Quality Assurance Project Plan for Bantam Lake Nutrient TMDL Model

Prepared for

United States Environmental Protection Agency Region 1 – New England
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Prepared by

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A. Project Management

A.1. Title and Approval Sheet

Quality Assurance Project Plan for Bantam Lake Nutrient TMDL Model

12/13/18

Steven Winnett (EPA), Task Order Contracting Officer Representative — Date

12/11/18

Robert Reinhart (EPA), Quality Assurance Officer — Date

12/7/2018

Bob Hartzel (Comprehensive Environmental), Task Order Manager — Date

12/7/18

Ken Hickey (HydroAnalysis), Quality Assurance Coordinator — Date

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A.3. Distribution List

This Quality Assurance Project Plan (QAPP) will be distributed to the key project personnel listed in Table 1, and to all contractor and subcontractor personnel involved in the project, including those who may join the project after approval of the QAPP.

Table 1. QAPP Distribution

Name, Agency, Role	Contact Information	Mailing Address
Steven Winnett U.S. Environmental Protection Agency Task Order Contracting Officer Representative	617-918-1687 winnett.steven@epa.gov	5 Post Office Square, Suite 100 (OEP06-2) Boston, MA 02109
Mary Garren U.S. Environmental Protection Agency Project Team Leader	617-918-1322 garren.mary@epa.gov	5 Post Office Square, Suite 100 (OEP06-2) Boston, MA 02109
Toby Stover U.S. Environmental Protection Agency Project Technical Advisor	617-918-1604 stover.toby@epa.gov	5 Post Office Square, Suite 100 (OEP06-2) Boston, MA 02109
Robert Reinhart U.S. Environmental Protection Agency Quality Assurance Coordinator	617-918-8633 reinhart.robert@epa.gov	EPA New England Regional Laboratory 11 Technology Drive (EQA) North Chelmsford, MA 01863-2431
Bob Hartzel Comprehensive Environmental, Inc. Task Order Manager	508-281-5201 rhartzel@ceiengineers.com	225 Cedar Hill Street, Marlborough, MA 01752
Laura Blake HydroAnalysis, Inc. Technical Lead	lblake@hydroanalysisinc.com 617-320-6000	481 Great Road, Suite 3 Acton, MA 01720
Ken Hickey HydroAnalysis, Inc. Quality Assurance Coordinator	khickey@hydroanalysisinc.com 978-501-5111	481 Great Road, Suite 3 Acton, MA 01720

A.4. Project Organization

Comprehensive Environmental, Inc. (CEI) and HydroAnalysis, Inc. have been contracted by the U.S. Environmental Protection Agency (EPA) Region 1 (through a task order under EPA Contract No. 68HE0118A0001 with PARS Environmental) to provide support in developing the modeling capacity of staff at Connecticut Department of Energy and Environmental Protection (CT DEEP) to support nutrient total maximum daily load (TMDL) development for lakes and impoundments. An organization chart for the project team is depicted in Figure 1, and includes the relationships and lines of communication among all key project personnel. The roles and responsibilities of key project personnel are summarized below.

Steve Winnett (EPA) is the Task Order Contracting Officer Representative (TOCOR), and will provide overall project and budget oversight for the task order, including tasking contractors with work required to complete the project. Mr. Winnett will review and approve the QAPP and ensure that all contractual issues are addressed as work is performed on this project.

Mary Garren (EPA) is the Project Team Leader, and will coordinate with contractors to ensure that project objectives are attained. Ms. Garren will also review project deliverables developed by the contractors to ensure technical quality and contract adherence.

Toby Stover (EPA) is the Technical Advisor, will assist with the review of project deliverables developed by the contractors to ensure technical quality and contract adherence.

Robert Reinhart (EPA) is the QA Officer, and will be responsible for reviewing and approving this QAPP. In addition, Mr. Reinhart will conduct external performance and system audits, as needed, and participate in any EPA reviews of work performed. Mr. Reinhart will remain independent from the project.

Bob Hartzel (CEI) is the Task Order Manager, and is responsible for overall management of the contract team, including overseeing CEI staff and subcontractor staff and coordinating with the EPA TOCOR. Mr. Hartzel will review project deliverables (including model setup), assist with model training, and ensure the completion of high quality work within the established budget and schedule.

Laura Blake (HydroAnalysis) is the Technical Lead, and will develop model input data sets, calibrate and validate the model, apply the model, conduct the model training, and prepare project deliverables. Ms. Blake will implement the QA/QC program, complete assigned work on schedule and with strict adherence to the established procedures, and complete required documentation.

Ken Hickey (HydroAnalysis) is the Quality Assurance Coordinator, and will support the preparation of the QAPP, review and approve the QAPP, and perform monitoring of quality control (QC) activities to determine conformance with quality assurance and quality control (QA/QC) requirements.

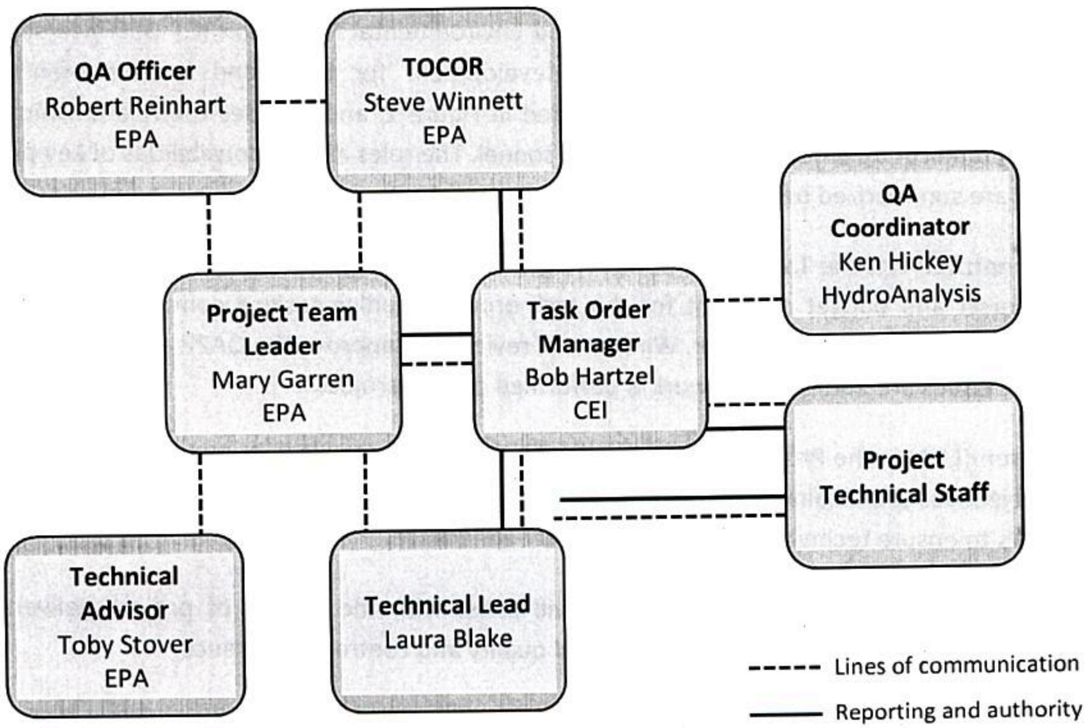

Figure 1. Project Organizational Chart

A.5. Problem Definition and Background

Excess nutrients can lead to eutrophication and potential formation of Harmful Algal Blooms (HABs) in lakes and impoundments. Addressing nutrient impacts to water quality has been identified as a high priority for the state by the CT DEEP. In order to address the impact of nutrients on lakes and impoundments in Connecticut and the potential for development of HABs within these waterbodies, CT DEEP is proposing to develop a statewide TMDL to address nutrient loading and HAB formation with watershed specific appendices to address site-specific conditions. The statewide TMDL will include a core document and watershed specific appendices. The core document will provide background information on the water quality impacts associated with nutrients and HABs and include a general TMDL and discussion of implementation resources. Nutrient loads will be evaluated against changes in lake trophic status, as defined in Section 22a-426-6 of Connecticut's Water Quality Standards Regulations. The watershed specific appendices will provide site-specific information to document existing nutrient loads and conditions contributing to HABs as well as identify necessary nutrient load reductions and other actions to prevent HABs formation in the future.

CT DEEP has selected Bantam Lake for the first appendix that will accompany a future statewide HAB Nutrient TMDL. With surface area of 947 acres, Bantam Lake is Connecticut's largest natural lake. Bantam Lake is an important local resource for public recreation, including boating and swimming. Bantam Lake has a history of frequent blooms of cyanobacteria due to eutrophication of the lake from external and internal loading of nutrients. Bantam Lake was listed on CT DEEP's 2016 Integrated Water Quality Report as impaired for recreation with chlorophyll a, excess algal growth, and nutrient/eutrophication biological indicators identified as the causes of impairment. CT DEEP selected the BATHTUB model (Walker, 1999, 1987, 1985) to support the evaluation of nutrient loading and estimation of watershed based annual load reductions needed to attain the natural trophic status of Bantam Lake.

CEI and HydroAnalysis have been contracted by EPA Region 1 (through a task order under EPA Contract No. 68HE0118A0001 with PARS Environmental) to provide support in developing the modeling capacity of staff at CT DEEP to support nutrient TMDL development for lakes and impoundments. The specific project objectives are as follows:

1) Setup, calibrate, and validate the BATHTUB model for Bantam Lake.

2) Using the calibrated and validated BATHTUB model, calculate nutrient loading capacities and load reductions necessary to meet water quality targets for Bantam Lake, including total phosphorus (TP), total nitrogen (TN), chlorophyll-a concentrations, transparency, and hypolimnetic oxygen depletion rate.

3) Provide CT DEEP staff with model training such that they are able to independently replicate the analysis for Bantam Lake and apply the modeling analysis to support the development of TMDLs for nutrients in other lakes and impoundments in Connecticut.

This QAPP describes the quality system that will be implemented for this project. This QAPP presents the data quality objectives for the BATHTUB model and describes the quality control steps and techniques to be followed to achieve the QA/QC criteria established for the project. This QAPP also addresses the use of secondary data (i.e., data collected for another purpose or collected by an organization not under the scope of this QAPP) to support model development and TMDL calculations. This QAPP was developed in accordance with EPA guidance documents for QAPPs, including *EPA Guidance for Quality Assurance Project Plans* (EPA QA/G-5) (EPA, 2002), *EPA New England Environmental Data Review Program Guidance* (EPA, 2018), EPA *New England Quality Assurance Project Plan Guidance for Environmental Projects Using Only Existing (Secondary) Data* (EPA 2009), and the EPA New England templates and checklist for modeling QAPPs.

A.6. Project and Task Description

A.6.1. Project Tasks

CEI and HydroAnalysis have been contracted by EPA Region 1 (through a task order under EPA Contract No. 68HE0118A0001 with PARS Environmental) to provide support in developing the modeling capacity of staff at CT DEEP to support nutrient TMDL development for lakes and impoundments. The specific tasks to be completed under this project are as follows:

- Develop a Quality Assurance Project Plan.
- Assemble, review, and format secondary data for the BATHTUB model input for Bantam Lake.
- Prepare a technical memorandum to summarize the modeling methodology and BATHTUB model input data.
- Setup, calibrate, and validate the BATHTUB model for Bantam Lake.
- Use the calibrated BATHTUB model to calculate nutrient loading capacities and load reductions necessary to meet water quality targets for Bantam Lake, including TP, TN, chlorophyll a, transparency, and hypolimnetic oxygen depletion rate.
- Develop and conduct model training for CT DEEP staff, such that CT DEEP staff are able to independently replicate the analysis for Bantam Lake, and apply the modeling analysis to other lakes.
- Prepare a final report that summarizes the model setup, calibration, validation, and application to calculate nutrient load reductions needed to meet the water quality targets for Bantam Lake.
- Provide all data and related files used in the modeling of Bantam Lake.

A.6.2. Project Schedule

The project schedule for deliverables and other key milestones is provided below.

Milestone	**Date**
Notice to Proceed	September 19, 2018
Technical Progress Reports & Invoices (Task 1)	Monthly
Kickoff Call (Task 1A)	October 2018
Kickoff Call Summary (Task 1A)	Within 7 days of call
Conference Calls (Task 1B)	To be scheduled as needed
Conference Call Summaries (Task 1B)	Within 7 days of each call
QAPP – draft (Task 2)	October 9, 2018
QAPP – EPA comments (Task 2)	October 30, 2018
QAPP – final (Task 2)	November 13, 2018
QAPP – EPA approval (Task 2)	November 27, 2018
Technical Memo & Model Input Files – draft (Task 3)	January 22, 2019
Technical Memo – EPA comments (Task 3)	February 5, 2019
Technical Memo – final (Task 3)	February 19, 2019
Complete Model Files (Task 4)	April 30, 2019
Onsite Model Training (Task 5)	Week of May 20, 2019 (tentative)
Final Report – draft (Task 6)	June 28, 2019
Final Report - EPA comments (Task 6)	July 26, 2019
Final Report – final (Task 6)	August 23, 2019

A.7. Quality Objectives and Criteria for Measurement Data

This section describes the quality objectives for the project, including the performance and acceptance criteria to achieve the objectives. The QA process for this project consists of using data of acceptable quality, data analysis procedures, modeling methodology and tools, administrative procedures, and technical reviews. Project quality objectives and criteria for data will be addressed by: (1) evaluating the quality of the data used, and (2) assessing the results of the model application.

A.7.1. Measurement Data Acceptance Criteria

Model setup, calibration, validation, and application for this project will be accomplished using secondary data from qualified sources, including governmental agencies. Data of known and documented quality are essential components of the success of the water quality modeling analysis to be conducted under this project because the model will generate data to be used to support the TMDL decision-making process. Table 2 summarizes the acceptance criteria for secondary data that will be used in the setup and calibration of the model.

The organizations generating the secondary data that may be used in this project typically apply their own review and verification procedures to evaluate a dataset's integrity and conformance to QA/QC requirements. The quality of the data will be judged using information in source documents, from websites of origin, or directly from the authors. If the quality of the data can be adequately determined, the data will be used. If it is determined that no quality requirements exist or can be established for a dataset that must be used for this task, a case-by-case basis determination will be made regarding the use of the data. Data of unknown quality will not be used if the use of such data is believed to have a significant or disproportionate impact on the TMDL results.

Secondary data will be assembled, reviewed, and formatted in an Excel spreadsheet format ready for input into BATHTUB. Data that are outside of typical ranges for a given parameter will be flagged for exclusion during model setup, calibration, and validation. Flagged data will only be excluded if they are determined to be erroneous (e.g., pH >14). The final data used in the model, the period of record of the data, and the source of the data will be documented in the final report. Any use of secondary data of unknown quality and any data gaps and the assumptions used in filling such gaps will also be documented in the final report.

Table 2. Data Acceptance Criteria for Secondary Data

Quality Criterion	Description
Reasonableness	Datasets will be reviewed to identify anomalous values that may represent data entry or analytical errors. Such values will not be used without clarification from the agency providing the data.
Completeness	Datasets will be reviewed to determine the extent of gaps in space and time. It is likely that some data gaps will be evident. These gaps and the methods used to fill the gaps will be discussed in project deliverables.
Comparability	Datasets from different sources will be compared by checking the methods used to collect the data and that the units of reporting are standardized.
Representativeness	Datasets will be evaluated to ensure that the reported variable and its spatial and temporal resolution are appropriate for the project. For example, datasets must be able to be reasonably aggregated (or disaggregated) to represent conditions in the model and must be representative of conditions during the simulation periods. The goal is for data and information to reflect present day conditions. Where possible, data from the past 10 years will be used.
Relevance	Data specific to the study site will be used. If needed, regional data and information that most closely represent the study site will be used.
Reliability	Sources of data and information will be considered reliable if they meet at least one of the following acceptance criteria: • The information or data are from a peer-reviewed, government, industry-specific source. • The source is published. • The author is engaged in a relevant field such that competent knowledge is expected (i.e., the author writes for an industry trade association publication versus a general newspaper). • The information was presented in a technical conference where it is subject to review by other industry experts. • The information or data are from a lake association / watershed group, deemed credible by CT DEEP. Sources of data that use unknown collection and data review procedures are considered less reliable, and will be used only if necessary to fill data gaps and following discussion with and approval by EPA.

A.7.2. Model Performance and Acceptance Criteria

EPA's *Guidance for Quality Assurance Project Plans for Modeling* (EPA QA/G-5M) discusses the importance of using performance criteria as the basis by which judgments are made on whether the model results are adequate to support the decisions required to address the study objectives. The focus of this section is to specify model performance criteria for the BATHTUB model to be developed for Bantam Lake.

A 'weight of evidence' approach that embodies the following principles will be adopted for model calibration in this project (Donigian 2002):

- Given that models are approximations of natural systems, exact duplication of observed data is not a performance criterion. The model calibration process will measure, through comparability goals, the ability of the model to simulate observed data.
- No single procedure or statistic is widely accepted as measuring, nor capable of establishing, acceptable model performance. Thus, both quantitative (error statistics) and qualitative (graphical) comparisons of observed data and model results will be used to provide sufficient evidence to weight the decision of model acceptance or rejection.
- All model and observed data comparisons must recognize, either qualitatively or quantitatively, the inherent errors and uncertainty in both the model and the measurements of the observed data sets. These errors and uncertainties will be documented, where possible, in the final report.

The BATHTUB model will be deemed acceptable when it is able to simulate observed data within predetermined statistical measures. Table 3 lists the model performance criteria, sometimes referred to as calibration criteria, that will be used to compare and evaluate the percent mean errors between model predictions and observed data. The ranges in Table 3 are intended to be applied to mean values; individual observations may show larger differences and still be deemed calibrated and validated for application so long as such excursions are limited (Donigian 2000). Model performance will be deemed acceptable where a performance evaluation of "good" or "very good" is attained. While the ranges in Table 3 will be used as targets for model calibration and validation, they cannot be guaranteed to be met as they may not be achievable. The model will be considered calibrated when it reproduces data within an acceptable level of accuracy determined in consultation with EPA, which will be documented in project deliverables.

Table 3. Model Calibration / Validation Targets (Donigian 2002)

Variable	Percent Difference between Simulated and Observed Values		
	Very Good	***Good***	***Fair***
Water Quality / Nutrients	< 15	15 – 25	25 - 35

A.8. Special Training and Certification

Contractor personnel working on this project hold advanced degrees from universities that are well known for excellence in surface water modeling. Further, the contractor personnel all have more than 20 years of experience calibrating, validating, and applying hydrologic and water quality models to support TMDL development in numerous types of water bodies. This experience includes the application of the BATHTUB model to support the development of nutrient TMDLs for lakes.

No special training or certification is required for personnel working on this project beyond the already high degree of academic training and professional experience that they have obtained in order to fulfill job requirements commensurate with their current assignments.

A.9. Documentation and Records

All data and information collected and generated during this project will be stored in a project folder area on HydroAnalysis' network. At project completion, HydroAnalysis will transmit a copy of all project files to EPA and CT DEEP through use of a Microsoft OneDrive folder created for this project. HydroAnalysis will also maintain a copy of all project files on HydroAnalysis' network for a minimum of five years following completion of the project.

The following deliverables will be prepared under this project:

- Quality Assurance Project Plan
- Monthly technical progress reports
- Teleconference summaries
- BATHTUB model
- Modeling methodology technical memorandum
- Model input data tables
- Model execution files
- Model output files

- Excel spreadsheet tools
- Final report

The final report will provide a complete and clear summary of the modeling methodology and all data and assumptions used in the model for Bantam Lake such that the analysis can be easily reproduced by CT DEEP staff.

B. Data Generation and Acquisition

B.1. Data Acquisition Requirements (Non-Direct Measurements)

This project will require the use of secondary data, also referred to as non-direct measurements. Secondary data are data that were collected under a different effort outside of this project. Secondary data to be used in this project will be collected from government publications and databases, scientific literature, industry published studies, lake associations / watershed groups, and other organizations. Table 2 summarizes the acceptance criteria for use of secondary data in the setup and calibration of the model.

The proposed data (including sources) to be used in the model setup and calibration will be submitted to EPA for review and approval prior to model setup. The final report will include a summary of all final data (including complete citations) used in the setup, calibration, and validation of the model.

B.2. Data Management

Consistent data management procedures will be used during pre-processing, model calibration, and post-processing stages of the project. All data and information collected and generated during this project will be stored in a project folder area on HydroAnalysis' network. Original data sources will be documented to identify the website or contact person that provided the data, data query parameters, and data request correspondence. Original (unaltered) copies of all sources of data used in the project will be retained in the project folder on HydroAnalysis' network.

At project completion, HydroAnalysis will transmit a copy of all of the project files to EPA. HydroAnalysis will maintain a copy of the project files on HydroAnalysis' network for a minimum of five years following completion of the project.

C. Assessment and Oversight

C.1. Assessments and Response Actions

The QA program under which this project will operate includes surveillance, with independent checks of the data obtained from data-gathering and analysis activities. The essential steps in the QA program are as follows:

- Identify and define the problem;
- Assign responsibility for investigating the problem;
- Investigate and determine the cause of the problem;
- Assign and accept responsibility for implementing appropriate corrective action;
- Establish the effectiveness of and implement the corrective action; and
- Verify that the corrective action has eliminated the problem.

If quality problems that require attention are identified, the Technical Lead will determine whether attaining acceptable quality requires either short- or long-term corrective actions. Many of the technical problems that might occur can be solved on the spot by the staff members involved, for example, by modifying the technical approach or correcting errors or deficiencies in documentation. Immediate corrective actions form part of normal operating procedures and are noted in records for the project (e.g., monthly progress reports). Problems that cannot be resolved in this manner require more formalized, long-term corrective action. Examples of major corrective actions may include the following:

- Reemphasizing to staff the project objectives, the limitations in scope, the need to adhere to the agreed upon schedule and procedures, and the need to document QC and QA activities.
- Securing additional commitment of staff time to devote to the project.
- Retaining outside consultants to review problems in specialized technical areas.
- Changing procedures (for example, replacing a staff member, if it is the best interest of the project to do so).

The Technical Lead has primary responsibility for monitoring the activities of this project and identifying or confirming any quality problems. These problems will also be brought to the attention of the Task Order Manager and Quality Assurance Coordinator, who will initiate corrective actions described above, document the nature of the problem, and ensure that the recommended corrective action is carried out. The Task Order Manager and Quality Assurance Coordinator have the authority to stop work on the project if problems affecting data quality that will require extensive effort to resolve are identified. The TOCOR and Project Team Leader will be notified of major corrective actions and stop work orders. The TOCOR and Project Team Leader have the authority to stop work on the project if there are QA concerns.

The Task Order Manager and Technical Lead will each perform surveillance activities throughout the duration of the project to ensure that management and technical aspects are being properly implemented according to the schedule and quality requirements specified in this QAPP. These surveillance activities will include assessing how project milestones are achieved and documented, corrective actions are implemented, budgets are adhered to, technical reviews are performed, and data are managed. QA surveillance activities will be documented in monthly progress reports.

D. Model Application

D.1. Model Parameterization (Calibration)

Model calibration is the systematic changing of initial model parameters to minimize error between observed and simulated values. The calibration begins with the best estimates for model input on the basis of measurements and subsequent data analyses. Results from initial simulations are then used to improve the concepts of the system or to modify the values of the model input parameters. The success of a model calibration is largely dependent on the validity of the underlying model formulation.

Models are often calibrated through a subjective trial-and-error adjustment of model input data because a large number of interrelated factors influence model output. The model calibration *goodness of fit* measures can be either qualitative or quantitative. Qualitative measures of calibration progress are commonly based on the following:

- Graphical time-series plots of observed and predicted data.
- Graphical transect plots of observed and predicted data at a given time interval.
- Comparison between contour maps of observed and predicted data, providing information on the spatial distribution of the error.
- Scatter plots of observed versus predicted values in which the deviation of points from a 45 degree straight line gives a sense of fit.
- Tabulation of measured and predicted values and their deviations.

The BATHTUB model will be calibrated to the best available data, including literature values and interpolated or extrapolated existing field data. If multiple datasets are available, an appropriate period and corresponding dataset will be chosen on the basis of factors characterizing the dataset, such as corresponding weather conditions, amount of data, and temporal and spatial variability of data.

The model will be considered calibrated when it reproduces data within an acceptable level of accuracy (see Table 3). Calibration and validation activities and procedures, along with goodness-of-fit validation targets for specific parameters will be documented in the technical memorandum and final report.

D.2. Model Corroboration (Validation and Simulation)

Data review and validation processes provide a method for determining the usability and limitations of data and provide a standardized data quality assessment. HydroAnalysis staff will be responsible for reviewing data entries, transmittals, and analyses for completeness and adherence to QA requirements. The HydroAnalysis Technical Reviewer will perform evaluations to ensure that QC is maintained throughout project. QC evaluations will include reviewing model setup and double-checking work, and other review to ensure that the standards set forth in the QAPP are met or exceeded.

Raw (original) data will be entered into a standard database. All entries will be compared to the original data files to ensure no transcription errors. A screening process will be used to scan through the database and flag data that are outside typical ranges for a given parameter. Values outside typical ranges will not be used to develop model calibration data sets or model kinetic parameters.

Some data may be manipulated using Microsoft Excel (e.g., if lake data for total phosphorus data are reported in mg/L will, minor calculations will be performed to convert the values to ug/L for input into the model). Ten percent of the calculations will be recalculated to ensure that correct formula commands were entered into the program. If five percent of the data calculations are incorrect, all calculations will be rechecked after the correction is made to the database.

Model validation is an evaluation of the model goodness-of-fit using an independent data set. The model will be considered validated if its accuracy and predictive capability have been proven to be within acceptable limits of error independently of the calibration data. Model validation will be performed using a dataset that differs from the calibration dataset. Acceptable limits are those defined by the combined process of quantitative and qualitative examination of the model versus the data. The limits used will be documented in the final report.

Data quality will be assessed by comparing entered data to original data, performing the data and model evaluations described in this QAPP, and comparing results with the measurement performance or acceptance criteria summarized in this QAPP. Results of the review and performance processes and results will be documented in the final report.

D.3. Reconciliation with User Requirements

The value of the information generated by this project will be determined by evaluating data quality and by comparing methods and results with published data and scientific literature and the data quality objectives identified in this QAPP. Confidence in model predictions can be limited by a number of factors including representativeness of calibration data, knowledge of actual nutrient inputs (external loading and internal loading), and the inherent ability of the model to simulate the conditions in the lake.

Data quality indicators will be calculated during model setup, calibration, and validation. Measurement quality requirements will be compared with the data quality objectives to confirm that the correct type, quality, and quantity of data are being used for the model setup and calibration. Computation and post-simulation analysis results will be reviewed for reasonableness.

To ensure reproducibility of the work by CT DEEP, the final report will identify sources of data, assumptions made during model setup, and calculations performed as part of input data pre- and post-processing.

D.4. Reports to Management

The following reports will be prepared under this project and submitted to EPA for review and approval:

- Quality Assurance Project Plan (draft and final)
- Monthly technical progress reports
- Teleconference summaries
- Modeling methodology technical memorandum (draft and final)
- Final report (draft and final)

The final report will provide a complete and clear summary of the modeling methodology and all data and assumptions used in the model for Bantam Lake such that the analysis can be easily reproduced by CT DEEP staff.

E. References

Donigian, A.S. Jr. 2002. Watershed Model Calibration and Validation: The HSPF Experience. WEF National TMDL Science and Policy 2002, November 13-16, 2002. Phoenix, AZ. WEF Specialty Conference Proceedings on CD-ROM.

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Walker, W. W., Jr. 1987. Empirical Methods for Predicting Eutrophication in Impoundments: Report 4— Phase III: Applications Manual. Technical Report E-81-9. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS. July 1987.

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