

NH NATURAL HERITAGE BUREAU & NATURESERVE

**LEVEL 2.5
ECOLOGICAL INTEGRITY ASSESSMENT
MANUAL**

MARCH 2012



WETLAND SYSTEMS

NEW HAMPSHIRE NATURAL HERITAGE BUREAU & NATURESERVE

**LEVEL 2.5
ECOLOGICAL INTEGRITY ASSESSMENT MANUAL
WETLAND SYSTEMS**

March 26, 2012

Cover Photo:

Taken by: Ben Kimball

Location: Horseshoe Pond, Concord

This manual is a modification of the following document:

Faber-Langendoen, D. 2010. Wetlands Ecological Integrity Assessment Field Manual, Version 1.1. NatureServe, Arlington, VA.

1. EXECUTIVE SUMMARY

This document provides a basic guide to conducting Level 2.5 field and office assessments of ecological integrity for wetland systems in New Hampshire (NH). NH Natural Heritage Bureau (NHB) Level 2.5 protocols are intermediate between NatureServe's Level 2 rapid ground-based metrics approach and Level 3 intensive ground-based metrics approach (Faber-Langendoen 2010). A Level 1 remote sensing approach is also applied, in part, to evaluating landscape context during Level 2.5 assessments.

Application of methods described in this manual requires a moderate to advanced level of ecological expertise and experience, not unlike that needed to understand and conduct wetland delineations. For that reason, surveyors document the ecological context and classify natural community and system types first, in order that a basic understanding of the wetlands structure, composition, and function are established. This will aid in properly assessing the ecological integrity of wetland systems.

The manual gives instructions and guidelines for collecting field data and completing office forms on L2.5 ecological integrity assessments (EIAs) for wetland systems. It provides detailed, field-by-field coding conventions for the primary data forms to be used in the field and office. Steps and forms involved in a Level 2.5 assessment include:

Pre-field:

- EIA Level 1 Land Use Index

Field:

- EIA Level 2.5 Rapid Recon Form

Post-field:

- EIA Level 2.5 General Form
- EIA Level 2.5 Metrics Rating Form
- EIA Level 2.5 Stressors Checklist Form

The NatureServe manual (Faber-Langendoen 2010) and forms have been adopted by NHB and adapted for New Hampshire, based on extensive testing in 2009 and 2010.

2. ACKNOWLEDGEMENTS

This manual is a modification of the following document:

Faber-Langendoen, D. 2010. Wetlands Ecological Integrity Assessment Field Manual, Version 1.1. NatureServe, Arlington, VA.

Modifications to the original document (Faber-Langendoen 2010) primarily stem from...

- adapting existing NatureServe methods to match the protocols of NH Natural Heritage Bureau
- the development of new components to the existing EIA methods developed by NatureServe

The design of this wetland ecological integrity assessment manual is based on an extensive effort by NatureServe and the Natural Heritage Network to improve core methodology by using an ecological integrity framework. These improvements draw on the experience and collaboration with partners, including The Nature Conservancy, and with federal partners, particularly, the Environmental Protection Agency (EPA), which provided funds to NatureServe to work on ecological integrity assessments for all wetland types in the U.S. Other support comes from the National Park Service, the Army Corps of Engineers, and the U.S. Forest Service.

This manual and the EIA project were supported by EPA Region I Wetlands Program Development Grant CD-97193901-0.

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3. OVERVIEW

Data collected in the field will be used to evaluate wetland condition using an ecological integrity assessment method (Faber-Langendoen et al. 2009). This data will be used for a number of purposes:

- Adapt and apply EIA methods to critical wetlands
- Assess soil conditions
- Provide information on rare species and exotics
- Upgrade the EO rank for wetland polygons tracked by the NH Natural Heritage Bureau (NHB)
- Enable remote identification of wetland condition
- Develop an interpreted landscape analysis map of predicted wetland types
- Cross-reference NH natural communities to hydrogeomorphic wetland types
- Add critical wetlands to the NHB database
- Inform conservation planning and environmental review
- Identify and establish benchmark wetlands
- Inform mitigation, stewardship, and protection
- Enhance information on wetland condition and importance
- Improve agency, local government, and nongovernmental organization conservation, watershed planning, land protection, and stewardship activities
- Improve NHB and Department of Environmental Services (DES) status and trend evaluation
- Update NH natural communities and systems classification
- Develop EIA training materials
- Develop workshop presentations

The following pages describe each of the EIA protocols and forms. For digital versions of EIA Level 2.5 forms, please contact the NH Natural Heritage Program (603-271-2215).

Pre-field:

- EIA Level 1 Landscape Context Protocols

Field:

- EIA Level 2.5 Rapid Recon Form

Post-field:

- EIA Level 2.5 General Form
- EIA Level 2.5 Metrics Rating Form
- EIA Level 2.5 Stressors Checklist Form

4. BACKGROUND

Building on the related concepts of biological integrity and ecological health, ecological integrity is a broad and useful endpoint for ecological assessment and reporting (Harwell et al. 1999). “Integrity” is the quality of being unimpaired, sound, or complete. An ecological integrity assessment can be defined as “an assessment of the structure, composition, and function of an ecosystem as compared to reference ecosystems operating within the bounds of natural or historic disturbance regimes” (adapted from Lindenmayer and Franklin 2002; Young and Sanzone 2002; Parrish et al. 2003). To have ecological integrity, an ecosystem should be relatively unimpaired across a range of ecological attributes and spatial and temporal scales. The notion of naturalness depends on an understanding of how the presence and impact of human activity relates to natural ecological patterns and processes (Kapos et al. 2002). Identification of reference or benchmark conditions based on natural or historic ranges of variation, although challenging, can provide a basis for interpretation of ecological integrity (Swetnam et al. 1999). These general concepts need greater specificity to become a useful guide for conducting ecological integrity assessments. This manual addresses some of those needs.

The scientific community has a strong interest in developing approaches to ecological integrity assessment (EIA) methods to assist in conservation and management of ecosystems. Concerns have evolved from “how much of it is out there?” and “is it protected?” to “how is it doing?” and “what condition is it in?” NHB’s EIA method builds on NatureServe and the Network of Natural Heritage Program’s historic approaches to assessing condition. However, earlier methods are adapted by building on the variety of existing wetland rapid assessment methods, and the 3-level approach of the U.S. Environmental Protection Agency and others. The NHB method emphasizes metrics that are condition-based, distinct from stressor-based approaches.

Characteristics of the NHB EIA includes:

- Reliance on a general conceptual model that:
 - Identifies the major ecological attributes – landscape context, size, and the condition of vegetation, soils, and hydrology
 - Provides a narrative description of declining integrity levels based on changes to ecological attributes
 - Uses a metrics-based approach to assess the levels of integrity
- Use of ecological classifications at multiple scales to guide the development of the conceptual models, thereby enhancing attribute assessment
- Use of an approach intermediate to Level 2 rapid ground-based and a Level 3 intensive ground-based assessments (see Faber-Langendoen 2010)
- A Level 1-like remote sensing approach for assessing landscape context using GIS prior to a site visit
- Ratings and thresholds for each metric based on “normal” or “natural range of variation” benchmarks
- A scorecard matrix for rating and integrating metrics into an overall set of indices of ecological integrity
- A mechanism for adapting metrics over time as new information and methods are developed

The NHB EIA enables consistent and repeated assessment of biodiversity sites to determine if value is conserved, enhanced, or diminished.

5. PRE-FIELD ASSESSMENT AND PLANNING

5.1. IDENTIFY EIA LEVEL 2.5 ASSESSMENT AREA

Using data layers in GIS, identify the wetland system of interest.

5.2. LEVEL 1 LAND USE INDEX

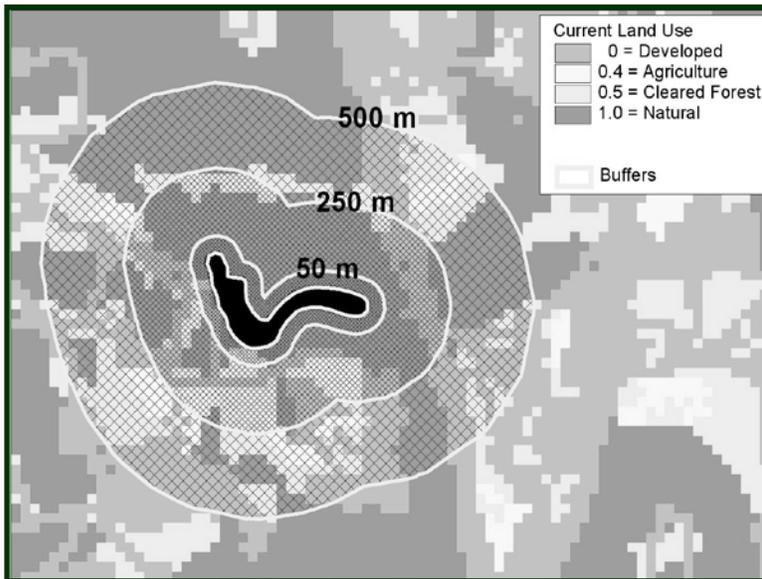
Calculate landscape context rank using Landsat land cover data in a GIS following these guidelines:

1. Use values in the “Land Use Coefficient Table” to score land use surrounding the wetland system, and calculate the index for buffer, surrounding land use, and landscape connectivity as follows:
 - a. **Buffer**
 - i. Land use within 50 m of wetland system edge
 - ii. Proportional average of all land uses within buffer
 - iii. Comprises 60 percent of total landscape context score
 - b. **Surrounding land use**
 - i. Land use between 51 and 250 m of wetland system edge
 - ii. Proportional average of all surrounding land uses
 - iii. Comprises 25% of total landscape context score
 - c. **Landscape connectivity**
 - i. Land use between 251 and 500 m of wetland system edge
 - ii. Proportional average of all land uses between 251 and 500 m
 - iii. Comprises 15% of total landscape context score

Land Use Coefficient Table*

Current Land Use	Coefficient
Paved roads; parking lots; domestic or commercially developed buildings; mining (gravel pit, quarry, open pit, strip mining)	0
Unpaved roads (e.g., driveway, tractor trail); abandoned mines	0.1
Agriculture (tilled crop production); intensively developed vegetation (golf courses, lawns, etc.)	0.2
Vegetation conversion (clearcut)	0.3
Heavy grazing on pasture lands	0.3
Heavy logging with 50-75% of trees >30 cm dbh removed	0.4
Intense recreation (ATV use, camping, sport fields, popular fishing spot, etc.); military training areas	0.4
Permanent crop agriculture (vineyards, orchards, nurseries, berry production, introduced hay field and pastures, etc.)	0.4
Commercial tree plantations, holiday tree farms	0.5
Dam sites and flood disturbed shorelines around water storage reservoirs	0.5
Recent old fields and other disturbed fallow lands dominated by ruderal and exotic species	0.5
Moderate grazing on pasture lands	0.6
Moderate recreation (high-use trail)	0.7
Mature old fields and other fallow lands with natural composition	0.7
Selective logging with less than 50% of trees >30 cm dbh removed	0.8
Light grazing; light recreation (low-use trail); haying of native grassland	0.9
Natural area; land managed for native vegetation	1

* Modified from Hauer et al. 2002.



Landscape context: buffer, surrounding land use, and landscape connectivity surrounding a wetland system.

- Determine the overall landscape context score by averaging the weighted buffer, surrounding land use, and landscape connectivity scores. Use the “Landscape Context Scoring Table” to determine letter grade for site’s landscape context.

Landscape Context Scoring Table

Metric Rating			
Poor (D)	Fair (C)	Good (B)	Excellent (A)
< 0.4	0.4 - 0.79	0.80 - 0.94	0.95 - 1.0

5.3. PREPARING FOR THE FIELD

5.3.1. Maps and Aerial Photographs

Field crews should produce and review the following maps and aerial photographs before leaving the office:

- Topographic map (1:12,000 or 1:24,000 scale) delineating:
 - Targeted wetland system
 - National Wetland Inventory polygons
 - Element occurrence boundaries for exemplary systems and natural communities, plants, and animals
 - Conservation lands
- Aerial photograph
 - Same scale as topographic map
 - Delineating targeted wetland system, National Wetland Inventory polygons, Element Occurrence boundaries, and conservation lands
- Level 1 land use index map
 - Using GIS data layers, review and identify questionably classified land cover polygons requiring field check

The goal of producing and reviewing maps and aerial photographs is to enhance efficiency by prioritizing which areas of the wetland system and surrounding landscape appear most important to visit in the field.

5.3.2. Other Equipment, Materials, and Supplies

Field checklist:

- GPS receiver (set to **NAD 83** and with sufficient memory)
- camera (with sufficient memory)
- pH meter (calibrated with pH 4 and 7 solutions before each survey)
- flashlight, radios
- back-up batteries for all electronic needs
- field forms, clipboard, pens, pencils, sharpies
- aerial photos, topo maps, land use index maps, road/trail maps
- compass, hand lens, binoculars, pocket knife
- tape measure, flagging
- shovel, soil auger, trowel
- plastic bags for plants
- plant press, blotters, newspaper
- increment borer, wax, straws
- ancillary information: botany manual, natural community/system manuals, species/natural community keys, miscellaneous reference sheets, species list
- head-net, repellent
- orange hat/vest
- food, water, clothing, foot wear, rain gear, first-aid kit

5.3.3. Mission Planning

Considerations for mission planning:

- considerations based on topography, existing access routes, density and complexity of vegetation (more time for forest and woodland plots, less for herbaceous and shrub dominated communities)
- considerations based on priority needs

5.3.4. Level 2.5 EIA Forms

Review the *General*, *Metrics*, and *Stressors* EIA Level 2.5 forms to ensure you are prepared to complete them after collecting field data using the *EIA Level 2.5 Rapid Recon Form*.

6. FIELD SAMPLING

Application of the field methods described below requires a moderate to advanced level of ecological expertise and experience, not unlike that needed to understand and conduct wetland delineations. For that reason, ecologists should document the ecological context and classify natural community and system types first, to establish a basic understanding of the wetlands structure, composition, and function. This step will aid in properly assessing the ecological integrity of wetland systems.

6.1. EIA LEVEL 2.5 RAPID RECON FORM

6.1.1. Overview

Conduct an initial reconnaissance in the areas of the wetland system and surrounding landscape you identified as most important to visit. Collect plot data in each natural community type using the *EIA Level 2.5 Rapid Recon Form*, surveying as much of the wetland system as time allows. Rely on your field skills and ability to interpret aerial photographs to minimize collecting data in natural community types already surveyed. Do not feel you have to survey the entire wetland system; rather take a *moderate risk approach*, presuming that the area you can see nearby and/or interpret as being similar using an aerial photograph is the same as what are you walking through.

- If you find two or more system types in the wetland, collect natural community data in each system and complete EIA forms (General, Metric, and Stressors) for each system type.
Note: At the office, complete the remaining EIA forms (*General, Metrics, and Stressors*) using the digital entry form as soon as possible after the *EIA Level 2.5 Rapid Recon Form* has been completed in the field.

6.1.2. Organizing the Field Crew

Data collection can be completed by one person. However, if there is a field crew of two people, responsibilities for completing the *EIA Level 2.5 Rapid Recon Form* can be divided as follows:

- One person takes photographs and collects soil profile, stem profile, pH, and GPS data.
- One person collects plant species composition data.

6.1.3. General Information

Site Name

Assign site name using relevant label on a topographic map or for a site name already used in the NH NHB database (if applicable).

Surveyor(s)

Name of surveyor(s): crew leader listed first, then co-leader, then assistant (if applicable).

Site Code

Enter site code (if applicable).

Date

Date the field data was collected: yyyy-mm-dd.

Source Code

Source code is a unique code used for each site. For example, “F12SMI02NHUS” breaks down as follows:

- F12 = field year 2012.
- SMI = first three letters of surveyors last name (in this example, “SMI” for “Ms. Smith”).
- 02 = unique site number you assign, beginning with the first site you visit at the start of each field season (e.g., first site you visit in a particular year = 01; second site visited = 02; etc.).
- NHUS = New Hampshire, United States.

NH town

Record town(s) wetland system occurs in.

Directions

If good GPS coordinates are taken, this field can be used only to track issues of how to get into a site (e.g., land owner issues, avoiding cliffs, indicating river crossings, etc.). Otherwise, provide precise directions to the wetland system using a landmark readily locatable on a topographic map as the starting point (e.g., named village, highway, or road). Use clear sentences that will be understandable to someone who is unfamiliar with the area and has only your directions to follow. Give distances as close as possible (within 0.1 mile) and use compass directions. Do not take more than a couple of minutes to complete this field.

6.1.4. Establishing Natural Community Plots

- Using an *EIA Level 2.5 Rapid Recon Form*, complete plot data collection for all dominant natural community types (and all peripheral types if possible) in the wetland system.
- Locating natural community plots is a somewhat subjective process. Choose an area that seems to be both relatively **homogenous** and **representative** of the vegetation and condition of the community type. In other words, avoid areas where the vegetation appears to be transitioning from one community type to another and areas with anomalous or heterogeneous structure or species composition.
- Lay out the plot: 20 x 20 m in swamps; 10 x 20 m or 10 x 10 m for more homogenous, open wetlands (e.g., shrub and or herb dominated communities).
- Plot shape can be rectangular when natural community zones are narrow and linear (e.g., 5 x 40 m in linear floodplain forest or open wetlands).

6.1.5. Species Profile

- In the natural community plot area on the form, identify the natural community type (see “NC”), list all plant species occurring in the plot, and estimate percent cover of each species by strata.
- Estimate foliar cover, that is % of ground covered by vertical portion of plants as viewed from above; the vertical projection of the shoots, stems, and leaves (vs. canopy cover: % of ground covered by the vertical projection of the outermost perimeter of the natural spread of foliage of plants). Document plant species cover by selecting from the following cover scale:

<1%
1%
1-2%
2-5%
5-10%
10-25%
25-50%
50-75%
75-95%
>95%

If a single number is used as a cover value and it is divisible by 5 (e.g., 10, 20, 75, etc.), append the number with a plus (+) or minus (–) to indicate which side of the cover value the estimate more likely falls. This allows a single number value to be placed in a cover class category during community classification analyses.

- Always use absolute cover, not relative cover. Absolute cover is the actual cover of a plant species; total cover of all plants can exceed 100%. (Note: relative cover is the cover of a plant species as a

percentage of total plant cover; relative cover will always tally up to 100%, even when absolute cover is quite low).

- Strata include:
 - **T1:** Supra-canopy
 - **T2:** Canopy
 - **T3:** Subcanopy
 - **S1:** Tall shrub 1.5 – 6 m 5 – 20 ft.
 - **S2:** Medium shrub 0.5 – 1.49 m 1.5 – 5 ft.
 - **S3:** Short shrub < 0.5 m < 1.5 ft.
 - **H:** Herbaceous no height limit
 - **N:** Non-vascular (mosses, lichens, and macro-algae; describe each growth form separately)

Note: treat percent cover of each woody vine species as you would for a tree species (i.e., provide cover in each stratum it occurs in).

- Enter plot dimensions under “**Plot size.**”
- Except in very diverse plots, don’t spend more than **30 minutes** collecting species data in a plot. Remember that these plot data are to be used to classify the overall vegetation and characterize its condition; a diagnostic, semi-comprehensive list is needed, not an exhaustive complete species list.
 - If you can’t identify some of the plants to species...
 - Record them on your form as “unknown species 1,” “unknown species 2,” “unknown *Carex* sp. 1,” etc.
 - Record associated cover class and other data for the unknown plant species as you would for any other species.
 - Take a sample of the species with as much of the plant as possible, especially intact flowers and fruits, if present. Place the sample in a baggie, and label the baggie (or specimen) with the plot code and the name you gave it on the data form.
 - Press the plant if you do not intend to key it out right away. Mark the newspaper the plant specimen is pressed in with the plot code and name you gave it on the data form.
 - Store specimens in a cool, dry place. Bagged specimens will keep fresh longer in the refrigerator or ice chest until pressed or identified.
- Collecting plant species plot data requires a certain level of botanical expertise and experience. Minimally, a surveyor should have the ability to identify dominant and other diagnostic plant species required to accurately classify natural communities within a wetland system.
 - You can, of course, key some of these out yourself if you want to, but don’t let plant keying get in the way of your primary responsibility – field data collection. No one expects you to identify every plant but you should make an effort to learn at least the common species that keep recurring in plots.
 - A quick prioritization of what to key and/or collect and press may be made based on the recurrence of the species in samples and on the cover value estimate of the species in a particular plot. If the species has a cover value >1%, it is more of a priority to either key and identify in the field or to collect and key out later.

6.1.6. Soil Profile

- Complete a soil profile (minimum depth 20”) in each natural community type that vegetation plot data has been collected.
 - Describe horizon colors, soil texture, mottling, moisture levels, location of saturation/water table, impervious layers, organic matter decomposition (von Post scale),

and depth to these and other features (see appendices for von Post scale and a mineral soil texture key).

- Record pH using a calibrated pH tester.

6.1.7. Stand Profile

- Complete a stand profile after recording plant species presence and cover for a given natural community.
 - Record the following:
 - **T2 dbh ave:** average canopy dbh in inches.
 - **T2 dbh range:** canopy dbh range in inches.
 - **T2 height:** average height of canopy in feet.
 - **Pit/Md (E+-):** Describe pit and mound microtopography (relative to benchmark conditions) as “E”= expected; “E+”= greater than expected; “E-”= less than expected.
 - **Stand age est:** estimate of stand age.
 - **Max age:** estimate age of oldest trees.
 - In a 20 x 20 meter area, record in the rows labeled **Live stem**, **Snags>6'**, and **Downed** the following:
 - **6-12”** column: Describe relative to benchmark conditions as “E”= expected; “E+”= greater than expected; “E-”= less than expected.
 - Keep in mind that in fire-dependent systems, or in forest types where smaller trees are the norm (e.g., tamarack swamps, xeric pine sites) less coarse woody debris is expected under natural conditions.
 - **12-20”** column: Count the number of stems, snags, or downed in the 20 x 20 m area with a dbh between 12-20”.
 - **>20”** column: Count the number of stems, snags, or downed in the 20 x 20 m area with a dbh greater than 20”.

Note: complete for all forest or woodland types (optional where trees are establishing or scattered in shrub or herb types).

6.1.8. Comments

- Write notes in the “**Comments**” field as needed on vegetation, soils, hydrology, land use, surrounding landscape, wildlife, etc. for each natural community plot completed.

6.1.9. Assessment of Natural Community Rank Factors

- Provide a field assessment of size (**S**), condition (**C**), landscape context (**LC**), and overall rank (**rank**) for each natural community type surveyed. Assessment values may be:
 - A: excellent
 - B: good
 - C: fair
 - D: poor
- Exact ratings are encouraged when information is not limited and little uncertainty exists. However, values for rank factors and overall rank may be represented by two letter grades when a range of uncertainty exists. Range-rating can be helpful whenever rating proves challenging because of unusual situations in the field or assessor inexperience with a natural community type.
 - The use of the “range-rating” combinations AB, AC, BC, and CD should be applied when information is limited.
 - The use of AD and BD ranks are discouraged; their ability to express conservation value is limited. An E rank (verified extant) is often preferable in these cases.

- Ranks for each type of natural community are applied in a global context, considering the extent of expression for that type throughout its range. In some cases, the best example of a natural community type in New Hampshire will not be viable in a global context.
- Assessment values determined in the field for a natural community's size, condition, landscape context, and overall rank are adjusted as needed at the office after reviewing any existing rank specifications, field form data and the NHB database for other examples of that type, and consultation with other ecologists.
- For more background on natural heritage ranking methodology, see NatureServe's "Standards and Methods" at the following website:
<http://www.natureserve.org/prodServices/standardsMethods.jsp>
- Assessment of rank factors in this manner is optional and only important if the full EIA will not be completed.

6.1.10. Site Sketches and Cross-Sections

Illustrate as needed under "**X-Section**" and "**Site Map/Detail**" important features poorly represented in existing maps/aerials and/or poorly documented otherwise.

6.1.11. Other Plot Data

- GPS plot location and record observation point number under "**OP**."
- Take a diagnostic photo in each natural community plot. The purpose of the photo is to get a good representation of the vegetation of the plot, not individual species. Take the photograph looking across the contour if plot is steep.

6.1.12. Site Summary

Record the following information in the "**Site Summary**" section:

- **Interesting Feature** column: record the following site features.
 - Wetland systems and associated natural communities.
 - Upland natural communities in the surrounding landscape.
 - Rare, uncommon, and/or invasive species.
 - Photo locations (record only if specific location of photo point is important).
 - Anthropogenic features (e.g., cellar holes, ditches, trails, refuse dumping, etc.).
- **Status** column: prescribe the following codes for wetland systems and natural communities (note: these field assessments may be adjusted after additional research at the office).
 - Ex: exemplary
 - L: locally significant
 - -: neither exemplary nor locally significant
- **Status** column: use the following codes for rare, uncommon, and/or invasive species.
 - SE: state endangered.
 - ST: state threatened.
 - SW: state watch.
 - Ind: indeterminate.
 - Inv: invasive.
- **Status** column: use the following code for anthropogenic features.
 - Anthro: anthropogenic.
- **S-rank** column: write in the state rank for each system, natural community, and species.
- **%in sys** column: estimate the percent cover for each natural community within a system (total cover of natural communities within a system = 100%)
- **OP** column: note the GPS observation point number for each natural community; rare, uncommon, and/or invasive species; and anthropogenic feature.

7. POST-FIELD FORMS

After your field visit, complete at the office digital EIA forms (*General, Metrics, and Stressors*). These digital forms should be completed as soon as possible after the *EIA Level 2.5 Rapid Recon Form* has been completed in the field.

7.1. EIA LEVEL 2.5 GENERAL FORM

7.1.1. General Information

Site Name

Assign site name after relevant label on a topographic map or after a site name already used in the NH NHB database (if applicable).

Site Code

Enter site code (if applicable).

Date

Date the field data was collected: yyyy-mm-dd.

Source Code

Source code is a unique code used for each site. For example, “F12SMI02NHUS” breaks down as follows:

- F12 = field year 2012.
- SMI = first three letters of surveyors last name (in this example, “SMI” for “Ms. Smith”).
- 02 = unique site number you assign, beginning with the first site you visit at the start of each field season (e.g., first site you visit in a particular year = 01; second site visited = 02; etc.).
- NHUS = New Hampshire, United States.

Surveyor(s)

Name of surveyor(s): crew leader listed first, then co-leader, then assistant (if applicable).

Photographer

Name of photographer.

NH Town

Record town(s) wetland system occurs in.

Ownership

Record owners of wetland system.

7.1.2. Site Summary

Record the following information in the “**Site Summary**” section of the *EIA Level 2.5 General Form*:

- **System Name:** record type of wetland system being assessed.
- **Natural Community/Rare Sp/Invasive/Other:** record the following features associated with the wetland system.
 - Wetland natural communities.
 - Rare, uncommon, and/or invasive species.
 - Photo locations (record only if specific location of photo point is important).
 - Anthropogenic features (e.g., cellar holes, ditches, trails, refuse dumping, etc.).

- Upland natural communities in the surrounding landscape.
- **Status** column: prescribe the following codes for wetland systems and natural communities (note: original field assessments may be adjusted now as needed after reviewing relevant data sources).
 - Ex: exemplary
 - L: locally significant
 - –: neither exemplary nor locally significant
- **Status** column: use the following codes for rare, uncommon, and/or invasive species.
 - SE: state endangered.
 - ST: state threatened.
 - SW: state watch.
 - Ind: indeterminate.
 - Inv: invasive.
- **Status** column: use the following code for anthropogenic features.
 - Anthro: anthropogenic.
- **State Rank** column: write in the state rank for each system, natural community, and species.
- **%cov in sys** column: estimate the percent cover for each natural community within the system (total cover of natural communities within a system = 100%)
- **OP** column: note the GPS observation point number for each natural community; rare, uncommon, and/or invasive species; and anthropogenic feature.
- **Hydro Regime** column: indicate primary and secondary (if applicable) hydrologic regimes for each natural community using descriptions at bottom of page.
- **Soil Drain** column: indicate primary and secondary (if applicable) soil drainage for each natural community using descriptions at bottom of page.

7.1.3. System Descriptors

The following descriptors are assessed for the wetland system.

HGM Class

Indicate primary and secondary (if applicable) hydrogeomorphic class/subclass (from NRCS 2008; Tiner 2003).

- **Riverine wetlands**

Riverine wetlands occur in flood plains and riparian corridors in association with river and stream channels. Dominant water sources are often overbank flow from the channel or subsurface hydraulic connections between the stream channel and wetlands. However, sources may be interflow and return flow from adjacent uplands, occasional overland flow from adjacent uplands, tributary inflow, and precipitation. At their headwater, riverine wetlands often are replaced by slope or depressional wetlands where the channel morphology may disappear. They may intergrade with poorly drained flats or uplands. Perennial flow in the channel is not a requirement.

- **Intermittent flow:** Water flow is intermittent during the year.
- **High gradient:** Water flow is generally rapid due to steep gradient; typically little or no floodplain development; watercourse is generally shallow with rock, cobbles, or gravel bottoms; first- and second-order streams in hilly to mountainous terrain.
- **Middle gradient:** Water flow is fast to moderate; with little to some floodplain; usually third-, fourth- and higher order streams associated with hilly to mountainous terrain.
- **Low gradient:** Water flow is generally slow; typically with extensive floodplain; water course shallow or deep with mud or sand bottoms; typically fifth and higher order streams, but includes lower order streams in landscapes with low relief (lower order streams may lack significant floodplain development).

- **Dammed reach:** Water flow is dammed, yet still flowing downstream, at least seasonally.
- **Depressional wetlands**
 Depressional wetlands occur in topographic depressions. Dominant water sources are precipitation, ground water discharge, and both interflow and overland flow from adjacent uplands. The direction of flow is normally from the surrounding uplands toward the center of the depression. Elevation contours are closed, thus allowing the accumulation of surface water. Depressional wetlands may have any combination of inlets and outlets or lack them completely. Dominant hydrodynamics are vertical fluctuations, primarily seasonal. Depressional wetlands may lose water through intermittent or perennial drainage from an outlet, by evapotranspiration and, if they are not receiving ground water discharge, may slowly contribute to ground water. Peat deposits may develop in depressional wetlands.
 - **Isolated:** There is no surface or groundwater inflow from a stream, other waterbody, or wetland (i.e., no documented surface or ground water inflow from a wetland or other waterbody at a higher elevation) and no observable or known outflow of surface or ground water to other wetlands or waters.
 - **Throughflow:** Wetland receives surface or ground water from a stream, other waterbody or wetland (i.e., at a higher elevation) and surface or ground water passes through the subject wetland to a stream, another wetland, or other waterbody at a lower elevation; a flow-through.
 - **Inflow:** Wetland receives surface or ground water inflow from a wetland or other waterbody (perennial or intermittent) at a higher elevation and there is no observable or known significant outflow of surface or ground water to a stream, wetland or waterbody at a lower elevation.
 - **Outflow:** Wetland receives no surface or ground water inflow from a wetland or permanent waterbody at a higher elevation (may receive flow from intermittent streams only) and surface or ground water is discharged from this wetland to a stream, wetland, or other waterbody at a lower elevation.
- **Slope wetlands**
 Slope wetlands normally are found where there is a discharge of ground water to the land surface. They normally occur on sloping land; elevation gradients may range from steep hillsides to slight slopes. Slope wetlands are usually incapable of depressional storage because they lack the necessary closed contours. Principal water sources are usually ground water return flow and interflow from surrounding uplands, as well as precipitation. Hydrodynamics are dominated by downslope unidirectional water flow. Slope wetlands can occur in nearly flat landscapes if ground water discharge is a dominant source to the wetland surface. Slope wetlands lose water primarily by saturation subsurface and surface flows and by evapotranspiration. Slope wetlands may develop channels, but the channels serve only to convey water away from the slope wetland.
 - **Lacustrine fringe wetlands**
 Lacustrine fringe wetlands are adjacent to lakes where the water elevation of the lake maintains the water table in the wetland. In some cases, these wetlands consist of a floating mat attached to land. Additional sources of water are precipitation and ground water discharge, the latter dominating where lacustrine fringe wetlands intergrade with uplands or slope wetlands. Surface water flow is bidirectional, usually controlled by water-level fluctuations such as seiches in the adjoining lake. Lacustrine fringe wetlands are indistinguishable from depressional wetlands where the size of the lake becomes so small relative to fringe wetlands that the lake is incapable of stabilizing water tables. Lacustrine fringe wetlands lose water by flow returning to the lake

after flooding, by saturation surface flow, and by evapotranspiration. Organic matter normally accumulates in areas sufficiently protected from shoreline wave erosion.

- **Estuarine fringe wetlands**

Estuarine fringe wetlands occur along coasts and estuaries and are under the influence of sea level. They intergrade landward with riverine wetlands where tidal currents diminish and riverflow becomes the dominant water source. Additional water sources may be ground water discharge and precipitation. The interface between the estuarine fringe and riverine classes is where bidirectional flows from tides dominate over unidirectional ones controlled by flood plain slope of riverine wetlands. Because estuarine fringe wetlands frequently flood and water table elevations are controlled mainly by sea surface elevation, estuarine fringe wetlands seldom dry for significant periods. Estuarine fringe wetlands lose water by tidal exchange, by saturated overland flow to tidal creek channels, and by evapotranspiration. Organic matter normally accumulates in higher elevation marsh areas where flooding is less frequent and the wetlands are isolated from shoreline wave erosion by intervening areas of low marsh.

Water Source

Indicate primary and secondary (if applicable) sources of water.

- **Direct Precipitation:** Snow and rain falling on the site. Potential examples: raised bogs.
- **Surface/Overland Flow:** Local rain runoff or snowmelt arriving at low points by surface flow which is too small to create streams or permanent channels. Potential examples: coves.
- **Groundwater:**
 - **Groundwater Discharge:** Water released into a wetland and above the wetland soil surface of the wetland, discharge has a strong lateral directional flow component. Potential examples: seepage fens.
 - **Groundwater Saturation:** Water which stays at, near, or sometimes above the soil surface simply because the local area or region is near the water table surface. The water may cycle up and down but it does not appear to have a rapid discharge and lateral flow component. Potential examples: some wet meadows, marshes, and swamp forests.
- **Water Body Inundation:** Surface water (water above the soil) that is present due to the larger hydrologic context of a lake, pond, river, estuary, large swamp system, or ocean. Potential examples: marsh or swamp forests along a lake edge or low gradient river.
- **Overbank flow (flooding):** Water periodically washing in above the surface from a swollen and flooding stream, river, lake, estuary, or ocean. Potential examples: floodplain forests and marshes, and wet meadows along streams and rivers.
- **Inbank flow:** Channel water below bankfull (above which water spills out from channel).
- **Anthropogenic:**
 - **Direct Input:** Water source is direct irrigation, pumped water, or other artificially provided hydrology (please describe).
 - **Overland Flow:**
 - **Urban:** Local rain runoff or snowmelt arriving at low points by surface flow directly off paved areas, roads, rooftops, etc. Water may arrive indirectly via pipe, lawns, or man-made drainage swales, but if arriving by any other route (e.g., via rivers, streams, marsh systems, or lakes) then water source should be put in another category. Potential examples: subdivision detention ponds.
 - **Rural:** See above description; includes farmland and other rural runoff.
- **Other:** Please describe.

Hydrological Condition

Describe evidence of flooding and flood depth (if applicable).

- **Hydrology Comment:** comment on hydrology as needed.

Landform

Select landform type.

System Description

Comment as needed on landscape context, size, and condition of upland and wetland communities, vegetation, hydrology, soils, animals, unique features, human-related alterations, etc.

System Drawing

Depict as needed vegetation structure and physical features, placement of plots, etc.

7.2. EIA LEVEL 2.5 METRICS FORM

7.2.1. Landscape Context

Complete assessment of **Land Use**, **Buffer Length**, and **Buffer Condition** metrics only if the land use index was not calculated using Landsat land cover data in a GIS. In the absence of the land use index calculation, the overall landscape context score is based on your assessment of **Land Use**, **Buffer Length**, and **Buffer Condition** metrics.

Land Use

Your assessment (guided by field results and aerial) of the condition of the 0-50 m buffer zone, 50-250 m surrounding land use zone, 250-500 m landscape connectivity zone, and overall land use score.

Buffer Length

Estimate that part of the wetland system’s perimeter that has a natural buffer. Use a 5 m minimum buffer width and length. Perimeter excludes water bodies. For example, if wetland perimeter is 30% lake or river, exclude that part, and treat the rest as 100% perimeter, within which buffer length is assessed.

Guidelines for identifying wetland buffers and breaks in buffers		
<p>Examples of land covers included in buffers:</p> <ul style="list-style-type: none"> • natural upland habitats and plant communities • roads not hazardous to wildlife • vegetated levees, rough meadows or greenbelts (exotic and native) • swales and ditches • foot trails, horse trails, bike trails • lightly grazed pastures • plantations 	<p>Examples of land covers excluded from buffers:</p> <ul style="list-style-type: none"> • open water not included in evaluation • parking lots • commercial and private developments • active roadways, bike trails, railroads • agriculture • moderately to heavy grazed pastures (e.g., horse paddock, feedlot and turkey ranch) • lawns, sports fields, golf courses 	<p>Examples of land covers crossing and breaking buffers:</p> <ul style="list-style-type: none"> • large paved roads (two lanes or larger), bridges, railroads • residential areas • culverts • sound walls • fences that interfere with movements of water, sediment, or wildlife species that are critical to the overall functions of the wetland

Buffer Condition

Estimate the overall condition of vegetation cover within that part of the perimeter that has a buffer. If buffer length is only 30% of the perimeter and 15 m wide, then assess condition within that area. Buffer

condition is based on cover of native vs. non-native vegetation, disruption to soils, amount of trash or refuse, or intensity of human visitation or recreation. Estimate out to a maximum of 50 meters.

Note: Document the average natural buffer width in first 50 meters. “Natural buffer” includes natural communities, roads not hazardous to wildlife, trails, lightly grazed pastures, etc. No longer considered a buffer if agricultural, busy road, RR, lawn, heavily grazed pastures, etc.

7.2.2. Vegetation

Vegetation Structure

First, choose which broad habitat type the wetland system is found in:

- **Floodplain & Swamp Forest**
- **Bog and Fen**
- **Shrub Swamp, Meadow Marsh, Aquatic, Open Riparian-Channel, Other_____**

Then for the wetland system, estimate the variation in overall structure, including age/size and density, overall canopy cover, abundance of canopy gaps with regeneration, and number of different age/size patches represented.

Organic Matter Accumulation

First, choose which broad habitat type the wetland system is found in:

- **Floodplain & Swamp Forest**
- **Bog and Fen**
- **Shrub Swamp, Meadow Marsh, Aquatic, Open Riparian-Channel, Other_____**

Then for the wetland system, estimate the variation in organic matter accumulation, including size and density of woody materials or fine litter.

Cover of Native Plant Increases

For the wetland system, list the increasers and estimate their percent cover. Native plant increasers are indicative of anthropogenic disturbance and include some members of *Acer*, *Betula*, *Toxicodendron*, *Rubus*, *Rhus*, *Typha*, *Dennstaedtia*, among others.

Relative Cover of Native Plant Species

For the wetland system, estimate the relative percent cover of native plant species as follows:

- Estimate total native plant cover (across all strata), then total exotic cover (e.g., 80% total cover, 5% exotic cover).
- Calculate relative cover (for example above, relative exotic cover=6%; relative native cover=94%).

Cover of Exotic Invasive Plant Species

For the wetland system, estimate the percent cover of exotic invasive plant species. Use the Invasive Plant Atlas of New England (IPANE) list of invasive species as your reference:

IPANE website: <http://nbii-nin.ciesin.columbia.edu/ipane/>

Vegetation Regeneration (floodplain and swamp forest only, exclude tall shrub swamps)

For the wetland system, estimate the extent of native woody regeneration (saplings and seedlings).

Vegetation Composition

This metric partially integrates other vegetation metrics above. It considers anthropogenic impacts to vegetation composition including native species sensitive to anthropogenic degradation; functional groups

indicative of anthropogenic disturbance (increasers, weedy, or ruderal species); and proportion of expected diagnostic species.

7.2.3. Hydrology

Water Source

This is an assessment of the extent, duration, and frequency of saturated or ponded conditions within a wetland system, as affected by the kinds of direct inputs of water into, or any diversions of water away from, the system.

The natural sources of water for freshwater wetlands are mainly direct rainfall, groundwater discharge, runoff, and riverine flows. Whether the water sources are perennial or seasonal, alterations result in changes in either the high water or low water levels. Such changes can be assessed based on the patterns of plant growth along the wetland margins or across the bottom of the wetlands. For sloped wetlands, such as seeps and springs, ground water is the primary source of water. It is generally expected that the source is perennial and relatively constant in volume throughout most years. The water source can be assessed, therefore, based on plant indicators of its permanence and consistency (Collins et al. 2007).

The natural source of water for estuarine wetlands is primarily tidal; other sources are direct rainfall, runoff, and riverine flows.

Hydroperiod

Assessment of the natural condition of a wetland system's hydroperiod.

- **Riverine/Lacustrine**

Estimate the degree to which channel and shore stability is intact.

Indicators of channel equilibrium, degradation, aggradation (Collins et al. 2007):

Channel Equilibrium

- well-defined high water line corresponds to lower limit of vegetation
- bankfull stage clearly indicated by an obvious floodplain
- little or no active undercutting or burial of riparian vegetation

Degradation

- deeply undercut banks with exposed living roots of trees or shrubs
- abundant bank slides or slumps
- channel bed appears scoured to bedrock or dense clay
- channel bed lacks any fine-grained sediment
- riparian vegetation may be declining in stature or vigor

Aggradation

- channel lacks a well-defined usual high water line
- active floodplain with fresh splays of sediment covering older soils or recent vegetation
- partially buried tree trunks or shrubs
- cobbles and/or coarse gravels recently deposited on floodplain
- partially buried, or sediment-choked, culverts

- **Non-Riverine Enriched**

Indicators of reduced extent and duration of inundation or saturation (Collins et al.2007):

- upstream spring boxes, diversions, impoundments, pumps, ditching or draining from the wetland

- evidence of aquatic wildlife mortality
- encroachment of terrestrial vegetation
- stress or mortality of hydrophytes
- compressed or reduced plant zonation
- excessive exotic vegetation along perimeter
- desiccation when comparable wetlands are typically inundated or saturated

Indicators of increased extent and duration of inundation or saturation (Collins et al.2007):

- berms, dikes, or other water control features that increase duration of ponding
 - pumps, diversions, ditching or draining into the wetland
 - late-season vitality of annual vegetation
 - recently drowned riparian or terrestrial vegetation
 - extensive fine-grain deposits on wetland margins
- **Poor Isolated Wetlands**
Assess the degree of alteration (if any) to expected natural patterns of saturation, inundation, or drawdown.
 - **Estuarine**
Assess the degree of alteration (if any) to expected natural tidal patterns.

Hydrologic Connectivity

Assessment of the natural condition of a wetland system's hydrologic connectivity.

- **Riverine/Lacustrine**
For the wetland system, estimate by observing signs of overbank flooding, channel or shore migration or incision, and geomorphic modifications.
- **Non-Riverine Enriched**
An assessment of the ability of water to flow into or out of the wetland system, or to inundate adjacent areas. This metric is scored by assessing the degree to which the lateral movement of flood waters or the associated upland transition zone of the wetland system is restricted by unnatural features such as levees or road grades (Collins et al. 2007).
- **Poor Isolated Wetlands**
Assess the degree of alteration (if any) to expected natural patterns of water movement into and out of the wetland system (or lack thereof).
- **Estuarine**
Assess the degree of alteration (if any) to expected natural patterns of tidal water movement.

7.2.4. Soil / Substrate

Disturbance

Evaluate physical disturbances to the soil and surface substrates. Examples of physical disturbances include filling, grading, plowing, pugging, vehicle use, sedimentation, dredging, and other mechanical disturbances.

Water Quality

An assessment of water quality based on visual evidence of degradation (e.g., algae mats, odd water color or turbidity, etc.).

Physical Patch Type Diversity

An assessment of the anticipated patch types possible for the wetland system at the site (not in general for the wetland system type).

A physical patch type worksheet is provided to inform the metric ratings. On the worksheet, first choose which broad habitat type the wetland system is found in:

- **River/Stream Channel or Pond/Lake Shore**
- **Floodplain**
- **Bogs & Fens**
- **Marsh & Shrubland**
- **Swamp Forest**
- **Estuary**
- **Other _____**

Then for each biotic and abiotic patch type anticipated for the wetland system at the site, code expected patch type frequency as follows:

- E** = as expected
- E+** = greater than expected
- E-** = less than expected
- A** = absent but expected at the site

Note: leave blank if patch type absent but not expected at the site.

7.2.4. Size

Relative Size

An assessment of the wetland systems current size relative to reference sizes for the type throughout its range. For available size rank specifications, contact NH Natural Heritage Bureau (603-271-2215).

Alternatively, reference the following Absolute Patch Size Rating Table:

Absolute Patch Size Rating Table*				
Spatial Pattern Type	Metric Rating (ha)			
	Excellent	Good	Fair	Poor
Matrix	>5,000	500–5,000	50–500	<50
Very Large Patch	>500	100–500	20–100	<20
Large Patch	>125	25–125	5–25	<5
Medium Patch	>50	10–50	2–10	<2
Small patch	>10	2–10	0.5–2	0.5
Very Small Patch	>2	0.5–2	0.1–0.5	0.1
Linear	>5 km in length	1–5 km in length	0.1–1 km in length	<0.1 km in length

*NatureServe draft table (6/2/2011)

Size Condition

A measure of the current size of the wetland system divided by the historic size of the wetland (within most recent period of intensive settlement or 200 years), multiplied by 100. Wetland area can be lost due

to human disturbance such as roads, impoundments, development, ditching, draining, mining, flooding for reservoirs, etc. Estimate using best available information (maps, aerial photographs, etc.).

7.3. EIA LEVEL 2.5 STRESSORS CHECKLISTS

Role of Stressor Checklists (Faber-Langendoen 2009)

Stressor checklists are used only for informative purposes, as an aid to further understanding the overall condition of the wetland. Stressors are considered *direct threats*, defined as “the proximate (human) activities or processes that have caused, are causing, or may cause the destruction, degradation, and/or impairment of biodiversity and natural processes” (from Salafsky et al. 2008). *Indirect threats* (e.g., farm operations, forest companies) are not included.

For the most part, direct threats are related to human activities, but they may be natural. The impact of human activity may be very conspicuous (e.g., destruction of habitat) or more inconspicuous (e.g., invasive species introduction). Effects of natural phenomena (e.g., fire, hurricane, or flooding) may be especially important when the wetland system type is concentrated in one location or has few occurrences, which may be a result of human activity. Strictly speaking, these natural phenomena may be part of natural disturbance regimes; but they need to be considered a threat if a habitat is damaged from other threats and has lost its resilience, and is thus vulnerable to the disturbance (Salafsky et al. 2008).

For purposes of ecological integrity assessments, threat impact is calculated considering only present observed or inferred stressors. If inferred, the reason for the inference should be clearly stated. Stressors that do not occur yet but are projected to occur in the near term are not included.

In some cases, where stressors appear to be having a negative impact on the site, but the condition metrics do not reflect these impacts, it may be important to over-ride the overall calculated score. This should only be done in exceptional circumstances. The need for manual over-rides may suggest that the current condition metrics may be insensitive to degradation of certain stressors, and future adjustments to the metrics may be needed.

Stressors may be characterized in terms of *scope* and *extent/severity*. Scope is defined as the proportion of the wetland system that can reasonably be expected to be affected by the stressor within 10 years given continuation of current circumstances and trends. Current circumstances and trends include both existing as well as potential new stressors. The ten-year time frame can be extended for some longer-term stressors, such as global warming, that need to be addressed today. For wetland systems, scope is measured as the proportion of the system affected by the stressor.

Within the scope (as defined spatially and temporally in assessing the scope of the threat/stressor), extent/severity is the level of damage to the wetland system from the stressor that can reasonably be expected with continuation of current circumstances and trends. Note that extent/severity of stressors is assessed within a ten-year time-frame. For wetland systems, extent/severity is typically measured as the degree of degradation caused by the stressors.

Assessing Stressor Impact

Below is a description of the process involved in the assessment of scope and extent/severity of stressors and calculation (automated or manual) of overall stressors impact to a wetland system (modification of Faber-Langendoen 2009; adapted from Master et al. (2009).

Step 1. Estimation of scope and extent/severity of each stressor.

Estimate the scope and extent/severity for applicable individual stressors/threats to the wetland system using the rating tables below.

Example: subset of five stressors and two major ecological attributes (MEAs):

LEVEL 2.5 STRESSOR CHECKLIST

Stressors: *direct threats*; "the proximate (human) activities or processes that have caused, are causing, or may cause the destruction, degradation, and/or impairment of biodiversity and natural processes (e.g., ditching, logging, exotic pest diseases, septic tanks, or pesticide spray). Altered disturbance regime may be stressor (e.g., flooding, fire, or browse).

Some Important Points about Stressors Checklists.

1. Stressors checklists must be completed for Landscape Context (LC), Vegetation, Soils, and Hydrology.
2. Assessment of LC is for stressors found from system perimeter out to 250 m (not for stressors beyond 250 m or the degree to which LC stressors may impact the wetland system being evaluated).
3. Stressors for Vegetation, Soils, and Hydrology are assessed by site-specific metrics with the Level 2.5 metrics ratings are applied (i.e., to the wetland system).
4. Threat impact is calculated on the basis of the severity of the threat and the reason for the inference should be clearly stated).

Site Name: _____ Site Code: _____ Last Obs (yyyy-mm-dd): _____
 System: _____ Surveyor: _____

SCOPE of threat: percent of LC or system affected [Assess for up to next 10 yrs]

S1 = Small	Affects a small (1-10%) proportion of the total occurrence
S2 = Restricted	Affects some (11-30%) of the total occurrence
S3 = Large	Affects much (31-70%) of the total occurrence
S4 = Pervasive	Affects all or most (71-100%) of total occurrence

EXTENT or SEVERITY of degradation in scope [for Veg, Soil, Hydro] [Assess for up to next 10 yrs]

E1 = Low	Likely to only slightly degrade/reduce occurrence
E2 = Moderate	Likely to moderately degrade/reduce occurrence
E3 = Serious	Likely to seriously degrade/reduce occurrence
E4 = Extreme	Likely to extremely degrade/destroy or eliminate occurrence

	LC [250 m]			Vegetation [WS]			Soil/Substrate [WS]			Hydrology [WS]			Comments [LC=LandCon, V=Veg, S=Soil, H=Hydro]
	Scope	Extent	Impact	Scope	Extent	Impact	Scope	Extent	Impact	Scope	Extent	Impact	
STRESSORS CHECKLIST													
D Residential													
D Industrial, commercial, military													
D Utility/powerline corridor													
V Sports field, golf course, urban parkland													
L Row-crop agriculture, orchard/nursery													
O Other (specify):													
P Roads (gravel, paved, highway), railroad													
P Livestock, grazing, excessive herbivory													
P Other (specify):													
R Passive recreation (bird, hike, trample, camp)													
E Active recreation (ATV, mt bike, hunt, fish, boat)													
C Other (specify):													
V Woody resource extraction: logs, shrub cuts, debris													
V Vegetation management: cutting, mowing													
E Excessive animal herbivory or insect damage													
G Invasive exotic plant species													
G Herb-Pesticide, vector control, chemicals (give evid)													
G Other (specify):													
N Altered nat disturb regime (specify expected regime)													
D Other (specify):													
S Incr sediment/org debris, erosion, gully (logged sites)													
S Filling, spoils, excavation													
O Soil disturbance: trampling, vehicle, pugging, skidding													
I Grading, compaction, plowing, discing													
L Physical resource extraction: rock, sand, gravel, etc													
L Trash or refuse dumping													
L Other (specify):													
H Dam, ditch, diversion, dike, levee, unrat inflow, reser													
Y Water extraction (lake/groundwat; wat table lowered)													
D Flow obstructions (culverts, paved stream crossings)													
R Engineered channel (riprap, armored bank, bed)													
O Actively managed hydrology (controlled lake level)													
L Tide gate, weir/drop structure, dredged inlet/channel													
O PS Discharge: treatmt water, non-storm disch, septic													
G NPS Discharge: urban runoff, farm drainage													
Y Other (specify):													
G Other (specify):													
Overall Stressor Impact													

NatureServe / NH NHB EIA, Wetland 11-15-2010, Level 2.5 Stressor Rating Form

Example Stressors Checklist	Landscape Context [250 m]			Vegetation		
	Scope	Extent	Impact	Scope	Severity	Impact
Residential	Small	Low				
Industrial, commercial, military						
Utility/powerline corridor						
Sports field, golf course, parkld	Large	Moderate				
Livestock, grazing, ex herbivory	Restricted	Serious		Small	Low	

Rating	SCOPE of threat: percent of LC or system affected [Assess for up to next 10 yrs]
Small	Affects a small (1-10%) proportion of the wetland system or surrounding landscape
Restricted	Affects some (11-30%) of the wetland system or surrounding landscape
Large	Affects much (31-70%) of the wetland system or surrounding landscape
Pervasive	Affects most or all (71-100%) of the wetland system or surrounding landscape
Rating	EXTENT or SEVERITY of degradation within scope [Assess for up to next 10 yrs]
Low	Likely to only slightly degrade/reduce the affected habitat
Moderate	Likely to moderately degrade/reduce the affected habitat
Serious	Likely to seriously degrade/reduce the affected habitat
Extreme	Likely to extremely degrade or eliminate the affected habitat

Step 2. Calculation of impact of scope and extent/severity for each stressor.

For each stressor, the automated scorecard combines scope and extent/severity into an impact score (numeric) using the “Threat Impact Calculator” table below.

Stressors Checklist	Landscape Context [250 m]			Vegetation		
	Scope	Extent	Impact	Scope	Severity	Impact
Residential	Small	Slight	Low = 1			
Industrial, commercial, military						
Utility/powerline corridor	Large	Moderate	Med = 3			
Sports field, golf course, parkld						
Livestock, grazing, ex herbivory	Restricted	Serious	Med = 3	Small	Slight	Low = 1

Threat Impact Calculator		Scope			
		Pervasive	Large	Restricted	Small
Extent	Extreme	Very High=7	High=5	Medium=3	Low=1
	Serious	High=5	High=5	Medium=3	Low=1
	Moderate	Medium=3	Medium=3	Low=1	Low=1
	Slight	Low=1	Low=1	Low=1	Low=1

Step 3. Calculation of stressors impact for each of the four major ecological attributes.

For each MEA, the scorecard sums the numerical impact score.

Stressors Checklist	Landscape Context [250 m]			Vegetation		
	Scope	Extent	Impact	Scope	Severity	Impact
Residential	Small	Slight	Low = 1			
Industrial, commercial, military						
Utility/powerline corridor	Large	Moderate	Med = 3			
Sports field, golf course, parkld						
Livestock, grazing, ex herbivory	Restricted	Serious	Med = 3	Small	Slight	Low = 1
Sum of Scores			7			1

Step 4. Convert summed impact scores into impact index for each MEA.

For each MEA, the scorecard then converts the summed impact score into an impact to MEA index using the “Index of Impact to MEA” table below. For each MEA, the summed impact scores and impact index can then be compared between sites.

Major Ecological Attribute	Summed Impact Score	Impact to MEA Index
Landscape Context	7	High
Vegetation	1	Low
Soil/Substrate	4	Medium
Hydrology	1	Low

Index of Impact to Major Ecological Attribute	
Sum of Individual Stressors for each Major Ecological Attribute	Index
11 or greater	Very High
7-10	High
4-6	Medium
0-3	Low

Step 5. Calculation of overall stressors impact to the wetland system.

It may be possible to calculate an ecologically meaningful overall stressors impact score for the wetland system. Possible steps may involve dividing each MEA stressor impact score by the number of stressors possible for that MEA. Depending on the wetland system type, one or more MEA impact scores can be weighted to reflect a greater or lesser importance of the score(s) to the system type compared to the other MEAs. Whether or not you choose to weight one or more MEA impact scores, the four MEA impact scores can next be averaged and the overall score converted into an overall impact index.

7.3.3. ASSESSMENT FOR STRESSORS CHECKLIST

Important Points about Stressors Checklists

- Where applicable, stressors checklists must be completed for all four major ecological attributes (landscape context, vegetation, hydrology, and soils).
- Landscape context includes the entire area between the wetland system edge out to a distance of 250 meters. Use aerial photographs to assess areas you did not visit or see during the survey.
- Assess landscape context stressors and their effects from the wetland edge out to 250 meters (NOT how landscape context stressors may impact the wetland system).
- Stressors for vegetation, soils, and hydrology are assessed within the wetland system.
- If two stressors conceptually overlap as applied at a particular site, choose only one and note the overlap.

8. SCORECARD

8.1. LEVEL 2.5 ECOLOGICAL INTEGRITY ASSESSMENT SCORECARD

The description below for an Ecological Integrity Assessment Scorecard has been modified from the following document:

Faber-Langendoen, D. 2009. A freshwater wetlands monitoring and assessment framework for the Northeast Temperate Network, National Park Service. Natural Resource Report NPS/NETN/NRR—2009/143. National Park Service, Fort Collins, Colorado.

We first structure the scorecard so that each metric is assigned a weight, based on how important it is considered in evaluating ecological integrity. Second, each rating for a metric is assigned a point value with A = 4.5 – 5.0, B = 3.5 – 4.4, etc. When a field value is assigned for a metric (e.g., the Buffer Index is given a B rating), it is first converted to a point rating (i.e., B = 4), then the points are multiplied by the weight (4 x 1 = 4). The weighted scores for all metrics within a major attribute (e.g., Landscape Context) are then summed and divided by the sum of the weights, giving a weighted average score. Finally, the weighted average of each attribute can be summed and divided by the total number of attributes (or if the attributes themselves are also weighted, then the division would be based on the weighted sum of those attributes). The point-based approach is consistent with that of many IBI scoring methods (e.g., Karr and Chu 1999).

Landscape Context

Rate the Landscape Context metrics according to their specified ratings. Use the Land Use Index (adjust as needed after field verifying any questionable land cover polygons) calculated using Landsat land cover data in a GIS as the overall Landscape Context rating. If the Land Use Index was not calculated in a GIS, then use the scoring table below to roll up the alternative metrics into an overall Landscape Context rating.

Rational for Scoring: In addition to assessing the sub-metrics Surrounding Land Use and Landscape Connectivity, the Land Use metric also assesses the sub-metric Buffer in a slightly different way than the Buffer metric. Therefore, the Land Use Metric is given more weight than the Buffer Metric.

Landscape context rating* calculation for wetland systems						
Metric	A	B	C	D	Weight	Weighted Score
Land Use	5	4	3	1	1	
Buffer (60%)						
Surrounding Land Use (25%)						
Landscape Connectivity (15%)						
Buffer	5	4	3	1	0.5	
Buffer Length (50%)						
Buffer Condition (50%)						
					Σ = sum of weights	Σ = sum of weighted scores
						Score = (sum of weighted scores / sum of weights)

* Landscape Context Rating: A = 4.5 – 5.0; B = 3.5 – 4.4, C = 2.5 – 3.4; D = 0 – 2.4

Size

Rate the size metrics according to their specified ratings. Use the scoring table below to roll up the metrics into an overall size rating.

Rationale for Scoring: Absolute Patch Size is always used as a metric, but Relative Patch Size is optional. Even when used, it carries less weight than current absolute size. The focus is on current condition, not historic patterns per se.

Size rating* calculation for wetland systems						
Metric	A	B	C	D	Weight	Weighted Score
Absolute Patch Size	5	4	3	1	1	
Relative Patch Size**	5	4	3	1	0.5	
					Σ = sum of weights	Σ = sum of weighted scores
						Score = (sum of weighted scores / sum of weights)

* Size Rating: A = 4.5-5.0; B = 3.5-4.4; C = 2.5-3.4; D = 0 - 2.4

**Optional metric

Vegetation

Rate the vegetation metrics according to their specified ratings. The scoring table below is used to roll up the metrics into an overall vegetation rating.

Rationale for Scoring: Each of the metrics is judged to be equally important as a measure of biotic (vegetation) integrity.

Vegetation rating* calculation for wetland systems							
Metric	A	B	C	D	E	Weight	Weighted Score
Vegetation Structure	5	4	3	1		1	
Organic Matter Accumulation		5	3	1		1	
Cover of Native Plant Increasers	5	4	3	1		1	
Relative Cover of Native Plant Species	5	4	3	2	1	1	
Cover of Exotic Invasive Plant Species	5	4	3	1		1	
Vegetation Regeneration	5	4	3	1		1	
Vegetation Composition	5	4	3	1		1	
						Σ = sum of weights	Σ = sum of weighted scores
							Score = (sum of weighted scores / sum of weights)

*Vegetation Rating: A = 4.5-5.0; B = 3.5-4.4; C = 2.5-3.4; D = 0-2.4

Hydrology

Rate the metrics according to their specified ratings. Use the scoring table below to roll up the metrics into an overall hydrology rating.

Rationale for Scoring: Each of the hydrologic metrics is judged to be equally important to the overall hydrologic integrity.

Hydrology rating* calculation for wetland systems						
Metric	A	B	C	D	Weight	Weighted Score
Water Source	5	4	3	1	1	
Hydroperiod	5	4	3	1	1	
Hydrologic Connectivity	5	4	3	1	1	
					Σ = sum of weights	Σ = sum of weighted scores
						Score = (sum of weighted scores / sum of weights)

*Hydrology Rating: A = 4.5-5.0; B = 3.5-4.4; C = 2.5-3.4; D = 0-2.4

Soils

Rate the soil metrics according to their specified ratings. Use the scoring table below to roll up the metrics into an overall soil rating.

Rationale for Scoring: Physical Patch Type Diversity is weighted less heavily than the other two metrics because it is not yet clear how much diversity of patch types is an inherent property of ecological integrity. Water quality may be difficult to observe in the field for floodplain and for bog and fen systems, where standing water is often not present.

Soils rating* calculation for wetland systems						
Metric	A	B	C	D	Weight	Weighted Score
Disturbance	5	4	3	1	1	
Water Quality**	5	4	3	1	1	
Physical Patch Type Diversity		5	3	1	0.5	
					Σ = sum of weights	Σ = sum of weighted scores
						Score = (sum of weighted scores / sum of weights)

* Soils Rating: A = 4.5–5.0; B = 3.5–4.4; C = 2.5–3.4; D = 0–2.4

**Optional metric

Ecological Integrity Assessment: Overall Wetland System Rank

The overall wetland system rank is based on a roll-up of the scores for each of the major ecological attributes (see scorecard metrics above). The table below is used to calculate overall ecological integrity for a wetland system and is structured so that the score for each of the major attributes is provided, along with the overall index. Managers may find trends at both levels helpful when assessing the integrity of wetlands on their lands.

Rationale for Scoring: Each of the major attributes is given a specific weight. In the current model, we weight size and soils less heavily than the other factors. Size and soils are down-weighted because at this time we are not as confident that the rapid metrics for these attributes can be as readily used to assess ecological integrity as metrics for the other attributes. In addition, consideration is being given to a rule for interactions between size and landscape context scores, whereby when landscape context scores are high (i.e., the wetland is found in an intact natural landscape), less weight is given to size, whereas as landscape context decreases in integrity, increasing weight is given to size.

Overall wetland system rank* calculation for wetland systems						
Category	A	B	C	D	Weight	Weighted Score
Landscape Context	5	4	3	1	1	
Size	5	4	3	1	0.5	
Vegetation	5	4	3	1	1	
Hydrology	5	4	3	1	1	
Soils	5	4	3	1	0.5	
					Σ = sum of weights	Σ = sum of weighted scores
						Score = (sum of weighted scores / sum of weights)

*Overall Wetland System Rating: A = 4.5–5.0; B = 3.5–4.4; C = 2.5–3.4; D = 0–2.4

An example is provided in the table below. In this example, the Weighted Attribute Score column multiplies the attribute score (e.g., for size the attribute score is 6.5 / 1.5 = 4.3) by the weight (e.g., for size the weight is 0.5) to get a Weighted Attribute Score (e.g., for size = 2.2). The weighted score is summed, as are the weights. The “Score” column is calculated by dividing the total sum of weighted

attribute scores (in this example: $4.0 + 2.2 + 3.6 + 4.0 + 2.0 = 15.8$) by the total sum of attribute weights ($1 + 0.5 + 1 + 1 + 0.5 = 4$). A score of 3.95 equals an overall wetland system rank of “B.”

Example of overall wetland system rank* calculation for a Level 2.5 assessment								
Metric	Assigned Metric Rating	Assigned Metric Points	Weight (W)	Major Attributes		Rank Factor Rank	Score	Overall Wetland System Rank
				Metric Score (M)	Weighted Attribute Score (WAS)			
Landscape Context					$4.0 \times 1 = 4.0$	B		
Land Use Index	B	4	1	4				
Buffer Index	B	4	0.5	2				
			$\Sigma = 1.5$	$\Sigma = 6$				
Size					$4.3 \times 0.5 = 2.2$	B		
Absolute Patch Size	B	4	1	4				
Relative Patch Size	A	5	0.5	2.5				
			$\Sigma = 1.5$	$\Sigma = 6.5$				
Vegetation					$3.6 \times 1 = 3.6$	B		
Vegetation Structure	C	3	1	3				
Organic Matter Accum.	C	3	1	3				
Cover of Native Plant	B	4	1	4				
Increasesers								
Relative Cover of	B	4	1	4				
Native Plant Species								
Cover of Exotic Invasive	C	3	1	3				
Plant Species								
Vegetation Regeneration	B	4	1	4				
Vegetation Composition	B	4	1	4				
			$\Sigma = 7$	$\Sigma = 25$				
Hydrology					$4.0 \times 1 = 4.0$	B		
Water Source	C	3	1	3				
Hydroperiod	B	4	1	4				
Hydrologic Connectivity	A	5	1	5				
			$\Sigma = 3$	$\Sigma = 12$				
Soil					$4.0 \times 0.5 = 2.0$	B		
Disturbance	B	4	1	4				
Water Quality	B	4	1	4				
Physical Patch Type Div.	B	4	0.5	2				
			$\Sigma = 2.5$	$\Sigma = 10$				
Overall ecological integrity $\Sigma = 15.8$ (4)							3.95	B

*Rating: A = 4.5–5.0; B = 3.5–4.4; C = 2.5–3.4; D = 0–2.4

8.2. ADAPTING METHODS OVER TIME

It is important to remember that our efforts to assess ecological integrity are approximations of our current understanding of wetland systems. In reality, these systems are far too complex to be fully represented by a suite of metrics and attributes. Moreover, our rapid metrics, indices, and scorecards must be flexible enough to allow change over time as our knowledge grows. What is important is that we present as clearly as possible methods used in conducting our assessments, so that communication and understanding is fostered among people with different backgrounds, goals, and points of view.

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10. APPENDICES

10.1. SOIL TEXTURE

Organic soil texture

Use the guide below to determine muck and peat types of organic soils. “

Determination of Peatlands vs. Mineral Soil Wetlands

Prepared by Greg Edinger, Ecologist, NY Natural Heritage Program, May 6, 2002

Definitions from Ecological Communities of NY State (Reschke 1990, Edinger et al. 2002)

Mineral soil: soil with less than 20% organic matter if the mineral fraction contains no clay; or less than 30% organic matter if the mineral fraction contains 50% or more clay. For more information see Appendix D in: Cowardin *et al.* (1979).

Muck - sapric: highly decomposed organic material in which the original plant parts are not recognizable; contains more mineral matter and is usually darker in color than peat (von Post H7 to H10; see below)

Peat - hemic: the partially-decayed remains of plant material accumulating on wet sites because of water-logging; unconsolidated soil material consisting of accumulated, slightly decomposed organic matter (von Post H4 to H6).

Peat - fibric: the partially-decayed remains of plant material accumulating on wet sites because of water-logging; unconsolidated soil material consisting of accumulated, undecomposed organic matter (von Post H1 to H3).

From Community Field Form Instruction (Edinger et al. 2000)

Average organic soil texture - average texture of the top meter of organic soil. See the Von Post decomposition scale below for organic soils.

von Post* scale of peat decomposition:

H1: Completely undecomposed peat (but not “live”); only clear water can be squeezed out.

H2: Almost undecomposed and mud-free peat; water that is squeezed out is almost clear and colorless.

H3: Very little decomposed and very slightly muddy peat; when squeezed water is obviously muddy but no peat passes through fingers. Residue retains structure of peat.

H4: Poorly decomposed and somewhat muddy peat; when squeezed, water is muddy. Residue muddy but it clearly shows growth structure of peat.

H5: Somewhat decomposed, rather muddy peat; growth structure visible but somewhat indistinct; when squeezed some peat passes through fingers but mostly very muddy water. Press residue muddy.

H6: Somewhat decomposed, rather muddy peat; growth structure indistinct; less than 1/2 of peat passes through fingers when squeezed. Residue very muddy, but growth structure more obvious than in unpressed peat.

H7: Rather well-decomposed, very muddy peat; growth structure visible, about 1/2 of peat squeezed through fingers. If water is squeezed out, it is porridge-like.

H8: Well-decomposed peat; growth structure very indistinct; about 2/3 of peat passes through fingers when pressed, and sometimes a somewhat porridge-like liquid. Residue consists mainly of roots and resistant fibers.

H9: Almost completely decomposed and mud-like peat; almost no growth structure visible. Almost all peat passes through fingers as a homogeneous porridge if pressed.

H10: Completely decomposed and muddy peat; no growth structure visible; entire peat mass can be squeezed through fingers.

Adapted from: Damman, A.W.H. and T.W. French. 1987. The ecology of peat bogs of the glaciated northeastern United States: a community profile. U.S. Fish and Wildlife Service. Washington, D.C.

Peatland and mineral soil wetlands are distinguished on the depth of peat. Peatlands generally should have at least 20 cm of peat. This depth allows occurrences with shallow peat over bedrock to be classified as peatlands (e.g., sliding fen, rich sloping fen, perched bog). This specification is workable in most cases. Classifying occurrences with muck soil poses a greater challenge, especially if the occurrence has deep muck, or shallow peat (<20 cm) over deep muck. Classification of muck soil wetlands is probably best done by looking at the dominant and characteristic vegetation and comparing to the closest peatland or mineral soil wetland community.

Mineral soil texture

For mineral soils, use the key below to assess soil texture of the A or top horizon. Focus on the broad categories only, as described below. Document the finer levels, only as needed to validate the higher level. For example, if you are unsure if texture is clay loam or silty clay loam, check both – the main thing is that you are sure it is CLAYEY.

Mineral Soils: soil with less than 20% organic matter if the mineral fraction contains no clay; or less than 30% organic matter if the mineral fraction contains 50% or more clay. For more information see Appendix D in: Cowardin et al. (1979). Four broad categories help group the individual textures (Sandy, Sandy Loam, Loamy, Clayey, as taken from Beckingham et al. 1996).

Simplified Key to Mineral Soil Texture (Brady and Weil 2002):

- A1 Soil does not remain in a ball when squeezed.....**sand** (SANDY)
- A2 Soil remains in a ball when squeezed.....B
- B1 Squeeze the ball between your thumb and forefinger, attempting to make a ribbon that you push up over your finger. Soil makes no ribbon.....**loamy sand** (SANDY)
- B2 Soil makes a ribbon; may be very short.....C
- C1 Ribbon extends less than 1 inch before breaking.....D
- C2 Ribbon extends 1 inch or more before breaking.....E
- D1 Add excess water to small amount of soil. Soil feels at least slightly gritty.....**loam** (slightly gritty) (LOAMY) or **sandy loam** (grittiness prominent, grinding noise is audible) (SANDY LOAM)
- D2 Soil feels smooth, floury.....**silt loam** (LOAMY)
- E1 Soil makes a ribbon that breaks when 1- 2 inches long; cracks if bent into a ring.....F
- E2 Soil somewhat shiny, makes a ribbon 2+ inches long; does not crack when bent into a ring.....(CLAYEY).....G
- F1 Add excess water to small amount of soil; soil feels at least slightly gritty.....**sandy clay loam** (grittiness prominent, grinding noise is audible) (CLAYEY), or **clay loam** (slightly gritty) (CLAYEY)
- F2 Soil feels smooth, floury.....**silty clay loam** (very smooth) (CLAYEY), or **silt** (slightly gritty) (LOAMY)
- G1 Add excess water to a small amount of soil; soil feels at least slightly gritty.....**sandy clay** (grittiness is dominant feel, grinding noise audible) (CLAYEY), or **silt clay** (slightly gritty, floury, very strong ribbon) (CLAYEY)
- G2 Soil feels smooth, very sticky, very strong ribbon.....**clay** (CLAYEY)