East Carolina Farm Credit, ACA
Greenville, North Carolina

IRREVOCABLE STANDBY LETTER OF CREDIT

LETTER OF CREDIT NO.:
DATE: December 28, 2005
APPLICANT:
Greene Environmental Services, LLC
90 Ham Produce Rd.
Snow Hill, NC 28580

ADVISING BANK:
East Carolina Farm Credit, ACA
Post Office Box 1366
100 East 1st Street
Greenville, NC 27835

BENEFICIARY:
North Carolina Department of Environment
And Natural Resources
1601 Mail Service Center
Raleigh, NC 27699-1601

AMOUNT: $1,290,000.00

EXPIRATION DATE: November 15, 2006

Dear Bill Gilmore:

We hereby establish our Irrevocable Standby Letter of Credit in your favor.

Available by: At Sight
Your Draft(s)

Drawn on: Sight. East Carolina Farm Credit, ACA, P. O. Box 1366, Greenville, NC 27835

Draft(s) must be marked - "Drawn under East Carolina Farm Credit, ACA Credit No. 730895-28."

Which must be accompanied by this letter and the following documentation:

A notarized statement from The North Carolina Department of Environment and Natural Resources indicating that Greene Environmental Services, LLC of Snow Hill, NC have not completed satisfactorily the improvements as described in Contract No. D04009-1 as submitted to and approved by The North Carolina Department of Environment and Natural Resources and consequently the funds drawn hereunder are due to The North Carolina Department of Environment and Natural Resources.

SPECIAL INSTRUCTIONS:
Send documents to: Don Miller (252-758-6087) Ext. 579
East Carolina Farm Credit, ACA
Post Office Box 1366
Greenville, NC 27835

This credit is subject to the uniform customs and practice for documentary credits (1963 Revision) International Chamber of Commerce Publication No. 400.

We hereby engage with drawers and or bona fide holders that drafts presented in conformity with the terms of this credit will be duly honored on presentation at our counters and that drafts accepted within the terms of this credit will be duly honored at maturity.

Very Truly Yours,

Don Miller
East Carolina Farm Credit, ACA

Little Contentnea Creek
Riparian Buffer Restoration – Phase 3
Greene County, North Carolina

RESTORATION PLAN

Greene Environmental Services, LLC

90 Ham Produce Road
Snow Hill, NC 28580

EEP contract 005020

December, 2005

Greene Environmental Services, LLC
90 Ham Produce Road, Snow Hill, NC 28580 (252) 747-8200

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1.0. INTRODUCTION

In 2002, the Division of Water Quality's, Ecosystem Enhancement Program (EEP) (formerly the Wetland Restoration Program) collaborated with private environmental firms to restore riparian buffers, streams, and wetlands within the Neuse River drainage basin in an effort to reduce non-point source pollution in its riparian and estuarine systems, particularly nitrate and phosphate. EEP awarded Greene Environmental Services, LLC (GES) of Snow Hill, North Carolina a contract to restore 37.1 acres of riparian buffer along 5,800 feet of an unnamed perennial first order tributary to Contentnea Creek on the Moye Farm in southeastern Greene County (Moye Farm/Contentnea Creek Riparian Buffer Restoration – Phase 1) (Figure 1).

Approximately 17,000 bare root, hardwood tree saplings (18 species) were planted during spring 2003. Weeds were controlled throughout the 2003 growing season using chemical and manual methods. Monitoring along permanent transects during December 2003 indicated an overall density of 792 live saplings per acre (GES, 2003). EEP staff toured the site on 18 March 2004 to evaluate the project's status and determined that restoration goals were met or exceeded.

On 31 December 2003, the North Carolina Division of Purchase and Services (PS) issued a Request for Proposals (RFP) on behalf of the EEP to provide Riparian Buffer Mitigation in the Neuse River Basin (RFP16-D4009). Up to 150 Buffer Mitigation Units (BMUs) were requested in four Cataloging Units (CUs). Fifty BMUs were requested in the Contentnea Creek Basin (CU 03020203).

Pursuant to the RFP, projects in Hydrologic Units (HUs) within these four CUs identified as Targeted Local Watersheds (TLWs) in EEP's *Neuse River Basin Watershed Restoration Plan* were given priority during proposal evaluation. TLWs demonstrate the need and opportunity for water and riparian resource restoration, enhancement, and preservation. EEP's selection criteria include water quality problems, cumulative wetland and stream impacts, resource values, watershed approach, partnership opportunities, land cover, and local resource professional comments and recommendations (WRP, 2002).

EEP identified ten TLWs in the Contentnea Creek Basin. In July 2004 GES was awarded a contract for riparian buffer restoration in one of them (HU 03020203070050) and in an adjacent HU (03020203050040), also in Cataloging Unit 03020203 (Phase 2) (Figure 1).

The Phase 2 project has restored 50 acres of riparian buffer along 14,312 feet of stream (20.87 acres are along 5,825 feet of stream that is contiguous with and upstream of the Phase 1 project, and 29.21 acres are along 8,487 feet of Little Contentnea Creek and its unnamed tributary). The Little Contentnea portion of the project lies on the C.L. Stokes farm in USGS Hydrologic Unit 03020203070050, an EEP Targeted Local Watershed (TLW) and EPA 303d listed stream reach. The restoration areas are in USGS Cataloging Unit 03020203, are geographically contiguous, receive nutrient inputs from the same local turkey and on-site hog operations, and are part of neighboring farming operations.

On 21 October 2004 EEP and PS published another full delivery RFP (16-D05020) for 50 BMUs in the Contentnea Creek Basin (CU 03020203). On 17 February 2005 GES submitted a proposal for 54.16 BMUs. The proposal was accepted by EEP on 27 June 2005. The project, Little Contentnea Creek Riparian Buffer Restoration Phase 3, was planted in late January and early February 2005 and has restored 54.16 acres of riparian buffer along 17,859 feet of Little Contentnea Creek and its unnamed tributaries in an EEP TLW (USGS H U 03020203070050). Pursuant to the RFP, all project acreage qualifies as "restoration" because tree density is below the 100 stems per acre threshold in all tracts.

A conservation easement has been purchased and the land is protected from development in perpetuity. GES will monitor the restoration area and perform necessary maintenance for five years to ensure planting success. When

monitoring has indicated five consecutive years of planted stem density of greater than 320 stems per acre, the state of North Carolina will assume maintenance and management responsibilities, in accordance with the terms of the conservation easement.

2.0. GOALS AND OBJECTIVES

Reestablishing native hardwoods within riparian buffers has been successful in nutrient attenuation, storage, and removal, especially when agricultural inputs are present (Gilliam et al. 1997, and Lowrance, et al. 1995a). Lowrance, et al. (1995b) estimated that 74.3 percent reduction in nitrate-nitrogen, a 70.0 percent reduction in phosphorous and a 89.9 percent reduction in sediments was achieved in 19 meter wide riparian buffers in a Chesapeake Bay watershed. Nitrogen removal occurs primarily via vegetation uptake and storage, and the microbial denitrification process in saturated and organic soils.

Tree roots in natural drainages penetrate more deeply into the soil than roots of herbaceous vegetation. This increased contact with nitrogen in shallow groundwater provides more effective nitrogen removal than herbaceous vegetation alone (Kuenzler, et al. 1977 and Lowrance, et al. 1984 and 1995a). Fallen trees and branches, leaf litter, and tree roots add carbon, which is essential to the denitrification process in the upper soil profile. Gilliam, et al. (1978) demonstrated that denitrification more effectively removes nitrogen in soils that are greater than ten percent organic.

The Phase 3 riparian buffer restoration project's primary goal is to improve water quality in the Little Contentnea Creek watershed by reducing agricultural nutrient inputs into the systems. Establishing, maintaining, and protecting the 54.16 acre buffer will enhance microbial denitrification in shallow surface water and ground water that is currently entering local streams, sequester nutrients (chiefly nitrogen and phosphorous) in woody biomass as the buffer matures, and trap nutrient laden sediments before they enter local streams.

A number of secondary benefits will be realized as the buffer matures. As leaf litter and other organic material in the upper soil profile increases, flood attenuation and storage will become important functions. A growing canopy that shades the stream will decrease water temperature and algal blooms, which will increase dissolved oxygen levels. As stream banks stabilize and water quality improves, native terrestrial and aquatic organisms will colonize the restoration area.

3.0. LOCATION INFORMATION

The project area is in southeastern Greene County, northwest of the confluence of Contentnea Creek and Little Contentnea Creek, approximately one mile north of the Scuffleton community. The Phase 3 project is a continuation of the successful Phase 1 and Phase 2 projects described above. It is approximately two miles north of the Phase 2 project and 2.5 miles north of Phase 1. Phase 3 has restored 54.16 acres of riparian buffer along 17,859 feet of stream (6.06 acres are along 2,694 feet of Little Contentnea Creek and 48.1 acres are along 15,165 feet of unnamed first and second order tributaries to Little Contentnea Creek). The entire project lies on Little Creek Hog Farms, Inc. property in USGS Hydrologic Unit 03020203070050, an EEP Targeted Local Watershed and an EPA 303d listed stream reach. Hay fields and pastures adjacent to Phase 3 buffers receive liquid hog waste from the Sandy Ridge Farm (east of Lower Field Road (SR 1337), Photos 1 and 3) and the Red Hill Farm (west of SR 1337, Photos 2 and 4) (Figures 2 and 3). Pursuant to the RFP, all project acreage qualifies as "restoration" because tree density is below the 100 stems per acre threshold in all tracts. Little Contentnea Creek, and its tributaries have DWQ surface water use classifications of C Sw NSW.

4.0. GENERAL WATERSHED INFORMATION

4.1. Drainage Area

The entire project lies within the Little Contentnea Creek drainage basin. USGS HU 03020203070050 is an EEP TLW with a 33.77 square mile drainage area. Little Contentnea Creek is an EPA 303d listed stream from its

headwaters to its confluence with Contentnea Creek, approximately five stream-miles south of the project area (3.13 linear miles). The Phase 3 buffer restoration streams receive drainage from approximately 2.5 square miles. Cataloguing Unit 03020203 drains 82.94 square miles.

4.2. Land Use

Agriculture is the dominant land use in the project area's immediate drainage area, its hydrologic units, and its cataloguing unit.

Because of the intensive agricultural use of upland areas in the project vicinity and throughout Greene, Pitt, and Lenoir counties for the last century, mature forests generally occupy floodplains and other areas with low topographic position that are too wet to farm. Aerial photography from 1974, 1993, and 1998 indicates that little change to land use has occurred in the project vicinity during the last three decades. A few scattered forest stands have been converted to agricultural use.

Little Creek Hog Farms, Inc. owns and operates both the Red Hill Farm and the Sandy Ridge Farm. Mr. Chuck L. Stokes (Ayden, NC) owns Little Creek Hog Farms. His land includes confined-operation hog facilities, and hay fields that are used as cow pasture after harvesting. Liquid hog waste form both farms is applied to all fields adjacent to the Phase 3 project area (Figure 4).

Agricultural practices provide the primary nitrogen inputs entering surface waters on the site. Aerial application of hog waste contributes nitrates to groundwater, delivers nutrient loaded sediment to streams, and releases ammonia-nitrogen into the air. Mr. Stokes has developed the required Waste Management Plans for land application of the liquid hog waste.

According to the unpublished Waste Management Plan provided by Mr. Stokes, each animal produces 1.9 tons of waste per year containing 2.3 pounds of plant available nitrogen. Each of the two operations produces approximately 12,500 hogs per year. Liquid hog waste application rates vary by crop type and soil series. The Waste Management Plan indicated an appropriate average application rate of 155 pounds of plant available nitrogen per acre per year. Using this average application rate, 15,500 pounds of plant available nitrogen in 12,804 tons of hog waste can be applied to the 100 acres of field immediately adjacent to the restoration area.

Another nitrogen source in local surface and ground water is the synthetic fertilizer that is applied to row-crops (off-site and upstream). Most of this nitrogen is applied early in the growing season. Runoff during rain events is a pathway for nitrogen, sediments, and other agricultural chemicals. Based on NC Department of Agriculture estimates, application rates for nitrogen can be significant. Statewide, recommended annual application rates of nitrogen to soybeans, cotton and corn are 24, 85, and 123 pounds per acre, respectively (NCDA 2000). The nitrogen may be taken up by crops, incorporated into the trophic system of field ecosystem, volatilized or enter ground water or surface water runoff.

Residential development pressure has not reached southeastern Greene County from Greeneville or Snow Hill and existing land uses are expected to continue for the foreseeable future. Changes within the agricultural land use are evidenced by a number of confined livestock facilities that were constructed on agricultural fields between 1993 and 1998.

5.0. DESCRIPTION OF EXISTING CONDITIONS

The Phase 3 buffer project has restored 54.16 acres of riparian buffer along approximately 17,859 feet of intermittent and perennial streams on two active farms in the same HU. The restoration areas are geographically contiguous and receive nutrient inputs from two on-site hog farms (Figures 4 and 5). The restored buffer tracts are all on fields that were previously used for growing hay and as cow pastures. They all received liquid hog waste. During January the

existing electric fences were moved, prior to planting. The remaining, immediately adjacent fields occupy more than twice the restoration area (~120 acres). They remain cow pastures and hay fields. They all receive liquid hog waste.

5.1. Vegetation

Vegetation within the Phase 3 project site has been modified by farming and drainage for decades. Remnant tree stands with individuals at least five inches in diameter at breast height (dbh) exist along narrow strips immediately adjacent to the stream channels in portions of Tracts B, C, D, E, F, and G. All trees at least five inches dbh were counted in the Phase 3 project area. The highest tree density (number of trees ≥ five inches dbh/(100 feet x linear feet of stream reach/43560)= number of trees per acre) measured was 87.59 trees per acre in Tract B. The number of trees per acre for the entire project is 31.68. Tree densities in all tracts were within the allowable limit of no more than100 trees per acre considered eligible for inclusion as riparian buffer restoration, rather than enhancement (Section 5.4). This calculation assumes a 50-foot wide buffer on each side, which produces a total project area of 31.68 acres. Much wider buffers were appropriate for restoration in many tracts. If density calculations were based on the actual restoration area (54.16 acres), total density for the entire project would be 22.16 trees per acre. All densities presented below follow the RFP definition. All native trees greater than five inches diameter at breast height (dbh) were counted in each tract and totaled 977 for the entire project.

Table 1. Pre-restoration land use in the Phase 3 riparian buffer.

Land Use	Acres	Buffer Percentage	Tract
Hayfield	2.17	4	D
Hayfield and pasture	44.95	83	A, B, C, D, D1, E, F, G, and H
Hog incinerator ash disposal	1.24	2	D
Woodland remnant	5.79	11	B, C, D, D1, E
Total	**54.16**	**100**	

Acreage is approximated from interpretation of 1998 infrared aerial photography and on-site observation.

Prior to conversion to agriculture, the project site was likely to have been a mixture of upland forest and swamp forest. Based on the community classification system developed by Schafale and Weakley (1990), the plant communities likely to have been present were *Coastal Plain Bottomland Hardwoods (Brownwater Subtype)* along streams and *Coastal Plain Small Stream Swamp (Brownwater Subtype)* on stream banks. These communities likely graded into *Mesic Mixed Hardwood Forest (Coastal Plain Subtype)* and/or *Mesic Pine Flats* upslope on more well drained soils at the outer edge of the buffer restoration zone.

5.2. Soils

The Soil Survey for Greene County, North Carolina indicates nine soil series mapped at the project site (USDA-SCS 1980) (Table 2 and Figure 3). Two of these soil series underlie nearly three-quarters of the project area; Lumbee (64 percent) and Pactolus (35 percent), both of which are classified as hydric soils because of presence of extensive hydric inclusions (Table 2). The inclusions occur especially in narrow flats adjacent to the steam and are probably relic Bibb complex soils although this was not mapped in the Greene County Soil Survey (personal communication, D. Radford, NC Division of Soil and Water Conservation, Greene County). Generally, the soils within 50 feet of the stream are of lower chroma and higher organic content than the soils greater than 50 feet from the stream. Soil Leaching Potential (SLP) is a measure of a soil's susceptibility to leaching- especially the leaching of pesticides, based on organic content, texture and pH (NC Cooperative Extension Service 1994). Sixty-four percent of soils in the Phase 3 project area have high to very high SLP, which may indicate the potential for the leaching of nitrogen into groundwater from surface application. Site suitability for hardwoods is generally good but poor on the sandier soils (Table 2).

Table 2. Soils series in the Phase 3 project area identified in the Soil Survey of Greene County, NC (USDA-SCS 1980).

Soil Series	Texture	Hydric Status*	SLP+	Acres (percent of total)	Common Trees-Site Index	Seedling Mortality	Hardwood potential
Lumbee (Lu)	Sandy loam	Hydric; poorly drained	52	19.57 (36.0)	loblolly pine 94, slash pine-91, Pond pine-75, Yellow-poplar-96, water tupelo-70, sweetgum-90, white oak--	severe	fair
Pactolus (Pa)	Fine sand	Hydric inclusions; moderately well to somewhat poorly drained	88	18.92 (34.9)	loblolly pine-84, longleaf pine-70, slash pine-83	moderate	good
Bibb (BB)	Loam	Hydric; poorly drained	77	6.83 (12.6)	loblolly pine-90, sweetgum-90, water oak-90	severe	poor
Alpin (AnB)	Fine sand	Hydric inclusions; excessively drained	85	2.36 (4.4)	loblolly pine-85, slash pine-80, longleaf pine-70	moderate	poor
Kinston (KN)	Loam	Hydric; poorly drained	-	2.10 (3.9)	loblolly pine-100, sweetgum-95, white oak-90, eastern cottonwood-100, cherrybark oak-95	severe	poor
Kenansville (KeA)	Fine sand	Non-hydric; well drained	85	1.91 (3.5)	loblolly pine-80, longleaf pine-65	moderate	good
Johns (Jo)	Sandy loam	Hydric inclusions; poorly to moderately well drained	74	1.59 (2.7)	loblolly pine-86, sweetgum-90, slash pine-86	slight	good
Cowarts (CoC2)	Sandy loam	Hydric inclusions; well drained	-	0.85 (1.6)	loblolly pine-86, slash pine-86, longleaf pine-67	slight	good
Kalmia (KaA)	Loamy sand	Non-hydric; well drained	74	0.028 (<1)	loblolly pine-88, slash pine -88, sweetgum-85, yellow-poplar-96, southern red oak--, white oak--	slight	good

* Numbers in parentheses are codes for basis of hydric status (Hydric code - Vegetation Code) HC: 1=Hydric soils, only because of saturation for a significant period during the growing season
HC: 2=Hydric soils that are frequently flooded for long or very long periods during the growing season
VC: 1=Hydric soils that support woody vegetation under natural conditions
+Soil Leaching Potential; ranging from lowest leaching potential (1) to highest leaching potential (100).

5.3. Hydrology

The Phase 3 project has restored 54.16 acres of riparian buffer along 17,859 feet of unnamed intermittent and perennial tributaries to Little Contentnea Creek (Figure 2). These streams discharge into Little Contentnea Creek approximately five stream miles above its confluence with Contentnea Creek (Figure 1).

Streams in the Phase 3 project area have been channelized, straightened, and realigned as part of agricultural activities. Aerial photographs from 1970 show most reaches approximately in their current alignments (SCS 1980), except for the Streams in Tracts F and G, which appear to have been realigned to accommodate construction of the Red Hill Farm hog facilities.

No quantitative data for stream hydrology are available, but groundwater discharges to most Phase 3 streams maintained flow, even during the 2002 drought of record. All streams were evaluated using DWQ's Stream Evaluation Form and all were determined to be at least intermittent.

Water enters the streams via sheet flow from adjacent fields (99 acres of fields bordering the buffers are used for liquid hog waste disposal and cow pasture) and concentrated flow in lateral farm ditches and public roadway ditches. .

5.4. Tract Descriptions

The Phase 3 buffer project has restored 54.16 acres of riparian buffer along approximately 17,859 feet of intermittent and perennial streams on two active farms. The restoration areas are in USGS hydrologic unit 03020203070050 in Cataloging Unit 03020203, are geographically and hydrologically contiguous, receive nutrient inputs from the on-site hog operations, and are part of neighboring farming operations owned and operated by Little Creek Hog Farms, Inc. (Figures 2 and 3).

Depth to water table, hydrology, soils, topographic position, position in the watershed, and existing vegetation were evaluated in each tract to determine appropriate buffer width and location.

5.4.1 Sandy Ridge Farm (east of Lower Field Road)

5.4.1.1 Tract A (Photo 7)

Tract A measures 8.81 acres and provides buffer along 3,820 feet of stream in the most downstream portion of the Phase 3 project. The northern-most portion (1.07 acres) buffers the north bank of an unnamed intermittent second order tributary to Little Contentnea Creek for 618 feet. A 14.8 acre hay field/pasture is north of the buffer. The middle portion of Tract A (6.06 acres) buffers 2,694 feet of Little Contentnea Creek's western bank. A large (29.6 acre) hay field/pasture lies west of this portion of Tract A. This field is between Contentnea Creek and the farm's confined hog facilities, including the lagoon. The southern-most portion of Tract A (1.62 acres) buffers approximately 60 feet of an unnamed intermittent tributary to Little Contentnea Creek and approximately 190 feet of an intermittently inundated area adjacent to and connected with the stream. Groundwater maintains the hydrology in the inundated area (water two to ten inches deep persists in this area during most of the year, even between widely spaced precipitation events), which is probably an abandoned stream meander (oxbow). The northern intermittent tributary is depicted on sheets six and three of the Greene County Soil Survey

(Barnhill, 1977). Little Contentnea Creek and the southern tributary are depicted in the soil survey and on the USGS Ayden and Hookerton topographic quadrangles. No erosion control or bank stabilization was needed in Tract A.

The stream channel is not incised in the northern portion, incised one to three feet from the limit of inundation to the top of the bank along the Little Contentnea Creek section, and not incised in the southern section. Bank slopes are generally 1:3 or shallower throughout Tract A.

Tract A's northern stream scored a 28.75 on the DWQ Stream Classification Form, Little Contentnea Creek scored a 65.5, and the southern stream scored a 34.5.

Eight trees greater than five inches dbh are present where the buffer crosses the northern tributary. This equates to 1.8 trees per acre using the RFP definition and 0.9 trees per acre when the entire tract is included.

Soil series in Tract A included Pactolus fine sand (62 percent), Kinston loam (23.79 percent), Kenansville fine sand (12 percent), and Lumbee sandy loam (two percent). Soil samples indicated that contact with groundwater, as evidenced by saturated soil and hydric soil, was greater than four feet at a number of locations in tract A (Figure 3, Table 2). In spite of this, it was determined that the significant nutrient input from the large pasture upslope from Little Contentnea Creek warranted inclusion of this area in the Phase 3 project and 50 foot wide buffers.

5.4.1.2 Tract B (Photo 8)

Tract B is upstream from the northern portion of Tract A and measures 5.43 acres along 1,417 feet of two streams, which are shown in the Greene County Soil Survey but not on the Ayden or Hookerton topographic quadrangles. Both streams discharge into Tract B from forested areas. The streams confluence at Tract B's eastern edge, before discharging into Tract A's northern boundary. Tract B streams scored 28.75 on the DWQ Stream Classification Form.

Approximately 23 acres of hay field/pasture border Tract B to the north and south. Six hog parlors, which house the 18,375 "feeder to finish" hogs produced annually on the Sandy Ridge Farm, occupy the highest topographic position on the farm (10 meters above mean sea level) and are located 125 feet south of Tract B.

Remnant woodland (mostly hardwood) exists along both streams. The 285 trees in Tract B equate to 91.6 trees per acre according to the RFP definition and 52.4 trees per acre if the entire tract is included.

Soils series in tract B include Pactolus fine sand (92 percent), and Kenansville fine sand (eight percent). Soil samples indicated water at the surface in some locations and saturated soil as deep as one meter (3.28 feet). All samples had hydric soils in the upper meter, as evidenced by low soil matrix chromas and redoxomorphic features in horizons above saturated soils. Buffers widths between 75 and 100 feet wide are appropriate in Tract B, based on depth to water table, soils, and topography.

5.4.1.3 Tract C (Photo 9)

Tract C measures 7.92 acres along 2,743 feet of three stream reaches and 325 feet of the intermittently inundated wetland area described in Tract A. Tract C's primary stream enters the tract's northern boundary and flows south through the tract for 350 feet before joining another

unnamed perennial tributary, turning east and flowing along the buffer's southern boundary for 2,080 feet.

Approximately 30 acres of hay field/pasture border Tract C's northern boundary. Remnant woodland occurs along streams in portions of Tract C. The 40 trees in Tract C equate to ten trees per acre according the RFP definition and five trees per acre if the entire tract is included.

Soils in Tract C include Lumbee sandy loam (65 percent) and Pactolus fine sand (35 percent). Soil samples indicated water at the surface (sample 1) and saturated soil as deep as one meter (3.28 feet). Hydric soil was observed throughout Tract C. Buffers between 60 and 130 feet wide were appropriate in Tract C, based on hydrology and topography.

5.4.1.4 Tract D (Photo 10)

Tract D totals 5.81 acres and restores buffers along 2,182 feet of streams draining east into Tracts C and D1. Tract D occurs in five discontinuous sections and buffers portions of three stream reaches. One of these is shown on the Ayden quad and flows into Tract D from tracts F and G. The two southernmost streams are not shown on the Ayden quad or the soil survey and drain from the southwest and abruptly turn east within Tract D. The three streams converge near Tract D's eastern boundary. Tract D streams scored between 29.5 and 34.5 on the DWQ Stream Classification Form.

Approximately eight acres of hay field/pasture border portions of Tract D. Remnant woodland (mostly hardwood) exists along all streams in Tract D with the majority of the tract occurring on only one side of any given stream reach. The 142 trees in Tract D equate to 44.4 trees per acre according to the RFP definition and 24.5 trees per acre if the entire tract is included.

Soils series in tract D include Lumbee sandy loam (68 percent) and Pactolus fine sand (32 percent). Soil samples indicated water at the surface in 6 of the 12 sample locations with all locations having saturated soil within 60 cm of the surface (< 2 feet). Almost all samples had hydric soils in the upper meter, as evidenced by low soil matrix chromas and redoxomorphic features in horizons above saturated soils. Buffers widths between 50 and 150 feet wide are appropriate in Tract D, based on depth to water table, soils, and topography.

5.4.1.5 Tract D-1 (Photo 11)

Tract D-1 measures 4.48 acres along 1,186 feet of stream that drains east into Tract C. Tract D-1 buffers three stream reaches. The northernmost two of these reaches are depicted on the Ayden quad. The southern one is not shown on the Ayden quad or the Greene County Soil Survey (SCS, 1980). The northernmost reach in this tract drains south along the western edge of the 180-day capacity hog waste lagoon. The lagoon occupies over four acres approximately 100 feet north of tract D-1. Buffer will be restored to both sides of this stream, which scored a 34.5 on the DWQ Stream Classification Form.

Approximately 6 acres of hay field/pasture border portions of Tract D-1. Remnant woodland (mostly hardwood) exists along all streams in Tract D-1. The 214 trees in Tract D-1 equate to 128 trees per acre according to the RFP definition and 47.7 trees per acre if the entire tract is included.

Soils series in tract D include Lumbee sandy loam (53 percent), Johns sandy loam (35 percent), and Pactolus fine sand (11 percent). Soil samples indicated water at the surface in two of the five

sample locations with all locations having saturated soil within 88 centimeters of the surface (2.9 feet). All samples had hydric soils in the upper meter, as evidenced by low soil matrix chromas and redoxomorphic features in horizons above saturated soils. Buffers widths between 100 and 200 feet wide are appropriate in Tract D-1, based on depth to water table, soils, and topography.

5.4.1.6 Tract E (Photo 12)

Tract E measures 4.11 acres along 1,830 feet of one perennial stream that drains into Tract D. This stream reach is depicted on Greene County Soil Survey (SCS, 1980, sheet 6). Buffer will be restored to north side of this stream, which scored a 34.5 on the DWQ Stream Classification Form. Approximately 1.6 acres of hay field border Tract E. The 215 trees in the tract equate to 102 trees per acre according to the RFP definition and 52.3 trees per acre if the entire tract is included.

Soils series in Tract E include Pactolus fine sand (80 percent) and Lumbee sandy loam (20 percent). Soil samples all locations had saturated soil within 98 cm of the surface (3.2 feet), 100 to 150 feet from the stream. All samples had hydric soils in the upper meter, as evidenced by low soil matrix chromas and redoxomorphic features in horizons above saturated soils. Buffers widths between 100 and 150 feet wide are appropriate in Tract E, based on depth to water table, soils, and topography.

5.4.1.6 Tract H (Photo 15)

Tract H measures 7.81 acres along 2,430 feet of a six to eight foot wide stream shown on the Ayden quad and the soil survey. The majority of this tract is surrounded by 23 acres of fields used for liquid hog waste application and as cattle pasture.

This stream scored 26 on the NCDWQ Stream Classification Form and is depicted on the USGS quad and the Greene County Soil Survey (SCS, 1980). The stream's banks are nearly vertical in several locations and will require limited earthwork to reduce bank slope and improve stability. Earthwork will require submittal of a PreConstruction Notification to the US Army Corps of Engineers and NCDWQ and will therefore be completed following contract execution. Disturbance to planted buffers will be kept to an absolute minimum during construction an any trees damaged will be immediately replaced.

There were no trees in Tract H prior to restoration.

Soils series in Tract H include Bibb loam (87 percent), Alpin fine sand (6 percent), and Kenansville fine sand (6 percent), and Kalmia loamy sand (less than one percent). Soil samples indicated saturated soil between 78 and 115 cm of the surface (2.5 and 3.8 feet) except at two locations. Six of the seven soil samples had hydric soils in the upper meter, as evidenced by low soil matrix chromas and redoxomorphic features in horizons above saturated soils. Buffers widths between 50 and 130 feet wide are appropriate in Tract H, based on depth to water table, soils, and topography.

5.4.2 Red Hill Farm (west of Lower Field Road)

5.4.2.1 Tract F (Photo 13)

Tract F measures 4.94 acres along 1,290 feet of perennial stream. The tract is bound to the east by Lower Field Road (SR 1337), to the north by hay field/pasture, to the south by Tract G, and to the west by mature pine plantation. The 5.3 acre field along Tract F's northern boundary is used for liquid hog waste application and as a cattle pasture.

The stream enters Tract F from the north until converging with the stream in Tract G. Downstream of this confluence, the stream forms the boundary between Tract F and G until passing under Lower Field Road (SR 1337). With the exception of a small area above the confluence, tract F is on the north side of the stream, which scored 28.5 on the NCDWQ Stream Classification Form. These stream reaches are depicted on the Ayden quad.

Remnant woodland exists along the stream channel in Tract F. The 40 trees in Tract F equate to 17.3 trees per acre according to the RFP definition and 8.1 trees per acre if the entire tract is included.

Soil series in tract D include Lumbee sandy loam (53 percent), Alpin fine sand (37 percent), and Cowarts sandy loam (10 percent). All soil samples indicated saturated soil within 100 cm of the surface (3.28 feet). Almost all samples had hydric soils in the upper meter, as evidenced by low soil matrix chromas and redoxomorphic features in horizons above saturated soils. Buffers between 150 and 200 feet wide are appropriate in Tract F, based on depth to water table, soils, and topography.

5.4.2.2 Tract G (Photo 14)

Tract G measures 4.85 acres along 961 feet of stream that drains from the south into Tract D. The tract is bound to the east by Lower Field Road (SR 1337), to the south by field, to the north by Tract F, and west by planted pine. The 6.1-acre field along Tract G's southern boundary is used for liquid hog waste application and as a cattle pasture. The stream drains east approximately 100 ft from the northern edge of the 180-day capacity hog waste lagoon before entering Tract G. The lagoon occupies 2.2 acres approximately 100 feet south of Tract G. The majority of buffer will be restored to the south side of this stream, which scored a 29.5 on the DWQ Stream Classification Form. These stream reaches are depicted on the USGS quad and the Greene County Soil Survey (SCS, 1980).

Remnant woodland exists along portions of the stream channel in Tract G. The 41 trees in Tract G equate to 26.1 trees per acre according to the RFP definition and 8.4 trees per acre if the entire tract is included.

Lumbee sandy loam is the dominant soil series in Tract G (92 percent), then, Cowarts sandy loam (seven percent) and Alpin fine sand (one percent). Soil samples indicated saturated soil within 60 cm of the surface two feet) in all sample locations except one where saturated soil depth was greater than 130 cm (4.3 feet). Almost all samples had hydric soils in the upper meter, as evidenced by low soil matrix chromas and redoxomorphic features in horizons above saturated soils. Buffers widths between 50 and 200 feet wide are appropriate in Tract G, based on depth to water table, soils, and topography.

6.0. RIPARIAN BUFFER RESTORATION STUDIES

Depth to water table, hydrology, soils, topographic position, position in the watershed, and existing vegetation were evaluated in each tract to determine appropriate buffer width and location. Detailed descriptions of these parameters for each tract are in the preceding section.

An assessment of depth to water table was made during January 2005. The purpose of the assessment was to correlate approximate local topography to water table depth then determine which stream reaches were most suitable for inclusion as riparian buffer restoration. NC-WRP's *Guidelines for Riparian Buffer Restoration* (2001) require water tables within three to four feet of the surface for restoration sites.

Water table elevation (top of the surficial aquifer) is not static; it is influenced by season, evapotranspiration, precipitation, soil infiltration rates, proximity of streams and anthropogenic drainage and land alteration.

Precipitation in the project area has increased steadily over the last century (Figure 5). Average annual precipitation from 1900 to 2003 measured 47.5 inches in the 16 square kilometer area surrounding the project area. Total precipitation during 2003 was 61.04 inches (22 percent above the long-term average). Total precipitation during October, November, and December 2003 was 11.71 inches (25 percent above the long term average for the same period) (SCAS, 2004).

Soil samples were taken at 64 sites throughout the project area using a Dutch auger (Table 3). Water table contact was determined by the presence of saturated soils, often in coarse sand or organic loamy sands. Above the water table, however, the presence of low chroma soils, mottled clays and reducing conditions indicated that the water table was periodically higher, probably during spring and winter or during years of normal or above normal rainfall.

Generally, within 50 feet of streams, the soils were probably former floodplain and highly organic, relic Bibb Complex soils or similar soils exhibiting indicators of an active hydrologic regime. Beyond the 50-foot zone, topography varied from nearly level to a rise of up to 6 feet, 150 feet from the streambank. Low chroma, organic soil conditions, that are indicative of an active hydrologic regime, often persisted up to 2 feet above the elevation of the 50-foot zone.

Precipitation and stream gauge data indicate that near normal hydrologic conditions were evident at the time water table depth measurements were taken. These data were used to determine buffer width and alignment to insure groundwater contact in the root zone.

Table 3. Soil Color and Depth to Groundwater on the Phase 3 Site.

Tract	Sample Number	Depth to Saturation		Profile	
		cm	ft	depth (cm)	Munsell color
A	1	60	1.97	0-60	10YR 3/2
	2	80	2.62	0-80	2.5Y 6/3
	3	> 130	> 4.27		10YR 6/3
	4	> 130	> 4.27		10YR 6/3
	5	> 130	> 4.27		10YR 6/3
	6	> 130	> 4.27		10YR 6/3
	7	80	2.62	0-50	2.5Y 4/4
				50-80	2.5Y 6/1
	8	> 130	> 4.27		10YR 6/3
	9	114	3.74	0-20	2.5Y 3/1
				20-95	2.5Y 5/6
				95-114	2.5Y 3/4
	10	> 130	> 4.27		10YR 6/3
	11	110	3.61	0-110	2.5Y 6/4
	12	> 130	> 4.27	0-10	2.5Y 3/3
				10-30	2.5Y 6/6
				30-120	2.5Y 7/5
	13	85	2.79	0-15	10YR 4/4
				15-80	10YR 5/5
				80-85	2.5Y 6/3
B	1	40	1.31	0-20	2.5Y 2.5/1
				20-40	10YR 3/6
	2	40	1.31	0-40	10YR 2/1
	3	110	3.61	0-40	2.5Y 7/6
				40-80	7.5YR 5/6
				80-100	7.5YR 4/3
				100-110	7.5YR 7/1
B	4	100	3.28	0-20	10YR 3/2
				20-80	10YR 5/6
				80-100	10YR 7/1
	5	85	2.79	0-55	10YR 5/3
				55-85	10YR 6/2
	6	Surface	0		10YR 2/1
	7	Surface	0		10YR 2/1
	8	Surface	0		10YR 2/1
	9	45	1.48	0-20	10YR 2/1
				20-45	2.5Y 6/3
C	1	Surface	0		10YR 2/1
	2	21	0.69	0-21	10YR 2/1
	3	88	2.89	0-88	2.5Y 5/2
	4	95	3.12	0-50	2.5Y 5/3
				50-95	2.5Y 6/2
	5	75	2.46	0-75	2.5Y 6/3
	6	40	1.31	0-40	10YR 4/2
	7	72	2.36	0-40	2.5Y 6/4
				40-72	2.5Y 7/2
	8	100	3.28	0-100	2.5Y 6/2
D	1	Surface	0		10YR 2/1
	2	Surface	0		10YR 2/1
	3	Surface	0		10YR 3/2
	4	Surface	0		10YR 2/1
	5	30	0.98	0-30	10YR 2/1
	6	Surface	0		10YR 3/2
	7	23	0.75	0-23	2.5Y 4/2

Table 3. Soil Color and Depth to Groundwater on the Phase 3 Site (continued).

Tract	Sample Number	Depth to Saturation		Profile	
		cm	ft	depth (cm)	Munsell color
D	8	Surface	0		10YR 3/2
	9	Surface	0		10YR 2/1
	10	18	0.59	0-18	10YR 2/1
	11	38	1.25	0-38	10YR 2/1
	12	60	1.97	0-50	2.5Y 6/3
				50-60	10YR 6/6
	13	Surface	0		10YR 3/2
	14	20	0.66	0-20	10YR 2/1
	15	50	1.64	0-25	10YR 2/1
				25-50	10YR 5/6
E	1	60	1.97	0-20	2.5Y 2.5/1
				20-60	2.5Y 4/3
	2	98	3.22	0-20	10YR 3/3
				20-60	2.5Y 5/6
				60-98	2.5Y 6/2
	3	72	2.36	0-20	10YR 2/1
				20-72	2.5Y 5/3
	4	45	1.48	0-45	10YR 2/1
F	1	33	1.08	0-33	10YR 2/2
	2	100	3.28	0-20	2.5Y 4/4
				20-80	2.5Y 5/4
				80-90	2.5Y 7/2
	3	70	2.30	0-10	2.5Y 4/2
				10-30	2.5Y 5/4
				30-70	2.5Y 5/6
G	1	>130	> 4.27	0-70	10YR 4/3
				70-130	10YR 6/4
	2	60	1.97	0-40	10YR 4/1
				40-60	10YR 2/1
	3	33	1.08	0-33	10YR 2/1
	4	23	0.75	0-23	2.5Y 3/2
	5	45	1.48	0-20	2.5Y 3/3
				20-45	2.5Y 5/1
H	1	>130	> 4.27	0-130	2.5Y 5/6
	2	95	3.12	0-45	10YR 6/1
				45-95	10YR 6/2
	3	78	2.56	0-35	10YR 2/1
				35-78	10YR 5/1
	4	115	3.77	0-62	10YR 4/2
				62-115	10YR 6/1
	5	130	4.27	0-32	2.5Y 4/3
				32-80	2.5Y 7/1
				80-130	2.5Y 5/4
	6	115	3.77	0-90	2.5Y 5/4
				90-115	2.5Y 6/2
	7	105	3.44	0-30	10YR 2/2
				30-80	10YR 4/3
				80-105	10YR 5/2

7.0. RESTORATION PLAN

7.1. Site Preparation

Prior to restoration, abandoned farm equipment, debris, and undesirable vegetation were removed from the Phase 3 buffer areas (Photo 7). Remaining woody debris that would have interfered with planting and maintenance was pushed into windrows adjacent to planting areas.

Nearly all stream banks in the Phase 3 buffer restoration areas are incised less than three feet and have 3:1 slopes. Most are shallower. Tract H contains some reaches with steeper slopes and more incised channels, but existing woody vegetation stabilizes the banks. It was determined that removal of this vegetation and mechanical grading of banks along these reaches would have a net adverse water quality impact. Wax myrtle (*Myrica cerifera*) from 12 inch container stock and black willow (*Salix nigra*) stakes were planted at the top and on the sides of stream banks in erosion-prone reaches. The stakes are approximately one half inch in diameter and were harvested from local trees and trimmed to two foot lengths. Silt fencing and straw bales were anchored in these areas to reduce sediment input into the stream.

Undesirable vegetation that would compete with species targeted for restoration was mechanically removed using an excavator, and manually removed using chainsaws, brush axes and machetes. Undesirable vegetation included non-native woody species (e.g. Chinese privet (*Ligustrum sinense*)); native and introduced grasses with aggressive, rhizomatous and stoloniferous habits (e.g. cane (*Arundinaria gigantea*) and Bermuda grass (*Cynodon dactylon*)); and native vines (*Smilax* spp.). Native hardwood saplings were avoided. Compacted soils were disked or ripped prior to planting.

7.2. Implementation

Approximately 25,500 bare root hardwood saplings of 10 species and 2,500 bald cypress saplings were planted in the Phase 3 restoration area during February 2005 (Table 4). Crews planted the saplings in irregular rows following surface contours and channel alignment during February 2005. Between and within rows, saplings were planted approximately nine feet apart. At this rate, density will be 538 saplings per acre after planting. This planting density was selected to allow up to 40 percent mortality while meeting the 320 stem per acre targeted density. In addition to the bare root saplings, black willow (*Salix nigra*) stakes were planted at the top and on the sides of stream banks in erosion-prone reaches. The stakes are approximately one half inch in diameter and were harvested from local trees and trimmed to two foot lengths.

Most of the tree species planted are suitable for the range of soil moisture conditions found at the site, but some species (e.g. green ash and bald cypress) are best suited for the more hydric soils nearest the stream and in other low-lying areas. Other species (e.g. red oak and longleaf pine) should be more successful on the more well-drained soils. Two planting zones were established based on soil hydroperiod. Zone boundaries were determined based on field evaluation and soil sampling results. Generally, the wetter zone (zone one) extends outward 20-50 feet from the streambank and is planted with species tolerant of poorly-drained soils. The wet zone was significantly expanded where soil moisture warranted (e.g. Tract C, Figure 4). Similarly, where a drier soil moisture regime prevailed, species suitable for more well-drained conditions were planted in the drier zone (zone two), which extended to the interior buffer boundary in some areas (e.g. Tract A).

Applying glyphosate herbicide with a concentration of 0.25% will be used to control competing grasses and herbaceous vegetation. The herbicide will be applied to actively growing plant tissue in May through July and as necessary. Backpack sprayers will be used to apply herbicide concentrating in a 3-foot radius around and in between saplings. Existing native vegetation that is stabilizing the stream bank will be avoided. Removal of undesirable woody vegetation was followed by application of glyphosate herbicide to stumps and actively growing tissue. Naturally colonizing tree species, especially sweetgum and loblolly pine, will be removed if they appear to be out-competing planted seedlings. Native species that are allowed to persist will be noted in stem density measurements and separate calculations for total density and planted density will be provided.

Table 4. Trees Planted in the Phase 3 Riparian Buffer Restoration

Species	Common Name	Number Planted	(Percent of Total)	Soil Drainage Suitability
Fraxinus americana	white ash	4,200	15	mesic
Fraxinus pennsylvanica	Green ash	9,000	32	hydric
Liriodendron tulipifera	yellow poplar	300	1	mesic, hydric
Pinus palustrus		1,000	4	
Platanus occidentalis	coastal sycamore	5,000	18	mesic
Quercus nigra	water oak	2,000	7	mesic
Quercus pagoda	cherrybark oak	500	2	mesic
Quercus phellos	Willow oak	2,000	7	mesic, hydric
Quercus virginiana	live oak	1,000	4	mesic
Quercus rubra	Northern red oak	500	2	mesic
Taxodium distichum	Bald cypress	2,500	9	hydric
	TOTAL	28,000	100	

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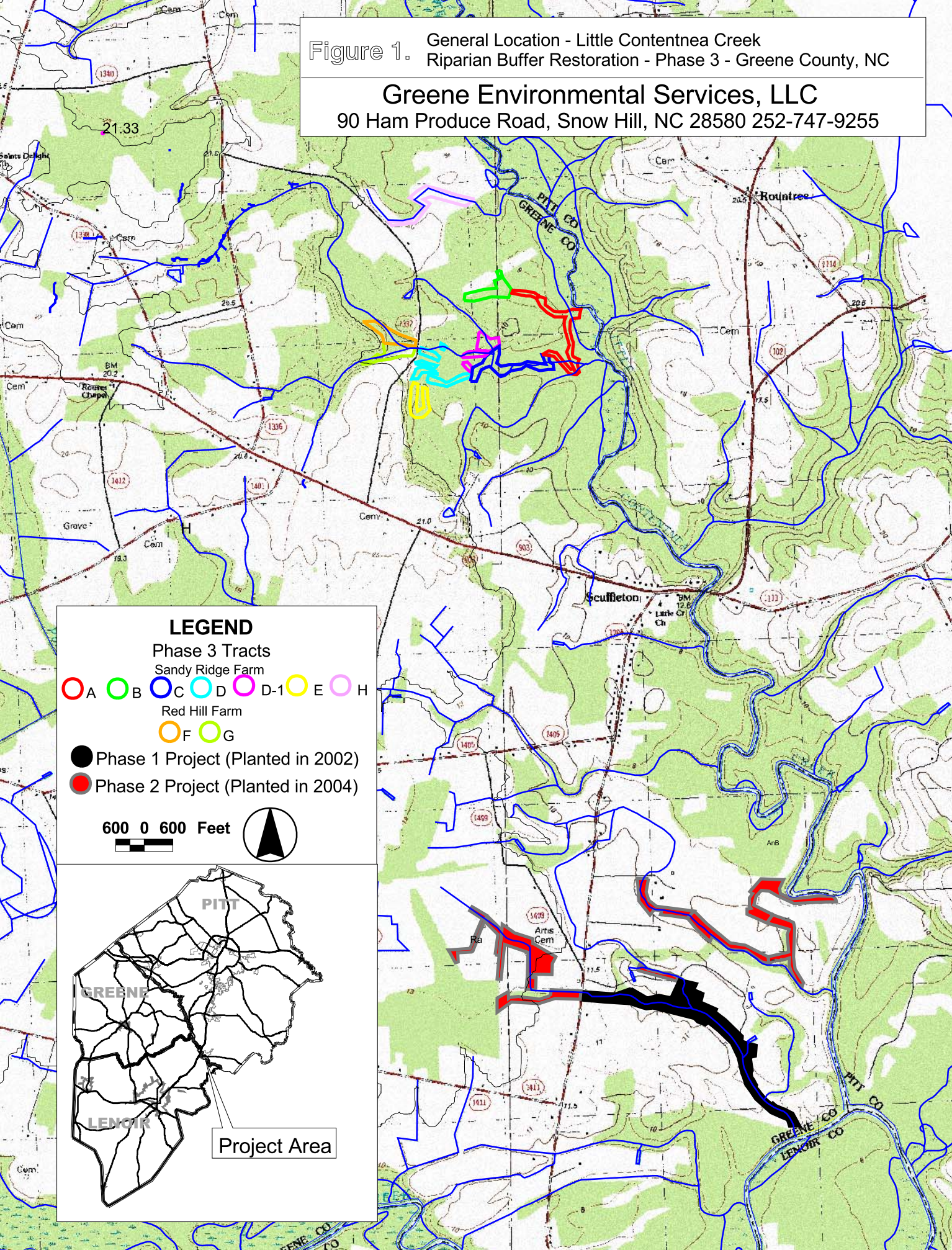
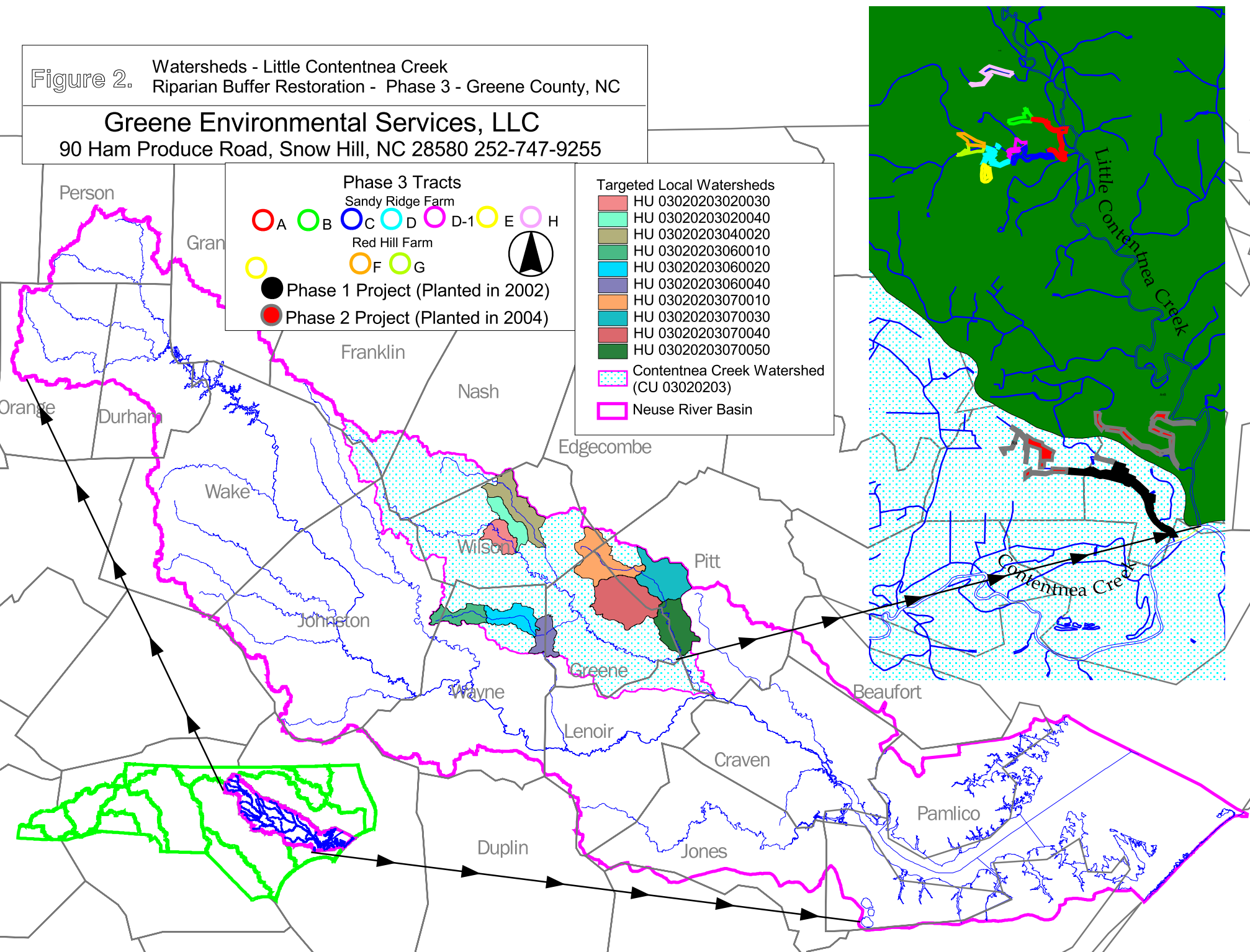


Figure 1.
General Location - Little Contentnea Creek
Riparian Buffer Restoration - Phase 3 - Greene County, NC
Greene Environmental Services, LLC
90 Ham Produce Road, Snow Hill, NC 28580 252-747-9255
LEGEND
Phase 3 Tracts
Sandy Ridge Farm
A B C D D-1 E H
Red Hill Farm
F G
Phase 1 Project (Planted in 2002)
Phase 2 Project (Planted in 2004)
600 0 600 Feet
PITT
GREENE
LENOIR
Project Area
Rountree
Scuffleton
PITT CO
GREENE CO
LENOIR CO

Figure 2. Watersheds - Little Contentnea Creek
Riparian Buffer Restoration - Phase 3 - Greene County, NC

Greene Environmental Services, LLC

90 Ham Produce Road, Snow Hill, NC 28580 252-747-9255



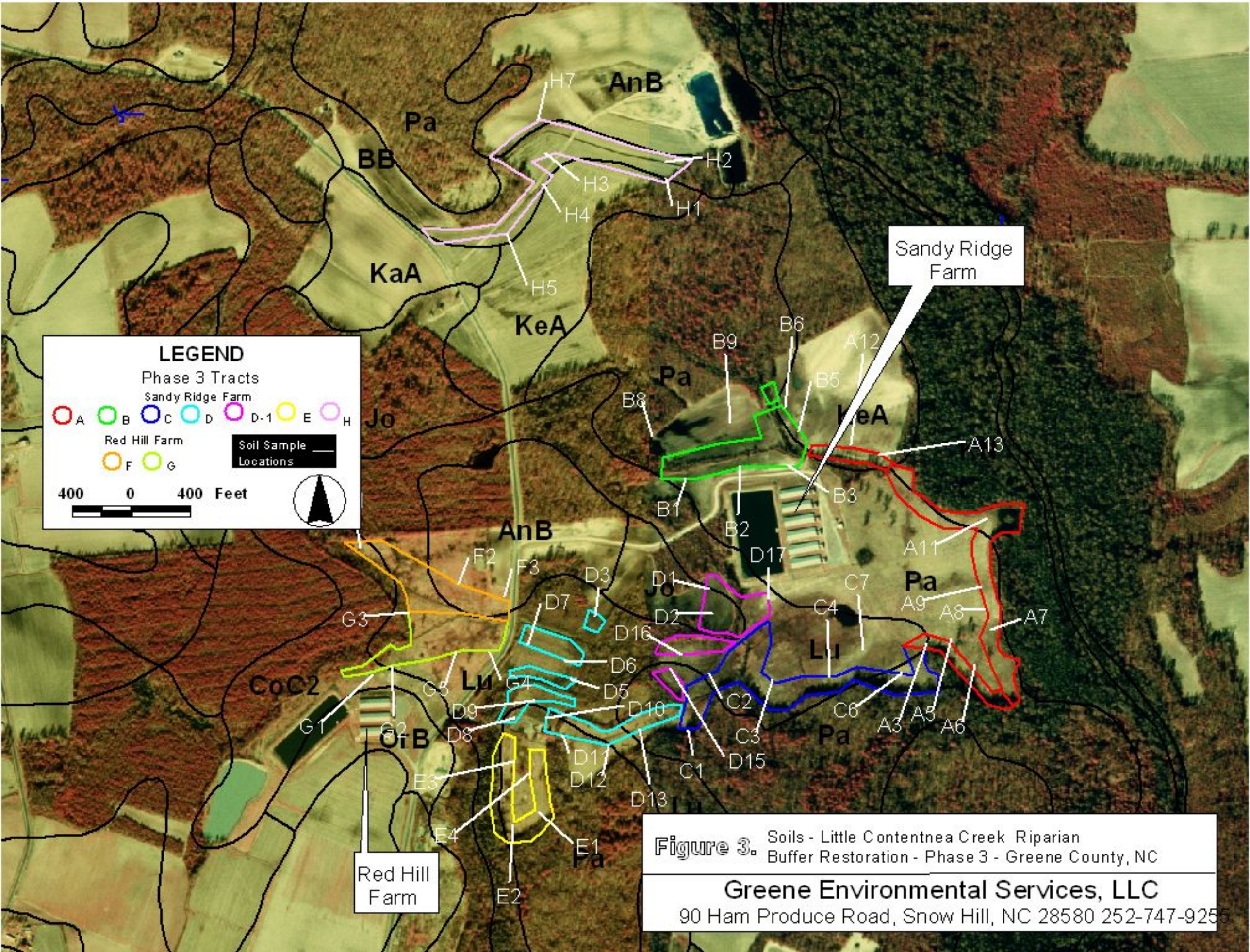


Figure 3. Soils - Little Contentnea Creek Riparian Buffer Restoration - Phase 3 - Greene County, NC

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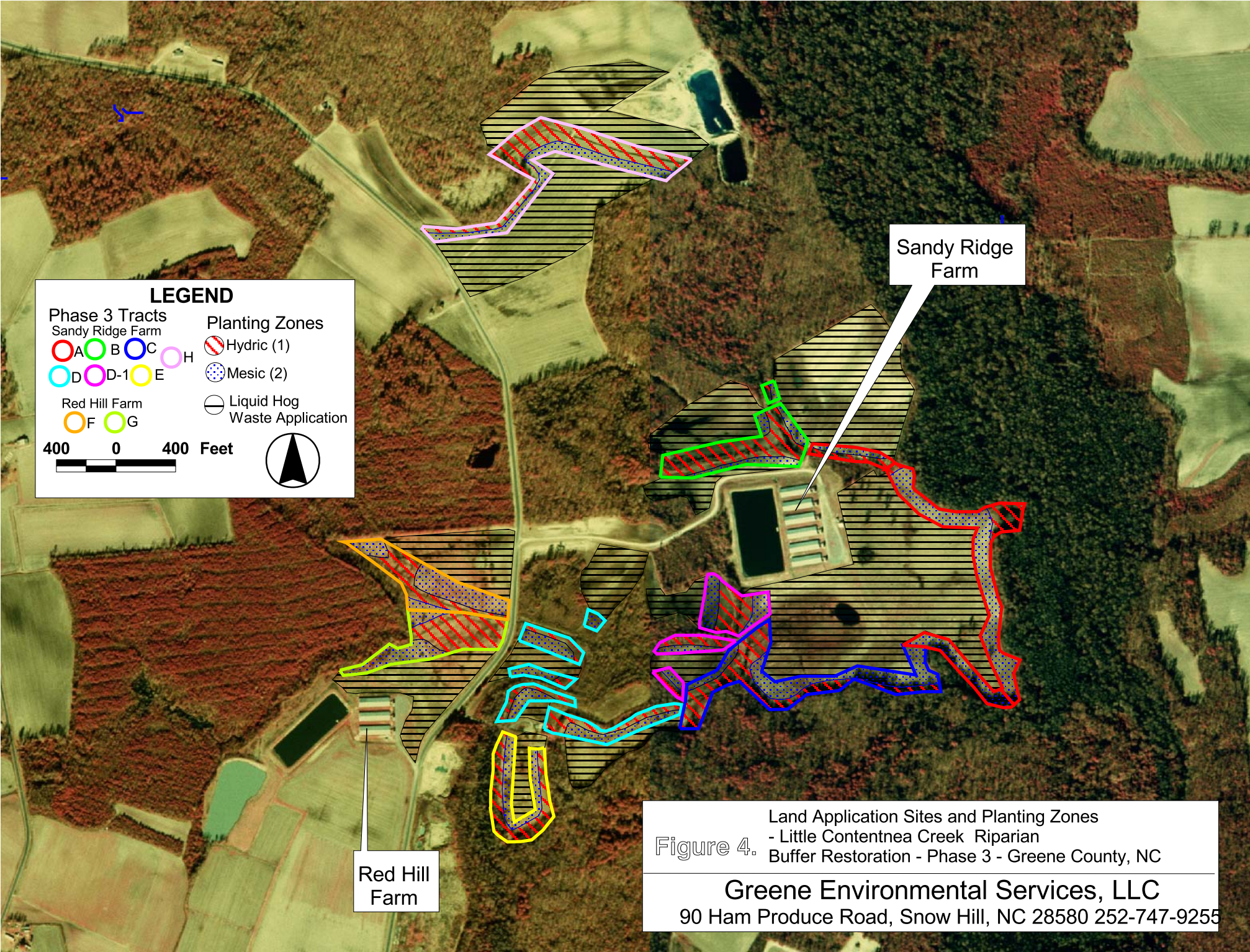

Figure 4. Land Application Sites and Planting Zones - Little Contentnea Creek Riparian Buffer Restoration - Phase 3 - Greene County, NC

Greene Environmental Services, LLC
90 Ham Produce Road, Snow Hill, NC 28580 252-747-9255

Figure 5. Total Precipitation in the Contentnea Creek/Little Contnentnea Creek Vicinity 1900-2003

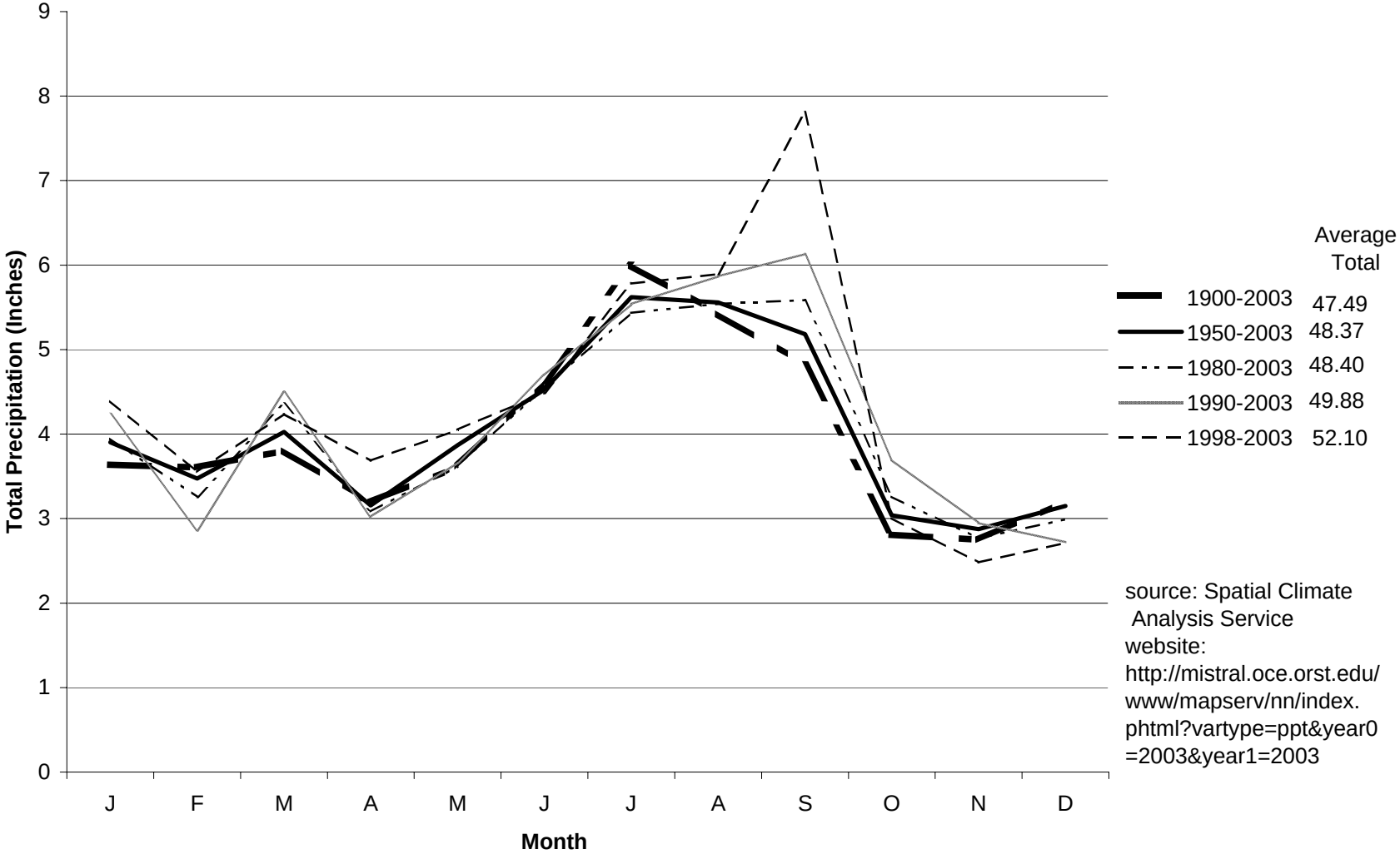

Photo 1. Sandy Ridge Farm

Photo 2. Red Hill Farm

Photo 3. Sandy Ridge Hog Parlor

Photo 4. Red Hill Pasture

Photo 5. Scrap Metal and Debris (Tract D)

Photo 6. Hog Incinerator

Photo 7. Tract A

Photo 8. Tract B

Photo 9. Tract C

Photo 10. Tract D

Photo 11. Tract D1

Photo 12. Tract E

Photo 13. Tract F

Photo 14. Tract G

Photo 15. Tract H