Restoration Plan

Greenbrier Creek Stream Restoration
Alamance and Chatham Counties, North Carolina
SCO Project Number 04-06210-02

Prepared for:
NCDENR-Ecosystem Enhancement Program
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Ecosystem Enhancement PROGRAM

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Executive Summary

The project site is approximately eight miles north of Siler City, in the general vicinity of where Staley-Snow Camp/Pleasant Hill Church Road crosses over Greenbrier Creek. There are easements on three properties, the Jerrold Murchison property (PIN # 8756532958) and the Charles Cheek property (PIN # 8756244509) to the north in Alamance County, and the Larry Matthews property (PIN # 8756613184) to the south in Alamance and Chatham Counties (see Figures 1 and 2). A power line easement crosses the site, between the Muchison and Matthews easements. The project reaches include the portions of Greenbrier Creek that flow through the Murchison, Cheek and Matthews easements, as well as a tributary that flows into Greenbrier Creek just upstream of the bridge and two tributaries that originate from the Matthews property and join Greenbrier Creek downstream of the bridge on the Matthews easement. The existing land use is active row crop production on the Murchison parcel and active pasture on the Matthews/Cheek parcels.

The Murchison and Cheek easements are intended solely for stream and wetland preservation. The northernmost section of the Matthews property is also intended for stream and wetland preservation. On the Matthews property, from the point where Greenbrier Creek flows under the fence downstream into the pasture area, Enhancement Level I is proposed. This reach was channelized at some point in the distant past. The project stream Enhancement reaches included within the Matthews easement are portions of Greenbrier Creek, a tributary flowing into Greenbrier Creek upstream of the bridge and two tributaries that originate from Matthews property and join Greenbrier Creek downstream of the bridge (Please refer to Figure 2). That portion of the tributary upstream of the bridge, from the mouth to the culvert upstream (~738') has also been channelized as some point in the past.

The total existing channel length of Greenbrier Creek in the preservation reaches on the Murchison, Cheek and Matthews properties is 5,024 feet (thalweg) based on GPS measurements. The unnamed tributaries(UT's) to Greenbrier Creek proposed for preservation are 1,306 feet in length. The total preservation length is 6,330 feet.

The total existing channel length of Greenbrier Creek proposed for Enhancement I on the Matthews property, based on survey stationing, is 2,624 feet. The total length of UT's proposed for Enhancement I on the Matthews property, based on survey stationing and GPS data, is 1,575 feet. The total Enhancement I length is 4,937feet.

There are 17.05 acres of buffer restoration proposed with this project.

All the wetlands delineated on the site are proposed for preservation. None will be disturbed by construction activities. There are 6 wetlands on the Murchison property totaling 7.18 acres and 3 wetlands on the Matthews property totaling 0.46 acres.

The entire Greenbrier Creek reach and the unnamed tributary that are proposed for Enhancement I were assessed in the field by Biohabitats using the Bank Erosion Hazard Index (BEHI) (Rosgen 2001). The entire project reach of the Greenbrier Creek channel (2,624') has a BEHI rating of Moderate, and a Near Bank Stress (NBS) rating of Low. The rate of sediment export per year is

somewhat higher where the study banks are higher and have higher angles (~40% of the reach) and somewhat lower where the banks are lower and have lower angles. The bank height ratio (BHR) varies from a low of approximately 1.0 to a high of approximately 1.25. It should be noted that estimates of BHR are only that, because the channel is degraded to the extent that bankfull indicators such as depositional benches are uncommon and therefore were deemed to have limited reliability. The total sediment export on the Greenbrier mainstem is estimated to be 40.5 tons per year.

The unnamed tributary (1,928') also has two different BEHI ratings. The lower rated length (1,157') has a BEHI rating of Moderate and an NBS rating of Low. This reach length has lower study banks and a somewhat lower NBS rating. The export rate for this section of stream is approximately 10 tons per year. The higher rated section of the unnamed tributary (771') has a BEHI rating of High and a NBS rating of Low. The export rate for this section is approximately 23.4 tons per year. The BHR on the unnamed tributary ranges from approximately 1 to approximately 3. The total sediment export rate on the unnamed tributary is estimated to be 33.4 tons per year.

Chanelization of Greenbrier Creek caused degradation to the system which resulted from the loss of pronounced riffle pool sequences, the associated loss of aquatic habitat, and accelerated bank erosion. The pervasive extent of high BEHI scores and BHR's indicates that both the Greenbrier mainstem and the unnamed tributary are unstable and creating high sediment loads in a water supply watershed.

The goals of the project are:

- To improve water quality by reducing nutrient loading from a livestock operation in a water supply watershed
- To reduce the high level of sediment loading to the stream from steep, eroding banks
- To improve both aquatic and terrestrial riparian buffer habitat.

These goals will be accomplished through the implementation of the following objectives:

- preservation and protection of important wetlands and stream channel reaches upstream of the Matthews property
- improvement of water quality (reduction of nutrient and sediment inputs) by creating a vegetated riparian buffer filter strip between the stream and the livestock production operation currently on the site
- reduction of high sediment loads in the stream through stabilization of eroding channel banks
- improvement of deteriorated aquatic habitat by reduction of nutrient and sediment loads in the streams, providing a more variable stream channel geometry and creating more opportunities for carbon inputs from the trees in the restored buffer zone
- improvement of terrestrial habitat through restoration of diverse native woody vegetation in the riparian buffer zone and control of invasive privet (*Ligustrum* spp.)

The goals will be accomplished by designing and constructing a stable profile and dimension for the stream channels and re-establishing continuous riparian buffers along the banks. Project implementation will greatly reduce bank erosion and consequently decrease the amount of

sediment load in the stream at flows above baseflow (measurable with BEHI values, channel geometry stability and vegetative monitoring success). Enhancement I design is proposed on the project, due to unstable channel geometry and streambank steepness. Restoration was deemed to be too disruptive of the existing mature vegetation, so the planview of the channel will not be changed. Structures will be used to raise and stabilize the channel invert. These structures will also create riffles, which are almost non-existent in the project reach, and deepen the shallow pools. Riparian buffer vegetation will be established to provide food and cover for terrestrial fauna and to provide a carbon source and shade for aquatic habitat.

Stream restoration on Greenbrier Creek will help alleviate two problems identified in the existing conditions analysis as being recognized sources of water quality degradation-inadequate riparian buffers and a high sediment export rate. This project has added benefit in that it occurs in a watershed supply stream. The project site is upstream of the Rocky River Reservoir watershed, a WS-III public water supply watershed. The site is also located within the Upper and Middle Rocky River Local Watershed Planning Area and Targeted Local Watershed Area.

To meet the goals listed above, the proposed objectives for Greenbrier Creek are to preserve 6,330' of Greenbrier Creek and its unnamed tributaries on the Murchison and Matthews property, and perform Enhancement I (Priority II) on 5,016 feet of the mainstem and its tributaries and Enhancement II on 738 feet on the Matthews property. In addition, 17.05 acres of buffer restoration will be performed (see Table A).

Table A. Estimated Project Reach Existing and Designed Channel Descriptions (Existing Lengths = Designed Lengths) and Wetland Areas

	Locations	**EI***	**Preservation**
Greenbrier Mainstem	u/s areas of project, Murchison, Cheek and Matthews Properties		5,024
Tributaries			1,306
	Total		6,330
Greenbrier Mainstem	Matthews Property, u/s of Staley-Snow Camp Road	659	
	d/s of Staley-Snow Camp Rd. to project end	1,965	
Tributaries			
#1	Main trib. u/s of Staley Snow Camp Rd., u/s of existing culvert	1,190	
#1	Main trib. u/s of Staley Snow Camp Rd., d/s of existing culvert	738	
#2	Matthews Property , first trib. d/s of Staley-Snow Camp Rd	185	
#3	Matthews Property , second trib. d/s of Staley-Snow Camp Rd	200	
	Totals	4,937	6,330

Table A. Estimated Project Reach Existing and Designed Channel Descriptions (Existing Lengths = Designed Lengths) and Wetland Areas (CONTINUED)
***EI = Enhancement I –lengths are in feet and represent existing and proposed (designed lengths)** **Wetland Preservation on Murchison Property = 6.93 acres and on the Matthews Property = 0.46 acres**
Total Project Wetland preservation = 7.39 acres **Riparian Buffer Restoration on Matthews Property = 17.05 acres.**

This project, as proposed, will improve water quality in a water supply watershed. It will also protect and rehabilitate valuable water quality resources and wildlife habitat. Degraded reaches of stream channel will be stabilized by reconfiguring channel profile and dimension and riparian buffers will be restored and enhanced.

1.0 Project Site Identification and Location

The project site is approximately eight miles north of Siler City, in the general vicinity of where Staley-Snow Camp/Pleasant Hill Church Road crosses over Greenbrier Creek. There are easements on three properties, the Jerrold Murchison property (PIN # 8756532958) and the Charles Cheek property (PIN # 8756244509) to the north in Alamance County, and the Larry Matthews property (PIN # 8756613184) to the south in Alamance and Chatham Counties (see Figures 1 and 2). The project reaches include the portions of Greenbrier Creek that flow through the Murchison, Cheek and Matthews easements, as well as a tributary that flows into Greenbrier Creek just upstream of the bridge and two small tributaries that originate from the Matthews property and join Greenbrier Creek downstream of the bridge on the Matthews easement.

The total existing channel length of Greenbrier Creek proposed for preservation on the Murchison, Cheek and Matthews properties is 6,330 feet (thalweg) based on GPS data. The total length of Greenbrier Creek on the Matthews property proposed for Enhancement I is 2,624 feet based on survey stationing. The unnamed tributaries to Greenbrier Creek proposed for EI on the Matthews property are 2,313 feet based on the survey and GPS data. The latitude and longitude of the midpoint of the restored mainstem is -79.48 89 50N, 35.84 01 17E decimal degrees using the NAD83 coordinate system. For the tributary section the coordinates are -79.48 84 91N, 35.84 31 57E decimal degrees.

1.1 Directions to Project Site

From I-40/85 in Graham, NC turn south on NC 49/Maple Street and travel 11.6 miles. Turn left (southeast) onto West Greensboro Chapel Hill Road and travel 1.1 miles. Bear right (south) onto Coble Mill Road and travel 1.9 miles. Turn right (southwest) onto Pleasant Hill Church Road and travel 2.3 miles to 10264 Pleasant Hill Church Road, the Larry Matthews property, which adjoins the project site. If you continue to the bridge 0.3 miles from the Matthews house, Pleasant Hill Church Road crosses over Greenbrier Creek on the project site.

Alternatively, from Raleigh follow US 64 to Siler City, turn right (north) onto US 421 and travel approximately 3 miles to Piney Grove Church Road, exit and turn right (northwest) on Piney Grove Church Road. Travel approximately 4.5 miles to the intersection with Staley Snow Camp Road, turn right (northeast) and travel approximately 2 miles to the bridge over Greenbrier Creek.

1.2 USGS Hydrological Unit Code and NCDWQ River Basin Designations

Greenbrier Creek is in the 03030003 USGS 8-digit Hydrologic Unit Code (HUC), and in the 03030003070010 14-digit HUC. The N.C. Division of Water Quality stream classification is WS-III and the stream index number is 17-43-5. The project site is upstream of the Rocky River Reservoir watershed, a WS-III public water supply watershed. The site is also located within the Upper and Middle Rocky River Local Watershed Planning Area and Targeted Local Watershed Area.

1.3 Project Vicinity Map

See Figure 1 (Appendix 10.0).

2.0 Watershed Characterization

The Greenbrier Creek watershed is located in a rural area of a moderately populated Alamance County and in a rural area of a sparsely populated Chatham County. Alamance County land area is 428 square miles. The population of Alamance County as of the 2000 Census was 130,800, rendering a population density of 305 people per square mile. Chatham County land area is 709 square miles. The population of Chatham County as of the 2000 Census was 49,329, rendering a population density of 70 people per square mile (NCSD 2007).

The annual normal mean temperature for Alamance and Chatham Counties is 55-60 degrees Fahrenheit. The annual normal precipitation for Alamance County and the western half of Chatham County is 48-52 inches, while the eastern half of Chatham County is 52-56 inches (SCO 2000).

2.1 Drainage Area, Project Area, and Easement Acreage

The drainage area of the Greenbrier Creek stream restoration project area is approximately 3,387 acres (5.3 mi^2). The area within the Murchison property conservation easement is approximately 33.9 acres and the area within the Matthews property easement is approximately 17 acres.

2.2 Surface Water Classification / Water Quality

Greenbrier Creek is located in the USGS 8-digit Hydrological Unit Code (HUC) 03030003, and in the 03030003070010 14-digit HUC. The N.C. Division of Water Quality stream index number for Greenbrier Creek is 17-43-5. This stream is classified a WS-III.

2.3 Physiography, Geology, and Soils

Alamance and Chatham Counties are bordering counties located in central North Carolina. Both counties are located entirely in the Piedmont physiographical region of central North Carolina. The counties' topography is typical of the Piedmont consisting of gently rolling hills with higher resistant hills rising from the general terrain. The elevation within the Piedmont ranges from 200 ft to 1500ft depending on relative location to the Coastal Plain or the Blue Ridge, respectively. Greenbrier Creek project site has elevations ranging from 188 to 250 feet. The Greenbrier Creek watershed is underlain by sedimentary and metamorphic rock from the late Proterozoic to early Paleozoic Period and metamorphic rocks from the Carolina slate belt (NCGS 1985).

Biohabitats obtained spatial and tabular soil survey GIS data from the NRCS Web Soil Survey 2.0 website (http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx) for Alamance County and Chatham County, North Carolina. Where applicable, soil map units with the same name in both counties were joined in GIS to create one soil map unit. The soil map units and their associated acreage and percent for the Greenbrier Creek

watersheds are listed below in Table B. Refer to Figure 3 for a map of the soils within Greenbrier Creek watersheds.

Table B. Soils Statistics for the Project Site Watershed				
Map Unit Name	**Map Unit Symbol**	**Acres**	**Percent**	**Hydric Soil***
Alamance	AaB	54.5	1.6	-
Appling	AbC2, AcC3, AdB, AdB2, AdC, AdC2, AdD, AdD2	356.2	10.5	-
Cecil	CbB, CbB2, CbC, CbC2, CcB2, CcC2,	33.1	1.0	-
Chewacla	Cd	46.8	1.4	Yes
Chewacla and Wehdadkee	ChA	43.8	1.3	Yes
Cid	CmB	76.7	2.3	Yes
Colfax	Ce	154.4	4.6	Yes
Davidson	DaC3,DaD3, DbB, DbC	164.6	4.9	-
Durham	DcB, DdB, DdB2, DdC, DdC2	955.4	28.2	-
Efland	EaB2, EaC2	8.3	0.2	-
Georgeville	GaB, GaB2, GaC, GaC2, GbB3, GcC, GeB2, GeC2	485.3	14.3	-
Georgeville-Badin Complex	GkD	4.5	0.1	-
Helena	HbB2, HcC2	6.1	0.2	Yes
Herndon	HdB, HdB2, HdC, HdC2, HrB	90.7	2.7	-
Iredell	IaA, IaB, IaB2, LbB2	11.2	0.34	-

Table B. Soils Statistics for the Project Site Watershed (cont.)				
Map Unit Name	**Map Unit Symbol**	**Acres**	**Percent**	**Hydric Soil***
Llyod	LbB2	2.0	.06	-
Local alluvial	Lc, Ld	54.7	1.6	Yes
Mecklenburg	MaA, MbB2, MbC2, MbD2	36.1	1.1	-
Mixed alluvial land	Mc	11.9	0.4	Yes
Moderately gullied land	Me, Mf, Mg	7.0	0.2	-
Nanford-Badin complex	NaB, NaC	22.3	0.7	-
Pittsboro	OaB, OaB2, ObB, ObB2, ObC2	282.8	8.4	-
Severely gullied land	Sa	3.9	0.1	-
Starr	Sb	5.9	0.2	-
Tarrus	TaB, TaB2, TaC2, TaC3	67.6	2.0	-
Vance	VbC3, VcB2, VcC2	35.2	1.0	-
water	W	40.1	1.2	-
Worsham	Wd, We	324.4	9.6	Yes
TOTALS:		**3385.8**	**100**	

* Map Unit Names are from both Alamance and Chatham County and grouped by map unit's major soil series.
* Hydric soil rating was generated with NRCS Soil Data Mart (http://soildatamart.nrcs.usda.gov) hydric soil report function. The hydric soil report is a table listing the soil map unit components rated as hydric soils in the survey area. Some soil map unit components make up a small percentage of the total soil map unit; therefore site investigations should be conducted to determine the exact location of hydric soils within the project site.

By far the most prevalent soil series in the watershed is the Durham series (28.2%, Typic Hapludults) followed by Georgeville (14.3%, Typic Kanhapludults) and Appling (10.5%, Typic Kanhapludults) soils. Each of these prevalent soil series are very deep, well drained upland soils.

2.4 Historical Land Use and Development Trends

The main land use patterns for the Greenbrier Creek watershed of the project are approximately 53% (1,777 ac) Pasture and Hay, and 31% (1,043 ac) Deciduous Forest (see Table 3 in Section 9.0). A major component of Alamance County's economic history and present economy is similar with less than 1% attributed to agriculture, and a majority of their economy is based in manufacturing (~28%), education, social and health services (~19%), and retail (~11%). Even though a majority of the county's economy is manufacturing, the project site is located entirely in agriculture land. Therefore, a majority of the stream degradation has occurred due to agricultural influence rather than urbanization.

A major component of Chatham County's economic history and present economy is agriculture, agribusiness and manufacturing. The high percentage of pasture in the watershed reflects this economic trend. A major cause of accelerated stream bank erosion can be related to land use change (Henderson, 1986). For decades livestock, poultry and dairy production has known to compact soils, increase stormwater runoff and increase sediment loading in stormwater. For example, overgrazing and soil compaction in the uplands often lead to rill erosion and elevated peak flows instream. Soil can become compacted by the repeated pressure of moving animals, especially if the soil is wet. The combination of soil exposure and compaction can decrease infiltration and increase surface runoff. If infiltration capacity is severely limited on a large fraction of a catchment, the extra runoff can quickly enter streams and generate higher peak flows (Davis, 1977). The high percentage of land in the watershed converted to pasture indicates a high potential for non-point source runoff and pollution to be generated upstream of the site and transported downstream. Today, 27% of the total land in the county is in cultivated land. Based on Table 3 in Section 9.0, the watershed consists of 54% farmland (pasture/hay and cultivated land), 39% forest, herbaceous, shrub, or woody wetland and 7% development or water.

Projected population growth for the state of North Carolina from 2000 to 2006 was 10.1% while Alamance County's population was projected to grow by 6.87-9.7% indicating a lower rate of increase in population and development growth compared to the state as a whole (NCSD, 2007). Chatham County's projected growth rate is 16.97% indicating a substantial increase in population and development growth compared to the state as a whole (NCSD, 2007). From the same data source, the projected growth rate from 2010-2020 is approximately 13.6% in Alamance County and 20.4% in Chatham County (NCSD 2007).

2.5 Endangered / Threatened Species

A visual on-site assessment was conducted by traversing the entire project site. Biohabitats inspected the site for any indication of suitable habitat for any listed species. Based on the visual assessment, Biohabitats determined if the project may affect one or more federally listed species or designated critical habitats. Prior to the site visit, we

obtained an updated species list for Alamance County and Chatham County from the US Fish and Wildlife Service web site (www.fws.gov/southeast/es/county%20lists.htm). There are no rare, threatened or endangered species in Alamance County.

The USFWS lists the following protected species for Alamance County.

Table C. USFWS List of Protected Species in Alamance County, N.C.

Common Name	Scientific name	Federal Status	Record Status
Vertebrate:			
American eel	Anguilla rostrata	FSC	Current
Carolina darter	Etheostoma collis lepidinion	FSC	Probable/potential
Invertebrate:			
Carolina creekshell	Villosa vaughaniana	FSC	Current
Yellow lampmussel	Lampsilis cariosa	FSC	Historic
Vascular Plant:			
Buttercup phacelia	Phacelia covillei	FSC	Current
Sweet pinesap	Monotropsis odorata	FSC	Obscure

The USFWS lists the following protected species for Chatham County.

Table D. USFWS List of Protected Species in Chatham County, N.C.

Common Name	Scientific name	Federal Status	Record Status
Vertebrate:			
American eel	*Anguilla rostrata*	FSC	Current
Bachman's sparrow	*Aimophila aestivalis*	FSC	Current
Bald eagle	*Haliaeetus leucocephalus*	BGPA	Current
Cape Fear shiner	*Notropis mekistocholas*	E	Current
Carolina darter	*Etheostoma collis lepidinion*	FSC	Current
Carolina redhorse	*Moxostoma* sp. *2*	FSC	Current
Red-cockaded woodpecker	*Picoides borealis*	E	Historic
Invertebrate:			
Atlantic pigtoe	*Fusconaia masoni*	FSC	Current
Brook floater	*Alasmidonta varicosa*	FSC	Current
Carolina creekshell	*Villosa vaughaniana*	FSC	Current
Septima's clubtail	*Gomphus septima*	FSC	Current
Yellow lampmussel	*Lampsilis cariosa*	FSC	Current
Vascular Plant:			
Buttercup phacelia	*Phacelia covillei*	FSC	Current
Harperella	*Ptilimnium nodosum*	E	Current
Sweet pinesap	*Monotropsis odorata*	FSC	Current
Virginia quillwort	*Isoetes virginica*	FSC	Historic

Note: T(S/A) = threatened due to similarity or appearance. A species that is threatened due to similarity of appearance with other rare species and is listed for its protection. These species are not biologically

endangered or threatened and are not subject to Section 7 consultation. Federal Species of Concern (FSC) are defined as species under consideration for listing, for which there is insufficient information to support listing at this time (USFWS, May 2007).

There are several federally endangered species listed for Chatham County including: Cape Fear shiner (*Notropis mekistocholas*), Red-cockaded woodpecker (*Picoides borealis*) and Harperella (*Ptilimnium nodosum*).

Cape Fear shiner (*Notropis mekistocholas*). The Cape Fear shiner is a small, yellowish minnow with a black band along the sides of its body, a black upper lip, and a lower lip that bears a thin black bar along its margin. It has yellow, fairly pointed fins. Its habitat requirements are small rivers to medium-sized creeks near the Fall Line; areas of moderate gradient and riffles alternating with long deep pools, and substrate a mixture of sand-gravel, rubble, and boulders. Occurs in slow pools, riffles, slow runs. Juveniles occupy slackwater, areas near rock outcrops, and flooded areas. The riffle/pool structure on the tributaries and the mainstem of Greenbrier Creek where restoration and enhancement activities are proposed degraded by many years of impact from livestock production. Additionally, channel incision both upstream and onsite has created eroding banks, which have produced large amounts of sediment which dominates the channel substrate. Suitable habitat for the Cape Fear shiner onsite is extremely limited, to the extent that it makes up such a small percentage of the channel length (estimated length of less than 100 feet) that, for practical purposes, it does not exist. **The biological conclusion for Cape Fear shiner is NO EFFECT.**

Red-cockaded woodpecker (*Picoides borealis*). The red-cockaded woodpecker is 18 to 20 centimeters long with a wing span of 35 to 38 centimeters. There woodpecker has black and white horizontal stripes on its back, white cheeks and underparts, black streaked flanks, a black cap and throat, and a black stripe on the side of the neck. The male red-cocked woodpecker has a small red spot on each side of the black cap. It requires older growth pine trees, preferably long leaf pine, for nesting cavities. There are a very limited number of loblolly pines (*Pinus taeda*) on the site where restoration and enhancement activities are proposed. However, the limited number of individuals coupled with the narrow width of the forest stand beside the creek through the existing pasture makes the project site unsuitable habitat for this species. **The biological conclusion for red-cockaded woodpecker is NO EFFECT.**

Harperella (*Ptilimnium nodosum*). The harperella is an annual herb that grows to a height of 6 to 36 inches. The leaves are hollow, quill-like structures. Its small, white flowers occur in the heads, or umbels. The harperella's seed are elliptical and laterally compressed approximately 1.5 to 2.0 mm in length. Harperella typically occurs in two habitat types: (1) rocky or gravel shoals and margins of clear, swift-flowing stream sections; and (2) edges of intermittent pineland ponds in the coastal plain. Neither of these habitats occur onsite. **The biological conclusion for harperella is NO EFFECT.**

The N.C. Natural Heritage Program's database listed the species in the table below for the Crutchfield Crossroads 7.5 minute U.S. Geological Survey Topo Quad.

Table E. N.C. Natural Heritage Program List of Rare, Threatened and Endangered Species				
Major Group	**Scientific Name**	**Common Name**	**State Status**	**Federal Status**
Invertebrate Animal	*Strophitus undulatus*	Squawfoot	T	None
Invertebrate Animal	*Villosa constricta*	Notched Rainbow	SC	None
Invertebrate Animal	*Villosa delumbis*	Eastern Creekshell	SR-D	None
Vertebrate Animal	*Hemidactylium scutatum*	Four-toed Salamander	SC	None
Vertebrate Animal	*Lanius ludovicianus*	Loggerhead Shrike	SC	None

Animal statuses for the NHP list are determined by the Wildlife Resources Commission and the Natural Heritage Program. Endangered, Threatened, and Special Concern species of mammals, birds, reptiles, amphibians, freshwater fishes, and freshwater and terrestrial mollusks have legal protection status in North Carolina (Wildlife Resources Commission). The Significantly Rare designation indicates rarity and the need for population monitoring and conservation action.

The Greenbrier Creek Stream Restoration project will not cause any issues with respect to endangered species and essential fish habitats associated with the stream restoration project.

2.6 Cultural Resources

A visual on-site assessment was conducted by traversing the entire project site thoroughly, on both side of the stream. An abandoned, deteriorated mill dam was observed on the Cheek property, but will not be disturbed by the project. The Environmental Data Resources, Inc. review for the project site revealed no record of mapped historical sites within the project site.

In addition, a request for formal review and evaluation was submitted to the N.C. Department of Cultural Resources, State Historic Preservation Office (SHPO). SHPO conducted a review of the site and is not aware of any historical resources that would be affected by the restoration project. In a letter dated February 15, 2007, SHPO stated that it has no comment on the Greenbrier Creek stream restoration and preservation project, as proposed.

A formal letter was sent to the Tribal Historic Preservation Office of the Eastern Band of Cherokee Indians on January 17, 2007. It was concluded that the project was located in a county east of their area of interest.

2.7 Potential Constraints

2.7.1 Property Ownership, Boundaries and Commitments to Owners

a. The project site and easements are located on three properties, the Jerrold Murchison property (PIN # 8756532958) and Charles Cheek property (PIN# 8756244509) to the north, in Alamance County, and the Larry Matthews property (PIN # 8756613184) to the south, in Alamance and Chatham Counties. The Murchison and Cheek easements are intended for stream and wetland preservation. A power line easement separates the Murchison/Cheek easements from the Matthews easements. The northernmost section of the Matthews easement is also a preservation area. The project stream enhancement reaches included within the Matthews easement are portions of Greenbrier Creek, a tributary flowing into Greenbrier Creek upstream of the bridge and two tributaries that originate from Matthews property and join Greenbrier Creek downstream of the bridge (Please refer to Figure 2). The boundaries of all the easements are marked with metal fence posts painted orange on the top.
b. A stream crossing to be installed by the proposed project, will separate the upper and lower reaches of the UT on the Matthews property. Fencing will be provided through cost share contract with Alamance/Chatham County Soil and Water.

2.7.2 Site Access

The easement is accessed from Staley-Snow Camp Road, through gates in the fence. There is free access to the entire stream enhancement area.

The site properties are owned by J. Murchison, C. Cheek, and L. Matthews, as described in Section 1.0. Site access will be allowed by the landowners.

2.7.3 Utilities

There are no known utilities that exist on the project site that will interfere with the execution of work on the proposed project. The EDR report shows a 500 kV power transmission line crossing over Greenbrier Creek near the bridge crossing, but that line actually crosses the creek north of that location, between the Murchison and Matthews easements, off of the project property.

2.7.4 FEMA / Hydrologic Trespass

The project site is upstream of the Rocky River Reservoir watershed, a WS-III public water supply watershed. The site is not located within an EEP Local Watershed Planning Area or Targeted Local Watershed.

Greenbrier Creek and the tributaries to it that are proposed for channel alterations are mapped by the N.C. Floodmaps Program as being in a designated AE floodplain. Based upon conversations with Mr. Ed Curtis of Division of

Emergency Management – Floodplain Management Branch, the area must be treated as a detail study area.

A "No Impact Study" is required by the Local Floodplain Administrator to assess the extent of horizontal and vertical displacement of the stream. Based on the No Impact Study, the base Flood Elevation will be lowered slightly by the proposed grading requiring a LOMR to be submitted within 6 months after project completion.

No wetlands are being restored with this project. Wetlands are being preserved. Stream restoration will be Enhancement Level I, which will not reintroduce the stream to more floodplain than it already can access during periods of high flows. Therefore, there is no possibility of hydrological trespass from the project property to adjacent properties.

2.7.5 Landowner commitments

EEP has agreed to install a culvert crossing across the main tributary upstream of the bridge. The crossing is not included in the project easements. Fencing will be provided by the landowner through cost share contract with Alamance/Chatham County Soil and Water Conservation Service.

2.7.6 Invasive Species Mangement

Invasive species are present on the easements, most notably privet (*Ligustrum* spp.). Based on field assessments, it is estimated that there is 5-7% canopy coverage of privet throughout the preservation easements, except in the southernmost regions of the Murchison and Matthews easements, where the percent coverage estimate is 50-60%. The areas of the higher percent coverage are ~4 acres on the Murchison easement, and ~3 acres on the Matthews easement. Privet will be controlled on the preservation easements by felling the existing stems and immediately applying small amounts of glyphosate or triclopyr directly to the exposed stumps. The initial treatment will be in late fall or winter. Regeneration that appears in the following years will be controlled by foliar

Privet in the Matthews easement will be mechanically controlled in the areas to be graded. Methods described above will be used to control privet in the remaining areas of the easement.

Fescue in the riparian buffer area of the tributary will be treated with glyphosate to control it before site preparation and tree planting.

2.7.7 Bedrock in Channel

Bedrock is present at several locations on the site. Initially, during the site assessment phase of the project, a seismic investigation was proposed to

determine depth to bedrock. However, with Enhancement Level 1, changes to the channel being proposed where the channel invert is only raised in some locations and the channel banks are graded to decrease the width/depth ratio, bedrock in the channel itself does not present an obstacle to construction. Therefore the seismic investigation was not conducted.

2.7.8 Beaver Dams on Greenbrier Creek

Beaver have constructed dams on Greenbrier Creek upstream and downstream of the project site. The upstream dam does not pose any threat to the success of the enhancement project, and has been inactive for approximately 9 months. The downstream dam is creating backwater in the mainstem channel on the project site. In January 2008, when channel assessment work was performed, the backwater depth was approximately two feet deep. This is at least two feet below bankfull elevation. There were no signs of sediment deposition in the channel caused by the backwater. As of July 2008, the maximum backwater depth was approximately 1.5 feet, and extended upstream on the Matthews property to the second fence line, approximately 600 feet.

If a dam was constructed within the project area EEP would remove the dam. If the height of the downstream dam was increased to the point that the backwater within the project reach was at or above bankfull elevation, EEP would get permission from that property owner to remove the dam or modify it to lower the backwater elevation.

3.0 Project Site Streams (Existing Conditions)

3.1 Channel Classification

As part of the field reconnaissance, the Rosgen classification system (Rosgen, 1994) was used to determine channel type at each field cross section on the basis of existing morphological features of the stream channel. Two representative riffle cross sections were surveyed on Greenbrier Creek. The measured channel dimensions for the representative cross sections generate an E5 classification; except for sinuosity which is 1.1. These channel parameters are characteristic of man-altered channels: low width/depth and low sinuosity. One riffle cross section was measured on the unnamed tributary upstream of the culvert. Based on the measurements taken in the field, the unnamed tributary classifies as a G4c. It has a very low width/depth ratio, a very low entrenchment ratio, and very low sinuosity. One riffle cross section was measured downstream of the culvert.

3.2 Discharge (bankfull, trends)

In adjustable, alluvial, transport-limited rivers in temperate climates, flows of moderate frequency (e.g., the 1.5- to 2-year storm event) and magnitude perform most of the geomorphic work (Wolman and Miller, 1960). This concept of the "dominant discharge" provides a statistical index for the flow that corresponds with the peak volume of sediment transported. Dominant discharge is the maximum possible product of the frequency of a flow occurrence and the amount of sediment transported by that flow event. Channel morphology is ultimately a result of all flows above a sediment transport threshold that do some geomorphic work. However, the dominant discharge is commonly used as a single-value estimate for a flow that may be largely responsible for resulting geomorphic form.

It is thought that, in many cases, the morphological feature of a bankfull elevation corresponds fairly well to the flow stage of the dominant discharge. This has led to the concept of bankfull elevation as a tool in stream restoration design. However, the concept should be applied cautiously in stream restoration design. It should be noted that as channel boundaries are more resistant or less adjustable (i.e., bedrock, hillslope constraints, or large bed material) or in more arid environments, the majority of geomorphic work is more likely to be performed by larger and rarer flood events. For the purposes of this restoration plan, here the bankfull discharge is considered to be essentially equivalent to the dominant discharge, and serves a guiding value in many aspects of the restoration design.

Bankfull elevations are typically derived from all available indications including depositional features, changes in bank angle, vegetation, scour lines, and storm debris lines. Due to the man-altered nature of Greenbrier Creek in the project area and the severe bank erosion on both the mainstem and the unnamed tributary, no bankfull indicators were found within the project area. In lieu of bankfull indicators, we looked at discharges developed by the North Carolina regional curve for rural streams in the

Piedmont physiographic province (Harman *et al.,* 1999) and TR-20 hydrologic model. The regional curve discharges were not used as bankfull discharges. They were used to verify that our TR-20 discharges and Manning's equation discharges were reasonable.

As a comparison, we computed full channel flow at our measured cross sections. Full channel discharge was estimated by solving the Manning equation for discharge given the top of bank elevation, local channel geometry, slope, and roughness. Channel roughness, represented by Manning's "n", was approximated using the standard references Chow (1959) and Barnes (1967) based on field observations of bed material, channel geometry, and adjacent riparian vegetation.

The table below shows that the discharge in Greenbrier Creek when flow is at top of bank is very similar to the TR-20, 1-year peak discharge. (Cross section 2 appeared to be somewhat larger than the typical channel section in the project area.) Because of this we decided to use the TR-20, 1-year peak discharge as our design discharge. The full channel discharge for the tributary is much higher than the regional curve and TR-20 discharges. This indicates the entrenched nature of the tributary. We decided to use the TR-20, 2-year peak discharge as our design discharge because the TR-20, 1-year peak discharge seemed too small and the discharge computed using the regional curve could be inaccurate due to the small watershed size of the tributary.

Table F. Discharge Computation Comparison Table

	Manning's Equation (full channel)	**Piedmont Regional Curve**	**Peak Flow, TR-20**	**Design Discharge**
Greenbrier Creek				
Discharge (cfs)	X/S 1: 155	283.7	1-yr: 195	195
	X/S 2: 287		2-yr: 432	
Unnamed Tributary				
Discharge (cfs)	76	35.6	1-yr: 2.7	15
			2-yr: 15	

3.3 Channel Morphology (pattern, dimension, profile)

The diagnostic classification, measured at riffle cross sections for Greenbrier Creek is E5. An E channel is usually considered to be a desirable, stable channel type. However, in this case the E classification is a consequence of channelization. The channel is very straight, even though it flows through a broad flat floodplain, and remnant spoil piles can be seen along most of the creek. The majority of the mainstem channel has experienced over-widening and incision, probably due to cattle accessing the channel and the extremely low sinuosity. The very low gradient of the creek has probably kept the channel from becoming an over-wide F channel, although it appears that the creek is trending toward that channel type with continued bank erosion. There are few well developed riffles due to the low gradient and lack of source gravel in the channel banks.

The existing E5 channel has a sinuosity close to 1.0, a riffle cross sectional area of approximately 53 ft2, and an average slope of 0.0015 ft/ft.

The unnamed tributary classifies as a G4c channel. The lower case c signifies a low gradient G channel. This channel also looks like it was channelized, especially in the lower reach where it flows across the grassy floodplain of Greenbrier Creek. (The culvert crossing on the tributary is the approximate dividing line between the upper reach and the lower reach.) The lower reach is probably an "E" channel because it appears to have a low width/depth ratio and it looks like bankfull is at top of bank. Although this lower, grassy reach is different from the upper wooded reach, no riffles were found in the lower reach and therefore no cross sections were measured. The upper reach has a low entrenchment ratio. The floodprone elevation is in the channel. However the TR-20, 10-year peak discharge of 104 cfs would get out of bank.

The existing G4c channel has a sinuosity close to 1.0, a riffle cross sectional area of approximately 5.8 ft2, and an average slope of 0.0038 ft/ft.

3.4 Channel Stability Assessment

The entire Greenbrier Creek reach and the unnamed tributary that are proposed for Enhancement I were assessed in the field by Biohabitats using the Bank Erosion Hazard Index (BEHI) (Rosgen 2001). The entire project reach of the Greenbrier Creek channel (2,624') has a BEHI rating of Moderate, and a Near Bank Stress (NBS) rating of Low. The rate of sediment export per year is somewhat higher where the study banks are higher and have higher angles (~40% of the reach) and somewhat lower where the banks are lower and have lower angles. The bank height ratio (BHR) varies from a low of approximately 1.0 to a high of approximately 1.25. It should be noted that estimates of BHR are only that, because the channel is degraded to the extent that bankfull indicators such as depositional benches are uncommon and therefore were deemed to have limited reliability. The total sediment export on the Greenbrier mainstem is estimated to be 40.5 tons per year.

The unnamed tributary (1,928') also has two different BEHI ratings. The lower rated length (1,157') has a BEHI rating of Moderate and an NBS rating of Low. This reach length has lower study banks and a somewhat lower NBS rating. The export rate for this section of stream is approximately 10 tons per year. The higher rated section of the unnamed tributary (771') has a BEHI rating of High and a NBS rating of Low. The export rate for this section is approximately 23.4 tons per year. The BHR on the unnamed tributary ranges from approximately 1 to approximately 3. The total sediment export rate on the unnamed tributary is estimated to be 33.4 tons per year.

Chanelization of Greenbrier Creek caused degradation to the system which resulted from the loss of pronounced riffle pool sequences, the associated loss of aquatic habitat, and accelerated bank erosion. The pervasive extent of high BEHI scores and BHR's indicates that both the Greenbrier mainstem and the unnamed tributary are incised or entrenched, unstable and creating high sediment loads in a watershed supply watershed. The

channelization of Greenbrier Creek, which straightened the channel and lowered its invert, had a very negative impact on aquatic habitat. Channelization destroyed the natural riffle-pool sequence and initiated a process of bank erosion that caused accelerated sedimentation of the channel.

3.5 Bankfull Verification

As previously discussed, it appears that Greenbrier Creek was channelized in the project area. The channel is very straight, even though it flows through a broad flat floodplain and remnant spoil piles can be seen along most of the creek. As with most man-altered channels, this channel was not constructed to carry the natural bankfull discharge. The channel is adjusting its cross sectional area by eroding its banks and widening. The creek cannot make the channel much deeper because the gradient is already very low (0.09%). Therefore the top of bank is bankfull. The table below shows that the discharge in Greenbrier Creek when flow is at top of bank is very similar to the TR-20, 1-year peak discharge and the Piedmont Regional Curve bankfull discharge.

The unnamed tributary also appears to be man-altered because it is very straight. It had a much higher gradient compared to the mainstem and was able to incise its channel. The full channel discharge for the tributary is much higher than the regional curve and TR-20 discharges. This indicates the entrenched nature of the tributary. Because it is so entrenched there were no bankfull indicators found. It was determined that the TR-20, 2-year peak discharge would be a closer approximation to a natural bankfull discharge than the Piedmont Regional Curve discharge because the TR-20 model is tailored to the watershed conditions.

Table G. Discharge Comparisons

	Manning's Equation (full channel)	**Piedmont Regional Curve**	**Peak Flow, TR-20**
Greenbrier Creek			
Discharge (cfs)	X/S 1: 155	283.7	1-yr: 195
	X/S 2: 287		2-yr: 432
Unnamed Tributary			
Discharge (cfs)	76	35.6	1-yr: 2.7
			2-yr: 15

3.6 Vegetation

The riparian area along Greenbrier Creek has been disturbed throughout a significant portion of its length by long-term agricultural practice. However, there are also substantial portions of the riparian area, particularly upstream on the main tributary and on Greenbrier Creek on the downstream end of the project that have relatively intact riparian forest. In those areas the dominant canopy species are red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*) and yellow poplar (*Liriodendron tulipifera*). Other

species present include willow oak (*Quercus phellos*), white oak (*Quercus alba*), American elm (*Ulmus americana*) and sugarberry (*Celtis laevigata*). Common species in the understory/shrub layer include ironwood (*Carpinus caroliniana*), dogwood (*Cornus florida*) and smaller overstory species specimens.

3.7 Riparian Buffer Condition

The trees greater than 5" diameter at breast height (dbh) were counted within the easement on the Matthews property, where Enhancement I is proposed on Greenbrier Creek and its tributaries. A total of 1,602 trees with a dbh greater than 5" were counted within the easement, which is 17.05 acres. Therefore there are 94 trees per acre greater than 5" dbh within the easement.

4.0 Reference Streams

Landrum Creek was used as the reference stream (see Figure 6 and Figure 7). It is located in Chatham County, 7 miles east of Siler City, and 1.2 miles south of Interstate 64. The reference stream can be accessed from Pleasant Hill Church Road. This reference reach was surveyed and analyzed by Stantec, Inc. and used successfully on the Unnamed Tributary to Mary's Creek stream restoration project.

4.1 Watershed Characterization

The Landrum Creek watershed was delineated (see Figure 8) and the land cover and land uses (see Figure 10) within it are summarized below. The watershed is approximately 74% forested, and less than 5% developed.

Table H. Land Cover Land Use in Landrum Creek Watershed (Reference)

Land Cover Land Use	**Acreage**	**Percentage (%)**
Developed Open Space	48.5	3.2
Developed Low Intensity	19.1	1.2
Developed Medium Intensity	1.1	0.1
Barren Land	6.2	0.4
Deciduous Forest	739.8	48.1
Evergreen Forest	238.1	15.5
Mixed Forest	157.6	10.3
Shrub/Scrub	8.9	0.6
Grassland/Herbaceous	28.0	1.8
Pasture/Hay	257.6	16.8
Cultivated Crops	4.2	0.3
Woody Wetland	1.1	0.1
Totals	**1,536.8**	**100.0**

4.2 Channel Classification

Based on the data collected in the field, the channel has a Rosgen Stream Type Classification of C4.

4.3 Discharge (bankfull, trends)

The reference bankfull discharge, estimated from a combination of techniques including the Manning's equation, the N.C. Piedmont Regional Curve and Rosgen methodology is approximately 174 cfs. There were consistent bankfull indicators present in the channel, and the bankfull elevation estimate for the reach combined these.

The very high percentage of forest land and pasture/hay cover in the watershed (~90%) has served to stabilize and maintain bankfull discharge quantities, which has helped create relatively stable channel geometry features that were used in the discharge estimation process.

4.4 Channel Morphology (pattern, dimension, profile)

The reference channel; has a sinuosity of 1.1, a riffle bankfull cross-sectional area of 33.5 square feet and an average slope of 0.0077 (see Table 4 in Section 9.0).

4.5 Channel Stability Assessment

The BEHI rating for the reach (369') is low and the NBS rating for the reach is low. The sediment export rate is estimated to be 1.5 tons per year.

4.6 Bankful Verification

As stated in Section 4.3, there were consistent bankfull indicators present in the channel, and the bankfull elevation estimate for the reach combined these. The discharge estimate was reached and confirmed by combining existing channel geometry data, regional curve data and empirical engineering hydraulic equations.

4.7 Vegetation

The reference reach on Landrum Creek supports a typical Piedmont mixed hardwood forest comprises most of the riparian zone along this reference reach. A fenced pasture is located *20* to 60 feet off the stream channel on the north side. The forest on the south side has been partially cleared and has a dense herbaceous coverage. Vegetation along the banks and bankfull benches of the stream are dominated by clearweed *(Pilea pumila),* false nettle *(Boehmeria cylindrica),* jewelweed *(Impatiens capensis),*and Polygonum species *(P. sagittatum,* tearthumb, and *P. persicaria).* Cardinal flower *(Lobelia cardinalis)* and Asiatic dayflower *(Commelina communis)* were also observed. The forest vegetation between the stream channel and the pasture on the north side consisted of the following canopy trees: swamp chestnut oak *(Quercus michauxi~),* chestnut oak *(Quercus prinus),* willow oak *(Quercus phellous),* white oak *(Quercus alba),* northern red oak *(Quercus rubra),* American elm *(Ulmus americana),* American sycamore *(Platanus occidentalis),* yellow poplar *(Liriodendron tulipifera),* green ash, sweetgum, box elder *(Acer negundo),* pignut hickory *(Carya glabra),* and hackberry *(Celtis occidentalis).* The understory contained many of the canopy species along with ironwood *(Carpinus caroliniana),* dogwood *(Cornus florida),* and redbud *(Cercis canadensis).* The shrub layer consists of scattered spicebush *(Lindera benzoin),* buckeye *(Aesculus pavia),* and small thickets of multilora rose. The vines and sparse herbaceous cover contained Christmas fern, *(Polystichum acrostichoides),* microstegium spp., poison ivy *(Rhus radicans),* greenbriar *(Smilax* spp.), and muscadine grape (*Vitis rotundifolia).* The cleared forest area south of the stream channel is dominated by herbaceous species such polygonum sp., microstegium sp., wingstem *(Actinomeris alternifolia),* large-flowered leaf cup *(Polymnia uvedalia),* and various grasses such as bottle-brush grass *(Hystrix patula).* The riparian forest on the north side of Landrum Creek is more of typical Piedmont floodplain forest with somewhat "wetter" species.

5.0 Project Site Wetlands (Existing Conditions)

5.1 Jurisdictional Wetlands on Murchison Property

Wetlands on the site were evaluated by Kevin Nunnery of Biohabitats, Inc. based on the U.S. Army Corps of Engineers 1987 Wetland Delineation Manual. The presence or absence of three wetland parameters was documented (hydric soils, hydrophytic vegetation and wetland hydrology), following the guidance set forth in the Manual.

Six jurisdictional wetlands were delineated along the stream floodplain within the Murchison property (See Figure 5 for map and Appendix 12.0 for forms).

The areas of the individual wetlands are as follows:

Table I. Delineated Wetlands on Murchison Property of the Greenbrier Creek Restoration Project

Property	Wetland ID	Area (acres)
Murchison	Mu-1	0.02
Murchison	Mu-2	6.05
Murchison	Mu-3	0.10
Murchison	Mu-4	0.08
Murchison	Mu-5	0.44
Murchison	Mu-6	0.24
Total Wetland Area on Murchison Property		**6.93**

These wetland areas will not be disturbed; they will be preserved with the proposed project.

5.2 Soil Characterization for Murchison Property

The USDA NRCS Soil Survey shows the area where the wetlands occur in Chewacla fine silty loam, 0 to 2 percent slopes, occasionally flooded soil map unit. The wetland soil present on the project site are Chewacla series soil (Fluvaquentic Dystrudepts). This conclusion is based on soil color, texture, and soil map unit. The typical horizon description for Chewacla series is 0-4 inches 7.5YR 4/4 loam, 4-26 inches 10YR 4/4 clay loam with iron depletions and masses of oxidized iron starting, 26-60 inches 7.5YR 5/8 clay loam, 60-80 inches 7.5YR 4/4 and 7.5YR 5/1 loam. From the wetland delineation soil descriptions, the hydric soils found onsite are typically 10YR 4/1 or 4/2 sandy clay loams with occasional appearance of 7.5YR 4/8 masses of oxidized iron in the upper 18 inches of the profile, similar to the Chewacla series.

5.3 Plant Community Characterization for Murchison Property

The wetland areas onsite are individually quite small with the exception of Wetland Mu-2, approximately 6.3 acres. The dominant woody vegetation occupying the wetlands is red maple (*Acer rubrum*) and sweet gum (*Liquidambar styraciflua*). The herbaceous layer where present is dominated by common rush (*Juncus effusus*) and spotted touch-

me-not (*Impatiens capensis*), along with various sedge species. These wetlands most closely resemble the Low Elevation Seep community (Schafale and Weakley, 1990).

5.5 Jurisdictional Wetlands on Matthews Property

Wetlands on the site were evaluated by Kevin Nunnery of Biohabitats, Inc. based on the U.S. Army Corps of Engineers 1987 Wetland Delineation Manual. The presence or absence of three wetland parameters was documented (hydric soils, hydrophytic vegetation and wetland hydrology), following the guidance set forth in the Manual.

Six jurisdictional wetlands were delineated on along the stream within the Matthews property (See Figure 5 for map and Appendix 12.0 for forms).

The areas of the individual wetlands are as follows:

Table J. Delineated Wetlands on Matthews Property of the Greenbrier Creek Restoration Project

Property	Wetland ID	Area (acres)
Matthews	M-1	0.27
Matthews	M-2	0.04
Matthews	M-3	0.15
Total Wetland Area on Matthews Property		**0.46**

These wetland areas will not be disturbed; they will be preserved with the proposed project.

5.6 Soil Characterization for Matthews Property

The USDA NRCS Soil Survey shows the area where the wetlands occur in Chewacla and Wehadkee soils, 0 to 2 percent slopes, frequently flooded soil map unit. The wetland soil present on the project site are Chewacla series soil (Fluvaquentic Dystrudepts). This conclusion is based on soil color, texture, and soil map unit. The typical horizon description for Chewacla series is 0-4 inches 7.5YR 4/4 loam, 4-26 inches 10YR 4/4 clay loam with iron depletions and masses of oxidized iron starting, 26-60 inches 7.5YR 5/8 clay loam, 60-80 inches 7.5YR 4/4 and 7.5YR 5/1 loam. From the wetland delineation soil descriptions, the hydric soils found onsite are typically 7.5YR 4/5, 10YR 4/2 or 2.5YR 5/2 sandy clay loams to clay loams with occasional appearance of 10YR 5/8 masses of oxidized iron in the upper 18 inches of the profile, similar to the Chewacla series.

5.7 Plant Community Characterization for Matthews Property

The wetland areas onsite are individually quite small, and the dominant woody vegetation occupying the wetlands is red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), and tulip poplar (*Liriodendron* tulipifera). The herbaceous layer was sparse along the

wetlands. These wetlands most closely resemble the Low Elevation Seep community (Schafale and Weakley, 1990).

6.0 Project Site Restoration Plan

6.1 Restoration Project Goals and Objectives

The goals of the project are:

- To improve water quality by reducing nutrient loading from a livestock operation in a water supply watershed
- To reduce the high level of sediment loading to the stream from steep, eroding banks
- To improve both aquatic and terrestrial riparian buffer habitat.

These goals will be accomplished through the implementation of the following objectives:

- preservation and protection of important wetlands and stream channel reaches upstream of the Matthews property
- improvement of water quality (reduction of nutrient and sediment inputs) by creating a vegetated riparian buffer filter strip between the stream and the livestock production operation currently on the site
- reduction of high sediment loads in the stream through stabilization of eroding channel banks
- improvement of deteriorated aquatic habitat by reduction of nutrient and sediment loads in the streams, providing a more variable stream channel geometry and creating more opportunities for carbon inputs from the trees in the restored buffer zone
- improvement of terrestrial habitat through restoration of diverse native woody vegetation in the riparian buffer zone and control of invasive privet (*Ligustrum* spp.)

The goals will be accomplished by designing and constructing a stable profile and dimension for the stream channels and re-establishing continuous riparian buffers along the banks. Project implementation will greatly reduce bank erosion and consequently decrease the amount of sediment load in the stream at flows above baseflow. Enhancement Level I (Rosgen Priority Level IV) design is proposed on all the reaches of the project, due to existing unstable channel geometry, sinuosity and streambank steepness. Restoration was deemed to be too disruptive of the existing mature vegetation, so the planview of the channel will not be changed. In-channel structures will be used to raise and stabilize the channel invert grade. Riparian buffer vegetation will be established to provide food and cover for terrestrial fauna and to provide a carbon source and shade for aquatic habitat.

To meet the goals listed above, the proposed project at Greenbrier Creek will preserve 6,330’ of Greenbrier Creek and its unnamed tributaries on the Murchison and Matthews property , along with 7.39 acres of wetlands. Enhancement I will be implemented on 4,937 feet of the mainstem and its tributaries on the Matthews property. In addition, 17.05 acres of riparian buffer will be restored.

Privet will be controlled in all the riparian buffer areas. The riparian buffer restoration areas will be improved by planting native grasses and woody species that will help reduce stream bank erosion and improve natural wildlife habitat.

6.1.1 Designed Channel Classification and / or Wetland Type

Designed Channel Classification

The designed channel classification, based on the existing channel substrate (D50=4 mm) and the designed channel average slope (0.0009), entrenchment ratio (>2.2), width/depth ratio (20) and sinuosity (>1.2) is a Rosgen C5.

Designed Channel Structures

Greenbrier Creek has been channelized. As such it has a very uniform cross section and profile. Because it has such a low gradient and is so straight it has not been able to form pools that a meandering stream would form. There is not much difference between pools and riffles in Greenbrier Creek. Therefore we did not see the usefulness in collecting pool data. Also, because we are already proposing to widen the existing channel considerably, we did not want to make the pool areas even wider. The existing channels of Greenbrier Creek and the unnamed tributary have very minimal bed diversity (riffles are not well developed and pools are shallow) due to the low gradients and small bed material size. Also, these channels are nearly straight and thus have no well defined meanders. Because we are designing a level 1 stream enhancement we will not be altering the channel planform and thus will not change the channel gradient. Therefore in order to increase the bed diversity we propose to install riffle structures in both the mainstem and tributary. These structures will be installed approximately one foot above the existing channel invert in the mainstem at locations where riffles are trying to form. These structures will not only create well defined riffles but they will also create deeper pools upstream of the structures. Because the unnamed tributary is entrenched (entrenchment ratio 1.2) the riffle structures will be installed one foot below the top of bank in the tributary. This will increase the entrenchment ratio well above 2.2, create stable riffles, and form deep pools upstream of the structures.

The only other channel structure proposed for this enhancement is boulder grade control/drop structures. These structures will be installed on the small tributaries which enter Greenbrier Creek downstream of Staley-Snow Camp Road. These structures will raise the inverts of the small tributaries so they are no longer entrenched and will capture excess sediments. Two of these structures will also be utilized on the unnamed tributary. An existing pipe crossing in the unnamed tributary will be replaced with a stone ford. The existing pipe has a two feet drop on the end. Boulder grade control/drop structures will be used on each side of the proposed ford to take up the two feet of grade created by the pipe.

6.1.2 Target Buffer Community

The project is located on a small third order stream in the Piedmont physiographic province. These conditions most closely match the Piedmont Small Stream Forest community type as described in Schafale and Weakley (Fourth Approximation, unpublished). Please see Section 6.5.1 for a detailed description of this community type.

6.2 Sediment Transport Analysis

6.2.1 Methodology

For use as a guideline for sizing the substrate in the proposed restoration channel, a sediment competency analysis was undertaken, using shear stresses computed for the channel. The competency analysis provides an estimate of the local ability of the channel to move sediment for a given discharge and is embodied by estimating the local threshold grain size. For many engineering applications the threshold of sediment motion for unisize or unimodal sediment can be characterized with the Shields criteria:

$$\tau_c^* = \frac{\tau'}{(s-1)\rho g D} \approx 0.045$$

where τ_c^* is the dimensionless critical Shields parameter (in this case assumed to be approximately 0.045), τ' is the grain stress (that component of the total boundary shear stress that acts upon the sediment grains populating the channel bed surface), s is the specific gravity of sediment (2.65), ρ is the density of water (1000 kg/m^3), g is the gravitational acceleration constant (9.81 m/s^2), and D is the median grain size of an unimodal sediment or the grain size of an unisize sediment (in meters when adopting the above values for the other parameters). When rearranged to solve for the critical grain size, the above equation is transformed to:

$$D = \frac{\tau'}{(s-1)\rho g \tau_c^*} \approx 1.37\tau'$$

where D is now in units of millimeters and τ' is expressed in Pascals (N/m^2). To estimate the threshold grain size for any location within the project reach, the total boundary shear stress acting on the channel was computed and then decomposed into the grain stress. For steady, uniform flow the local total boundary stress is provided by the depth-slope product:

$$\tau_o = \rho g R_h S$$

where τ_o is the total channel boundary shear stress, ρ and g are as defined before, R_h is the hydraulic radius, and S is the channel slope. In addition, the Manning's Equation holds for steady uniform flow:

$$U = \frac{C}{n} R_h^{2/3} S^{1/2}$$

where *U* is the mean channel velocity, C is a dimensioning coefficient (1.0 for SI units, 1.49 for Imperial units), and *n*, R_h, *S* and are as defined before. By using the Strickler Equation, a Manning's *n*-value attributable to the sediment roughness can be estimated:

$$n_D = 0.013D^{1/6}$$

where n_D is the Manning's *n*-value and *D* is the sediment grain size in millimeters. When the above equations are combined, an equation for the stress decomposition can be developed:

$$\frac{\tau_o}{\tau'} = \left(\frac{n}{n_D} \right)^{3/2}$$

where all terms are as defined earlier. When this equation is folded into the Shields criteria, the following estimate for the threshold grain size is attained:

$$D = \left(\frac{0.00203\tau_o}{n^{3/2}} \right)^{4/3}$$

where all terms are as defined earlier. This equation provides an estimate of the local threshold grain size at each cross-section for a given discharge (or shear stress).

6.2.2 Calculations and Discussion

The competency analysis provides an estimate of the local ability of the channel to move sediment for a given discharge and is embodied by estimating the local threshold grain size (D84).

The local threshold grain size mobilized at bankfull discharge was computed for Greenbrier Creek and the unnamed tributary for existing and proposed conditions. The list below summarizes the results of the computations.

	Computed Channel Shear (lbs/ft^2)	**Threshold Diameter (mm)**
Greenbrier Creek		
Proposed (riffle)	0.11	7
Existing (riffle)		
Cross section 1	0.14	8.7
Cross section 2	0.30	16.1
Unnamed Tributary		
Proposed (riffle)	0.15	10
Existing (riffle)	0.18	10.8

The reader will note that the Greenbrier Creek and Unnamed Tributary proposed conditions are similar to the existing conditions but slightly lower. This is because the existing channel has a much lower width/depth ratio than the proposed channel. As discussed in Section 3, the existing channel classifies as an E channel because of its near-vertical, eroding banks. This lower width/depth creates higher shear stress due to a larger flow depth (and therefore a larger hydraulic radius in the shear stress equation). The existing channel at Cross section 1 is smaller than at Cross section 2 such that the channel at Cross section 1 cannot carry the bankfull discharge. (Top of bank discharge at Cross section 1 is 155 cfs.) This is why the shear stress at Cross section 1 is lower than at Cross section 2.

It is also interesting to note the existing channel grain sizes (as determined by pebble count) and how they compare with the computed threshold grain sizes.

	D50 (mm)	**D84 (mm)**
Greenbrier Creek		
Cross section 1	7.2	14
Cross section 2	0.6	6
Unnamed Tributary	9.9	61

The D84 of the unnamed tributary is high because there is bedrock in this area which is contributing large fragments to the channel. However our field observations indicate that this larger material is not being transported downstream by the tributary. When the D84 of the tributary is removed as an outlier, it can be concluded that the proposed channel will be sized appropriately to convey the existing channel material and will neither aggrade nor degrade.

The design criteria for this project is to restore the existing channel to a "C" channel using Enhancement Level I. The existing channel has a w/d ratio of approximately 8. The "C" channel reference reach has a w/d ratio of 23. The proposed design w/d ratio is 20. In order to increase the w/d ratio from 8 to 20, the channel invert could be raised to reduce the bankfull depth. However, raising the channel invert too much would increase the 100-year flood elevation. To avoid increasing the 100 year flood elevation while increasing the w/d ratio, the proposed channel was widened. The reference reach is a gravel system with a bankfull slope of 0.0077 ft/ft while Greenbrier Creek is a sand system with a bankfull slope of 0.002 1ft/ft. We were not able to find a C5 reference reach in the area. Therefore we did not want to match the velocity of the reference reach. Our sediment transport computations show that the proposed channel will move the existing sand bed material.

6.3 HEC-RAS Analysis

6.3.1 No-rise, LOMR, CLOMR

The proposed channel improvements are located in non-encroachment areas on Greenbriar Creek, a FEMA regulated stream that was studied using limited detailed methods (Eff. Date February 2, 2007), between FEMA Sections 208 (Station 20,788) and 175 (Station 17,500).

The effective model entitled "GreenbriarCreek" received from the NCFMP was used as the base model for the water surface profile modeling. Elevations in the HEC-RAS model are referenced to North American Vertical Datum of 1988 (NAVD 88). The Effective model was run on USACE HEC-RAS version 3.1.3 computer program to create the Duplicate Effective Model.

An Existing Conditions Model was prepared to revise the Duplicate Effective Model to reflect site specific existing conditions using surveyed topographic data collected in the project area by Cavanaugh & Associates, P.A. of Winston-Salem. This data is limited to the area in and around the channel. Several FEMA cross sections are located within the project area. Cross section data for FEMA Sections and one added section within the project area was revised to reflect surveyed existing conditions. The elevation data was adjusted + 66.33 ft as directed by Cavanaugh & Associates, P.A. due to a necessary benchmark correction. Culvert data at the Staley Snow Camp Road crossing was also updated using survey data.

The proposed improvements were incorporated into the Proposed Conditions Model by modifying the cross section and culvert data to reflect the proposed modifications to the stream per design information provided by Biohabitats, Inc. The modeled modifications were limited to re-grading of the channel banks and removal of sediment deposition from the southern most culvert.

The results from the Existing Conditions Model show minor increases in water surface elevations compared to the Duplicate Effective Model due to updating cross section and culvert data with survey data. The results from the Proposed Conditions Model show slightly lower predicted water surface elevations for the 100-yr floodplain and floodway compared to the Existing Conditions Model, **indicating that the proposed improvements as modeled will not result in increases to base flood elevations.**

6.4 Soil Restoration

Topsoil Salvage, Soil Testing and Nutrient Amendments

Where grading is performed for channel stabilization, the overlying 4-6 inches of topsoil will be stockpiled for redistribution over the site after grading is complete. Soil cores

taken onsite confirmed alluvial soils that are clay loam, sandy clay loam and loamy in texture, with a moderate to low bulk density. Since these soils have had a constant livestock presence for many years, they will not require any more fertilization or lime application than is usually applied for tree seedling and live stake establishment.

6.5 Natural Plant Community Restoration

6.5.1 Narrative and Plant Community Restoration

The project is located on a small third order stream in the Piedmont physiographic province. These conditions most closely match the Piedmont Small Stream Forest community type as described in Schafale and Weakley (Fourth Approximation, unpublished). This community type covers forests of floodplains of small to medium size Piedmont streams, where flooding and alluvial processes have some, but limited, influence on vegetation. Most of the canopy is of widespread species such as sweetgum (*Liquidambar styraciflua*) and yellow poplar (*Liriodendron tulipifera*), and upland species may be present as well as characteristic alluvial species such as sycamore (*Platanus occidentalis*) and river birch (*Betula nigra*). The community type description lists spicebush (*Lindera benzoin*) and buckeye (Aesculus sylvatica) as the primary understory species, which is a divergence from what is found onsite, which is a much more diverse assemblage. Common understory species onsite also include saplings of the canopy species along with smooth alder (*Ulmus serrulata*), ironwood (*Carpinus caroliniana*), black gum (*Nyssa sylvatica*), and sourwood (*Oxydendron arboretum*). Species consistent with both Schafale and Weakley and the site are proposed for establishment after construction. Please see Table 6 for details of the planting plan, and how diversity is incorporated into the design. Forty-eight balled in burlap trees will be planted in the easement along the main tributary, in the existing pasture area.

6.5.2 On-site Invasive Species Management

Privet spp. is by far the most prevalent invasive species onsite. Multiflora rose (*Rosa multiflora*) and honeysuckle (*Lonicera japonica*) are also present. The privet occurs mostly in the more open areas beside Greenbrier Creek upstream and downstream of the bridge. Privet will be controlled mechanically where grading is proposed. Outside of the areas to be graded, privet will be controlled by cutting the existing stems down and immediately applying small amounts of glyphosate or triclopyr directly to the freshly exposed stumps. The initial treatment will be in late fall or winter. Regeneration that appears in the following years will be controlled by foliar treatments.

Fescue within the conservation easement on the tributary will be treated with glyphosate before site preparation and planting.

6.6 Beaver Presence

Since the project negotiations began in 2004, there has been a beaver presence off and on in the Murchison property preservation reach and also downstream of the project property. When the property owner downstream of the current project boundary was considering participation in 2005, 4 beaver dams were observed in approximately 2000 feet of channel immediately downstream of the current boundary.

In January 2008 there was a beaver dam on Greenbrier Creek approximately 300-400 feet downstream of the project. At that time the dam was creating a backwater which extended about 1,000 feet into the project reach. The water surface of the backwater in the project reach was 2' - 3' below bankfull. Even with the backwater from the dam, no excessive sediment deposits in the project reach were observed. Because the beaver dams are downstream of the project boundary it is not possible to eradicate them. However, beaver dams are transient and therefore it is not possible to predict where, when or how large these dams will be constructed. Therefore the strategy is to design the enhancement as if the beaver dam was not there. Then when the dam is abandoned the channel will function as designed. The riffle structure proposed at Station 219+00 will provide grade control in the event the beaver dam is abruptly removed by a large storm event and a headcut forms in any accumulated sediments.

7.0 Performance Criteria

All performance criteria for this project are taken directly from the April 2003 Stream Mitigation Guidelines, as adopted by the USACE, EPA, NCWRC and NCDWQ, Monitoring Level 1.

7.1 Streams and Wetlands

The stream reaches on the Murchison, Cheek and the non-pasture areas of the Matthews easements will be preserved, undisturbed, in perpetuity. All the wetlands on the project easements will be preserved, undisturbed, in perpetuity.

Upon completion of the project, an as-built survey will be conducted, to document the dimension, pattern and profile of the restored channel. Permanent cross sections will be established with an approximate frequency of one per 20 bankfull-width lengths. The as-built survey will include photo documentation at all cross sections and structures, a plan view diagram, a longitudinal profile, vegetation information and a pebble count for at least 6 cross sections. The stream will be resurveyed each year and the survey data compared to the previous year. Success is defined as the documentation of no substantial aggradation or degradation of the channel or banks. Downcutting, deposition, bank erosion and an increase in sands or finer substrate material must be documented for assessment by the regulatory agencies. Comparison of the existing conditions BEHI values with the BEHI values computed after vegetation is established will indicate bank stabilization trajectories.

7.2 Vegetation

Plant survival will be documented with survival plots and photographs. A minimum of 320 stems per acre must be surviving after year 3, 288 stems per acre after year 4 and 260 stems per acre after five years of monitoring.

7.3 Schedule / Reporting

Monitoring will be performed each year for 5 years with no less than 2 bankfull events documented throughout the period. If less than 2 bankfull events occur, then monitoring will continue until the second bankfull event is documented. The bankfull events must occur during separate years. In the event that the bankfull events do not occur during the five year period, the USACE and NCDWQ, in consultation with the resource agencies, may determine that further monitoring is not necessary.

The CVS-EEP Protocol for Recording Vegetation (Lee et al. 2007) will be used to document and track vegetation survival and growth.

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9.0 Tables

Table 1. Project Restoration Structure and Objectives

Restoration Segment / Reach ID	Station Range (Existing)	Restoration Type	Priority Approach	Existing Linear Footage or Acreage	Designed Linear Footage or Acreage
Greenbrier Mainstem u/s of bridge	0+00-6+59	EI	III	659	659
Greenbrier Mainstem d/s of bridge	6+60-26+25	EI	III	1,965	1,965
UT u/s of bridge	0+00-19+28	EI	III	1,928	1,928
1st UT d/s of bridge	0+00-1+85	EI	III	185	185
2nd UT d/s of bridge	0+00-2+00	EI	III	200	200

Table 2. Drainage Areas

Reach	Drainage Area (Acres)
Greenbrier Mainstem	3,206.8
Unnamed Tributary	180.7
Total	

Table 3. Land Use of Watershed

Land Use/Cover Type	Acreage	Percentage
Pasture/Hay	1776.8	52.5
Deciduous Forest	1042.8	30.8
Developed, Open Space	170.9	5.0
Evergreen Forest	84.7	2.5
Mixed Forest	72.7	2.1
Cultivated Crops	64.7	1.9
Shrub/Scrub	44.9	1.3
Developed, Low Intensity	38.9	1.1
Grasslands/Herbaceous	38.9	1.1
Woody Wetlands	33.3	1.0
Water	17.1	0.5
Developed, Medium Intensity	1.1	0.03
TOTALS:	**3387**	**100**

Table 4. Morphological Table

Project Number 040621002 (Greenbrier Creek Stream Restoration)						
Item	**Existing Conditions**	**Designed Conditions**	**Existing Conditions**	**Existing Conditions**	**Designed Conditions**	**Reference Reach**
LOCATION	Greenbrier Cr	Greenbrier Cr	UT u/s of culvert	UT d/s of culvert	UT	Landum Cr.
STREAM TYPE	E5	C5	G4c		C4	C4
DRAINAGE AREA, Ac-Sq Mi	3207 ac-5.0 mi^2	3207 ac-5.0 mi^2	181 ac-0.3 mi^2	181 ac-0.3 mi2	181 ac-0.3 mi2	1619 ac-2.5 mi^2
BANKFULL RIFFLE WIDTH, (W_{bkf}), ft	20.0	35.0	6.6	3.2	12.0	27.6
BANKFULL MEAN RIFFLE DEPTH (d_{bkf}), ft	2.5	1.8	0.9	0.9	0.7	1.2
MAXIMUM BANKFULL RIFFLE DEPTH (d_{max}), ft	3.2	2.5	1.2	1.4	1.0	2.0
WIDTH/DEPTH RATIO (W_{bkf}/d_{bkf})	8.1	20.0	7.4	3.7	18.0	23.0
BANKFULL RIFFLE X-SECTION AREA (A_{bkf}), ft^2	50.4	61.0	5.8	2.7	7.8	33.5
BANKFULL MEAN VELOCITY, fps	3.9	3.3	2.6	0.6	1.9	5.2
BANKFULL DISCHARGE, cfs	195.0	195.0	15.0	1.7	15.0	174.0
WIDTH FLOODPRONE AREA (W_{fpa}), ft	160-200	160-200	8.0	50.0	40.0	140.0
ENTRENCHMENT RATIO (ER)	>2.2	>2.2	1.2	>2.2	>2.2	5.1
MEANDER L. (Lm), ft	N/A	N/A	N/A	N/A	N/A	94-100
RADIUS OF CURVATURE (R_c), ft	N/A	N/A	N/A	N/A	N/A	10-13 (NA)
BELT WIDTH (W_{blt}), ft	N/A	N/A	N/A	N/A	N/A	77 (NA)
MEANDER W. RATIO	N/A	N/A	N/A	N/A	N/A	2.8
SINUOSITY	1.0	1.0	1.0	1.0	1.0	1.1
AVERAGE BANKFULL SLOPE (s), ft/ft	0.0009	0.0009	0.0038	0.0030	0.0038	0.0077
VALLEY SLOPE (s), ft/ft	0.0019	0.0019	0.007	0.007	0.007	0.008
POOL BANKFULL WIDTH (W_{pool}), ft	46.7	N/A	N/A	N/A	N/A	27.4
MAX. POOL DEPTH (D_{pool}), ft	4.5	N/A	N/A	N/A	N/A	2.8
POOL X-SECTION AREA (A_{pool}) ft^2	90.0	N/A	N/A	N/A	N/A	N/A
POOL TO POOL SPACING (P-P) ft	N/A	N/A	N/A	N/A	N/A	25-104
BANK HEIGHT RATIO	1.0	1.0	~1-3	<1.0	1.0	~1.0
CHANNEL MATERIALS						
SIZE DISTRIBUTION						
D16, mm	0.37	NA	0.5	NA	NA	0.09
D35, mm	0.7	NA	1.74	0.25	NA	1.5
D50, mm	4	NA	9.9	0.60	NA	9.5
D84, mm	10	NA	61	2.00	NA	65
D95, mm	15	NA	103	6.00	NA	120

Table 5. BEHI/NBS and Sediment Export Estimate for Project Site and Reference Streams

Time Point	Segment/ Reach	Linear Footage or Acreage	Extreme		Very High		High		Moderate		Low		Very Low		Sediment Export
			ft	%	ft	%	ft	%	ft	%	ft	%	ft	%	Ton/yr
Pre-project	Mainstem	2,624							2,624	100					40.5
	UT	1,928					771	40	1,157	60					33.4
	Reference	369									369	100			1.5

Table 6. Design Vegetative Communities by Zone

PLANT COMPOSITION SCHEDULE

NOTE: EACH TREE SPECIES SHOULD COMPRISE AT LEAST 10% AND NO MORE THAN 25% OF THE TOTAL STEMS PLANTED IN EACH VEGETATION STRATA

Riparian Woodlands - Mesic-Plant in Zones 1 and 2 **Acres= 8.6**

Overall Spacing (feet off center)	Quantity per acre	Maximum Frequency (%)	Maximum Stem Quantity	Vegetation Strata/ Species Name	Common Name	Unit Type	Size	Spacing Type	Individual Spacing (ft.)
14.5	380			**TREES: Minimum of 5 Species**					
		20	654	*Fraxinus pennsylvanica*	Green Ash	container	2-3'	Random	24
		20	654	*Liriodendron tulipifera*	Tulip Poplar	container	2-3'	Random	24
		20	654	*Quercus phellos*	Willow Oak	container	2-3'	Random	24
		20	654	*Quercus falcata*	Southern Red Oak	container	2-3'	Random	24
		20	654	*Platanus occidentalis*	Sycamore	container	2-3'	Random	24
		20	654	*Nyssa sylvatica*	Black Gum	container	2-3'	Random	24
		20	654	*Ulmus americana*	American Elm	container	2-3'	Random	24
		20	654	*Acer rubrum*	Red Maple	container	2-3'	Random	24
		20	654	*Acer negundo*	Box Elder	container	2-3'	Random	24
		20	654	*Prunus serotina*	Black Cherry	container	2-3'	Random	24
			3270	**TOTAL**					
17	150			**MIDSTORY TREES: Minimum of 5 Species**					
		20	258	*Betula nigra*	River Birch	container	2-3'	Random	38
		20	258	*Ostrya virginiana*	American Hophornbeam	container	2-3'	Random	38
		20	258	*Ilex decidua*	Deciduous Holly	container	2-3'	Random	38
		20	258	*Oxydendron arboretum*	Sourwood	container	2-3'	Random	38
		20	258	*Amelanchier canadensis*	Serviceberry	container	2-3'	Random	38
		20	258	*Chionanthus virginicus*	Fringetree	container	2-3'	Random	38
		20	258	*Cercis canadensis*	Redbud	container	2-3'	Random	38
			1290	**TOTAL**					
17	150			**SHRUBS and VINES: Minimum of 5 Species**					
		20.0	258	*Lindera benzoin*	Spicebush	container	18-24"	Random	38
		20.0	258	*Calycanthus florida*	Sweetshrub	container	18-24"	Random	38
		20.0	258	*Alnus serrulata*	Tag Alder	container	18-24"	Random	38
		20.0	258	*Callicarpa americana*	American Beautyberry	container	18-24"	Random	38
		20.0	258	*Hydrangea arborescens*	Wild Hydrangea	container	18-24"	Random	38
		20.0	258	*Vaccinium stamineum*	Common Deerberry	container	18-24"	Random	38
		20.0	258	*Viburnum dentatum*	Southern Arrowwood	container	18-24"	Random	38
	680		**1290**	**TOTAL**					

CON=container

Permanent Herbaceous Seed-Plant in Zone 1 **Acres= 5.2**

Lbs./Ac	Frequency (%)	Lbs per Species	Species Name	Common Name	Unit	Additional Amendment	Quantity LBS/AC
ZONE 1 RIPARIAN WOODLANDS PERMANENT HERBACEOUS SEED							
40-rye	100	208.0	*Secale cereale*	Rye grain	LB of P.L.S. 76 %	Ground Limestone	4,000
30-other	20	31.2	*Panicum virgatum*	Switchgrass	LB of P.L.S. 76 %	Organic Fertilizer	320
species	20	31.2	*Dicanthelium clandestinium*	Deer tongue	LB of P.L.S. 76 %	Straw Mulch	4,000
combined	10	15.6	*Sorghastrum nutans*	Indian grass	LB of P.L.S. 76 %		
	10	15.6	*Elymus virginicus*	Virginia wild rye	LB of P.L.S. 76 %		
	10	15.6	*Tridens flavus*	Purpletop	LB of P.L.S. 76 %		
	5	7.8	*Andropogon glomeratus*	Bluestem	LB of P.L.S. 76 %		
	5	7.8	*Rudbeckia hirta*	Black-eyed susan	LB of P.L.S. 76 %		
	5	7.8	*Baptista australis*	Blue false indigo	LB of P.L.S. 76 %		
	5	7.8	*Daucus carota*	Queen Anne's lace	LB of P.L.S. 76 %		
	5	7.8	*Senna hebecarpa*	Wild senna	LB of P.L.S. 76 %		
	5	7.8	*Parthenium integrifolium*	Wild quinine	LB of P.L.S. 76 %		
	100	**364.0**	**= Total LBS**				

1. APPLY SOIL AMENDMENTS EVENLY AND INCORPORATE TO A DEPTH OF 4-6 INCHES. LOOSEN SURFACE JUST BEFORE BROADCASTING.
2. MULCH MUST COVER 75% OF THE GROUND SURFACE.

Fescue-Plant in Zone 3 **Acres= 1**

Lbs./Ac	Frequency (%)	Lbs per Species	Species Name	Common Name	Unit	Additional Amendment	Quantity LBS/AC
ZONE 3 Fill Area-Pasture Re-establishment							
50	100	50.0	*Festuca arundinacea*	Tall Fescue	LB of P.L.S. 76 %	Ground Limestone	4,000
					LB of P.L.S. 76 %	Organic Fertilizer	320
					LB of P.L.S. 76 %	Straw Mulch	4,000
	0	**50.0**	**= Total LBS**				

1. APPLY SOIL AMENDMENTS EVENLY AND INCORPORATE TO A DEPTH OF 4-6 INCHES. LOOSEN SURFACE JUST BEFORE BROADCASTING.
2. MULCH MUST COVER 75% OF THE GROUND SURFACE.

TEMPORARY HERBACEOUS SEED

Date	Species Name	Common Name	Unit	Additional Amendment	Quantity LBS/per acre
Jan.1-May 15	*Secale cereale*	Rye grain	LB of P.L.S. 76 %		35
				Ground Limestone	4,000
				Organic Fertilizer	320
				Straw Mulch	4,000
May 15-Aug.15	*Setaria italica*	German millet	LB of P.L.S. 76 %		40
				Ground Limestone	4,000
				Organic Fertilizer	320
				Straw Mulch	4,000
Aug. 15-Dec. 31	*Secale cereale*	Rye grain	LB of P.L.S. 76 %		35
				Ground Limestone	4,000
				Organic Fertilizer	320
				Straw Mulch	4,000

Notes:
1. SELECT AN APPROPRIATE TEMPORARY SPECIES BASED ON THE DATES GIVEN.
2. AVOID SEEDING IN DECEMBER OR JANUARY. IF NECESSARY TO SEED AT THESE TIMES, USE RYE GRAIN AND A SECURELY TACKED MULCH.
3. APPLY SOIL AMENDMENTS EVENLY AND INCORPORATE TO A DEPTH OF 4-6 INCHES. LOOSEN SURFACE JUST BEFORE BROADCASTING.
4. MULCH MUST COVER 75% OF THE GROUND SURFACE.

Riparian Woodlands - Mesic-Plant in Zone 4 **Acres= 1.7**

Overall Spacing (feet off center)	Quantity per acre	Maximum Frequency (%)	Maximum Stem Quantity	Vegetation Strata/ Species Name	Common Name	Unit Type	Size	Spacing Type	Individual Spacing (ft.)
14.5	380			**TREES: Minimum of 5 Species**					
		20	129	*Fraxinus pennsylvanica*	Green Ash	container	2-3'	Random	24
		20	129	*Liriodendron tulipifera*	Tulip Poplar	container	2-3'	Random	24
		20	129	*Quercus phellos*	Willow Oak	container	2-3'	Random	24
		20	129	*Quercus falcata*	Southern Red Oak	container	2-3'	Random	24
		20	129	*Platanus occidentalis*	Sycamore	container	2-3'	Random	24
		20	129	*Nyssa sylvatica*	Black Gum	container	2-3'	Random	24
		20	129	*Ulmus americana*	American Elm	container	2-3'	Random	24
		20	129	*Acer rubrum*	Red Maple	container	2-3'	Random	24
		20	129	*Acer negundo*	Box Elder	container	2-3'	Random	24
		20	129	*Prunus serotina*	Black Cherry	container	2-3'	Random	24
			645	**TOTAL**					
17	150			**MIDSTORY TREES: Minimum of 5 Species**					
		20	51	*Betula nigra*	River Birch	container	2-3'	Random	38
		20	51	*Ostrya virginiana*	American Hophornbe	container	2-3'	Random	38
		20	51	*Ilex decidua*	Deciduous Holly	container	2-3'	Random	38
		20	51	*Oxydendron arboretum*	Sourwood	container	2-3'	Random	38
		20	51	*Amelanchier canadensis*	Serviceberry	container	2-3'	Random	38
		20	51	*Chionanthus virginicus*	Fringetree	container	2-3'	Random	38
		20	51	*Cercis canadensis*	Redbud	container	2-3'	Random	38
			255	**TOTAL**					
17	150			**SHRUBS and VINES: Minimum of 5 Species**					
		20.0	51	*Lindera benzoin*	Spicebush	container	18-24"	Random	38
		20.0	51	*Calycanthus florida*	Sweetshrub	container	18-24"	Random	38
		20.0	51	*Alnus serrulata*	Tag Alder	container	18-24"	Random	38
		20.0	51	*Callicarpa americana*	American Beautyberr	container	18-24"	Random	38
		20.0	51	*Hydrangea arborescens*	Wild Hydrangea	container	18-24"	Random	38
		20.0	51	*Vaccinium stamineum*	Common Deerberry	container	18-24"	Random	38
		20.0	51	*Viburnum dentatum*	Southern Arrowwood	container	18-24"	Random	38
	680		**255**	**TOTAL**					
				BALLED IN BURLAP TREES-Zone 4				**Acres= 1.7**	
Overall Spacing (feet off center)	**Quantity per acre**	**Maximum Frequency (%)**	**Maximum Stem Quantity**	**Vegetation Strata/ Species Name**	**Common Name**	**Unit Type**	**Size**	**Spacing Type**	**Individual Spacing (ft.)**
14.5	28			**TREES: Minimum of 3 Species, # of Trees = 48**					
		33	16	*Fraxinus pennsylvanica*	Green Ash	balled in burlap	2-3" caliper	Random	68
		33	16	*Liriodendron tulipifera*	Tulip Poplar	balled in burlap	2-3" caliper	Random	68
		33	16	*Quercus phellos*	Willow Oak	balled in burlap	2-3" caliper	Random	68
		33	16	*Quercus falcata*	Southern Red Oak	balled in burlap	2-3" caliper	Random	68
		33	16	*Platanus occidentalis*	Sycamore	balled in burlap	2-3" caliper	Random	68
		33	16	*Nyssa sylvatica*	Black Gum	balled in burlap	2-3" caliper	Random	68
		33	16	*Ulmus americana*	American Elm	balled in burlap	2-3" caliper	Random	68
		33	16	*Acer rubrum*	Red Maple	balled in burlap	2-3" caliper	Random	68
		33	16	*Acer negundo*	Box Elder	balled in burlap	2-3" caliper	Random	68
		33	16	*Prunus serotina*	Black Cherry	balled in burlap	2-3" caliper	Random	68
			48	**TOTAL**					

CON=container

10.0 Figures

Figure 1. Project Site Vicinity Map

Greenbrier Creek Stream Restoration

Alamance and Chatham Counties, North Carolina

May 2008

0 2,500 5,000 10,000 Feet

Legend

- Murchison Easement
- Matthews Easement
- County Boundary
- Cities
- USGS 7.5 Minute Quadrangle
- Highway
- Major Road
- Local Road
- Other Road
- Rivers (Local)
- Lake/Pond

Ecosystem Enhancement Program

Biohabitats

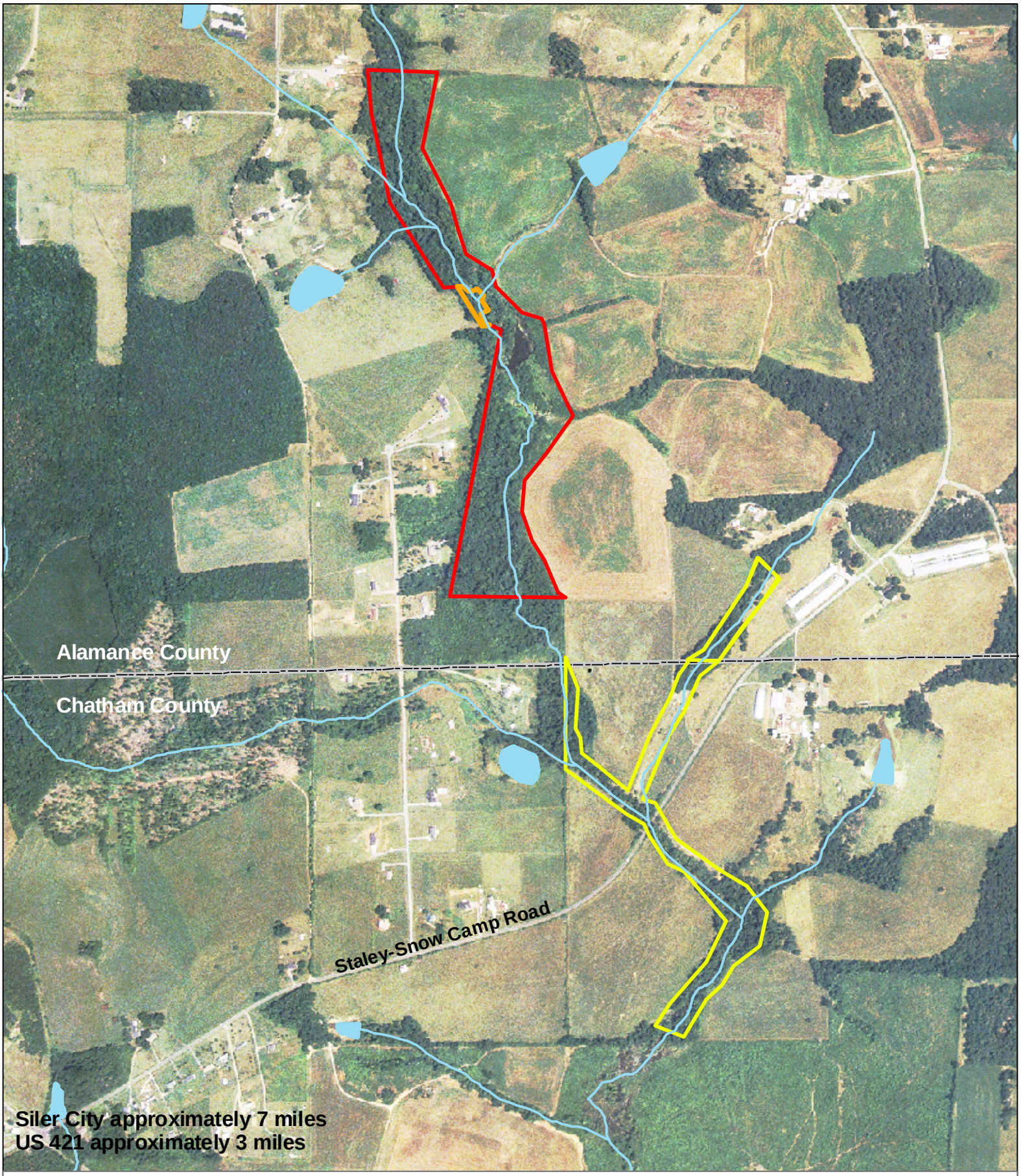


Figure 2. Project Site Study Area Map

Greenbrier Creek Stream Restoration

Alamance and Chatham Counties, North Carolina

May 2008

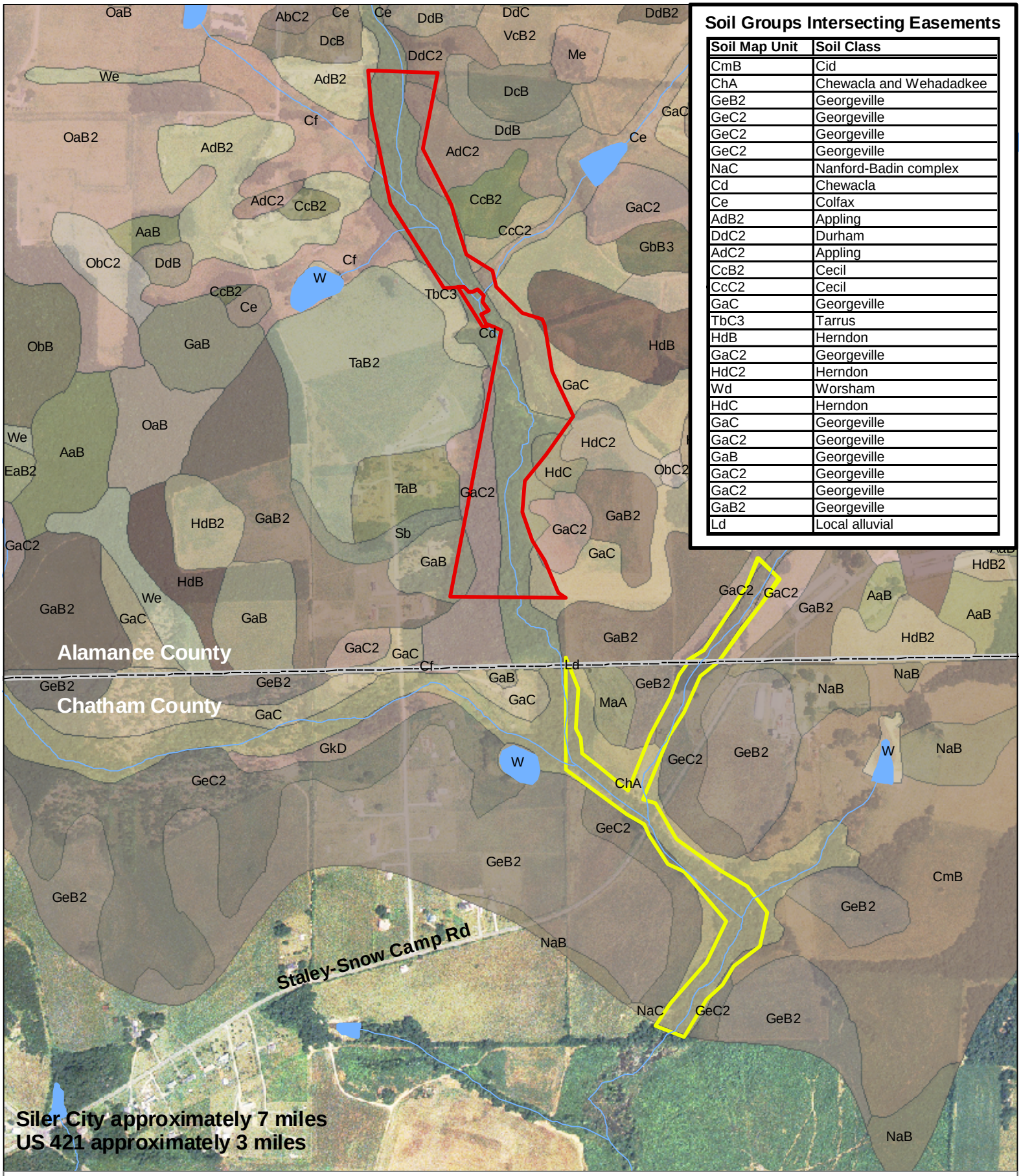
0 250 500 1,000 Feet

Legend

- County Boundary
- Stream
- Lake/Pond
- Matthews Easement - 17.1 Acres
- Murchison Easement - 33.9 Acres
- Cheek Easement - 0.52 Acres

Ecosystem Enhancement

Biohabitats



Soil Groups Intersecting Easements

Soil Map Unit	Soil Class
CmB	Cid
ChA	Chewacla and Wehadadkee
GeB2	Georgeville
GeC2	Georgeville
GeC2	Georgeville
GeC2	Georgeville
NaC	Nanford-Badin complex
Cd	Chewacla
Ce	Colfax
AdB2	Appling
DdC2	Durham
AdC2	Appling
CcB2	Cecil
CcC2	Cecil
GaC	Georgeville
TbC3	Tarrus
HdB	Herndon
GaC2	Georgeville
HdC2	Herndon
Wd	Worsham
HdC	Herndon
GaC	Georgeville
GaC2	Georgeville
GaB	Georgeville
GaC2	Georgeville
GaC2	Georgeville
GaB2	Georgeville
Ld	Local alluvial

Figure 3. Project Site NRCS Soil Survey Map

Greenbrier Creek Stream Restoration

Alamance and Chatham Counties, North Carolina

May 2008

0 250 500 1,000 Feet

Legend

- Matthews Easement
- Murchison Easement
- Stream
- Lake/Pond

Ecosystem Enhancement Program

Biohabitats

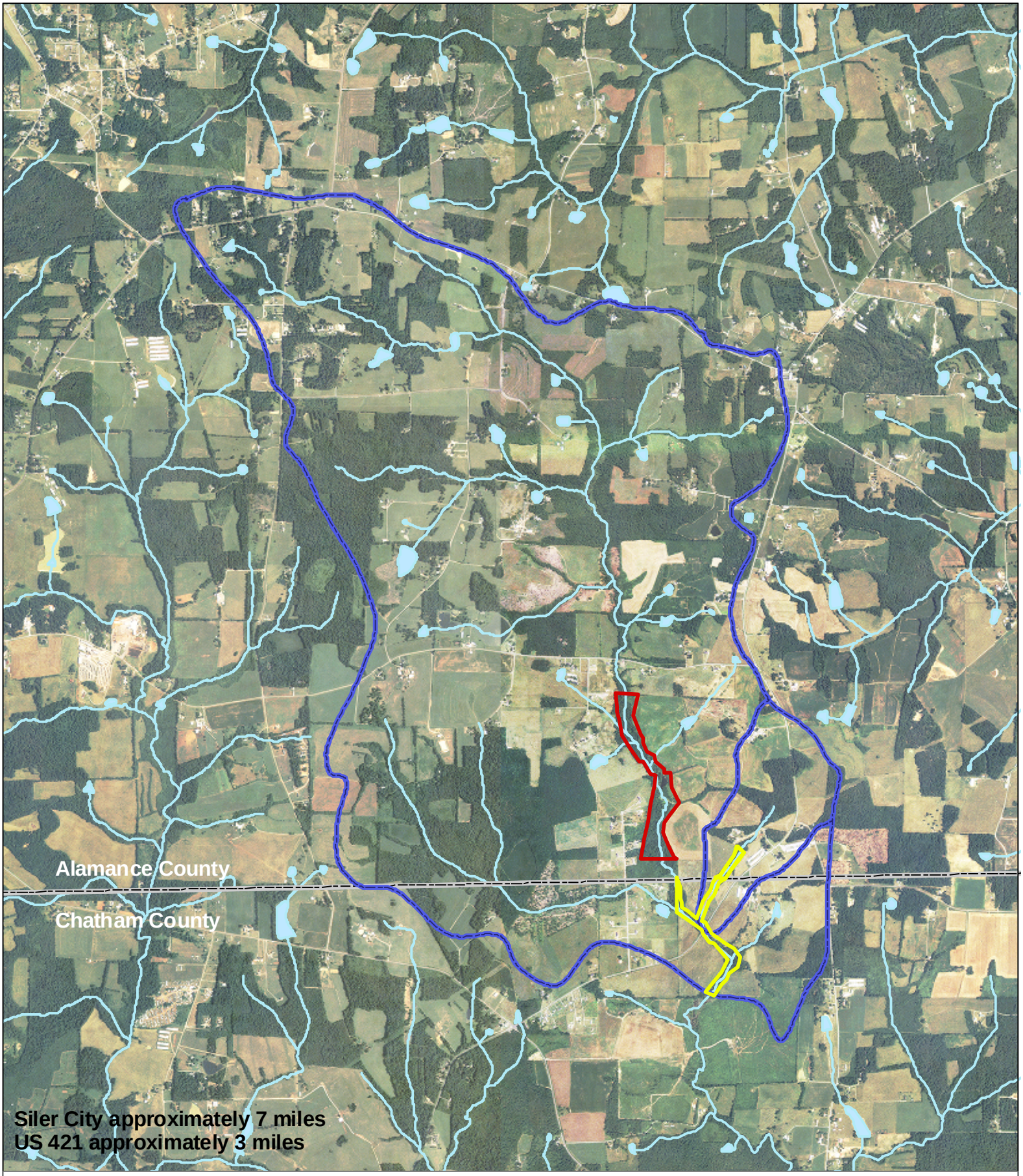


Figure 4. Project Site Watershed Map

Greenbrier Creek Stream Restoration

Alamance and Chatham Counties, North Carolina

May 2008

0 750 1,500 3,000 Feet

Legend

- Matthews Easement
- Murchison Easement
- Project Watershed Boundary - 3387 acres (5.3 sqmi)
- Site Streams
- Lake/Pond

Ecosystem Enhancement

Biohabitats

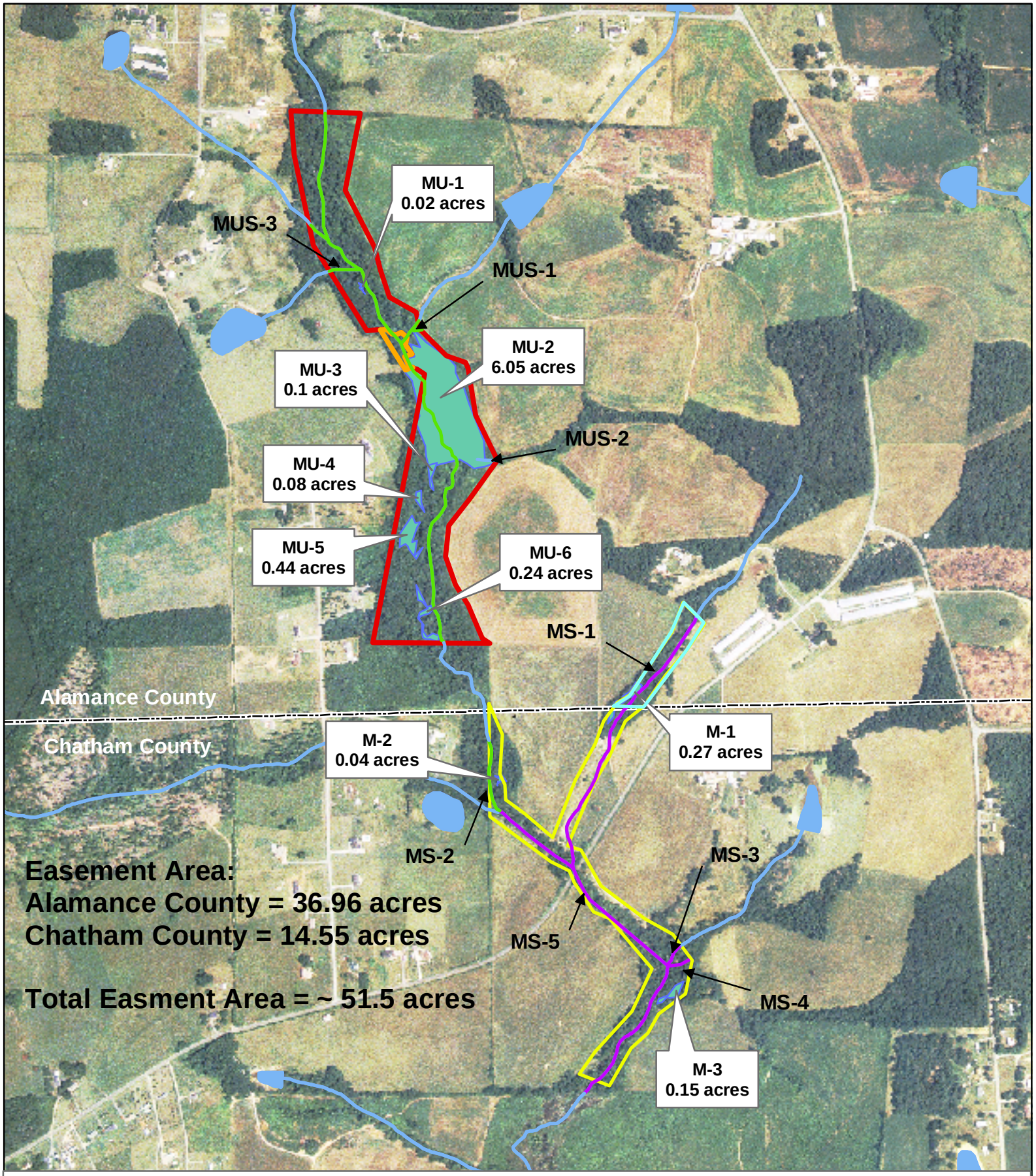


Figure 5. Project Site Wetlands and Stream Features Map

Greenbrier Creek Stream Restoration

Alamance and Chatham Counties, North Carolina

May 2008

0 370 740 1,480 Feet

Legend

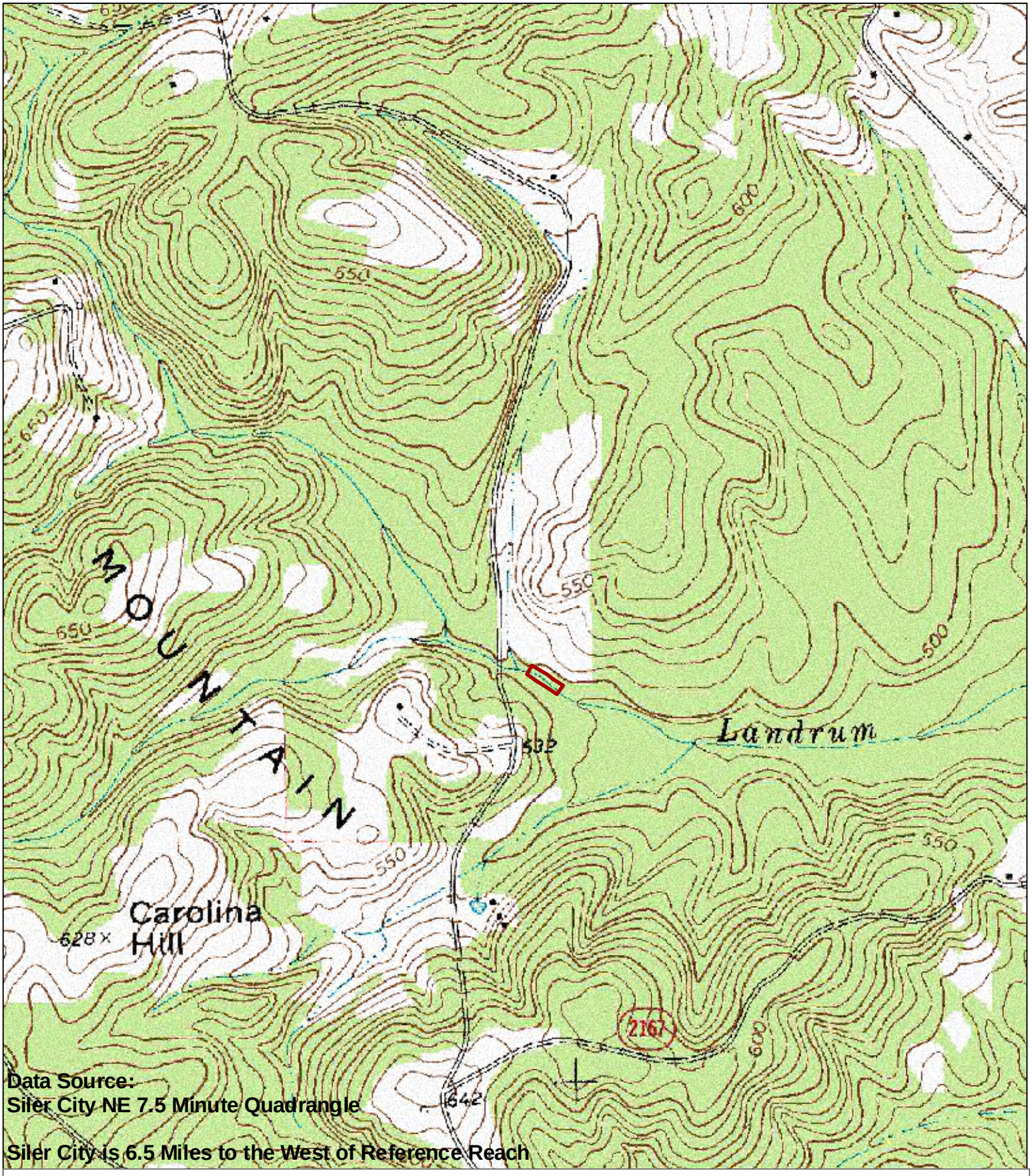
- County Boundaries
- Matthews Easement
- Murchison Easement
- Murchison Easement
- Wetlands
- Streams

Proposed Mitigation

- Enhancement I
- Preservation

Ecosystem Enhancement Program

Biohabitats Southeast Bioregion



Data Source:
Siler City NE 7.5 Minute Quadrangle

Siler City is 6.5 Miles to the West of Reference Reach

Figure 6. Reference Reach Vicinty Map

Greenbrier Creek Stream Restoration
Alamance and Chatham Counties, North Carolina

May 2008

0 500 1,000 2,000 Feet

Legend

ReferenceReach

Ecosystem Enhancement

Biohabitats

Figure 7. Reference Reach Study Area Map

Greenbrier Creek Stream Restoration
Alamance and Chatham Counties, North Carolina

May 2008

0 50 100 200 300 Feet

Legend

Reference Reach

Streams/Creeks

Ecosystem Enhancement

Biohabitats

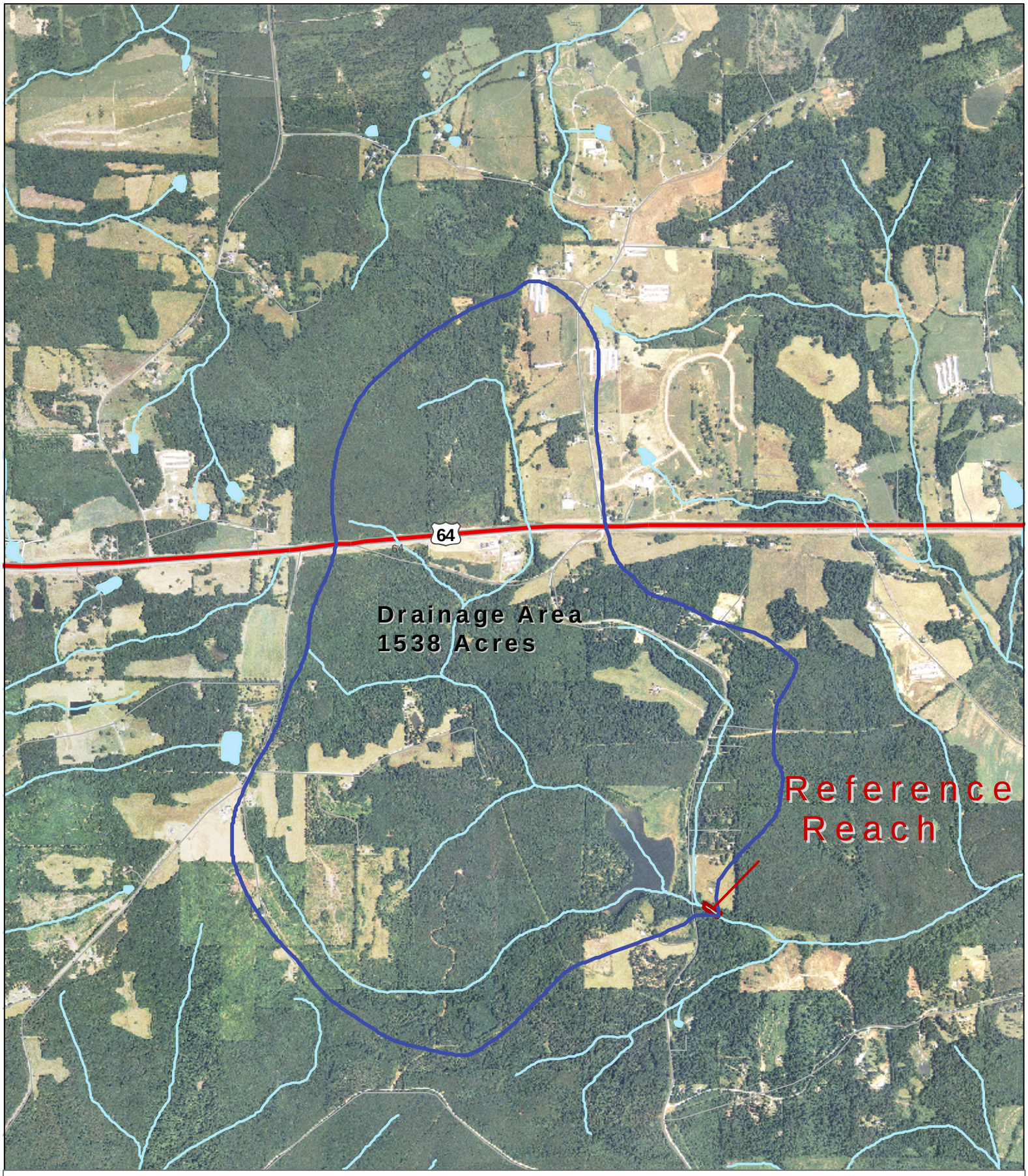


Figure 8. Reference Reach Watershed Map

Greenbrier Creek Stream Restoration
Chatham and Alamance Counties, North Carolina

May 2008

0 500 1,000 2,000 Feet

Legend

- Reference Watershed - 1538.0 acres (2.40 sqmi)
- Reference Reach
- Streams

Ecosystem Enhancement

Biohabitats

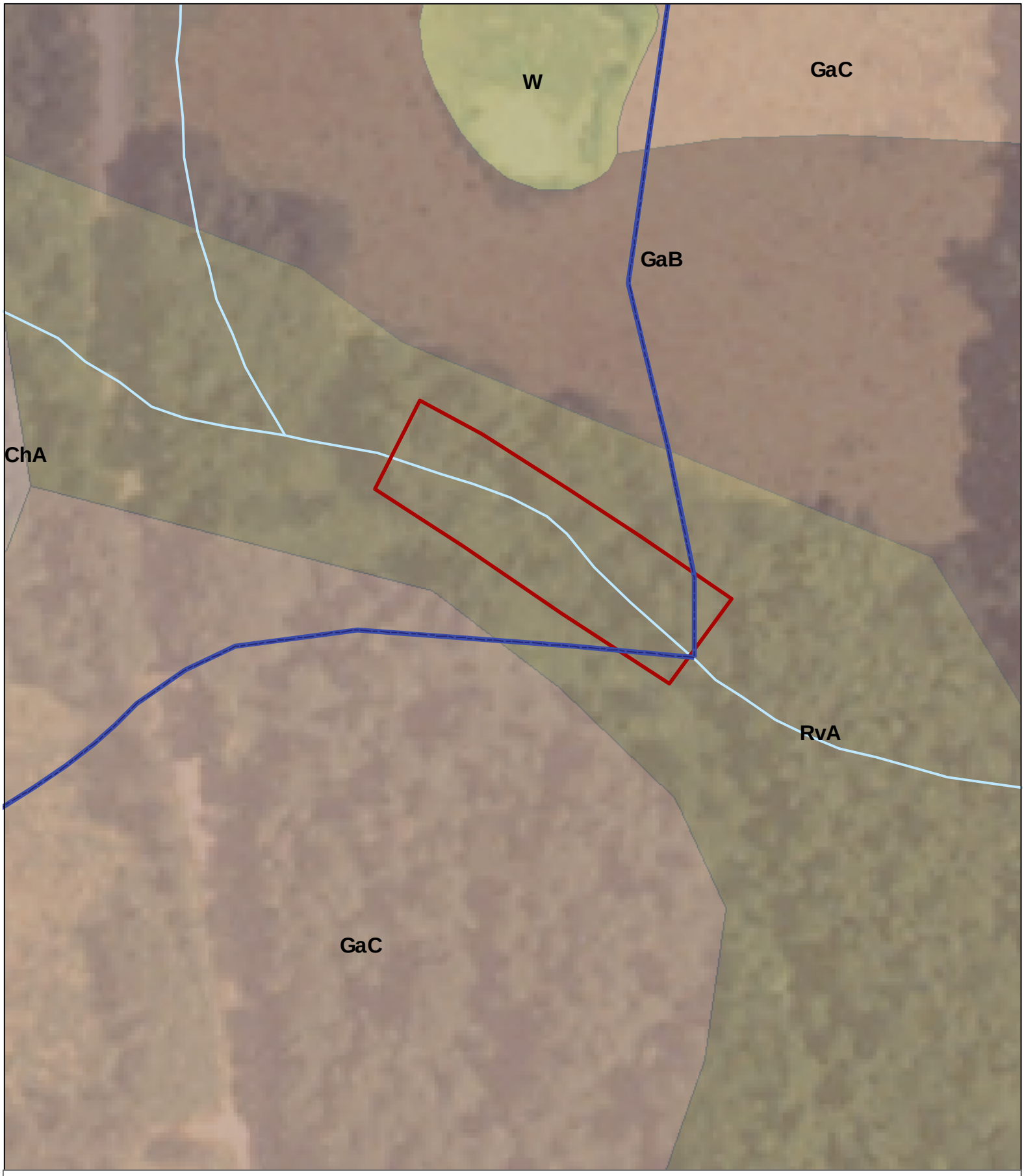


Figure 9. Reference Reach NRCS Soil Survey Map

Greenbrier Creek Stream Restoration
Alamance and Chatham Counties, North Carolina

May 2008

0 25 50 100 Feet

Legend

- Reference Watershed
- Reference Reach
- RvA, Riverview

Ecosystem Enhancement

Biohabitats

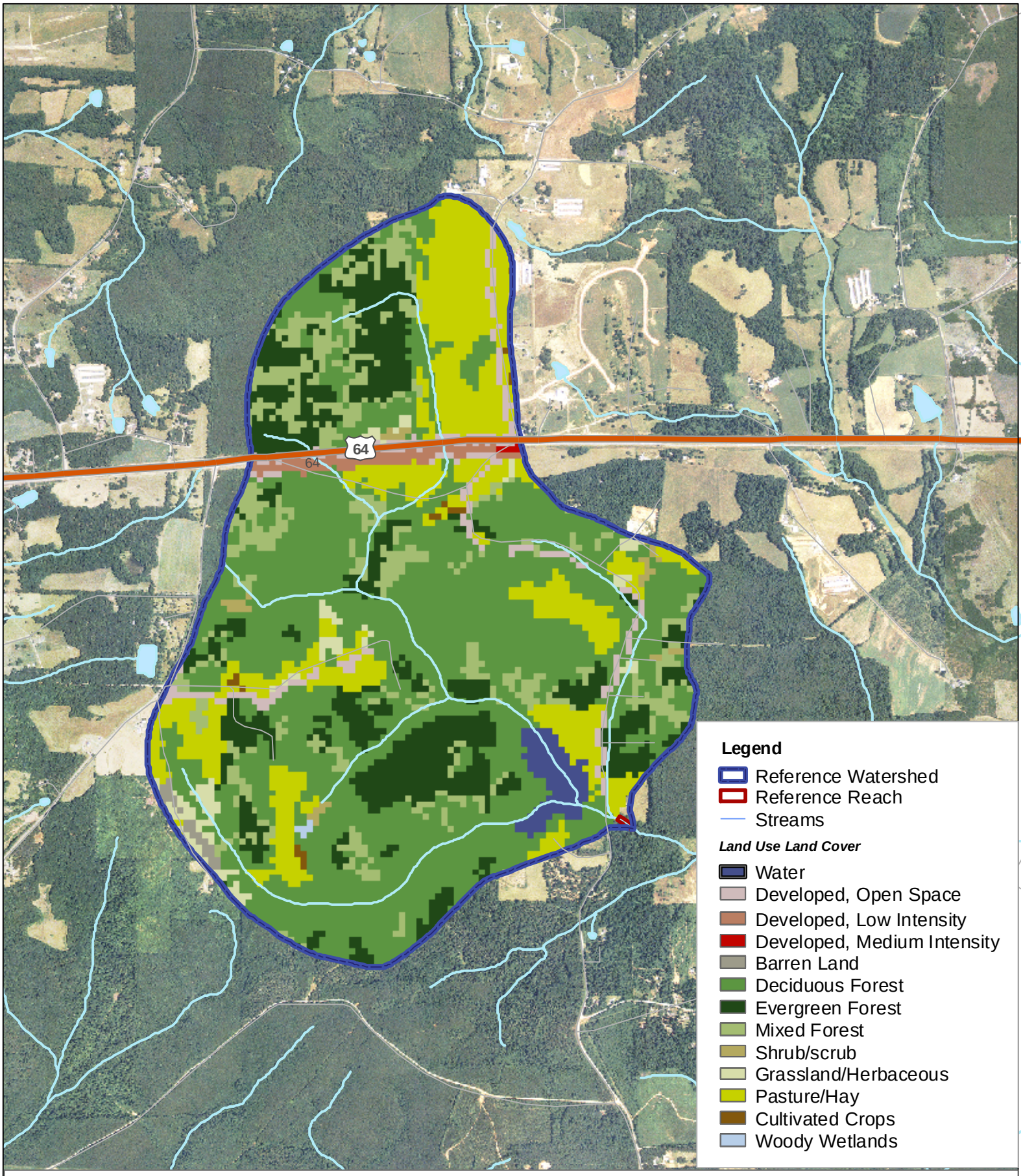


Figure 10. Reference Reach Land Cover Land Use Map

Greenbrier Creek Stream Restoration

Alamance and Chatham Counties, North Carolina

May 2008

0 500 1,000 2,000 Feet

Ecosystem Enhancement

Biohabitats

11.0 Design Sheets

Sheet 1: Title Sheet

Sheet 2: Legend & Symbols

Sheet 3: Details

Sheet 4: Construction Sequence and General Notes

Sheet 5: Geometry Plans

Sheet 6: Grading Plan Tributary

Sheet 7: Grading Plan Tributary

Sheet 8: Grading Plan Tributary

Sheet 9: Grading Plan Tributary

Sheet 10: Grading Plan Mainstem

Sheet 11: Grading Plan Mainstem

Sheet 12: Grading Plan Mainstem

Sheet 13: Grading Plan Mainstem

Sheet 14: Grading Plan Mainstem

Sheet 15: Typical Cross Sections

Sheet 16: Morphology Tables

Sheet 17: Sediment & Erosion Control Details

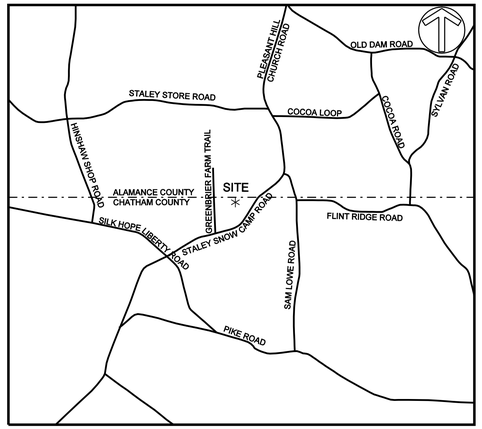
Sheet 18: Sediment & Erosion Control Details

Sheet 19: Planting Plan

Sheet 20: Planting Schedules

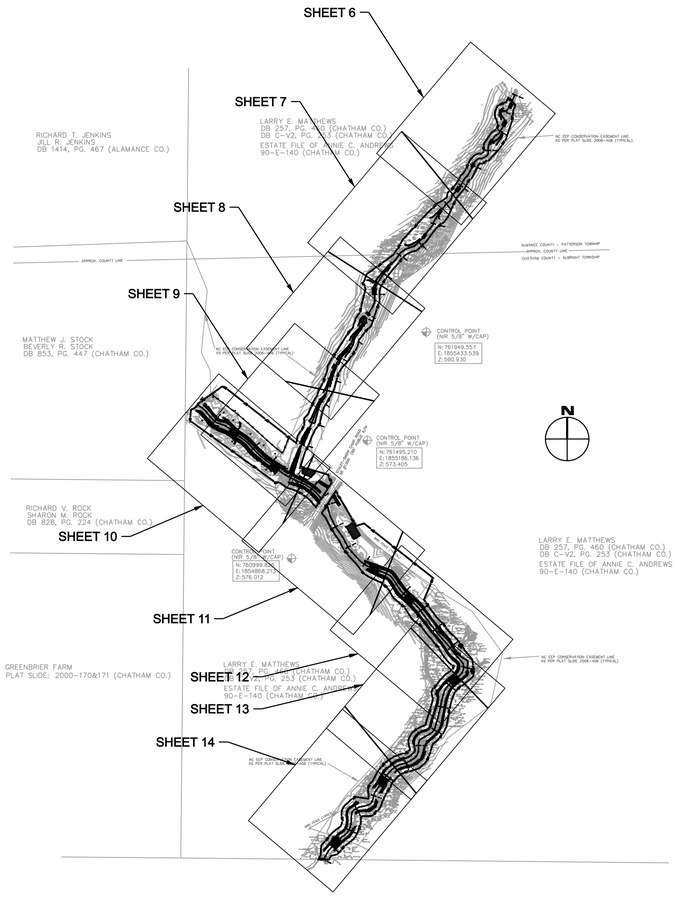
GREENBRIER
STREAM ENHANCEMENT

SITE VICINITY MAP



NOT TO SCALE

LATITUDE: 35 50'27"
LONGITUDE: 79°29'25"



INDEX OF SHEETS

NOTES:

1. SURVEY PERFORMED BY CAVANAUGH IN JANUARY 2008.
   NAVD88
2. TOTAL DISTURBED AREA = 11.1 Ac. INCLUDES PLANTING AREAS
3. THE CONTRACTOR SHALL CALL THE "CALL BEFORE YOU DIG" AT 1-800-632-4949, WITHIN 48 HOURS PRIOR TO EXCAVATION WORK.

REVISIONS

Mark	Description	Date	Appr.

North Carolina
Ecosystem Enhancement Program
2728 Capitol Blvd, Suite 1H 103
Raleigh, NC 27604
Tel:919-715-0476

Biohabitats
8218 Creedmoor Rd, Suite 200
Raleigh, NC 27613
Tel: 919-518-0311 Fax: 919-518-0313
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Inspiring Ecological Stewardship

GREENBRIER
STREAM
ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

TITLE SHEET

PROJECT NO.: 06801.03

SCALE:

SEAL:

DESIGNED BY: VLS/KTN

DRAWN BY: CB

CHECKED: JXR/EMM

APPROVED:

DATE: OCTOBER 2008

DWG. NO.:

1 OF 20

LEGEND

- EXISTING CONTOUR
- EXISTING THALWEG
- EXISTING CONSERVATION EASEMENT
- EXISTING BEDROCK
- EXISTING BEDROCK
- PROPOSED CONTOURS
- PROPOSED BASELINE OF CONSTRUCTION
- TEMPORARY STOCKPILE AREA
- PROPOSED LIMIT OF DISTURBANCE
- SILT FENCE
- STABILIZED CONSTRUCTION ENTRANCE
- RIFFLE STRUCTURE
- GRADE CONTROL STRUCTURE
- PROPOSED CATTLE CROSSING
- PLANTING ZONE 1
- PLANTING ZONE 2
- PLANTING ZONE 3
- PLANTING ZONE 4

LEGEND FOR PROFILES

- EXISTING GROUND AT CENTERLINE
- PROPOSED RIFFLE STRUCTURE

LEGEND FOR CROSS SECTIONS

- EXISTING GROUND
- PROPOSED GRADE
- BANKFULL
- RIFFLE MATERIAL

REVISIONS

Mark	Description	Date	Appr.

North Carolina
Ecosystem Enhancement Program
2728 Capitol Blvd, Suite 1H 103
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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

LEGEND & SYMBOLS

PROJECT NO.: 06801.03	SCALE:
SEAL:	DESIGNED BY: VLS/KTN; DRAWN BY: CB
	CHECKED: JXR/EMM; APPROVED:
	DATE: OCTOBER 2008
	DWG. NO.: 2 OF 20

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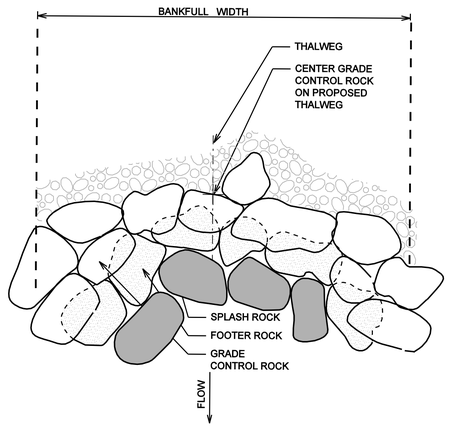
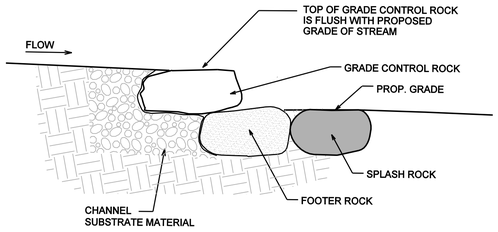
10/15/2008

100% SUBMITTAL



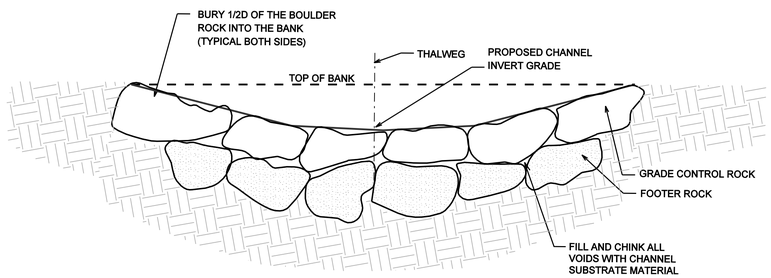
ROCK GRADE CONTROL
PLAN VIEW-TYPICAL

NOT TO SCALE



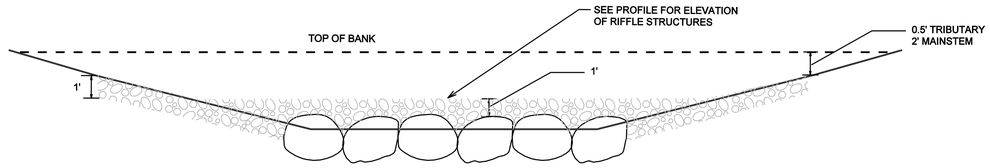
ROCK GRADE CONTROL
PROFILE-TYPICAL

NOT TO SCALE



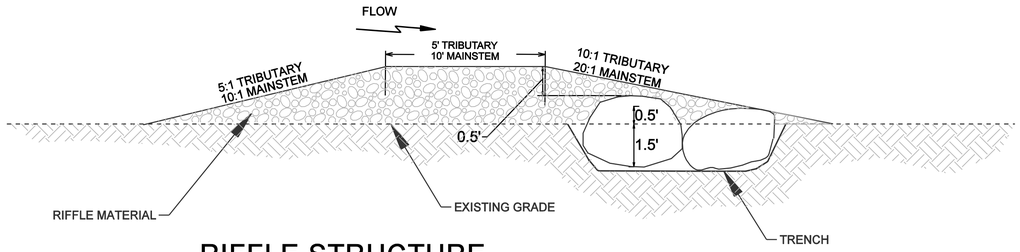
ROCK GRADE CONTROL
SECTION-TYPICAL

NOT TO SCALE



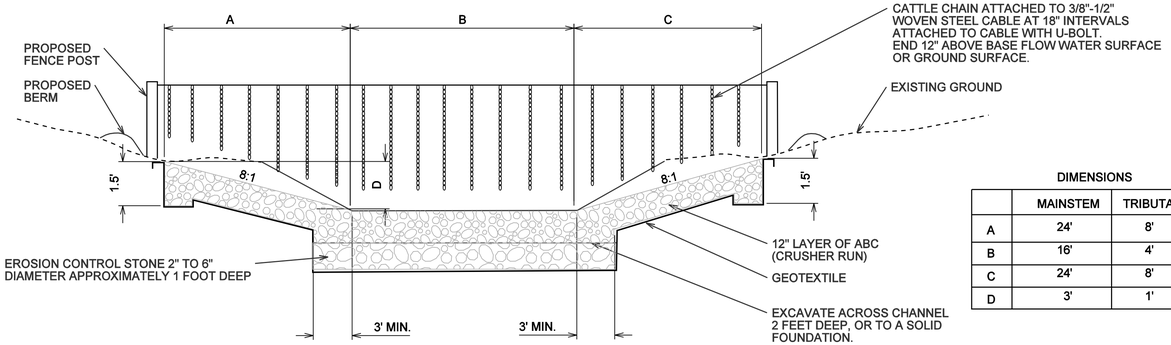
RIFFLE STRUCTURE
CROSS SECTION-TYPICAL

NOT TO SCALE



RIFFLE STRUCTURE
PROFILE-TYPICAL

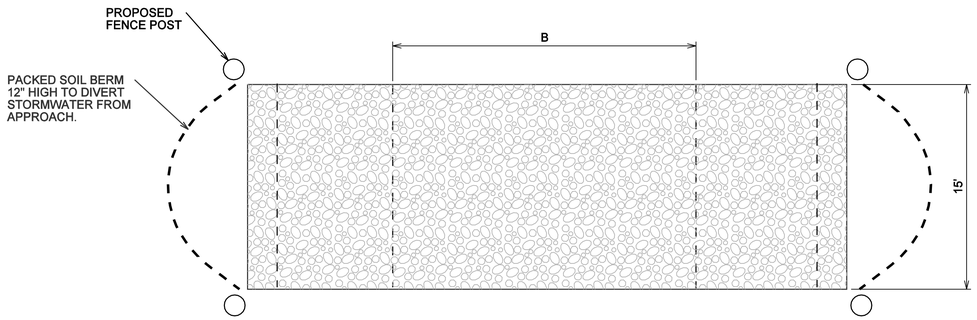
NOT TO SCALE



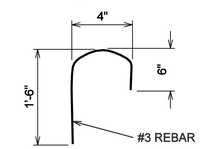
DOWNSTREAM VIEW

DIMENSIONS

	MAINSTEM	TRIBUTARY
A	24'	8'
B	16'	4'
C	24'	8'
D	3'	1'



PLAN VIEW



ANCHORING PIN DETAIL

CATTLE CROSSING

NOT TO SCALE

NOTES

1. CONSTRUCTION SHALL TAKE PLACE DURING A PERIOD OF LOW STREAM FLOW OR DURING A TIME PERIOD SPECIFIED BY NRCS.

2. CONTACT NRCS/DISTRIC PERSONNEL TO SET FLAGS FOR CONSTRUCTION LAYOUT 336-228-1753 EXT. 3. PERSONELL SHALL REVIEW DESIGN AND LAYOUT WITH OWNER AND GRADING CONTRACTOR.

2. GEOTEXTILE SHALL BE 8 OUNCE, CLASS I NON-WOVEN, NEEDLE-PUNCHED. SPLICES SHALL OVERLAP AT LEAST 18 INCHES.

3. GEOTEXTILE SHALL BE PLACED ON THE EXCAVATED SURFACE PARALLEL TO STREAM FLOW. GEOTEXTILE SHALL BE KEYED IN ONE FOOT AT ENDS. NO FABRIC SHALL BE EXPOSED AT THE EDGES OF THE CROSSING.

4. NO PORTION OF THE CROSSING SHALL EXTEND ABOVE THE ADJACENT GROUND SURFACE ELEVATIONS. THE FINISHED GRADE OF THE CROSSING MUST BE FLUSH WITH THE BOTTOM OF THE CHANNEL.

5. ROCK SHALL BE COMPACTED WITH RUBBER TIRE OR TRACKED EQUIPMENT UNTIL ROCKS NO LONGER SHIFT OR PUMP.

REVISIONS

Mark	Description	Date	Appr.

North Carolina
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2728 Capitol Blvd, Suite 1H 103
Raleigh, NC 27604
Tel:919-715-0476

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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

DETAILS

PROJECT NO.: 06801.03
SCALE:
SEAL:
DESIGNED BY: VLS/KTN
DRAWN BY: CB
CHECKED: JXR/EMM
APPROVED:
DATE: OCTOBER 2008
DWG. NO.: 3 OF 20

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10/15/2008

100% SUBMITTAL

SEQUENCE OF CONSTRUCTION EVENTS

1. The Contractor must follow the erosion control measures in the construction drawings as part of the sediment and erosion control permit.

2. Stake out the limit of disturbance and construction baseline.

Note: the Contractor shall stay within the limits of disturbance as shown on the plans and minimize disturbance within the working area wherever possible. The contractor shall minimize disturbance to trees within the LOD. All trees to be removed shall be marked in the field and on the drawings. Any tree removal not marked shall be subject to the approval of the EEP Project Manager.

3. The Contractor shall conduct a pre-construction meeting on site with the Project Engineer, Construction Supervisor, and appropriate agency personnel to review the erosion and sediment control requirements, sequence of construction, limits of disturbance, channel layout, and tree impact before work begins.

4. Notify NCDENR Division of Land Resources, Land Quality Section, Raleigh Regional Office at least 7 days prior to construction.

5. Install stabilized construction entrances and other sediment control devices as shown on the plans or as indicated in the special provisions.

6. Establish staging and stockpile areas and install silt fence around the perimeter of each area.

7. Materials for in-stream pump around diversion and temporary stream crossings shall be located on site. Equipment shall not cross through the channel when water is flowing in it. Equipment shall only cross the channel on an approved temporary stream crossing or at the active work area when flow is being pumped around the active work area.

8. When erosion and sediment control measures are adequately installed, the Contractor may begin grading operations. Do not clear and grub the entire project area at once. Clear and grub only the area where channel construction is taking place. Clearing and grubbing shall move with the channel construction.

9. The Contractor shall install a pump around device and dewatering device as necessary to divert stream base flow around the work area. The pump intake and sandbag coffer dam shall be installed just upstream of the active work area. The pump discharge and velocity dissipater shall be located downstream of the active work area and shall be located such that water does not flow back into the active work area. The active work area shall only be as large of an area that can be constructed to final grades in one day. The pump around device shall be moved when the active construction area reaches the pump discharge area. Sediment shall not be released into the stream. Dirty water is to be pumped into a sediment filtering bag. The sediment filtering bag shall be located downstream of the active work area such that water discharged from the sediment filtering bag does not flow back into the active work area. Clean water only is to be discharged into the stream. No work shall be conducted in the channel during rain events.

10. Refer to cross sections and grading plans for bank grading. It is preferred that grading proceed from upstream to downstream. Install riffle structures as indicated on the grading plans and longitudinal profiles.

11. Groundcover, in accordance with the Planting Schedule, must be established on exposed slopes within 48 hours after completion of any phase of grading.

12. A stable flow channel must be operable at the end of each day such that any base flow or storm flow can be safely conveyed.

13. All excess soil shall be placed in the designated fill areas as shown on the construction drawings. All excess soil brought to the designated fill areas shall be graded to blend with the surrounding contours. The contractor shall maintain the access way to the fill area in a stable manner such that sediments will not be washed into the stream during rain events. If the fill area needs to be expanded, the contractor shall first obtain approval from the Project Engineer. The sediment controls for the fill area shall be modified before the area is expanded.

14. When construction is complete, stabilize any remaining disturbed areas. Permanent groundcover must be established within 21 calendar days.

15. Plant trees according to the planting schedule at a time approved by the EEP project manager.

16. With the approval of the sediment control inspector, remove the sediment control devices. Stabilize any areas disturbed by sediment control removal.

Notes:
The Contractor shall be responsible for maintaining sediment and erosion control measures during construction activities and will maintain the erosion control measures in accordance construction drawings and specifications as approved by the Land Quality Section.

Sediment and erosion control measures shall be inspected on a weekly basis and after each significant rainfall event.

Total disturbed area = 9.2 AC.

REVISIONS

Mark	Description	Date	Appr.

North Carolina
Ecosystem Enhancement Program
2728 Capitol Blvd, Suite 1H 103
Raleigh, NC 27604
Tel:919-715-0476

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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:
CONSTRUCTION SEQUENCE AND GENERAL NOTES

PROJECT NO.: 06801.03
SCALE:
SEAL:
DESIGNED BY: VLS/KTN
DRAWN BY: CB
CHECKED: JXR/EMM
APPROVED:
DATE: OCTOBER 2008
DWG. NO.:
4 OF 20

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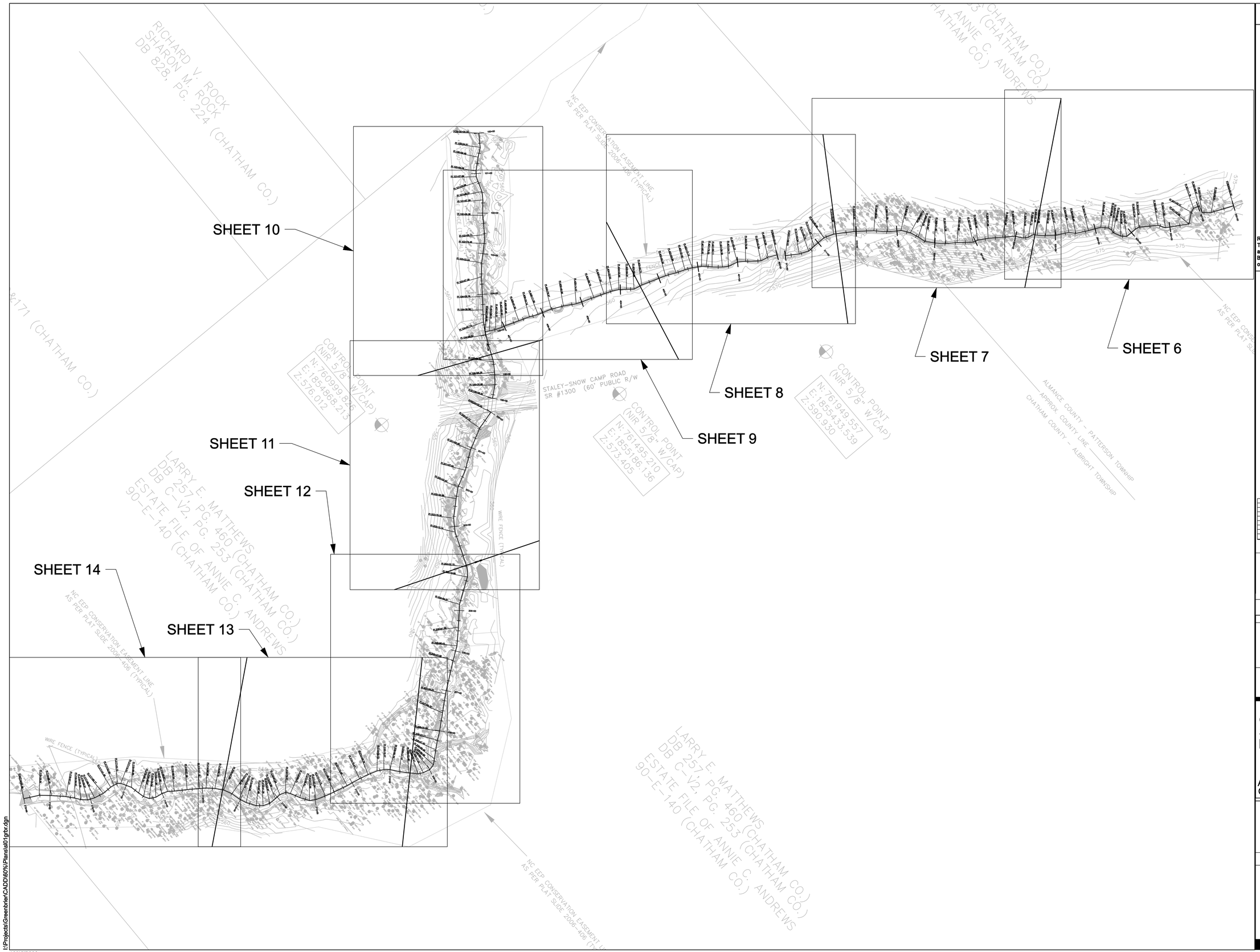

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0 100 200

REVISIONS			
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2728 Capitol Blvd, Suite 1H 103
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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

GEOMETRY PLAN

PROJECT NO.: 06801.03		SCALE: 1" = 100'	
SEAL:		DESIGNED BY: VLS/KTN	DRAWN BY: CB
		CHECKED: JXR/EMM	APPROVED:
		DATE: OCTOBER 2008	
		DWG. NO.: 5 OF 20	

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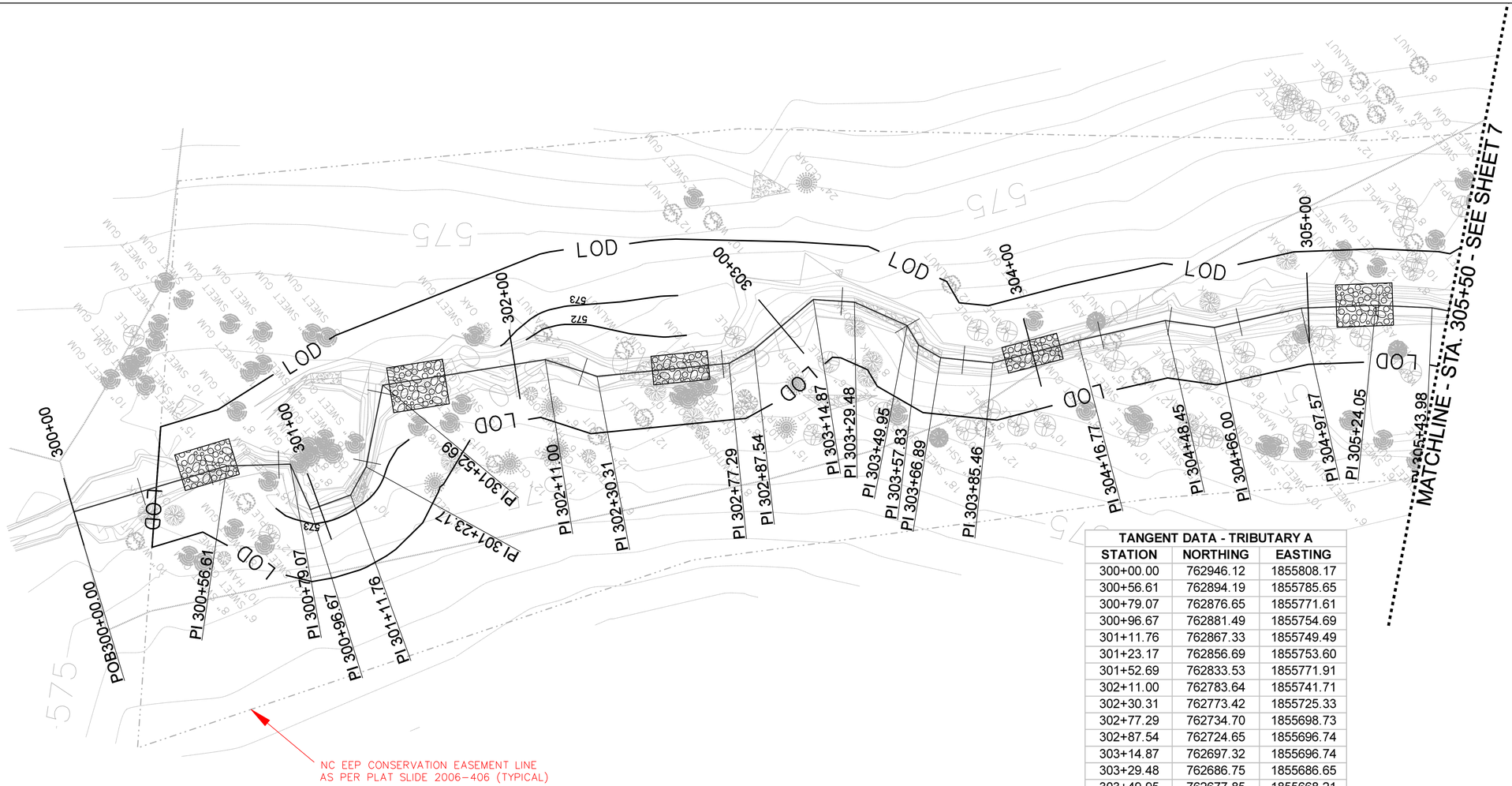
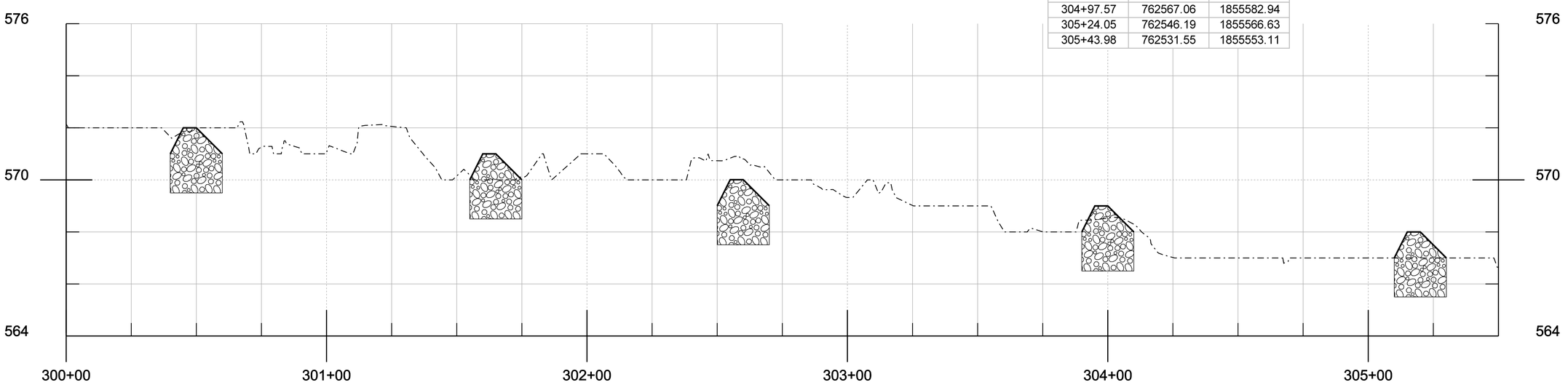


TANGENT DATA - TRIBUTARY A		
STATION	NORTHING	EASTING
300+00.00	762946.12	1855808.17
300+56.61	762894.19	1855785.65
300+79.07	762876.65	1855771.61
300+96.67	762881.49	1855754.69
301+11.76	762867.33	1855749.49
301+23.17	762856.69	1855753.60
301+52.69	762833.53	1855771.91
302+11.00	762783.64	1855741.71
302+30.31	762773.42	1855725.33
302+77.29	762734.70	1855698.73
302+87.54	762724.65	1855696.74
303+14.87	762697.32	1855696.74
303+29.48	762686.75	1855686.65
303+49.95	762677.85	1855668.21
303+57.83	762679.20	1855660.45
303+66.89	762676.09	1855651.94
303+85.46	762663.18	1855638.58
304+16.77	762634.91	1855625.14
304+48.45	762606.75	1855610.62
304+66.00	762595.05	1855597.54
304+97.57	762567.06	1855582.94
305+24.05	762546.19	1855566.63
305+43.98	762531.55	1855553.11



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VERTICAL 0 2 4

REVISIONS

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Raleigh, NC 27604
Tel:919-715-0476

Biohabitats
ECOLOGY AND RESTORATION
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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

GRADING PLAN TRIBUTARY

PROJECT NO.: 06801.03
SCALE: 1" = 20'
SEAL:
DESIGNED BY: VLS/KTN
DRAWN BY: CB
CHECKED: JXR/EMM
APPROVED:
DATE: OCTOBER 2008
DWG. NO.: 6 OF 20

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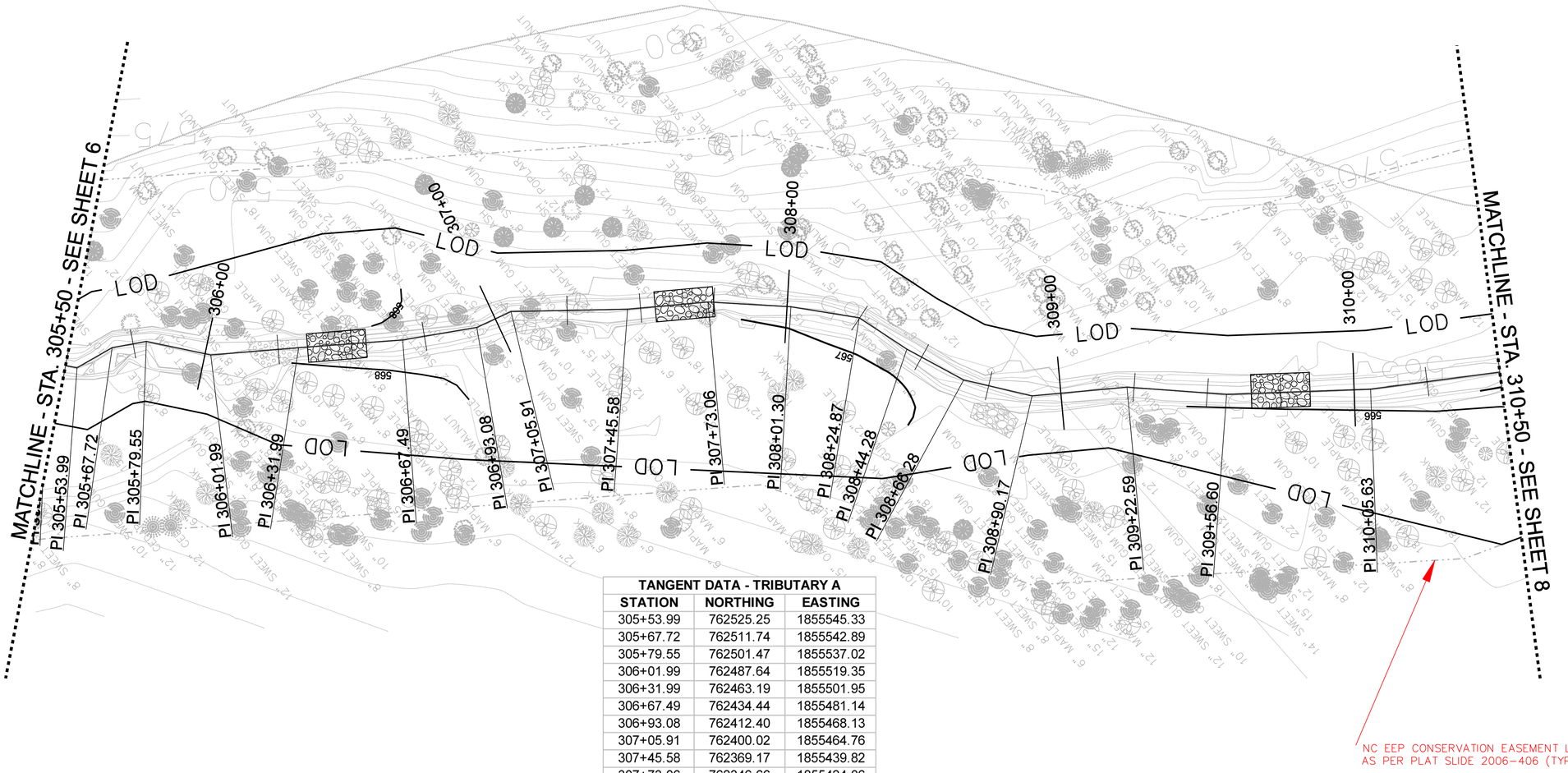
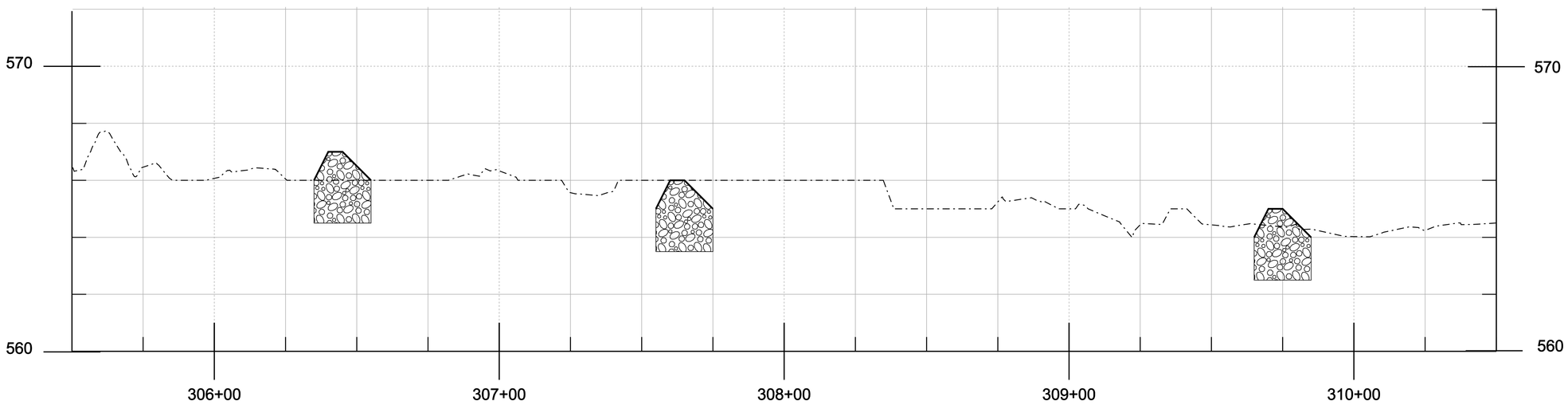


TANGENT DATA - TRIBUTARY A		
STATION	NORTHING	EASTING
305+53.99	762525.25	1855545.33
305+67.72	762511.74	1855542.89
305+79.55	762501.47	1855537.02
306+01.99	762487.64	1855519.35
306+31.99	762463.19	1855501.95
306+67.49	762434.44	1855481.14
306+93.08	762412.40	1855468.13
307+05.91	762400.02	1855464.76
307+45.58	762369.17	1855439.82
307+73.06	762346.66	1855424.06
308+01.30	762326.17	1855404.64
308+24.87	762310.81	1855386.76
308+44.28	762305.27	1855368.15
308+66.28	762297.25	1855347.67
308+90.17	762282.94	1855328.53
309+22.59	762256.36	1855309.98
309+56.60	762232.01	1855286.23
310+05.63	762193.39	1855256.02



HORIZONTAL 0 20 40

VERTICAL 0 2 4

REVISIONS

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Raleigh, NC 27604
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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

GRADING PLAN TRIBUTARY

PROJECT NO.: 06801.03
SCALE: 1" = 20'
SEAL:
DESIGNED BY: VLS/KTN
DRAWN BY: CB
CHECKED: JXR/EMM
APPROVED:
DATE: OCTOBER 2008
DWG. NO.: 7 OF 20

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10/15/2008

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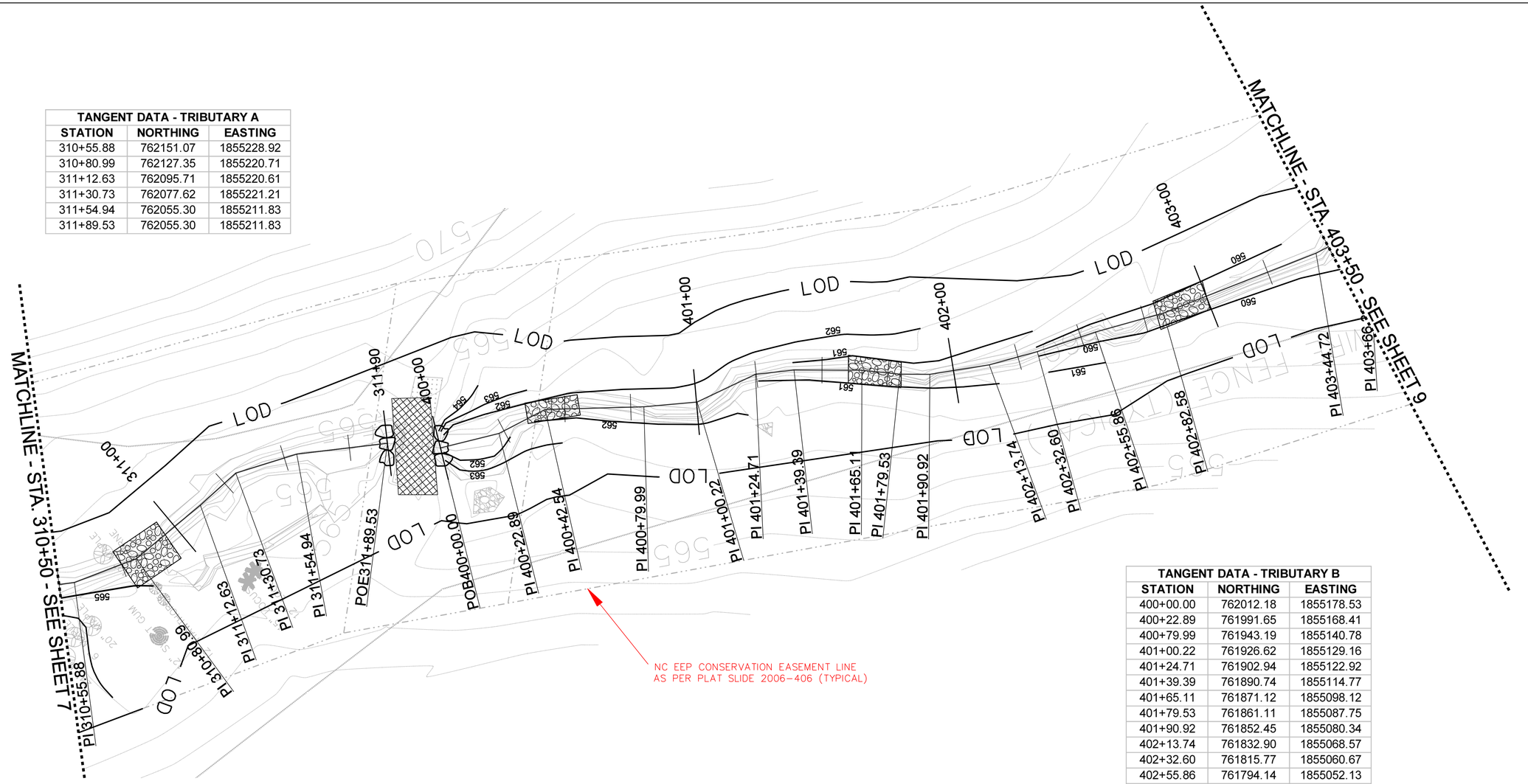
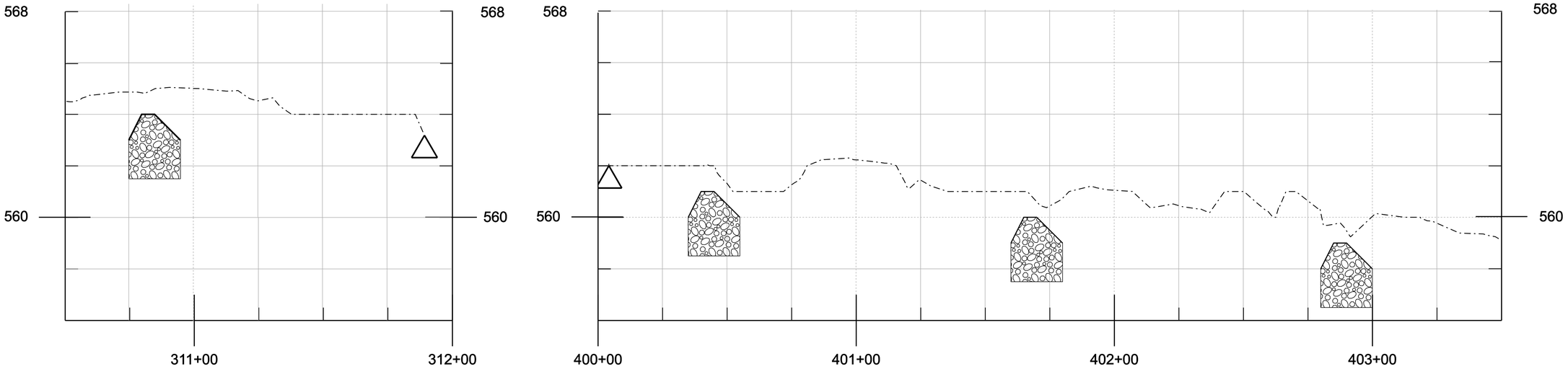
TANGENT DATA - TRIBUTARY A		
STATION	NORTHING	EASTING
310+55.88	762151.07	1855228.92
310+80.99	762127.35	1855220.71
311+12.63	762095.71	1855220.61
311+30.73	762077.62	1855221.21
311+54.94	762055.30	1855211.83
311+89.53	762055.30	1855211.83



TANGENT DATA - TRIBUTARY B		
STATION	NORTHING	EASTING
400+00.00	762012.18	1855178.53
400+22.89	761991.65	1855168.41
400+79.99	761943.19	1855140.78
401+00.22	761926.62	1855129.16
401+24.71	761902.94	1855122.92
401+39.39	761890.74	1855114.77
401+65.11	761871.12	1855098.12
401+79.53	761861.11	1855087.75
401+90.92	761852.45	1855080.34
402+13.74	761832.90	1855068.57
402+32.60	761815.77	1855060.67
402+55.86	761794.14	1855052.13
402+82.58	761769.82	1855041.06
403+44.72	761710.97	1855021.12



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VERTICAL 0 2 4

REVISIONS

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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

GRADING PLAN TRIBUTARY

PROJECT NO.: 06801.03
SCALE: 1" = 20'
SEAL:
DESIGNED BY: VLS/KTN
DRAWN BY: CB
CHECKED: JXR/EMM
APPROVED:
DATE: OCTOBER 2008
DWG. NO.:
8 OF 20

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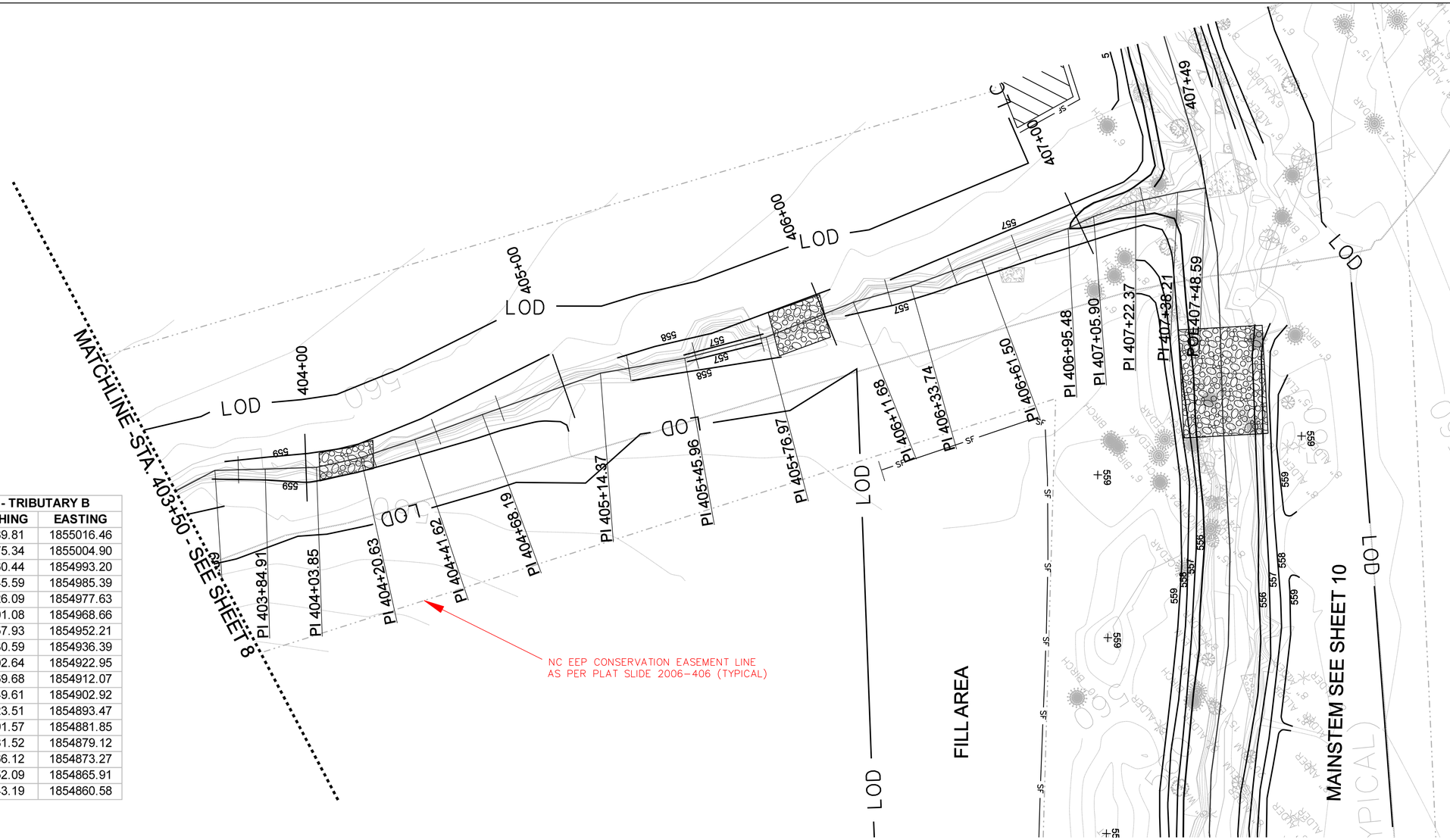
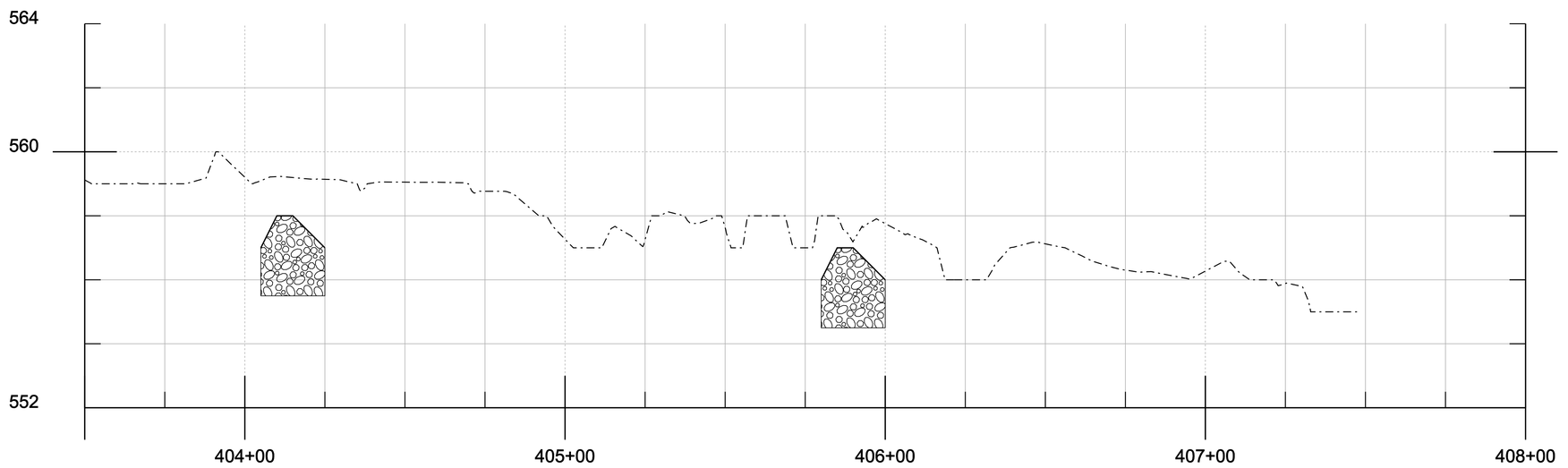
TANGENT DATA - TRIBUTARY B		
STATION	NORTHING	EASTING
403+66.39	761689.81	1855016.46
403+84.91	761675.34	1855004.90
404+03.85	761660.44	1854993.20
404+20.63	761645.59	1854985.39
404+41.62	761626.09	1854977.63
404+68.19	761601.08	1854968.66
405+14.37	761557.93	1854952.21
405+45.96	761530.59	1854936.39
405+76.97	761502.64	1854922.95
406+11.68	761469.68	1854912.07
406+33.74	761449.61	1854902.92
406+61.50	761423.51	1854893.47
406+95.48	761391.57	1854881.85
407+05.90	761381.52	1854879.12
407+22.37	761366.12	1854873.27
407+38.21	761352.09	1854865.91
407+48.59	761343.19	1854860.58





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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

GRADING PLAN TRIBUTARY

PROJECT NO.: 06801.03		SCALE: 1" = 20'	
SEAL:		DESIGNED BY: VLS/KTN	DRAWN BY: CB
		CHECKED: JXR/EMM	APPROVED:
		DATE: OCTOBER 2008	
		DWG. NO.: 9 OF 20	

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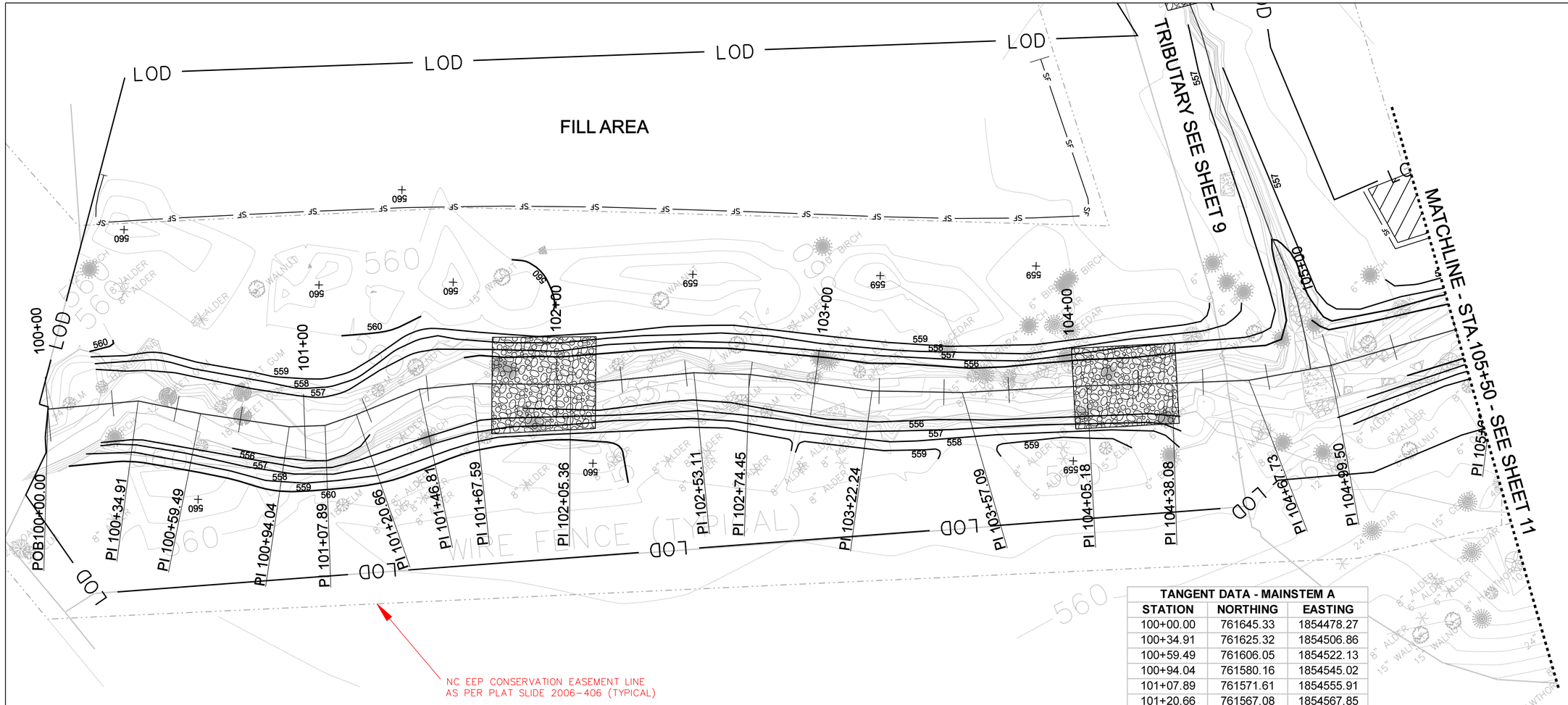
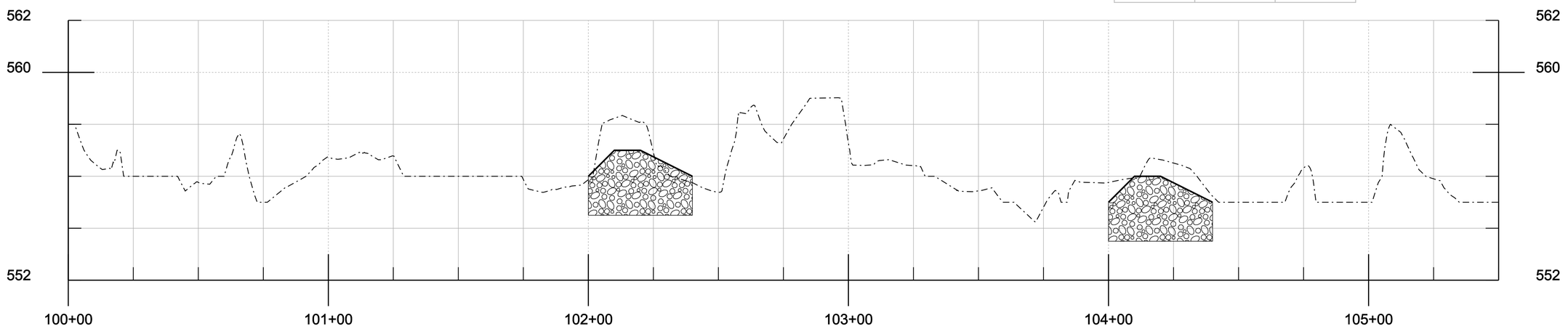


TANGENT DATA - MAINSTEM A		
STATION	NORTHING	EASTING
100+00.00	761645.33	1854478.27
100+34.91	761625.32	1854506.86
100+59.49	761606.05	1854522.13
100+94.04	761580.16	1854545.02
101+07.89	761571.61	1854555.91
101+20.66	761567.08	1854567.85
101+46.81	761558.92	1854592.69
101+67.59	761547.21	1854609.86
102+05.36	761522.61	1854638.52
102+53.11	761495.45	1854677.80
102+74.45	761481.21	1854693.68
103+22.24	761445.82	1854725.81
103+57.09	761422.87	1854752.02
104+05.18	761393.9	1854790.41
104+38.08	761373.45	1854816.18
104+67.73	761355.22	1854839.57
104+99.50	761339.43	1854867.14



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REVISIONS			
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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

GRADING PLAN MAINSTEM

PROJECT NO.: 06801.03
SCALE: 1" = 20'
SEAL:
DESIGNED BY: VLS/KTN
DRAWN BY: CB
CHECKED: JXR/EMM
APPROVED:
DATE: OCTOBER 2008
DWG. NO.:
10 OF 20

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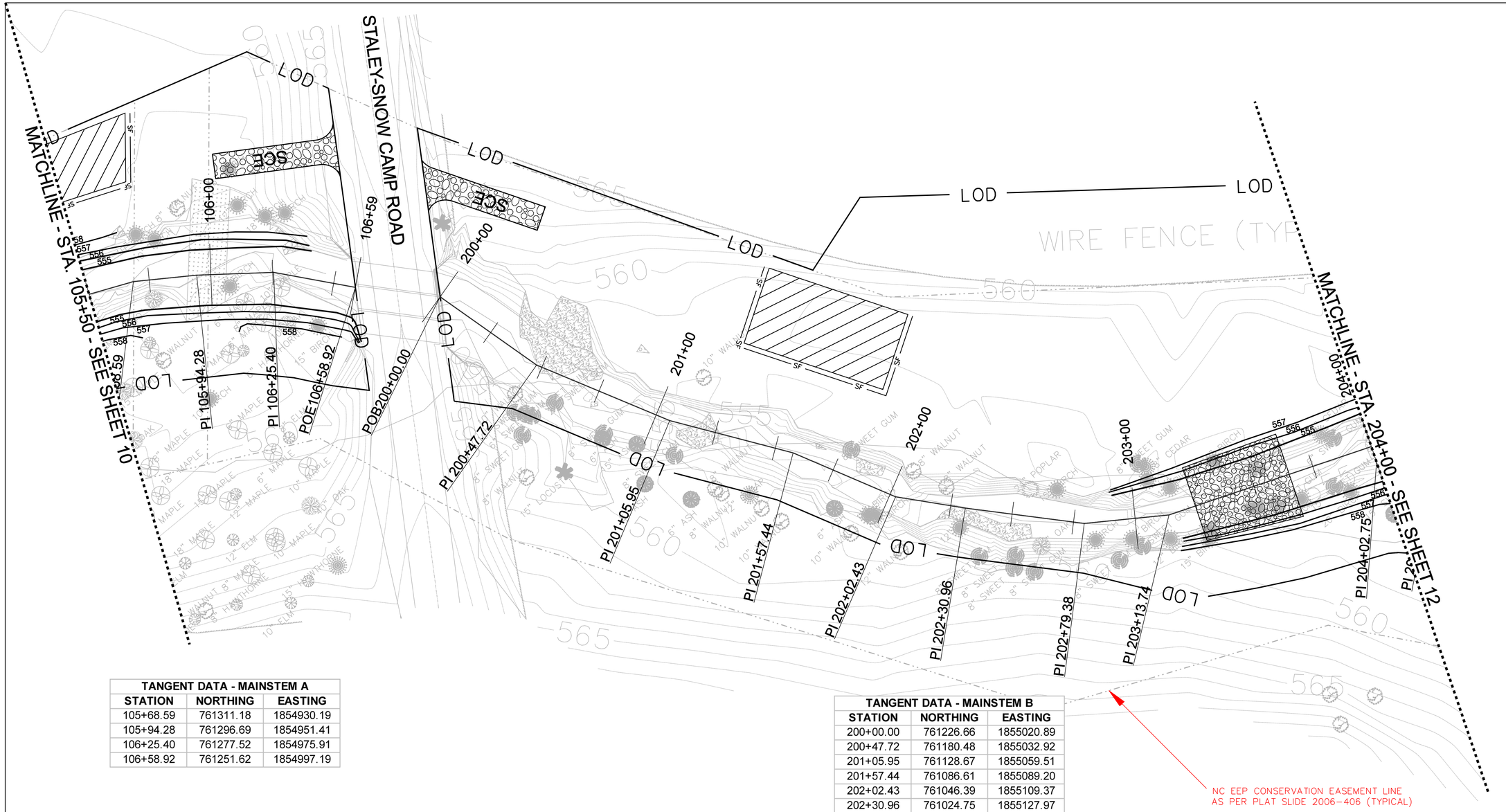
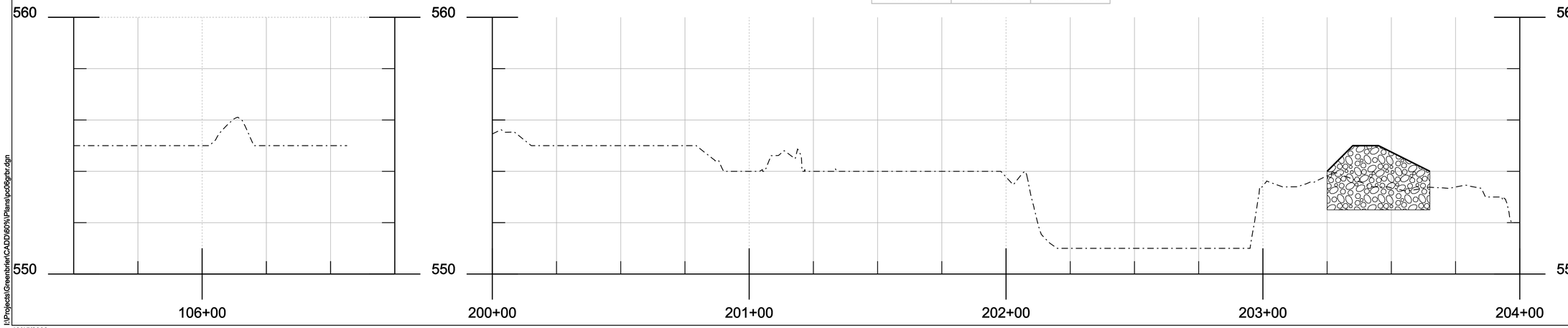


TANGENT DATA - MAINSTEM A		
STATION	NORTHING	EASTING
105+68.59	761311.18	1854930.19
105+94.28	761296.69	1854951.41
106+25.40	761277.52	1854975.91
106+58.92	761251.62	1854997.19

TANGENT DATA - MAINSTEM B		
STATION	NORTHING	EASTING
200+00.00	761226.66	1855020.89
200+47.72	761180.48	1855032.92
201+05.95	761128.67	1855059.51
201+57.44	761086.61	1855089.20
202+02.43	761046.39	1855109.37
202+30.96	761024.75	1855127.97
202+79.38	760989.06	1855160.69
203+13.74	760969.64	1855189.03



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HORIZONTAL 0 20 40

VERTICAL 0 2 4

REVISIONS			
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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

GRADING PLAN MAINSTEM

PROJECT NO.: 06801.03
SCALE: 1" = 20'
SEAL:
DESIGNED BY: VLS/KTN
DRAWN BY: CB
CHECKED: JXR/EMM
APPROVED:
DATE: OCTOBER 2008
DWG. NO.:
11 OF 20

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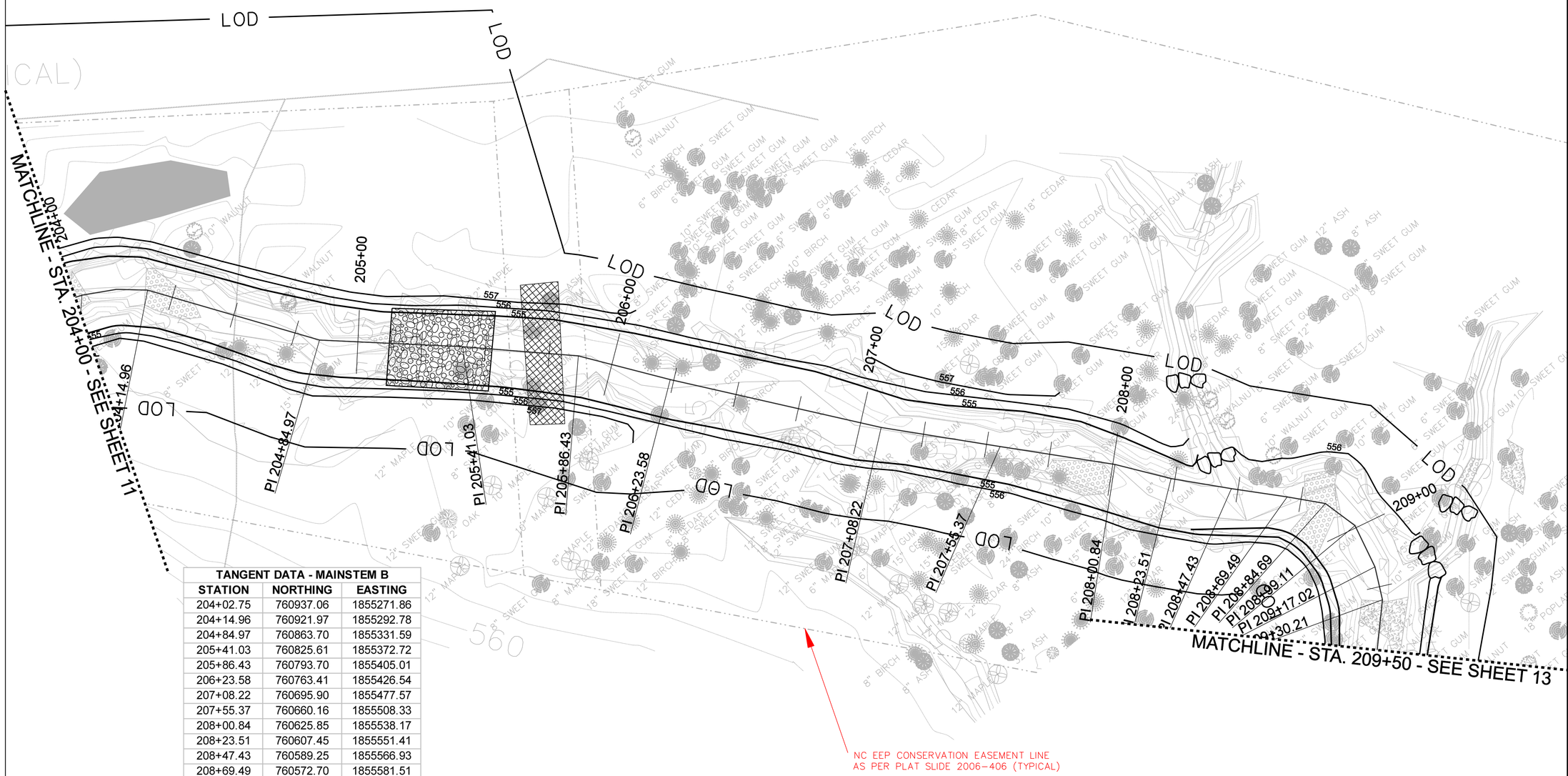
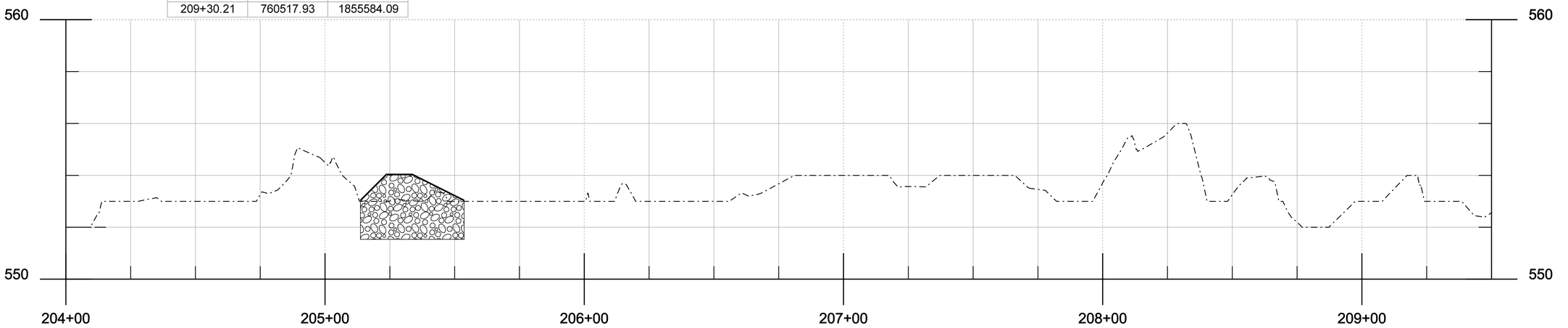


TANGENT DATA - MAINSTEM B		
STATION	NORTHING	EASTING
204+02.75	760937.06	1855271.86
204+14.96	760921.97	1855292.78
204+84.97	760863.70	1855331.59
205+41.03	760825.61	1855372.72
205+86.43	760793.70	1855405.01
206+23.58	760763.41	1855426.54
207+08.22	760695.90	1855477.57
207+55.37	760660.16	1855508.33
208+00.84	760625.85	1855538.17
208+23.51	760607.45	1855551.41
208+47.43	760589.25	1855566.93
208+69.49	760572.70	1855581.51
208+84.69	760561.05	1855591.28
208+99.11	760547.00	1855594.56
209+17.02	760529.65	1855590.14
209+30.21	760517.93	1855584.09



HORIZONTAL 0 20 40

VERTICAL 0 2 4

REVISIONS

Mark	Description	Date	Appr.

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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

GRADING PLAN MAINSTEM

PROJECT NO.: 06801.03
SCALE: 1" = 20'
SEAL:
DESIGNED BY: VLS/KTN
DRAWN BY: CB
CHECKED: JXR/EMM
APPROVED:
DATE: OCTOBER 2008
DWG. NO.:
12 OF 20

I:\Projects\Greenbrier\CADD\60%\Plans\pc07gbr.dgn
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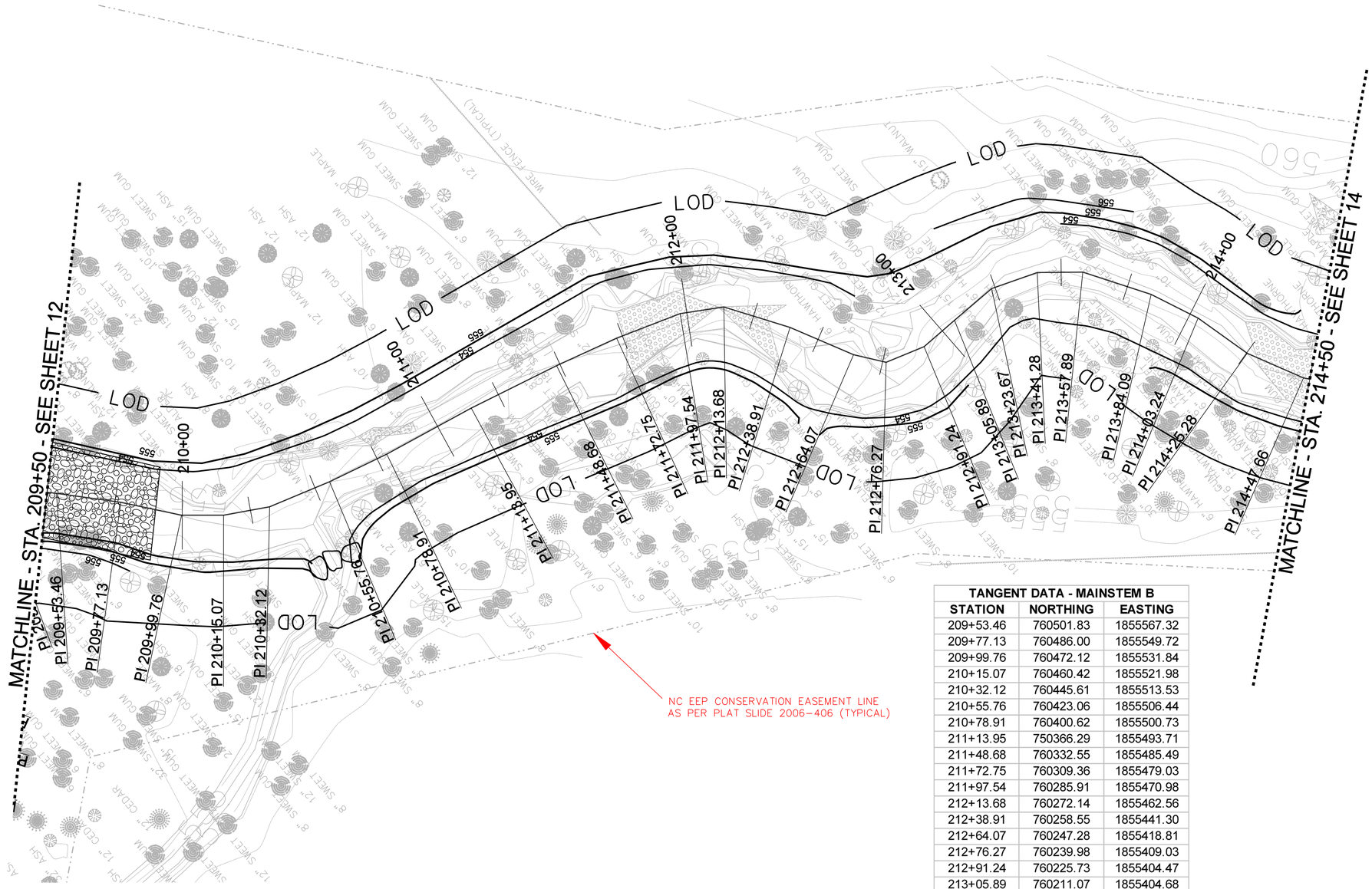
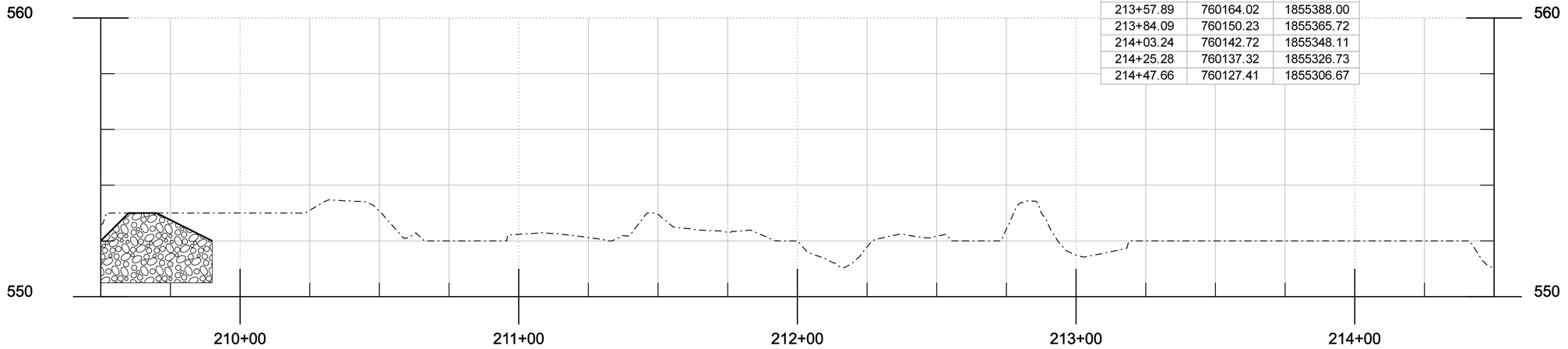


TANGENT DATA - MAINSTEM B		
STATION	NORTHING	EASTING
209+53.46	760501.83	1855567.32
209+77.13	760486.00	1855549.72
209+99.76	760472.12	1855531.84
210+15.07	760460.42	1855521.98
210+32.12	760445.61	1855513.53
210+55.76	760423.06	1855506.44
210+78.91	760400.62	1855500.73
211+13.95	750366.29	1855493.71
211+48.68	760332.55	1855485.49
211+72.75	760309.36	1855479.03
211+97.54	760285.91	1855470.98
212+13.68	760272.14	1855462.56
212+38.91	760258.55	1855441.30
212+64.07	760247.28	1855418.81
212+76.27	760239.98	1855409.03
212+91.24	760225.73	1855404.47
213+05.89	760211.07	1855404.68
213+23.67	760193.29	1855404.80
213+41.28	760176.82	1855398.58
213+57.89	760164.02	1855388.00
213+84.09	760150.23	1855365.72
214+03.24	760142.72	1855348.11
214+25.28	760137.32	1855326.73
214+47.66	760127.41	1855306.67



HORIZONTAL 0 20 40

VERTICAL 0 2 4

REVISIONS

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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

GRADING PLAN MAINSTEM

PROJECT NO.: 06801.03
SCALE: 1" = 20'
SEAL:
DESIGNED BY: VLS/KTN
DRAWN BY: CB
CHECKED: JXR/EMM
APPROVED:
DATE: OCTOBER 2008
DWG. NO. :
13 OF 20

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10/15/2008

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MATCHLINE - STA. 214+50 - SEE SHEET 13

LOD

PI 214+69.18
PI 214+90.86
PI 215+07.18
PI 215+37.58
PI 215+69.04
PI 215+85.67
PI 216+01.08
PI 216+17.86
PI 216+34.34
PI 216+49.37
PI 216+64.19
PI 216+86.66
PI 217+14.51
PI 217+22.72
PI 217+32.26
PI 217+41.48
PI 217+65.17
PI 217+89.20
PI 218+06.87
PI 218+23.33
PI 218+39.52
PI 218+61.01
PI 218+96.26
PI 219+26.55
POE 219+65.39

215+00
216+00
217+00
218+00
219+00
219+65

554
555
556

NC EEP CONSERVATION EASEMENT LINE
AS PER PLAT SLIDE 2006-406 (TYPICAL)

MIRE FENCE (TYPICAL)

TANGENT DATA - MAINSTEM B

STATION	NORTHING	EASTING
214+69.18	760113.75	1855290.04
214+90.86	760097.83	1855275.33
215+07.18	760084.65	1855265.71
215+37.58	760059.72	1855248.31
215+69.04	760033.51	1855230.90
215+85.67	760020.29	1855220.82
216+01.08	760005.67	1855215.94
216+17.86	759989.13	1855213.07
216+34.34	759974.61	1855205.30
216+49.37	759967.04	1855192.31
216+64.19	759963.39	1855177.95
216+86.66	759958.90	1855155.93
217+14.51	759945.34	1855131.61
217+22.72	759938.60	1855126.91
217+32.26	759929.46	1855124.18
217+41.48	759920.33	1855122.88
217+65.17	759896.64	1855122.70
217+89.20	759873.20	1855117.42
218+06.87	759857.00	1855110.36
218+23.33	759844.95	1855099.14
218+39.52	759835.19	1855086.22
218+61.01	759821.43	1855069.72
218+96.26	759796.12	1855045.19
219+26.55	759773.39	1855025.17
219+65.39	759739.07	1855006.97

560
550
215+00
216+00
217+00
218+00
219+00

HORIZONTAL 0 20 40
VERTICAL 0 2 4

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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:
GRADING PLAN MAINSTEM

PROJECT NO.: 06801.03
SCALE: 1" = 20'
SEAL:
DESIGNED BY: VLS/KTN
DRAWN BY: CB
CHECKED: JXR/EMM
APPROVED:
DATE: OCTOBER 2008
DWG. NO.:
14 OF 20

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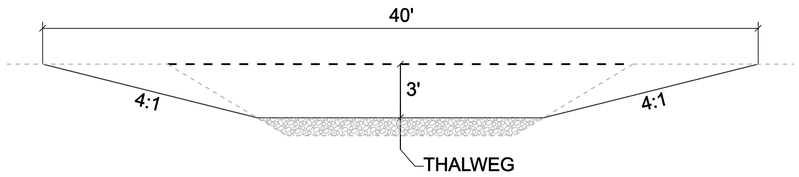
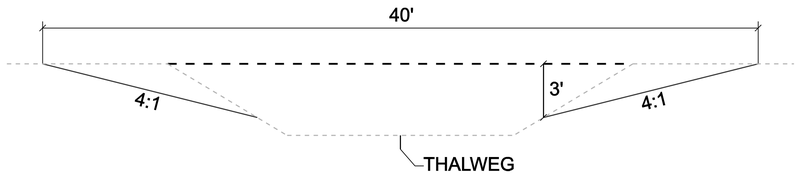


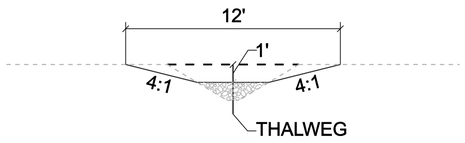
MAINSTEM TYPICAL CROSS SECTION
AT RIFFLE STRUCTURE

NOT TO SCALE



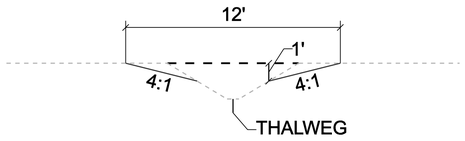
MAINSTEM TYPICAL CROSS SECTION

NOT TO SCALE



TRIBUTARY TYPICAL CROSS SECTION
AT RIFFLE STRUCTURE

NOT TO SCALE



TRIBUTARY TYPICAL CROSS SECTION

NOT TO SCALE

EXISTING GRADE
PROPOSED GRADE
PROPOSED BANKFULL

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CHATHAM COUNTY, NC.

TITLE:

TYPICAL CROSS SECTION

PROJECT NO.: 06801.03
SEAL:
SCALE:
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Table 4. Morphological Table						
Project Number 040621002 (Greenbrier Creek Stream Restoration)						
Item	**Existing Conditions**	**Designed Conditions**	**Existing Conditions**	**Existing Conditions**	**Designed Conditions**	**Reference Reach**
LOCATION	Greenbrier Cr	Greenbrier Cr	UT u/s of culvert	UT d/s of culvert	UT	Landum Cr.
STREAM TYPE	E5	C5	G4c		C4	C4
DRAINAGE AREA, Ac-Sq Mi	3207 ac-5.0 mi^2	3207 ac-5.0 mi^2	181 ac-0.3 mi^2	181 ac-0.3 mi2	181 ac-0.3 mi2	1619 ac-2.5 mi^2
BANKFULL RIFFLE WIDTH, (W_{bkf}), ft	20.0	35.0	6.6	3.2	12.0	27.6
BANKFULL MEAN RIFFLE DEPTH (d_{bkf}), ft	2.5	1.8	0.9	0.9	0.7	1.2
MAXIMUM BANKFULL RIFFLE DEPTH (d_{max}), ft	3.2	2.5	1.2	1.4	1.0	2.0
WIDTH/DEPTH RATIO (W_{bkf}/d_{bkf})	8.1	20.0	7.4	3.7	18.0	23.0
BANKFULL RIFFLE X-SECTION AREA (A_{bkf}), ft^2	50.4	61.0	5.8	2.7	7.8	33.5
BANKFULL MEAN VELOCITY, fps	3.9	3.3	2.6	0.6	1.9	5.2
BANKFULL DISCHARGE, cfs	195.0	195.0	15.0	1.7	15.0	174.0
WIDTH FLOODPRONE AREA (W_{fpa}), ft	160-200	160-200	8.0	50.0	40.0	140.0
ENTRENCHMENT RATIO (ER)	>2.2	>2.2	1.2	>2.2	>2.2	5.1
MEANDER L. (Lm), ft	N/A	N/A	N/A	N/A	N/A	94-100
RADIUS OF CURVATURE (R_c), ft	N/A	N/A	N/A	N/A	N/A	10-13 (NA)
BELT WIDTH (W_{blt}), ft	N/A	N/A	N/A	N/A	N/A	77 (NA)
MEANDER W. RATIO	N/A	N/A	N/A	N/A	N/A	2.8
SINUOSITY	1.0	1.0	1.0	1.0	1.0	1.1
AVERAGE BANKFULL SLOPE (s), ft/ft	0.0009	0.0009	0.0038	0.0030	0.0038	0.0077
VALLEY SLOPE (s), ft/ft	0.0019	0.0019	0.007	0.007	0.007	0.008
POOL BANKFULL WIDTH (W_{pool}), ft	46.7	N/A	N/A	N/A	N/A	27.4
MAX. POOL DEPTH (D_{pool}), ft	4.5	N/A	N/A	N/A	N/A	2.8
POOL X-SECTION AREA (A_{pool}) ft^2	90.0	N/A	N/A	N/A	N/A	N/A
POOL TO POOL SPACING (P-P) ft	N/A	N/A	N/A	N/A	N/A	25-104
BANK HEIGHT RATIO	1.0	1.0	2.3	<1.0	1.0	~1.0
CHANNEL MATERIALS						
SIZE DISTRIBUTION						
D16, mm	0.37	NA	0.5	NA	NA	0.09
D35, mm	0.7	NA	1.74	0.25	NA	1.5
D50, mm	4	NA	9.9	0.60	NA	9.5
D84, mm	10	NA	61	2.00	NA	65
D95, mm	15	NA	103	6.00	NA	120

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MORPHOLOGY TABLE

PROJECT NO.: 06801.03
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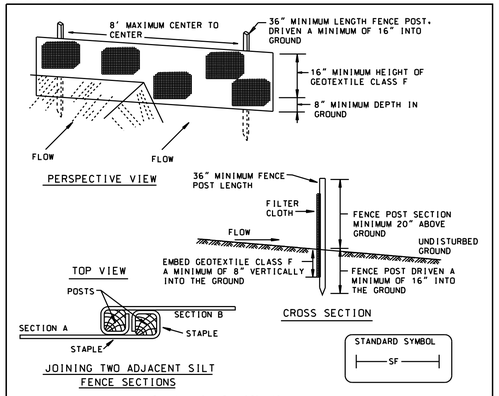
SILT FIBER



Construction Specifications

1. Fence posts shall be a minimum of 36" long driven 16" minimum into the ground. Wood posts shall be 1½" x 1½" square (minimum) cut, or 1¾" diameter (minimum) round and shall be of sound quality hardwood. Steel posts will be standard T or U section weighting not less than 1.00 pond per linear foot.

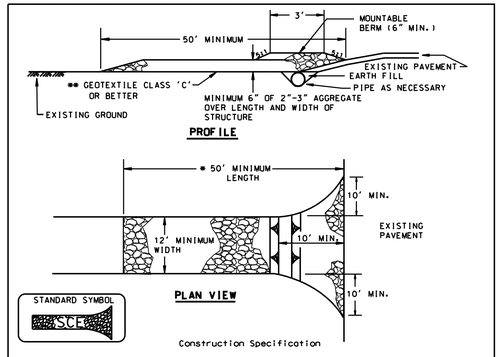
2. Geotextile shall be fastened securely to each fence post with wire ties or staples at top and mid-section and shall meet the following requirements for Geotextile Class F:

Tensile Strength	50 lbs/in (min.)	Test: MSMT 509
Tensile Modulus	20 lbs/in (min.)	Test: MSMT 509
Flow Rate	0.3 gal ft²/ minute (max.)	Test: MSMT 322
Filtering Efficiency	75% (min.)	Test: MSMT 322

3. Where ends of geotextile fabric come together, they shall be overlapped, folded and stapled to prevent sediment bypass.

4. Silt Fence shall be inspected after each rainfall event and maintained when bulges occur or when sediment accumulation reached 50% of the fabric height.

STABILIZED CONSTRUCTION ENTRANCE



Construction Specification

1. Length - minimum of 50' (*30' for single residence lot).

2. Width - 10' minimum, should be flared at the existing road to provide a turning radius.

3. Geotextile fabric (filter cloth) shall be placed over the existing ground prior to placing stone. **The plan approval authority may not require single family residences to use geotextile.

4. Stone - crushed aggregate (2" to 3") or reclaimed or recycled concrete equivalent shall be placed at least 6" deep over the length and width of the entrance.

5. Surface Water - all surface water flowing to or diverted toward construction entrances shall be piped through the entrance, maintaining positive drainage. Pipe installed through the stabilized construction entrance shall be protected with a mountable berm with 5:1 slopes and a minimum of 6" of stone over the pipe. Pipe has to be sized according to the drainage. When the SCE is located at a high spot and has no drainage to convey a pipe will not be necessary. Pipe should be sized according to the amount of runoff to be conveyed. A 6" minimum will be required.

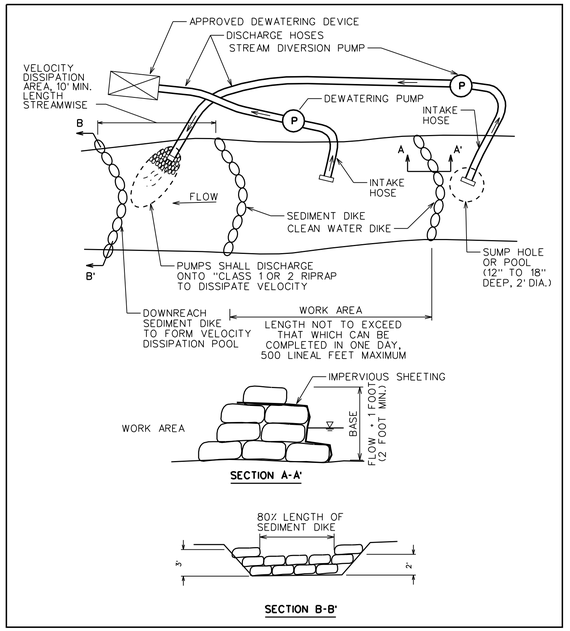
6. Location - A stabilized construction entrance shall be located at every point where construction traffic enters or leaves a construction site. Vehicles leaving the site must travel over the entire length of the stabilized construction entrance.

TEMPORARY HERBACEOUS SEED

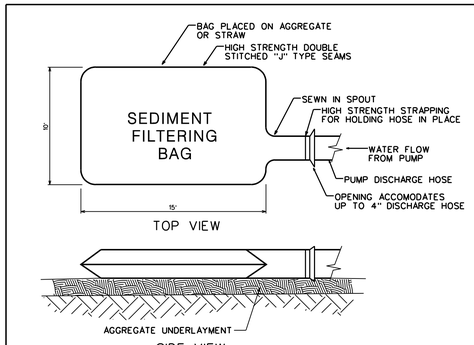
Date	Species Name	Common Name	Unit	Additional Amendment	Quantity LBS/per acre
Jan.1-May 15	*Secale cereale*	Rye grain	LB of P.L.S. 76 %		35
				Ground Limestone	4,000
				Organic Fertilizer	320
				Straw Mulch	4,000
May 15-Aug.15	*Setaria italica*	German millet	LB of P.L.S. 76 %		40
				Ground Limestone	4,000
				Organic Fertilizer	320
				Straw Mulch	4,000
Aug. 15-Dec. 31	*Secale cereale*	Rye grain	LB of P.L.S. 76 %		35
				Ground Limestone	4,000
				Organic Fertilizer	320
				Straw Mulch	4,000

Notes:
1. SELECT AN APPROPRIATE TEMPORARY SPECIES BASED ON THE DATES GIVEN.
2. AVOID SEEDING IN DECEMBER OR JANUARY. IF NECESSARY TO SEED AT THESE TIMES, USE RYE GRAIN AND A SECURELY TACKED MULCH.
3. APPLY SOIL AMENDMENTS EVENLY AND INCORPORATE TO A DEPTH OF 4-6 INCHES. LOOSEN SURFACE JUST BEFORE BROADCASTING.
4. MULCH MUST COVER 75% OF THE GROUND SURFACE.

PUMP AROUND AND VELOCITY DISSIPATER



DEWATERING BAG DETAIL FOR CONTROL OF SEDIMENT IN PUMPED WATER



THE DEWATERING BAG SHALL BE MADE OF NON-WOVEN GEOTEXTILE WITH A MIN. SURFACE AREA OF 225 SQUARE FEET PER SIDE. ALL STRUCTURAL SEAMS SHALL BE SEWN WITH A DOUBLE STITCH USING A DOUBLE NEEDLE MACHINE WITH HIGH STRENGTH THREAD. THE SEAM STRENGTH SHALL WITHSTAND 100 lb/in. USING ASTM D-4884 TEST METHOD. THE DEWATERING BAG SHALL HAVE A NOZZLE LARGE ENOUGH TO ACCOMODATE A FOUR INCH DISCHARGE HOSE. THE NOZZLE SHALL BE SEALED TIGHTLY AROUND THE DISCHARGE HOSE WITH A STRAP OR SIMILAR DEVICE TO PREVENT UNTREATED WATER FROM ESCAPING. THE GEOTEXTILE FABRIC SHALL BE A NON-WOVEN FABRIC WITH THE FOLLOWING PROPERTIES:

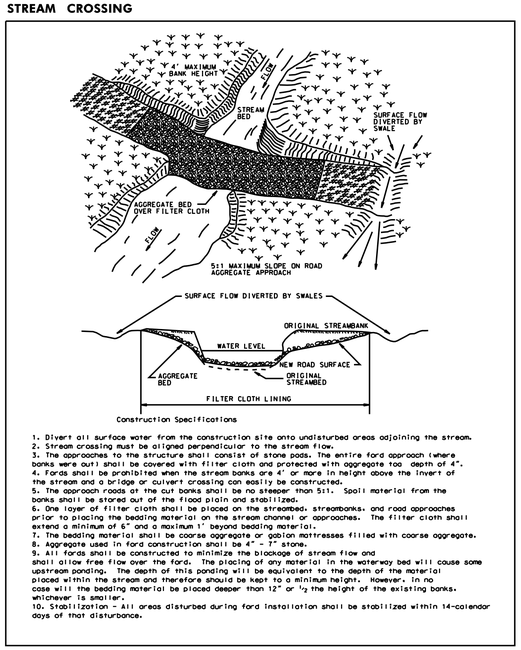
NOTE:
DIRTBAG 55 TEST METHOD:ASTM D-4884
TEST RESULT:100LB/IN

GEOTEXTILE FABRIC FOR DIRTBAG			
PROPERTIES	TEST METHOD	UNITS	NONWOVEN 55
WEIGHT	ASTM D-3776	OZ/YD	10
GRAB TENSILE	ASTM D-4632	LBS.	270
PUNCTURE	ASTM D-4833	LBS.	150
FLOW RATE	ASTM D-4491	GAL/MIN/FT2	70
PERMITIVITY	ASTM D-4491	SEC-1	1.3
MULLEN BURST	ASTM D-3786	LBS.IN2	550
UV RESISTANT	ASTM D-4355	%	70
AOS % RETAINED	ASTM D-4751	%	100

NOTE:
ALL PROPERTIES ARE MINIMUM AVERAGE ROLL VALUE EXCEPT THE WEIGHT OF THE FABRIC WHICH IS GIVEN FOR INFORMATION ONLY.

CONSTRUCTION: THE DEWATERING BAG SHALL BE INSTALLED OVER A 3 INCH GRAVEL BASE TO PROMOTE INFILTRATION AND DEWATERING OF THE BAG.

STREAM CROSSING



Construction Specifications

1. Divert all surface water from the construction site onto undisturbed areas adjoining the stream.
2. Stream crossing must be aligned perpendicular to the stream flow.
3. The approaches to the structure shall consist of stone pads. The entire ford approach (where banks were cut) shall be covered with filter cloth and protected with aggregate top depth of 4".
4. Fords shall be prohibited when the stream banks are 4" or more in height above the invert of the stream and a bridge or culvert crossing can easily be constructed.
5. The approach roads at the cut banks shall be no steeper than 5:1. Spoil material from the banks shall be stored out of the flood plain and stabilized.
6. One layer of filter cloth shall be placed on the streambed, streambanks, and road approaches prior to placing the bedding material on the stream channel or approaches. The filter cloth shall extend a minimum of 6" and a maximum 1' beyond bedding material.
7. The bedding material shall be coarse aggregate or gabion mattresses filled with coarse aggregate.
8. Aggregate used in ford construction shall be 4" - 7" stone.
9. All fords shall be constructed to minimize the blockage of stream flow and shall allow free flow over the ford. The placing of any material in the waterway bed will cause some upstream ponding. The depth of this ponding will be equivalent to the depth of the material placed within the stream and therefore should be kept to a minimum height. However, in no case will the bedding material be placed deeper than 12" or ½ the height of the existing banks, whichever is smaller.
10. Stabilization - All areas disturbed during ford installation shall be stabilized within 14-calendar days of that disturbance.

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GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

EROSION & SEDIMENT CONTROL DETAILS

PROJECT NO.: 06801.03	SCALE:	
SEAL:	DESIGNED BY: VLS/KTN	DRAWN BY: CB
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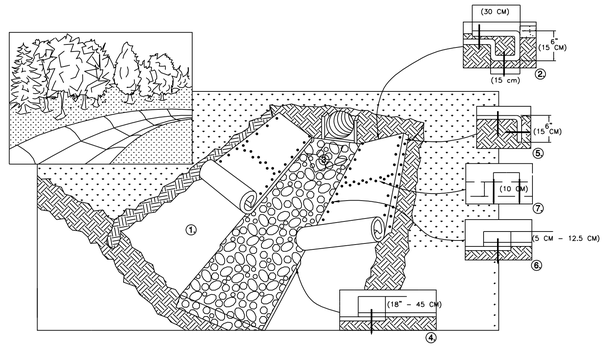
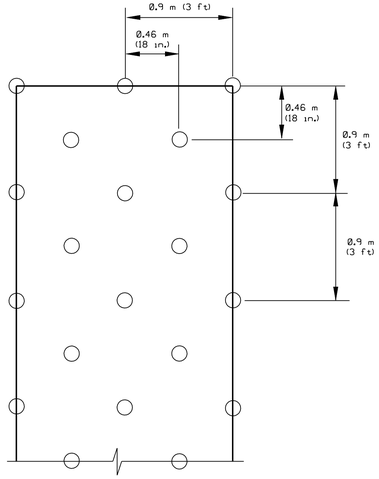
COIR FIBER AND TEMPORARY MATTING - PLAN VIEW



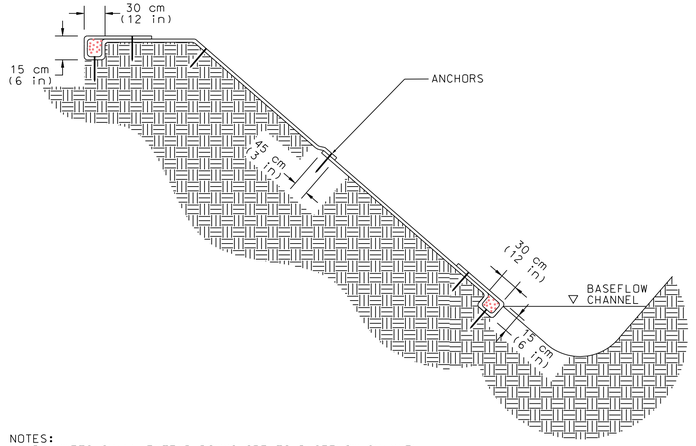
1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP's), INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL-O-SEED DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE CHANNEL BY ANCHORING THE RECP's IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH WITH APPROXIMATELY 12" (30 CM) OF RECP's EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP's WITH A ROW OF STAKES APPROXIMATELY 12" (30 CM) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAKING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30 CM) PORTION OF RECP's BACK OVER SEED AND COMPACTED SOIL. SECURE RECP's OVER COMPACTED SOIL WITH A ROW OF STAKES SPACED APPROXIMATELY 12" (30 CM) ACROSS THE WIDTH OF THE RECP's.
3. ROLL CENTER RECP's IN DIRECTION OF WATER FLOW IN BOTTOM OF CHANNEL. RECP's WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP's MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM™,STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAKE PATTERN.
4. PLACE CONSECUTIVE RECP's END OVER END (SHINGLE STYLE) WITH A 18" (45 CM) OVERLAP. USE A DOUBLE ROW OF STAKES STAGGERED 4" (10 CM) APART AND 4" (10 CM) ON CENTER TO SECURE RECP's.
5. FULL LENGTH EDGE OF RECP's AT TOP OF SIDE SLOPES MUST BE ANCHORED WITH A ROW OF STAKES APPROXIMATELY 12" (30 CM) APART IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
6. ADJACENT RECP's MUST BE OVERLAPPED APPROXIMATELY 2" - 5" (5 CM -12.5 CM) (DEPENDING ON RECP's TYPE) AND STAKED.
7. IN HIGH FLOW CHANNEL APPLICATIONS, A STAKED CHECK SLOT IS RECOMMENDED AT 30 TO 40 FOOT (9 M - 12 M) INTERVALS. USE A DOUBLE ROW OF STAKES STAGGERED 4" (10 CM) APART AND 4" (10 CM) ON CENTER OVER ENTIRE WIDTH OF THE CHANNEL.
8. THE TERMINAL END OF THE RECP's MUST BE ANCHORED WITH A ROW OF STAKES APPROXIMATELY 12" (30 CM) APART IN A 6" (15 CM) DEEP X 6" (15 CM) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAKING.

COIR FIBER AND TEMPORARY MATTING - STAKE PATTERN GUIDE



NOTES:
1. ANCHOR PATTERN 2.5 ANCHORS / $m^3/_{64}$ (2 ANCHORS / $Yd^3/_{64}$) FOR : 2H : 1V < SLOPES < 1H : 1V)
2. WOODEN STAKES SHALL BE USED TO ANCHOR COIR MATTING TO THE GROUND SURFACE.
3. KEY COIR MATTING INTO TOE OF SLOPE. SECURE WITH 1.5"x1.5"x18" HARDWOOD STAKES. CONTRACTOR SHALL CUT NOTCH INTO SIDE OF STACK 1" FROM TOP.
4. USE 1.5"x1.5"x18" HARDWOOD STAKES TO SECURE ALL OTHER AREAS OF COIR MATTING, USING NOTCHES AS IN #3.
5. USE 6" - 11 GAUGE WIRE STAPLES TO SECURE TEMPORARY MATTING. LONGER STAPLES ARE REQUIRED IN LOOSE SOIL.

COIR FIBER MATTING - TYPICAL SLOPE CROSS SECTION



NOTES:
1. BLANKETS SHALL EXTEND DOWNSLOPE TO BASEFLOW CHANNEL.
2. SECURE BOTTOM EDGE OF BLANKET AS DONE AT TOP OF SLOPE.

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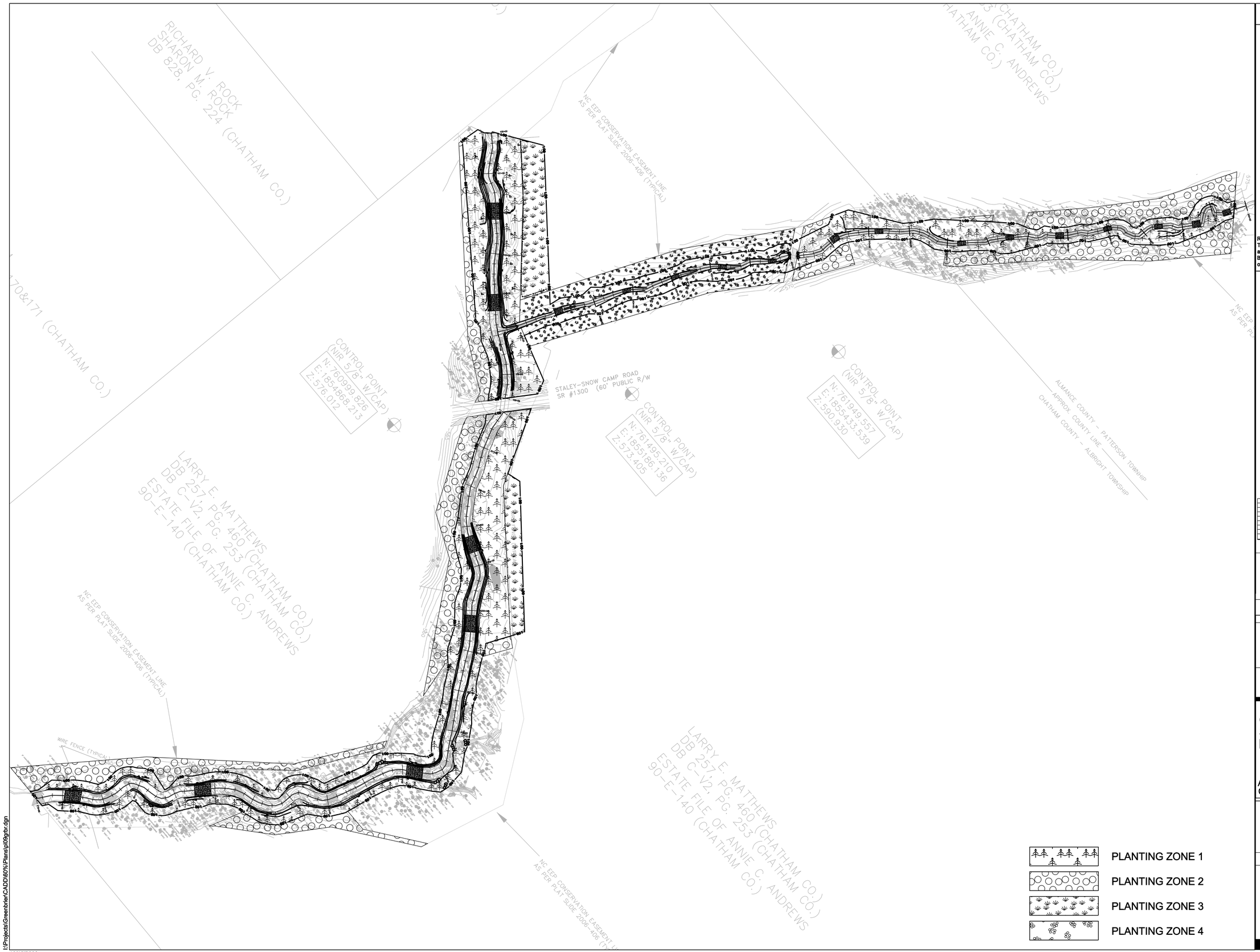

PLANTING ZONE 1

PLANTING ZONE 2

PLANTING ZONE 3

PLANTING ZONE 4

N

HORIZONTAL
0 100 200

REVISIONS			
Mark	Description	Date	Appr.

North Carolina
Ecosystem Enhancement Program
2728 Capitol Blvd, Suite 1H 103
Raleigh, NC 27604
Tel:919-715-0476

Biohabitats
8218 Creedmoor Rd, Suite 200
Raleigh, NC 27613
Tel: 919-518-0311 Fax: 919-518-0313
www.biohabitats.com
Inspiring Ecological Stewardship

GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

PLANTING PLAN

PROJECT NO.: 06801.03	SCALE: 1" = 100'	
SEAL:	DESIGNED BY: VLS/KTN	DRAWN BY: CB
	CHECKED: JXR/EMM	APPROVED:
	DATE: OCTOBER 2008	
	DWG. NO.: 19 OF 20	

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10/15/2008

100% SUBMITTAL

PLANT COMPOSITION SCHEDULE

NOTE: EACH TREE SPECIES SHOULD COMPRISE AT LEAST 10% AND NO MORE THAN 25% OF THE TOTAL STEMS PLANTED IN EACH VEGETATION STRATA

Riparian Woodlands - Mesic-Plant in Zones 1 and 2 — Acres= 8.6

Overall Spacing (feet off center)	Quantity per acre	Maximum Frequency (%)	Maximum Stem Quantity	Vegetation Strata/ Species Name	Common Name	Unit Type	Size	Spacing Type	Individual Spacing (ft.)
14.5	380			**TREES: Minimum of 5 Species**					
		20	654	*Fraxinus pennsylvanica*	Green Ash	container	2-3'	Random	24
		20	654	*Liriodendron tulipifera*	Tulip Poplar	container	2-3'	Random	24
		20	654	*Quercus phellos*	Willow Oak	container	2-3'	Random	24
		20	654	*Quercus falcata*	Southern Red Oak	container	2-3'	Random	24
		20	654	*Platanus occidentalis*	Sycamore	container	2-3'	Random	24
		20	654	*Nyssa sylvatica*	Black Gum	container	2-3'	Random	24
		20	654	*Ulmus americana*	American Elm	container	2-3'	Random	24
		20	654	*Acer rubrum*	Red Maple	container	2-3'	Random	24
		20	654	*Acer negundo*	Box Elder	container	2-3'	Random	24
		20	654	*Prunus serotina*	Black Cherry	container	2-3'	Random	24
			3270	**TOTAL**					
17	150			**MIDSTORY TREES: Minimum of 5 Species**					
		20	258	*Betula nigra*	River Birch	container	2-3'	Random	38
		20	258	*Ostrya virginiana*	American Hophornbeam	container	2-3'	Random	38
		20	258	*Ilex decidua*	Deciduous Holly	container	2-3'	Random	38
		20	258	*Oxydendron arboretum*	Sourwood	container	2-3'	Random	38
		20	258	*Amelanchier canadensis*	Serviceberry	container	2-3'	Random	38
		20	258	*Chionanthus virginicus*	Fringetree	container	2-3'	Random	38
		20	258	*Cercis canadensis*	Redbud	container	2-3'	Random	38
			1290	**TOTAL**					
17	150			**SHRUBS and VINES: Minimum of 5 Species**					
		20.0	258	*Lindera benzoin*	Spicebush	container	18-24"	Random	38
		20.0	258	*Calycanthus florida*	Sweetshrub	container	18-24"	Random	38
		20.0	258	*Alnus serrulata*	Tag Alder	container	18-24"	Random	38
		20.0	258	*Callicarpa americana*	American Beautyberry	container	18-24"	Random	38
		20.0	258	*Hydrangea arborescens*	Wild Hydrangea	container	18-24"	Random	38
		20.0	258	*Vaccinium stamineum*	Common Deerberry	container	18-24"	Random	38
		20.0	258	*Viburnum dentatum*	Southern Arrowwood	container	18-24"	Random	38
	680		**1290**	**TOTAL**					

CON=container

Riparian Woodlands - Mesic-Plant in Zone 4 — Acres= 1.7

Overall Spacing (feet off center)	Quantity per acre	Maximum Frequency (%)	Maximum Stem Quantity	Vegetation Strata/ Species Name	Common Name	Unit Type	Size	Spacing Type	Individual Spacing (ft.)
14.5	380			**TREES: Minimum of 5 Species**					
		20	129	*Fraxinus pennsylvanica*	Green Ash	container	2-3'	Random	24
		20	129	*Liriodendron tulipifera*	Tulip Poplar	container	2-3'	Random	24
		20	129	*Quercus phellos*	Willow Oak	container	2-3'	Random	24
		20	129	*Quercus falcata*	Southern Red Oak	container	2-3'	Random	24
		20	129	*Platanus occidentalis*	Sycamore	container	2-3'	Random	24
		20	129	*Nyssa sylvatica*	Black Gum	container	2-3'	Random	24
		20	129	*Ulmus americana*	American Elm	container	2-3'	Random	24
		20	129	*Acer rubrum*	Red Maple	container	2-3'	Random	24
		20	129	*Acer negundo*	Box Elder	container	2-3'	Random	24
		20	129	*Prunus serotina*	Black Cherry	container	2-3'	Random	24
			645	**TOTAL**					
17	150			**MIDSTORY TREES: Minimum of 5 Species**					
		20	51	*Betula nigra*	River Birch	container	2-3'	Random	38
		20	51	*Ostrya virginiana*	American Hophornbe	container	2-3'	Random	38
		20	51	*Ilex decidua*	Deciduous Holly	container	2-3'	Random	38
		20	51	*Oxydendron arboretum*	Sourwood	container	2-3'	Random	38
		20	51	*Amelanchier canadensis*	Serviceberry	container	2-3'	Random	38
		20	51	*Chionanthus virginicus*	Fringetree	container	2-3'	Random	38
		20	51	*Cercis canadensis*	Redbud	container	2-3'	Random	38
			255	**TOTAL**					
17	150			**SHRUBS and VINES: Minimum of 5 Species**					
		20.0	51	*Lindera benzoin*	Spicebush	container	18-24"	Random	38
		20.0	51	*Calycanthus florida*	Sweetshrub	container	18-24"	Random	38
		20.0	51	*Alnus serrulata*	Tag Alder	container	18-24"	Random	38
		20.0	51	*Callicarpa americana*	American Beautyberr	container	18-24"	Random	38
		20.0	51	*Hydrangea arborescens*	Wild Hydrangea	container	18-24"	Random	38
		20.0	51	*Vaccinium stamineum*	Common Deerberry	container	18-24"	Random	38
		20.0	51	*Viburnum dentatum*	Southern Arrowwood	container	18-24"	Random	38
	680		**255**	**TOTAL**					

BALLED IN BURLAP TREES-Zone 4 — Acres= 1.7

Overall Spacing (feet off center)	Quantity per acre	Maximum Frequency (%)	Maximum Stem Quantity	Vegetation Strata/ Species Name	Common Name	Unit Type	Size	Spacing Type	Individual Spacing (ft.)
14.5	28			**TREES: Minimum of 3 Species, # of Trees = 48**					
		33	16	*Fraxinus pennsylvanica*	Green Ash	balled in burlap	2-3" caliper	Random	68
		33	16	*Liriodendron tulipifera*	Tulip Poplar	balled in burlap	2-3" caliper	Random	68
		33	16	*Quercus phellos*	Willow Oak	balled in burlap	2-3" caliper	Random	68
		33	16	*Quercus falcata*	Southern Red Oak	balled in burlap	2-3" caliper	Random	68
		33	16	*Platanus occidentalis*	Sycamore	balled in burlap	2-3" caliper	Random	68
		33	16	*Nyssa sylvatica*	Black Gum	balled in burlap	2-3" caliper	Random	68
		33	16	*Ulmus americana*	American Elm	balled in burlap	2-3" caliper	Random	68
		33	16	*Acer rubrum*	Red Maple	balled in burlap	2-3" caliper	Random	68
		33	16	*Acer negundo*	Box Elder	balled in burlap	2-3" caliper	Random	68
		33	16	*Prunus serotina*	Black Cherry	balled in burlap	2-3" caliper	Random	68
			48	**TOTAL**					

CON=container

Permanent Herbaceous Seed-Plant in Zones 1 and 4 — Acres= 6.9

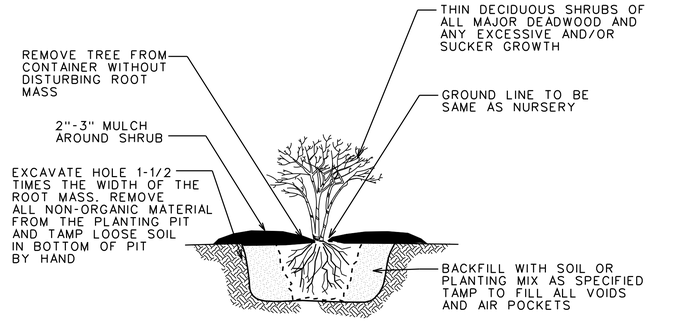
Lbs./Ac	Frequency (%)	Lbs per Species	Species Name	Common Name	Unit	Additional Amendment	Quantity LBS/AC
			ZONE 1 RIPARIAN WOODLANDS PERMANENT HERBACEOUS SEED				
40-rye	100	276.0	*Secale cereale*	Rye grain	LB of P.L.S. 76 %	Ground Limestone	4,000
30-other	20	41.4	*Panicum virgatum*	Switchgrass	LB of P.L.S. 76 %	Organic Fertilizer	320
species	20	41.4	*Dicanthelium clandestinium*	Deer tongue	LB of P.L.S. 76 %	Straw Mulch	4,000
combined	10	20.7	*Sorghastrum nutans*	Indian grass	LB of P.L.S. 76 %		
	10	20.7	*Elymus virginicus*	Virginia wild rye	LB of P.L.S. 76 %		
	10	20.7	*Tridens flavus*	Purpletop	LB of P.L.S. 76 %		
	5	10.4	*Andropogon glomeratus*	Bluestem	LB of P.L.S. 76 %		
	5	10.4	*Rudbeckia hirta*	Black-eyed susan	LB of P.L.S. 76 %		
	5	10.4	*Baptista australis*	Blue false indigo	LB of P.L.S. 76 %		
	5	10.4	*Daucus carota*	Queen Anne's lace	LB of P.L.S. 76 %		
	5	10.4	*Senna hebecarpa*	Wild senna	LB of P.L.S. 76 %		
	5	10.4	*Parthenium integrifolium*	Wild quinine	LB of P.L.S. 76 %		
	100	**483.3**	**= Total LBS**				

1. APPLY SOIL AMENDMENTS EVENLY AND INCORPORATE TO A DEPTH OF 4-6 INCHES. LOOSEN SURFACE JUST BEFORE BROADCASTING.
2. MULCH MUST COVER 75% OF THE GROUND SURFACE.

Fescue-Plant in Zone 3 — Acres= 1

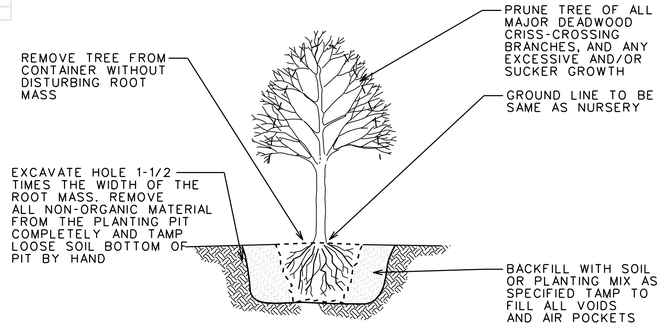
Lbs./Ac	Frequency (%)	Lbs per Species	Species Name	Common Name	Unit	Additional Amendment	Quantity LBS/AC
			ZONE 3 Fill Area-Pasture Re-establishment				
50	100	50.0	*Festuca arundinacea*	Tall Fescue	LB of P.L.S. 76 %	Ground Limestone	4,000
					LB of P.L.S. 76 %	Organic Fertilizer	320
					LB of P.L.S. 76 %	Straw Mulch	4,000
	0	**50.0**	**= Total LBS**				

1. APPLY SOIL AMENDMENTS EVENLY AND INCORPORATE TO A DEPTH OF 4-6 INCHES. LOOSEN SURFACE JUST BEFORE BROADCASTING.
2. MULCH MUST COVER 75% OF THE GROUND SURFACE.



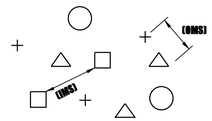
SHRUB PLANTING– CONTAINER GROWN

Not To Scale



TREE PLANTING– CONTAINER GROWN

Not To Scale



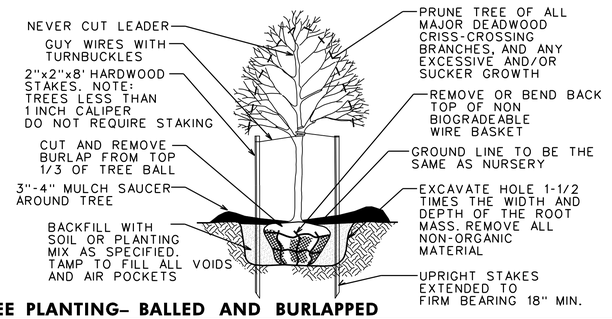
OMS- AN OVERALL MINIMUM SPACING DISTANCE •OMS• IS ASSIGNED TO THE PLANTING CONFIGURATION •SEE PLANT SCHEDULE•

IMS- AN INDIVIDUAL MINIMUM SPACING DISTANCES •IMS• IS ASSIGNED TO EACH INDIVIDUAL SPECIES •SEE PLANT SCHEDULE•

NOTE: DO NOT PLACE NEW PLANT MATERIAL UNDER THE DRIP LINE OF REMAINING LARGE TREES ON SITE.

RANDOM SPACING
PLAN VIEW

Not To Scale



TREE PLANTING– BALLED AND BURLAPPED

Not To Scale

REVISIONS

Mark	Description	Date	Appr.

North Carolina
Ecosystem Enhancement Program
2728 Capitol Blvd, Suite 1H 103
Raleigh, NC 27604
Tel:919-715-0476

Biohabitats
8218 Creedmoor Rd, Suite 200
Raleigh, NC 27613
Tel: 919-518-0311 Fax: 919-518-0313
www.biohabitats.com
Inspiring Ecological Stewardship

GREENBRIER STREAM ENHANCEMENT

ALAMANCE COUNTY, NC.
CHATHAM COUNTY, NC.

TITLE:

PLANTING SCHEDULES

PROJECT NO.: 06801.03	SCALE:
SEAL:	DESIGNED BY: VLS/KTN; DRAWN BY: CB
	CHECKED: JXR/EMM; APPROVED:
	DATE: OCTOBER 2008
	DWG. NO.: 20 OF 20

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10/15/2008

100% SUBMITTAL

12.0 Appendices

Appendix 1. Project Site and Reference Reach Photographs

Appendix 2. Project Site USACE Routine Wetland Determination Data Form

Appendix 3. Project Site NCDWQ Stream Classification Forms

Appendix 4. HEC-RAS Analysis

Appendix 5. EEP Floodplain Requirements Checklist

Appendix 6. CE Checklist

Appendix 7. Pebble Counts

MU-1 wetland on Murchison Easement.

MU-2 wetland of the view downstream of the upstream beaver dam on Murchison Easement.

MU-2 wetland of the upstream beaver pond and dam.

MU-3 wetland on the Murchison Easement.

MU-4 wetland on the Murchison Easement.

MU-4 wetland on the Murchison Easement.

MU-5 wetland on the Murchison Easement.

MU-6 wetland downstream.

MU-6 wetland origin.

M-1 wetland beside MS-1 on Matthews Easement.

M-2 wetland on Matthews Easement.

Another view of M-2 wetland.

M-3 wetland on Matthews Easement.

Another view of M-3 wetland.

MS-1 with M-1 on left side on Matthews Easement

MS-3, northern-most tributary downstream from bridge.

Another view of MS-3, northern-most tributary downstream from bridge.

MS-4, southern-most stream downstream from bridge.

.

Another view of MS-4, southern-most stream downstream from bridge.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Greenbrier Creek - Murchison Property Applicant/Owner: NCEEP Investigator: Kevin Nunnery	Date: 3/15/07 County: Alamance State: NC
Do Normal Circumstances exist on the site? Yes No Is the site significantly disturbed (Atypical Situation)? Yes No Is the area a potential Problem Area? Yes No (If needed, explain on reverse.)	Community ID: _____ Transect ID: _____ Plot ID: MU1

Northernmost wetland on Murchison property

flags 1-8

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Acer rubrum	Tree	FAC
2. Impatiens capensis	herb	FACW
3.		
4.		
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-): 100

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
✓ No Recorded Data Available

Field Observations:

Depth of Surface Water: 1-6 (in.)

Depth to Free Water in Pit: _____ (in.)

Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:
Primary Indicators:
✓ Inundated
✓ Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
✓ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Chewacla

Drainage Class: Somewhat poorly

Taxonomy (Subgroup): Fluvaquentic Dystrudepts

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-18		10YR 4/1			Sandy clay loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ✓ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)

Wetland Hydrology Present? (Yes) No

Hydric Soils Present? (Yes) No

Is this Sampling Point Within a Wetland? (Circle) (Yes) No

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Greenbrier Creek - Murchison Property
Applicant/Owner: NCEEP
Investigator: Kevin Nunnery

Date: 3/19/07
County: Alamance
State: NC

Do Normal Circumstances exist on the site?	Yes	No	Community ID:
Is the site significantly disturbed (Atypical Situation)?	Yes	No	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse.)	Yes	No	Plot ID: MU2

beaver pond complex

flags 1-30

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Acer rubrum	Tree	FAC
2. Liquidambar styraciflua	Tree	FAC+
3.		
4. Juncus effusus	herb	FACW+
5. Impatiens capensis	herb	FACW
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-): 100

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
✓ No Recorded Data Available

Field Observations:

Depth of Surface Water: 0-24 (in.)
Depth to Free Water in Pit: 0 (in.)
Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:
Primary Indicators:
✓ Inundated
✓ Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Chewacla

Drainage Class: somewhat poorly

Taxonomy (Subgroup): Fluvaquentic Dystrudepts

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-18		10YR5/2	7.5YR5/8	distinct, common, medium	sandy clay loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ✓ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

(Circle)
Is this Sampling Point Within a Wetland? (Yes) No

Remarks: delineator estimates that there is approximately 10-15% open water with no emergent vegetation present in this delineated polygon. Does USACE agree?

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Greenbrier Creek - Murchison Property Applicant/Owner: NCEEP Investigator: Kevin Nunnery	Date: 3/19/07 County: Alamance State: NC
Do Normal Circumstances exist on the site? Yes No Is the site significantly disturbed (Atypical Situation)? Yes No Is the area a potential Problem Area? Yes No (If needed, explain on reverse.)	Community ID: _____ Transect ID: _____ Plot ID: MU3 - small wetland just d/s of upper beaver dam

flags 1-5

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Acer rubrum	Tree	FAC
2. Liquidambar styraciflua	Tree	FAC+
3. Juncus effusus	herb	FACW+
4.		
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-): 100

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

✓ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)

Depth to Free Water in Pit: _____ (in.)

Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
- ___ Inundated
- ✓ Saturated in Upper 12 Inches
- ___ Water Marks
- ✓ Drift Lines
- ✓ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Chewacla

Taxonomy (Subgroup): Fluvaquentic Dystrudepts

Drainage Class: somewhat poorly

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-18		10YR 4/1			sandy clay loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ✓ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	(Yes) No (Circle)	(Circle)
Wetland Hydrology Present?	Yes No	
Hydric Soils Present?	(Yes) No	Is this Sampling Point Within a Wetland? (Yes) No

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Greenbrier Creek - Murchison Property Applicant/Owner: NCEEP Investigator: Kevin Nunnery	Date: 3/19/07 County: Alamance State: NC
Do Normal Circumstances exist on the site? Yes No Is the site significantly disturbed (Atypical Situation)? Yes No Is the area a potential Problem Area? Yes No (If needed, explain on reverse.)	Community ID: _____ Transect ID: _____ Plot ID: MU4 wetland

flags 1-5

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Acer rubrum	Tree	FAC	9.		
2. Liquidambar styraciflua	Tree	FAC+	10.		
3.			11.		
4. Lonicera japonica	vine	FAC-	12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-): 66

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)

Depth to Free Water in Pit: _____ (in.)

Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
- ___ Inundated
- ✓ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ✓ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Chewacla

Taxonomy (Subgroup): Fluvaquentic Dystrudepts

Drainage Class: somewhat poorly

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-18		10YR4/2	7.5YR4/8	Common, distt, med	sandy clay loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ✓ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

(Circle)
Is this Sampling Point Within a Wetland? (Yes) No

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Greenbrier Creek - Murchison Property Applicant/Owner: NCEEP Investigator: Kevin Nunnery	Date: 3/15/07 County: Alamance State: NC
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: _____ Transect ID: _____ Plot ID: MU-5

flags 1-14

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Acer rubrum	Tree	FAC	9.		
2. Liquidambar styraciflua	Tree	FAC+	10.		
3.			11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-).

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)
Depth to Free Water in Pit: _____ (in.)
Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
✓ Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
✓ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Chewaela

Drainage Class: somewhat poorly

Taxonomy (Subgroup): Fluvaquentic Dystrudepts

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-18		10YR 4/2	7.5YR 4/8	few, dist., med	sandy clay loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ✓ Reducing Conditions
- ✓ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

Is this Sampling Point Within a Wetland? (Yes) No (Circle)

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Greenbrier Creek - Murchison Property Applicant/Owner: NCEEP Investigator: Kevin Nunnery	Date: 3/19/07 County: Alamance State: NC
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: _____ Transect ID: _____ Plot ID: MU-6

flags 1-24

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Acer rubrum	Tree	FAC	9.		
2. Liquidambar styraciflua	Tree	FAC+	10.		
3.			11.		
4. Carex spp	herb	?	12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 66

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 6-18 (in.)

Depth to Free Water in Pit: _____ (in.)

Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:
Primary Indicators:
✓ Inundated
✓ Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
✓ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Chewacla

Drainage Class: somewhat poorly

Taxonomy (Subgroup): Fluvaquentic Dystrudepts

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-18		10YR 4/1			sandy clay loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ✓ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	(Yes) No (Circle)	(Circle)
Wetland Hydrology Present?	(Yes) No	
Hydric Soils Present?	(Yes) No	Is this Sampling Point Within a Wetland? (Yes) No

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Greenbrier Creek - Murchison Property Applicant/Owner: NCEEP Investigator: Kevin Nunnery	Date: 3/19/07 County: Alamance State: NC
Do Normal Circumstances exist on the site? Yes No Is the site significantly disturbed (Atypical Situation)? Yes No Is the area a potential Problem Area? Yes No (If needed, explain on reverse.)	Community ID: _____ Transect ID: _____ Plot ID: typical forested upland plot

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Liriodendron tulipifera	Tree	FAC
2. Quercus alba	Tree	FACU
3. Carya glabra	Tree	FACU
4.		
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 33

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____(in.)

Depth to Free Water in Pit: _____(in.)

Depth to Saturated Soil: _____(in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks: no hydrologic indicators present

SOILS

Map Unit Name (Series and Phase): Cid

Drainage Class: Moderately well

Taxonomy (Subgroup): Aquic Hapludults

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-4		10YR 7/4			loam
4-18		10YR 7/6			clay loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: not a hydric soil

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)

Wetland Hydrology Present? Yes (No)

Hydric Soils Present? Yes (No)

Is this Sampling Point Within a Wetland? (Circle) Yes (No)

Remarks: typical upland plot - forested - on Murdison property

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Greenbrier Creek- Murchison Property Applicant/Owner: NCEEP Investigator: Kevin Nunnery	Date: 5/19/07 County: Alamance State: NC
Do Normal Circumstances exist on the site? Yes No Is the site significantly disturbed (Atypical Situation)? Yes No Is the area a potential Problem Area? Yes No (If needed, explain on reverse.)	Community ID: _____ Transect ID: _____ Plot ID: _____

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Festuca spp	herb	FACU	9.		
2.			10.		
3.			11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 0

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____(in.)

Depth to Free Water in Pit: _____(in.)

Depth to Saturated Soil: _____(in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks: no hydrologic indicators present

SOILS

Map Unit Name (Series and Phase): Georgeville

Drainage Class: well

Taxonomy (Subgroup): Typic Kanhapludults

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-8		2.5 YR 3/6			clay loam
8-18		2.5 YR 5/6			clay loam

Hydric Soil Indicators:

___ Histosol
___ Histic Epipedon
___ Sulfidic Odor
___ Aquic Moisture Regime
___ Reducing Conditions
___ Gleyed or Low-Chroma Colors
___ Concretions
___ High Organic Content in Surface Layer in Sandy Soils
___ Organic Streaking in Sandy Soils
___ Listed on Local Hydric Soils List
___ Listed on National Hydric Soils List
___ Other (Explain in Remarks)

Remarks: not a hydric soil

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)
Wetland Hydrology Present? Yes (No)
Hydric Soils Present? Yes (No)

Is this Sampling Point Within a Wetland? (Circle) Yes (No)

Remarks: typical pasture upland plot - Morchism property

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

linear wetland b/s tributary U/S of bridge on Staley Snow Camp Road

Project/Site: Greenbrier Creek - Matthews Property Applicant/Owner: NCEEP Investigator: Kevin Nunnery	Date: 3/15/07 County: Chatham State: NC
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: _____ Transect ID: _____ Plot ID: Wetland 1 northern most M-1

wetland on Matthews property

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Acer rubrum	Tree	FAC
2. Liquidambar styraciflua	Tree	FAC+
3.		
4.		
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 100

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
✓ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____ (in.)
Depth to Free Water in Pit: 0 (in.)
Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
✓ Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
✓ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks: Saturated, some shallow ponding 2/20

SOILS

Map Unit Name (Series and Phase): Chewacla

Drainage Class: SPD

Taxonomy (Subgroup): Fluvaquentic Dystrudepts

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-3		7.5YR 4/5	mixed up		clay loam
3-18		2.5YR 5/2	7.5YR 4/6	few	loamy clay

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ☑ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)
Wetland Hydrology Present? (Yes) No
Hydric Soils Present? (Yes) No

(Circle)
Is this Sampling Point Within a Wetland? (Yes) No

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Greenbrier Creek - Matthews Property Applicant/Owner: NCEEP Investigator: Kevin Nunnery	Date: 3/15/07 County: Chatham State: NC
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: _____ Transect ID: _____ Plot ID: upland plot for 1+2 on Matthews property, wetlands taken in pasture

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. fescue	herb	FACU	9.		
2.			10.		
3.			11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 0

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____(in.)

Depth to Free Water in Pit: _____(in.)

Depth to Saturated Soil: _____(in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks: no hydrologic indicators present

SOILS

Map Unit Name (Series and Phase): Georgeville
Drainage Class: well
Taxonomy (Subgroup): Typic Kanhapludults
Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-8		2.5YR 3/6			sandy clay loam
8-18		2.5YR 5/6			clay loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: not a hydric soil

WETLAND DETERMINATION

Hydrophytic Vegetation Present? Yes (No) (Circle)
Wetland Hydrology Present? Yes (No)
Hydric Soils Present? Yes (No)

Is this Sampling Point Within a Wetland? (Circle) Yes (No)

Remarks:

upland

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Greenbrier Creek - Matthews Property Applicant/Owner: NCEEP Investigator: Kevin Nunnery	Date: 3/15/07 County: Chatham State: NC
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: _____ Transect ID: _____ Plot ID: upland plot for wetlands 1 & 2 on Matthews property, taken in pasture

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. fescue	herb	FACU	9.		
2.			10.		
3.			11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 0

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____(in.)

Depth to Free Water in Pit: _____(in.)

Depth to Saturated Soil: _____(in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks: no hydrologic indicators present

SOILS

Map Unit Name (Series and Phase): Georgeville

Drainage Class: well

Taxonomy (Subgroup): Typic Kanhapludults

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-8		2.5YR 3/6			Sandy clay loam
8-18		2.5YR 5/6			clay loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: not a hydric soil

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes (No) (Circle)	(Circle)
Wetland Hydrology Present?	Yes (No)	
Hydric Soils Present?	Yes (No)	Is this Sampling Point Within a Wetland? Yes (No)

Remarks:

upland

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Greenbrier Creek - Matthews Property
Applicant/Owner: NCEEP
Investigator: Kevin Nunnery

Date: 3/19/07
County: Chatham
State: NC
Wetland 2 - beside main trib., U/S of bridge on Staley-Snow Camp Road

Do Normal Circumstances exist on the site? Yes No
Is the site significantly disturbed (Atypical Situation)? Yes No
Is the area a potential Problem Area? Yes No
(If needed, explain on reverse.)

Community ID: _____
Transect ID: _____
Plot ID: Wetland 2

M-2

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Acer rubrum	Tree	FAC
2. Liquidambar styraciflua	Tree	FAC+
3. Carpinus caroliniana	Sap	FAC
4.		
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 100

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
✓ No Recorded Data Available

Field Observations:
Depth of Surface Water: 2-6 (in.)
Depth to Free Water in Pit: _____ (in.)
Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:
Primary Indicators:
✓ Inundated
✓ Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Chewacla

Drainage Class: SPD

Taxonomy (Subgroup): Fluvaquentic Dystrudepts

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-1	organic	10YR 3/1			organic layer
1-18		10YR 4/2	10YR 5/8	common	sandy clay loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ✓ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)

Wetland Hydrology Present? (Yes) No

Hydric Soils Present? (Yes) No

Is this Sampling Point Within a Wetland? (Circle) (Yes) No

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Greenbrier Creek - Matthews Property
Applicant/Owner: NCEEP
Investigator: Kevin Nunnery

Date: 3/19/07
County: Chatham
State: NC

Do Normal Circumstances exist on the site? (Yes) No
Is the site significantly disturbed (Atypical Situation)? Yes (No)
Is the area a potential Problem Area? Yes (No)
(If needed, explain on reverse.)

Community ID: _____
Transect ID: _____
Plot ID: Southernmost wetland on Matthews property, near d/s end of easement
Wetland 3
M-3

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Acer rubrum	Tree	FAC
2. Fraxinus pennsylvanica	Tree	FACW
3. Ulmus americana	Tree	FACW
4.		
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 100

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
✓ No Recorded Data Available

Field Observations:
Depth of Surface Water: 1-6" (in.)
Depth to Free Water in Pit: _____ (in.)
Depth to Saturated Soil: _____ (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
___ Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks: ponding in wetland, depressional area

SOILS

Map Unit Name (Series and Phase): Chewacla

Drainage Class: somewhat poorly

Taxonomy (Subgroup): Fluvaquentic Dystrudepts

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-18		10YR4/2	10YR5/8	dist./common/med.	sandy clay loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ✓ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present? (Yes) No (Circle)

Wetland Hydrology Present? (Yes) No

Hydric Soils Present? (Yes) No

(Circle)

Is this Sampling Point Within a Wetland? (Yes) No

Remarks:

Approved by HQUSACE 3/92

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Greenbrier Creek-Matthews Property Applicant/Owner: NC EEP Investigator: Kevin Nunnery	Date: 3/19/07 County: Chatham State: NC
Do Normal Circumstances exist on the site? (Yes) No Is the site significantly disturbed (Atypical Situation)? Yes (No) Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse.)	Community ID: _____ Transect ID: _____ Plot ID: upland plot for wetland 3 on Matthews property

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Liriodendron tulipifera	Tree	FAC	9.		
2.			10.		
3.			11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 100

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____(in.)

Depth to Free Water in Pit: _____(in.)

Depth to Saturated Soil: _____(in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
___ Saturated in Upper 12 Inches
___ Water Marks
___ Drift Lines
___ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks: no hydrologic indicators present

SOILS

Map Unit Name (Series and Phase): Cid

Drainage Class: moderately well

Taxonomy (Subgroup): Aquic Hapludults

Field Observations Confirm Mapped Type? (Yes) No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0-4		10 YR 7/4			loam
4-18		10 YR 7/6			sandy clay loam

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- ___ Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: not a hydric soil

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	(Yes) No (Circle)	(Circle)
Wetland Hydrology Present?	Yes (No)	
Hydric Soils Present?	Yes (No)	Is this Sampling Point Within a Wetland? Yes (No)

Remarks: upland

Approved by HQUSACE 3/92

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 3/19/07	**Project:** Greenbrier Creek	**Latitude:** 79° 29 28.19	
Evaluator: K. Nunnery	**Site:** Murchison Property	**Longitude:** 35° 50 41.19	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 21	**County:** Alamance	**Other** e.g. *Quad Name:* MUS-1	MUS-1

A. Geomorphology (Subtotal = 13.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	(2)	3
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	(0)	1	2	3
6. Depositional bars or benches	0	1	(2)	3
7. Braided channel	0	1	(2)	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	1	(2)	3
11. Grade controls	0	(0.5)	1	1.5
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0) 4.5		9 Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 4)				
14. Groundwater flow/discharge	0	(1)	2	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel – dry or growing season	0	(1)	2	3
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	(1)	1.5
19. Hydric soils (redoximorphic features) present?	(No = 0)		Yes = 1.5	

4

C. Biology (Subtotal = 3.5)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	0	(0.5)	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	0	(1)	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

4.5 2

Notes: (use back side of this form for additional notes.)

Sketch:

drainage way between 2 fields on north end of property, enters Greenbrier from east, into U/S end of beaver pond

no macros found except small larvae of blackflies

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 3/19/07	**Project:** Greenbrier Creek	**Latitude:** 79° 29 28.19	
Evaluator:	**Site:** Murchison Property	**Longitude:** 35° 50 41.19	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 21.5	**County:** Alamance	**Other** *e.g. Quad Name:* MUS-2	MUS-2

A. Geomorphology (Subtotal = 11.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	(2)	3
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	(0)	1	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	0	(1)	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	(1)	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 3.5)				
14. Groundwater flow/discharge	0	(1)	2	3
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	(1)	2	3
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	(No = 0)		Yes = 1.5	

C. Biology (Subtotal = 6.5)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	0	(0.5)	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	0	(1)	2	3
28. Iron oxidizing bacteria/fungus.	0	(0.5)	1	1.5
29[b]. Wetland plants in streambed	(FAC = 0.5); FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Stream from old pond to beaver pond on Greenbrier Cr., just U/S of dam

few blackfly larvae found

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 12/17/07	Project: Greenbrier Creek	Latitude: 79° 29' 28.19"
Evaluator: K. Nunnery	Site: Murchison Property	Longitude: 35° 50 41.19
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 22	County: Alamance	Other *e.g. Quad Name:* MUS-3

A. Geomorphology (Subtotal = 16.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	(2)	3
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	(0)	1	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	0	(1)	2	3
8. Recent alluvial deposits	0	1	(2)	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	1	(2)	3
11. Grade controls	0	(0.5)	1	1.5
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		(Yes = 3)	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 2.5)				
14. Groundwater flow/discharge	(0)	1	2	3
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	(0)	1	2	3
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	(1)	1.5
19. Hydric soils (redoximorphic features) present?	(No = 0)		Yes = 1.5	

C. Biology (Subtotal = 3)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	0	(1)	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Northern-most UT on Murchison Property. Flows from pond to the west of easement to Greenbrier Creek

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 3/19/07	Project: Greenbrier Creek	Latitude: 79° 29 28.19
Evaluator: K. Nunnery	Site: Matthews Property	Longitude: 35° 50 41.19
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 47	County: Alamance	Other MS1 *e.g. Quad Name:*

MS-1

A. Geomorphology (Subtotal = 26)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	1	(2)	3
7. Braided channel	0	1	(2)	3
8. Recent alluvial deposits	0	1	2	(3)
9[a] Natural levees	0	1	(2)	3
10. Headcuts	0	1	(2)	3
11. Grade controls	0	0.5	1	(1.5)
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 10.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	(1.5)
19. Hydric soils (redoximorphic features) present?	No = 0		1.5 (Yes = 1.5) 7.5	

C. Biology (Subtotal = 10.5)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	0	(0.5)	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	0	(0.5)	1	1.5
25. Amphibians	0	0.5	(1)	1.5
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	0	1	2	(3)
28. Iron oxidizing bacteria/fungus.	0	0.5	(1)	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

5.5 2 3

Sketch:

Notes: (use back side of this form for additional notes.)

main tributary to Greenbrier Cr. u/s of Staley Snow Camp bridge, on Matthews property

few red larvae ⇒ blackflies, nutrient concentration ↑

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 3/15/07	**Project:** Greenbrier Creek	**Latitude:** 79° 29 28.19	
Evaluator:	**Site:** Matthews Property	**Longitude:** 35° 50 41.19	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 43,5	**County:** Chatham	**Other** MS-2 northernmost *e.g. Quad Name:* Matthews trib	MS-2

A. Geomorphology (Subtotal = 25.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	2	(3)
3. In-channel structure: riffle-pool sequence	0	1	2	(3)
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	1	2	(3)
7. Braided channel	0	(1)	2	3
8. Recent alluvial deposits	0	1	2	(3)
9[a] Natural levees	0	(1)	2	3
10. Headcuts	0	(1)	2	3
11. Grade controls	0	0.5	(1)	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8,5)				
14. Groundwater flow/discharge	0	1	(2)	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	0.5	1	(1.5)
18. Organic debris lines or piles (Wrack lines)	0	0.5	(1)	1.5
19. Hydric soils (redoximorphic features) present?	(No = 0)		Yes = 1.5	

C. Biology (Subtotal = 9,5)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	0	(0.5)	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	0	(0.5)	1	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	0	1	(2)	3
28. Iron oxidizing bacteria/fungus.	0	(0.5)	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; (Other = 0)			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

tributary on northern U/S end of easement on Matthews property, U/S of Staley Snow Camp Road - flowing from pond from west side of property to Greenbrier Creek

few macros found - blackfly larvae, a few mayflies

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 3/19/07	**Project:** Greenbrier Creek	**Latitude:** 79° 29 28.19
Evaluator: K. Nonnery	**Site:** Matthews Property	**Longitude:** 35° 50 41.19
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 37	**County:** Chatham	**Other** e.g. Quad Name: MS3 northernmost trib d/s of bridge

MS-3

A. Geomorphology (Subtotal = 16.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	2	(3)
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	1	(2)	3
7. Braided channel	0	1	(2)	3
8. Recent alluvial deposits	0	1	2	(3)
9[a] Natural levees	0	(1)	2	3
10. Headcuts	0	1	2	(3)
11. Grade controls	0	0.5	(1)	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 11)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	0	0.5	1	(1.5)
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	(1.5)
19. Hydric soils (redoximorphic features) present?	No = 0		(Yes = 1.5)	

C. Biology (Subtotal = 9.5)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	0	(0.5)	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	0	(0.5)	1	1.5
25. Amphibians	0	0.5	(1)	1.5
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	0	(1)	2	3
28. Iron oxidizing bacteria/fungus.	0	0.5	(1)	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; (Other = 0)			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

northernmost tributary d/s of Staley Snow Camp Road to Greenbrier Creek

few small insect larvae found, indeterminate ID

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 3/19/07	**Project:** Greenbrier Creek	**Latitude:** 79° 29 28.19
Evaluator: K. Nunnery	**Site:** Matthews Property	**Longitude:** 35° 50 41.19
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 47	**County:** Chatham	**Other** MS4 southernmost *e.g. Quad Name:* trib d/s of bridge

MS-4

A. Geomorphology (Subtotal = 25.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	2	(3)
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	1	2	(3)
7. Braided channel	0	(1)	2	3
8. Recent alluvial deposits	0	1	2	(3)
9[a] Natural levees	0	(1)	2	3
10. Headcuts	0	1	2	(3)
11. Grade controls	0	0.5	(1)	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 11)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	0	0.5	1	(1.5)
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	(1.5)
19. Hydric soils (redoximorphic features) present?	No = 0		(Yes = 1.5)	

C. Biology (Subtotal = 10.5)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	0	(0.5)	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	0	(0.5)	1	1.5
25. Amphibians	0	0.5	(1)	1.5
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	0	1	(2)	3
28. Iron oxidizing bacteria/fungus.	0	0.5	(1)	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

southernmost trib to Greenbrier Creek on Matthews property

no macros found

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 3/19/07	**Project:** Greenbrier Creek	**Latitude:** 79° 29 28.19
Evaluator: K. Nunnery	**Site:** Matthews Property	**Longitude:** 35° 50 41.19
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 19.5	**County:** Chatham	**Other** Greenbrier Creek *e.g. Quad Name:* mainstem

MS-5 Greenbrier mainstem

A. Geomorphology (Subtotal = 27)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	2	(3)
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	1	2	(3)
6. Depositional bars or benches	0	1	2	(3)
7. Braided channel	0	(1)	2	3
8. Recent alluvial deposits	0	1	2	(3)
9[a] Natural levees	0	1	(2)	3
10. Headcuts	0	(1)	2	3
11. Grade controls	0	0.5	1	(1.5)
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		(Yes = 3)	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 10)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, **or** Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	0.5	1	(1.5)
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	(1.5)
19. Hydric soils (redoximorphic features) present?	(No = 0)		Yes = 1.5	

C. Biology (Subtotal = 12.5)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	0	0.5	(1)	1.5
23. Bivalves	0	(1)	2	3
24. Fish	0	0.5	1	(1.5)
25. Amphibians	0	0.5	1	(1.5)
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	0	1	(2)	3
28. Iron oxidizing bacteria/fungus.	0	0.5	(1)	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

taken approx 200' d/s of bridge (Staley Show Camp Road)

found a few worms, black fly larvae, some caddisflys (few)

Sketch:

HEC-RAS OUTPUT FOR GREENBRIER CREEK

Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach - 1	22300	100-Year	bio-prop1	1693	623.77	635.32		635.49	0.001887	5.25	1262.3	385.37	0.28
Reach - 1	22300	100-Year	Plan01	1693	623.77	635.32		635.49	0.001887	5.25	1262.33	385.37	0.28
Reach - 1	22300	100-Year	bio-ex1	1693	623.77	635.33		635.49	0.001883	5.24	1263.55	385.44	0.28
Reach - 1	21571	100-Year	bio-prop1	1693	623.57	633.23		633.52	0.004103	6.83	870.97	282.12	0.4
Reach - 1	21571	100-Year	Plan01	1693	623.57	633.23		633.52	0.004105	6.83	870.83	282.11	0.4
Reach - 1	21571	100-Year	bio-ex1	1693	623.57	633.24		633.54	0.004051	6.8	875.41	282.35	0.39
Reach - 1	20788	100-Year	bio-prop1	1693	620.81	631.71		631.79	0.001297	4.18	1499.73	502.98	0.23
Reach - 1	20788	100-Year	Plan01	1693	620.81	631.7		631.78	0.001312	4.2	1492.7	502.27	0.23
Reach - 1	20788	100-Year	bio-ex1	1693	620.81	631.45		631.56	0.001644	4.63	1369.44	494.48	0.26
Reach - 1	20112	100-Year	bio-prop1	2218	618.75	631.07		631.14	0.000784	3.76	2048.68	520.23	0.19
Reach - 1	20112	100-Year	Plan01	2218	618.75	631.05		631.12	0.000796	3.79	2036.59	519.56	0.19
Reach - 1	20112	100-Year	bio-ex1	2218	618.75	630.58		630.68	0.001096	4.33	1796.65	505.21	0.22
Reach - 1	19732	100-Year	bio-prop1	2218	618.09	630.29	623.53	630.67	0.001284	5.2	523.61	330.65	0.26
Reach - 1	19732	100-Year	Plan01	2218	618.09	630.26	623.53	630.65	0.001296	5.21	522.09	329.76	0.26
Reach - 1	19732	100-Year	bio-ex1	2218	618.09	629.66	623.53	630.09	0.001557	5.52	490.64	296.23	0.29
Reach - 1	19705			Culvert									
Reach - 1	19678	100-Year	bio-prop1	2218	617.91	629.48	623.34	629.91	0.001556	5.52	490.75	296.3	0.29
Reach - 1	19678	100-Year	Plan01	2218	617.91	629.44	623.34	629.88	0.001572	5.54	488.98	295.17	0.29
Reach - 1	19678	100-Year	bio-ex1	2218	617.91	628.71	623.34	629.22	0.001995	5.97	450.73	270.09	0.32
Reach - 1	19447	100-Year	bio-prop1	2218	622	628.29		629.1	0.008556	8.23	452.89	132.96	0.63
Reach - 1	19447	100-Year	Plan01	2218	617.53	627.85		628.99	0.007386	10.23	472.16	126.4	0.57
Reach - 1	19447	100-Year	bio-ex1	2218	617.5	627.99		628.58	0.00391	6.61	510.27	126.97	0.42

Reach - 1	19000	100-Year	bio-prop1	2218	620.72	627.55	627.63	0.001377	3.52	1740.16	550.34	0.26
Reach - 1	19000	100-Year	Plan01	2218	616.75	627.66	627.74	0.000972	3.85	2004.19	557.2	0.21
Reach - 1	19000	100-Year	bio-ex1	2218	619.23	627.53	627.61	0.001045	3.33	1782.4	549.18	0.23
Reach - 1	18500	100-Year	bio-prop1	2218	619	626.61	626.79	0.002009	4.63	1233.75	407.91	0.32
Reach - 1	18500	100-Year	Plan01	2218	615.63	626.75	627	0.002299	6.01	1233.93	403.98	0.32
Reach - 1	18500	100-Year	bio-ex1	2218	618.5	626.65	626.84	0.002411	5.21	1241.19	409.7	0.34
Reach - 1	18000	100-Year	bio-prop1	2218	618.22	625.77	625.9	0.001537	4.03	1355.73	362.26	0.28
Reach - 1	18000	100-Year	Plan01	2218	615.13	625.81	625.97	0.001782	5.15	1347.1	363.15	0.28
Reach - 1	18000	100-Year	bio-ex1	2218	618.87	625.76	625.89	0.001502	3.95	1355.8	362	0.27
Reach - 1	17500	100-Year	bio-prop1	2218	613.35	624.71	624.97	0.002216	5.99	1340.09	362.36	0.32
Reach - 1	17500	100-Year	Plan01	2218	613.35	624.71	624.97	0.002216	5.99	1340.09	362.36	0.32
Reach - 1	17500	100-Year	bio-ex1	2218	613.35	624.71	624.97	0.002216	5.99	1340.09	362.36	0.32

EEP Floodplain Requirements Checklist

This form was developed by the National Flood Insurance program, NC Floodplain Mapping program and Ecosystem Enhancement Program to be filled for all EEP projects. The form is intended to summarize the floodplain requirements during the design phase of the projects. The form should be submitted to the Local Floodplain Administrator with three copies submitted to NFIP (attn. Edward Curtis), NC Floodplain Mapping Unit (attn. John Gerber) and NC Ecosystem Enhancement Program.

Project Location

Name of project:	Greenbrier Creek Stream Restoration
Name if stream or feature:	Greenbrier Creek
County:	Chatham County
Name of river basin:	Cape Fear
Is project urban or rural?	rural
Name of Jurisdictional municipality/county:	Chatham Countys
DFIRM panel number for entire site:	8746 and 8744
Consultant name:	Biohabitats, Inc
Phone number:	919-518-0311
Address:	8218 Creedmoor Road, Suite 200 Raleigh, NC 27613

Design Information

Provide a general description of project (one paragraph). Include project limits on a reference orthophotograph at a scale of 1" = 500".
This project is located generally where Staley-Snow Camp Road crosses over Greenbrier Creek in northwestern Chatham County. Enhancement I, Priority II design will be applied to approximately 2,600 feet of Greenbrier Creek and 2,300 feet of unnamed tributaries to Greenbrier Creek. No work in the FEMA floodplain will be done in Alamance County.

Summarize stream reaches or wetland areas according to their restoration priority.

Reach	Length	Priority
Greenbrier Creek mainstem	*2,624*	*Two (Enhancement Level I)*
Unnamed tributaries to Greenbrier Creek along reach listed above	*2,313*	*Two (EnhancementLevel I)*

Floodplain Information

Is project located in a Special Flood Hazard Area (SFHA)?

☉ Yes ○ No

If project is located in a SFHA, check how it was determined:

☐ Redelineation

☐ Detailed Study

☑ Limited Detail Study

☐ Approximate Study

☐ Don't know

List flood zone designation:

Check if applies:

☑ AE Zone

- ○ Floodway
- ☉ Non-Encroachment
- ○ None

☐ A Zone

- ○ Local Setbacks Required
- ○ No Local Setbacks Required

If local setbacks are required, list how many feet:

Does proposed channel boundary encroach outside floodway/non-encroachment/setbacks?

☐ Yes ☒ No

Land Acquisition (Check)

☐ State owned (fee simple)

☑ Conservation easment (Design Bid Build)

☐ Conservation Easement (Full Delivery Project)

Note: if the project property is state-owned, then all requirements should be addressed to the Department of Administration, State Construction Office (attn: Herbert Neily, (919) 807-4101)

Is community/county participating in the NFIP program?

☒ Yes ☐ No

Note: if community is not participating, then all requirements should be addressed to NFIP (attn: Edward Curtis, (919) 715-8000 x369)

Name of Local Floodplain Administrator: Jason Sullivan
Phone Number:919-542-8233

Floodplain Requirements

This section to be filled by designer/applicant following verification with the LFPA

☐ No Action

☑ No Rise

☐ Letter of Map Revision

☐ Conditional Letter of Map Revision

☐ Other Requirements

Comments:

Name: _____ Signature: _____

Title: _____ Date: _____

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

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

Part 1: General Project Information	
Project Name:	Greenbrier Creek Stream Restoration/Preservation and Wetland Preservation Project
County Name:	Alamance and Chatham
EEP Number:	671
Project Sponsor:	NCEEP
Project Contact Name:	Kevin Nunnery
Project Contact Address:	Biohabitats, Inc. 8218 Creedmoor Road, Suite 200, Raleigh, NC 27613
Project Contact E-mail:	knunnery@biohabitats.com
EEP Project Manager:	Kristie Corson

Project Description

For Official Use Only

Reviewed By:

9/4/07
Date

Kristi F. Corson
EEP Project Manager

Conditional Approved By:

Date

For Division Administrator
FHWA

☐ **Check this box if there are outstanding issues**

Final Approval By:

9-6-07
Date

For Division Administrator
FHWA

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

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

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

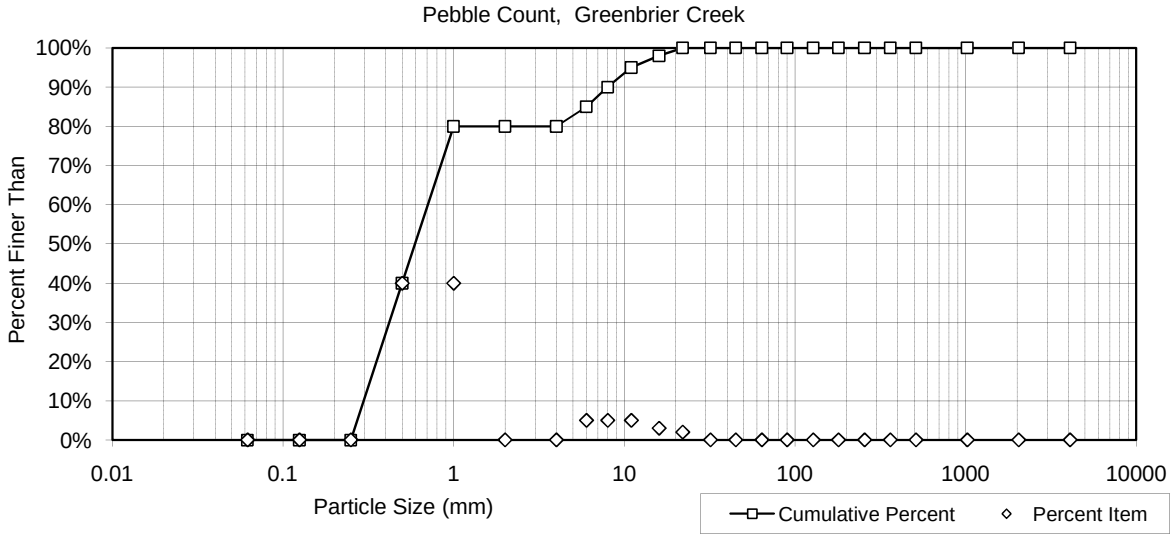
Pebble Count

Material	Size Range (mm)		Count	
silt/clay	0	0.062		# #
very fine sand	0.062	0.13		# #
fine sand	0.13	0.25	**0**	# #
medium sand	0.25	0.5	**40**	# #
coarse sand	0.5	1	**40**	# #
very coarse sand	1	2	**0**	# #
very fine gravel	2	4	**0**	# #
fine gravel	4	6	**5**	# #
fine gravel	6	8	**5**	# #
medium gravel	8	11	**5**	# #
medium gravel	11	16	**3**	# #
coarse gravel	16	22	**2**	# #
coarse gravel	22	32	**0**	# #
very coarse gravel	32	45	**0**	# #
very coarse gravel	45	64	**0**	# #
small cobble	64	90	**0**	# #
medium cobble	90	128	**0**	# #
large cobble	128	180		# #
very large cobble	180	256		# #
small boulder	256	362		# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock				#
Total Particle Count:			100	

Pebble Count,

	Greenbrier Creek

	North Carolina
Note:	**mainstem downstream x-sec 2**



Size percent less than (mm)				
D16	D35	D50	D84	D95
0.330	0.46	0.6	6	11

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	80%	20%	0%	0%	0%

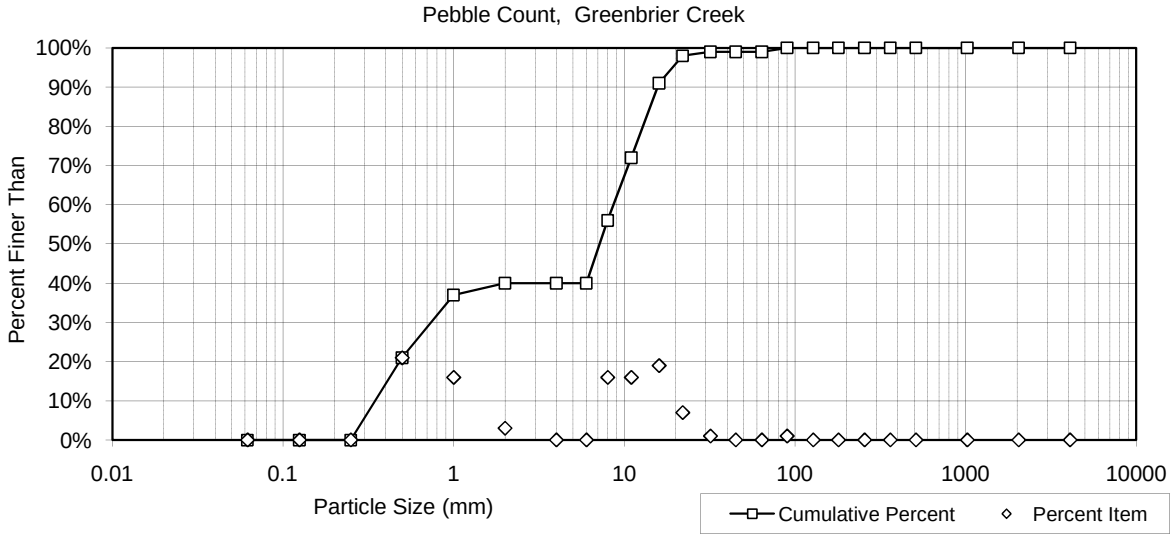
Pebble Count

Material	Size Range (mm)		Count	
silt/clay	0	0.062		# #
very fine sand	0.062	0.13		# #
fine sand	0.13	0.25	**0**	# #
medium sand	0.25	0.5	**21**	# #
coarse sand	0.5	1	**16**	# #
very coarse sand	1	2	**3**	# #
very fine gravel	2	4	**0**	# #
fine gravel	4	6	**0**	# #
fine gravel	6	8	**16**	# #
medium gravel	8	11	**16**	# #
medium gravel	11	16	**19**	# #
coarse gravel	16	22	**7**	# #
coarse gravel	22	32	**1**	# #
very coarse gravel	32	45	**0**	# #
very coarse gravel	45	64	**0**	# #
small cobble	64	90	**1**	# #
medium cobble	90	128	**0**	# #
large cobble	128	180		# #
very large cobble	180	256		# #
small boulder	256	362		# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock				#
		Total Particle Count:	100	

Pebble Count,

	Greenbrier Creek

	North Carolina
Note:	**mainstem upstream x-sec 1**



Size percent less than (mm)				
D16	D35	D50	D84	D95
0.424	0.92	7.2	14	19

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	40%	59%	1%	0%	0%

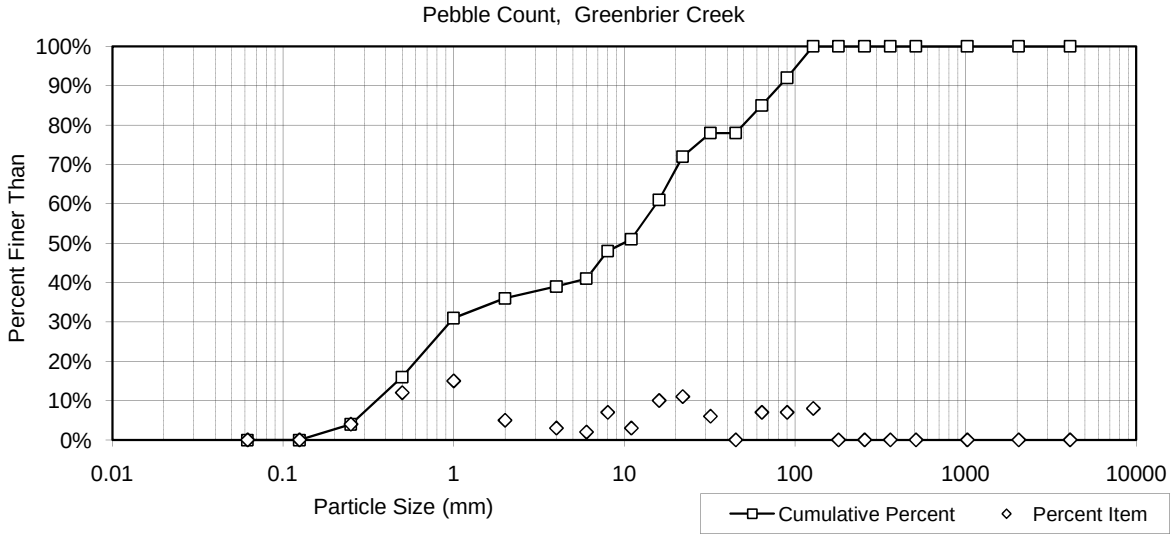
Pebble Count

Material	Size Range (mm)		Count	
silt/clay	0	0.062		# #
very fine sand	0.062	0.13		# #
fine sand	0.13	0.25	**4**	# #
medium sand	0.25	0.5	**12**	# #
coarse sand	0.5	1	**15**	# #
very coarse sand	1	2	**5**	# #
very fine gravel	2	4	**3**	# #
fine gravel	4	6	**2**	# #
fine gravel	6	8	**7**	# #
medium gravel	8	11	**3**	# #
medium gravel	11	16	**10**	# #
coarse gravel	16	22	**11**	# #
coarse gravel	22	32	**6**	# #
very coarse gravel	32	45	**0**	# #
very coarse gravel	45	64	**7**	# #
small cobble	64	90	**7**	# #
medium cobble	90	128	**8**	# #
large cobble	128	180		# #
very large cobble	180	256		# #
small boulder	256	362		# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock				#
		Total Particle Count:	100	

Pebble Count,

	Greenbrier Creek

	North Carolina
Note:	**Tributary Riffle U/S of culvert**



Size percent less than (mm)				
D16	D35	D50	D84	D95
0.500	1.74	9.9	61	103

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	36%	49%	15%	0%	0%