Field Testing and Technical Evaluation of the Natural Resource Conservation Service Stream Visual Assessment Protocol Version 2 (SVAP2) in 35 Wadeable Streams throughout New England

US Army Corps of Engineers New England District
US Army Engineer Research and Development Center
2018

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EXECUTIVE SUMMARY

ERDC Environmental Laboratory (EL), in partnership with the US Army Corps of Engineers New England District ("NAE" or "the District") Regulatory Division, and assisted by The Nature Conservancy - Maine (TNC-ME) providing advance GIS preliminary data collection and site selection, completed an intensive two-week field test with follow-on technical evaluation of the Natural Resources Conservation District (NRCS) 2009 Stream Visual Assessment Protocol Version 2 (SVAP2). A total of 35 field sites were assessed in ME, NH, VT, CT, MA and RI to determine the efficacy of this method in distinguishing stream condition for District Regulatory permit program application in New England. Representatives from the Maine Natural Areas Program (MNAP), Natural Resources Conservation Service (NRCS), New Hampshire Department of Environmental Services (NHDES), and United States Environmental Protection Agency (EPA) also joined in at selected field sites. Numerous additional local and regional organizations served as points of contact to assist with accessing sites. University of New Hampshire joined the team at a number of selected sites in a coordinated effort with their study of low-altitude stream assessment methods incorporating the SVAP2. The results of the field test show that the SVAP2 can be applied to New England streams, with some additional information applied to two of the 16 Elements (Salinity and Waste/Manure). Statistical analysis showed that the SVAP2 can effectively distinguish between our assumed three populations of sites representing good condition (Preserved sites), degraded condition (Proposed Project sites) and trending to good condition (Completed Project sites). Significant narrative changes are recommended for the Salinity element. Recommended modifications or adjustments to other elements involve assessment methods, training or field materials only, with no changes criteria or scoring. The analysis also demonstrated that the SVAP2 can be used to identify reference standards which facilitate development of performance standards and success criteria for compensatory mitigation. Further, the District may consider assessing additional least impacted or minimally disturbed sites to set that end of the scoring criteria for better comparison with mitigation site condition trajectories, identifying restoration and habitat targets for design, and possible future protocol modifications, if warranted. The outcomes of this work will help NAE Regulatory to more efficiently and effectively assess and compare functional value at stream sites associated with actions under Section 404 of the Clean Water Act, including the 2008 Mitigation Rule.

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INTRODUCTION

Statement of Problem

New England District (NAE or "the District") is in the process of revising guidance for stream mitigation (credits and debits) pursuant to 40 CFR Part 230 – Compensatory Mitigation for Losses of Aquatic Resources or "Mitigation Rule" (DoD, EPA 2008). As part of that effort, the District's Stream Project Delivery Team has included the Natural Resource Conservation Service's (NRCS) 2009 Stream Visual Assessment Protocol, Version 2 (SVAP2), in the NAE 2016 Mitigation Guidance Document.

Although the original NRCS Stream Visual Assessment Protocol (SVAP) developed in 1999, and further refined in the 2009 SVAP2, included field testing around the country, no New England states were included in either round of testing. Table A-1 in the 1999 SVAP indicates field testing was confined to VA, NC, SC, MI, NJ, OR, CO, WA, and GA, with SVAP2 updates including additional testing sites in CA, OR, ND, SD, NB, IO, MN, PA, MD and VA. Attempting to apply this methodology as written and tested outside of New England without adequate evaluation and testing in New England could compromise efficacy in determining and comparing stream condition for assigning mitigation debits and credits.

Study Goal and Objectives

Updates presented by NRCS (2009) focused largely on relevance and expansion of applicability of this methodology nationwide, especially to additional projects or programs, such as the Farm Bill and fish and wildlife natural resource conservation (NRCS 2009). As application and interpretation of the SVAP increased beyond original intended uses, NRCS (2009) undertook to update and revise the protocol to increase accuracy and repeatability, viewing the SVAP2 "…as a national framework for States to revise or amend, if necessary, to better assess local stream and riparian conditions." Concerns of field users in the intervening ten years were addressed, including 1) congruency with current wildlife habitat evaluation guidelines, with an SVAP2 score of 5 or above constituting a new threshold between a source and sink habitat for aquatic species, 2) general revision of wording to increase consistency and repeatability among and between States through time, and 3) revision of scoring elements to reflect state of the science in stream corridor conservation, including channel condition, hydrologic alteration, riparian quality, riparian quantity and bank condition. Additionally and importantly, the updated guidelines include "Instructions for modification of SVAP2 to better reflect local conditions," with the explicit goals of ease of use, responsiveness to changes or trends in stream condition over time, and increased precision and accuracy of the method.

The goals of this study therefore are to 1) Test and confirm the appropriateness of SVAP2 for use in New England and, 2) Make any recommendations for modifications to render it appropriate, per guidelines for modifications contained in SVAP2 documentation (NRCS 2009).

Participants

Integrated use and appropriate application and interpretation of SVAP2 is founded on a collaborative approach to achieve consistency, efficiency and effectiveness of the method (NRCS 2009). In this spirit, the District sought broad participation from cooperating agencies and other stakeholders in execution of our field test. The core field team, Sarah Miller and Bruce Pruitt (ERDC Environmental Laboratory, Ecological Resources Branch), Ruth Ladd (Chief, Policy and Technical Support Branch, NAE Regulatory

Division) and Taylor Bell (Project Manager, NAE Regulatory Division), was joined by Kathy Jensen (The Nature Conservancy - Maine) in preparation of GIS preliminary data and protocols, training coordination at TNC-Maine, and joined us at selected field sites. Additionally, the core field team was joined by one or more interested parties at over two thirds of our test sites totaling over 20 visiting participants, providing exposure to the method and fostering an increased level of understanding and support (Appendix A). Prior to field work, at least two dozen points of contact for site access, including numerous conservation organization members, DOT, city, town and state officials, and numerous landowners, were critical to the success of the study. We especially acknowledge Scott Greenwood and Alexandra Evans, University of New Hampshire, who joined the field team for office and field training, and assisted field data collection at 14 sites in MA, ME, NH and RI as part of their related study to assess use of remotely sensed data in conducting visual stream condition assessment.

STUDY AREA

Study Area Description

The six New England states of Maine, New Hampshire, Vermont, Massachusetts, Connecticut and Rhode Island, totaling 71,992 square-miles, comprise the USACE New England District, one of five Districts in the USACE North Atlantic Division (USACE NAE 2013). With several different mountain ranges, thousands of miles of streams and rivers, over 6,000 miles of coastline and spanning greater than 6 degrees of latitude (over 400 miles), the climate, geology, hydrology, physiography and level of development of this region is highly varied. We considered this variation, in addition to types, sizes and locations of streams for which District personnel are responsible, in selecting and evaluating the field sites sampled to ensure the range of conditions commonly encountered is represented, in addition to providing for geographic equity, land use conditions, disturbance level and site access.

Delineative Criteria

A total of 38 potential field test sites were selected based on these considerations, segregated by state, with the following associated categorical information attached for prioritization, organization and logistical purposes:

- Map ID (a naming convention that included two-letter State abbreviation and a two digit number starting with 01)
- Project or reach type (Completed project, planned disturbance or currently disturbed or degraded (Proposed project), or Preserved site)
- State
- Town
- Other location designation (other local or common property or stream name)
- Permit number (if/as applicable for identification, site location and additional data resources)
- Project Manager (if/as applicable)
- Stream Name (or tributary to specific stream, if known)
- EPA Level III Ecoregion and Name
- EPA Level IV Ecoregion and Name (with an additional designation if the site location fell on or less than two miles from the map line between regions, assuming the site could be located in either region and that the transition between two regions would occur on some continuum between the two)
- Project or reach type (additional information on the work done or proposed)
- Dates of interest (dates project work completed, monitored, etc.)
- Drainage Area (calculated from GIS data)
- Notes (any additional pertinent information)
- Latitude and Longitude (in decimal degrees for plotting using ArcMap or Google Earth platforms)

The final list of sites completed includes 34 of the original 38, plus an additional pre dam removal site added (Appendix B). ME03 was eliminated because this site was no longer a single-thread stream at the time of assessment due to the previous wetland restoration project success; NH01 was eliminated due to time constraints; MA07 was eliminated also due to time constraints, but was deemed similar enough to MA06 to be redundant; ME10 was eliminated just prior to field assessment due to logistical constraints.

Physiography

The US Environmental Protection Agency (EPA) EPA has divided North America into areas of generally similar regional ecosystem characteristics called Ecoregions, with increasing level of detail and resolution from Level I through IV (Griffith, et al., 2009). The New England Region includes five Level III Ecoregions with a total of forty Level IV Ecoregions (Figure 1).

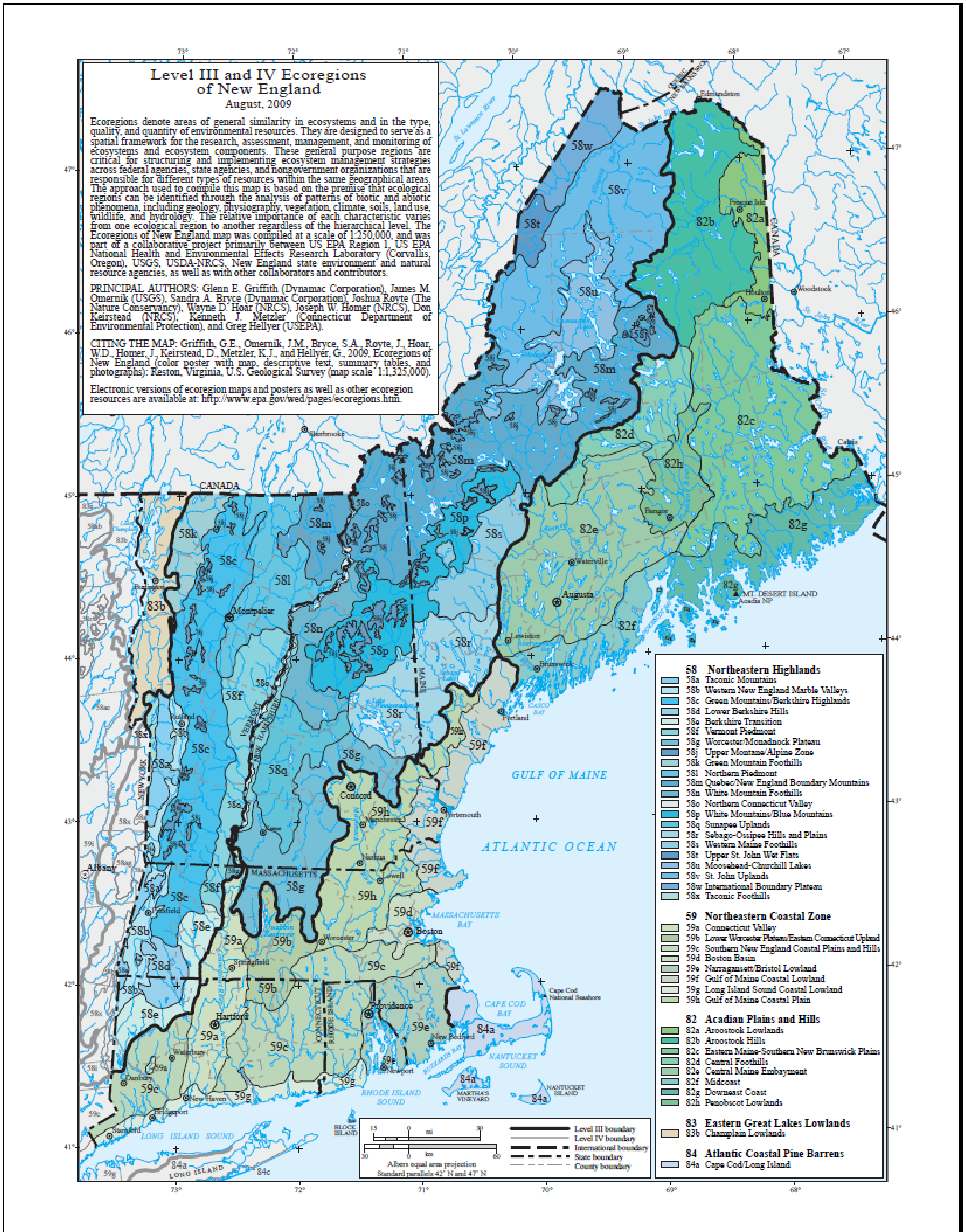

Figure 1. Level III and IV Ecoregions of New England (Griffith et al., 2009).

All five Level III Ecoregions were represented by the field sites selected for assessment using SVAP2, of which three contained field sites within more than one Level IV site (Table 1). The number of sites in each Level IV region is too small for any statistically significant comparisons, and while there are a significant number of sites in Northeastern Highlands Regions (58) and Northeastern Coastal Zone (59), differences unrelated to physiographic parameters (drainage area, land use, level and type of disturbance, etc.) would limit our capability to distinguish between the ecoregions with the SVAP2.

Table 1. Level III and IV Ecoregions represented in New England, with number of field sites assessed in each.

Ecoregion - Level III	Total # of sites in Level III Regions	Total # of Level IV Regions Represented
58, Northeastern Highlands	13	5
59, Northeastern Coastal Zone	15	5
82, Acadian Plains and Hills	6	6
83, Eastern Great Lakes Lowlands	2	1
84, Atlantic Coastal Pine Barrens	2	1
Totals	38	18

Regulatory Context

Under the Clean Water Act, Section 404, the Corps is responsible for the Regulatory Program, which includes permitting impacts involving the discharge of dredged or fill material into waters of the U.S. In the evaluation of impacts to waterways, the Corps requires permit applicants to first look at opportunities to avoid impacts. If impacts are unavoidable, they must be minimized to the maximum extent practicable. Lastly, compensation may be required for the impacts which cannot be avoided. As part of the evaluation process, project managers assess the impacts to the functions of the aquatic resources and, if compensation is required, whether the proposed compensation will do so adequately. If third party compensation is required, that work must also be evaluated to determine what kind and how much credit can be granted for it.

A methodology for addressing impacts to streams and rivers and compensation resulting from restoration and enhancement is needed to assist project managers and the regulated public in determining ecological impacts and compensation benefits.

METHODS

SVAP2 Overview

This report follows the Natural Resources Conservation District (NRCS) 2009 Stream Visual Assessment Protocol Version 2 (SVAP2), designed as a tool for rapid, field-based, largely qualitative assessment of stream ecosystem condition. The method provides description, references, protocols and data forms for assessing, interpreting and documenting up to 16 elements (biotic and abiotic stream ecosystem variables, components or properties). The details of the methods as applied to this study are described below.

Field Support Documentation

In addition to the SVAP2 Protocol (NRCS 2009), an effective field effort requires additional support documentation to assure consistent, repeatable and safe field work.

(a) A Quality Assurance Project Plan provided for staff training, field equipment and procedures, data collection and management, and chain of custody (Appendix D);
(b) A Safety Plan provided emergency contact information for core Team staff, known allergies or other pertinent medical information, and was provided to all field personnel, contacts, and supervisors, and was carried to the field at every site (Appendix E);
(c) Field Schedule provided detailed information including dates, times, activity planned (travel or field work), meeting locations, site Map ID and property or stream name, site Points of Contact, additional attendees expected with affiliations, and contact information as appropriate (Appendix F);
(d) GIS and Preliminary Data forms, Images and Maps for each site provided invaluable information for identifying, characterizing and locating each site (stored in SharePoint, NAE, SVAP2 All Documents, Folders by State);
(e) Field Forms were copied from the SVAP2 on water-resistant (Rite in the Rain) paper whenever possible and three-hole punched as available for all field personnel to ensure all required data were collected, as long as all blanks were filled in or marked by staff as appropriate (stored in SharePoint, NAE, SVAP2 All Documents, NAE_SVAP2_field_June_2017, field_forms_raw_QCed, and revised field forms Appendix I); and
(f) Laminated summary Field Tables for each element (variable) in the protocol, including the criteria and score values, to greatly speed assignment of scores for each variable without having to carry and look up each variable in the complete 75-page document (Appendix G).

Site Selection Criteria – Office methods

The selection of sites initially involved reviewing NAE active mitigation sites. This was done using NAE's ORM2 (OMBIL [Operations and Maintenance Business Information Link] Regulatory Module, Version 2) database, categorizing mitigation sites by state and asking project managers for suggestions. When that did not result in sufficient numbers of projects, we used two additional methods of finding suitable streams for study: a) review of in-lieu fee projects with streams, both those in preserved areas and those with proposed or completed dam or culvert removals or replacements, and b) streams located in state protected land, such as state parks.

Before we could select the sites to study, we developed categories of streams covering the range of options or conditions we would normally encounter in the field:

1. Type of stream (ephemeral, intermittent, perennial);
2. Land use (pre-mitigation, post-mitigation, post-construction, disturbed, and preserved);
3. Location (EPA ecoregions);
4. Previously scored SVAP2 streams (primarily because they were of great interest to the NAE staff); and
5. Drainage area associated with the stream (this generally correlates to item 1 but perennial is very broad so drainage area allows differentiation).

We wanted to assess at least one site that fit each of the characteristics to sample the full range of site types and conditions. In an effort not to duplicate sites, if we found two sites with the exact same criteria we generally chose just one of the sites. Accessibility was also a consideration since the amount of time we could devote to any one site was limited; sites requiring long hikes or very long drives to access were not considered further.

We also focused on the states where the majority of permit actions take place. States such as Maine, Massachusetts, New Hampshire and Connecticut included a greater number of sites due to the fact that this is where most of the NAE stream impacts take place. Vermont and Rhode Island had the least number of stream sites due to the fact that they had minimal stream impacts.

Finally, we hypothesized that our full dataset would include a sample from three populations that the SVAP2 would be able to distinguish between – sites representing good condition (Preserved sites), degraded condition (Proposed project sites) and trending to good condition (Completed project sites).

Preliminary Data Collection – GIS methods

Section (a) "Preliminary assessment of the stream's watershed" in "Using this protocol" describes preliminary data collection required for the SVAP2, which includes remotely sensed data collection and organization (NRCS 2009). GIS screening by TNC for Maine In-Lieu Fee (ILF) sites began with a review of the stream and watershed data available in the state. The USGS StreamStats program (USGS 2017) was used to define the watershed as it allows the drainage basin to be determined from a selected point on a stream, as opposed to the Watershed Boundary Dataset (or Hydrologic Units) which are standardized watershed boundaries determined using national criteria, and which were found in many cases to be far larger than suited the needs of this assessment. The following general steps were completed for each pre-selected field site:

1. The project watershed was created in StreamStats from either the most downstream point of a parcel purchased as part of a project or from the point of the obstruction for dam removal or fish passage projects. This point was placed as close as possible to the anticipated field assessment location.
2. Once the watershed boundaries were determined, the StreamStats basin characteristics and streamflow statistics were run in StreamStats. Of particular note in these calculations were the watershed drainage area, mean basin slope, percent storage (combined National Wetland

Inventory waterbodies and wetlands), average percent impervious area; bankfull width, depth, area, and peak 2-year and 100-year flows.

3. The StreamStats watershed boundary was downloaded and used for the remaining analysis in GIS.
4. The Nature Conservancy has developed a classification system for rivers and streams in the Northeast, referred to as the Northeast Aquatic Habitat Classification System (NAHCS, Olivero and Anderson, 2008). This system classifies rivers and streams by size, gradient, geology and buffering capacity, and temperature, which give an indication of the physical characteristics of the stream or river being studied. Looking at the stream classifications on a watershed level often produced variable classifications, depending on where in the watershed the various stream segments were located. For the purposes of SVAP2, it is more useful to confine the assessment to the reach on which the project site falls.
5. In addition to an assessment of the GIS data available, aerial photographs were used to give an overview of the conditions around the project site.
6. After doing the GIS assessment, element scores were assigned for each project site to the extent practicable. The initial scoring was done prior to the field surveys. Some adjustments, such as limiting the NAHCS screening to specific stream reaches, and evaluating wetland and riparian cover in a smaller area around the project site, would likely produce more consistent results with the field surveys. However, for element 11, Barriers to Movement, a watershed view is likely to give a fuller picture of impacts to the stream resulting from barriers outside the SVAP2 reach.

Analyses conducted by TNC-Maine for study sites in ME specifically include the following:

1. Maine has fairly in-depth data on stream barriers across most area of the state, including dams and crossings. The number and nature of any barriers identified in the watershed were noted. Since the entire watershed was being evaluated, this frequently resulted in a larger number of barriers than the field study noted.
2. The StreamStats watershed boundary was intersected with the 2011 National Land Cover Dataset (NLCD) to determine land use/land cover in the watershed. A secondary intersect was done for the 100 foot riparian buffer along the stream, to determine riparian cover types.
3. Geographic data are available for conserved lands, which was intersected with the StreamStats watershed. This, along with the land cover data gave an idea of the level of development stress within the watershed.

There are a number of elements that are difficult to assess remotely. Salinity and the location of any pools could not be determined, for example. It was possible to make approximations for most of the other elements based on a combination of the information noted above.

Additional data or information useful to preliminary data collection efforts was used where available. Maine, for example, has a number of stream datasets pertaining to water quality. The Maine Department of Environmental Protection (MEDEP) has a classification system for Maine waters (38 M.R.S. Sections 464, 465), consisting of 4 classes from highest, Class AA, applied to outstanding waters that are free-flowing and natural to lowest, Class C, for which some criteria may be of lower quality. Maine waters are also monitored for water quality criteria and categorized according to whether they attain their statutory class or have impaired uses. Water attainment data is summarized in an

"Integrated Water Quality Monitoring and Assessment Report" according to Sections 305(b) and 303(d) of the Clean Water Act.

Data on Maine water classifications and attainment status is available for use in GIS. For the Maine ILF sites, the StreamStats watershed was intersected with the classification and attainment data to determine the water quality status of the stream in question. Some of the ILF sites also had monitoring stations within the immediate watershed of the field survey site, with data and reports available online. This gave more detailed information on the water quality and impacts that might be causing impairment.

MEDEP also maintains data on what are referred to as "urban impaired watersheds" under Chapter 502 of the state's Stormwater Management Rules. None of the Maine survey sites fell within an urban impaired watershed.

A number of study sites were located in urban settings or could potentially be impaired by heavily developed areas, though were not specifically investigated as to State-specific urban-impairment ratings. Watershed condition is an important factor in determining stream condition, so further investigation of sites with specific regard to impaired urban areas or percent impervious surface upstream could provide valuable insight to stream condition. Sites at or near heavily developed areas included Biddeford (ME01, West Brook at the ice rink), Riverton (CT04, West Branch Farmington River between I-84 North-bound and Reidville Ave), Waterbury (CT03, Great Brook at Jonathan Reed Elementary School, and Dover (NH06, Berry Brook below urban impoundment). Berry Brook (NH06) site was restored to improve water quality by routing runoff from the upstream impoundment through a well-vegetated, morphologically balanced section of stream channel. This work was done in conjunction with diverting impervious surfaces from the brook through rain gardens, vegetated swales and other stormwater BMPs. This was the only site that was dry at the time of site assessment.

Pre-field Orientation and Training

As part of the field Quality Assurance Project Plan (see Appendix D) ERDC, NAE and TNC-ME conducted an orientation and training session on the first day of field testing for core team staff and cooperating UNH representatives. Training included brief review and discussion of preliminary GIS data collection methods, the SVAP2 protocol, the 16 elements (variables), field forms and other support documents, personal and field equipment, environmental health and safety measures and detailed review of the Field Schedule (NRCS, 2009, and see Appendices E, F and G).

Assessment Reach – Field Determination

Locating and determining the reach for assessment is the first step in the assessment procedure on arriving at the actual stream or site. In some cases, locating the site takes some amount of time if the precise location of a project is unknown, or a preserved or completed reach is much longer than the 12 bankfull widths required. Aerial photographs prepared as part of Office Methods above were especially useful in locating or navigating to landmarks or determining a more suitable location for a site assessment if the original site was eliminated or adjusted. See also Section (b) "Delineating the assessment reach" in "Using this Protocol" (NRCS 2009).

Regional Curves Availability and Usage

NRCS National Water Management Center (NWMC) maintains a database of published regional curves of bankfull discharge and hydraulic geometry, organized by Physiographic Province for the US (Fenneman 1946). Regional curves available through this database were consulted to calculate anticipated bankfull discharge and cross-sectional area to corroborate field estimates required to delineate field reaches if field indicators weren't clear. Most of the study area is contained in the New England Physiographic Province, 9a – 9e. Regional curves consulted for this study included Coastal and Central Maine regional curves produced by USGS (Dudley 2004), two bankfull site surveys in CT conducted by NRCS and the NWMC (Garday et al. 2001) and VT regional curves put together by VTDEC (Jaquith and Kline 2006, see Appendix C).

Photographic Log and Site Sketches

ERDC personnel took GPS-referenced photographs at each of the 35 study sites to accompany site sketches and to augment assessment and quality control of element scores that took place following field assessment (photos and site sketches where completed are stored on SharePoint, NAE, SVAP2 – All Documents, dated folders, subfolders labeled by Site ID). While there is no specific protocol included in the SVAP2 for setting up photo points per se, space is provided for Photo Point Locations and Descriptions on the second of four pages of "Exhibit 1, Summary Sheet". For the purposes of this study, most reaches are photographed from the estimated middle of the reach looking up- and downstream, with additional photographs documenting closer views of vegetation, insects, sediment, obstructions, or other items of interest such as bridges, culverts, inflows, water appearance characteristics, etc. Though a GPS-enabled camera was used for this documentation, not all photographs have an associated latitude/longitude location, due to absence of satellites or other obstructed "view" caused by valley walls or dense vegetation. For our purposes, this level of accuracy isn't strictly required, i.e., the top and bottom of each reach was GPS located and can be plotted on a map if general location of photo points are required. If there are sites for which specific locations are critical, photodocumentation would need to be fixed to a particular landmark or planned ahead, insofar as practicable, to account for visibility of satellites on the date and time of the site visit.

General Botanical Description

Species lists were not originally part of the plan as part of the SVAP2 testing protocol. However, after having completed the Maine sites, the team decided the information could prove useful for determining site trends qualitatively, as well as refining assessment of the Riparian Quality element regionally. Species lists are helpful in understanding the character of the riparian area, including the types and extent of invasive species, if any (see Appendix H). The on-the-ground data collection was a quick listing of species noted in the stream and riparian buffer by field personnel on the core team with some botanical expertise. The lists are not intended to be comprehensive, but do include the dominant species and other species noted. To ensure there are similar data for all the sites, the earlier site species lists not identified in the field were developed through examination of the photos of each site. An NAE botanist assisted in the photo interpretation and reviewed the lists to ensure the scientific names are accurate.

Field Variables – Interpretation and Implementation

This section covers all data collected in the field using field forms provided as Exhibit 1 in the SVAP2 protocol, and following the protocol as written except where specifically noted. The field forms are separated into sections, 1. Preliminary Assessment, A. Watershed Description and B. Stream/Reach Description (these are largely office-stage data collection efforts, prior to field data collection), and 2. Field Assessment, A. Preliminary Field Data and B. Element Scores (these are almost entirely collected in the field).

Preliminary Assessment – Watershed Description

Field Form page one provides space to document preliminary assessment data our team largely collected before going into the field (1. Preliminary Assessment, A. Watershed Description and B. Stream/Reach Description), so these sections in our original field forms are generally marked "see GIS data/preliminary" to indicate we have this information elsewhere, collected as part of the Preliminary Data Collection efforts led by Jensen and Bell described above. The "tributary to" and HUC is also included with the preliminary assessment; these are also most often marked "see GIS data" on field forms. Site owner name was typically known by at least one person in the field or the point of contact noted on the field itinerary was substituted. Stream name and our unique site ID code were included on all sheets to ensure all site data were appropriately organized. Evaluator names were always noted for the core team, with efforts to document the many additional site participants, though these visitors were not tasked with field data collection directly or given that responsibility in order to preserve consistency.

Field Assessment – Preliminary Field Data

Field Form page two, 2. Field Assessment, A. Preliminary Field Data, is intended for documenting meta-data about the site to gain valuable perspective from which to assess scoring for the 16 elements (Table 2). Every effort was made during this study to measure or assess and record each data point for each site, though some adjustments were made to accommodate equipment, capability, time or other constraints, noted in Table 2.

Table 2. Data fields from the Preliminary Field Data Form, page two of four of Exhibit 1 from the SVAP2 Handbook (NRCS 2009).

Variable or Data	Type or Units	Method we used	Notes
Date	One blank, page two	Wrote date on more than one page	Only one spot for date on entire 4 page form – should be written on each page
Weather conditions today	Qualitative, no guidelines	General observation of conditions	
Weather conditions past 2-5 days	# of days of precipitation and average daytime temp	When raining/rained, we checked area rain gages for depth, daytime temps were estimated	
Reach location	UTM or lat/long	Referred to GIS data	
Channel type/classification	No specific type	Used Schumm and estimated Rosgen type where possible	Schumm evolution stage is used in channel condition element

Variable or Data	Type or Units	Method we used	Notes
Riparian cover types	% each tree, shrub, herbaceous layers and bare	Experienced personnel estimated these percentages – they do not specify relative out of 100% or actual % each category on its own	This requires previous training and/or experience to do credibly
Bank profile	Check stratified or homogenous, AND cohesive or non-cohesive	Made notes where a yes/no choice was not reasonable for the entire reach	
Gradient	Low, moderate or high, in % ranges 0-2, >2-<4, >4	Estimated in the field, with lots of discussion	This is really hard to do in the field, particularly if the gradient appears to be about 2%
Bankfull channel width	Feet	Best professional judgment, using *rangefinder*, *tape* or *folding rule*, augmented by *regional curves* if necessary, also used the metric system where equipment didn't allow easy use of feet…	This parameter is critical to establish immediately as it sets the reach length – this also requires experience or regional curves or both to get right
Reach length	Feet	12 x bankfull, *rangefinder*	Per protocol, pretty clear, rangefinder would underestimate total length for sinuous reaches, leading to longer than needed – OK. For extremely small, intermittent streams or small properties, the reach can be very short – while none of this dataset contains reaches shorter than 10-12 bankfull widths in length, it's possible this could be necessary in the future – the SVAP2 advises assessing a reach as long as practicable in these cases.
Floodplain width	Feet	Variable methods initially, settled on average width as if measured out from one bank, not total width, and used *tape*, *rangefinder* or *calibrated pacing*	Not clear whether total width, or average on each side measured out from the bank, or how this should be assessed – we settled on consistency
Average riparian zone width, with method used	Feet	Variable methods initially, settled on 2x bankfull width on each side (total width would be 5 bankfull widths…) sometimes measured by *tape*, *rangefinder* or *calibrated pacing*	This variable needs additional documentation to define riparian zone… there is no "official" designated definition of riparian zone.
Average height of woody shrubs, with method used	Feet	Estimated by eye in the field by experienced personnel	This requires trained and/or experienced personnel, but did not seem to provide useful information
Floodplain wetlands	Acres	Estimated by eye in the field by experienced personnel. We eventually estimated in square feet for smaller sites;	This requires trained and/or experienced personnel, particularly if using acres in small sites. For larger sites, imagery should be used to

Variable or Data	Type or Units	Method we used	Notes
			estimate area, adding this to the preliminary data collection where wetland area can be identified
Dominant substrate	% boulder, cobble, gravel, sand, fine sediments	Checked the "dominant" category estimated by eye in the field by experienced personnel	This type of assessment can't be credibly done in the field without a pebble count or other quantitative procedure – since this number isn't used, an estimate of what comprises most of the substrate was agreed to be sufficient
Photo point locations and descriptions	#, GPS coordinates, description	Initially used back page since only three blanks provided, eventually relied on nightly download with GPS tagged on the photo, and careful organization into specific site files	This is tough to include on a data form, some sites required very few photos, some more than a dozen
Start time, end time	No unit specified	Recorded time	This should be at the top of the form, often the times would be estimated
start water temp, end water temp	No unit specified	Initially marked NA or made estimates of "cold" or "warm" – determined a *thermometer* is quick and easy and way more accurate	Temperature is used in scoring criteria (cold vs. warm water streams, Canopy Cover element), though assumed to be yearly *average* temperature. Protocol does not specify seasonally limiting temp., and there isn't a standard way to do that if assessing in winter or on an unmonitored site – may require additional research
Notes	Small unlined space	Many different notes required, lots of scribbling	Ended up using spaces in margins, etc., this will require a field form redesign.

Field Assessment – Scored Elements

Per instructions provided in the SVAP2 protocol, Field Form page two, 2. Field Assessment, B. Element Scores table was filled in following site assessment and determination of specific scores for each variable. Using laminated field forms summarizing the scoring criteria categories and scores as assigned from the SVAP2 protocol (Pruitt), the core field team conducted assessment and scoring to the protocol as closely as practicable to conform to and test the protocol as written (see Appendix G). Where deviations or eliminations were necessary, these were documented (Table 3). In some cases variables required assessments that may not have been designed for the New England setting – these too were performed to the best of the field team's ability, with the understanding these variables may require adjustment or modification per the SVAP2 protocol in order to improve the scoring system for application within NAE.

In general, most of the variables are executable by a reasonably well-experienced team, though specific areas of expertise – e.g., vegetation and insect identification, or hydrologic and geomorphic channel features and channel evolution characterization – are critical to getting these assessments as accurate and repeatable as possible, particularly since there are no specific quantitative measurements strictly required. For this study, personnel quickly self-sorted into sub-teams to increase efficiency of data collection, with a subset of one or two of the four primary staff working together on specific elements, and the team coming together at the end of each field visit to share and corroborate results.

Estimation of lengths, depths, percent cover or distribution, and temperature were conducted with measuring devices as much as possible to limit bias and subjectivity, which included 200 or 300 foot fiberglass measuring tape, laser rangefinder, folding rule or stadia rod, thermometer, densitometer, and calibrated pacing.

Table 3. Elements included in the SVAP2, with methods adjustments, deviations or eliminations, and additional comments resulting from field testing on 35 sites in New England.

Element (variable) number and name	Protocol Adjustments made in the field	Eliminated or Single Score Elements	Additional comments
1. Channel Condition	No adjustment, protocol relatively straightforward	All sites assessed	Dependent on correct Schumm CEM class ID – need better materials for this classification, particularly for constructed type I… Non-ERDC staff struggled with this, so training is needed.
2. Hydrologic Alteration	Little adjustment, protocol relatively straightforward	All sites assessed	Some disagreement about evidence of shift in regime – few sites should get a 10 unless the watershed is completely undeveloped
3. Bank Condition	Average left and right bank scores, little adjustment except to give mitigated sites higher scores even if banks are constructed – as long as ecologically functional	All sites assessed	If functioning ecologically, constructed banks should be able to get the highest scores
4. Riparian Area Quantity	Little adjustment, protocol relatively straightforward, though used measuring tape in some areas and documentation of % or extents for comparison	All sites assessed	% values and widths of gaps compared to bankfull or floodplain extent difficult to estimate by eye
5. Riparian Area Quality	Little adjustment, protocol relatively straightforward – exception was careful documentation of species to show presence or dominance of invasive species, used as an indicator in this element in % categories	All sites assessed	This element requires some knowledge and training in plant ID and estimating cover

Element (variable) number and name	Protocol Adjustments made in the field	Eliminated or Single Score Elements	Additional comments
6. Canopy Cover	First – used a thermometer to get a better temperature estimate for "cold" vs "warm" streams. Second, used a standard densitometer rather than estimating water surface shading	All sites assessed	No changes to score categories, simply increased objectivity by using real data. Some confusion about low-lying vegetation or very small streams, however. Densitometer was extremely helpful. Note temperature is highly seasonal, take this into account and use summer high temperature or other data.
7. Water Appearance	Little adjustment, protocol relatively straightforward, though had to remember dark water is natural in high tannic streams – "appropriate to site"	NH06 (Berry Brook, channel dry at time of assessment)	For these areas, protocol or element may mention the effect of tannic waters
8. Nutrient Enhancement	Little adjustment, protocol relatively straightforward	All sites assessed	Not all algal blooms or overgrowth are green, considered others as well
9. Manure or Human Waste	No adjustment, protocol relatively straightforward	Two of 35 sites scored 9 (ME07 Masse outlet stream and CT01 Still River) - remainder scored 10. Unidentified inlet pipe at ME07 & suspicious odor and unusual algae at CT01 resulted in 9s. No visible evidence for direct inputs.	We discussed recommending a different type of assessment here, or eliminating this element in areas with adequate WWTP systems and well-managed feed lots – no sites had obvious outlets or access from these sources. However, future sites may have this element, see Recommendations section for additional detail.
10. Pools	Little adjustment, protocol relatively straightforward, though added documentation of max pool depths and associated max riffle depths – deep pools are 2x deeper than upstream riffle – to form margins or notes spaces, since the total number per reach matters	NH06 (Berry Brook, channel dry at time of assessment)	This element depends on assigning the correct gradient category – this should be measured on site or taken from GIS data. Also depends on depth measurements and documentation space
11. Barriers to Movement	Little adjustment, protocol relatively straightforward, considered other native migratory species – turtles, salamanders and fish	All sites assessed	Include reference to barriers impacting other than fish species in this element

Element (variable) number and name	Protocol Adjustments made in the field	Eliminated or Single Score Elements	Additional comments
12. Fish Habitat Complexity	Little adjustment, protocol relatively straightforward, except documented the count of each habitat element required for the reach count	All sites assessed	Form needs space to document these features, as specific numbers of each are important. Also, these features bias against small streams with finer sediments – can't get as high scores without boulders and large wood, undercut banks, etc., not scaled against regional least disturbed or minimally disturbed conditions
13. Aquatic Invertebrate Habitat	As above in 12.	All sites assessed	Especially important to count the correct elements for each of these, as some features overlap and others are similar but different – also biased against small streams with fine substrate
14. Aquatic Invertebrate Community	Little adjustment, protocol relatively straightforward, with the exception of considering two species of caddis fly that are considered tolerant (see Model Assumptions section), and use of a D-net or kick-net to capture insects for sampling from the substrate rather than turning over rocks – this really worked well!	NH06 (Berry Brook, channel dry at time of assessment), CT02 (Transfer Stn, safety issues prevented direct access), CT03 (Reed School urban setting, no direct access)	Regional or local insect guides would be very helpful here, to identify the types that deviate from "typical" behavior of a given order. Additional orders may also be present that are not represented. Turning over rocks and wood is not good enough for this part of the score, and would dramatically skew taxa discovered.
15. Riffle Embeddedness	Little adjustment, protocol relatively straightforward, except this element not as doable in fine-grained settings or organic matter dominated settings	CT02 (Transfer Stn, safety issues), CT03 (Reed School urban setting, no direct access), CT06 (Naugatuck Forest, sand-bedded), VT01 (Mississiquoi, very fine sediments, no discernible riffles, bidirectional flow)	Direct access should be required for this method in unknown systems where sediment shapes are unknown. This element also favors coarse-bedded systems, so finer beds get lower scores even if it's the appropriate substrate

Element (variable) number and name	Protocol Adjustments made in the field	Eliminated or Single Score Elements	Additional comments
16. Salinity	No adjustment, protocol relatively straightforward	All sites but one scored 10, no evidence of salt problems – ME08 got a 9 primarily because the team was initially uncomfortable with giving a 10 without evidence…	Recommend carrying a meter to measure salinity, esp. if streams are near stormwater outfalls from heavily salted areas, but this effect is seasonal in this region and may represent a very minor regional impact. Additional recommended criteria in Recommendations section.

Data Reduction and Statistical Methods

The SVAP2 protocol uses an arithmetic mean (average) to combine the 16 elements, effectively giving each variable the same weight, as well as making the implicit assumption that none of the variables is related or correlated (statistically speaking) to any of the others. The average defines the "central tendency" of the data but does not provide any information to how closely "packed" or "spread out" the data are (variability). The SVAP2 dataset was subjected to descriptive statistics which characterize the diversity or "spread" within and across the 35 stream reaches, and the shape or nature of the distribution. The reason this is important is that numerous statistical analyses, including those we did for this study, require that data are distributed "normally," that is, appear as a "bell-shaped" curve with predictable qualities. Many datasets in the natural sciences are normally distributed, can be transformed or are "close enough" to allow application of descriptive and comparative statistics.

Though we don't expect strict adherence to a normal distribution, we nonetheless can apply statistical analyses specifically designed to describe how close to normal we can assume our data distributions are.

1. The simplest method of assessing variability is examining whether the central tendency of the data is the same across multiple metrics like the mean (simple average of all data points), median (50^{th} percentile) or the mode (the most frequent value).
2. Range: Range represents the difference between the highest (maximum) and the lowest (minimum) values of the data.
3. Standard Deviation: Variance accounts for the total amount of variation in the data (the average of the squared deviations from the arithmetic mean). Calculating variance is simply a way to get positive (absolute) values for the differences or "deviations", both positive and negative, between each data point and the mean. Standard deviation is the square root of the variance, basically returning variance to an average difference that makes sense – add or subtract this number from the mean to get the range of the standard deviation. This is an important number for describing normally distributed data – in a normal distribution, 65% of the datapoints will be within one standard deviation from the mean, 95% within two standard deviations, and 99% within three standard deviations.
4. Skewness and Kurtosis: These metrics address the shape of the distribution of the data as described below. Many basic statistical analyses assume normally distributed data, so we used skewness and kurtosis, two measures of departure from normality, to see how appropriate other statistical analyses are to apply to our data.

Skewness is the degree of symmetry of the distribution (NIST 2012). The most common type of skewness is to the right (positive skew value), where the tail extends out to the right. Skewness of normally distributed or symmetrical datasets should be at or near zero. Negative skewness indicates left-skewness, or a longer tail to the left. If the data has more than one mode (bi or multi-modal), this may affect the skewness sign.

Kurtosis (in our case, we are looking at "excess kurtosis" due to the calculation method Excel uses) is a measure of how spread out the distribution is, specifically with regard to the data contained in the tails. Excess kurtosis for normally distributed data should also be at or near zero. A negative kurtosis indicates there is a concentration of data points in the tails of the distribution (platykurtic or "heavy-tailed" distribution); a positive kurtosis indicates a concentration of data points toward the center of the distribution (leptokurtic or "light-tailed" distribution).

Once we test for normality, we then compared the samples using different measures (descriptions below). Once assumptions of normality are confirmed to our satisfaction, we can look at the data visually with total range, mean and standard deviation to get an initial interpretation of whether we can distinguish between three populations. We can also compare the mean value of each group with each of the others to determine if the sample sets are from different populations. If our sample datasets represent three different populations, we should expect our analysis to show that it is unlikely they are all from the same population.

The t-test is a statistic used to compare the difference between the mean value of two populations, here we use it to test whether the difference between the sample means is zero, that is, if the samples are from the same population, the sample means should be statistically indistinguishable. If this is the result, the SVAP2 did not distinguish between the three populations as we hypothesize.

Use of an independent pooled t-test assumes the datasets are independent from each other, that the data are normally distributed, and that the variances are roughly equal. The t-statistic we calculate for each comparison is then compared with a critical value of the statistic based on the combined degrees of freedom and the confidence level at which we want to assess the probability that our populations are actually the same. Degrees of freedom is calculated from the sample sizes, i.e., the number of streams in each sample, or 11, 11 and 13 for our three datasets. If we want to be 95% confident in the result, we set the confidence level, α, at 5% or 0.05. Because we want to assess the difference in sample means in both positive and negative directions (one mean could be either higher or lower than the other), we have to split our confidence level between each tail of the distribution – 2.5% each.

For additional descriptions of statistical concepts and formulas or reference values used, refer to the following web resources were accessed: Berman 2018; Penn State 2018; Frontline Systems, Inc., 2018; and NIST 2012 (see References Cited).

RESULTS

Summary Element Scores with Descriptive Statistics

The 35 sample sites as a whole were subjected to general descriptive statistics, as described above in Section 3.10, to look at the behavior of the 16 individual element scores throughout the dataset and the total scores as a whole (Table 4). Based on skewness (with departure from zero indicating non-normal distribution), hydrologic alteration, manure or human waste, pools, barriers and salinity are the least normally distributed variables among the elements, the remainder of elements we can assume are reasonably normally distributed. With the exception of hydrologic alteration, manure or human waste and salinity, most elements showed kurtosis near zero, also indicating relatively normally distributed data. We can reasonably assume most variables and especially the overall score are normally distributed according to our analysis, having near-zero skewness and kurtosis, so should be robust to other analyses.

Table 4. Element scores, total site scores, and descriptive statistics for 35 stream sites in New England. Sites listed in alphabetical order by Map ID.

Station Field ID	OVERALL SCORE	Element Count	Channel Condition	Hydrologic Alteration	Bank Condition	Riparian Quantity	Riparian Quality	Canopy Cover	Water Appearance	Nutrient Enrichment	Manure or Human Waste	Pools	Barriers	Fish Habitat Complexity	Aquatic Invert. Habitat	Aquatic Invert. Community	Riffle Embed.	Salinity
CT01	5.9	15	4	8	8	3	1	9	6	3	9	6	10	6	6	4	1	10
CT02	4.9	14	4	2	7	7	4	6	0	2	10	0	10	2	4	NA	NA	10
CT03	5.4	15	8	10	2	1	2	2	10	10	10	2	0	2	6	NA	1	10
CT04	5.8	16	8	8	5	0	0	0	8	5	10	10	10	4	3	1	10	10
CT05	8.6	16	6	10	8	10	9	10	10	9	10	10	4	9	6	8	8	10
CT06	8.2	15	3	8	9	10	5	10	9	10	10	10	10	5	6	8	NA	10
CT09	4.1	16	0	3	5	5	4	2	3	5	10	1	7	3	5	3	0	10
CT10	7.0	16	2	9	5	6	4	10	10	9	10	9	10	5	7	4	2	10
MA02	8.7	16	8	10	9	9.5	6	10	9	10	10	10	7	10	9	4	8	10
MA03	9.4	16	10	10	10	10	7	10	10	10	10	10	10	10	9	7	7	10
MA04	6.7	16	5	10	4	6	2.5	4	6	5	10	7	10	9	9	6	3	10
MA05	6.8	16	4	10	6	5	5	10	6	7	10	6	10	4	7	4	5	10
MA06	7.8	16	10	10	10	9	5	0	8	5	10	8	10	9	10	6	4	10
ME01	5.8	16	4	9	4	2.5	5	4	7	5	10	8	10	6	6	1	1	10
ME02	9.0	16	10	10	10	10	10	10	7	7	10	7	8	10	9	7	9	10
ME04	5.6	15	6	9	3	3	5.5	4	2	5	10	1	10	5	6	4	NA	10
ME05	6.4	15	7	10	8	10	5	2	5	6	10	1	10	4	3	5	NA	10
ME06	6.3	16	6	8	6	4	3	4	6	8	10	8	0	8	7	4	9	10
ME06.5	3.6	16	0	1	7	1	6	1	6	3	10	0	0	3	4	2	0	10
ME07	5.3	16	6	7	3	1	4	1	6	3	9	8	0	7	8	7	5	10
ME08	9.3	16	10	10	10	10	10	10	9	9	10	9	10	10	8	7	8	9
ME09	6.5	16	5	7	4	1	4	1	7	8	10	8	8	7	7	9	8	10
NH02	7.2	16	3	10	8	10	5	4	10	10	10	5	10	5	6	7	2	10
NH03	7.5	16	4	10	6	8	7.5	4	9	8	10	8	10	9	6	7	4	10
NH04	7.0	16	8	10	7	9.5	5	3	7	9	10	5	10	6	6	4	2	10
NH05	7.1	16	3	9	7	9	5	6	9	7	10	7	10	7	7	5	2	10

Station Field ID	OVERALL SCORE	Element Count	Channel Condition	Hydrologic Alteration	Bank Condition	Riparian Quantity	Riparian Quality	Canopy Cover	Water Appearance	Nutrient Enrichment	Manure or Human Waste	Pools	Barriers	Fish Habitat Complexity	Aquatic Invert. Habitat	Aquatic Invert. Community	Riffle Embed.	Salinity
NH06	7.1	13	10	4	10	10	7	4	NA	9	10	NA	7	3	4	NA	4	10
RI01	9.4	16	10	10	10	10	10	10	10	10	10	10	10	10	9	6	6	10
RI02	7.8	16	8	9	10	10	8	9	7	9	10	8	10	5	6	4	2	10
VT01	8.5	15	10	10	10	10	10	6	10	7	10	8	10	6	6	4	NA	10
VT02	6.4	16	4	9	4	3.5	4	7	7	8	10	8	10	7	7	4	0	10
VT03	8.0	16	4	10	7	5	7	4	10	9	10	10	10	8	8	10	6	10
VT04	7.8	16	4	10	6	3.5	6	5	10	8	10	10	10	9	9	9	6	10
VT05	8.0	16	8	9	9	10	8	6	5	5	10	10	10	8	8	3	9	10
VT06	6.8	16	4	10	4	10	8	4	10	7	10	8	0	7	7	8	1	10
# Samples	**35**	NA	35	35	35	35	35	35	34	35	35	34	35	35	35	32	30	35
Min	**3.6**	13	0	2	2	0	0	0	0	2	9	0	0	2	3	1	0	9
Max	**9.4**	16	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Mean	**7.0**	NA	6.7	8.5	6.9	6.6	5.6	5.5	8.0	7.1	9.9	7.5	8.0	6.5	6.7	6.0	5.1	10.0
Median	**7.0**	NA	6	10	7	8	5	4	7.5	8	10	8	10	7	7	5	4	10
Mode	**7.8**	NA	4	10	10	10	5	10	10	5	10	8	10	9	6	4	2	10
Standard Deviation	**1.5**	NA	5.6	2.4	2.5	3.5	2.5	3.4	5.2	2.4	0.2	5.6	3.6	2.5	1.8	5.2	5.6	0.2
Skewness	**-0.28**	NA	-0.07	-2.07	-0.21	-0.50	0.03	0.11	-1.09	-0.55	-3.99	-1.12	-1.69	-0.2	-0.3	0.0	0.2	-5.9
Kurtosis	**-0.27**	NA	-0.83	3.57	-1.14	-1.33	-0.22	-1.31	1.22	-0.75	14.75	0.08	1.31	-1.1	-0.3	-0.6	-1.4	35.0

General Site Similarities/Dissimilarities

A simple plot of the data showing individual scores on the y-axis and associated average score for each site on the x-axis, including simple linear regression for each relationship, shows the degree of correlation of each variable with the overall score (Figure 2). In other words, how much influence does each variable have on the final score or how well does each element correspond with the overall stream condition at each site. Salinity and Waste elements have no relationship to overall condition as all were 9 or 10. Note ME08 scores 9 in Salinity primarily because the field team was not sure whether a 10 was ever warranted. The high quality of sites with reference to this element became quickly evident, so all subsequent sites scored 10. For the purposes of this study we did not go back to alter that score. All other variables show a positive relationship to the overall score, where higher values of the element generally correspond with higher overall score. Riparian Quantity has the steepest slope which means Riparian Quantity score increases fastest with increasing overall score and Aquatic Insect Habitat has the flattest slope, which indicates very little increase in that element with overall score and that this element is relatively constant for all sites compared with the other elements. However, correlation coefficients (R^2) are generally low, showing poor relationships between individual element scores and the overall score. This indicates that while individual element scores generally correspond with increasing overall condition as we expect they should, each element score should not be considered indicative of stream condition on its own. None of the individual variables singlehandedly drives the overall score. This is important, because it's the combination of biotic and abiotic variables required by the SVAP2 that determines overall stream condition.

To add detail and interpretation to our visual analysis of the plotted data points, our hypothesized populations are represented by colored brackets below the x-axis in Figure 2, showing total range (bracket), mean (point of the bracket) and standard deviation (double arrow extends +/- one standard deviation from the mean). Total range of scores with for proposed project sites is 3.4 to 7.8 (in red), for completed project sites is 5.4 to 8.0 (in yellow), and for preserved sites is 7.2 to 9.4 (in green).

Figure 2. SVAP2 element score vs. overall score for 35 stream sites. Linear regression shows most individual elements are positively correlated with overall score (excepting Salinity and Waste). Brackets delineate range, mean and one standard deviation for the three site types – Proposed project, Completed project and Preserved site.

Separating and assessing the sample dataset for each of three populations – Completed Projects, Preserved Sites and Proposed Sites – can help us assess differences between each population and the extent to which the SVAP2 can distinguish between them for mitigation program application (Table 5). Average raw scores for 11 mitigated or completed project sites of varying age is 7.0 (high "fair" condition), for 11 preserved sites in low impacted condition is 8.6 (high "good" condition) and for 13 proposed project sites and three sites in higher impacted condition is 5.8 (mid "fair" condition).

Table 5. Summary scores and selected descriptive statistics for samples from our hypothesized three populations.

Completed Projects Through 2015				**Preserved/Natural Sites**				**Proposed Project Sites**			
Site ID	*Raw Total*	*Elements Scored*	*Overall Score*	*Site ID*	*Raw Total*	*Elements Scored*	*Overall Score*	*Site ID*	*Raw Total*	*Elements Scored*	*Overall Score*
CT03	76	14	5.4	NH02	115	16	7.2	ME06.5	54	16	3.6
ME05	96	15	6.4	VT04	125.5	16	7.8	CT09	66	16	4.1
MA04	106.5	16	6.7	VT05	128	16	8.0	CT02	68	14	4.9
VT06	108	16	6.8	CT06	123	15	8.2	ME07	85	16	5.3
MA05	109	16	6.8	VT01	127	15	8.5	ME04	83.5	15	5.6
NH04	111.5	16	7.0	CT05	137	16	8.6	CT04	92	16	5.8

Completed Projects Through 2015				**Preserved/Natural Sites**				**Proposed Project Sites**			
NH06	92	14	7.1	MA02	139.5	16	8.7	ME01	97.5	16	5.8
NH05	113	16	7.1	ME02	144	16	9.0	CT01	95	16	5.9
NH03	120.5	16	7.5	ME08	149	16	9.3	ME06	101	16	6.3
RI02	125	16	7.8	MA03	150	16	9.4	VT02	102.5	16	6.4
VT03	128	16	8.0	RI01	151	16	9.4	ME09	104	16	6.5
								CT10	117	16	7.0
								MA06	124	16	7.8
Average of 11 Completed Projects Score			7.0	Average of 11 Preserved Sites Score			8.6	Average of 13 Proposed Projects Score			5.8
Standard Deviation			0.71	Standard Deviation			0.71	Standard Deviation			1.13
Skewness			-0.75	Skewness			-0.48	Skewness			-0.31
Kurtosis			1.60	Kurtosis			-0.44	Kurtosis			0.21
Normally Distributed?			Yes	Normally Distributed?			Yes	Normally Distributed?			Yes

Assuming normally distributed data (near zero skewness and kurtosis), independent samples, and equivalent variance (neither standard deviation is more than twice the other), we can calculate the pooled t-statistic for each pair comparison, define the critical t-statistic for our chosen significance level, and compare our calculated t-statistic with the critical value (Table 6). If our calculated value is more extreme, either greater than the positive value or less than the negative value (critical values are given as positive but apply to either tail), then the likelihood that our samples are from the same population (our null hypothesis) is lower than the confidence limit. In this case, our t values are more extreme than the critical 2-tailed value at $\alpha = 0.05$, so we can reject the null hypothesis – our original test hypothesis that the populations are the same.

So, it is unlikely enough that the populations are the same that we can judge the sample sets to represent different populations. In other words, according to this t-test analysis, the SVAP2 works to distinguish between the three types of site in our dataset!

Table 6. Summary pooled t-statistic calculations and comparisons with critical values, with determination whether to reject the null hypothesis which states the three sample sets come from the same population (i.e., the SVAP2 overall score cannot distinguish between Completed Projects, Preserved Sites or Proposed Project sites).

Comparison Pairs	**Std dev. pooled**	**Degrees of Freedom**	**Calculated t-statistic, pooled**	**Critical t-statistic value for 2 tails, α = 0.05**	**Is our calculated t-statistic more extreme than critical value?**
Completed Projects vs. Preserved Sites	0.71	20	-5.27	+/- 2.086	Yes – reject null hypothesis
Preserved Sites vs. Proposed Projects	0.96	22	7.06	+/- 2.228	Yes – reject null hypothesis
Completed Projects vs. Proposed Projects	0.96	22	3.03	+/- 2.228	Yes – reject null hypothesis

Additional Analysis – Relationships between Elements

Significant correlations were determined based on linear regression analysis (F-test, $p < 0.05$, Table 7). In this case, the F-test for linear regression tested whether the correspondence between any of the SVAP2 variables was significant. Consequently, if the p-value of the F-Test was less than 0.05, the relationship between those SVAP2 variables was significant (Table 7). The values of each of the variables were subjected to Spearman's r correlation and tabulated in a product matrix (Table 8). Spearman's r is a measure of the strength of the relationship between the variables. Consequently, in sequence, first the significance of the relationship between variables is determined (F-Test, Table 7) followed by the strength of the relationship between those significant variables (Spearman's r, Table 8). Overall, this statistical treatise of the data improves the confidence in the SVAP2 variable interdependency (Table 9).

Channel condition and hydrologic alteration had the largest influence (direct effects) on eleven of the other variables (see Table 9). The status of bank condition and pools also influenced several stream variables including riparian zone quantity and quality, canopy cover, fish habitat complexity, benthic macroinvertebrate habitat and community, and riffle embeddedness. No significant correlations were observed between salinity and other variables.

Table 7. Regression analysis using F-Test (p<0.05), significant regressions highlighted.

VARIABLE		Channel	Hydrologic	Bank	Riparian		Canopy	Water	Nutrient	Cattle		Barriers to	Fish Habitat	Aquatic Invertebrate		Riffle	
		Condition	Alteration	Condition	Quantity	Quality	Cover	Appearance	Enrichment	Access	Pools	Movement	Complexity	Habitat	Community	Embedded	Salinity
	Symbol	CC	HA	BC	RQuan	RQual	CAN	WA	NE	CA	P	BTM	FISH	BMH	BMC	EMB	SAL
Channel Condition		1.0000															
Hydrologic Alteration		0.0141	1.0000														
Bank Condition		0.0019	0.6056	1.0000													
Riparian	Quantity	0.0149	0.0551	0.0000	1.0000												
	Quality	0.0186	0.1581	0.0002	0.0000	1.0000											
Canopy Cover		0.2899	0.0686	0.0030	0.0027	0.0071	1.0000										
Water Appearance		0.6952	0.0000	0.5648	0.3439	0.1626	0.1364	1.0000									
Nutrient Enrichment		0.1298	0.0015	0.1067	0.0090	0.0346	0.0112	0.0003	1.0000								
Cattle Access		0.9842	0.5357	0.4199	0.0549	0.0688	0.8391	0.5161	0.0082	1.0000							
Pools		0.1924	0.0001	0.2670	0.3276	0.1641	0.0171	0.0000	0.0213	0.9143	1.0000						
Barriers to Movement		0.4569	0.0925	0.0346	0.0715	0.6235	0.0698	0.9547	0.5918	0.2226	0.2477	1.0000					
Fish Habitat Complexity		0.0249	0.0002	0.0661	0.0458	0.0048	0.0338	0.0024	0.0802	0.9934	0.0000	0.4082	1.0000				
BMI	Habitat	0.0939	0.0009	0.3595	0.2468	0.0712	0.0481	0.0074	0.1153	0.8012	0.0001	0.6099	0.0000	1.0000			
	Community	0.8309	0.0039	0.4644	0.1532	0.0310	0.2886	0.0007	0.0431	0.7578	0.0005	0.6297	0.0000	0.0005	1.0000		
Riffle Embeddedness		0.0054	0.1125	0.1549	0.7798	0.2414	0.3379	0.1931	0.1555	0.7277	0.0003	0.8349	0.0001	0.0106	0.0809	1.0000	
Salinity		0.1555	0.5467	0.2033	0.3439	0.0793	0.1828	0.5322	0.4315	0.8097	0.5051	0.5837	0.1564	0.4616	0.4376	0.2073	1.0000

Table 8. Spearman's r correlation coefficients, significant correlations highlighted and correspond to F-Test results in Table 7.

VARIABLE		Channel	Hydrologic	Bank	Riparian		Canopy	Water	Nutrient	Cattle		Barriers to	Fish Habitat	Aquatic Invertebrate		Riffle	
		Condition	Alteration	Condition	Quantity	Quality	Cover	Appearance	Enrichment	Access	Pools	Movement	Complexity	Habitat	Community	Embedded	Salinity
	Symbol	CC	HA	BC	RQuan	RQual	CAN	WA	NE	CA	P	BTM	FISH	BMH	BMC	EMB	SAL
Channel Condition		1.0000															
Hydrologic Alteration		0.4099	1.0000														
Bank Condition		0.5202	0.0938	1.0000													
Riparian	Quantity	0.3972	0.3256	0.7823	1.0000												
	Quality	0.3823	0.2443	0.6574	0.6608	1.0000											
Canopy Cover		0.1869	0.3240	0.4830	0.5418	0.5412	1.0000										
Water Appearance		0.0697	0.6641	0.1076	0.1537	0.2287	0.2764	1.0000									
Nutrient Enrichment		0.2650	0.5298	0.3178	0.4058	0.2884	0.5114	0.5822	1.0000								
Cattle Access		-0.0035	0.1129	0.2736	0.2872	0.1296	0.2276	0.0817	0.3314	1.0000							
Pools		0.2229	0.6149	0.1967	0.1664	0.2410	0.4145	0.7054	0.3953	-0.0638	1.0000						
Barriers to Movement		0.1423	0.2941	0.3534	0.3324	0.1237	0.2991	-0.0024	0.1300	0.3897	0.2055	1.0000					
Fish Habitat Complexity		0.3771	0.5878	0.3181	0.3390	0.4796	0.3725	0.4958	0.3035	-0.0331	0.7340	0.1486	1.0000				
BMI	Habitat	0.2824	0.5351	0.1659	0.1926	0.3038	0.3551	0.4419	0.2638	-0.1270	0.6177	0.0964	0.8119	1.0000			
	Community	-0.0446	0.4742	0.1332	0.2402	0.3659	0.1989	0.5434	0.3425	-0.1341	0.5557	0.0908	0.6550	0.5529	1.0000		
Riffle Embeddedness		0.4515	0.2704	0.2609	0.0233	0.1668	0.1986	0.2167	0.2127	-0.0582	0.5772	-0.0228	0.6053	0.4221	0.2940	1.0000	
Salinity		-0.2437	-0.1044	-0.2235	-0.1623	-0.3075	-0.2398	-0.1073	-0.1348	-0.0303	-0.1155	-0.0992	-0.2440	-0.1270	-0.1341	-0.2166	1.0000

Table 9. Direct correlations between most significant model variables.

Channel Condition ~ Hydrologic Alteration, Bank Condition, Riparian Quantity and Quality, Fish Habitat Complexity, Riffle Embeddedness
Habitat Alteration ~ Water Appearance, Nutrient Enrichment, Pools, Fish Habitat Complexity, Benthic Macroinvertebrate Habitat and Community
Bank Condition ~ Riparian Quantity and Quality, Canopy Cover, Barriers to Movement
Pools ~ Fish Habitat Complexity, Benthic Macroinvertebrate Habitat and Community, Riffle Embeddedness

RECOMMENDATIONS

The SVAP2 provides instructions for modification of the method to enable better alignment with regional conditions by calibrating elements and scoring categories if needed, summarized below (NRCS 2009, see Appendix C). Either individual elements may be modified, or the narrative descriptions and rating scales may be adjusted. This process generally requires a deliberate and formalized approach, convening an interdisciplinary team, assessing a range of sites evaluated by an independent method as well as using the SVAP2, and evaluating the protocol through an eight-step process to determine whether or not the protocol requires revision. This system results in a statistically defensible rationale for adjusting elements or scoring criteria that result in real changes in responsiveness of different classes of sites that represent selected populations. Alternatively, stepping through this process with the scoring system as written can illuminate areas of concern or verify that the protocol can be applied satisfactorily.

Modifications to the protocol should be very carefully considered, if comparisons with previous or future assessments or between sites or dates, are required. Substantial changes to elements or breakpoints can complicate assessing trends or program scores regionally, as well as for individual project sites requiring regular monitoring over time. Eliminating selected variables if access, safety or other legitimate limitations prevent it, is justifiable and provision is explicitly made to allow dropping out certain elements for documentable reasons. However, this sets up a situation where comparisons should be made cautiously and future monitoring handled carefully.

Importantly – whether or not there are modifications suggested by the process described below, the NAE may consider setting up a process by which future modifications might be made, particularly as additional sites are added to the existing database. In particular, this final step recommends that practitioners be encouraged to find and assess additional least impacted or minimally disturbed sites to set that end of the scoring criteria for better comparison and interpretation. This strategy has other benefits, including fixing a benchmark for comparison with the trajectory of Mitigated sites to ensure these projects are adjusting in the direction of the appropriate regional reference condition. Additionally, these sites can be documented in more detail for design parameters, such as slope, sinuosity, geomorphic feature dimensions (pool, riffle, run and glide widths, depths, slopes, etc.) and target riparian community species and structure.

SVAP2 Protocol Requirements for Modification

Step 1.
Determine the number of different versions desired – one for each state, each ecoregion, etc. For NAE, a single Protocol would be desired to cover the entire New England region.

Step 2.
Develop a tentative stream classification. Suggestions include ecoregion, State, stream order, elevation, and the like. For NAE, possible classification could be based on the populations

discussed and used in selecting study sites – a "Project" type classification. In other words, Completed Project, Planned or Proposed Project, and Preserved Site or No Project. However, sites in the NAE study set are not necessarily in a low impact or good condition if in the No Project category, nor are they necessarily in a high impact or poor condition if in the Proposed Project category.

Step 3.
Assess sites. They recommend at least 10 per class, and a full range of impacted to non-impacted reaches, assessed preferably using another evaluation method for comparison, and to make sure site assessments are well-documented as to particular elements that might be difficult to score or other factors that may be influential in classification. In this project case, we have a good number of sites per designated class, but it's unclear whether the "classes" are distinct enough across the region.

Step 4.
Rank the sites from most to least impacted – preferably this is done using an independent assessment method for best results, though can be done using SVAP2 results.

Step 5.
Display scoring data for all element scores for each site, with sites arranged by ranking.

Step 6.
Evaluate responsiveness. A few questions are asked at this stage in our analyses, including how responsive the scores are to the condition gradient (from most to least impacted), whether individual element scores respond to key resource problems, and whether users of the protocol are comfortable with all the elements. If the answer to all these questions is yes, the protocol probably doesn't need to be changed. However, in the case of the NAE region, it's possible some changes need to be made, specifically with regard to modifying Salinity and Manure or Human Waste elements.

Step 7.
Evaluate the narrative rating breakpoints related to other assessments of condition. In this step, the SVAP2 breakpoints for individual elements and the overall score could be compared with other assessment methods. For the current study, this isn't strictly possible, but is qualitatively approached with what is known about these sites and best professional judgment. One suggestion in the protocol is to use the least impacted sites to set the break point for the "excellent" category, and use judgement to set the other breakpoints, indicating this approach might be applicable to the sites in the NAE study.

Step 8.
Evaluate tentative classification system. At this final step, the chosen classification system – in the NAE case, our three types of Project state – the team goes back to Step 4 and displays the information for each class, repeating the ranking, displaying, evaluating etc. through Step 7 to

determine how the classes fare against the entire data set, and whether each class is significantly different in responsiveness from the entire dataset, or whether the breakpoints appear to be different from the entire dataset. If this is the case, a revised protocol is warranted, otherwise the single system as it stands is sufficient. In the case of this study, minor but important modifications are warranted, described below.

Individual Variables – Modification Recommendations

Section 614.04, Using this Protocol, paragraph (c) *Scoring the elements of the Stream Visual Assessment Protocol*, states (emphasis added) "Some of the 16 elements, for example, salinity, may not be relevant to the stream being assessed. Score only those elements *appropriate to the ecological setting of the stream*. Livestock or human waste should be scored in all reach assessments." Interestingly, this statement addresses the two elements that are of most concern with regard to impact on final scores and relevance to types of sites encountered in New England and especially in the current dataset under study. The only two variables in the SVAP2 that have near zero relationship with overall score are Salinity and Manure and Human Waste categories, consistently evaluated at 9 or 10 (see Figure 2).

To the extent practicable, all variables should be monitored to preserve the statistical power of the overall scoring system and add to the database of site information, as well as to maximize comparability of scored sites in future monitoring efforts, particularly at sites in the Mitigation Program. This should be an explicitly stated requirement in application of this method, particularly for Regulatory purposes, with clear rationale provided in legitimate cases where one or more variables cannot be assessed.

A Special Note on Salinity in New England

Though not explicitly stated as such, the SVAP2 is implicitly designed for assessment of small freshwater streams, stating "This protocol is developed for relatively small streams, be they perennial or intermittent. If the stream can be sampled during low flow or seasonally wet periods of the year without a boat [i.e., they are wadeable], it can be assessed using the SVAP." The assumption is that most wadeable streams are not located in saline or brackish environments. This is implicit in the construction of elements and scoring criteria such as riparian vegetation focused on salt-intolerant species, macro-invertebrate species that are suited only or primarily to freshwater environments, and most importantly the Salinity element itself, which calls out only negative impacts of saline waters as visible indicators of degraded stream condition. Therefore, this particular system should not be used in any stream with a tidal or saltwater influence, either known or expected, present or anticipated. As noted above, New England possesses over 6,000 miles of coastline, with numerous streams emptying to the Atlantic, most of which are heavily managed, and many of which will be specifically considered at some time within the Corps Regulatory Program. In these cases, the SVAP2 is not the right tool for assessment of stream condition or for comparison with other sites.

Sensitivity of Overall Score to High Individual Element Scores

There is some concern regarding the potential for inappropriately raising overall scores of sites that, aside from Salinity or Waste impacts, are in a degraded condition. Because the scoring system is only batched into general condition categories after final score is calculated, the number is the critical piece of information about site condition rather than the precise category. For example, there is not any real statistical difference between a site scoring 4.9 (Poor) and 5.0 (Fair); these are semantic distinctions. However, subtracting a high scoring element from an otherwise low scoring site can decrease the overall score significantly, whereas subtracting a high scoring element from an otherwise high scoring site may not change the score by more than a tenth or two in the final score (Table 10). In this event, not only are the categories changing for some marginal sites, but the overall effect of the high scoring variables is greater for low scoring sites. Testing out this scenario on our dataset to look at how sensitive the overall score is to one or two high individual element scores, we can see this effect, which is exaggerated if other elements were not sampled (e.g., if all 16 were assessed vs. 14, the removal of two elements naturally has a greater numerical impact).

Table 10. Sensitivity of overall score to high Salinity and Waste scores. Overall score is shown with associated "condition category" from the SVAP2. Salinity and Waste elements are both removed and corresponding scores, condition and the score difference is shown. The final column shows the score difference if only Salinity is removed. Sites are ranked low to high.

	Original Scores *Including* Salinity and Waste Elements			Original Scores *Excluding* Salinity and Waste Elements					
Station ID	**Element Count**	**Overall Score**	**Condition Category**	**Element Count**	**Overall Score**	**Condition Category**	**Score Difference**	**Overall Score w/o Salinity**	**Score Difference**
ME06.5	16	3.6	Poor	14	2.6	Severely Degraded	1.0	3.1	0.5
CT09	16	4.1	Poor	14	3.3	Poor	0.8	3.7	0.4
CT02	14	4.9	Poor	12	4.0	Poor	0.9	4.5	0.4
ME07	16	5.3	Fair	14	4.7	Poor	0.6	5.0	0.3
CT03	14	5.4	Fair	12	4.7	Poor	0.7	5.1	0.3
ME04	15	5.6	Fair	13	4.9	Poor	0.7	5.3	0.3
CT04	16	5.8	Fair	14	5.1	Fair	0.6	5.5	0.3
ME01	16	5.8	Fair	14	5.2	Fair	0.6	5.5	0.3
CT01	16	5.9	Fair	14	5.4	Fair	0.5	5.6	0.3
ME06	16	6.3	Fair	14	5.8	Fair	0.5	6.1	0.2
MEO5	15	6.4	Fair	13	5.8	Fair	0.6	6.1	0.3
VT02	16	6.4	Fair	14	5.9	Fair	0.5	6.2	0.2
ME09	16	6.5	Fair	14	6.0	Fair	0.5	6.3	0.2
MA04	16	6.7	Fair	14	6.2	Fair	0.5	6.4	0.2
VT06	16	6.8	Fair	14	6.3	Fair	0.5	6.5	0.2
MA05	16	6.8	Fair	14	6.4	Fair	0.4	6.6	0.2
NH04	16	7.0	Good	14	6.5	Fair	0.5	6.8	0.2
CT10	16	7.0	Good	14	6.6	Fair	0.4	6.8	0.2
NH05	16	7.1	Good	14	6.6	Fair	0.4	6.9	0.2
NH06	14	7.1	Good	12	6.5	Fair	0.6	6.8	0.2
NH02	16	7.2	Good	14	6.8	Fair	0.4	7.0	0.2
NH03	16	7.5	Good	14	7.2	Good	0.4	7.4	0.2
MA06	16	7.8	Good	14	7.4	Good	0.3	7.6	0.2
RI02	16	7.8	Good	14	7.5	Good	0.3	7.7	0.1
VT04	16	7.8	Good	14	7.5	Good	0.3	7.7	0.1
VT03	16	8.0	Good	14	7.7	Good	0.3	7.9	0.1
VT05	16	8.0	Good	14	7.7	Good	0.3	7.9	0.1
CT06	15	8.2	Good	13	7.9	Good	0.3	8.1	0.1
VT01	15	8.5	Good	13	8.2	Good	0.2	8.4	0.1
CT05	16	8.6	Good	14	8.4	Good	0.2	8.5	0.1
MA02	16	8.7	Good	14	8.5	Good	0.2	8.6	0.1
ME02	16	9.0	Excellent	14	8.9	Good	0.1	8.9	0.1
ME08	16	9.3	Excellent	14	9.3	Excellent	0.0	9.3	0.0
MA03	16	9.4	Excellent	14	9.3	Excellent	0.1	9.3	0.0
RI01	16	9.4	Excellent	14	9.4	Excellent	0.1	9.4	0.0

Each of the 16 elements on average represents 6.25% of the total score, or up to +/- 0.6 of the overall score for the site, depending on the element score and the overall score. Depending on the designated use of the SVAP2, deciding to include or exclude Salinity and Waste elements if they are always scored a 9 or 10 can result in artificially (or unrealistically) elevating a very low score, but will have very little impact on very high scores, from zero difference in the highest scoring sites to an entire point (10%) in the lowest scoring sites. Assuming the Waste element must be scored per the SVAP2 protocol, the effect is cut in half (see the final column in Table 10). If the intent of the index is to evaluate priority for restoration of degraded sites with very low score, or potentially comparing a change in severely degraded condition as a result of restoration intervention, these elements could be removed from scoring to allow direct comparison without "artificial" elevation of condition score by two elements that always score high, such that the actual point value of increase or decrease in condition can be more accurately assessed. However, once the site is restored to the Good range (7 to 8.9), the effect of subtracting these elements decreases. Nonetheless, in all cases, removal of one or more elements from assessment must be justified, and sites evaluated for priority or other comparison purposes should all include the same elements.

Ultimately, two factors argue for keeping these two elements in the system as planned for use in NAE mitigation assessments. First, and less influential, is that the intent of the index as written is to assess changes or differences between sites in addition to actual condition. The most frequent use of the index will be in comparing between sites or between the same site at a different time rather than assessing an absolute condition, arguing for keeping all elements to the extent practicable. However, the protocol allows explicitly for eliminating elements if or as necessary if not appropriate to the setting, while recommending that the Waste element be included at all sites, "Livestock or human waste should be scored in all reach assessments." (NRCS 2009)

In the event that assessing condition is necessary for prioritization of mitigation actions or permitting impacts without mitigation, the otherwise artificial lift associated with inclusion of Salinity could mask the true level of degradation. However, Table 10 suggests that this impact difference at most is unlikely to cause a site to be re-categorized to such an extent to make the difference in whether to require mitigation of a disturbed site. Adding half a point out of ten in the worst sites is unlikely to elevate the overall score to anything approaching mitigation if enough element scores are at or near zero.

Second and more importantly, the fact that there are sites within the NAE site universe that may have impaired salinity or waste elements indicates that sites that are not degraded in this specific way are in fact functioning at a higher level even if other elements are degraded. If, for example, NAE personnel must monitor sites in the future that have direct cattle access, failing septic systems or broken sewer mains, or are associated with stormwater outfalls from a sand and salt storage area or animal waste outlets, or are downstream from heavily irrigated lands, these elements may prove important in comparing overall scores with the current dataset or other similar sites without such resource issues.

Additionally, these elements as they might occur in New England (e.g., below road sites, bridge crossings, heavily paved areas or agricultural outfalls) might be addressed by mitigation or restoration (e.g., rerouting or treating runoff, installing bioremediation BMPs, purchasing bridge cleaning equipment) such that they can be seen and assessed as point sources. In other words, the level of risk should be, in many cases, readily discernible. As such, a lower scoring site will show an appropriately low score and, if these elements are low, an appropriate lift if they are addressed. If sites are assessed to determine restoration priority, the effect of a lower Salinity or Waste score will also appropriately elevate restoration lift potential if included and compared to other sites that do not have this impairment. The effects of including or excluding Salinity and Waste elements are substantially (though not wholly) confined to the Severely Degraded, Poor and Fair categories, which would be those vying for restoration priority or to set compensatory mitigation targets. In this way, including the variables in a site without these impairments may seem to unfairly reward an otherwise poorly functioning site, reducing the amount of restoration that might otherwise be required by comparison. On the other hand, including an element only when its impaired might create legitimate questions about the use and interpretation of the SVAP2 overall.

Individual Element Discussion and Recommendations

Specific recommendations and discussion of these two elements, plus additional minor modifications to selected elements are summarized in the following sections. Manure and Human Waste, and Salinity, are presented first; remaining elements are in no particular order.

Manure and Human Waste (Element 9)

As noted above, selected elements may be eliminated if not appropriate to the setting. However, in addition to directing that "Livestock or human waste should be scored in all reach assessments," (NRCS 2009). The Manure or Human Waste Presence element section of the SVAP2 goes further, stating "*Score this element on the entire property and all properties where SVAP2 is completed*." This clearly indicates this element is an important one in assessing stream condition, particularly having been included in the SVAP relating more to livestock, and revised in the SVAP2 including human waste, and meeting the statistical standards of the NRCS testing process for this protocol. Just as clearly, there may be many areas that do not have any visible or apparent issue related to this element, or for which restoration actions can't or won't have any impact, or both. However, livestock farming remains an active (if not booming) agricultural industry in the Northeast, with dairy, ranching, poultry and specialty product farming, with the presence and access of animals to streams in the form of runoff from feedlots or manure storage areas or from direct access to streams by the animals themselves.

As for human waste, while municipal sewage treatment is common and undergoing widespread upgrades to comply with the Clean Water Act and numerous state water quality standards and regulations, combined sewer overflow (CSO) systems are still operated in communities where heavy rainfall events overwhelm wastewater treatment facility capacity (NH Department of Environmental Services 2016). In the NH example, 33 communities have been in process of controlling CSOs since 1989 with their CSO control strategy, working on dozens of discharge locations and hundreds of miles drains, pipes and sewer lines (NHDES 2016). The work is not complete, and these communities do not necessarily represent the statewide, or regional, number and rate of CSO operations or upgrades, but do illustrate an example of a type of source for waste pollutants into streams.

In relation to the scoring for Manure or Human Waste, the scoring criteria narratives are all right as is, though additional data should be gleaned from local municipalities and state environmental agencies prior to assessment work to document sewerage infrastructure in the vicinity, particularly upstream from, the assessment site. Similarly, agricultural operations and potential untreated drainage or livestock access should be assessed from the site itself per the protocol, but additional efforts should be made to evaluate GIS data, other local or regional databases or the New England Field Office of the USDA. The same narrative also works, but outfalls, pipes are not always obvious in the field, nor are some drainage ditches.

Salinity (Element 16)

The basis for four categories of Salinity scores in the SVAP2 as written focus on the look of riparian and streamside vegetation – degree (none, minimal, significant or severe) of wilting, bleaching, leaf burn, stunting, and presence or proportion of salt-tolerant vegetation on site (none, some, dominant or most). Other indicators are whitish salt accumulations on streambanks. The rationale for this element cites irrigation of salt-laden soils, dryland crop/fallow systems with saline seeps, oil and gas well operations and animal waste, with a caveat for naturally occurring geologic weathering that can produce salts and should not be scored. However, there are numerous sources of elevated salinity in streams that may be factored into stream assessments where these factors are or may be present.

Salinity sources can include (NSW 2018):

- Watering lawns, golf courses, crops – all can increase salinity (in addition to nutrient loads).
- Other urban sources:
- effluent
- building materials
- industrial waste water
- fertilizers and chemicals
- Direct measurements using specific conductivity block or refractometer

In addition, many industrial processes may increase stream salinity levels:

- saline water from mines (working and abandoned) from groundwater seepage and from rainwater coming into contact with mine workings or spoil
- discharged cooling water from coal-fired power stations that has been partly evaporated, concentrating the salt content

On its face, the protocol suggests elimination of the salinity element from the New England standard set is reasonable, since none of the streams in our broadly distributed dataset were impaired according to the criteria set out in the SVAP2 elements, and the protocol itself allows for eliminating elements that clearly do not apply. In addition to various sources of increased salinity from urbanized areas, industrial operations and agricultural sources, deicing operations of roads, bridges and other paved areas may be the most ubiquitous source in many streams throughout New England. Roads in mountainous areas are often in the stream valleys, where the flattest and most regular grades are found, and where settlements were historically made. Heavily developed areas also tend to have roads and streams in close proximity, with additional paved areas requiring treatment throughout the winter months. Road crossings (bridges and culverts) constitute the most direct access to streams from deiced surfaces, with bridges typically receiving the greatest amount of treatment due to the lower overall temperatures (suspended in air, without the partial insulation provided by the ground), though these may be considered point sources rather than a reach-wide impact.

A recent summary of Transportation and Hydrology Studies of the U.S. Geological Survey in New England cites locally-focused Water Quality investigations that include "…determinations of the effects of road salting on the quality of runoff and receiving waters." These studies are being led by the USGS New England Water Science Center (USGS 2018) in cooperation with state Departments of Transportation of Connecticut (CTDOT), Maine (MEDOT), Massachusetts (MassDOT), New Hampshire (NHDOT), Rhode Island (RIDOT) and Vermont (VTrans). As of 2016, USGS had ongoing or completed projects on various pollutant inputs – sediment, nutrients, metals, deicing chemicals and others from highways and bridges in MA, NH, VT and CT, and featured a 2013 regional effort to develop a highway-runoff discharge model to evaluate the potential effects of various pollutant loading on receiving waters, with potential effectiveness of stormwater BMPs on reducing impacts (Granato 2013). Another report conducted in 2015 on four watersheds along Interstate 95 in Connecticut revealed that of the five variables that best explain peak specific conductance following deicing, number of "State operated road lane miles divided by watershed area" and amount of Cl in deicer applied to those roads per lane mile are significant (Brown, et al., 2015).

With the above, we propose to adjust the narratives in scoring the Salinity Element, #16, using the following additional indicators (see Appendix G). Note many of these require additional evaluation of GIS data to evaluate presence or proximity to different sources, as these are not necessarily visible from within the assessment site.

For scores of 8 to 10, look for the following:

- No wilting, bleaching, leaf burn, or stunting of riparian vegetation;
- No streamside salt-tolerant vegetation present
- Little or no development in basin upstream, little or no deicing of impervious surfaces (e.g., seasonal use highways only, or plowing only)
- Little or no irrigation agriculture return drainage upstream

For scores of 5 to 7, look for the following:

- Minimum wilting, bleaching, leaf burn, or stunting of riparian vegetation;
- Some salt-tolerant streamside vegetation
- Some development with impervious surfaces upstream, small settlements only with deicing of roads, bridges and parking areas, villages without heavy industry
- No direct roadside drainage or bridge crossings
- Some stormwater or deicing control (bridge washing with removal, covered sand and salt storage, stormwater treatment BMPs)
- Little or no irrigation agriculture return drainage upstream

For scores of 3 to 4, look for the following:

- Riparian vegetation may show significant wilting, bleaching, leaf burn, or stunting;
- Dominance of salt-tolerant streamside vegetation
- Significant urban development upstream and/or adjacent to stream, dense road networks and/or larger towns or urban areas, industrial areas and extensive areas needing deicing
- Direct roadside drainage or bridge crossings

- No stormwater controls or BMPs
- Direct irrigation agriculture return drainage

For scores of 0 to 2, look for the following:

- Severe wilting, bleaching, leaf burn, or stunting;
- Presence of only salt tolerant riparian vegetation is salt tolerant
- High rates of development or urbanization, no stormwater controls
- Significant direct drainage from roads, bridges and paved surfaces
- Direct irrigation returns combined with evidence of salt damages to vegetation or a significant refractometer direct reading

Barriers to Movement (Element 11)

As noted in GIS Preliminary data collection, taking a broader watershed view would provide a more complete representation of the impact of barriers in the watershed that may not be in the assessment reach. Many barriers can be documented using GIS methods, where culverts, bridges, head-cuts and even large woody debris jams may be seen in imagery or topography, particularly for larger streams or streams with less riparian vegetation cover. For species that migrate upstream, including fish, salamanders or turtles, any barriers that exceed passage height, length or velocity should be documented both within and downstream from the SVAP2 assessment reach.

For the purposes of application in NAE, off-site barriers downstream should be documented, especially if there are native species that could or would utilize the assessment reach if they could reach it. In particular, dam removal or culvert replacement/rehabilitation sites constitute a specific project type where the assessment should include the structure itself as a barrier to movement, even if the representative assessment reach does not include the structure, because removal of the structure will impact aquatic population conditions upstream and downstream. Alternatively, mitigation sites immediately upstream or downstream from a barrier may not achieve the same ecological lift if the barrier is left intact. If barriers comprise a limiting factor, noting the presence of a problematic culvert or debris jam, or the presence of one or more headcuts moving up the valley from downstream, might provide opportunities to coordinate with other agencies or property owners to address those problems at a larger scale, improving the overall success of mitigation actions in the assessment reach.

Known barriers outside the assessment reach do not necessarily need to be included in assessing the element score, since any impact of mitigation would be confined to the study reach itself and only those variables that can be influenced. The important consideration here is to maintain consistency in application, wherein documenting barriers upstream or downstream is important but will typically not be included in assessing a specific reach, except in rare cases. If there is a good reason to consider barriers outside an assessment reach, this exception must be carried through all future assessments of this reach or associated sites to preserve continuity of the method.

Hydrologic Alteration (Element 2)

This element is difficult to assess in the field unless the larger watershed context is understood. Upstream conditions are most important – impervious surface area, rate of urbanization, stormwater inputs, out of basin transfers either in or out, other water withdrawal mechanisms, and impoundments all influence the hydrology of the assessment reach but may be out of sight. Preliminary GIS data collection should note the number and type of impoundments (different purposes result in different seasonal management of water releases) and any other large scale water rerouting that may impact the reach. Knowing whether there may be more or less water than would be there "naturally" and timing and extent of high and low flows will help field staff better assess the physical/geomorphological signs of hydrologic alteration. Few stream sites should really receive a score of 10 unless the entirety of the watershed upstream is undeveloped and in naturally occurring vegetation types.

Bank Condition (Element 3)

We noted in Table 3 that mitigated banks, if functioning ecologically, should be able to achieve a score of 9 or 10, even if they have been constructed. However, this is only if the structures present fully function like natural soils, rock and vegetative materials that occur naturally, that is, an occasional boulder in many mountain streams is fine, but a complete stacked rock wall will not provide the same shade, growth medium, or nutrient source. Banks constructed of a combination of natural and synthetic or hard materials may also still mimic a natural bank. For example, use of non-biodegradable rolled erosion control products (RECPs) or high performance turf reinforcement mats (HPTRMs) can be effectively used in bank revetment allowing fully functional riparian vegetation and hyporheic flow while providing a semi-permanent bank structure (Miller et al. 2012). Of course, each reach setting needs to be evaluated case by case, not all artificial or hard materials can be ecologically effectively incorporated into a mitigation design. Nonetheless, structure doesn't automatically preclude a high condition score for this element.

Aquatic Invertebrate Community (Element 14)

Identification of aquatic benthic macroinvertebrates using the SVAP2 at the order or family level introduces potential error in regards to making assumptions about water quality with respect to pollution tolerance. For instance, the SVAP2 uses the EPT index (Orders: Ephemeroptera, Plecoptera, and Trichoptera). Whereas it is generally accepted and assumed that these Orders are pollution intolerant (indicators of good water quality), there are exceptions to the rule. For example, caddisflies of the family Hydropsychidae, which are considered somewhat sensitive to pollution, were identified at several stations in NAE. Consequently, in contrast to most of the other Families of Trichoptera which are highly sensitive to pollution, Hydropsychid caddisflies can withstand some degree of pollution. In addition to Hydropsychids, a Trichopteran was identified at station ME01, near Biddeford, Maine. It was obviously the dominant taxa, at least, based on our qualitative sampling methods. The Trichopteran was keyed out to Family Uenoidae, Genus *Neophylax* (Pruitt, unconfirmed). *Neophylax* is somewhat pollution tolerant.

There is no specific provision in the SVAP2 to make adjustments for benthic macroinvertebrates belonging to EPT but are pollution tolerant. However, we recommend adding (or shifting category of) known tolerant species (or intolerant species) if and as identified, to improve SVAP2 field guide materials for this region. These species (or genera) would be added to the appropriate group (I, II or III). All other invertebrates in those groups would still be documented and assessed according to the element scoring criteria unless and until shown otherwise.

In New England applications based on the sites studied, we recommend Hydropsychidae and Uenoidae *Neophylax* be moved from Group I to Group II Taxa: "Somewhat pollution tolerant taxa found in good or fair quality water" (NRCS 2009).

Methods Recommendations

Training

A number of elements require specific expertise or experience to assess with any accuracy. A multi-disciplinary team is recommended to conduct the SVAP2 effectively, however, all reasonably experienced natural resources field staff should be familiar with the basic ingredients for credibly assigning a score for each element. A day or two of office and field training should be sufficient to introduce and familiarize new field personnel to the method, the factors included in each element, what to look for and how to conduct the assessments. A few critical areas were revealed during this study for which additional training or information should be made available to field staff.

Table 3 summarizes the set of 16 elements, with notes on methods we used in the field and any deviations or additional techniques we used to improve our results. For those elements that were not straightforward or for which modifications led to improvements or additional confusion, we offer the following additional comments directed at supplemental information, reference materials or methods that should be included in training new staff or allowing present staff to brush up (Table 11).

Table 11. Elements that may require additional training, equipment, field guides or other reference material.

Element (variable)	**Additional training, reference material or field guides**
Channel Condition	Correct Schumm Channel Evolution Model (CEM) class identification needs more attention in training. Better field ID reference materials for this classification, particularly for constructed type I, would be helpful. A field guide with photographs specific to this region would be ideal.
Riparian Area Quality	This element requires knowledge and training in plant ID and estimating cover percentages, this should be included explicitly in training. Qualitative vegetation lists developed through this study will be very helpful to include as part of field reference materials. Field guides would also be ideal, particularly for invasive species.
Canopy Cover	Clarification and training on cover for low-lying vegetation in small streams, with training on use of a Densitometer should be included.
Manure or Human Waste	We discussed recommending a different type of assessment here, primarily using GIS to identify pasture, feedlots, direct stream access (usually for water), septic and sewerage systems that may not be evident on site.
Aquatic Invertebrate Community	More targeted regional or local insect guides would be very helpful here. Additional training on use of a D-net rather than turning over rocks and wood should be included. For New England, Hydropsychidae and Uenoidae *Neophylax* would be moved from Group I to Group II Taxa. See Model Assumptions section below for additional discussion and information to be included here.
Salinity	Recommend investing in a refractometer to measure salinity directly. Training should include new narrative indicators such as roads and crossings, paved surfaces, etc., requiring deicing, in addition to other factors recommended for+ this element.

Field Forms – updates to original Exhibit 1 (NRCS 2009, see Appendix I)

1. Site ID, date, page number/total pages should be included on each page
2. Note taker or team should be included on each page (initials noted for each task performed) and the entire team documented
3. List of items included on sketches with codes or initials described, with legend
4. Cite regional curves used where appropriate, with expected bankfull dimensions, Drainage Area included
5. Places needed for documenting
    a. embeddedness values
    b. canopy cover values
    c. aquatic insect ID taxa and Group
    d. vegetation lists
    e. elements counts for habitat complexity for both invertebrates and fish
    f. pool and riffle depths for all pools or enough to score pool depths
6. Better places needed for additional notes
7. Better organization to correctly document starting and ending time and temperature, and placing data in the most sensible order
8. Photo documentation needs additional space and guidelines, or place to note number, locations, photographer, camera used, etc. Download checkbox on the field form to double check during data entry

Field Equipment (not including personal protective equipment for health and safety)

A. Six-foot long straight stick, selected by Dr. Pruitt, to which a six foot tape measure is attached with electrical tape. Must be used with much hilarity but also much accuracy to measure depths of riffles and pools.
B. Blank data entry forms, preferably on Rite-in-the-Rain® paper, three-hole punched to place in binders.
C. Thermometer that can be suspended in the water while other measurements are taken
D. Densitometer (not required per protocol, but strongly recommended for standardizing results)
E. Laser rangefinder, 100-300 foot tape or calibrated pace count (in descending order of preference)
F. D-net (kick net), water bottle, large white bucket or other shallow container, tweezers or a pencil, magnifying glass if needed, for use in examining macroinvertebrates
G. Pencils (many) and sharpies
H. Camera, highly recommended with a date stamp and GPS location recorded with the photo files
I. Hip boots/waders – closed toe only for safety
J. Clipboards
K. Element-specific field documentation, in addition to laminated Element Scoring sheets (see Appendix H):
    a. Channel condition – Schumm CEM stage model with diagrams and photos (NRCS 2009 p 614-9 to 614-16), Updates to this with region-specific photos would be ideal, in addition to field guides for other classification types – Rosgen (1996), etc.
    b. Fish and Aquatic Invertebrate Habitat Complexity – (NRCS 2009 p 614-33 and 614-35) listing all habitat features with lengths, count per reach, etc.
    c. Aquatic Invertebrate Community – (NRCS 2009 p 614-38 and 614-39).

Miscellaneous Future Needs

1. Regionally appropriate invertebrate and algae/flora guides (especially for invasive species and locally deviant taxa of macroinvertebrates, tolerant or intolerant), Region specific pollution tolerance guides, where available, or additions based on local/regional knowledge of species that deviate from SVAP2 Groups (such as the two added species of somewhat tolerant Trichoptera, caddisfly)
2. Regional curves ready to roll, with equations and graphs
3. Additional regional curve development in under-represented regions to aid identification of bankfull channel cross sectional area, particularly for disturbed or recently constructed sites where field indicators are ambiguous
4. Map of non-municipal sewerage (septic systems) and active livestock operations upstream, map or description of municipal waste treatment outlets
5. Reservoirs – study and determination of the best method to score these sites as a before dam removal area as if it is supposed to be a stream? General guidelines on NA or zero
6. Recommend a refractometer and salinity guidelines for taking direct salinity measurements, particularly in spring thaw conditions, in addition to new recommended narrative descriptions of salinity indicators for scoring
7. Test recommended additional narrative salinity scoring guidelines

Model Assumptions

As with any ecosystem assessment, numerous assumptions are made. There is error associated with the SVAP2 protocol, each input variable, and the interdependency of those variables. In addition, there is error associated with the practitioner in regards to accuracy and precision. Precision is a measure of how consistent and reproducible the protocol is between practitioners. The best approach to improving accuracy and precision is training, including practitioners running the SVAP2 protocol independent of each other on the same stream, comparing scores of each variable, and making adjustments based on the overall consensus. This exercise improves consistency and reproducibility, thus precision in reproducibility between different users. Evaluating accuracy would require correlating the SVAP2 with separate assessment methods as recommended in the SVAP2 Requirements for Modification Step 7, and is therefore outside the scope of this study.

DISCUSSION AND CONCLUSIONS

In general, the Stream Visual Assessment Protocol (SVAP2) differentiated between sites representing good condition (Preserved sites), degraded condition (Proposed project sites) and trending to good condition (Completed project sites) for streams sampled throughout New England. Overlap between SVAP2 scores in regards to preserved, degraded, and trending to good condition is expected along environmental gradients and is evidence of the dynamism associated with successional stages common to aquatic ecosystems. Minor modifications to narrative elements for Salinity should increase the relevance of this element in New England, and while this element and Manure and Human Waste were not immediately influential in the sites studied, assessing these elements may nonetheless impact other water quality indicators discussed below, and may call for additional testing against other indices for further refinement. The SVAP2 provides an excellent tool for multiple applications including assessment of 1) alternative analysis, B-1 Guidelines; 2) cost/benefit analysis; 3) reference standards or restoration targets; 4) compensatory mitigation credit calculations; 5) performance standards and success criteria; and 6) adaptive management and monitoring.

Excellent cause and effect relationships was observed between channel condition, habitat alteration, bank condition, and pools versus the elements that caused the impairment (Table 9). Consequently, hydrologic alteration, bank erosion and failure, riparian zone degradation, fish habitat complexity diminution, and elevated riffle embeddedness directly affected channel condition. Similarly, degraded water quality, as measured using water appearance and nutrient enrichment, and loss of physical habitat for fish and benthic macroinvertebrates resulted in habitat alteration. Reduction in pool bedforms was caused by habitat loss, as well. Decreased bank condition as an expression of reduced riparian quantity and quality, canopy cover and barriers to movement is noteworthy. Overall, fish habitat complexity and benthic macroinvertebrates (community), in combination, were influenced by the most causes (elements) of impairment including: channel condition, hydrologic alteration, riparian zone quantity and quality, canopy cover, water appearance, nutrient enrichment, and pools (Table 9). The implications of this discussion suggest further modifications to an index score could improve the accuracy of the SVAP2 beyond a simple arithmetic mean as designed.

The importance of field personnel experience, training and field of expertise were important factors in ensuring a high degree of precision in implementation of the SVAP2. Large and small details have been summarized in this report to document ways in which the field team worked together to augment skillsets, and how the proper equipment and reference materials can make a difference and reduce measurement or observer bias. While these factors weren't tested explicitly, we can qualitatively assess our own office and field experience to suggest areas for improvement.

The consideration of significant outputs ("ecological lift") is central to identification of restoration targets. In general, the SVAP2 can provide a means of comparison and determination of departure from reference conditions and significance of outputs or ecological lift potential of a proposed restoration action or compensatory mitigation, with a means to assess trends in condition of mitigated sites for determination of credit.

The overwhelming majority of wetter sites scored very high on riparian quantity and quality. This suggests possible improvements to the SVAP2 by improving characterization of riparian quantity and quality elements, if additional focus is placed on vegetation in wetter areas, typical of functioning riparian zones in temperate regions. Another implication is that possible trends in sites to a more mesic condition might be detected by a transition away from water loving plants, which might indicate stream incision and transition to less stable Schumm channel evolution model stages, or a decrease in water availability potentially due to water routing or use changes, or possibly to drought conditions.

Otherwise, a good to excellent stream corridor in New England, which could form the beginning of a stable or minimally disturbed reference database, is characterized by:

1. A high degree of bedform diversity, combined with a complex structured riparian zone, creating diverse aquatic habitats;
2. Balanced sediment supply rather than accelerated sedimentation and embeddedness or degradation and unstable banks;
3. Good water quality with generally mesotrophic conditions that support a great variety of organisms and plants;
4. Limited barriers to movement of migrating species, both upstream and downstream;
5. A broad riparian zone with woody vegetation, high species and growth form diversity, and ample channel shading; and
6. Frequent overbank events and nutrient exchange between the stream and riparian zone.

Assessments of stream corridors (in-channel and riparian zone condition) requires a suite of elements (variables). Expressly, it is a multi-variate procedure, and the evaluation of no single variable is conclusive in regards to the stream corridor condition. In addition, it is inherent in aquatic diversity that there is an interplay between physical, chemical and biological attributes of the biosphere. The protocol tested herein (SVAP2) is no exception to the rule. Thoughtful treatment of each of the 16 elements is essential to the outcome efficiency.

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APPENDICES

Appendix A. SVAP2 Field Assessment Participants: Name, Affiliation and Sites Attended. Presence noted by “x” in each Site ID column.

Name	Affiliation	CT01	CT02	CT03	CT04	CT05	CT06	CT09	CT10	MA02	MA03	MA04	MA05	MA06	MA06.5	ME01	ME02	ME04	ME05	ME06	ME07	ME08	ME09	NH02	NH03	NH04	NH05	NH06	RI01	RI02	VT01	VT02	VT03	VT04	VT05	VT06
Sarah Miller	US Army Engineer Research and Development Center, Environmental Laboratory	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bruce Pruitt	US Army Engineer Research and Development Center, Environmental Laboratory	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Ruth Ladd	US Army Corps of Engineers New England District	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Taylor Bell	US Army Corps of Engineers New England District	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Kathy Jensen	The Nature Conservancy - Maine																x	x	x	x	x							x								
Alexandra Evans	University of Hampshire										x	x	x	x	x	x	x	x				x		x	x		x	x		x						
Scott Greenwood	University of Hampshire										x	x	x	x	x	x	x	x				x		x	x		x	x		x						
Beth Alafat	US Environmental Protection Agency																														x	x		x	x	
Jackie LeClair	US Environmental Protection Agency										x	x																								

Ed Reiner	US Environmental Protection Agency										x	x																								
Lisa Krall	Natural Resources Conservation Service				x		x																													
Mike Adams	US Army Corps of Engineers New England District																														x	x				x
Dan Breen	US Army Corps of Engineers New England District									x			x	x	x																					
Ruthann Brien	US Army Corps of Engineers New England District									x			x	x	x																					
Josh Helms	US Army Corps of Engineers New England District									x			x	x	x																					
Angela Repella	US Army Corps of Engineers New England District																														x	x				x
Paul Sneeringer	US Army Corps of Engineers New England District												x	x	x																					
Mike Wierbonics	US Army Corps of Engineers New England District															x	x	x																		
Cheryl Bondi	New Hampshire Department of Environmental Services																								x	x	x									
Mindy Bubier	New Hampshire Department of Environmental Services																								x	x	x									
Nancy Rendall	New Hampshire Department of Environmental Services, Site Selection Committee																																	x	x	

Lori Sommer	New Hampshire Department of Environmental Services																							x	x	x										
Kristen Puryear	Maine Natural Areas Program																		x		x															
D. Robinson	Police Department, Waterbury, Connecticut			x																																

Appendix B. Final Field Sites Assessed, alphabetical order by state and Map ID number.

Map ID	Complete Project, Preserved Site, Proposed	State	Town	Other location notes	Permit ID/ name	Project Manager	Stream Name	EPA III #	EPA IV #	EPA III name	EPA IV name	Project or reach type	Dates of interest	Drainage Area, sq. mi	Notes	Latitude decimal deg.	Longitude decimal deg.
CT01	PP	CT	Brookfield		2013-01657		Still River	59	59c	North-eastern Coastal Zone	Southern New England Coastal Plains & Hills	In stream work. 3300 feet		103	East of Rt. 7 at Silvermine Road	41.46738	-73.40327
CT02	PP	CT	Trumbull	transfer station	2016-02284	Taylor Bell	Trib to Pequannock River	59	59c	North-eastern Coastal Zone	Southern New England Coastal Plains & Hills	Culvert installation	Will be culverted (after field testing).	0.64	Tried SVAP2 and passed straight-face test.	41.29506	-73.238957
CT03	CP	CT	Waterbury	Jonathan Reed Elementary School	2010-00930	Cori Rose	Great Brook	59	59c	North-eastern Coastal Zone	Southern New England Coastal Plains & Hills	Stream Restoration, Dam removal	complete 9/28/2015	1.96	NOTE: Lat/Longs corrected - need to fix on Google Earth map. iIghly disturbed area.	41.566414	-73.026223
CT04	NP	CT	Riverton	American Legion State Park	N/A		West Branch Farmington River? & Tribs	58	58d/ 58e	North-eastern Highlands	Lower Berkshire Hills / Berkshire Transition	Preserved/ site between two highways, nuked	N/A	218	NOTE: Lat/Longs corrected - need to fix on Google Earth map. Minimally disturbed area.	41.941	-73.010443
CT05	CP	CT	Waterbury	revised location... Farmington Rd, NP	2012-1062	Susan Lee	Beaver Pond Brook?	59	59c	North-eastern Coastal Zone	Southern New England Coastal Plains & Hills	Stream Relocation	Complete	4.62	Between I-84 and Readville Drive. Highly modified.	41.538	-73.002

Map ID	Complete Project, Preserved Site, Proposed	State	Town	Other location notes	Permit ID/ name	Project Manager	Stream Name	EPA III #	EPA IV #	EPA III name	EPA IV name	Project or reach type	Dates of interest	Drainage Area, sq. mi	Notes	Latitude decimal deg.	Longitude decimal deg.
CT06	NP	CT	Cheshire	Naugatuck Forest Mount Sanford Cheshire & Hamden	N/A		Sanford Brook	59	59a/ 59c	North-eastern Coastal Zone	Connecticut Valley / Southern New England Coastal Plains & Hills	preservation	N/A	0.2	South of Bethany Mountain Road; just north of Mt. Sanford	41.46556389	-72.94950278
CT09	PP	CT	Bloomfield	impoundmt grade control too high	2009-01511	Lindsay Flieger	trib to Mill Brook	59	59a	North-eastern Coastal Zone	Connecticut Valley	Dam Removal - completed, but done wrong...		0.93		41.86723	-72.709
CT10	PP?	CT	Storrs	nr UConn	2004-3990	Cori Rose	Swamp Brook headwaters	59	59c	North-eastern Coastal Zone	Southern New England Coastal Plains & Hills	Farmland Creation		0.09	NOTE: Lat/Longs corrected	41.820326	-72.265465
MA02	NP	MA	Shrewsbury			Dan Vasconcelos		59	59h	North-eastern Coastal Zone	Gulf of Maine Coastal Plain	Proposed culvert installation? Roadside stream		0.28	Tried SVAP2 and passed straight-face test. There may be construction at the point used for SVAP2 but could do reach above or below	42.28197778	-71.67333333
MA03	NP	MA	Bedford	Behind Shawsheen Cemetery	Bedford Conser-vation Land	Ruth M Ladd	unnamed	59	59d/ 59h	North-eastern Coastal Zone	Boston Basin / Gulf of Maine Coastal Plain	Preserved	N/A	0.17	There are two small streams that flow from east to west, join, and discharge into a small reservoir. One is perennial, the other intermittent. Drainage starts from residential but then flows through forested land.	42.486382	-71.251033

Map ID	Complete Project, Preserved Site, Proposed	State	Town	Other location notes	Permit ID/ name	Project Manager	Stream Name	EPA III #	EPA IV #	EPA III name	EPA IV name	Project or reach type	Dates of interest	Drainage Area, sq. mi	Notes	Latitude decimal deg.	Longitude decimal deg.
MA04	CP	MA	Andover		2012-00032	Alan - Anacheka-Nasemann	Shawsheen River	59	59h	North-eastern Coastal Zone	Gulf of Maine Coastal Plain	Bioengineer.	Complete July 2014	69.1	Location correct	42.6488	-71.1503
MA05	CP	MA	East Bridgewater	Ridder Farm Golf Club	2009-01810		trib to Black Brook?	59	59e	North-eastern Coastal Zone	Narragansett / Bristol Lowland	Culvert Daylighting	Complete	0.48	NOTE: Modified Lat/Long a bit	42.033589	-70.951185
MA06	PP	MA	Plymouth		Town Brook Reservoir		Town Brook	84	84a	Atlantic Coastal Pine Barrens	Cape Cod/Long Island	Dam Removal		8.46	See comment for MA6 for Town Brook except this isn't an ILF project. NOTE: Slightly modified lat/long	41.946589	-70.673938
ME01	NP	ME	Biddeford	2 streams	Clifford Park		West Brook, under Road	59	59f	North-eastern Highlands	Gulf of Maine Coastal Lowland	Ice rink site		3	ME ILF project. There are two streams: one is intermittent and very small on the west side and another larger on the east side.	43.482368	-70.4503622
ME02	NP	ME	Gray	Unnamed stream crossing Egypt Rd	Morgan Meadow	Ruth M Ladd	Sucker Brook	58	58r	North-eastern Highlands	Sebago-Ossipee Hills and Plains	Preservation north of road	Done	2.9	ILF preservation parcel	43.926712	-70.397695
ME04	NP	ME	Falmouth		Falmouth	Ruth M Ladd	East Branch Piscataqua River	59	59f	North-eastern Highlands	Gulf of Maine Coastal Lowland	entrenched former ag site, very muddy		15.2	Info in SVAP2-ME folder-need to move to Sharepoint. ILF project - preservation	43.7570951	-70.2649887

Map ID	Complete Project, Preserved Site, Proposed	State	Town	Other location notes	Permit ID/ name	Project Manager	Stream Name	EPA III #	EPA IV #	EPA III name	EPA IV name	Project or reach type	Dates of interest	Drainage Area, sq. mi	Notes	Latitude decimal deg.	Longitude decimal deg.
ME05	CP	ME	Wiscasset	Montsweag Dam	2010-00956	Peter Tischbein, Ruth M Ladd	Montsweag Brook	82	82f	Acadian Plains and Hills	Midcoast	dam removal in recovery		10.5	Stream Stats ME ILF project. Info in SVAP2-ME folder-need to move to Sharepoint	43.9692507	-69.7194445
ME06	PP	ME	Vassalboro		Lombard Dam	Ruth M Ladd	Outlet Stream	82	82e	Acadian Plains and Hills	Central Maine Embayment	Dam removal	Planned	16.9	ME ILF project	44.4635	-69.6123
ME 06.5	PP	ME		impoundmt above Lombard Dam													
ME07	PP	ME	East Vassalboro		Masse Dam	Ruth M Ladd	Outlet Stream	82	82e	Acadian Plains and Hills	Central Maine Embayment	Dam removal	Planned	33.6	ME ILF project	44.451992	-69.606158
ME08	NP	ME	Bradley		Blackman Stream	Ruth M Ladd	Blackman Stream	82	82h	Acadian Plains and Hills	Penobscot Lowlands	Reference - excellent condition		45.2	Aerial & other info saved in SVAP2-E folder-need to move to Sharepoint. ILF project (fish ladder) NOTE: Refined Lat/Long	44.872449	-68.634411
ME09	PP	ME	Washburn		Salmon Brook	Ruth M Ladd	Salmon Brook	82	82a/ 82b	Acadian Plains and Hills	Aroostook Lowlands / Aroostook Hills	Dam removal followed by enhancemt.	Planned	0.2	Dam to be removed by the Town	46.79301	-68.155499

Map ID	Complete Project, Preserved Site, Proposed	State	Town	Other location notes	Permit ID/ name	Project Manager	Stream Name	EPA III #	EPA IV #	EPA III name	EPA IV name	Project or reach type	Dates of interest	Drainage Area, sq. mi	Notes	Latitude decimal deg.	Longitude decimal deg.
NH02	NP	NH	Keene	Keene		Ruth M Ladd	Beaver Brook	58	58g/ 58q	North-eastern Highlands	Worcester/ Monadnock Plateau / Sunapee Uplands	No work in stream		8.16	Stream Stats. NOTE: Lat/Long corrected	42.9418078	-72.2691928
NH03	CP	NH	Francestown			Ruth M Ladd	South Branch Piscataqua River	58	58g	North-eastern Highlands	Worcester/ Monadnock Plateau	Enhancemt. & preservation	Complete	10.1	NH ILF project;	42.958018	-71.778399
NH04	CP	NH	Manchester		McQuesten Dams	Ruth M. Ladd	McQuesten Brook	59	59h	North-eastern Coastal Zone	Gulf of Maine Coastal Plain	Dam Removals (3)	Complete in monitoring period	0.27	ILF site. Three very small dams were removed	42.969403	-71.481228
NH05	CP	NH	Manchester/ Bedford			Ruth M Ladd	McQuesten Brook	59	59h	North-eastern Coastal Zone	Gulf of Maine Coastal Plain	Stream Rehab.	Completed 2015	0.38	NH ILF project	42.9646912	-71.4786749
NH06	CP	NH	Dover			Ruth M Ladd	Berry Brook	59	59f	North-eastern Highlands	Gulf of Maine Coastal Lowland	Reconstruct Stream; ILF site	Complete	0.11	ILF site. Entire stream is 1 mile long, being studied by UNH	43.2122124	-70.8784561
RI01	NP	RI	Burrillville (barely)		Pulaski State Park and Rec. Area		Trib to pond and Tribs of Pond	59	59c	North-eastern Coastal Zone	Southern New England Coastal Plains & Hills	Natural		1.91		41.93193	-71.798453

Map ID	Complete Project, Preserved Site, Proposed	State	Town	Other location notes	Permit ID/ name	Project Manager	Stream Name	EPA III #	EPA IV #	EPA III name	EPA IV name	Project or reach type	Dates of interest	Drainage Area, sq. mi	Notes	Latitude decimal deg.	Longitude decimal deg.
RI02	PP	RI	Warwick	Airport	2002-01925	Michael Elliot	Buckeye Brook or trib?	59	59e	North-eastern Coastal Zone	Narragansett / Bristol Lowland	Stream Restoration		2.29		41.71768	-71.41716
VT01	NP	VT	Swanton	Mississiquoi River	Mississiquoi NWR		Dead Creek, Wood Duck Creek?	83	83b	Eastern Great Lakes Lowlands	Champlain Lowlands	bi-directional wetland stream		6	NOTE: Modified Lat/Long	44.945161	-73.15561
VT02	NP	VT	Middlebury	Middlebury River, streams by road			Tribs to Middlebury River	83	83b	Eastern Great Lakes Lowlands	Champlain Lowlands	Natural, but planned exclusion		62.9	ILF site	43.9684306	-73.1546549
VT03	CP	VT	Readsboro				Deerfield River or Tobey Brook?	58	58c	North-eastern Highlands	Green Mountains/ Berkshire Highlands	Post dam		191	http://www.vtfishandwildlife.com/UserFiles/Servers/Server_73079/File/Where%20to%20Hunt/Springfield%20District/Atherton%20Meadows%20WMA.pdf	42.77116944	-72.94578333
VT04	NP	VT		Streams in Okemo State Forest	2010-1452		Trib to Jewells Brook	58	58c	North-eastern Highlands	Green Mountains/ Berkshire Highlands	nearby stream		0.13	Permit saved in SVAP2-VT folder-move to Sharepoint	43.39217	-72.73129
VT05	NP	VT		Knapp Brook Ponds	Knapp Brook Wildlife Mgt Area		Knapp Brook	58	58c/ 58f	North-eastern Highlands	Green Mountains/ Berkshire Highlands / Vermont Piedmont	below dam		2.88	http://www.vtfishandwildlife.com/UserFiles/Servers/Server_73079/File/Where%20to%20Hunt/Springfield%20District/Knapp%20Brook%20WMA.pdf	43.44721944	-72.56541111

Map ID	Complete Project, Preserved Site, Proposed	State	Town	Other location notes	Permit ID/ name	Project Manager	Stream Name	EPA III #	EPA IV #	EPA III name	EPA IV name	Project or reach type	Dates of interest	Drainage Area, sq. mi	Notes	Latitude decimal deg.	Longitude decimal deg.
VT06	PP	VT		Jay Peak Ski Resort	2008-01314		Trib to trib to Jay Branch?	58	58c/ 58j	North-eastern Highlands	Green Mountains/ Berkshire Highlands / Upper Montane Alpine Zone	Stream Enhancemt.		0.63	Stream Stats Inspection on stream SVAP2-VT folder- move to Sharepoint	44.93125	-72.50381

Appendix C. Regional Hydraulic Geometry Curves for ME, VT and two CT gages.

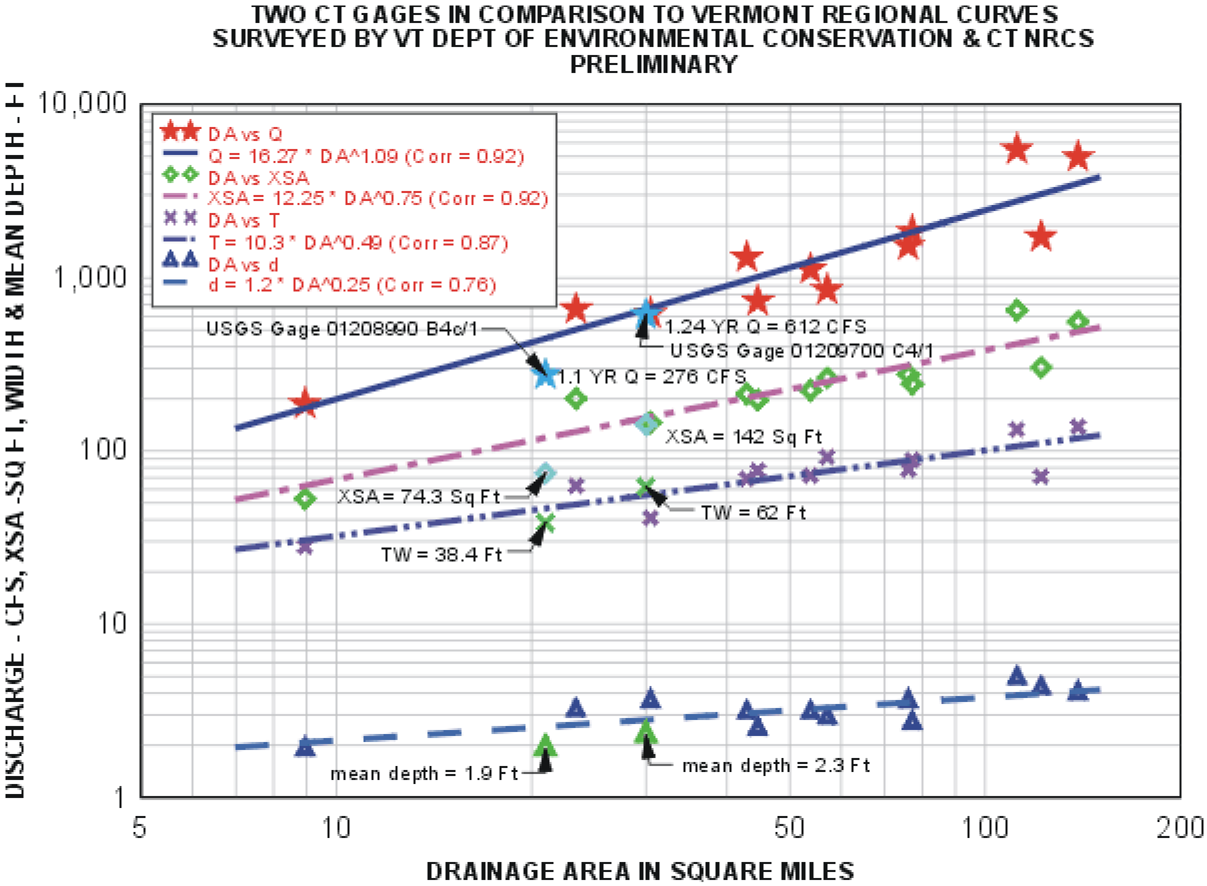

Table 6. Regional regression equations for estimating bankfull streamflow, channel width, channel depth, and channel cross-sectional area as functions of drainage area for rivers in coastal and central Maine.

[Q_{bkf}, bankfull streamflow in cubic feet per second; w_{bkf}, bankfull channel width, in feet; d_{bkf}, bankfull mean channel depth, in feet; A_{bkf}, bankfull cross-sectional area, in square feet ; DA, drainage area in square miles; R^2, fraction of variance explained by regression]

Regression equation	Average standard error of estimate	R^2
$Q_{bkf} = 5.19DA^{1.05}$	+66.0 to -39.8	0.88
$w_{bkf} = 7.67DA^{0.52}$	+37.9 to -27.5	0.82
$d_{bkf} = 0.594DA^{0.34}$	+29.4 to -22.7	0.76
$A_{bkf} = 4.55DA^{0.86}$	+70.5 to -41.3	0.82

Appendix D. Quality Assurance Project Plan – Field Copy Scan used June 2017

ERDC Project ID No.:

B4. Analytical Methods

ERDC:	Laboratory analysis is not required on this project.
CLP:	No contract laboratory program required.
Other:	none

B5. Quality Control

The following is a brief description of field and laboratory quality control measures to be implemented during this field investigation.

Field:	The Natural Resource Conservation Service's (NRCS) Stream Visual Assessment Protocol, Version 2 (SVAP2) will be followed during field work. Modifications to the Protocol to suit regional conditions will be noted, tested and refined as necessary.
Laboratory:	No laboratory analysis required.

B6. Instrument/Equipment Testing, Inspection and Maintenance

All field equipment will be maintained prior to field excursions.

of the field work including recommendations of SVAP2 for future use by the NAE.

SECTION B: Data Generation and Acquisition

B1. Sampling Design

The following matrix lists the proposed numbers and types of samples to be collected. Sample locations are described in Section A6 of this QAPP.

Station ID:	Number of Samples:	Analyses:
Per SVAP2 Spdsht	33	In-situ Observations

B2. Sampling Methods, General Procedures

The following ERDC field measurement and sampling procedures will be followed during this field study, as applicable:

Natural Resource Conservation Service's (NRCS) Stream Visual Assessment Protocol, Version 2 (SVAP2)

Assessment Methodology, Science Support for North Atlantic Division, Scope of Work, Sarah Miller, Version 7.0, 20-Oct-16

B3. Sampling Handling and Custody

All field observations will be collected and handled according to the procedures listed in Section B2 of this QAPP. After collection, samples will managed according to the following:

1) Field observations and forms will be maintained and either photocopied and/or entered electronically at the end of each day;
2) Field forms will be saved in multiple media and places;
3) Daily notes on modifications, as needed, to the SVAP2 will be maintained and distributed to the PDT;
4) The ERDC PI is responsible for maintenance of quality control/assurance.

and Background Information):	has not been tested in the New England District (NAE).
A6. Project Description:	Confirm the appropriateness of SVAP2 use in New England and, if necessary, make recommendations for modifications to render it appropriate, per guidelines for modifications contained in SVAP2 documentation (NRCS 2009). Testing includes predetermined stream reaches in Maine, Massachusetts, New Hampshire, Connecticut, Rhode Island, Vermont
Applicable regulatory information, action levels, etc.	Clean Water Act, Section 404
Decision(s) to be made based on data:	Determine if the SVAP2 is appropriate for use in the New England District, with modifications, if necessary.
Field Study Date:	Initially, the period from June 12 to 23, 2017 has been scheduled. Additional time may be required.
Projected Lab Completion Date:	No laboratory analysis required
Projected Final Report Completion Date:	End of FY17.

A7. Quality Objectives and Criteria

All samples/sample locations meet the field investigation objectives and purposes summarized in Sections A5 and A6 of this QAPP.

A8. Special Training/Certifications

Initially, some time will be spent training the field team for consistency and reproducibility.

A9. Documents and Records

For this project, ERDC will implement the following procedures pertaining to Documents and Records: A final report will be prepared by ERDC specify regarding the findings and conclusions

US Army Corps of Engineers

Quality Assurance Project Plan
U.S. Army Corps of Engineers
Engineer Research and Development Center
3909 Halls Ferry Rd.
Vicksburg, MS 39180

ERDC
Engineer Research and Development Center

ERDC Project ID No.:

SECTION A: Project Planning Elements		
A1. Title (*Project Name*):	Field Testing of NRCS's Stream Visual Assessment Protocol, Version 2 (SVAP2) in New England	
Project Location:	New England District (NAE), Maine, Massachusetts, New Hampshire, Connecticut, Rhode Island, Vermont	
Project Requestor and Organization:	Ruth Ladd, New England District (NAE), Concord, MA	
Project Leader's Name, Position and Organization:	Sarah Miller, Research Geomorphologist, ERDC-EE-E	
Project Leader's Signature:		Date:
Technical Reviewer's Name and Position:	Not required	
Technical Reviewer's Signature:	Not required	Date:
Branch Chief's Name and Position:	Jennifer M. Seiter, Chief, EE-E	
Branch Chief's Signature:		Date:
A2. Table of Contents	N/A	
A3. Distribution List	New England SVAP2 PDT	
A4. Project Personnel	Organization	Responsibilities
Ruth Ladd	NAE	Field Team Member
Taylor Bell	NAE	Field Team Member
Sally Stroupe	ERDC	Oversight
Sarah Miller	ERDC	PI, Field Team Member
Bruce Pruitt	ERDC	Field Team Member
A5. Problem Definition (Investigation Objectives	The NRCS Stream Visual Assessment Protocol, Version 2 (SVAP2)	

ERDC Project ID No.:

B7. Instrument/Equipment Calibration and Frequency
All field equipment will be calibrated per manufacturer's recommendations and standards (if applicable).

B8. Inspection/Acceptance for Supplies and Consumables
No field supplies and consumables are required for this study.

B9. Non-direct Measurements: Non-direct measurements (surrogates) are per Natural Resource Conservation Service's (NRCS) Stream Visual Assessment Protocol, Version 2 (SVAP2).

B10. Data Management
The field project leader, Sarah Miller, will be responsible for ensuring that all requirements for data management are met. All data generated for this field investigation, whether hand-recorded or recorded and stored in an electronic data logger will be recorded, stored and managed according to the following procedures: see B3 above.

SECTION C: Assessment/Oversight and SECTION D: Data Validation/Usability

ERDC addresses the Assessment/Oversight and Data Validation/Usability elements as required. **This document is for USACE use only.**

Appendix E. Safety Plan – Field Copy Scan used June 2017

The following safety plan has been prepared by Bruce Pruitt (USACE-ERDC) to provide maximum health and safety for personnel during field excursions and alert supervisors, administrative staff and family members to contact information.

Project Dates: June 11 to 23, 2017

Project Location: New England District, field sites in Maine, New Hampshire, Massachusetts, Connecticut, and Vermont

Emergency Response: 911

Training: Monday, June 12, TNC-ME offices in Fort Andross Mill, Cabot St, Brunswick (4th floor)

Motels:

MOTEL	Address	Phone No.	Arrive	Depart
Hilton Garden Inn, Portland, ME	65 Commercial St., Portland, ME 04101	(207) 780-0780	11-Jun	12-Jun
Presque Isle Inn, ME	116 Main St., Presque Isle, ME 04769	(207) 764-3321	12-Jun	13-Jun
Comfort Inn, Brunswick, ME	199 Pleasant St., Brunswick, ME 04011	(207) 729-1129	13-Jun	14-Jun
Comfort Inn, Manchester, NH	298 Quenn City Ave., Manchester, NH 03102	(603) 688-2600	14-Jun	15-Jun
Hampton Inn, Hadley, MA	24 Bay Rd., Hadley, MA 01035	(413) 586-4851	15-Jun	16-Jun
Embassy Suites, Waltham, MA	550 Winter St., Waltham, MA 02451	(781) 890-6767	16-Jun	19-Jun
Comfort Inn and Suites, Dayville, CT	16 Tracy Rd., Dayville, CT 06241	(860) 779-3200	19-Jun	20-Jun
Hampton Inn, Waterbury, CT	777 Chase Pkwy., Waterbury, CT 06708	(203) 753-1777	20-Jun	21-Jun
Marriott Courtyard, Middlebury, VT	309 Court Street/US Route 7, Middlebury, VT 05753	(802) 388-7600	21-Jun	22-Jun
Marriott Courtyard, Lebanon, NH	10 Morgan Dr., Lebanon, NH 03766	(603) 643-5600	22-Jun	23-Jun
Pruitt Only:				
Swift House Inn, Middlebury, VT	25 Stewart Lane, Middlebury, VT 05753	(802) 388-9925	21-Jun	22-Jun

1. Field Personnel:

Name	Cell Number	Emergency Contact Person	Phone
Sarah Miller	(601) 618-5974	Jane Miller	(845) 586-4736; cell (518) 878-1561
		Stephen Moser	(601) 634-9449; cell (706) 994-6647
		GP: Thomas Sligh	(601) 883-3340
Bruce Pruitt	(706) 248-1757	Melanie Pruitt (wife)	(706) 769-5667; cell (706) 255-0492

- Currently taking no prescription drugs, no known allergies; GP: Philip Morris (706) 546-7149

Ruth Ladd	(781)956-6774	Larry Ladd (husband)	(781) 862-6575

- Currently on one prescription drug that I can skip w/o a problem. No known allergies; GP: Richard Zangara (Lahey Health) (781) 372-7100

Taylor Bell (404) 309-6944 Bryce M (SO) 978-886-4860

No drugs, no allergies

UNH:

Alexandra Evans (603) 264-6210

Scott Greenwood (603) 682-7603

2. Trip Expectations: Expect long field days from ~ 0700 to 1900. Daily field excursion will be determined based on weather and river stage conditions.

3. First Aid (provided by Pruitt)
   - A first aid kit (backpack type) will be carried on field excursions away from the field vehicle. (If there's available space in luggage, Pruitt may provide a complete trauma kit to keep in the vehicle).

4. Directions to nearest trauma center:
   - Considering we are staying at 10 different locations across 5 states, we will use 911 in case of medical emergencies to locate nearest hospital.

Appendix F. Field Schedule/Itinerary – Field Copy Scan used June 2017

SCHEDULE FOR SVAP2 FIELD WORK (as of 6/9/17)
Ruth Ladd 781-956-6774

Photos ✓

Monday, June 12

6:15 – 8:15 Ruth and Taylor drive to Portland
8:15 Ruth and Taylor pick up Sarah and Bruce at Hilton Garden Inn, 145 Jetport Boulevard, Portland
9:00 – 1:00 SVAP2 training in Brunswick, ME, Fort Andross Mill, Cabot St,4th floor, and get lunch

1:00 – 3:00 Drive to Bradley. Meet at the end of Government Rd near the river.
3:00 – 4:00 Field work at Blackman Stream ILF site (ME08) ✓ Tab 1
POC: Andy Goode, ASF, 207-725-2833, cell-207-751-5124
[illegible] – 5/24 left message for Andy; he called back and said he'll be out of contact until 6/8
OTHER ATTENDEES:
Jay Clement, NAE (tentative), 207-329-3950
Kristen Puryear, MaineNAP, 413-313-4719

4:00 – 6:30 Drive to Presque Isle
Stay in Presque Isle. 116 Main St. (Presque Isle Inn and Conference Center)

Tuesday, June 13

8:00 – 8:15 Drive to Washburn
8:15 – 9:15 Field work on Salmon Brook in Washburn (ME09) ✓
POC: Beverly Turner, Town Manager, 207-455-8485 – 5/24 left message
6/8 tried to call and got a message that my call couldn't be completed as dialed.
OTHER ATTENDEES:

9:15 – 1:30 Drive to Vassalboro – lunch along the way. Meet near the junction of Gray Road and Rt. 32 (Main St.)
1:30 – 2:30 Field work on Outlet Stream/Lombard Dam ILF site (ME06) ✓ x2 – eval reservoir to show before/after ME0.6.5
POC: Landis Hudson, Maine Rivers, 207-847-9277, cell-207-831-3223
[illegible] – got the OK
OTHER ATTENDEES:
Dawn Hallowell, MEDEP
Jay Clement (tentative) , 207-329-3950
Kristen Puryear, MaineNAP, 413-313-4719

2:30 – 3:30 Field work on Outlet Stream/Masse Dam ILF site (ME07) ✓
POC: Landis Hudson, Maine Rivers, 207-847-9277, cell-207-831-3223
[illegible] – got the OK (but will let me know if the current owner has a problem with it)
OTHER ATTENDEES:
Dawn Hallowell, MEDEP

Jay Clement, NAE (tentative), 207-329-3950
Kristen Puryear, MaineNAP, 413-313-4719

3:30 – 4:30 Drive to Wiscasset ✓
4:30 – 5:30 Field work on Montsweag Brook ILF site (ME05). Meet at the pull-off area at the gate and walk-through opening.
POC: Dan Creek, Chewonki Foundation, 207-712-1467, dncreek@gmail.com – OK
OTHER ATTENDEES:
Dawn Hallowell, MEDEP
Jay Clement, NAE (tentative), 207-329-3950
Kristen Puryear, MaineNAP, 413-313-4719

5:30 – 6:00 Drive to Brunswick
Stay in Brunswick (199 Pleasant St, Comfort Inn)

Wednesday, June 14

8:00 – 8:45 Drive to Auburn. Meet near the Summer Street/Youngs Corner Road intersection
8:45 - 9:45 Field work at ABDC mitigation site in Auburn/Lewiston Junction (ME03) ✗
? POC: Scott Benson 207-777-5019 (PM) OK
OTHER ATTENDEES:
Jay Clement, NAE (tentative), 207-329-3950
Nancy Rendell, NH SSC, 603-856-6391
Scott Greenwood, UNH, 603-682-7603
Alexandra Evans, UNH, 603-264-6210

were there then?

couldn't find this one – not a stream any longer

9:45 – 10:15 Drive to Gray ✓
10:15 – 11:15 Field work at Sucker Brook in Morgan Meadow ILF site (ME02) – NOTE: Site is north of Egypt Road. Meet at the junction Egypt Road and Westwood Road.
POC: Bethany Atkins, MEDIFW, (may be able to get a number online under Maine Dept of Inland Fisheries and Wildlife) – sent email 6/1/2017
OTHER ATTENDEES:
? ✗ Jay Clement, NAE (tentative), 207-329-3950
Nancy Rendell, NH SSC, 603-856-6391
Scott Greenwood, UNH, 603-682-7603
Alexandra Evans, UNH, 603-264-6210

11:15 – 12:30 Drive to Falmouth – lunch along the way ✓
12:30 – 1:30 Field work at East Branch Piscataqua ILF site (ME04) – Access from Woodville Road. Meet just east of intersection with Birkdale Road where the river goes under the road.
POC: Robert Shafto, Town of Falmouth, 207-272-7403 or 207-781-5253, openspace@maine.rr.com 6/8 Spoke to someone from the town – assume is OK

OTHER ATTENDEES:
Jay Clement, NAE (tentative), 207-329-3950
Nancy Rendell, NH SSC, 603-856-6391
Scott Greenwood, UNH, 603-682-7603
Alexandra Evans, UNH, 603-264-6210

1:30 – 2:00 Drive to Biddeford

2:00 – 3:00 Field work at Clifford Park site (ME01) – There is a large area of city land but I was thinking we could use the stream on the east side (and/or a small stream on the west side). Meet in the parking lot on the south side of Pool St around 142-150 Pool St.
POC: Bill Durkin, City of Biddeford, 207-283-0925 or 207-284-9307, [redacted] - OK
OTHER ATTENDEES:
Jay Clement, NAE (tentative), 207-329-3950
Nancy Rendell, NH SSC, 603-856-6391
Scott Greenwood, UNH, 603-682-7603
Alexandra Evans, UNH, 603-264-6210

3:00 – 4:00 Drive to Dover, NH

4:00 – 5:00 Field work at Berry Brook ILF site (NH06). Meet at the end of Lowell Avenue (off Central Ave.)
POC: Bill Boulanger, City of Dover- [redacted]; Jamie Houle, UNH Stormwater Center - [redacted]; Tom Ballestero - [redacted] - OK
OTHER ATTENDEES:
Nancy Rendell, NH SSC, 603-856-6391
Mike Wierbonics, NAE, (603) 828-1627
Scott Greenwood, UNH, 603-682-7603
Alexandra Evans, UNH, 603-264-6210

5:00 – 6:00 Drive to Manchester

Stay in Manchester (298 Queen City Avenue – Comfort Inn Airport)

Thursday, June 15

8:00 -- 10:00 Field work at both McQuesten ~~Brook ILF~~ site (NH05) and McQuesten Brook Dam Removal ILF site (NH04). Meet at ~~907 Second~~ Street (McDonalds), Manchester for ~~the dam~~ site; at the Bagel Café at 19 South River Road, Bedford (junction with Wathen Road) for the brook site.
POC for the Brook: Michele L. Tremblay, NH Rivers Council, [redacted]; Jeff Foote, Town of Bedford, [redacted]
POC for the dam removals: Michele L. Tremblay, NH Rivers Council, [redacted]; Jay Davini, City of Manchester, [redacted] SENT EMAIL to ALL
OTHER ATTENDEES:

10:00 – 10:45 Drive to Russell Station Road, Francestown. Meet just west of access drive to farm on Russell Station Road, just before Woodward Hill Road.
10:45 – 11:45 Field work at Stewart ILF site (NH03) ✓
POC: Barry Wicklow, Anselm College, [illegible] – SENT EMAIL
OTHER ATTENDEES:

eliminated due to time constraints

11:45 – 12:30 Drive to Keene, NH – pick up lunch. Meet on Chapel Drive at the bottom of the hill (near where NH02 is shown on map).
12:30 – 1:30 Field work at Beaver Brook (NH01) ✗
1:30 – 2:30 Field work at Beaver Brook tributary (NH02) ✓
POC: Tara Kessler; City of Keene; [illegible] SENT EMAIL
OTHER ATTENDEES:

2:30 – 3:45 Drive to Readsboro, VT
3:45 – 4:45 Field work on West Branch Deerfield River and/or Deerfield River in town (VT03) ✓ trib →
POC:
OTHER ATTENDEES:

4:45 – 5:45 Drive to Hadley, MA
Stay in Hadley (24 Bay Road, Hampton Inn)

Friday, June 16

8:00 – 9:15 Drive to Barkhamsted (Riverton), CT. Meet at junction of West River Road and Legend Road. ✓
9:15 – 10:15 Field work in Farmington River, Barkhamstead (CT05)
POC:
OTHER ATTENDEES:
Lisa Krall, NRCS, (860) 207-0803 - TENTATIVE
10:15 – 11:30 Drive to Brookfield, CT. Meet in small parking lot on south side of Silvermine Road across from Dean Road.
11:30 – 12:30 Field work in Brookfield (CT01) ✓ Still River
POC: Dennis DiPinto Town of Brookfield, [illegible], 203-775-7321 – SENT EMAIL
OTHER ATTENDEES:
Lisa Krall, NRCS, (860) 207-0803 - TENTATIVE

12:30 – 1:30 Drive to Trumbull – pick up lunch. Meet at the Trumbull Transfer Station, 157R Spring Hill Road. ✓
1:30 – 2:30 Field work at Trumbull Transfer Station (CT02) EMAIL SENT
POC: Taylor Bell
OTHER ATTENDEES:
Lisa Krall, NRCS, (860) 207-0803 - TENTATIVE

NE 9, 7, 8, 10 Adirondack province
province Appalachian plateau
St Lawrence Valley

2:30 – 5:00 Drive to Concord, MA - Sarah and Bruce can drop Taylor and Ruth at our cars in Concord and use the van to go to a hotel (Embassy Suites, 550 Winter St, Waltham)

Monday, June 19

8:00 – 8:45 Pick up Taylor and Ruth and drive to Shrewsbury, MA. TENTATIVE MEETING LOCATION: Near MOOYAH Burgers at 10002 Shops Way which is the first left off Shops Way which is off Route 20 just north of Route 9.

8:45 – 9:45 Field work along Rt. 9 in Shrewsbury (MA02) 0.28 mi²
POC: Dan Vasconcelos & DOT – EMAIL SENT
OTHER ATTENDEES:
Dan Breen, NAE, 617-435-1308
Josh Helms, NAE, (508) 221-7055

9:45 – 10:45 Drive to East Bridgewater 0.48 mi²

10:45 – 11:45 Field work at Church Street Conservation Area-mitigation for Ridder Farm G.C. (MA05). Meet in parking lot of Church Street Conservation Area at about 80 Church Street.
POC: from ORM
OTHER ATTENDEES:
Dan Breen, NAE, 617-435-1308
Josh Helms, NAE, (508) 221-7055
Paul Sneeringer, NAE, (978) 995-6012

MA06 = 8.46
~~MA07~~ = ? both same

11:45 – 12:30 Drive to Plymouth – pick up lunch along the way

12:30 – 1:30 Field work on Town Brook in Plymouth (MA06 & ~~07~~). Meet on Off Billington Street
Very similar and behind schedule
POC: David Gould, Town of Plymouth Dept of Marine and Env Affairs, 508-747-1620 x127, dgould@townhall.plymouth.ma.us OK
OTHER ATTENDEES:
Dan Breen, NAE, 617-435-1308
Josh Helms, NAE, (508) 221-7055
Paul Sneeringer, NAE, (978) 995-6012

1:30 – 2:45 Drive to Lake Shore Drive, Warwick, RI. Meet at about 200 Lake Shore Drive.

2:45 – 3:45 Field work on Providence Airport site (RI02) 1.91 mi²
POC: from ORM
OTHER ATTENDEES:
Dan Breen, NAE, 617-435-1308

3:34 – 4:30 Drive to Burrillville, RI. Meet at junction of Border Trail with Pulaski Road (RI)/Elmwood Hill Road (CT). It is actually in CT and is just west of where Keach Brook goes under the road.

4:30 – 5:30 Field work at Pulaski State Park (RI01) 2.29
POC:

OTHER ATTENDEES:

5:30 – 5:45 Drive to 17 Tracy Road, Dayville, CT (Comfort Inn and Suites)
Stay in Dayville

Tuesday, June 20

8:00 – 8:45 Drive to Storrs. Meet in parking lot off Tower Loop Road (off Storrs Rd. Rt. 195), north side
8:45 – 9:45 Field work near UConn (CT10) 0.09
POC: Sent email to Ferri, Paul [illegible]
[illegible], to verify on-site and attendance - OK
OTHER ATTENDEES:
Dan Breen, NAE, 617-435-1308
Lisa Krall, NRCS, (860) 207-0803 - TENTATIVE

9:45 – 10:30 Drive to Bloomfield. Meet at junction of Blue Hills Ave and Mustad Road
10:30 – 11:30 Field work in Bloomfield (CT09) 0.93
POC: from ORM
OTHER ATTENDEES:
Dan Breen, NAE, 617-435-1308
Lisa Krall, NRCS, (860) 207-0803 - TENTATIVE

11:30 – 1:00 Drive to Cheshire – get lunch along the way. Meet at about 973 Bethany Mountain Road (Rt. 42). It's sort of across from 1200 BMR.
2:00 – 3:00 Field work in Naugatuck Forest in Cheshire (CT06) 0.2
POC:
OTHER ATTENDEES:
Dan Breen, NAE, 617-435-1308
Lisa Krall, NRCS, (860) 207-0803 - TENTATIVE

3:00 – 3:15 Drive to Waterbury
3:15 – 4:15 Field work in Waterbury (CT04) 218
POC: Susan Lee DOT ~~Project~~
OTHER ATTENDEES:
Dan Breen, NAE, 617-435-1308
Lisa Krall, NRCS, (860) 207-0803 - TENTATIVE
Stay in Waterbury (63 Grand St, Courtyard by Marriott – all but Bruce)

Wednesday, June 21

8:00 - 9:00 Meet at the Jonathan Reed School, end of Robinson ~~St (off~~ Griggs St.).
Field work at the Jonathan Reed School, Waterbury (CT03) 1.96
POC: from ORM We MUST get permission since this is at a school
OTHER ATTENDEES:
Lisa Krall, NRCS, (860) 207-0803 - TENTATIVE

9:00 – 12:30 Drive to Okemo Ski Area, VT – pick up lunch. Meet at the Jackson Gore Inn on the Okema Mountain Resort (off Rt. 103)

12:30 – 1:30 Field work at Okemo State Forest (VT04) 0.13 3.8'
POC: Tim Morton, Stewardship Forester with state (802-777-6899, [illegible]) said OK. 6/9 – Mike Adams will contact Andrew Becker, ski area POC
OTHER ATTENDEES:
Beth Alafat, EPA
John Connell, NAN, 802-733-7054
*Nancy Rendell, NH SSC, 603-856-6391
Angela Repella, NAE, (508) 308-5607
Mike Adams, NAE, (802) 598-1038

1:30 – 2:00 Drive to Reading/Cavendish. Meet at Dame for Knapp Brook Ponds which is at about 1101 Knapp Pond Rod (before it becomes Chaos Turnpike – LOVE the name!)

2:00 – 3:00 Field work at Knapp Brook Wildlife Management Area (VT05) 2.88
POC: Tim Morton, Stewardship Forester with state (802-777-6899, [illegible]) said OK 17'
OTHER ATTENDEES:
*Beth Alafat, EPA
John Connell, NAN, 802-733-7054
*Nancy Rendell, NH SSC, 603-856-6391
Angela Repella, NAE, (508) 308-5607

3:00 – 5:00 Drive to Middlebury
Stay in Middlebury, VT (309 Court St, Courtyard by Marriott)

Thursday, June 22

(79)

8:00 – 9:00 Meet at the junction of Creek Road and 3 Mile Bridge Road.
Field work at 3 Mile Bridge Road ILF site (VT02) 62.9 80'
POC: Ed Farley, DU, [illegible] or John Fraser, DU, (315) 453-8025 or (315) 730-0488, [illegible]
OTHER ATTENDEES:
*Beth Alafat, EPA *Mike Adams
(Nancy Rendell, NH SSC, 603-856-6391)
*Angela Repella, NAE, (508) 308-5607

9:00 – 10:30 Drive to Swanton. Meet in the ~~parking~~ lot at 325 North River St (Rt. 78).

10:30 – 11:30 Field work at Missisquoi NWR (VT01) 6 → 25'
POC: Refuge Manager
OTHER ATTENDEES:
Beth Alafat, EPA
Nancy Rendell, NH SSC, 603-856-6391
Angela Repella, NAE, (508) 308-5607

11:30 – 1:00 Drive to Jay, VT - get lunch in Swanton. Meet in the parking lot for the Jay Peak Resort Golf Course on Clubhouse Road off Jay Peak Road.

1:00 – 2:00 Field work at Jay Peak Ski Resort (VT06) 0.63 → 8'
POC: from ORM
OTHER ATTENDEES:
Beth Alafat, EPA
Nancy Rendell, NH SSC
Angela Repella, NAE, (508) 308-5607

2:00 – 4:00 Drive to Lebanon, NH
Stay in Lebanon, NH (10 Morgan Drive, Courtyard by Marriott)

Friday, June 23

8:00 – 10:00 Drive Andover, MA. Meet at 49 Lupine Road (apartment complex), just north of intersection with Central Street.

10:00 – 11:00 Field work at Shawsheen River in Andover (MA04) 69.1 W= 82' VTRC
POC: Michael Perrault 505-378-3421 Left a message and told him our intentions, USACE Project
OTHER ATTENDEES:
Ed Reiner, EPA, 978-376-4449
Josh Helms, NAE, (508) 221-7055
Jackie LeClair, EPA, 857-243-0811

11:00 – 12:00 Drive to Bedford, MA – pick up lunch. At the back of the Shawsheen Cemetery. The entrances are off Rts 4 & 225 (The Great Road) and Shawsheen Road. Go to the far east corner.

12:00 – 1:00 Field work behind Shawsheen Cemetery, Bedford (MA03) 0.17 W= 4.3
POC: Elizabeth Bagdonas, Bedford Conservation Agent, (781) 275-6211, elizabethb@bedfordma.gov NOTE: I already spoke with her and she gave the OK (rml)
OTHER ATTENDEES:
Ed Reiner, EPA, 978-376-4449
Jackie Leclair, EPA
Josh Helms, NAE, (508) 221-7055

1:00 – 2:00 Drive to Logan Airport. Sarah: American #2149 leaving 5:00 pm

Appendix G. SVAP2 Element Tables for field reference

Natural, stable channel with established bank vegetation	**If channel is incising (appears to be downcutting or degrading), score this element based on the descriptions in the upper section of the matrix**		
No discernible signs of incision (such as vertical banks) or aggradation (such as very shallow multiple channels) Active channel and flood plain are connected throughout reach, and flooded at natural intervals Streambanks low with few or no bank failures Stage I : Score 10 Stage V: Score 9 (if terrace is visible) No more than 1 bar forming in channel	Evidence of past incision and some recovery; some bank erosion possible Active channel and flood plain are connected in most areas, inundated seasonally Streambanks may be low or appear to be steepening Top of point bars are below active flood plain Stage I: Score 8 Stage V: Score 7–8 Stage IV: Score 6	Active incision evident; plants are stressed, dying or falling in channel Active channel appears to be disconnected from the flood plain, with infrequent or no inundation Steep banks, bank failures evident or imminent Point bars located adjacent to steep banks Stage IV: Score 5 Stage III: Score 4 Stage II: Score 3	Headcuts or surface cracks on banks; active incision; vegetation very sparse Little or no connection between flood plain and stream channel and no inundation Steep streambanks and failures prominent Point bars, if present, located adjacent to steep banks Stage II or III, scores ranging from 2 to 0, depending on severity
	8 7 6	5 4 3	2 1 0
	If channel is aggrading (appears to be filling in and is relatively wide and shallow), score this element based on the descriptions in the lower section of the matrix		
	Minimal lateral migration and bank erosion A few shallow places in reach, due to sediment deposits Minimal bar formation (less than 3)	Moderate lateral migration and bank erosion Deposition of sediments causing channel to be very shallow in places 3–4 bars in channel	Severe lateral channel migration, and bank erosion Deposition of sediments causing channel to be very shallow in reach Braided channels (5 or more bars in channel)
10 9	8 7 6	5 4 3	2 1 0

Hydrologic Alteration (Element 2)

Bankfull or higher flows occur according to the flow regime that is characteristic of the site, generally every 1 to 2 years **and** No dams, dikes, or development in the flood plain[1/], or water control structures are present **and** natural flow regime[2/] prevails	Bankfull or higher flows occur only once every 3 to 5 years or less often than the local natural flow regime Developments in the flood plain, stream water withdrawals, flow augmentation, or water control structures may be present, but do not significantly alter the natural flow regime[2/]	Bankfull or higher flows occur only once every 6 to 10 years, or less often than the local natural flow regime Developments in the flood plain, stream water withdrawals, flow augmentation, or water control structures alter the natural flow regime[2/]	Bankfull or higher flows rarely occur Stream water withdrawals completely dewater channel; and/or flow augmentation, stormwater, or urban runoff discharges directly into stream and severely alters the natural flow regime[2/]
10 9	8 7 6	5 4 3	2 1 0

1/ Development in the flood plain refers to transportation infrastructure (roads, railways), commercial or residential development, land conversion for agriculture or other uses, and similar activities that alter the timing, concentration, and delivery of precipitation as surface runoff or subsurface drainage.

2/ As used here, "natural flow regime" refers to streamflow patterns unaffected by water withdrawals, flood plain development, agricultural or wastewater effluents, and practices that change surface runoff (dikes and levees) or subsurface drainage (tile drainage systems).

Bank Condition (Element 3)

Banks are stable; protected by roots of natural vegetation, wood, and rock [1/] No fabricated structures present on bank No excessive erosion or bank failures [2/] No recreational or livestock access		Banks are moderately stable, protected by roots of natural vegetation, wood, or rock or a combination of materials Limited number of structures present on bank Evidence of erosion or bank failures, some with reestablishment of vegetation Recreational use and/or grazing do not negatively impact bank condition	Banks are moderately un- stable; very little protection of banks by roots of natural wood, vegetation, or rock Fabricated structures cover more than half of reach or entire bank Excessive bank erosion or active bank failures Recreational and/or live- stock use are contributing to bank instability	Banks are unstable; no bank protection with roots, wood, rock, or vegetation Riprap and/or other structures dominate banks Numerous active bank failures Recreational and/or livestock use are contributing to bank instability
Right Bank	10 9	8 7 6	5 4 3	2 1 0
Left Bank	10 9	8 7 6	5 4 3	2 1 0

1/ Natural wood and rock does not mean riprap, gabions, log cribs, or other fabricated revetments. 2/ Bank failure refers to a section of streambank that collapses and falls into the stream, usually because of slope instability.

Riparian Area Quantity (Element 4)

Natural plant community extends at least two bank-full widths or more than the entire active flood plain and is generally contiguous throughout property		Natural plant com-munity extends at least one bankfull width or more than 1/2 to 2/3 of active flood plain and is generally contiguous throughout property Vegetation gaps do not exceed 10% of the estimated length of the stream on the property	Natural plant com-munity extends at least 1/2 of the bank-full width or more than at least 1/2 of active flood plain Vegetation gaps do not exceed 30% of the estimated length of the stream on the property	Vegetation gaps do not exceed 10% of the estimated length of the stream on the property Vegetation gaps exceed 30% of the estimated length of the stream on the property	Natural plant community extends less than 1/3 of the bankfull width or less than 1/4 of active flood plain Vegetation gaps exceed 30% of the estimated length of the stream on the property
Right Bank	10 9	8 7	6 5	4 3 2	1 0
Left Bank	10 9	8 7	6 5	4 3 2	1 0

Note: Score each bank separately. Scores should represent the entire stream riparian area within the property. Score for this element = left bank score plus right bank score divided by 2. If the score of one bank is 7 or greater and the score of the other bank is 4 or less, subtract 2 points from final score.

Riparian Area Quality (Element 5)

Natural and diverse riparian vegetation with composition, density and age structure appropriate for the site No invasive species or concentrated flows through area		Natural and diverse riparian vegetation with composition, density and age structure appropriate for the site: Little or no evidence of concentrated flows through area Invasive species present in small numbers (20% cover or less)	Natural vegetation compromised Evidence of concentrated flows running through the riparian area Invasive species common (>20% <50% cover)	Little or no natural vegetation Evidence of concentrated flows running through the riparian area Invasive species wide-spread (>50% cover)
Right Bank	10 9	8 7 6	5 4 3	2 1 0
Left Bank	10 9	8 7 6	5 4 3	2 1 0

Notes: Score should represent the entire stream riparian area within the property. Score for this element = left bank score plus right bank score divided by 2.

Canopy Cover (Element 6)

(a) Cold water streams

>75% of water surface shaded within the length of the stream in landowner's property	75–50% of water surface shaded within the length of the stream in land- owner's property	49–20% of water surface shaded within the length of the stream in land- owner's property	<20% of water surface shaded within the length of the stream in land- owner's property
10 9	8 7 6	5 4 3	2 1 0

(b) Warm water streams

50–75% of water surface shaded within the length of the stream in landowner's property	>75% of water surface shaded within the length of the stream in landowner's property	49–20% of water surface shaded within the length of the stream in landowner's property	<20% of water surface shaded within the length of the stream in landowner's property
10 9	8 7 6	5 4 3	2 1 0

Water Appearance (Element 7)

Water is very clear, or clarity appropriate to site; submerged features in stream (rocks, wood) are visible at depths of 3 to 6 feet No motor oil sheen on surface; no evidence of metal precipitates in streams	Water is slightly turbid, especially after storm event, but clears after weather clears; submerged features in stream (rocks, wood) are only visible at depths of 1.5 to 3 feet No motor oil sheen on surface or evidence of metal precipitates in stream	Water is turbid most of the time; submerged features in stream (rocks, wood) are visible at depths of only .5 to 1.5 feet **and/or** Motor oil sheen is present on water surface or areas of slackwater **and/or** There is evidence of metal precipitates in stream	Very very turbid water most of the time; submerged features in stream (rocks, wood) are visible only within .5 feet below surface and/or Motor oil sheen is present on the water surface or areas of slackwater
10 9 8	7 6 5	4 3 2	1 0

Nutrient Enrichment (Element 8)

Clear water along entire reach Little algal growth present	Fairly clear or slightly greenish water Moderate algal growth on substrates	Greenish water particularly in slow sections Abundant algal growth, especially during warmer months **and/or** Slight odor of ammonia or rotten eggs **and/or** Sporadic growth of aquatic plants within slack water areas	Pea green color present; thick algal mats dominating stream **and/or** Strong odor of ammonia or rotten eggs **and/or** Dense stands of aquatic plants widely dispersed
10 9	8 7 6	5 4 3	2 1 0

Manure or Human Waste Presence (Element 9)

Livestock do not have access to stream No pipes or concentrated flows discharging animal waste or sewage directly into stream	Livestock access to stream is controlled and/or limited to small watering or crossing areas No pipes or concentrated flows discharging animal waste or sewage directly into stream	Livestock have unlimited access to stream during some portion of the year Manure is noticeable in stream **and/or** Pipes or concentrated flows discharge treated animal waste or sewage directly into stream	Livestock have unlimited access to stream during entire year Manure is noticeable in stream and/or Pipes or concentrated flows discharge untreated animal waste or sewage directly into stream
10 9	8 7 6	5 4 3	2 1 0

(a) Low Gradient

More than two deep pools separated by riffles, each with greater than 30% of the pool bottom obscured by depth, wood, or other cover Shallow pools also present	One or two deep pools separated by riffles, each with greater than 30% of the pool bottom obscured by depth wood, or other cover At least one shallow pool present	Pools present but shallow (<2 times maximum depth of the upstream riffle) Only 10–30% of pool bottoms are obscured due to depth or wood cover	Pools absent, but some slow water habitat is available No cover discernible **or** Reach is dominated by shallow continuous pools or slow water
10 9	8 7 6	5 4 3	2 1 0

(b) High Gradient

More than three deep pools separated by boulders or wood, each with greater than 30% of the pool bottom obscured by depth, wood, or other cover. For small streams, pool bottoms may not be completely obscured by depth, but pools are deep enough to provide adequate cover for resident fish Shallow pools also present	Two to three deep pools, each with greater than 30% of the pool bottom obscured by depth wood or other cover; at least one shallow pool present. For small streams, pool bottoms may not be completely obscured by depth, but pools are deep enough to provide some cover for resident fish At least one shallow pool also present	Pools present but relatively shallow, with only 10–30% of pool bottoms obscured by depth or wood cover. For small streams, pool bottoms may not be completely obscured by depth, but pools are deep enough to provide minimal cover for resident fish No shallow pools present	Pools absent
10 9	8 7 6	5 4 3	2 1 0

Barriers to Aquatic Species Movement (Element 11)

No artificial barriers that prohibit movement of aquatic organisms during any time of the year	Physical structures, water withdrawals and/ or water quality season- ally restrict movement of aquatic species	Physical structures, water withdrawals and/ or water quality restrict movement of aquatic species throughout the year	Physical structures, water withdrawals and/ or water quality prohibit movement of aquatic species
10	9 8 7	6 5 4 3	2 1 0

Fish Habitat Complexity (Element 12)

Ten or more habitat features available, at least one of which is considered optimal in reference sites (large wood in forested streams)	Eight to nine habitat features available	Six to seven habitat features available	Four to five habitat features available	Less than four habitat features available
10 9	8 7	6 5	4 3	2 1 0

Note: Fish habitat features: logs/large wood, deep pools, other pools (scour, plunge, shallow, pocket) overhanging vegetation, boulders, cobble, riffles, undercut banks, thick root mats, dense macrophyte beds, backwater pools, and other off-channel habitats

Aquatic Invertebrate Habitat (Element 13)

At least 9 types of habitat present A combination of wood with riffles should be present and suitable in addition to other types of habitat (If nonforested stream, consider reference site's optimal habitat type needed for this high score)	8 to 6 types of habitat Site may be in need of more wood or reference habitat features and stable wood-riffle sections	5 to 4 types of habitat present	3 to 2 types of habitat present	None to 1 type of habitat present
10 9	8 7 6	5 4	3 2	1 0

Note: Aquatic invertebrate habitat types, in order of importance: Logs/large wood, cobble within riffles, boulders within riffles. Additional habitat features should include: leaf packs, fine woody debris, overhanging vegetation, aquatic vegetation, undercut banks, pools, and root mats.

Aquatic Invertebrate Community (Element 14)

Invertebrate community is diverse and well represented by group I or intolerant species One or two species do not dominate	Invertebrate community is well represented by group II or facultative species, and group I species are also present One or two species do not dominate	Invertebrate community is composed mainly of groups II and III **and/or** One or two species of any group may dominate	Invertebrate community composition is predominantly group III species **and/or** only one or two species of any group is present and abundance is low
10 9 8	7 6 5	4 3 2	1 0

Riffle Embeddedness (Element 15)

Gravel or cobble substrates are <10% embedded	Gravel or cobble substrates are 10–20% embedded	Gravel or cobble substrates are 21–30% embedded	Gravel or cobble substrates are 31–0% embedded	Gravel or cobble substrates are >40% embedded
10 9	8 7	6 5	4 3	2 1 0

Narrative Criteria updated April 2018, S.J. Miller

No wilting, bleaching, leaf burn, or stunting of riparian vegetation; No streamside salt-tolerant vegetation present Little or no development in basin upstream, little or no deicing of impervious surfaces (e.g., seasonal use highways only, or plowing only) Little or no irrigation agriculture return drainage upstream	Minimum wilting, bleaching, leaf burn, or stunting of riparian vegetation; Some salt-tolerant streamside vegetation Some development with impervious surfaces upstream, small settlements only with deicing of roads, bridges and parking areas, villages without heavy industry No direct roadside drainage or bridge crossings Some stormwater or deicing control (bridge washing with removal, covered sand and salt storage, stormwater treatment BMPs) Little or no irrigation agriculture return drainage upstream	Riparian vegetation may show significant wilting, bleaching, leaf burn, or stunting; Dominance of salt-tolerant streamside vegetation Significant urban development upstream and/or adjacent to stream, dense road networks and/or larger towns or urban areas, industrial areas and extensive areas needing deicing Direct roadside drainage or bridge crossings No stormwater controls or BMPs Direct irrigation agriculture return drainage	Severe wilting, bleaching, leaf burn, or stunting; Presence of only salt tolerant riparian vegetation is salt tolerant Development, urbanization, no stormwater controls, significant direct drainage from roads, bridges and paved surfaces, direct irrigation returns combined with evidence of salt damages to vegetation or a significant refractometer direct reading
10 9 8	7 6 5	4 3	2 1 0

Appendix H. Qualitative List of Plants Tabulated by State and Station Identification

Appendix H-1. Qualitative list of plants observed at Connecticut stream assessment stations.

CT01

Common Name	Species	Status
Norway maple	Acer platanoides	UPL
Red maple	Acer rubrum	FAC
Silver maple	Acer saccharinum	FACW
Mugwort	Artemisia sp.	FACU
Japanese barberry	Berberis thunbergii	FACU
Ironwood	Carpinus caroliniana	FAC
Catalpa	Catalpa bignonioides	FACU
Bittersweet	Celastrus orbiculatus	UPL
Silky dogwood	Cornus amomum	FACW
Russian olive	Elaeagnus angustifolia	FACU
Witch hazel	Hamamelis virginiana	FACU
Jewelweed	Impatiens capensis	FACW
Yellow iris	Iris pseudacorus	OBL
Honeysuckle - shrub	Lonicera sp.	FACU
Sycamore	Platanus occidentalis	FACW
Glossy buckthorn	Rhamnus frangula	FAC
Multiflora rose	Rosa multiflora	FACU
Nettle	Urtica sp.	FACU

CT02

Common Name	Species	Status
Red maple	Acer rubrum	FAC
Tree of heaven	Ailanthus altissima	UPL
Bittersweet	Celastrus orbiculatus	UPL
Japanese knotweed	Fallopia japonica	FACU
White ash	Fraxinus americana	FACU
Honeysuckle - shrub	Lonicera sp.	FACU
Virginia creeper	Parthenocissus quinquefolia	FACU
White pine	Pinus strobus	FACU
Red oak	Quercus rubra	FACU
Multiflora rose	Rosa multiflora	FACU
Willow	Salix sp.	FACW
Poison Ivy	Toxicodendron radicans	FAC

CT03

Common Name	Species	Status
Norway maple	Acer platanoides	UPL
Red maple	Acer rubrum	FAC
Sugar maple	Acer saccharum	FACU
Tree of heaven	Ailanthus altissima	UPL
Ragweed	Ambrosia sp.	
Chokeberry	Aronia sp.	
Mugwort	Artemisia sp.	
Grey birch	Betula populifolia	FAC
Bittersweet	Celastrus orbiculatus	UPL
Sweet pepperbush	Clethra alnifolia	FAC
Dogwood	Cornus sp.	
Horsetail	Equisetum sp.	
Japanese knotweed	Fallopia japonica	
Winterberry	Ilex verticillata	FACW
Purple loosestrife	Lythrum salicaria	OBL
Smartweed	Persicaria sp.	
Common reed	Phragmites australis	FACW
Swamp white oak	Quercus bicolor	FACW
Red oak	Quercus rubra	FACU
Black willow	Salix nigra	OBL
Elderberry	Sambucus nigra	FACW
Steeplebush	Spiraea tomentosa	FACW
Spiderwort	Tradescantia virginiana	UPL
Narrowleaf cattail	Typha angustifolia	OBL
blueberry	Vaccinium corymbosum	FACW

CT04

Common Name	Species	Status
Red maple	Acer rubrum	FAC
Silver maple	Acer saccharinum	FACW
Crabgrass	Digitaria sp.	FACU
Japanese knotweed	Fallopia japonica	
Tulip tree	Liriodendron tulipifera	FACU
Purple loosestrife	Lythrum salicaria	OBL
Pokeweed	Phytolacca americana	FACU
Willow	Salix sp.	FACW

Appendix H -1. Qualitative list of plants observed at Connecticut stream assessment stations (continued).

CT05		
Common Name	**Species**	**Status**
Sugar maple	Acer saccharum	FACW
Speckled alder	Alnus incana	FACW
Sarsaparilla	Aralia nudicaulis	FACU
Jack-in-the-pulpit	Arisaema triphyllum	FAC
Aster	Aster sp.	UPL
Lady Fern	Athyrium angustum	FAC
Japanese barberry	Berberis thunbergii	FACU
Yellow birch	Betula alleghaniensis	FAC
Silky dogwood	Cornus amomum	FACW
Corkbark euonymus	Euonymus alatus	FAC
American beech	Fagus grandifolia	FACU
White ash	Fraxinus americana	FACU
Mountain holly	Nemopanthus mucronatus	OBL
Jewelweed	Impatiens capensis	FACW
Canada mayflower	Maianthemum canadense	FACU
False Solomon's Seal	Maianthemum racemosum	FACU
Massachusetts fern	Parathelypteris simulata	FACW
Virginia creeper	Parthenocissus quinquefolia	FAC
White pine	Pinus strobus	FACU
Christmas fern	Polystichum acrostichoides	FACU
Wild black cherry	Prunus serotina	FACU
Red raspberry	Rubus idaeus	FACU
Basswood	Tilia americana	FACU
Poison Ivy	Toxicodendron radicans	FAC
Trillium	Trillium sp.	FACU
Eastern hemlock	Tsuga canadensis	FACU
American elm	Ulmus americana	FACW
Nettle	Urtica sp.	FAC
False hellebore	Veratrum viride	FACW
maple	Viburnum lananoides	FACU

CT06		
Common Name	**Species**	**Status**
Red maple	Acer rubrum	FAC
Sugar maple	Acer saccharum	FACU
Wood aster	Aster sp.	
Yellow birch	Betula alleghaniensis	FAC
Black birch	Betula lenta	FACU
Horsetail	Equisetum sp.	
Corkbark euonymus	Euonymus alatus	
Spice bush	Lindera benzoin	FACW
Princess pine	Lycopodium obscurum	
Canada mayflower	Maianthemum canadense	FACU
False Solomon's seal	Maianthemum racemosum	FACU
Virginia creeper	Parthenocissus quinquefolia	FACU
Christmas fern	Polystichum acrostichoides	FACU
Red oak	Quercus rubra	FACU
Skunk cabbage	Symplocarpus foetidus	OBL
New York fern	Thelypteris novaboracensis	FACW
Poison ivy	Toxicodendron radicans	FAC
Wakerobin	Trillium sp.	FACU
Highbush blueberry	Vaccinium corymbosum	FACW
Violet	Viola sp.	

CT09		
Common Name	**Species**	**Status**
Red maple	Acer rubrum	FAC
Mugwort	Artemisia vulgaris	UPL
Shallow sedge	Carex lurida	OBL
Sedge	Carex sp.	OBL
Bedstraw	Galium sp.	FACU
Jewelweed	Impatiens capensis	FACW
Soft rush	Juncus effusus	OBL
Purple loosestrife	Lythrum salicaria	OBL
Sensitive fern	Onoclea sensibilis	FACW
Virginia creeper	Parthenocissus quinquefolia	FACU
Multiflora rose	Rosa multiflora	FACU
Elderberry	Sambucus nigra	FACW
Pink clover	Trifolium pratense	FACU
Cattail	Typha latifolia	OBL
Cow vetch	Vicia cracca	FACU
Grape vine	Vitis sp.	FACW
Unknown grass		UPL

CT10		
Common Name	**Species**	**Status**
Red maple	Acer rubrum	FAC
Jack-in-the-pulpit	Arisaema triphyllum	FAC
nightshade	Solanum dulcamara	FAC
Japanese barberry	Berberis thunbergii	FACU
Yellow birch	Betula alleghaniensis	FAC
White ash	Fraxinus americana	FACU
Jewelweed	Impatiens capensis	FACW
Sensitive fern	Onoclea sensibilis	FACW
Virginia Creeper	Parthenocissus quinquefolia	FACU
Common reed	Phragmites australis	FACW
Christmas fern	Polystichum acrostichoides	FACU
Multiflora rose	Rosa multiflora	FACU
Blackberry	Rubus sp.	FAC
Bittersweet	Celastrus orbiculata	UPL
Goldenrod	Solidago sp.	FACU
Basswood	Tilia americana	FACU
Poison Ivy	Toxicodendron radicans	FAC
American elm	Ulmus americana	FACW
Viburnum	Viburnum sp.	

Appendix H -2. Qualitative list of plants observed at Massachusetts stream assessment stations.

MA02

Common Name	Species	Status
Bittersweet nightshade	Solanum dulcamara	FAC
Japanese barberry	Berberis thunbergii	FACU
Yellow birch	Betula alleghaniensis	FAC
Sedge	Carex sp.	FACW
Mockernut hickory	Carya tomentosa	UPL
Bittersweet	Celastrus orbiculatus	UPL
Green ash	Fraxinus pennsylvanica	FACW
Mannagrass	Glyceria sp.	OBL
Winterberry	Ilex verticillata	FACW
Jewelweed	Impatiens capensis	FACW
Honeysuckle - shrub	Lonicera sp.	FACU
Skunk Cabbage	Symplocarpus foetidus	OBL
Cinnamon fern	Osmundastrum cinnamomeum	FACW
Goldenrod species	Solidago sp.	FACU
Basswood	Tilia americana	FACU
Poison Ivy	Toxicodendron radicans	FAC
American elm	Ulmus americana	FACW

MA03

Common Name	Species	Status
Buckthorn	Rhamnus cathartica	FAC
Spicebush	Lindera benzoin	FACW
Ash	Fraxinus sp.	FACW
Jewelweed	Impatiens capensis	FACW
Skunk cabbage	Symplocarpus foetidus	OBL
White pine	Pinus strobus	FACU
Wood fern	Dryopteris marginalis	FACU
Cinnamon fern	Osmundastrum cinnamomeum	FACW
American elm	Ulmus americana	FACW
Red oak	Quercus rubra	FACU
Soft needle rush	Juncus sp.	OBL
Multiflora rose	Rosa multiflora	FACU
Jack-in-the-pulpit	Arisaema triphyllum	FAC
Canada mayflower	Maianthemum canadense	FACU
Gold thread	Coptis trifolia	FACW

MA04

Common Name	Species	Status
Norway maple	Acer platanoides	UPL
Red maple	Acer rubrum	FAC
Dogwood	Cornus sp.	FAC
Joe pye weed	Eutrochinum purpureum	FAC
Ash	Fraxinus sp.	FACW
Winterberry	Ilex verticillata	FACW
vine?	Lonicera japonica	FACU
False Solomon's Seal	Maianthemum racemosum	FACU
Sensitive fern	Onoclea sensibilis	FACW
Red oak	Quercus rubra	FACU
White pine	Pinus strobus	FACU
Japanese knotweed	Fallopia japonica	FAC
Black cherry	Prunus serotina	FACU
glossy?	Rhamnus cathartica	FAC
Multiflora rose	Rosa multiflora	FACU
Blackberry	Rubus sp.	FAC
Bittersweet	Solanum dulcamara	FAC
goldenrod	Solidago rugosa	FAC
Tall meadow-rue	Thalictrum dasycarpum	FACW
Poison Ivy	Toxicodendron radicans	FAC
Southern arrowwood	Viburnum dentatum	FAC
Grape vine	Vitis sp.	FAC

MA05

Common Name	Species	Status
Red maple	Acer rubrum	FAC
Aster	Aster sp.	FAC
Shallow sedge	Carex lurida	OBL
Bittersweet	Celastrus orbiculatus	UPL
pepperbush	Clethra alnifolia	FAC
Orchard grass	Dactylis glomerata	FACU
Hayscented fern	Dennstaedtia punctilobula	UPL
White pine	Pinus strobus	FAC
buckthorn	Rhamnus frangula	FAC
Multiflora rose	Rosa multiflora	FACU
Red raspberry	Rubus sp.	FACU
Elderberry	Sambucus nigra	FACW
Greenbrier	Smilax sp.	FAC
Goldenrod	Solidago sp.	FACU
Basswood	Tilia americana	FACU
Lawn grasses		UPL

MA06

Common Name	Species	Status
Speckled alder	Alnus incana	FACW
Shallow sedge	Carex lurida	OBL
pepperbush	Clethra alnifolia	FAC
dogwood	Cornus alba	FACW
Umbrella sedge	Cyperus sp.	FACW
Waterwillow	Decodon verticillatus	OBL
Deer-tongue grass	Dichanthelium clandestinum	FACW
Jewelweed	Impatiens capensis	FACW
Soft rush	Juncus effusus	OBL
Bush clover	Lespedeza sp.	FAC
Purple loosestrife	Lythrum salicaria	OBL
Yellow water-lily	Nuphar advena	OBL
Black gum	Nyssa sylvatica	FAC
Smartweed	Persicaria sp.	FAC
Common reed	Phragmites australis	FACW
Willows	Salix spp.	FACW
Goldenrods	Solidago sp.	FAC
arrowwood	Viburnum dentatum	FAC
Nettle	Urtica sp.	FACU
Misc. grass		UPL

Appendix H -3. Qualitative list of plants observed at Maine stream assessment stations.

ME01		
Common Name	**Species**	**Status**
Norway maple	Acer platanoides	UPL
Horsetail	Equisetum sp.	FACW
Boxelder	Acer negundo	FACW
Poison ivy	Toxicodendron radicans	FACW
Silky dogwood	Cornus amomum	FACW

ME02		
Common Name	**Species**	**Status**
Virginia creeper	Parthenocissus quinquifolia	FACU
Spicebush	Lindera benzoin	FACW
Royal fern	Osmunda spectabilis	OBL
Sensitive fern	Onoclea sensibilis	FACW
Maple	Acer sp.	FACU
Cinnamon fern	cinnamomeum	FACW

ME04		
Common Name	**Species**	**Status**
Box elder	Acer negundo	FAC
Red maple	Acer rubrum	FAC
American elm	Ulmus americana	FACW
Green ash	Fraxinus pennsylvanica	FACW

ME05		
Common Name	**Species**	**Status**
Sensitive fern	Onoclea sensibilis	FACW
Speckled alder	Alnus incana	FACW
Gray birch	Betula populifolia	FAC
Moosewood	Acer pensylvanicum	FACU
White pine	Pinus strobus	FACU
Goldenrod	Solidago sp	FACU
Steeplebush	Spiraea tomentosa	FACW
Pickerelweed	Pontederia cordata	OBL
Elderberry	Sambucus nigra	FACW

ME06		
Common Name	**Species**	**Status**
Boxelder	Acer negundo	
English ivy	Hedera helix	FACU
American elm	Ulmus americana	FACW
Sensitive fern	Ococlea sensibilis	FACW
Willow	Salix sp.	FACW
Grape	Vitis sp.	FACW
Virginia creeper	Parthenocissus quinquifolia	FACU
Honeysuckle	Lonicera sp.	FAC
Bittersweet nightshade	Solanum dulcamara	FAC
Jewelweed	Impatiens capensis	FACW

ME07		
Common Name	**Species**	**Status**
Poison ivy	Toxicodendron radicans	FAC
Burdock	Arctium minus	FACU
Jewelweed	Impatiens capensis	FACW
Boxelder	Acer negundo	FACW
Red maple	Acer rubrum	FACW
Willow	Salix sp	FACW
Elderberry	Sambucus nigra	FACW
Moosewood	Acer pensylvanicum	FACU
American elm	Ulmus americana	FACW
Grape	Vitis sp.	FACW

ME08		
Common Name	**Species**	**Status**
Royal fern	Osmunda spectabilis	OBL
Yellow birch	Betula allegheniensis	FAC
Canadian hemlock	Tsuga canadensis	FACU
Sensitive fern	Onoclea sensibilis	FACW
Bracken fern	Pteridium aquilinum	FACU
Goldthread	Coptis trifolia	FACW

ME09		
Common Name	**Species**	**Status**
Willow	Salix sp.	FACW
Speckled alder	Alnus rugosa	FACW
Hawkweed	Hieracium sp.	FACU
Red clover	Trifolium pratense	FACU
Cow vetch	Vicia cracca	UPL

Appendix H -4. Qualitative list of plants observed at New Hampshire stream assessment stations.

NH02

Common Name	Species	Status
Common yarrow	Achillea millefolium	FACU
Mustard	Brassicaceae	UPL
Silky dogwood	Cornus amomum	FACW
Deer tongue grass	Dichanthelium clandestinum	FACW
Joe-pye-weed	Eutrochium purpureum	FAC
Jewelweed	Impatiens capensis	FACW
Morning glory	Ipomoea sp.	FACU
Sensitive fern	Onoclea sensibilis	FACW
Virginia creeper	Parthenocissus quinquefolia	FAC
Goldenrod	Solidago spp.	FACU
Tall meadow-rue	Thalictrum dasycaroum	FACW
Common mullein	Verbascum thapsus	UPL

NH03

Common Name	Species	Status
Red maple	Acer rubrum	FAC
Sedge	Carex crinita	OBL
Gray's sedge	Carex grayi	FACW
Sedge	Carex sp.	FACW
Virgin's bower	Clematis virginiana	FAC
Winterberry	Ilex verticillata	FACW
Sensitive fern	Onoclea sensibilis	FACW
Royal fern	Osmunda spectabilis	OBL
New York fern	Parathelypteris noveboracensis	FAC
Virginia creeper	Parthenocissus quinquefolia	FACU
Eastern cottonwood	Populus deltoides	FAC
Black cherry	Prunus serotina	FACU
Sumac	Rhus sp.	UPL
Multiflora rose	Rosa multiflora	FACU
Black willow	Salix nigra	OBL
Elderberry	Sambucus nigra	FACW
Goldenrod	Solidago sp.	FACU
Steeplebush	Spiraea tometosa	FACW
Tall meadow-rue	Thalictrum dasycarpum	FACW
Poison Ivy	Toxicodendron radicans	FAC
False hellebore	Veratrum viride	FACW
Southern arrowwood	Viburnum dentatum	FAC
Grape	Vitas sp.	FAC
Blackberry	Rubus sp.	FAC
Grass sp.		UPL

NH04

Common Name	Species	Status
Red maple	Acer rubrum	FAC
Garlic mustard	Alliaria petiolata	FACU
Sedge	Carex sp.	FAC
Bittersweet	Celastrus orbiculatus	UPL
Spike rush	Eleocharis sp.	FACW
Jewel weed	Impatiens capensis	FACW
Soft rush	Juncus effusus	OBL
Purple loosestrife	Lythrum salicaria	OBL
Reed canary grass	Phalaris arundinacea	FACW
Common reed	Phragmites australis	FACW
Multiflora rose	Rosa multiflora	FACU
Skunk cabbage	Symplocarpus foetidus	OBL
Poison ivy	Toxiodendron radicans	FAC
Broad-leaved cattail	Typha latifolia	OBL

NH05

Common Name	Species	Status
Box elder	Acer negundo	FAC
Red maple	Acer rubrum	FAC
Garlic mustard	Alliaria petiolata	FACU
Lady Fern	Athyrium angustum	FAC
Greater celandine	Chelidonium majus	UPL
Silky dogwood	Cornus amomum	FACW
Ash	Fraxinus sp.	FACW
Winterberry	Ilex verticillata	FACW
Jewelweed	Impatiens capensis	FACW
Honeysuckle	Lonicera sp.	FACU
Forget-me-not	Myosotis scorpioides	OBL
Cinnamon fern	Osmundastrum cinnamomeum	FACW
Virginia creeper	Parthenocissus quinquefolia	FACU
Common reed	Phragmites australis	FACW
Black cherry	Prunus serotina	FACU
Buttercup	Ranunculus sp.	FAC
Common Buckthorn	Rhamnus cathartica	FAC
Multiflora rose	Rosa multiflora	FACU
Willow (shrub)	Salix sp.	FACW
Elderberry	Sambucus nigra	FACW
Skunk cabbage	Symplocarpus foetidus	OBL
Tall meadow-rue	Thalictrum dasycarpum	FACW
Poison ivy	Toxicodendron radicans	FAC
American elm	Ulmus americana	FACW
Southern arrowwood	Viburnum dentatum	FAC
Grape vine	Vitis sp.	FAC
Lawn grasses	unknown	UPL

NH06

Common Name	Species	Status
Willow	Salix sp.	FACW
Purple loosestrife	Lythrum salicaria	OBL
Broadleaved cattail	Typha latifolia	OBL
Ox-eye daisy	Leucanthemum vulgare	UPL
Japanese knotweed	Fallopia japonica	FACU
Multiflora rose	Rosa multiflora	FACU
Hawkweed	Hieracium sp.	FACU
Goldenrod	Solidago sp.	

Appendix H -5. Qualitative list of plants observed at Rhode Island stream assessment stations.

RI01		
Common Name	**Species**	**Status**
Red maple	Acer rubrum	FAC
Sugar maple	Acer saccharum	FACW
Lady fern	Athyrium angustum	FAC
Wild oats	Avena fatua	UPL
Yellow birch	Betula alleghaniensis	FAC
Shallow sedge	Carex lurida	OBL
Sweet pepperbush	Clethra alnifolia	FAC
Winterberry	Ilex verticillata	FACW
Interrupted fern	Osmunda claytoniana	FAC
Red oak	Quercus rubra	FACU
Sassafras	Sassafras albidum	FACU
Skunk Cabbage	Symplocarpus foetidus	OBL
American elm	Ulmus americana	FACW
RI02		
Common Name	**Species**	**Status**
Red maple	Acer rubrum	FAC
Speckled alder	Alnus incana	FACW
Shallow sedge	Carex lurida	OBL
Sweet pepperbush	Clethra alnifolia	FAC
Silky dogwood	Cornus amomum	FACW
Boneset	Eupatorium perfoliatum	FACW
Soft rush	Juncus effusus	OBL
Water milfoil	Myriophyllum spicatum	OBL
Deertongue grass	Panicum clandestinum	FACW
Buckthorn	Rhamnus sp.	FAC
Willow	Salix sp.	FACW
Burreed	Sparganium eurycarpum	OBL
Cattail	Typha latifolia	OBL
Highbush blueberry	Vaccinium corymbosum	FACW
Southern arrowwood	Viburnum dentatum	FAC
SAV prevalent		

Appendix H -6. Qualitative list of plants observed at Vermont stream assessment stations.

VT01		
Common Name	**Species**	**Status**
Silver maple	Acer saccharinum	FACW
Jack-in-the-pulpit	Arisaema triphyllum	FAC
Gray birch	Betula populifolia	FAC
Fringed sedge	Carex crinita	OBL
Sedge	Carex sp.	FACW
Swamp dogwood?	Cornus amomum	FACW
Deer tongue grass	Dichanthelium clandestinum	FACW
Green ash	Fraxinus pennsylvanica	FACW
Winterberry	Ilex verticillata	FACW
Canada mayflower	Maianthemum canadense	FACU
Ostrich fern	Matteuccia struthiopteris	FAC
Sensitive fern	Onoclea sensibilis	FACW
Cinnamon fern	Osmundastrum cinnamomeum	FACW
Royal fern	Osmunda spectabilis	OBL
Virginia creeper	Parthenocissus quinquefolia	FACU
Red oak	Quercus rubra	FACU
Blackberry	Rubus sp.	FAC
Tall meadow-rue	Thalictrum dasycarpum	FACW
Marsh fern	Thelypteris palustris	FACW
Slippery elm	Ulmus rubra	FAC

VT02		
Common Name	**Species**	**Status**
Box elder	Acer negundo	FAC
Silver maple	Acer saccharinum	FACW
Burdock	Arctium sp.	
Sedge	Carex sp.	
Bindweed	Convolvulus arvensis	
Dogwood	Cornus sp.	
Boneset	Eupatorium perfoliatum	FACW
Ash	Fraxinus sp.	FACW
Bedstraw	Galium sp.	
Geranium	Geranium sp.	
Creeping Charlie	Glechoma hederacea	FACU
Jewelweed	Impatiens capensis	FACW
Ostrich fern	Matteuccia struthiopteris	FAC
Sensitive fern	Onoclea sensibilis	FACW
Reed canarygrass	Phalaris arundinacea	FACW
Buckthorn	Rhamnus cathartica	FAC
Crown vetch	Securigera varia	
Goldenrod	Solidago sp.	
Basswood	Tilia americana	FACU
American elm	Ulmus americana	FACW
Witherod	Viburnum nudum	FACW
Grape vine	Vitis sp.	

VT03		
Common Name	**Species**	**Status**
Sumac	Rhus sp.	UPL
Japanese knotweed	Fallopia japonica	FACU
Elderberry	Sambucus rubra	FACW

VT04		
Common Name	**Species**	**Status**
Moosewood	Acer pensylvanicum	FACU
Sugar maple	Acer saccharum	FACU
Serviceberry	Amelanchier canadensis	FAC
Aster	Aster sp.	
Yellow birch	Betula alleghaniensis	FAC
White birch	Betula papyrifera	FACU
Tussock sedge	Carex stricta	OBL
Russian olive	Elaeagnus angustifolia	FACU
American beech	Fagus grandifolia	FACU
Japanese knotweed	Fallopia japonica	
White ash	Fraxinus americana	FACU
Honeysuckle	Lonicera sp.	
Sensitive fern	Onoclea sensibilis	FACW
Interrupted fern	Osmunda claytoniana	FAC
Virginia creeper	Parthenocissus quinquefolia	FACU
White pine	Pinus strobus	FACU
Cottonwood	Populus deltoides	FAC
Quaking aspen	Populus tremuloides	FACU
Black cherry	Prunus serotina	FACU
Red oak	Quercus rubra	FACU
Buttercup	Ranunculus sp.	
Goldenrod	Solidago sp.	
Meadowsweet	Spiraea latifolia	FACW
Lilac	Syringa vulgaris	
Poison Ivy	Toxiodendron radicans	FAC
Eastern hemlock	Tsuga canadensis	FACU

VT05		
Common Name	**Species**	**Status**
Balsam fir	Abies balsamea	FAC
Rosy bells??	Allium??	
Jack-in-the-pulpit	Arisaema triphyllum	FAC
Lady Fern	Athyrium angustum	FAC
Yellow birch	Betula alleghaniensis	FAC
American beech	Fagus grandifolia	FACU
Ash	Fraxinus sp.	
Canada mayflower	Maianthemum canadense	FACU
Sensitive fern	Onoclea sensibilis	FACW
Cinnamon fern	Osmundastrum cinnamomeum	FACW
Christmas fern	Polystichum acrostichoides	FACU
Red oak	Quercus rubra	FACU
New York fern	Parathelypteris noveboracensis	FAC
Basswood	Tilia americana	FACU
Eastern hemlock	Tsuga canadensis	FACU

VT06		
Common Name	**Species**	**Status**
Striped maple	Acer pensylvanicum	FACU
Yellow birch	Betula alleghaniensis	FAC
cool	Castilleja sp.	FAC
Horsetail	Equisetum sp.	FACW
American Beech	Fagus americana	FACU
Ash	Fraxinus sp.	FACW
Ragged robin	Lychnis flos-cuculi	
Spruce	Picea sp.	FACU
Buttercup	Ranunculus sp.	
Willow	Salix sp.	FACW
Rough-stemmed goldenrod	Solidago rugosa	FAC
Goldenrod	Solidago sp.	FACU
Tall meadow-rue	Thalictrum dasycarpum	FACW
New York fern	Parathelypteris noveboracensis	FAC
Basswood	Tilia americana	FACU
False hellebore	Veratrum viride	FACW

Appendix I. SVAP2 NRCS 2009 Exhibit 1 – Revised Data Forms

Exhibit 1: Stream Visual Assessment Protocol 2

Date:__________ Page____of___
Site ID:______________________
Data recorder:________________

Data Forms

Owner's name*____

Contact info*__________________________ Evaluator's name(s)__________________________________
(*property owner or POC for access) (include all personnel on site during assessment)

Stream name_________________________ Tributary to__________________________________

Assessment or Site Type ____
(include purpose or goal of assessment as needed)

Preliminary Assessment (GIS/Office data collection)

A. Watershed Description (**fill in from preliminary data sheets, or refer to preliminary data location**)

Ecoregion or MLRA___________________HUC: _____________Drainage area (acres or mi^2)_____________

Watershed management structures: (#): dams______water controls_____irrigation diversions___

Miles of contiguous riparian cover/mile of entire stream in watershed upstream (estimated)________

Land use within watershed (%): cropland______hay land_____grazing/pasture______forest

urban_________industrial______other (specify) _______

Agronomic practices in uplands include: ____

Confined animal feeding operations (#)_______ Conservation (acres)_______ industrial(acres)_______

Number of stream miles on property__________Number of upstream total stream miles_______

Stream hydrology:_______intermittent; months of year wetted: _________________

_______ perennial; months of year at baseflow:_________________

_______impounded / controlled; distance upstream or downstream________________

B. Stream/Reach Description:

Stream Gage Name or Location/Discharge:______________________/______________ft^3/s

Reach location (UTM or Lat./Long.)________________/_____________________

Applicable Reference Stream:____________________Reference Stream Location:_____/_____

Information Sources or other notes:

____
____
____
____
____
____
____

SVAP2 Field Assessment

Photo #/ID __________to__________
Total #_____ Download √__by_____
Photographer(s)___________________
Camera ID________________________

Date:___________ Page____of
Site ID:_____________________
Data recorder:

Preliminary Field Data

Start Time / Water Temp:_______________/_________SVAP2 End Time / Water Temp:___________/__________

Weather conditions today____
(ambient temp.\ % cloud cover \ precip.)

Weather conditions over past 2 to 5 days:____
(No. of days precip, amount of precip., average daytime temp.)

Schumm stage________________other channel type / classification scheme______________/______________

Riparian Cover Type(s):
Actual %: Tree________________% Shrub___________% Herbaceous___________% Bare___________%
Relative %: Tree________________% Shrub___________% Herbaceous___________% Bare___________%

Bank Profile (√ one): Stratified______ or Homogenous______ ; Cohesive soil______ or Non-cohesive soil____

Gradient (√ one): Low (0-2%)________ Moderate (>2<4%)_______ High (>4%) ________

Regional curve used ___________________________Expected bankfull width_________________________

Bankfull channel width_________ (ft , m) Reach length _______ (ft , m) Flood plain width_____________ft , m

Avg. riparian zone width________ (ft , m) Method used___________Floodplain wetlands_____acres or ft^2 / reach

Dominant substrate (% or √): boulder_____cobble_____gravel_____sand_____fines/silt/clay
(> 250 mm) (60-250mm) (2-60 mm) (2-.06 mm) (< .06 mm)

6. Canopy cover #	6. Canopy cover%	10. Pool depth	10. Riffle depth	15. Riffle Embed %	12. & 13. Habitat Features **B**oth, **F**ish, **I**nverts	12. Fish count	13. Invert. count	14. Aquatic Invert name/type	14. Group I,II,III
					B Large wood				
					B Small wood				
					B Overhang. Veg.				
					B Root mats				
					B Undercut banks				
					B Cobble riffles				
					B Macrophyte beds				
					F Deep pools				
					F Other pools (shallow, scour, plunge, pocket)				
					I Any pools				
					F >20” boulders				
					F 10-20” boulder clusters				
					I >20” boulders in riffles				
					I 10-20” Boulder clusters in riffles				
					F Off-channel				
					B Other locally important				

Element Scores

Date:__________ Page____of___
Site ID:______________________
Data recorder:________________

Element	Notes	Score
1. Channel Condition		
2. Hydrologic Alteration		
3. Bank Condition		
4. Riparian Area Quantity		
5. Riparian Area Quality		
6. Canopy Cover		
7. Water Appearance		
8. Nutrient Enrichment		
9. Manure or Human Waste		
10. Pools		
11. Barriers to Movement		
12. Fish Habitat Complexity		
13. Aquatic Invertebrate Habitat		
14. Aquatic Invertebrate Community		
15. Riffle Embeddedness		
16. Salinity		
A. Sum of all elements scored		
B. Number of elements scored		

Overall score: A/B ________

1 to 2.9	Severely Degraded
3 to 4.9	Poor
5 to 6.9	Fair
7 to 8.9	Good
9 to 10	Excellent

1 to 2.9 Severely Degraded (list elements)

____

3 to 4.9 Poor (list elements)

____

9 to 10 Excellent (list elements)

____

Suspected causes of SVAP2 scores less than 5 (does not meet quality criteria for stream species)

____

____

Recommendations for further assessment or actions:

____

____

C. Site Map – Include and label: Legend (define abbreviations), flow direction, orientation & scale, reach top/bottom, landmarks, large wood, boulders, bank/channel work, infrastructure, barriers, vegetation, sampling locations.

**** Note Riparian Vegetation Left Bank and Right Bank separately for entire reach**

** Quantity (Natural community, width compared to bankfull width and active floodplain, % vegetation gaps)

** Quality (Natural & diverse %, age structure, invasive species %, concentrated flows, species present)

Date:__________ Page____of___

Site ID:______________________

Data recorder:________________

VEGETATION LIST

LEGEND:

Provide additional notes related to each element scored on back of site diagram, if needed.