RESTORATION PLAN

CUTAWHISKIE CREEK STREAM AND WETLAND RESTORATION SITE

Hertford County, North Carolina

Prepared for:

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EXECUTIVE SUMMARY

The North Carolina Ecosystem Enhancement Program (NCEEP), a division of the Department of Environment and Natural Resources (NCDENR) is currently developing stream and wetland restoration strategies for the Chowan River Basin (Cataloguing Unit 03010204200010). NCEEP has circulated a request for proposals (RFP) for full delivery wetlands and stream restoration in the region. In response to the RFP, Restoration Systems, LLC (RS) proposed to perform stream and wetland restoration at the Cutawhiskie Creek Restoration Site (Site) located in Hertford County.

This document details proposed stream and wetland restoration procedures for the 23.9 acre Site located within the Chowan River Basin. The Site encompasses approximately 4930 linear feet of intermittent and perennial stream channel, most of which has been channelized for agricultural and flood abatement purposes. The primary Site watershed, comprising approximately 18.2-square miles, supports a mixture of agricultural, silvicultural, and light residential uses. Land use within the Site is facilitated by the historic modification of the local water table through dredging and channelization activities.

Under existing conditions, Cutwhiskie Creek and its unnamed tributary (UT) have been dredged and straightened to support various agricultural and silvicultural practices. Impacts resulting from stream alteration include bank erosion, channel incision, and loss of characteristic riffle/pool complex morphology. Natural vegetation within adjacent areas, including stream buffers zones, has been removed throughout much of the Site. The floodplain has been impacted by deforestation and groundwater draw-down from stream channel dredging activities. A significant increase in nutrient and sediment loading has resulted from such site modifications, and adjacent wildlife habitats have been eliminated or fragmented.

Restoration activities have been proposed to restore historic stream and wetland functions that existed at the Site prior to dredging and vegetation removal that supported agriculture activities. Site alterations will include removal of debris and backfilling of the existing UT, re-establishment of the adjacent floodplain, and construction of a new stream channel within that floodplain. These activities will reintroduce surface water flood hydrodynamics from a 0.9-square mile watershed along the newly restored length of stream and floodplain. Characteristic wetland soil features, groundwater wetland hydrology, and hydrophytic vegetation communities will develop in areas immediately adjacent to the constructed channel. The new channel will be constructed to reflect regional stream characteristics and accommodate bankfull flows. Subsequently, wetland and adjacent slope soil surfaces will be restored and the Site reforested with streamside and riparian hardwood and mixed-mesic forest communities. Forested stream and upland buffers will be restored along the entire stream and floodplain to further protect water quality and enhance opportunities for wildlife.

A Monitoring Plan has been prepared that entails a 5-year analysis of stream geomorphology, wetland hydrology, and plant communities. Success of the project will be based on criteria set forth under each of the three monitored parameters.

After implementation, restoration activities are expected to provide the following mitigation units.

Restoration Design Component	Mitigation Type	Design Units	Proposed Credit Ratio	Available Mitigation Units
UT to Cutawhiskie Creek Upper Reach	Restoration	2630 LF	1:1	2630
UT to Cutawhiskie Creek Lower Reach	Restoration	190 LF	1:1	190
Cutawhiskie Creek	Preservation	2790 LF	5:1	558
Total Stream Mitigation Units				3378
Riparian Wetland	Restoration	13.1 AC	1:1	13.1
Riparian Wetland	Enhancement	1.2 AC	2:1	0.6
Total Wetland Mitigation Units				13.7

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1.0 INTRODUCTION

1.1 Restoration Project Description

Restoration Systems, LLC. (RS) proposes to perform stream and wetland restoration at the Cutawhiskie Creek Restoration Site (Site) located in Hertford County (Figure 1, Appendix A). The Site is located approximately 9 miles southwest of Murfreesboro (36.3292N, 77.1645W [NAD27]) and encompasses approximately 23.9 acres that is currently managed for agriculture and timber production. The Site is positioned within the floodplains at the confluence of Cutawhiskie Creek and an unnamed tributary to Cutawhiskie Creek (UT) [Figure 2 and 3, Appendix A]. The Site includes approximately 2080 linear feet of the UT, approximately 2790 linear feet of Cutawhiskie Creek, and approximately 13.1 acres of restorable floodplain soils. The floodplains have been drained to support agricultural and silvicultural activities. Streams have been dredged, straightened, and levees constructed to further support existing land uses. The Site offers opportunities for stream and wetland restoration with benefits to water quality and wildlife.

1.2 Restoration Project Goals and Objectives

Restoration activities have been proposed to restore historic stream and wetland functions that existed at the Site prior to dredging and vegetation removal that currently supports agriculture and silvicultural practices. Proposed Site alterations will include removal of debris and backfilling of the existing UT, re-establishment of the adjacent floodplain, and construction of a new stream channel within that floodplain. These activities will reintroduce surface water flood hydrodynamics from a 0.9-square mile watershed along the newly restored length of stream and floodplain. Characteristic wetland soil features, groundwater wetland hydrology, and hydric vegetation communities will re-develop in areas adjacent to the constructed channel. The new channel will be constructed to reflect regional stream characteristics and accommodate bankfull flows. Subsequently, wetland and adjacent slope soil surfaces will be restored and the Site reforested with streamside and riparian hardwood and mixed-mesic forest communities. Forested stream and upland buffers will be replanted to further protect water quality and enhance opportunities for wildlife.

Numerous ecological benefits are anticipated as a result of on-site restoration activities. Elevated water tables in the floodplain adjacent to the UT will restore the characteristic flood regime to the stream. Restored and enhanced wetland and riparian buffer along Cutawhiskie Creek and the UT will help to improve water quality via nutrient removal, increase local vegetative biodiversity, provide wildlife habitat, and serve as a forested corridor, linking the Site with adjacent natural areas.

2.0 EXISTING CONDITIONS

2.1 Physiography, Topography, and Land Use

The Site watershed is located in the United States Geological Survey (USGS) Hydrologic Cataloguing Unit 03010204200010 (North Carolina Division of Water Quality [NCDWQ] Sub-basin 03-01-02) of the Chowan River Basin (Figure 4, Appendix A). This region of the Chowan basin extends from points along the Virginia border in Northhampton County east across the central portion of Hertford County. The Site is located within the Mid-Atlantic Flatwood ecoregion of North Carolina (Griffith et al. 2002). In comparison to the Rolling Coastal Plains to the west, this ecoregion is characterized by wider upland surfaces, lower elevations, less local relief, and more poorly drained soils. Streams occurring within the Mid-Atlantic Flatwoods ecoregion are typically low-gradient (i.e., slopes less than 1 percent) and highly sinuous, with sand-bottom substrates. Soils such as Aquults and some Udults formed in the mostly Pleistocene-age clays and sands provide for slow natural subsurface drainage, except near streams. Local elevations range from 55 feet National Geodetic Vertical Datum (NGVD) along low ridges immediately adjacent to the Site to 45 feet NGVD along the Cutawhiskie Creek floodplain (USGS Woodland, North Carolina 7.5-minute topographic quadrangle) (Figure 5, Appendix A).

Land-uses in the vicinity of the Site consist primarily of agriculture, forest, pastureland, roadside shoulders, and residential lots. Row crops including soybeans, cotton, and corn are actively cultivated on the Site and surrounding areas. The Site is immediately adjacent to a farm and timberland owned by the Vaughan family. There is no livestock or poultry production in the vicinity. Timber is actively harvested from adjacent forested areas. A large, contiguous bottomland hardwood stand was harvested just west of the Site along the Cutawhiskie floodplain in the spring of 2006.

Relatively large areas of forest cover remain, relegated to non productive agrarian areas including interstream flats, drainageways, and floodplain bottoms associated with the regions streams and rivers. Throughout the area state roads provide access to scattered residential homes and commercial interests. Based on the ocular estimates from recent aerial photography, agriculture and livestock operations occupy approximately 25 percent of the Site's watershed areas while small commercial and residential development occurs within less than 2 percent of the watershed. Forest cover occupies the remaining 73 percent of the land area.

The Site encompasses approximately 23.9 acres of primary and secondary floodplain associated with Cutawhiskie Creek. The Site includes a UT that flows into Cutawhiskie Creek from the north (Figure 4, Appendix A). Portions of the Site have recently been logged (Photo 1 and 2). Other areas within the Site are currently in timber or agricultural production. Site vegetation is generally characterized by bottomland hardwood forests along un-logged areas on the Cutawhiskie Creek floodplain and low terraces, row crops including soybeans and corn, and successional communities associated with cut-over timberland.

The headwaters of the UT are approximately 1 mile northwest of the Site just north of SR 1158 on the Hertford/Northampton County border. Land-use within the unnamed tributary's approximate 0.9-square mile watershed is comprised primarily of agriculture (row crops), forest (typically pine plantation), and light residential. Land-use within the Cutawhiskie Creek watershed, comprising approximately

Photo 1. Recently timbered area within the Site.

Photo 2. UT to Cutawhiskie looking south.

18.2-square miles at the Site outfall, is similar, with a higher proportion of light residential and limited commercial and light industrial land-uses (Figure 3, Appendix A).

The primary restoration features within the Site include the UT and approximately 12.9 acres of drained, hydric soils. The UT has been dredged and straightened, such that it no longer retains stable dimension, pattern, and profile. Side-cast material (spoil piles) from dredging lines the west bank of the channel (Photo 2 and 3). A moderate headcut (approximately 2 foot drop in elevation over 20 linear feet of stream channel) was observed near the upstream (north) extent of the Site boundary, indicating vertical instability. Due to its high level of entrenchment because of dredging/incision, large flooding events are confined within the channel at its current dimension. These high-energy flows, which are ordinarily dissipated along the floodplain, exert high shear stress on stream banks, intensifying erosion.

Photo 3. UT to Cutawhiskie Creek.

Photo 4. Cutawhiskie Creek

Cutawhiskie Creek is a third-order stream that is approximately 40 feet wide and 9 feet deep through the on-site reach (Figure 3 and 4, Appendix A). According to the former property owner, Cutawhiskie Creek was dredged along its entire length in the mid-1960s in accordance with historic agricultural/silvicultural management practices. The side-cast material from dredging activities lines both banks of Cutawhiskie Creek, creating levees approximately 3 to 4 feet in height. The levees are vegetated with mature

bottomland hardwood species. Minimal bank erosion is observed within, upstream, and downstream of the Site (Photo 4).

2.2 Soils

Two distinct land features occur within the Site: 1) primary floodplain and terrace associated with Cutawhiskie Creek, and 2) the adjacent low, flat terraces and broad depression. The floodplain portion of the Site is underlain by the Wilbanks general soil mapping unit characterized by clayey, nearly level very poorly drained soils. The adjacent flat terraces are underlain by the Craven-Leaf-Caroline complex characterized by nearly level, somewhat poorly drained to moderately drained, loamy surficial soils.

Based on soil mapping for Hertford County (SCS 1984), the Site is underlain by three soil map units: Craven fine sandy loam (*Aquic Hapludults*), Leaf loam (*Typic Albaquults*), and Wilbanks silty clay loam (*Cumulic Humaquepts*) [Figure 6, Appendix A). The Leaf and Wilbanks series are considered hydric by the Natural Resources Conservation Service (NRCS) [1997]. Landscape alterations associated with current land-use practices including channel modifications (dredging and straightening.) and lateral ditching for agricultural and timber production have resulted in disturbances and alterations to the hydric soils identified on-site. Site soils are described below.

Craven fine sandy loam, with slopes ranging between 1 and 4 percent consists of moderately well drained soils on Coastal Plain uplands. Permeability is moderate, available water capacity is medium, and the shrink-swell potential is moderate. The depth of the solum exceeds 60 inches.

Leaf loam, with slopes typically less than 1 percent, consists of poorly drained soils on Coastal Plain uplands or low terraces. Permeability is very slow, available water capacity is high, and shrink-swell potential is high. The depth of the solum exceeds 60 inches.

Wilbanks silty clay loam, with slopes typically less than 1 percent, consists of very poorly drained soils on floodplains. Permeability is slow to moderately slow, available water capacity is high, and shrink-swell potential is moderate. The depth of the solum exceeds 60 inches. This soil is subject to frequent flooding for brief periods.

2.3 Hydrology

The Site is located in a hydrophysiographic region which is characterized by low elevation, wide upland surfaces with little local relief and significant areas with poorly drained soils. This description is considered characteristic of the Coastal Plain physiographic province, which extends throughout the eastern portion of North Carolina (see Section 2.1, Physiography, Topography, and Land-Use). In Hertford County, precipitation averages approximately 46.3 inches per year with peak annual precipitation months typically occurring in July and August (SCS 1984). Large floods (25-year plus return interval) correspond with tropical systems and hurricanes, spawned over the Gulf of Mexico and Atlantic Ocean.

Valley slopes in the region typically range from 0.004 rise/run (0.4 percent) in small drainages to less than 0.001 rise/run (0.1 percent) in larger drainages (usually third-order or greater). A combination of low valley slopes, dense vegetation, and bed material consisting of coastal coarse sand and silts induce the formation of relatively slow flowing, highly sinuous streams and rivers. The relative lack of land slope discourages runoff, promoting elevated groundwater tables, predominantly vertical groundwater flow,

extensive wetland presence along interstream divides and broad, relatively low relief valleys with well developed floodplains along streams.

Hydrology within the Site is complex, driven by landscape-level interactions between riparian groundwater flow and discharge and stream hydrology. A summary description of stream geometry, hydraulics, and substrate and description of surface and groundwater features is included below.

2.3.1 On-Site Streams

Stream geometry and substrate data have been evaluated to orient stream restoration based on a classification utilizing fluvial geomorphic principles (Rosgen 1996). This classification system stratifies streams into comparable groups based on pattern, dimension, profile, and substrate characteristics. Primary components of the classification include degree of entrenchment, width/depth ratio, sinuosity, channel slope, and stream substrate composition. The stream classes characterizing reaches within the Site include G, F, C, and E. Each stream type is modified by the number 1 through 6 (ex. E5) denoting a stream type which supports a substrate dominated by 1) bedrock, 2) boulders, 3) cobble, 4) gravel, 5) sand, or 6) silt/clay.

Historically, stream reaches in the region appear to have been characterized predominantly as E-type streams. E-type streams are slightly entrenched, riffle-pool channels exhibiting high sinuosity (greater than 1.4). In North Carolina, E-type streams occur in both narrow to wide valleys with well-developed alluvial floodplains (Valley Type VIII). These streams are typically stabilized with dense riparian vegetation. E-type streams typically exhibit a sequence of riffles and pools associated with a sinuous flow pattern. E-type channels are considered very stable. The proposed on-site stream restoration will emulate E-type channels based on the width-depth ratio predicted by regional curves and reference streams in the region. Channel substrate is dominated by sand and silt (subclassification 5/6).

Cutawhiskie Creek

The on-site reach of Cutawhiskie Creek includes approximately 2790 linear feet of channel (Figure 5, Appendix A). Cutawhiskie Creek supports a primary watershed of approximately 18.2 square miles at the Site outfall. Cutawhiskie Creek has been dredged and straightened with stream-side spoil levees apparent throughout. Stream channel assessment surveys affirm that Cutawhiskie Creek is currently an entrenched stream that is confined within the existing channel even under very large storm events. Relative to the abandoned floodplain, the current channel supports a width of approximately 40 feet wide, an average depth of 9 feet, and a cross-sectional area of approximately 260 square feet. The channel cross section is effectively enlarged to 475 square feet by the constructed levees. Conversely, estimated cross-sections of the historic channel approximated 81 square feet (Sweet and Geratz 2003). The dredging of the channel and spoil levee construction has effectively eliminated over bank flooding events.

UT to Cutawhiskie Creek

The sub-watershed for the UT originates from the interstream flat located 1.0 mile northwest of the Site outfall and encompasses approximately 0.9 square miles or 576 acres (Figure 2, Appendix A). The watershed is comprised of approximately 3000 linear feet of intermittent stream channel upstream of the Site and approximately 2080 linear feet of perennial stream channel within the Site. All streams and conveyances within the UT watershed have been straightened and channelized for agricultural and flood abatement purposes. The valley along the UT is relatively flat with a slope of approximately 0.0021 (rise/run).

Discharge appears to be dominated by a combination of upstream basin catchment, groundwater flow, and precipitation. Based on regional curves (Sweet and Geratz 2003), the bankfull discharge for a 0.9-square mile watershed is expected to average approximately 8 cubic feet per second and occur approximately every 0.1 to 0.3 years (Sweet and Geratz 2003).

The UT has been characterized based on fluvial geomorphic principles (Rosgen 1996). Table 1 (Appendix B) provides a summary of measured stream geometry attributes under existing conditions (considered to be unstable) and potentially stable stream attributes for the post-restoration channel. Estimates of stable stream attributes are based primarily upon data observations from the existing stream, reference streams in the region, and regional curves for the Coastal Plain of North Carolina (Sweet and Geratz 2003).

Dimension

Reference streams and regional curves (Sweet and Geratz 2003) were utilized to determine the natural bankfull channel cross-sectional area of the UT, associated with effective discharge. The cross-sectional area was then utilized to determine the bankfull width, average bankfull depth, maximum depth, and floodprone area of the existing on-site channel. Using this method, a departure from stability was estimated based on a comparison of existing and proposed/stable dimension variables (Table 1 and 2, Appendix B). Based on the regional curves a stable cross-section for the UT would be approximately 9 square feet.

During field investigations a cross-section was measured at several locations along the UT. Based on field measurements, the stream is characterized as an enlarged and entrenched channel, where flood flows are fully contained within the channel. Under existing conditions the UT has been classified as a G-type stream, with a bank-to-bank cross sectional area between 64 and 137 square feet. The regional curve suggests a stable cross-sectional area of 9 square feet.

Based on the cross-sectional area from the regional curve, the UT is characterized by eroded and/or highly incised channels (i.e., entrenched) with bank-height ratios greater than 2.0 (i.e., low bank height/bankfull maximum depth). Measures to restore suitable channel size (cross-sectional area and bank-height ratio) will be targeted for this project.

Profile

Based on the Site stream measurements, the on-site valley slope, measured from the infall and outfall locations, is approximately 0.0021 rise/run (Table 1, Appendix B). The low estimated valley slope is typical for the Coastal Plain physiographic region of North Carolina. Sinuosity of the UT was estimated at approximately 1.0 (thalweg distance/valley distance). Water surface slope of the UT was calculated from survey points collected in the thalweg in the upstream and downstream reaches. The calculated water surface slope of the UT measures approximately 0.0031 rise/run.

The UT has been over steepened due to human manipulation and increased erosive forces have resulted from stream straightening and channelization. Measures designed to dissipate energy and increase riffle and pool complexes will be targeted within the restored stream.

Plan Form

Current sinuosity of the UT measures approximately 1.0 (thalweg distance/valley distance). Sinuosity of 1.0 is indicative of a channel with no discernible pattern. Stable sinuosity for E-type streams is expected to vary significantly (thalweg distance/valley distance). Reference streams typically exhibited a sinuosity of 1.4 to 1.6, with some values measuring greater than 2.2. Due to the lack of a distinct repetitive pattern of riffles and pools, values for belt-width, pool-to-pool spacing, and meander wavelength were not readably measured.

Based on plan form variables, evidence of the degradation of the UT include 1) slight to moderate bank collapse and erosion, 2) channelization, resulting in very little discernable riffle and pool sequences and negligible sinuosity, and 3) a subsequent reduction in the overall length of the on-site channel. Restoration efforts along the degraded sections will target restoration of riffle and pool pattern and bringing pool-to-pool spacing and meander wavelength into suitable ranges for this region.

2.3.2 Groundwater Hydrology

Periodic and prolonged river and stream flooding, fluvial sediment deposition, flood storage, and hydraulic energy dissipation represent important attributes of floodplains and riparian swamp forests in the region. The infiltration of surface water (through flow) and movement of groundwater through the permeable soil horizons generally flow along pathways that are a combination of downward, down slope, and radial vectors. Because the slopes within these systems are very low, the corresponding movement of water tends to be very slow. The surface water elevation of the stream directly relates to the surface of the groundwater elevation, and the stream will rise and fall as the water table rises. Local stream channels intercept groundwater flow (effluent streams) and therefore represent groundwater withdrawal conveyances throughout most of the year.

The groundwater inputs represent the primary hydrologic factor in the development and maintenance of riparian wetlands at the Site. Wetland hydroperiods tend to be greatest along the outer floodplain at the toe of adjacent upland slopes (i.e., groundwater discharge areas). Hydroperiods decrease across the floodplain as the groundwater table approaches large stream channels (i.e., groundwater discharge features). The dredging of Cutawhiskie Creek and the UT has increased the size and depth of these channels which has significantly lowered the groundwater table and steepened the groundwater discharge throughout much of the Site (see 3.2 Groundwater Modeling).

2.4 Jurisdictional Wetlands and Streams

Jurisdictional areas are defined using the criteria set forth in the U.S. Army Corps of Engineers (USACE) Wetlands Delineation Manual (USACE 1987). Wetlands are defined by the presence of three criteria: hydrophytic vegetation, hydric soils, and evidence for wetland hydrology during the growing season (USACE 1987). Surface water systems and wetlands receive similar treatment and consideration with respect to Section 404 review. Site jurisdictional areas include surface water in bank-to-bank streams and vegetated wetlands.

Site jurisdictional areas were delineated and located utilizing Trimble XRS Differential Global Positioning System (GPS) technology on September 6 and 7, 2006. Based on the jurisdictional boundary mapping approximately 4870 linear feet of perennial streams, 60 linear feet of intermittent stream, and 0.7 acre of jurisdictional wetlands were identified within the Site (Figure 7, Appendix A).

2.5 Water Resources

The Site is located within sub-basin 03-01-02 of the Chowan River Basin (NCDWQ 2002). This area is part of USGS Hydrologic Unit 03010204 of the South Atlantic/Gulf Region. Cutawhiskie Creek and its UT occur within the Site. The portion of Cutawhiskie Creek that lies within the Site has been assigned Stream Index Number 25-4-8-8 by the NCDWQ [NCDWQ 2006a].

Classifications are assigned to waters of the State of North Carolina based on the existing or contemplated best usage of various streams or segments of streams within the basin. A Best Usage Classification of **C-NSW** has been assigned to Cutawhiskie Creek (NCDWQ 2006a). UTs are considered to carry the same classification as their receiving waters and therefore the UT to Cutawhiskie Creek is assumed to also carry a Best Usage Classification of **C-NSW**. Class **C** waters are suitable for aquatic life propagation and protection, agriculture, and secondary recreation. Secondary recreation includes wading, boating, and other uses not involving human body contact with waters on an organized or frequent basis. Class **NSW** waters are nutrient sensitive and require limitations to nutrient inputs. No Outstanding Resource Waters (**ORW**), Water Supply I (**WS-I**), Water Supply II (**WS-II)**, or watershed Critical Areas (**CA**) occur within 1.0 miles of the Site (NCDWQ 2002).

The NCDWQ has initiated a whole-basin approach to water quality management for the 17 river basins within the state. Water quality for the proposed study area is summarized in the Chowan River Basinwide Water Quality Plan (NCDWQ 2002). Cutawhiskie Creek and the UT are currently **Not Rated** for their designated uses. With respect to temperature regimes, both streams are designated as warm water streams (USACE et al. 2003).

The NCDWQ has assembled a list of impaired waterbodies according to the Clean Water Act (CWA) Section 303(d) and 40 CFR 130.7, (Section 303(d) list). The list is a comprehensive public accounting of all impaired waterbodies. An impaired waterbody is one that does not meet water quality standards including designated uses, numeric and narrative criteria, and anti-degradation requirements defined in 40 CFR 131. Cutawhiskie Creek and its UT are not listed on any section of the Section 303(d) list (NCDWQ 2006b).

There are no NPDES wastewater discharge permits in this subbasin (03-01-02). No point-source dischargers are hydrologically connected to the Site. Major non-point sources of pollution for the entire Chowan River Basin include agriculture, construction, forestry, onsite wastewater disposal, solid waste disposal, and atmospheric deposition (NCDWQ 2002). One Superfund site is listed in Winton, NC approximately 8 miles from the study area (U.S. Environmental Protection Agency [EPA] 2006a).

The project will entail stream restoration work that will temporarily impact the subject streams and adjacent areas. Temporary construction impacts due to erosion and sedimentation will be minimized through implementation of a stringent erosion-control schedule and the use of Best Management Practices (BMPs). The contractor will follow contract specifications pertaining to erosion control measures as outlined in 23 CFR 650 Subpart B and Article 107-13 entitled Control of Erosion, Siltation, and Pollution (NCDOT, Specifications for Roads and Structures). These measures include the use of dikes, berms, silt basins, and other containment measures to control runoff; elimination of construction staging areas in floodplains and adjacent to waterways; re-seeding of herbaceous cover on disturbed sites; management of chemicals (herbicides, pesticides, de-icing compounds) with potential negative impacts on water quality; and avoidance of direct discharges into steams by catch basins and roadside vegetation.

2.6 Plant Communities

Four plant communities were identified within the Site: agricultural land, timbered land, mixed hardwood forest, and bottomland hardwood forest. These communities are described below. Wildlife directly observed in a plant community or determined to be present through evidence (i.e., tracks, scat, and burrows) during field investigations are indicated with an asterisk (*). Vascular plant names follow nomenclature found in Radford et al. (1968) with adjustments for updated nomenclature (Kartesz 1998). Wildlife and habitat use were determined through field observations, evaluation of habitat type distributions, and available supportive documentation (Martof et al. 1980, Potter et al. 2006, Webster et al. 1985, Hamel 1992, and Palmer and Braswell 1995).

Agricultural Land – Less than one acre of the Site is agricultural land that is actively managed for soybean cultivation. Borders along agricultural fields that were not actively managed were dominated by common field weeds including fescue (*Festuca* sp.), wild onion (*Allium canadense*), clover (*Trifolium* sp.), henbit (*Lamium amplexicaule*), dandelion (*Taraxicum officionale*), and ragweed (*Ambrosia artemisiifolia*).

Within the agricultural land, it can be expected that mammalian, avian, and reptilian diversity will be limited to species adapted to fragmentation and disturbance. Agricultural land may provide an easily-traveled corridor between forested communities as well as foraging habitat for herbivores, granivores, and insectivores, but little cover from predation. Insectivores which take advantage of available food resources in such areas include American robin* (*Turdus migratorius*), eastern bluebird* (*Sialia sialis*), common grackle (*Quiscalus quiscula*), eastern kingbird (*Tyrannus tyrannus*), eastern fence lizard (*Sceloporus undulatus*), five-lined skink (*Eumeces faciatus*), American toad* (*Bufo americana*), northern cricket frog (*Acris crepitans*), eastern mole (*Scalopus aquaticus*), least shrew (*Cryptotis parva*), and red bat (*Lasiurus borealis*). Herbivores that graze many of the grasses and forbs present include meadow vole (*Microtus pennsylvanicus*), woodchuck (*Marmota monax*), hispid cotton rat (*Sigmodon hispidus*), and white-tailed deer* (*Odocoileus virginianus*). Granivores that feed upon the seeds of grasses and herbs include northern cardinal* (*Cardinalis cardinalis*), American goldfinch (*Carduelis tristis*), house finch (*Carpodacus mexicanus*), field sparrow* (*Spizella pusilla*), mourning dove* (*Zenaida macroura*), and eastern harvest mouse (*Reithrodontomys humulis*). Other wildlife which may find food resources within agricultural land include carnivores such as red-tailed hawk* (*Buteo jamaicensis*), rat snake (*Elaphe obsoleta*), striped skunk (*Mephitis mephitis*), and eastern garter snake (*Thamnophis sirtalis*); omnivores including American crow* (*Corvus brachyrhynchos*), red fox (*Vulpes vulpes*), raccoon* (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), and eastern box turtle (*Terrapene carolina*); and scavengers such as turkey vulture* (*Cathartes aura*).

Timbered Land - Approximately 10 acres of the Site is comprised of timbered land. Recent timber harvesting activities on the Site have left cut-over areas dominated by coppice regeneration and early-successional shrubs and herbs. This areas is characterized by a sparse sapling layer of red maple (*Acer rubrum*), sycamore (*Platanus occidentalis*), and American elm (*Ulmus americana*). A dense shrub and herb layer is comprised of pokeweed *(Phytolacca americana*), multiflora rose (*Rosa multiflora*) jewelweed (*Impatiens capensis*), tearthumb *(Polygonum sagittatum)*, common greenbrier (*Smilax rotundifolia*), rushes (*Juncus* spp.) and sedges (*Carex* spp.).

Several wildlife species are well-adapted to using the disturbed ecotone along agricultural land, and roadside edges. The herbivorous eastern cottontail (*Sylvilagus floridanus*) and white-tailed deer* forage

in disturbed/maintained land but prefer brushy clearings and shrubby woodland edges that provide shelter from predators. Birds commonly found along forest/grassland ecotones include northern mockingbird (*Mimus polyglottos*), brown thrasher (*Toxostoma rufum*), brown-headed cowbird (*Molothrus ater*), indigo bunting (*Passerina cyanea*), and eastern towhee (*Pipilo erythrophthalmus*). These species provide food for predators in disturbed/maintained land including black racer, timber rattlesnake (*Crotalus horridus*), Cooper's hawk (*Accipiter cooperii*), American kestrel (*Falco sparverius*), and red-shouldered hawk (*Buteo lineatus*). Terrestrial reptiles and amphibians which may occur within disturbed/maintained land include eastern box turtle, six-lined racerunner (*Cnemidomorphorus sexlineatus*), eastern garter snake, and five-lined skink.

Mixed Hardwood Forest – Approximately 5 acres of the Site is comprised of Mixed Hardwood Forest. This community exists east of the UT, and extends from the northern boundary of the Site to a transition zone with bottomland hardwood forest. This community consists of a mature forest characterized by a relatively well-developed mid-story. Loblolly pines are scattered amongst hardwoods becoming less frequent at the southern end of the Site.

This community is dominated by willow oak (*Quercus phellos*), sweetgum (*Liquidambar styraciflua*), loblolly pine, red maple, American elm and southern red oak (*Quercus falcata*) in the canopy. Canopy species as well as Chinese privet (*Ligustrum sinense*), persimmon (*Diospyros virginiana*), winged elm (*Ulmus alata*), and black cherry (*Prunus serotina*) dominate the subcanopy/shrub layer. Honeysuckle (*Lonicera japonica*), multiflora rose, greenbrier (*Smilax* sp.), poison ivy (*Toxicondendron radicans*), and Japanese stilt grass (*Microstegium vimineum*) occur in the herb layer.

This community provides food for wildlife, while its stratification creates numerous shelter opportunities for species such as Virginia opossum, meadow vole, red bat, raccoon, eastern mole, eastern box turtle, and white-tailed deer*. The proximity to a water supply is also beneficial. Wildlife species which may take advantage of food sources such as herbaceous vegetation, hardwood mast, or seeds from red maple and gray squirrel* (*Sciurus carolinensis*), white-footed mouse (*Peromyscus leucopus*), northern cardinal*, field sparrow,* Carolina chickadee (*Poecile carolinensis*), tufted titmouse* (*Baeolophus bicolor*), purple finch (*Carpodacus purpureus*), eastern chipmunk (*Tamias striatus*), southern flying squirrel (*Glaucomys volans*), brown thrasher, and blue jay (*Cyanocitta cristata*). Some wildlife species that may take advantage of cover such as the forest floor, loose bark, and arboreal areas, or prey upon species utilizing these habitats include northern flicker (*Colaptes auratus*), downy woodpecker (*Picoides pubescens*), hairy woodpecker (*Picoides villosus*), Carolina wren (*Thryothorus ludovicianus*), wood thrush (*Hylocichla mustelina*), red-eyed vireo (*Vireo olivaceus*), eastern wood-pewee (*Contopus virens*), American toad, five-lined skink, upland chorus frog (*Pseudacris triseriata*), southeastern shrew (*Sorex longirostris*), southern short-tailed shrew (*Blarina carolinensis*), eastern pipistrelle (*Pipistrellus subflavus*), white-spotted slimy salamander (*Plethodon cylindriceus*); sharp-shinned hawk (*Accipiter striatus*), eastern screech owl (*Otus asio*), eastern garter snake, copperhead (*Agkistrodon contortrix*), timber rattlesnake, and gray fox (*Urocyon cineareoargenteus*).

Bottomland Hardwood Forest – Approximately 5 acres of the Site is comprised of bottomland hardwood forest. This community type exists adjacent to Cutawhiskie Creek in the southern portion of the Site. Due to the dredging and levee construction along Cutawhiskie Creek, the historic floodplain no longer receives frequent overbank flooding as would be expected under natural conditions. The mature canopy is dominated by red maple, box elder, loblolly pine, and green ash. Bald cypress (*Taxodium*

distichum) exists in the lowest areas and along stream banks of Cutawhiskie Creek. The understory is relatively thick and includes canopy species as well as Chinese privet, ironwood (*Carpinus caroliniana*), jewelweed, poison ivy, and Japanese stilt grass.

Birds which are likely to inhabit bottomland forest, especially along water courses, are likely to include sharp-shinned hawk, red-shouldered hawk, American woodcock (*Scolopax minor*), barred owl (*Strix varia*), belted kingfisher (*Ceryle alcyon*), yellow-throated warbler (*Dendroica dominica*), Louisiana waterthrush (*Seiurus motacilla*), hooded warbler (*Wilsonia citrina*), Carolina wren (*Thryothorus ludovicianus*), eastern phoebe (*Sayonoris phoebe*), blue-gray gnatcatcher (*Polioptila caerulia*), Carolina chickadee, downy woodpecker (*Picoides pubescens*), red-eyed vireo (*Vireo olivaceus*), and northern cardinal.*

Mammal species expected to occur within this area include raccoon, southeastern shrew, golden mouse (*Ochrotomys nuttali*), eastern cottontail, white-tailed deer, gray squirrel, and red bat. Some terrestrial reptiles and amphibians which may occur within the forest include eastern box turtle, five-lined skink (*Eumeces fasciatus*), southern ringneck snake (*Diadophis punctatus*), copperhead, spring peeper (*Pseudacris crucifer*), southern cricket frog (*Acris gryllus*), bullfrog (*Rana catesbeiana*), American toad, eastern garter snake, northern fence lizard, and slimy salamander (*Plethodon glutinosus*).

2.7 Federally Protected Species

The most current USFWS (2006) listing of federally protected species with ranges extending into Hertford County (September 18, 2006) is considered in this report. The Site was walked and visually surveyed for potential protected species habitat. Species with the federal classification of Endangered, Threatened, or officially Proposed for such listing are protected under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*.). The term "Endangered Species" is defined as "any species which is in danger of extinction throughout all or a significant portion of its range," and the term "Threatened Species" is defined as "any species which is likely to become an Endangered species within the foreseeable future throughout all or a significant portion of its range" (16 U.S.C. 1532). One federally protected species is listed for Hertford County: red-cockaded woodpecker (*Picoides borealis)*. Due to the absence of available habitat, the proposed project will have **No Effect** on the red-cockaded woodpecker.

The North Carolina Natural Heritage Program (NCNHP) records indicate the presence of Chowanoke crayfish (*Orconectes virginiensis*) in Cutawhiskie Creek approximately 8000 feet downstream of the Site (September 18, 2006). Chowanoke crayfish is listed by the USFWS as a Federal Species of Concern (FSC). FSC are not afforded federal protection under the Endangered Species Act of 1973, as amended, and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as Threatened or Endangered. An FSC is defined as a species that is under consideration for listing for which there is insufficient information to support listing. In addition, species that are listed as Endangered, Threatened, or Special Concern by the NCNHP list of Rare Plant and Animal Species and are afforded state protection under the N.C. State Endangered Species Act and the N.C. Plant Protection and Conservation Act of 1979, as amended.

2.8 Constraint Analysis

A site constraints and potential fatal flaw analysis has been completed for the Site. The purpose of a constraint analysis is to evaluate the suitability of the Site for restoration and identify any outstanding issues which may jeopardize the success of the project. As a part of this effort, a Categorical Exclusion (CE) document has been completed for the Site. The CE documentation is provided in Appendix C. A list of potential constraints that are examined during the feasibility stage of most restoration projects is provided below.

Potential Constraint	Constraint Assessment	Comment
Access to Site	No	Agreement with the adjacent landowner provides access to Site during the construction and monitoring period.
Presence of Utilities	No	No utilities or easements are located within the Site.
Threatened and Endangered Species	No	The only endangered species listed for Hertford County is the red-cockaded woodpecker. There is no suitable habitat on the Site, and the Biological Conclusion is **No Effect**.
Hydrologic Trespass	Yes	An increase in ponding within the bottom of the existing ditch immediately upstream of the Site can be expected. The adjacent landowner has been apprised of the situation. From conversations with the adjacent landowner, the additional ponding was acceptable as long as the ditch remains at least 3 feet deep and water does top the ditch. (Mr. Vaughn, personal communication). Over-banking of the existing ditch from large events is not expected following completion of restoration activities.
Environmental Limited Phase 1	No	No known or potential hazardous waste sites occur within or adjacent to the Site.
Historic Places	No	No historic resources will be affected by the project.
Soils/Bedrock	No	No limiting soils or bedrock have been identified.
Property Ownership	No	A conservation easement has been recorded for the Site.
CAMA county	Yes	The project does involve ground-disturbing activities within a CAMA Area of Environmental Concern. The project meets CAMA's consistency requirements. A General Permit from the Division of Coastal Management will be obtained prior to construction.

3.0 WETLAND AND STREAM RESTORATION STUDIES

3.1 Reference Streams

A fundamental concept in stream classification entails the development and application of regional reference curves to guide stream reconstruction and enhancement activities. Regional reference curves can be utilized to predict bankfull stream geometry, discharge, and other parameters in altered systems. Regional reference curves for the Coastal Plain of North Carolina were published in 2003 (Sweet and Geratz, 2003). Regional curves for the coastal plain are located in Appendix D. These curves characterize a broad size-range of streams within the Coastal Plain physiographic province. However, small watersheds or deviations in valley slope, land-use, or geologic substrates may not be accurately described by the curves. Therefore, verification of individual watersheds (or regions) may be necessary and are typically accomplished through the use of reference studies.

Three reference stream reaches located within the Middle Atlantic Coastal Plain have been utilized in conjunction with regional curves for detailed planning and stream characterization for this restoration project. All three reference streams are characterized by a well-developed floodplain, moderately sinuous channel pattern, moderately low channel gradient, cohesive channel materials with high accumulations of organics, and dense floodplain vegetation with root mats along the channel banks. The reference stream channels are classified as E-type channels. Table 2 (Appendix B) provides a summary of the reference streams utilized to establish reconstruction parameters. The tables include common reference stream geometry measurements as well as ratios of geometry relative to bankfull width and bankfull depth.

Black Branch

Black Branch is located in south central Craven County, which lies in the Carolina Flatwoods sub-ecoregion of the MACP (Griffith et al. 2002). The watershed encompasses approximately 1.2 square miles at the reference reach and is characterized as gently undulating with wide floodplains and broad, flat, interstream divides. Land cover within the uplands of the Black Branch watershed is primarily southern yellow pine (77 percent). Mixed upland hardwoods and shrubland are also found in the uplands and cover a combined 12 percent of the watershed. Bottomland hardwood swamps found along drainages cover approximately 8 percent of the watershed. The plant community type adjacent to the reference reach was classified as Coastal Plan Small Stream Swamp (Blackwater Subtype (Schafale and Weakley 1990). The dominant canopy species within this community type are bald cypress, swamp blackgum (*Nyssa biflora*), tulip poplar (*Liriodendron tulipifera*), red maple, and sweetgum.

Bullard Branch

Bullard Branch is located in north central Duplin County, which lies in the Rolling Coastal Plain sub-ecoregion of the MACP (Griffith and Omernik 2000). The watershed encompasses approximately 1.3 square miles at the reference reach and is characterized as gently undulating with wide floodplains and broad, flat, interstream divides. Land-use within the watershed includes primarily cultivated land, bottomland hardwood swamp, and southern yellow pine. The cultivated areas occurring primarily in uplands, constitute approximately 44 percent of the watershed. The remaining watershed acreage is a mosaic of various forested land cover types. The plant community type adjacent to the reference reach was classified as Coastal Plan Small Stream Swamp (Blackwater Subtype (Schafale and Weakley 1990). The dominant canopy species within this community type are swamp blackgum, tulip poplar, American holly (*Ilex opaca*), sweet bay magnolia (*Magnolia virginiana*), and water oak (*Quercus nigra*).

Unnamed Tributary to Town Creek
The unnamed tributary to Town Creek (UT) is located in north central Brunswick County, which lies in the Carolina Flatwoods sub-ecoregion of the MACP (Griffith and Omernik 2000). The watershed of the UT encompasses approximately 0.6 square miles at the reference reach and is characterized by low slopes, wide floodplains, and swampy interstream flats. Land-use within the watershed includes is primarily yellow pine plantation (46 percent), cultivated land (35 percent) and pocosin swamp (12 percent). The plant community type adjacent to the reference reach was classified as Coastal Plan Small Stream Swamp (Blackwater Subtype (Schafale and Weakley 1990). The dominant canopy species within this community type are swamp blackgum, green ash (*Fraxinus pennsylvanica*), red maple, sweetgum, and bald cypress.

3.2 Groundwater Modeling

3.2.1 Model Description
Groundwater modeling was performed to characterize the water table under current drainage conditions. DRAINMOD groundwater modeling software was utilized to simulate subsurface conditions, groundwater behavior, and the lateral effect of ditches and dredged stream channels within the Site on the depth to the groundwater table. This model was developed by R.W. Skaggs, Ph.D., P.E., of North Carolina State University (NCSU) to simulate the performance of water table management systems implemented by parallel drains. Dr. Skaggs recently developed a method for determining the lateral effect of a single drainage ditch on wetland hydrology (hereafter referred to as the "Skaggs Method", Skaggs et al. 2005). This method employs the Boussinesq equation supplied with input parameters calibrated to reflect threshold drainage intensities determined for local drainage conditions in each North Carolina county. The Boussinesq equation can be used to estimate the effect of a single ditch on water table drawdown (Skaggs 1976).

DRAINMOD was originally developed to simulate the performance of agricultural drainage and water table control systems on sites with shallow water table conditions. DRAINMOD predicts water balances in the soil-water regime at the midpoint between two drains of equal elevation. The model is capable of calculating hourly values for water table depth, surface runoff, subsurface drainage, infiltration, and actual evapotranspiration over long periods referenced to climatological data. The reliability of DRAINMOD has been tested for a wide range of soil and climatological conditions. The result of tests on a variety of sites (He et al. 2004, Chescheir et al. 1994, Amatya 1993) indicates that the model can be used to reliably predict water table elevations and drain flow rates. Methods for evaluating water balance equations and equation variables are discussed in detail in Skaggs (1980). DRAINMOD has also been used to evaluate wetland hydrology by Skaggs et al. (1993).

DRAINMOD was modified for application to wetland studies by adding a counter that accumulates the number of events wherein the water table rises above a specified depth and remains above that threshold depth for a given duration during the growing season. Important inputs into DRAINMOD include rainfall data, soil and surface storage parameters, evapotranspiration rates, ditch depth and spacing, and hydraulic conductivity values. The length of the growing season was obtained from the soil survey for Hertford County (SCS 1980). Inputs for soil parameters such as the water table depth/volume drained/upflux relationship, Green-ampt parameters, and the water content/matric suction relationship were derived from

published sources utilizing the method described in Amatya et al. (2001). Input values for each model is provided in Appendix E.
Wetland hydrology is defined for the model as groundwater within 12 inches of the ground surface for 12 and 28 consecutive days during the growing season (5 and 12.5 percent of the growing season respectively). For the purpose of this study, the growing season is defined as the period between March 28 and November 7 (SCS 1984). Wetland hydrology is achieved in the model if target hydroperiods are met for one-half of the years modeled (i.e., 17 out of 32 years).

3.2.1 DRAINMOD Application, Verification, and Results

DRAINMOD simulations were used to model the current zone of wetland loss within the Site. Simulation results were compared to applications of the Skaggs method as well as the Boussinesq equation with drawdown times of 5 and 12.5 percent of the growing season. Model applications and results are summarized below.

Application

DRAINMOD was used to model the zone of wetland loss resulting from the presence of the shallow on-site ditch, Cutawhiskie Creek, and the UT. This zone was estimated by determining the threshold drain spacing of parallel ditches that would result in the area adjacent to the ditches meeting the wetland hydrology criterion in just over one-half of the years simulated. Ditches spaced any closer than this threshold distance would result in the entire area between the ditches experiencing a loss of wetland hydrology. If ditches were spaced any further apart than the threshold distance, there would be a strip between the ditches which would still meet the wetland hydrology criteria. Since only one ditch exists, areas outside of one-half of the threshold distance are predicted to have wetland hydrology; therefore, one-half of this threshold spacing provides a safe-side estimate of the drainage effect that the subject ditch will have. This application of the model recognizes that the water table midway between ditches spaced at the threshold spacing will be lower (i.e., the soil at that point will be drier) than would be the case at the same distance from a single ditch (i.e., at a distance of one-half the threshold spacing from a single ditch). Therefore, the width of the strip of land that would experience hydrologic conversion from wetland to upland hydraulic conditions due to a single ditch should be less than a distance equal to one-half the threshold spacing.

The floodplain is mapped as Leaf silt loam and Wilbanks silty clay loam. Amatya et al. (2001) describe a process for using the County Soil Survey Report's mapped series to collect soil input parameters for DRAINMOD. In the absence of undisturbed soil samples obtained from the field, the taxonomic class of the mapped series is matched to the class of soil series for which soil hydraulic properties for DRAINMOD have been published. Of the soil series closely resembling Wilbanks with published soil information, Cape Fear loam was judged to most closely resemble the soils mapped as Wilbanks at the Site. Soil water characteristics, drainage volume, upward flux, infiltration rate, depth to impermeable layer, and hydraulic conductivities were assigned for the Cape Fear (Skaggs and Nassahzadeh-Tabrizi, 1986) and Leaf soil (Tweedy 1998). Surface depressional storage was estimated from published ranges (Skaggs et al. 1994 and Skaggs 1980).

Weather data for a 32-year period were obtained for Murfeesboro, NC in Hertford County. Missing measurements were estimated to be the average value of that date for the period of record (1974 to 2006). Potential evapotranspiration rates were calculated based on Thornthwaite's method and adjusted using monthly factors derived for Eastern North Carolina. The DRAINMOD simulation was conducted for the

time period from January 1974 through April 2006. The on-site, shallow ditch was estimated to be 3 feet deep throughout. Cutawhiskie Creek is estimated at 9 feet deep within the Site. Depths for the UT ranged from 6 feet in the upper reach to 9 feet in the lower reach.

Verification

DRAINMOD is currently the most widely used and studied method for determining ditch influence on adjacent wetland soils. However, concerns over the accuracy of DRAINMOD have led to a comparison of results to the Boussinesq equation and the Skaggs Method.

The Boussinesq equation calculates the zone of influence from a single drain given soil hydraulic conductivity, drainable porosity (i.e., a measure of water holding capacity derived from the soil water characteristic), depth of drain, and depth to an impermeable layer, and length of drawdown. For this application the length of drawdown was considered to be the target hydroperiod (i.e., 12 and 28 days).

The Skaggs Method was developed for the North Carolina Department of Transportation to address concerns with the two previously described methods. The application of DRAINMOD described above, yields a theoretical maximum zone of influence for a single ditch. The application of the Boussinesq equation described above, using drawdown times of 5 and 12.5 percent of the growing season but ignoring precipitation during the drawdown period, can overestimate the zone of influence. The Skaggs method defines new drawdown periods for each county (Phillips 2006 and personal communication). These shorter periods were calibrated to reflect the removal of wetland hydrology for 5 percent of the growing season using a variety of ditch depths and surface storage conditions. Not all soils and depths have been published. The maximum ditch depth published using the Skaggs Method is 6 feet.

Based on various published investigations, the Skaggs Method appears to be most accurate in determining wetland influences. However, values greater than 6 feet are currently not available for soils found at the Site. DRAINMOD estimates are reasonably close to estimates using the Skaggs Method and always less than those predicted by the Boussinesq equation for 12.5 percent of the growing season. Therefore, for the purposes of this report, DRAINMOD results were used to estimate the pre- and post drainage effects of the on-site ditch and dredged stream channels.

Results

The wetland loss models have been applied to the Site to determine which areas may not achieve wetland criteria (i.e., less than 12.5 percent of the growing season) under existing conditions. In Leaf soils, the maximum wetland degradation predicted by DRAINMOD ranged from 154 to 233 feet away from the specified drainage feature, 3 to 9 feet in depth respectively (Table 3, Appendix B). These soils were located adjacent to the ditch and UT. In Cape Fear loam soils, those adjacent to Cutawhiskie Creek, the wetland degradation predicted by DRAINMOD was 262 feet (Table 3, Appendix B).

Figure 8 (Appendix A) provides a depiction of modeled wetland hydroperiods based on ditch depths and spacing under pre-restoration conditions. The DRAINMOD simulations indicate that most of the hydric soils have been effectively drained (i.e., support hydroperiods less than 12.5 percent of the growing season). Only a couple of areas including jurisdictional wetlands were excluded from site drainage effects. The model suggests that approximately 19.2 acres of hydric soils are currently in a degraded state.

The model was applied to predict post-restoration site alterations to restore wetland hydrology. Primary alterations include effectively eliminating drainage along the man-made drainage systems (i.e., on-site ditch and dredged UT). However, the dredged channel along Cutawhiskie Creek must remain intact in order to drain the upper watershed. Without auxiliary inputs of surface or groundwater, hydric soils will continue to be drained for a zone extending approximately 262 feet adjacent to Cutawhiskie Creek. A backwater slough condition will be established on the secondary floodplain that provides 1) an elevated groundwater gradient across the primary floodplain and 2) re-introduction of periodic surface flows estimated to occur several times a year for prolonged periods. These auxiliary sources of hydrology are predicted to reduce the steep groundwater gradient associated with Cutawhiskie Creek, and provide wetland d hydroperiods in areas with 50 feet or less of the stream channel. Based on post-restoration simulations, wetland hydrology (greater than 12.5 percent of the growing season) is expected to occur within approximately 12.9 acres of the primary and secondary floodplain (Figure 9, Appendix A).

4.0 STREAM AND WETLAND RESTORATION PLAN

The restoration concepts being developed for the Site follow a watershed approach for stream and wetland design. Therefore, the plan takes into account the surrounding land-use and management practices that could realize additional benefit from having an adjacent restoration project in-place. This concept also subscribes to the restoration of all ecosystems located within the Site including upland plant communities. Restoration of land form in all areas that fit within the restoration scheme has therefore been incorporated into the plan. The restoration planning approach, proposed design units, and available mitigation units are depicted on Figure 10 (Appendix A). After implementation, restoration activities are expected to provide the following stream and wetland design units (see Table 4, Appendix B).

- 2820 linear feet of stream restoration, including approximately 2630 linear feet of Priority 1 restoration of the UT and 190 linear feet of passive braided restoration of the UT.
- 2790 linear feet of stream preservation along Cutawhiskie Creek.
- 13.1 acres of riparian wetlands restoration.
- 1.2 acres of riparian wetlands enhancement.

Components of this plan may be modified based on construction or access constraints. Primary activities designed to restore the stream and wetland complex include 1) stream restoration, 2) wetland restoration and enhancement and 3) plant community restoration. Subsequently, a monitoring plan is outlined.

4.1 Stream Restoration

Stream restoration efforts using Priority 1 methodology (Rosgen 1996) are designed to restore a stable, meandering stream that approximates the hydrodynamics and stream geometry relative to natural conditions in the region. Primary activities designed to restore the channel on a new location include floodplain excavation, floodplain preparation and stake out, stream construction, followed by the plugging and backfill of the existing channel. Stream design parameters will follow those depicted in Table 1 (Appendix B). The excavation limits of the constructed floodplain and plan view of the proposed channel are depicted on Figure 11A-B (Appendix A). Representative cross-sections are provided on Figure 12 (Appendix A).

Stream restoration activities will restore the existing, entrenched UT channel with approximately 2630 linear feet of a stable E-type channel configuration. Restoration of this channel will reduce

sediment and nutrient loading, introduce natural flooding frequencies within the floodplain, increase in-stream habitat including pools and associated micro-habitat, and lower water temperatures resulting from the shading by planted vegetation.

An erosion control plan will be developed in conjunction with detailed. Erosion control will be performed locally throughout the Site and will be incorporated into the construction sequencing. Exposed surficial soils at the Site will include primarily dense, nutrient poor subsoils that do not vegetate rapidly after disturbance. Therefore, seeding with appropriate annual grasses and immediate planted with disturbance-adapted woody species will be employed following the earth-moving process. Planting of the floodplain with native vegetation is expected to quickly stabilize and help reduce flow velocities in floodwaters, filter out pollutants and particulates, and provide wildlife habitat.

4.1.1 Floodplain Excavation

A new floodplain will be excavated in the upper reaches of the Site as depicted in Figures 11A and 12 (Appendix A). The objective of floodplain excavation is to reconnect the stream with the historic floodplain at an appropriate elevation, minimize hydrologic impacts upstream, and provide quicker flood dissipation from upstream in periods of high flow. Excavated material is expected to be used to backfill the existing channel location within the Site. After excavation, the floodplain will provide a relatively level surface that is expected to develop wetland functions. Planting of the floodplain with native vegetation is expected to quickly stabilize and help reduce flow velocities in floodwaters, filter pollutants, and provide wildlife habitat.

4.1.2 Floodplain Preparation and Grading

Preparation of the proposed stream channel corridor will include plugging and backfilling the on-site ditch, and clearing and grubbing large stumps. Spoil material stockpiled adjacent to the ditch will be used to fill the ditch. Excess material will be stockpiled immediately adjacent to the existing stream channel to be backfilled after stream diversion is complete. The backfilled ditch and adjacent stockpiled areas will be graded to the floodplain elevation as specified in the profile.

Clearing and grubbing large stumps within the stream alignment will be required. Care will be taken to avoid the unnecessary removal of stumps that may provide channel stability. Woody debris will remain on-site and can be either buried or equally distributed on the floodplain to provide habitat.

After floodplain and corridor preparation, the design channel layout shall be surveyed in and staked out according to the meandering pattern. The stake out will provide the radius identification (ID), radius location, radius length, and the top and bottom of each riffle elevation. The surveyors will set an offset stake outside the limits of construction. An off-set stake will allow the stream channel to be constructed without disturbing the stake.

4.1.3 Stream Channel Construction

After the floodplain has been excavated, the proposed channel will be constructed to the average width, depth, and cross-sectional area derived from regional curves and detailed measurements of the on-site reach (Table 1, Appendix B). Stream banks and local belt-width area of constructed channels will be immediately matted with coir fiber matting and planted with shrub and herbaceous vegetation. Once the proposed design channel has been excavated and stabilized, the abandoned channel will be filled with the material stockpiled from floodplain excavation.

4.1.4 Plugs and Backfill of Abandoned Channel

Following stream diversion, impermeable plugs will be installed at regular intervals along the abandoned channel. The plugs will consist of impermeable soils excavated from the adjacent spoil pile or floodplain surface. The material shall be of sufficient strength to withstand the erosive energy of surface flow across the Site. The plugs will be backfilled in 2-foot lifts of vegetation free material and compacted into the bottom of the channel. The plugs will be sufficiently wide and deep to form an imbedded overlap in the existing bank and bed of the channel.

The remaining portions of the abandoned channel will be backfilled using the adjacent spoil material. The backfilled channel sections will be filled, compacted and graded to the approximate elevation of the adjacent wetland surface.

4.2 Controlled Water Outlet Structures

Flows from the constructed stream channel will daylight within the floodplain of Cutawhiskie Creek, several feet above the normal water elevation. It is anticipated that the regular flows from the constructed stream channel will rehydrate the hydric soils adjacent to Cutawhiskie Creek. Reducing drainage outflows while conserving water during the growing season is the primary aim for wetland restoration in this area. In order to regulate water from these wetlands into Cutawhiskie Creek, controlled water outfall structures are proposed at designated outlets through the river levee associated with the creek. As surface water exits the Site, the banks of the Cutawhiskie Creek may experience increased erosive flows from the hydraulic head, causing instability to the bank and increase the risk of headcuts. To preclude erosion events at the convergence with Cutawhiskie Creek, a proposed water control outlet will be installed upslope of the Cutawhiskie Creek channel. The water control outlet will be a log weir in which multiple logs are cabled together to form a confinement structure that will protect, reinforce, and restrain vegetation, thereby controlling down-slope movement due to hydrodynamic and gravitational forces.

4.3 Riparian Wetland Restoration and Enhancement

Riparian wetland restoration will significantly reduce groundwater withdrawal rates and reconnect surface water flood hydrodynamics from an approximately 0.9 square mile watershed onto the floodplain adjacent to approximately 2608 linear feet of constructed channel. Restoration will be achieved through the backfilling of the existing channel and reintroduction of surface water from overbank events. Additionally, the plan includes the re-establishment of riparian swamp forest communities. Therefore, riparian hydrodynamic and biogeochemical functions will be restored, including pollutant removal, organic carbon export, sediment retention, nutrient cycling, flood storage, and energy dissipation. Physical wetland functions typically associated with water quality will be replaced within the Chowan River Basin.

Riparian wetland enhancement will occur within areas where jurisdictional status has been verified or in hydric soil areas where wetland models have not indicated wetland loss. Riparian wetland enhancement will be achieved through the planting of a riparian swamp forest community.

Biological functions associated with the riparian system, including in-stream aquatic habitat, structural floodplain habitat, and interspersion and connectivity between the restored stream, floodplain, and adjacent uplands, will also be restored. Based on restoration analyses, the Site includes approximately 1.2 acres of riparian wetland enhancement and 13.1 acres of riparian wetland restoration (Figure 10, Appendix A).

4.4 Groundwater and Soil Restoration

Restoration of groundwater, wetland hydrology and wetland soil attributes involves 1) excavation and grading of certain floodplain areas, 2) backfilling of the abandoned stream reach (described above), and 3) scarification of disturbed floodplain soils prior to planting. In addition, the construction of (or provisions for) surface water storage depressions (i.e., small floodplain pools and depression) also represents an important component of groundwater restoration activities.

4.4.1 Topsoil Excavation and Stockpiling

Based on local conditions, topsoil from the excavated floodplain and future spoil locations may be excavated and stockpiled, then redistributed over excavated areas that lack sufficient topsoil depth. Topsoil will provide a seed source and substrate for wetland vegetation establishment. Sufficient amounts of this material will be stockpiled in areas adjacent to identified areas.

Because restoration success will depend on the creation of a productive wetland forest community, it is critical that soils be adequate to support characteristic plant growth. Since local soils have a relatively shallow layer of topsoil, it is expected that excavation of the new floodplain may expose very fine textured soils that may have decreased infiltration and permeability characteristics. In the event these phenomena are observed, the floodplain will be undercut and replaced with a nominal 12-inch layer of topsoil. The topsoil will help in the reduction of the rate of groundwater flow through surficial soil layers, which is critical to restoration of hydrology, and will increase the depth of substrate required for a mature wetland community.

4.4.2 Soil Scarification

Microtopography and differential drainage rates within localized floodplain areas represent important components of floodplain functions. Reference forests in the region exhibit complex surface microtopography. Small concavities, swales, exposed root systems, seasonal pools, oxbows, and hummocks associated with vegetative growth and hydrological patterns are scattered throughout the system. Efforts to advance development of characteristic surface microtopography shall be implemented.

In areas where soil surfaces have been compacted, ripping, or scarification shall be performed. Mixing of vegetation debris in surface soils and surface modifications (i.e., constructed concavities and swales) shall also promote complexity across the Site landscape. After construction, the soil surface should exhibit complex microtopography across floodplain surface with up to 1 foot vertical asymmetry. Subsequently, community restoration will be initiated on complex floodplain surfaces. Exposed surfaces will support complex microtopography, including hummocks and troughs, to maximize water-storage potential.

4.5 Plant Community Restoration

Restoration of riparian and upland buffer forest communities provides habitat for area wildlife and allows for development and expansion of characteristic forest species across the landscape. Ecotonal changes between community types contribute to diversity and provide secondary benefits, such as enhanced feeding and nesting opportunities for mammals, birds, amphibians, and other wildlife. Plant community restoration within the Site will include the planting of bare-root specimens consistent with reference data, on-site observations, and community descriptions (Schafale and Weakley 1990).

Revegetating the floodplain and stream banks will provide stream bank stability, shade, cool surface waters, filter pollutants from adjacent runoff, and provide habitat for area wildlife. Scarification of all

planting surfaces will be required prior to planting. Species distribution and densities are expected to be determined during development of the detailed restoration plan.

4.5.1 Plant Community Associations

On-site observations and community descriptions from Classification of the Natural Communities of North Carolina (Schafale and Weakley 1990) were used to develop the primary plant community associations that will be promoted during community restoration activities. These Community associations include 1) Coastal Plain Levee Forest, 2) Coastal Plain Small Stream Swamp, 3) Cypress-Gum Swamp, and 4) Mesic Mixed Hardwood Forest (Figure 13, Appendix A). Figure 14 (Appendix A) identifies the location, based on elevation and position relative to the restored stream, of each target community acreage to be planted. Targeted planting elements within each map unit are listed below.

Coastal Plain Levee Forest

1. Laurel Oak (*Quercus laurifolia*)
2. Overcup Oak (*Quercus lyrata*)
3. Willow Oak (*Quercus phellos*)
4. River Birch (*Betula nigra*)
5. Bald Cypress (*Taxodium distichum*)
6. American Holly (*Ilex opaca*)
7. Swamp Tupelo (*Nyssa biflora*)
8. Ironwood (*Carpinus caroliniana*)
9. Cherrybark Oak (*Quercus pagoda*)
10. American Elm (*Ulmus americana*)

Cypress-Gum Swamp

1. Swamp Tupelo (*Nyssa biflora*)
2. Bald Cypress (*Taxodium distichum*)
3. Overcup Oak (*Quercus lyrata*)
4. Swamp Cottonwood (*Populus heterophylla*)
5. Carolina Ash (*Fraxinus caroliniana*)

Coastal Plain Small Stream Swamp

1. Swamp Tupelo (*Nyssa biflora*)
2. Bald Cypress (*Taxodium distichum*)
3. Laurel Oak (*Quercus laurifolia*)
4. Overcup Oak (*Quercus lyrata*)
5. Swamp Chestnut Oak (*Quercus michauxii*)
6. American Elm (*Ulmus americana*)
7. Tulip Poplar (*Liriodendron tulipifera*)
8. River Birch (*Betula nigra*)
9. Green Ash (*Fraxinus pennsylvanica*)
10. Ironwood (*Carpinus caroliniana*)
11. American Holly (*Ilex opaca*)
12. Sweetbay Magnolia (*Magnolia virginiana*)
13. Red Bay (*Persea borbonia*)
14. Giant Cane (*Arundinaria gigantea*)

Mesic Mixed Hardwood Forest

1. Tulip Poplar (*Liriodendron tulipifera*)
2. White Oak (*Quercus alba*)
3. Southern Red Oak (*Quercus falcata*)
4. American Beech (*Fagus grandifolia*)
5. Northern Red Oak (*Quercus rubra*)
6. Pignut Hickory (*Carya glabra*)
7. Mockernut Hickory (*Carya alba*)
8. Black Gum (*Nyssa sylvatica*)
9. Cherrybark Oak (*Quercus pagoda*)
10. Ironwood (*Carpinus caroliniana*)
11. Southern Sugar Maple (*Acer floridanum*)
12. American Holly (*Ilex opaca*)
13. Sourwood (*Oxydendron arboretum*)
14. Hop-hornbeam (*Ostrya virginiana*)

Coastal Plain Small Stream Swamp Forest and Cypress-Gum Swamp are the primary target communities for the floodplain locations, whereas mesic hardwood species will be planted along the valley side slopes and on adjacent uplands within the Site. Certain opportunistic species that may dominate the early successional forests have been excluded from plant community restoration efforts. Opportunistic species consist primarily of pines, red maple, and sweetgum.

The following planting plan is the blueprint for plant community restoration. The anticipated results stated in the Success Criteria (Section 5.7) are expected to reflect potential vegetative conditions achieved after steady-state conditions prevail over time.

4.5.2 Planting Plan

The purpose of a planting plan is to re-establish vegetative community patterns across the landscape. The plan consists of 1) acquisition of available plant species, 2) implementation of proposed site preparation, and 3) planting of selected species.

Species selected for planting will be dependent upon availability of local seedling sources. Advance notification to nurseries (1 year) will facilitate availability of various non-commercial species. Bare-root seedlings of the listed species will be planted within most specified map areas at a density of 1000 stems per acre on 6.6-foot centers. Table 5 (Appendix B) provides the total number of stems and species distribution within each vegetation association. The table only lists those species currently available in the trade.

The Site shall be prepared for planting including soil scarification, topsoil excavation (see 4.4 Groundwater and Soil Restoration), fertilization, and lime application. Planting will be performed between December 1 and March 15 to allow plants to stabilize during the dormant period and set root during the spring. A total of approximately 18,000 tree and shrub specimens will be planted within the Site boundary during restoration activities.

5.0 MONITORING REPORT

Monitoring of the Site will be performed over a 5-year period (e.g., five growing seasons), including a minimum of two bankfull events recorded at the Site, or thereafter until success criteria are fulfilled. Monitoring reports will be submitted at the end of each monitoring year. Each report will include compilation of collected data in spreadsheet, tabular, and graphic format. ESC will follow the format provided by the EEP (Content, Format and Data Requirements for EEP Monitoring Reports, Version 1.1 - 9/16/05). Monitoring is proposed for stream restoration, wetland creation, and buffer restoration. Three distinct tasks are covered under the monitoring plan including stream monitoring, hydrological monitoring, and vegetation monitoring. Each of these tasks is described below.

5.1 Stream Monitoring

As part of the post-project As-built Mitigation Plan, a baseline survey encompassing the stream restoration reach will have been completed and will have become available for use for base line mapping. The As-built Mitigation Plan will establish the channel plan view, establish permanent channel cross-sections on riffles and pools, provide substrate analysis, and establish the channel profile. Profile measurements will include bed facets (pool and riffles), water surface, and bankfull elevations. A

minimum of two pool and two riffle cross-section locations will be identified within the monitored reach. Subsequent monitoring will revisit cross-section locations, re-survey of the pattern and profile, and provide substrate analysis. Data will be presented in graphic and tabular format consistent with the EEP format. Stream monitoring shall also include photo documentation of changes observed within the channel, including bank erosion (Bank Erosion Hazard Index [BEHI] assessment), aggradation, degradation, and presences of in-stream bars. Significant changes in channel morphology will be tracked and reported by comparing most-recent monitoring data with previous monitoring data.

In order to substantiate the extent of floodplain restoration, one stream crest gauge shall be placed in the primary stream channel to verify bankfull stage events.

5.2 Stream Success Criteria

Success criteria for stream restoration will include 1) successful classification of the reach as a functioning stream system (Rosgen 1996) and 2) channel parameters that are indicative of a stable stream system. Channel configuration will be evaluated every year to monitor for changes in channel geometry, profile, or substrate. These data will be utilized to determine the success in restoring stream channel stability.

The channel configuration will be compared to the design plans and previous geometry data to track changes in channel geometry, profile, or substrate. These data will be utilized to assist in determining the success of restored stream channel stability. Specifically, there shall be no significant change in channel geometry from the constructed channel; pool depths and widths should remain consistent with the constructed geometry; the profile should continue to show the development of bed features with no significant channel aggradation or degradation; and over time the channel will be successfully classified as an E-type stream. Field indicators of bankfull will be described in each monitoring year and indicated on representative channel cross-sections.

Channel stability will be assessed based on dimension, pattern, and profile variables. Bank erosion and headcut migration through the Site will be assessed visually (photo record) and through cross-section and profile data.

5.3 Stream Contingency

In the event that stream success criteria are not fulfilled, a mechanism for contingency will be implemented. Stream contingency may include, but is not be limited to repair of dimension, pattern, and profile variables or bank stabilization. The method of contingency is expected to be dependent upon stream variables not in compliance with success criteria. Primary concerns that may jeopardize stream success include headcut migration through the Site or bank erosion.

Headcut Migration Through the Site – In the event that a headcut occurs (identified visually or through on-site measurements), provisions for impeding headcut migration and repairing damage caused by the headcut may be implemented. Headcut migration may be impeded through the installation of in-stream grade control structures (log cross vane) and/or restoring stream geometry variables until channel stability is achieved. Channel repairs to stream geometry may include stabilizing the material with erosion-control matting, and vegetative stabilization (seeding or planting).

Bank Erosion – In the event that severe bank erosion results in width/depth ratios significantly higher than that of the previous monitoring year, contingency measures to reduce these variables may take place. Bank erosion contingency may include bank stabilization measures. If the resultant bank erosion induces chute cutoffs or channel abandonment, the channel may be modified to reduce shear stress.

5.4 Wetland Hydrology Monitoring

Following construction, groundwater monitoring gauges will be placed in accordance with specifications in the USACE Installing Monitoring Wells/Piezometers in Wetlands (WRP Technical Note HY-IA-3.1, August 1993). Monitoring gauges shall be situated in various microtopographic regimes within the excavated floodplain area and at a frequency sufficient to provide representative coverage. Each monitoring gauge shall be set to a minimum depth of 24 inches below the soil surface. Hydrological sampling shall be performed throughout the growing season at intervals necessary to satisfy the hydrology success criteria within each community restoration area (USEPA 1990).

5.5 Wetland Hydrology Success Criteria

Target hydrological characteristics will require a minimum regulatory criteria or supporting documentation for atypical dry years when success criterion is not achieved. Under normal climatic conditions, the hydrologic success criterion requires saturation (free water) within 1 foot of the soil surface for a minimum 5 percent (consecutive days) of the growing season. This hydroperiod translates to saturation for a minimum 11-day consecutive period during the growing season, extending from March 28 to November 7 (224 days) (NRCS 1984). If wetland parameters are marginal as indicated by vegetation and hydrological monitoring, consultation with EEP personnel will be undertaken to determine the extent of wetland restoration in these area.

5.6 Vegetation Monitoring

Vegetation monitoring procedures are designed in accordance with the Stream Mitigation Guidelines (USACE et al. 2003) and guidelines and procedures developed by the Carolina Vegetation Survey (CVS) (CVS-EEP Protocol for Recording Vegetation, Level 1-2 Plot Sampling Only, Version 4.0, 2006). A general discussion of the plant community restoration-monitoring program is provided.

After planting has been completed in winter or early spring, an initial evaluation will be performed to verify planting methods and determine initial species composition and density. Supplemental planting and additional site modifications will be implemented, if necessary. During the first year, vegetation will receive cursory, visual evaluation on a periodic basis to ascertain the degree of overtopping of planted elements by nuisance species.

Collection of the Year-1 data must be performed no earlier than six months after planting. The Year-2 and all subsequent vegetation sampling will be collected near the end of the growing season or until the vegetation success criterion is achieved.

As part of the post-project As-built Mitigation Plan, approximately six (6), permanent 100 square meter sampling plots (modules) will be established at stratified locations within the Site. The sampling plots will equally represent the various hydrologic regimes and plant communities found within the Site. Vegetation Baseline Data will be collected on the new plots with new plants installed for inclusion of the As-built Mitigation Plan. In each sampling plot, protocol Level 1 and 2 will be used to identify and track

both planted and volunteer stems. Exotic vegetation will also be noted during data collection. One photograph of each plot will be required.

5.7 Vegetative Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for floodplain forest development. Success criteria are dependent upon the density and survival of planted species identified in Plant Community Associations (see section 4.4.1). All planted canopy tree species and species identified by Schafale and Weakley (1990) will be utilized to define "Character Tree Species" as termed in the success criteria.

An average density of 320 stems-per-acre of Character Tree Species must be surviving following the first year of monitoring. Subsequently, 290 character tree stems-per-acre must be surviving in Year 3, and 260 character tree stems per acre in Year 5. This is consistent with USACE Wilmington District guidelines for wetland mitigation (USACE 1993).

5.8 Vegetation Contingency

If vegetation success criteria are not achieved, based on average density calculations from combined sample plot data, supplemental planting will be performed with a tree species listed in Plant Community Associations (see section 4.5.1). Supplemental planting will be performed as needed until vegetation success criteria are achievement. No quantitative sampling requirements are proposed for herb assemblages as part of the vegetation success criteria. Development of the floodplain forest over several decades shall dictate the success in restoration and establishment of desired understory and groundcover populations.

5.9 Special Considerations

The Site shall be periodically monitored for structures that significantly impede surface flow of the newly constructed stream channel (e.g., beaver dams or fallen snags). Snags and other woody debris that pose such obstruction shall be removed by hand or "cabled out" of the riparian area with minimum impacts to soil compaction and vegetation. There shall be no excessive clearing or pruning of vegetation within the Site. Corrective action shall be applied to any monitoring activity that causes channelized flow within the riparian area.

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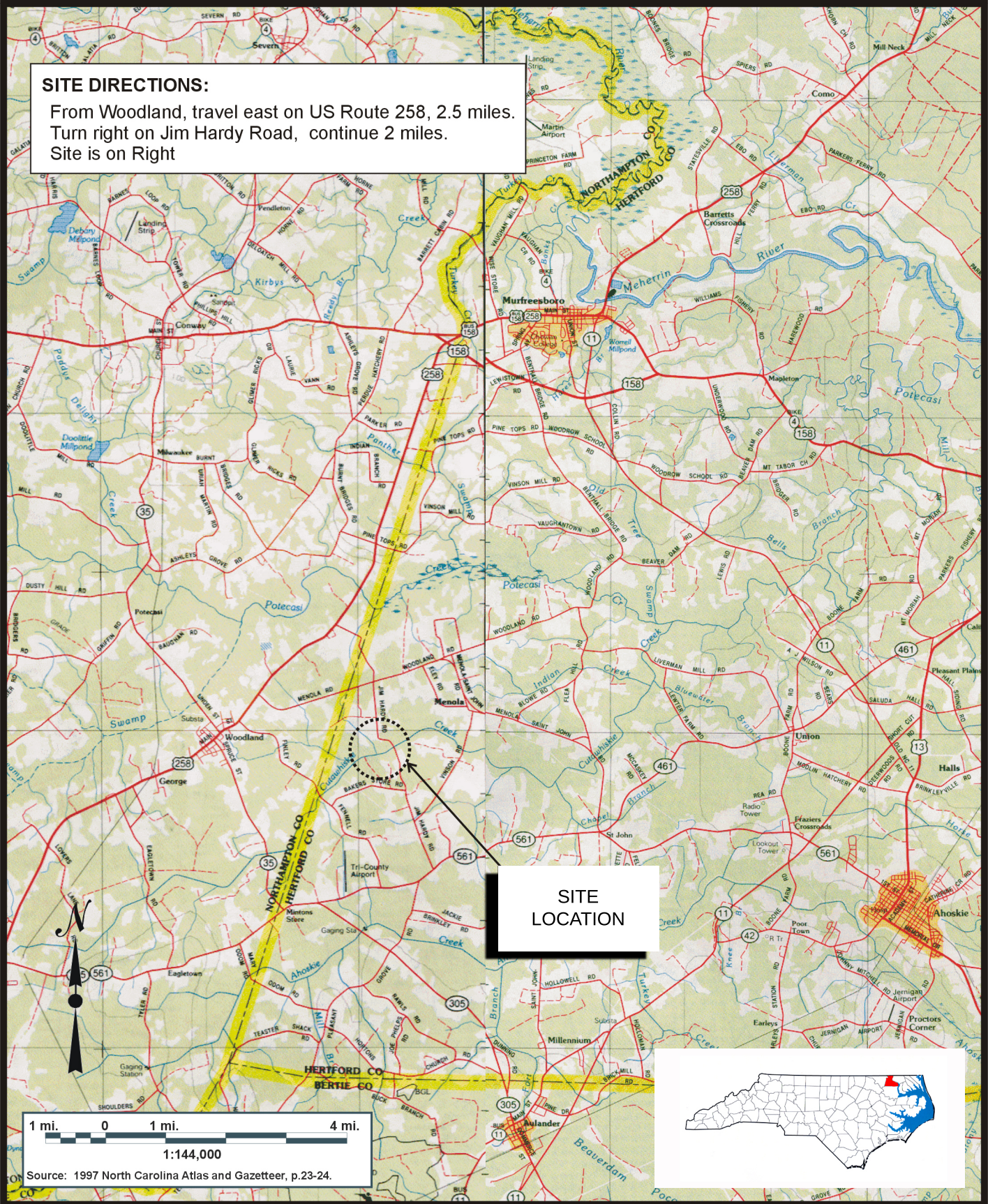
APPENDICES

APPENDIX A

Figures



Ecosystem Enhancement Program

Ecoscience Corporation

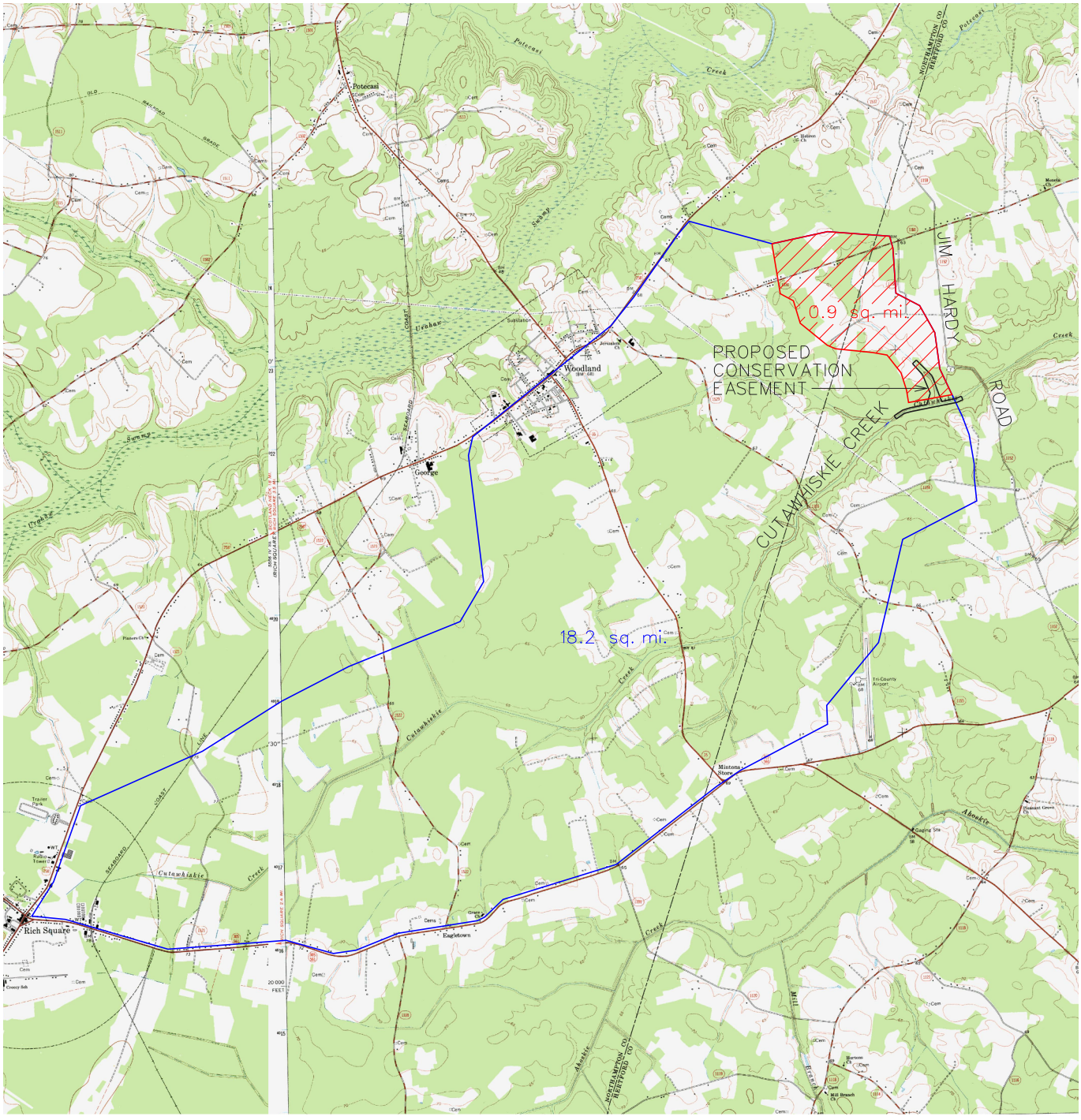
Project:

SITE LOCATION

CUTAWHISKIE CREEK
STREAM AND WETLAND RESTORATION SITE
Hertford County, North Carolina

Dwn. by:	GWN
Ckd by:	JWG
Date:	OCT 2006
Project:	03-306

FIGURE 1



6000 0 6000

SCALE IN FEET

N

UT to CUTAWHISKIE CREEK DRAINAGE AREA

CUTAWHISKIE CREEK DRAINAGE AREA

EcoScience Corporation

Project:

LOCAL TOPOGRAHPY AND DRAINAGE AREA

Cutawhiskie Creek
Stream and Wetland Restoration Site
Hertford County, North Carolina

Dwn By:	Ckd By:
GWN	JWG

Date: JAN 2007

Scale: AS SHOWN

ESC Project No.: 06-306

FIGURE

2

Ecoscience Corporation

Project:

AERIAL PHOTOGRAPH
Cutawhiskie Creek
Stream and Wetland Restoration Site
Hertford County, North Carolina

Dwn By:	Ckd By:
GWN	JWG

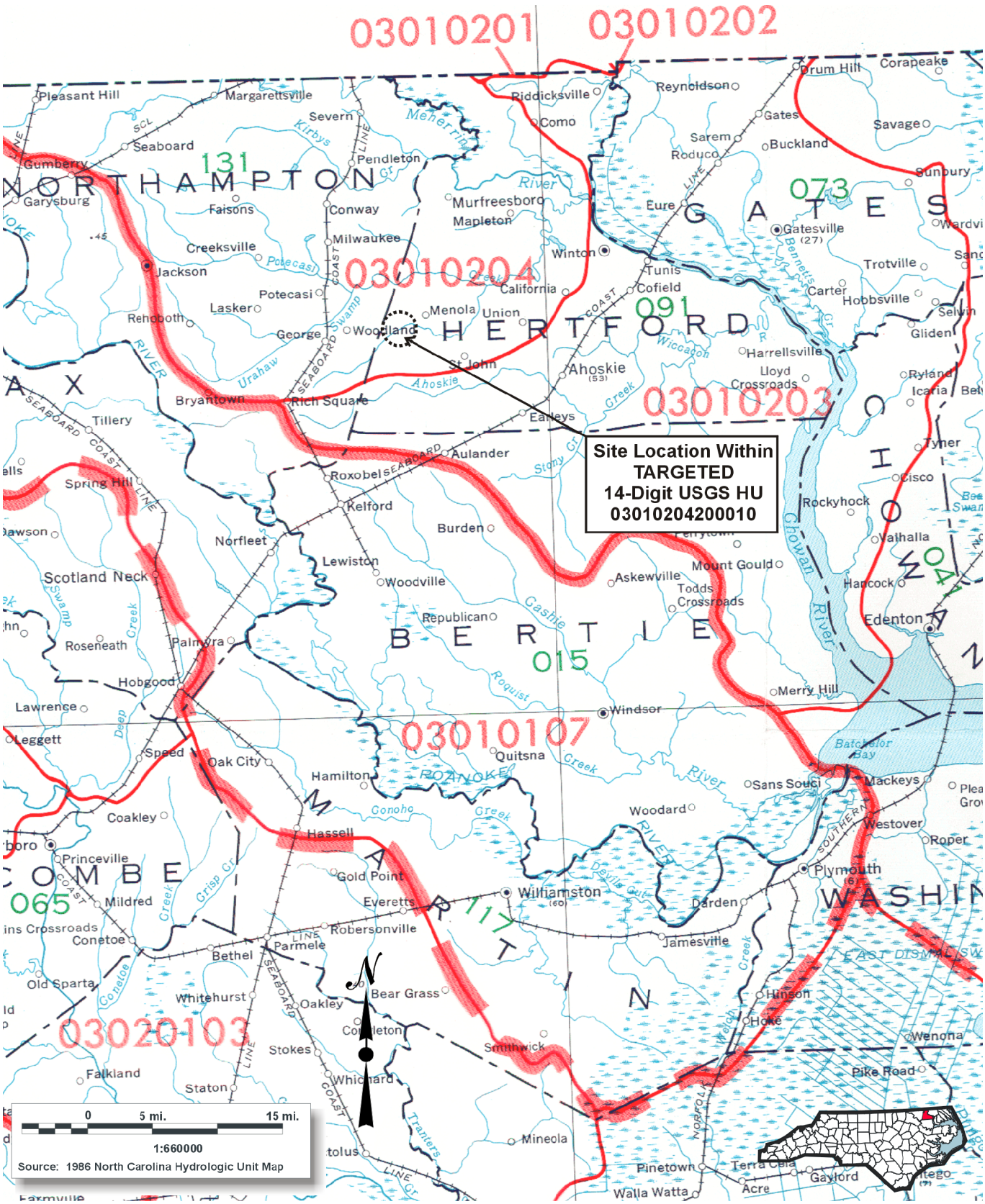
Date: JAN 2007

Scale: 1"=500'

ESC Project No.: 06-306

FIGURE

3



EcoScience Corporation

USGS HYDROLOGIC UNIT MAP
Cutawhiskie Creek
Stream and Wetland Restoration Site
Hertford County, North Carolina

Dwn By:	Ckd By:	FIGURE
GWN	JWG	
Date: JAN 2007		
Scale: AS SHOWN		4
ESC Project No.: 06-306		

EcoScience Corporation
Raleigh, North Carolina

REVISIONS

Client:
RESTORATION SYSTEMS, LLC

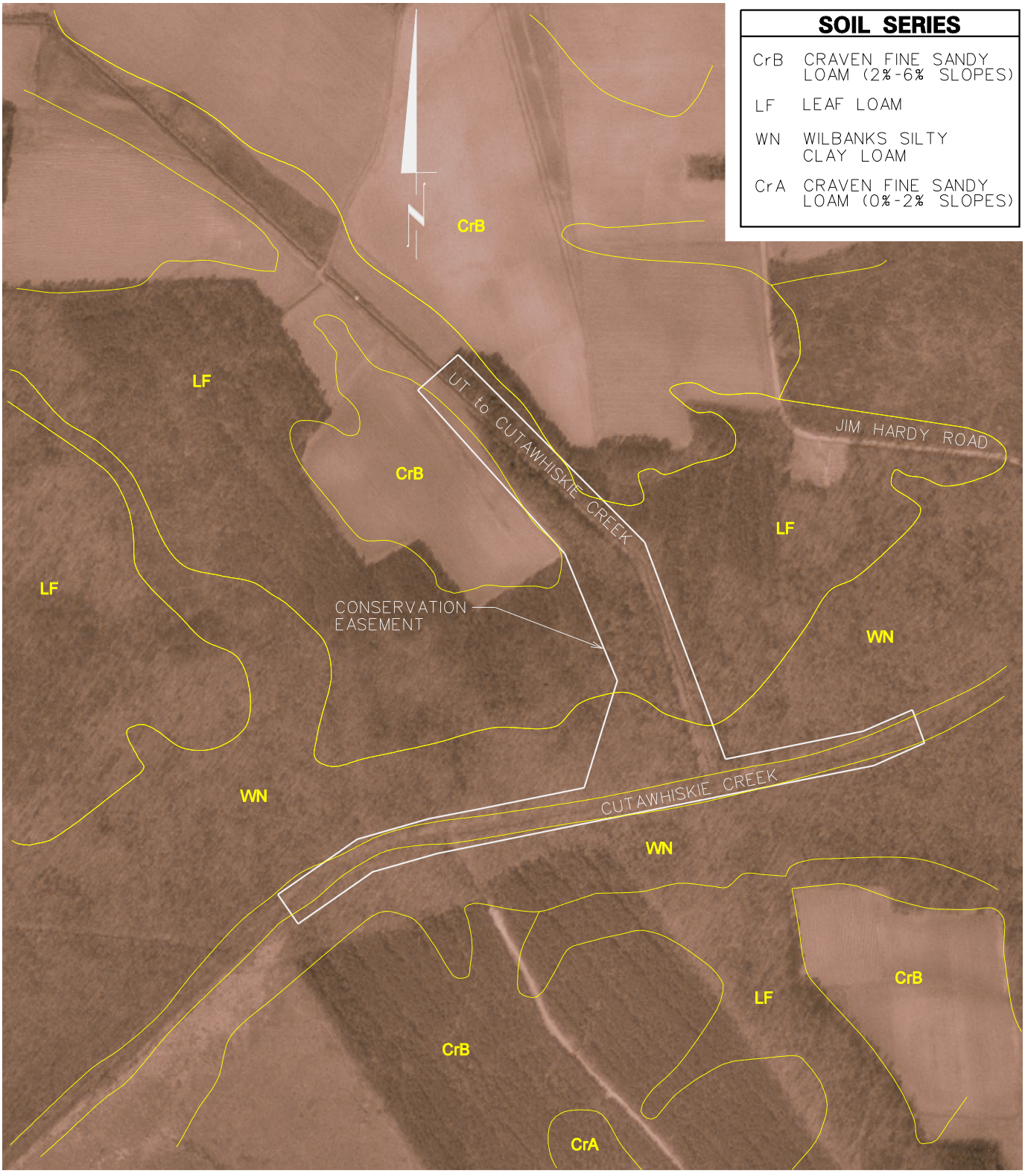
Project:
CUTAWHISKIE CREEK STREAM AND WETLAND RESTORATION SITE
HERTFORD COUNTY, NORTH CAROLINA

Title:
PHYSIOGRAPHY, TOPOGRAPHY, AND LAND USE

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1"=300'

ESC Project No.: 06-306

FIGURE
5



Source: 1984 USDA-SCS Soil Survey, Hertford Co., NC

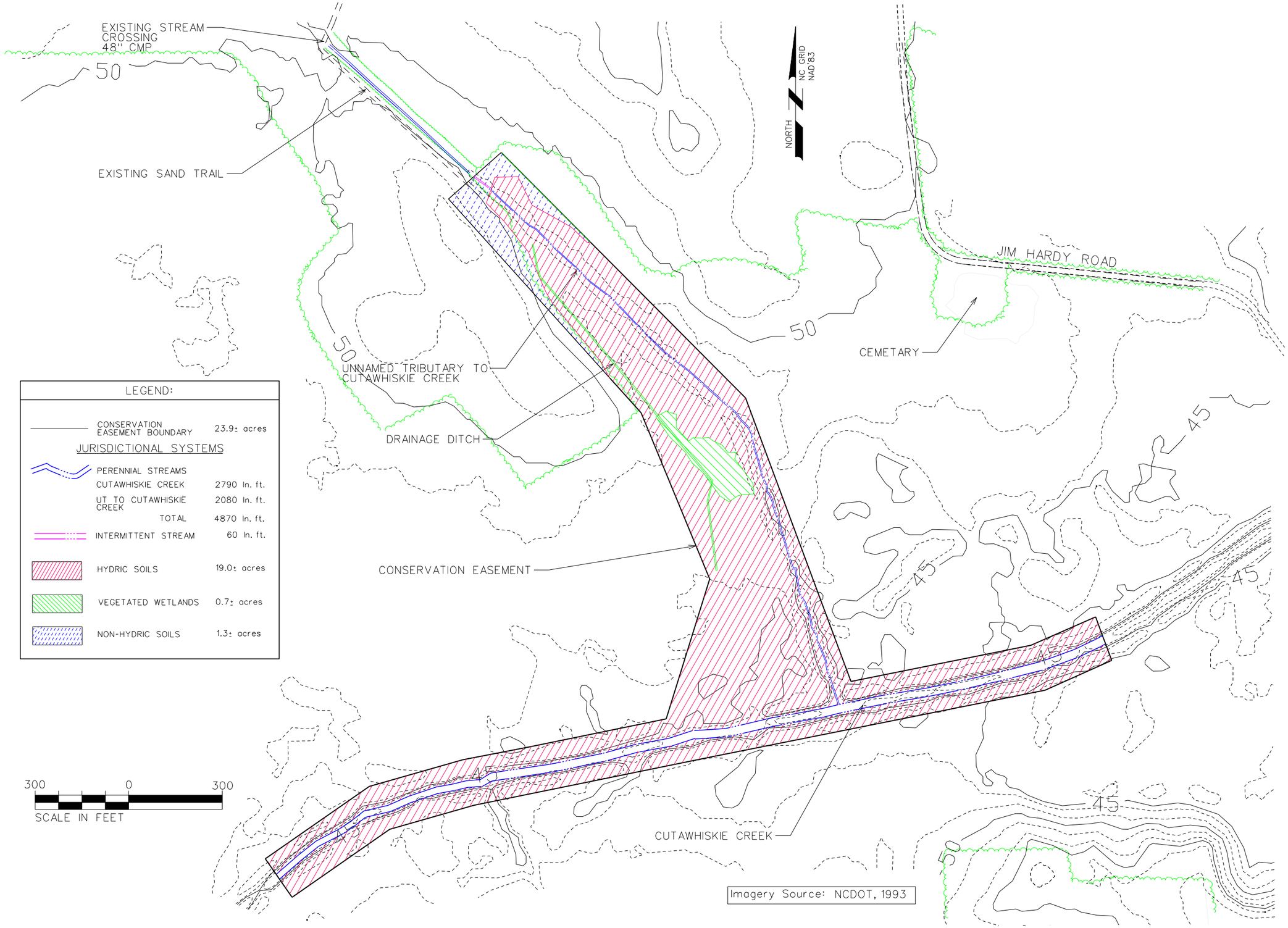
600 0 600
SCALE IN FEET

EcoScience Corporation

NRCS SOIL UNITS
Cutawhiskie Creek
Stream and Wetland Restoration Site
Hertford County, North Carolina

Dwn By:	Ckd By:
GWN	JWG
Date:	JAN 2007
Scale:	1"=600'
ESC Project No.:	06-306

FIGURE 6



EcoScience Corporation
Raleigh, North Carolina

REVISIONS

Client: RESTORATION SYSTEMS, LLC

Project:

CUTAWHISKIE CREEK STREAM AND WETLAND RESTORATION SITE

HERTFORD COUNTY, NORTH CAROLINA

Title:

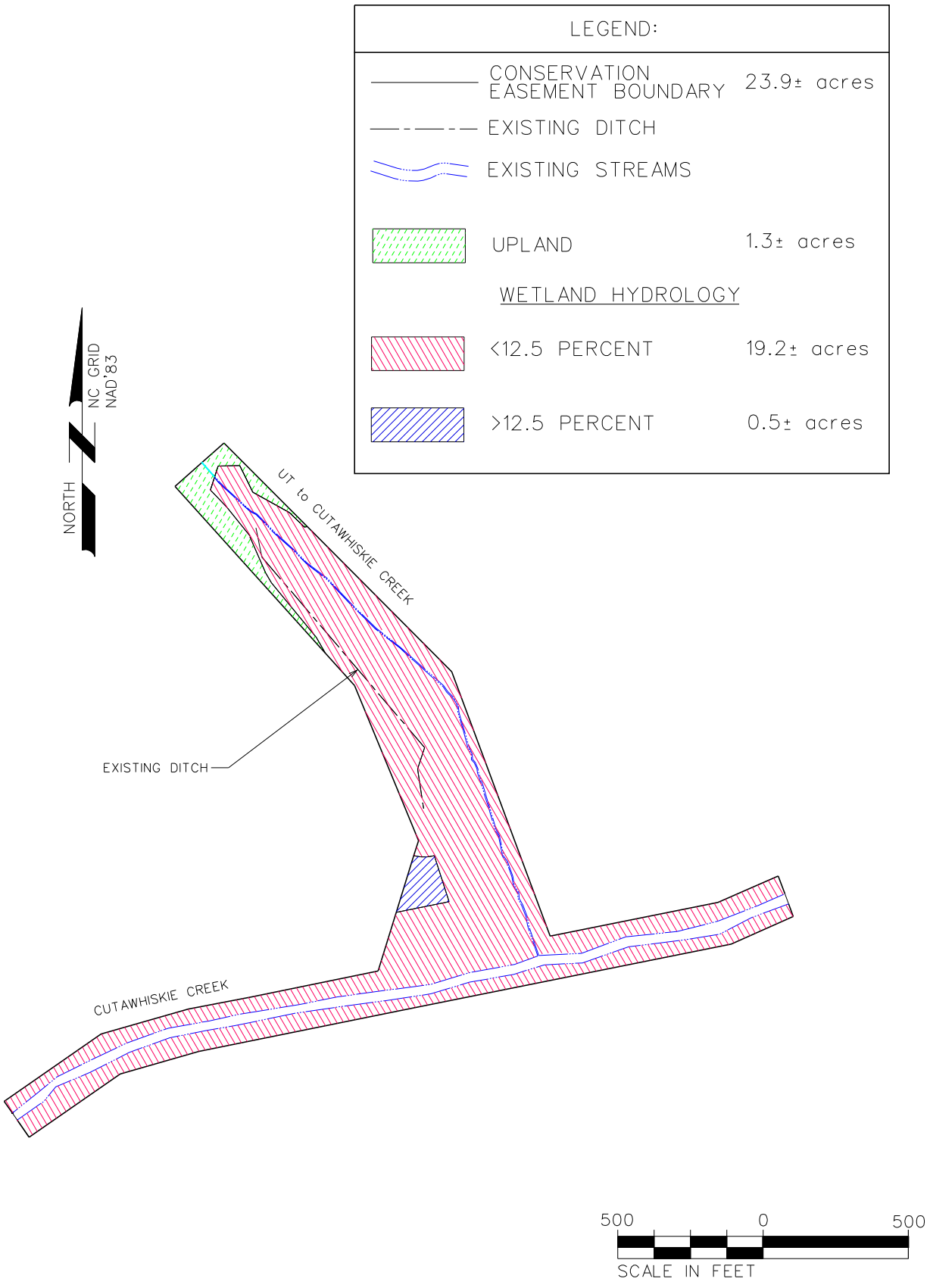
JURISDICTIOINAL MAPPING/ HYDRIC SOILS

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1"=300'

ESC Project No.: 06-306

FIGURE

7



EcoScience Corporation

Pre–Restoration DRAINMOD Results
Cutawhiskie Creek
Stream and Wetland Restoration Site
Hertford County, North Carolina

Dwn By:	Ckd By:
GWN	JWG
Date:	JAN 2007
Scale:	1"=500'
ESC Project No.:	06-306

FIGURE

8

LEGEND:

CONSERVATION EASEMENT BOUNDARY 23.9± acres

RESTORED STREAM

OVERLAND FLOW

EXISTING STREAM

UPLAND 1.3± acres

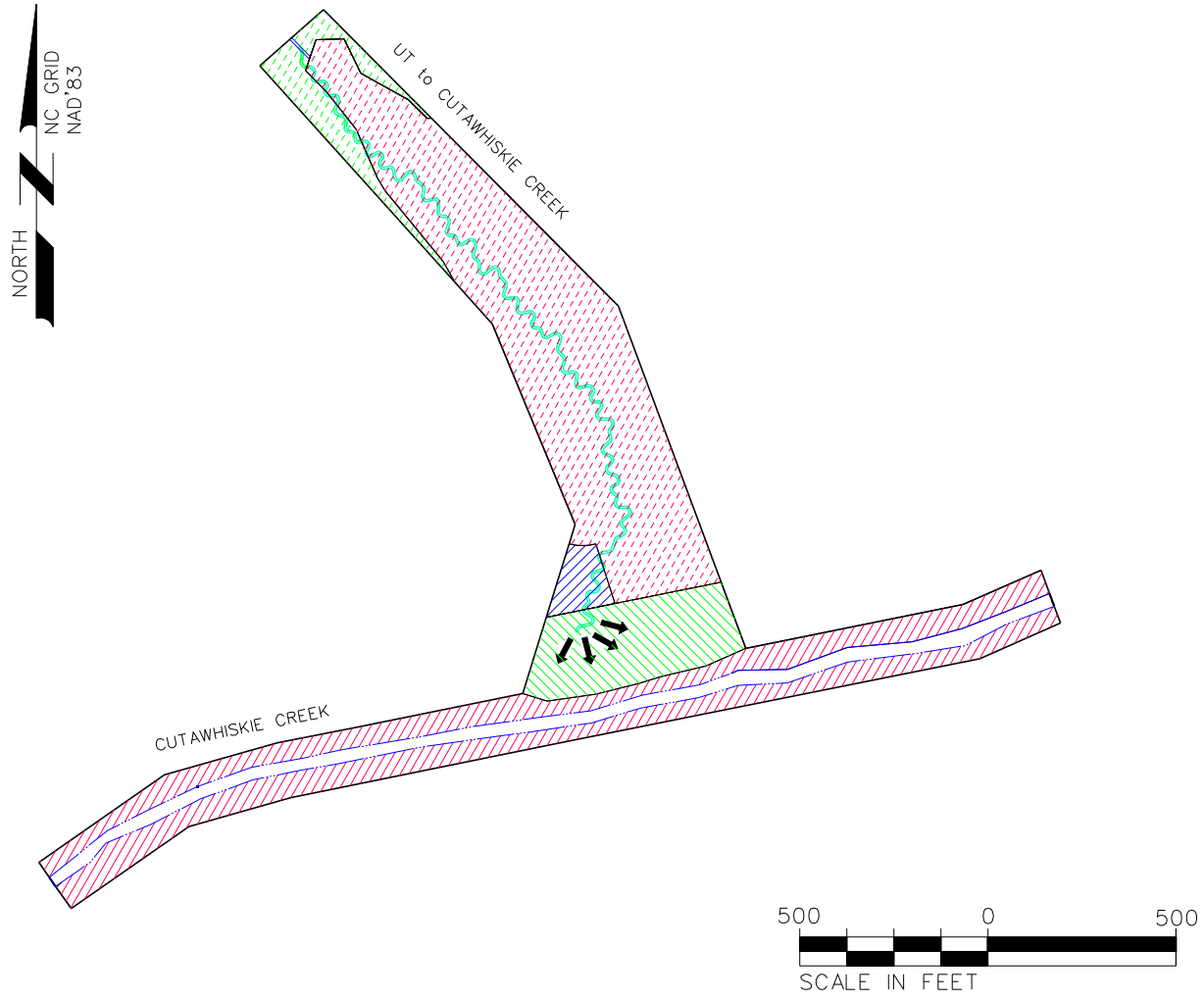
WETLAND HYDROLOGY

<12.5 PERCENT 7.0± acres

>12.5 PERCENT 0.5± acres

>12.5 PERCENT 10.2± acres
(provided by backfilling on-site ditches)

>12.5 PERCENT 2.7± acres
(provided by overland flow from restored channel)



EcoScience Corporation

Post Restoration DRAINMOD Results
Cutawhiskie Creek
Stream and Wetland Retoration Site

Hertford County, North Carolina

Dwn By:	Ckd By:
GWN	JWG

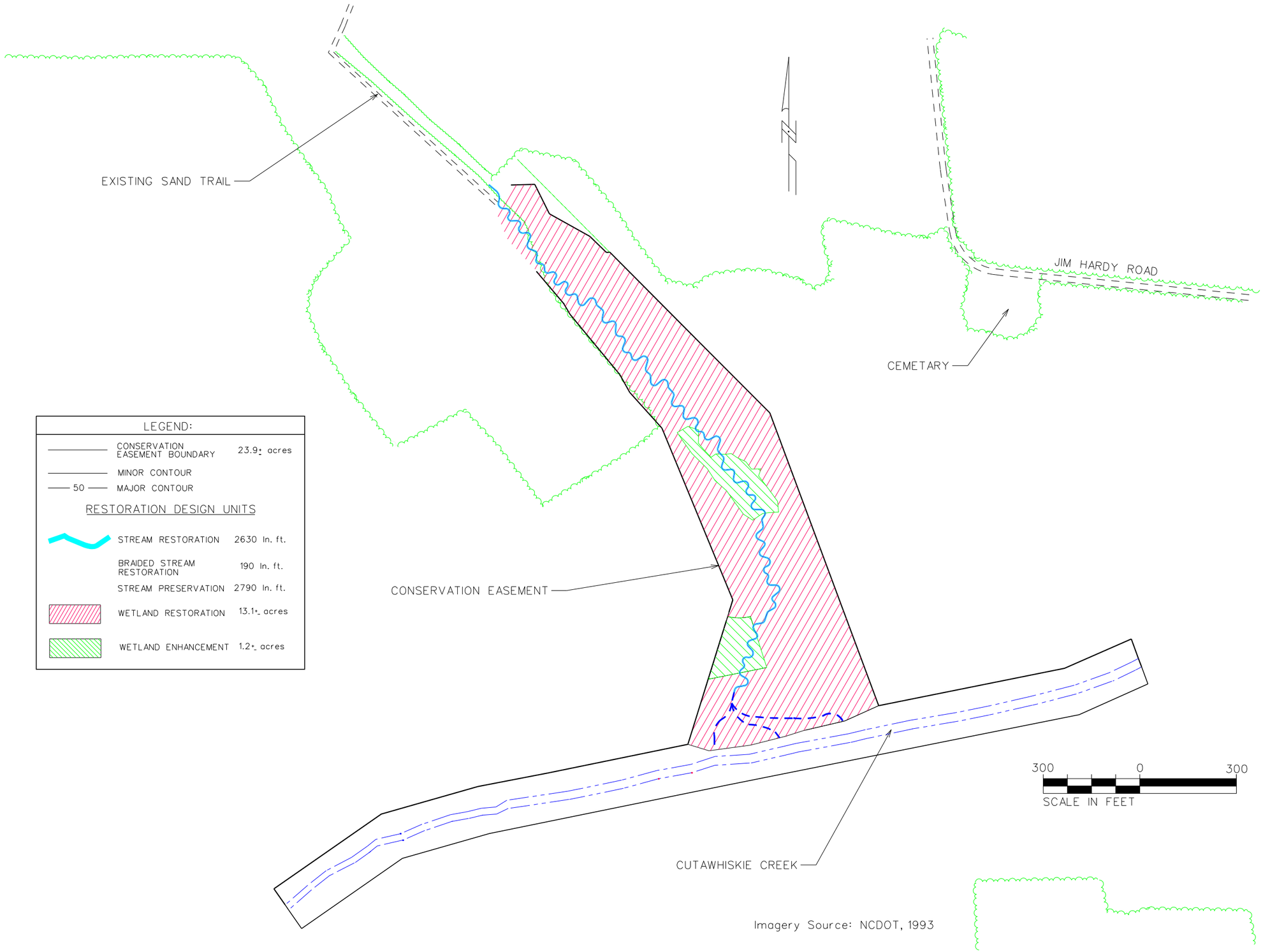
Date: JAN 2007

Scale: 1"=500'

ESC Project No.: 06-306

FIGURE

9



EcoScience Corporation
Raleigh, North Carolina

REVISIONS

Client:

Project:

CUTAWHISKIE CREEK STREAM AND WETLAND RESTORATION SITE

HERTFORD COUNTY, NORTH CAROLINA

Title:

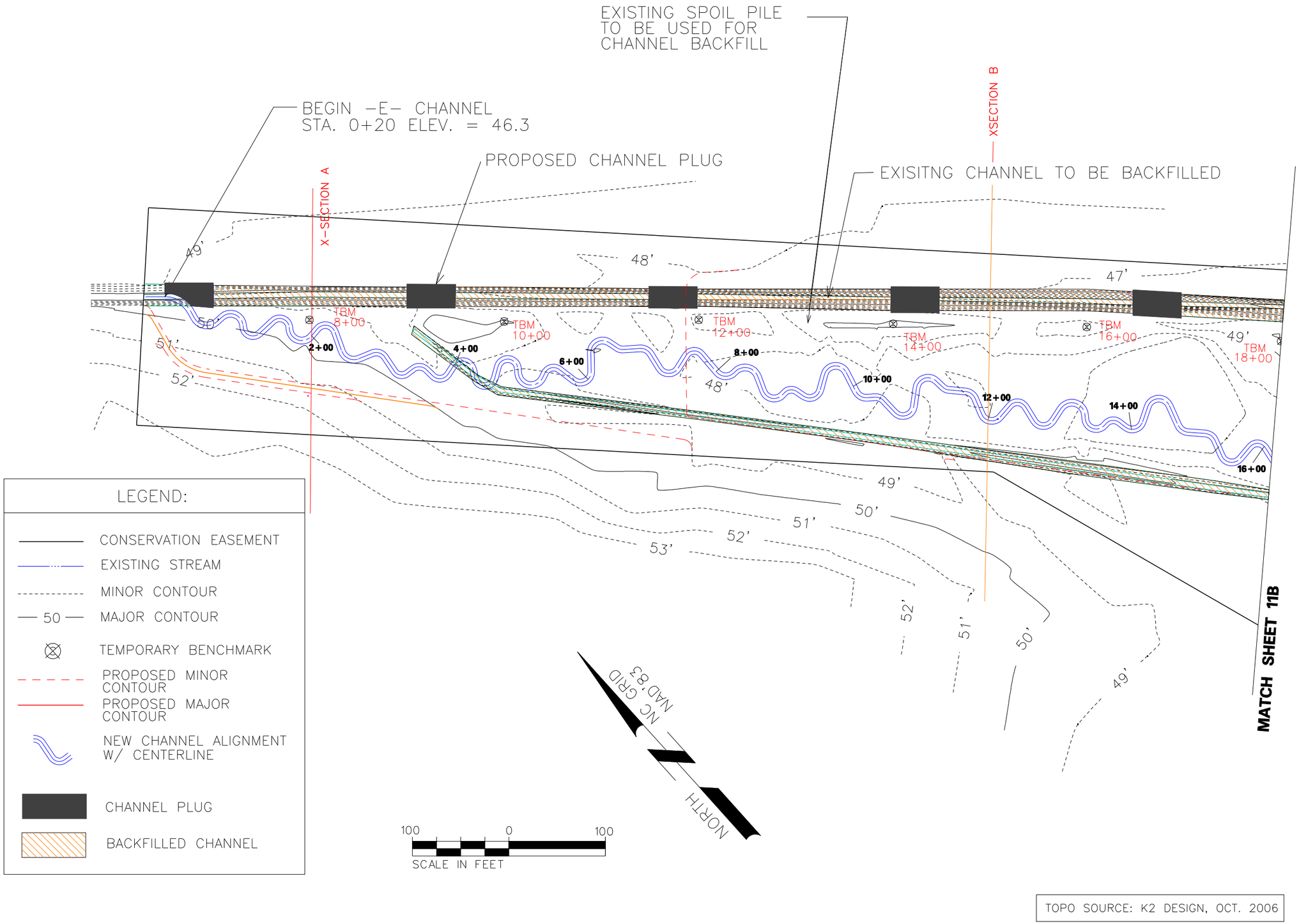
RESTORATION DESIGN UNITS

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1"=300'

ESC Project No.: 06-306

FIGURE

10



LEGEND:

- CONSERVATION EASEMENT
- EXISTING STREAM
- MINOR CONTOUR
- 50 — MAJOR CONTOUR
- TEMPORARY BENCHMARK
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- NEW CHANNEL ALIGNMENT W/ CENTERLINE
- CHANNEL PLUG
- BACKFILLED CHANNEL

TOPO SOURCE: K2 DESIGN, OCT. 2006

EcoScience Corporation
Raleigh, North Carolina

REVISIONS

Client: RESTORATION SYSTEMS, LLC

Project:

CUTAWHISKIE CREEK STREAM AND WETLAND RESTORATION SITE

HERTFORD COUNTY, NORTH CAROLINA

Title:

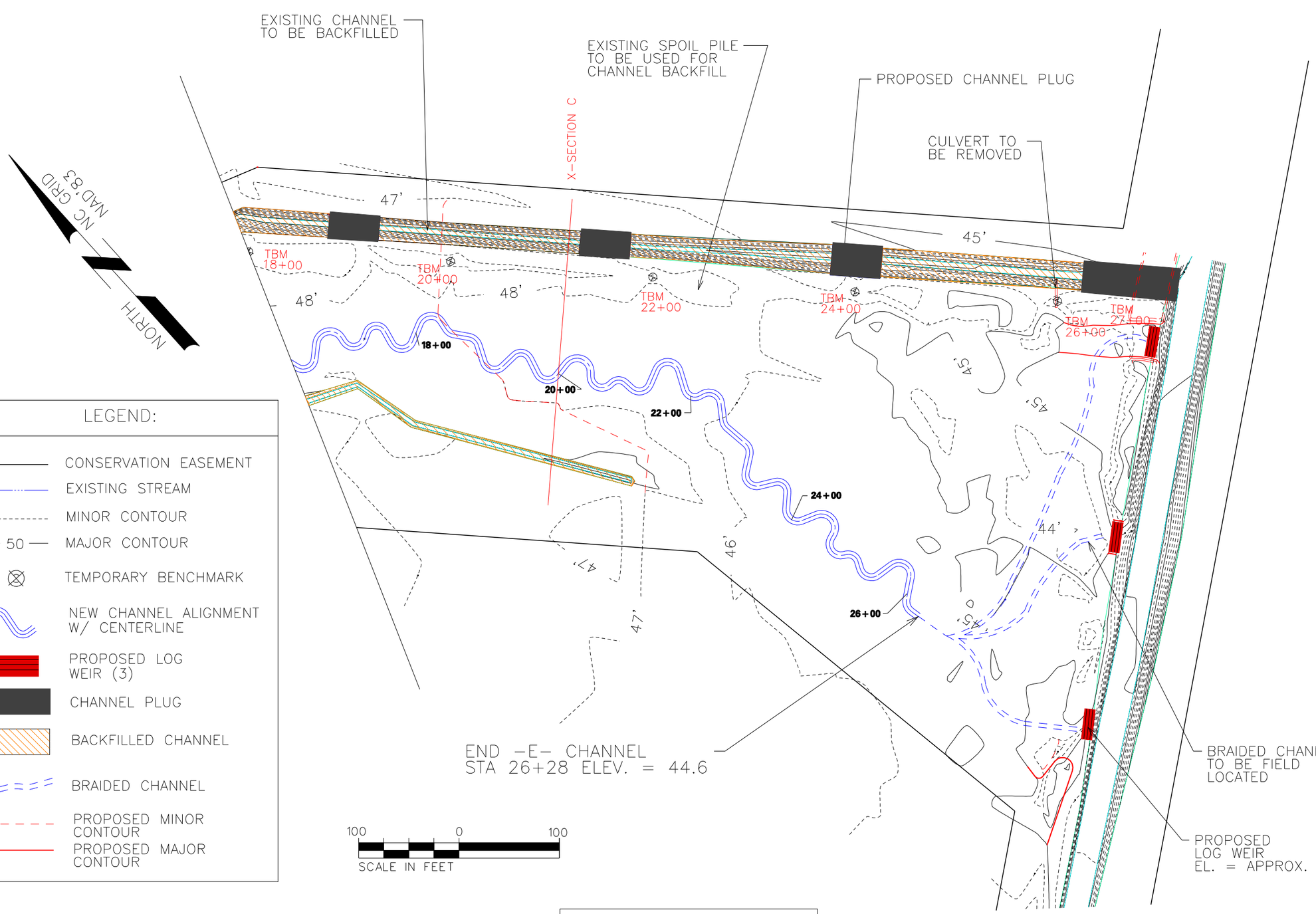
STREAM & WETLAND RESTORATION PLAN

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1" = 100'

ESC Project No.: 06-306

FIGURE

11A



LEGEND:

- CONSERVATION EASEMENT
- EXISTING STREAM
- MINOR CONTOUR
- 50 MAJOR CONTOUR
- TEMPORARY BENCHMARK
- NEW CHANNEL ALIGNMENT W/ CENTERLINE
- PROPOSED LOG WEIR (3)
- CHANNEL PLUG
- BACKFILLED CHANNEL
- BRAIDED CHANNEL
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR

TOPO SOURCE: K2 DESIGN, OCT. 2006

EcoScience Corporation
Raleigh, North Carolina

REVISIONS

Client: RESTORATION SYSTEMS, LLC

Project:

CUTAWHISKIE CREEK STREAM AND WETLAND RESTORATION SITE

HERTFORD COUNTY, NORTH CAROLINA

Title:

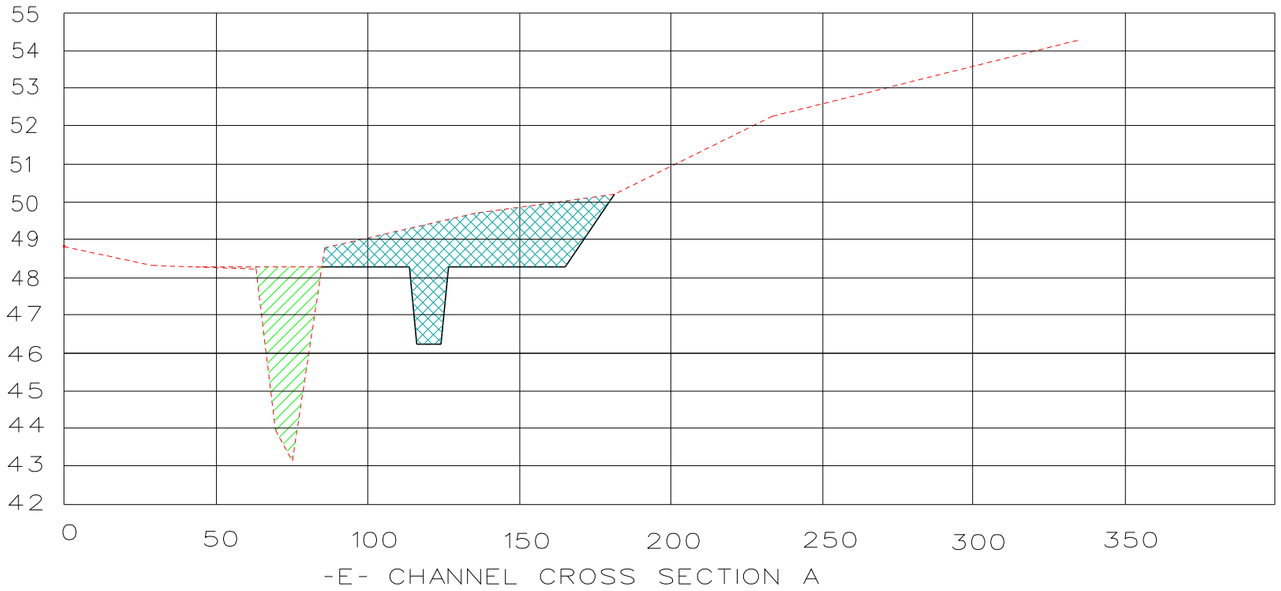
STREAM & WETLAND RESTORATION PLAN

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1"=100'

ESC Project No.: 06-306

FIGURE

11B



-E- CHANNEL CROSS SECTION A

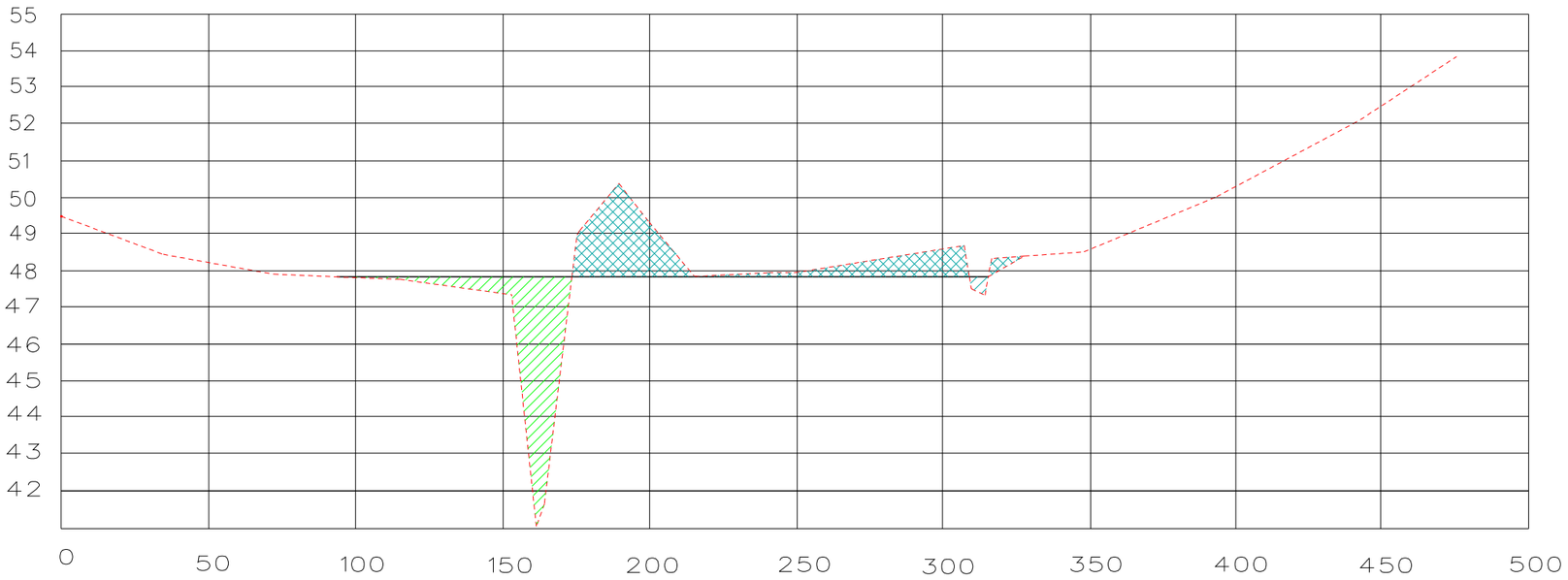
LEGEND :

PROPOSED GRADE

EXISTING GROUND

PROPOSED CUT

PROPOSED FILL



-E- CHANNEL CROSS SECTION B

EcoScience Corporation
Raleigh, North Carolina

REVISIONS

Client:

RESTORATION SYSTEMS, LLC

Project:

CUTAWHISKIE CREEK STREAM AND WETLAND RESTORATION SITE

HERTFORD COUNTY, NORTH CAROLINA

Title:

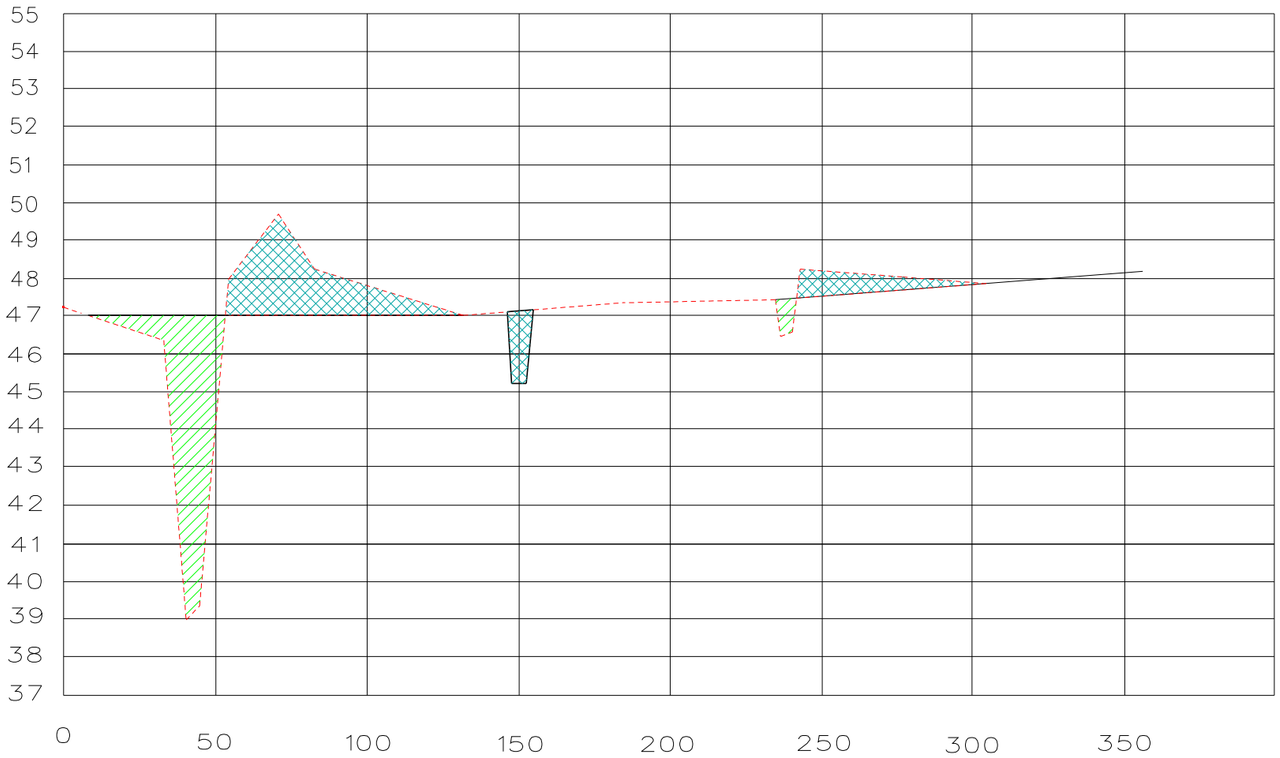
EXISTING AND PROPOSED STREAM CROSS-SECTIONS

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	AS SHOWN

ESC Project No.: 06-306

FIGURE

12A



-E- CHANNEL CROSS SECTION C

LEGEND :

PROPOSED GRADE

EXISTING GROUND

PROPOSED CUT

PROPOSED FILL

EcoScience Corporation

Raleigh, North Carolina

REVISIONS

Client:

RESTORATION SYSTEMS, LLC

Project:

CUTAWHISKIE CREEK STREAM AND WETLAND RESTORATION SITE

HERTFORD COUNTY, NORTH CAROLINA

Title:

STREAM RESTORATION PLAN

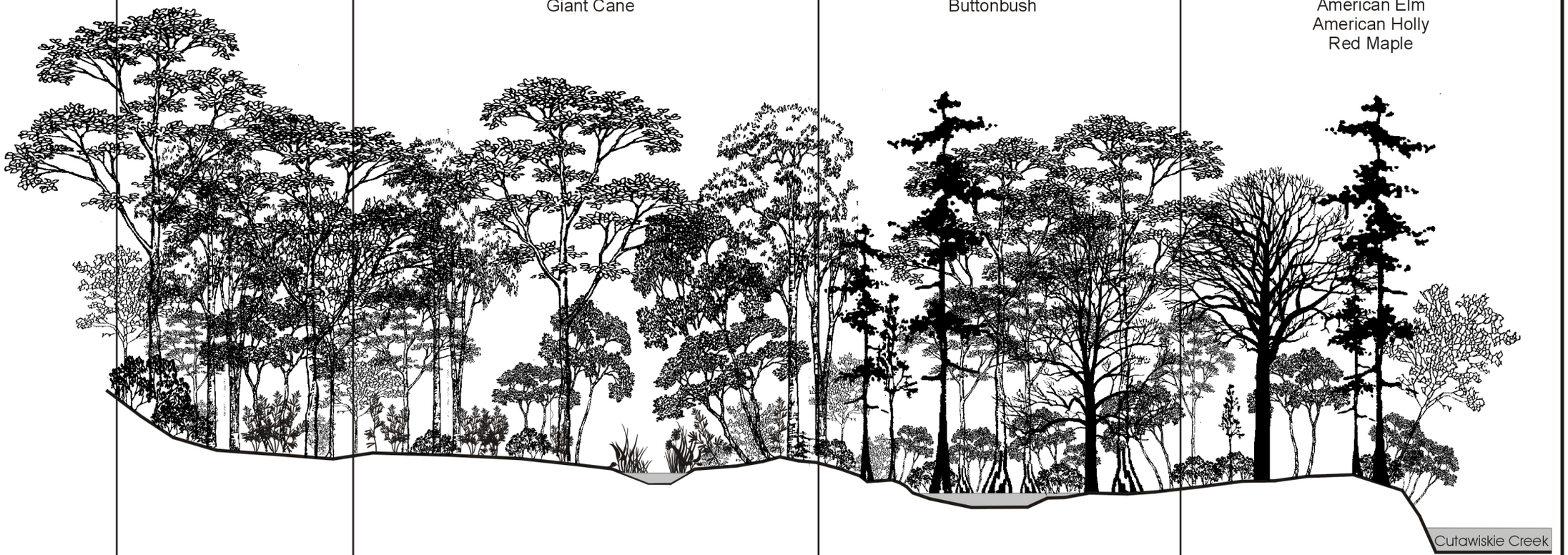
Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	AS SHOWN

ESC Project No.: 06-306

FIGURE

12B

COMMUNITY ASSEMBLAGE (Shafale and Weakley, 1990)	Mesic Mixed Hardwood Forest	Coastal Plain Small Stream Swamp	Cypress-Gum Swamp (Relict Slough and Backwater Variants)	Coastal Plain Levee Forest
DIAGNOSTIC VEGETATION	Southern Sugar Maple White Oak Southern Red Oak American Beech Northern Red Oak Pignut Hickory Black Gum	Bald Cypress Swamp Tupelo Overcup Oak Swamp Chestnut Oak Sweetbay Magnolia Green Ash American Elm Giant Cane	Bald Cypress Pond Cypress Swamp Tupelo Overcup Oak Green Ash Sweetbay Magnolia Ti-ti Buttonbush	Bald Cypress Swamp Tupelo Overcup Oak Laurel Oak River Birch Willow Oak Ironwood American Elm American Holly Red Maple
LANDSCAPE POSITION	Upland Slope	Headwater Stream/Secondary Floodplain	Primary Floodplain Bottom	Levee and Stream Bank
SOILS	Craven fine sandy laom (CrB) Moderately Well Drained	Leaf loam (LF) Poorly Drained	Wilbanks silty clay loam (WN) Very Poorly Drained	

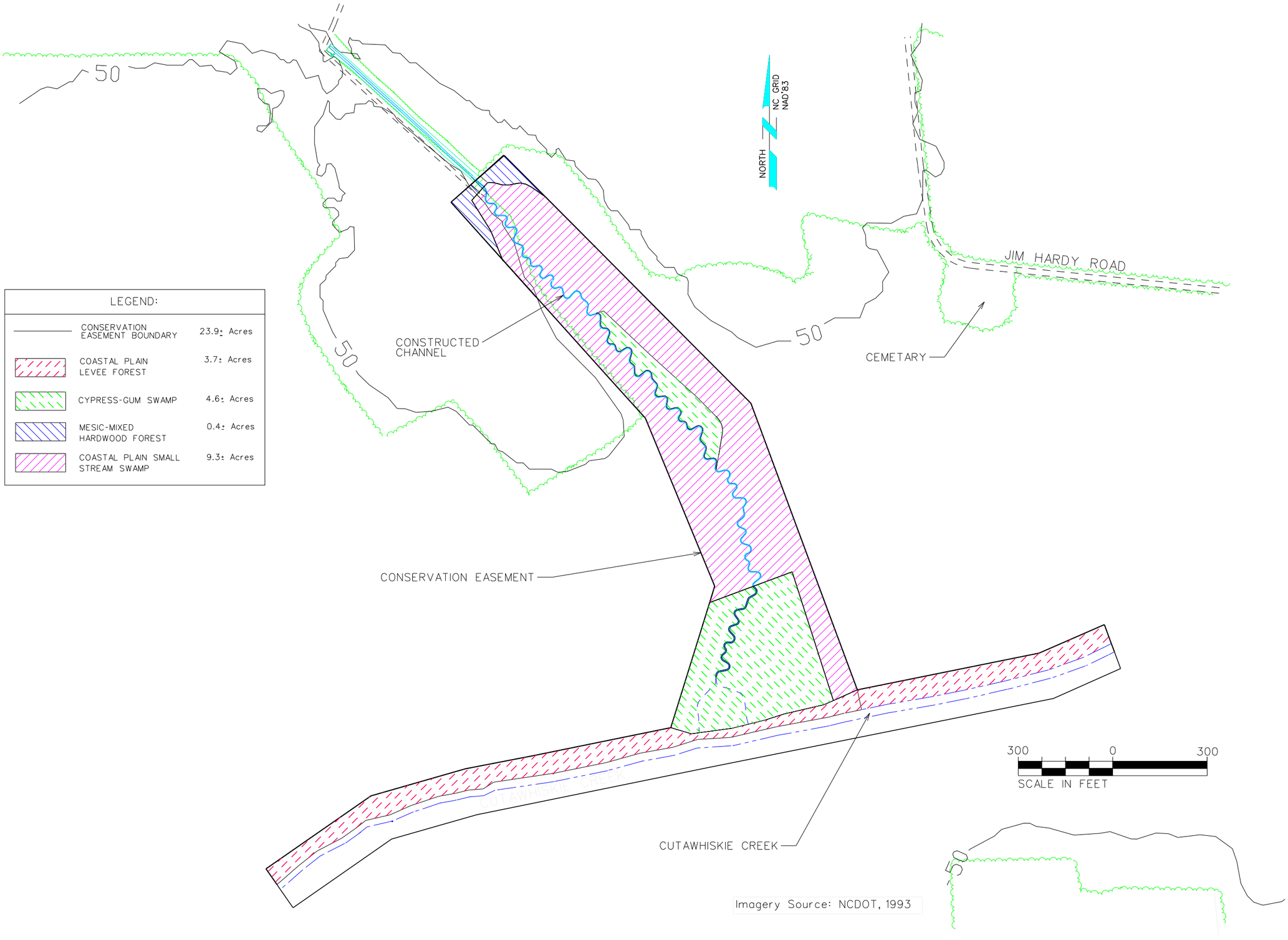


Restoration Systems, LLC
1101 Haynes Street., Suite 107
Raleigh, North Carolina 27604
919 755-9490

TARGET PLANT COMMUNITIES
CUTAWHISKIE CREEK RESTORATION SITE
HERTFORD COUNTY, NORTH CAROLINA

EcoScience Corporation
1101 Haynes Street., Suite 100
Raleigh, North Carolina 27604
919 828-3433

Figure:	13
Project:	06-306
Date:	JAN 2007



EcoScience Corporation
Raleigh, North Carolina

REVISIONS

Client:
RESTORATION SYSTEMS, LLC

Project:

CUTAWHISKIE CREEK STREAM AND WETLAND RESTORATION SITE

HERTFORD COUNTY, NORTH CAROLINA

Title:

PLANTING PLAN

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1"=300'

ESC Project No.: 06-306

FIGURE

14

APPENDIX B

Tables

Table 1. Existing and Proposed Stream Geometry and Classification for the UT to Cutawhiskie Creek.

ATTRIBUTE	EXISTING CONDITIONS UT to Cutawhiskie Creek	PROPOSED CONDITIONS UT to Cutawhiskie Creek
Drainage Area (sq. mi.)	0.9	0.9
DIMENSION		
Bankfull Area (A_{bkf}) [sq. ft.]	9.0	9.0
Ditch Area (A_{ditch}) [sq. ft.]	64-137	NA
Bankfull Width (W_{bkf}) [ft.]	9.1 (8.4-9.6)	7
Bankfull Mean Depth (D_{bkf}) [ft.]	1.0 (0.9-1.1)	1.3
Width/Depth Ratio (W_{bkf}/D_{bkf})	9.1	5.4
Bankfull Maximum Depth (D_{mbkf}) [ft.]	1.6 (1.5-1.7)	1.8
Pool Width (W_{pool}) [ft.]	NA	8.4
Pool Width Ratio (W_{pool}/W_{bkf})	NA	1.2
Maximum Pool Depth (D_{pmax}) [ft.]	NA	2.8
Pool Depth Ratio (D_{pmax}/D_{bkf})	NA	2.2
Floodprone Area (W_{FPA}) [ft.]	12-13	125+
Entrenchment Ratio (W_{FPA}/W_{bkf})	1.4	>18
Bank Height Ratio	3.4–5.0	1.0
PATTERN		
Meander Belt Width (W_{belt}) [ft.]		40 (30-50)
Belt Width Ratio (W_{belt}/W_{bkf})	No Distinct Riffles and Pools	5.7 (4.3-7.1)
Meander Length (L_M) [ft.]	or Repetitive Channel	50 (40-60)
Meander Length Ratio (L_M/W_{bkf})	Pattern due to Channel	7.9 (5.7-10)
Radius of Curvature (R_C) [ft.]	Dredging and Straightening	19 (14–24)
Radius of Curvature Ratio (R_C/W_{bkf})		2.7 (2.0-3.4)
Channel Sinuosity (SIN)	1.0	1.5
PROFILE		
Average Water Surface Slope (S_{ws}) [ft./ft/]	0.0031	0.0008
Valley Slope (S_{valley}) [ft./ft/]	0.0021	0.0013
Pool Length (L_{pool}) [ft.]	NA	25 (20-30)
Pool to Pool Spacing (L_{p-p}) [ft.]	NA	35 (25-45)
SUBSTRATE	Sand	Sand
STREAM TYPE	**G5**	**E5**

Table 2. Reference Stream Geometry and Classification.

ATTRIBUTE	Black Branch, Craven County	Bullard Branch, Duplin County	UT to Town Creek, Brunswick County
Drainage Area (square miles)	1.2	1.3	0.6
DIMENSION			
Bankfull Area (A_{bkf}) [sq. ft.]	11.5	10.	9.0
Bankfull Width (W_{bkf}) [ft.]	9.8	9.2	7.2
Bankfull Mean Depth (D_{bkf}) [ft.]	1.2	1.1	1.3
Width/Depth Ratio (W_{bkf}/D_{bkf})	8.2	8.4	5.5
Bankfull Maximum Depth (D_{mbkf}) [ft.]	1.8	1.5	1.9
Pool Width (W_{pool}) [ft.]	12.0	13	11.5
Pool Width Ratio (W_{pool}/W_{bkf})	1.2	1.3	1.4
Maximum Pool Depth (D_{pmax}) [ft.]	2.3	2.1	2.5
Pool Depth Ratio (D_{pmax}/D_{bkf})	1.9	1.9	2.3
Floodprone Area (W_{FPA}) [ft.]	225	200	175
Entrenchment Ratio (W_{FPA}/W_{bkf})	23.1	20.3	20.9
PATTERN			
Meander Belt Width (W_{belt}) [ft.]	53.2 (31-113)	30.5 (12-45)	31.3 (15-60)
Belt Width Ratio (W_{belt}/W_{bkf}) [ft.]	5.5 (2.5-14.0)	3.1 (1.1-4.9)	3.7 (1.1-8.6)
Meander Length (L_M) [ft.]	118 (65-175)	66.4 (54-79)	42.7 (28-63)
Meander Length Ratio (L_M/W_{bkf})	11.7 (5.3-21.6)	6.5 (4.8-8.6)	6.0 (2.1-10.3)
Radius of Curvature (R_C) [ft.]	29.2 (18-58)	19.1 (14-27)	9.8 (7-13)
Radius of Curvature Ratio (R_C/W_{bkf})	3.1 (1.5-7.1)	1.9 (1.3-2.9)	1.2 (0.5-1.9)
Channel Sinuosity (SIN)	1.6	1.4	2.2
PROFILE			
Average Water Surface Slope (S_{ws}) [ft./ft/]	0.0023	0.0013	0.0036
Valley Slope (S_{valley}) [ft./ft/]	0.0037	0.0018	0.0080
Pool Length (L_{pool}) [ft.]	34.6 (5-84)	33 (22-44)	22 (15-30)
Pool to Pool Spacing (L_{p-p}) [ft.]	58.9 (20-102)	48 (35-66)	51 (19-113)
SUBSTRATE	Sand	Sand	Sand
STREAM TYPE	**E5**	**E5**	**E5**

Table 3. Groundwater Model Results: Zone of Wetland Degradation and Wetland Loss.

Depth (feet)	Soil Type	Zone of Influence (feet) 5 percent of growing season		
		Skaggs Method	DRAINMOD	Boussinesq
3	Leaf silt loam	187	0	256
6	Leaf silt loam	246	0	357
8	Leaf silt loam	NA	0	371
9	Leaf silt loam	NA	0	384
9	Cape Fear loam	NA	0	482

Depth (feet)	Soil Type	Zone of Influence (feet) 12.5 percent of growing season		
		Skaggs Method	DRAINMOD	Boussinesq
3	Leaf silt loam	NA	154	394
6	Leaf silt loam	NA	223	538
8	Leaf silt loam	NA	230	567
9	Leaf silt loam	NA	233	587
9	Cape Fear loam	NA	262	738

Table 4: Stream and Wetland Design Units.

Restoration Design Component	Mitigation Type	Approach	Stationing	Design Units	Proposed Credit Ratio	Available Mitigation Units	Comment
UT to Cutawhiskie Creek Upper Reach	Restoration	Priority 2	0+00 – 26+28	2630 LF	1:1	2630	Constructed channel on new location.
UT to Cutawhiskie Creek Lower Reach	Restoration	Priority 1	--	190 LF	1:1	190	Average straight line distance through braided section to Site outfall
Cutawhiskie Creek	Preservation	--	--	2790 LF	5:1	558	Includes a 50-foot buffer
Riparian Wetland	Restoration	--		13.1 AC	1:1	13.1	Backfilling existing stream channel and on-site ditches. Site planting
Riparian Wetland	Enhancement	--	--	1.2 AC	2:1	0.6	Existing wetlands will be planted and hydrologically reconnected to Site stream.

Table 5. Planting Plan

PLANT COMMUNITY ASSOCIATION (Schafale and Weakley, 1990)		Coastal Plain Small Stream Swamp	Coastal Plain Levee Forest	Cypress-Gum Swamp	Mesic Mixed Hardwood Forest	TOTAL STEMS PLANTED
Area (acres)		9.3	3.7	4.6	0.4	18.0
Stem Target (per acre)		1000	1000	1000	1000	--
SPECIES		**# planted (% total)**	**# planted (% total)**	**# planted (% total)**	**# planted (% total)**	--
Common Name	**Scientific Name**					
Swamp Chestnut Oak	*Quercus michauxii*	1395 (15)	--	--	--	1395
Red Bay	*Persea borbonia*	465 (5)	--	--	--	465
Green Ash	*Fraxinus pennsylvanica*	465 (5)	--	--	--	465
Sweetbay Magnolia	*Magnolia virginiana*	465 (5)	--	--	--	465
River Birch	*Betula nigra*	465 (5)	370 (10)	--	--	589
American Elm	*Ulmus americana*	465 (5)	370 (10)	--	--	507
Bald Cypress	*Taxodium distichum*	1395 (15)	555 (15)	1840 (40)	--	3790
Swamp Tupelo	*Nyssa biflora*	1395 (15)	555 (15)	1840 (40)	--	3790
Overcup Oak	*Quercus lyrata*	1395 (15)	555 (15)	920 (20)	--	2870
Cherrybark Oak	*Quercus pagoda*	930 (10)	555 (15)	--	40 (10)	1525
Tulip Poplar	*Liriodendron tulipifera*	465 (5)	--	--	20 (5)	485
Willow Oak	*Quercus phellos*	--	740 (20)	--	--	740
American Beech	*Fagus grandifolia*	--	--	--	60 (15	60
Southern Red Oak	*Quercus falcate*	--	--	--	40 (10)	40
Southern Sugar Maple	*Acer floridanum*	--	--	--	40 (10)	40
Black Gum	*Nyssa sylvatica*	--	--	--	40 (10)	40
Mockernut Hickory	*Carya alba*	--	--	--	40 (10)	40
Northern Red Oak	*Quercus rubra*	--	--	--	40 (10)	40
Pignut Hickory	*Carya glabra*	--	--	--	40 (10)	40
White Oak	*Quercus alba*	--	--	--	40 (10)	40
TOTAL		9300	3700	4600	400	18,000

APPENDIX C

Categorical Exclusion Documentation

Appendix C

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

Note: Only Appendix A should to be submitted (along with any supporting documentation) as the environmental document.

Part 1: General Project Information	
Project Name:	Cutawhiskie Creek Restoration Site
County Name:	Hertford
EEP Number:	Contract # D06066-A
Project Sponsor:	Restoration Systems, LLC
Project Contact Name:	Jay St. Clair
Project Contact Address:	1101 Haynes Street, Suite 107, Raleigh, NC 27607
Project Contact E-mail:	jay@restorationsystems.com
EEP Project Manager:	Guy Pearce

Project Description

The project is located along Cutawhiskie Creek in the Chowan River Basin in Hertford County, approximately 11 miles south-southwest Murfreesboro within HU 03010204xxxx. The 23-acre site is currently utilized for timber and agricultural production. The project will restore approximately 2,000 feet of streams and 12 acres of wetlands and preserve an additional 2,800 feet of streams.

For Official Use Only

Reviewed By:

Date — EEP Project Manager

Conditional Approved By:

Date — For Division Administrator FHWA

☐ Check this box if there are outstanding issues

Final Approval By:

11-6-06
Date

For Division Administrator FHWA

Part 2: All Projects Regulation/Question	Response
Coastal Zone Management Act (CZMA)	
1. Is the project located in a CAMA county?	☑ Yes ☐ No
2. Does the project involve ground-disturbing activities within a CAMA Area of Environmental Concern (AEC)?	☑ Yes ☐ No ☐ N/A
3. Has a CAMA permit been secured?	☐ Yes ☑ No ☐ N/A
4. Has NCDCM agreed that the project is consistent with the NC Coastal Management Program?	☑ Yes ☐ No ☐ N/A
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)	
1. Is this a "full-delivery" project?	☑ Yes ☐ No
2. Has the zoning/land use of the subject property and adjacent properties ever been designated as commercial or industrial?	☐ Yes ☑ No ☐ N/A
3. As a result of a limited Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☑ No ☐ N/A
4. As a result of a Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☐ No ☑ N/A
5. As a result of a Phase II Site Assessment, are there known or potential hazardous waste sites within the project area?	☐ Yes ☐ No ☑ N/A
6. Is there an approved hazardous mitigation plan?	☐ Yes ☐ No ☑ N/A
National Historic Preservation Act (Section 106)	
1. Are there properties listed on, or eligible for listing on, the National Register of Historic Places in the project area?	☐ Yes ☑ No
2. Does the project affect such properties and does the SHPO/THPO concur?	☐ Yes ☐ No ☑ N/A
3. If the effects are adverse, have they been resolved?	☐ Yes ☐ No ☑ N/A
Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)	
1. Is this a "full-delivery" project?	☑ Yes ☐ No
2. Does the project require the acquisition of real estate?	☑ Yes ☐ No ☐ N/A
3. Was the property acquisition completed prior to the intent to use federal funds?	☐ Yes ☑ No ☐ N/A
4. Has the owner of the property been informed: * prior to making an offer that the agency does not have condemnation authority; and * what the fair market value is believed to be?	☑ Yes ☐ No ☐ N/A

Part 3: Ground-Disturbing Activities Regulation/Question	Response
American Indian Religious Freedom Act (AIRFA)	
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	☐ Yes ☑ No
2. Is the site of religious importance to American Indians?	☐ Yes ☐ No ☑ N/A
3. Is the project listed on, or eligible for listing on, the National Register of Historic Places?	☐ Yes ☐ No ☑ N/A
4. Have the effects of the project on this site been considered?	☐ Yes ☐ No ☑ N/A
Antiquities Act (AA)	
1. Is the project located on Federal lands?	☐ Yes ☑ No
2. Will there be loss or destruction of historic or prehistoric ruins, monuments or objects of antiquity?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Archaeological Resources Protection Act (ARPA)	
1. Is the project located on federal or Indian lands (reservation)?	☐ Yes ☑ No
2. Will there be a loss or destruction of archaeological resources?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Endangered Species Act (ESA)	
1. Are federal Threatened and Endangered species and/or Designated Critical Habitat listed for the county?	☑ Yes ☐ No
2. Is Designated Critical Habitat or suitable habitat present for listed species?	☐ Yes ☑ No ☐ N/A
3. Are T&E species present or is the project being conducted in Designated Critical Habitat?	☐ Yes ☐ No ☑ N/A
4. Is the project "likely to adversely affect" the species and/or "likely to adversely modify" Designated Critical Habitat?	☐ Yes ☐ No ☑ N/A
5. Does the USFWS/NOAA-Fisheries concur in the effects determination?	☐ Yes ☐ No ☑ N/A
6. Has the USFWS/NOAA-Fisheries rendered a "jeopardy" determination?	☐ Yes ☐ No ☑ N/A

Executive Order 13007 (Indian Sacred Sites)	
1. Is the project located on Federal lands that are within a county claimed as "territory" by the EBCI?	☐ Yes ☑ No
2. Has the EBCI indicated that Indian sacred sites may be impacted by the proposed project?	☐ Yes ☐ No ☑ N/A
3. Have accommodations been made for access to and ceremonial use of Indian sacred sites?	☐ Yes ☐ No ☑ N/A
Farmland Protection Policy Act (FPPA)	
1. Will real estate be acquired?	☑ Yes ☐ No
2. Has NRCS determined that the project contains prime, unique, statewide or locally important farmland?	☑ Yes ☐ No ☐ N/A
3. Has the completed Form AD-1006 been submitted to NRCS?	☑ Yes ☐ No ☐ N/A
Fish and Wildlife Coordination Act (FWCA)	
1. Will the project impound, divert, channel deepen, or otherwise control/modify any water body?	☑ Yes ☐ No
2. Have the USFWS and the NCWRC been consulted?	☑ Yes ☐ No ☐ N/A
Land and Water Conservation Fund Act (Section 6(f))	
1. Will the project require the conversion of such property to a use other than public, outdoor recreation?	☐ Yes ☑ No
2. Has the NPS approved of the conversion?	☐ Yes ☐ No ☑ N/A
Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat)	
1. Is the project located in an estuarine system?	☐ Yes ☑ No
2. Is suitable habitat present for EFH-protected species?	☐ Yes ☐ No ☑ N/A
3. Is sufficient design information available to make a determination of the effect of the project on EFH?	☐ Yes ☐ No ☑ N/A
4. Will the project adversely affect EFH?	☐ Yes ☐ No ☑ N/A
5. Has consultation with NOAA-Fisheries occurred?	☐ Yes ☐ No ☑ N/A
Migratory Bird Treaty Act (MBTA)	
1. Does the USFWS have any recommendations with the project relative to the MBTA?	☐ Yes ☑ No
2. Have the USFWS recommendations been incorporated?	☐ Yes ☐ No ☑ N/A
Wilderness Act	
1. Is the project in a Wilderness area?	☐ Yes ☑ No
2. Has a special use permit and/or easement been obtained from the maintaining federal agency?	☐ Yes ☐ No ☑ N/A

Environmental Documentation
for
Cutawhiskie Creek Stream and Wetland Restoration Site

EEP Contract Number D06066-A

Categorical Exclusion Form Items

CZMA

See the attached letters to and from the Division of Coastal Management. DCM has determined that a portion of the project falls within an Area of Environmental Concern by encroaching the 30 feet buffer of Public Trust Shoreline along Cutawhiskie Creek. As such, the project will require a General Permit from DCM. This permit will be applied for along with other necessary permits. The project will require a NW27 permit and we have been informed verbally by Mr. Stephen Rynas of DCM that it is consistent with the NC Coastal Management Program by virtue of DCM's review of the USACE's NW27 (see page 21 of the NW27 permit). The project is also consistent with Hertford County's Land Use Plan with respect to mitigation projects.

CERCLA
See the attached Executive Summary of the limited Phase 1 Site Assessment.

National Historic Preservation Act (Section 106)
See the attached letters to and from the State Historic Preservation Office.

Uniform Act
See the attached letter that was sent to the landowner.

American Indian Religious Freedom Act
Not applicable, as the project is not located in a county claimed by the Eastern Band of Cherokee Indians.

Antiquities Act
Not applicable, as the project is not located on Federal lands.

Archaeological Resources Protection Act
Not applicable, as the project is not located on Federal or Indian lands.

Endangered Species Act
See attached internal memo related to protected species. The only endangered species listed for Hertford County is the Red-cockaded Woodpecker. There is no suitable habitat on the site and the Biological Conclusion is No Effect.

Executive Order 13007
Not applicable, as the project is not located in a county claimed by the Eastern Band of Cherokee Indians.

Farmland Protection Policy Act
See the attached USDA Form AD-1006

Fish and Wildlife Coordination Act
See the attached letters to the NCWRC and the USFWS. Neither agency made a comment on the project.

Land and Water Conservation Fund Act
Not applicable. The project will not convert recreation lands.

Magnuson-Stevens Fishery Conservation and Management Act
Not applicable. The project is not located in an estuarine system. See previous response from NC Division of Coastal Management.

Migratory Bird Treaty Act
See the attached letters to the NCWRC and the USFWS. Neither agency made a comment on the project.

Other Miscellaneous Items

Public Notice
See the attached Affidavit of Publication of a Public Notice in the Jacksonville Daily News.

Environmental Documentation
for
Cutawhiskie Creek Stream and Wetland Restoration Site

EEP Contract Number D06066-A

Categorical Exclusion Form Items

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Public Notice
See the attached Affidavit of Publication of a Public Notice in the Jacksonville Daily News.

RESTORATION SYSTEMS, LLC
Natural Resources
Restoration & Conservation

October 4, 2006

North Carolina Department of Environment
And Natural Resources
Division of Coastal Management
Washington Regional Office
943 Washington Square Mall
Washington, North Carolina 27889

ATTN: Terry Moore, District Manager

SUBJECT: CAMA Jurisdictional Determination for the Cutawhiskie Creek Stream and Wetland Restoration Site in **Hertford County**

On December 19, 2005, the North Carolina Ecosystem Enhancement Program (EEP) issued a Request for Proposals for stream and wetland mitigation in the Chowan River Basin, Cataloging Unit 03010204. Subsequently Restoration Systems, LLC (RS), of Raleigh, NC was awarded a contract by the EEP to provide 3,375 Stream Mitigation Units (SMUs) and 12.3 Riverine Wetland Mitigation Units (WMUs) at the Cutawhiskie Creek Stream and Wetland Restoration Site. EcoScience Corporation is under contract to RS to provide technical environmental consulting and design services.

One of the earliest tasks to be performed by RS is completion of an environmental screening and preparation/submittal of a Categorical Exclusion (CE) document. This document is specifically required by the Federal Highway Administration (FHWA) to ensure compliance with various federal environmental laws and regulations. The EEP must demonstrate that its projects comply with federal mandates as a precondition to FHWA reimbursement of compensatory mitigation costs borne by the North Carolina Department of Transportation to offset its projects' unavoidable impacts to streams and wetlands.

In order for the project to proceed under the EEP guidance, RS is obligated to coordinate with your office to determine if our proposal will impact any Areas of Environmental Concern (AECs). This letter provides you with certain details of the Cutawhiskie Creek Stream and Wetland Restoration Site, including the project's location, a general description of its physiography, hydrography and existing land uses, as well as the intended modifications to the site proposed by RS. We request your review of the details provided and a field determination of whether CAMA jurisdiction will be taken on any portion of the proposed site.

Project Location & Description

The mitigation site is located approximately 9 miles southwest of Murfreesboro, in southwestern Hertford County (Figures 1 and 2). The site includes approximately 23 acres of land that is managed for agriculture and timber production and is situated on the floodplain and low terraces of Cutawhiskie Creek. The property targeted for restoration activities includes approximately 1,970 linear feet of an unnamed tributary to Cutawhiskie Creek and 2,786 linear feet of the Cutawhiskie Creek main channel. Portions of the site have recently been logged (Photos 1 and 2). Site vegetation is typical of bottomland hardwood forests and, in portions of the site, row crops and successional areas predominate.

The unnamed tributary has a drainage area of approximately 0.9 square mile at the point it flows south into the site. It has been dredged and rechannelized over the years so that it no longer retains stable dimension, pattern and profile. A large spoil pile lines the west bank of the channel (Photo 3). A moderate headcut is apparent near the upstream end of the site boundary, suggesting vertical instability. Due to its high degree of entrenchment resulting from historical dredging and channel incision, bankfull flows are confined within the channel in its existing morphological configuration. High energy flows, which are normally dissipated through a floodplain, presently exert high shear stress on the walls of the channel, exacerbating erosion.

The main drainage feature, Cutawhiskie Creek, is a third-order stream with a watershed area of approximately 18.2 square miles, measured at the point where it enters the mitigation site. Property owner reports it was dredged along its entire length in the mid-1960's in accordance with historical agricultural/silvicultural management practices.

Restoration Means & Methods

Work proposed includes construction of a stable, E-type stream channel, restoration of riverine wetlands, enhancement of water quality functions such as reduction of non-point source sedimentation and nutrient inputs, establishment of a forested buffer along both stream reaches, and restoration of wildlife habitat. All of these goals will be achieved through the implementation of new stream channel design, which will reconfigure pattern profile and dimension of the unnamed tributary to Cutawhiskie Creek. The results of this work will be a stable stream channel, which will shed storm flows to the adjacent floodplain where wetlands were historically located.

The adjacent floodplains will again be hydrated from overbank flooding events, restoring the missing hydrology to these important areas. Surface contours of the adjacent floodplains will be "roughened" to facilitate temporary ponding of surface water in the wetland restoration areas. No work is proposed that would impact the main channel of Cutawhiskie Creek.

Should you have any questions or if any additional information is needed to complete your review, please feel free to contact the project manager, Jay St. Clair at (919) 755-9490, or (919) 219-0271 (cell).

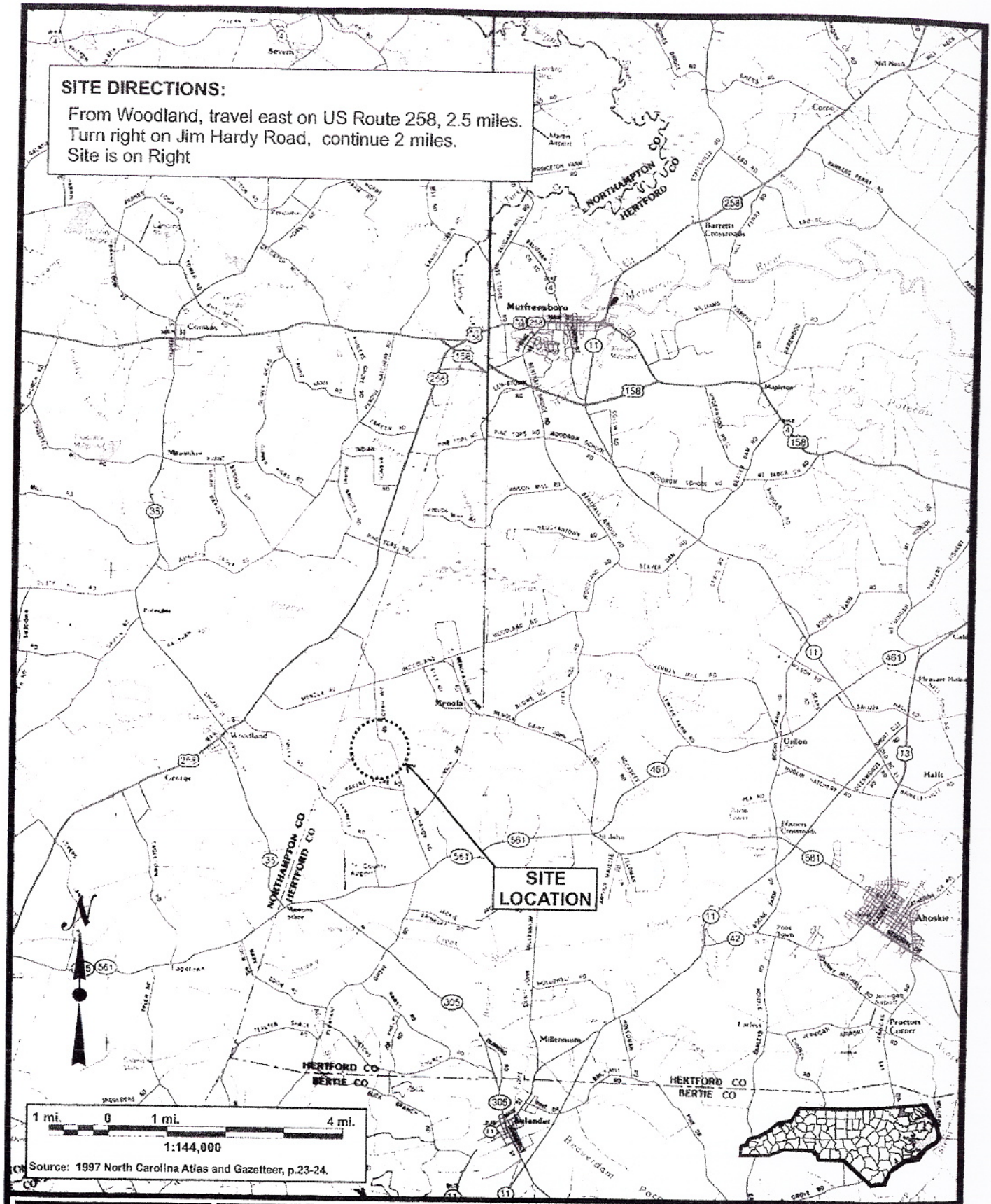
Your valuable time and cooperation are much appreciated.

Sincerely,

M. Randall Turner, Senior Scientist

Attachments

cc: Mr. Dave Schiller, Restoration Systems, LLC



Client: RESTORATION SYSTEMS, LLC

Project:

SITE LOCATION
CUTAWHISKIE CREEK
STREAM AND WETLAND RESTORATION SITE
Hertford County, North Carolina

Dwn. by:	MAF
Ckd by:	JDC
Date:	APR 2006
Project:	P06-030

FIGURE 1

North Carolina Department of Environment and Natural Resources
Division of Coastal Management
Michael F. Easley, Governor **Charles S. Jones, Director** William G. Ross, Jr., Secretary

26 October 2006

Restoration Systems, LLC
Mr. M. Randall Turner
1101 Haynes St.
Suite 107, Pilot Mill
Raleigh, North Carolina 27604

Dear Mr. Turner:

This letter is in reference to your request for a jurisdictional determination for the purpose of conducting stream and wetland restoration of an unnamed tributary to Cutawhiskie Creek located off SR 1152 near Ahoskie in Hertford County. I have reviewed in-house jurisdictional determination references and been on-site with Terry Moore to determine if permits for the proposed development are required per the Coastal Area Management Act or the State's Dredge and Fill Law.

From our review of the area we have determined that Cutawhiskie Creek does fall within the jurisdiction of the Division of Coastal Management (DCM) at that location. Additionally the lateral ditch/stream that flows into Cutawhiskie Creek at the project location is also found to be within the jurisdiction of the DCM for a distance of approximately 75 feet as measured in an upstream direction from its confluence with Cutawhiskie Creek. The specific Areas of Environmental Concern (AEC) that would be affected by the proposed project are Public Trust Area and Public Trust Shoreline. Any activities defined, as development occurring in or within 30' of Cutawhiskie Creek and the downstream end of the lateral ditch/stream will require a permit from the Division of Coastal Management. Per our previous conversation the DCM has a General Permit for such projects provided all permit conditions can be complied with (see attached).

Thank you for your time and concern in these matters. If you have any questions regarding permit requirements for this project or future projects, please do not hesitate to contact me at (252) 948-3853.

Sincerely,

R. Kelly Spivey
Coastal Management Representative

Attachment
cc: Terry E. Moore- District Manager, Washington Office, DCM
Raleigh Bland – U.S. Army Corps of Engineers, Washington Office

environment.

NORTH CAROLINA DIVISION OF WATER QUALITY GENERAL CERTIFICATION CONDITIONS

For the most recent General Certification conditions, call the NC Division of Water Quality, Wetlands/401 Certification Unit at (919) 733- 1786 or access the following website:

http://h2o.enr.state.nc.us/ncwetlands/certs.html

NORTH CAROLINA DIVISION OF COASTAL MANAGEMENT STATE CONSISTENCY

Consistent.

Citations:
2002 Nationwide Permits - Federal Register Notice 15 Jan 2002
2002 Nationwide Permits Corrections - Federal Register Notice 13 Feb 2002
2002 Regional Conditions – Authorized 17 May 2002

The EDR Radius Map
with GeoCheck®

Cutawhiskie Creek Restoration Site
Hertford County
Woodland, NC 27897

Inquiry Number: 01718882.22r

July 20, 2006

EDR® Environmental Data Resources Inc

The Standard in Environmental Risk Management Information

440 Wheelers Farms Road
Milford, Connecticut 06461

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

FORM-BPK-ERN

TABLE OF CONTENTS

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-05) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

HERTFORD COUNTY
WOODLAND, NC 27897

COORDINATES

Latitude (North):	36.327300 - 36° 19' 38.3"
Longitude (West):	77.161000 - 77° 9' 39.6"
Universal Tranverse Mercator:	Zone 18
UTM X (Meters):	306023.7
UTM Y (Meters):	4022218.0
Elevation:	45 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	36077-C2 WOODLAND, NC
Most Recent Revision:	1997

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

FEDERAL RECORDS

NPL ..... National Priority List
Proposed NPL ..... Proposed National Priority List Sites
Delisted NPL ..... National Priority List Deletions
NPL RECOVERY ..... Federal Superfund Liens
CERCLIS ..... Comprehensive Environmental Response, Compensation, and Liability Information System
CERC-NFRAP ..... CERCLIS No Further Remedial Action Planned
CORRACTS ..... Corrective Action Report
RCRA-TSDF ..... Resource Conservation and Recovery Act Information
RCRA-LQG ..... Resource Conservation and Recovery Act Information

EXECUTIVE SUMMARY

RCRA-SQG	Resource Conservation and Recovery Act Information
ERNS	Emergency Response Notification System
HMIRS	Hazardous Materials Information Reporting System
US ENG CONTROLS	Engineering Controls Sites List
US INST CONTROL	Sites with Institutional Controls
DOD	Department of Defense Sites
FUDS	Formerly Used Defense Sites
US BROWNFIELDS	A Listing of Brownfields Sites
CONSENT	Superfund (CERCLA) Consent Decrees
ROD	Records Of Decision
UMTRA	Uranium Mill Tailings Sites
ODI	Open Dump Inventory
TRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
SSTS	Section 7 Tracking Systems
ICIS	Integrated Compliance Information System
PADS	PCB Activity Database System
MLTS	Material Licensing Tracking System
MINES	Mines Master Index File
FINDS	Facility Index System/Facility Registry System
RAATS	RCRA Administrative Action Tracking System

STATE AND LOCAL RECORDS

SHWS	Inactive Hazardous Sites Inventory
NC HSDS	Hazardous Substance Disposal Site
IMD	Incident Management Database
SWF/LF	List of Solid Waste Facilities
OLI	Old Landfill Inventory
LUST	Regional UST Database
LUST TRUST	State Trust Fund Database
UST	Petroleum Underground Storage Tank Database
AST	AST Database
INST CONTROL	No Further Action Sites With Land Use Restrictions Monitoring
VCP	Responsible Party Voluntary Action Sites
DRYCLEANERS	Drycleaning Sites
BROWNFIELDS	Brownfields Projects Inventory
NPDES	NPDES Facility Location Listing

TRIBAL RECORDS

INDIAN RESERV	Indian Reservations
INDIAN LUST	Leaking Underground Storage Tanks on Indian Land
INDIAN UST	Underground Storage Tanks on Indian Land

EDR PROPRIETARY RECORDS

Manufactured Gas Plants	EDR Proprietary Manufactured Gas Plants
EDR Historical Auto Stations	EDR Proprietary Historic Gas Stations
EDR Historical Cleaners	EDR Proprietary Historic Dry Cleaners

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were not identified.

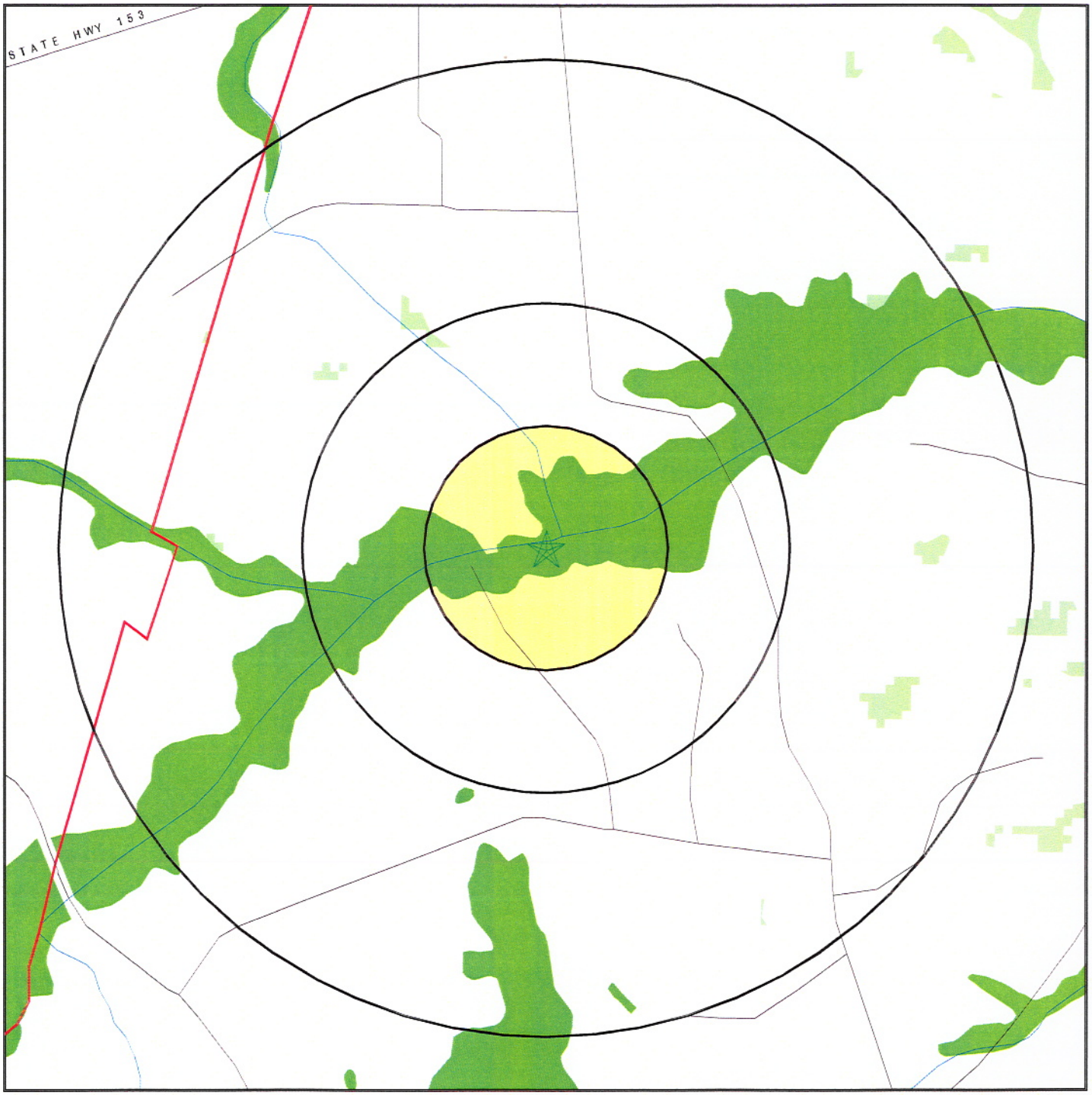
Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped:

Site Name	Database(s)
MINUTE MAN FOODS	LUST, UST, LUST TRUST, IMD
BOWENS GROCERY	LUST
PARKER MANUFACTURING	LUST, IMD
PEEDE STORE (MILDRED)	LUST
BOONE'S MARKET AMOCO	LUST TRUST
RED APPLE MARKET #10	LUST TRUST
SLADES GROCERY	UST
VERNON VINSON GROCERY	UST
E.T. HOLLOWELL FARMS. INC.	UST
MINUTE MAN	UST
LEE MOTOR CO.	UST
WOODLAND-OLNEY ELEMENTARY SCH	UST
BOONES MARKET	UST
PARKER MFG. CO.. INC.	UST
FRIENDLY MARKETS	UST
NEWSOME OIL CO INC (WOODLAND PLT)	AST
PARKER MFC CO	RCRA-SQG, FINDS
PEEDE STORE (MILDRED)	IMD

OVERVIEW MAP - 01718882.22r



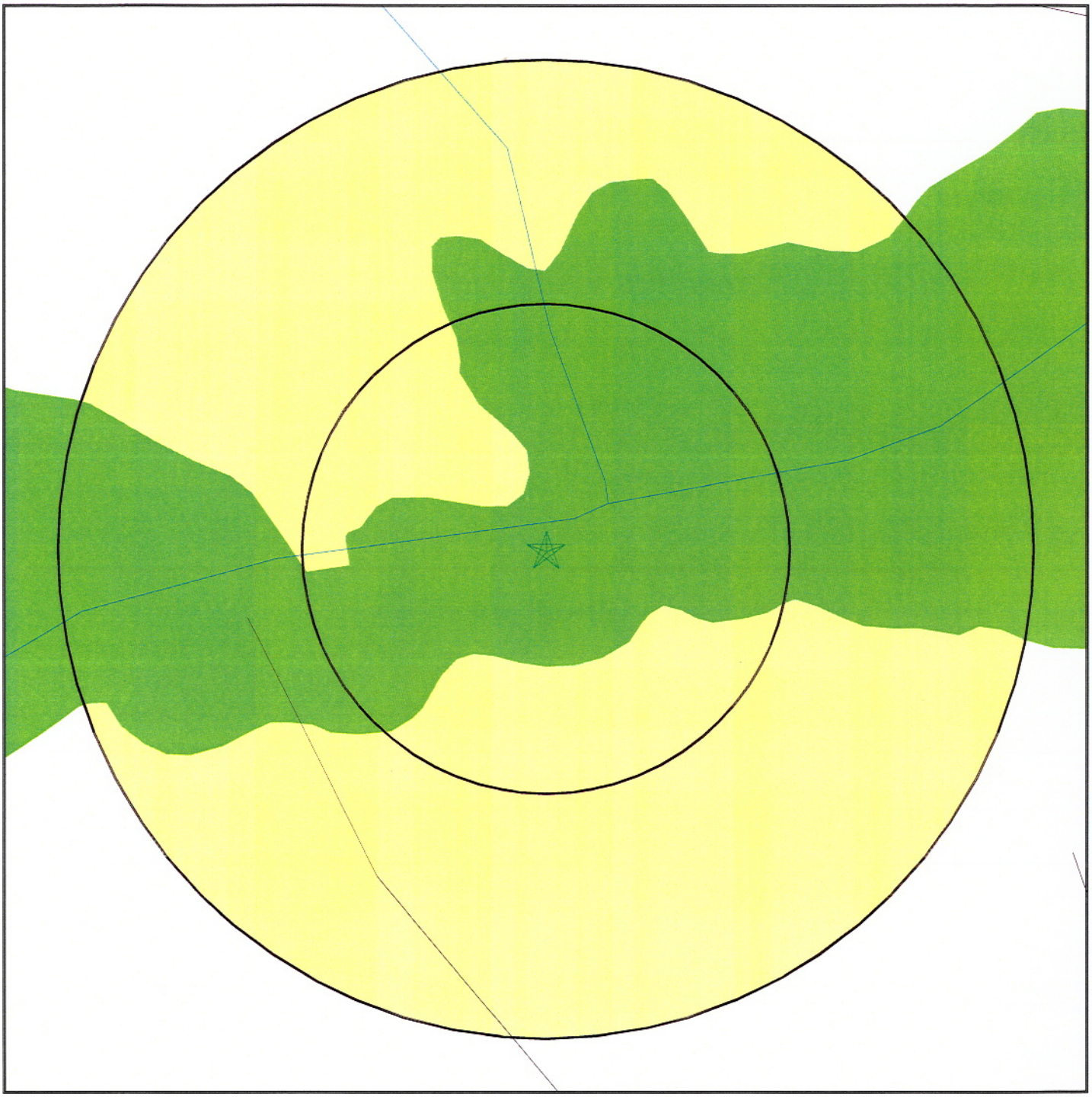
- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Landfill Sites
- Dept. Defense Sites
- Indian Reservations BIA
- County Boundary
- Oil & Gas pipelines
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

0 1/4 1/2 1 Miles

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Cutawhiskie Creek Restoration Site ADDRESS: Hertford County Woodland NC 27897 LAT/LONG: 36.3273 / 77.1610	CLIENT: Restoration Systems, LLC CONTACT: Dave Schiller INQUIRY #: 01718882.22r DATE: July 20, 2006

DETAIL MAP - 01718882.22r



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Landfill Sites
- Dept. Defense Sites

0 1/16 1/8 1/4 Miles

- Indian Reservations BIA
- Oil & Gas pipelines
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Cutawhiskie Creek Restoration Site ADDRESS: Hertford County Woodland NC 27897 LAT/LONG: 36.3273 / 77.1610	CLIENT: Restoration Systems, LLC CONTACT: Dave Schiller INQUIRY #: 01718882.22r DATE: July 20, 2006

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
FEDERAL RECORDS								
NPL		1.000	0	0	0	0	NR	0
Proposed NPL		1.000	0	0	0	0	NR	0
Delisted NPL		1.000	0	0	0	0	NR	0
NPL RECOVERY		TP	NR	NR	NR	NR	NR	0
CERCLIS		0.500	0	0	0	NR	NR	0
CERC-NFRAP		0.500	0	0	0	NR	NR	0
CORRACTS		1.000	0	0	0	0	NR	0
RCRA TSD		0.500	0	0	0	NR	NR	0
RCRA Lg. Quan. Gen.		0.250	0	0	NR	NR	NR	0
RCRA Sm. Quan. Gen.		0.250	0	0	NR	NR	NR	0
ERNS		TP	NR	NR	NR	NR	NR	0
HMIRS		TP	NR	NR	NR	NR	NR	0
US ENG CONTROLS		0.500	0	0	0	NR	NR	0
US INST CONTROL		0.500	0	0	0	NR	NR	0
DOD		1.000	0	0	0	0	NR	0
FUDS		1.000	0	0	0	0	NR	0
US BROWNFIELDS		0.500	0	0	0	NR	NR	0
CONSENT		1.000	0	0	0	0	NR	0
ROD		1.000	0	0	0	0	NR	0
UMTRA		0.500	0	0	0	NR	NR	0
ODI		0.500	0	0	0	NR	NR	0
TRIS		TP	NR	NR	NR	NR	NR	0
TSCA		TP	NR	NR	NR	NR	NR	0
FTTS		TP	NR	NR	NR	NR	NR	0
SSTS		TP	NR	NR	NR	NR	NR	0
ICIS		TP	NR	NR	NR	NR	NR	0
PADS		TP	NR	NR	NR	NR	NR	0
MLTS		TP	NR	NR	NR	NR	NR	0
MINES		0.250	0	0	NR	NR	NR	0
FINDS		TP	NR	NR	NR	NR	NR	0
RAATS		TP	NR	NR	NR	NR	NR	0
STATE AND LOCAL RECORDS								
State Haz. Waste		1.000	0	0	0	0	NR	0
NC HSDS		1.000	0	0	0	0	NR	0
IMD		0.500	0	0	0	NR	NR	0
State Landfill		0.500	0	0	0	NR	NR	0
OLI		0.500	0	0	0	NR	NR	0
LUST		0.500	0	0	0	NR	NR	0
LUST TRUST		0.500	0	0	0	NR	NR	0
UST		0.250	0	0	NR	NR	NR	0
AST		0.250	0	0	NR	NR	NR	0
INST CONTROL		0.500	0	0	0	NR	NR	0
VCP		0.500	0	0	0	NR	NR	0
DRYCLEANERS		0.250	0	0	NR	NR	NR	0
BROWNFIELDS		0.500	0	0	0	NR	NR	0
NPDES		TP	NR	NR	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
TRIBAL RECORDS								
INDIAN RESERV		1.000	0	0	0	0	NR	0
INDIAN LUST		0.500	0	0	0	NR	NR	0
INDIAN UST		0.250	0	0	NR	NR	NR	0
EDR PROPRIETARY RECORDS								
Manufactured Gas Plants		1.000	0	0	0	0	NR	0
EDR Historical Auto Stations		TP	NR	NR	NR	NR	NR	0
EDR Historical Cleaners		TP	NR	NR	NR	NR	NR	0

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

RESTORATION SYSTEMS, LLC
Natural Resources
Restoration & Conservation

August 1, 2006

Ms. Renee Gledhill-Earley,
Environmental Review Coordinator
State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 29699-4617

Subject: Request for Letter of Concurrence on Cutawhiskie Creek Stream and Wetland Restoration Project

Dear Ms. Gledhill-Earley:

Restoration Systems (RS) has been awarded a contract by the NC Ecosystem Enhancement Program (EEP) to restore a stream and wetland restoration site providing 12.3 acres of riverine wetland and 3,375 feet of stream in the Chowan River Basin. The project is located in Hertford County, approximately 9 miles southwest of the Town of Murfreesboro adjacent to Jim Hardy Road. A map showing the location of the site is attached.

The site consists of 23 acres of land that is currently managed for agriculture and timber production. Within the Site, approximately 1,970 linear feet of an unnamed tributary to Cutawhiskie Creek and approximately 12.3 acres of hydric soils exhibit mitigation potential. Additionally, approximately 2,786 linear feet of Cutawhiskie Creek is available for stream preservation. The primary goals of this stream and wetland restoration project focus on improving water quality, enhancing flood attenuation, and restoring aquatic and riparian habitat.

There are no structures on or adjacent to the site. RS staff examined the records in your office and determined that there are no listed historic properties or archeological records on or within 0.5 miles of the site. A letter of concurrence from your office is required as part of the Environmental Screening of the project. I would appreciate receiving such a letter for this project at your earliest convenience.

Sincerely,

Jay St. Clair
Project Manager

Attachments

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

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

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

September 15, 2006

Jay St. Clair
Restoration Systems, LLC
Pilot Mill
1101 Haynes Street, Suite 107
Raleigh, NC 27604

Re: EEP, Cutawhiskie Creek Stream and Wetland Restoration, Hertford County, ER 06-2102

Dear Mr. St. Clair:

Thank you for your letter of August 1, 2006, concerning the above project.

We have conducted a review of the proposed undertaking and are aware of no historic resources that would be affected by the project. Therefore, we have no comment on the undertaking as proposed.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919/733-4763, ext. 246. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Peter B. Sandbeck bgk mpn

Peter Sandbeck

RESTORATION SYSTEMS, LLC

Natural Resources
Restoration & Conservation

April 3, 2006

John S. Vaughan, Jr.
Charles J. Vaughan
Joseph B. Vaughan
Hannah Vaughan
Cola Franklin Vaughan
David F. Vaughan

P. O. Box 8
Woodland, NC 27897

To Whom It May Concern:

The purpose of this letter is to notify you that Restoration Systems, LLC, in offering to purchase a conservation easement on your property in Hertford County, North Carolina, does not have the power to acquire it by eminent domain. Also, Restoration Systems' offer to purchase your property is based on what we believe to be its fair market.

If you have any questions, please feel free to call me on my mobile phone at 919-219-0271 or at work at 919-755-9490.

Sincerely,

Jay St. Clair
Project Manager

August 8, 2006

MEMO TO: Dave Schiller
FROM: Jay St. Clair
SUBJECT: Cutawhiskie Creek Biological Conclusion

Project Location & Description

Restoration Systems, LLC (RS), of Raleigh, NC was awarded a contract by the North Carolina Ecosystem Enhancement Program to provide 3,375 stream mitigation units and 12.3 riverine wetland mitigation units at the Cutawhiskie Creek Stream and Wetland Restoration Site. The Cutawhiskie Creek Stream and Wetland Restoration Site is located approximately 9 miles southwest of Murfreesboro, in southwestern Hertford County (Figure 1). The Site is located at 36.327332 North and -77.161020 West and encompasses approximately 23 acres of land that is managed for agriculture and timber production. Portions of the site have recently been logged. Within the Site, approximately 1,970 linear feet of a highly disturbed, dysfunctional unnamed tributary to Cutawhiskie Creek will be restored, and approximately 12.3 acres of hydric cropland will be restored to riverine wetlands. Additionally, approximately 2,786 linear feet of Cutawhiskie Creek will be preserved via a conservation easement (Figure 6).

Site vegetation is generally characterized by a mixture of relatively undisturbed bottomland hardwood forests along the Cutawhiskie Creek floodplain and low terraces, row crops including soybeans and corn, and successional communities associated with cutover timberland. Topography within the site ecoregion is characterized by low relief and broad interstream divides. Due to the history of extensive dredging of the unnamed tributary and Cutawhiskie Creek, the local water table has been lowered in elevation, effectively removing jurisdictional wetland hydrology from adjacent hydric soil areas.

Restoration Means & Methods

Primary activities designed to restore the stream and wetland complex include 1) stream restoration, 2) stream preservation, 3) riverine wetland restoration, and 4) vegetative planting. Stream restoration is expected to entail 1) belt-width preparation, 2) channel excavation, 3) spoil stockpiling, 4) channel stabilization, 5) channel diversion, and 6) existing channel backfill.

Restoration of wetland hydrology and wetland vegetation may involve 1) existing channel cleaning prior to backfill, 2) channel plug installation, 3) channel backfill, and 4) scarification of soils prior to planting. In addition, the construction of surface water storage depressions (ephemeral pools) also adds an important component to groundwater restoration activities.

Revegetating the floodplain and stream banks will provide stream bank stability, shade, cooler surface waters, habitat for local wildlife, as well as filter pollutants from adjacent runoff. The vegetated stream buffer will extend approximately 50 feet on both sides of Cutawhiskie Creek. Scarification of floodplain surfaces may be required prior to planting. Plant community restoration within the Site will include the planting of bare-root seedlings consistent with reference data, on-site observations, and descriptions of the community.

Federally Listed Species

There is one federally listed species with at least historical records of occurring in Hertford County as identified through the US Fish & Wildlife Service web site (http://nc-es.fws.gov/es/countyfr.html).

Table 1. Federally Listed Species for Hertford County

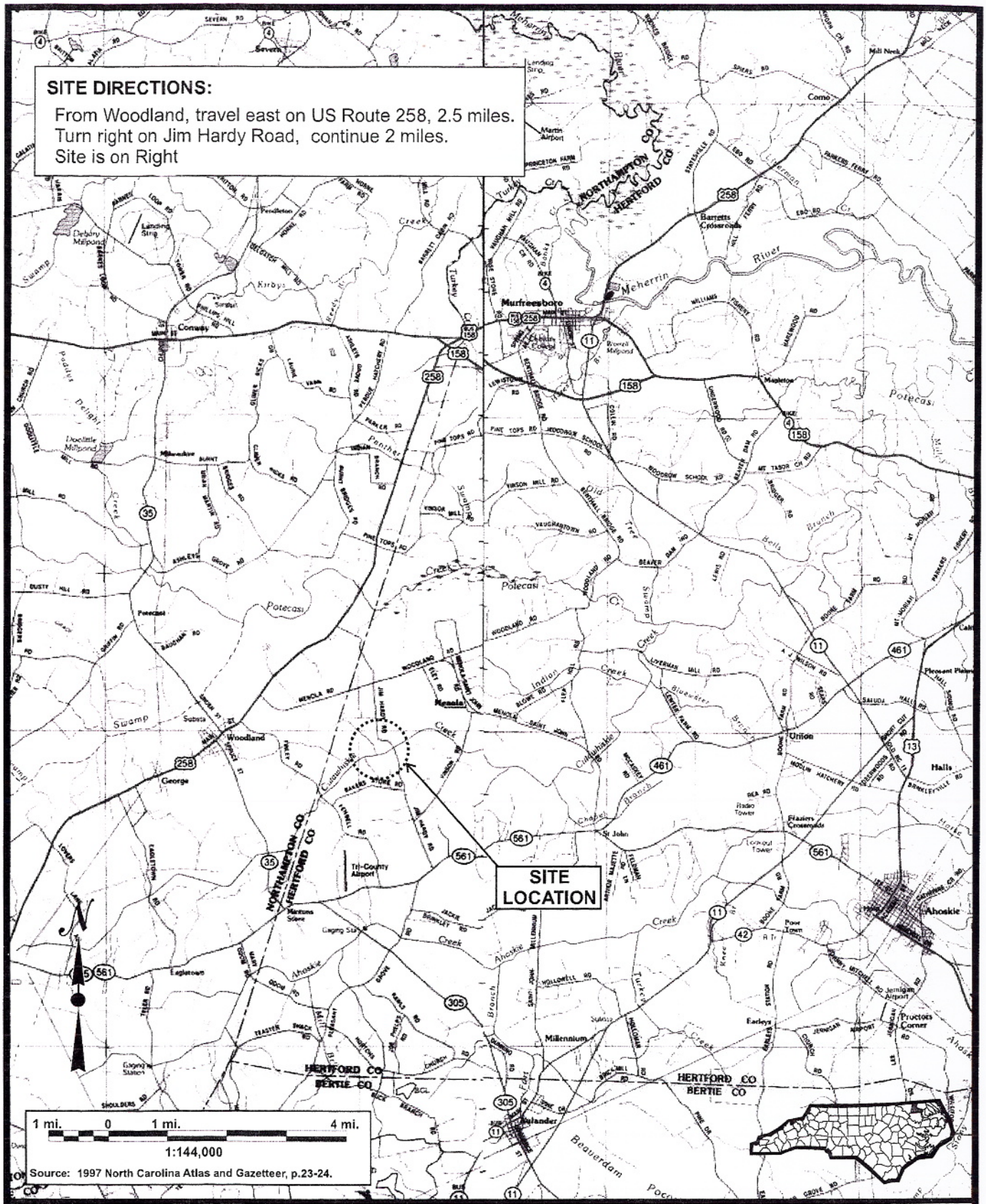
SPECIES	COMMON NAME	FEDERAL STATUS
Picoides borealis	Red-cockaded woodpecker	Endangered

Note: "Endangered" is a taxon in danger of extinction throughout all or a significant portion of its range; "Threatened" is a taxon likely to become endangered within the foreseeable future throughout all or a portion of its range; "Threatened (S/A)" is a taxon which is threatened due to similarity of appearance with other rare species. This species does not require Section 7 consultation.

Red-cockaded woodpecker ***Picoides borealis*** **Endangered Current**

The red-cockaded woodpecker requires mature, open pine stands for roosting/nesting habitat. For foraging habitat, it requires pine and mixed pine/hardwood stands 30 years or older with a preference for pine trees 10 inches or great in diameter. Site vegetation consists primarily of recently harvested timberland, cultivated row crops, and bottomland hardwood forests with dense under story growth. Thus, there is no suitable roosting/nesting or foraging habitat for the red-cockaded woodpecker on-Site.

Biological Conclusion: No Affect



Client: RESTORATION SYSTEMS, LLC

Project:

SITE LOCATION
CUTAWHISKIE CREEK
STREAM AND WETLAND RESTORATION SITE
Hertford County, North Carolina

Dwn. by:	MAF
Ckd by:	JDC
Date:	APR 2006
Project:	P06-030

FIGURE 1

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 8/3/06
Name Of Project Cutawhiskie Creek Stream and Wetland Restoratic	Federal Agency Involved FHWA
Proposed Land Use stream and wetland restoration	County And State Hertford County, North Carolina
PART II *(To be completed by NRCS)*	Date Request Received By NRCS

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).*	Yes ☒	No ☐	Acres Irrigated NONE	Average Farm Size 587 ac
Major Crop(s) CORN	Farmable Land In Govt. Jurisdiction Acres: 184,173 % 81		Amount Of Farmland As Defined in FPPA Acres: 178,781 % 78	
Name Of Land Evaluation System Used Hertford LE	Name Of Local Site Assessment System NONE		Date Land Evaluation Returned By NRCS 8-31-06 gab	

PART III *(To be completed by Federal Agency)*	Alternative Site Rating			
	Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	23			
B. Total Acres To Be Converted Indirectly	0			
C. Total Acres In Site	23	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	1			
B. Total Acres Statewide And Local Important Farmland	0			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	4.01			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	80.8			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	22.8	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	15			
2. Perimeter In Nonurban Use	10	10			
3. Percent Of Site Being Farmed	20	10			
4. Protection Provided By State And Local Government	20	0			
5. Distance From Urban Builtup Area	15	15			
6. Distance To Urban Support Services	15	15			
7. Size Of Present Farm Unit Compared To Average	10	10			
8. Creation Of Nonfarmable Farmland	10	0			
9. Availability Of Farm Support Services	5	4			
10. On-Farm Investments	20	9			
11. Effects Of Conversion On Farm Support Services	10	0			
12. Compatibility With Existing Agricultural Use	10	0			
TOTAL SITE ASSESSMENT POINTS	160	88	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	22.8	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	88	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	110.8	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐
Reason For Selection:		

(See Instructions on reverse side)

This form was electronically produced by National Production Services Staff

Form AD-1006 (10-83)

Natural Resources
Restoration & Conservation

July 31, 2006

North Carolina Wildlife Resources Commission
Division of Inland Fisheries
Falls Lake Office
1142 I-85 Service Road
Creedmore, NC 27522

ATTN: David Cox, Technical Guidance Supervisor

SUBJECT: Coordination with the North Carolina Wildlife Resources Commission on Behalf of the Fish and Wildlife Coordination Act for the Cutawhiskie Creek Stream and Wetland Restoration Site in Hertford County.

Mr. Cox:

On December 19, 2005, the North Carolina Ecosystem Enhancement Program (EEP) issued a Request for Proposals for 5000 stream mitigation units, 3 riverine wetland mitigation units, and 5 non-riverine wetland mitigation units in the Chowan River Basin, Cataloging Unit 03010204. Restoration Systems, LLC (RS), of Raleigh, NC was subsequently awarded a contract by the EEP to provide 3,375 stream mitigation units and 12.3 riverine wetland mitigation units at the Cutawhiskie Creek Stream and Wetland Restoration Site. EcoScience Corporation is under contract to RS to provide technical environmental consulting and design services.

One of the earliest tasks to be performed by RS is completion of an environmental screening and preparation/submittal of a Categorical Exclusion (CE) document. This document is specifically required by the Federal Highway Administration (FHWA) to ensure compliance with various federal environmental laws and regulations. The EEP must demonstrate that its projects comply with federal mandates as a precondition to FHWA reimbursement of compensatory mitigation costs borne by the North Carolina Department of Transportation to offset its projects' unavoidable impacts to streams and wetlands.

In order for the project to proceed, RS is obligated to coordinate with your office on behalf of the Fish and Wildlife Coordination Act (FWCA). This letter provides you with certain details of the Cutawhiskie Creek Stream and Wetland Restoration Site project, including the project's location, a general description of its physiography, hydrography and existing land uses, as well as the intended modifications to the site proposed by RS. You are encouraged to determine if the actions proposed by RS may be inimical to any

resources embraced by the FWCA, and provide comments to RS based on your evaluation. It is reasonable to assume that you will comment if the actions proposed by RS are, in your opinion, likely to result in harm to resources embraced by the FWCA .

Project Location & Description

The Cutawhiskie Creek Stream and Wetland Restoration Site is located approximately 9 miles southwest of Murfreesboro, in southwestern Hertford County (Figure 1). The Site is located at 36.327332 North and -77.161020 West and encompasses approximately 23 acres of land that is managed for agriculture and timber production. Portions of the site have recently been logged. Within the Site, approximately 1,970 linear feet of a highly disturbed, dysfunctional unnamed tributary to Cutawhiskie Creek will be restored, and approximately 12.3 acres of hydric cropland will be restored to riverine wetlands. Additionally, approximately 2,786 linear feet of Cutawhiskie Creek will be preserved via a conservation easement (Figure 6).

Site vegetation is generally characterized by a mixture of relatively undisturbed bottomland hardwood forests along the Cutawhiskie Creek floodplain and low terraces, row crops including soybeans and corn, and successional communities associated with cutover timberland. Topography within the site ecoregion is characterized by low relief and broad interstream divides. Due to the history of extensive dredging of the unnamed tributary and Cutawhiskie Creek, the local water table has been lowered in elevation, effectively removing jurisdictional wetland hydrology from adjacent hydric soil areas.

Restoration Means & Methods

Primary activities designed to restore the stream and wetland complex include 1) stream restoration, 2) stream preservation, 3) riverine wetland restoration, and 4) vegetative planting. Stream restoration is expected to entail 1) belt-width preparation, 2) channel excavation, 3) spoil stockpiling, 4) channel stabilization, 5) channel diversion, and 6) existing channel backfill.

Restoration of wetland hydrology and wetland vegetation may involve 1) existing channel cleaning prior to backfill, 2) channel plug installation, 3) channel backfill, and 4) scarification of soils prior to planting. In addition, the construction of surface water storage depressions (ephemeral pools) also adds an important component to groundwater restoration activities.

Revegetating the floodplain and stream banks will provide stream bank stability, shade, cooler surface waters, habitat for local wildlife, as well as filter pollutants from adjacent runoff. The vegetated stream buffer will extend approximately 50 feet on both sides of Cutawhiskie Creek. Scarification of floodplain surfaces may be required prior to planting. Plant community restoration within the Site will include the planting of bare-root seedlings consistent with reference data, on-site observations, and descriptions of the community.

Summary of Anticipated Effects

The proposed stream and wetland restoration matrix will restore a dysfunctional stream system to full functionality and will restore wetland functions that have been absent for many years. This work will provide the capacity to efficiently transport watershed flows and sediment loads, will enhance flood storage capacity, provide nutrient abatement, remove and/or neutralize toxic compounds, and will create a variety and abundance of wildlife habitat. Revegetation of the floodplain will provide stream bank stability, reduce erosion, promote floodwater attenuation, and improve aquatic and terrestrial habitat. In conclusion, the proposed actions are not likely to result in long-term negative effects to fish or wildlife, but instead improve wildlife habitat.

Should you have any questions or if any additional information is needed to complete your review/evaluation, please feel free to contact me at work at 919-755-9490 or on my mobile phone at 919-219-0271. Your valuable time and cooperation are much appreciated.

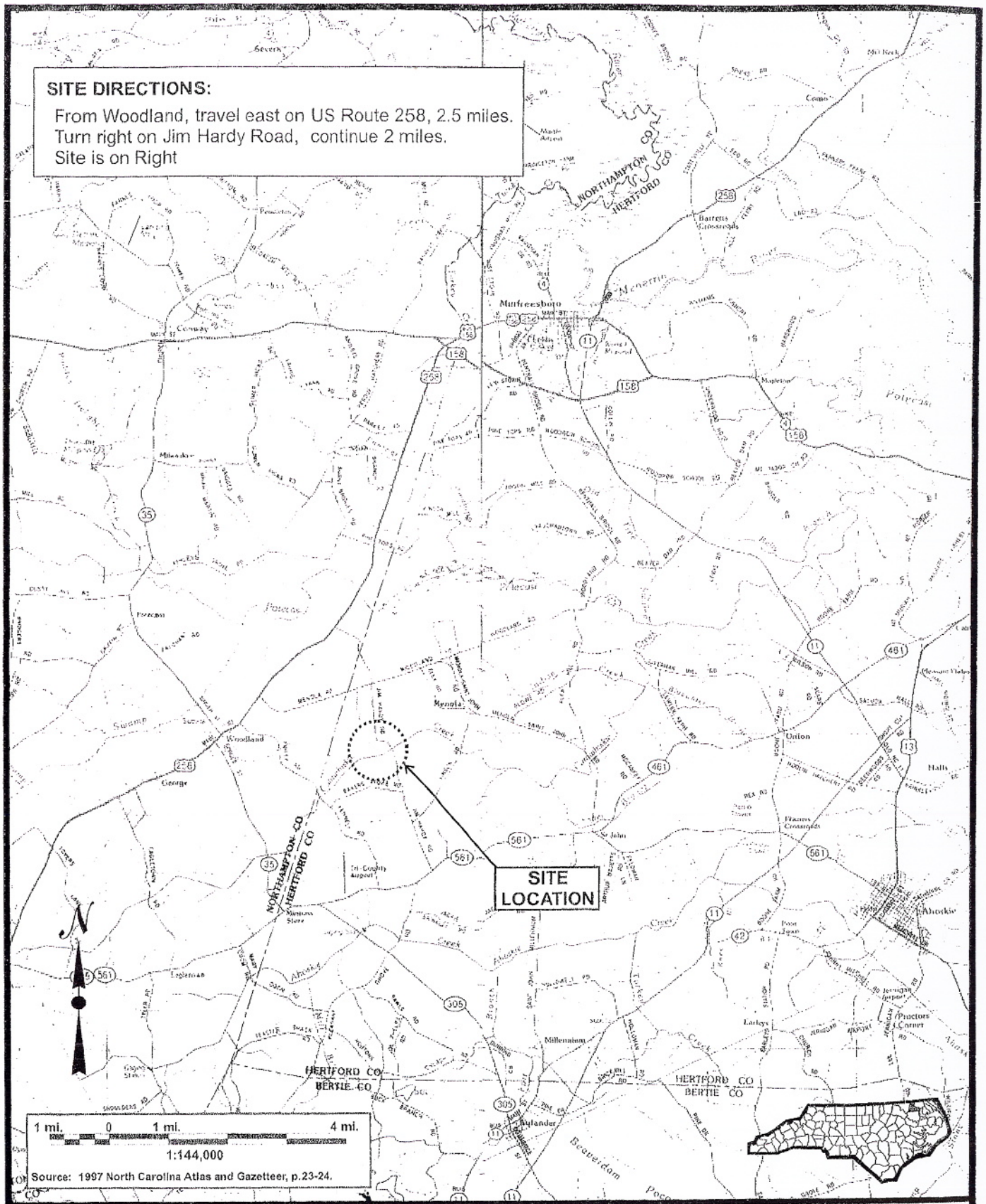
Sincerely,

Jay St. Clair

Jay St. Clair, Project Manager

Attachments

cc: Mr. Dave Schiller, Restoration Systems, LLC



Client: RESTORATION SYSTEMS, LLC

Project:

SITE LOCATION
CUTAWHISKIE CREEK
STREAM AND WETLAND RESTORATION SITE
Hertford County, North Carolina

Dwn. by:	MAF
Ckd by:	JDC
Date:	APR 2006
Project:	P06-030

FIGURE
1

RESTORATION SYSTEMS, LLC
Natural Resources
Restoration & Conservation

July 31, 2006

U. S. Department of the Interior
Fish and Wildlife Service
Raleigh Field Office
P. O. Box 33726
Raleigh, NC 28801

ATTN: Dale Suiter, Fish and Wildlife Biologist

SUBJECT: Coordination with the U.S. Fish and Wildlife Service on Behalf of (1) Fish and Wildlife Coordination Act and (2) Migratory Bird Treaty Act for the Cutawhiskie Creek Stream and Wetland Restoration Site in Hertford County.

Mr. Suiter:

On December 19, 2005, the North Carolina Ecosystem Enhancement Program (EEP) issued a Request for Proposals for 5000 stream mitigation units, 3 riverine wetland mitigation units, and 5 non-riverine wetland mitigation units in the Chowan River Basin, Cataloging Unit 03010204. Restoration Systems, LLC (RS), of Raleigh, NC was subsequently awarded a contract by the EEP to provide 3,375 stream mitigation units and 12.3 riverine wetland mitigation units at the Cutawhiskie Creek Stream and Wetland Restoration Site. EcoScience Corporation is under contract to RS to provide technical environmental consulting and design services.

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In order for the project to proceed, RS is obligated to coordinate with your office on behalf of the Fish and Wildlife Coordination Act (FWCA) and the Migratory Bird Treaty Act (MBTA). This letter provides you with certain details of the Cutawhiskie Creek Stream and Wetland Restoration Site project, including the project's location, a general

description of its physiography, hydrography and existing land uses, as well as the intended modifications to the site proposed by RS. You are encouraged to determine if the actions proposed by RS may be inimical to any resources embraced by the FWCA, or the MBTA and provide comments to RS based on your evaluation. It is reasonable to assume that the Service will comment if the actions proposed by RS are, in the Service's opinion, likely to result in harm to resources embraced by the FWCA or the MBTA.

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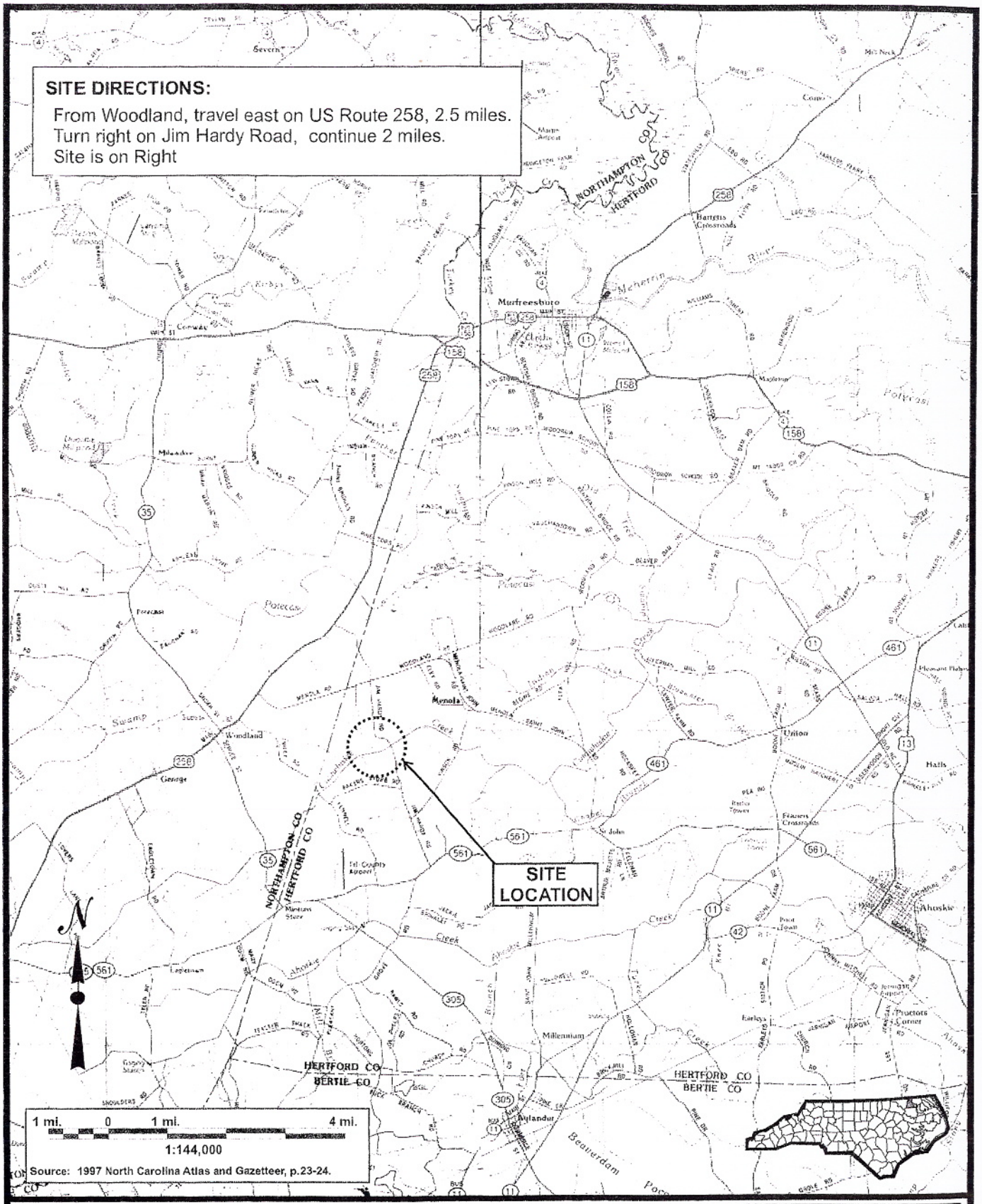
Should you have any questions or if any additional information is needed to complete your review/evaluation, please feel free to contact me at work at 919-755-9490 or on my mobile phone at 919-219-0271. Your valuable time and cooperation are much appreciated.

Sincerely,

Jay St. Clair, Project Manager

Attachments

cc: Mr. Dave Schiller, Restoration Systems, LLC



Client: RESTORATION SYSTEMS, LLC

Project:

SITE LOCATION
CUTAWHISKIE CREEK
STREAM AND WETLAND RESTORATION SITE
Hertford County, North Carolina

Dwn. by:	MAF
Ckd by:	JDC
Date:	APR 2006
Project:	P06-030

FIGURE 1

AFFIDAVIT OF PUBLICATION

This is not an Invoice

Roanoke-Chowan News-Herald

Post Office Box 1325
Ahoskie, North Carolina 27910

IN ACCOUNT WITH
c/oKristen Poillon
Restoration Systems
1101 Haynes Street, Suite 107
Raleigh, NC 27604

Date	Description	Words/Lines	Rate	Amount
	Notice of Opportunity for an Infor. Pub. Meeting on the Purchase and or Use of Property for the Restoration of Streams and Wetlands	2x4		$59.60
09-29-2006				

Attorneys placing legal advertising are held responsible for payment. All statements payable 10 days after billing.
Additional copies of this notice will be furnished except upon payment of fee of $15.00.

NORTH CAROLINA
HERTFORD COUNTY

AFFIDAVIT OF PUBLICATION

Before the undersigned, a Notary Public, duly commissioned, qualified, and authorized by law to administer oaths, personally appeared the undersigned representative who being duly sworn, deposes and says that he (she) is an employee or other officer authorized to make this affidavit of Roanoke-Chowan Publications, LLC, engaged in the publication of a newspaper known as the Roanoke-Chowan News-Herald, issued and entered as second class mailing in the Town Ahoskie, N.C., in said county and state; that he (she) is authorized to make this affidavit and sworn statement; and the notice or other legal advertisement, a true copy of which is attached hereto, was published in the Roanoke-Chowan News-Herald on the following date

September 23, 2006

And that the said newspaper in which such notice, paper, document or legal advertisement was published was at the time of each and every such publication, a newspaper meeting all of the requirements and qualifications of Section 1-597 of the General Statutes of North Carolina and was a qualified newspaper within the meaning of Section 1-597 of the General Statutes of North Carolina.

This the 29th day of September, 2006.

Cheryl J. Manley

(Signature of representative making affidavit)

Sworn to and subscribed before me this 29th day of September, 2006.

Donna Jenkins

(Notary Public)
My Commission Expires October 17, 2009

DONNA JENKINS
NOTARY PUBLIC
NORTHAMPTON COUNTY, N.C.

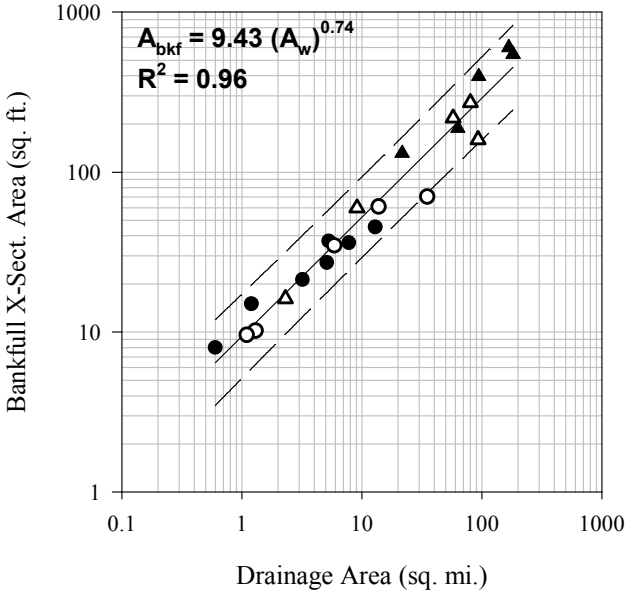
PUBLIC NOTICE

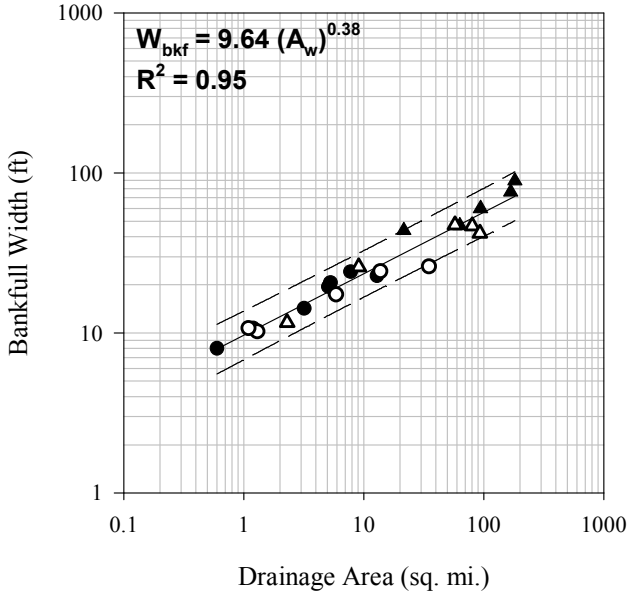
NOTICE OF OPPORTUNITY FOR AN INFORMATIONAL PUBLIC MEETING ON THE PURCHASE AND OR USE OF PROPERTY FOR THE RESTORATION OF STREAMS AND WETLANDS.

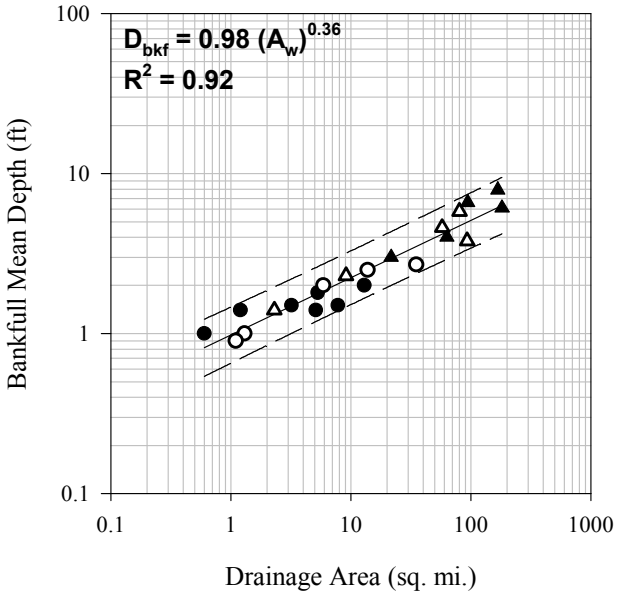
Hertford County – Restoration Systems proposes to purchase and/or use a 23-acre tract of land in Hertford County, North Carolina. The purpose of acquiring and/or using this property is to provide mitigation for impacts to streams and wetlands that will result from existing or future development in this area. Anyone desiring that an informational public meeting be held for this proposed action may make such a request by registered letter c/o Kristen Poillon to Restoration Systems located at 1101 Haynes Street (Suite 107), Raleigh, NC 27604. Request must be made by October 4, 2006. If additional information is required, please contact Kristen Poillon at 919-755-9490. The NC Ecosystem Enhancement Program reserves the right to determine if a public meeting will be held.

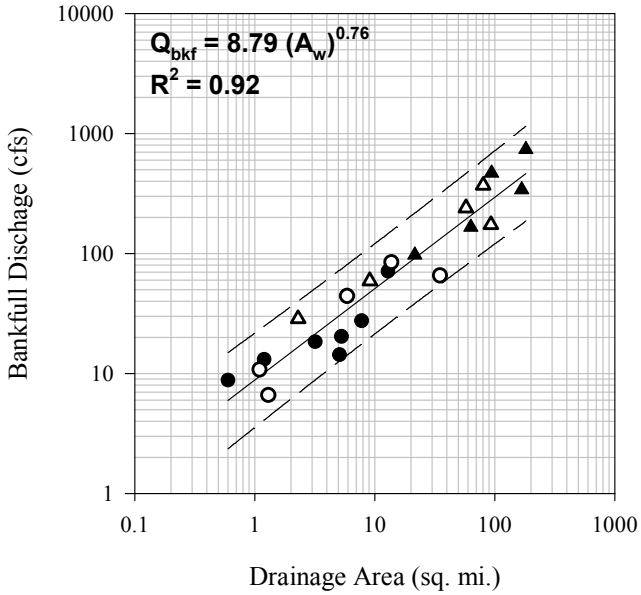
APPENDIX D

North Carolina Coastal Plain Regional Curves









Sweet, W.V and J.W. Geratz. 2003. Bankfull Hydraulic Geometry Relationships and Recurrence Intervals for North Carolina's Coastal Plain. Journal of the American Water Resources Association (JAWRA). 39(4):861-871.

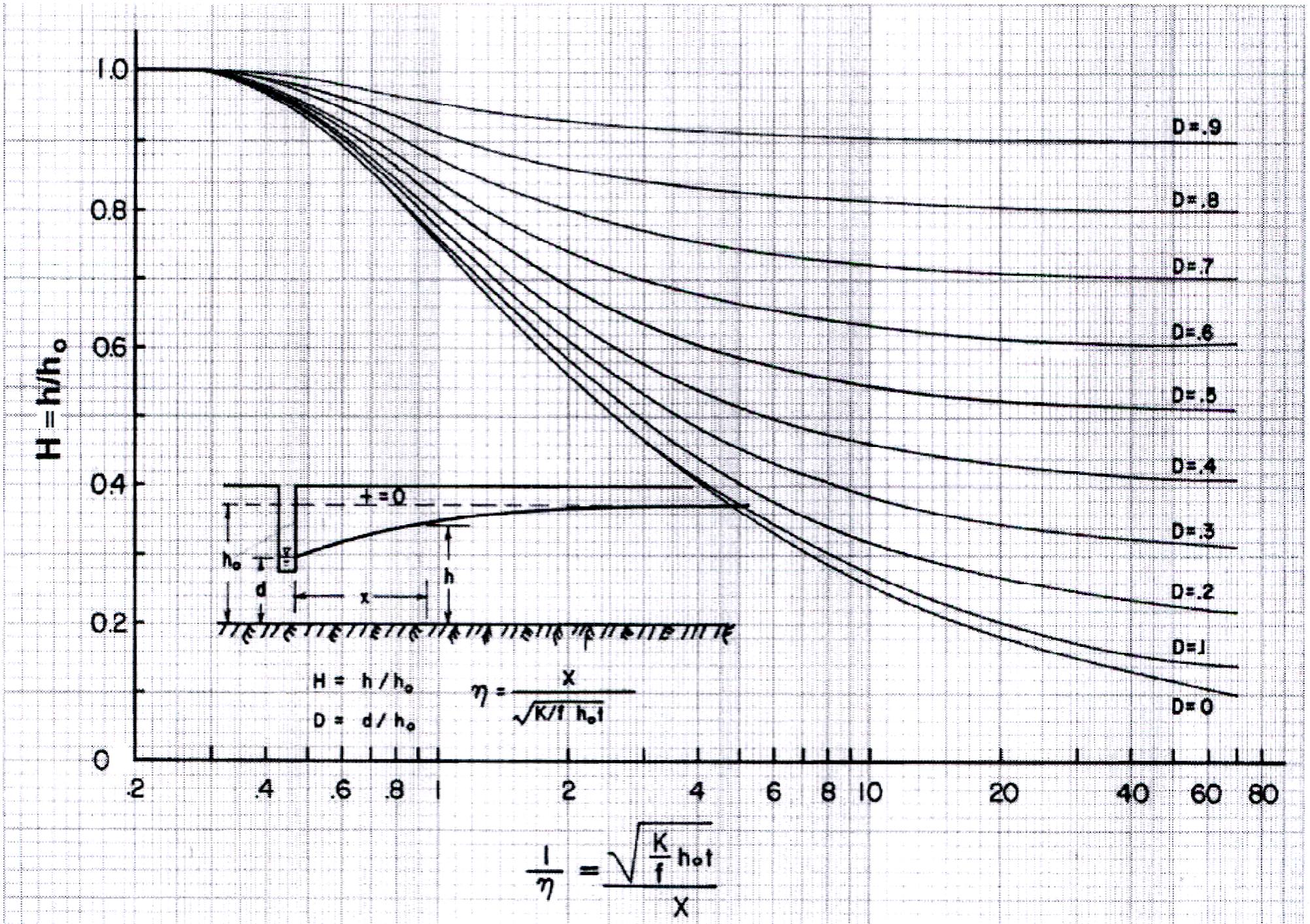
APPENDIX E

Groundwater Model Inputs

DRAINMOD simulation parameters

Reach	Ditch depth (cm)	Depth to impermeable layer (cm)	Hydraulic conductivity (cm/hr) (depth range cm)	Water content in root zone (cm^3/cm^3)	Saturated water content at wilting point (cm^3/cm^3)
Shallow ditch	90	300	9 (0-45) 27 (45-90) 20 (90-300)	0.45	0.33
UT 6' section	180	300	9 (0-45) 27 (45-90) 20 (90-300)	0.45	0.33
UT 8' portion	240	300	9 (0-45) 27 (45-90) 20 (90-300)	0.45	0.33
UT 9' portion	270	300	9 (0-45) 27 (45-90) 20 (90-300)	0.45	0.33
Cutawhiskie Creek	270	300	15 (0-100) 45 (100-300)	0.48	0.22

Root depth = 45 cm, Maximum surface storage = 5 cm, Kirkham's depth = 3 cm, Drainage coefficient 2.5 cm/day



Nondimensional solutions to the Boussineq equation (Skaggs et al. 2005)

Boussinesq equation parameters

Reach	Ditch depth (cm)	d (cm)	h (cm)	h0 (cm)	K (m/hr)	f	t (days)	D	H	1/n
5% of Growing Season										
Shallow ditch	90	210	270	300	0.18	0.036	12	0.7	0.9	0.84
UT 6' section	180	120	270	300	0.19	0.036	12	0.4	0.9	0.63
UT 8' portion	240	60	270	300	0.1925	0.036	12	0.2	0.9	0.6
UT 9' portion	270	30	270	300	0.193	0.036	12	0.1	0.9	0.58
Cutawhiskie Creek	270	30	270	300	0.338	0.04	12	0.1	0.9	0.58
12.5% of Growing Season										
Shallow ditch	90	210	270	300	0.18	0.036	28	0.7	0.9	0.84
UT 6' section	180	120	270	300	0.19	0.036	28	0.4	0.9	0.63
UT 8' portion	240	60	270	300	0.1925	0.036	28	0.2	0.9	0.6
UT 9' portion	270	30	270	300	0.193	0.036	28	0.1	0.9	0.58
Cutawhiskie Creek	270	30	270	300	0.338	0.04	28	0.1	0.9	0.58

Skaggs method parameters

Reach	Ditch depth (cm)	d (cm)	h (cm)	h0 (cm)	K (m/hr)	f	t (days)	D	H	1/n
Shallow ditch	90	210	275	300	0.18	0.036	5.7	0.7	0.917	0.8
UT 6' section	180	120	275	300	0.19	0.036	5.7	0.4	0.917	0.62