Quality Assurance Project Plan for Forested Wetland Monitoring and Assessment: Central Watershed

Version 2: June30, 2016

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EPA RFA # EPA-
2016-2017

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Table of Contents

1.0 Project Management

1.1 Distribution List

MassDEP, Director Wetlands & Waterways Program – Lealdon Langley
MassDEP, Wetland Program Chief – Michael Stroman
MassDEP, Environmental Analyst, MassDEP Project Manager – Lisa Rhodes
MassDEP, Quality Assurance Officer – Richard Chase
MassDEP, Lead Field Manager, Analyst – Michael McHugh
MassDEP, Field Scientist-Alice Smith
EPA Regional Director, Jackie LeClair
EPA Project Manager, Beth Alafat
EPA, QA Manager, Bryan Hogan
UMass Advisor - Dr. Kevin McGarigal
UMass Project and QA Manager, Scott Jackson
Seasonal Hire

1.2 Project/Task Organization

The participating individuals and/or organizations and their roles include:

Beth Alafat – EPA Project Manager – Oversee Grant commitments
Bryan Hogan- EPA QA Officer- participates in the development and implementation of QA/QC procedures for the project.
Lisa Rhodes - MassDEP Project Manager/Field Scientist – oversee the involvement of MassDEP personnel and project commitments; coauthor of results.
Michael McHugh – MassDEP Field Manager and Lead Analyst – participate in data review and decision-making relative to site selection; field data collection;

co-author of results

Alice Smith – MassDEP Field Scientist and Researcher – participate in research and field data collection.

Richard Chase – MassDEP QA Officer – participates in the development and implementation of QA/QC procedures for the project.

Lealdon Langley – MassDEP Advisor/Reviewer – participates in data review and decision-making relative to study development.

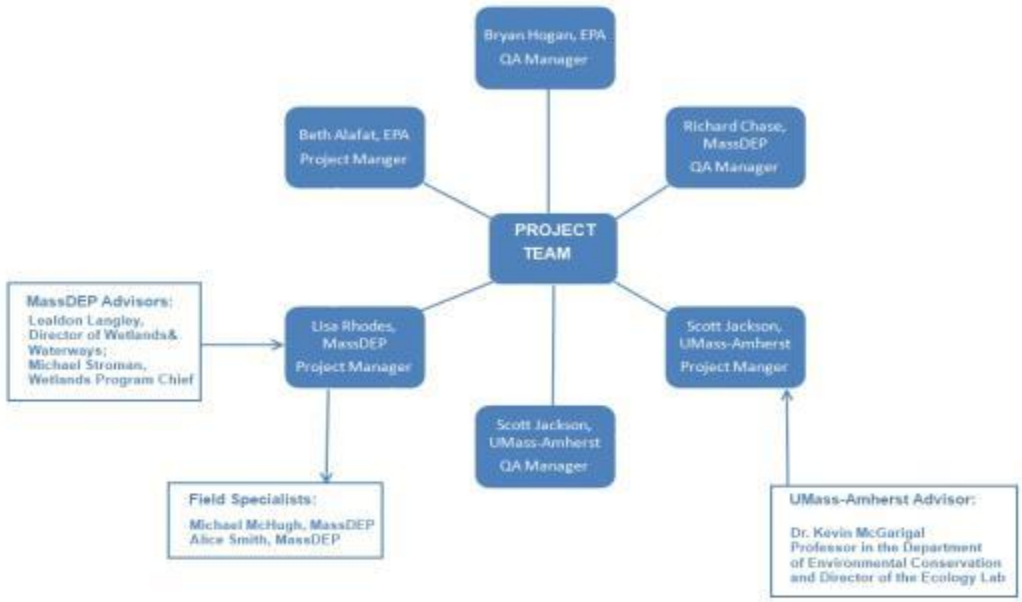
Michael Stroman – MassDEP Advisor/Reviewer – participates in decision-making relative to study development.

Dr. Kevin McGarigal – UMass Project Manager - data review and decision-making relative to study development and statistical analyses.

Scott Jackson – UMass Project and QA Manager - Lead in Study methodology development, participation in data review and decision-making

1 Fully Trained Season Hire – assist with recording of data in field

Figure 1.2-1 Project Organization Chart



2.0 <u>Problem Definition/Background</u>

2.1 Project:

This project is being undertaken by the MassDEP Wetlands Program to monitor and assess wetlands in the Central Basin in Massachusetts for reporting under the Clean Water Act (CWA). This work will contribute to the effort by the MassDEP Division of Watershed Management - Watershed Planning Program (WPP) to monitor and assess the quality of Massachusetts surface waters and provides periodic status reports to the U.S. Environmental Protection Agency (EPA) pursuant to Sections 305(b) and 303(d) of the CWA. The objective of this statute is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters; and to evaluate them with respect to their capacity to support designated uses as defined in the Massachusetts Surface Water Quality Standards. The reports that are submitted to EPA are referred to as the 'Integrated List of Waters.' Because wetlands are defined as 'waters' pursuant to the CWA, this study is being done to comply with Section 305(b) of the CWA.

Since 2006, the MassDEP Wetlands Program has developed tools to monitor and assess (M&A) wetland condition based on EPA's *Application of Elements of a State Water Monitoring and Assessment Program for Wetlands* (April 2006). The tools developed include a Level 1

Assessment based on CAPS, a GIS based model [1] developed by the University of Massachusetts at Amherst ("UMass") that predicts ecological integrity based on over 20 anthropogenic stressors (e.g. habitat loss, buffer zone impacts) and 3 resiliency metrics (e.g. connectedness). The CAPS output is the Index of Ecological Integrity (IEI), a score ranging from 0 to 1 for each 30 m^2 point on the landscape. The CAPS stressor gradient has been rigorously tested by UMass using taxa abundance data collected in the field and approximates the 'Biological Condition Gradient' model for waters (www.umasscaps.org).

The Continuous Aquatic Life Use (CALU) approach for assessment is based on the relationship between IEI (i.e. constraints on biological condition identified from GIS data of the surrounding landscape) and the Index of Biological Integrity (IBI) (i.e. index of biological condition of a site based on field data). In this approach, IEIs and the IBI's yield scores that are continuous throughout their range and on the same scale and a site's biological condition compared to its landscape context can be assessed to determine if site condition is stressed or if it falls within or exceeds the expected range of variability. See Section 3.2.5 for further detail.
Vegetation sampling data will be used to assess forested wetlands at 20 sites by utilizing vegetation based IBI's. Sites will then be assessed by comparing the field derived IBI with the CAPS predicted IEI and plotting the value on the CALU graph. Individual CAPS metrics will be assessed to determine which stressors are contributing the most to site condition so that we can recommend strategies for improving wetland condition. Physical alteration data will also be collected and used to assess forested wetlands to identify additional disturbances that may be affecting the wetlands that are not apparent from vegetation data or from CAPS. These findings will be presented in a final report, , and a summary and link will be referenced in the next scheduled Integrated Waters report in order to provide further information relative to the overall ecological integrity of wetlands in the Central Reporting Basin.

3.0 Project/Task Description

3.1 Selection of Sites

In 2016 we will sample a total of 20 deciduous dominated (<30% conifer cover) forested wetland sites in the Central Massachusetts Watershed. This watershed was selected in accordance with the MassDEP 5-year basin cycle for water quality sampling and reporting. The Central reporting Basin is a large basin encompassing roughly 1400 square miles and ranges from the New Hampshire border south to the Connecticut and Rhode Island Border. It encompasses the watersheds of six major rivers.

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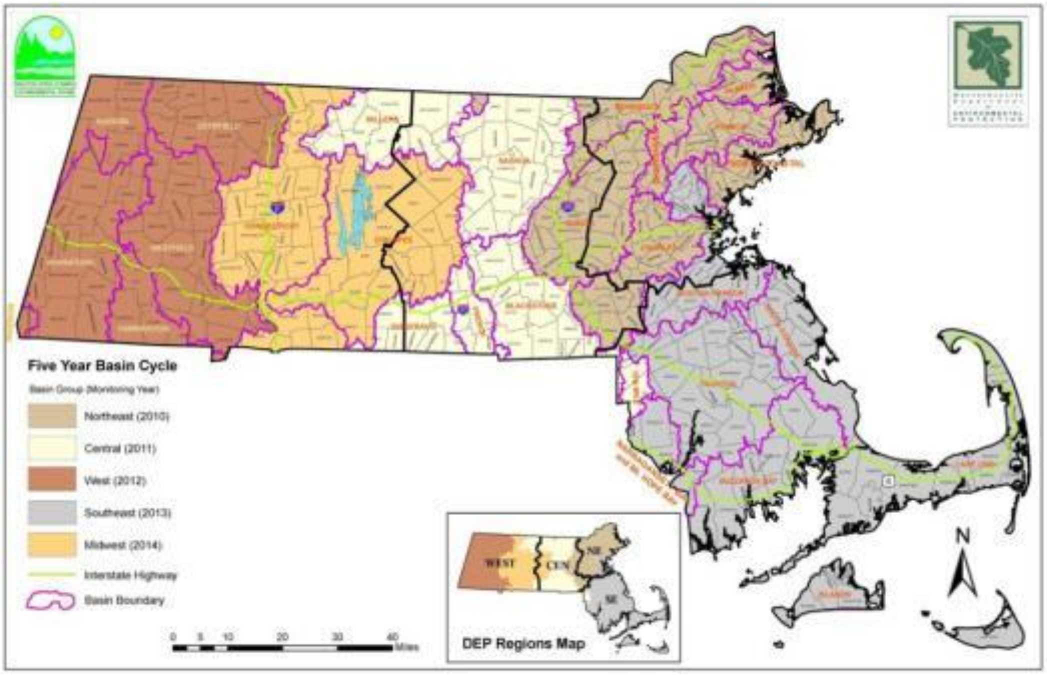
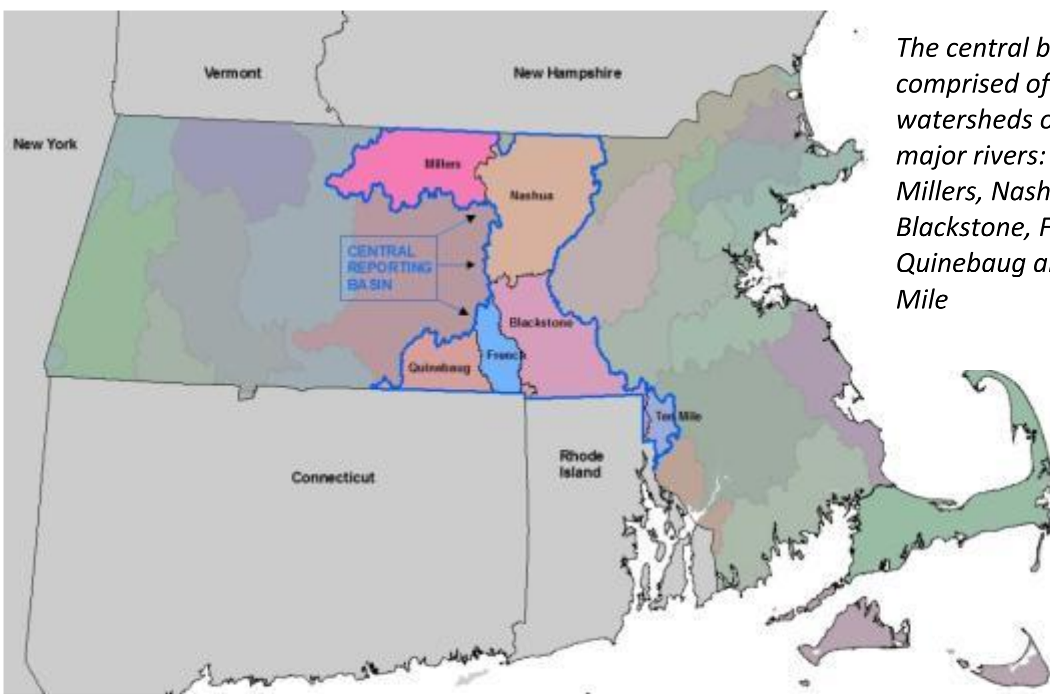
[1] CAPS reports submitted to EPA include *DRAFT – A Framework for Ecosystem Monitoring and Assessment: The Conservation Assessment and Prioritization System (CAPS),* December 11, 2007*; Conservation Assessment and Prioritization System(CAPS)Western Massachusetts Assessment – Final Report* May 19, 2008; *Conservation Assessment and Prioritization System (CAPS) Preliminary Statewide Massachusetts Assessment,* June 2, 2009*; Developing Tools for More Effective Assessment of Wetlands and Aquatic Ecosystems – Final Report for Project 09-01/ARRA604,* August 18, 2010*; Development of a Comprehensive State Water Monitoring and Assessment Program for Wetlands in Massachusetts-Final Report for the FY07 Wetlands Development Grant – Phase 2b: Development of a Site Level Assessment Method (SLAM) for Forested Wetlands and field validation of the Conservation Assessment and Prioritization System (CAPS),* May 31, 2009, Revised February 11, 2010*; Development of a Comprehensive State Water Monitoring and Assessment Program for Wetlands in Massachusetts* February 28, 2011; *Progress Report* May 23, 2011 Reports were authored by UMass-Amherst*.* Also, *Development and Use of Aquatic Life Use Standards for Wetlands in Massachusetts dated May 12, 2011 co-authored by UMass-Amherst and MassDEP.*

Figure 3.1-1 Massachusetts 5 Year Cycle Reporting Basins



Massachusetts watersheds are combined into five major basins for the purposes of reporting water quality under the Clean Water Act. Basins are sampled on a five year rotating cycle.

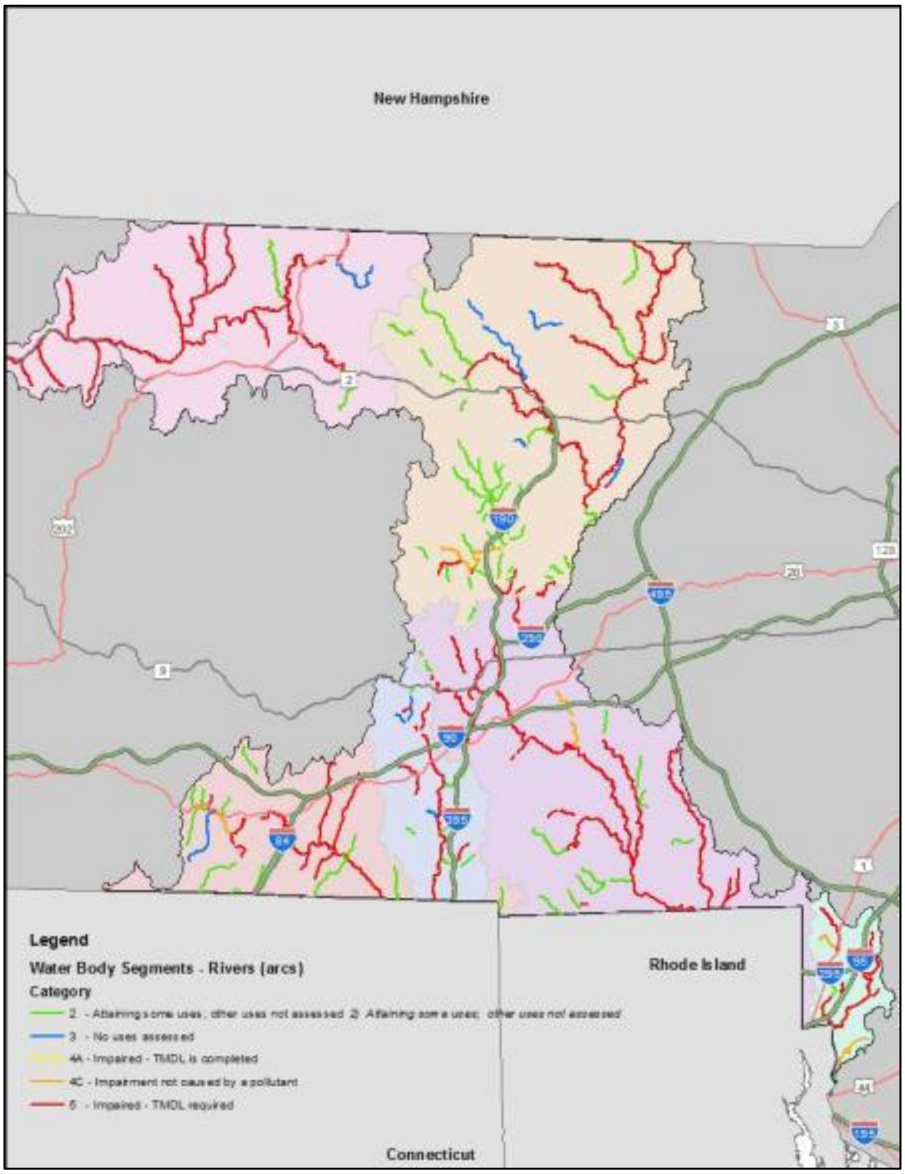
Figure 3.1-2 Major River Watersheds of the Central Reporting Basin



The central basin is comprised of the watersheds of six major rivers: the Millers, Nashua, Blackstone, French, Quinebaug and Ten Mile

In accordance with the CWA, MassDEP WPP conducts water quality assessments of waterbodies within the reporting basin and reports on the condition of those waters. In broad terms, the waters are assessed to determine if they are meeting their designated uses or are impaired. The results of those assessments are reported to EPA and are also made available in a GIS format at: http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/wbs2012.html WPP maintains a data layer[2] that presents the results of water monitoring and assessment that was documented in the 2012 Integrated Waters Report.

Figure 3.1-3 Assessed Waterways in Central Reporting Basin



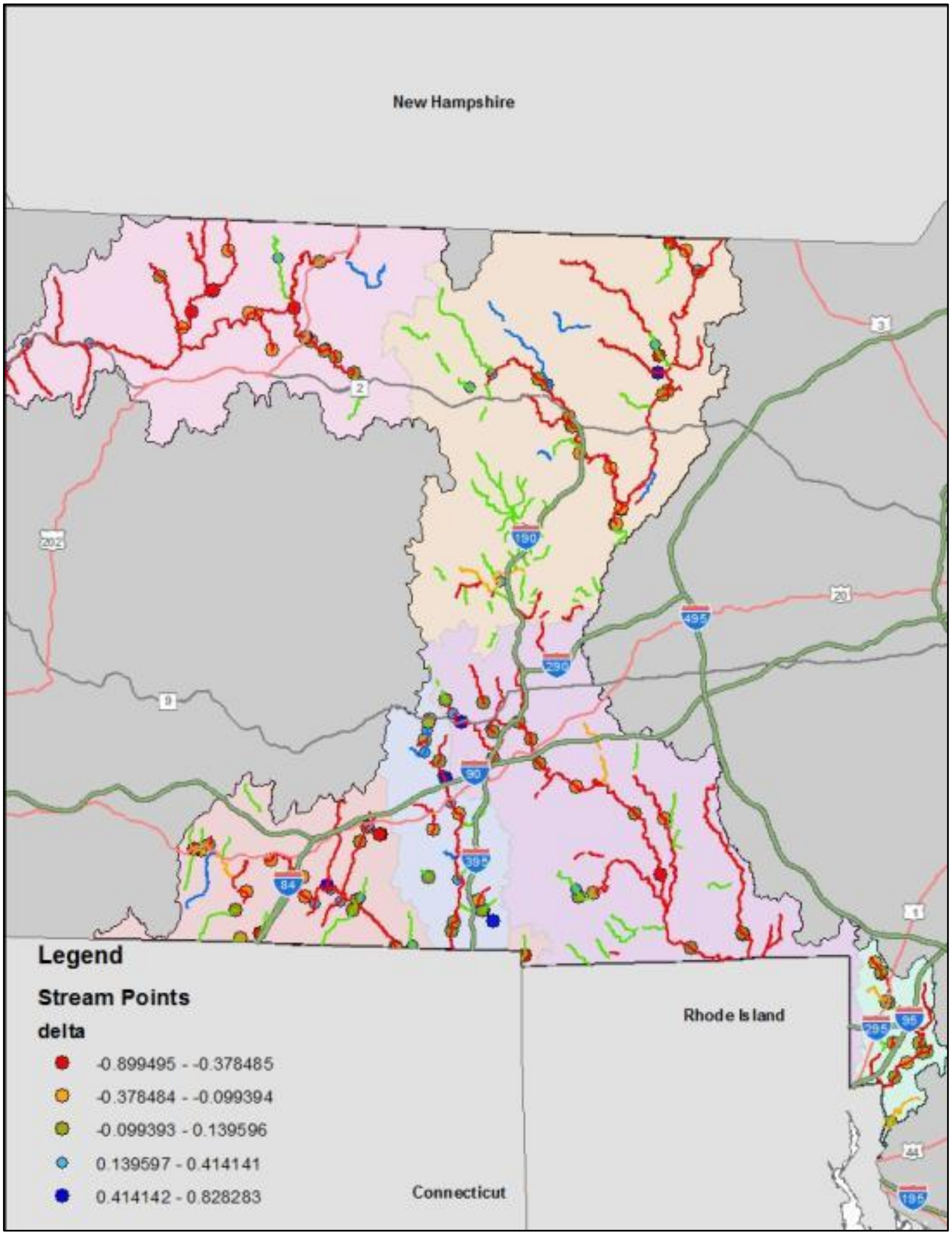
Water bodies are assessed by the MassDEP Division of Watershed Management in accordance with the Clean Water Act.

[2] Integrated List of Waters: http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/wbs2012.html

During development of this wetland monitoring and assessment strategy, UMass used water quality sampling data collected over a period of time in addition to data collected from wetlands between 2006 - 2014 to calibrate the CAPS landscape model and to create IBI's for wetland site assessment. As part of this research, UMass also developed IBI's for wadable streams. The IBI's that were developed were determined to be ecologically and statistically reliable, with coefficients of concordance ranging from 0.5 to 0.84. Subsequent to IBI development, UMass identified stream points where the IEI predicted a high ecological condition (i.e. pristine) whereas the IBI data indicated low condition (i.e. highly stressed). This difference between the IEI and the IBI is referred to as the IBI-IEI delta. Because of the strong concordance relationship between IEI and IBI, waters with a high IBI-IEI delta indicate that there may be something occurring on the landscape that is adversely impacting the waterbody.

The goal of this study is to assess the role that healthy wetlands play in protecting downstream water quality. Sampling sites have been selected in forested wetlands within two watersheds that drain to waters with a high IBI-IEI delta and two watersheds that have a low IBI-IEI delta. The waters with a high IBI-IEI delta have also been determined to be "impaired" by the MassDEP WPP, and the other two waters with low IBI-IEI delta have been determined by WPP to be not impaired. The waters with a high IBI-IEI delta are impaired by excessive nutrients and indicators of eutrophication, as well as excessive turbidity. Those are pollutants that could be mitigated by healthy wetlands. Five sites are proposed to be sampled in each of the four watersheds. Sampling in this manner may provide data on whether wetlands in watersheds that drain to impaired waters are themselves impaired, thus contributing to the impairment of the water.

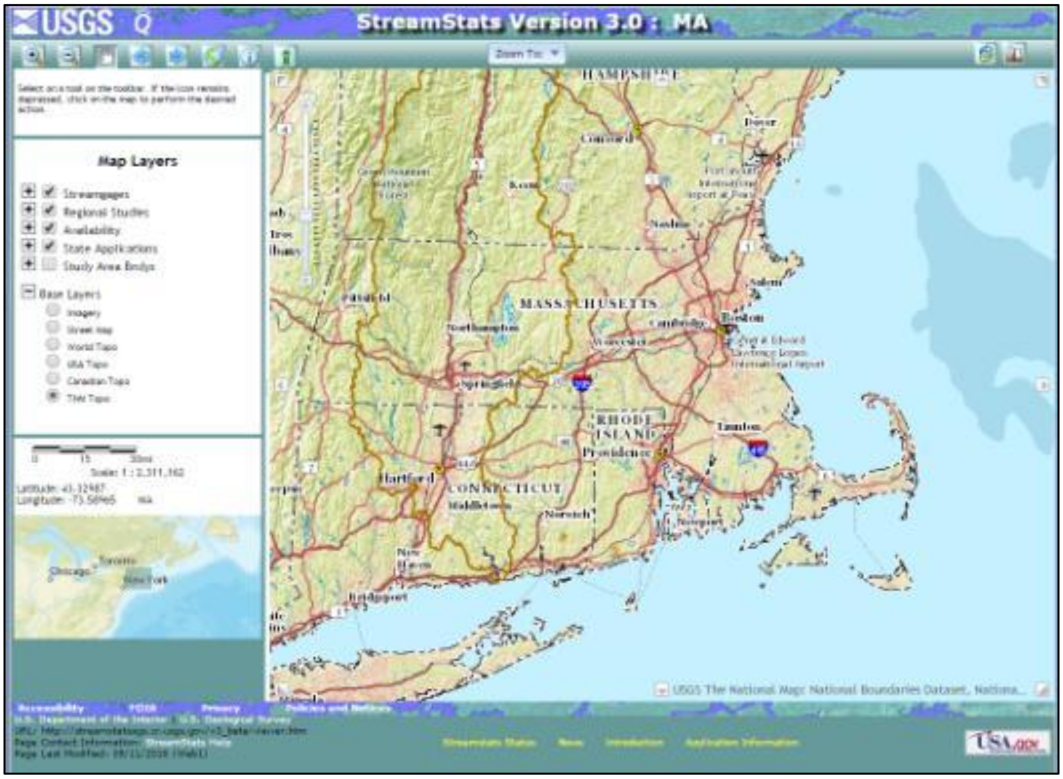
Figure 3.1-4 Waterway Sample Points with IBI-IEI delta



By comparing the predicted ecological integrity (IEI) to the site determined biological integrity (IBI) the difference can be identified. A negative difference (delta) represents situations where the IBI is lower than the IEI. A positive delta indicates situations where the IEI is lower than the IBI. This study will focus on watersheds where the IBI is significantly lower than the IEI (shown in orange or red) since that is presumed to represent situations where stressors are most likely to exist that were not predicted.

In order to identify the watershed of the IEI_IBI delta data points, USGS Stream Stats (http://water.usgs.gov/osw/streamstats/index.html) was used. Stream Stats is a web application developed by USGS to provide users with access to an assortment of analytical tools for water resource planning and management purposes. One of those tools is an application that identifies the watershed boundary of a given point by using digital terrain models developed for topographic mapping. That watershed is then made available to users in the form of a shapefile so that it can be easily incorporated into a GIS.

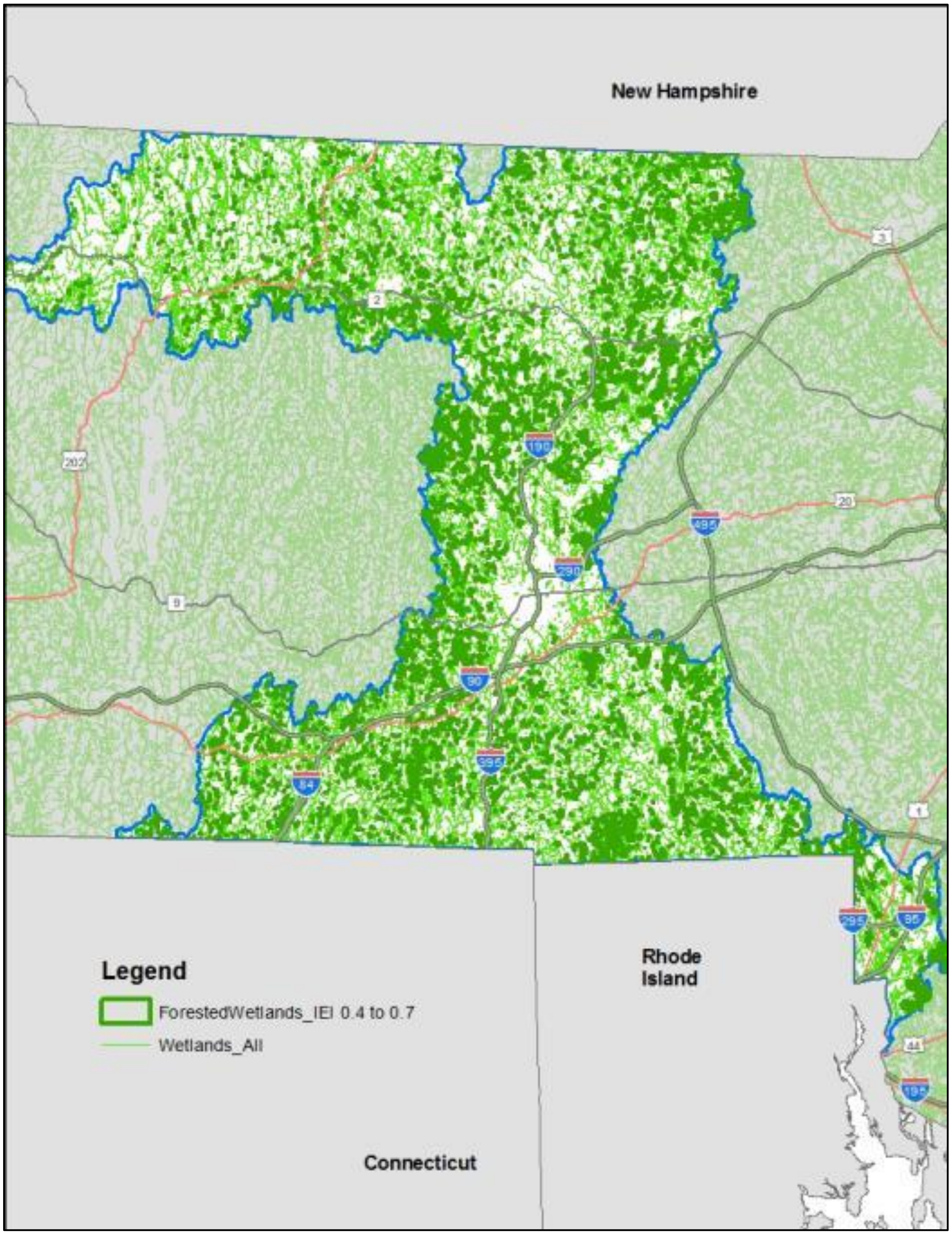
Figure 3.1-5 USGS StreamStats Online Watershed Tools User Interface



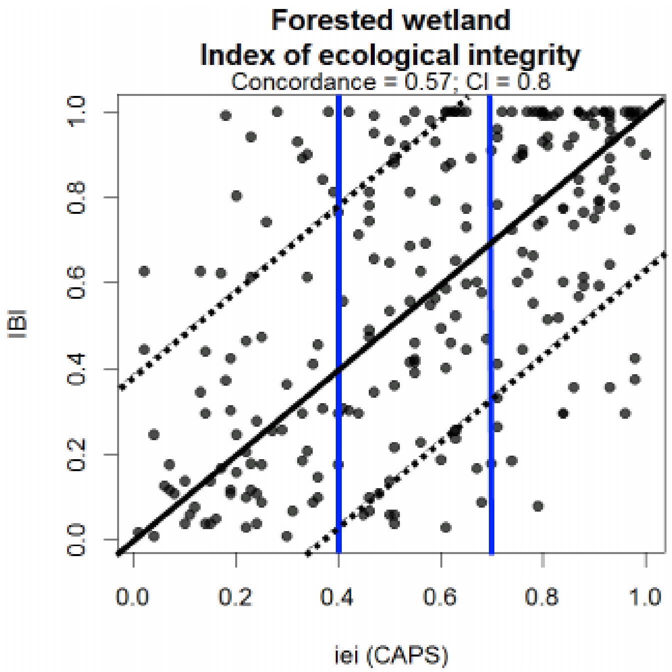
Tools in the upper left hand corner allow the user to navigate through the map and chose a point for assessment. Those tools include an online delineation of the watershed of a given point, presented in a downloadable (shapefile) format.

All twenty forested wetland sites that were targeted for sampling within the selected watersheds have an IEI value between 0.4 and 0.7. This range of IEI values was chosen because previous IBI assessment work has demonstrated that sites that are at the extremes of IEI value, either very high or very low, are unable to reflect an even higher or lower value (respectively) when plotted on the CALU graph.

Figure 3.1-6 Target Forested Wetlands from MassDEP Wetlands Data Layer



Forested wetlands with IEI values between 0.4 and 0.7 were identified and projected onto the map as a separate layer in order to target sample sites.



In order to ensure that we have five sites per watershed that can be sampled, we have selected 10 sites within each watershed. The first five sites will be sampled if available. If for some reason a given site is not available for sampling (i.e. it is not forested wetland, landowner permission is not forthcoming) we will proceed with the next site on the list until we have reached a total of five sites. Past experience at wetlands sampling in the Chicopee River watershed and the North Coastal watershed has demonstrated that doubling the number of sites (i.e. create an oversample that is equal to the targeted number of sample sites) is sufficient to achieve sampling of the requisite number of sites. Since the many of these sites are likely to be located on private property, landowner permission will be necessary in order to enter onto the property to conduct an evaluation of the selected wetland. We will identify landowners using assessor's maps available either on-line or in town hall. Attached as Appendix A is a form letter that will be sent to landowners requesting that they contact MassDEP via phone or email to indicate their permission for us to access the site. If we do not hear back within 1-2 weeks we will call. We will consider going to homes and knocking on doors if access cannot be obtained through a phone call, but either way if we are unable to obtain permission we will drop the site and go to the next site on the list.

Figures 3.1-7 (a to d) Target Watershed and Sample Sites:

Figure 3.1-7 (a) Kettle Brook Segment Watershed

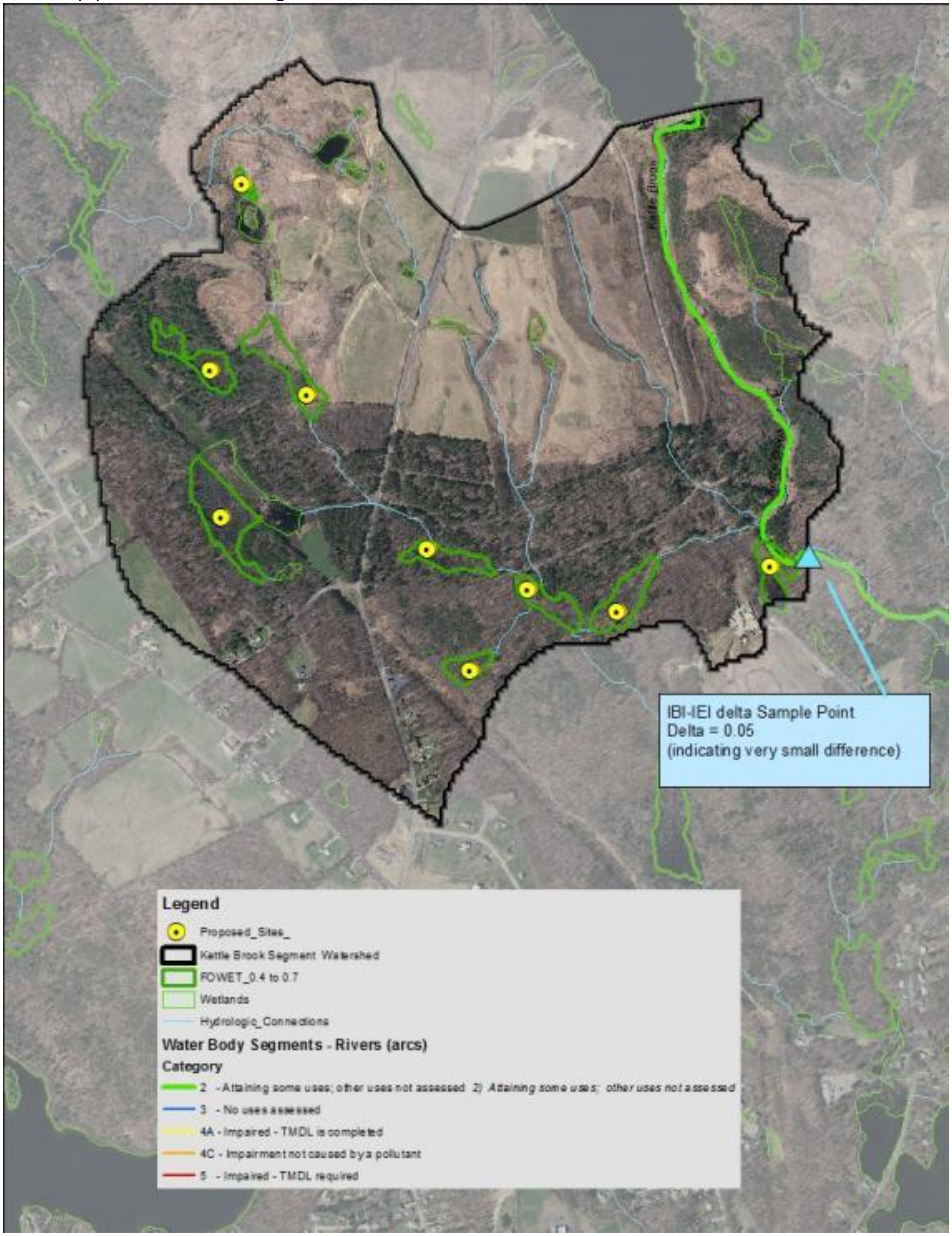


Figure 3.1-7 (b) Blackstone Segment Watershed

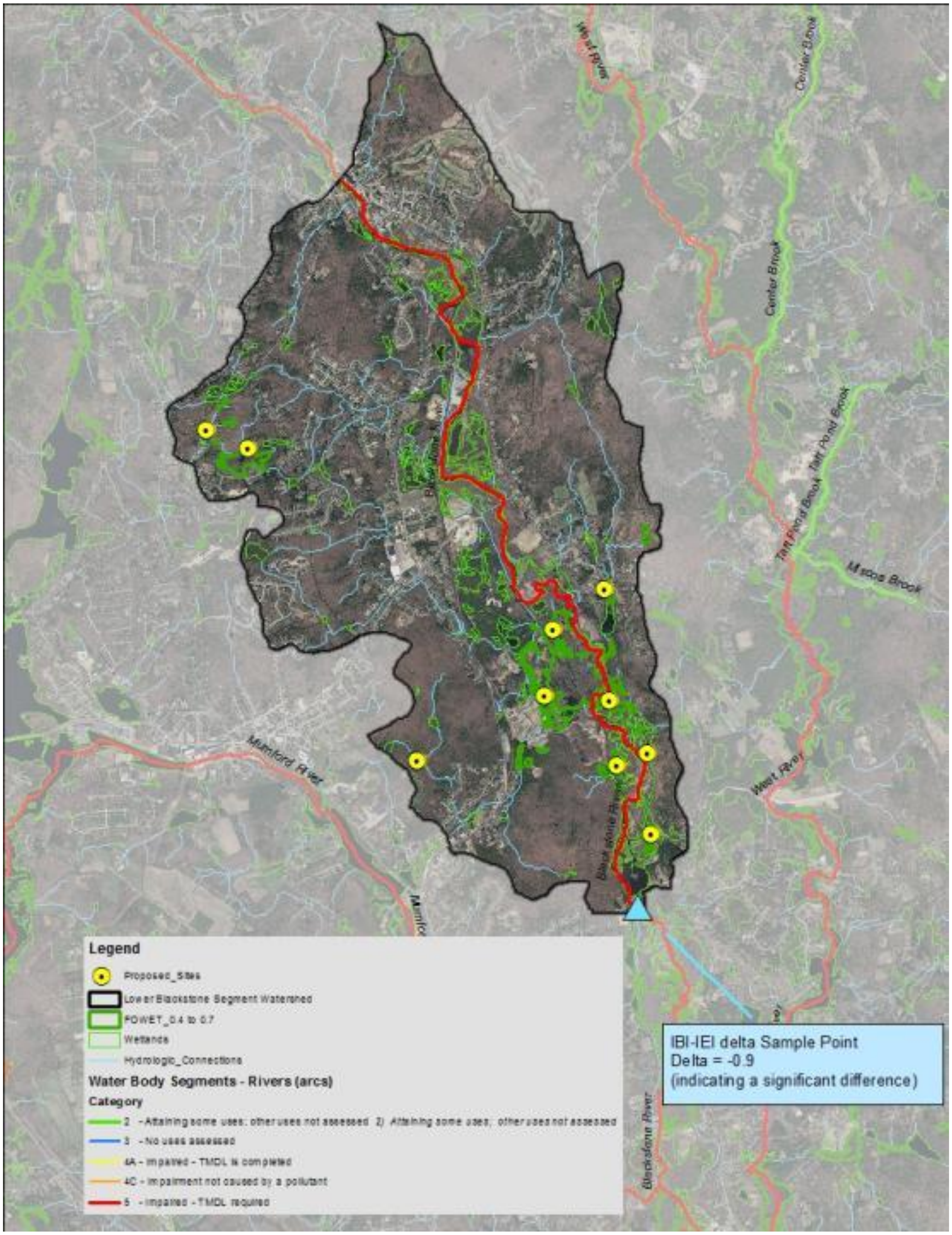
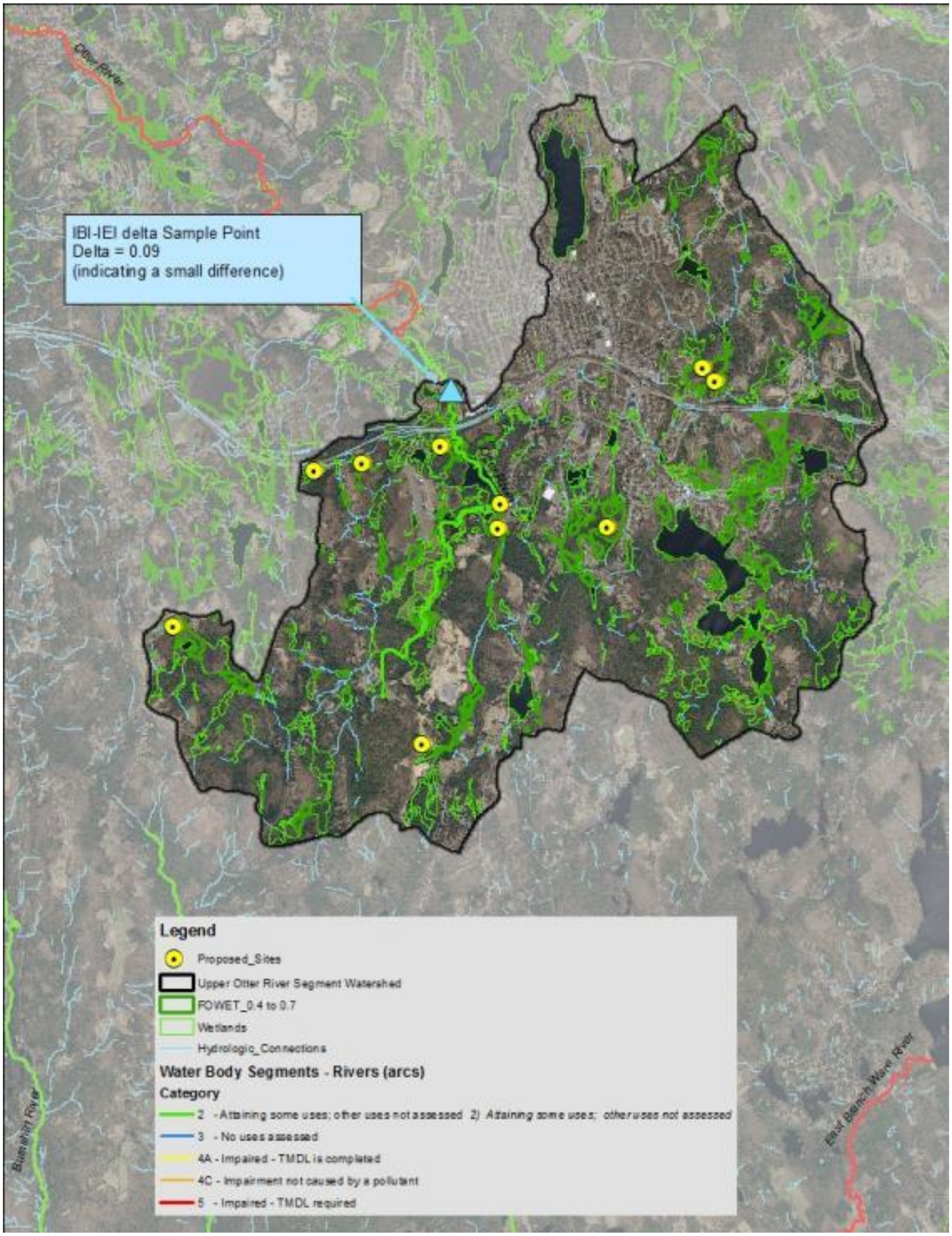
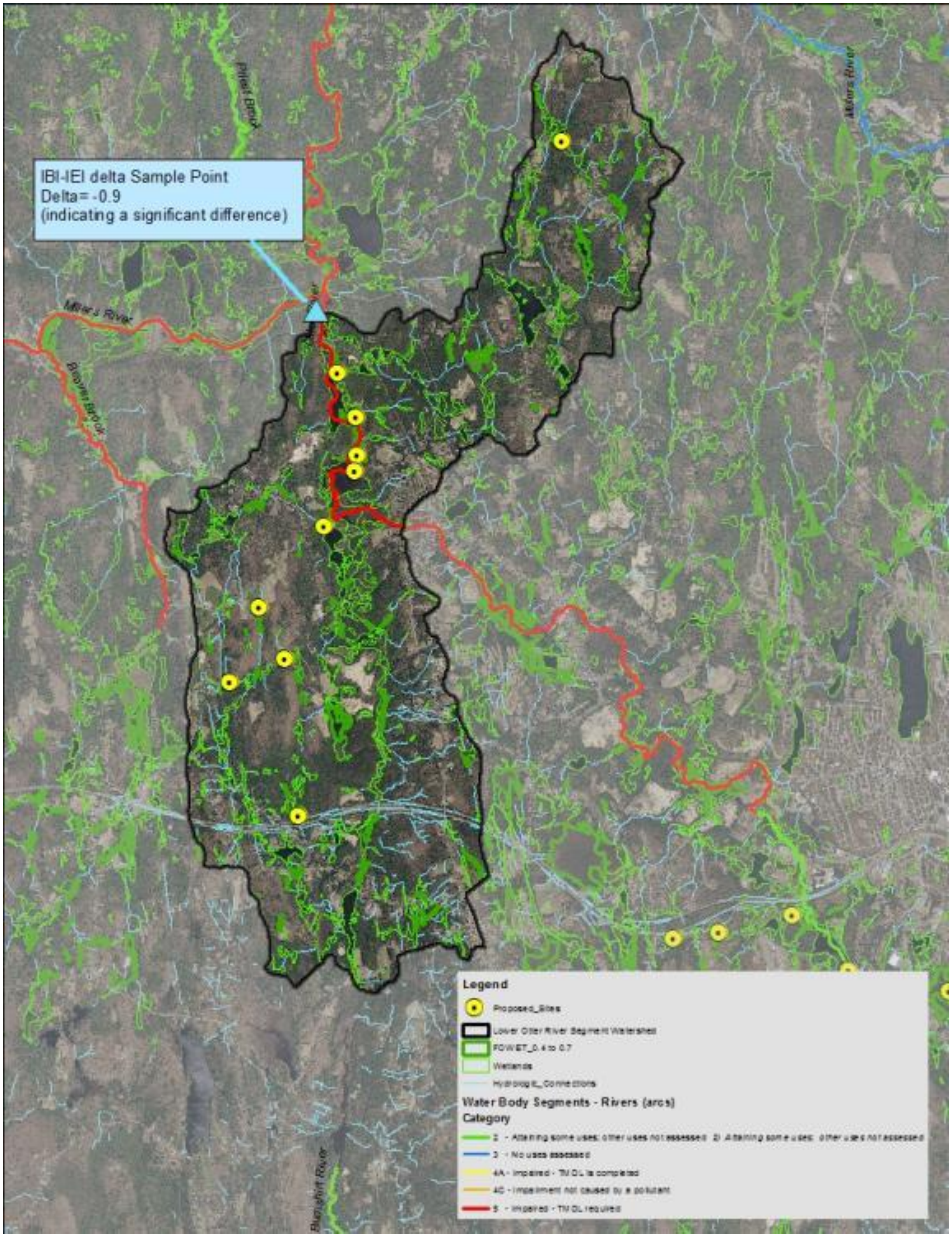


Figure 3.1-7 (c) Upper Otter River Segment Watershed



3.1-7 (d) Lower Otter River Segment Watershed



3.2 PHASE II: Site Visits and Data Analysis

The site visits and vascular plant assessments are based on the procedures identified in previously developed and approved QAPPs.[3] An overview of those methodologies is presented below**.**

3.2.1 Forested Wetland Assessment Sites

Each wetland area that is identified and where access permission is obtained will be visited to collect data. All sites will be located in the field using a Trimble Yuma 2 GPS or other comparable electronic unit and data will be entered directly into an excel spreadsheet using that same unit. GPS navigation will be used to locate each wetland plot. GPS precision must be 10 m or less and the navigator will stop and establish the plot once the distance to plot center is 0 m. In the case of GPS interference from tree-canopy or atmospheric effects two procedures may be followed. The first is to wait 10 minutes for satellite reception to improve. If a dense forest canopy appears to be the problem we will use triangulation to locate the plot. We will approach the plot from three different locations where the canopy is mainly open. Using compass and distance measurements provided by the GPS (precision must be 10 m or less), the plot will be located. It will not be necessary to hit the plot precisely it just needs to be selected without bias. As long as the field determined plot center falls within the original proposed plot, it will be deemed acceptable. Thus, if the plot center needs to be moved greater than 30 meters, then the site will be abandoned and the next site on the random list will be accessed. However, once a plot is established a reasonably precise GPS point is needed of the plot center. The strategy is: (1) do the best we can when locating the plot and (2) take a precise location (precision ≤ 10 m RMS) once the plot has been established. Field workers will be on the plot for 1-2 hours and will be able to keep trying until they get good GPS coverage.

3.2.2 Vascular plants Data Collection

Vascular plant data will be collected as an indicator of community composition and species diversity, and provide useful information on potential threats to natural systems. Data collection will occur throughout the field season, June – October 2016. The procedure for sampling plants is:

a. Calculate species abundance of all vascular plants in a 30 m radius plot by using a point intercept method. Calculate percent cover as the tally of each plant species that is directly intercepted by a vertical projection from forest floor to canopy at one meter interval

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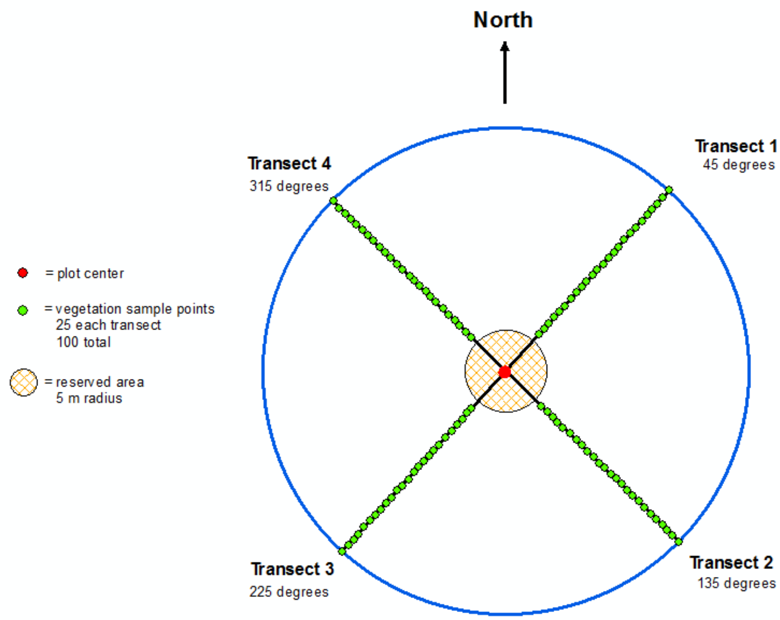
[3] *Quality Assurance Project Plan for Forested Wetland Monitoring and Assessment: Chicopee Watershed*, Version 5 FINAL, Final Signature 6/25/14.
Quality Assurance Project Plan for Forested Wetland Monitoring and Assessment: North Coastal watershed-QA Tracking #:15057, Version 1, Final Signature 6/29/15.
Available at: http://www.mass.gov/eea/agencies/massdep/water/watersheds/quality-assurance-project-plans-qapps.html

points along four 30 m transects (excluding a 5 meter reserved area at plot center) placed in the four ordinal directions. This creates 25 sample points along each of the four transects.

Figure 3.2.2-1 Standard vascular Plant Survey Plot



Transects are established in the ordinal directions and plant species are tallied at 1 meter intervals along each transect. A timed twenty minute walk around is then conducted throughout the plot to tally species that did not occur on a transect. Because it is likely disturbed in establishing the plot, a 5 meter radius at the center of the plot is not sampled.

b. Following transect sampling conduct a 20-minute walk around (within) the entire plot and list species not encountered on transects. Assign these additional species a percent cover class of 1%.

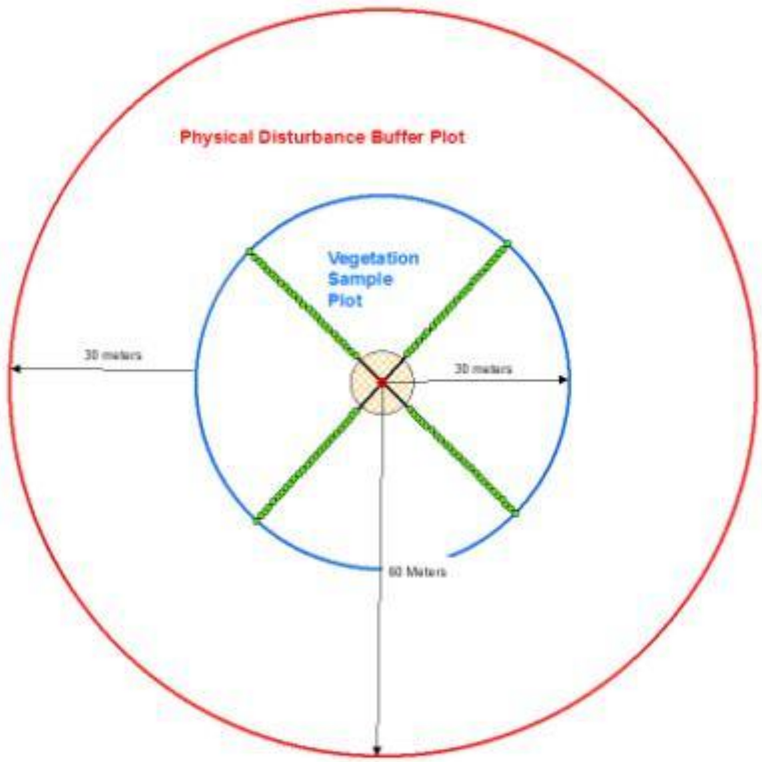
While it is the intent of this study that the field crew implements the 30 meter radius plot sampling described above it is understood that “finger-like” or other odd shaped wetlands will be encountered. If the standard plot described above does not fit within the wetland to be sampled, it is acceptable to reconfigure the plot. A wetland could be sampled as long as it is at least 30m across the short axis and long enough to add the difference onto the long axis (for example 30m wide x 90m long, and could be longer on one end of the long axis than the other). There will always be 4 transects established and vegetation tallies will always occur at one meter intervals along those transects. A five meter reserved area at plot center will always remain reserved (i.e. no plant sampling is to occur within this area) because the vegetation in that area is likely trampled by the field crew when establishing the GPS point.

In all cases, taxonomic identification at the species level (preferred) or genus level (if species identification is not possible) will be achieved through the use of Regional Field Guides, and/or technical keys and as needed, reference to regional herbaria housed at research universities such as the Harvard University Herbarium or the University of

Massachusetts Herbarium. In addition, other recognized experts within state government, private non-profits, and University settings are available to assist with the identification of difficult or unusual specimens as needed. . The physical collection of samples of vegetation will be limited to those species that cannot be identified in the field. When plant samples are taken from the field, they will be labeled in the field with a unique ID (e.g., “unknown sedge #1”) site location, date, and person who collected the sample (Note tags that will be attached to samples in Appendix D) in order to avoid misrepresenting where the species came from. Plant samples that are taken from the field shall be identified with 24 hours in order to avoid degradation of the sample, which complicates identification (i.e. as grass species dessicate the auricles lose their shape which can confound identification). In the few situations where a plant specimen cannot be identified within 24 hours and outside assistance is sought, the specimen shall be pressed between to clean sheets of white paper, enclosed in cardboard, clasped shut with rubber bands and then mailed or hand delivered to the appropriate expert Plant specimens will not be kept for future reference however. Once a plant has been identified, it is recorded in the field data form, and the sample is appropriately disposed of. All wetland plants shall be identified in accordance with the USDA Plants Database (http://plants.usda.gov/java/) nomenclature.

3.2.3 Physical Alteration Data Collection

As indicated earlier in this QAPP, the objective of the CWA is to restore and maintain the physical, biological and chemical integrity of the nation’s waters. Thus this Central Basin study will add a new component of sampling physical alteration indicators in addition to the biological sampling that has been done in the past two years. The CAPS model is a landscape level tool and as such uses GIS data to assess the degree of potential stresses that are affecting the survey plot. However, some sources of potential stress or change in a wetland may not be identified on any GIS data layer. Physical alterations documented may be the result of natural occurrences or anthropogenic activities. For instance, beaver impoundments can cause inundation of forested wetlands and subsequently dramatically change the composition of the vegetation community. Insect infestations and storm damage from hurricanes, downbursts, or summer storms, are other examples of natural disturbances which can affect the plant composition. Human activities such as ATV use, cutting of vegetation, or ditching are examples of anthropogenic stressors that may not be captured on any GIS layer yet can also affect wetland ecological integrity. In order to better understand how these physical alterations are affecting the integrity of the assessed wetlands, the presence or absence of any perturbations will be documented. This project will apply the following standard operating procedures during this monitoring effort and evaluate the results as a part of the final report.



In order to document the physical alterations present, the investigators will walk throughout the vegetation sample plot and the physical disturbance buffer plot and document the presence and extent of physical alterations observed on the Physical Alteration Form (See Appendix F). The protocol was developed by consulting the National Wetlands Condition Assessment Procedures, The Ohio Rapid Assessment Method, and the Rhode Island Rapid Assessment of Freshwater wetland condition as well as other state programs. The physical metrics chosen for identification and tracking were chosen because they were consistently identified as those most likely to be impacting freshwater wetlands. The size of the buffer plot was chosen for two reasons: 1) in order to focus on alterations that are in close proximity to, and therefore more likely to be having a direct impact on the wetland; and, 2) in order to have a manageable size. Large plots become difficult to traverse and the effort to get landowner permission to do so, especially in densely developed or suburban parts of the state, is to time prohibitive.

Since all vegetation sample plots will have received landowner permission to assess, all physical disturbance assessments within these plots will be documented in the field. While every effort will be made to inspect the physical disturbance buffer plot in the field as well, it is possible, that portions of the disturbance plot will extend onto adjacent private property or onto residential, commercial, or other inaccessible areas. In such cases the investigators will observe that portion of the plot that is inaccessible from the nearest available vantage point. Since many physical alterations such as buildings, roads, ditches and even beaver activity are readily discernible on aerial photographs, in situations where a portion of the plot cannot be viewed in the field, aerial imagery may be used to help document physical alterations. The source of the aerial imagery will be Ortho Imagery approved and maintained by MassGIS[4] and will be viewed in ArcMap 10.1 or a comparable version of ArcGIS. The following types of physical alteration will be noted:

Anthropogenic Alterations:

- Water control structures (culvert, tide gate, dam, weir, storm water input, fill (road/railroad), ditching, channelization, and other human activity affecting the hydrology of the site
- Roads
- Impervious surfaces
- Structures
- Lawn or other landscaped areas
- Soil disturbance
- Obvious spills
- Direct point or non-point source discharge from agricultural operations, septic or sewage treatment systems, or storm water affecting water quality of the site
- Walking trails, horse trails, and roads (excluding wildlife trails)
- Presence of trash/litter
- Presence of dumping, debris, old tires, etc.
- ATV Use
- Ditching
- Tree Clearing/Vegetation Removal
- Herbicide Use
- Other

Natural Alterations:

- Beaver Activity
- Insect Infestation
- Storm Damage
- Drift material and soil deposition due to flooding events
- Other

Additionally, a general category called “Other” will be included for physical alterations that may not fit neatly into the category of “Anthropogenic Alteration” or “Natural Alteration.” For example, when the presence of any evidence of wildfire is observed, it is unlikely that we will be able to determine in the field what the cause was (i.e. natural wildfire or anthropogenic).

[4] http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/layerlist.html

In addition to tracking the presence or absence of alterations, the severity of the alteration will be determined by estimating the areal extent (i.e. percent cover) of the plot that it impacted by the alteration. To help calibrate our ability to accurately determine percent cover, percent cover charts will be used, similar to those used for wetland plant estimation in boundary determinations, or for estimating redoximorphic features in hydric soil determinations. The chart we will be using in for this purpose is available in Appendix E. That chart will be carried by field personnel during the physical disturbance assessment to assist in accurately and consistently determining the extent of physical alterations.

The following values will be assigned to document the extent of physical disturbance:
0 = no disturbance present
1 = 1-24% of the plot is impacted
2 = 25-49% of the plot is impacted
3 = 50-74% of the plot is impacted
4 = 75-100% of the plot is impacted.

This data will be tracked in an excel spreadsheet and populated in the appropriate cell using the Trimble YUMA 2. All cells in the spreadsheet must be populated (i.e. blank cells are not permitted; a number from 0-4 must be entered in each cell in order to confirm that the investigator reviewed that metric). In cases where the physical disturbance is determined via aerial photography, the cell will be colored light blue. Because excel allows for selecting and sorting based on cell color this will allow investigators to readily identify which disturbances were viewed on site and which were determined via aerial photography and, if necessary, sort or separate them. In cases where "other" physical alterations are documented, the comments tool in Excel will be used to describe the cause or source. The Comments tool leaves a small red triangle in the upper right hand of the cell which will identify that it has been inserted. Since we are already tracking vascular plant composition in Excel, another worksheet for tracking physical disturbance and stressors has been added. The use of Excel facilitates assessing the data at the conclusion of the field season since the data is collected in a suitable format for conducting statistical analysis and avoids data transfer errors resulting from transcribing paper field notes into a digital form. A representative example of the excel spreadsheet (Physical Alteration Form) is attached as Appendix F.

3.2.4. Safety Considerations

All staff will be advised that they must follow the safety rules listed below.

- Fieldwork will not be conducted during flooding events or unsafe conditions such as electrical storms or high wind events.
- Special attention shall be given to Department of Public Health warnings and outbreak locations for West Nile Virus and Eastern Equine Encephalitis (EEE).
- Notice shall be given to the Project Manager as to locations and time of field work to be conducted and participating personnel. Practice "safety first."

- If there is no safe access to a site, the site assessment will be abandoned. Any decision to abandon a site must be reported to the Project Manager. Safety concerns for abandoning the site will be detailed in such report.
- Flagging tape will be used to mark access point locations for safe exit, in instances where such locations could be difficult to find as deemed appropriate by field crew.
- Good judgment will be used in selecting clothes and personal protection items. Common items needed include: high visible safety vests, extra clothing, sunshade, sunscreen, hats, insect repellent, and waterproof knee boots— or chest waders with appropriate restriction waist belt or quick release hip waders for highest anticipated depths. Any staff not dressed appropriately for field work should not participate in the site assessments. Proper footwear is a must (e.g., no “flip-flops” for field work).
- Good judgment will be used in walking within wetlands; ditches/streams will be circumvented, or when deemed possible, crossed with caution.
- A safety equipment shall accompany all site visits and shall contain, at a minimum, the following items:
    - First aid kit
    - Insect repellant
- All personal and field equipment shall be cleaned and decontaminated upon exiting the wetland and before entering a new area to prevent the spread of invasive species.
- Personal clothing checks shall be conducted for deer & dog ticks.

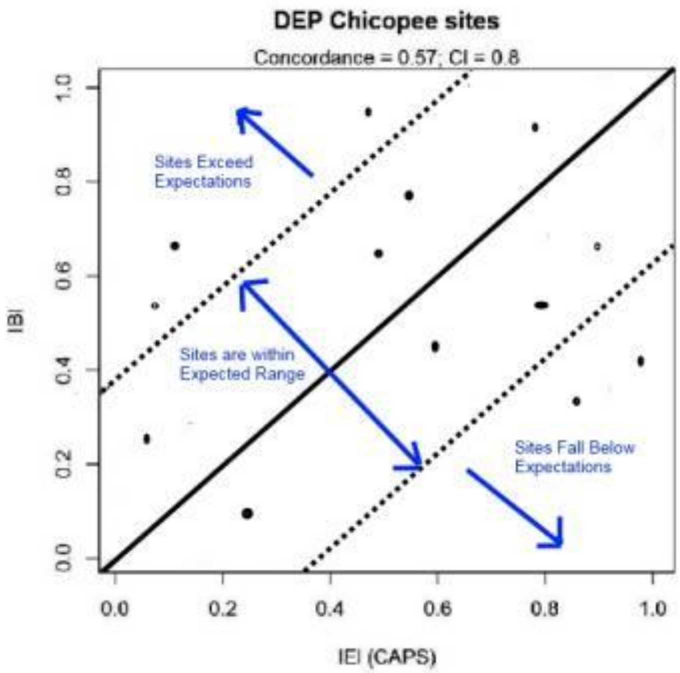
3.2.5. Data Analysis

IBI & CALU

MassDEP staff will calculate IBI values based on the vascular plant data collected in the field. UMass has developed software that allows us to develop these IBI values so that they can be used for assessment and MassDEP staff is experienced in its use. The sampled site’s biological condition within its landscape context will be assessed relative to the lines on the Continuous Aquatic Life Use (CALU) figures similar to the one shown below, and relative to the CAPS IEI and individual metric values for that site and for the surrounding area. In conducting the CALU assessment, sites that fall between the dotted lines (expected range of variability) would meet the predicted biological condition; those falling above the highest dotted line would exceed the predicted biological condition; and sites falling below the lowest dotted line would be flagged as not meeting the predicted biological condition.

Those sites that meet or exceed the biological condition would be presumed to be performing at the ecological level that is expected given their landscape position. Sites that fall below the predicted level would be flagged for further evaluation in order to attempt to determine the reasons why the site is not meeting its predicted level.

Figure 3.2.5-1 CALU Chart



Sites that have been deemed as not meeting their predicted condition could then be targeted for further investigation to determine which stressors may be contributing to the impairment of the associated water body. It should be noted that the stressors that are contributing to the degradation of a given site may not be ones modeled by CAPS (i.e. the site is being impacted by something that CAPS doesn't consider). The focus of analysis is to determine the condition of the sampled wetland to determine if there is a relationship between wetland condition and water quality. Wetlands that are exceeding expectations are likely to be playing a role in improving water quality, whereas wetlands that are failing to meet expectations are indicative of stressed conditions and may be failing to perform certain functions (e.g. pollution filtration). Once the analysis is completed remedial strategies will be evaluated and the findings will be included in a final report, and a summary and link will be referenced in the next scheduled Integrated Waters Report in order to provide further information relative to the overall ecological integrity of wetlands in the Central Reporting Basin.

3.2.5 Physical Alteration Analysis

MassDEP will use the physical alteration data to assess the presence and extent of physical alteration for each site, for all sites within the targeted watershed, and a total for all sites in the reporting basin. This data will be presented in chart or other format. The report will identify the most common physical alterations, as well as whether there is a relationship between the CALU value and the physical alterations that were documented for both the sample plot (vegetation plot) and the 30 meter buffer plot around it. By differentiating between the sample plot and the 30 meter buffer, we will see if a relationship exists between the alterations in the sample plot and those in the 30 m buffer (note the buffer may be wetland and/or upland). Additional analyses of the data may be conducted such as analyzing weighted averages or quantile analysis depending on the results of the data collection (i.e. if there is very little physical alteration it may not be appropriate to do additional analysis; if there is extensive physical alteration data the need for additional analysis will be evaluated).

4.0 Deliverables and Schedule

Table 4-1 Anticipated Schedules for Implementation

Project Tasks	Start/End (mo/yr)
Prepare QAPP	March 2016-June2016
Identify Wetland Assessment Sites	April2016-May 2016
Obtain Landowner Permission	April 2016-June 2016
Conduct site visits for20 assessment sites	June 2016-October 2016
Data Analyses for assessment Sites	October 2016-June 2017
Prepare Report	June - December 2017

5.0 Quality Objectives and Criteria

5.1 Objectives and Criteria

QA/QC is laid out in the assessment sampling protocol as a system of audits, standard procedures, and training for each section of the data collection and management plan. These activities and procedures begin with the assessment protocol conceptualizations, where the data requirements are determined, and continue throughout all phases of the project to ensure that data quality meets those standards. Quality assurance is overseen by the Project Manager.

Along with proper methodologies, confidence in the quality of the data is critical in the subsequent assessment protocol development stages as well as during assessment protocol application. Therefore, quality assurance procedures must be incorporated into the assessment protocol and used in a reliable and consistent manner to provide reproducible data with known statistical properties. In addition to the standardized sampling, measurement, and data handling procedures listed above, the assessment protocol includes a statement of data quality standards and methods for: 1) training, 2) internal data audits, and 3) external data audits for which the Project Manager is responsible for coordinating.

Before quality assurance methods to maintain data quality standards can be developed, the quality standards must be determined. Terms used to express data quality standards and examples of the QA/QC used to assure those standards are given below (Sherman et al. 1991):

1) *Precision* - is a measure of mutual agreement among individual measurements of the same variable, usually under prescribed similar conditions. Data precision of the assessment protocol can be checked through the use of replicate field measurements and standard procedures.

2) *Accuracy* - is the degree to which a measurement reflects the true or accepted value of the measured parameter. It is a measure of the bias in a system. Accuracy depends on the technique used to measure a parameter and the care with which it is executed. Standard procedures and QA audits are used to maintain data accuracy.

3) *Completeness* - is a measure of the amount of valid data actually obtained compared with the amount that was expected to be obtained under normal conditions. Ideally, 100% of the data should be collected. Data may be incomplete due to incomplete data collection, lost or damaged data forms, or errors in data transcription.

4) *Representativeness* - expresses the degree to which data accurately and precisely represent a characteristic of the parameter measured. Representativeness is established by proper site selection and appropriate spatial arrangement of sampling areas (i.e. site selection stratified by frequency distribution of selected metrics).

5) *Comparability* - expresses the confidence with which one data set can be compared to another. Collection of data by different investigators is the primary cause of variability in the data. Standardized procedures, internal QA audits, and training minimize variability in the data. Field testing of the assessment models will be used to determine the level of comparability achieved.

Table 5.1-1 Data Quality Objectives

Parameter	Units	Expected Range	Accuracy (+/-)	Precision
Establishment of Assessment area wetland Plot	Square meters	2544-3108 square meters	+/- 10 %	95% agreement on actual measurements among separate observers
Vegetation assessment	Species presence (or genus if species ID is not possible);	50-3000 individual plant species	95% accuracy of identification at the species level; 100% agreement at the genus level. External expertise is available in the event that unfamiliar taxa are encountered	100% agreement on presence/absence among separate observers.
Location of plot center	Meters	na	+/- 5 meters	+/- 5 meters
Physical Alteration Assessment	Presence/Absence	0 to 12 occurrences per site	100% accuracy of identification of the occurrence.	100% agreement on presence/absence among separate observers
Physical Alteration Assessment	Percent cover	0 to 5 cover classes	100% accuracy of identification of the occurrence.	95% agreement on cover class estimate.

5.2 Documents and Records

The most current approved version of the QAPP will be provided to the appropriate personnel by the Project Manager. All data collected will be maintained on a protected and backed up drive at the Boston Office of MassDEP, 1 Winter Street, Boston. The QAPPs will be dated to distinguish among different versions in case there are revisions made over the course of the project. The Project Manager will maintain all reports of the project status, including any problems and the proposed recommended solutions. The Final report will be provided in electronic form to everyone on the distribution list. Hard and soft copies of reports, and all electronic data records, will be maintained at MassDEP and made available upon request. In accordance with the Massachusetts Statewide Records Retention Schedule 02-11 (Section 14.8 Environmental Monitoring and Inspection Records) all data will be kept for a minimum of 15 years.

6.0 Data Generation and Acquisition

6.1 Data Collection

The data to be collected is described in the following table:

Table 6.1-1 Data Collection: Forested Wetlands

Data	Method	Units	Sample Data Records[5]	Method Sample Preservative	Minimum Holding Time
Plant Community	Species presence (or genus if species ID is not possible);	Individual tally	Microsoft Office Excel 2007	NA	NA
Plot Center	Trimble Yuma 2 GPS Unit	State Plane Meters	ArcGIS Software Suite	NA	NA
Physical Alterations	Observation of site	Presence or Absence	Microsoft Office Excel 2007	NA	NA
Physical Alterations	Observation of site	Percent Cover	Microsoft Office Excel 2007	NA	NA

[5] Note that the only data that will be taken from the field is if a sample plant specimen cannot be identified. The specimen will be identified in the office as quickly as possible and then discarded. All other plant data collection is by observation and recording in the field only.

6.2 Data Handling and Custody

All data will be downloaded immediately upon returning to the office. It will be downloaded to a master copy that is stored on protected and backed up drive at MassDEP. Two separate Backup copies will be made, stored on a separate drive in the office and the other on a flash drive for offsite storage.

6.3 Quality Control

Quality Control will be maintained throughout the project through the following measures.

- Development of comprehensive field data collection methodologies discussed above in section 3.2.2 and 3.2.3. Note that section 3.2.2 was developed as part of previously approved QAPPs.[6] Specifications provide for completeness and comparability of the data that is gathered. (completeness, comparability)
- Computer aided use of stratified random sampling procedures for site selection discussed above provides for representative sample selection and accuracy of site locations on the landscape.
- Use of standardized field data collection procedures as described in Sections 3.2.2 and 3.2.3, such as transect establishment, point intercept methodology and time-constrained sampling provide for precision, accuracy, and repeatability.
- Prompt review and documentation of any changes to the SOPs will address precision, accuracy, and comparability.
- All field managers have at least 10 years of experience in wetland evaluations. The use of highly qualified field scientists provide for precision, accuracy and comparability of data.
- Rigorous training, in both structured and informal settings, of all team members provides for precision, accuracy, and comparability.
- External validation of taxonomic identification for taxa with which the field crew has had limited prior experience (100% of samples) provides for accuracy and precision;
- Daily checks by field staff and periodic checks by the Project Manager to ensure that data forms are completely filled out, all data will be rechecked by the field manager when they are entered into the final database (completeness).

It is important to maintain consistency in data collection and handling methods throughout the effort. It is not uncommon for methods to change as new situations arise and must be incorporated into the data set. The Project Manager is responsible for periodically inspecting the methods used and inconsistencies will be documented and if possible, corrected. Any changes will be made in coordination with EPA and other QAPP signatories. If corrections are not possible, documentation will be included with the reference data for interpretation during subsequent analyses.

[6] Quality Assurance Project Plan for Forested Wetland Monitoring and Assessment: Chicopee Watershed Version 5 FINAL, Final Signature 6/25/14, Section 3.2.1 and 3.2.2; also the Quality Assurance Project Plan for Forested Wetland Monitoring and Assessment: North Coastal Watershed – QA Tracking#: 15057, Final Signature 6/29/15 , Sections 3.2.1 and 3.2.2, both available at http://www.mass.gov/eea/agencies/massdep/water/watersheds/quality-assurance-project-plans-qapps.html

6.4 Instrument/Equipment Testing, Inspection, and Maintenance

Table 6.2-1 Instrument/Equipment Calibration, Inspection, Testing and Maintenance.

Equipment	Calibration	Inspection/testing	Maintenance
Trimble Yuma 2	As per manufacturer's specs	As per manufacturer's specs	As per manufacturer's specs

7.0 Assessment and Oversight

Reports to Management

The Project Manager will save and document all reports of the project status, including any problems and the proposed recommended solutions. Any deviations to the QAPP will be reported.

8.0 Data Validation and Usability

Data Review, Verification, and Validation

All data will be reviewed by the Project Manager to determine if the data meets QAPP objectives. Data will be reviewed, prior to being entered, in order to ensure completeness. The Project Manager will make the ultimate decisions to reject or qualify data.

Reconciliation with User Requirements

It is not uncommon for methods to change as new situations arise and must be incorporated into the data set. As discussed in Section 6.3, the data and methods will be periodically inspected for inconsistencies or user conflicts and will be documented and if possible, corrected. If corrections are not possible, documentation will be included for interpretation during subsequent analyses. If enough data are collected such that the final report can be written, then the project objectives will have been met and the project considered complete. If this is not the case, then the Project Manager will determine what additional information will be necessary to complete this project.

APPENDIX A: LANDOWNER LETTER

[Landowner Address] [Date]

Dear [Landowner]

The Massachusetts Department of Environmental Protection (MassDEP) Wetland Program will be conducting a field assessment of wetlands in the Central Massachusetts watershed during the summer of 2016. Our goal is to document the ecological integrity of forested wetlands in order to assess wetland health within Massachusetts as required by the Federal Clean Water Act. We have created a random sample of wetland areas, and one of those random wetland areas occurs on your property at [Site location]. Therefore, we are requesting your permission to enter onto your property in order to view the wetland.

The site visit will be conducted by two trained MassDEP field scientists and they will have MassDEP identification on them at all times. The assessment will likely take 1-2 hours and will involve documenting the plants that are present within a 30-meter radius plot. There will be no disturbance to the land. You do not need to be present during the visit (though you are welcome if you wish). Please be assured that any follow-up reporting to EPA on the data collected will not include property owner names and addresses.

We are scheduling this field work between June and October of 2015 and would appreciate it if you would sign the enclosed copy of this letter and mail it back to us in the enclosed stamped envelope. If you would prefer to call or email, you may contact Principal Investigator Michael McHugh at 617.556.1163 Michael.McHugh@Massmail.state.ma.us or myself at (617)292-5512 Lisa.Rhodes@Massmail.state.ma.us. If we don't hear from you, it is likely that one of our staff scientists will give you a call to follow up. MassDEP appreciates your assistance with this important work.

Sincerely,

Lisa Rhodes, Project Manager
Wetland Monitoring & Assessment Program

I agree that MassDEP may enter my property to conduct the site visit described in this letter.

__________________________________ __________________________________

Name (Printed) Signature

Appendix B: Equipment

The primary equipment used in this project is a Trimble YUMA 2. The YUMA 2 is a ruggedized tablet sized field computer with an integrated highly accurate GPS. It operates on the Windows platform and as such runs the full Microsoft Office Suite (Word, Excel, etc.). It has been loaded with ArcGIS software in order to capture spatial data (i.e. coordinates of sample points) as well as view aerial photograph, with realtime location displayed, in the field in order to navigate to and from the sample point.

Trimble YUMA 2 Specification sheet: http://trimblemcs.com/downloads/Yuma-2_datasheet_Rev-B_English.pdf

Trimble YUMA 2 User's Guide:
https://www.fondriest.com/pdf/trimble_yuma_2_manual.pdf

APPENDIX C: Field Data Form

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1				Transect Splitter:	30	6-10	11-15	16-20	21-25	26-30						
2	Site ID	Transect	Genus	Species	Common (lookup)	Group 1	Group 2	Group 3	Group 4	Group 5	Group Totals	Date	Site Location	Staff	Transect deg	Transect length
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																
16																
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19																
20																
21																
22																
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26																
27																
28																
29																
30																

Note: The data will be collected electronically using the Trimble YUMA 2 (or other comparable unit), and not in hard copy format. If the electronic device is not available, the data could be collected in hard copy form. The data that will be collected is shown above. The plot diagram and site location will be uploaded in the format of a shapefile that can be viewed in ArcGIS. The plant data will be uploaded in the form of the excel spreadsheet above.

The Transect Splitter field allows the field scientist to enter a different transect length for atypical sites and it automatically calculates the correct grouping categories.
Once the field scientist clicks on the Genus and species fields a drop down menus pops up that includes the entire USDA plant database for Massachusetts. Once the field scientist clicks on the Genus and Species names, the fields will be populated and the common name will automatically populate the “Common (lookup)” field. The number of times that plant is observed in each group is entered in the Group 1-5 fields and the Total field automatically populates. Transect deg means the angle that the transect heads to from the center point.

Appendix D: Plant Sample Tags

PLANT SAMPLE TAG	
DATE:	SITE ID:
SAMPLE ID:	Collector ID:
COMMENTS:	

PLANT SAMPLE TAG	
DATE:	SITE ID:
SAMPLE ID:	Collector ID:
COMMENTS:	

PLANT SAMPLE TAG	
DATE:	SITE ID:
SAMPLE ID:	Collector ID:
COMMENTS:	

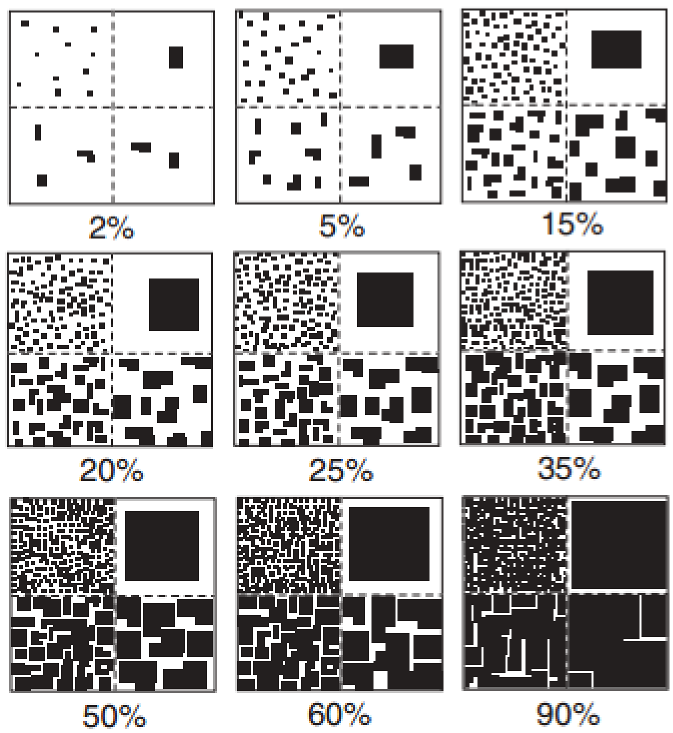
PLANT SAMPLE TAG	
DATE:	SITE ID:
SAMPLE ID:	Collector ID:
COMMENTS:	

Appendix E: Percent Cover Chart

Compiled by: P.J. Schoeneberger, D.A. Wysocki, E.C. Benham, H.E. LaGarry, NRCS, Lincoln, NE.

EXAMPLES OF PERCENT OF AREA COVERED

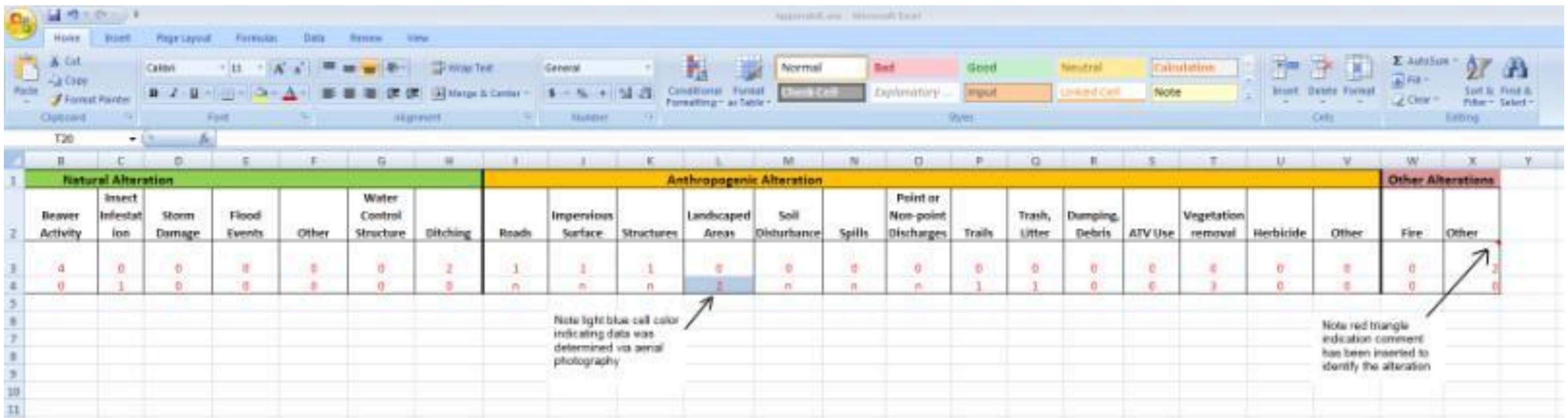
The following graphic can be used for various data elements to convey "Amount" or "Quantity." ***NOTE***: Within any given box, each quadrant contains the same total area covered, just different sized objects.



USDA-NRCS *7-1* *September 2002*

Chart courtesy of: USDA-Natural Resource Conservation Service

Appendix F: Physical Alterations Data Sheet Sample



Natural Alteration							Anthropogenic Alteration															Other Alterations	
Beaver Activity	Insect Infestation	Storm Damage	Flood Events	Other	Water Control Structure	Ditching	Roads	Impervious Surface	Structures	Landscaped Areas	Soil Disturbance	Spills	Point or Non-point Discharges	Trails	Trash, Litter	Dumping, Debris	ATV Use	Vegetation removal	Herbicide	Other	Fire	Other
4	0	0	0	0	0	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
0	1	0	0	0	0	0	n	n	n	1	n	n	n	1	1	0	0	3	0	0	0	0