AH Environmental Consultants, Inc.

FINAL

WETLANDS ASSESSMENT

Road Shoulder Widening Bodie Island Entrance/ North Carolina State Route 12

Cape Hatteras National Seashore
Dare County North Carolina

Prepared for the

FEDERAL HIGHWAY ADMINISTRATION
and the
NATIONAL PARK SERVICE

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ACRONYMS

E1UB2/3	Estuarine Subtidal Unconsolidated Bottom Sand/Mud
E2SS1	Estuarine Intertidal Scrub-Shrub Broad-leaved Deciduous Wetland
E2EM1	Estuarine Intertidal Emergent Persistent Wetland
EPA	Environmental Protection Agency
FACW	Facultative Wetland Plant Species
FHWA	Federal Highway Administration
HGM	Hydrogeomorphic
NAP	National Action Plan
NC	North Carolina
NC-12	North Carolina State Route 12
NC-158	North Carolina Route 158
NCDENR	North Carolina Department of Environment and Natural Resources
NCNHP	North Carolina Natural Heritage Program
NC WAM	North Carolina Wetland Assessment Method
NRCS	Natural Resources Conservation Service
NPS	National Park Service
OBL	Obligate Wetland Plant Species
PPT	Parts per Thousand
PPM	Parts per Million
SC	Species of Concern
T&E	Threatened and Endangered
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
WFAT	Wetland Functional Assessment Team
WET	Wetland Evaluation Technique

1. INTRODUCTION

The National Park Service (NPS), in cooperation with the Federal Highway Administration (FHWA), proposes to improve North Carolina State Route 12 (NC-12) from Whalebone Junction south for 5.28 miles. This section of NC-12 runs through the Cape Hatteras National Seashore (Seashore). The proposed roadway improvements would include shoulder widening, culvert replacement, and the construction of drainage swales, in addition to milling and paving the existing roadway. Areas with a potential for wetland presence were determined by the NPS and FHWA and were the focus of a wetlands delineation conducted in July 2009. A wetland delineation verification and a jurisdictional determination were finalized by the US Army Corps of Engineers (USACE), Wilmington District on May 3, 2010.

2. PROJECT DESCRIPTION

The study area for the wetlands delineation consisted of a section of the Bodie Island Entrance Road (National Park Service Route 10) which is a portion of NC-12, and is the main access route for park visitors to the three main islands at Cape Hatteras National Seashore, in Dare County, North Carolina. As described in the Park Roads Standards, the road is classified as a Principal Park Road. The posted speed limit along NC-12 is 55 miles per hour and the terrain is relatively flat. The section of road in the study area is two-lane with 11-foot paved lanes and 2-foot paved shoulders plus an additional 12-foot or greater turf shoulder.

As part of the proposed road improvements, the 2-foot paved shoulders along NC-12 from Whalebone Junction to Coquina Beach Access Road, would be widened by 3 feet to provide 5-foot paved shoulders on each side of the roadway. The existing roadway pavement would be milled, and new asphalt would be placed. Associated storm water

treatment features would be re-constructed to treat storm water resulting from the additional impervious surface. Three culverts within the study area would be extended and/or replaced where necessary.

The study area identified with a potential for wetland presence and impacts includes the roadway shoulders approximately 30 feet from the edge of pavement on each side of NC-12 from Station 261+00 to Station 291+70, which is equivalent to 3,070 linear feet along each side of the road (Appendix A). Station numbers refer to the linear distance in feet, stated in surveying/engineering terms, starting from the beginning of the project at the intersection of NC-12 and NC-158 at Whalebone Junction. The station numbers increase correspondingly as one moves south along NC-12. Three culvert locations at approximately Station 97+20, 80', 140+25, 70' and 164+20, 55' are included in the study area. An area of about 4,000 square feet was identified for delineation at each culvert location.

3. GENERAL ECOLOGICAL SETTING

The project site is located along a coastal barrier island complex, with the Atlantic Ocean to the east and the Pamlico Sound estuary to the west. The section of NC-12 included in the study area was constructed on the sound side of Bodie Island, primarily through an upper saltmarsh system. The footprint of the roadway fill varies, but on average is 55 to 60 feet wide. The mowed grassed shoulders provide positive drainage from the roadway surface, and generally have a 3 to 5 percent slope. In many instances the lower edge of the fill slope extends beyond the current limits of shoulder mowing activities. The delineated wetlands located within the 30-foot wide study area range from 0 to 24 feet wide with an average width of approximately 12 feet. The placement of the original roadway fill and subsequent maintenance activities induced permanent changes to the pre-existing upper saltmarsh community. The addition of fill material to elevate the roadway prism severed tidal sheet flow across the marsh, restricted fresh-

water input from the barrier island to the sound, and, as a consequence, altered the floristic composition, especially along the base of the fill. A densely vegetated scrub-shrub "fringe" wetland now exists where a former upper saltmarsh once prevailed. In its current state, this transition zone serves as a buffer between the roadway and the saltmarsh.

Additional anthropogenic changes to the surrounding saltmarsh complex are evidenced by early attempts to provide mosquito control by excavating ditches through the saltmarsh and construction of water control structures and excavations for waterfowl impoundments. Such activities, in part, have permanently changed the ecological zonation on Bodie Island.

4. ASSESSMENT METHODOLOGIES

Wetland assessment procedures are tools that provide either an objective or subjective way of evaluating wetland functions or attributes depending on the desired goal(s) and the methodology selected.

In May 2003, the USACE, North Carolina Division of Water Quality and North Carolina Department of Transportation, along with other State and federal agencies established the NC Wetland Functional Assessment Team (WFAT) to address and develop an accurate, consistent, rapid, observational and scientifically based method for wetland functional assessment. WFAT evaluated over forty different methodologies of wetland functional assessment in the process of developing a methodology specifically for North Carolina. In December 2007 WFAT published the NC Wetland Assessment Method (NC WAM) Draft User Manual, version 5.0. (NCDENR 2007). According to the USACE Wilmington District Regulatory Branch, the proposed NC WAM will not be available for use until calendar year 2010 at the earliest. The draft methodology must first be public noticed and subject to comment, reviewed and revised before fina-

lization. Prior to field implementation, all potential users must be trained by the Wilmington District prior to use (Lexson, per com).

On 16 August 1996 a National Action Plan (NAP) to implement the Hydrogeomorphic (HGM) Approach was published. The NAP was developed by the USACE, US Environmental Protection Agency (EPA), Natural Resources Conservation Service (NRCS), Federal Highway Administration (FHWA), and the US Fish and Wildlife Service (USFWS). The publication was designed to outline a strategy and promote the development of Regional Guidebooks for assessing the functions of regional wetland subclasses using the HGM Approach (USACE 1997). However, no guidebook has yet been developed which is applicable to the coastal estuarine wetlands of the mid-Atlantic region.

The Wetland Evaluation Technique (WET) vol. 2 developed in 1987 has been categorically outdated by the development of HGM methodologies. WET is no longer acceptable for use within the Wilmington District (Lexson, per com).

The vast majority of the wetlands identified within the study area consist of a dense scrub-shrub fringe area located upslope of the saltmarsh at the base of the road fill. In most cases, the width of this linear fringe averages 20-25 feet. On average, approximately 12 feet of the fringe is located within the 30-foot wide study area. Traditional wetland assessment methodologies generally require assessment areas with square or round polygons that comprise much larger areas than those that exist in this linear fringe community. Existing assessment methodologies established for other geographic areas (for example, the Mid-Atlantic Tidal Wetland Rapid Assessment Method, (Mid-Atlantic 2009), require data collection and evaluation within a 50-meter radius and an accompanying 250-meter wide buffer area. Such methodologies would not provide accurate or meaningful results for the linear wetlands situated in this study area.

Based on consultations with the NPS and the FHWA, a suite of wetland functions were identified and a determination made that those functions would be addressed and evaluated using best professional judgment for this wetlands assessment. In addition, it was requested that the NC WAM Field Assessment Form be completed and appended to the wetland assessment. It should be noted that the metrics evaluated on the form are generally applicable to assessments undertaken on larger polygons and the form is not sensitive to finely defined linear assessment areas. The vast majority of the wetlands delineated in the study area average 12 feet or less in width and may include a boundary between two or more wetland types such as estuarine scrub-shrub and estuarine emergent. To complicate matters further, the majority of the delineated wetland area contained estuarine scrub-shrub wetlands and mowed wetlands on the road shoulder within the same narrow polygon. As a consequence, many of the metrics evaluated on the form contain attributes of different wetland types which possess different soil, hydrologic and vegetative conditions clearly definable within the narrow study area. Comparison of data on the form with the information presented in the narrative of this wetlands assessment will be inconsistent in many cases because of the disparity in the scales used. A completed NC WAM Field Assessment Form is provided at Appendix B.

5. SYSTEM CLASSIFICATIONS

Wetlands and ecological systems classification involves the grouping of specified characteristics, such as vegetation, hydrology, soils, animals species present, function, value, to serve specific goals. Classification may be undertaken for mapping, planning, regulatory, mitigation or other purposes. However it should be recognized that classification schemes do not infer any particular attribute or function will occur or at what level.

5.1 COWARDIN CLASSIFICATION

The Estuarine wetland system, as defined by Cowardin, et al. (USFWS 1979), consists of deepwater habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and which ocean water is at least occasionally diluted by freshwater runoff from the land. The salinity may be periodically increased above that of the open ocean by evaporation. The Estuarine wetland system extends upstream and landward to where the ocean-derived salts measure less than 0.5 ppt during the period of average annual low flow, and extends downstream to an imaginary line closing the mouth of a river, bay or sound, and extends to the seaward limit of wetland emergents, shrubs, or trees.

Estuarine tidal fringe wetlands occur along estuaries and rivers that are under the influence of tidal sea level fluctuations. Because tidal fringe wetlands frequently flood and water table elevations are controlled mainly by sea surface elevation, tidal fringe wetlands seldom dry for significant periods. Tidal wetlands lose water by tidal exchange, by overland flow to tidal creek channels and by evapotranspiration.

Two vegetated wetland types were identified in the study area. Over 95 percent of the wetlands are classified as Estuarine intertidal scrub-shrub broad-leaved deciduous (E2SS1) wetlands with the remaining area classified as Estuarine intertidal emergent persistent (E2EM1) wetlands. The non-vegetated open water area within the culvert study areas are classified as Estuarine subtidal unconsolidated bottom sand/mud (E2UB2/3).

5.2 INTERNATIONAL ECOLOGICAL CLASSIFICATION STANDARD

NatureServe (2007) compiled a subset of the International Ecological Classification Standard which covers associations and alliances attributed to Cape Hatteras National Seashore and Cape Lookout National Seashore. The dominant terrestrial ecological classification type encountered within the study area is:

III.Shrubland

III.B.2.N.h. Tidal cold-deciduous shrubland,

A.1023-***Baccharis halimifolia – Iva frutescens*** Tidal Shrubland Alliance.

(CEGL003920) Goundsel-tree – Maritime Marsh-elder – Wax myrtle – (Yaupon) Shrubland

According to NatureServe (2007), the element concept for this standard is stated as follows.

> "This shrubland, dominated by the nominal species, occurs in slightly elevated areas within salt flats and salt marshes as well as in marsh edges throughout much of the East Gulf, South Atlantic, and Mid-Atlantic coastal plains. This community is usually best developed at the upper limit of non-storm tidal inundation, on natural levees deposited by above-normal tides. The most common species are typically ***Baccharis halimifolia*** (eastern baccharis), ***Morella cerifera*** (wax myrtle), ***Iva frutescens ssp. frutescens*** (Jesuit's bark), ***Yucca gloriosa*** (moundlily yucca), ***Juniperus virginiana var. silicicola*** (southern redcedar), ***Lycium carolinianum*** (Carolina desert-thorn), ***Baccharis angustifolia*** (saltwater false willow), and ***Ilex vomitoria*** (yaupon). Other species which may be present include ***Borrichia frutescens*** (bushy seaside tansy), ***Fimbristylis castanea*** (marsh fimbry), ***Limonium carolinianum*** (Carolina sealavender) and ***Solidago sempervirens*** (seaside goldenrod)."

A small area of herbaceous saltmarsh was located on the west side of culvert D (Station 140-25). The dominant terrestrial ecological classification type encountered within the study area is:

V. Herbaceous Vegetation

V.A.5.N.n. Tidal temperate or subpolar grassland

A.1471-*Spartina alterniflora* Tidal Herbaceous Alliance

(CEGL004191) Saltmarsh Cordgrass Carolinian Zone Herbaceous Vegetation

According to NatureServe (2007), the element concept for this standard is stated as follows.

> "This vegetation includes various tidal marshes dominated by *Spartina alterniflora* (smooth cordgrass), from Cape Hatteras, North Carolina, south to the Atlantic Coast of the Florida peninsula. The hydrology is usually regularly tidally flooded. *Spartina alterniflora* (smooth cordgrass) is limited to the low marsh zone by moderate salinity; it can withstand longer submergence than other salt marsh grasses, but still requires periodic exposure of the substrate. It also requires moderately high levels of iron (7-15 ppm). This community is commonly known as the 'low salt marsh, 'occurring as a tall grassland strongly dominated by *Spartina alterniflora* (smooth cordgrass). There is little variation in vascular plant species composition across the range. *Spartina alterniflora* (smooth cordgrass) occurs in nearly pure stands, occasionally with other low stature species."

6. ASSESSMENT FUNCTIONS

Four (4) functions (biotic and hydrologic) and values (cultural and economic), were selected in accordance with the NPS Procedural Manual Section 5.3.3. and were evaluated. Individual evaluation components for each function or value describes attributes which are applicable to the wetlands situated within the study area. They include the various elements which are applicable to all three Cowardin wetland types, where appropriate.

6.1 BIOTIC FUNCTIONS

Wetlands provide habitat for a diverse array of plants and animals ranging from large mammals to invertebrates (including algal and microbial populations) in the soil.

6.1.1 Fish and Wildlife Habitat

Habitat is an ecological or environmental area that is inhabited by a particular species. It includes all aspects of the physical and biological components within a species range that interact with, and influence, the life cycle of that species. Use of a habitat may be subject to continual use by resident species, used intermittently by migratory species, or used only for certain life cycle requirements such as breeding or rearing of young. The diversity of plant community structure, hydroperiod, depth of water, edaphic conditions, weather and other bio-geochemical conditions all interact to produce habitats that are favored by some species and unusable by others. Three separate community types were identified in the study area. These included two plant communities; an estuarine scrub-shrub community, a herbaceous saltmarsh and non-vegetated open water community. Some portions of the scrub-shrub wetlands are routinely mowed and provide limited foraging habitat for grazers such as the white tailed deer and rabbit. Because of the close proximity of these varied habitat types, many species of animals are able to find suitable habitats within very short distances.

6.1.2 Amphibians and Aquatic Invertebrates

All amphibians and many reptiles are dependent on aquatic habitats at some stage in their life cycle. Most species are primary or secondary carnivores and feed on a wide variety of animal matter from tiny insects to medium-sized animals (both warm and cold blooded), fishes and birds. The invertebrate fauna, including insects, nematodes and mollusks are import processors of organic material and sources of food for higher levels consumers. Many species of amphibians and reptiles endemic to the Seashore spend considerable time foraging and hiding in the wetlands and associated buffer

zones since the biodiversity and population densities of prey species in these habitats tend to be relatively high. The close proximity to varied upland zones adjacent to wetlands provides many species of amphibians the necessary suite of habitats to complete their life cycles. The scrub-shrub wetlands located in the study area provide important foraging habitat and escape cover for many of the amphibian and reptilian species which inhabit the Seashore. The mowed scrub-shrub wetlands parallel to the roadway provides little or no opportunity to support amphibian or reptile habitat. The subtidal and intertidal communities prevalent at the culvert study sites provide important habitat for aquatic invertebrates and additional foraging areas for amphibians and reptiles.

6.1.3 Floral Productivity

Stem density, species diversity, patterns of distribution, dominance and plant vigor vary substantially across the topographic and hydrologic gradients of a saltmarsh. Biogeochemical constituents of the local habitat, especially edaphic conditions, provide additional selective input or stress on a plant's physiology and potential reproductive success. Plant type (annual or perennial) and seasonal timing of emergence and anthesis (flowering) also play an important role in the perpetuation of any particular species. At the lower topographic and hydrologic gradients of the saltmarsh, few species can tolerate the high salt concentration of estuarine waters close to the ocean. As a consequence, only those species which are typically adapted to withstand high salinity concentrations will survive and reproduce, such as smooth cordgrass (*Spartina alterniflora*). As the elevation increases and the hydroperiod and salinity concentrations decrease, additional plant species can successfully compete for available resources. Plant species occurrence and dominance data collected during the wetland delineation documented approximately a one to one distribution between annual and perennial species across the study area. Herbaceous ground cover averaged between 98-100 percent in the open marsh. The transition zone between the saltmarsh and the upland is usually devoid of saline water, except during storm surges. The scrub-shrub wetlands in the transition zone support a large number of species, however, perennial species

dominate and the development of a canopy generally shades out annuals which usually require unrestricted sunlight for survival. This shift in floral productivity is a clear indication that the estuarine ecosystem, which includes the important transition (buffer) zone, is in healthy condition, and biomass productivity appears to be high.

6.1.4 Non-Native Plant Species

Saltmarsh fringe wetlands typically support plant communities with greater species richness and diversity than the low or high saltmarsh due to changes in topographic, edaphic and hydrologic gradients. The number of facultative wetland species increases steadily as the sustaining hydroperiod decreases. These transition zones, especially in areas subject to anthropogenic changes, also have a tendency to be highly susceptible to pioneering invasive species. Non-native invasive species that have the ability to outcompete and exclude native species, such as the common reed (*Phragmites australis*), and may pose a serious threat to native plant species and communities. The presence of non-native or invasive plant species is considered an indicator of site degradation. As the number of non-native or invasive plant species increases, the functions and values of the native plant community usually diminish. Table 1 lists the non-native and invasive plant species identified in the wetland study areas at the time the wetland delineation was conducted. Appendix C provides a listing of the non-native and invasive plant species identified for the State of North Carolina.

Table 1. Non-Native and Invasive Species Identified in the Study Area

Scientific Name	Common Name	Growth Form
Arthraxon hispidus	Hairy jointgrass	grass
Loniceria japonica	Japanese honeysuckle	vine
Phragmites australis	Common reed	grass

Hairy jointgrass was located in, and generally confined to, the wetland and non-wetland areas in the mowed road shoulder or in the edges of the scrub-shrub fringe adjacent to the roadway. In many locations it was a dominant species. Japanese honeysuckle was found occasionally in the scrub-shrub fringe, but not a dominant species. The common reed was located at along the edges of the fringe scrub-shrub fringe and the culvert study areas. Small monotypic stands were identified at culvert study area E (Appendix A).

6.1.5 Threatened and Endangered Species

The presence of any threatened or endangered species (T&E) was not observed at the time the wetland delineation was conducted. A listing of T&E species and species of concern (SC) obtained from the North Carolina Natural Heritage Program identified twenty (20) State listed plant and animal species and thirteen (13) federally listed species for Dare County, North Carolina (Appendix D). The wetlands identified in the study area do not include any critical habitat or provide any suitable nesting, foraging or escape cover for the federally listed animal species. Only one federally listed plant, seabeach amaranth (*Amaranthus pumilus*) occurs in Dare County, however its habitat is restricted to the xeric sandy soil conditions which prevail in the fore- and inter-dunal habitats adjacent to the Atlantic Ocean. Woolly beachheather (*Hudsonia tomentosa),* a Federal Species of Concern and a state Significantly Rare plant species, was detected present immediately adjacent to the project area and on xeric soils with little canopy cover; however, no individual were detected within the project area (Margaret Carfioli, per com). Four (4) of the seven (7) State listed plant species are considered hydrophytes. They include saltmarsh spikerush (*Eleocharis halophia*) (OBL), Carolina grasswort (*Lilaeposis carolinensis*) (OBL), small-flowered hemicarpha (*Lipocarpha micrantha)* (OBL), and snowy orchid (*Plantanthera nivea*) (FACW). The latter two species are only known from historical records. All four species require wide open habitats with unrestricted ultraviolet light penetration. No suitable habitat exists in the scrub-shrub wetlands of the study area for these species. None of the State listed T&E

animal species would find suitable habitat for nesting, foraging or escape cover in the wetlands located in the study area.

6.1.6 Habitat Diversity

Habitat diversity is made up of several components, but vegetative diversity is the most easily recognized. The greater the number of plant species per unit area the greater the vegetative diversity. Diverse plant communities increase the likelihood that some of the plants that serve as required food and cover species for a particular wildlife species are present. The NPS has documented over 1000 species (including subspecies) of plants which have been identified on the 30,000+ acres of the Cape Hatteras National Seashore. The development of varied habitat types across narrow spatial scales is the result, in part, of interactions among other factors such as geologic setting, landscape position, latitude, elevation, hydrological influences, bio-geochemical components, soils, climate and anthropogenic changes. The distribution of habitat types is important. Numerous habitat types which create a landscape mosaic are usually desirable. This is particular true in coastal plain estuarine systems. Habitat types identified within the study areas include subtidal estuarine bottom, non-vegetated intertidal zones, low saltmarsh, high saltmarsh, estuarine scrub-shrub, sandy backdune barrier island uplands, and upland communities which have developed on dredged spoils. Although some of the habitats identified in the study area are the direct result of anthropogenic manipulations, they also provide a variety of habitats which may be important to certain animal species on the Seashore. In contrast, the mowed scrub-shrub wetlands parallel to the roadway provides little to the quality of habitat diversity within the study area.

6.2 HYDROLOGIC FUNCTIONS

Hydrology is the driving force that maintains the unique characteristics of wetlands, including hydric soils and hydrophytic vegetation, and which differentiates wetlands from uplands. Hydrology is fundamental to supporting numerous functions which de-

fine a wetland's plant and animal composition, richness, physical borders and nutrient cycling.

6.2.1 Flood Attenuation

Wetlands located near roadsides have the potential to provide an increased function of flood attenuation because they help compensate for the related increase in impervious cover of the roadway. Since storm water runoff flows more quickly off impervious surfaces, wetlands serve to slow runoff velocities before entering open water areas. The wetland transition zone situated between the herbaceous wetland flats and the roadway of NC-12 provide additional flood storage capacity, which is an important function during severe storm events. This function offsets the loss of flood storage capacity of the high saltmarsh when fill was placed for roadway construction.

6.2.2 Groundwater Recharge and Discharge

The linear scrub-shrub wetlands identified in the study area parallel to NC-12 are extremely narrow in width, but more importantly, are situated in a zone which is only slightly higher in elevation above the existing broad and extensive saltmarsh, and only slightly lower than the imperious road surface. As such, these wetlands have little or no opportunity to function as a ground water recharge area above and beyond the capacity of the extensive saltmarsh which they buffer. No groundwater discharge occurs in these wetlands since no source of groundwater, with any substantive hydraulic head, is available.

6.2.3 Erosion and Sediment Control

Wetland plants bind soil with their roots systems and thus help hold the soil in place in the face of erosive forces. The above ground structure, coupled with the loosely aggregated soil surface, function to slow runoff velocities and provide opportunity for infiltration. Reduced runoff velocities decrease the erosive forces acting upon the soil

surface. Further, the reduced velocities induce sedimentation of the suspended particles. The scrub-shrub wetlands in the study area are generally located at the base of the maintained road shoulder. These wetlands perform the very important function of erosion and sedimentation control by slowing runoff generated from the roadway. Any sediments generated upslope from the roadway and/or road shoulder are quickly retained within the scrub-shrub wetland zone.

6.2.4 Water purification – Nonpoint Source Pollution

Wetlands located near roadsides provide important functions in terms of storm water purification. The wetlands help cleanse the runoff by absorbing deleterious constituents generated from vehicles and the asphalt roads themselves. Nutrients, pesticides, herbicides, petroleum based products and other wastes are absorbed, stored, and transformed into useable forms by, and for, other organisms. The above ground plant structure also helps to reduce surface sheet flow velocities, thereby increasing the resident time of the runoff, which in turn increases the rate and duration of infiltration into the soil. Long-term storage of nutrients and other compounds is facilitated by the development of above-ground woody biomass and below-ground roots in tree and shrub species. The scrub-shrub wetlands occupying the zone parallel to NC-12 play an important role in removing and sequestering nutrients and pollutants before they enter the open water column of the estuary.

6.3 CULTURAL VALUES

The wetlands in the study area are situated immediately adjacent to NC-12, which is the primary access road for visitors and residents throughout the islands of the Cape Hatteras National Seashore. In particular, the extensive scrub-shrub wetlands which parallel the roadway, provide an aesthetically pleasing view of the natural buffer and transition into the larger saltmarsh system. The cultural value of the wetlands within the study area is intrinsically high due to their location within the Seashore and other national treasure historic landmark sites located nearby.

Cape Hatteras National Seashore was the nation's first national seashore, established in 1937. The National Park Service preserves and protects the Seashore's dynamic barrier islands and the ongoing natural processes which sustain them while also providing for recreational use and enjoyment compatible with the preservation and protection of the park's resources. The Seashore is significant because it is part of a natural system with a geologic process unique to barrier islands-characterized by constant change both seasonally and daily, subtle and dramatic. It's diversity of ecological habitats (including beach, dunes, maritime forest, inlets, freshwater wetlands, salt marshes, and tidal flats) historically influenced the livelihood and activities of Native American life, self-sufficient and isolated island communities, waterfowl hunting camps, commercial fisheries, lighthouses, U.S. Life Saving Stations, U.S. Coast Guard Stations, shipwrecks, military structures and sites, a U.S. Weather Station, and sites associated with the Civilian Conservation Corps. Today, the Seashore is an outdoor recreational resource offering outstanding opportunities for hiking, camping, boating, sailing, nature study, solitude and reflection, beach combing, fishing, hunting, shellfishing, swimming, birding, biking, picnicking and many other leisure activities. It is an educational resource offering outstanding opportunities for visitors and educational groups to learn about the significance of the park's natural and cultural resources in the past, currently, and in the future (NPS 2007).

6.4 ECONOMIC VALUES

Wetlands are important ecosystems that provide numerous goods and services that have an economic value, not only to the local population living in its periphery, but also to communities living outside the wetland area. They are important sources for food and provide valuable services such as water treatment and purification, erosion control and flood protection.

6.4.1 Flood Protection

Flood protection and attenuation are functional benefits that wetlands perform. Landscape position and anthropogenic changes within the watershed dictate, in part, the ability of any particular wetland to perform those functions. Sections of NC-12 in the study area were constructed through an estuarine complex, bisecting the continuity of some functions. Hydrologic connectivity of surface waters located on the east side of the roadway is maintained only through a number of sporadically placed culverts. Sheet flow of flood waters has been eliminated across the saltmarsh complex to the east side of the roadway, however the wetlands continue to provide flood protection, storm water storage, and attenuation functions. Once water levels rise above the herbaceous saltmarsh, the scrub-shrub wetlands provide additional benefits by further reducing velocities and wave energies acting on the shoulder fill of the roadway. The estuarine complex, located both inside and outside of the study area, provides substantial economic benefits to the public and the National Park Service by protecting NC-12 from erosive and destructive forces associated with storm surges and flooding.

6.4.2 Fisheries

Fish use both open water and near shore aquatic habitats over a variety of scales for refuge, reproduction, feeding and other functions. In turn, they serve as vehicles for nutrient cycling and energy transfer across habitats at a number of levels in the food web. The only open water areas with a direct connection to the Pamlico Sound are located at culvert study sites C and D. The connections were created by extensive ditching through the saltmarsh for the purpose of mosquito control or to facilitate improved upland drainage, or both. The only fish species observed during the field work conducted in July 2009 was the mummichog (*Fundulus heteroclitus*), also known as the killifish. The mummichog is an important food source for larger fish and is often used as bait. The mummichog also has been used as a natural method of mosquito control in marsh ponds and ditches. It has been reported that one mummichog can eat

as many as 2,000 mosquito larvae ("wrigglers") a day. The mummichog also feeds on other insects, small fish, crustaceans, and plant material. It is anticipated that no commercially valuable fish species, such as stripped bass or flounder would use the habitat located at the head of the ditch culvert sites C and D.

7. SUMMARY

The wetland delineation conducted in July 2009 identified 51,278 square feet of jurisdictional waters and wetlands in the study area. Approximately 95% of the vegetated wetlands were comprised of estuarine scrub-shrub wetlands (E2SS1). The remaining portion supported a mixture of estuarine intertidal persistent herbaceous wetlands (E2EM1) and estuarine subtidal unconsolidated bottom sand/mud (E2UB2/3). Most of the scrub-shrub wetlands have recently developed as a result of fill placed in a high saltmarsh community for the original construction of NC-12. Other anthropogenic activities have further altered the saltmarsh community complex which have resulted in the development of different wetlands types (i.e. conversion of herbaceous highmarsh to scrub-shrub), creation of small upland habitats and changes in hydrologic conductivity in the marsh complex. While changes may be viewed as deleterious to the overall continuity of the highmarsh complex, the changes have resulted in the development of varied aquatic and upland habitats. This mosaic of habitats provides habitat diversity and bio-chemical functions which did not exist prior to construction of the road. The altered habitats exist in a relatively stable state and are available for use by a wide range of species. The scrub-shrub wetland fringe adjacent to the roadway is mature and appears to be functioning at levels equivalent to similar natural wetlands located nearby the study area. The mowed scrub-shrub wetlands located in the roadway shoulder provide little opportunity to perform any biotic function and only marginal hydrologic functions.

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APPENDIX A
AERIAL PHOTOGRAPH AND LOCATION MAP


Whalebone Junction
N
Culvert Study Area
Section C
Culvert Study Area
Section D
Culvert Study Area
Section E
NC -12
Study Area
Sections A & B
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2009 TerraMetrics
Image USDA Farm Service Agency
Image © 2009 DigitalGlobe
©2009 Google
Imagery Dates: Aug 7, 2004 - Jul 2006
35°52'03.18" N 75°37'07.07" W
Eye alt 44935 ft

APPENDIX B
NC WAM FIELD ASSESSMENT FORM

NC WAM FIELD ASSESSMENT FORM
VERSION 3.13 (January 12, 2007)

Wetland Site Name	CAPE HATTERAS N.S.	Date	12-16-09
Wetland Type	ESTUARINE	Assessor Name/Organization	R. HAROLD JONES, PWS
Level III Ecoregion	63g	Nearest Named Water Body	PAMLICO SOUND
River Basin	PAMLICO	USGS 8-Digit Catalogue Unit	03020105
☐ Yes ☒ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	35°50'09" N 75°33'39" W

Evidence of stressors affecting the assessment area (may not be within the assessment area)

Please circle and/or make note below if evidence of stressors is apparent. Consider departure from reference, if appropriate, in recent past (for instance, within 10 years). Noteworthy stressors include, but are not limited to the following.

- Hydrological modifications (examples: ditches, dams, beaver dams, dikes, berms, ponds, etc.)
- Surface and sub-surface discharges into the wetland (examples: discharges containing obvious pollutants, presence of nearby septic tanks, underground storage tanks (USTs), hog lagoons, etc.)
- Signs of vegetation stress (examples: vegetation mortality, insect damage, disease, storm damage, salt intrusion, etc.)
- Habitat/plant community alteration (examples: mowing, clear-cutting, exotics, etc.)

Is the assessment area intensively managed? ☒ Yes ☒ No

Describe effects of stressors that are present. PORTIONS OF THE ASSESSMENT ARE LOCATED ALONG THE SHOULDER OF ROADWAY (NC-12) THAT IS REGULARLY MOWED.

Regulatory Considerations

Select all that apply to the assessment area.

- ☒ Anadromous fish
- ☐ Federally protected species or State endangered or threatened species
- ☐ NCDWQ riparian buffer rule in effect
- ☒ Wetland adjacent to or associated stream drains to a Primary Nursery Area
- ☒ Publicly owned property
- ☒ N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
- ☐ N.C. Division of Water Quality best usage classification of SA or supplemental classifications of HQW, ORW, or Trout
- ☐ Designated NCNHP reference community

What type of natural stream is associated with the wetland, if any? (Check all that apply)

- ☐ Blackwater
- ☐ Brownwater
- ☒ Tidal (if tidal, check one of the following boxes) ☒ Lunar ☐ Wind ☐ Both

Is the assessment area on a coastal island? ☒ Yes ☐ No

Is the assessment area's surface water storage capacity or duration substantially altered by beaver? ☐ Yes ☒ No

1. **Ground Surface Condition/Vegetation Condition – assessment area condition metric**

Check a box in each column. Consider alteration to the ground surface (GS) in the assessment area and vegetation structure (VS) in the assessment area. Compare to reference wetland if applicable (see User Manual v1.0). If a reference is not applicable, then rate the assessment area based on evidence of alteration.

GS	VS	
☒A	☒A	Not severely altered
☐B	☐B	Severely altered over most of the assessment area (ground surface alteration examples: vehicle tracks, excessive sedimentation, fire-plow lanes, skidder tracks, bedding, fill, soil compaction, obvious pollutants) (vegetation structure alteration examples: mechanical disturbance, herbicides, salt intrusion [where appropriate], exotic species, grazing, less diversity [if appropriate], artificial hydrologic alteration)

2. **Surface and Sub-Surface Storage Capacity and Duration – assessment area condition metric**

Check a box in each column. Consider surface storage capacity and duration (Surf) and sub-surface storage capacity and duration (Sub). Consider both increase and decrease in hydrology. Refer to the NRCS Scope and Effect Guide (see User Manual v1.0 Appendix G) for North Carolina hydric soils for the zone of influence of ditches in hydric soils. A ditch ≤ 1 foot deep is considered to affect surface water only, while a ditch > 1 foot deep is expected to affect both surface and sub-surface water. Consider tidal flooding regime, if applicable.

Surf	Sub	
☐A	☐A	Water storage capacity and duration are not altered.
☒B	☒B	Water storage capacity or duration are altered, but not substantially (typically, not sufficient to change vegetation).
☐C	☐C	Water storage capacity or duration are substantially altered (typically, alteration sufficient to result in vegetation change) (examples: intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, stream incision, sewer lines, soil compaction).

3. **Water Storage/Surface Relief – assessment area/wetland type condition metric**

Check a box in each column. Select the appropriate storage for the assessment area (AA) and the wetland type (WT).

AA	WT	
☐A	☐A	> 50% of the wetland type with depressions able to pond water > 2 feet
☐B	☐B	> 50% of the wetland type with depressions able to pond water 1 to 2 feet
☐C	☐C	> 50% of wetland type with depressions able to pond water 6 inches to 1 foot
☐D	☐D	> 50% of wetland type with depressions able to pond water 3- to 6-inches deep
☒E	☒E	Depressions able to pond water < 3-inches deep

4. **Soil Texture/Structure – assessment area condition metric**

Select all that apply. Dig soil profile in the dominant assessment area landscape feature. Make soil observations within the top foot. National Technical Committee for Hydric Soils regional indicators are noted (use most recent guidance).

- [X] A Sandy soil
- [X] B Predominantly characterized by mottled (redoxymorphic features), mineral soil (F6, F8, F12, TF10, S5, S6)
- [ ] C Predominantly characterized by other, mineral soil (no mottling)
- [ ] D Gleyed mineral soil (F2, S4)
- [X] E Soil ribbon < 1 inch
- [ ] F Soil ribbon ≥ 1 inch
- [ ] G No peat or muck presence
- [X] H A peat or muck presence (A6, A7, A8, A9, A10, F1, S1)
- [X] I Peat or muck soil (histosol or histic epipedon) (A1, A2, A3)

5. **Discharge into Wetland – opportunity metric**

Check a box in each column. Consider surface pollutants or discharges (Surf) and sub-surface pollutants or discharges (Sub). Examples of sub-surface discharges include presence of nearby septic tank, underground storage tank (UST), etc.

Surf	Sub	
[X] A	[X] A	Little or no evidence of pollutants or discharges entering the assessment area
[ ] B	[ ] B	Noticeable evidence of pollutants or discharges entering the wetland and stressing, but not overwhelming the treatment capacity of the assessment area
[ ] C	[ ] C	Noticeable evidence of pollutants or discharges (pathogen, particulate, or soluble) entering the assessment area and potentially overwhelming the treatment capacity of the wetland (water discoloration, dead vegetation, excessive sedimentation)

6. **Land Use – opportunity metric**

Check all that apply. Evaluation of this metric involves a GIS effort with field adjustment. Consider sources draining to assessment area within entire upstream watershed (WS), within 5 miles and within the watershed draining to the assessment area (5M), and within 2 miles and within the watershed draining to the assessment area (2M). Effective riparian buffers are considered to be 50 feet wide in the Coastal Plain and Piedmont and 30 feet wide in the Mountains.

WS	5M	2M	
[ ] A	[ ] A	[ ] A	> 30% impervious surfaces with stormwater Best Management Practices (BMPs) (land use examples: industrial, commercial, and high-density residential)
[ ] B	[ ] B	[ ] B	> 30% impervious surfaces without stormwater BMPs
[ ] C	[ ] C	[ ] C	10 to 30% impervious surfaces
[X] D	[X] D	[X] D	< 10% impervious surfaces
[ ] E	[ ] E	[ ] E	Old urban development (pink areas on USGS 7.5-minute quadrangles)
[X] F	[X] F	[X] F	New adjacent development
[ ] G	[ ] G	[ ] G	Confined animal operations (or other local, concentrated source of pollutants)
[ ] H	[ ] H	[ ] H	≥ 20% coverage of pasture without riparian buffer
[ ] I	[ ] I	[ ] I	≥ 20% coverage of pasture with effective riparian buffer
[ ] J	[ ] J	[ ] J	≥ 20% coverage of agricultural land (regularly plowed land) without riparian buffer
[ ] K	[ ] K	[ ] K	≥ 20% coverage of agricultural land (regularly plowed land) with effective riparian buffer
[ ] L	[ ] L	[ ] L	≥ 20% coverage of maintained grass/herb
[ ] M	[ ] M	[ ] M	Silvicultural land with disturbance < 5 years old
[ ] N	[ ] N	[ ] N	Little or no opportunity. Lack of opportunity may result from hydrologic modifications that prevent drainage or overbank flow from affecting the assessment area.

7. **Wetland Acting as Vegetated Buffer – assessment area condition metric**

Is the assessment area within 50 feet of a stream or other open water? ("open water" does not include man-made ditches or canals)

[ ] Yes [X] No If No, skip to next metric.

Stream width (Stream width is normal flow width [ordinary high water to ordinary high water]). If the stream is anastomosed, combine widths of channels/braids for a total stream width.

[ ] ≤ 15-feet wide [ ] > 15-feet wide [X] Not Applicable

Do roots of assessment area vegetation extend into the bank of the adjacent stream/open water?

[X] Yes [ ] No

Is stream or other open water sheltered or exposed?

[ ] Sheltered – adjacent open water with width < 2500 feet and no regular boat traffic.

[X] Exposed – adjacent open water with width ≥ 2500 feet or regular boat traffic.

8. **Wetland/Riparian Buffer Width – assessment area/wetland type/wetland complex metric**

Check a box in each column. Select the appropriate width for the wetland type at the assessment area (WT), the wetland complex (WC), and the riparian buffer at the assessment area (RB) (if applicable). Riparian buffer width is measured from top of bank and need only be present on one side of the water body. The riparian buffer is measured from the outside banks of the outer channels of an anastomosed system. Make buffer judgment based on dominant landscape feature. Record a note if a portion of the buffer has been removed or disturbed.

WT	WC	RB (if applicable)	
[X] A	[X] A	[ ] A	≥ 100 feet
[ ] B	[ ] B	[ ] B	From 80 to < 100 feet
[ ] C	[ ] C	[ ] C	From 50 to < 80 feet
[ ] D	[ ] D	[ ] D	From 40 to < 50 feet
[ ] E	[ ] E	[ ] E	From 30 to < 40 feet
[ ] F	[ ] F	[ ] F	From 15 to < 30 feet
[ ] G	[ ] G	[ ] G	From 5 to < 15 feet
[ ] H	[ ] H	[ ] H	< 5 feet

9. **Inundation Duration – assessment area condition metric**

Answer for assessment area dominant landform.

- ☐A Evidence of short-duration inundation (< 7 consecutive days)
- ☐B Evidence of saturation, without evidence of inundation
- ☒C Evidence of long-duration inundation (7 to 30 consecutive days or more)

10. **Indicators of Deposition – assessment area condition metric**

Consider recent deposition only (no plant growth since deposition).

- ☒A Sediment deposition is not excessive, but at approximately natural levels.
- ☐B Sediment deposition is excessive, but not overwhelming the wetland.
- ☐C Sediment deposition is excessive and is overwhelming the wetland.

11. **Wetland Size – wetland type/wetland complex condition metric**

Check a box in each column. Involves a GIS effort with field adjustment. This metric evaluates three aspects of the wetland area: the size of the wetland type (WT), the size of the contiguous wetland complex (WC), and the size of the contiguous, forested wetland (FW) (if applicable, see User Manual). Boundaries are formed by uplands, four-lane roads, or urban landscapes. An observed beaver pond forms a boundary if it extends across the entire width of the floodplain. Additionally, other wetland types are considered boundaries for column WT. If assessment area is clear-cut, select "K" for FW column.

WT	WC	FW (if applicable)	
☐A	☒A	☐A	≥ 500 acres
☐B	☐B	☐B	From 100 to < 500 acres
☐C	☐C	☐C	From 50 to < 100 acres
☐D	☐D	☐D	From 25 to < 50 acres
☐E	☐E	☐E	From 10 to < 25 acres
☒F	☐F	☐F	From 5 to < 10 acres
☐G	☐G	☐G	From 1 to < 5 acres
☐H	☐H	☐H	From 0.5 to < 1 acre
☐I	☐I	☐I	From 0.1 to < 0.5 acre
☐J	☐J	☐J	From 0.01 to < 0.1 acre
☐K	☐K	☐K	< 0.01 acre

12. **Wetland Intactness – wetland type condition metric (evaluate for Pocosins only)**

- ☒A Wetland type is the full extent (≥ 90%) of its natural landscape size.
- ☐B Wetland type is < 90% of the full extent of its natural landscape size.

13. **Connectivity to Other Natural Areas – landscape condition metric**

Check appropriate box(es). This metric refers to the landscape patch, the contiguous naturally vegetated area and open water (if appropriate) that includes the wetland type. Boundaries are formed by four-lane roads, urban landscapes, maintained fields (pasture and agriculture), or open water > 300 feet wide. Consider if the wetland type is well-connected (WC) or loosely-connected (LC) to the landscape patch.

WC	LC	
☒A	☐A	≥ 500 acres
☐B	☐B	From 100 to < 500 acres
☐C	☐C	From 50 to < 100 acres
☐D	☐D	From 10 to < 50 acres
☐E	☐E	< 10 acres
☐F	☐F	Wetland type has a poor or no connection to other natural habitats

Check Yes or No.

- ☒Yes ☐No Does wetland type have a surface hydrology connection to open waters or tidal wetlands? (evaluate for marshes only)
- ☒Yes ☐No Is the assessment area subject to overbank flooding during normal conditions?

14. **Edge Effect – wetland type condition metric**

Estimate distance from wetland type boundary to artificial edges. Artificial edges include permanent features such as fields, development, two-lane or larger roads (≥ 40-feet wide), utility line corridors wider than a two-lane road, and clear-cuts < 10 years old. Consider the eight main points of the compass.

- ☐A No artificial edge within 150 feet in all directions
- ☐B No artificial edge within 150 feet in four to seven directions
- ☒C An artificial edge occurs within 150 feet in more than four directions or assessment area is clear-cut

15. **Vegetative Composition – assessment area condition metric (skip for marshes and Pine Flat)**

- ☐A Vegetation is close to reference condition in species present and their proportions. Lower strata composed of appropriate species, with exotic plants absent or sparse within the assessment area.
- ☒B Vegetation is different from reference condition in species diversity or proportions, but still largely composed of native species characteristic of the wetland type. This may include communities of weedy native species that develop after clearcutting or clearing. It also includes communities with exotics present, but not dominant, over a large portion of the expected strata.
- ☐C Vegetation severely altered from reference in composition. Expected strata are unnaturally absent or dominated by exotic species or composed of planted stands of non-characteristic species or inappropriately composed of a single species.

16. **Vegetative Diversity – assessment area condition metric (evaluate for Non-tidal Freshwater Marsh only)**

- ☒A Vegetation diversity is high and is composed primarily of native species.
- ☐B Vegetation diversity is low or has > 10% cover of exotics.
- ☐C Vegetation is dominated by exotic species.

17. Vegetative Structure – assessment area/wetland type condition metric

☐ Vegetation present

Evaluate percent coverage of vegetation for marshes only

☒A ≥ 25% coverage of vegetation
☐B < 25% coverage of vegetation

Check a box in each column for each stratum. Evaluate this portion of the metric for non-marsh wetlands. Consider structure in airspace above the assessment area (AA) and the wetland type (WT) separately.

AA	WT	
☐A	☐A	Canopy closed, or nearly closed, with natural gaps associated with natural processes
☐B	☐B	Canopy present, but opened more than natural gaps
☒C	☒C	Canopy sparse or absent
☐A	☐A	Dense mid-story/sapling layer
☒B	☒B	Moderate density mid-story/sapling layer
☐C	☐C	Mid-story/sapling layer sparse or absent
☐A	☐A	Dense shrub layer
☒B	☒B	Moderate density shrub layer
☐C	☐C	Shrub layer sparse or absent
☐A	☐A	Dense herb layer
☒B	☒B	Moderate density herb layer
☐C	☐C	Herb layer sparse or absent

☐ Vegetation absent

18. Snags – wetland type condition metric

☐A Large snags (more than one) are present (> 12-inches DBH, or large relative to species present and landscape stability).
☒B Not A

19. Diameter Class Distribution – wetland type condition metric

☐A Most canopy trees have stems > 6-inches in diameter at breast height (DBH); many large trees (> 12-inches DBH) are present.
☐B Most canopy trees have stems between 6- and 12-inches DBH, few are > 12-inch DBH.
☒C Most canopy trees are < 6-inches DBH or no trees.

20. Large Woody Debris – wetland type condition metric

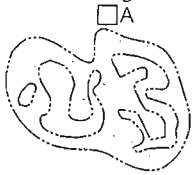
Include both man-made and natural debris piles.

☐A Large logs (more than one) are present (> 12-inches in diameter, or large relative to species present and landscape stability).
☒B Not A

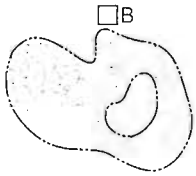
21. Vegetation/Open Water Dispersion – wetland type/open water condition metric (evaluate for Non-Tidal Freshwater Marsh only)

Select the figure that best describes the amount of interspersion between vegetation and open water in the growing season. Patterned areas indicate vegetated areas, while solid white areas indicate open water.

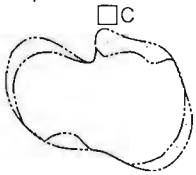
☐A



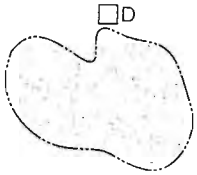
☐B



☐C



☐D



22. Habitat Uniqueness – wetland type condition metric

☐Yes ☒No Has the N.C. Environmental Management Commission classified the assessment area as "Unique Wetlands" (UWL)?

Notes

APPENDIX C
NON-NATIVE AND INVASIVE SPECIES

North Carolina Native Plant Society

Enjoy and conserve NC's native plants and their habitats *Join NCNPS.*

Invasive Exotic Species List

We hope this list will help eliminate the use of invasive exotic plants in landscaping and restoration projects.

The intent of this list is to:

- Rank exotic plants based on their demonstrated invasive characteristics
- Educate the public and resource managers
- Encourage early detection of invasive exotic species so that a rapid response can be implemented when needed

Rank 1 *Rank 2* *Rank 3* *Watch List A* *Watch List B* *Credits*

Rank 1 - Severe Threat

Exotic plant species that have invasive characteristics and spread readily into native plant communities, displacing native vegetation.

Scientific name	Common name
Ailanthus altissima (Mill.) Swingle	Tree of Heaven
Albizia julibrissin Durz.	Mimosa
Alliaria petiolata (Bieb.) Cavara & Grande	Garlic-mustard

Alternanthera philoxeroides (Mart.) Griseb.	Alligatorweed
Celastrus orbiculatus Thunb.	Asian bittersweet
Elaeagnus angustifolia L.	Russian olive
Elaeagnus umbellata Thunb.	Autumn olive
Hedera helix L.	English ivy
Hydrilla verticillata (L.f.) Royle	Hydrilla
Lespedeza bicolor	Bicolor lespedeza
Lespedeza cuneata (Dum.-Cours.) G. Don	Sericea lespedeza
Ligustrum sinense Lour.	Chinese privet
Lonicera fragrantissima Lindl. & Paxton	Fragrant honeysuckle
Lonicera japonica Thunb.	Japanese honeysuckle
Microstegium vimineum (Trin.) A. Camus	Japanese stilt-grass
Murdannia keisak (Hassk.) Hand.-Mazz.	Asian spiderwort
Myriophyllum aquaticum (Vell.) Verdc.	Parrotfeather
Paulownia tomentosa (Thunb.) Sieb.&Zucc. ex Steud.	Princess tree
Phragmites australis (Cav.) Trin. ssp. australis	Common reed
Polygonum cuspidatum Seib. & Zucc.	Japanese knotweed
Pueraria montana (Lour.) Merr.	Kudzu
Rosa multiflora Thunb.	Multiflora rose

Salvinia molesta Mitchell	Aquarium water-moss
Vitex rotundifolia L.f.	Beach vitex
Wisteria sinensis (Sims) DC	Chinese wisteria

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Rank 2 - Significant Threat

Exotic plant species that display some invasive characteristics, but do not appear to present as great a threat native communities in NC as the species listed in Rank 1.

Scientific name	Common name
Ampelopsis brevipedunculata (Maxim.) Trautv.	Porcelain-berry
Arthraxon hispidus (Thunb.) Makino	Hairy jointgrass
Bambusa spp.	Exotic bamboo
Berberis thunbergii DC	Japanese barberry
Broussonetia papyrifera (L.) L'Her. ex Vent.	Paper mulberry
Cayratia japonica (Thunb. ex Murray) Gagnep.	Bushkiller
Centaurea biebersteinii DC	Spotted knapweed
Clematis terniflora DC (=C. dioscoreifolia)	Leatherleaf clematis
Conium maculatum L.	Poison hemlock
Coronilla varia L.	Crown vetch
Dioscorea oppositifolia L.	Air-potato
Eichhornia crassipes (Mart.) Solms	Water-hyacinth

Euonymus alata (Thunb.) Sieb.	Burning bush
Euonymus fortunei (Turcz.) Hand. - Mazz	Winter creeper
Glechoma hederacea L.	Gill-over-the-ground, ground ivy
Humulus japonicus	Japanese Hops
Lamium purpureum L.	Henbit
Lespedeza bicolor Turcz.	Bicolor lespedeza, shrubby bushclover
Ligustrum japonicum Thunb.	Japanese privet
Ligustrum vulgare L.	Common privet
Lonicera maackii (Rupr.) Maxim.	Amur bush honeysuckle
Lonicera morrowii A. Gray	Morrow's bush honeysuckle
Lonicera standishii Jaques	Standish's Honeysuckle
Lonicera ×bella [morrowii × tatarica]	Hybrid Bush Honeysuckle
Ludwigia uruguayensis (Camb.) Hara	Creeping waterprimrose
Lygodium japonicum (Thunb. ex Murr.) Sw.	Japanese climbing fern
Lythrum salicaria L.	Purple loosestrife
Mahonia beali (Fortune) Carriere	Oregon grape
Miscanthus sinensis Andersson	Chinese silver grass
Morus alba L.	White mulberry
Myriophyllum spicatum Komarov	Eurasian watermilfoil
Nandina domestica Thunb.	Nandina

Persicaria longiseta (de Bruijn) Moldenke (=Polygonum caespitosum Blume)	Oriental ladies-thumb
Persicaria maculata (Rafinesque) S.F. Gray (=Polygonum persicaria L.)	Lady's thumb
Phyllostachys spp.	Exotic bamboo
Poncirus trifoliata (L.) Raf.	Hardy-Orange
Pseudosasa japonica (Sieb. & Zucc. ex Steud.) Makino ex Nakai	Arrow bamboo
Pyrus calleryana Decne.	Bradford pear
Rhodotypos scandens (Thunb.)	Makino jetbead
Rubus phoenicolasius Maxim.	Wineberry
Solanum viarum Dunal	Tropical soda apple
Sorghum halepense (L.) Pers.	Johnson grass
Spiraea japonica L.f.	Japanese spiraea
Stellaria media (L.) Vill.	Common chickweed
Veronica hederifolia L.	Ivyleaf speedwell
Vinca major L.	Bigleaf periwinkle
Vinca minor L.	Common periwinkle
Wisteria floribunda (Willd.) DC	Japanese wisteria
Xanthium strumarium L.	Common cocklebur
Youngia japonica (L.) DC.	Oriental false hawksbeard

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Rank 3 - Lesser Threat

Exotic plant species that spread into or around disturbed areas, and are presently considered a low threat to native

plant communities in NC.

Scientific name	Common name
Ajuga reptans L.	Bugleweed
Allium vineale L.	Field garlic
Artemisia vulgaris L.	Mugwort, common wormwood
Arundo donax L.	Giant reed
Baccharis halimifolia L. (*)	Silverling, groundsel tree
Bromus catharticus Vahl	Bromegrass, rescue grass
Bromus commutatus Schrad.	Meadow brome
Bromus japonicus Thunb. ex Murray	Japanese bromegrass
Bromus secalinus L.	Rye brome
Bromus tectorum L.	Thatch bromegrass, cheat grass
Buddleia davidii Franch	Butterfly bush
Chicorium intybus L.	Chicory
Chrysanthemum leucanthemum L.	Ox-eye daisy
Cirsium vulgare (Savi) Ten.	Bull thistle
Daucus carota L.	Wild carrot, Queen Anne's-lace
Dipsacus fullonum L.	Fuller's teasle
Egeria densa Planch.	Brazilian elodea, Brazilian water-weed
Fatoua villosa (Thunb.) Nakai	Hairy crabweed
Festuca pratensis Huds.	Meadow fescue

Ipomoea quamoclit L.	Cypressvine morningglory
Kummerowia stipulacea (Maxim.)	Makino Korean clover
Kummerowia striata (Thunb.) Schindl	Japanese clover
Lysimachia nummularia L.	Moneywort, creeping Jenny
Melilotus albus Medik.	White sweet clover
Melilotus officinalis (L.) Lam.	Yellow sweet clover
Najas minor All.	Brittle naiad
Pastinaca sativa L.	Wild parsnip
Perilla frutescens (L.) Britt.	Beefsteakplant
Populus alba L.	White poplar
Senecio vulgaris L.	Ragwort
Setaria faberi R.A.W. Herrm.	Nodding foxtail-grass
Triadica sebifera (L.) Small	Chinese tallowtree
Tussilago farfara L.	Coltsfoot
Vicia sativa L.	Garden vetch

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Watch List A

Exotic plants that naturalize and may become a problem in the future; includes species that are or could become widespread in North Carolina. At this time, more information is needed.

Scientific name	Common name
Arum italicum P. Mill.	Italian lords and ladies

Buglossoides arvensis (L.) I.M. Johnston (L.) I.M.	Corn gromwell
Bupleurum rotundifolium L.	Hound's-ear, hare's ear
Centaurea cyanus L.	cornflower
Echium vulgare L.	Viper's bugloss
Elaeagnus pungens Thunb	Thorny olive
Hibiscus syriacus L.	Rose of Sharon
Hypericum perforatum L.	St. John's-wort
Ornithogalum umbellatum L.	Star of Bethlehem
Solanum dulcamara L.	Climbing nightshade
Verbascum thapsus L.	Common mullein

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Watch List B

Exotic plant species that cause problems in adjacent states but have not yet been reported to cause problems in NC.

Scientific name	Common name
Acer platanoides L.	Norway maple
Akebia quinata (Houtt.) Dcne.	Fiveleaf akebia
Bromus inermis Leyss.	Smooth bromegrass
Cardiospermum halicacabum L.	Balloonvine
Carduus nutans L.	Musk thistle
Cirsium arvense (L.) Scop.	Canada thistle
Commelina benghalensis L.	Bengal dayflower
Elaeagnus pungens Thunb.	Thorny-olive

Hesperis matronalis L.	Dame's rocket
Imperata cylindrica	Cogon grass
Iris pseudoacorus L.	Pale-yellow iris
Lonicera tatarica L.	Tartarian honeysuckle
Melia azedarach L.	Chinaberry
Persicaria perfoliata (Linnaeus) H. Gross (=Polygonum perfoliatum L.)	Mile-a-minute vine
Pistia stratiotes L.	Watter-lettuce
Potamogeton crispus L.	Curly pondweed
Quercus acutissima Carruthers	Sawtooth oak
Rhamnus cathartica L.	European buckthorn
Setaria italica (L.) P. Beauv.	Foxtail-millet
Setaria verticillata (L.) Beauv.	Bur-foxtail
Setaria viridis (L.) P. Beauv.	Green millet
Stachys floridana Shuttlw. ex Benth.	Florida Hedge nettle
Torilis arvensis (Huds.) Link	Spreading hedge-parsley
Tragopogon dubius Scop.	Yellow goat's-beard
Trapa natans L.	Water Chestnut
Tribulus terrestris L.	Puncturevine
Xanthium spinosum L.	Spiny cocklebur

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Credits

Compiled by Misty Franklin,

with review and input from biologists in the following agencies:
NC Natural Heritage Program,
NC DENR Aquatic Weed Control Program,
NC Exotic Pest Plant Council,
US Fish &Wildlife Service,
The Nature Conservancy,
NC Zoo,
NC Botanical Garden,
and UNC Herbarium.

2006 marked the first edition of the NC Native Plant Society Invasive Exotic Plant list. The 2004 Tennessee Exotic Pest Plant Council Invasive Exotic Plant list was used as a model for organization of this list, but species listed and ranks assigned here are applicable to North Carolina. The NC Native Plant Society Invasive Exotic Plant List is considered a work in progress, and will be evaluated and updated as new information is gathered about these and other species.

Please send your comments to:

North Carolina Native Plant Society
C/O North Carolina Botanical Garden
Totten Center 3375,
Chapel Hill, NC 27599-3375

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If you have questions about NC Native Plant Society that this website does not answer, please email tom @ ncwildflower.org

last updated: May 2008

http://www.ncwildflower.org/invasives/list.htm

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Webmaster:terry@ncwildflower.org

APPENDIX D
LIST OF THREATENED AND ENDANGERED SPECIES

NC NHP County Element Search Results

New Search

Returned Elements: 41 using: DARE LISTED

[Vascular Plant 7] [Vertebrate Animal 34]

Major Group	Scientific Name	Common Name	State Status	Federal Status	State Rank	Global Rank	County - Status	Map - Habitat
Vascular Plant	*Amaranthus pumilus*	Seabeach Amaranth	T	T	S2	G2	Dare - Current	Link
Vascular Plant	*Dichanthelium caerulescens*	Blue Witch Grass	E	None	S1S2	G2G3	Dare - Current	Link
Vascular Plant	*Eleocharis halophila*	Saltmarsh Spikerush	T	None	S1	G4	Dare - Current	Link
Vascular Plant	*Lilaeopsis carolinensis*	Carolina Grasswort	T	None	S2	G3G5	Dare - Current	Link
Vascular Plant	*Lipocarpha micrantha*	Small-flowered Hemicarpha	E	None	SH	G5	Dare - Historical	Link
Vascular Plant	*Platanthera nivea*	Snowy Orchid	T	None	S1	G5	Dare - Historical	Link
Vascular Plant	*Trichostema sp. 1*	Dune Bluecurls	SR-L	FSC	S2	G2	Dare - Current	Link
Vertebrate Animal	*Acipenser brevirostrum*	Shortnose Sturgeon	E	E	S1	G3	Dare - Current	Link
Vertebrate Animal	*Alligator mississippiensis*	American Alligator	T	T	S3	G5	Dare - Current	Link
Vertebrate Animal	*Canis rufus*	Red Wolf	SR	E	S1	G1Q	Dare - Current	Link
Vertebrate Animal	*Caretta caretta*	Loggerhead Seaturtle	T	T	S3B,S3N	G3	Dare - Current	Link
Vertebrate Animal	*Charadrius melodus*	Piping Plover	T	T	S2B,S2N	G3	Dare - Current	Link
Vertebrate Animal	*Charadrius wilsonia*	Wilson's Plover	SC	None	S3B	G5	Dare - Current	Link
Vertebrate Animal	*Chelonia mydas*	Green Seaturtle	T	T	S1B,SUN	G3	Dare - Current	Link
Vertebrate Animal	*Condylura cristata pop. 1*	Star-nosed Mole - Coastal Plain Population	SC	None	S2	G5T2Q	Dare - Current	Link
Vertebrate Animal	*Corynorhinus rafinesquii macrotis*	Rafinesque's Big-eared Bat - Coastal Plain Subspecies	SC	FSC	S3	G3G4TNR	Dare - Current	Link
Vertebrate Animal	*Crotalus horridus*	Timber Rattlesnake	SC	None	S3	G4	Dare - Obscure	Link
Vertebrate Animal	*Dendroica virens waynei*	Black-throated Green Warbler - Coastal Plain Population	SR	FSC	S2S3B	G5TU	Dare - Current	Link
Vertebrate Animal	*Dermochelys coriacea*	Leatherback Seaturtle	E	E	S1B,SUN	G2	Dare - Current	Link
Vertebrate Animal	*Egretta caerulea*	Little Blue Heron	SC	None	S3B,S3N	G5	Dare - Current	Link
Vertebrate Animal	*Egretta thula*	Snowy Egret	SC	None	S3B,S3N	G5	Dare - Current	Link
Vertebrate Animal	*Egretta tricolor*	Tricolored Heron	SC	None	S3B,S3N	G5	Dare - Current	Link
Vertebrate Animal	*Eretmochelys imbricata*	Hawksbill Seaturtle	E	E	SUN	G3	Dare - Current	Link
Vertebrate Animal	*Falco peregrinus*	Peregrine Falcon	E	None	S1B,S2N	G4	Dare - Current	Link

Vertebrate Animal	*Gelochelidon nilotica*	Gull-billed Tern	T	None	S2B	G5	Dare - Current	Link
Vertebrate Animal	*Haematopus palliatus*	American Oystercatcher	SC	None	S3B,S4N	G5	Dare - Current	Link
Vertebrate Animal	*Haliaeetus leucocephalus*	Bald Eagle	T	None	S3B,S3N	G5	Dare - Current	Link
Vertebrate Animal	*Ixobrychus exilis*	Least Bittern	SC	None	S3B	G5	Dare - Current	Link
Vertebrate Animal	*Lampropeltis getula sticticeps*	Outer Banks Kingsnake	SC	None	S2	G5T2Q	Dare - Current	Link
Vertebrate Animal	*Laterallus jamaicensis*	Black Rail	SC	FSC	S3B,S2N	G4	Dare - Current	Link
Vertebrate Animal	*Lepidochelys kempii*	Kemp's Ridley Seaturtle	E	E	S1B,SUN	G1	Dare - Current	Link
Vertebrate Animal	*Malaclemys terrapin terrapin*	Northern Diamondback Terrapin	SC	FSC	S3	G4T4Q	Dare - Current	Link
Vertebrate Animal	*Nerodia sipedon williamengelsi*	Carolina Watersnake	SC	None	S3	G5T3	Dare - Current	Link
Vertebrate Animal	*Peromyscus leucopus buxtoni*	Buxton Woods White-footed Mouse	SC	FSC	S2	G5T2	Dare - Current	Link
Vertebrate Animal	*Picoides borealis*	Red-cockaded Woodpecker	E	E	S2	G3	Dare - Current	Link
Vertebrate Animal	*Plegadis falcinellus*	Glossy Ibis	SC	None	S2B	G5	Dare - Current	Link
Vertebrate Animal	*Rynchops niger*	Black Skimmer	SC	None	S3B,S3N	G5	Dare - Current	Link
Vertebrate Animal	*Sterna dougallii*	Roseate Tern	E	E	SUB	G4	Dare - Current	Link
Vertebrate Animal	*Sterna hirundo*	Common Tern	SC	None	S3B	G5	Dare - Current	Link
Vertebrate Animal	*Sternula antillarum*	Least Tern	SC	None	S3B	G4	Dare - Current	Link
Vertebrate Animal	*Trichechus manatus*	West Indian Manatee	E	E	S1N	G2	Dare - Current	Link

NC NHP database updated on Sunday, August 2nd, 2009.
Search performed on Thursday, 3 December 2009 @ 14:19:21 EST
Explanation of Codes