STONEHOUSE FOREST ECOLOGICAL INVENTORY

BARRINGTON, NEW HAMPSHIRE

JEFFRY N. LITTLETON

Moosewood Ecological LLC
Innovative Conservation Solutions for New England
PO Box 9 — Chesterfield, NH 03443-0009
(603) 831-1980

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JEFFRY N. LITTLETON, M.S.*
Conservation Ecologist

With Contributions from

Chris Frauenhofer, M.S.*
Field Ecologist

Chris Kane, M.S.*
Conservation Biologist
Kane Conservation

Laura Deming, M.S.*
Conservation Biologist
NH Audubon Society

Moosewood Ecological LLC
Innovative Conservation Solutions for New England
PO Box 9
Chesterfield, NH 03443-0009
(603) 831-1980
Jeff@moosewoodecological.com
www.moosewoodecological.com

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Cover photograph – An exemplary black gum-red maple basin swamp. This black gum is over 400 years old.

***** See Appendix J for a description of qualifications.

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INTRODUCTION

An ecological inventory was conducted on the Stonehouse Forest property located in Barrington, New Hampshire, from May-December 2016. The purpose of the project was to better understand the significance of this tract of land for conservation and land management planning. The primary goals of this project were to collect data on 1) breeding and migratory birds, 2) wildlife species of greatest conservation need, 3) rare plants, 4) wildlife habitats, and 5) significant natural communities. The specific objectives set forth were as follows:

1. Determine the presence, distribution, breeding, and migratory status of upland and wetland-associated birds;
2. Determine the relative abundance[1] and frequency of occurrence[2] of upland and wetland-associated breeding birds with a focus on secretive wetland species and species of conservation concern;
3. Record observations and locations of wildlife species of greatest conservation concern;
4. Map locations and document population size of rare plants;
5. Map site-specific upland and wetland wildlife habitats; and
6. Classify and map significant natural communities

METHODOLOGY

Study Area

The 1,528-acre Stonehouse Forest property is located Barrington, NH (Figure 1). The northern portion of the property, including Round Pond and Little Round Pond, forms the headwaters of the Bellamy River, while the southern section forms the headwaters to the Little River. Both headwaters are part of the larger Lamprey River watershed and eventually drains into the Great Bay estuary. The overall topography includes moderate-sized hills with some steep terrain, cliffs and bedrock outcropping, glacial erratics, and crevices along with several intermittent and perennial streams that drain the numerous wetlands in the low-lying areas.

[1] Relative abundance refers to the number of birds of one species as a percentage of the total population of the Harvey Forest property.

[2] Frequency of occurrence is the number of bird stations (calculated as a proportion) that a species was recorded.

Elevation ranges from 610 feet atop the highest point in the middle of the property to approximately 300 feet where several drainages meet the eastern boundary (Figure 2).

A diverse array of wildlife habitats can be found on the property (Appendix A). The study area consists of approximately 1,280 acres of mostly mature hemlock-hardwood-pine forests with small patches of hardwood-dominated stands and a small example of an oak-mountain laurel forest. The northern half of the property hosts older forest stands while the southern half has experienced logging more recently. Embedded in the forested matrix are approximately 232 acres of wetlands, including emergent marshes (61 acres), shrub wetlands (94 acres), forested swamps (18 acres), and numerous shallow beaver impoundments (59 acres). Also included are 38 known and potential vernal pools. These wetlands and their forested upland buffers provide significant habitats for a diverse wildlife community.

The property is located within a 4,260-acre block of unfragmented forests, wetlands, and streams. This large tract of land is surrounded by multiple smaller unfragmented blocks. The Stonehouse Forest property plays a significant role in providing habitats for area-sensitive species that function best in a less human-disturbed ecological setting.

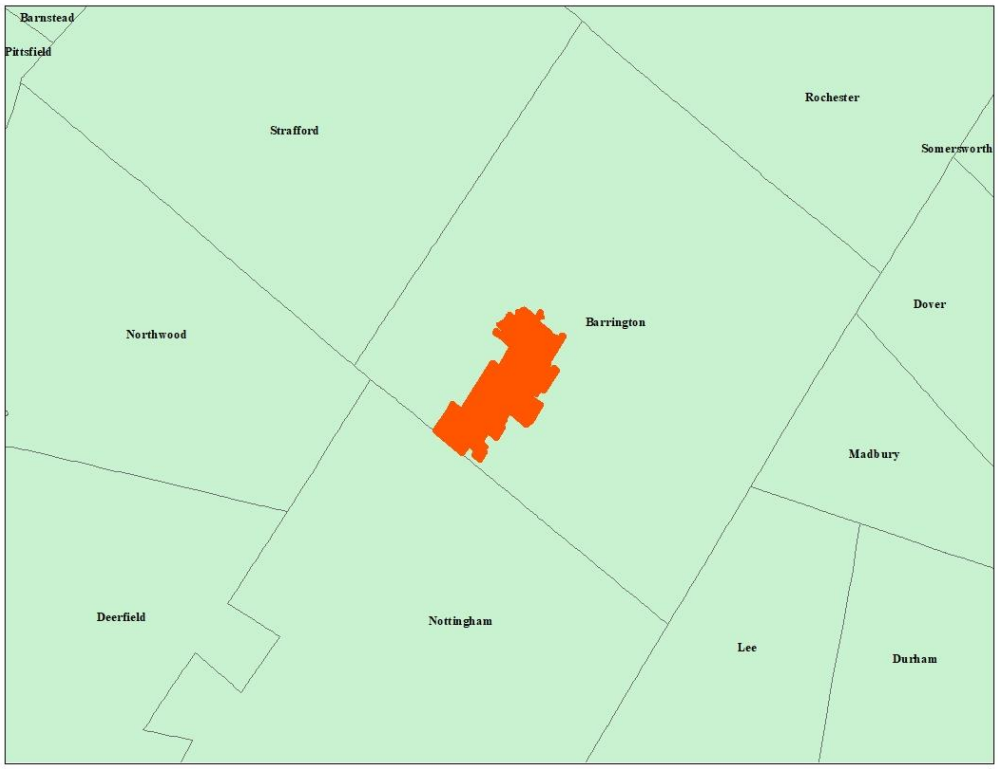

Figure 1. Locus map of the Stonehouse Forest property in Barrington, NH.

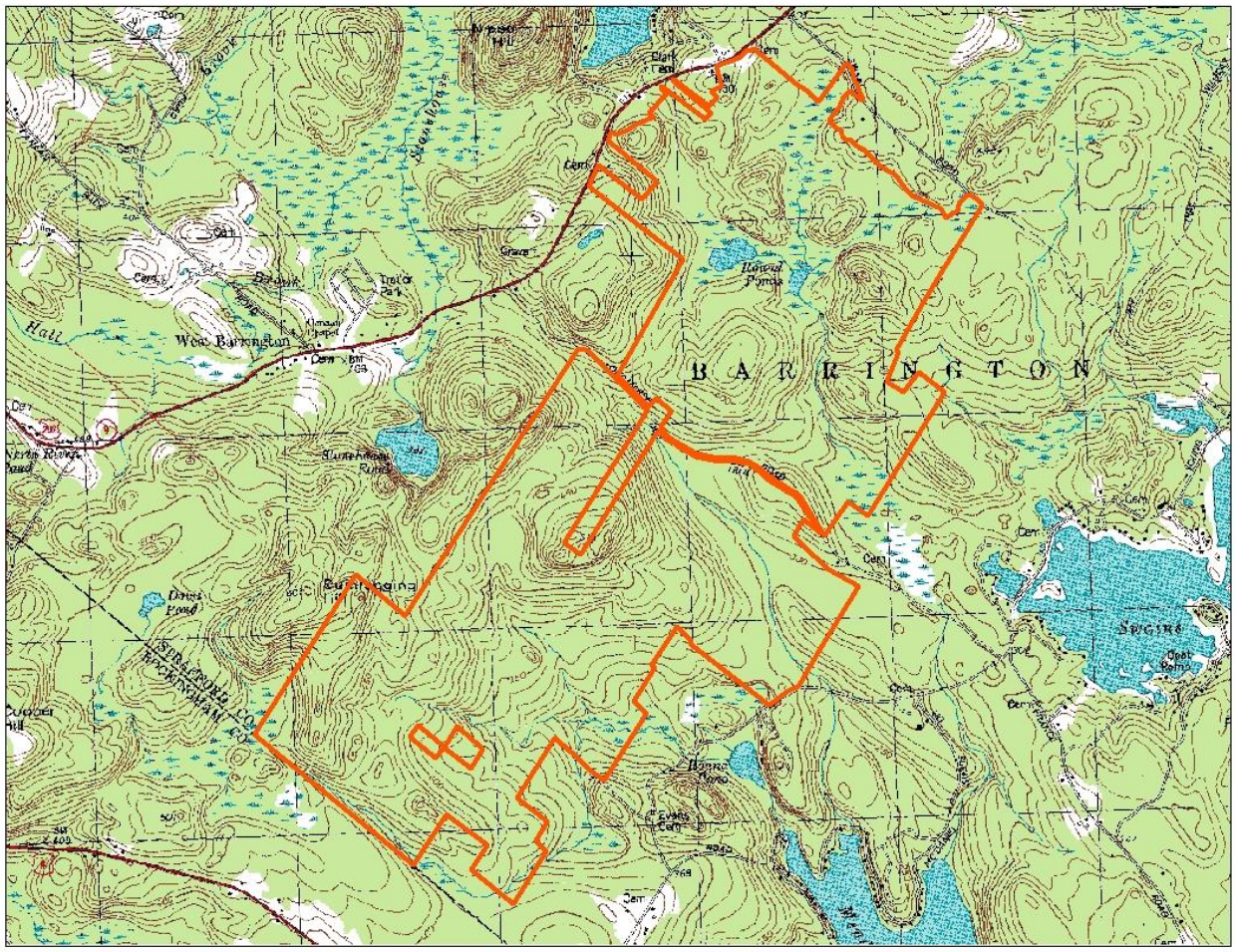

Figure 2. Topography of the Stonehouse Forest property in Barrington, NH.

Survey Methodology

Bird Surveys

Forest and marsh/shrub wetland birds were surveyed during the spring of 2016 from 5:00 am to 10:00 am during the height of the breeding season. These surveys were designed to calculate relative abundance and frequency of occurrence, as well as to determine presence/non-detection of targeted species. Forested bird stations were located at least 250 meters apart, representing a total of 19 point count stations (Appendix B). Each station was sampled three times from May 9 - June 10, 2016. Birds were recorded by sight and sound for a total of 10 minutes at each forested station.

Marsh/shrub wetland bird stations were placed at least 250 meters apart, representing a total of 11 point count stations (Appendix B). Each station was sampled at least two times from

May 6 - June 11, 2016. Selected wetland stations were sampled three times. Birds were recorded by sight and sound for a total of 16 minutes using broadcast calls of secretive species, including least bittern, sora, Virginia rail, American bittern, common gallinule (formerly known as common moorhen), and pied-billed grebe. Broadcast surveys consisted of a 5-minute quiet period, followed by a 6-minute broadcast of each species above, then followed by a 5-minute quiet period. In addition, signs of breeding behavior were recorded for all bird stations (Table 1).

Supplemental sampling was conducted within forest and wetland habitats. These direct search surveys were aimed at detecting secretive species and to increase the probability of detecting additional species of conservation concern, as well as to identify signs of breeding (i.e., nests and fledglings) during spring migration and breeding season. Secretive wetland bird call playback was used in conjunction with the direct searches in wetlands.

Table 1. List of the breeding evidence codes.

Breeding Code	Description of Indicators
OB = "Observed "	1. Species observed during its breeding season, but not in potential nesting habitat
PO = "Possible" Breeding	1. Individual observed in possible nesting habitat 2. Singing male; OR courtship display of waterfowl or diurnal raptors
PR = "Probable" Breeding	1. Pair observed in possible nesting habitat 2. Territory presumed from observations of territorial behavior 3. Courtship and display 4. Visiting probable nest sight 5. Agitated behavior or anxiety calls 6. Brood patch or cloacal protuberance 7. Excavating nest hole; OR nest building by wrens 8. Species observed at point during both sampling periods
CO = "Confirmed" Breeding	1. Distraction display 2. Nest building for species other than wrens 3. Used nests 4. Recently fledged young 5. Adult leaving or entering cavity indicating occupied nest; OR adult on nest 6. Adult carrying food or fecal sac 7. Nest containing eggs 8. Nest with young

Source: Foss (1994).

Turtle Trapping

Turtle trapping was conducted on the property from June 13-24, 2016. Targeted species included Blanding's turtle (State-endangered) and spotted turtle (State-threatened). During this two-week period a total of six traps were set in three separate wetlands (Appendix C). Traps were set and baited on Monday, checked every other day and then pulled on Friday, resulting in a total of eight trap nights over two weeks. Traps were baited with canned sardines in either soybean oil or water. All species captured were identified to species and recorded. Target species were identified by sex and aged if possible.

Fish Surveys

Dip nets were used to survey fish along the vegetated edge of Round Pond in July 2016. In addition, Moosewood Ecological assisted the NH Fish and Game Department with electro-fishing surveys within the outlet stream flowing from Round Pond. Targeted species included bridle shiner (State-threatened), swamp darter, and banded sunfish.

Rare Plant and Significant Natural Community Surveys

A GIS (geographic information system) was used to develop a landscape analysis of the property prior to field investigations for rare plants and significant natural communities. This analysis identified several areas as targets for intensive field surveys. These targets included steep slopes, ridge tops, wetlands, areas of enriched bedrock, and drainages. Main emphasis was placed on wetland habitats. A provisional predictive GIS-based model for locating undocumented populations of small-whorled pogonia (*Isotria medeoloides*) also directed field efforts. Natural communities and systems were classified according to Sperduto and Nichols (2011) and Sperduto (2005), respectively.

RESULTS

Bird Surveys

A total of 82 species, representing 30 families, were recorded during systematic surveys and incidental observations during the breeding season (Appendix D). These included a variety of wetland, forest, and grassland birds, as well as those that generally utilize edges between these habitat types. The majority of the species observed during the breeding season were classified as

possible breeders (35 species). However, 5 species were confirmed breeders and 33 species were classified as probable breeders based on various behavioral characteristics. Nine species were only observed during spring migration. Species noted in bold in the following tables are considered as species of conservation concern.

Wetland Birds

A total of 37 wetland-related species were recorded during standardized surveys (Table 2). These surveys focused on marshes and shrub swamps but did not include isolated forested swamps. Birds included wetland obligate species, species that use wetlands for feeding, and birds associated with forest/wetland edges. In addition to these species many other birds were recorded as incidental observations (Appendix D).

The most abundant species with widespread distribution within marsh and shrub wetlands was common yellowthroat, followed by wood duck, swamp sparrow, blue jay, Canada goose, song sparrow, common grackle, and yellow warbler (Figure 3 and Appendix E). Wood ducks were by far the most abundant waterfowl species documented, comprising 56.1% of waterfowl detected during surveys, followed closely by Canada geese (41.5%) and mallards (2.4%). Wood ducks and Canada geese were confirmed breeders. All three species were present during spring migration, as well as American black ducks. Twenty species are considered to be of conservation concern (Table 2 and Appendix G).

Table 2 Relative abundance and relative frequency of occurrence of breeding birds associated with wetlands on the Stonehouse Forest property in Barrington, NH. May-June 2016.

Species	Relative Abund.(%)	Relative Freq. (%)	Species	Relative Abund.(%)	Relative Freq. (%)
Common yellowthroat	9.02	90.90	**Common loon**	**1.13**	**27.30**
Wood duck	**8.65**	**45.50**	Least flycatcher	1.13	27.30
Swamp sparrow	**7.14**	**54.50**	**Spotted sandpiper***	**1.13**	**18.20**
Blue jay	6.77	72.70	Cedar waxwing	0.75	9.10
Canada goose*	**6.39**	**45.50**	**Eastern kingbird**	**0.75**	**18.20**
Song sparrow	6.02	63.60	Northern cardinal	0.75	18.20
Common grackle	4.89	36.40	**American redstart**	**0.75**	**18.20**
Yellow warbler	4.89	36.40	Ruby-throated hummingbird	0.75	18.20
Tree swallow	4.51	45.50	**Alder flycatcher**	**0.75**	**18.20**
Gray catbird	**4.51**	**54.50**	**Purple finch**	**0.75**	**18.20**
Chestnut-sided warbler	**4.51**	**36.40**	**Mallard**	**0.38**	**9.10**
Scarlet tanager	**4.51**	**81.80**	**Red-shouldered hawk**	**0.38**	**9.10**
Red-winged blackbird	4.14	45.50	Golden-crowned kinglet	0.38	9.10
Great crested flycatcher	**3.38**	**63.60**	**Louisiana waterthrush**	**0.38**	**9.10**
American goldfinch	3.01	45.50	**Marsh Wren**	**0.38**	**9.10**
Great blue heron	**1.88**	**36.40**	Osprey	0.38	9.10
Eastern towhee	**1.88**	**27.30**	Ruby-crowned kinglet	0.38	9.10
Baltimore oriole	**1.13**	**27.30**	**Brown thrasher**	**0.38**	**9.10**
Belted kingfisher	1.13	27.30			

Species in **bold** are listed as species of conservation concern.

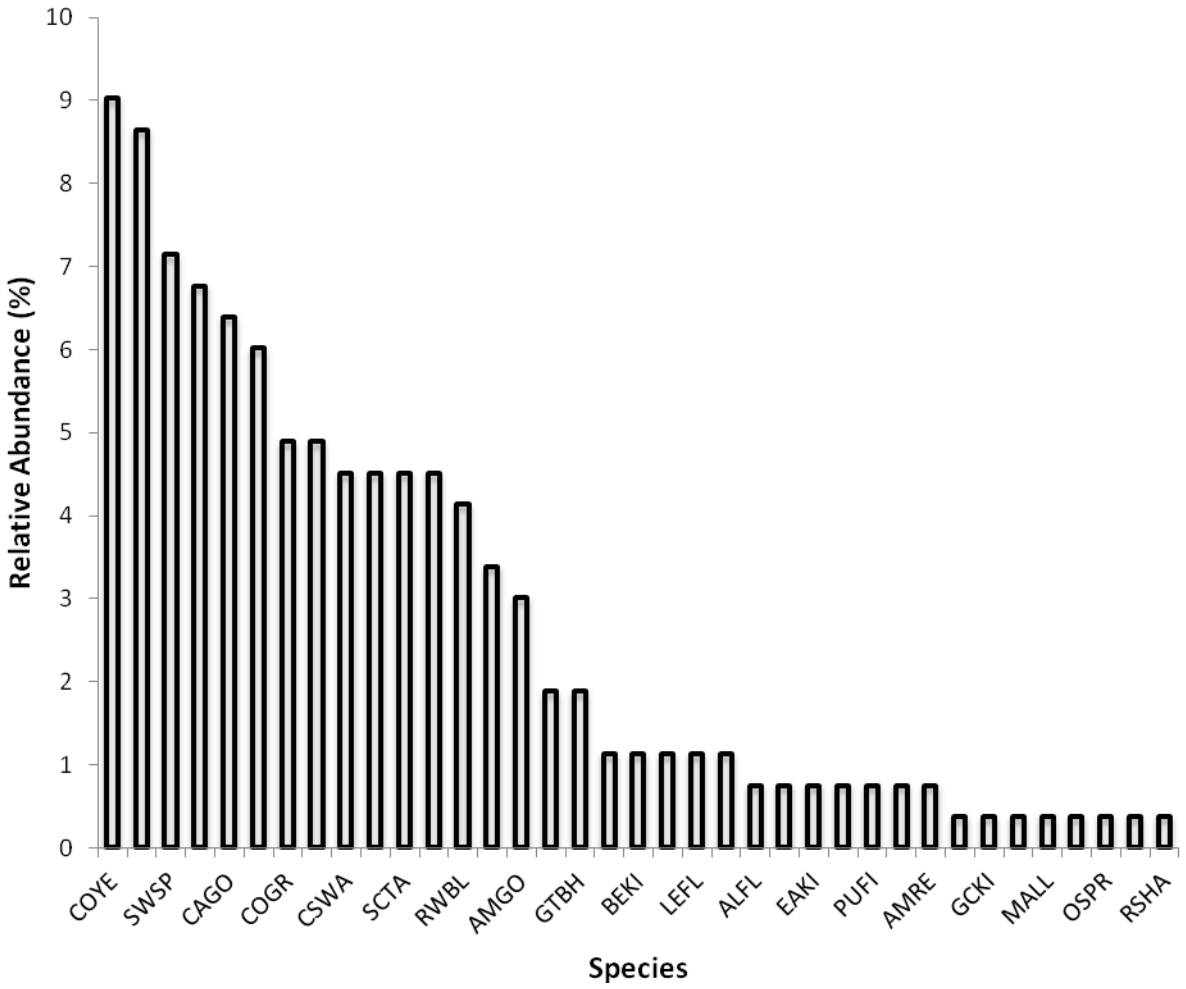

Figure 3. Relative abundance of wetland-associated breeding birds observed on the Stonehouse Forest property in Barrington, NH. May-June 2016.

Forest Birds

A total of 33 forest-related species were recorded during standardized surveys (Table 3). These included birds typically associated with upland forests, isolated forested wetlands, and edge species. Additional species were also recorded as incidental observations (Appendix D). The most abundant species with widespread distribution included the ovenbird, black-capped chickadee, red-eyed vireo, chipping sparrow, blue jay, black-throated green warbler, hermit thrush, tufted titmouse, and black-and-white warbler (Figure 4 and Appendix F). Sixteen species are considered to be species of conservation concern (Table 3 and Appendix G).

Table 3 Relative abundance and relative frequency of occurrence of breeding birds associated with upland forests on the Stonehouse Forest property in Barrington, NH. May-June 2016.

Species	Relative Abund. (%)	Relative Freq. (%)	Species	Relative Abund. (%)	Relative Freq. (%)
Ovenbird	**16.97**	100.00	**Blue-headed vireo**	**1.48**	15.79
Black-capped chickadee	11.07	89.47	**Chestnut-sided warbler**	**1.48**	21.05
Red-eyed vireo	7.01	73.68	Winter wren	**1.48**	21.05
Chipping sparrow	7.01	68.42	Hairy woodpecker	1.11	10.53
Blue jay	5.90	68.42	Pileated woodpecker	1.11	15.79
Black-throated green warbler	**5.90**	57.89	**Rose-breasted grosbeak**	1.11	10.53
Hermit thrush	5.54	52.63	Eastern phoebe	**1.11**	15.79
Tufted titmouse	4.80	63.16	**Great-crested flycatcher**	1.11	15.79
Black-and-white warbler	**4.06**	21.05	Song sparrow	**0.74**	10.53
White-breasted nuthatch	3.69	42.11	Common yellowthroat	**0.74**	10.53
Scarlet tanager	**2.58**	31.58	**Northern flicker**	0.74	10.53
Eastern wood-pewee	**1.85**	26.32	**Baltimore oriole**	**0.74**	10.53
Veery	**1.85**	21.05	Yellow-rumped warbler	**0.74**	10.53
Downy woodpecker	1.85	26.32	**American redstart**	**0.37**	5.26
Yellow-throated vireo	**1.85**	26.32	American crow	0.37	5.26
American goldfinch	1.48	21.05	**Northern parula**	**0.37**	5.26
Black-throated blue warbler	**1.48**	21.05			

Species in **bold** are listed as species of conservation concern.

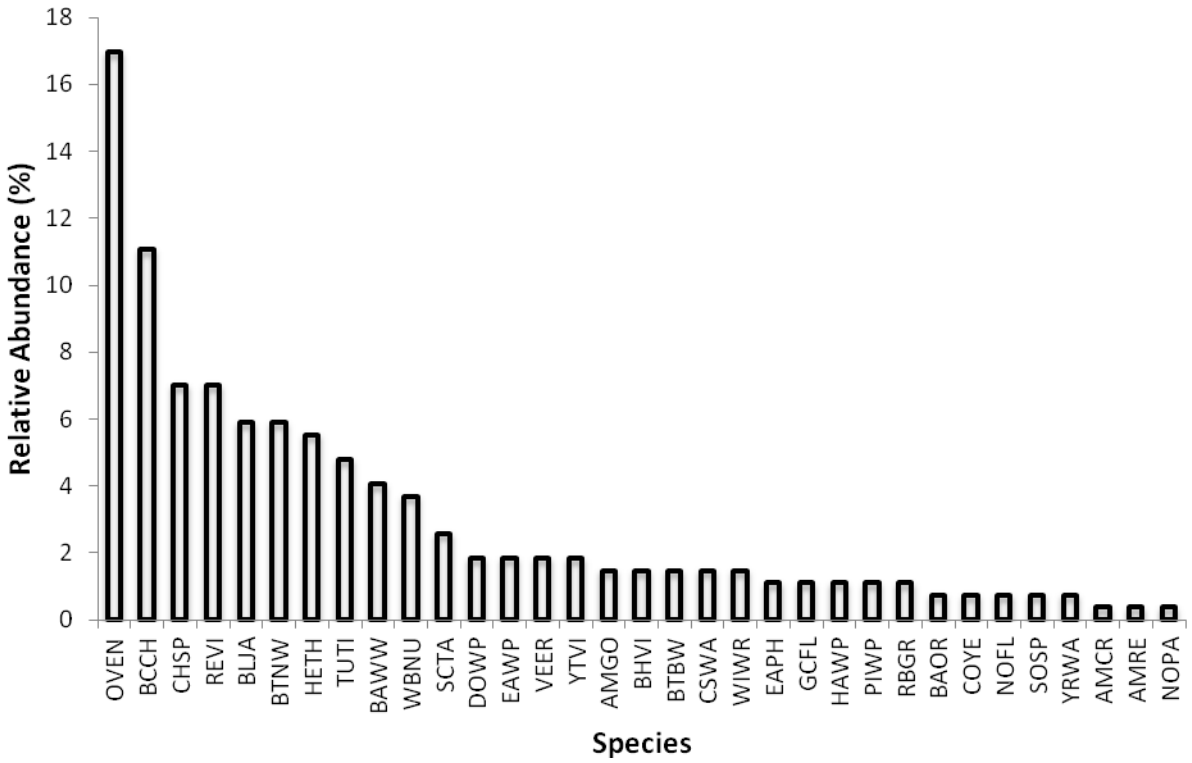

Figure 4. Relative abundance of forest birds observed on the Stonehouse Forest property in Barrington, NH. May-June 2016.

Bird Species of Conservation Concern

A total of 47 species of conservation concern were observed on the Stonehouse Forest property (Table 4), representing over half of birds present. These species were identified through systematic surveys, as well as incidental observations. Conservation status was based on the NH Wildlife Action Plan (2015, Partners in Flight North American Landbird Conservation Plan (Rich et al. 2004), US Shorebird Conservation Plan: Northern Atlantic Regional Shorebird Plan (Clark and Niles, ND), Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan (Kushlan et al. 2002), North American Waterfowl Management Plan (NAWMP Plan Committee 2012), New England/Mid-Atlantic Coast Bird Conservation Region 30 Implementation Plan (Steinkamp 2008), and Atlantic Northern Forest Bird Conservation Region 14 (Dettemers 2003). Appendices E and F illustrate the distribution of these species of conservation concern.

Table 4 Species of conservation concern on the Stonehouse Forest property in Barrington, NH. May-June 2016.

Species	Conservation Status	Species	Conservation Status
Canada goose	3; 7	**Veery**	1; 3
Mallard	3; 7; 8	**Gray catbird**	7
Wood duck	3; 7; 8	**Brown thrasher**	1; 2; 7
Common merganser	8	**Yellow-throated vireo**	2; 7
Hooded merganser	7; 8	**Blue-headed vireo**	2
Common loon	1; 3	**Northern parula**	3
Chimney swift	1; 7	**American redstart**	3
Killdeer	3; 6; 7	**Black-throated blue warbler**	3
Spotted sandpiper*	6; 7	**Blackburnian warbler**	2; 3; 7
Solitary sandpiper	6; 7	**Chestnut-sided warbler**	2; 3
American Woodcock	1; 2; 3; 6; 7	**Magnolia warbler**	2
Red-shouldered hawk	2	**Black-throated green warbler**	2; 3
Broad-winged hawk	7	**Louisiana waterthrush**	7
Red-bellied woodpecker	2	**Palm Warbler***	2; 3
Northern flicker	3; 7	**Pine warbler**	2
Yellow-bellied sapsucker	2; 3	**Black-and-white warbler**	7
Eastern kingbird	7	**Ovenbird**	3
Great-crested flycatcher	7	**Rose-breasted grosbeak**	3
Alder flycatcher	2	**American tree Sparrow***	2
Eastern wood-pewee	3	**Eastern towhee**	1; 2; 7
Marsh Wren	1; 7	**Swamp sparrow**	2
Wood thrush	1; 2; 3; 7	**White-throated sparrow***	2
Baltimore oriole	7	**Purple finch**	1; 3
Scarlet tanager	1; 7		

Conservation Status

1 = NH Fish and Game Wildlife Action Plan (species of conservation concern)
2 = Partners in Flight (Watch List and/or Stewardship List for Eastern and Northern Forest Biome)
3 = Atlantic Northern Forest Bird Conservation Region (BCR 14)
4 = NH Fish and Game Big Game Management Plan
5 = North American Waterbird Conservation Plan
6 = North Atlantic Regional Shorebird Plan
7 = New England/Mid-Atlantic Coast Bird Conservation Region (BCR 30)
8 = North American Waterfowl Management Plan

Turtle Surveys

Three turtle species were observed as a result of the trapping effort, including painted turtle, snapping turtle, and Blanding's turtle (State-endangered). The Blanding's turtle was observed in only one of the three wetlands, and only one juvenile individual was captured. The NH Fish and Game also conducted a 4-night trapping session in the same wetlands later in the field season, as well as the small beaver flowages located in the southern part of Stonehouse Forest. No rare turtles were trapped during their study. Spotted turtles (State-threatened) were observed in April basking on logs in vernal pools directly adjacent to the property along with Blanding's turtles. Spotted turtles were also observed in a large wetland that partially lies on the property along the eastern boundary.

Fish Surveys

There were no fish caught during the dip net surveys. Also, the electro-fishing surveys conducted with NH Fish and Game in the outlet stream yielded no results. This may have been the result of extremely low water levels in light of the drought. As such, it may take a few years for certain fish to recolonize the stream after normal water levels return. More robust fish surveys are recommended.

Rare Plants and Significant Natural Communities

Two rare plants (small-whorled pogonia and dwarf huckleberry) and six examples of significant natural communities and systems were documented on the property (Appendix H). The matrix forest includes the hemlock-hardwood-pine ecosystem, which is common and widespread throughout the southern tier of New Hampshire. However, one small interesting forest community is embedded within this matrix forest in the northern part of the property, including an oak-mountain laurel forest. Significant wetlands include an exemplary black gum-red maple basin swamp, and poor level fen/bog systems, which are comprised of numerous types of wetlands communities.

<u>Small-whorled Pogonia (*Isotria medeoloides*)</u>

A new population of small-whorled pogonia was discovered at the bottom of a southwest-facing slope above a linear wetland that follows the west boundary in the

southwestern portion of the property and in one other location southeast of there. This species is a Federally-threatened (G2) and State-threatened (S2) orchid species. A total of four plants were tallied at this location, all in vegetative, non-flowering state. Another individual plant was also documented at another location about 500 yards to the southeast near the property boundary. Together this constitutes the second population of this species to be documented in Barrington. The other Barrington population is approximately 2.4 km. southeast of the Stonehouse Forest property.

Small-whorled pogonia, a type of orchid, was observed in two locations on the property. Additional locations at the Stonehouse Forest are a strong possibility.

Dwarf Huckleberry *(Gaylussacia bigeloviana)*

Dwarf huckleberry was documented to occur in four locations on the property. The species forms a low and sparse shrub cover on each of the four *Sphagnum rubellum* – small cranberry moss carpet communities on Round Pond East, and the open peatland to the northeast.

This species is State-threatened (S2) and grows side by side with another from its genus; black huckleberry *(Gaylusaccia bacatta)* at the shrubby edge of the moss carpets. It is distinguished from black huckleberry by the dense presence of stipitate hairs covering most parts of the plant. There was an existing NH Natural Heritage Bureau record of this species in Barrington, but it has been ranked historic. This find at Stonehouse Pond represents the fourth extant New Hampshire population, and is most likely a re-documentation of the original Barrington population.

Dwarf huckleberry forms a low, sparse cover over red *Sphagnum* moss in this poor level fen/bog system.

Oak-Mountain Laurel Forest

Mountain laurel *(Kalmia latifolia)*, like other deciduous shrubs, is uncommon in New Hampshire. It is a southerly shrub species that occurs primarily along the southern tier of New Hampshire towns and the lower Connecticut River valley with disjunct occurrences in Carroll County. It is often associated with acidic bedrock and Appalachian hardwood forests. However, it can be associated with mixed forests as well. Mountain laurel can form a dense thicket whereby out-competing other species such as herbaceous plants and trees.

The oak-mountain laurel forest community is listed as S3, which does suggest that it is vulnerable to extirpation. Due to its size, landscape position, and biological condition it doesn't

appear that it would be considered for exemplary status by the NH Natural Heritage Bureau. However, it is significant as an S3 forest community, as well as its presence on the Stonehouse Forest property. This small community is unlike any other forest on the property, and it occurs in one of the most significant areas on the property. This forest community contributes to the diversity within the upland forests.

Mountain laurel, nearly in bloom, is associated with acidic forests. This species is uncommon in New Hampshire's forests.

Black Gum-Red Maple Basin Swamps

There are three examples of black gum-red maple basin swamps on the property. Collectively, they cover 14.7 acres, whereas the largest example is approximately 11 acres. These swamps are dominated by black gum followed by red maple. Understory shrubs can be quite dense in some areas and include highbush blueberry and winterberry. Herbaceous vegetation is not lush but dominated by cinnamon ferns. Sphagnum mosses create a blanket groundcover. Hummock and hollow topography is common, forming small pockets of standing water suitable for vernal pool breeding amphibians. The largest swamp was confirmed as functioning as a vernal pool. The other two examples are most likely functioning as vernal pools as well.

Black gum-red maple basin swamps are listed as S3 (vulnerable to extirpation) in New Hampshire. However, these swamps were quite unusual in that they have been relatively undisturbed and support trees greater than 400 years old. Upon closer inspection and data analyses these three examples have been collectively listed as exemplary status by the NH Natural Heritage Bureau based on the collective size, landscape position, and biological condition. Appendix I provides the data sheets submitted in consideration of exemplary status.

Numerous black gums are over 400 years old. However, this black gum measures 34 inches in diameter and is estimated to be about 675 years old.

Poor Level Fen/Bog System

There are two examples of the poor level fen/bog system located in the northern part of Stonehouse Forest. The first example is in the northeast part of the property and covers approximately 27 acres. It is characterized as a vegetated peatland with no open water, draining towards Swains Lake to the southeast. The other example lies to the west, occupying 73.5 acres.

The wetland in the northeast has multiple natural communities that make up this ecosystem. This example of the poor level fen/bog system exhibits all four of the diagnostic natural communities, as well as one more closely associated with kettle hole bogs. In the middle one can observe an open *Sphagnum* peatland surrounded by a tall shrub-dominated peatland. Here, examples of *Sphagnum rubellum* – small cranberry moss carpet (S3), leather-leaf – black

spruce bog (S3), leather-leaf – sheep laurel dwarf shrub bog (S2S3), and liverwort – horned bladderwort fen (S3) communities were observed. These open peatland communities are surrounded by the highbush blueberry-mountain holly wooded fen (S3S4). One of the rare dwarf huckleberry populations noted above can be found in the *Sphagnum rubellum* – small cranberry moss carpet community. This community also supports an uncommon plant, grass pink orchid.

The other example of the poor level fen/bog system contains two natural ponds known as Round Ponds. These wetlands flow southeast into several marsh/shrub swamp systems (which supports at least two rare species of wildlife), forming the headwaters of Bellamy River. This wetland system also contains several types of natural communities, including those resembling *Sphagnum rubellum*-small cranberry moss carpet (S3), leather-leaf – black spruce bog (S3), leather-leaf – sheep laurel dwarf shrub bog (S2S3), water willow-*Sphagnum* lag (S3), and highbush blueberry-mountain holly wooded fen (S3S4).

While none of these natural communities within these two wetland systems are considered rare they all are vulnerable to extirpation. These wetlands provide distinct peatland habitat for various species not found elsewhere on the property. These communities and wetland systems deserve more attention to determine if they warrant exemplary status.

Poor level fen/bog system with stunted black spruce trees along the edge of the open *Sphagnum* mat.

Grass pink orchid on *Sphagnum* moss mat next to the liverwort-horned bladderwort fen in background. This orchid is uncommon in New Hampshire.

Round Pond with the adjacent leatherleaf-sheep laurel dwarf shrub bog that transitions into the highbush blueberry-mountain holly fen in areas less prone to seasonally flooding.

Sphagnum rubellum-small cranberry moss carpet community (left) next to the dwarf shrub communities (right).

DISCUSSION

The Stonehouse Forest offers a large 1,290-acre forested refuge with nearly 238 acres of diverse wetlands, including emergent marshes, peatlands, shrub wetlands, forest swamps, shallow beaver impoundments, natural ponds, and vernal pools. These wetlands provide critical habitats for nesting, brood rearing, feeding, and migration for a variety of birds. Breeding and migratory bird surveys yielded over 40 species of waterfowl and other wetland-dependant and associated species, including common loon, Canada goose, mallard, wood duck, American black duck, common merganser, hooded merganser, great blue heron, spotted sandpiper, and solitary sandpiper. In addition, 47 species of conservation concern were also observed using the various habitats during the breeding and migratory seasons (Table 4). These species have been identified in eight distinct conservation plans (Dettmers and Rosenberg 2000, NH Fish and Game 2006, Steinkamp 2008, Dettmers 2004, Clark and Niles, Kushlin et al. 2002, Rich et al. 2004, NAWMP Plan Committee 2012).

Species that are considered to be of conservation concern meet one or more of the following criteria: 1) a species is listed as rare, 2) a species is considered as a concern due to a significant decline in populations, and/or 3) a species is identified as a management concern in one of the plans listed above. Several species occur on multiple plans (Table 4 and Appendix D).

In addition to noting the various species of conservation concern it is also helpful to understand the general population trends of birds observed on the Stonehouse Forest property. In her attempt to better understand the conservation status of birds in New Hampshire, Hunt (2009) has assembled state and regional data to help determine these population trends, as well as threats and strategies for each species. Each bird has been categorized into one of five general trends: increasing, stable, uncertain, unknown, or declining (Appendix D). Of the 82 species recorded for the Stonehouse Forest property, 33% (or 27 species) are considered to be declining.

The Stonehouse Forest is not only significant for birds. During field visits, a wide variety of other wildlife species were observed on the property by sight, sound, track, scat, browse, and other signs. Mammals included bear, moose, porcupine, deer, bobcat, coyote, red fox, mink, beaver, raccoon, red squirrel, gray squirrel, and chipmunk. Ten amphibians were noted, including redback salamander, red-spotted newt, spotted salamander, spring peeper, gray treefrog, wood frog, pickerel frog, green frog, bullfrog, and American toad. Representative among the reptiles were painted turtle, snapping turtle, eastern ribbonsnake, brown snake, garter

snake, and Blanding's turtle (State-endangered). Spotted turtles (State-threatened) were observed basking on logs in vernal pools directly adjacent to the eastern part of the property, as well as within a large wetland that partially lies on the property. Based on habitat types it is expected that additional wildlife are using the property throughout the year.

Four species noted above are listed as species of greatest conservation need in New Hampshire (NH Fish and Game 2015). These included moose, eastern ribbonsnake, and Blanding's turtle (State-endangered), and spotted turtle (State-threatened).

Blanding's turtles are known to exist on the study area, and spotted turtles were observed basking in a vernal pool directly adjacent to the property and using a large wetland partly on the property. There was only one juvenile Blanding's turtle observed during the basking and trapping surveys on the Stonehouse Forest property. The size of Blanding's turtle populations in New England can vary greatly, depending on the population's location, as well as the size of the focal area and integrity of its habitats. A similar study was conducted just to the south of this study area for Blanding's turtles. Turtle densities were estimated to be at least 0.15-0.22 individuals/acre of wetlands (Littleton 2015). This estimate is consistent with a more recent trapping study conducted in Merrimack, NH, less than 30 miles southwest of the study site (Littleton 2016). Therefore, based on suitable habitats and landscape context it is expected that 20-30 individuals could use the study area for breeding, feeding and wintering (Maine Dept of Inland Fisheries and Wildlife 2003a; Littleton 2016; Marchand 2016). As a state-endangered species it is important to protect local populations of Blanding's turtles within relatively large unfragmented blocks, especially in southeast NH where such blocks are becoming rarer due to development pressure and past land use history.

Similar to Blanding's, spotted turtles densities can be low and highly localized. They need road less areas to maintain viable populations. A recent study concluded a density of at least 16.9 individuals/acre of wetland for breeding and feeding habitat, while a density of 2.3 individuals/acre of wetland for overwintering (Littleton 2016). Based on suitable habitats and landscape context it is expected that this study could help maintain at least 20-25 spotted turtles for breeding, feeding and wintering (Maine Dept of Inland Fisheries and Wildlife 2003b; Littleton 2016).

Based on suitable habitats and location in southeastern NH additional species of conservation concern identified in the NH Wildlife Action Plan (2015) may use the property. These include the following:

- New England cottontail (State-endangered) – documented within the region; associated with shrub habitat; some suitable habitat exists but management could greatly enhance the opportunity to support a population
- Northern long-eared bat (State-threatened and Federally-threatened) – known pattern of distribution is not complete; could use snags for breeding and roosting during summer
- Spotted turtle (State-threatened) – observed in vernal pools adjacent to the property; observed within large wetland system which partially lies on property; property affords significant habitats for this species
- Blue-spotted/Jefferson salamander complex - documented throughout the region; associated with vernal pools and adjacent upland forests
- Bridle shiner (State-threatened) – documented throughout the region; associated with backwater streams and ponds, including marshes and beaver impoundments
- Banded sunfish – documented in the region; associated with vegetated areas of ponds, including marshes and beaver impoundments
- Swamp darter – documented in the region; associated with streams and ponds, including marshes and beaver impoundments
- American eel – documented in the region and habitat exists on the property

The presence of two rare plants adds great significance to the property. Although rather small populations were observed there is a strong likelihood that additional locations of small-whorled pogonia (Federally-threatened and State-threatened) may exist on the property. Additional surveys are warranted in areas where land management activities (e.g., logging) will occur.

The dwarf huckleberry populations are confined to the open peatlands located in the northern part of the property. Proper management within the adjacent upland forest will help ensure the ecological integrity of the wetlands. Also, beaver management may be necessary as excessive flooding could alter the open *Sphagnum* communities associated with dwarf huckleberry and potentially kill the individuals.

An additional interesting plant included dangleberry or blue huckleberry. It was located within the upland forest east of Round Pond East. While this species is not rare it is uncommon and considered to be a "state watch" species by the in NH Natural Heritage Bureau. State watch species are considered vulnerable to becoming threatened. Further investigations are warranted to better understand the full distribution of this species.

The Stonehouse Forest property contains numerous significant habitats throughout. All wetland and stream habitats provide significance for wildlife and maintaining good water quality. The upland forest buffers surrounding the wetlands also play an important role for wildlife, as well as maintaining healthy ecosystems. The wetlands and combined 500-foot upland forest buffers constitute 1,252 acres or nearly 85% of the property.

The peatlands in the north and the exemplary black gum swamps provide floristic diversity that compliments the various beaver impoundments and vernal pools. The peatlands offer unique habitats for plants and wildlife alike, including at least one rare species, dwarf huckleberry. North Ponds are significant for aquatic and semi-aquatic wildlife, including fish, amphibians, and migratory waterfowl. Both examples of the poor level fen/bog systems deserve further attention. Provisional ranking of these systems indicate the following: size rank = B, condition rank = A, and landscape context rank = B for an overall summary rank of B+. The exemplary threshold has yet to be determined though. This effort would require additional field and office time to conduct an Ecological Integrity Assessment of the wetlands. This assessment, developed by the NH Natural Heritage Bureau, determines various field metrics and stressors associated with nearby developments, recreation, land use and management, vegetation, soils and hydrology. This assessment would be needed in order to determine if exemplary status is warranted.

Dr. Ruth Varner, Associate Professor of Biochemistry in the Department of Earth Sciences at the University of New Hampshire in Durham, has been researching one of the peatlands (Sallie's Fen) at the Stonehouse Forest property for several years. Her research is part of a long term project focused on understanding how peatlands contribute to greenhouse gas sequestration. Since peatlands contain 1/3 of global carbon Dr. Varner seeks to gain more knowledge on potential methane release as a result of a warmer climate. In addition, she incorporates her empirical data into models to test their efficacy to help predict methane emission under changing environmental conditions.

Dr. Varner and her researchers have investigated the production, oxidation, emission, and transport of methane in peatland communities. Some of their research examined changes in methane emissions by the removal of *Carex rostrata*, which proved to decrease methane emissions. They have also conducted experiments on different types of technology to test methane emissions. Finally, they have studied methyl bromide exchange rates to understand how peatlands may serve as global sinks or sources in climatic changes and its affect on ozone.

The exemplary black gum swamps provide a wonderful example of an old growth forested community on the property with some individuals estimated to be well over 600 years old. Many black gum trees naturally hollow out, providing habitat for many cavity nesting wildlife, including porcupine, fisher, owls, chickadees, and woodpeckers. Due to their remote nature these communities were fairly straightforward to document as exemplary once adequate field data was collected. Documentation for these swamps can be found in Appendix I.

The many beaver impoundments found throughout the property provide great habitats for a robust wildlife community, including Blanding's turtles (State-endangered) and various other wildlife species of conservation concern. While the beaver impoundments in the southern part of the property are rather small at this point there is ample opportunity for beaver to continue to expand these ponds, offering additional habitat for aquatic and semi-aquatic species. Careful management along the edges of these wetlands can continue to provide a food source for beaver that would encourage their persistence and expansion of wetlands over time.

Stonehouse Forest is rich in vernal pool habitats. At least 38 known and potential vernal pools exist, and additional pools are a strong possibility. Vernal pools support critical habitat for amphibians, including spotted salamander, Jefferson salamander complex, and wood frog, as well as Blanding's turtle (State-endangered), spotted turtle (State-threatened), eastern ribbonsnake, bobcat, migratory waterfowl, and aquatic macroinvertebrates. A closer inspection for additional vernal pools is recommended, as well as documenting each using *Identification and Documentation of Vernal Pools in New Hampshire* by Anne Tappan and Mike Marchand (2004, second edition).

As noted above the oak-mountain laurel forest community also provides significance to the property. This is the most unusual forest type surrounded by hemlock-hardwood-pine forests. This community is associated with boulders and rock outcropping that may have prevented the

site from being exposed to early agricultural activity. However, logging has occurred, and this site may have been part of a woodlot during 1700-1800s.

Invasive plants were rather minimal on the property surprisingly. This is unusual for properties within the southern tier of New Hampshire, and especially so for the southeastern part of the state. Areas associated with small openings in the central and southeastern part of the property has experienced some infestation. Japanese barberry was the primary species observed. Other areas to be monitored include edges associated with forest and wetlands. Prior to any type of management each site should be assessed for presence of invasive plants, and a plan should be devised to manage the site after the project has been completed. Also, there were no invasive forest insects observed on the property during this project.

Not only does the Stonehouse Forest property support many significant habitats and high biodiversity, including many species of concern, but it is also part of a much larger landscape from which it should also be viewed. When making considerations for conservation planning it is critical to incorporate a landscape-level perspective with fine-scale habitat data. This consideration aids in a more comprehensive approach that recognizes large-scale habitats and ecological processes within the developed and natural environments. When these elements are considered in combination with the distribution of currently protected lands then a more successful conservation plan can be prepared that incorporates the concepts of biological conservation and ecosystem reserve design to help maximize and sustain biodiversity protection for the long-term.

The Stonehouse Forest property is part of a 4,260-acre unfragmented block, which is uncommon in southeastern New Hampshire. Only 9% of this block is conserved. This large, intact forest with its wetlands and streams is surrounded by many smaller blocks that are unable to support certain wildlife that the Stonehouse Forest can. Therefore, the property plays a significant role for providing critical habitats for area-sensitive wildlife while affording protection of the ecological integrity of the core forests and wetlands. This large tract of land is surrounded by multiple smaller unfragmented blocks. The Stonehouse Forest property plays a significant role in providing habitats for area sensitive species that function best in a less human-disturbed ecological setting.

Unfragmented blocks of land include a variety of natural habitats such as forests, wetlands, streams, and ponds but also can include human-modified areas such as agricultural

lands, meadows, and shrublands. They are defined by the surrounding human infrastructure (roads and developed areas) and can negatively affect species survival rates, including mortality, lowered rates of breeding success, or species loss altogether. The degree of severity of fragmentation depends upon many aspects, such as the size and shape of unfragmented block, the species or community in question, the extent of loss of natural habitats, intensity of human use, and colonization of invasive species.

Large blocks of unfragmented areas are widely known to support greater biodiversity than smaller blocks. As forest blocks become smaller due to the construction of roadways and developments their biodiversity will generally be reduced. This fragmentation affect has less immediate impact on generalist species or those with small home ranges (such as gray squirrels, raccoon, and small rodents) while affecting and potentially eliminating area-sensitive specialists that need large blocks with little human disturbance in order to maintain their home ranges and for long-term survival (such as American black duck, bear, bobcat, moose, Blanding's turtle, wood thrush, and ovenbird).

Large landscapes provide the ability for wildlife movement and connect multiple habitat elements. By maintaining connectivity between critical habitats it may be possible to provide permanent wildlife corridors within the developed environment. Wildlife travel corridors function as areas that one or many species may use to move from one habitat need to another. This movement can be based on traveling to different areas for feeding, breeding, or shelter. These habitat elements are required by all species.

Wildlife must be able to travel safely throughout the landscape in order to meet their biological needs. Many depend upon a variety of habitats for their survival and may utilize many natural features for travel. These may include areas such as riparian zones of wetlands, ponds, and streams, ridgelines, utility right-of-ways, and forest patches acting as a safe route between two or more habitats. A variety of wildlife can be associated with these corridors, including otter, fox, coyote, bobcat, deer, moose, fisher, mink, beaver, and bear.

Corridors are not only significant for mammals but equally as important for amphibians, reptiles and migratory birds. Both amphibians and reptiles begin to move from their wintering habitats to their respective breeding and nesting grounds in the spring. This is the time of year that most mortality can be noticed as these species travel across roadways in search of critical habitats. This can be especially devastating for local turtle populations as some species breed

only after 15 years of age (e.g., Blanding's turtle and wood turtle). This effect can often be exacerbated as the same individuals must return back to their wintering habitats. Thus, there is a great significance in maintaining habitat connectivity, as well as understanding where these patterns of movement are taking place.

The protection and proper management of the 1,528-acre Stonehouse Forest can play a significant role in maintaining ecological integrity and biodiversity in the region. Protection of this property will afford the opportunity to maintain on-site water quality in the wetlands and streams. It will also help maintain water quality within the Lamprey River, the largest tributary to the Great Bay Estuary. It will continue the conservation efforts of a 4,260-acre unfragmented block of important habitats that is significant to many migratory birds and other wildlife.

The protection of the Stonehouse Forest property will also further contribute to the important conservation efforts within New Hampshire and the greater northeastern United States. The property has been identified as a focus area in at least three conservation plans (Zankel et al. 2004, Steinkamp 2008, NH Fish and Game 2006). Zankel et al. (2004) identified the Bumfagging Hill Conservation Focus Area as part of the conservation plan for NH's coastal watersheds. The NH Wildlife Action Plan (2015) has identified the core part of the property as having the highest ranked habitat in the state. Areas adjacent to this as identified it as having the highest rank in the biological region. Finally, the Atlantic Coast Joint Venture (Steinkamp 2008) has identified the property as being part of the Great Bay Waterfowl Focus Area.

The Stonehouse Forest also has been ranked very high for its index of ecological integrity (North Atlantic Landscape Conservation Cooperative 2016). This metric was developed by The Nature Conservancy to better understand the intactness and resiliency of natural habitats. Intactness refers to the degree of human impairment, while resiliency refers to a site's ability to recover from various disturbances and stress. This metric is an important tool in conservation planning as it helps us to understand and prioritize sites for protection. Thus, this index further exemplifies the conservation significance of the Stonehouse Forest. Furthermore, the Open Space Institute (OSI) has used this index to identify priorities for its land protection efforts (Open Space Institute 2016). As such, the Stonehouse Forest is one of OSI's priorities for land protection based on its resilient landscape.

The findings presented above and the underlying data collected should be used to help develop a comprehensive land management plan to meet the desired goals and objectives. This

can afford the opportunity to develop appropriate buffers and habitat management adjacent to wetlands and vernal pools, as well as sites in upland forests geared towards wildlife management on both a commercial and non-commercial scale. For example, examining the breeding bird data can provide insight into the areas of highest diversity and the species of greatest conservation need using these areas. This can in turn provide valuable insight on management techniques for these species of concern. Conversely, it can also provide data to inform areas of management to increase overall biological diversity through management techniques that seek to diversify forest age classes.

In conclusion, the Stonehouse Forest property offers a robust array of significant habitats for diverse wildlife and plant communities, from aquatic and wetland-related species to those that use large, unfragmented forests with significant embedded wetland ecosystems. These diverse habitats within large blocks of land can function as biologically diverse hotspots within an otherwise more fragmented landscape. Rare plants and wildlife, old growth exemplary black gum swamps, significant peatlands, numerous beaver impoundments, and a large unfragmented block within a climate resilient landscape provide New Hampshire with an impressive example of its natural history.

Fresh bark stripping by beaver.

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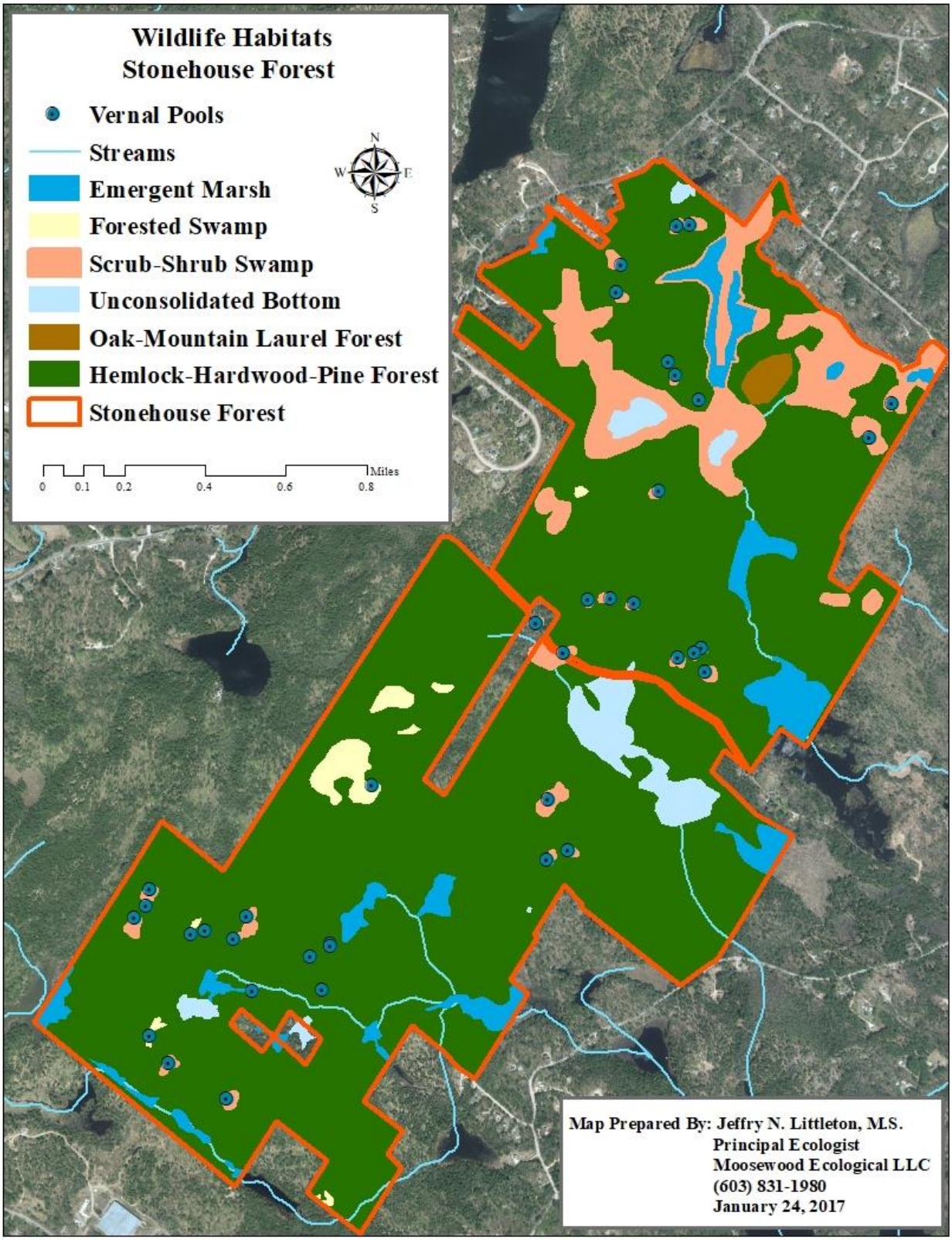
APPENDIX A

Stonehouse Forest
Wildlife Habitats


Wildlife Habitats
Stonehouse Forest
Vernal Pools
Streams
Emergent Marsh
Forested Swamp
Scrub-Shrub Swamp
Unconsolidated Bottom
Oak-Mountain Laurel Forest
Hemlock-Hardwood-Pine Forest
Stonehouse Forest
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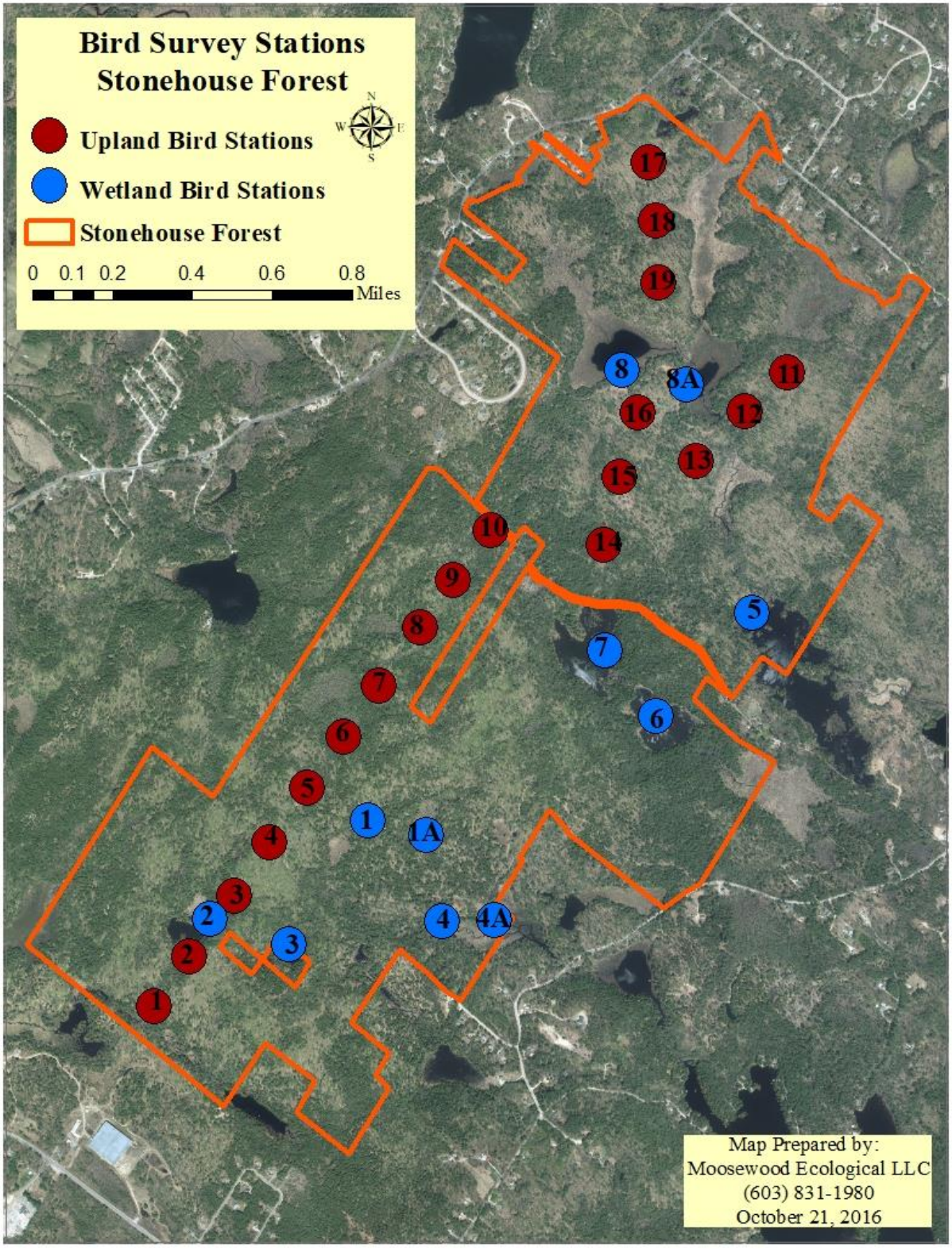
0 0.1 0.2 0.4 0.6 0.8
Miles
Map Prepared By: Jeffry N. Littleton, M.S.
Principal Ecologist
Moosewood Ecological LLC
(603) 831-1980
January 24, 2017

APPENDIX B

Stonehouse Forest
Bird Stations


Bird Survey Stations
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Upland Bird Stations
Wetland Bird Stations
Stonehouse Forest
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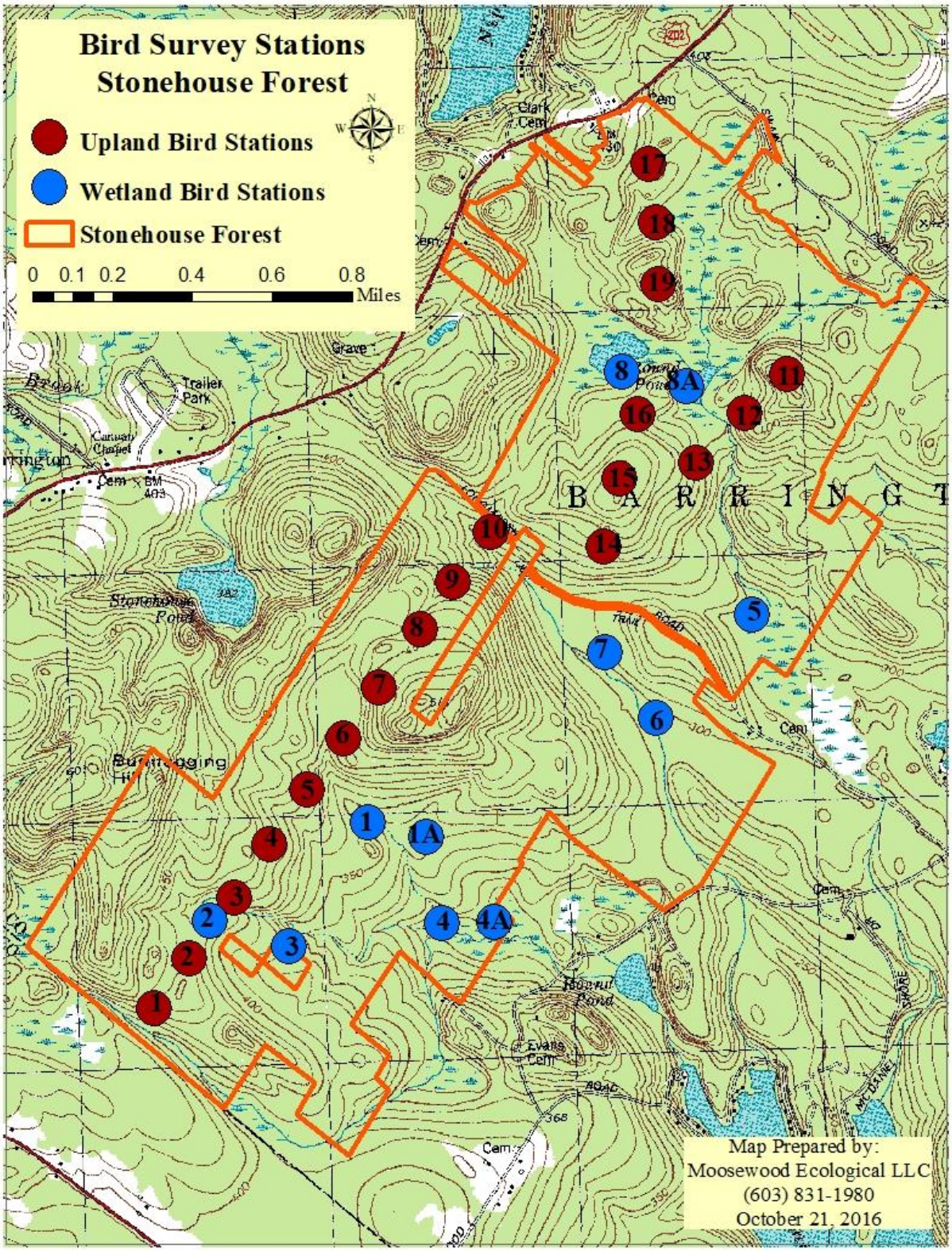
Map Prepared by:
Moosewood Ecological LLC
(603) 831-1980
October 21, 2016


Bird Survey Stations
Stonehouse Forest
Upland Bird Stations
Wetland Bird Stations
Stonehouse Forest
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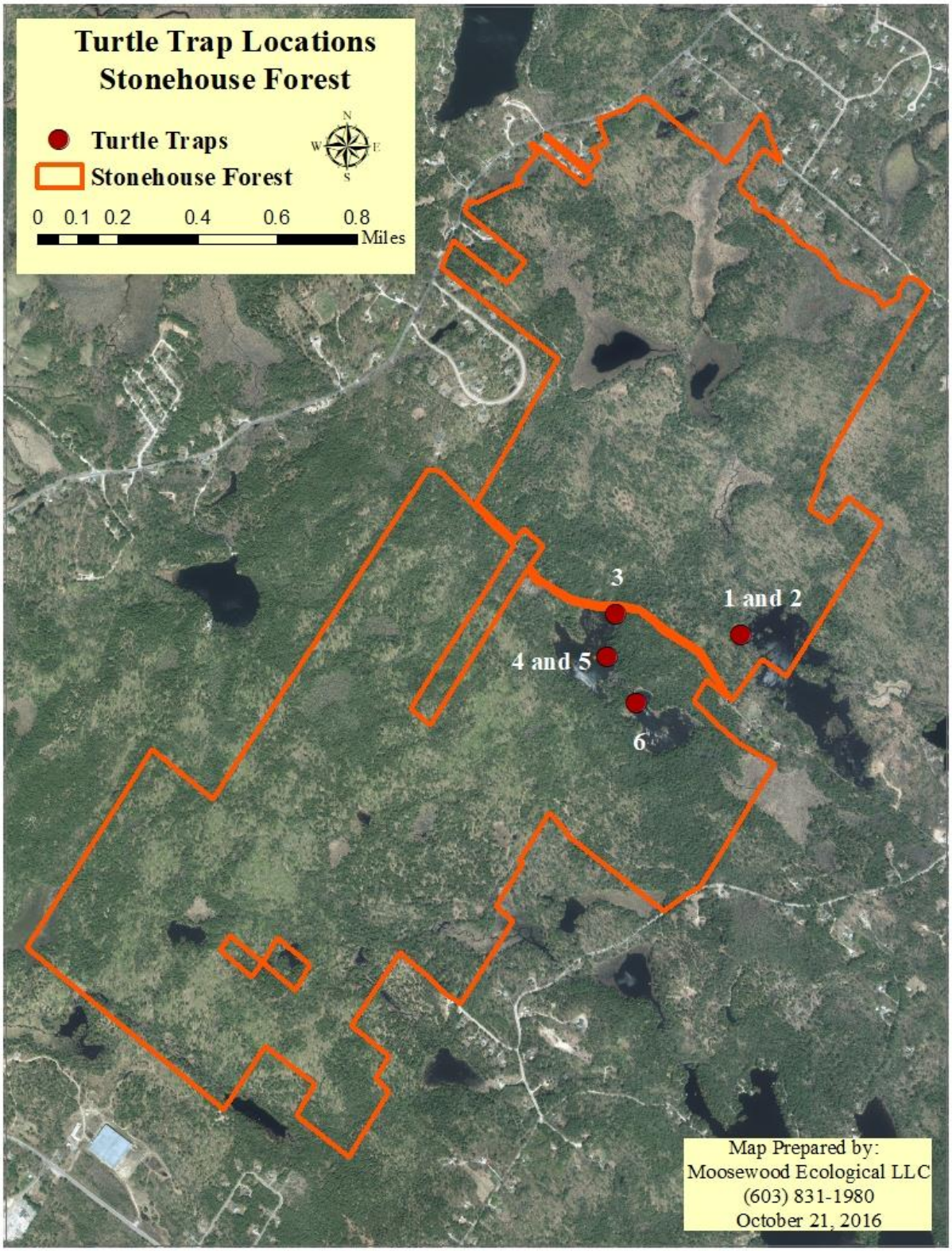
Miles
Map Prepared by:
Moosewood Ecological LLC
(603) 831-1980
October 21, 2016

APPENDIX C

Stonehouse Forest
Turtle Trap Locations


Turtle Trap Locations
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Turtle Traps
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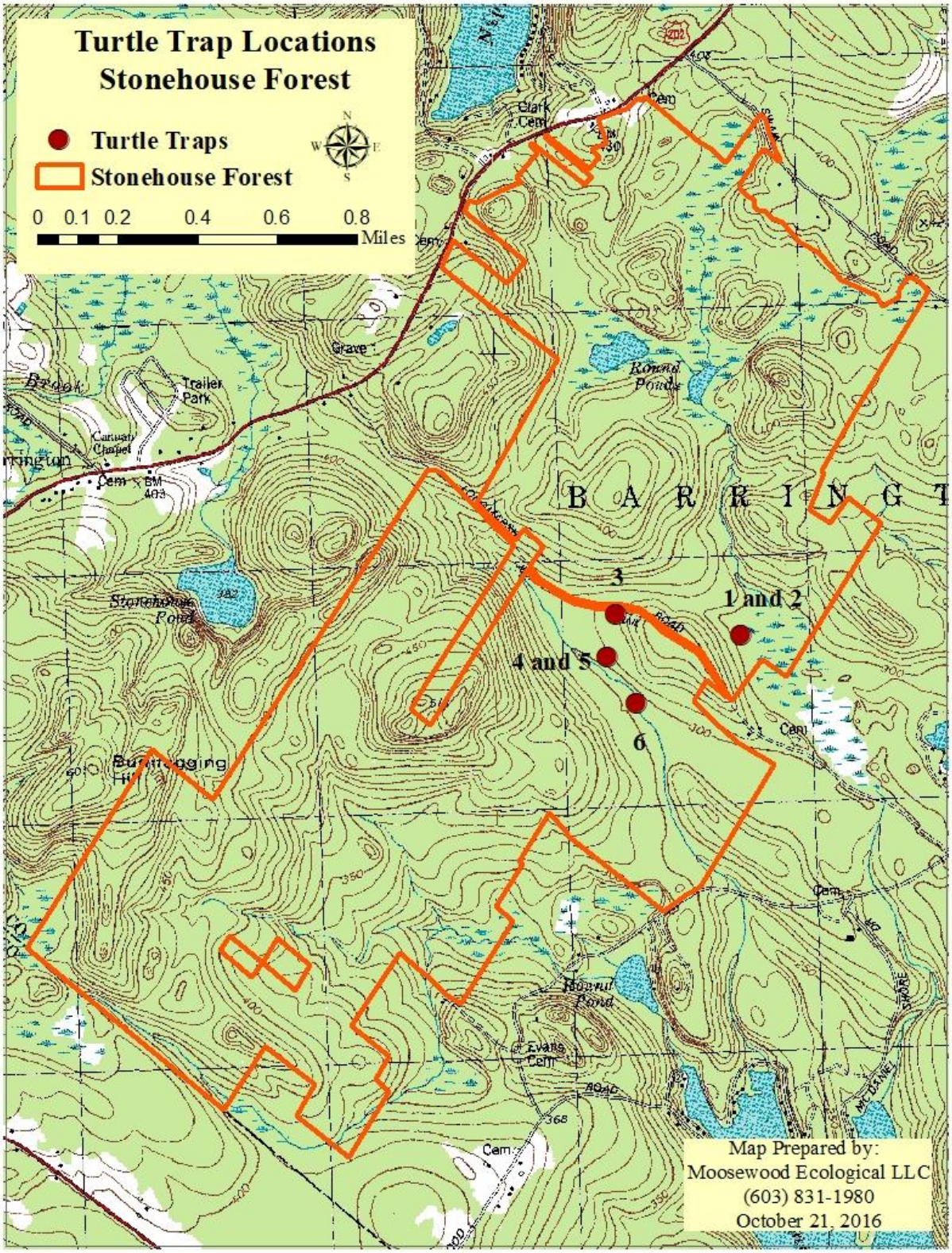
Map Prepared by:
Moosewood Ecological LLC
(603) 831-1980
October 21, 2016


Turtle Trap Locations
Stonehouse Forest
Turtle Traps
Stonehouse Forest
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Map Prepared by:
Moosewood Ecological LLC
(603) 831-1980
October 21, 2016

APPENDIX D

Stonehouse Forest
Bird List

Common Name	*Scientific Name*	Breeding Evidence	Conservation List	General Trend
Great-blue heron	*Ardea herodias*	PR		uncertain
Canada goose	*Branta canadensis*	CO	3; 7	increasing
Mallard	*Anas platyrhynchos*	PR	3; 7; 8	increasing
Wood duck	*Aix sponsa*	CO	3; 7; 8	increasing
Common merganser	*Mergus merganser*	PO	8	uncertain
Hooded merganser	*Lophodytes cucullatus*	PR	7; 8	unknown
Common loon	*Gavia immer*	PO	1; 3	increasing
Chimney swift	*Chaetura pelagica*	OB	1; 7	declining
Killdeer	*Charadrius vociferus*	PO	3; 6; 7	declining
Spotted sandpiper*	*Actitis macularius*	PR	6; 7	uncertain
Solitary sandpiper	*Tringa solitaria*	OB	6; 7	N/A
American Woodcock	*Scolopax minor*	OB	1; 2; 3; 6; 7	declining
Turkey vulture	*Cathartes aura*	OB		increasing
Red-shouldered hawk	*Buteo lineatus*	PO	2	uncertain
Broad-winged hawk	*Buteo platypterus*	PO	7	stable
Osprey	*Pandion haliaetus*	OB		increasing
Mourning dove	*Zenaida macroura*	PO		increasing
Barred owl	*Strix varia*	PO		unknown
Ruby-throated hummingbird	*Archilochus colubris*	PO		increasing
Belted kingfisher	*Ceryle alcyon*	PO		stable
Red-bellied woodpecker	*Melanerpes carolinus*	PR	2	increasing
Northern flicker	*Colaptes auratus*	PR	3; 7	declining
Yellow-bellied sapsucker	*Sphyrapicus varius*	PO	2; 3	increasing
Downy woodpecker	*Picoides pubescens*	PO		increasing
Hairy woodpecker	*Picoides villosus*	PO		stable
Pileated woodpecker	*Dryocopus pileatus*	PO		increasing
Eastern kingbird	*Tyrannus tyrannus*	PO	7	declining
Great-crested flycatcher	*Myiarchus crinitus*	PO	7	stable
Alder flycatcher	*Empidonax alnorum*	PO	2	uncertain
Least flycatcher	*Empidonax minimus*	PO		declining
Eastern wood-pewee	*Contopus virens*	PO	3	declining
Eastern phoebe	*Sayornis phoebe*	CO		stable

Common Name	*Scientific Name*	Breeding Status	Conservation Status	General Trend
Tree swallow	*Tachycineta bicolor*	CO		uncertain
Blue jay	*Cyanocitta cristata*	PR		declining
American crow	*Corvus brachyrhynchos*	PO		increasing
Common raven	*Corvus corax*	PO		increasing
Tufted titmouse	*Baeolophus bicolor*	PR		increasing
Black-capped chickadee	*Poecile atricapillus*	PR		uncertain
White-breasted nuthatch	*Sitta carolinensis*	PR		increasing
Marsh Wren	*Cistothorus palustris*	PO	1; 7	uncertain
Winter wren	*Troglodytes troglodytes*	PR		increasing
Wood thrush	*Hylocichla mustelina*	PO	1; 2; 3; 7	declining
Veery	*Catharus fuscescens*	PR	1; 3	declining
Hermit thrush	*Catharus guttatus*	CO		increasing
Gray catbird	*Dumetella carolinensis*	PR	7	declining
Brown thrasher	*Toxostoma rufum*	PO	1; 2; 7	declining
Cedar waxwing	*Bombycilla cedrorum*	PO		declining
Yellow-throated vireo	*Vireo flavifrons*	PR	2; 7	stable
Blue-headed vireo	*Vireo solitarius*	PR	2	stable
Red-eyed vireo	*Vireo olivaceus*	PR		uncertain
Warbling Vireo	*Vireo gilvus*	PO		stable
Northern parula	*Setophaga americana*	PO	3	increasing
American redstart	*Setophaga ruticilla*	PR	3	declining
Black-throated blue warbler	*Setophaga caerulescens*	PR	3	stable
Blackburnian warbler	*Setophaga fusca*	PO	2; 3; 7	stable
Chestnut-sided warbler	*Setophaga pensylvanica*	PR	2; 3	declining
Magnolia warbler	*Setophaga magnolia*	PO	2	stable
Yellow-rumped warbler	*Setophaga coronata*	OB		increasing
Black-throated green warble	*Setophaga virens*	PR	2; 3	stable
Louisiana waterthrush	*Parkesia motacilla*	PO	7	stable
Palm Warbler*	*Setophaga palmarum*	OB	2; 3	increasing
Pine warbler	*Setophaga pinus*	PO	2	increasing
Yellow warbler	*Setophaga petechia*	PR		declining
Black-and-white warbler	*Mniotilta varia*	PR	7	declining

Common Name	*Scientific Name*	Breeding Status	Conservation Status	General Trend
Ovenbird	*Seiurus aurocapilla*	PR	3	stable
Common yellowthroat	*Geothlypis trichas*	PR		declining
Northern cardinal	*Cardinalis cardinalis*	PO		increasing
Rose-breasted grosbeak	*Pheucticus ludovicianus*	PR	3	declining
American tree Sparrow*	*Spizella arborea*	OB	2	N/A
Song sparrow	*Melospiza melodia*	PR		declining
Chipping sparrow	*Spizella passerina*	PR		increasing
Eastern towhee	*Pipilo erythrophthalmus*	PO	1; 2; 7	declining
Swamp sparrow	*Melospiza georgiana*	PR	2	stable
White-throated sparrow*	*Zonotrichia albicollis*	OB	2	declining
Red-winged blackbird	*Agelaius phoeniceus*	PR		stable
Common grackle	*Quiscalus quiscula*	PR		declining
Baltimore oriole	*Icterus galbula*	PR	7	declining
Scarlet tanager	*Piranga olivacea*	PR	1; 7	declining
Golden-crowned kinglet	*Regulus satrapa*	PO		stable
Ruby-crowned kinglet	*Regulus calendula*	PO		declining
Purple finch	*Haemorhous purpureus*	PO	1; 3	declining
American goldfinch	*Carduelis tristis*	PR		increasing

* = Species observed in migration only

Conservation Status

1 = NH Fish and Game Wildlife Action Plan (species of conservation concern)

2 = Partners in Flight (Watch List and/or Stewardship List for Eastern and Northern Forest Biome)

3 = Atlantic Northern Forest Bird Conservation Region (BCR 14)

4 = NH Fish and Game Big Game Management Plan

5 = North American Waterbird Conservation Plan

6 = North Atlantic Regional Shorebird Plan

7 = New England/Mid-Atlantic Coast Bird Conservation Regin (BCR 30)

Bold = species of conservation concern

Breeding Status - Adapted from Foss (1994); see next page for explanations of codes.

General Trend - Hunt (2009); see next page for explanations.

Breeding Code

OB = "Observed "	1. Species observed during its breeding season, but not in potential breeding habitat
PO = "Possible" Breeding	1. Individual observed in possible nesting habitat 2. Singing male; OR courtship display of waterfowl or diurnal raptors
PR = "Probable" Breeding	1. Pair observed in possible nesting habitat 2. Territory presumed from observations of territorial behavior 3. Courtship and display 4. Visiting probable nest sight 5. Agitated behavior or anxiety calls 6. Brood patch or cloacal protuberance 7. Excavating nest hole; OR nest building by wrens 8. Species observed at point during both sampling periods
CO = "Confirmed" Breeding	1. Distraction display 2. Nest building for species other than wrens 3. Used nests 4. Recently fledged young 5. Adult leaving or entering cavity indicating occupied nest; OR adult on nest 6. Adult carrying food or fecal sac 7. Nest containing eggs 8. Nest with young

General Trend

1) Increasing: significant positive trend at all scales where data are available
2) Stable: no trend at all scales where data are available
3) Declining: significant negative trend at all scales where data are available
4) Uncertain: trends at different scales do not agree
5) Unknown: insufficient data to determine trend

APPENDIX E

Stonehouse Forest
Wetland Bird Distribution

Species	Distribution by Bird Station
Alder flycatcher	W4, W8
American goldfinch	W1a, W4, W5, W8, W8a
American redstart	W4, W8a
Baltimore oriole	W3, W4, W4a
Belted kingfisher	W6, W7, W8
Blue jay	W3, W4, W4a, W6, W7, W8, W8a
Brown thrasher	W8
Canada goose	W3, W5, W6, W7, W8
Cedar waxwing	W1
Chestnut-sided warbler	W4, W4a, W8, W8a
Common grackle	W1, W5, W6, W7
Common loon	W4a, W7, W8a
Common yellowthroat	W1, W1a, W2, W3, W4, W4a, W5, W6, W8, W8a
Eastern kingbird	W6, W7
Eastern towhee	W4, W8, W8a
Golden-crowned kinglet	W8a
Gray catbird	W1, W1a, W4, W4a, W8, W8a
Great-blue heron	W1a, W4, W5, W6
Great-crested flycatcher	W1a, W2, W4, W5, W6, W7, W8
Least flycatcher	W4, W4a, W8a
Louisiana waterthrush	W3
Mallard	W6
Marsh Wren	W5
Northern cardinal	W4a, W8
Osprey	W8
Purple finch	W8, W8a
Red-shouldered hawk	W7
Red-winged blackbird	W4a, W5, W7, W8, W8a
Ruby-crowned kinglet	W5
Ruby-throated hummingbird	W3, W8a
Scarlet tanager	W1, W1a, W2, W3, W4, W4a, W6, W7, W8
Song sparrow	W3, W4, W4a, W5, W8, W8a
Spotted sandpiper	W2
Swamp sparrow	W3, W4, W4a, W5, W8, W8a
Tree swallow	W1a, W2, W6, W7, W8
Wood duck	W4, W5, W6, W7, W8a
Yellow warbler	W4, W4a, W8, W8a

Species in **bold** are listed as species of conservation concern.

APPENDIX F

Stonehouse Forest
Forest Bird Distribution

Species	Distribution by Bird Station
American crow	11
American goldfinch	1, 5, 13, 18
American redstart	14
Baltimore oriole	13, 15
Black-and-white warbler	1, 2, 4, 5, 6, 7, 8, 9, 11, 13, 14
Black-capped chickadee	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19
Black-throated blue warbler	11, 12, 13, 18
Black-throated green warbler	1, 3, 4, 5, 7, 8, 9, 10, 13, 14, 15
Blue Jay	3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 16, 17, 18
Blue-headed vireo	14, 18, 19
Chestnut-sided warbler	6, 8, 15, 17
Chipping sparrow	2, 3, 4, 7, 9, 10, 11, 12, 14, 15, 16, 18, 19
Common yellowthroat	1, 9
Downy woodpecker	5, 9, 11, 15, 18
Eastern phoebe	15, 16, 19
Eastern wood-pewee	1, 15, 17, 18, 19
Great-crested flycatcher	2, 5, 7
Hairy woodpecker	9, 14
Hermit thrush	6, 7, 8, 10, 13, 15, 16, 17, 18, 19
Northern flicker	3, 17
Northern parula	17
Ovenbird	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
Pileated woodpecker	7, 8, 16
Red-eyed vireo	1, 2, 3, 4, 6, 8, 9, 11, 13, 14, 15, 16, 17, 19
Rose-breasted grosbeak	11, 17
Scarlet tanager	2, 3, 5, 6, 15, 18
Song sparrow	2, 10
Tufted titmouse	4, 6, 7, 11, 12, 13, 14, 15, 16, 17, 18, 19
Veery	4, 8, 9, 18
White-breasted nuthatch	3, 5, 9, 10, 11, 13, 14, 19
Winter wren	6, 9, 10, 12
Yellow-rumped warbler	6, 13
Yellow-throated vireo	1, 2, 3, 10, 16

Species in **bold** are listed as species of conservation concern.

APPENDIX G

Stonehouse Forest
Birds of Conservation Concern

Species	Conservation Status	Species	Conservation Status
Canada goose	3; 7	**Veery**	1; 3
Mallard	3; 7; 8	**Gray catbird**	7
Wood duck	3; 7; 8	**Brown thrasher**	1; 2; 7
Common merganser	8	**Yellow-throated vireo**	2; 7
Hooded merganser	7; 8	**Blue-headed vireo**	2
Common loon	1; 3	**Northern parula**	3
Chimney swift	1; 7	**American redstart**	3
Killdeer	3; 6; 7	**Black-throated blue warbler**	3
Spotted sandpiper*	6; 7	**Blackburnian warbler**	2; 3; 7
Solitary sandpiper	6; 7	**Chestnut-sided warbler**	2; 3
American Woodcock	1; 2; 3; 6; 7	**Magnolia warbler**	2
Red-shouldered hawk	2	**Black-throated green warbler**	2; 3
Broad-winged hawk	7	**Louisiana waterthrush**	7
Red-bellied woodpecker	2	**Palm Warbler***	2; 3
Northern flicker	3; 7	**Pine warbler**	2
Yellow-bellied sapsucker	2; 3	**Black-and-white warbler**	7
Eastern kingbird	7	**Ovenbird**	3
Great-crested flycatcher	7	**Rose-breasted grosbeak**	3
Alder flycatcher	2	**American tree Sparrow***	2
Eastern wood-pewee	3	**Eastern towhee**	1; 2; 7
Marsh Wren	1; 7	**Swamp sparrow**	2
Wood thrush	1; 2; 3; 7	**White-throated sparrow***	2
Baltimore oriole	7	**Purple finch**	1; 3
Scarlet tanager	1; 7		

Conservation Status

1 = NH Fish and Game Wildlife Action Plan (species of conservation concern)
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3 = Atlantic Northern Forest Bird Conservation Region (BCR 14)
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6 = North Atlantic Regional Shorebird Plan
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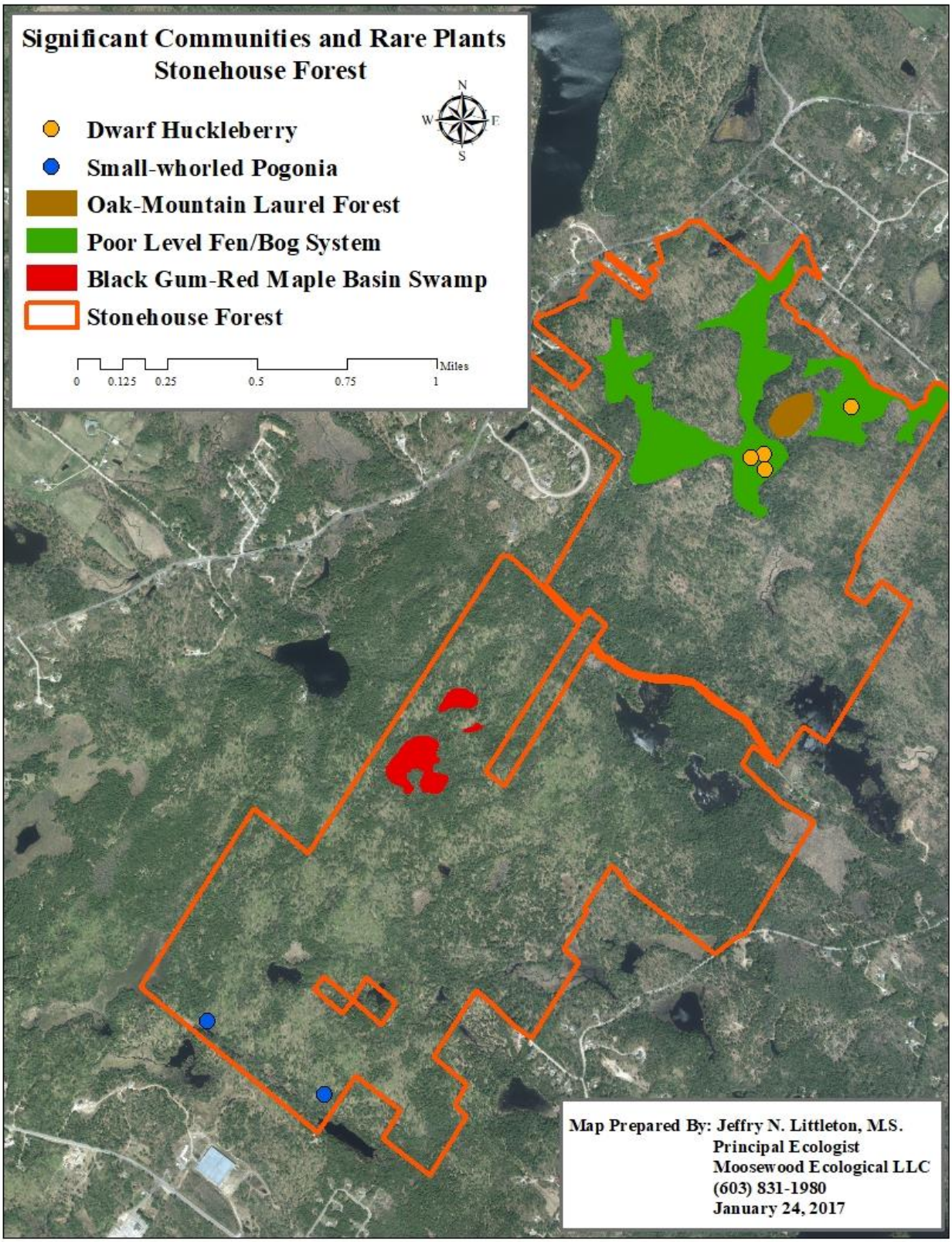
APPENDIX H

Stonehouse Forest
Significant Natural Communities and Rare Plants


Significant Communities and Rare Plants
Stonehouse Forest
N
W
E
S
Dwarf Huckleberry
Small-whorled Pogonia
Oak-Mountain Laurel Forest
Poor Level Fen/Bog System
Black Gum-Red Maple Basin Swamp
Stonehouse Forest
0
0.125
0.25
0.5
0.75
1
Miles
Map Prepared By: Jeffry N. Littleton, MS.
Principal Ecologist
Moosewood Ecological LLC
(603) 831-1980
January 24, 2017

APPENDIX I

Stonehouse Forest
Exemplary Black Gum Swamp Documentation

Natural Community Reporting Form for Potentially Significant Examples

Please provide the following information to the NH Natural Heritage Bureau (NHB) if you have located a potentially significant natural community. *Particularly important information is indicated by an asterisk; other items are desirable but not required*. Call (603) 271-2214 with any questions.

***Your Name:** **Jeff Littleton** ***Phone:** **831-1980** **Email:** **jeff@moosewoodecological.com**

Location Information

*Date natural community last observed: 12-14-16

*Town: Barrington Site Name: Stonehouse Forest

*Directions: Just east and adjacent to Stonehouse Pond off Route 9/202; see maps provided

*Please attach a map. **Note**: A photocopied portion of a USGS topographic map is preferred, with an outline of the area you actually visited. You may add another outline of what you believe to be the full extent of the natural community, beyond the area actually visited.

Natural Community Classification

*Your ad hoc name (e.g., cattail marsh): Black gum swamp

NHB Community Name (if known): Black gum-red maple basin swamp (boggy forest variant)

*Broad habitat type (e.g., riparian forest; coastal marsh): Forested swamp

***Community Structure** (select one)

X	Forest (canopy cover >60%)		Herbaceous (herb dom; < 25% woody)
	Woodland (canopy cover 25-60%)		Nonvascular (lichen, bryophyte, or algae dom.)
	Shrubland (<25% trees and >25% shrubs)		Sparse veg. (substrate dominated; < 25% veg.)

***Cover Type** (select one of the following if you selected forest, woodland, or shrubland above):

	Generally coniferous-dominated
	Generally mixed (each >25% total cover)
X	Generally deciduous-dominated

Veg Cover. For each vegetation layer below, provide an estimate of cover from the following list: >60%, 25-60%, 10-25%, 5-10%, 1-5%, <1%, 0%

Canopy cover: >60%

Shrub cover: 25-60%

Herb cover: 25-60%

Nonvascular cover: 25-60%

Bare substrate cover: 1-5%

Substrate type (loam, sand, boulder, etc.):

Community Composition

*Dominant canopy species: Black gum/red maple

Other common canopy species: White pine, hemlock, red spruce, yellow birch, pitch pine (2 individuals observed)

Dominant understory species: Hemlock, red spruce, red maple, black gum

Dominant shrub layer species: Highbush blueberry, winterberry, sheep laurel (occasional)

Dominant herb layer species: Cinnamon fern, *Sphagnum* mosses present

*Other characteristic species (indicators of distinctive conditions such as high pH soil, elevation, geographic region; other particularly abundant species):

Environment

*Topographic position (e.g., ridge crest, toe slope): 3 isolated basins in close proximity in saddle between ridges

Soil texture or type (peat, muck, sand, silt, etc. or NRCS name): No sample taken

*Moisture regime		*Flood regime	
Hydric	X	Inundated	
Wet-mesic		Seasonally flooded	X
Mesic		Temporarily flooded	
Dry-mesic		Saturated	X
Dry (xeric)		Other	

Other important environmental factors (e.g., steep slope, wind exposure):
Site with small pockets of standing water in some areas between hummocks; protected from wind exposure

Quality

*Estimated size of community (contiguous or close together in natural landscape): 14.72 acres

*Confidence in size estimate: High X Medium Low

Size of surrounding natural landscape (total natural area): 4,260acres of forests and wetlands (WAP data)

*Quality of nearby surrounding landscape (excellent, good, fair, or poor): Excellent

*Maturity if forest/woodland (estimated age and DBH of canopy trees; frequency of large snags):
Mature hemlock-beech-oak-pine forest at least 80-100 years old; hemlocks and white pines 2-3 ft DBH; hardwoods mostly smaller (1+ ft DBH); selective logging about 50-60 years ago based on coppiced hardwoods, no stumps present; occasional large snags and CWD

Evidence of human disturbance (logging, old roads, ditches, foot trails):
Some logging within the 2 smaller swamps but no logging within the larger example; no other signs of human disturbance

How much has human disturbance impacted the integrity of the natural community?:
Very little impact from limited logging within the edges of the 2 smaller examples; no logging within larger example

Exotic species (species, abundance):
None

Disruption of natural disturbance regime (e.g., fire suppression, flood alteration):
None

Other Site Information

Other natural community types present: Hemlock-hardwood-pine forest system, appearing to be mainly hemlock-beech-oak-pine community

Rare species present: None observed

*Owner/manager of site: Contact Duane Hyde at Southeast Land Trust 658-9718

Documentation

Describe any additional information or documentation you have for this occurrence/site:
There were no stonewalls in the area. I have visited the entire 1,500-acre property as part of an ecological inventory to support grant funding for land acquisition by the Southeast Land Trust

Others knowledgeable about the community or site: Duane Hyde; USFS

BLACK GUM SWAMP DATA SHEET

Date:	12-15-16	Town:	Barrington
Field worker NAME(s):	Jeff Littleton	Swamp Name:	Stonehouse Forest Black Gum Swamps
Field worker PHONE #:	831-1980		
Landowner information:	see Duane Hyde at Southeast Land Trust 658-9718		

Black Gum Data:

Number of black gum trees found:		Approx. acres of swamp:	14.72
Approx. acres of black gum concentration (if different than swamp size):	Same		

Approximate diameters (DBH=diameter at breast height) of black gum trunks: **11.1 acre site (only 60% sampled and reported below but visual inspection confirms similar distribution by size classes)**

<12 inches:	50
12-24 in.:	104
> 24 in.:	28 (20 up to 29"/8 >30")

Approximate diameters (DBH=diameter at breast height) of black gum trunks: **3.1-acre site (80% sampled and reported below but visual inspection confirms similar distribution by size classes)**

<12 inches:	62
12-24 in.:	29
> 24 in.:	3 (25"/26"/38")

Approximate diameters (DBH=diameter at breast height) of black gum trunks: **0.5-acre site (100% sampled)**

<12 inches:	58
12-24 in.:	10
> 24 in.:	1 (33")

Other species (plant or animal):

Red maple, white pine, pitch pine, hemlock, red spruce, yellow birch, highbush blueberry, winterberry, cinnamon fern sheep laurel, *Sphagum* mosses

Describe any other natural features and qualities of the swamp, including open areas, standing or flowing water, surrounding land-use, abundance of tip-up trees, cut stumps, wildlife sign, beaver dams, etc:

Pockets of standing water (known vernal pools within swamps); no beaver sign; porcupine denning in older trees; no logging within larger swamp but some logging within the 2 smaller swamps; no stonewalls in the area; at least 10 individuals 30+ inches DBH; surrounding land use is forested; tip-up trees observed but site appears to be fairly protected from wind

Are there more areas nearby that need to be surveyed for black gum? Where are they?

Potential other black gum swamps to the west on the Stonehouse Pond property

****

Related digital files provided for documentation (Type = photo, shapefile, spreadsheet...):

File name	Type	Contents

PRE-FIELD METRICS

Site Name: Stonehouse Forest **Site Code:** BG-3 **Date** (yyyy-mm-dd)**:** 2016-12-23
System: Temperate Peat Swamp **Primary Surveyor:** Jeff Littleton
Overall EIA Rank: A

LANDSCAPE CONTEXT

LAND USE INDEX

Calculate Land Use Index score using Landsat land cover data in a GIS (or calculate manually) following guidelines in manual; convert score to appropriate A–D rank.

Land Use Index Score	**10–9.5**	9.4–8	7.9–4	<4
Land Use Index Rank	**A**	**B**	**C**	**D**

Explain rank if adjusted: non-maintained trail located in the southern area next to the edge of the 500-m buffer is well outside the watershed for all 3 black gum swamps, and therefore was deemed to have relatively no effect, if any, on the wetland system (see attached LUI map); LUI = 10

BUFFER

PERIMETER WITH NATURAL BUFFER [estimate using 10 m minimum buffer width and length]		WIDTH OF NATURAL BUFFER [average width measured along 8 spokes in 100 m zone surrounding wetland]	
Natural buffer is 100%	**A**	Average natural buffer width is ≥100 m	**A**
Natural buffer is 75–99%	**B**	Average natural buffer width is 75–99 m	**B**
Natural buffer is 25–74%	**C**	Average natural buffer width is 25–74 m	**C**
Natural buffer is <25%	**D**	Average natural buffer width is <25 m	**D**
Explain rank if adjusted:		Explain rank if adjusted:	

SIZE

COMPARATIVE SIZE *SEE WETLAND SYSTEM RANK SPEC*		CHANGE IN SIZE *OPTIONAL*	
Very large compared to other examples of the same type (see system rank spec or Comparative Size Rank Table in manual)	**A**	Occurrence has not been artificially reduced (0%) from its original, natural extent; any detectable change in size is due to natural fluctuations Note: Reduction in size for metric ratings A-D can include conversion or disturbance (e.g., changes in hydrology due to roads, impoundments, development, human-induced drainage; or changes caused by recent cutting); assigning a metric rating depends on the degree of reduction	**A**
Large compared to other examples of the same type (see system rank spec or Comparative Size Rank Table in manual)	**B**	Occurrence is minimally reduced (1-5%) from its original natural extent	**B**
Medium to small compared to other examples of the same type (see system rank spec or Comparative Size Rank Table in manual)	**C**	Occurrence is moderately reduced (5-30%) from its original, natural extent	**C**
Small to very small compared to other examples of the same type (see system rank spec or Comparative Size Rank Table in manual)	**D**	Occurrence is substantially reduced (>30%) from its original, natural extent	**D**
Explain rank if adjusted from one given in system rank spec or Comparative Size Rank Table: comparative size rank based on Rank Summary Specs for Black Gum provided by NHNHB; total acreage = 14.72		Explain rank if B, C, or D:	

Site Name: __Stonehouse Forest_____ Date: _12-23-16_____

VEGETATION

VEGETATION STRUCTURE *SEE WETLAND SYSTEM RANK SPEC* [vertical layers and horizontal patches]

FORESTED FLOODPLAIN & SWAMP		NON-FORESTED WETLAND	
Canopy a mosaic of patches of different ages or sizes; gap sizes also vary; # of live tree stems 12-20" and >20" dbh well within expected range; *using a quick qualitative approach and where applicable to type*, there exists a very wide size-class diversity of downed logs and standing snags and characteristic woody species are regenerating with expected abundance and diversity, so no human-related degradation to vegetation structure evident	A	Characteristic woody species present with expected abundance and diversity, so no human-related degradation to vegetation structure evident; some very wet peatlands or marshes may naturally not have any woody vegetation or only scattered stunted individuals; standing tree snags, dead shrubs, downed woody debris, and litter due to natural factors	A
Canopy largely heterogeneous in age or size; # of live tree stems of medium and large size slightly below expected range; wide size-class diversity of downed logs and standing snags; characteristic woody species regenerating but present in somewhat lower abundance and/or diversity than expected due to human-related factors, so slight degradation to vegetation structure evident (e.g., low levels of cutting, browsing, and/or grazing)	B	Characteristic woody species somewhat lower in abundance and/or diversity than expected due to human-related factors, so slight degradation to vegetation structure evident (e.g., low levels of cutting, browsing, grazing, and/or mowing); standing tree snags, dead shrubs, downed woody debris, and/or litter with minor alterations from human disturbances	B
Canopy somewhat homogeneous in age or size; # of live tree stems of medium and large size moderately below expected range; moderate size-class diversity of downed logs and standing snags; characteristic woody species with noticeably reduced regeneration, abundance, and/or diversity than expected due to human-related factors, so moderate degradation to vegetation structure evident (e.g., intermediate levels of cutting, browsing, and/or grazing)	C	Characteristic woody species moderately lower in abundance and/or diversity than expected due to human-related factors, so moderate degradation to vegetation structure evident (e.g., intermediate levels of cutting, browsing, grazing, and/or mowing); standing tree snags, dead shrubs, downed woody debris, and/or litter with moderate alterations from human disturbances	C
Canopy very homogeneous in age or size; # of live tree stems of medium and large size substantially below expected range; low size-class diversity of downed logs and standing snags (or absent); characteristic woody species with severely reduced regeneration, abundance, or diversity than expected due to human-related factors, so substantial degradation to vegetation structure evident (e.g., high levels of cutting, browsing, or grazing)	D	Characteristic woody species strongly altered in abundance or diversity than expected due to human-related factors, so substantial degradation to vegetation structure evident (e.g., high levels of cutting, browsing, grazing, or mowing); standing tree snags, dead shrubs, downed woody debris, or litter with substantial alterations from human disturbances	D
Explain rank if B, C, or D:			

INVASIVE NONNATIVE PLANT SPECIES COVER *SEE WETLAND SYSTEM RANK SPEC*

Invasive plant species apparently absent	A
Cover of invasive plant species <1–3%	B
Cover of invasive plant species 4–30%	C
Cover of invasive plant species >30%	D
Explain rank if B, C, or D:	

NATIVE PLANT SPECIES COMPOSITION *SEE WETLAND SYSTEM RANK SPEC*

Native vegetation composition with expected species abundance and diversity: • Typical range of native diagnostic species present, including those native species sensitive to anthropogenic degradation, and • Native species indicative of anthropogenic disturbance (aggressive and weedy natives) absent to minor	A
Native vegetation composition with minor alterations from expected due to human factors: • Some native diagnostic species absent or substantially reduced in abundance (including those sensitive to anthropogenic degradation), and/or • Native species indicative of anthropogenic disturbance (aggressive and weedy natives) are present in low cover	B
Native vegetation composition moderately altered from expected due to human factors: • Many native diagnostic species absent or substantially reduced in abundance (including those sensitive to anthropogenic degradation), and/or • Native species indicative of anthropogenic disturbance (aggressive and weedy natives) are present in moderate cover	C
Native vegetation composition substantially altered from expected due to human factors: • Most or all native diagnostic species absent (including those sensitive to anthropogenic degradation), a few may remain in very low abundance, or • Native species indicative of anthropogenic disturbance (aggressive and weedy natives) are present in high cover	D
Explain rank if B, C, or D:	

Site Name: __Stonehouse Forest_____ Date: _12-23-16_____

HYDROLOGY

WATER SOURCE *SEE WETLAND SYSTEM RANK SPEC*

[evaluation of the nature of water inputs]
[evaluate the effects of human constructed dams under Hydroperiod]

Non-Tidal			Tidal	
Water source is natural; hydrology is dominated by precipitation, groundwater, natural runoff, and/or overbank flow; there is no indication of direct artificial water sources; land use in the wetland's local drainage area is primarily open space or low density, passive uses	**A**		Tidal and non-tidal water sources are natural with no artificial alterations to natural salinity; no indication of direct artificial water sources (e.g., land use in the local drainage area of the wetland is primarily open space or low density, passive uses); lacks point source discharges into or adjacent to the wetland	**A**
Water source contains slight amounts of inflow from anthropogenic sources; indications of anthropogenic input include developed land (<20%) in the immediate drainage area of the wetland, some road runoff, small storm drains, and/or minor point source discharges into or adjacent to the wetland	**B**		Tidal and non-tidal water sources are slightly altered by human impacts; wetland directly receives slight amounts of inflow from anthropogenic sources; indications of anthropogenic input include developed land (<20%) in the immediate drainage area of the wetland, some road runoff, small storm drains and/or minor point source discharges into or adjacent to the wetland	**B**
Water source contains moderate amounts of inflow from anthropogenic sources; indications of anthropogenic input include 20-60% developed land adjacent to the wetland, moderate amounts of road runoff, moderately-sized storm drains, and/or moderate point source discharges into or adjacent to the wetland	**C**		Tidal and non-tidal water sources are moderately altered by human impacts; wetland directly receives moderate amounts of inflow from anthropogenic sources; indications of anthropogenic input include 20-60% developed land adjacent to the wetland, moderate amounts of road runoff, moderately-sized storm drains, and/or moderate point source discharges into or adjacent to the wetland	**C**
Water source contains substantial amounts of inflow from anthropogenic sources; indications of anthropogenic input include >60% developed land adjacent to the wetland, large amounts of road runoff, large-sized storm drains, or major point source discharges into or adjacent to the wetland	**D**		Tidal and non-tidal water sources are substantially altered by human impacts; wetland directly receives substantial amounts of inflow from anthropogenic sources; indications of anthropogenic input include >60% developed land adjacent to the wetland, large amounts of road runoff, large-sized storm drains, or major point source discharges into or adjacent to the wetland	**D**
Explain rank if B, C, or D:				

Site Name: __Stonehouse Forest_____ Date: _12-23-16_____

HYDROLOGY

HYDROPERIOD

SEE WETLAND SYSTEM RANK SPEC

[evaluation of water patterns within the wetland system, regardless of source]
[assessment of the characteristic frequency, duration, degree, and/or timing of inundation, saturation, and/or drawdown]
[includes assessment of the effects dams may have on wetland system hydroperiod even when the dam is located a considerable distance up- or downstream from the wetland]

Riverine/Lacustrine [channels, open & forested floodplains, shores]		**Non-Riverine Enriched** [rich swamps, medium & rich fens, drainage marshes]		**Nutrient-Poor Isolated Wetlands** [bogs & poor fens, poor swamps, basin marshes]		**Tidal** [salt & brackish marshes, tidal flats, subtidal]	
Natural patterns of flood frequency, duration, level, and/or timing; stressors that impact the natural hydroperiod absent; channel/riparian zone characterized by equilibrium conditions, with no evidence of severe aggradation or degradation indicative of altered hydroperiod (see field indicators in manual)	**A**	Natural patterns of inundation & drawdown, saturation, and/or seepage discharge; stressors that impact the natural hydroperiod absent	**A**	Naturally stable and saturated hydrology, or natural cycles of saturation and partial drying; stressors that impact the natural hydroperiod absent	**A**	Full natural tidal prism, with two daily tidal minima and maxima; storm tides, tidal river flooding, and onshore wind-maintained high tides causing short-term changes in tidal amplitude are within the expected norm	**A**
Flood frequency, duration, level, and/or timing deviate slightly from natural conditions due to stressors (e.g., flood control dams upstream or downstream slightly effect hydroperiod, small ditches/diversions, minor artificial groundwater pumping, and/or minor flow additions); outlets may be slightly constricted by dam (if managed water levels, they closely mimic natural hydroperiod patterns); shore/bank with minor aggradation or degradation indicative of altered hydroperiod	**B**	Deviates slightly from natural patterns of inundation & drawdown, saturation, and/or seepage discharge due to stressors (e.g., small ditches/diversions, minor artificial groundwater pumping, and/or minor flow additions); outlets may be slightly constricted by dam (if managed water levels, they closely mimic natural hydroperiod patterns)	**B**	Deviates slightly from naturally stable and saturated hydrology, or natural cycles of saturation and partial drying due to stressors (e.g., small ditches/diversions, minor artificial groundwater pumping, and/or minor flow additions)	**B**	Slightly muted tidal prism (although two daily minima and maxima are observed) and/or slightly inadequate drainage such that a small part of the marsh remains flooded during low tide	**B**
Flood frequency, duration, level, and/or timing deviate moderately from natural conditions due to stressors (e.g., flood control dams upstream or downstream moderately effect hydroperiod, ditches/diversions 1–3 ft. deep, moderate artificial groundwater pumping, and/or moderate flow additions); outlets may be moderately constricted by dam, but flow still possible (if managed water levels, they less closely mimic natural hydroperiod patterns); shore/bank with moderate to severe aggradation or degradation indicative of altered hydroperiod	**C**	Deviates moderately from natural patterns of inundation & drawdown, saturation, and/or seepage discharge due to stressors (e.g., ditches/diversions 1–3 ft. deep, moderate artificial groundwater pumping, and/or moderate flow additions); outlets may be moderately constricted by dam, but flow still possible (if managed water levels, they less closely mimic natural hydroperiod patterns)	**C**	Deviates moderately from naturally stable and saturated hydrology, or natural cycles of saturation and partial drying due to stressors (e.g., ditches/diversions 1–3 ft. deep, moderate artificial groundwater pumping, and/or moderate flow additions)	**C**	Moderately muted tidal prism and/or moderately inadequate drainage such that a significant portion of the marsh remains flooded during low tide	**C**
Flood frequency, duration, level, and/or timing deviate substantially from natural conditions due to stressors (e.g., flood control dams upstream or downstream substantially effect hydroperiod, diversions >3 ft. deep that withdraw a significant portion of flow, significant artificial groundwater pumping, or heavy flow additions); outlets may be significantly constricted by dam, blocking most flow (if managed water levels, they are disconnected from natural seasonal fluctuations); shore/bank with severe aggradation or degradation indicative of altered hydroperiod	**D**	Deviates substantially from natural patterns of inundation & drawdown, saturation, and/or seepage discharge due to stressors (e.g., ditches/diversions >3 ft. deep & withdraw a significant portion of flow, significant artificial groundwater pumping, or heavy flow additions); outlets may be significantly constricted by dam, blocking most flow (if managed water levels, they are disconnected from natural seasonal fluctuations)	**D**	Deviates substantially from naturally stable and saturated hydrology, or natural cycles of saturation and partial drying due to stressors (e.g., ditches/diversions >3 ft. deep that withdraw a significant portion of flow, significant artificial groundwater pumping, or heavy flow additions)	**D**	Substantially muted tidal prism or inadequate drainage such that most or all of the marsh remains flooded during low tide	**D**
Explain rank if B, C, or D:							

Site Name: __Stonehouse Forest_____ Date: _12-23-16_____

HYDROLOGY

HYDROLOGIC CONNECTIVITY

[assessed of alteration to overbank flooding, channel migration, channel incision, and geomorphic modifications]
[evaluation of water exchange between wetland and surrounding systems, regardless of water patterns within the wetland system]

Riverine/Lacustrine [channels, open & forested floodplains, shores]		**Non-Riverine Enriched** [rich swamps, medium & rich fens, drainage marshes]		**Nutrient-Poor Isolated Wetlands** [bogs & poor fens, poor swamps, basin marshes]		**Tidal** [salt & brackish marshes, tidal flats, subtidal]	
River or lake is completely connected to floodplain/shore, backwater sloughs, and channels; no geomorphic modifications made to contemporary floodplain/shore; channel is not unnaturally entrenched	**A**	No unnatural obstructions to lateral and vertical movement of ground or surface water; rising water in the wetland has unrestricted access to adjacent upland, without obstructions to the lateral movement of flood flows; if perched water table then impermeable soil layer intact	**A**	No unnatural barriers restricting water movement into or out of wetland from adjacent areas	**A**	Tidal channel sinuosity reflects natural processes; unimpeded tidal flooding; total absence of tide gates, flaps, dikes, culverts, and human-made channels	**A**
River or lake is slightly disconnected from floodplain/shore, backwater sloughs, and channels (<25% of banks affected) due to dikes, rip rap, and/or elevated culverts; channel is slightly entrenched (overbank flow occurs during most floods)	**B**	Slight restrictions (impacting <25% of the wetland) to the lateral and/or vertical movement of ground or surface waters by unnatural features (e.g., levees and/or excessively high banks); restrictions may be intermittent along the wetland, or the restrictions may occur only along one bank or shore; flood flows may exceed the obstructions, but drainage back to the wetland is incomplete due to impoundment; if perched then impermeable soil layer slightly disturbed (e.g., by drilling or blasting)	**B**	Surrounding land use slightly restricts water movement into or out of wetland	**B**	Tidal channel sinuosity slightly altered; tidal flooding is slightly impeded by tide gates, flaps, dikes, culverts, and/or human-made channels	**B**
River or lake is moderately disconnected from floodplain/shore, backwater sloughs, and channels (25-75% of banks affected) due to dikes, rip rap, and/or elevated culverts; channel is moderately entrenched (overbank flow only occurs during moderate to severe floods)	**C**	Moderate restrictions (impacting 25-75% of the wetland) to the lateral and/or vertical movement of ground or surface waters by unnatural features (e.g., levees and/or excessively high banks); flood flows may exceed the obstructions, but drainage back to the wetland is incomplete due to impoundment; if perched then impermeable soil layer moderately disturbed (e.g., by drilling or blasting)	**C**	Surrounding land use moderately restricts water movement into or out of wetland	**C**	Tidal channel sinuosity moderately altered; tidal flooding is moderately impeded by tide gates, flaps, dikes, culverts, and/or human-made channels	**C**
River or lake is substantially disconnected from floodplain/shore, backwater sloughs, and channels (>75% of banks affected) due to dikes, rip rap, or elevated culverts; channel is substantially entrenched (overbank flow never occurs or only during severe floods)	**D**	Substantial restrictions (impacting >75% of the wetland) to the lateral or vertical movement of ground or surface waters by unnatural features (e.g., levees or excessively high banks); most or all water stages are contained within the obstructions; if perched then impermeable soil layer substantially disturbed (e.g., by drilling or blasting)	**D**	Surrounding land use substantially restricts water movement into or out of wetland	**D**	Tidal channel sinuosity substantially altered; tidal flooding is substantially impeded by tide gates, flaps, dikes, culverts, or human-made channels	**D**

Explain rank if B, C, or D:

Site Name: __Stonehouse Forest_____ Date: _12-23-16_____

SOIL

SOIL CONDITION

Non-Tidal		Tidal	
Disturbed or bare soil limited to natural causes such as flood deposition or wildlife trails	A	Disturbed soil limited to natural causes; bare soils are naturally occurring and largely limited to salt pannes, creek banks, and intertidal flats	A
Small amounts of disturbed or bare soil due to human causes (e.g., small areas of soil removal or additions; sedimentation due to human causes; unnatural hummocks/hollows; evidence of past ploughing or soil leveling; erosion by wind or water from over-grazing or other activities that remove protective vegetation cover; compaction by machinery or trampling; pockmarking by livestock; and/or ruts from vehicles); extent and impact is minimal	B	Small amounts of disturbed or bare soil due to human causes (e.g., small areas of soil removal or additions; erosion from boat wake, altered current/tidal patterns, or over-grazing or other activities that remove protective vegetation cover; compaction by machinery or trampling; pockmarking by livestock; ditching for mosquito control or improved salt marsh hay production; berms formed by ditch spoils; artificial pannes created by rafts of anthropogenic debris or impoundments from ditch spoil berms; and/or ruts from vehicles); extent and impact is minimal	B
Moderate amounts of disturbed/degraded soil due to human causes (e.g., moderate areas of soil removal or additions; sedimentation due to human causes; unnatural hummocks/hollows; evidence of past ploughing or soil leveling; erosion by wind or water from over-grazing or other activities that remove protective vegetation cover; compaction by machinery or trampling; pockmarking by livestock; and/or ruts from vehicles); extent and impact is moderate	C	Moderate amounts of disturbed/degraded soil due to human causes (e.g., moderate areas of soil removal or additions; erosion from boat wake, altered current/tidal patterns, or over-grazing or other activities that remove protective vegetation cover; compaction by machinery or trampling; pockmarking by livestock; ditching for mosquito control or improved salt marsh hay production; berms formed by ditch spoils; artificial pannes created by rafts of anthropogenic debris or impoundments from ditch spoil berms; and/or ruts from vehicles); extent and impact is moderate	C
Substantial amounts of disturbed/degraded soil due to human causes (e.g., substantial areas of soil removal or additions; sedimentation due to human causes; unnatural hummocks/hollows; evidence of past ploughing or soil leveling; erosion by wind or water from over-grazing or other activities that remove protective vegetation cover; compaction by machinery or trampling; pockmarking by livestock; or ruts from vehicles); extent and impact is substantial and long lasting	D	Substantial amounts of disturbed/degraded soil due to human causes (e.g., substantial areas of soil removal or additions; erosion from boat wake, altered current/tidal patterns, or over-grazing or other activities that remove protective vegetation cover; compaction by machinery or trampling; pockmarking by livestock; ditching for mosquito control or improved salt marsh hay production; berms formed by ditch spoils; artificial pannes created by rafts of anthropogenic debris or impoundments from ditch spoil berms; or ruts from vehicles); extent and impact is substantial and long lasting	D
Explain rank if B, C, or D:		Explain rank if B, C, or D:	

Site Name: _Stonehouse Forest_____Surveyor: Jeff Littleton_____
System: _Temperate Peat Swamp_____ Date: _12-23-16_____

LEVEL 2 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" or altered disturbance regime (e.g. flooding, fire, or browse).

Some Important Points about Stressors Checklists:

1. The Stressors Checklist must be completed for Buffer, Vegetation, Soil, and Hydrology (where applicable).
2. Assess Buffer stressors and their effects within the Buffer 0-100 m (*NOT how buffer stressors may impact the wetland*).
3. Stressors for Vegetation, Soils, and Hydrology are assessed for the wetland system.
4. Some stressors may overlap, e.g., 10 (Low impact recreation) may overlap with 27 (Indirect soil disturbance [trampling]). Choose one and note the overlap.
5. Severity has been pre-assigned for many stressors. If the severity differs from the pre-assigned rating, cross it out and note the true severity. If there is more than one pre-assigned value, circle the appropriate value.

SCOPE of Threat* (% of wetland system or buffer [0-100 m] affected by direct threat)	
1 = Small	Affects a small area (1-10%) of wetland or buffer (0-100 m)
2 = Restricted	Affects some (11-30%) of wetland or buffer (0-100 m)
3 = Large	Affects much (31-70%) of wetland or buffer (0-100 m)
4 = Pervasive	Affects all or most (71-100%) of wetland or buffer (0-100 m)
SEVERITY of Threat* within the defined scope	
1 = Slight	Likely to only slightly (1-10%) degrade/reduce integrity in scope
2 = Moderate	Likely to moderately (11-30%) degrade/reduce integrity in scope
3 = Serious	Likely to seriously (31-70%) degrade/reduce integrity in scope
4 = Extreme	Likely to extremely (71-100%) degrade/destroy or eliminate
* **Assess Scope and Severity for up to next 10 years**	

		BUFFER (0-100 m)			WETLAND SYSTEM									
					Vegetation			Soil			Hydrology			
	STRESSORS CHECKLIST	Scope	Severity	IMPACT	Scope	Severity	IMPACT	Scope	Severity	IMPACT	Scope	Severity	IMPACT	**Comments**
	1. Residential, recreational buildings, associated pavement	0	0	0	0	0	0	0	0	0	0	0	0	No development stressors within 100m buffer and well beyond
D	2. Industrial, commercial, military buildings, associated pavement	0	0	0	0	0	0	0	0	0	0	0	0	
E	3. Oil and gas wells and surrounding footprint	0	0	0	0	0	0	0	0	0	0	0	0	
V	4. Roads (gravel=2, paved=3, highway=4), railroad=3	0	0	0	0	0	0	0	0	0	0	0	0	
E	5. Sports field, golf course, urban parkland, expansive lawns	0	0	0	0	0	0	0	0	0	0	0	0	
L	6. Row-crop agriculture, orchard, nursery	0	0	0	0	0	0	0	0	0	0	0	0	
O	7. Hay field, fallow field	0	0	0	0	0	0	0	0	0	0	0	0	
P	8. Utility / power line corridor	0	0	0	0	0	0	0	0	0	0	0	0	
	9. Other [specify]:													
R	10. Low impact recreation (hunting, fishing, camping, hiking, bird-watching, canoe/kayak)	1	1	1	1	1	1	1	1	1	1	1	1	Property posted against trespassing
E	11. High impact recreation (ATV, mountain biking, motor boats)	0	0	0	0	0	0	0	0	0	0	0	0	None observed ; property posted against trespassing
C	12. Other [specify]:													
	13. Tree resource extraction (clear cut=3 for buffer, 4 for wetland; selective cut=2 or 3)	2	1	1	2	1	1	1	1	1	1	1	1	Last logging event was selective having occurred about 50-60 yrs ago
	14. Vegetation management (cutting, mowing)	0	0	0	0	0	0	0	0	0	0	0	0	No current management
V	15. Livestock grazing, excessive herbivory by native species	1	1	1	1	1	1	1	1	1	1	1	1	Potential by native species
E	16. Insect pest damage (exotic pest or excessive damage by native)	1	1	1	1	1	1	1	1	1	1	1	1	Potential pest damage; none observed
G	17. Invasive plant species (see invasive weed list)	1	1	1	1	1	1	1	1	1	1	1	1	None observed
	18. Direct application of agricultural chemicals, herbicide spraying	0	0	0	0	0	0	0	0	0	0	0	0	None
	19. Other [specify]:													
N	20. Altered natural disturbance regime (specify expected regime)	0	0	0	0	0	0	0	0	0	0	0	0	No alterations to ND expected or observed
D	21. Other [specify]:													

Site Name: __Stonehouse Forest_____ Date: _12-23-16_____

		BUFFER (100 m)			WETLAND SYSTEM									
					Vegetation			Soil			Hydrology			
	STRESSORS CHECKLIST	Scope	Severity	IMPACT	Scope	Severity	IMPACT	Scope	Severity	IMPACT	Scope	Severity	IMPACT	Comments
	22. Excessive sediment or organic debris (inputs from recently logged sites, sedimentation)	0	0	0	0	0	0	0	0	0	0	0	0	None or very little potential soil stressors within 100m buffer and well beyond
	23. Excessive erosion or loss of organic matter (gullying, decay of organic soils)	0	0	0	0	0	0	0	0	0	0	0	0	
	24. Trash or refuse dumping	1	1	1	1	1	1	1	1	1	1	1	1	
S	25. Filling or dumping of sediment (spoils from excavation)	1	1	1	1	1	1	1	1	1	1	1	1	
O	26. Substrate removal (excavation)	1	1	1	1	1	1	1	1	1	1	1	1	
I	27. Indirect soil disturbance (compaction or trampling by livestock, human use, vehicles)	1	1	1	1	1	1	1	1	1	1	1	1	
L	28. Direct soil disturbance (grading, compaction, plowing, discing, deeply dug fire lines)	1	1	1	1	1	1	1	1	1	1	1	1	
	29. Physical resource extraction (rock, sand, gravel, minerals, etc.)	1	1	1	1	1	1	1	1	1	1	1	1	
	30. Obvious excess salinity (dead/stressed plants, salt crusts)	0	0	0	0	0	0	0	0	0	0	0	0	
	31. Other [specify]:													
	32. PS discharge (waste water treatment, factory discharge, septic)	0	0	0	0	0	0	0	0	0	0	0	0	No hydrology stressors within 100m buffer and well beyond
	33. NPS discharge (urban / storm water runoff)	0	0	0	0	0	0	0	0	0	0	0	0	
H	34. NPS discharge (agricultural runoff, excess irrigation, feedlots, excess manure)	0	0	0	0	0	0	0	0	0	0	0	0	
Y	35. NPS discharge (mine runoff, discharge from oil and gas)	0	0	0	0	0	0	0	0	0	0	0	0	
D	36. Large dams, reservoirs (managed hydrology)	0	0	0	0	0	0	0	0	0	0	0	0	
R	37. Impoundments, berms, dikes, levees that hold water in or out	0	0	0	0	0	0	0	0	0	0	0	0	
O	38. Diversions, ditches, pumps that move water in or out	0	0	0	0	0	0	0	0	0	0	0	0	
L	39. Excavation for water retention (ponds)	0	0	0	0	0	0	0	0	0	0	0	0	
O	40. Groundwater extraction (few small wells=2, extensive extraction cause a lowered water table=4)	0	0	0	0	0	0	0	0	0	0	0	0	
G	41. Flow obstructions (culverts, paved stream crossings)	0	0	0	0	0	0	0	0	0	0	0	0	
Y	42. Engineered channel (riprap, armored channel bank, bed)	0	0	0	0	0	0	0	0	0	0	0	0	
	43. Control of flow and energy (weir, tide-gates)	0	0	0	0	0	0	0	0	0	0	0	0	
	44. Other [specify]:													
Stressors Very Minimal or Not Evident (check box, if true)		☐			☐			☐			☐			
STRESSOR RATING BY CATEGORY (Buffer, Veg, Soils, Hydro)		Rating:	Score:		Rating:	Score:		Rating:	Score:		Rating:	Score:		
Multiply following weights to each MEF score then sum to calculate Human Stressor Index (HSI) score (then use table to right for HIS rating)		0.3			0.3			0.1			0.3			**HSI Site Score:** **HSI Site Rating:**

Threat Impact Calculator		Scope			
		4 =Pervasive	3 = Large	2 = Restricted	1 = Small
Severity	4 = Extreme	VERY HIGH = 10	High = 7	Medium = 4	Low = 1
	3 = Serious	High = 7	High = 7	Medium = 4	Low = 1
	2 = Moderate	Medium = 4	Medium = 4	Low = 1	Low = 1
	1 = Slight	Low = 1	Low = 1	Low = 1	Low = 1

HSI Score	HSI Rating
10+	Very High
7 – 9.9	High
4 – 6.9	Medium
1 – 3.9	Low
0 – 0.9	Absent

APPENDIX J

Professional Qualifications

Jeffry Littleton, Principal Ecologist and Project Manager
Moosewood Ecological LLC

Jeffry holds a B.S. in wildlife biology from Georgia Southern University in 1995. He received a M.S. in conservation biology from Antioch University New England. His graduate years focused on biological inventory, conservation planning, and landscape ecology. His professional goal is to assist various organizations and private landowners with conservation of natural resources.

Jeffry Littleton has owned and managed Moosewood Ecological LLC for 15 years. He has over 25 years of experience in ecological research, inventory, and education. He specializes in Conservation Planning, Natural Resources Inventory, Comprehensive Ecological Assessments and Management, Biological Monitoring, Natural Community Classifications, Wildlife Research, Habitat Management and Restoration, and Community Outreach and Education.

He incorporates a systems approach to understanding the spatial dynamics of the environment, which blends concepts of community and landscape ecology with conservation biology. This approach is further complimented by his proficient use of a Geographic Information System (GIS), affording the unique opportunity to analyze the spatial distribution of natural resources on the landscape to develop science-based conservation planning. In addition, Jeffry is skilled in the identification of the flora and fauna of the Northeast and has led many natural history interpretive tours throughout northern New England.

As the principal of Moosewood Ecological, Jeffry has been lead investigator and project manager on a wide range of natural resources investigations, including coarse-filter analyses and site-specific assessments of wetland and terrestrial ecosystems. Such projects have included municipal natural resources inventories and conservation planning, wetland evaluations, and restoration plans, as well as biological surveys for birds, amphibians, mammals, reptiles, fish, dragonflies, damselflies, butterflies, and vascular plants. He is skilled in the identification of natural communities and critical wildlife habitats as defined by the NH Natural Heritage Bureau and NH Fish and Game Department, respectively.

Jeffry has developed a strong working relationship with many state organizations and agencies, which include the NH Natural Heritage Bureau, NH Fish and Game, NH Department of Environmental Services Wetlands Bureau, NH Audubon Society, The Nature Conservancy, Monadnock Conservancy, Harris Center for Conservation and Education, Southeast Land Trust, and NH Association of Conservation Commissions. Jeffry was a contributing partner for the newly released Ecosystems and Wildlife: Climate Change Adaptation Plan (an amendment to the NH Wildlife Action Plan by the NH Fish and Game Dept.).

He currently serves as adjunct faculty at Antioch University New England. He provides course instruction on a variety of natural resource topics, which include survey techniques for wildlife, vegetation, and soils in both terrestrial and aquatic ecosystems, as well as conservation planning, forest ecology, and interpreting past land use history. In addition, Jeffry serves as the treasurer of the Monadnock Sustainability Network.

Chris Frauenhofer, Field Ecologist
Moosewood Ecological LLC

Chris has earned a Master of Science in Conservation Biology from Antioch University. He has worked with Moosewood Ecological LLC for 3 years during course instruction at Antioch University and upon completion of his degree. He is highly skilled in wildlife

identification and habitat mapping. Chris brings forth a tenacious appetite to document common and rare wildlife through sight, sound, and other signs.

Laura Deming, Senior Wildlife Biologist
New Hampshire Audubon

Laura holds a B.A. in biology from Dartmouth College, a Master's in wildlife biology from the University of Vermont, and is currently enrolled in the Environmental Studies doctoral program at Antioch University New England. Since coming to work at NH Audubon in 1992, she has focused primarily on birds, coordinating statewide surveys of wintering bald eagles, monitoring peregrine nest cliffs, surveying migratory raptors, as well as breeding bird populations in montane forests, floodplain forests, and wetland habitats. In addition to birds, she has radio-tracked Blanding's turtles, conducted surveys of stream salamanders and vernal pool amphibians, helped developed a Phenology monitoring program for NH Audubon sanctuaries, and established a partnership with state and federal organizations to coordinate statewide surveys for bats.

For many of these projects, she has worked closely with staff from state and federal agencies (N.H. Fish & Game Dept., U.S. Fish & Wildlife Service, U.S. Environmental Protection Agency, U.S. Forest Service), other non-profit organizations (The Nature Conservancy, the Society for the Protection of N.H. Forests, Conservation Law Foundation, The Jordan Institute), town conservation commissions, and dozens of volunteers. Laura has served on several working groups related to natural resource policy and management, most recently the Vernal Pool Workgroup, Stream Crossing Workgroup, and Land Use Impacts Legislative Commission. She has researched and written a variety of documents on wildlife-related issues for agencies, municipalities, and environmental organizations, and has reviewed and commented on plans for major transportation projects, including the expansion of I-93 and the Manchester Airport Access Road.

Chris Kane, Botanist
Kane Conservation

Chris received a M.S. in conservation biology from Antioch University New England. His graduate years focused on botany and predicting old growth eastern hemlock stands in New Hampshire.

For six years Chris was Easement Steward for the Society for the Protection of New Hampshire Forests where he was responsible for the stewardship of 85,000 acres of protected land. More recently Chris established Kane Conservation, a consulting company that specializes in land conservation that protects the ecology and rural traditions of New England. He has over 20 years of experience in land conservation and stewardship, conservation planning, resource inventory and field ecology.

Chris has conducted numerous botanical surveys and ecological assessments for municipalities, businesses, and agencies in New England. He rediscovered the exceptional old growth forest in Mt. Sunapee State Park and was co-coordinator of the 2004 Eastern Old Growth Forest Conference. He also has extensive experience applying the possibilities of GIS to natural resource and land conservation planning projects. He holds licenses for ESRI ArcView 3.x and ArcGis 9.3.