BOROUGH OF KINNELON

CRITICAL HABITAT CONSERVATION AND MANAGEMENT PLAN

MORRIS COUNTY

THE LAND CONSERVANCY OF NEW JERSEY

August 12, 2020

KINNELON BOROUGH INCORPORATED 1922 WHERE THE FUTURE IS ENRICHED BY THE PAST MORRIS COUNTY, NEW JERSEY

CRITICAL HABITAT CONSERVATION AND MANAGEMENT PLAN

for

Borough of Kinnelon

County of Morris

Prepared August 12, 2020 by:

The Land Conservancy of New Jersey
An accredited land trust
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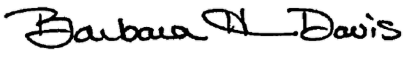
Boonton, NJ 07005



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This original document was appropriately signed and sealed in accordance with Chapter 41, Title 13 of the State Board of Professional Planners.

CRITICAL HABITAT CONSERVATION AND MANAGEMENT PLAN

for

Borough of Kinnelon

County of Morris

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The Land Conservancy of New Jersey

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Mayor and Borough Council
James J. Freda, Mayor
Randall Charles
James Lorkowski
Robert Roy
Vincent Russo
Glenn Sisco
William "Bill" Yago

Planning Board	Open Space Advisory Committee	Environmental Committee
Tamara Roselius, Chairperson	Tamara Roselius, Chairperson, Planning Board	Lisa Hankes, Chairperson
James Freda, Mayor	Robert Roy, Vice Chair, Historical Committee	Karen Iuele, Secretary
William Yago, Councilman	James Freda, Mayor	Cheryl Canale
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The Borough of Kinnelon Critical Habitat Conservation and Management Plan *was prepared with the assistance of a Grant from the New Jersey Highlands Water Protection and Planning Council*

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Sunset on Bald Hill, *Nina Mickey*
Unnamed Tributary to Stone House Brook, *The Land Conservancy of New Jersey*
Pinxter Azalea, Silas Condict, *Carol Vreeland*

The photographs provided by Nina and Carol were taken as part of the Borough's 2013 *Environmental Resource Inventory Update*

Critical Habitat Resource Area - *Left to right:*

Vernal Pool, Weber Tract, *Carol Vreeland*
American Toad, *The Land Conservancy of New Jersey*
Spotted Salamander, *Richard Radis*
Vernal Pool, *The Land Conservancy of New Jersey*

ABSTRACT

Biodiversity is the variety of plant species, animal species, and all other organisms found in a particular environment and is a critical indicator of ecological integrity.[1] These specific geographic areas, known as Critical Habitat, contain features essential to the conservation of endangered and/or threatened species and may require special management and protection. Critical Habitat is defined by the Regional Master Plan (RMP) as habitat which falls into one of three categories: Critical Wildlife Habitat, Significant Natural Areas, and Vernal Pools.[2]

This Critical Habitat Conservation and Management Plan (CHCMP) is intended to be used by municipal planning officials and professionals, including the engineer and planner, to incorporate standards and criteria for the protection, conservation and management of Critical Habitat. The CHCMP is to be adopted as an Element of the municipal Master Plan.[3]

As defined by the RMP, a CHCMP is

> "written guidance, approved by the Highlands Council, that conforming municipalities and counties must include in master plans and development regulations that may include, but not be limited to
>
> - ✓ Performance and design standards for development within or adjacent to Critical Habitat;
> - ✓ Restoration of the ecological functions and processes of impaired or disturbed Critical Habitat;
> - ✓ Procedures for modifications to Critical Habitat areas;
> - ✓ Prevention of habitat fragmentation through open space preservation; and
> - ✓ Corporate, non-profit and community involvement in creating, protecting and restoring habitat."[4]

The CHCMP supports and fulfills the requirements for the protection of Critical Habitat through Municipal Plan Conformance. The CHCMP is consistent with the stated goals, policies, and objectives of the Highlands Regional Master Plan, adopted pursuant to the Highlands Water Protection and Planning Act (N.J.S.A. 13:20-8).

EXECUTIVE SUMMARY OF GUIDELINES

The Borough of Kinnelon should adopt the CHCMP as an Element of the Borough's Master Plan to include the Critical Habitat Area management objectives and program in the Borough's planning review. Once adopted by the Planning Board, the next step will be for the Borough Council to adopt the Highlands referral ordinance. [a] When the Borough of Kinnelon adopts the Highlands referral ordinance, all projects that trigger review would be referred for review to the Highlands Council. Minor development applications would be exempt in almost every case. The Highlands Council would review any development application that meets the applicability of the referral ordinance. If the Highlands Council review is not triggered, then the Critical Habitat provisions are not triggered.

Major Highlands Development applies to only the Preservation Area. Major Highlands Developments fall under the jurisdiction of the New Jersey Department of Environmental Protection (N.J.A.C. 7:38). Additionally, if projects trigger the referral ordinance they then are subject to the policies in the RMP. Planning Area properties are also subject to these polices if the development triggers referral. If the application does not meet the applicability of the referral ordinance, then the Highlands Council would not be involved, and Highlands polices, including the CHCMP, would not apply.

When there are exemptions, exclusions, or other situations where the referral ordinance does not apply, then the policies identified by the RMP also do not apply. Board of Adjustment applications are affected only if the development meets the applicability in the referral ordinance, similar to planning board applications. Any application that does not meet the applicability guidelines would not require Critical Habitat review.

The following flowchart (**Figure 1**) provides a summary of the guidelines for applicants and will help the municipal boards decide whether or not an application has to be referred to the Highlands Council.

As part of the Highlands Council review, and as a condition of their approval of an application, stewardship and monitoring of Critical Habitat will be required of the applicant. The Highlands Council will provide grant funding for the Borough to develop a habitat stewardship program, if requested and applicable.

[a] The Highlands referral ordinance is located here:
https://www.nj.gov/njhighlands/planconformance/guidelines/model.html

When is Project Review for Critical Habitat Necessary?

Is Your Project Exempt from the Highlands Water Protection and Planning Act?

No

Visit https://nj.gov/dep/landuse/highlands.html for the Summary of Exemptions

Yes → A Project Review is Not Necessary

Where is it located?

Highlands Preservation Area **OR** Planning Area (Conforming Municipality) **OR** Highlands Planning Area (Non-Conforming Municipality)

Capital government projects where 2 or more acres are disturbed, or impervious surface is increased by 1 or more acres

3 or More Residential Units Proposed [Including Existing Unit(s)]

1 Any Non-Residential Development

2 Any Residential Development, State Entity, or Local Government Capital Project that

- Requires NJDEP environmental land use or water permit, or
- Disturbs 1 or more acres, or
- Increases impervious surface by 0.25 acres or more

3 Any Non-Development Activity Defined by the Municipal Land Use Law that

- Disturbs 0.25 or more acres of forest, or
- Increases impervious surface by 0.25 acres or more

→ A Project Review is Necessary

STATUTORY PLATFORM, PURPOSE AND FUNDING

Through the passage of the Highlands Water Protection and Planning Act of 2004, the New Jersey Legislature finds and declares that the Highlands Region contains exceptional natural resources including critical habitat for fauna and flora (N.J.S.A. 13:20-10). The legislative act further requires the New Jersey Highlands Water Protection and Planning Council (the Highlands Council) prepare and adopt a Regional Master Plan (N.J.S.A. 13:20-8) with the explicit intent to "protect the natural … resources of the Highlands Region, including … critical habitat for fauna and flora" and "preserve to the maximum extent possible any environmentally sensitive lands and other lands needed for … conservation purposes" (NJSA 13:20-10.b(3) & 10(c)2).

The Highlands Regional Master Plan specifies two goals in furtherance of this intent:

- ✓ Goal 1F: Protection and Enhancement of Critical Wildlife Habitats, Significant Natural Areas, and Vernal Pools.
- ✓ Goal 1G: Inclusion of Critical Habitat Area Management Programs in the Master Plans and Development Regulations of Conforming Municipalities and Counties.

The **Critical Habitat Conservation and Management Program** includes:

1) Requirements to avoid Critical Habitat unless allowed by a waiver based on the Highlands Act or for projects that are in conformance with the **Critical Habitat Conservation and Management Plan**;
2) Low Impact Development Best Management Practices for such development designed to, in order of preference:
    a. Avoid disturbance of Critical Habitat,
    b. Minimize impacts, and
    c. Mitigate adverse modification to Critical Habitat;
3) Performance and design standards for direct and indirect impacts from development within or adjacent to Critical Habitat;
4) Mitigation standards for no net loss of Critical Habitat;
5) Methods for achieving restoration of the ecological functions and processes of impaired or disturbed Critical Habitat;
6) Procedures for modifications to vernal pool boundaries;
7) Procedures for modifications to Critical Wildlife Area and Significant Natural Areas;
8) Prevention of habitat fragmentation through open space preservation; and
9) Strategies for securing corporate, non-profit, and community involvement in creating, protecting, and restoring habitat.[5]

The **Critical Habitat Conservation and Management Plan** includes the following sections and methodology:

- ✓ Identification of Critical Habitat: Critical Wildlife Habitat, Significant Natural Areas, and Vernal Pools;

- ✓ Species and their Life Cycle/Habitat Requirements;
- ✓ Conservation and Restoration Strategies and Methodologies – Including Stewardship and Monitoring Recommendations; and
- ✓ Recommendations for Local Development Review and mapping the **Critical Habitat Resource Area**.

Funding to support this work in Kinnelon Borough was provided through the Highlands Plan Conformance process. Municipalities with approved Plan Conformance Petitions are eligible for grant funding to cover the reasonable expenses of planning activities associated with the Conformance process.

CRITICAL HABITAT MANAGEMENT PROGRAM: GOALS, POLICIES, AND OBJECTIVES

The Highlands Regional Master Plan specifies two goals for the protection of Critical Habitat:

- ✓ Goal 1F: Protection and Enhancement of Critical Wildlife Habitats, Significant Natural Areas, and Vernal Pools.
- ✓ Goal 1G: Inclusion of Critical Habitat Area Management Programs in the Master Plans and Development Regulations of Conforming Municipalities and Counties.

The **Critical Habitat Management Program** is comprised of two components:

- ✓ Critical Habitat Conservation and Management Plan – identifies Critical Habitat, Species, Mitigation/Conservation Measures, and Management (Monitoring) Recommendations; and
- ✓ Critical Habitat Resource Area – includes a description of the overlay mapping identifying Critical Habitat within the municipality, guidance for Highlands Plan Conformance/Review, guidance for municipal review of an applicant whose project falls within a Critical Habitat, and monitoring recommendations/protocol.

The policies and objectives for the Critical Habitat Goals are included below from the RMP.[6]

Goal 1F: Protection and Enhancement of Critical Wildlife Habitats, Significant Natural Areas, and Vernal Pools

Policy 1F1: **Critical Habitat** shall be:

- ✓ Critical Wildlife Habitat, defined as those areas within the NJDEP's Landscape Project[b] that are Landscape Rank 3 through 5 and Landscape Rank 2 with Highlands Conservation Rank of Critically Significant or Significant.
    - Landscape Rank 5 – Habitat supporting a federally listed threatened or endangered species;
    - Landscape Rank 4 – Habitat supporting a species designated as State Endangered;
    - Landscape Rank 3 – Habitat supporting a species designated as State Threatened;
    - Landscape Rank 2 – Habitat supporting a species designated as Special Concern. The Highlands Conservation Rank index for each species occurrence based upon how critical the Highlands Region is to the continued existence of the species within New Jersey. Following are the Highlands Conservation Ranks that were used:
        - Critically Significant (Rank 3) – If habitats in the Highlands Region were lost, that species would not exist in the State; and

[b] As of January 2020, the NJDEP Landscape Project was updated in 2017 (Version 3.3).

- Significant (Rank 2) – Highlands Region habitats play a significant role for that species' existence in the State.

- ✓ Significant Natural Areas, defined as the 95 NJDEP Natural Heritage Priority Sites, including habitat for documented threatened and endangered plant species, and lands that include unique or regionally significant ecological communities and other significant natural sites or features; and
- ✓ Vernal pools, defined as NJDEP-certified vernal pools and buffer.[c]

Policy 1F2: To prohibit through Plan Conformance, local development review, and Highlands Project Review the direct impact of new human development or expansion or increased intensity of existing development within Critical Habitat.

Policy 1F3: To assign land within Critical Habitat a high priority for fee simple and/or easement acquisition with periodic monitoring of easement restrictions protecting Critical Habitat, species, and ecological communities from any changes in land use or management practices that would impair these resources.

Policy 1F4: To promote the restoration and enhancement of impaired lands in Critical Habitat.

Policy 1F5: To establish a **Habitat Conservation and Management Program**, including minimum performance standards and criteria for the protection, enhancement, and restoration of lands within Critical Habitat.

Objective 1F5a: Implement the Habitat Conservation and Management Program through a Critical Habitat Conservation and Management Plan to include performance standards to be required through local development review and Highlands Project Review.

Objective 1F5b: Establish performance standards such that all development shall employ Low Impact Development Best Management Practices to, in this order:

1) Avoid the disturbance of Critical Habitat;
2) Minimize impacts to Critical Habitat; and
3) Mitigate all adverse modification to Critical Habitat so that there is no net loss of habitat value. Habitat value is determined by quantity (e.g., acreage), quality (e.g., core forest vs. edge forest), type (e.g., scrub-shrub), and function (e.g., winter hibernacula for timber rattlesnakes). The mitigation requirement of no net loss of habitat value shall ensure that all four elements are accounted for and included in the mitigation design. Mitigation must meet the habitat and life-cycle requirements of the specific impacted species.

Objective 1F5c: Establish performance standards that include a requirement and criteria for mitigation of disturbed Critical Habitat. Mitigation shall be required for all adverse modification to Critical Habitat so that there is no net loss of habitat value based on the criteria in Objectives 1F5a and 1F5b.

[c] For the CHCMP the buffer used is 300 meters (versus 1,000 feet as noted in the RMP) for consistency with NJDEP guidelines for vernal pool buffers.

Objective 1F5d: Establish performance standards for the enhancement or restoration of historically disturbed Critical Habitat.

Objective 1F5e: The Critical Habitat Conservation and Management Plan shall include a GIS or map-series **Critical Habitat Overlay District** for inclusion in municipal master plans to identify Critical Habitat that highlights:

- ✓ Habitat in need of protection from fragmentation and other anthropogenic impacts;
- ✓ Habitat critical to maintaining wildlife and plant populations; and
- ✓ Habitat that serves other essential ecosystem functions, including, but not limited to, carbon sequestration and ground water recharge.

Objective 1F5f: The Critical Habitat Conservation and Management Plan shall include guidelines for a municipal habitat stewardship program, including, but not limited to prevention of habitat fragmentation through open space preservation and corporate, non-profit, and community involvement in creating, protecting, and restoring habitat.

Policy 1F6: To require that applications for any local development review and Highlands Project Review for Critical Habitat be subject to minimum standards and criteria outlined in the Habitat Conservation and Management Plan.

Objective 1F6a: Prohibit direct impacts from new development or expansion or increased intensity of existing development that will jeopardize the continued existence of, or result in the likelihood of the destruction or adverse modification of Critical Habitat, except as permitted through the issuance of a waiver under Policy 7G1 or 7G2.[d]

Objective 1F6b: Prohibit indirect impacts from activity that is off-site, adjacent to, or within Critical Habitat that will jeopardize the continued existence of, or result in the likelihood of the destruction or adverse modification of Critical Habitat, except as permitted through the issuance of a waiver under Policy 7G1 or 7G2.

Objective 1F6c: Waiver applications under Policy 7G2 for local development in a municipality with a Council-approved Critical Habitat Conservation and Management Plan shall be subject to the minimum standards and criteria for waiver provisions as set forth in the plan, to the maximum extent practicable.

Objective 1F6d: Waiver applications under Policy 7G2 for development in a municipality without a Council-approved Critical Habitat Conservation and Management Plan shall be subject to the Low Impact Development Best Management Practices required in Objective 1F5b.

Objective 1F6e: A vernal pool protection buffer may be reduced only if an applicant can demonstrate, to the satisfaction of the Highlands Council in coordination with the

[d] Policy 7G1 and 7G2 are waiver policies for project review, they are included in the **Glossary** following this report.

NJDEP's Endangered and Nongame Species Program, that the reduction is the minimum feasible and that:

- ✓ In an undisturbed wetland, documented and field-determined vernal pool-breeding wildlife require a smaller protective buffer, as documented in scientific literature; or
- ✓ Existing land uses present a significant, insurmountable and permanent barrier to the migration or viability of vernal pool-breeding wildlife that is infeasible to mitigate.

Requirements for demonstrating the above criteria shall be included in the Critical Habitat Conservation and Management Plan.

Objective 1F6f: A Critical Wildlife Habitat area or Significant Natural Area delineation may be modified if an applicant can demonstrate, to the satisfaction of the Highlands Council in coordination with the NJDEP's Endangered and Nongame Species Program or Natural Heritage Program, that:

- ✓ The nature of the site is such that it does not provide habitat for species of concern;
- ✓ The species of concern are not present on the site during any critical part of their life cycle, do not depend upon the site for food, shelter or breeding, and the habitat on the site is either unsuitable or not critical to species' recovery in the Highlands Region; or
- ✓ Existing land uses present a human, natural, or development barrier to the use of the site by species of concern.

Requirements for demonstrating the above criteria shall be included in the Critical Habitat Conservation and Management Plan.

Policy 1F7: To require through local development review and Highlands Project Review that projects qualifying as major Highlands Developments, affecting or potentially affecting Critical Habitat in the Preservation Area, comply with the NJDEP Preservation Area Rules at N.J.A.C. 7:38-3.11 and with the minimum standards and criteria outlined in the Critical Habitat Conservation and Management Plan. All projects in the Preservation Area that are not major Highlands Developments shall comply with Policies 1F1 through 1F6.

Policy 1F8: To establish standards and procedures, in coordination with the NJDEP's Endangered and Nongame Species Program or Natural Heritage Program, for the identification of lands where it is necessary that Critical Wildlife Habitat, Significant Natural Areas, or vernal pool buffers be expanded in order to protect an individual species or ecological community in the event that it is determined that a larger area is required to protect the functional integrity of the habitat.

Policy 1F9: To establish standards and criteria for the identification of Critical Habitat features in coordination with the NJDEP's Endangered and Nongame Species Program or Natural Heritage Program.

Goal 1G: Inclusion of Critical Habitat Area Management Programs in the Master Plans and Development Regulations of Conforming Municipalities and Counties

Policy 1G1: To require that conforming municipalities and counties identify Critical Habitat and management programs in their master plans and development regulations.

Policy 1G2: To require that conforming municipalities and counties include approved Habitat Conservation and Management Plans in master plans and development regulations.

CRITICAL HABITAT CONSERVATION AND MANAGEMENT PLAN

Identification of Critical Habitat

Critical Wildlife Habitat

Much of Kinnelon Borough provides habitat that is suitable for threatened or endangered species. The NJDEP Landscape Project[7] ranks patches of habitat using a numeric system, for the purpose of identifying habitat which may be suitable for threatened and endangered species. Habitat identified as Ranks 3 through 5 are considered environmentally significant by the NJDEP:

- ✓ **Rank 5**: Species-specific patches containing one or more occurrences of wildlife listed as endangered and threatened pursuant to the Federal Endangered Species Act of 1973.
- ✓ **Rank 4**: Species-specific patches with one or more occurrences of State endangered species.
- ✓ **Rank 3**: Species-specific patches containing one or more occurrences of State threatened species.
- ✓ **Rank 2**: Species-specific patches containing one or more occurrences of species considered to be species of special concern (this rank represents “rare species” of wildlife as defined in the Highlands Water Protection and Planning Act rules).
- ✓ **Rank 1**: Species-specific patches that meet habitat-specific suitability requirements such as minimum size criteria for endangered, threatened or priority wildlife species, but that do not intersect with any confirmed occurrences of such species.
- ✓ **Rank 0**: Species-specific patches that do not contain any species occurrences and do not meet any habitat-specific suitability requirements.

According to the NJDEP Landscape Project Kinnelon contains habitat patches of all ranks. The majority of Kinnelon (45%) is identified as Rank 5, federal endangered species habitat, covering a majority of the western half of the Borough. Rank 4 (31% of the Borough) is identified as habitat for state listed endangered species in the eastern half of the Borough. The Rank 3 patches, state threatened species, are clustered around the Kakeout Reservoir area, making up approximately 4% of Kinnelon. Habitat for species of special concern (Rank 2), make up 17.14% of the Borough, and are located predominantly in the northwestern portion of the Borough. Many of these patches overlap, as an area may be suitable to support species of several ranks.

Critical Wildlife Habitat is defined as those areas within the NJDEP's Landscape Project that are Landscape Rank 3 through 5 and Landscape Rank 2 with Highlands Conservation Rank of Critically Significant or Significant. The Highlands Conservation Rank index for each species occurrence is based upon how critical the Highlands Region is to the continued existence of the species within New Jersey:

- ✓ Critically Significant (Rank 3) – If habitats in the Highlands Region were lost, that species would not exist in the State.
- ✓ Significant (Rank 2) – Highlands Region habitats play a significant role for that species' existence in the State.

Map 1 illustrates threatened and endangered species habitat for Kinnelon Borough. **Map 2** is a map of the Critical Wildlife Habitat in the municipality.

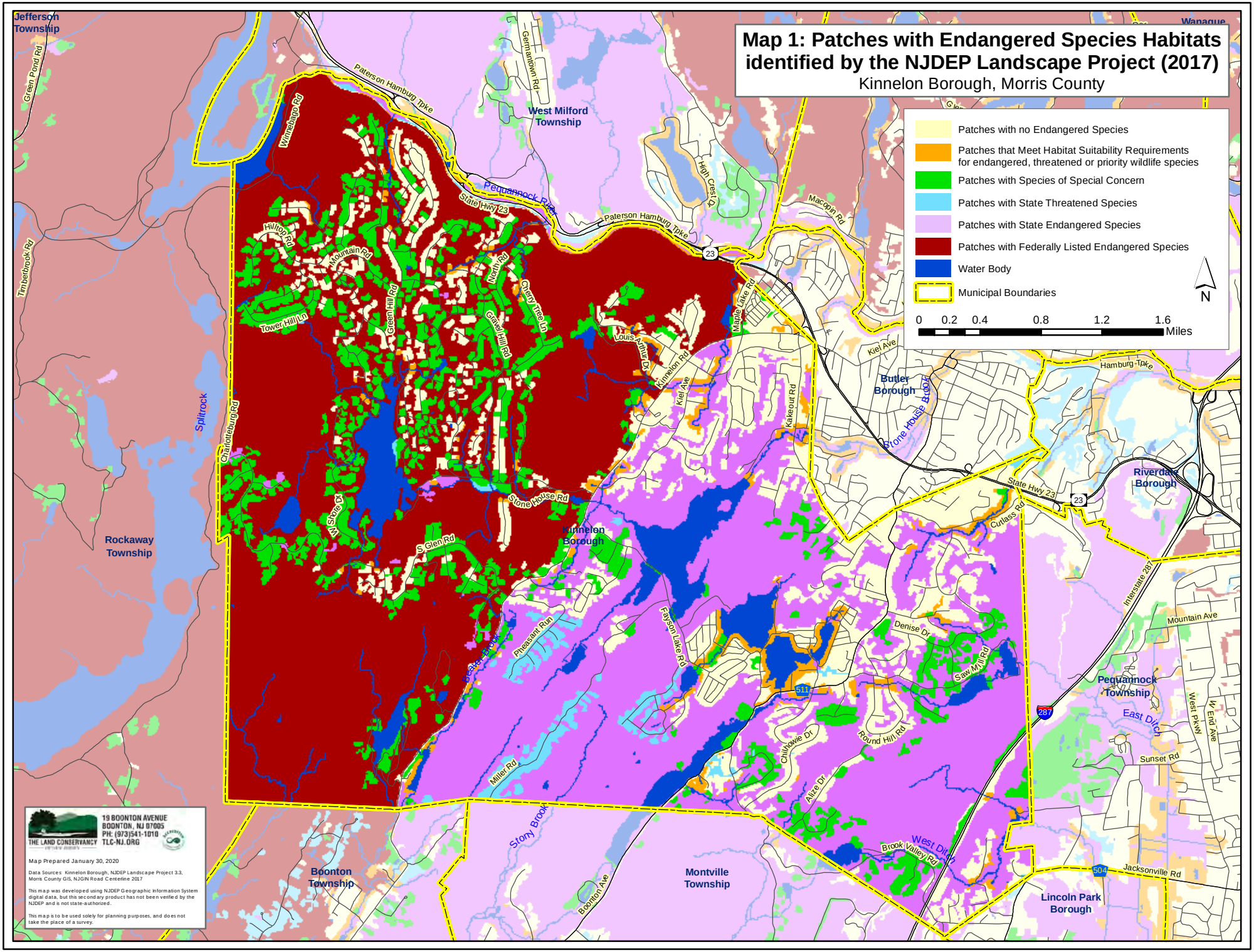
Threatened and Endangered Species

Kinnelon is home to 28 state and federal endangered and threatened species. The Indiana Bat and Northern Myotis are federally listed endangered species.

There are six state-listed endangered species that inhabit Kinnelon: Bobcat, Northern Goshawk, Red-shouldered Hawk, Bald Eagle, Golden-winged Warbler, and Timber Rattlesnake.

Kinnelon is also home to three state threatened species: Wood Turtle, Barred Owl, and Red-headed Woodpecker.

A full list of all species is included in **Table 1**.


Map 1: Patches with Endangered Species Habitats identified by the NJDEP Landscape Project (2017)
Kinnelon Borough, Morris County
Patches with no Endangered Species
Patches that Meet Habitat Suitability Requirements for endangered, threatened or priority wildlife species
Patches with Species of Special Concern
Patches with State Threatened Species
Patches with State Endangered Species
Patches with Federally Listed Endangered Species
Water Body
Municipal Boundaries
N
0 0.2 0.4 0.8 1.2 1.6 Miles
Jefferson Township
West Milford Township
Rockaway Township
Kinnelon Borough
Butler Borough
Riverdale Borough
Pequannock Township
Boonton Township
Montville Township
Lincoln Park Borough
Wanaque
Paterson Hamburg Tpke
Pequannock River
State Hwy 23
Hamburg Tpke
Interstate 287
Splitrock
Stone House Brook
Stony Brook
West Ditch
East Ditch
Green Pond Rd
Timberbrook Rd
Winnetago Rd
Germantown Rd
High Crest Dr
Macopin Rd
Hilltop Rd
Mountain Rd
North Rd
Cherry Tree Ln
Tower Hill Ln
Green Hill Rd
Gravel Hill Rd
Louis Arthur Dr
Maple Lake Rd
Kiel Ave
Kinnelon Rd
Kakeout Rd
Charlotteburg Rd
W Shore Dr
S Glen Rd
Stone House Rd
Cutlass Rd
Fayson Lake Rd
Pleasant Run
Denise Dr
Saw Mill Rd
Mountain Ave
Chilawee Dr
Round Hill Rd
Alize Dr
Miller Rd
Brook Valley Rd
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West Pkwy
W End Ave
Jacksonville Rd
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Map Prepared January 30, 2020
Data Sources: Kinnelon Borough, NJDEP Landscape Project 3.3, Morris County GIS, NJGIN Road Centerline 2017
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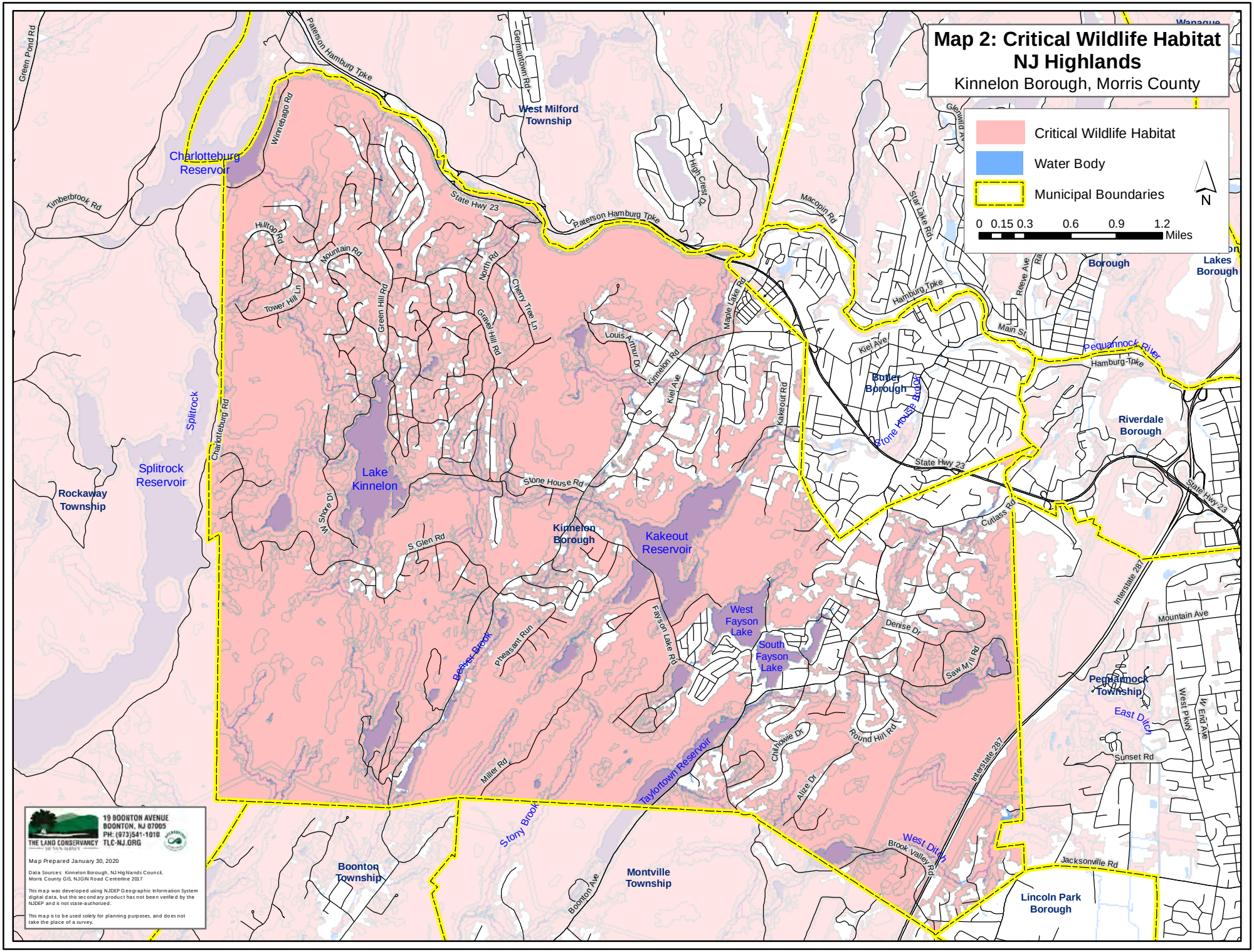
Map 2: Critical Wildlife Habitat
NJ Highlands
Kinnelon Borough, Morris County
Critical Wildlife Habitat
Water Body
Municipal Boundaries
N
0 0.15 0.3 0.6 0.9 1.2
Miles
Charlotteburg Reservoir
West Milford Township
Splitrock Reservoir
Rockaway Township
Lake Kinnelon
Kinnelon Borough
Kakeout Reservoir
Butler Borough
Riverdale Borough
Pequannock Township
Lincoln Park Borough
Montville Township
Boonton Township
West Fayson Lake
South Fayson Lake
Taylortown Reservoir
Pequannock River
Stone House Brook
Beaver Brook
Stony Brook
East Ditch
West Ditch
Paterson Hamburg Tpke
State Hwy 23
Interstate 287
Timberbrook Rd
Green Pond Rd
Winnebago Rd
Germantown Rd
High Crest Dr
Macopin Rd
Star Lake Rd
Maple Lake Rd
Hamburg Tpke
Reeve Ave
Main St
Kiel Ave
Louis Arthur Dr
Kinnelon Rd
Kakeout Rd
Hilltop Rd
Mountain Rd
Tower Hill Ln
Green Hill Rd
North Rd
Cherry Tree Ln
Gravel Hill Rd
Charlotteburg Rd
W Shore Dr
S Glen Rd
Stone House Rd
Cutlass Rd
Fayson Lake Rd
Pheasant Run
Denise Dr
Saw Mill Rd
Mountain Ave
West Pkwy
Ivy End Ave
Sunset Rd
Round Hill Rd
Chinawie Dr
Alize Dr
Miller Rd
Brook Valley Rd
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Table 1. Threatened and Endangered Species in Kinnelon Borough

Species: Common Name	***Species: Scientific Name***	**Taxonomic Class**	**Lay Classification**	**Taxonomic Order**	**NJDEP Rank**	**Highlands Rank**	**Vernal Pool Dependent?**
Bobcat	*Lynx rufus*	Mammalia	Mammals	Carnivora	4	3	
Indiana Bat	*Myotis sodalis*	Mammalia	Mammals	Chiroptera	5	3	
Northern Myotis	*Myotis septentrionalis*	Mammalia	Mammals	Chiroptera	5	2	
Cooper's Hawk	*Accipiter cooperii*	Aves	Raptors	Accipitriformes	2	1	
Northern Goshawk	*Accipiter gentilis*	Aves	Raptors	Accipitriformes	4	3	
Red-shouldered Hawk	*Buteo lineatus*	Aves	Raptors	Accipitriformes	4	3	
Broad-winged Hawk	*Buteo platypterus*	Aves	Raptors	Accipitriformes	2	2	
Bald Eagle	*Haliaeetus leucocephalus*	Aves	Raptors	Accipitriformes	4	1	
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Aves	Songbirds	Cuculiformes	2	2	
Veery	*Catharus fuscescens*	Aves	Songbirds	Passeriformes	2	2	
Black-throated Blue Warbler	*Dendroica caerulescens*	Aves	Songbirds	Passeriformes	2	3	
Black-throated Green Warbler	*Dendroica virens*	Aves	Songbirds	Passeriformes	2	3	
Worm-eating Warbler	*Helmitheros vermivorum*	Aves	Songbirds	Passeriformes	2	3	
Wood Thrush	*Hylocichla mustelina*	Aves	Songbirds	Passeriformes	2	2	
Kentucky Warbler	*Oporornis formosus*	Aves	Songbirds	Passeriformes	2	2	

Species: Common Name	***Species: Scientific Name***	**Taxonomic Class**	**Lay Classification**	**Taxonomic Order**	**NJDEP Rank**	**Highlands Rank**	**Vernal Pool Dependent?**
Golden-winged Warbler	*Vermivora chrysoptera*	Aves	Songbirds	Passeriformes	4	3	
Hooded Warbler	*Wilsonia citrina*	Aves	Songbirds	Passeriformes	2	2	
Great Blue Heron	*Ardea herodias*	Aves	Water Birds	Pelecaniformes	2	1	
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Aves	Arboreal Birds	Piciformes	3	2	
Barred Owl	*Strix varia*	Aves	Raptors	Strigiformes	3	2	
Fowler's Toad	*Anaxyrus fowleri*	Amphibia	Amphibians	Anura	2	1	Facultative
Marbled Salamander	*Ambystoma opacum*	Amphibia	Amphibians	Urodela	2	1	Obligate
Northern Copperhead	*Agkistrodon contortrix mokasen*	Reptilia	Reptiles	Squamata	2	3	
Timber Rattlesnake	*Crotalus horridus*	Reptilia	Reptiles	Squamata	4	3	
Wood Turtle	*Glyptemys insculpta*	Reptilia	Reptiles	Testudines	3	3	Facultative
Eastern Box Turtle	*Terrapene carolina carolina*	Reptilia	Reptiles	Testudines	2	1	Facultative
Harris' Checkerspot	*Chlosyne harrisii*	Insecta	Butterflies	Lepidoptera	2	3	
Tiger Spiketail	*Cordulegaster erronea*	Insecta	Dragonflies	Odonata	2	3	

Significant Natural Areas

The NJDEP Natural Heritage Priority Sites (NHP) mapping was created to identify critically important areas to conserve New Jersey's biological diversity, with particular emphasis on rare plant species and ecological communities. Natural Heritage Priority Sites are based on analysis of information in the New Jersey Natural Heritage Database. However, these sites do not cover all the known habitat for endangered and threatened species in New Jersey. Using the Natural Heritage Database, the Office of Natural Lands Management (ONLM) has identified 343 Natural Heritage Priority Sites, representing some of the best remaining habitat for rare species and rare ecological communities in the state.[8] Of these, there are 95 NHP sites located in the New Jersey Highlands Region.

There are no mapped Significant Natural Areas in Kinnelon for rare plant species (**Map 3**). Neighboring Rockaway Township is home to the Splitrock Reservoir NHP site. The Natural Heritage Program reviews its data periodically to identify priority sites for natural diversity in the State. These areas should be considered top priorities for the preservation of biological diversity in New Jersey.

Vernal Pools

Kinnelon is home to many beautiful vernal wetland habitats, also referred to as vernal pools. These natural wetland depressions fill with water and usually remain ponded until the warmer weather in early summer causes them to dry out. The vernal pools provide habitat for a wide array of amphibians, reptiles, invertebrates, and many species of wetland vegetation, but cannot support a fish population because of the pools' dry period. Certain wildlife species, referred to as "obligate" vernal pool breeders, have evolved with a reliance upon these fish-free breeding sites and cannot successfully reproduce elsewhere. Other wildlife species, referred to as "facultative" vernal pool species, also take advantage of vernal habitats for breeding and/or feeding purposes, but are not limited to performing these functions solely in vernal pools.[9]

The NJDEP defines a vernal habitat in the Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A-1.4) as a wetland that meets the following criteria:

- ✓ The wetland must consist of or contain a confined basin or depression without a permanently flowing outlet;
- ✓ The pool must feature evidence of breeding by at least one obligate or two facultative vernal habitat species (these species are identified in N.J.A.C. 7:7A, Appendix 1);
- ✓ The area must maintain ponded water for at least two continuous months between March and September of a normal rainfall year; and
- ✓ The area must remain free of fish populations throughout the year, or it must dry up at some time during a normal rainfall year.

The NJDEP maps both certified "vernal habitat areas" and "potential vernal habitat areas" using the Landscape Project. The mapping uses a 300-meter buffer to protect the water quality and

terrestrial habitat needs of vernal pool species. The Landscape Project defines its mapping of vernal habitats as follows:

- ✓ *Potential vernal habitat area* – These are areas identified as possibly containing a vernal pool that meets the criteria of a "vernal habitat" pursuant to N.J.A.C. 7:7A-1.4. These sites include sites that have been determined to meet the physical characteristics of a vernal habitat, but for which biological criteria have not yet been measured, as well as sites that have not been checked by NJDEP staff.
- ✓ *Vernal habitat areas* – These are areas that contain pools that have been field-verified by the NJDEP Endangered and Nongame Species Program (ENSP) and have been determined to meet both the physical and biological characteristics of a vernal habitat in accordance with N.J.A.C. 7:7A-1.4.

The obligate and facultative species for vernal pools are included in Appendix 1 of N.J.A.C. 7:7A. Obligate species include those dependent on vernal pools for the completion of their lifecycle, and facultative species are those which may use vernal pool habitat but do not necessarily rely on it. Descriptions of the reptiles and amphibians found in New Jersey, including the obligate and facultative vernal pool species, can be found on the NJDEP Division of Fish and Wildlife website.[10]

In Kinnelon Borough the Landscape Project mapping identifies 14 vernal pools that have been field inspected and confirmed to meet the certification requirement (**Map 4**).

Critical Habitat

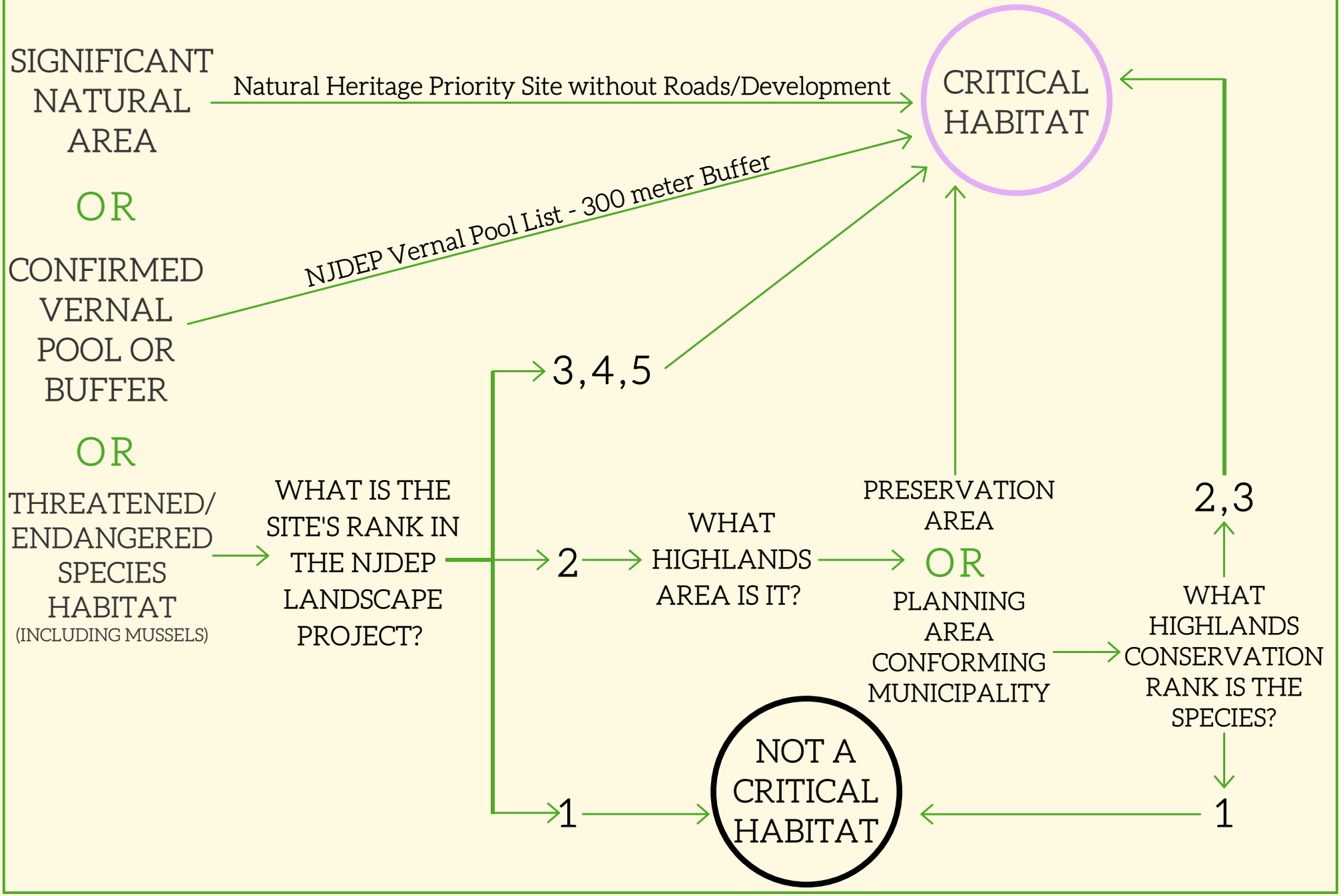
The protection of habitats that are critical to maintain biodiversity includes the habitats for rare, threatened, and endangered plant and animal species. The Highlands Act provides for the protection of the Region's rare communities, and where disturbed, that they be restored in both quality and function. Critical Habitat is comprised of:

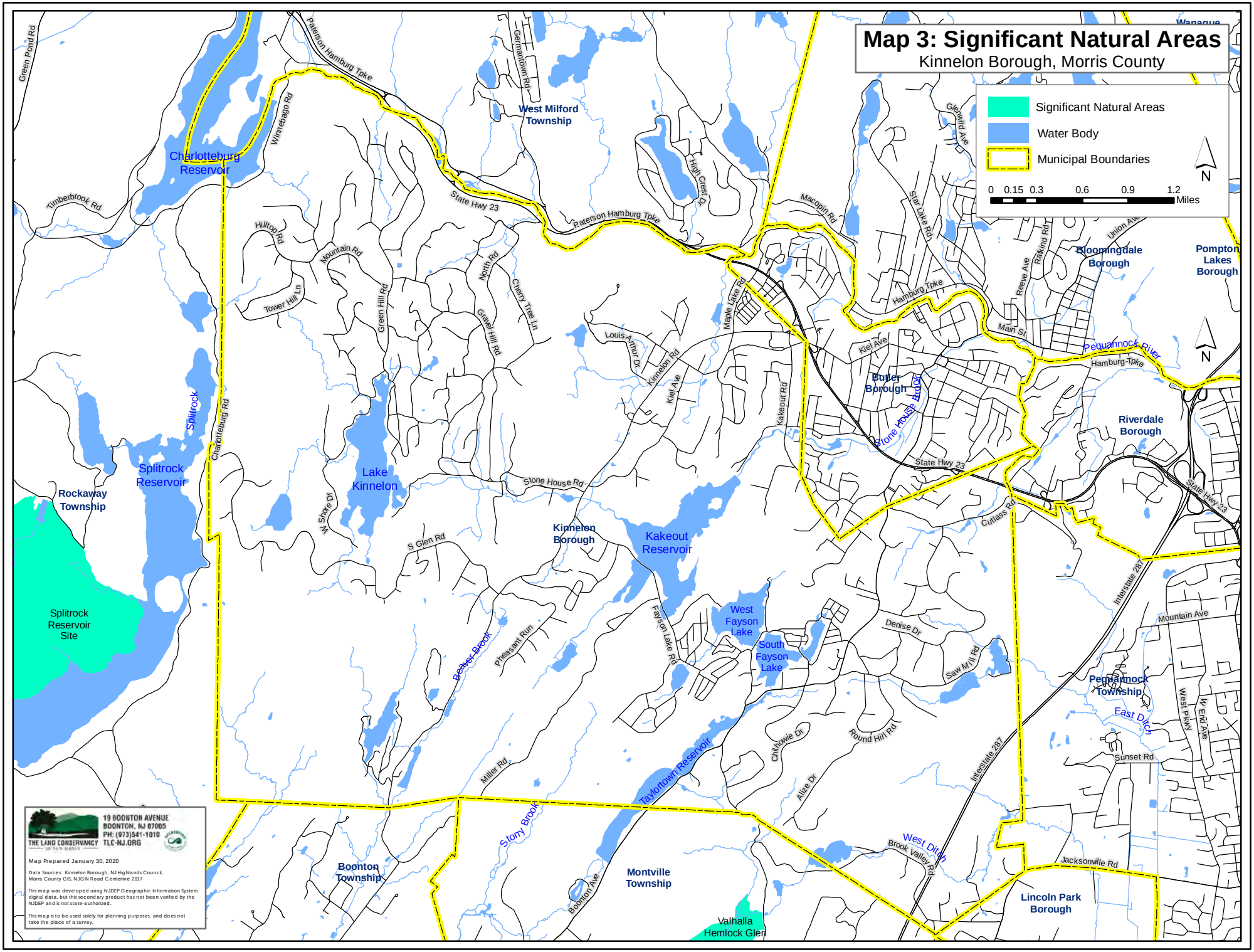
- ✓ Critical Wildlife Habitat – habitat for rare, threatened, and endangered species;
- ✓ Significant Natural Areas – regionally significant ecological communities; and
- ✓ Vernal Pools – certified by the NJDEP, confined ephemeral wet depressions that support distinctive species that are specially adapted to periodic extremes in water level.

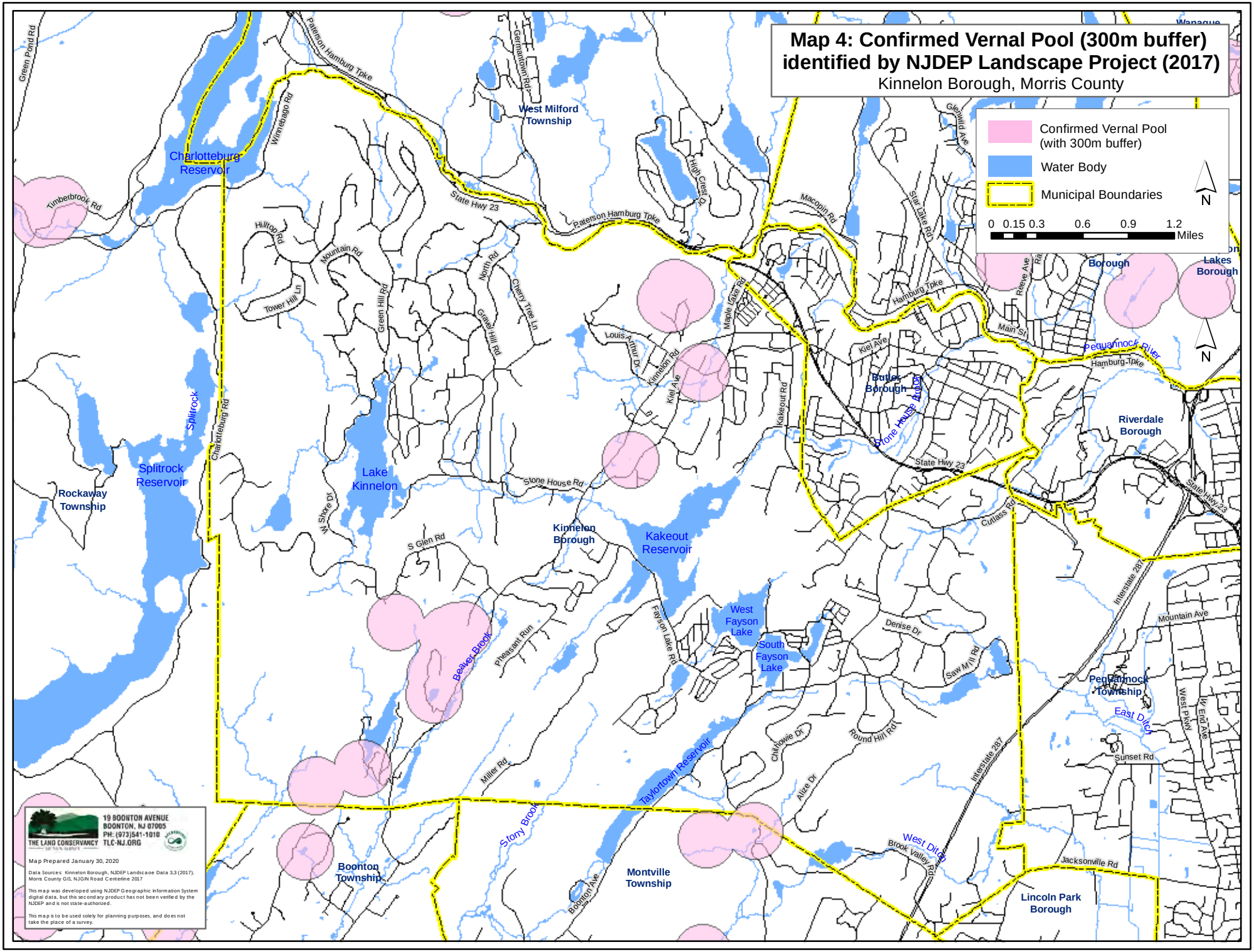
Due to the extent of Critical Wildlife Habitat in the Borough, nearly all of Kinnelon is identified as having Critical Habitat (**Map 5**).

Figure 2 is a fact sheet explaining what Critical Habitat is and how it can be mapped.

Is it a Critical Habitat?




Map 3: Significant Natural Areas
Kinnelon Borough, Morris County
Significant Natural Areas
Water Body
Municipal Boundaries
0 0.15 0.3 0.6 0.9 1.2
Miles
N
Charlotteburg Reservoir
West Milford Township
Splitrock Reservoir
Rockaway Township
Splitrock Reservoir Site
Lake Kinnelon
Kinnelon Borough
Kakeout Reservoir
West Fayson Lake
South Fayson Lake
Bloomingdale Borough
Pompton Lakes Borough
Butler Borough
Riverdale Borough
Pequannock Township
Boonton Township
Montville Township
Lincoln Park Borough
Valhalla Hemlock Glen
Pequannock River
Stone House Brook
Beaver Brook
Pheasant Run
Stony Brook
West Ditch
East Ditch
Taylortown Reservoir
Green Pond Rd
Timberbrook Rd
Paterson Hamburg Tpke
Winnebago Rd
Germantown Rd
State Hwy 23
High Crest Dr
Macopin Rd
Glenwild Ave
Star Lake Rd
Union Ave
Rakind Rd
Reeve Ave
Hamburg Tpke
Main St
Hilltop Rd
Mountain Rd
Tower Hill Ln
Green Hill Rd
North Rd
Cherry Tree Ln
Gravel Hill Rd
Maple Lake Rd
Louis Arthur Dr
Kinnelon Rd
Kiel Ave
Kakeout Rd
Splitrock
Charlotteburg Rd
W Shore Dr
S Glen Rd
Stone House Rd
Cutlass Rd
Interstate 287
Mountain Ave
Denise Dr
Saw Mill Rd
Fayson Lake Rd
Chinawie Dr
Round Hill Rd
Alize Dr
Miller Rd
Sunset Rd
West Pkwy
Ivy End Ave
Brook Valley Rd
Jacksonville Rd
Boonton Ave
19 BOONTON AVENUE
BOONTON, NJ 07005
PH: (973)541-1010
TLC-NJ.ORG
THE LAND CONSERVANCY
Map Prepared January 30, 2020
Data Sources: Kinnelon Borough, NJ Highlands Council, Morris County GIS, NJGIN Road Centerline 2017
This map was developed using NJDEP Geographic Information System digital data, but this secondary product has not been verified by the NJDEP and is not state-authorized.
This map is to be used solely for planning purposes, and does not take the place of a survey.


Map 4: Confirmed Vernal Pool (300m buffer) identified by NJDEP Landscape Project (2017)
Kinnelon Borough, Morris County
Confirmed Vernal Pool (with 300m buffer)
Water Body
Municipal Boundaries
N
0 0.15 0.3 0.6 0.9 1.2
Miles
West Milford Township
Charlotteburg Reservoir
Splitrock Reservoir
Rockaway Township
Lake Kinnelon
Kinnelon Borough
Kakeout Reservoir
West Fayson Lake
South Fayson Lake
Taylortown Reservoir
Boonton Township
Montville Township
Butler Borough
Riverdale Borough
Pequannock Township
Lincoln Park Borough
Lakes Borough
Pequannock River
Stone House Brook
Beaver Brook
Stony Brook
West Ditch
East Ditch
Paterson Hamburg Tpke
State Hwy 23
Interstate 287
Green Pond Rd
Timberbrook Rd
Winnebago Rd
Germantown Rd
High Crest Ln
Macopin Rd
Star Lake Rd
Glenwild Ave
Hilltop Rd
Tower Hill Ln
Mountain Rd
Green Hill Rd
North Rd
Cherry Tree Ln
Gravel Hill Rd
Maple Lake Rd
Louis Arthur Dr
Kinnelon Rd
Kiel Ave
Kakeout Rd
Hamburg Tpke
Reeve Ave
Main St
Charlotteburg Rd
Splitrock
W Shore Dr
S Glen Rd
Stone House Rd
Cutlass Rd
Fayson Lake Rd
Pheasant Run
Denise Dr
Saw Mill Rd
Mountain Ave
West Pkwy
Ivy End Ave
Sunset Rd
Round Hill Rd
Chilowie Dr
Alize Dr
Miller Rd
Brook Valley Rd
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Map Prepared January 30, 2020
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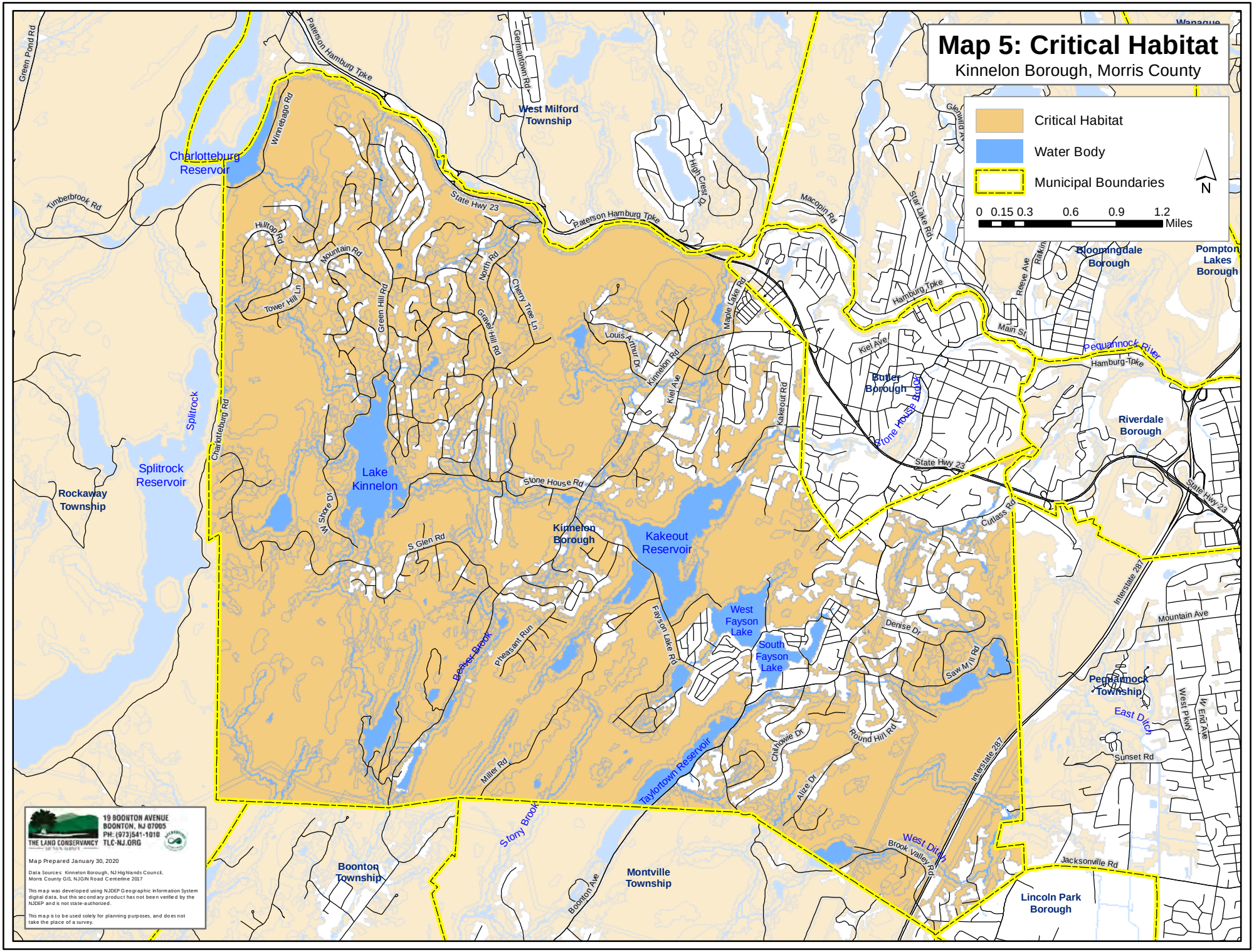
Map 5: Critical Habitat
Kinnelon Borough, Morris County
Critical Habitat
Water Body
Municipal Boundaries
N
0 0.15 0.3 0.6 0.9 1.2
Miles
Charlotteburg Reservoir
West Milford Township
Bloomingdale Borough
Pompton Lakes Borough
Butler Borough
Riverdale Borough
Pequannock Township
Rockaway Township
Splitrock Reservoir
Lake Kinnelon
Kinnelon Borough
Kakeout Reservoir
West Fayson Lake
South Fayson Lake
Taylortown Reservoir
Boonton Township
Montville Township
Lincoln Park Borough
Pequannock River
Stone House Brook
Beaver Brook
Stony Brook
West Ditch
East Ditch
Green Pond Rd
Paterson Hamburg Tpke
Winnebago Rd
Timberbrook Rd
State Hwy 23
Hilltop Rd
Mountain Rd
Tower Hill Ln
Green Hill Rd
North Rd
Gravel Hill Rd
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Louis Arthur Dr
Kinnelon Rd
Kiel Ave
Maple Lake Rd
Kakeout Rd
Macopin Rd
Star Lake Rd
Glenwild Ave
Hamburg Tpke
Reeve Ave
Rankin
Main St
Charlotteburg Rd
W Shore Dr
S Glen Rd
Stone House Rd
Cutlass Rd
Interstate 287
Mountain Ave
Denise Dr
Saw Mill Rd
Fayson Lake Rd
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Chinkowie Dr
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Species: Life Cycle Requirements and Conservation Strategies

The protection of habitats that are critical to maintain biodiversity includes the habitats for rare, threatened, and endangered plant and animal species. The Highlands Act provides for the protection of the Region's rare communities and, where disturbed, that they be restored in both quality and function. The identification of the individual species' life cycle requirements, including habitat needs for hibernation, foraging, nesting, and breeding, offers the basis for best management practices to minimize and mitigate impacts to these rare ecological communities.

Life Cycle Requirements

Kinnelon Borough supports habitat for 28 rare, threatened, and endangered species. To determine the life cycle requirements of these species a series of steps was undertaken:

1. Determination of which habitat land use type (from the NJDEP Land Use/Land Cover mapping) is the individual species found;
2. At what point in the life cycle of the species was it observed;
3. Identification of land cover types essential to the health and viability of the species;
4. Grouping of rare, threatened and endangered species by taxon (mammals, birds, reptiles/amphibians and insects); and
5. Development of tables by species type, habitat type, and basic life functions (nesting, foraging, breeding).

There are 28 rare, threatened, and endangered species recorded in Kinnelon by the NJDEP Endangered and Nongame Species Program (ENSP) through the Landscape Project (**Table 1**). These species are observed in a variety of locales. The NJDEP maps these locations using digital orthophotography and categorizes them using a modified Anderson Land Use/Land Cover (LU/LC) Classification system in the land cover mapping. In the Highlands Region, observations of rare, threatened, and endangered species are seen in 58 different LU/LC types. The descriptions for each of these is included in the **Glossary** which accompanies this report.

As detailed in the **Technical Report** which accompanies this plan, the NJDEP Land Use/Land Cover (LU/LC) types were regrouped into generalized categories based upon their functional habitat geography (**Table 2**). To identify what Critical Habitat is in the Highlands Region, this coding was simplified to group similar types of observations for the different wildlife species. Overall, there are seven types of observations for the Highlands Region: breeding (Br), foraging (F), hibernaculum (H), nesting colony (NCo), occupied habitat (OH), sighting (S), and wintering (W). (**Figure 3**) The **Glossary** provides details on the terminology used for habitat observation type.

Table 3 is a detailed summary of the habitat observations for Critical Habitat species in the Borough of Kinnelon for each of the major land use cover types.

Table 2. Land Use/Land Cover Classifications of Critical Habitat in the NJ Highlands Region

LU	LABEL	TYPE	LAND COVER SUB-TYPE	FINAL TYPE
1120	RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY	URBAN	HOUSING	URBAN
1130	RESIDENTIAL, SINGLE UNIT, LOW DENSITY	URBAN		
1140	RESIDENTIAL, RURAL, SINGLE UNIT	URBAN		
1700	OTHER URBAN OR BUILT-UP LAND	URBAN		
1400	TRANSPORTATION/COMMUNICATION/UTILITIES	URBAN	SHOULDERS, UPLAND / WETLAND ROWs	
1461	WETLAND RIGHTS-OF-WAY	WETLANDS		
1462	UPLAND RIGHTS-OF-WAY DEVELOPED	URBAN		
1463	UPLAND RIGHTS-OF-WAY UNDEVELOPED	URBAN		
1499	STORMWATER BASIN	URBAN	ARTIFICIAL GREEN SPACE	
1710	CEMETERY	URBAN		
1711	CEMETERY ON WETLAND	WETLANDS		
1750	MANAGED WETLAND IN MAINTAINED LAWN	WETLANDS		
1800	RECREATIONAL LAND	URBAN		
1850	MANAGED WETLAND IN BUILT-UP MAINTAINED REC.	WETLANDS		
1211	MILITARY INSTALLATIONS	URBAN	MILITARY AND AIRPORT	
1440	AIRPORT FACILITIES	URBAN		
1419	BRIDGE OVER WATER	WATER	SURFACE WATER	
7100	BEACHES	BARREN	SAND OR ROCK SUBSTRATE	BARREN LAND
7200	BARE EXPOSED ROCK, ROCKSLIDES, ETC	BARREN		
7300	EXTRACTIVE MINING	BARREN		
7400	ALTERED LANDS	BARREN	ALTERED AND TRANSITIONAL AREAS	
7430	DISTURBED WETLANDS (MODIFIED)	WETLANDS		
7500	TRANSITIONAL AREAS	BARREN		
2140	AGRICULTURAL WETLANDS (MODIFIED)	WETLANDS	EMERGENT & AGRICULTURAL WETLANDS	AGRICULTURE
2150	FORMER AGRICULTURAL WETLAND (SHRUBBY)	WETLANDS		
2100	CROPLAND AND PASTURELAND	AGRICULTURE	CROPLANDS, PASTURES, HORTICULTURE, OTHER AGRICULTURE	
2200	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL	AGRICULTURE		
2300	CONFINED FEEDING OPERATIONS	AGRICULTURE		
2400	OTHER AGRICULTURE	AGRICULTURE		

LU	LABEL	TYPE	LAND COVER SUB-TYPE	FINAL TYPE
4110	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	FOREST	DECIDUOUS	FOREST
4120	DECIDUOUS FOREST (>50% CROWN CLOSURE)	FOREST		
4210	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	FOREST	CONIFEROUS	
4220	CONIFEROUS FOREST (>50% CROWN CLOSURE)	FOREST		
4230	PLANTATION	FOREST		
4311	MIXED (>50% CONIFEROUS, 10-50% CLOSURE)	FOREST	MIXED FOREST	
4312	MIXED (>50% CONIFEROUS >50% CROWN CLOSURE)	FOREST		
4321	MIXED (>50% DECIDUOUS 10-50% CROWN CLOSURE)	FOREST		
4322	MIXED (>50% DECIDUOUS >50% CROWN CLOSURE)	FOREST		
4410	OLD FIELD (< 25% BRUSH COVERED)	FOREST	BRUSHLAND AND SHRUBLAND	
4411	PHRAGMITES DOMINATE OLD FIELD	FOREST		
4420	DECIDUOUS BRUSH/SHRUBLAND	FOREST		
4430	CONIFEROUS BRUSH/SHRUBLAND	FOREST		
4440	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUB	FOREST		
5100	STREAMS AND CANALS	WATER	SURFACE WATER	WATER
5200	NATURAL LAKES	WATER		
5300	ARTIFICIAL LAKES	WATER		
6210	DECIDUOUS WOODED WETLANDS	WETLANDS	FORESTED WETLANDS	WETLANDS
6220	CONIFEROUS WOODED WETLANDS	WETLANDS		
6221	ATLANTIC WHITE CEDAR WETLANDS	WETLANDS		
6251	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	WETLANDS		
6252	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	WETLANDS		
6231	DECIDUOUS SCRUB/SHRUB WETLANDS	WETLANDS	SCRUB/SHRUB WETLANDS	
6232	CONIFEROUS SCRUB/SHRUB WETLANDS	WETLANDS		
6233	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS)	WETLANDS		
6234	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS)	WETLANDS		
6120	FRESHWATER TIDAL MARSHES	WETLANDS	EMERGENT & AGRICULTURAL WETLANDS	
6240	HERBACEOUS WETLANDS	WETLANDS		
6241	PHRAGMITES DOMINATE INTERIOR WETLANDS	WETLANDS		

HABITAT OBSERVATION	ABBREVIATION	FINAL CODING
Nest	Br	Breeding
Roost Site	Br	
Territorial Display	Br	
Foraging	F	Foraging
Hibernaculum	H	Hibernaculum
Nesting Colony	NCo	Nesting Colony
Occupied Habitat	OH	Occupied Habitat
Active Season Sighting	S	Sighting
Breeding Sighting	S	
Capture Location	S	
Casual Flyby	S	
Live Individual Sighting	S	
Non-breeding Sighting	S	
On Road	S	
Physical evidence	S	
Telemetry: Home Range	S	
Wintering	W	Wintering

Figure 3. Habitat Observations – Simplified Coding

Table 3. Habitat Observations for Critical Habitat Species in Kinnelon Borough

SPECIES		LAND USE/LAND COVER					
Common Name	**Taxonomic Class**	**Urban**	**Barren Land**	**Agriculture**	**Forest**	**Water**	**Wetlands**
Fowler's Toad	Amphibia	OH	OH	OH	OH	OH	OH
Marbled Salamander	Amphibia	OH			OH		OH
Bald Eagle	Aves		Br W	Br	F Br W	F Br W	F Br W
Barred Owl	Aves	S			S		S
Black-billed Cuckoo	Aves	S		S	S		S

SPECIES		LAND USE/LAND COVER					
Common Name	**Taxonomic Class**	**Urban**	**Barren Land**	**Agriculture**	**Forest**	**Water**	**Wetlands**
Black-throated Blue Warbler	Aves	S			S		S
Black-throated Green Warbler	Aves	S			S		S
Broad-winged Hawk	Aves				S		S
Cooper's Hawk	Aves				S Br		S Br
Golden-winged Warbler	Aves				S		S
Great Blue Heron	Aves				Nco	F	F NCo
Hooded Warbler	Aves	S			S		S
Kentucky Warbler	Aves	S			S		S
Northern Goshawk	Aves	S BR			S Br		S Br
Red-headed Woodpecker	Aves	S			S		
Red-shouldered Hawk	Aves				S Br		S Br
Veery	Aves	S			S		S
Wood Thrush	Aves	S			S		S
Worm-eating Warbler	Aves	S			S		S
Harris' Checkerspot	Insecta	S	S	S	S		S
Tiger Spiketail	Insecta	Br			Br	Br	Br
Bobcat	Mammalia	S		S	S		S
Indiana Bat	Mammalia	S H		S H	S H	S H	S H

SPECIES		LAND USE/LAND COVER					
Common Name	**Taxonomic Class**	**Urban**	**Barren Land**	**Agriculture**	**Forest**	**Water**	**Wetlands**
Northern Myotis	Mammalia	S H Br			S H Br	S H Br	S H Br
Eastern Box Turtle	Reptilia	OH	OH	OH	OH		OH
Northern Copperhead	Reptilia	OH	OH		OH		OH
Timber Rattlesnake	Reptilia	OH			OH		OH
Wood Turtle	Reptilia	OH	OH	OH	OH		OH

Conservation Strategies

As noted in the Highlands Regional Master Plan, Critical Habitat is to be protected and, where disturbed, restored in both quality and function. The **Conservation Strategies** (included as an attachment to this report) include Low Impact Development Best Management Practices to:

- ✓ Avoid the disturbance of Critical Habitat;
- ✓ Minimize impacts to Critical Habitat; and
- ✓ Mitigate all adverse modification to Critical Habitat so that there is no net loss of habitat value.

In addition, these strategies provide:

- ✓ Restoration methodologies and strategies for both quality and function; and
- ✓ Best Management Practices for Low Impact Development to avoid, minimize, and mitigate impacts of development for Critical Habitat.

These are included in the **Conservation Strategies** section of this report.

Guidelines for a Municipal Stewardship Program

A municipal stewardship program for the protection of Critical Habitat includes the following:

- ✓ Prevention of habitat fragmentation through open space preservation; and
- ✓ Partnerships for creating, protecting, and restoring habitat.

Open Space Preservation

Open space preservation helps communities protect their environment, improve quality of life, preserve critical natural and cultural resources, and enhance the economic viability of the local community. Well-managed open space programs provide places for recreation, preserve important environmental and ecological functions, and offer opportunities for healthy living for residents. Lack of planning can lead to fragmentation of conserved lands. Small fragments of conserved land have less ecological value as wildlife corridors, are less accessible to community members, and have reduced value in directing growth to existing areas than larger parcels connected by corridors.[11] The implementation of the CHCMP will help communities identify critical areas for preservation and the permanent protection of those resources will ensure that habitat remains secure for the rare, threatened and endangered species which rely upon it.

The Borough of Kinnelon updated its Open Space and Recreation Plan in 2012 and offered the following vision for open space in their community:[12]

- ✓ Preserve ground and surface water recharge areas for the protection of both local and regional sources of drinking water;
- ✓ Preserve the rural character and historic beauty of the Borough;
- ✓ Protect scenic vistas and ridgelines in the Borough;
- ✓ Conserve forested land for critical wildlife habitat and for continued health of watershed land;
- ✓ Promote and create a system of interconnected trails and greenways that will link local neighborhoods with parks and natural areas, including the identification and retention of local unmarked trails in natural areas; and
- ✓ Expand recreational areas and facilities, including the development of a community center.

Benefits of Open Space Preservation

Preserved land performs valuable economic services

> "Forested open space and wetlands are particularly valuable. Trees control erosion, help clean the air of pollutants, mitigate global warming by absorbing carbon dioxide and other greenhouse gases, and help shelter and cool homes…Wetlands serve as wildlife habitat, absorb storm and flood water, reduce pollutant and sediment loads in watershed runoff. These are all services society would have to pay for otherwise. Natural open space provides these services for free; in its absence, society must pay for them."
>
> *The Economic Benefits of Parks and Recreation, Trust for Public Land*

"Protected open space in the five-county region contributes an estimated $133 million in annual cost savings and economic benefits through the provision of six ecosystem services: water supply, water quality, flood mitigation, wildlife habitat, air pollution removal, and the sequestration of carbon in yearly growth of trees on protected open space. This sum represents costs avoided by not having to artificially replace vital ecosystem services currently provided by protected open space within the five-county region."

The Economic Value of Protected Open Space in Southeastern Pennsylvania, Delaware Valley Regional Planning Commission

Preserved land increases adjacent property value

"Homeowners near parks and protected areas are repeatedly seen to have property values more than 20% higher than similar properties elsewhere. "

The Economics Associated with Outdoor Recreation, Natural Resources Conservation and Historic Preservation in the United States, National Fish and Wildlife Foundation

"By increasing the value of homes within a one-mile radius, protected open space also increases the amount of property taxes and transfer taxes that local governments and school districts receive."

The Economic Value of Protected Open Space in Southeastern Pennsylvania, Delaware Valley Regional Planning Commission

Preserved lands "have been shown to bolster property values and make adjacent properties easier to sell."

Economic Benefits of Trails and Greenways, Rails to Trails Conservancy

"The real estate market consistently demonstrates that many people are willing to pay a larger amount for property located close to parks and open space areas than for a home that does not offer this amenity."

The Proximate Principle, John Crompton, National Recreation and Park Association

Preserved land protects the economic health of communities

"Studies show that residential development costs the municipality more in educational and public services than it generates in tax revenue."

Open Space is a Good Investment, The Financial Argument for Open Space Preservation, Association of New Jersey Environmental Commissions

"Since the 1980s, studies have increasingly shown that for every $1.00 collected in taxes, residential development costs their host communities between $1.04 and $1.67 in services – and these costs continue forever, generally increasing over time."

"The Economics of Open Space" in Our Environment, AIM Community News, West Milford

Stewardship and Monitoring Recommendations

Engaging the stakeholders in the community to protect and restore various native habitats, streams, wildlife corridors, and forests is the basis of effective land management. Habitat restoration, planting native trees, restoring riparian corridors, managing the impacts of deer herbivory, and controlling invasive species are land stewardship practices which can ensure the sustainability and resiliency of the landscape.

The rapid establishment and encroachment of invasive plant and animal species and the overpopulation of deer are major problems to the integrity of northern New Jersey forests and the Critical Habitat they afford. Site restoration programs, in addition to the conservation and mitigation strategies recommended for the individual species, need to be sensitive to the encroachment of invasive species and over-browsing of deer during the restoration and monitoring of the site. Education of the public is a critical aspect in successful stewardship programs. Hosting educational programs and hikes, and providing informational materials to the surrounding neighbors, will provide resources and materials to help increase the understanding and awareness of the users and local stakeholders as to why a site restoration program has been undertaken.

Monitoring Guidelines

If minimization or avoidance is not feasible, mitigation measures will need to be undertaken. Monitoring recommendations for mitigation sites within Critical Habitat areas are based upon the NJDEP requirements for monitoring in wetlands areas. Site needs are similar, and the monitoring protocol has a history of compliance and success.

Starting with the first full growing season after the project is completed, it is recommended that the mitigation site be monitored biannually during spring and fall for five years, unless a different timeframe is approved. It is recommended that monitoring occur during species-appropriate timescales and frequencies for the targeted wildlife and habitat, considering factors including but not limited to breeding, migration, or hibernation cycles.

The baseline report should include the following:

- ✓ Observations of mapped threatened and endangered species;
- ✓ Assessment of threatened and endangered species habitat;
- ✓ Description of the mitigation project and monitoring results;
- ✓ Requirements and goals of the mitigation project;
- ✓ Maps and imagery of mitigation site that includes:
    - A USGS quad map;
    - A county road map showing the location of the mitigation site, including the lot and block of the mitigation site;
    - A copy of an aerial photograph of the mitigation site; and
    - Flagged boundary of project site and GPS location of field data points.

- ✓ Field data of the mitigation project site, describing the vegetation present, and the percent coverage of the vegetation;
- ✓ Grade elevations at one-foot contours, plantings (including species, size, and densities), and any structures included in the approved mitigation proposal, with a table listing the vegetative species and quantities of each that were planted; and
- ✓ Color photographs of the mitigation site conditions and project area, accompanied by a map showing the location and direction from which each photograph was taken.

The annual monitoring reports should include:

- ✓ Details in which the mitigation has or has not achieved progress towards the goals of the approved mitigation proposal. This should include field data sheets and corrective actions;
- ✓ Separate assessments of the planted vegetation, species that are naturally colonizing the site, and an overall assessment of vegetation coverage. There should be sufficient sampling locations recorded to accurately assess the vegetation and site conditions across the entire mitigation site; and
- ✓ Documentation of any invasive or noxious species colonizing the site and how they are being eliminated.

The final reports should include the following:

- ✓ Documentation that demonstrate that the goals of the mitigation project have been met;
- ✓ Documentation that the planted vegetation as detailed in the approved mitigation proposal has been achieved, or, if not yet achieved, all site indicators suggest that the site is on a positive trajectory to meeting the desired plant community; and
- ✓ Documentation that the mitigator has executed and recorded a conservation restriction for the mitigation area that is acceptable to the Highlands Council.

Mitigation Strategies – Adaptive Management

In July 2010, Biohabitats, Inc., prepared a report for the Highlands Council entitled Mitigation Strategies: Critical Habitat, which included a detailed overview and presentation on management strategies for a mitigation site. The report was developed with the understanding that mitigation should meet the habitat and life-cycle requirements of the specific species affected and be species specific. As written in the guidance document:

> *Adaptive Management (AM) was developed for wildlife management but has been tailored to broader management scenarios. Adaptive management differs from traditional approaches in that it addresses uncertainty directly by using management as a tool to gain critical knowledge. Management is adaptive when management actions are measured and evaluated before and after they occur, and the resulting information is then used to refine the next round of management questions.*

Two sections of the Mitigation Strategies: Critical Habitat guidance document are included as an **Appendix** to this plan. These are Step 6: Develop and Employ the Adaptive Management Program and Appendix 2: Fundamentals of the Adaptive Management Process.

CRITICAL HABITAT RESOURCE AREA

Critical Habitat Resource Area: Overview

What is a Critical Habitat Resource Area?

A critical indicator of ecological integrity is biodiversity, which is the variety of plant species, animal species, and other organisms found within a particular environment. Where ecosystems no longer support a diverse array of living organisms, ecological integrity has likely been compromised. Developed areas exemplify such circumstances, even as they continue in some cases to provide habitat for a limited number of species. Areas known to support species of plants and animals that have become rare, threatened, and/or endangered across most of New Jersey, are considered "critical habitats," signifying that they are essential to the survival of such species, and thus to retaining a measure of the rich biodiversity that once existed across most of the state. The Highlands Region contains extensive areas of such remaining habitat and the Highlands Regional Master Plan (RMP) seeks to protect and preserve these areas to the greatest extent possible, and to help reduce critical habitat loss.

Accordingly, the RMP calls for a Critical Habitat Resource Area, a Highlands Resource Area specifically delineated to encompass critical habitat in the Region and intended to protect (and where feasible, enhance) such areas. The RMP seeks development and adoption of protective regulatory provisions to ensure the ecological integrity of the Critical Habitat Resource Area and thus maximize its potential for biodiversity. In accordance with the RMP, the Critical Habitat Resource Area is comprised of three (3) different components, each as described below:

1. Significant Natural Areas. A Significant Natural Area represents the presence of rare or endangered plant species or exemplary ecological communities. These sites include some of the best remaining habitat for rare plant species and regionally significant ecological communities within the Highlands Region. The destruction of these sites could result in the loss of unique components of our natural heritage.

2. Confirmed Vernal Pools. Vernal pools are defined within the RMP [Policy 1F1(3)] to include a 1,000-foot (~300 meter) wide buffer area along the full length the perimeter. A vernal pool is a unique system that:

   ✓ Provides critical breeding habitat for a variety of amphibian and invertebrate species;

- ✓ Contributes significantly to local biodiversity by supporting plants, animals and invertebrates that would otherwise not occur in the landscape; and
- ✓ Contributes significant amounts of food to adjacent habitats.

Vernal pools periodically either dry out completely or draw down to shallow levels unsuitable for sustaining fish. Fish are highly predatory on amphibian and invertebrate eggs and larvae, and several species of salamanders and frogs require fish-free vernal habitats for their survival. The protection of vernal pools and their adjacent terrestrial habitat is important for maintaining ecological integrity and providing amphibian and invertebrate breeding habitats. Most amphibians return each year to breed in the pond where they were born, and therefore are dependent on the protection of such areas. Because of their ephemeral nature and small size, vernal pools are not comprehensively mapped and, as a result, are often overlooked from a planning and protection standpoint.

3. Threatened/Endangered Species Habitat. The Highlands Council utilized the NJDEP's Endangered and Nongame Species Program Landscape Project data to identify potential habitats for rare, threatened, and endangered species wildlife within the Highlands Region. An updated Landscape Project was developed for the Highlands Region to identify habitat ranked by documented occurrences of rare, threatened, or endangered species as follows:

    - ✓ *Landscape Rank 5*. Habitat supporting a federally listed threatened or endangered species;
    - ✓ *Landscape Rank 4*. Habitat supporting a species designated as State Endangered;
    - ✓ *Landscape Rank 3*. Habitat supporting a species designated as State Threatened;
    - ✓ *Landscape Rank 2*. Habitat supporting a species designated as Special Concern; and
    - ✓ *Landscape Rank 1*. Habitat that meets minimum species habitat suitability needs but does not support a document occurrence of a special concern, threatened, or endangered species.

    In addition to the above, a Highlands Conservation Rank index was also assigned to each species occurrence based upon how critical the Highlands Region is to the continued existence of species within the state. The following Highlands Conservation Ranks are established:

    - ✓ *Critically Significant (Rank 3)*. If habitats in the Highlands Region were lost, that species would not exist in the state;
    - ✓ *Significant (Rank 2)*. Highlands Region habitats play a significant role for the species' existence in the State, and;
    - ✓ *Low Significance (Rank 1)*. Highlands Region habitats do not play an important role for that species' existence in the state.

    Any lands which are identified in Landscape Ranks 3, 4, and 5 are included in a Critical Habitat Resource Area. If land is identified as being in Landscape Rank 2 and is also located within the Highlands Preservation Area, it is included in a Critical Habitat

Resource Area. Similarly, if land is identified as being in Landscape Rank 2, is located in the Highlands Planning Area, and is located in the Highlands Conservation Critically Significant (Rank 3) or the Significant (Rank 2) categories, it is included in a Critical Habitat Resource Area.

Summary of a Critical Habitat Resource Area

In summary, a Critical Habitat Resource Area is a regulated Highlands Resource Area which is designed to protect biodiversity. It is an agglomeration of three (3) different resources:

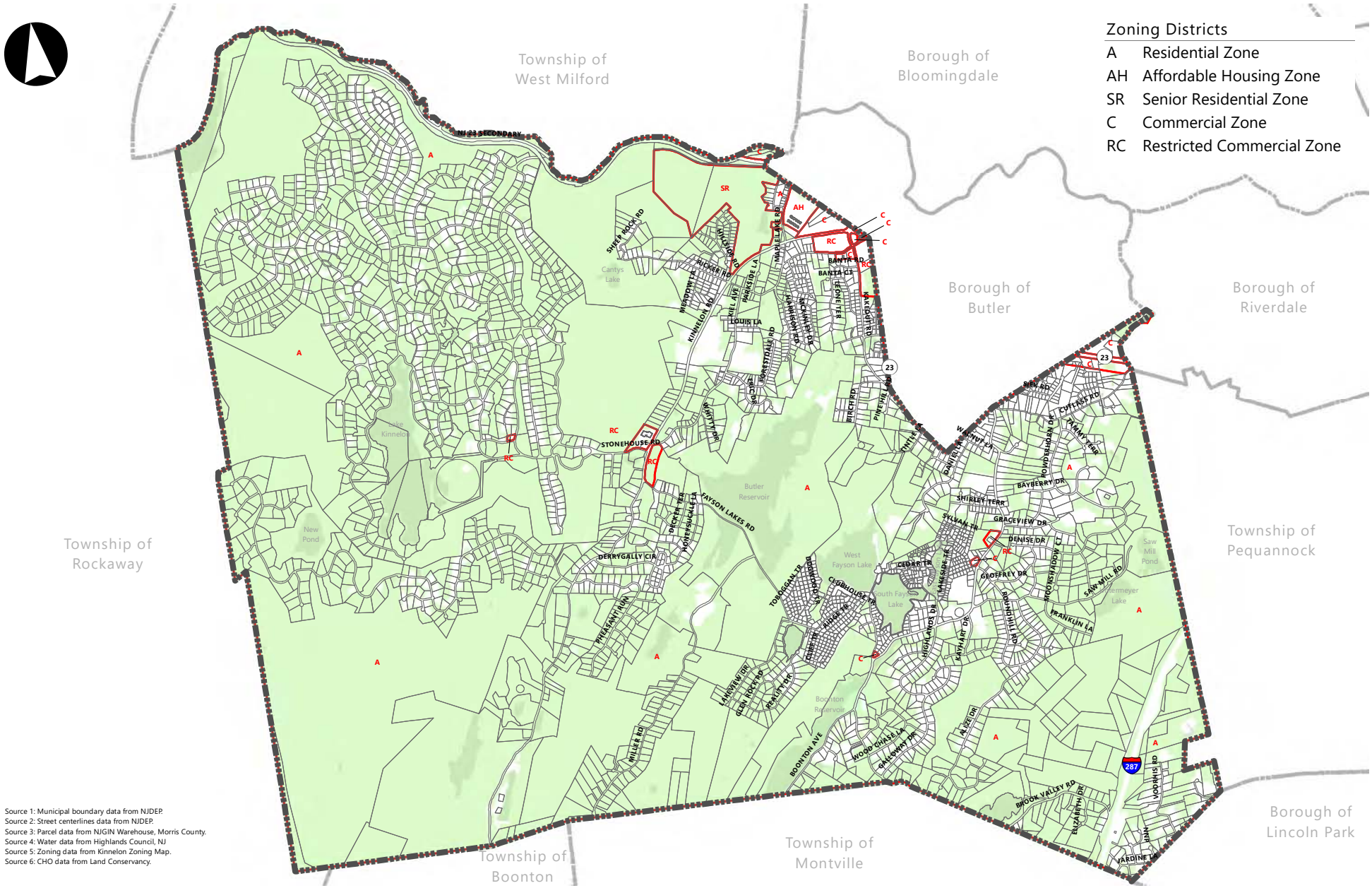
1. Significant Natural Areas;
2. Confirmed Vernal Pools (inclusive of 300-meter wide perimeter buffers); and
3. Threatened and Endangered Species Habitats with:
    - ✓ Landscape Ranks of 3, 4, and 5.
    - ✓ Landscape Rank of 2 and located in the Highlands Preservation Area.
    - ✓ Landscape Rank of 2, location in the Highlands Planning Area, and Highlands Conservation Ranks of Critically Significant (Rank 3) or Significant (Rank 2).

What does a Critical Habitat Resource Area entail?

As noted above, a Critical Habitat Resource Area is a natural resource area established by the Highlands RMP which is designed to protect habitats that support the rare, threatened, and endangered plant and animal species of the Region. As such, applications for non-exempt development projects on sites located within the Critical Habitat Resource Area may be subject to additional regulatory provisions. Information regarding the Critical Habitat Resource Area and its specific characteristics and extent within the community is provided in the municipality's Critical Habitat Conservation & Management Plan (CHCMP).

Critical Habitat Resource Area for Kinnelon Borough

Map 6 is a conceptual overlay map for the Borough of Kinnelon showing the extent of the Critical Habitat Resource Area in the municipality, and its relationship to current zoning. This is not intended as a regulatory map and is included for review and planning purposes only. Once the CHCMP is adopted as an element of the Master Plan by the Planning Board, the Board's planner will review and draft the Critical Habitat Resource Area overlay map for approval by the Board.



Dwg. Title

Conceptual Overlay Map

Project No.	Date	Drawn
3553.01	03.20.20	DN

Legend

Boundary
Parcels
Zoning District
Critical Habitat Overlay

BURGIS ASSOCIATES, INC.
COMMUNITY PLANNING | LAND DEVELOPMENT AND DESIGN | LANDSCAPE ARCHITECTURE
25 Westwood Avenue
Westwood, New Jersey 07675
p: 201.666.1811
f: 201.666.2599

Project Title

Critical Habitat Conservation & Management Plan

BOROUGH OF KINNELON | MORRIS COUNTY, NEW JERSEY

Scale: 1 " = 4,100 '

Dwg. No.: overlay

Critical Habitat Resource Area: Conformance Process

Introduction

The outline below provides information regarding the Borough of Kinnelon's work with the New Jersey Highlands Water Protection and Planning Council ("Highlands Council") in the process of achieving conformance with the Highlands Regional Master Plan (RMP). The Borough is located primarily within the "Preservation Area" (97%) portion of the Highlands Region, for which conformance with the RMP is required by the Highlands Act. The remainder of the Borough lies in the "Planning Area (3%)," for which conformance is optional. Municipalities achieve "conformance," meaning alignment of the municipal planning/regulatory program with the policies, goals, and objectives of RMP, through participation in the Highlands Council's process of "Plan Conformance." All steps included in this process are fully funded by the Highlands Council, through its Plan Conformance Grant Program.

Completed Steps

To date, implementation steps completed by the Borough include:

1. Petition for Plan Conformance. The Borough submitted its Petition for Plan Conformance to the Highlands Council on December 8, 2009. The Petition, which included such items as a draft Highlands Environmental Resource Inventory (ERI), Master Plan, and Land Use Ordinance (LUO), was deemed complete in April of 2010. Following an iterative process of review and deliberation between Borough and Highlands Council staff, all Petition documents were finalized, made available for public review and comment, and ultimately approved by the Highlands Council following a public hearing on May 19, 2011.

Following all petition approvals, municipalities engage in the process of Plan Conformance implementation. Implementation plans include a variety of activities (all funded by the Highlands Council) as necessary to formally align the municipality's planning program with the RMP. This process begins with consideration, finalization, and adoption of Highlands documents (e.g., ERI, Master Plan, LUO) by local boards and/or the governing body, as applicable, following all legal and public notice protocols as set forth under state land use law.

The Borough of Kinnelon has completed the following steps:

2. Planning Area Petition Ordinance. The Borough Council of Kinnelon adopted the Planning Area Petition Ordinance (Borough Ordinance #16-16) on October 20, 2016. Specifically required by the Highlands Act for all municipalities choosing to conform for Planning Area lands, this ordinance formalizes the Borough's Petition to the Highlands Council for Plan Conformance to include those lands located within the Planning Area. It provides the legal basis for all implementation steps to follow that pertain to Planning Area lands.

3. Highlands Environmental Resource Inventory. The Borough's Environmental Committee approved the Highlands Environmental Resource Inventory on August 31, 2017. The purpose of the Highlands ERI is to provide a framework that supports the efforts of the Borough of Kinnelon to bring its planning documents into conformance with the RMP. The Highlands ERI supplements the Borough of Kinnelon Natural Resource Inventory of 1975 as well as the Environmental Resource Inventory Update of 2013.

Next Steps

In order to establish the Critical Habitat Resource Area, the Borough may elect one of the two processes below. The first process (Process 1) abbreviates the implementation program, leaving off the adoption of the full Highlands Master Plan Element and Highlands Land Use Ordinance, as provided under Process 2. Kinnelon Borough is eligible for this alternative because approximately ninety-seven percent (97%) of the Borough is located within the Preservation Area, while only three percent (3%) is located in the Planning Area. As such, the Borough is permitted to simply rely upon the Highlands Referral Ordinance, which assigns responsibility for Highlands Resource reviews (for covered Applications for Development) to the Highlands Council.

In either case, it will be important to fully develop both the Critical Habitat Conservation & Management Plan and the appropriate Highlands Land Use Ordinance provisions that will effectuate the intents of the Plan. The following "next steps" are listed in the Borough's Highlands Implementation Plan and Schedule, inclusive of the indicated Highlands Council grant funding allocations.

A. Process 1 – Regulation via Referral Ordinance

1. Highlands Critical Habitat Conservation & Management Plan ($20,000).[e]
    a. Element of the Borough Master Plan and Amendment to the Highlands ERI. Prepare inventory of flora/fauna species identified in Kinnelon and any associated mapping details. Determine best management practices appropriate to each species. Adopt all of these as an amendment to the Highlands ERI, inclusive of any edits necessary within the narrative portion of the ERI to incorporate same.

    b. Highlands Master Plan Element. Prepare the Critical Habitat Conservation & Management Plan for incorporation into the Highlands Element. Picking up on information already provided in the adopted Kinnelon Highlands ERI, the Plan should briefly explain what Critical Habitat (CH) is and why it is important, endorse and adopt the ERI language by reference, specifically describe CH in Kinnelon (expounding upon any info that is new/refined/expanded from that already in ERI narrative), establish and illustrate the Kinnelon Critical Habitat Resource Area (including indication/mapping of any priority areas for protection/enhancement, as applicable), and provide pertinent protection/enhancement goals and objectives for the CH areas identified in

[e] The adoption of the Borough's CHCMP, of which this section is a part of, satisfies this requirement.

Kinnelon (including but not limited to development and adoption of regulatory standards applicable to the Critical Habitat Resource Area).

2. Highlands Critical Habitat Regulations. Fully prepare effectuating regulatory provisions for incorporation into the Highlands LUO. The LUO would designate the Critical Habitat Resource Area (as established in the Highlands Master Plan Element) as a regulatory area inclusive of parcel-specific mapping, indicate any particular applicability provisions for projects within the Critical Habitat Resource Area that are not already a part of the LUO (which sets general thresholds for review of development applications), set forth regulatory standards for development projects within the Critical Habitat Resource Area, provide for waiver and/or mitigation allowances as may be applicable to certain cases (and if so, the specific descriptions for such consideration and the requirements pertinent thereto), and establish application submission requirements.

3. Reexamination Report ($ Funded under Highlands Element, below). The Borough Planning Board would prepare and adopt the Highlands Reexamination Report (based on model provided) as an amendment to the municipal master plan, the purpose of which is to take into consideration Kinnelon's draft Highlands Master Plan Element and draft Highlands Land Use Ordinance (each as amended pursuant to 1-2, above respectively) as approved by the Highlands Council, and to identify the specific changes needed to conform its planning documents to the goals, requirements, and provisions of the RMP.

4. Referral Ordinance ($1,000). Following the adoption of the Reexamination Report, the Borough Council would prepare and adopt the Highlands Referral Ordinance (based on model provided). This ordinance requires that, prior to any non-exempt (or otherwise non-covered) application for development being deemed complete for review by the local Land Use Board, the application must be referred to and reviewed by the Highlands Council for consistency with Kinnelon's draft Highlands LUO and the RMP. Highlands Council reviews would include determinations as to adherence with the regulatory provisions developed for the Critical Habitat Resource Area. All applicants must address any Highlands Council findings of inconsistency in order to proceed with their submission to the municipal board.

5. Highlands Element ($3,000). An abbreviated version of the Highlands Master Plan Element (inclusive of amendments referenced above) would then be finalized and adopted by the Planning Board. This document sets forth the policies that are intended to guide future land use and development throughout the Borough. By choosing to rely upon the Referral Ordinance, certain portions of the Highlands Element needed in support of municipal regulatory provisions would no longer be necessary.

B. Process 2 – Regulation via Municipal Ordinance

This process would include all of the preceding steps as well as finalization and adoption of the Highlands Element and the Highlands LUO.

6. Highlands Element ($3,000). The full Highlands Master Plan Element (inclusive of amendments referenced above) would then be finalized and adopted by the Planning Board. This document sets forth the policies that are intended to guide future land use and development throughout the Borough. It also provides the rationale and the framework for the adoption of land use regulations that are protective of Highlands Resources and consistent with the Highlands RMP. Any effectuating regulatory requirements to follow would apply to non-exempt land use activities.

7. Highlands Land Use Ordinance ($10,000). The full Highlands Land Use Ordinance (inclusive of amendments referenced above) would then be finalized and adopted by the Borough Council. Under this option, a full mark-up of the draft LUO would be necessary to address all components on both a substantive and administrative level. Mark-up should include all items noted in #2, above, as well as fee schedules, and standards for required level of professional review of applications. If/when a municipality adopts the Highlands LUO, it concurrently repeals the Highlands Referral Ordinance, which would no longer apply. The municipality would conduct all reviews for Highlands Resources, with very limited provisions for Highlands Council purview, only as provided in the text of the LUO.

Critical Habitat Resource Area: Applicant Guidelines

What is a Critical Habitat Resource Area?

A Critical Habitat Resource Area is an assemblage of three (3) different resources:

1. Significant Natural Areas;
2. Confirmed Vernal Pools (which include adjoining buffer areas); and
3. Threatened and Endangered Species Habitats with:
   - ✓ Landscape Ranks of 3, 4, and 5;
   - ✓ Landscape Rank of 2 and located in the Highlands Preservation Area; and
   - ✓ Landscape Rank of 2, location in the Highlands Planning Area, and Highlands Conservation Ranks of Critically Significant (Rank 3) or Significant (Rank 2)

What are the Guidelines for Applicants?

The following step-by-step guidelines are offered for applicants:

1. Step 1. First, the applicant must determine whether the proposed development site lies within a Critical Habitat Resource Area. A map illustrating the full extent of the Critical Habitat Resource Area is provided within the municipality's Critical Habitat Conservation & Management Plan (CHCMP).

2. Step 2. If the subject site is located within a Critical Habitat Resource Area, the applicant must then determine whether a project review is required. With the exception of any project listed as an "exclusion" in the model Highlands Area Land Use Ordinance, including any project eligible for a Highlands Act exemption, Critical Habitat Resource Area regulatory provisions shall apply to any application seeking approval of a site plan, subdivision, or change in use where approval of such application would reach any of the following development thresholds (all terms and interpretations relating thereto as provided in the model Highlands Area Land Use Ordinance):

   a. For residential development create three (3) or more dwelling units; and
   b. For non-residential development:
      i. Resulting in the ultimate disturbance of one (1) acre or more of land;
      ii. Producing a cumulative impervious surface area of one-quarter (¼) acre, or more; or
      iii. Introducing or expand a use not permitted by the Highlands Area Land Use Ordinance.

3. Step 3. If the subject site is within the Critical Habitat Resource Area and the proposed development reaches one or more of the thresholds listed above, the application is subject to review for compliance with (as yet to be developed) Critical Habitat Resource Area regulatory standards. The applicant should evaluate the extent of such compliance and may consider modifying the proposal if necessary, to either, avoid application of the

regulatory standards, comply fully with the standards, or comply to the maximum extent believed feasible.

4. Step 4. Subject to the provisions of the Critical Habitat Resource Area regulations (and those of the model Highlands Area Land Use Ordinance of which they will become a part), certain projects may be eligible for waivers and/or exceptions. The applicant should review and consider whether the proposed project may meet the eligibility standards as set forth by the regulations and determine whether to make such application.

5. Step 5. Subject to the provisions of the Critical Habitat Resource Area regulations, certain projects may be eligible for approvals conditioned upon development and implementation of Critical Habitat Mitigation Plans. The standards for development of such plans and their submission will be provided within the text of the Critical Habitat Resource Area regulations.

Where municipalities adopt the full Highlands Area Land Use Ordinance (which will include the Critical Habitat Resource Area regulatory requirements), reviews for Critical Habitat Resource Area regulatory compliance will require qualified professionals, retained as needed by the municipality. Reviews will occur during the normal review process for covered applications (see model Highlands Area Land Use Ordinance). Where municipalities adopt only the Highlands Referral Ordinance, such reviews will be conducted by Highlands Council staff as part of any required Highlands Consistency Determination.

CONSERVATION STRATEGIES

As noted in the Highlands Regional Master Plan, Critical Habitat is to be protected and, where disturbed, restored in both quality and function. The **Conservation Strategies** include Low Impact Development Best Management Practices to:

- ✓ Avoid the disturbance of Critical Habitat;
- ✓ Minimize impacts to Critical Habitat; and
- ✓ Mitigate adverse modifications to Critical Habitat so that there is no net loss of habitat value.

Species Common Name	*Species Scientific Name*	Taxonomic Class	Conservation Strategies	Restoration Methodologies/Strategies	Best Management Practices for Low Impact Development to AVOID, MINIMIZE, MITIGATE IMPACTS
Bobcat	*Bobcat Lynx rufus*	Mammalia	Preserve large unfragmented tracts of forest, particularly those that are not crossed extensively by roads or developed inholdings. Protect potential denning sites: rocky areas with ledges and talus on slopes, large downed trees, and areas of dense, tangled vegetation's such as greenbrier and multiflora rose thickets.	Replant cut forest with locally-occurring trees and shrubs such as oaks, hickories, maples, beeches, tulip poplars, viburnums, blackberries, native vine species, and others. Bobcats in New Jersey and in the developed Northeast are apparently adapting to disturbed and fragmented habitat and are being seen in suburban and semi-rural areas where they did not formerly occur. Deliberate translocation of bobcats is generally not workable on a town or township level.	Route new trails and roads away from known denning areas—generally sites with ledges, talus, small caves, and crevices suitable for hibernation and denning. Educate schoolchildren and residents that bobcats are not a threat to humans, and as predators serve a vital function in the ecosystem.
Indiana Bat	*Myotis sodalis*	Mammalia	Preserve forested upland and wetland hunting and roosting habitat. Preserve wetland habitat along riparian zones and bottomland. Preserve forested upland, successional areas, and agricultural land near hibernacula and roosting areas. Preserve standing dead trees—particularly those with bark—in forested uplands, forested wetlands, forested edges, and fencelines and hedgerows. Preserve and protect hibernacula, in most areas usually unsealed mineshafts and mine airshafts.	Construct or purchase bat boxes, and erect boxes (for roosting Indiana bats) in suitable habitat. Details for building, proper siting, and erecting effective bat boxes are available from the US Fish and Wildlife Service (USFWS) and from the NJ Endangered and Nongame Species Program.	Avoid tree cutting during the breeding period stipulated by the USFWS. Avoid sealing mine shafts and mine ventilation shafts without notifying the USFWS. For guidance, consult US Fish and Wildlife Service NJ field offices, and the NJ Department of Environmental Protection, Endangered and Nongame Species Program. Avoid pesticide and herbicide spraying over bat foraging habitat.

Taxonomic Class: Mammalia

Species Common Name	*Species-Scientific Name*	Taxonomic Class	Conservation Strategies	Restoration Methodologies/Strategies	Best Management Practices for Low Impact Development to AVOID, MINIMIZE, MITIGATE IMPACTS
Northern Myotis	*Myotis septentrionalis*	Mammalia	Preserve standing dead trees, particularly those with bark, in wetland and upland forests, forested edges, and palustrine corridors. Forested areas are critical to this species, and efforts should be made to preserve large, unfragmented tracts of forested wetlands and uplands, as well as palustrine corridors and successional areas. Preserve and protect hibernacula, in most areas usually unsealed mineshafts and mine ventilation shafts.	Locate optimal sites, build/purchase, and erect bat boxes for roosting Northern Long-eared bats in a suitable habitat. Details for building, proper siting, and erecting effective bat boxes are available from the US Fish and Wildlife Service (USFWS) and from the NJ Endangered and Nongame Species.	Avoid tree cutting during the breeding period stipulated by the USFWS. Avoid the use of pesticides in areas where this species—which feeds extensively on insects. Avoid the use of herbicides. Locate and map open mine shafts and mine ventilation tunnels and contact the USFWS and the NJDEP Endangered and Nongame Species Program for protocols and specifications for installing grates to these underground openings.

Species Common Name	*Species Scientific Name*	Taxonomic Class	Conservation Strategies	Restoration Methods/Strategies	Best Management Practices for Low Impact Development to AVOID, MINIMIZE, MITIGATE IMPACTS
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Aves	Unclear, due to scanty data on breeding territory preservation for this species; birds tend to move around each year depending on tent caterpillar outbreak locations. Preserve forested edges, thickets composed of *Rubus* species, multiflora rose, cherry (a favorite host of tent caterpillars), aspens (also a preferred host), and birch species, greenbrier and other native vines, and maintain mid- to late-successional area of shrubs and young trees.	Unclear, as this species is heavily depended on caterpillar outbreaks—particularly tent caterpillar moths (*Malacosoma spp*.). In clearings plant a mixture of cherry species, plus aspens and birches.	Maintain successional habitats in old farmland, old fields, utility-rights-of-way, and along forested edges. Avoid spraying for tent caterpillars. Avoid clearing of understory, and retain tent caterpillar-infested cherry and aspens.
Veery	*Catharus fuscescens*	Aves	Preserve large tracts of deciduous upland forest—particularly those with a dense understory of shrubs—and damp, shrubby, bottomland forest near rivers and streams.	Replant locally occurring native tree and shrub species such as oaks, maples, hickories, sour gum, tulip poplar, spicebush, highbush blueberries, and viburnums.	Avoid selective logging and fragmentation of intact forested tracts. Avoid use of herbicides and pesticides in forested tracts. Control and remove invasive shrub and vine species such as Japanese barberry, autumn olive, Oriental bittersweet, and others.
Black-throated Blue Warbler	*Dendroica caerulescens*	Aves	Preserve large tracts of mature forested uplands, particularly open canopy areas with a shrub layer of mountain laurel, great rhododendron and other shrub species, particularly if there is a stream or wetland present on the tract or nearby.	Replant large cleared areas with native trees and shrubs such as tulip poplar, maples, hickories, oaks, viburnums, mountain laurel, heaths, witch hazel, hornbeam, and rhododendrons.	Avoid use of herbicides and herbicides in forested tracts. Avoid fragmenting habitat and selective logging, particularly during breeding season April-August.

Taxonomic Class: Aves

Species Common Name	*Species Scientific Name*	Taxonomic Class	Conservation Strategies	Restoration Methods/Strategies	Best Management Practices for Low Impact Development to AVOID, MINIMIZE, MITIGATE IMPACTS
Worm-eating Warbler	*Helmitheros vermivorum*	Aves	Preserve large tracts of deciduous forest with a shrub understory, on hillsides and steep slopes.	Replant cleared hillsides with locally-native trees and shrubs such as oaks, hickories, maples, beech, tulip poplar, viburnums, witch hazel, mountain laurel, rhododendrons, and heaths.	Avoid spraying herbicides and pesticides over forested areas. Avoid clearing of understory.
Wood Thrush	*Hylocichla mustelina*	Aves	Preserve larger, intact (i.e. few or no roads, few or no utility rights-of way, no inholdings with large buildings) mature forests. Preferably, those forests with closed canopy and a mature native shrub cover. Preserve smaller (2-5 hectares) tracts where they exist in/near existing subdivisions or planned new construction.	Replant cleared areas with native upland tree species such as tulip poplars, maples, oaks, hickories and native shrub species as viburnums, mountain laurel, heaths (blueberries and huckleberry), rhododendrons.	Avoid spraying of herbicides and pesticides in forest. Avoid selective logging or clearing of dead trees. Avoid clearing of understory. Limit trail routing to the perimeters of Wood Thrush habitat.
Kentucky Warbler	*Oporornis formosus*	Aves	Preserve open canopy upland deciduous forest with fairly dense understory. This includes forest which has disturbed areas and clearing, and areas which have invasive shrub and herb vegetation, as Kentucky warbler seems to tolerate these habitats.	Replant with native upland tree species such as oaks, tulip poplar, maples, beech, cherries, birch, viburnums, spicebush, heaths and other species.	Remove dense occurrences of red cedar (*Juniperis virginiana*) growing under forest canopy, and replant with native shrubs such as viburnums, heaths, rhododendrons, mountain laurel, witch hazel and others. Avoid use of herbicides and pesticides. Provide data security, as this is a rare and sought-after species in the Highlands Region; territorial Kentucky Warblers have been driven away by avid birders.

Taxonomic Class: Aves

Species Common Name	*Species Scientific Name*	Taxonomic Class	Conservation Strategies	Restoration Methods/Strategies	Best Management Practices for Low Impact Development to AVOID, MINIMIZE, MITIGATE IMPACTS
Golden-winged Warbler	*Vermivora chrysoptera*	Aves	Preserve mid-successional shrub and small tree cover in utility rights-of-way and successional fields, particularly along large powerline ROWs. Preserve mid-successional shrub and herb cover in wetlands such as marshes and wet meadows crossed by utility rights of way. Preserve mid-successional habitat in areas adjacent to ROWs.	Restoration is a difficult question in this area of Golden-winged Warbler's range, as it is being genetically "swamped" by its close relative, the Blue-winged Warbler—a "problem" with no real solution. Restore successional upland habitat along extensive forested edges with locally native shrubs and herbaceous species; restore successional wetland habitat along extensive forested edges with locally native wetland shrubs and herbaceous species.	Clear and prune back utility rights-of-way with machinery only. Avoid pesticide and herbicide use in ROWs. Maintain successional lever according to recent vegetation guidelines for Golden-winged Warbler.
Hooded Warbler	*Wilsonia citrina*	Aves	Preserve large tracts of deciduous forest, particularly woods with an intact shrub layer. Preserve fragmented deciduous forest as small as 2.5 HA (6 acres) in size, particularly when it has an intact shrub layer.	Replant areas with deciduous upland tree species that are native to the local area—oaks, hickories, maples, ashes question), tulip poplar, beech—and locally native shrub and vine species. Like Kentucky Warbler, studies have shown that Hooded Warbler will return to relatively recently replanted (10-20 years) tracts if invasive species are controlled early. Plant locally-native shrubs such as viburnums, spicebush, dogwood shrubs, witch hazel, and hornbeam.	Avoid use of herbicides and pesticides in forested area during the period March through September. Avoid planting non-native shrub species.

Taxonomic Class: Aves

Species Common Name	*Species Scientific Name*	Taxonomic Class	Conservation Strategies	Restoration Methods/Strategies	Best Management Practices for Low Impact Development to AVOID, MINIMIZE, MITIGATE IMPACTS
Great Blue Heron	*Ardea herodias*	Aves	Preserve open wooded swamps which have standing dead trees.	Install nesting platforms in large open marsh areas, particularly where Great Blue Herons are frequently seen. (Specifications available from Cornell Nest Watch.)	Avoid spraying herbicides and pesticides in and near open wetland areas, streams, and ponds where this species occurs. In areas used by anglers install boxes for disposing of of used fishing line, hooks, and lures. Post signs alerting visitors about the dangers of such materials to wildlife, particularly to herons and other waterfowl.
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Aves	Difficult in the Highlands Region as this is a successional species which moves in after wildfires, windstorms, tree death caused by beaver dam flooding, and sometimes intensive selective logging. Protect recently-flooded beaver swamps which contain standing dead trees, and open public parkland where there is little or no understory; maintain dead trees in such habitat, if possible.	Fire and clear-cut logging and selective logging have been used in restoration for this species in South Jersey and in the Pine Barrens, but this is probably not feasible in most of the Highlands Region.	If possible, do not cut down standing dead trees in open areas. Red-headed Woodpeckers can be impacted by spraying: do not use pesticides or herbicides in areas where there is suitable habitat.

Taxonomic Class: Aves

Species Common Name	*Species Scientific Name*	Taxonomic Class	Conservation Strategies	Restoration Methods/Strategies	Best Management Practices for Low Impact Development to AVOID, MINIMIZE, MITIGATE IMPACTS
Barred Owl	*Strix varia*	Aves	Preserve large forested wetland tracts and palustrine wetlands. Preserve large individual living or dead trees (18 inches +) in forested wetlands which have cavities sufficient for Barred Owl nest holes (10-14 inches wide x 15+ inches deep). For hunting territory, preserve adjacent uplands of successional fields, open utility rights-of-way, agricultural land. Do not use pesticides or herbicides in wetland or upland forested habitat.	Replant locally native trees and shrubs appropriate to uplands (oaks, hickories, tulip poplar, beech, viburnums, blueberry, huckleberry and other species) or to wetlands (red maple, sour gum, highbush blueberry, spicebush, wetland dogwoods and viburnum species). Construct or purchase and install Barred Owl boxes at proper locations and tree heights in or near wetland habitat, or along edges of forested wetland.	Avoid cutting down large dead trees with cavities in or immediately adjacent to forested wetland habitat. Avoid spraying herbicides and pesticides in forested wetland habitat and in upland habitat immediately adjacent. Avoid development (including clearing of underbrush around scattered trees) of successional fields and agricultural fields adjacent to wetlands.

Species Common Name	*Species Scientific Name*	Taxonomic Class	Conservation Strategies	Restoration Methods/Strategies	Best Management Practices for Low Impact Development to AVOID, MINIMIZE, MITIGATE IMPACTS
Fowler's Toad	*Anaxyrus fowleri*	Amphibia	Preserve wetland breeding habitat: freshwater marshes, small ponds, vernal pools, seasonally flooded bottomlands. Preserve adjacent foraging habitat.	Little data available for this generally common species. Install small animal tunnels under new road construction and reconstruction. Restore wetland breeding habitat. Some studies indicate that Fowler's Toads will repopulate sites where they have been eliminated if habitat is restored and adjacent populations persist. Captive-raised Fowler's Toads have been used in restoration projects.	Little Data. Avoid clearing of leaf litter and woody debris around ponds. Avoid pesticide and herbicide use in wetland, open, and wooded habitat. Educate: Do not handle amphibians (salamanders, frogs, and toads) when wearing insect or tick repellant of any kind. Avoid handling amphibians unless necessary.
Marbled Salamander	*Ambystoma opacum*	Amphibia	An autumn vernal pond obligate. Preserve vernal pond sites with maximum buffers. Preserve leaf cover, debris (branches, logs) around vernal ponds Preserve surrounding upland forested foraging habitat. Preserve accumulated leaf litter and forest floor debris, which serve as wintering habitat.	Install carefully planned and situated small animal tunnels below surface of new or redesigned roads. Replant area with locally sourced native tree, shrub, and herbaceous species.	Avoid clearance of leaf litter and woody debris—logs, branches, bark—around vernal ponds. Avoid pesticide and herbicide use in upland and wetland areas containing vernal ponds. Install herptile tunnels under surface of new road construction or road improvement. Use drift fencing to direct amphibians to these crossing tunnels. Educate and enlist "amphibian crossing" volunteers during fall breeding period.

Species Common Name	*Species Scientific Name*	Taxonomic Class	Conservation Strategies	Restoration Methods/Strategies	Best Management Practices for Low Impact Development to AVOID, MINIMIZE, MITIGATE IMPACTS
Northern Copperhead	*Agkistrodon contortrix mokasen*	Reptilia	Preserve winter hibernacula areas in south-facing rocky areas; areas of cliffs, boulders, and ledges. Preserve wooded rocky habitat, particularly on slopes. Preserve brush piles and piles of tree trunks and branches. If possible preserve remains of old structures: foundations or building debris. Preserve wetland habitats adjacent to wooded hillsides. This species will not usually be found in water but will feed on toads, frogs, and other small wetland species.	Little data on restoring this species. Reforest rocky slopes with native deciduous tree species—particularly black, red, scarlet, and white oaks; hickories, tulip poplar. Reforest with native shrub species such as maple-leaved viburnum, blueberries and huckleberries. Captive-raised Northern Copperheads have been used in restoration projects, but the results have been unclear.	Avoid pesticide and herbicide use in habitat. Maintain utility rights-of-way using mechanical means only. Educate residents and schoolchildren about the value of snakes, including northern copperheads to a healthy ecosystem and to rodent & small mammal control.
Timber Rattlesnake	*Crotalus horridus horridus*	Reptilia	Preserve winter breeding and hibernation habitat: rocky talus and bouldery areas on south facing cliffs, hills, and talus slopes. Preserve surrounding foraging and resting areas in adjacent upland forest and successional areas. Preserve adjacent wetland areas such as wooded swamps and marshes. This species will hunt in wetlands and will swim if necessary.	Little data. Can be restored if suitable habitat is protected or restored and there is a nearby expanding or stable population, or by transplanting adult snakes (controversial) or captive-raised snakes. Replant wooded slopes with native upland deciduous tress such as oaks, hickories, and tulip poplars.	Maintain data security, as this species is vulnerable to collecting; wild specimens sell for substantial sums, and there are markets for rattlesnakes in New Jersey and nearby areas. Educate residents and schoolchildren about the value of snakes, including timber rattlesnakes, to a healthy ecosystem and to rodent & small mammal control.

Taxonomic Class: Reptilia

Species Common Name	*Species Scientific Name*	Taxonomic Class	Conservation Strategies	Restoration Methods/Strategies	Best Management Practices for Low Impact Development to AVOID, MINIMIZE, MITIGATE IMPACTS
Wood Turtle	*Glyptemys insculpta*	Reptilia	Maintain native vegetation along streambanks. Maintain natural gravel streambanks and stream beds. Preserve or maintain adjacent successional (early-, mid-, and late-successional) habitats for foraging adults and nesting females. Maintain adjacent forested habitat for foraging adult and immature Wood Turtles.	Little data. If disturbed, restore natural stream and riverbank structure. Captive-raised Wood Turtles have been used in successful reintroduction programs.	Through silt fencing and other methods, avoid stream siltation. Avoid alteration of stream structure: avoid channelization, rip-rap banks, ditching, or concrete channels. Avoid pesticide or herbicide use in stream and river channel and banks.
Eastern Box Turtle	*Terrapene carolina carolina*	Reptilia	Maintain and preserve large forested upland tracts and successional uplands, particularly those with a mosaic of wetland types and small ponds. Maintain adjacent wetland habitats.	Translocation of Eastern Box Turtles is rarely successful, as they are very dependent on their natal home territory. Some success with captive raised young (citation). Install carefully planned and situated small animal tunnels below surface of new or redesigned roads. Replant area with locally sourced native tree, shrub, and herbaceous species.	Prohibit collection of box turtles. Educate about the harm relocation of these turtles causes. Unless unavoidable, do not move box turtles from immediate wooded or field area where they were found. This species has a very small home range, and if removed from it, these animals have a difficult time reorienting themselves in new locations and may wander aimlessly in an effort to find original habitat. Avoid pesticide and herbicide use in forest habitat. Eastern Box Turtles will utilize wildlife tunnels and drift fencing.

Taxonomic Class: Insecta

Species Common Name	*Species-Scientific Name*	Taxonomic Class	Conservation Strategies	Restoration Methodologies/Strategies	Best Management Practices for Low Impact Development to AVOID, MINIMIZE, MITIGATE IMPACTS
Harris' Checkerspot	*Chlosyne harrisii*	Insecta	Maintain early- and mid-successional vegetation in utility rights-of way where there are populations of flat-topped aster (*Aster umbellatus, syn. Doellingeria umbellata*).	Replant with locally-sourced larval foodplant, flat-topped aster. Replant successional areas and rights-of-way with native, locally occurring shrub and herbaceous species. Replant with native, locally derived, pollinator-friendly shrub and herb species.	Use mechanical clearing only in maintaining successional areas, and only conduct clearing from period September through March. Avoid pesticide and herbicide use in utility rights-of way, avoid clearing of rights-of-way during period April-August.
Tiger Spiketail	*Cordulegaster erronea*	Insecta	Preserve large tracts of forested uplands, particularly those with small streams and seepage areas (wetland patches with isolated skunk cabbage and fern growths in uplands). Maintain maximum stream buffers, and buffers around vernal ponds and seepage areas.	Reforestation of logged, dead, or damaged trees with appropriate local species restoration of vernal ponds and seepage areas. Replanting of native, locally occurring shrub and herbaceous species.	Avoid use of pesticides and herbicides. Avoid changes in stream drainage. Avoid artificial stream bank material—riprap, plastic sheeting, etc. Avoid changes to hydrology that would alter the water table and impact small streams, intermittent streams, and seepage areas.

MITIGATION: ADAPTIVE MANAGEMENT

In July 2010, Biohabitats, Inc., prepared a report for the Highlands Council entitled Mitigation Strategies: Critical Habitat, which included a detailed overview and presentation on management strategies for a mitigation site.

Two sections of the Mitigation Strategies: Critical Habitat guidance document are included in this report:

- ✓ Step 6: Develop and Employ the Adaptive Management Program
- ✓ Appendix 2: Fundamentals of the Adaptive Management Process

Mitigation Strategies: Critical Habitat

Critical Habitat Conservation and Management

Prepared For:
New Jersey Highlands Council

Prepared By:
Biohabitats, Inc.

April 2010
Revised July 2010

Step 6: Develop and Employ the Adaptive Management Program

Because natural communities undergo a process of maturation, succession, and diversification over time, it will take some years between the initial ecosystem restoration efforts and the final development of resilient, diverse ecosystems that contain the full suite of attributes expressed in the degraded Critical Habitat. Post-restoration monitoring by qualified professionals is necessary to ensure the measurement, documentation, maintenance and ranking of this progression over time. Each Critical Habitat type will have different post-restoration trajectories, defined by their undisturbed, natural condition, making measurable benchmarks for post-restoration distinct for each community.

The "success" of restoration actions can be determined through the evaluation of post-project monitoring data, and through a comparison to the ecological reference site to determine if ecosystem succession is occurring along the desired trajectory. Feedback from monitoring efforts will inform decisions on adjusting restoration actions and even the trajectories depending on the response of the system. Monitoring data can also be used to modify the timing of restoration actions, using adaptive management as necessary to maintain a logical sequence of restoration activities (e.g. control of invasive species should be addressed before native plants are established).

The restoration of a particular ecosystem component is completed when it has been determined that the desired restoration trajectory has been fulfilled, including:

- The quantity or extent of the desired Critical Habitat has been established.
- The restored Critical Habitat has species assemblage and distribution essentially equivalent to the reference ecosystem.
- The acknowledgement that no net loss of Critical Habitat value has been achieved.

If, according to post-project monitoring data, a restoration action is not succeeding, additional studies or surveys will need to be performed to evaluate the source(s) of ecological stress, and the strategy adjusted accordingly. The adaptive management strategy is intended to be dynamic and flexible, a "living document" that can be adjusted to account for new information and changing environmental conditions.

Introduction to Adaptive Management Strategies

Adaptive Management (AM) was developed for wildlife management but has been tailored to broader management scenarios. Adaptive management differs from traditional approaches in that it addresses uncertainty directly by using management as a tool to gain critical knowledge. Management is adaptive when management actions are measured and evaluated before and after they occur, and the resulting information is then used to refine the next round of management questions. (Additional information on the fundamentals of adaptive management is presented in Appendix 2.)

The following quote is from a paper by Barry L. Johnson, published in *Conservation Ecology* in 1999, and it presents a good synopsis of the AM concept:

> "The use of adaptive management as a resource management technique began in the 1970s (Holling 1978). Various definitions of adaptive management are available in the literature (e.g., Walters 1986, Parma et al. 1998, Shea et al. 1998, Callicott et al. 1999), but the basic concepts are simple and appealing. Adaptive management tries to incorporate the views and knowledge of all interested parties. It accepts the fact that management should proceed even if we do not have all the information we would like, or we are not sure what all the effects of management might be. It views management not only as a way to achieve objectives, but also as a process for probing to learn more about the resource or system being managed. Thus, learning is an inherent objective of adaptive management. As we learn more, we can adapt our policies to improve management success and to be more responsive to future conditions."

AM techniques are relevant to the management of the Highlands Region because they can be used: 1) to assess methods of management and their physical results; and 2) to find ways to improve those methods and results in an orderly, methodical manner. Over time, the AM techniques will provide descriptive data on the actions taken, analysis of whether the desired results are or have been achieved, and insight into how methods and actions can be changed in order to improve the results.

Application of the AM Process to the Highlands Region

In implementing mitigation plans for the Highlands Region, each individual plan should adopt an adaptive management strategy consistent with the Regional Master Plan. The framework for these adaptive management strategies should be developed in parallel with site assessments and mitigation implementation, and should include the principles and structure discussed below.

In implementing a formalized adaptive management plan, there are a series of linked steps:

1) Gather all available information about the system and, based on that information, create alternative models regarding management of the system and clarify policies on approaches that will meet mitigation goals (Walters 1986).
2) Create a small set of testable hypotheses for different management options. This step can involve consideration of entirely new management approaches that are outside existing procedures and policies. The contribution of scientists in this step is advisable.
3) Develop an experimental design and monitoring program. The design should specify which system components are to be used as a response variable (measured to assess the success of different management options). Pilot studies may be required (Silsbee and Peterson 1993) and a robust experimental design is required to avoid the limitations of trial-and-error management.
4) Implement management changes based on the results of the experiments. Monitoring and continuing assessment of the data stream continue with regard to the modified management strategies. Continued and iterative field research is coupled with result-driven management actions.
5) Carefully document the adaptive management program, including detailed information about all the steps of the process (Taylor et al. 1997).

Adaptive management can play a key role in Highlands' resource management and mitigation. Already, much is known about the physical and biological processes that constitute the Highlands ecosystems. As the ecosystem processes are dynamic and the processes of mitigated or restored systems can quickly become

more complex, a continual monitoring and research effort is required to forecast and comprehend the implications of management actions. However, there is no way to have perfect knowledge of how the "system" will respond when these actions are applied together in the unique setting of the Highlands Region, which dictates that the mitigation should include monitoring, interpreting, and adapting.

Adaptive management allows the mitigation plans and actions to be responsive to new information, optimizing the allocation of resources towards key issues. To facilitate this process, the mitigation strategy should be structured to promote:

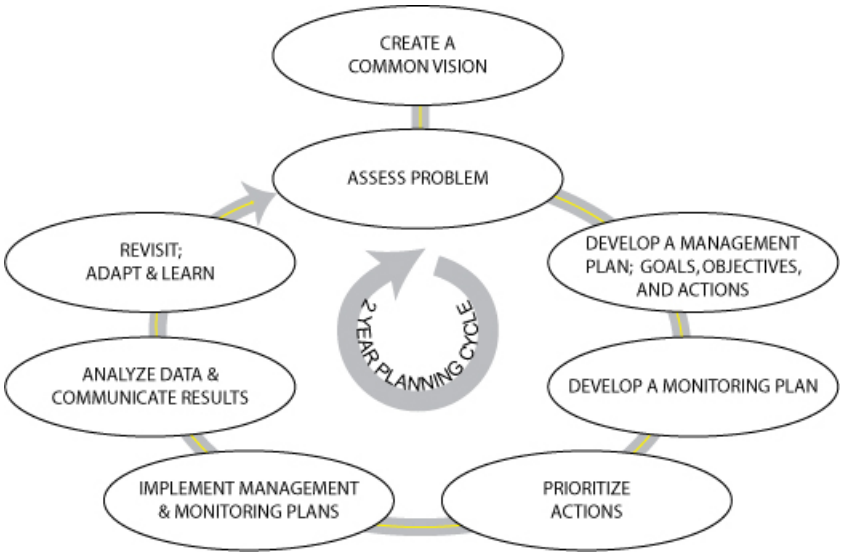
- Continual formulation and implementation of research and monitoring activities;
- Sharing of this information among stakeholders and resource managers; and
- Active integration of this information into management decision-making.

Essentially, the adaptive management component allows the mitigation plan to be a "living document," responding to new information and incorporating it into long-term resource management strategies.

To illustrate how the process works, *Adaptive Management: A Tool for Conservation Practitioners* (Salafsky *et al.*, 2001) presents the following process as well as the diagram presented below:

START: Establish a clear and common purpose
Step A: Design an explicit model of your system
Step B: Develop a management plan that maximizes results and learning
Step C: Develop a monitoring plan to test your assumptions
Step D: Implement your management and monitoring plans
Step E: Analyze data and communicate results
ITERATE: Use results to adapt and learn

The following diagram graphically illustrates the planning framework, and how adaptive management is integrated into this process:



STEP	DESCRIPTION
Create a common vision	Provides a unified "target" for conservation and restoration actions. The Vision is the ultimate desired state of the resource.
Assess problem	Characterizes the problems or issues being addressed by the strategy. Provides a common understanding of existing conditions and constraints.
Develop a management plan with stated goals	The formulation of a management strategy provides a common set of Goals, specific targets listed as objectives, and actions that are pursued to accomplish an objective.
Develop a monitoring plan	A specific process by which information is actively gathered to inform the management plan. These efforts are spelled out as specific Action Items.
Prioritize actions	The process of prioritizing management actions. Using the prioritization process, convene regular (e.g. biennial) workshops and allow stakeholders to rank actions according a Cost/Benefit Matrix.
Implement management & monitoring plans	Funding and implementation of the prioritized list of restoration, conservation, capital improvements, and monitoring actions.
Analyze data & communicate results	New information from monitoring/research efforts is gathered by stakeholder institutions, passed along to a centralized information bank, and disseminated back to stakeholders.
Revisit; adapt and learn	Adaptive management in action. At the end of the 2-year planning horizon, the strategy is revisited, problems re-assessed, and Goals, Objectives, and Action Items are adjusted and reprioritized by stakeholders at a workshop.

How to Measure Success

Knowing how to accurately measure success of the mitigation effort complicates the development of a good mitigation strategy. There is no overall agreement on how to measure success, and much information is still not known because many mitigation projects have not been extensively monitored and restoration trajectories are not yet well understood.

It has been widely documented that there is a relatively high failure rate for recent mitigation projects. A recent study by NOAA and Biohabitats of over 200 mitigation projects undertaken in the New York/New Jersey Harbor Estuary found the causes for failure were typically related to poor siting due to lack of understanding of locational criteria and inadequate funding for baseline studies and follow-up maintenance.

Within the framework of adaptive management, it is important to develop measurable goals that are related to mitigation actions. Determination of the relative effectiveness of the mitigation actions will allow for a greater ability to prioritize these actions.

Clear goals need to be set (e.g. no net loss of the Critical Habitat value), and then the objectives need to be developed to provide specific, measurable targets. In some cases the objectives are quantitative (such as "mitigate ___ acres of habitat"), and in others, the targets may be more qualitative. This system enables a range of specificity when attempting to rate the amount of progress made towards a certain objective. For easily quantifiable metrics, there will be objectives that clearly measure quantity and type. The more difficult, qualitative objectives (regarding function and quality) should be stated as clearly as possible. Progress toward these qualitative objectives can be evaluated, in part, in terms of the actions initiated or completed, although a rating of success is dependent upon a more descriptive, less absolute measure.

Submittal: Adaptive management plan that includes a statement of goals that can accurately track the measure quantifiable objectives related to quantity and type, as well as tools to measure qualitative objectives related to quality and function.

APPENDIX 2: FUNDAMENTALS OF THE ADAPTIVE MANAGEMENT PROCESS

The following list contains the major steps in the adaptive management (AM) process:

1. Cleary specify management goals.
2. Develop strategies for reaching those goals.
3. Gather field data to document conditions before a management strategy activity or action is implemented, then develop a model or description of those conditions, as well as for target conditions.
4. Implement management strategies.
5. Gather monitoring data, analyze results and conclusions reached on effects.
6. Formulate adaptations to management strategies based on the conclusions reached.
7. Adjust new management strategies based on conclusions drawn from the initial strategy; and
8. Carry out data collection.

A commitment from the management team must be made to complete each step in the process, and the commitment must be sustained until a satisfactory outcome is reached. Without these dedication, AM is not feasible and will not be successful.

Fundamental Organizational Structure

An organizational framework must be in place to effectively formulate management priorities, adaptive management goals and the strategies to achieve those goals. Historically, adaptive management concepts have been applied to large, complex natural resource management areas such as wilderness areas or populations of wild animals, and stakeholder meetings were used to develop management goals and objectives. There are two main groups that contribute to the AM process, the Goals and Objectives group and the Implementation group. The Goals and Objectives group confers together at regular intervals and is essential to develop goals and strategies for achieving those goals and may be comprised of stakeholders ranging from persons representing the land-holding entities to the general public. Overseeing the revision of goals and strategies based on on-going monitoring data and analysis is also one of the group's key functions. Specific members the group may want to include may be staff members from the various land holding entities, technical consultants from the staff of those entities, nearby universities, cooperating state resource agencies and representatives from the local community.

The Implementation group should include professionals with the technical expertise to assess existing conditions, implement management strategies in the field, monitor and accumulate accurate data for analysis, appropriately analyze the collected data, draw meaningful conclusions from the results and report those results in a timely and effective manner. This group is characterized by their ability to perform technical tasks, monitor the results of those actions, analyze the monitoring data with appropriate mathematical, statistical or technical expertise, and report the findings clearly, effectively and in a timely manner. The implementation group will need to involve natural resources agency staff and possibly researchers from local universities or state agency personnel.

While including members of the Goals and Objectives group in the Implementation group may not be productive in every case, it is advisable in almost every case to include members of the Implementation group in the Goals and Objectives group. Such cross-pollination is important because members of the Goals and Objectives group may not have the technical expertise to help implement the objectives, but the members of the Implementation team can lend valuable technical guidance when Goals and Objectives are being formulated, potentially making them more realistic and achievable.

It is important that the Goals and Objectives group understand how to formulate, in a technical sense, effective and feasible goals that the Implementation group can reasonably test and evaluate. Conversely, it is important that the Implementation group understands the intent of the Goals and Objectives, so that appropriate testing methodologies are developed to investigate the best way to achieve the Goals.

Fundamental Goal and Objectives Development

For AM to succeed, Goals and Strategies must be carefully crafted. This step is critical to AM success. The Department of the Interior (DOI) has perhaps more experience with AM and has reported the results from AM efforts more than any public natural resource management entity. The DOI guidance on goal and strategy development is clear and succinct, though not necessarily easily accomplished (Williams et al. 2009). That guidance states that objectives need to be:

- **Specific:** Objectives should be unambiguous, with specific metrics and specific target conditions. Specificity can be encouraged by articulating objectives with Who, What, Why, and/or Where phrases.

- **Measurable:** Objectives should contain elements that can be readily measured, so as to promote the evaluation of management actions and recognize their contributions to successful management.

- **Achievable:** Objectives should be based on the capacities of the natural resource system being managed and the political or social system within which management occurs.

- **Results-oriented:** Objectives should contain resource endpoints and/or conditions representing their achievement. For example, a results-oriented habitat objective might describe the habitat conditions expected when the objective is achieved.

- **Time-fixed:** Objectives should indicate the timeframe for achievement, consistent with the duration of the project. Project implementation may be in stages, but the overall timeframe should be clear.

Implementation, Monitoring, Feedback and Adaptation of Objectives to Meet Goals

Implementation: Implementation of the objectives must utilize a "model" or conceptualization of the system to which the objectives are being applied. For instance, if a certain treatment for control of invasive species is being tested, a "model" of non-infested vs. infested forest cover needs to be described in order to quantify acceptable levels of invasive species presence in both existing conditions and future condition terms. Or, if the objective is establishment of a certain forest cover type on a non-forested area, then the desired

suite of species and density of stems must be described, to use as a measurement milestone, in order to evaluate establishment success.

Monitoring: Monitoring is the method for measuring a given objective's performance. From the DOI guidance, "…learning that is at the heart of adaptive management occurs through a comparison of model-based predictions against estimated responses based on monitoring data. It is by means of these comparisons that monitoring is used to understand resource dynamics, and thus to confirm the most appropriate hypotheses about resource processes and their responses to management. By tracking useful measures of system response, well designed monitoring programs facilitate evaluation and learning in adaptive management."

At this point in the AM sequence, information is available to evaluate the performance of objectives used to achieve management goals. It is very important that the Implementation group possesses the expertise needed to determine how the information gathered in the field should be analyzed, so that valid results are obtained for consideration. Depending on how an objective is designed and implemented, the analysis may be mathematically straight-forward (e.g. tree seedling survival data from a planted area). An appropriate statistical analysis may be required if the objective design incorporates multiple variables, such as testing more than one type of site preparation, fertilization or maintenance regime on a grassland restoration site. As more variables are introduced and tested in an objective, the analysis of the results requires additional statistical and mathematical analysis techniques to identify meaningful differences in the results.

Feedback and Adaptation: As monitoring data are gathered and analyzed, the efficacy of the Objectives can be determined. Then either the Objectives can be modified to improve success or the Goals can be revised to accommodate the newest data. The process is repeated as for as long as needed to achieve management goals.

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TECHNICAL REPORT

The attached **Technical Report** details the data sources and methodology for creating the Species Tables used in the *Critical Habitat Conservation and Management Plan*. Questions regarding data sources can be directed to the GIS staff at the Highlands Council and the NJDEP Office of Information Technology.

SPECIES HABITAT TABLE FOR MUNICIPALITIES IN THE NEW JERSEY HIGHLANDS REGION

Purpose and Introduction

The Highlands Council (created by NJSA 13:20-4) requires conforming municipalities in the New Jersey Highlands develop a Critical Habitat Conservation and Management Plan (CHCMP) reflecting Goal 1F and Policies 1F1–1F5 of the Regional Master Plan (RMP). This document provides guidance on how to create a location-specific data table that will identify all local native wildlife species in need of conservation, as well as the land types that they inhabit. The resulting data table can inform planning and decision-making regarding **Critical Habitat** in the Highlands Region.

Per RMP Policy 1F1, **Critical Wildlife Habitat** is based upon NJDEP Landscape Project Version 3.3 data (2017), as described on pages 52–54 of the Highlands Ecosystem Management Technical Report. This data is created by the State of New Jersey for planning and stewardship purposes. To read an introductory summary of the Landscape project, visit NJDEP Landscape Project.[1a]

STEPS 1-2: Download, Clip, and Convert the Landscape Project Data into a Spreadsheet

Step 1a: Determine your municipality's Landscape Region

Most municipalities in the Highlands Planning Area or the Highlands Preservation Area are located entirely within the Skylands Region, and several municipalities may lie partly in the Piedmont Plains Region (**Figure 1**). To determine which region(s) is applicable to your municipality, consult the Landscape Region map data at NJDEP Bureau of GIS Landscape Regions[2]

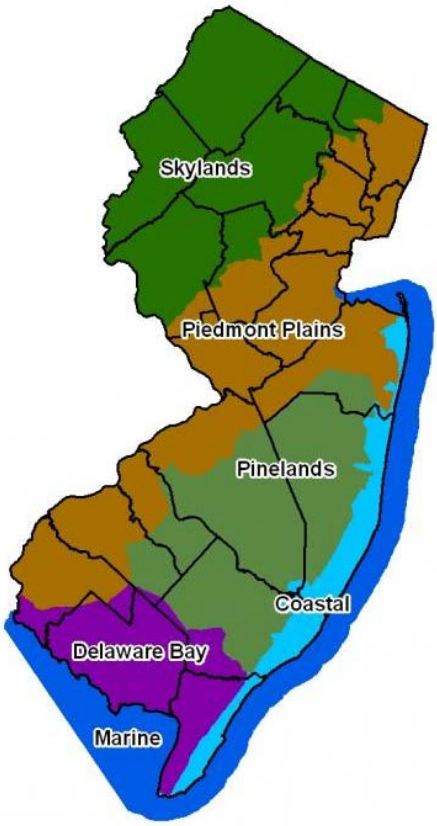


Figure 1. New Jersey Landscape Regions

[a] A NOTE ON DATA SOURCES: As of November 2019, all links to online GIS data sources have been verified functional. Please consult the NJDEP-BGIS or the NJOIT-OGIS for data acquisition questions.

Step 1b: Download the species table(s) for your Landscape Region(s)

Download the link for NJDEP Landscape 3.3 Species Table for Skylands Region of New Jersey.[3]

Download link for NJDEP Landscape 3.3 Species Table for Piedmont Plains Region of New Jersey.[4]

Examine the metadata to familiarize yourself with the data fields: LINKID, COMNAME, SCINAME, FEAT_LABEL, CLASS, and RANK.

Step 1c: Download the shapefile for your Landscape Region(s) (Fig. 2)

Download the link for the NJDEP Skylands Landscape Region[5]

Download the link for the Piedmont Plains Landscape Region.[6]

It is also recommended to review the metadata to become more familiar with data fields, particularly LINKID, LU12, LABEL12, and TYPE12.

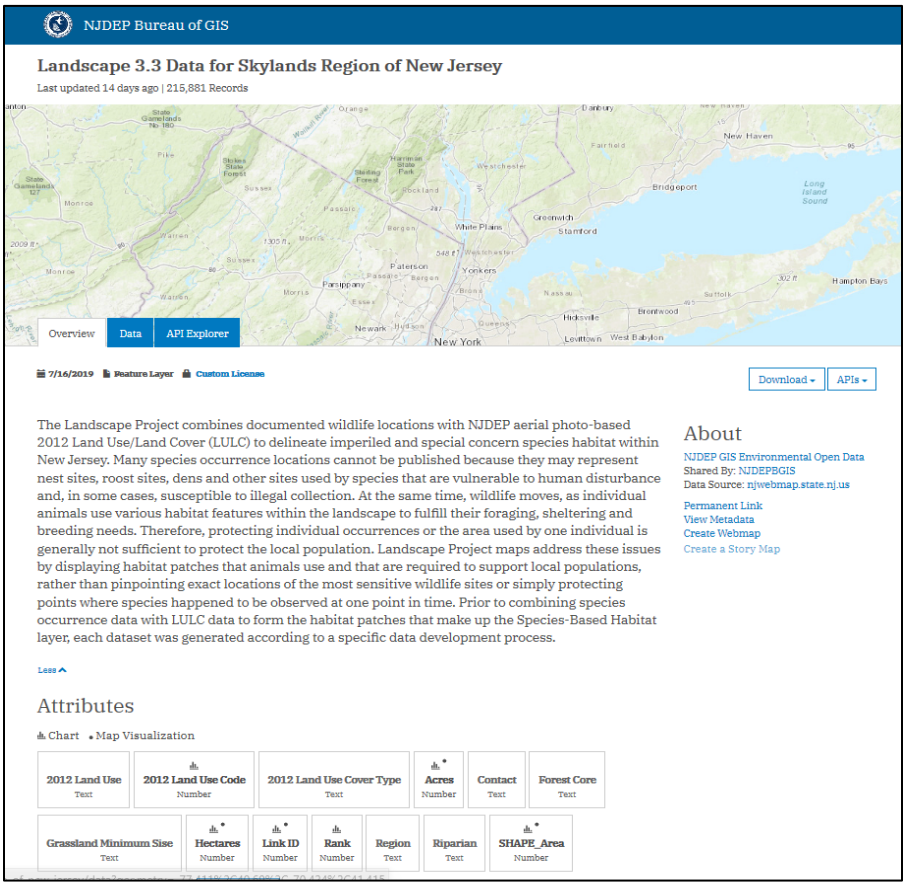


Figure 2. Skylands Region Download Page (NJDEP Bureau of GIS)

Step 2: Clip and Join in GIS application

Restrict the data to only your municipality. (This should be done using a "Clip" function in ArcMap or other appropriate GIS software.) Then join the clipped habitat data to the unclipped species data, using the field LINKID as the joining attribute. Export the joined table to Excel. The resulting spreadsheet will become the "master sheet" for later reference.

STEP 3: Species Taxonomy and Conservation

Once data has been obtained from the NJDEP Highlands GIS database, the information needs to be simplified for incorporation into the CHCMP. At the same time, it may also be beneficial at this point to add additional species information to aid analysis.

It is recommended to create working copies of the master sheet for this step and the next step.

In order to provide succinct information on species taxonomy and conservation status for each species, first use the Excel command "Remove duplicates," selecting only:

- "common name"
- "scientific name"
- "class"
- "species rank"

In some cases, the species will have two species conservation ranks (e.g., bald eagles may be both ranks 4 and 3); retain the higher number for simplicity's sake.

You can hide the extra columns in the master sheet, or you may wish to copy those four columns with the simplified information into a new sheet, leaving the master sheet intact.

Optional columns: at this point, you have the option of adding columns with additional taxonomic and conservation information. This information can be added manually or joined with another table if the data is available in Excel table format.

3a.) You may add columns for additional taxonomic classifications (such as taxonomic order or lay classifications such as "songbird" or "raptor") to aid in later analysis.
3b.) It is also optional to add a column for Highlands Conservation Rank, this information is available through the Highlands Council staff.

3c.) Finally, you may wish to add a column indicating whether a particular species is facultatively or obligately dependent on vernal pools.

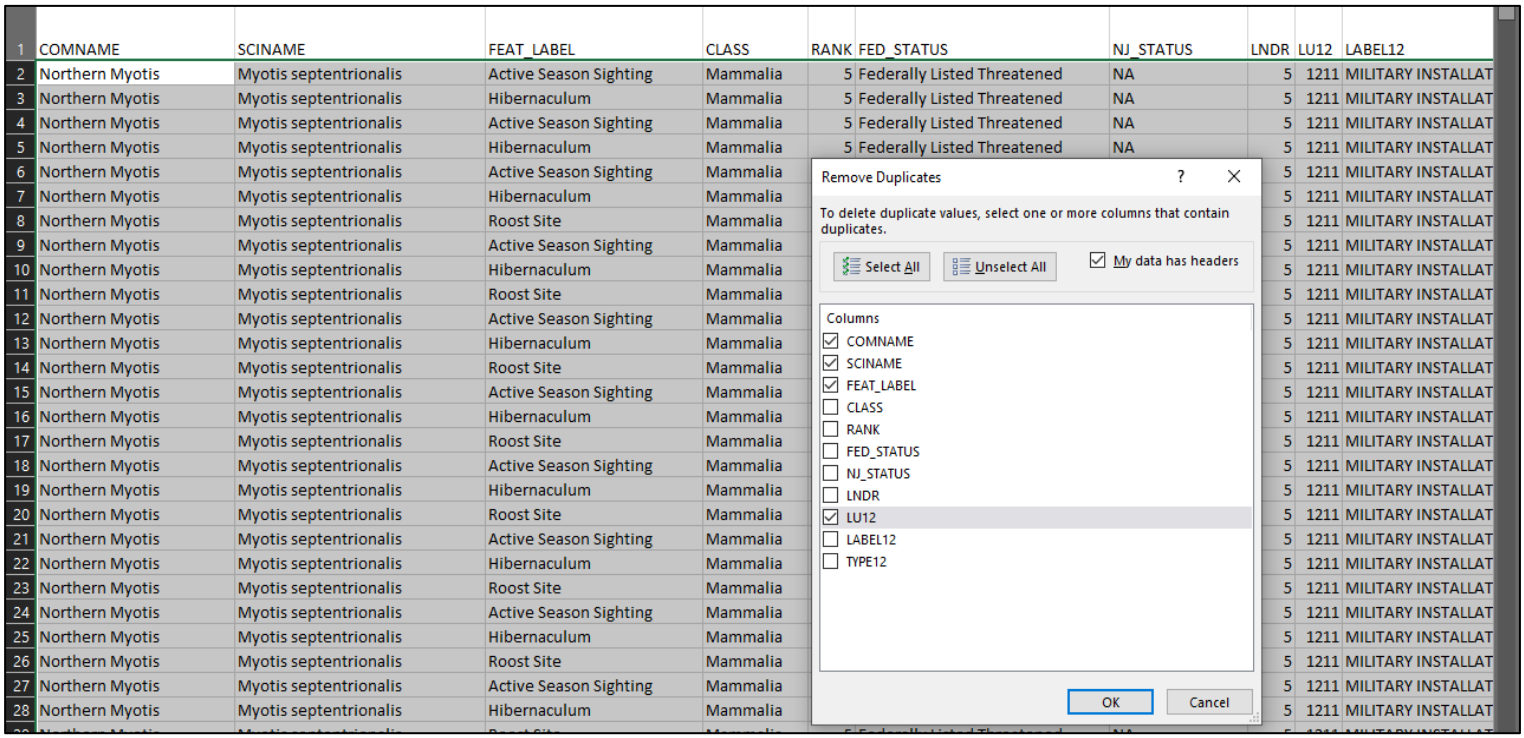
STEPS 4-6: Species Habitat Type and Sighting Type

Step 4:

Next, you will create columns that identify which land types are used by which species within your municipal geography. Once again, on a master sheet copy, use "Remove duplicates" in Excel (**Figure 3**) but this time select only:

- Species name (COMNAME / SCINAME -- either or both are fine)
- Sighting Type (column labeled FEAT_LABEL)
- Land Cover (LU12 numeric code / LABEL12 descriptive text -- either or both)

Then, hide or delete all other columns and copy the relevant information into a new sheet.



	COMNAME	SCINAME	FEAT_LABEL	CLASS	RANK	FED_STATUS	NJ_STATUS	LNDR	LU12	LABEL12
2	Northern Myotis	Myotis septentrionalis	Active Season Sighting	Mammalia	5	Federally Listed Threatened	NA	5	1211	MILITARY INSTALLAT
3	Northern Myotis	Myotis septentrionalis	Hibernaculum	Mammalia	5	Federally Listed Threatened	NA	5	1211	MILITARY INSTALLAT
4	Northern Myotis	Myotis septentrionalis	Active Season Sighting	Mammalia	5	Federally Listed Threatened	NA	5	1211	MILITARY INSTALLAT
5	Northern Myotis	Myotis septentrionalis	Hibernaculum	Mammalia	5	Federally Listed Threatened	NA	5	1211	MILITARY INSTALLAT
6	Northern Myotis	Myotis septentrionalis	Active Season Sighting	Mammalia				5	1211	MILITARY INSTALLAT
7	Northern Myotis	Myotis septentrionalis	Hibernaculum	Mammalia				5	1211	MILITARY INSTALLAT
8	Northern Myotis	Myotis septentrionalis	Roost Site	Mammalia				5	1211	MILITARY INSTALLAT
9	Northern Myotis	Myotis septentrionalis	Active Season Sighting	Mammalia				5	1211	MILITARY INSTALLAT
10	Northern Myotis	Myotis septentrionalis	Hibernaculum	Mammalia				5	1211	MILITARY INSTALLAT
11	Northern Myotis	Myotis septentrionalis	Roost Site	Mammalia				5	1211	MILITARY INSTALLAT
12	Northern Myotis	Myotis septentrionalis	Active Season Sighting	Mammalia				5	1211	MILITARY INSTALLAT
13	Northern Myotis	Myotis septentrionalis	Hibernaculum	Mammalia				5	1211	MILITARY INSTALLAT
14	Northern Myotis	Myotis septentrionalis	Roost Site	Mammalia				5	1211	MILITARY INSTALLAT
15	Northern Myotis	Myotis septentrionalis	Active Season Sighting	Mammalia				5	1211	MILITARY INSTALLAT
16	Northern Myotis	Myotis septentrionalis	Hibernaculum	Mammalia				5	1211	MILITARY INSTALLAT
17	Northern Myotis	Myotis septentrionalis	Roost Site	Mammalia				5	1211	MILITARY INSTALLAT
18	Northern Myotis	Myotis septentrionalis	Active Season Sighting	Mammalia				5	1211	MILITARY INSTALLAT
19	Northern Myotis	Myotis septentrionalis	Hibernaculum	Mammalia				5	1211	MILITARY INSTALLAT
20	Northern Myotis	Myotis septentrionalis	Roost Site	Mammalia				5	1211	MILITARY INSTALLAT
21	Northern Myotis	Myotis septentrionalis	Active Season Sighting	Mammalia				5	1211	MILITARY INSTALLAT
22	Northern Myotis	Myotis septentrionalis	Hibernaculum	Mammalia				5	1211	MILITARY INSTALLAT
23	Northern Myotis	Myotis septentrionalis	Roost Site	Mammalia				5	1211	MILITARY INSTALLAT
24	Northern Myotis	Myotis septentrionalis	Active Season Sighting	Mammalia				5	1211	MILITARY INSTALLAT
25	Northern Myotis	Myotis septentrionalis	Hibernaculum	Mammalia				5	1211	MILITARY INSTALLAT
26	Northern Myotis	Myotis septentrionalis	Roost Site	Mammalia				5	1211	MILITARY INSTALLAT
27	Northern Myotis	Myotis septentrionalis	Active Season Sighting	Mammalia				5	1211	MILITARY INSTALLAT
28	Northern Myotis	Myotis septentrionalis	Hibernaculum	Mammalia				5	1211	MILITARY INSTALLAT

Figure 3. "Remove Duplicates" Command to Identify Relevant Land Types

Step 5:

In a new worksheet, create a Pivot Table with the NJDEP Land Use/Land Cover (LU/LC) data (**Figure 4**). You can sort this information in several different ways, but it is recommended to use LU12 (or LABEL 12) and FEAT_LABEL as columns, COMNAME (or SCINAME) as rows, and Count of FEAT_LABEL as sum values. You will need this information to create the habitat matrix.

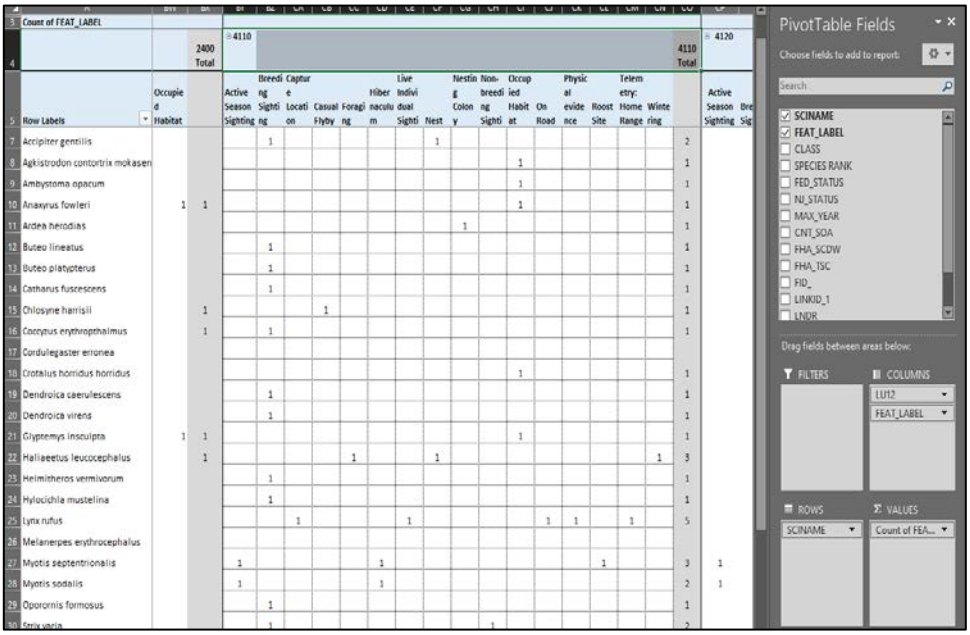


Figure 4. Pivot Table with NJDEP LU/LC Data

Step 6:

The next step is to combine the Sighting Type with the relevant Land Cover to create a matrix demonstrating what types of sightings occurred where for each individual species.

To do this, copy the pivot table to the clipboard, and paste "As Values" into a new worksheet. In this new worksheet, create an Excel formula for the cells in non-Total columns, wherein a value of "1" sets a value equal to the column heading. (A simpler, method, albeit more tedious, is to copy and paste manually.)

In the "Total" columns only, set every cell to concatenate all columns for that land cover using the "concatenate" or "text join" function. It is advisable to save a backup worksheet at this point.

Delete all columns except for the "Total" columns for each land cover type. The matrix is now formatted wherein each cell in a given column is populated with the Sighting type (e.g., Occupied Habitat, Nest, Casual Flyby, Breeding Sighting) for that particular species in that particular land cover. The species and land use information can then be copied and pasted into the worksheet with the taxonomic and conservation status to create a single, comprehensive species matrix sheet (**Figure 5**).

	A	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
1	Species - Common Name								AGRICULTURE LU/LC			FOREST LU/LC											WATER LU/LC		
2	*LULC Sub-TYPE	1463 Upland Rights-of-Way, Undeveloped	1499 Stormwater Basin	1700 Other Urban or Built-up Land	1710 Cemetery	1750 Managed Wetland, in Maintained Lawn Green space	1800 Recreational Land	1850 Managed Wetland, in Built-up Maintained Rec Area	2100 Cropland and Pasturelnd	2140 Agricultural Wetlands (Cranberry Farms & Modified Uplands)	2400 Other Agricultur e	4110 Deciduous Forest (10-50% Crown Closure)	4120 Deciduous Forest (>50% Crown Closure)	4210 Coniferous Forest (10-50% Crown Closure)	4220 Coniferous Forest (>50% Crown Closure)	4311 Mixed Forest (>50% Coniferous with 10-50% Crown Closure)	4312 Mixed Forest (>50% Coniferous with >50% Crown Closure)	4322 Mixed Forest (>50% Deciduous with >50% Crown Closure)	4410 Old Field (< 25% Brush Covered)	4420 Deciduous Brush/Shrubland	4430 Coniferous Brush/Shrubland	4440 Mixed Deciduous/Coniferous Brush/Shrubland	5100 Streams and Canals	5200 Natural Lakes	5300 Artificial Lakes
3	Bald Eagle									Nest	Nest	Foraging; Nest; Wintering	Foraging; Nest; Wintering	Nest	Nest; Wintering		Foraging; Nest; Wintering	Foraging; Nest; Wintering	Nest	Nest		Nest	Foraging; Nest	Foraging; Nest; Wintering	Foraging; Nest; Wintering
4	Barred Owl	Breeding Sighting; Non-breeding Sighting										Breeding Sighting; Non-breeding Sighting	Breeding Sighting; Non-breeding	Breeding Sighting; Non-breeding	Breeding Sighting; Non-breeding	Breeding Sighting; Non-breeding	Breeding Sighting; Non-breeding	Breeding Sighting; Non-breeding							
5	Black-billed Cuckoo	Breeding Sighting		Breeding Sighting			Breeding Sighting		Breeding Sighting	Breeding Sighting	Breeding Sighting	Breeding Sighting	Breeding Sighting	Breeding Sighting	Breeding Sighting		Breeding Sighting	Breeding Sighting	Breeding Sighting	Breeding Sighting	Breeding Sighting	Breeding Sighting			
6	Black-throated Blue Warbler	Breeding Sighting										Breeding Sighting	Breeding Sighting	Breeding Sighting	Breeding Sighting		Breeding Sighting	Breeding Sighting		Breeding Sighting		Breeding Sighting			
7	Black-throated Green Warbler	Breeding Sighting										Breeding Sighting	Breeding Sighting	Breeding Sighting	Breeding Sighting		Breeding Sighting	Breeding Sighting		Breeding Sighting		Breeding Sighting			
8	Bobcat	Capture Location; Live Individual Sighting; On Road;							Capture Location; Live Individual Sighting; On Road;	Capture Location; Live Individual Sighting; On Road;		Capture Location; Live Individual Sighting; On Road;	Capture Location; Live Individual Sighting;	Capture Location; Live Individual Sighting;	Capture Location; Live Individual Sighting;	On Road	Capture Location; Live Individual Sighting;	Capture Location; Live Individual Sighting;	Capture Location; Live Individual Sighting;	Capture Location; Live Individual Sighting;	Live Individual Sighting; On Road	Capture Location; Live Individual Sighting;		
9	Broad-winged Hawk											Breeding Sighting	Breeding Sighting	Breeding Sighting	Breeding Sighting		Breeding Sighting	Breeding Sighting							
10	Cooper's Hawk											Breeding Sighting; Nest	Breeding Sighting;	Breeding Sighting;	Breeding Sighting;		Breeding Sighting;	Breeding Sighting;							
11	Eastern Box Turtle	Occupied Habitat				Occupied Habitat		Occupied Habitat		Occupied Habitat	Occupied Habitat	Occupied Habitat	Occupied Habitat	Occupied Habitat	Occupied Habitat		Occupied Habitat	Occupied Habitat	Occupied Habitat	Occupied Habitat		Occupied Habitat			
12	Fowler's Toad		Occupied Habitat							Occupied Habitat	Occupied Habitat	Occupied Habitat	Occupied	Occupied	Occupied		Occupied	Occupied	Occupied	Occupied		Occupied		Occupied	Occupied
13	Golden-winged Warbler											Breeding Sighting	Breeding Sighting	Breeding Sighting	Breeding Sighting		Breeding Sighting	Breeding Sighting	Breeding Sighting	Breeding Sighting		Breeding Sighting			

Figure 5. Table with Concatenated Sighting Types in each Land Cover Column

STEP 7: Formatting for Readability

At this point it may also be preferable to format the table for readability. You may wish to include both the numeric code for LU12 and the descriptive LABEL 12 in the column header. You may also want to situate the specific land cover type in the second row down (**Figure 5**). Once the individual columns for each LU/LC sub-type have been created, they can then be color-coded according to their general category (i.e., Urban, Agricultural, Forest, Water, Wetlands, Barren). The general LU/LC type can be indicated in the first row of the sheet to aid in aggregation later.

Insert the columns from the **Step 3** worksheet result (taxonomy and conservation rank) into the current worksheet, making sure that the lists of species from both worksheets are in the same order.

STEPS 8-10: Simplifying Sighting Types and Habitat Types

Step 8:

Once this matrix has been created, the next step is to further condense it into a simplified, more easily understandable visual format. Create a new sheet existing of the same information in the same configuration, but with abbreviations for the Sighting Type separated by semicolons. Consult **Table 1** to match the Sighting Type to the correct Unique Abbreviation. (the simplified coding will become relevant in **Step 11**.)

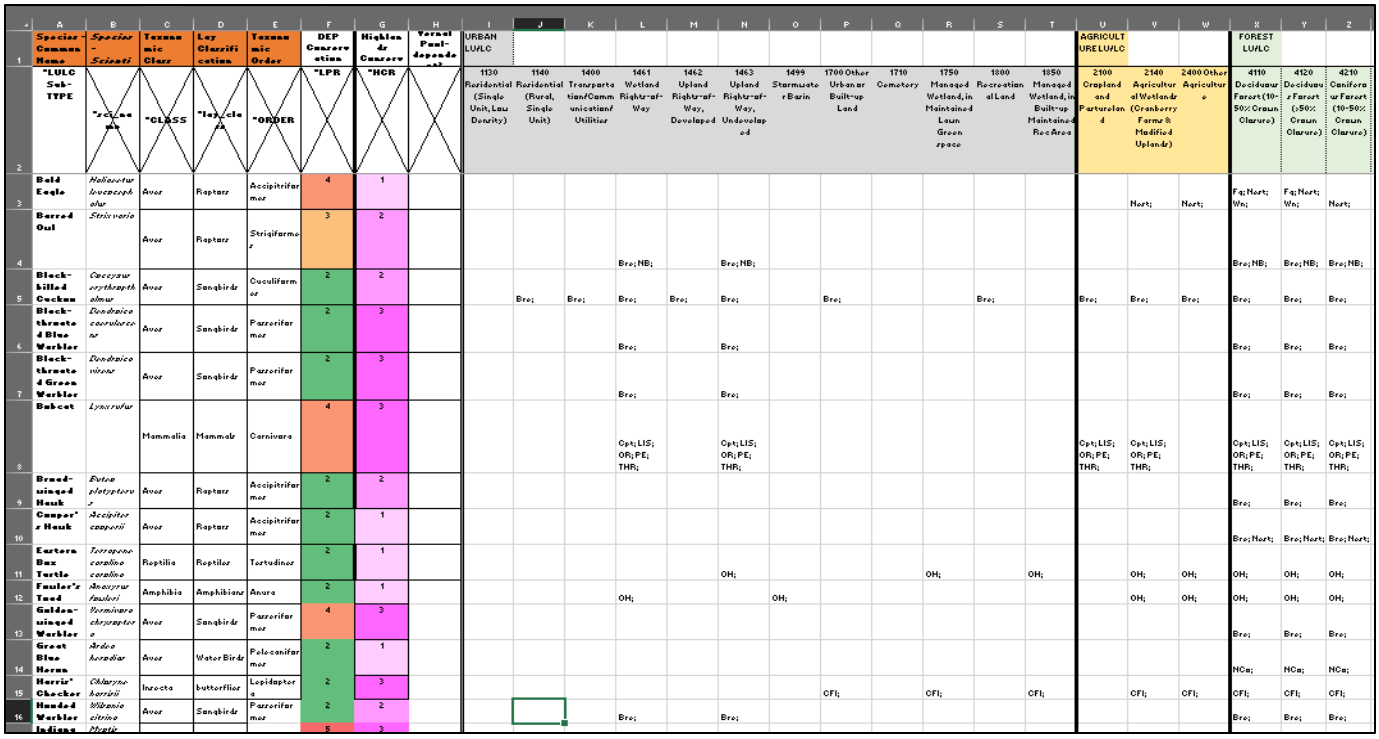
Table 1. Sighting Codes

LIST OF FEATURE LABELS (sighting type)	Unique Abbreviation	Simplified Coding
Breeding/Courtship	BrCo	br
Nest	Nest	br
Roosting Area	RA	br
Roost Site	RS	br
Territorial Display	TD	br
Foraging	Fg	f
Nectaring	Nct	f
Hibernaculum	HB	h
Maternity Colony	MC	mc

LIST OF FEATURE LABELS (sighting type)	Unique Abbreviation	Simplified Coding
Nesting Colony	NCo	nco
Occupied Habitat	OH	oh
Active Season Sighting	Actv	s
Breeding Sighting-Confirmed	BrCf	s
Breeding Sighting	Bre	s
Capture Location	Cpt	s
Casual Flyby	CFl	s
Exuviae Sighting	Exuv	s
Larvae Sighting	Larv	s
Live Individual Sighting	LIS	s
Non-breeding Sighting	NB	s
On Road	OR	s
Physical evidence	PE	s
Telemetry: Home Range	THR	s
Vernal Pool Breeding	VPB	vpb
Vernal Pool Non-breeding	VPN	vpnb
Wintering	Wn	w

This condensation can be done by creating a copy of the original sheet, then using the find/replace function to change the relevant Sighting Type into its abbreviated form (**Figure 6**).

Care must be taken to ensure that replacements don't introduce errors. If one were to "find/replace" all instances of "breeding sighting" with "Bre", the term "Nonbreeding Sighting" would also be affected. To avoid such errors, find/replace longer terms first.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	Species - Common Name	Species - Scientific	Taxonomic Class	Key Classification	Taxonomic Order	DEP Conservation	Highland Conservation	Vernal Pool-dependent	URBAN LU/LC												AGRICULTURE LU/LC			FOREST LU/LC		
2	*LULC Sub-TYPE	*SCIENTIFIC	*CLASS	*[illegible]	*ORDER	*LPR	*HCR		1130 Residential (Single Unit, Low Density)	1140 Residential (Rural, Single Unit)	1400 Transportation/Communication/Utilities	1461 Wetland Right-of-Way	1462 Upland Right-of-Way, Developed	1463 Upland Right-of-Way, Undeveloped	1499 Stormwater Basin	1700 Other Urban or Built-up Land	1710 Cemetery	1750 Managed Wetland, in Maintained Lawn Green space	1800 Recreational Land	1850 Managed Wetland, in Built-up Maintained Rec Area	2100 Cropland and Pasturelond	2140 Agricultural Wetlands (Cranberry Farms & Modified Uplands)	2400 Other Agricultur e	4110 Deciduous Forest (10-50% Crown Closure)	4120 Deciduous Forest (>50% Crown Closure)	4210 Coniferous Forest (10-50% Crown Closure)
3	Bald Eagle	*Haliaeetus leucocephalus*	Aves	Raptors	Accipitriformes	4	1																	Fq; Nort; Wn;	Fq; Nort; Wn;	Nort;
4	Barred Owl	*Strix varia*	Aves	Raptors	Strigiformes	3	2					Bro; NB;		Bro; NB;								Nort;	Nort;	Bro; NB;	Bro; NB;	Bro; NB;
5	Black-billed Cuckoo	*Coccyzus erythropthalmus*	Aves	Songbirds	Cuculiformes	2	2			Bro;	Bro;	Bro;	Bro;	Bro;		Bro;				Bro;	Bro;	Bro;	Bro;	Bro;	Bro;	Bro;
6	Black-throated Blue Warbler	*Dendroica caerulescens*	Aves	Songbirds	Passeriformes	2	3					Bro;		Bro;										Bro;	Bro;	Bro;
7	Black-throated Green Warbler	*Dendroica virens*	Aves	Songbirds	Passeriformes	2	3					Bro;		Bro;										Bro;	Bro;	Bro;
8	Bobcat	*Lynx rufus*	Mammalia	Mammals	Carnivora	4	3					Opt; LIS; OR; PE; THR;		Opt; LIS; OR; PE; THR;							Opt; LIS; OR; PE; THR;	Opt; LIS; OR; PE; THR;		Opt; LIS; OR; PE; THR;	Opt; LIS; OR; PE; THR;	Opt; LIS; OR; PE; THR;
9	Broad-winged Hawk	*Buteo platypterus*	Aves	Raptors	Accipitriformes	2	2																	Bro;	Bro;	Bro;
10	Cooper's Hawk	*Accipiter cooperii*	Aves	Raptors	Accipitriformes	2	1																	Bro; Nort;	Bro; Nort;	Bro; Nort;
11	Eastern Box Turtle	*Terrapene carolina carolina*	Reptilia	Reptiles	Testudines	2	1							OH;				OH;		OH;		OH;	OH;	OH;	OH;	OH;
12	Fowler's Toad	*Anaxyrus fowleri*	Amphibia	Amphibians	Anura	2	1					OH;			OH;							OH;	OH;	OH;	OH;	OH;
13	Golden-winged Warbler	*Vermivora chrysoptera*	Aves	Songbirds	Passeriformes	4	3																	Bro;	Bro;	Bro;
14	Great Blue Heron	*Ardea herodias*	Aves	Water Birds	Pelecaniformes	2	1																	NCa;	NCa;	NCa;
15	Harris' Checker	*Chlosyne harrisii*	Insecta	butterflies	Lepidoptera	2	3									CFI;		CFI;		CFI;			CFI;	CFI;	CFI;	CFI;
16	Hooded Warbler	*Wilsonia citrina*	Aves	Songbirds	Passeriformes	2	2					Bro;		Bro;										Bro;	Bro;	Bro;
	Indiana	*Myotis*				5	3																			

Figure 6. Species Table with Abbreviated Sighting Types

Step 9:

The next step in the condensation process is to create a new sheet with the same information as the previous, accompanied by simplified, aggregated columns for each general Land Cover category. The aggregated columns should reduce each general Land Cover type as shown in **Table 2**. *Note:* Each bulleted point constitutes a separate column in the aggregated sheet, and some disaggregated codes are recategorized (marked with an asterisk*) as a different general type.

Table 2. Aggregated Land Cover Types for Species Table

General Land Cover Type	Old Columns: Disaggregated Numeric Codes	New Columns: Aggregated Types (Numeric codes)
Urban	1120, 1130, 1140, 1211, 1400, 1419*, 1440, 1461, 1462, 1463, 1499, 1700, 1710, 1711, 1750, 1800, 1850	• Housing (1120, 1130, 1140, 1700) • Shoulders and upland/wetland ROWs (1400, 1461, 1462, 1463) • Artificial Greenspace (1499, 1710, 1711, 1750, 1800, 1850) • Military and Airport (1211, 1440)
Barren	7100, 7200, 7300, 7400, 7430, 7500	• Sand or Rock Substrate (7100, 7200, 7300) • Altered and Transitional Areas (7400, 7430, 7500)

General Land Cover Type	Old Columns: Disaggregated Numeric Codes	New Columns: Aggregated Types (Numeric codes)
Agricultural	2100, 2140*, 2150*, 2200, 2300, 2400	• Croplands, Pastures, Hort, and Other Agriculture (2100, 2200, 2300, 2400)
Forest	4110, 4120, 4210, 4220, 4230, 4311, 4312, 4321, 4322, 4410, 4411, 4420, 4430, 4440	• Deciduous (4110, 4120) • Coniferous (4210, 4220, 4230) • Mixed Forest (4311, 4312, 4321, 4322) • Brushland and Shrubland (4410, 4411, 4420, 4430, 4440)
Water	5100, 5200, 5300	• Surface Waters (1419*, 5100, 5200, 5300)
Wetlands	6120, 6210, 6220, 6221, 6231, 6232, 6233, 6234, 6240, 6241, 6251, 6252	• Forested Wetlands (6210, 6220, 6221, 6251, 6252) • Scrub-Shrub Wetland (6231, 6232, 6233, 6234) • Emergent & Ag Wetlands (2140*, 2150*, 6120, 6240, 6241)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	
1	Species - Common Name	Species - Scientif	Taxonomic Class	Lay Classification	Taxonomic Order	DEP Conservation Rank	Highlands Conservation Rank	Vernal Pool-dependent?	urban aggregated			URBAN LU/LC												barren aggregated		B N
2	*LULC Sub-TYPE	*sci_name	*CLASS	*lay_class	*ORDER	*LPR	*HCR		Housing 1130, 1140, 1700	Shoulders and upland/wetland ROWs 1400, 1461, 1462, 1463	Artificial Greenspace 1499, 1710, 1750, 1800, 1850	1130 Residential (Single Unit, Low Density)	1140 Residential (Rural, Single Unit)	1400 Transportation/Communication/Utilities	1461 Wetland Rights-of-Way	1462 Upland Rights-of-Way, Developed	1463 Upland Rights-of-Way, Undeveloped	1499 Stormwater Basin	1700 Other Urban or Built-up Land	1710 Cemetery	1750 Managed Wetland, in Maintained Lawn Green space	1800 Recreational Land	1850 Managed Wetland, in Built-up Maintained Rec Area	sand or rock substrate 7100, 7200	altered and transitional areas 7430, 7500	B
3	Bald Eagle	Haliaeetus leucocep	Aves	Raptors	Accipitriformes	4	1																		Nest; Wn;	
4	Barred	Strix varia	Aves	Raptors	Strigiform	3	2			Bre; NB;					Bre; NB;		Bre; NB;									
5	Black-billed Cuckoo	Coccyzus erythropt	Aves	Songbirds	Cuculiformes	2	2		Bre;	Bre;	Bre;		Bre;	Bre;	Bre;	Bre;	Bre;		Bre;			Bre;				
6	Black-throated Blue Warbler	Dendroica caerulesc ens	Aves	Songbirds	Passeriformes	2	3			Bre;					Bre;		Bre;									
7	Black-throated Green Warbler	Dendroica virens	Aves	Songbirds	Passeriformes	2	3			Bre;					Bre;		Bre;									
8	Bobcat	Lynx rufus	Mammalia	Mammals	Carnivora	4	3			Cpt; LIS; OR; PE; THR;					Cpt; LIS; OR; PE; THR;		Cpt; LIS; OR; PE; THR;									
9	Broad-winged Hawk	Buteo platypteru s	Aves	Raptors	Accipitriformes	2	2																			
10	Cooper's Hawk	Accipiter cooperii	Aves	Raptors	Accipitriformes	2	1																			
11	Eastern Box Turtle	Terrapen e carolina carolina	Reptilia	Reptiles	Testudines	2	1			OH;	OH;						OH;				OH;		OH;		OH;	
12	Fowler's Toad	Anaxyrus fowleri	Amphibia	Amphibians	Anura	2	1			OH;	OH;				OH;			OH;							OH;	
13	Golden-winged Warbler	Vermivor a chrysopt	Aves	Songbirds	Passeriformes	4	3																			

Figure 7. Species Table with Simplified Land Cover Types

To produce these new columns, first create a copy of the previous sheet (so that the previous ones can be used for verification later, it is recommended to protect the earlier sheets to avoid introducing errors). To the left of each set of disaggregated land cover types, insert the relevant

number of columns for the aggregated Land Use types. For each of these columns, copy the data from the relevant disaggregated columns into the new cells (e.g., for the aggregated Housing column, insert data from columns 1130, 1140, and 1700). The result should be a matrix that includes columns for both aggregated and disaggregated LU/LC types side by side.

Step 10:

The final combined species matrix will contain the species names alongside their associated aggregated LU/LC columns. Create a copy of the previous sheet to create an intermediate-stage backup. Next, delete the disaggregated LU/LC columns to create the simplified sheet.

STEP 11: Simplifying Sighting Types Further

To create a further-simplified public-facing species matrix table, begin with the final combined species matrix from the **Step 10**. Referring to the table from **Step 8**, replace the unique abbreviations with the simplified coding (**Figure 8**). It is recommended to create separate sheets for different species types: reptiles/amphibians, birds, mammals, and insects. To create each sheet, use Excel's sort function to select only the relevant species of each type, then copy/paste the relevant data into the new public-facing document. One can then further simplify by excluding scientific names and LU12 numeric codes; by regularizing the width of columns; by orienting LULC descriptions horizontally; and by adding a key to Sighting Type abbreviations(**Figure 9**).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	**Species - Common Name**	***Species - Scientif***	**Taxonomic Class**	**Lay Classification**	**Taxonomic Order**	**DEP Conservation Rank**	**Highlands Conservation Rank**	**Vernal Pool-dependent?**	urban aggregated			barren aggregated		agriculture aggregated	forest aggregated			
2	***LULC Sub-TYPE**	***sci_name**	***CLASS**	***lay_class**	***ORDER**	***LPR**	***HCR**		Housing 1130, 1140, 1700	Shoulders and upland/wetland ROWs 1400, 1461,	Artificial Greenspace 1499, 1710, 1750, 1800, 1850	sand or rock substrate 7100, 7200	altered and transitional areas 7430, 7500	croplands, pastures, and other ag 2100, 2400	Deciduous 4110, 4120	Coniferous 4210, 4220	mixed forest 4311, 4312, 4322	brushland and shrubland 4410, 4420, 4430,
3	**Bald Eagle**	*Haliaeetus leucocep*	Aves	Raptors	Accipitriformes	4	1						br; w;	br;	f; br; w;	br; w;	f; br; w;	br;
4	**Barred Owl**	*Strix varia*	Aves	Raptors	Strigiform	3	2			s;					s;	s;	s;	
5	**Black-billed Cuckoo**	*Coccyzus erythropt*	Aves	Songbirds	Cuculiformes	2	2		s;	s;	s;			s;	s;	s;	s;	s;
6	**Black-throated Blue Warbler**	*Dendroica caerulescens*	Aves	Songbirds	Passeriformes	2	3			s;					s;	s;	s;	s;
7	**Black-throated Green Warbler**	*Dendroica virens*	Aves	Songbirds	Passeriformes	2	3			s;					s;	s;	s;	s;
8	**Bobcat**	*Lynx rufus*	Mammalia	Mammals	Carnivora	4	3			s;				s;	s;	s;	s;	s;
9	**Broad-winged Hawk**	*Buteo platypterus*	Aves	Raptors	Accipitriformes	2	2								s;	s;	s;	
10	**Cooper's Hawk**	*Accipiter cooperii*	Aves	Raptors	Accipitriformes	2	1								s; br;	s; br;	s; br;	
11	**Eastern Box Turtle**	*Terrapene carolina carolina*	Reptilia	Reptiles	Testudines	2	1			oh;	oh;		oh;	oh;	oh;	oh;	oh;	oh;
12	**Fowler's Toad**	*Anaxyrus fowleri*	Amphibia	Amphibians	Anura	2	1			oh;	oh;		oh;	oh;	oh;	oh;	oh;	oh;
13	**Golden-winged Warbler**	*Vermivora chrysopt*	Aves	Songbirds	Passeriformes	4	3								s;	s;	s;	s;
14	**Great Blue Heron**	*Ardea herodias*	Aves	Water Birds	Pelecaniformes	2	1								nco;	nco;	nco;	
15	**Harris' Checkersp**	*Chlosyne harrisii*	Insecta	butterflies	Lepidoptera	2	3		s;		s;	s;	s;	s;	s;	s;	s;	s;

Figure 8. Species Table with Merged Land Cover Types and Sighting

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	**Threatened and Endangered Species Habitats in the Borough of Kinnelon**														
2	**Habitat by Land Use & Cover Type.** Oh= Occupied Habitat														
3		urban aggregated			Barren aggregated		Agricultural	Forest				Surface Water	Wetlands		
4	**Reptile & Amphibian species**	Housing	Shoulders and upland/wetland ROWs	Artificial Greenspace	Altered and Transitional Areas	Sand or Rock substrate		deciduous	coniferous	mixed	Brushland and shrubland		Forested	scrub-shrub	Emergent
5	Fowler's Toad		oh;	oh;		oh;	oh;	oh;	oh;	oh;	oh;	oh;	oh;	oh;	oh;
6	Marbled Salamander		oh;					oh;			oh;		oh;	oh;	oh;
7	Eastern Box Turtle		oh;	oh;		oh;	oh;	oh;	oh;	oh;	oh;		oh;	oh;	oh;
8	Northern Copperhead		oh;		oh;			oh;	oh;	oh;	oh;		oh;	oh;	oh;
9	Timber Rattlesnake		oh;					oh;	oh;	oh;	oh;		oh;	oh;	
10	Wood Turtle		oh;	oh;	oh;	oh;	oh;	oh;	oh;	oh;	oh;		oh;	oh;	oh;

Figure 9. Habitat by Land Use and Cover Types in Kinnelon

Data Sources and References

[1] NJDEP Landscape Project. https://njdep.maps.arcgis.com/apps/Cascade/index.html?appid=6cd21ef042634609904beae390f34482.

[2] NJDEP Bureau of GIS. Landscape Regions. https://gisdata-njdep.opendata.arcgis.com/datasets/landscape-3-3-regions-of-new-jersey Alternate Link: https://gisdata-njdep.opendata.arcgis.com/datasets/56cc839c150d4ad38dbbaec5f551ca58_83.

[3] NJDEP Bureau of GIS. Landscape 3.3 Species Table for Skylands Region of New Jersey. https://gisdata-njdep.opendata.arcgis.com/datasets/landscape-3-3-species-table-for-skylands-region-of-new-jersey Alternate Link: https://gisdata-njdep.opendata.arcgis.com/datasets/707b47b3ebd84a05bec72464cb01a68f_118.

[4] NJDEP Bureau of GIS. Landscape 3.3 Species Table for Skylands Region of New Jersey.https://gisdata-njdep.opendata.arcgis.com/datasets/landscape-3-3-species-table-for-piedmont-plains-region-of-new-jersey Alternate Link: https://gisdata-njdep.opendata.arcgis.com/datasets/5499065318624361b487b6bfb1985af5_114.

[5] NJDEP Bureau of GIS. Landscape 3.3 Data for Skylands Region of New Jersey. https://gisdata-njdep.opendata.arcgis.com/datasets/landscape-3-3-data-for-skylands-region-of-new-jersey Alternate Link: https://gisdata-njdep.opendata.arcgis.com/datasets/66b2d839930f4bea801bcf14f6b5586c_85.

[6] NJDEP Bureau of GIS. Landscape 3.3 Data for Piedmont Plains Region of New Jersey. https://gisdata-njdep.opendata.arcgis.com/datasets/f84f7df34b1147e696131baeb6105596_87.

GLOSSARY

Frequently Used Terms in the CHCMP

Biodiversity
The variety of species, both plant and animal, that is collectively important to maintaining the ecological viability of natural systems.

Category One Waters
Waters designated in the tables in N.J.A.C. 7:9B1.15(c) through (h), for purposes of implementing the antidegradation policies set forth at N.J.A.C. 7:9B-1.5(d), for protection from measurable changes in water quality characteristics because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resource(s).

Critical Habitat
The full extent of habitat occupied by a precisely documented occurrence of a rare plant species or ecological community.

Critical Habitat Resource Area
Highlands Resource Area specifically delineated to encompass Critical Habitat in the Region and intended to protect (and where feasible, enhance) such areas.

Critical Wildlife Habitats
Habitats for rare, threatened or endangered wildlife species as identified through the Landscape Project of the NJDEP.

Developed Lands
Previously developed lands including residential, commercial, industrial and public service uses and attendant features.

Endangered Species
Species whose prospects for survival are in immediate danger because of a loss or change in habitat, over-exploitation, predation, competition, disease, disturbance or contamination.

Highlands Council
The Highlands Water Protection and Planning Council (Highlands Council) is a regional planning agency that works in partnership with municipalities and counties in the Highlands Region to encourage a comprehensive regional approach to implementing the 2004 Highlands Water Protection and Planning Act (the Highlands Act).

Highlands Open Waters
All springs, streams, wetlands and bodies of surface water, whether natural or artificial, located wholly or partially within the boundaries of the Highlands Region.

Highlands Region
The area designated pursuant to the Highlands Water Protection and Planning Act; an over 800,000-acre region covering over 1,250 square miles and 88 municipalities in seven counties (Bergen, Hunterdon, Morris, Passaic, Somerset, Sussex and Warren.

Highlands Waiver Policies 7G1 and 7G2
Policy 7G1: For the Preservation Area, coordinate with NJDEP during Highlands permit review for any major Highlands development including the review of waivers on a case-by-case basis: 1) if determined to be necessary in order to protect public health and safety; 2) for redevelopment in certain previously developed areas as identified by the Highlands Council, or 3) in order to avoid the taking of property without just compensation.

Policy 7G2: For both the Preservation Area and the Planning Area, a waiver may be issued by the Highlands Council on a case-by-case basis from the requirements of the RMP or any amendments to a master plan, development regulations, or other regulations adopted by a local government unit specifically to conform them with the RMP: 1) if determined to be necessary in order to protect public health and safety; 2) for redevelopment in certain previously developed areas as identified by the Highlands Council, or 3) in order to avoid the taking of property without just compensation. Any waiver issued shall be conditioned upon a determination that the proposed development meets the requirements prescribed for a finding as listed in Section 36.a of the Highlands Act to the maximum extent possible.

Landscape Project
Designed to guide strategic wildlife habitat conservation, the Landscape Project is a proactive, ecosystem-level approach for the long-term protection of imperiled species and their important habitats in New Jersey. The project began in 1994 by the NJDEP Division of Fish Wildlife's Endangered and Nongame Species Program (ENSP). The Landscape Project focuses on large land areas called "landscape regions" that are ecologically similar with regard to their plant and animal communities. Using an extensive database that combines imperiled and priority species location information with land-use/land-cover data, the ENSP has identified and mapped areas of critical importance for imperiled species within each landscape region.

Low Impact Development (LID) Best Management Practices
Low Impact Development is an environmentally sensitive approach to storm water management that emphasizes conservation and the use of existing natural site features integrated with distributed, small scale storm water controls to more closely mimic natural hydrologic patterns in residential, commercial and industrial settings.

Plan Conformance
Plan Conformance includes the revision of local planning and regulatory documents to integrate the land use and resource management requirements of the Highlands Act so those documents will conform to the goals, requirements and provisions of the Regional Master Plan (RMP). Plan conformance is required by the Highlands Act throughout the Preservation Area and is voluntary in the Planning Area.

Planning and Preservation Areas
In the Highlands Water Protection and Planning Act (Highlands Act), the Legislature designated specific boundaries within the Highlands Region as the Preservation Area and the Planning Area. The fundamental distinction between the Preservation and Planning Areas is that municipal and county conformance with the Regional Master Plan is required in the Preservation Area and is voluntary in the Planning Area. The Planning Area consists of nearly 445,000 acres located in 83 municipalities. There are five municipalities that lie entirely within the Preservation Area, 47 municipalities that have land in both the Preservation and Planning Areas and 36 municipalities that have land only in the Planning Area

Rare Species
Those species which may be widely distributed in the state but consist of restricted distribution and/or population levels and have experienced recent declines in populations that may jeopardize their continued survival in the state if current trends continue.

Riparian
Of, or pertaining to, the bank of a river or stream.

Riparian Area
Areas adjacent to rivers and streams that exhibit period inundation or saturation of soils, are subject to periodic flooding and include wildlife corridors within 300 feet of a surface water feature.

Significant Natural Area
A site or area, typically with unusual or exemplary floristic qualities, that constitutes an outstanding example of that particular resource type (such as bog, forest or geological feature).

Species of Special Concern
Nongame wildlife species that warrants special attention because of inherent vulnerability to environmental deterioration or habitat modification that would result in it becoming threatened if conditions surrounding the species begin or continue to deteriorate.

Threatened Species
Species who may become endangered if conditions surrounding them begin to or continue to deteriorate.

Vernal Pool
Confined, ephemeral wet depressions, either natural or man-made, that support distinctive, and often endangered, species that are specially adapted to periodic extremes in water pool levels.

References

New Jersey Highlands Water Protection and Planning Council. (2008). Highlands Regional Master Plan.
https://www.highlands.state.nj.us/njhighlands/master/rmp/final/highlands_rmp_112008.pdf.

New Jersey Highlands Water Protection and Planning Council. (2008) Highlands Ecosystem Management Technical Report.
https://www.nj.gov/njhighlands/master/tr_ecosystem_management.pdf.

New Jersey Highlands Water Protection and Planning Council. https://www.nj.gov/njhighlands/.

New Jersey Department of Environmental Protection (NJDEP). Landscape Project Report Version 3.3. https://www.state.nj.us/dep/fgw/ensp/landscape/lp_report_3_3.pdf.

NJDEP Division of Fish and Wildlife. New Jersey's Landscape Project.
https://www.state.nj.us/dep/fgw/ensp/landscape/.

Habitat Features and Species Occurrence

Table 1. Habitat Features - Definitions

Feature Label	Definition
Active Season Sighting	A sighting of live individual(s) or physical evidence during the active season.
Breeding Sighting (Birds)	Observed (seen or heard) during safe dates,[a] no other indication of nesting activity.
Breeding Sighting-Confirmed (Birds)	Location of suitable habitat where any of the following occurs: calling or conducting territorial behavior, adults in courtship, carrying nesting material, feeding young or the presence of unfledged young.
Breeding/Courtship (Insects)	Observation of mated and/or tandem pairs, oviposition and courtship behavior.
Capture Location (Mammals)	Any location where an animal has been captured in a live trap or snare.
Casual Flyby (Insects)	Individuals that are identifiable but that cannot be specifically attributed to any habitat.
Exuviae Sighting (Insects)	Presence of exuvial shells on stream bands, shorelines, vegetation or other platforms (e.g. bridge abutments).
Foraging (Birds)	Feeding area based on observations and/or proximity to a known nest or nesting colony.

[a] NJDEP has safe date periods when surveys for threatened or endangered species are valid, and the dates vary with species; usually averaging mid- April to mid-June but not always; it depends on a species life cycle, territoriality, or breeding times.

Feature Label	Definition
Foraging (Insects)	Observation of individual(s) (often juvenile or teneral) utilizing uplands or fields adjacent to water or feeding.
Hibernaculum (Mammals)	A shelter occupied during the winter by a dormant animal.
Larvae Sighting (Insects)	Confirmed presence of larvae.
Live Individual Sighting	Positively identified live individual(s).
Maternity Colony	A place where females raise young and customarily settle down for rest or sleep.
Nectaring (Insects)	Observation of individual or multiple individuals utilizing a nectar or fluid source.
Nest	Nest location confirmed.
Nesting Colony	Area containing at least 1 pair of nesting birds.
Non-breeding Sighting (Birds)	1 or more birds observed before or after core breeding season or during migration.
Non-breeding Sighting (Amphibian)	Occurrence in a non-vernal aquatic habitat, with no evidence of breeding.
Occupied Habitat	A sighting of live individual(s) or physical evidence.
On Road	Individual(s) observed on a road (alive, dead, or injured).
Physical evidence	Physical evidence left by an individual such as tracks, scat, hair, etc.
Roost Site	A place where males or females settle down for sleep and rest but is not used to raise young.
Roosting Area	Evidence of recurring presence of multiple individuals outside their breeding season (including historical), particularly nighttime locations and communal roosts.
Telemetry: Home Range	Line or polygon created based upon approximately one year of telemetry data.
Territorial Display (Insects)	Observation of males holding obvious territories or flying consistent patrols over a given area.
Vernal Pool Breeding	Evidence of breeding in a vernal pool.
Vernal Pool Non-breeding	Occurrence in a vernal pool, with no evidence of breeding.
Wintering (Birds)	One or more birds observed in January or in the course of the Midwinter Eagle Survey.
Source: Kerri Smith, Biotics & GIS Database Manager at the NJDEP-ENSP Landscape Project (October 2019)	

Land Use/Land Cover Mapping: Codes and Terminology

NJDEP 2015 Land Use / Land Cover Update and Impervious Surface Mapping Project: Modified Anderson System

In 2013, The New Jersey Department of Environmental Protection (NJDEP) contracted Aerial Information Systems, Inc. (AIS) to revise the State's existing GIS Land Use/Land Cover and Impervious Surface, (LU/LC) database. The LU/LC layer is a resource for trend analysis. In the NJ Highlands Region, there are 58 LU/LC types which support Critical Habitat for rare, threatened and endangered species (**Table 2**).

Table 2. Anderson Land Use Classifications in the NJ Highlands Region for Critical Habitat

LU	LABEL	TYPE
1120	RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY	URBAN
1130	RESIDENTIAL, SINGLE UNIT, LOW DENSITY	URBAN
1140	RESIDENTIAL, RURAL, SINGLE UNIT	URBAN
1211	MILITARY INSTALLATIONS	URBAN
1400	TRANSPORTATION/COMMUNICATION/UTILITIES	URBAN
1419	BRIDGE OVER WATER	WATER
1440	AIRPORT FACILITIES	URBAN
1461	WETLAND RIGHTS-OF-WAY	WETLANDS
1462	UPLAND RIGHTS-OF-WAY DEVELOPED	URBAN
1463	UPLAND RIGHTS-OF-WAY UNDEVELOPED	URBAN
1499	STORMWATER BASIN	URBAN
1700	OTHER URBAN OR BUILT-UP LAND	URBAN
1710	CEMETERY	URBAN
1711	CEMETERY ON WETLAND	WETLANDS
1750	MANAGED WETLAND IN MAINTAINED LAWN GREENSPACE	WETLANDS
1800	RECREATIONAL LAND	URBAN
1850	MANAGED WETLAND IN BUILT-UP MAINTAINED REC AREA	WETLANDS
2100	CROPLAND AND PASTURELAND	AGRICULTURE
2140	AGRICULTURAL WETLANDS (MODIFIED)	WETLANDS
2150	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	WETLANDS
2200	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	AGRICULTURE
2300	CONFINED FEEDING OPERATIONS	AGRICULTURE
2400	OTHER AGRICULTURE	AGRICULTURE
4110	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	FOREST
4120	DECIDUOUS FOREST (>50% CROWN CLOSURE)	FOREST
4210	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	FOREST
4220	CONIFEROUS FOREST (>50% CROWN CLOSURE)	FOREST
4230	PLANTATION	FOREST
4311	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	FOREST

LU	LABEL	TYPE
4312	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	FOREST
4321	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	FOREST
4322	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	FOREST
4410	OLD FIELD (< 25% BRUSH COVERED)	FOREST
4411	PHRAGMITES DOMINATE OLD FIELD	FOREST
4420	DECIDUOUS BRUSH/SHRUBLAND	FOREST
4430	CONIFEROUS BRUSH/SHRUBLAND	FOREST
4440	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	FOREST
5100	STREAMS AND CANALS	WATER
5200	NATURAL LAKES	WATER
5300	ARTIFICIAL LAKES	WATER
6120	FRESHWATER TIDAL MARSHES	WETLANDS
6210	DECIDUOUS WOODED WETLANDS	WETLANDS
6220	CONIFEROUS WOODED WETLANDS	WETLANDS
6221	ATLANTIC WHITE CEDAR WETLANDS	WETLANDS
6231	DECIDUOUS SCRUB/SHRUB WETLANDS	WETLANDS
6232	CONIFEROUS SCRUB/SHRUB WETLANDS	WETLANDS
6233	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	WETLANDS
6234	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	WETLANDS
6240	HERBACEOUS WETLANDS	WETLANDS
6241	PHRAGMITES DOMINATE INTERIOR WETLANDS	WETLANDS
6251	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	WETLANDS
6252	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	WETLANDS
7100	BEACHES	BARREN LAND
7200	BARE EXPOSED ROCK, ROCK SLIDES, ETC	BARREN LAND
7300	EXTRACTIVE MINING	BARREN LAND
7400	ALTERED LANDS	BARREN LAND
7430	DISTURBED WETLANDS (MODIFIED)	WETLANDS
7500	TRANSITIONAL AREAS	BARREN LAND

Definition of Land Use Codes:

1120 Residential (Single Unit, Medium Density): Residential urban/suburban neighborhoods greater than 1/8 acre and up to and including ½ acre lots.

1130 Residential (Single Unit, Low Density): Single unit residential neighborhoods with areas greater than ½ acre up to and including 1 acre lots.

1140 Residential (Single Unit): Single unit residential neighborhoods with lots that are at least 1 acre or larger. Found in sparsely populated regions surrounded by or adjacent to forested or agricultural lands. Also included are estates or modern sub-divisions with large lot sizes providing a density less than or equal to 1 dwelling unit per acre.

1211 Military Installations: Military bases and camps, armories, ordnance depots, missile sites, National Guard and Reserve armories are included in this category.

1400 Transportation, Communication, & Utilities: The transportation, communication, and utilities land uses are usually associated with the other Urban or Built-up Land categories.

1419 Bridges over Water: Areas in the dataset where polygonal water bodies intersect major roadways or roads.

1440 Airport Facilities: Contain parallel primary runways, smaller parallel taxi strips, intervening land, aircraft parking aprons, hangars, terminals, service buildings, navigation aids, fuel storage areas, parking lots, and limited buffer zones. This category also includes heliports and land associated with seaplane bases.

1461 Wetland Rights-of-Way: Rights-of-way that exist in former wetland areas, and which still exhibit evidence of soil saturation on the photography.

1462 Uplands Rights-of-Way, Developed: Upland rights-of-way that exist in Developed non-Urban areas. These rights-of-way are defined for the purposes of this project as utilities, meaning they are not necessarily electrical rights-of-way.

1463 Uplands Rights-of-Way, Undeveloped: Upland rights-of-way that exist in undeveloped non-Urban areas. As in the 1462 category, these rights-of-way are also defined as utilities, meaning they do not only include electrical rights-of-way.

1499 Stormwater Basins: They are typically located in office parks, commercial and industrial parks, and newer residential developments. They are often identifiable by the curved boundaries, interior drainage lines, and characteristic depressional shape.

1700 Other Urban or Built-Up Land: Undeveloped, open lands within urban areas. Some structures may be visible, other areas may be brush-covered or grassy. Large, managed, maintained lawns common to some residential areas, and those open areas of commercial/service complexes, educational installations, etc., are also included.

1710 Cemetery: Large tracts of primarily open land within urban areas. Large cemeteries can be identified by layout of driveways, lots, mausoleums and marking stones.

1711 Cemetery on Wetland: Areas that lie within cemetery boundaries and can be classified as wetlands.

1750 Managed Wetland in Maintained Lawn Greenspace: Included in this category are former natural wetlands areas that now are part of an altered managed landscape, but still exhibit signs of soil saturation on the imagery. These areas primarily vegetated by grasses that are routinely maintained.

1800 Recreational Land: Areas that have been specifically developed for recreational activities that are open to the general public.

1850 Managed Wetland in Built-up Maintained Recreation Area: Included in this category are former natural wetland areas that now are part of an altered managed recreational area, but still exhibit signs of soil saturation on the imagery.

2100 Cropland and Pastureland: This agricultural category contains lands managed for the production of both row and field crops and for the grazing of livestock. This category includes fallow croplands.

2140 Agricultural Wetlands (Modified): This category includes lands under cultivation that are modified former wetlands, and which still exhibit evidence of soil saturation on imagery. Included in this category are cranberry bogs and blueberry farms.

2150 Former Agricultural Wetland (Becoming Shrubby, not Built-up): This category includes areas identified as 2140 agricultural wetlands but are no longer under active cultivation. Eventually, these areas may develop into scrub/shrub wetland if active cultivation is not resumed.

2200 Orchards, Vineyards, Nurseries, and Horticultural Areas: This agricultural category contains lands that are intensively managed for the production of fruits, tress, ornamental plants, and vegetable seedlings.

2300 Confined Feeding Operations: This category contains specialized livestock and poultry production enterprises. These operations have high livestock populations in relatively small areas, resulting in a concentration of waste material.

2400 Other Agriculture: This category contains miscellaneous agricultural areas, including experimental fields, horse farms and isolated dikes and access roads.

4110 Deciduous Forest, 10-50% Crown Closure: This category includes deciduous forests that have crown closure greater than 10%, but less than 50%. Crown closure is the percentage of

forest area that contains vertical tree crowns. It provides an estimate of how dense the trees are in the forested area.

4120 Deciduous Forest, > 50% Crown Closure: This category includes deciduous forests with crown closure greater than 50%. The majority of New Jersey forests are in this category.

4210 Coniferous Forest, 10-50% Crown Closure: This category includes coniferous forests that have crown closure greater than 10%, but less than 50%.

4220 Coniferous Forest, > 50% Crown Closure: This category includes natural coniferous stands with crown closure greater than 50%.

4230 Plantation: This category includes conifer stands that have been artificially planted. This category includes stands planted for timber harvesting or Christmas tree farms.

4311 Mixed Forest (> 50% Coniferous with 10-50% Crown Closure): This category includes stands of mixed forest where coniferous make up more than 50% of the stand, with crown closure between 10% and 50%.

4312 Mixed Forest (> 50% Coniferous with > 50% Crown Closure)
This category includes mixed forest where coniferous make up more than 50% of the stand, with crown closure greater than 50%.

4321 Mixed Forest (> 50% Deciduous with 10-50% Crown Closure)
This category includes mixed forest where deciduous make up more than 50% of the stand, with crown closure between 10% and 50%.

4322 Mixed Forest (> 50% Deciduous with > 50% Crown Closure)
This category includes mixed forest where deciduous make up more than 50% of the stand, with crown closure greater than 50%.

4410 Old Field (< 25% Brush Covered)
This category includes open areas that have less than 25% brush cover. The predominant cover types are grasses, herbaceous species, and tree seedlings and/or saplings.

4411 Phragmites Dominate Old Field
This category includes herbaceous vegetation in open areas that is dominated by the invasive grass *Phragmites australis*.

4420 Deciduous Brush/Shrubland (> 25% Brush Covered with Deciduous Species Predominant > 75%): This category contains natural forested areas with deciduous species less than 20 feet in height. An area must have greater than 25% brush cover to be placed in this category. This category also contains inactive agricultural areas that have been grown over with brush.

4430 Coniferous Brush/Shrubland (> 25% Brush Covered with Coniferous Species Predominant > 75%): This category contains natural forested areas with coniferous species less than 20 feet

high. This category is for natural areas; therefore, Christmas tree farms should be placed in the Nursery category.

4440 Mixed Deciduous/Coniferous Brush/Shrubland (> 25% Brush Covered with a Mixture of Coniferous Species; < 75% of One Type): This category contains natural forested areas less than 20 feet in height with a mixture of coniferous and deciduous trees.

5100 Streams & Canals: Includes rivers, streams, canals, exposed flats and other linear water bodies that have a minimum width of 30 feet.

5200 Natural Lakes: This category includes water bodies that are non-flowing and naturally enclosed, including regulated natural lakes but excluding reservoirs.

5300 Artificial Lakes: All artificial impoundments of water. Water in this category includes water impounded for irrigation, flood control, municipal water supplies, recreation, landscaping and hydro-electric power or the result of an active extractive operation.

6120 Freshwater Tidal Marshes: These marshes are co-dominated by annual and perennial herbaceous vegetation on substrates associated with tidal waters with very low salinity. These marshes are found on the tidal Delaware River and tributaries downstream of Trenton to Salem and upstream of the saline marshes on the Atlantic drainage watercourses.

6210 Deciduous Wooded Wetlands: These wetlands are closed canopy swamps dominated by deciduous trees normally associated with watercourses, edges of marshes, and isolated wetlands.

6220 Coniferous Wooded Wetlands: These wetlands are closed canopy, dominated by coniferous tree species associated with watercourses, seeps, and low topographic land.

6221 Atlantic White Cedar Wetlands: Predominantly closed canopy, seasonally flooded wetlands of southern New Jersey dominated by Atlantic White Cedar, *Chamaecyparis thyoides*.

6231 Deciduous Scrub/Shrub Wetlands: Communities composed primarily of young saplings of deciduous tree species and woody shrubs.

6232 Coniferous Scrub/Shrub Wetlands: Communities composed primarily of young saplings of coniferous tree species and shrubs.

6233 Mixed Scrub/Shrub Wetlands with Deciduous Dominant: Brush and bog wetlands with a mixture of deciduous and coniferous species, with the deciduous species > 50% but < 75%.

6234 Mixed Scrub/Shrub Wetlands with Coniferous Dominant: Brush and bog wetlands with a mixture of deciduous and coniferous species, with the coniferous species > 50% but < 75%.

6240 Herbaceous Wetlands: Wetlands dominated by various herbaceous species that are not connected or associated with tidal waters. Lake edges, open flood plains and abandoned wetland agricultural fields are locations for this cover type.

6241 Phragmites Dominate Interior Wetlands: Contains herbaceous vegetation in interior wetland settings dominated by *Phragmites australis*.

6251 Mixed Wooded Wetlands (Deciduous Dominant): This category contains mixed wooded wetlands with the deciduous tree species > 50 % but < 75%.

6252 Mixed Wooded Wetlands (Coniferous Dominant): This category contains mixed wooded wetlands with the coniferous tree species > 50% but <75%.

7100 Beaches: Predominantly composed of sand and may occur at the land-water interface of oceans, bays and estuaries. Beaches are generally elongated non-vegetated buffering systems subject to the action of waves and tides.

7200 Bare Exposed Rock, Rock Slides: Areas lacking vegetation and composed of rock or rock faces are included in this category.

7300 Extractive Mining: Extractive operations include a wide variety of mining activities, both surface and subsurface. Included are stone quarries, gravel, sand and clay pits, and limestone quarries, to mention a few. Extractive industries are characterized by disturbed ground usually with depth, extractive machinery, buildings and roads for and with heavy equipment.

7400 Altered Lands: Altered lands are areas outside of an urban setting that have been changed due to man's activities other than for mining.

7430 Disturbed Wetlands (Modified): Former natural wetlands that have been altered by some form of clearing, leveling, grading, filling and/or excavating, but which still exhibit obvious signs of soil saturation on the imagery. They exist in areas shown on the US Soil Conservation Service soil surveys to have hydric soils, and exhibit the darker tonal signatures associated with saturated soils on the photography.

7500 Transitional Areas: Lands on which future site plans are being prepared, but do not yet exist on the land. Included are residential, commercial and industrial areas under construction.

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