Lake Horace Marsh Restoration Project
Quality Assurance Project Plan

August 1, 2005

Prepared by
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Project Manager: _____
Signature / Date
Margaret Watkins, PWA

Project QA Officer: _____
Signature / Date
Sarah Allen, Normandeau Associates

Program Quality Assurance Coordinator: _____
Signature / Date
Jillian Jones, NHDES

NHDES Quality Assurance Manager: _____
Signature / Date
Vincent Perelli, NHDES

USEPA Project Manager: _____
Signature / Date
Warren Howard, US EPA Region I

USEPA QA Representative: _____
Signature / Date
TBD, US EPA Region I

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A3 – Distribution List

Table 1 presents a list of people who will receive the approved QAPP, the QAPP revisions, and any amendments.

Table 1. QAPP Distribution List

QAPP Recipient Name	Project Role	Organization	Telephone number and Email address
Margaret Watkins	Project Manager	PWA	487-3331; mwatkins@pwa-nh.org
Sarah Allen	Project QA Officer	Normandeau Associates	472-5191; sallen@normandeau.com
John Magee	DU Liaison	NH F&GD	271-2744; jmagee@wildlife.state.nh.us
Jillian Jones	Program QA Coordinator	NHDES Watershed Management Bureau	603-271-8475; jjones@des.state.nh.us
Vincent Perelli	NHDES Quality Assurance Manager	NH DES Planning Unit	603-271-8989; vperelli@des.state.nh.us
Warren Howard	USEPA Project Manager	USEPA New England	617-918-1587; Howard.Warren@epamail.epa.gov
TBD	USEPA Quality Assurance Representative	USEPA New England	TBD

Based on EPA-NE Worksheet #3

A4 – Project/Task Organization

The Piscataquog Watershed Association (PWA) is the lead organization for this project. PWA will contract with and oversee subcontractors, recruit and supervise volunteers unless otherwise indicated, be responsible for ensuring all reports are completed and delivered as scheduled, and otherwise serve as the central coordinating and project management entity.

Normandeau Associates, Inc. (NAI) will be contracted with to perform all activities related to gauge installation, vegetational analysis, aerial photography interpretation and evaluation, and water level data analysis. NAI will contribute to the writing of reports conveying information on activities with which they are involved. Staff will communicate regularly with PWA.

NH Fish & Game is contributing financially towards this project and is coordinating with Ducks Unlimited in connection with preparation of weir design. Fish & Game will also participate in monitoring activities not included in the QAPP and advise on matters relating to fish passage and wildlife. Fish & Game staff works closely with PWA.

Ducks Unlimited is providing design services and will oversee all activities related to construction, including hiring and supervision of contractors for construction.

Town of Weare will own the structure and be responsible for its management and maintenance. The Weare Conservation Commission has contributed financially to the project and intends to conduct one or more educational programs at the site as part of this project.

Data users are discussed in A5, below, and include the PWA, Weare Conservation Commission, NH DES and US EPA.

Figure 1 shows an organizational chart for this project.

Figure 1. Project organizational chart

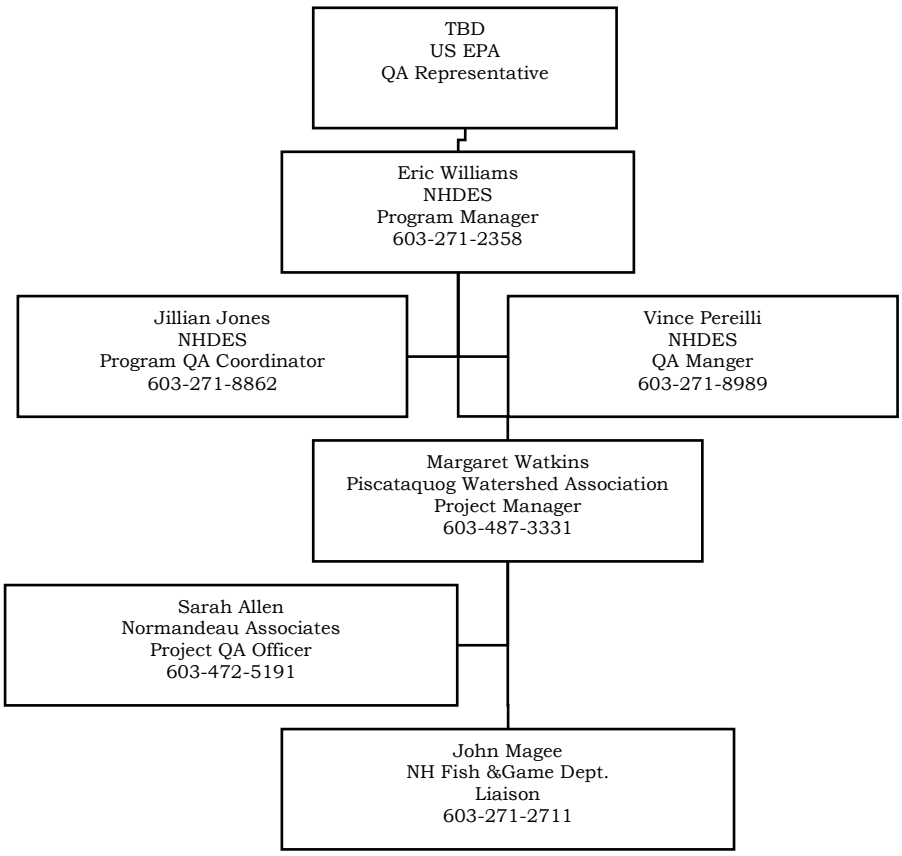


Table 2. Personnel Responsibilities and Qualifications

Name and Affiliation	Responsibilities	Qualifications
Margaret Watkins, Executive Director, PWA	Oversee project finances and subcontractors, specifically Normandeau Associates and Ducks Unlimited	On file at PWA
Sarah Allen, Normandeau Associates	Direct QA/QC activities for pre and post weir installation	Sr. Biologist, On file at PWA
John Magee, NH F&GD	Coordinate technical aspects of weir design and construction with Ducks Unlimited	Fisheries Scientist, on file at NHF&GD
Eric Williams, NH DES Watershed Management Bureau	Watershed Assistance Supervisor	On file at NHDES
Vince Perelli, NH DES	Responsible for review and approval of QAPP	On file at NHDES
Jillian Jones NH DES Watershed Management Bureau	Reviews QAPP preparation and other QA/QC activities	On file at NHDES
TBD EPA Region I Laboratory	Responsible for review and approval of QAPP	On file at EPA

Based on EPA-NE Worksheet #6.

A5 – Problem Definition/Background

Project goal: To restore a locally designated "prime wetland" that is adversely affected by downstream dam management practices. See Appendix A, "site map."

Problem Statement: Lake Horace Marsh is one of two legislatively designated "prime wetlands" in Weare, New Hampshire. It lies along the North Branch of the Piscataquog River, just above Abijah Bridge, a Town-owned bridge on Abijah Bridge Road. When there is water in it, this 181-acre marsh is spectacularly beautiful. Its ecological functions, however, are severely compromised by downstream dam operations. The Weare Reservoir Dam is owned by the State and managed for recreation and conservation. While often compatible goals, in the case at hand they are not. Raising lake levels in the spring and lowering them in the fall to accommodate waterfront dock protection creates a death trap for most aquatic flora and fauna. Attempts to alter the State's dam management have failed. Informal wildlife surveys conducted over a period of decades throughout the marsh by Gordon Russell of New Boston (formerly of Weare), a naturalist and long-time watershed conservationists, reflect drastic reductions from numbers one would expect of waterfowl, amphibians, furbearers, aquatic reptiles, and insects. The fall drawdown almost guarantees high mortality for animals that have prepared for freezing conditions when the water was high. The spring fill-up floods waterfowl nests and creates harsh conditions for fish redds and hatched fry.

Proposed Solution: The Town is planning to replace Abijah bridge. Concurrently, project partners (PWA, DU, Fish & Game Department, and Town of Weare in particular) plan to install a water control structure at the bridge crossing and the mouth of the marsh of sufficient size to stabilize water levels throughout the year. Upon completion, the Town will own and maintain the dam.

Questions to be Answered:

- Did the weir effectively stabilize marsh levels to the point where herbaceous and scrub-shrub vegetation zones stabilize and flourish?

- How reliable are relatively inexpensively obtained aerial photographs for quantifying vegetational changes, or is their effectiveness limited to extent of open water vs. vegetated areas?
- How quickly does the marsh vegetation stabilize?
- Based on informal observational techniques, what benefits to birds and wildlife can be linked to stabilized marsh water levels?

Use and Users of the Data: Most of the data generated will be used by project partners to evaluate the extent of the benefits for birds and wildlife accruing as a result of marsh levels having been stabilized. The Weare Conservation Commission, which has contributed financially to the project, and the PWA will use the information for general educational purposes. The future use of aerials for similar assessments will have broader implications, and may benefit many organizations with similar evaluative needs. Other users include NHDES Watershed Management Bureau and the US EPA. Secondary data users may include the NH Fish and Game Department, NHDES Wetlands Bureau, and the US Army Corps of Engineers. Other secondary data users may include the local Conservation District and the public. Coordination with state, federal, or local organizations, or the public for the purposes of initial data collection, eyewitness accounts, etc. may occur.

A6 – Project/Task Description

QAPP activities are designed to document changes induced by installation of a low weir at the mouth of Lake Horace Marsh. Two approaches to establishing baseline documentation of existing vegetation conditions and conditions post installation will be implemented, as follows:

Aerial Photography: In early spring, after ice-out and before leafout, oblique black and white or color aerial photographs will be taken of the marsh for purposes of documenting the interspersion of vegetation and water, the distribution of emergent, scrub-shrub, and forested wetland communities, and the distribution of invasive species, if any. A Normandeau Associates, Inc, (NAI) scientist will delineate upland and wetland cover types on photographs. Cover types will be marked on clear acetate overlaid on the photographs. On each photo, the delineator will mark the apparent extent of open water and herbaceous and scrub-shrub wetland vegetation. If stereoscopic photographs are available from a secondary source, wetlands will be classified following the U.S. Fish and Wildlife Service method (Cowardin, et al. 1979). Forested wetlands and terrestrial land use will be indicated around the periphery of the study area. Mapping unit size will be dependent on the scale of the photographs. For example, at a scale of 1"=800' (1:9600), the minimum map unit is approximately ¼ acre, or 100 ft by 100 ft (1/8 inch square on the photos).

If the aerial photos can be orthorectified, the completed delineation will be photocopied, scanned, rubbersheeted/stitched together by a NAI computer graphics expert and overlayed onto a geo-referenced basemap (source yet to be determined). Printouts of this product will be reviewed prior to digitizing the cover type boundaries using ArcView GIS versions 8.3 and 9.

Field Vegetation Sampling: Permanent monitoring transects will be established during the pre-construction monitoring effort. A minimum of 5 transects will be placed systematically along the length of the study area running from the approximate edge of the former stream bed to the upland or forested wetland edge. A minimum of 50 plots will be located along the transects to capture herbaceous and scrub-shrub vegetation zones. Data will be collected late in the growing season and will include percent cover by species using visual estimates based on a modified Braun-Blanquet (1965) method (<1, 1-5%, 6-

25%, 26-50%, 51-75%, and >75% cover). Aquatic vegetation and emergent invasives will be assessed and qualitatively sampled for species composition and distribution. Emergent invasives will be qualitatively sketched on the base map. In the office, the cover type maps will be revised to reflect the ground-truthing results of the field work. The final maps will subjected to another round of QC by the field scientist, Sarah Allen, comparing the field note annotations to the cover type map. The approved maps will then be analyzed in GIS (Arc View 9) to provide acreages of the various cover types in each reservoir. Data collection will occur at the same time annually.

In addition, permanent photo stations will be established; photos will be taking during each vegetation monitoring visit. Pre-construction assessment will occur in August/September, 2005. Post-construction assessments will occur in August/September 2006, 2007, and 2008. DES Photo Documentation procedure will be used for this activity. The SOP is contained in Appendix B.

Water Level Measurements: Baseline data will also be developed for water levels by installing two gauges capable of being visually monitored from the road, one above and one below the weir. The gauges will be placed in locations that permit measurements of water levels that are unrestricted by debris or structures. A PWA volunteer will read the gauge/gauges monthly at a minimum and record the value in a log book. More readings are preferable, particularly during extreme events of rain or drought. Data will include date, time and weather conditions for each measurement. It will be collected pre-construction and for 2 years post construction.

Wildlife Observations: NAI scientist and PWA volunteers will note any wildlife sign observed during visits to the marsh.

Table 3. Project Schedule Timeline

Activity	Dates (MM/DD/YYYY)		Product	Due Date
	Anticipated Date(s) of Initiation	Anticipated Date(s) of Completion		
QAPP Preparation	02/04/05	08/01/05	QAPP Document	
EPA Approval	8/01/05	8/15/05	QAPP Approval	
Pre-installation assessment: 1. Aerial photography	04/15/06	05/15/06	Aerial photographs, preinstallation	
2. Vegetation documentation: species composition and distribution	08/15/05*	09/30/05	Written data and photographs	
3. Water level measurement	08/15/05*	4/15/06	Monthly water levels, relevant weather	
4. Wildlife observation	08/15/05*	12/15/05	Notes	
Construction of BMPs	10/01/06	12/31/06	Not applicable	
Post-installation assessment (activities 1, 2, and 4)	04/15/06	09/30/08	Aerials; transect data; sightings	
Post-installation, activity 3	12/01/05	12/31/07	water level data	
Data validation				
Data assessment report	09/30/05	06/30/08	Written report	
Final project report preparation	09/01/08	12/01/08	Written report (incl. data assessment for summer '08)	

Based on EPA-NE Worksheet #10.
*Pending approval by EPA, or advance approval to initiate pre-construction assessments.

A7 – Quality Objectives and Criteria

Data quality assessment criteria and objectives for measuring data are described below.

Precision: Aerial photos will be flown by Light Hawk Services, pilots who volunteer to assist conservation-related projects. Light Hawk Services was selected in order to evaluate the reliability and usefulness of aerials acquired relatively inexpensively. Quality control (QC) will applied at several stages in the photo-interpretation process. As cover type delineations of a photo flightline are completed, 30% to 100% of the flightline will be reviewed by another NAI scientist skilled at photointerpretation for consistency and completeness. As errors, inconsistencies, or differences of opinion are encountered, notations will be made on the photos for review, discussion and final modifications by the original delineator. Unresolved areas will be marked for ground-truthing. If able to be orthorectified, and after acetates are scanned and electronically stretched to the base map, a printout will be reviewed by the photointerpreter for completeness and consistency with delineation protocols. Once approved, the cover-type boundaries will be traced and digitized, and a database and legend developed for each cover type. Water levels will be precise to within 0.1" both above and below the structure.

Accuracy/Bias: QC measures are designed to minimize bias and inaccuracy. Ground truthing and field work will be performed by a senior staff ecologist for NAI. Visual estimates of percent cover by species will be based on a modified Braun-Blanquet (1965) cover type classification (<1, 1-5%, 6-25%, 26-50%, 51-75%, and >75% cover). These Braun-Blanquet procedures are well established. Training of volunteers conducting water level measurements and wildlife observations will stress the importance of accurate readings and accurate reportings.

Representativeness: Transects will be located to maximize capture of data representative of the changes occurring as a result of weir installation. Gauges will reflect water levels above and below the road, and post-construction, the weir. Wildlife sightings will be random and unquantifiable. They will, however, provide qualitative evidence of marsh use by birds and wildlife, nesting success, presence or absence of habitat degradation due to fluctuating water levels.

Comparability: The protocols for analysis of changes in vegetation and changes in water levels are repeatable and comparable over time, personnel changes, or against data from similar projects. Shortcomings of wildlife data in this regard are discussed above. Note that the original data used to document environmental degradation at Lake Horace Marsh resulting from downstream hydromodification activity were informal and qualitative sightings. To the extent both data sets are similar, they are comparable.

Completeness: There are no legal or compliance uses anticipated for data collected. Since none of the activities must be performed on a particular date, site work can be timed so as to be unimpeded by inclement weather or other adverse environmental conditions. The Project QA Officer, a senior ecologist at NAI, will determine whether the survey data are sufficient to accurately characterize the marsh and changes to it.

Quantitation Limits: There are no action limits or detection limits associated with this project, therefore there are no quantitation limits.

A8 – Special Training/Certification

Aerial photographs are interpreted by qualified NAI scientists, Sarah Allen, Lee Carbonneau, and Patrick Fairbairn, each of whom, through coursework in the course of natural resource education and on the job experience is well versed and experienced in this work. Data collection on marsh vegetation is conducted and/or overseen by a qualified ecologist. Gauge reader(s) will be trained prior to assuming responsibility.

The Project Manager has general experience in the various activities to be undertaken. She will assess credentials of volunteers prior to inviting them to assist with the project and provide training, if necessary. Training records will be maintained to document that training has occurred and volunteers have achieved an appropriate level of proficiency for the tasks to which they are assigned. Volunteer(s) working with NAI staff will receive training, as necessary, based on NAI assessment of their skills and the skill level needed to perform field tasks. NAI staff will conduct the training, and/or supplement and fine-tune any prior training the field assistant has had.

A9 – Documentation and Records

All interim and final reports will be stored electronically on the Project Manager's computer system in Word, Excel, or other format used in original document development. Files are backed up weekly. Field files prepared by NAI will be maintained by NAI; copies of all electronically displayed information will be submitted to the PWA as well. Maps will be housed at both NAI and PWA. Project files are archived in electronic format on disks and paper format at the project's completion. Trend-related files will be maintained indefinitely. Other materials will be maintained for a period of five years or more. They can be accessed through the PWA Executive Director. All information requested by NHDES will be provided for archiving or other purposes.

Aerials will be maintained by NAI throughout the project. At its end, they will be delivered to PWA for permanent storage. Hard copies of field data, field notes, second hand data, or photographs developed by volunteers will be housed at the PWA, except water level logs, which will be housed at NAI. Data logs will be developed for water level measurements, including date, time, weather conditions, and gauge reading. Logs will also be developed for volunteers observing wildlife, to include: observer, date, time, weather, species, activity observed, map location where observed. A copy of the approved QAPP will be electronically stored in NHDES's database and hard copies will be retained by NAI and PWA. This is a multi-year QAPP. As such an annual QAPP assessment will be conducted. The results of the review will be summarized in an annual report to the NHDES Project Manager and QA Manager. Significant changes to the QAPP will be submitted to EPA for review and re-approval.

B1 – Sampling Process Design

Aerial Photography: The methods selected for generating basic marsh data are pre- and post-construction aerial flights (2005, 2008), followed by field ground truthing and office analysis of the data. More definite changes would be visible after year 5. However, this exceeds the grant period. Photointerpreted wetland cover types and locations will be verified in the course of field work. Areas of questionable identity will be visited and the mapped lines and cover types evaluated and adjusted, if necessary. General wetland cover types will be characterized by visiting multiple wetlands within a given cover type and describing the plant community species composition and structure, soil characteristics, and ground features such as amount of litter, rockiness, and microtopography. Photointerpreted forested wetland and upland cover types will be more generally verified. Aerials flown by others, such as NH DOT, will be obtained, as possible, and used if they offer additional interpretive opportunities, e.g., stereoscopic imagery. Dates of such imagery may be both pre- and post- construction. A key parameter for this project is the extent to which marsh vegetation itself is stabilized. Aerial interpretation was selected to help document extent of open water, distribution of emergent, scrub-shrub, and forested wetland communities, and the distribution of invasives, if any.

Field Vegetation Sampling: A minimum of 5 permanent transect end points and plots will be marked with 0.5" PVC stakes and coordinates taken with a hand-held GPS unit. A minimum of 50 plots will be

established. Major shrub and emergent community types will be captured, with at least 10 plots per major community type. Plot sizes will be 1-m^2 in emergent vegetation, and 1.5-m radius plots in scrub-shrub vegetation. The permanent plots will be visited annually, at the end of August/beginning of September, in 2005 (pre construction), in 2006, 2007, and 2008. Analysis will focus on percent cover by species. Aquatic vegetation will be qualitatively sampled for species composition and distribution. Emergent invasives will be qualitatively sketched on the base map.

Permanent photo stations will be selected to provide long views of the marsh from different directions. Photographs will be taken at least annually, in August/September, by NAI staff. They may also be used by volunteers from the Weare Conservation Commission during other months for pubic information and educational purposes.

Water Level Measurements: Gauges installed at the project will consist of 0.5" diameter PVC pipe driven into the sediment. The pipe will be marked in 0.1' increments, easily legible from a distance. Monthly measurements by a volunteer will be recorded on a regular basis pre-construction and for 2 years post-construction. As possible, measurements will be taken following major rain events or other unusual weather conditions that may influence water levels. It is anticipated from 12 to 24 measurements will be made per year.

The two post-construction gauges will be surveyed using a transit and level to provide relative elevations. PWA will work with NHDOT to determine a local benchmark. If such a benchmark is located, actual elevations of the gauges will be determined to allow water levels to be converted to true elevations.

Wildlife Observations: Marsh water level manipulations have caused serious harm to wildlife, flooding nests and exposing fish, tadpoles, and other water-dependent species to desiccation. In spring and fall, both pre-and post-construction, PWA volunteers will visit the marsh at least three times per season to observe and document wildlife activity. As indicated, their observations will be qualitative. Documentation will be by photographs. Photographs will be identified by date and location on map. GPS may be used for locational information, or simply notation on maps provided to each volunteer. The Project Manager will maintain contact with volunteers throughout the project period to ensure documentation is successfully taking place.

B2 – Sampling Methods

Aerial Photography: Aerials will be taken using a SLR camera at a scale between 1:9600 and 1:4800 during leaf off. All aerial interpretation will be performed by trained professionals. Level of detail will be dictated by the quality and form of the photographs. Ground truthing will be performed by a senior field ecologist from NAI, accompanied by one or more PWA volunteers. It will help ensure accuracy of photointerpretation.

Field Vegetation Sampling: Data establishing percent cover by species will be collected using visual estimates based on a modified Braun-Blanquet (1965) method (<1, 1-5%, 6-25%, 26-50%, 51-75%, and >75% cover). Field sampling will establish species-level specificity. Aquatic vegetation will be assessed qualitatively by an NAI wetlands ecologist, as will invasive species, if any. Photographs will be taken annually by NAI ecologist from established photo stations using an Olympus digital camera. NAI senior ecologist and a PWA volunteer will be responsible for this activity. SOP for photo documentation is attached in Appendix B.

Water Level Measurements: Gauges installed above and below the weir will consist of 0.5" diameter PVC pipe driven into the sediment and marked in 0.1' increments. Water levels will be observed from

the road. Two post-construction gauges will be surveyed using a transit and level to provide relative elevations. PWA will work with NHDOT to determine a local benchmark, if possible. A copy of the recording form for this activity is contained in Appendix B

Wildlife Observation: NAI scientists will record sightings using a Magellan Meridian Gold handheld GPS unit. Volunteers will use their own equipment. This will include individual GPS units, as feasible, using datum NAD 27. Feasibility of use will dependent on location of sighting in the marsh. Some locations will not be readily accessible. Volunteers will visit the site throughout the growing season, particularly in spring and fall, when the most dramatic impacts of hydromodification have been witnessed and are predicted to occur. NAI scientists will visit in late summer. A copy of the Wildlife Sightings recording form is contained in Appendix B. Volunteers will use either digital or 35 mm cameras to document sightings.

PWA and NAI will support volunteers with data forms and respond to their questions. The Project Manager will be responsible for corrective actions if there is a failure in the sampling system.

B3 – Sample Handling and Custody

The date and time measurements are taken for aerials and transect-based field work will be recorded on simple field sheets of waterproof paper. The forms will record date, location, recorders, plot, plant layer, species, % cover, and any relevant comments. The forms will be stored at NAI offices. After the first year, forms will be generated by NAI that show the previous years' data and provide space for the current year. A volunteer will assist the ecologist with such notations for vegetational analyses in the field. The ecologist will identify species and call out the information, while her assistant tallies the data, writes down the information, and repeats it back for confirmation. Each individual is responsible for making sure the measurements have been properly communicated.

Wildlife observations and water level measurements will be recorded on data forms, including date and time. Data forms will be submitted to the PWA immediately after first use to ensure correct use and understanding, and two times per year, end of July and end of November, thereafter, together with all photographic information. Data will be shared with NAI.

B4 – Analytical Methods

Aerial Photography: Wetland cover types and locations will be photointerpreted by NAI staff skilled in the interpretation of aerial photography. Photointerpreted wetland cover types and locations will be verified in the course of field work. Areas of questionable identity will be visited. The mapped lines and cover types will be field-evaluated and corrected on maps, as necessary. General wetland cover types will be characterized by visiting multiple wetlands within a given cover type and describing the plant community species composition and structure, soil characteristics, and ground features such as amount of litter, rockiness, and microtopography. Photointerpreted forested wetland and upland cover types will be more generally verified.

Field Vegetation Sampling: Vegetation data collected from permanent plots will be entered into an Access database. Parameters will include date, field staff, transect, plot, species and percent cover. The data will be entered into Microsoft Access XP, summarized in SAS 9.1.3 and outputed as graphs and tables by NAI staff. ArcView (currently ArcGIS 9) will be used to map and analyze the GIS data.

Water Level Measurement: The water level measurements will be transcribed from the data sheets into an Excel spreadsheet. Parameters will include date, time gauge reading and conversion to elevation, if possible. The data will be summarized in hydrographs and provided in the report.

Wildlife Observations: GPS coordinates of sampling locations and wildlife observations, where available, will be downloaded and overlain onto the basemap for the project. Stored with the GPS coordinates will be the date, observation and observer. Mapped information lacking GPS coordinates will be indicated by map symbol indicative of general area where observed. Data analyses will focus on changes pre- and post-construction. Apparent changes in activity or location of activity post-construction will be analyzed as well.

B5 – Quality Control

Aerial Photography: Quality control will be applied at several stages in the photo-interpretation process. As cover type delineations of a photo flightline are completed, 30% to 100% of the flightline will be reviewed by another scientist skilled at photointerpretation for consistency and completeness. As errors, inconsistencies, or differences of opinion are encountered, notations will be made on the photos for review, discussion and final modifications by the original delineator. Unresolved areas will be marked for ground-truthing.

After acetates are scanned and electronically stretched to the base map, a printout will be reviewed by the photointerpreter for completeness and consistency with delineation protocols. Once approved, the cover-type boundaries will be traced and digitized, and a database and legend developed for each cover type.

Field Vegetation Sampling: The plant identification and ocular estimates of percent cover will be performed by a trained NAI ecologist. Any plant species that cannot be identified in the field will be collected and keyed in the office. QC for vegetation data entry and analysis will include review of the data output prior to analysis in SAS by the field ecologist for accuracy and completeness. Additional QC will occur during the review and assessment of the summarized data by the field ecologist to ensure the results reflect general field conditions. Obvious discrepancies will be investigated to eliminated the possibility of incorrect data entry.

Water Level Management: Training will be provided to the volunteer who is responsible for this work. All readings will be performed by the same individual, to ensure consistency. Individual will record reading twice each time, with 1 minute between readings to ensure accuracy. Gauges will be checked annually by NAI ecologist to ensure stability.

Wildlife Observations: Individuals selected for this activity will have sufficient knowledge for identification purposes. Any questionable or unlikely observations will be confirmed by a second person, confirmed by analysis of photographs (if sufficiently clear), or identified as "possible" sightings. Observers will be asked to report unusual sightings immediately, so more knowledgeable individual(s) can get to the site to confirm. Unusual sightings not confirmed by a second observer will be flagged as suspect.

B6 – Instrument/Equipment Testing, Inspection, Maintenance

Equipment to be used in this assessment includes cameras for aerial photographs and for on-the-ground documentation. Cameras will be owned by individuals and maintenance is the individual's responsibility.

They may include digital cameras. At the time of training, available equipment will be reviewed for consistent image quality, e.g., number of mega-pixels. Capacity of the equipment to function will be demonstrated by quality of the photographs. GPS units will use the same datum.

Water level gauges will be constructed by NAI with PVC pipe marked with indelible marker at 0.1-foot increments. The gauges will be installed in the lake above and below the weir at a known depth in the sediment. NAI will survey the gauges to a local bench mark to obtain relative elevations, and if possible, true elevations. The depth and elevations of the gauges will be periodically rechecked for stability. If one appears to have shifted, the gauge will be inspected and reset, if necessary.

The Project Manager will serve as contact for equipment failure.

B7 – Instrument/Equipment Calibration and Frequency

Water level gauges to conduct water level monitoring are the only equipment requiring periodic inspection to insure stability and consistent depth in sediment. Visual inspection will occur at least monthly by volunteer monitor during water level measurement activities. A more detailed inspection will occur at least once annually, by NAI scientist. Inspections will be recorded along with the water level data. Any repairs or modifications to the gauges will be documented.

B8 – Inspection/Acceptance Requirements for Supplies and Consumables

The critical consumable required, besides data sheets, is film. NAI scientist will use digital camera, but volunteers likely will use either digital or 35 mm cameras. Aerials will be taken using a 35 mm camera. Only standard, commercially available film will be used. It will be purchased by volunteers, who will be responsible for visually checking the cartridge prior to use to ensure it is undamaged. Acetate overlays and other office supplies will be standard, commercially available materials. NAI scientist will inspect acetate to ensure it is acceptable. If visual review indicates damage, the material will be rejected.

B9 – Non-direct Measurements

Historical data from the site will be used as background information. Much of this information is photographic, with photographs taken by Gordon Russell of New Boston, New Hampshire. Data from the Weare Conservation Commission used in establishing Lake Horace Marsh as a prime wetland will be integrated into the project evaluation, as useful. Aerials from NH DOT will be used to augment aerials flown for this project.

USGS 7.5 minute topographic maps will be used for scale measurements and to identify site locations, land-use activities, and landscape features. National Wetland Inventory maps and Natural Resource Conservation Service soil maps will supplement the aerial photointerpretation.

Acceptance criteria are based on use of data from reliable sources, including G.A. Russell, the Weare Conservation Commission, the Town of Weare, USGS, the NH DOT, and NH Fish & Game Department. Data will also be geographically and temporally relevant.

B10 – Data Management

Field data sheets to be used in field activities are included in Appendix D. Field data sheets used for vegetation sampling will be checked for completeness after each survey and at the end of each day. The NAI ecologist will inspect field records before leaving the site. Any omissions or discrepancies will be handled immediately. Original field data sheets will remain in the possession of NAI throughout the project period. Refer to Section A9 for a more in-depth discussion on documentation and record keeping. Data sheets prepared by volunteers will be submitted twice a year to the PWA for analysis and permanent storage.

Any secondary data will be stored in the project file, in either hardcopy or electronic format.

All project files and drawings will have a unique file name, e.g., LHM, QAPP 4-05, submitted. Every drawing and all data sheets will have a back up copy.

Electronic files are password protected and will not be modified without proper authorization. They shall be backed up weekly and stored off-site. Inactive files are archived, and once archived they are changed to read-only status.

Software used includes Microsoft Excel, Microsoft Access XP, SAS 9.1.3, ArcGIS 9, and Magellan Meridian Gold handheld GPS unit. The versions are likely to change in the course of the project as equipment and software is upgraded.

C1 – Assessments and Response Actions

The Project Manager will monitor and address all activities of the data collection process and will review data (see D-1). Volunteers will have a refresher training performed by the QA Officer or Project Manager annually. Data collection methods are standardized and the reporting method is consistent. The QA Officer will ensure that field team members are performing all data collection as prescribed by the quality assurance project plan and are properly trained to conduct Activities 3 and 4.

All field activities may be reviewed and project sites may be visited by NHDES and EPA quality assurance officers as requested. Because this is a multiyear project, NAI and Project Manager will conduct an annual QAPP review. Any modifications made as a result of the review will be summarized in a letter to the NHDES Project Manager and the NHDES QA Manager. Copies will be retained on file at NHDES. Significant modifications, as determined by NHDES, will be submitted to EPA for review and approval. Data collected by volunteers will also be assessed annually to ensure information collected is helpful. Modifications will be made, as necessary, to provide the best possible assessment of pre- and post-installation information.

C2 – Reports to Management

The following documentation, as applicable to the project, will be presented at the end of data collection and analysis.

- Site sketch or plan showing limits of study, transect locations, gauge locations, weir location, and other pertinent information.
- Aerial photographs with wetland delineations, ground-truthing sites
- Digitized cover type boundaries and map, if aerial photos can be orthorectified.

- Analysis of vegetational changes, changes in vegetation/open water interspersion, and related evaluations
- Log with water level measurements over time,
- Summary of wildlife sightings.
- Annual QAPP review summaries, as required in A9 and C1.

According to the scope of services listed in this grant agreement, semi-annual progress reports will be submitted to DES each December 31 and June 30 throughout the project period. A final project report will submitted when the project is finished. Such reports will document project status, any performance evaluations and audits, quality of data, QA problems, if any. Project Manager will be responsible for ensuring timeliness, accuracy, and completeness of reports. NAI, DU, NH Fish & Game Department, and volunteers will provide necessary information for reports. DES will review and respond to information contained in the reports, as necessary.

D1 – Data Review, Verification and Validation

The project QA Officer will review all data collected as well as subsequent analyses of the data to evaluate whether QC requirements have been met and whether data are usable to obtain the stated objectives of the project based on criteria contained in the QAPP. Subsequent final review and approval will be made by the Project Manager.

Specific review and verification/validation processes are as follows:

Aerial photographs	Interpretation of aerial information will be field verified, and cover type maps will be modified, as necessary; technique will be validated if field verification is consistent with in-house interpretation.
Field vegetation sampling	Data sheets will be checked daily for completeness; unfamiliar species will be collected and keyed in the office to ensure identification accuracy; photographs will be reviewed for content, clarity, and capacity to capture marsh conditions visually.
Water Level Measurement	Data will be reviewed for wildly unexpected fluctuations and for conformity with anticipated changes, e.g., reduction in levels below weir following fall draw down. A report by monitors of wild fluctuations will trigger immediate review. Otherwise, data will be review annually.
Wildlife Observations	Data sheets and photographs will be reviewed twice annually, after spring and fall observation periods. Precision of observation and locational precision will be key review criteria, as will extent of coverage, i.e., are observations sufficiently frequent to capture wildlife activity.

D2 – Verification and Validation Procedures

Field data are submitted to the Project Manager and QA Officer. The QA Officer reviews all field data for completeness. The Project Manager makes sure that any questionable data are verified by speaking to the volunteer and noting any unusual or anomalous data in the project files.

Any decisions made regarding the usability of data will be ultimately left to the Project Manager, however the Project Manager may consult with the QA Officer, project personnel, NHDES QA staff, or with personnel from EPA-NE.

When it is found that data do not meet the quality objectives from Section A7, or do not adhere to the quality control measures from Section B5, the Program Manager may determine what corrective action must be taken.

- Incomplete data may lead to the need for re-survey of the affected site if it is found that the available data are insufficient to meet project goals.
- When data quality is poor, the project manager will apply one of the following actions.
    1. Immediate on-site re-survey of the measurements in question;
    2. Rejection of data with a written explanation; or
    3. Retraining or re-assignment of the volunteer.

D3 – Reconciliation with User Requirements

Data will be generated based on the quality objectives defined in Section A-7 and verified according to Section D2. Limitations in the data will be clearly defined for potential end users in all reports produced

If the project objectives from Section A7 are met, the user requirements have been met. If the project objectives have not been met, corrective action as discussed in Section D2 will be established by the Project Manager.

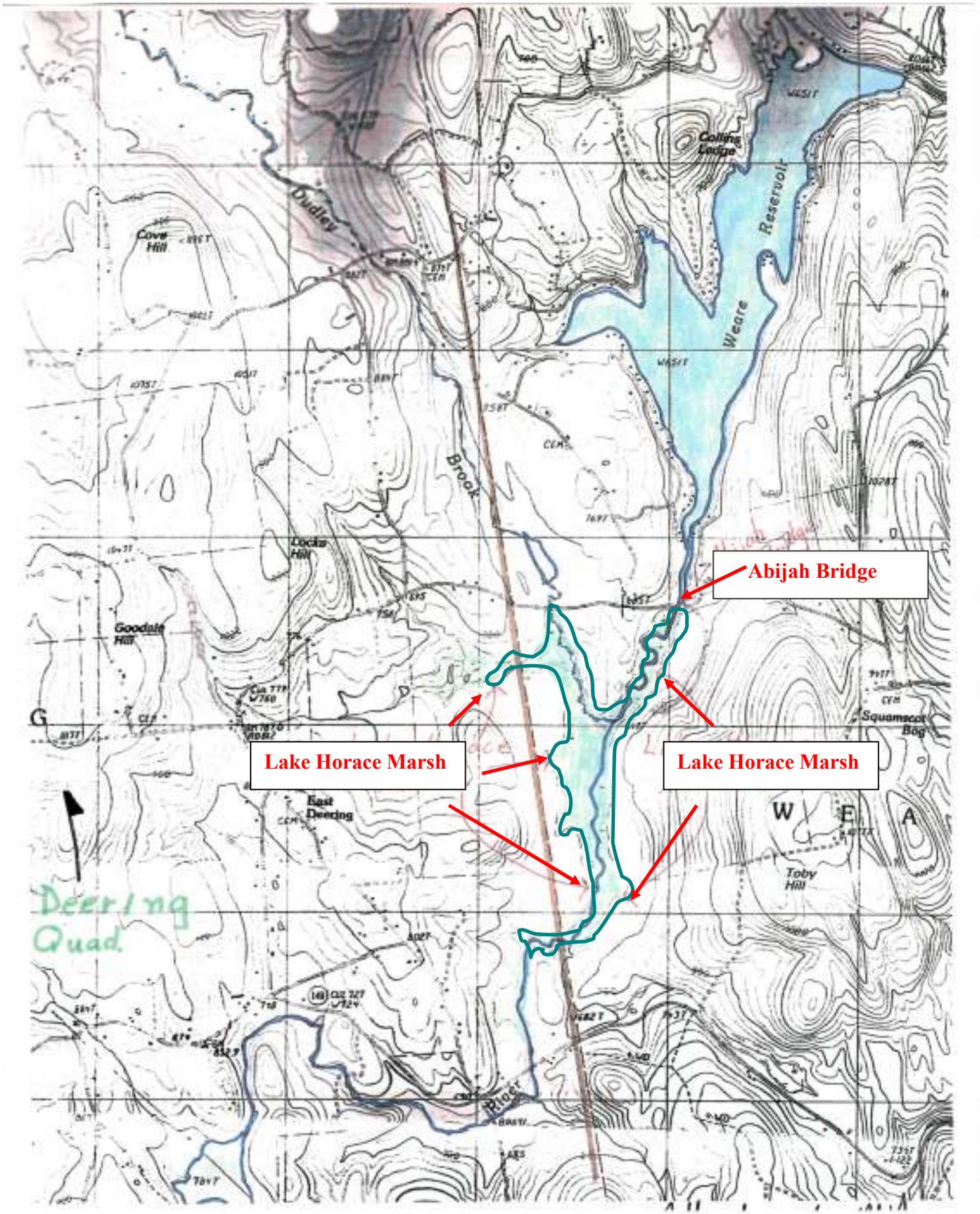
References

Braun-Blanquet, J. 1965. Plant Sociology; the study of plant communities. [Transl. rev. and ed. By C.D.Fuller and H.S,Conard.] Hafner, London, 439 pp.

Cowardin, L.M., V. Carter, F.C.Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service. FWS/OBS-79/31

Appendix A

Site Map:
Lake Horace Marsh Restoration Project


Abijah Bridge
Lake Horace Marsh
Lake Horace Marsh
Deering Quad
Dudley Brook
Weare Reservoir
Goodale Hill
Cove Hill
Locke Hill
East Deering
Toby Hill
Squamscot Bog
Rocky

Appendix B

Standard Operating Procedures and Data Forms