Natural Resource Management Options Study

Horseshoe Farm Park

Prepared for the City of Raleigh Parks and Recreation Department by

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1.0 Introduction

This is a Natural Resource Management Options Study that was developed as part of the first phase of planning for the City of Raleigh's Horseshoe Farm Park project. This Study is intended to provide information that will ultimately assist in the conversion of the existing site to the Park envisioned by both the Master Plan and the WHZAT Team (described below) and to help guide the ongoing management of valuable ecological assets of the Park.

From the Horseshoe Farm Park Master Plan to the Management Plan

The Horseshoe Farm Park Master Plan was drafted with considerable input from the public and was completed in February 2009. A citizens' master plan committee was formed to lead the master planning effort. The initial master plan was adopted by the Raleigh City Council on May 15, 2007 and was revised by Council on March 17, 2009.

In 2008, the Horseshoe Farm Master Plan Committee developed Environmental Stewardship Recommendations which suggested the creation of a Wildlife Habitat Zones Advisory Team (WHZAT). That team was formed and is composed of experts from wildlife management non-profits, the N.C. Wildlife Resources Commission, the N.C. Natural Heritage Program, professors from N.C. State University and City staff. The WHAZAT Team's charge was to meet the fifth stewardship goal mandated by the City Council in the document, *Environmental Stewardship Recommendations from the Horseshoe Farm Master Plan Committee*.

The WHZAT Team met five times on the Park property. From those meetings and discussions, an ecological conceptual framework for the Park was generated (the WHZAT team findings are summarized in the report: *Wildlife Habitat Zones, Wildlife Habitat Zones: Horseshoe Farm Park, Raleigh, North Carolina* at http://raleighnc.gov/arts/content/PRecDesignDevelop/Articles/HorseshoeFarmPark.html). That framework is based on the division of the Park into Habitat Zones. For each Habitat Zone, the WHZAT team produced a series of recommendations, set forth to guide the planning, development and ongoing maintenance of the Park's ecological assets. The content of this Management Plan is based on those recommendations and expands upon many of the ideas and strategies developed by the WHZAT Team. It is recognized that the development and maintenance of the Park will be a team effort, and it is the goal of this document to present ideas and potential options and alternatives, leaving the final decision with the WHZAT team and the City of Raleigh.

2.0 Wildlife Habitat Zones

As described in *Wildlife Habitat Zones: Horseshoe Farm Park*, the WHZAT Team defined a total of six habitat areas or zones (See **Appendix A**):

Zone 1: Significant Natural Heritage Area (SNHA)
Zone 2: Wetlands
Zone 3: Butterfly Meadow
Zone 4: Upper Meadow
Zone 5: Giant Cane
Zone 6: Lower Field

These Zones are the organizational foundation for which the remaining recommendations are made. The Zones have (or will have when they are created) distinct ecological attributes. The establishment

and/or maintenance of these Zones will have different requirements and challenges. Each Zone, as well as existing conditions, will be addressed in more detail in sections that follow.

2.1 Existing Conditions Description

The City purchased the 146.2-acre Horseshoe Farm Park site in 2004. Upland fields occupy approximately 60 acres of the site, and forest occupies approximately 85 acres of the site. The upland fields have been farmed as crops or pasture for generations. The two dominant species present are fescue (*Festuca* spp.) and bermudagrass (*Cynodon* spp.); both are exotic species that were established for grazing livestock.

The floodplain and levee forest adjacent to the Neuse River as it flows around the oxbow that borders the property is an exceptional example of a mature bottomland hardwood forest with natural levees. This site is designated by the State of North Carolina as a Significant Natural Heritage Area due to the presence of the mature bottomland hardwood forests, wetlands and the system of natural river levees.

A very small fraction of the total area of the site can be classified as developed. The entrance road, a barn in the pasture, and a house previously used as a residence constitute the existing infrastructure on the property.

An extensive description of the existing conditions on the site are contained in "Interim Environmental Assessment Report, Horseshoe Farms Park Site, Wake County, North Carolina *ESI Project ER04-122"* dated March 2005 and its accompanying Addenda and "Horseshoe Farm Park Comprehensive Inventory" by Lena Gallitano and Harry LeGrand (both documents are in **Appendix B**).

3.0 Significant Natural Heritage Area-Habitat Zone 1

The forested area adjacent to the Neuse River and practically all the forest onsite has been designated by the N.C. Natural Heritage Program as part of the Upper Neuse Significant Natural Heritage Area (a Significant Natural Heritage Area, as defined by the Program, is an area of significant ecological importance). The Upper Neuse Significant Natural Heritage Area (SNHA) extends both north and south from the site, contributes to ecologically important interior forest along the Upper Neuse River, and is a diverse and mature bottomland hardwood forest, situated on the levees that have been formed over time by high flow events. The combination of the maturity of the forest, its landscape position on the natural levees of the Neuse River, and its intact structure make it a rare remaining example of the type of forest that occupied these types of sites before widespread development occurred. The primary management objective for this Zone is protection and preservation.

3.1 Assessment

This Zone is the ecological linchpin of the Park. Its formation over time is not a process that can be easily recreated or duplicated if the forest is damaged or allowed to degrade. For that reason, this area must be protected and carefully preserved and any impacts must be carefully minimized. In order to preserve the forest's integrity, its vegetative structure must be characterized more fully and the condition of that structure must be evaluated and sustained over time.

The vegetative structure must be known in order to track and detect changes in the future. The structure is determined by vegetative survey, i.e. sampling the vegetation using plots. The size, number and location of the plots must be determined based on the total area of the forest, the percent coverage of the survey that is desired, the budget available, the variability in the forest composition, and other

considerations. The decisions about how the forest vegetation should be surveyed, and how often it should be resurveyed, are vital to the success of the management of this Zone, and should be carefully made. When the vegetative survey details are established (plot size, location, number etc) the locations of the plots should be surveyed and marked, using appropriate technology. These permanent plot locations can then be resampled in the future, and vegetation change can be assessed going forward.

The variables recorded in a vegetation survey plot vary, based on the objectives of the survey. Types of data gathered include species, height, diameter breast height, percent cover, crown closure, vegetative strata, large woody debris, and dead snags etc. The information recorded in each plot is used to produce a parameterized description of the vegetation present within each plot, and that plot information can be used to extrapolate the structure of that part of the forest where the plots are located.

A detailed description of how vegetation can be effectively sampled is presented by Peet et al. (1998). This method, developed by ecologists at the University of North Carolina and N.C. State University, is currently being used as the protocol for the Carolina Vegetation Survey and has been adapted for use by the Ecosystem Enhancement Program to monitor wetland and stream mitigation projects.

Many factors will help determine the vegetation sampling protocol chosen, including the agreement on the list of parameters that need to be measured, the size of the sample that is needed, the budget available for sampling and the review of the WHZAT.

When the sampling methodology is determined, the vegetation in the Zone can be sampled periodically and its relative condition determined. If changes in forest composition or structure can be discovered in a timely way, then corrective or restorative action, if needed, can be carried out.

3.2 WHZAT Management Considerations

The WHZAT management considerations for this Zone are varied, yet related in a general way. First and foremost, the Park's design and construction must be carried out in a way that preserves the integrity of the SNHA, its habitat value or its fauna. Towards those ends, there are specific instructions such as:

- Control invasive species by intervention and by using best management practices to control their spread during construction and ongoing operation of the Park.
- Protect heritage trees and their critical root zones
- Quantify snags, preserve them and determine if more would be beneficial to habitat quality
- Investigate the USFWS Forest Land Legacy Program for its potential benefits to the Park
- If supplemental plantings are determined to be advisable, only use native species
- Preserve the wildflower slope and develop a plan to preserve a healthy native violet population to provide habitat for the Falcate Orangetip butterfly.

The processes needed to carry these recommendations out are relatively straight-forward, and should be done under the direct supervision of the WHZAT.

The N.C. Wildlife Resources Commission contributed forest habitat recommendations, in addition to other habitat recommendations, to the park planning process in the document "Wildlife Habitat Recommendations, Horseshoe Farm City Park, Raleigh, NC, Wake County, 24 March 2009" by Joe Folta. It is included in **Appendix C.**

4.0 Wetlands-Habitat Zone 2

The three wetlands at Horseshoe Farm Park lie within the SNHA forest. They are listed as a discrete Habitat Zone in the WHZAT report and are divided into a Western Zone (two wetlands) and an Eastern Zone (one wetland). A description of these wetlands and recommendations for their management are also included in the report. The main management concern for all wetland areas is protection. Recommendations for the wetlands include:

- Plugging the drainage ditches
- Protect the wetlands from stormwater runoff, pesticides, and the introduction of fish to their waters, to maintain the high-quality, predator-free environment which is the basis for reptile and amphibian breeding
- Use silt fence or other appropriate measures to exclude amphibians from construction areas, but avoid disturbing migration corridors between the two wetlands
- Provide a substantial buffer for the wetlands, varying from a minimum of 100 feet out to 600 feet
- Preserve the river oats, standing snags and coarse woody debris in the wetlands vicinity,
- Use the wetlands for educational purposes, while protecting them from the potential impacts associated with ease of access and proximity of access.
- Cluster any infrastructure to a concentrated area equal to no more than 25 percent of the prescribed wetland buffer

These recommendations suggest preserving the wetlands, with minimal disruption being allowed by development or for educational purposes, in order to protect their delicate ecological resources. The recommendations can be accomplished by appropriate design and management techniques, which preserve the natural integrity of the water quality, plant life and animal life the wetlands currently exhibit. Plugging the drainage ditches should be attempted by hand before allowing earth-moving equipment into the floodplain forest. Contamination by stormwater runoff and pollution can be avoided through the design of Park stormwater BMPs and by providing the recommended buffers.

The Eastern Zone wetland is not recommended for educational programming due to its ephemeral hydrology. Therefore it is not recommended that trail access be created to this wetland, and the primary goal for this wetland is preservation.

5.0 Butterfly Meadow-Habitat Zone 3

5.1 Establishment

5.1.1 Basic Planning

All four stages of the butterfly and moth life cycle – egg, caterpillar, chrysalis, and adult – must be provided for when creating the Butterfly Meadow at Horseshoe Farm Park. Each stage requires specific food and environmental needs. The cycle begins with eggs being laid on the leaf of a host plant, a plant caterpillars prefer to eat. When the eggs hatch, the caterpillar will consume the leaves of the host plant. After a period of time, the caterpillar molts into a chrysalis, a protective hard casing, in which it will transform into a butterfly. An adult butterfly or moth will emerge from the chrysalis after approximately 2 weeks and being searching for nectar and a mate. This cycle will continue to repeat itself as long as the necessary habitat is available (Bowen and Moorman, 2002).

5.1.2 Selecting Native Plants

All plantings selected for the Horseshoe Farm Park Butterfly Meadow will be native to the Piedmont and Inner Coastal Plain of North Carolina and will be acquired from local sources (City of Raleigh Parks and Recreation, 2010). Native plants are ideal for the Butterfly Meadow because they are adapted to the region requiring little maintenance and watering and will attract butterflies and moths native to the region. It is also the native plants that provide the specific food sources for caterpillars that are commonly restricted to a certain host plant species. Ornamental plants should be avoided because while bred for optimum bloom size and color, they provide little nectar and wildlife value (Bowen and Moorman, 2002). Lists of native plants that provide habitat for butterflies and butterfly species that may be encountered at Horseshoe Farm Park are in **Appendix D**.

The species of butterflies and moths that would be expected at Horseshoe Farm Park and native host and nectar plants are included in Appendix C. To attract the largest range of butterflies and moths, a large diversity of caterpillar host plants and nectar plants that supports each stage of the life cycle will be chosen. A variety of nectar plants with blooming times ranging from early spring to late fall should be used to provide food throughout the growing season for multiple butterfly and moth species. Night-blooming nectar plants should also be included specifically for moths. Unlike caterpillars, most adults do not have specific food requirements and tend to visit various flowering plant species for nectar. A variety of plant heights and bloom sizes, colors, fragrances and shapes will also be selected. It is important to select plants with varying bloom sizes to accommodate different sizes of proboscises, the slender tubular feeding structure of butterflies and moths. For instance, smaller butterflies and moths have shorter proboscises and are unable to attain nectar from larger blooms (Bowen and Moorman, 2002).

While a majority of adult butterflies and moths require nectar as a food source, a few also feed on rotting fruit, sap, and carrion (LeGrand, 2010). To accommodate these butterflies and moths, peelings and cores of fruit can be discarded throughout the meadow in partially shady areas (Bowen and Moorman, 2002). The sap and carrion would be provided by surrounding vegetation and through the natural cycles occurring at Horseshoe Farm Park.

Since most host and nectar plants require full sun and butterflies and moths are most active in the sun, the optimum location of the Butterfly Meadow will have full sun from mid-morning to mid-afternoon. The soil types in those areas receiving full sun will need to support a large diversity of native plants. The light, soil, and moisture conditions will be considered when selecting native plants for the Butterfly Meadow (Bowen and Moorman, 2002).

The best strategy to attract butterflies and moths to a particular area is to plant a diversity of nectar and caterpillar host plants. However, to encourage the butterflies and moths to remain within the habitat created at Horseshoe Farm Park, the other basic needs - shelter, water, and sun - must also be provided (North American Butterfly Association, 2010a).

An additional consideration in regard to the plantings for the Butterfly Meadow is the feasibility of the City raising their own plants. The cost/benefit/feasibility of the collection of local native-species seeds, germination in either a greenhouse (City-owned or contracted) vs. direct sowing onsite, the types of labor available to perform these tasks, and the coordination of these operations with the implementation of the park should be explored with the WHZAT team and City staff.

5.1.3 Shelter

Portions of the Butterfly Meadow should be sheltered from wind, rain, and predators to allow the butterflies and moths easier movement throughout the meadow (North American Butterfly Association, 2010a). This may be achieved by strategically placing taller plants, such as tree and shrubs, behind shorter plants or by situating the Butterfly Meadow adjacent to an area with existing trees and shrubs. Snags and brush piles may also be left to lie within the created habitat providing the butterflies and moths with additional shelter (Bowen and Moorman, 2002).

5.1.4 Water

Wet areas should be designated for puddling within the Butterfly Meadow. These areas provide water and a source of dissolved salts necessary for male butterflies. This feature can be incorporated in the Butterfly Meadow by designing water puddles or wet, sandy areas (Bowen and Moorman, 2002). The damp ground feature should be situated in an easily visible area and sheltered from the wind (North American Butterfly Association, 2010a).

5.1.5 Sun

Butterflies and moths are cold-blooded insects and often warm their bodies in the early morning sun before taking flight (North American Butterfly Association, 2010a). Flat rocks, gravel areas, and exposed soil should be available for butterflies and moths to use to bask in the morning sunlight. These sunning areas should be located in areas within the Butterfly Meadow that will receive at least six hours of direct sunlight a day (Bowen and Moorman, 2002).

5.1.6 Design

Once the location of the Butterfly Meadow is established and prior to design, soil testing should be performed (City of Raleigh Parks and Recreation, 2010). Soil testing will enable the designer to determine the existing soil conditions and decide if soil amendments are necessary.

When designing the Butterfly Meadow, taller plants should be placed behind smaller plants to maximize visibility of all plants. This strategic placement of taller plants will also allow them act as shelter from wind, rain, and predators for the butterflies and moths. Flowering plants with similar blooming periods should be placed together to allow easier access to nectar sources and to reduce exposure to predators. Space should be left between each native plant to accommodate for future plant growth and a few other habitat features such as puddling and sunning areas (Bowen and Moorman, 2002).

5.1.7 Establishment

The vegetation in the Butterfly Meadow can be established in much the same way as the Upper Meadow and the Lower Field. A diverse mixture of plants will need to be planted, but the site preparation and planting for the native warm season grasses and the flowers will be the same.

5.2 Maintenance

Since native plants, which are already adapted to the region, will be selected for the Butterfly Meadow, no growing season maintenance and watering is essential. Optional watering of easily accessible areas should be considered by staff if there is a severe drought and if a sustainable source of irrigation water is available. If desired, mulch may be placed around the plantings. The mulch will not only hold moisture in the soil and reduce weeds, but it may also provide shelter for some type caterpillars (North American Butterfly Association, 2010b).

Dead flowers and foliage should be left on the plants during the growing season to avoid unintentionally removing and disturbing eggs and chrysalises (Bowen and Moorman, 2002). To encourage butterfly and moth interactions, the Butterfly Meadow should be allowed to remain in its natural state.

Pesticides should not be used within the Butterfly Meadow. Typically, pesticides used to kill pests can also kill butterflies, moths, and other useful insects (Bowen and Moorman, 2002). If pests need to be controlled, other natural methods should be used rather than pesticides. Ladybugs and dragonflies can be used to control pests (Butterfly House, 2010). Also marigolds, petunias, mint and other herbs can be planted throughout the meadow to naturally repel pests (Butterfly House, 2010). Fire ant (*Solenopsis invicta*) control will require caution to avoid harming any beneficial insects (City of Raleigh Parks and Recreation, 2010).

Long-term maintenance of the meadow's vegetative structure should be determined after the efficacy of mowing, discing and controlled burning techniques are further explored during initial Park operations. Mowing can cause thatch build-up that degrades wildlife habitat. Discing can cause fire ant infestation spread, and burning may perhaps be problematic due to the Parks location and the process of obtaining a burning permit in a timely manner (Charles Yelton, Prairie Ridge Ecostation, personal communication).

5.3 Public Education

The Butterfly Meadow will offer public program opportunities for wildlife viewing, butterfly identification, landscaping for wildlife, nature photography, and native plant identification. To enhance the public education opportunities, educational signage should be included throughout the Butterfly Meadow. Some examples of signage include butterfly and moth identification, ecology explanations, landscape for wildlife explanation, and plant identification (City of Raleigh Parks and Recreation, 2009).

6.0 Upper Meadow and Lower Field-Habitat Zones 4 and 6

The WHZAT recommendations and guidance provide substantial details on the structure of these Zones and how they should be established, managed and maintained. The main vegetative components are native warm season grasses and wildflowers, with a shrub border separating the existing forest and the grass and wildflowers. Shrub and tree islands are also recommended. These areas are intended to have visual appeal, high wildlife habitat value and be the locus for native warm season grass education opportunities.

The WHZAT report specifies some recommendation differences between the areas, which for the Upper Meadow include:

- This area should contain a higher percentage of wildflower species than the Lower Field, and include flowers that attract hummingbirds
- Create a narrow, 30 foot-wide shrub border adjacent to the wood line
- Consider replacing the crape myrtles, or install a second line of native species trees behind the existing crape myrtles, so that when the crape myrtles senesce, they native trees will be established and can fill the gap created by the loss of the crape myrtles

For the Lower Field, specific differences include:

- Only a moderate amount of trails should be used, with most located on the field periphery, and trails through the interior limited, to prevent opening the interior to edge predators, invasives and human impacts

- Total area should include 1/3rd shrub thicket, 2/3rd grassland
- Shrub line should have a meandering border or "feathering", which is most beneficial to wildlife
- Immediate recommendation to stop mowing a lower 10 acre zone which was delineated by City of Raleigh staff in April 2009
- Ten acre no-mow area includes drainage swale on the east side, which can potentially allow wetland vegetation to re-establish and increase plant and wildlife diversity
- Maintain an approximately four foot-wide trail along the edge of the current unmowed area (shift the current trail away from the edge of the woods)

6.1 Pre-Establishment Competition Control

A quantitative vegetation survey of the existing pasture vegetation should be undertaken, to determine what species are present, and where, especially native warm season grasses and invasive or non-native grasses. If it is determined to be appropriate by the WHZAT, the following competition control measures can be taken. Non-native grasses (e.g. tall fescue, bermudagrass, crabgrass, and Johnsongrass) out-compete native warm-season grasses (NWSGs). Therefore, prior to planting native warm-season grasses, non-native grasses must be controlled. The non-native species that are present dictate which control methods should be used before planting NWSGs. The techniques listed in this plan for the control of non-native competitors, the establishment of NWSGs and their ongoing maintenance are taken from *A Landowner's Guide to Native Warm Season Grasses in the Mid-South* (Harper 2004), per guidance from the WHZAT (See **Appendix E**). From correspondence with Chris Moorman of the WHZAT, the following general points about the establishment of NWSGs were made:

- The presence of fescue or bermudagrass at these locations will significantly compromise the value of the areas for wildlife. Both are mat-forming grasses that alter the plant community structure in a way that makes the area inaccessible or low quality for numerous species (e.g., rabbits, turkey poults, mice and rats).
- Although desirable plant species may emerge through the mat of non-native grasses, the continued presence of these grasses along the ground will inhibit the long-term development of a native and wildlife-friendly plant community.
- Aggressive efforts to kill the bermuda and fescue should be pursued for at least one year prior to planting the site to a native mix.
- In most cases, 1 application of an herbicide is not satisfactory to remove the non-native grass, especially bermuda. Also, there are specific practices that should precede herbicide application to maximize the uptake by the grass.

Perennial cool-season grasses such as fescue and orchardgrass can be controlled by applying herbicide to the existing pasture. Before herbicide is applied to the existing pasture to control perennial cool- season grasses, the field should be mowed, grazed, hayed, or burned to ensure the herbicide application comes in contact the actively growing plant rather than the dead plant material from the previous year's growth. For the most success of controlling perennial cool-season grasses, spray in the fall with glyphosate herbicide at an application of two quarts per acre. If a fall herbicide application is not feasible and a spring application is necessary, a mixture of two quarts of Roundup with eight ounces of Plateau and two pints of Methylated Seed Oil (or 22 ounces of Journey with 1 ½ quarts of Roundup) can be used. Following herbicide application for perennial cool-season grasses, warm-season competitors may emerge if present within the seedbank.

Bermudagrass can be controlled by burning the existing pasture in late winter and allowing the existing bermudagrass to re-grow. When the bermudagrass begins to flower, it should be sprayed with impazapyr (24 ounces of Arsenal AC per acre with 2 pints of Methylated Seed Oil). The pasture should be checked for bermudagrass re-growth during the following growing season, since it is practically impossible to eliminate bermudagrass with a single herbicide application. The pasture should be ready to plant native warm-season grasses two years after the initial spray treatment.

If it is determined either before or after the initial treatment that crabgrass or Johnson grass are present, then to control these warm-season competitors spray the existing pasture during the growing season prior to planting with native warm-season grasses. The type of pre-emergence herbicide application to be used will be determined based on the native warm-season grass to be planted. A pre-emergence application of an imazapic herbicide, such as Plateau (6-8 ounces for acre) or Journey (16-20 ounces per acre), is recommended when planting bluestem, indiangrass or sideoats grama, while a pre-emergence application of OutRider (2 ounces per acre) is recommended when planting switchgrass and eastern gamagrass.

6.2 Preparing the Seedbed

The seedbed should be prepared once the native warm-season grass competitors have been controlled and prior to planting. The seedbed preparation will depend on how the seed is to be placed - drilled of topsown. A firm seedbed free of deep thatch or dead plant stems and other materials is desired if the seed is to be drilled. Deep thatch can be best removed by burning. However, if the thatch is sparse and thin, only a few inches thick, then no preparation will be needed. The seedbed should be prepared using conventional tillage techniques if the seed is to be topsown. Soil amendments, if needed, should be applied before plowing and/or discing to ensure amendments are thoroughly incorporated into the soil.

6.3 Planting

Soil fertility and soil testing before planting is recommended to determine the pH and nutrient availability of the existing pasture. When managing for wildlife, as in the case of Horseshoe Park, lime and fertilizer should only be considered with the pH is below 5.0. Since native warm-season grasses are adapted to low pH, nutrient deficient soil, it is expected that little to no soil amendments will be required.

There are myriad choices for seeding mixtures. For wildlife habitat, tall grass or short grass mixtures are options. As noted in the WHZAT report, wildflowers are also recommended as a prominent addition to the mix. Forbs are also an important consideration, as they provide a food source for many wildlife species that occur in grassland habitats. Planting lists of potential species are listed below.

Tall grass mixture (lbs PLS per acre)
1.5 lbs big bluestem
1.5 lbs Indiangrass
1.0 lb little bluestem
0.5 lb switchgrass
1.0 lb native forbs

Short grass mixture (lbs PLS per acre)
3 lbs little bluestem
1.0 lb side oats grama
0.5 lb Indiangrass
1.0 lb native forbs

Forbs often added to native warm season grass mixtures include partridge pea, Illinois bundleflower, roundhead lespedeza, perennial sunflowers, purple prairieclover, purple coneflower, black-eyed susan, blazing star and lance-leaved coreopsis.

Wildflowers from the butterfly meadow list can also be incorporated into these Zones with ease. The Upper Meadow seed mix should contain more wildflower seed, as recommended by the WHZAT report.

The WHZAT report directs that planting be done in September-October. This is in conflict with the common recommendation in the literature to plant in the early to late spring. Seeding can be done in the fall, but a higher rate of seeding is required to compensate for seed loss due to rotting and consumption by birds and other wildlife. More discussion is needed to resolve this issue.

Warm season grasses do not germinate until soil temperatures are above 50 to 55 degrees F. Planting after June 1 should be avoided because moisture and weed competition may delay stand establishment. Early establishment allows seedlings to develop good root systems before summer drought and greatly increases the ability of the grasses to compete with weeds.

Native grass seed typically contains higher percentages of dormant seed than cool season forages. Planting early into cool soil will chill the seed and may help dormant seed to germinate. Seeding into warmer soil in late spring can be helpful in controlling weeds. The first flush of weeds is allowed to germinate and then is killed by final tillage or contact herbicide just prior to planting. Ideally, this practice would result in the shortest period of bare ground and would get grass seedlings up as quick as possible to compete with other weeds.

Seeding rates are dictated by objectives. For wildlife, a relatively sparse stand of grasses with abundant forbs and interspersed, adequate bare ground is desired. If hay production is an objective, a denser stand without forbs and less bare ground is desired. Thus, a relatively light seeding rate (4–6 pounds Pure Live Seed or PLS per acre) is recommended when establishing NWSGs for wildlife and a heavier seeding rate (8–12 pounds PLS) is recommended when establishing hayfields or pasture. The desired objectives need to be determined before planting. Testing different methods may be advisable. It should be noted that the PLS and germination rate percentage should be carefully incorporated into the calculation for the amount of seed that needs to be purchased to achieve the desired planting rate per acre. If the seed label lists the PLS as 65% and the germination rate is 85%, then there is only 27.6 lbs of viable seed in a 50 pound bag of seed (50lbs x 65% x 85% = 27.6 lbs).

For haying or livestock grazing a more even grass distribution and a continuous, solid stand is desired. When bluestems or indiangrass is being planted, a drill with a specialized seed box containing “picker wheels” is necessary or the fluffy seed of these grasses lodge in the seed chute. These drills often are available for use through state wildlife agencies, soil conservation districts, the Natural Resources Conservation Service and some local chapters of Quail Unlimited. Switchgrass can be planted with a conventional drill. Any drill, however, must be calibrated before planting. Eastern gamagrass is usually planted with a corn planter in rows 18–24 inches apart, but some hay producers like to plant rows only 12 inches apart to reduce stool size and make stems more upright so haying is easier.

However, NWSG fields intended for wildlife habitat can be established successfully by broadcast seeding (Harper 2004). When planting bluestems and indiangrass, a broadcast seeder with picker wheels (similar to those found in drills designed for fluffy seed) is helpful; otherwise, some type of carrier (pelletized lime, fertilizer, cracked corn, cottonseed hulls) is needed to distribute the seed. Prior to broadcasting, it is critical to thoroughly prepare the seedbed and cultipack after seeding to ensure firm seed-to-soil contact and improve germination rate.

For competition control, many sources in the literature recommend application of a pre-emergent herbicide for weed control.

6.4 Early Establishment

The first growing season after planting, NWSG establishment and survival often look quite sparse. Most of the grass's energy the first year is expended on root development. Leaf and stem growth may not reach more than 2 feet tall by the end of the first growing season.

6.5 Maintenance

There are 3 basic options for NWSG maintenance-prescribed fire, discing and mowing. While there are varying opinions in the scientific and extension literature as to the efficacy of the 3 methods for maintenance, the following information is taken from Harper (2004) per recommendation of Chris Moorman, a WHZAT member. For the most optimal wildlife habitat, burning is preferred, followed by discing, with mowing a poorly performing third choice.

Prescribed fire reduces litter buildup, sets back succession, increases nutrient availability and stimulates herbaceous growth. Fields are most often burned in late winter, just before spring green-up. This reduces winter cover only for a short time and does not disrupt nesting birds and rabbits. If woody succession is a problem, fields can be burned just after bud break to kill woody competition. Prescribed fire in late summer/early fall can be used when NWSG have become too dense and additional forb growth is desired. Burning at this time also can be used to reduce woody succession, if completed before leaf senescence. Using prescribed fire is efficient, effective, cheap and easy; however, planning and experience are necessary. Burning is controlled and objectives are met only when conducted under the appropriate conditions. State wildlife and forestry agencies and/or local chapters of Quail Unlimited often help landowners who need burning assistance.

Prescribed fire is contained by creating firebreaks (disced strips 10–30 feet wide) around the area to be burned. Firebreaks should be planted for increased food resources around NWSG fields. By planting various mixtures in different sections of the firebreak, a supplemental food source is available year-round. Other sections can be left fallow for weed growth.

In some areas, it is difficult to burn because of smoke-management issues. Also, many landowners are reluctant to burn because of inexperience. In these situations, NWSG fields should be managed by discing. Discing sets back succession, increases open space at ground level, facilitates litter decomposition and stimulates the seedbank. Discing can be completed in blocks (> 1 acre) or strips (> 50 feet wide) oriented with the contour of the field (to prevent erosion). Undisced strips should be about twice as wide as disced strips. This allows one-third of the field to be disced each year.

Discing at different times of the year affects vegetation composition, depending on site conditions and the seedbank present. For example, discing in the fall may produce a different suite of forbs than discing in spring. Discing in the fall also creates walking and shooting lanes for hunting quail or rabbits. A good way to determine the preferred time to disc and the seedbank response within individual fields is to disc strips at various times through the year. Disced areas can be interseeded with legumes and other forbs if needed. Bushhogging (without burning or discing) is not a recommended practice for managing NSWG because it increases the litter layer, makes travel through the field difficult for small wildlife and inhibits the seedbank from germinating. It is usually necessary, however, to bushhog before discing is possible. Bushhogging along a firebreak prior to burning also may be used to reduce flame heights.

Mowing is a much less desirable management strategy than burning, from a habitat standpoint. Mowing will eventually promote a grass-dominated plant community and leaves a dense thatch layer that prohibits use by many species of wildlife. Burning has numerous advantages over mowing. Of course, numerous potential constraints exist related to using prescribed fire in suburban landscapes.

6.5 Shrub Border and Tree Island Establishment and Maintenance

The WHZAT recommends that this border be at least 30 feet wide in the Upper Meadow and that it occupy approximately 1/3 of the area of the Lower Field. It is also stipulated that the shrub area should be composed of a diversity of native tree and shrub species and that the border of this area should meander or "feather" so as to be most beneficial to wildlife.

There is a wide array of native trees and shrubs that can be incorporated into this area. Species typically found in a Piedmont Oak-Hickory or Mixed Pine Hardwood forest would be well-suited to the upland field habitat. Trees and shrubs that produce seeds, fruit or other types of wildlife food should receive preference. The following lists are not comprehensive, but include many of the major species for consideration.

Major species

Within the broad oak-hickory type, the Society of American Foresters has defined nine forest cover types as oak types. The great range of climate, soil, and topography results in widely different stand compositions. White oak (*Quercus alba* L.), northern red oak (*Q. rubra* L.), and black oak (*Q. velutina* Lam.) are found throughout the type. Other common oaks on drier sites are scarlet oak (*Q. coccinea* Muenchh.), post oak (*Q. stellata* Wangenh.), blackjack oak (*Q. marilandica* Muenchh.), and southern red oak (*Q. falcata* Michx.) in the West and South. Hickories include pignut hickory (*Carya glabra* (Mill.) Sweet), mockernut hickory (*C. tomentosa* (Poir.) Nutt.), and shagbark hickory (*C. ovata* (Mill.) K. Koch).

The mixture may also contain yellow-poplar (*Liriodendron tulipifera* L.), ashes (*Fraxinus* L. spp.), elms (*Ulmus* L. spp.), sugar maple (*Acer saccharum* L.), red maple (*A. rubrum* L.), blackgum (*Nyssa sylvatica* Marsh.), black cherry (*Prunus serotina* Ehrh.), black walnut (*Juglans nigra* L.), persimmon (*Diospyros virginiana*), and many other hardwood species. Shortleaf pine (*Pinus echinata* Mill.), loblolly pine (*P. taeda* L.), Virginia pine (*P. virginiana* Mill.), and eastern redcedar (*Juniperus virginiana* L.) may also be present.

Understory species

Many species of understory trees and shrubs occur in oak-hickory stands. Some of the most common small trees are flowering dogwood (*Cornus florida* L.), sassafras (*Sassafras albidum* (Nutt.) Nees), sourwood (*Oxydendrum arboreum* (L.) DC.), eastern redbud (*Cercis canadensis* L.), downy serviceberry (*Amelanchier arborea* (Michx. f.) Fem.) and American holly (*Ilex opaca*). Shrub species include sumac (*Rhus* spp.), beautyberry (*Callicarpa americana*), blueberry (*Vaccinium* L. spp.), witch-hazel (*Hamamelis virginiana* L.), and bramble (*Rubus* L. spp.). Additional species are listed in **Appendix C**.

The maintenance strategy for the shrub border was not described in the WHZAT report, however it is an important consideration. From the description in the WHZAT report, it is assumed that the intermediate height of this area must be maintained. Possible choices for achieving that status are periodic burning, mowing/chopping and chemical control.

Burning this area periodically will kill back the vegetation in a manner simulating a natural process. However, the fire tolerance of many species is limited, and some stock will be likely be lost, and need to be replanted.

Mowing will control and reset the vegetative height also. There are many shrub and tree species that can resprout after mowing, so the need for replanting would be diminished. However, mowing produces thatch which degrades habitat for some wildlife species.

A combination approach of planting just shrub species and mowing around groups of shrubs, while chopping down and/or spot-treating volunteer tree species periodically could also be tested.

The size of the tree islands is not specified in the WHZAT report, but the assumption is they would be relatively small (less than 500 square feet). The species composition of these islands could be quite similar to the shrub areas. The difference in structure between shrub borders and tree islands can be controlled by which species are allowed to dominate as far as height and density. The other major consideration is the method used to control or adjust the stature and species dominance of the respective habitat areas. An option could be to protect the shrub and tree areas from burning for a five to ten-year cycle, then burn some or all of them simultaneously with the prescribed NWSG maintenance burns. There are many potential alternatives for managing these areas, and further review by the WHZAT team is recommended.

7.0 Giant Cane-Habitat Zone 5

The giant cane (*Arundinaria gigantea*) area at Horseshoe Farm Park is on the eastern side, adjacent to the River. It was designated as a separate habitat zone by the WHZAT. The primary WHZAT recommendations for this area are to preserve it and control invasive species as needed.

In order to preserve the area and its habitat value, invasive species must be controlled. There is problematic Japanese stiltgrass (*Microstigeum vimineum*) presence throughout the giant cane area. Microstigeum can be controlled manually by pulling, or with herbicides. Manual control over an area as large as the Giant Cane Zone will be a challenge.

Herbicide treatment will also be a challenge because the Microstigeum is closely interspersed with the giant cane in most locations. A high degree of accuracy is required or damage to the giant can stems will occur. A pre-emergent or foliar treatment of Plateau (4 oz/ac) or Round-Up Pro (2% solution) have been shown to achieve 95% control. Plateau can harm native seed germination, but is very selective to grass species post-emergence. Round-Up Pro is non-selective and requires accurate application, as previously noted. Plateau is not aquatic-safe, but if applied correctly in upland areas it can eliminate 3-4 years of Microstigeum seedbank. An application in March should be followed by an application in September for best results.

<u>River Oats</u>
Microstigeum is also a threat to the river oats on the site, and the treatment techniques would be the same as for the giant cane.

8.0 Trails

8.1 Design and Construction Considerations

When designed and constructed properly natural surface trails can provide many years of sustained use without requiring excessive maintenance or significant changes to the alignment. Once the goals of the trail system have been established, a rough map of the trail corridor should be created to determine the locations of natural features that make good destination points, and sensitive areas that should be avoided. Relatively narrow natural surface trails are excellent for multiple user types. The narrower trails can provide the user with a "wilderness" experience, even in relatively dense urban areas. They are easily constructed and maintained with a small labor force using only hand tools, and result in minimal impacts to forest resources.

Trails that accommodate handicapped access are not specifically addressed in this section, because their design and construction specifications are narrowly defined in the literature. This section specifically addresses the trails that are not designated to be ADA compliant.

8.1.1 Trail Issues

There are four major temporary and potentially chronic impacts associated with trail construction and trail use. These are the impacts to existing vegetation, wildlife, water resources, and soil (IMBA, 2007). Careful trail planning, design and maintenance will lessen these impacts and result in durable trail system that will serve the public needs and provide a quality recreational experience.

8.1.1.1 Vegetation

During the initial construction of a trail and during the creation of a user-generated "informal" trail, vegetation will be trampled. In addition, trail creation can result in some breaching of the forest canopy. This breaching can increase light penetration to the forest floor and change the microclimate, creating niches for plant species more adapted for sun and heat.

To minimize trampling of vegetation and breaching of the forest canopy, it is important to construct the trail only wide enough for the intended use. It is also important to design trails that lead the users to points of interest. Otherwise, trail users often create their own informal trails that often follow poorly executed routes and result in increased trampling of vegetation.

8.1.1.2 Wildlife

Trails that run through large stands of interior forest and deep within natural areas bring humans in contact with wildlife. Humans, and more often their unleashed pets, can disturb wildlife. Wildlife generally detect humans well before they are within sight. This disturbance disrupts daily activities such as foraging, searching for mates, and avoiding more significant predators. As a result, these stresses can reduce the ecological fitness of the wildlife. Repeated disturbance will cause more sensitive wildlife to relocate to more suitable habitat if it is available.

Some less sensitive wildlife can become habituated to repeated disturbance from humans. In some cases the wildlife such as deer can adapt to the presence of humans with little issue. Other wildlife learn to associate humans with food and can become a nuisance. This habituation is detrimental to both humans and wildlife. Animals suffer from consuming poor quality food, while humans can become less

appreciative of wildlife. In extreme cases, dangerous animals such as bears can become too accustomed to close proximity with humans.

When designing a trail, it is important to avoid areas that are known habitat for particularly sensitive wildlife species. If critical habitat cannot be avoided, full- or partial trail closures can be instituted during critical breeding and rearing seasons. Leash laws for dogs should be enacted and enforced and trail users should be well-educated about the problem of perpetuating nuisance animal behavior when they provide handouts to wildlife.

8.1.1.3 Water Resources

At some point on their alignment, nearly all trails follow along or cross water features. Trails that are poorly designed around or through water features can impact wetlands and streams, and become conduits for delivering sediments, nutrients, and pathogens to the water body. Trails that cross streams can also become management headaches, as trail/stream crossings frequently exhibit bank and/or streambed erosion.

When crossing small, headwater streams it is best to align the trail as far upstream as possible in the narrowest section of stream channel. Crossings should run through a section of channel that is naturally armored with a cobble, or bedrock riffle. Consider constructing additional armoring depending on the proposed trail use. Trail features such as rolling dips or knick points should be constructed on the trail to drain water before the trail crosses the water body. Where possible, trails should follow the contours along the adjacent valley wall and kept off the floodplains that are generally poorly drained and wet during long periods of the year. Trials through wetlands should be avoided. Choose the narrowest point if wetlands must be crossed.

8.1.1.4 Soil

There are four common impacts to soil associated with natural surface trails. These are compaction, muddiness, displacement, and erosion. Compaction of the trail tread is necessary to maintain a durable trail surface. Soil compaction becomes problematic when a trail is overly wide. Compacted soils do not absorb moisture, thus an overly wide trail will produce higher quantities of stormwater run-off, and thus more potential erosion. An overly wide compacted tread will also impact more vegetation. Once soil has been compacted it must be augmented to reestablish vegetation in a reasonable time.

Muddiness occurs on trails that are poorly drained and hold water for extended periods of time. Muddy trails promote excessive tread widening, as trail users tend to walk around muddy and chronically wet areas. Trails that are properly designed and constructed will shed water and are relatively firm even after periods of rain. To prevent mud, trails should be constructed along contours using a 5% outslope (USDA, 2007). This will help shed water and result in quick drying trails. Flat areas, depressions, and floodplains should be avoided when constructing trails.

Soil displacement occurs when loose surface soil is carried off the center of the trail tread, or when this soil is pushed laterally to the side of the tread. This results in a “bermed” or “cupped” trail. Bermed and cupped trails collect and channel water causing trail erosion and mud. Informal trails often exhibit the worst cupping (i.e. erosion and mud) because the surface material has not been removed during creation (IMBA, 2007). To prevent cupping, the loose organic material and topsoil should be removed from the tread surface during new trail construction. Existing trails should be checked annually for signs of cupping and be de-bermed where necessary. These materials are easily displaced under user traffic.

Excessive trail soil erosion is the result of water collecting flowing on the trail surface with enough volume and velocity to carry away soil. This results in a degraded trail surface and potential impacts to water resources. Unless they are built on solid rock, trails that run directly up and down the fall line of a slope are prone to erosion and generally cannot be maintained over time. Therefore fall line trails should be avoided when possible. It is best to construct "contour" trails that follow along the sideslope of a hill. These trails are characterized by having a gentle grade (10% average) and have a series of brief undulations, or elevation changes called grade reversals (USDA, 2007). Contour trails are also outsloped 5% from the face of the hill to aid in sheeting water off the trail during rain events. These trails disperse and shed water in a non-erosive manner. In addition contour trails can enhance the user experience. The short turns and elevation changes when combined with vegetation can shorten lines of sight. This can give the user a feeling of truly being in the wilderness.

8.1.2 General Best Management Practices

Best Management Practices include:
-prevent off trail use/informal trails
-understand ecological resources and make decisions on unique features that the public should visit, and sensitive areas that should be avoided (e.g. scenic vistas and champion trees)
-limit trail width to that necessary for the intended use
-meander trails to limit lines of site to enhance the "wilderness experience"
-implement regulations that discourage or prevent trail use during wet and muddy conditions
-avoid wetlands and water crossings where possible

8.1.3 Specific Trail Construction Guidelines

Specific trail construction guidelines include:
-10% rule (try to keep the slope of the trail ≤10% wherever possible)
-unless the trail is solid rock then the maximum slope over any length should be ≤15%
-scrape away the organic layer and topsoil to build trail on more durable mineral soil
-avoid the fall line and build contour trials
-never construct a trail with a slope greater than ½ of the uphill sideslope (the half rule, USDA, 2007)
-outslope trails 3-5%
-shed water prior to water crossings if they can't be avoided

8.2 Maintenance

The primary advantage of natural surface trails is that the majority of regular maintenance can be performed with a small labor force, using hand tools. Mechanized equipment and large labor forces are rarely required.

Maintenance practices will range from routine pruning of overhanging and intrusive vegetation, to occasional reclamation and rerouting of trails. Some general trail evaluation and maintenance practices are listed below.

- evaluate trails promptly after major storm events for blowdown and deadfall that should be cleared
- evaluate trails in the late spring and after heavy rain to identify chronically muddy, or eroding/degrading. Determine if the issue can be corrected locally, or if a section of the trail should be reclaimed and rerouted.
- annually inspect trails for signs of cupping/berming and perform corrective maintenance

The amount and type of trail use will determine the level of maintenance required to ensure a positive user experience.

9.0 Invasive Species Management

The intent of the content of this section is to propose a work prioritization model that can be used by the Parks and Recreation staff in assessing the relative level of risk of biological invasion at the Park and to provide an aid in determining the allocation of limited resources for control.

Invasive species abundance within the Park is closely correlated to disturbance regimes. Historically, disturbances were most likely the result of agriculture, other previous landowner activities and flooding. Today, disturbances can come from varied sources, but include white-tailed deer herbivory, flooding from the Neuse River, infrastructure modifications, and ongoing park maintenance. Based on past history and levels of disturbance, there is high spatial variability in the levels of non-native invasive (NNI) species infestation. Where invasive species are the most dense on the site, they negatively impact forest regeneration and the quality of wildlife habitat. They will also have a direct negative impact on park visitor experience.

Invasive species management is composed of three main components, site assessment, treatment strategy and monitoring. A comprehensive site assessment is essential to defining the extent of the problem, and thus formulating a strategy for treatment. Effective monitoring of the site is needed to evaluate the treatment strategies and to maintain desirable native vegetation.

9.1 Assessment

A comprehensive assessment of what NNIs are present, where they are and their densities are a first and critical step in NNI control. A system that not only maps the location and extent of the infestations but also provides information on species present and densities is required. A working knowledge of invasive species identification and field mapping skills are necessary for this task. Information could potentially be collected by trained volunteers equipped with relatively low-cost GPS units. A map, with polygons showing the location of infestations and descriptive information on species presence and densities is one goal of the assessment. The other goal is a ranking of infested areas. The ranking should include information on the level of infestation, but also include a ranking of the general ecological importance of the area in which the infestation occurs. For example, rankings for infestation level might be as follows:

Low Level	<5 percent cover
Medium Level	5 percent – 20 percent cover
High Level	> 20 percent cover

or some other type of density/percent cover metric.

And rankings for ecological importance might be:

Low Level	Relatively young forest with low/moderate species diversity (1-4 species recorded)
Medium Level	Moderately mature forest with moderate to high species level (≥ 4 species recorded)
High Level	Mature forest

or some other type of descriptive metrics that convey information about the infestation location and its ecological value.

From the map and vegetative information obtained from the field investigation, the problem areas can be ranked for treatment based on the intensity of infestation vs. the ecological importance of the vegetation in their location. Using this approach, the best ecological assets are protected and the other areas are treated in a systematic way, as budget allows.

9.2 Treatment Strategy Development

Once accurate mapping of where NNIs are located and information describing the species present and their densities is available, strategies for treatment can be developed. From past experience, and from working with park managers across the U.S., Biohabitats has found that the majority of NNI control strategies are developed based on park visitors' complaints, ease of access to the infested area, and cost. Often, a great deal of energy and funds are spent on the perceived worst infestations, and budgets are expended on those areas without the benefit of knowing the status of the total extent of infestation or the valuable ecological assets that may be at risk. A strategy based on a comprehensive knowledge of the infestation(s) and a prioritized approach to treatment is not the norm.

A recent development in invasive species management has been the "protect the best first" principle that targets protecting the most valuable ecological assets first, then progresses from the most valuable down the rankings towards progressively lower ecologically ranked sites. This strategy assumes that mapping and rankings have been done, and the budget can be expended protecting the most important resources, based on the rankings. Treatment prescriptions can be formulated based on location and budget considerations.

9.3 Monitoring

The battle against invasive species is ongoing and permanent. Any lapse in monitoring provides an opportunity for NNIs to reestablish and degrade habitat. Without vigilance in monitoring, past gains can be lost and future budgets are depleted by the need for retreatment. A regular schedule for monitoring invasive species at the Park is an essential part of managing the wildlife habitat for sustainability.

9.4 Recommendations

- Adopt a goal of "protect the best first" that targets high value sites for restoration.
- Implement prioritization of site treatment using a scoring system model based upon ecological value, invasive threat, and cultural use.
- Undertake the development of a systematic assessment of park ecological assets and liabilities using both professional and volunteer resources.
- Institute a phased treatment program for prioritized sites that utilizes contractual, internal, and volunteer resources appropriate to the level of intervention required.
- Practice prevention through the adherence and enforcement of best management practices for operations and maintenance for control of the spread of NNI's.
- Seek deferred and yearly maintenance funding for invasive control consistent with scale of threat.
- Support a reduction in the county-wide population of white-tailed deer to levels consistent with the ecological carrying capacity.
- Disseminate invasive plant information to public stakeholders.

10.0 Forest Regeneration and Deer Management

The survival of forest understory seedlings and saplings is essential for forest regeneration. In a healthy mature forest, when older trees die, seedlings and saplings are in place to occupy the available space, capture the sunlight and grow, thus ensuring that the forest will maintain itself. If viable native species seedlings are not present in the forest understory when mature trees die and canopy gaps occur, the resultant increase in sunlight reaching the forest floor can trigger rapid growth of invasive species or less desirable weedy native species. A key component of forest sustainability is self-regeneration.

10.1 Site Regeneration Assessment

Data from the vegetation surveys can be used to determine if sufficient seedlings are available for forest regeneration. If the vegetation data collected in the forested areas indicate that the seedling strata is very sparse or absent, then strategies must be implemented to enhance this strata.

10.2 Deer Management Options

Since the 1950s, white tailed deer populations have increased in many areas within North Carolina (North Carolina Wildlife Resources Commission, 2010). This increase in population has negatively affected forest regeneration. Presently, the deer population in and around Horseshoe Farm Park appears to be excessive, as indicated by limited natural regeneration due to high deer browse (City of Raleigh Parks and Recreation, 2010). Therefore, management of the deer population will be needed to ensure forest regeneration and the sustainability of the Significant Natural Heritage Area forest (City of Raleigh Parks and Recreation, 2010).

While there are several options to consider for deer management at Horseshoe Farm Park, some prove to be more effective than others. These options include live capture, contraception, repellents, frightening, exclusion and shooting.

10.2.1 Live Capture

Live capture is an option where deer can be relocated to another area that can support their population. Deer can be captured using rocket nets, drop-door box traps, portable paddock traps, or tranquilizer guns. However, all of these methods are time-consuming, expensive, and require professional expertise (Craven and Hygnstrom, 1994; North Carolina Wildlife Resources Commission, 2010). Tranquilizer guns in particular may be a public safety concern if the shot misses the deer and the dart is lost, potentially to be found later by a hiker or visitor (North Carolina Wildlife Resources Commission, 2010).

Live capture may not be an effective method of deer management at Horseshoe Farm Park for several reasons. Live capture of deer can be difficult and expensive. If the project site is located next to an area with a high deer population, it is expected that other deer will move into the area to replace those captured. In addition, the survival rate of deer after live capture is low because of the stress from the trapping, transportation, and adapting to the new environment (North Carolina Wildlife Resources Commission, 2010).

10.2.2 Contraception

Chemical fertility control to reduce or eliminate reproduction within the deer population has been researched in the past (Craven and Hygnstrom, 1994). The administration of the contraceptive chemical has proven to be very labor intensive requiring capture and hand-injections. Also, the effectiveness of the contraceptives has had poor to no result in preventing pregnancy in does (NJ Division of Fish and

Wildlife, 2010). Until chemical fertility control is improved, it is not an effective control for large areas such as Horseshoe Farm Park.

10.2.3 Repellents

Repellents are used as a method to keep deer away. To work effectively, repellents must be used at the start of the problem before the deer become accustomed to browsing the property. The success of repellents is measured by its ability to reduce damage from deer browse; it is not expected to totally eliminate damage (Craven and Hygnstrom, 1994).

There are two types of repellents: contact and area. Contact repellents are applied directly to the vegetation and repel deer by taste. Area repellents are applied in the vicinity of or along the perimeter of vegetation to be protected and repel deer by odor. Typically, contact repellents are more effective than area repellents (Craven and Hygnstrom, 1994).

The effectiveness of repellents will depend on the weather and food stress. Most repellents wash off with rain and may need to be reapplied after a rain to remain potent. Even in the absence of rain, repellents can weaken over time requiring reapplication. Also, deer may ignore the taste and odor repellents if they are hungry and more palatable food sources are limited (Craven and Hygnstrom, 1994). While the high cost and variable effectiveness may make control and area repellents less practical for large areas (Craven and Hygnstrom, 1994), repellents may work effectively on smaller newly planted zones at Horseshoe Farm Park. Also, repellents may be effectively used at Horseshoe Farm Park when applied in combination with other effective deer management options.

10.2.4 Frightening

Similar to repellents, frightening devices must be used at the start of the problem and before deer have established movement and behavioral patterns. Frightening devices are most effective used when the vegetation is most vulnerable (Craven and Hygnstrom, 1994).

Gas exploders, a type of frightening device, can be detonated at regular intervals within a project site to deter deer damage. To avoid deer from becoming accustomed to the noise pattern, the gas exploders should be moved every few days and exploded in different sequences. To increase effectiveness, motion-activated mechanisms are being tested (Craven and Hygnstrom, 1994).

Frightening devices are considered only a temporary control method and may not be an effective option when used alone. However, frightening devices may be effective at Horseshoe Farm Park when used in combination with other deer management options.

10.2.5 Exclusion

Exclusion of deer by fencing is the most consistent control option to effectively minimize deer damage. There are several types of fences such as temporary electrical fence, permanent high-tensile electrical fence, and permanent woven-wire fence that can be used depending on the situation. Fencing in general can be expensive, potentially requiring a cost-benefit analysis. Fencing is considered to be practical for 40 acres or less because the cost per acre decreases. For acreages larger than 40 acres, the cost effectiveness of the fencing should be compared to the value of the vegetation to be protected, the associated acreage, the fencing type, maintenance of the fencing, and life expectancy of the fencing (Craven and Hygnstrom, 1994).

A temporary electrical fence is inexpensive and easily constructed requiring only weekly inspections and maintenance. When deer are shocked by the fence after being lured to it by the smell and appearance, the deer learns to avoid the fenced area. Some examples of temporary electrical fences include peanut butter fence and polytape fence (Craven and Hygnstrom, 1994). Permanent high-tensile electrical fences are more expensive than temporary electrical fences due to stricter construction guidelines and frequent inspection and maintenance; however, these fences provide year-round protection from deer damage and last approximately 20 to 30 years. Offset and double fence, vertical deer fence, and slanted seven-wire deer fence are examples of permanent high-tensile electrical fences (Craven and Hygnstrom, 1994). Similar to permanent electrical fencing, permanent woven-wire fences are expensive, difficult to construct, offer year-round protection, and are expected to last approximately 20 years. The one difference is permanent woven-wire fences require less maintenance. Regardless of the fence type, quality fence products, proper fence installation and regular inspection and maintenance are important to ensuring effectiveness and longevity (Craven and Hygnstrom, 1994). The type of fence should be selected based on the type of vegetation and the size of area to be protected.

The size and layout of the wildlife habitat zones are not conducive to fencing as an option for deer management. In addition fencing might have a negative impact on park visitor's experience at Horseshoe Farm Park. However, an option for incorporating exclusion at Horseshoe Farm Park could be to have a graduate student from a local university install a deer exclusion fence to determine the amount of natural regeneration that would be taking place at Horseshoe Farm Park without extreme deer pressure (City of Raleigh Parks and Recreation, 2009).

10.2.6 Shooting

The most effective option for managing deer population and damage may be through the use of legal deer season (Craven and Hygnstrom, 1994). Using sportsmen during the regular hunting season is both effective and economical (NJ Division of Fish and Wildlife, 2010). To successfully reduce deer populations, several hunting management techniques can be used such as increasing the bag limits, offering antlerless- (does and fawns) only permits, and either-sex seasons (Craven and Hygnstrom, 1994). Prior to allowing hunting, a desirable population level for deer should be determined for the project area.

Hunting on Horseshoe Farm Park could be managed by allowing hunting only at regulated times to avoid conflicts with educational programs or by suspending educational programs for a few weeks during the legal hunting season. Another option to encourage safety at Horseshoe Farm Park is to select sportsmen based on their safety and efficiency record. These sportsmen could also be trained as volunteers to maintain the deer population at Horseshoe Farm Park (NJ Division of Fish and Wildlife, 2010).

Another option, though potentially more expensive, may be hiring a company of trained professionals to hunt deer outside of the legal deer season with no bag limits. This option would need to be approved by the appropriate state agencies and could require applying for a permit (NJ Division of Fish and Wildlife, 2010).

10.2.7 Conclusion

Live capture and contraception are the least viable deer management options and are not recommended for use at Horseshoe Farm Park. While not as effective individually, repellents and frightening devices could be used in combination with other effective deer management options, such as shooting. Exclusion, while a viable option for deer management, is not suitable for Horseshoe Farm

Park's size and layout of wildlife habitat zones. The most effective and economical deer management option for Horseshoe Farm Park is shooting which could utilize sportsmen during the legal deer season.

11.0 Monitoring

Vegetation surveys, if performed regularly, should provide sufficient information with which to monitor the forest regeneration status and the need for deer browse control.

12.0 Conclusions and Recommendations for Further Action

The environmental stewardship goal envisioned for Horseshoe Farm Park is commendable. It will protect valuable existing ecological assets. It will also return large sections of the land area in the park to a more natural vegetative state, improving wildlife habitat and providing opportunities to view native plants and animals in their natural environment. It will also require a great deal of work.

The WHZAT Team has done an excellent job of framing goals for the park. This management plan maps strategies for achieving the WHZAT Team goals. The WHZAT Team's recommendations protect existing valuable ecological assets such as the Significant Natural Heritage Area, the pristine wetlands and the giant cane areas. They also provide a vision for converting non-native pasture into native habitat areas that will offer excellent opportunities to interact with nature at the park, such as a butterfly meadow and native warm season grasslands.

A plan to assess and control invasive species, which works on a practical level, is very important to the ecological success of the park. The assessment and monitoring of natural regeneration in the Significant Natural Heritage Area forest is also an important component of the stewardship of the park's ecological assets. Control of the deer population and the deer's adverse effect on natural regeneration of vegetation is also very important to the long-term health of the Significant Natural Heritage Area forest.

During the process of investigating and composing this management plan, the names of several people were noted as having specialized expertise or equipment that may be very useful to the City staff in establishing, operating and monitoring the status of Horseshoe Farm Park. Their contact information is listed below.

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Charles Yelton has been instrumental in the establishment and maintenance of the Prairie Ridge Ecostation, and has agreed to assist in matters concerning Horseshoe Farms Park.

These professionals have first-hand experience in NWSG establishment and maintenance, and will be valuable sources of information and insight as the Park is planned, established and operated.

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14.0 Appendices

Appendix A

Horseshoe Farm Park: 146.26 Acres - WHZAT Zones

05/07/2009

Fee

Appendix B

INTERIM ENVIRONMENTAL ASSESSMENT REPORT

Horseshoe Farms Park Site
Wake County, North Carolina

ESI Project ER04-122

Prepared for:

City of Raleigh
Parks and Recreation Department

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March 2005

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1.0 INTRODUCTION

This Interim Environmental Assessment Report is submitted to the City of Raleigh (the City) Parks and Recreation Department to provide documentation for the Horseshoe Farms Park Site. Environmental Services, Inc., (ESI) of Raleigh, NC was asked by the City to provide baseline natural and cultural resource documentation to help guide the City's efforts in developing the site as a public park. This report will be provided to the master plan committee for use in guiding their site design. As requested by the City, this report contains information on the following categories: wetland delineation, GPS mapping, rare and protected species, plant and animal community inventory, initial cultural resource assessment, and critical natural elements. Portions of this report are incomplete, primarily the vegetation list, wildlife list, and the heritage tree list. The vegetation and wildlife list will continue to be expanded as the 2005 growing season begins. Additional information is contained in this report for use if state or federal permitting is required for this project; this report will supplement the permit application.

1.1 Project Description

The proposed project involves developing the Horseshoe Farms Park Site into a public park. The project is located northeast of Raleigh in Wake County, North Carolina, and covers approximately 146 acres. The specific location is 2928 Horseshoe Farms Road, on an oxbow of the Neuse River upstream of the US 401 bridge. Please refer to **Figure 1** for a location map of the project study area. The project study area was held as a private parcel with residence until being acquired by the City.

1.2 Background Research

Published information and resources were collected prior to initiating the field investigation. Information sources used to prepare this report include, but are not limited to, the following:

- United States Geological Survey (USGS) quadrangle map (Wake Forest, NC, 1993)
- United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) Map (Wake Forest, NC, 1995)
- *Soil Survey of Wake County, North Carolina* (USDA 1970).
- North Carolina Department of Environment and Natural Resources- Division of Water Quality, Neuse River Basinwide Water Quality Plan (DWQ 2002) and <http://h2o.enr.state.nc.us/bims/Reports/reports.html>
- USFWS list of protected and candidate species (USFWS 2005)
- North Carolina Natural Heritage Program (NHP) records review (NHP 2005)

NHP files were reviewed on 28 December 2004 for documented sightings of species on state or federal protected species lists and locations of significant natural areas.

The field investigation was initiated in December 2004. Jurisdictional wetlands were delineated and mapped with GPS technology. Water resources were identified and their physical characteristics were recorded. For the purposes of this study, a preliminary habitat assessment

was performed within the project study area, including the Neuse River. Plant communities and potential associated wildlife were identified using a variety of observation techniques, including active searching, visual observations, and identifying characteristic signs of wildlife (sounds, tracks, scats, and burrows). Terrestrial community classifications generally follow Schafale and Weakley (1990) where appropriate and plant taxonomy follows Radford *et al.* (1968). Vertebrate taxonomy follows Rohde *et al.* (1994), Conant and Collins (1998), Palmer and Braswell (1995), and Webster *et al.* (1985).

Jurisdictional wetlands were identified using the three-parameter approach (hydrophytic vegetation, hydric soils, and hydrology) outlined in the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987). Wetlands were classified based on Cowardin *et al.* (1979). Wetlands were mapped with sub-meter Trimble Global Positioning System (GPS) equipment at the time of the delineation.

1.3 Terminology and Definitions

For the purposes of this report, the following terms are used for describing the limits of the environmental assessment. "Project study area" denotes all areas within the Horseshoe Farms Park Site property boundaries as depicted on maps provided to ESI during the kickoff meeting held with the City on 22 November 2004. The "project vicinity" is an area extending 1 mile on all sides of the project area, and "project region" is an area equivalent in size to the area represented by a 7.5-minute USGS quadrangle map (about 61.8 sq miles) with the project study area occupying the center position. When referring to stream banks, "left bank" and "right bank" are relative to an observer facing downstream.

2.0 PHYSICAL RESOURCES

Soil and water resources that occur in the project study area are discussed with respect to possible environmental concerns and also with respect to general environmental conditions that may be useful during plan development potential permitting scenarios.

2.1 Regional Characteristics

The project study area lies in the central portion of North Carolina within the Piedmont physiographic province. Elevations in the project study area range from approximately 170 feet to approximately 240 feet above mean sea level (USGS 1993). Topography within the project study area ranges from generally flat to moderate slopes along the edge of the Neuse River floodplain. The North Carolina Floodplain Mapping Information System (2004) indicates that the floodplain forest located within the project study area is located within the 100-year floodway.

2.2 Soils

Information about soils in the project study area was obtained from the *Soil Survey of Wake County, North Carolina* (USDA 1970). There are seven (7) soil-mapping units that are expected to occur within the project study area. An assessment was made to determine if any hydric soils

occur within the project study area. A hydric soil is defined as a soil that is saturated, flooded, or ponded long enough to develop anaerobic conditions in the upper part. The USDA identifies hydric soil mapping units as either Class A or Class B (USDA 1991). Class A mapping units are all hydric or have hydric soils as a major component. There are no Class A hydric soil mapping units within the project study area. Class B soil-mapping units are predominantly non-hydric soils that may have hydric soil inclusions or wet spots. There are three (3) Class B soil-mapping units within the project study area. The remaining four (4) soil-mapping units are classified as non-hydric soils. The following information describes the seven (7) soil-mapping units that occur in the project study area. Refer to **Figure 2** for a map depicting the soil-mapping units within the project study area boundaries.

- **Altavista fine sandy loam, 0 to 4% slopes (AfA)** is mapped in upland areas along the southern portion of the pasture and up slope of the Neuse River floodplain. This nearly level to gently sloping, moderately well drained soil has moderate permeability with flooding occurring infrequently. The seasonal high water table is approximately 2.0 feet below the ground surface. Altavista fine sandy loam is a Class B soil-mapping unit indicating that it may contain hydric soil inclusions or wet spots.
- **Appling sandy loam, 2 to 6% slopes (ApB)** is mapped in upland areas in the northern portion of the pasture area. This nearly level to gently sloping, well-drained soil has moderate permeability. The seasonal high water table is generally greater than 10.0 feet below the ground surface. Appling sandy loam is a non-hydric soil.
- **Cecil sandy loam, 2 to 6% slopes (CeB)** is mapped in upland areas in the northern portion of the pasture area. This nearly level to gently sloping, well-drained soil has moderate permeability. The seasonal high water table is generally greater than 10.0 feet below the ground surface. Cecil sandy loam is a non-hydric soil.
- **Congaree silt loam (0 to 2% slopes) (Co)** is mapped in the Neuse River floodplain areas. This nearly level, well-drained soil has moderate permeability. The seasonal high water table is approximately 2.5 feet below the ground surface. Congaree silt loam is a Class B soil-mapping unit indicating that it may contain hydric soil inclusions or wet spots.
- **Faceville sandy loam, 2 to 6% slopes (FaB)** is mapped in the center of the project study area within the pasture area. This gently sloping to sloping, well-drained soil has moderate permeability. The seasonal high water table is generally 10.0 feet below the ground surface. Faceville sandy loam is a non-hydric soil.
- **Wahee fine sandy loam (0 to 2% slopes) (Wh)** is mapped in the center portion of the project study area within the pasture area. This nearly level to gently sloping, somewhat poorly drained soil has slow permeability. The seasonal high water table is approximately 1.5 feet below the ground surface. Wahee fine sandy loam is a Class B soil-mapping unit indicating that it may contain hydric soil inclusions or wet spots.
- **Wedowee sandy loam, 2 to 6% slopes, eroded (WmB2)** is mapped in the north-central portion of the project study area near the existing gate. This gently sloping, well-drained soil has moderate permeability. The seasonal high water table is generally greater than 10.0 feet below the ground surface. Wedowee sandy loam with 2 to 6% slopes is a non-hydric soil.
- **Wedowee sandy loam, 6 to 10% slopes, eroded (WmC2)** is mapped in side slope, upland areas in the northern portion of the project study area within the pasture. This gently sloping to moderately sloping, well-drained soil has moderate permeability. The seasonal high water

table is generally greater than 10.0 feet below the ground surface. Wedowee sandy loam with 6 to 10% slopes is a non-hydric soil.

- **Wedowee sandy loam, 15 to 25% slopes (WmE)** is mapped on the east and west sides of the pasture area in the moderately sloping transitional areas between the uplands and Neuse River floodplain. This gently sloping to moderately steep, well-drained soil has moderate permeability. Wedowee sandy loam with 15 to 25% slopes is a non-hydric soil.

2.3 Water Resources

This section contains information concerning water resources located adjacent to or within the project study area. Water resources assessments include the physical characteristics, Best Usage Classifications (BUC), and water quality aspects of the water resources located within the project study area and project vicinity.

Physical Characteristics of Surface Waters
The project study area is located within sub-basin 030402 of the Neuse River Basin (DWQ 2002) and is part of USGS hydrologic unit 03020201 (USGS 1974). Within the project study area the Neuse River ranges from approximately 80 to 105 feet in width. The project study area is located in a large "horseshoe" meander of the river as it flows in an overall easterly direction. The banks of the Neuse River are about 6 to 10 feet high, nearly vertical to moderately sloping, and moderately to heavily vegetated. There is extensive floodplain present within the project study area. Near the banks, the substrate consisted of silts, sands, and other alluvium.

A small, unnamed tributary (UT) of the Neuse River is located along the entrance road and flows in a southerly direction out of the project study area toward the river. This stream channel outfalls from a mad-made pond located on the north side of the entrance road. It is mapped as intermittent on the USGS map, however closer inspection reveals that it may be perennial due to the outfall from the upstream ponds outside of the project study area. This feature is less than 6 feet wide with a bank height of 2-3 feet.

Best Usage Classification
Surface waters in North Carolina are assigned a classification by the DWQ that is designed to maintain, protect, and enhance water quality within the state. Best Usage Classifications (BUC) and Stream Index Numbers (SIN) follow Classifications and Water Quality Standards published for each river basin. The portion of the Neuse River [SIN # 27-(22.5)] adjacent to the project study area has been assigned a BUC of Class **C, NSW** from the Town of Wake Forest proposed water supply intake to the mouth of Beddingfield Creek (DWQ 2005).

Class **C** water resources are freshwaters protected for secondary recreation, fishing, aquatic life (including propagation and survival), wildlife, and agriculture. Secondary recreation is any activity involving human body contact with water on an infrequent or incidental basis. There are no restrictions on watershed development activities. The **NSW** supplemental designation is a classification intended for waters needing additional nutrient management. This is due to their being subject to excessive growth of microscopic or macroscopic vegetation.

No waters classified as High Quality Water (HQW), Water Supplies (WS-I or WS-II), or Outstanding Resource Waters (ORW) occurs within 1.0 mile of the project study area (DWQ 2005). The Neuse River within the project vicinity has not been listed as impaired waters according to the 303(d) list (DWQ 2004).

3.0 BIOTIC RESOURCES

Terrestrial and aquatic communities are included in the description of biotic resources. Living systems described in the following sections include communities of associated plants and animals. These descriptions refer to the dominant flora and fauna in each community and the relationships of these biotic components. Descriptions of the terrestrial systems are presented in the context of plant community classifications. These classifications follow Schafale and Weakley (1990) where possible. Representative animal species that are likely to occur in these habitats (based on published range distributions) are also cited. Scientific nomenclature and common names (when applicable) are used for the plant and animal species described. Subsequent references to the same species are by the common name only.

Vegetation Survey

ESI is in the process of compiling a woody and herbaceous vegetation list for the Horseshoe Farms Park Site. **Appendix A** contains the vegetation list that has been compiled to date, which contains mostly woody species identified during the initial field investigation. The list will be expanded to include more herbaceous species upon the start of the 2005 growing season.

Heritage Trees

The Horseshoe Farms Park Site contains a large number of mature hardwood trees of various species as well as some very large pines. Many of these trees have been identified as "Heritage Trees", which are defined as a canopy tree with a diameter at breast height (DBH) of 36 inches or greater or a mid-canopy tree with a DBH of 10 inches or greater. These heritage trees are located primarily within the floodplain forest adjacent to the Neuse River. The Final Report will contain a list of the heritage trees in **Appendix B** along with their location coordinates and a reference map depicting their approximate locations. ESI is in the process of continuing to identify and map Heritage Trees.

Wildlife

Each of the communities encountered within the Horseshoe Farms Park Site share certain wildlife species, while other species may require certain habitat types. ESI is in the process of compiling a wildlife list that will contain data for observed or anticipated mammals, reptiles, amphibians, birds, and fish (**Appendix C**).

A large white-tailed deer (*Odocoileus virginianus*) herd has been reported to utilize the project study area. ESI staff has encountered this large deer herd on several occasions. They have always been encountered within the forested portions of the site, although they undoubtedly also utilize the large pasture for a food source. ESI staff has reported seeing up to twenty (20) deer running in one group. This amount of deer can cause significant damage to row crops; however, they do not appear to be causing any damage to the pasture. It is also possible that this large number of deer could have a detrimental effect on newly sprouting herbaceous vegetation within the floodplain. Young buds of deciduous trees are also a favorite food source of deer. It is not feasible to determine the amount of herbivory occurring in the floodplain during the non-growing season. More information may become available upon the start of the 2005 growing season.

3.1 Terrestrial Communities

Five terrestrial communities were identified within the project study area: Pasture, Piedmont Levee Forest, Piedmont Bottomland Forest, Successional Pine/Hardwood Forest, and Maintained/Disturbed (**Figure 3**). Dominant floral components associated with these terrestrial areas will be discussed in each community description.

Pasture

The pasture terrestrial community encompasses the central portion of the project study area. Past and present agriculture practices have continuously maintained this area for either crop or livestock production. Vegetation growing within the pasture community is predominantly a mixture of grasses. Wildlife utilization is likely high as the pasture provides foraging habitat for many herbivorous mammals and birds of prey.

Piedmont Levee Forest

The Piedmont Levee Forest occurs on the natural levee deposits adjacent to the Neuse River. The occasional input of nutrients and new sediment from the river makes these communities very fertile (Schafale and Weakley 1990). The hydrology of the Piedmont Levee Forest is seasonally to intermittently flooded. This community typically grades into swamp forest or bottomland forest as one moves away from the river.

Dominant vegetation found within the Piedmont Levee Forest within the project study area include such species as sycamore (*Plantanus occidentalis*), river birch (*Betula nigra*), tulip poplar (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), American elm (*Ulmus americana*), willow oak (*Quercus phellos*), buckeye (*Aesculus sylvatica*), American holly (*Ilex opaca*), giant cane (*Arundinaria gigantea*), and microstegium (*Microstegium vimineum*). Microstegium is an invasive and exotic grass species.

NHP has identified the Piedmont Levee Forest within the project study area as a N atural Community as well as a Significant Natural Heritage Area (Upper Neuse River Floodplain). Refer to **Figure 4** for a map depicting these NHP features. The Upper Neuse River Floodplain Natural Heritage Area encompasses a large section of the Neuse River, and extends out from the project study area into the project vicinity.

Piedmont Bottomland Forest

The Piedmont Bottomland Forest is located on floodplain ridges and terraces other than active levees adjacent to the river channel. This type of community contains a broad range of hydrologic conditions, related to the height of ridges or terraces (Schafale and Weakley 1990). Piedmont Bottomland Forest is believed to be a stable climax forest type. The fertility and infrequent flooding of these communities have made them excellent choices for agriculture. This has resulted in Bottomland Forests (both Piedmont and Coastal Plain) being one of the rarest natural communities in North Carolina. This particular habitat type in the project study area is intact and appears to be functioning as a climax forest. Herbaceous groundcover is sparse, consisting primarily of shade

tolerant species. NHP recognizes the importance of the Upper Neuse River Floodplain and has identified this floodplain in their inventory database.

Dominant vegetation within Piedmont Bottomland Forest includes such tree and shrub species as tulip poplar, sweetgum, water oak (*Quercus nigra*), laurel oak (*Quercus laurifolia*), red maple (*Acer rubrum*), Southern sugar maple (*Acer saccharum* spp. *floridanum*), winged elm (*Ulmus alata*), beech (*Fagus grandifolia*), flowering dogwood (*Cornus floridana*), black cherry (*Prunus serotina*), loblolly pine (*Pinus taeda*), ironwood (*Carpinus caroliniana*), hop hornbeam (*Ostrya virginiana*), and mockernut hickory (*Carya tomentosa*). Groundcover species consist of ebony spleenwort (*Asplenium platyneuron*), muscadine grape (*Vitis rotundifolia*), laurel-leaf catbriar (*Smilax laurifolia*), Christmas fern (*Polystichum acrostichoides*), Japanese honeysuckle (*Lonicera japonica*), and mock strawberry (*Duchesnea indica*). Japanese honeysuckle and mock strawberry are exotic and invasive species.

Successional Pine/Hardwood Forest

This community is a result of apparent past disturbances within the Piedmont Bottomland Forest just east of the northeast corner of the pasture. Timbering may have occurred in this area historically as evidenced by the dense reestablishment of young pine and hardwood species. Loblolly pine is the dominant species in this area with white oak (*Quercus alba*), water oak, red maple comprising the dominant hardwood component.

Maintained/ Disturbed

This community type is characterized by either current or past human occupation or manipulation. Within the project study area, the area surrounding the existing house and attendant structures represents this community. Vegetation growing within this area is a mixture of native species and ornamentals. The animal species present in these disturbed habitats are opportunistic and capable of surviving on a variety of resources, ranging from vegetation to both living and dead faunal components.

3.2 Aquatic Communities

There are three aquatic communities located within or directly adjacent to the project study area: Floodplain Pool, Neuse River, and the UT of the Neuse River (**Figure 3**). NHP has identified the Floodplain Pools within the project study area as a Natural Community (**Figure 4**). The jurisdictional wetlands that have been delineated in the floodplain contain the Floodplain Pool Natural Communities.

Floodplain Pool

Floodplain pools are depressions in abandoned river channels or floodplains that hold water much or all of the year. These communities are generally surrounded by bottomland or alluvial forest, including Piedmont Levee Forest. Upland slopes may often border these communities on one side (Schafale and Weakley 1990). This community type is represented by bot h jurisdictional wetlands delineated within the project study area.

The larger of the two Floodplain Pools (Wetland 1) located within the project study area is approximately 2.78 acres in size. Dominant vegetation within this Floodplain Pool includes sweetgum, red maple, sedges (*Cyperus strigosus* and *Carex lurida*), and microstegium. An old man-made ditch is located on the northwest side of this wetland and was likely dug in the past to help drain this area. At the time of the delineation, this area contained 3-6 inches of water. The ditch currently contains remnants of a beaver dam that is helping to retain water in the Floodplain Pool. It is assumed that beavers remain active in this area. This wetland area provides beneficial wildlife habitat for many different species known or expected to utilize the area. The smaller of the two Floodplain Pools (Wetland 2) is approximately 0.03 acre in size and is vegetated with a few small sweetgum trees. This small depression appears to be natural and no evidence of human alteration was observed.

Neuse River

Please refer to Section 2.3.1 for a characterization of the Neuse River adjacent to the project study area. This section of the river appears to be a sand and silt dominated system with recent alluvial deposits visible along the riverbanks. The riverbanks appear stable in most area due to a healthy vegetative community (Piedmont Levee Forest). The Neuse River is home to numerous native fish, mussels, reptiles and amphibians. It also provides foraging habitat for wading birds and ducks, as well as semi-

aquatic mammals including beaver and river otter.

UT of Neuse River

The small UT of the Neuse River flows through a culvert under the entrance road leading into the project study area. These small headwater stream systems are vital to the health of downstream water resources such as the Neuse River. They serve as filters and provide food and nutrients to receiving waters. Benthic macroinvertebrates are typically common in small stream systems such as this. These small invertebrates are typically found under leaf packs, root wads, logs, and rocks. They form that base of the food chain that feeds small fish, crustaceans, and amphibians. Benthic macroinvertebrate sampling was not conducted in this UT because the culvert under the road has previously impacted the majority of this channel located in the project study area.

4.0 JURISDICTIONAL ISSUES

Section 404 of the Clean Water Act (CWA) requires regulation of discharges into "Waters of the United States." Although the principal administrative agency of the CWA is the U.S. Environmental Protection Agency (EPA), the ACOE has major responsibility for implementation, permitting, and enforcement of provisions of the Act. The ACOE regulatory program is defined in 33 CFR 320-330.

Water bodies such as rivers, lakes and streams are subject to jurisdictional consideration under the Section 404 program. However, by regulation, wetlands are also considered "Waters of the United States." Wetlands have been described as:

> "Those areas that are inundated or saturated by groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas. [33 CFR 328.3(b) (1986)]."

The ACOE requires the presence of three parameters (hydrophytic vegetation, hydric soils, and evidence of wetland hydrology) in support of a jurisdictional determination.

4.1 Waters of the United States

The Wake Forest, NC NWI map (USFWS 1995) indicates that the Neuse River floodplain is a palustrine forested, broad-leaved deciduous (PFO1) wetland. ESI conducted a field investigation in December 2004 and January 2005 to determine the presence or absence of jurisdictional waters of the United States based on the 1987 U.S. Army Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987). The field investigation results indicate that there are two PFO1 wetlands located within the Neuse River floodplain. These wetlands were delineated and GPS mapped. **Figure 5** depicts the delineated jurisdictional wetlands. **Table 1** provides information on the delineated waters of the United States within the Horseshoe Farms Park Site.

Table 1. Waters of the US within the Horseshoe Farms Park Site.

Feature	Wetland Type	Size (acre)	Hydrology Indicators	Hydric Soil Indicators
Wetland 1	PFO1	2.78 ac	Inundated, water stained leaves, oxidized root channels	Munsell color 2.5Y 4/2 with 10YR 4/6 mottles
Wetland 2	PFO1	0.03 ac	Inundated	Munsell color 2.5Y 5/2 with 10YR 6/8 mottles
UT of Neuse River	Riverine-perennial	na	na	na
Neuse River	Riverine-perennial	na	na	na

PFO1 – palustrine, forested, broad-leaved deciduous

Palustrine Wetlands

Palustrine wetlands are defined as all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas were salinity due to ocean derived salt is less than 0.5 parts per thousand (Cowardin et. al. 1990).

The first PFO1 wetland (W1) is consistent with a Floodplain Pool community and comprises approximately 2.8 acres. This wetland was delineated and mapped with GPS by ESI staff (**Figure 5**). ACOE data forms were completed for this wetland and are included in **Appendix D**. This wetland contains hydrophytic vegetation such as sweetgum, red maple, and sedges. An old ditch is located along the northwest side of this wetland. It was likely intended to drain the wetland, although beavers have partially dammed the ditch.

The second PFO1 wetland (W2) is a small, 0.03-acre depression located within the Piedmont Bottomland Forest community. This wetland is also consistent with a Floodplain Pool community. Although this area is very small, it meets the criteria to be considered jurisdictional and it was delineated and mapped with GPS by ESI staff (**Figure 5**). ACOE data forms were completed for this wetland and are included in **Appendix D**. This wetland is vegetated primarily with sweetgum, which is considered hydrophytic by ACOE.

Riverine Wetlands

The Neuse River and the UT of the Neuse River are considered riverine wetlands pursuant to Cowardin *et al*. (1979). Riverine systems may be perennial or intermittent and are identified as those areas within a channel that are not dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and contain less than 0.5 parts per thousand ocean-derived salts (Cowardin *et al.* 1979). Both the Neuse River and the UT of the Neuse River are waters of the United States and subject to ACOE jurisdiction. Neither of these features was delineated in the field. Existing mapping such as USGS maps accurately depict the location of these features.

Stream Importance
The United States Army Corps of Engineers (ACOE) designates streams as either important or unimportant. Streams that have perennial flow, associated wetlands, significant aquatic fauna, or associated Threatened and Endangered species are generally considered to be important and impacts to these streams would require mitigation. Intermittent streams may be considered important if the associated wetlands, significant aquatic fauna, or Threatened and Endangered species criteria are met. Streams designated as unimportant do not typically require mitigation. Unimportant streams tend to be very small intermittent channels with undefined bed and bank or excavated ditches that have captured groundwater flow. Since the Neuse River is a perennial water body, it is considered important by the USACE. The small channel flowing under the entrance road will also be considered important by ACOE.

ACOE Field Review
ESI met with Ms. Andrea Wade of ACOE on 15 February 2005. The purpose of the meeting was to allow the ACOE to review the wetland delineation as completed by ESI. Ms. Wade reviewed both wetland areas and agreed with the delineation. No changes were made to the wetland lines. Ms. Wade did indicate that the old ditch leading from Wetland 1 towards the Neuse River might also be considered jurisdictional. This ditch will be reevaluated in the growing season and it will be included in the Final Report should it meet ACOE jurisdictional criteria. All ACOE correspondence to date is included in **Appendix D**. A traditional survey will be required if the City wishes to have the delineation validated by ACOE for a period of 5 years. The GPS mapping will be sufficient for planning and if wetland impacts will be avoided.

4.2 Riparian Buffers

The project study area is located within the Neuse River Basin; therefore, streams and surface waters (*i.e.*, ponds, lakes, etc.) depicted on the most recent versions of USGS topographic maps or county soil survey maps are subject to the Neuse River Riparian Buffer Rules. The Neuse River and the UT of the Neuse River are subject to the Neuse River Riparian Buffer Rules. The jurisdictional wetlands are not subject to the buffer rule.

Certain activities within the 50-foot riparian buffer are regulated by DWQ and will require their approval. The riparian buffer consists of two distinct zones. Zone 1 comprises a 30-foot wide area adjacent to the surface water that cannot be disturbed except for those specific activities that are allowed by the Neuse River Riparian Buffer Rules. Zone 2 comprises a 20-foot wide area adjacent to Zone 1 that is to be left undisturbed except for those specific activities allowed by the Buffer Rules. Grading and re-vegetating Zone 2 is allowed provided that the condition of Zone 1 is not compromised.

4.3 Permits

Section 404
Impacts to greater than 0.10 acre of waters of the U.S. will require approval from ACOE pursuant to Section 404 of the CWA. A Nationwide Permit (NWP) can authorize wetland

impact up to 0.5 acre and/or stream impacts up to 300 feet of important channel. Impacts are defined as any discharge of a material into waters of the U.S.

Section 10
Section 10 of the Rivers and Harbors Act protects navigable waters of the United States. The Neuse River is considered to be navigable waters and any impacts to the river will require prior approval from the ACOE pursuant to Section 10.

Section 401
The State of North Carolina is required to monitor and protect the state's water quality as it relates to federal actions (*i.e.* permits). A 401 Water Quality Certification or waiver thereof, from DWQ is required prior to issuance of any federal permit. Section 401 of the CWA requires that the state issue or deny the water quality certification for any federally permitted or licensed activity that results in a discharge into waters of the United States.

4.4 Mitigation

Mitigation has been defined in National Environmental Policy Act (NEPA) regulations to include efforts which: a) avoid; b) minimize; c) rectify; d) reduce or eliminate; or e) compensate for adverse impacts to the environment [40 CFR 1508.20 (a-e)]. Mitigation of wetland impacts is recommended in accordance with Section 404 (b) (1) Guidelines of the CWA (40 CFR 230), FHWA step-down procedures (23 CFR 777.1 et seq.), mitigation policy mandates articulated in the COE/EPA Memorandum of Agreement (MOA), Executive Order 11990 (42 FR 26961) (1977), and USFWS mitigation policy directives (46 FR 7644-7663) (1981).

Section 404 (b) (1) Guidelines, the COE/EPA MOA and Executive Order 11990 stress avoidance and minimization as primary considerations for protection of wetlands. Practicable alternatives must be fully evaluated before compensatory mitigation can be discussed.

Wetland impacts exceeding 0.10 may require compensatory mitigation for ACOE. In accordance with the DWQ Wetland Rules [15A NCAC 2H .0506 (h)] "Fill or alteration of more than one acre of wetlands will require compensatory mitigation; and fill or alteration of more than 150 linear feet of streams may require compensatory mitigation." If the final length of stream impact is greater than 150 linear feet, compensatory mitigation may be required.

5.0 RARE AND PROTECTED SPECIES

5.1 Federal Protected Species

Plants and animals with a federal classification of Endangered (E), Threatened (T), Proposed Endangered (PE), or Proposed Threatened (PT) are protected under provisions of Section 7 and Section 9 of the Endangered Species Act of 1973, as amended. The USFWS lists four species under federal protection that are considered to have ranges extending into Wake County (USFWS 2005). These species are listed below.

Table 2. Federal Threatened and Endangered Species for Wake County, NC.

Common Name	Scientific Name	Federal Status
Vertebrates		
Bald eagle	*Haliaeetus leucocephalus*	T
Red-cockaded woodpecker	*Picoides borealis*	E
Invertebrates		
Dwarf wedgemussel	*Alasmidonta heterodon*	E
Vascular Plants		
Michaux's sumac	*Rhus michauxii*	E

Notes: E Endangered - A species that is threatened with extinction throughout all or a significant portion of its range.
T Threatened - A species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

ESI conducted an internet-based quad search with the North Carolina Natural Heritage Program (NHP) on 17 February 2005 in order to check for updates to the December 2004 database search. The search was intended to determine if any federal protected species have been documented with 3.0 miles of the project study area. **Figure 4** depicts the results of the NHP search. One federal protected plant, Michaux's sumac, has been documented approximately 1.5 miles southwest of the project study area. It was last observed in 1997. No other federal protected species have been documented within 3.0 miles of the project study area. Note that the Neuse River Floodplain within the project study area is considered a Significant Natural Heritage Area. Two representations of Natural Communities also occur within the floodplain: Piedmont Levee Forest and Floodplain Pool.

A brief description of the characteristics and habitat requirements of each species follows, along with a Biological Conclusion regarding potential impact to the species resulting from the project.

***Haliaeetus leucocephalus* (Bald eagle) Threatened**

Bald eagles typically feed on fish but may also take birds and small mammals. In the Carolinas, nesting season extends from December through May (Potter *et al*. 1980). Bald eagles typically nest in tall, living trees in a conspicuous location near water and forage over large bodies of water with adjacent trees available for perching (Hamel 1992). Preventing disturbance activities within a primary zone extending 750 to 1500 feet outward from a nest tree is considered critical for maintaining acceptable conditions for eagles (USFWS 1987). USFWS recommends avoiding any disturbance activities, including construction and tree-cutting, within this primary zone. Within a secondary zone, which starts at primary zone boundary and extends out to a distance of up to 1.3 miles (6,864 feet) from a nest tree, construction and land-clearing activities should be restricted to the non-nesting period. USFWS also recommends avoiding alteration of natural shorelines where bald eagles forage, and avoiding significant land-clearing activities within 1,500 feet of roosting sites.

Biological Conclusion: May Affect; Not Likely to Adversely Effect

Suitable nesting, perching and foraging habitat for the bald eagle is present along the banks of the Neuse River. ESI staff did not observe any nest trees, perching eagles or foraging activity during the several visits to the project study are during the field investigation. NHP does not document any bald eagle occurrences within 3 miles of the

project study area. Although suitable habitat is present for the bald eagle, the proposed project is not likely to adversely affect the species.

***Picoides borealis* (Red-cockaded woodpecker) Endangered**

Primary habitat consists of mature to over-mature southern pine forests dominated by loblolly (*Pinus taeda*), longleaf (*P. palustris*), slash (*P. elliotii*), and pond (*P. serotina*) pines. Nest cavities are constructed in the heartwood of living pines, generally older than 60 years that have been infected with red-heart disease. Nest cavity trees typically occur in clusters, which are referred to as colonies. Pine flatwoods or pine savannas that are fire maintained serve as ideal nesting and foraging sites for this species. Development of a thick understory within a given area usually deters nesting and foraging. Potential nest sites for RCW's include pine and pine/hardwood stands greater than 60 years of age. Hardwood/pine stands (>50% pine) greater than 60 years of age may also be considered potential nesting habitat if adjacent to potential foraging habitat (Henry 1989). Foraging habitat is typically comprised of open pine/mixed hardwood stands over 30 years of age (Henry 1989). Pines must comprise at least 60 percent of the canopy in order to provide suitable foraging for RCW's. Somewhat younger pine stands may be utilized if the trees have an average diameter at breast height (DBH) greater than or equal to 9 inches. Foraging stands must be connected to other foraging areas or nesting areas in order to be deemed a viable foraging site. Open spaces or unsuitable habitat wider than approximately 200 feet are considered a barrier to RCW foraging (USFWS 2003).

Biological Conclusion: No Effect

No suitable red-cockaded woodpecker habitat exists within the project study area. These birds are not associated with hardwood riparian areas. The successional pine/hardwood forest is too young to be considered nesting habitat, and would not be considered foraging habitat due to its isolation from any potential nesting habitat. A search of the NHP files did not reveal any records of red-cockaded woodpeckers within 3.0 miles of the project study area. The proposed project will not affect this endangered species.

***Alasmidonta heterodon* (Dwarf wedgemussel) Endangered**

The dwarf wedgemussel is generally small with a shell length ranging between 25 mm and 38 mm. The historic range of this species was from New Brunswick, Canada to the Neuse River, North Carolina (USFWS 1993a). In North Carolina populations are found in portions of the Neuse and Tar River basins. This mussel species typically inhabits streams with moderate flow velocities and substrates varying in texture from gravel and coarse sand to mud with little silt deposition (USFWS 1993a). In North Carolina they often occur within submerged root mats along stable stream banks. The low numbers of individuals and the restricted range of most surviving populations make then extremely vulnerable to extirpation from a single catastrophic event (Strayer et al. 1996).

Biological Conclusion: May Affect; Not Likely to Adversely Effect

The Neuse River represents potential habitat for the dwarf wedgemussel. Species-specific surveys may be warranted if any impacts to the river or its streambank vegetation are anticipated. The UT of the Neuse River located within the project study area does not contain potential habitat for the dwarf wedgemussel due to disturbances from the existing culvert. Best Management Practices should be strictly enforced during any future

construction on the site in order to avoid any erosion and turbidity issues in the site's receiving waters, as these conditions are detrimental to the dwarf wedgemussel. A search of the NHP files did not reveal any records of dwarf wedgemussel within 3.0 miles of the project study area.

***Rhus michauxii* (Michaux's sumac)** **Endangered**

Michaux's sumac is a dioecious, densely pubescent rhizomatous shrub, generally 2 to 3 feet in height, which produces fruits (drupes) and seeds in late summer (Radford *et al*. 1968). Most populations appear to be monoclonal, consisting exclusively of male or female plants that propagate by way of rhizomes. Michaux's sumac tends to grow in disturbed areas where competition is reduced by periodic fire or other disturbances, and may grow along roadside margins or utility rights-of-way (USFWS 1993b). Michaux's sumac appears to prefer sandy or rocky substrates consisting of basic soils.

Biological Conclusion: Unresolved

Potential habitat for Michaux's sumac occurs along the edge of the existing pasture and along the portions of the entrance road near the gate. These disturbed areas within the project study area are potential habitat for Michaux's sumac, however they do not represent the typical habitat in which the species is encountered. This species has been documented by NHP as occurring within 1.5 miles of the project study area (**Figure 4**) along Perry Creek. A species-specific survey for this species is warranted and it should be conducted during the appropriate survey window (May -October). The survey will document the presence or absence of this federal protected species. Formal consultation with the USFWS will be warranted if the species is encountered.

5.2 Federal Species of Concern and State Status

Federal Species of Concern (FSC) are not legally protected under the Endangered Species Act and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as Threatened or Endangered. **Table 3** includes FSC species listed for Wake County (USFWS 2005, Franklin *et al*. 2004, LeGrand *et al*. 2004) and their state classifications. Organisms, which are listed as Endangered (E), Threatened (T), or Special Concern (SC) on the North Carolina Natural Heritage Program list of Rare Plant and Animal Species are afforded state protection under the State Endangered Species Act of 1987 and the North Carolina Plant Protection and Conservation Act of 1979.

Table 3. Federal Species of Concern (FSC) for Wake County, NC.

Common Name	Scientific Name	State Status	Habitat Present
Vertebrates			
Bachman's sparrow	*Aimophila aestivalis*	SC	NO
Carolina darter	*Etheostoma collis lepidinion*	SC	YES
Southern hognose snake +	*Heterodon simus*	SC	NO
Pinewoods shiner	*Lythrurus matutinus*	W2	YES
Carolina madtom	*Noturus furiosus* pop. 1	SC (PT)	YES
Invertebrates			
Yellow lance	*Elliptio lanceolata*	E	YES
Atlantic pigtoe	*Fusconaia masoni*	E	YES
Green floater	*Lasmigona subviridis*	E	YES
Diana fritillary butterfly	*Speyeria diana*	W2	YES
Vascular Plants			
Bog spicebush	*Lindera subcoriacea*	T	NO
Sweet pinesap	*Monotropis odorata*	SR-T	NO
Flatrock panic grass	*Panicum lithophilum*	SR-T	NO
Carolina least trillium	*Trillium pusillum* var. *pusillum*	E	NO

Sources: Franklin *et al*., 2004; LeGrand *et al*., 2004
Key: T = Threatened – any species which is likely to become and endangered species within the foreseeable future throughout all or a significant portion of its range; E = Endangered – any species whose continued existence is determined to be in jeopardy; SC = Special Concern – species native or once-native to North Carolina which requires monitoring; SC (PT) – Special Concern – Proposed Threatened – species which have been formally proposed for listing as threatened; C = Candidate - species proposed to be listed as endangered or threatened, SR = Significantly Rare – species which are very rare in North Carolina generally with 1-100 populations in the state; SR-T = Significantly Rare – Throughout – species are rare throughout their ranges;
*=Historic record. The species was last observed in the county more than 20 years ago.
+=Obscure record. No date of occurrence (e.g., data from an atlas/dot map) for the species.

NHP has not documented any FSC or state-protected species within the project study area or within 3.0 miles of the project study area. Glade milkvine (*Matelea decipiens*), which is a state-listed Significantly Rare-Piedmont species, has been documented approximately 2.0 west of the project study area. Four-toed salamander (*Hemidactylium scutatum*), a state-listed Special Concern species, has been documented 3.0 miles north of the project study area. Potential habitat for this species is present within the project study area wetlands. Neuse River waterdog (*Necturis lewisi*), a state-listed Special Concern species, has been documented upstream and downstream of the project study area in the Neuse River. The closest location is at the Highway 401 bridge just east of the project study area. This species can be expected to occur in the portion of the Neuse River adjacent to the project study area.

Regulatory protection of state-listed rare plants and animals is only necessary if they are listed as E, T, or SC on the most recent version of the North Carolina Natural Heritage Program list of Rare Plant and Animal Species and if the particular species is documented within the project

study area. The following fish and invertebrate species would receive special protection as a state-listed species and habitat within the project study area consists of the Neuse River: Carolina darter, pinewoods shiner, Carolina madtom, yellow lance, Atlantic pigtoe, green floater. No impacts to these species are anticipated as a result of this project since their habitat is restricted to the Neuse River. No state-listed plant species that would receive regulatory protection will be affected by the proposed project due to lack of suitable habitat.

6.0 CULTURAL RESOURCES

Previous Regulatory Coordination

Mr. David Shouse of the City of Raleigh Parks and Recreation Department sent an email to Renee Gledhill-Earley of the SHPO on 18 May 2004 about the proposed Horseshoe Farms park Site project. In a response letter dated 7 July 2004 addressed to David Shouse (**Appendix E**), the SHPO stated that the proposed park has a high potential for the presence of archaeological resources and recommended a comprehensive archaeological survey be conducted.

Previous Archaeological Investigations

No official archaeological investigations have occurred on the project area. However, two projects have taken place in close proximity to the project area. The first was an archaeological reconnaissance survey for the Neuse River/Perry Creek Sewer Interceptor Project (Hargrove 1986, 1987). This project extended along the west bank of the Neuse River from its confluence with Richland Creek in the north towards its confluence with Crabtree Creek in the south, as well as portions of Perry Creek and Beaverdam Creek. Most of the western bank of the Neuse River across from the project area was subjected to survey, including pedestrian inspection of exposed ground surfaces and shovel testing. One site discovered during the investigation is 31WA523, located across the Neuse River from the project area along Perry Creek.

The second project was an archaeological survey for US 401 and supplemental site testing at two archaeological sites (Maher 1992; Glover 1993). The survey for this project resulted in the recording of two prehistoric archaeological sites (31WA1137 and 31WA1138) on the north side of the Neuse River where US 401 crosses it. Based on the presence of buried Late Archaic and Early Woodland material at 31WA1137, the site was tested to determine its National Register eligibility. Testing revealed deeply buried, stratified archaeological material

Previously Recorded Archaeological Sites

No recorded archaeological sites are located in the project study area. However, a number of archaeological sites have been recorded along the Neuse River upstream and downstream from the project area within the project vicinity and project region. These sites include 31WA575, 31WA155, 31WA523, 31WA1407, 31WA1137, 31WA1138, 31WA657, 31WA789, and 31WA518. Although not officially recorded at the OSA, a prehistoric dugout canoe was reportedly recovered from the east bank of the Neuse approximately 200 meters north of the project area.

Table 4. Archaeological Sites along the Neuse River.

Site Number	Component(s)	Topographic Location	National Register Eligibility?
31WA155	Late Woodland	Terrace	Unknown
31WA523			
31WA1407			
31WA1137	Middle Archaic, Late Archaic, Early Woodland, Late Woodland	Remnant Levee	Eligible
31WA1138	Prehistoric	Hill	Not Eligible
31WA657	Archaic, Woodland, Middle Woodland	Terrace	Not Eligible
31WA789	Archaic, Woodland, Late Woodland	Upland Slope	Unknown
31WA518	Prehistoric	Terrace	Unknown
31WA575	Early Archaic, Woodland	Upland Slope	Unknown

Informant Interview

Amy Sawyer, who lives adjacent to the project area, corresponded with David Shouse of the City of Raleigh in an email on 8 December 2004. In this email, Ms. Sawyer stated that previous owners of the project area had reported to her that large numbers of tools and artifacts had been found after plowing in agricultural fields on the southern half of the property. A representative of ESI met with Ms. Sawyer on 12 January 2005, at which time she relayed the same information. She also stated that a large rock pile is located near the Neuse River on property immediately adjacent to the eastern boundary of the project area. Additionally, Ms. Sawyer showed the ESI representative artifacts collected from her property, including a Guilford projectile point, a small Woodland triangular arrow point, and quartz and rhyolite debitage. She also has a Yadkin ceramic sherd and a large biface preform.

Ms. Sawyer supplied ESI with a copy of a ca. 1950s aerial photograph of the project area (**Figure 6**). In this photo, it is possible to see that almost all of the project area except for steep upland slopes and the floodplain of the Neuse River were used as agricultural land. The photo also shows a now removed historic home was once located at the approximate location of the access gate to the property. Additionally, the photo shows a small (~20 meters in diameter) copse of trees on the scarp or at the base of the scarp leading from the uplands to the terrace near the center of the project area. This copse of trees no longer exists. It is possible that this copse marked the location of a cemetery. It is not unusual for historic cemeteries to be located in agricultural fields and overgrown with trees.

Results of Project Area Reconnaissance

A representative of ESI undertook a limited reconnaissance of the project area on 12 January 2005. This reconnaissance included walking over portions of the project area, as well as the excavation of six shovel tests in selected areas. **Figure 7** shows general landforms located within the project area and the locations of the six shovel tests. The soils map in **Figure 2** and the associated soils description were utilized in determining the general landform types shown in **Figure 7** and discussed below.

Inspection of the floodplain of the Neuse River (**Figure 7**) identified up to four separate levees between the Neuse River and the bottoms of the floodplain. The first levee is located along the bank of the Neuse River and ranges from 1-5 meters in width and 1-3 meters above the floodplain. A trough about 3 meters wide separates the small second levee, which ranges from 1-3 meters in width and is 1 meter above the floodplain, from the first. The third levee, separated from the second levee by an average of 3 meters, is the largest of the four. It ranges between 10-15 meters in width and 1-4 meters in height above the surrounding floodplain. A fourth levee was observed in the southeastern and eastern portions of the floodplain around where the Neuse River turns northward. This levee is separated from the third levee by about 10 meters, varies in width from 5-15 meters, and rises about 1 meter above the floodplain. The vegetation in the floodplain is hardwood forest and cane, with some of the trees having trunk diameters greater than 1 meter.

One shovel test (ST R-1) was dug in the third levee in the south of the project area (**Figure 7**). It encountered 20 centimeters of gray brown silt over 80 centimeters of orange brown very fine sand with occasional silt lamellae. Two artifacts were recovered from this test: one quartz tertiary flake at 20-30 centimeters below ground surface (bgs) and one aphyric rhyolite tertiary flake at 30-50 centimeters bgs. A second shovel test (ST R-2) was dug in the fourth levee in the east of the project area (**Figure 7**). It encountered 20 centimeters of gray brown-brown silty clay over 50+ centimeters of brown sandy loam.

An expansive first terrace occupies the south-central portion of the project area (**Figure 7**). The margins of the terrace are covered in pine-hardwood forest, while the bulk of the terrace is pasture that was once utilized as agricultural land. Three shovel tests were excavated in the west, center, and northeast portions of the terrace, respectively. Shovel tests R-3 and R-4 both encountered 30 centimeters of gray brown silt and sandy silt over 20+ centimeters of dense orange brown/yellow brown silty clay (**Figure 7**). The soil layer appeared to be remnant plow zone. Shovel test R-5 encountered 30 centimeters of very dark red brown silty sand (plow zone) over 20+ centimeters of dark red brown sandy silt to silty sand (**Figure 7**), an unexpected profile given the USDA soil description for the location, which is similar to the soils encountered in STs R-3 and R-4. Another first terrace is located in the eastern part of the project area (**Figure 7**), though it is covered in mixed pine-hardwood forest.

One shovel test (ST R-6) was excavated on the top of an upland pasture overlooking the terrace (**Figure 7**). It encountered 25 centimeters of reddish gray brown silty sand over 20+ centimeters of red loam. It appears likely that the soil profile encountered in ST R-5 contains colluvium eroded from this upland. Based on a ca. 1950s aerial photograph, the vast majority of the uplands were previously utilized as agricultural land. The uplands in the central part of the project area are separated from the alluvial landforms of the Neuse River by steep scarps on the west, south, and north (**Figure 7**). However, the uplands in the northeast part of the project area are afforded easier access to the Neuse River southward due to a reduced gradient. It is near this area that a local informant found Late Archaic to Woodland artifacts, including a Guilford projectile point, a small Woodland triangular arrow point, and a Yadkin ceramic sherd.

A complex of historic buildings is located on the uplands in the center of the project area. This complex includes a house with a large addition and two barns. No sign of the historic house

shown in **Figure 6** was found, though no subsurface testing was conducted at this location. Although no subsurface testing was conducted around either the existing historic house or the removed historic house, it is possible that subsurface features associated with each are present.

Cultural Resource Summary and Recommendations

Based on the results of previous archaeological investigations in the area, informant interview, and a limited reconnaissance, the project area has a high potential to contain archaeological resources.

The third and possibly fourth levees identified in the floodplain of the Neuse River have a high potential to contain buried prehistoric archaeological sites. Site 31WA1137 located less than 500 meters downstream from the project area was discovered in just such a context. ST R-1 confirmed the presence of cultural material in the third terrace on the project area. The floodplain itself has a low potential to contain buried cultural resources due to the threat of frequent flooding.

The first terraces of the Neuse River located in the project area have a high potential to contain prehistoric archaeological sites. Informant interview indicates that previous landowners collected artifacts ranging from the Middle Archaic to Woodland periods from the ground surface of the larger terrace when it was still used as an agricultural field. Additionally, there is the potential for a historic cemetery at the base of the upland scarp where it intersects the large terrace, based on a vegetated area shown on a ca. 1950's aerial photograph of the project area.

The upland areas of the project area have a moderate potential to contain prehistoric archaeological sites dependant on the accessibility of a location to water. This is based on limited pedestrian inspection of dirt roads and areas of exposed ground surface as well as informant interview. Additionally, the USDA Soil Map (**Figure 2**) shows that the soils in this area are eroded (WmB2, WmC2). The uplands also have a moderate potential to contain subsurface remains associated with the historic occupation of the area, as evidenced by two historic houses, one standing on the property and one removed.

It is recommended that archaeological investigations occur in locations that will be impacted by proposed improvements, including roads, trails, ball fields, restroom facilities, power/water/sewer lines, etc, to ensure that such activities do not adversely effect National Register eligible archaeological sites or historic cemeteries. Limited investigation of other areas to identify archaeological sites may be prudent to allow for efficient, informed planning of future park improvements.

7.0 SUMMARY

The results of the Interim Environmental Assessment Report for the Horseshoe Farms Park Site indicate that the project study area contains diverse and healthy vegetative communities, some of which have been recognized as being Significant Natural Heritage Areas and Natural Communities by the NHP. The Neuse River floodplain contains numerous mature hardwood and pine trees that meet the definition of a heritage tree. These GPS coordinates of these heritage trees have been collected. The size parameters of these trees will be collected concurrently with

the final vegetation and wildlife surveys. The regulatory implications of this NHP designation are unknown at this time and will be investigated. Two palustrine, forested wetlands subject to Section 404 regulations as administered by ACOE occur within the floodplain. The Neuse River and the small stream channel flowing under the entrance road are also subject to ACOE jurisdiction as well as the Neuse River Riparian Buffer Rule. Potential habitat for federally endangered Michaux's sumac is present within the project study area and a species-specific survey will be conducted during the appropriate season. Further archaeological investigations may be warranted in order to better guide the planning team during the design process and to document any potentially significant cultural or archaeological resources.

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[USFWS] U.S. Fish and Wildlife Service. 1987. Habitat Management Guidelines for the Bald Eagle in the Southeast Region. U.S. Department of the Interior, Fish and Wildlife Service. 8 pp.

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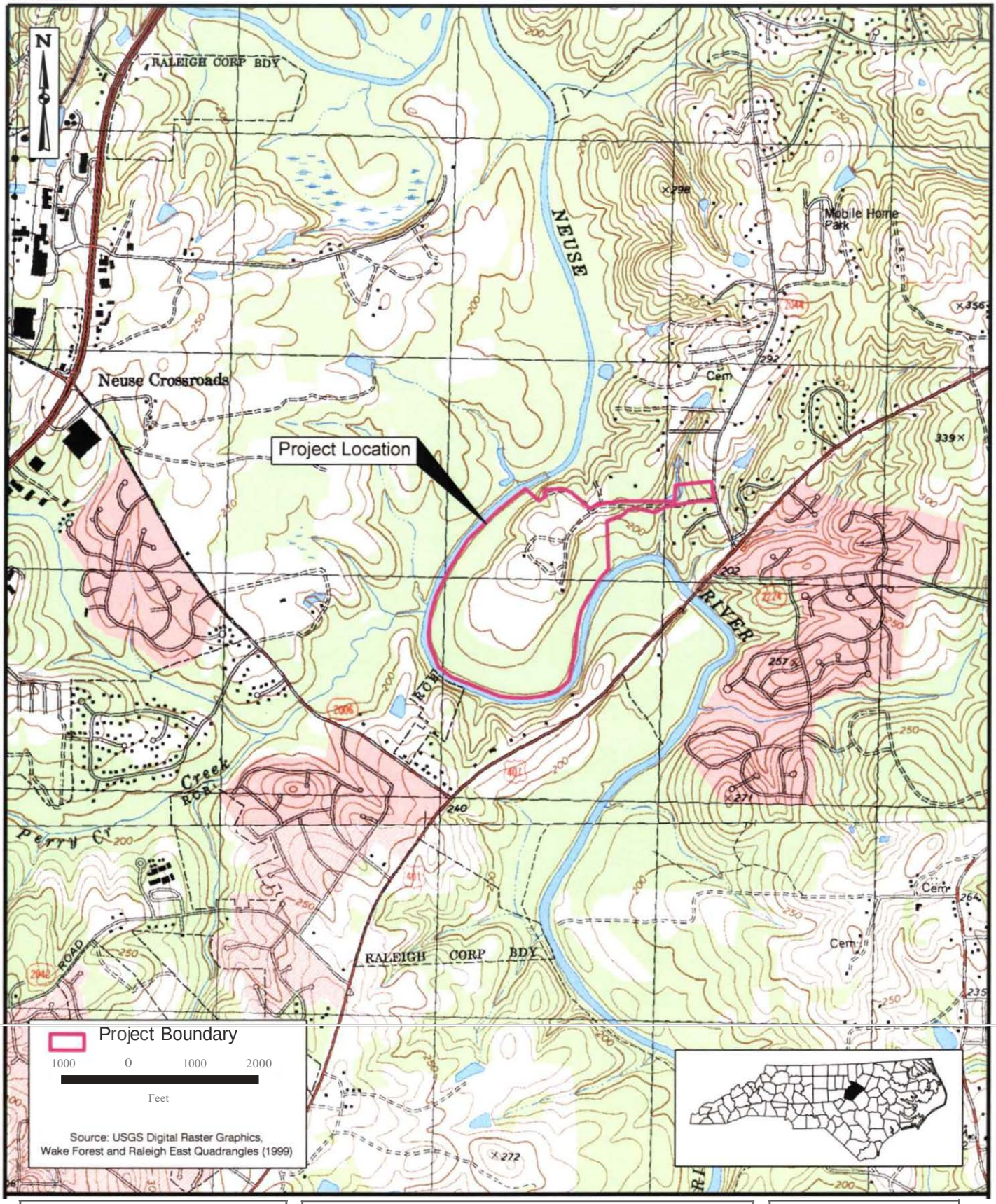
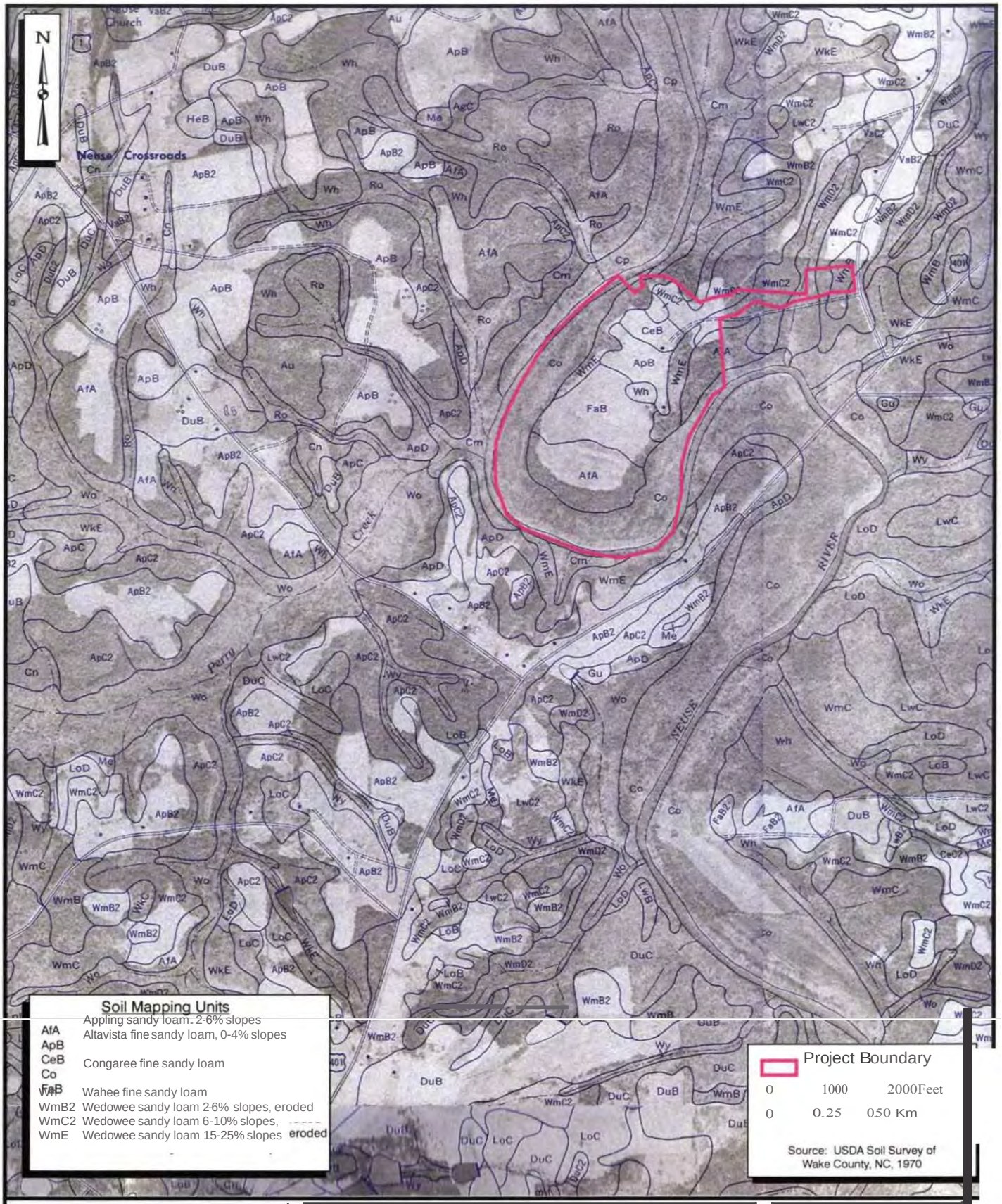


.st Environmental Services, Inc.

Project Location Map
Horseshoe Farms Park Site
Wake County, North Carolina

Figure:	1
Project:	ER04122
Date:	Feb 2005



Environmental Services, Inc.

Horseshoe Farms Park Site

Figure:	2
Project:	ER04122
Date:	Feb 2005

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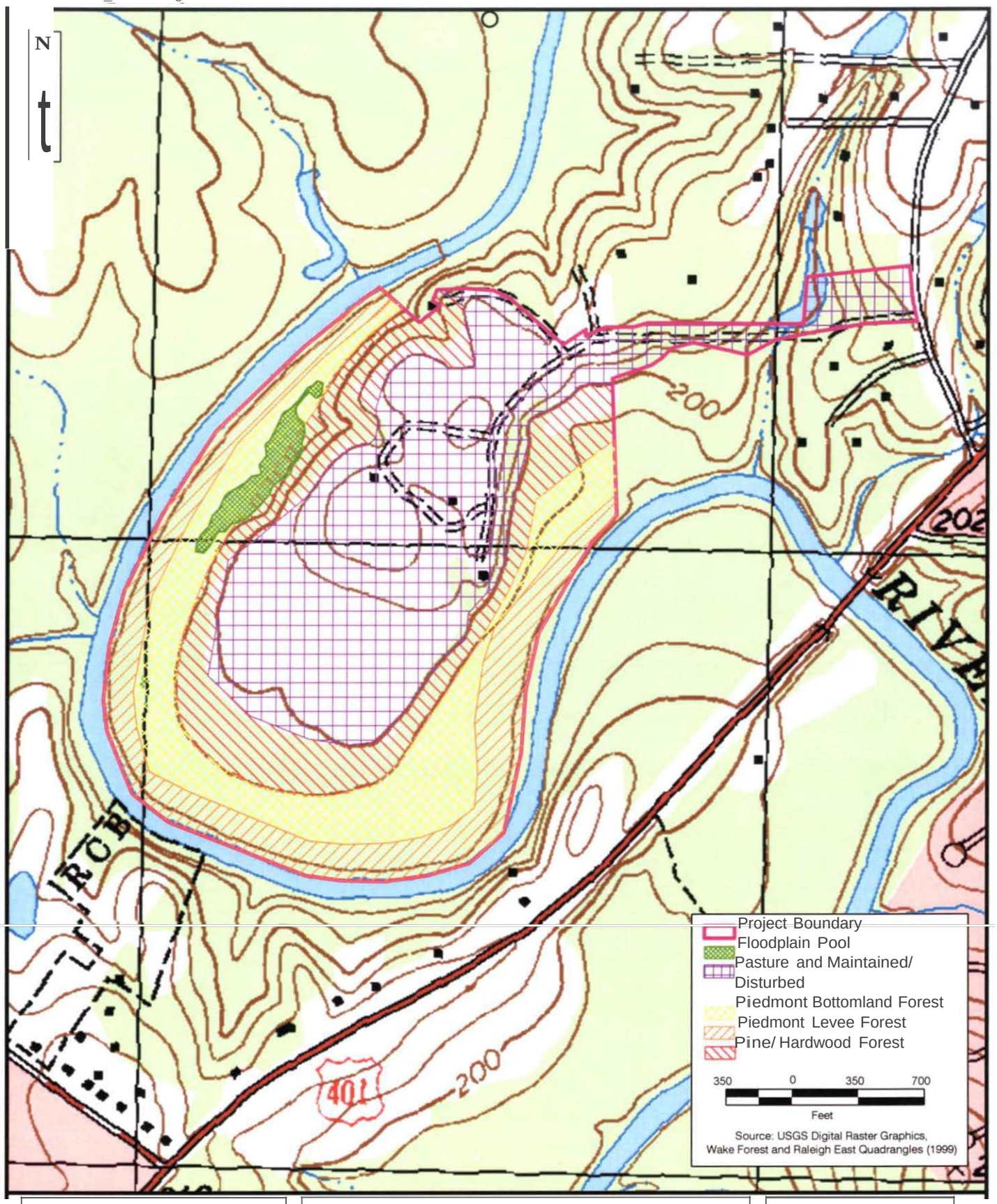
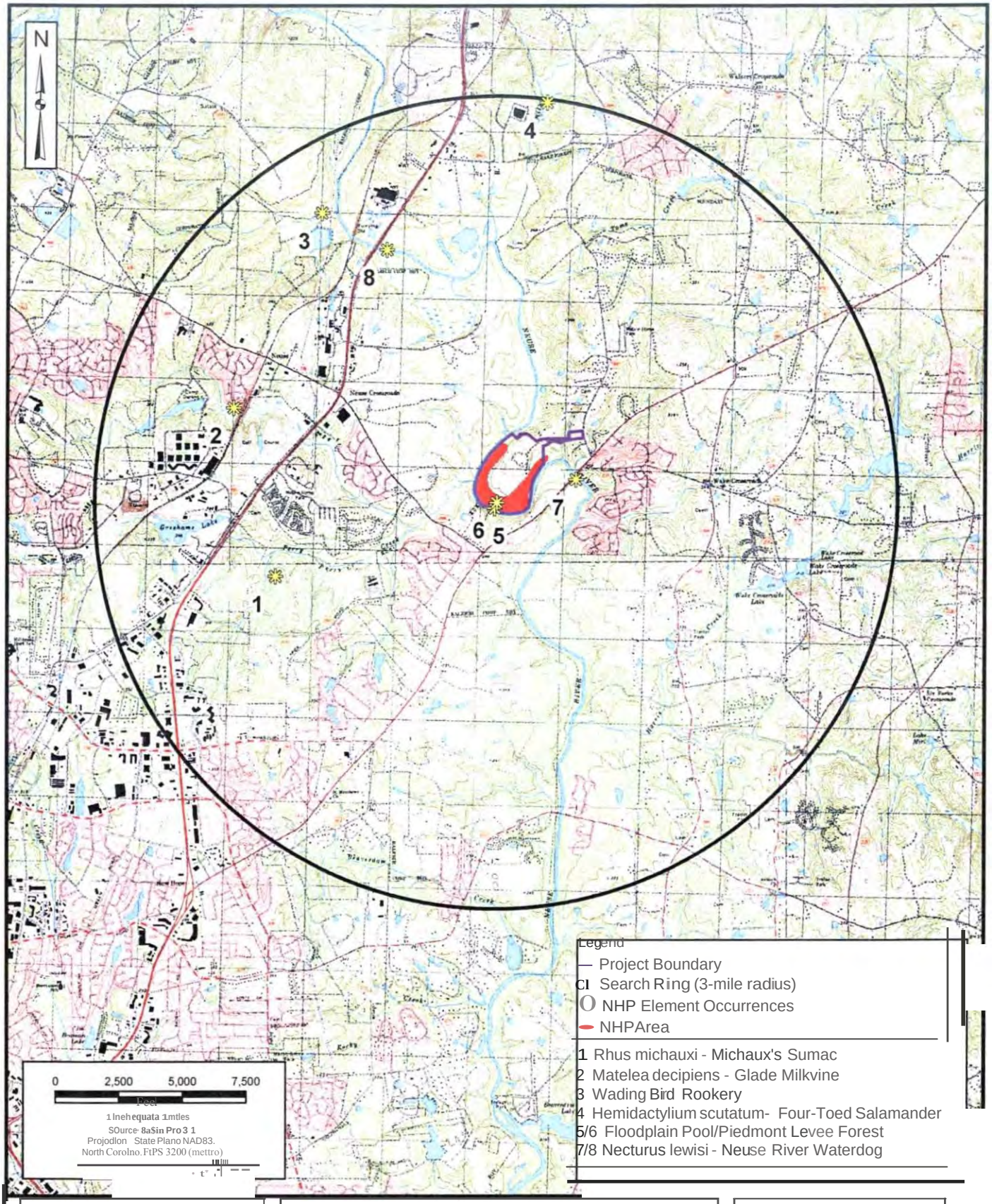


&J1 Environmental Services, Inc.

Plant Community Mapping
Horseshoe Farms Park Site
Wake County, North Carolina

Figure:	3
Project:	ER04122
Date:	Feb 2005

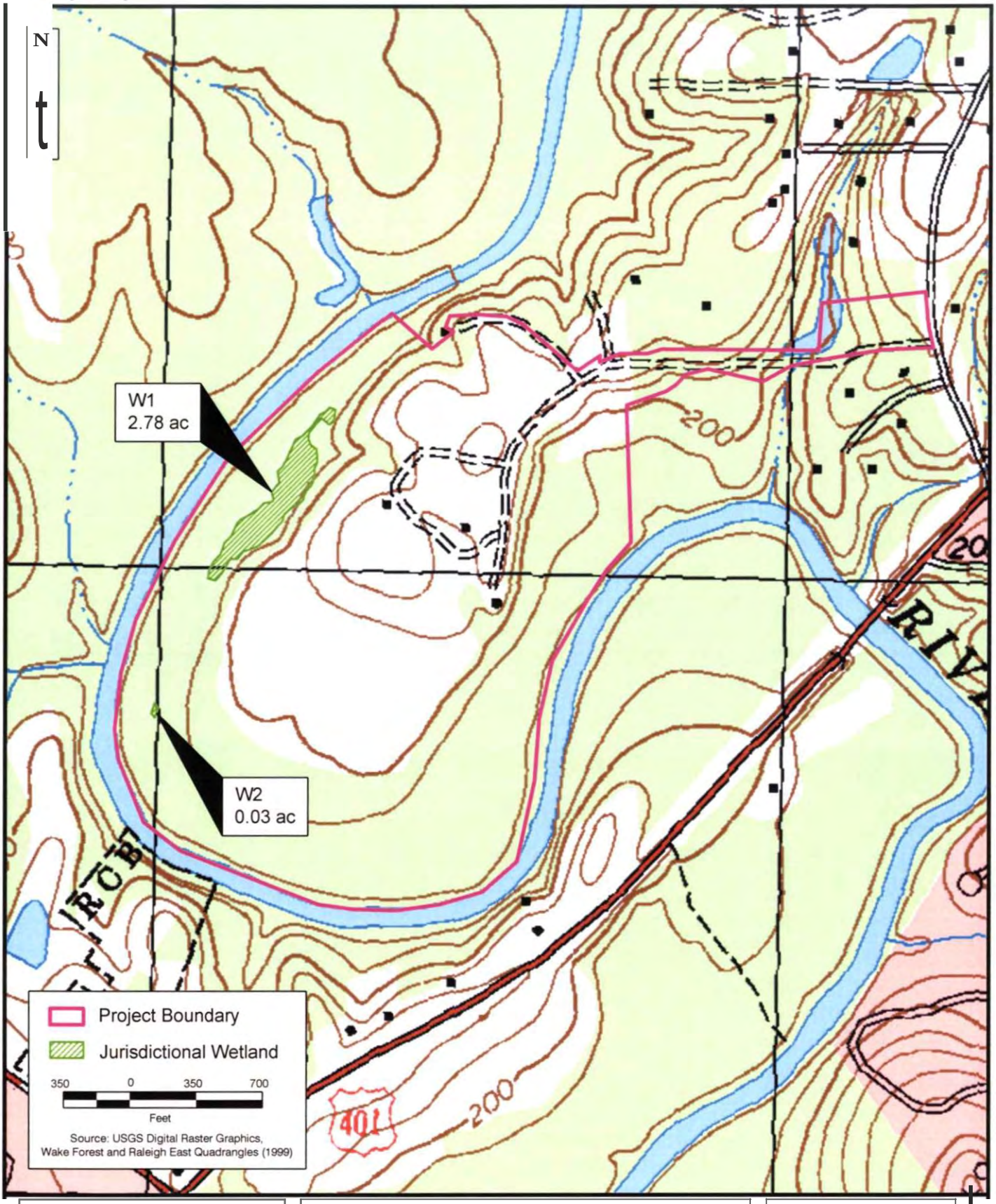


Environmental Services, Inc.

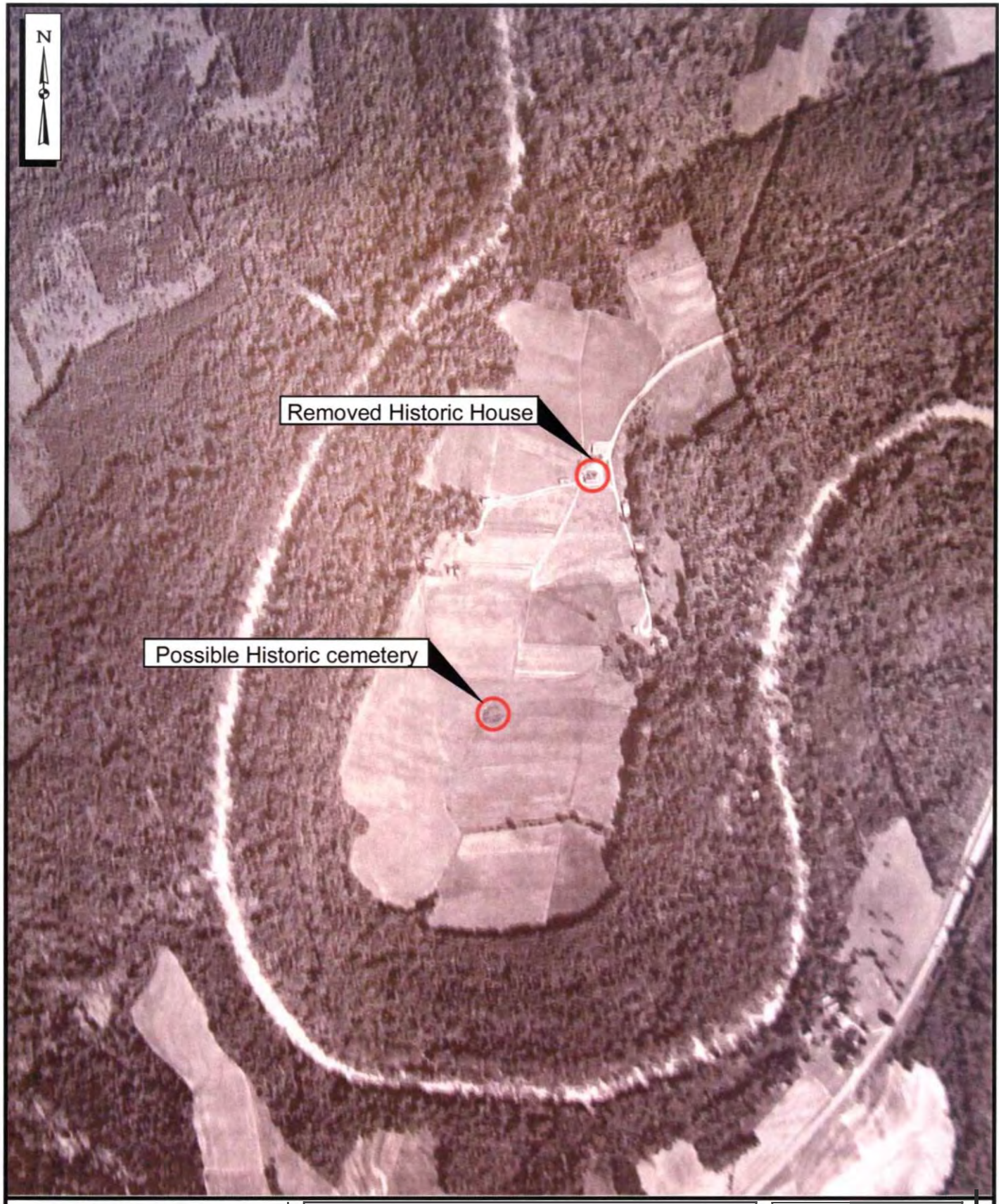
Natural Heritage Program (NHP) Data
Horseshoe Farms Park Site
Wake County, North Carolina

Figure:	4
Project:	ER04122
Date:	Feb. 2005

ER04122{juns dwg



&Jt Environmental Services, Inc.	Jurisdictional Wetland Map **Horseshoe Farms Park Site** Wake County, North Carolina	Figure: 5 Project: ER04122 Date: Feb 2005



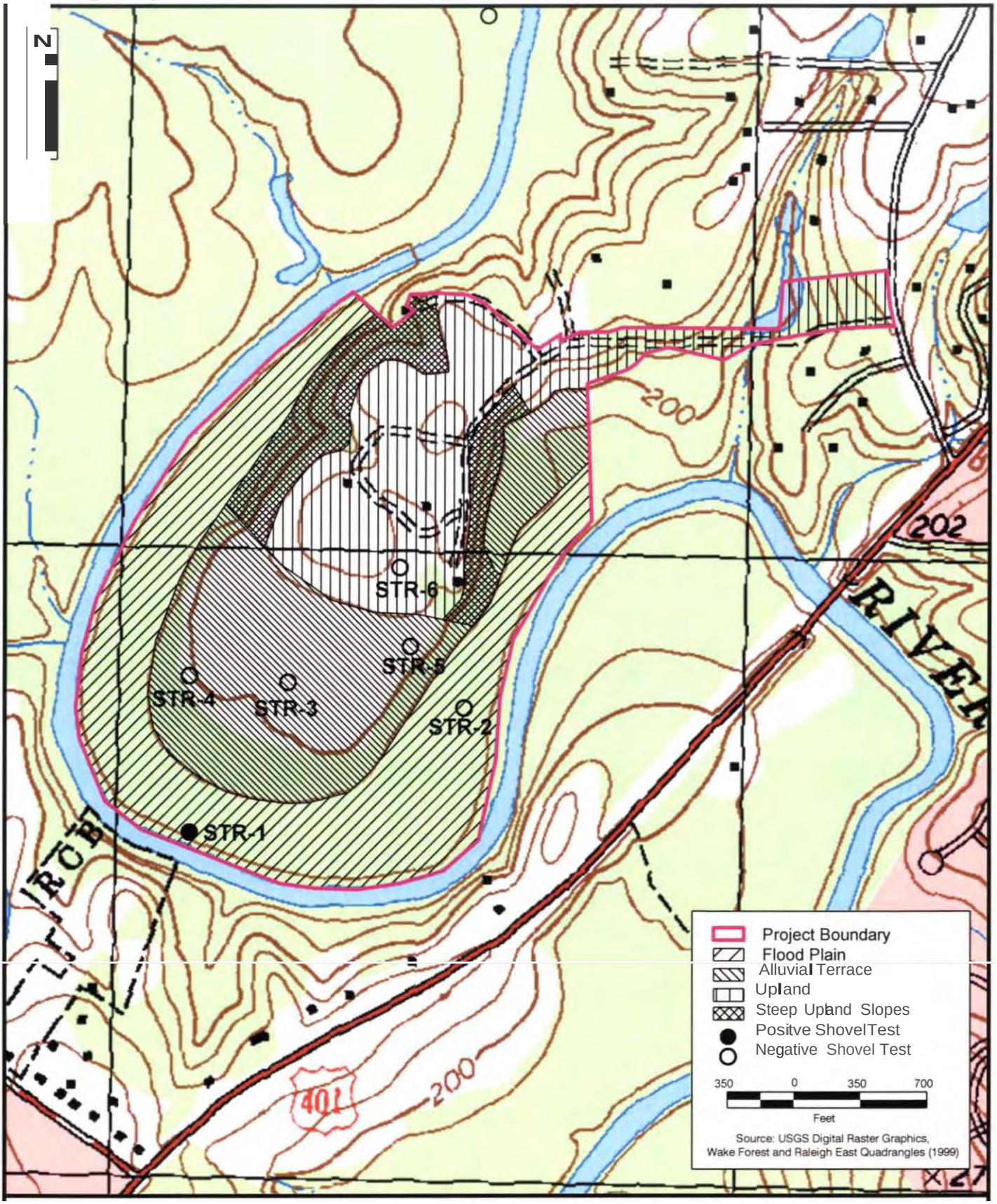
Environmental Services, Inc.

Ca. 1950's Aerial Photo of Project Area
Horseshoe Farms Park Site
Wake County, North Carolina

Figure:	6
Project:	ER04122
Date:	Feb 2005

ER04122/aerial.cdr

ER04122JST_land.dwg



Environmental Services, Inc.	Generalized Landforms and Shovel Test Location Map **Horseshoe Farms Park Site** Wake County, North Carolina	Figure: 7 Project: ER04122 Date: Feb 2005

Appendix A. Vegetation List for the Horseshoe Farms Park Site, Wake County, NC.

(NOT COMPLETE)

Common Name	Scientific Name	Habitat
TREES		
American elm	*Ulmus americana*	
Beech	*Fagus grandifolia*	
Black cherry	*Prunus serotina*	
Flowering dogwood	*Cornus floridanum*	
Hop hornbeam	*Ostrya virginiana*	
Ironwood	*Carpinus caroliniana*	
Laurel oak	*Quercus laurifolia*	
Loblolly pine	*Pinus taeda*	
Mockernut hickory	*Carya tomentosa*	
Red maple	*Acer rubrum*	
River birch	*Betula nigra*	
Southern sugar maple	*Acer saccharum* spp. *floridanum*	
Sweetgum	*Liquidambar styraciflua*	
Sycamore	*Plantanus occidentalis*	
Tulip poplar	*Liriodendron tulipifera*	
Water oak	*Quercus nigra*	
White oak	*Quercus alba*	
Willow oak	*Quercus phellos*	
Winged elm	*Ulmus alata*	
SHRUBS		
American holly	*Ilex opaca*	
Buckeye	*Aesculus sylvatica*	
VINES		
Japanese honeysuckle	*Lonicera japonica*	
Laurel-leaf catbriar	*Smilax laurifolia*	
Muscadine grape	*Vitis rotundifolia*	
HERBACEOUS		
Christmas fern	*Polystichum acrostichoides*	
Ebony spleenwort	*Asplenium platyneuron*	
Flat sedge	*Carex strigosa*	
Giant cane	*Arundinaria gigantea*	
Microstegium grass	*Microstegium vimineum*	
Mock strawberry	*Duchesnea indica*	
Sedge	*Carex lurida*	

Appendix B. Heritage Trees

(NOT COMPLETE)

Tree Species	DBH (inches)	Latitude	Longitude
Beech		35 53 11.100	78 32 14.996
Beech		35 53 08.625	78 32 17.325
Beech		35 52 51.106	78 32 19.501
Hackberry		35 53 07.913	78 32 17.771
Loblolly pine		35 53 06.926	78 32 00.442
Swamp chestnut oak		35 52 56.218	78 32 04.442
Sweetgum		35 53 03.593	78 32 01.851
Sweetgum		35 53 12.699	78 32 13.063
Sweetgum		35 52 53.268	78 32 06.556
Sycamore		35 53 02.758	78 32 03.113
Sycamore		35 52 59.544	78 32 04.304
Sycamore		35 52 57.585	78 32 04.585
Sycamore		35 52 49.382	78 32 13.805
Sycamore		35 52 51.517	78 32 23.219
Water oak		35 53 01.763	78 32 06.556
Water oak		35 53 02.574	78 32 06.104
Willow oak		35 53 13.207	78 31 56.313
Willow oak		35 53 03.890	78 32 01.346
Willow oak		35 53 02.233	78 32 03.564
Willow oak		35 53 01.962	78 32 02.718
White oak		35 53 14.553	78 32 12.755
White oak		35 53 12.983	78 32 12.666
Unidentified oak		35 52 49.548	78 32 13.431
Unidentified oak		35 52 51.774	78 32 16.832
Unidentified oak		35 53 02.396	78 32 26.171

Note: Heritage trees are defined as any canopy tree that has a DBH of at least 36 inches and sub-canopy trees with a DBH of at least 10 inches. This investigation focused on canopy trees within the Neuse River Floodplain.

Appendix C. Wildlife List

(NOT COMPLETE)

Common Name	Scientific Name
MAMMALS	
Beaver	*Castor canadensis*
Eastern chipmunk	*Tamias striatus*
Eastern cottontail	*Sylvilagus floridanus*
Eastern mole	*Scalopus aquaticus*
Gray fox	*Urocyon cinereoargenteus*
Gray squirrel	*Sciurus carolinensis*
House mouse	*Mus musculus* Long-
tailed weasel	*Mustela frenata*
Raccoon	*Procyon lotor*
Southeastern shrew	*Sorex longirostris*
Striped skunk	*Mephitis mephitis*
Virginia opossum	*Didelphis virginiana*
White-tail deer	*Odocoileus virginianus*
Woodchuck	*Marmota monax*
BIRDS	
American robin	*Turdus migratorius*
Brown thrasher	*Toxostoma rufum*
Carolina wren	*Thryothorus ludovicianus*
Dark-eyed junco	*Junco hyemalis*
Eastern towee	*Pipilo erythropthalmus*
European starling	*Sturnus vulgaris*
Great blue heron	*Ardea herodias*
Northern cardinal	*Cardinalis cardinalis*
Northern mockingbird	*Mimus polyglottos*
Pileated woodpecker	*Dryocopus pileatus*
Red-tailed hawk	*Buteo jamaicensis*
Turkey vulture	*Cathartes aura*
REPTILES	
Black racer	*Coluber constrictor*
Copperhead	*Agkistrodon contortrix*
Eastern box turtle	*Terrapene carolina*
Eastern garter snake	*Thamnophis sirtalis*
Eastern mud turtle	*Kinosternon subrubrum*
Northern water snake	*Nerodia sipedon*
Rat snake	*Elaphe obsoleta*
River cooter	*Chrysemys concinna*
Yellowbelly slider	*Chrysemys scripta*

Appendix C. Continued

AMPHIBIANS

American toad	*Bufo americanus*
Bullfrog	*Rana catesbeiana*
Green frog	*Rana clamitans*
Northern cricket frog	*Acris crepitans*
Southern leopard frog	*Rana sphenocephala*
Spring peeper	*Hyla crucifer*
Upland chorus frog	*Pseudacris triseriata*

Appendix C. Army Corps of Engineers Correspondence

January 17, 2005

Ms. Andrea Wade
U.S. Army Corps of Engineers
6508 Falls of the Neuse Road, Suite 120
Raleigh, NC 27615

Re: **Horseshoe Farm Jurisdictional Determination**
Wake County, North Carolina

Ms. Wade:

Environmental Services, Inc., (ESI) is submitting this Jurisdictional Determination request on behalf of the City of Raleigh. The project study area is located north of US 401 and west of Ligon Mill Road. ESI has delineated the limits of the on-site jurisdictional wetlands. The following items are included with this submittal:

1. Location map
2. Soils map
3. Wetlands map
4. ACOE data forms
5. Access agreement from the City of Raleigh

Per our recent conversation, we will meet at the site on 15 February 2005 at 9am to review the delineation. Please call Josh Witherspoon or me if you have any questions.

Sincerely,

ENVIRONMENTAL SERVICES, INC.

Jeff Harbour, PWS
Senior Project Manager

Attachments

Cc: David Shouse-City of Raleigh

DATA FORM WA

ROUTINE WETLAND DETERMINATION wet

(1987 CE Wetlands Delineation Manual)

Project/Site: Horseshoe Farms	Date: 12/29/2004
Applicant/Owner: City of Raleigh	County: Wake
Investigator: Environmental Services, Inc. (ESI)	State: NC
Do normal circumstances exist on the site? ✓Yes ☐ No	Community ID: forested
Is the site significantly disturbed (atypical situation)? ☐ Yes ✓ No	Transect ID: wetland
Is the area a potential problem area (If needed, explain)? ☐Yes ☑No	Data Point #: wa55

VEGETATION

DOMINANT PLANT SPECIES	STRATUM	INDICATOR	DOMINANT PLANT SPECIES	STRATUM	INDICATOR
1. sweetgum *Liquidambar styraciflua*	tree	FAC+	7. *#N/A*	#N/A	#N/A
2. red maple *Acer rubrum*	tree	FAC	8. *#N/A*	#N/A	#N/A
3. flatsedge *Cyperus strigosus*	herb	OBL	9. *#N/A*	#N/A	#N/A
4. microstegium *Microstegium vimineum*	herb	FAC+	10. *#N/A*	#N/A	#N/A
5. sedges *Carex lurida*	herb	OBL	11. *#N/A*	#N/A	#N/A
6. *#N/A*	#N/A	#N/A	12. *#N/A*	#N/A	#N/A

Percent of dominant species that are OBL, FACW, or FAC (Excluding FAC-): 100%

Remarks The hydrophytic vegetation criterion has been met.

HYDROLOGY

☐ RECORDED DATA (DESCRIBE IN REMARKS):

- ☐ Stream, Lake, or Tide Gauge
- ☐ Aerial Photographs
- ☐ Other

☑ NO RECORDED DATA AVAILABLE

FIELD OBSERVATIONS

Depth of Surface Water: 6"

Depth to Free Water in Pit: 0"

Depth to Saturated Soil: 0"

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

- ☑ Inundated
- ☑ Saturated in Upper 12 Inches
- ☐ Water Marks Drift
- ☐ Lines Sediment
- ☐ Deposits
- ☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):

- ☐ Oxidized Root Channels in Upper 12 Inches
- ☑ Water-Stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other (Explain in Remarks)

Remarks: The hydrologic criterion has been met.

SOILS

MAP UNIT NAME (Series and Phase): Mapped as Congaree fine sandy loam Series	DRAINAGE CLASS: well drained
TAXONOMY (SUBGROUP): Typic Udifluvents	FIELD OBSERVATIONS: Confirm Mapped Type? ☐ Yes ☑ No

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Color (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-14"		2.5Y 4/2	10YR 4/6	common/distinct	clay loam
14-18"		2.5Y 4/2	10YR 4/6	common/distinct	sand

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Concretions
- ☐ Histic Epipedon
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Reducing Conditions
- ☐ Aquic Moisture Regime
- ☐ Sulfidic Odor
- ☐ Organic Streaking in Sandy Soils
- ☐ Listing on National Hydric Soils List
- ☐ Listed on State or Local Hydric Soils List
- ☑ Gleyed or Low Chroma
- ☐ Color
- ☐ Other (Explain in Remarks)

Remarks: The hydric soil criterion has been met.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	☑ Yes	☐ No	Is this Sampling Point Within a Wetland? ☑ Yes ☐ No
Wetland Hydrology Present?	☑ Yes	☐ No	
Hydric Soil Present?	☑ Yes	☐ No	

Remarks: Data point is jurisdictional.

DATA FORM WA
ROUTINE WETLAND DETERMINATION up
(1987 CE Wetlands Delineation Manual)

Project/Site: Horseshoe Farms	Date: 12/29/2004
Applicant/Owner: City of Raleigh	County: Wake
Investigator: Environmental Services, Inc. (ESI)	State: NC
Do normal circumstances exist on the site? ✓ Yes ☐ No	Community ID: forested
Is the site significantly disturbed (atypical situation)? ☐ Yes ✓ No	Transect ID: upland
Is the area a potential problem area (If needed, explain)? ☐ Yes ✓ No	Data Point #: wa55

VEGETATION

DOMINANT PLANT SPECIES	STRATUM	INDICATOR	DOMINANT PLANT SPECIES	STRATUM	INDICATOR
1. sweetgum *Liquidambar styraciflua*	tree	FAC+	7. honeysuckle *Lonicera japonica*	vine	FAC-
2. ironwood *Carpinus caroliniana*	tree	FAC	8. *#N/A*	#N/A	#N/A
3. sourwood *Oxydendron arboreum*	tree	FACU+	9. *#N/A*	#N/A	#N/A
4. microstegium *Microstegium vimineum*	herb	FAC+	10. *#N/A*	#N/A	#N/A
5. river oats *Chasmanthium latifolium*	herb	FAC-	11. *#N/A*	#N/A	#N/A
6. greenbrier *Smilax spp.*	vine	FAC	12. *#N/A*	#N/A	#N/A

Percent of dominant species that are OBL, FACW, or FAC (Excluding FAC-): 57%

Remarks The hydrophytic vegetation criterion has been met.

HYDROLOGY

☐ RECORDED DATA (DESCRIBE IN REMARKS):

- ☐ Stream, Lake, or Tide Gauge
- ☐ Aerial Photographs
- ☐ Other

✓ NO RECORDED DATA AVAILABLE

FIELD OBSERVATIONS

Depth of Surface Water: 0

Depth to Free Water in Pit: >18"

Depth to Saturated Soil: >18"

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

- ☐ Inundated
- ☐ Saturated in Upper 12 Inches
- ☐ Water Marks Drift
- ☐ Lines Sediment
- ☐ Deposits
- ☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):

- ☐ Oxidized Root Channels in Upper 12 Inches
- ☐ Water-Stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other (Explain in Remarks)

Remarks: The hydrologic criterion has not been met.

SOILS

MAP UNIT NAME (Series and Phase): Mapped as Congaree fine sandy loam Series	DRAINAGE CLASS: well drained
TAXONOMY (SUBGROUP): Typic Udifluvents	FIELD OBSERVATIONS: Confirm Mapped Type? ☐ Yes ☑ No

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Color (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-12"		10YR 3/4			clay loam
12-18"		10YR 4/4			sandy loam

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Concretions
- ☐ Histic Epipedon
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Reducing Conditions
- ☐ Aquic Moisture Regime
- ☐ Sulfidic Odor
- ☐ Organic Streaking in Sandy Soils
- ☐ Listing on National Hydric Soils List
- ☐ Listed on State or Local Hydric Soils List
- ☐ Gleyed or Low Chroma
- ☐ Color
- ☐ Other (Explain in Remarks)

Remarks: The hydric soil criterion has not been met.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	☑ Yes	☐ No	Is this Sampling Point Within a Wetland? ☐ Yes ☑ No
Wetland Hydrology Present?	☐ Yes	☑ No	
Hydric Soil Present?	☐ Yes	☑ No	

Remarks: Data point is not jurisdictional.

DATA FORM

ROUTINE WETLAND DETERMINATION

(1987 CE Wetlands Delineation Manual)

YA
Upland

Project/Site: Horseshoe farms	Date: 12/29/2004
Applicant/Owner: City of Raleigh	County: Wake
Investigator: Environmental Services, Inc.	State: NC
Do normal circumstances exist on the site? ✓ Yes ☐ No	Community ID: forested
Is the site significantly disturbed (atypical situation)? ☐ Yes ✓ No	Transect ID: YA 4
Is the area a potential problem area (If needed, explain)? ☐ Yes ✓ No	Plot ID: Upland

VEGETATION

DOMINANT PLANT SPECIES	STRATUM	INDICATOR	DOMINANT PLANT SPECIES	STRATUM	INDICATOR
1. water oak *Quercus nigra*	tree	FAC	7.		
2. sweetgum *Liquidambar styraciflua*	tree	FAC+	8.		
3. red maple *Acer rubrum*	tree	FAC	9.		
4. southern red oak *Quercus falcata*	tree	FACU-	10.		
5. American holly *Ilex opaca var. opaca*	shrub	FAC-	11.		
6. greenbrier *Smilax spp.*	vine	N/A	12.		

Percent of dominant species that are OBL, FACW, or FAC (Excluding FAC-): 50%

Remarks The hydrophytic vegetation requirement has been met.

HYDROLOGY

☐ RECORDED DATA (DESCRIBE IN REMARKS):

- ☐ Stream, Lake, or Tide Gage
- ☐ Aerial Photographs
- ☐ Other

✓ NO RECORDED DATA AVAILABLE

FIELD OBSERVATIONS

Depth of Surface Water: 0"

Depth to Free Water in Pit: >18"

Depth to Saturated Soil: >18"

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

- ☐ Inundated
- ☐ Saturated in Upper 12 Inches
- ☐ Water Marks Drift
- ☐ Lines Sediment
- ☐ Deposits
- ☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):

- ☐ Oxidized Root Channels in Upper 12 Inches
- ☐ Water-Stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other (Explain in Remarks)

Remarks: The hydrologic criterion has not been met.

SOILS

MAP UNIT NAME (Series and Phase): Mapped as Congaree Series	DRAINAGE CLASS: well drained
TAXONOMY (SUBGROUP): Typic Udifluvents	FIELD OSERVATIONS: Confirm Mapped Type? ☐ Yes ☑ No

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Color (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-15"		2.5Y5/3	10YR5/8	common/prominent	clay
15-18"		2.5Y5/2	7.5YR5/8	common/prominent	clay

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Concretions
- ☐ Histic Epipedon
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Reducing Conditions
- ☐ Aquic Moisture Regime
- ☐ Sulfidic Odor
- ☐ Organic Streaking in Sandy Soils
- ☐ Listing on National Hydric Soils List
- ☐ Listed on State or Local Hydric Soils List
- ☑ Gleyed or Low Chroma
- ☐ Color
- ☐ Other (Explain in Remarks)

Remarks: The hydric soil criterion has not been met.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	☑ Yes	☐ No	Is this Sampling Point Within a Wetland? ☐ Yes ☑ No
Wetland Hydrology Present?	☐ Yes	☑ No	
Hydric Soil Present?	☐ Yes	☑ No	

Remarks: Data point is not jurisdictional.

DATA FORM

ROUTINE WETLAND DETERMINATION

(1987 CE Wetlands Delineation Manual)

YA wetland

Project/Site: Horseshoe farms	Date: 12/29/2004
Applicant/Owner: City of Raleigh	County: Wake
Investigator: Environmental Services, Inc.	State: NC
Do normal circumstances exist on the site? ✓ Yes ☐ No	Community ID: forested
Is the site significantly disturbed (atypical situation)? ☐ Yes ✓ No	Transect ID: YA 4
Is the area a potential problem area (If needed, explain)? ☐ Yes ✓ No	Plot ID: wetland

VEGETATION

DOMINANT PLANT SPECIES	STRATUM	INDICATOR	DOMINANT PLANT SPECIES	STRATUM	INDICATOR
1. sweetgum *Liquidambar styraciflua*	tree	FAC+	7.		
2.			8.		
3.			9.		
4.			10.		
5.			11.		
6.			12.		

Percent of dominant species that are OBL, FACW, or FAC (Excluding FAC-): 100%

Remarks The hydrophytic vegetation requirement has been met.

HYDROLOGY

☐ RECORDED DATA (DESCRIBE IN REMARKS):

- ☐ Stream, Lake, or Tide Gage
- ☐ Aerial Photographs
- ☐ Other

✓ NO RECORDED DATA AVAILABLE

FIELD OBSERVATIONS

Depth of Surface Water: 3"

Depth to Free Water in Pit: 0"

Depth to Saturated Soil: 0"

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

- ✓ Inundated
- ✓ Saturated in Upper 12 Inches
- ☐ Water Marks Drift
- ☐ Lines Sediment
- ☐ Deposits
- ☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):

- ☐ Oxidized Root Channels in Upper 12 Inches
- ☐ Water-Stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other (Explain in Remarks)

Remarks: The hydrologic criterion has been met.

SOILS

MAP UNIT NAME (Series and Phase): Mapped as Congaree Series	DRAINAGE CLASS: well drained
TAXONOMY (SUBGROUP): Typic Udifluvents	FIELD OSERVATIONS: Confirm Mapped Type? ☐ Yes ☑ No

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Color (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-4"		2.5Y5/2	10YR6/8	common/prominent	clay
4-18"		2.5Y4/2	10YR5/8	common/prominent	clay

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Concretions
- ☐ Histic Epipedon
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Reducing Conditions
- ☐ Aquic Moisture Regime
- ☐ Sulfidic Odor
- ☐ Organic Streaking in Sandy Soils
- ☐ Listing on National Hydric Soils List
- ☐ Listed on State or Local Hydric Soils List
- ☑ Gleyed or Low Chroma
- ☐ Color
- ☐ Other (Explain in Remarks)

Remarks: The hydric soil criterion has been met.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	☑ Yes	☐ No	Is this Sampling Point Within a Wetland? ☑ Yes ☐ No
Wetland Hydrology Present?	☑ Yes	☐ No	
Hydric Soil Present?	☑ Yes	☐ No	

Remarks: Data point is jurisdictional.

Appendix E. State Historic Preservation Office Correspondence

North Carolina Department of Cultural Resources

State Historic Preservation Office

:Michael F. Easley, Governor
Lisbeth C. Evans, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division ofHistorical Resources
David Brook, Director

July 7, 2004

David Shouse
City of Raleigh Parks and Recreation
P. O. Box 590
Raleigh, NC 27602

Re: Horseshoe Farm Park, Wake County, ER 04-1400

Dear Mr. Shouse:

Thank you for your email of May 18, 2004, transmitting information conceming the above project. We have reviewed our maps and files and offer the following comments.

With regard to archaeological resources, the proposed park area has a high probability for the presence of archaeological resources. Although the park area has never been surveyed, numerous sites, including a stratified Native American site and dugout canoe, were located within the immediate vicinity.

We recommend that a comprehensive survey be conducted by an experienced archaeologist to identify and evaluate the significance of archaeological remains that may be damaged or destroyed by the proposed project. Potential effects on unknown resources must be assessed prior to the initiation of construction activities. Since you are in the early planning stages of the park project, you may want to phase the archaeological investigations, beginning with background research and a sample field survey. The resulting information from this first phase could then be used to delineate which remaining park areas should be surveyed. Staff of the Office of State Archaeology would be glad to assist you in preparation of a scope of work for the project and to evaluate any proposals you may receive.

Two copies of the resulting archaeological survey report, as well as one copy of the appropriate site forms, should be forwarded to us for review and comment as soon as they are submitted by the consulting archaeologist and well in advance of any construction activities.

A list of archaeological consultants who have conducted or expressed an interest in contract work in North Carolina is available atw_____ww.arch.dcr.state.nc.us/consults. The archaeologists listed, or any other experienced archaeologist, may be contacted to conduct the recommended survey.

The. above comments :rre madepursuant to Section 106 of the National HistoricPreservation Act and the Ad:;;J:sory Co®cil cin Historic Preservation's Regulations for Compliance W1th S tflon 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-E:rrley, environmental review coordinator, at 919/733-4763. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

dBrook
o.ueputy State Historic Preservation Officer

cc: Dan Becker, HPC

be: ,_elaggett/Hall
County

ADDENDU!\1 TO THE

INTERIM ENVJRO MENTAL ASSESSME T REPORT

Hor eshoe Farms Park Site
Wake County, orth Carolina

ESI Project ER04-122

Prepared for:

City of Raleigh
Parks and Recreation Department

Prepared By:

E VIRO MENTAL SERVICES, 1 C.
524 S. ew Hope Road
Raleigh, C 27610
Tel (919) 212-1760 Fax (919) 212-1707

June 2005

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1.0 PURPOSE OF ADDE O M

Environmental Services, Inc., (ESI) has collected additional natural resource and cultural re ource data from the Horse hoc Farms Park Site since the completion and submittal of the March 2005 Interim Environmental A scssment Report. Thi new data is intended to complement the previous data collected for the interim report. Thi Addendum to the Interim Envi ronmental Assessment Report contain additional information on the following subject : ephemeral wetland, additiona l delineation (W2), heritage trees, vegetation and wi ldlife inventorie . Michau x· sumac survey. Nort h Carolina tate Historic Preservation Office (SHPO) comments, and additional cemetery rc earch.

2.0 ADDITIO AL ATURAL RESOURCE I FORMATIO

2.1 Ephemeral Wetland

ESI encountered one ephemeral wetland along the eastern boundary near the ri er while conducting additional fieldwork a part of the vegetation and wildlife inventorie . This ephemeral wetland appear to be a man-made feature that was excavated during an unknown period in the itc's history. The area i labeled a WJ on the enclosed **Figure** S (revised) and i approximately 0.55 acre in size. ESI characterizes this wetland as ephemeral becau e it appears to hold water on a casonal basis. The soil in the bottom of this area are non-hydric and evidence of hydrology was not pre ent during the original delineation effort that occurred in December 2004. It is E rs professional opinion that this ephemeral ·: etland is non-juri dictional pursuant to Section 404 of the Clean Water Act: however, it remains a valuable and unique ecosystem within the euse River floodplain. Additional Corps of Engi neers (COE) coordination will be required if any impacts are propo cd in this area. Efforts should be made to avoid impacting thi area and protecting this unique aquatic habitat is recommended.

2.2 Wetland 2 Additional Delineation

The original configuration of Wetland 2 (W2) as delineated in December 2004 was ba ed on evidence of wetland hydrology within 12 inches of the ground urface. In December 2004, wetland hydrology was only evidenced in the small 0.03-acre area a documented in the Interim Environmental A c ment Report dated March 2005.

dditional ticiJwork conducted in A pril and May ot 2005 rc\ ealed that JUrisdictional wetland hydrology was pre ent in a lightly larger area than origmally delineated. As a re ull. W2 wa expanded to it current ize of 0.63 acre. Thi wetland appear to be inundated on a easonal ba is and crvc · as important easonal habitat for amphibians. W2 is depicted on Figure 5 (revi ed). Table I hown below has been revi ed to document the current wetland located within the Horse hoe Farms Park Site.

Table I. \Vaters of the US within the Horseshoe Farms Park Site.

Feature	Wetland Type	Size (acre)	Hydrology Indicators	Hydric Soil Indicators
Wetland l	PFOl	2.78 ac	Inundated. water stained leaves, oxidized root channels	Munsell color 2.5Y 4/2 with lOYR 4/6 mottles
Wetland 2	PFOl	0.63 ac	Inundated, saturated soil within 12 inches of ground surface	Munsell color 2.5Y 512 with lOYR 6/8 mottles
Wetland 3 (ephemeral: non-jurisdictional)*	PFOI	0.55 ac	None On 5/31/05	Non-hydric oil
UTofNeu e River	Riverine-perennial	na	na	na
Neuse River	Riverine-perennial	na	na	na

PFOI – palustrme, forested. broad-lea,ed dec•duous
• - requin:s ACOE concurrence

2.3 Heritage Tree

··Heritage Trees.. are defined as a canopy tree with a diameter at breast height {DBH) of 36 inches or greater or a mid-canopy tree with a DBH of l0 inches or greater. ESl collected data on 14 canopy trees that meet the definition of a heritage tree. Mo t of these are oak and are located within the euse River floodplain throughout the Hor eshoe Farms Park Site. This data, which i located in Appendix A, includes the latitude and longitude of each heritage tree, specie , and diameter.

2.4 Vegetation Inventory

ESI ha al o performed additional fieldwork to document woody and herbaceous vegetation growing within the Horseshoe Farms Park site. ESI biologists vi ited the site on two occasions, earl y spring and late spring, to record addit ional vegetation. An adjacent property owner also provided orne very useful information with regard to vegetation that has been documented on ite. Thi additional information ï belie ed to be accurate although ESI cannot confirm or deny the pre ence of orne pecies li ted by the adjacent property owner. Many of the species li ted by the property owner *are* commonly een on the site and are likely present each year. However, some of the

pecies may not appear C\Cf) grO\\ ing season due t(\ \ arious environmental factors. The species list compiled from the \Cgetation imentory is provided in Appendix B.

2.5 Wildlife Inventory

E I has documented e\ idenced of' ildlife within the project study area during all of our site vi it . The project study area provides habitat for a di verse mixture of terrestrial and aquatic v ildlife. Birds are represented by both year-round and migratory species. The wildlife species that ha\'e been documented at the Horseshoe Fanns Park ite are listed in Appendix C. As with the vegetation in entory. some of the wildlife pccies in Appendix C were provided by an adjacent property 0\\mer. This additional information is believed to be accurate although E 1 cannot confirm or deny the presence of some species listed by the adjacent property owner.

2.6 Michaux's Sumac unrey

E I has completed the strrve) Jor federally endangered Michaux· sumac on the Horseshoe Farms Park ite. Potential habitat was located during the initial field effort: however. surveys for this species could not be conducted in the \vinter. E I visited a reference population of Michaux's sumac located in eastern Wake County on 18 April 2005 to document the vegetative status of the species. The species was starting to leaf out and po itive identification was possi ble. E I biologists conducted the initial species-pecific survey for Michaux's sumac on 18 April 2005. The areas of potential habitat (roadside and field edges) were surveyed and no Michaux's sumac \ as located. A second si te in estigation was conducted on 31 May 2005 in order to have additional documentation during the fom1al survey window (mid-May – July). No Michaux's sumac was observed during this second investigation. Based on these results, E I is able to provide the follov.ing biological conclusion for Michaux's sumac.
BiologicaJ Conclusion: No Effect

3.0 ADDITIONAL CULTURAL RE OURCE INFORMATIO

3.1 ortb Carolina State Historic Pre ervation Office (NCSHPO) Comment

The C HPO made three comments on the Interim Em ironmental As e ment Report in a letter addressed to David M. house on 21 March 2005. The three comments are addressed below.

Comment l. The now removed house was con tructed prior to 1938. as it is visible on a 1938 aerial photograph (Figure 8). The house is also visible on a ca. 1950 aerial photograph (Figure 4) and a 1970 soils map (Figure 2). No surface indications of the house were visible at the time of the reconnaissance. Figures 2 and 4 are provided in the original Interim Report.

Comment 2. Accordi ng to a North Carolina Historic tructures hort Data heet filled out by Kelly Lally in 1991. the complex of buildings located in the cast-central portion of the project area, designated WA2248, ▾ as constructed between 1916 and 1930. Pre ious research indicates that these buildings were not considered eligible for listing in the atural Register.

Comment 3. A North Carolma Archaeolog•cal itc Form was lilted out on 10 \!larch *2005.* E 1-1 i now designated a 31 WA15 5.

3.2 ddi tional Cemetery Investigation

Additional archival investigation was conducted in an attempt to more accurately a cenain if there is an unrecorded cemetery on the Horseshoe Farms Park Site. This investigation included re earch at the Genealogy Services of the onh Carolina State Library (Library), the onh Carolina State Archive (Archives). and of old maps of Wake County.

Re earch at the Library did not re cal any information on cemeterie in Wake County. The following files were researched at Archives: Wake County WPA File. Cemetery Record File, and the orth Carolina Cemetery Survey file for Wake County. one of the file contained information about a cemetery on the Horseshoe Farms Park Site. The Archives did have a series of aerial photographs of Wake Coun t y taken in 1938. one of which (Figure 8) howed a cop e of tree on the property at the arne location a ' a copse of trees vi ible on the ca. 1950 aerial photograph (Figure 4).

Hi toric maps consulted as part of this research included the 1878 Bever map of Wake County. the 1887 hatTer's Map of Wake County. the 1904 chool Map of Wake Count}. the 1914 Soil Map of Wake County. and the 1940-1950 Raleigh 15 minute quadrangle. o cemetery was identified on the Hor eshoe Fanns Park Site on any of the e maps.

Although no written record of a cemetery on the Hor eshoe Farms Park Site was found, the pre ence of a cop e of trees in the middle of an agricultural field on both the 193 and ca. 1950 aerial photographs strongly sugge ts the presence of an unreorded cemetery. If con truction or other ground disturbing activities is planned for this location. field investigation to determine the presence of an unrecorded cemetery, and if o, to delineate its extent, are recommended.

Interim Report Addendum
Appendix A. Heritage Tree

Tree Species	DBH (inches}	Latitude	Longitude
Beech	36	35 53 08.625	78 32 17.325
Sycamore	39	35 52 51.517	78 32 23.219
Water oak	44	35 53 01.763	78 32 06.556
Water oak	42	35 53 02.574	78 32 06.104
Willow oak	38	35 53 13.207	78 31 56.313
Willow oak	40	35 53 03.890	78 32 01.346
Willow oak	36	35 53 02.233	78 32 03.564
Willow oak	37	35 53 01.962	78 32 02.718
White oak	47	35 53 14.553	78 32 12.755
White oak	36	35 53 12.983	78 32 12.666
Poplar	51	35 52 49.548	78 32 13.431
Willow Oak	39	35 52 51.774	78 32 16.832
Willow Oak	47	35 53 02.396	78 32 26.171
Poplar	37	35 52 53.1	78 32 24.5

Note: Heritage tree are defined as any canopy tree that has a DBH of at least 36 inche and ub-canopy trees with a DBH of at least 10 inche . This inve tigation focused on canopy tree within the eusc River Floodplain.

Appendi x B. Vegetation List for the Horse hoe Fanns Park ite. Wake County, l\C.

Common Name	Scientific Name
Trees	
American elm	*Ulmus americana*
Beech	*Fagus grandi(olia*
American holly	*flex opaca*
Black cherry	*Prwws serotina*
Black oak	*Quercus velutina*
Box elder	*Acer negundo*
Buckeye	*Aesculus Sl'lvarica*
Eastern red cedar	*Juniperus \'irginiana*
Flowering dogwood	*Conuts floridanum*
Fringetree	*Chionamlws virJ[inicus*
Hackberry	*Celtis occidentalis*
Hophornbeam	*Ostrya virginiana*
Ironwood	*Ca pinus caroliniana*
Laurel oak	*Quercus lauri(olia*
Loblolly pine	*Pinus raeda*
Mockernut hickory	*Carya tomentosa*
Northern red oak	*Quercus rubra*
Parsley hawthorn	*Craraegus* sp.
Persimmon	*Diospyros virginianus*
Pignut hickory	*Cary·a glabra*
Redbud	*Cercis canadensis*
Red maple	*Acer rubrum*
Red mulberry	*Morus rubra*
River birch	*Betula nigra*
Sassafras	*Sassafras albidum*
Shon!eaf pine	*Pinus echinata*
Slippery elm	*Ulmus rubra*
Sourwood	*O.wdendron arboreum*
Southern sugar maple	*Acer saccharum* spp. *{loridanum*
Southern red oak	*Quercus falcata*
Sweetgum	*Liquidambar s(vrac(flua*
Sycamore	*Plamanus occidentalis*
Tulip poplar	*Liriodendron wlip{(era*
Water hickory	*Carva aquatica*
Water oak	*Quercus nigra*
White ash	*Fraxinus americana*
White oak	*Quercus alba*
Willow oak	*Quercus phellos*
Winged elm	*Ulmus alata*

Shrubs and Vines	
Blackberry	*Rubus sp.*
Strawberry bush	*Euom-mus americamtS*
Chinese privet	*Ligustrum sinense*
Common greenbrier	*Smilax rotundtfolia*
Horsesugar	*Symplocos tinctoria*
Huckleberry	*Gavlussacia* sp.
Japanese honeysuckle	*Lonicera japonica*
Laurel-leaf catbriar	*Smilax lauri(olia*
Mountain laurel	*Kalmia lati(olia*
Muscadine grape	*l'iris rotundi(olia*
Pinxter azalea	*Rhododendron mtdiflorwn*
Wild rose	*Rosa Carolina*
Witch hazel	*Hamamelis "irginiana*
Herbaceous	
American vetch	*Vicia americana*
Beech drops	*Epi(agus virginiana*
Blue-eyed grass	*Sisrrinclzitmt sp.*
Blue star	*Amsonia sp.*
Bluets	*Houstonia caerulea*
Bloodroot	*Sanguinaria sp.*
Broomsedge	*Andropogon "irginicus*
Bur-marigold	*Bidens lae,'is*
Butterfly pea	*Centrosema virginianum*
Cardinal tlower	*Lobelia ca ·dina/is*
Coral honeysuckle	*Lonicera sempenirens*
Crane-fly orchid	*Tipularia discolor*
Christmas fern	*Polystichum acrosriclzoides*
Cross vine	*Anisosticlws capreolara*
Dayflower	*Commelina sp.*
Dogbane	*Apocynum sp.*
Ebony_spleenwort	*Asplenium plarvneuron*
Elephant"s foot	*Elephantopus sp.*
False nettle	*Biehmeria crlindrica*
False solomons seal	*Smilacina racemosa*
Featherbells	*Stenanrlzium gramineum*
Flat sedge	*Carex strigosa*
Giant cane	*Anmdinariag_igal11ea*
Golden alexander	*Taenidia illlegerrima*
Goldenrod	*Solidago sp.*
Grapefem	*Botrvclzium sp.*
Ground pine	*Licopodium obscurum*
Heart lea(wild ginger	*Hexastrlis sp.*
Henbit	*Lamium sp.*
Horsenettle	*Solanum sp.*

Herbaceous – Coned	
Indian strawbcrr	*Duchesnea sp.*
Ironweed	*Vernonia sp.*
Johnnv-jump-up	*'iola tricolor*
Knotweed	*Pohgonum sp.*
Lady fern	*Atlnrium sp.*
Lespedeza	*Lespede=a sp.*
Liverleaf	*Hepatica sp.*
Lyreleaf sage	*Sall'ia lvrata*
May-apple	*Podophvllum pe/tatum*
Microstegium grass	*Microstegium vimineum*
Mock strawberry	*Duchesnea indica*
Morning glory	*ipomoea sp.*
Pale corydalis	*Con'dalis sp.*
Partridge berry	*Mitclzella repens*
Passion flower vine	*Passijlora sp.*
Perfoliate bellwort	*Umlaria per[oliata*
Pink lady slipper orchid	*C\pripedium acaule*
Pink woodsorrel	*Oxalis debilis*
Poison ivy	*Toxicodendron radicans*
Pokeweed	*Phvtolacca americana*
Poppy	*A1gemone sp.*
Putty root	*Aplectrum hremale*
Queen Anne's lace	*Daucus carota*
Rabbit tobacco	*Gnaphalium obtusi{olium*
Rattlesnake plantain	*Goodvera sp.*
River oats	*Chasmanthium latifolium*
Running cedar	*Lvcopodium sp.*
Saxifrage	*Saxi{raga sp.*
Sedge	*Carex lurida*
Self-heal	*Prunella sp.*
Solomon's seal	*Po/ygona/Lim sp.*
Spotted wintergreen	*Clzimaphila maculata*
Strawberry	*Fragaria sp.*
Tansy	*Tanacetum \'ulgare*
Tick trefoil	*Codariocalvx*
Toothwort	*Dentaria sp.*
Trefoil	*Lotus sp.*
Trumpet vine	*Campsis radicans*
Violet	*Viola sp.*
Virginia creeper	*Parthenocissus quinque{olia*
Venus' looking-glass	*Specu/aria sp.*
White snakeroot	*Ageratina a/tissima*
Wild geranium	*Geranium macularwn*
Wild onion	*Aliium canadense*

Herbaceous– Cont'd	
Wild quinine	*Parthenium integri(olium*
Wooly mullein	*Verbascum thapsus*
Yellowroot	*Xanthorhi=a sp.*

Interim Report Addendum
Appendix C. Wildlife Ltst

Mammals	
Beaver	*Castor canadensis*
Eastern chipmunk	*Tamias srriatus*
Eastern cottontail	*sh·ilagus floridanus*
Eastern mole	*Sea/opus aquaticus*
Gray fox	*Urocvon cinereoargenteus*
Gray squirrel	*Sciurus carolinensis*
House mouse	*Mus musculus*
Long-tailed "easel	*Mustela (renata*
Muskrat	*Ondatra =ibetlzicus*
Raccoon	*Procvon loror*
Red fox	*Vulpes \'ulpes*
Southeastern shrew	*Sorex longirostris*
Striped skunk	*Mephitis mephitis*
Virginia o_possum	*Didelphis virginiana*
White-tail deer	*Odocoileus virginianus*
Woodchuck	*darmota monax*
Birds	
American Gold finch	*Carduelis tristis*
American redstart	*Setopltaga rwicilla*
American robin	*Ttu·dus migratorius*
American woodcock	*Scolopax minor*
Bam swallow	*1/inmdo rustica*
Barred owl	*Strix ,·aria*
Belted kingfisher	*Megacervle alcvon*
Black-capped chickadee	*Pants atricapillus*
Blue grosbeak	*Guiraca caerulea*
Blue jay	*Cvanicitta crista/a*
Blue-_gJ"a)' &rnatcatcher	*Polioptila caerulea*
Bobwhite	*Colin11s virginianus*
Brown thrasher	*Toxostoma rufitm*
Brown-headed nuthatch	*Siua pusil/a*
Canada goose	*Branta canadensis*
Carolina chickadee	*Porus carolinensis*
Carolina wren	*Thn·othorus ludoviciamtS*
Chipping sparrow	*Spi=ella passerina*
Common grackle	*Quiscalus quiscula*
Cowbird	*Molothrus ater*
Crow	*Corvus brachrrhynchos*
Dark-eyed junco	*l11nco hvemalis*
Downy woodpecker	*Picoides pubescens*
Eastern bluebird	*Sialia sialia*

Birds-Coot't.l	
Eastern meadowlark	*Stumella magna*
Eastern towee	*Pipilo ervthropthalmus*
European starling	*Sturmts 1'/ilgaris*
Fox sparrow	*Passerel/a iliaca*
Great blue heron	*Ardea herodias*
Hairy woodpecker	*Picoides \'illosus*
Hermit thrush	*Catharus RLiflatus*
House wren	*Troglodvtes aedon*
Jndigo bunting	*Passerina cvanea*
Killdeer	*Charadri11s voci(erus*
Mourning dove	*Zenaida status*
Northern cardinal	*Cardinalis cardinalis*
Northern mockingbird	*lvlimus po/yg/ouos*
Pileated woodpecker	*Drrocopus pilearus*
Prothonotary warbler	*Protonotaria citrea*
Purple finch	*CarpodacusJ!urpure11s*
Red-bellied woodpecker	*Melanerpes carolimts*
Red-shouldered hawk	*Buteo linea/Us*
Red-tailed hawk	*Buteo jamaicensis*
Ruby-throated hummingbird	*Arclziloclws co/ubris*
Song sparrow	*Melospiza melodia*
Summer tanager	*Piranga rubra*
Tufted titmouse	*Pants bicolor*
Turkey vulture	*Cathartes aura*
White-breasted nuthatch	*Sitra carolinensis*
White-throated sparrow	*Zonorriclzia albicollis*
Wild turkey	*Meleagris ga//opa\'0*
Wood duck	*Aix sponsa*
Wood thrush	*Hylocichla mustelina*
Yellow-bellied sapsucker	*Sph yrapiCIIS varius*
Yellow-rumped warbler	*Dendroica coronata*
Yellow-throated warbler	*Dendroica dominica*
Reptiles	
Black racer	*Coluber constrictor*
Carolina anolc	*Anolis caroliniensis*
Copperhead	*Agkistrodon contortrix*
Com snake	*Elaphe gwtata*
Eastern box turtle	*Terrapene carolina*
Eastern garter snake	*Thamnophis sirtalis*
Eastern mud turtle	*Kinostemon subrubrum*
Northern water snake	*Nerodia sipedon*
Rat snake	*Elaphe obsoleta*
River cooter	*Chrysemvs COIICillna*
Yellowbell y slider	*Chrvseml's scripta*

Amphibians	
American toad	*Bu/0 americamtS*
Bullfrog	*Rana caresbeiana*
Green frog	*Rana clamirans*
Northern cricket frog	*Acris crepirans*
Southern leopard frog	*Rana sphenocephala*
Spring peeper	*Hvla crucifer*
Upland chorus frog	*Pseudacris triseriara*

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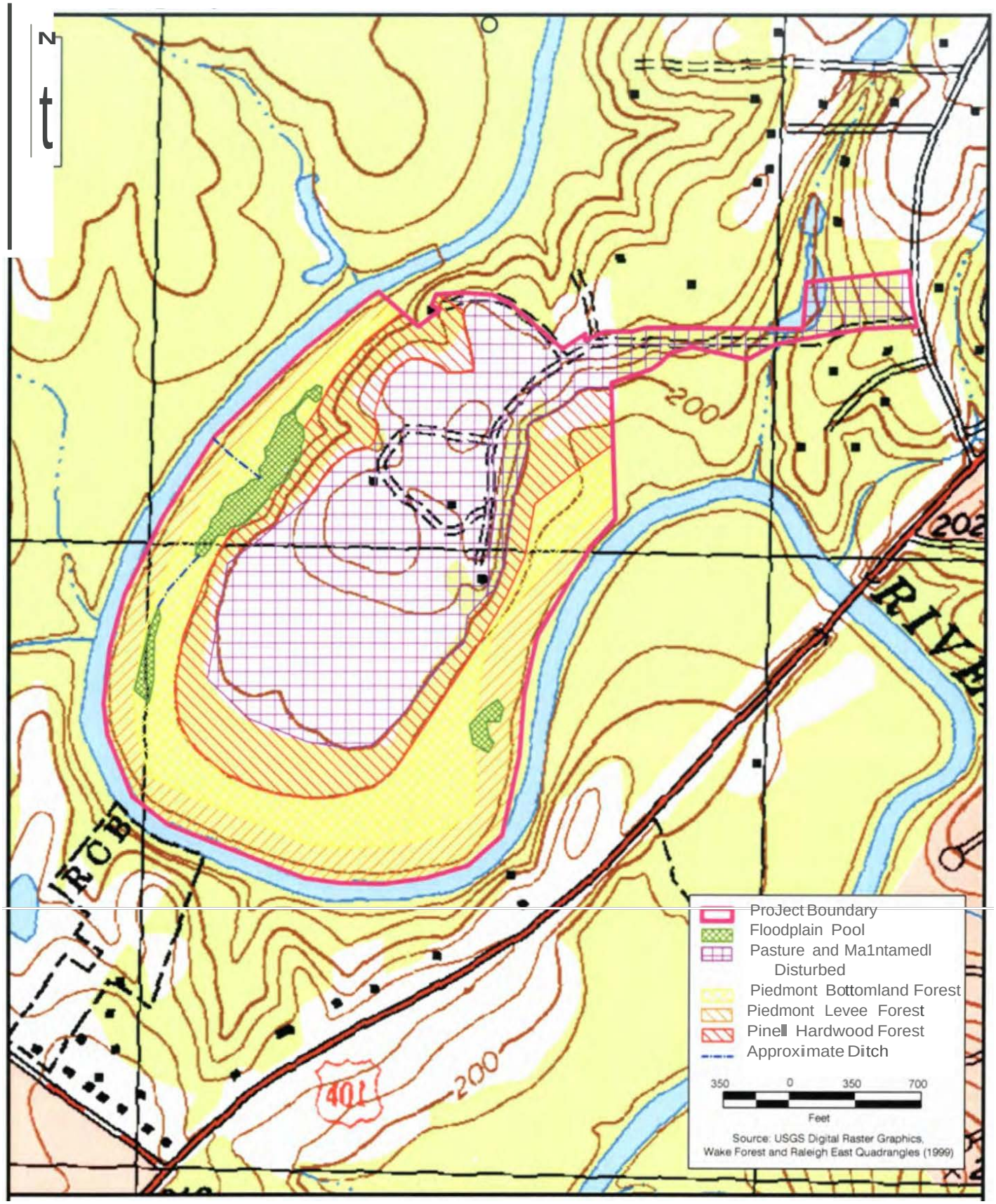

:QJt Environmental Services, Inc.

Plant Community Mapping
Horseshoe Farms Park Site
Wake County, North Carolina

Figure:	3
Project:	ER04122
Date:	May 2005

ER041
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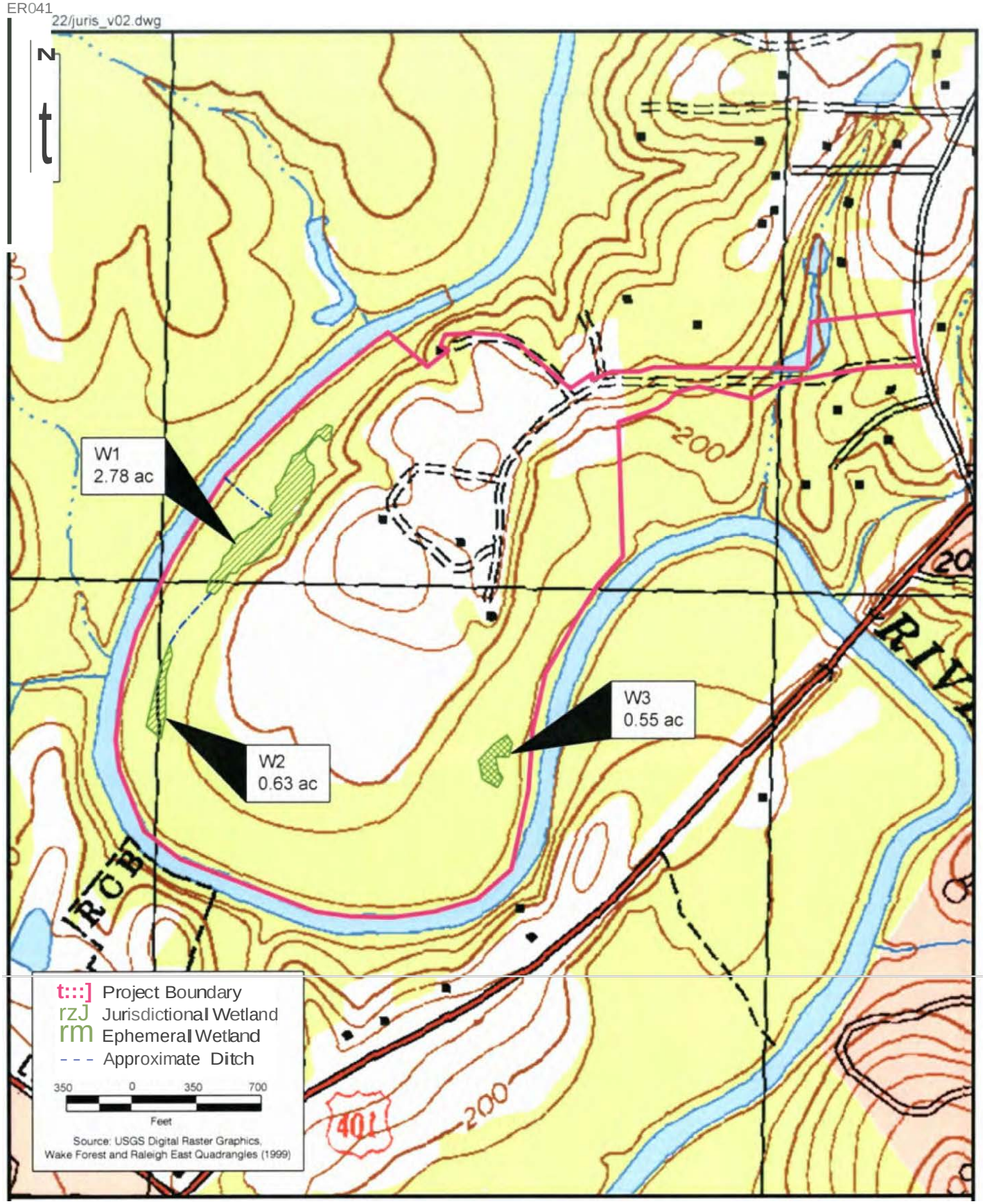
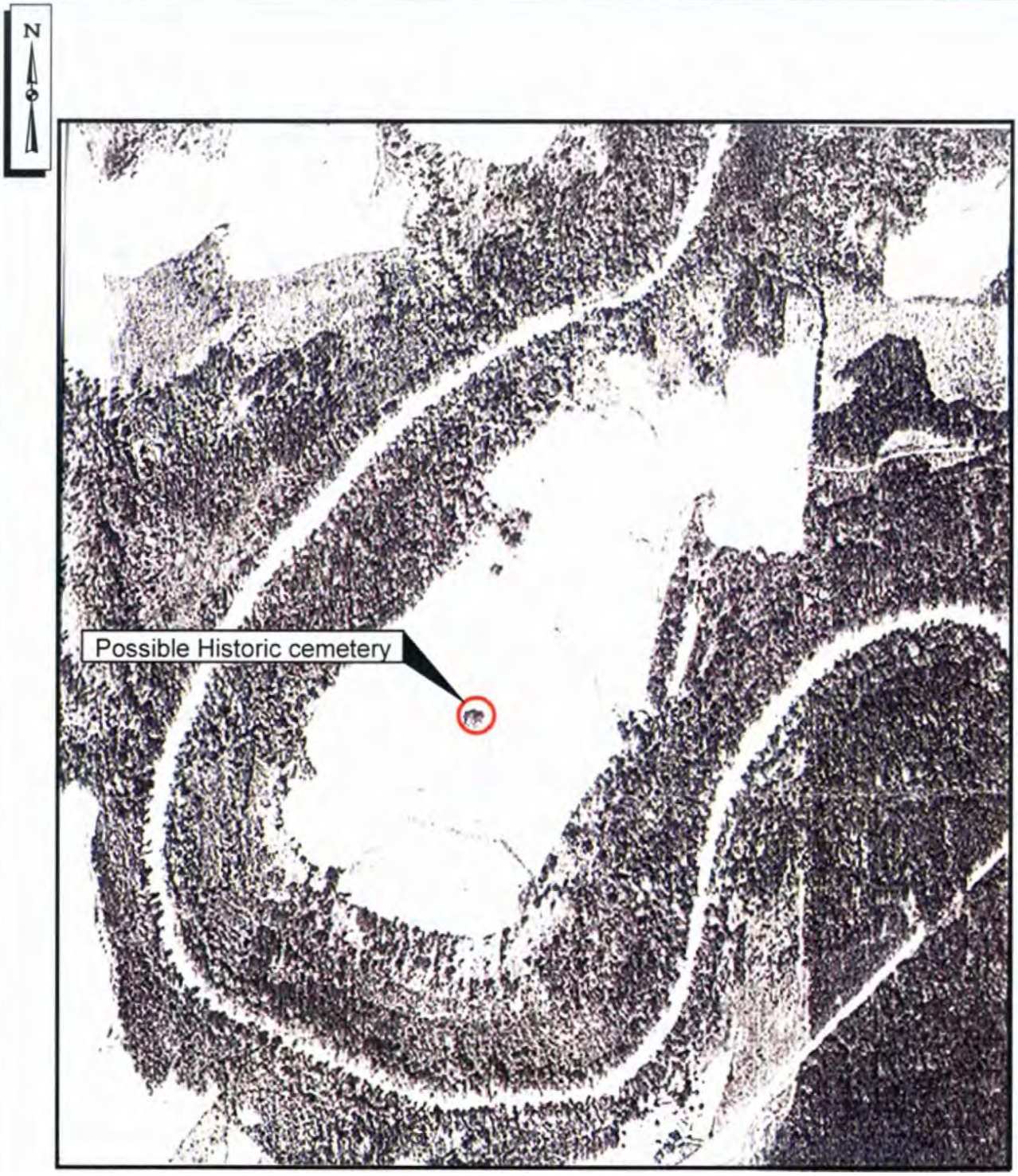


Environmental Services, Inc.	Jurisdictional Wetland Map **Horseshoe Farms Park Site** Wake County, North Carolina	Figure: 5 Project: ER04122 Date: May 2005



Environmental
Services, Inc.

1938 Aerial Photo of Project Area
Horseshoe Farms Park Site
Wake County, North Carolina

Figure:	8
Project:	ER04122
Date:	May 2005

Horseshoe Farm Park

Comprehensive Inventory

April 2008 -- revised February 2009

Compiled by Lena Gallitano (April 2008); revised by Harry LeGrand (Feb. 2009)

Coding Notations:
1 = ESI - Interim (what should be there but not documented)
1a = ESI - Addendum (From Vicki Weis inventory)
2 = Natural Heritage Program, LeGrand Inventories
3 = Vicki Weis Inventory
4 = John Connors Inventory - includes all dated columns for birds and animals
5 = Other sources
5a = Clyde Smith, Lena Gallitano
Bold = Heritage trees (Canopy trees with DBH of at least 36 inches)
*New to Horseshoe since 1990
Bird Inventories beginning in 2008 are in a separate Excel file and will be maintained on an annual basis by year.
File name is HSFP Bird Inventory by Year

Plants	Common Name	Scientific Name	Comments
Trees			
	Florida maple	*Acer barbatum*	
	Box-elder	*Acer negundo*	
	Red maple	*Acer rubrum*	
	Tall pawpaw	*Asimina triloba*	
	River birch	*Betula nigra*	
	Ironwood, Am. Hornbeam	*Carpinus caroliniana*	
	Bitternut hickory	*Carya cordiformis*	
	Mockernut hickory	*Carya tomentosa*	
	Sugarberry (1)	*Celtis laevigata*	
	Flowering dogwood	*Cornus florida*	
	American beech (3)	*Fagus grandifolia*	
	Green ash	*Fraxinus pennsylvanica*	
	American holly	*Ilex opaca*	
	Black walnut	*Juglans nigra*	
	Eastern red cedar	*Juniperus virginiana*	
	Sweetgum (3)	*Liquidambar styraciflua*	1- 120' x 40" dbh
	Tulip poplar/tuliptree	*Liriodendron tulipifera*	
	Red mulberry	*Morus rubra*	
	Black gum	*Nyssa sylvatica*	
	Hop-hornbeam	*Ostrya virginiana*	
	Sourwood	*Oxydendrum arboreum*	
	Shortleaf pine	*Pinus echinata*	
	Loblolly pine (1)	*Pinus taeda*	
	Eastern sycamore (5)	*Platanus occidentalis*	
	Black cherry	*Prunus serotina*	
	White oak (2)	*Quercus alba*	
	Southern red oak	*Quercus falcata*	
	Swamp chestnut oak (1)	*Quercus michauxii*	
	Water oak (2)	*Quercus nigra*	1- 115' x 36" dbh
	Willow oak (4)	*Quercus phellos*	
	Sasafras	*Sassafras albidum*	
	Winged elm	*Ulmus alata*	
	American elm	*Ulmus americana*	
	unidentified oak - (3)		
Shrubs			
	Giant cane	*Arundinaria gigantea*	
	Dwarf pawpaw	*Asimina parviflora*	
	Strawberry-bush; Hearts-a'-bustin	*Eunoymus americanus*	
	Deciduous holly	*Ilex decidua*	
	Chinese privet	*Ligustrum sinense*	exotic
	Smooth black-haw	*Viburnum prunifolium*	

Vines			
	Crossvine	*Bignonia capreolata*	
	Trumpet-creeper	*Campsis radicans*	
	Ground ivy	*Glecoma hederacea*	
	Japanese hops	*Humulus japonicus*	exotic
	Japanese honeysuckle	*Lonicera japonica*	exotic
	Anglepod	*Matelea sp.*	
	Virginia creeper	*Parthenocissus quinquefolia*	
	Saw greenbrier	*Smilax bona-nox*	
	Common greenbrier	*Smilax rotundifolia*	
	Poison-ivy	*Toxicodendron radicans*	
	Muscadine grape	*Vitis rotundifolia*	
	grape	*Vitis sp.*	
Herbs			
	Broomsedge	*Andropogon virginianum*	
	Wild ginger	*Asarum canadense*	locally uncommon
	Ebony spleenwort	*Asplenium platyneuron*	
	Calico aster	*Aster lateriflorus*	
	False nettle	*Boehmeria cylindrica*	
	Grape fern	*Botrychium sp.*	
	sedge sp.	*Carex lurida/Cyperus sp.*	
	River oats	*Chasmanthium latifolium*	
	Virginia dayflower	*Commelina virginica*	
	Yellow corydalis	*Corydalis flavula*	any Corydalis is rare in area; may be first record in Wake County; identified by Dr. Jon Stucky and Harry LeGrand
	Virginia wild-rye	*Elymus virginica*	
	Fireweed	*Erechtites hieraciifolia*	
	Mistflower	*Eupatorium coelestinum*	
	Late thoroughwort	*Eupatorium serotinum*	
	Bluets	*Houstonia caerulea*	
	Slender St.John's-wort	*Hypericum mutilum*	
	Henbit	*Lamium sp.*	
	Bushy seedbox	*Ludwigia alternifolia*	
	Lanceleaf loosestrife	*Lysimachia lanceolata*	scarce in the county
	Microstegium grass	*Microstegium vimineum*	exotic
	Sharp-wing monkeyflower	*Mimulus alatus*	
	Square-stem monkeyflower	*Mimulus ringens*	
	Panic-grass	*Panicum spp.*	
	Beef-steak plant	*Perilla frutescens*	
	Camphorweed	*Pluchea camphorata*	
	Mayapple	*Podophyllum peltatum*	
	Lady's-thumb	*Polygonum persicaria*	exotic
	Dotted smartweed	*Polygonum punctatum*	
	Christmas fern	*Polystichum acrostichoides*	

	Bloodroot	*Sanguinaria canadensis*	
	Maryland figwort	*Scrophularia marilandica*	rare in the county
	Mad-dog skullcap	*Scutellaria lateriflora*	
	American germander, Wood sage	*Teucrium canadense*	
	Perfoliate bellwort	*Uvularia perfoliata*	
	Wing-stem	*Verbesina alternifolia*	
	Crown-beard	*Verbesina occidentalis*	
	violets	*Viola spp.*	

Animals	Common Name	*Scientific Name*	Data Source*	4/22/2004 11-2 PM	3/26/2006 8-11 AM	6/3/2006 8-10 AM	6/9/2006 9-11 AM	Comments
MAMMALS								
	Beaver	*Castor canadensis*	1,1a,3,4	evidence	evidence	evidence	evidence	
	Eastern Gray Squirrel	*Sciurus carolinensis*	1,1a,4	x	x	x	x	
	Eastern Mole	*Scalopus aquaticus*	1,1a,4	evidence		evidence		
	Raccoon	*Procyon lotor*	1,1a,3,4	evidence	evidence	evidence	evidence	
	Red Fox	*Vulpes vulpes*	1a,3,4	x				
	River Otter	*Lontra canadensis*	4				evidence	
	Southern Short-tailed Shrew	*Blarina carolinensis*	4	x				
	Virginia Opossum	*Didelphis virginiana*	1,1a,3,4	evidence				
	White-tailed Deer	*Odocoileus virginianus*	1,2,3,4	x	x	x	x	Albino twins 97-99
	Woodchuck	*Marmota monax*	1,1a, 4	x	evidence	evidence	evidence	
BIRDS								
Herons, Egrets and Bitterns								
	Great Blue Heron	*Ardea herodias*	1,1a,3,4,5a	1			1	
Ducks, Geese and Swans								
	Canada Goose	*Branta canadensis*	1a,3,4	3	1			feral; 2 pair with young 2001
	Wood Duck	*Aix sponsa*	1a,3,4	2				
	Muscovy	*Cairina moschata*	3,5					exotic/feral
Raptors								
	Turkey Vulture	*Cathartes aura*	1,1a,3,4,5	1	1		2	
	Black Vulture*	*Coragyps atratus*	5a					
	Red-shouldered Hawk	*Buteo lineatus*	1a,3,4,5a	1	1	1	2	
	Red-tailed Hawk	*Buteo jamaicensis*	1,1a,4,5a	1	1	1	1	
Upland Game Birds								
	Wild Turkey	*Meleagris gallopavo*	1a,3,4,5a	evidence				
Pigeons and Doves								
	Mourning Dove	*Zenaida macroura*	1a,3,4,5a		1	2		
Cuckoos								
	Yellow-billed Cuckoo	*Coccyzus americanus*	4,5a	2		1	1	
Owls								
	Barred Owl	*Strix varia*	1a,3,4,5a	1	2			
Swifts								
	Chimney Swift*	*Chaetura pelagica*	3,4,5a	6			2	Nesting in chimney
Hummingbirds								
	Ruby-throated Hummingbird	*Archilochus colubris*	1a,3,4				1	
Kingfishers								
	Belted Kingfisher	*Ceryle alcyon*	1a,3,4		1			

Animals	Common Name	*Scientific Name*	Data Source*	4/22/2004 11-2 PM	3/26/2006 8-11 AM	6/3/2006 8-10 AM	6/9/2006 9-11 AM	Comments
Woodpeckers								
	Red-headed Woodpecker	*Melanerpes erythrocephalus*	3,5a					1993
	Red-bellied Woodpecker	*Melanerpes carolinus*	1a,2,3,4,5a	2	3	2	6	7/08 Eating apple!
	Downy Woodpecker	*Picoides pubescens*	1a,2,3,4,5	3	2		4	
	Hairy Woodpecker	*Picoides villosus*	1a,2,3,4				1	
	Northern Flicker	*Colaptes auratus*	2,3,4		4			
	Pileated Woodpecker	*Dryocopus pileatus*	1,1a,2,3,4,5a			2		
Tyrant Flycatchers								
	Eastern Wood-Pewee	*Contopus virens*	3,4,5a			1		
	Acadian Flycatcher	*Empidonax virescens*	4,5a	3		1	4	
	Eastern Phoebe	*Sayornis phoebe*	4,5a			1		
	Great Crested Flycatcher	*Myiarchus crinitus*	4,5a	3		2	4	
Shrikes and Vireos								
	White-eyed Vireo	*Vireo griseus*	4	1				
	Yellow-throated Vireo	*Vireo flavifrons*	4	4		1	3	
	Red-eyed Vireo	*Vireo olivaceus*	4,5a	2			5	
Swallows								
	No. Rough-winged Swallow	*Stelgidopteryx serripennis*	4,5a			2	2	
	Cliff Swallow	*Petrochelidon pyrrhonota*	4	8		8	2	
	Barn Swallow	*Hirundo rustica*	1a,3,4,5a	4		3	8	
	Purple Martin	*Progne subis*	3,5a					1990-97
Jays, Crows and Their Allies								
	Blue Jay	*Cyanicitta cristata*	1a,2,3,4,5a	1			2	
	American Crow	*Corvus brachyrhynchos*	1a,2,4,5a	4	12	2	3	
	Fish Crow	*Corvus ossifragus*	3,4	3				
Chickadees, Nuthatches and Their Allies								
	Carolina Chickadee	*Poecile carolinensis*	1a,2,3,4,5	4	3		6	
	Tufted Titmouse	*Baeolophus bicolor*	1a,2,3,4,5a	2	6		8	
	Brown-headed Nuthatch*	*Sitta pusilla*	1a,3,5a					
	White-breasted Nuthatch	*Sitta carolinensis*	1a,2,3,4	2	3		2	
Wrens								
	Carolina Wren	*Thryothorus ludovicianus*	1,1a,2,3,4,	4	6		6	
	Winter Wren	*Troglodytes troglodytes*	4		4			
Kinglets and Gnatcatchers								
	Golden-crowned Kinglet	*Regulus satrapa*	4		15			
	Ruby-crowned Kinglet	*Regulus calendula*	4		6			
	Blue-gray Gnatcatcher	*Polioptila caerulea*	1a,3,4,5a	5	1		4	
Thrushes								
	Eastern Bluebird	*Sialia sialis*	1,1a,2,3,4,5a	3	4	4	8	7/08 One pair feeding in house
	Hermit Thrush	*Catharus guttatus*	1a,3,4		3			
	Wood Thrush	*Hylocichla mustelina*	1a,3,4				1	

Animals	Common Name	*Scientific Name*	Data Source*	4/22/2004 11-2 PM	3/26/2006 8-11 AM	6/3/2006 8-10 AM	6/9/2006 9-11 AM	Comments
	American Robin	*Turdus migratorius*	1,1a,2,3,4		45			
Mimids								
	Northern Mockingbird*	*Mimus polyglottos*	1,1a,3,4	1	2	2		
	Gray Catbird	*Dumetella carolinensis*	2					
	Brown Thrasher*	*Toxostoma rufum*	1,1a,3,4,5a		1	1	1	
Waxwings								
	Cedar Waxwing	*Bombycilla cedrorum*	3,4	10				
Wood-Warblers								
	Yellow-rumped Warbler	*Dendroica coronata*	1a,3,4		14			
	Yellow-throated Warbler	*Dendroica dominica*	1a,3,4	1		1	3	
	Pine Warbler	*Dendroica pinus*	4,5a	2		1	1	
	Yellow Warbler	*Dendroica petechia*	5a					
	Prothonotary Warbler	*Protonotaria citrea*	1a,3,4			1	2	
	Ovenbird	*Seiurus aurocapillus*	2					
	Yellow-breasted Chat	*Icteria virens*	4				1	
Tanagers, Cardinals and Their Allies								
	Summer Tanager*	*Piranga rubra*	1a,3,4,5a	2		1	4	
	Northern Cardinal	*Cardinalis cardinalis*	1,1a,2,3,4,5a	4	7	3		
	Blue Grosbeak*	*Guiraca caerulea*	1a,3,4,5a	2			1	
	Indigo Bunting*	*Passerina cyanea*	1a,3,4	1		1	2	
Emberizine Sparrows and Their Allies								
	Eastern Towhee*	*Pipilo erythropthalmus*	1,1a,3,4					
	Chipping Sparrow	*Spizella passerina*	1a,3,4,5a			2	2	
	Field Sparrow	*Spizella pusilla*	4		2			
	Song Sparrow	*Melospiza melodia*	1a,3,4		12			
	White-throated Sparrow	*Zonotrichia albicollis*	1a,3,4		36			
	Dark-eyed Junco	*Junco hyemalis*	1,1a,3,4		12			
Icterids								
	Red-winged Blackbird	*Agelaius phoeniceus*	4		20			
	Brown-headed Cowbird	*Molothrus ater*	1a,3,4,5a	1	2		2	
	Common Grackle	*Quiscalus quiscula*	1a,3,4				2	
Finches and Old World Sparrows								
	American Goldfinch	*Carduelis tristis*	1a,3,4,5a	2	20	2	6	
	House Finch	*Carpodacus mexicanus*	4,5a	1			2	exotic

REPTILES								
	Common Gartersnake	*Thamnophis sirtalis*	1,1a,4	x				
	Copperhead	*Agkistrodon contortrix*	1,1a					
	Eastern Box Turtle	*Terrapene carolina*	1,1a,4	x				
	Eastern Fence Lizard	*Sceloporus undulatus*	4	x				
	Eastern Mud Turtle	*Kinosternon subrubrum*	1,1a					
	Eastern Ratsnake	*Elaphe obsoleta*	1,1a,4	x				

Animals	Common Name	*Scientific Name*	Data Source*	4/22/2004 11-2 PM	3/26/2006 8-11 AM	6/3/2006 8-10 AM	6/9/2006 9-11 AM	Comments
	Eastern Wormsnake	*Carphophis amoenus*	4	1				
	Green Anole	*Anolis carolinensis*	1a					
	Ground Skink	*Scincella lateralis*	4		1			
	Northern Watersnake	*Nerodia sipedon*	1,1a					
	Racer	*Coluber constrictor*	1,1a					
	Red Cornsnake	*Elaphe guttata*	1a					
	River Cooter	*Pseudemys concinna*	1,1a,4		4			
	Yellowbelly Slider	*Trachemys scripta*	1,1a					
AMPHIBIANS								
	American Toad	*Bufo americanus*	1,1a,4	x				
	Bullfrog	*Rana catesbeiana*	1,1a					Recorded calling
	Eastern Spadefoot Toad	*Scaphiopus holbrookii*	5					6/14/06 - First record in Wake County since
	Fowler's Toad	*Bufo fowleri*	4			xx		
	Green Frog	*Rana clamitans*	1,1a,4	x				
	Marbled Salamander	*Ambystoma opacum*	4		xx			Larvae in vernal pool
	Northern Cricket Frog	*Acris crepitans*	1,1a,4		5			
	Red-spotted Newt	*Notophthalmus viridescens*	4			x		Larvae in vernal pool
	Southern Leopard Frog	*Rana sphenocephala*	1,1a,4			x		
	Spotted Salamander	*Ambystoma maculatum*	4		x			Eggs in vernal pool
	Spring Peeper	*Pseudacris crucifer*	1,1a,4		5+			
	Upland Chorus Frog	*Pseudacris feriarum*	1,1a,4	x				
BUTTERFLIES								
	Carolina Satyr	*Hermeuptychia sosybius*	2					
	Clouded Skipper	*Lerema accius*	2					
	Cloudless Sulphur	*Phoebis sennae*	2					
	Creole Pearly-eye	*Enodia creola*	2					cane is sole hostplant
	Dun Skipper	*Euphyes vestris*	2					
	Eastern Tailed-Blue	*Cupido comyntas*	2					
	Least Skipper	*Ancyloxypha numitor*	2					
	Pearl Crescent	*Phyciodes tharos*	2					
	Red-banded Hairstreak	*Calycopis cecrops*	2					
	Sachem	*Atalopedes campestris*	2					
	Sleepy Orange	*Abaeis nicippe*	2					
	Gray Hairstreak	*Strymon melinus*	2					
	American Snout	*Libytheana carinenta*	2					
	Eastern Comma	*Polygonia comma*	2					
	Red Admiral	*Vanessa atalanta*	2					
	Appalachian Brown	*Satyrodes appalachia*	2					
	Northern Pearly-eye	*Enodia anthedon*	2					

Animals	**Common Name**	***Scientific Name***	**Data Source***	4/22/2004 11-2 PM	3/26/2006 8-11 AM	6/3/2006 8-10 AM	6/9/2006 9-11 AM	Comments
	Gemmed Satyr	*Cyllopsis gemma*	2					
	Northern Broken-Dash	*Wallengrenia egeremet*	2					
	Zabulon Skipper	*Poanes zabulon*	2					
	Little Glassywing	*Pompeius verna*	2					
	Crossline Skipper	*Polites origenes*	2					
	Dion Skipper	*Euphyes dion*	2					scarce in the county
	Lace-winged Roadside-Skipp	*Amblyscirtes aesculapius*	2					cane is sole hostplant
	Southern Pearly-eye	*Enodia portlandia*	2					cane is sole hostplant
	Falcate orangetip	*Anthocharis midea*	4					

Birds	Common Name	Scientific Name	Data Source*	4/22/2004 11-2 PM	3/26/2006 8-11 AM	6/3/2006 8-10 AM	6/9/2006 9-11 AM	Comments
Herons, Egrets and Bitterns								
	Great Blue Heron	*Ardea herodias*	1,1a,3,4,5a	1			1	
	Cattle Egret	*Bubulcus ibis*	3					1990-93
	Green Heron	*Butorides virescens*	3					
Ducks, Geese and Swans								
	Canada Goose	*Branta canadensis*	1a,3,4	3	1			feral; 2 pair with young 2001
	Wood Duck	*Aix sponsa*	1a,3,4	2				
	Mallard	*Anas platyrhynchos*	3					feral?
	Muscovy	*Cairina moschata*	3,5					exotic/feral
Raptors								
	Turkey Vulture	*Cathartes aura*	1,1a,3,4,5a	1	1		2	
	Black Vulture*	*Coragyps atratus*	5a					
	Red-shouldered Hawk	*Buteo lineatus*	1a,3,4,5a	1	1	1	2	
	Cooper's Hawk *	*Accipiter cooperii*	3					
	Red-tailed Hawk	*Buteo jamaicensis*	1,1a,4,5a	1	1	1	1	
	Bald Eagle	*Haliaeetus leucocephalus*	3					occasionally
Upland Game Birds								
	Wild Turkey	*Meleagris gallopavo*	1a,3,4,5a	evidence				
	Northern Bobwhite	*Colinus virginianus*	1a,3					1990-93, 2001
Shorebirds								
	Killdeer	*Charadrius vociferus*	1a,3					
	American Woodcock	*Scolopax minor*	1a,3					
Pigeons and Doves								
	Mourning Dove	*Zenaida macroura*	1a,3,4,5a		1	2		
Cuckoos								
	Yellow-billed Cuckoo	*Coccyzus americanus*	4,5a	2		1	1	
Owls								
	Barred Owl	*Strix varia*	1a,3,4,5a	1	2			
Nightjars								
	Common Nighthawk	*Chordeiles minor*	3					
Swifts								
	Chimney Swift*	*Chaetura pelagica*	3,4,5a	6			2	Nesting in chimney
Hummingbirds								
	Ruby-throated Hummingbird	*Archilochus colubris*	1a,3,4				1	
Kingfishers								
	Belted Kingfisher	*Ceryle alcyon*	1a,3,4		1			

Birds	Common Name	Scientific Name	Data Source*	4/22/2004 11-2 PM	3/26/2006 8-11 AM	6/3/2006 8-10 AM	6/9/2006 9-11 AM	Comments
Woodpeckers								
	Red-headed Woodpecker	*Melanerpes erythrocephalus*	3,5a					1993
	Red-bellied Woodpecker	*Melanerpes carolinus*	1a,2,3,4,5a	2	3	2	6	7/08 Eating apple!
	Yellow-bellied Sapsucker	*Sphyrapicus varius*	1a,3					
	Downy Woodpecker	*Picoides pubescens*	1a,2,3,4,5a	3	2		4	
	Hairy Woodpecker	*Picoides villosus*	1a,2,3,4				1	
	Northern Flicker	*Colaptes auratus*	2,3,4		4			
	Pileated Woodpecker	*Dryocopus pileatus*	1,1a,2,3,4,5a			2		
Tyrant Flycatchers								
	Eastern Wood-Pewee	*Contopus virens*	3,4,5a			1		
	Acadian Flycatcher	*Empidonax virescens*	4,5a	3		1	4	
	Eastern Phoebe	*Sayornis phoebe*	4,5a			1		
	Great Crested Flycatcher	*Myiarchus crinitus*	4,5a	3		2	4	
	Eastern Kingbird	*Tyrannus tyrannus*	3					entered as Gray Kingbird
Shrikes and Vireos								
	White-eyed Vireo	*Vireo griseus*	4	1				
	Yellow-throated Vireo	*Vireo flavifrons*	4	4		1	3	
	Red-eyed Vireo	*Vireo olivaceus*	4,5a	2			5	
Swallows								
	No. Rough-winged Swallow	*Stelgidopteryx serripennis*	4,5a			2	2	
	Cliff Swallow	*Petrochelidon pyrrhonota*	4	8		8	2	
	Barn Swallow	*Hirundo rustica*	1a,3,4,5a	4		3	8	
	Purple Martin	*Progne subis*	3,5a					1990-97
Jays, Crows and Their Allies								
	Blue Jay	*Cyanicitta cristata*	1a,2,3,4,5a	1			2	
	American Crow	*Corvus brachyrhynchos*	1a,2,4,5a	4	12	2	3	
	Fish Crow	*Corvus ossifragus*	3,4	3				
Chickadees, Nuthatches and Their Allies								
	Carolina Chickadee	*Poecile carolinensis*	1a,2,3,4,5a	4	3		6	
	Tufted Titmouse	*Baeolophus bicolor*	1a,2,3,4,5a	2	6		8	
	Brown-headed Nuthatch*	*Sitta pusilla*	1a,3,5a					
	White-breasted Nuthatch	*Sitta carolinensis*	1a,2,3,4	2	3		2	
Wrens								
	Carolina Wren	*Thryothorus ludovicianus*	1,1a,2,3,4,5a	4	6		6	
	House Wren	*Troglodytes aedon*	1a,3					
	Winter Wren	*Troglodytes troglodytes*	4		4			

Birds	Common Name	Scientific Name	Data Source*	4/22/2004 11-2 PM	3/26/2006 8-11 AM	6/3/2006 8-10 AM	6/9/2006 9-11 AM	Comments
Kinglets and Gnatcatchers								
	Golden-crowned Kinglet	*Regulus satrapa*	4		15			
	Ruby-crowned Kinglet	*Regulus calendula*	4		6			
	Blue-gray Gnatcatcher	*Polioptila caerulea*	1a,3,4,5a	5	1		4	
Thrushes								
	Eastern Bluebird	*Sialia sialis*	1,1a,2,3,4,5a	3	4	4	8	7/08 One pair feeding in house
	Veery	*Catharus fuscescens*	3					
	Hermit Thrush	*Catharus guttatus*	1a,3,4		3			
	Wood Thrush	*Hylocichla mustelina*	1a,3,4				1	
	American Robin	*Turdus migratorius*	1,1a,2,3,4		45			
Mimids								
	Northern Mockingbird*	*Mimus polyglottos*	1,1a,3,4	1	2	2		
	Gray Catbird	*Dumetella carolinensis*	2					
	Brown Thrasher*	*Toxostoma rufum*	1,1a,3,4,5a		1	1	1	
Waxwings								
	Cedar Waxwing	*Bombycilla cedrorum*	3,4	10				
Starlings								
	European Starling	*Sturnus vulgaris*	1,1a					exotic
Wood-Warblers								
	Black-throated Blue Warbler	*Dendroica caerulescens*	3					
	Yellow-rumped Warbler	*Dendroica coronata*	1a,3,4		14			
	Yellow-throated Warbler	*Dendroica dominica*	1a,3,4	1		1	3	
	Pine Warbler	*Dendroica pinus*	4,5a	2		1	1	
	Yellow Warbler	*Dendroica petechia*	5a					
	American Redstart	*Setophaga ruticilla*	1a,3					1993 - 2001
	Prothonotary Warbler	*Protonotaria citrea*	1a,3,4			1	2	
	Ovenbird	*Seiurus aurocapillus*	2					
	Yellow-breasted Chat	*Icteria virens*	4				1	
Tanagers, Cardinals and Their Allies								
	Summer Tanager*	*Piranga rubra*	1a,3,4,5a	2		1	4	
	Northern Cardinal	*Cardinalis cardinalis*	1,1a,2,3,4,5a	4	7	3		
	Blue Grosbeak*	*Guiraca caerulea*	1a,3,4,5a	2			1	
	Indigo Bunting*	*Passerina cyanea*	1a,3,4	1		1	2	
Emberizine Sparrows and Their Allies								
	Eastern Towhee*	*Pipilo erythropthalmus*	1,1a,3,4					
	Chipping Sparrow	*Spizella passerina*	1a,3,4,5a			2	2	

Birds	Common Name	Scientific Name	Data Source*	4/22/2004 11-2 PM	3/26/2006 8-11 AM	6/3/2006 8-10 AM	6/9/2006 9-11 AM	Comments
	Field Sparrow	*Spizella pusilla*	4		2			
	Song Sparrow	*Melospiza melodia*	1a,3,4		12			
	Fox Sparrow	*Passerella iliaca*	1a,3					
	White-throated Sparrow	*Zonotrichia albicollis*	1a,3,4		36			
	Dark-eyed Junco	*Junco hyemalis*	1,1a,3,4		12			
Icterids								
	Eastern Meadowlark	*Sturnella magna*	1a,3					1990-92
	Red-winged Blackbird	*Agelaius phoeniceus*	4		20			
	Brown-headed Cowbird	*Molothrus ater*	1a,3,4,5a	1	2		2	
	Common Grackle	*Quiscalus quiscula*	1a,3,4				2	
Finches and Old World Sparrows								
	Evening Grosbeak	*Coccothraustes vespertinus*	3					Small flock Jan. 1996
	American Goldfinch	*Carduelis tristis*	1a,3,4,5a	2	20	2	6	
	House Finch	*Carpodacus mexicanus*	4,5a	1			2	exotic
	Purple Finch	*Carpodacus purpureus*	1a,3					

Appendix C

WILDLIFE HABITAT RECOMMENDATIONS

Horseshoe Farm City Park

Raleigh, NC

Wake County

24 March 2009

Introduction

The following recommendations were written based upon conditions observed during my visit on 18 March 2009 and upon the understanding that the management needs for this tract are to improve the habitat conditions to make them more wildlife friendly and to promote wildlife diversity.

I've included options for management in many cases. The option(s) you choose will depend upon your overall vision for the park and the ability (i.e., labor, expense, equipment, etc.) to accomplish those recommendations.

In addition to the following recommendations, several booklets have been included for additional information. Potential seed source lists also have been included.

Field Edges

A. <u>Shrub Zone</u>:

A shrub component should be established adjacent to the mature forestland. This, along with the herbaceous component (see next section), will create a feathering effect and provide edge habitat. Edge habitat is important for a variety of wildlife species. The plants in this ecotone provide food in the form of browse, soft mast, and seeds. These plants also provide good cover habitat for escaping predators and adverse weather conditions, and for nesting and brooding.

Much of the open space is dominated by bermudagrass and fescue. These grass species are not favorable to wildlife and may impede the development of more favorable habitat.

1. **Establishment**
   The shrub zone should be a minimum of 30 feet wide, but I recommend a wider zone (perhaps 50 feet or more) to provide more of this type of habitat and to make it more difficult for predators to find their prey in this habitat.

   a. Control the fescue and bermudagrass by applying a glyphosate-based herbicide (e.g., Roundup®) at a rate of approximately 2 quarts per acre. The fescue and bermudagrass should be actively growing. The herbicide will not be effective if the grasses are dormant. Often better control can be achieved if the grasses are allowed to start growing, then mowed. Once the grasses begin to grow again, apply the herbicide.

   *****When applying herbicides, read and follow all safety and direction labels*****

   b. Plant a variety of native shrub species in this zone. Shrub species may include, but are not limited to, blackberry, beautyberry, red cedar, American plum, wax myrtle, red mulberry, huckleberry, blueberry, arrowwood, and wild raisin.

   c. It may be beneficial to protect these new plantings with tree shelters or fencing until they are able to sustain heavy browsing by deer and rabbits and antler rubbing.

   d. Forest edges can be thinned to allow more sunlight to penetrate to the forest floor and promote more growth in the understory, adding to the feathering effect. Remove undesirable trees species such as sweetgum and sycamore and any poor-quality (due to deformity, disease, or insect infestation) from the forest edge. Try to produce a band at least 50 feet wide where the density of the trees is 60 square feet of basal area or less per acre. A good rule of thumb is that at least 50% of the ground should receive sunlight when the sun is at its peak.

2. Maintenance

a. Maintenance will require periodic control of unwanted seedlings that may become established from nearby seed sources. Loblolly pine seedlings can be easily killed by cutting them with a machete or ax. Hardwood seedlings, such as sweetgum should be controlled with an appropriate application of herbicide. Small seedlings can be foliar sprayed with herbicides such as Arsenal® or Accord®. The seedling should not be dormant at the time of herbicide treatment. Best results may be attained if herbicides are applied in the early fall just as the seedling is transporting nutrients to its root system to survive the winter. As the nutrients are drawn toward the roots for storage, so too is the herbicide. Therefore, rather than just killing the top growth, the entire plant is killed.

b. Preventative maintenance can be performed by cutting unwanted, heavy seeding trees along the forest edge. This is especially applicable to sweetgum and sycamore. They can easily invade the areas that you want to maintain in early succession habitat. In most cases, it will be best to fell and remove or fell and leave the trees to provide habitat for small mammals, reptiles, and amphibian. In other cases, it would be a good idea to girdle or kill and leave standing a couple of the large diameter trees that would not cause a safety risk. These trees will provide habitat for a variety of wildlife species at varying stages of decay. As the bark begins to slough, small animals can take refuge under the bark. As insects invade the snag, woodpeckers, brown creepers, and many other insectivorous birds will forage on these snags. Snags will become great perching sites for raptors. Many snags will form cavities that may house birds and small mammals.

c. In addition to the shrubs component, there should be native warm season grasses (NWSG) and native forbs in this zone. Management may also include prescribed burning in the winter. Some shrubs will respond well to occasional burning others will not. If burning is used to maintain the shrub zone, care should be taken to rake fuels away from the beneficial shrubs to prevent them from being damaged by fire. Your goal should be to maintain native warm season grasses and forbs, while controlling fescue and bermudagrass in the understory. Spot herbicide treatments may be needed to control these exotic grasses. Apply a sethoxydim-based herbicide (e.g., Poast®, Poast Plus®, Arrest®, Sethoxydim G-Pro®) to control grasses as needed. These chemicals will also kill native warm season grasses, so care should be taken to avoid spraying these beneficial grasses. Follow all direction and safety labels. See direction labels for specific application rates, but should be approximately 2 pints per acre.

B. <u>Herbaceous Zone (Field Border)</u>

Field borders are bands of early succession habitat, and as the name implies, they border the edges of fields. Field borders are important in today's landscape for wildlife species that require early succession habitat and species that prefer both field and forest habitats.

The benefits of a proper field borders are many-fold. They provide cover for traveling, nesting, and escape from predators and adverse weather. They provide food (browse, seeds, soft mast, etc.). They are low maintenance. So, there are fewer acres to tend annually. They reduce soil erosion and siltation.

What is a proper field border? Field borders should be a minimum of 30 feet wide, but wider is better. Narrow field borders only make it more efficient for predators to find there prey. Borders are most beneficial because they connect habitats creating travel corridors. Field borders that encircle a field are optimum for wildlife. Plant composition in a proper field border includes NWRGs and native forbs. Exotic species such as fescue, bermudagrass, honeysuckle, privet, etc. should be controlled using mechanical and/or chemical means.

1. Establishment

1. Evaluate what is in the seed bank. This is done by observing the plant species in the immediate area. Currently, preferable species in the area includes broomstraw and fall panicum. However, the large majority of the area is dominated by exotic, invasive plants such as fescue and bermudagrass.
2. The easiest and most cost efficient way to establish a field border is to stop disking/mowing the field edge for a couple years. If invasive species aren't too big of a problem, most of the plants that will naturally grow in the field border will be beneficial to wildlife in one form or another. You will need to treat the area chemically first if you choose to establish a field border using this method by applying a glyphosate-based herbicide (e.g., Roundup®) at a rate of approximately 2 quarts per acre. Apply the herbicide when the exotic grasses are actively growing. You can control many of the non-native and cool season species by applying herbicide in the early spring and late fall when the native warm season species are dormant.
3. The second way to establish a field border is to control what grows by planting NWSGs and forbs.
    - i) Test the soil to determine any fertilizer or lime requirements. The NC State Cooperative Extension can help with this service. Optimum growing conditions for NWSG is pH to 6.0–6.5 and phosphorus and potassium at 19–30 and 91–160 pounds available per acre, respectively.
    - ii) Determine how much to plant. Below are the recommended planting rates and an example of how much seed to plant based on the amount of Pure Live Seed (PLS).

Examples of recommended seed mixes (weights are Pure Live Seed per acre):

3.0 lbs big bluestem 1.0 lbs sideoats grama 0.5 lbs indiangrass 1.0 lbs. native forbs (e.g., partridge pea, coreopsis, black-eyed Susan, ragweed, lance leaf coreopsis, etc.)

2.0 lbs Blackwell switchgrass 2.0 lbs Rountree big bluestem 2.0 lbs partridge pea 1.0 lbs blackeyed Susan 1.0 lbs lance leaf coreopsis

iii) Disk the area to be planted. Roll the area with a cultipacker to create a firm seed bed. Drill the seeds to a depth of no greater than ¼ inch. Cultipack again to make sure there is good seed to soil contact.

It may be to your advantage to try both methods of establishment and use the results as a teaching tool for future environmental education classes.

2. Maintenance

Maintaining the field borders is important to stimulate germination and new growth and to control unwanted plants. The preferred methods used to maintain field borders are prescribed burning and disking. Prescribed burning is most preferred method; the second most preferred method is by disking. Field borders should be divided such that there is a mixture of treated and untreated field borders scattered across the landscape, thus providing different stages of succession.

a. Prescribed burning should be done every 2-3 years in February to mid-March. A strip should be disked between the field border and the adjacent shrub zone as a firebreak prior to burning. Contact the NC Forest Service prior to burning for assistance with a burn plan and a list of certified burners if one is not available in your staff.
b. Disking should be done every 2-3 years in October to mid-March. Disking should be light only to expose the soil and allow seed to soil contact. Disking in the fall usually results in more favorable forbs, whereas disking in the late winter usually favors grasses. However, by disking in the fall, winter habitat is temporarily destroyed. So, it is important to make sure that there is other winter habitat available.
c. Periodic spot treatments with an appropriate herbicide may be needed to control encroachment of woody vegetation. (See 2. Maintenance for the Shrub Zone above)

Again, a combination of methods may be beneficial as a learning tool for environmental education classes.

C. <u>Bluebird Nest Boxes</u>

Bluebirds are territorial. Many of the bluebird nest boxes are located too close to one another such that the potential territories of neighboring bluebirds would overlap. Nest boxes should be placed at least 200 yards apart. Also, make sure that the opening to the nest box faces the open area.

Field Interior (Meadow)

In interior portion of the field will likely be used for recreational activities. Therefore, the vegetation should be low-growing. I understand that your desire is to plant and promote only native vegetation; however, the existing grasses in this area are not only exotic, but there are not wildlife-friendly. In fact, they can be detrimental. First, the growth structure of these grasses can inhibit the movement of small animals, and predispose themselves to predation. Second, fescue is often infected with an endophyte (fungus) that can cause many reproductive and milk production problems in wildlife just as it does in livestock. An effort should be made to convert the fescue and Bermudgrass to something more wildlife-friendly.

Option 1:
Although not native, clover would be my plant of choice in this area. It provides forage for deer, rabbits, turkeys, and other charismatic species. It provides seeds for songbirds and small rodents. The flowers will attract pollinators and butterflies. It is low maintenance and can be visually striking. (See photos below.)

Below are descriptions of 3 types of clovers (crimson, red, and white). Establish 50-60 foot wide strips of alternating clover types. Strips should follow the contour of the land to reduce soil erosion. Each variety listed below includes a description of the establishment and maintenance requirements. Part of the seedbed preparation will require herbicide treatment of the grasses in the area. Use a glyphosate-based product (e.g., Roundup®) 1-2 weeks prior to tilling or drilling the clover seed. Be sure to read and follow all direction and safety labels.

CRIMSON CLOVER (*Trifolium incarnatum*)

Photo credit: www.treearth.com

Description: Crimson clover is an upright, annual legume that grows as high as 3 feet under good conditions. Roots may penetrate to a depth roughly equal to plant's height.

Uses: Crimson clover is used for grazing, wildlife, erosion control, soil improvement, and seed production.

Soil Adaptation: Crimson clover is best adapted to fertile, well-drained soils. However, it has a wide range of soil adaptations. This clover will thrive on both sandy and clay soils doing better than most clovers on poor soils.

Varieties: Autanga, Chief, Dixie, Tibbee.

Cultural Specifications

Method of Establishment: By seeding.

Fertilizer Requirements: Apply fertilizer based upon soil tests. However, in the absence of a soil test, apply 300 lbs/acre of 8-24-24 or 60 lbs. of phosphorus and 60 lbs. of potassium per acre at planting time to insure good growth. Apply 40-60 lbs. of phosphorus and 40-60 lbs. of potassium per acre annually in September as a maintenance fertilizer.

Lime Needs: Follow soil test recommendations. Best results are obtained where pH is 5.5 to 7.0.

Planting Time: Plant September to October.

Planting Rate: Broadcast or drill 20 lbs. of clean, inoculated (Rhizobium bacteria - strain R) seed per acre. Planting depth should not exceed ¼ inch deep.

Management: Mow in late August and follow with a *light* disking. Herbicides may be required. Apply a sethoxydim-based herbicide (e.g., Poast®, Poast Plus®, Arrest®,

Sethoxydim G-Pro®) to control grasses if needed. Follow all direction and safety labels. See direction labels for application rates.

RED CLOVER (*Trifolium pratense*)

Description: Medium rooted, biennial. Medium to tall growth. Grows well with upright type grasses. Requires high fertility. Has a characteristic red bloom.

Uses: Used for hay, grazing, and to provide ground cover in winter, spring, and early summer. Can be used in conservation cropping systems for soil improvement.

Soil Adaptation: Grows best on fertile, moderately well-drained neutral soils with high organic matter. Poorly adapted to light sandy soils.

Varieties: Kenland

Cultural Specifications

Method of Establishment: By seeding.

Land Preparation: Break land in June or July and fallow until time to plant.

Fertilizer Requirements: Follow soil test recommendations. If not available, 60 lbs. phosphorus and 60 lbs. of potassium per acre at time of land preparation and work into soil. For maintenance, apply 60 lbs. phosphorus and 40 lbs. of potassium per acre annually in September.

Lime Needs: Maintain a soil pH of 6.0 to 6.5.

Planting Time: Plant in September to October.

Planting Rate: Plant 8 lbs. of inoculated (Rhizobium bacteria - Strain B) seed per acre or 5-7 lbs with 40-45 lbs of wheat or rye on firm seedbed and follow with a cultipacker.

Management: Mow when seed heads begin turning brown (August). Allow seed to mature each year to maintain stand. Herbicides may be required. Apply a sethoxydim-based herbicide (e.g., Poast®, Poast Plus®, Arrest®, Sethoxydim G-Pro®) to control

grasses if needed. Follow all direction and safety labels. See direction labels for application rates.

WHITE CLOVER (*Trifolium repens*)

Photo Credit - www.buckeyewildlifeinstitute.com

Description: White clover is ordinarily a long-lived perennial. It is shallow rooted and spreads by creeping branches (stolons) which root at the nodes and by seeds. The flowers are white and in clusters or heads. Clover provides palatable forage for a variety of wildlife, as well as providing "bugging areas" for turkey and quail chicks. White clover grows well in mixtures with annual plants or perennial grasses. It adapts well to a variety of soil conditions, except those with moisture extremes. Performing the best in full sun, white clover will tolerate partial shading; therefore, it is well suited to planting on wood paths and openings.

Uses: White clover is used in combination with grasses for grazing, furnishes nitrogen, increases the quantity and quality of forage and extends grazing periods. It has some value for wildlife.

Soil Adaptation: White clover is adapted to a wide range of soils, including wet and hard pan soils. It is best suited to fertile, moist bottom or second bottom clay or loam soils. Not suited to lightly textured, droughty upland soils of medium to low fertility or to extremely wet soils.

Varieties: (1) large, called Ladino; (2) intermediate, as in Louisiana white; (3) low growing, called common white; and (4) a synthetic strain, called La-S1.

Ladino clover is the most common variety planted. Several strains of this variety have been developed, usually each with varying peak growth periods and adapted to different regions of the country. Osceola, Regal, and California are all strains of the ladino variety. White clover commercially marketed under name brands; often utilize a mix of several varieties to lengthen the peak growth period of the planting. This idea can be replicated

by obtaining several varieties best adapted to your area from a local seed company. Common white and a few other less well known varieties exist, however are not as readily available.

Cultural Specifications

Method of Establishment: By seeding.

Fertilizer Requirements: Follow soil tests if available; if not, apply 80 lbs. phosphorus and 80 lbs. of potassium per acre at planting time. Annual applications of 40-60 lbs. phosphorus and 40-60 lbs. of potassium (approximately 300 lbs. of 19-19-19 or 8-24-24) per acre should be made in August or September.

Lime Needs: Apply according to soil test or 1-2 tons per acre as needed to maintain a soil pH of 6.5.

Land Preparation: Prepare a clean, smooth, firm seedbed and allow to settle before planting. If planting on established grass sod, disc lightly or plant with sod seeding machine.

Planting Time: Plant from September 1 to November 15.

Planting Rate: 3-8 lbs./acre for drilled plantings, 8-12 lbs./ acre for broadcast plantings. For broadcast plantings, set seed using a cultipacker.

Inoculation: Rhizobium bacteria (Strain B)

Maintenance: Mowing may be used if control of overtopping vegetation is needed. Pure stands of clover may be cut to 2-4 inches in height in late August or early September, the clover will then put out a flush of growth shading out competition. Herbicides may be required. Apply a sethoxydim-based herbicide (e.g., Poast®, Poast Plus®, Arrest®, Sethoxydim G-Pro®, Vantage®) to control grasses if needed. Follow all direction and safety labels. See direction labels for application rates.

Option 2:
Plant the meadow to a mixture of native wildlife flowers. Some species and varieties will serve as forage for some wildlife species. Seeds will serve as food for many small mammals and many bird species. Flowers will attract pollinators, butterflies, and depending on the species of flower, hummingbirds.

Part of the seedbed preparation will require herbicide treatment of the grasses in the area. Use a glyphosate-based product (e.g., Roundup®) 1-2 weeks prior to tilling or drilling the clover seed. Be sure to read and follow all direction and safety labels.

There is a variety of native wildflowers from which to choose. Several are listed in the enclosed booklets as well as the "North Carolina Native Prairie Meadow Plants" seed source list. Choose a variety of native wildflowers from these lists.

1. Establishment

Soil tests should be run to determine the appropriate fertilizer and lime needs based upon the wildflowers that you choose. Generally, soil pH should be in the 6.0-7.0 range, and lime should be applied accordingly. Usually that requires approximately 2 tons of lime per acre.

The seedbed should be disked and firmed with a cultipacker and be ready for planting in September – October. The mixture you select will determine how much of each seed is planted, but in general you will plant 7-15 lbs. of seed per acre. Seeds can be broadcast and followed with a cultipacker or drilled to a maximum depth of ¼ inch.

2. Maintenance

Wildflowers can be maintained and unwanted weeds and grasses controlled by annual mowing and light disking. After the seeds on the flowers have matured in the late summer to early fall, mow the wildflowers and *lightly* disk the area to reseed the flowers. It may not be necessary to mow and disk the entire meadow. Strips that are left standing will provide cover for songbirds that are foraging on the seeds.

Herbicides may be necessary to control unwanted grasses. When necessary, apply a graminicide such as sethoxydim (e.g., Vantage®, Poast®, Poast Plus®, Arrest®, Sethoxydim G-Pro®) or fluazifop (e.g., Ornamec®, Grass-B-Gon®). Whenever possible, spot treatments should be used rather than a broadcast application.

Road Edge

Currently, an old pasture fence parallels to access road. Because this no longer serves a purpose and the boards are beginning to rot and are a hazard, this fence should be removed. This area should be managed so that it is aesthetically pleasing because it is the first thing people will notice when entering the park, but it should not obscure the view to the rest of the open habitat. This area also should be wildlife-friendly.

Scattered shrubs and small trees can be planted parallel to the roadway (where the fence now stands) to provide nesting habitat and soft mast. Shrubs and trees may include wax myrtle, red cedar, flowering dogwood, persimmon, serviceberry, Eastern redbud, red mulberry, just to name a few. Space the trees widely (20+ feet apart) so that there are areas to view the rest of the open habitat.

Tree shelters or fence exclosures may be necessary to reduce the risk of damage by deer until the shrubs and trees are of sufficient size.

Forests

The forest land may qualify for the Forest Landbird Legacy Program (FLLP; see enclosed brochure). Through this program we will develop habitat management recommendations that are best suited to managing interior forest songbirds. Many of these songbirds are listed by the state and or federal government as endangered, threatened, or species of special concern. Cost share may be available to offset some of the management recommendations.

I've contacted several of the committee members regarding this tract and have received some positive responses. If you would like to pursue enrolling in FLLP, please let me know and I'll set up a site visit with several of the FLLP committee members.

Appendix D

Plant List for Horseshoe Farm
Butterfly Meadow

The City of Raleigh Parks and Recreation Department coordinated a Wildlife Habitat Zones Advisory Team (WHZAT) in 2009 to develop recommendations for stewarding Horseshoe Farm. A Butterfly Meadow is a component of the Horseshoe Farm Master Plan. The goal of the Butterfly Meadow is to use native plants to provide nectar sources and larval food sources for moths and butterflies, to create butterfly and moth habitat, and to provide public education opportunities. WHZAT developed a recommendation: "All plantings within this zone should use plants native to the Piedmont and Inner Coastal Plain of North Carolina." Also included are recommendations to provide plant diversity
(including diversity in flower color, size, shape, fragrance, plant height, and bloom time) and to include night blooming flowers and native fruiting trees or shrubs.

The Butterfly Meadow will be 1-3 acres. The final location has yet to be determined, but is likely to be located within the soil mapping unit FaB (Faceville sandy loam 2-6 % slopes), in full sun.

Key: larval host plantspring summer fall winter

Upland Butterfly Meadow recommendations:
(X indicates commercial availability; it is also noted if there is a known local seed source)

Herbacious

Agastache nepetoides	Yellow giant-hyssop (X) (summer nectar source, deer resistant, drought tolerant)
Amorpha fruticosa	Tall indigo-bush (X) (larval host for silver-spotted skipper and gray hairstreak, and io moth (*Automeris io*), spring blooming, deer resistant, drought tolerant)
Antennaria plantaginifolia	Plantain-leaved pussytoes (X) (larval host for american lady, spring blooming, evergreen, drought tolerant)
Aristolochia serpentaria	Virginia snakeroot (X, local seed source) (larval host for pipevine swallowtail)
Asclepias syriaca	Common Milkweed (X, local seed source) (larval host for monarch, summer nectar source, deer resistant, drought tolerant)
Asclepias tuberosa	Butterfly weed (X, local seed source) (larval host for monarch, summer nectar source, deer resistant, drought tolerant)
Asclepias variegata	Redring milkweed (local seed source) (larval host for monarch, summer nectar source, deer resistant, drought tolerant)

Baptisia tinctoria	Yellow wild indigo (X) (larval host for frosted elfin, hoary edge, and wild indigo duskywing, and io moth (*Automeris io*), early summer nectar source, drought tolerant)
Cardamine angustata	Slender toothwort (local seed source) (larval host for falcate orangetip, understory plant)
Chamaecrista fasciculata	Partridge Pea (X) (larval host for sleepy orange, cloudless sulphur, eastern tailed-blue, gray hairstreak, and little yellow, and io moth (*Automeris io*), blooms summer-fall, fixes nitrogen, drought tolerant)
Cirsium horridulum `	Yellow thistle (X, local seed source) (larval host for painted lady, summer nectar source, deer resistant, drought tolerant)
Eryngium yuccifolium	Rattlesnake master (X) (larval host for swallowtails, late summer nectar source, deer resistant, drought tolerant)
Eupatorium rotundifolium	Roundleaf eupatorium (X, local seed source) (fall nectar source, deer resistant, drought tolerant)
Eupatorium serotinum	Late eupatorium (X) (fall nectar source, deer resistant, drought tolerant)
Helianthus atrorubens	Purple disk sunflower (X, local seed source) (larval host for silvery checkerspot, late summer-fall nectar source, drought tolerant)
Helianthus strumosus	Roughleaf sunflower (X) (larval host for silvery checkerspot, late summer-fall nectar source, drought tolerant)
Heliopsis helianthoides	Eastern sunflower (X, local seed source) (summer-fall nectar source, drought tolerant)
Liatris graminifolia	Blazing star (local seed source) (fall nectar source, drought tolerant)
Liatris pilosa	Shaggy blazing star (X, local seed source) (fall nectar source, drought tolerant)
Liatris squarrosa	Scaly blazing star (X) (fall nectar source, drought tolerant)
Lobelia puberula	Downy lobelia (local seed source) (late summer-fall nectar source)
Lupinus perennis	Wild lupine (X, local seed source) (larval host for frosted elfin, wild indigo duskywing, and gray hairstreak, spring nectar source, fixes nitrogen, drought tolerant)

Monarda clinopodia	Basil bergamot (X) (late spring-summer nectar source, deer resistant)
Monarda punctata var. punctata	Eastern horse-mint (X) (late summer nectar source, attracts hummingbirds, drought tolerant, deer resistant)
Oenothera biennis	Common evening-primrose (X) (larval host for banded sphinx moth (*Eumorpha fasciatus*) and white-lined sphinx moth (*Hyles lineata*), spring-fall nectar source, night blooming, drought tolerant)
Oenothera fruticosa var. fruticosa	Southern sundrops (X) (larval host for banded sphinx moth (*Eumorpha fasciatus*) and white-lined sphinx moth (*Hyles lineata*), summer nectar source, night blooming, drought tolerant)
Opunita humifusa	Prickly pear cactus (X, local seed source) (late spring nectar source, drought tolerant, deer resistant)
Parthenium integrifolium	Common wild quinine (X) (summer-fall nectar source, drought tolerant)
Penstemon laevigatus	Eastern beardtongue (X) (larval host for common buckeye, spring blooming nectar source)
Phlox amoena	Hairy phlox (X) (spring nectar source)
Phlox carolina	Thick-leaf phlox (X) (summer nectar source, drought tolerant)
Pycnanthemum incanum	Hoary mountainmint (X) (summer nectar source, deer resistant, drought tolerant)
Pycnanthemum pycnanthemoides	Southern mountainmint (X) (summer nectar source, deer resistant, drought tolerant)
Rudbeckia fulgida	Orange coneflower (X) (summer-fall nectar source, drought tolerant)
Ruellia caroliniensis	Wild petunia (X, local seed source) (larval host for common buckeye, late spring-summer nectar source, drought tolerant)
Salvia lyrata	Lyreleaf sage (X, local seed source) (spring nectar source, attracts hummingbirds, evergreen, drought tolerant, deer resistant)
Silphium asteriscus	Southern rosinweed (local seed source) (summer blooming, drought tolerant, seed source for birds)

Silphium compositum	Kidneyleaf rosinweed (local seed source) (late summer blooming, drought tolerant, seed source for birds)
Smallanthus uvedalius (formerly Polymnia uvidalia)	Bear's foot (local seed source) (mid-summer to mid-fall nectar source, drought tolerant, seed source for birds)
Solidago erecta	Slender goldenrod (local seed source) (fall nectar source, drought tolerant)
Solidago nemoralis	Gray goldenrod (local seed source) (late summer-fall nectar source, drought tolerant)
Solidago odora	Anise scented goldenrod (local seed source) (late summer-fall nectar source, drought tolerant)
Solidago petiolaris	Downy goldenrod (local seed source) (early summer-fall nectar source, drought tolerant)
Solidago pinetorum	Small's goldenrod (local seed source) (mid summer-fall blooming, drought tolerant)
Solidago speciosa	Showy goldenrod (X) (fall nectar source, drought tolerant)
Symphyotrichum lateriflorum	Calico aster (X) (larval host for pearl crescent and banded woolybear moth, fall nectar source, drought tolerant)
Symphyotrichum patens	Late purple aster (X) (larval host for pearl crescent and banded woolybear moth, fall nectar source, drought tolerant)
Symphyotrichum pilosum	Frost aster (X, local seed source) (larval host for pearl crescent and banded woolybear moth, fall nectar source, drought tolerant)
Tephrosia virginiana	Goat's rue (X, local seed source) (larval host for southern & northern cloudywing, early summer nectar source, attracts hummingbirds, drought tolerant)
Vernonia acaulis	Stemless ironweed (X) (larval host for American lady, late summer-fall nectar source, drought tolerant)
Vernonia glauca	Broadleaf ironweed (X) (larval host for American lady, late summer-fall nectar source, drought tolerant)
Veronicastrum virginicum	Culver's root (X) (summer nectar source)

Yucca filamentosa	Curlyleaf yucca (X, local seed source) (larval host for yucca giant-skipper, late spring blooming, night blooming, drought tolerant, deer resistant)
Grasses, Sedges, Rushes	
Agrostis hyemalis	Winter bentgrass (X) (spring blooming, drought tolerant)
Andropogon gerardii	Big bluestem (X) (larval host for dusted skipper, clouded skipper, least skipper, fiery skipper, crossline skipper, zabulon skipper, Ocala skipper, cobweb skipper, gemmed satyr, Carolina satyr, and little wood satyr, drought tolerant)
Andropogon ternarius	Splitbeard bluestem (X, local seed source) (larval host for dusted skipper, clouded skipper, least skipper, fiery skipper, crossline skipper, zabulon skipper, Ocala skipper, cobweb skipper, gemmed satyr, Carolina satyr, and little wood satyr, drought tolerant)
Carex pensylvanica	Pennsylvania sedge (X) (larval host for carolina satyr, little wood satyr, dun skipper, and Appalachian brown, drought tolerant once established)
Elymus hystrix	Common bottlebrush grass (X, local seed source) (larval host for several moths and northern pearly-eye, blooms in summer, drought tolerant)
Eragrostis spectabilis	Purple lovegrass (X, local seed source) (larval host for zabulon skipper, fall blooming, drought tolerant, deer resistant)
Schizachyrium scoparium	Little bluestem (X) (larval host for swarthy skipper and crossline skipper, fall blooming, drought tolerant)
Sorghastrum nutans	Yellow indiangrass (X) (larval host for pepper-and-salt skipper, fall blooming, drought tolerant, deer resistant)
Sorghastrum elliottii	Slender indiangrass (X) (larval host for pepper-and-salt skipper, fall blooming, drought tolerant, deer resistant)
Tridens flavus	Purpletop (X, local seed source) (larval host for crossline skipper and little glassywing, fall blooming, drought tolerant)
Vines	
Bignonia capreolata	Crossvine (X, local seed source) (larval host for rustic sphinx moth (*Manduca rustica*), spring nectar source, attracts hummingbirds, evergreen, drought tolerant)
Campsis radicans	Trumpet creeper (X, local seed source) (larval host for trumpet vine sphinx moth, summer-fall nectar source, drought tolerant)

Gelsemium sempervirens	Carolina Jessamine (X, local seed source) (winter-spring nectar source, evergreen, moderately deer resistant)
Lonicera sempervirens	Coral honeysuckle (X, local seed source) (larval host for hummingbird clearwing moth, spring-fall nectar source, attracts hummingbirds, drought tolerant)
Passiflora incarnata	Passionflower (X, local seed source) (larval host for variegated and gulf fritillary, summer nectar source, drought tolerant)
Wisteria frutescens	American wisteria (X, local seed source) (larval host for zarucco duskywing and long-tailed skipper, late spring-early summer nectar source, moderate drought tolerance, deer resistant)

Shrubs and Small Trees

Asimina parviflora	Dwarf pawpaw (X, local seed source) (larval host for zebra swallowtail, spring blooming, understory shrub)
Callicarpa americana	American beautyberry (X) (summer nectar source, drought tolerant)
Ceanothus americanus	New Jersey tea (X, local seed source) (larval host for mottled duskywing and summer azure, late spring nectar source, drought tolerant)
Celtis tenuifolia	Dwarf hackberry (larval host for hackberry emperor, tawny emperor, and American snout, drought tolerant)
Crataegus flava	Yellow hawthorn (X) (larval host for red-spotted purple, bluish spring moth (*Lomographa semiclarata*), blinded sphinx moth (*Paonias excaecata*), and hummingbird clearwing moth, spring nectar source, drought tolerant, deer resistant)
Gaylussacia baccata	Black huckleberry (X) (larval host for brown elfin, spring nectar source, drought tolerant)
Prunus angustifolia	Chickasaw plum (X, local seed source) (larval host for eastern tiger swallowtail, red-spotted purple, spring azure, coral hairstreak, and cecropia moths, great wildlife food source, drought tolerant)
Rosa carolina	Carolina rose (X) (larval host for mourning cloak, summer nectar source, drought tolerant, deer resistant)

Sassafras albidum	Sassafras (X, local seed source) (larval host for spicebush swallowtail, promethea silkmoth (*Callosamia promethea*), and imperial moth (*Eacles imperialis*)
Vaccinium arboreum	Farkleberry (X) (larval host for spring azure, and huckleberry sphinx moth (*Paonias astylus*), spring nectar source, great wildlife food source, understory tree, mostly evergreen, drought tolerant)
Viburnum prunifolium	Blackhaw (X) (larval host for spring azure and Virginia creeper sphinx moth, spring nectar source, great wildlife food source, evergreen, drought tolerant)
Viburnum rufidulum	Rusty blackhaw (X) (larval host for spring azure and Virginia creeper sphinx moth, spring nectar source, great wildlife food source, evergreen, drought tolerant)

Table 1. Butterlly Species Potentially Present at Horseshoe Fann Park		
Common Name	**Scientific Name**	**Abundance Code**
Eastern Tiger Swalbwtail	*Papilionidae glaucus*	CIA
Eastern Tailed-Blue	*Cupido comyntas*	CIA
Pearl Crescent	*Phyciodes tharos*	CIA
Carolina Satyr	*Hermeuptychia sosybius*	CIA
Silver-spotted Skipper	*E pargyreus clarus*	CIA
Sachem	*Atalopedes campestris*	CIA
Spicebush Swallowtail	*Papilionidae troilus*	C
Cabbage White	*Pierudae rapae*	C
Falcate Or etip	*Anthocharis midea*	C
Orange Sulplur	*Coliadinae eurytheme*	C
Sleepy Orange	*Abaeis nicippe*	C
Gray Hairstreak	*Strymon melinus*	C
SpringA=e	*Celastrina ladon*	C
SummerA=e	*Celastrina ne:.;lecta*	C
Variegated Fritillary	*Euptoieta claudia*	C
Question Mark	*Polu:.;onia interro:.;ationis*	C
American Lady	*Vanessa virginiensis*	C
Common Buckeye	*Junonia coenia*	C
Red-spotted Purple	*Limenitis arthemis astyanax*	C
Horace's Duskywing	*Erynnis horatius*	C
Clouded Skipper	*Lerema accius*	C
Least Skipper	*Ancyloxypha numitor*	C
Fiery Skipper	*Hylephila phyleus*	C
Crossline Skipper	*Polites origenes*	C
Little Glassywing	*Pompeius verna*	C
Zabulon Skipper	*Poanes zabulon*	C
Cloudless Sulphur	*Phoebis sennae*	UIC
Red-banded hairstreak	*Calycopis cecrops*	UIC
American Snout	*Libytheana carinenta*	UIC
Great Spangled Fritillary	*Speyeria cybele*	UIC
Slivery Checkerspot	*Chlosyne nycteis*	UIC
Eastern Comma	*Poly:.;onia comma*	UIC
Hackberry Emperor	*Asterocampa celtis*	UIC
Gemmed Satyr	*Cyllopsis :.;emma*	UIC
Little Wood-Satyr	*Megisto cymela*	UIC
Monarch	*Danaus plexippus*	UIC
Hoary Edge	*Achalarus lyciades*	UIC
Southern Cbud	*Thorybes bathyllus*	UIC
Northern Cbud	*Thorybes pylades*	UIC
Common Checkered-Skipper	*Pyrgus communis*	UIC
Swarthy Skipper	*Nastra Iherminier*	UIC
Dun Skipper	*Euphyes vestris*	UIC
Ocola Skipper	*Panoquina ocala*	UIC

Abundance Codes: A = Abunclant, C = Common, U = Un:ommon Adapted from: Leekand, Harry E. Notes on the Butterflies of North Carolina Seventeenth Approximation. O!ecklist of the 174 Butterfly Species ofNC. March 2010.

Table 2. Native Host Plants for Horseshoe Farm Park		
ConumnName	**Scientific Name**	**Butterfly LaiYae or Caterpillars**
	Trees	
Hackbeny	*Celtts tenwfolw*	Question Marl<, American SnOli, Hackt> enEirrp"rcr
Yellow PCl'lar	***LirLodendron tuliplfe ra***	Eastern T1ger Swallcwtail
WildPim	***Prun.J.Samen"cam***	Eastern TJger Swallcwtail, Red-spotted Purple, Spr ng A:zJ:ce, Sunner *Azl:re*
Chickasaw Plm	*Prunus angust!folia*	Eastern TJger Swallcwtail, Red-spct1ed Purple, Spnng A:zJ:ce
Black Cherry	***Pnvrus serotina***	Eastern TJger Swallcwtail, Red-spotted Purple, Spr ng A:zJ:ce, Sunner *Azl:re*
Oaks	*gu,rr:u:;spp.*	**Gray Harstreak, Horace's** Dusk;wng
Black Locust	***RiJbinia rxeudoacacia***	Silver-Spotted Skvper Sachem
Sassafras	***Sassa ras albidwn***	Sv>eebush Swalbwtail
Wnged Em	***Ulmusalata***	Question Marl<, Eastern Corrrm, Red-Spotted Purple
	Small Trees	
Serv>eeberrv	***.Amelanchser arborea***	Red-Spotted Purple
Ira-mood	***Carpinus caroliniana***	Eastern TJger Swallcwtail, Red-spotted Purple
Fbwering Dogwood	*Cornu:; (Iondo*	Spring Amre, Sumner A:zJ:ce
Hawl:lum	*Crataegus spp .*	Gray Hairstreak, Red-Spetted Purple
WaxM;rtle	***Myrica cer fera***	Red-Banded HaiJ-stn,ak
Wnged Sunac	*Rhuscopalll!111*	Red-Banded HaiJ-stn,ak
Sln)oth St.rrnc	*Rhus zlohra*	Red-Banded HaiJ-stn,ak
	Shrubs	
Sp>eebush	***Lmdera benzoin***	Sp>eebush Swalbwtail
	Vines	
Pass:KJnflower	***Passiflora incamata***	Vanegated FnW!ary
	Herbs and Wildflowers	
Plantan+Leaved Pus s	*hltennanaE_/antagmif_olia*	Amen:an Lady
Soltary Pussytoes	***Antennaria sot itarna***	Amen:an Lady
Butterfly Weed	***Asclepias tuherosa***	Eastern T ger Swallcwtail, Sp>eebush Swalbwtail, Monarch
Whte Mikweed	***Asclepias variegata***	Eastern TJger Swallcwtail, Sp >eebush Swalbwtail, Monarch
False Nettle	***Boehmeria cylindrica***	Eastern Ccnrm, Questim Mark
Partndge Pea	***Chamaecrista fascicuJata***	Sleepy Orange, Cbudless Sulplur, Fa!:ate Orangetv
Beggarl>ee	*Desmodium spp.*	Gray Harstreak, Eastern Tailed-Bue, Silver-Spotted Skipper, Hoary edge, Southern Cbudywng, Nerthern Cbud;wil;(
Joe-pve-weЄd	*Eupatonum { IS/uloswn*	Pearl Crescert
Rabb i Tobacco	*Gmphal1um o/:tu.sifol t m*	Amen:an Lady
Sunflower	***Helianthus atrarubens***	Silvery Checkerspot
Bush Cbver	*Lespedeza cap ata*	Eastern Tailed-Blue
V inia Bush *Cmer*	***Lespedeza v irxmica***	Eastern Tailed-Blue
Bl>eToadtlax	***Linana canadensis***	Corrrnon Bockeye
Sn>eoth Beardtongue	*Penstemon ia<N Xatus*	Corrrnon Bockeye
WikiPettnia	***Ruellsa carolmiensis***	Corrroon Bockeye
Goat's Rue	***Tephrossa vLrginian.a***	Southern Cbudywing, Northern Cbudvwno
Buffab *Cmer*	*Trifol1um rejlexwn*	Eastern Tailed-Blue, G!'ay Hairstreak, Orange Stiphur, Nerthem Cbudywn& Cabbage Whll.e, Fak:ate Orangetip
HeartleafNettle	*Urtica chamaed_ryides*	Eastern Ccnrm,Q_uestioo Mark
Stngng Nettle	***Urticadioica***	Eastern Ccnrm,Questioo Mark
V>Olets	*Vlolaspp.*	Vaneg;<ted Fmllary, G!'eat SpangledFrtillary
Buestem, Broomsedge	***hldropcgon spp.***	Corrmon Checkered-Skipper, Swarthy Sk per, C buded Sk per, Least Sk per, hry Sk per, Crosslne Skper, Utle Glassywng, SabubnSkipper, Ocola Sk per, G€11'1'red Satyr, Carolm Satyr, LitleWood -Satyr
LltleBI>estem	*Schrmchynum scopariUS*	Swarthy Skipper
Purple-T'1'	*Tridensji<Nu:;*	Crosslne Sk per, Litle Glassywmg
Sedges	***Cart!!X spp .***	Gemmed Satyr, Carolna Satyr, Lltle Wood-Satyr, Dun Skipper

Adapted from Bow:n, Liessa Thon:as and Moonmn, Chris. Urban Wildlife Butter:flies in Your Backyard. North Carolina CoOp!".tRtive E:-iension Service. North Carolina State University. 20'J2
LeChnd, funy E. Notes on ili.e Butter:flies of North CarohnaSeventemth Appm:-in:ation. March 2010

Table 3. Native Nectar Plants for Horseshoe Fannl'art<.		
Scitntific Namt	**ConnnonName**	Blooming Period
Aesculus pav w	Red Buckeye	MarchA pril
Ame!nnchier arborea	Serviceberry	MarchA pril
Gelsemium sempeirens	Carolina Jessamine	MarchA pril
Comus flonda	floweringDogwood	MarchA pril
Pnmus americana	Wild Plum	MarchA pril
Frunus angust1jolw	Chickasaw Plum	MarchA pril
Vaccinium corymbosum	Highbush Blueberry	MarchMay
Cercis canadensis	Redbud	MarchMay
Aawle£w canadensis	Wild Cohurbine	March·M_ay
11ex vomitona	Yaupon	MarchMay
Halesw tetraptera	Carolina Silverben	MarchMay
Symplocos tmctoria	Sweetleaf	MarchMay
Gaylussacw dumosa	DwarfHucklebeny	March·Jme
Rhododendron penclimenoides	Wild Azalea	April-May
Rhododendron atlanticum	Dwarf Azalea	AprilM ay
Gaylussacia frondosa	Blue Huckleberry	AprilM ay
Houstonia caernlea	Bluets	AprilM ay
Salvw lyrata	LyreleafSage	AprilM ay
Crataef:WJ spp.	Hawthorn	AprilM ay
llex decidua	Possumhaw	AprilM ay
Jlex verticillata	Winterberry	AprilM ay
Prunus serotma	Black Cherry	AprilM ay
Prnnus pennsylvamca	Fire Cherry	AprilM ay
JJex opaca	American Holly	April·Jme
Kalmia lati{oiJa	Mountain Laurel	April·Jme
Coreopsis lanceolata	Lance- Leaved Coreopsis	April·Jme
Geramum maculatum	Wild Geranium	April·Jme
RubUSS£2.	Blackbeny, Dewberry	April·Jme
liriodendron tullp1{era	Yenow Poplar	April·Jme
Coreopsis aunculata	Eared Coreopsis	April·Jme
Vacczmum staminewn	Deerbeny	April·Jme
::1/ene VIr£1mca	Fire Pink	April-July
Vaccinium arboreum	Spaikleberry	May·Jme
Asclepias vanegata	White Milkweed	May·Jme
Penstemon laevigatus	Smooth Beardtongue	May·Jme
Ceanothus americanus	New Jersey Tea	May·Jme
Hydrangea arborescens	Wild Hydrangea	May·July
Phlox carolina	Carolina Phlox	May-July
Ru.dbeckw h1rta	Black-Eyed Susan	May-July
Penstemon canescens	Hairy Beardtongne	May·July
Rhododendron calendulaceum	Flame Azalea	May·July
Apocynum cannabmum	Indian Hemp (Dogbane)	May·July
CoreopsiS falcata	Sickle Tlckseed	May·July
CoreopsiS verticillata	Threadleaf Coresis	M_ay·1_uly
Pass<!lora mcamata	Passiontlower	M_ay·1_uly
Asclepias tuberosa	Butted!y Weed	MayAug
Heliopsis helianthoides	OxEye	MayO ct
1llia americana	Basswood	Jnne
Clethra alm{olw	Sweet Pepperbush	Jme-July
Rhus £iabra	Smooth Sumac	Jme-July
Oxydendrum arboreum	Sourwood	Jme·July
Echmacea purpurea	Purple Coneflower	Jnoe·Aug
Monarda {istu/osa	Wild Bergamot	Jme·Sept.
Aralia spmosa	Devil's Walking Stick	Jme·Sept.
Phlox pamculata	Sumner Phlox	JulyAug
Pycnanthemum incanum	Hoary Mountainmint	JulyA
stokesia laevis	Stoke's Aster	JulyAug
Monarda didyma	Beebalm	JulyS ept
liatrns spicata	Blaling Star	JulyS ept
Rhus copallina	Winged Sumac	JulyS ept
Vernonia noveboracensis	Ironweed	JulyS ept
Eupatonum fistulosum	Joe:EYeWeed	J_uly·Oct.
Monarda punctata	Horsemint	A ·Sept.
Ru.dbeckia julf:<da	Orange Coneflower	Ang·Oct
Lobelia puberula	Blue Lobetia	Ang·Oct
Helianthus atrorubens	Sun:tlower	Ang·Oct
SJlida£Q spp.	Goldenrod	An.e.·Oct
Ipomoea coccmea	Red Morning GIOIY	An.e.·frost

Adapted from LeGrand, Hany E. Notes on the Butterflies of North Carolina Seventeenth Appro>rimation. Checklist of the 174 Butterfly Species of NC. March 2010.

Appendix E

UT Extension

PB 1746

A Landowner's Guide to

Native Warm-Season Grasses in the Mid-South

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A Landowner's Guide to Native Warm-Season Grasses in the Mid-South

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Native warm-season grasses (nwsg) are grasses historically native to an area that grow during the warm months of the year and are dormant during autumn and winter. They differ from cool-season grasses, which make their active growth during spring and fall. There are many warm-season grasses native to the Mid-South region; however, seven species are most commonly promoted as cover for wildlife and/or forage for livestock. These are big bluestem, little bluestem, broomsedge bluestem, indiangrass, switchgrass, sideoats grama and eastern gamagrass. Not all of these, however, have the same quality for wildlife habitat or livestock forage. For example, broomsedge offers excellent nesting habitat for bobwhites, but poor forage for livestock.

IDENTIFICATION AND DESCRIPTION

Big bluestem may reach 8–9 feet, depending on cultivar and site conditions. One of the best features used to identify this grass before flowering is the presence of fine silky hairs dispersed near the base of the upper leaf surface. The seedhead has three racemes that resemble a turkey's foot. Seed are relatively dark and hairy. Big bluestem grows on a wide variety of soils and is extremely drought-tolerant, with root systems that may grow 12 feet deep. Big bluestem provides excellent wildlife habitat and quality forage for livestock. 'Rountree,' 'Kaw' and 'Oz-70' are cultivars suited for the Mid-South.

Big bluestem

Little bluestem

Little bluestem grows 2–4 feet in height. The stem is flattened at the base and often red or purplish during early growth. Mature plants are reddish-brown. Little bluestem seed also appear hairy. Little bluestem grows on a wide variety of soils and is one of the most attractive grasses in summer and fall. Little bluestem provides quality wildlife habitat and has great potential for landscaping and erosion control on poor, droughty soils. The 'Aldous' cultivar is best suited for the Mid-South.

Broomsedge bluestem grows 2–4 feet in height and is commonly seen throughout the Mid-South. The stem is flattened at the base and smooth. Mature plants are tannish-brown and somewhat resemble little bluestem; however, broomsedge is lighter in color than little bluestem, which usually has a reddish hue. When dormant, broomsedge appears quite orange, while little bluestem is distinctly more reddish-brown. Broomsedge grows on a wide variety of soils and is renowned for growing in fields low in fertility. Broomsedge provides quality nesting habitat for many birds, but its forage quality is low.

Broomsedge bluestem

Indiangrass is typically 4–7 feet in height. Leaves are flat and narrow at the base, growing 10–24 inches long. The seedhead is golden bronze-to-yellow, 6–12 inches long, and usually formed in late August. The seed are tan and very fluffy. Indiangrass produces a deep root system and is quite drought-tolerant. Indiangrass provides quality wildlife habitat and quality forage for livestock. ‘Newberry,’ ‘Osage’ and ‘Rumsey’ are cultivars best-suited for the Mid-South.

Indiangrass

Switchgrass typically reaches 3–6 feet in height. Switchgrass is an early-maturing warm-season grass, flowering in early to mid-June. Switchgrass is adapted to a wide variety of soils and site conditions. With an extensive root system, switchgrass is extremely drought-tolerant, but also does well on relatively wet sites with at least one cultivar (‘Kanlow’) tolerant of extended flooding. Seed from switchgrass are small, smooth and hard, somewhat resembling millet in size and color. There are many cultivars of switchgrass. In the Mid-South, ‘Kanlow’ (uplands and lowlands) and ‘Cave-in-Rock’ (uplands) are well-suited for wildlife cover and livestock forage. ‘Durham’ and ‘Blackwell’ are well-suited for wildlife habitat.

Switchgrass

Sideoats grama grows to a height of 1–3 feet. Seedstalks begin to appear in June and July. The oat-like seeds hang down uniformly along one side of the slender rachis, thus the name “sideoats.” Leaf blades are fine and have single hairs evenly spaced along the edges of the blade. Sideoats grama grows well on well-drained uplands and shallow ridges, but is not well-adapted to lowlands. ‘El Reno’ and ‘Trailway’ are cultivars best-suited for the Mid-South.

Sideoats grama

Eastern gamagrass may reach 6–8 feet in height, producing conspicuous stools up to 4 feet in diameter. Over time, stool size increases with age and the center will lack stems and leaves. Eastern gamagrass will grow to 5–9 feet tall. The seedhead is comprised of two or three terminal spikes 6–10 inches long. Seed somewhat resemble corn kernels. It is highly recommended to use cold-stratified seed when planting to maximize germination. Eastern gamagrass is extremely deep-rooted and drought-tolerant. It grows best on relatively moist, well-drained fertile soils, but does not tolerate standing water for long periods. 'Highlander,' 'Pete' and 'Iuka' are cultivars well-suited for the Mid-South.

Eastern gamagrass

Other nwsg found in the Mid-South include splitbeard bluestem, Elliot's bluestem, bushy bluestem, purpletop, giant cane, beaked panicum, Scribner's panicum, Florida paspalum, silver plumegrass, knotroot bristlegrass and lovegrass. Their value to wildlife varies, but their value as forage is minimal.

USING NATIVE WARM-SEASON GRASSES FOR WILDLIFE HABITAT

Native grasslands are the most endangered ecosystem in the Mid-South. Historically, the region contained vast acreages of native grassland and savannas with scattered trees and shrub cover, which was maintained by fire. Today, that acreage has been replaced with non-native grasses (e.g., tall fescue, orchardgrass and bermudagrass), agricultural crops, forest cover and suburban development. As a result, several wildlife species dependent upon quality early successional habitat have experienced significant declines in population.

Historically, mixed grassland savannas were prevalent across the Mid-South. This scene in southeast Tennessee was a high-graded oak-hickory stand through most of the 20th century until it was cleared of all but a few select trees. After timber removal, the area has been maintained with fire. Note the big and little bluestem – they were **not** planted, but arose naturally from the seedbank, remaining viable after at least 80 years. In addition, this site has never been sprayed. When invasive, non-native species (e.g., tall fescue, crabgrass, johnsongrass, bermudagrass) are not present, native plants can colonize an area easily and herbicide applications are often not necessary.

Nwsg can be used to enhance early successional cover for species such as bobwhite quail, cottontail rabbit, field sparrow, Henslow's sparrow, grasshopper sparrow, indigo bunting, prairie warbler, dickcissel, eastern meadowlark, loggerhead shrike, American kestrel, northern harrier and others. Fields of nwsg and associated forbs (broadleaf herbaceous plants) are also used by wild turkeys for nesting and brood rearing and by white-tailed deer for bedding and escape cover. **Nwsg are established for wildlife primarily because of the structure of cover provided**. Suitable cover is more often a limiting factor for species such as quail, rabbits and grassland songbirds than food. Nwsg are not planted as food plots.

Importance of open structure

Because most nwsg grow in "bunches," open space at ground level can be provided when bunches are not too dense. An open structure at ground level allows mobility for small wildlife (e.g., quail, rabbits, sparrows and young turkeys) through the field. Dense vegetation and thatch build-up (such as that presented by perennial cool-season grasses) inhibits movement and makes finding food (seed and invertebrates) difficult. When these conditions prevail, the number of animals an area can support is reduced, leading to stagnant or declining populations.

Sparse stands of nwsg with an open structure at ground level are obviously attractive for brood rearing, but they are also used for nesting – one bunch of nwsg represents a potential nesting site – if the field has not been burned or disced in the past year. Birds and rabbits use senescent (dead) leaves of previous years' growth to construct and line nests. An attractive characteristic of nwsg is that senescent leaves and stems remain erect into the following growing season. This reduces thatch build-up, provides protective cover through winter and allows birds, such as Henslow's and field sparrows, dickcissels and indigo buntings, to nest above ground amongst the senescent stems the following spring.

Although moderately dense stands of nwsg may not be as attractive for brooding, they are used for nesting and escape cover. Obviously, these stands may have more potential as nesting sites than sparse stands, but they also offer more protective cover, especially during winter. Extremely dense stands, however, inhibit movement of some small animals and become less attractive. At this point, management is needed to thin the stand.

Importance of forbs and shrubs

An open structure at ground level also enables the seedbank (seed in the top few inches of soil) to germinate. Arising from the seedbank are plants such as ragweed, blackberry, partridge pea, beggar's-lice, pokeweed, native lespedezas and annual sunflowers. Forb cover is critical in making a field of nwsg most attractive to wildlife. These plants provide an excellent canopy of brood-rearing cover for quail and wild turkeys; quality forage for deer, rabbits and groundhogs; and later produce seed and soft mast that is an important source of energy through summer and into fall and winter for many wildlife species. Scattered brush and small trees also can make a field of nwsg and associated forbs more attractive to wildlife, particularly bobwhites and several spe-

This is what a field planted for wildlife should look like in early June. Sparse nwsg, abundant forbs (ragweed, partridge pea) and open ground space provide the optimum structure for brooding and a seed source for fall and winter.

Bobwhite quail nest situated at the base of a 2-year-old bunch of broomsedge. Note how the senescent leaves from last year are used to construct the nest.

Forbs (e.g., blackberries, partridge pea and ragweed) provide excellent brooding cover and a source of seed for bobwhites and other species.

cies of songbirds. Bobwhites often use brushy cover as a "covey headquarters" during fall and winter. Indigo buntings, dickcissels, yellow-breasted chats, cardinals, prairie warblers, white-eyed vireos, eastern kingbirds, loggerhead shrikes and others use scattered clumps of shrubs and small trees for perching and nesting. Many of these shrubs and small trees also offer a valuable food source for many birds and mammals. Examples include American crabapple, wild plum, hawthorn, sumac, wild cherry, persimmon, elderberry, hazelnut, witch-hazel, dogwoods, Carolina buckthorn, viburnums and devil's walkingstick.

Winter cover

Nwsg provide quality cover during winter if the grasses are not previously bushhogged or otherwise destroyed. Fields of nwsg are often magnets for rabbits, over-wintering songbirds and deer. This can be especially critical for small wildlife at a time when quality cover is at a premium. Tall nwsg, such as big bluestem, indiangrass and switchgrass, are especially valuable as their stems "lodge" (remain somewhat upright, leaning against each other), continuing to provide cover even after winter rains, snow and wind. Deer seek out nwsg fields on cold, clear days because they can remain hidden in the tall grasses, yet are able to absorb the sun's warm rays. In low-lying bottomlands that periodically flood in winter, fields of switchgrass (especially the Kanlow variety) can attract large numbers of ducks when shallowly flooded.

Taller nwsg species (e.g., big bluestem, indiangrass and switchgrass) provide excellent cover in winter because their stems "lodge," creating usable space for wildlife. Here, a rabbit finds a winter home. This type of structure is not available in cool-season grass fields.

PROBLEMS ASSOCIATED WITH TALL FESCUE AND OTHER PERENNIAL COOL-SEASON GRASSES

There are many problems associated with tall fescue and other perennial cool-season grasses, both for wildlife and livestock. Problems for livestock are associated with an endophyte fungus found within tall fescue that is highly toxic. Cattle consuming tall fescue (either grazing or as hay) often experience poor weight gains, reduced conception rates, intolerance to heat, failure to shed the winter hair coat, elevated body temperature and loss of hooves. Problems with horses are more severe, especially 60–90 days prior to foaling. Fescue toxicity in horses often leads to abortion, prolonged gestation, difficulty with birthing, thick placenta, foal deaths, retained placentas, reduced (or no) milk production and death of mares during foaling. As a forage, tall fescue and other perennial grasses (e.g., orchardgrass) are

Fields of tall fescue are common throughout the Mid-South. This is poor wildlife habitat and, for many species, it might as well be covered in asphalt.

least preferred by white-tailed deer among cool-season forages. Cottontail rabbits had lower weights and smaller litters in tall fescue habitats. When fed a diet of tall fescue seed, bobwhites exhibited cloacal swelling, which ultimately led to increased mortality. Undoubtedly, many of the toxic effects from tall fescue on wildlife that consume the seed or foliage are unknown.

This is the structure presented in a field of tall fescue (and other perennial cool-season grasses) for a quail chick, sparrow, turkey poult or young rabbit 4–5 inches tall. If you were 5 inches tall and had to travel through this, where would you go? To the edge – and that's where small wildlife are forced to go. Tall fescue has displaced more wildlife habitat in the Mid-South than any other practice.

Known problems of tall fescue for wildlife are associated more with the structure created by the growth habit. Other introduced cool-season perennial grasses (e.g., orchardgrass, bromegrasses, timothy and Kentucky bluegrass) also develop sub-optimal growing conditions (dense growth and deep thatch) near ground level, making travel and foraging difficult for many wildlife species (especially ground birds). The dense growth structure and thatch layer not only prevent birds from picking seed up off the ground, but also prevent seeds in the seedbank from germinating. Thus, vegetative diversity and weed seed available as food are drastically reduced. Cool-season grasses also provide poor winter cover for wildlife because of a lack of overhead structure.

Cool-season perennial grasses (especially tall fescue and bromegrass) are very competitive. When grown in association with nwsg, perennial cool-season grasses will, over time, lead to reduced coverage of nwsg and make the field less attractive to wildlife. When grown in association with clovers in a firebreak or forage food plot, tall fescue, orchardgrass and bromegrasses will dominate the site within 18 months, leaving little or no clover available for forage.

MANAGING NATIVE WARM-SEASON GRASS FIELDS FOR WILDLIFE

A field of nwsg is no better than the technique(s) used to manage it. If not managed correctly, nwsg can become rank and unattractive to many wildlife species. Management is needed to set back succession and create the vegetative composition and structure desired. **An open structure at ground level within a nwsg field is determined largely by the density of grass bunches and stand management, especially burning**. If the field is not disturbed periodically by prescribed burning or discing, an open structure at ground level will not be maintained.

Burning

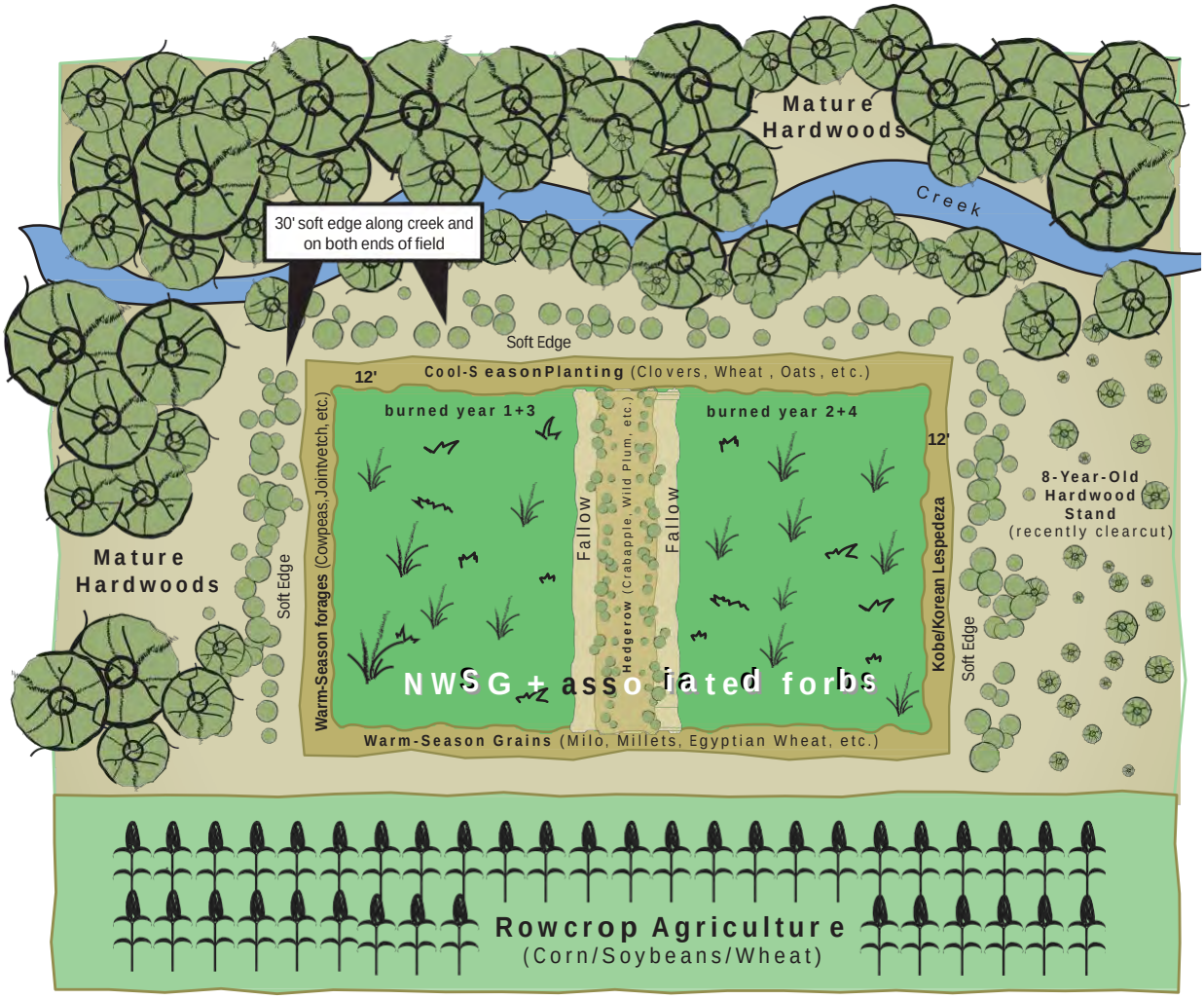
Prescribed fire reduces litter buildup, sets back succession, increases nutrient availability and stimulates herbaceous growth. Fields are most often burned in late winter, just before spring green-up. This reduces winter cover only for a short time and does not disrupt nesting birds and rabbits. If woody succession is a problem, fields can be burned just after bud break to kill woody competition. Prescribed fire in late summer/early fall can be used when nwsg have become too dense and additional forb growth is desired. Burning at this

time also can be used to reduce woody succession, if completed before leaf senescence. Using prescribed fire is efficient, effective, cheap and easy; however, planning and experience are necessary. Burning is controlled and objectives are met only when conducted under the appropriate conditions. State wildlife and forestry agencies and/or local chapters of Quail Unlimited often help landowners who need burning assistance.

Prescribed fire is contained by creating firebreaks (disced strips 10–30 feet wide) around the area to be burned. Firebreaks should be planted for increased food resources around nwsg fields. By planting various mixtures in different sections of the firebreak, a supplemental food source is available year-round. Other sections can be left fallow for weed growth. Examples of mixtures for firebreaks are on page 10. [For additional mixtures and planting information, refer to ***Growing and Managing Successful Wildlife Food Plots in the Mid-South***, UT Extension PB 1743.] Regardless of the mixture used, introduced perennial grasses (e.g., orchardgrass and tall fescue) should never be planted to a firebreak because of reasons stated previously.

Burning is strongly recommended to manage fields of nwsg. This series of pictures shows a nwsg field just before, during, immediately after and the growing season after burning. Burning stimulates growth, recycles nutrients to the soil and creates excellent early successional habitat.

Planting Mixtures for Firebreaks (rates are per acre)	
Cool-season mixture (annual) 25# wheat or oats 20# Austrian winter peas 10# crimson clover 3# arrowleaf clover **Cool-season mixture (perennial)** 25# wheat or oats 6# red clover 5# ladino white clover 2# birdsfoot trefoil	**Warm-season mixture (annual)** 20# soybeans 15# iron-clay cowpeas 10# buckwheat 5# browntop millet 5# grain sorghum (milo) **Warm-season mixture (annual)** 15# Kobe or Korean lespedeza 2# partridge pea



This diagram shows a field of nwsg and how it might be placed in arrangement with other cover types. Note how the firebreak is planted in different sections with various plantings to provide a supplemental food source throughout the year.

Discing

In some areas, it is difficult to burn because of smoke-management issues. Also, many landowners are reluctant to burn because of inexperience. In these situations, nwsg fields should be managed by discing. Discing sets back succession, increases open space at ground level, facilitates litter decomposition and stimulates the seedbank. Discing can be completed in blocks (≥ 1 acre) or strips (≥ 50 feet wide) oriented with the contour of the field (to prevent erosion). Undisced strips should be about twice as wide as disced strips. This allows one-third of the field to be disced each year.

This field is being managed by discing alternate strips in winter. This will provide brooding cover adjacent to nesting cover.

Discing at different times of the year affects vegetation composition, depending on site conditions and the seedbank present. For example, discing in the fall may produce a different suite of forbs than discing in spring. Discing in the fall also creates walking and shooting lanes for hunting quail or rabbits. A good way to determine the preferred time to disc and the seedbank response within individual fields is to disc strips at various times through the year. Disced areas can be interseeded with legumes and other forbs if needed. **Bushhogging (without burning or discing) is not a recommended practice for managing nwsg** because it increases the litter layer, makes travel through the field difficult for small wildlife and inhibits the seedbank from germinating. It is usually necessary, however, to bushhog before discing is possible. Bushhogging along a firebreak prior to burning also may be used to reduce flame heights.

Herbicide applications

Another management practice often necessary is herbicide applications. Strip spraying a grass-selective herbicide (e.g., Select◆) in late April using alternate spray nozzles can decrease grass density, create additional open space at ground level and stimulate the seedbank. Strip spraying should be conducted in patterns similar to those recommended for discing. Spot spraying or broadcast spraying other selective herbicides (see Appendix 1) may be necessary to reduce several problem grasses (e.g., crabgrass, tall fescue) and forbs (e.g., sericea lespedeza, thistles), as well as woody competition (e.g., sweetgum, winged elm). In all cases, herbicide labels should be read before use and followed closely with regard to restrictions, precautions, rates, recommended tank mixtures, surfactants and sprayer-cleaning recommendations.

Managing on rotation

Because structural requirements vary among wildlife species and among seasons, it is not recommended to set back succession on an entire field (depending upon field size) or on all fields (depending upon the number of fields and their proximity on a property) in one year. Instead, fields (or portions of) should be burned or disced on a 2- to 4-year rotation. For example, if brood habitat and forage quality are prime in a field the summer after a winter burn and nesting habitat is prime two or three years after a burn, then it is undesirable to burn all available habitat every year. Escape cover may be best three or four years after burning. Large individual fields can be managed by discing firebreaks and creating smaller sections within the field. Sections then can be managed on rotation. Smaller fields can be burned or disced entirely.

This landowner has gone out of his way to juxtapose different successional stages. Burning in a checkerboard fashion ensures quality brooding cover is adjacent to nesting cover. While burning half the field one year and the other half the following year is fine, burning sections such as this provides a very diverse structure across the field.

MANAGING THE ARRANGEMENT

When a property is managed specifically for wildlife, the most important consideration is matching the habitat types available to the preferred habitat composition and arrangement for the targeted species (see Appendix 2). Arranging cover, food and water in close proximity helps minimize travel and exposure for animals. Size, shape and *placement* of the field in the arrangement should be considered. When managing for bobwhites and other species with small home ranges (e.g., rabbits), all habitats needed to meet various seasonal requirements should be within a 40–50-acre area and, optimally, should be *juxtaposed* in close proximity. While the amount of nwsg acreage needed varies among wildlife species, quality early successional habitat should be well interspersed across the entire property.

Another important consideration is the surrounding properties (i.e., the surrounding landscape), especially for properties or landowner cooperatives less than 1,000 acres. If suitable habitat is lacking on surrounding properties for animals to immigrate to and emigrate from, it is possible the local population may become stagnant or begin to decline. It is also in these situations where predation can become a limiting factor. Predators are fully capable of identifying areas with an abundance of prey. Once located, predation rates can become artificially increased and limit small game populations, even where quality habitat exists.

Using nwsg when wildlife is a secondary objective to farming

Nwsg can be an integral part of a productive, profitable and environmentally sound farm operation. Most producers are interested in conserving natural resources, which includes providing adequate wildlife habitat. Sites not suitable for cropping can be targeted for nwsg establishment. Highly erodible soils, rocky soils, riparian buffers, field corners and other unproductive areas can be managed for wildlife, while dedicating better soils for production agriculture.

Recent research has shown creating field borders around crop fields can increase bobwhite and songbird populations. In fact, even on farms where exhaustive predator removal took place, bobwhite populations remained steady or declined, **unless field borders were established**. Researchers at North Carolina State University showed *predator* control alone did not work, unless *predation* was controlled by providing quality nesting and brood-rearing cover. Wildlife populations weren't the only things to increase – so did farm profits! By taking field borders out of production, lime, fertilizer, fuel, seed and herbicide costs were reduced. This coupled with the fact that borders along wooded areas naturally produce less yield (because of competition for nutrients and sunlight), helped increase crop profit margins.

Establishing nwsg borders (>30 feet wide) can provide excellent nesting, brooding and escape cover around fields. Using this practice alone will help increase local populations of quail and various songbirds.

Planting field borders (>50–120 feet wide) and "odd areas" to nwsg not only provides enhanced cover for wildlife, but also reduces runoff and increases infiltration, which improves water quality by trapping and preventing sediments, fertilizers, animal waste and pesticides from entering creeks and rivers. Interested landowners should contact their county USDA-NRCS office to learn of the many programs that provide cost-share and technical assistance to establish nwsg buffers, hay, pasture and wildlife habitat.

USING NATIVE WARM-SEASON GRASSES FOR LIVESTOCK FORAGE

Nwsg can provide excellent forage for livestock and, when properly managed, can still provide quality nesting and brood-rearing habitat. Nwsg are attractive as a forage crop because nwsg produce the majority of their growth during the summer, when cool-season grasses produce relatively little. Yields of two to five tons per acre of nwsg forage can be expected, depending on rainfall, soil type and other conditions. Crude protein can be as high as 16–17 percent, but normally is 8–12 percent at optimum harvest. Just as with any forage species, nutrient content of nwsg is influenced by plant maturity. As plants mature, percent protein and digestible energy decrease, while fiber content increases. Maximum tonnage and high forage quality do not occur at the same time. From a practical standpoint, all grass hay should be cut just before seedheads begin to emerge, whether warm- or cool-season.

Haying

Delayed harvest and exposure to the environment are major factors influencing hay quality; thus, nwsg have fewer problems in hay production than cool-season grasses because rain is less likely during summer. Once hay is cut, higher temperatures enable faster drying, resulting is less nutrient loss from respiration. Nwsg are similar in available protein and digestible nutrients as cool-season grasses, but the weather provides better haymaking conditions.

Nwsg can provide excellent hay for livestock. Here, Gene Hartman harvests approximately 7,000–8,000 pounds per acre of big bluestem and indiangrass hay. Gene makes sure to cut his hay just before it begins to seed out, ensuring optimum nutrition with the highest yield. One cutting per year allows plenty of grass re-growth before fall, leaving ample cover for wildlife during winter.

Excellent hay can be produced from single-species plantings or mixtures. Switchgrass and eastern gamagrass are often planted in pure stands and cut for the first time in June. Big and little bluestem are often planted with indiangrass and hayed for the first time in early July, which is advantageous to wildlife species nesting in May and June.

Grazing

The advantage of nwsg for grazing is similar to their advantage as a hay crop. During summer, high temperatures and limited rainfall cause cool-season grasses to be relatively unproductive, and pastures can be overgrazed. Overgrazing stresses the pasture even further, resulting in stand loss and increased weed pressure. By converting 25 percent of the pasture acreage to nwsg, animals may be grazed on actively growing forage during the summertime, which can provide higher-quality forage while allowing cool-season grasses to rest. This strategy reduces the need for hay, which can be required to supplement cool-season pasture during mid-summer.

Nwsg can offer excellent grazing opportunities for livestock. Grazing nwsg during summer can produce daily weight gains for cattle of more than 2 pounds. Grazing nwsg also allows cool-season paddocks to rest and minimize overgrazing. Nwsg should not be grazed regularly below 4 or 5 inches.

Cutting and grazing heights

Nutrient reserves can be limiting for nwsg if an adequate stubble height is not maintained or if overgrazing occurs. Nwsg should not be consistently grazed or cut below 4 or 5 inch- es; otherwise, yield and persistence may be reduced and increased weed problems will oc- cur. If a stubble height of 6 inches is left, more leaf area will be present for rapid re-growth. If cut or grazed after early August, the ability of nwsg to rebuild carbohydrate reserves is limited, which can reduce next year's growth. This can lead to increased weed pressure, es-

pecially winter annuals. A controlled grazing program should be used to prevent overgrazing. Big bluestem, indiangrass, switchgrass and eastern gamagrass should be grazed when they reach approximately 12–18 inches or hayed when they reach 30 inches in height.

Fertilization, burning and weed control

Soil fertility is very important and soil testing is key to knowing lime and fertilizer requirements. Although nwsg are adapted to poor soil fertility, they will respond to lime and fertilizer applications when appropriate (see ***pH and fertilizer recommendations*** on page 17). Burning rejuvenates nwsg and improves forage quality. Burning in late March and early April can help reduce invasion of cool-season grasses while stimulating nwsg growth. When managing pure grass stands, forb-selective herbicides (e.g., 2,4-D, Banvel®, Overdrive®) will help control problem broadleaf weeds. Local Extension offices can provide specific recommendations for herbicide applications. Read and follow all herbicide label recommendations and restrictions.

Maximizing forage production and wildlife habitat

Nwsg are hayed and grazed when many wildlife species are nesting and rearing young. Waiting until after the nesting season to hay or graze will result in poor-quality forage, especially if switchgrass or eastern gamagrass is used. Because big and little bluestem and indiangrass flower later in the growing season (July through early August), they may be most appropriate to use when wildlife is a primary consideration. Including little bluestem in the mixture is especially important for nesting cover.

Another important consideration for wildlife is to cut or graze the stand only once per year. A second cutting can reduce winter cover for wildlife and render the field similar to a field of cool-season grasses. Rotational haying and grazing is another way to improve wildlife habitat in an nwsg forage system. By resting (i.e., excluding livestock and refraining from haying) a different portion of a field every year, additional wildlife habitat is made available.

ESTABLISHING NATIVE WARM-SEASON GRASSES

The benefits of nwsg cannot be realized until establishment is successful. Unfortunately, some landowners' attempts to establish nwsg have failed and it is widely acknowledged that establishing nwsg can be slow, especially if certain steps are not taken. Reasons for inconsistent success vary, but the most common include drilling (or covering) seed too deep (> ¼ inch), inadequate weed control and planting too late in the growing season. Recent equipment innovations and information concerning the use of various herbicides have helped increase the success of establishment efforts.

Competition control

Nwsg do not compete well with non-native grasses (e.g., tall fescue, bermudagrass, crabgrass, johnsongrass), so it is critical to control these competitors (as well as problem broadleaf plants) prior to planting. Most often, a glyphosate herbicide (e.g., Roundup◆, Gly-4 Plus◆) is used to kill existing cover.

Perennial cool-season grasses (e.g., tall fescue and orchardgrass) – spray in the fall prior to planting with a glyphosate herbicide (two quarts per acre).

Top five reasons establishment efforts fail:

1) Planted too deep
   - bluestems, indiangrass, switchgrass and sideoats grama should not be planted any deeper than ¼ inch
2) Inadequate weed control
   - existing sod must be killed prior to planting; post-emergence competition can be limiting factor
3) Planted too late
   - mid-April to early June is the ideal planting window
4) Drill not calibrated and/or PLS not calculated
   - these are absolutely necessary
5) No patience!
   - landowners often have a perfect stand, but just don't realize what it should look like

Roundup◆-only applications in the spring have been less than successful. However, by tank-mixing 2 quarts of Roundup◆ with 8 ounces of Plateau◆ and 2 pints of Methylated Seed Oil (or 22 ounces of Journey◆ with 1 1/2 quarts of Roundup◆), a spring herbicide application can be successful. Before existing sod is sprayed, the field should be burned, hayed, grazed or mowed and allowed to re-grow 6–10 inches. This ensures the herbicide comes in contact with an actively growing plant, not dead thatch from the previous year's growth. After killing cool-season grasses, expect warm-season competitors (e.g., johnsongrass, crabgrass) to emerge from the seedbank.

Herbicide applications are often necessary when establishing nwsg. Existing sod must be sprayed before planting. Pre-emergence applications are usually necessary at planting. Post-emergence applications are often necessary for adequate weed control.

Johnsongrass, crabgrass and broadleaf control – Spray during the growing season prior to planting with a glyphosate herbicide or a grass-selective herbicide. This will help reduce the seedbank, but there will be some residual growth the following growing season. Thus, **a pre-emergence application of an imazapic herbicide, such as Plateau◆ (6–8 ounces per acre) or Journey◆ (16–20 ounces per acre), is strongly recommended when planting bluestems, indiangrass or sideoats grama to provide adequate control for several weeks after planting. When planting switchgrass or eastern gamagrass, a pre-emergence application of OutRider® (2 ounces per acre) should control johnsongrass and many broadleaf competitors**.

Bermudagrass control – Burn the field in late winter and allow bermudagrass to re-grow. Spray bermudagrass as it begins to flower with imazapyr (24 ounces of Arsenal® AC per acre with two pints of Methylated Seed Oil). Research by the Georgia Department of Natural Resources found imazapyr very effective in controlling bermudagrass; however, it is virtually impossible to eliminate bermudagrass entirely with a single spraying. Patience and persistence are required. The field should be checked for bermudagrass re-growth through the *following* growing season after the initial treatment and spot-sprayed as necessary. The next growing season (two years after initial treatment), the field should be ready to plant nwsg.

Mechanical control – Another practice is to mow non-desirable broadleaf weeds before they flower and seed. Shading limits growth of nwsg considerably and prolonged shading can kill them. The mower (or bushhog) should be set relatively high so nwsg are not clipped any more than necessary. Mowing weeds is less successful than herbicide applications, but nwsg (including switchgrass and eastern gamagrass) will often out-compete non-desirable plants during the second growing season.

Seedbed preparation

Once the competition has been controlled, the seedbed should be prepared before planting. If the seed is to be drilled, a firm and "clean" seedbed, free of deep thatch and other material, is desired. This is best accomplished by burning. If the dead material on the field is sparse and only a few inches high, no preparation may be necessary. If the seed is to be topsown, the seedbed should be prepared by conventional tillage techniques. If the soil needs amending, it is best to do so before plowing/discing to ensure the lime and fertilizer are well-incorporated.

pH and fertilizer recommendations

Although nwsg are adapted to nutrient-deficient soils low in pH, soil fertility is important and soil testing is recommended to determine pH and nutrient availability. This is particularly important when growing nwsg for livestock forage. For optimum growth on pasture or hayfields, pH should be raised to 6.0–6.5, P and K brought to medium or high levels (31–120 and 161–320 pounds available per acre, respectively) and up to 60 pounds of N should be applied in April/May and after cutting hay or after removing livestock from the paddock. An application of N at planting is not necessary (when growing nwsg for wildlife) or recommended (when growing nwsg for livestock forage) because of weed competition. However, if bluestems and/or indiangrass are planted and an imazapic herbicide is applied pre-emergence, 15–30 pounds of N per acre may be added once the grasses are 4–6 inches high if adequate moisture is available. When planting pure stands of switchgrass or eastern gamagrass, N should not be applied until the stand is established and weeds controlled. When planting nwsg solely for wildlife, lime and fertilizer are not normally needed unless pH is below 5.0.

Seed quality and estimating PLS

Buying quality seed is an important consideration when establishing nwsg. Seed purity commonly runs 50–70 percent because of an inordinate amount of inert material (stems, leaves and other debris) and the germination rate may be only 50–60 percent. Therefore, it is critical to plant according to percentage of pure live seed (PLS), which is determined from information on the seed tag.

PLS is calculated as follows:

Seed: Indiangrass (Osage)

Pure seed: 67.62%	Germination: 64.00% Other
crop: 0.05%	Firm/Dormant: 22.00%
Weed Seed: 0.42%	Total Germination: 86.00%
Inert: 26.23%	Noxious Weeds: NONE
Origin: MISSOURI	Test date: 28 December 2003

[67.62% (pure seed) 86.00% (total germination)] √ 100 = 58.15% PLS. To plant 6 lbs. PLS per acre: [6 lbs (desired rate) √ 58.15 (PLS)] 100 = 10.32. Therefore, approximately 10 lbs of bulk material from the seed bag should be planted.

Seed dormancy

Switchgrass and eastern gamagrass tend to have a high dormancy rate. Germination can be improved by treating the seed. Switchgrass seed can be wet-chilled by soaking it in a mesh sack overnight and allowing it to drip-dry the following morning. The seed then should be stored in a cool location (e.g., a cellar or walk-in cooler set at approximately 40–45^0 F) for at least two weeks. For best germination, remove seed from chill treatment and allow to air dry with a fan blowing over the seed until seed flows freely. Plant immediately. Eastern gamagrass requires a six-week chilling process. The best option for planting eastern gamagrass is to buy cold-stratified seed direct from a seed dealer and plant immediately upon receiving shipment.

Planting date and methods

Nwsg should be planted mid-April through early June. Later plantings can be successful, but germination and growth may be reduced, as rain is less dependable in June and July. Seed may be top-sown or drilled, but **should not be planted any deeper than ¼ inch**. In fact, when drilled, at least one-third of the seed should be obvious on top of the planting furrow. The exception to this rule is eastern gamagrass, which should be planted approximately 1 inch deep. Drilling is usually the preferred method for planting nwsg (especially larger fields). As mentioned under ***Competition control*** on page 15, **a pre-emergence herbicide application at planting is strongly recommended** to ensure adequate weed control.

Planting with a no-till drill designed for nwsg seed is highly recommended. Do not drill seed any deeper than ¼ inch! In fact, as much as 30 percent of the seed should be obvious on top of the planting furrow.

Drilling – For even grass distribution and a continuous, solid stand, nwsg planted for haying or grazing should be planted with a drill. When drilling bluestems or indiangrass, a drill with a specialized seed box containing "picker wheels" is necessary or the fluffy seed of these grasses lodge in the seed chute. These drills often are available for use through state wildlife agencies, soil conservation districts, the Natural Resources Conservation Service and some local chapters of Quail Unlimited. Switchgrass can be planted with a conventional drill. Any drill, however, must be calibrated before planting. Eastern gamagrass is usually planted with a corn planter in rows 18–24 inches apart, but some producersß like to plant rows only 12 inches apart to reduce stool size and make stems more upright so haying is easier.

Broadcasting – Nwsg fields intended for wildlife habitat can be established successfully by broadcast seeding. When planting bluestems and indiangrass, a broadcast seeder with picker wheels (similar to those found in drills designed for fluffy seed) is helpful; otherwise, some type of carrier (pelletized lime, fertilizer, cracked corn, cottonseed hulls) is needed to distribute the seed. Prior to broadcasting, it is **critical** to thoroughly prepare the seedbed and cultipack after seeding to ensure firm seed-to-soil contact and improve germination rate.

Seeding rates and mixtures

Seeding rates depend upon landowner objectives. If sown for wildlife, a sparse stand of grasses with abundant forbs and adequate bare ground is desired. If sown for hay or pasture, a denser stand without forbs and less bare ground is desired. Thus, a relatively light seeding rate (4–6 pounds PLS per acre) is recommended when establishing nwsg for wildlife and a heavier seeding rate (8–12 pounds PLS) is recommended when establishing hayfields or pasture.

Tall mixtures provide cover for ground-nesting birds, as well as those that nest above-ground (e.g., dickcissel, field sparrow, Henslow's sparrow and red-winged blackbird). Tall mixtures also provide excellent cover for brood rearing and escaping predators. In addition, sufficient structure is present in tall nwsg fields for deer to bed during the day and excellent cover is available through winter for many wildlife species. Short mixtures provide quality nesting cover for ground-nesting birds and can provide attractive brood-rearing cover. Selected forbs should be added to wildlife mixtures to enhance brood habitat, invertebrate availability, seed production, forage and/or aesthetic value. Planted forbs are intended to complement the forb community that should arise naturally from the seedbank. Forbs most often added to nwsg mixtures include partridge pea, Illinois bundleflower, roundhead lespedeza, perennial sunflowers, purple prairieclover, purple coneflower, black-eyed susan, blazing star and lance-leaved coreopsis.

Tall mixtures of nwsg usually include some combination of big bluestem, indiangrass and switchgrass. These stands can provide excellent cover for nesting, brooding and foraging, as well as winter and escape cover.

Seeding mixture (lbs PLS per acre)	**Objectives & Considerations**
Wildlife – tall grass mixture 1.5 lbs big bluestem 1.5 lbs indiangrass 1.0 lb little bluestem 0.5 lb switchgrass 1.0 lb native forbs	Nesting cover Brooding cover Winter cover
Wildlife – short grass mixture 3.0 lbs little bluestem 1.0 lb sideoats grama 0.5 lb indiangrass 1.0 lb native forbs	Nesting cover Brooding cover
Forage – 3.5 lbs big bluestem 3.5 lbs indiangrass 3.0 lbs little bluestem	Hayed after primary nesting season Imazapic can be used for competition control
Forage – 8–10 lbs switchgrass	Wet-chill seed before planting Seed with conventional equipment
Forage – 10–12 lbs eastern gamagrass	Buy cold-stratified seed Plant with corn planter with rows 12–24 inches apart

Species and mixtures for livestock forage are generally determined by preference and potential problems with competitive weeds. For example, pure stands of switchgrass or eastern gamagrass can provide excellent forage for livestock. However, if crabgrass and/or johnsongrass are prevalent, a mixture of big and little bluestem and indiangrass might be a better choice, because an imazapic herbicide can be used to help ensure successful establishment.

Short mixtures of nwsg usually are dominated by little bluestem, broomsedge and/or sideoats grama. These stands can provide excellent cover for nesting, brooding and foraging.

Evaluating success – what to expect

Nwsg develop relatively slowly during the year of establishment. Most of the first-year plant growth is root development. Leaf and stem growth may not reach more than 2 feet high by the end of the first growing season. Typically, it is not until the second growing season that most nwsg develop considerable aboveground biomass, flower and produce seed. However, if the correct planting procedures are followed and soil moisture is not limiting, excellent growth will occur during the year of establishment, with considerable aboveground biomass and extensive flowering.

This is what you are looking for! This is a big bluestem seedling with its characteristic “fountain” appearance. Note the bare ground and lack of weeds germinating around the seedling. This is what should be expected from a properly applied pre-emergence herbicide.

Nwsg planted for wildlife **should be very sparse** during the year of establishment. Remember, bare ground space between bunches is desirable! “Weeds” may be numerous and should be expected. Many, hopefully most, of the “weeds” will be desirable forbs (as described earlier). Landowners planting nwsg should not expect the field to look like a field planted to cool-season grasses. Patience is necessary!

This field was planted in May 2000. By July, most people would consider this effort a failure. However, this rate of development is not unusual, especially with little rainfall in soil that has not been amended with lime and fertilizer. Remember, the structure will become more dense in the second year and bare ground space is desired!

Even with little rain and low nutrient availability, this amount of growth should be expected by the end of the first growing season (with proper weed control).

By the second growing season, excellent cover for wildlife was available and quail were found in the field regularly.

With adequate rainfall and nutrient availability, this amount of growth can be expected by the end of the first growing season.

CONCLUSION

Nwsg can provide excellent wildlife habitat. Converting perennial cool-season grass acreage to nwsg and establishing field borders around crop fields will help increase wildlife populations dependent upon early successional habitats. Nwsg also can produce high-quality forage for livestock. For producers interested in wildlife, nwsg are a much better alternative than non-native, warm-season grasses, such as bermudagrass, sorghum-sudan and the Old World bluestems.

Establishing and managing nwsg is quite different from cool-season grasses. However, **landowners should not be skeptical**. The advantages for wildlife and the quality of forage produced have been proven time and again throughout the Mid-South and in other regions as well. Technical assistance is as close as the county NRCS or Extension office. Advice and assistance is also available through state wildlife resources agencies. For comprehensive and detailed information on establishing and managing nwsg, ask for a copy of ***Native Warm-Season Grasses: Identification, Establishment and Management for Wildlife and Forage Production in the Mid-South***, available through UT Extension.

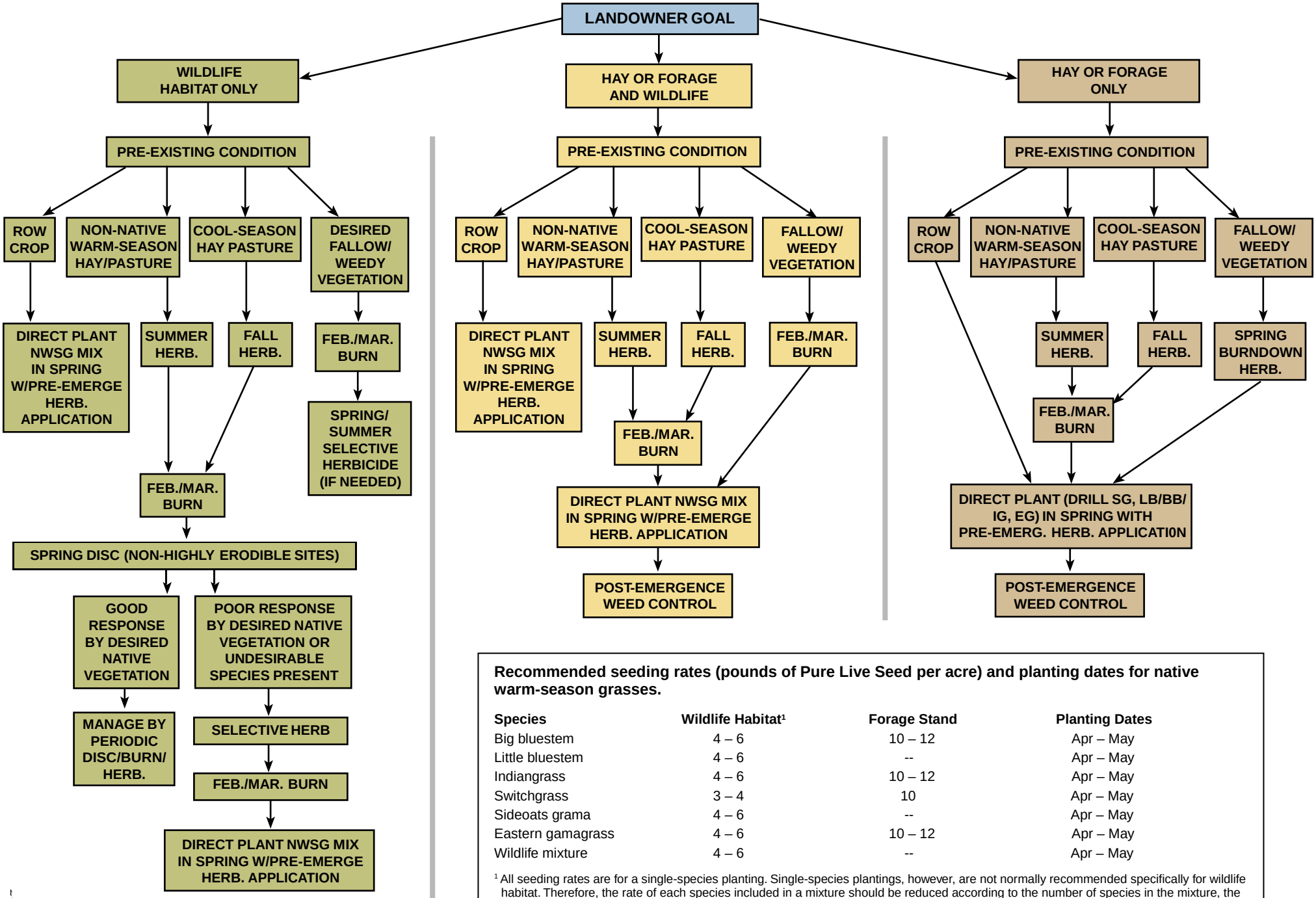
Appendix 1. Herbicide use guide for common native warm-season grass applications.

Herbicide	Use	Application Rate	Objectives/Considerations
Glyphosate (Roundup, Accord, Gly-4, others)	Eradicating tall fescue and other existing cover prior to nwsg establishment, or while nwsg are dormaant. Controlling woody saplings, sericea lespedeza, thistles, bermudagrass, dallisgrass, yellow nutsedge	Fall – 1.5-2.0 qts/ac Spring – 2.0 qts/ac 2.5 – 4.0 qts/ac	Broad spectrum herbicide, not selective. Post-emergence only – no soil activity or residual control. Additional applications may be necessary. Better control may be realized by tank mixing with other herbicides.
Imazapic (Plateau)	Pre-emergence weed control when planting bluestems, indiangrass and sideoats grama. Eradicating tall fescue and other select cover to allow the seedbank to respond. Post-emergence weed control of johnsongrass, crabgrass, cocklebur and others in established nwsg.	6 – 8 oz/ac 12 oz/ac 6-8 oz/ac	Residual weed control for approximately 60 days. Contact state wildlife agency if unavailable through private distributor. Check label for tolerance of specific nwsg and select forbs.
Imazapic + *Glyphosate* (Journey)	Pre-emergence weed control when planting bluestems, indiangrass and sideoats grama. Also for eradicating tall fescue and other existing cover prior to nwsg establishment, or while nwsg are dormant. Post-emergence weed control of johnsongrass, crabgrass, cocklebur and others in established nwsg.	11 – 32 oz/ac 11 oz/ac	May damage nwsg and forbs if applied after greenup. Residual weed control for approximately 60 days. Additional glyphosate is necessary to effectively kill tall fescue when using lower rates of Journey.
2,4-D	Controlling unwanted broadleaf plants, such as thistles & cocklebur.	1 – 4 pts/ac Post-emergence application	Will also kill desired legumes and other broadleaf plants. May damage nwsg seedlings.
Dicamba (Banvel, Clarity)	Controlling unwanted broadleaf plants and woody species.	2 – 4 pts/ac Pre- or post-emergence application	Will also kill desired legumes and other broadleaf plants.
Sulfosulfuron (OutRider)	Pre- and post-emergence control of johnsongrass and other weeds in nwsg (including switchgrass).	0.75 – 2.0 oz/ac Pre- or post-emergence application	Groundwater may be contaminated when used in areas where soils are permeable or shallow water table.
Triclopyr (Garlon 3A)	Controlling sericea lespedeza and other broadleaf plants in established nwsg. Controlling woody saplings	1.0 qt/ac Post-emergence application 1 – 5 gal/ac; see label for various applications	Apply in early summer when sericea is in early vegetative stage. Does not damage nwsg, but kills most broadleaf plants. Refer to label for rates to control other species. High-volume and low-volume treatments require different rates.
Metsulfuron methyl (Escort, Cimarron)	Control of sericea lespedeza, bicolor lespedeza and other broadleaf plants.	0.1 – 2.0 oz/ac Post-emergence application	For sericea control, apply in bloom stage (August – September). Fall application may provide spring residual control. Does not affect grasses.
Imazapyr (Arsenal)	Control of woody saplings. Sometimes best accomplished with tank mixes of other herbicides.	See label for selected woody plants, application rates & mixes	Use as spot treatment where tree or shrub seedlings are invading.
Sethoxydim (Poast Plus)	Controlling undesirable cool-season grasses before nwsg emerge in spring. Reducing nwsg coverage when growth becomes too dense.	2 pts/ac Post-emergence application	When reducing nwsg density, use only every third spray nozzle (i.e., 1 open/2 closed).
Clethodim (Select)	Controlling undesirable cool-season grasses before nwsg emerge in spring. Reducing nwsg coverage when growth becomes too dense.	10 oz/ac Post-emergence application	When reducing nwsg density, use only every third spray nozzle (i.e., 1 open/2 closed).
Imazethapyr (Pursuit)	Controlling undesirable grass and broadleaf plants, including yellow nutsedge.	1 – 2 oz/ac Pre- or post-emergence application	Will not control legumes; thus, Pursuit can be sprayed over desirable legumes to control non-leguminous forbs.

Appendix 2. Major habitat types and arrangement preferred by selected wildlife.

Primary species managed	Percent nwsg and associated forbs	Arrangement of nwsg	Percent cool-season legumes and annual grains	Percent row cropland	Percent mast-producing hardwoods	Percent brushy cover (incl. 0–3-year-old hardwood and pine stands)
Bobwhite quail	20 – 80	Blocks ≥ 2 acres or strips ≥ 50’ wide	2; In firebreaks	5 – 50	5 – 20	20 – 50
Cottontail rabbit	10 – 80	Blocks 1 – 5 acres or strips ≥ 50’ wide	2; In firebreaks or small fields	5 – 50	10 – 40	20 – 50
Wild turkey	10 – 30	Blocks ≥ 2 acres	2 – 5; In firebreaks or fields	5 – 50	30 – 60	10 – 30
White-tailed deer	5 – 30	Blocks ≥ 2 acres	2 – 5; In firebreaks or fields	5 – 50	30 – 60	20 – 40
Grass/shrub songbirds (field sparrow, blue grosbeak, indigo bunting, yellow-breasted chat)	30 – 70	Blocks ≥ 5 acres or strips ≥ 50’	In firebreaks	<10	0	50 – 70
Grassland songbirds (grasshopper sparrow, Henslow’s sparrow, eastern meadowlark, dickcissel)	70 – 100	Blocks or complexes ≥ 100 acres	In firebreaks	<10	0	<20

Appendix 3. Flow chart for landowners planning to plant native warm-season grasses.



Recommended seeding rates (pounds of Pure Live Seed per acre) and planting dates for native warm-season grasses.

Species	Wildlife Habitat[1]	Forage Stand	Planting Dates
Big bluestem	4 – 6	10 – 12	Apr – May
Little bluestem	4 – 6	--	Apr – May
Indiangrass	4 – 6	10 – 12	Apr – May
Switchgrass	3 – 4	10	Apr – May
Sideoats grama	4 – 6	--	Apr – May
Eastern gamagrass	4 – 6	10 – 12	Apr – May
Wildlife mixture	4 – 6	--	Apr – May

[1] All seeding rates are for a single-species planting. Single-species plantings, however, are not normally recommended specifically for wildlife habitat. Therefore, the rate of each species included in a mixture should be reduced according to the number of species in the mixture, the composition preferred and the desired structure of the resulting stand.

Disclaimer: Use of brand or trade names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others, which may be of similar, suitable composition. Always be sure to read, understand and follow directions and precautions on herbicide labels before use. As herbicides, herbicide labels and their availability and recommendations may change, it is best to consult your local Extension agent for the latest recommendations on herbicide use.

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