FINAL GIS-BASED

NATURAL RESOURCES TECHNICAL REPORT – UPDATED

US 70 Kinston Bypass
Lenoir, Jones, and Craven Counties, North Carolina

STIP R-2553
WBS Element No. 34460

THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

November 2017

TABLE OF CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

The North Carolina Department of Transportation (NCDOT) is proposing to construct a multi-lane facility on new location in Lenoir County, North Carolina. As it is currently defined, the Kinston Bypass would consist of a four-lane, median divided freeway facility from US 70 near LaGrange in Lenoir County to US 70 near Dover, on the Jones and Craven county line (Figure 1, Appendix A). The proposed project is designated in the 2018-2027 NCDOT State Transportation Improvement Program (STIP) as STIP Number R-2553 and described as "US 70 Kinston Bypass, Four-Lane Divided Freeway on New Location." The following Natural Resources Technical Report (NRTR) has been prepared to assist in the preparation of an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) and the North Carolina State Environmental Policy Act (SEPA) for the proposed project. This project has been designated as a pilot project by the North Carolina Interagency Leadership Team, which includes using Geographic Information Systems (GIS) data as the basis for alternative development, alternative evaluation, and selection of the Least Environmentally Damaging Practicable Alternative/Preferred Alternative (LEDPA). The intention of pilot projects is to reserve detailed field investigations for the LEDPA. Therefore, traditional methodologies were not always possible for portions of this document. This document follows NCDOT's most recent NRTR guidance where possible (NRTR Template, July 2012; NRTR Format Guidance, November 2012; Preparing Natural Resource Technical Reports, December 2012). In instances where the pilot project is unable to follow the traditional guidance, a detailed explanation of the methodologies used is included in Section 2.0.

There are 12 Detailed Study Alternative (DSA) corridors being evaluated within this NRTR. The NRTR study area was developed around the 17 DSA corridors evaluated in the original 2013 NRTR and includes each of the corridors and all areas between the corridors. The NRTR study area and the DSA corridor numbers are shown on Figure 2 in Appendix A.

Field verification of the data used in the development of this document occurred between March 22, 2012 – November 29, 2012 and February 27, 2013 – March 27, 2013. Field verifications included NCDOT staff, URS staff, and agency personnel. Specific dates, attendees, and the purpose of each field verification are listed in each applicable section.

2.0 METHODOLOGY AND QUALIFICATIONS

As detailed above, this project is a North Carolina Interagency Team pilot project. The intent of these pilot projects is to use GIS data in lieu of detailed field studies during the preliminary stages of project development. Therefore, the methodologies followed in this NRTR rely heavily on the use of GIS data, and do not include detailed field studies.

Base mapping for the project was developed using ArcGIS, ArcMap Version 10. DSA corridors designed in MicroStation were overlaid on 2010 orthoimagery and United States Geological Survey (USGS) topographic quadrangles to choose an appropriate NRTR study area. Base mapping also includes NCDOT road and railroad layers, county and municipal boundaries, and stream and waterbody layers from NC OneMap.

Once the NRTR Study Area was determined, all analyses performed as part of this NRTR were clipped to the NRTR study area boundary. Clipping is a GIS exercise to obtain the features of one layer that fall within the boundaries of another given layer. The NRTR study area is approximately 211 square miles (Figure 2, Appendix A).

2.1 Coastal Change Analysis Program Land Cover Data

North Carolina's Coastal Change Analysis Program Regional Land Cover Data (C-CAP) were used to identify terrestrial communities in the NRTR study area. These community types were verified with aerial photography, USGS topographic mapping, and field reconnaissance. Typically, terrestrial communities presented in an NRTR are classified based on species composition and topography. This approach differs from classifications presented within C-CAP data in that C-CAP data are based more on land cover type (residential or forested), resulting in a much larger number of classes than typically identified in an NRTR.

In order to remain consistent with the number and types of terrestrial communities typically presented, the C-CAP classes were initially grouped into larger terrestrial community types based on similarities between C-CAP classes. Aerial imagery was used to verify the classifications shown by the C-CAP data to ensure that they were grouped properly. During aerial verifications, it was discovered that some of the C-CAP classes were actually better-suited to be placed with other land cover types than those which they were originally grouped. Upon identifying this, these C-CAP classes were re-grouped into terrestrial communities accordingly. This was first discovered with the 'developed open space' C-CAP class. Initially, 'developed open space' was suspected to include agricultural areas. However, upon inspection of aerial photography, it was determined that 'developed open space' was almost always being used in conjunction with residential areas and appeared to include manicured lawns and parks. Such lands are generally classified as 'maintained/disturbed' in traditional NRTR documents. Therefore, 'developed open space' was grouped with other classes that were developed residential and/or commercial lands into a single 'maintained/disturbed' terrestrial community type.

A similar discrepancy was noted in the 'bare land,' 'grassland,' and 'scrub/shrub' classes. Both 'bare land' and 'grassland' were often found along the edge of 'cultivated' or 'pasture/hay' classes. Through inspection of aerial imagery, it appeared that the majority of these areas were part of the connected agricultural activity. While some areas shown as 'bare land' fell in residential areas, over yards or open maintained fields, the majority appear to be in some sort of agriculture; therefore, these classes were placed in the 'agriculture' terrestrial community type. The placement of the 'scrub/shrub' class was somewhat more problematic in that it appears to cover both cutover areas (presumably cutover of pine plantation) as well as young pine plantations. The decision was made to place the 'scrub/shrub' class along with 'evergreen forest' in a 'pine plantation' terrestrial community. Through aerial photography, it is evident that the largest and most contiguous of the 'scrub/shrub' classes and the majority of 'evergreen forest' are in pine plantation.

The remaining groupings were straight forward and combined all other forested non-wetland types into 'forested upland' and all wetland types into 'palustrine wetland.'

The terrestrial community types and C-CAP classes that comprise them are outlined below. For the purpose of this NRTR, the wetland community 'Palustrine Wetland' and an 'Open Water' community are being grouped with the terrestrial communities since they are included in total acreage calculations for the study area. Metadata for the C-CAP dataset are located in Appendix D.

- Maintained/Disturbed
    - Developed open space
    - High intensity developed
    - Medium intensity developed
    - Low intensity developed
- Agriculture
    - Bare land
    - Cultivated
    - Grassland
    - Pasture/hay
- Pine Plantation
    - Evergreen forest
    - Scrub/shrub
- Forested Upland
    - Deciduous forest
    - Mixed forest
- Palustrine Wetland
    - Palustrine emergent wetland
    - Palustrine forested wetland
    - Palustrine scrub/shrub wetland
- Open Water
    - Water

The C-CAP classes assigned to each terrestrial community were grouped in ArcGIS, then clipped to the NRTR study area to determine the acreage of each community present within the NRTR study area, and clipped again to each alternative's slope stake limits plus 40 feet to estimate the acreage of each community within each alternative.

2.2 DWR Lenoir Model (Streams)

Two ArcGIS models were used in order to assess potential stream and wetland impacts for the project. A jurisdictional stream model was created by the North Carolina Division of Water Resources (NCDWR) and a jurisdictional wetland model was created by NCDOT.

The jurisdictional stream analysis was completed by NCDWR for this pilot project. The data generated for the project consisted of stream lines within the three US Environmental Protection Agency (USEPA) Level IV ecoregions that were present in the larger project study area for the entire project. The ecoregions present were Rolling Coastal Plain (RCP), Carolina Flatwoods (CF) and Southeastern Floodplains and Terraces (SEFT). Jurisdictional stream models were developed for the RCP and CF ecoregions by utilizing 20-foot grid cell digital elevation models (DEM) generated from bare-earth Light Detection and Ranging (LIDAR) data and subsequent terrain derivatives and other ancillary data as variables. The models were developed in SAS 9.2

as binary logistic regression models. The National Hydrography Dataset (NHD) flowlines were used for SEFT in lieu of a model due to the streams in this ecoregion being heavily manipulated by channelization (ditching) and impractical to model accurately. NHD is similar to USGS 24k hydrolines, but does not include 'double line' streams and polygons that appear in USGS 24k line. All procedures used to collect stream data for the three ecoregions are collectively referred to as the 'DWR Lenoir Model.' Metadata for the Model are located in Appendix D.

The outputted data from the most recent version of the DWR Lenoir Model (January 29, 2013) was clipped to the NRTR study area to determine which streams are located within the NRTR study area, and clipped again to each alternative's slope stake limits plus 40 feet to estimate which streams might be impacted by each alternative. Named streams were labeled (S1, S2, S3, etc.) in numerical order according to watershed moving from west to east across the NRTR study area.

Streams subject to the Neuse River Buffer Rules were identified based solely on their presence on 24k USGS topographic mapping. For the purposes of this document, streams absent from the topographic mapping were not considered to be subject to buffer rules. NRCS soils mapping was not consulted for buffer applicability at this time.

2.3 Wetland Prediction Model

Wetland data were derived from a wetland prediction model completed by NCDOT Natural Environment Section (NES) for this pilot project (April 15, 2011). The layer depicts wetlands of Lenoir County and portions of Jones and Craven Counties. Similar to the DWR Lenoir Model, the model utilizes 20-foot grid cell DEMs generated from bare-earth LIDAR data and subsequent terrain derivatives and other ancillary data as variables. The model was developed in SAS 9.2 as a binary logistic regression model. An updated set of models was developed using the next generation LiDAR data that was in the process of being acquired statewide. The purpose of these models, referred to as the 2017 QL2 models, were requested by the resource agencies to study the effects of using the next generation LiDAR in the models as compared to the legacy LiDAR data in the original 2011 models. For more information on the accuracy comparison of these models, please refer to the memo titled "Revised Supplement to NCDOT's Wetland Predictive Model Accuracy Assessment" dated September 14, 2017.

The wetland model used for this project is an aggregate of five different models based on ecoregion (listed below). Each model applies to one of the discrete areas for which it was developed. The ecoregion boundaries were edited based on terrain data to improve the accuracy, which in turn, improved the model accuracy for each respective region. The applications of riparian and non-riparian within each of the ecoregion models were based on a riparian shapefile that NCDOT digitized based on terrain data and aerial photography. The resulting models included: Non-Riparian Rolling Coastal Plain Wetland, Riparian Rolling Coastal Plain Wetland, Non-Riparian Flatwood Wetland, Riparian Flatwood Wetland, and Southeastern Floodplains and Low Terraces Wetland. These data were also verified through multiple field surveys with the resource agencies. Field verifications of the wetland model took place on March 22, April 11, April 19, and June 7, 2012. Tom Steffens of US Army Corps of Engineers (USACE) and David Wainwright of NCDWR were in attendance, along with Leilani Paugh and Morgan Weatherford of NCDOT, Sandy Smith of Axiom, and Susan Westberry of URS. Complete wetland model metadata are located in Appendix D.

The wetland model resulted in a wetland prediction raster file. The original raster file was converted to a polygon layer in order to assess potential wetland impacts of the project. First, the raster file was converted to an integer file such that geoprocessing could occur. Next, the Raster to Polygon tool was used to convert the integer raster to a single polygon layer (that included the five different wetland types listed above). The resulting polygon layer was then clipped to the NRTR study area to determine the acreage of each wetland type located within the NRTR study area, and clipped again to the slope stake limits plus 40 feet to determine the acreage of each wetland type located within each alternative.

2.4 Protected Species Habitat

The identification of potential habitat areas for federally threatened and endangered species was also determined through the use of ArcGIS. Potential habitat areas were initially determined using the following sequence: consultation with the US Fish and Wildlife Service (USFWS), identification of suitable C-CAP land class types, verification of C-CAP areas through aerial photography, and presence/absence of North Carolina Natural Heritage Program (NCNHP) element occurrences. Once the exercise was complete, areas of potentially suitable habitat that may require field verification were digitized in ArcGIS.

The areas of potentially suitable habitat identified through the process described above were then spot checked in the field by Susan Westberry of URS/AECOM on March 27, May 2, and June 5, 2013. On May 22, 2013 a field meeting was held with Gary Jordan of USFWS, Travis Wilson of North Carolina Wildlife Resources Commission (NCWRC), David Wainwright of NCDWR, Tom Steffens of USACE, and Leilani Paugh and Morgan Weatherford of NCDOT. During this meeting, the protocol used to define habitat areas for the project were discussed (habitat for RCW, in particular) and refined. Summaries of this meeting and the protocol in use for the project are included in Appendix C. The habitat determination protocol used are applicable to Lenoir County. The protocol is not intended for general use in all pilot projects or in other areas of the state.

2.5 Principal Personnel

The principal personnel contributing to this document were:

Principal Investigator: Susan Westberry, AICP, PWS, CPESC, LSSIT
Education: M.S. Botany, 2003; B.S. Wildlife Ecology, 1999
Experience: Environmental Scientist, URS/AECOM – North Carolina, 2005-2015
Environmental Scientist, Stantec, 2003-2005
Biologist, US Forest Service, 1999-2001
Responsibilities: Wetland and stream field spot checks, natural communities assessment, T&E assessment, and document preparation

Investigator: Laura Anderson
Education: B.S. Geographic Information Science, 2008
Experience: GIS Analyst/Planner, URS – North Carolina, 2008-2014
GIS Analyst, Amalgam LLC, Mount Pleasant, Michigan, 2007-2008
Responsibilities: GIS mapping and analysis and T&E assessment

Investigator: Paul Gerlach
Education: M.E.M Environmental Management, 2013, B.S. Biology, 2011
Experience: Environmental Scientist, AECOM – North Carolina, 2014-Present
Responsibilities: Document update, GIS mapping and analysis

3.0 PHYSICAL RESOURCES

The NRTR study area lies in the Southeastern Plains and Middle Atlantic Coastal Plain physiographic regions of North Carolina and straddles the following North Carolina Level IV ecoregions: *Southeastern Floodplains and Low Terraces, Carolina Flatwoods,* and *Rolling Coastal Plain*. The NRTR study area extends one mile from the outside edge of each DSA corridor, and includes all area between DSA corridors (Figure 2, Appendix A). Topography in the project vicinity is comprised of broad interstream divides with gentle to steep side slopes dissected by numerous small stream channels and major river floodplains and associated terraces. The Neuse River flows through the NRTR study area. Elevations in the NRTR study area range from six to 38 feet above sea level. Land use in the project vicinity consists primarily of agricultural fields and pine plantations outside of the City of Kinston. The NRTR study area contains the City of Kinston, which is made up of residential, infrastructure, commercial, and industrial land uses. Rural residential areas, small commercial businesses, an airport, the Neuse River, and a large swath of river floodplain along the Neuse River are also present within the NRTR study area.

3.1 Soils

The NRTR study area contains portions of Lenoir, Jones, and Craven counties. Table 1 contains the soil series and map units present within the NRTR study area. The Lenoir County Soil Survey identifies 38 soil map units within the NRTR study area, the Jones County Soil Survey identifies 20 soil map units within the NRTR study area, and the Craven County Soil Survey identifies 11 soil map units within the NRTR study area.

Table 1: Soils in the NRTR study area

Soil Series	Map Unit	Drainage Class	Hydric Status	County[1]
Alpin fine sand, 0-6% slopes	AnB	Excessively drained	Nonhydric	J
Autryville loamy fine sand, 0-4% slopes	AuB	Well drained	Hydric[2]	J
Bibb soils, frequently flooded	BB	Poorly drained	Hydric	L
Blanton sand, 0-6% slopes	Bn	Moderately well drained	Hydric[2]	L
Chewacla loam, frequently flooded	Ch	Somewhat poorly drained	Hydric[2]	L
Coxville loam	Co	Poorly drained	Hydric	L
Craven fine sandy loam, 1-4% slopes	Cr	Moderately well drained	Hydric[2]	L

Soil Series	Map Unit	Drainage Class	Hydric Status	County[1]
Croatan muck	Ct	Very poorly drained	Hydric	J
Craven fine sandy loam, 4-8% slopes	Cv	Moderately well drained	Hydric[2]	L
Goldsboro loamy sand, 0-2% slopes	Go	Moderately well drained	Hydric[2]	L, J
Goldsboro loamy sand, 0-2% slopes	GoA	Moderately well drained	Hydric[2]	C
Grifton sandy loam	Gr	Poorly drained	Hydric	L
Grifton fine sandy loam	Gt	Poorly drained	Hydric	J
Johns sandy loam	Jo	Moderately well drained	Hydric[2]	L, J
Kalmia loamy sand, 0-2% slopes	Ka	Well drained	Nonhydric	L
Kalmia loamy sand, 0-3% slopes	KaA	Well drained	Hydric[2]	J
Kalmia loamy sand, 2-6% slopes	Kb	Well drained	Hydric[2]	L
Kenansville loamy sand, 0-6% slopes	Ke	Well drained	Nonhydric	L
Kinston loam, frequently flooded	Kn	Poorly drained	Hydric	L
Lakeland sand, 0-6% slopes	La	Excessively drained	Hydric[2]	L
Leaf loam	Le	Poorly drained	Hydric	L
Lenoir loam	Ln	Somewhat poorly drained	Hydric[2]	L
Leon sand	Ln	Poorly drained	Hydric	C, J
Leon sand	Lo	Poorly drained	Hydric	L
Lumbee sandy loam	Lu	Poorly drained	Hydric	L
Lynchburg sandy loam	Ly	Somewhat poorly drained	Hydric[2]	L, C, J
Meggett fine sandy loam	Me	Poorly drained	Hydric	L, C, J
Muckalee loam	Mk	Poorly drained	Hydric	J
Masontown mucky fine sandy loam and Muckalee sandy loam, frequently flooded	MM	Poorly drained and very poorly drained	Hydric	C
Murville fine sand	Mu	Very poorly drained	Hydric	L, J

Soil Series	Map Unit	Drainage Class	Hydric Status	County[1]
Norfolk loamy sand, 0-2% slopes	Na	Well drained	Hydric[2]	L
Norfolk loamy sand, 2-6% slopes	Nb	Well drained	Hydric[2]	L
Norfolk loamy sand, 6-10% slopes	Nc	Well drained	Nonhydric	L
Norfolk loamy sand, 1-4% slopes	NoB	Well drained	Hydric[2]	J
Norfolk loamy fine sand, 2-6% slopes	NoB	Well drained	Hydric[2]	C
Onslow fine sandy loam	On	Moderately well drained	Hydric[2]	J
Onslow loamy sand	On	Moderately well drained	Hydric[2]	C
Pactolus loamy sand	Pa	Moderately well drained	Hydric[2]	L, C
Pamlico muck	Pc	Very poorly drained	Hydric	L
Pantego loam	Pe	Very poorly drained	Hydric	L
Pantego loam	Pn	Very poorly drained	Hydric	J
Pocalla loamy sand, 0-6% slopes	Po	Somewhat excessively drained	Nonhydric	L
Portsmouth loam	Pr	Very poorly drained	Hydric	L
Rains sandy loam	Ra	Poorly drained	Hydric	L, C, J
Stallings loamy sand	St	Somewhat poorly drained	Hydric[2]	L, J
Stockade loamy fine sand	Sx	Very poorly drained	Hydric	J
Tomotley fine sandy loam	Tm	Poorly drained	Hydric	C
Torhunta loam	To	Very poorly drained	Hydric	L, C, J
Umbric ochraqualfs	Uo	Poorly drained	Hydric[2]	L
Wagram loamy sand, 0-6% slopes	Wb	Well drained	Hydric[2]	L
Wagram loamy sand, 6-10% slopes	Wc	Well drained	Nonhydric	L
Wagram loamy sand, 10-15% slopes	Wd	Well drained	Nonhydric	L
Wickham loamy sand, 1-6% slopes	Wk	Well drained	Hydric[2]	L
Woodington loamy sand	Wn	Poorly drained	Hydric	L
Woodington fine sandy loam	Wo	Poorly drained	Hydric	J

1. County abbreviations (L = Lenoir, C = Craven, J = Jones)

2. Soils which are primarily nonhydric, but which may contain hydric inclusions

3.2 Water Resources

Water resources in the NRTR study area are part of the Neuse River Basin (USGS Hydrologic Units 03020202, 03020203, and 03020204). The NRTR study area includes 33 named streams and 716 unnamed tributaries of each of these streams. The NRTR study area also includes one unnamed tributary to Mosley Creek, two unnamed tributaries to Jumping Run, and two unnamed tributaries to Rattlesnake Branch, but not their main stems. These water resources are listed in Table 2 below. Figure 3 in Appendix A shows the location of these water resources.

Table 2 contains the named water resources within the NRTR study area and the named water resources outside of the NRTR study area that have tributaries within the NRTR study area. The Best Usage Classification and Designation column contains the assigned NCDWR Best Usage Classification as well as any other notable water designation. These include Class C Waters (C), Nutrient Sensitive Waters (NSW), Swamp Waters (Sw), Anadromous Fish Spawning Areas (AFSA), Shellfish Growing Areas (SGA), Primary Nursery Areas (PNA), Inland Primary Nursery Areas (IPNA), Outstanding Resource Waters (ORW), High Quality Waters (HWQ), and/or waters within a water supply watershed (WS-I, -II, -III, -IV, or –V).

Water resources within the NRTR study area that are located within a Federal Emergency Management Act (FEMA) floodway are listed in the fifth column.

No streams within the NRTR study area appear on the North Carolina 2014 Final or 2016 Draft 303(d) lists of impaired waters due to sedimentation or turbidity.

Table 2: Notable water resources in the NRTR study area

Stream Name	Map ID	NCDWR Index Number	Best Usage Classification and Designation	Within Designated FEMA Floodway	# of Unnamed Tributaries within NRTR Study Area
Neuse River	S1	27-(75.7)	C;NSW AFSA, IPNA, WS Watershed	Yes	185
Falling Creek	S2	27-77	C;Sw,NSW AFSA	Yes	87
Southwest Creek	S3	27-80	C;Sw,NSW	Yes	70
Bear Creek	S4	27-72-(5)	WS-IV; Sw,NSW	Yes	9
Mosely Creek	S5	27-77-2	C;Sw, NSW	Yes	5
Buck Branch	S6	27-77-2-0.5	C;Sw, NSW	No	5
Walters Mill Pond	S7	27-77-2-1	C;Sw,NSW	No	5
Squirrel Creek	S8	27-75	WS-IV; Sw,NSW	Yes	2
Whitley's Creek	S9	27-76	C;Sw,NSW	Yes	12

Stream Name	Map ID	NCDWR Index Number	Best Usage Classification and Designation	Within Designated FEMA Floodway	# of Unnamed Tributaries within NRTR Study Area
White Mash Run	S10	27-77-2.5	C;Sw,NSW	Yes	6
Gum Swamp Creek	S11	27-77-3	C;Sw, NSW	Yes	21
Peter Creek	S12	27-78	C;Sw,NSW	No	14
Clarks Branch	S13	27-80-4	C;Sw, NSW	Yes	8
Lucy Branch	S14	27-80-5-1	C;Sw, NSW	No	2
Spring Branch	S15	27-80-5	C;Sw, NSW	Yes	6
Vine Swamp	S16	27-101-15-1	C;Sw,NSW	No	5
Wheat Swamp Creek	S17	27-86-24	C;Sw,NSW	No	26
Briery Run	S18	27-81-1	C;Sw, NSW	Yes	34
Taylors Branch	S19	27-81-1-1	C;Sw,NSW	Yes	4
Stonyton Creek	S20	27-81	C;Sw,NSW	Yes	56
Yadkin Branch	S21	27-79	C;Sw,NSW	Yes	22
Mott Swamp	S22	27-80-6	C;Sw, NSW	Yes	9
Strawberry Branch	S23	27-80-7	C;Sw,NSW	Yes	15
Jericho Run	S24	27-81-2	C;Sw, NSW	Yes	19
Mill Branch	S25	27-80-8	C;Sw, NSW SGA	Yes	11
Heath Branch	S26	27-80-9	C;Sw, NSW	Yes	18
Rattlesnake Branch*	S27	27-101-15-2	C;Sw,NSW	No	2
Beaverdam Branch	S28	27-83	C;Sw, NSW	No	12
Bone Gray Branch	S29	27-82	C;Sw, NSW	Yes	2
Mosley Creek*	S30	27-84	C;Sw,NSW SGA	Yes	1
Harrys Branch	S31	27-84-3	C;Sw, NSW SGA	Yes	7
Tracey Swamp	S32	27-84-1	C;Sw,NSW SGA	No	22
Gum Swamp	S33	27-84-1-1	C;Sw, NSW SGA	No	2
Core Creek	S34	27-90	C;Sw, NSW SGA	No	11
Hallam Branch	S35	27-86-24-1	C;Sw, NSW	No	4
Jumping Run*	S36	27-77-1	C;Sw, NSW	Yes	2

* The main stems of Mosley Creek, Jumping Run, and Rattlesnake Branch are not within the NRTR study area. Tributaries to these water resources are contained within the NRTR study area.

4.0 BIOTIC RESOURCES

4.1 Terrestrial Communities

Sixteen C-CAP types were identified within the NRTR study area. These types were grouped into six terrestrial communities (which includes one wetland type and open water) typical of those discussed in traditional NRTR documents. The C-CAP categories, their respective terrestrial community designations, and total acreage within the NRTR study area are shown in Table 3. The wetland type and open water were included so that their respective acreages were accounted for. Terrestrial communities are shown on Figure 4 in Appendix A.

4.1.1 Terrestrial Community Impacts

Terrestrial communities in the NRTR study area may be impacted by project construction as a result of clearing vegetation, grading, and paving of portions of the NRTR study area. Terrestrial community data are presented in the context of total coverage of each type within the NRTR study area in Table 3.

Potential terrestrial community impacts based on each alternative are shown in Table 9 of Appendix B.

Table 3: Terrestrial communities and C-CAP types within the NRTR study area

Terrestrial Community	Coverage (ac.)	C-CAP Type
Maintained/Disturbed	12,138	Developed open space
		High intensity developed
		Medium intensity developed
		Low intensity developed
Agriculture	59,863	Bare land
		Cultivated
		Grassland
		Pasture/hay
Pine Plantation	28,274	Evergreen forest
		Scrub/shrub
Forested Upland	5,378	Deciduous forest
		Mixed forest
Palustrine Wetland	27,490	Palustrine emergent wetland
		Palustrine forested wetland
		Palustrine scrub/shrub wetland
Open Water	2,010	Water
TOTAL	**135,153**	

4.1.2 Wetland Impacts

The C-CAP classifications estimate 27,490 wetland acres in the NRTR study area. In contrast, the NCDOT wetland prediction model estimates 33,564 wetland acres in the NRTR study area. The difference is due to higher accuracy in the NCDOT wetland prediction model from its use of additional information and data beyond what is captured by C-CAP classifications. The NCDOT wetland prediction model utilized GAP data and also includes variables such as soils,

topography, and vegetation type whereas the C-CAP classifications are based on landcover/vegetation type alone. C-CAP classifications were used in the natural communities classifications section of the NRTR, but were not used to define wetland areas. Descriptions of the development of the NCDOT wetland prediction model and the source of C-CAP data are provided in Section 2.3. Metadata are located in Appendix D.

Results of the wetland prediction model are presented in Table 4. The Non-Riparian wetland hydrologic classification includes results from the Non-Riparian Rolling Coastal Plain Wetland and Non-Riparian Flatwood Wetland models. The Riparian wetland hydrologic classification includes results from the Riparian Rolling Coastal Plain Wetland, Riparian Flatwood Wetland, and Floodplain Wetland models. Spot field verification of the wetland model results within the NRTR study area was conducted on November 29, 2012. Tom Steffens of USACE, Travis Wilson of NCWRC, and David Wainwright of NCDWR were in attendance, along with Leilani Paugh, Chris Manley, Jim Mason, and Morgan Weatherford of NCDOT, and Susan Westberry of URS/AECOM.

Wetland community types may be impacted, bridged, culverted, or re-routed as a result of the proposed project.

Table 4: Wetlands in the NRTR study area

Wetland Hydrologic Classification	Area (ac.)
Non-Riparian	17,461
Riparian	16,103
Total	**33,564**

4.2 Invasive Species

Species that appear on the NCDOT Invasive Exotic Plant List for North Carolina will be identified and their presence noted, where applicable, during field investigations once a LEDPA has been chosen.

The University of Georgia Center for Invasive Species and Ecosystem Health maintains a database of exotic plants and their occurrence by county. Table 5 contains the species from that database known to occur within Lenoir, Jones, and Craven counties that also appear on the NCDOT Invasive Exotic Plant List for North Carolina and their threat status.

NCDOT will manage invasive plant species as appropriate.

Table 5: Invasive exotic plant species known to occur in Lenoir, Jones, and Craven counties

Common Name	Scientific Name	Threat Level	County[1]
Mimosa	*Albizia julibrissin*	Moderate threat	L
Alligatorweed	*Alternanthera philoxeroides*	Threat	L, J, C
Asiatic dayflower	*Commelina communis*	Watch list	L, J, C
Brazilian waterweed	*Egeria densa*	Moderate threat	L, C
Japanese knotweed	*Reynoutria japonica*	Threat	L, C
English ivy	*Hedera helix*	Moderate threat	L

Common Name	Scientific Name	Threat Level	County[1]
Japanese hop	*Humulus japonicus*	Watch list	C
Shrubby lespedeza	*Lespedeza bicolor*	Moderate threat	L, J
Sericea lespedeza	*Lespedeza cuneata*	Threat	J, C
Japanese privet	*Ligustrum japonicum*	Moderate threat	C
Chinese privet	*Ligustrum sinense*	Threat	L, J, C
Japanese honeysuckle	*Lonicera japonica*	Moderate threat	L, J, C
Chinaberry	*Melia azedarach*	Watch list	L, J
Japanese stiltgrass	*Microstegium vimineum*	Threat	L, J, C
Chinese silvergrass	*Miscanthus sinensis*	Threat	C
Marsh dayflower	*Murdannia keisak*	Threat	L
Parrot feather milfoil	*Myriophyllum aquaticum*	Moderate threat	J
Princess tree	*Pawlownia tomentosa*	Threat	C
Kudzu	*Pueraria montana* var. *lobata*	Threat	L, J, C
Multiflora rose	*Rosa multiflora*	Threat	J
Giant salvinia	*Salvinia molesta*	Moderate threat	C
Johnsongrass	*Sorghum halepense*	Moderate threat	L, J, C
Chinese tallowtree	*Triadica sebifera*	Watch list	C
Chinese wisteria	*Wisteria sinensis*	Moderate threat	J

1. County abbreviations (L = Lenoir, C = Craven, J = Jones)

5.0 JURISDICTIONAL ISSUES

5.1 Clean Water Act Waters of the U.S.

Jurisdictional streams and wetlands that were predicted to occur within the NRTR study area by the DWR Lenoir Model and the NCDOT wetland prediction model are shown for each of the 12 alternatives on Figures 5a through 5l in Appendix A. All jurisdictional streams in the NRTR study area have been designated as warm water streams for the purposes of stream mitigation.

The total stream impacts for each alternative are shown in Table 6. Detailed stream impacts are shown in Tables 10 through 21 of Appendix B. These impacts are based on the slope stake limits plus 40 feet for each alternative.

Table 6: Jurisdictional stream impacts by alternative within slope stake limits plus 40 feet

Alternative	Total Stream Crossings	Total Stream Length (ft.)
Alternative 1 (Upgrade Existing)	37	32,512
Alternative 1 (Southern Bypass)	38	33,508
Alternative 11	39	27,217
Alternative 12	42	34,296
Alternative 31	40	27,915
Alternative 32	43	34,994
Alternative 35	39	31,295

Alternative	Total Stream Crossings	Total Stream Length (ft.)
Alternative 36	37	24,885
Alternative 51	37	23,638
Alternative 52	40	30,717
Alternative 63	42	32,663
Alternative 65	39	25,584

The total number of wetland acres within each alternative's slope stake limits plus 40 feet is shown below in Table 7.

Table 7: Jurisdictional wetland impacts by alternative within slope stake limits plus 40 feet

Alternative	Riparian Wetlands (ac.)	Non-Riparian Wetlands (ac.)	Total Wetlands (ac.)
Alternative 1 (Upgrade Existing)	12	74	86
Alternative 1 (Southern Bypass)	24	41	65
Alternative 11	49	68	118
Alternative 12	37	55	93
Alternative 31	61	67	127
Alternative 32	49	53	102
Alternative 35	107	42	149
Alternative 36	116	55	172
Alternative 51	82	60	142
Alternative 52	70	47	117
Alternative 63	38	75	113
Alternative 65	50	88	138

5.2 Clean Water Act Permits

The proposed project has been designated as an EIS for the purposes of NEPA and SEPA documentation. As a result, a Section 404 Individual Permit (IP) and a Section 401 Water Quality Certification (WQC) will likely be applicable. The US Army Corps of Engineers (USACE) holds the final discretion as to what permit will be required to authorize project construction. Additionally, the project will likely require a Buffer Authorization from NCDWR for impacts to buffers subject to the Neuse River Basin Buffer Rules.

5.3 Coastal Area Management Act Areas of Environmental Concern

There is potential for the presence of Coastal Area Management Act (CAMA) Areas of Environmental Concern (AECs) within the Craven County portion of the NRTR study area. Craven County is one of the 20 designated coastal counties for North Carolina. The portion of the NRTR study area within Craven County contains three named streams (Tracey Swamp, Gum Swamp, and Core Creek) and a large floodplain wetland system associated with Tracey Swamp. These streams and/or floodplain wetlands could be considered AECs by the Division of Coastal Management (DCM). AEC determinations and potential impacts will be determined once a LEDPA has been selected and formal consultation with DCM has been completed.

Lenoir and Jones counties are not designated coastal counties for North Carolina.

5.4 Construction Moratoria

Construction moratoria will likely be required for the proposed project. The Neuse River is designated as both an anadromous fish spawning area and a primary inland nursery area. A moratorium on in-water work from February 15 through June 30 each year (USACE 2017) could be expected during the spawning season for anadromous fish species..

Final decisions regarding moratoria will be made during the project merger process.

5.5 N.C. River Basin Buffer Rules

Streamside riparian zones within the NRTR study area are protected under provisions of the Neuse River Buffer Rules administered by NCDWR (15A NCAC 02B .0233). Streams subject to the Neuse River Buffer Rules that cross the project alternatives are identified in Tables 10 through 26 of Appendix B. Streams subject to the Neuse River Buffer Rules were identified based solely on their presence on 24k USGS topographic mapping. Potential impacts to protected stream buffers will be determined once a LEDPA has been selected and formal stream delineations have been performed.

5.6 Rivers and Harbors Act Section 10 Navigable Waters

The Neuse River is considered a Navigable Water under Section 10 of the Rivers and Harbors Act. Bridges over the Neuse River will require a Section 10 permit from the US Coast Guard.

6.0 ENDANGERED SPECIES ACT PROTECTED SPECIES

As of December 26, 2012, the USFWS lists two federally protected species for Lenoir County; as of May 23, 2017, eight federally protected species for Craven County; and as of April 20, 2015, two federally protected species for Jones County. These species are shown in Table 8. A brief description of each species' habitat requirements follows. Habitat requirements for each species are based on the current best available information from referenced literature and/or USFWS.

Biological Conclusions have been rendered where appropriate based on GIS data review and scheduled field reviews with resource agencies. If detailed field surveys are required, then Biological Conclusions will be prepared separately from this document.

Table 8: Federally protected species listed for Lenoir, Jones, and Craven counties

Scientific Name	Common Name	Federal Status[1]	Habitat Present	Biological Conclusion	County[2]
Alligator mississippiensis	American alligator	T(S/A)	Yes	Not Required	C, J
Dermochelys coriacea	Leatherback sea turtle	E	No	No Effect	C
Picoides borealis	Red-cockaded woodpecker	E	Yes	Unresolved	L, C, J

Scientific Name	Common Name	Federal Status[1]	Habitat Present	Biological Conclusion	County[2]
Trichechus manatus	West Indian manatee	E	Yes	No Effect	C
Lysimachia asperulaefolia	Rough-leaved loosestrife	E	Yes	No Effect	C
Aeschynomene virginiana	Sensitive joint-vetch	T	Yes	No Effect	L, C
Calidris canutus rufa	Rufa red knot	T	No	No Effect	C
Myotis septentrionalis	Northern long-eared bat	T	Unknown	Unresolved	C

1. E – Endangered; T – Threatened; T(S/A) – Threatened Due to Similarity in Appearance
2. County abbreviations (L = Lenoir, C = Craven, J = Jones)

American alligator

USFWS optimal survey window: year round (only warm days in winter)

Habitat Description: In North Carolina, American alligators have been recorded in nearly every coastal county, and in many inland counties (up to the fall line). The alligator is found in rivers, streams, canals, lakes, swamps, and coastal marshes. Adult animals are highly tolerant of salt water, but the young appear to be more sensitive, with salinities greater than five parts per thousand considered harmful. The American alligator remains on the protected species list due to its similarity in appearance to the Endangered American crocodile.

Biological Conclusion: Not Required

There is habitat for American alligator present within the NRTR study area. Habitat is present within the Neuse River and several of the larger stream and swamp systems within the NRTR study area. A review of NCNHP records (September 2017) indicates a historical element occurrence record for American alligator within the lower reaches of the Neuse River within the NRTR study area.

Atlantic sturgeon

USFWS optimal survey window: not required; assume presence in appropriate waters

Habitat Description: Atlantic sturgeon occur in most major river systems along the eastern seaboard of the United States. The species prefers the near-shore marine, estuarine, and riverine habitat of large river systems. It is an anadromous species that migrates to faster-moving, upriver freshwater areas to spawn in the spring, but spends most of its life in saltwater. Large freshwater rivers that are unobstructed by dams or pollutants are imperative to successful reproduction. Distribution information by river/waterbody is lacking for the rivers of North Carolina; however, records are known from most coastal counties.

Biological Conclusion: No Effect

There is no habitat for Atlantic sturgeon present within the NRTR study area. The NRTR study area is more than 31 miles from waters which could be considered estuarine (New

Bern) and more than 40 miles from the mouth of the Pamlico Sound. A review of NCNHP records (September 2017) indicates no records for Atlantic sturgeon within or within one mile of the NRTR study area.

Leatherback sea turtle

USFWS optimal survey window: April – August

Habitat Description: Leatherback sea turtles are distributed world-wide in tropical waters of the Atlantic, Pacific, and Indian oceans. They are generally open ocean species, and may be common off the North Carolina coast during certain times of the year. However, in northern waters the species is reported to enter into bays, estuaries, and other inland bodies of water. Major nesting areas occur mainly in tropical regions. In the United States, primary nesting areas are in Florida, however nests are known from Georgia, South Carolina, and North Carolina as well. Nesting occurs from April to August. Leatherback sea turtles need sandy beaches backed with vegetation in the proximity of deep water and generally with rough seas. Beaches with a relatively steep slope are usually preferred.

Biological Conclusion: No Effect

There is no habitat for leatherback sea turtle present within the NRTR study area. The NRTR study area is more than 40 miles from the mouth of the Pamlico Sound, and more than 70 miles from the Atlantic Ocean. A review of NCNHP records (September 2017) indicates no record of leatherback sea turtles within or within one mile of the NRTR study area.

Red-cockaded woodpecker

USFWS optimal survey window: year round; November – early March (optimal)

Habitat Description: The red-cockaded woodpecker (RCW) typically occupies open, mature stands of southern pines, particularly longleaf pine (*Pinus palustris*), for foraging and nesting/roosting habitat. The RCW excavates cavities for nesting and roosting in living pine trees, aged 60 years or older, which are contiguous with pine stands at least 30 years of age to provide foraging habitat. The foraging range of the RCW is normally no more than one-half mile.

Biological Conclusion: Unresolved

Desktop habitat analysis began with the identification of potential habitat areas based on C-CAP data. Figure 6 in Appendix C displays the results of this analysis. Scrub/shrub and evergreen forest layers were used to identify pine forests. Through previous field investigations, it was discovered that young pine plantations had often been identified as scrub/shrub community types. Evaluation of these areas against aerial photography was then performed. This resulted in the identification of 96 potential forested areas that would require further investigation. These areas vary in size from less than 20 acres to more than 100 acres and, based on aerial imagery, appear to range in age as well. These areas are shown on Figure 7 in Appendix C.

Gary Jordan of USFWS was consulted on the project via email on November 8, 2012. He noted that the only known occurrence of RCW for Lenoir County is a historical record,

and that there is probably only a minimal chance of the presence of RCW, but it is prudent to consider since there is potential habitat for the species.

Initial field evaluations of the 96 potential sites were conducted during the week of March 25, 2013. Approximately 28 sites were visited during that time. The 28 sites visited were concentrated in the western portion of the NRTR study area. None of the 28 sites visited represent suitable nesting habitat for RCW. Marginal foraging habitat was present in some areas in the form of 40 to 60 year old loblolly pine (*Pinus taeda*) plantations, however, these areas were small in size and disjunct from anything representing nesting habitat. There were no longleaf pine forests present/observed within any of the sites visited. Most of the sites contained loblolly pine forests and/or plantations, mixed pine and hardwood forests, and young overgrown plantations. Representative photographs are located in Appendix C.

On May 22, 2013 a field meeting was held with Gary Jordan of USFWS, Travis Wilson of NCWRC, David Wainwright of NCDWR, Tom Steffens of USACE, Leilani Paugh and Morgan Weatherford of NCDOT, and Susan Westberry of URS/AECOM. During this meeting, the protocol used to define habitat areas for RCW were discussed and refined. The purpose of the field meeting was to verify and spot check the accuracy of the protocol being used to assess the presence of habitat for threatened and endangered species in the NRTR study area. Five sites were chosen and viewed on May 22, 2013. Two additional sites were also visited at the end of the field meeting that occurred within the radius of the previous record of red-cockaded woodpecker for Lenoir County.

USFWS and NCWRC expressed agreement with the protocol being used to assess community types. Gary Jordan offered further guidance that may help to reduce the number of potential habitat areas identified using the protocol. These discussions are summarized in the meeting minutes located in Appendix C.

The North Carolina Forest Service was contacted to obtain timber stand age data. Timber stand age data would help to further refine the sites generated by GIS methodology. Data were not available for all stands in the study area, but the data that were obtained suggest that the stands are younger than estimated through field investigations. A large majority of the expansive timber stands located in Craven and Jones counties are owned by the Weyerhaeuser Timber Company. Weyerhaeuser will be contacted to obtain stand age information for their land.

Thirty of the remaining 68 sites (generated by GIS methods) were visited on June 5, 2013. The last 38 sites will be further evaluated using the results of discussions with Gary Jordan during the field meeting and timber stand age data obtained from the NC Forest Service and the Weyerhaeuser Timber Company. Results of field investigations up to and including June 5, 2013 are included on Figure 7a in Appendix C.

No formal surveys for RCW will be conducted until a LEDPA has been chosen. The Biological Conclusion will remain unresolved until formal surveys have been completed.

A review of NCNHP records (September 2017) indicates one historical element occurrence record for RCW just outside of the southern edge of the NRTR study area.

The edge of the element occurrence records is more than one-half mile from the nearest DSA corridor. This occurrence record is shown on Figures 6 and 7 in Appendix C.

West Indian manatee

USFWS optimal survey window: not required; assume presence in appropriate waters

Habitat Description: West Indian manatee have been observed in all the North Carolina coastal counties. Manatees are found in canals, sluggish rivers, estuarine habitats, salt water bays, and as far off shore as 3.7 miles. They utilize freshwater and marine habitats at shallow depths of five to 20 feet. In the winter, between October and April, manatees concentrate in areas with warm water. During other times of the year habitats appropriate for the manatee are those with sufficient water depth, an adequate food supply, and in proximity to freshwater. Manatees require a source of freshwater to drink. Manatees are primarily herbivorous, feeding on any aquatic vegetation present, but they may occasionally feed on fish.

Biological Conclusion: No Effect

There is marginal habitat for West Indian manatee present within the NRTR study area. The NRTR study area is more than 31 miles from waters which could be considered estuarine (New Bern) and more than 40 miles from the mouth of the Pamlico Sound. However, a review of NCNHP records (September 2017) indicates an element occurrence record for West Indian manatee that extends into the Neuse River at the very edge of the NRTR study area. These records begin in the Neuse River approximately 400 feet inside of NRTR study area and extend downstream of the NRTR study area. It is unlikely that the species travels any further upstream within the Neuse River. The closest potential crossing of the river by one of the DSA corridors is approximately one mile upstream of the mapped extent of the species.

Rough-leaved loosestrife

USFWS optimal survey window: mid-May – June

Habitat Description: Rough-leaved loosestrife, endemic to the Coastal Plain and Sandhills of North and South Carolina, generally occurs in the ecotones or edges between longleaf pine uplands and pond pine (*Pinus serotina*) pocosins in dense shrub and vine growth on moist to seasonally saturated sands and on shallow organic soils overlaying sand (spodosolic soils). Occurrences are found in such disturbed habitats as roadside depressions, maintained power and utility line rights-of-way, firebreaks, and trails. The species prefers full sunlight, is shade intolerant, and requires areas of disturbance (*e.g.*, clearing, mowing, periodic burning) where the overstory is minimal. It can, however, persist vegetatively for many years in overgrown, fire-suppressed areas. The plant is known to occur on the Blaney, Gilead, Johnston, Kalmia, Leon, Mandarin, Murville, Torhunta, and Vaucluse soil series.

Biological Conclusion: No Effect

Desktop habitat analysis resulted in the identification of what appears to be marginal habitat for rough-leaved loosestrife within the Craven County portion of the NRTR study

area in the form of maintained roadside rights-of-way and pine plantation/agricultural ecotones. No optimal habitat areas were detected during desktop analyses. It is likely that the plantation/agricultural edges are maintained on too frequent a basis to support the species. However, both Leon and Torhunta soils are present within the Craven County portion of the NRTR study area. There is an approximately eight-acre patch of Leon soils located directly adjacent to an approximately 140-acre patch of Torhunta soils. The desktop habitat analysis process is displayed in Figures 8 and 9 in Appendix C.

Foot surveys for rough-leaved loosestrife were conducted on June 5, 2013. These surveys were conducted within the field/forested edge regions of Leon and Torhunta soils within Craven County identified during the desktop habitat analysis (shown on Figures 8 and 9). No rough-leaved loosestrife plants were identified. A review of NCNHP records (September 2017) indicates no records of rough-leaved loosestrife within the NRTR study area or within a one-mile radius.

Sensitive joint-vetch

USFWS optimal survey window: mid-July – October

Habitat Description: Sensitive joint-vetch grows in the mildly brackish inter-tidal zone where plants are flooded twice daily. This annual legume prefers the marsh edge at an elevation near the upper limit of tidal fluctuation, but can also be found in swamps and on river banks. Sensitive joint-vetch normally occurs in areas with high plant diversity where annual species predominate, and can grow in sand, mud, gravel, or peat substrates. Bare to sparsely vegetated substrates appear to be a microhabitat feature of critical importance to this plant. Such microhabitats may include accreting point bars that have not yet been colonized by perennial species, areas scoured out by ice, low swales within marshes, muskrat "eat outs" where this rodent removes all of the vegetation within a small portion of the marsh, storm damaged areas, and the saturated organic sediments of some interior marshes that have local nutrient deficiencies. In North Carolina, stable occurrences have been found in the estuarine meander zone of tidal rivers where sediments transported from up-river settle out and extensive marshes are formed. Additional North Carolina occurrences are also found in moist to wet roadside ditches and moist fields, but these are not considered stable populations.

Biological Conclusion: No Effect

A review of NCNHP records (September 2017) indicates no record of sensitive joint-vetch within the NRTR study area or within a one-mile radius. The only large swamp system present within the Craven County portion of the NRTR study area is Core Creek. Core Creek is not tidal and is heavily vegetated. It does not contain suitable habitat for the species. In an email dated November 8, 2012, Gary Jordan of USFWS states that the known historical occurrence of the species within Lenoir County is highly questionable, as the only record predates 1900. He goes on to state that habitat for the sensitive-joint vetch is the slightly brackish, intertidal zone of coastal marshes where plants are flooded twice daily. He does not view the Neuse River in Lenoir County as potential habitat for sensitive joint-vetch. Sensitive joint-vetch is not a species that warrants significant amounts of time or effort within Lenoir County. Based on Mr. Jordan's statements and

the age of the only other record of the species within Lenoir County, the Biological Conclusion for the species is No Effect.

Rufa red knot

USFWS optimal survey window: April – August

Habitat Description: The rufa red knot is one of the six recognized subspecies of red knots, and is the only subspecies that routinely travels along the Atlantic coast of the United States during spring and fall migrations. It is known to winter in North Carolina and to stop over during migration. Habitats used by red knots in migration and wintering areas are similar in character: coastal marine and estuarine habitats with large areas of exposed intertidal sediments. In North America, red knots are commonly found along sandy, gravel, or cobble beaches, tidal mudflats, salt marshes, shallow coastal impoundments and lagoons, and peat banks. Ephemeral features such as sand spits, islets, shoals, and sandbars, often associated with inlets can be important habitat for roosting.

Biological Conclusion: No Effect

The NRTR study area is more than 31 miles from waters which could be considered estuarine (New Bern), more than 40 miles from the mouth of the Pamlico Sound, and more than 70 miles from the coast. A review of NCNHP records (September 2017) indicates no record of rufa red knot within the NRTR study area or within a one-mile radius.

Northern long-eared bat

USFWS optimal survey window: May 15 through August 15

Habitat description: Northern long-eared bat is found across much of the eastern and north central US and all Canadian provinces. Winter hibernating habitat consists of caves and abandoned mines with constant, cooler temperatures with high humidity and no air currents. While within hibernacula, they often form colonies with other bat species. Summer roosting occurs singly or in colonies underneath bark, in cavities and crevices of both live trees and snags, and to a lesser degree in human-made structures such as buildings, barns, behind window shutters, on utility poles, and in bat houses. This species is a medium-sized bat with females tending to be slightly larger than males. Average body length ranges from 3 to 4 inches, with a wingspan ranging from 9 to 10 inches. This species is distinguished by its relatively long ears that extend beyond the nose when laid forward.

Biological Conclusion: Unresolved

A review of NCNHP records (September 2017) indicated no known northern long-eared bat occurrences within one mile of the study area.

6.1 Bald Eagle and Golden Eagle Protection Act

Habitat for the bald eagle primarily consists of mature forests in proximity to large bodies of open water for foraging. Large, dominant trees are utilized for nesting sites, typically within one mile of open water.

Within the NRTR study area, the banks of the Neuse River present potential bald eagle nesting habitat. Adjacent agricultural fields and small forested areas could provide foraging habitat. However, the NRTR study area is fragmented by sporadic development and swamplands that do not represent ideal nesting or foraging areas.

A review of NCNHP records (September 2017) indicates two element occurrence records for bald eagle within the vicinity of the NRTR study area. One of the records is located approximately one mile outside of the NRTR study area and is listed as a historical record. The other record was documented in 2009 and is located along the Neuse River within the NRTR study area between DSA corridors 1 (Upgrade Existing) and 53.

Due to the presence of suitable habitat for the species and a documented occurrence within the NRTR study area, surveys for bald eagle should be conducted once a LEDPA has been chosen.

6.2 Essential Fish Habitat

Identification of Essential Fish Habitat will be coordinated with the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) and NCDOT's Biological Surveys Group.

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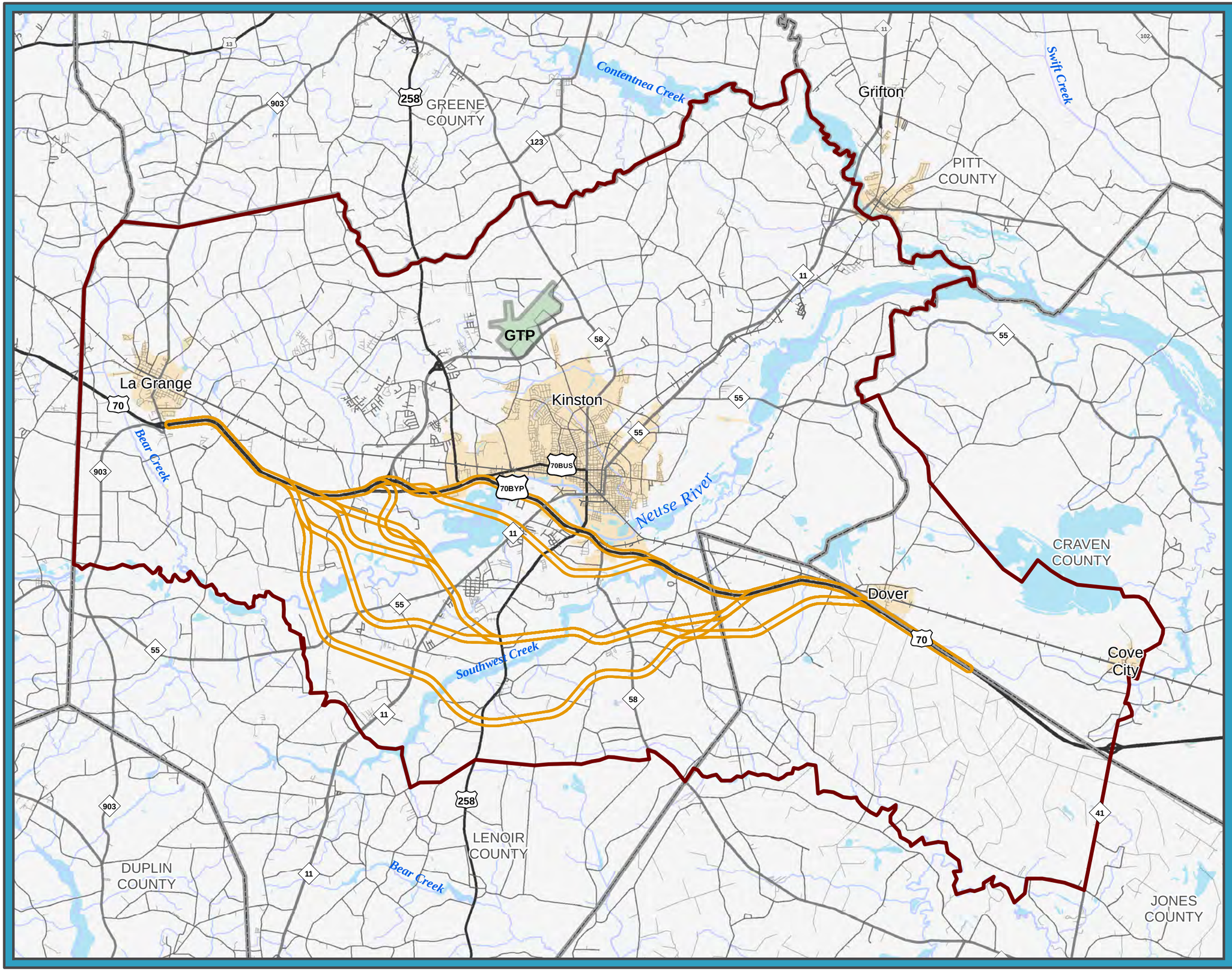
Appendices

Appendix A: Figures

Kinston Bypass
STIP Project No. R-2553

Figure 1
Vicinity Map



Legend

- DSA Corridors
- Project Study Area
- Railroad
- Global TransPark (GTP)
- County
- US Highway
- NC Highway
- State Road
- Local Road
- GTP Complex Boundary
- Stream/River
- Waterbody
- Municipal Area

0 2.5 Miles

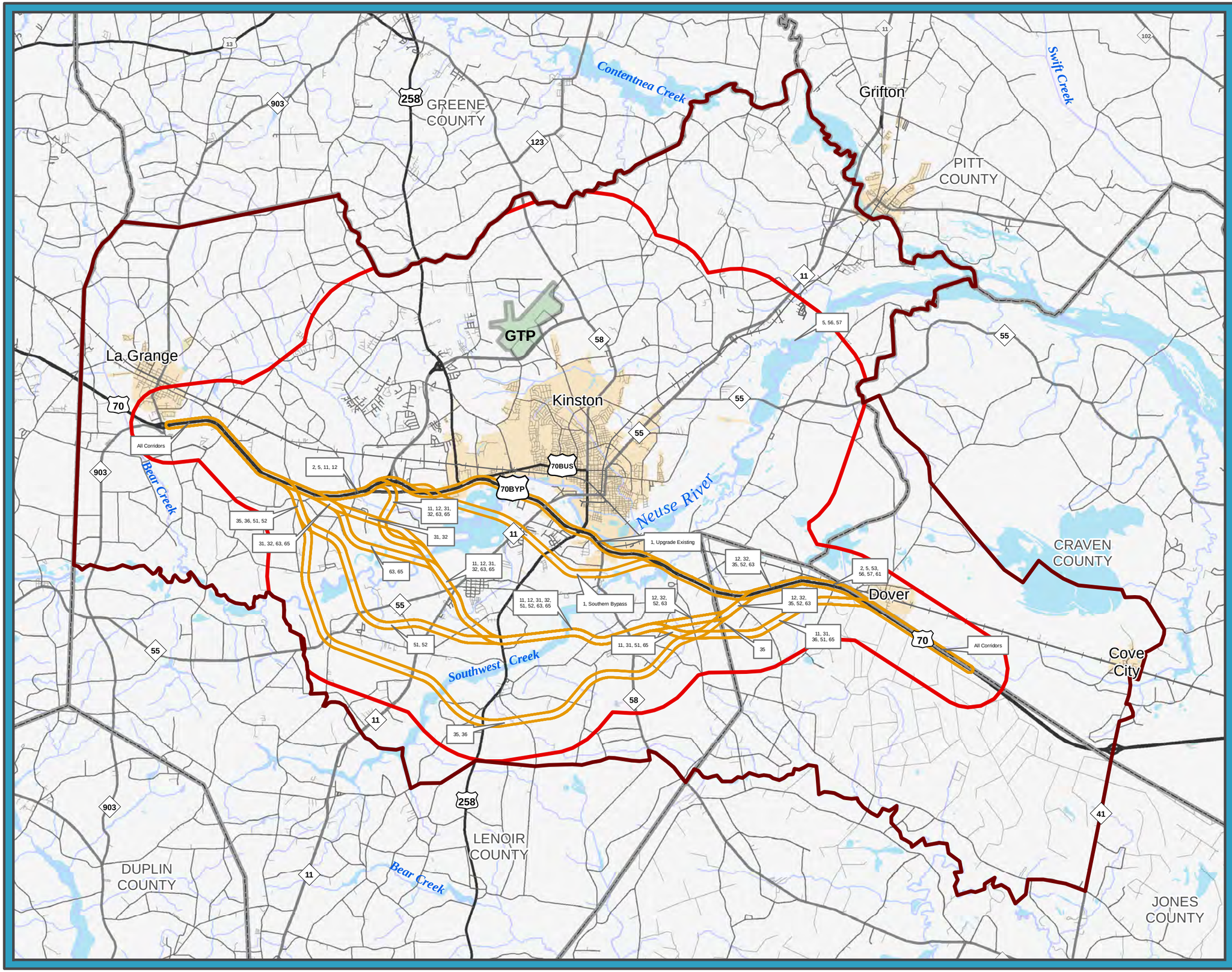
N

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.

Kinston Bypass
STIP Project No. R-2553

Figure 2
NRTR Study Area



Legend

- Project Study Area
- NRTR Study Area
- DSA Corridors
- Railroad
- Global TransPark (GTP)
- County
- US Highway
- NC Highway
- State Road
- Local Road
- GTP Complex Boundary
- Stream/River
- Waterbody
- Municipal Area

* call out boxes indicate DSA corridors in each segment

0 2.5 Miles

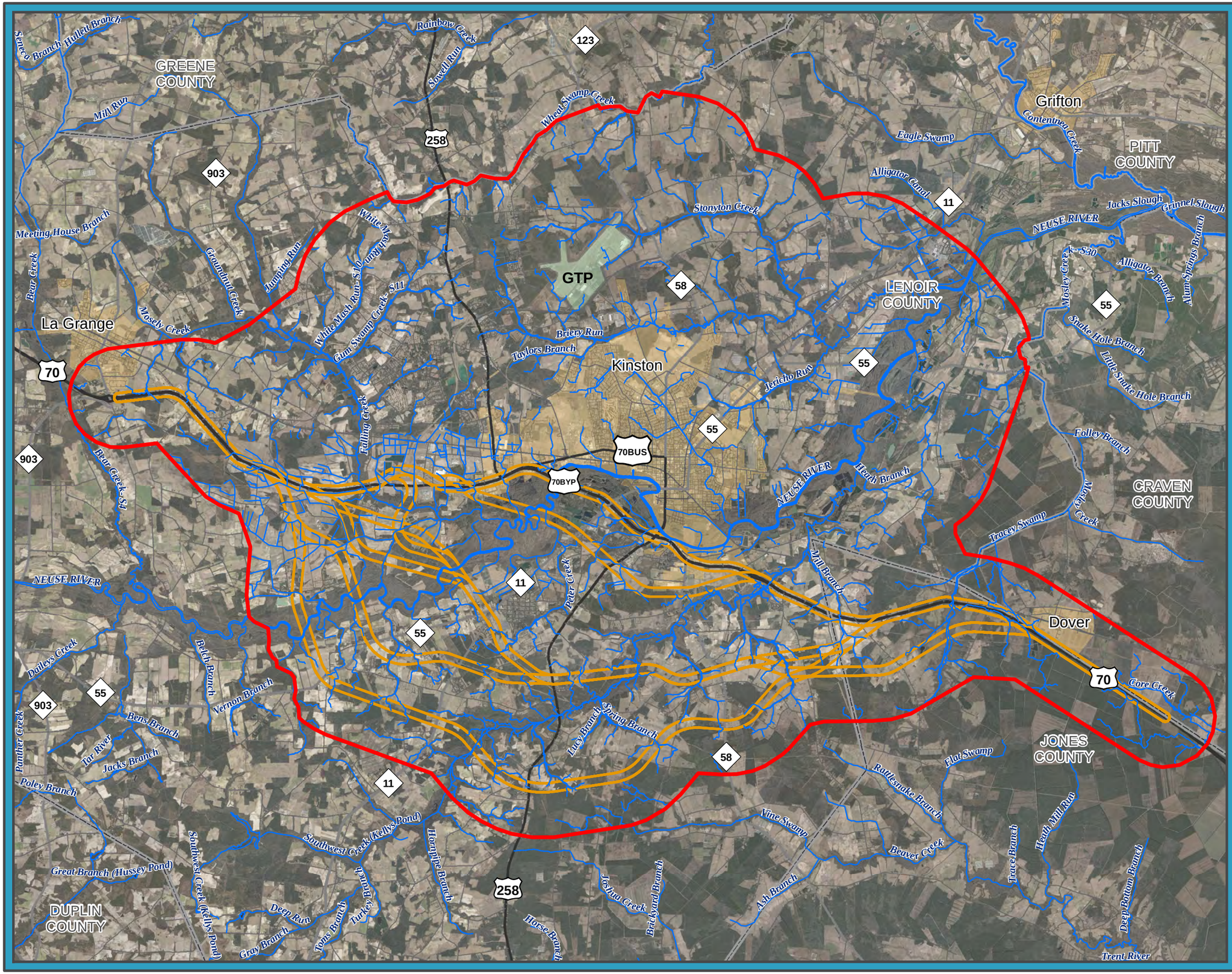
N

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.

Kinston Bypass
STIP Project No. R-2553

Figure 3
Water Resources Map



Legend

- NRTR Study Area
- DQW Lenoir Model Streams
- DSA Corridors
- Global TransPark (GTP)
- County
- US Highway
- NC Highway
- State Road
- Local Road
- Railroad
- Municipal Area

N

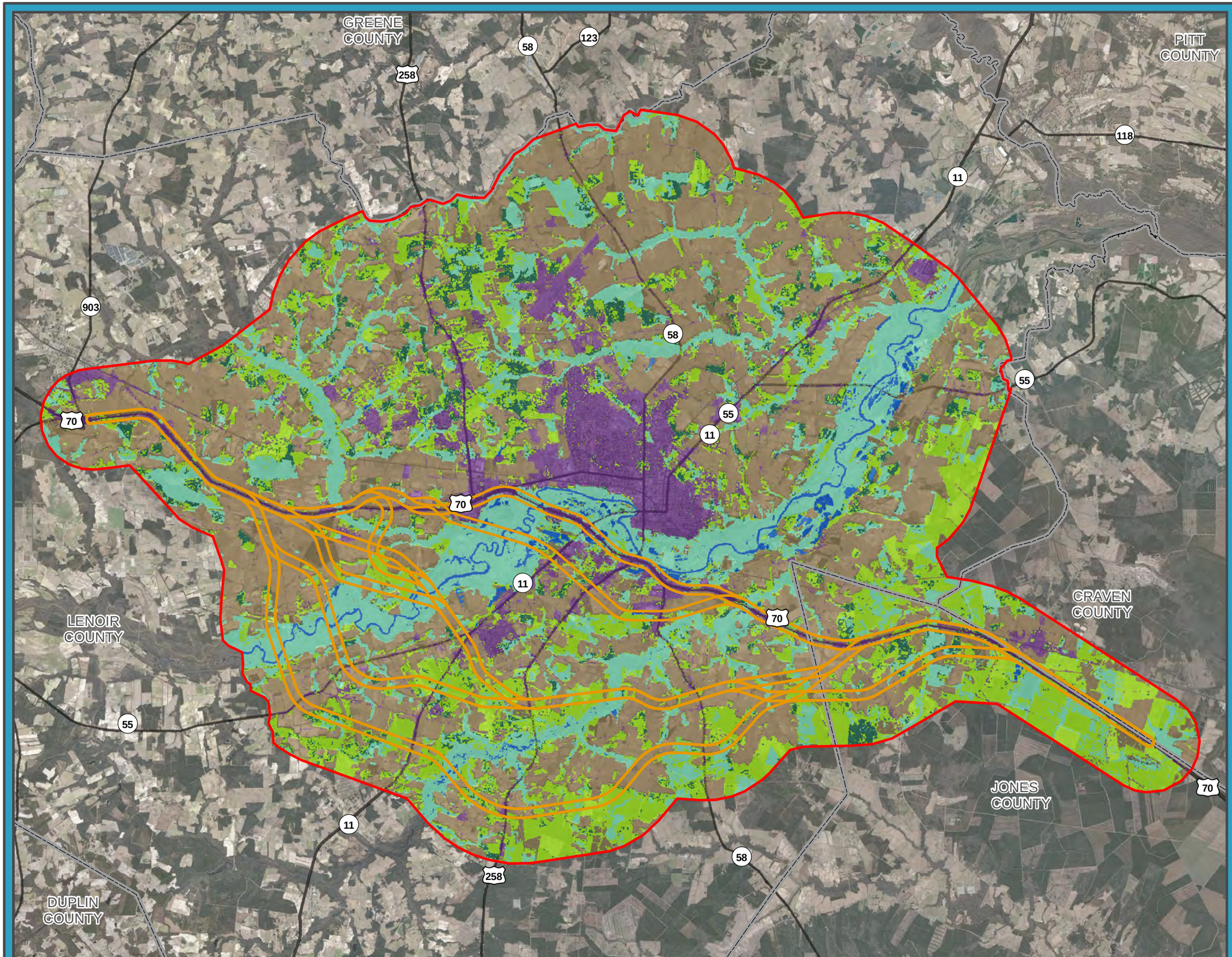
0 2.5 Miles

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.

Kinston Bypass
STIP Project No. R-2553

Figure 4
Terrestrial Communities



Legend

- NRTR Study Area
- DSA Corridors
- County

Terrestrial Communities:

- Agriculture
- Forested Upland
- Maintained/Disturbed
- Pine Plantation
- Palustrine Wetland
- Open Water

0 2.5 Miles

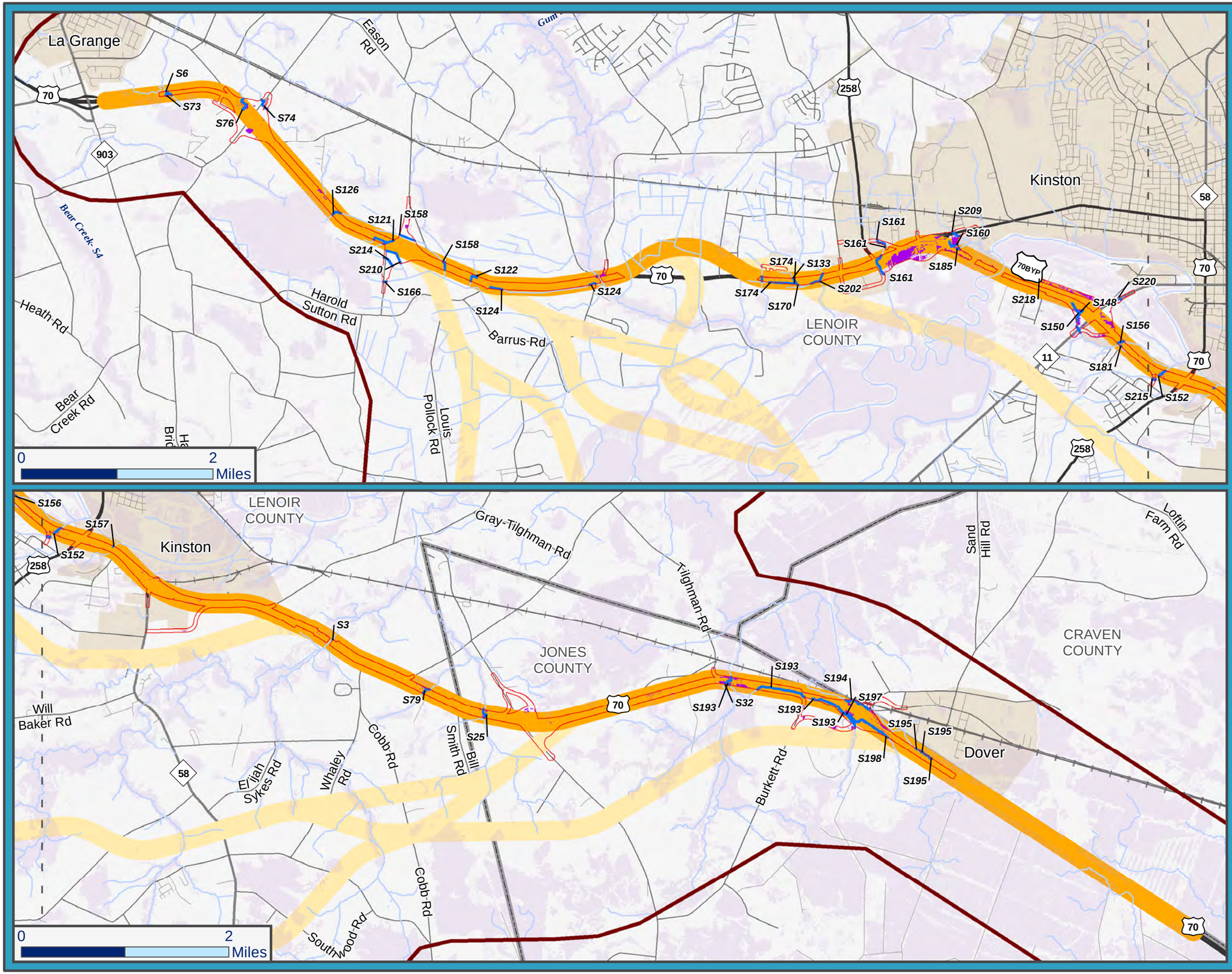
N

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.

Kinston Bypass
STIP Project No. R-2553

Figure 5a
Predicted Streams
and Wetlands



Legend

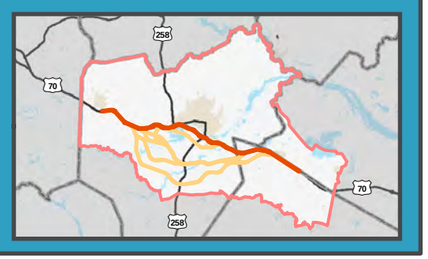
- NRTR Study Area
- Stream/Rivers within Corridor
- Stream/River
- Wetlands within Corridor
- Wetland
- Sheet Match Line
- DSA Corridors
- Slope Stake Limits Plus 40 Feet
- US Highway
- NC Highway
- State Road
- Local Road
- Railroad
- County
- Global TransPark (GTP)
- Municipal Area

N

Corridor 1
Upgrade Existing

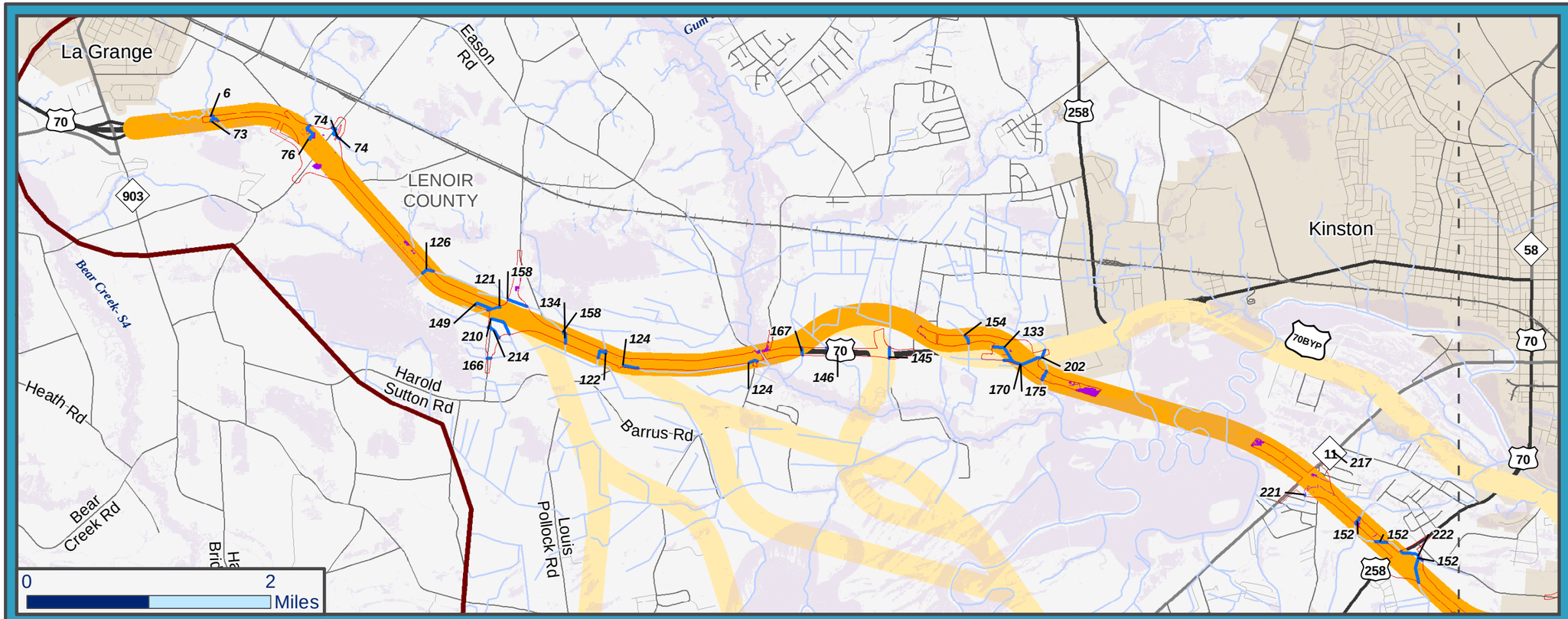
September 2017

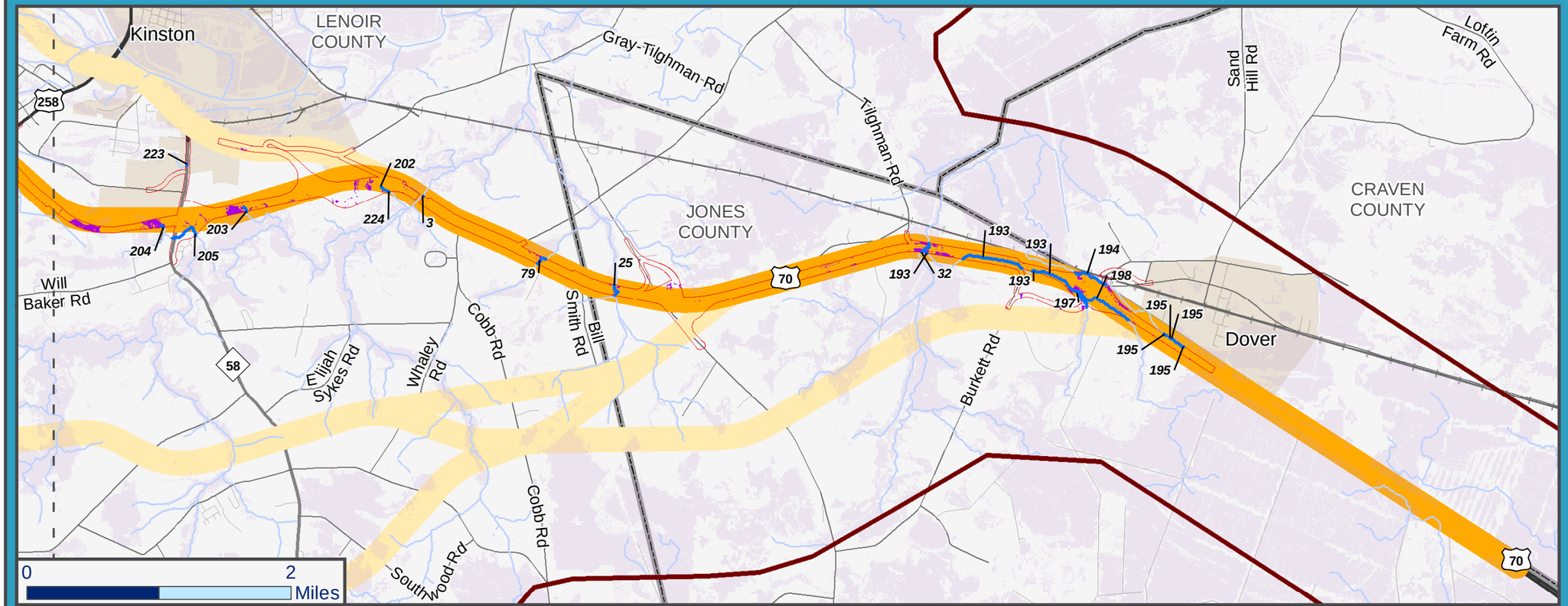
This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.



Kinston Bypass
STIP Project No. R-2553

Figure 5b
Predicted Streams
and Wetlands





Legend

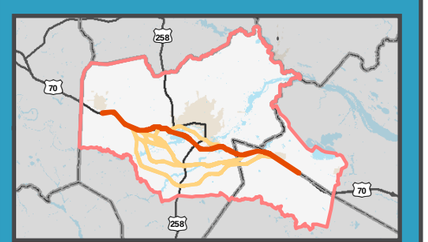
- NRTR Study Area
- Stream/Rivers within Corridor
- Stream/River
- Wetlands within Corridor
- Wetland
- Sheet Match Line
- DSA Corridors
- Slope Stake Limits Plus 40 Feet
- US Highway
- NC Highway
- State Road
- Local Road
- Railroad
- County
- Global TransPark (GTP)
- Municipal Area

N

Corridor 1
Southern Bypass

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.



Kinston Bypass
STIP Project No. R-2553

Figure 5c
Predicted Streams
and Wetlands

Legend

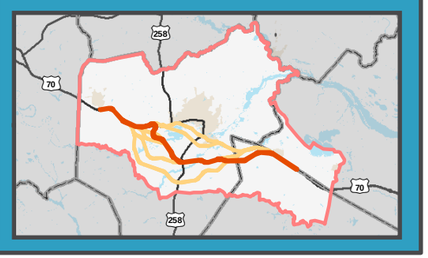
- NRTR Study Area
- Stream/Rivers within Corridor
- Stream/River
- Wetlands within Corridor
- Wetland
- Sheet Match Line
- DSA Corridors
- Slope Stake Limits Plus 40 Feet
- US Highway
- NC Highway
- State Road
- Local Road
- Railroad
- County
- Global TransPark (GTP)
- Municipal Area

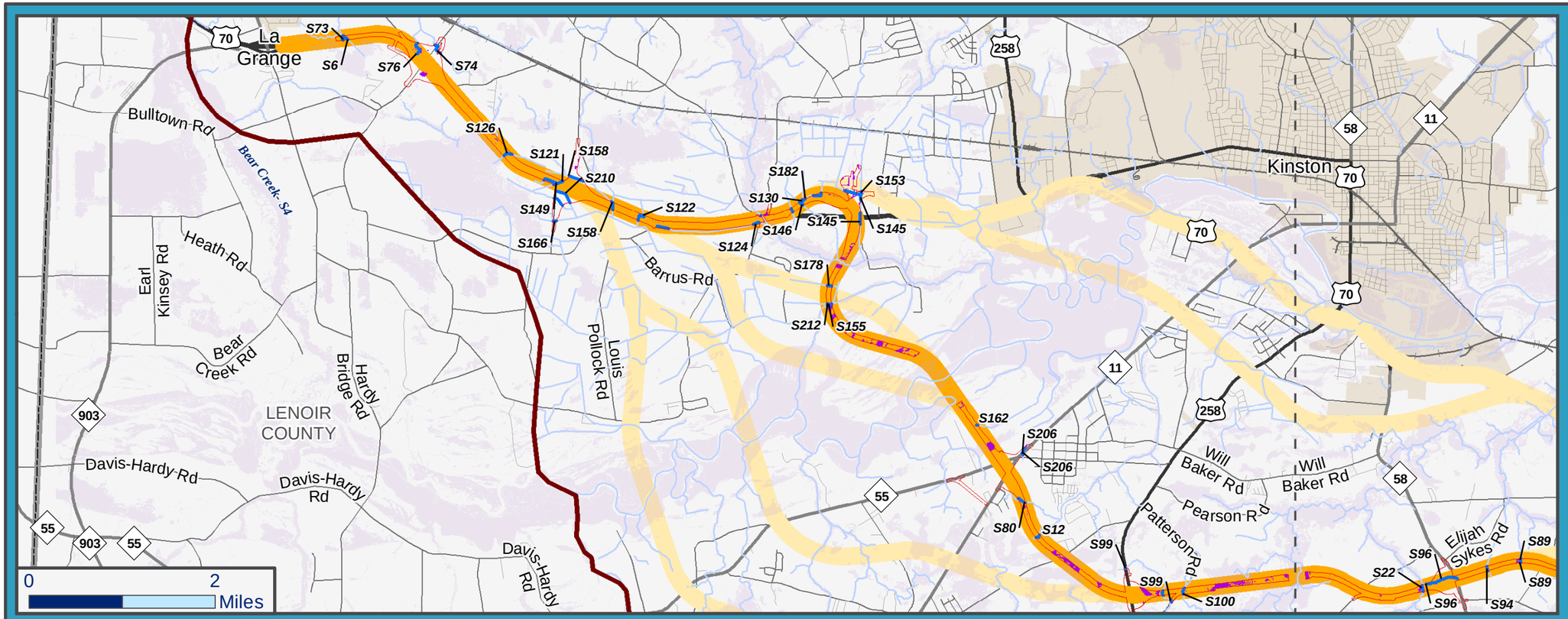
N

Corridor 11

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.





Kinston Bypass
STIP Project No. R-2553

Figure 5d
Predicted Streams
and Wetlands

Legend

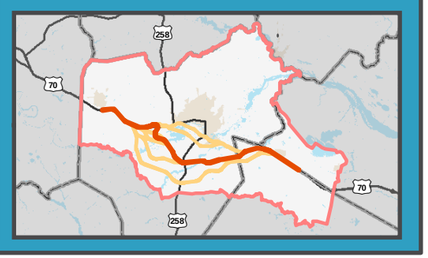
- NRTR Study Area
- Stream/Rivers within Corridor
- Stream/River
- Wetlands within Corridor
- Wetland
- Sheet Match Line
- DSA Corridors
- Slope Stake Limits Plus 40 Feet
- US Highway
- NC Highway
- State Road
- Local Road
- Railroad
- County
- Global TransPark (GTP)
- Municipal Area

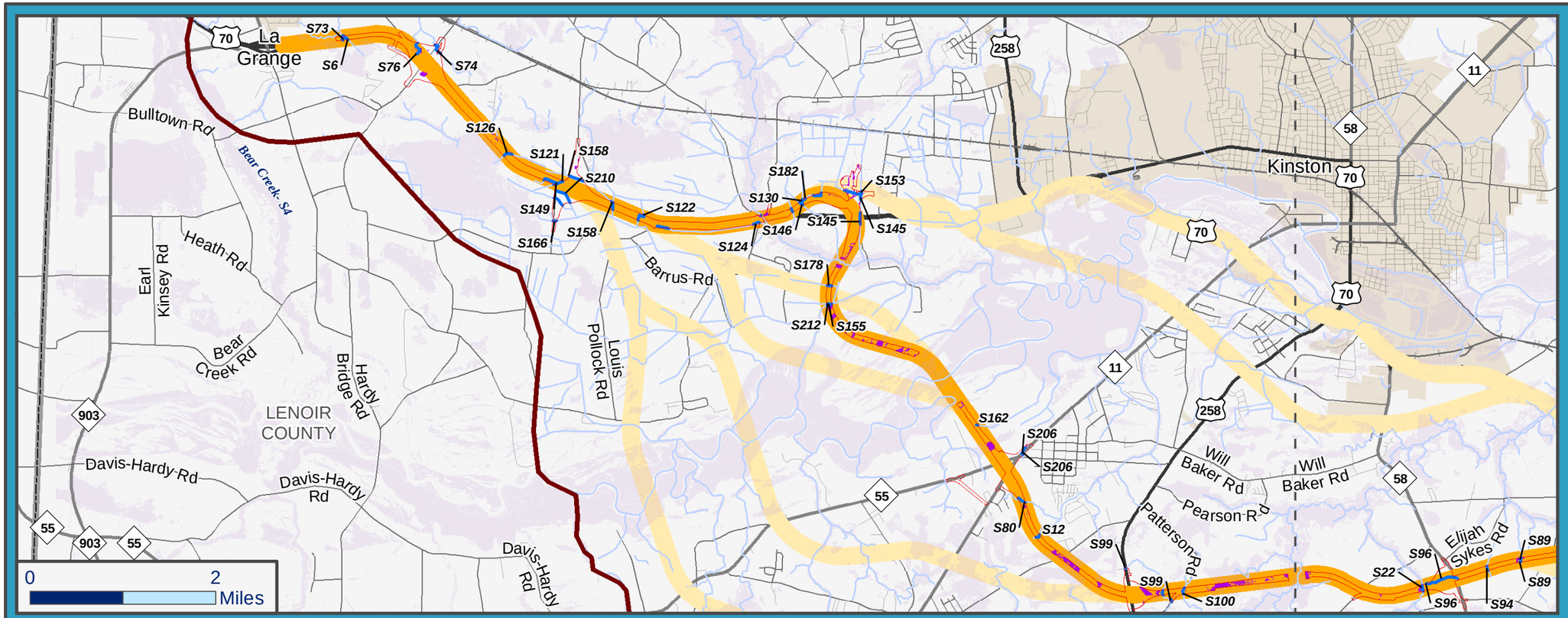
N

Corridor 12

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM





Kinston Bypass
STIP Project No. R-2553

Figure 5e
Predicted Streams
and Wetlands

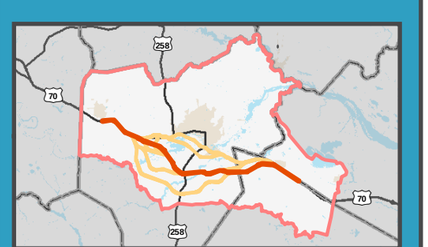
Legend

- NRTR Study Area
- Stream/Rivers within Corridor
- Stream/River
- Wetlands within Corridor
- Wetland
- Sheet Match Line
- DSA Corridors
- Slope Stake Limits Plus 40 Feet
- US Highway
- NC Highway
- State Road
- Local Road
- Railroad
- County
- Global TransPark (GTP)
- Municipal Area

N

Corridor 31

September 2017



0 2 Miles

0 2 Miles

Kinston Bypass
STIP Project No. R-2553

Figure 5f
Predicted Streams
and Wetlands

Legend

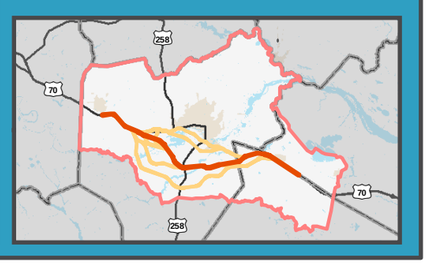
- NRTR Study Area
- Stream/Rivers within Corridor
- Stream/River
- Wetlands within Corridor
- Wetland
- Sheet Match Line
- DSA Corridors
- Slope Stake Limits Plus 40 Feet
- US Highway
- NC Highway
- State Road
- Local Road
- Railroad
- County
- Global TransPark (GTP)
- Municipal Area

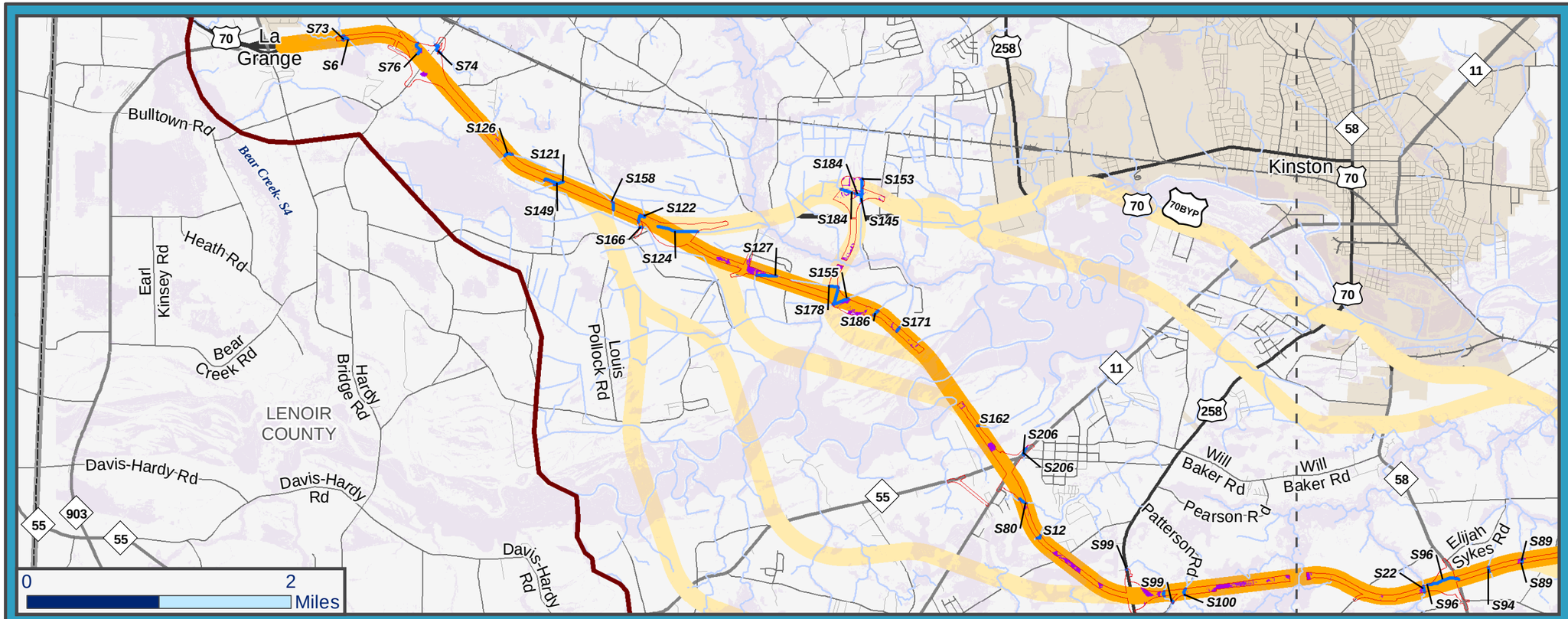
N

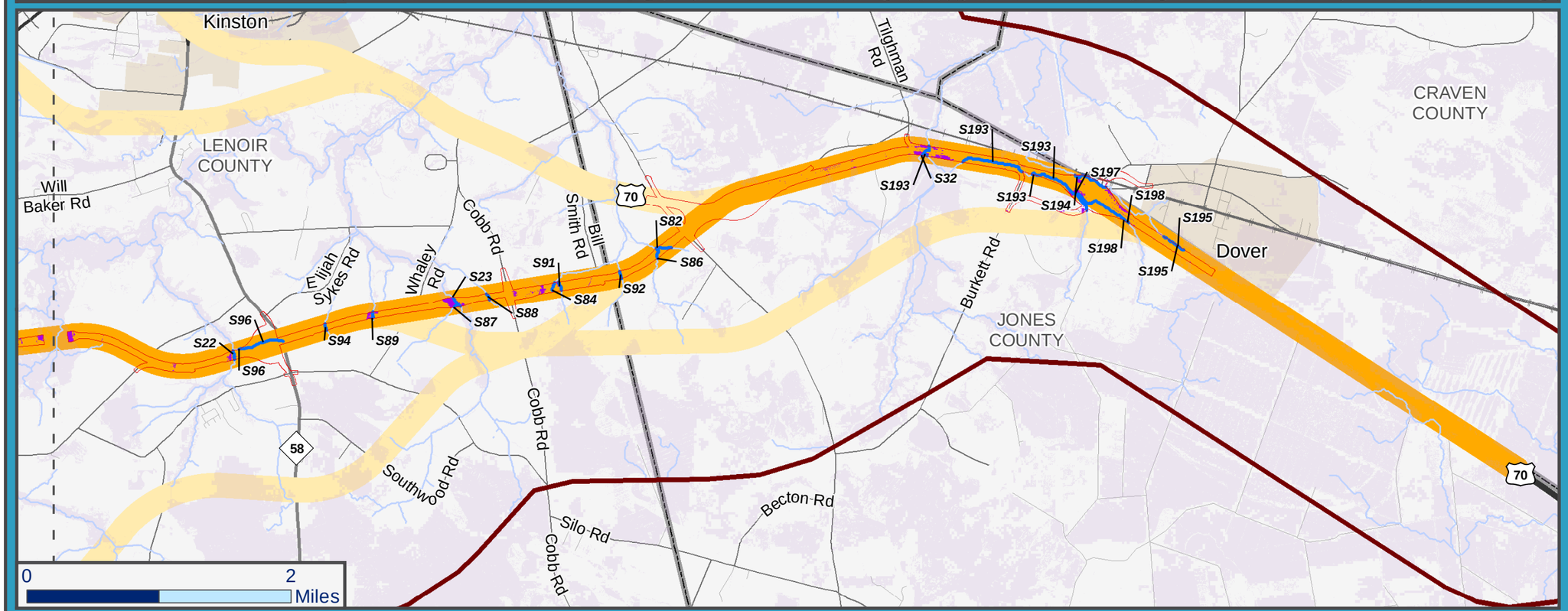
Corridor 32

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.







Kinston Bypass
STIP Project No. R-2553

Figure 5g
Predicted Streams and Wetlands

Legend

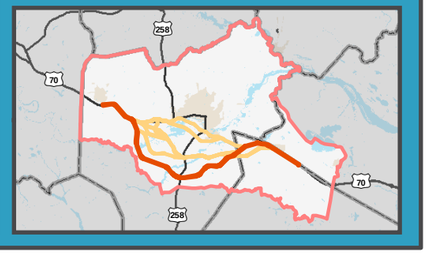
- NRTR Study Area
- Stream/Rivers within Corridor
- Stream/River
- Wetlands within Corridor
- Wetland
- Sheet Match Line
- DSA Corridors
- Slope Stake Limits Plus 40 Feet
- US Highway
- NC Highway
- State Road
- Local Road
- Railroad
- County
- Global TransPark (GTP)
- Municipal Area

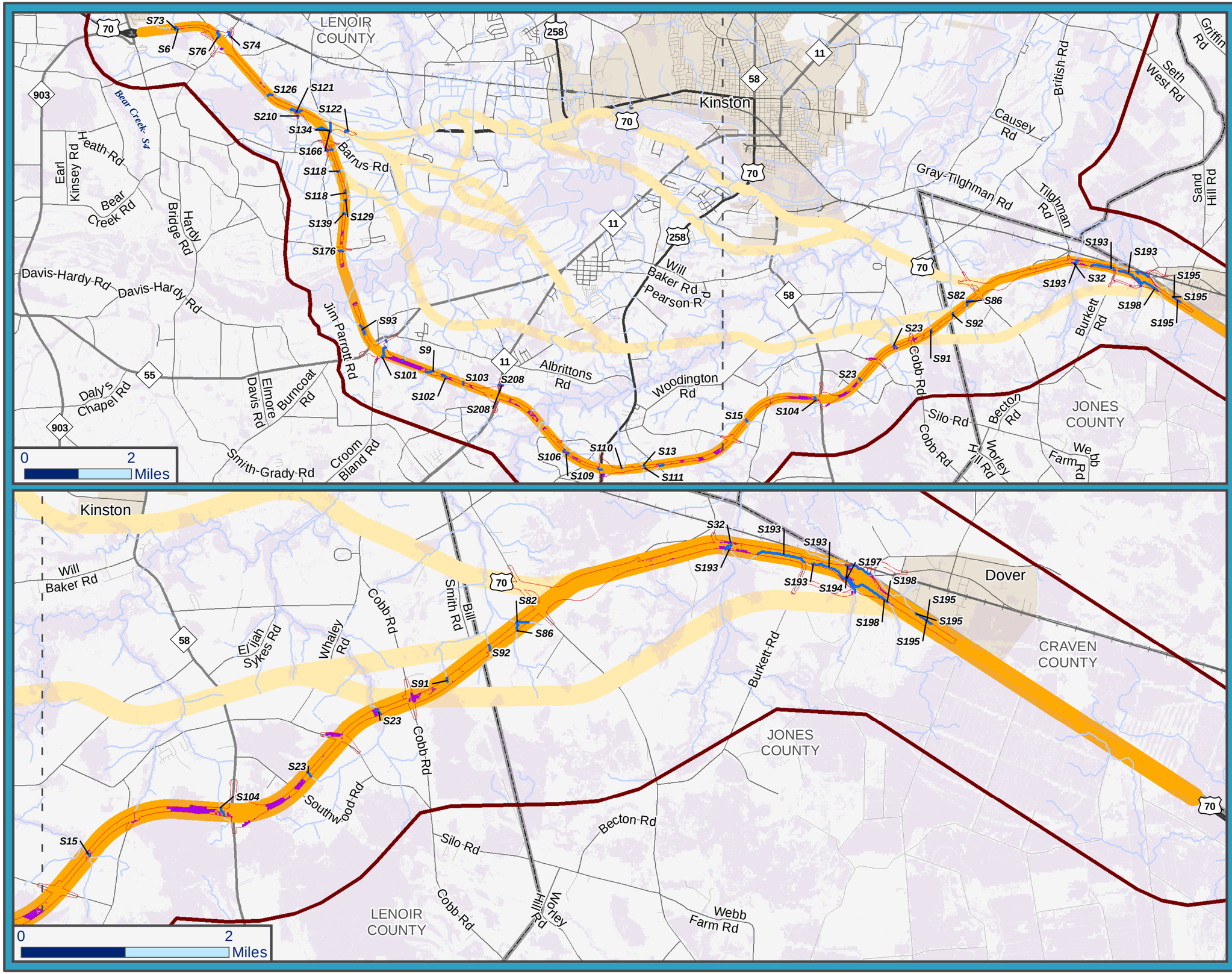
N

Corridor 35

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.





Kinston Bypass
STIP Project No. R-2553

Figure 5h
Predicted Streams
and Wetlands

Legend

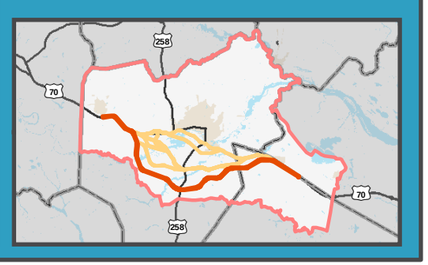
- NRTR Study Area
- Stream/Rivers within Corridor
- Stream/River
- Wetlands within Corridor
- Wetland
- Sheet Match Line
- DSA Corridors
- Slope Stake Limits Plus 40 Feet
- US Highway
- NC Highway
- State Road
- Local Road
- Railroad
- County
- Global TransPark (GTP)
- Municipal Area

N

Corridor 36

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.

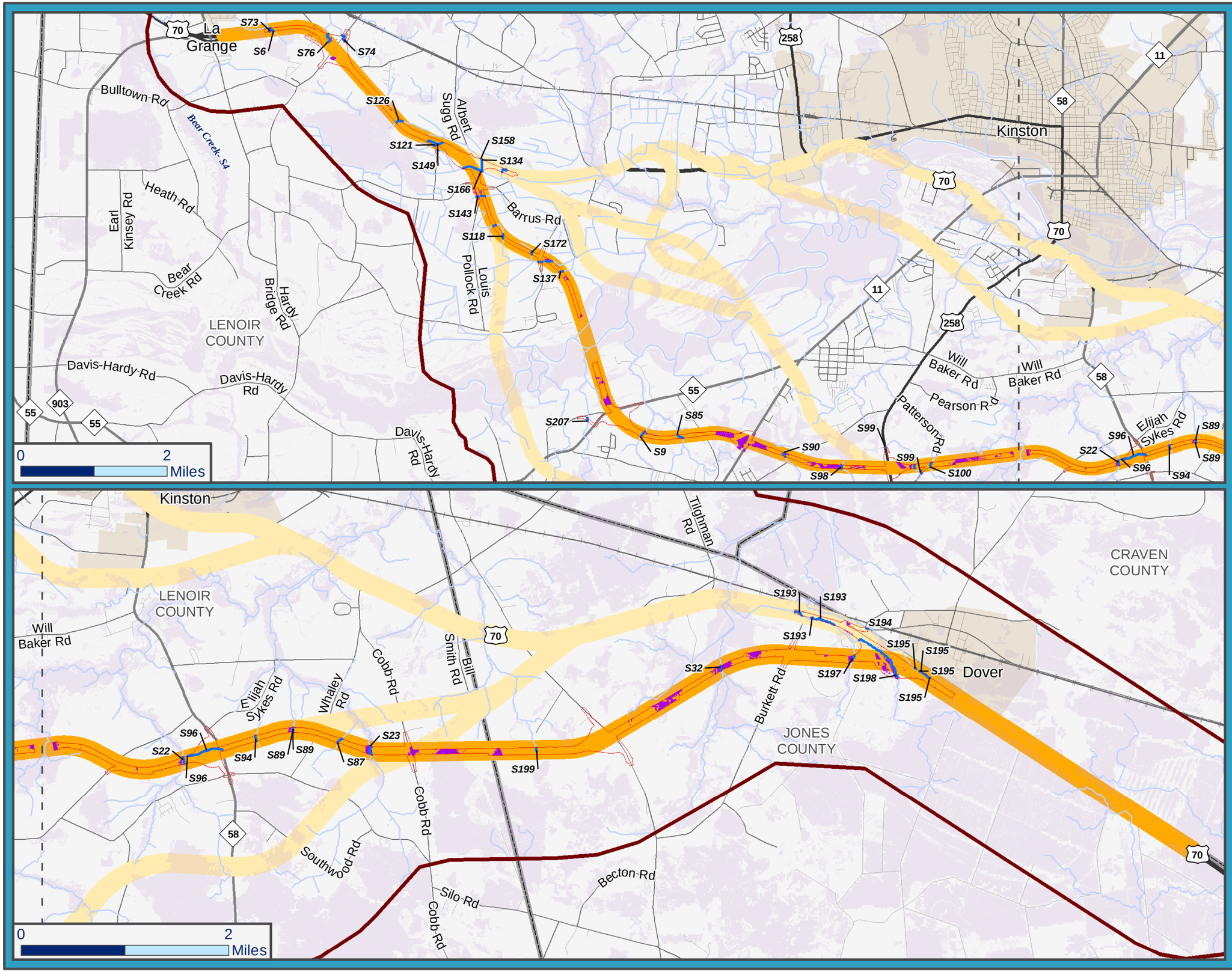


0 2 Miles

Kinston
LENOIR COUNTY
CRAVEN COUNTY
JONES COUNTY
Dover
Heath Rd
Bear Creek Rd
Hardy Bridge Rd
Davis-Hardy Rd
Daly's Chapel Rd
Elmore Davis Rd
Burncoat Rd
Smith-Grady Rd
Croom Bland Rd
Jim Parrott Rd
Barrus Rd
Albrittons Rd
Will Baker Rd
Pearson Rd
Woodington Rd
Cobb Rd
Silo Rd
Becton Rd
Webb Farm Rd
Worley Hill Rd
Southwood Rd
Smith Rd
Bill
Whaley Rd
Elijah Sykes Rd
Causey Rd
British Rd
Seth West Rd
Griffin Rd
Gray-Tilghman Rd
Tilghman Rd
Burkett Rd
S6 S74 S76 S121 S122 S126 S210 S134 S166 S118 S129 S139 S176 S93 S101 S9 S102 S103 S208 S106 S109 S110 S111 S13 S15 S104 S23 S199 S32 S193 S194 S195 S196 S197 S198

Kinston Bypass
STIP Project No. R-2553

Figure 5i
Predicted Streams and Wetlands



Legend

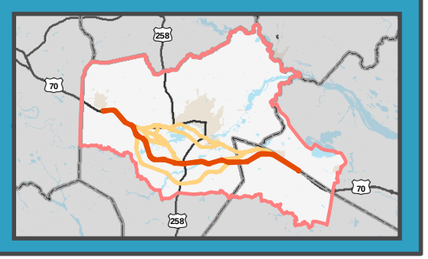
- NRTR Study Area
- Stream/Rivers within Corridor
- Stream/River
- Wetlands within Corridor
- Wetland
- Sheet Match Line
- DSA Corridors
- Slope Stake Limits Plus 40 Feet
- US Highway
- NC Highway
- State Road
- Local Road
- Railroad
- County
- Global TransPark (GTP)
- Municipal Area

N

Corridor 51

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.



Kinston Bypass
STIP Project No. R-2553

Figure 5j
Predicted Streams
and Wetlands

Legend

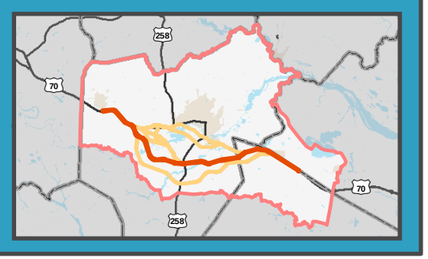
- NRTR Study Area
- Stream/Rivers within Corridor
- Stream/River
- Wetlands within Corridor
- Wetland
- Sheet Match Line
- DSA Corridors
- Slope Stake Limits Plus 40 Feet
- US Highway
- NC Highway
- State Road
- Local Road
- Railroad
- County
- Global TransPark (GTP)
- Municipal Area

N

Corridor 52

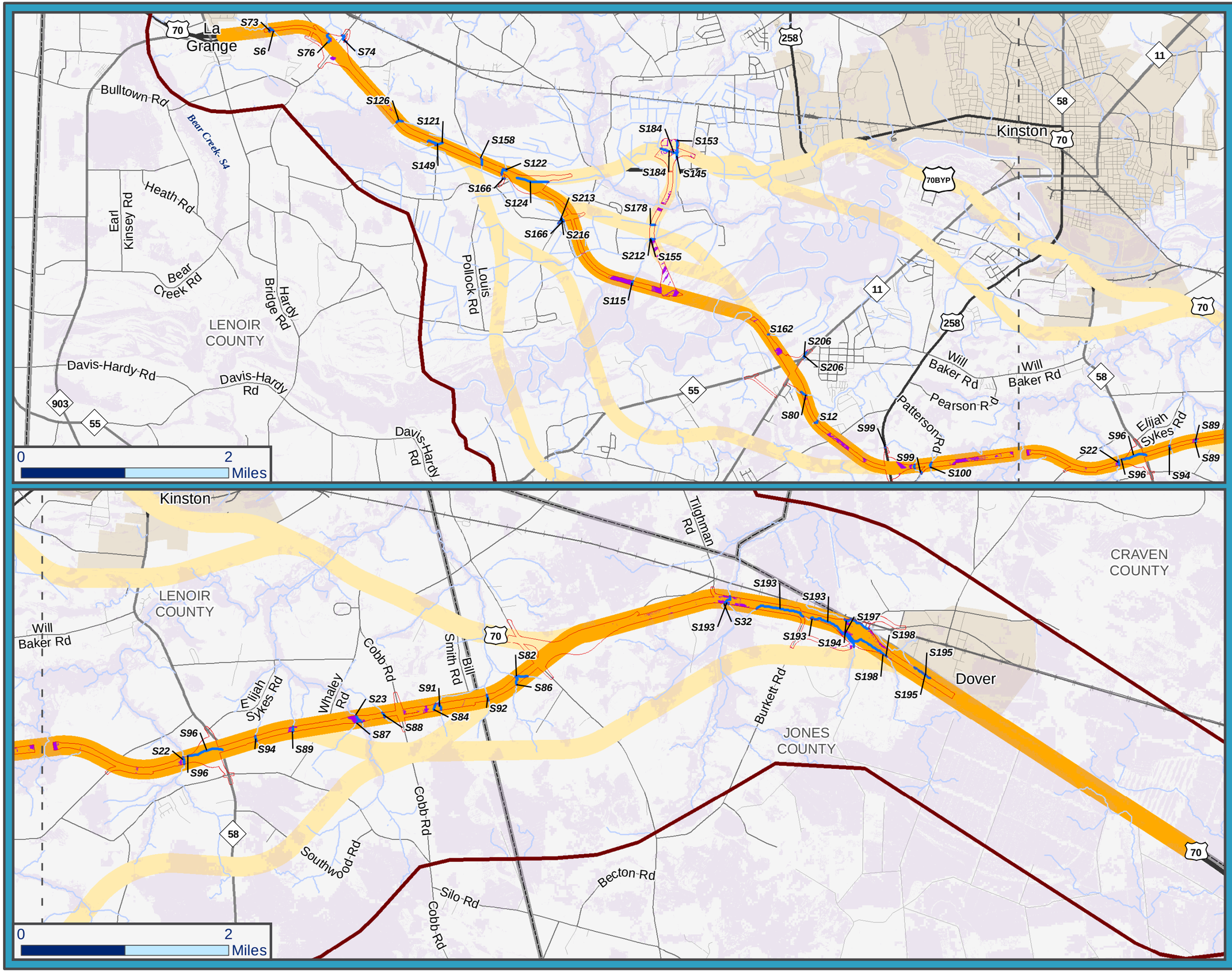
September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.



Kinston Bypass
STIP Project No. R-2553

Figure 5k
Predicted Streams and Wetlands



Legend

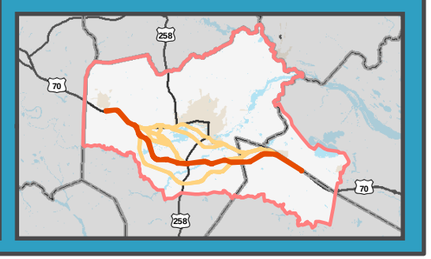
- NRTR Study Area
- Stream/Rivers within Corridor
- Stream/River
- Wetlands within Corridor
- Wetland
- Sheet Match Line
- DSA Corridors
- Slope Stake Limits Plus 40 Feet
- US Highway
- NC Highway
- State Road
- Local Road
- Railroad
- County
- Global TransPark (GTP)
- Municipal Area

N

Corridor 63

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.



Kinston Bypass
STIP Project No. R-2553

Figure 5l
Predicted Streams
and Wetlands

Legend

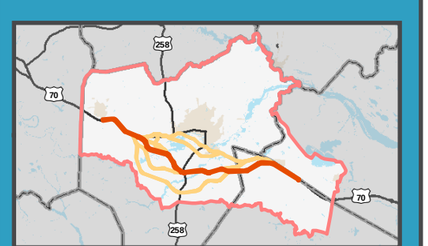
- NRTR Study Area
- Stream/Rivers within Corridor
- Stream/River
- Wetlands within Corridor
- Wetland
- Sheet Match Line
- DSA Corridors
- Slope Stake Limits Plus 40 Feet
- US Highway
- NC Highway
- State Road
- Local Road
- Railroad
- County
- Global TransPark (GTP)
- Municipal Area

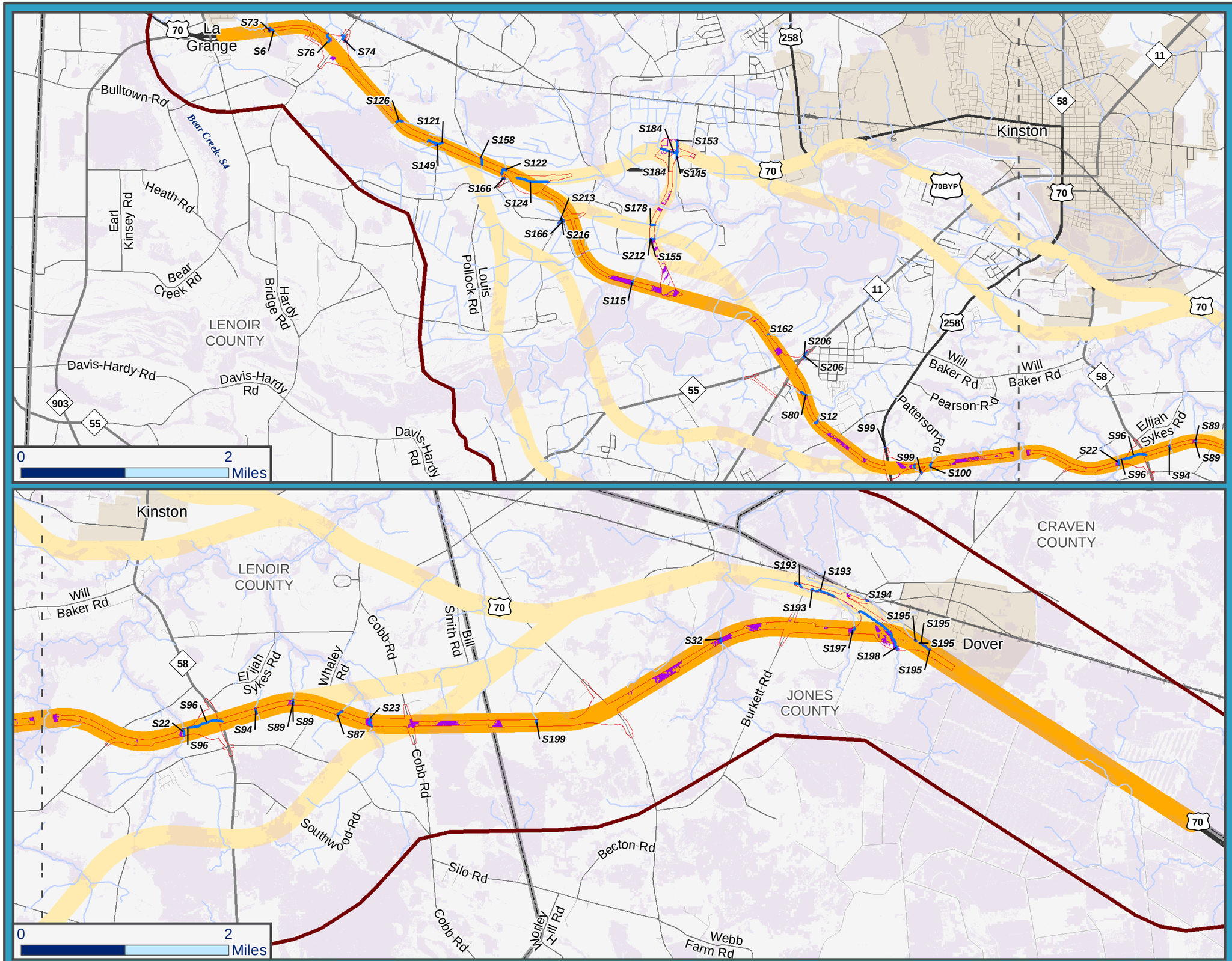
N

Corridor 65

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.





Appendix B: Natural Resource Summary for the Alternatives

Table 9: Coverage of terrestrial communities by alternative within slope stake limits plus 40 feet

Alternative	Maintained/ Disturbed	Agriculture	Pine Plantation	Forested Upland	Palustrine Wetland	Open Water	Coverage Total (ac.)
Alternative 1 (Upgrade Existing)	779	376	84	24	107	4	**1,374**
Alternative 1 (Southern Bypass)	583	583	158	27	55	5	**1,411**
Alternative 11	303	708	253	31	69	2	**1,366**
Alternative 12	393	729	201	21	59	1	**1,403**
Alternative 31	281	747	252	31	69	2	**1,383**
Alternative 32	371	768	200	21	60	1	**1,421**
Alternative 35	356	759	279	31	90	0	**1,514**
Alternative 36	266	731	316	41	101	1	**1,456**
Alternative 51	252	667	274	37	92	2	**1,323**
Alternative 52	341	689	221	27	83	0	**1,361**
Alternative 63	362	750	216	21	82	1	**1,431**
Alternative 65	273	729	268	31	92	2	**1,394**

Table 10: Jurisdictional characteristics of water resources crossing Alternative 1 – Upgrade Existing

Alternative 1 – Upgrade Existing							
Stream Name	**Map ID**	**NCDWR Index Number**	**Best Usage Classification and Designation***	**Within Designated FEMA Floodway**	**303(d) Listed**	**Length (ft.)**	**Subject to Buffer Rules*****
Falling Creek	S2	27-77	C;Sw,NSW, AFSA	Yes	No	0	Yes
Southwest Creek	S3	27-80	C;Sw,NSW	Yes	No	26	Yes
Buck Branch	S6	27-77-2-0.5	C;Sw,NSW	No	No	504	Yes
Mill Branch	S25	27-80-8	C;Sw,NSW, SGA	Yes	No	616	Yes
Tracey Swamp	S32	27-84-1	C;Sw,NSW, SGA	No	No	562	Yes
UT to Buck Branch	S73	27-77-2-0.5	C;Sw,NSW	No	No	234	No
UT to Walters Mill Pond	S74	27-77-2-1	C;Sw,NSW	No	No	815	Yes
UT to Walters Mill Pond	S76	27-77-2-1	C;Sw,NSW	No	No	911	No
UT to Mill Branch	S79	27-80-8	C;Sw,NSW, SGA	No	No	478	Yes
UT to Neuse River	S121	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	587	Yes
UT to Neuse River	S122	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	717	Yes
UT to Falling Creek	S124	27-77	C;Sw,NSW, AFSA	No	No	1,059	Yes
UT to Neuse River	S126	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	553	No
UT to Falling Creek	S133	27-77	C;Sw,NSW, AFSA	No	No	339	Yes
UT to Neuse River	S134	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	445	Yes
UT to Neuse River	S148	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	244	Yes
UT to Neuse River	S149	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	863	Yes
UT to Neuse River	S150	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	696	Yes
UT to Neuse River	S152	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	Yes	No	467	Yes
UT to Falling Creek	S154	27-77	C;Sw,NSW, AFSA	No	No	251	Yes
UT to Neuse River	S156	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	381	Yes
UT to Neuse River	S157	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	Yes	No	42	No
UT to Neuse River	S158	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,049	Yes
UT to Neuse River	S160	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	658	Yes
UT to Neuse River	S161	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,957	Yes
UT to Neuse River	S166	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	191	Yes
UT to Falling Creek	S170	27-77	C;Sw,NSW, AFSA	No	No	149	Yes
UT to Falling Creek	S174	27-77	C;Sw,NSW, AFSA	No	No	1,275	Yes
UT to Falling Creek	S175	27-77	C;Sw,NSW, AFSA	No	No	536	Yes
UT to Neuse River	S181	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	76	Yes
UT to Neuse River	S185	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	Yes	No	150	No
UT to Tracey Swamp	S193	27-84-1	C;Sw,NSW, SGA	No	No	4,968	No
UT to Gum Swamp	S194	27-84-1-1	C;Sw,NSW, SGA	No	No	1,550	Yes
UT to Gum Swamp	S195	27-84-1-1	C;Sw,NSW, SGA	No	No	876	Yes
UT to Tracey Swamp	S197	27-84-1	C;Sw,NSW, SGA	No	No	826	Yes
UT to Tracey Swamp	S198	27-84-1	C;Sw,NSW, SGA	No	No	2,671	Yes
UT to Falling Creek	S202	27-77	C;Sw,NSW, AFSA	No	No	450	Yes
UT to Neuse River	S209	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	479	Yes
UT to Neuse River	S210	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,153	Yes
UT to Neuse River	S211	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	928	Yes
UT to Falling Creek	S214	27-79	C;Sw,NSW, AFSA	No	No	700	Yes
UT to Neuse River	S215	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	Yes	No	182	Yes
UT to Neuse River	S218	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	Yes	No	714	Yes
UT to Neuse River	S220	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	Yes	No	182	Yes
Alternative 1 – Upgrade Existing Total						**35,512**	

* The Best Usage Classification and Designation column contains the assigned NCDWR Best Usage Classification as well as any other notable water designation. These include Class C Waters (C), Nutrient Sensitive Waters (NSW), Swamp Waters (Sw), Anadromous Fish Spawning Areas (AFSA), Primary Nursery Areas (PNA), Inland Primary Nursery Areas (IPNA), Outstanding Resource Waters (ORW), High Quality Waters (HWQ), and/or waters within a water supply watershed.

***Determination of the applicability of Neuse River Buffer Rules was based solely on their presence or absence on 24k USGS topographic mapping. NRCS soils mapping was not consulted for these determinations. Potential impacts to protected stream buffers will be determined once a LEDPA has been selected and formal stream delineations have been performed.

Table 11: Jurisdictional characteristics of water resources crossing Alternative 1 – Southern Bypass

Alternative 1 – Southern Bypass							
Stream Name	**Map ID**	**NCDWR Index Number**	**Best Usage Classification and Designation***	**Within Designated FEMA Floodway**	**303(d) Listed**	**Length (ft.)**	**Subject to Buffer Rules*****
Falling Creek	S2	27-77	C;Sw,NSW, AFSA	Yes	No	0	Yes
Southwest Creek	S3	27-80	C;Sw,NSW	Yes	No	18	Yes
Buck Branch	S6	27-77-2-0.5	C;Sw,NSW	No	No	504	Yes
Mill Branch	S25	27-80-8	C;Sw,NSW, SGA	Yes	No	616	Yes
Tracey Swamp	S32	27-84-1	C;Sw,NSW, SGA	No	No	562	Yes
UT to Buck Branch	S73	27-77-2-0.5	C;Sw,NSW	No	No	234	No
UT to Walters Mill Pond	S74	27-77-2-1	C;Sw,NSW	No	No	815	Yes
UT to Walters Mill Pond	S76	27-77-2-1	C;Sw,NSW	No	No	911	No
UT to Mill Branch	S79	27-80-8	C;Sw,NSW, SGA	No	No	478	Yes
UT to Neuse River	S121	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	587	Yes
UT to Neuse River	S122	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	717	Yes
UT to Falling Creek	S124	27-77	C;Sw,NSW, AFSA	No	No	1,059	Yes
UT to Neuse River	S126	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	553	No
UT to Falling Creek	S133	27-77	C;Sw,NSW, AFSA	No	No	1,162	Yes
UT to Neuse River	S134	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	445	Yes
UT to Falling Creek	S145	27-77	C;Sw,NSW, AFSA	No	No	508	Yes
UT to Falling Creek	S146	27-77	C;Sw,NSW, AFSA	No	No	753	Yes
UT to Neuse River	S149	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	863	Yes
UT to Neuse River	S152	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	Yes	No	2,857	Yes
UT to Falling Creek	S154	27-77	C;Sw,NSW, AFSA	No	No	407	Yes
UT to Neuse River	S158	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,049	Yes
UT to Neuse River	S166	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	191	Yes
UT to Falling Creek	S167	27-77	C;Sw,NSW, AFSA	No	No	348	Yes
UT to Falling Creek	S170	27-77	C;Sw,NSW, AFSA	No	No	453	Yes
UT to Falling Creek	S174	27-77	C;Sw,NSW, AFSA	No	No	382	Yes
UT to Falling Creek	S175	27-77	C;Sw,NSW, AFSA	No	No	915	Yes
UT to Tracey Swamp	S193	27-84-1	C;Sw,NSW, SGA	No	No	4,968	No
UT to Gum Swamp	S194	27-84-1-1	C;Sw,NSW, SGA	No	No	1,550	Yes
UT to Gum Swamp	S195	27-84-1-1	C;Sw,NSW, SGA	No	No	876	Yes
UT to Tracey Swamp	S197	27-84-1	C;Sw,NSW, SGA	No	No	826	Yes
UT to Tracey Swamp	S198	27-84-1	C;Sw,NSW, SGA	No	No	2,671	Yes
UT to Falling Creek	S202	27-77	C;Sw,NSW, AFSA	No	No	776	Yes
UT to Southwest Creek	S203	27-80	C;Sw,NSW	Yes	No	215	Yes
UT to Southwest Creek	S204	27-81	C;Sw,NSW	No	No	129	No
UT to Southwest Creek	S205	27-82	C;Sw,NSW	Yes	No	1,353	Yes
UT to Neuse River	S210	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,153	Yes
UT to Falling Creek	S214	27-79	C;Sw,NSW, AFSA	No	No	700	Yes
UT to Neuse River	S217	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	201	Yes
UT to Falling Creek	S219	27-79	C;Sw,NSW, AFSA	No	No	38	Yes
UT to Peter Creek	S221	27-78	C;Sw,NSW	No	No	38	Yes
UT to Neuse River	S222	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	221	Yes
UT to Neuse River	S223	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	63	Yes
UT to Southwest Creek	S224	27-81	C;Sw,NSW	No	No	341	No
Falling Creek	S2	27-77	C;Sw,NSW, AFSA	Yes	No	0	Yes
Alternative 1 – Southern Bypass Total						**35,508**	

* The Best Usage Classification and Designation column contains the assigned NCDWR Best Usage Classification as well as any other notable water designation. These include Class C Waters (C), Nutrient Sensitive Waters (NSW), Swamp Waters (Sw), Anadromous Fish Spawning Areas (AFSA), Primary Nursery Areas (PNA), Inland Primary Nursery Areas (IPNA), Outstanding Resource Waters (ORW), High Quality Waters (HWQ), and/or waters within a water supply watershed.

***Determination of the applicability of Neuse River Buffer Rules was based solely on their presence or absence on 24k USGS topographic mapping. NRCS soils mapping was not consulted for these determinations. Potential impacts to protected stream buffers will be determined once a LEDPA has been selected and formal stream delineations have been performed.

Table 12: Jurisdictional characteristics of water resources crossing Alternative 11

Alternative 11							
Stream Name	**Map ID**	**NCDWR Index Number**	**Best Usage Classification and Designation***	**Within Designated FEMA Floodway**	**303(d) Listed**	**Length (ft.)**	**Subject to Buffer Rules*****
Falling Creek	S2	27-77	C;Sw,NSW, AFSA	Yes	No	0	Yes
Buck Branch	S6	27-77-2-0.5	C;Sw,NSW	No	No	504	Yes
Peter Creek	S12	27-78	C;Sw,NSW	No	No	356	Yes
Mott Swamp	S22	27-80-6	C;Sw,NSW	Yes	No	389	Yes
Strawberry Branch	S23	27-80-7	C;Sw,NSW	Yes	No	532	Yes
Tracey Swamp	S32	27-84-1	C;Sw,NSW, SGA	No	No	253	Yes
UT to Buck Branch	S73	27-77-2-0.5	C;Sw,NSW	No	No	234	No
UT to Walters Mill Pond	S74	27-77-2-1	C;Sw,NSW	No	No	815	Yes
UT to Walters Mill Pond	S76	27-77-2-1	C;Sw,NSW	No	No	911	No
UT to Peter Creek	S80	27-78	C;Sw,NSW	No	No	560	No
UT to Strawberry Branch	S87	27-80-7	C;Sw,NSW	No	No	343	Yes
UT to Strawberry Branch	S89	27-80-7	C;Sw,NSW	No	No	260	Yes
UT to Strawberry Branch	S94	27-80-7	C;Sw,NSW	No	No	305	Yes
UT to Mott Swamp	S96	27-80-6	C;Sw,NSW	No	No	1,864	Yes
UT to Southwest Creek	S99	27-80	C;Sw,NSW	No	No	630	Yes
UT to Southwest Creek	S100	27-80	C;Sw,NSW	No	No	421	No
UT to Neuse River	S121	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	587	Yes
UT to Neuse River	S122	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	717	Yes
UT to Falling Creek	S124	27-77	C;Sw,NSW, AFSA	No	No	1,059	Yes
UT to Neuse River	S126	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	553	No
UT to Falling Creek	S130	27-77	C;Sw,NSW, AFSA	No	No	205	Yes
UT to Neuse River	S134	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	445	Yes
UT to Falling Creek	S138	27-77	C;Sw,NSW, AFSA	No	No	99	Yes
UT to Falling Creek	S145	27-77	C;Sw,NSW, AFSA	No	No	965	Yes
UT to Falling Creek	S146	27-77	C;Sw,NSW, AFSA	No	No	278	Yes
UT to Neuse River	S149	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	863	Yes
UT to Falling Creek	S153	27-77	C;Sw,NSW, AFSA	No	No	235	Yes
UT to Falling Creek	S155	27-77	C;Sw,NSW, AFSA	No	No	298	Yes
UT to Neuse River	S158	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,049	Yes
UT to Peter Creek	S162	27-78	C;Sw,NSW	No	No	97	Yes
UT to Neuse River	S166	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	191	Yes
UT to Falling Creek	S167	27-77	C;Sw,NSW, AFSA	No	No	261	Yes
UT to Neuse River	S178	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	268	No
UT to Falling Creek	S182	27-77	C;Sw,NSW, AFSA	No	No	872	Yes
UT to Falling Creek	S184	27-77	C;Sw,NSW, AFSA	No	No	980	Yes
UT to Tracey Swamp	S193	27-84-1	C;Sw,NSW, SGA	No	No	1,760	No
UT to Gum Swamp	S194	27-84-1-1	C;Sw,NSW, SGA	No	No	127	Yes
UT to Gum Swamp	S195	27-84-1-1	C;Sw,NSW, SGA	No	No	776	Yes
UT to Tracey Swamp	S197	27-84-1	C;Sw,NSW, SGA	No	No	350	Yes
UT to Tracey Swamp	S198	27-84-1	C;Sw,NSW, SGA	No	No	3,100	Yes
UT to Mill Branch	S199	27-80-8	C;Sw,NSW, SGA	No	No	244	Yes
UT to Neuse River	206	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	448	Yes
UT to Neuse River	210	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,153	Yes
UT to Falling Creek	212	27-77	C;Sw,NSW, AFSA	No	No	162	Yes
Alternative 11 Total						**27,217**	

* The Best Usage Classification and Designation column contains the assigned NCDWR Best Usage Classification as well as any other notable water designation. These include Class C Waters (C), Nutrient Sensitive Waters (NSW), Swamp Waters (Sw), Anadromous Fish Spawning Areas (AFSA), Primary Nursery Areas (PNA), Inland Primary Nursery Areas (IPNA), Outstanding Resource Waters (ORW), High Quality Waters (HWQ), and/or waters within a water supply watershed.

***Determination of the applicability of Neuse River Buffer Rules was based solely on their presence or absence on 24k USGS topographic mapping. NRCS soils mapping was not consulted for these determinations. Potential impacts to protected stream buffers will be determined once a LEDPA has been selected and formal stream delineations have been performed.

Table 13: Jurisdictional characteristics of water resources crossing Alternative 12

Alternative 12							
Stream Name	**Map ID**	**NCDWR Index Number**	**Best Usage Classification and Designation***	**Within Designated FEMA Floodway**	**303(d) Listed**	**Length (ft.)**	**Subject to Buffer Rules*****
Falling Creek	S2	27-77	C;Sw,NSW, AFSA	Yes	No	0	Yes
Buck Branch	S6	27-77-2-0.5	C;Sw,NSW	No	No	504	Yes
Peter Creek	S12	27-78	C;Sw,NSW	No	No	356	Yes
Mott Swamp	S22	27-80-6	C;Sw,NSW	Yes	No	389	Yes
Strawberry Branch	S23	27-80-7	C;Sw,NSW	Yes	No	491	Yes
Tracey Swamp	S32	27-84-1	C;Sw,NSW, SGA	No	No	562	Yes
UT to Buck Branch	S73	27-77-2-0.5	C;Sw,NSW	No	No	234	No
UT to Walters Mill Pond	S74	27-77-2-1	C;Sw,NSW	No	No	815	Yes
UT to Walters Mill Pond	S76	27-77-2-1	C;Sw,NSW	No	No	911	No
UT to Peter Creek	S80	27-78	C;Sw,NSW	No	No	560	No
UT to Mill Branch	S82	27-80-8	C;Sw,NSW, SGA	No	No	619	Yes
UT to Mill Branch	S84	27-80-8	C;Sw,NSW, SGA	No	No	340	No
UT to Mill Branch	S86	27-80-8	C;Sw,NSW, SGA	No	No	506	Yes
UT to Strawberry Branch	S87	27-80-7	C;Sw,NSW	No	No	224	Yes
UT to Strawberry Branch	S88	27-80-7	C;Sw,NSW	No	No	310	Yes
UT to Strawberry Branch	S89	27-80-7	C;Sw,NSW	No	No	250	Yes
UT to Mill Branch	S91	27-80-8	C;Sw,NSW, SGA	No	No	400	No
UT to Mill Branch	S92	27-80-8	C;Sw,NSW, SGA	No	No	308	Yes
UT to Strawberry Branch	S94	27-80-7	C;Sw,NSW	No	No	305	Yes
UT to Mott Swamp	S96	27-80-6	C;Sw,NSW	No	No	1,864	Yes
UT to Southwest Creek	S99	27-80	C;Sw,NSW	No	No	630	Yes
UT to Southwest Creek	S100	27-80	C;Sw,NSW	No	No	421	No
UT to Neuse River	S121	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	587	Yes
UT to Neuse River	S122	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	717	Yes
UT to Falling Creek	S124	27-77	C;Sw,NSW, AFSA	No	No	1,059	Yes
UT to Neuse River	S126	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	553	No
UT to Falling Creek	S130	27-77	C;Sw,NSW, AFSA	No	No	205	Yes
UT to Neuse River	S134	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	445	Yes
UT to Falling Creek	S138	27-77	C;Sw,NSW, AFSA	No	No	99	Yes
UT to Falling Creek	S145	27-77	C;Sw,NSW, AFSA	No	No	965	Yes
UT to Falling Creek	S146	27-77	C;Sw,NSW, AFSA	No	No	278	Yes
UT to Neuse River	S149	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	863	Yes
UT to Falling Creek	S153	27-77	C;Sw,NSW, AFSA	No	No	235	Yes
UT to Falling Creek	S155	27-77	C;Sw,NSW, AFSA	No	No	298	Yes
UT to Neuse River	S158	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,049	Yes
UT to Peter Creek	S162	27-78	C;Sw,NSW	No	No	97	Yes
UT to Neuse River	S166	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	191	Yes
UT to Falling Creek	S167	27-77	C;Sw,NSW, AFSA	No	No	261	Yes
UT to Neuse River	S178	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	268	No
UT to Falling Creek	S182	27-77	C;Sw,NSW, AFSA	No	No	872	Yes
UT to Falling Creek	S184	27-77	C;Sw,NSW, AFSA	No	No	980	Yes
UT to Tracey Swamp	S193	27-84-1	C;Sw,NSW, SGA	No	No	4,967	No
UT to Gum Swamp	S194	27-84-1-1	C;Sw,NSW, SGA	No	No	1,550	Yes
UT to Gum Swamp	S195	27-84-1-1	C;Sw,NSW, SGA	No	No	873	Yes
UT to Tracey Swamp	S197	27-84-1	C;Sw,NSW, SGA	No	No	826	Yes
UT to Tracey Swamp	S198	27-84-1	C;Sw,NSW, SGA	No	No	2,596	Yes
UT to Neuse River	206	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	448	Yes
UT to Neuse River	210	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,153	Yes
UT to Falling Creek	212	27-77	C;Sw,NSW, AFSA	No	No	162	Yes
UT to Falling Creek	214	27-79	C;Sw,NSW, AFSA	No	No	700	Yes
Alternative 12 Total						**34,296**	

* The Best Usage Classification and Designation column contains the assigned NCDWR Best Usage Classification as well as any other notable water designation. These include Class C Waters (C), Nutrient Sensitive Waters (NSW), Swamp Waters (Sw), Anadromous Fish Spawning Areas (AFSA), Primary Nursery Areas (PNA), Inland Primary Nursery Areas (IPNA), Outstanding Resource Waters (ORW), High Quality Waters (HWQ), and/or waters within a water supply watershed.

***Determination of the applicability of Neuse River Buffer Rules was based solely on their presence or absence on 24k USGS topographic mapping. NRCS soils mapping was not consulted for these determinations. Potential impacts to protected stream buffers will be determined once a LEDPA has been selected and formal stream delineations have been performed.

Table 14: Jurisdictional characteristics of water resources crossing Alternative 31

Alternative 31							
Stream Name	**Map ID**	**NCDWR Index Number**	**Best Usage Classification and Designation***	**Within Designated FEMA Floodway**	**303(d) Listed**	**Length (ft.)**	**Subject to Buffer Rules*****
Buck Branch	S6	27-77-2-0.5	C;Sw,NSW	No	No	504	Yes
Peter Creek	S12	27-78	C;Sw,NSW	No	No	356	Yes
Mott Swamp	S22	27-80-6	C;Sw,NSW	Yes	No	389	Yes
Strawberry Branch	S23	27-80-7	C;Sw,NSW	Yes	No	532	Yes
Tracey Swamp	S32	27-84-1	C;Sw,NSW, SGA	No	No	253	Yes
UT to Buck Branch	S73	27-77-2-0.5	C;Sw,NSW	No	No	234	No
UT to Walters Mill Pond	S74	27-77-2-1	C;Sw,NSW	No	No	815	Yes
UT to Walters Mill Pond	S76	27-77-2-1	C;Sw,NSW	No	No	911	No
UT to Peter Creek	S80	27-78	C;Sw,NSW	No	No	560	No
UT to Strawberry Branch	S87	27-80-7	C;Sw,NSW	No	No	343	Yes
UT to Strawberry Branch	S89	27-80-7	C;Sw,NSW	No	No	260	Yes
UT to Strawberry Branch	S94	27-80-7	C;Sw,NSW	No	No	305	Yes
UT to Mott Swamp	S96	27-80-6	C;Sw,NSW	No	No	1,864	Yes
UT to Southwest Creek	S99	27-80	C;Sw,NSW	No	No	630	Yes
UT to Southwest Creek	S100	27-80	C;Sw,NSW	No	No	421	No
UT to Neuse River	S121	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	587	Yes
UT to Neuse River	S122	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	834	Yes
UT to Falling Creek	S124	27-77	C;Sw,NSW, AFSA	No	No	2,303	Yes
UT to Neuse River	S126	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	553	No
UT to Neuse River	S127	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,166	No
UT to Neuse River	S128	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	988	Yes
UT to Neuse River	S134	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	445	Yes
UT to Falling Creek	S145	27-77	C;Sw,NSW, AFSA	No	No	381	Yes
UT to Neuse River	S149	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	863	Yes
UT to Falling Creek	S153	27-77	C;Sw,NSW, AFSA	No	No	945	Yes
UT to Falling Creek	S155	27-77	C;Sw,NSW, AFSA	No	No	946	Yes
UT to Neuse River	S158	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	153	Yes
UT to Peter Creek	S162	27-78	C;Sw,NSW	No	No	97	Yes
UT to Neuse River	S166	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	180	Yes
UT to Falling Creek	S171	27-77	C;Sw,NSW, AFSA	No	No	278	Yes
UT to Neuse River	S178	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	530	No
UT to Falling Creek	S184	27-77	C;Sw,NSW, AFSA	No	No	1,107	Yes
UT to Falling Creek	S186	27-77	C;Sw,NSW, AFSA	No	No	379	Yes
UT to Tracey Swamp	S193	27-84-1	C;Sw,NSW, SGA	No	No	1,760	No
UT to Gum Swamp	S194	27-84-1-1	C;Sw,NSW, SGA	No	No	127	Yes
UT to Gum Swamp	S195	27-84-1-1	C;Sw,NSW, SGA	No	No	776	Yes
UT to Tracey Swamp	S196	27-84-1	C;Sw,NSW, SGA	No	No	0	Yes
UT to Tracey Swamp	S197	27-84-1	C;Sw,NSW, SGA	No	No	350	Yes
UT to Tracey Swamp	S198	27-84-1	C;Sw,NSW, SGA	No	No	3,100	Yes
UT to Mill Branch	S199	27-80-8	C;Sw,NSW, SGA	No	No	244	Yes
UT to Neuse River	S206	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	448	Yes
Alternative 31 Total						**27,915**	

* The Best Usage Classification and Designation column contains the assigned NCDWR Best Usage Classification as well as any other notable water designation. These include Class C Waters (C), Nutrient Sensitive Waters (NSW), Swamp Waters (Sw), Anadromous Fish Spawning Areas (AFSA), Primary Nursery Areas (PNA), Inland Primary Nursery Areas (IPNA), Outstanding Resource Waters (ORW), High Quality Waters (HWQ), and/or waters within a water supply watershed.

***Determination of the applicability of Neuse River Buffer Rules was based solely on their presence or absence on 24k USGS topographic mapping. NRCS soils mapping was not consulted for these determinations. Potential impacts to protected stream buffers will be determined once a LEDPA has been selected and formal stream delineations have been performed.

Table 15: Jurisdictional characteristics of water resources crossing Alternative 32

Alternative 32							
Stream Name	**Map ID**	**NCDWR Index Number**	**Best Usage Classification and Designation***	**Within Designated FEMA Floodway**	**303(d) Listed**	**Length (ft.)**	**Subject to Buffer Rules*****
Buck Branch	S6	27-77-2-0.5	C;Sw,NSW	No	No	504	Yes
Peter Creek	S12	27-78	C;Sw,NSW	No	No	356	Yes
Mott Swamp	S22	27-80-6	C;Sw,NSW	Yes	No	389	Yes
Strawberry Branch	S23	27-80-7	C;Sw,NSW	Yes	No	491	Yes
Tracey Swamp	S32	27-84-1	C;Sw,NSW, SGA	No	No	562	Yes
UT to Buck Branch	S73	27-77-2-0.5	C;Sw,NSW	No	No	234	No
UT to Walters Mill Pond	S74	27-77-2-1	C;Sw,NSW	No	No	815	Yes
UT to Walters Mill Pond	S76	27-77-2-1	C;Sw,NSW	No	No	911	No
UT to Peter Creek	S80	27-78	C;Sw,NSW	No	No	560	No
UT to Mill Branch	S82	27-80-8	C;Sw,NSW, SGA	No	No	619	Yes
UT to Mill Branch	S84	27-80-8	C;Sw,NSW, SGA	No	No	340	No
UT to Mill Branch	S86	27-80-8	C;Sw,NSW, SGA	No	No	506	Yes
UT to Strawberry Branch	S87	27-80-7	C;Sw,NSW	No	No	224	Yes
UT to Strawberry Branch	S88	27-80-7	C;Sw,NSW	No	No	310	Yes
UT to Strawberry Branch	S89	27-80-7	C;Sw,NSW	No	No	250	Yes
UT to Mill Branch	S91	27-80-8	C;Sw,NSW, SGA	No	No	400	No
UT to Mill Branch	S92	27-80-8	C;Sw,NSW, SGA	No	No	308	Yes
UT to Strawberry Branch	S94	27-80-7	C;Sw,NSW	No	No	305	Yes
UT to Mott Swamp	S96	27-80-6	C;Sw,NSW	No	No	1,864	Yes
UT to Southwest Creek	S99	27-80	C;Sw,NSW	No	No	630	Yes
UT to Southwest Creek	S100	27-80	C;Sw,NSW	No	No	421	No
UT to Neuse River	S121	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	587	Yes
UT to Neuse River	S122	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	834	Yes
UT to Falling Creek	S124	27-77	C;Sw,NSW, AFSA	No	No	2,303	Yes
UT to Neuse River	S126	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	553	No
UT to Neuse River	S127	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,166	No
UT to Neuse River	S128	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	988	Yes
UT to Neuse River	S134	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	445	Yes
UT to Falling Creek	S145	27-77	C;Sw,NSW, AFSA	No	No	381	Yes
UT to Neuse River	S149	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	863	Yes
UT to Falling Creek	S153	27-77	C;Sw,NSW, AFSA	No	No	945	Yes
UT to Falling Creek	S155	27-77	C;Sw,NSW, AFSA	No	No	946	Yes
UT to Neuse River	S158	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	153	Yes
UT to Peter Creek	S162	27-78	C;Sw,NSW	No	No	97	Yes
UT to Neuse River	S166	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	180	Yes
UT to Falling Creek	S171	27-77	C;Sw,NSW, AFSA	No	No	278	Yes
UT to Neuse River	S178	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	530	No
UT to Falling Creek	S184	27-77	C;Sw,NSW, AFSA	No	No	1,107	Yes
UT to Falling Creek	S186	27-77	C;Sw,NSW, AFSA	No	No	379	Yes
UT to Tracey Swamp	S193	27-84-1	C;Sw,NSW, SGA	No	No	4,967	No
UT to Gum Swamp	S194	27-84-1-1	C;Sw,NSW, SGA	No	No	1,550	Yes
UT to Gum Swamp	S195	27-84-1-1	C;Sw,NSW, SGA	No	No	873	Yes
UT to Tracey Swamp	S197	27-84-1	C;Sw,NSW, SGA	No	No	826	Yes
UT to Tracey Swamp	S198	27-84-1	C;Sw,NSW, SGA	No	No	2,596	Yes
UT to Neuse River	S206	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	448	Yes
Alternative 32 Total						**34,994**	

* The Best Usage Classification and Designation column contains the assigned NCDWR Best Usage Classification as well as any other notable water designation. These include Class C Waters (C), Nutrient Sensitive Waters (NSW), Swamp Waters (Sw), Anadromous Fish Spawning Areas (AFSA), Primary Nursery Areas (PNA), Inland Primary Nursery Areas (IPNA), Outstanding Resource Waters (ORW), High Quality Waters (HWQ), and/or waters within a water supply watershed.

***Determination of the applicability of Neuse River Buffer Rules was based solely on their presence or absence on 24k USGS topographic mapping. NRCS soils mapping was not consulted for these determinations. Potential impacts to protected stream buffers will be determined once a LEDPA has been selected and formal stream delineations have been performed.

Table 16: Jurisdictional characteristics of water resources crossing Alternative 35

Alternative 35							
Stream Name	**Map ID**	**NCDWR Index Number**	**Best Usage Classification and Designation***	**Within Designated FEMA Floodway**	**303(d) Listed**	**Length (ft.)**	**Subject to Buffer Rules*****
Buck Branch	S6	27-77-2-0.5	C;Sw,NSW	No	No	504	Yes
Whitleys Creek	S9	27-76	C;Sw,NSW	Yes	No	879	Yes
Clarks Branch	S13	27-80-4	C;Sw,NSW	Yes	No	758	Yes
Spring Branch	S15	27-80-5	C;Sw,NSW	Yes	No	252	Yes
Strawberry Branch	S23	27-80-7	C;Sw,NSW	Yes	No	729	Yes
Tracey Swamp	S32	27-84-1	C;Sw,NSW, SGA	No	No	562	Yes
UT to Buck Branch	S73	27-77-2-0.5	C;Sw,NSW	No	No	234	No
UT to Walters Mill Pond	S74	27-77-2-1	C;Sw,NSW	No	No	815	Yes
UT to Walters Mill Pond	S76	27-77-2-1	C;Sw,NSW	No	No	911	No
UT to Mill Branch	S82	27-80-8	C;Sw,NSW, SGA	No	No	619	Yes
UT to Mill Branch	S86	27-80-8	C;Sw,NSW, SGA	No	No	506	Yes
UT to Mill Branch	S91	27-80-8	C;Sw,NSW, SGA	No	No	239	No
UT to Strawberry Branch	S92	27-80-7	C;Sw,NSW	No	No	307	Yes
UT to Neuse River	S93	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,080	No
UT to Neuse River	S101	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,549	Yes
UT to Whitleys Creek	S102	27-76	C;Sw,NSW	No	No	733	Yes
UT to Whitleys Creek	S103	27-76	C;Sw,NSW	No	No	290	Yes
UT to Mott Swamp	S104	27-80-6	C;Sw,NSW	No	No	491	Yes
UT to Southwest Creek	S106	27-80	C;Sw,NSW	No	No	330	Yes
UT to Southwest Creek	S109	27-80	C;Sw,NSW	No	No	599	Yes
UT to Clarks Branch	S110	27-80-4	C;Sw,NSW	No	No	57	Yes
UT to Clarks Branch	S111	27-80-4	C;Sw,NSW	No	No	50	Yes
UT to Neuse River	S118	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	601	Yes
UT to Neuse River	S121	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	709	Yes
UT to Neuse River	S122	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	613	Yes
UT to Neuse River	S126	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	553	No
UT to Neuse River	S129	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	271	Yes
UT to Neuse River	S134	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	892	Yes
UT to Neuse River	S139	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	325	Yes
UT to Neuse River	S143	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	487	Yes
UT to Neuse River	S149	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	863	Yes
UT to Neuse River	S158	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	121	Yes
UT to Neuse River	S166	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,554	Yes
UT to Neuse River	S176	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	426	Yes
UT to Tracey Swamp	S193	27-84-1	C;Sw,NSW, SGA	No	No	4,967	No
UT to Gum Swamp	S194	27-84-1-1	C;Sw,NSW, SGA	No	No	1,550	Yes
UT to Gum Swamp	S195	27-84-1-1	C;Sw,NSW, SGA	No	No	873	Yes
UT to Tracey Swamp	S197	27-84-1	C;Sw,NSW, SGA	No	No	826	Yes
UT to Tracey Swamp	S198	27-84-1	C;Sw,NSW, SGA	No	No	2,596	Yes
UT to Neuse River	S207	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	129	Yes
UT to Southwest Creek	S208	27-82	C;Sw,NSW	No	No	384	Yes
UT to Neuse River	S210	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	60	Yes
Alternative 35 Total						**31,295**	

* The Best Usage Classification and Designation column contains the assigned NCDWR Best Usage Classification as well as any other notable water designation. These include Class C Waters (C), Nutrient Sensitive Waters (NSW), Swamp Waters (Sw), Anadromous Fish Spawning Areas (AFSA), Primary Nursery Areas (PNA), Inland Primary Nursery Areas (IPNA), Outstanding Resource Waters (ORW), High Quality Waters (HWQ), and/or waters within a water supply watershed.

***Determination of the applicability of Neuse River Buffer Rules was based solely on their presence or absence on 24k USGS topographic mapping. NRCS soils mapping was not consulted for these determinations. Potential impacts to protected stream buffers will be determined once a LEDPA has been selected and formal stream delineations have been performed.

Table 17: Jurisdictional characteristics of water resources crossing Alternative 36

Alternative 36							
Stream Name	**Map ID**	**NCDWR Index Number**	**Best Usage Classification and Designation***	**Within Designated FEMA Floodway**	**303(d) Listed**	**Length (ft.)**	**Subject to Buffer Rules*****
Buck Branch	S6	27-77-2-0.5	C;Sw,NSW	No	No	504	Yes
Whitleys Creek	S9	27-76	C;Sw,NSW	Yes	No	881	Yes
Clarks Branch	S13	27-80-4	C;Sw,NSW	Yes	No	758	Yes
Spring Branch	S15	27-80-5	C;Sw,NSW	Yes	No	252	Yes
Strawberry Branch	S23	27-80-7	C;Sw,NSW	Yes	No	729	Yes
Tracey Swamp	S32	27-84-1	C;Sw,NSW, SGA	No	No	263	Yes
UT to Buck Branch	S73	27-77-2-0.5	C;Sw,NSW	No	No	234	No
UT to Walters Mill Pond	S74	27-77-2-1	C;Sw,NSW	No	No	815	Yes
UT to Walters Mill Pond	S76	27-77-2-1	C;Sw,NSW	No	No	911	No
UT to Neuse River	S93	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,083	No
UT to Neuse River	S101	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,545	Yes
UT to Whitleys Creek	S102	27-76	C;Sw,NSW	No	No	730	Yes
UT to Whitleys Creek	S103	27-76	C;Sw,NSW	No	No	290	Yes
UT to Mott Swamp	S104	27-80-6	C;Sw,NSW	No	No	491	Yes
UT to Southwest Creek	S106	27-80	C;Sw,NSW	No	No	330	Yes
UT to Southwest Creek	S109	27-80	C;Sw,NSW	No	No	599	Yes
UT to Clarks Branch	S110	27-80-4	C;Sw,NSW	No	No	57	Yes
UT to Clarks Branch	S111	27-80-4	C;Sw,NSW	No	No	50	Yes
UT to Neuse River	S118	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	601	Yes
UT to Neuse River	S121	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	709	Yes
UT to Neuse River	S122	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	613	Yes
UT to Neuse River	S126	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	553	No
UT to Neuse River	S129	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	271	Yes
UT to Neuse River	S134	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	892	Yes
UT to Neuse River	S139	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	325	Yes
UT to Neuse River	S143	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	487	Yes
UT to Neuse River	S149	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	863	Yes
UT to Neuse River	S158	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	121	Yes
UT to Neuse River	S166	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,554	Yes
UT to Neuse River	S176	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	426	Yes
UT to Tracey Swamp	S193	27-84-1	C;Sw,NSW, SGA	No	No	1,760	No
UT to Gum Swamp	S194	27-84-1-1	C;Sw,NSW, SGA	No	No	127	Yes
UT to Gum Swamp	S195	27-84-1-1	C;Sw,NSW, SGA	No	No	776	Yes
UT to Tracey Swamp	S196	27-84-1	C;Sw,NSW, SGA	No	No	9	Yes
UT to Tracey Swamp	S197	27-84-1	C;Sw,NSW, SGA	No	No	356	Yes
UT to Tracey Swamp	S198	27-84-1	C;Sw,NSW, SGA	No	No	3,100	Yes
UT to Mill Branch	S199	27-80-8	C;Sw,NSW, SGA	No	No	249	Yes
UT to Neuse River	S207	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	127	Yes
UT to Southwest Creek	S208	27-82	C;Sw,NSW	No	No	384	Yes
UT to Neuse River	S210	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	60	Yes
Alternative 36 Total						**24,885**	

* The Best Usage Classification and Designation column contains the assigned NCDWR Best Usage Classification as well as any other notable water designation. These include Class C Waters (C), Nutrient Sensitive Waters (NSW), Swamp Waters (Sw), Anadromous Fish Spawning Areas (AFSA), Primary Nursery Areas (PNA), Inland Primary Nursery Areas (IPNA), Outstanding Resource Waters (ORW), High Quality Waters (HWQ), and/or waters within a water supply watershed.

***Determination of the applicability of Neuse River Buffer Rules was based solely on their presence or absence on 24k USGS topographic mapping. NRCS soils mapping was not consulted for these determinations. Potential impacts to protected stream buffers will be determined once a LEDPA has been selected and formal stream delineations have been performed.

Table 18: Jurisdictional characteristics of water resources crossing Alternative 51

Alternative 51							
Stream Name	**Map ID**	**NCDWR Index Number**	**Best Usage Classification and Designation***	**Within Designated FEMA Floodway**	**303(d) Listed**	**Length (ft.)**	**Subject to Buffer Rules*****
Buck Branch	S6	27-77-2-0.5	C;Sw,NSW	No	No	504	Yes
Whitleys Creek	S9	27-76	C;Sw,NSW	Yes	No	502	Yes
Mott Swamp	S22	27-80-6	C;Sw,NSW	Yes	No	389	Yes
Strawberry Branch	S23	27-80-7	C;Sw,NSW	No	No	532	Yes
Tracey Swamp	S32	27-84-1	C;Sw,NSW, SGA	No	No	253	Yes
UT to Buck Branch	S73	27-77-2-0.5	C;Sw,NSW	No	No	234	No
UT to Walters Mill Pond	S74	27-77-2-1	C;Sw,NSW	No	No	815	Yes
UT to Walters Mill Pond	S76	27-77-2-1	C;Sw,NSW	No	No	911	No
UT to Whitleys Creek	S85	27-76	C;Sw,NSW	No	No	499	Yes
UT to Strawberry Branch	S87	27-80-7	C;Sw,NSW	No	No	343	Yes
UT to Strawberry Branch	S89	27-80-7	C;Sw,NSW	No	No	260	Yes
UT to Southwest Creek	S90	27-80	C;Sw,NSW	No	No	431	No
UT to Strawberry Branch	S94	27-80-7	C;Sw,NSW	No	No	309	Yes
UT to Mott Swamp	S96	27-80-6	C;Sw,NSW	No	No	1,871	Yes
UT to Southwest Creek	S98	27-80	C;Sw,NSW	No	No	424	No
UT to Southwest Creek	S99	27-80	C;Sw,NSW	No	No	630	Yes
UT to Southwest Creek	S100	27-80	C;Sw,NSW	No	No	421	No
UT to Neuse River	S118	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	568	Yes
UT to Neuse River	S121	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	667	Yes
UT to Neuse River	S122	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	613	Yes
UT to Neuse River	S126	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	553	No
UT to Neuse River	S129	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	780	Yes
UT to Neuse River	S134	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	892	Yes
UT to Neuse River	S137	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	298	Yes
UT to Neuse River	S143	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	487	Yes
UT to Neuse River	S149	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	863	Yes
UT to Neuse River	S158	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	121	Yes
UT to Neuse River	S166	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,554	Yes
UT to Neuse River	S172	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	259	No
UT to Tracey Swamp	S193	27-84-1	C;Sw,NSW, SGA	No	No	1,760	No
UT to Gum Swamp	S194	27-84-1-1	C;Sw,NSW, SGA	No	No	127	Yes
UT to Gum Swamp	S195	27-84-1-1	C;Sw,NSW, SGA	No	No	776	Yes
UT to Tracey Swamp	S196	27-84-1	C;Sw,NSW, SGA	No	No	0	Yes
UT to Tracey Swamp	S197	27-84-1	C;Sw,NSW, SGA	No	No	350	Yes
UT to Tracey Swamp	S198	27-84-1	C;Sw,NSW, SGA	No	No	3,100	Yes
UT to Mill Branch	S199	27-80-8	C;Sw,NSW, SGA	No	No	244	Yes
UT to Neuse River	S207	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	240	Yes
UT to Neuse River	S210	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	60	Yes
Alternative 51 Total						**23,638**	

* The Best Usage Classification and Designation column contains the assigned NCDWR Best Usage Classification as well as any other notable water designation. These include Class C Waters (C), Nutrient Sensitive Waters (NSW), Swamp Waters (Sw), Anadromous Fish Spawning Areas (AFSA), Primary Nursery Areas (PNA), Inland Primary Nursery Areas (IPNA), Outstanding Resource Waters (ORW), High Quality Waters (HWQ), and/or waters within a water supply watershed.

***Determination of the applicability of Neuse River Buffer Rules was based solely on their presence or absence on 24k USGS topographic mapping. NRCS soils mapping was not consulted for these determinations. Potential impacts to protected stream buffers will be determined once a LEDPA has been selected and formal stream delineations have been performed.

Table 19: Jurisdictional characteristics of water resources crossing Alternative 52

Alternative 52							
Stream Name	**Map ID**	**NCDWR Index Number**	**Best Usage Classification and Designation***	**Within Designated FEMA Floodway**	**303(d) Listed**	**Length (ft.)**	**Subject to Buffer Rules*****
Buck Branch	S6	27-77-2-0.5	C;Sw,NSW	No	No	504	Yes
Whitleys Creek	S9	27-76	C;Sw,NSW	Yes	No	502	Yes
Mott Swamp	S22	27-80-6	C;Sw,NSW	Yes	No	389	Yes
Strawberry Branch	S23	27-80-7	C;Sw,NSW	Yes	No	491	Yes
Tracey Swamp	S32	27-84-1	C;Sw,NSW, SGA	No	No	562	Yes
UT to Buck Branch	S73	27-77-2-0.5	C;Sw,NSW	No	No	234	No
UT to Walters Mill Pond	S74	27-77-2-1	C;Sw,NSW	No	No	815	Yes
UT to Walters Mill Pond	S76	27-77-2-1	C;Sw,NSW	No	No	911	No
UT to Mill Branch	S82	27-80-8	C;Sw,NSW, SGA	No	No	619	Yes
UT to Mill Branch	S84	27-80-8	C;Sw,NSW, SGA	No	No	340	No
UT to Whitleys Creek	S85	27-76	C;Sw,NSW	No	No	499	Yes
UT to Mill Branch	S86	27-80-8	C;Sw,NSW, SGA	No	No	506	Yes
UT to Strawberry Branch	S87	27-80-7	C;Sw,NSW	No	No	224	Yes
UT to Strawberry Branch	S88	27-80-7	C;Sw,NSW	No	No	310	Yes
UT to Strawberry Branch	S89	27-80-7	C;Sw,NSW	No	No	250	Yes
UT to Southwest Creek	S90	27-80	C;Sw,NSW	No	No	431	No
UT to Mill Branch	S91	27-80-8	C;Sw,NSW, SGA	No	No	400	No
UT to Mill Branch	S92	27-80-8	C;Sw,NSW, SGA	No	No	308	Yes
UT to Strawberry Branch	S94	27-80-7	C;Sw,NSW	No	No	309	Yes
UT to Mott Swamp	S96	27-80-6	C;Sw,NSW	No	No	1,871	Yes
UT to Southwest Creek	S98	27-80	C;Sw,NSW	No	No	424	No
UT to Southwest Creek	S99	27-80	C;Sw,NSW	No	No	630	Yes
UT to Southwest Creek	S100	27-80	C;Sw,NSW	No	No	421	No
UT to Neuse River	S118	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	568	Yes
UT to Neuse River	S121	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	667	Yes
UT to Neuse River	S122	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	613	Yes
UT to Neuse River	S126	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	553	No
UT to Neuse River	S129	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	780	Yes
UT to Neuse River	S134	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	892	Yes
UT to Neuse River	S137	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	298	Yes
UT to Neuse River	S143	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	487	Yes
UT to Neuse River	S149	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	863	Yes
UT to Neuse River	S158	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	121	Yes
UT to Neuse River	S166	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	1,554	Yes
UT to Neuse River	S172	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	259	No
UT to Tracey Swamp	S193	27-84-1	C;Sw,NSW, SGA	No	No	4,967	No
UT to Gum Swamp	S194	27-84-1-1	C;Sw,NSW, SGA	No	No	1,550	Yes
UT to Gum Swamp	S195	27-84-1-1	C;Sw,NSW, SGA	No	No	873	Yes
UT to Tracey Swamp	S197	27-84-1	C;Sw,NSW, SGA	No	No	826	Yes
UT to Tracey Swamp	S198	27-84-1	C;Sw,NSW, SGA	No	No	2,596	Yes
UT to Neuse River	S207	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	240	Yes
UT to Neuse River	S210	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	60	Yes
Alternative 52 Total						**30,717**	

* The Best Usage Classification and Designation column contains the assigned NCDWR Best Usage Classification as well as any other notable water designation. These include Class C Waters (C), Nutrient Sensitive Waters (NSW), Swamp Waters (Sw), Anadromous Fish Spawning Areas (AFSA), Primary Nursery Areas (PNA), Inland Primary Nursery Areas (IPNA), Outstanding Resource Waters (ORW), High Quality Waters (HWQ), and/or waters within a water supply watershed.

***Determination of the applicability of Neuse River Buffer Rules was based solely on their presence or absence on 24k USGS topographic mapping. NRCS soils mapping was not consulted for these determinations. Potential impacts to protected stream buffers will be determined once a LEDPA has been selected and formal stream delineations have been performed.

Table 20: Jurisdictional characteristics of water resources crossing Alternative 63

Alternative 63							
Stream Name	**Map ID**	**NCDWR Index Number**	**Best Usage Classification and Designation***	**Within Designated FEMA Floodway**	**303(d) Listed**	**Length (ft.)**	**Subject to Buffer Rules*****
Buck Branch	S6	27-77-2-0.5	C;Sw,NSW	No	No	504	Yes
Peter Creek	S12	27-78	C;Sw,NSW	No	No	356	Yes
Mott Swamp	S22	27-80-6	C;Sw,NSW	Yes	No	389	Yes
Strawberry Branch	S23	27-80-7	C;Sw,NSW	Yes	No	491	Yes
Tracey Swamp	S32	27-84-1	C;Sw,NSW, SGA	No	No	562	Yes
UT to Buck Branch	S73	27-77-2-0.5	C;Sw,NSW	No	No	234	No
UT to Walters Mill Pond	S74	27-77-2-1	C;Sw,NSW	No	No	815	Yes
UT to Walters Mill Pond	S76	27-77-2-1	C;Sw,NSW	No	No	911	No
UT to Peter Creek	S80	27-78	C;Sw,NSW	No	No	560	No
UT to Mill Branch	S82	27-80-8	C;Sw,NSW, SGA	No	No	619	Yes
UT to Mill Branch	S84	27-80-8	C;Sw,NSW, SGA	No	No	340	No
UT to Mill Branch	S86	27-80-8	C;Sw,NSW, SGA	No	No	506	Yes
UT to Strawberry Branch	S87	27-80-7	C;Sw,NSW	No	No	224	Yes
UT to Strawberry Branch	S88	27-80-7	C;Sw,NSW	No	No	310	Yes
UT to Strawberry Branch	S89	27-80-7	C;Sw,NSW	No	No	250	Yes
UT to Mill Branch	S91	27-80-8	C;Sw,NSW, SGA	No	No	400	No
UT to Mill Branch	S92	27-80-8	C;Sw,NSW, SGA	No	No	308	Yes
UT to Strawberry Branch	S94	27-80-7	C;Sw,NSW	No	No	305	Yes
UT to Mott Swamp	S96	27-80-6	C;Sw,NSW	No	No	1,864	Yes
UT to Southwest Creek	S99	27-80	C;Sw,NSW	No	No	630	Yes
UT to Southwest Creek	S100	27-80	C;Sw,NSW	No	No	421	No
UT to Neuse River	S115	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	335	Yes
UT to Neuse River	S121	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	587	Yes
UT to Neuse River	S122	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	834	Yes
UT to Falling Creek	S124	27-77	C;Sw,NSW, AFSA	No	No	2,303	Yes
UT to Neuse River	S126	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	553	No
UT to Neuse River	S134	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	445	Yes
UT to Falling Creek	S145	27-77	C;Sw,NSW, AFSA	No	No	381	Yes
UT to Neuse River	S149	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	863	Yes
UT to Falling Creek	S153	27-77	C;Sw,NSW, AFSA	No	No	945	Yes
UT to Falling Creek	S155	27-77	C;Sw,NSW, AFSA	No	No	335	Yes
UT to Neuse River	S158	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	153	Yes
UT to Peter Creek	S162	27-78	C;Sw,NSW	No	No	97	Yes
UT to Neuse River	S166	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	456	Yes
UT to Neuse River	S178	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	332	No
UT to Falling Creek	S184	27-77	C;Sw,NSW, AFSA	No	No	1,107	Yes
UT to Tracey Swamp	S193	27-84-1	C;Sw,NSW, SGA	No	No	4,967	No
UT to Gum Swamp	S194	27-84-1-1	C;Sw,NSW, SGA	No	No	1,550	Yes
Alternative 63 Total						**32,663**	

* The Best Usage Classification and Designation column contains the assigned NCDWR Best Usage Classification as well as any other notable water designation. These include Class C Waters (C), Nutrient Sensitive Waters (NSW), Swamp Waters (Sw), Anadromous Fish Spawning Areas (AFSA), Primary Nursery Areas (PNA), Inland Primary Nursery Areas (IPNA), Outstanding Resource Waters (ORW), High Quality Waters (HWQ), and/or waters within a water supply watershed.

***Determination of the applicability of Neuse River Buffer Rules was based solely on their presence or absence on 24k USGS topographic mapping. NRCS soils mapping was not consulted for these determinations. Potential impacts to protected stream buffers will be determined once a LEDPA has been selected and formal stream delineations have been performed.

Table 21: Jurisdictional characteristics of water resources crossing Alternative 65

Alternative 65							
Stream Name	**Map ID**	**NCDWR Index Number**	**Best Usage Classification and Designation***	**Within Designated FEMA Floodway**	**303(d) Listed**	**Length (ft.)**	**Subject to Buffer Rules*****
Buck Branch	S6	27-77-2-0.5	C;Sw,NSW	No	No	504	Yes
Peter Creek	S12	27-78	C;Sw,NSW	No	No	356	Yes
Mott Swamp	S22	27-80-6	C;Sw,NSW	Yes	No	389	Yes
Strawberry Branch	S23	27-80-7	C;Sw,NSW	Yes	No	532	Yes
Tracey Swamp	S32	27-84-1	C;Sw,NSW, SGA	No	No	253	Yes
UT to Buck Branch	S73	27-77-2-0.5	C;Sw,NSW	No	No	234	No
UT to Walters Mill Pond	S74	27-77-2-1	C;Sw,NSW	No	No	815	Yes
UT to Walters Mill Pond	S76	27-77-2-1	C;Sw,NSW	No	No	911	No
UT to Peter Creek	S80	27-78	C;Sw,NSW	No	No	560	No
UT to Strawberry Branch	S87	27-80-7	C;Sw,NSW	No	No	343	Yes
UT to Strawberry Branch	S89	27-80-7	C;Sw,NSW	No	No	260	Yes
UT to Strawberry Branch	S94	27-80-7	C;Sw,NSW	No	No	305	Yes
UT to Mott Swamp	S96	27-80-6	C;Sw,NSW	No	No	1,864	Yes
UT to Southwest Creek	S99	27-80	C;Sw,NSW	No	No	630	Yes
UT to Southwest Creek	S100	27-80	C;Sw,NSW	No	No	421	No
UT to Neuse River	S115	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	335	Yes
UT to Neuse River	S121	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	587	Yes
UT to Neuse River	S122	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	834	Yes
UT to Falling Creek	S124	27-77	C;Sw,NSW, AFSA	No	No	2,303	Yes
UT to Neuse River	S126	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	553	No
UT to Neuse River	S134	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	445	Yes
UT to Falling Creek	S145	27-77	C;Sw,NSW, AFSA	No	No	381	Yes
UT to Neuse River	S149	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	863	Yes
UT to Falling Creek	S153	27-77	C;Sw,NSW, AFSA	No	No	945	Yes
UT to Falling Creek	S155	27-77	C;Sw,NSW, AFSA	No	No	335	Yes
UT to Neuse River	S158	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	153	Yes
UT to Peter Creek	S162	27-78	C;Sw,NSW	No	No	97	Yes
UT to Neuse River	S166	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	456	Yes
UT to Neuse River	S178	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	332	No
UT to Falling Creek	S184	27-77	C;Sw,NSW, AFSA	No	No	1,107	Yes
UT to Tracey Swamp	S193	27-84-1	C;Sw,NSW, SGA	No	No	1,760	No
UT to Gum Swamp	S194	27-84-1-1	C;Sw,NSW, SGA	No	No	127	Yes
UT to Gum Swamp	S195	27-84-1-1	C;Sw,NSW, SGA	No	No	776	Yes
UT to Tracey Swamp	S196	27-84-1	C;Sw,NSW, SGA	No	No	0	Yes
UT to Tracey Swamp	S197	27-84-1	C;Sw,NSW, SGA	No	No	350	Yes
UT to Tracey Swamp	S198	27-84-1	C;Sw,NSW, SGA	No	No	3,100	Yes
UT to Mill Branch	S199	27-80-8	C;Sw,NSW, SGA	No	No	244	Yes
UT to Neuse River	S206	27-(75.7)	C;NSW,AFSA,IPNA, WS Watershed	No	No	448	Yes
UT to Falling Creek	S212	27-77	C;Sw,NSW, AFSA	No	No	190	Yes
UT to Falling Creek	S213	27-78	C;Sw,NSW, AFSA	No	No	432	Yes
UT to Falling Creek	S216	27-79	C;Sw,NSW, AFSA	No	No	55	Yes
Alternative 65 Total						**25,584**	

* The Best Usage Classification and Designation column contains the assigned NCDWR Best Usage Classification as well as any other notable water designation. These include Class C Waters (C), Nutrient Sensitive Waters (NSW), Swamp Waters (Sw), Anadromous Fish Spawning Areas (AFSA), Primary Nursery Areas (PNA), Inland Primary Nursery Areas (IPNA), Outstanding Resource Waters (ORW), High Quality Waters (HWQ), and/or waters within a water supply watershed.

***Determination of the applicability of Neuse River Buffer Rules was based solely on their presence or absence on 24k USGS topographic mapping. NRCS soils mapping was not consulted for these determinations. Potential impacts to protected stream buffers will be determined once a LEDPA has been selected and formal stream delineations have been performed.

Appendix C: Habitat Areas

Kinston Bypass
STIP Project No. R-2553

Figure 6
Potential Red-Cockaded Woodpecker Habitat Area Using C-CAP Data

GREENE COUNTY
LENOIR COUNTY
PITT COUNTY
CRAVEN COUNTY
JONES COUNTY
DUPLIN COUNTY
Grifton
La Grange
Kinston
Dover
GTP
123
258
903
11
58
55
70
70BUS
70BYP

Legend

- NRTR Study Area
- DSA Corridors
- NCNHP Red-Cockaded Woodpecker Element Occurrence Data
- Evergreen Forest and Scrub/Shrub C-CAP Types
- US Highway
- NC Highway
- State Road
- Local Road
- Global TransPark (GTP)
- County
- Municipal Area

0 2.5 Miles

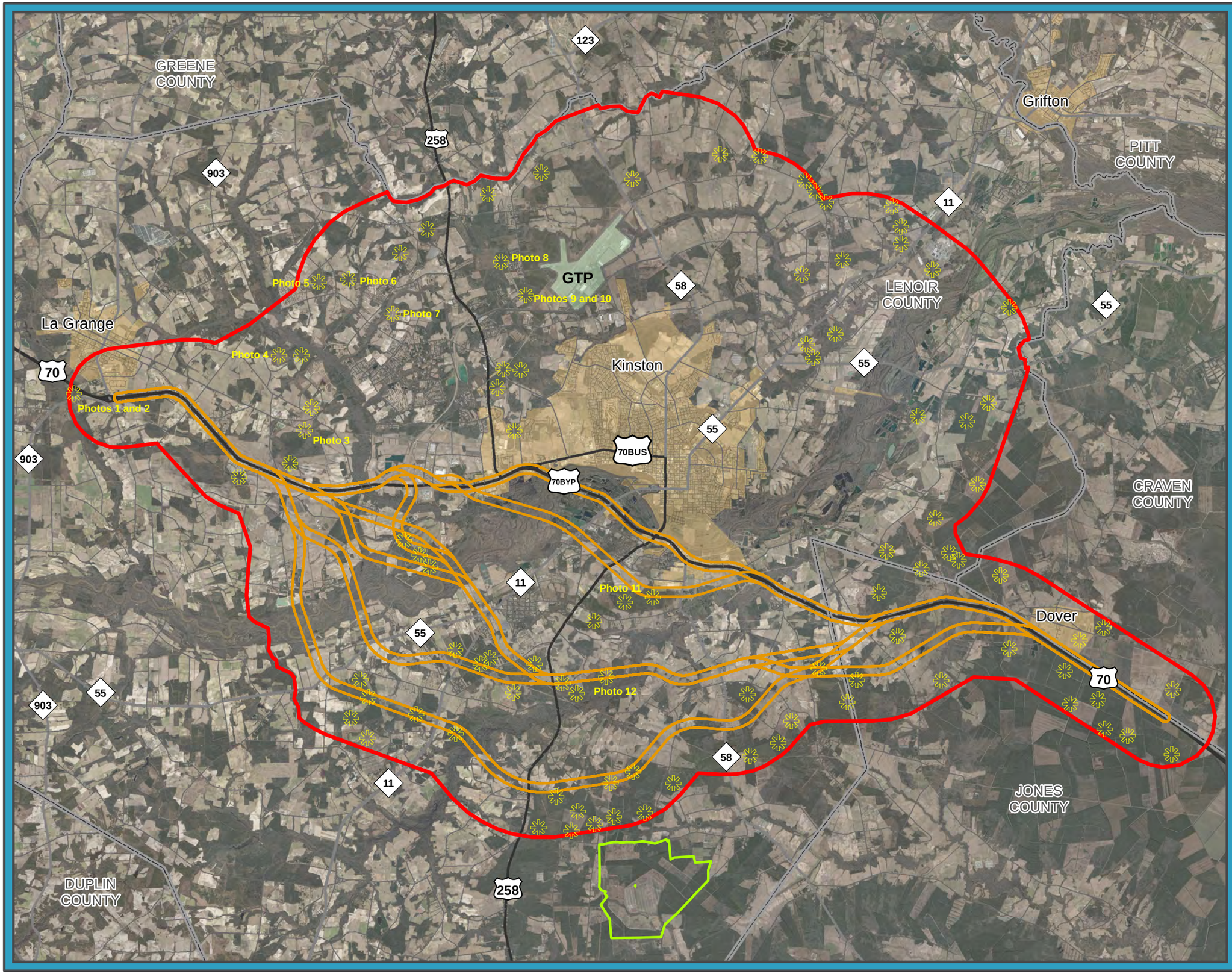
N

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.

Kinston Bypass
STIP Project No. R-2553

Figure 7
GIS-Generated
Potential Red-Cockaded
Woodpecker Habitat Area
Using Aerial Imagery



Legend

- NRTR Study Area
- Potential Red-Cockaded Woodpecker Habitat
- NCNHP Red-Cockaded Woodpecker Element Occurrence Data
- DSA Corridors
- US Highway
- NC Highway
- State Road
- Local Road
- Global TransPark (GTP)
- County
- Municipal Area

N

0 2.5 Miles

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.

Kinston Bypass
STIP Project No. R-2553
Figure 7a
GIS-Generated Potential Red-Cockaded Woodpecker Habitat Area Site Visit Status

Legend

- NRTR Study Area
- NCNHP Red Cockaded Woodpecker EO Data
- DSA Corridors
- Field visit not complete
- Field site visited
- Field site visited, Survey for cavity trees if within LEDPA range
- US Highway
- NC Highway
- State Road
- Local Road
- Global TransPark (GTP)
- Municipal Area
- County

0 2.5 Miles

N

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.

GREENE COUNTY
PITT COUNTY
LENOIR COUNTY
CRAVEN COUNTY
JONES COUNTY
DUPLIN COUNTY
La Grange
Kinston
Grifton
Dover
GTP
123
258
903
70
70BUS
70BYP
11
55
58
Site 1
Photos 1 and 2
Site 2
Site 3
Site 4
Photo 3
Site 5
Photo 4
Site 6
Site 7
Site 8
Photo 5
Photo 6
Site 9
Site 10
Photo 7
Site 11
Site 12
Site 13
Site 14
Site 15
Site 16
Photo 8
Site 17
Photos 9 and 10
Site 18
Site 19
Site 20
Site 21
Site 22
Site 23
Site 24
Photo 11
Site 25
Site 26
Site 27
Site 28
Photo 12
Site 29
Site 30
Site 31
Site 32
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Site 95
Site 96

Kinston Bypass
STIP Project No. R-2553

Figure 8
Potential Rough-Leaved Loosetrife Habitat Area Within Craven County

Legend

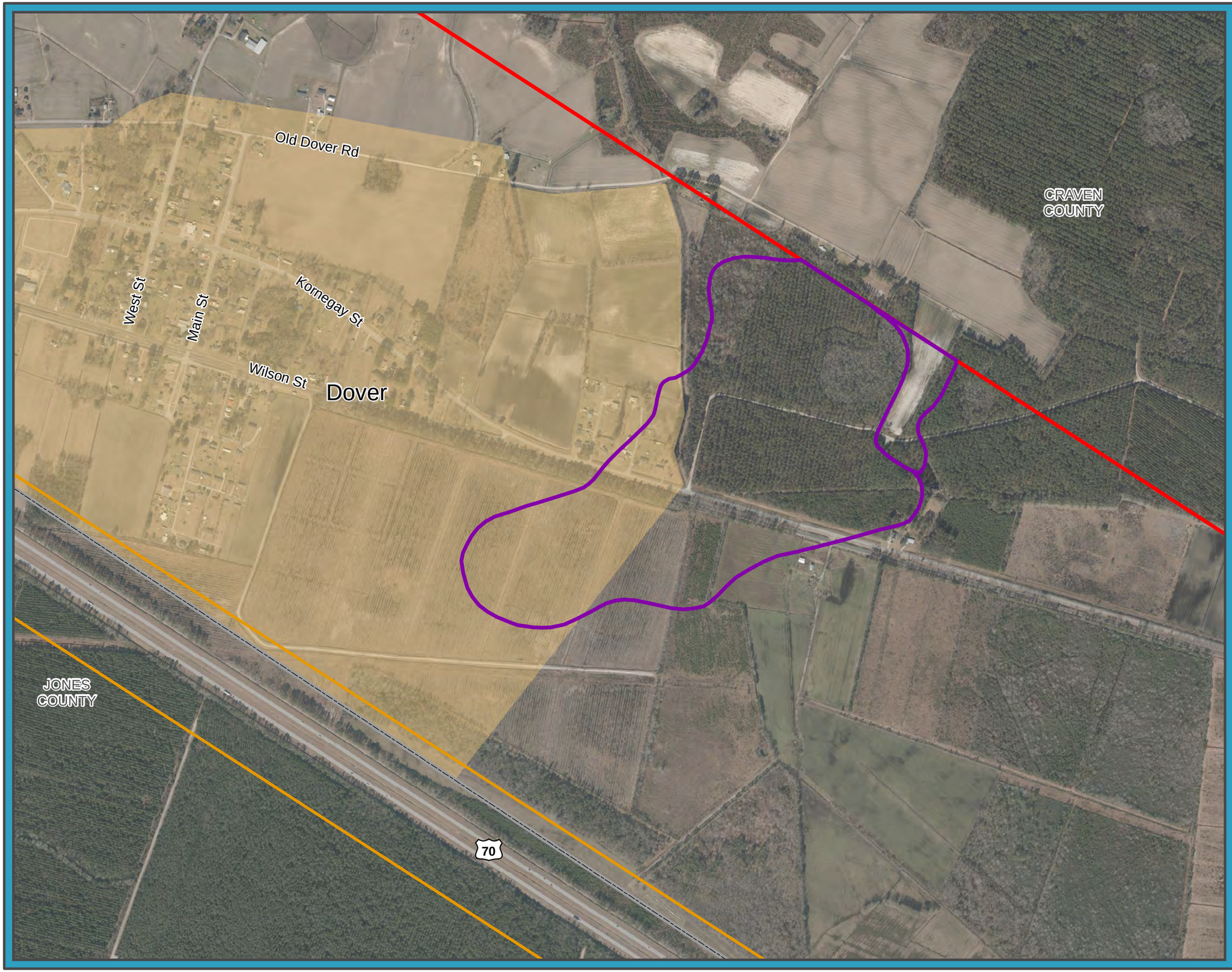
- NRTR Study Area
- Leon and Torhunta Soils
- DSA Corridors
- County
- Municipal Area

N

0 1 Miles

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.



Kinston Bypass
STIP Project No. R-2553

Figure 9
Potential Rough-Leaved Loosetrife Habitat Area
Leon and Torhunta Soils

Legend

- NRTR Study Area
- Leon and Torhunta Soils
- DSA Corridors
- County
- Municipal Area

N

0 0.2 Miles

September 2017

This map is for reference only.
Sources: CGIA, NCDOT, NCDENR, NCFPM, Craven County, NCDCM, NCEM, Lenoir County, Pitt County, Kinston Planning Department, NCOneMap, NCWRC, NCSHPO,EPA, USFWS, USDA, NRCS, DWQ, ESRI and AECOM.

Photos 1 and 2. Loblolly pine forest in extreme western portion of study area. Largest pines noted during surveys. Forest is small (20 acres) and bordered by US 70 on the north and young scrub pine forest to the south and east. Not contiguous to any other habitat.

Photo 3. Middle-aged loblolly plantation

Photo 4. Loblolly plantation

Photo 5. Mixed pine-hardwood forest

Photo 6. Loblolly plantation overgrown with greenbrier


Photo 7. Young loblolly plantation


Photo 8. Older loblolly plantation


Photo 9. Mixed pine-hardwood forest


Photo 10. Overgrown young loblolly plantation


Photo 11. Thick pine forest


Photo 12. Overgrown young loblolly plantation

Appendix D: Metadata

2001 GAP Land Cover Metadata

1. lc_segap_nc

Metadata also available as

2. Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator:

Biodiversity and Spatial Information Center, USGS North Carolina Cooperative Fish and Wildlife Research Unit, NC State University

Publication_Date: 20080825

Title: lc_segap_nc

Geospatial_Data_Presentation_Form: raster digital data

Online_Linkage:

\\Glaurung\Ilex\Proj\SEGap\SE01_mosaic\mosaic_segap2001\segap_lc_web_deliverables\lc_segap_nc\lc_segap_nc

Description:

Abstract:

Multi-season satellite imagery (Landsat ETM+) from 1999-2001 were used in conjunction with digital elevation model (DEM) derived datasets (e.g. elevation, landform) to model natural and semi-natural vegetation. General land cover classes (i.e. water, urban, row crop) were included from the National Land Cover Dataset 2001 (<http://www.epa.gov/mrlc/nlcd-2001.html>). The minimum mapping unit for this dataset is 0.4 ha (1 acre). Vegetation classes were drawn from NatureServe's Ecological System Classification (Comer et al. 2003; <http://www.natureserve.org/explorer/classeco.htm>). Two hundred fourteen (214) land cover classes (140 Ecological Systems, 32 modified classes, and 42 general land cover classes recognized as occurring in the 13 USGS mapping zones comprising the Southeast region were mapped. Land cover classes were mapped with a variety of techniques including decision tree classifiers, unsupervised classification, and expert decision rules. The 13 USGS mapping zones were mapped independently of one another by one of three cooperating spatial analysis laboratories: 1. Biodiversity and Spatial Information Center, North Carolina State University, Raleigh, NC 27695-7617. 2. Alabama Gap Project, Alabama Cooperative Fish & Wildlife Research Unit, Auburn University, Alabama 36839. 3. Natural Resources and Spatial Analysis Laboratory (NARSAL), University of Georgia, Athens Georgia 30602. An internal validation for modeled classes is in progress. Results of the validation will be presented in the project final report.

Purpose:

The digital land cover dataset may be used for various purposes with user's discretion. Specifically, this dataset was created for regional terrestrial biodiversity assessment. These data are not intended to be used at scales larger than 1:100,000.

Supplemental_Information:

Current Version - segap_13oct10

This version corrects coding errors where areas of Atlantic Coastal Plain Sea Island Beach (Class 10, CES203.383) between the St. John's River (FL) and Savannah, GA were incorrectly labelled as Atlantic Coastal Southern Beach (Class 11, CES203.535) and Soutwest Florida Beach (Class 15, CES411.276).

Previous Version - segap_29mar10

This version reflects the following changes made to the sandy beach classes of Florida. Unconsolidated Shore (Beach/Dune) along the Gulf Coast in mapping zones 46 and 55 was re-coded to Florida Panhandle Beach Vegetation (Class 12). Unconsolidated Shore (Beach/Dune) along the Atlantic Coast in mapping zone 55 was re-coded to Southwest Florida Beach (Class 15). Atlantic Coastal Plain Upland Longleaf Pine Woodland (Class 93)in Zone 60 was re-coded to Northern Atlantic Coastal Plain Pitch Pine Barrens - Pine Modifier (Class 120). The official release date for this version is 29 March 2010.

Previous Version - segap_25aug08

This version includes corrections of a recoding error that incorrectly labeled Row Crop (Class 149) as Utility Swath-Herbaceous (Class 147) in the Piedmont of North and South Carolina (Mapping Zone 59). The official release date for this version is 25 August 2008.

Previous Version - segap_21may08

This land cover data layer was updated to reflect errors associated with ecological systems range contradictions and minor

recoding errors associated with the mapping zone mosaic operation. Some of the more extensive edits increased the pixels of Class 146 (grassland/herbaceous class - clearcut) in Zone 46, increased the pixels of Class 91 (Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland) and added Class 64 (Atlantic Coastal Plain Xeric River Dune) in Zone 55, and recoding Class 102 (Allegheny-Cumberland Dry Oak Forest and Woodland - Pine Modifier) to Class 38 (Allegheny-Cumberland Dry Oak Forest and Woodland - Hardwood Modifier) in Zone 53. The official release date for this version is 21 May 2008.
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 1999
Ending_Time: 2001
Currentness_Reference: ground condition
Status:
Progress: Complete
Maintenance_and_Update_Frequency: None planned
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -84.392037
East_Bounding_Coordinate: -75.137371
North_Bounding_Coordinate: 37.639688
South_Bounding_Coordinate: 33.392476
Keywords:
Theme:
Theme_Keyword_Thesaurus: none
Theme_Keyword: land cover
Theme_Keyword: vegetation mapping
Place:
Place_Keyword: Southeast US
Place_Keyword: Alabama
Place_Keyword: Florida
Place_Keyword: Georgia
Place_Keyword: Kentucky
Place_Keyword: Mississippi
Place_Keyword: North Carolina
Place_Keyword: South Carolina
Place_Keyword: Tennessee
Place_Keyword: Virginia
Access_Constraints: none
Use_Constraints:
Appropriate scale for these data is 1: 100,000 or smaller. The user assumes responsiblity when using this dataset.
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Alexa McKerrow
Contact_Organization:
Biodiversity and Spatial Information Center, USGS North Carolina Cooperative Fish and Wildlife Research Unit, NC State University
Contact_Position: Land Cover Mapping Coordinator
Contact_Address:
Address_Type: mailing address
Address: 127 David Clark Labs
Address: Department of Biology, NCSU
Address: Campus Box 7617
City: Raleigh
State_or_Province: NC
Postal_Code: 27695-7617
Country: US
Contact_Voice_Telephone: 919-513-2852
Contact_Facsimile_Telephone: 919-515-4454
Contact_Electronic_Mail_Address: Alexa_McKerrow@ncsu.edu
Native_Data_Set_Environment:
Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 3; ESRI ArcCatalog 9.2.6.1500

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:

Model validation for this dataset is ongoing. Results of validation will be available in the Southeast Regional Gap Final Report, and are not available with this dataset.

Logical_Consistency_Report: Not applicable for raster data

Completeness_Report:

All cells within the Southest regional boundary have an attributed CODE and DESCRIPTION. See Process_Description for more details.

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator:

United States Geological Survey, EROS Data Center, National Elevation Dataset

Publication_Date: 1999

Title: 30 Meter Digital Elevation Model

Geospatial_Data_Presentation_Form: raster digital data

Online_Linkage: <http://ned.usgs.gov/>

Source_Information:

Source_Citation:

Citation_Information:

Originator:

United States Geological Survey, EROS Data Center, Multi-Resolution Land Characteristics Consortium

Publication_Date: 1999-2001

Title: Landsat 7 , ETM+ Imagery

Geospatial_Data_Presentation_Form: raster digital data

Online_Linkage: <http://www.mrlc.gov/index.asp>

Type_of_Source_Media: digital

Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 1999

Ending_Time: 2001

Source_Citation_Abbreviation: USGS

Source_Contribution:

Landsat 7 ETM+ Imagery provided for Spring, Summer and Fall dates between 1999 and 2001

Process_Step:

Process_Description:

Land cover mapping for the Southeast Region Gap Analysis Project was a cooperative effort of three spatial analysis laboratories. Each group was responsible for ancillary data layer preparation, training sample collection and land cover modeling. The BASIC lab coordinated the activities of the land cover mapping teams, to assure as much regional standardization as possible. Detailed documentation on process steps will be included in the project final report. The following provides a brief outline of the process steps. USGS National Land Cover Dataset Mapping Zone assignments - The southeast region contains all or part of 13 NLCD 2001 mapping zones (<http://landcover.usgs.gov/pdf/homer.pdf>) across 11 states. Land cover mapping for each zone was assigned to one of the three cooperating groups in such a way as to take advantage of prior knowledge, local expertise, and prior or ongoing research activity. Zone 46 was completed by the Alabama GAP Analysis Project based at Auburn University. Zones 45, 48, 55, 56, 58, 60, adn 61 were mapped by BASIC personnel at North Carolina State University. Zones 47, 53, 54, and 59 were mapped by NARSAL personnel at University of Georgia. Land cover mapping -- Each mapping team used a variety of mapping methods to model ecological systems in their assigned zones. Where applicable, decision tree classifiers were used. Decision tree classification was implemented through the use of a custom interface for ERDAS Imagine (developed under contract by Earthsat, Corp. for USGS EROS Data Center) and See5 software (www.rulequest.com). Land cover types that were not mapped using decision tree classifiers typically had too few reference samples due to their sparse occurrence on the landscape or poor discrimination among or between spectrally similar cover classes (e.g. mesic vs. dry-mesic forested systems) to yield an acceptable result. Where the decision tree could not be used, other techniques such as localized unsupervised classification, area of interest inclusion/exclusion masks, and expert decision rules were used to map these cover classes. Map review, edits, and mosaic -- Mapping zones were mosaicked by the BASIC team. During the mosaic process, a limited number of gross errors were identified for editing prior to the generation of the final mosaic. These included erroneous data omission, recoding errors, and systems mistakenly mapped outside of NatureServe ranges. Data distribution -- The final product is an 8-bit ArcInfo grid or 8-bit ERDAS Imagine file covering the southeast region. The data are also available clipped to state boundaries.

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Vertical_Count: 1

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False_Northing: 0.000000
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Planar_Coordinate_Encoding_Method: row and column
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Abscissa_Resolution: 30.000000
Ordinate_Resolution: 30.000000
Planar_Distance_Units: meters
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Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222

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Entity_Type_Definition: ArcInfo attribute table
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Attribute:
Attribute_Label: Value

Attribute:
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Attribute:
Attribute_Label: COUNT
Attribute_Definition: Number of 30 m x 30 m pixels per class
Attribute:
Attribute_Label: OPACITY
Attribute:
Attribute_Label: Rowid
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain:
Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: CLASS_NAMES
Detailed_Description:
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Entity_Type_Label: Name
Entity_Type_Definition: NatureServe Ecological System name
Detailed_Description:
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Detailed_Description:
Entity_Type:
Entity_Type_Label: Count
Entity_Type_Definition: the number of pixels for that class
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Entity_Type_Label: Red
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Detailed_Description:
Entity_Type:
Entity_Type_Label: Green
Entity_Type_Definition: Green color value
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Entity_Type_Definition: Blue color value
Detailed_Description:
Entity_Type:
Entity_Type_Label: Opacity
Entity_Type_Definition: transparency level
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Entity_and_Attribute_Overview:
A complete description for each class is available in the document "Ecological Systems Descriptions for the Southeast Regional Gap Project" found at <http://www.basic.ncsu.edu/segap/> Value Code Name
1 SEGAP111 Open Water (Fresh) 2 SEGAP112 Open Water (Brackish/Salt) 3 SEGAP113 Open Water (Aquaculture) 4 SEGAP211 Developed Open Space 5 SEGAP220 Low Intensity Developed 6 SEGAP230 Medium Intensity Developed 7 SEGAP240 High Intensity Developed 9 CES203.301 Atlantic Coastal Plain Northern Sandy Beach 10 CES203.383 Atlantic Coastal Plain Sea Island Beach 11 CES203.535 Atlantic Coastal Plain Southern Beach 12 CES203.266 Florida Panhandle Beach Vegetation 13 CES411.271 South Florida Shell Hash Beach 14 CES411.272 Southeast Florida Beach 15 CES411.276 Southwest Florida Beach 16 SEGAP311 Bare Sand 17 SEGAP312 Bare Soil 18 SEGAP313 Quarry/Strip Mine/Gravel Pit 19 CES202.327 Southern Appalachian Rocky Summit 20 CES202.297 Southern Appalachian Granitic Dome 21 CES202.601 North-Central Appalachian Acidic Cliff and Talus 22 CES202.603 North-Central Appalachian Circumneutral Cliff and Talus 24 CES202.690 Central Interior Calcareous Cliff and Talus 25 CES202.689 Central Interior Acidic Cliff and Talus 26

CES202.330 Southern Appalachian Montane Cliff 28 CES202.309 Southern Interior Acid Cliff 29 CES202.356 Southern Interior Calcareous Cliff 30 CES202.386 Southern Piedmont Cliff 32 CES203.492 East Gulf Coastal Plain Dry Chalk Bluff 33 CES202.329 Southern Piedmont Granite Flatrock 35 SEGAP321 Unconsolidated Shore (Lake/River/Pond) 36 SEGAP322 Unconsolidated Shore (Beach/Dune) 37 SEGAP410 Deciduous Plantations 38 CES202.359b Allegheny-Cumberland Dry Oak Forest and Woodland - Pine Modifier 39 CES203.241 Atlantic Coastal Plain Dry and Dry-Mesic Oak Forest 40 CES203.242 Atlantic Coastal Plain Mesic Hardwood and Mixed Forest 42 CES202.596 Central and Southern Appalachian Montane Oak Forest 43 CES202.029 Central and Southern Appalachian Northern Hardwood Forest 44 CES203.506b East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest - Hardwood Modifier 45 CES203.502 East Gulf Coastal Plain Limestone Forest 46 CES203.483a East Gulf Coastal Plain Northern Dry Upland Hardwood Forest 47 CES203.481 East Gulf Coastal Plain Northern Loess Bluff Forest 48 CES203.482a East Gulf Coastal Plain Northern Loess Plain Oak-Hickory Upland - Hardwood Modifier 49 CES203.477 East Gulf Coastal Plain Northern Mesic Hardwood Forest 50 CES203.556 East Gulf Coastal Plain Southern Loess Bluff Forest 51 CES203.476 East Gulf Coastal Plain Southern Mesic Slope Forest 52 CES202.592a Northeastern Interior Dry Oak Forest-Hardwood Modifier 53 CES202.898 South-Central Interior Highlands Dry Oak Forest 54 CES202.887 South-Central Interior Mesophytic Forest 55 CES202.373 Southern and Central Appalachian Cove Forest 56 CES202.886 Southern and Central Appalachian Oak Forest 57 CES203.560 Southern Coastal Plain Dry Upland Hardwood Forest 60 CES202.457b Southern Ridge and Valley Dry Calcareous Forest - Hardwood Modifier 61 CES203.254d Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland - Offsite Hardwood Modifier 62 CES203.496d East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland - Offsite Hardwood Modifier 63 CES203.479a East Gulf Coastal Plain Jackson Plain Dry Flatwoods - Open Understory Modifier 64 CES203.497 Atlantic Coastal Plain Xeric River Dune 66 CES202.339a Southern Piedmont Dry Oak-(Pine) Forest - 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Loblolly Pine Modifier 87 CES202.023b Southern Piedmont Dry Oak-Heath Forest - Virginia/Pitch Pine Modifier 88 CES411.368 Southwest Florida Coastal Strand and Maritime Hammock 90 CES203.254c Atlantic Coastal Plain Fall-Line Sandhills Longleaf Pine Woodland - Loblolly Modifier 91 CES203.254a Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland - Open Understory Modifier 92 CES203.254b Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland - Scrub/Shrub Understory Modifier 93 CES203.281 Atlantic Coastal Plain Longleaf Pine Woodland 94 CES203.496c East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland - Loblolly Modifier 95 CES203.496a East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland - Open Understory Modifier 96 CES203.496b East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland - Scrub/Shrub Modifier 97 CES411.367 South Florida Pine Rockland 98 CES202.331 Southern Appalachian Montane Pine Forest and Woodland 99 CES203.494 Southern Coastal Plain Oak Dome and Hammock 100 CES202.319 Southern Piedmont Longleaf Pine Woodland 101 CES203.483b East Gulf Coastal Plain Northern Dry Upland Hardwood Forest - 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Floodplain Forest 154 CES203.250 Atlantic Coastal Plain Small Brownwater River Floodplain Forest 155 CES202.608a Central Appalachian Floodplain - Forest Modifier 156 CES202.609a Central Appalachian Riparian - Forest Modifier 157 CES203.489a East Gulf Coastal Plain Large River Floodplain Forest - Forest Modifier 158 CES203.559 East Gulf Coastal Plain Small Stream and River Floodplain Forest 159 CES203.195 Mississippi River Low Floodplain (Bottomland) Forest 160 CES203.490a Lower Mississippi River Bottomland Depressions - Forest Modifier 161 CES202.705a South-Central Interior Large Floodplain - Forest Modifier 162 CES202.706 South-Central Interior Small Stream and Riparian 163 CES203.493 Southern Coastal Plain Blackwater River Floodplain Forest 164 CES202.324a Southern Piedmont Large Floodplain Forest - Forest Modifier 165 CES202.323 Southern Piedmont Small Floodplain and Riparian Forest 166 CES203.190 Mississippi River Riparian Forest 167 CES203.304b Atlantic Coastal Plain Nonriverine Swamp and Wet Hardwood Forest - 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Herbaceous Modifier 240 CES202.705b South-Central Interior Large Floodplain - Herbaceous Modifier 245 CES203.270 Atlantic Coastal Plain Central Salt and Brackish Tidal Marsh 246 CES203.260 Atlantic Coastal Plain Embayed Region Tidal Salt and Brackish Marsh 247 CES203.257 Atlantic Coastal Plain Indian River Lagoon Tidal Marsh 248 CES203.519 Atlantic Coastal Plain Northern Tidal Salt Marsh 249 CES203.508 Florida Big Bend Salt-Brackish Tidal Marsh 250 CES203.303 Mississippi Sound Salt and Brackish Tidal Marsh 251 CES411.286 South Florida Everglades Sawgrass Marsh 253 CES202.886b Southern and Central Appalachian Oak Forest - Xeric

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NatureServe. October 2006. Descriptions of Ecological Systems for Modeling of LANDFIRE Biophysical Settings.

Distribution_Information:

Distributor:

Contact_Information:

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Contact_Person: Alexa McKerrow

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City: Raleigh
State_or_Province: NC
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Country: US
Contact_Voice_Telephone: 919-513-2853
Contact_Facsimile_Telephone: 919-515-4454
Contact_Electronic_Mail_Address: Alexa_McKerrow@ncsu.edu
Resource_Description: Downloadable Data
Distribution_Liability:
The BASIC Laboratory, North Carolina State University nor any institution responsible for creating this dataset are responsible for the re-distribution, content, or use of these data.
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Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Todd Earnhardt
Contact_Organization:
Biodiversity and Spatial Information Center, USGS North Carolina Cooperative Fish and Wildlife Research Unit, NC State University
Contact_Position: Plant Community Ecologist and RS Specialist
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Address_Type: mailing address
Address: 127 David Clark Labs
Address: Department of Biology, NCSU
Address: Campus Box 7617
City: Raleigh
State_or_Province: NC
Postal_Code: 27695-7617
Country: USA
Contact_Voice_Telephone: 919-513-7292
Contact_Facsimile_Telephone: 919-515-4454
Contact_Electronic_Mail_Address: Todd_Earnhardt@ncsu.edu
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Profile_Name: ESRI Metadata Profile

2006 C-CAP Land Cover Metadata

Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), Coastal Services Center (CSC)
20090428
nlcd
raster digital data

Charleston, SC
NOAA's Ocean Service, Coastal Services Center (CSC)

This classification is based on Landsat TM scenes p014r035 4/11/2006 p014r036 4/11/2006 p015r035 4/21/2007 p015r036 4/21/2007 p015r037 5/4/2006 p016r035 10/15/2005 p016r036 7/27/2005 p016r037 4/25/2006 p016r038 10/15/2005 p017r036 5/21/2007 p017r037 5/2/2006
\\rd17.ad.urscorp.com\rduprojects\Jobs3\31826742_Kinston Bypass\GIS\Shapefiles\CGIA_Data\GIS_Data_CGIA_Original_20101020\nlcd
nlcd

This is a final classification. This data set is the 2006-era classification of U.S. South East Region, zone 58. This data set utilized 11 full or partial Landsat scenes which were analyzed according to the Coastal Change Analysis Program (C-CAP) protocol to determine land cover.
To improve the understanding of coastal uplands and wetlands, and their linkages with the distribution, abundance, and health of living marine resources.
en

20050727
20070521

REQUIRED: The year (and optionally month, or month and day) for which the data set corresponds to the ground.

Date of the Landsat scenes

Complete
5 years

-77.940478
-77.284790
35.502951
34.931581

1624531.712206
1673971.712206

1483445.864330
1538916.520257

None
Land Cover Analysis

ISO 19115 Topic Category
ImageryBaseMapsEarthCover

None
Coastal Zone
U.S. South East
North Carolina
South Carolina

None, except for a possible fee.
Data set is not for use in litigation. While efforts have been made to ensure that these data are accurate and reliable within the state of the art, NOAA, cannot assume liability for any damages, or misrepresentations, caused by any inaccuracies in the data, or as a result of the data to be used on a particular system. NOAA makes no warranty, expressed or implied, nor does the fact of distribution constitute such a warranty.
Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 3; ESRI ArcCatalog 9.3.1.3000
Raster Dataset

According to an accuracy assessment performed by Sanborn, for zones 55/58 2001 landcover, the overall accuracy is 81.2% and 0.793 Kappa. The 2006 update is based on updating the change areas between 2001 and 2006 imagery, and overlaying the results over 2001 land cover. Therefore the accuracy of the 2001 product is a sufficient indication of 2006 update accuracy as well within +/- 4.05% (percent area change from 2001). The following methodology and results are from the accuracy assessment of the 2001 zones 55/58 dataset conducted by Sanborn. A total of 1508 points are located in US Coastal zones 55/58. (Errors of Omission/Commission) 0 Background (N/A) 1 Unclassified (Cloud, Shadow, etc)(N/A) 2 High Intensity Developed (79.2%/79.2%) 3 Medium Intensity Developed (52.8%/37.3%) 4 Low Intensity Developed (45.8%/57.9%) 5 Open Spaces Developed (78.3%/85.5%) 6 Cultivated Land (86.4%/93.7%) 7 Pasture/Hay (80.6%/74.6%) 8 Grassland (71.1%/60.4%) 9 Deciduous Forest (48.8%/63.6%) 10 Evergreen Forest (92.7%/96.6%) 11 Mixed Forest (40.7%/44%) 12 Scrub/Shrub (60.3%/67.7%) 13 Palustrine Forested Wetland (88.3%/82.5%) 14 Palustrine Scrub/Shrub Wetland (71%/72.1%) 15 Palustrine Emergent Wetland (77.6%/75%) 16 Estuarine Forested Wetland (N/A) 17 Estuarine Scrub/Shrub Wetland (100%/100%) 18 Estuarine Emergent Wetland (100%/95.3%) 19 Unconsolidated Shore (100%/84.8%) 20 Bare Land (93.8%/77.9%) 21 Water (90.1%/100%) 22 Palustrine Aquatic Bed (100%/50%) 23 Estuarine Aquatic Bed (N/A) 24 Tundra (N/A) 25 Snow/Ice (N/A The validation points were both collected in the field and photo interpreted. The sites were selected to capture the physical and spectral diversity of the land cover. Because the starting point for this classification was the NLCD data produced by the Southeast GAP, this data layer was utilized in identifying potential AA sites. Segments created with Definiens software were buffered in one pixel to eliminate edge effect. Segments smaller than the assessment's minimum mapping unit of 3x3 pixels were eliminated. The remaining segments were summarized by the NLCD data and segments with a majority class equaling less than 90% were removed. The remaining segments were entered into the pool of potential AA sites. The field sampling then focused on labeling these segments with the goal being to collect a minimum number of 50 samples per class

with samples stratified geographically to ensure that the diversity of the landscape and imagery was captured. Sites collected in the field were then verified in the office using the triple date imagery to ensure consistency with all dates, and classes with less than 50 samples were supplemented with photo interpreted sites. For some classes, the minimum of 50 sites could not be achieved and as many sites as possible were used. These classes and their actual sample numbers are: Deciduous Forest (33); Mixed Forest (25); Estuarine Forested Wetland (0); Estuarine Scrub/Shrub Wetland (2); Palustrine Aquatic Bed (6); Estuarine Aquatic Bed (0). These classes are either rare or scattered in the area making it difficult to locate homogeneous sites for these classes. Accuracy assessment sites were QC'd to ensure that edge effects, heterogeneity, and sample size would not adversely affect the assessment. In addition as some of the class definitions were refined through the draft review processes, the AA database was updated to reflect these changes. A total of 1,292 accuracy assessment points were used excluding urban classes. Post-Processing Steps: None Known Problems: None Spatial Filters: None

Tests for logical consistency indicate that all row and column positions in the selected latitude/longitude window contain data. Conversion and integration with vector files indicates that all positions are consistent with earth coordinates covering the same area. Attribute files are logically consistent.
Data does not exist for all classes. There are no pixels representing class 16 (Estuarine Forested Wetland), class 23 (Estuarine Aquatic Bed). Class 1 (Unclassified) is intentionally left blank. All pixels have been classified. The NOAA Coastal Change Analysis Program (C-CAP): Guidance for Regional Implementation, NOAA National Marine Fisheries Service Report 123, discusses the interagency effort to develop the land cover classification scheme and defines all categories.

Landsat scenes were geo-referenced by Eros Data Center. Spatial accuracy assessed by MDA Federal is found to be to within 2 pixels accuracy.

There was no terrain correction in the geo-referencing procedure.

MDA Federal
20090428
C-CAP zone 58 2006-Era Land Cover Classification
remote-sensing image

Charleston SC
NOAA's Ocean Service, Coastal Services Center (CSC)

http://www.csc.noaa.gov/landcover

DVD/CD-ROM

20050729
20061020

Date of the Landsat scenes

NOAA CSC

NOAA CSC

This dataset was created by MDA Federal. This classification is based on Landsat TM imagery from the MRLC 2006 database. The study area is zone 58, U.S. South East Region. Pre-processing steps: Each Landsat TM scene was geo-referenced by USGS (United States Geological Survey) EROS Data Center. Then MDA Federal staff verified the scenes for spatial accuracy to within 2 pixels. The data was geo-referenced to Albers Conical Equal Area, with a spheroid of GRS 1980, and Datum of WGS84. The data units is in meters. At-satellite reflectance was performed on each scene and the tasseled cap transformation applied. All of the image data used was Landsat TM 5 or 7. The mosaicked dataset was used for classification. Change Detection: The next step was to determine the areas of change between 2006 and 2001. The change detection algorithm used is the Cross Correlation Analysis process (CCA) developed at MDA Federal. This copyrighted procedure produced 2 Z-score files per scene of likelihood of change. These files were thresholded and mosaicked to create a binary change layer for that scene. All of the binary files were mosaicked to create a change layer for the entire study area. A focal majority was run on the change layer to fill in some clumps to make sure all of the change was accounted for. The change layer is a slight over-estimation of change to make sure to include as much change as detectable. Classification: The classification of the change areas was a mixture of automated and manual approaches. The change areas were removed from the 2001 classification. The areas with no change between 2006 and 2001 were used as training for a Classification and Regression tree (CART) analysis of the changed areas. Modelling and hand-editing were used to further refine the CART output and create a final classification. The classified change areas were overlaid on the 2001 C-CAP product to create a 2006 C-CAP classification. Attributes for this product are as follows: 0 Background 1 Unclassified (Cloud, Shadow, etc) 2 High Intensity Developed 3 Medium Intensity Developed 4 Low Intensity Developed 5 Open Space Developed 6 Cultivated Land 7 Pasture/Hay 8 Grassland 9 Deciduous Forest 10 Evergreen Forest 11 Mixed Forest 12 Scrub/Shrub 13 Palustrine Forested Wetland 14 Palustrine Scrub/Shrub Wetland 15 Palustrine Emergent Wetland 16 Estuarine Forested Wetland 17 Estuarine Scrub/Shrub Wetland 18 Estuarine Emergent Wetland 19 Unconsolidated Shore 20 Bare Land 21 Water 22 Palustrine Aquatic Bed 23 Estuarine Aquatic Bed 24 Tundra 25 Snow/Ice
20090428

CRS (Coastal Remote Sensing) Program Manager
NOAA Coastal Services Center Coastal Change Analysis Program (C-CAP)

CRS Program Manager

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2234 S. Hobson Ave.
Charleston
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29405
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843-740-1224
clearinghouse@csc.noaa.gov
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Classification

Unknown

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843-740-1210
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csc@csc.noaa.gov
Monday to Friday, 8 a.m. to 5 p.m., Eastern Standard Time

Metadata imported.
C:\DOCUME~1\jwderry\Local Settings\Temp\xml228.tmp
20100928
13165800

Raster

Grid Cell
1950
1738
28.446490
28.446490
8
1
Upper Left
TRUE
Default
1
matrix coded
TRUE
GRID

row and column

28.446490

28.446490

meters

Albers Conical Equal Area

29.500000
45.500000
-96.000000
23.000000
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North American Datum of 1983
Geodetic Reference System 80
6378137.000000
298.257222

GCS_North_American_1983
NAD_1983_Albers

nlcd.vat
C-CAP zone 58 (U.S. South East Region) as delineated by NOAA using scene boundaries, hydrological units, and county boundaries
unknown
Table
16

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Rowid
OID
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Internal feature number.
ESRI

Sequential unique whole numbers that are automatically generated.

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VALUE
Integer
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0
0

COUNT
COUNT
Integer
4
0
0

RED
RED
Double
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0
0

GREEN
GREEN
Double
8
0
0

BLUE
BLUE
Double
8
0
0

CLASS_NAMES
CLASS_NAMES
String
32
0
0

OPACITY
OPACITY
Double
8
0
0

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clearinghouse@csc.noaa.gov
Monday-Friday, 8-5 EST

Downloadable Data
Users must assume responsibility to determine the usability of these data.

ERDAS Imagine image file (.img)
1.658
1.658

CD-ROM
ISO 9660
ISO 9660 format allows the CD-ROM to be read by most computer operating systems.

none

20120601
20090706

NOAA Coastal Services Center
Metadata Specialist

Metadata Specialist

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FGDC Content Standards for Digital Geospatial Metadata
FGDC-STD-001-1998
en
local time

http://www.esri.com/metadata/esriprof80.html
ESRI Metadata Profile

{9F775F09-2616-4A4F-B28D-F44F40FF97E7}
20100928
13165800
FALSE
20120601
11093900
20120601
11093900

Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 3; ESRI ArcCatalog 9.3.1.3000

nlcd

1624531.712206
1673971.712206
1538916.520257
1483445.86433
1

-77.940478
-77.28479
35.502951
34.931581

1

ISO 19115 Geographic Information - Metadata
DIS_ESRI1.0

dataset

file://\\rd17.ad.urscorp.com\rduprojects\Jobs3\31826742_Kinston Bypass\GIS\Shapefiles\CGIA_Data\GIS_Data_CGIA_Original_20101020\nlcd
Local Area Network
002

1.658

Raster Dataset

NAD_1983_Albers

2

1

1738

28.44649

Meter

1 Meter = 1 Meter(s)

1950

28.44649

Meter
1 Meter = 1 Meter(s)

20120601

2011 NLCD Land Cover Metadata

NLCD 2011 Land Cover (2011 Edition, amended 2014) - National Geospatial Data Asset (NGDA) Land Use Land Cover

Metadata also available as - [Questions & Answers] - [Parseable text] - [XML]

Metadata:

Identification_Information:

Citation:
Citation_Information:
Originator: U.S. Geological Survey
Publication_Date: 20141010
Title:
NLCD 2011 Land Cover (2011 Edition, amended 2014) - National Geospatial Data Asset (NGDA) Land Use Land Cover
Edition: 2011
Geospatial_Data_Presentation_Form: remote-sensing image
Series_Information:
Series_Name: None
Issue_Identification: None
Publication_Information:
Publication_Place: Sioux Falls, SD
Publisher: U.S. Geological Survey
Other_Citation_Details:
References: (1) Jin, S., Yang, L., Danielson, P., Homer, C., Fry, J., and Xian, G. 2013. A comprehensive change detection method for updating the National Land Cover Database to circa 2011. Remote Sensing of Environment, 132: 159 – 175. (2) Xian, G., Homer, C., Dewitz, J., Fry, J., Hossain, N., and Wickham, J., 2011. The change of impervious surface area between 2001 and 2006 in the conterminous United States. Photogrammetric Engineering and Remote Sensing, Vol. 77(8): 758-762. (3) Coulston, J. W., Moisen, G. G., Wilson, B. T., Finco, M. V., Cohen, W. B., and Brewer, C. K. 2012. Modeling percent tree canopy cover: a pilot study. Photogrammetric Engineering & Remote Sensing 78(7): 715-727. The USGS acknowledges the support of USGS and contractor NLCD 2011 Land Cover Mapping Teams in development of data for this map.
Online_Linkage: http://www.mrlc.gov
Description:
Abstract:
The National Land Cover Database products are created through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) Consortium. The MRLC Consortium is a partnership of Federal agencies (www.mrlc.gov), consisting of the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture - Forest Service (USDA-FS), the National Park Service (NPS), the U.S. Fish and Wildlife Service (USFWS), the Bureau of Land Management (BLM) and the USDA Natural Resources Conservation Service (NRCS). The success of NLCD over nearly two decades is credited to the continuing collaborative spirit of the agencies that make up the MRLC. NLCD 2011 is the most up-to-date iteration of the National Land Cover Database, the definitive Landsat-based, 30-meter resolution land cover database for the Nation. The data in NLCD 2011 are completely integrated with NLCD 2001 (2011 Edition, amended 2014) and NLCD 2006 (2011 Edition, amended 2014).
For NLCD 2011, there are 5 primary data products: 1) NLCD 2011 Land Cover 2) NLCD 2006/2011 Land Cover Change Pixels labeled with the 2011 land cover class 3) NLCD 2011 Percent Developed Imperviousness 4) NLCD 2006/2011 Percent Developed Imperviousness Change Pixels 5) NLCD 2011 Tree Canopy Cover provided by an MRLC partner - the USDA Forest Service Remote Sensing Applications Center.
In addition, ancillary metadata includes the NLCD 2011 Path/Row Index shapefile showing the footprint of Landsat scenes and change analysis pairs used to derive 2006/2011 spectral change. All Landsat scene acquisition dates are included in the shapefile's attribute table. As part of the NLCD 2011 project, NLCD 2001 and 2006 land cover and impervious data products were revised and reissued (2011 Edition, amended 2014) to provide full compatibility with the new NLCD 2011 products. The 2014 amended version corrects for the over-elimination of small areas of the four developed classes.
NLCD Tree Canopy Cover was created using MRLC mapping zones from NLCD 2001 (see Tree Canopy Cover metadata for

additional detail). All other NLCD 2011 products were created on a path/row basis and mosaicked to create a seamless national product. Questions about the NLCD 2011 land cover product can be directed to the NLCD 2011 land cover mapping team at the USGS/EROS, Sioux Falls, SD (605) 594-6151 or mrlc@usgs.gov.
Purpose:
The goal of this project is to provide the Nation with complete, current, and consistent public domain information on its land use and land cover.
Supplemental_Information:
Corner Coordinates (center of pixel, projection meters) Upper Left Corner: -2493045 meters(X), 3310005 meters(Y) Lower Right Corner: -177285 meters(X), 2342655 meters(Y)
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 20040409
Ending_Date: 20111111
Currentness_Reference: ground condition
Status:
Progress: In work
Maintenance_and_Update_Frequency: Every 5 years
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -130.232828
East_Bounding_Coordinate: -63.672192
North_Bounding_Coordinate: 52.877264
South_Bounding_Coordinate: 21.742308
Keywords:
Theme:
Theme_Keyword_Thesaurus: NGDA Portfolio Themes
Theme_Keyword: NGDA
Theme_Keyword: National Geospatial Data Asset
Theme_Keyword: Land Use Land Cover Theme
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Land cover
Theme_Keyword: Image processing
Theme_Keyword: GIS
Theme_Keyword: U.S. Geological Survey (USGS)
Theme_Keyword: digital spatial data
Theme:
Theme_Keyword_Thesaurus: ISO 19115 Category
Theme_Keyword: ImageryBaseMapEarthCover
Theme_Keyword: 010
Theme:
Theme_Keyword_Thesaurus:
U.S. Department of Commerce, 1995, (Countries, dependencies, areas of special sovereignty, and their principal administrative divisions, Federal Information Processing Standard 10-4): Washington, D.C., National Institute of Standards and Technology
Theme_Keyword: United States
Theme_Keyword: U.S.
Theme_Keyword: US
Access_Constraints: None
Use_Constraints: None
Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey
Contact_Position: Customer Services Representative
Contact_Address:
Address_Type: mailing and physical address
Address: USGS EROS
Address: 47914 252nd Street
City: Sioux Falls
State_or_Province: SD

Postal_Code: 57198-0001
Country: USA
Contact_Voice_Telephone: 605/594-6151
Contact_Facsimile_Telephone: 605/594-6589
Contact_Electronic_Mail_Address: custserv@usgs.gov
Hours_of_Service: 0800 - 1600 CT, M - F (-6h CST/-5h CDT GMT)
Contact_Instructions:
The USGS point of contact is for questions relating to the data display and download from this web site. For questions regarding data content and quality, refer to: http://www.mrlc.gov/mrlc2k.asp or email: mrlc@usgs.gov
Data_Set_Credit: U.S. Geological Survey
Security_Information:
Security_Classification_System: None
Security_Classification: Unclassified
Security_Handling_Description: N/A
Native_Data_Set_Environment:
Microsoft Windows 7 Version 6.1 (Build 7601: Service Pack 1); ESRI ArcCatalog 9.3.1.4000 (Service Pack 2)

Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report:
A formal accuracy assessment has not been conducted for NLCD 2011 Land Cover, 2006-2011 Land Cover Change, NLCD 2011 Percent Developed Imperviousness or 2006-2011 Percent Developed Imperviousness Change products. For Canopy attribute accuracy, refer to Canopy metadata.
Quantitative_Attribute_Accuracy_Assessment:
Attribute_Accuracy_Value: Unknown
Attribute_Accuracy_Explanation:
This document and the described land cover map are considered "provisional" until a formal accuracy assessment is completed. The U.S. Geological Survey can make no guarantee as to the accuracy or completeness of this information, and it is provided with the understanding that it is not guaranteed to be correct or complete. Conclusions drawn from this information are the responsibility of the user.
Logical_Consistency_Report:
The NLCD 2011 final seamless products include: 1) NLCD 2011 Land Cover; 2) NLCD 2011 Percent Developed Imperviousness; 3) NLCD 2006/2011 Change Pixels labeled with the 2011 land cover class; 4) NLCD 2006/2011 Percent Developed Imperviousness Change; and 5)NLCD 2011 Tree Canopy Cover.
Completeness_Report: This NLCD product is the version dated October 10, 2014.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: N/A
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report: N/A
Lineage:
Process_Step:
Process_Description:
Landsat image selection and preprocessing: For NLCD 2011 change analysis, two 2-date pairs of Landsat scenes were selected for each path/row to represent ground conditions in circa 2006 and 2011. One additional circa 2011 scene was selected to enhance modeling results for land cover labeling. In selecting the 5 scenes, the temporal range of the imagery was restricted to reduce the impact of seasonal and phenological variation. A pre-processing step was performed to convert the digital number to top of atmosphere reflectance using procedures similar to those established for the NLCD 2001 mapping effort (Homer et al., 2004). Reflectance derivatives, including a tasseled-cap transformation and a 3-ratio index, were generated for each scene to use in the modeling process as independent variables. Where present, clouds and cloud shadows were digitized and masked.
NLCD 2011 Percent Developed Imperviousness and Percent Developed Imperviousness Change Analysis: Because the four NLCD developed classes are derived from a percent imperviousness mapping product, an overview of steps required to update the NLCD 2001 imperviousness to reflect urban growth captured in 2006 era Landsat imagery is provided here (Xian et al., 2010). These same procedures were employed to produce NLCD 2011 Percent Developed Imperviousness and 2006-2011 Percent Developed Imperviousness Change.
First, 2009 nighttime lights imagery from the NOAA Defense Meteorological Satellite Program (DMSP) was imposed on the NLCD 2006 impervious surface product to exclude low density imperviousness outside urban and suburban centers so that only imperviousness in urban core areas would be used in the training dataset. Two training datasets, one having a relatively larger urban extent and one having a smaller extent, were produced through imposing two different thresholds on city light imagery.
Second, each of the two training datasets combined with 2006 Landsat imagery was separately applied using a regression tree

(RT) algorithm to build up RT models. Two sets of RT models were then used to estimate percent imperviousness and to produce two 2006 synthetic impervious surfaces. Similarly, the same two training datasets were used with 2011 Landsat imagery to create two sets of RT models that produce two 2011 synthetic impervious surfaces.

Third, the 2006 and 2011 synthetic impervious surface pairs were compared using both 2006 impervious surface products to retain 2006 impervious surface area (ISA) in the unchanged areas. The 2009 DMSP nighttime lights imagery was then employed to ensure that non-imperviousness areas were not included and that new impervious surfaces emerged in the city light extent. After this step, two 2011 intermediate impervious surfaces were produced. Finally, the two intermediate products and 2006 imperviousness were compared to remove false estimates in non-urban areas and generate a 2011 impervious surface estimate. Imperviousness threshold values used to derive the NLCD developed classes are: (Class 21) developed open space (imperviousness < 20%), (Class 22) low-intensity developed (imperviousness from 20 - 49%), (Class 23) medium intensity developed (imperviousness from 50 -79%), and (Class 24) high-intensity developed (imperviousness > 79%).

To improve NLCD imperviousness the 2011 project included a process to reduce omission and commission error in NLCD 2001, 2006, and 2011 products. This activity was completed for urban areas in most of the eastern ½ of the conterminous United States. High resolution (one-meter ground sample distance) National Aerial Imagery Program (NAIP - http//fsa.usda.gov/FSA/) imagery was used to verify imperviousness. Using hand-edits, imperviousness was removed from areas incorrectly identified as developed and added to areas where developed land cover was missed. A modeling process was implemented to add missed imperviousness changes to the correct era and to fill areas where developed was removed with an appropriate non-developed land cover class. These improvements were incorporated with the derived developed classes in all areas of imperviousness and land cover versions released with NLCD 2011 editions. Revised products, NLCD 2001 and NLCD 2006 Impervious (2011 Editions) and NLCD 2001-2006 Impervious Change Pixels (2011 Edition) are included as part of the NLCD 2011 product release.

Land Cover Change Analysis: For the NLCD 2011 Land Cover Update, a variation of the Multi-Index Integrated Change Analysis (MIICA) used in NLCD 2006 spectral change analysis was refined to capture land cover disturbance and potential land cover change patterns for updating the National Land Cover Database 2011 (Jin et al. 2013). Four indices were integrated into one model to more accurately detect true spectral changes between two time periods. Within the model, normalized burn ratio (NBR), change vector (CV, Xian et al., 2009), relative change vector (RCV), and normalized difference vegetation index (NDVI) are calculated separately for the early date (circa 2006) and late date (circa 2011) scenes. The four pairs of indices for the two dates are differenced and then evaluated in a final model conditional statement that categorizes each pixel as either biomass increase, biomass decrease, or no change. For NLCD 2011, two image pairs of circa 2006 and circa 2011, ideally one leaf-on pair and one leaf-off pair are used interactively in each path/row. The integrated change result is clumped and sieved to produce a refined change/no-change mask used to identify potential change pixels that are then labeled with the NLCD 2011 class.

NLCD 2011 Land Cover Classification: Land cover mapping protocols used during NLCD 2011 processing are similar to those used to label the NLCD 2001 product (Homer et al., 2004), but applied on a path/row basis instead of multiple path/row MRLC zones (Xian et al., 2009). Classification was achieved using decision tree modeling that employed a combination of Landsat imagery, reflectance derivatives, and ancillary data (independent variables) with training data points (dependent variable) collected from a refined version of the NLCD 2006 land cover product. Training points were randomly sampled and limited to those areas that were determined to be unchanged between 2006 and 2011 during the MIICA spectral change analysis process. Training data for pixels changed to developed land cover were not collected since the four classes in urban and sub-urban areas were mapped separately using a regression tree modeling method (described in the Imperviousness Change Analysis process steps above). Post classification modeling and hand-editing were used to further refine the decision tree output. Following classification, the 2011 land cover was masked with the change/no-change result (captured during the MIICA change analysis modeling) to extract a label for spectrally changed pixels. Labeled change pixels were then compared to the NLCD 2006 land cover base to exclude those pixels identified as spectral change, but classified with the same label as the corresponding 2006 pixel.

NLCD 2011 percent developed impervious pixels, identified as changed, were extracted to NLCD developed class codes using NLCD 2011 legend thresholds for developed classes and added to the change pixel map. This intermediate change pixel product was generalized using the NLCD Smart Eliminate tool with the following minimum mapping units (mmu) applied: 1 acre (approximately 5 ETM+ 30 m pixel patch) for developed classes (class codes 21, 22, 23, and 24); 7.12 acres (approximately 32 ETM+ pixel patch) for agricultural classes (class codes 81 and 82); and 2.67 acres (approximately 12 ETM+ pixel patch) for all other classes (class codes 11, 12, 31, 41, 42, 43, 52, 71, 90, and 95). The smart eliminate aggregation program subsumes pixels from the single pixel level to the mmu pixel patch using a queens algorithm at doubling intervals. The algorithm consults a weighting matrix to guide merging of cover types by similarity, resulting in a product that preserves land cover logic as much as possible. During the NLCD 2011 analysis and modeling process, inconsistencies in the NLCD 2001 and 2006 land cover products were corrected with the revised products, NLCD 2001 and NLCD 2006 Land Cover (2011 Editions), included as part of the NLCD 2011 product release.

NLCD 2011 Land Cover (Final Product): Additional processing steps were implemented to create the final NLCD 2011 land cover map. Individual path/row change pixel results were assembled to form an intermediate seamless national product. This seamless change pixel map was reviewed and edited to remove regional inconsistencies. Refined NLCD 2011 change pixels were then combined with the re-issued NLCD 2006 Land Cover Version (2011 Edition), and the resulting image was smart-eliminated to a 5-pixel mmu. This final step eliminated single pixels and patches less than 5 pixels in extent that appeared as a result of combining the separate images.

NLCD 2011 Change Pixels (Final Product): A comparison of the NLCD 2006 (2011 Edition) base and the NLCD 2011 Land Cover was necessary to extract a final version of the NLCD 2011 Change Pixels. In a model, pixels that were labeled with the same land cover class code were removed and only those pixels that did not agree in the two classifications were retained as final NLCD 2011 Change Pixels.
NLCD 2006/2011 Percent Developed Imperviousness Change: The NLCD 2006 Percent Developed Imperviousness (2011 Edition)and the NLCD 2011 Percent Developed Imperviousness were compared in a model to provide the user community with a layer that depicts imperviousness change between 2006 and 2011. Landsat data and ancillary data used for the land cover prediction - For a list of Landsat scene dates by path/row used in this project, please see: appendix3_nlcd2011_scene_list_by_path_row.txt Data Type of DEM composed of 1 band of Continuous Variable Type. Data Type of Slope composed of 1 band of Continuous Variable Type. Data Type of Aspect composed of 1 band of Categorical Variable Type. Data type of Position Index composed of 1 band of Continuous Variable Type. Data type of 3-ratio index composed of 3 bands of Continuous Variable Type.
Source_Used_Citation_Abbreviation: Landsat ETM, Landsat TM, DEM, USGS/EROS
Process_Date: Unknown
Source_Produced_Citation_Abbreviation: USGS National Land Cover Database
Process_Step:
Process_Description:
Process Step for NLCD 2011 (amended 2014): The release in 2014 of amended versions of land cover for 2001, 2006, and 2011 was made to correct for unintended differences between the impervious dataset and the four land cover developed classes (Open Space, Low Intensity, Medium Intensity, and High Intensity). NLCD developed classes are tied directly to the impervious product values. However, the land cover product Minimum Mapping Unit (MMU) is five pixels whereas the impervious product MMU is single pixel. This MMU difference creates problems when the impervious single pixel MMU product is directly crosswalked into the 5-pixel MMU land cover developed classes. The smoothing process, which generalizes the land cover product to a 5-pixel MMU, can create small areas which are no longer directly represented in the imperviousness product because they are artifacts of the smoothing. Since these changes are not real and not present in the impervious layer, the new version removes these artifacts and re-establishes the direct linkage between the imperviousness and land cover products for any developed area. Combined developed areas (all developed classes combined into a group) in the land cover product must still meet the 5-pixel MMU threshold; however, the four NLCD land cover individual developed classes within the group patch are now represented by a single pixel MMU to retain the direct linkage to the imperviousness product.
Process_Date: Unknown

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Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
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Vertical_Count: 1

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Latitude_of_Projection_Origin: 23.000000
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False_Northing: 0.000000
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Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 30.000000
Ordinate_Resolution: 30.000000
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000

Denominator_of_Flattening_Ratio: 298.257222

Entity_and_Attribute_Information:
Detailed_Description:
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Entity_Type_Definition_Source: National Land Cover Database
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Attribute_Definition_Source: ESRI
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Attribute:
Attribute_Label: Count
Attribute_Definition:
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Attribute_Label: Value
Attribute_Definition: Land Cover Class Code Value.
Attribute_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 11
Enumerated_Domain_Value_Definition:
Open Water - All areas of open water, generally with less than 25% cover or vegetation or soil
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 12
Enumerated_Domain_Value_Definition:
Perennial Ice/Snow - All areas characterized by a perennial cover of ice and/or snow, generally greater than 25% of total cover.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
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Enumerated_Domain_Value: 21
Enumerated_Domain_Value_Definition:
Developed, Open Space - Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 22
Enumerated_Domain_Value_Definition:
Developed, Low Intensity -Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 23
Enumerated_Domain_Value_Definition:
Developed, Medium Intensity - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.

Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 24
Enumerated_Domain_Value_Definition:
Developed, High Intensity - Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to 100 percent of the total cover.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 31
Enumerated_Domain_Value_Definition:
Barren Land (Rock/Sand/Clay) - Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 41
Enumerated_Domain_Value_Definition:
Deciduous Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 42
Enumerated_Domain_Value_Definition:
Evergreen Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 43
Enumerated_Domain_Value_Definition:
Mixed Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 51
Enumerated_Domain_Value_Definition:
Dwarf Scrub - Alaska only areas dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20% of total vegetation. This type is often co-associated with grasses, sedges, herbs, and non-vascular vegetation.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 52
Enumerated_Domain_Value_Definition:
Shrub/Scrub - Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 71
Enumerated_Domain_Value_Definition:
Grassland/Herbaceous - Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:

Enumerated_Domain_Value: 72
Enumerated_Domain_Value_Definition:
Sedge/Herbaceous - Alaska only areas dominated by sedges and forbs, generally greater than 80% of total vegetation. This type can occur with significant other grasses or other grass like plants, and includes sedge tundra, and sedge tussock tundra.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 73
Enumerated_Domain_Value_Definition:
Lichens - Alaska only areas dominated by fruticose or foliose lichens generally greater than 80% of total vegetation.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 74
Enumerated_Domain_Value_Definition:
Moss - Alaska only areas dominated by mosses, generally greater than 80% of total vegetation.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 81
Enumerated_Domain_Value_Definition:
Pasture/Hay - Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 82
Enumerated_Domain_Value_Definition:
Cultivated Crops - Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 90
Enumerated_Domain_Value_Definition:
Woody Wetlands - Areas where forest or shrub land vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute_Domain_Values:
Enumerated_Domain:
Enumerated_Domain_Value: 95
Enumerated_Domain_Value_Definition:
Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
Enumerated_Domain_Value_Definition_Source: NLCD Legend Land Cover Class Descriptions
Attribute:
Attribute_Label: Red
Attribute_Definition:
Red color code for RGB. The value is arbitrarily assigned by the display software package, unless defined by user.
Attribute_Definition_Source: NLCD
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 100
Attribute_Units_of_Measure: Percentage
Attribute_Measurement_Resolution: 0.1
Attribute:
Attribute_Label: Green
Attribute_Definition:
Green color code for RGB. The value is arbitrarily assigned by the display software package, unless defined by user.
Attribute_Definition_Source: NLCD

Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 100
Attribute_Units_of_Measure: Percentage
Attribute_Measurement_Resolution: 0.1
Attribute:
Attribute_Label: Blue
Attribute_Definition:
Blue color code for RGB. The value is arbitrarily assigned by the display software package, unless defined by user.
Attribute_Definition_Source: NLCD
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 100
Attribute_Units_of_Measure: Percentage
Attribute_Measurement_Resolution: 0.1
Attribute:
Attribute_Label: Opacity
Attribute_Definition:
A measure of how opaque, or solid, a color is displayed in a layer.
Attribute_Definition_Source: NLCD
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 100
Attribute_Units_of_Measure: Percentage
Attribute_Measurement_Resolution: 0.1
Overview_Description:
Entity_and_Attribute_Overview: Land Cover Class RGB Color Value Table
Entity_and_Attribute_Detail_Citation:
Attributes defined by USGS and ESRI. Value Red Green Blue 0 0.00000000000 0.00000000000 0.00000000000 11 0.27843137255 0.41960784314 0.62745098039 12 0.81960784314 0.86666666667 0.97647058824 21 0.86666666667 0.78823529412 0.78823529412 22 0.84705882353 0.57647058824 0.50980392157 23 0.92941176471 0.00000000000 0.00000000000 24 0.66666666667 0.00000000000 0.00000000000 31 0.69803921569 0.67843137255 0.63921568628 41 0.40784313726 0.66666666667 0.38823529412 42 0.10980392157 0.38823529412 0.18823529412 43 0.70980392157 0.78823529412 0.55686274510 51 0.64705882353 0.54901960784 0.18823529412 52 0.80000000000 0.72941176471 0.48627450980 71 0.88627450980 0.88627450980 0.75686274510 72 0.78823529412 0.78823529412 0.46666666667 73 0.60000000000 0.75686274510 0.27843137255 74 0.46666666667 0.67843137255 0.57647058824 81 0.85882352941 0.84705882353 0.23921568628 82 0.66666666667 0.43921568628 0.15686274510 90 0.72941176471 0.84705882353 0.91764705882 95 0.43921568628 0.63921568628 0.72941176471
Overview_Description:
Entity_and_Attribute_Overview: N/A
Entity_and_Attribute_Detail_Citation:
Attribute accuracy is described, where present, with each attribute defined in the Entity and Attribute Section.

Distribution_Information:
Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey
Contact_Position: Customer Service Representative
Contact_Address:
Address_Type: mailing and physical address
Address: USGS EROS
Address: 47914 252nd Street
City: Sioux Falls
State_or_Province: SD
Postal_Code: 57198-0001
Country: USA
Contact_Voice_Telephone: 605/594-6151
Contact_TDD/TTY_Telephone: 605/594-6933

Contact_Facsimile_Telephone: 605/594-6589
Contact_Electronic_Mail_Address: custserv@usgs.gov
Hours_of_Service: 0800 - 1600 CT, M - F (-6h CST/-5h CDT GMT)
Contact_Instructions:
The USGS point of contact is for questions relating to the data display and download from this web site. Questions about the NLCD 2011 Land Cover (2011 Edition, amended 2014) can be directed to the NLCD 2001 land cover mapping team at USGS EROS, Sioux Falls, SD (605) 594-6151 or mrlc@usgs.gov.
Resource_Description: Downloadable data
Distribution_Liability:
Although these data have been processed successfully on a computer system at the USGS, no warranty expressed or implied is made by the USGS regarding the use of the data on any other system, nor does the act of distribution constitute any such warranty. Data may have been compiled from various outside sources. Spatial information may not meet National Map Accuracy Standards. This information may be updated without notification. The USGS shall not be liable for any activity involving these data, installation, fitness of the data for a particular purpose, its use, or analyses results.
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: ERDAS
Format_Version_Number: Imagine 9.3
Format_Specification: .img
Transfer_Size: 1032
Digital_Transfer_Option:
Online_Option:
Computer_Contact_Information:
Network_Address:
Network_Resource_Name: http://www.mrlc.gov
Access_Instructions:
The URL http://www.mrlc.gov provides a download interface that allows for data downloads. The download page allows the customer to download a zipped file that can be saved on the customer's computer. The file can then be unzipped and imported into various user software applications.
Online_Computer_and_Operating_System: Not available for dissemination
Fees: None
Ordering_Instructions: Contact Customer Services
Turnaround: Variable
Custom_Order_Process: Contact Customer Services Representative
Technical_Prerequisites:
ESRI ArcMap Suite and/or Arc/Info software, and supporting operating systems.

Metadata_Reference_Information:
Metadata_Date: 20141205
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey
Contact_Person: Customer Service Representative
Contact_Position: Customer Services Representative
Contact_Address:
Address_Type: mailing and physical address
Address: USGS EROS
Address: 47914 252nd Street
City: Sioux Falls
State_or_Province: SD
Postal_Code: 57198-0001
Country: USA
Contact_Voice_Telephone: 605/594-6151
Contact_TDD/TTY_Telephone: 605/594-6933
Contact_Facsimile_Telephone: 605/594-6589
Contact_Electronic_Mail_Address: custserv@usgs.gov
Hours_of_Service: 0800 - 1600 CT, M - F (-6h CST/-5h CDT GMT)
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Time_Convention: local time

NRCS Lenoir County Soils Metadata

```
Identification_Information:
  Citation:
    Citation_Information:
      Originator:
        U.S. Department of Agriculture, Natural Resources
        Conservation Service
      Publication_Date: 20070807
      Title:
        Soil Survey Geographic (SSURGO) database for Lenoir
        County, North Carolina
      Publication_Information:
        Publication_Place: Fort Worth, Texas
        Publisher:
          U.S. Department of Agriculture, Natural Resources
          Conservation Service
      Other_Citation_Details: nc107
      Online_Linkage: URL:http://SoilDataMart.nrcs.usda.gov/
  Description:
    Abstract:
      This data set is a digital soil survey and generally is the most
      detailed level of soil geographic data developed by the National
      Cooperative Soil Survey. The information was prepared by digitizing
      maps, by compiling information onto a planimetric correct base
      and digitizing, or by revising digitized maps using remotely
      sensed and other information.

      This data set consists of georeferenced digital map data and
      computerized attribute data. The map data are in a soil survey area
      extent format and include a detailed, field verified inventory
      of soils and miscellaneous areas that normally occur in a repeatable
      pattern on the landscape and that can be cartographically shown at
      the scale mapped. A special soil features layer (point and line
      features) is optional. This layer displays the location of features
      too small to delineate at the mapping scale, but they are large
      enough and contrasting enough to significantly influence use and
      management. The soil map units are linked to attributes in the
      National Soil Information System relational database, which gives
      the proportionate extent of the component soils and their properties.
    Purpose:
      SSURGO depicts information about the kinds and distribution of
      soils on the landscape. The soil map and data used in the SSURGO
      product were prepared by soil scientists as part of the National
      Cooperative Soil Survey.
    Supplemental_Information:
      Digital versions of hydrography, cultural features, and other
      associated layers that are not part of the SSURGO data set may be
      available from the primary organization listed in the Point of
      Contact.
  Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 20060906
        Ending_Date: 20070807
    Currentness_Reference: publication date
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: As needed
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -77.834
      East_Bounding_Coordinate: -77.391
      North_Bounding_Coordinate: 35.427
      South_Bounding_Coordinate: 35.008
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: soil survey
      Theme_Keyword: soils
      Theme_Keyword: Soil Survey Geographic
      Theme_Keyword: SSURGO
    Place:
      Place_Keyword_Thesaurus: USGS Geographic Names Information System (GNIS)
```

Place_Keyword: North Carolina
Place_Keyword: Lenoir County
Place_Keyword: Ayden Quadrangle
Place_Keyword: Hookerton Quadrangle
Place_Keyword: Snow Hill Quadrangle
Place_Keyword: Grifton Quadrangle
Place_Keyword: Kinston Quadrangle
Place_Keyword: Falling Creek Quadrangle
Place_Keyword: La Grange Quadrangle
Place_Keyword: Dover Quadrangle
Place_Keyword: Rivermont Quadrangle
Place_Keyword: Deep Run Quadrangle
Place_Keyword: Seven Springs Quadrangle
Place_Keyword: Comfort Quadrangle
Place_Keyword: Pink Hill Quadrangle
Place_Keyword: Albertson Quadrangle
Access_Constraints: None
Use_Constraints:
The U.S. Department of Agriculture, Natural Resources Conservation Service, should be acknowledged as the data source in products derived from these data.

This data set is not designed for use as a primary regulatory tool in permitting or citing decisions, but may be used as a reference source. This is public information and may be interpreted by organizations, agencies, units of government, or others based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions that they make. The Natural Resources Conservation Service will not perform any evaluations of these maps for purposes related solely to State or local regulatory programs.

Photographic or digital enlargement of these maps to scales greater than at which they were originally mapped can cause misinterpretation of the data. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale. The depicted soil boundaries, interpretations, and analysis derived from them do not eliminate the need for onsite sampling, testing, and detailed study of specific sites for intensive uses. Thus, these data and their interpretations are intended for planning purposes only. Digital data files are periodically updated. Files are dated, and users are responsible for obtaining the latest version of the data.
Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Department of Agriculture, Natural Resources Conservation Service
Contact_Position: State Soil Scientist
Contact_Address:
Address_Type: mailing address
Address: USDA - Natural Resources Conservation Service
Address: North Carolina State Office
Address: 4407 Bland Road, Room 117
City: Raleigh
State_or_Province: NC
Postal_Code: 27609
Contact_Voice_Telephone: 919-873-2141
Contact_TDD/TTY_Telephone: 800-877-8339
Contact_Facsimile_Telephone: 919-873-2157
Contact_Electronic_Mail_Address: roy.vick@nc.usda.gov
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report:
Attribute accuracy is tested by manual comparison of the source with hard copy plots and/or symbolized display of the map data on an interactive computer graphic system. Selected attributes that cannot be visually verified on plots or on screen are interactively queried and verified on screen. In addition, the attributes are tested against a master set of valid attributes. All attribute data conform to the attribute codes in the signed classification and correlation document and amendment(s).

Logical_Consistency_Report:
Certain node/geometry and topology GT- polygon/chain relationships are collected or generated to satisfy topological requirements (the GT-polygon corresponds to the soil delineation). Some of these requirements include: chains must begin and end at nodes, chains must connect to each other at nodes, chains do not extend through nodes, left and right GT-polygons are defined for each chain element and are consistent throughout, and the chains representing the limits of the file are free of gaps. The tests of logical consistency are performed using vendor software. All internal polygons are tested for closure with vendor software and are checked on hard copy plots. All data are checked for common soil lines (i.e., adjacent polygons with the same label). Edge locations generally do not deviate from centerline to centerline by more than 0.01 inch. This soil survey is not edge matched to the Craven County, North Carolina, Greene County, North Carolina, and Jones County, North Carolina, soil surveys.

Completeness_Report:
A map unit is a collection of areas defined and named in terms of their soil components or miscellaneous areas or both. Each map unit differs in some respect from all others in a survey area and each map unit has a symbol that uniquely identifies the map unit on a soil map. Each individual area, point, or line so identified on the map is a delineation.

Soil Scientists identify small areas of soils or miscellaneous areas that have properties and behavior significantly different than the named soils in the surrounding map unit. These minor components may be indicated as special features. If they have a minimal effect on use and management, or could not be precisely located, they may not be indicated on the map.

A map unit has specified kinds of soils or miscellaneous areas (map unit components), each with a designated range in proportionate extent. Map units include one or more kinds of soil or miscellaneous area. Miscellaneous areas are areas that have little or no recognizable soil.

Specific National Cooperative Soil Survey standards and procedures were used in the classification of soils, design and name of map units, and location of special soil features. These standards are outlined in Agricultural Handbook 18, Soil Survey Manual, 1993, USDA, NRCS; Agricultural Handbook 436, Soil Taxonomy, 1995, USDA, NRCS; and all Amendments; Keys to Soil Taxonomy, (current issue) USDA, NRCS; National Soil Survey Handbook, title 430-VI,(current issue) USDA, NRCS.

The actual composition and interpretive purity of the map unit delineations were based on data collected by scientists during the course of preparing the soil maps. Adherence to National Cooperative Soil Survey standards and procedures is based on peer review, quality control, and quality assurance. Quality control is outlined in the memorandum of understanding for the soil survey area and in documents that reside with the Natural Resources Conservation Service state soil scientist. Four kinds of map units are used in soil surveys: consociations, complexes, associations, and undifferentiated groups.

Consociations - Consociations are named for the dominant soil. In a consociation, delineated areas use a single name from the dominant component in the map unit. Dissimilar components are minor in extent. The soil component in a consociation may be identified at any taxonomic level. Soil series is the lowest taxonomic level. A consociation that is named as a miscellaneous area is dominantly that kind of area and minor components do not significantly affect the use of the map unit. The total amount of dissimilar inclusions of other components in a map unit generally does not exceed about 15 percent if limiting and 25 percent if nonlimiting. A single component of a dissimilar limiting inclusion generally does not exceed 10 percent if very contrasting.

Complexes and associations - Complexes and associations consist

of two or more dissimilar components that occur in a regularly repeating pattern. The total amount of other dissimilar components is minor extent. The following arbitrary rule determines whether complex or association is used in the name. The major components of an association can be separated at the scale of mapping. In either case, because the major components are sufficiently different in morphology or behavior, the map unit cannot be called a consociation. In each delineation of a complex or an association, each major component is normally present though their proportions may vary appreciably from one delineation to another. The total amount of inclusions in a map unit that are dissimilar to any of the major components does not exceed 15 percent if limiting and 25 percent if nonlimiting. A single kind of dissimilar limiting inclusion usually does not exceed 10 percent.

Undifferentiated groups - Undifferentiated groups consist of two or more components that are not consistently associated geographically and, therefore, do not always occur together in the same map delineation. These components are included in the same named map unit because their use and management are the same or very similar for common uses. Generally they are grouped together because some common feature, such as steepness, stoniness, or flooding, determines their use and management. If two or more additional map units would serve no useful purpose, they may be included in the same unit. Each delineation has at least one of the major components, and some may have all of them. The same principles regarding the proportion of minor components that apply to consociations also apply to undifferentiated groups. The same principles regarding proportion of inclusion apply to undifferentiated groups as to consociations.

Minimum documentation consists of three complete soil profile descriptions that are collected for each soil added to the legend, one additional per 3,000 acres mapped; three 10 observation transects for each map unit, one additional 10 point transect per 3,000 acres.

A defined standard or level of confidence in the interpretive purity of the map unit delineations is attained by adjusting the kind and intensity of field investigations. Field investigations and data collection are carried out in sufficient detail to name map units and to identify accurately and consistently areas of about 4 acres.

Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:
The accuracy of these digital data is based upon their compilation to base maps that meet National Map Accuracy Standards at a scale of 1 inch equals 1,000 feet. The difference in positional accuracy between the soil boundaries and special soil features locations in the field and their digitized map locations is unknown. The locational accuracy of soil delineations on the ground varies with the transition between map units.

For example, on long gently sloping landscapes the transition occurs gradually over many feet. Where landscapes change abruptly from steep to level, the transition will be very narrow. Soil delineation boundaries and special soil features generally were digitized within 0.01 inch of their locations on the digitizing source. The digital map elements are edge matched between data sets. The data along each quadrangle edge are matched against the data for the adjacent quadrangle. Edge locations generally do not deviate from centerline to centerline by more than 0.01 inch.

Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator:
United States Department of Agriculture,
Soil Conservation Service

```
      Publication_Date: 1977
      Title: Soil Survey of Lenoir County, North Carolina
      Geospatial_Data_Presentation_Form: atlas
      Publication_Information:
        Publication_Place: Washington, D.C.
        Publisher: U.S. Government Printing Office
  Source_Scale_Denominator: 20000
  Type_of_Source_Media: paper
  Source_Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: 1977
    Source_Currentness_Reference: publication date
  Source_Citation_Abbreviation: SCS1
  Source_Contribution: Information about soils and landscape
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator: U.S. Geological Survey
      Publication_Date: 1988
      Title: multiple orthophotographs
      Geospatial_Data_Presentation_Form: remote sensing image
      Publication_Information:
        Publication_Place: Reston, Virginia
        Publisher: U.S. Geological Survey
  Source_Scale_Denominator: 24000
  Type_of_Source_Media: stable base material
  Source_Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 1994
        Ending_Date: 1994
    Source_Currentness_Reference: publication date
  Source_Citation_Abbreviation: USGS1
  Source_Contribution: base for compilation
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator:
        U.S. Department Of Agriculture,
        Natural Resources Conservation Service
      Publication_Date: unpublished material
      Title: annotated overlays
      Geospatial_Data_Presentation_Form: maps
  Source_Scale_Denominator: 24000
  Type_of_Source_Media: stable base material
  Source_Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 1995
        Ending_Date: 1995
    Source_Currentness_Reference: 1995
  Source_Citation_Abbreviation: NRCS1
  Source_Contribution: scanning source
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator:
        U.S. Department of Agriculture,
        Natural Resources Conservation Service
      Publication_Date: 2006
      Title: National Soil Information System (NASIS) data base
      Geospatial_Data_Presentation_Form: tabular digital data
      Publication_Information:
        Publication_Place: Fort Collins, Colorado
        Publisher:
          U.S. Department of Agriculture,
          Natural Resources Conservation Service
  Type_of_Source_Media: database
  Source_Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
```

```
        Beginning_Date: 2006
        Ending_Date: 2006
    Source_Currentness_Reference: publication date
  Source_Citation_Abbreviation: NASIS
  Source_Contribution: attribute (tabular) information
Process_Step:
  Process_Description:
    Lenoir County, North Carolina, had a previously published soil
    survey, 1977, at a 1:20,000 scale. An evaluation was made of
    the survey in 2005. It was determined that the soil map unit
    delineations and map unit components were accurate.
  Source_Used_Citation_Abbreviation: SCS1
  Process_Date: 1994
Process_Step:
  Process_Description:
    Soil map unit delineations and special soil futures were
    manually compiled to 1:24,000 7.5 minute series orthophotoquads
    (1983 North American Datum). Soil delineations, special and ad
    hoc features, cultural features, and hydrographic features were
    manually transferred onto 7 mil stable base overlays. Four
    control points corresponding to four corners of the full 7.5
    minute topographic quadrangle were used for registration
    during the transfer process. Soil scientists and cartographic
    technicians from North Carolina USDA Natural Resources
    Conservation Service performed compilation, transfer and
    quality control.
  Source_Used_Citation_Abbreviation: SCS1, USGS1, NRCS1
  Process_Date: 1995
Process_Step:
  Process_Description:
    The soil map unit delineation overlays, prepared by NRCS
    personnel, were raster scanned.) The data were formatted in
    DLG-3 Optional. Vendor developed software to export the data
    in DLG format. Author error corrections were resolved by state
    staff and indicated on checkplots which were submitted to
    NCCGIA for use in correcting the digital data. Special
    features were manually digitized in Arc/Info by North Carolina
    NRCS staff.
  Source_Used_Citation_Abbreviation: SCS1, USGS1, NRCS1
  Process_Date: 1996
Process_Step:
  Process_Description:
    The National Soil Information System data base was developed by
    Natural Resources Conservation Service soil scientists according
    to national standards.
  Source_Used_Citation_Abbreviation: NASIS
  Process_Date: 2006
Process_Step:
  Process_Description:
    The survey-wide coverages from North Carolina staff were
    imported to ARC/INFO 7.2 by certification staff at the Virginia
    Digitizing Unit. Evaluation macros of October 1998 were applied to
    the data. Map unit labels were compared to the map unit legend
    from the National Soil Information System data base. ARCEDIT was
    used to join to adjacent survey boundaries and verify previous
    adjacent survey joins. The data were forwarded the soil data
    warehouse.
  Source_Used_Citation_Abbreviation: SCS1, USGS1, NRCS1
  Process_Date: 20060906
Process_Step:
  Process_Description:
    The point special feature coverage was edited to change MPI to
    BPI.  Also, BPI points that coincided with Bp map units were
    deleted.  Evaluation macros of October 1998 were applied to
    the data. The data were forwarded the soil data warehouse.
  Source_Used_Citation_Abbreviation: SCS1, USGS1, NRCS1
  Process_Date: 20060908
Process_Step:
  Process_Description:
    The Natural Resources Conservation Service State Soil Scientist or
    delegate verified that the labels on the digitized soil map units
    link to map units in the tabular database, and certified the joined
```

data sets for release to the Soil Data Warehouse. A system assigned version number and date stamp were added and the data were copied to the data warehouse. The tabular data for the map units and components were extracted from the data warehouse and reformatted into the soil data delivery data model, then stored in the Soil Data Mart. The spatial data were copied to the Soil Data Mart without change.
      Source_Used_Citation_Abbreviation: NASIS
      Process_Date: 20060908
    Process_Step:
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        The Natural Resources Conservation Service State Soil Scientist or delegate, generated new rating values for selected interpretations using current interpretation rules from the NASIS database.
      Source_Used_Citation_Abbreviation: NASIS
      Process_Date: 20070119
    Process_Step:
      Process_Description:
        The Natural Resources Conservation Service State Soil Scientist or delegate, upon completion of data quality verification, determined that the tabular data should be released for official use. A selected set of map units and components in the soil survey legend was copied to a staging database, and rating values for selected interpretations were generated. The list of selected interpretations is stored in the database table named sainterp.
      Source_Used_Citation_Abbreviation: NASIS
      Process_Date: 20070807
    Process_Step:
      Process_Description:
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    Process_Step:
      Process_Description: The tabular data were extracted from the data mart without change. The spatial data's coordinate system was transformed to State Plane North Carolina (NAD83, meters) using ESRI ArcObjects 8.3 "ConvertFeatureClass" and exported to an ESRI shapefile.
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      Process_Date: 20101009
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Denominator_of_Flattening_Ratio: 298.257222
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Special Soil Features represent soil, miscellaneous area, or landform features that are too small to be digitized as soil delineations (area features).
Entity_Type_Definition_Source: Agricultural Handbook 18, Soil Survey Manual, 1993, USDA, SCS.
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Attribute_Definition:
Special Soil Features labels represent specific Special Soil Features. These features are identified with a descriptive label. The label is assigned to the point or line assigned to represent the feature on maps.
Attribute_Definition_Source:
Agricultural Handbook 18, Soil Survey Manual, 1993, USDA, SCS; National Soil Survey Handbook, Title 430-VI, part 647 (current issue), USDA, NRCS.
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Codeset_Name:
Classification and Correlation of the Soils of Lenoir County, North Carolina
Codeset_Source:
U.S. Department of Agriculture, Natural Resources Conservation Service
Overview_Description:
Entity_and_Attribute_Overview:
Map Unit Delineations are closed polygons that may be dominated by a single soil or miscellaneous area component plus allowable similar or dissimilar soils, or they can be geographic mixtures of groups of soils or soils and miscellaneous areas.

The map unit symbol uniquely identifies each closed map unit delineation. Each symbol corresponds to a map unit name. The map unit key is used to link to information in the National Soil Information System tables.

Map Unit Delineations are described by the National Soil Information System database. This attribute database gives the proportionate extent of the component soils and the properties for each soil. The database contains both estimated and measured data on the physical and chemical soil properties and soil interpretations for engineering, water management, recreation, agronomic, woodland, range, and wildlife uses of the soil.

The National Soil Information System database contains static metadata. It documents the data structure and includes such information as what tables, columns, indexes, and relationships are defined as well as a variety of attributes of each of these database objects. Attributes include table and column descriptions and detailed domain information.

The National Soil Information System database also contains a distribution metadata. It records the criteria used for selecting map units and components for inclusion in the set of distributed data.

Special features are described in the feature table. It includes an area symbol, feature label, feature name, and feature description for each special and ad hoc feature in the survey area.
Entity_and_Attribute_Detail_Citation:
Soil Taxonomy: A basic system of soil classification for making and interpreting soil surveys. Agricultural Handbook 436, 1999, USDA, SCS.

Keys to Soil Taxonomy (current issue), USDA, SCS.

National Soil Survey Handbook, Title 430-VI, part 647 (current

issue), USDA, NRCS.

Agricultural Handbook 18, Soil Survey Manual, 1993, USDA, SCS.

Distribution_Information:
  Distributor:
    Contact_Information:
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        Contact_Organization:
          U.S. Department of Agriculture, Natural
          Resources Conservation Service, National
          Cartography and Geospatial Center
      Contact_Address:
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        Address: 501 West Felix Street, Building 23, P.O. Box 6567
        City: Fort Worth
        State_or_Province: Texas
        Postal_Code: 76115
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      Contact_TDD/TTY_Telephone: 202 720 2600
      Contact_Facsimile_Telephone: 817 509 3469
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  Distribution_Liability:
    Although these data have been processed successfully on a computer
    system at the U.S. Department of Agriculture, no warranty expressed
    or implied is made by the Agency regarding the utility of the data
    on any other system, nor shall the act of distribution constitute
    any such warranty. The U.S. Department of Agriculture will warrant
    the delivery of this product in computer readable format, and will
    offer appropriate adjustment of credit when the product is determined
    unreadable by correctly adjusted computer input peripherals, or
    when the physical medium is delivered in damaged condition. Request
    for adjustment of credit must be made within 90 days from the date
    of this shipment from the ordering site.

    The U.S. Department of Agriculture, nor any of its agencies are
    liable for misuse of the data, for damage, for transmission of
    viruses, or for computer contamination through the distribution of
    these data sets. The U.S. Department of Agriculture (USDA) prohibits
    discrimination in all its programs and activities on the basis of race,
    color, national origin, sex, religion, age, disability, political
    beliefs, sexual orientation, or marital or family status. (Not all
    prohibited bases apply to all programs.)
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            anonymous FTP. Anticipate a delay between submission of request
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            address is required for receipt of instructions on retrieval via
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            Select desired survey area at above Internet Web site. An email
            address is required for receipt of instructions on retrieval via
            anonymous FTP. Anticipate a delay between submission of request
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            anonymous FTP. Anticipate a delay between submission of request
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      There is currently no direct charge for requesting data or for
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      Visit the above mentioned Internet Web Site, select state or
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      ESRI ArcGIS (ArcView,ArcInfo) shapefile, coverage and interchange
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      delimited, ASCII file format.
    Turnaround: Typically within four hours
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  Metadata_Contact:
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Conservation Service
      Contact_Position: State Soil Scientist
      Contact_Address:
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        Address: USDA - Natural Resources Conservation Service
        Address: North Carolina State Office
        Address: 4407 Bland Road, Room 117
        City: Raleigh
        State_or_Province: NC
        Postal_Code: 27609
      Contact_Voice_Telephone: 919-873-2141
      Contact_TDD/TTY_Telephone: 800-877-8339
      Contact_Facsimile_Telephone: 919-873-2157
      Contact_Electronic_Mail_Address: roy.vick@nc.usda.gov
  Metadata_Standard_Name: Content Standard for Digital Geospatial Metadata
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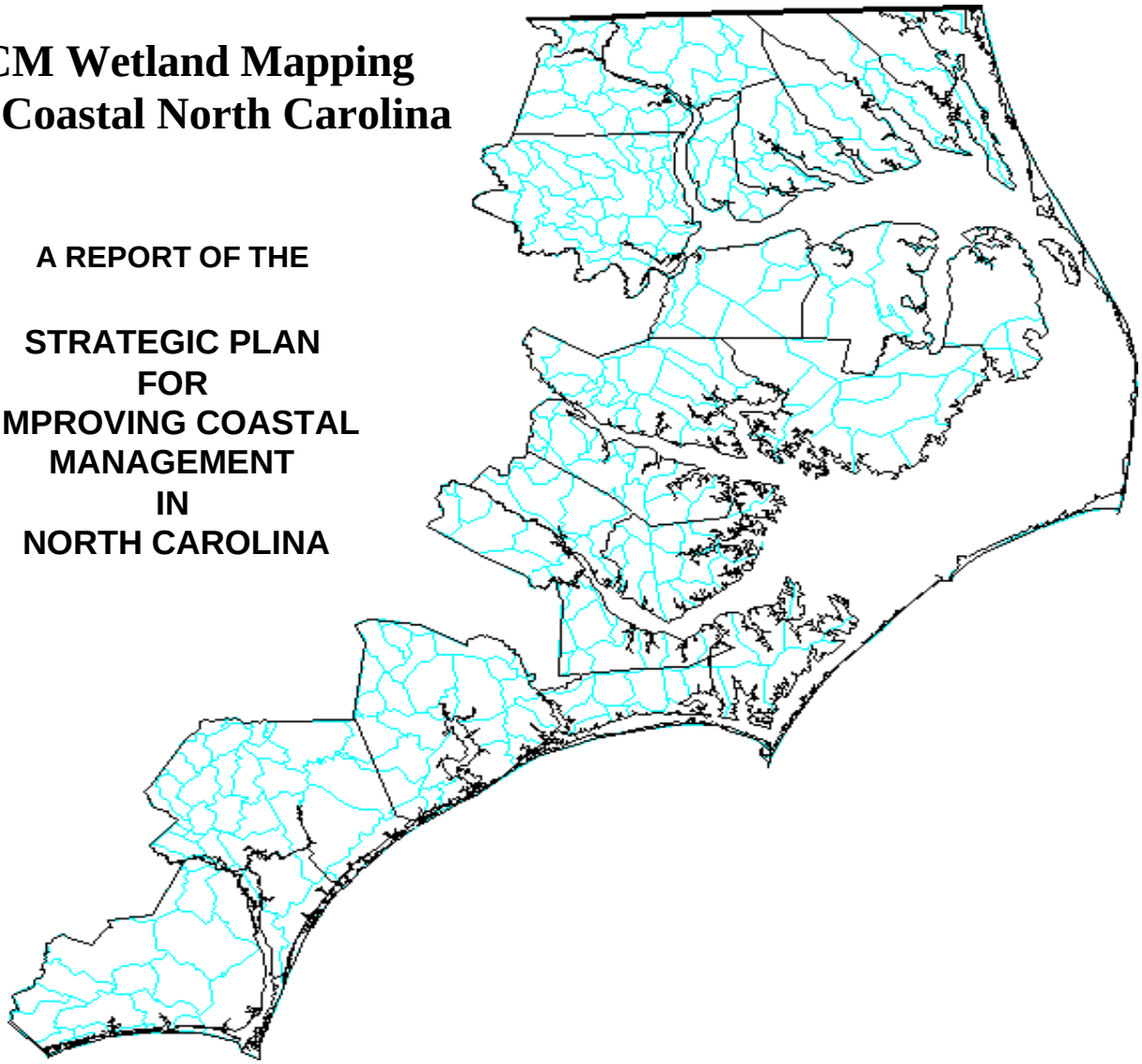
NC-CREWS Metadata

DCM Wetland Mapping In Coastal North Carolina



A REPORT OF THE

STRATEGIC PLAN FOR IMPROVING COASTAL MANAGEMENT IN NORTH CAROLINA

Performed Under The Coastal Zone Enhancement Grants Program

Division of Coastal Management
North Carolina Department of Environment and Natural Resources

May 1999

NOAA

EPA United States Environmental Protection Agency

DCM Wetland Mapping
In Coastal North Carolina

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Department of Environment and Natural Resources

May 1999

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Table of Contents

Figures and Tables

**Note: This document was originally published in May 1999. It has been reformatted and edited for the web and color figures have been added to enhance readers' understanding of the mapping procedure. Some additional text has also been added as clarification. Hardcopies of the 1999 document can be requested from DCM, but they will not include these additional figures or text. Also, this mapping procedure has been extended into the North Carolina Inner Coastal Plain counties so that a total of 37 counties have been evaluated. The text of this document focuses on the project originally confined to the 20 Coastal Counties, but the methods used for the Inner Coastal Plain were not changed.*

Introduction

Section 1

Context

The coastal area of North Carolina covers 20 counties and more than 9000 square miles of land area and about 20 percent of the state. It also includes more than 87 percent of the state's surface water. The North Carolina Coastal Management Program (NC CMP) is responsible for managing this area to meet the goals set forth in the Coastal Area Management Act (CAMA - NCGS 113A, Article 7). These goals provide a broad mandate to protect the overall environmental quality of the coastal area and to guide growth and development in a manner "consistent with the capability of the land and water for development, use, or preservation based on ecological considerations", (NCGS 113A-102(b)(2)).

Much of the North Carolina coastal area is occupied by wetlands. In many areas, wetlands comprise nearly 50 percent of the landscape. These wetlands are of great ecological importance, in part because they occupy so much of the area and are significant components of virtually all coastal ecosystems, and also because of their relationships to coastal water quality, estuarine productivity, wildlife habitat, and the overall character of the coastal area.

Estimates indicate that approximately 50 percent of the original wetlands of the coastal area have been drained and converted to other land uses (Hefner and Brown, 1985; Dahl, 1990; DEM, 1991). Although agricultural conversion, the largest historical contributor to wetlands loss, has largely stopped, wetlands continue to be lost as they are drained or filled for development. Conflicts between economic development and wetlands protection continue to be a major concern, with many coastal communities considering wetlands protection to be a major barrier to economic development.

Since wetlands are such a dominant part of the coastal landscape and are vitally important to many aspects of the area's ecology, their management and protection is a major concern of the NC CMP. Tidal wetlands, or "coastal wetlands" as they are referred to in law and administrative rules, are stringently protected by the State Dredge and Fill Act (NCGS 113-229) and the Coastal Area Management Act (CAMA) regulatory programs. Coastal wetlands are designated Areas of Environmental Concern (AECs). The management objective in AECs is "to give highest priority to the protection and management of coastal wetlands so as to safeguard and perpetuate their biological, social, economic and aesthetic values; and to coordinate and establish a management system capable of conserving and utilizing coastal wetlands as a natural resource essential to the functioning of the entire estuarine system", (15A NCAC 7H .0205).

Non-tidal freshwater wetlands, on the other hand, were not specifically protected under North Carolina law until recently. State involvement in protection of fresh water wetlands was limited to the regulatory authority given under federal laws for state agency review of federal permits, in this case §404 permits granted by the US Army Corps of Engineers. Under §401 of the Federal Water Pollution Control Act (33 USC 1341), a Water Quality Certification from the NC Division of Water Quality (DWQ) (formerly the Division of Environmental Management (DEM)) is required for a §404 permit to discharge fill material into wetlands. Section 307 of the Federal Coastal Zone Management Act (CZMA - 16 USC 1451 *et seq.*) also requires that §404 permits be consistent with the enforceable rules and policies of the NC CMP. The standards for consistency are the use standards for AECs and wetlands policies stated in the applicable local land use plan. Outside of AECs, there are no consistent standards or policies in the NC CMP regarding wetlands. A few local land use plans include policies to protect fresh water wetlands, but most do not. It was under these circumstances that the idea of a Wetland Conservation Plan came about.

Wetland Conservation Plan

The NC CMP's lack of specific protection for non-tidal wetlands was recognized in the CZMA §309 Assessment of the NC CMP performed during 1991 (DCM, 1992a). During the assessment, it was apparent that both opponents and proponents of wetlands protection felt that the current system was inadequate. Economic development interests found the §404 regulatory program to be unpredictable and inconsistent, often resulting in the loss of needed economic growth in coastal counties. Environmental interests felt that it allowed the continued loss of ecologically important wetlands. As a result, wetlands management and protection was chosen as one of the primary program areas in need of enhancement.

The North Carolina Division of Coastal Management (DCM) developed a five-year Strategy (DCM, 1992b) for improving wetlands protection and management in the coastal area using funds provided under the Coastal Zone Enhancement Grants Program established by 1990 amendments to §309 of the federal CZMA. The §309 Program is administered by the Office of Ocean and Coastal Resource Management (OCRM) in the National Oceanographic and Atmospheric Administration (NOAA), U.S. Department of Commerce. Funds provided under this Program were used for the work reported here. The work was also partially funded by a separate grant from the U.S. Environmental Protection Agency (EPA) for a Wetlands Advance Identification project in Carteret County, North Carolina.

The key element of DCM's strategy for improving wetlands protection is the development of a Wetland Conservation Plan for the North Carolina coastal area. The Plan has several components:

Wetlands Mapping & Inventory

Functional Assessment of Wetlands

Wetland Restoration Identification & Prioritization

Coordination with Wetland Regulatory Agencies

Potential Coastal Area Wetlands Policies

Local Land Use Planning

The obvious first step toward a Wetland Conservation Plan is describing the type, location and extent of the wetland resource, which will provide a factual basis for policy and decision-making. This is being accomplished by an extensive Geographic Information System-based (GIS) wetlands mapping program, which has produced GIS wetland data by wetland type for the entire coastal area of North Carolina. Using the GIS coverage, paper maps can be generated for areas within any boundaries available in GIS format. The methods and results of this mapping effort are the subject of this report.

Development of the Wetland Conservation Plan also includes an assessment of the ecological significance of all wetlands to determine which of the wetlands are the most important in maintaining the ecological integrity of the area. If there are choices and trade-offs to be made in wetlands protection, as there inevitably are in an area with as many wetlands as the North Carolina coastal area, a rational management system should address the most ecologically important natural resource areas. To identify which wetlands are most significant, a GIS-based functional assessment procedure called the North Carolina Coastal Region Evaluation of Wetland Significance (NC-CREWS) has been developed that will result in a designation of each wetland polygon in the GIS coverage as being of exceptional, substantial or beneficial functional significance in the watershed in which it exists. Development and application of that procedure is described in a separate report (Sutter et al., 1998).

The remaining components of the Wetland Conservation Plan are the means by which the results of the wetland mapping and functional assessment will be used to improve wetland protection and management. Close coordination with other state and federal agencies involved in wetlands protection and management has been an important component of the entire effort. Agency representatives have been involved in development of the methods used, and the resulting maps will be provided to the agencies for use in their own planning and decision-making. Policies for protection of wetlands of varying functional significance could be proposed to the Coastal Resources Commission to serve as the basis for consistency review of §404 permit applications. Wetland maps and functional assessment results will also

be provided to local governments for use in local land use planning, and DCM will work with local governments to increase their involvement in wetlands protection.

Wetland Identification

Technical and Legal Definitions

The first step toward improving the management of wetlands is defining the location and extent of the resource. In North Carolina there are two laws that define wetlands. Section 404 of the Federal Water Pollution Control Act ("the Clean Water Act) defines wetlands as "areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation adapted to life in saturated soil conditions." The North Carolina Coastal Area Management Act (CAMA) defines "coastal wetlands" as "any salt marsh or other marsh subject to regular or occasional flooding by tides, including wind tides (whether or not the tide waters reach the marshland areas through natural or artificial water courses), provided this shall not include hurricane or tropical storm tides." Coastal wetlands contain at least one of 10 specified species of marsh plants. The wetlands defined by these two laws, "404 wetlands" and "coastal wetlands", are the only wetlands directly regulated by state or federal agencies in North Carolina.

There are several limitations to relying on only a technical or legal definition in wetland management. Comprehensive wetland maps indicating where "404" or coastal wetlands occur or are likely to occur can be an invaluable tool as guidance for planning and policy-making purposes. While a definition of wetlands is necessary from a regulatory standpoint, a planning tool that shows the location and type of wetlands could improve wetland impact through avoidance and minimization, thus improving the ability to make planning and policy-making decisions. For example, with only a technical definition, a landowner or developer is less able to determine in advance whether wetlands are present in a given area. This makes decision-making and land use planning more difficult and time-consuming because legally, wetland delineations and determinations require on-site field visits. Wetland delineations include an on-site assessment of wetland criteria present including vegetation, soils, and hydrologic conditions that must meet certain requirements to qualify as a wetland. Wetland delineations or "jurisdictional calls" must be verified and approved by a representative from the US Army Corps of Engineers or, for coastal wetlands, a representative from the NC Division of Coastal Management.

Relying solely on a technical definition effectively limits wetland protection from land use planning where the objective is to guide development into areas best suited for it and away from ill-suited areas. Environmental considerations play a significant role in land use decision-making and are one of the major objectives of the local land use planning mandated by the NC Coastal Area Management Act. Yet, with the exception of areas obviously recognizable as wetlands, a technical definition does not provide local governments with the information needed to guide development away from ecologically important wetlands.

Wetland Mapping

Broad scale wetland mapping would alleviate many of the drawbacks associated with the use of a technical definition. By knowing where significant wetland areas exist on the landscape, land use planners can evaluate the costs and benefits of protecting them in view of other planning considerations. Developers can more easily avoid wetland areas and, therefore, the difficulties of the permit process. Policy-makers could use the maps to define policy alternatives in terms of the impact a specific policy decision may have on wetlands and other environmental factors.

However, the mapping of wetlands on a broad scale can be difficult, expensive, and time-consuming. The US Fish and Wildlife Service's National Wetland Inventory began in the 1970s and has yet to be completed. Furthermore, wetland delineations are typically approved by the Army Corps of Engineers for three years. The three-year period can be extended two more years to make a five-year period. Using the current Corps approach, to legally field delineate and map all 404 wetlands in North Carolina would require that the maps be updated and approved a minimum of once every five years. Considering the extent of wetlands in North Carolina (roughly five million acres), precise 404 boundary identification is not a viable nor affordable option at

this time. Nevertheless, the advent of computerized Geographic Information Systems (GIS) and techniques for interpretation of satellite imagery in recent years has, for the first time, made organizing and analyzing the large amounts of information necessary for broad scale, generalized wetland mapping practical.

Mapping procedures based on remotely-sensed data do have inherent limitations and inaccuracies. Even with sophisticated image interpretation, resolutions better than a minimum mapping unit of one to several acres are normally difficult to achieve. Some wetland areas can be missed entirely or mistakenly identified as other wetland types. Image interpretation relies on often subtle differences in spectral reflectance patterns, which is a much less definitive way of defining wetlands than the criteria used for on-site delineations. These accuracy limitations of mapping wetlands based on remotely-sensed data are of particular concern if the data and maps are meant to form the basis of a regulatory program. In North Carolina, wetland maps produced in this manner can be useful tools and predict the probable locations of 404 or coastal wetlands, but these generalized wetland locations cannot substitute for on-site inspections. They can, however, be a significant first step in the minimization and avoidance of wetland impacts and can fit into the currently used regulatory and planning system.

DCM's Wetland Mapping

The chief value of broad scale wetland mapping is to provide guidance for planning and policy-making purposes. The limitations of remotely sensed wetland maps from a regulatory perspective, however, do not lessen their value for the other purposes discussed above. Whether the plans are for development projects or general land use management, knowing in advance where wetlands are likely to exist with a high degree of confidence can be of great value. As users realize that, for regulatory purposes, on-site wetland delineation is still required, wetland maps based on remotely-sensed data are a useful planning tool. Having at least a close approximation of the extent and location of wetlands in various categories will provide a sound basis for wetland policy decisions. These planning and policy-making applications form the context of DCM's wetland mapping as a component of the Wetland Conservation Plan.

In application, however, the question of the relationship of mapped wetlands to jurisdictional wetlands under the §404 Program remains significant. If the primary interest in avoiding wetland impacts is to avoid the difficulties and limitations of the wetlands regulatory program, then this is a very pertinent question. DCM conducted an accuracy assessment to provide users with the various accuracies of this product. As described in the rest of this report, DCM's wetland mapping is based on an analysis of overlays of several data sets that indicate the likely presence or absence of wetland characteristics on a given site. It is highly probable that any area identified as a wetland by DCM will be functioning as a wetland and that portions or all of the area will, indeed, be a jurisdictional wetland as defined in the 1987 *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory, 1987).

A general difficulty of relating mapped wetlands to jurisdictional boundaries is that jurisdictional boundaries are the result of political decisions and are subject to change. In the past decade, the generic wetland definition upon which boundary delineation is based has changed at least three times: once with the introduction of the 1987 Manual (Environmental Laboratory, 1987); again when the 1989 Manual (Federal Interagency Committee for Wetland Delineation, 1989) was introduced; and still again with the return to the 1987 Manual. Each time the jurisdictional boundary line changed. If the proposed 1991 Manual (Environmental Protection Agency et al., 1991) had been put into effect, an even greater change in jurisdictional boundaries would have occurred. During the same period, wetlands were also delineated for other purposes using the SCS *Food Security Act Manual* (U.S.D.A. Soil Conservation Service, 1988) and the EPA *Wetland Identification and Delineation Manual* (Sipple, 1987). Continuing controversy over wetlands regulation make additional changes in the definition of jurisdictional wetlands, and thus the boundary, a constant possibility.

It is important to recognize that the wetland to upland transition is often a broad continuum and that placement of a delineated wetland boundary is subjective to some extent. Impacts to areas immediately adjacent to wetlands often have direct impact on the wetland's ability to function. In the final analysis, however, a specific boundary line somewhere along the continuum between dry land and open water is arbitrary (Mitsch and Gosselink, 1986). A regulatory program that must decide on a daily basis whether a given spot is within or beyond its jurisdiction must incorporate such an arbitrary line and specify as precisely as possible how it is to be located in the field. How closely this line relates to the presence or absence of wetland functions depends upon many factors and varies from site to site.

The objective of DCM's wetland mapping is to identify areas greater than one acre in size that are highly likely to display specific wetland characteristics and to perform wetland functions. Areas smaller than one acre cannot be reliably identified with the remotely-sensed data and interpretation techniques currently in use. (See Section 3.) If the objective of wetland management is to protect wetland functionality, then the mapped areas should be considered worthy of protection. How stringently they will be protected under the §404 or other regulatory programs is a separate, politically-determined decision. The maps may help to make those political decisions more informed.

Uses of Wetland Data & Maps

As part of the Wetlands Conservation Plan, the wetland data will be used in several ways. In combination with the results of the functional assessment, the data show the locations and relative ecological significance of wetlands in the coastal area. This information will be provided to state and federal wetland management and regulatory agencies, local governments, the Coastal Resources Commission (CRC), and the Environmental Management Commission (EMC). It will be made available to other interested parties, such as economic development councils and to the public.

Maps showing the location, extent, and functional significance of wetlands will provide a better basis for policy decisions regarding wetland protection at the state and local levels. State-level commissions and the General Assembly will have much improved information available on which to base decisions regarding the state's role in wetland management. Local governments can use the maps in land use planning and as an aid in determining which, if any, local wetland management approaches are appropriate.

Wetland regulatory agencies will be encouraged to use the maps for guidance regarding wetland location and functional importance. While the maps are not meant to substitute for field delineation and on-site inspection in making regulatory decisions, they can provide additional information for that purpose. The wetland maps will also provide valuable information for government agencies and private organizations involved in wetland acquisition and/or management. For example, they can be used to identify and prioritize wetlands for protection by acquisition or easement and for identifying areas within larger land-holdings that might be subject to more or less intensive uses.

The maps will provide useful planning tools to economic development councils and the general public. Economic development groups should find the maps useful in attracting appropriate development by locating sites where wetlands are less likely to provide barriers to development. Developers and the general public can use the maps to determine whether particular land use activities may be appropriate in a given area. While not a substitute for regulatory wetland protection or a panacea for dealing with all wetland-related problems, DCM's wetland maps are expected to make significant contributions toward improved wetland management in the North Carolina coastal area.

Wetland Mapping and Inventories

Section 2

Historic Interest

Since the early 1700s there have been numerous attempts, both in North Carolina and nationally, to inventory wetlands. This early interest was based on the potential of many wetlands to provide rich farmland, and early inventories were designed to identify suitable areas for drainage. Since the objective was an evaluation of agricultural potential, these early surveys deliberately excluded areas such as salt marshes that were immediately deemed unsuitable for agriculture (Gosselink and Baumann, 1980). These surveys indicate that even though the reasons for mapping wetlands have changed over time, interest in mapping and inventorying wetlands is not new.

In North Carolina, Col. William Byrd surveyed the area of the Great Dismal Swamp and proposed that it be drained as early as 1728 (Lilly, 1981). Wetland drainage for conversion to agriculture continued throughout the 1700s, but it was the creation of the State Literary Fund by the General Assembly in 1825 that most stimulated state involvement in wetland inventories. All swamp lands in the state were ruled to be state property and were turned over to the Literary Fund as a means of raising money for education. This resulted in intense interest in the extent, location, and agricultural potential of these wetlands. Several attempts were made to inventory state wetlands and estimate the extent of the larger swamps to which the state had laid claim (Lilly, 1981). Chief among these was the state-commissioned book on swamp lands written by Edmund Ruffin (Ruffin, 1861).

The Civil War, along with a general lack of financial success in converting swamps to agriculture, led to decreasing interest in wetland inventories in the last half of the 1800s. State reports published during the post-war period discouraged further state activity in actively draining and farming wetlands and encouraged that they simply be sold to raise revenues (Kerr, 1867; Scarborough, 1883). This lack of continued state interest, combined with efforts to attract outside capital to stimulate the state's economy and the intense climate of land speculation after the war, resulted in the remaining state-owned wetlands passing into private ownership.

At the national level, the first efforts to inventory wetlands resulted from the Federal Swampland Acts of 1849, 1850, and 1860. All lands in the public domain unfit for cultivation due to flooding were turned over to the states to be used for flood control and, where practical, for draining for agriculture. The states were to report the extent and location of these wetlands to the federal government. For the most part, these lands were quickly sold to private interests before detailed surveys were completed (Gosselink and Baumann, 1980).

Although the flooded lands had been ceded to the states primarily to avoid the federal government from bearing the costs of reclaiming them, the politically influential landowners who had acquired the wetlands put pressure on Congress and on the states to provide funds to drain them. Congress requested the USDA to inventory all wetlands east of the Rocky Mountains, resulting in the first large-scale wetland survey completed in 1906. This survey, which was based on information supplied by each county in each state, was based on either existing records or rapid estimates (Gosselink and Baumann, 1980).

In North Carolina, the same pressures led to the passage of legislation to enable groups of landowners to establish drainage districts and support area-wide drainage projects through assessments against land (Lilly, 1981). This stimulated several large drainage projects, and the revived interest in wetland drainage resulted in additional attempts to estimate the extent of reclaimable wetlands (Pratt, 1909).

The first scientific approach toward wide-scale wetland mapping occurred in 1922 when the Bureau of Agricultural Economics conducted the second national inventory of wetlands. This survey was based on data from soil survey reports, the 1920 census of drainage projects, topographic maps, and field data from the U.S. Bureau of Public Roads. The maps produced by this survey were not published, however, and most have been subsequently lost. Another

inventory of wetlands for agricultural drainage purposes was conducted by the Soil Conservation Service in 1940. Unfortunately, the 1940 inventory was not as complete or as well done as the 1922 survey (Gosselink and Baumann, 1980).

By the 1950s, enough wetland area had been drained nationally that wildlife management agencies began to become concerned over the loss of wetland habitat. In 1954 the U.S. Fish and Wildlife Service conducted the first federal wetland inventory with a purpose other than evaluation of agricultural potential. This stimulated the interest of many state wildlife management agencies to similarly inventory wetlands from a wildlife habitat perspective. In North Carolina, the work for the USFWS inventory was conducted by the Office of River Basin Studies, which plotted wetlands on aerial photographs (Office of River Basin Studies, 1954).

Based on these aerial photographs, field work was carried out in the late 1950s for the classic wetland mapping and inventory project published by the North Carolina Wildlife Resources Commission in 1962 (Wilson, 1962). The objectives of that project were to map and classify wetland areas and evaluate their potential for development of waterfowl habitat. Since waterfowl habitat management consists mostly of providing open water and food sources, some of the practices recommended, such as clearing swamps and diking bottomland hardwoods off from adjacent rivers, seem almost as destructive of other wetland functions as was drainage for agriculture. Nevertheless, the methods used for mapping wetlands were sound, and, subject to their limitations, provide useful information about the location and extent of wetlands of different types at that time.

Wilson used the aerial photograph plots produced earlier by the Office of River Basin Studies to plot wetlands of 40 acres or more on county base maps of 41 coastal plain counties. Field surveys were conducted in each county, and detailed information on soils, vegetation, water characteristics, and wildlife populations was collected for those areas with the highest potential for development of waterfowl habitat. Maps of each county showing all larger wetland areas were produced and included in the published report.

While Wilson's report is undeniably the best source of information on the location and extent of wetlands in coastal North Carolina during the 1950s, users of the information need to keep in mind its inherent limitations. The initial plotting of wetlands by the Office of River Basin Studies was performed in a relatively short period of time on black and white aerial photographs using unspecified criteria and techniques. Wilson transferred those plots to county base maps without careful geographic controls, deliberately excluding all areas less than 40 acres. In addition, since the survey was looking primarily for waterfowl habitat, open water (including inland lakes and rivers, coastal fresh water areas in Currituck Sound, and the entire area) are included in the total wetland figures. Open water is not normally defined as a wetland, especially as reviewed under §404 and CAMA. Since many wetland surveys do not include open waters, comparison of Wilson's acreage totals with those of other surveys can be extremely misleading unless the open water numbers and wetlands smaller than 40 acres are excluded.

More Recent Inventories

Because wetlands provide vital habitat for waterfowl, the U.S. Fish & Wildlife Service (USFWS) has maintained a keen interest in the protection of these ecosystems. Shaw & Fredine (1956) authored an inventory entitled *Circular 39,* which presented a simplified classification of wetlands nationwide. *Circular 39* presented 20 wetland types nationwide, divided into coastal and inland wetlands, fresh water or saline, specifically for wetlands that provided waterfowl habitat.

Recognizing the limitations of *Circular 39*, the USFWS developed a national classification (Cowardin et al. 1979) to address issues broader than waterfowl habitat. This classification was adopted by the National Wetlands Inventory (NWI) program of the USFWS. This classification scheme separates wetlands from deep-water habitats. It recognizes 5 broad wetland systems: marine, estuarine, riverine, lacustrine and palustrine. Marine wetlands are those associated with the ocean. Estuarine wetlands are salt influenced wetlands with fresh water influx and limited mixing with the ocean. Riverine wetlands are those associated with rivers and lacustrine wetlands are associated with lakes. Palustrine wetlands are the remaining freshwater wetlands (<5% salt) and comprise a substantial portion of the landscape in coastal North Carolina.

The NWI uses color infrared photography to recognize moisture and vegetative patterns on the landscape. According to Cowardin et al. (1979), this inventory meets four objectives:

-to describe ecological habitats that have certain homogenous natural attributes,

-to arrange these units in a system that will aid decisions about resource management,

-to furnish units for inventory and mapping, and

-to provide uniformity in concepts and terminology throughout the United States.

Until DCM's current effort, the NWI provided the most comprehensive inventory of wetlands in the coastal area of North Carolina. Certain limitations led to concerns among the North Carolina wetland management community about the realistic use of the NWI, even though the product clearly stated that the data should not be used for regulatory purposes. Users were encouraged to use the resource appropriately.

The method employed by the National Wetlands Inventory team is aerial photography interpretation. Interpretation of aerial photography, however, is time consuming and subject to human interpretation. It has been the experience of staff of DCM that interpretations can vary in adjacent areas, leading to discrepancies in the data. Since NWI requires extensive manual interpretation, some believed that an automated technique applying satellite data would be more cost efficient. As a result, methods emerged for using satellite imagery to identify wetlands.

A remote sensing option is the use of satellite imagery to identify patterns on the landscape and develop a classification based on vegetative reflectance signatures obtained by the satellite. As in all the methods outlined above, this method also is subject to human interpretation. Imagery also produces data in pixels, which can appear "blocky" and unnatural if not carefully controlled.

One such effort in North Carolina was a land cover classification completed for the Albemarle-Pamlico Estuarine Study, as part of the Environmental Protection Agency's National Estuarine Program. The Albemarle-Pamlico (A/P) estuarine system in North Carolina is one of the estuaries in the EPA's National Estuary Program. The lack of a current land use/land cover inventory was identified as a critical gap in the A/P Study resource database. At an A/P Study workshop held late in 1987, Landsat Thematic Mapper (TM) digital data were recommended as the most cost effective and practical source for developing an inventory for the 23,000 square mile drainage basin. The Computer Graphics Center (CGC), North Carolina State University (currently called the Center for Earth Observation), and the North Carolina Center for Geographic Information & Analysis (CGIA) were given responsibility for the development, storage and dissemination of the inventory.

The study area included a portion of Virginia and nearly one-third of North Carolina including almost the entire Tidewater region. CGC had the responsibility of analyzing the five Landsat TM scenes needed to cover the area. Digital TM data were converted to a Lambert Conformal Conic projection and classified into 18 land use/land cover classes using a supervised approach. Results of the project included image files in raster format with every pixel classified by land use/land cover category. Classification verification was performed using 1,931 one acre sample sites located on the classified TM imagery and on aerial photography. Class accuracies were 73% or greater for all Level I classes except developed areas, which had an accuracy of 46%.

Image data were converted to a format compatible with CGIA's software, filtered using a standard 5X5 mode filter, converted to vector format and integrated with CGIA's database for the A/P drainage basin. Data are georeferenced to the NC State Plane Coordinate System and stored as digital ARC/INFO coverage. Land use/land cover data are available from CGIA as map products or in digital format. Final results also include descriptions of the methodology and land use/land cover classes as well as classification error matrices for each physiographic province and for the entire study area.

There is some debate about the preferred method of identifying wetlands from remotely sensed data. Both methods outlined above have strengths and weaknesses. It is the opinion of DCM that given current products available, the NWI provides the most accurate base of wetlands in coastal North Carolina. While there is certainly error associated with that product, the work of DCM to update and improve the products with ancillary data will produce the best outcome.

As explained in Section 1, the most accurate delineation of wetlands involves on-site evaluation of the system and possibly includes studies to determine hydrology. Using standards enforced by the US Army Corps of Engineers, a wetland must be identified based on vegetative cover, soil condition and hydrology. Nearly all US Army Corps of Engineers wetland delineations are required to be conducted on-site. Rarely and only for very large-scale projects, can wetland delineation via remote sensing be allowed. These remote sensing wetland delineations must be pre-approved by the US Army Corps of Engineers on a case-by-case basis. Unfortunately, since each of these ecological characteristics must be interpreted by a human, discrepancies can develop between different interpreters. While this is the most accurate of methods known today, it is subject to human interpretation and political nuances, and can be extremely costly. It is not possible for the coastal area of North Carolina to be completely surveyed for

wetlands by on-site visits without a substantial change in philosophy of state decision makers and a significant change in resource allocation. It is clear that some means of remote sensing must be used to develop the most comprehensive data available.

DCM's methods incorporate the strengths of the NWI, the county soil surveys, and the TM Landsat imagery obtained via satellite. In addition, DCM performed extensive field verification to develop the most accurate data possible. Using GIS, DCM extracted accurate components from each of three layers and created a final wetland layer that more accurately identifies wetlands than any of the three sources. GIS allows this to be done relatively quickly, and, as new ancillary data become available, permits data updates and corrections.

The value of using GIS is that the data can be analyzed and viewed spatially, and each of the input data can be maintained. This will allow future updates to occur more efficiently. Also, with the completion of this project, wetlands can be over-layed with many other referenced layers to help decision makers in many arenas.

DCM Wetland Mapping Procedures

Section 3

Background

When developing methods for mapping, DCM quickly realized that the 9000+ square mile coastal area was too large for any exhaustive field mapping effort (see Figure 1). To efficiently map the coastal area, DCM found it necessary to use existing data compatible with Geographic Information Systems (GIS). A review of the existing data revealed that most are not applicable for one of two reasons: (1) available wetlands data are based on older photography or (2) more recent data are not classified with the intent of wetlands identification. Both of these data types, used independently, are inappropriate for use in a coastal area wetlands conservation plan. In addition, the classification schemes used in the existing methods are either too complex or not focused on wetlands.

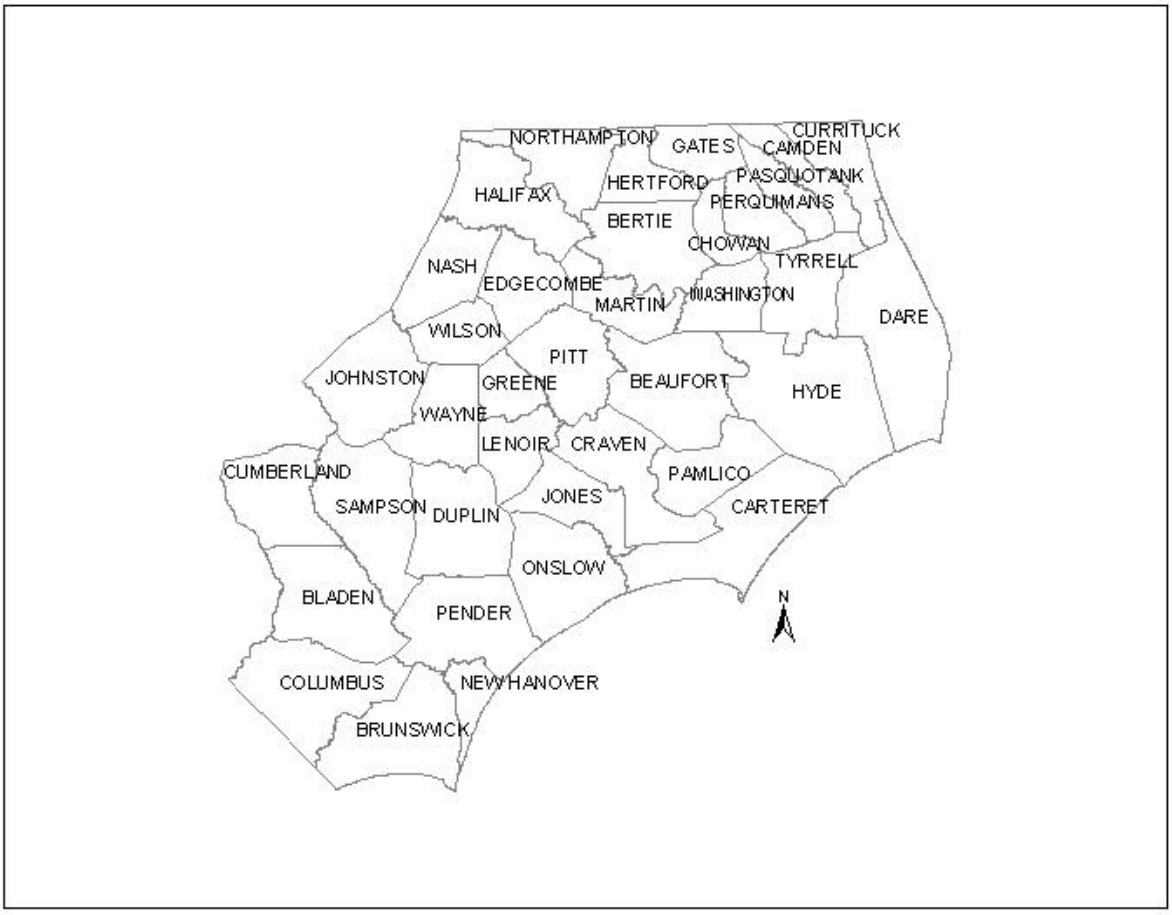

Figure. 1 Extent of Wetland Mapping for 37 Coastal Plain Counties.

Several data sets were believed to be inappropriate if used exclusively for wetlands mapping in coastal North Carolina. Each contains some information useful for mapping wetlands. DCM elected to combine three primary layers of data and extract the most pertinent information from each layer. The three primary digital

data layers selected for use were the US Fish & Wildlife National Wetlands Inventory (NWI), the County Soil Surveys, and 30 meter Thematic Mapper (TM) Satellite Imagery.

The National Wetlands Inventory (NWI) was selected because its primary purpose is to map wetlands. Unfortunately, these maps were created with photography from the early 1980s in coastal North Carolina, and many changes have occurred in the landscape during that time. In North Carolina, NWI omitted many pine dominated wetland areas. It also tended to exaggerate the boundary of linear wetlands (based on field data collected at random sites with representatives from USFWS, NC Division of Soil and Water Conservation and DCM). DCM wished to improve upon the NWI, and in particular include pine-dominated wetlands, as these areas are important to the ecology of the coastal area.

Detailed soils information from the county soil surveys were also selected for use in DCM's mapping efforts. While soils alone should not be used to identify wetlands, they can be very useful in identifying marginal areas. They are also extremely useful in helping to define the type of wetland one should expect to find in an area. Pocosins, for example, would only be expected to occur on a limited range of organic and certain sandy soil types.

Thematic Mapper (TM) Satellite Imagery was employed in the development of a mapping methodology as well. Imagery that had been classified in the late 1980s in much of coastal North Carolina to support the Albemarle-Pamlico Estuarine Study, a National Estuary Program, was used to identify developed areas, pine monocultures and other habitat types. Because this data layer was not developed as a wetlands inventory, many of the classes were not directly applicable to DCM's approach. However, the imagery was more recent than that from the soil surveys and NWI, and it provided additional habitat data not available in either of the other sources.

DCM chose to incorporate the benefits of each of these data sources into its mapping techniques. Users should be aware that the method chosen was an overlay analysis, and the final data can only be as accurate as the least accurate data used as source input.

The information provided by this mapping project will be useful to county and municipal planners in helping guide inappropriate growth away from environmentally sensitive areas. For this reason, DCM elected to pursue mapping on a county-by-county basis. In addition, a single county allowed DCM to focus methodology development to a limited geographical area to refine its methods. Carteret County was selected as a methods development laboratory because data were available for the area and because Carteret County has a large number of representative wetlands. Officials in the county were also supportive of the effort and received additional financial assistance as a result of their cooperation. Methods derived in Carteret County were then applied to the remaining coastal counties.

Source Data Descriptions

The US Fish & Wildlife Service has the responsibility of producing the National Wetlands Inventory for all wetlands in the country. For the North Carolina coastal area, these vector data were developed from 1: 58,000 scale color infrared photography taken during the winters of 1981, 1982 and 1983. Photointerpreters delineated wetland polygons on clear stabilene mylar taped over the photographs. After an initial scan of the photographs to identify questions or problem signatures, the photointerpreters reviewed areas in the field. Approximately one half to one full day of field verification was performed per 7.5 minute topographical quadrangle (Hefner and Moorhead 1991, Hefner, pers. comm.). Features were compared to USGS topographical maps for consistency. Once the 'draft' paper maps were complete, the data were reviewed by the Regional Coordinator. When approved as a final map, each 7.5 minute quadrangle was digitized. The coastal North Carolina NWI maps were digitized initially by the North Carolina Center for Geographic Information and Analysis (NCCGIA) and later by NWI Headquarters in St. Petersburg, Florida, who sub-contracted the task. Digital maps were obtained initially from 1/4" tape transfer and later from direct access to NWI via the Internet (see 'Photointerpretation Conventions for the National Wetlands Inventory', 'Cartographic Conventions for the National Wetlands Inventory', and 'Digitizing Conventions for the National Wetlands Inventory').

Digital, detailed County Soil Survey data were obtained from NCCGIA. These data are vector data based on 1:24,000 quads. County soil scientists delineated soil boundaries on aerial photographs based on slope,

topography, vegetative cover and other characteristics. A description of this process can be found in any North Carolina county soil survey. Once approved by appropriate personnel at the Natural Resource Conservation Service, the lines were recompiled onto orthophotograph quads by a qualified soil scientist. These lines were scanned or manually digitized by NCCGIA. Databases describing soil characteristics were incorporated into the coverage and then released for use.

The Landsat Thematic Mapper (TM) imagery was classified as part of the Albemarle-Pamlico Estuarine Study (APES). To provide complete coverage for the southernmost region of DCM's jurisdiction (Onslow, Pender, Brunswick and New Hanover counties), DCM contracted with NCCGIA and the NCSU Computer Graphics Center to have that area processed using the APES methods. These data provide a raster-based coverage of approximately 30 meter pixel resolution. Some of the imagery was taken at high tide, which precludes some near-water wetlands from appearing in some areas. Using Erdas Imagine®, imagery processors grouped similar spectral signatures into one of 20 classes. DCM uses these data in two formats: filtered and unfiltered. The unfiltered data were vectorized with the ArcInfo GRIDPOLY command. To remove some of the background noise in the coverage, the unfiltered data were filtered using Erdas 'scan' with a Majority filter of 5x5 pixels and then vectorized by the ArcInfo GRIDPOLY command.

Source Data Verification

Within each county, mapping was based on 1: 24,000 US Geological Survey quadrangles (7.5“ quads). As each quad was completed, it was assembled into a county-wide coverage, which was then assembled into a coastal area coverage. The initial step in the mapping process was to ensure that the base layers described previously were complete. Reviewing for errors at early stages prevented confusion and correction later in the process; therefore, the importance of the preliminary techniques cannot be over-emphasized.

The NWI data were first inspected to ensure that the coverage was complete. If parts of the quadrangle were missing, the error was investigated and corrected. Omissions may be areas of severe cloud cover on the photography or areas neglected during the digitization process. Next, the coverage was reviewed for missing label points. Any omissions were corrected based on the finalized version of the published NWI paper map. If there were omissions from this map, appropriate NWI staff were contacted for the information. At this time, labels were verified for typographical mis-entry. If not corrected, these errors would lead to confusion later in the mapping process. Once the label errors were detected and corrected, the polygons were reviewed for completion. It was not possible to verify every line in the areas of coastal North Carolina densely populated with wetlands, but the lines were reviewed for completeness. Any omissions again were submitted to NWI staff for correction.

The soils data were prepared in a similar manner to the NWI data, with questions being directed to qualified soil scientists within the NC Division of Soil and Water Conservation or the US Natural Resource Conservation Service. Prior to the steps described previously, soils were verified for completeness. It is important to note that gaps may occur if the county boundaries from two adjacent soil surveys do not adjoin. When this occurred, it was handled on a case-by-case basis.

The LandSat data do not require additional verification processes. However, it was often helpful to review this layer to ensure that the geographic boundaries match.

DCM’S Wetland Classification

DCM's wetland mapping project is an integral component of the Wetland Conservation Plan. Since the Wetland Conservation Plan is being developed to improve wetland planning and management in coastal North Carolina at local, state, and federal levels, the wetland classification system used by DCM needed to be accurate and easy to use for persons with varying levels of wetland expertise.

When the wetland mapping project began in the early 1990s, the North Carolina Natural Heritage Program had developed a very detailed classification system of all natural areas in the state. These breakdowns were based on vegetative composition, and assumed complete homogeneity at all sites (Schafale and Weakley, 1990). Although the Natural Heritage Program's classification system is very thorough, DCM chose not to use

their classification system for two reasons. First, DCM's mapping approach uses remotely sensed data which cannot provide the level of detail necessary to accurately support the Natural Heritage classification system. Second, the Natural Heritage classification system uses numerous habitat types that would result in complex maps. A product of this type would require users to have a strong technical understanding of the classification system; thus limiting the use of the maps to only those with appropriate technical training.

At the same time DCM was developing a wetlands classification scheme, the NC Division of Water Quality (then the Division of Environmental Management) also was developing a comprehensive classification for wetlands statewide. Obviously, a statewide program would encounter wetlands types elsewhere that would not apply to the coastal region. A comparison of these types can be reviewed in Table 1. DCM staff worked with staff from all of these agencies to develop a classification scheme that met the needs of its clients without introducing conflict into the existing classification schemes.

Each wetland polygon is assigned to one of DCM's classes based on all the attributes it contains from input data sources. Classification of the Cowardin types into DCM wetland types has been reviewed by personnel from the National Wetlands Inventory and the NC Department of Environment and Natural Resources Division of Soil and Water Conservation (DSWC). Further soils breakdown was reviewed by certified soil scientists at DCM and the DSWC. The classes currently recognized by DCM are salt/brackish marsh, estuarine shrub scrub, estuarine forest, maritime forest, pocosin, bottomland hardwood or riverine swamp forest, depressional swamp forest, headwater swamp, hardwood flat, pine flat and managed pineland (Table 2). NWI Cowardin classifications common to each wetland type can be seen in Table 3. Polygons that do not have criteria designating it as a wetland are considered non-wetlands.

Additional Classifications

The hydrogeomorphology of a wetland is unique in defining the wetland's function (see Brinson 1994). Because these data serve as the base for additional wetland projects, an accurate determination of this characteristic is essential. Immediately following the overlay procedure, technicians add a new item (HGM) to the wetland coverage. DCM uses three hydrogeomorphic (HGM) classifications to describe wetlands in the North Carolina coastal plain. The three HGM classes of wetlands are riverine, headwater and flat/depressional. Because DCM considers both vegetation and landscape position in its classification (discussed later), riverine, headwater and flat/depressional wetland polygons are assigned an HGM class of 'r', 'h' or 'f', respectively. Digital line graphs of hydrography are relied upon in this step of the procedure. All wetlands that are adjacent to streams or rivers are considered to be in the riverine HGM class and are designated as riverine polygons. This class should include all bottomland hardwood swamps and some swamp forests. It rarely includes any of the interfluvial wetland types. On the occasion that it does, it is a small section of a large flat from which a small stream emerges. Only the polygons adjacent to the stream are considered riverine. Headwaters are defined as linear areas adjacent to riverine areas that do not have a stream designated on the hydrography data layer. Since these are unique systems that form the transition between flatwoods and riverine wetlands, they are treated specially. Finally, polygons that exist on interfluvial divides are designated as flat/depressional wetlands. No wetlands along streams should be found in this class, unless field verification showed otherwise.

DCM recognizes that there also are wetlands that border large sounds that do not adequately “fit” into any of the r, h, or f HGM classes. These wetlands are often considered to be ‘fringe wetlands’. DCM staff are currently investigating an adequate means to address this omission and incorporate additional HGM classifications as they are defined by the scientific community.

DCM also recognizes soils as hydric or non-hydric based on List A of the US Soil Conservation Service List of Hydric Soils.

Overlay Analysis

The complete source data coverages were overlaid to create a new, integrated coverage that often approached 100,000 polygons. Each of these polygons had many characteristics assigned to it, including the Cowardin classification assigned by the NWI, the soil series provided by the detailed soil lines, the unfiltered land use/land cover code, and the filtered land use/land cover code. HGM was assigned at the same time as wetland type.

One of the uses of the TM imagery was to identify NWI wetland areas that were devoid of vegetation (e.g., classified as developed, agriculture, or other bare land or grassland). In the original overlay analysis, these areas were thought to have been converted from wetlands to other uses and therefore were given a 'cleared' modifier by DCM and considered to no longer be wetland. An analysis of the draft data upon completion of the 20 coastal counties revealed that approximately 100,000 acres of area the NWI called wetland had been assigned a 'cleared' designation by DCM. This number seemed high based on the judgment of DCM staff, and field verification at a number of representative sites confirmed that this was an over-estimation of converted wetland area. Many of the field sites visited had indeed been cut-over around the time the imagery was taken, but they were either regenerating naturally or had been planted for silvicultural activities. In addition, field visits confirmed that some marsh areas were mistaken for agriculture in the TM imagery. Based on this, and the fact that "coastal wetlands" or salt/brackish marshes have been stringently protected by regulatory programs since prior to the development of the NWI data in North Carolina, DCM removed the 'cleared' designation from all salt/brackish marshes.

Around the same time that DCM was discovering this weakness of the TM imagery, new land cover data was released for North Carolina by the state Center for Geographic Information and Analysis. These data were compiled from 30 meter resolution Thematic Mapper Satellite Imagery taken in 1994 in a manner similar to that used in the Albemarle-Pamlico Estuarine Study (APES). This represented the most recent data set available.

Based on field verification of representative sites and comparison of these new land cover data to the 1988 data from APES, DCM established a new 'cutover' modifier to its wetland classifications. The 'cleared' modifier was removed from wetland areas for which the 1988 data indicated a lack of vegetation, but which appeared to be vegetated in the 1994 data. Areas for which the 1994 data indicated a lack of vegetation were designated as 'cut-over'. Based on field verification, these areas are likely to still be wetlands. The 'cleared' modifier was only assigned to wetland areas for which both land cover data sets indicated a lack of vegetation. A similar analysis will be performed upon receipt of land cover data completed by the NOAA Coastal services Center Coastal Change Analysis Program.

The base of the map is the NWI polygon coverage. Some of the NWI polygons are omitted from the DCM maps because they are temporarily flooded but on non-hydric soils, or because recent TM imagery indicates these areas are currently bare ground. These areas are excluded because they typically would fail to meet current wetland determination criteria as defined by the 1987 UCACE Wetland Delineation Manual. Areas that NWI considers uplands, identified as pine monocultures on the imagery, and occurring on hydric soil are considered in the managed pineland wetland group on DCM maps.

Based on these characteristics, each polygon is assigned to one of DCM's classes through an automated ArcInfo model using Arc Macro Language (AML). In addition, DCM also provides a modifier to some of these polygons. If the area has been drained or ditched as determined by the NWI, it is so noted. Areas designated as wetlands at the time of the NWI photography that currently appear as bare ground on the TM imagery are designated as 'cleared' or 'cutover' on the maps. Many of the cleared areas would no longer be considered jurisdictional wetlands. Finally, spoil piles or excavated areas indicative of human activity are identified as 'human impacted' wetlands. The 'human impacted' category also contains many impoundments and some cutovers. These modifiers are useful indicators of the impacts wetlands are sustaining from human activities.

When the automated procedure was complete, an interactive session was initiated. During this session, landscape characters that are not easily described in a computer model were considered in finalizing the classification. This was especially important in distinguishing bottomland hardwood wetlands from hardwood flat wetlands. Both contain deciduous, broad leaf species of trees and can be seasonally and temporarily flooded. The hydrology of these systems, however, is completely different. All bottomland hardwood forests, for example, must be adjacent to a river where they receive seasonal floodwaters from the channel. Conversely, hardwood flats are typically located on interfluvial divides and not adjacent to any streams. Water is not introduced into hardwood flats via a channel, rather precipitation and groundwater provide the water for this system. Polygons that are adjacent to rivers or estuaries but do not have a distinct channel designated in the hydrography coverage are considered headwater swamps. The overlay analysis is depicted in Figure 2.

Field Verification

As methods were being developed, field verification was ongoing to ensure that the classification system reflected reality. Approximately 400 wetlands in and around Carteret County were visited. Sites were randomly selected within a stratification of watersheds (14 digit hydrologic units). Within each watershed, sites

were classified based on landscape position, vegetative cover and soil and hydrologic characteristics. Ongoing field verification also allowed staff the opportunity to adequately assess the classification assigned by NWI. If a particular Cowardin class was found to be systematically misidentified, the algorithm for automation was updated. While this method does not provide for a usable accuracy assessment, it allowed the most accurate methods to be developed. None of the data collected for this purpose were applied to the final accuracy assessment.

A concurrent accuracy assessment was made possible by a grant from the United States Environmental Protection Agency. The assessment provides details about the likelihood of finding a wetland where DCM indicates one should exist as well as an indication of how likely a user is to find the mapped wetland type in that location. Details of the accuracy assessment can be found in the next section.

Table 1. Cross reference of wetlands for different NC agencies.

DCM Type	DWQ Type	Natural Heritage Program Type
Salt/Brackish Marsh	Salt Marsh	Salt Marsh or Salt Flat
	Brackish Marsh	Brackish Marsh
Estuarine Shrub Scrub	Salt Shrub	Salt Shrub
Estuarine Forest	Estuarine Fringe Forest	Estuarine Fringe Loblolly Forest
Maritime Forest	none	Maritime Swamp Forest
		Maritime Shrub Swamp
Freshwater Marsh	Freshwater Marsh	Tidal Freshwater Marsh
		Maritime Wet Grassland
		Natural Lake Shoreline
		Small Depression Pond
Pocosin	Pocosin	Low Pocosin
		High Pocosin
		Pond Pine Woodland
		Peatland Atlantic White Cedar Forest
		Bay Forest
		Small Depression Pocosin
Swamp or Bottomland Hardwood	Swamp Forest	Cypress-gum swamp (blackwater)
		Cypress-gum swamp (brownwater)
		Coastal Plain Semi-permanent impoundment
		Tidal Cypress-gum Swamp
	Bottomland Hardwood Forest	Coastal Plain Bottomland Hardwood (blackwater)
		Coastal Plain Bottomland Hardwood (brownwater)
Headwater Swamp	Headwater Forest	Coastal Plain Small Stream Swamp (blackwater)
		Coastal Plain Small Stream Swamp (brownwater)
		Streamhead Pocosin
		Streamhead Atlantic White Cedar Forest
Hardwood Flat	Wet Flat	Nonriverine Wet Hardwood Forest
		Nonriverine Swamp Forest
Pine Flat	Wet Flat	Pine Savannah
		Wet Pine Flatwood
Managed Pineland	none	none

Wetland Type	ID#	General Definition	Typical Species
Salt/Brackish Marsh	1	Any salt marsh or other marsh subject to regular or occasional flooding by tides, including wind tides	*Spartina alterniflora, S. patens, S. cynosuroides; Typha* spp., *Juncus roemerianus, Salicornia* spp., *Scirpus* spp., *Distichlis spicata, Limonium* spp., *Cladium jamaicense*
Estuarine Scrub-Shrub	3	Shrub/scrub dominated community subject to flooding by tides, including wind tides.	*Myrica* spp. and *Juniperus virginiana*
Estuarine Forest	15	Forested wetlands subject to flooding by tides, including wind tides.	pine dominated communities with *Juncus* spp. understories
Maritime Forest	16	Forested wetlands with stunted growth imposed by salt spray from the ocean.	*Quercus virginiana, Acer rubrum* and *Nyssa biflora*
Freshwater Marsh	2	Herbaceous areas which are flooded for extended periods during the growing season.	sedges, millets, rushes and grasses not specified in CAMA. *Arundinaria gigantea, Sagittaria* spp., *Pontederia* spp,. *Peltandr*a spp., *Polygonum* spp.,*Typha* spp.
Pocosin	4	Evergreen shrub/scrub. Often occur on saturated, acid, nutrient poor, sandy or peaty soils.	evergreen shrubs, often mixed with pond or loblolly pines (*Pinus serotina* or *P. taeda*)
Swamp or Bottomland Hardwood	6/7	Riverine and non-riverine forested or scrub/shrub communities which are seasonally to semi-permanently flooded.	*Taxodium* spp., *Nyssa* spp., *Acer rubrum, Fraxinus pennsylvanica*, *Carya aquatica*, other hickories, oaks, gums, cottonwoods, willows, river birch, and occasionally pines
Headwater Swamp	17	Wooded systems along first order streams. Receive water from overland flow and rarely overflow their own banks	*T distichum, Nyssa biflora, Liquidambar styraciflua*, *L tulipfera, Acer rubrum, Quercus* spp., and *Pinus* spp.
Hardwood Flat	9	Poorly drained interstream flats. Seasonally saturated by high water table or poor drainage.	Varies greatly but often include *Liquidambar styraciflua* and *Acer rubrum*.
Pine Flat	10	Seasonally saturated pines on hydric soils (often quite dry for part of the year). Generally on flat or nearly flat interfluves.	*Pinus taeda*
Managed Pineland	11	Seasonally saturated, managed pine forests occurring on hydric soils.	*Pinus taeda*
Human Impacted	40	Human impacts have physically disturbed the wetland. Impoundments, some cutovers and other disturbed areas are included in this category.	Non-native, invasive species often present and prevalent
Modifiers			
Drained	21-39	Any wetland system described above which is or has been effectively drained.	See above primary class for likely historical wetland type
Cleared	41-59	Areas of hydric soils for which satellite imagery indicates a lack of vegetation in 1988 *and* 1994. Likely not a wetland today.	See above primary class for likely historical wetland type
Cutover	61-79	Areas for which satellite imagery indicates a lack of vegetation in 1994. These areas are likely to still be wetlands, however, vegetation has been removed.	See above primary class for likely historical wetland type

Table 2. Wetland Types and Descriptions Mapped by the Division of Coastal Management

Salt/Brackish Marsh
E2EM*

Freshwater Marsh

PEM*	L*EM	PAB3*	PFO5/OWHh

Estuarine Shrub-Scrub
E2SS*

Pocosin (or Pine Flat if not on pocosin soil)

PSS7*	PFO3B*	PFO3/6F*	PSS3/4B*	PSS1/3B*
PSS3B*	PFO4/1B*	PFO7/SS6B*	PSS3/4A*	PSS1/3G*
PSS4B*	PSS4*	PFO3/1B*	PFO4/6B*	PFO7/1B*
PSS6B*	PSS4Ad*	PFO7/FO4B*	PSS1/4B*	PFO3/4B*
PSS6/7*	PSS7/6B*	PFO7C*	PSS6G*	PFO7B*
PSS3/1B*	PFO7/6A*	PFO4/SS7B*	PFO3/4A*	(not PFO7Bg*)
PSS3C*	PSS4*	PFO7/6B*	PSS7/FO4B*	PFO4B*
PSS1B*	PSS1/3C*	PFO7/1C*	PSS7A*	(not PFO4Bg*)
PSS4/1B*	PSS7T*	PSS4/EM1B*		

Hardwood Flat (must be on hydric soil)

PFO/SS1A*	PSS1/4A*	PFO1/4A*	PFO6/7B*	PFO1/3A*

Pine Flat (must be on hydric soil)

PFO4/1A*	PFO4S*	PFO4/SS1A*	PFO4/SS4A*	PFO4R*
PFO4A*	PFO7A*	PFO4/3B*	PSS3A*	PFO4/3A*

Bottomland Hardwood

PFO/SS1C*	PFO4/1C*	PSS6C*	PSS3R*
PSS1/4C*	PFO7R*	PSS4C*	PSS1C*

PFO1* (not PFO1B*,PFO1/3A*,PFO1F*, PFO1/4A*, PFO1C*)

Swamp Forest

PFO6*	PFO4/SS1C*	PFO/SS6F*	PFO1C*	PFO7/6F*	PSS2G*
PFO1F*	PSS6F*	PFO3C*	PFO1/2F*	PFO1B*	PFO4C*
PFO4Bg*	PFO/SS6F*	PSS6/7T*	PFO1/4C*	PSS6T*	PSS6R*
PFO7Bg*	PFO3F*	PFO7/EM1C*	PFO/EM1F*	PFO7/6C*	PFO1B*
PFO2*	PSS1F*	PSS6/7F*	PSS/EM1C*	PFO7C*	

Estuarine Forest

E2FO4P*	PFO4/EM1B*

Maritime Forest

PFO7A*	PFO7F*

Human Impacted

PSS1A*	PSS1C* (if isolated & not riverine)

Table 3. Cowardin classifications common to each wetland type.

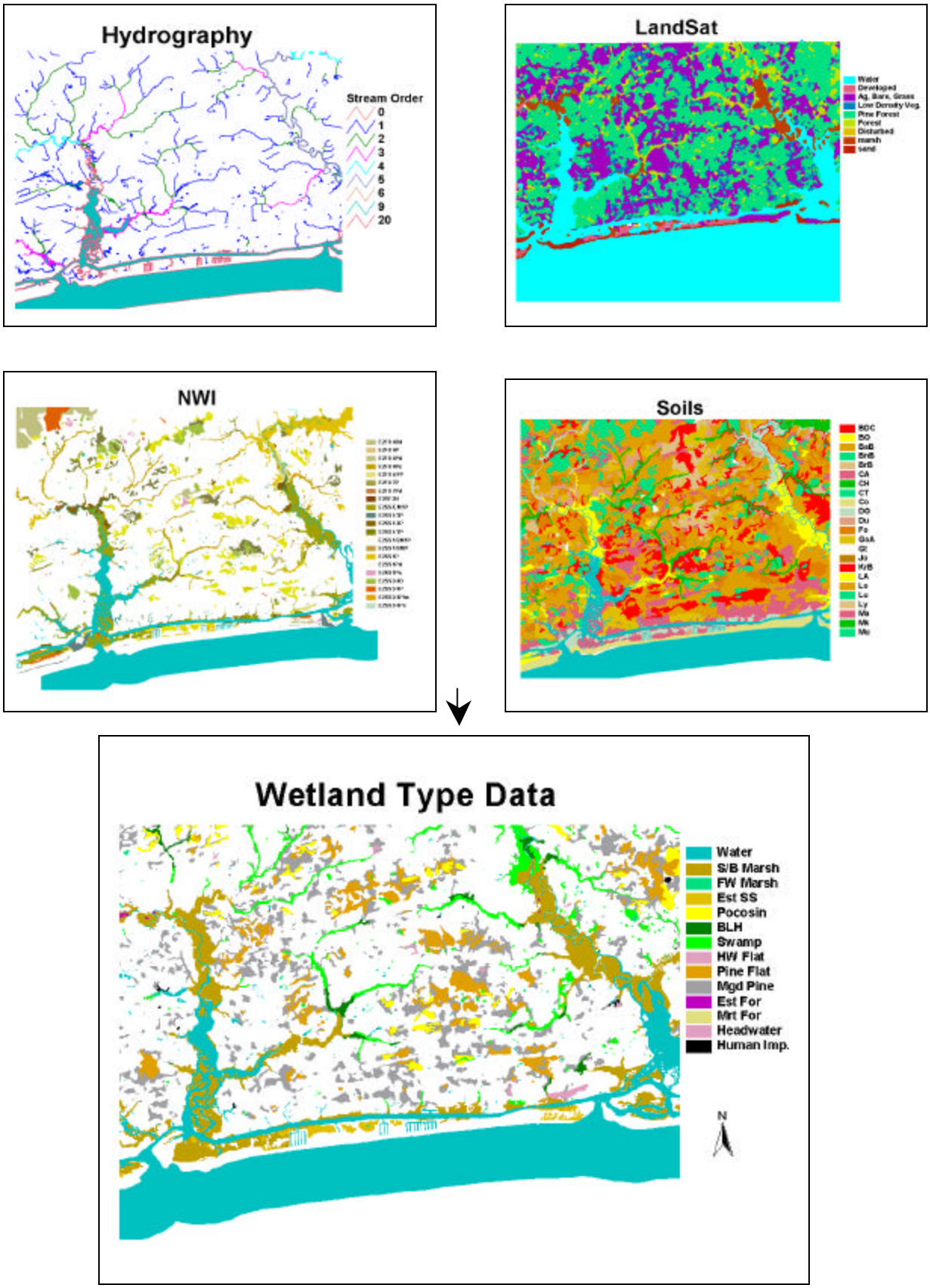

Figure 2. Overlay analysis is one step in the Wetland Type Mapping Procedure.

Results

Section 4

DCM's GIS Wetland Type Maps can be viewed on DCM's web site at www.nccoastalmanagement.net. In addition, the digital data are available from the North Carolina Center for Geographic Information and Analysis and will also be made available on DCM's website. By understanding the complexity of these ecosystems, it is DCM's intent that local governments will take an active role in wetlands conservation and protection. Several tools have been developed at DCM to assist with wetland protection and management, including wetland functional assessments, and potential wetland restoration site maps. These maps and data have been provided to local planning agencies, state wetland managers and federal wetland regulators. As stated in Section 1, these data and maps are not designed to replace an on-site jurisdictional evaluation of any wetland. They are intended to be used in a planning context and to help understand the environment in which we live.

As we continue to understand more about the role of wetlands in maintaining a healthy environment, the value of GIS wetlands data continues to grow in importance. GIS data can assist county planners in guiding development away from environmentally sensitive areas. Landowners now have the capability to look at a map and determine wetlands may exist in a given area. With this information, the public can be aware of the impact they have on natural resources, such as water quality. In addition, economic development councils can use this information to plan development in areas attractive to a particular industry. If a new business or industry wishes to locate in an area positioned such that the wetlands permitting process could be avoided, a dataset showing areas void of wetlands could be a significant tool.

As additional data become available, the DCM wetland coverage will be updated. When additional land cover data are completed for North Carolina, for example, the data will be updated to reflect changes that have occurred on the landscape since the last update. DCM has completed wetland type mapping for the 20 coastal counties and for 17 of the Inner Coastal Plain counties. It is possible that other agencies will adapt this methodology to map wetlands in other physiographic regions of the state.

DCM mapped more than 2.8 million acres (1,150,000 ha) of wetlands within the 20 coastal counties (Table 5) and more than 1.5 million acres (600,000 hectares) in the Inner Coastal Plain (Table 4). The maps confirm that there are large areas of wetlands that until recently received no additional protection under state regulations. Salt/Brackish marshes, which do enjoy additional state protection under the state Coastal Area Management Act and the Dredge and Fill Act, are only 8% of the wetlands that fall within the jurisdictional area of the North Carolina Coastal Management Program. Total wetland acreage for this mapping project is in Table 6. Wetland acreage by county can be reviewed in Appendix 2.

To better understand the accuracy of these data, DCM obtained a grant from the US Environmental Protection Agency. Based on a sample size of at least 50 sites per wetland type (selected in a stratified random sample), data indicate that the overall accuracy of the wetland data is 89%. This means that if an area is shown as a wetland in DCM data, there is only an 11% possibility that it is not actually a wetland. Conversely, upland areas identified on the map had a 73% probability of actually being an upland. In other words, any upland area on a DCM map has a 27% chance of containing a wetland (Shull 1999).

It should be noted that not all jurisdictional wetlands were captured in DCM's mapping process. DCM was more successful identifying some classes than others. This is expected because the natural system is a continuum from one community, ecosystem and landscape to another. Placing a wetland area into one of several classes means that there will be cases where there is not a clear fit. The DCM Wetland Type maps are, therefore, more accurate for some community types than for others. For example, as one might expect, there was some difficulty distinguishing headwater swamps from riverine swamp/bottomland hardwood wetlands because these habitat types often grade into one another. Determining a precise boundary between them can be difficult even in the field.

Finally, where local entities might have developed a more accurate inventory of wetlands, it is conceivable that those data could replace those developed by DCM. It is DCM's desire to distribute the most accurate information available. Since decisions might be influenced by these (or any other) data, it is hoped that all parties might work together to create a product that is most useful to all.

Table 4. Inner Coastal Plain Wetland Acreage

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	**0**
Freshwater Marsh	10,337	2,357	0	**12,694**
Estuarine Shrub Scrub	0	0	0	**0**
Pocosin	64,497	20,936	2,031	**87,464**
Bottomland Hardwood	169,242	11,505	5,039	**185,786**
Riverine Swamp Forest	454,890	15,253	7,383	**477,526**
Depressional Swamp Forest	30,471	2,716	1,188	**34,375**
Hardwood Flat	83,825	37,219	3,936	**124,980**
Pine Flat	99,631	51,063	5,485	**156,179**
Managed Pineland	424,964	n/a	n/a	**424,964**
Estuarine Forest	0	0	0	**0**
Maritime Forest	0	0	0	**0**
Headwater Swamp	11,619	1,129	693	**13,441**
Human Impacted	14,672	n/a	n/a	**14,672**
Total	1,364,148	142,178	25,755	**1,532,081**

Table 5. Wetland Acreage for 20 Coastal Counties

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	198,999	29,230	0	**228,229**
Freshwater Marsh	23,060	559	0	**23,619**
Estuarine Shrub Scrub	28,326	2,195	571	**31,092**
Pocosin	458,181	85,289	4,784	**548,254**
Bottomland Hardwood	76,602	5,067	3,471	**85,140**
Riverine Swamp Forest	483,091	12,577	107	**495,775**
Depressional Swamp Forest	192,573	59,843	4,966	**257,382**
Hardwood Flat	98,679	40,891	10,544	**150,114**
Pine Flat	223,173	64,712	11,635	**299,520**
Managed Pineland	656,633	n/a	n/a	**656,633**
Estuarine Forest	965	19	5	**989**
Maritime Forest	3,558	17	138	**3,713**
Headwater Swamp	22,236	1,590	2,341	**26,167**
Human Impacted	23,906	n/a	n/a	**23,906**
Total	2,489,982	301,989	38,562	**2,830,533**

Table 6. Coastal Plain Wetland Acreage

Wetland Type	Area (acres)				
	Unaltered	Drained	Cutover	**Total**	Percent of total
Salt/Brackish Marsh	198,999	29,230	0	**228,229**	5.2%
Freshwater Marsh	33,397	2,916	0	**36,313**	0.8%
Estuarine Shrub Scrub	28,326	2,195	571	**31,092**	0.7%
Pocosin	522,678	106,225	6,815	**635,718**	14.5%
Bottomland Hardwood	245,844	16,572	8,510	**270,926**	6.2%
Riverine Swamp Forest	937,981	27,830	7,490	**973,301**	22.3%
Depressional Swamp Forest	223,044	62,559	6,154	**291,757**	9.2%
Hardwood Flat	182,504	78,110	14,480	**275,094**	6.2%
Pine Flat	322,804	115,775	17,120	**455,699**	10.4%
Managed Pineland	1,081,597	n/a	n/a	**1,081,597**	24.7%
Estuarine Forest	965	19	5	**989**	0.03%
Maritime Forest	3,558	17	138	**3,713**	0.08%
Headwater Swamp	33,855	2,719	3,034	**39,608**	0.9%
Human Impacted	38,578	n/a	n/a	**38,578**	0.8%
Total	**3,854,130**	***444,167***	**64,317**	***4,362,614***	
Percent of Total	88.0%	9.8%	1.4%		

Note: Acreages shown are the results of the DCM wetland type mapping project. Numbers are approximate. See http://dcm2.enr.state.nc.us/Wetlands/disclaimer2.htm for more information and online displays of DCM's wetland type maps.

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Appendix 1 - Wetland Acreage by County

20 Coastal Counties

Beaufort

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	6,054	1,710	0	7,764
Freshwater Marsh	275	2	0	277
Estuarine Shrub Scrub	1,208	133	18	1,359
Pocosin	8,996	2,949	669	12,614
Bottomland Hardwood	3,828	834	312	4,974
Riverine Swamp Forest	29,333	2,723	3	32,060
Depressional Swamp Forest	8,162	5,545	630	14,337
Hardwood Flat	8,952	1,860	1,036	11,847
Pine Flat	9,822	3,368	441	13,631
Managed Pineland	84,892	n/a	n/a	84,892
Estuarine Forest	172	0	0	172
Maritime Forest	0	0	0	0
Headwater Swamp	3,280	34	174	3,488
Human Impacted	4,828	n/a	n/a	4,828
Total	169,802	19,158	3,283	192,243

Bertie

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	457	7	0	464
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	0	0	0
Bottomland Hardwood	20,444	396	473	21,313
Riverine Swamp Forest	68,373	419	69	68,861
Depressional Swamp Forest	1,886	3,246	85	5,216
Hardwood Flat	2,993	1,750	154	4,898
Pine Flat	318	198	17	532
Managed Pineland	34,324	n/a	n/a	34,324
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	1,449	139	164	1,753
Human Impacted	1,673	n/a	n/a	1,673
Total	131,917	6,155	962	139,034

Brunswick

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	15,275	0	0	15,275
Freshwater Marsh	6,310	0	0	6,310
Estuarine Shrub Scrub	731	0	37	768
Pocosin	33,520	7,661	498	41,679
Bottomland Hardwood	5,549	453	401	6,403
Riverine Swamp Forest	45,984	696	1	46,681
Depressional Swamp Forest	5,195	455	482	6,132
Hardwood Flat	2,490	581	238	3,309
Pine Flat	26,639	22,299	1,049	49,986
Managed Pineland	101,541	n/a	n/a	101,541
Estuarine Forest	77	0	2	79
Maritime Forest	0	0	0	0
Headwater Swamp	1,816	2	47	1,866
Human Impacted	1,611	n/a	n/a	1,611
Total	246,738	32,147	2,755	281,640

Camden

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	Total
Salt/Brackish Marsh	1,673	0	0	1,673
Freshwater Marsh	31	6	0	37
Estuarine Shrub Scrub	92	0	0	92
Pocosin	374	0	0	374
Bottomland Hardwood	2,292	370	72	2,734
Riverine Swamp Forest	34,143	695	0	34,838
Depressional Swamp Forest	2,951	16,359	1	19,310
Hardwood Flat	6,840	3,282	1,087	11,209
Pine Flat	7,539	1,873	405	9,817
Managed Pineland	8,599	n/a	n/a	8,599
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	927	457	259	1,643
Human Impacted	95	n/a	n/a	95
Total	65,556	23,042	1,823	90,421

Carteret

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	52,607	4,730	0	57,337
Freshwater Marsh	452	357	0	809
Estuarine Shrub Scrub	6,411	337	204	6,952
Pocosin	37,054	4,233	374	41,661
Bottomland Hardwood	1,636	156	106	1,898
Riverine Swamp Forest	4,962	300	0	5,262
Depressional Swamp Forest	1,819	373	98	2,290
Hardwood Flat	7,160	276	434	7,870
Pine Flat	31,969	4,081	2,980	39,030
Managed Pineland	29,496	n/a	n/a	29,496
Estuarine Forest	166	0	0	166
Maritime Forest	148	0	46	194
Headwater Swamp	4,342	284	1,027	5,653
Human Impacted	1,650	n/a	n/a	1,650
Total	179,872	15,127	5,269	199,951

Chowan

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	35	5	0	40
Estuarine Shrub Scrub	0	0	0	0
Pocosin	1	0	0	1
Bottomland Hardwood	2,547	177	92	2,816
Riverine Swamp Forest	9,032	996	0	10,028
Depressional Swamp Forest	345	17	15	377
Hardwood Flat	1,711	765	421	2,897
Pine Flat	54	118	8	180
Managed Pineland	14,234	n/a	n/a	14,234
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	238	135	112	485
Human Impacted	481	n/a	n/a	481
Total	28,678	2,213	648	31,539

Craven

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	1,881	0	0	1,881
Freshwater Marsh	2,123	28	0	2,151
Estuarine Shrub Scrub	211	0	3	214
Pocosin	35,516	4,171	197	39,884
Bottomland Hardwood	4,865	384	129	5,378
Riverine Swamp Forest	38,283	2,347	3	40,633
Depressional Swamp Forest	7,574	5,178	362	13,114
Hardwood Flat	8,039	2,885	369	11,293
Pine Flat	24,524	7,366	801	32,691
Managed Pineland	57,686	n/a	n/a	57,686
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	3,807	371	121	4,299
Human Impacted	1,629	n/a	n/a	1,629
Total	186,138	22,730	1,985	210,853

Currituck

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	25,949	0	0	25,949
Freshwater Marsh	165	4	0	169
Estuarine Shrub Scrub	947	0	7	954
Pocosin	0	0	0	0
Bottomland Hardwood	1,897	471	190	2,558
Riverine Swamp Forest	33,806	409	16	34,231
Depressional Swamp Forest	3,199	56	176	3,431
Hardwood Flat	4,419	2,339	441	7,199
Pine Flat	1,658	2,363	356	4,377
Managed Pineland	9,743	n/a	n/a	9,743
Estuarine Forest	15	0	0	15
Maritime Forest	14	0	0	14
Headwater Swamp	224	10	33	267
Human Impacted	675	n/a	n/a	675
Total	82,711	5,652	1,219	89,582

Dare

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	25,774	3,567	0	29,341
Freshwater Marsh	2,870	0	0	2,870
Estuarine Shrub Scrub	11,625	670	153	12,448
Pocosin	84,182	27	185	84,395
Bottomland Hardwood	422	0	0	422
Riverine Swamp Forest	3,233	0	0	3,233
Depressional Swamp Forest	49,250	0	377	49,627
Hardwood Flat	1,058	0	8	1,066
Pine Flat	15,234	134	197	15,564
Managed Pineland	3,367	n/a	n/a	3,367
Estuarine Forest	213	0	0	213
Maritime Forest	3,397	17	92	3,506
Headwater Swamp	0	0	0	0
Human Impacted	1,258	n/a	n/a	1,258
Total	201,883	4,415	1,012	207,310

Gates

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	60	1	0	61
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	11	0	11
Bottomland Hardwood	4,838	79	126	5,043
Riverine Swamp Forest	27,886	490	0	28,376
Depressional Swamp Forest	525	13,111	25	13,661
Hardwood Flat	3,100	6,456	58	9,614
Pine Flat	395	24	0	419
Managed Pineland	22,480	n/a	n/a	22,480
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	319	6	24	349
Human Impacted	1,359	n/a	n/a	1,359
Total	60,962	20,178	233	81,373

Hertford

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	252	0	0	252
Estuarine Shrub Scrub	0	0	0	0
Pocosin	1	0	0	1
Bottomland Hardwood	7,422	514	64	8,000
Riverine Swamp Forest	20,022	300	0	20,322
Depressional Swamp Forest	250	11	15	276
Hardwood Flat	549	214	19	782
Pine Flat	111	7	0	118
Managed Pineland	11,181	n/a	n/a	11,181
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	620	31	16	667
Human Impacted	220	n/a	n/a	220
Total	40,628	1,077	114	41,819

Hyde

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	39,984	248	0	40,232
Freshwater Marsh	3,661	23	0	3,684
Estuarine Shrub Scrub	3,168	7	82	3,257
Pocosin	74,100	24,478	349	98,927
Bottomland Hardwood	59	0	3	62
Riverine Swamp Forest	5,833	42	0	5,875
Depressional Swamp Forest	29,119	2,373	896	32,388
Hardwood Flat	10,678	2,432	1,041	14,151
Pine Flat	17,848	3,141	698	21,687
Managed Pineland	24,606	n/a	n/a	24,606
Estuarine Forest	210	3	3	216
Maritime Forest	0	0	0	0
Headwater Swamp	513	0	11	524
Human Impacted	2,076	n/a	n/a	2,076
Total	211,855	32,747	3,083	247,685

New Hanover

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	8,193	0	0	8,193
Freshwater Marsh	2,419	0	0	2,419
Estuarine Shrub Scrub	322	0	8	330
Pocosin	6,587	2,291	615	9,493
Bottomland Hardwood	900	195	135	1,230
Riverine Swamp Forest	9,823	655	0	10,478
Depressional Swamp Forest	508	80	77	665
Hardwood Flat	893	102	36	1,031
Pine Flat	5,182	621	546	6,349
Managed Pineland	12,968	n/a	n/a	12,968
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	79	0	36	115
Human Impacted	643	n/a	n/a	643
Total	48,517	3,944	1,453	53,914

Onslow

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	9,267	2,034	0	11,301
Freshwater Marsh	348	86	0	434
Estuarine Shrub Scrub	2,379	0	37	2,416
Pocosin	30,193	4,161	369	34,723
Bottomland Hardwood	7,385	625	425	8,435
Riverine Swamp Forest	23,853	690	1	24,544
Depressional Swamp Forest	7,650	693	212	8,555
Hardwood Flat	2,607	1,268	156	4,031
Pine Flat	24,436	6,536	1,352	32,324
Managed Pineland	69,628	n/a	n/a	69,628
Estuarine Forest	78	0	0	78
Maritime Forest	0	0	0	0
Headwater Swamp	1,330	0	97	1,427
Human Impacted	1,156	n/a	n/a	1,156
Total	180,310	16,093	2,649	199,052

Pamlico

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	4,173	16,934	0	21,107
Freshwater Marsh	576	3	0	579
Estuarine Shrub Scrub	869	1,047	18	1,934
Pocosin	13,141	2,938	452	16,531
Bottomland Hardwood	1,752	41	180	1,973
Riverine Swamp Forest	6,655	785	1	7,441
Depressional Swamp Forest	5,736	102	468	6,306
Hardwood Flat	11,273	1,027	762	13,062
Pine Flat	24,280	2,595	1,241	28,116
Managed Pineland	19,611	n/a	n/a	19,611
Estuarine Forest	31	16	0	47
Maritime Forest	0	0	0	0
Headwater Swamp	933	0	25	958
Human Impacted	3,314	n/a	n/a	3,314
Total	92,344	25,488	3,147	120,979

Pasquotank

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	75	0	0	75
Freshwater Marsh	7	0	0	7
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	0	0	0
Bottomland Hardwood	874	103	20	997
Riverine Swamp Forest	12,507	332	0	12,839
Depressional Swamp Forest	195	3,184	39	3,418
Hardwood Flat	3,993	7,193	1,570	12,756
Pine Flat	291	1,013	115	1,419
Managed Pineland	10,841	n/a	n/a	10,841
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	24	0	4	28
Human Impacted	89	n/a	n/a	89
Total	28,896	11,825	1,748	42,469

Pender

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	7,475	5	0	7,480
Freshwater Marsh	788	35	0	823
Estuarine Shrub Scrub	165	0	2	167
Pocosin	91,950	16,896	694	109,540
Bottomland Hardwood	6,670	64	498	7,232
Riverine Swamp Forest	53,545	50	6	53,601
Depressional Swamp Forest	9,301	144	310	9,755
Hardwood Flat	6,472	1,642	678	8,792
Pine Flat	24,907	7,445	1,236	33,588
Managed Pineland	76,781	n/a	n/a	76,781
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	1,037	114	88	1,239
Human Impacted	638	n/a	n/a	638
Total	279,729	26,395	3,512	309,636

Perquimans

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	1	0	0	1
Freshwater Marsh	108	1	0	109
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	0	0	0
Bottomland Hardwood	742	53	148	943
Riverine Swamp Forest	13,826	266	0	14,092
Depressional Swamp Forest	62	50	3	115
Hardwood Flat	3,435	2,221	817	6,473
Pine Flat	156	14	3	173
Managed Pineland	25,795	n/a	n/a	25,795
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	492	6	22	520
Human Impacted	40	n/a	n/a	40
Total	44,657	2,611	993	48,261

Tyrrell

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	616	0	0	616
Freshwater Marsh	216	0	0	216
Estuarine Shrub Scrub	196	0	0	196
Pocosin	39,005	2,535	153	41,693
Bottomland Hardwood	1,397	0	0	1,397
Riverine Swamp Forest	25,916	381	4	26,301
Depressional Swamp Forest	49,866	4,331	295	54,492
Hardwood Flat	7,167	691	314	8,172
Pine Flat	6,933	783	98	7,814
Managed Pineland	22,654	n/a	n/a	22,654
Estuarine Forest	3	0	0	3
Maritime Forest	0	0	0	0
Headwater Swamp	44	0	1	45
Human Impacted	326	n/a	n/a	326
Total	154,339	8,721	865	163,925

Washington

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	1,907	0	0	1,907
Estuarine Shrub Scrub	0	0	0	0
Pocosin	3,559	12,939	229	16,727
Bottomland Hardwood	1,082	151	95	1,328
Riverine Swamp Forest	16,076	0	3	16,079
Depressional Swamp Forest	8,980	4,535	402	13,917
Hardwood Flat	4,849	3,906	906	9,661
Pine Flat	878	734	94	1,706
Managed Pineland	16,204	n/a	n/a	16,204
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	761	0	80	841
Human Impacted	145	n/a	n/a	145
Total	54,441	22,265	1,809	78,515

Inner Coastal Plain Counties

Bladen

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	2,184	927	0	3,111
Estuarine Shrub Scrub	0	0	0	0
Pocosin	21,029	3,545	67	24,641
Bottomland Hardwood	9,084	349	0	9,433
Riverine Swamp Forest	40,092	1,350	790	42,232
Depressional Swamp Forest	9,968	218	179	10,365
Hardwood Flat	20,396	3,944	502	24,842
Pine Flat	29,850	4,914	1,462	36,226
Managed Pineland	69,749	n/a	n/a	69,749
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	733	72	9	814
Human Impacted	2,643	n/a	n/a	2,643
Total	205,728	15,319	3,009	224,056

Columbus

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	789	152	0	941
Estuarine Shrub Scrub	0	0	0	0
Pocosin	5,585	3,415	1,418	10,418
Bottomland Hardwood	13,917	2,883	553	17,353
Riverine Swamp Forest	82,629	4,406	1,225	88,260
Depressional Swamp Forest	5,540	204	245	5,989
Hardwood Flat	11,707	5,381	788	17,876
Pine Flat	14,930	10,244	1,295	26,469
Managed Pineland	79,554	n/a	n/a	79,554
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	2,121	122	185	2,428
Human Impacted	850	n/a	n/a	850
Total	217,622	26,807	5,709	250,138

Cumberland

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	763	64	0	827
Estuarine Shrub Scrub	0	0	0	0
Pocosin	10,559	2,321	121	13,001
Bottomland Hardwood	5,115	75	242	5,432
Riverine Swamp Forest	14,393	812	524	15,729
Depressional Swamp Forest	3,469	128	175	3,772
Hardwood Flat	7,846	1,077	330	9,253
Pine Flat	4,721	519	197	5,437
Managed Pineland	19,920	n/a	n/a	19,920
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	886	107	70	1,063
Human Impacted	893	n/a	n/a	893
Total	68,565	5,103	1,659	75,327

Duplin

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	406	84	0	490
Estuarine Shrub Scrub	0	0	0	0
Pocosin	5,443	234	112	5,789
Bottomland Hardwood	10,071	130	285	10,486
Riverine Swamp Forest	35,674	91	592	36,357
Depressional Swamp Forest	906	91	97	1,094
Hardwood Flat	6,962	1,042	178	8,182
Pine Flat	11,978	4,367	417	16,762
Managed Pineland	39,967	n/a	n/a	39,967
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	624	77	62	763
Human Impacted	426	n/a	n/a	426
Total	112,457	6,116	1,743	120,316

Edgecombe

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	211	140	0	351
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	0	0	0
Bottomland Hardwood	7,910	1,617	179	9,706
Riverine Swamp Forest	16,584	1,164	159	17,907
Depressional Swamp Forest	978	657	37	1,672
Hardwood Flat	1,566	1,838	84	3,488
Pine Flat	1,083	789	24	1,896
Managed Pineland	11,191	n/a	n/a	11,191
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	277	61	10	348
Human Impacted	310	n/a	n/a	310
Total	40,110	6,266	493	46,869

Greene

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	70	22	0	92
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	0	0	0
Bottomland Hardwood	3,837	476	74	4,387
Riverine Swamp Forest	9,261	26	97	9,384
Depressional Swamp Forest	304	89	7	400
Hardwood Flat	1,069	1,906	121	3,096
Pine Flat	378	780	2	1,160
Managed Pineland	2,900	n/a	n/a	2,900
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	183	20	17	220
Human Impacted	106	n/a	n/a	106
Total	18,108	3,319	318	21,745

Halifax

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	1,508	324	0	1832
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	0	0	0
Bottomland Hardwood	14,918	376	232	15,526
Riverine Swamp Forest	29,564	243	295	30,102
Depressional Swamp Forest	1,247	40	72	1,359
Hardwood Flat	2,088	196	40	2,324
Pine Flat	220	9	18	247
Managed Pineland	6,944	n/a	n/a	6,944
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	324	28	13	365
Human Impacted	776	n/a	n/a	776
Total	57,589	1,216	670	59,175

Johnston

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	485	65	0	550
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	0	0	0
Bottomland Hardwood	20,147	651	414	21,212
Riverine Swamp Forest	30,829	40	360	31,229
Depressional Swamp Forest	417	0	31	448
Hardwood Flat	3,079	85	209	3,373
Pine Flat	1,277	175	60	1,512
Managed Pineland	14,023	n/a	n/a	14,023
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	245	0	14	259
Human Impacted	1,593	n/a	n/a	1,593
Total	72,095	1,016	1,088	74,199

Jones

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	302	10	0	312
Estuarine Shrub Scrub	0	0	0	0
Pocosin	21,006	11,059	309	32,374
Bottomland Hardwood	4,808	343	432	5,583
Riverine Swamp Forest	14,243	360	701	15,304
Depressional Swamp Forest	1,706	192	100	1,998
Hardwood Flat	2,983	4,387	347	7,717
Pine Flat	10,211	10,715	892	21,818
Managed Pineland	57,302	n/a	n/a	57,302
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	781	416	62	1,259
Human Impacted	84	n/a	n/a	84
Total	113,426	27,482	2,843	143,751

Lenoir

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	129	35	0	164
Estuarine Shrub Scrub	0	0	0	0
Pocosin	125	295	3	423
Bottomland Hardwood	5822	268	135	6,225
Riverine Swamp Forest	14,795	221	190	15,206
Depressional Swamp Forest	213	26	6	245
Hardwood Flat	1,892	3,073	116	5,081
Pine Flat	2,194	2,618	79	4,891
Managed Pineland	13,616	n/a	n/a	13,616
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	246	47	7	300
Human Impacted	569	n/a	n/a	569
Total	39,601	6,583	536	46,720

Martin

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	201	6	0	207
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	0	0	0
Bottomland Hardwood	7,536	127	173	7,836
Riverine Swamp Forest	43,017	250	421	43,688
Depressional Swamp Forest	557	137	21	715
Hardwood Flat	1,821	1,004	23	2,848
Pine Flat	2,059	1,482	131	3,672
Managed Pineland	16,265	n/a	n/a	16,265
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	546	41	16	603
Human Impacted	117	n/a	n/a	117
Total	72,119	3,047	785	75,951

Nash

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	241	26	0	267
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	0	0	0
Bottomland Hardwood	17,567	30	505	18,102
Riverine Swamp Forest	11,341	0	142	11,483
Depressional Swamp Forest	369	36	26	431
Hardwood Flat	2,313	144	137	2,594
Pine Flat	1,165	41	17	1,223
Managed Pineland	6,624	n/a	n/a	6,624
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	507	0	40	547
Human Impacted	934	n/a	n/a	934
Total	41,061	277	867	42,205

Northampton

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	1,111	180	0	1,291
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	0	0	0
Bottomland Hardwood	14,479	82	166	14,727
Riverine Swamp Forest	20,328	182	112	20,622
Depressional Swamp Forest	1,083	20	51	1,154
Hardwood Flat	2,290	533	49	2,872
Pine Flat	268	1	2	271
Managed Pineland	6,066	n/a	n/a	6,066
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	1,030	0	21	1,051
Human Impacted	1,964	n/a	n/a	1,964
Total	48,619	998	401	50,018

Pitt

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	158	72	0	230
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	0	0	0
Bottomland Hardwood	6,887	2,416	209	9,512
Riverine Swamp Forest	24,973	4,256	398	29,627
Depressional Swamp Forest	1,315	763	29	2,107
Hardwood Flat	3,646	10,001	434	14,081
Pine Flat	2,145	7,482	112	9,739
Managed Pineland	22,833	n/a	n/a	22,833
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	358	78	6	442
Human Impacted	886	n/a	n/a	886
Total	63,201	25,068	1,188	89,457

Sampson

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	3	4	0	7
Estuarine Shrub Scrub	0	0	0	0
Pocosin	42	66	0	108
Bottomland Hardwood	9	11	0	20
Riverine Swamp Forest	39,185	4	689	39,878
Depressional Swamp Forest	1,102	2	61	1,165
Hardwood Flat	9	12	1	22
Pine Flat	17	28	1	46
Managed Pineland	4	n/a	n/a	4
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	8	7	1	16
Human Impacted	5	n/a	n/a	5
Total	40,384	134	753	41,271

Wayne

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	585	162	0	747
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	0	0	0
Bottomland Hardwood	10,681	520	406	11,607
Riverine Swamp Forest	17,204	659	347	18,210
Depressional Swamp Forest	718	113	23	854
Hardwood Flat	3,347	1,386	93	4,826
Pine Flat	1,440	2,187	60	3,687
Managed Pineland	8,870	n/a	n/a	8,870
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	508	14	25	547
Human Impacted	506	n/a	n/a	506
Total	43,859	5,041	954	49,854

Wilson

Wetland Type	Area (acres)			
	Unaltered	Drained	Cutover	**Total**
Salt/Brackish Marsh	0	0	0	0
Freshwater Marsh	125	1	0	126
Estuarine Shrub Scrub	0	0	0	0
Pocosin	0	0	0	0
Bottomland Hardwood	10,642	1,117	613	12,372
Riverine Swamp Forest	11,077	1,190	341	12,608
Depressional Swamp Forest	579	2	27	608
Hardwood Flat	4,042	331	195	4,568
Pine Flat	2,117	876	204	3,197
Managed Pineland	11,818	n/a	n/a	11,818
Estuarine Forest	0	0	0	0
Maritime Forest	0	0	0	0
Headwater Swamp	888	0	84	972
Human Impacted	1,386	n/a	n/a	1,386
Total	42,674	3,517	1,464	47,655

Stream and Wetland Prediction Model Metadata

North Carolina Department of Environment and Natural Resources
Division of Water Quality

Pat McCrory
Governor

Charles Wakild, P. E.
Director

John E. Skvarla, III
Secretary

January 29, 2013

To: Leilani Paugh, NCDOT Natural Environment Unit

From: Periann Russell, NCDWQ Transportation Permitting Unit

Subject: Delivery of Updated Final Stream Map for Kinston Bypass Study Area

For the last several months DWQ has been working to improve the Carolina Flatwoods headwater stream model. We have improved the consistency and accuracy for this ecoregion by recalibrating the model, reducing the number of variables in the model and removing known ditchlines from the model streamlines; please see the updated table below.

The attached shape file includes the stream map created by DWQ for the Kinston bypass study area. The map consists of stream lines for five EPA Level IV ecoregions; they are Rolling Coastal Plain (RCP), Carolina Flatwoods (CF), Mid-Atlantic Floodplains and Low Terraces (MAFLT), Southeastern Floodplains and Terraces (SEFT) and Swamps and Peatlands (no streams in this ecoregion). As previously discussed, United States Geological Survey (USGS) stream lines were used for SEFT stream lines. The National Hydrography Dataset (NHD) flowlines were applied to this ecoregion and provide more flexible and complete stream line data than USGS 24k hydrolines. NHD is similar to USGS 24,000 hydrolines, but does not include "double line" streams and polygons that appear in USGS 24k lines. NHD flowlines are also attributed with descriptive data that may be useful in calculating stream impact lengths.

1617 Mail Service Center, Raleigh, North Carolina 27699-1617
Location: 512 N. Salisbury St. Raleigh, North Carolina 27604
Phone: 919-807-6300 \ FAX: 919-807-6492
Internet: www.ncwaterquality.org

Map Description

The study area stream map includes an attribute table with the fields listed in Table 1. The use of NHD flowlines in SEFT resulted in some inconsistency of stream line continuation and alignment across ecoregion boundaries, e.g., a modeled stream may be present in the RCP but not continue into the SEFT, or the stream may be present on both maps, not in alignment. Since DWQ has a higher confidence in the modeled streams and the LiDAR-derived topography than in the NHD flowlines, these few inconsistencies were not edited across boundaries. Additionally, stream lines may stop or start at ecoregion boundaries due to DEM shifts in the original data layers delivered by Michael Baker Corp. The DEM shift issue was discovered during this project and has been resolved for future mapping projects.

Table 1: Attribute Table Definitions

Field	Description	Values
Grid Code	stream	1 – is a stream
Source	Source of stream line	M-RCP/CF Model F-Field Determined NHDFType558-Artifical Path (center line of stream) NHDFType460-Stream/River NHDFtype336-Canal/Ditch
Ecoregion	EPA Level IV ecoregion	63h-Carolina Flatwoods 65m-Rolling Coastal Plain 65p-Southeastern Floodplains and Terraces 65n-Mid-Atlantic Floodplains and Low Terraces
Field date	Date Field data collected	
Length	Length of stream segment in feet	

Headwater Stream Model Accuracy

General observations and field verification of the modeled streams indicate that in most areas overestimation of stream length occurs due to pronounced ditching in valleys and in wetlands that occur in pronounced, narrow valleys. Overestimation is also associated with low elevation roads that were misclassified as streams (Figures 1, 2 and 3) and extension of streams into ponds and lakes.

Errors associated with ditches, wetlands, roads and ponds were removed using known field data, 2010 aerial photos, DOT roads, and USGS 24K hydro polygons. Many of the ponds shown on the 24k polygon file do not exist on the ground, so all final decision to remove were made based on the 2010 aerial photos. Accuracies of the model vs. field stream length are listed in Table 2. For comparison, the accuracies of USGS stream length vs. field stream length are included as well.

Table 2: Headwater Stream Model Accuracy

	Site	Field Stream Length (ft)	Model Stream Length (ft)	Model Length Accuracy	USGS Stream Length (ft)	USGS Length Accuracy
RCP	LCB	20770	24657	119%	30241	146%
	LCC	23348	28320	121%	42423	182%
	LCD	50850	59728	117%	47094	93%
Total RCP		94968	112705	119%	119758	126%
CF						
	On02	2252	2105	93%	5758	256%
	Le02	9581	9071	95%	10234	107%
	Co02	9481	8879	94%	8825	93%
Total CF		21314	20055	94%	24817	116%
Total Study Area		116282	132760	114%	144575	124%

Please call or email if you have any questions. I can be reached by phone at 919.807.6478 or email at periann.russell@ncdenr.gov.

cc: Cheryl Gregory (DWQ-TPU)
Morgan Weatherford (NCDOT-NEU)

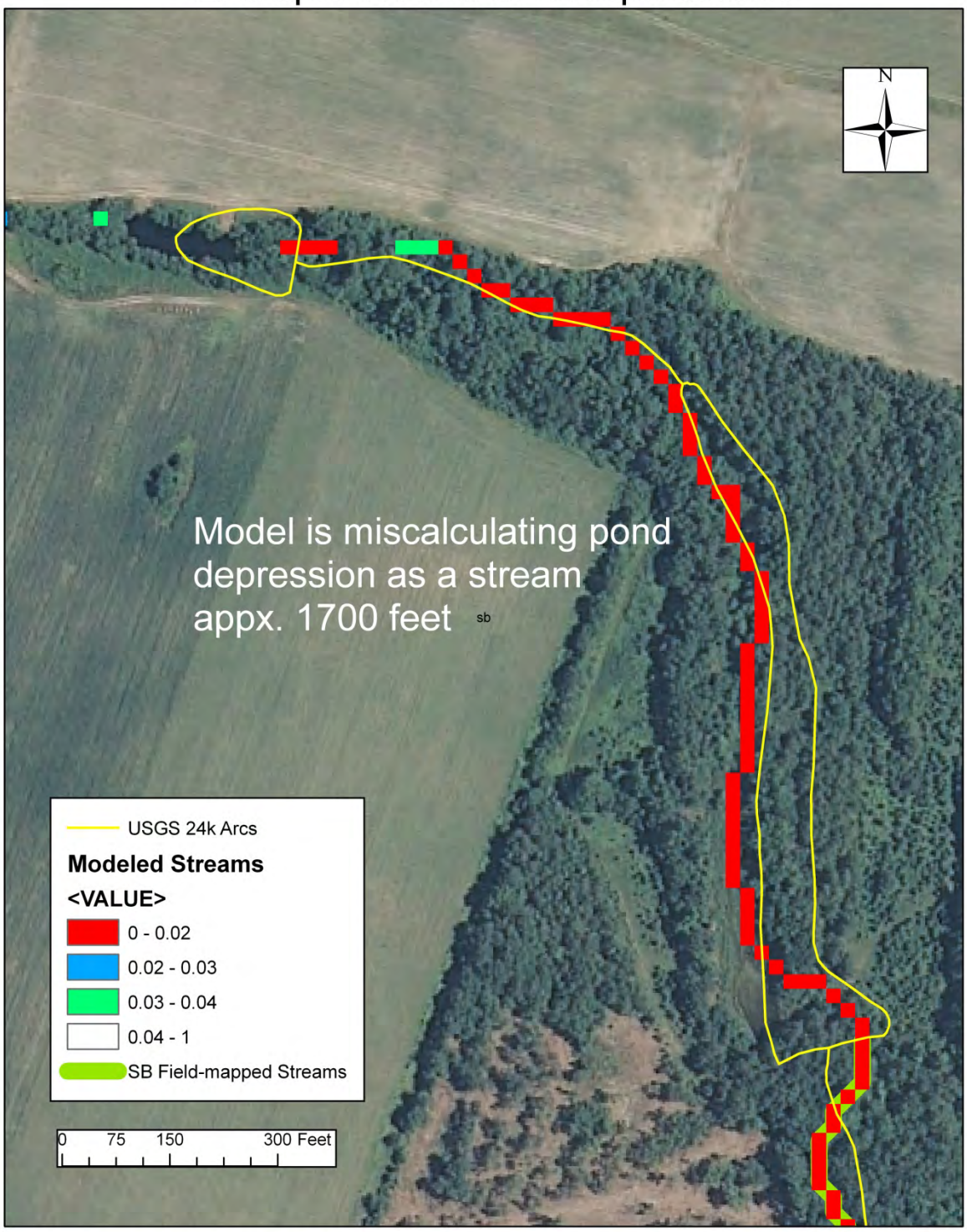
Carolina Flatwoods Headwater Stream Model
Example of Area of Overprediction
N
Model is miscalculating pond depression as a stream appx. 1700 feet
sb
USGS 24k Arcs
Modeled Streams
<VALUE>
0 - 0.02
0.02 - 0.03
0.03 - 0.04
0.04 - 1
SB Field-mapped Streams
0 75 150 300 Feet

Figure 1

Carolina Flatwoods Headwater Stream Model
Example of Area of Overprediction (2)

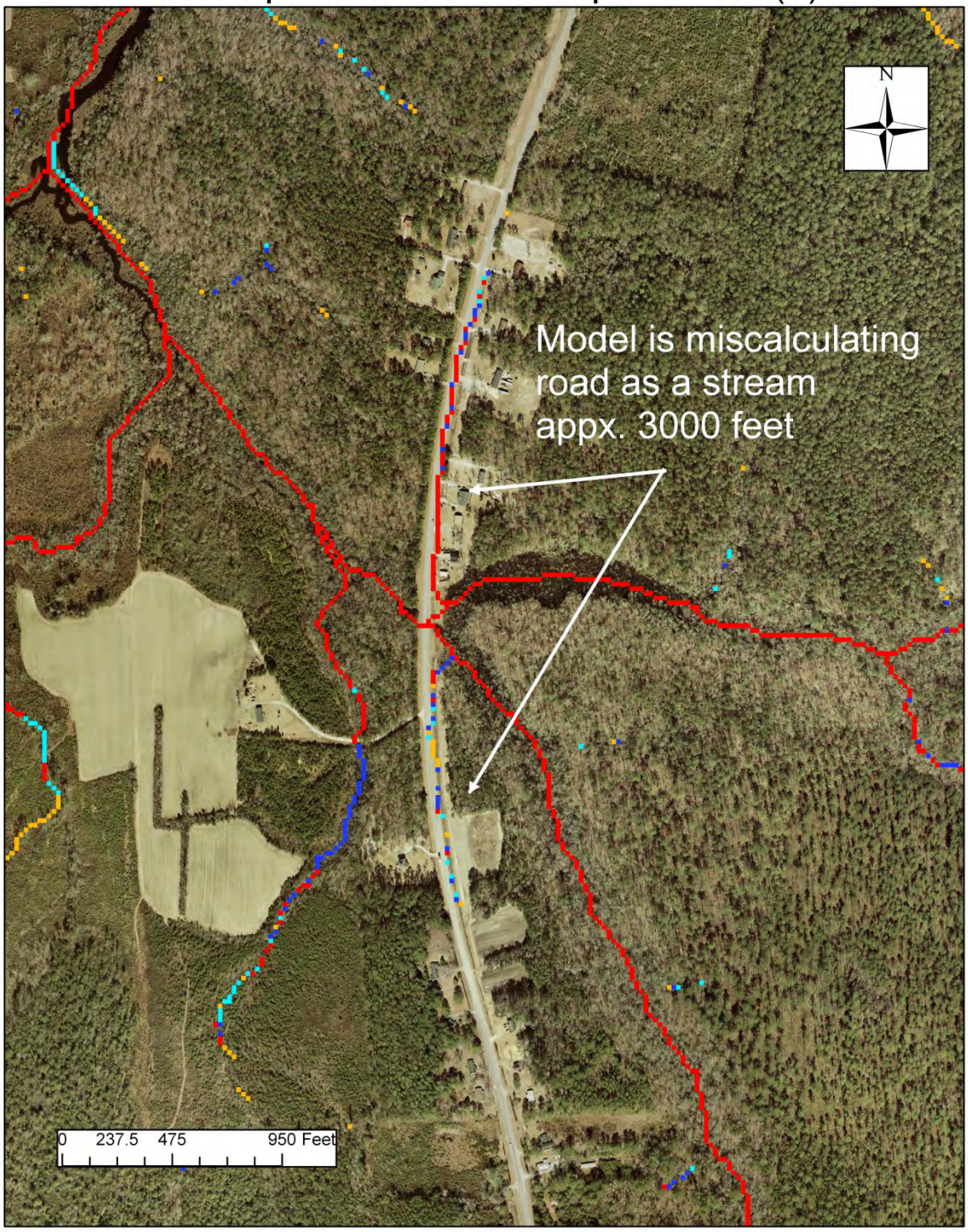

Figure 2

Carolina Flatwoods Headwater Stream Model
Example of Area of Overprediction (2)

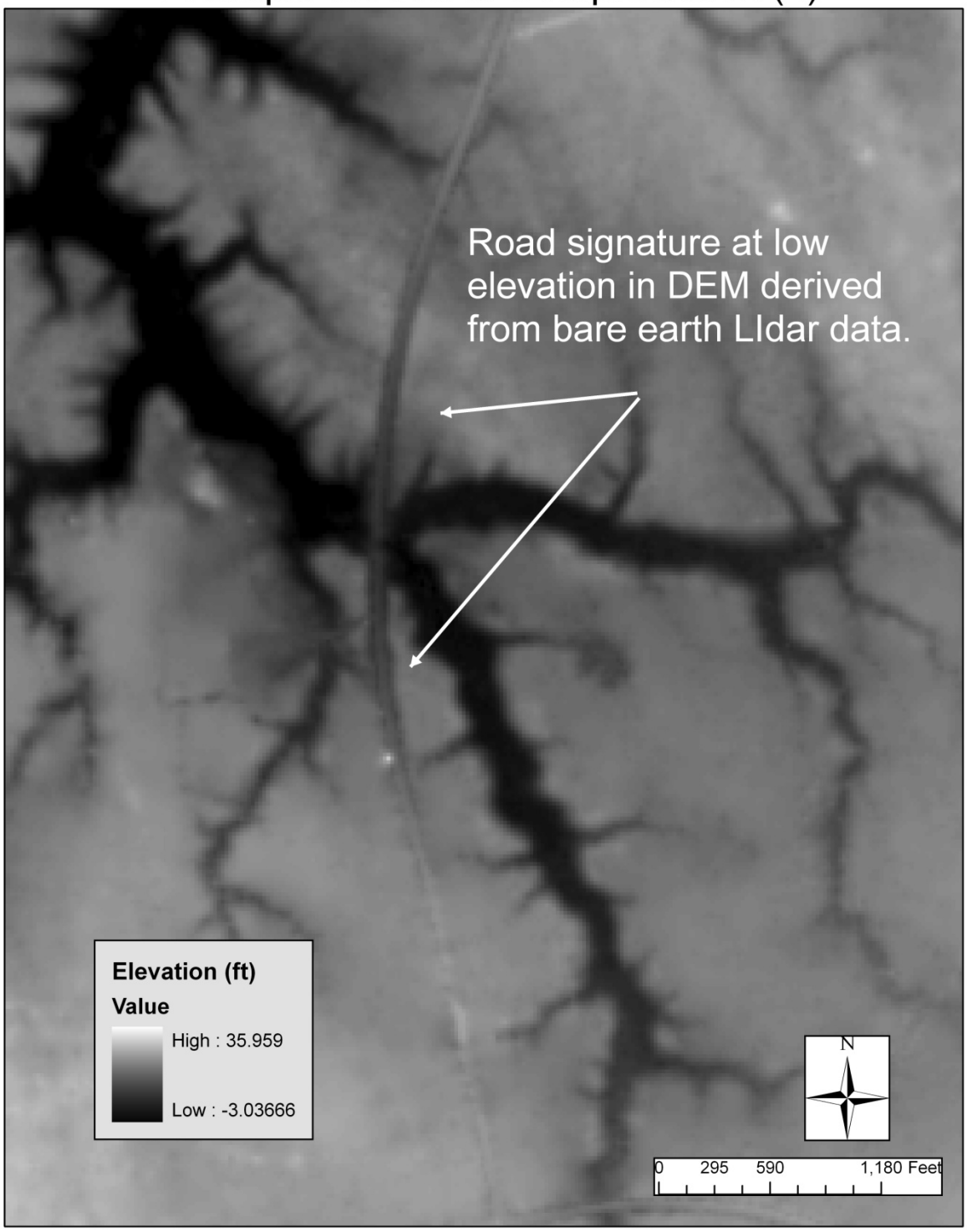

Figure 3

RollingCP_Riparian

Shapefile

Description | Spatial | Attributes

Keywords

Theme: Wetlands

Place: Lenoir County

Description

Abstract

This layer depicts wetlands of Lenoir County and portions of Jones and Craven Counties. These wetland locations were generated by the North Carolina Dept. of Transportation wetland prediction model. The model utilizes 20' grid cell digital elevation models generated from bare-earth LiDAR data and subsequent terrain derivatives as variables. The model may also use Southeast GAP land cover data, NOAA C-CAP land cover data, NC Division of Coastal Managment NC CREWS data and NRCS SSURGO soils data as variables. The model is developed in SAS 9.2 as a binary logistic regression model.

Purpose

These wetland locations were created as part of the Lenoir County GIS pilot project initiated and funded by NCDOT.

Status of the data

Complete

Data update frequency: As needed

Time period for which the data is relevant

Date and time: REQUIRED: The year (and optionally month, or month and day) for which the data set corresponds to the ground.

Description:

publication date

Publication Information

Who created the data: NCDOT- Natural Environment Unit - Indirect and Cumulative Impacts Group

Date and time: 4/15/2011

Data storage and access information

File name: RollingCP_Riparian

Type of data: vector digital data

Data processing environment: Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 3; ESRI ArcCatalog 9.3.1.4000

Accessing the data

Size of the data: 78.970 MB

Data transfer size: 78.970 MB

Constraints on accessing and using the data

Access constraints: None

Use constraints:

These wetland locations are for planning purposes only and do not consistently represent the delineated boundaries as defined by the 1987 US Army Corps of Engineers Wetland Delineation Manual of the wetlands contained herein. Specific locations should be verified if any actions to be taken in proximity of these locations. The North Carolina Department of Transportation shall not be held liable for any errors in this data. This includes errors of omission, commission, errors concerning the content of the data, and relative and positional accuracy of the data. This data cannot be construed to be a legal document. Primary sources from which this data was compiled must be consulted for verification of information contained in this data.

Details about this document

Contents last updated: 20110815 at time 15425400

Who completed this document

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Standards used to create this document

Standard name: FGDC Content Standards for Digital Geospatial Metadata

Standard version: FGDC-STD-001-1998

Time convention used in this document: local time

Metadata profiles defining additonal information

- ESRI Metadata Profile: http://www.esri.com/metadata/esriprof80.html

Appendix E: Records of Field Meetings and Protected Species Determinations

RECORD OF FIELD MEETING

To: Project File

From: Susan Westberry

Date: May 2, 2012

RE: STIP Number R-2553, Kinston Bypass, Lenoir County, North Carolina
Stream and Wetland Modeling Verification and Field Spot Checking

Two meetings were held on Wednesday, April 11, 2012 and Thursday, April 19, 2012 at the project site in Kinston, NC. The meeting began at the District Engineers Office on Hwy 258 at 9:00am. Attendees of the meeting are listed below:

LeiLani Paugh	North Carolina Department of Transportation Natural Environment Section (NCDOT)
Morgan Weatherford	NCDOT
Tom Steffens	United States Army Corp of Engineers (USACE)
David Wainwright	North Carolina Department of Environment and Natural Resources Division of Water Quality (NCDWQ)
Sandy Smith	Axiom Environmental
Susan Westberry	URS

Purpose of Meeting

The purpose of the field meetings was to verify and spot check the accuracy of the wetland model being used by NCDOT to assess wetland impacts for the project.

The intent of the first field meeting was for NCDOT to show the USACE and NCDWQ (agencies) five sites where the wetland model had issues and/or inaccuracies. These sites were chosen by NCDOT as 'problem areas.'

The intent of the second field meeting was to allow the agencies to choose sites that they wanted to visit based on the mapping provided by NCDOT.

General Overview of Meeting #1

The meeting began with discussion about the modeling efforts to date, project mapping, and potential issues NCDOT has seen with the modeling. Mr. Weatherford detailed the modeling methodologies and provided mapping of each of the five sites the group was to visit during the meeting.

The sites chosen included 'fringe' areas where the modeling had potential to be inaccurate. These sites included areas within pine plantations that could be impacted by ditching, sites near agricultural fields containing ditches, and pine flats. Overall, the model was found to be fairly accurate and both the USACE and NCDWQ expressed confidence in the model.

Discussions also included the development of a new model, a 'ditch' model. The intent of the 'ditch' model is to locate areas that have been modeled as wetlands by the wetland model where drainage features have negatively affected the hydrology of the site. The USACE and NCDWQ are both very interested in seeing the results of this model. It was also determined that the 'ditch' model should be referred to as the 'linear drainage model' as it does not determine the jurisdictionality of a feature.

NCDOT has contracted consultants to digitize the linear drainage features within the study area. Once the features have been delineated, NCDOT will develop a model that will adjust the wetland model according to the location of drainage features that may be removing hydrology from the wetlands.

The meeting concluded with NCDOT providing USACE and NCDWQ mapping to assist them in choosing the sites to be visited during the second field meeting. NCDOT expressed that they wish to be transparent with the agencies throughout this process and that they value their input and opinion during the field investigations.

General Overview of Meeting #2

Meeting #2 began with discussions between the agencies and NCDOT regarding the sites that were to be visited. The USACE chose sites that were within the delineated 'riparian' area, adjacent to wetlands, but not modeled as wetlands. There was also a site that was suspect of being candidate for the 'ditch' model that the agencies wished to visit to determine if it should be removed by the ditch model. The intent was to locate sites where NCDOT and the agencies agree that linear drainages are negatively affecting hydrology of wetlands shown by the model in order to spot check the 'ditch' model once it has been completed.

Three sites were visited. NCDOT and the agencies were pleased with what was found at each site. The agencies expressed that the 'ditch' model would be an important component in their confidence with the modeling. No decisions/determinations will be made until the ditch model is complete and more spot checking is accomplished.

The meeting concluded with all agreeing that more field spot checking would be necessary once the ditch model was complete.

Action Items

- NCDOT will continue working on the digitization of the Riparian model. Delineation of riparian zones to be used in NC Wetland Assessment Methodology (NCWAM) wetland classifications could come into play later in the project.
- NCDOT will inform the agencies when the ditch model has been complete. The data will be provided to the agencies once finished so that additional field meetings can be held.
- NCDOT will update mapping/modeling upon the completion of the ditch model.
- Additional field meetings will be needed to spot check the ditch model and address any other concerns the agencies may have.

General Summary

The field exercises provided URS and the agencies with some insight into the accuracy and history of stream and wetland modeling. Model parameters were discussed. The addition of parameters to the ditch model was explored. The utility of such modeling for use in future projects was discussed, as was the agencies' ability to 'sign off' on impacts/alternatives based on such modeling.

Neither agency member is willing to sign off on anything at this point. Both agencies feel the ditch model is going to be an important factor in their decision, and any/all future stream and wetland project decisions.

The ditch model is estimated to be complete sometime during the summer of 2012. Additional field meetings should be anticipated late summer/early fall 2012.

RECORD OF FIELD MEETING

To: Project File

From: Susan Westberry

Date: December 17, 2012

RE: STIP Number R-2553, Kinston Bypass, Lenoir County, North Carolina
Sample NRTR Stream and Wetland Verification and Field Spot Checking

A meeting was held on Thursday, November 29, 2012 at the project site in Kinston, NC. The meeting began at the TradeMark/Hess gas station at the corner of US 258 and US 70 in Kinston at 9:30 am. Attendees of the meeting are listed below:

Chris Manley	NCDOT NES
James Mason	NCDOT NES
LeiLani Paugh	NCDOT Natural Environment Section (NES)
Tom Steffens	US Army Corps of Engineers (USACE)
David Wainwright	NC Division of Water Quality (NCDWQ)
Morgan Weatherford	NCDOT NES
Susan Westberry	URS
Travis Wilson	NC Wildlife Resources Commission (NCWRC)

Purpose of Meeting

The purpose of the field meeting was to verify and spot check the accuracy of the stream and wetland models being used by NCDOT to assess wetland impacts for the project – and in particular, to assess the accuracy of the modeled features within the study area for the Sample NRTR. Additionally, the NCWRC used the field meeting as an opportunity to spot check community classifications identified within the C-CAP data.

The intent of the meeting was to give the NCWRC, NCDWQ, and USACE an opportunity to hand choose sites within the Sample NRTR study area that they would like to view (to verify streams, wetlands, and natural communities/potential T&E habitat).

Five sites were chosen and viewed on November 29, 2012.

All agency members were pleased with the field meeting and instructed NCDOT to proceed with the completion of the NRTR for the entire study area based on the discussions held during the November 27, 2012 Sample NRTR review meeting.

Travis Wilson noted that after seeing the communities within the study area that he would like to look further into the C-CAP classifications and their derivations, but that his exercises were for his knowledge only, and should not delay the project in any way.

RECORD OF FIELD MEETING

To: File

From: Susan Westberry

Date: July 3, 2013

RE: STIP Number R-2553, Kinston Bypass, Lenoir County, North Carolina
NRTR Threatened and Endangered Species Protocol Verification and Field Spot Checking

A meeting was held on Wednesday, May 22, 2013 at the project site in Kinston, NC. The meeting began at the TradeMark/Hess gas station at the corner of US 258 and US 70 in Kinston at 9:30 am. Attendees of the meeting are listed below:

LeiLani Paugh	NCDOT Natural Environment Section (NES)
Morgan Weatherford	NCDOT NES
Tom Steffens	US Army Corps of Engineers
David Wainwright	NC Division of Water Quality
Gary Jordan	US Fish and Wildlife Service
Travis Wilson	NC Wildlife Resources Commission
Susan Westberry	URS

Purpose of Meeting

The purpose of the field meetings was to verify and spot check the accuracy of the protocol being used to assess the presence of habitat for threatened and endangered species in the NRTR study area. This protocol is being used mainly for the identification of habitat for red-cockaded woodpecker, but similar protocols could be developed for other plant and animal species with particular habitat requirements. The GIS-based protocol proposed within the NRTR for this pilot project utilizes C-CAP landcover data in conjunction with aerial photography to screen for potential habitat sites.

A total of 96 potential habitat sites were identified within the NRTR. These sites were developed using the evergreen forest and scrub/shrub landcover types within the C-CAP data coupled with a size threshold of 30 acres and visual screening against aerial photography. URS performed field spot checking of 28 of the potential sites prior to this meeting.

The intent of the meeting was to take the USFWS and NCWRC to a number of the sites that URS had visited during field spot checks to show the agencies 1. What types of habitat the protocol was producing, 2. The habitat features that URS was using to determine the presence or absence of suitable habitat, and 3. To gain information/guidance/acceptance of the protocol in use.

Five sites were chosen and viewed on May 22, 2013. Two additional sites were also visited at the end of the field meeting that occurred within the radius of the previous record of red-cockaded woodpecker for Lenoir County.

USFWS and NCWRC expressed agreement with the protocol being used to assess community types. Gary Jordan offered further guidance that may help to reduce the number of potential habitat areas identified using the protocol. These discussions are summarized below.

Summary of Guidance

- Could discount the need to search for foraging habitat if we could determine the absence of nesting habitat first.
- Suggested a screening for 60+ year pines. If no old pine stands fall within the ½ mile radius, no foraging assessment would be required.
- If we could determine at the onset that no nesting is present, could make a 'No Effect' determination.
- Foraging habitat needs to be connected to suitable nesting habitat – no more than 200 feet of separation.
- RCW are not bothered by human activity. If nesting and foraging habitat are separated by humans (residence, golf course, etc.), potential for colonies does exist.
- If located within the context of a larger pine-dominated landscape of any age, 30 acres minimum of combined nesting and foraging habitat (only a few potential cavity trees are required) would require field investigation to determine the presence or absence of cavity trees.
- If **not** located within the context of a larger pine-dominated landscape of any age a minimum threshold of 75 acres of combined nesting and foraging habitat would be required to trigger the need for field investigation to determine the presence or absence of cavity trees.
- Areas smaller than 30 acres in total wooded size do not need to be assessed. No habitat.
- In even-aged stands, the entire stand can be discounted based on size/age determination. No nesting/cavity searches are needed if it is known the stand is even-aged.

Mr. Jordan stressed that the guidance given during the May 22, 2013 field meeting is guidance applicable to RCW habitat assessments for Lenoir County, and this project in particular. He stated that different protocol would be appropriate for different projects in different parts of the state. This is due to new findings related to RCW and habitat variability in Outer Banks and southeastern counties.

SUMMARY OF FIELD INVESTIGATIONS AND ACTIVITY

To: File

From: Susan Westberry

Date: July 3, 2013

RE: STIP Number R-2553, Kinston Bypass, Lenoir County, North Carolina
Summary of Field Investigations and Activity Since May 22, 2013 T&E Spot Checks

---

Foot surveys for rough-leaved loosestrife were conducted on June 5, 2013. These surveys were conducted within the field/forested edge regions of Leon and Torhunta soils within Craven County identified within the Draft NRTR. No rough-leaved loosestrife plants were identified. The biological conclusion for this species can be changed to **No Effect** within the NRTR.

Thirty additional RCW habitat sites were also spot checked on June 5, 2013. An attempt was made to visit sites 51-70 and 72-81. Eleven of the sites were not accessible due to gated plantation roads. In general, the majority of the sites in the east (Craven and Jones counties) appear to be Weyerhauser property. Many of these are contained within extensive Weyerhauser logging roads. If any of these areas require further investigation in the future, an attempt should be made to obtain keys for these gates.

Sites 68, 69, and 70 should be surveyed for cavity trees if they fall within the range of the LEDPA. These three sites appear to be timber plantation and are also part of the land used by Dover Mosley Creek Hunting Club. These three sites support potential nesting habitat and are contiguous to hundreds of acres of younger plantation.

As a result of the May 22, 2013 field meeting, the District Ranger for the Kinston Area of the NC Forest Service was contacted to obtain timber stand age information. Rhonda Huttlinger was provided with several of the sites visited during the first round of spot checks for RCW habitat. It appears that the NC Forest Service maintains data on privately owned timber plantations, but does not keep data on larger plantations (Weyerhauser properties).

Data provided by the NC Forest Service indicates that our estimations of stand age in the field on May 22 were over-estimates in almost all cases. Site 10 – potential foraging habitat was aged in the field to be 40-50 years. Plantation data show the stand is 25 years old.

Site 17 – field notes indicate that the trees were large enough for cavities but the stand was exceedingly thick. Plantation data show the stand is 24-25 years old.

Site 21 – roadside stand next to golf course neighborhood with large potential cavity trees across the road. Plantation data show 22-23 years old.

An attempt will be made to contact Weyerhauser to obtain timber stand age data for the NRTR study area – particularly sites 68-70.

RECORD OF FIELD MEETING

To: File

From: Susan Westberry

Date: November 7, 2013

RE: STIP Number R-2553, Kinston Bypass, Lenoir County, North Carolina
Remote Wetland Quality Assessment Methodology Field Verifications

A meeting was held on Wednesday, October 23, 2013 at the project site in Kinston, NC. The meeting began at the TradeMark/Hess gas station at the corner of US 258 and US 70 in Kinston at 9:00 am. Attendees of the meeting are listed below:

LeiLani Paugh	NCDOT Natural Environment Section (NES)
Morgan Weatherford	NCDOT NES
David Johnson	NCDOT NES
Tom Steffens	US Army Corps of Engineers
Gary Jordan	US Fish and Wildlife Service
Travis Wilson	NC Wildlife Resources Commission
Susan Westberry	URS

Purpose of Meeting

The purpose of the field meeting was to verify the accuracy of the methodologies developed by NCDOT to remotely assess wetland quality for hydraulic crossings on the project. The methodology is intended to aid in decision making on hydraulic crossings during CP2A. NCDOT developed a form/checklist to evaluate each crossing. The checklist documents wetland stressors and attributes identifiable with GIS data layers. If no stressors or other attributes can be identified to negatively impact wetland quality, the wetland is assumed to be high quality (see form attached).

David Johnson of NCDOT identified five sites to visit during the field meeting (#s 132, 48, 110, 150, and 118). Each of the five sites were different in size and potential stressors. A summary of the discussion at each of the five sites and a general summary of discussions is included below.

Summary of Discussion

- Travis Wilson warned that 'typical' CP2A decisions would not be possible with this limited data. He does not feel comfortable committing to bridge sizes or culvert sized 100% based solely on GIS data.
- It was suggested that crossings could be 'categorized' into broad types.
- Mr. Wilson suggested final length and size decisions be pushed to CP4A.
- Agencies want to be sure that expectations of the types and finality of decisions made at CP2A are understood – agencies want to reserve the right to change their sizing decisions when field verified data are made available (after LEDPA field studies).
- Agencies feel confident that the 'obvious' crossings could be committed to. Definite bridges and areas where minimum hydraulic will be sufficient.
- There will likely be a population of sites left over that will need revisiting once a LEDPA has been chosen.
- These data would be sufficient to make alternative decisions.

- There is concern that stream quality assessments have not been done – only wetlands. For crossings where it is stream only and not wetland, there is no assessment.
- Agencies want reassurance that if poor decisions are made at CP2A, changes can be made at CP4A.
- NCDOT stressed that new information allows for changes to be made to merger decisions and that stream and wetland delineations would constitute new information and allow for changes.
- Travis Wilson would like to push structure decisions until after LEDPA.
- **Agencies request to have more than two weeks lead time with CP2A package.**

Summary of Crossing Sites

#132

'Stressed' crossing. Crossing itself does not require large hydraulic opening, but the riparian structure and floodplain width dictate otherwise. This site is an example of where the decision would likely be different desktop vs. field visit. The width and quality of the wetland and floodplain is not obvious from data.

#48

Triple box culvert now and proposed. Travis Wilson requested that these types of data be provided at CP2A (list of existing and proposed structures).

#110

Existing bridge. This would be a crossing where a decision could be made.

#150

Site had stressors in all three categories. Travis Wilson agreed with culvert call on this location on the ground – not sure if he would be as positive in the office.

A discussion ensued about farm fields having both positive and negative effects from a wildlife perspective – dependent upon surrounding landscape.

#118

A single 6' x 6' proposed for this location. Not sufficient. See photo. Agencies asked how watersheds are being calculated. In this instance, this would be undersized.

Next Steps

- NCDOT to develop 'categories' for lumping of crossing types (for example, bridge, single box, minimum hydraulic, etc.).
- A trial run of sites will be completed prior to CP2A to be sure that 'categories' are sufficient.
- An office meeting to lump sites will be done (similar to what would be done at CP2A).
- A field meeting to each site would occur to verify accuracy of grouping methodology.

Assessor Name:_____ Crossing No:_____

Remote Wetland Quality Assessment Form for Major Stream Crossings

Usage Guidance:

This form seeks to document wetland stressors and attributes identifiable with GIS data layers. If no stressors or other attributes can be identified to negatively impact wetland quality, we will assume the wetland is of high quality.

Terminology, thresholds and criteria are based on definitions provided in NCWAM manual version 4.1.

Potential wetland types for this exercise are assumed to be limited to Bottomland Hardwood, Riverine Swamp Forest, Headwater Forest and Non-Tidal Freshwater marsh.

Wetland type boundaries cannot generally be distinguished with this approach and answers to the questions may be applied to the wetland complex instead.

The following GIS data layers must be acquired to assess the wetlands with this method:

- 2010 Statewide and 2012 Orthoimagery (if available)
- NCDOT Wetland Prediction Model raster
- NLCS SSURGO soils layer
- 2006 National Land Cover Database raster
- USGS 24K hydrography layer
- NCDOT Lateral Effect GIS Model drainage feature layer
- NCDWQ 303D stream layer
- NCNHP Elemental Occurrence layer
- NPDES Point Source layer
- NCDMF Anadromous Fish layer
- NCDMF Fish Nursery Area layer
- NCDENR Animal Feeding Operation Permits layer
- Other layers that may identify the site as federally or state-owned or conservation area

Consider the three major functions of wetlands according to NCWAM and identify the stressors/attributes that may affect those functions.

Hydrologic Function

1) Is there any evidence the vegetation is severely altered?

☐Yes ☐No

2) Is there any evidence of extensive ditching or fill?

☐Yes ☐No

3) Is there any evidence of long duration inundation or saturation?

☐Yes ☐No

4) Is there any evidence the over-land or over-bank flow is severely altered?

☐Yes ☐No

Notes:_____

_____

_____

Water Quality Function

1) Record the total lateral width of wetland in feet: _____

(include width from both sides of stream, if applicable)

2) Record the estimated width of the actual channel in feet: _____

3) Based on canopy coverage, do the roots of the vegetation appear to extend into the bank of the tributary?

☐Yes ☐No

Notes:_____

_____

_____

Habitat Function

1) Record the estimated size of the wetland in acres: _____

2) Is the wetland well connected to ≥100 acres *or* loosely connected to ≥500 acres of landscape patch?

☐Yes ☐No

3) Is there an artificial edge within 150 feet in four or more directions *or* is the wetland clear-cut?

☐Yes ☐No

Notes:_____

_____

_____

Opportunity-Watershed Landuse

Execute NCDOT's Watershed Landuse Calculator tool which provides a report that answers NCWAM question 6. The report should be pasted below and used to interpret the wetland's opportunity to improve water quality in the wetland assessment report.

Notes:_____

SUMMARY OF T&E DETERMINATIONS

To: File

From: Susan Westberry

Date: November 19, 2013

RE: STIP Number R-2553, Kinston Bypass, Lenoir County, North Carolina
Summary of T&E Determinations

A summary of field investigations and activities pertaining to T&E investigations for the R-2553 Kinston Bypass project was distributed on June 12, 2013. A Section 404/NEPA Interagency Merger Process Team Informational Meeting was held on June 13, 2013. During the Informational Meeting, T&E investigations and summaries were discussed with the team. One of the conclusions made during field investigations and site visits with the USACE, NCDWR, USFWS, and NCWRC was that screening for pines younger than 60 years of age may be necessary within the project area due to the larger size of some of the younger-aged pine stands. It was preliminarily suggested that screening would be needed for pines in the 30-40 year age range. URS and NCDOT recommended dropping the age of stands from 60 years to 30 to 40 years for identifying potential RCW nesting areas.

In an email dated June 20, 2013, Gary Jordan of USFWS advised that upon further investigation, RCW will not nest in trees younger than 60 years of age regardless of their diameter. RCW require thick heartwood in which to nest. Heartwood is thin in young trees and increases in width as trees age. In younger trees, the sapwood is too thick for RCW to nest. If it can be determined that there is no nesting habitat within the survey area, there is no need to search for foraging habitat.

Based upon Mr. Jordan's statements above, it was determined that further field spot checks and/or investigations may not be needed if forest stand age could be determined based on either aerial photography or landowner information. URS had been in touch with Rhonda Huttlinger, the District Ranger with NC Forest Service (rhonda.huttlinger@ncagr.gov; 252-520-2400). Ms. Huttlinger was able to provide stand age for some tracts visited during spot checks where the team (USACE, NCDWR, USFWS, NCWRC, NCDOT, and URS) felt that trees would be sufficiently large enough for nesting. Information provided by Ms. Huttlinger verified that these stands were all within the 20-30 year age range. Further field spot checks performed by URS located several stands in the southern and eastern portion of the study area with trees that appeared to be sufficiently large for nesting. Most of the timber land in the southern and eastern portions of the study area is owned by the Weyerhaueser Paper Company.

URS contacted Jessica Homyack, the Southern Wildlife Program Leader with Weyerhaueser on November 7, 2013 (jessica.homyack@weyerhaueser.com; 252-633-7525). Ms. Homyack was not able to issue specific stand information due to their confidentiality policies, but was able to provide the following statements pertaining to RCW on their lands in Lenoir, Jones, and Craven counties:

- There are no records of RCW within any of their timber stands.
- Typical rotation lengths for their stands are between 20 and 30 years.
- They do have some 'natural' stands which get to be 50 or 60 years old, but they are not maintained and are often a dense mixture of pine and hardwood species.
- They provide some known foraging habitat adjacent to the Croatan National Forest, but that is the only RCW in the vicinity of any of their lands that they are aware of.

- Weyerhaueser contractors are trained to look for signs of RCW in all of their stands prior to harvesting; Ms. Homyack is consulted if RCW are suspected.

Based on URS' previous investigations and the forest size and structure that has been observed within the study area coupled with the information that Ms. Huttlinger and Ms. Homyack have provided, URS has concluded that T&E investigations for RCW habitat can be concluded at this time. The largest trees observed have been within stands that were less than 30 years old (as verified by Ms. Huttlinger and Ms. Homyack). URS has determined there is no potential nesting habitat within the study area and, therefore, no need to search for foraging habitat. In an email dated November 15, 2013, NCDOT agreed with URS' conclusion.

Once a LEDPA has been selected, URS/NCDOT should request specific stand information from both the NC Forest Service and Weyerhaueser to confirm that conditions have not changed. The Biological Conclusion for RCW will be left 'unresolved' until a LEDPA has been chosen.