CRITICAL HABITAT FOR FLORA AND FAUNA IN NEW JERSEY: REVISITING THE DEFINITION

FINAL REPORT

Scientific Advisory Board - Ecological Processes Standing Committee (EPSC)

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FOREWORD

Balancing human needs with the ability of ecosystems to provide the goods and services that we all depend on is a fundamental formula for the global sustainability transition. Responsible decision-makers have called for the prioritization of uses in order to minimize conflicts, protect resources, and ensure that all uses are compatible with sustainability goals. The public interest is addressed through recommendations to balance long- and short-term strategies for sustaining human life support systems while building thriving economies and quality of life for all citizens.

Most New Jerseyans now recognize that natural resources are not inexhaustible, and a widespread call for fundamental shifts in governance, political will, and resource management is underway. The challenges we face in moving towards a sustainable New Jersey are substantial and often underappreciated:

1. The complexity of natural systems precludes am experimental approach to environmental management. Consequently, our "imperfect science" and the effects of natural variability and uncertainty lead to an inability to reach consensus and accurately predict the environmental consequences of our actions. We are often left with a wide range of opinions on the issues.

2. With acquired wealth comes political and social power that is often used to promote further unlimited exploitation of natural resources.

3. Traditional demography and economics do not incorporate sufficient appreciation of environmental principles. Furthermore, ecologists tend to disregard human influence and instead concentrate on ecosystem function and dynamics. Numerous authors have suggested that the failure to agree on a collective vision of how to attain sustainability lies in the limitations and disconnects among disciplines.

4. In anthropocentric terms, humans have the "right" to control the natural world for the benefit of humanity. This tenet sometimes leads to a large divide between scholars and practitioners, environmental organizations and industry, public and government, etc. Thus, the ultimate compromises and sacrifices required—a distasteful concept to many, and possibly the root cause of the "we versus them" mentality — will be necessary to accommodate human needs. Thomas Friedman commented, "if you think we can deal with these huge problems without asking [the American] people to do anything hard, you're a fool or a fraud." Successfully balancing the demands of competing uses is perhaps the greatest challenge we face.

In the end, the successful transition to sustainability rests on a complex infrastructure that translates science-based information into public policy. This, in turn, elicits effective responses from society at large. It is the performance and long-term capacity of this diverse array of entities from global to local scales that will ultimately determine the

tempo and mode of the sustainability transition. Our future rests in societal action involving all stakeholders, consensus building, and accepting the trade-offs that will ensure environmental and social justice.

Members of the Ecological Processes Standing Committee

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EXECUTIVE SUMMARY

The Scientific Advisory Board, Ecological Processes Standing Committee (EPSC) was tasked with addressing issue: *Definition of Critical Wildlife Habitat*, as it is used to steward the conservation, protection and revitalization of New Jersey's natural resources. It is important to note at the outset that the EPSC's attempts are based solely on a *scientific* review of the topic(s). No attempt is made to formulate new or revised policy, but simply to use the best available science to inform policy and assist decision makers in managing the State's valuable natural capital. The EPSC approached the challenge by adopting an Ecosystem-Based Management (EBM) framework, one that considers multiple activities within specific areas defined by *ecosystem* rather than *political* boundaries. It also places humans in the landscape, within the broader context of the biological and physical environment, and ultimately combines ecology and human dimensions into "society-integrated" management guidelines. This is the essence of sustainable development that recognizes the importance of the life support systems around us, systems that we are an integral part of. We go beyond simple consideration of threatened and endangered species to consider aspects of ecosystem integrity, functions and processes, and community/population biology that allows ecosystems to persist in a 'healthy' state, one that not only improves habitats for species in jeopardy, but prevents other species from achieving this dubious distinction.

We are, however, equally sensitive to sustaining a 'balance' between ecology and economy because the quality of life for all New Jersey's citizens also depends on a healthy economy. The state is not only rich in productive human enterprises, but is also rich in resources that provide the natural capital (goods and services) needed for human well-being: clean water, clean air, fertile soils, abundant wildlife, and ample recreational opportunities for families to enjoy nature. Meeting human needs in our rapidly growing state, however, has placed increasing pressures on the natural world and its ability to contribute to our well-being, and has resulted in ecosystem degradation, with concomitant loss of ecosystem goods and services throughout the region. We cannot sustain a healthy economy without stewardship of the life support systems around us.

Early in EPSC's deliberations, it became clear that the term 'critical wildlife habitat, as presently used, fell short of its ultimate ecological context; e.g., how to include flora[1] and other components in the definition that are critical to ecosystem health, processes and functions. The EPSC therefore suggests that New Jersey resource agencies, managers and decision makers adopt the broader term *Critical Habitat* as the best descriptor for natural resource management in the New Jersey. The basis for this statement is laid out in the body of the report, an approach that largely adopts ecosystem-based management for protecting, conserving and managing New Jersey's natural capital.

It should also be noted that any discussion of "critical habitat" must include at least two key elements. The first addresses scale (in part) and the traits of ecosystems that make them resilient. On the one hand, the definition must include structural, process and

[1] Flora are not usually included in the term "wildlife".

functional ecosystem attributes such as diversity, complexity, trophodynamics (food web complexity), primary and secondary production, and other characteristics that reduce the risk of ecosystems transforming to some new, less desirable, stable state. Thus the definition should include traits at the "community level". Secondly, whether already designated threatened and/or endangered, or species of concern or likely to become so in the future, the second element of the definition should address "population" characteristics, and the ability of species to sustain their populations relative to critical patch size (breeding, feeding and resting areas), edge (transition zones among habitats), presence of contaminants, and a plethora of other factors that affect population dynamics. This approach is but one way to include the definition of critical habitat for threatened species (at the population level) within the overall ecosystem health of those critical life support systems that also includes humans at the community level.

Biogeography should be considered when identifying the areas that need to be protected and managed as *Critical Habitat*. Biogeographic provinces have been well established and defined in New Jersey by the Division of Fish and Wildlife and serve to organize the state's efforts to implement the New Jersey Wildlife Action Plan. Preserving the flora and fauna that characterizes these biogeographical zones protects the natural heritage of New Jersey and ecological processes unique to the state. It also promotes biodiversity which makes wildlife more resilient to threats such as disease, habitat fragmentation, pollution and invasive species. Unfortunately, landscape transformation that supports the expansion of human enterprises is believed to be the driving force in the loss of biodiversity worldwide and because humans are so dominant in the Earth's ecosystems it is urgent that we take more responsibility for better managing the natural world. More specifically, the earth's ecosystems have been doing relatively well for 2.5 billion years, and are quite capable of managing themselves, the issue for the future is that we humans need to do a better job of managing ourselves!

The land use requirements of New Jersey's large and growing human population (as noted earlier, New Jersey is the most densely populated state in the nation) have led to extensive conversion of natural habitat. In large parts of the United States, including New Jersey, more than half of the original vegetation types have been destroyed, converted to agriculture, housing, industrial use, and plantation forestry. Losses of wetlands are equally dramatic; it is believed that half of all wetlands in the continental US and New Jersey have been lost in the past century. It is a fundamental ecological principle that a given species can tolerate only a limited range of habitat variability, so the documented degree of habitat destruction and alteration in the US has led to an enormous toll of extinction and endangerment. Many species are specialized to use only a narrow range of habitats, and such habitat specialists have been particularly affected by habitat alteration and destruction.

One of the important consequences of historical land use patterns in the state, including accelerated urbanization, is that greater fragmentation of remaining habitats leads to smaller and more isolated species populations and increasing potential for extinction. This is precisely why New Jersey decision makers are trying to address the issues of

threatened and endangered species and the need to catalogue the State's *Critical Habitats* to protect currently endangered taxa and prevent others from being added to the list.

Similarly, the EPSC addressed potential impacts on *Critical Habitat* and its functions associated with invasive species, climate change and eutrophication:

Invasive Species - Biological invasions can have substantial, multifaceted effects on biodiversity and ecosystem functions. Some invasive plants transform entire landscapes, and may completely eliminate species locally. The invasive variety of *Phragmites australis*, for example, forms dense monocultures in brackish wetland regions of New Jersey, and severely alters habitat complexity, diversity and numerous functions and processes in these wetlands. *P. australis* covers more than 16,000 hectares (40,000 acres) in the upper Delaware estuary alone, and forms similarly extensive stands in other areas such as the Hackensack Meadowlands. Introduced species can have many other impacts, some of them quite subtle (e.g., changed nutrient cycles, and its influence on biomass production) that can affect entire ecosystems to the great detriment of many of the native animals and plants.

Climate Change - Climate change due to human activities is modifying the distribution, abundance, and behavior of aquatic and terrestrial organisms, and is therefore, likely to significantly alter fundamental ecological responses within diverse ecosystems. Among all the predicted effects of climate change, sea level rise may be one of the most significant and growing threats to New Jersey coastal areas. Sea level rise is a well-documented physical reality that is impacting coastline in New Jersey and throughout the world. Effects of sea level rise could include coastal inundation, coastal flooding, coastal beach erosion, and salt water intrusion. Worldwide, natural coastal systems are highly susceptible to the effects of sea level rise, and the loss of coastal wetlands and beaches will likely produce significant ecological impacts and result in a loss of ecological services (e.g., coastal recreation). The mid-Atlantic coast contains some of the most valuable estuarine and wetland ecosystems in the U.S. and is also among the most threatened due to sea level rise. Recent projections indicate that sea-level in the mid-Atlantic region may rise from 46 to as much as 190 cm (18-75 inches). It is estimated that 1 to 3% of the land area in New Jersey will be affected by inundation and 6.5% to over 9% by episodic coastal flooding over the next century.

Eutrophication – Defined as an excess of nutrients in the water column, eutrophication is arguably the most serious threat to aquatic ecosystems. Due to combined point and non-point source inputs, nutrient enrichment is prevalent throughout New Jersey and the region. Combined with atmospheric depositions, anthropogenic inputs of nitrogen and phosphorus, from urban and municipal sources in northern New Jersey and agricultural runoff in southern New Jersey, affect watersheds statewide. *Critical Habitat* is especially vulnerable to eutrophication that affects ecosystem structure and function, and influences oxygen concentrations in poorly flushed aquatic systems, e.g. Lake Hopatcong, Barnegat Bay, and coastal waters of New Jersey. As a consequence, entire aquatic ecosystems and their critical habitats may be altered and/or degraded.

A key task for the committee was to discuss how we might measure *Critical Habitat* and the limitations of the science. Elements of that discussion included: (1) transferring knowledge into concrete actions; (2) reconciling conservation objectives with the aims of economic development by sustaining essential ecological processes and life support systems; (3) ensuring that the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony; (4) defining sustainable development in terms of integrated ecological, socio-economic and cultural factors; (5) understanding that once satisfactory definitions have been developed, indicators (ecological, socio-economic and cultural) for measuring progress towards a sustainable New Jersey should also be formulated; and (6) understanding that in the future, ecological constraints be recognized in determining the limits of economic activities and social development. Although the NJDEP has been in the national forefront in stewardship of its natural capital and conserving its ecosystems, The EPSC believes that much more can be done to balance ecology and economy, but necessarily in that order!

Clearly, there are limitations of the present state of the science, but that should not stop scientists with engaging the community of stakeholders, decision makers and managers to more effectively steward New Jersey's priceless natural resources. Current evidence demonstrates that the resistance of ecosystem functioning to disturbance is strongly dependent on ecosystem diversity, a finding consistent with the observation that more diverse (species rich) ecosystems are more stable. However, it is less clear from recent work if ecosystem resilience similarly rests in biodiversity. Although there appears to be an upper limit between primary productivity (i.e., foodstuff produced by green plants) and biodiversity in both natural and agricultural ecosystems, it is also clear that management practices that maintain diverse forests, grasslands and aquatic systems will help ensure the sustained production of the ecological goods and services we all depend on.

Despite scientific advances, we still have only rudimentary knowledge of many ecosystem processes, in part, because there have been few long-term experiments and many functional processes and ecosystems themselves have never been explored. We need far better knowledge of the number of species required to assure the sustainability of various ecosystem functions and how they depend on spatial patterning, spatial scale and time. Addressing these shortcomings will be of great importance for sustainably managing ecosystems to provide sustainable flows of services essential for human well-being.

Finally, the EPSC considered the current regulatory purview for protecting rare species and their habitats. Although much desirable content appears therein, the standing committee recommends that New Jersey's regulations for protecting rare species and their habitats be integrated into a single set of rules, and streamlined for consistency and inclusion of the tenets presented herein.

I. INTRODUCTION

The Scientific Advisory Board, Ecological Processes Standing Committee (EPSC) was tasked with addressing the concept of 'critical wildlife habitat' as it is used to steward the conservation and revitalization of New Jersey's natural resources including threatened and endangered species:

> *Examine and develop ecological mitigation criteria to offset impacts to natural resources including ecological function and threatened & endangered species. After consultation with the relevant programs within the Department the following four elements were considered central to addressing the original issue: 1) what is the definition of critical wildlife habitat and to what habitats and species does it apply? 2) should critical habitat be protected everywhere in the state as it is in the Coastal Zone? 3) can you mitigate for Critical Wildlife/E&T losses and what are the standards for this mitigation? 4) does the science support treating Critical Wildlife/E&T habitat the same in all regulatory programs?*

The EPSC in its deliberations and writing of the final report considered all of these four elements. It is important to note, however, that the committee attempted a solely scientific review of the topic(s); i.e., no effort was made to formulate new or revised policy, but simply to use the best available science to inform that policy and assist decision makers in moving forward.

Origin of the Term 'Critical Wildlife Habitat' in New Jersey

The Federal Endangered Species Act (ESA) defines critical habitat as "the specific areas within the geographical area occupied by a given species, at the time it is listed … on which are found those physical or biological features (a) essential to the conservation of the species and (b) which may require special management considerations or protection. Critical habitat must be designated on the basis of the best scientific data available and after taking into consideration the economic impact of the designation". The EPSC begins with this definition because New Jersey's provision for 'Critical Wildlife Habitat' (CWH) in stewarding its living resources is more inclusive in an important way; i.e., New Jersey's designation for CWH "is not necessarily habitat that is occupied by an endangered or threatened (T&E) species, but instead is defined as areas known to serve an essential role in maintaining *wildlife* [emphasis added], particularly for wintering, foraging, resting, hibernating, breeding, and migrating" (N.J.A.C. 7:7E–3.39; Appendix A). Specific examples include avian rookeries, 'stopovers' for migrants, and ecotones (edges between two habitats such as the wetland-upland interface). *As such, habitat for non-listed species can be considered CWH*. This is important, because New Jersey's approach may help prevent otherwise non-listed species that are nonetheless under stress from attaining this dubious distinction, and just as importantly, this designation allows for an

ecosystem (community) based approach to managing the state's natural resources. Additionally, the Federal designation requires a cost-benefit economic analysis; thus, critical wildlife habitat must be designated not only on the basis of the best scientific data available but must also take into consideration the economic impact of the designation. It appears that economic considerations are less explicit in New Jersey's approach.

The preceding section, and N.J.A.C. 7:E-3.38 (Appendix B), are also explicit in their habitat recommendations for T&E wildlife and plant species, terrestrial or aquatic, that occupy CWH on a seasonal or permanent basis, or that may occupy certain habitats at a critical life stage. Both Federal and State listed species populate this list. Habitats that contain T&E species may also require certain buffer areas[2] (considered part of the habitat) that help ensure continued survival of the population as well as serving as corridors for movement of T&E species and other wildlife.

Early in the standing committees deliberations it became clear that the term, as presently used, fell short of its ultimate ecological context; e.g., how to include flora[3] and other components that are critical to ecosystem health, processes and functions. The EPSC therefore suggests that New Jersey resource agencies, managers and decision makers adopt the broader term *Critical Habitat* as the best descriptor for natural resource management in the New Jersey. The basis for this statement is laid out in the remainder of this report, an approach that largely adopts an ecosystem-based management perspective for protecting, conserving and managing New Jersey's natural capital.

II. ECOLOGICAL COMMUNITIES

The quality of life for New Jersey's citizens depends as much on a healthy environment as it does on a healthy economy. The state is not only rich in productive human enterprises, but is also rich in resources that provide the natural capital (goods and services) needed for human well-being: clean water, clean air, fertile soils, abundant wildlife, and ample recreational opportunities for families to enjoy nature. Meeting human needs in our rapidly growing state, however, has placed increasing pressures on the natural world and its ability to contribute to human well-being, and has resulted in ecosystem degradation, with concomitant loss of ecosystem goods and services throughout the region.

It should also be noted that any discussion of "critical habitat" must include at least two key elements. The first addresses scale (in part) and the traits of ecosystems that make them resilient. On the one hand, the definition must include structural, process and functional ecosystem attributes such as diversity, complexity, trophodynamics (food web complexity), primary and secondary production, and other characteristics that reduce the risk of ecosystems transforming to some new, less desirable, stable

[2] Based upon the home range and habitat requirements of the species and anticipated impacts of land uses on the species habitat.
[3] Flora are not usually included in the term "wildlife".

state. Thus the definition should include traits at the "community level". Secondly, whether already designated threatened and/or endangered, or species of concern or likely to become so in the future, the second element of the definition should address "population level" characteristics, and the ability of a species to sustain its populations relative to critical patch size (breeding, feeding and resting areas), edge, presence of contaminants, and a plethora of other considerations that affect population dynamics. This approach is but one way to include the definition of critical habitat for threatened species (at the population level) within the overall ecosystem health of those critical life support systems that also includes humans at the community level.

A. Structure and Function

1. Geological Setting (e.g. Topography, Biogeochemical Cycles, Abiotic (Non-Living) Factors, Nutrient Fluxes, Etc.)

Natural ecosystems including those occupied by humans are heterogeneous in both their biophysical and social settings consequently they exhibit substantial horizontal and vertical variability in time and space (Smith 1972). Factors that influence topography of landscapes include geologic processes (e.g., mountain and ridge formation), erosive effects of water (e.g., creation of channels, banks, and shallow depositional areas); wind effects (e.g., creation of dunes and bluffs), wave action (e.g., creation of beaches and rock formations), and biotic activity (e.g., development of mounds, tussocks, reefs, buildings, roads by 'ecological engineers', humans and otherwise). New Jersey is the most densely populated state, and with few exceptions topographic heterogeneity in New Jersey is influenced by the urban environment and other cultural influences. The cumulative effect of these drivers provides three-dimensional complexity in ecosystems that, in turn, exert tremendous influence on the composition, structure and functions of ecosystems (Larkin et al. 2006). The scale of effects can be at the "micro-level" such as a sea grass meadow in Barnegat Bay providing habitat complexity and living space for a myriad of creatures both in and around the bed; or occur at the "macro-level" such as in the "rain shadow" of a mountain range that creates deserts behind it. In nature, heterogeneous environments are the rule, rather than the exception and planning the protection, management (and perhaps restoration) of critical habitat should consider both scales of effects.

Living and non-living components of an ecosystem often interact to create variability, making it difficult to separate cause and effect (Larkin et al. 2006). For these and other reasons, ecologists urge consideration of heterogeneity in designing preserves, maintaining rare species, and preserving ecosystem functions (Dobkin et al. 1987; Ludwig and Tongway 1996; Fleishman et al. 1997). Understanding how habitat heterogeneity influences the viability of critical habitat, and ecosystem functions in general is one of the great challenges before us. Unfortunately, humans tend to 'homogenize' landscapes in their land use practices and quest for reliability-stability in provision of ecosystem goods and services. If we are serious about managing natural capital, including rare species, and thus preserving our life support systems, then some tradeoffs may be required in future land use planning practices state-wide.

In their thoughtful treatise *Topographic Heterogeneity Theory and Ecological Restoration*, Larkin et al. (2006) listed several key questions for planning effective restoration of degraded sites. These are reproduced here in the context of critical life habitat; preserving what is left, restoring, or at least improving, degraded critical habitat by reducing fragmentation (and/or by improving connectivity), and managing for the well-being of rare species (threatened, endangered, or species of concern):

- What topographic patterns will facilitate reestablishment and preservation of desired ecosystem structure and function?
- Will mimicking the topography of a reference ecosystem be sufficient for reestablishing species?
- How much topographic variability needs to be in place before nature can 'engineer' the rest?
- What are the costs (time, money, resources) of incorporating topographic heterogeneity into protecting and/or restoring critical habitats?
- Are there ecosystem engineers that need to be introduced into the site to help structure topography and to facilitate the establishment of target species?
- Will topographic heterogeneity facilitate 'self-sustainability' of the site and improve its ecological resilience?

No organism threatened or otherwise can exist independently of interactions with other organisms or its physical environment. If we can conserve and preserve existing designated critical habitat and implement best management practices to restore other 'natural capital' assets in New Jersey, then we will have done much to contribute to a sustainable future for generations to come.

2. Flora and Fauna

In ecosystems, the term structure refers to both the physical and biological characteristics that define the area at a point in time: topographic complexity, vegetation structure (species composition, stem density, percent cover, and biomass), soil attributes (texture, nutrient content, moisture and organic matter), and animal composition (species richness, density, size, demographics, etc.) while functions refer mainly to rates and processes (nutrient cycling, productivity, growth and mortality, etc.) The New Jersey Pinelands, for example, is characterized by sandy soils and low soil moisture. These conditions support a soil microbial community which in part serves the function of providing plant available nitrogen (Landesman and Dighton, 2010). If the ultimate goal is to maintain the character and function of New Jersey's natural resources, we must also consider preserving ecosystems as well as individual organisms.

Biogeography should be considered when identifying the areas that need to be protected and managed as critical habitat. These biogeographic provinces have been well established and defined in New Jersey by the Division of Fish and Wildlife (Fig. 1) and serve to organize the state's efforts to implement the New Jersey Wildlife

Action Plan. Preserving the flora and fauna that characterizes these biogeographical zones protects the natural heritage of New Jersey and ecological processes unique to the state. It also promotes biodiversity which makes wildlife more resilient to threats such as disease, habitat fragmentation, pollution and invasive species.

The Highlands Act and Pineland Act are important legislative documents with the goal of preserving New Jersey's natural heritage within a biogeographical context. The Highlands Act covers zones 22, 24, 25 and 26, while the Pineland Act covers zones 16, 17, 18, and 19 (Fig. 1). A review of these Acts, supporting technical documents and other materials provided on their associated websites, reveals a common intent that helps define critical habitat. Both documents state the goals of maintaining the character of their region, reducing habitat fragmentation (see below) and preserving water quality. The Pinelands is described in terms of "exemplary" species and not endangered ones. For example, there is the pine oak upland forest, pygmy pine plains, Atlantic white cedar swamp, and savanna. The Highlands Act seeks to protect "contiguous forests, wetlands, vegetated stream corridors, steep slopes and critical habitat for fauna and flora…" In this statement "critical habitat" appears to be something separate from other habitat types. Critical habitat was not defined in the Highlands Act but was addressed in a related report on land preservation and stewardship (NJWAP – Technical Report 2012). In the latter document, critical wildlife areas were defined using the NJDEP Landscape Project which ranks areas based on rare, threatened and endangered species and serves as a database used to identify and

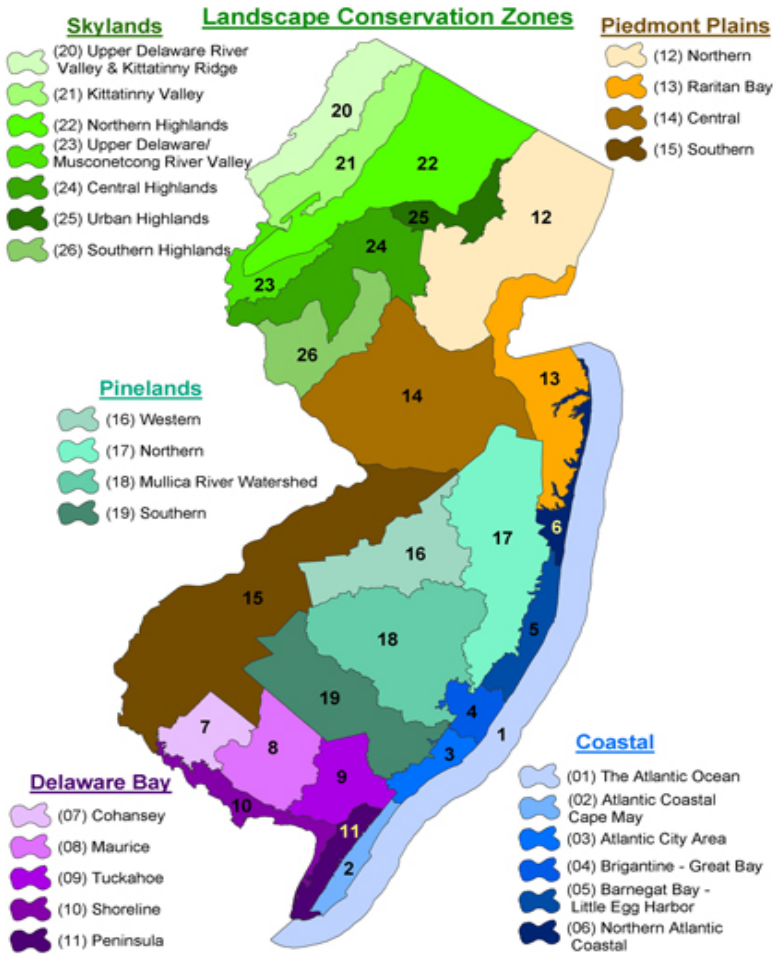

Fig. 1. NJ Wildlife Action Plan Map
http://www.njfishandwildlife.com/ensp/wap/wap_zones.htm

monitor these species. However, the definition of critical wildlife areas in the Highlands Act goes further and includes species "significant" to the Highlands region. These "significant" species are those that would be "unlikely to exist if the Highland ecosystem was lost." It is clear that both the Pineland Act and Highlands Act recognize the need to protect major ecosystems as well as rare, threatened and endangered species. The Highland Act refers to the importance of protecting "irreplaceable land types", and minimizing development effecting "topography, hydrology, geology, and vegetation types". The Pineland Act emphasizes the need to protect ground and surface water. Therefore, both Acts extend protection to features characteristic of their biogeographical region and not just species with low populations. It therefore follows that a definition of critical habitat needs to address geological features that provide structure to a region as well as exemplary, indigenous flora.

Another important focus of the Pineland and Highlands Acts is on water quality and contiguous habitat. These features are recognized as essential for maintaining the character of their particular region. Habitats fragmented by human land-use and development activities have been associated with degraded water quality and loss of exemplary species. For example, Pinelands swamps that drained developed areas were found to lose the herbaceous species that characterized the region (Ehrenfeld, 1983). The indigenous flora was replaced by species from surrounding biogeographic regions as well as exotic and invasive species. Low pH is characteristic of Pineland streams. Scientists reported that increased pH in streams was positively correlated with the percentage of land use and presence of non-native fish and anuran species (Zampella et al. 2006). Non-native species alter the biotic community and can be associated with a loss of function. Restoration of regional hydrology has been found to improve native species abundance and ecosystem function. For example, a major wetland restoration effort was undertaken during 1996-1998 by the Public Service Enterprise Group's, Estuary Enhancement Program (Weinstein et al. 2001; Teal and Weinstein 2002). The objective was to restore natural tidal flow to marshes in the Delaware Bay biogeographical region. These marshes had been diked for the salt hay industry. The targeted wetlands were located near more pristine areas and once restored, provided contiguous areas for resident and transient species. Studies immediately following the restoration showed an increased abundance of indigenous aquatic species and high levels of foraging and production (Litvin and Weinstein 2004; Nemersen and Able, 2005; Weinstein et al. 2005). More long term studies showed increased biomass in the restored areas and structural changes in the ecosystem associated with increased abundance of many species, including Atlantic menhaden, an important planktivore found along the Atlantic Coast (Frisk et al. 2011). Based on these findings, critical habitat should include contiguous areas with natural water ways of high quality and characteristic of a particular biogeographical region.

B. Biodiversity and Ecosystem Resilience

Biodiversity

Ecosystems are comprised of non-living (abiotic) and living (biotic) elements. The former, such as climate and geophysical components are extrinsic factors that collectively determine the boundaries of ecosystems[4]. The latter, or intrinsic factors -- the abundance, distribution, dynamics and functional variation of individual species and their populations -- regulate the magnitude and variability of ecosystem processes, such as production (creation of biomass) or decomposition of organic matter. Together, these extrinsic and intrinsic factors determine the specific properties of an ecosystem, such as its stability, its fertility, or its susceptibility to invasion. Biodiversity, or the variety of life on Earth, comprises ecosystems and living organisms: animals, plants, their habitats and their genes that populate them. Biodiversity is fundamental to ecosystem functioning, and is intrinsically linked to the provision of ecosystem services; i.e., the benefits that humans derive from ecosystems (see Section IIE): breathable air, fertile soils, and productive forests and fisheries, as well as many cultural benefits such as recreational hunting or the aesthetic value of natural areas. Such ecosystem services are obtained only if ecosystems include the biodiversity that guarantees the functional processes necessary to deliver them.

Threats to Biodiversity

Species populations are usually the level at which we can best observe the relationship between biodiversity and ecosystem functioning. Most of the services provided by ecosystems require healthy local populations (Hughes et al. 1997). For example, the change in the status of a population provides insight into the status of genetic diversity, as the extinction of a population may represent the loss of unique genetic material (MEA 2005). Measuring change in populations is thus important for understanding the link between biodiversity and ecosystem function, as significant changes in populations can have important implications for the function of ecosystems long before any species actually goes extinct (e.g., Jackson et al. 2001; Springer et al. 2003). Moreover, such thresholds may become lower as anthropogenic impacts simplify ecosystems and reduce their intrinsic resilience to change as noted below.

It is widely believed that current changes in biodiversity result primarily from processes intrinsic to life on Earth that derive almost exclusively from human activities. These processes are known as anthropogenic direct drivers, human induced forces that have defined the modern era as the Anthropocene, or Age of Humans (Crutzen 2006). Over the past 400,000 years, humans have become a true force of nature and human actions have taken their place alongside the biosphere, lithosphere, hydrosphere, and atmosphere as defining processes shaping the global landscape (Ellis

[4] The definition of an ecosystem, as used here, is adopted from the Convention on Biological Diversity: ‘‘a dynamic complex of plant, animal and microorganism communities and their nonliving environment interacting as a functional unit’’ (UN 1992).

and Haff 2009). Germaine to this discussion are the rapid extinction of species caused by human activities in the past few centuries and with it dramatically reduced biodiversity world-wide. Current rates of species extinction are at least 100 times (i.e., two orders of magnitude) above background rates and are expected to rise to at least three orders above background rates. We appear to be in the midst of the sixth mass extinction the earth has witnessed, but the first created by the activities of a single species, *Homo sapiens*.

The most important direct impacts on biodiversity are believed to be habitat destruction, the introduction of alien species, overexploitation, disease, pollution, and climate change. Among these, habitat change is believed to be the most pervasive anthropogenic driver, with habitat fragmentation, introduced invasive, non-native species, and exploitation being the next most frequent drivers. However, threats such as disease, pollution, and climate change will likely play an increased role in the future (Thomas et al. 2004 a,b). Where trend estimates have been made, all the main direct drivers are expected to increase in intensity (MEA 2005).

Land Use

The land use requirements of New Jersey's large and growing human population (as noted earlier, the densest in the nation) have led to high levels of conversion of natural habitat. Loss of habitat through clearing and/or degradation is likely the primary cause of range declines in species and populations, and has led to the need for regulations that are the subject of this report to protect remaining critical habitats. When areas of high human activity and significant human land transformation are spatially congruent with areas of high species richness or endemism, such as in the New Jersey Pinelands, the Delaware Bayshore, and the New Jersey Skylands, the negative implications for biodiversity are greatly exacerbated. One of the consequences of historical land use patterns in the state, including accelerated urbanization, is that greater fragmentation of remaining habitats leads to smaller and more isolated species populations and increasing potential for extinction. This is precisely why New Jersey decision makers are trying to address the issues of threatened and endangered species and the need to catalogue the State's critical habitats to protect currently endangered species and to prevent others from being added to the list.

Ecosystem Resilience

Healthy ecosystems do not have a single equilibrium state with 'steady state' (homeostatic) controls. Rather, multiple equilibria commonly define functionally different states. Thus, variability in ecosystems is not just an inconvenient characteristic of these productive, dynamic systems, it is essential for their maintenance and well-being. Reducing variability and diversity produces conditions that may cause s system to 'flip' into an irreversible (typically degraded) state controlled by intractable processes. The ecosystems of the Hackensack Meadowlands, Barnegat Bay and the brackish potions of the Delaware Bay shore come to mind as systems where this may be occurring.

The term *ecosystem resilience* is used to describe the magnitude of disturbance that can be absorbed before an ecosystem changes its structure by changing the variables and processes that control behavior (Holling and Gunderson 2002). Sustainable relationships between people and nature will therefore depend on better understanding of the interplay between stabilizing and destabilizing forces that are at the heart of present issues of development and the environment – global change, biodiversity loss, ecosystem health and restoration, and sustainable development. What must be avoided is the dangerous notion that the variability of nature can be effectively controlled, that the consequences of human actions are predictable, and that sustained economic growth is attainable as a sustainable goal (Gunderson, Holling and Light 1995)[5].

C. Humans in the Landscape: Land Use and Legacy Issues

World human population was only about 1 billion at the dawn of the nineteen-century, but its growth has greatly accelerated since then. It took 123 years to add another billion and less than 100 years to add another 5 billion! The world human population surpassed 7 billion in 2011 and is expected to reach 9 billion by 2050 (UN 2004). Not only has the growth of world human population accelerated, but with it, the resource use per capita or human 'footprint' (Global Footprint Network 2011). The growth in both human population and the resource base used by humanity is maintained by continuous expansions in a suite of human enterprises such as agriculture, industry, fishing, and international commerce. These enterprises transform the land surface (through agriculture, forestry, and urbanization), alter the major biogeochemical cycles, and add or remove species and genetically distinct populations in most of Earth's ecosystems (Vitousek et al. 1997). In their first assessment at a global scale of human impacts on the Earth's ecosystem, the authors made the following observations: between one-third and one-half of the land surface has been transformed by human action; the carbon dioxide concentration in the atmosphere has increased by nearly 30 percent, most of this increase beginning with the Industrial revolution; more atmospheric nitrogen is fixed by humanity than by all natural terrestrial sources combined; more than half of all accessible surface fresh water is put to use by humanity; and about one-quarter of the bird species on Earth have been driven to extinction. The newly released *Living Planet Report* by the World Wildlife Fund (WWF 2012) suggested that biodiversity has declined globally by around 30 percent between 1970 and 2008; by 60 percent in the tropics. Demand on natural resources has doubled since 1966 and we are currently using the equivalent of 1.5 planets to support our activities. Landscape transformation that supports the expansion of human

[5] In this context, scientist speak of the 'resolution of the paradox of the dual mandate' -- whereas complexity, interdependence, high levels of uncertainty, unpredictability, and dynamism characterize natural systems – traits that prevent competitive dominance by any one species – human-dominated systems require predictability and stability to ensure uninterrupted provision of resources for human use. The paradox of the dual mandate arises from the need to reconcile society's desire to preserve, restore, and rehabilitate natural ecosystems while at the same time ensuring the provision of reliable, predictable, and stable supplies of goods and services at a time of escalating demand (Roe and van Eeten 2001; Weinstein et al. 2007).

enterprises is the driving force in the loss of biodiversity worldwide and because humans are so dominant in the Earth's ecosystems it is urgent that we take responsibility for managing the planet (Vitousek et al. 1997; Crutzen and Schwagerl 2011). Nobel Prize-winning chemist Paul Crutzen coined the current state of human dominance in the Earth ecosystems as Anthropocene, a new geological epoch in which humans had altered the planet Earth. "It's no longer us against 'Nature.'" Instead, it's we who decide what nature is and what it will be." (Crutzen and Schwagerl 2011).

Landscape changes, which are primarily driven by urban development, are among the most pressing issues in the United States. Based on the 2007 Natural Resource Inventory conducted by the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture, about 16.3 million hectares (ha) - an area larger than the size of Illinois - were converted to developed uses between 1982 and 2007. By 2007, the total developed area in the contiguous United States was slightly more than 44.9 million ha. The rate of development between 1982 and 2007 averaged 0.65 million ha per year (USDA 2009). Similar trends exist in New Jersey, one of the most densely populated states in the U.S. During the 21-year period between 1986 and 2007, New Jersey urbanized 131,312 ha of land, which is equivalent to a 26.8 percent increase. During this same period, New Jersey lost 72,261 ha (24 percent) of its agricultural lands, 46,620 ha (7 percent) of its forested lands and 13,209 ha (5 percent) of its wetlands. Of the classified developed lands during the period 2002-2007, 67 percent was used for low density residential development (Hasse and Lathrop 2010).

D. Vulnerability

1. Habitat Loss and Alteration

As noted above, a staggering amount of both terrestrial and aquatic habitat has been transformed in the last two centuries, and the rate of that transformation has accelerated rapidly over the past few decades (MEA 2005). In large parts of the United States, including New Jersey, more than half of the original vegetation type has been destroyed, converted to agriculture, housing, industrial use, and plantation forestry. Losses of wetlands are equally dramatic; it is believed that half of all wetlands in the continental US and New Jersey have been lost in the past two centuries (Tiner 1984). It is a fundamental ecological principle that a given species can tolerate only a limited range of habitat variability, so the documented degree of habitat destruction and alteration in the US has led to an enormous toll of extinction and endangerment (Simberloff 2012). Many species are specialized to use only a narrow range of habitats, and such habitat specialists have been particularly affected by habitat destruction (Simberloff 2012).

For one particularly well-studied group, the birds, out of 116 species and subspecies whose cause of recent extinction is known, 68 (59%) were driven to extinction by habitat change (Simberloff 1986). Of 98 bird species of the United States whose causes of imperilment are believed to be known, habitat degradation or loss was wholly or partly responsible for the plight of 88 species (Wilcove et al. 2000). For

1,880 imperiled species of all types in the United States for which causes of imperilment are established, 85% are wholly or partly threatened by habitat loss or degradation. It is possible that birds are particularly sensitive to habitat alteration (see, e.g., Simberloff 1986), but many other taxa include large numbers of habitat specialists. Of imperiled species in the United States, more than 80% of plants, mammals, reptiles, amphibians, fishes, freshwater mussels, tiger beetles, and butterflies are threatened wholly or partly by changed habitat (Wilcove et al. 2000).

Not only is habitat being lost, but for many species the remaining natural area is increasingly fragmented (Primack 2010). Patches of forest and grasslands are increasingly smaller and more isolated in many areas. One reason is land cleared for agriculture and pasture. Similarly, remaining bogs are increasingly separated as more of them are drained. For some species, even if enough habitat exists, the fragmented state of the habitat can threaten their persistence—for example, they can be preyed upon as they move from patch to patch, or they can experience great difficulty finding food or mates (Simberloff 2012). Highways and railroads can serve as formidable impediments to movement for some species (Forman and Alexander 1998; Spellerberg 2002). Further, the patches themselves, if they are small enough, might be heavily influenced by edge effects, so that large fractions of the patch differ subtly from the habitat in the center (Ries et al. 2004). Because fragmentation of a habitat is inevitably accompanied by loss of area of the habitat (e.g., the area of a road corridor bisecting a formerly continuous forest), the relative impacts of habitat loss and habitat fragmentation have been difficult to tease apart (Fahrig 2003; Ewers and Didham 2006). However, there is little doubt that fragmentation can result in substantial threats to a species survival.

Land development in New Jersey has similarly limited the acreage of contiguous vegetation and thus threatens the sustainability of our ecosystems. Nowhere is this more apparent than in the coastal region where housing, landfills and industrial ports have destroyed wetlands and altered natural shorelines. One goal of the New Jersey Wildlife Action Plan (NJWAP) is to protect migratory bird populations by conserving a network of migratory and stopover locations along the New Jersey shore. This could mean that smaller land areas would become “critical habitat” for their role in linking large tracts and providing supplemental ecosystem services. Constructing natural corridors to link larger tracts and/or designing landscapes that juxtapose “soft” development (i.e. golf courses), suburban housing (with landscaping and gardens) and natural areas has been proposed (Colding, 2007). The term used is “ecological land-use complementation”. The idea is that patches of land “can form ecologically functional units” by providing additional nesting areas or alternative food resources. However, research on bird communities provides evidence that the area of the landscape is also correlated to species richness and biodiversity. A study comparing salt marsh bird communities in Long Island Sound found 25% more species riches in large (>35 ha) versus small marshes (Shriver et al, 2004). A bird community study in coastal montane forest on Vancouver Island found that narrow corridors (20-25 m) contained unstable populations and functioned best for travel and foraging not breeding. Forest interior species needed > 100 m corridors in order to be present at

levels comparable to control sites (Shirley and Smith 2005). A study in coastal southern California may be highly relevant to NJ. The response of avifauna to a gradient of urban fragmentation was evaluated (Crooks et al. 2004). Results found species specific responses to habitat fragmentation. Unfragmented habitat had a high diversity of urbanization-sensitive birds, while urban areas contained mostly non-native and anthropophilic' birds. Interestingly, the species succeeding in urbanized southern California were the same as those in urban Ohio. These studies raise concern that corridors and networks alone will not provide sufficient ecosystem services for supporting New Jersey's indigenous flora and fauna. Providing large tracts of open space may be necessary in order to retain our natural heritage as well as protect endangered species.

2. Invasive Species

Biological invasions are an enormous, multifaceted environmental and conservation threat (Mack et al. 2000; Baskin 2002) with substantial but sometimes subtle impacts on biodiversity. For instance, invasive species—especially mammalian predators such as introduced rats and cats —have entirely or partly caused most bird extinctions over the past two centuries, and invasive species trail only habitat destruction and direct exploitation (especially for human food) as a threat to currently imperiled bird species, affecting ca. 350 of the 1,186 threatened species (Birdlife International 2000). Not only introduced predators, but also introduced competitors, herbivores, and plants threaten various bird species. Invasions are a key factor in biodiversity decline for other taxa as well. On islands, invasions are the leading cause of extinction over the past 20 years, and in freshwater habitats, invasions are the second leading cause (MEA 2005). In the United States, invasions are the second leading threat to imperiled species (after habitat destruction), affecting almost half of all such species (Wilcove et al. 2000).

Many other invasive animals have eliminated native species or threaten to do so (Simberloff and Rejmánek 2011). However, some invasive plants transform entire landscapes or water bodies and generally have the greater impacts (Simberloff 2002; Ehrenfeld 2010), and may completely eliminate species locally. Each such event brings them closer to global extinction. Often introduced plants simply overgrow and thereby replace native vegetation. For instance, the invasive variety of *Phragmites australis* forms dense monocultures in brackish regions of New Jersey estuaries and freshwater wetlands, and severely alters habitat complexity, diversity and numerous functions and processes in these wetlands. *P. australis* covers more than 16,000 hectares (40,000 acres) in the upper Delaware estuary alone, and forms similarly extensive stands in other areas such as the Hackensack Meadowlands. Introduced plants can have many other impacts, some of them quite subtle (e.g., changed nutrient cycles [Vitousek 1986]) and others very obvious (e.g., intensified fire regime [D'Antonio and Vitousek 1992]), that can affect entire ecosystems to the great detriment of many of the native animal and plant species (Ehrenfeld 2010). Introduced species can interact with one another to exacerbate the total impact on native species (Simberloff 2006).

3. Climate Change and Sea Level Rise

Climate change due to human activities is modifying the distribution, abundance, and behavior of aquatic and terrestrial organisms, and is therefore, likely to significantly alter fundamental ecological responses within diverse ecosystems. Climate changes due to increasing carbon dioxide levels in the atmosphere, increasing temperature, and rising sea levels have been well documented (IPCC 2007). Among all the predicted effects of climate change, sea level rise may be one of the most significant and growing threats to New Jersey coastal areas. The coastal area spans 204 km along the United States mid-Atlantic coast with an additional 134 km of shoreline along the Raritan and Delaware Bays. The New Jersey coast sustains a diverse range of ecosystems in a series of bays, estuaries, wetlands, sandy beaches, dunes and forests which provides critical habitat for an abundance of plant species as well as an array of fish and wildlife. The coastal ecosystems in New Jersey are home to at least 23 endangered and threatened wildlife species (http://www.nj.gov/dep/fgw/tandespp.htm), 10 of which are listed under the federal Endangered Species Act. New Jersey's beaches and coastal wetlands serve as a globally significant stopover for an estimated 1.5 million migratory shorebirds and are home to the world's largest population of horseshoe crabs (New Jersey Coastal Management Program 2002). The coastal counties of Atlantic, Cape May, Monmouth, and Ocean contain nearly 405 km^2 of parkland in addition to over 773 km^2 of State Wildlife Management Areas and National Wildlife Refuges (NJDEP 2001).

Sea level rise is a well-documented physical reality that is impacting coastline in New Jersey and throughout the world. Effects of sea level rise could include coastal inundation, coastal flooding, coastal beach erosion, and salt water intrusion. Worldwide, natural coastal systems are highly susceptible to the effects of sea level rise, and the loss of coastal wetlands and beaches will likely produce significant ecological impacts and result in a loss of ecological services (e.g., coastal recreation). It was predicted that sea level rise alone could promulgate the loss of up to 22% of the world's coastal wetlands over the next century (Nicholls et al. 1999). The combination of sea-level rise and direct human impacts during this same timeframe could result in a 70% loss (Nicholls et al. 1999). The mid-Atlantic coast contains some of the most valuable estuarine and wetland ecosystems in the U.S. and is also among the most threatened due to human activity. Recent projections based on climate modeling and semi-empirical temperature estimates indicate that sea-level in the mid-Atlantic region could rise 46 to as much as 190 cm (18-75 inches) (CCSP, 2009; Horton et al., 2008; Rahmstorf, 2007; Vermeer and Rahmstorf, 2009, Shuang-Yeywu et al. 2009). It is estimated that 1 to 3% of the land area in New Jersey will be affected by inundation and 6.5% to over 9% by episodic coastal flooding over the next century.

Changes in sea level rise and changes in timing and availability of freshwater in intertidal river systems, e.g., the lower Delaware River and Delaware Bay, will greatly alter the availability of tidal wetland and brackish marsh habitats to many state and regional species of concern (e.g., Red knot, Atlantic sturgeon, short-nosed sturgeon).

Coastal wetlands in New Jersey are highly susceptible to sea level rise. Coastal wetlands risk permanent inundation if sea level rises faster than the rate by which these wetlands can accrete. Undoubtedly, this process will greatly restrict the amount of critical habitat available to species that rely on coastal wetlands as feeding, nursery, and rearing areas.

4. Eutrophication

Eutrophication, an excess of nutrients in the water column, is arguably the most serious threat to aquatic ecosystems (Diaz and Rosenberg 2008). Eutrophication of aquatic, estuarine, and marine ecosystems due to both point and non-point sources is prevalent throughout New Jersey and the region. Anthropogenic inputs of nitrogen and phosphorus, from urban and municipal sources in northern New Jersey and agricultural runoff in southern New Jersey, affect watersheds throughout the state (Berry and Cohen 2012). Atmospheric deposition from urban input is increasingly recognized as an additional source of nitrogen in New Jersey lakes (Li et al. 2008) and coastal waters (Gao et al. 2007). Critical habitat is especially vulnerable to eutrophication that affects ecosystem structure and function, and influences oxygen concentrations in static or poorly flushed aquatic systems, e.g. Lake Hopatcong (Sussex and Morris Counties), Barnegat Bay (Monmouth and Ocean Counties,) and coastal waters of the state. As a consequence, entire aquatic ecosystems and their critical habitats may be altered and/or degraded.

One of the first signs of increased availability of nutrients is growth of epiphytes (algae) on bottom substrates, and of phytoplankton in the water column. As a result, eutrophication creates conditions that lead to dramatic loss of submerged aquatic

Fig.2. Bottom dwelling plants of a marine ecosystem that received natural rates of nitrogen input. Note the high diversity of these plants and their spacing (photograph by Dr. Robert Howarth).

Fig.3. Bottom dwelling plants of a marine ecosystem that received high rates of nitrogen input. Note the reduced water clarity, and the dominance by a single plant species whose leaves are covered by a thick layer of algae (photograph by Dr. Robert Howarth).

vegetation (SAV) due to shading (increased turbidity) and excessive attached algal growth on sea grass leaves (Figs. 1 and 2). In Barnegat Bay, estimates of SAV losses range from 2,000-3,000 ha (25,000 to 37,000 acres) (Lathrop et al. 2001) in the past several decades, and has also led to widespread loss of biodiversity, harmful algal blooms (HAB) and increases in stinging nettle (jelly fish) populations. Toxins produced by HAB may also impact organisms directly or may bioaccumulate in tissue (Gastrich 2000). Aerobic bacterial decomposition of HAB and SAV also results in a

decrease in dissolved oxygen. Resulting hypoxic and anoxic conditions affect benthic organisms and impact commercial and recreational fisheries (Kennish et al. 2007). Mobile organisms such as blue crab *Callinectes sapidus* and fishes migrate out of hypoxic and anoxic estuarine habitats (Pihl et al. 1991), while sedentary invertebrates, e.g. hard clam *Mercenaria mercenaria* and softshell clam *Mya arenaria*, suffer mortality (Carmichael et al. 2004). Hypoxic conditions may also lead to a release of trace metals from sediments (Berry and Cohen 2012), leading to further degradation of the ecosystem.

E. Critical Habitat

1. How do we Measure It?

Ecological evaluation of ecosystem characteristics including the ability of the system to support populations of rare species requires value judgments that range from assessing the conservation status (for a given rare species) to priority ranking of natural areas (e.g., the New Jersey Pinelands). Thus, scale considerations are important; e.g., the New Jersey Pinelands, a nationally recognized ecosystem houses numerous rare and endangered taxa! By necessity, these value judgments are, for better or worse, based on the notion that some ecosystem characteristics are more important than others. Usually, the purpose of the evaluations is to determine the 'conservation value' of certain species or ecosystems in order to set priorities for their protection. Value judgments are primarily based on criteria such as naturalness, diversity, species richness, and in our case, rarity. Value judgments may also include socio/economic criteria.

We have come to learn that the biosphere has limits in terms of its carrying capacity for human life. Lasting benefits from nature depend not only on our ability to sustain essential ecological processes and life support systems, but also on the diversity of life forms. Dolph de Groot (1992) summarized the roles of sustainable development and functional evaluation in achieving more sustainable land use practices and decision making:

- Although the need for sustainable development is being accepted more and more, maintenance of environmental quality and many important values of natural systems are not being given adequate consideration in development planning and decision making;
- In spite of the growing knowledge about the importance of natural ecosystems to human welfare, it has been difficult to translate this knowledge into concrete actions to steward the health of our natural environment;
- To reconcile conservation objectives with the aims of economic development, the World Conservation Strategy (ICUN, UNEP and WWF 1980) was developed consisting of three primary objectives; a) maintenance of essential ecological processes and life support systems; b) preservation of genetic diversity; and c) sustainable utilization of species and ecosystems;

- The Bruntland Report (WCED 1987) on sustainable development states that "in essence, sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony…";
- Because of its far reaching consequences, sustainable development should also be defined more specifically in terms of ecological, socio-economic and cultural sustainability (e.g., social justice precepts among others);
- Once satisfactory definitions have been developed, indicators (ecological, socio-economic and cultural) for measuring progress towards a sustainable New Jersey should also be formulated. These indicators in turn should form the basis for establishing common paradigms and concepts to integrate ecology and economics and to develop practical incentives for conservation and sustainable use of New Jersey's natural resources including its biodiversity; and
- In the future, ecological constraints should be recognized in determining the limits of economic activities and social development.

Although the NJDEP has been in the national forefront in stewardship of its natural capital and conserving its ecosystems, much more can be done to balance ecology and economy, but necessarily in that order!

2. Limitations of the Science

In section II. B., we gave a brief account of the role of biodiversity and ecosystem resilience in maintaining ecosystem functions in an optimum state. Without giving explicit bounds to that optimality, there are several comments that may be made about the link between biodiversity and ecosystem health. Scientists have long noted the many aspects of the stability, functioning and sustainability of ecosystems depend on biodiversity. Current evidence demonstrates that the resistance of ecosystem functioning to disturbance is strongly dependent on ecosystem diversity, a finding consistent with the observation that more diverse (species rich) ecosystems are more stable (May 1973; Tilman 1997). However, it is less clear from recent work if ecosystem resilience similarly rests in biodiversity. Although there appears to be an upper limit between primary productivity (i.e., foodstuff produced by green plants) and biodiversity in both natural and agro ecosystems, it is also clear that management practices that maintain diverse forests, grasslands and aquatic systems will help ensure the sustained production of the ecological goods and services on which we all depend (Tilman and Downing 1994).

Despite scientific advances, we still have only rudimentary knowledge of many ecosystem processes, in part, because there have been few long-term experiments and many functional processes and ecosystems themselves have never been explored. We need far better knowledge of the number of species required to assure the sustainability of various ecosystem functions and how they depend on spatial patterning, spatial scale and time. Addressing these shortcomings will be of great importance for sustainably managing ecosystems to provide sustainable flows of services essential for human well-being.

Necessarily, ranking natural areas according to 'importance' based on a selection of conservation criteria cannot be avoided if we are to protect T&E species. To assist decision making, numerous attempts have been made to translate qualitative information into quantitative metrics (indicators) of ecosystem/habitat value by assigning numerical scores to them. New Jersey's approach to ranking the quality of habitat patches is discussed in section III of this report (Regulatory Overview); in brief habitats that support T&E species are prioritized by a point ranking system with the largest number of points assigned defining habitats of the highest priority (e.g., N.J.A.C. 7:7E-3.39). Among other products, the process can lead to the production of habitat maps that show the various number values of different ecological units in the region. However, de Groot (1992) and others have noted several shortcomings of the method among them the difficulty of simply adding figures which may represent values of a completely different nature. For example, Site A may score 3 for diversity and 7 for uniqueness, while scores for Site B might be 6 for naturalness and 4 for ecological fragility. In this particular case, both score equally high on the conservation list but for different reasons[6] (Burggraaf 1979).

More recently, emphasis has been placed on *ecological functional*[7] evaluation in attempts to integrate conservation with land use evaluation[8] to provide relatively objective reference systems for measuring the importance of natural systems to human welfare. The concept not only includes natural capital and land uses but also references other benefits of the natural environment that are less tangible, and quite difficult to quantify. An example is the report prepared by Dr. Robert Costanza, a prominent ecological economist (Costanza 2007).

F. Ecosystem Goods and Services

> *Ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life. They maintain biodiversity and the production of ecosystem goods, such as seafood, forage, timber, biomass fuels, natural fiber and many pharmaceuticals, industrial product, and their precursors ... in addition, to the production of goods, ecosystem services are the actual life support functions, such as cleansing, recycling and renewal, and they confer many intangible aesthetic and cultural benefits as well.*
>
> Daily1997

Collectively, ecological goods and services are referred to as 'natural capital'. Rapid population growth in the past two centuries along with accelerated consumption and

[6] Although different weights might be assigned to the importance of each criterion the problem remains that numerical calculations cannot fully account for the different qualities of the regions under investigation.

[7] Ecological functions are defined as the capacity of natural processes and components to provide goods and services that satisfy human needs (both biological and societal).

[8] Land use evaluations places emphasis on the benefits and suitability of a given natural (or semi-natural) area for human use.

production patterns have, however, placed added stresses on the environment, which in turn impact the quantity and quality of the ecosystem goods and services delivered.

Addressing the issue of ecosystem goods and services in context of critical habitats is important given the rapid rate of biodiversity degradation that is occurring world-wide. Costanza et al. (2006) note that according to the World Conservation Union 2007 report, one out of every four mammals, one out of eight birds, one third of amphibians, and seven out of ten world plants may be considered endangered. This reinforces the special attention required so that we are able to increase or sustain natural capital (Metrick and Weitzman 1996). The concern for infringement of development activities on critical habitats is even more evident in states such as New Jersey that have seen continuous and significant land use changes.

The effect of negative trends in ecological goods and services on societal well-being have been variously described by ecological economists (Bartelmus 2012), yet increasing scarcity has not resulted in corrective market solutions. This is because the services provided by critical habitats, for example, are usually not traded or correctly valued in the market place. Such inherent failure has justified government's active intervention where public resources are involved by way of incentives and fees to manage natural capital.

The valuation of the ecosystem services concept was initiated in 1940s and has evolved not only conceptually but also in terms of tools and techniques that are applied to arrive at total economic value of an environmental asset. The total value of ecological goods and services can be estimated not only in terms of actual use but also in terms of *non-use* values. In the context of critical habitat, non-use values contribute to social well-being via the societal satisfaction accrued through conservation of nature and its constituent species (Bartelmus 2012). Hanemann (1994) notes that the earliest works included a travel cost method valuation of recreation activities used by Hotelling in 1949 in his work titled *An Economic Study of the Monetary Valuation of Recreation in the National Parks*. Contingent valuation based approaches were initiated in the late 1940s and 1950s as well. Costanza et al. (2006) notes that option value concept while calculating ecosystem services gained traction in 1960s. This was later complemented by Duffield (1991) who attributed economic value just due to mere existence of an ecosystem. These non-use values also justified government's active intervention in exercising good stewardship and recognizing the contribution of the ecosystem to human well-being.

Several tools developed for ecosystem services valuation have been adopted in multiple policy designs (Langpap 2006). The decision to restrict use of critical habitats or species can be determined through valuations based on lost possible revenue (Bell, Huppert and Johnson 2003). Duffield (1991) noted that designation of critical habitat may not necessarily imply increased conservation measures; rather they include administering relevant regulations with various economic benefits in terms of existence and option values. The valuation might expand to reclusion for locals that are not currently

inhabited by the species under consideration or the effective limits of the critical habitat if there is evidence of extinction risks (Richardson and Loomis 2009).

Ecosystem service valuation approaches are not currently used during listing of biota in the endangered lists; however, there might be a role for them in designating critical habitats and development of recovery plans. The role of ecosystem service valuation in critical habitat contexts is evident through studies like Costanza (2000), who conducted a five site hedonic approximation study in New Jersey to assess value contribution of habitats. They found that in three cases— Toms River, Long Branch, and South Coast—the economic value was positive and significant. However, a word of caution is also ingrained in case of such studies, whereby rising application of valuation tools in public policy making, have resulted in instances where failure to effectively value the benefits have led to flaws in ensuing cost benefit assessments. Costanza et al. (2006) notes that such flaws led to downsizing the designation of critical habitats. Costanza (2000) noted that large variability in valuation of ecosystem services is not only due to different value attributed to these species and habitats but also due to differing study designs. Bulte and Van Kooten (1998) found that the willingness of people to pay premiums to enable perpetual existence of these goods and services is sensitive to change in population size, use type of the species, and the type of species and charisma effect. Furthermore, results are sensitive to issues like choice of discount rate and sustainability assumptions and definitions.

The current practice of ‘green accounting’ fails to fully include the contribution of environmental resources to the total economic value calculations (Hecht 2005). These failures lead to misinformation at a policy level in terms of identifying priorities and evaluating the tradeoffs while dealing with sustainability issues to inform policy for a more optimal outcome. Possible adjustments to current practice may involve accounting for environmental expenditures that have traditionally been aggregated with other incomes. Consistent with this approach is accounting for expenditures incurred in maintaining the said natural environment. These maintenance expenditures can be deducted from total economic value of environmental assets. The ‘green estimate’ does not necessarily lend itself for regional level disaggregation of environmental data nor can it be directly and equivalently interpreted as the social cost benefit of habitat conservation projects. Another issue pertains to non-marketed goods and services that form part of the total consumption but fail to be accounted for or are considered only through rough proxies. Along a related line, the inclusion of natural resource in its physical term or monetary account might be beneficial. While the former is more accurate the latter reduces the different items into a convenient and easily understandable unit, though suffering from several technical challenges (Hecht 2005). In addition to this, given the limit to natural resources and the interlocked carrying capacities of critical habitats, evaluating these figures and informing policies would benefit from developing a standard system that allows for easy aggregation and comparison of performance across conservation regions.

III. REGULATORY OVERVIEW

A. Current Regulatory Framework: How Definitions Protect and Define Critical Habitat

The State of New Jersey has enacted numerous regulations over the course of the past 50 years that are intended to protect the State's natural resources. Administered by the NJDEP, the regulations generally include the management of critical habitat as a corollary to protecting threatened and/or endangered species.

The NJDEP regulates activities that may impact threatened and endangered species habitat through various regulations including CAFRA, the Freshwater Wetland Protection Act, the Waterfront Development Law and the Flood Hazard Area Control Act. Although the NJDEP has the legal authority under the Endangered and Non-game Species Conservation Act (N.J.S.A. 23:2A-1 et seq.) to protect listed species anywhere in the state, it has instead limited its management to those species and their habitats indirectly through other regulations such as those listed above. It is important to note that those regulations with critical habitat or endangered and threatened species provisions typically limit the NJDEP's jurisdiction to regulated activities proposed in these areas through the permitting process. It is also important to note that the NJDEP has limited ability to manage habitat that may be associated with species not-listed as threatened and/or endangered, except in circumstances where the habitat is a protected resource such as a freshwater or coastal wetland. The following sections describe the various New Jersey regulations that include provisions for the management or protection of critical habitat or endangered and threatened species.

1. Freshwater Wetlands Protection Act Rules N.J.A.C. 7:7A

The governing regulation for freshwater wetlands in the state is the New Jersey Freshwater Wetlands Protection Act (N.J.A.C. 7:7A) (the "Act"). The Act requires that freshwater wetlands be identified or delineated in New Jersey using the three parameter approach as described in the *Federal Manual for Identifying and Delineating Wetlands (1989*) ("1989 Manual"). Such an approach dictates that areas meeting the defined criteria of vegetation, soils and hydrology will be designated as jurisdictional wetlands.

For vegetation, the criteria means that more than 50% of the composition of the dominant species from all strata must be categorized as hydrophytic or adapted to living in saturated areas. That is, the plant species must be classified as obligate, facultative wetland or facultative as defined in the "National List of Plant Species That Occur in Wetlands", published by the United States Fish & Wildlife Service. Soils are considered hydric if they meet the criteria defined by the National Technical Committee for Hydric Soils. Hydrology must be present to effect either permanent or periodic saturation of the soil. The 1989 Manual does allow you to assume that the hydrologic parameter is present if hydric soils and hydrophytic vegetation are present and field indications of hydrology are present.

There are two unique features to the Act. First, it characterizes wetlands based on resource value. Wetlands are classified as Exceptional, Intermediate or Ordinary (N.J.A.C. 7:7A-2.5). The second feature is the regulation by the Act of buffer zones (called Transition Areas) around wetland areas. These are upland areas surrounding wetlands that are regulated with regard to various activities that can be conducted in them (N.J.A.C. 7:7A, Subchapters 6 and 7). The sizes of the transition areas depend on the type of wetlands. The transition area for an exceptional value wetland is 150 feet wide and for an intermediate wetland is 50 feet wide. There are no transition areas for ordinary value wetlands.

The Act does allow for the intrusion into wetlands or their transition areas, provided those appropriate permits are obtained. The Act describes two types of permits, General (N.J.A.C. 7:7A, Subchapters 5) and Individual (N.J.A.C. 7:7A, Subchapters 7), which may be applied for to allow various activities to occur in wetlands. Two types of transition area waivers may be applied for to allow various activities to occur solely in the transition areas.

Prior to development of the wetland permit application, the Act does allow for a process by which the wetland boundaries that have been delineated by an outside contractor are confirmed as appropriate by the NJDEP. This is called the development of a Letter of Interpretation (LOI) (N.J.A.C. 7:7A, Subchapters 3). The procedures for obtaining an LOI are outlined in the Act. While LOI's are not always obtained for permitting activities, they are recommended in those situations where the delineation is complex or the site conditions are complicated.

The Act addresses habitat for threatened and/or endangered species in specific circumstances. The Act defines critical habitat, or habitat that is documented to support threatened or endangered species as:

1. Habitat where there is recorded evidence of past use by a threatened or endangered species of flora or fauna for breeding, resting, or feeding. Evidence of past use by a species may include, but is not limited to, sightings of the species, or of its sign (for example, skin, scat, shell, track, nest, herbarium records, etc.), as well as identification of its call; and
2. Habitat where the Department makes the finding that the area remains suitable for use by the specific documented threatened or endangered species during the normal period(s) the species would use the habitat.

The manner in which the Act addresses threatened and/or endangered species is in assigning wetlands having habitat that is documented to support threatened or endangered species as have an Exceptional Resource Value. Resource values are identified during the LOI stage and will ultimately resort in the placement of a 300-foot buffer around the defined wetland boundaries. Additionally, the Act forces any responsible party seeking a permit for an activity that would impact habitat supportive of a threatened or endangered species to obtain an Individual Permit. General Permits

are not allowed for wetlands classified as Exceptional Resource Value. The result is a much greater level of scrutiny for the need and technical merits of the project by the Department.

2. Coastal Zone Management Rules N.J.A.C. 7:7E

The Coastal Zone Management Rules at N.J.A.C. 7:7E are the substantive rules of the NJDEP regarding the use and development of coastal resources under the Coastal Area Facility Review Act (CAFRA) N.J.S.A. 13:19-1 et seq., Waterfront Development Law, N.J.S.A. 12:5-3, Water Quality Certification (401 of the Federal Clean Water Act) and Federal Consistency Determinations of the Federal Coastal Zone Management Act. In accordance with section 7:7E1.1 the Coastal Management Program and the Coastal Zone Management rules are founded on eight broad coastal goals. Section 7:7E1.19(c) states that "Each goal is supplemented by related policies that set forth the means to realize that goal. The Coastal Zone Management rules, including the coastal goals and policies set forth below, are enforceable policies of New Jersey's Coastal Management Program as approved under the Federal Coastal Zone Management Act (16 U.S.C. 1450)". A reoccurring element of the goals is related to the protection and maintenance of natural resources including valuable wildlife and plant habitats and sensitive ecosystems. Goal 1, Section 7:7E1.1(c)1 Healthy coastal ecosystems, is however directly relevant to critical habitat and the biodiversity of New Jersey's coastal areas. This goal specifically states the need to "Protect, enhance and restore coastal habitats and their living resources to promote biodiversity, water quality, aesthetics, recreation and healthy coastal ecosystems" and to "Manage coastal activities to protect natural resources and the environment".

Subchapter 3 of the Coastal Rules (7:7E-3.1) identifies a variety of **"**Special Areas" that are indicated to be "areas that are so naturally valuable, important for human use, hazardous, sensitive to impact, or particular in their planning requirements, as to merit focused attention and special management rules. The special areas set forth include several that are essential to the maintenance of the state's critical habitat including the following; 7:7E-3.6 Submerged vegetation habitat; 7:7E-3.15 Intertidal and subtidal shallows; 7:7E-3.26 Riparian zones; 7:7E-3.27 Wetlands; 7:7E-3.28 Wetlands buffers; 7:7E-3.31 Coastal bluffs; 7:7E-3.38 Endangered or threatened wildlife or plant species habitats; and 7:7E-3.39 Critical Wildlife Habitats.

The 'critical wildlife habitat' special area is the broadest of the special areas related to natural resources as it includes the range of wildlife habitats that are known to serve an essential role in maintaining wildlife, particularly in wintering, breeding, and migrating. As indicated earlier in this report 'critical wildlife habitat' as defined in the Coastal Rules is not limited to habitat that is occupied by an endangered or threatened species. The Coastal Zone Management Rules at (N.J.A.C) 7:7E–3.39; Appendix A) include in the definition of 'critical wildlife habitat' such areas as rookeries for colonial nesting birds (herons, egrets, terns, gulls and skimmers); stopovers for migratory birds including salt marsh waterfowl wintering areas, natural corridors for wildlife movement, and ecotones or edges between two types of habitats.

This special area rule discourages any development that would directly or through secondary impacts adversely affects these habitats unless an applicant can illustrate that the project minimizes interference with the habitat, that there is no prudent or feasible alternative location for the development and that the proposal or application includes appropriate mitigation measures.

The protection of Endangered or threatened wildlife or plant species habitats under the Coastal Rules is set forth in Section 7:7E-3.38. This rule states **"**Endangered or threatened wildlife or plant species habitats are terrestrial and aquatic (marine, estuarine or freshwater) areas known to be inhabited on a seasonal or permanent basis by or to be critical at any stage in the life cycle of any wildlife or plant identified as an "endangered" or "threatened" species on official Federal or State lists of endangered or threatened species, or under active consideration for State or Federal Listing". In accordance with this section of the Coastal Rules "the definition of endangered or threatened wildlife or plant species habitats includes a sufficient buffer area to ensure continued survival of the population of the species as well as areas that serve an essential role as corridors for movement of endangered or threatened wildlife. Absence of such a buffer area does not preclude an area from being endangered or threatened wildlife or plant species habitat."

Development activities proposed in habitat designated as supporting endangered or threatened wildlife or plant species are prohibited unless it can be demonstrated, through an Endangered or Threatened Wildlife or Plant Species Impact Assessment as described at N.J.A.C. 7:7E-3C.2, that endangered or threatened wildlife or plant species habitat would not directly or through secondary impacts on the proposed project site or in the surrounding area be adversely affected.

Subchapter 3C (N.J.A.C. 7:7E-3C) provides the requirements for demonstrating through the preparation of an impact assessment that a proposed development will not negatively affect the population(s) or habitat of endangered or threatened wildlife species that resulted in identification of the site, or an area abutting the site, as endangered or threatened wildlife species habitat in accordance with N.J.A.C. 7:7E-3.38. In accordance with N.J.A.C. 7:7E-3C.2 "The impact assessment shall consider the likely effects of the proposed development on the local populations of the particular species on or abutting the site. The impacts shall be assessed using accepted ecological principles and scientific literature on each species and both direct and indirect impacts of the proposed development shall be considered. This assessment shall be based on habitat requirements and life history of each species, and the manner in which the proposed development may alter habitat, including, but not limited to, vegetation, soils, substrate, bathymetry, salinity**,** hydrology, wildlife movement corridors**,** human disturbance, and effects on competitor, parasite, or predator species". Of importance is that the Coastal Zone Management Rules do not mention or provide for off-site mitigation relative to compensating for impacts to endangered and threatened species habitat although the rules do expressly permit and provide

standards for mitigation with respect to other regulations, such as wetlands and riparian zones.

Impacts to exceptional resource value wetlands and their transition areas are, however, feasible through the receipt of a freshwater wetlands individual permit. In these cases compensatory mitigation is required. In addition, impacts to riparian zones that possess endangered and threatened species habitat can also be realized through receipt of an individual Flood Hazard Control Act permit.

Those areas mapped as endangered or threatened wildlife species habitat on the Department's Landscape Maps are subject to the requirements of this section unless an applicant can demonstrate that the site of a proposed development is not habitat for endangered or threatened wildlife species.

The coastal zone regulations associated with activities in wetlands are set forth at 7:7E-3.27. The regulations regarding proposed activities in wetlands are derived primarily from the Freshwater wetlands protection act (N.J.S.A. 13-9B) and The Wetlands Act of 1970 (N.J.S.A. 13:9A-1 et seq.).

The intent of The Wetlands Act of 1970 was as follows**; "**The Legislature hereby finds and declares that one of the most vital and productive areas of our natural world is the so-called "estuarine zone," that area between the sea and the land; that this area protects the land from the force of the sea, moderates our weather, provides a home for water fowl and for all fish and shellfish, and assists in absorbing sewage discharge by the rivers of the land; and that in order to promote the public safety, health and welfare, and to protect public and private property, wildlife, marine fisheries and the natural environment, it is necessary to preserve the ecological balance of this area and prevent its further deterioration and destruction by regulating the dredging, filling, removing or otherwise altering or polluting thereof, all of the extent and in the manner provided herein". Although neither critical habitat nor endangered and threatened species are specifically referenced in the act, the rules provide regulations designed to protect critical habitat in the coastal zone. The wetland buffers set forth in the Coastal Zone Management Rules at 7:7E 3.28 establish the need for buffers of up to 300 feet. The wider buffers are required to "establish conformance with other rules including but not limited to 7:7E-3.38 Endangered or Threatened Wildlife or Plant Species and 3.39 Critical Wildlife Habitats".

Freshwater wetlands within the Coastal Zone are regulated in accordance with the provisions of the Freshwater Wetlands Protection Act (to be discussed above). A unique provision set forth in the Coastal Zone Management Rules as it relates to habitat protection is that it specifically states at 7:7E-3.27(f) that "Development that adversely affects white cedar stands such as water table drawdown, surface and groundwater quality changes and the introduction of non-native plants species is prohibited".

Riparian zones are identified as special areas, N.J.A.C. 7:7E-2.26, in accordance with the requirements of the Flood Hazard Area Control Act N.J.A.C. 7:13

3. Stormwater Management Rules N.J.A.C. 7:8

The stated purpose of the Stormwater Management Rules is to establish general requirements for stormwater management plans and stormwater control ordinances, as well as content requirements and procedures for the adoption and implementation of regional stormwater management plans and municipal stormwater management plans under the Municipal Land Use Law, N.J.S.A. 40:55D-1 *et seq.*; the Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq.: the Water Pollution ControlAct, N.J.S.A. 58:10A-1 et seq.; and the Flood Hazard Area Control Act, N.J.S.A.58:16A-50 et seq.; and implementing rules.

The rules identify two levels of habitat relative to threatened or endangered species. The first is identified as an environmentally constrained area, meaning an area where the physical alteration of the land is in some way restricted, such as through the presence of threatened and endangered species sites or designated habitats. Environmentally critical areas mean an area or feature which is of significant environmental value to habitats of endangered or threatened species.

4. Surface Water Quality Standards N.J.A.C. 7:9B

The Surface Water Quality Standards (N.J.A.C. 7:9B) establish the designated uses and anti-degradation categories of the State's surface waters, classify surface waters based on those uses (i.e., stream classifications), and specify the water quality criteria and other policies and provisions necessary to attain those designated uses. Designated uses include drinking water supply, fish consumption, shellfish resources, propagation of fish and wildlife, recreation, and agricultural and industrial water supplies. In addition, the SWQS specify general, technical, and interstate policies, and policies pertaining to the establishment of water quality-based effluent limitations. Under the SWQS, all existing and designated uses shall be maintained and protected for all surface waters of the State. Surface water quality that is better than the applicable criteria must also be maintained and protected. These antidegradation protections apply to all surface waters of the State. Surface waters of the State include rivers, lakes, streams, wetlands, estuaries, and near-shore coastal waters.

Relative to habitat for threatened and/or endangered species, the focus of the SWQS is on preventing the degradation of aquatic resources in the state. The SWQS note that the maintenance, migration, and propagation of threatened or endangered species (as defined under the Federal Endangered Species Act of 1973 as amended, 16 U.S.C. 1531 *et seq*., and/or the New Jersey Endangered and Nongame Species Conservation Act N.J.S.A. 23:2A-1 et seq.) is considered an existing use that must be maintained. No other mention of habitat protection for threatened and/or endangered species appears in the SWQS.

5. Flood Hazard Area Control Act Rules N.J.A.C. 7:13

The stated purpose of the Flood Hazard Control Act is set forth in section 7:13-1.1 (c). This section states "The purpose of this chapter is to minimize damage to life and property from flooding caused by development within fluvial and tidal flood hazard areas, to preserve the quality of surface waters, and to protect the wildlife and vegetation that exist within and depend upon such areas for sustenance and habitat". The natural resource protection element of this regulation is primarily derived from the establishment of a riparian zone along every regulated water. A riparian zone of 150 feet exists on both side of every regulated water "that contains documented habitat for a threatened or endangered species of plant or animal, which is critically dependent on the regulated water for survival, and all upstream waters (including tributaries) within one linear mile as measured along the length of the regulated water". The NJDEP indicated that "a riparian zone of 150 feet is the minimum necessary to protect endangered species habitat (39 N.J.R. 4626). It is however important to understand that the rule limits its jurisdiction to those areas that possess species that are deemed to be "critically dependent" on the regulated water for survival. The NJDEP provided a list of the species that satisfy this requirement (http://www.nj.gov/dep/landuse/forms/tecritical.pdf). This list includes amphibians, reptiles, invertebrates and plants. No listed mammals or birds are on this list.

The identification of habitat of a critically dependent species is an important element of a regulated project under the flood hazard control act. Every Flood Hazard Control Act Application (except general permits 2F, 2G and 4) must include an analysis of the project's status with regard to the Department's "Landscape Project" mapping, as well as a "natural heritage data request" letter from the Department's Natural Heritage Program. The Landscape Project mapping and Natural Heritage Program data request shall, at a minimum, identify all threatened and endangered species on site, as well as all threatened and endangered species that are "critically dependent on the regulated water for survival" which occur within one mile of the project site. The NJDEP shall only issue an individual permit for a regulated activity if the activity does not adversely affect a threatened or endangered species or a documented habitat for a threatened or endangered species.

6. Pollution Discharge Elimination System Act Rules N.J.A.C. 7:14A

The stated intent of the Pollution Discharge Elimination System Act Rules is to (a) restore, enhance, and maintain the chemical, physical, and biological integrity of the waters of the State; (b) protect public health and safety; (c) protect potable water supplies; (d) safeguard fish and aquatic life and scenic and ecological values; (e) enhance the domestic, municipal, recreational, industrial, agricultural and other uses of water; and (f) prevent, control, and abate water pollution. The rules are implemented through various permits that provide control or treatment of all point and nonpoint sources of pollution, regulate the location, modification and construction of any facilities which may result in any discharge in such area, and assure that any industrial or commercial wastes meet pretreatment requirements.

One facet of these rules is to exempt Environmentally Sensitive Areas from future sewer service. ESA's are defined as 25 or more contiguous acres consisting of threatened and Endangered Species Habitats, natural Heritage Priority Sites, buffers along Category One Waters and wetlands.

7. Highlands Protection Act Rules N.J.A.C. 7:38

Passed in 2004, the intention of the Highlands Water Protection and Planning Act N.J.A.C. 13:20-1 et seq. (Highlands Act), is to establish environmental standards and procedures by which the NJDEP will review any application for major development proposed in the Preservation Area of the Highlands Region; or for a waiver from any requirement for a Highlands Preservation Area Approval, any resource or applicability determination or exemption from the Act, and any permit or plan reviewed by the NJDEP in the Highlands Region. The Highlands Act established two distinct areas of influence identified as the Preservation District and the Planning District. The Preservation Area is the more sparsely populated section of the Highlands Region and is dominated by forest. Conversely, the Planning Area contains areas of substantial development and some farmland and has a greater population density.

The Highlands act identifies critical habitat as "Highlands resource areas", meaning those features of the Highlands that merit special protection such as rare, threatened or endangered species habitat; and rare or threatened plant habitat. These areas are mapped in the State's Landscape Maps as part of the Regional Master Plan and are ranked according to the level of threatened and/or endangered species that is found in the mapped area. The rules do state that the NJDEP may not issue a Highlands Preservation Act Approval (HPAA) unless it determines that the proposed activity will not jeopardize the continued existence of, or result in the likelihood of the destruction or adverse modification of habitat for, any rare, threatened or endangered species of animal or plant.

8. Pinelands Comprehensive Management Plan N.J.A.C. 7:50

The National Parks and Recreation Act of 1978 established the Pinelands National Preserve, encompassing parts of seven southern New Jersey counties (including Fort Dix), and authorized a planning entity, which eventually became the New Jersey Pinelands Commission (NJPC). The NJPC was formed by passage of The Pinelands Protection Act of 1979 (NJSA 13:18A-1 *et seq*.). The governing rules of the NJPC are embodied in the State of New Jersey Comprehensive Management Plan (CMP) of 1981, as amended (NJAC 7:50-1 *et seq*.).

The purpose of the NJPC is to protect the unique biological resource of the New Jersey Pinelands through implementation of the CMP. The CMP is a planning tool "designated to promote orderly development of the Pinelands so as to preserve and protect the significant and unique natural, ecological, agricultural, archaeological, historical, scenic, cultural, and recreational resources of the Pinelands." The Pinelands

is a 1.1 million-acre area of large pine, oak and cedar forests interlaced by Atlantic white cedar swamps, hardwood swamps, and cranberry bogs in southern New Jersey. Unique communities such as the "pygmy" pines and endemic species such as curly grass fern led the Pinelands to become the Nation's first National Reserve in 1983. Further, the Pinelands is a Biosphere Reserve designated by the U.S. Man and Biosphere Program and the United Nations Educational, Scientific and Cultural Organization (UNESCO).

While the CMP maintains a significant prohibition on development or impacts that will affect threatened or endangered species, the CMP does not specifically identify critical habitat of any type in association with these species. The focus is on the protection of the species, not the identification of the supporting habitat. However, the CMP does note as one of its objectives to protect the wide diversity of rare, threatened and endangered plant and animal species and the many significant and unique natural, ecological characteristics of the Pinelands.

VI. RECOMMENDATIONS

Based on its overall project deliberations, the Ecological Processes Standing Committee submits the following recommendations to the Department:

- The term ***Critical Habitat (CH)*** should replace "Critical Wildlife Habitat (CWH)" and be expanded to include *both* plants and animals recognizing that the former are essential to the health of an ecosystem and its associated biophysical processes and functions. Moreover, ecosystem resilience and functions are tied to ecosystem engineers that are often comprised of plants. We further recognize that non-living components of the ecosystem are linked to flora and fauna through biogeochemical cycling, and other ecosystem processes. The Committee recommends that the revised definition be applied to all relevant regulatory documents for consistency in enforcement through the State;

- Environmental management of New Jersey's natural resources including critical habitat will benefit from spatial planning and ***Ecosystem-Based Management (EBM)*** protocols. The latter focuses on multiple activities within specific areas defined by *ecosystem* rather than *political* boundaries. It also places humans in the landscape, within the broader context of the biological and physical environment, and ultimately combines ecology and human dimensions into "society-integrated" management guidelines.

- A statewide series of ***Critical Habitat Maps*** (building upon New Jersey's current Landscape Maps; see Appendix C below) should be prepared for: (a) each biogeographical province identified by the NJ Department of Fish and Wildlife; (b) for exemplary, or unique communities such as fens or grasslands or others identified by the Natural Heritage Program; and (c) for exemplary natural assets identified in New Jerseys' Wildlife Action Plan. The inventory should also identify the range of species with unique habitat requirements that are particularly

threatened in New Jersey, and species whose presence in the state is at the limit of their biogeographical range. These maps would allow environmental stewards to work towards conserving/restoring/preserving ecosystem diversity and habitat connectivity (by reducing habitat fragmentation). Ultimately, this activity would enhance ecosystem resilience while preserving the natural heritage of New Jersey.

- The impacts of ***Climate Change and Sea-Level Rise*** should be evaluated in the context of ecological responses within diverse coastal and inland ecosystems. Degraded ecosystem processes and habitat fragmentation/loss are expected to alter species distributions and their relative abundances. Growth and survival of migratory and resident species that depend on coastal and inland habitats for feeding, nesting, resting, spawning, nursery areas, protection from predators, and other functions will result from these altered earth system dynamics. Information derived from these efforts can be integrated into planning, protection, and land management programs as guidelines for species conservation and protection.

- A statewide strategy should be developed for managing and reducing ***Invasive*** (e.g. *Phragmites australis*) and ***Nuisance Species*** (e.g. deer, coyotes, raccoons, starlings, black bear, Canada goose, etc.) impacts on *Critical Habitat* focused on ecosystem processes and functions.
  Because many invasive species are still spreading rapidly, and new ones have only been recently introduced, state resource agencies not only need to consider the impact of extant invasive forms, but should also work proactively to reduce the potential impact of *impending* threats on *Critical Habitats*. Invasive species may also benefit from human-induced disturbance and anthropogenic alteration of existing ecosystems that may give invaders a selective advantage over resident species. Consequently, planning agencies should factor these elements into future land development and/or build-out scenarios.

- ***Conservation Banks (CB)*** and other land acquisitions approaches should be explored to help preserve Critical Habitat. *Conservation Banks* are permanently protected lands that contain natural resource values. They are conserved and permanently managed for species that are endangered, threatened, candidates for listing as endangered or threatened, or are otherwise species-at-risk. *Conservation Banks* may function to offset adverse impacts to these species that occur elsewhere, and are sometimes referred to as off-site mitigation.

  CB may be privately or publicly owned sites where a bank operator is allowed to sell habitat credits to developers who need to satisfy legal requirements for compensating environmental impacts of development projects. A conservation or mitigation bank is a free-market enterprise that: a) offers landowners economic incentives to protect natural resources; and b) saves developers time and money by providing them with the certainty of pre-approved compensation lands and provides for long-term protection and management of habitat. *CB* are now established in ten states including Maryland, California, North Carolina, Texas and Florida.

- ***Ecohydrologic*** criteria (e.g., variations in stream flow, etc.) should be included in the characterization of *Critical Habitat*. Scientific knowledge concerning these criteria has expanded dramatically in the past decade, and many investigators have identified hydrologic alteration as a serious threat to stream and river ecosystems, and their associated biota. Water is necessary for sustaining a watershed's provision of ecological services (e.g., critical habitats, fisheries production, potable water, recreation, etc). How aquatic ecosystem functions and processes are modified by climate change and are influenced by changes in base-flow, evapotranspiration and other hydrologic features are important to understanding the links between hydrologic functions and the health of a watershed. Better understanding of temporal and spatial trends in hydrologic drivers also form a strong basis for improved decision making and water resource management.

- ***Monitoring Programs for Indicator Species*** should be developed. Individual species, such as 'keystone' predators or 'ecosystem engineers', can be important indicators of ecosystem health and resilience. Monitoring their population trends and demographics can offer a cost-effective means for assessing anthropogenic influences on *Critical Habitat.* Monitoring of indicator species status should also be linked to adaptive management plans to ensure that potential impacts are regularly evaluated, and if necessary, mitigated.

- A statewide strategy should be developed for ***Habitat Restoration***, with activities focused on reducing habitat 'fragmentation', and finding/acting on opportunities to improve habitat 'connectivity'. Habitat fragmentation is often a cause of species becoming threatened or endangered, or even driven to extinction. Although it is desirable to expand existing habitat fragments to increase the area of 'interior' habitat, cost constraints/land availability may prevent managers from achieving this desired result. It is equally important to maintain some habitat types, e.g., grasslands, in an early successional state to preserve interior habitat.

  Alternatively, resource managers can attempt to link existing fragments by preserving or planting corridors of native vegetation. The latter has the potential to mitigate the problem of isolation but not the loss of interior habitat. The best solutions are generally dependent on the particular species or ecosystem that is being considered. Highly mobile species, like birds do not necessarily need connected habitat while some smaller species, like rodents, may be more exposed to predation on open lands.

- Current regulations should be revisited and integrated into a ***Single Set of Statewide Rules*** and streamlined for consistency and inclusion of the tenets presented herein. The recommendations set forth in the New Jersey Wildlife Action Plan, currently the most comprehensive document related to the protection of New Jersey's *Critical Habitat*, is presently of limited use due to the absence of direct linkages to other planning documents or regulation. The EPSC suggests

that the content of the NJWAP be integrated into all New Jersey's planning documents as well as combined with relevant text in the Coastal Zone Rules, Freshwater Wetlands Protection Act and Flood Hazard Areas Control Act.

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NJ Natural Heritage Database: http://www.nj.gov/dep/parksandforests/natural/heritage/index.html

NJ Wildlife Action Plan: http://www.njfishandwildlife.com/ensp/waphome.htm.

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APPENDICES

A. CRITICAL WILDLIFE HABITAT (N.J.A.C. 7:7E-3.39)

Introduction:

The Endangered and Nongame Species Program (ENSP) is in the process of developing definitions and mapping criteria to aid in the identification of Critical Wildlife Habitat within the NJ coastal zone. Critical Wildlife Habitat (CWH) is not necessarily habitat that is occupied by an endangered or threatened species, but instead is defined as "areas known to serve an essential role in maintaining wildlife, particularly in wintering, breeding, and migrating" in the Coastal Zone Management Rules (N.J.A.C. 7:7E–3.39). As such, habitat for non-listed species can be considered CWH. ENSP has identified the 6 categories listed below as the primary types of critical wildlife habitat in the coastal zone. Some of the types of CWH will have ordinal rankings of importance for that habitat type (e.g. migratory bird stopover habitat and vernal habitat) while others will simply identify "critical habitat" with no attempt to rank or prioritize (e.g. Colonial Water Bird and Beach Nesting Bird Habitat). Of all the CWH categories described in this document it is the "Migratory Bird Stopover Habitat" that is in the most draft form. The basic elements that would feed into the ranking criteria for this habitat type have been identified, but exactly how these elements fit together into an ordinal ranking of Migratory Bird Stopover Habitat has not been determined. This category is also the most predictive in nature and, unlike the other categories, whether or not an area gets valued as Migratory Bird Stopover Habitat is not dependent on the presence or absence of known occurrences.

Critical Wildlife Habitat Categories:

1. Migratory Bird Stopover Habitat
2. Migratory Shorebird Concentration Areas
3. Vernal Habitat
4. American Oystercatcher Habitat – Breeding Habitat
5. American Oystercatcher Habitat – Wintering Habitat
6. Colonial Water Bird and Beach Nesting Bird Habitat

Mapping Criteria:

1. Migratory Bird Stopover Habitat (land birds)

Name of Wildlife habitat or area of concern (WH or AC) – CAFRA Migratory Land Bird Stopover Habitat

General Description of Habitat to be Identified Through Mapping
Map of habitats that are suitable and important/critical to support the significant autumn migration of land birds (raptors and songbirds) in the CAFRA zone. Develop a ranking

Background

The CAFRA zone in NJ is critical for migratory forest songbirds. According to Avian Knowledge Network data (AKN), at least 60% of most of NJ migratory forest/scrub-shrub songbird species stop over in the CAFRA zone: 91% (21/23) Bicknell's thrush (BITH), 83% (58/70) black-billed cuckoo (BBCU), 74% (700/944) northern parula (NOPA), 72% (195/271) least flycatcher (LEFL), 71% (22/31) Whip-poor-will (WPWI), 71% (704/992) black-throated blue warbler (BTBW), 66% (117-178) worm-eating warbler (WEWA), 65% (15/23) cerulean warbler (CERW), 64% (23/36) golden-winged warbler (GWWA), 62% (255/410) Nashville warbler (NAWA), 60% (3/5) loggerhead shrike (LOSH). The majority of habitat within 180 m of migrant forest songbird AKN observations include LULC categories that comprise of forest, but also include recreational lands and saline marsh (high and low). On Cape May Peninsula, however, especially in the lower 10 km, all LULC classes, including residential, are used by forest songbirds. This area on the Cape May Peninsula contains 88% (3,033/3,432) of migratory forest songbird AKN observations in the CAFRA zone.

Because migrants have particular habitat affinities during migration, it is important to maintain a diverse mosaic of habitats (Mabey et al. 1993). In urban areas, abundance of migrants is higher in upland forests (Rodewald and Matthews 2005) and % urbanization or % forest cover within 1 km did not affect abundance. Abundance of forest-interior breeding birds is highest during fall migration in forest-ag edge, scrub-shrub habitat, and suburban forest (lightly wooded housing developments). Forest migrants can also use pole-stage forest and interior forest (Rodewald and Brittingham 2004). Abundance of scrub-shrub breeding birds is highest during fall migration in scrub-shrub habitat and forest-ag edge. Scrub-shrub migrants rarely used interior forest or pole-stage forest (Rodewald and Brittingham 2004). Hughes (2001) found that BBCUs frequent wooded areas and dense thickets during migration through Florida and in woodlands, particularly along streams and ponds, dense borders of meadows and margins of forests, and also groves and thickets of coastal prairies in Texas. BBCUs are also found near human habitation in orchards and gardens, but remain well hidden. Moldenhauer and Regelski (1996) found NOPAs to use stopover habitat similar to that of breeding season in the spring (forest canopy). In N. Carolina, NOPAs showed a preference for beech forest but also occurred (with decreasing frequency) in floodplain forest, oak-hickory forest, pine-hardwood forest, and pine forest. In the fall, they can be found in any tree or shrub. Briskie (1994) found little information about LEFL stopover habitat. Migrating Least Flycatchers in w.-central Kansas were found in wooded habitats along water courses, gullies and windbreaks, although occasionally found in tall weed growth and isolated trees. Cink (2002) found little information for WPWI, but many occur in same types of open forests they breed in. May occur in coastal scrub during migration through Mexico. Holmes et al. (2005) found BTBW to use forest edges, riparian woodlands, and other well-vegetated habitats, including parks and gardens. In spring, they often inhabit well-developed upland or riparian forests. Hanners and Patton (1998) found little information about WEWA stopover habitat. They presume that WEWAs are restricted to deciduous and mixed deciduous-coniferous forests as they are found in subcanopy and shrub layers during spring migration in Piedmont and coastal plain areas around Raleigh, NC.

Williams (1996) found that NAWAs use deciduous trees or shrubs in open mixed forests at mid-canopy level, bushy edges of woodlands along streams, roads, and paths, or edges of fields, meadows, and ponds, swamps, or marshes.

While past surveys of songbirds showed them concentrating in the lower 10 km of the peninsula, recent surveys of raptors concluded that they are now concentrating in a larger portion of the peninsula than found earlier. Surveys conducted by Niles et al. (1996) on the peninsula during fall, 1984 and 1986, demonstrated that migratory raptors were associated with habitat throughout the Cape May stopover but concentrated near the southern tip of the peninsula. Surveys of the concentration area (i.e., the lower 10 km) showed that raptors were distributed throughout the concentration area, using a variety of habitats and avoiding developed land (Niles et al. 1996). In 2002, a follow-up study found a reduced concentration of raptors and an even distribution throughout the northern portions of the peninsula (Frank 2007). The loss of habitat in the lower peninsula has caused raptors to fly and forage (i.e., stop over) in a larger area of the peninsula than previously found (Frank 2007). These findings, and the continued habitat loss in the lower peninsula, have led to the recommendation that land-use protections in place for the lower 10 km be extended to the entire peninsula, and the lower 20 km at a minimum (Frank 2007). The changes in raptor distribution in Cape May peninsula can generally be interpreted to songbirds as well, because the most abundant raptor species (sharp-shinned and Cooper's hawks) feed on songbirds; thus raptor distribution is determined in large part by songbird distribution. The changes observed in the peninsula emphasize the importance of maintaining good conditions in the stopover region: continued loss and degradation of habitat will ultimately reduce the carrying capacity of the stopover. Lower carrying capacity of the Cape May stopover (the peninsula and the Bayshore), will translate to reduced raptor and passerine populations that can survive migration (Myers et al. 1987, Moore 2000).

Migrating songbirds also funnel into Cape May peninsula, even though their migration strategy differs somewhat from raptors. Songbirds migrate at night using both the night sky and terrestrial landmarks (Able 2001). Many birds, especially inexperienced juvenile birds, get carried by northwest winds to the coastal barrier islands and beyond, and must make their way back to land in early morning hours (Wiedner et al. 1992). In a study of migrating songbirds in the mid-Atlantic region (New Jersey, Delaware, Maryland, Virginia), biologists documented the distribution of Neotropical migrant songbirds in coastal and interior areas on the Cape May and Delmarva peninsulas (Mabey et al. 1993). Four distribution patterns emerged:

1) Migrant abundance and species richness were significantly greater near the coast (0 – 0.9 miles [0 – 1.5 km]) than in areas farther away from the coast (0.9 – 1.9 miles [1.5 – 3 km])
2) Bay coastal zones (in NJ, 0-3 km from the Delaware Bayshore) have higher abundances of migrants than seaside coastal zones or peninsula interiors (6.2 – 14.3 miles [10 – 23 km] from the mean high tide line).
3) Migratory songbirds are more abundant on barrier islands than the coastal mainland.

4) Migrants are associated with particular habitats on a species-specific basis; i.e., migration stopover and breeding habitat affinities were similar for individual species.

Migrating songbirds have a strong geographic distribution pattern toward coastal areas, and barrier islands are clearly critical for migrating land birds (Yong and Moore, 1997, Mabey et al. 1993, Moore et al. 1990). Geographic factors override habitat factors; therefore, all native habitats in coastal areas are important (Mabey et al. 1993).

Migrant songbirds will use all available habitat patches regardless of size particularly where habitat is limited due to surrounding landscape (urban or agriculture) or proximity to significant barriers (Biebach 1995, Skagen et al. 1998, Somershoe and Chandler 2004, Mehlman et al. 2005). Small and isolated patches or "fire escapes" serve both as critical stopover sites and migratory "stepping stones" (Skagen et al. 1998, Mehlman et al. 2005). Large forest and scrub-shrub patches are most important for migrant birds and will support greater numbers and diversity of migrant birds and also provides breeding habitat (Mehlman et al. 2005). Migrant songbirds fall out along coastal areas and will remain there to rest, forage and shelter from predators until fat reserves and hydration are restored. This is particularly true for fat-depleted birds which stay for longer periods than fatter birds (Moore and Kerlinger, 1987) and inexperienced first-year birds where the benefits of rejecting even marginal habitat is outweighed by the energetic cost of finding more suitable sites (Kuenzi et al. 1991, Moore et al. 1990).

Prioritizing stopover habitats should be based upon (from Mehlman et al. 2005):

1) Ecological context (degree of isolation, proximity to ecological barriers)
2) Intrinsic characteristics (diversity and abundance of resources)
3) Migrant use (relative abundance, frequency and consistency of use)

<u>Ranking Criteria or Method of developing ranking</u>

Prioritize all patches based upon the following and in the respective order (see Mehlman et al. 2005). The patches with the largest # points are higher priority:

1) Proximity to barrier – patches within close proximity to the Atlantic Ocean and the Delaware Bay (Cape May Peninsula ranks highest due to proximity to both)
    a. Calculate distance of patch edge to Atlantic Coast (Mean High Tide Line). Rank distance to Atlantic Ocean by category: Barrier Island, 1,500 m inland of upland-salt marsh interface, 3,000 m inland of upland-salt marsh interface, and >3,000 m of upland-salt marsh interface up to the CAFRA boundary (Mabey et al. 1993), increasing the # points by 1 the closer the category is to the Atlantic Ocean.
    b. Calculate distance of patch edge to Delaware Bay (Mean High Tide Line). Rank distance to Delaware Bay via increments of 10 km up to the CAFRA boundary, increasing the # points by 1 the closer the category is to the Delaware Bay

2) Degree of isolation - calculate distance of patch to nearest other suitable patch, increasing the # points by 1 for every 1 km between patches (Rodewald and Matthews 2005)
3) Diversity of habitat types in patch – add 1 point for each LULC type within the habitat patch
4) Patch size – separate HECTARES into 5-ha categories and add 1 point for each 5-ha increment
5) Proximity to fresh water – use the Water layer and calculate distance of lakes and streams and freshwater tidal wetlands to the patch. Separate into 200-m categories up to 1 km and add 1 point for each increment that is closer to fresh water (Rodewald and Matthews 2005)
6) Relative abundance of migrant species in patch; 1 point for every 5 individuals up to 20+ individuals
7) Frequency/consistency of patch use by migrant species; 1 point for every 5 years of use up to 20 years

2. Migratory Shorebird Concentration Areas

Name of Wildlife habitat or area of concern (WH or AC) – Migratory Shorebird Concentration Areas

General Description of Habitat to be Identified Through Mapping– Important and Critical areas for shorebird migration:

1) Habitats/habitat complexes used by shorebirds on migration (stopover sites) and during winter.
2) Connectivity between migratory shorebird habitats, where supported by shorebird movement data and scientific literature.

Source Data

NJDEP 2002 LU/LC

Citation_Information:
Originator:
New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS)
Publication_Date: 20070101
Title:
NJDEP 2002 Land use/Land cover Update, Upper Delaware Watershed Management Area, WMA-1, Edition 20080304
Edition: 20080304
Geospatial_Data_Presentation_Form: vector digital data
Publication_Information:
Publication_Place: Trenton, NJ
Publisher:

New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS)
Online_Linkage:
<http://www.state.nj.us/dep/gis/digidownload/zips/lulc02/w01lu02.zip>

NJDEP Landscape Project Data
Citation_Information:
Originator:
New Jersey Department of Environmental Protection (NJDEP), Division of Fish Wildlife, Endangered Nongame Species Program (ENSP)
Publication_Date: 200706
Title:
NJDEP Landscape Project Data
Edition: Version 3, 20061002
Geospatial_Data_Presentation_Form: vector digital data
Publication_Information:
Publication_Place: Trenton, NJ
Publisher:
New Jersey Department of Environmental Protection (NJDEP), Division of Fish Wildlife, Endangered Nongame Species Program (ENSP)
Other_Citation_Details:
Version 1 was released in 2001. Version 2 was released in February 2004. Version 2.1 and 3.0 were released to the public in April 2008.
Online_Linkage:
http://www.state.nj.us/dep/gis/landscape.html

Mapping Criteria – Create shapefiles that delineate important and critical shorebird use areas. Habitat types to be used include: beaches, sandy creek mouths, sod banks, marshes, mudflats, sandflats.

1) Identify suitable and occupied habitats/complexes especially those associated with coastal inlets (riparian or barrier island estuaries). Use data in Biotics for NJ special concern and regional priority species (per US Shorebird Conservation Plan).

Attributes needed in final GIS layer –
COUNT_INF- count information
SPECIES- observed species
REG_STATUS- State SC status or SWAP regional priority status

Ranking Criteria or Method of developing ranking – Combine attributes to define important and critical shorebird use areas. Critical areas contain multiple points of known observations, and important areas contain some observational data and/or habitat suitability based on known data.

- Critical: Suitable habitat occupied by NJ special concern species (sanderling, semipalmated sandpiper, American oystercatcher, whimbrel), or by regular, annual concentrations of >5,000 total shorebirds of special concern and regional priority status.

- Important: Suitable habitat occupied by SC or Regional priority species (sanderling, semipalmated sandpiper, American oystercatcher, whimbrel, irregularly or in annual concentrations of <5,000 total shorebirds of special concern and regional priority status.

Justification documentation – Despite the high degree of development along NJ's Atlantic coastline, it serves as stopover habitat for many different species of migratory shorebirds along the Atlantic Flyway. The beaches, tidal inlets, marshes and mudflats along coastal NJ serve as important foraging, roosting and wintering areas for over 30 species of shorebirds annually. These important and critical habitats host threatened and endangered species, species of special concern and species of regional priority. Conservation of these areas is essential to continue to their value to migrating coastal birds.

3. Vernal Habitat

Name of Wildlife habitat or area of concern (WH or AC) – Vernal Habitat

General Description of Habitat to be Identified Through Mapping – This layer (or map) will depict "critical vernal habitat", which is defined as the vernal pool and surrounding upland habitats that serve and essential role in maintaining the breeding, foraging, and overwintering opportunities required by facultative and obligate vernal pool species.

Source Data
NJDEP 2002 LU/LC

Citation_Information:
Originator:
New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS)
Publication_Date: 20070101
Title:
NJDEP 2002 Land use/Land cover Update, Upper Delaware Watershed Management Area, WMA-1, Edition 20080304
Edition: 20080304
Geospatial_Data_Presentation_Form: vector digital data
Publication_Information:
Publication_Place: Trenton, NJ
Publisher:

New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS)
Online_Linkage:
<http://www.state.nj.us/dep/gis/digidownload/zips/lulc02/w01lu02.zip>

NJDOT Roads 2009

Citation_Information:
Originator:
New Jersey Department of Transportation (NJDOT), Bureau of Transportation Data Development (BTDD)
Publication_Date: 20080612
Publication_Time: 1400
Title: roads_2008
Edition: 1.9
Geospatial_Data_Presentation_Form: vector digital data
Publication_Information:
Publication_Place: Trenton, NJ
Publisher:
New Jersey Department of Transportation (NJDOT), Bureau of Transportation Data Development (BTDD)
Online_Linkage: <http://www.state.nj.us/transportation/gis/zip/roads_2008.zip>

CRSSA Vernal Pool Coverage

Mapping Criteria – Apply buffers to all "potential" and "certified" vernal pools from the CRSSA vernal pool coverage. Buffers will consist of an "inner buffer" of 150-m from the vernal pool point and an "outer buffer" extending from 150-m to 300-m from the vernal pool point. Within each buffer separately calculate the amount of "URBAN LULC" (use same level 3 classes as Landscape *v.2a* to define urban). Also calculate the amount of "FOREST" within each buffer zone separately (using level 3 classes for "Forest" and "Wetland Forest" defined in Landscape *v.2a*). Determine presence and absence of roads within each buffer. *Question: Would it be possible to come up with some calculation of the "amount" of roads within each buffer? Maybe length of the road segment(s) within each buffer?*

Attributes needed in final GIS layer
VHID – vernal habitat unique ID
CERTIFIED_VP– yes or no
HECTARES – ACRES * 2.471
IN_BUFFER_URBAN – Area (acres) of inter buffer (0-150m) that is "urban"
OUT_BUFFER_URBAN – Area (acres) of outer buffer (>150-300m) that is "urban"
IN_BUFFER_URBAN_PERCENT – % of inter buffer (0-150m) that is "urban"
OUT_BUFFER_URBAN_PERCENT - % of outer buffer (>150-300m) that is "urban"
IN_BUFFER_FOREST – Area (acres) of inter buffer (0-150m) that is "forest"
OUT_BUFFER_FOREST – Area (acres) of outer buffer (>150-300m) that is "forest"

IN_BUFFER_FOREST_PERCENT – % of inter buffer (0-150m) that is "forest"
OUT_BUFFER_FOREST_PERCENT - % of outer buffer (>150-300m) that is "forest"
IN_BUFFER_ROADS – Yes or No
OUT_BUFFER_ROADS – Yes or No
IN_BUFFER_ROADS_AMOUNT – if possible
OUT_BUFFER_ROADS_AMOUNT – if possible

Ranking Criteria or Method of developing ranking
The vernal pool buffer will be divided into an "inner zone" (Vernal Pool Point with a 150-m buffer) and an "outer zone" (300-m buffer with the inner zone clipped from it). Ranking will be based on the amount of urban development and roads contained within the inner and outer zone. Vernal pools with the most intact buffers (i.e. the least amount of urban development and fewest roads) will receive the highest ranking.

Justification documentation

Facultative and obligate vernal pool species require intact habitats adjacent to their breeding pools to successfully complete their lifecycles. Some species inhabit the breeding the pools for a little as 2-3 months, spending the remainder of the year in the habitats surrounding the pool. Protection of the upland buffer to a vernal pool is therefore equally important to protecting the pool itself. Conversion of natural habitats to urban, or other impervious land-cover types, degrades the suitability of vernal pool buffers and is most detrimental when this type of habitat loss occurs close to the edge of the vernal pool. Roads in close proximity to the pool further degrade the quality of the habitat because roads create barriers to movement and can lead to high mortality.

4. American Oystercatcher Habitat – Breeding Habitat

Name of Wildlife habitat or area of concern (WH or AC) –American Oystercatcher Nesting Areas

General Description of Habitat to be Identified Through Mapping – We are trying to depict known nesting areas of American Oystercatchers. These areas will be represented as polygons. They mostly occur on marsh islands but also on barrier islands.

Source Data

NJDEP, DFW, ENSP SOA v5 – all polygons that are listed in the attribute table of SOA v5 where Comname= American Oystercatcher, Feat_desc= Nesting Area *and* LucDesc=Breeding should be included.

Citation_Information:
Originator:
New Jersey Department of Environmental Protection - Endangered and Nongame Species Program (NJDEP- ENSP),
Publication_Date: 20091015

Title:
NJDEP- ENSP SOA v5
Edition: version 5
Geospatial_Data_Presentation_Form:
Publication_Information:
Publication_Place: Trenton, NJ
Publisher:
New Jersey Department of Environmental Protection (NJDEP-ENSP),
Online_Linkage:

2007 American Oystercatcher State Survey Data, provided by Tom Virzi, Rutgers university through a grant from ENSP

Citation_Information:
Originator: Tom Virzi, Rutgers University
Publication_Date: Not published (also not yet in Biotics)
Title: 2007 American Oystercatcher State Survey Data
Edition:
Geospatial_Data_Presentation_Form:
Publication_Information:
Publication_Place:
Publisher:
Online_Linkage:

Mapping Criteria –All the nesting polygons, unbuffered, from SOA 5 for American Oystercatcher included in this layer. All points in the 2007 American Oystercatcher data shapefile that do not fall within one of the SOA v5 polygons should be buffered by 500 meters. Within that buffer, water should be excluded.

Attributes needed in final GIS layer
1. Species
2. Site Name
3. Peak Number of Pairs
4. Minimum # of Pairs
5. # of Years Surveyed
6. # of Years Occupied

Ranking Criteria or Method of developing ranking – Have not determined how will be calculated yet. It may be that we do not rank the sites.

Justification documentation – American Oystercatchers are a species of Special Concern in New Jersey. Regionally, much attention have been given to this species based on pressures on its habitat (Schulte et. al, 2008). They share the same habitat as Piping Plovers, Least Terns and Black Skimmers (all state endangered species). The variables that have played a role in the declines of those species (habitat loss, predation pressure, etc.) are also likely to influence American Oystercatchers (Pover, pers. comm.). Unlike those species, a long-term data set is not available to assess the population status in NJ.

American Oystercatchers breed and winter in New Jersey, although it is not the same individuals during each cycle. Basic life history (life expectancy, reproductive rates, etc.) is not well understood. Recent years have focused on acquiring these data and initial research shows that they are a vulnerable species (Virzi 2008). Research and surveys over the past few years have also indicated that this species exhibits a strong site fidelity to both wintering and breeding locations so mapping these areas is critical to the protection of this species (Pover, unpubl. data). A 500-meter buffer was applied to

5. American Oystercatcher - Wintering Habitat

Name of Wildlife habitat or area of concern (WH or AC) –
Migratory Shorebird Concentration Sites, specifically American Oystercatcher

General Description of Habitat to be Identified Through Mapping – The areas that represent winter roost locations for American Oystercatcher. These are mostly located in inlets on beach/marsh habitat.

Source Data

NJDEP, DFW, ENSP SOA v5 – all polygons that are listed in the attribute table of SOA v5 where Comname= American Oystercatcher, Feat_desc= Non-breeding Concentration *and* LucDesc=Nonbreeding should be included.

Citation_Information:
Originator:
New Jersey Department of Environmental Protection - Endangered and Nongame Species Program (NJDEP- ENSP),
Publication_Date: 20091015
Title:
NJDEP- ENSP SOA v5
Edition: version 5
Geospatial_Data_Presentation_Form:
Publication_Information:
Publication_Place: Trenton, NJ
Publisher:
New Jersey Department of Environmental Protection (NJDEP-ENSP),
Online_Linkage:

Mapping Criteria –All the American Oystercatcher wintering roost polygons should be merged into the migratory shorebird concentration site layer.

Attributes needed in final GIS layer
1. Species
2. Site Name
4. Peak Number of Individuals
5. Minimum # of Individuals
6. # of Years Surveyed

7. # of Years Occupied

Ranking Criteria or Method of developing ranking – There are not many sites so we have decided not to rank. Each should be treated equally to the others.

Justification documentation – American Oystercatchers are a species of Special Concern in New Jersey. Regionally, much attention have been given to this species based on pressures on its habitat (Schulte et. al, 2008). They share the same habitat as Piping Plovers, Least Terns and Black Skimmers (all state endangered species). The variables that have played a role in the declines of those species (habitat loss, predation pressure, etc.) are also likely to influence American Oystercatchers (Pover, pers. comm.). Unlike those species, a long-term data set is not available to assess the population status in NJ. American Oystercatchers breed and winter in New Jersey, although it is not the same individuals during each cycle. The individuals that overwinter in New Jersey make up as much as 10% of the east coast population. Basic life history (life expectancy, reproductive rates, etc.) is not well understood. Recent years have focused on acquiring these data and initial research shows that they are a vulnerable species (Virzi 2008). Research and surveys over the past few years have also indicated that this species exhibits a strong site fidelity to wintering locations so mapping these areas is critical to the protection of this species (Pover, unpubl. data).

6. Colonial Water Bird and Beach Nesting Bird Habitat

Name of Wildlife habitat or area of concern (WH or AC) – Rookery and Tern Colony Sites

General Description of Habitat to be Identified Through Mapping – The perimeters of all known long-legged bird and tern colonies in the areas within the coastal zone.

Source Data

NJDEP, DFW, ENSP SOA v5 – all polygons that are listed in the attribute table of SOA v5 where Comname= Great Egrets, Snowy Egrets, Glossy Ibis, Tricolored Heron, Little Blue, Black-crowned Night-herons, Yellow-crowned Night-heron, Cattle Egret, Great Blue Heron, Caspian Tern, Common Tern, Gull-billed Tern, and Roseate Tern, Feat_desc= Nesting Colony *and* LucDesc=Breeding should be included.

Mapping Criteria
Create a layer that merges all the species specific SOA's into one master layer (where each polygon represents a site with multiple species in it) called Rookery and Tern Colony Sites. No buffers will be applied.

Delete any Rookeries that have had 2 or less individuals in 2 or less survey years. Delete any Tern Colonies that 10 or less individuals in 2 or less survey years. We may delete any rookiers or colonies that were only active prior to 1995 (this is mainly b/c we probably do not have the data organized enough prior to that date to fill in the table but also b/c if they

have been abandoned for at least 15 years it is not likely it is an important rookery or colony).

Attributes needed in final GIS layer –
1. Site Name
2-15. Every species listed above (plus Forster's Tern which is not in the SOA file – any colonies that are just FOTE colonies will not be included until the updates, ie any FOTE colonie that are included will also have other species listed above and therefore already in the state database system), should have its own column, where we can mark an "X" to indicate presence.
16. Peak # of Individuals
17. Average # of Individuals
18. # of Surveyed Years Active since 1995 (can put in metadata that all sites were likely surveyed).
19. Suburban Colony (this will either be a "X" or "Y/N" situation)

Ranking Criteria or Method of developing ranking – Not planning on ranking sites. Each should be considered equal to the others.

Justification documentation – New Jersey has a long-term dataset that represents a population index of the long-legged wading bird populations over the last 30 years. This record indicates that many of the species represented in this layer are decreasing, some at an alarming rate (NJDFW, unpub. data). The marsh islands that represent the majority of the habitat these birds utilize for nesting is susceptible to direct human impacts, such as boater traffic and disturbance as well as indirect impacts, such as pollution affecting their prey base and an increase of human-subsidized predators (such as gulls, fox and raccoons) (Davis & Kricher 2000, Frederick 1997, Rodgers & Smith 1995). The size of colonies, and the number of species nesting in them, can vary widely throughout the state (NJDFW, unpub. data). There is a fair amount of site fidelity among these species but there can often be quite a bit of turnover (NJDFW, unpub. data).

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Migratory Bird Stopover Habitat

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Vernal Habitat

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American Oystercatcher

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Colonial Water Bird and Beach Nesting Bird Habitat

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B. THREATENED AND ENDANGERED ANIMAL AND PLANT SPECIES IN NEW JERSEY: STATE AND FEDERALLY LISTED

The State of New Jersey maintains and regularly updates inventories of its threatened and endangered plant and animal species, both state and federally listed. The lists of New Jersey's endangered and nongame wildlife species are maintained by the DEP's Division of Fish and Wildlife's Endangered and Nongame Species Program. This work is made possible through voluntary contributions received through check-off donations to the Endangered Wildlife Conservation Fund on the New Jersey State Income Tax Form, the sale of Conserve Wildlife License Plates, and donations. These lists are used to determine protection and management actions necessary to ensure the survival of the state's endangered and nongame wildlife. Contact information is as follows:

Endangered and Nongame Species Program
NJ Division of Fish and Wildlife
Mail Code 501-03, PO Box 420
Trenton, NJ 08625-0420

Similarly, inventories of state and federally listed threatened and endangered plant species, including those of special concern, are maintained by the DEP's Division of Parks and Forestry, Office of Natural Lands Management, Natural Heritage Program. Below are listed sources available for public access to these inventories. Unique ecological communities and locational information are available via special request through the same agency. Contact information is as follows:

State of New Jersey Department of Environmental Protection
Natural Heritage Data Request Form
The New Jersey Natural Heritage Program
DEP - Office of Natural Lands Management
Mail Code 501-04
P.O. Box 420
501 E. State Street

Station Plaza #5, 4th Floor
Trenton, New Jersey 08625-0420
Phone No. (609) 984-1339
Fax No.: (609) 984-1427

Sources:
State listed T&E Wildlife (Animal) Species:
http://www.state.nj.us/dep/fgw/tandespp.htm (State and Federal)
http://www.state.nj.us/dep/fgw/ensp/pdf/spclspp.pdf (State only)
Plants:
http://www.nj.gov/dep/parksandforests/natural/heritage/countylist.html

Definitions
Endangered: Applies to a species whose prospects for survival within the state are in immediate danger due to one or several factors, such as loss or degradation of habitat, over-exploitation, predation, competition, disease or environmental pollution, etc. An endangered species likely requires immediate action to avoid extinction within NJ.
Threatened: Applies to species that may become endangered if conditions surrounding it begin to or continue to deteriorate. Thus, a Threatened species is one that is already vulnerable as a result of, for example, small population size, restricted range, narrow habitat affinities, significant population decline, etc.
Special Concern: Applies to species that warrant special attention because of inherent vulnerability to environmental deterioration or habitat modification that would result in its becoming threatened if conditions surrounding the species begin or continue to deteriorate. Factors that can lead to classification as special concern include, but are not limited to, species rarity in the State, highly specialized food and/or habitat requirements, low reproductive rate, isolated populations of the species within the State and/or other characteristics that make the species particularly susceptible to environmental or habitat changes. This category includes a species that meets the foregoing criteria and for which there is little understanding of its current population status in the state.
Stable: Applies to species that appear to be secure in NJ and not in danger of falling into any of the preceding the categories in the near future.
Undetermined: A species about which there is not enough information available to determine the status.

C. REGULATIONS PROTECTING ENDANGERED AND THREATENED WILDLIFE AND PLANT SPECIES, AND SPECIAL ECOLOGICAL COMMUNITIES

	Regulations				
Resource	**Coastal Zone Management Rules**	**Flood Hazard Area Control Act Rules**	**FW Protection Act Rules**	**Highlands Water Protection & Planning Act**	**Pinelands Protection Act**
E&T Wildlife Spp.	**X**	**X**	**X**	**X**	**X**
E&T Plant Spp.	**X**	**X**	**X (?)**	**X**	**X**
"Heritage" Sites				**X**	
Special Ecological Communities		**X**		**X**	**X**
Critical Wildlife Habitat	**X**	**X**	**X**	**X**	**X**

"E&T Spp." = Endangered & Threatened Species

Coastal Zone Management Rules for T&E and CWH

10/5/10 revised 10/8/10

7:7E-3.38 Endangered or threatened wildlife or plant species habitats

(a) Endangered or threatened wildlife or plant species habitats are terrestrial and aquatic (marine, estuarine or freshwater) areas known to be inhabited on a seasonal or permanent basis by or to be critical at any stage in the life cycle of any wildlife or plant identified as "endangered" or "threatened" species on official Federal or State lists of endangered or threatened species, or under active consideration for State or Federal listing. The definition of endangered or threatened wildlife or plant species habitats includes a sufficient buffer area to ensure continued survival of the population of the species as well as areas that serve an essential role as corridors for movement of endangered or threatened wildlife. Absence of such a buffer area does not preclude an area from being endangered or threatened wildlife or plant species habitat.

1. Areas mapped as endangered or threatened wildlife species habitat on the Department's Landscape Maps of Habitat for Endangered, Threatened and Other Priority Wildlife (known hereafter as Landscape Maps) are subject to the requirements of this section unless excluded in accordance with (c) 2 below. Buffer areas, which are part of the endangered or threatened wildlife species habitat, may extend beyond the mapped areas. The Department's Landscape Maps, with a listing of the endangered and threatened species within a specific area, are available from the Department's Division of Fish and Wildlife, Endangered and Nongame Species Program at the Division's web address, www.state.nj/us/dep/fgw/ensphome.

2. Information on the areas mapped as endangered or threatened plant species habitat on the Department's Landscape Maps and the occurrence of endangered or threatened plant species habitat is available from the Department's Office of Natural Lands Management, Natural Heritage Database at PO Box 404, Trenton, New Jersey 08625-0404.

3. The required endangered or threatened wildlife or plant species habitat buffer area shall be based upon the home range and habitat requirements of the species and the development's anticipated impacts on the species habitat.

(b) Development of endangered or threatened wildlife or plant species habitat is prohibited unless it can be demonstrated, through an Endangered or Threatened Wildlife or Plant Species Impact Assessment as described at N.J.A.C. 7:7E-3C.2 that endangered or threatened wildlife or plant species habitat would not directly or through secondary impacts on the relevant site or in the surrounding area be adversely affected.

(c) Applicants for development of sites that contain or abut areas mapped as endangered or threatened wildlife species habitat on the Landscape Maps shall either:
1. Demonstrate compliance with this rule by conducting an Endangered or Threatened Wildlife Species Impact Assessment in accordance with N.J.A.C. 7:7E-3C.2; or
2. Demonstrate that the proposed site is not endangered or threatened wildlife species habitat and this rule does not apply by conducting an Endangered or Threatened Wildlife Species Habitat Evaluation in accordance with N.J.A.C. 7:7E-3C.3.

(d) If the Department becomes aware of an occurrence of an endangered or threatened wildlife species on a site that is not mapped as endangered or threatened wildlife species habitat on the Department’s Landscape Maps, and the Department determines that the habitat may be suitable for that species, the Department shall notify the applicant and the applicant shall demonstrate compliance with or inapplicability of this rule in accordance with (c) above.

(e) If the Department becomes aware of an occurrence of an endangered or threatened plant species on a site that is not in the Natural Heritage Database, the Department will notify the applicant and the applicant shall demonstrate compliance with this rule in accordance with (b) above.

(f) The Department is responsible for the promulgation of the official Endangered and Threatened Wildlife lists pursuant to the Endangered and Non-Game Species Conservation Act, N.J.S.A. 23:2A et seq. These lists include wildlife species that are endangered and threatened in New Jersey as well as wildlife species officially listed as endangered or threatened pursuant to the Endangered Species Act of 1973, 16 S.C.1531 et seq. Because the lists are periodically revised by the Department in accordance with N.J.S.A. 23:2A-1 et seq., the lists are not published as part of this rule. The lists are found at N.J.A.C. 7:25-4.13 and 7:25-4.17, the rules adopted pursuant to the Endangered and Non-Game Species Conservation Act. To obtain a copy of the most current Endangered and Threatened Wildlife lists, please contact the Department, Division of Fish and Wildlife, Endangered and Nongame Species Program at the Division's web address, www.state.nj.us/dep/fgw/ensphome, or by writing to the Division at PO Box 400, Trenton, New Jersey 08625-0400.

(g) The Department is responsible for promulgation of the official Endangered Plant Species List pursuant to N.J.S.A. 13:1B-15. The Endangered Plant Species List, N.J.A.C. 7:5C-5.1, includes plant species determined by the Department to be endangered in the State as well as plant species officially listed as endangered or threatened or under active consideration for Federal listing as Endangered or Threatened. Because the Endangered Plant Species List is periodically revised based on new information documented by the the Department, it is not published as part of this rule. To obtain the most current Endangered Plant Species List, please contact the Department, Division of Parks and Forestry, Office of Natural Land Management, PO Box 404, Trenton, NJ 08625-0404.

(h) For sites located within the Pinelands National Reserve and the Pinelands Protection Area, the plant species listed in the Pinelands Comprehensive Management Plan (N.J.A.C. 7:50-6.24) are also considered endangered or threatened plant species. (i) Rationale: See OAL Note at the beginning of this chapter.

7:7E-3.39 Critical wildlife habitats

(a) Critical wildlife habitats are specific areas known to serve an essential role in maintaining wildlife, particularly in wintering, breeding, and migrating.
1. Rookeries for colonial nesting birds, such as herons, egrets, ibis, terns, gulls, and skimmers; stopovers for migratory birds, such as the Cape May Point region; and natural corridors for wildlife movement merit a special management approach through designation as a Special Area.
2. Ecotones, or edges between two types of habitats, are a particularly valuable critical wildlife habitat. Many critical wildlife habitats, such as salt marsh water fowl wintering areas, and muskrat habitats, are singled out as water or water's edge areas.
3. Definitions and maps of critical wildlife habitats are currently available only for colonial waterbird habitat in the 1979 Aerial Colony Nesting Waterbird Survey for New Jersey (NJDEP, Division of Fish and Wildlife). Until additional maps are available, sites will be considered on a case-by-case basis by the Division of Fish Wildlife.

(b) Development that would directly or through secondary impacts on the relevant site or in the surrounding region adversely affect critical wildlife habitats is discouraged, unless:
1. Minimal feasible interference with the habitat can be demonstrated;
2. There is no prudent or feasible alternative location for the development; and
3. The proposal includes appropriate mitigation measures.

(c) The Department will review proposals on a case-by-case basis.

(d) Rationale: See the note at the beginning of this Chapter.

Flood Hazard Area Control Act Rules

7:13-1.2 Definitions
"Threatened or endangered species" means a species identified pursuant to the Endangered and Nongame Species Conservation Act, N.J.S.A. 23:2A-1 et seq., the

Endangered Species Act of 1973, 16 U.S.C. § § 1531 et seq. or the Endangered Plant Species List, N.J.A.C. 7:5C-5.1, and any subsequent amendments thereto.

7:13-10.6 Requirements for a regulated activity in a documented habitat for threatened or endangered species

(a) This section sets forth specific design and construction standards that apply to any regulated activity proposed in a documented habitat for a threatened or endangered species.
(b) For the purposes of this chapter, the Department identifies present and/or documented habitat for most threatened or endangered wildlife species using the Landscape Project method, which focuses on habitat areas required to support local populations of threatened and endangered wildlife species. This method is further described in the Flood Hazard Area Technical Manual, available from the Department at the address listed at N.J.A.C. 7:13-1.1(g). The report entitled New Jersey's Landscape Project provides additional information on mapping methodology and is available at the website www.nj.gov/dep/fgw/ensphome.htm or by contacting the address given below. The Department's Landscape Maps may be updated periodically and may be obtained via file download from www.nj.gov/dep/fgw/ensphome.htm or through the Interactive I-map NJ website: www.state.nj.us/dep/gis/imapnj/imapnj.htm or by writing to the Division of Fish and Wildlife, Endangered and Nongame Species Program at:

The Landscape Project
State of New Jersey Department of Environmental Protection
Division of Fish and Wildlife Endangered and Nongame Species Program
P.O. Box 400
Trenton, NJ 08625-0400

(c) For endangered or threatened plant species and for those wildlife species for which a landscape model in the Landscape Project has not been developed (models do not exist for certain aquatic species), the Department shall rely on the New Jersey Natural Heritage Database for site-specific information. To determine which animal species are not included in the Landscape Project, see Appendix IV of the New Jersey Landscape Mapping Project, Version 2.0 report, available at www.nj.gov/dep/fgw/ensphome.htm. Information regarding the Natural Heritage Program Database is available at: www.nj.gov/dep/parksandforests/natural/heritage/.

(d) The Department shall issue an individual permit for a regulated activity only if the activity will not adversely affect either of the following:
1. A threatened or endangered species; or
2. A documented habitat for a threatened or endangered species.

(e) The Department shall require a survey and/or a habitat assessment for threatened or endangered species as part of an environmental report, as described at N.J.A.C. 7:13-15.5(c), for an individual permit for any regulated activity which is likely to do either of the following:

1. Disturb an area known to contain a threatened or endangered species; or
2. Disturb any habitat that could support a threatened or endangered species.

(f) Persons seeking information pertaining to threatened or endangered species sightings on or near a particular site can contact: State of New Jersey Department of Environmental Protection, Natural Heritage Program P.O. Box 404 Trenton, New Jersey 08625 Telephone: (609) 984-1339
Website: www.nj.gov/dep/parksandforests/natural/heritage/

(g) The Department shall restrict a regulated activity during times of year when a threatened or endangered species is especially sensitive to disturbance, such as during mating or migratory periods. The Department shall not limit the regulated activity to fewer than 183 calendar days per year under this section. Note that the 183-day period during which the Department determines that activities may occur need not be consecutive. For example, the Department may determine that restricting activities for three months in the spring and three months in the fall best protects a threatened or endangered species in a particular case.

N.J.A.C. 7:7A Freshwater Wetlands Protection Act Rules

7:7A-1.4 Definitions

"Documented habitat for threatened or endangered species" means areas for which:
1. There is recorded evidence of past use by a threatened or endangered species of flora or fauna for breeding, resting, or feeding. Evidence of past use by a species may include, but is not limited to, sightings of the species, or of its sign (for example, skin, scat, shell, track, nest, herbarium records, etc.), as well as identification of its call; and
2. The Department makes the finding that the area remains suitable for use by the specific documented threatened or endangered species during the normal period(s) the species would use the habitat.

"Major discharge" means a discharge or activity that the Department must transmit to EPA for review in accordance with the Department's 1993 MOA with EPA regarding assumption of the Federal 404 program. Provisions regarding EPA review of major discharges are found at N.J.A.C. 7:7A-12.2. The following are major discharges:
1. A draft general permit;
2. A discharge with reasonable potential to affect Federally listed or proposed endangered or threatened species as determined by the U.S. Fish and Wildlife Service;
3 (Criteria 3-10 of this definition were omitted from this document for brevity)…

"Threatened or endangered species" means a species identified pursuant to the Endangered and Nongame Species Conservation Act, N.J.S.A. 23:2A-1 et seq., or those identified pursuant to the Endangered Species Act of 1973, 16 U.S.C. §§1531 et seq., and subsequent amendments thereto.

N.J.A.C.-7:7A-2.4 Classification of freshwater wetlands by resource value

(a) Freshwater wetlands shall be divided into three classifications based on resource value. The Department shall consider the resource value classification of a wetland in, among other things, evaluating alternatives to the proposed regulated activity, in determining the size of the transition area, and in determining the amount and/or type of mitigation required.

(b) A freshwater wetland of exceptional resource value, or exceptional resource value wetland, is a freshwater wetland which:
1. Discharges into FW1 or FW2 trout production waters or their tributaries;
2. Is a present habitat for threatened or endangered species; or
3. Is a documented habitat for threatened or endangered species, and which remains suitable for breeding, resting, or feeding by these species during the normal period these species would use the habitat.

(c) The Department identifies present or documented habitat for threatened or endangered species for purposes of (b) above using the Landscape Project method, which focuses on habitat areas required to support local populations of threatened or endangered wildlife species. The details of this method are described in the Division of Land Use Regulation freshwater wetlands technical manual, available from the Department's Office of Maps and Publications at the address in N.J.A.C. 7:7A-1.3. An applicant may request that a documented habitat not result in the classification of a freshwater wetland as a freshwater wetland of exceptional resource value. Such a request shall include a demonstration of the long-term loss of one or more habitat requirements of the specific documented threatened or endangered species, including, but not limited to, wetlands size or overall habitat size, water quality, or vegetation density or diversity. Upon such a request, the Department shall review all available information, and shall make a final classification of the wetland.

N.J.A.C. 7:7A-4.3 Conditions that apply to all general permit authorizations

(b) The following conditions apply to all activities conducted under the authority of a general permit:
1……
2. ….
3. The activities shall not destroy, jeopardize, or adversely modify a present or documented habitat for threatened or endangered species; and shall not jeopardize the continued existence of any local population of a threatened or endangered species;

Specific General Permits (9, 20, 23, 26) also have conditions that do not allow adverse impacts to T&E species.

N.J.A.C. 7:7A-6.2 Transition area averaging plan waiver

(d) In addition to the presumptions at (b) and (c) above, the Department shall also presume that, for a transition area adjacent to an exceptional resource value wetland, the following will result in a substantial impact on the adjacent freshwater wetlands, and the Department shall not issue a transition area averaging plan waiver unless the applicant demonstrates that the activity would qualify for an individual permit under this chapter:
1. The freshwater wetland adjacent to the transition area is a breeding or nesting habitat for a threatened or endangered species as defined a N.J.A.C. 7:7A-1.4;

N.J.A.C. 7:7A-6.4 Matrix type width reduction transition area waiver

c) The only type of exceptional resource value wetland for which a transition area matrix waiver may be issued is a wetland that meets both of the following criteria:
1. The wetland is located on a tributary to an FW1 water or on a tributary to an FW2 trout production water; and
2. The wetland does not:
i. Contain a present or documented habitat for threatened or endangered species, as defined at N.J.A.C. 7:7A-1.4; or

N.J.A.C. 7:7A-7.2 Standard requirements for all individual permits

(b) The Department shall issue an individual freshwater wetlands or open water fill permit only if the regulated activity:
1. …..
2. Will result in the minimum feasible alteration or impairment of the aquatic ecosystem including existing contour, vegetation, fish and wildlife resources, and aquatic circulation of the freshwater wetland and hydrologic patterns of the HUC 11 in which the activity is located;
3. Will not destroy, jeopardize or adversely modify a present or documented habitat for threatened or endangered species; and shall not jeopardize the continued existence of a local population of a threatened or endangered species, as defined at N.J.A.C. 7:7A-1.4;
4. Will not be likely to result in the destruction or adverse modification of a habitat which is determined by the Secretary of the United States Department of the Interior or the Secretary of the U.S. Department of Commerce, as appropriate, to be a critical habitat under the Endangered Species Act of 1973, 16 U.S.C. § 1531 et seq.;

N.J.A.C. 7:7A-12.2 USEPA review

(k) The Department shall submit an application to the U.S. Fish and Wildlife Service for review of the potential for impacts on Federally listed threatened or endangered species in accordance with the 1993 Memorandum of Agreement between the Department and the U.S. Fish and Wildlife Service, and all modifications, addenda, and clarifications thereto, executed in order for the Department to assume responsibility for the Federal 404 program

N.J.A.C. 7:7A-15.4 Property suitable for mitigation and the criteria for addressing contaminated sites

(g) The Department shall not approve mitigation that would destroy, jeopardize, or adversely modify a present or documented habitat for threatened or endangered species; and shall not jeopardize the continued existence of any local population of a threatened or endangered species.

N.J.A.C. 7:7A-15.5 Mitigation for a smaller disturbance

(e) In determining if onsite or offsite mitigation for a smaller disturbance would be environmentally beneficial for the purposes of (c) above, the Department shall consider the following factors and any other relevant factors specific to the site or project:

1……
2……
3. Habitat value. A mitigation area that will provide valuable habitat for critical wildlife species or threatened or endangered species is more likely to be environmentally beneficial; and

N.J.A.C. 7:38 Highlands Water Protection and Planning Act

7:38-1.4 Definitions

“Endangered species” means species included on the list of endangered species that the Department promulgates pursuant to the Endangered and Nongame Species Conservation Act, N.J.S.A. 23:2A-13 et seq., and the Endangered Plant Species List Act, N.J.S.A. 13:1B-15.151 et seq., and any species or subspecies of wildlife appearing on any Federal endangered species list or any species or subspecies of plant designated as listed, proposed, or under review by the federal government pursuant to the Endangered Species Act of 1973, 16 U.S.C. §§ 1531 et seq.

“Highlands resource areas” means those features of the Highlands that merit special protection pursuant to N.J.S.A. 13:20-32b such as Highlands open waters; flood hazard areas; steep slopes; forested areas; rare, threatened or endangered species habitat; rare or threatened plant habitat; areas with historic or archaeological features; and unique or irreplaceable land types.

"Landscape Maps of Habitat for Endangered, Threatened and Other Priority Wildlife or "Landscape Maps” means the Department’s maps delineating areas used by or necessary for endangered and threatened species and other priority wildlife to sustain themselves successfully. The maps depict areas of contiguous habitat types (forest, grassland, forested wetland, emergent wetland and beach/dune) that are ranked based upon intersection with documented occurrences of endangered and threatened and priority wildlife species. Mapped habitat areas are classified based upon the status of the wildlife species whose presence is documented. Rank 5 is assigned to areas containing one or

more documented occurrences of at least one wildlife species listed as endangered or threatened on the Federal list of endangered and threatened species. Rank 4 is assigned to areas with one or more documented occurrences of at least one State endangered species. Rank 3 is assigned to areas containing one or more documented occurrences of at least one State threatened species. Rank 2 is assigned to areas containing one or more documented occurrences of at least one non-listed State priority wildlife species. The maps also delineate, as Rank 1, habitat areas that meet habitat-specific suitability requirements, such as minimum area criteria for endangered, threatened and priority wildlife species, but that do not intersect with any documented occurrences of such species. The report entitled New Jersey's Landscape Project provides additional information on mapping methodology and is available at the website www.nj.gov/dep/fgw/ensphome.htm or by contacting the address given below. The Department's Landscape Maps may be updated periodically and may be obtained via file download from www.nj.gov/dep/fgw/ensphome.htm or through the Interactive ImapNJ website: www.state.nj.us/dep/gis/imapnj/imapnj.htm or by writing to the Division of Fish and Wildlife, Endangered and Nongame Species Program at:

The Landscape Project
NJ Division of Fish and Wildlife
Endangered and Nongame Species Program
PO Box 400
Trenton, NJ 08625-0400.

7:38-3.11 Rare, threatened or endangered plant and animal species

The Department shall not issue a HPAA unless it determines that the proposed activity will not jeopardize the continued existence of, or result in the likelihood of the destruction or adverse modification of habitat for, any rare, threatened or endangered species of animal or plant.

7:38-5.1 Rare or Threatened or Endangered Species Habitat Evaluations

This subchapter sets forth the standards for conducting a Rare or Threatened or Endangered Animal Species Habitat Evaluation or a Rare or Endangered Plant Species Habitat Evaluation. A completed Habitat Evaluation shall be submitted by any HRAD or HPAA applicant seeking to rebut a presumption pursuant to N.J.A.C. 7:38-4.1(d)3 or 4 that a portion of a site or footprint of disturbance constitutes suitable habitat for any rare, threatened or endangered animal species and/or rare or endangered plant species. The standards for conducting a Habitat Evaluation for animal species are found at N.J.A.C. 7:38-5.2; the standards for plant species are found at N.J.A.C. 7:38-5.3. Submittal requirements for all Habitat Evaluations are found at N.J.A.C. 7:38-5.4. 7:38-5.2 Rare, or Threatened or Endangered Animal Species Habitat Evaluation (a) An applicant for an HRAD or HPAA seeking to rebut a presumption pursuant to N.J.A.C. 7:38-4.1(d) 3 that all or part of a site constitutes suitable habitat for a rare, or threatened or endangered animal species shall submit a rare, or threatened or endangered animal species Habitat Evaluation to the Department.

(b) The Department shall consider as suitable habitat any area that, based on the best available scientific information, provides all of the components necessary to sustain any rare, or threatened or endangered animal species, including, but not limited to, nesting or breeding areas, foraging or feeding areas, resting or roosting areas, hibernacula or denning areas; or any area that is a part of a larger habitat area that provides all of the components necessary to sustain the rare, or threatened or endangered animal species in question based upon evaluation of the following:

1. The information provided by the applicant under N.J.A.C. 7:38-5.4 and any other information available to the Department identifying which, if any, rare, threatened or endangered animal species may have suitable habitat on the site. Such information includes, but is not limited to, the Landscape Maps, Natural Heritage Database, records of documented species occurrences and public comment;
2. The results of any animal species surveys done in consultation with the Department and in accordance with the survey procedures at N.J.A.C. 7:7E-3C.4 (a) and (b) (Coastal Zone Management);
3. Scientific information related to the life history characteristics and habitat needs of the species; and
4. The extent to which the site or footprint of disturbance contains the characteristics of suitable habitat for each species identified in (b)1 and 2 above, including onsite and adjacent vegetation structure and composition, soil characteristics, wetland characteristics and hydrologic conditions, surrounding land use and disturbance levels, and any other factor that may affect the habitat suitability for any rare, or threatened or endangered animal species that are identified as part of on-site inspection(s) or in the HRAD or HPAA application.

7:38-5.3 Rare or Endangered Plant Species Habitat Evaluation
(a) An applicant for an HRAD or HPAA seeking to rebut a presumption pursuant to N.J.A.C. 7:38-4.1(d)4 that all of a site, or a footprint of disturbance, constitutes suitable habitat for a rare or endangered plant species shall submit a rare or endangered plant species Habitat Evaluation to the Department.(b) The Department shall consider as habitat any area identified in the Natural Heritage Database as habitat for any rare or endangered plant species that provides all of the components necessary to sustain the plant species in question, based upon evaluation of the following:

1. The information provided by the applicant under N.J.A.C. 7:38-5.4 and any other information available to the Department identifying which, if any, rare or endangered plant species are documented on the site or footprint of disturbance.Department information includes, but is not limited to, the Natural Heritage Database, records of documented occurrences, public comments and other pertinent information;
2. The results of any plant species surveys conducted in consultation with the Department following the survey procedures at N.J.A.C. 7:7E-3C.4 (a) and (b) (Coastal Zone Management);
3. Scientific information related to the life history characteristics and habitat needs of the rare or endangered plant species; and

4. The extent to which the site or footprint of disturbance contains the characteristics of the documented habitat for each species identified in (b)1 and 2 above including onsite and adjacent vegetation structure and composition, soil characteristics, wetland characteristics and hydrologic conditions, surrounding land use and disturbance levels, that are identified as part of on-site inspection(s) or in the HRAD or HPAA application, and any other factor that may affect the rare or endangered plant species.

7:38-5.4 Submittal requirements for Habitat Evaluations

(a) Each Habitat Evaluation submitted to the Department shall include:
1. An introduction describing the goals of the Habitat Evaluation;
2. A description of the habitat requirements for each species identified in the Natural Heritage Program letter pursuant to N.J.A.C. 7:38-4.1(d)3 or 4, including citations to appropriate literature and studies; and
3. The names, addresses and professional qualifications of all persons who performed habitat evaluations, and/or species surveys relied upon to support any conclusion reached in the Habitat Evaluation.

(b) Animal habitat evaluations pursuant to N.J.A.C. 7:38- 5.2, shall include three copies of the following:
1. A description of the site or footprint of disturbance (as applicable), including, but not limited to:
i. Vegetation, elevation, slope and aspect, and a description of any important topographic features such as cliffs, bluffs and sinkholes on or within 0.5 mile of the boundary of the site or footprint;
ii. The geology on the site or within the footprint as described in the most current U.S.Geological.Survey (U.S.G.S.) bedrock geologic maps, a description of bedrock and surficial deposits and location and description of any important geologic features such as talus and caves within 0.5 mile from the boundary of the footprint or site;
iii. The soil types on the site or within the footprint as most currently classified and mapped by the U.S. Department of Agriculture (U.S.D.A.) Natural Resources Conservation Service and the location and description of any important soil features present within 0.5 miles of the boundary of the footprint or site;
iv. The location and description of all hydrologic features on the site or within the footprint, such as rivers, streams, lakes, ponds, springs, seeps, vernal pools and waterfalls as well as those located within 0.5 mile from the boundary of the footprint or site;
v. The location and description of all evidence of natural or man-made disturbance both on the site or footprint and within 0.5 mile from the boundary of the footprint or site;
vi. The location and description of all upland, wetland, and aquatic ecological vegetative communities on the site or within the footprint, based on quantitative data collected during optimal time(s) of year using appropriate, scientifically accepted terms of description and analysis techniques. Guidance with regard to appropriate classification systems and techniques may be found in Guidelines for Describing Associations and Alliances of the U.S. National Vegetation Classification by Jennings et al. (2003), The Ecological Society of America -- Vegetation Classification Panel, available at: www.esa.org/vegweb/NVC_guidelines_v3.pdf; Ecological Systems of the United States:

A Working Classification of U.S.Terrestrial System by Comer et al. (2003), NatureServe, available at:www.natureserve.org/library/usEcologicalsystems.pdf; and Classification of Vegetation Communities of New Jersey: Second Iteration by Breden et al. (2001), Association for Biodiversity Information and New Jersey Natural Heritage Program, available at: http://njedl.rutgers.edu/njdlib, Record ID#1980. For each ecological community identified on the site or within the footprint, the evaluation shall include physiognomy, species composition with a list of the most abundant plant species by strata (canopy tree, subcanopy tree, shrub, vine, herbaceous, bryophyte), a description of successional stage, slope degrees and aspect, geologic substrate (as indicated in the most recent U.S.G.S. bedrock geologic maps), soil texture and pH (as indicated in the most recent Soil Survey and verified by field sampling), depth to water table (as indicated in the most recent Soil Surveys), and hydrologic influences;

vii. A map showing the location and composition of ecological communities on the site or within the footprint and the location of important topographical, geological and hydrological features identified in (b)1iv above;

viii. The results of rare, or threatened or endangered animal species surveys for the purpose of supplementing scientific data regarding the suitability of a particular habitat for a particular species that were conducted in consultation with the Department and in accordance with all Federal and State laws and regulations, including for each species surveyed: the survey method, the surveyor's name(s), dates and times surveys were performed, number of samples, and number of replications;

ix. A copy of any other relevant animal survey or report to which the HPAA or HRAD applicant or their agent has access; and

x. Any other information relevant to assessing the suitability of habitat on the site or footprint of disturbance for any rare, or threatened or endangered animal species.

(c) Plant habitat evaluations pursuant to N.J.A.C. 7:38-5.3 shall include three copies of the following: 1. A description of the site or footprint of disturbance (as applicable), including, but not limited to:

i. Vegetation, elevation, slope and aspect, and a description of any important topographic features such as cliffs, bluffs and sinkholes within the footprint or on the site and as well as those located within 0.5 mile from the boundary of the site or footprint;

ii. The geology on the site or within the footprint as described in the most current U.S.G.S. bedrock geologic maps and field sampling, a description of bedrock and surficial deposits and the location and description of any important geologic features such as talus and caves, as well as such features on or within 0.5 mile from the boundary of the site or footprint;

iii. The soil types on the site or within the footprint as most currently classified and mapped by the U.S.D.A. Natural Resources Conservation Service and the location and description of any important soil features present on and within 0. 5 mile from the boundary of the site or footprint;

iv. The location and description of all hydrologic features on the site or within the footprint such as rivers, streams, lakes, ponds, springs, seeps, vernal pools, and waterfalls present as well as those located within 0.5 mile from the boundary of the site or footprint;

v. The location and description of natural or anthropogenic disturbance both on the site or within the footprint as well as within 0.5 mile from the boundary of the footprint or site;

vi. The location and description of all upland, wetland, and aquatic ecological vegetative communities on the site or within the footprint, based on quantitative data collected during optimal time(s) of year using appropriate, scientifically accepted terms of description and analysis techniques. Guidance with regard to appropriate systems and techniques may be found in: Guidelines for Describing Associations and Alliances of the U.S. National Vegetation Classification, by Jennings et al. (2003), The Ecological Society of America -- Vegetation Classification Panel, available at: www.esa.org/vegweb/NVC_guidelines_v3.pdf; Ecological Systems of the United States: A Working Classification of U.S. Terrestrial System, by Comer et al. (2003), NatureServe, available at:www.natureserve.org/library/usEcologicalsystems.pdf; and Classification of Vegetation Communities of New Jersey: Second Iteration, by Breden et al. (2001), Association for Biodiversity Information and New Jersey Natural Heritage Program, available at: http://njedl.rutgers.edu/njdlib, Record ID#1980. For each identified ecological community on the site or footprint, the applicant shall submit data describing physiognomy, species composition with a list of the most abundant plant species by strata (canopy tree, subcanopy tree, shrub, vine, herbaceous, bryophyte), a description of successional stage, slope degrees and aspect, geologic substrate (as indicated in available U.S.G.S. bedrock geologic maps), soil texture and pH (as indicated in available U.S.D.A. Natural Resources Conservation Service Soil Surveys and verified by field sampling), depth to water table (as indicated in available U.S.D.A. Natural Resources Conservation Service Soil Surveys), and hydrologic influences;
vii. A map identifying the location of the rare or endangered plant species habitat on the site or within the footprint of disturbance as well as within 0.5 miles of the boundary of the site or footprint, along with a list of the plant species documented in the Department's Natural Heritage Database;
viii. The results of rare or endangered plant surveys for the purpose of supplementing scientific data regarding the suitability of a particular habitat for a particular species that were conducted in consultation with the Department and in accordance with all applicable Federal and State laws and regulations, including for each species surveyed: the survey method, the surveyor's name(s), dates and times surveys were performed, number of samples, and number of replications; literature citations for the methodology used and a description of how the methodology was applied to the survey, giving the following information: surveyor's name(s), dates and times surveys were performed, number of samples, and number of replications. This information shall be provided for each species surveyed;
ix. A copy of any other relevant plant survey or report to which the HPAA or HRAD applicant or their agent has access; and
x. Any other information relevant to assessing rare, or endangered plant species habitat at the site or within the footprint of disturbance..

7:38-6.2 Standard requirements for all HPAAs
(a) The Department shall issue an HPAA only if it determines, based upon the information provided by the applicant, that the proposed major Highlands development:

5. Will not jeopardize the continued existence of species listed pursuant to the Endangered and Nongame Species Conservation Act, N.J.S.A.23:2A-1 et seq., the

Endangered Plant Species List Act, N.J.S.A. 13:1B-15.151 et seq.), or which appear on the Federal endangered or threatened species list, and will not result in the likelihood of the destruction or adverse modification of habitat for any rare, threatened, or endangered species of animal or plant.