characterized as 'single-parameter, multiple visit' providing insight into trophic fluctuations that influence water clarity. In contrast, lakes undergoing TMDL development are annually sampled using a 'multiple parameter, multiple visit' or intensive in-lake monitoring approach. Baseline Sampling can be characterized as a 'multiple parameter, single visit' during the mid summer period of peak productivity in a lake's annual cycle. As mentioned in Section 4.3, lakes visited during baseline include all TMDL lakes, a subset of VLMP lakes, project lakes and lakes for which there is special concern. Baseline data is gathered as a check of TMDL data, to supplement VLMP data or to gain insight into the trophic character of the lake. The Lakes Assessment Program conducts a training/QA session in May of each year to review procedures and perform field checks on dissolved oxygen/temperature meters. All staff and cooperators are expected to attend. Experienced staff my miss a session occasionally providing they review procedural changes prior to sampling.

Volunteer Lake Monitoring Program. Approximately 350 Maine lake basins are monitored annually by volunteers. As previously mentioned, most lake sampling conducted through the VLMP can be characterized as 'single-parameter, multiple visit' intended to provide a seasonal snapshot of the trophic status in a given lake. Since volunteers conduct this monitoring, it is not possible to predict which lakes will be actively included in the program for a given year. Lakes fall in and out of the program with the availability of a volunteer, thus the likelihood that a lake will be monitored is directly related to its size and the number of shorefront properties. These factors result in a sampling bias toward lakes having the most human impact located in the more developed and accessible areas of the state. In recent years, between 5-6% of Maine's lakes or between 45% - 50% of Maine's lake surface area have been monitored through the VLMP. Highly motivated volunteers or volunteers that participate through a regional entity may obtain data for different parameters to give additional insight into trophic status. These parameters include temperature and dissolved oxygen profiles, total phosphorus, chlorophyll_a, pH, alkalinity, color and specific conductance.

As stated previously, annotated Maine Department of Inland Fisheries and Wildlife bathymetric maps are used to determine sample station numbers. DEP, VLMP and PEARL maintain copies of these maps. New stations are added as needed; Judy Potvin maintains copies of the annotated maps for DEP and PEARL. New lakes are generally monitored at their deepest location, unless other arrangements are made. Transparency readings are obtained by volunteers every two weeks. Volunteers are encouraged to monitor for 5 open water months. When transparency data are collected at this frequency according to the SOP, a reliable picture of the within-year variability at that station is obtained for the open-water season. When collected in this manner for multiple years, the data allows insight into year-to-year variability. Trend analysis is most reliable when performed on continuous datasets spanning a minimum of 8-10 years. Annual SAPs are not generally prepared for the Volunteer Lake Monitoring Program unless the scope of a special project falls outside of the content of this QAPP.

DEP Lake Baseline sampling uses a multiple parameter, single visit during the August index period. This program is designed to 1) help interpret data collected by the volunteers on lakes for which general assessment is being conducted, 2) track parameters as part of long-term monitoring efforts on lakes located in ecoreserve areas, 3) add to an intensive TMDL dataset, or 4) obtain an index period snapshot of conditions in a lake of concern. Baseline preparation begins in the spring of any given year during which funding and personnel are available. A standard suite of parameters is generally negotiated in the spring followed by an agreement with the Environmental Chemistry Lab (contract) or the state Health and Environmental Testing Lab. Staff commitments are usually sought before the end of July. Linda Bacon seeks nominations for baseline sampling from May through July. Linda prepares a final lake list by the end of July consisting of lakes nominated by staff, TMDL lakes and lakes that are part of the VLMP that have not been visited within the last 4 years. Field sheets, lake maps and sampling bottle packets are generally assembled by the Conservation Aid, Linda Bacon or Judy Potvin before the end of July. QA/QC training generally occurs during the first week of August. All team leaders are required to attend this training or a similar training session that occurs in May. Sampling occurs between the index period of August 10 – August 31 using boats and float plane. Two state trucks are reserved for this period; canoes are locked to the roof racks and gear is assigned to

each truck. An effort is made to sample lakes in Northern Maine first. Logistic details are built into the daily routine (e.g., ice and bottle packets are replenished at the beginning of each day; gas tanks are refilled at the end of each day). Staff sampling the lakes need to be primarily concerned with obtaining a packet of lakes to sample a few days before going out, making sure there is an adequate supply of bottle packets, coolers and ice in the vehicle before heading out. Staff are also designated to process samples the day after they are brought in and to transport samples to the lab. Baseline Bottle Packet Preparation Guidelines and Sampling Procedure Guidelines can be found in Appendix 9.3. One or more folders are kept in the file cabinet in L. Bacon's cubicle with these baseline details. Electronic files are also kept in the Lake Assessment Section's designated space on the department's server under H:\L&W\Watershed\Monitoring & Assessment\Waterbody Type\Lakes\Sampling\Baseline*year*. Annual SAPs are not generally prepared for Baseline sampling.

TMDL Sampling. Lakes in the process of having TMDLs developed will undergo intensive monitoring for two consecutive years to establish a reasonably reliable estimate of current trophic status. This includes a minimum of seven visits during the open-water period in which data is gathered from the deepest station (unless alternative stations provide better information) including Secchi disk transparency, dissolved oxygen/temperature profiles, total phosphorus (core and 1 or 2 hypolimnetic grab samples if lake is deep enough). Additional stations are monitored at the discretion of the TMDL project manager. At the August index period visit, additional samples for chlorophyll-a analysis and routine chemistry (pH, alkalinity, color) will be collected under Baseline Sampling.

Lakes listed on the 303(d) list (designated for TMDLs) should have a historical dataset that has been evaluated using assessment criteria. Lakes that require the development of Total Maximum Daily Load (TMDL) studies generally receive the most intensive monitoring by DEP staff, contractors and volunteers trained to do advanced monitoring. The intensity of monitoring in a given lake generally corresponds to its attainment status with respect to water quality standards. Specific annual monitoring designs are found in the annual TMDL Sampling SAP.

Other lake projects are conducted, as necessary, to answer specific questions. Both are dependent on available human and financial resources. A combination of shotgun, targeted and stratified random approaches is used as needed to accomplish the goals of our program. Special Projects will have a SAP prepared including sampling design details when wholly or partially funded with federal funds.

5.2 Sampling Methods. [B2. (Element 11)]

Sampling methods used in all lake assessment activities will follow established SOPs (Appendix 9.4). New SOPs will be developed and appended as necessary. SAPs will list the SOPs being followed, including the revision date. Deviations from or amendments to existing SOPs will be identified along with justification(s) for these changes. Any after–the-fact deviations from the QAPP/SOPs/SAP must be appended to the SAP with an explanation of the reason(s) why the deviation was necessary. SAPs will remain in the possession of each project manager until a project is complete, at which time the document will be filed with copies of results, correspondence and reports produced.

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

Samples will be labeled, preserved, stored and transported according to storage and holding time needs identified in individual SOPs (Appendices 9.4 & 9.5). Chain of Custody forms will be completed and submitted with samples processed by HETL (Appendix 9.7). Sample Submission forms will be completed and submitted with samples processed by the Environmental Chemistry Lab (Appendix 9.6). Any deviations will be noted in specific project plans.

5.4 Analytical Methods. [B4. (Element 13)]

Analytical methods will meet or exceed quality objectives outlined in Table 4 (Section 4.4). Copies of methods utilized by external laboratories will be accumulated and retained as reference documents and retained in archive status when retired. Current SOPs for both HETL and ECL are included in Appendices 9.6 & 9.7. SAPs will reference specific laboratory analytical SOPs used for each parameter. When appropriate, copies of analytical SOPs will be kept with project files to facilitate referencing. If SOPs have not been established for a particular analyte, project plans will reference the starting point for procedure development (Standard Methods or other citation) and maintain copies of quality trials while the method is under development.

5.5 Quality Control. [B5. (Element 14)]

SOPs are a part of the Lake Assessment Program's quality assurance foundation. Within each SOP, there may be specific quality control measures recommended. From the overall program perspective, field duplicates are obtained for 10% of each sampling effort. Each individual dissolved oxygen/temperature profile will have a minimum of 10% of the number of readings duplicated and entered on the field sheet on 80% of the profiles obtained during any year. Duplicate readings are intentionally obtained in stable areas of the profile so to assure that the readings are a check of the instrument and operation rather than reflecting variation in the water column. If discrepancies of > +/- 0.2 ppm or degrees Centigrade are observed, operator technique should be checked immediately. If discrepancies of > +/- 0.5 ppm or degrees Centigrade are observed, the meter should be checked immediately. Profiles having more than half the duplicate readings varying > +/- 0.3 ppm or degrees Centigrade are not accepted into the electronic file unless best professional judgement determines that there is an acceptable reason for the discrepancy. That reason must be noted on the field sheet along with the initials of the person making the determination. (Appendix 9.4, SOPs for Field Procedures).

Duplicate water samples are obtained for one out of every 10^{th} lake sampled. During Baseline Sampling, the number is tracked by team and posted on the cabinet in the field prep./lab area so that a team knows when a duplicate is needed. Duplicates will be obtained for every parameter. This set of samples will be designated as a set of replicates for that lake on the label (e.g., circled 'R'). Duplicate results for total phosphorus and chlorophyll-a are expected to be within 10% of each other 75% of the time and 20% of each other 90% of the time.

Laboratories are expected to provide their own internal approach to quality control for each parameter in the SOP for each parameter. For example, we routinely submit duplicate filters for analysis so that the labs may perform splits as necessary to meet their quality objectives. Quality control data is received from each lab at minimum, on an annual basis.

The lake assessment section will provide blind splits for inter-lab comparisons at the beginning of the monitoring season and periodically through the season to achieve comparisons of 2% of the overall number of samples for a given parameter. Results from these splits are expected to be within 15% of each other 75% of the time and 25% of each other 90% of the time.

When quality objectives are not met, and best professional judgement suspects analytical error, the lab will be contacted and some resolution to the problem will be sought. Circumstances where best professional judgement might not indicate evidence of analytical error include results obtained from extremely oligotrophic waters, where parameter levels are extremely low. Similarly, extremely productive waters may yield results for duplicate samples that are highly variable due to the patchy nature of algal cell distribution within the water column.

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

Instruments will be tested at a frequency that is appropriate for the parameter. Scales and balances are generally tested annually at the beginning of the monitoring season. Dissolved oxygen meters undergo significant testing at the beginning of the monitoring season as part of probe preparation (Appendix 9.5). Inspection is performed at each time of use and maintenance performed as needed [following inspection or when QC tolerances are exceeded]. Devices used to obtain samples are tested at the beginning of the sampling season and repaired or replaced as necessary. Maintenance and storage details can be found in SOPs that address use of these pieces of equipment.

Laboratories are expected to perform their own testing, inspections and maintenance as necessary to achieve quality objectives outlined in Table 4 (Section 4.4).

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

Instruments are calibrated and checked at pre-established frequencies. Refer to SOPs for use of each instrument/piece of equipment for specific details. Instruments / pieces of equipment that fail to calibrate or hold calibration will not be used until the problem is corrected.

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

Supplies and consumables are inspected upon receipt. In the event that these are found to be unacceptable, they will be returned to the supplier or manufacturer. Once accepted, if an item appears to be damaged or soiled, the item is not used but discarded or returned to the provider, as appropriate. There are not many items used under the Lake Assessment Program that require specific testing procedures before they are used.

5.9 Non-direct Measurements. [B9. (Element 18)]

Water quality data in the Maine DEP Lakes dataset are used for project implementation and decision making. These data are stored on the DEP computer network file server and are backed up onto 2 CDs after major new data uploads. One of these CDs is stored off-site in the heated room in the Bureau's equipment storage facility (a/k/a boat house) in Augusta. These data have limitations inherent in storage systems used from 1970 to 1990 when keypunch cards were used to maintain datasets. Paper copies of field sheets from most of these sampling events remain on

site so that data integrity questions may be answered immediately. Note: some data sheets may have been lost due to contamination by asbestos being stored in an adjacent location in Ray Building attic.

Data may also be used from studies conducted by Cooper in the late 1930s and early 1940s. Some of these data have been put into the DEP database; all of it resides in the original paper reports at the Maine State Library. DEP also maintains paper file folders for many lakes into which correspondence, project reports, newspaper clippings, etc. for a particular lake are kept as reference. These files are stored in the Bureau of Land and Water Quality file room in the basement of the Departments main office, the Ray Building, Augusta. The Lake Assessment Section also uses morphometric data and fishery data electronic files, and lake bathymetry maps maintained by the Maine Department of Inland Fisheries and Wildlife. Updates to bathymetric map set are received on an annual basis; updates to the electronic files are requested and received either on an annual basis or as needed.

The Lake Assessment Section uses geographic data derived from U.S.G.S. maps and State GIS coverages, the latter of which have metadata associated with them detailing limitations. U.S. Census data is available by municipality through the State of Maine Planning Office and is used to evaluated risk of anthropomorphic influences on water quality at the town level. Vulnerability models developed at DEP are also used. The final responsibility rests with the individual using lake data and associated geographic information to become aware of the limitations inherent in any information source.

These data sources may be used within the section for decisions regarding trend evaluation, use attainment, and as historical background for TMDL projects. Other programs within Maine DEP use the data for permitting evaluations.

5.10 Data Management.

[B10. (Element 19)]

Lake water quality data are entered on standard field forms that are often updated annually. Three standard forms exist (Appendix 9.8); although these forms are updated periodically, the basic lake monitoring parameters have been included on the various iterations since the mid-1970s. These forms include space for data elements that will be entered into the Maine Lakes Database, code look-up tables and areas to indicate specific dissolved oxygen method, equipment and calibration notations. We have found that most individuals are more likely to double-check their form prior to submitting if their signature is required, thus forms include a signature line at the bottom. Voluntary compliance is expected; sheets are not rejected for lack of signature. (Copies of these forms and the instruction sheet given to volunteers are located in Appendix 9.8.)

Data are entered into the Maine Lakes Database through various means. Most of the data collected through the Volunteer Lake Monitoring Program are entered into electronic files (dbf) before arriving at DEP. Data diskettes are distributed to the 20 or so Data Coordinators during the summer of any given year. The data entry program, written in the language C, was developed and is maintained by one of the volunteers in the VLMP program. First, individual data sheets received by Regional Coordinators are checked for completeness then sent to Data

Coordinators for entry. Data Coordinators proof their entries before returning the sheets and electronic media to their Regional Coordinator. The Regional Coordinator checks for packet completeness then forwards the field sheets and diskettes via the U.S. Postal Service (Registered, Return Receipt Requested) to the VLMP office where the electronic files are checked for completeness and sheets are photocopied. These batches are submitted to DEP. Two of the VLMP 'regions' (Cobossee Watershed District and Acadia National Park) submit data in Access electronic files similar to the program used for entering lake data at DEP. Another region (Lakes Environmental Association) submits data in MS Excel. These electronic files are emailed directly to Linda Bacon who manipulates them into a format compatible with the DEP file structures. The data sheets are mailed to the VLMP office for photocopying.

Judy Potvin or Linda Bacon will print out the data from the various files for proofing. Lake Assessment staff or VLMP staff proofs all of these data. Data are proofed for typing errors and data sheet errors. Quality control readings obtained for dissolved oxygen profiles are examined against profile readings. Best professional judgement is used to exclude data from the dataset (e.g., surface readings should be close to what is expected for air saturated water unless algal productivity suggests otherwise; QC readings obtained from areas of the profile where temperature and dissolved oxygen are stable, should be within 0.2 units of one another). If comparisons between QC readings and profile readings are not comparable, the profile is marked for deletion from the electronic file. The profile is crossed out on the field sheet and an explanation of why the profile is indicated on the sheet. Proofed sheets are initialed and dated by the proofer.

Judy Potvin or Linda Bacon correct the files. These file sets are merged into one or two large data sets. Judy Potvin performs a number of error checking procedures to validate that the proper lake identification number was used, that parameters are within an expected range (primarily a check for decimal point errors) and that dates have been handled properly (to identify conversion errors related to how century is handled). Data are uploaded to 'master files' on the network thereafter. Write access to these files can only be done by Judy Potvin or Linda Bacon. The data currently resides in Foxpro 2.0 files that are not truly relational. [Data are to be migrated to a relational database system after undergoing standard normalization procedures.] Data are linked among tables using complex keys (multiple fields). Annual data summaries are produced using a combination of Foxpro 2.0/2.6 and a graphics program called DGE. Extraction of the raw and summary data for any lake can be done by modifying a Foxpro program named extract.prg to specify the appropriate lake identification number and names for the files that hold the extracted data. These files are in dbf format and may be easily imported into Access or Excel for manipulation. All of the software we are using originated or is currently owned by Microsoft except DGE. These programs run on most desktop Windows 95-2000 computers. DGE is an old, DOS based TSR add-on to Foxpro, so when we do copy files to a CD and transfer those files to a Pentium I machine that has the ability to boot in DOS and allow execution of DGE.

This data management system has not been a high priority to upgrade within the department. Because the system is not used directly to track fees, licenses or compliance data, it has only been identified for an upgrade in 2004 as hardware, networking issues and operating systems move several generations away from the DOS environment. For the purposes of tracking lake

data related to trophic assessment of Maine lakes, this system has been reliable. As of May 2004, the five tables that store the raw data are 32 megabytes in size.

6. Assessment and Oversight

6.1 Assessments and Response Actions. [C1. (Element 20)]

Spring & Summer Workshops. The Lakes Assessment Section conducts a staff workshop in conjunction with the Executive Director of the VLMP, in May of each year after the dissolved oxygen/temperature meters have been prepared for field use and passed lab QA checks. Lab QA checks include comparison to a Winkler titration and NIST thermometer. Meters must read within 0.2 ppm of the Winkler dissolved oxygen result and within 0.2 degrees C. of the NIST thermometer. The workshop has two goals: to review all procedures and to compare dissolved oxygen and temperature readings taken by the various meters. Occasionally meters that pass lab standards will fail when subjected to increased pressure with increased depth. Meters that fail this 'pressure' test are returned to the lab where the probes are disconnected and connections allowed to dry. 'O' rings and associated grooves are cleaned then re-coated with stopcock grease. The probe/meter assembly is re-tested in the field. Generally Lake Assessment staff, VLMP staff and consultants hired for TMDL sampling attend the spring workshop.

An agenda is for the 2003 May session is included in the Appendix 9.8. Data collected at these sessions are filed and if/when time allows, entered into a spreadsheet. Profiles are examined; meters that give readings that are consistently high or low as compared to the mean are further examined for air bubbles, dirty anode or cathode and/or weak batteries. After repairs are made the meter/probe assembly is tested again. Meters that fail are not taken into the field. Repairable meters are returned to YSI for service.

A similar workshop is held in early August before Baseline Sampling begins. Staff designated as team leaders need to attend this workshop if they have missed the May workshop. The agenda is similar to the May workshop with the addition of any other Baseline Specific procedures (e.g., obtaining biological samples from ecoreserve lakes).

VLMP Recertification Workshops. Up to 16 additional workshops are held across the State of Maine at various lakes so volunteers may be re-certified for the parameters they collect. Transparency re-certifications are valid for three to five years. We encourage recertification every three years but will extend the span as needed to accommodate needs that arise (e.g., illness). All other parameter certifications expire in one year. For those volunteers obtaining dissolved oxygen data, it is necessary to check expiration dates on chemicals in kits, check accuracy of their meters, often perform basic meter maintenance as well as check calibration procedures. A meter/probe check is performed as often as possible but may be waived at a session due to extreme weather conditions that make travel to deep water dangerous. Meters that do not pass must be serviced before used. Staff travel to workshops with copies of dissolved oxygen manuals, a chemical dissolved oxygen kit, and numerous other items as listed on a QA/QC Workshop Checklist (Appendix 9.8). Staff also have a procedure review checklist and a QA form to complete for each volunteer (Appendix 9.8).

Lab Analyses (chlorophyll-a and total phosphorus). Duplicate water samples are obtained for one out of every 10th lake sampled. Duplicate results for total phosphorus and chlorophyll-a are expected to be within 10% of each other 75% of the time and 20% of each other 90% of the time. Laboratories are expected to provide their own internal approach to quality control for each parameter in the SOP for each parameter. For example, we routinely submit duplicate filters for analysis so that the labs may perform splits as necessary to meet their quality objectives. Quality control data is received from each lab at minimum, on an annual basis.

The lake assessment section will provide blind splits for inter-lab comparisons at the beginning of the monitoring season and periodically through the season to achieve comparisons of 2% of the overall number of samples for a given parameter. Results from these splits are expected to be within 15% of each other 75% of the time and 25% of each other 90% of the time.

When quality objectives are not met, and best professional judgement suspects sampling error, procedures are reviewed to determine which steps are critical for establishing consistency. Further detail may be added or modifications made to the SOP and emphasis will be placed on these changes at future workshops. When quality objectives are not met, and best professional judgement suspects analytical error, the lab will be contacted and some resolution to the problem will be sought. Circumstances where best professional judgement might not indicate evidence of sampling error or analytical error include results obtained from extremely oligotrophic waters, where parameter levels are extremely low. Similarly, extremely productive waters may yield results for duplicate samples that are highly variable due to the patchy nature of algal cell distribution within the water column.

6.2 Reports to Management.

[C2. (Element 21)]

Reports derived within the Lake Assessment Section are not necessarily produced for management staff as implied by the title of this section. Rather they are more likely to be used in decisions made by the individual citizen (property acquisition), municipalities (comprehensive planning), lake associations (targeted efforts), and in reports by state agencies to federal entities (Integrated Report to EPA).

Individual reports are produced for each lake after data are uploaded to the network. These reports depict transparencies for the previous season (if obtained), long term annual transparencies, annual and overall summary data for major parameters, most recent late summer dissolved profiles and may contain a narrative summary. These are the same reports given to the volunteers in their spring packet (Appendix 9.2).

TMDL reports include: a lake description, watershed GIS assessment and estimation of NPS pollutant sources, identification of a total phosphorus target goal (acceptable amount), allocation of watershed/land-use phosphorus loadings, and uncertainty concerns and seasonal variation. These reports include a public participation component to allow for public review prior to submission to EPA.

An Integrated Water Quality Report is submitted to EPA on a biannual cycle. This satisfies reporting requirements in Sections 314, 305(b) and 303(d). Assessment of lakes is based on all data in the Lake Assessment Database regardless of under which project it was collected.

Workshop attendance is tracked and eventually entered into a spreadsheet stored on the department network, VLMP workshop attendance is tracked and entered into the VLMP database. Summaries of DQO attainment reside in electronic files on the department network.

7. Data Validation and Usability

7.1 Data Review, Verification, and Validation. [D1. (Element 22)]

Criteria used to review/validate data are listed in Table 5. Best professional judgement may override these criteria when supporting data or information suggests a valid anomaly. Data evaluations occur prior to datasheet submission (by sampler/project manager), during data proofing (by lake assessment staff) and when gross error checking is performed prior to uploading.

Data that are highly questionable are never entered into the Lake Assessment Database. For example, all chlorophyll-a data received from one lab in 1995 do not reside in the pigment table because analytical error was determined to be the cause of anomalous results and violation of Data Quality Objectives (DQOs). Likewise, dissolved oxygen/temperature profiles may be removed from the database when the duplicate readings indicate unresolved operator or meter error.

All validated data are included in the Lake Assessment Database, regardless of whether they meet frequency and intensity goals outlined in a specific SAP. It is the responsibility of each project manager to evaluate a dataset for completeness when compiling reports under project specific SAPs.

Table 5. Criteria used to review/validate data.

Parameter	Min. Value	Max. Value	Missing data indicator	Notes
Secchi Transparency	0.05 m	25 m	99.99	Decimal errors
Water Temperature	-0.5 C	30 C	99.99	
Dissolved Oxygen	0 ppm	~15 ppm	99.99	See SOP & Examine field dups(Section 5.1)
Total Phosphorus (epilimnetic)	0.001 ppm	0.020 ppm*	99.999	*values exceeding this level need to be evaluated for contamination by comparing with transparency readings and chl a data, if available

Total Phosphorus (hypo-limnetic)	0.001 ppm	1.0 ppm*	99.99	*same as above; high hypolimnetic total phosphorus generally indicates release from sediments- check against values at nearby depths
PH	4.5	~9.0*	99.99	*can be exceeded during bloom conditions; range with data for a particular lake should be scrutinized carefully and outliers treated with BPJ given methodology used to obtain reading
Alkalinity	0 mg/l CaCO3	200 mg/l CaCO3	999	When below 5 mg/l, determine ANC; convert to Alk prior to entering by dividing by factor of 20.
Specific conductance	0 uS/cm	1000uS/ cm*	99999	*most Maine lakes<100; > 100 indicates salt water influence, intrusion or meromixis.
Color	0 SPU	250 SPU	999	
Chlorophyll a	0 ppb	80 ppb	99.99	Review of dup. filter data provided by lab
Surveyor Certification	N/A	N/A	99-999	Required for 99% of data.
Date	1930	Current year	N/A	Most dates will reflect data obtained in previous season
Wind Velocity	0	25	99	Question validity of velocity>25mph; verify that 'range' was not squeezed into field – if range was entered, enter midpoint of range

7.2 Verification and Validation Methods. [D2. (Element 23)]

Chain-of-custody of the field forms is described in the section pertaining to data management (Section 5.1). Data verification and data validation are interwoven in the data proofing step (Sections 5.1 & 7.1). Issues that pertain to the individual's responsibility for recording data accurately, fall under 'verification' aspects. Validation issues involve application of criteria listed in Table in Section 7.1 above as well as the analysis of laboratory results for duplicate samples and if applicable to the analysis, blanks and spikes.

7.3 Reconciliation with User Requirements. [D3. (Element 24)]

Each project manager submitting Sample and Analysis Plans under this QAPP will be responsible for summarizing how well the data quality objectives (DQOs) outlined in Table 4 were met (e.g., 100% of the total phosphorus replicates met the DQO). For the parameters requiring laboratory analysis, we expect that 80% of the duplicates will meet the DQO. This is a conservative level but reasonable to achieve given the analytes of concern.

Assessments of trophic state are made using the lake water quality data in the Maine Lakes Database as required for submission of Integrated Reports to EPA [under Sections 303(d) and 305(b)]. If data violates the statutory standard for Class GPA due to a pollutant, the data is listed under Listing Category 5a in the Integrated Report and is listed as a Section 303(d) water requiring a TMDL. Details regarding the assessment criteria can be found in the current Integrated Report (or past 305(b) reports).

Lake water quality reports are produced for each lake on an annual basis (total of 3000 pages). Volunteers monitoring specific lakes are provided copies of these reports for their lakes. These reports are often used by lake associations for planning purposes, towns for comprehensive planning and lake protection activities (zoning, ordinance development). Individuals requesting information about a particular lake are given a copy of this report and a page explaining the significance and parameter averages and expected range for parameters in Maine lakes.

Data for 'project' or TMDL lakes will be used within lake specific reports to evaluate whether internal recycling of nutrients is an issue for a particular lake. Lake data collected through the Lake Assessment Program is not intended to be used for issuing stop-work orders or enforcement relating to a particular activity. Rather, this lake data set is used to evaluate the condition of a lake's trophic state, which is a result of features unique to the lake (flushing rate, drainage area, volume, etc.) and land uses (past and present) in its direct and indirect watershed. It is used to answer questions like: how clear is the water, are oxygen levels in the hypolimnion adequate to support a coldwater fishery, is it desirable to own property on this lake, is it desirable to swim in this lake. If the data used to answer these questions indicate that a water is in violation of its classification, then steps are taken to list the water as 'impaired' (Listing Category 5a in the Integrated Report).

8. References

Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998, Prepared and published jointly by: American Public Health Association, American Water Works Association, and Water Environmental Federation, United Book Press, Inc., Baltimore, Maryland.

9. Appendices

9.1. SAP Element Template

9.2. VLMP Spring Mailing Packets

(packets added annually to Master Copy of QAPP will have similar content)

A. 'Save Paper' Notice
B. Spring Monitoring Update (2004)
C. Letter from Regional Coordinator
D. Recertification Letter
E. Recertification Workshop Schedule
F. Annual Meeting Announcement
G. Explanation of Lake Water Quality Monitoring Report
H. Lake Water Quality Monitoring Report
I. Water Quality Summary
J. Instructions for DEP Lake Monitoring Field Forms
K. Example of properly completed form
L. Two-part form
M. Two envelopes addressed to Regional coordinator
N. Annual Report

9.3. Lake Baseline Documents

(annual updates to Master Copy of QAPP will be inserted in each subsection)

A. Bottle Packet Preparation Guidelines
B. Baseline Procedures
C. Equipment Checklist
D. Baseline Schedule
E. Baseline Contacts
F. Lab Worksheet/Sample Processing Checklist
G. Example of bathymetric map with sample station indicated

9.4. SOPs for Field Procedures

A. Draft SOP: Secchi Disk Transparency
B. Draft SOP: Dissolved Oxygen/Temperature Profiles (electronic meters)
C. Draft SOP: Dissolved Oxygen (chemical kits)
D. Draft SOP: Epilimnetic Core Sample Collection
E. Draft SOP: Collection of Grab (discrete) Samples
F. Draft SOP: Total Phosphorus Sample Collection
G. Draft SOP: Chlorophyll Sample Collection
H. Draft Procedure for collection of Zooplankton Samples
I. Draft Procedure for collection of Surface Sedimented diatoms

9.5. SOPs for Processing/Sample Preparation

A. Draft SOP: Chlorophyll Filtration
B. Draft SOP: Alkalinity by Titration
C. Draft SOP: True and Apparent Color (Nessler Tubes, Hach Color Wheel, Spectrophotometric)
D. Draft SOP: Specific Conductance

9.6. Environmental Chemistry Lab SOPS

A. SOP: Chlorophyll ‘a’
B. SOP: Total Phosphorus
C. SOP: Alkalinity (ANC)
D. SOP: Anions (Ion Chromatography)
E. SOP: Cations and Aluminum by Ultrasonic Nebulization ICP-AES
F. SOP: Color, Apparent and True
G. SOP: Dissolved Organic and Dissolved Inorganic Carbon (Model 1010 & 1051)
H. SOP: Total Nitrogen

9.7. Health & Environmental Testing Lab SOPS

A. SOP: Chlorophyll ‘a’
B. SOP: Total Phosphorus

9.8. Data Forms

A. Two-part, Multiple Date Transparency Form
B. Two-part, Single Date Transparency and Temperature Dissolved Oxygen Form
C. One page, Side One: Single Date Transparency and Temperature Dissolved Oxygen Form; Side Two: Chemistry Form

9.9. Miscellaneous Documents & Guidelines

A. QA/QA Workshop Checklist of what to bring

B. QA/QC Workshop Checklist of what to review
C. QA/QC Volunteer Forms

9.10. QAPP modifications

9.11. Retired Procedures

A. Red Book V1
B. Red Book V2
C. Red Book V3
D. Standard Methods for Lake Sampling
E. Baseline Monitoring