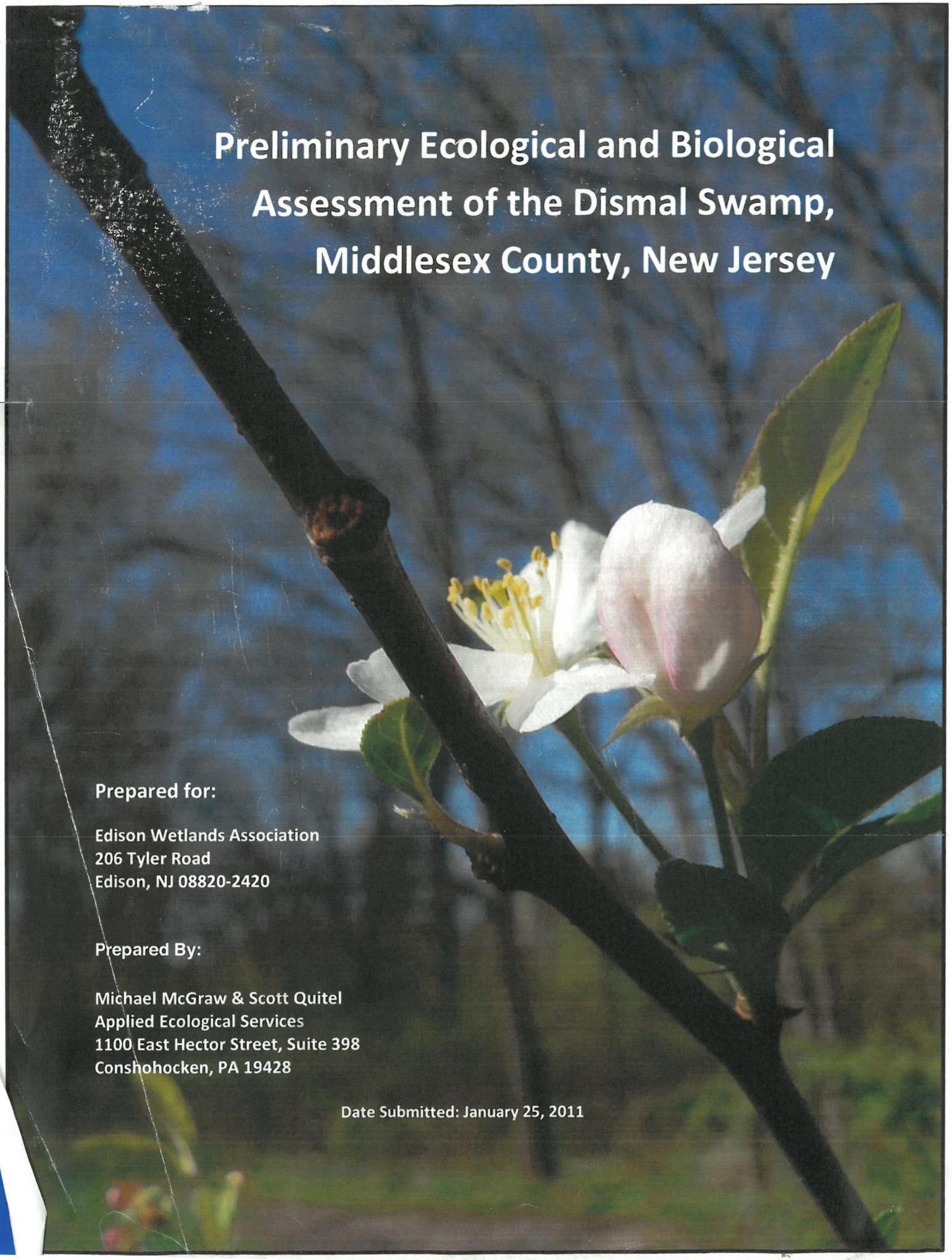


Preliminary Ecological and Biological Assessment of the Dismal Swamp, Middlesex County, New Jersey

Prepared for:

Edison Wetlands Association
206 Tyler Road
Edison, NJ 08820-2420

Prepared By:

Michael McGraw & Scott Quitel
Applied Ecological Services
1100 East Hector Street, Suite 398
Conshohocken, PA 19428

Date Submitted: January 25, 2011

Table of Contents

Tables

Photo Figures

1. Introduction

The Dismal Swamp Conservation Area (DSCA) of New Jersey is 1,240 acres of contiguous natural habitats situated within three municipalities (Metuchen, Edison, and South Plainfield) in Middlesex County, New Jersey (Map 1). It is largely comprised of a mosaic of wetland habitats, including open water, ponds, streams, and palustrine forested, emergent, sedge, shrub/scrub, cattail, and successional wetlands. Additionally, a variety of upland and lowland deciduous and mixed (coniferous and deciduous) forests are present. Its proximity to the Piedmont-Coastal Plain Fall Line adds to its unique value. The Dismal Swamp is a contiguous section of natural areas in Middlesex County and serves critical roles for both natural stormwater management and habitat to a plethora of wild plants and animals native to eastern central New Jersey and, in some cases, specific to regionally rare wetland ecosystems that still exist within the Dismal Swamp. In addition, the DCSA holds a range of prehistoric Native American archaeological artifacts, with at least five sites retaining artifacts over 8,000 years old.

The DSCA is the largest clean water source within the highly industrial Lower Raritan Watershed (Wheeler, pers. comm.). Thanks in large part to the longtime environmental leadership of the nonprofit Edison Wetlands Association (hereafter, EWA), the Raritan River – the longest river solely in New Jersey – has made tremendous progress in its ecological recovery over the past two decades. Crucial to that endeavor is the ongoing protection, restoration, and preservation of the DSCA. Its spring-fed, clean water is critical to the Raritan's continued recovery. The DSCA holds the headwaters of the Bound Brook, draining almost 12 miles through a number of municipalities into the Green Brook and Raritan River. Unfortunately, the DSCA is only about half preserved, and faces continuing threats from a number of sources, including development, proposed highway construction, pollution, illegal hunting, destructive off-road vehicles, and midnight dumping.

Applied Ecological Services, Inc. (hereafter, AES) has been hired to provide EWA with a snapshot of ecological conditions as well as the current state of breeding songbirds, frogs and toads within the property. While this patchwork of properties functions largely as a contiguous ecosystem, its conservation status is partial and disconnected. With a long history of proprietor issues, illegal dumping, hunting, filling of wetlands and constant development pressure, the future of this dynamic ecosystem is uncertain. The goal of this project is to initiate formal ecological and biological studies to assess the Dismal Swamp from a faunal and floral perspective, generating a means of evaluating the habitat for current and future land-use goals, such as enhanced passive recreation capabilities, habitat restoration, preservation, and ensured protection of rare, threatened, and/or endangered species that may inhabit the Dismal Swamp.

2. Background

Situated between Philadelphia and New York City, central New Jersey is home to some of the most densely populated counties in the United States. The northern Middlesex County region of Central New Jersey is especially highly overdeveloped and has been almost entirely overlooked by national and state environmental organizations in their land acquisitions, despite the DSCA's recognition by the U.S. Fish

and Wildlife Service and U.S. Environmental Protection Agency as a Federal Priority Wetland. This region boasts critical wetlands ecosystems that protect water quality and provide crucial wildlife habitat within the Lower Raritan Watershed, including the DSCA; the Rutgers Ecological Preserve in Piscataway, Highland Park, and Edison; the Former Raritan Arsenal Wetlands (also Federal Priority) in Edison and Woodbridge, and the National Lead Wetlands Complex in Sayreville. The protection of these areas, threatened by overdevelopment and pollution impacts, is especially critical because of the dearth of open space and wetlands in this heavily developed region. The nearby Great Swamp National Wildlife Refuge was determined to be of ecological importance and purchased for conservation in 1960 in the face of a proposed jetport for metropolitan New York. The current land parcels within the Dismal Swamp represent a remnant portion of a previously much larger, contiguous complex of wetlands, woodlands, meadows and shrubby swamps similar to that found within the Great Swamp NWR. Residential developments in response to the urban sprawl-effect of New York City, in conjunction with industrial zoning and development, have chronically chipped away at the margins of the Dismal Swamp, limiting its ecological boundaries to the existing state (see Map 8.1). A grass-roots conservation group named Save Our Swamp (SOS), led by Jane Tousman, fought adamantly to warrant ecological recognition similar to that of the Great Swamp in 1960 for the Dismal Swamp through preservation and development opposition. While formal and complete recognition has not yet been achieved, the group's work has resulted in a history of opposition to proposed development projects on land parcels adjacent to and within the Dismal Swamp, playing a large role in its conservation history. EWA was founded in 1989 with the mission of cleaning up and restoring the highly industrial Lower Raritan Watershed region of New Jersey, including protecting the ecological integrity of the DSCA's stream and surface waters. EWA, led by founding member, Robert Spiegel, whose relentless oversight of the proposed land-use actions and illegal activities has helped keep this vulnerable natural area intact, has continued these grassroots conservation and watchdog actions, despite constant development pressure and a long history of contaminant dumping (multiple responsible parties for dumping/pollution sources as well as a Superfund site). In addition to constant development opposition within the Dismal Swamp and the current ecological investigations, EWA conducts toxicological studies, educational programs, numerous outdoor events, and neighborhood assistance efforts.

Like many other valuable ecosystems in New Jersey, the Dismal Swamp warrants protection. A Dismal Swamp Preservation Commission was enacted in 2009 (approved October 1, 2009) in order to define the ecologically based metes and bounds of the DSCA, establish a master plan and works to protect the remaining area from overdevelopment and pollution.

Although metes and bounds are currently vague, all existing naturalized locations within the region are connected ecologically. EWA has defined the Dismal Swamp Conservation Area from an ecosystem perspective and assumes it to include all connected green-space and habitats within the core regions, regardless of block and lot ownership or proposed land use (See Addendum to Master Plan Map).

In 1994, the United States Environmental Protection Agency determined the Dismal Swamp ecosystem to be a 'federal priority wetland'. This was determined by recognizing the following characteristics of the Dismal Swamp: 1) the presence of unique habitat for flora and fauna; 2) the presence of regionally rare or unusual wetland types; 3) ecological importance and imminent threat from development

pressure; 4) importance to the sustainability of surface water systems; 5) its critical value to the protection of water supplies; and, 6) providing extreme value for floodwater storage capacity.

3. Methods

3.1 Ecological Assessment – A set of general, scientifically-accepted methods for assessing ecological conditions were employed to create a rapid, yet effective, snapshot of the ecological variety within the Dismal Swamp. For assessing the various vegetative communities onsite, AES first performed an analysis of existing data. Maps provided by EWA (Dismal Swamp Watershed Management Plan, 2009) were used to generate survey strategies to best represent the available landscape features within the property and deploy our survey methods to best represent the existing habitats of the Dismal Swamp.

3.1a General Vegetation Meander – Planned meanders were conducted, assessing overstory, understory and groundstory vegetative components. Notes were taken for each encountered habitat type and/or change in vegetation. When employed by an experienced ecologist, this method is an effective means to determine valuable components of the surveyed landscape. Elements such as soil type, hydrology, invasive species (floral and faunal), stressors (source and non-source point pollution), intra-species interactions, evidence of human disturbance, and evidence of rare habitat suitability (structure, associative species) are some of the factors that contribute to the ecological assessment process.

To assess the faunal composition within the Dismal Swamp, AES used two main survey tactics under this assessment phase of the project. Below are brief descriptions of these methods:

3.1b Random Opportunistic Sampling (ROS) - This is an extremely effective survey method used by experienced herpetologists to sample the relative abundance and diversity of reptiles and amphibians. This method can be used during other activities onsite when the surveyor opportunistically encounters suitable conditions, structure, or the presence of herpetofauna or evidence thereof. Combined with ample time in the field, a keen eye and knowledge of local herpetological composition and life histories can result in valuable observations regarding the presence or absence of herpetofauna in a particular location. This survey method is best when used in conjunction with other, more formal survey methods, such as Time-Constrained Surveys, Drift Fence Trapping, Calling Amphibian Surveys, Coverboard Transects, and Pitfall Trapping Arrays.

This method is also very effective in understanding ecological value and presence/absence of bird species during various seasons onsite. It is best used in conjunction with other avifaunal sampling methods, such as point count breeding bird surveys, neo-tropical passerine migratory surveys, raptor breeding and migration surveys, marsh bird surveys, and wintering bird surveys.

3.1c Time Constrained-Surveys (TCS) – Defined by temporal and spatial parameters, this method is used to target specific habitat types and periods of time in an attempt to maximize the chance of encounter for particular animals. Due to the extremely cryptic nature of reptiles and amphibians, their presence is often overlooked or under-detected. Additionally, their ectothermic nature creates an intimate relationship with external climatic and weather conditions, often resulting in bi-modal activity seasons in reptiles and brief periods of increased surface activity by amphibians. A time- (and spatially-)

constrained survey for target species within the best time frame (season, day/night, and hours) in optimal climatic conditions (temperature, relative humidity, barometric pressure, weather conditions) involves carefully and methodically searching under all surface cover (logs, rocks, trash, leaf litter, etc.) and within water features, earthen cavities, and dead-standing trees. Time limits assist in not degrading the study area by over-sampling.

3.2 Calling Amphibian Survey - The Dismal Swamp is dominated by various wetland habitat types. Forested wetlands are most common and were much more expansive historically, as many impacted areas were part of a much larger forested wetland ecosystem (EPA, 1994). Even with significant encroachment, draining of wetlands and channelizing of streams, the remnant natural landscape in the Dismal Swamp supports numerous isolated pools, streams, and ponds providing a significant amount of potential breeding habitat for various amphibians native to New Jersey. In an effort to survey as many locations within the Dismal Swamp as possible in one season, AES used existing road cuts, dirt bike paths, game trails, and electrical rights-of-way to navigate the landscape and listen for male frogs attempting to breed. Detecting amphibians audibly is a well-exercised survey method which provides a significant amount of information regarding population, seasonal activities, and habitat preference (Martof 1953; Blair 1961; Woolbright 1985; Knutson *et al.* 1999). Amphibian Calling Survey methods used in this study are similar to those tested in Shirose et. al. 1997 and practiced in the North American Amphibian Monitoring Program (NAAMP) (Weir and Mossman, 2005). These methods are very repeatable and are comparable to data taken annually throughout more than half of the United States and multiple provinces in Canada (Weir and Mossman 2005). Surveys were conducted on warm, humid nights from March through July. Dates were selected in an attempt to target the various breeding seasons of frogs and toads potential to be present onsite. All listening stations were geo-referenced using a Garmin 60CSx GPS unit. Species, relative abundance and location were noted, along with climatic and weather variables during each survey evening. Representative audio recordings were taken using a Handy H4N digital audio recorder and Rode NTG-1 directional condenser microphone (recordings to be provided with final report).

3.3 Point Count Breeding Bird Survey- Methods for sampling the breeding bird population at Dismal Swamp followed the USGS North American Breeding Bird Survey Protocol. Activity codes are derived from the New Jersey Breeding Bird Atlas Breeding Codes. Points were set up along transects at least 150m apart. Transects were laid out to best represent each habitat type within the Dismal Swamp and, in some areas, comprehensively sample locations for breeding bird species. A total of 149 points were sampled throughout the Dismal Swamp. Listening radii for each point are approximately 75m in all directions, formulating a circle of sampled area at each point. This data collection method is comparable to breeding bird atlas data and other formalized breeding bird data sets (Ralph et al. 1995; NJAS, 1997). Points are sampled within the first four hours of daylight when singing birds are most conspicuous. At each point, the observer documents all species detected as well as individual locations relative to the observer (both compass direction and approximate distance from observer). If a bird moves throughout the point location during the survey, only the first observed location is documented for that individual. Counts should not be conducted in periods of heavy rain or high wind speeds. While

moving as quietly as possible, the observer travels from one point to the next. Any additional observations made while walking between sample points is documented.

4. Results

4.1 Ecological Assessment

The Dismal Swamp was assessed through three methods to characterize its current ecological state, by means of vegetative communities, wildlife habitat, and faunal observations. The summation of these observations has revealed that the Dismal Swamp (as defined by the boundaries within this report) currently includes wetland and upland ecosystems varying in condition from extremely negatively impacted to very healthy. While the system is natural and self-sustaining, there is evidence of anthropogenic influence throughout (channelized waterways, dirt bike paths, trash dumps, electrical/railroad/gas pipeline rights-of-way, hunting stands, old clearings, building foundations, un-natural grade transitions to wetlands by filling, abandoned pavings and property markers). Within multiple locations throughout the Dismal Swamp, AES observed structural (abiotic and biotic) and hydrologic conditions suitable to sustain a variety of NJ threatened and endangered plant, bird, amphibian and reptile species. See faunal assessment section for detail on these existing habitat types and potentially present species. The most dominant habitat present onsite is pin oak-dominated forested wetland.

Please see the below descriptions for specific information regarding the various sections of the Dismal Swamp. Area delineations coincide with the Addendum to the Dismal Swamp Master Plan.

Dismal Swamp Deep Woods Tract- This large, triangular-shaped section is completely situated within Edison Township, Middlesex County. It is approximately 250 acres and is preserved by the Township of Edison. It is bordered to the south by a managed gas line right-of-way and paralleling railroad line. The railroad line is elevated by high-grade slopes to the east, reaching similar grade to the gas line ROW traveling west. Aligned from north-northwest to south-southeast, the eastern border is a linearly-projected, abandoned railroad line with dense residential development and private school grounds abutting the other side. This abandoned rail line is slated to potentially be a continuation of the Middlesex Greenway. The northern border is the Talmadge Street Bridge. The western border is dense residential developments on either side of Talmadge road as it courses southwest from the northern border. Soil type varies from well drained loams to extremely poor silt loams and muck. The majority of this tract is Palustrine Forested Wetland (PFO), however, it consists of a variety of habitat types as described below:

Oak-Dominated Hardwood Forest – These forest portions (see map) are located mainly within the southern and southeastern sections of this tract and seemingly contain the oldest stands of hardwood trees in the Dismal Swamp Conservation Area. Overstory is dominated by pin oak, red oak, white oak, and American beech. Woody understory is largely inhibited due to over-grazing by deer. However, significant sections remain where dogwood, viburnum, high bush blueberry, and other native woody shrubs exist, especially along ecotonal/hydrologic transitions from lowland to wetland (Figure 1).

Herbaceous groundstory is sparse, with patchy populations of Canada mayflower (dense), spring beauty (moderate), Indian pipe (sparse), wild sarsaparilla, Virginia creeper (dense), poison ivy (dense), etc.

Pin-Oak Lowland Forest - In the northwest portion of the Deep Woods tract is a pin oak-dominated forest. Other tree species present include black gum, red maple and swamp white oak. While there is significant over-grazing by deer, the relatively higher elevations have moderate to dense shrub understory, while the lower elevations and wetter locations host herbaceous wetland plants, such as skunk cabbage, sedges, cattails (one small population), rushes, etc. Similar to all of these forested wetlands is the pothole-like ponded water within the low-grade forest, generating a variety of hydrologic, soil, and sunlight conditions suitable to support plant (and animal) diversity.

Mixed Hardwood Lowland Forest (PFO) – Due to the proximity to the water table, only subtle changes in topography give way to more wet-tolerant tree species, such as black gum, sweet gum, and red maple. Pocked through this landscape are transitional overstory compositions associated with elevation and/or hydrology. Understory vegetation within the lowland forest sections include greenbrier, multiflora rose, blackberry, and poison ivy.

Figure 1. Mature oak trees in south portion of Deed Woods Tract. Note greenbrier (*Smilax rotundifolia)* and highbush blueberry (*Vaccinium corymbosum)* in understory. Photograph taken by Michael McGraw November 16, 2009.

Ash/Maple Forested Wetland (PFO) – The southeast section of the Deep Woods tract is comprised largely of an ash/maple forested wetland. Woody understory is moderate to sparse, dominated by dogwood and highbush blueberry. The herbaceous understory is moderate to dense, with thick patches of skunk cabbage, jewelweed, and sedges. Additionally, floodplain forested wetlands are present along the margins of both channelized and natural meandering streams within the entire tract. Within these forested wetlands are numerous ephemeral water bodies, hosting a variety of shade-tolerant wetland plant species as well as open-space emergent wetland species in canopy breaks (downed trees via storms/disease/wind, etc.; within trails and trail margins, hydrologic inhibition of overstory tree development).

Shrub/Scrub Wetland – To the east of the Bound Brook in the northeastern portion of the Deep Woods Tract is a section of habitat (approximately 20-30 acres) with savannah-like overstory canopy (well spaced, sprawling canopy trees) or no overstory trees. A woody shrub thicket dominates this section, with arrowwood viburnum, buttonbush, and red osier dogwood. Due to increased light penetration and subtle changes in topography (and the resultant hydrological variation), a wide diversity and abundance of herbaceous plant species are thriving in this area. Key species of note include tussock sedge, common rush, goldenrod, and wool grass. This habitat is bordered to the east by a thin strip of forested wetland then the abandoned railroad ROW. There are numerous pocket-wetland locations within both the forested and open-canopied sections of this ecotone, mostly associated with the channelized drainage ways (Figure 2.).

Figure 2. Emergent wetland with mucky, inundated soils along margin of scrub/shrub wetland in northeast section of Deep Woods Tract. Photograph by Michael McGraw on April 14, 2010.

Soil type varies, but remains hydric. In some locations, deep, organic muck soil is present in association with sedges, ferns, and other associative plant species indicative of potential threatened and endangered reptile habitat (spotted and bog turtles, respectively) (see Discussion). Typical wetland plant species present in the open-canopied wetland pockets include tussock sedge, common rush, sensitive fern, iris, and sweet flag, while more shaded wetlands are currently supporting jewelweed and skunk cabbage. To the west, the shrub wetland habitat transitions into a grass-dominated (non-native/invasive species) floodplain, largely devoid of woody plant species. Channelized drainage ditches flow into the Bound Brook (also channelized), suggesting an agricultural history contributing to the origin of this location's savannah-like trees and successional habitat composition. Both historic and present American beaver activity was observed, suggesting beaver-induced flooding likely also contributes to the area's successional state. Shrubby, successional/hedgerow habitat borders the drainage ditch outflows in the floodplain. Submergent vegetation observed within the Bound Brook and channelized ditches provide excellent habitat for fish and aquatic insects, while also serving as a food source for waterfowl and redbelly turtles. Emergent vegetation observed along margins of open water and throughout some drainage ditches includes; smartweed, iris, and arrow arum (Figure 3).

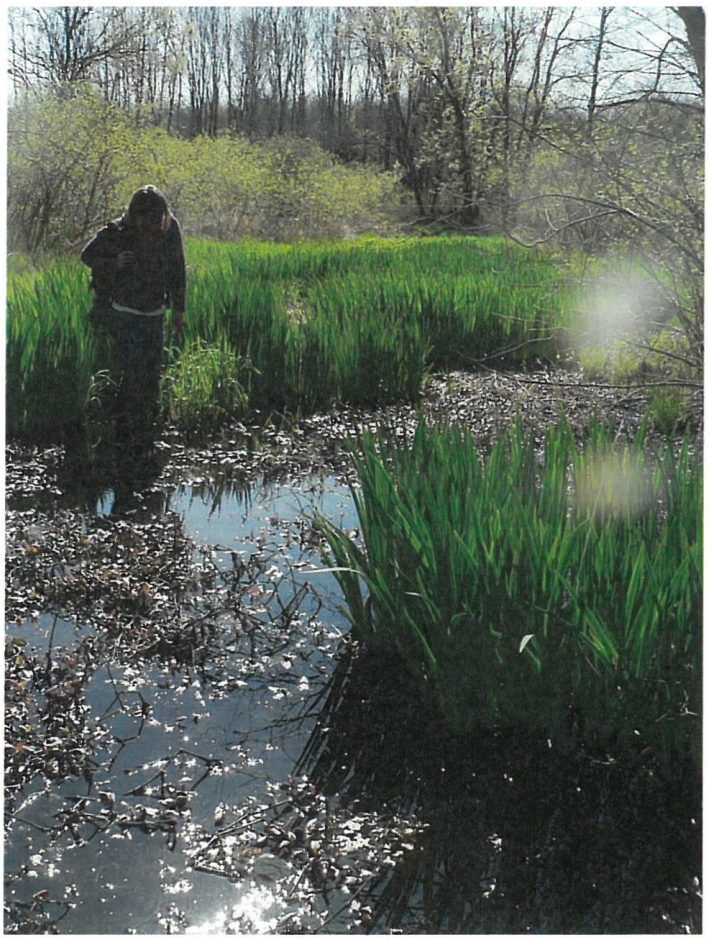


Figure 3. AES surveyor, Julie Hendrickson, exploring channelized ditch at margin of scrub/shrub wetland dominated by iris and smartweed. Photograph by Michael McGraw on April 14, 2010.

Emergent Wetlands – Along both sides of the Bound Brook in the northeastern portion of this tract are patchy sections of emergent wetland habitats up to the Talmadge Street Bridge (Figure 4). Dominant species within these patches of open-canopied, often inundated habitats includes cattail, sedges, ferns, bulrushes, and invading phragmites in some areas. Regarding the remainder of the Deep Woods tract, almost any break in canopy or inundation of surface soil within this tract results in the establishment of emergent wetland vegetation. These locations are too numerous and random to pinpoint. This abundance of surface water-derived ecosystems onsite provides opportunity for significant variation in water depth, temperature, light, aspect, chemical components, and plant community structure. This heterogeneity provides significant potential for rare, sensitive, and habitat-specific plant species to be present in active growth and/or seed bank state.

Figure 4. Emergent wetland immediately south/partially underneath the Talmadge Street bridge. View is from the bridge (approximately 20 feet above). Photograph by Michael McGraw.

Stream/Riparian – Along most waterways within the Dismal Swamp are the dredged/displaced soils generated from channelizing and previous mosquito management techniques. These now-compacted soils create linear, relatively higher-grade strips of disturbance along one or both banks. These disturbed areas support tree and shrub species, such as multiflora rose, viburnum, and red maple. Otherwise, with the exception of the Bound Brook within the north and east sections of the tract,

stream banks are forested and minimal vegetation is present within the streams. In sections where there is open canopy adjacent to the streams, submergent and emergent plant species are present.

Triple C Ranch – The Triple C Ranch (approximately 40 acres) consists of a small building and parking area, barn and equipment storage, housing pens for less than 50 livestock, a small pond and adjacent garden, mowed areas, spring-fed wetlands, stream and riparian corridor, and hardwood forest. It is owned and operated by EWA. Below are habitat descriptions regarding the natural areas onsite.

Figure 5. Emergent vegetation wetland on Triple C Ranch property. Photo by Scott M. Quitel.

Emergent Wetlands – A spring-fed wetland courses through the Ranch on a northwest to southeast projection. A variety of smaller vegetative communities are supported by this wetland ecosystem, varying by soil/water niche partitioning. In the northernmost sections of the wetland, it is dominated by rushes and sedges. The flow is interrupted by a raised path (constructed in preparation for a proposed development many years ago). On the south side of the path the vegetative community is dominated by sedges, especially tussock sedge and common rush and is bordered by a dogwood-dominated shrub wetland (Figure 5). It is then interrupted by a utility ROW (see below for description). The wetland continues south and east, becoming patches of shrub wetland, cattail-dominated emergent wetland, sedge-dominated emergent wetland, open woodland. The soil is mucky, with areas of inundated, but not flooded soils. Based upon the existing vegetation, hydrology, and soil, AES believes that there is marginally suitable habitat for bog turtle in the southern portion of this wetland complex and strongly suggests further investigations to determine presence or absence of this federally-threatened and NJ state-endangered species.

Utility Right-Of-Way Wetland – Bisecting the Triple C Ranch into two (roughly northern and southern) sections is a gas pipeline right-of-way. As per management protocols for utility rights-of-way in New Jersey, this is mowed on an annual basis to inhibit the establishment of woody vegetation. The existing hydrology and maintained open canopy provide conditions for a sedge-dominated wetland/ wet meadow (Figure 6). On either side of this ROW is contiguous wetland (hydrologically connected). Woody vegetation (mostly dogwood) growing on either side of the ROW at the wetland is sparse, along with occasional understory trees, especially in areas of higher elevation.

Figure 6. Sedge-dominated wetland in managed ROW at Triple C Ranch. Photograph by Michael J. McGraw.

Pin Oak Forest/Riparian Corridor – Bordering the Bound Brook as it meanders northwest through the southern section of the Triple C Ranch, a pin oak-dominated forest is present. Heavy grazing by deer in this region limits the understory growth. The groundstory is sparse to non-existent.

South Plainfield Holdings – This large section (69 acres), located within South Plainfield Township and Edison Townships was recently preserved by Middlesex County. Bisected by an electrical ROW, this tract is composed largely of forested wetland and lowland forest, with small sections of open-canopied, emergent wetlands. It is bordered to the north by the Woodbrook Road/EPA Superfund site and the Quincy Place property. To the east and south are Visco-owned properties, the DiLeo property, and existing, dense residential development. The tract is bordered to the west by various Industrial development sites.

Oak-dominated Lowland Forest – South of the bisecting ROW and north of the tributary stream near Tracts Visco II and the DiLeo Property the dominant overstory is composed of pin oak, red oak, swamp white oak, black tupelo, American sweet gum, and green ash (Figure 7). The understory is sparse to moderate, consisting of highbush blueberry, arrowwood viburnum, blackberry, multiflora rose, common greenbrier, Virginia creeper, poison ivy and Japanese honeysuckle. Overgrazing by deer has limit groundstory vegetation to sparse to moderate patches of Pennsylvania sedge, smartweed, and goldenrod.

Figure 7. Forest stratification in lowland forest within South Plainfield Holdings. Photograph by Michael McGraw.

Upland Hardwood Forest – Bordering the Woodbrook Road Site is a section of land with moderately-well to well-drained soils. It is forested, dominated by oaks and American beech. There is a moderate to dense woody understory, with large patches of lowbush blueberry and sweet pepperbush (Figure 8).

Figure 8. Upland forest in northern section of South Plainfield Holdings. Note woody understory transition from lowbush blueberry (upland) in the foreground, to sweet pepperbush (transitional), to highbush blueberry (lowland). Photograph by Michael McGraw.

Forested Wetland/Potential Vernal Pool- Along the ecotonal transition from lowland to upland in the northern section of this tract is a large ephemeral pool (Figure 9). As per breeding amphibian observations in 2010, AES believes this complex to be a candidate for vernal pool certification. Within this tract are several (approximately 5) other potential vernal pool locations.

Figure 9. Red maple-dominated ephemeral/vernal pool located in South Plainfield Holdings where wood frog successfully reproduced in 2010. Photograph by Michael McGraw.

Visco Tracts I & II – As privately-owned properties, these tracts were observed from their margins via binoculars and audible survey methods. Habitat consisted largely of forested wetland, with a good mix of hardwood canopy tree species and thick shrub margins to a tributary stream. Springs and seeps are found along the stream and moderate to dense herbaceous groundcover is present in floodplain and stream meander wetlands. A small cattail wetland onsite is hosting both breeding amphibians (spring peepers) and bird species (common yellowthroat, red-winged blackbird). This section currently serves as a buffer to developed lands to the south, contains a stream complex with natural meander, floodplain habitat, emergent wetlands, potential vernal pools and may contain critical habitat for a variety of birds and herpetofauna.

Helen Street Wetland – This is the largest open-water resource in the entire Dismal Swamp Conservation Area. Immediately downstream from the Woodbrook Road/EPA Superfund site, this emergent wetland and open water complex is currently difficult to access. Structural habitat elements relatively unique to this area includes; dead standing, or snag, trees (perch foraging site for raptor, habitat-specific nesting for tree swallow and prothonotary warbler); duck potato, arrow arum, and other peltate-leaved emergent plants; pond-like habitat suitable for ducks (diving and dabbling), grebes, and other waterfowl; and shrub thicket bordering open water (conducive for various wetland associated sparrows, warblers, and wrens). Thick patches of emergent vegetation, especially cattail and pickerelweed, provide suitable breeding habitat for rails, bitterns, common moorhen marsh wren, and pied-billed grebe. This area also provides unique habitat suitable for a variety of herpetofauna, including frogs, toads, numerous turtle species (including spotted turtle and redbelly turtle, and snake species, specifically northern watersnake, eastern ribbon snake, northern brown snake and eastern worm snake (at the ponded margins).

Open Water/Marsh Complex – Dominated by species such as cattail, arrow arum, pickerelweed, and smartweed in the emergent zone, this section is extremely diverse and unique. More dramatic grade banks support buttonbush thickets. There is some encroachment by Phragmites in this area, but it largely remains in a natural state and hosts a diverse assemblage of native plants.

Wet Meadow - The adjacent open field and western margins of the Helen Street Wetland are comprised of various agricultural weeds, horsetails, algae, and various sedges and rushes. This has been impacted by previous development (existing, graded lot with mix of pavement, and various grasses and weedy trees established on non-native fill soil). This disturbed open field (Quincy Place) currently supports open space breeding birds and grassland and successional habitat species in migration.

Hollywood Boulevard Wetland – This location is immediately north of the Helen Street wetland. It is bordered to the west by industrial facilities, to the south by the Helen Street wetland and Quincy Place tracts, to the north by ball fields and residences, and to the east by industrial facilities and an abandoned railroad ROW. The area contains numerous forested wetland areas (including potential vernal pools), Beaver Run, Bound Brook, emergent wetland and some partially developed landscapes (fill into wetland with un-natural grading).

Observations within the Hollywood Boulevard Wetland suggest this to be an ecologically significant area, with a rich diversity and abundance of bird species in migration, including bird species which employ specific foraging strategies (insectivorous-probing, stalk-foraging piscivores, aerial-foraging, flycatching, foliage-gleaning, ground-foraging, and bark-foraging) numerous mammal species, basking turtles and salamanders. In addition to the above faunal observations, structural habitat is present to potentially support rare species, such as American bittern, least bittern, pied-billed grebe, spotted turtle, prothonotary warbler, yellow-crowned night heron, barred owl, and red-shouldered hawk. Specific surveys should be conducted to further confirm these assumptions.

Old Lot – A paved old lot onsite hosts a variety of weedy native and non-native grasses and forbs. The surrounding tree species include sweet gum, pin oak, red maple, and tree-of-heaven.

Mixed Hardwood Swamp Forest – A relatively narrow tract of forest to the north of the emergent marsh and Helen Street Wetland remains before the landscape gives way to industrial and active recreational lands. Ditched waterways support American beaver. The understory is a diverse mix of wetland plants, woody shrubs (dogwood, viburnum, multiflora rose, buttonbush), and open water, with patches becoming more dense where light penetrates the canopy. Swamp white oak trees are complemented by red and American elm trees, creating a wonderful overstory canopy.

Emergent Wetlands/Open Water/ and Floodplain Wetlands - Due to the relative inaccessibility of this location, a large portion of sensitive wetland habitat was not surveyed in this study. There is significant potential for a variety of breeding marsh birds (Figure 10) and wetland dependant raptor (red-shouldered hawk and barred owl) to be present and breeding within these areas. More in-depth studies should be conducted in this area. No action should be taken that may impact, alter, or further disturb this tract until specific investigations for threatened and endangered plants and animals are conducted. Efforts to protect and enhance this wetland complex are encouraged.

Figure 10. Cattail-dominated emergent wetland just south of ditched waterway (in foreground). Open canopied sections provide ideal nesting habitat for numerous marsh bird species. American beaver currently manage a dam and lodge along this ditch. Photograph by Michael McGraw.

Durham Woods Set Aside –

Metuchen Portion - This small but unique section of the Dismal Swamp is characterized by its increased amount of surface water and mucky soils. The site is currently in a successional state, with older dead overstory trees, with significant light penetration to the flooded soil surface, resulting in a plethora of emergent wetland vegetation (Figure 11). Large sections are dominated by skunk cabbage, arrow arum, rushes, sedges, sensitive fern, cattail, and jewelweed. There is also a large presence of shrubs (viburnum and buttonbush) established in patches, especially within the northern section Figure 12). Young red maple and sweet gum trees are growing in dense pockets, shading out the understory wetland plants. Along the banks of the Bound Brook as it courses through this tract are floodplain-like areas with washed out, but moderately present patches of skunk cabbage and green arrow arum on exposed/drying hydric soils within a canopy of green ash and red maple. There is significant potential for bog turtle and spotted turtle within this section, as the vegetation, hydrology, and soil types are all suitable. Canopy varies from partially-shaded to open-canopied. Species such as woolgrass, swamp verbena, grass-leaved goldenrod, swamp milkweed, Allegheny monkeyflower, panic grass, and wild rye are present as emergent vegetation and herbaceous groundstory.

Figure 11. Successional wetland in Metuchen section of Durham St. Set Aside. Photograph by Michael McGraw.

Figure 12. Section of Metuchen successional wetland with significant presence of arrowwood viburnum and buttonbush. Photograph by Michael McGraw.

Edison Portion – Unlike the mucky soil sections in Metuchen, this area of forested wetland largely mimics that of the pin oak-dominated lowlands to the north. Eroded banks along the Bound Brook are supporting northern rough-winged swallows and belted kingfisher nests.

4.1a Vegetative Communities

AES has conducted a vegetative community assessment of the Dismal Swamp. While this effort was not comprehensive (due to a limited budget), much of the Dismal Swamp Conservation Area was physically surveyed and mapped via dominant plant species. Areas that were not surveyed are characterized by general assumptions based upon previous studies and aerial imagery analysis. Below are lists of dominant species found within the varying habitat patches surveyed Table 1. Please refer to the plant community map to associate the plant species with the locations.

Table 1. Vegetative Communities within Various Tracts of the Dismal Swamp

Location		Common Name	Taxonomic Binomial
South Plainfield Holdings			
Vernal Pool Complex	Trees	red maple	*Acer rubrum*
		pin oak	*Quercus palustris*
		grey birch	*Betula populifolia*
	Shrubs	highbush blueberry	*Vaccinium corymbosum*
Pin oak - Red maple Lowland	Trees	pin oak	*Quercus palustris*
		red oak	*Quercus rubra*
		swamp white oak	*Quercus bicolor*
		red maple	*Acer rubrum*
		black tupelo	*Nyssa sylvatica*
		sweetgum	*Liquidambar styraciflua*
		green ash	*Fraxinus pensylvanica*
		black cherry	*Prunus serotina*
	Shrubs	highbush blueberry	*Vaccinium corymbosum*
		arrowwood viburnum	*Viburnum dentatum*
		blackberry	*Rubus spp.*
		multiflora rose	*Rosa multiflora*
	Vines	common greenbrier	*Smilax rotundifolia*
		Virginia creeper	*Parthenocissus quinquefolia*
		poison ivy	*Toxicodendron radicans*
		Japanese honeysuckle	*Lonicera japonica*
	Herbaceous	smartweed	*Polygonum spp.*
		sedge	*Carex spp.*
		Pennsylvania sedge	*Carex pensylvanica*
		goldenrod	*Solidago spp.*
Sweetgum Forest	Trees	sweetgum	*Liquidambar styraciflua*
		red maple	*Acer rubrum*

		American beech	*Fagus grandifolia*
		tulip poplar	*Liriodendron tulipifera*
		black tupelo	*Nyssa sylvatica*
		black cherry	*Prunus serotina*
		white oak	*Quercus alba*
		hickory	*Carya spp.*
	Shrubs	highbush blueberry	*Vaccinium corymbosum*
		lowbush blueberry	*Vaccinium pallidum*
		blackberry	*Rubus spp.*
Mixed Hardwood	Trees	pin oak	*Quercus palustris*
		white oak	*Quercus alba*
		red maple	*Acer rubrum*
		green ash	*Fraxinus pensylvanica*
		American elm	*Ulmus americana*
		sweetgum	*Liquidambar styraciflua*
		hickory	*Carya spp.*
		tulip poplar	*Liriodendron tulipifera*
	Shrubs	multiflora rose	*Rosa multiflora*
	Herbaceous	sedge	*Carex spp.*
		Canadian clearweed	*Pilea pumila*
		sensitive fern	*Onoclea sensibilis*
		smartweed	*Polygonum spp.*
		deer tongue grass	*Panicum clandestinum*
		white wood aster	*Aster divaricatus*
Red maple - Pin oak - Sweetgum Lowland	Trees	red maple	*Acer rubrum*
		pin oak	*Quercus palustris*
		swamp white oak	*Quercus bicolor*
		sweetgum	*Liquidambar styraciflua*
		hickory	*Carya spp.*
		American hornbeam	*Carpinus caroliniana*
	Shrubs	red osier dogwood	*Cornus sericea*
		serviceberry	*Amelanchier spp.*
		multiflora rose	*Rosa multiflora*
		highbush blueberry	*Vaccinium corymbosum*
		arrowwood viburnum	*Viburnum dentatum*
		spicebush	*Lindera benzoin*
	Herbaceous	poison ivy	*Toxicdendron radicans*
		roundleaf greenbrier	*Smilax rotundifolia*
		goldenrod	*Solidago spp.*
		aster	*Aster spp.*
		Canadian clearweed	*Pilea pumila*

		cutleaf coneflower	*Rudbeckia laciniata*
		smartweed	*Polygonum spp.*
		common rush	*Juncus effusus*
		sedge	*Carex spp.*
		skunk cabbage	*Symplocarpus foetidus*
		sensitive fern	*Onoclea sensibilis*
		New York fern	*Thelypteris noveboracensis*
Higher Elevation Areas in Red maple-Pin oak - Sweetgum Forest	Trees	red oak	*Quercus rubra*
		white oak	*Quercus alba*
		scarlet oak	*Quercus coccinea*
		American beech	*Fagus grandifolia*
		sweet birch	*Betula lenta*
		American holly	*Ilex opaca*
	Shrubs	lowbush blueberry	*Vaccinium pallidum*
		black huckleberry	*Gaylussacia baccata*
		partridge berry	*Mitchella repens*
White oak Forest	Trees	white oak	*Quercus alba*
		pin oak	*Quercus palustris*
		scarlet oak	*Quercus coccinea*
		red oak	*Quercus rubra*
		sweetgum	*Liquidambar styraciflua*
		black cherry	*Prunus serotina*
	Shrubs	highbush blueberry	*Vaccinium corymbosum*
		lowbush blueberry	*Vaccinium pallidum*
		black huckleberry	*Gaylussacia baccata*
	Herbaceous	Pennsylvania sedge	*Carex pensylvanica*
		goldenrod	*Solidago spp.*
		hair cap moss	*Polytrichum spp.*
Red maple Mixed	Trees	red maple	*Acer rubrum*
		pin oak	*Quercus palustris*
		poplar birch	*Betula populifolia*
		big-tooth aspen	*Populus grandidentata*
		sweetgum	*Liquidambar styraciflua*
	Shrubs	high bush blueberry	*Vaccinium corymbosum*
		lowbush blueberry	*Vaccinium pallidum*
		black huckleberry	*Gaylussacia baccata*
		blackberry	*Rubus spp.*
	Herbaceous	roundleaf greenbrier	*Smilax rotundifolia*
		Pennsylvania sedge	*Carex pensylvanica*
		switchgrass	*Panicum virgatum*

Red maple-Pin oak-Sweetgum (Low)	Trees	red maple	*Acer rubrum*
		pin oak	*Quercus palustris*
		red oak	*Quercus rubra*
		sweetgum	*Liquidambar styraciflua*
		hickory	*Carya spp.*
		black tupelo	*Nyssa sylvatica*
		big-tooth aspen	*Populus grandidentata*
		eastern cottonwood	*Populus deltoides*
		sassafras	*Sassafras albidum*
	Shrubs	highbush blueberry	*Vaccinium corymbosum*
		lowbush blueberry	*Vaccinium pallidum*
		huckleberry	*Gaylussacia spp.*
		sweet pepperbush	*Clethra alnifolia*
		arrowwood viburnum	*Viburnum dentatum*
	Herbaceous	spotted wintergreen	*Chimaphila maculata*
Mixed oak (High)	Trees	red oak	*Quercus rubra*
		white oak	*Quercus alba*
		scarlet oak	*Quercus coccinea*
		pin oak	*Quercus palustris*
		sassafras	*Sassafras albidum*
		red maple	*Acer rubrum*
	Shrubs	highbush blueberry	*Vaccinium corymbosum*
		lowbush blueberry	*Vaccinium pallidum*
		sweet pepperbush	*Clethra alnifolia*
		mapleleaf viburnum	*Viburnum acerifolium*
Mixed oak south of Woodbrook Tract	Trees	white oak	*Quercus alba*
		red oak	*Quercus rubra*
		scarlet oak	*Quercus coccinea*
		pin oak	*Quercus palustris*
		sweetgum	*Liquidambar styraciflua*
		black cherry	*Prunus serotina*
		pin cherry	*Prunus pensylvanica*
		red maple	*Acer rubrum*
		tulip poplar	*Liriodendron tulipifera*
		sassafras	*Sassafras albidum*
		black tupelo	*Nyssa sylvatica*
		shagbark hickory	*Carya ovata*
		quaking aspen	*Populus tremuloides*
		American beech	*Fagus grandifolia*
		American elm	*Ulmus americana*
	Shrubs	mapleleaf viburnum	*Viburnum acerifolium*

		arrowwood viburnum	*Viburnum dentatum*
		lowbush blueberry	*Vaccinium pallidum*
		black huckleberry	*Gaylussacia baccata*
		common greenbrier	*Smilax rotundifolia*
	Herbaceous	wintergreen	*Gaultheria procumbens*
		pyrola	*Pyrola spp.*
		spotted wintergreen	*Chimaphila maculata*
Red maple - Pin oak – Highbush blueberry Wetland (vernal)	Trees	red maple	*Acer rubrum*
		pin oak	*Quercus palustris*
	Shrubs	highbush blueberry	*Vaccinium corymbosum*
Deep Woods Tract/ Edison			
Interconnected Areas of Open Marsh	Herbaceous	tussock sedge	*Carex stricta*
Wet Meadow - Wet Savanna - Swamp Patches		sedge	*Carex spp.*
		common rush	*Juncus effusus*
		woolgrass	*Scirpus spp*
		spikerush	*Eleocharis spp.*
		goldthread	*Coptis groenlandica*
		smartweed	*Polygonum spp.*
Wet Savanna - Wet Meadow Shrub Swamp	Trees	red maple	*Acer rubrum*
		pin oak	*Quercus palustris*
		green ash	*Fraxinus pensylvanica*
		crabapple	*Malus spp.*
	Shrubs	arrowwood viburnum	*Viburnum dentatum*
		red osier dogwood	*Cornus sericea*
		blackberry	*Rubus spp.*
		swamp rose	*Rosa palustris*
		multiflora rose	*Rosa multiflora*
	Herbaceous	Japanese honeysuckle	*Lonicera japonica*
		skunk cabbage	*Symplocarpus foetidus*
		purple loosestrife	*Lythrum salicaria*
		swamp verbena	*Verbena hastata*
		Allegheny monkeyflower	*Mimulus ringens*
		woolgrass	*Scirpus cyperinus*
		sedge	*Carex spp.*
		common rush	*Juncus effusus*
		smartweed	*Polygonum spp.*
		goldenrod	*Solidago spp.*
		garlic mustard	*Alliaria petiolata*
Green ash Swamp	Trees	green ash	*Fraxinus pensylvanica*

(Vernal Pool)	Herbaceous	skunk cabbage	*Symplocarpus foetidus*
		sedge	*Carex spp.*
Pin oak - dominated forested wetland			
	Trees	pin oak	*Quercus palustris*
		swamp oak	*Quercus bicolor*
		red maple	*Acer rubrum*
		sweetgum	*Liquidambar styraciflua*
		green ash	*Fraxinus pensylvanica*
		black gum	*Nyssa sylvatica*
		American elm	*Ulmus americana*
		slippery elm	*Ulmus rubra*
		American sycamore	*Platanus occidentalis*
		cottonwood	*Populus deltoides*
		musclewood	*Carpinus caroliniana*
	Shrubs	highbush blueberry	*Vaccinium corymbosum*
		arrowwood viburnum	*Viburnum dentatum*
		red osier dogwood	*Cornus sericea*
		silky dogwood	*Cornus amomum*
		buttonbush	*Cephalanthus occidentalis*
		spicebush	*Lindera benzoin*
	Herbaceous	skunk cabbage	*Symplocarpus foetidus*
		soft rush	*Juncus effusus*
		sedge spp.	*Carex spp.*
		goldenrod	*Solidago spp.*
		deer-tongue grass	*Panicum clandestinum*
		goldthread	*Coptis groenlandica*
		cardinal flower	*Lobelia cardinalis*
		jewelweed	*Impatiens capensis*
Upland Areas	Trees	red oak	*Quercus rubra*
		white oak	*Quercus alba*
		black oak	*Quercus velutina*
		scarlet oak	*Quercus coccinea*
		American beech	*Fagus grandifolia*
		tulip poplar	*Liriodendron tulipifera*
		quaking aspen	*Populus tremuloides*
		bigtooth aspen	*Populus grandidentata*
		black locust	*Robinia pseudoacacia*
		tree-of-heaven	*Ailanthus altissima*
		crabapple	*Malus spp.*
	Shrubs	lowbush blueberry	*Vaccinium pallidum*
		black huckleberry	*Gaylussacia baccata*

		mapleleaf viburnum	*Viburnum acerifolium*
		multiflora rose	*Rosa multiflora*
		bush honeysuckle	*Lonicera spp.*
	Vines	Japanese honeysuckle	*Lonicera japonica*
		poison ivy	*Toxicodendron radicans*
		greenbrier	*Smilax rotundifolia*
	Herbaceous	spotted wintergreen	*Chimaphila maculata*
		wintergreen	*Gaultheria procumbens*
		pyrola	*Pyrola spp.*
		Pennsylvania sedge	*Carex pensylvanica*
		goldenrod	*Solidago spp.*
		white wood aster	*Aster divaricatus*
Durham Woods Set Aside/ Metuchen Section			
Successional Red Maple Swamp (and Wet Savanna)	Trees	red maple	*Acer rubrum*
		green ash	*Fraxinus pensylvanica*
	Shrubs	blackberry	*Rubus spp.*
		arrowwood viburnum	*Viburnum dentatum*
		common buttonbush	*Cephalanthus occidentalis*
		red osier dogwood	*Cornus sericea*
		gray dogwood	*Cornus racemosa*
	Herbaceous	sedge	*Carex spp.*
		virgin's bower	*Clematis virginiana*
		common rush	*Juncus effusus*
		woolgrass	*Scirpus cyperinus*
		spikerush	*Eleocharis spp.*
		skunk cabbage	*Symplocarpus foetidus*
		cardinal flower	*Lobelia cardinalis*
		aster	*Aster spp.*
		goldenrod	*Solidago spp.*
		goldthread	*Coptis groenlandica*
		ironweed	*Vernonia noveboracensis*
		Allegheny monkeyflower	*Mimulus ringens*
		common reed	*Phragmites australis*
		cattail	*Typha spp.*
		sensitive fern	*Onoclea sensibilis*
Helen Street Wetland			
	Trees	willow	Salix spp.
		red maple	*Acer rubrum*
	Shrubs	common buttonbush	*Cephalanthus occidentalis*
		dogwood	*Cornus spp.*
	Herbaceous	common cattail	*Typha latifolia*

		narrowleaf cattail	*Typha angustifolia*
		common reed	*Phragmites australis*
		common rush	*Juncus effusus*
		sedge	*Carex spp.*
		green arrow arum	*Peltandra viriginica*
		smartweed	*Polygonum spp.*
	Herbaceous	various ag weeds	
		common rush	*Juncus effusus*
		tussock sedge	*Carex stricta*
		spikerush	*Eleocharis spp.*
		algae	
Hollywood Ave. Extension			
Old Lot	Herbaceous	various ag weeds	
		common reed	*Phragmites australis*
		goldenrod	*Solidago spp.*
		aster	*Aster spp.*
		mugwort	*Artemisia vulgaris*
Forest Edge Surrounding Lot	Trees	pin oak	*Quercus palustris*
		red maple	*Acer rubrum*
		ash	*Fraxinus spp.*
		sweetgum	*Liquidambar styraciflua*
		black locust	*Robinia pseudoacacia*
		tree of heaven	*Ailanthus altissima*
		cottonwood	*Populus spp.*
Mixed Hardwood Swamp Forest	Trees	red maple	*Acer rubrum*
		pin oak	*Quercus palustris*
		swamp white oak	*Quercus bicolor*
		white oak	*Quercus alba*
		green ash	*Fraxinus pensylvanica*
		American elm	*Ulmus americana*
		slippery elm	*Ulmus rubra*
	Shrubs	common buttonbush	*Cephalanthus occidentalis*
		silky dogwood	*Cornus amomum*
		arrowwood viburnum	*Viburnum dentatum*
		multiflora rose	*Rosa multiflora*
		Amur honeysuckle	*Lonicera maackii*
	Vines	Japanese honeysuckle	*Lonicera japonica*
		Virginia creeper	*Parthenocissus quinquefolia*
	Herbaceous	smartweed	*Polygonum spp.*
		cattail	*Typha spp.*
		common reed	*Phragmites australis*

		woolgrass	*Scirpus cyperinus*
		common rush	*Juncus effusus*
		sedge	*Carex spp.*
		deer tongue grass	*Panicum clandestinum*
		green arrow arum	*Peltandra viriginica*
		American pokeweed	*Phytolacca americana*
		bittercress	*Cardamine spp.*
		Appalachian barren strawberry	*Waldsteinia fragarioides*
		Canada thistle	*Cirsium arvense*
		threeleaf goldthread	*Coptis groenlandica*
Triple C Ranch			
Wet Savanna (NW Corner)	Trees	pin oak	*Quercus palustris*
		red maple	*Acer rubrum*
	Shrubs	blackberry	*Rubus spp.*
		red osier dogwood	*Cornus sericea*
		swamp rose	*Rosa palustris*
		multiflora rose	*Rosa multiflora*
	Herbaceous	common rush	*Juncus effusus*
		sedge	*Carex spp.*
		woolgrass	*Scirpus cyperinus*
		smartweed	*Polygonum spp.*
		swamp verbena	*Verbena hastata*
		New York ironweed	*Vernonia noveboracensis*
		goldenrod	*Solidago spp.*
		grass-leaved goldenrod	*Euthamia graminifolia*
		swamp milkweed	*Asclepias incarnata*
		Allegheny monkeyflower	*Mimulus ringens*
		panic grass	*Panicum spp.*
		rye	*Elymus spp.*
Road Edge	Trees	crabapple	*Malus spp.*
	Shrubs	Amur honeysuckle	*Lonicera maackii*
		multiflora rose	*Rosa multiflora*
	Herbaceous	mugwort	*Artemisia vulgaris*
		common reed	*Phragmites australis*
		goldenrod	*Solidago spp.*
		Japanese knotweed	*Polygonum cuspidatum*
		annual ragweed	*Ambrosia artemisiifolia*
Hedgerow at Triple C	Trees	black locust	*Robinia pseudoacacia*
		autumn olive	*Eleaeagnus umbellata*
	Shrubs	multiflora rose	*Rosa multiflora*
		Japanese honeysuckle	*Lonicera japonica*

		oriental bittersweet	*Celastrus orbiculatus*
		grape	*Vitis spp.*

4.2 Calling Amphibian Survey

Twenty-four (24) listening stations were established throughout the Dismal Swamp (Map 8.3). Locations were selected by proximity to wetlands/potential breeding pools, accessibility at night, and high priority locations (as determined by the client). Due to the size of the swamp complex and access constraints, this effort has been designed to provide representative sampling, rather than comprehensive. A total of seven (7) species of frog and toad were observed breeding within the Dismal Swamp. Included within the most abundant breeding frog species is wood frog, a vernal pool-obligate breeder. Efforts to further determine the abundance and distribution of vernal pool habitats within the Dismal Swamp is strongly encouraged, as these unique ecosystems support a variety of rare plants and animals. Below are summary tables detailing survey dates, environmental conditions, and observed species.

Table 2. Frog and Toad Species Observed During Amphibian Calling Survey within the Dismal Swamp in 2010

Common Name		Taxonomic Binomial	Approximate Abundance of Observed Calling Males
Frogs	spring peeper	*Pseudacric c. crucifer*	350+ sitewide
	northern gray treefrog	*Hyla versicolor*	300+ sitewide
	wood frog	*Lithobates sylvatica*	200+ at vernal pool locations
	southern leopard frog	*Lithobates sphenocephala utricularia*	~20 at open-canopied and forest edge wetlands
	northern green frog	*Lithobates clamitans melanota*	300+ sitewide
	bullfrog	*Lithbates catesbeiana*	~50 at open water features
Toads	American toad	*Bufo americana*	>50 at select open-canopied wetlands

4.3 Birds

In 2010, a total of 161 bird species were observed onsite (or flying overhead) in 2010 (Table 3). This is a combination of observations from a formally-conducted breeding bird survey (see section 4.3a) and random opportunistic observations made by AES lead biologist/project manager, Michael McGraw, while conducting other investigations throughout the season. While both spring and fall migrations are represented in these observations, this does not constitute a formal investigation of the migratory birds within the Dismal Swamp. All birds within the below table were confirmed present onsite. In the notes column, 'Confirmed', 'Probable', and 'Possible' refer to the breeding status of this species as per the New Jersey Breeding Bird Atlas Codes.

Table 3. Total Birds Observed at or above the Dismal Swamp in 2010

Alpha Code	Common Name	Taxonomic Binomial	Notes
COLO	common loon	*Gavia immer*	F/O

PBGR	pied-billed grebe***	*Podilymbus podiceps*	Probable
DCCO	double-crested cormorant	*Phalacrocorax auritus*	F/O
AMBI	American bittern***	*Botaurus lentiginosus*	F/O
GBHE	great blue heron*	*Ardea herodias*	foraging
GREG	great egret*	*Ardea alba*	F/O
SNEG	snowy egret	*Egretta thula*	F/O
LBHE	little blue heron*	*Egretta caerulea*	foraging
GRHE	green heron*	*Butorides virescens*	Probable
CAGO	Canada goose	*Branta canadensis*	Confirmed
SNGO	snow goose	*Chen caerulescens*	F/O
WODU	wood duck	*Aix sponsa*	Confirmed
MALL	mallard	*Anas platyrhynchos*	Confirmed
ABDU	American black duck	*Anas rupripes*	Possible
NOPI	northern pintail	*Anas acuta*	Migration
BWTE	blue-winged teal	*Anas discors*	Migration
GWTE	green-winged teal	*Anas crecca*	Migration
RNDU	ring neck duck	*Aythya collaris*	Migration
BUFF	bufflehead	*Bucephala albeola*	Migration
HOME	hooded merganser	*Lophodytes cucullatus*	Possible
COME	common merganser	*Mergus merganser*	Migration
TUVU	turkey vulture	*Cathartes aurus*	Observed
BLVU	black vulture	*Coragyps atratus*	Observed
NOHA	northern harrier***	*Circus cyaneus*	Migration
SSHA	sharp-shinned hawk*	*Accipiter striatus*	Migration
COHA	Cooper's hawk**	*Accipiter cooperii*	Possible
RSHA	red-shouldered hawk***/**	*Buteo lineatus*	Possible
BWHA	broad-winged hawk	*Buteo platypterus*	Possible
RTHA	red-tailed hawk	*Buteo jamaicensis*	Probable
BAEA	bald eagle***	*Haliaeetus leucocephalus*	Observed
OSPR	osprey**	*Pandion haliaetus*	foraging
MERL	merlin	*Falco columbarius*	foraging
AM.KE	American kestrel*	*Falco sparverius*	foraging
WITU	wild turkey	*Meleagris gallopavo*	Confirmed
COMO	common moorhen	*Gallinula chloropus*	Possible
AMCO	American coot	*Fulica americana*	Wintering
VIRA	Virginia rail	*Rallus limnicola*	Possible
KILL	killdeer	*Charadrius vociferus*	Confirmed
GRYE	greater yellowlegs	*Tringa melanoleuca*	Migration
LEYE	lesser yellowlegs	*Tringa flavipes*	Migration
SOSA	solitary sandpiper	*Tringa solitaria*	Migration
SPSA	spotted sandpiper	*Actitis macularia*	Possible

AMWO	American woodcock	*Scolopax minor*	Probable
COSN	common snipe	*Gallopavo gallopavo*	Probable
LAGU	laughing gull	*Larus atricilla*	F/O
RBGU	ring-billed gull	*Larus delawarensis*	F/O
HEGU	herring gull	*Larus argentatus*	F/O
GBBG	great black-backed gull	*Larus marinus*	F/O
MODO	mourning dove	*Zenaida macroura*	Probable
RODO	rock dove	*Columba livia*	Probable
YBCU	yellow-billed cuckoo*	*Coccyzus americanus*	Probable
BBCU	black-billed cuckoo*	*Coccyzus erythrophthalmus*	Probable
GHOW	great-horned owl	*Bubo virginiana*	Probable
CONI	common nighthawk*	*Cordeiles minor*	foraging
CHSW	chimney swift*	*Chaetura pelagica*	foraging
RTHU	ruby-throated hummingbird	*Archilochus colubris*	Probable
BEKI	belted kingfisher	*Cerle alcyon*	Probable
RBWO	red-belied woodpecker	*Melanerpes carolinus*	Confirmed
YBSA	yellow-bellied sapsucker	*Sphyrapicus varius*	Wintering
DOWO	downy woodpecker	*Picoides pubescens*	Confirmed
HAWO	hairy woodpecker	*Picoides villosus*	Confirmed
NOFL	northern flicker*	*Colaptes auratus*	Confirmed
PIWO	pileated woodpecker	*Dryocopus pileatus*	Confirmed
EAWP	eastern wood pewee	*Contopus virens*	Confirmed
ACFL	Acadian flycatcher*	*Empidonax virescens*	Probable
WIFL	willow flycatcher*	*Empidonax traillii*	Probable
LEFL	least flycatcher*	*Empidonax minimus*	Probable
EAPH	eastern phoebe	*Sayornis phoebe*	Confirmed
GCFL	great-crested flycatcher*	*Myiarchus crinitus*	Probable
EAKI	eastern kingbird*	*Tyrannus tyrannus*	Probable
REVI	red-eyed vireo	*Vireo olivaceus*	Confirmed
WAVI	warbling vireo	*Vireo gilvus*	Confirmed
PHVI	Philadelphia vireo	*Vireo philadelphicus*	Migration
WEVI	white-eyed vireo	*Vireo griseus*	Probable
YTVI	yellow-throated vireo*	*Vireo flavifrons*	Probable
BHVI	blue-headed vireo*	*Vireo solitarius*	Probable
BLJA	blue jay	*Cyanocitta cristada*	Confirmed
AMCR	American crow	*Corvus brachyrhynchos*	Confirmed
FICR	fish crow	*Corvus ossifragus*	Probable
PUMA	purple martin	*Progne subis*	Probable
NWSW	northern rough-winged-swallow	*Stelgidopteryx serripennis*	Possible
TRSW	tree swallow	*Tachycineta bicolor*	Confirmed

BARS	barn swallow*	*Hirundo rustica*	Confirmed
TUTI	tufted titmouse	*Baeolophus bicolor*	Confirmed
BCCH	black-capped chickadee	*Poecile atricapilla*	Confirmed
RBNU	red-breasted nuthatch	*Sitta canadensis*	Wintering
WBNU	white-breasted nuthatch	*Sitta carolinensis*	Confirmed
BRCR	brown creeper	*Certhia americana*	Confirmed
CAWR	Carolina wren	*Thyrothorus ludovicianus*	Confirmed
HOWR	house wren	*Troglodytes aedon*	Confirmed
WIWR	winter wren*	*Troglodytes troglodytes*	Wintering
MAWR	marsh wren*	*Cistothorus palustris*	Probable
GCKI	golden crowned kinglet	*Rugulus satrapa*	Wintering
RCKI	ruby-crowned kinglet	*Rugulus calendula*	Migration
BGGN	blue-gray gnatcatcher	*Polioptila caerulea*	Probable
EABL	eastern bluebird	*Sialia sialis*	Probable
AMRO	American robin	*Turdus migratorius*	Confirmed
WOTH	wood thrush*	*Hylocichla mustelina*	Confirmed
VEER	veery*	*Catharus fuscescens*	Possible
SWTH	Swainson's thrush	*Catharus ustulatus*	Migration
GCTH	gray-cheeked thrush*	*Catharus minimus*	un-confirmed
HETH	hermit thrush	*Catharus guttatus*	Possible
GRCA	gray catbird*	*Dumetella carolinensis*	Confirmed
NOMO	northern mockingbird	*Mimus polyglottus*	Confirmed
BRTH	brown thrasher*	*Toxostoma rufum*	Confirmed
EUST	European starling	*Sturnus vulgaris*	Confirmed
CEDW	cedar waxwing	*Bombycilla cedrorum*	Confirmed
NOPA	northern parula*	*Parula americana*	Probable
TEWA	Tennessee warbler	*Vermivora peregrina*	Migration
BWWA	blue-winged warbler*	*Vermivora pinus*	Possible
NAWA	Nashville warbler	*Vermivora ruficapilla*	Migration
YEWA	yellow warbler	*Dendroica petechia*	Confirmed
CSWA	chestnut-sided warbler	*Dendroica pennsylvanica*	Confirmed
MAWA	magnolia warbler	*Dendroica magnolia*	Migration
BTEW	black-throated blue warbler*	*Dendroica caerulescens*	Migration
BLWA	blackburnian warbler*	*Dedroica fusca*	Migration
YRWA	yellow-rumped warbler	*Dendroica coronata*	Migration
BTNW	black-throated green warbler*	*Dendroica virens*	Possible
PRWA	prairie warbler*	*Dendroica discolor*	Possible
PAWA	palm warbler	*Dendroica palmarum*	Migration
PIWA	pine warbler*	*Dendroica pinus*	Possible
BPWA	blackpoll warbler	*Dendroica striatus*	Migration

BAWW	black and white warbler*	*Mniotilta varia*	Probable
WEWA	worm-eating warbler*	*Helmitheros vermivora*	Migration
AMRE	American redstart	*Setophaga ruticilla*	Confirmed
OVEN	ovenbird	*Seiurus aurocapillus*	Confirmed
NOWA	northern waterthrush	*Seiurus noveboracensis*	Probable
LOWA	Louisiana waterthrush*	*Seiurus motacilla*	Confirmed
KEWA	Kentucky warbler*	*Oporornis formosus*	Possible
COYE	common yellowthroat	*Geothlypis trichas*	Confirmed
CAWA	Canada warbler*	*Wilsonia canadensis*	Possible
HOWA	hooded warbler*	*Wilsonia citrina*	Possible
YBCH	yellow-breasted chat*	*Icteria virens*	Possible
SCTA	scarlet tanager*	*Piranga olivacea*	Confirmed
NOCA	northern cardinal	*Cardinalis cardinalis*	Confirmed
RBGR	rose-breasted grosbeak*	*Pheucticus ludovicianus*	Confirmed
BLGR	blue grosbeak	*Guiraca caerulea*	Possible
INBU	indigo bunting	*Passerina cyanea*	Confirmed
EATO	eastern towhee*	*Pipilo erythrophthalmus*	Confirmed
ATSP	American tree sparrow	*Spizella arborea*	Wintering
FISP	field sparrow *	*Spizella pusilla*	Probable
CHSP	chipping sparrow	*Spizella passerina*	Probable
GRSP	grasshopper sparrow**	*Ammodramus savannarum*	Possible
SASP	savannah sparrow**	*Passerculus sandwichensis*	Possible
WTSP	white-throated sparrow	*Zonotrichia albicollis*	Wintering
WCSP	white-crowned sparrow	*Zonotrichia leucophrys*	Migration
FOSP	fox sparrow	*Passerella iliaca*	Wintering
SOSP	song sparrow	*Melospiza melodia*	Confirmed
LISP	Lincoln's sparrow	*Melospiza lincolnii*	Migration
SWSP	swamp sparrow	*Melospiza georgiana*	Probable
DEJU	dark-eyed junco	*Junco hyemalis*	Wintering
BHCO	brown-headed cowbird	*Molothrus ater*	Probable
RWBB	red-winged blackbird	*Agelaius phoeniceus*	Confirmed
RUBB	rusty blackbird	*Euphagus carolinus*	Migration
COGR	common grackle	*Quiscalus quiscula*	Confirmed
BAOR	Baltimore oriole*	*Icterus galbula*	Confirmed
ORIOR	orchard oriole	*Icterus spurius*	Probable
PUFI	purple finch*	*Carpodacus purpureus*	Wintering
HOFI	house finch	*Carpodacus mexicanus*	Probable
AMGO	American goldfinch	*Carduelis tristis*	Confirmed
HOSP	house sparrow	*Passer domesticus*	Confirmed

***= New Jersey state-endangered bird species (breeding population)

** = New Jersey state-threatened bird species (breeding population & RSHA non-breeding)
* = New Jersey species of special concern
Highlighted in blue= observed in point-count breeding bird survey

Both species diversity and relative abundance proved to be high within the surveyed areas during the breeding, wintering, and spring and fall migration seasons in 2010. Observations during migration periods suggest that the Dismal Swamp is a critical habitat zone for migratory passerine, providing cover and foraging capabilities for numerous species as they migrate to and from breeding grounds. Some highlighted species which are solely migratory in the region include Philadelphia vireo, Swainson's thrush, blackpoll warbler, and blackburnian warbler. Species subject to regional and/or global declines that were observed during the breeding season include scarlet tanager, hooded warbler, and eastern towhee. A total of 26 wood warbler, 7 wading bird, 12 waterfowl, 12 raptor, 6 woodpecker, and 13 sparrow species illustrate the diversity of bird species and available habitat present within the Dismal Swamp.

As per the New Jersey Wildlife Action Plan (NJDEP, 2008), 5 state-endangered bird species, 4 state-threatened bird species, and 49 bird species of conservation concern were observed within the Dismal Swamp in 2010 by AES. Of these, 2 state-endangered bird species were observed during the breeding season (pied-billed grebe and red-shouldered hawk). Two state-threatened species were observed in the breeding season as well (Cooper's hawk and grasshopper sparrow). Of the 46 bird species of special concern observed, 22 were observed in the breeding season and have revealed either probable or confirmed breeding behavior. In addition to the observed species, there is potential/suitable breeding habitat for American bittern (state-endangered), barred owl (state-threatened), red-headed woodpecker (state-threatened), and yellow-crowned night heron (state-threatened).

4.3a Breeding Bird Survey

A total of 89 bird species were observed during point-count breeding bird surveys within the Dismal Swamp in May and June of 2010 (highlighted in blue in Table 3). Interior-forest breeding birds present onsite include ovenbird, hermit thrush, pileated woodpecker, and wood thrush. The most abundant breeding bird species within forested sections (interior forest, edge forest, woodlots) of the Dismal Swamp in 2010 were American robin, gray catbird, yellow warbler, and wood thrush. The most abundant breeding bird species within the open areas (grassland, emergent wetlands and shrublands) of the Dismal Swamp in 2010

Figure 13. Active killdeer nest with three eggs at Triple C Ranch. Photograph by Michael McGraw.

were red-winged blackbird, tree swallow, American goldfinch, and song sparrow.

4.4 Random Opportunistic Sampling/Time-Constrained Survey

Ten (10) site visits were conducted throughout 2010 where an AES biologist and/or ecologist conducted ROS and/or TCS. Surveys were conducted during both day and night and targeted all representative habitat types within the Dismal swamp. This study was designed to serve within a budget constraint and, therefore, was not a comprehensive approach. Due to this, an additional table of potentially-present herpetofauna is provided. Please see Summary and Recommendations section for detail. The following tables summate the observed vertebrate species within the Dismal Swamp during these investigations:

Table 4. Herpetofauna Observed by AES in the Dismal Swamp in 2010

Total Herpetofauna Observed within the Dismal Swamp in 2010

Common Name		Taxonomic Binomial	Observational Notes
Amphibians			
Salamanders	red-backed salamander	*Plethedon cinereus*	common throughout site
	northern two-lined salamander	*Eurycea bislineata*	in and along streams
Frogs	spring peeper	*Pseudacric c. crucifer*	most abundant calling frog species
	northern gray treefrog	*Hyla versicolor*	common throughout site
	wood frog	*Lithobates sylvatica*	localized breeding locations, but common onsite
	southern leopard frog	*Lithobates sphenocephala utricularia*	observed on open-canopied wetlands
	northern green frog	*Lithobates clamitans melanota*	fairly common
	bullfrog	*Lithbates catesbeiana*	only at larger bodies of water
Toads	American toad	*Bufo americana*	found sparsely calling in open-canopied wetlands
Reptiles			
Turtles	common snapping turtle	*Chelydra serpentina*	throughout site
	musk turtle	*Sternothorus odoratus*	observed at Helen Street Wetland
	redbely turtle	*Psuedemys rubiventris*	in Bound Brook and Helen Street
	eastern painted turtle	Chysemys p. picta	in Bound Brook, Triple C pond, and Helen Street
	red-eared slider	*Trachemys scripta elegans*	in Bound Brook, Triple C pond, and Helen Street
Snakes	northern brown snake	*Storeria dekayi*	observed in forested wetland in Deep Wood Tract
	eastern garter snake	*Thamnophis s. sirtalis*	throughout site
	northern watersnake	*Nerodia s. sipedon*	comon onsite, mostly along stream margins in sunny areas
	northern black racer	*Coluber c. constrictor*	hibernaculum located in South Plainfield Holdings

A total of eighteen (18) reptile and amphibian species were observed in 2010. Red-backed salamander (148 observations) (Figures 14 & 15) and northern spring peeper (approximately 300+ calling males) are the two most abundantly observed amphibian species. The red-backed salamander population within the Dismal Swamp is abundant and widely distributed throughout all available habitat types. Significant variation in color, age, and sex suggests a genetically diverse and healthy, functionally-reproducing

Figure 14. Juvenile red-backed salamander (red phase) found onsite. Photograph by Michael McGraw.

Figure 15. Adult red-backed salamander (lead phase) found onsite. Photograph by Michael McGraw.

population. The most commonly observed reptiles were painted turtle (21 observations) and eastern garter snake (13 observations).

A confirmed snake hibernaculum was located in the northern section of the South Plainfield Holdings Tract within a small, upland forest section. Observations (on October 8, 2010) resulting in a confirmation of this critical habitat included seven (7) adult northern black racers found basking within a 5m radius. Forest structure at the site includes a closed to partially-open canopy with dense woody understory on a sloped, southwest aspect, dominated by lowbush blueberry, sweet pepperbush, and highbush blueberry, from upland to lowland, respectively. The snakes were of varying age and size (approximately .75m to 2m in length), but all had adult coloring (all black with white chin). AES herpetologist, Michael McGraw, intentionally flushed (by passive approach, no contact) one of the snakes and observed its subsequent behavior. The snake, at first, rapidly moved in an opposite direction, then stopped and began to 'taste' the air (tongue flicking for chemo-receptive habitat recognition). The snake then began an intentional meander back towards the observer, with constant tongue flicking and probing of the soil and vegetation with its head. Upon recognition of an indiscriminant hole in the soil surface, the snake rapidly escaped down into the hole. The observer then repeated the same flushing process with another, much larger snake, with similar results, strongly suggesting communal denning at this location.

Due to the heterogeneity of habitat and the scale of the site, there are numerous herpetofaunal species that have potential to be present within the Dismal Swamp that were not observed by AES in 2010 (Table 5).

Table 5. List of Herpetofauna Potential to be Present within the Dismal Swamp that were not Observed in 2010

Herpetofaunal Species Not Observed, but Potentially Present within the Dismal Swamp			
Amphibians			
Salamanders	blue-spotted salamander***	*Ambystoma laterale*	just south of known range limit. Suitable habitat present onsite
	spotted salamander	*Ambystoma maculatum*	Suitable habtiat present onsite
	marbled salamander	*Ambystoma opaca*	Suitable habtiat present onsite
	northern red salamander	*Pseudotriton ruber*	Suitable habtiat present onsite
Frogs	New Jersey Chorus frog	*Pseudacris feriarum kalmii*	Survey in March for this species
	pickerel frog	*Lithobates palustris*	Suitable habtiat present onsite
Reptiles			
Turtles	spotted turtle*	*Glyptemys guttata*	very likely to be present. Abundant suitable habitat
	bog turtle***	*Glyptemys muhlenbergii*	potential habitat present in multiple locations
	wood turtle**	*Glyptemys insculpta*	very unlikely due to urbanization
	eastern box turtle*	*Terrapenne c. carolina*	should be present onsite
	eastern mud turtle	*Kinosternum s. subrubrum*	rare species, unlikely, but potentially present
Lizards	northern fence lizard	*Sceloporus undulatus hyacinthinus*	more abundant in the souther regions, but potential
	northern five-lined skink	*Eumeces fasciatus*	
Snakes	black rat snake	*Pantherophis alleghenensis*	if present, likely negatively impacted by surrounding land use
	milk snake	*Lampropeltis triangulum*	Likely present, especially in open and brushy habitat
	eastern ribbon snake	*Thamnophis s. sauritus*	likely present especially in open areas near water
	smooth earth snake	*Virginia v. valeriae*	very secretive, fossorial species
	eastern worm snake	*Carphophis a, amoenus*	in forested margins of water with much coarse woody debris
	northern redbelly snake	*Storeria o. occipitomaculata*	likely present
	northern ringneck snake	*Diadophis puncataus edwardsii*	likely present, especially in dump piles or any rocky areas

***= New Jersey state-endangered species
** = New Jersey state-threatened species
* = New Jersey species of special concern

economically, these animals are considered pests), discouraging dam-breaking, and promoting the subsequent habitat alteration associated with beaver activity should be exercised.

A significant and under-studied element regarding mammals at the Dismal Swamp is the bat diversity and abundance. The Dismal Swamp provides roost trees and ample foraging habitat for a variety of species. The location sits within a significant migration corridor for migratory bats, including the Federally Endangered and critically imperiled Indiana bat (*Myotis sodalis*). Suitable roost trees and habitat type are abundant onsite for this species and other bat species which are currently considered species of special concern (i.e. eastern red bat, eastern small-footed Myotis, and hoary bat). AES observed an abundance of bats during nocturnal surveys and strongly suggests a formalized bat survey be conducted to determine the critical value of the Dismal Swamp to these winged mammals.

4.5 Seeking Funding

AES performed an exercise to callout various funding source opportunities that may exist for the Dismal Swamp and Edison Wetland Association, considering the Diz's natural resources, land ownership/proprietorship variation, surrounding land-use (existing and proposed), and conservation goals set forth by EWA and other stakeholders. This is meant to be a general and brief review to hopefully trigger some pursuable avenues for the funding of future biological/ecological studies, habitat preservation, ecological/habitat restoration, educational program buy-in, and other conservation-based means to enhance and protect the existing Dismal Swamp. Please forgive any existing redundancies with ongoing funding efforts that may be present within the recommended funding/grant avenues provided in Section 9.3.

In addition to the numerous grant opportunities for the Dismal Swamp, many strategic partnership possibilities exist. These partnerships leverage the combined assets of all parties involved and strengthen the ability of the Edison Wetlands Association to garner funding as well as increase visibility and interest. Alliances with local groups and governments, such as schools and townships, provide a strong foundation for support. However, organizations such as Ducks Unlimited (DU) provide opportunities for funding through broader collaboration. Although DU does not provide funds through a direct grant process, it has access to monies for projects that are aligned with its conservation goals. Because one of DU's core objectives is the conservation of wetlands, it is an ideal partner for the Edison Wetlands Association. Another beneficial partnership may be with the Ramsar Convention on Wetlands of International Importance. This organization does not provide grants for project work, but is a global group that increases the awareness and protection of wetlands internationally. Designation as a wetland of international importance gives a wetland higher visibility and can many times lend priority in a grant award process. Ramsar does provide small grants to organizations such as Edison Wetlands Association for the preparation of designation application materials.

In the course of our herpetofaunal investigations, 17 confirmed mammal species were observed (Table 6) within the Dismal Swamp in 2010.

Table 6. Total Mammal Species Observed Within the Dismal Swamp in 2010

Mammals Observed within the Dismal Swamp in 2010			
Common Name		**Taxonomic Binomial**	**Observational Notes**
Mammals			
Small Mammals	eastern white-footed mouse	*Peromyscus leucopus*	throughout site
	meadow vole	*Mictorus pennsylvanicus*	wet meadow at Triple C Ranch. Observed predation by nothern harrier
	northern short-tailed shrew	*Blarina bervicauda*	throughout site
	eastern chipmunk	*Tamias striatus*	throughout site
	southern flying squirrel	*Glaucomys volans*	observed at night in southern section of Deep Woods Tract
	eastern gray squirrel	*Sciurus carolinensis*	throughout site
	eastern red bat*	*Lasiurus borealis*	foraging at dusk at forest edges
	unidentified bat species	*??*	foraging within the canopy, low to the ground, in the Deep Woods Tract
	unidentified bat species	*??*	foraging above the canopy and at forest edges at night
Medium Mammals	oppossum	*Didelphis virginiana*	throughout site
	eastern cottontail rabbit	*Sylvilagus floridanus*	mostly in open canopied shrublands and wetlands
	striped skunk	*Mephitis mephitis*	throughout site
	raccoon	*Procyon lotor*	throughout site
	American beaver	*Castor canadensis*	common along Bound Brook and larger tributaries
	woodchuck	*Marmota monax*	in fields and near buildings
	muskrat	*Ondatra zibethicus*	common along Bound Brook and larger tributaries
	red fox	*Vulpes vulpes*	throughout site
Large Mammals	white-tailed deer	*Odocoileus virginiana*	throughout site
	eastern coyote	*Canis latrans*	observed in Deep Woods Tract at night

*= New Jersey species of special concern

A total of seventeen (17) confirmed mammal species were observed in 2010 by AES. The most commonly observed mammal species in 2010 were eastern gray squirrel and white-tailed deer. Every nocturnal survey revealed active skunk, opossum, and raccoon. On one evening, both southern flying squirrel and eastern coyote were observed within the Deep Woods Tract. White-footed mouse, short-tailed shrew, and meadow vole were all observed in low frequencies (1-5 observations per species). However, numerous nests and shelters were found while searching for herpetofauna and it is likely that each of these species is relatively abundant within the respective, preferred habitat types. American beaver activity is present along the Bound Brook and some of the larger tributary streams. Margins of the Helen Street Wetland show significant historical and current tree girdling, lodge, and dam management. The American beaver plays a critical role in the habitat heterogeneity and successional dynamics within the Dismal Swamp. Its continued role likely contributes to the sustained suitable habitat types for both spotted and bog turtle onsite. Efforts to prevent beaver killing (culturally and

5. Discussion

AES conducted an ecological assessment, coupled with two biological survey methods to determine the general ecological health of the Dismal Swamp and simultaneously initiate the first of a series of studies to determine the floral and faunal composition of the Dismal Swamp. Based on our preliminary assessment, AES believes that the Dismal Swamp is an extremely valuable ecological resource. Efforts to minimize degradation and ensure its conservation in perpetuity are of the utmost importance.

Suitable habitats for New Jersey state-threatened spotted turtle, state-endangered bog turtle, and state-endangered blue-spotted salamander are all present onsite. Additionally, suitable breeding habitat for a variety of NJ state-threatened and endangered bird species is present, including: red-shouldered hawk (breeding-endangered), barred owl (threatened), yellow-crowned night heron (threatened), Cooper's hawk (threatened), pied-billed grebe (breeding-endangered), American bittern (breeding-endangered) and least bittern. In addition to critical breeding habitat, the Dismal Swamp provides critical roosting and foraging habitat for bats and migratory birds, specifically: neo-tropical passerine, waterfowl, wading birds, raptor, shorebirds, and goatsuckers. Current open space habitats connected to or part of the Dismal Swamp support grassland bird species in migration, support Lepidopterids (butterflies) and Orthopterids (grasshoppers), and likely provide key foraging and basking areas for snakes.

From a habitat patch perspective, the Dismal Swamp provides a suitable, contiguously forested area to support interior forest birds. This resource is limited in this highly developed/urbanized region of New Jersey and should be considered extremely valuable in this regard.

A plethora of unconfirmed vernal pool ecosystems are present within the forested and open-canopied habitats in the Dismal Swamp. This study has validated some vernal pools by virtue of breeding wood frogs (vernal pool-obligate breeder) observed. Additional studies should be conducted to determine the potential presence of other vernal pool-obligate breeding vertebrates, such as marbled (*Ambystoma opacum*), spotted (*Ambystoma maculatum*), and blue-spotted salamanders (*Ambystoma laterale*) as well as search effort for rare plants and invertebrates associated with these and other wetland community types present onsite.

Figure 16. Open woodland and floodplain wetland along Bound Brook. This habitat can support rare turtles and a variety of habitat-specific breeding birds. Photograph by Michael McGraw.

6. Summary and Recommendations

6.1 Summary

In conducting this preliminary ecological assessment and accompanied biological surveys, AES has developed an understanding of the vegetation and animals that inhabit the Dismal Swamp. Of equal importance, we have gained a perspective of the hydrological dynamics that exist within the Swamp.

These study efforts were conducted on a limited budget and only constitute a portion of a desired comprehensive analysis. As funds become available, AES strongly suggest the implementation of continued biological and ecological assessment methods to best understand the Diz in its current state. This is the foundation for all key decision making within the Dismal Swamp moving forward, as its natural features are surely what sets this location above many. At the same time, the natural communities are most vulnerable, given surrounding land-use pressure, and warrant recognition for preservation, restoration, and protection.

Below is a list of recommended actions to be taken at the Dismal Swamp to protect, enhance, and share this resource with the neighboring communities and beyond.

6.2 Recommendations

- Build upon limited ecological investigations conducted to date through a more detailed Natural Resource Inventory (NRI) in conjunction with:
- Corresponding study of vernal pools and potential vernal pools and water quality in vernal pools and potential vernal pools:
    - Study of confirmed and potential vernal pools – There are many areas which exhibit potential vernal pool conditions. Such areas should be mapped in conjunction with NRI work from this report and any potential ongoing NRI studies in 2011.
    - Characterize vernal pools within the Dismal Swamp to develop a standardized set of protocols implementable throughout NJ. This would be an enhancement of existing vernal pool certification protocols.
    - Call out and search for appropriate indicator species.
    - Analyze water samples from chosen wetlands for appropriate chemical parameters
    - Conduct scientifically valid study to determine correlation of chemical parameters and absence or presence of indicator species.
    - Formalize the study to establish reliable studies for quantifying the health of vernal pools (and other temporary waters).
    - Publish "Dismal Swamp Standards" to be used for vernal pool analysis, characterization and restoration in Dismal Swamp and other areas containing both natural and man-induced vernal pool conditions.
- Conduct a study of adjacent upland inputs (primarily surface water and, secondarily, groundwater) via a mapping analysis of surrounding properties. The purposes of this study are to: identify the most serious negative inputs and establish a feasible remediation plan: encourage obligate "polluters" – such as industrial firms, developments with much impervious

surface, etc. – to remediate with appropriate bioremediation systems (BMPs) on their sites; alternatively, identify areas near the edges but within the defined Dismal Swamp natural area where vegetation-based infiltration/filtration systems (BMPs) could be installed.

- Devise a conceptual communication-signage program with a focus on educational signage, along with way-finding signage and permitted/not-permitted use signage. Include a plan for demarking areas of ecological sensitivity, as well as inherent danger. Comprise a list of "The Key Rules of the Dismal Swamp" to be posted in appropriate areas.
- Move forward with trail and associated amenity planning. Carefully considered and located trails will offer visitors meaningful opportunities to discover and explore interesting areas of the Dismal Swamp. At the same time, well-marked trails, along with effective signage, will contribute greatly to keeping visitors on the trails and out of the many ecologically sensitive areas located throughout the Dismal Swamp.
- Devise an ecological improvement plan for the area on and near the Triple C Ranch. Such a plan will help make the Triple C Ranch more of a destination and showcase the Triple C Ranch as exemplary, ecologically, setting the tone for the rest of the Dismal Swamp.
- Utilize results of above studies to prepare a preliminary priority-based Restoration Plan and Long-Term Management Plan. Included in these plans would be a list of feasible, low-cost activities that can be carried out by volunteers.
- Establish a program for involving public schools, private schools, and universities with various issues and aspects of the Dismal Swamp.
- Take all relevant data/information on the Dismal Swamp, including the "Master Plan," this report, and deliverables resulting from the above recommendations and produce a refined "Priority Plan" that focuses on realistic actions that can be taken or begun over the next decade
- Use key findings to support a more focused effort on fund/grant-raising opportunities.
- Develop invasive species management protocols specific to plant and insect species and also site-specific plans to manage existing populations of invasive species within the Dismal Swamp
- Incorporate faunal and vegetative communities information within this report into the design, alignment, and experience of any future trail construction or guided ecological tours.
- Review NJDEP Wildlife Action Plan for Northern Piedmont Plains (NJDEP 2008). Incorporate section d. Conservation Goals and section e. Conservation Actions into the master planning and management of the Dismal Swamp where appropriate.

Recommended Additional Surveys

- Conduct nocturnal breeding bird survey to target barred owl, and whip-poor-will.
- Conduct breeding marsh bird survey to determine breeding status of rails, grebes, and bitterns onsite.
- Conduct breeding wading bird survey to determine the presence or absence of breeding wading birds onsite.
- Conduct nesting raptor surveys specific for Cooper's hawk (NJ state-Threatened breeder) and red-shouldered hawk (NJ state-Endangered breeder).
- Establish a long-term approach to monitoring migratory and breeding birds through volunteer efforts with professional oversight.
- Conduct formal migratory songbird studies.
- After coordination with New Jersey DEP Endangered and Non-game Species Division, conduct Phase II (and possible Phase III) survey methods for bog turtle within onsite suitable and marginal habitats.
- Continue Amphibian Calling Surveys every year. Expand upon initial design to deploy multiple observers throughout the Dismal Swamp for simultaneous and comprehensive survey effort.
- Coordinate with North American Amphibian Monitoring Program (NAAMP) to enlist skilled volunteer assistance with long-term amphibian monitoring at the Dismal Swamp
- Engage research projects at the peer-reviewed/academic level through population biology studies such as:

    - Conduct long-term terrestrial vertebrate study through random stratified coverboard deployment.
    - After recognition of existing threatened and/or endangered species, conduct population study and long-term monitoring efforts. For animals, this may include radio-telemetry.
    - Engage in deer exclusion studies to further investigate seed banking and restoration efforts.

- Conduct threatened and endangered plant species surveys, targeting wetland-associated herbaceous/forb species.
- Conduct active acoustic monitoring for bat species populations within the Dismal Swamp.
- Conduct site-specific multi-criteria surveys focusing on at-risk sensitive areas.

7. Referenced Literature

Altomari C., Mark Gallagher, and Michael Rehman. 2009. Dismal Swamp Watershed Management Plan. Edison Wetlands Association. February 2009.

Barry, Simon C. and A. H. Welsh. 2001. Distance Sampling Methodology. Journal of the Royal Statistical Society. Series B (Statistical Methodology), Vol. 63, No. 1 (2001), pp. 31-53

Blair, W. F. 1961. Calling and spawning seasons in a mixed population of anurans. *Ecology*, **42**, 99–110.

Conant, R. and J.T. Collins. 1991. A Field Guide to Reptiles and Amphibians: Eastern and Central North America. Third edition. Houghton Mifflin Company, Boston, Massachusetts.

deMaynadier, P. G., and M. L. Hunter Jr. 1995. The relationship between forest management and amphibian ecology: a review of the North American literature. Environmental Review 3:230-261.

Dupuis, L., J. N. M. Smith, and F. Bunnell. 1995. Relation of terrestrial- breeding amphibian abundance to tree-stand age. Conservation Biology 9:645-653

Ernst, Carl H. and Ernst, Evelyn M. 2003. Snakes of the United States and Canada

Farnsworth et al 2002. A Removal Model for Estimating Detection Probabilities from Point-Count Surveys. The Auk, Vol. 119, No. 2 (Apr., 2002), pp. 414-425

Haxton, Tim and Berrill , Michael. 2001. Seasonal Activity of Spotted Turtles (Clemmys guttata) at the Northern Limit of Their Range. Journal of Herpetology, Vol. 35, No. 4 (Dec., 2001), pp. 606-614 Published by: Society for the Study of Amphibians and Reptiles

Hulse, C. and McCoy, C.J., 1998. Amphibians and Reptiles of Pennsylvania and the Northeast.

Kenney and Burne. 2001. Salamanders, Frogs, and Turtles of New Jersey's Vernal Pools, NJDEP, Division of Fish and Wildlife, Endangered and Nongame Species Program, circa 2001 (no date specified).

Kenney and Burne. 2009. A Field Guide to the Animals of Vernal Pools, Natural Heritage & Endangered Species Program, MA Division of Fisheries & Wildlife, 2009.

Knutson, M. G., Sauer, J. R., Olsen, D. A., Mossman, M. J., Hemesath, L. M., and Lannoo, M. J. 1999. Effects of landscape composition and wetland fragmentation on frog and toad abundance and species richness in Iowa and Wisconsin, U.S.A. *Conservation Biology*, **13**, 1437–46.

Martof, B. S. 1953. Territoriality in the green frog, *Rana clamitans*. *Ecology*, **34**, 165–74.

NJDEP. 2008. New Jersey Wildlife Action Plan. Section F - Priority Conservation Zones, Assessments, and Strategies within the Piedmont Plains. New Jersey Department of Environmental Protection

Parnell, James F., David G. Ainley, Hans Blokpoel, Brian Cain, Thomas W. Custer, Julian L. Dusi, Stephen Kress, James A. Kushlan, William E. Southern, Lynne E. Stenzel, Bruce C. Thompson. 1988.

Colonial Waterbird Management in North America. Colonial Waterbirds, Vol. 11, No. 2 (1988), pp. 129-169

Rittenhouse, Tracy A. G., Meaghan C. Doyle, C. Rachel Mank, Betsie B. Rothermel, Raymond D. Semlitsch. 2004. Substrate Cues Influence Habitat Selection by Spotted Salamanders. The Journal of Wildlife Management, Vol. 68, No. 4 (Oct., 2004), pp. 1151-1158

Royle, J. Andrew and James D. Nichols. 2003. Estimating Abundance from Repeated Presence-Absence Data or Point Counts. Ecology, Vol. 84, No. 3 (Mar., 2003), pp. 777-790

Sibley, David A. 2000. The Sibley Guide to Birds. National Audubon Society. First Edition. Published by Chanticleer Press, Inc. 544 p.

Shirose, Leonard J., C. A. Bishop, D. M. Green, C. J. MacDonald, R. J. Brooks, & N. J. Helferty. 1997. Validation Tests of an Amphibian Call Count Survey Technique in Ontario, Canada. Herpetologica, Vol. 53, No. 3 (Sep., 1997), pp. 312-320

Stewart, George D. and Bellis, Edward D.. 1970. Dispersion Patterns of Salamanders along a Brook. Copeia, Vol. 1970, No. 1 (Mar. 2, 1970), pp. 86-89

Schwartz and Golden. 2002. Field Guide to Reptiles and Amphibians of New Jersey, NJ Division of Fish and Wildlife, 2002.

Tennant, Alan, 2003. Snakes of North America; Eastern and Central Regions

Ward, F. Prescott; Hohmann, Carl J.; Ulrich, Jeffrey F.; Hill, Steven E.. 1976. Seasonal Microhabitat Selections of Spotted Turtles (Clemmys guttata) in Maryland Elucidated by Radioisotope Tracking. Herpetologica, Vol. 32, No. 1 (Mar., 1976), pp. 60-64

Weber, Thomas P.; Houston, Alasdair I.; Ens, Bruno J.. 1999. Consequences of Habitat Loss at Migratory Stopover Sites: A Theoretical Investigation. Journal of Avian Biology, Vol. 30, No. 4 (Dec., 1999), pp. 416-426

Weir, L. A. and Mossman, M. J. 2005. North American amphibian monitoring program (NAAMP). In M. Lannoo (ed.), *Amphibian Declines: The Conservation Status of United States Species*, pp. 307–13. University of California Press, Berkeley, CA.

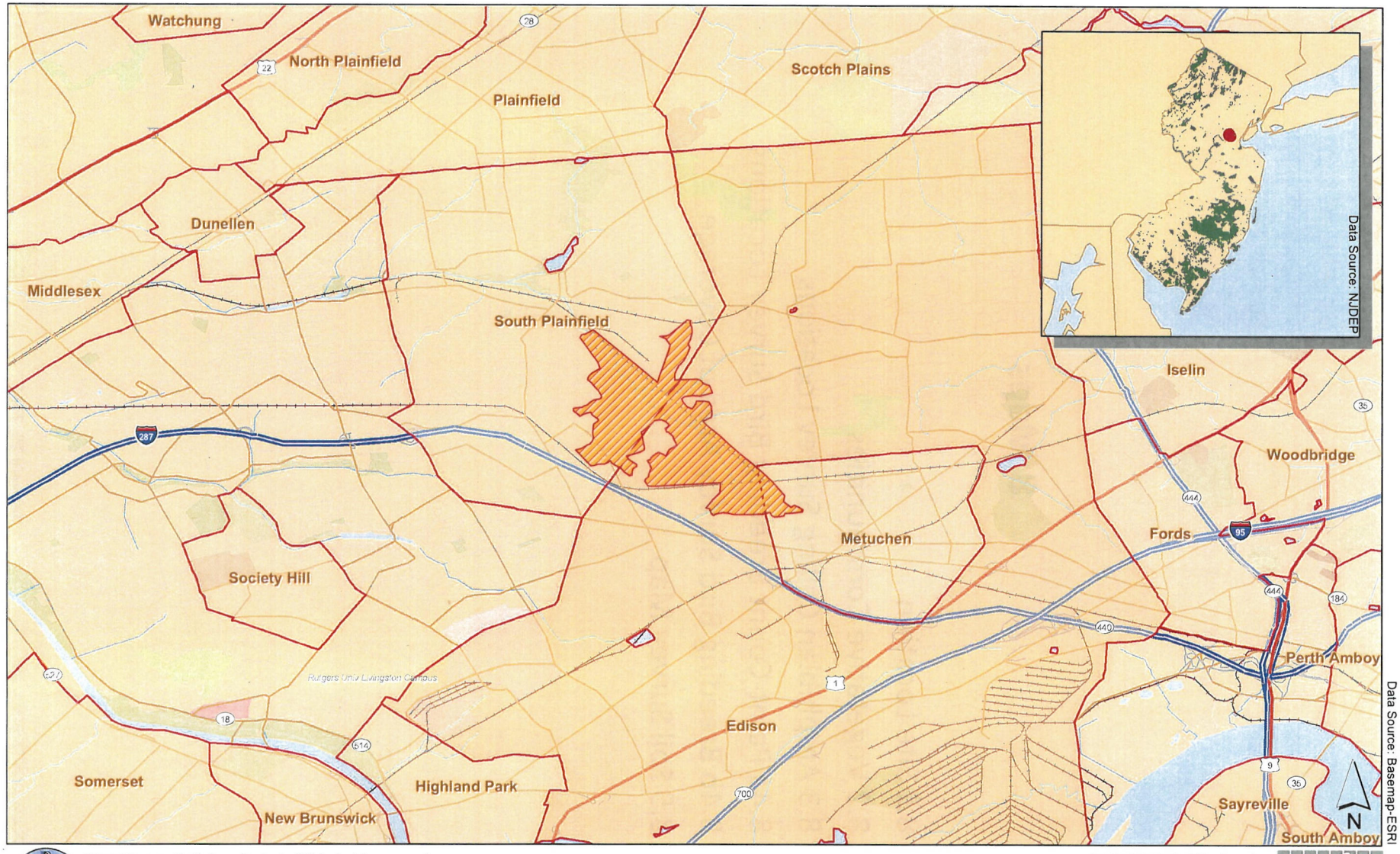
Weir, L. A., Royle, J. A., Nanjappa, P., and Jung, R. E. 2005. Modeling anuran detection and site occupancy on North American Amphibian Monitoring Program (NAAMP) routes in Maryland. *Journal of Herpetology*, **39**, 627–39.

Welsh Jr., Hartwell H. and Droege, Sam. 2001. A Case for Using Plethodontid Salamanders for Monitoring Biodiversity and Ecosystem Integrity of North American Forests. Conservation Biology, Vol. 15, No. 3 (Jun., 2001), pp. 558-569

Woolbright, L. L. 1985. Patterns of nocturnal movement and calling by the tropical frog, *Eleutherodactylus coqui*. *Herpetologica*, **41**, 1–9.

8. Maps

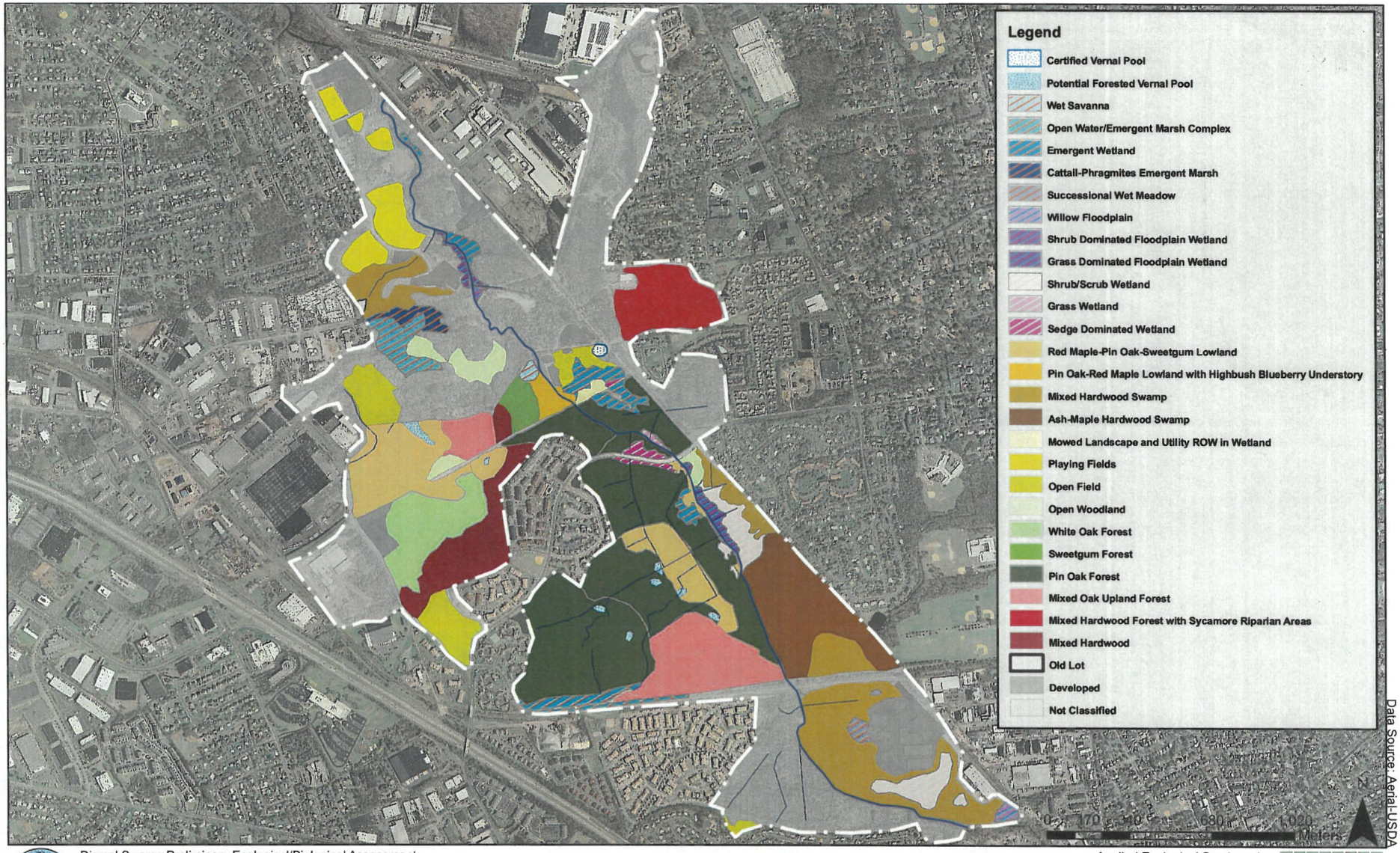
8.1 Site Location



Dismal Swamp Preliminary Ecological/Biological Assessment
206 Tyler Road
Edison, NJ 08820
www.edisonwetlands.org

Applied Ecological Services, Inc
1100 E. Hector Street #398
Conshohocken, PA 19428
www.appliedeco.com

8.2 Vegetation Map



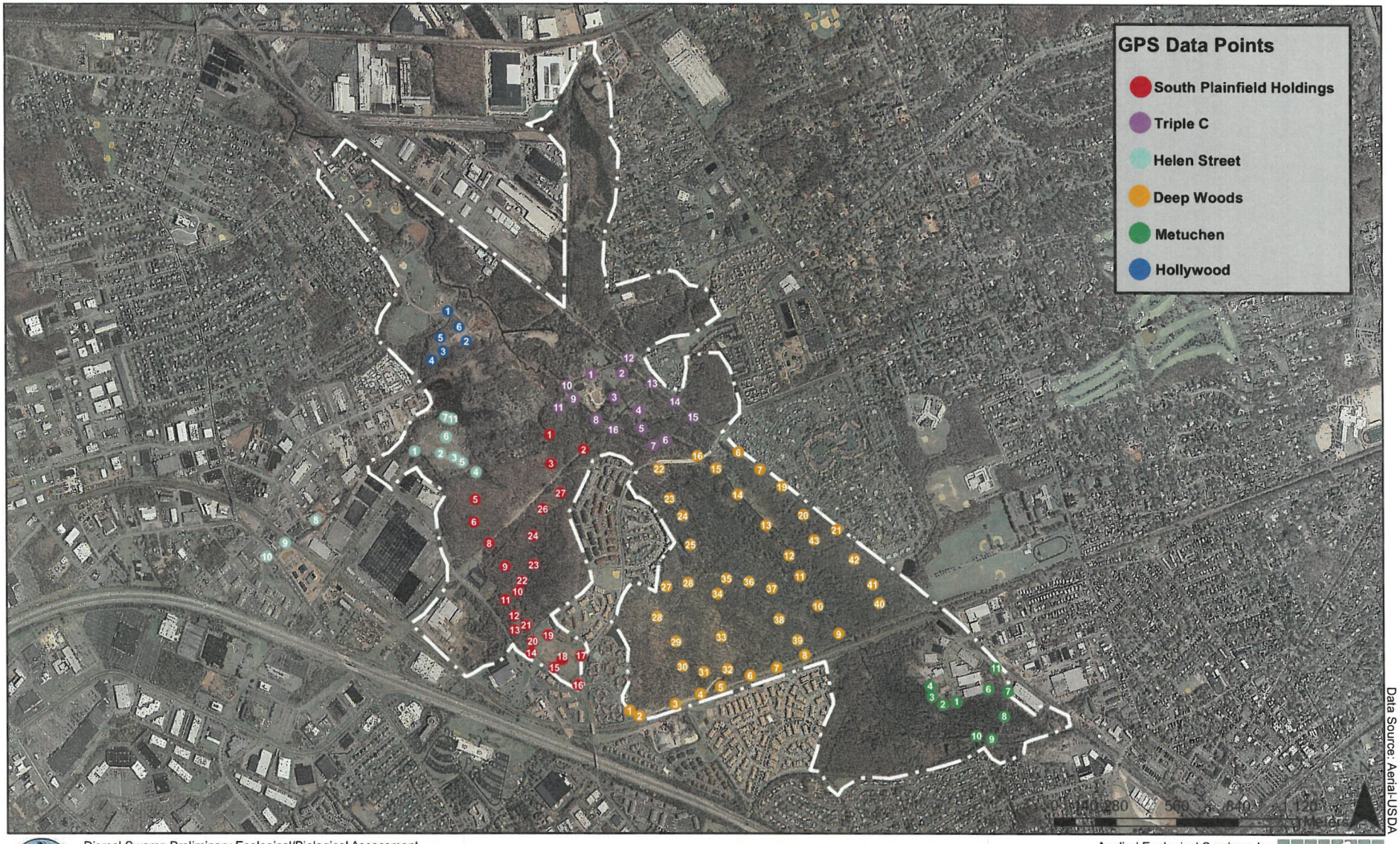
8.3 Amphibian Calling Survey

Data Source: Aerial-USDA

Dismal Swamp Preliminary Ecological/Biological Assessment
206 Tyler Road
Edison, NJ 08820
www.edisonwetlands.org

Applied Ecological Services, Inc
1100 E. Hector Street #398
Conshohocken, PA 19428
www.appliedeco.com

8.4a Point-Count Breeding Bird Survey

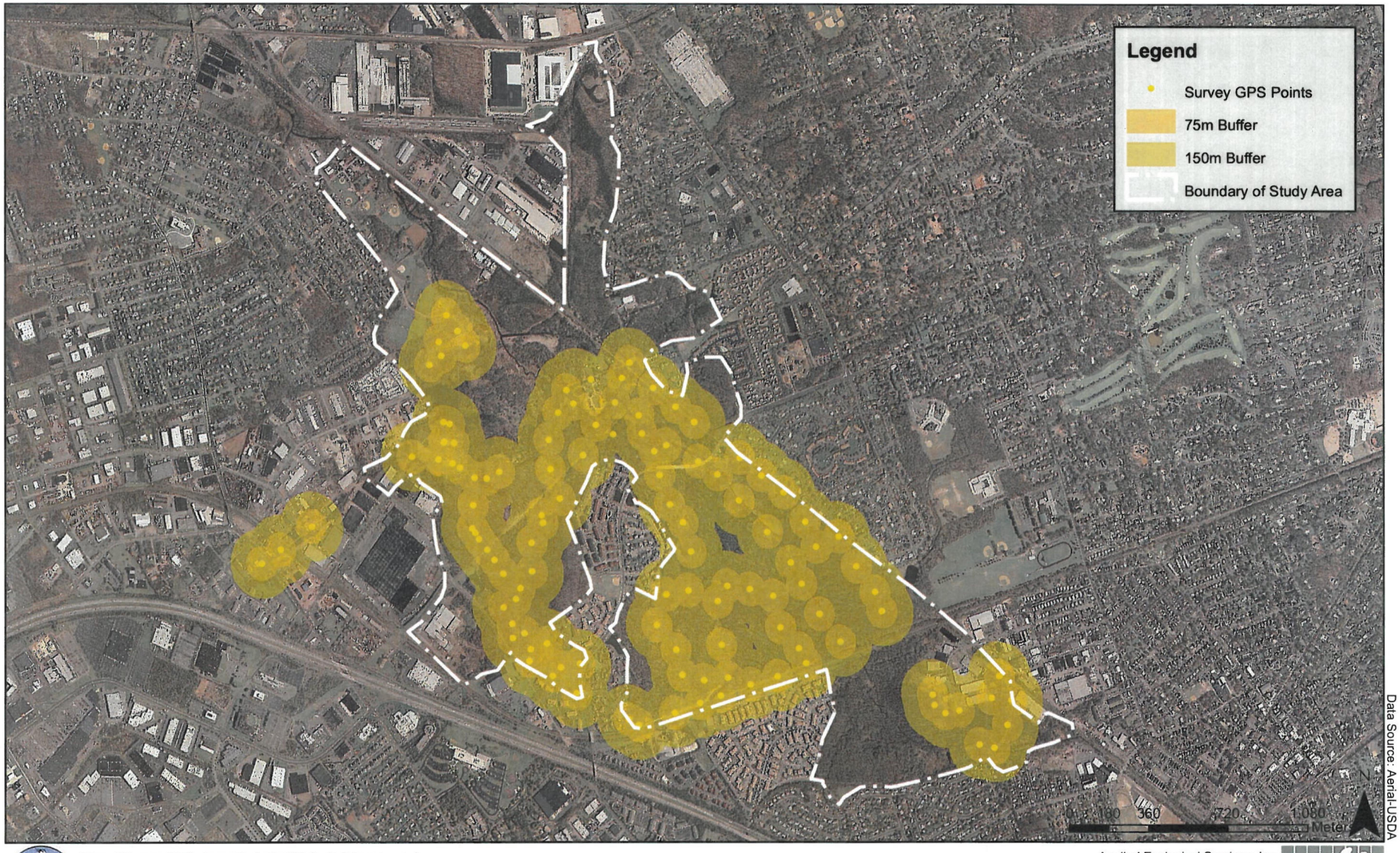


Dismal Swamp Preliminary Ecological/Biological Assessment
206 Tyler Road
Edison, NJ 08820
www.edisonwetlands.org

Applied Ecological Services, Inc
1100 E. Hector Street #398
Conshohocken, PA 19428
www.appliedeco.com

48

8.4b Point-Count Breeding Bird Survey Area of Coverage

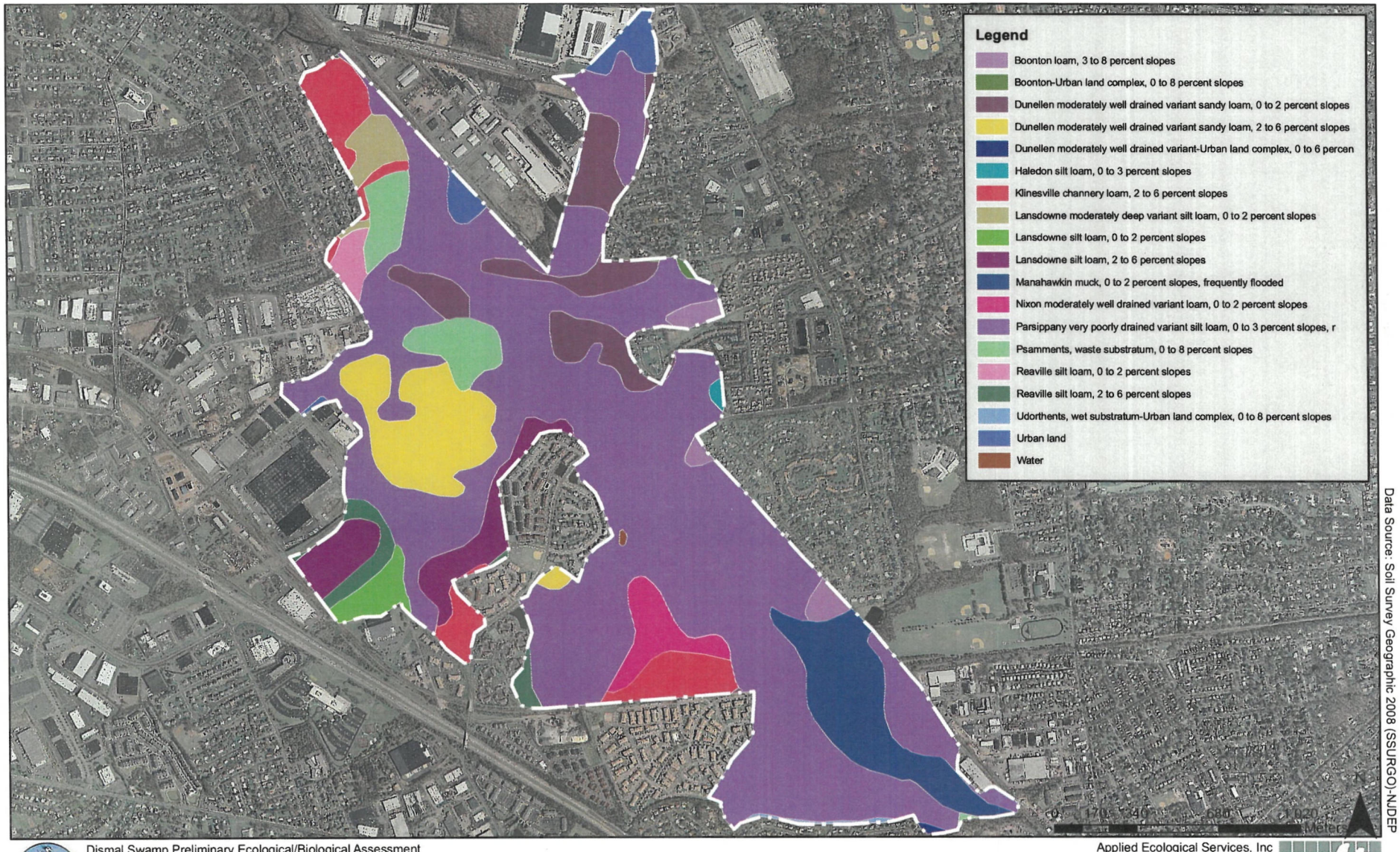


Data Source: Aerial-USDA

Dismal Swamp Preliminary Ecological/Biological Assessment
206 Tyler Road
Edison, NJ 08820
www.edisonwetlands.org

Applied Ecological Services, Inc
1100 E. Hector Street #398
Conshohocken, PA 19428
www.appliedeco.com

8.5 Soil Survey Map



Data Source: Soil Survey Geographic 2008 (SSURGO)-NJDEP

Dismal Swamp Preliminary Ecological/Biological Assessment
206 Tyler Road
Edison, NJ 08820
www.edisonwetlands.org

Applied Ecological Services, Inc
1100 E. Hector Street #398
Conshohocken, PA 19428
www.appliedeco.com

9. Data Sheets

Amphibian Calling Survey Data Sheet Summary

Point-Count Breeding Bird Survey Data Sheet Summary (*to be provided separately*)

Location	Description	Date	Species	Calling Intensity	Ambient Temp (°C)	Ambient Rel Humidity (%)	Surface Temp (°C)	Surface RH (%)	Soil (°C)	Wind (Beaufort Wind Scale)	Precipitation (coded)	Additonal Notes
1	Parking lot at end of Orosz Blvd next to Phragmites-invaded marsh.	4/1/2010	*Pseudacris c. crucifer*	3	18.4	52	21.1	60	13.6	1	0	Humid, Warm
		4/14/2010	*Pseudacris c. crucifer*	2	14.1	40	14	62	14.6	1	0	Cool, but humid
		5/7/2010	*Pseudacris c. crucifer*	2	21.7	43	20.3	65	16.4	0	0	Overcast, Warm
		5/7/2010	*Hyla versicolor*	2								
2	Along railroad trail at emergent vegetation wetland (Phragmites-dominated)	4/1/2010	*Psuedacris c. crucifer*	1	18.4	52	21.1	50	13.6	1	0	
		4/14/2010	*no frogs calling*	N/A	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Hyla versicolor*	1	21.7	43	20.3	65	16.4	1	0	
3	Sedge wetland at trail dead-end/ open-canopied	4/1/2010	*Pseudacris c. crucifer*	1	18.4	52	19.4	57	12.8	1	0	
		4/14/2010	*no frogs calling*	N/A	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Hyla versicolor*	1	21.7	43	20.3	65	16.4	0	0	
4	Ditch in ATV trail in Deep Woods Tract	4/1/2010	*Lithobates sylvatica*	1	18.3	52	19.4	57	12.8	0	0	WOFR egg masses present
		4/14/2010	*no frogs calling*	N/A	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Hyla versicolor*	2	21.7	43	20.3	65	16.4	0	0	
5	Ditch in ATV trail in Deep Woods Tract	4/1/2010	*Lithobates sylvatica*	1	18.3	52	19.4	57	12.8	0	0	WOFR egg masses present
		4/14/2010	*no frogs calling*	N/A	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Hyla versicolor*	2	21.7	43	20.3	65	16.4	0	0	
6	Forested wetland complex in central Deep Woods Tract	4/1/2010	*Psuedacris c. crucifer*	1	18	52	20.7	51	12.9	0	0	
		4/14/2010	*no frogs calling*	N/A	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Psuedacris c. crucifer*	1	21.7	43	20.3	65	16.4	0	0	
		5/7/2010	*Hyla versicolor*	N/A								
7	Father east in same complex as ACS# 6	4/1/2010	*no frogs calling*	N/A	18.1	51	20.6	50	12.6	0	0	
		4/14/2010	*no frogs calling*	N/A	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Lithobates clamitans melanata*	2	21.7	43	20.3	65	16.4	0	0	
8	Forested wetland complex in central Deep Woods Tract	4/1/2010	*Lithobates sylvatica*	2	17.5	54	20.1	57	12.4	0	0	WOFR egg masses present
		4/14/2010	*no frogs calling*	N/A	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Lithobates clamitans melanata*	1						0	0	
9	Potential vernal pool in southeast section of Deep Woods Tract	4/1/2010	*no frogs calling*	N/A	17.3	53	20.1	55	12.5	0	0	
		4/14/2010	*Bufo americana*	1	14.1	40	14	62	14.6	1	0	
		5/7/2010	*no frogs calling*	N/A	21.7	43	20.3	65	16.4	0	0	
10	Next to pond at Triple C Ranch	4/1/2010	*Pseudacris c. crucifer*	2						0	0	
		4/14/2010	*no frogs calling*	N/A	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Lithobates clamitans melanata*	1	21.7	43	20.3	65	16.4	0	0	
			Lithobates catesbeiana	1						0	0	
11	Northern sectionof wet meadow at Triple C Ranch	4/1/2010	*Pseudacris c. crucifer*	2	17.3	53	20.1	55	12.5	0	0	
		4/14/2010	*Psuedacris c. crucifer*	1	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Lithobates clamitans melanata*	2	21.7	43	20.3	65	16.4	0	0	
		5/7/2010	*Lithobates sphenocephala utricularia*	1						0	0	
12	Vernal pool in northeast section of Triple C Ranch	4/1/2010	*Lithobates sylvatica*	2	16.4	52	20.1	58	12.5	0	0	
		4/14/2010	*no frogs calling*	N/A	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Hyla versicolor*	2	21.5	44	20.1	66	16.4	0	0	
13	Along path intersecting wet meadow at Triple C Ranch	4/1/2010	*Pseudacris c. crucifer*	3	15.7	53	19.5	55	12.5	0	0	
		4/14/2010	*Pseudacris c. crucifer*	1	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Lithobates clamitans melanata*	2	18.3	38	17.8	67	17.3	0	0	
		5/7/2010	*Lithobates sphenocephala utricularia*	1								
14	Along Bound Brook in pin oak forest at Triple C Ranch	4/1/2010	*no frogs calling*	N/A	15.5	53	19.5	55	12.5	0	0	
		4/14/2010	*Bufo americana (distant)*	1	14.1	40	14	62	14.6	1	0	
		5/7/2010	*no frogs calling*	N/A	18.3	38	17.8	67	17.3	0	0	
15	In open-canopied wetland within pin oak forest at Triple C Ranch	4/1/2010	*no frogs calling*	N/A	14.5	65	12.6	87	12.5	0	0	
		4/14/2010	*Bufo americana*	1	14.1	40	14	62	14.6	1	0	
		5/7/2010	*L. c. melanata*	1	18.3	38	17.8	67	17.3	0	0	
16	Along abandoned rail line near channelized ditches supporting wetland vegetation	4/1/2010	*Pseudacris c. crucifer*	2	14.5	65	12.6	87	12.5	0	0	
		4/14/2010	*no frogs calling*	N/A	14.1	40	14	62	14.6	1	0	
		5/7/2010	*no frogs calling*	N/A	18.3	38	17.8	67	17.3	0	0	
17	Similar to ACS# 16 but farther south	4/1/2010	*Psuedacris c. crucifer*	2	14.5	65	12.6	87	12.5	0	0	
		4/14/2010	*Lithobates sphenocephalautricularia*	1	14.1	40	14	62	14.6	1	0	
		5/7/2010	*no frogs calling*	N/A	21.7	43	20.3	65	16.4	0	0	
18	South of Talmadge Bridge on abandoned rail line. Near larger ruts in path holding water and wetland vegetation.	4/1/2010	*Pseudacris c. crucifer*	1	14.5	65	12.6	87	12.5	0	0	
		4/14/2010	*Lithobates clamitans melanota*	1	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Lithobates clamitans melanata*	2	21.7	43	20.3	65	16.4	0	0	
19	At edge of shrub wetland/forested wetland ecotone.	4/1/2010	*no frogs calling*	N/A	14.5	65	12.6	87	12.5	0	0	
		4/14/2010	*no frogs calling*	N/A	15.2	45	15.8	66	15.2	1	0	
		5/7/2010	*Hyla versicolor*	2	21.7	43	20.3	65	16.4	0	0	
20	Within hardwood swamp near open water with emergent vegetation in margins.	4/1/2010	*no frogs calling*	N/A	13.9	65	12.3	92	12.2	0	0	
		4/14/2010	*no frogs calling*	N/A	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Hyla versicolor*	2						0	0	
21	At edge of open water/ marsh complex at Helen St. Wetland.	4/1/2010	*Psuedacris c. crucifer*	3	13.9	65	12.3	92	12.2	0	0	
		4/1/2010	*Lithobates sylvatica*	1						0	0	(from south in forest)
		4/14/2010	*Pseudacris c. crucifer*	1	14.1	40	14	62	14.6	1	0	
		4/14/2010	*Lithobates clamitans melanata*	0						0	0	
		5/7/2010	*Pseudacris c. crucifer*	2	21.7	43	20.3	65	16.4	0	0	
		5/7/2010	*Hyla versicolor*	3						0	0	
		5/7/2010	*Lithobates clamitans melanata*	3						0	0	
		5/7/2010	*Lithobates sphenocephala*	2						0	0	
		5/7/2010	*Lithobates catesbeiana*	2						0	0	
22	Closed canopy vernal pool at junction of Woodbrook Rd., Quincy Place, and South Plainfield Holdings (within SPH).	4/1/2010	*Lithobates sylvatica*	2	13.9	65	12.3	92	12.2	0	0	Already significant egg mass deposits
		4/14/2010	*no frogs calling*	N/A	14.1	40	14	62	14.6	1	0	
		5/7/2010	*no frogs calling*	N/A	21.7	43	20.3	65	16.4	0	0	
23	Potential vernal pool loaction at margin of Visco II Tract	4/1/2010	*Lithobates sylvatica*	1	13.9	65	12.3	92	12.2	0	0	
		4/14/2010	*no frogs calling*	N/A	14.1	40	14	62	14.6	1	0	
		5/7/2010	*no frogs calling*	N/A	21.7	43	20.3	65	16.4	0	0	
24	Cattail marsh within hardwood swamp in South Plainfield Holdings	4/1/2010	*Pseudacris c. crucifer*	2	13.9	65	12.3	92	12.2	0	0	
		4/14/2010	*Pseudacris c. crucifer*	1	14.1	40	14	62	14.6	1	0	
		5/7/2010	*Pseudacris c. crucifer*	1	21.7	43	20.3	65	16.4	0	0	
		5/7/2010	*Hyla versicolor*	2						0	0	

Precipitation Scale:

Precipitation Code	Description
0	No Precipitation
1	Fog/Mist
2	Light Rain/Drizzle
3	Moderate Rain. Steady precipitation but not too much noise pollution
4	Heavy Rain. Significant noise pollution. Impedes breeding beahavior.
5	Extreme weather. Hail, thunder, and/or lightening storms. Do not perform survey

Beaufort Wind Scale:

Beaufort Wind Scale	Wind Speed (mp	Description
0	<1	CALM: smoke rises vertically
1	1 to 3	LIGHT AIR: rising smoke drifts; weathervane inactive
2	4 to 7	LIGHT BREEZE: leaves rustle; can feel wind on face
3	8 to 12	GENTLE BREEZE: leaves and twigs in constant motion
4	13 to 18	MODERATE BREEZE: moves small branches (too windy to monitor)
5	19 to 24	FRESH BREEZE: small trees sway (too windy to monitor)

Calling Intensity:

Calling Intensity Code	Description
0	No frogs or toads can be heard calling.
1	Individual calls (con-specific) are not overlapping. Count Individuals
2	Some (con-specific) overlap of calls , but individuals still distinguishable
3	A full chorus/cacophony; constant, continuous, and overlapping calls (con-specific)

South Plainfield Dismal Swamp Ecological Perimeter

Eastern Border:

Edison Twp. Border north to Oak Tree Rd.

Northern Border:

Oak Tree Rd. west to cross rail lines to Hamilton Blvd.

Western Border:

Hamilton Blvd. south to Spicer Ave.

Spicer Ave. southeast to Belmont Ave.

Belmont Ave. west to Harvard Ave.

Harvard Ave. south to Garfield Ave.

Garfield Ave. west to Beatrice Place

Beatrice Place south to Hillside Ave.

Hillside Ave. west to Hamilton Blvd.

Hamilton Blvd. south to Durham Ave.

Durham Ave. south to Rt. 287

Rt. 287 east to Edison Border

10. Funding/Grant Source Matrix

9.3. POTENTIAL FUNDING SOURCES FOR DISMAL SWAMP PROJECTS

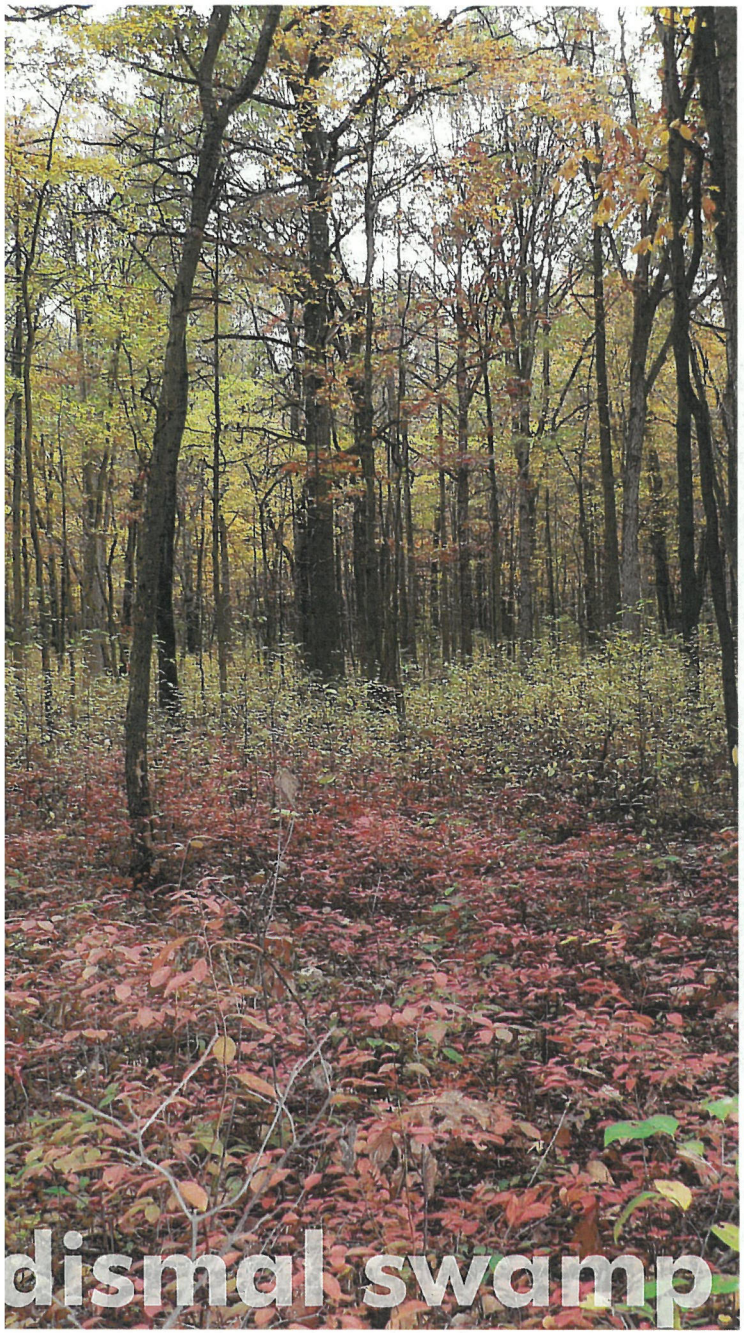
PROGRAM/SOURCE	APPLICATION DEADLINE	FUNDING RANGE	COST SHARE	ELIGIBLE APPLICANTS/PARTNERS	ELIGIBLE ACTIVITIES	COMMENTS
Five Star Matching Grants Program Administered by US EPA, National Fish and Wildlife Foundation, and NOAA. The Five Stars are the partner organizations who must be involved to apply for the grant. Contact: http://nfwf.org/programs/5star-rfp.cfm	Early March	$10,000 – 40,000	1:1 Federal/nonfederal match Nonfederal partner match can be in-kind services and donations	• Schools or youth groups • Local or tribal governments • Local businesses or corporations • Conservation organizations or local citizens groups • State and federal resource management agencies	• Community-based wetland, riparian, and coastal habitat restoration projects that build diverse partnerships and foster local natural resource stewardship through education, outreach and training activities	• Projects with long term monitoring and protection plans are preferred
Pulling Together Initiative Administered by National Fish and Wildlife Foundation (NFWF). Funding for proposals that will help control invasive plant species, mostly through the work of public/private partnerships. Emphasis on demonstrating successful collaborative efforts such as the development of permanent funding sources for Weed Management Areas. Contact: Teal Edelen, Acting Program Director, National Wildlife Refuge Programs teal.edelen@nfwf.org	Online pre-proposal application required: www.nfwf.org/grantapplication • June 30 - Pre-proposal deadline • September 30 - Full proposal deadline • January 31 - Formal announcement of award recipients	$5,000 – 200,000	1:1 Federal/nonfederal match (1:2 preferred)	• Private non-profit (501)(c) organizations • Federally recognized tribal governments • Local, county, and state government agencies • Field staff of federal government agencies	• Prevent, manage, or eradicate invasive and noxious plants through a coordinated program of public/private partnerships • Public education about the adverse impacts of invasive and noxious plants Special consideration: address invasive species threats impacting one of the NFWF Keystone Initiative focal topics, e.g., • Eastern North America Early Successional Habitat (Wildlife and Habitat, Birds) • Shortgrass Prairie (Birds)	• Target a specific and measurable conservation outcome. • Have a clear long-term weed management plan that is based on an integrated pest management approach using the principles of ecosystem management. • Include a specific, ongoing, and adaptive public outreach and education component.
Native Plant Conservation Initiative Administered by National Fish and Wildlife Foundation (NFWF) in cooperation with the Plant Conservation Alliance (PCA). Funding for projects that provide conservation benefit for native plants (including associated pollinators), involve multiple partnerships, demonstrate the ability to find matching funds exceeding the minimum requirement, and use innovative ideas (such as landscape approach, shareable new technologies, and teaching by example). Contact: Teal Edelen, Acting Program Director, National Wildlife Refuge Programs teal.edelen@nfwf.org	July 1	$5,000 – 100,000	1:1 Federal/nonfederal match (1:2 preferred)	• Private non-profit (501)(c) organizations • Federally recognized tribal governments • Local, county, and state government agencies	• Multi-stakeholder projects that focus on the conservation of native plants and pollinators under any of the following six focal areas: conservation, education, restoration, research, sustainability, and data linkages	• Strong preference for "on-the-ground" projects that provide plant conservation benefit according to the priorities established by one or more of the funding federal agencies and to the Plant Conservation Alliance strategies for plant conservation
North American Wetlands Conservation Act Grants Program Administered by US Fish & Wildlife Service, Division of Bird Habitat Conservation. Funding supports public–private partnerships for projects that further the goals of the North American Wetlands Conservation Act. Contact: Standard Grants Program Proposal Coordinators: David Buie (david_buie@fws.gov) (301) 497-5870 Bonnie Gaukler (bonnie_j -gaukler@fws.gov) (703) 358-2017 Small Grants Program Coordinators: Rodecia Mcknight (rodecia_mcknight@fws.gov) (703) 358-2266 Lacy Alison (lacy_alison@fws.gov) (703) 358-2552	March 5 and July 30	Standard Grants: Up to $1,000,000 Small Grants: < $75,000	1:1 Federal/nonfederal match	• Private non-profit (501)(c) organizations • Federally recognized tribal governments • Local, county, and state government agencies • Local businesses or corporations	• Long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats for the benefit of all wetlands-associated migratory birds	

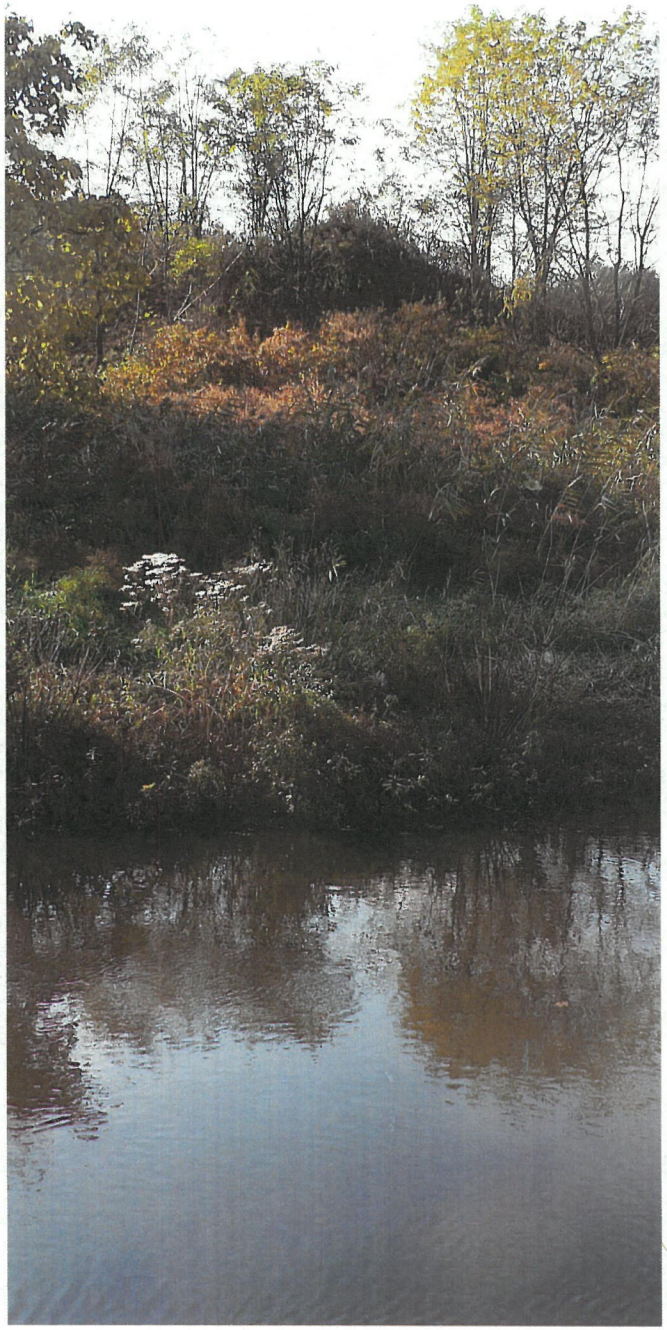
PROGRAM/SOURCE	APPLICATION DEADLINE	FUNDING RANGE	COST SHARE	ELIGIBLE APPLICANTS/PARTNERS	ELIGIBLE ACTIVITIES	COMMENTS
Recreational Trail Program Administered by New Jersey Department of Environmental Protection Contact: Larry Miller, Coordinator NJDEP-Division of Parks & Forestry Office of Natural Lands Management PO Box 404 Trenton, NJ 08625-0404 (609) 984-1339 larry.miller@dep.state.nj.us	Mid December of each year 2012 Application is currently open	Maximum $25,000 for non-motorized trails	4:1 Federal/ nonfederal match	• Public agencies at the federal, state, county, and municipal level. • Nonprofit organizations qualifying under section 501 (c) of the Internal Revenue Service code. • Friends of a Park group recognized by a governmental agency as a volunteer organization. •	• Maintenance and restoration of existing recreational trails. • Development and rehabilitation of trailside and trailhead facilities and trail linkages for recreational trails. • Purchase and lease of recreational trail construction and maintenance equipment. • Construction of new recreational trails in existing parks or in new rights-of-way.	• Land on which trail facility is to be funded must be public land or private land with an easement for public recreational use.
Green Acres Nonprofit Acquisition Grants Administered by New Jersey Department of Environmental Protection Contact: Martha Sapp, Chief Bureau of Local Assistance and Program Policy NJDEP-Green Acres Program PO Box 412 Trenton, NJ 08625-0412 Telephone: (609) 984-0570 martha.sapp@dep.state.nj.us	Applications are accepted at anytime of the year	Differ from year to year depending on funds available and total applications received	1:1 Federal/ nonfederal match	• Any tax-exempt, non-profit organization that qualifies as a "charitable conservancy" as defined in N.J.S.A. 13:8B-1 et seq.	• The Green Acres Program assists qualifying tax exempt nonprofit organizations in the acquisition of open space for recreation and conservation purposes and the development of outdoor recreation facilities.	• Meaningful public access must be provided to every project funded under this program.
Endangered Species Program Administered by US Fish and Wildlife Services Contact: Martin Miller Phone: (413) 253-8615 Fax: (413) 253-8482 U.S. Fish and Wildlife Service Endangered Species Program 300 Westgate Center Drive Hadley, MA 01035-9589	July 2 of each year	Differ from year to year depending on funds available and total applications received	Not required but recommended	• states, • other Federal agencies, • landowners, • educators, • non-profit organizations, researchers and other potential partners	• habitat restoration • undertaking endangered and threatened species research, • surveys and monitoring, • educational outreach	• Projects should show a clear conservation benefit that will help prevent the need to list by addressing identified threats • All projects will be considered independently on a year-to-year basis • Projects that involve multiple partnerships are encouraged
Wetlands Reserve Program Administered by New Jersey Department of Agriculture Natural Resources Conservation Service Contact: Beth Cusio (609) 383-3938 x19 Or Janice Reid, Assistant State Conservationist for Programs (732) 537-6042 Or Freehold SCD 4000 Kozloski Road - PO Box 5033 Freehold, NJ 07728 Phone: 732-683-8500 Fax: 732-683-9140 email: info@freeholdscd.org Online @ www.freeholdscd.org	Rolling	Variable	N/A	• Non-governmental individual landowner or entities	• Restore, enhance and protect wetland	

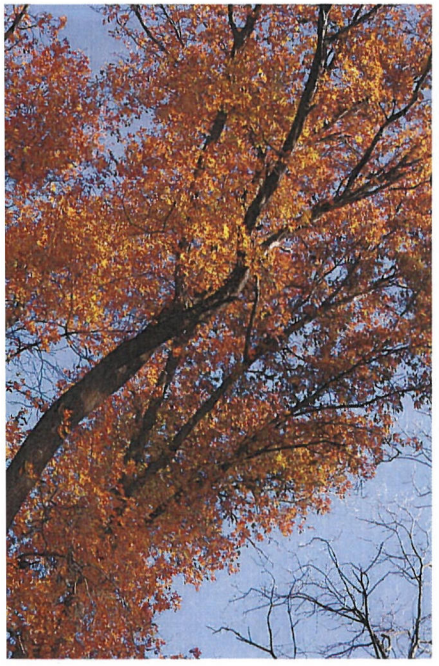
PROGRAM/SOURCE	APPLICATION DEADLINE	FUNDING RANGE	COST SHARE	ELIGIBLE APPLICANTS/PARTNERS	ELIGIBLE ACTIVITIES	COMMENTS
Land and Water Conservation Fund Program Administered by the National Park Service. Funds provided to the States, and through the States to local agencies for the acquisition, development and/or rehabilitation of outdoor park and recreation facilities. Contact: Commissioner, Office of Parks, Recreation and Historic Preservation Agency Building #1, Empire State Plaza Albany NY, 12238 Tel: 518-474-0443	Funding Currently on Hold Check for Updates		Matching grant program up 50% of the total project-related allowable costs for the acquisition of land and the development of facilities for public outdoor recreation	• Non-federal governmental agencies/departments (general purpose or special purpose government unit)	• Development of basic outdoor recreation and trail facilities to serve the general public • Surveys, planning studies, data collection and analysis, public participation efforts, and other activities essential to production of a Statewide Comprehensive Outdoor Recreation Plan (SCORP). • Studies of natural, ecological, or recreational resource areas, demonstration studies and topics of statewide significance or national concern related to public outdoor recreation. The study must go beyond "basic research" or simple data collection to provide information likely to be used for state or local decision-making on outdoor recreation issues and programs, so it may provide specific recommendations for inclusion in the State's published SCORP.	• Funded projects must reflect the priorities established in the SCORP, be sponsored by a governmental agency, and meet other state and federal requirements.
Neotropical Migratory Bird Conservation Act Administered by US Fish & Wildlife Service, Division of Bird Habitat Conservation. Funding supports public-private partnerships to promote the long-term conservation of Neotropical migratory birds and their habitats. Contact: Division of Bird Habitat Conservation. Guy Foulks (Coordinator) or Andrea Grosse (Co-coordinator), at 703-358-1784 or neotropical@fws.gov.	Announcement date for 2011 grant application has not been announced Check for Updates	$20,000-$250,000	1:3 Federal/nonfederal match	• An individual, corporation, partnership, trust, association, or other private entity	• Protection and management of neotropical migratory bird populations; • Maintenance, management, protection, and restoration of neotropical migratory bird habitat; • Research and monitoring; • Law enforcement; and • Community outreach and education.	
Urban Conservation Treaty for Migratory Birds Administered by US Fish and Wildlife Service and participating cities. Contact: Alicia F. King, National Coordinator Urban Bird Treaty 4401 Fairfax Dr. Arlington, VA 22203 or emailed to Alicia_F_King@fws.gov	New City Funding Application Deadline February, 29, 2011	$30,000-$70,000	1:1 Federal/nonfederal match	• City or Township Government	• Protect, restore, and enhance urban/suburban habitats for birds • Reduce hazards to birds • Educate and engage citizens in monitoring, caring about, and advocating for birds • and their conservation • Foster youth environmental education with a focus on birds • Manage invasive species to benefit and protect birds • Increase awareness of the value of migratory birds and their habitats, especially for • their intrinsic, ecological, recreational, and economic significance	
Landowner Incentive Program Grant Administered by New Jersey Department of Environmental Protection Division of Fish and Wildlife Endangered and Nongame Species Program Contact: Kim Korth, LIP Project Manager, at 609-292-9400 or Kim.Korth@dep.state.nj.us. New Jersey Department of Environmental Protection Division of Fish and Wildlife Endangered and Nongame Species Program Landowner Incentive Program 501 E. State St., 3rd Floor P.O. Box 400 Trenton, New Jersey 08612-0400	2011 Funding announcement made during August Funding has not been announced for 2012 fiscal year	Total 2010 Grant $69,900	3:1 Federal/ nonfederal match	• Private landowners; and • Individuals, non-profit organizations, and corporations with a documented long-term lease on private property (minimum of five years remaining on lease agreement).	• The proposals should focus on the enhancement of at least one rare species or its habitat in a significant way and describe actions on the private landowner's property that will address management, protection and restoration of habitats that benefit Federally and/or State listed species and/or species of special concern.	• Funding priority will be given to non-traditional projects like bog turtle habitat preservation • This grant is currently out of funding

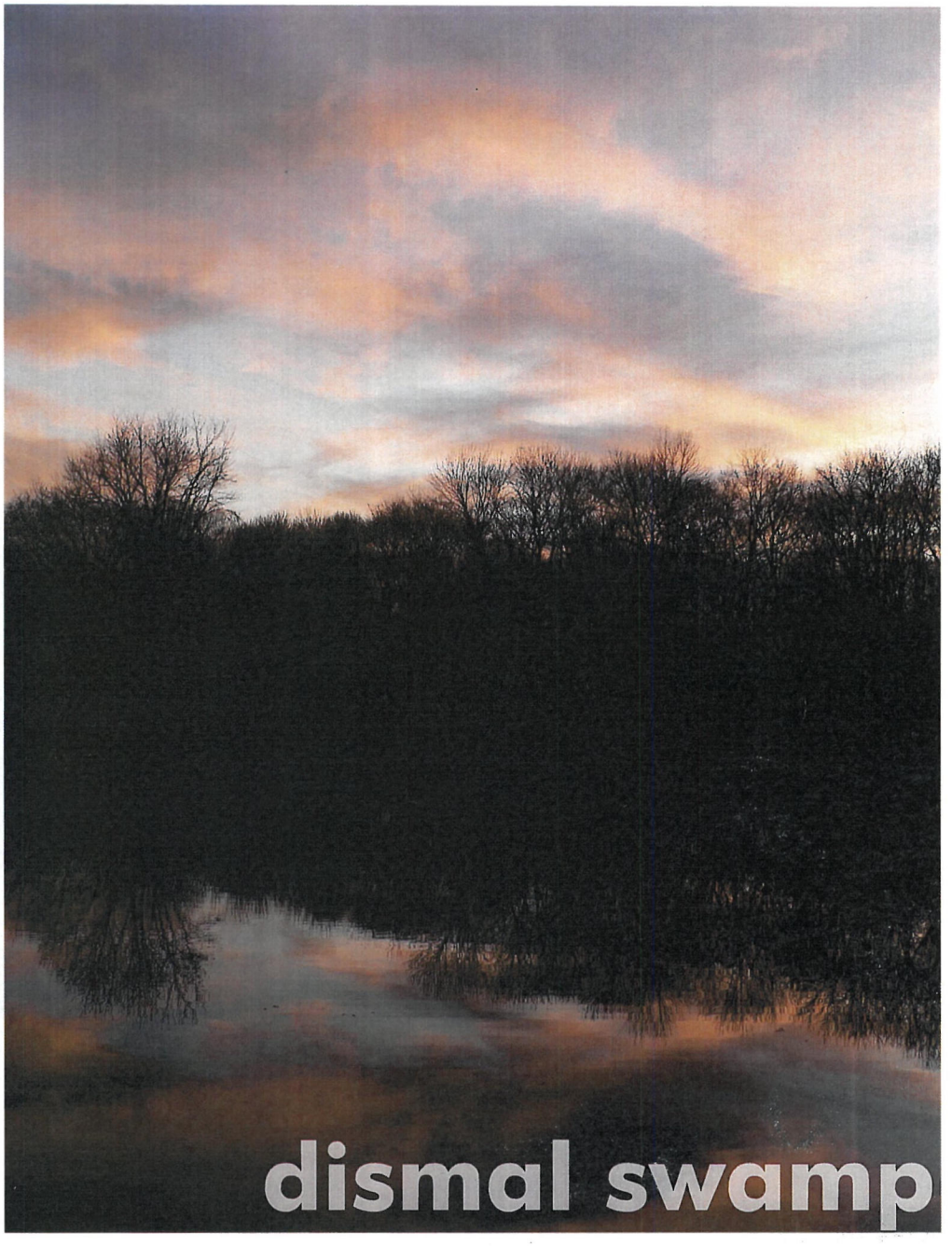
PROGRAM/SOURCE	APPLICATION DEADLINE	FUNDING RANGE	COST SHARE	ELIGIBLE APPLICANTS/PARTNERS	ELIGIBLE ACTIVITIES	COMMENTS
Wildlife Habitat Incentive Program (WHIP) Administered by New Jersey Department of Agriculture Natural Resources Conservation Service Janice Reid, Assistant State Conservationist for Programs (732) 537-6042 Or Freehold SCD 4000 Kozloski Road - PO Box 5033 Freehold, NJ 07728 Phone: 732-683-8500 Fax: 732-683-9140 email: info@freeholdscd.org Online @ www.freeholdscd.org	Rolling	60%-70% of Program Implementation; capped at $50,000	N/A	• Non-governmental individual landowner or entities	• Development of a wildlife management plan with NRCS guidance, which becomes the basis for a contract. The contract will then be competitively funded with payments made upon completion or meeting of goals	The plan becomes the basis for a contract which, if funded through a competitive ranking process, provides payments for completed practices that create or improve the approved wildlife habitat.

11. Photograph Montage of Site Surveys in 2010


dismal swamp






dismal swamp

dismal swamp

FLORA

dismal swamp

FLORA