CROATAN WETLAND MITIGATION BANK
Craven County, North Carolina

TIP No. R-1015 WM

Consultant Project No. 98-ES-07

The North Carolina Department of Transportation
Raleigh, North Carolina

September 2000

Table of Contents

List of Figures

List of Tables

List of Appendices

Wetland Mitigation Plan
Croatan Wetland Mitigation Bank
Craven County, North Carolina
T.I.P. Number R-1015WM

1.0 INTRODUCTION

The North Carolina Department of Transportation (NCDOT) recognizes in fulfilling its public service mission of roadway and other transportation constructions, it has an important responsibility to protect the State's environment and to protect the State's wetland resources in a prudent manner in compliance with applicable State and Federal law. The Croatan Wetland Mitigation Bank (CWMB) is proposed for use in providing in-kind compensatory mitigation for unavoidable wetland impacts on NCDOT projects for which no on-site, in-kind mitigation is available.

General Assembly House Bill 399, ratified in 1989, provides for the establishment of the North Carolina Highway Trust Fund. This fund was established to facilitate the development of free-flowing, safe intrastate travel for motorists, and to support statewide growth and development objectives. In 1999 the North Carolina Board of Transportation adopted the 2000-2006 Transportation Improvement Program (TIP), the NCDOT's blueprint for statewide transportation projects. The TIP also sets aside funding for environmental protection, including wetland mitigation. As part of the 2000-2006 TIP, the NCDOT is planning roadway improvement projects in the eastern portion of North Carolina. Locating suitable on-site/in-kind compensatory mitigation sites is sometimes difficult for projects involving wetland impacts.

NCDOT is attempting to establish up-front mitigation in regions of North Carolina projected to receive multiple roadway improvement projects. In 1997, NCDOT commissioned a preliminary feasibility investigation of an approximately 4035-acre (ac) site in Craven County that resulted in the identification of the subject site as a property suitable for the development of a wetland mitigation bank. Following more detailed site investigations (1998-2000) the NCDOT is now preparing to develop the subject site as the CWMB (Figure 1-1).

NCDOT contracted Environmental Services, Inc., (ESI) to provide assistance with wetland restoration components of the mitigation plan. Additional technical expertise was provided by Eddy Engineering, P.C. (Eddy), to model surface water hydrology and develop the conceptual mitigation design.

The purpose of this document is to: 1) describe existing conditions at the CWMB, including a summary of wetland component analysis; 2) present a mitigation plan for restoring, enhancing, and preserving nonriverine wetlands and riverine wetlands; and 3) present a plan for monitoring and measuring success of the mitigation efforts.

2.0 METHODS

The site assessment included a review of existing background material as well as intensive field investigations. A preliminary feasibility study was conducted between June and August 1997, with a report of findings and recommendations provided to NCDOT in September 1997 (ESI 1997).

When NCDOT initiated CWMB planning in 1997, the goal was to segment the CWMB into smaller, more manageable phases for implementation. The preliminary feasibility study identified three phases for sequential development and implementation of mitigation plans. Preliminary data collection was initiated for the approximately 1,470-acre Phase I area in 1998. Results of the Phase I investigation were provided in series of summary reports (ESI 1998; Eddy 1998; ESI 1999a) Subsequently, a comparable level of documentation and planning was requested for the remaining phases of CWMB as part of the approval process for the mitigation banking process. The remaining 2,565 acres were combined into Phase II and preliminary data collection was initiated in 1999. Results of this investigation were provided in a series of summary reports (ESI 1999b; ESI 2000a; ESI 2000b; Eddy 2000). The present document summarizes existing site conditions, summarizes wetland investigations, and provides a mitigation plan for both Phase I and Phase II of the CWMB.

2.1 Physiography, Topography, and Land Use

General topographic information was obtained from U.S. Geological Survey (USGS) topographic mapping. Detailed topographic mapping was developed for portions of the CWMB by NCDOT using aerial photography and land elevation surveys. Land surveys were used to obtain accurate land surface elevations along a series of 29 transects established through densely vegetated portions of the CWMB. Additional land surveys were performed to obtain accurate land surface elevations at groundwater piezometers, within streams and ditches, and Long Lake.

A mosaic aerial photograph provided by NCDOT (photo date March 7, 1997) was used to assist in mapping relevant environmental features. Additional aerial photographs (January 9, 1994) obtained from Weyerhaeuser Company and historical aerial photographs (1949, 1958, 1964, 1970, 1974, and 1981) obtained from the Craven County Natural Resource Conservation Service (NRCS, formerly Soil Conservation Service) office were used to document recent on-site changes. The 1974 aerial photograph is the base used in the current county soils map (USDA 1989); the other aerial photographs are presented in Appendix A.

The CWMB has been sectioned into two phases (see Figure 3-1) for proposed planning and implementation activities. Proposed phasing allows for progressive watershed control and hydrologic management beginning in upper reaches of the watershed and proceeding down-slope. Each phase has been subdivided into

discrete sections (Management Units). The use of Management Units facilitates data presentation and analysis. Management Units are typically bounded by roadside ditches or other major ditches; larger Management Units have been subdivided into subsections (i.e., MU12A and MU12B) utilizing surveyed transects as subsection boundaries.

2.2 Geology

Investigations were conducted to evaluate subsurface and hydrogeological conditions on the CWMB. These investigations were undertaken to: 1) evaluate local geology, including determination of the extent and condition of shallow clay layers; 2) evaluate the degree of soil degradation; 3) evaluate local hydrogeology, including groundwater flow patterns; 4) model predicted drainage for existing conditions and post-restoration conditions; and 5) to evaluate hydraulic trespass issues. This investigation also was used to provide data and recommendations for facilitating completion of the mitigation plan. More detailed discussions of groundwater and subsurface investigations are provided in Section 4.1.

2.3 Water Resources

Water quality information for area streams and tributaries was derived from available sources; quantitative sampling was not undertaken to support existing data. Stream channels on the CWMB were delineated, mapped using GPS technology, and classified using the Natural Stream Channel Classification System (Rosgen 1996). The classification effort was a Level I classification, consisting of a general description of channel type without detailed measurement. Physical descriptions of water resources and quality information are provided in Section 3.3.

Surface water investigations were undertaken to: 1) determine the area contributing runoff to the CWMB; 2) develop a means to predict flood flows within and around the CWMB; 3) select locations and types of site modifications to the existing road and ditch system needed to enhance or restore wetland hydrology; and 4) determine if increased peak flood flows are likely after site modifications, because of the increase in soil moisture and the large percentage of the drainage area that will be wetlands. More detailed discussion of the surface water investigation is provided in Section 4.2.

2.4 Soils

Preliminary studies of the CWMB utilized existing soils mapping (USDA 1989) to determine the extent of hydric soils. Mapping indicated nonhydric soils were a minor component of the CWMB. Mapped nonhydric soil areas and soil series with the potential for nonhydric soil inclusions were investigated, confirmed, field delineated, and mapped using GPS technology.

Initial subsurface investigations revealed that organic soil series have been severely degraded due to the lack of hydrology. Additionally, during well installation several

boring profiles were found not to match typical pedon descriptions as published by the NRCS (USDA 1989). During the course of field data collection for mitigation planning, a series of 396 shallow soil borings were established across the CWMB, to better define existing soil boundaries. NRCS mapping was modified if sufficient data were available to indicate a different soil series than published data indicated. Several areas were found to be nonhydric soil pockets not shown on NRCS mapping. Some areas containing organic soils were found having up to six feet of organic material oxidized; these areas were no longer conforming to published typical pedon descriptions and physical characteristics.

Modifications were made to update soil mapping for use in DRAINMOD modeling. This refinement of the published county soils mapping was conducted under the direction of a State of North Carolina Licensed Soil Scientist. Descriptions of soils of the CWMB are provided in Section 3.4.

2.5 Plant Communities

Existing plant communities within the CWMB were mapped. Plant community descriptions are based on a classification system utilized by North Carolina Natural Heritage Program (NHP) (Schafale and Weakley 1990). When appropriate, community classifications were modified to better reflect field observations. Descriptions of existing plant communities within the CWMB are provided in Section 3.5.

To aid in developing a planting plan, 146 vegetation evaluation plots were established across the CWMB. The vegetation sampling was conducted to quantify the structural layers of vegetation in a given area. Vegetation sampling was conducted using a plot method. Trees and shrubs within the respective plots were identified to species and diameter at breast height (dbh) recorded. Importance values were generated for the tree and shrub values. Importance values are an index generated for a species based on relative density, relative frequency, and relative dominance. Groundcover species occurring within the shrub plots were recorded and relative dominance noted.

2.6 Wildlife

Wildlife sightings were documented during the course of field investigations. These observations were mostly incidental to other efforts. Techniques used to document terrestrial wildlife included visual observations, identification of bird and frog calls and songs, and identification of tracks and scat. Cursory sampling of aquatic wildlife was conducted through the limited use of dip nets, seines, and backpack electroshocker.

2.7 Threatened and Endangered Species

NHP records were consulted for the presence of federal and state listed species as well as to identify designated natural areas that may serve as reference (relatively

undisturbed) wetlands for restoration design. Protected species surveys were undertaken for federally protected species for which potentially suitable habitat was identified on the CWMB. A discussion of threatened and endangered species is provided in Section 3.7.

2.8 Wetlands

U.S. Fish and Wildlife Service (FWS) National Wetlands Inventory (NWI) mapping, USGS topographic mapping, and NRCS soil survey were consulted at the onset of the investigation to determine the approximate extent of potential wetland areas on the CWMB. The field delineation of jurisdictional areas was conducted using the three parameter approach (hydrophytic vegetation, hydric soils, wetland hydrology) following U.S. Army Corps of Engineers (COE) delineation guidelines (DOA 1987).

Beginning in 1998 and continuing into 2000, Remote Data Systems (RDS) continuous monitoring wells were installed throughout the CWMB in selected locations to assist in jurisdictional hydrology determination efforts. A total of 156 monitoring well stations were established, including five on-site and five off-site hydrology reference stations. The monitoring well stations also provide data for baseline hydrology conditions under pre-mitigation conditions.

The jurisdictional wetland delineation has been reviewed by the COE. Details of the jurisdictional delineation have been provided in summary report (ESI 2000b). A discussion of the jurisdictional wetlands of the CWMB is provided in Section 3.8.

2.9 Cultural Resources

To assist in planning for the CWMB, an archaeological reconnaissance survey of the approximately 4035-acre site was conducted in June 1999. The goal of this field and background study was to evaluate the potential of the CWMB to contain significant prehistoric and historic cultural resources. The results of this investigation were provided in a report to NCDOT (ESI 1999b). A summary of the cultural resource investigation is provided in Section 3.9.

2.10 Hazardous Materials

A preliminary evaluation was conducted during the preliminary feasibility investigation (ESI 1997) to determine whether implementation of wetland mitigation activities on the CWMB could be affected by the presence of hazardous materials. The preliminary hazardous materials assessment included a limited on-site evaluation of the CWMB along with a review of agency file information. Database research included review of the National Priorities List (NPL) (search radius 1.0 mile), Active and Inactive Superfund Sites Lists (search radius 0.5 mile), Hazardous Waste Notifiers List (search radii 0.5 mile for generators, 1.0 mile for transporters, storers, disposers [TSDs]), and the Leaking Underground Storage Tank (LUST) Incident Lists (search radius 0.5 mile). A summary of the hazardous materials evaluation is provided in Section 3.10.

2.11 Key Project Personnel

2.11.1 Environmental Services, Inc.

Kevin Markham served as project manager for this investigation and mitigation plan development. Mr. Markham has a M.S. in Marine Biology with a concentration in Coastal Ecology from the University of North Carolina at Wilmington. He has more than 12 years professional experience with natural resource investigations, wetlands, threatened and endangered species, and mitigation planning and monitoring.

Brian L. Hayes, P.G., conducted the Hydrogeological Site Assessment. Mr. Hayes has a B.S. in Geology from North Carolina State University and is licensed to practice geology in North Carolina (License # 1018). Mr. Hayes has over 14 years of experience conducting geological and hydrogeological investigations in the Blue Ridge, Piedmont, and Coastal Plain Physiographic Provinces of North Carolina.

Jan U Gay, Licensed Soil Scientist (North Carolina License # 1158), supervised the soil characterization efforts, monitoring well installation, and planting plan data collection. Mr. Gay has a M.S. in Forestry from Clemson University with a research emphasis in Landscape Ecosystem Classification. Mr. Gay has over 8 years of professional experience in the Southeast in soils assessments, forestry, wetlands, and natural resource investigations.

Greg C. Smith, a Registered Professional Archaeologist, conducted the cultural resource investigation. Mr. Smith has a Ph.D. in Anthropology from the University of Florida. Mr. Smith has over 20 years professional experience conducting and managing cultural resource management projects throughout the Southeast.

Matthew K. Smith supervised much of the jurisdictional delineation, vegetation characterization, and threatened and endangered species surveys. Mr. Smith has a B.S. in Marine Biology from the University of North Carolina at Wilmington and more than 5 years professional experience in natural resources, wetlands, and threatened and endangered species.

B. Gail Tyner supervised the monitoring well data collection and compilation, and assisted with jurisdictional delineation and threatened and endangered species surveys. Ms. Tyner has a B.S. in Fisheries and Wildlife from North Carolina State University and more than 2 years professional experience in natural resource investigations, wetlands, and red-cockaded woodpecker evaluations.

Joseph (Josh) Witherspoon, a North Carolina Soil-Scientist-in-Training, assisted with the soil characterizations, well installations, and jurisdictional delineation. Mr. Witherspoon has a B.S. in Natural Resources with a concentration in Soils and

Water Systems from North Carolina State University. Mr. Witherspoon has more than 3 years professional experience in soil investigations, wetlands, and natural resource investigations.

Clay H. DeVane, a North Carolina Soil-Scientist-in-Training, assisted with the soil characterizations, well installations, and jurisdictional delineation. Mr. DeVane has a B.S. in Natural Resources with a concentration in Soils and Water Systems from North Carolina State University. Mr. DeVane has more than 2 years professional experience in soil investigations, wetlands, and natural resource investigations.

Kevin D. Lapp assisted with the jurisdictional delineation, well installations and monitoring, and natural resource investigation. Mr. Lapp has a M.S. in Biology from Appalachian State University and more than 2 years professional experience in natural resource investigations, wildlife biology, and habitat management.

2.11.2 Eddy Engineering, P.C.

John L. Eddy, P.E. (NC License No. 17604) has a M.S. degree in Geotechnical and Water Resources Engineering from North Carolina State University and is licensed to practice engineering in North Carolina, Virginia, and Florida. Mr. Eddy is a civil engineer experienced in geotechnical engineering, hydrologic engineering, hydraulic engineering, and dam engineering. He has performed engineering investigations, analyses, design, or evaluations on building, roadway, dam, pipeline, airport, harbor, stream, wetland, and landfill projects. He has over 12 years of experience on projects representing a wide range of locations including Coastal Plain, Piedmont, and Mountain physiographic provinces in several states.

Patrick K. Smith, P.E. (NC License No. 25525) has a M.E. degree in Civil Engineering with a concentration in Environmental and Hydrologic Engineering from Clarkson University and is licensed to practice engineering in North Carolina. Mr. Smith is a civil engineer experienced in hydrologic engineering, hydraulic engineering, and dam engineering. He has performed engineering analyses and design on streams, wetlands, open and closed stormwater systems, dams, and sediment and erosion control projects. He has over 13 years of design and construction management experience on projects representing a wide range of domestic and overseas locations.

Christopher G. Ply, E.I.T. has a M.S. degree in Structural Engineering from North Carolina State University. Mr. Ply is a civil engineer experienced in foundation engineering, structural concrete design, and hydrologic engineering. He has performed engineering analyses and design on wetlands, dams, and concrete structures to include foundations, retaining walls, headwalls, and dam spillways.

2.11.3 North Carolina Department of Transportation

Clarence Coleman, P.E. (NC License No. 22954) serves as the NCDOT project manager. Mr. Coleman has a B.S. degree in Civil Engineering from North Carolina State University. He has been employed by the NCDOT since 1992. He currently serves as a Natural Systems Engineer in the Natural Systems Unit of the Project Development and Environmental Analysis Branch. His major duties include management of the planning, design, implementation, and monitoring of NCDOT mitigation projects.

Previous NCDOT project managers have included Tanner Holland, Kelly Williams, and Robin Little.

3.0 EXISTING CONDITIONS

The CWMB constitutes a contiguous parcel of approximately 4035 ac located approximately 3.6 miles (mi) northwest of the City of Havelock in Craven County (Figure 1-1). Specifically, the CWMB is located between the northeastern shore of Long Lake and East Prong Brice Creek at Catfish Lake Road (SR 1100).

3.1 Physiography, Topography, and Land Use

The CWMB is located in the Atlantic Coastal Plain Physiographic Province of North Carolina within the lower portion of the Neuse River Drainage Basin. The CWMB is included in USGS hydrologic cataloging unit 03020204 which includes watersheds of the Neuse and associated tributaries from the Pamlico Sound upstream to New Bern.

USGS 7.5-minute topographic mapping (Havelock, NC and Catfish Lake, NC) shows the CWMB as nearly level with a gradual down-gradient slope from Long Lake at 38 feet (ft) above mean sea level (MSL), north to East Prong Brice Creek at approximately 20 ft MSL (Figure 3-1). This elevation difference equates to approximately 18 ft over a distance of approximately 17,000 ft, for an average land slope of 0.001 ft per ft rise/run.

The northeastern shore of Long Lake forms the southern boundary of the CWMB. U.S. Department of Agriculture (USDA) Forest Service lands border the entire western and northern boundaries of the CWMB and much of the eastern boundary. A single private holding abuts the CWMB along the southeastern boundary. The only other non-Forest Service tract adjoining the CWMB is a tract located along the central portion of the eastern boundary; this tract was purchased by NCDOT as part of right-of-way acquisition for the planned Havelock Bypass (T.I.P. R-1015).

Land use of the CWMB under previous ownership was for timber production and recreational hunting. A hunting lodge and associated out-structures (sheds, dog pens) are located in the southwestern portion of the CWMB on the shore of Long Lake. A Carolina Power & Light (CP&L) power transmission line, with 170 ft of associated cleared easement, crosses the northern portion of the CWMB.

The Forest Service lands and private holding that border the CWMB appear to be used for timber production and recreational hunting. The designated Sheep Ridge Wilderness Area, located west of the CWMB, is separated from the CWMB by a buffer of other Forest Service land; this buffer generally increases in width from approximately 400 ft wide at Long Lake to 8000 ft wide at Catfish Lake Road. Residential development occurs within 1.0 mi to the east of the CWMB along US 70, and along Catfish Lake Road (SR 1100) to the northeast; the proportion of landscape occupied by residential, commercial, and military development progressively increase eastward towards Havelock and Cherry Point.

3.2 Geology

The North Carolina Geological Map (Brown *et al.* 1985) describes the primary geologic unit in the vicinity of the CWMB to be the Yorktown and Duplin Formations, Undivided, of Tertiary Age. The Yorktown Formation is described as a fossiliferous clay with varying amounts of fine-grained sand, bluish-gray (gleyed), with shell material commonly concentrated in lenses, and mainly present in areas north of the Neuse River. The Duplin Formation is described as a bluish gray, shelly, medium to coarse grained sand, sandy marl, and limestone occurring mainly in the area south of the Neuse River (Brown *et al.* 1985).

The subsurface investigation revealed that deeper sediments become gleyed in color and consist of marine sediments. The underlying Geologic Formation at the CWMB was confirmed as the Tertiary-aged Yorktown and Duplin formation. Geological cross sections of the CWMB are presented in *the Subsurface Investigation and Hydrogeological Assessment* (ESI 2000a).

Soil borings in the Phase I area revealed shallow clay in numerous locations at depths ranging from 0.5 to 5.5 ft below land surface. The borings installed during soil mapping indicate that the shallow clays are generally localized and are not present as a continuous stratum. At several other locations clay was not encountered until reaching a clay layer within the Yorktown/Duplin Formation at depths ranging from 11 to 45 ft below land surface. The type and thickness of the shallow clay varied from organic rich mucky clay to stiff, plastic, silty clays.

Soil borings in the Phase II area, which is farther north and more distant from Long Lake, encountered shallow clay layers at depths ranging from 0.5 to 5.5 ft below land surface at several locations. The borings installed during soil mapping indicate that some of the shallow clays are generally localized and are not present as a continuous stratum. In all borings below the clay bearing stratum, an unconsolidated sand was encountered at an average depth of 5 ft below land surface that prevented further advance of the hand auger borings. This sand was also present in the other boring locations in the Phase II area.

In some locations, the clay layer extended below the invert of the nearest ditch/canal, while in others it did not. In areas where the inverts of the ditches are below the bottom of the shallow clay layer, a hydraulic connection between the upper and lower shallow saturated zones would have been established. These areas are discussed in Section 4.1. Section 4.1 also summarizes the results of the detailed investigations of subsurface and hydrogeological investigations conducted for the CWMB (ESI 2000a).

3.3 Water Resources

A summary is provided of surface waters present on the CWMB (Section 3.3.1), water quality (Section 3.3.2), and Neuse River Drainage Basin Buffer Rules (Section 3.3.3). A summary of the results of more detailed investigations of surface waters is presented in Section 4.2.

3.3.1 Surface Waters

The northeastern shore of Long Lake forms the southern boundary of the CWMB. Long Lake is located at a higher elevation than most of the CWMB and is presumed to have provided a substantial amount of radial to lateral groundwater flow into the historic wetlands. Long Lake is approximately 1125 ac in size with an average depth of 3 feet and a maximum depth of 5 ft (DEHNR 1996). Groundwater flow from Long Lake historically extended through Gum Swamp and into East Prong Brice Creek.

Two main stream channels are present on the CWMB or form part of the boundary. These streams are East Prong Brice Creek and an unnamed tributary to East Prong Brice Creek (hereafter referred to as the Oates Branch). In total, approximately 15,030 linear feet of stream channel exists within the CWMB or form part of the boundary.

East Prong Brice Creek, which originates on the CWMB, forms part of the northeastern boundary of the CWMB. Approximately 8,770 linear feet of stream channel comprises the northeast boundary; most of the stream channel along the boundary has been channelized and straightened. Additionally, 720 linear feet of the stream channel of East Prong Brice Creek occurs from the origin on the CWMB to the boundary and an additional approximately 153 linear feet of a side branch to the main channel also occurs on the CWMB.

- From its origin to the CWMB boundary, East Prong Brice Creek has been classified as an **"E"** channel. **"E"** type streams are gently to moderately sloped, relatively deep and narrow, slightly entrenched channels with high sinuosity. From the point where it begins to follow the CWMB boundary downstream to the boundary between Management Units 2A and 2B, East Prong Brice Creek has been channelized and is contained within large berms. This segment alternates between a **"B"** channel and **"G"** channel, depending on site specific conditions. **"B"** type streams are moderately sloped, relatively wide and shallow, moderately entrenched channels with low to moderate sinuosity. **"G"** type streams are moderately to gently sloped, relatively deep and narrow, highly entrenched, moderately to highly sinuous channels. East Prong Brice Creek alternates between an "E" channel and **"C"** channel for most of its length from the 2A/2B boundary downstream to the crossing at Catfish Lake Road. **"C"** type streams are gently sloped, relatively wide and shallow, slightly entrenched channels with moderate to high sinuosity.

The Oates Branch is located in the northern portion of the CWMB. The Oates Branch flows northward from its origin on the CWMB to its confluence with East Prong Brice Creek along the CWMB property boundary near Catfish Lake Road. The entire main stream channel for the Oates Branch, which is approximately 4,434 linear feet, is contained on the CWMB. Approximately 275 feet of the total represents an impounded stretch where the channel was not mapped. An additional approximately 578 linear feet of side branches to the main channel also occur on the CWMB. Ditching through the headwaters of this system has intercepted a substantial amount of groundwater and surface water flow, effectively isolating the Oates Branch from most of its historic watershed.

- The Oates Branch alternates from a **"DA"** channel to a **"C"** channel from its origin to the center of Management Unit 5. **"DA"** type streams are highly interconnected, very gently sloped channel systems associated with broad, unconfined valleys with well-developed floodplains. From the center of Management Unit 5 downstream to the boundary between Management Units 5 and 2A, the Oates Branch is characterized as a **"C"** channel. Downstream from this point to its confluence with East Prong Brice Creek, the Oates Branch has been subjected to impoundment activities by beavers.

A large portion of the interstream area between Long Lake and the headwaters of East Prong Brice Creek is dominated by the remains of Gum Swamp, which historically appeared to be a large, nonriverine forested wetland system.

3.3.2 Water Quality

East Prong Brice Creek has not been assigned a stream index number or separate best use classification by the Division of Water Quality, but carries the same **C Sw NSW** classification as Brice Creek (stream index number 27-101-40-[1]) (DEM 1993a). Gum Swamp and Long Lake (stream index number 27-101-40-2) have been assigned the same **C Sw NSW** classification. Class **C** waters are freshwaters protected for secondary recreation, fishing, aquatic life (including propagation and survival), and wildlife. The **Sw** supplemental classification refers to swamp waters, which are waters with low velocities and other natural characteristics different from adjacent streams. The **NSW** supplemental designation refers to Nutrient Sensitive Waters that are waters subject to growths of microscopic or macroscopic vegetation and as such, require limitations on nutrient inputs. There are no High Quality Waters (**HQW**), Outstanding Resources Waters (**ORW**), Water Supply I (**WS I**), or Water Supply II (**WS II**) waters within 2 mi of the CWMB. Brice Creek is not designated as a North Carolina Natural and Scenic River, nor is it designated as a national Wild and Scenic River.

Brice Creek and tributaries are characterized as "partially supporting" their designated use (DEM 1993b). Non-point sources are identified as problems

affecting pH and dissolved oxygen in Brice Creek near Riverdale (SR 1101). Long Lake is an oligotrophic lake fully supporting its designated uses in 1995 (DEM 1996). There are no NPDES discharges into the Brice Creek system (DEM 1993b). Another measure of water quality is provided by long-term studies of benthic macroinvertebrate populations. No benthic macroinvertebrate study sites are located in East Prong Brice Creek, but a special study site is located on West Prong Brice Creek approximately 3.9 mi west of the CWMB. This West Prong Brice Creek study site, sampled as part of a study to identify undisturbed coastal blackwater swamps, received a bioclassification of "good" rather than "excellent" due to stresses from naturally low pH (DEM 1993b). Wetlands mitigation activities at the CWMB will protect water quality in this nutrient sensitive watershed by providing protection against non-point source discharges within a large portion of the East Prong Brice Creek watershed.

3.3.3 Neuse River Drainage Basin Buffer Rules

In December 1997 the Environmental Management Commission approved the *Neuse River Basin: Nutrient Sensitive Waters Management Strategy: Protection and Maintenance of Riparian Buffers* (15A NCAC 2B .0233) (the Rules). The most recent version of these temporary rules went into effect 22 June 1999. The temporary initiative adopted rules protecting riparian areas immediately adjacent to surface waters within the Neuse River Basin, including intermittent and perennial streams, lakes, ponds, and estuaries. Stream determination for these rules requires the channel to be present on either the most current version of NRCS soil survey or as a blue line (bluelines) on the most recent USGS topographic quadrangles.

A review of the applicable mapping indicates that Long Lake is present as a surface water subject to the Rules. East Prong Brice Creek is depicted on USGS maps as extending for a distance of only approximately 250 ft upstream of Catfish Lake Road, but is depicted on NRCS maps as extending along the northeast boundary of the CWMB from Catfish Lake Road to the eastern boundary of Management Unit 3. The East Prong Brice Creek channel was verified, field-delineated to its origin, and GPS mapped. The Oates Branch is not depicted on USGS topographic quadrangles, but is present on NRCS soil mapping as occurring in Management Units 2A and 5; this stream channel was verified, field-delineated upstream to the point where stream function is no longer present, and mapped using GPS technology.

NRCS soil mapping indicates two small tributaries extending from the CWMB into East Prong Brice Creek in the north-central portion of the site; an extensive ditch network exists in the vicinity of these two features. Field investigations failed to find defined stream channels for either feature. Another channel is shown within the CWMB boundary on NRCS soil mapping as crossing the northwestern portion of the CWMB parallel and adjacent to Catfish Lake Road; field investigations indicate this feature is acting more as a roadside ditch than a stream. This feature is currently subject to the Rules, but is located in an area of the CWMB not slated for

any clearing activities. Two of the borrow pits on the CWMB show up on USGS topographic maps as surface waters; both areas have been confirmed as seasonally flooded or saturated.

3.4 Soils

Figure 3-2 presents soils mapping for the CWMB. This map includes modifications to the NRCS county soils mapping for the CWMB based on detailed soil investigations conducted under the direction of a North Carolina Licensed Soil Scientist. Detailed investigations included confirmation of mapped series and evaluation of organic soil degradation.

Nonhydric soil mapping units account for less than 30 acres of the 4035-acre CWMB. Nonhydric soil boundaries have been delineated in the field and mapped using GPS technology. Nonhydric soil series on the CWMB include Goldsboro loamy fine sand and Lynchburg fine sandy loam.

The dominant hydric soils on the CWMB include Croatan muck, an organic soil, Bayboro mucky loam, and Pantego fine sandy loam. Other organic soils present include Dare muck along Long Lake and Dorovan muck along the upper floodplain of the headwaters of the Oates Branch. Masontown mucky fine sandy loam, found along the floodplain of the Oates Branch, and Murville mucky loamy sand, found along the interstream divide, have relatively higher organic content compared to other mapped mineral soils. Muckalee sandy loam is also found along the Oates Branch floodplain and would have been frequently flooded under undisturbed conditions. The remaining hydric soils (Leaf silt loam, Leon sand, and Rains fine sandy loam) are found in broad flats and depressions. No Torhunta fine sandy loam was confirmed onsite despite intensive investigations in the area mapped as Torhunta on the NRCS county soils map. More detailed discussion of soils is provided in the *Subsurface Investigation and Hydrogeological Assessment* (ESI 2000a).

3.5 Plant Communities

The CWMB has seen heavy degradation of its natural plant communities over the last several decades. Ditching has altered natural hydrologic patterns across the CWMB. The CWMB was actively managed for forest production for nearly 50 years prior to purchase by NCDOT. During this period (and prior to this period), most of the desirable hardwood species were removed. Successional, opportunistic hardwoods such as sweetgum (*Liquidambar styraciflua*) and red maple (*Acer rubrum*) along with swamp red bay (*Persea palustris*) have achieved dominance in stands that under natural conditions should be dominated by bald cypress (*Taxodium distichum*), swamp tupelo (*Nyssa biflora*), Atlantic white cedar (*Chamaecyparis thyoides*), and a mixture of hydrophytic oaks (*Quercus* spp.). The CWMB presently contains a mix of forested stands of varying degrees of disturbance, regenerating cut-overs, and recent clear cuts. Figure 3-3 presents a

recent (March 1997) aerial photograph of the CWMB with the existing vegetation communities.

Although most communities have been altered, many areas retain characteristics of natural communities as described in Schafale and Weakley (1990). Natural communities present on the CWMB include: Bay Forest, Coastal Plain Small Stream Swamp (Blackwater Subtype), Nonriverine Swamp Forest, Nonriverine Wet Hardwood Forest, Wet Pine Flatwoods, Mesic Pine Flatwoods, and Natural Lake Shoreline.

3.6 Wildlife

3.6.1 Terrestrial Wildlife

The location of the CWMB is nearly ideal with respect to wildlife and wildlife potential. The CWMB has a diversity of plant community types ranging from open areas to early-, mid-, and late-succession forests. Food, cover, nesting sites, and water are all available for a variety of wildlife species. The potential for wildlife is further enhanced by the presence of large, adjacent tracts of forest lands of the Croatan National Forest which nearly encircle the CWMB. The CWMB is a large, contiguous tract providing wildlife habitat for a variety of species and serving as a wildlife corridor for adjacent tracts designated as Croatan Game Lands on Forest Service property.

Of special note are area-sensitive species occurring on the CWMB. Area-sensitive species documented on the CWMB include black bear (*Ursus americanus*) and wild turkey (*Meleagris gallopavo*) which require large tracts of land for foraging. Area-sensitive Neotropical migrants that are conspicuous breeders in the extant forested areas of the CWMB include species such as Acadian flycatcher (*Empidonax virescens*), black-and-white warbler (*Mniotilta varia*), prothonotary warbler (*Prothonotaria citrea*), northern parula (*Parula americana*), black-throated green warbler (*Dendroica virens*), ovenbird (*Seiurus aurocapillus*), Kentucky warbler (*Oporornis formosus*), and hooded warbler (*Wilsonia citrina*). Mitigation activities resulting in maintenance of existing contiguous forested areas will benefit area-sensitive species. A list of wildlife species documented on CWMB is provided in Appendix B.

3.6.2 Aquatic Wildlife

Fish documented in waters of the CWMB are species common to the blackwater systems of this portion of the Coastal Plain. Limited observations and surveys in the Oates Branch and adjacent ditches documented yellow bullhead (*Ameirus natalis*), redfin pickerel (*Esox americanus*), eastern mudminnow (*Umbra pygmaea*), pirate perch (*Aphredoderus sayanus*), swampfish (*Chologaster cornuta*), and flier (*Centrarchus macropterus*) on the CWMB. Yellow perch (*Perca flavescens*) were documented in Long Lake.

The streams, lake, ditches, and borrow pits provide habitat for aquatic amphibians and reptiles. Species documented during the course of field investigations include a variety of species expected to occur in these types of habitats within this portion of the Coastal Plain. Commonly observed aquatic amphibians include green frog (*Rana clamitans*), southern leopard frog (*Rana utricularia*), and carpenter frog (*Rana virgatipes*). The most commonly observed aquatic reptile species documented on the CWMB include American alligator (*Alligator mississippiensis*), yellowbelly slider (*Trachemys scripta*), Florida cooter (*Chrysemys floridana*), spotted turtle (*Clemmys guttata*), redbelly watersnake (*Nerodia erythrogaster*), brown watersnake (*Nerodia taxispilota*), and cottonmouth (*Agkistrodon piscivorus*).

Waters of ditches, borrow pits, and depressional areas on the CWMB provide seasonal breeding pools for a variety of other amphibians. Breeding choruses were commonly heard for species including southern toad (*Bufo terrestris*), southern cricket frog (*Acris gryllus*), green treefrog (*Hyla cinerea*), pine woods treefrog (*Hyla femoralis*), Cope's gray treefrog (*Hyla chrysoscelis*), and little grass frog (*Limnaoedus ocularis*)

3.7 Threatened and Endangered Species

3.7.1 Federal Protected Species

Species with the federal classification of Endangered (E) or Threatened (T), or officially proposed (P) for such listing, are protected under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). The most current U.S> Fish and Wildlife Service (FWS) listing of federal protected species with ranges that extend into Craven County was obtained prior to initiation of the field investigation and periodically checked to verify changes. Table 3-1 presents the federal protected species listed for Craven County at the time of this current report (FWS list date June 16, 2000).

Table 3-1. Federal Protected Species Listed for Craven County.

Common Name	Scientific Name	Status	Potential Habitat on CWMB	Biological Conclusion
American alligator	*Alligator mississippiensis*	T (S/A)	Yes	No Effect
Leatherback sea turtle	*Dermochelys coriacea*	E	No	No Effect
Bald eagle	*Halieaeetus leucocephalus*	T*	Yes	No Effect
Red-cockaded woodpecker	*Picoides borealis*	E	Yes	No Effect
Manatee	*Trichechus manatus*	E	No	No Effect
Sensitive joint-vetch	*Aeschynomene virginica*	E	Yes	No Effect

*proposed for delisting

NHP records were consulted prior to initiating the field investigation and periodically reviewed for changes. NHP records document the presence of American alligator in

Long Lake. NHP records do not provide any documentation for the presence of any other federal protected species on the CWMB. Synopses for each of these species are provided in the following sections.

3.7.1.1 American Alligator

American alligator is federal listed as threatened due to similarity of appearance to other crocodilians. This species is not biologically endangered or threatened on the federal level, is not subject to Section 7 consultation, and does not require a biological conclusion. American alligator is state listed as Threatened and receives limited protection under state regulations. Field investigations documented American alligator in several locations on the CWMB including Long Lake, the Oates Branch, roadside ditches, and borrow pit ponds. Successful hatching of young by females was noted for individual alligators in 1999 and 2000. Alligators documented on the CWMB range from hatchlings to large adults. Excluding hatchlings, at least eight individual alligators have been documented on the CWMB.

3.7.1.2 Leatherback Sea Turtle

The leatherback sea turtle is distinguished by its large size (46- to 70-inch carapace, 650 to 1,500 pounds) and a ridged shell of soft, leathery skin (Martof *et al.* 1980). The leatherback feeds extensively on jellyfish, although the diet includes other sea animals and seaweed. Although primarily tropical in distribution, the range of the leatherback may extend to Nova Scotia and Newfoundland (Martof *et al.* 1980). The leatherback sometimes moves into shallow bays, estuaries, and even river mouths.

Biological Conclusion: No Effect

There is no habitat on the CWMB for leatherback sea turtle. Implementation of the mitigation plan will not affect this species.

3.7.1.3 Bald Eagle

The bald eagle is a large raptor with a wingspan greater than 6 ft. Adult bald eagles are dark brown with white head and tail. Immature eagles are brown with whitish mottling on their tail, belly, and wing linings. Bald eagles typically feed on fish but may also take birds and small mammals. In the Carolinas, nesting season extends from December through May (Potter *et al.* 1980).

Bald eagles typically nest in tall, living trees in a conspicuous location near water and forage over large bodies of water with adjacent trees available for perching (Hamel 1992). Preventing disturbance activities within a primary zone extending 750 to 1,500 ft outward from a nest tree is considered critical for maintaining acceptable conditions for eagles (FWS 1987). FWS guidelines recommend avoiding any disturbance activities, including construction and tree-cutting, within this primary zone. Within a secondary zone extending from the primary zone boundary out to a distance of 1 mi from a nest tree, construction and land-clearing activities

should be restricted to the non-nesting period. FWS also recommends avoiding alteration of natural shorelines where bald eagles forage and avoiding significant land-clearing activities within 1,500 ft of roosting sites.

Biological Conclusion: No Effect

Potential nesting habitat for bald eagle, consisting of tall, living trees near large open water bodies, exists on the CWMB along Long Lake. Two adult bald eagles were documented flying over the CWMB near Long Lake in December 1998; subsequent sightings of adults continued through spring 1999. An aerial survey was conducted of the CWMB in June 1999. The aerial survey, utilizing a helicopter, surveyed for the presence of potential eagle nests along the shoreline of Long Lake and adjacent forested areas. No nests of sufficient size to be considered eagle nests were identified, but several osprey nests were identified. The pair of adult bald eagles was documented roosting in trees on the south shore of Long Lake during the aerial survey. Although eagle nesting was not documented on the CWMB, the continued presence of a pair of adult bald eagles through the 1998-1999 breeding season and confirmed presence in June 1999 indicates that nesting may be taking place nearby. Although bald eagle is proposed for delisting, to reduce the risk of disturbing nesting, roosting, or foraging activities of bald eagles utilizing Long Lake, the existing forested strip along the Long Lake shoreline will be maintained as part of CWMB mitigation plan. Road and ditch removal activities within 1 mi of the Long Lake shoreline will be avoided during the December through May nesting season.

3.7.1.4 Red-cockaded Woodpecker

The red-cockaded woodpecker (RCW) is a small woodpecker identified by a black head, prominent white cheek patch, black-and-white barred back and distinctive call. RCWs are found in association with a clan, which is a cooperative breeding group consisting of a breeding pair and one or more male offspring that were fledged in the previous one to three years (Hooper *et al.* 1980).

The RCW is endemic to pine forests of the southeastern United States. In North Carolina, the RCW is most prevalent in the Sandhills and Coastal Plain (Hamel 1992). Primary RCW habitat consists of mature to over-mature southern pine forests. Traditionally, pine flatwoods or pine-dominated savannas which have been maintained by frequent fires serve as ideal nesting and foraging sites for RCWs. Nesting and roosting cavities are constructed in the heartwood of living pines which are generally older than 60 years and often infected with red-heart fungus (*Fomes pini*). Cavities are usually located 20 to 50 ft above ground and below live branches. Development of a thick understory may result in abandonment of cavity trees. The resinous buildup around cavity openings allows for easy detection during surveys for RCWs. Most cavity trees tend to be clustered such that a colony can

typically be encompassed by a circle 1500 ft in diameter, although some cavity trees can be as much as 0.5 mi apart (Hooper *et al.* 1980).

RCW foraging areas are typically centered on colony sites and range in size from 100 acres to as much as 1000 acres, depending on the quality of habitat (Hooper *et al.* 1980). RCWs typically forage on pines in stands aged 30 years or older within 0.5 mi of the colony site (Henry 1989). Stands dominated by pines larger than 9 inches diameter at breast height (dbh) are considered to provide good foraging habitat, but RCWs will forage in stands dominated by pines 4 to 9 inches dbh (Hooper *et al.* 1980). Extreme impacts to foraging habitat can lead to reduced productivity and/or abandonment of the colony site. Minor habitat changes within the foraging range may have little or no impact to RCW behavior patterns.

Biological Conclusion: No Effect

NHP records indicate that one inactive and eight active RCW colonies have been documented within 2 mi of the CWMB; none of these is within 0.5 mi of the CWMB. Surveys were conducted for RCWs due to the presence of active colonies in close proximity to the CWMB and the presence of potentially suitable nesting and foraging habitat on the CWMB. Aerial surveys were conducted by ESI biologists in June 1999 for all stands of pines, pine-hardwoods, and hardwood-pines trees on the CWMB as well as within 0.5 mi of the CWMB that may be affected by mitigation implementation activities. The aerial survey was conducted using a Robinson R22 piston-powered helicopter flown by a pilot from Raleigh Helicopters with previous experience conducting RCW aerial surveys. Prior to initiation of surveys, a known RCW colony located within 2 mi of the CWMB was visited by biologists for field familiarization with local conditions for the species; overflights of this or another nearby site were also conducted to familiarize the biologists with RCW cavity trees from the air. Aerial surveys consisted of slow passes along north-south transects, spaced between approximately 250 to 500 ft apart, depending on stand canopy density. Surveys were conducted by flying at low speeds over potential RCW nesting habitat at a height ranging from 10 to 50 feet above the forest canopy. Any trees with suspicious cavities or sap flow were mapped and then ground-truthed to determine if RCW activity was involved.

Systematic surveys revealed no evidence of RCW activity on the CWMB or within 0.5 mi of the CWMB. A cluster of artificial cavities was identified within 0.5 mi of the CWMB entrance; discussions with the US Forest Service indicated that this artificial cavity site has not been occupied by RCWs (Megan Martoglio, personal communication, 4 August 1999). No evidence of RCWs was found during ground-truthing.

Implementation of the mitigation plan at the CWMB will not adversely affect RCW. Existing mature pine stands will not be cleared and young pine stands will be thinned to promote better potential foraging habitat. The planting plan incorporates establishing pines in selected disturbed areas to provide for eventual linkage of pine stands on the CWMB with suitable RCW habitat located northwest of the CWMB and with suitable RCW habitat located southeast of the CWMB.

3.7.1.5 Manatee

The manatee is a large aquatic mammal that averages 10 to 13 ft in length and weighs up to 1,000 pounds. The manatee maintains a year-round presence in Florida (FWS 1993). During summer months manatees may disperse from their normal Florida wintering areas up the east coast to as far north as Virginia. These mammals inhabit warm waters, both fresh and salt, where their diet consists mostly of aquatic vegetation (Webster *et al.* 1985).

Biological Conclusion: No Effect

There is no habitat on the CWMB for manatee. Implementation of the mitigation plan will not affect this species.

3.7.1.6 Sensitive Joint-vetch

Sensitive joint-vetch is a robust, bushy-branched, annual legume often exceeding 3 ft in height. Young stems have bristly hairs with large swollen bases (Leonard 1985). The alternate, compound leaves are even-pinnate, approximately 1.25 to 2 inches wide, with 30 to 56 toothless leaflets (Radford *et al.* 1968). Flowers are about 0.5 inches long, bright greenish-yellow with red veins, and are subtended by bractlets with toothed margins (Leonard 1985). The flowers are produced on few-flowered racemes from July to October. The jointed legume (loment) is about 2 inches long, has 6 to 10 segments, and a 0.5- to 1.0-inch long stalk.

Habitat for this species in North Carolina consists of moist to wet coastal roadside ditches and moist fields that are nearly tidal (FWS 1994), especially in full sun (Leonard 1985). This species seems to favor microhabitats where there is some reduction in competition from other plant species, and usually some form of soil disturbance (FWS 1994).

Biological Conclusion: No Effect

During preliminary investigations, ten sites on the CWMB could not be eliminated from consideration as at least marginally suitable habitat for this species. These areas included selected roadside ditches near East Prong Brice Creek and Oates Branch, ditches that crossed clear-cuts and the powerline easement, and selected borrow pits. A field survey was conducted of these potentially suitable habitats by ESI biologists on 24-26 August 1999 to determine if sensitive joint-vetch is present on the CWMB.

A reference population was visited to confirm the flowering status of sensitive joint-vetch prior to initiating on-site surveys. Surveys on the CWMB were conducted by walking transects 50 ft apart through all areas of potentially suitable habitat. No individuals of sensitive joint-vetch were observed during the survey. The development of the CWMB should not affect this species.

3.7.2 Federal Species of Concern and State Listed Species

The FWS also maintains a list of Federal Species of Concern (FSC). Species designated as FSC do not receive protection under the ESA unless formally proposed for listing. Most of these species are state listed and receive limited protection under state regulations. Species with the North Carolina status of Endangered (E), Threatened (T), or Special Concern (SC) receive limited protection under the North Carolina Endangered Species Act (G.S. 113-331 *et seq.*) and the North Carolina Plant Protection Act of 1979 (G.S. 106-202,12 *et seq.*).

Table 3-2 presents a list of species with the FSC designation listed for Craven County (FWS list dated June 16, 2000). State listing status is also given as well as the determination of whether potential habitat for these species is present on the CWMB. Potential habitat determinations were based on habitat descriptions provided in LeGrand and Hall (1999) and Amoroso (1999).

Table 3-2. Federal Species of Concern Listed for Craven County.

Common Name	Scientific Name	State Status*	Potential Habitat
Bachman's sparrow	*Aimophila aestivalis*	SC	Y
Southern hognose snake	*Heterodon simus*	SR (PSC)	Y
Black rail	*Laterallus jamaicensis*	SR	N
Croatan crayfish	*Procambarus plumimanus*	W3	Y
Annointed sallow moth	*Pyreferra ceromatica*	SR	Y
Carolina spleenwort	*Asplenium heteroresiliens*	E	N
Chapman's sedge	*Carex chapmanii*	W1	N
Venus flytrap	*Dionaea muscipula*	C-SC	Y
White wicky	*Kalmia cuneata*	E-SC	Y
Pondspice	*Litsea aestivalis*	C	Y
Godfrey's sandwort	*Minuartia godfreyi*	E	N
Loose watermilfoil	*Myriophyllum laxum*	-	Y
Savanna cowbane	*Oxypolis ternata*	W1	Y
Spring-flowering goldenrod	*Solidago verna*	T	Y
Carolina asphodel	*Tofieldia glabra*	C	Y

*Note: Status of Significantly Rare (SR), or Watch List species (W) are NHP designations and do not confer state protection on these species.

NHP records were consulted before commencing the field investigation and periodically reviewed for changes. NHP records do not provide any documentation for the presence of FSC or state listed species on the CWMB.

NHP records indicate that Croatan crayfish has been documented in a roadside ditch adjacent to East Prong Brice Creek near the CWMB entrance off Catfish Lake Road. Crayfish were noted in many of the roadside ditches of the CWMB and may belong to this species.

Spring flowering goldenrod has also been documented along Catfish Lake Road near the CWMB entrance. Potential habitat on the CWMB for this species was investigated on 17 May 2000, following a visit to a reference population in Maysville. All roadside and cleared areas on the CWMB containing potential habitat and prominent species noted in association with the reference population were checked. No spring flowering goldenrod were documented on the CWMB.

Limited habitat occurs on the CWMB for several other FSC and state listed species. With the possible exception of Croatan crayfish, none of the FSC species were documented during the course of other field investigations; however, no surveys were conducted to determine the presence of any of these species.

In addition to the state-listed bald eagle and American alligator, two other species tracked by NHP were identified on the CWMB. A large number of black-throated green warblers (*Dendroica virens waynei*) (SR) were documented singing on territory throughout much of the extant bay forest on site. Timber rattlesnakes (*Crotalus horridus*) (SR, state listed as PSC) were commonly observed.

3.8 Wetlands

A large proportion of the interstream area between Long Lake and the headwaters of East Prong Brice Creek is dominated by the remains of Gum Swamp, which historically appeared to be a large, nonriverine wetland forest system. Field efforts were undertaken to delineate the extent of jurisdictional wetlands on the CWMB. Figure 3-4 presents the results of the jurisdictional delineation. The jurisdictional delineation indicates that wetlands may remain on an estimated 2391 acres of the approximately 3826 acres of nonriverine hydric soils presumed to have been present historically.

The jurisdictional delineation and soils mapping indicate that wetlands may remain on an estimated 129 acres of the approximately 179 acres of riverine influenced soils presumed to have been present historically. These riverine wetlands are associated with channels of East Prong Brice Creek along the northeastern boundary and the Oates Branch located within the northwestern portion of the CWMB. Field efforts were undertaken to delineate and characterize the stream channels (see Section 3.3.1) and associated floodplain wetlands.

Approximately 17 miles of large roadside ditches and more than 11 miles of other ditches have been identified on the CWMB. A review of historic aerial photography shows that ditch construction was initiated between 1949 and 1964. Most of the road and ditch network was completed before 1974. Under historic conditions, the majority of the interior wetlands associated with Gum Swamp likely served as an above-headwater storage area for East Prong Brice Creek. The southern portion of the CWMB also historically received hydrologic input from groundwater flow from Long Lake.

Field evaluations, ditch drainage modeling, surficial monitoring well data, and jurisdictional delineation show that the ditches have depressed adjacent water tables throughout much of the CWMB. Most of the areas currently considered jurisdictional have greatly reduced hydroperiods compared to hydrologic reference wells in similar soil types and compared to published data. Extensive artificial drainage features throughout the CWMB have resulted in subsidence of organic layers within the organic soils.

3.9 Cultural Resources

Background data collection efforts indicate that one previously recorded site is within the tract. This site (31CV37**) that was apparently first recorded by Loftfield in 1987, and later revisited by Harmon and Ruesch, consisted of a scatter of late 19th/20th Century artifacts in a location that corresponds with a structure shown on 1929 soil and 1983 topographic maps. The site was judged to be not significant, and no additional work was recommended (Mike Harmon, personal communication, 1999). This location was not visited during the present field study.

A reconnaissance survey of the CWMB was conducted in June 1999 by ESI archaeologists. Surface inspection and limited testing were conducted in locations that exhibited the potential to contain prehistoric and historic sites or structures. With the exception of one previously recorded site (31CV37**) and an isolated occurrence of 20th century material, no prehistoric or historic sites are known to occur within the CWMB. Based on the results of this investigation (ESI, August 1999), and the poorly drained characteristics of the property, the CWMB was determined to represent a low probability for containing significant cultural resources.

3.10 Hazardous Materials

As part of the preliminary feasibility investigation, in June 1997 ESI conducted a vehicular reconnaissance of the CWMB to identify visible conditions warranting potential environmental concern. One structure was observed near the southwestern property boundary, situated on the shore of Long Lake. This structure appeared to be used occasionally as a hunting and/or fishing camp, and several outbuildings are associated with it. An empty 55-gallon drum, a container

of unknown contents, and a discarded battery were observed in the vicinity of one of the outbuildings. However, no dead vegetation or soil staining was noted in the area. Reconnaissance of the remainder of the subject site revealed a rusted tractor and motor grader (subsequently removed from the premises), discarded empty containers, and very minor dumping; however, no dead vegetation or soil staining was observed in connection with these objects.

Limited research was conducted in order to determine whether activities at properties/facilities within specified radii influence the environmental integrity of the CWMB. No facilities were listed within the parameters of the database search.

Based on field observations and limited records research, no obvious sources of contamination are associated with the CWMB that may affect its use or development as a wetlands mitigation bank. Therefore, no further environmental hazardous materials inquiry was recommended for this site.

4.0 WETLAND RESTORATION STUDIES

Wetland restoration studies undertaken on the CWMB included a groundwater and subsurface investigation (see Section 4.1), surface water investigation (see Section 4.2), and vegetation evaluation (see Section 4.3). The results of these investigations were used to develop the wetland mitigation plan (see Section 5.0).

4.1 Groundwater and Subsurface Investigation

In order to characterize existing conditions at the CWMB, ESI personnel conducted investigations in the Phase I and Phase II areas with assistance from the NCDOT Geotechnical Unit. This work was conducted under the supervision of a North Carolina Licensed Professional Geologist. Details of the groundwater and subsurface investigation are provided in a technical report to NCDOT (ESI 2000)

Subsurface investigations and hydrogeological assessments were undertaken to determine the presence and extent of any shallow or deep confining layers within the CWMB that may have been affected by historic ditching or that may be affected by mitigation efforts. The shallow clay layers in the CWMB consist of localized patches and do not serve as a confining layer. Several locations were identified where the localized clay layer has been breached by ditch excavation. The effect of the ditching while removing jurisdictional wetland hydrology for some radius from the channel, has not caused a perched water table to be drained completely.

A series of 60 soil borings were installed to characterize subsurface conditions, and then converted to 2-inch inner diameter (2-in ID) groundwater monitoring wells between 23 November 1998 and 11 June 1999. These groundwater monitoring wells consisted of shallow (8 ft) and deep (20-45 ft) piezometers installed throughout the CWMB. Monitoring was conducted to establish site horizontal and vertical groundwater gradients.

Ground water flow maps for both shallow and deep aquifers for the dates 16 and 29 June, 31 August, and 8 and 29 September 1999, confirm that groundwater flow is northward from Long Lake into East Prong Brice Creek. Following Hurricanes Dennis, Floyd, and Irene, water table elevations rebounded from late summer drawdown to conditions similar to those of a winter saturated wetland system. These data, while not representative of typical seasonal hydrology, provide indications of recharge of the deeper aquifer, as well as the surfical aquifer.

Analysis of the data from the 2-in ID monitoring wells indicates that vertical gradients fluctuate with changes in near-surface saturation. During periods of near-surface saturation, as in typical winter and early spring conditions, vertical gradients are upward in many portions of the CWMB, indicating that the lower saturated zone is contributing water to near-surface soils. During periods of drawdown, as in typical late summer conditions, the vertical gradients are reversed, indicating that

water is draining from the near-surface soils into the lower sediments. These data make it reasonable to conclude that in areas where the clay layers have been breached the soils would be wetter than historical conditions during near-surface saturation in the spring, and drier than historical conditions during periods of ground water drawdown in the summer, were the drainage network not conveying water off the CWMB.

As part of the hydrogeologic assessment, hydraulic conductivity data were collected from surficial soils to facilitate the modeling effort for predicting hydrologic restoration and enhancement. Hydraulic conductivity was determined by administering slug tests (*in situ* rising head tests).

The ground water modeling software selected as most appropriate for simulating shallow subsurface conditions and ground water behavior at the site was DRAINMOD. This model, developed by Dr. R.W. Skaggs of North Carolina State University (NCSU), simulates the performance of water table management systems. The model was originally developed to simulate the performance of agricultural drainage and water table control systems on sites with shallow water table conditions. DRAINMOD was subsequently modified for application to wetland studies by adding a counter that accumulates the number of times the water table rises above a specified depth and remains there for a given duration during the growing season. The model results can then be analyzed to determine if wetland hydrology criteria are satisfied during the growing season, on average, more frequently than 50 percent of the years modeled. Required model inputs include the threshold water table depth, required duration of high water tables, and beginning and ending dates of the growing season. Output from the DRAINMOD model was applied to the CWMB to determine which areas were not likely to achieve wetland hydrology.

DRAINMOD performs water balances in the soil-water regime at the midpoint between two drains of equal elevation. The model is capable of calculating hourly values for water table depth, surface runoff, subsurface drainage, infiltration, and actual evapotranspiration over long periods of climatological data. The reliability of DRAINMOD has been tested for a wide range of soil, crop, and climatological conditions. Results of tests in North Carolina (Skaggs 1982), Ohio (Skaggs *et al.* 1981), Louisiana (Gayle *et al.* 1985; Fouss *et al.* 1987), Florida (Rogers 1985), Michigan (Belcher and Merva 1987), and Belgium (Susanto *et al.* 1987) indicate the model can be used to reliably predict water table elevations and drain flow rates. DRAINMOD has also been used to evaluate wetland hydrology (Skaggs *et al.* 1991; Skaggs *et al.* 1993).

DRAINMOD was used to simulate existing conditions and conditions under a variety of restoration scenarios to determine the preferred alternative from both a hydrologic restoration perspective as well as a cost perspective. DRAINMOD was

instrumental in modeling and forecasting the extent of hydrologic enhancement potential available for existing degraded jurisdictional wetlands on the CWMB.

As part of the hydrology monitoring, three rain gauge stations, 17 surface water gauges, and 151 shallow monitoring well stations have been established on the CWMB. Surface water gauges consist of RDS WL-80 (80-inch) Continuous Monitoring Wells installed within the ditch network of CWMB, Long Lake, and East Prong Brice Creek. Shallow monitoring well stations consist of RDS WL-20 (20-inch) and WL-40 (40-inch) Continuous Monitoring Wells installed individually or clustered. Rain gauges consisted of Infinities USA, Inc., Rain Gauge Data Loggers, which record rainfall in 0.01-inch increments.

Reference wetland hydrology data are being collected using shallow monitoring wells installed at five on-site locations and five off-site reference wetland locations. On-site reference wetland monitoring sites are located along the periphery of the CWMB in areas with little hydrologic disturbance. Off-site reference wetland monitoring sites are located in close proximity to the CWMB on USDA Forest Service lands. Hydrology monitoring data were used to aid in validating jurisdictional delineations, to establish baseline groundwater hydrology data (pre-implementation conditions), and to validate modeling efforts. Hydrology monitoring following implementation will be used to document mitigation success.

Results of the jurisdictional delineation as well as predictive modeling supported by available data from the groundwater monitoring wells and reference wells were used to generate the various components of mitigation areas (*i.e.*, restoration, enhancement, preservation) on the CWMB. Results of this determination are presented in Section 8.1.

4.2 Surface Water Investigation

Hydrologic and hydraulic (H&H) analyses were conducted to model surface water runoff potential and estimate flows for watersheds and flow networks on the CWMB. The ability to predict surface water runoff potential was necessary for future design of water control and other features at this site in addition to understanding site hydrology. H&H analyses were conducted by Eddy Engineering, P.C., in 1998 and 1999. Details of these investigations are presented in summary reports (Eddy 1998, Eddy 2000).

The CWMB was visited for site characterization purposes and to take specific measurements of stream flow and other site features. Visits were also made to the CWMB to observe characteristics of site and surrounding area, verify surface and channel flow conditions, and observe water conveyance structures. Drainage catchments were initially identified using topographic data from USGS maps. This delineation was confirmed by visual observation during site visits. Aerial topographic survey data were used in watershed delineation where feasible.

A conceptual connectivity diagram of the ditch/stream/lake network was developed based on site data. This network was confirmed by visual observation during site visits. This information was later used in both hydrologic and hydraulic modeling of site conditions. Soils, cover, and land use data were used to assign Soil Conservation Service (SCS) runoff Curve Numbers (CN) to the various watershed elements.

Velocities were measured at select channel locations after rainfall events for use in developing stage-discharge relationships. The use of stage-discharge relationships at key site locations allowed for the conversion of water surface elevations to estimated channel discharges during the collection period.

Site data were collected and reduced to a useable format and selected portions were used in model calibration and verification. Using rainfall data from each of the three rain gauges, an areal averaging technique was used to determine probable average rainfall over specific watershed elements.

To develop a hydrologic model of the contributing watersheds, several options for modeling were evaluated. Both existing and future developed conditions were analyzed. The model included allowances for Base Flow Recession during storm events.

A hydraulic model was developed of the existing and future ditch/stream channel network. Models were later calibrated to more closely match site conditions based on site observations.

Site features were selected and evaluated in an attempt to attain site restoration goals. These included increases in hydroperiods for soils in select locations rather than across the entire site. Site features were selected for existing channels to meet wetland hydrology goals. To attain site hydrology goals, recommendations for modifications or removal of existing roadways were made to restore surface water flow conditions.

After proposed conceptual designs for restoring wetland hydrology were identified, their effects were evaluated on surrounding properties and other areas of the site. Evaluation of site flood levels before and after recommended hydraulic modifications was important to reduce the possibility of undesirable effects on surrounding properties and on the site itself. The potential for flooding of off-site properties due to the proposed site modifications was evaluated.

Upon completion of the analysis and development of conceptual designs, conceptual site plans and a report documenting findings and recommendations was prepared (Eddy 2000).

4.3 Vegetation Evaluation

A detailed evaluation of existing CWMB vegetative community composition and structure was conducted to develop a planting plan that incorporates existing vegetation wherever possible. Site mapping and stand evaluations were undertaken to identify components and maturity of existing vegetative community units on the CWMB. These data were used to aid in preparation of stand prescriptions and planting plan. The planting plan was developed in coordination with the NCDOT Roadside Environmental Unit, which will oversee implementation of the planting plan. The North Carolina Division of Forest Services provided recommendations for meeting the objectives of the CWMB planting plan.

5.0 WETLAND MITIGATION PLAN

Without implementation of the CWMB, the site would be expected to be used primarily for timber production with the areas containing drained hydric soils candidates for intensive silvicultural plantation operations. No net loss or gain in wetland acreage is expected; however, some loss in wetland function is expected. Within existing organic soil wetlands, degradation of soils is expected to continue in the absence of hydrologic restoration. With continuing oxidation of organic soils, loss of mature trees in these areas is expected to continue. Some loss in wetland function is expected to accompany the reduction in water storage and retention capacity.

A wetland mitigation plan has been developed to address hydrologic concerns across the CWMB and to restore vegetative communities in suitable areas.

5.1 Proposed Site Hydrology Treatments

In order to assist in a return of site hydrology to a more natural condition, sections of the existing road and ditch network will require removal or modification. However, to allow continued access to a large portion of the CWMB, some roads must remain in place. As such, various "treatments" or methods must be applied across the CWMB to meet hydrologic goals. These various treatments are described below.

5.1.1 Site Ditch Removal and Modifications

Existing roads and ditches must allow for conveyance of both surface and groundwater along the desired "natural" flow path. Figure 5-1 provides a schematic of the ditch network and natural drainage features. At first glance, one obvious solution might be to return existing road materials into the ditches with the hope that historic hydrology would return. Unfortunately, although some benefits might be realized through this method, some problems exist in this approach. First, existing zones of compressed soil and the fill material returned to the ditch will serve to restrict groundwater movement perpendicular to the road/ditch axis. Second, it is likely that a significant volume of soil was lost due to erosion, oxidation, and consolidation. It is therefore unlikely that sufficient local soil materials exist to completely fill the ditches, and as such the potential exists for surface water to eventually become concentrated such that ditches are reformed. More significant to restoration success is the potential for the ditches to reform through erosion. This is particularly true where post-restoration flow will parallel the alignment of the existing ditches. Another problem of simply returning the road fill to the ditches is that the site would no longer have road access. Thus, additional work is required to restore and enhance hydrologic function while avoiding these problems. The additional work is discussed in the following sections.

5.1.1.1 Ditch Plugs

In order to eliminate flow in the existing ditch network, earth plugs could be installed in selected site ditches. Two types or sizes are proposed. The first is a "Point" ditch plug, serving to stop the longitudinal flow of water in an existing ditch while limiting the volume of fill required. These plugs would be constructed from compacted fill material placed to the top of bank elevation over a discrete segment of the ditch. Details for proposed "Point" ditch plugs are shown in Figure 5-2. The second type of plug is a "Reach" ditch plug again serving to stop longitudinal flow of water in an existing ditch, but requiring significantly more fill. Fill requirements could exceed that available from the adjacent road. These plugs would be constructed over substantial ditch lengths, possibly hundreds or even thousands of feet. Details for proposed "Reach" ditch plugs are shown in Figure 5-3.

Placement of "Point" plugs would typically occur at locations where the surface water gradient is generally perpendicular to the longitudinal axis of the ditch. Placement of "Reach" plugs would typically occur at locations where the surface water gradient is generally parallel to the longitudinal axis of the ditch. The reach plugs are placed along such reaches since, due to their orientation, a greater potential exists for surface waters to become concentrated leading to ditch reformation.

Locations of "Point" and "Reach" plugs should be selected based on a localized assessment of surface conditions and local topography. An initial estimate of plug locations, based on hydrogeological, subsurface, jurisdictional wetland investigations by ESI, and reaches deemed critical to the restoration of natural hydrology by Eddy Engineering, P.C., is identified on Figure 5-4. Locations have been identified where the confining clay layer has been penetrated causing it to be desirable from a groundwater control standpoint to plug these ditch locations or reaches. These reaches to be plugged include all of channels (CH's) 14, 16, 20, and 21, as well as portions of CH's 13 and 18. Similarly, sections have been identified which will also require "Reach" plugs along selected portions of the other reaches deemed critical to the restoration of natural hydrology. These reaches to be plugged include the remaining portions of CH 18, as well as CH's 2, 4, 5, and a portion of CH 12. Other "Reach" plug locations may be identified during final design. "Point" plug locations, occurring in many of the remaining channels, will be evaluated and identified during final design.

5.1.1.2 Surface Water Diversions

To assist in the return of more natural surface water movement across the CWMB, particularly along ditches where the potential for surface waters to become concentrated, surface water diversions are proposed. These earthen berms, approximately 2 ft in height would be constructed perpendicular to, or at a slight angle to, the longitudinal axis of the ditch. Diversions could be as single entities, or as groups and, although they would be constructed to a standard height and depth,

their length would be allowed to vary such that they could be tied to local topography to better serve their intended purpose. These diversions should be based on a localized assessment of surface conditions and local topography and may be field adjusted during construction. Details for proposed surface water diversions are shown in Figures 5-2 and 5-3.

5.1.1.3 Scarification of Consolidated Soils

Due to road construction, zones of consolidated, and therefore less pervious, soils are present beneath existing road segments. With ditch filling, fill materials may also be less permeable than surrounding soils. To what extent these zones limit the flow of groundwater is unknown and will likely vary across the CWMB. However, scarification (ripping) of all such areas perpendicular to the expected flow will create a greater horizontal permeability. This will aid in returning groundwater conveyance to a more natural condition. Where roads are to be completely removed, scarification will be the least costly means of increasing horizontal groundwater conveyance. Scarification depth should be controlled to reduce the potential for penetrating confining layers. Unfortunately, for roads to remain in service, scarification is not a good alternative.

5.1.1.4 Removal of Existing Conveyance Structures

To assist in the achievement of site hydrology goals and better reduce the potential of surface flow returning to the existing channel network, select existing conveyance structures should be removed. Each existing structure should be evaluated on a case by case basis from a localized assessment of surface conditions and local topography and removed if it is deemed detrimental to site hydrology goals. This assessment would occur during final design.

As described in the *Preliminary Hydrologic and Hydraulic Analysis* (Eddy 1998) an outlet control structure does exist along the northeast side of Long Lake (POI 1). The structure appears to be in poor, if not unusable, condition, with the corrugated metal outlet barrel showing severe corrosion on exposed portions. Although no evidence of overtopping or surface flow was observed in the vicinity of the structure, it is recommended that this structure should be removed, or preferably grouted, to ensure that it does not serve as an outlet for Long Lake.

5.1.2 Site Road Modifications

To allow continued access to a large portion of the CWMB, some roads or road sections must remain in place, and as such steps must be taken to allow for conveyance of both surface and groundwater along the desired "natural" flow path. Details of which roads are to remain and which roads are to be removed are shown in Figure 5-5.

5.1.2.1 Improving Road Surface Course

Virtually all of the roads on the CWMB will be experiencing some type of modification. At some locations it is desired to completely remove the existing road. In these cases, road material would be used to fill ditches and entire cross-section would be scarified. A typical cross-section where the ditch is filled and the road removed is provided in Figure 5-6. A similar treatment will be applied at locations where roads will be removed coincident with natural drainage features. As a result of proposed site modifications, conditions where surface water exists within close vertical proximity of the remaining road surface are likely to occur more frequently. One result of this increased local water surface elevation is the degradation of existing subsurface conditions beneath the road, and in turn destabilization of the road surface itself. Accordingly, sections of road that are to remain open will require improvements for stability under these new conditions. The placement of a new compacted aggregate surface course is proposed. Details of an improved road cross-section are shown in Figure 5-7.

5.1.2.2 Surface Water Conveyance Measures

Using the synthesized hydrologic model (Eddy 2000), peak discharges were developed to be used to size required surface water conveyance structures. Since the model requires input of main channel length, centroid location, and watershed area the model could then be used for any locations around the project site. The Snyder's watershed timing coefficient, C_t, remains the same regardless of the location on the CWMB. Because the required structures are being designed for "Normal" site conditions, the SCS curve number (CN) associated with Antecedent Moisture Condition II (AMC II) (Normal), in this case 80, is used. Additionally, a percent impervious of 23 for "Normal" site conditions is used.

Structures at road crossings, such as those at the CWMB, are sized to allow for the passage of the 10-Year peak discharge through a culvert or culverts, without erosion in the vicinity of the structure. In this case, at select natural drainage features, not only is the safe passage of the 10-Year peak discharge desirable, but the ability to safely pass the 100-Year discharge over the road, again without erosion, is preferred. Accordingly the developed 12-hour design storm depths for the 10-Year and 100-Year storms of 5.77 inches and 8.55 inches of rainfall respectively were used. The resulting storm event hyetographs from the modified SCS Type III Rainfall Distribution (Eddy 2000) were used.

Details of locations for permanent road crossings at natural drainage features that were evaluated for conveyance structure requirements are shown in Figure 5-8. Results of the peak discharge analyses at specific locations are shown in Table 5-1.

Table 5-1. Peak Design Discharges at Permanent Road Crossings

	Permanent Road Crossing Number			
Recurrence Interval	PRC1	PRC2	PRC3	PRC4
10-Year	750 cfs	1085 cfs	670 cfs	815 cfs
100-Year	1230 cfs	1780 cfs	1090 cfs	1335 cfs

Each road crossing was then evaluated to determine alternative conveyance measures suitable for passing predicted peak discharges. At these crossings, differences in existing top of road elevation and existing natural ground elevation at the crossings ranged from approximately 1 to 3 ft. Because of the limited elevation change at the crossings, constraints are encountered on the maximum diameter of pipes that can be used. Two likely alternatives were considered for construction at locations where roads to be maintained cross existing natural drainage features.

If the ability to meet conveyance requirements is considered critical such that the potential for water to backup at crossings is small, then sufficient culvert capacity may necessitate an increased road elevation to obtain sufficient pipe cover. Typically, minimum pipe cover is considered 1 ft. Reinforced concrete pipe culverts ranging in size from 12- to 36-inches were considered in various configurations, with various combinations of pipe diameters. These pipes could be installed in conjunction with subsurface conveyance measures such as aggregrate drains, if needed. Culvert analyses were conducted for the 10-year peak discharge only. Findings showed that even when using 30- and 36-inch diameter culverts, the number of pipes was large and would require an increase in road elevations to meet minimum cover requirements. Additionally, the use of culverts of smaller diameter would require the installation of too many culverts to be practical. Even with the larger culverts, crossings would still require design for overtopping of the existing road surface to safely pass the 100-year discharge.

The second alternative for such road crossings is the installation of one or more smaller culverts at topographically low points along the road crossings to allow for the passage of daily discharges. These culverts would be located such that they coincided with the apparent low points in local topography to reduce the potential for standing water in the vicinity of the crossing. The crossing itself would consist of an improved and hardened road surface that would allow for vehicular traffic, while simultaneously allowing for the passage of peak discharges over the road surface. An example of such a crossing configuration alternative is shown in Figures 5-9 and 5-10.

Preliminary analyses on conditions where allowable depth of head over road surface is varied between 6 inches up to as much as two feet indicate weir or ford lengths ranging from around 150 ft to many hundreds of feet. These crossing sites can be

constructed in conjunction with subsurface conveyance measures such as aggregate drains, if needed. Improvements and armoring of the road surface at these locations may be required depending on design velocities.

5.1.2.3 Subsurface Aggregate Drains

As described previously, due to road construction significant consolidation of subsurface soils is likely beneath the existing road network. This has the effect of reducing horizontal conveyance of groundwater. Scarification is not compatible with roads that are to remain in service. For cases where groundwater conveyance is needed and the road must remain in service, aggregate drains would be a better choice. The aggregate drains can be sized and spaced such that the effective conveyance of the combined fill and drain section can be made equal to or greater than the undisturbed soils. Aggregates such as open graded sands and gravels have a higher permeability than on-site soils so a relatively small area of aggregate drain would be needed to dramatically increase effective conveyance. These drains would be installed in conjunction with surface conveyance measures such as culverts and lowered road crossings or ford sites as would be the case where roads are to remain as shown in Figures 5-9 and 5-10.

5.1.3 Locating Site Hydrology Treatments

As shown in Figures 5-5 and 5-8, approximate locations have already been identified for some specific site treatments. The type of treatment for roads and ditches is dependent on many factors. Because of the size of the site and the small variation in elevations over the CWMB, the locating of all site treatments as described above should be conducted through localized on-site evaluation during final design to be followed by confirmation during construction. Such evaluation includes, but is not limited to, local surface topography, existing road or ditch conditions, and expected future drainage conditions. In order to assure consistency in application of treatments and to estimate what features are likely to be applied at a given location on the project site the flow chart provided in Figure 5-11 can be used.

5.2 Proposed Soil Treatment

Since the majority of the CWMB has been documented as containing soils formed under hydric conditions, successful restoration or enhancement of hydrology to these applicable areas is all that proposed. No agricultural activities have been practiced on the CWMB, and disturbance to the soils other than that associated with ditch and road removal (see Section 5.1) is unwarranted.

5.3 Proposed Vegetation Treatment

As part of the mitigation banking process, NCDOT is coordinating with the N.C. Forest Service to institute a selective clearing and planting regimen across portions of the 4,035-ac CWMB. The specific targets of this regimen will vary across the CWMB, depending on site-specific conditions. Approximately 1571 ac of cut-over

and early successional areas will be cleared and replanted. Existing contiguous forested areas will be maintained.

Target planting areas will include riverine wetlands associated with East Prong Brice Creek and Oates Branch, and nonriverine wetlands throughout the remainder of the CWMB. Specific wetland community types targeted for restoration and/or enhancement on the CWMB are based on natural community descriptions presented by Schafale and Weakley (1990).

5.3.1 Target Communities

Vegetative restoration within the CWMB is based on a landscape approach and generally follows the U.S. Forest Service Forestwide Management Direction outlined in the proposed Croatan National Forest Land & Resource Management Plan (November 1999). Because of the nature of the forested communities proposed for restoration, active long-term management of these systems is imperative for success (see Section 10.0). Management of these systems may include selected herbicide treatment to reduce competition and allow for better survival and growth of target species, selected thinning of undesirable species, and limited use of prescribed fire. Long-term management would not include altering the vegetative composition or hydrologic regimes of these areas for commercial timber production nor the commercial harvesting of these areas.

Figure 5-12 depicts the areas proposed for planting. Communities are generally based on Schafale and Weakley Natural Community Descriptions (1990); however, the Nonriverine Wet Hardwood Forest (type b) is targeted with a pond pine component to augment future RCW habitat (see Section 3.7.1.4). Communities targeted for planting as part of the natural community restoration include:

- Coastal Plain Small Stream Swamp;
- Nonriverine Wet Hardwood Forest (type a);
- Nonriverine Wet Hardwood Forest (type b);
- Nonriverine Swamp Forest;
- Pond Pine Woodland;
- Wet Pine Flats, and
- Mesic Pine Flats.

Extensive areas of these communities and Bay Forest will be restored through hydrologic restoration activities. No clearing or replanting of Bay Forest restoration areas is justified due to the maturity of the existing Bay Forest structure (see Figure 3-3). Natural Lake Shoreline will be preserved; no clearing is proposed along the Natural Lake Shoreline to protect potential bald eagle roosting and foraging habitat. Figure 5-13 depicts areas proposed for clearing. No plantings are proposed for the small excavated ponds which function as Small Depression Pond or Vernal Pool community types depending on local hydrologic conditions.

Fifteen tree species are targeted for differing planting regimes within the CWMB. Species targeted for planting include river birch (*Betula nigra*), Atlantic white cedar (*Chamaecyparis thyoides*), green ash (*Fraxinus pennsylvanica*), loblolly bay (*Gordonia lasianthus*), tupelo (*Nyssa biflora*), longleaf pine (*Pinus palustris*), pond pine (*Pinus serotina*), loblolly pine (*Pinus taeda*), laurel oak (*Quercus laurifolia*), overcup oak (*Quercus lyrata*), swamp chestnut oak (*Quercus michauxii*), water oak (*Quercus nigra*), cherrybark oak (*Quercus pagoda*), willow oak (*Quercus phellos*), and either bald cypress (*Taxodium distichum*) or pond cypress (*Taxodium ascendens*).

5.3.1.1 Coastal Plain Small Stream Swamp

Coastal Plain Small Stream Swamp community will be replanted on approximately 44 ac around East Prong Brice Creek and the Oates Branch. These areas are located on Dorovan and Masontown/Muckalee soil series found within Management Units (MUs) 5 and 6, and limited fluvial-based Bayboro soil series found within MUs 2A, 2B, and 3. This community type is associated with small stream areas and organic or fluvial soils. Target vegetation within this community include bald cypress, swamp tupelo, green ash, laurel oak, swamp chestnut oak, pond pine, and river birch.

5.3.1.2 Nonriverine Wet Hardwood Forest (type a)

Nonriverine Wet Hardwood Forest (type a) community will be replanted on approximately 129 ac of the Pantego soil series found in MUs 2A, 4B, 5, 9, 10B, 10C, 12A, 12B, and 13A. Target vegetation within this community includes swamp chestnut oak, laurel oak, cherrybark oak, water oak, willow oak, overcup oak, and tupelo.

5.3.1.3 Nonriverine Wet Hardwood Forest (type b)

Nonriverine Wet Hardwood Forest (type b) community will be replanted on selected areas of the Bayboro, Leaf, and Pantego soil series. Approximately 737 ac will be replanted in MUs 2A, 2B, 3, 4b, 5, 6, 7, 8, 9, 10A, 10B, and 11. Target vegetation within this community includes pond pine, swamp chestnut oak, laurel oak, cherrybark oak, water oak, willow oak, overcup oak, and tupelo. The pond pine component of this community will be planted in higher relative densities along selected zones anticipated to provide linkage between pine-dominated areas to provide future habitat for the federally endangered RCW.

5.3.1.4 Nonriverine Swamp Forest

Nonriverine Swamp Forest community on the CWMB is associated with Croatan series, which is an organic soil not associated with any stream channels. Replanting will be conducted on approximately 129 ac in MUs 6, 8, 9, 10A, 10C, and 14. Target vegetation within this community includes bald cypress, swamp tupelo, Atlantic white cedar, pond pine, and green ash.

5.3.1.5 Pond Pine Woodlands

Pond Pine Woodlands community is associated with the Leon and Murville soil series; approximately 142 ac will be replanted in MUs 12A, 12B, 13A, 13B, and 16. Target vegetation for this community includes pond pine, loblolly bay, Atlantic white cedar, and loblolly pine. Mature pond pine woodlands can serve as habitat for the federally endangered red-cockaded woodpecker.

5.3.1.6 Wet Pine Flats

Wet Pine Flats community is associated with the Leon, Pantego, and Rains soil series; approximately 187 ac will be replanted in MUs 1, 2B, 5, 10B, 10C, 11, 12A, 12B, 13B, 15, and 16. Target vegetation for this community includes longleaf, loblolly, and pond pines.

5.3.1.7 Mesic Pine Flats

The Mesic Pine Flats community is associated with the nonhydric soils within the CWMB, the Goldsboro and Lynchburg series. These nonhydric soils are limited in area and scattered throughout the northern portion of the CWMB. The minor amount of non-hydric soil pockets scattered on the CWMB were evaluated for reforestation efforts targeting the nonjurisdictional Mesic Pine Flatwoods community type; selected areas containing degraded vegetation have been targeted for revegetation. The areas targeted for Mesic Pine Flats replanting are relatively small and surrounded by larger areas being cleared and replanted with a similar mix of species (see Wet Pine Flats). Mesic Pine Flats community will be replanted on approximately 27 ac in MUs 2A, 2B, 5, 10B, 10C, 11, and 12A. Target vegetation for this community includes longleaf pine and loblolly pine.

5.3.2 Site Preparation

Areas which are currently targeted for vegetative restoration are those areas which have been previously subjected to silvicultural clearing and currently contain few, if any, tree sized stems. Efforts will be made to preserve tree-sized stems of target species within these areas. Figure 5-13 depicts the areas proposed for clearing. These areas generally contain shrubby species of varying densities. Planting areas within the CWMB will follow one of two site preparation regimens, depending on when site preparation is done, the availability of contractors to conduct the work, and weather constraints.

The first site preparation regimen is targeted for the Phase I and Phase II areas and calls for all site preparation to occur in 2001. Two clearing methods are included. The first clearing method is targeted for a former impoundment located in MU14. This area contains herbaceous vegetation interspersed with large mounds that are currently vegetated with woody species. Site preparation for this regimen will include mowing the herbaceous vegetation and applying herbicide; the mounds would be left intact. This area would be targeted for planting in Winter/Spring

2002. The second method is targeted for the remaining areas within the Phase I and Phase II areas slated for re-vegetation. These areas would be subjected to drum chop and K-G shearing with herbicide treatment in early Spring 2001. Existing trees of target species within clearing areas will not be cut. These areas would then be subjected to a second drum chop in late Summer-early Fall 2001. Planting of these areas would occur in Winter/Spring 2002. Pine plantations in MUs 10C and 15 may be thinned to promote more rigorous growth and to provide potential RCW habitat.

Depending on contractor availability and contracting constraints, NCDOT may expedite the site preparation schedule for the Phase I area. This second regimen calls for site preparation to occur in Fall 2000 as well as during 2001. This regimen includes the use of the previously stated site preparation regime for the Phase II areas and former impoundment in MU14; however, the former impoundment would be subject to site preparation in Fall 2000 and planted in Winter/Spring 2001. A different regimen is targeted for stands within the Phase I area which may be subjected to site preparation during 2000. The second method will include the removal of standing vegetation within contiguous tracts which have previously been subjected to silvicultural clearing and contain few, if any, tree sized material. Existing trees of target species within the clearing areas will not be cut. The clearing method for these areas is double-drum chop and K-G shearing. This method will remove standing shrubby vegetation, allowing for better access for planting and reducing vegetative competition. This expedited schedule provides for planting in Winter/Spring 2001.

5.3.3 Planting

Planting will be conducted on 8-foot centers, resulting in the establishment of approximately 680 stems per acre. The vegetation planting will result in the initial establishment of approximately 1.07 million stems within the CWMB.

Table 5-1 contains a list of target restoration communities, with specific species mixes within each community by Management Unit. Species mixes are such that no single species comprises more than 14 percent of the total species composition across the entire CWMB.

Following hydraulic modifications within each Phase, the respective construction areas within each Phase will be replanted with appropriate species. These construction areas will typically include narrow zones associated with road removal and ditch alterations.

Responsibility for planting specifications, species acquisition, timing of planting, and planting oversight will be assumed by NCDOT Roadside Environmental Unit.

Table 5-2. Planting Regimen for the Croatan Wetland Mitigation Bank.

	Target Vegetation Community							
	Coastal Plain Small Stream Swamp	Mesic Pine Flats	Nonriverine Swamp Forest	Nonriverine Wet Hardwood Forest, type a	Nonriverine Wet Hardwood Forest, type b	Pond Pine Woodland	Wet Pine Flats	TOTAL
	Acres Planted within each Vegetation Types							
Target Area, Phase I	0	4	25	95	0	142	61	327
Total Area, Phase II	44	23	104	198	7	0	138	1,244
Total Area	44	27	129	293	737	142	199	1,571

Species	Number of stems planted (percent of total for each vegetation type in parentheses)							
Betula nigra	2,977 (10)							2,977 (0.2)
Chamaecyparis thyoides			8,803 (10)			9,667 (10)		18,470 (1.7)
Fraxinus pennsylvanica	2,977 (10)		8,803 (10)					11,780 (1.1)
Gordonia lasianthus						38,667 (40)		38,667 (3.6)
Nyssa biflora	7,443 (25)		17,607 (20)	29,958 (15)	75,264 (15)			130,272 (12.4)
Pinus palustris		9,262 (50)					47,432 (35)	56,694 (5.3)
Pinus serotina	2,977 (10)		17,607 (20)		50,176 (10)	38,667 (40)	40,656 (30)	150,083 (14.0)
Pinus taeda		9,262 (50)				9,667 (10)	47,432 (35)	66,361 (6.2)
Quercus laurifolia	2,977 (10)			29,958 (15)	75,264 (15)			108,199 (10.1)
Quercus lyrata				29,958 (15)	75,264 (15)			105,222 (9.8)
Quercus michauxii	2,977 (10)			29,958 (15)	75,264 (15)			108,199 (10.1)
Quercus nigra				19,971 (10)	50,176 (10)			70,147 (6.5)
Quercus pagoda				29,958 (15)	50,176 (10)			80,134 (7.5)
Quercus phellos				29,958 (15)	50,176 (10)			80,134 (7.5)
Taxodium ascendens	7,443 (25)		35,213 (40)					42,646 (4.0)
Total	29,771	18,524	88,033	199,719	501,760	96,668	135,520	1,069,995

6.0 IMPLEMENTATION SCHEDULE

The CWMB is proposed for implementation in two phases, corresponding to the 1469.3-acre Phase I area and the 2565.3-acre Phase II area depicted in Figure 3-1. Phase I includes Management Units 12A through 18. Phase II includes Management Units 1 through 11. Management Units are depicted in Figures 5-12 and 5-13.

Site preparation is expected to begin in the Phase I area in Fall 2000, with appropriate areas planted in Winter/Spring 2001. Hydrologic modifications to Phase I are expected to begin in Summer 2001 and to be completed by the end of 2001. The 5-year monitoring period for Phase I is expected to begin with the 2002 growing season or after completion of plantings and hydrologic modifications.

Site preparation for the Phase II area is expected to begin in Spring 2001, with appropriate areas planted in Winter/Spring 2002. Hydrologic modifications to Phase II are expected to begin in Summer 2002 and to be completed by the end of 2002. The 5-year monitoring period for Phase II is expected to begin with the 2003 growing season or after completion of plantings and hydrologic modifications.

This schedule is based on current projections and is subject to revision. The projected credit release schedule is provided in Section 8.0.

7.0 MONITORING PLAN

Mitigation value at the CWMB is being gained primarily through hydrologic restoration and hydrologic enhancement. Limited clearing and replanting will be conducted in recent clear-cuts and early successional areas. The monitoring plan for the CWMB will include a direct hydrologic comparison between relatively undisturbed reference wetlands and wetland restoration/enhancement areas of the CWMB. The wetland hydrology restoration and enhancement success criteria will be based upon a comparative analysis between designated reference wetlands and the wetland mitigation site. Monitoring of wetland restoration and enhancement efforts will be performed until success criteria are fulfilled.

7.1 Hydrology

7.1.1 Hydrology Monitoring

Surficial monitoring wells have been placed on the CWMB and within ten reference wetland sites along the CWMB periphery and nearby Forest Service property during 1998 and 1999. These wells are currently being monitored and following implementation will continue to be monitored throughout subsequent growing seasons at intervals necessary to satisfy the hydrology success criteria within each of the restoration and enhancement areas. Additional wells will be placed on the CWMB as needed following implementation to provide adequate coverage for documenting hydrologic restoration and enhancement.

7.1.2 Hydrology Success Criteria

Hydrologic success criteria will be different for areas being considered for hydrologic restoration and areas considered for hydrologic enhancement. These success criteria are presented in the following sections.

7.1.2.1 Hydrologic Restoration Success Criteria

Target hydrological characteristics for restoration areas include inundation or saturation within 12 inches of the ground surface for 12.5 percent of the growing season during normal climatic conditions for most soil types present. The hydrologic success criterion will be considered met in those areas being considered for hydrologic restoration when the defining jurisdictional hydroperiod can be demonstrated to have increased from baseline condition (typically less than 5 percent of the growing season) to greater than 12.5 percent of the growing season.

The hydrologic success criterion may also be considered met in selected areas where the defining jurisdictional hydroperiod can be demonstrated to have increased from baseline condition of less than 5 percent of the growing season to one approaching 12.5 percent of the growing season under certain conditions. These conditions may include direct comparison to comparable reference well data or site-

specific conditions. Any exceptions to the restoration success criteria set at greater than 12.5 percent of the growing season will be subject to approval on a case-by-case basis by the COE and MBRT.

7.1.2.2 Hydrologic Enhancement Success Criteria

Target hydrological characteristics for enhancement areas include increasing existing jurisdictional hydroperiods to soil type-specific hydroperiods approaching those of reference wetlands. Based on preliminary modeling, the return of hydrologic conditions approaching maximum forecast values is expected to be achieved on an incremental basis over several years. A single hydroperiod can not be selected that is applicable across the range of site conditions based on specific soil conditions, variability in degree of existing hydrologic disturbance, published values, and modeled variability. The hydrologic success criterion will be considered met in one of two ways in those areas being considered for hydrologic enhancement.

For areas considered jurisdictional but not achieving a minimum baseline defining jurisdictional hydroperiod of at least 12.5 percent of the growing season, the hydrologic enhancement criterion will be considered met when the defining jurisdictional hydroperiod can be demonstrated to have increased from baseline condition (typically between 5 and 12.5 percent of the growing season) to greater than 12.5 percent of the growing season.

For areas considered jurisdictional and achieving a minimum baseline defining jurisdictional hydroperiod of at least 12.5 percent of the growing season, the hydrologic enhancement criterion will be considered met when the defining jurisdictional hydroperiod can be demonstrated to have increased by at least 15 percent over baseline condition.

The mechanism for measuring the increase in hydroperiod will be through the use of a Reference Index. The Reference Index (R) will be determined by dividing the defining jurisdictional hydroperiod for a representative monitoring well (m_x) by the defining jurisdictional hydroperiod for the appropriate reference well (r_y) for the same growing season, such that $\mathbf{R = m_x/r_y}$. To demonstrate hydrologic enhancement, the post-implementation Reference Index (R_p) for a given growing season must be at least 15 percent higher than the baseline Reference Index (R_b), such that success is demonstrated if $\mathbf{R_p/R_b \geq 1.15}$. The use of Reference Indices reduces concerns about the normalcy of rainfall in any given year since the annual Reference Index is based on the same precipitation events for reference wells (r_x) and wells being evaluated (m_x).

Demonstration of hydrologic success for restoration and enhancement areas will require extensive groundwater monitoring. In addition to the existing 156 monitoring stations currently in use, additional data will be required from selected

representative areas to demonstrate hydrologic restoration or enhancement. Locations of existing monitoring well stations are depicted on Figure 7-1.

7.2 Vegetation

7.2.1 Vegetation Monitoring

After planting has been completed in winter or early spring, an initial evaluation will be performed to verify planting methods and to verify initial composition and density. Supplemental planting and additional site modifications will be implemented, if necessary.

During the first year, vegetation will receive cursory, visual evaluation on a periodic basis to ascertain the degree of overtopping of planted elements by nuisance species. Subsequently, quantitative sampling of vegetation will be performed between August 1 and November 30 each growing season until the vegetation success criterion is achieved.

Vegetation sampling plots will be placed within each restored community type. Sample plot distributions will be correlated with hydrological monitoring locations to provide point-related data on hydrological and vegetation parameters.

7.2.2 Vegetation Success Criteria

Performance criteria will be met if sample plots demonstrate that specific tree survival goals are met annually. For each of the first three complete years of monitoring, 320 target-species plants per acre must have survived such that at the end of three years, 320 three-year old target-species plants per acre have survived in the planted areas. In years four and five, 288 and 260 plants per acre, respectively, must have survived on the site, such that at the end of year five, 260 five-year old target-species plants per acre have survived on the site.

Characteristic tree species are those within the reference ecosystems as well as acceptable species naturally recruited and considered natural components of the target community types as described in Schafale and Weakley (1990). Naturally recruited non-target trees can not comprise more than 10 percent of the surviving stems/acre requirement in restoration areas targeted for reforestation.

Specific stand planting diversity and species representation (relative proportion) will be determined by target community type. Within targeted Pond Pine Woodland stands for example, pond pine and loblolly bay may constitute the majority of stems planted; lesser amounts of sweetbay, red bay, and Atlantic white cedar may be planted. Natural recruitment of red maple and loblolly pine is anticipated and should be acceptable since these species are natural components of Pond Pine Woodland as described in Schafale and Weakley (1990).

In existing forested areas where hydrologic restoration and enhancement is the goal, and no plantings are undertaken, no quantitative sampling is proposed. No quantitative sampling requirements are proposed for herb and shrub assemblages as part of the vegetative success criteria.

7.3 Soils

Since the majority of the CWMB has been documented as containing soils formed under hydric conditions, successful restoration or enhancement of hydrology to these applicable areas shall be considered successful attainment of the hydric soil criteria. No specific soil monitoring is proposed.

7.4 Report Submittal

An as-built report for each Phase of the CWMB, including plan drawings, initial species compositions by community type, and monitoring/sample plot locations will be provided within 90 days of completion of Phase implementation. A discussion of the planting design, including densities and numbers of each species planted, will also be included in the as-built report.

Subsequently, reports will be submitted yearly to the MBRT following each assessment. Submitted reports will document the sample transect locations, along with photographs which illustrate site conditions in reference and mitigation wetlands. Surficial well data will be summarized in tabular format. The duration of wetland hydroperiods during the growing season will also be calculated within each community restoration type and reference area. The survival and density of planted tree stock will be reported. A visual estimate and photographic evidence of the relative cover of shrub and herb species will be generated.

7.5 Contingency

In the event that vegetation or hydrology success criteria are not fulfilled, a mechanism for contingency will be implemented. For vegetation contingency, replanting and extending the monitoring period will be implemented if community restoration does not fulfill minimum species density and distribution requirements. Hydrologic contingency will require consultation with hydrologists and MBRT in the event that predicted wetland hydrology restoration or enhancement is not achieved during the monitoring period. Recommendations for contingency to establish wetland hydrology will be implemented and monitored until the hydrology success criteria are achieved.

8.0 MITIGATION CREDIT AND RELEASE SCHEDULE

8.1 Mitigation Credits

Credit production on the CWMB will be achieved through restoration, enhancement, and preservation of wetland functions through mitigative measures:

- Restoration credit will be produced by restoring jurisdictional hydrology to hydric soils currently lacking jurisdictional hydroperiods; suitable vegetative cover will also be restored in appropriate areas.

- Enhancement credit will be produced by increasing hydroperiods in existing degraded wetlands to levels approaching historic conditions; criteria for determining which areas are expected to be hydrologically enhanced are based on on-site hydrology monitoring, reference site monitoring, predictive modeling, and published data (see Sections 4.1 and 7.1.2). Suitable vegetative cover will be restored in appropriate areas of hydrologic enhancement. Less than 2 ac of plantings in jurisdictional areas will be in areas not expected to qualify for hydrologic enhancement credit.

- Preservation credit will be generated from existing jurisdictional wetlands for which no significant hydrologic enhancement is demonstrated or vegetative enhancement is undertaken.

- No credit will be generated for nonhydric soils or roads maintained on the CWMB following implementation. Nonjurisdictional hydric soil areas not achieving jurisdictional hydrology following site implementation will not generate credit; predictive modeling has been used to estimate the location and extent of these areas.

Table 8-1 presents the mitigation components for the CWMB. These areas are depicted in Figure 8-1.

Table 8-1. Mitigation Components for the CWMB.

CWMB Component		Phase I (acres)	Phase II (acres)	Total (acres)
Nonriverine Areas	Restoration	311.6	1123.6	1435.2
	Enhancement	1026.9	956.9	1983.8
	Preservation	108.0	253.0	361.0
Riverine Areas	Restoration	0	49.6	49.6
	Enhancement	0	91.6	91.6
	Preservation	0	37.8	37.8
Non-credit Areas	Non-restorable	18.9	27.1	46.0
	Nonhydric Soil	3.9	25.7	29.6
Total		1469.3	2565.3	4034.6

Approximately 1531 ac of hydric soils on the CWMB lack jurisdictional hydrology. Of this, approximately 50 ac are areas that were historically under riverine influence and approximately 1481 ac are nonriverine areas.

Approximately 2075 ac of the 2391 ac of existing jurisdictional wetlands are expected to experience hydrologic enhancement through prolonged near-surface hydroperiods. Of this 2075 ac, approximately 92 ac are areas that were historically under riverine influence and approximately 1984 ac are nonriverine areas. No hydrologic enhancement (as defined in Section 7.1.2) is predicted to be achieved for approximately 38 ac of riverine wetlands and 361 ac of nonriverine wetlands; these areas are considered preservation.

Of the 1481 acres of nonjurisdictional nonriverine areas, approximately 46 acres are predicted to not achieve jurisdictional hydrology following site implementation. These non-restorable areas include the roads to remain on the CWMB following implementation and narrow zones approximately 16.4 ft (5 meters according to model) along each side of these roads where jurisdictional delineations currently show a zone of drainage. These predicted non-restorable areas also include two additional areas in slightly wider zones of Leon soils adjacent to roads. Nonhydric soils, which will not generate credit, total approximately 30 ac.

Mitigation credit for the CWMB has been established based on the following formula provided by the MBRT:

$$\text{Credits} = R/2 + (C/1.5R \times R/2) + (E/2R \times R/2) + (P/5R \times R/2)$$

where R = Restoration Acres,
C = Creation Acres,
E = Enhancement Acres,
P = Preservation Acres,
and the number of credits is capped at R.

Table 8-2 presents the mitigation credits predicted to be available in the CWMB upon successful implementation of the mitigation plan. Riverine and nonriverine credits have been calculated separately. Credits have been rounded off to the nearest whole unit. The two CWMB implementation phases have also been treated separately.

Table 8-2. Credits Generated at the CWMB.

	Nonriverine Credits	Riverine Credits
Phase I	312	0
Phase II	938	50
Total	1250	50

The Restoration cap for nonriverine areas is exceeded in Phase I if the full amount of Enhancement and Preservation acres available are used, resulting in credits being capped at 312 credits. Therefore the residual Enhancement acres (447 acres) in excess of the value required to reach the Restoration cap in Phase I were transferred to Phase II. This transfer of residual Enhancement acres is done in accordance with guidelines provided with the mitigation credit formula provided by the MBRT.

- Each nonriverine mitigation credit will consist of approximately 1.1 ac of restored wetland, 1.6 ac of enhanced wetland, and 0.3 ac of preserved wetland for a total of approximately 3.0 ac mitigation for every 1.0 ac impacted (see Section 8.0).

Riverine credits for Phase II have been calculated at 51 credits, but the Restoration cap reduces the available credits to 50.

- Each riverine mitigation credit will consist of approximately 1.0 ac of restored wetland, 1.8 ac of enhanced wetland, and 0.8 ac of preserved wetland for a total of approximately 3.6 ac mitigation for every 1.0 ac impacted (see Section 8.0).

The 4035-acre CWMB will contain a variety of wetland types spanning a spectrum of hydrologic conditions from frequently flooded riverine wetlands to seasonally saturated nonriverine wetlands. Wetland types acceptable for debiting at the CWMB will include most non-tidal, freshwater wetland types commonly encountered within the lower Coastal Plain of North Carolina.

Mitigation credits will be used for unavoidable in-kind wetland losses associated with projects in the CWMB service area (see Section 9.0). Nonriverine credits will be used for nonriverine wetland impacts and riverine credits will only be used for riverine wetland impacts.

8.2 Mitigation Release Schedule

Table 8-3 presents the proposed schedule for release of credits. The credit release schedule accounts for the proposed two-phased approach to the implementation schedule for the CWMB. The actual dates for credit release may vary and will depend on when specific milestones are reached. Final release of the remaining credits will be contingent on demonstration of successful attainment of hydrology and vegetation goals. Actual credits available will be determined by the amount of successful hydrological restoration and enhancement achieved.

Table 8-3. Proposed Credit Release Schedule.

Date (Approx.)	Milestone Reached	Phased Release			
		Phase I		Phase II	
		Release	Cumulative	Release	Cumulative
December 2000	MBI Signed	15%	15%	15%	15%
January 2003	First Year Monitoring Report (Phase I)	10%	25%	0%	15%
January 2004	Second Year Monitoring Report (Phase I); First Year Monitoring Report (Phase II)	10%	35%	10%	25%
January 2005	Third Year Monitoring Report (Phase I); Second Year Monitoring Report (Phase II)	10%	45%	10%	35%
January 2006	Fourth Year Monitoring Report (Phase I); Third Year Monitoring Report (Phase II)	15%	60%	10%	45%
January 2007	Fifth Year Monitoring Report (Phase I); Fourth Year Monitoring Report (Phase II)	15%	75%	15%	60%
January 2008	Fifth Year Monitoring Report (Phase II)	0%	75%	15%	75%
January 2008	Final Credit Release (Upon Final Approval of MBRT)	25%	100%	25%	100%

Table 8-4 provides a timetable for anticipated available credits. This timetable includes both Phase I and Phase II credits on the schedule presented in Table 8-2. Actual credits available will be determined by the amount of successful hydrological restoration and enhancement achieved.

Table 8-4. Anticipated Availability of Credits.

Date (Approximate)	Nonriverine Credits		Riverine Credits	
	Release	Cumulative	Release	Cumulative
December 2000	188	188	8	8
January 2003	31	219	0	8
January 2004	125	344	5	13
January 2005	125	469	5	18
January 2006	141	610	5	23
January 2007	188	798	8	31
January 2008	452	1250	19	50
TOTAL	1250		50	

9.0 GEOGRAPHIC SERVICE AREA

The service area (Figure 9-1) for the CWMB is Hydrologic Cataloging Unit 03020204 (corresponding to DWQ sub-basins 03-04-10 and 03-04-11). This service area includes the lower portion of the Neuse River Drainage Basin including the Trent River watershed. Counties included within this service area include most of the southern and central portions of Craven County and northern Jones County, as well as portions of northern Carteret County, southern and western Pamlico County, northern Onslow County, and southern Lenoir County.

For projects located outside this service area, but still within the lower portion of the Neuse River Drainage Basin, use of the CWMB may be considered by the MBRT on a case-by-case basis.

The CWMB is proposed for use in providing in-kind compensatory mitigation for unavoidable wetland impacts occurring on NCDOT projects for which no on-site, in-kind mitigation is available. Proposed debiting wetlands will be within the proposed service area and will consist of the same types proposed for restoration, enhancement, and preservation at the CWMB.

The following NCDOT projects are wholly contained within the geographic service area and are expected to utilize the CWMB:

- **T.I.P. No. B-2531** US 17-NC 55, Bridge #28 Over Neuse River, Craven County.
- **T.I.P. No. R-1015** US 70, Havelock Bypass, North of Pine Grove to North of Carteret County Line, Craven County.

Portions of the following NCDOT projects are also located within the geographic service area for the CWMB and the CWMB may be utilized to fulfill at least part of the mitigation requirements for these projects:

- **T.I.P. No. R-2001** NC 11, NC 241 in Pink Hill to Jacksons Store, Lenoir County.
- **T.I.P. No. R-2235** US 258, NC 24 Near Richlands to US 70 at Kinston, Onslow-Jones-Lenoir Counties.
- **T.I.P. No. R-2301A** US 17, New Bern Bypass, US 17 South of New Bern to US 70, Craven County.
- **T.I.P. No. R-2514** US 17, Multi-lanes North of Jacksonville to Multi-lanes South of New Bern, Onslow-Jones Counties.
- **T.I.P. No. R-2539** NC 55, US 17 at Bridgeton to NC 304 in Bayboro, Craven-Pamlico Counties.
- **T.I.P. No. R-3403** US 17, Mills Street in Bridgeton to SR 1438, Craven County.

This list is included for preliminary consideration and is not a complete or final accounting of all eligible projects. Service area, availability of credits, debiting wetland type, and approval from the MBRT will determine which projects will be eligible to utilize the CWMB.

10.0 FINAL DISPOSITION OF PROPERTY

NCDOT will remain responsible for the CWMB during site implementation and monitoring. The USDA Forest Service is expected to be the ultimate recipient of the CWMB for inclusion and management as part of the Croatan National Forest. NDCOT is in negotiation with the USDA Forest Service over terms of the final disposition of the CWMB.

The wetlands mitigation plan developed for the CWMB is compatible with the proposed Croatan National Forest Land & Resource Management Plan (USDA 1999). The CWMB is located mostly within the Forest's Management Area 7, with the southernmost portion of CWMB Phase I located within Forest's Management Area 2. Several components of the CWMB mitigation plan complement specific goals of the Forest Service's Management Plan. Included among these are the protection of the East Prong Brice Creek watershed, restoring hydrologic function and sustaining aquatic systems, restoration/enhancement/preservation of the natural wetland communities (including hardwood/cypress wetlands), providing RCW habitat linkage, enhancing black bear habitat, providing unfragmented hardwood wetlands for interior Neotropical migratory bird habitat, and restoring hardwoods on suitable sites.

Long-term management of the CWMB may include land uses and practices that are compatible with the mitigation objectives of wetland restoration, enhancement, and preservation incorporating restoration of natural vegetation community structure. Management activities and long-term land uses on the CWMB may include the following:

- Stream channel restoration may be considered for the channelized segment of East Prong Brice Creek along the CWMB boundary with USDA Forest Service lands. If stream channel restoration is pursued, this activity should proceed prior to final implementation of wetland mitigation activities in adjacent portions of Phase II of the CWMB. If stream channel restoration is not possible prior to implementation of the CWMB wetland mitigation plan, with MBRT consent temporary disturbance to adjacent mitigation wetlands may be permitted provided stream channel restoration activities do not affect the overall wetland credits available.

- No hydrologic alterations, ditching, or new roads will be permitted. Roads left remaining on the CWMB should be kept closed to general traffic to reduce the possibility of off-road traffic damaging hydrologic and hydraulic control structures. These remaining roads may be maintained to provide access for fire control operations provided that hydrologic and hydraulic control structures are not impaired.

- Managing for the presence of large hardwood trees, cypress, or other desirable target species within each community type is required to provide optimal habitat for species typical of mature growth wetland forests. Protective covenants on the mitigation land will specify that the land be allowed to succeed to specified tree densities before timber harvest is considered. After implementation and achievement of target vegetation success criteria, covenants will stipulate that there is to be no forest clear-cutting. As part of long-term natural community management, selective timbering may be practiced in non-pine dominated natural communities provided selective timbering does not lower per-acre stem counts below a target density of 6 non-pine trees per ac greater than 15 inches dbh (within each acre of mitigation area). In addition, densities of hardwoods greater than 15 inches dbh will maintained at or greater than 30 ft^2 of basal area per ac (for each ac of land) to provide adequate foraging potential for mast-consuming wildlife (Yoakum *et al.* 1980, USDA 1999). For pine-dominated natural communities, management may be used according to accepted methods for improving or restoring selected areas for RCW use.

- Dead and dying trees, snags, and logs will be left on-site to provide foraging habitat as well as to provide cavity formation for cavity-nesting species.

- A long-term fire management program may be implemented, as necessary, to facilitate steady state natural community development, improve wildlife habitat, and promote endangered species habitat, provided such use of fire management does not convert the intended natural wetland community structure to other than the type intended by the mitigation plan.

- Wildlife harvesting activities in mitigation areas may be permitted following final release of the site, provided hunting activities do not conflict with the mitigation objectives of the CWMB, and based on recommendations from the WRC or other responsible wildlife management agency.

Additional management activities and land uses may be permitted at the discretion of the MBRT; these activities and land uses will be stipulated prior to the final disposition of the CWMB.

11.0 FINANCIAL ASSURANCES

NCDOT, the Bank Sponsor, has fee simple ownership of the 4035-acre CWMB. The NCDOT wetland mitigation process is funded as part of each construction project. This may be done with either State or Federal funds. NCDOT is financially supported through state and federal actions as authorized by legislation. This authorization includes a portion of the taxes collected from the sale of gasoline. NCDOT anticipates no difficulty in meeting its obligations for funding of wetland mitigation banks as specified by law, rule, or regulation.

12.0 ACCOUNTING PROCEDURES

Credits will be generated through successful implementation of the CWMB. The total available credits at the CWMB will be determined by the acreage of successful wetlands restoration and enhancement.

Each nonriverine mitigation credit will consist of approximately 1.1 ac of restored wetland, 1.6 ac of enhanced wetland, and 0.3 ac of preserved wetland for a total of approximately 3.0 ac mitigation for every 1.0 ac impacted (see Section 8.0).

Each riverine mitigation credit will consist of approximately 1.0 ac of restored wetland, 1.8 ac of enhanced wetland, and 0.8 ac of preserved wetland for a total of approximately 3.6 ac mitigation for every 1.0 ac impacted (see Section 8.0).

Monitoring results and subsequent reports will be the vehicle by which successful achievement of mitigation goals will be demonstrated. The Bank Sponsor, in consultation with the MBRT, will determine when performance standards have been met. If performance standards are not met, then the Bank Sponsor will perform any and all remedial activities to the satisfaction of the MBRT. Credits will be released according to the schedule approved by the MBRT.

The compensation ratio for debiting from the CWMB will be determined following completion of on-going site investigations to determine the amount of restoration, enhancement, and preservation expected to be available on the site. The Bank Sponsor will submit a written notification to the MBRT at the time of each transaction within the Bank. In addition, an accounting schedule (ledger) will be submitted to the MBRT on an annual basis. This accounting schedule will be certified by the Bank Sponsor prior to submission to the MBRT.

13.0 REFERENCES

Amoroso, J.L. 1999. Natural Heritage Program List of the Rare Plant Species of North Carolina. North Carolina Natural Heritage Program, Division of Parks and Recreation, N.C. Department of Environment, Health and Natural Resources, Raleigh. 85 pp.

Belcher, H.W. and G.E. Merva. 1987. Results of DRAINMOD verification study for Zeigenfuss soil and Michigan climate. ASAE Paper No. 87-2554. ASAE, St. Joseph, MI 49085.

Brown, Philip M., et al. 1985. Geologic Map of North Carolina, North Carolina Department of Natural Resources and Community Development, 1-500,000 scale.

Department of the Army (DOA). 1987. Corps of Engineers Wetlands Delineation Manual. Tech. Rpt. Y-87-1. Waterways Experiment Station, Corps of Engineers, Vicksburg, Miss. 100 pp.

Division of Environmental Management (DEM). 1993a. Classification and Water Quality Standards Assigned to the Waters of the Neuse River Basin. North Carolina Department of Environment, Health, and Natural Resources (DEHNR), DEM, Water Quality Section; Raleigh.

Division of Environmental Management (DEM). 1993b. Neuse River Basinwide Water Quality Management Plan. North Carolina DEHNR, Water Quality Section; Raleigh.

Division of Environmental Management (DEM). 1996. Draft Basinwide Assessment Report Support Document: Neuse River Basin. North Carolina DEHNR, Water Quality Section; Raleigh. 402 pp.

Eddy Engineering, P.C. (Eddy). 1998. Preliminary Hydrologic and Hydraulic Analysis: Croatan Wetland Mitigation Bank, Phase I. 26 pp, Appendices.

Eddy Engineering, P.C. (Eddy). 2000. Conceptual Design Report: Croatan Wetland Mitigation Bank. 75 pp, Appendices.

Environmental Services, Inc. (ESI). 1997. Preliminary Site Assessment: Croatan Wetland Mitigation Bank. Report to NCDOT. 22 pp, Appendices.

Environmental Services, Inc. (ESI). 1998. Summary Report for Croatan Wetland Mitigation Bank Phase I: Preliminary Data Collection. Report to NCDOT. 14 pp, Appendices.

Environmental Services, Inc. (ESI). 1999a. Croatan Wetland Mitigation Bank Preliminary Subsurface Investigation and Hydrogeological Assessment. Report to NCDOT. 13 pp, Appendices.

Environmental Services, Inc. (ESI). 1999b. An Archaeological Reconnaissance Survey for the Proposed Croatan Mitigation Bank. Report to NCDOT. 8 pp.

Environmental Services, Inc. (ESI). 2000a. Croatan Wetland Mitigation Bank Subsurface Investigation and Hydrogeological Assessment. Report to NCDOT. 38 pp, Appendices.

Environmental Services, Inc. (ESI). 2000b. Summary Report for Jurisdictional Delineation: Croatan Wetland Mitigation Bank. 605 pp.

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

Fish and Wildlife Service (FWS). 1993. West Indian Manatee: *Trichechus manatus* [Linnaeus]. **In**: Endangered and Threatened Species of the Southeastern United States (The Red Book). U.S. Department of the Interior, Fish and Wildlife Service, Southeastern Region, Atlanta, GA. 6 pp.

Fish and Wildlife Service (FWS). 1994. Sensitive Joint-vetch Recovery Plan. Technical/Agency Draft. September 1994.

Fouss, J.L., R.L. Bengtson, and C.E. Carter. 1987. Simulating subsurface drainage in the lower Mississippi Valley with DRAINMOD. Transactions of the ASAE 30(6):1679-1688.

Gayle, G., R.W. Skaggs, and C.E. Carter. 1985. Evaluation of a water management model for a Louisiana sugar cane field. Jour. of Am. Soc. of Sugar Cane Technologists, 4:18 -28.

Hamel, P.B. 1992. Land Manager's Guide to the Birds of the South. The Nature Conservancy, Southeastern Region, Chapel Hill, NC. 437 pp.

Henry, V.G. 1989. Guidelines for Preparation of Biological Assessments and Evaluations for the Red-cockaded Woodpecker. U.S. Fish and Wildlife Service, Southeast Region, Atlanta, GA. 13 pp.

Hooper, R.G., A.F. Robinson, Jr., and J.A. Jackson. 1980. The Red-cockaded Woodpecker: Notes on Life History and Management. U.S. Department of Agriculture, FOrest Service, Southeastern Area; Atlanta, GA. 8 pp.

LeGrand, H.E., Jr., and S.P. Hall. 1999. Natural Heritage Program List of the Rare Animal Species of North Carolina. North Carolina Natural Heritage Program, Division of Parks and Recreation, N.C. Department of Environment, Health and Natural Resources, Raleigh. 91 pp.

Leonard, S.W. 1985. Status Report on Aeschenomene virginica in North Carolina. Unpublished report to the Nature Conservancy, Boston, MA. 6+pp.

Martof, B.S., W.M. Palmer, J.R. Bailey, and J.R. Harrison III. 1980. Amphibians and Reptiles of the Carolinas and Virginia. The University of North Carolina Press, Chapel Hill, NC. 264 pp.

Potter, E.F., J.F. Parnell, and R.P. Teulings. 1980. Birds of the Carolinas. The University of North Carolina Press, Chapel Hill, NC. 408 pp.

Radford, A. E., H.E. Ahles, and C.R. Bell. 1968. Manual of the Vascular Flora of The Carolinas. The University of North Carolina Press, Chapel Hill, NC. 408 pp.

Rogers, J.S. 1985. Water management model evaluation for shallow sandy soils. Transactions of the ASAE 28 (3), pp 785-790.

Rosgen, D. 1996. Applied River Geomorphology. Printed Media Companies, Minneapolis Minnesota.

Schafale, M.P. and A.S. Weakley. 1990. Classification of Natural Communites of North Carolina: Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation; DEHNR; Raleigh. 325 pp.

Skaggs, R.W., 1982. Field evaluation of a water management simulation model. Transactions of the ASAE 25 (3), pp 666-674.

Skaggs, R.W., N.R. Fausey, and B.H. Nolte. 1981. Water management evaluation for North Central Ohio. Transactions of the ASAE 24 (4), pp 922-928.

Skaggs, R.W., J.W. Gilliam, and R.O. Evans. 1991. A computer simulation study of pocosin hydrology. Wetlands (11), pp 399-416.

Skaggs, R.W., et al. 1993. Methods for Evaluating Wetland Hydrology. ASAE meeting presentation Paper No. 921590. 21 p.

Susanto, R.H., J. Feyen, W. Dierickx, and G. Wyseure. 1987. The use of simulation models to evaluate the performance of subsurface drainage systems. Proc. of Third International Drainage Workshop, Ohio State Univ., pp. A67 - A76.

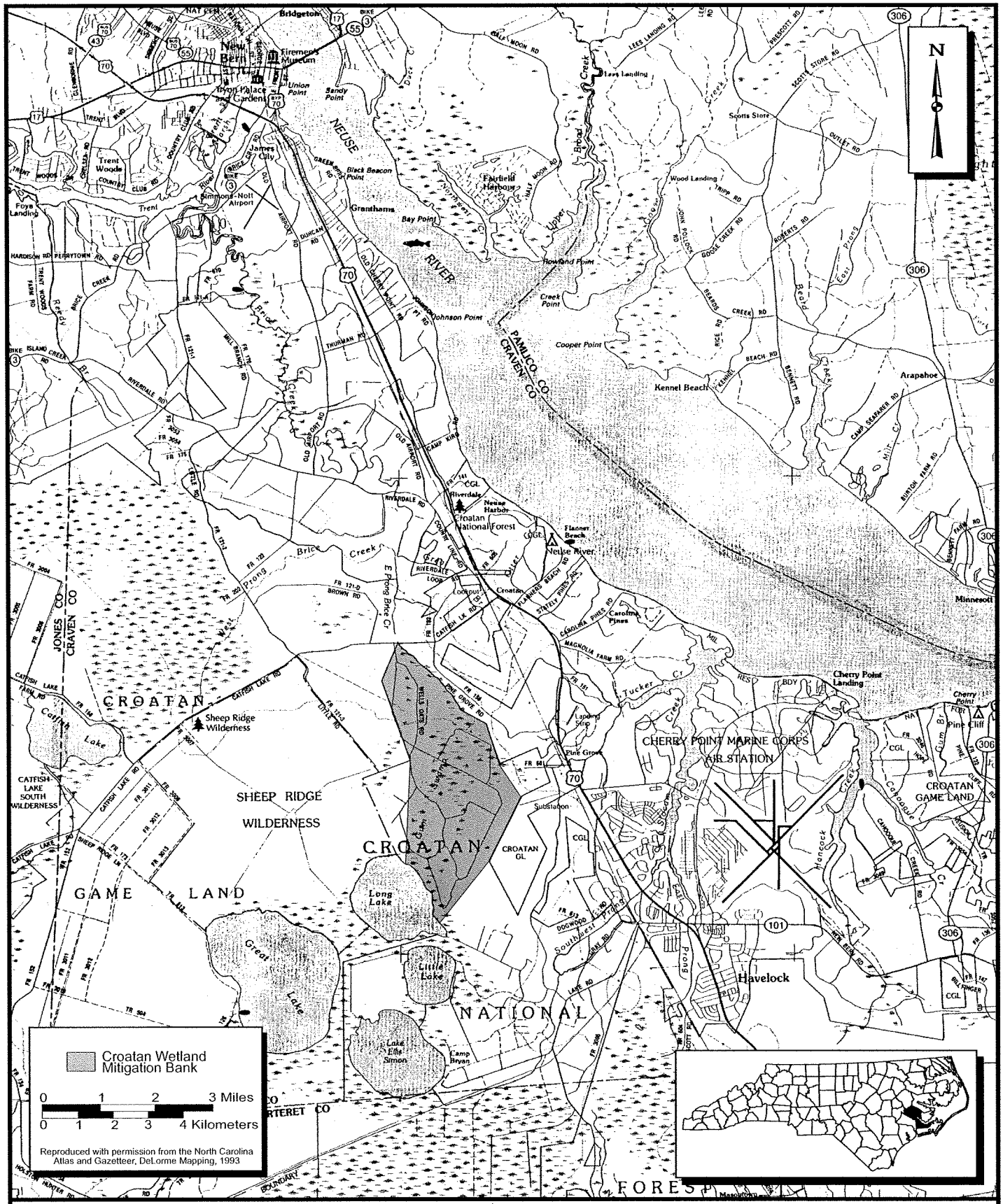
U.S. Department of Agriculture (USDA). 1989. Soil Survey of Craven County, North Carolina. USDA, Soil Conservation Service. 157 pp, Figures.

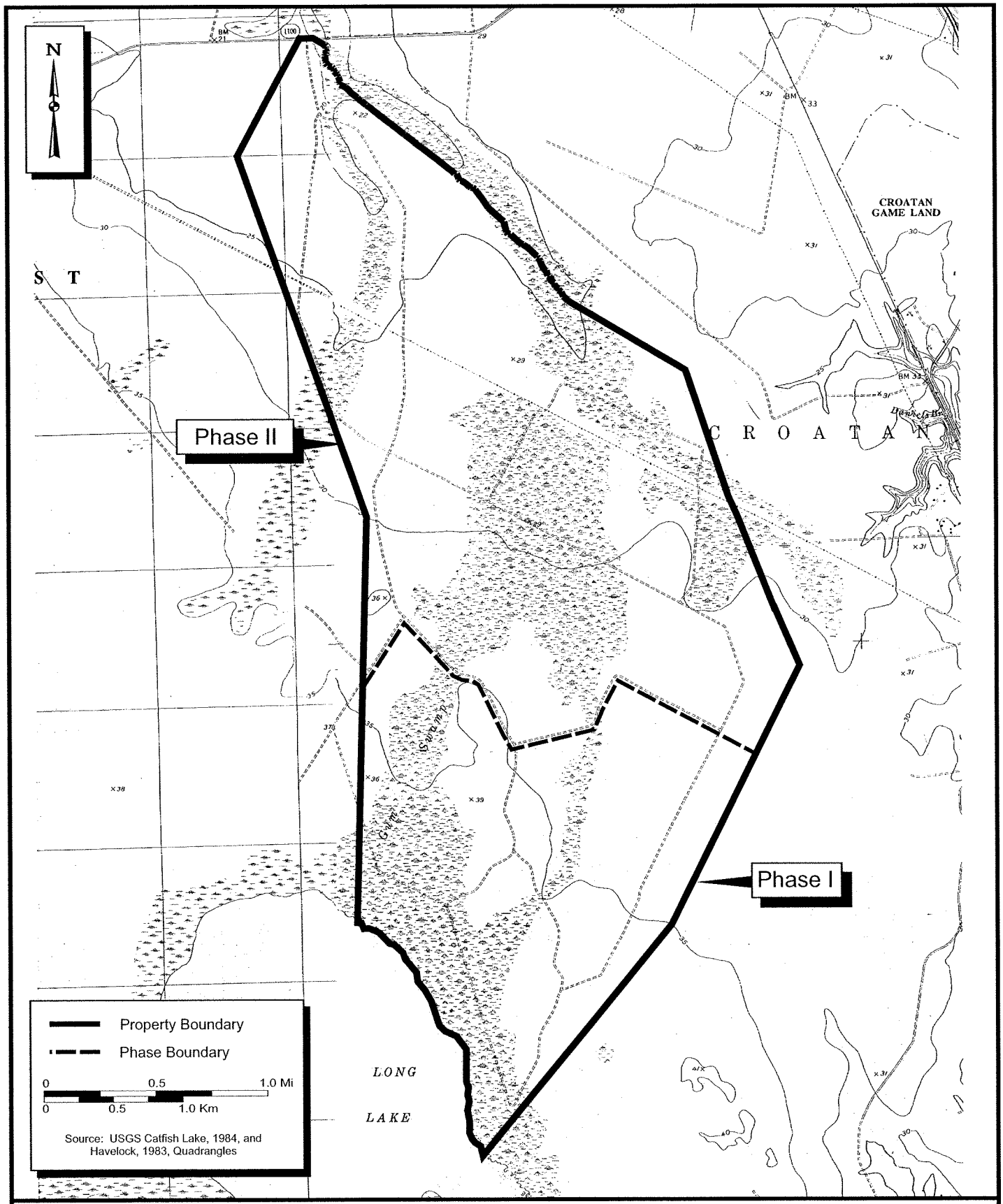
U.S. Department of Agriculture (USDA). 1999. Croatan National Forest Land and Resource Management Plan, Revision #1. USDA Forest Service.

U.S. Geological Survey (USGS). 1994. Catfish Lake Quadrangle, North Carolina 7.5 Minute Series (Topography).

U.S. Geological Survey (USGS). 1994. Havelock Quadrangle, North Carolina 7.5 Minute Series (Topography).

Yoakum, J., D.P. Dasmann, H.R. Sanderson, et al. 1980. Habitat Improvement Techniques. Pp. 329-403 in S.D. Schemintiz (Editor). Wildlife Management Techniques Manual, 4th ed., rev. The Wildlife Society, Washington, D.C. 686 pp.


N
Croatan Wetland Mitigation Bank
0 1 2 3 Miles
0 1 2 3 4 Kilometers
Reproduced with permission from the North Carolina Atlas and Gazetteer, DeLorme Mapping, 1993
CROATAN
SHEEP RIDGE WILDERNESS
GAME LAND
CHERRY POINT MARINE CORPS AIR STATION
CROATAN GAME LAND
CATFISH LAKE SOUTH WILDERNESS
Sheep Ridge Wilderness
NATIONAL FOREST
Havelock
New Bern
Bridgeton
Croatan National Forest
Neuse River
Bay Point
Cooper Point
Kennel Beach
Arapahoe
Minnesott
Cherry Point Landing
Pine Cliff
Pine Grove
Long Lake
Great Lake
Little Lake
Lake Ellis Simon
Camp Bryan
Catfish Lake
Fairfield Harbour
Howland Point
Johnson Point
Sandy Point
Union Point
Black Beacon Point
Grantham
Trent Woods
James City
Simmons-Nott Airport
Foys Landing
Sports Store
Wood Landing
Lees Landing
Riverdale
Neuse Harbor
Flanner Beach
Croatan
Carolina Pines
Tucker Creek
Broad Creek
Upper Broad Creek
Northeast Creek
Brice Creek
E Prong Brice Cr
Creek Point
Substation
CRAVEN CO
JONES CO
PAMLICO CO
BOUNDARY
CROATAN GL
CGL
BDY
RES
NAT FOR
Environmental Services, Inc.
Location Map
Croatan Wetland Mitigation Bank
Craven County, North Carolina
Figure: 1-1
Project: R-1015WM
Date: Sept 2000
ER98006.10/locat.cdr



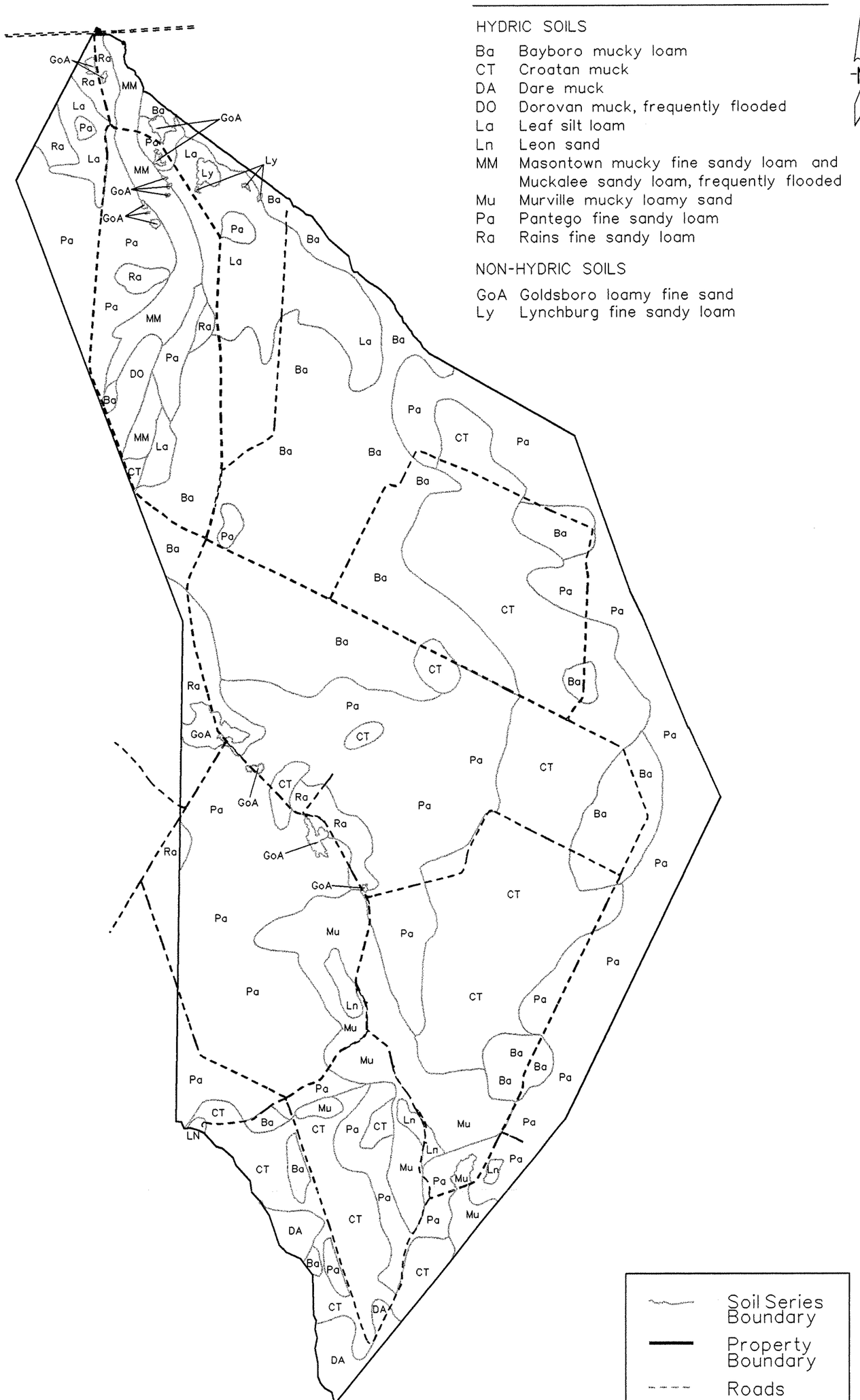
Environmental Services, Inc.

Topography
Croatan Wetland Mitigation Bank
Craven County, North Carolina

Figure:	3-1
Project:	R-1015WM
Date:	Sept 2000

ER98006.10/topography.cdr

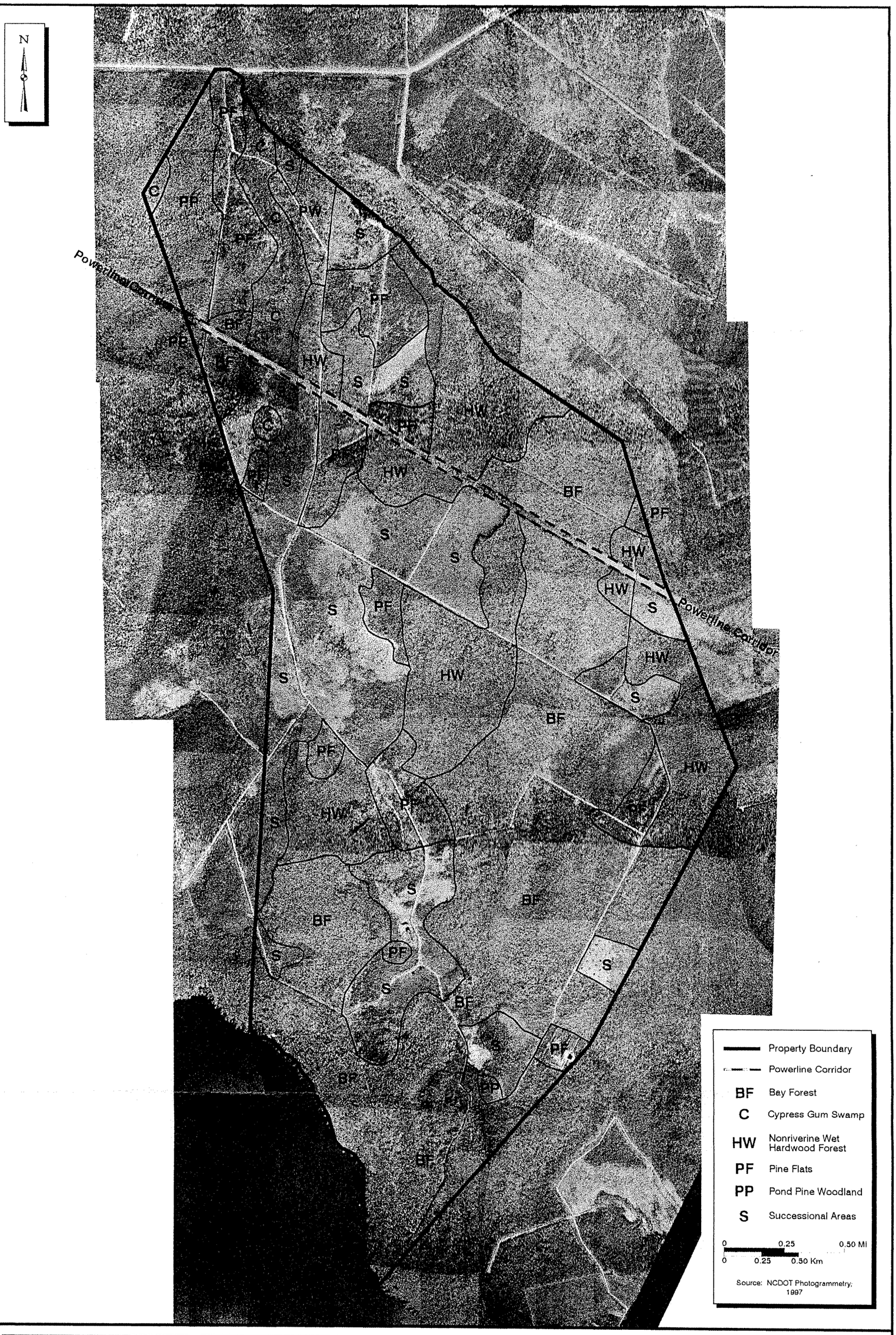
ER98006.10/soil_final.dgn



Environmental Services, Inc.

Soil Map
Croatan Wetland Mitigation Bank
Craven County, North Carolina

Drawn By: PJS	Figure: 3-2
Checked By: KWM	Project: R-1015WM
Scale: As Shown	Date: Sept 2000

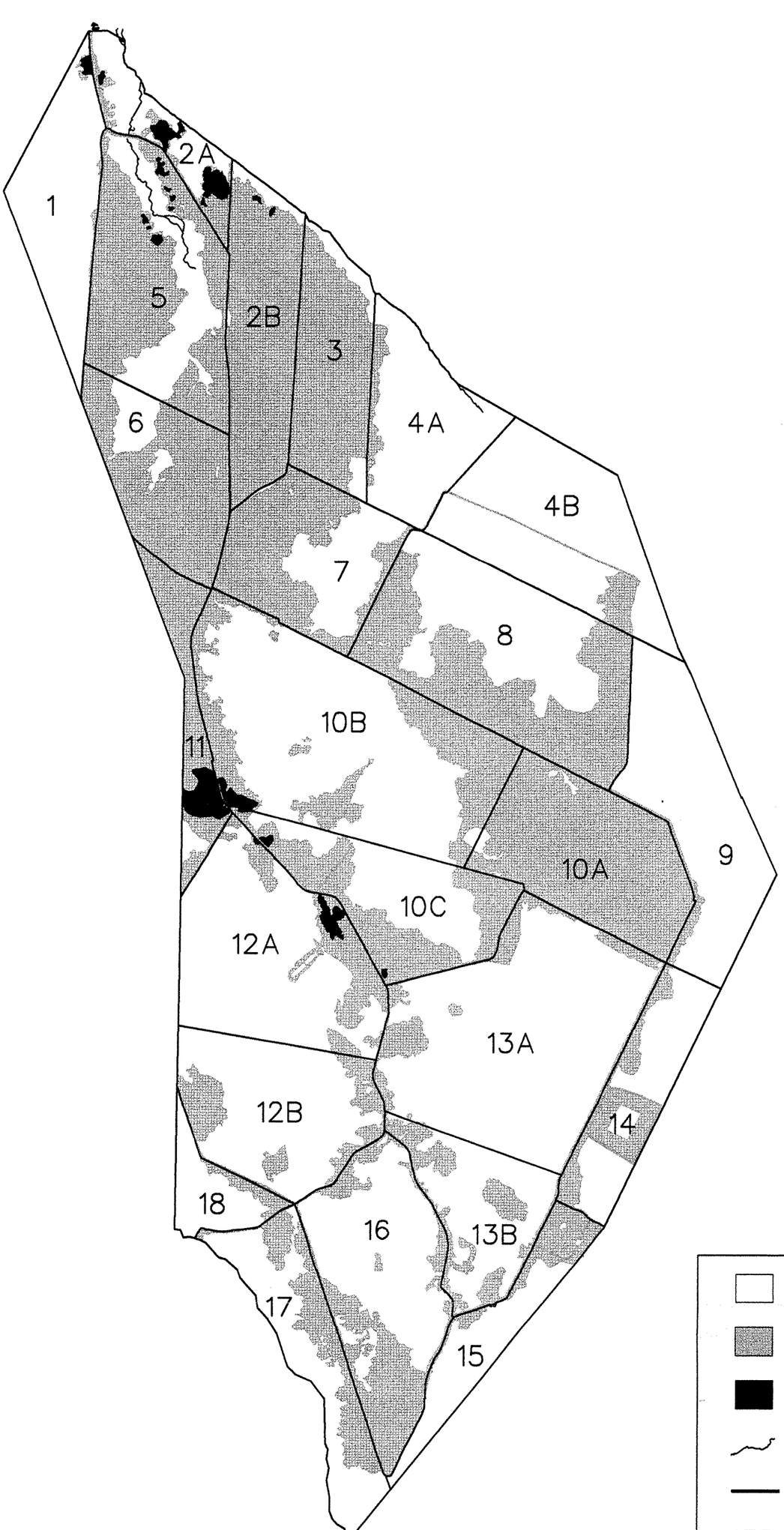


Environmental Services, Inc.

Existing Vegetation
Croatan Wetland Mitigation Bank
Craven County, North Carolina

Figure:	3-3
Project:	R-1015WM
Date:	Sept 2000

ER98006.10/Jurisdictional_delineation.dgn

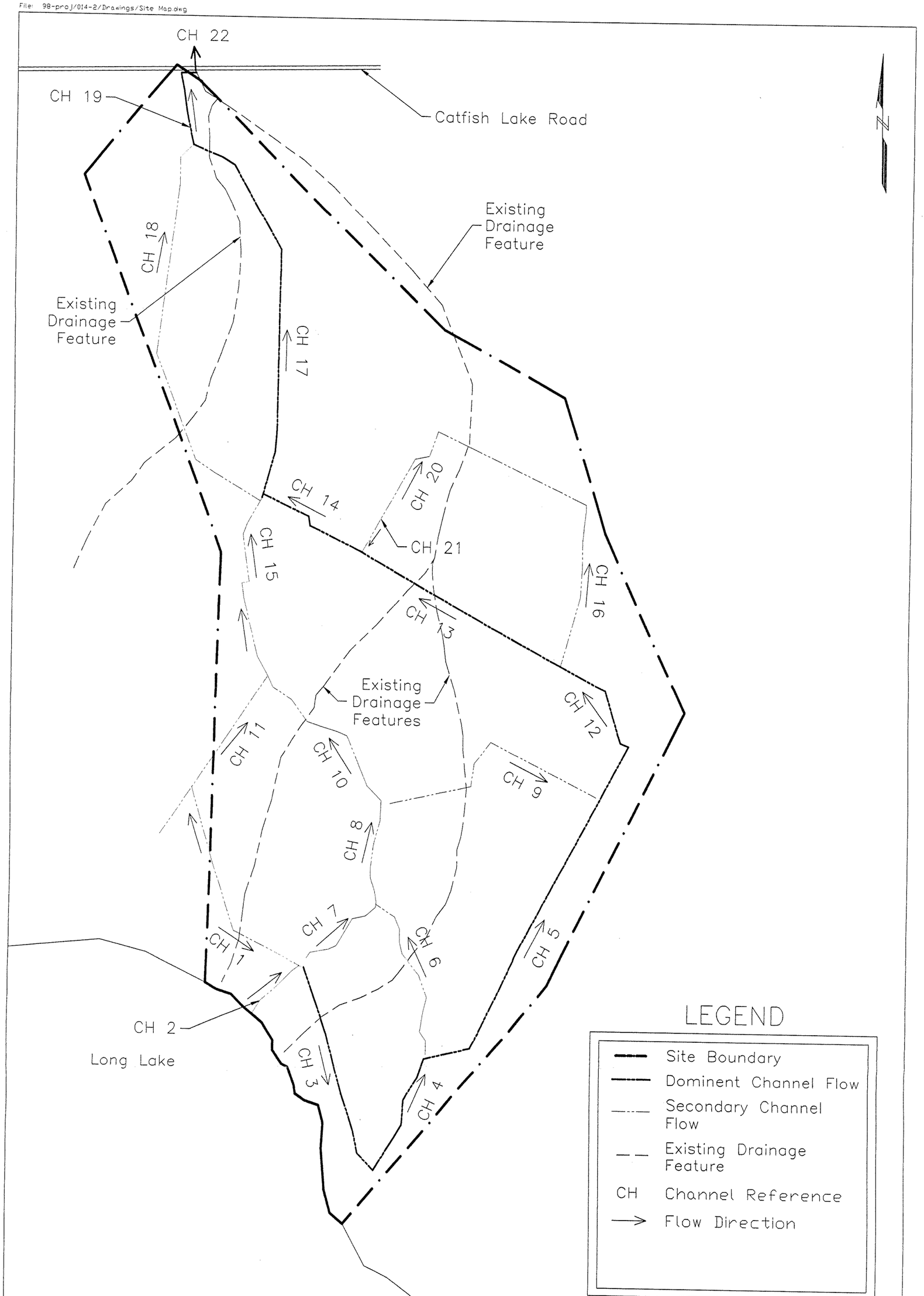


Environmental Services, Inc.

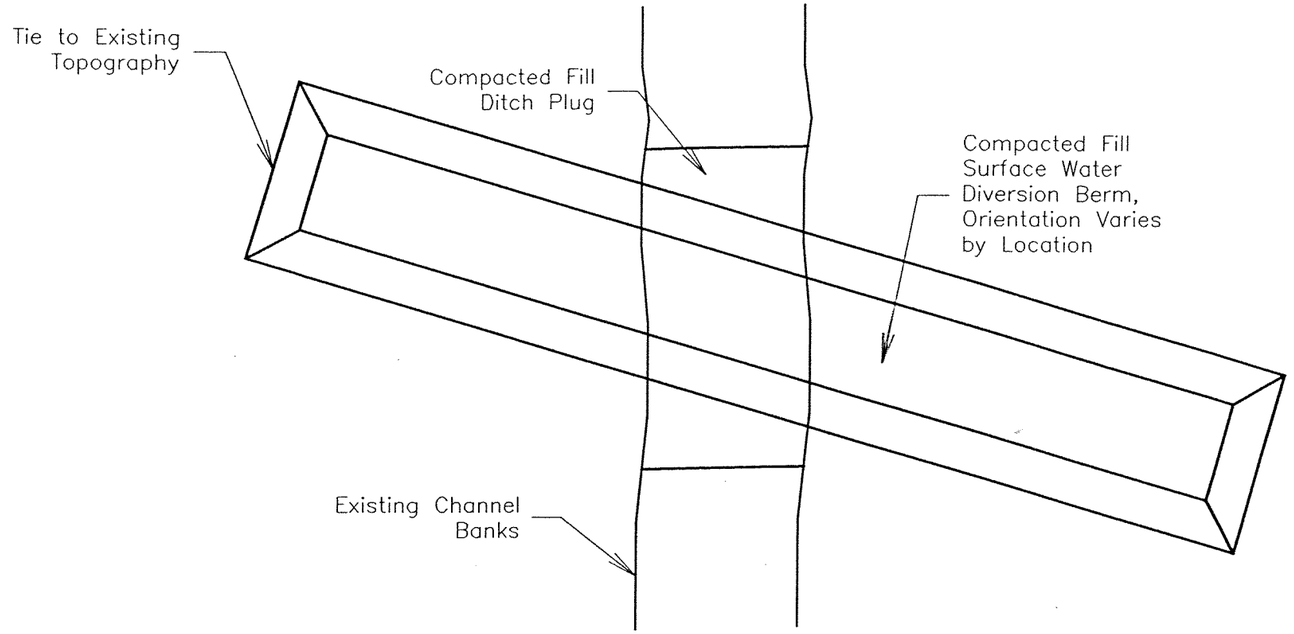
Jurisdictional Delineation
Croatan Wetland Mitigation Bank
Craven County, North Carolina

Drawn By: PJS	Figure: 3-4
Checked By: KWM	Project: R-1015WM
Scale: As Shown	Date: Sept 2000

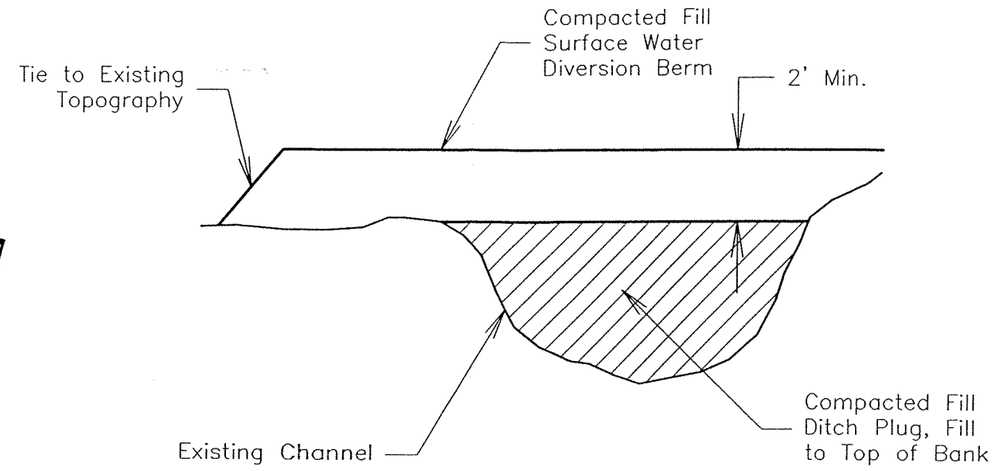
File: 98-proj/014-2/Drawings/Site Map.dwg



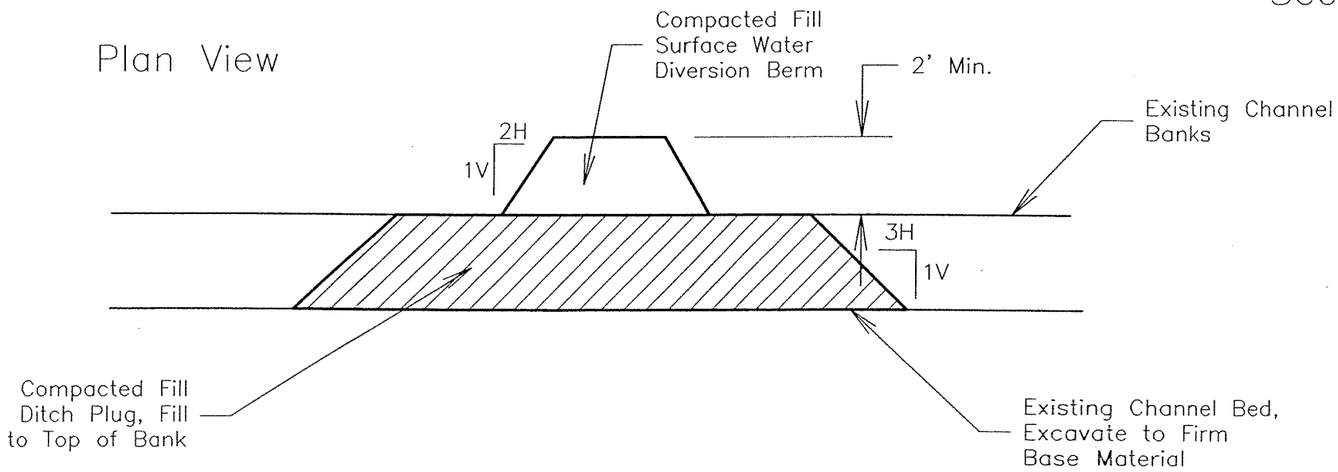
Environmental Services, Inc. Raleigh, North Carolina	Croatan Wetland Mitigation Bank Craven County, NC	DOMINANT CHANNEL REACHES AND NATURAL DRAINAGE FEATURES
EDDY ENGINEERING, P.C. 4420 LOURNOUD ROAD SUITE 200 RALEIGH, NC 27616 (919) 954-1902 FAX (919) 954-1904	Project No. R-1015WM	Sept 2000 Figure 5-1



Plan View



Section View

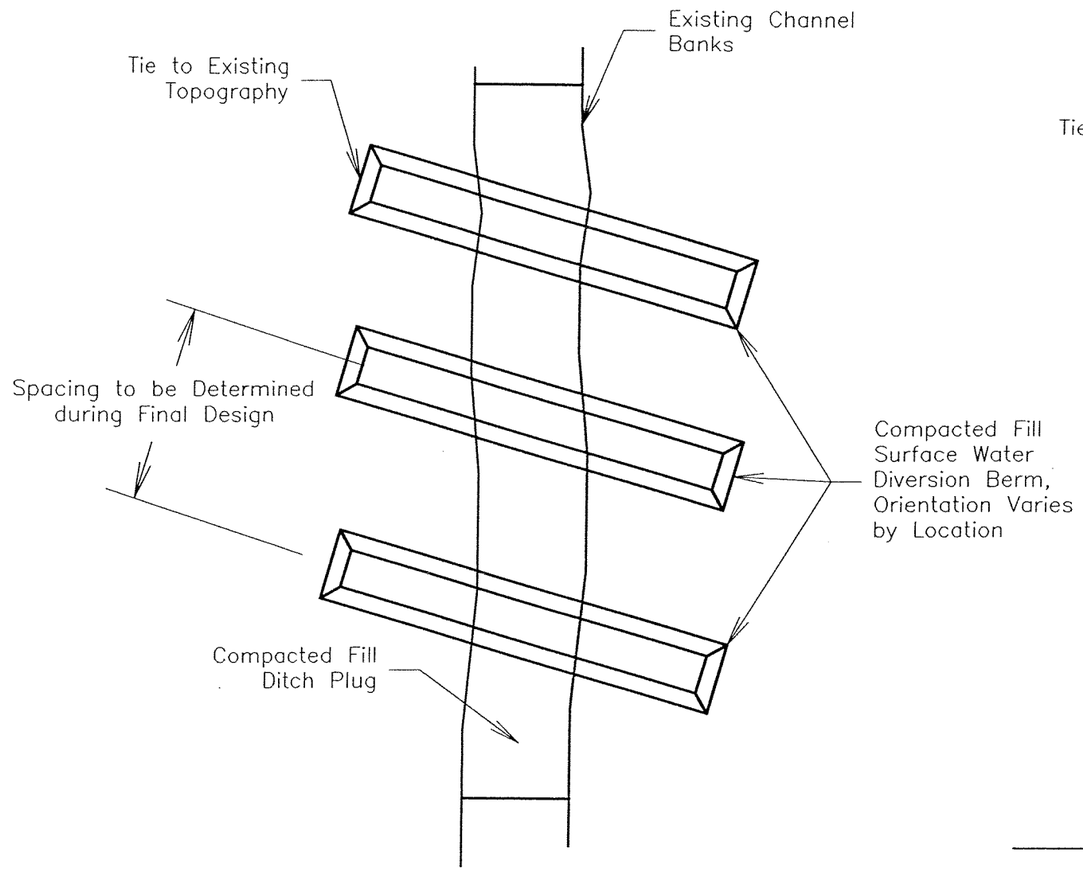


Profile View

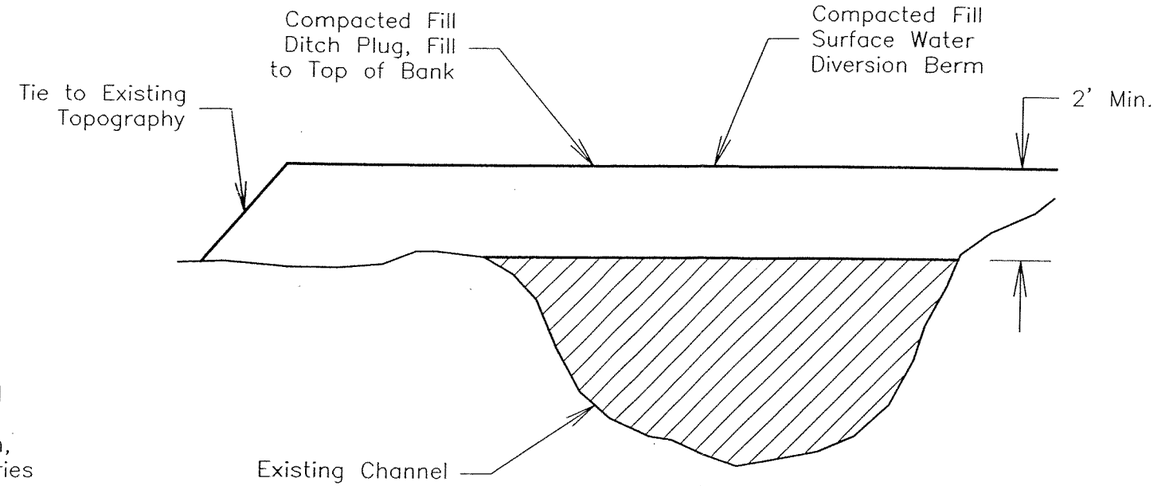
PROPOSED POINT DITCH PLUGS & SURFACE WATER DIVERSION

ENVIRONMENTAL SERVICES, INC. Raleigh, North Carolina.	CROATAN WETLAND MITIGATION BANK Craven County, NC	PROPOSED POINT DITCH PLUGS & SURFACE WATER DIVERSIONS
EDDY ENGINEERING, P.C. 4428 LOUISBURG ROAD SUITE 209 RALEIGH, NC 27616 (919) 954-1800 FAX (919) 954-1954	Project No. R-1015WM	Sept 2000 Figure 5-2

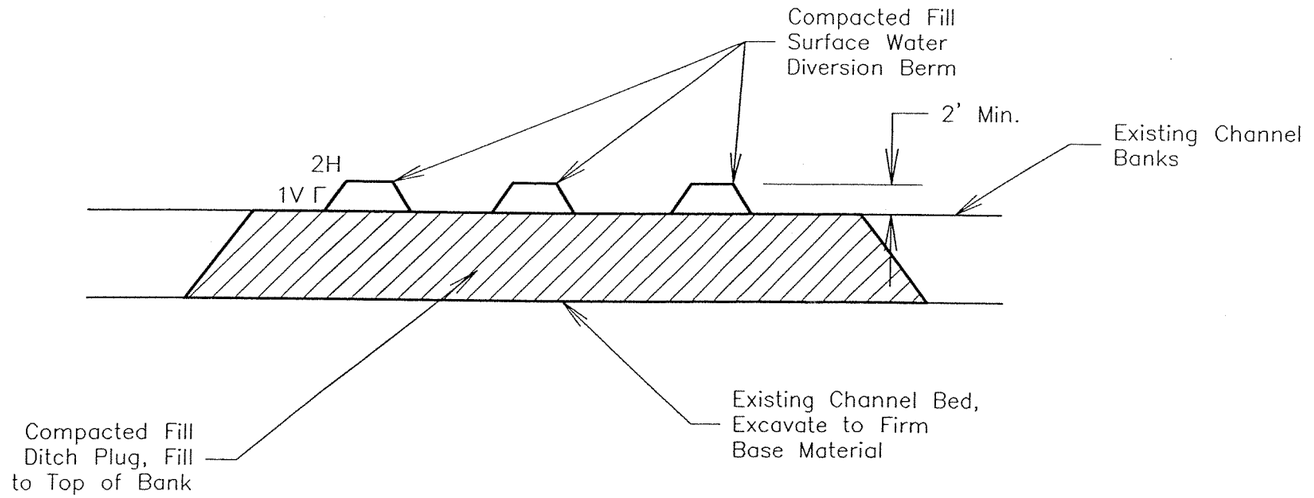
\1998\014\drawings\conceptual design figures.dwg JLE



Plan View



Section View

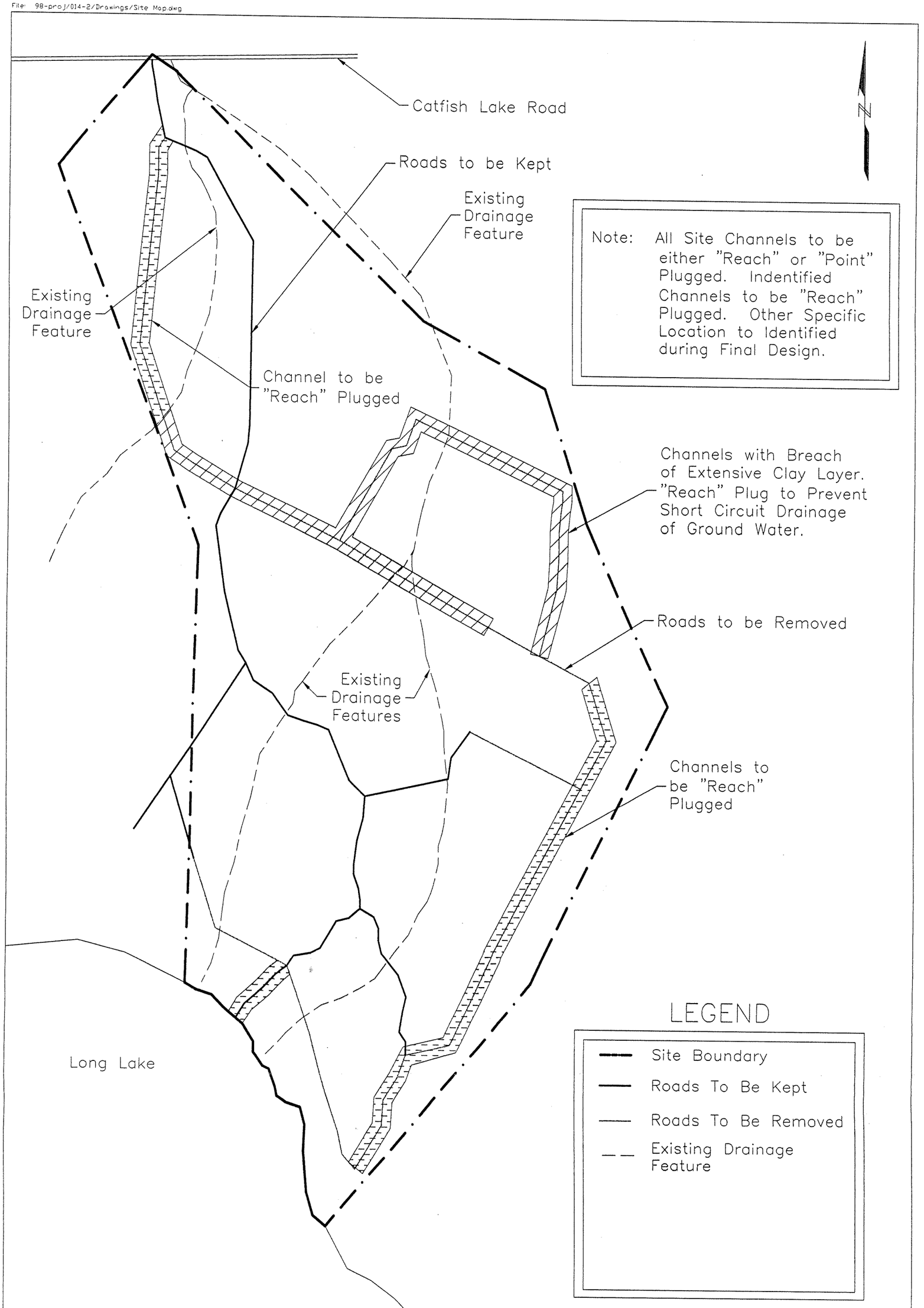


Profile View

PROPOSED REACH DITCH PLUGS & SURFACE WATER DIVERSIONS

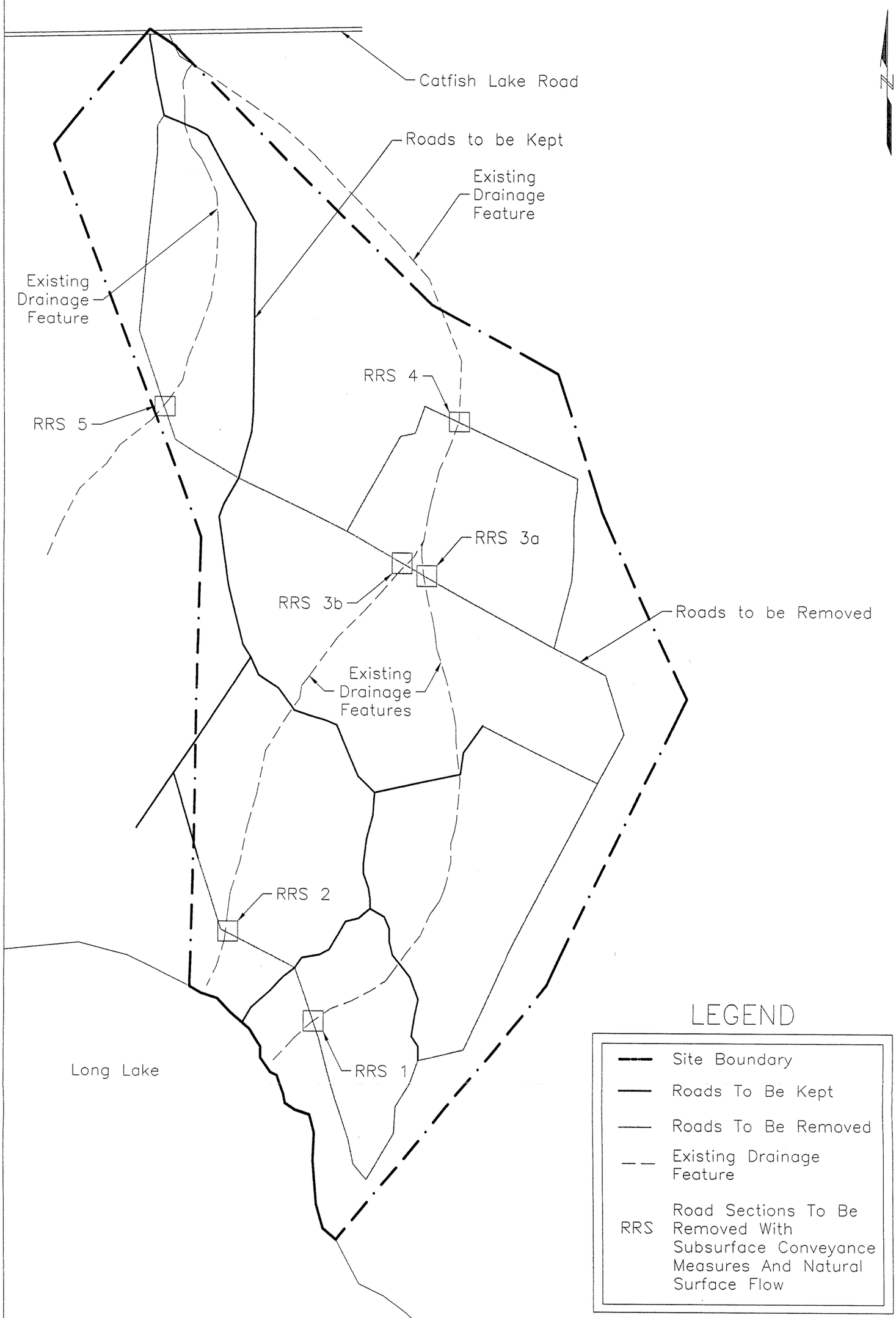
ENVIRONMENTAL SERVICES, INC. Raleigh, North Carolina	CROATAN WETLAND MITIGATION BANK Craven County, NC	PROPOSED REACH DITCH PLUGS & SURFACE WATER DIVERSIONS
EDDY ENGINEERING, P.C. 4429 LOUISBURG ROAD SUITE 209 RALEIGH, NC 27616 (919) 954-1802 FAX (919) 954-1804	Project No. R-1015WM	Sept 2000 Figure 5-3

File: 98-proj/014-2/Drawings/Site Map.dwg

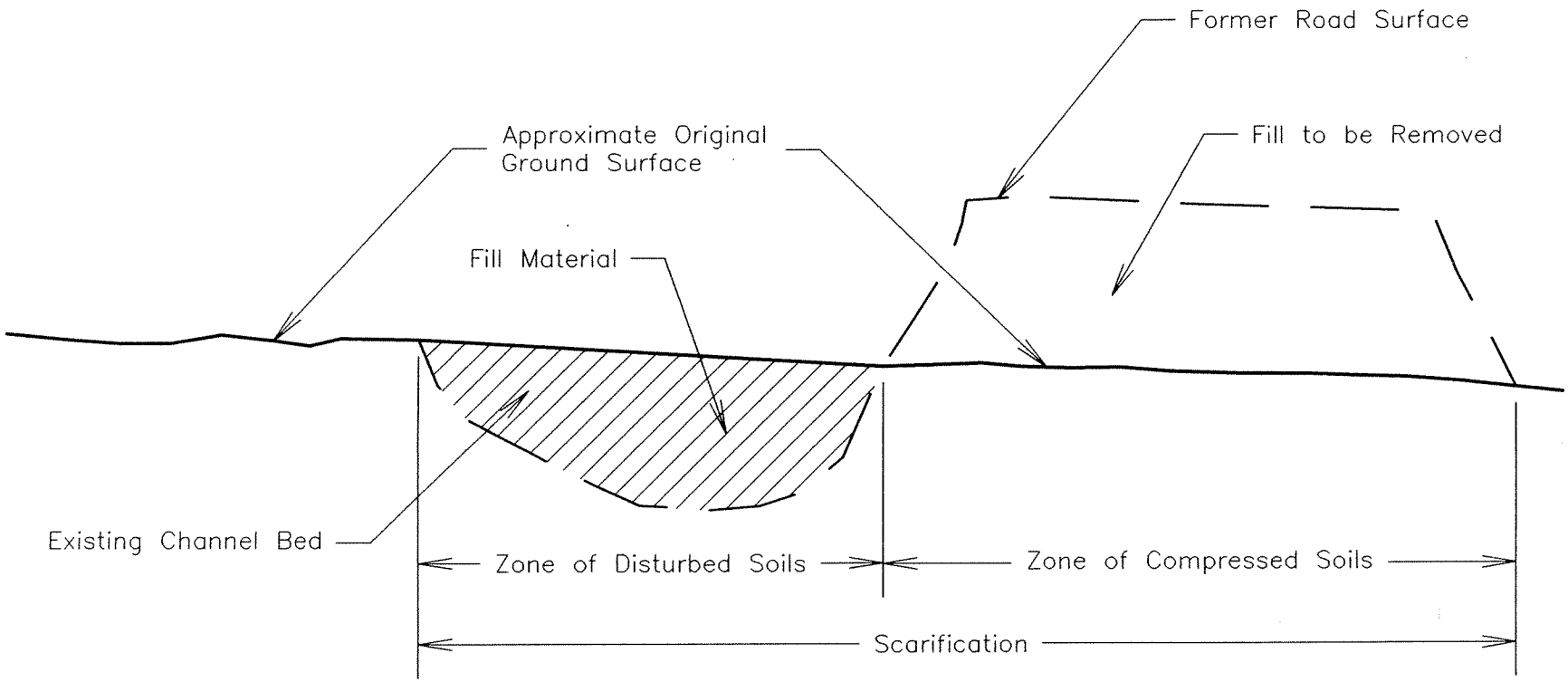


Environmental Services, Inc. Raleigh, North Carolina	Croatan Wetland Mitigation Bank Craven County, NC	PROPOSED SITE LAYOUT – POINT & REACH DITCH PLUG & SURFACE WATER DIVERSIONS
EDDY ENGINEERING, P.C. 1429 LOUISBURG ROAD SUITE 209 RALEIGH, NC 27610 (919) 854-1602 FAX (919) 854-1604	Project No. R-1015WM	Sept 2000 Figure 5-4

File: 98-proj/014-2/Drawings/Site Map.dwg

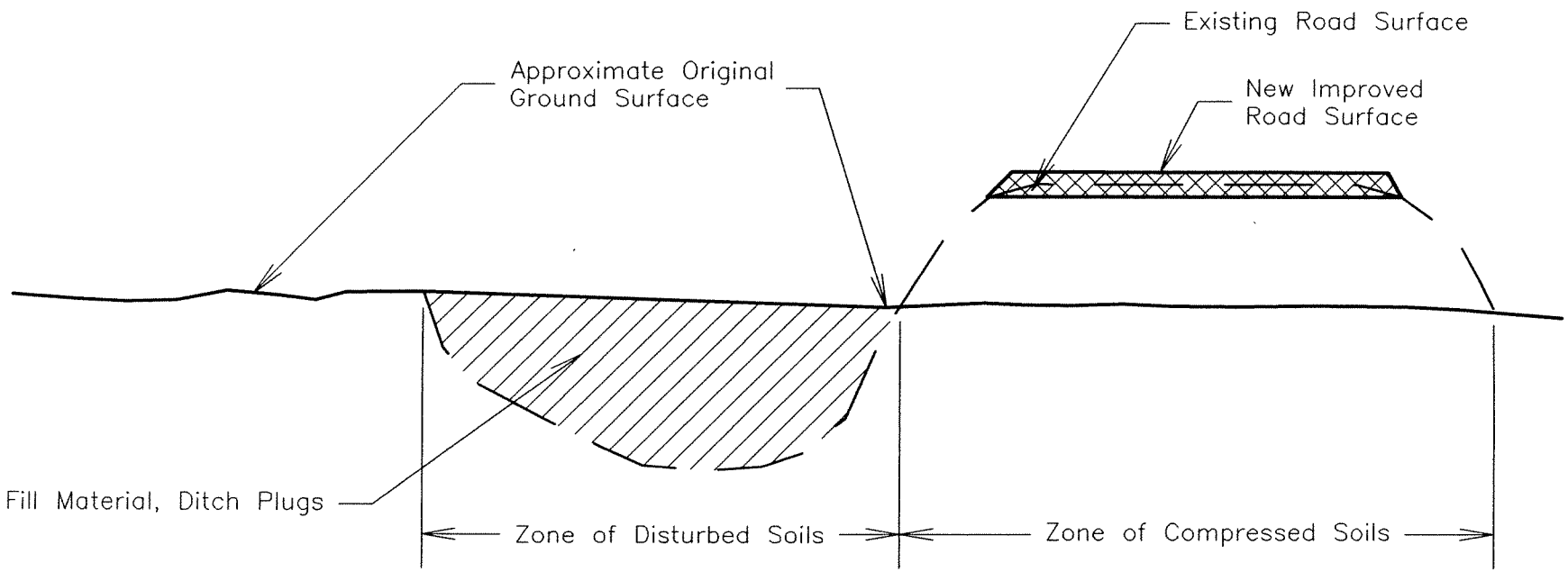


Environmental Services, Inc. Raleigh, North Carolina	Croatan Wetland Mitigation Bank Craven County, NC	PROPOSED SITE LAYOUT – ROAD REMOVALS
EDDY ENGINEERING, P.C. 1428 LOUISBURG ROAD SUITE 209 RALEIGH, NC 27604 (919) 954-1802 FAX (919) 954-1804	Project No. R-1015WM	Sept 2000 Figure 5-5



TYPICAL DITCH FILLING AND ROAD REMOVAL

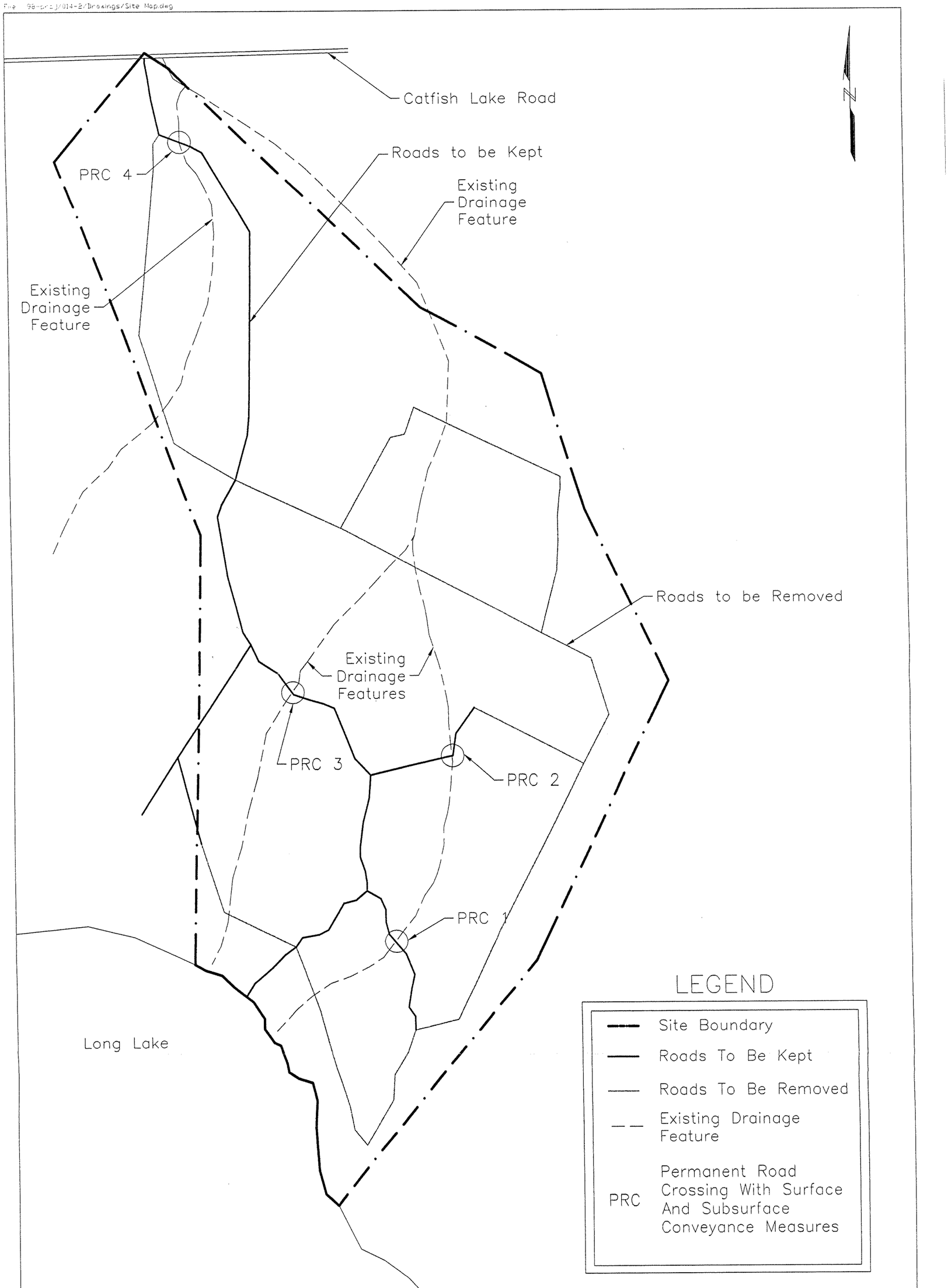
ENVIRONMENTAL SERVICES, INC. Raleigh, North Carolina	CROATAN WETLAND MITIGATION BANK Craven County, NC	TYPICAL DITCH FILLING AND ROAD REMOVAL
EDDY ENGINEERING, P.C. 4428 LOUISBURG ROAD SUITE 209 RALEIGH, NC 27616 (919) 954-1802 FAX (919) 954-1804	Project No. R-1015WM	Sept 2000 Figure 5-6



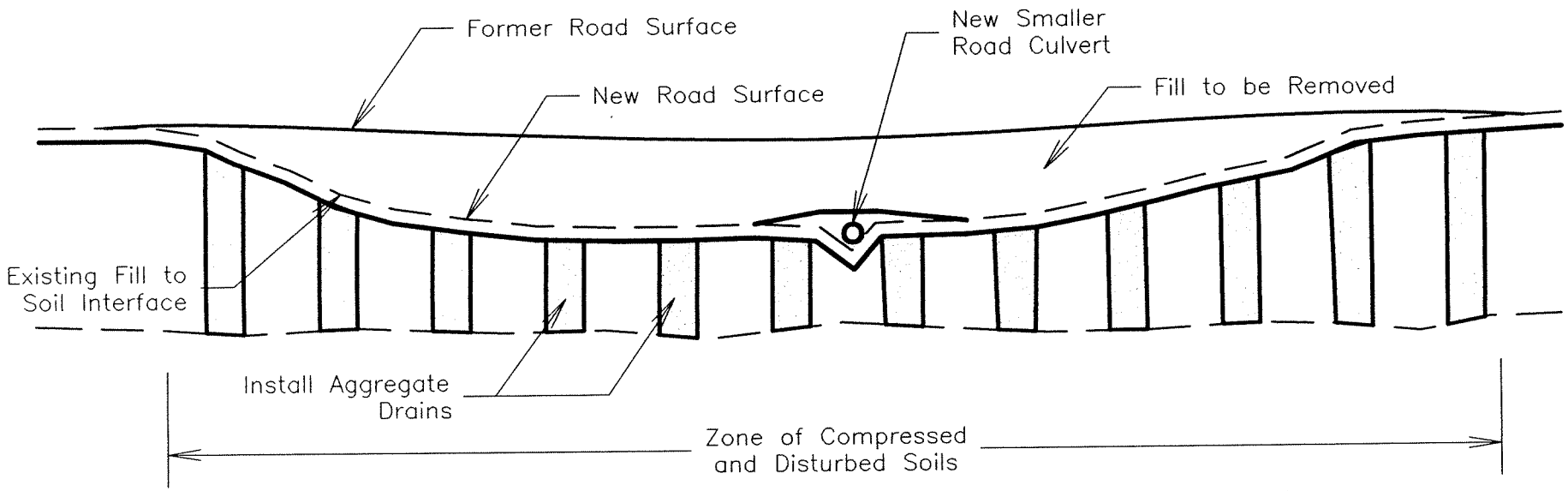
TYPICAL DITCH FILLING AND ROAD STABILIZATION

ENVIRONMENTAL SERVICES, INC. Raleigh, North Carolina	CROATAN WETLAND MITIGATION BANK Craven County, NC	TYPICAL DITCH FILLING AND ROAD STABILIZATION
EDDY ENGINEERING, P.C. 4428 LOUISBURG ROAD SUITE 209 RALEIGH, NC 27616 (919) 954-1602 FAX (919) 954-1804	Project No. R-1015WM	Sept 2000 Figure 5-7

File: 98-proj/014-2/Drawings/Site Map.dwg



Environmental Services, Inc. Raleigh, North Carolina	Croatan Wetland Mitigation Bank Craven County, NC	PROPOSED SITE LAYOUT – PERMANENT ROAD CROSSING LOCATIONS
EDDY ENGINEERING, P.C. 4428 LOUISBURG ROAD SUITE 209 RALEIGH, NC 27616 (919) 954-1602 FAX (919) 954-1904	Project No. R-1015WM	Sept 2000 Figure 5-8

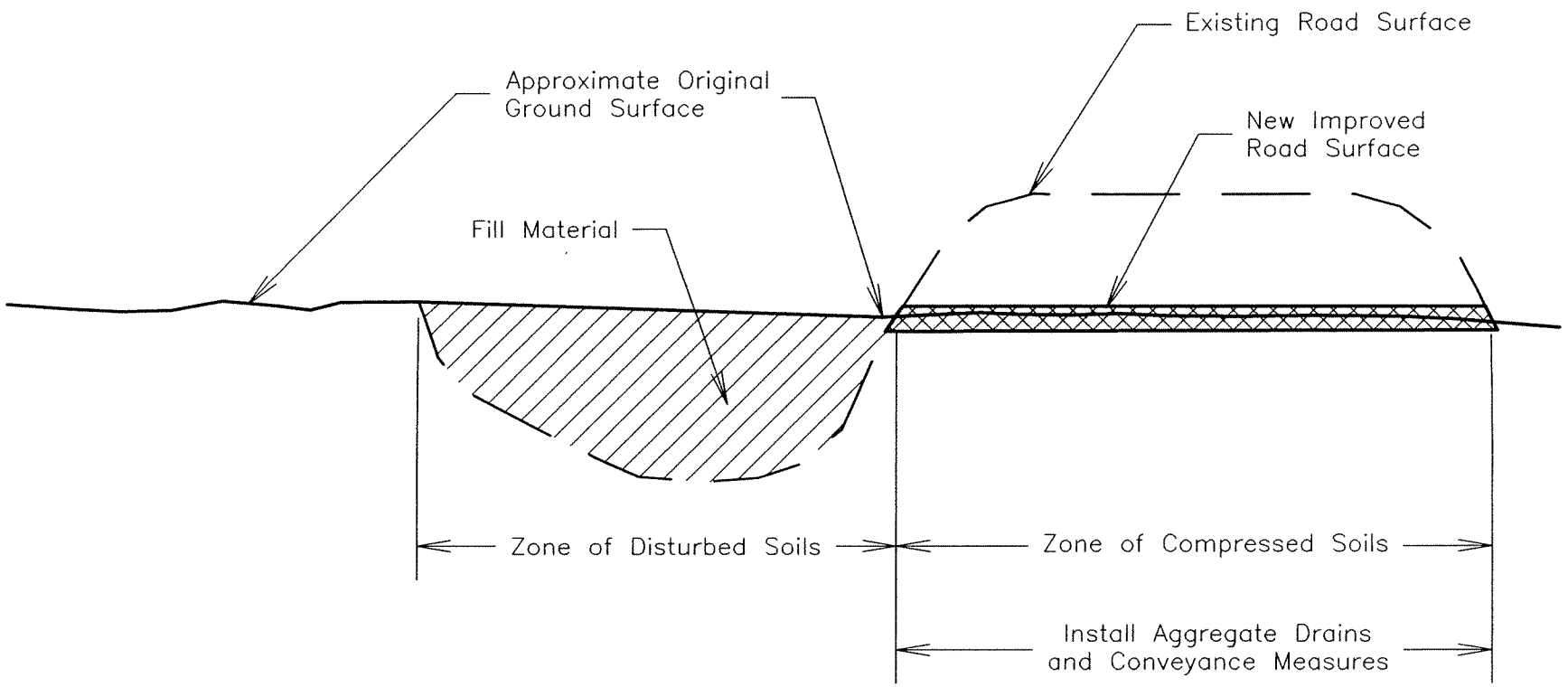


PROFILE VIEW

LOWER ROAD ELEVATION AND STABILIZE ROAD SURFACE AT NATURAL DRAINAGE FEATURE

ENVIRONMENTAL SERVICES, INC. Raleigh, North Carolina	CROATAN WETLAND MITIGATION BANK Craven County, NC	LOWER ROAD ELEV. AND STABILIZE ROAD SURFACE AT NATURAL DRAINAGE FEATURE
EDDY ENGINEERING, P.C. 4428 LOUISBURG ROAD SUITE 209 RALEIGH, NC 27616 (919) 954-1802 FAX (919) 954-1804	Project No. R-1015WM	Sept 2000 Figure 5-9

\1998\014\drawings\conceptual design figures.dwg JLE



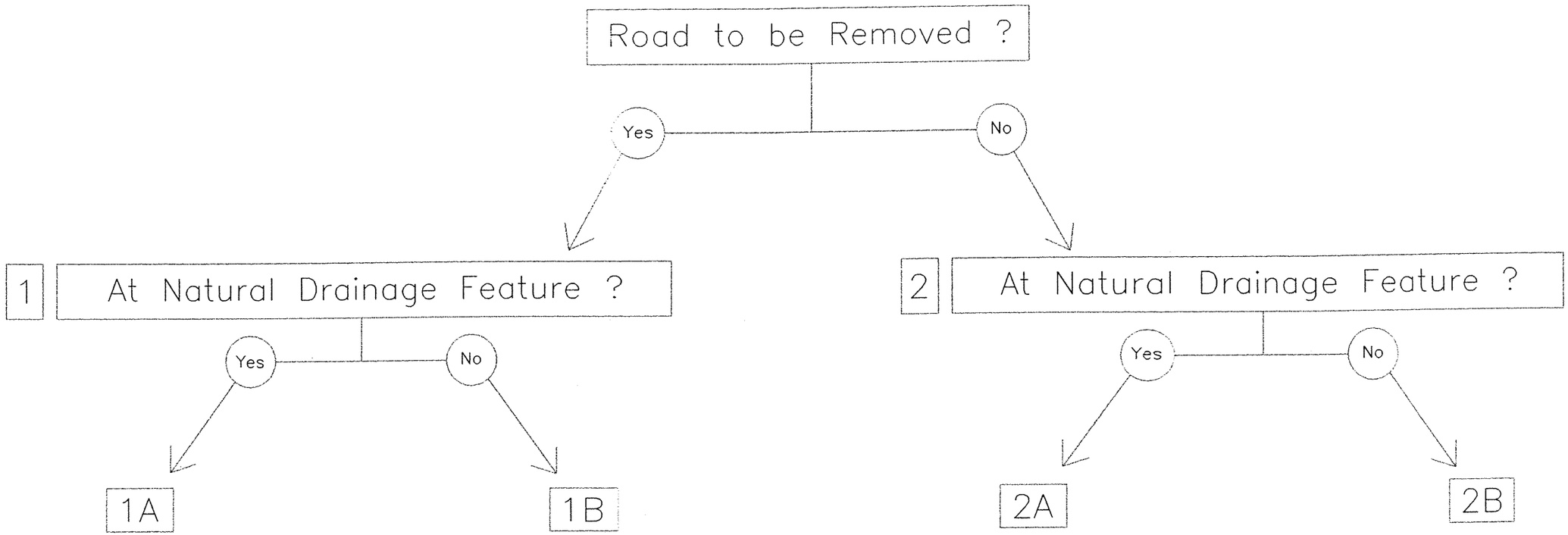
SECTION VIEW

LOWER ROAD ELEVATION AND STABILIZE ROAD SURFACE AT NATURAL DRAINAGE FEATURE

ENVIRONMENTAL SERVICES, INC. Raleigh, North Carolina	CROATAN WETLAND MITIGATION BANK Craven County, NC	LOWER ROAD ELEV. AND STABILIZE ROAD SURFACE AT NATURAL DRAINAGE FEATURE
EDDY ENGINEERING, P.C. 4429 LOUISBURG ROAD SUITE 209 RALEIGH, NC 27616 (919) 954-1802 FAX (919) 954-1804	Project No. R-1015WM	Sept 2000 Figure 5-10

\1998\014\drawings\conceptual design figures.dwg JLE

PROPOSED TREATMENT FLOW CHART



See Figure 5–6

1A1. Fill in Ditches with Road Material.
1A2. Remove Fill Material to Allow for Natural Surface Water Flow Along Drainage Feature.
1A3. Scarify with Deep Rippers in Direction Transverse to Ditch/Road or Parallel to Proposed Flow.
1A4. Install Surface Water Diversions Depending on Site Conditions.

See Figure 5–6

1B1. Fill in Ditches with Road Material.
1B2. Scarify with Deep Rippers in Direction Transverse to Ditch/Road or Parallel to Proposed Flow.
1B3. Install Surface Water Diversions Depending on Site Conditions.

See Figures 5–9 and 5–10

2A1. Lower Road Elevation and Stabilize Road Surface Course.
2A2. Fill Ditches.
2A3. Install Conveyance Measures, Pipes, and Fords.
2A4. Install Aggregate Subsurface Drains.

See Figure 5–7

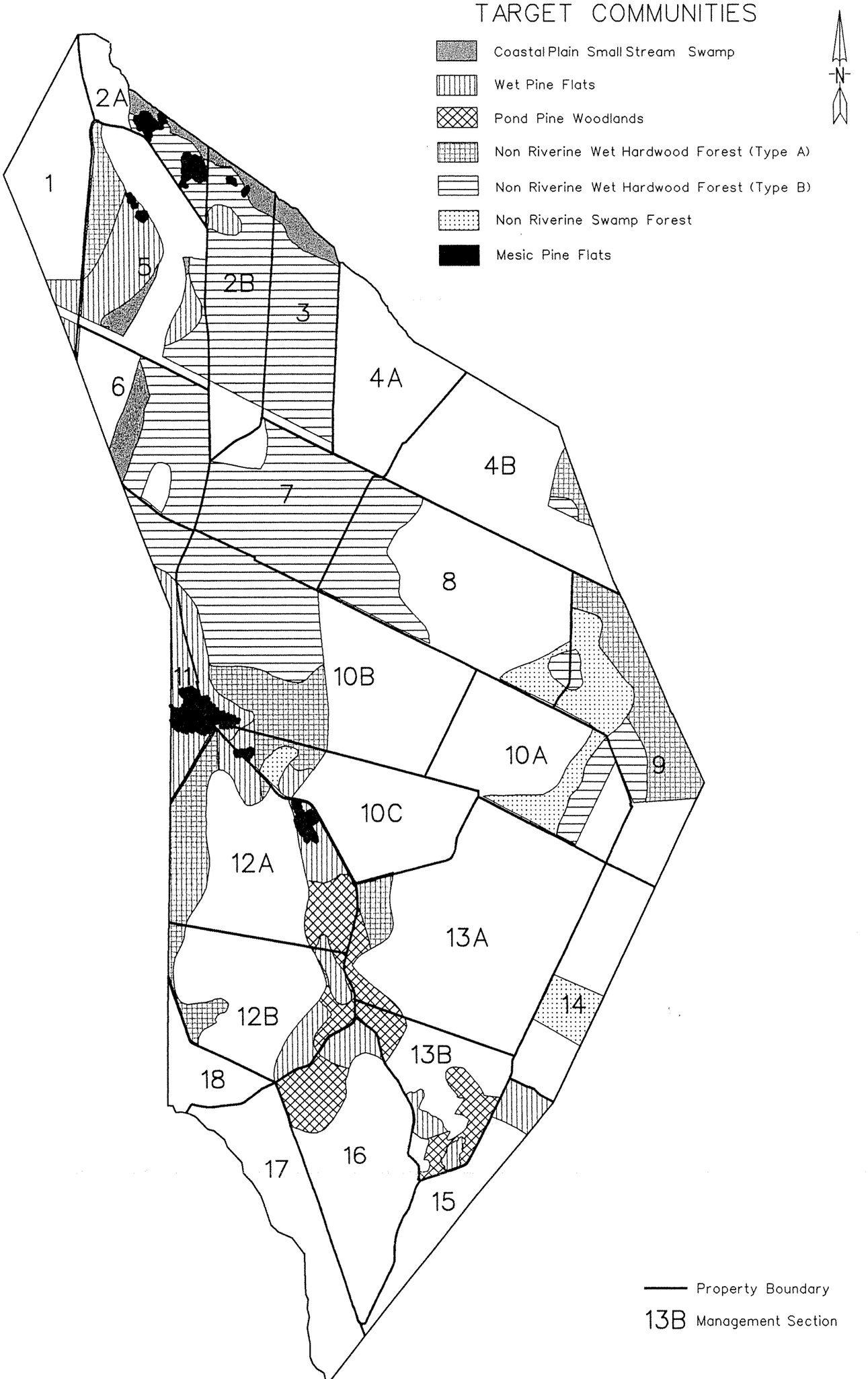
2B1. Stabilize Road Surface Course and Raise Road Elevation.
2B2. Fill Ditches.

Note: In Cases Where Surface Flow is Perpendicular to Existing Channel Flow, Point Filling to be Used.

Environmental Services, Inc. Raleigh, North Carolina	Croatan Wetland Mitigation Bank Craven County, NC	PROPOSED TREATMENT FLOW CHART
EDDY ENGINEERING, P.C. 4428 LOUISBURG ROAD SUITE 230 RALEIGH, NC 27616 (919) 954-1902 FAX (919) 954-1904	Project No. R–1015WM	Sept 2000 Figure 5–11

File: 98-proj/014-2/Drawings/Site Map.dwg

ER98006.10/planting_areas2.dgn



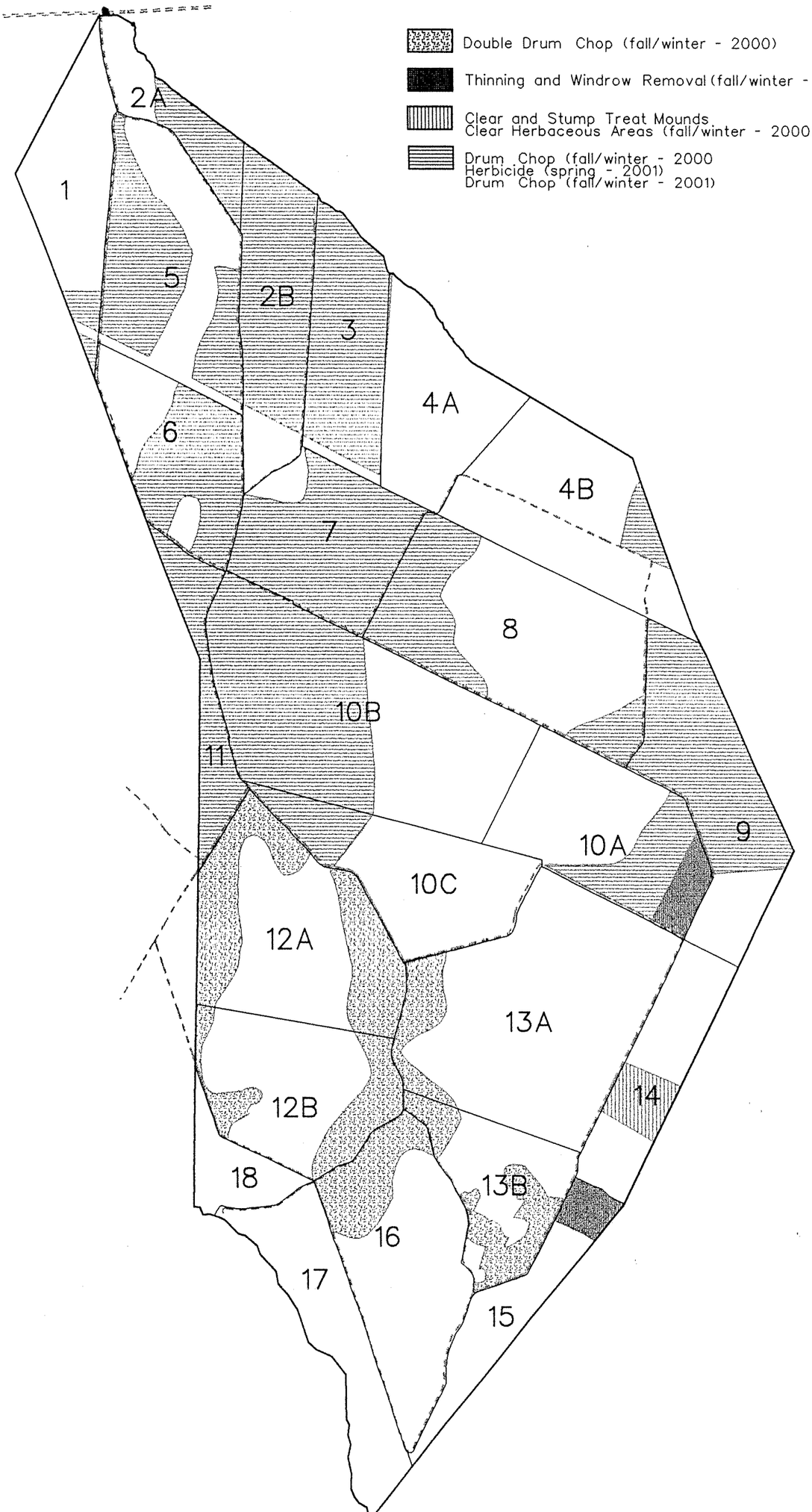
Environmental Services, Inc.

Target Planting Areas
Croatan Wetland Mitigation Bank
Craven County, North Carolina

Drawn By: PJS	Figure: 5-12
Checked By: KWM	Project: R-1015WM
Scale: As Shown	Date: Sept 2000

ER98006.10/Clearing_areas.dgn

SITE PREPARATION TREATMENT

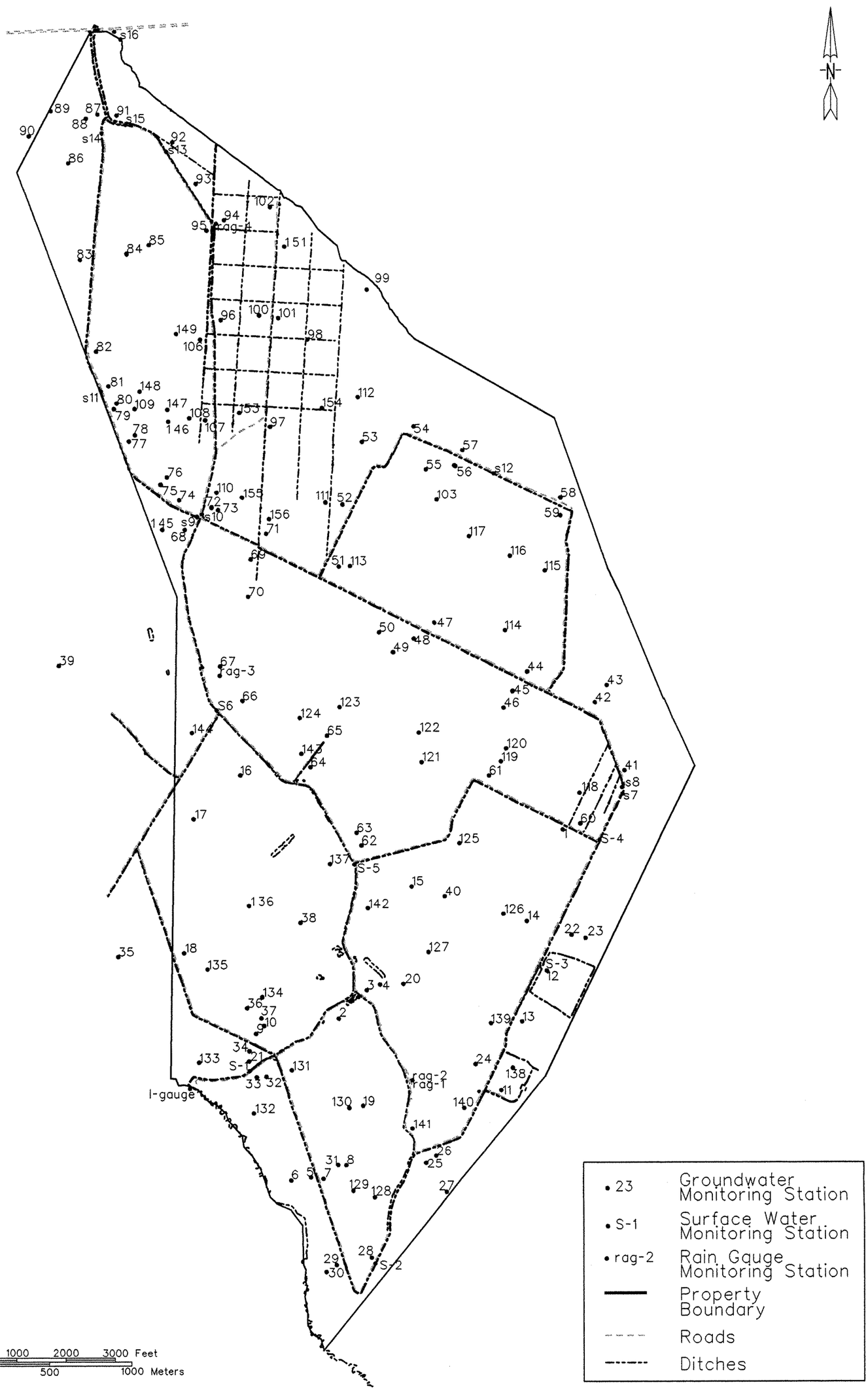


Environmental Services, Inc.

Clearing Areas
Croatan Wetland Mitigation Bank
Craven County, North Carolina

Drawn By: PJS	Figure: 5-13
Checked By: KWM	Project: R-1015WM
Scale: As Shown	Date: Sept 2000

ER98006.10/RDS_final.dgn

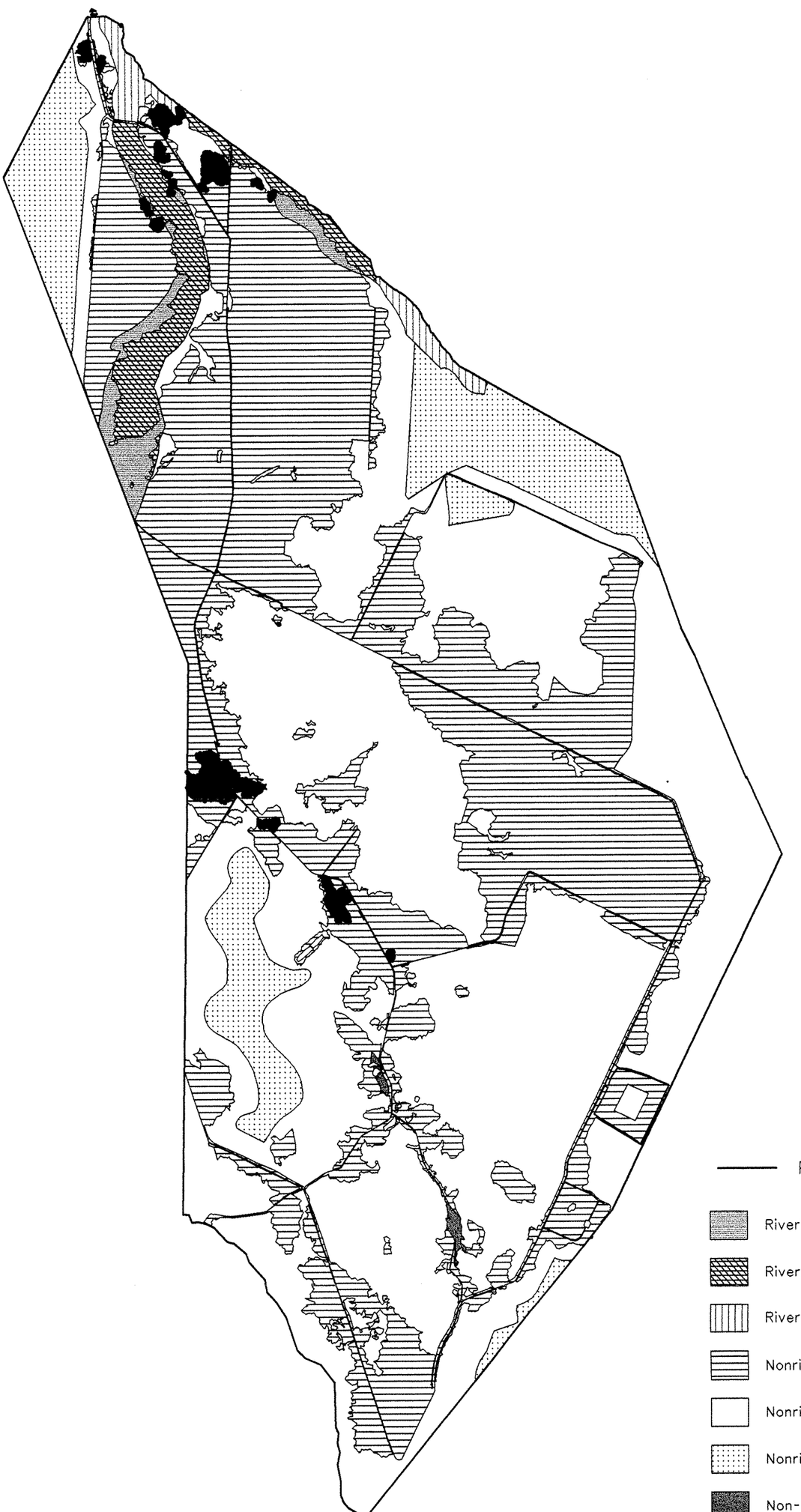


Environmental Services, Inc.

Locations of RDS Groundwater, Surface Water and Rain Monitoring Stations
Croatan Wetland Mitigation Bank
Craven County, North Carolina

Drawn By: PJS	Figure: 7-1
Checked By: KWM	Project: R-1015WM
Scale: As Shown	Date: Sept 2000

ER98006.10/Mitigation Components



Property Boundary

Riverine Wetland Restoration

Riverine Wetland Enhancement

Riverine Wetland Preservation

Nonriverine Wetland Restoration

Nonriverine Wetland Enhancement

Nonriverine Wetland Preservation

Non-restorable Hydric Soils

Nonhydric Soils

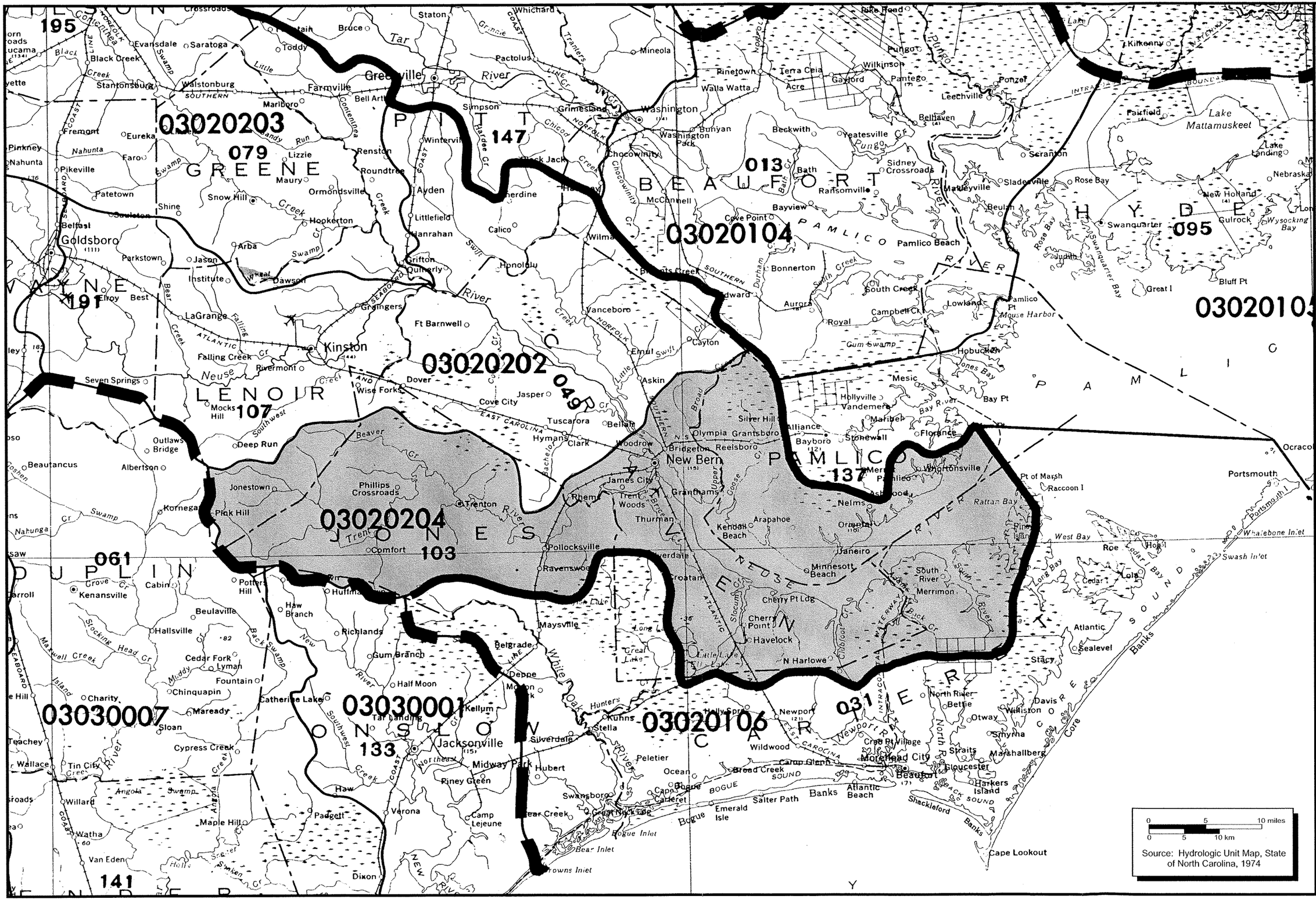
0 1000 2000 3000 Feet

0 500 1000 Meters

Environmental Services, Inc.

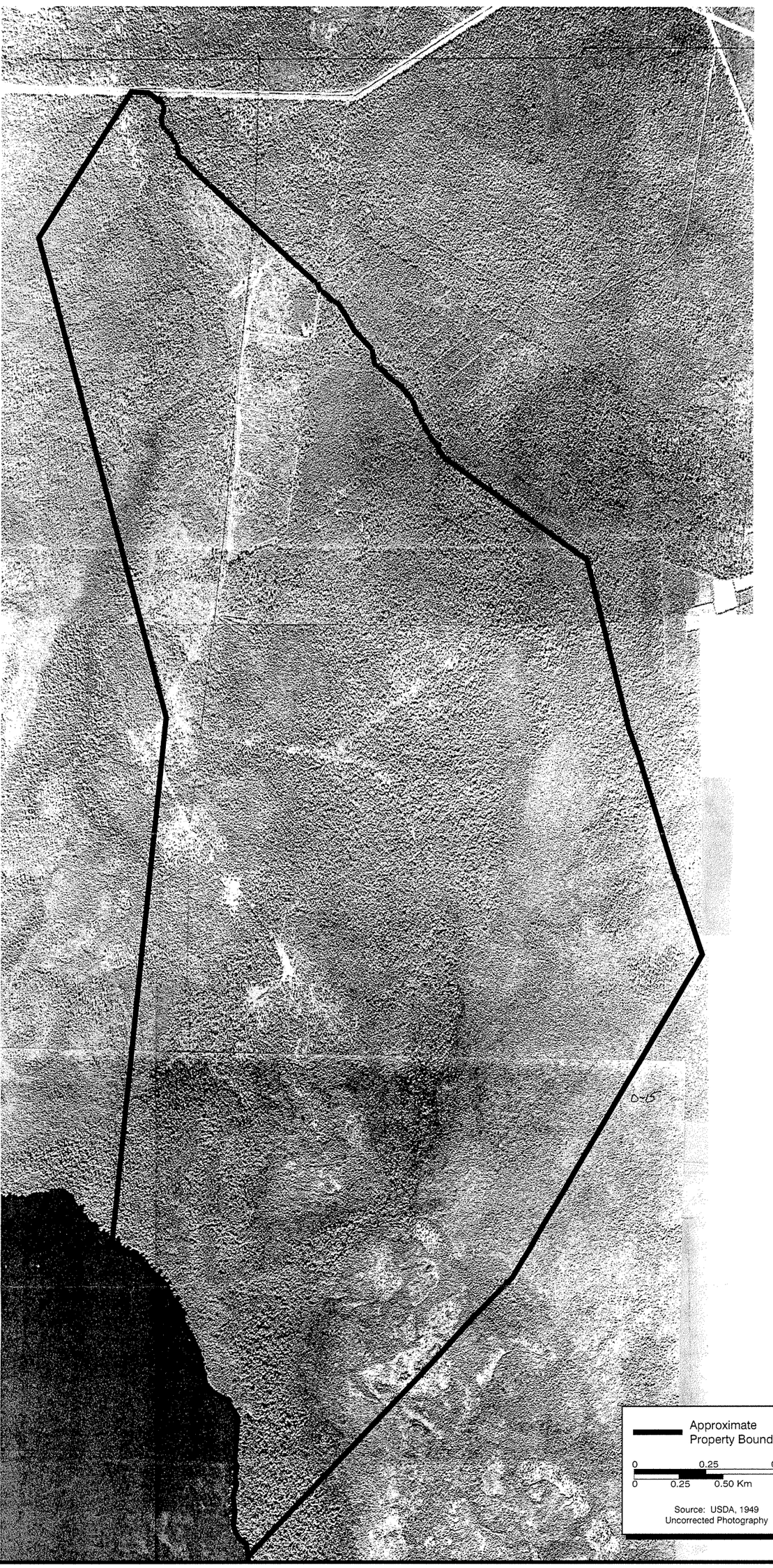
Mitigation Components
Croatan Wetland Mitigation Bank
Craven County, North Carolina

Drawn By: PJS	Figure: 8-1
Checked By: KWM	Project: R-1015WM
Scale: As Shown	Date: Sept 2000


03020203
079
GREENE
147
PITT
03020104
013
BEAUFORT
095
HYDE
03020105
03020202
049
LENOIR
107
191
195
03020204
061
JONES
103
137
PAMLICO
03030007
03030001
133
ONSLOW
03020106
031
CARTERET
Geographic Service Area
Croatan Wetland Mitigation Bank
Craven County, North Carolina
Figure: 9-1
Project: R-1015WM
Date: Sept 2000
Environmental Services, Inc.
0 5 10 miles
0 5 10 km
Source: Hydrologic Unit Map, State of North Carolina, 1974

Appendix A

Historical Aerial Photographs



Environmental Services, Inc.

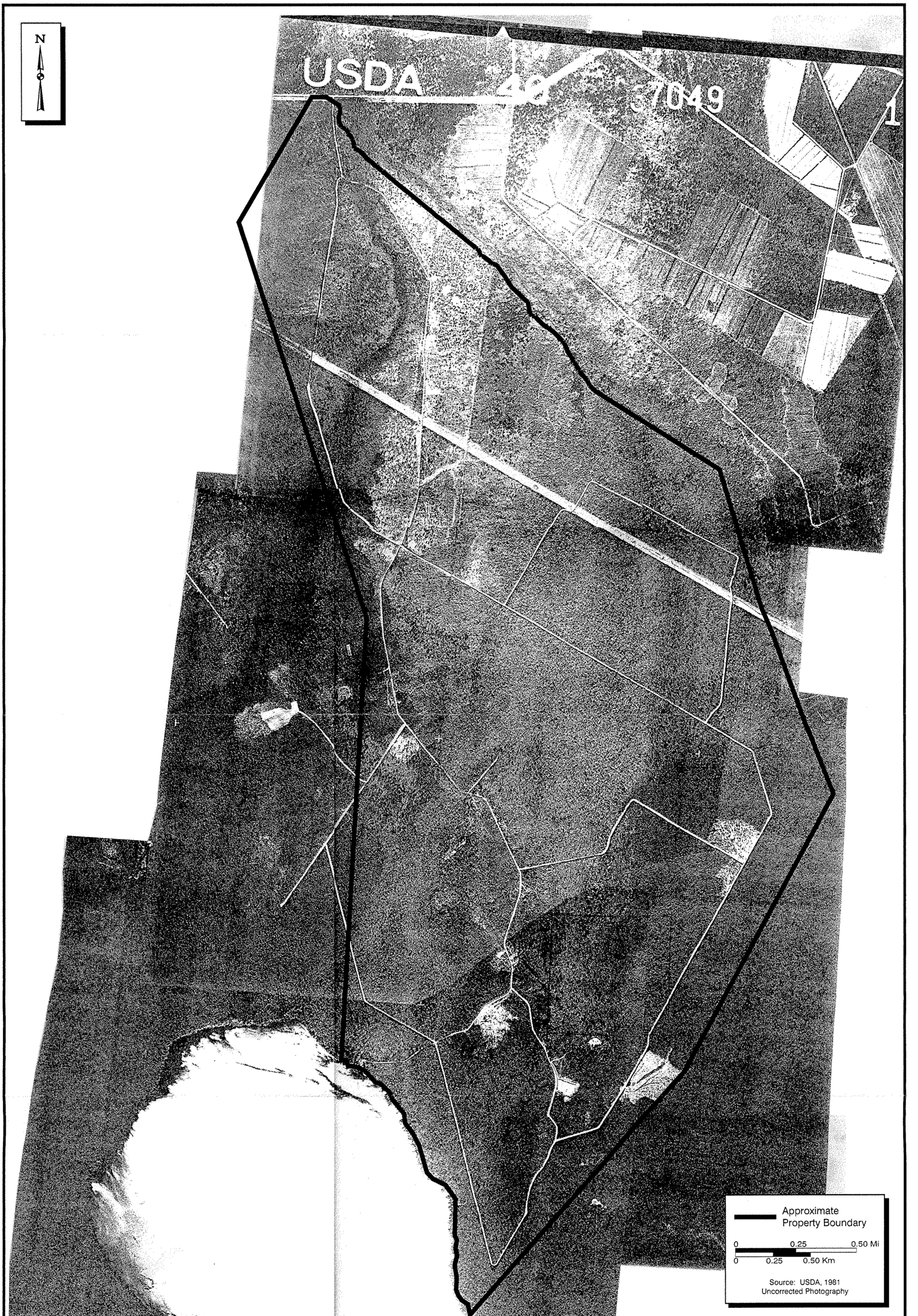
Historical Aerial Photograph: 1949
Croatan Wetland Mitigation Bank
Craven County, North Carolina

Figure:	A-6
Project:	R-1015WM
Date:	Sept 2000

Environmental Services, Inc.

Current Aerial Photo
Croatan Wetland Mitigation Bank
Craven County, North Carolina

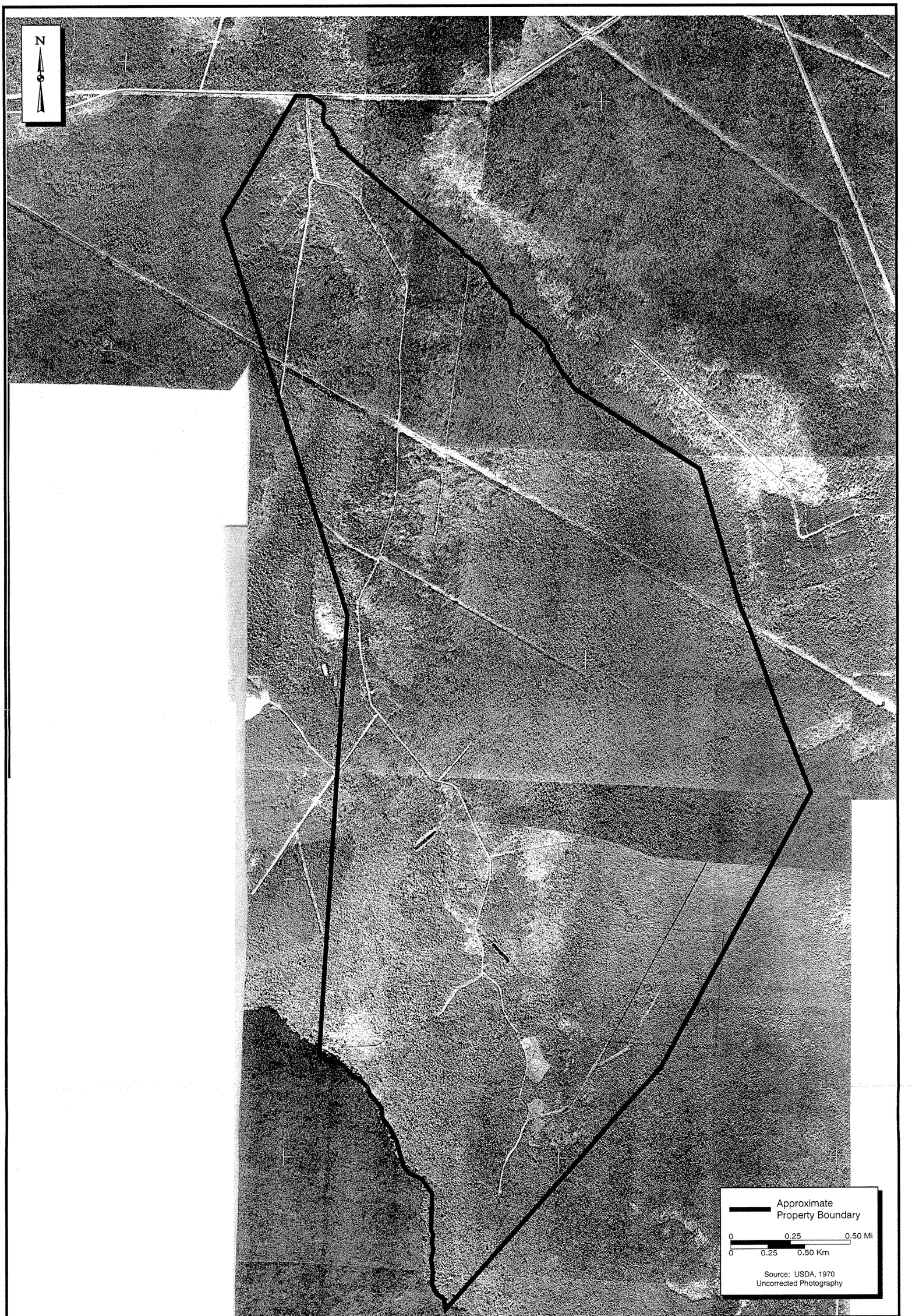
Figure:	A-1
Project:	R-1015WM
Date:	Sept 2000



Environmental Services, Inc.

Historical Aerial Photograph: 1981
Croatan Wetland Mitigation Bank
Craven County, North Carolina

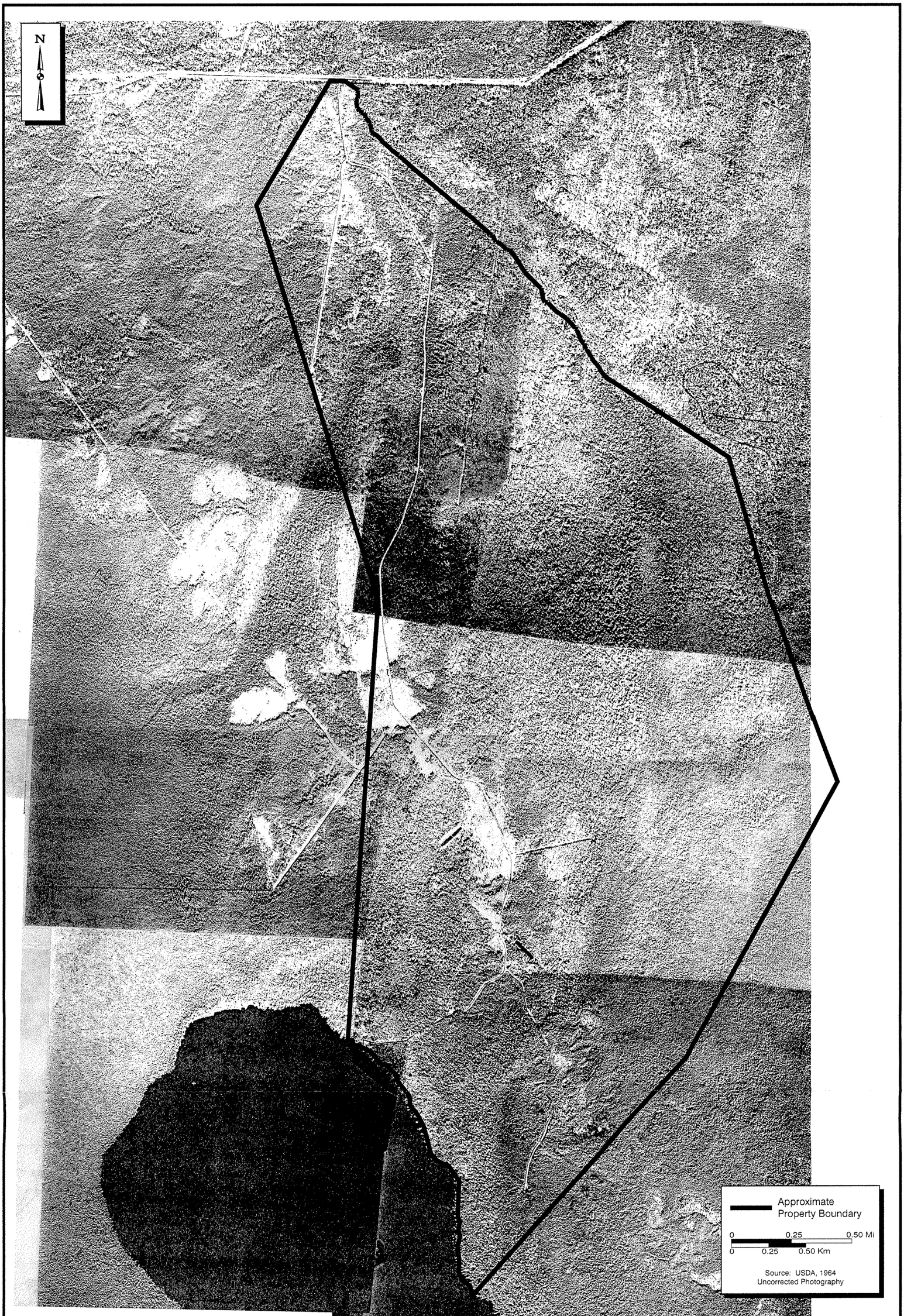
Figure:	A-2
Project:	R-1015WM
Date:	Sept 2000



Environmental Services, Inc.

Historical Aerial Photograph: 1970
Croatan Wetland Mitigation Bank
Craven County, North Carolina

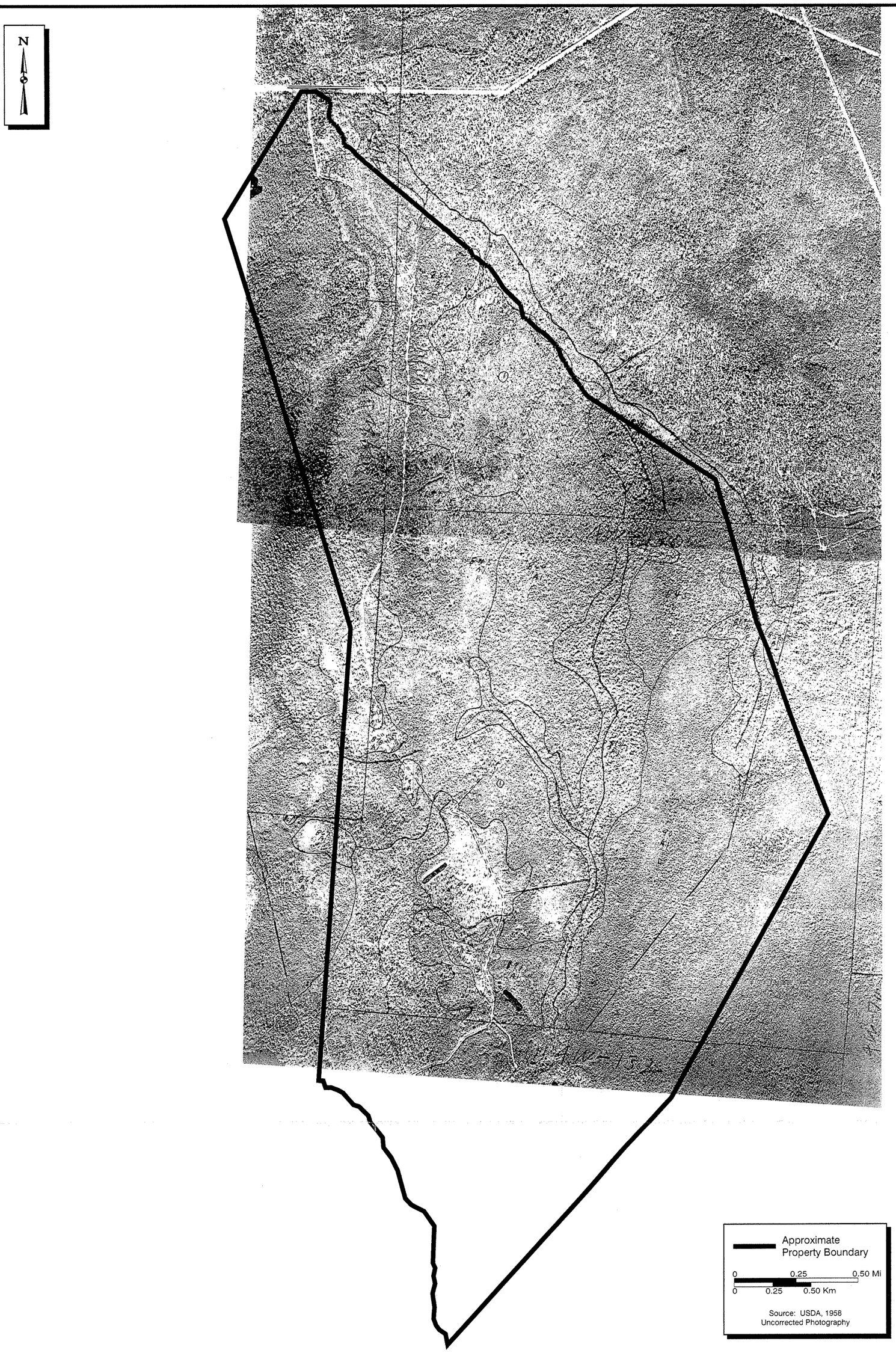
Figure:	A-3
Project:	R-1015WM
Date:	Sept 2000



Environmental Services, Inc.

Historical Aerial Photograph: 1964
Croatan Wetland Mitigation Bank
Craven County, North Carolina

Figure:	A-4
Project:	R-1015WM
Date:	Sept 2000



Environmental Services, Inc.

Historical Aerial Photograph: 1958
Croatan Wetland Mitigation Bank
Craven County, North Carolina

Figure:	A-5
Project:	R-1015WM
Date:	Sept 2000

Appendix B

Wildlife Documented on the CWMB

Fish Documented on the CWMB 1997-2000

Common Name	Scientific Name
Yellow bullhead	*Ameiurus natalis*
Redfin pickerel	*Esox americanus*
Eastern mudminnow	*Umbra pygmaea*
Pirate perch	*Aphredoderus sayanus*
Swampfish	*Chologaster cornuta*
Flier	*Centrarchus macropterus*
Yellow perch	*Perca flavescens*

Amphibians Documented on the CWMB 1997-2000

Common Name	Scientific Name
Southern Toad	*Bufo terrestris*
Southern Cricket Frog	*Acris gryllus*
Cope's Gray Treefrog	*Hyla chrysoscelis*
Green Treefrog	*Hyla cinerea*
Pine Woods Treefrog	*Hyla femoralis*
Squirrel Treefrog	*Hyla squirella*
Little Grass Frog	*Limnaoedus ocularis*
Spring Peeper	*Pseudacris crucifer*
Green Frog	*Rana clamitans*
Southern Leopard Frog	*Rana utricularia*
Carpenter Frog	*Rana virgatipes*

Reptiles Documented on the CWMB 1997-2000

Common Name	Scientific Name
American alligator	*Alligator mississippiensis*
Eastern mud turtle	*Kinosternon subrubrum*
Florida cooter	*Chrysemys floridana*
Yellowbelly slider	*Trachemys scripta*
Spotted turtle	*Clemmys guttata*
Eastern box turtle	*Terrepene carolina*
Carolina anole	*Anolis carolinensis*
Skink sp.	*Eumeces* sp.
Broadhead skink	*Eumeces laticeps*
Ground skink	*Scincella lateralis*
Six-lined racerunner	*Cnemidophorus sexlineatus*
Glass lizard sp.	*Ophisaurus* sp.

Reptiles (continued)

Black racer	*Coluber constrictor*
Corn snake	*Elaphe guttata*
Rat snake	*Elaphe obsoleta*
Rainbow snake	*Farancia abacura*
Eastern hognose snake	*Heterodon platyrhinos*
Eastern kingsnake	*Lampropeltis getulus*
Red-belly watersnake	*Nerodia erythrogaster*
Banded watersnake	*Nerodia fasciata*
Brown watersnake	*Nerodia taxispilota*
Rough green snake	*Opheodrys aestivus*
Copperhead	*Agkistrodon contortrix*
Cottonmouth	*Agkistrodon piscivorus*
Timber rattlesnake	*Crotalus horridus*

Mammals Documented on the CWMB 1997-2000

Common Name	Scientific Name
Virginia opossum	*Didelphis virginiana*
Red bat	*Lasiurus borealis*
Marsh rabbit	*Sylvilagus palustris*
Eastern cottontail	*Sylvilagus floridanus*
Gray squirrel	*Sciurus carolinensis*
Beaver	*Castor canadens*is
Muskrat	*Ondatra zibethicus*
Gray fox	*Urocyon cinereoargenteus*
Black bear	*Ursus americanus*
Raccoon	*Procyon lotor*
Bobcat	*Felis rufus*
White-tailed deer	*Odocoileus virginianus*

Birds Documented on the CWMB 1997-2000

Common Name	Scientific Name
Pied-billed grebe	*Podilymbus podiceps*
Double-crested cormorant	*Phalacrocorax auritus*
Anhinga	*Anhinga anhinga*
Great blue heron	*Ardea herodias*
Green heron	*Butorides virescens*
American bittern	*Botaurus lentiginosus*
Wood duck	*Aix sponsa*

Birds (continued)

Turkey vulture	*Cathartes aura*	
Red-tailed hawk	*Buteo jamaicensis*	
Red-shouldered hawk	*Buteo lineatus*	
Broad-winged hawk	*Buteo platypterus*	present 6/00
Bald eagle	*Haliaeetus leucocephalus*	@Long Lake 12/99- 6/00
Osprey	*Pandion haliaetus*	
Northern Bobwhite	*Colinus virginianus*	
Wild Turkey	*Meleagris gallopavo*	
Mourning dove	*Zenaida macroura*	
Yellow-billed cuckoo	*Coccyzus americanus*	
Eastern screech-owl	*Otus asio*	
Great horned owl	*Bubo virginianus*	
Barred owl	*Strix varia*	
Chuck-will's widow	*Caprimulgus carolinensis*	
Common nighthawk	*Chordeiles minor*	
Ruby-throated hummingbird	*Archilochus colubris*	
Northern flicker	*Colaptes auratus*	
Pileated woodpecker	*Dryocopus pileatus*	
Red-bellied woodpecker	*Melanerpes carolinus*	
Red-headed woodpecker	*Melanerpes erythrocephalus*	
Hairy woodpecker	*Picoides villosus*	
Downy woodpecker	*Picoides pubescens*	
Eastern kingbird	*Tyrannus tyrannus*	
Great crested flycatcher	*Myiarchus crinitus*	
Acadian flycatcher	*Empidonax virescens*	
Eastern wood-pewee	*Contopus virens*	
Blue jay	*Cyanocitta cristata*	
Common crow	*Corvus brachyrhynchos*	
Fish crow	*Corvus ossifragus*	
Carolina chickadee	*Poecile carolinensis*	
Tufted titmouse	*Baeolophus bicolor*	
White-breasted nuthatch	*Sitta carolinensis*	
Brown-headed nuthatch	*Sitta pusilla*	
Carolina wren	*Thryothorus ludovicianus*	
Gray catbird	*Dumatella carolinensis*	
Brown thrasher	*Toxostoma rufum*	
Wood thrush	*Hylocichla mustelina*	
Veery	*Catharus fuscescens*	migrant present 5/16/00
Eastern bluebird	*Sialia sialis*	
Blue-gray gnatcatcher	*Polioptila caerulea*	
White-eyed vireo	*Vireo griseus*	
Yellow-throated vireo	*Vireo flavifrons*	
Red-eyed vireo	*Vireo olivaceus*	
Black-and-white warbler	*Mniotilta varia*	
Prothonotary warbler	*Protonotaria citrea*	
Northern parula	*Parula americana*	
Black-throated blue warbler	*Dendroica caerulescens*	migrant present 9/7/00

Birds (continued)

Black-throated green warbler	*Dendroica virens*	
Yellow-thoated warbler	*Dendroica dominica*	
Pine warbler	*Dendroica pinus*	
Prairie warbler	*Dendroica discolor*	
Ovenbird	*Seirurus aurocapillus*	
Kentucky warbler	*Oporornis formosus*	
Common yellowthroat	*Geothlypis trichas*	
Yellow-breasted chat	*Icteria virens*	
Hooded warbler	*Wilsonia citrina*	
American redstart	*Setophaga ruticilla*	
Bobolink	*Dolichonyx oryzivorus*	migrant 9/7/00
Orchard oriole	*Icterus spurius*	
Common grackle	*Quiscalus quiscula*	
Brown-headed cowbird	*Molothrus ater*	
Summer tanager	*Piranga rubra*	
Northern cardinal	*Cardinalis cardinalis*	
Blue grosbeak	*Guiraca caerulea*	
Indigo bunting	*Passerina cyanea*	
American goldfinch	*Carduelis tristis*	
Eastern towhee	*Pipilo erythrophthalmus*	
Chipping sparrow	*Spizella passerina*	
Field sparrow	*Spizella pusilla*	