STILLHOUSE CREEK STREAM RESTORATION – Project # 363
Orange County, NC

Mitigation Plan – As-built Report
FINAL

Designed by:
United States Department of Agriculture
Natural Resources Conservation Services (NRCS)

May 28,2008

RECEIVED
MAY 30 2008
NC ECOSYSTEM
ENHANCEMENT PROGRAM

Submitted to:

North Carolina Department of Environment and
Natural Resources
Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Table of Contents

APPENDICES

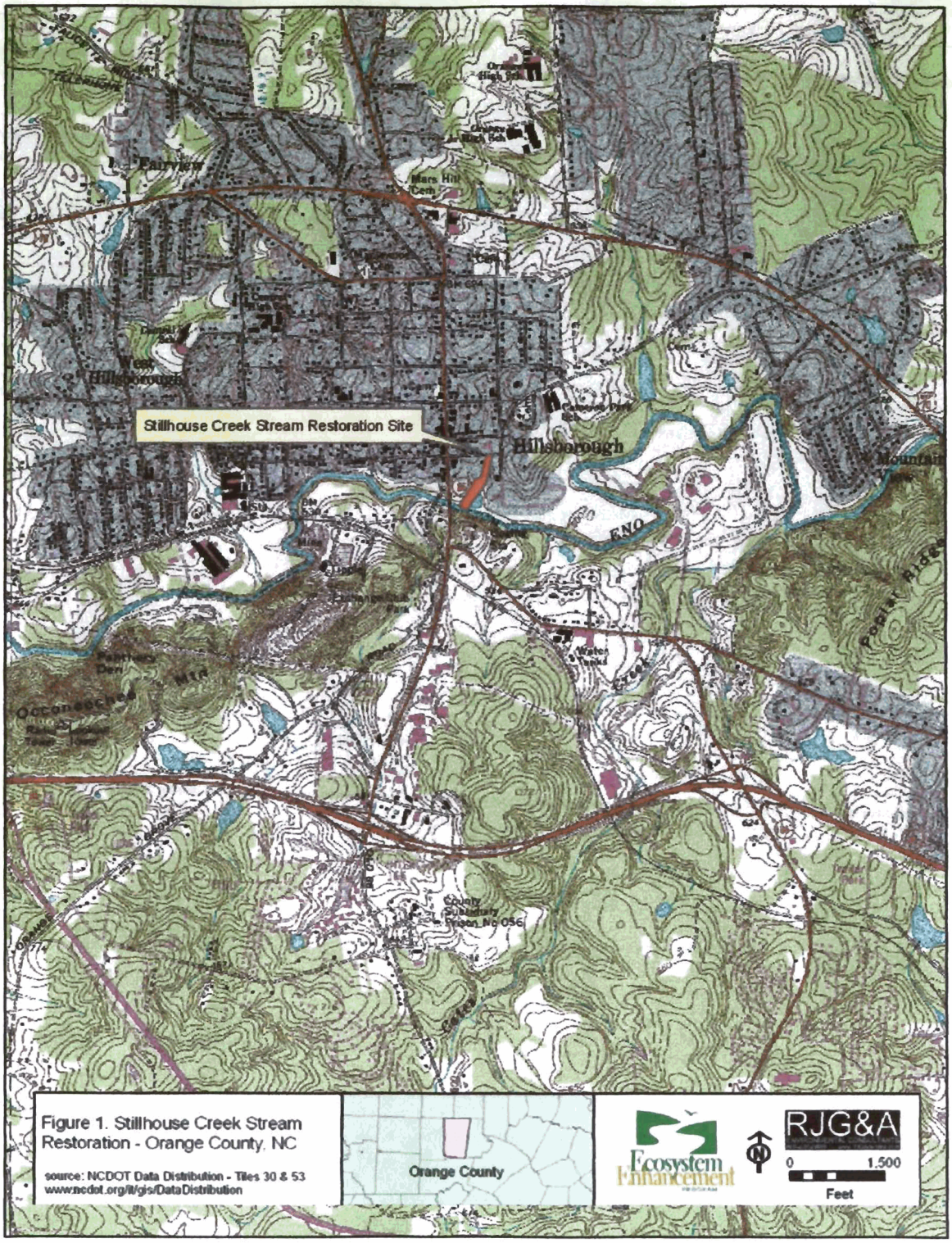


Figure 1. Stillhouse Creek Stream Restoration - Orange County, NC

source: NCDOT Data Distribution - Tiles 30 & 53
www.ncdot.org/it/gis/DataDistribution

Table I. Project Restoration Components Stillhouse Creek Stream Restoration – EEP Project #363								
Project Segment or Reach ID	**Existing Feet/Acres**	**Type**	**Approach**	**Footage or Acreage**	**Mitigation Ratio**	**Mitigation Units**	**Stationing**	**Comment**
Reach I	748	R	P1	235 lf	-	-	00+00 – 2+35	Shallow pools, small meanders, and steep riffles
Reach II		R	P1	400 lf	-	-	02+35 – 06+35	Realigned, reconnected to floodplain
Reach III		E	P4	220 lf	-	-	06+35 – 08+55	Banks stabilized
Reach IV	314	R	P3	355 lf	-	-	08+55 – 12+10	Connected to floodprone area

Mitigation Unit Summations

Stream (lf)	Riverine Wetland (Ac)	Nonriverine Wetland (Ac)	Total Wetland (Ac)	Buffer (Ac)	Comment
1,210	0.0	0.0	0.0	0.0	-

R = Restoration EII = Enhancement II P1 = Priority I P3 = Priority III
EI = Enhancement I S = Stabilization P2 = Priority II SS = Stream Bank stabilization

4. Project History, Contacts and Attribute Data –

Table II. Project Activity and Reporting History Stillhouse Creek Stream Restoration – EEP Project #363		
Activity or Report	**Data Collection Complete**	**Completion or Delivery**
Restoration Plan	-	November 2005
Final Design – Construction Plans	-	November 2005
Construction	NA	March 2006
Temporary seed mix applied to entire project area	NA	NA
Permanent seed mix applied to reach	NA	NA
Containerized and B&B plantings for reach	NA	March 2006
As-built (Year 0 Monitoring – baseline)	August 2006	August 2006
Mitigation Plan	August 2006	December 2007

Table III. Project Contact Table Stillhouse Creek Stream Restoration – EEP Project #363	
Designer Primary project design POC	USDA Natural Resources Conservation Service 4405 Bland Rd., Suite 205 Raleigh, NC 27609 919-873-2100
Construction Contractor Construction contractor POC	- -
Planting Contractor Planting contractor POC	Fluvial Solutions Peter Jelenevsky
Seeding Contractor Planting contractor point of contact	Fluvial Solution Peter Jelenevsky
Seed Mix Sources	Mellow Marsh
Nursery Stock Suppliers	Mellow Marsh
Monitoring Performers	RJG&A 1221 Corporation Parkway, Suite 100 Raleigh, NC 27610
Stream Monitoring POC	Ms. Jessi O'Neal
Vegetation Monitoring POC	Mr. Sean Doig
Wetland Monitoring POC	NA

Table IV. Project Attribute Table Stillhouse Creek Stream Restoration – EEP Project #363				
Project County	Orange			
Physiographic Region	152 Acres (0.24 square miles)			
Ecoregion	Carolina Slate Belt			
Project River Basin	Neuse			
USGS HUC for Project (14 digit)	03020201030020			
NCDWQ Sub-basin for Project	03-04-01			
Within extent of EEP Watershed Plan?	-			
WRC Class (Warm, Cool, Cold)	-			
% of project easement fenced or demarcated	0%			
Beaver activity observed during design phase?	-			
Restoration Component Attribute Table				
	Reach 1	Reach 2	Reach 3	Reach 4
Drainage area	0.14			0.22
Stream order	First			
Restored length (feet)	235	400	220	355
Perennial or Intermittent	Perennial			
Watershed type (Rural, Urban, Developing etc.)	Urban	Urban	Urban	Urban
Watershed LULC Distribution (e.g.)	-	-	-	-
Residential	-	-	-	-
Ag-Row Crop	-	-	-	-
Ag-Livestock	-	-	-	-
Forested	-	-	-	-
Etc.	-	-	-	-
Watershed impervious cover (%)	-	-	-	-
NCDWQ AU/Index number	27-2-(7)	27-2-(7)	27-2-(7)	27-2-(7)
NCDWQ classification	C-NSW	C-NSW	C-NSW	C-NSW
303d listed?	No	No	No	No
Upstream of a 303d listed segment?	No	No	No	No
Reasons for 303d listing or stressor	NA	NA	NA	NA
Total acreage of easement	2.09 acres			
Total vegetated acreage within the easement	-	-	-	-
Total planted acreage as part of the restoration	-	-	-	-
Rosgen classification of pre-existing	E4	E4	E4	G4c/1
Rosgen classification of As-built[1]	E4	E4	E4	B4/1
Valley type	-	-	-	-
Valley slope	0.012	0.012	0.012	0.0185
Valley side slope range (e.g. 2-3.%)	-	-	-	-
Valley toe slope range (e.g. 2-3.%)	-	-	-	-
Cowardin classification	NA	NA	NA	NA
Trout waters designation	No	No	No	No
Species of concern, endangered etc.? (Y/N)	No	No	No	No
Dominant soil series and characteristics				
Series	Georgeville	Georgeville	Georgeville	Congaree
Depth	65	65	65	63
Clay%	5-27	5-27	5-27	5-25
K	0.43	0.43	0.43	0.28
T	3	3	3	5

[1] No as-built cross section data collected. Rosgen classification in table is from NRCS design data. "-" indicates that data is unavailable.

II. Success Criteria

Success criteria for morphology, vegetation, and hydrology are based on the 2003 US ACE Stream Mitigation Guidelines unless otherwise described below.

1. Morphologic Parameters and Channel Stability

    a. **Dimension** – General maintenance of a stable cross-section and access to the floodplain features (e.g. Bank Height Ratios) over the course of the monitoring period will generally represent success in dimensional stability. However, some change is natural and expected and can even indicate that the design was successful and appropriate for the hydrologic and sediment regime. Moderate decreases in the width to depth ratio or cross-sectional area, as well as floodplain or bank deposition, will indicate functional performance.

    Significant widening of the channel cross-section or increases in the cross-sectional area generally represent trends of concern, although some adjustment in this direction is acceptable if the process is arrested after a period of moderate adjustment. In the case of riffle cross sections, maintenance of depths that represent small changes to target competency would also reflect stability. Likewise, a successful pool cross-section would experience only moderate changes in pool depth ratios such that pool habitat is maintained and lateral migration rates are moderate.

    b. **Pattern and Profile** – While some adjustments will occur, the relative abundance and spatial distribution of bedform features should be appropriate for the stream type E for the upper reaches and B for Reach 4, and be maintained over the monitoring period. Pool features should be lower in grade and deeper, while riffles steeper and shallower in keeping with design ratios. Pattern features should show little adjustment over the standard 5-year monitoring period.

    c. **Substrate** – Riffles and pools should either maintain or achieve their target particle size distributions, which is gravel throughout the restoration unless in a bedrock area. Generally as the monitoring period progresses, riffles and pools should exhibit coarser and finer sediment types, respectively.

    d. **Sediment transport** – The net effect of the state of the parameters in sections a, b, and c above, should be the absence of a significant trend in the aggradational or depositional potential of the channel.

2. Vegetation –Vegetation data will be collected using the guidelines outlined in the EEP/CVS vegetation monitoring protocol (Lee *et al* 2006). Four representative vegetation monitoring plots and the location, height, and diameter of each live planted stem within the plot will be recorded. Planted vegetation success will be based upon the survival of 320 stems per acre at the end of 3 years of monitoring. A tolerance of 10% mortality rate will be acceptable for each of years 4 (288 stems/acre) and 5 (260 stems/acre) (USACE 2003).

3. Hydrology – A minimum of two bankfull events must be documented within the standard 5-year monitoring period. In order for the monitoring to be considered complete, the 2 verification events must occur in separate monitoring years.

III. **Monitoring Plan Guidelines** – Annual data will be collected for the monitoring parameters below for 5 years after construction, unless otherwise stated or directed as part of the review process.

1. Stream Hydrology – Stillhouse Creek restoration includes a crest gauge to verify the on-site occurrence of bankfull events. Each site visit by the monitoring performer will include documentation of the highest stage for the monitoring interval and a reset of the gauge. The bankfull verification data will be included in each monitoring report.

2. Stream Channel Stability and Geomorphology - Stillhouse Creek hydraulic and geomorphic data for pre-existing condition, reference reaches, design conditions, and as-built conditions are presented in Exhibit Table V. The as-built data serves as a baseline data set with which to compare the following monitoring years' data (Exhibit Table VI). Dimension, pattern, and profile data will be collected annually and used to populate Exhibit tables VI and VII, and in this way, compared annually to the baseline condition.

   a. **Dimension** – Since each reach is less than 500 feet in length, a representative number of cross-sections and locations were chosen (5) and installed. Elevation data will be collected each monitoring year at each break in slope across each of the five cross-sections, according to the US ACE Stream Mitigation Guidelines and US Forest Service's Stream Channel Reference Sites (USACE, 2003; Harrelson et al., 1994).

   b. **Profile** – A longitudinal profile survey for the entire length of the Stillhouse Creek Restoration will be conducted annually, according to the US ACE Stream Mitigation Guidelines and US Forest Service's Stream Channel Reference Sites (USACE, 2003; Harrelson et al., 1994).

   c. **Pattern** – Pattern was restored in Reach 2 only so, the pattern data will be collected, analysis and reported for Reach 2, annually, according to the US ACE Stream Mitigation Guidelines and US Forest Service's Stream Channel Reference Sites (USACE, 2003; Harrelson et al., 1994).

   d. **Visual assessment** – Each year, a visual assessment will be conducted throughout the restoration project, to obtain qualitative stability and geomorphology data on all portions of the project. All along the stream, a total of 10 photopoints have been established to visually document the state of the channel annually. Stream photos from the established photopoints will be collected within the same two-month time period each monitoring year, preferably when the vegetation is minimal. The same photopoint and vantage point should be utilized for each plot to the maximum practical extent.

   e. **Bank Stability Assessments** –Detailed BEHI and NBS assessments will be performed in year 5. The entire project will be classified into the BEHI erosion hazard categories and accompanied by an NBS assessment for the purpose of describing the proportion of project bank footage in the various hazard categories and to produce project sediment export estimates (tonnage per annum).

3. Vegetation – Vegetation data will be collected using the guidelines outlined in the EEP/CVS vegetation monitoring protocol (Lee *et al* 2006). The number of vegetation monitoring plots will be determined using the CVS-EEP Access database "Calculate number of required plots" tool, which calculates a percentage of the planted area. The location of the four representative vegetation plots in the restoration area will determined using the guidance outlined in Section 3.2 of the CVS-EEP Protocol for Recording Vegetation (Lee et al., 2006). All plots will measure 100 square meters in area and will either be 10 meters by 10 meters, or five meters by 20 meters. The four corners of each plot (e.g. 0,0; 0,10; 10,0; and 10,10; or 0,0; 0,20; 5,0; and 5,20) will be marked with one-half inch diameter galvanized steel conduit. Level 1 (planted woody stems) and Level 2 (volunteer woody stems) data collection will be performed in all plots. Each planted woody stem location (x and y) will be recorded, and height (cm) and live stem diameter (ddh for plants less than 137 cm in height, DBH for woody stems 137 cm or taller) will be recorded for each stem location. All planted stems will be identified with pink flagging. Vegetation will be identified using Weakley (Weakley 2007). Photos will be taken of each vegetation plot from the 0,0 corner.

IV. Documenting the As-built Condition

Design parameters for Stillhouse Creek were divided into two segments that separate the stream into Reaches 1-3 and Reach 4. As-built calculations were divided in this same way for comparison to those of the design.

1. Morphological State of the Channel

   a. **Dimension** – No cross-sectional data were collected at Stillhouse Creek in the as-built state, and therefore, no baseline dimension data are available to report. Permanent cross-sections have since been installed and monitoring reports will use the Year 1 monitoring data as the baseline.

   b. **Pattern** - Pattern data were collected in the as-built state and are presented in the As-built drawing (Appendix A) and in Exhibit Table V.

      A comparison of the design to as-built pattern parameters of Reaches 1-3 of Stillhouse Creek reveals a smaller average radius of curvature and meander wavelength in the as-built state, resulting in a shorter thalweg length. This may be due to the decrease in number and severity of meanders (Appendix A and F). Reach 4 parameters remain similar to those of the design.

   c. **Profile** - Pattern data were collected in the as-built state and are presented in the longitudinal profile graph (Appendix D) and in Exhibit Table V.

      A comparison of the design to as-built profile parameters throughout Stillhouse Creek reveals an increase in average riffle slope and water surface slope in the as-built state, as well as a decrease in pool spacing. A steeper riffle may also result in a shorter riffle, and potentially a smaller distance between pools (Appendix B and F).

2. Sediment Transport in the As-built State

   The data necessary for analysis of sediment transport were not collected in the As-built state at Stillhouse Creek.

Exhibit Table V. Baseline Stream Data Summary

Stillhouse Creek Stream Restoration – EEP Project #363 - Segment/Reach: 1 – 3 (855 feet)

Parameter	Gauge[3]	Regional Curve			Pre-Existing Condition			Reference Reach(es) Data			Design		As-built/Baseline Data		
Dimension and Substrate - Riffle	Mean	LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Max	Min	Mean	Max
Bankfull Width (ft)		-	-	-	6.0	7.0	7.6	7.3	9.7	12.4	7.5	9.5	-	-	-
Floodprone Width (ft)					17.1	35.1	47.0	27.0	49.6	74.0	23	176	-	-	-
Bankfull Mean Depth (ft)		-	-	-	0.8	1.0	1.4	0.9	1.1	1.3	0.95	1.2	-	-	-
[1]Bankfull Max Depth (ft)					1.2	1.7	2.0	1.6	1.8	2.0	1.3	2.4	-	-	-
Bankfull Cross Sectional Area (ft^2)		-	-	-	5.6	7.3	8.1	7.3	10.35	13.2	Mean 9.0		-	-	-
Width/Depth Ratio					4.4	7.1	9.3	7.3	9.3	14.0	6.0	10.0	-	-	-
Entrenchment Ratio					2.3	5.1	6.3	2.7	5.6	10.1	2.7	20.7	-	-	-
[1]Bank Height Ratio					1.0	1.13	1.4	1.0	1.06	1.25	Mean 1.0		-	-	-
d50 (mm)					-	-	-	-	-	-					
Profile															
Riffle Length (ft)					-	-	-	-	-	-	-	-	2.4	6.6	15.3
Riffle Slope (ft/ft)					-	-	-	0.00	0.0204	0.054	0.0066	0.017	-0.003	0.029	0.140
Pool Length (ft)					11.0	22.5	46.5	7.5	11.8	17.0	8.5	19.6	9.4	22.8	76.0
Pool Spacing (ft)					-	37.2	-	-	21.5	-	Mean 15.3		0	5.0	18.2
[2]Pool Area (ft^2)					10.0	13.5	16.9	9.2	14.9	21.6	9.0	27.0	-	-	-
Pattern															
Channel Beltwidth (ft)					6	11.6	19	12.4	13.7	16.7	8.5	19.6	8.7	16.3	24.7
Radius of Curvature (ft)					8.7	12.2	16.5	6.5	14.6	20.5	12.8	23.8	4.6	10.0	32.7
Rc:Bankfull width (ft/ft)					1.2	1.7	2.4	0.5	1.5	2.8	1.5	2.8	-	-	-
Meander Wavelength (ft)					29	63	116	21.2	34.7	57.0	12.8	39.1	23.8	37.8	75.4
Meander Width Ratio					0.9	1.7	2.7	1.0	1.4	2.3	1.0	2.3	-	-	-
Substrate, bed and transport parameters															
[4]Ri% / Ru% / P% / G% / S%						-			-					-	
[4]SC% / Sa% / G% / C% / B% / Be%						-			-					-	
[4]d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)						-			-					-	
Reach Shear Stress (competency) lb/f^2						-						-		-	
Max part size (mm) mobilized at bankfull						-						-		-	
Stream Power (transport capacity) W/m^2						-									
Additional Reach Parameters															
Drainage Area (SM)						0.14			-						
Impervious cover estimate (%)						-			-			-		-	
Rosgen Classification						E4			E4/5			E4		-	
Bankfull Velocity (fps)						4.4-6.4						3.6-4.1		-	
Bankfull Discharge (cfs)						36									
Valley length (ft)						672			168						
Channel Thalweg length (ft)						748			267.5			946		855	
Sinuosity (ft)						1.1			1.6			1.4		1.3	
Water Surface Slope (Channel) (ft/ft)						0.0126			0.0094			0.0086		0.011	
BF slope (ft/ft)						-			-			-		-	
BEHI VL% / L% / M% / H% / VH% / E%						-			-						
Channel Stability or Habitat Metric						-			-						
Biological or Other						-			-						

1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile. 2 = Methodology should be described/cited. 3 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare). 4 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; di^p = max pave, di^{sp} = max subpave Shaded cells indicate that these will typically not be filled in.

Exhibit Table V. Baseline Stream Data Summary
Stillhouse Creek Stream Restoration – EEP Project #363 - Segment/Reach: 4 (355 feet)

Parameter	Gauge[3]	Regional Curve			Pre-Existing Condition			Reference Reach(es) Data			Design		As-built/Baseline Data		
Dimension and Substrate - Riffle	Mean	LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Max	Min	Mean	Max
Bankfull Width (ft)	-	-	-	-	9.8	11.8	14.8	23.1	25.6	28.0	14.9	19.5	-	-	-
Floodprone Width (ft)					15.5	19.3	26.8	33.0	33.7	35.0	17.9	35.1	-	-	-
Bankfull Mean Depth (ft)	-	-	-	-	1.7	1.9	2.0	1.5	1.7	1.9	1.1	1.2	-	-	-
[1]Bankfull Max Depth (ft)	-				2.6	2.7	2.8	2.4	2.7	2.9	1.7	1.9	-	-	-
Bankfull Cross Sectional Area (ft^2)	-	-	-	-	19.2	21.7	24.7	68.5	43.5	48.9	18	22	-	-	-
Width/Depth Ratio	-				4.9	6.2	8.6	12.4	15.2	17.2	12.4	17.2	-	-	-
Entrenchment Ratio	-				1.4	1.6	1.8	1.2	1.3	1.4	1.2	1.8	-	-	-
[1]Bank Height Ratio	-				2.5	2.6	2.9	1.0	1.0	1.0	1.0		-	-	-
d50 (mm)					-	-	-	-	-	-					
Profile															
Riffle Length (ft)					-	-	-	9.5	18.4	29.0	6.0	19.5	2.5	17.3	40.1
Riffle Slope (ft/ft)					-	-	-	0.00819	0.0122	0.0164	0.0168	0.0336	0.043	0.129	0.164
Pool Length (ft)					-	-	-	8.2	31.2	68.0	5	53	15.0	70.1	42.6
Pool Spacing (ft)					-	-	-	27.2	62.4	129.0	39	94	0	11.1	40.1
[2]Pool Area (ft^2)					-	-	-	59.9	70.3	79.8	25	40	-	-	-
Pattern															
Channel Beltwidth (ft)					-	-	-	40	51	43.7	23.8	39	12.0	19.6	27.9
Radius of Curvature (ft)					-	-	-	19.5	41.25	54.0	29.8	39.0	25.4	40.3	55.4
Rc:Bankfull width (ft/ft)					-	-	-	0.8	1.6	2.1	2.0		-	-	-
Meander Wavelength (ft)					-	-	-	130	168	245	39	94	96.2	132.6	187.8
Meander Width Ratio					-	-	-	1.6	1.7	2.0	1.6	2.0	-	-	-
Substrate, bed and transport parameters															
[4]Ri% / Ru% / P% / G% / S%					-			-					-		
[4]SC% / Sa% / G% / C% / B% / Be%					-			-							
[4]d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)					-			-							
Reach Shear Stress (competency) lb/f^2					-						-		-		
Max part size (mm) mobilized at bankfull					-						-		-		
Stream Power (transport capacity) W/m^2					-						-		-		
Additional Reach Parameters															
Drainage Area (SM)					0.22			3.3							
Impervious cover estimate (%)					-			-							
Rosgen Classification	-				G4c/1			B4c/1			B4/1		-		
Bankfull Velocity (fps)	-	-			3.7-4.8						4.2-5.1		-		
Bankfull Discharge (cfs)	-	-			92										
Valley length (ft)					282			325							
Channel Thalweg length (ft)					314			348			314		355		
Sinuosity (ft)					1.1			1.07			1.1		1.3		
Water Surface Slope (Channel) (ft/ft)	-				0.0168			0.00819			0.0168		0.020		
BF slope (ft/ft)	-				-			-			-		-		
BEHI VL% / L% / M% / H% / VH% / E%					-			-							
Channel Stability or Habitat Metric					-			-							
Biological or Other					-			-							

1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile. 2 = Methodology should be described/cited. 3 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare). 4 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; di^p = max pave, di^{sp} = max subpave Shaded cells indicate that these will typically not be filled in.

Table of Contents

APPENDICES

Executive Summary

The Stillhouse Creek stream restoration project has been designed and constructed to reduce stream bank erosion and prevent down-cutting; eliminate threat to an existing building foundation from lateral channel instability; increase nutrient and sediment uptake and retention; increase environmental education opportunities; improve terrestrial, aquatic, and semi-aquatic habitats; provide temporary stormwater storage; and improve stream corridor aesthetics.

The Stillhouse Creek stream restoration project is located in Orange County Park, in the historic district of Hillsborough, North Carolina (Figure 1). The project was designed and built through a combination of efforts by the North Carolina Ecosystem Enhancement Program (NCEEP, formerly North Carolina Wetlands Restoration Program), the Orange County Soil and Water Conservation District (SWCD), Natural Resources Conservation Service (NRCS), and Orange County. It includes restoration of 1,210 feet of Stillhouse Creek from south of Margaret Lane to its confluence with the Eno River. The area placed under conservation easement occupies 2.09 acres in USGS HUC 03020201030020 (NCDWQ Neuse River Subbasin 03-04-01). Construction was completed during March 2006.

The upper 235 feet of Stillhouse Creek involved restoration of a degraded, incised stream to a stable stream with a floodplain in a confined valley (Priority 1). The next 400-foot reach involved construction of a new channel reach to restore the pattern, profile, and dimension of a stable stream with a floodplain (Priority 1). Restoration of the next 220 feet involved enhancement of the existing stream features including the stabilization of eroding stream banks (Priority 4). The final 345 feet involved construction of a bankfull bench in a confined valley (Priority 3).

The most substantial differences between design and as-built parameters involved a change in pattern in Reach 2; resulting in an as-built state with higher meander lengths, lower radius of curvature, and a shorter thalweg length than the design. Although dimension and vegetation data were not collected in the as-built state, qualitative and quantitative hydrogeomorphological and vegetation monitoring data will be collected annually for five years and compared to success criteria and monitoring year 1 data, to determine overall project success.

3. Verification of Plantings

Although no vegetation data were collected in the As-built state, based on the As-built map and site inspection, it appears that the planting plan has been implemented at Stillhouse Creek (Appendix A and Appendix C). Vegetation monitoring plots have since been established (Appendix B).

V. Maintenance and Contingency Plans

If visual evaluations identify a high priority problem area, or monitoring findings indicate a failure to meet success criteria, then remedial action may be necessary. The appropriate remedial action for any stream or vegetation problem will be resolved on a case-by-case basis. Any remedial action must be approved by EEP.

1. Vegetation problems

Vegetation problems may include planted vegetation not meeting success criteria, persistent barren areas with no herbaceous vegetation, and the presence of invasive species. Upon determining the cause of the problems, the appropriate remedial actions will be initiated with the approval of EEP. These actions may include replanting woody stems, re-seeding, soil nutrient amendments, grading, and herbicide application to remove invasive vegetation.

2. Stream problems

Stream problems may include bank erosion, structure failure due to scour, and obstruction of flow due to debris or beaverdams. Upon determining the cause of any problems, appropriate remedial actions will be initiated with the approval of EEP. These actions may include re-establishing the eroded bank with an appropriate cross-section design, re-application of seed mix and/or matting, repair or replacement of an in-stream structure, mechanical or hand removal of obstructions, and possible elimination of beaver.

VI. References

Harrelson, Cheryl, C. L. Rawlins, and John Potpondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. USDA, Forest Service. General Technical Report RM-245.

Michael T. Lee, Robert K. Peet, Steven D. Roberts, Thomas R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation- Version 4.0. Retrieved October 30, 2006, from: http://cvs.bio.unc.edu/methods.htm.

US Army Corps of Engineers (USACE), 2003. Stream Mitigation Guidelines. Prepared with cooperation from the US Environmental Protection Agency, NC Wildlife Resources Commission, and the NC Division of Water Quality.

Weakley, Alan. 2007. *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas.* Retrieved March 27, 2007 from: http://www.herbarium.unc.edu/flora.htm.

Appendix A. As-built drawings
(Provided by NC EEP)

As-Built Plan View. Stillhouse Creek Stream Restoration, Hillsborough, Orange County, NC

Provided by NRCS

- Planting
- Tree
- Survey Traverse Point
- Wetlands
- Thalweg
- Top of Bank
- In-stream Rock Structure
- Pre-Existing Structures
- Contours
- Easement Boundary

0 75 150 Feet

0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000 1050 1100 1150 1200 1210

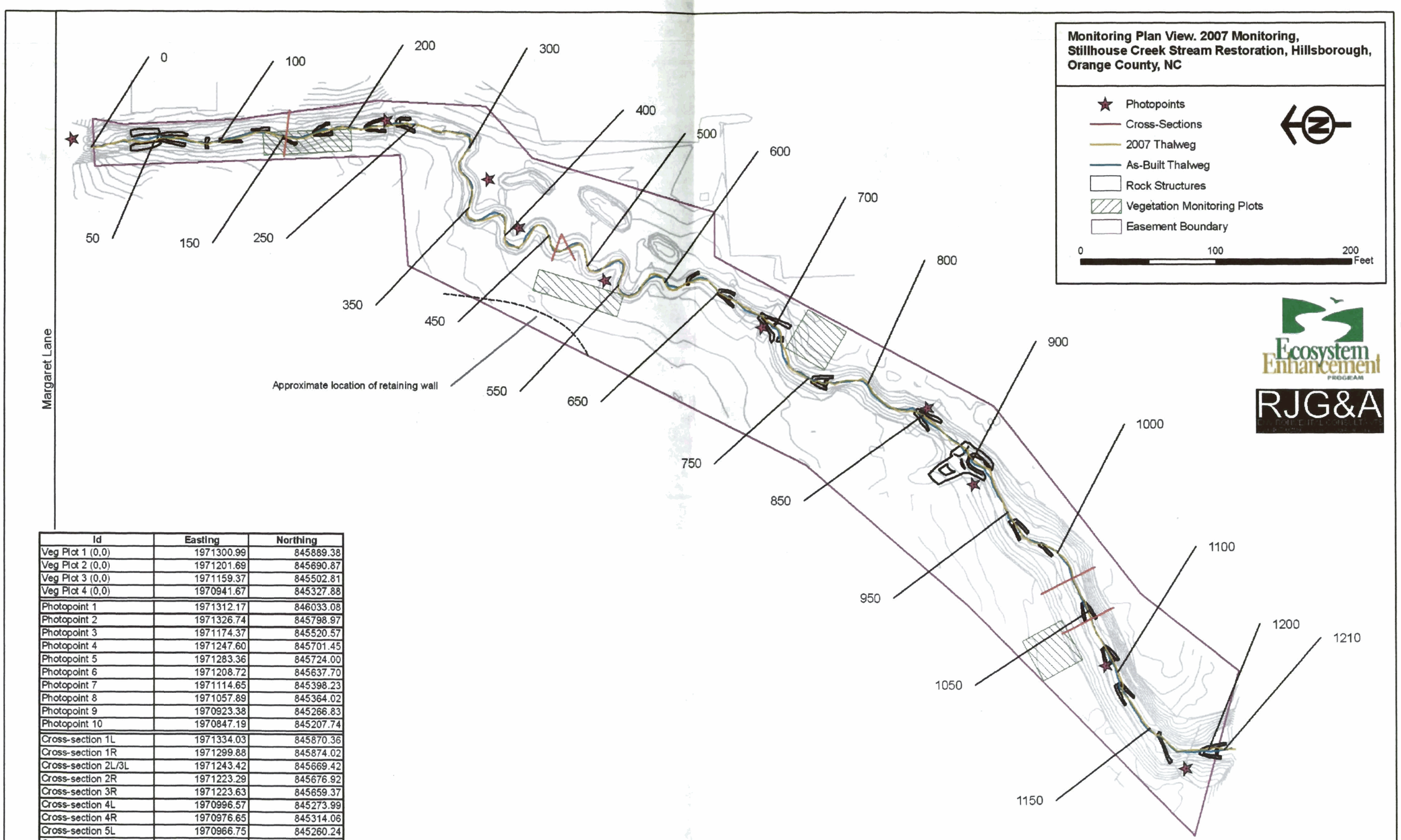
Ecosystem Enhancement Program

RJG&A Environmental Consultants 910-407-0889 www.RJGAcarolina.com

As-built CAD File Attribute Table

Entity	Layer	Color	Linetype
Polyline	asb_CONTOURS	252	CONTINUOUS
Polyline	asb_CONTOURS_IDX	1	CONTINUOUS
Insert	Bankfull_Lt	4	CONTINUOUS
Polyline	Bankfull_Lt_L	4	DASHEDX2
Polyline	Break_Line_L	7	CONTINUOUS
Polyline	Bridge_As-built_L	250	CONTINUOUS
Polyline	Brush_Mattress_L	3	CONTINUOUS
Polyline	Building_L	7	CONTINUOUS
Polyline	Concrete_L	2	CONTINUOUS
Polyline	Headwal_L	7	CONTINUOUS
Insert	Manhole	250	CONTINUOUS
Insert	Monument	250	CONTINUOUS
Insert	Pipe	5	CONTINUOUS
Insert	Planting	3	CONTINUOUS
Insert	Power_Pole	7	CONTINUOUS
Insert	Property_Marker	7	CONTINUOUS
Polyline	Road_Edge_L	251	CONTINUOUS
Insert	Rock_Structure	8	CONTINUOUS
Polyline	Rock_Structure_L	8	CONTINUOUS
Polyline	Sewer_Line_L	16	DASHED
Insert	Storm Inlet	7	CONTINUOUS
Insert	Thalwag	5	CONTINUOUS
Polyline	Thalwag_L	5	CENTERX2
Polyline	Top_Bank_Lt_L	3	CONTINUOUS
Polyline	Top_Bank_Rt_L	3	CONTINUOUS
Polyline	Traverse_L	7	CONTINUOUS
Insert	Traverse_Point	7	CONTINUOUS
Insert	tree	3	CONTINUOUS
Polyline	Walking_Trail_L	251	CONTINUOUS
Polyline	Water_Edge_Lt_L	5	DIVIDEX2
Polyline	Water_Edge_Rt_L	5	DIVIDEX2
Insert	Wetland	5	CONTINUOUS
Polyline	Wetland_L	4	WETLAND

Appendix B. Monitoring Plan View



Id	Easting	Northing
Veg Plot 1 (0,0)	1971300.99	845889.38
Veg Plot 2 (0,0)	1971201.69	845690.87
Veg Plot 3 (0,0)	1971159.37	845502.81
Veg Plot 4 (0,0)	1970941.67	845327.88
Photopoint 1	1971312.17	846033.08
Photopoint 2	1971326.74	845798.97
Photopoint 3	1971174.37	845520.57
Photopoint 4	1971247.60	845701.45
Photopoint 5	1971283.36	845724.00
Photopoint 6	1971208.72	845637.70
Photopoint 7	1971114.65	845398.23
Photopoint 8	1971057.89	845364.02
Photopoint 9	1970923.38	845266.83
Photopoint 10	1970847.19	845207.74
Cross-section 1L	1971334.03	845870.36
Cross-section 1R	1971299.88	845874.02
Cross-section 2L/3L	1971243.42	845669.42
Cross-section 2R	1971223.29	845676.92
Cross-section 3R	1971223.63	845659.37
Cross-section 4L	1970996.57	845273.99
Cross-section 4R	1970976.65	845314.06
Cross-section 5L	1970966.75	845260.24
Cross-section 5R	1970947.34	845298.51

Appendix C. Photographs
(Provided by NC EEP)

Appendix C. Photographs - Mitigation Plan - Stillhouse Creek Stream Restoration

Pre-existing condition - August 2005

As-built state - May 2006

Pre-existing condition - August 2005

As-built state - May 2006

Appendix C. Photographs - Mitigation Plan - Stillhouse Creek Stream Restoration

As-built state - May 2006

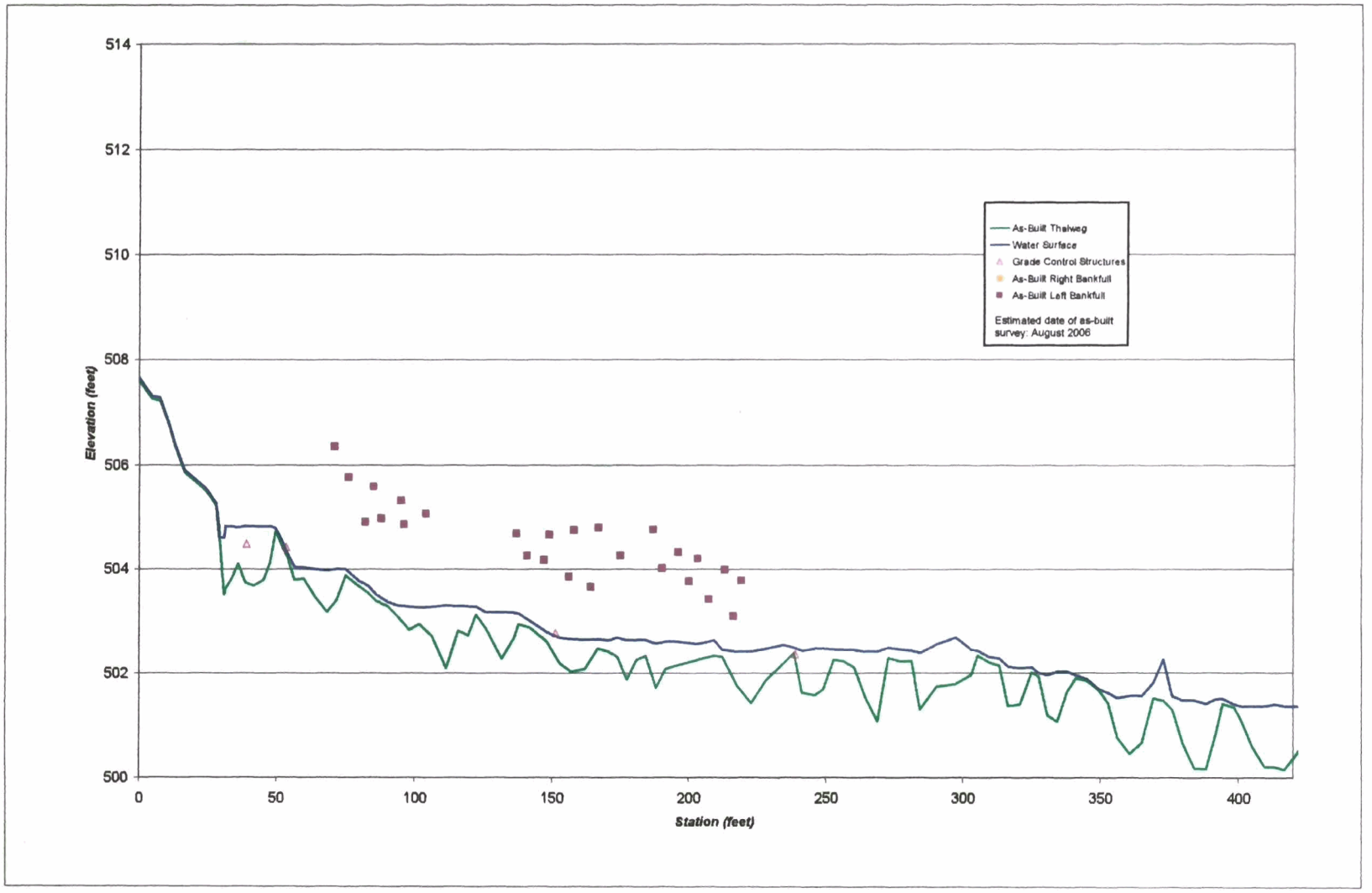
As-built state - May 2006

As-built state - May 2006

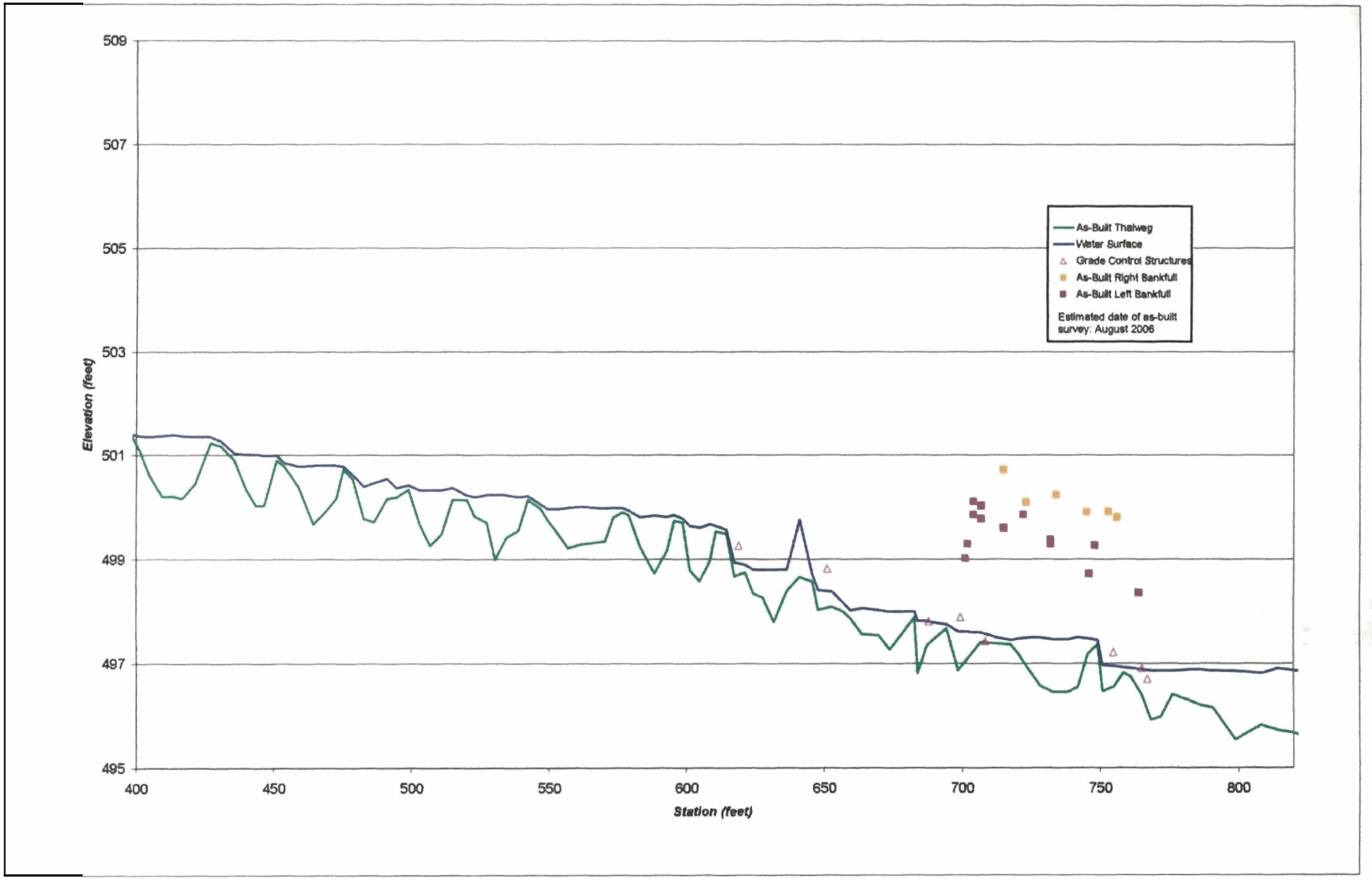
As-built state - May 2006

Appendix D. As-built Longitudinal Profile and Raw Data

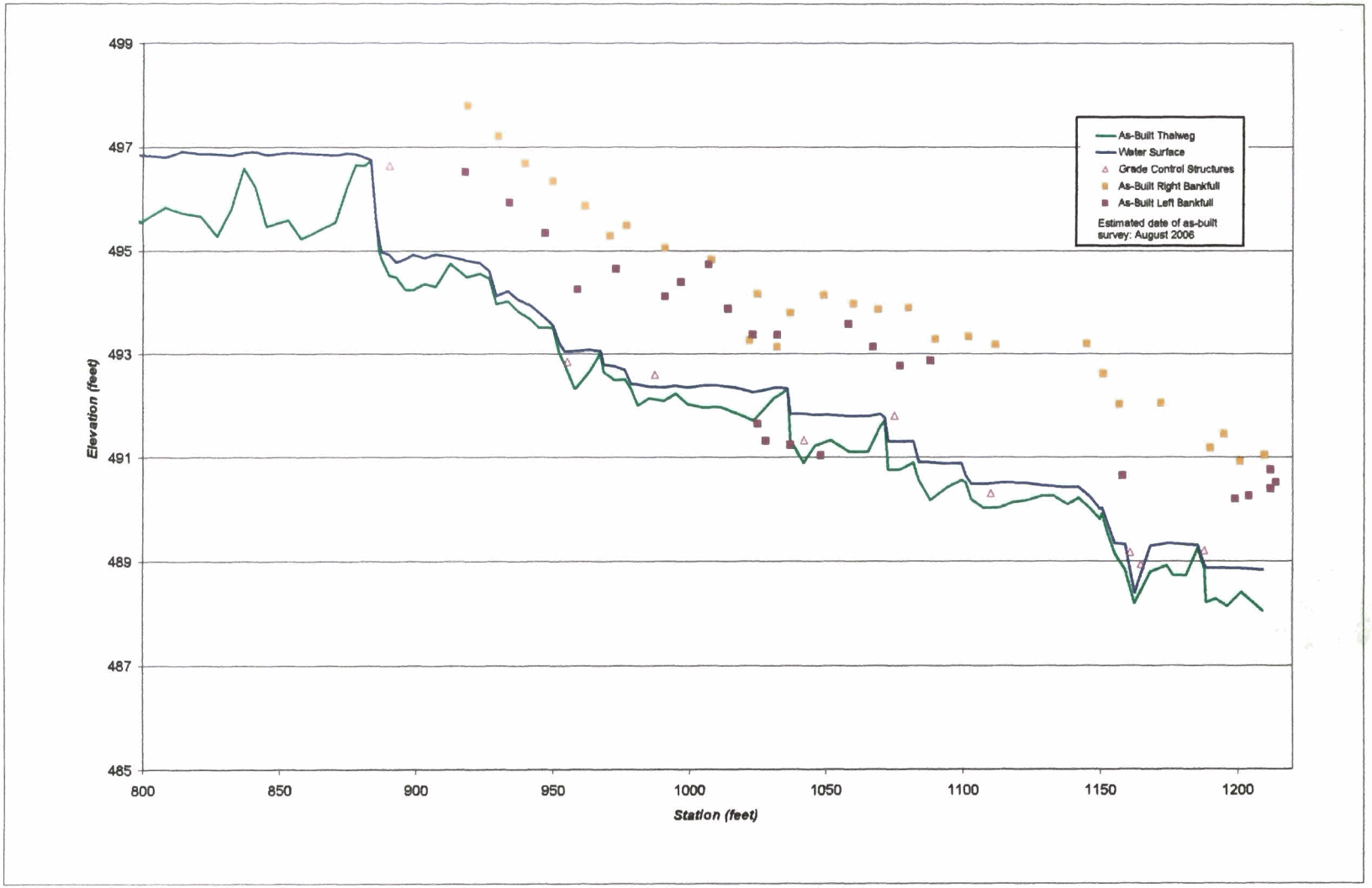
Longitudinal Profile - As-Built Survey - Stillhouse Creek Stream Restoration - EEP Project #363
Stationing 0 – 400



Longitudinal Profile - As-Built Survey - Stillhouse Creek Stream Restoration - EEP Project #363
Stationing d00 – 800



Longitudinal Profile - As-Built Survey - Stillhouse Creek Stream Restoration - EEP Project #363
Stationing 800 – 1210



As-Built Survey Data (estimated survey date August 2006)					
Station	Description	Water Depth	Easting	Northing	Elevation
0.00	Thalwag0.05	0.05	1971306.2203	846018.3484	507.6041
4.56	Thalwag0.05	0.05	1971306.5244	846013.8017	507.2534
7.45	Thalwag0.05	0.05	1971306.8104	846010.9248	507.2269
11.01	Thalwag0.05	0.05	1971308.3481	846007.7073	506.7147
13.03	Thalwag0.05	0.05	1971308.7516	846005.7289	506.3373
16.55	Thalwag0.05	0.05	1971309.0713	846002.2287	505.8512
24.23	Thalwag0.05	0.05	1971310.9153	845994.7708	505.5010
27.94	Thalwag0.05	0.05	1971310.2873	845991.1142	505.2215
28.85	Thalwag 0.23	0.23	1971310.6627	845989.9488	504.6211
29.17	Thalwag0.05	0.05	1971310.6306	845988.4173	504.5523
30.70	Thalwag 1.1	1.10	1971310.5869	845990.2538	503.5014
31.32	Thalwag 01.2	1.20	1971311.1752	845988.7232	503.6188
33.68	Thalwag 0.98	0.98	1971311.8828	845986.4703	503.8273
35.85	Thalwag 0.7	0.70	1971312.7595	845984.4852	504.0965
38.62	Thalwag 1.08	1.08	1971313.2719	845981.7719	503.7355
41.52	Thalwag 1.13	1.13	1971312.7505	845978.9120	503.6730
45.08	Thalwag 1.02	1.02	1971312.6424	845975.3589	503.7868
47.54	Thalwag .69	0.69	1971313.2530	845972.9742	504.1260
49.50	Thalwag .05	0.05	1971313.7053	845971.0612	504.7274
51.85	Thalwag .11	0.11	1971314.7492	845968.9565	504.4435
53.85	Thalwag .07	0.07	1971314.9656	845966.9746	504.2189
56.20	Thalwag .25	0.25	1971313.7487	845964.9626	503.7877
59.71	Thalwag .20	0.20	1971314.2010	845961.4824	503.8207
63.91	Thalwag .55	0.55	1971313.4683	845957.3499	503.4483
68.31	Thalwag .8	0.80	1971312.6692	845953.0196	503.1732
71.80	Thalwag .6	0.60	1971312.2680	845949.5474	503.4012
74.95	Thalwag .12	0.12	1971311.4039	845946.5234	503.8744
79.81	Thalwag .09	0.09	1971310.2511	845941.8032	503.6647
83.04	Thalwag .13	0.13	1971310.1306	845938.5767	503.5415
86.10	Thalwag .13	0.13	1971310.4372	845935.5333	503.3815
90.25	Thalwag .08	0.08	1971308.7529	845931.7343	503.2871
93.62	Thalwag .2	0.20	1971310.1280	845928.6548	503.0990
97.97	Thalwag .45	0.45	1971310.8079	845924.3644	502.8217
101.63	Thalwag .32	0.32	1971311.0113	845920.7045	502.9328
106.12	Thalwag .56	0.56	1971312.6745	845916.5422	502.7039
111.38	Thalwag 1.2	1.20	1971313.7003	845911.3816	502.0910
115.86	Thalwag .48	0.48	1971314.9539	845907.0725	502.8089
119.36	Thalwag .55	0.55	1971315.8624	845903.7025	502.7283
122.30	Thalwag .15	0.15	1971316.9781	845900.9813	503.1159
125.91	Thalwag .3	0.30	1971317.7230	845897.4461	502.8675
131.71	Thalwag .88	0.88	1971317.3312	845891.6543	502.2760
136.08	Thalwag .48	0.48	1971317.5912	845887.2986	502.6798
137.80	Thalwag .21	0.21	1971317.1192	845885.6416	502.9314
141.76	Thalwag .13	0.13	1971316.1580	845881.7959	502.8724
148.26	Thalwag .18	0.18	1971314.5481	845875.5049	502.6048
152.93	Thalwag .49	0.49	1971314.3213	845870.8342	502.1880
157.14	Thalwag .62	0.62	1971314.4327	845866.6292	502.0301
161.99	Thalwag .55	0.55	1971313.7691	845861.8303	502.0878
166.73	Thalwag .18	0.18	1971315.5553	845857.4390	502.4786
170.70	Thalwag .21	0.21	1971316.2458	845853.5268	502.4225
173.97	Thalwag .38	0.38	1971317.8438	845850.6674	502.3068
177.41	Thalwag .75	0.75	1971319.2363	845847.5250	501.8763
180.79	Thalwag .39	0.39	1971320.4006	845844.3557	502.2484
184.25	Thalwag .3	0.30	1971319.5934	845840.9844	502.3401
187.90	Thalwag .85	0.85	1971320.2306	845837.3944	501.7194
191.35	Thalwag .52	0.52	1971322.0190	845834.4412	502.0787

As-Built Survey Data (estimated survey date August 2006)					
Station	Description	Water Depth	Easting	Northing	Elevation
196.46	Thalwag .44	0.44	1971321.8504	845829.3332	502.1630
203.30	Thalwag .29	0.29	1971321.0108	845822.5534	502.2692
209.08	Thalwag .29	0.29	1971320.0143	845816.8518	502.3300
212.20	Thalwag .14	0.14	1971320.9660	845813.8794	502.3171
217.47	Thalwag .66	0.66	1971322.2833	845808.7777	501.7608
222.74	Thalwag .99	0.99	1971322.2338	845803.5099	501.4275
227.93	Thalwag .61	0.61	1971322.7847	845798.3522	501.8687
234.50	Thalwag .35	0.35	1971324.6073	845792.0432	502.1926
238.27	Thalwag .09	0.09	1971324.3298	845788.2741	502.3903
241.14	Thalwag .8	0.80	1971324.3079	845785.4042	501.6361
245.82	Thalwag .89	0.89	1971323.8252	845780.7569	501.5853
248.97	Thalwag .78	0.78	1971323.8157	845777.6074	501.6912
252.72	Thalwag .2	0.20	1971323.3314	845773.8849	502.2642
256.53	Thalwag .23	0.23	1971322.0775	845770.2834	502.2186
260.27	Thalwag .34	0.34	1971320.7529	845766.7950	502.1075
264.49	Thalwag .9	0.90	1971319.0492	845762.9256	501.5203
269.00	Thalwag 1.35	1.35	1971318.0742	845758.5268	501.0735
272.62	Thalwag .19	0.19	1971318.9109	845755.0059	502.2978
277.47	Thalwag .25	0.25	1971318.4589	845750.1750	502.2147
281.14	Thalwag .2	0.20	1971317.7224	845746.5764	502.2378
284.41	Thalwag 1.1	1.10	1971317.2923	845743.3337	501.2949
290.41	Thalwag 0.8	0.80	1971316.0779	845737.4654	501.7527
297.32	Thalwag .9	0.90	1971309.2355	845736.4547	501.7827
302.86	Thalwag .49	0.49	1971304.2853	845738.9240	501.9581
305.29	Thalwag .09	0.09	1971302.5065	845740.5901	502.3371
309.43	Thalwag .11	0.11	1971298.9237	845742.6560	502.2018
313.23	Thalwag .14	0.14	1971295.9990	845745.0927	502.1319
316.58	Thalwag .75	0.75	1971292.6861	845744.6150	501.3684
320.89	Thalwag .7	0.70	1971288.6034	845743.2381	501.4003
324.93	Thalwag .09	0.09	1971285.8589	845740.2763	502.0168
327.74	Thalwag .06	0.06	1971283.7478	845738.4236	501.9339
330.78	Thalwag .76	0.76	1971281.4220	845736.4657	501.1914
334.51	Thalwag .95	0.95	1971277.9325	845735.1324	501.0723
337.97	Thalwag .38	0.38	1971274.4840	845735.4328	501.6454
341.28	Thalwag .05	0.05	1971271.1800	845735.5803	501.9030
345.09	Thalwag .05	0.05	1971267.5621	845736.7846	501.8398
349.67	Thalwag .03	0.03	1971263.0345	845737.4549	501.6607
352.91	Thalwag .2	0.20	1971260.2257	845739.0569	501.4216
356.19	Thalwag .78	0.78	1971256.9851	845739.5621	500.7486
360.86	Thalwag 1.1	1.10	1971253.4396	845736.5094	500.4596
365.04	Thalwag .9	0.90	1971252.9614	845732.3608	500.6680
369.17	Thalwag .3	0.30	1971253.8350	845728.3225	501.5167
373.00	Thalwag .8	0.80	1971255.8245	845725.0479	501.4602
376.10	Thalwag .26	0.26	1971257.6969	845722.5842	501.2934
380.01	Thalwag .82	0.82	1971259.0111	845718.9009	500.6634
384.25	Thalwag 1.3	1.30	1971257.6477	845714.8843	500.1783
388.35	Thalwag 1.25	1.25	1971254.9468	845711.7957	500.1642
391.90	Thalwag .66	0.66	1971251.4720	845711.0930	500.8290
394.64	Thalwag .09	0.09	1971248.7358	845710.9938	501.4167
398.68	Thalwag .06	0.06	1971244.7545	845711.7113	501.3383
401.27	Thalwag .28	0.28	1971242.2041	845711.2806	501.0893
405.01	Thalwag .75	0.75	1971238.4652	845711.2789	500.6062
409.60	Thalwag 1.16	1.16	1971235.5146	845707.7649	500.2056
413.41	Thalwag 1.19	1.19	1971233.9904	845704.2718	500.2078
416.69	Thalwag 1.21	1.21	1971232.4760	845701.3623	500.1569
421.43	Thalwag .90	0.90	1971235.8344	845698.0063	500.4549

As-Built Survey Data (estimated survey date August 2006)					
Station	Description	Water Depth	Easting	Northing	Elevation
427.23	Thalwag .12	0.12	1971241.2314	845695.8837	501.2342
431.02	Thalwag .09	0.09	1971244.2466	845693.5997	501.1757
435.91	Thalwag .14	0.14	1971248.0812	845690.5558	500.8972
440.12	Thalwag .68	0.68	1971249.9854	845686.8077	500.3321
443.77	Thalwag .99	0.99	1971249.2581	845683.2271	500.0252
446.59	Thalwag .96	0.96	1971247.3796	845681.1179	500.0354
450.97	Thalwag .1	0.10	1971243.1754	845679.9118	500.8974
453.89	Thalwag .07	0.07	1971240.7165	845678.3294	500.7783
459.12	Thalwag .4	0.40	1971235.4979	845678.0196	500.3783
464.46	Thalwag 1.12	1.12	1971230.9975	845675.1435	499.6734
468.79	Thalwag 0.89	0.89	1971230.3810	845670.8547	499.9079
472.86	Thalwag 0.64	0.64	1971231.8220	845667.0551	500.1532
475.30	Thalwag .05	0.05	1971233.1487	845665.0075	500.7336
478.84	Thalwag .08	0.08	1971235.2248	845662.1416	500.5359
482.77	Thalwag .62	0.62	1971236.3892	845658.3842	499.7689
486.41	Thalwag .76	0.76	1971235.5267	845654.8440	499.7103
491.19	Thalwag .39	0.39	1971231.4332	845652.3859	500.1528
494.59	Thalwag .18	0.18	1971228.0528	845651.9669	500.1836
498.98	Thalwag .08	0.08	1971223.8074	845650.8783	500.3403
502.96	Thalwag .64	0.64	1971219.8551	845650.4184	499.6883
506.95	Thalwag 1.09	1.09	1971216.2942	845648.6066	499.2499
511.04	Thalwag .83	0.83	1971215.4534	845644.6056	499.4880
514.95	Thalwag .23	0.23	1971216.9612	845640.9933	500.1339
520.08	Thalwag .08	0.08	1971218.9659	845636.2798	500.1496
522.74	Thalwag .38	0.38	1971219.8783	845633.7764	499.8186
527.30	Thalwag .53	0.53	1971222.6270	845630.1383	499.6968
530.48	Thalwag 1.24	1.24	1971223.1027	845626.9964	498.9915
534.42	Thalwag .82	0.82	1971220.4788	845624.0561	499.4114
538.88	Thalwag .65	0.65	1971216.0236	845623.7620	499.5502
542.20	Thalwag .08	0.08	1971212.8101	845624.5892	500.1357
546.91	Thalwag .08	0.08	1971208.5693	845626.6314	499.9624
549.39	Thalwag .23	0.23	1971206.3320	845627.7019	499.7389
552.81	Thalwag .46	0.46	1971202.9501	845627.2189	499.5039
556.97	Thalwag .79	0.79	1971199.6857	845624.6362	499.2067
561.54	Thalwag .72	0.72	1971197.6998	845620.5198	499.2843
567.04	Thalwag .66	0.66	1971198.9314	845615.1538	499.3294
570.18	Thalwag .63	0.63	1971200.7773	845612.6162	499.3439
573.25	Thalwag .2	0.20	1971203.5083	845611.2095	499.7960
576.40	Thalwag .08	0.08	1971205.7647	845609.0239	499.8927
578.80	Thalwag .08	0.08	1971207.4520	845607.3177	499.8529
582.93	Thalwag .57	0.57	1971210.2258	845604.2523	499.2417
588.25	Thalwag 1.1	1.10	1971212.4763	845599.4307	498.7319
592.80	Thalwag .65	0.65	1971211.2587	845595.0453	499.1597
595.35	Thalwag .11	0.11	1971210.3008	845592.6887	499.7410
598.58	Thalwag .08	0.08	1971207.4715	845591.1279	499.7040
601.09	Thalwag .85	0.85	1971205.1058	845590.2920	498.7912
604.78	Thalwag 1.03	1.03	1971204.4890	845586.6491	498.5702
608.52	Thalwag .72	0.72	1971203.7687	845582.9761	498.9578
610.46	Thalwag .12	0.12	1971204.7049	845581.2862	499.5273
614.48	Thalwag .07	0.07	1971206.5616	845577.7198	499.4951
617.36	Thalwag .26	0.26	1971207.9850	845575.2095	498.6752
621.27	Thalwag .15	0.15	1971209.3376	845571.5436	498.7459
624.10	Thalwag .46	0.46	1971210.5984	845569.0130	498.3300
627.56	Thalwag .52	0.52	1971211.4356	845565.6524	498.2708
631.73	Thalwag 1.0	1.00	1971210.1423	845561.6854	497.7936
636.38	Thalwag .4	0.40	1971206.8030	845558.4489	498.3960

As-Built Survey Data (estimated survey date August 2006)					
Station	Description	Water Depth	Easting	Northing	Elevation
641.28	Thalwag 1.1	1.10	1971203.5265	845554.8148	498.6502
645.60	Thalwag .15	0.15	1971199.8798	845552.4945	498.5689
647.75	Thalwag .38	0.38	1971198.8269	845550.6185	498.0286
652.55	Thalwag .29	0.29	1971197.3159	845546.0573	498.0909
656.96	Thalwag .18	0.18	1971195.0614	845542.2778	497.9883
659.50	Thalwag .15	0.15	1971194.1148	845539.9180	497.8690
663.65	Thalwag .50	0.50	1971191.2301	845536.9306	497.5551
669.74	Thalwag 0.48	0.48	1971186.9248	845532.6305	497.5315
673.81	Thalwag 0.72	0.72	1971185.6698	845528.7509	497.2713
682.72	Thalwag 0.11	0.11	1971182.7402	845520.3367	497.8784
683.94	Thalwag 1	1.00	1971181.7247	845519.6635	496.8094
687.17	Thalwag .45	0.45	1971179.5802	845517.2464	497.3525
694.36	Thalwag .08	0.08	1971174.3037	845512.3638	497.6663
698.55	Thalwag .76	0.76	1971173.0424	845508.3731	496.8604
706.63	Thalwag .19	0.19	1971165.1060	845506.8467	497.4032
712.87	Thalwag .11	0.11	1971158.9981	845505.5583	497.3776
717.72	Thalwag .09	0.09	1971154.1762	845505.0524	497.3638
720.53	Thalwag .3	0.30	1971151.5208	845504.1226	497.1731
723.61	Thalwag .58	0.58	1971148.8211	845502.6383	496.9137
728.32	Thalwag .92	0.92	1971144.9454	845499.9705	496.5677
733.17	Thalwag 1.01	1.01	1971142.0121	845496.1105	496.4526
737.97	Thalwag 1.02	1.02	1971140.8023	845491.4618	496.4394
742.04	Thalwag .96	0.96	1971138.2298	845488.3069	496.5383
745.69	Thalwag .3	0.30	1971136.5891	845485.0484	497.1795
748.94	Thalwag .09	0.09	1971134.8907	845482.2810	497.3586
750.78	Thalwag .5	0.50	1971135.3942	845480.5080	496.4637
755.15	Thalwag .39	0.39	1971133.2523	845476.6930	496.5515
758.34	Thalwag .09	0.09	1971132.5886	845473.5776	496.8261
761.11	Thalwag .15	0.15	1971133.5664	845470.9910	496.7479
764.96	Thalwag .49	0.49	1971133.1377	845467.1642	496.3985
768.42	Thalwag .95	0.95	1971133.5285	845463.7198	495.9181
772.18	Thalwag .88	0.88	1971133.9813	845459.9853	495.9673
776.32	Thalwag .45	0.45	1971134.2449	845455.8553	496.4005
781.54	Thalwag .56	0.56	1971135.1630	845450.7211	496.3120
786.42	Thalwag .68	0.68	1971134.5445	845445.8744	496.1968
791.02	Thalwag .71	0.71	1971131.5162	845442.4229	496.1332
799.17	Thalwag 1.31	1.31	1971124.5035	845438.2584	495.5387
808.57	Thalwag .99	0.99	1971118.5237	845431.0036	495.8167
814.53	Thalwag 1.18	1.18	1971114.9115	845426.2700	495.7294
821.34	Thalwag 1.2	1.20	1971113.5128	845419.6037	495.6552
827.27	Thalwag 1.58	1.58	1971113.4897	845413.6754	495.2741
832.69	Thalwag 1.02	1.02	1971114.5806	845408.3609	495.8059
837.11	Thalwag .3	0.30	1971111.3479	845405.3498	496.5839
841.40	Thalwag .68	0.68	1971108.7015	845401.9748	496.2142
845.22	Thalwag 1.38	1.38	1971105.7173	845399.5850	495.4629
853.16	Thalwag 1.31	1.31	1971101.1665	845393.0876	495.5814
858.04	Thalwag 1.65	1.65	1971098.6475	845388.9009	495.2203
870.49	Thalwag 1.28	1.28	1971090.9669	845379.1012	495.5447
874.99	Thalwag .63	0.63	1971088.5940	845375.2810	496.2413
877.80	Thalwag .2	0.20	1971086.4337	845373.4820	496.6532
881.11	Thalwag .16	0.16	1971083.8698	845371.3920	496.6409
883.44	Thalwag .02	0.02	1971081.8701	845370.1877	496.7314
885.27	Thalwag .02	0.02	1971081.6476	845368.3743	495.5973
886.27	Thalwag .21	0.21	1971080.7383	845367.9694	494.9823
887.57	Thalwag .15	0.15	1971079.5560	845367.4289	494.8154
890.21	Thalwag .4	0.40	1971077.7078	845365.5430	494.5209

As-Built Survey Data (estimated survey date August 2006)					
Station	Description	Water Depth	Easting	Northing	Elevation
892.67	Thalwag .3	0.30	1971075.2785	845365.1300	494.4743
895.94	Thalwag .58	0.58	1971072.8820	845362.9034	494.2430
898.82	Thalwag .69	0.69	1971071.8200	845360.2305	494.2231
903.17	Thalwag .5	0.50	1971070.3255	845356.1443	494.3557
907.03	Thalwag .62	0.62	1971066.9172	845354.3321	494.3017
912.23	Thalwag .14	0.14	1971062.7539	845351.2109	494.7498
918.44	Thalwag .33	0.33	1971056.7954	845349.4756	494.4732
923.14	Thalwag .21	0.21	1971052.6686	845347.2149	494.5463
926.53	Thalwag .15	0.15	1971049.5295	845345.9516	494.4513
929.25	Thalwag .15	0.15	1971047.5596	845344.0658	493.9603
933.54	Thalwag .2	0.20	1971044.0246	845341.6403	494.0114
937.37	Thalwag .22	0.22	1971040.4068	845340.3927	493.8257
941.84	Thalwag .26	0.26	1971036.3364	845338.5437	493.6664
944.95	Thalwag .29	0.29	1971033.2691	845338.0528	493.4969
949.92	Thalwag .05	0.05	1971029.9516	845334.3465	493.5062
952.36	Thalwag .18	0.18	1971028.2551	845332.5874	493.0223
954.12	Thalwag .25	0.25	1971026.7467	845331.6860	492.7894
958.04	Thalwag .73	0.73	1971023.3109	845329.7977	492.3252
958.11	Thalwag .73	0.73	1971023.3498	845329.7382	492.3209
963.52	Thalwag .43	0.43	1971019.1031	845326.3947	492.6521
967.36	Thalwag .05	0.05	1971016.9915	845323.1861	493.0026
968.42	Thalwag .15	0.15	1971016.8051	845322.1367	492.6385
972.84	Thalwag .27	0.27	1971015.2430	845318.0034	492.4833
976.11	Thalwag .18	0.18	1971014.3008	845314.8762	492.5088
978.60	Thalwag .10	0.10	1971014.0222	845312.3991	492.3054
980.88	Thalwag .410	0.41	1971012.9040	845310.4162	491.9972
985.23	Thalwag .22	0.22	1971010.4710	845306.8082	492.1383
990.50	Thalwag .26	0.26	1971008.3101	845301.9988	492.0885
994.97	Thalwag .15	0.15	1971004.4934	845299.6839	492.2247
999.27	Thalwag .31	0.31	1971001.1406	845296.9802	492.0342
1005.15	Thalwag .41	0.41	1970996.5779	845293.2743	491.9624
1011.12	Thalwag .41	0.41	1970990.7813	845291.8581	491.9665
1016.70	Thalwag .50	0.50	1970985.4669	845290.1503	491.8553
1023.33	Thalwag .55	0.55	1970979.6967	845286.8960	491.7064
1030.75	Thalwag .20	0.20	1970972.7965	845284.1570	492.1331
1033.88	Thalwag .10	0.10	1970970.2667	845282.3150	492.2366
1035.77	Thalwag .01	0.01	1970968.3935	845282.0554	492.3055
1036.95	Thalwag .49	0.49	1970967.4420	845281.3533	491.3465
1041.99	Thalwag .95	0.95	1970962.9779	845279.0179	490.8929
1046.00	Thalwag .59	0.59	1970959.2399	845277.5773	491.2288
1051.75	Thalwag .49	0.49	1970953.7582	845275.8423	491.3230
1058.68	Thalwag .68	0.68	1970947.3959	845273.0739	491.1035
1065.16	Thalwag .69	0.69	1970942.0385	845269.4364	491.1011
1069.63	Thalwag .24	0.24	1970938.1250	845267.2762	491.5931
1071.28	Thalwag .05	0.05	1970936.7016	845266.4472	491.7089
1072.64	Thalwag .55	0.55	1970935.3509	845266.3039	490.7594
1076.99	Thalwag .52	0.52	1970931.6438	845264.0117	490.7745
1081.92	Thalwag .40	0.40	1970926.8707	845262.7804	490.8955
1083.71	Thalwag .35	0.35	1970925.7293	845261.4003	490.5585
1088.03	Thalwag .73	0.73	1970921.8026	845259.6167	490.1762
1094.13	Thalwag .46	0.46	1970915.8868	845258.1299	490.4243
1099.49	Thalwag .32	0.32	1970910.8480	845256.2863	490.5579
1100.95	Thalwag .12	0.12	1970909.5256	845256.8920	490.5226
1103.00	Thalwag .30	0.30	1970907.5314	845256.4153	490.1876
1107.45	Thalwag .46	0.46	1970904.2038	845253.4554	490.0309
1113.36	Thalwag .48	0.48	1970899.2623	845250.2143	490.0354

As-Built Survey Data (estimated survey date August 2006)					
Station	**Description**	**Water Depth**	**Easting**	**Northing**	**Elevation**
1118.60	Thalwag .38	0.38	1970894.5421	845247.9490	490.1405
1123.33	Thalwag .32	0.32	1970890.5086	845245.4679	490.1798
1128.43	Thalwag .21	0.21	1970886.3067	845242.5807	490.2438
1133.14	Thalwag .20	0.20	1970882.1637	845240.3420	490.2456
1138.23	Thalwag .33	0.33	1970878.2610	845237.0676	490.1028
1142.11	Thalwag .22	0.22	1970875.3953	845234.4576	490.2155
1146.41	Thalwag .22	0.22	1970873.4435	845230.6241	490.0128
1149.82	Thalwag .20	0.20	1970871.0161	845228.2238	489.8127
1150.65	Thalwag .10	0.10	1970871.2932	845227.4418	489.9198
1152.53	Thalwag .19	0.19	1970870.5436	845225.7272	489.5808
1155.07	Thalwag .20	0.20	1970869.2245	845223.5464	489.1607
1159.03	Thalwag .49	0.49	1970866.2600	845220.9330	488.8377
1162.58	Thalwag .19	0.19	1970863.5464	845218.6358	488.1980
1168.41	Thalwag .50	0.50	1970859.8987	845214.0873	488.7996
1174.14	Thalwag .42	0.42	1970859.9827	845208.3625	488.9230
1176.54	Thalwag .6	0.60	1970859.4119	845206.0251	488.7363
1181.31	Thalwag .59	0.59	1970859.5670	845201.2658	488.7295
1185.46	Thalwag .05	0.05	1970860.0503	845197.1421	489.2615
1187.92	Thalwag .07	0.07	1970860.7733	845194.7879	488.8541
1188.79	Thalwag .65	0.65	1970860.5891	845193.9364	488.2093
1192.29	Thalwag .59	0.59	1970860.0019	845190.4923	488.2778
1196.42	Thalwag .72	0.72	1970860.2615	845186.3651	488.1404
1201.33	Thalwag .46	0.46	1970860.9357	845181.5047	488.4082
1209.39	Thalwag .8	0.80	1970862.2884	845173.5573	488.0411
Station	L/R bankfull	WS	Easting	Northing	Elevation
71	L	NA	1971319.7696	845949.4610	506.3365
85	L	NA	1971320.6228	845937.3731	505.5715
95	L	NA	1971320.9589	845926.9273	505.3094
104	L	NA	1971321.0306	845918.0096	505.0596
96	L	NA	1971315.5515	845926.1194	504.8485
88	L	NA	1971314.7493	845933.1896	504.9614
82	L	NA	1971315.2775	845939.6203	504.8932
76	L	NA	1971316.7476	845944.8153	505.7606
137	L	NA	1971324.8707	845886.2118	504.6779
149	L	NA	1971324.2916	845874.1504	504.6540
158	L	NA	1971323.6452	845865.8916	504.7321
167	L	NA	1971325.2387	845857.9454	504.7916
175	L	NA	1971324.6973	845851.0401	504.2537
164	L	NA	1971319.7111	845860.1229	503.6524
156	L	NA	1971319.2927	845868.0570	503.8389
147	L	NA	1971319.4080	845876.5731	504.1650
141	L	NA	1971321.8398	845882.9191	504.2408
187	L	NA	1971327.5661	845839.5840	504.7512
196	L	NA	1971327.5446	845830.4499	504.3165
203	L	NA	1971327.5621	845822.3486	504.1897
213	L	NA	1971328.4054	845813.2247	503.9866
219	L	NA	1971328.8752	845807.0488	503.7745
216	L	NA	1971325.9846	845810.6167	503.0843
207	L	NA	1971324.9736	845817.9225	503.4150
200	L	NA	1971324.4668	845825.8006	503.7618
190	L	NA	1971325.5330	845835.6308	504.0030
701	L	NA	1971180.2676	845507.9985	499.0068
704	L	NA	1971176.6595	845501.5245	499.8535
707	L	NA	1971173.7676	845496.4304	499.7713
715	L	NA	1971166.8125	845495.5798	499.5923
702	L	NA	1971159.0180	845495.1744	499.2815

As-Built Survey Data (estimated survey date August 2006)					
Station	Description	Water Depth	Easting	Northing	Elevation
732	L	NA	1971149.5343	845493.3223	499.2765
746	L	NA	1971143.5192	845483.7475	498.7124
764	L	NA	1971139.7785	845471.6940	498.3568
748	L	NA	1971146.2261	845478.2277	499.2594
732	L	NA	1971152.3924	845488.8461	499.3636
722	L	NA	1971161.5749	845491.5538	499.8483
707	L	NA	1971175.8737	845494.0652	500.0124
704	L	NA	1971180.0403	845499.0850	500.1083
715	R	NA	1971154.8938	845522.0240	500.6988
723	R	NA	1971150.0706	845515.0502	500.0842
734	R	NA	1971138.6906	845510.3622	500.2305
745	R	NA	1971130.0087	845499.8058	499.8988
753	R	NA	1971123.6220	845490.4488	499.9012
756	R	NA	1971123.3931	845483.3886	499.7964
1172	R	NA	1970850.9689	845227.6866	492.0394
1157	R	NA	1970858.9796	845234.2918	492.0122
1151	R	NA	1970867.2346	845241.4085	492.6066
1145	R	NA	1970874.8383	845248.2349	493.1723
1032	R	NA	1970883.7452	845255.2738	493.1251
1022	R	NA	1970892.7526	845260.7996	493.2506
1112	R	NA	1970902.3222	845265.9166	493.1574
1102	R	NA	1970911.9403	845269.7101	493.3166
1090	R	NA	1970921.4743	845274.4322	493.2743
1080	R	NA	1970930.5570	845279.3081	493.8792
1069	R	NA	1970939.8772	845285.1224	493.8431
1060	R	NA	1970949.7799	845289.4991	493.9614
1049	R	NA	1970959.9967	845294.2135	494.1323
1037	R	NA	1970970.2546	845298.5726	493.7768
1025	R	NA	1970980.7851	845303.4088	494.1396
1008	R	NA	1970990.5001	845308.7613	494.8086
991	R	NA	1970999.2364	845316.7892	495.0331
977	R	NA	1971005.5318	845326.4270	495.4782
971	R	NA	1971012.5351	845335.1391	495.2737
962	R	NA	1971021.2198	845343.0201	495.8534
950	R	NA	1971030.3382	845349.4462	496.3327
940	R	NA	1971040.1408	845354.8319	496.6729
930	R	NA	1971048.6019	845360.1269	497.1925
919	R	NA	1971057.7578	845365.8116	497.7857
1210	R	NA	1970851.6970	845180.9316	491.0279
1201	R	NA	1970849.9105	845189.1231	490.9252
1195	R	NA	1970849.2588	845194.5044	491.4352
1190	R	NA	1970851.9848	845199.8089	491.1774
1199	L	NA	1970867.0614	845192.4546	490.1964
1204	L	NA	1970866.4736	845185.1467	490.2532
1158	L	NA	1970874.2689	845225.4786	490.6403
1212	L	NA	1970866.3922	845178.5621	490.3889
1048	L	NA	1970880.3328	845233.7397	491.0376
1214	L	NA	1970868.1490	845176.5555	490.5120
1037	L	NA	1970888.1744	845239.3134	491.2314
1212	L	NA	1970876.2337	845178.8246	490.7481
1028	L	NA	1970897.1201	845244.0443	491.3166
1025	L	NA	1970899.9486	845245.3648	491.6322
1088	L	NA	1970931.7551	845259.4212	492.8526
1077	L	NA	1970941.8135	845263.6990	492.7583
1067	L	NA	1970950.5662	845268.8502	493.1199
1058	L	NA	1970958.6046	845272.0178	493.5643

As-Built Survey Data (estimated survey date August 2006)					
Station	Description	Water Depth	Easting	Northing	Elevation
1032	L	NA	1970981.1177	845283.0413	493.3532
1023	L	NA	1970989.8378	845287.4868	493.3648
1014	L	NA	1970999.3626	845288.6838	493.8653
1007	L	NA	1971005.5470	845292.2085	494.7184
997	L	NA	1971014.6996	845298.6025	494.3818
991	L	NA	1971018.4694	845307.1570	494.0936
973	L	NA	1971022.4466	845320.9221	494.6311
959	L	NA	1971031.0732	845329.6849	494.2406
947	L	NA	1971041.6647	845336.3765	495.3340
934	L	NA	1971052.9491	845342.8646	495.9175
918	L	NA	1971067.9629	845347.5564	496.5127

Appendix E. Design/Construction Plans
(Provided by NC EEP)

INDEX TO DRAWING SHEETS

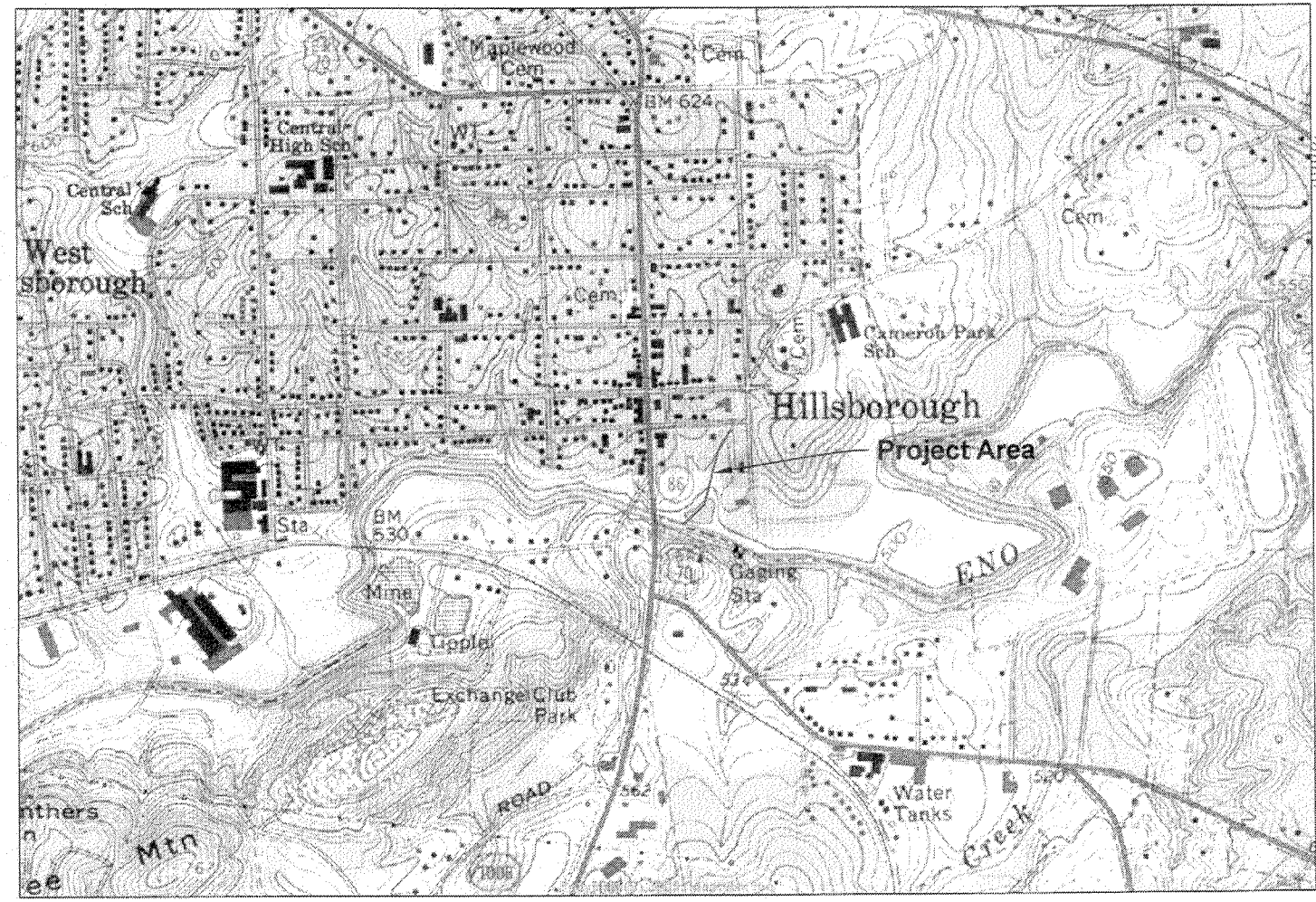
NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ANGELA DARLENE GREENE 11/21/05

CALL BEFORE YOU DIG 1-800-632-4949

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Drawing Index Sheet

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

REVISIONS
DATE | APPROVED | TITLE



NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ABELA DARLENE GIBBS

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Location Map

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

REVISIONS		
DATE	APPROVED	TITLE

Cp - Congaree fine sandy loam
-Nearly level, very deep, well drained to moderately well drained soil on flood plains.
-Formed in loamy alluvial deposits.
-Have a loamy surface layer and subsoil.
-Permeability is moderate and shrink-swell potential is low.

GhC - Georgeville - Urban land complex, 2 to 10% slopes

Georgeville Qualities:
-Very well deep and well drained.
-Uplands and formed in residuum from Carolina slates and other fine grained rocks.
-Loamy surface layer and clayey subsoil.
-Permeability is moderate and shrink-swell potential is low.

Urban Qualities:
-Original soils have been cut, filled, graded, or paved to the extent that soil type can not be recognized.

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 18112 ANGELA DARLENE GREEN 11/21/05

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Soils Information

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

REVISIONS		
DATE	APPROVED	TITLE

Sequence of Construction:

1. Install temporary gravel construction entrance/exit pad at designated construction entrance.
2. Install rock dam sediment basin at Station 4+76(±).
3. All equipment shall cross the stream, for hauling purposes or otherwise, over the rock dam portion of the sediment basins installed at Station 4+76 (±) and Station 10+87 (±). As an alternative, the contractor may provide a temporary bridge that will span the entire channel from top of bank on one side to top of bank on the other side of the channel. The engineer shall approve the placement of the temporary bridge if the contractor selects to use this alternative. NOTE: *The existing concrete footbridge at Station 3+35 is to remain at the present location throughout construction. It is the responsibility of the contractor to take necessary precautions to maintain and protect the bridge throughout the construction operations.*
4. Install impervious berm on upstream side of culverts under Margaret Lane to set up intake area for the pumping operation. Lay out temporary pipe through the culvert and begin the pumping operation. The pumping system shall outlet into the upstream side of the rock dam sediment basin at Station 4+76.
5. After the upper reach of the channel has been dewatered, install the rock step structure, rock cross vane and rock bed sill from Station 1+00 through Station 1+88 per the plans and specifications.
6. Grade, seed and install erosion control blanket on side slopes adjacent to the rock step structure and rock cross vane.
7. Prepare temporary stockpile area #1 for use by installing the silt fence as shown on the plans.
8. Discontinue pumping operation in existing channel.
9. Construct new channel from Station 4+12 through Station 7+86. Install rock structures as shown on plans or as staked by the engineer. Work shall progress in a downstream direction. Place all excavated material in the temporary stockpile area unless otherwise directed by the engineer.
10. When channel excavation and floodplain grading operations in this reach are completed, install bioengineering practices at locations shown on the drawings or as staked by the engineer. Seed and mulch or install erosion control blanket on the disturbed area per the plans and specifications. Daily seeding operations are preferred when practical.
11. Resume pumping operation in existing channel.
12. Resume work at Station 1+88. Shape channel, bankfull bench and floodplain per plans and specifications. Install rock structures and bioengineering practices as shown on plans or as staked by the engineer. Temporarily stop channel work at Station 3+74.
13. When channel shaping and floodplain grading operations are completed in this reach, seed and mulch or install erosion control blanket on the area per the plans and specifications. Daily seeding operations are preferred when practical.
14. Install the rock dam sediment basins: first at Station 13+16 (±) and then at Station 10+87 (±).
15. Install rock cross vane at Sta. 8+18 (to be used as pump intake area for next phase of water removal).
16. Resume work at Station 3+74 and connect the existing channel to the new channel. Plug the upper and lower ends of the existing channel section using backfill material from the temporary stockpile area.
17. Remove the rock dam sediment basin at Station 4+76. Use material from the temporary stockpile area to backfill selected sections of old channel as shown on plans. Shape shallow wetland habitat areas as shown onplans. Seed and mulch area per plans and specifications.
18. Install the impervious dike at the top of the slide below the rock cross vane at Sta. 8+18. Use as pump intake area. Layout temporary pipe down to the sediment basin at Sta. 10+87. The pumping system shall outlet into the upstream side of the rock dam sediment basin at Station 10+87. Begin dewatering operation.
19. Prepare temporary stockpile area #2 for use by installing the silt fence as shown on the plans.
20. After the reach has been dewatered, shape channel banks, install rock structures and bioengineering practices as shown on the plans or as staked by the engineer. Work shall progress in a downstream direction. Place all excavated material in the temporary stockpile areas unless otherwise directed by the engineer. The contractor may begin operations to haul and properly dispose of excess material offsite.
21. When channel shaping and floodplain grading operations are completed in this reach, seed and mulch or install erosion control blanket on the area per the plans and specifications. Daily seeding operations are preferred when practical.
22. The two Boy Scout footbridges, located in the lower reach of the project, are to be relocated to the locations staked by the engineer (unless the alternative to replace the footbridges is the option bid by the contractor). The other bridge structure to be removed from this stream reach is to be properly disposed of by the contractor.
23. Remove rock dam sediment basin at Station 10+87 and install rock step structure at outlet of side drainage and on side slopes of channel at Station 10+87 per plans and specifications.
24. Set up the pumping operation to dewater the remaining reach of channel. The pumping system shall outlet into the upstream side of the rock dam sediment basin at Station 13+16 (±).
25. Prepare temporary stockpile area #3 for use by installing the silt fence as shown on the plans if area is needed.
26. Excavate bankfull bench on right side and shape channel per plans and specifications. Install rock structures and bioengineering structures as shown on plans or as staked by the engineer.
27. When channel shaping and bench grading operations are completed in this reach, seed and mulch or install erosion control blanket on the area per the plans and specifications. Daily seeding operations are preferred when practical.
28. When seeding operations including installation of erosion control blanket are completed for this reach, remove rock dam sediment basin at Station 13+16 and complete channel shaping to the confluence with the Eno River. Install rock structures as shown on plans or as staked by the engineer. Seed and install erosion control blanket on channel slopes as soon as grading is completed. Daily seeding operations are preferred whenpractical.
29. Contractor shall complete operations to haul and properly dispose of excess material offsite. All temporary stockpile areas shall be restored to the preconstruction grade then seeded and mulched.
30. The shrubs and trees shall be planted per the requirements of the plans and specifications.
31. Any disturbed areas including the haul road and the temporary gravel construction entrance/exit pad shall be restored to the preconstruction grade, then seeded and mulched.

REVISIONS

DATE	APPROVED	TITLE

Drawing File Name:

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Sequence of Construction

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

Designed: Angela Greene 11/05
Drawn: Bill Gardner 11/05
Checked:

Drawing Number:

Sheet No. 3 of 37

MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL WITH REFERENCE REACH DATA (After Rosgen, 1996)

***Restoration Site* (Name of stream & location): Stillhouse Creek, Hillsborough, NC- Lower Reach**
***Reference Reach* (Name of stream & location): Silas Creek near Silas Crk Pkwy and Reynolda Rd, Winston-Salem, NC**

VARIABLES	EXISTING CHANNEL Stillhouse Creek	PROPOSED REACH Stillhouse Creek	REFERENCE REACH (Silas Creek)
1. Stream type	G4c/1	B4/1	B4c/1
2. Drainage area (sq. mi.)	0.22	0.22	3.3
3. Bankfull width (w_{bkf}) – ft.	Mean: 11.8 Range: 9.8-14.6	Mean: 17.4 Range: 14.9-19.5	Mean: 25.6 Range: 23.1-28.0
4. Bankfull mean depth (d_{bkf}) – ft.	Mean: 1.9 Range: 1.7-2.0	Mean: 1.15 Range: 1.1-1.2	Mean: 1.7 Range: 1.5-1.9
5. Width/depth ratio (w_{bkf}/d_{bkf})	Mean: 6.2 Range:4.9-8.6	Mean: 15.2 Range: 12.4-17.2	Mean: 15.2 Range: 12.4-17.2
6. Bankfull cross-sectional area (A_{bkf}) – sq. ft.	Mean: 21.7 Range: 19.2-24.7	Mean: 20 Range: 18-22	Mean: 43.5 Range: 38.5-48.9
7. Bankfull mean velocity (v_{bkf}) – f/s	Mean: 4.2 Range: 3.7-4.8	Mean: 4.5 Range: 4.2-5.1	Mean: 4.4 Range: 3.6-4.9
8. Bankfull discharge, cfs (Q_{bkf})	92	92	199
9. Bankfull Maximum depth (d_{max}) – ft.	Mean: 2.7 Range: 2.6-2.8	Mean: 1.8 Range: 1.7-1.9	Mean: 2.7 Range: 2.4-2.9
10. Max d_{riff}/d_{bkf} ratio	Mean: 1.45 Range: 1.4-1.5	Mean: 1.6 Range: 1.5-1.6	Mean: 1.6 Range: 1.5-1.6
11. Riffle length (L_{riff}) - ft.		Mean: 12.2 Range: 6.0-19.5	Mean: 18.4 Range: 9.5-29.0
12. Ratio of riffle length to bkf width (L_{riff}/w_{bkf})		Mean: 0.7 Range: 0.4-1.0	Mean: 0.7 Range: 0.4-1.0
13. Low bank height to max. d_{bkf} ratio	Mean: 2.6 Range: 2.5-2.9	Mean: 1.0 Range:	Mean: 1.0 Range: 1.0-1.0
14. Width of flood prone area (w_{fpa}) – ft.	Mean: 19.3 Range: 15.5-26.8	Mean: 26.1 Range: 17.9-35.1	Mean: 33.7 Range: 33.0-35.0
13. Entrenchment ratio (w_{fpa}/w_{bkf})	Mean: 1.6 Range: 1.4-1.8	Mean: 1.5 Range: 1.2-1.8	Mean: 1.3 Range: 1.2-1.4
14. Meander length (L_m) – ft.	Mean: Range:	Mean: 115 Range: 39-94	Mean: 168 Range: 130-245
15. Ratio of meander length to bankfull width (L_m/w_{bkf})	Mean: Range:	Mean: 6.6 Range: 5.1-9.6	Mean: 6.6 Range: 5.1-9.6
16. Radius of curvature (R_c) – ft.	Mean: Range:	Mean: 34.8 Range: 29.8-39.0	Mean: 41.25 Range: 19.5-54.0
17. Ratio of radius of curvature to bankfull width (R_c/w_{bkf})	Mean: Range:	Mean: 2.0 Range:	Mean: 1.6 Range: 0.8-2.1
18. Belt width (w_{blt}) - ft.	Mean: Range:	Mean: 29.6 Range: 23.8-39.0	Mean: 43.7 Range: 40-51
19. Meander width ratio (w_{blt}/w_{bkf})	Mean: Range:	Mean: 1.7 Range: 1.6-2.0	Mean: 1.7 Range: 1.6-2.0
20. Sinuosity = k (Stream Length$_{thalweg}$/ valley distance)	314 = 1.1 282	1.1	348 = 1.07 325
21. Valley slope (ft/ft)	0.0185	0.0185	Not measured
22. Average water surface slope-ft/ft (s_{avg}) = (s_{valley}/k)	0.0168	0.0168	0.00819
23. Pool slope (s_{pool}) – ft/ft	Mean: Range:	Mean: 0.00126 Range: 0.00-0.0025	Mean: 0.0000376 Range: -0.001316 to 0.00122
24. Ratio of pool slope to average slope (s_{pool}/s_{bkf})	Mean: Range:	Mean: 0.075 Range: 0.00-0.15	Mean: 0.00459 Range: -0.1607 to 0.149
25. Maximum pool depth ($d_{max\ pool}$) – ft.	Mean: Range:	Mean: 3.0 Range: 2.5-3.5	Mean: 4.5 Range: 4.0-5.0
26. Ratio of pool depth to average bankfull depth ($d_{max\ pool}/d_{bkf}$)	Mean: Range:	Mean: 2.6 Range: 2.3-2.9	Mean: 2.6 Range: 2.3-2.9
27. Pool width (w_{pool}) – ft.	Mean: Range:	Mean: 17.4 Range: 13.4-21.5	Mean: 26.0 Range: 22.6-28.0
28. Ratio of pool width to bankfull width (w_{pool}/w_{bkf})	Mean: Range:	Mean: 1.0 Range: 0.9-1.1	Mean: 1.0 Range: 0.9-1.1

REVISIONS

DATE	APPROVED	TITLE

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Rosgen Type B Morphological Table-- Part 1

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

Drawing Number:

Sheet No. 4 of 37

Drawing File Name:

MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL WITH REFERENCE REACH DATA (After Rosgen, 1996)

***Restoration Site* (Name of stream & location): Stillhouse Creek, Hillsborough, NC- Lower Reach**

***Reference Reach* (Name of stream & location): Silas Creek near Silas Crk Pkwy and Reynolda Rd, Winston-Salem, NC**

VARIABLES	EXISTING CHANNEL Stillhouse Creek	PROPOSED REACH Stillhouse Creek	REFERENCE REACH (Silas Creek)
29. Pool Area – sq ft (A_{pool})	Mean: Range:	Mean: 32 Range: 25-40	Mean: 70.3 Range: 59.9-79.8
30. Ratio of Pool Area to Bankfull Area (A_{poo}/A_{bkf})	Mean: Range:	Mean: 1.6 Range: 1.4-1.8	Mean: 1.6 Range: 1.4-1.8
31. Pool to pool spacing (p-p) – ft.	Mean: Range:	Mean: 57 Range: 39-94	Mean: 62.4 Range: 27.2-126.0
32. Ratio of p-p spacing to bankfull width (p-p/w_{bkf})	Mean: Range:	Mean: 3.3 Range: 2.6-4.8	Mean: 2.4 Range: 1.1-4.9
33. Pool length (L_{pool}) – ft.	Mean: Range:	Mean: 21 Range: 5-53	Mean: 31.2 Range: 8.2 – 68.0
34. Ratio of Pool length to bankfull width (L_{pool}/w_{bkf})	Mean: Range:	Mean: 1.2 Range: 0.3-2.7	Mean: 1.2 Range: 0.3-2.7
35. Avg. riffle slope (s_{riff}) - ft./ft.	Mean: Range:	Mean: 0.025 Range: 0.0168-0.0336	Mean: 0.0122 Range: 0.00819-0.0164
36. Ratio of riffle slope to avg. slope (s_{riff}/s_{avg})	Mean: Range:	Mean: 1.5 Range: 1.0-2.0	Mean: 1.5 Range: 1.0-2.0
37. Avg. run slope ft/ft	Mean: Range:	Mean: 0.04 Range: 0.0168-0.1445	Mean: 0.0196 Range: 0.00819-0.0704
38. Ratio of run slope to avg slope (s_{run}/s_{avg})	Mean: Range:	Mean: 2.4 Range: 1.0-8.6	Mean: 2.4 Range: 1.0-8.6
39. Avg. step slope-ft/ft	Mean: Range:	Mean: 0.168 Range: 0.01344-0.35616	Mean: 0.0817 Range: 0.00667 to 0.1733
40. Ratio of step slope to avg slope (s_{step}/s_{avg})	Mean: Range:	Mean: 10.0 Range: 0.8-21.2	Mean: 10.0 Range: 0.8-21.2
41. Avg. glide slope ft/ft	Mean: Range:	Mean: 0.01 Range: 0.00-0.02856	Mean: 0.004948 Range: 0.00-0.014
42. Ratio of glide slope to avg slope (s_{glide}/s_{avg})	Mean: Range:	Mean: 0.6 Range: 0.00-1.7	Mean: 0.6 Range: 0.0-1.7
43. Max run depth ($d_{max\ run}$) – ft.	Mean: Range:	Mean: 2.2 Range: 2.1-2.3	Mean: 3.3 Range: 3.3-3.3
44. Ratio of max. run depth to mean bkf depth ($d_{max\ run}/d_{bkf}$)	Mean: Range:	Mean: 1.9 Range:	Mean: 1.9 Range:
45. Run width (w_{run}) – ft.	Mean: Range:	Mean: 17.4 Range: 13.4-21.5	Mean: 26.5 Range: 24.0-29.0
46. Run width to bankfull width ratio (w_{run}/w_{bkf})	Mean: Range:	Mean: 1.0 Range: 0.9-1.1	Mean: 1.0 Range: 0.9-1.1
47. Mean run depth (d_{run}) ft.	Mean: Range:	Mean: 1.6 Range: 1.5-1.8	Mean: 2.4 Range: 2.2-2.6
48. Ratio mean run depth to mean bkf depth (d_{run}/d_{bkf})	Mean: Range:	Mean: 1.4 Range: 1.4-1.5	Mean: 1.4 Range: 1.4-1.5
49. Run w/d ratio (w_{run}/d_{run})	Mean: Range:	Mean: 13.7 Range: 12.4-15.5	Mean: 11.4 Range: 9.4-13.4
50. Ratio of run w/d to riffle w/d	Mean: Range:	Mean: 0.9 Range:	Mean: 0.75 Range: 0.6-0.9
51. Run length (L_{run}) – ft.	Mean: Range:	Mean: 5.9 Range: 1.5-11.7	Mean: 8.8 Range: 3.2-16.0
52. Ratio of run length to bankfull width (L_{run}/w_{bkf})	Mean: Range:	Mean: 0.34 Range: 0.1-0.6	Mean: 0.34 Range: 0.1-0.6
53. Max step depth ($d_{max\ step}$) - ft	Mean: Range:	Mean: 2.0 Range: 1.9-2.2	Mean: 2.95 Range: 2.9-3.0
54. Ratio of max step depth to mean bkf depth ($d_{max\ step}/d_{bkf}$)	Mean: Range:	Mean: 1.7 Range: 1.7-1.8	Mean: 1.7 Range: 1.7-1.8
55. Step width (w_{step}) - ft	Mean: Range:	Mean: 17.4 Range:13.4-21.5	Mean: 25.65 Range: 23.0-28.3
56. Step width to bankfull width ratio (w_{step}/w_{bkf})	Mean: Range:	Mean: 1.0 Range: 0.9-1.1	Mean: 1.0 Range: 0.9-1.1
57. Step area (A_{step}) – sq ft	Mean: Range:	Mean: 20 Range: 16.2-24.2	Mean: 44.1 Range: 42.6-45.6
58. A_{step}/A_{bkf} ratio	Mean: Range:	Mean: 1.0 Range: 0.9-1.1	Mean: 1.0 Range: 0.9-1.1
59. Mean step depth (d_{step}) - ft	Mean: Range:	Mean: 1.15 Range: 1.1-1.3	Mean: 1.75 Range: 1.6-1.9
60. d_{step}/d_{bkf} ratio	Mean: Range:	Mean: 1.0 Range: 1.0-1.1	Mean: 1.0 Range: 1.0-1.1

NORTH CAROLINA PROFESSIONAL SEAL 018877 ENGINEER ANGELA D. ARIENE 11/21/05

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Rosgen Type B Morphological Table--- Part 2

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

REVISIONS
DATE | APPROVED | TITLE

MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL WITH GAGE STATION AND REFERENCE REACH DATA

(After Rosgen, 1996)

Restoration Site (Name of stream & location): Stillhouse Creek, Hillsborough, NC **Reference Reach (Name of stream & location):** UT to Caraway Creek, Camp Caraway, Randolph County, NC **Reference Reach** (Name of stream & location): UT to North Fork New River, Ashe County, NC

VARIABLES	EXISTING CHANNEL Stillhouse Creek	PROPOSED REACH Stillhouse Creek	REFERENCE REACH UT to Caraway Creek	REFERENCE REACH (UT to N Fork New River)
1. Stream type	E4 (Incision, lat. migration)	E4 (Upper Reach)	E4/5 (Confined valley)	E4/5 (Confined valley)
2. Drainage area (sq. mi.)	0.14	0.14	0.17	0.25
3. Bankfull width (W_{bkf}) – ft.	Mean: 7.0 Range: 6.0-7.6	Mean: 8.5 Range: 7.5 – 9.5	Mean: 9.7 Range: 7.3 – 12.4	Mean: 7.2 Range: 6.0 – 9.0
4. Bankfull mean depth (d_{bkf}) – ft.	Mean: 1.0 Range: 0.8-1.4	Mean: 1.06 Range: 0.95 – 1.2	Mean: 1.1 Range: 0.9 – 1.3	Mean: 0.8 Range 0.6 – 1.0
5. Width/depth ratio (W_{bkf}/d_{bkf})	Mean: 7.1 Range: 4.4 - 9.3	Mean: 8.0 Range: 6.0 – 10.0	Mean: 9.3 Range: 7.3 – 14	Mean: 10.1 Range: 6.0 – 15.0
6. Bankfull cross-sectional area (A_{bkf}) – sq. ft.	Mean: 7.3 Range: 5.6 - 8.1	Mean: 9.0 Range:	Mean: 10.35 Range: 7.3 – 13.2	Mean: 5.4 Range: 4.4 – 6.1
7. Bankfull mean velocity (v_{bkf}) – f/s	Mean: 5.0 Range: 4.4 - 6.4	Mean: 3.8 Range: 3.6 - 4.1	Mean: 3.2 Range: 2.5 – 4.5	Mean: 6.1 Range: 5.4 – 7.5
8. Bankfull discharge, cfs (Q_{bkf})	36	36	33 (Note: Soil hydrologic group C)	33 (Note: Dry side of eastern mountains)
9. Bankfull Maximum depth (d_{max}) – ft.	Mean: 1.7 Range: 1.2 - 2.0	Mean: 1.8 Range: 1.3 – 2.4	Mean: 1.8 Range: 1.6 – 2.0	Mean: 1.5 Range: 1.4 – 1.6
10. Max d_{bkf}/d_{bkf} ratio	Mean: 1.6 Range: 1.2 - 2.0	Mean: 1.7 Range:1.2 – 2.3	Mean: 1.6 Range: 1.2 – 2.2	Mean: 1.9 Range: 1.6 – 2.3
11. Low bank height to max. d_{bkf} ratio	Mean: 1.13 Range: 1.0 - 1.4	Mean: 1.0 Range:	Mean: 1.06 Range: 1.0 – 1.25	Mean: 1.0 Range:
12. Width of flood prone area (W_{fpa}) – ft.	Mean: 35.1 Range: 17.1 - 47.0	Mean: 104 Range:23 – 176	Mean: 49.6 Range: 27.0 – 74.0	Mean: 135.5 Range: 122 – 149
13. Entrenchment ratio (W_{fpa}/W_{bkf})	Mean: 5.1 Range: 2.3 - 6.3	Mean: 12.2 Range:2.7 – 20.7	Mean: 5.6 Range: 2.7 – 10.1	Mean: 18.8 Range: 16.9 – 20.7
14. Meander length (L_m) – ft.	Mean: 63 Range: 29 - 116	Mean: 27.2 Range:12.8 – 39.1	Mean: 34.7 Range: 21.2 – 57.0	Mean: 20 Range: 13.5 – 26
15. Ratio of meander length to bankfull width (L_m/W_{bkf})	Mean: 9 Range: 4.1 - 16.6	Mean: 3.6 Range:2.2 – 6.0	Mean: 3.6 Range: 2.2 – 5.9	Mean: 2.8 Range: 1.9 - 3.6
16. Radius of curvature (R_c) – ft.	Mean: 12.2 Range: 8.7 - 16.5	Mean:17.0 Range:12.8 – 23.8	Mean: 14.6 Range: 6.5 – 20.5	Mean: 2.8 Range: 1.9 – 4.6
17. Ratio of radius of curvature to bankfull width (R_c/W_{bkf})	Mean: 1.7 Range: 1.2 - 2.4	Mean: 2.0 Range:1.5 – 2.8	Mean: 1.5 Range: 0.5 – 2.8	Mean: 0.4 Range: 0.3 – 0.8
18. Belt width (W_{blt}) - ft.	Mean: 11.6 Range: 6 - 19	Mean:11.9 Range:8.5 – 19.6	Mean: 13.7 Range: 12.4 – 16.7	Mean: 8.6 Range: 6.7 – 11
19. Meander width ratio (W_{blt}/W_{bkf})	Mean: 1.7 Range: 0.9 - 2.7	Mean: 1.4 Range: 1.0 – 2.3	Mean: 1.4 Range: 1.0 – 2.3	Mean: 1.2 Range: 0.7 – 1.8
20. Sinuosity = k (Stream $Length_{traveled}$/ valley distance)	748 = 1.1 672	946=1.4 672	267.5 = 1.6 168	557 = 1.5 363
21. Valley slope (ft/ft)	0.012	0.012	0.015	0.015
22. Average water surface slope-ft/ft (S_{wsp}) = (S_{valley}/k)	0.0126	0.0086	0.0094	0.010
23. Pool slope (S_{pool}) – ft/ft	Mean: Range:	Mean: 0.00017 Range:0.00 – 0.001	Mean: 0.00021 Range: 0.00-0.00125	Mean: 0.0089 Range:0.004 – 0.014
24. Ratio of pool slope to average slope (S_{pool}/S_{bkf})	Mean: Range:	Mean: 0.02 Range: 0.00 – 0.13	Mean: 0.022 Range: 0.00-0.13	Mean: 0.9 Range: 0.4 – 1.4
25. Maximum pool depth ($d_{max\ pool}$) – ft.	Mean: 2.6 Range: 2.6 - 2.7	Mean: 2.5 Range: 1.8 – 4.0	Mean: 2.6 Range: 2.1 – 3.1	Mean: 1.9 Range: 1.7 – 2.2
26. Ratio of pool depth to average bankfull depth ($d_{max\ pool}/d_{bkf}$)	Mean: 2.6 Range: 2.5 - 2.7	Mean: 2.4 Range: 1.7 – 3.7	Mean: 2.4 Range: 1.6 – 3.4	Mean: 2.4 Range: 1.7 – 3.7
27. Pool width (W_{pool}) – ft.	Mean: 8.0 Range:6.1 - 9.8	Mean: 10.2 Range: 8.5 – 15.3	Mean: 10.0 Range: 8.2 – 12.8	Mean: 9.1 Range: 7.0 – 10.3
28. Ratio of pool width to bankfull width (W_{pool}/W_{bkf})	Mean: 1.1 Range: 0.9 - 1.4	Mean: 1.2 Range: 1.0 – 1.8	Mean: 1.03 Range: 1.0 – 1.8	Mean: 1.3 Range: 0.8 – 1.7
29. Pool Area – sq ft (A_{pool})	Mean: 13.5 Range: 10.0 - 16.9	Mean: 13.5 Range: 9.0 – 27	Mean: 14.9 Range: 9.2 – 21.6	Mean: 7.1 Range: 5.4 – 8.5
30. Ratio of Pool Area to Bankfull Area (A_{pool}/A_{bkf})	Mean: 1.8 Range: 1.4 - 2.3	Mean: 1.5 Range: 1.0 – 3.0	Mean: 1.4 Range: 0.7 – 3.0	Mean: 1.3 Range: 0.9 – 1.9
31. Pool to pool spacing (p-p) –	Mean: 37.2	Mean: 15.3	Mean: 21.5	Mean: 17.2

NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ANGELA DARLENE GREENE

REVISIONS		
DATE	APPROVED	TITLE

Stillhouse Creek Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Rosgen Type E Morphological Table Part 1

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

Drawing No.

Sheet No. 5 of 37

MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL WITH GAGE STATION AND REFERENCE REACH DATA

(After Rosgen, 1996)

Restoration Site (Name of stream & location): Stillhouse Creek, Hillsborough, NC **Reference Reach (Name of stream & location):** UT to Caraway Creek, Camp Caraway, Randolph County, NC **Reference Reach** (Name of stream & location): UT to North Fork New River, Ashe County, NC

VARIABLES	EXISTING CHANNEL Stillhouse Creek	PROPOSED REACH Stillhouse Creek	REFERENCE REACH UT to Caraway Creek	REFERENCE REACH (UT to N Fork New River)
32. Ratio of p-p spacing to bankfull width (p-p/W_{bkf})	Mean: 5.3 Range: 1.7 - 16.2	Mean: 1.8 Range: 1.1 – 3.0	Mean: 2.2 Range: 1.4 – 3.4	Mean: 2.4 Range: 1 – 4.9
33. Pool length (L_{pool}) – ft.	Mean: 22.5 Range: 11.0 - 46.5	Mean: 13.6 Range: 8.5 – 19.6	Mean: 11.8 Range: 7.5 – 17.0	Mean: 5.7 Range: 2 – 16.7
34. Ratio of Pool length to bankfull width (L_{pool}/W_{bkf})	Mean: 3.2 Range: 1.6 - 6.6	Mean: 1.6 Range: 1.0 – 2.3	Mean: 1.2 Range: 0.6 – 2.3	Mean: 0.8 Range: 0.3 – 2.3
35. Avg. riffle slope (S_{rif}) - ft./ft.	Mean: Range:	Mean: 0.013 Range:0.0086 – 0.017	Mean: 0.0204 Range: 0.00 – 0.054	Mean: 0.0109 Range: 0.00360-0.0154
36. Ratio of riffle slope to avg. slope (S_{rif}/S_{avg})	Mean: Range:	Mean: 1.5 Range: 1.0 – 2.0	Mean: 2.2 Range: 0.00 – 5.7	Mean: 0.0109 Range:0.0032 – 0.02
37. Avg. run slope ft/ft	Mean: Range:	Mean: 0.02 Range:0.017-0.026	Mean: 0.00028 Range: 0.00-0.0025	Mean: 0.0076 Range:0.00 – 0.02
38. Ratio of run slope to avg slope (S_{run}/S_{avg})	Mean: Range:	Mean: 2.5 Range:2.0-3.0	Mean: 0.03 Range: 0.0 – 0.3	Mean: 0.8 Range: 0.0 – 2.0
39. Avg. glide slope ft/ft	Mean: Range:	Mean: 0.004 Range:0.00 – 0.0086	Mean: 0.0014 Range: 0.00-0.0055	Mean: 0.006 Range: 0.0 – 0.0125
40. Ratio of glide slope to avg slope (S_{glide}/S_{avg})	Mean: Range:	Mean: 0.5 Range:0.0 - 1.0	Mean: 0.15 Range:0.00-0.6	Mean: 0.6 Range: 0.0 – 1.25
41. Max run depth ($d_{max\ run}$) – ft.	Mean: Range:	Mean: 2.1 Range:	Mean: 2.2 Range:	Mean: Range:
42. Ratio of max run depth to mean bkf depth ($d_{max\ run}/d_{bkf}$)	Mean: Range:	Mean: 2.0 Range:	Mean: 2.0 Range:	Mean: Range:
43. Run width (W_{run}) – ft.	Mean: Range:	Mean: 9.4 Range:	Mean: 10.7 Range:	Mean: Range:
44. Run width to bankfull width ratio (W_{run}/W_{bkf})	Mean: Range:	Mean: 1.1 Range:	Mean: 1.1 Range:	Mean: Range:
45. Mean run depth (d_{run}) ft.	Mean: Range:	Mean: 1.15 Range:	Mean: 1.1 Range:	Mean: Range:
46. Run w/d ratio (W_{run}/d_{run})	Mean: Range:	Mean: 8.2 Range:	Mean: 9.6 Range:	Mean: Range:
47. Ratio of run w/d to riffle w/d	Mean: Range:	Mean: Range:	Mean: Range:	Mean: Range:
48. Run length (L_{run}) – ft.	Mean: Range:	Mean: 2.6 Range: 0.9 – 6.0	Mean: 2.6 Range: 0.7 – 7.0	Mean: 3.0 Range: 1.0 – 6.0
49. Ratio of run length to bankfull width (L_{run}/W_{bkf})	Mean: Range:	Mean: 0.3 Range: 0.1 – 0.7	Mean: 0.3 Range: 0.07 – 0.7	Mean: 0.4 Range: 0.14 – 0.83
50. Glide length (L_{glide}) – ft.	Mean: Range:	Mean: 4.7 Range: 1.7 – 17	Mean: 5.3 Range: 2.0 – 14.5	Mean: 2.8 Range: 1 – 5.5
51. Ratio of glide length to bankfull width (L_{glide}/W_{bkf})	Mean: Range:	Mean: 0.55 Range: 0.2 – 2.0	Mean: 0.55 Range: 0.2 – 2.0	Mean: 0.4 Range:0.14 – 0.8
52. Riffle thalweg slope ($S_{rif\ TW}$) – ft/ft	Mean: Range:	Mean: Range:	Mean: 0.0415 Range:0.02-0.073	Mean: Range:
53. Run thalweg slope ($S_{run\ TW}$) – ft/ft [Note: Run reach that goes into pool]	Mean: Range:	Mean: Range:	Mean: 0.1165 Range:0.011-0.222	Mean: Range:
54. Glide thalweg slope ($S_{glide\ TW}$)-ft/ft	Mean: Range:	Mean: Range:	Mean: -0.0604 Range: - 0.0192 to -0.1067	Mean: Range:
55. Pool entrance thalweg slope ($S_{pool\ TWentrance}$)-ft/ft	Mean: Range:	Mean: Range:	Mean: 0.059 Range:0.024 to 0.17	Mean: Range:
56. Pool exit thalweg slope ($S_{pool\ TWexit}$) – ft/ft	Mean: Range:	Mean: Range:	Mean: -0.071 Range:-0.0084 to -0.12	Mean: Range:

- Data in Item Nos. 59 through 63 are for use with a CAD system.

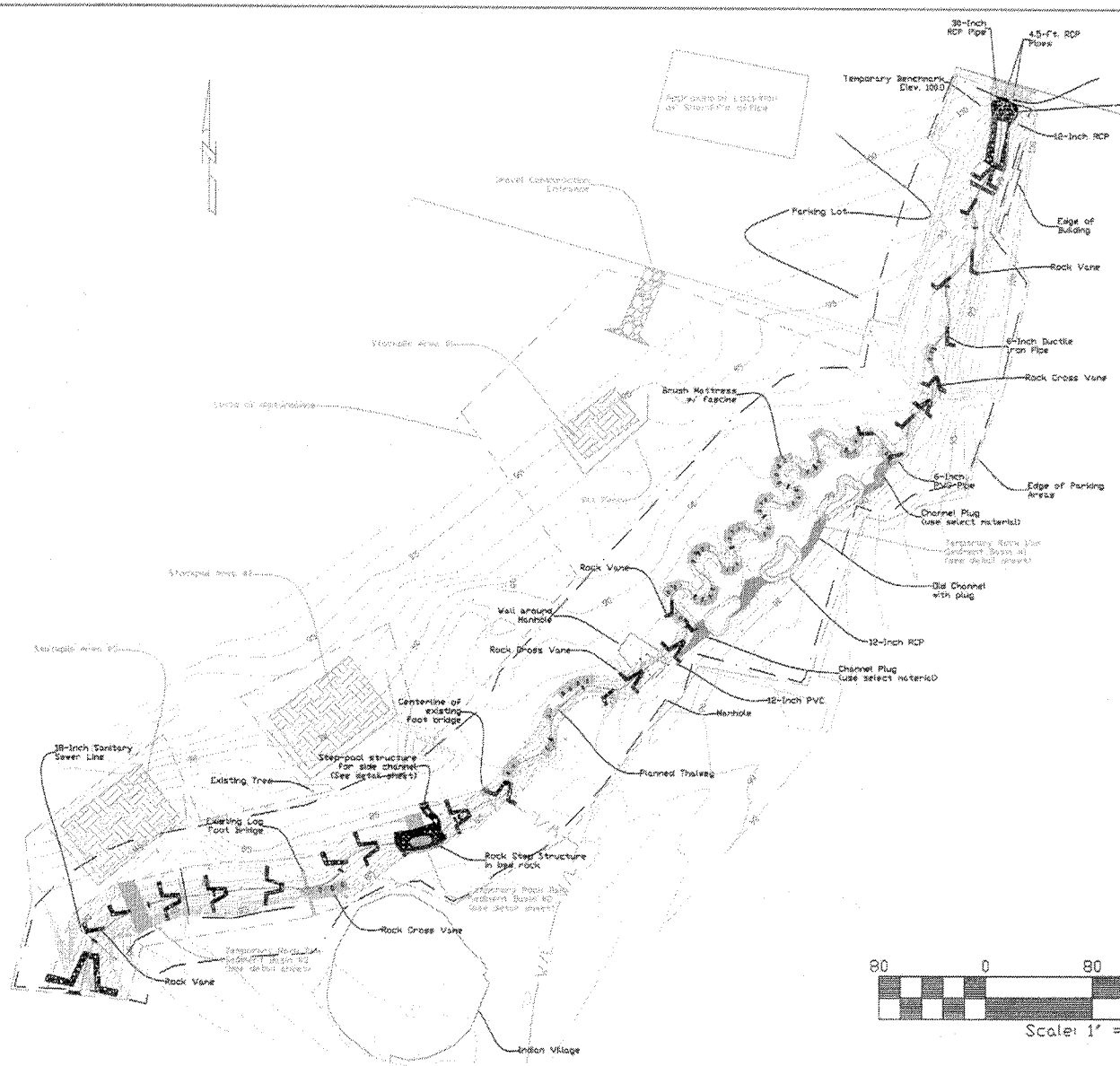
NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ANGELA DARLENE GREENE

Angela D. Greene 11/21/05

REVISIONS		
DATE	APPROVED	TITLE

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Program
Rosgen Type E Morphological Table Part 2

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE



Note: Structure symbols for approximate location only. See detail drawings for specific structure information. Location and angle may be adjusted during construction by engineering supervision.

80 0 80 160 240

Scale: 1" = 80'

NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ANGELA DARLENE GREENE

11/21/05

Stillhouse Creek Stream Restoration Project

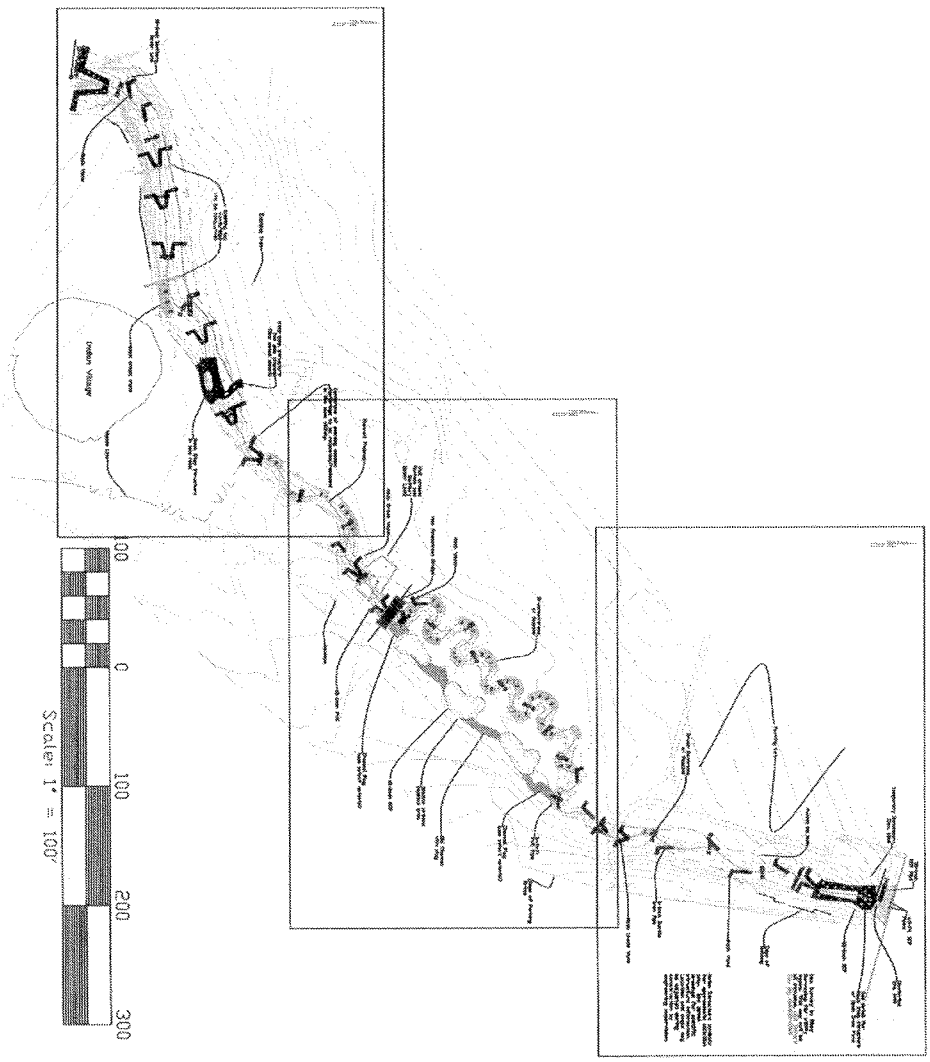
Orange County, North Carolina

North Carolina Ecosystem Enhancement Program

Erosion and Sedimentation Control Plan

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

REVISIONS		
DATE	APPROVED	TITLE



NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ANGELA DARLENE GREENE

11/21/05

Stillhouse Creek Stream Restoration Project

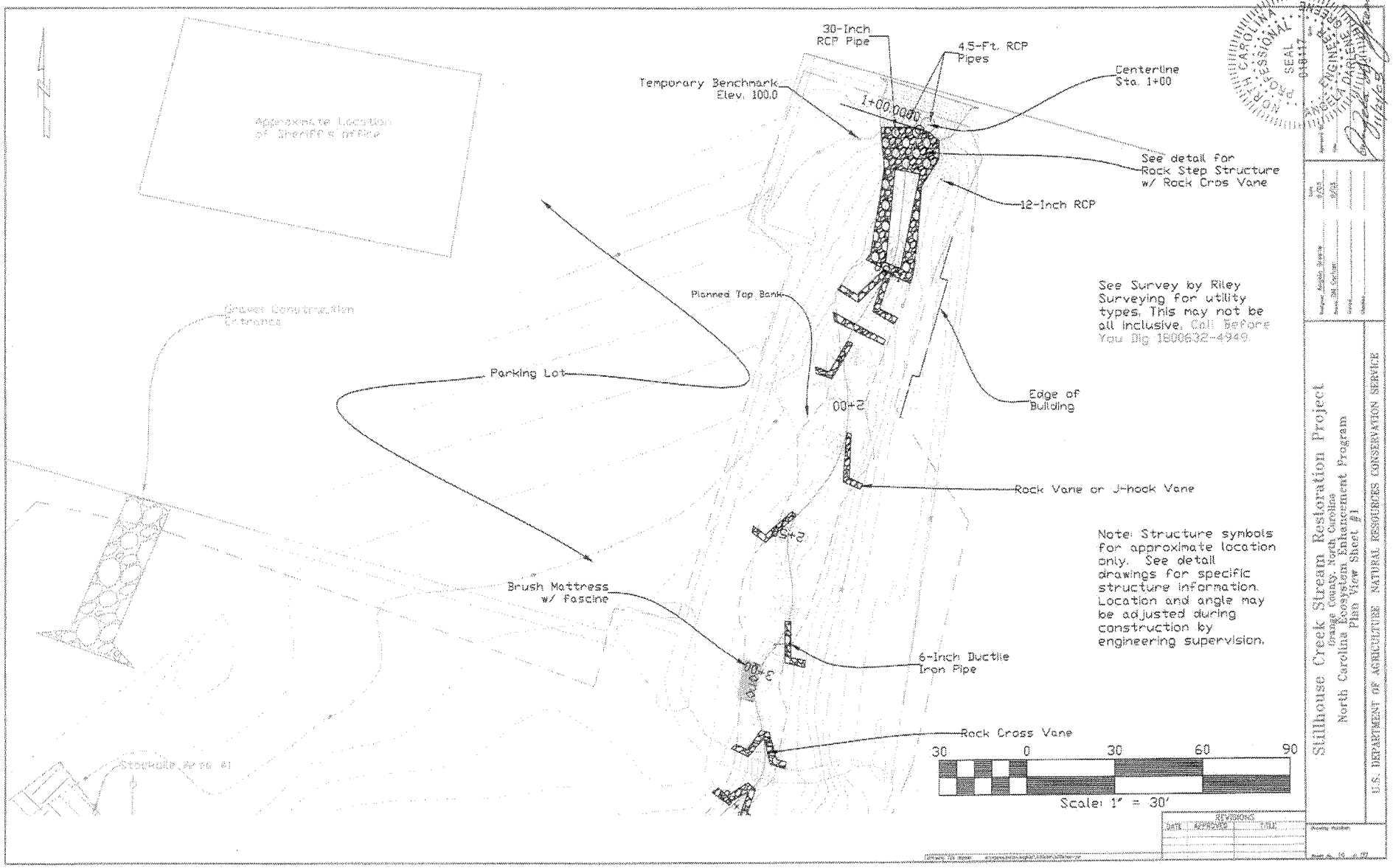
Orange County, North Carolina

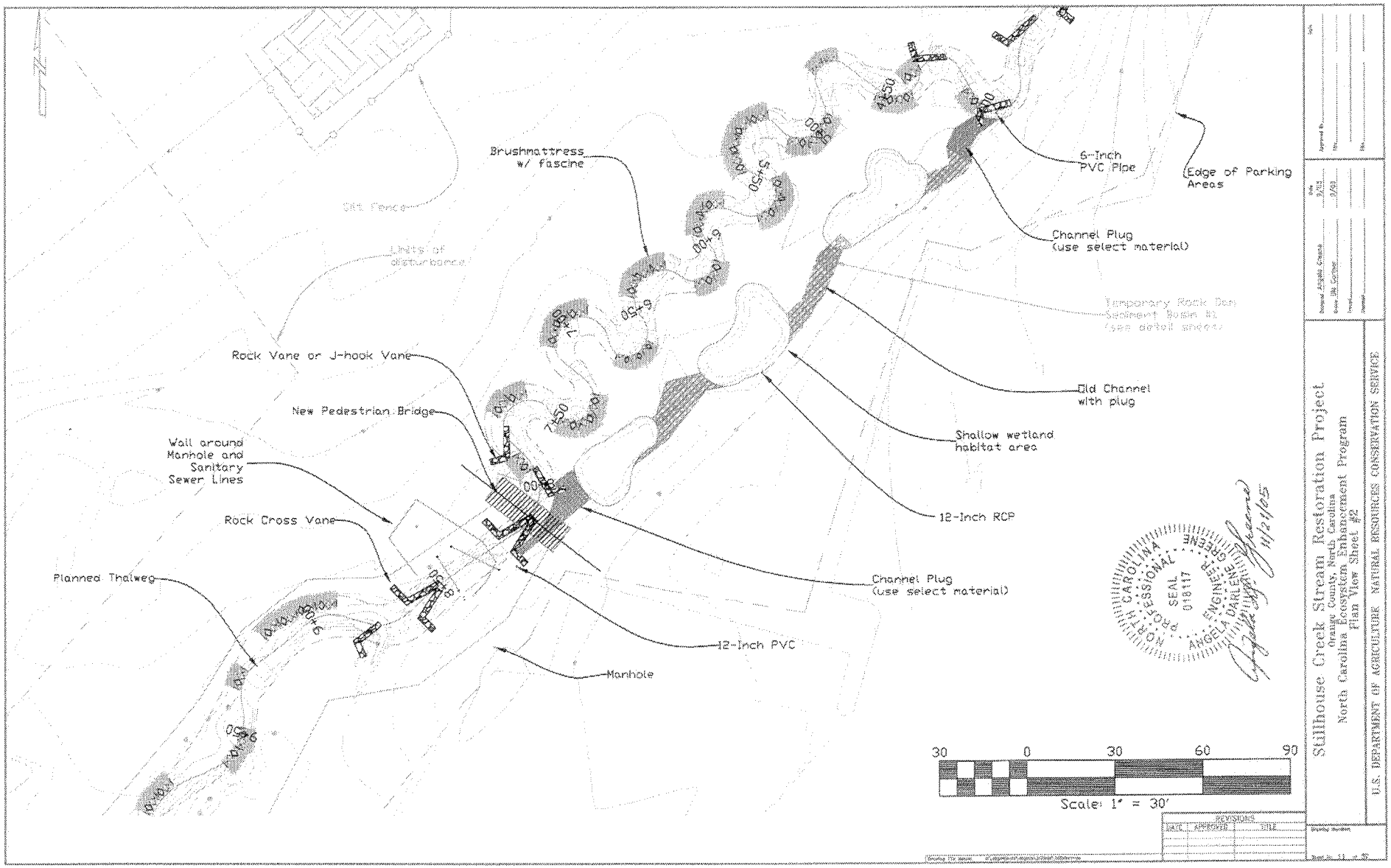
North Carolina Ecosystem Enhancement Program

Plan View Index Sheet

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

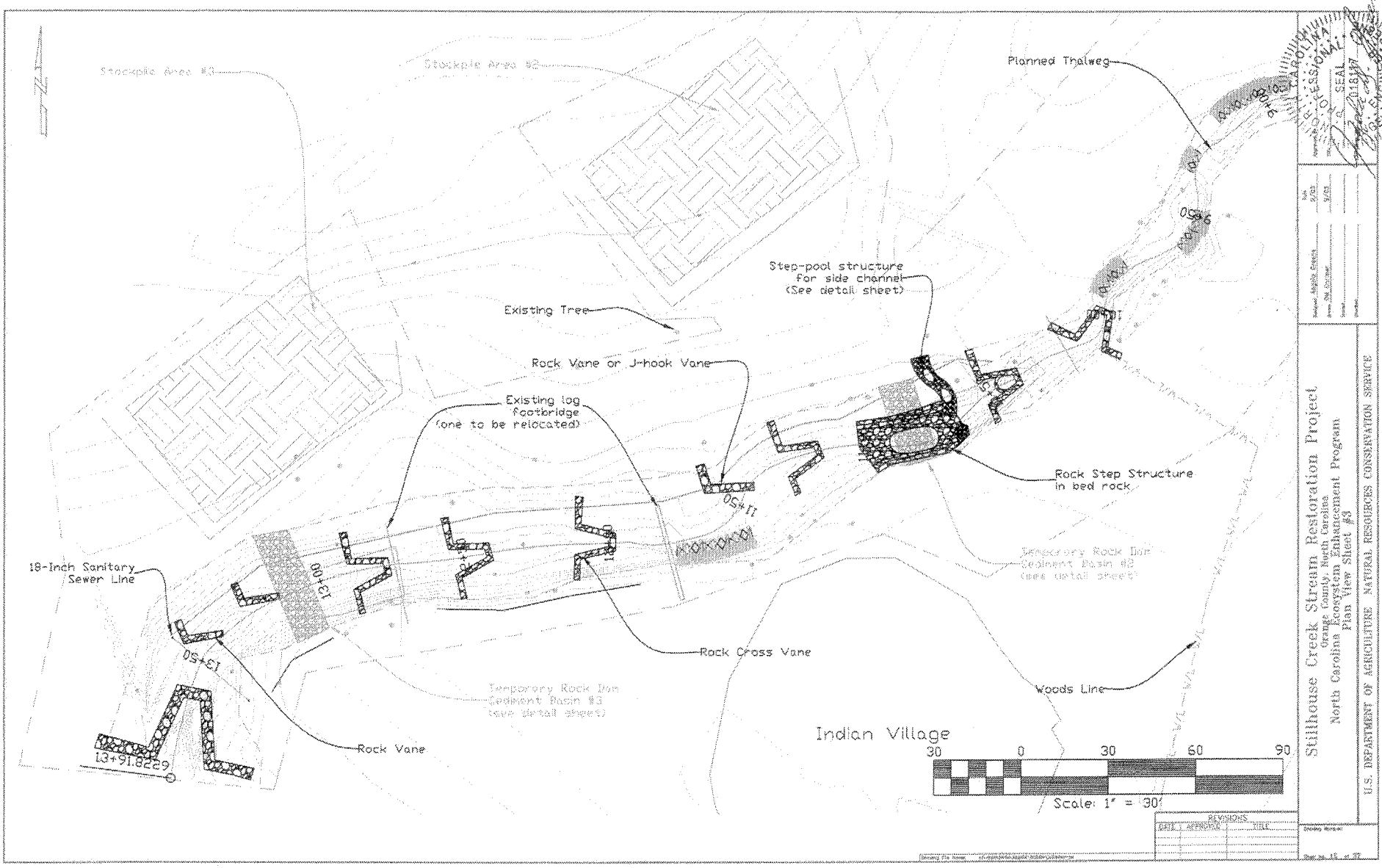
Designed: Angela Greene	Date: 9/05	Approved by:
Drawn: BM Gartner	Date: 9/05	Date:
Checked:		
Submitted:		Title:

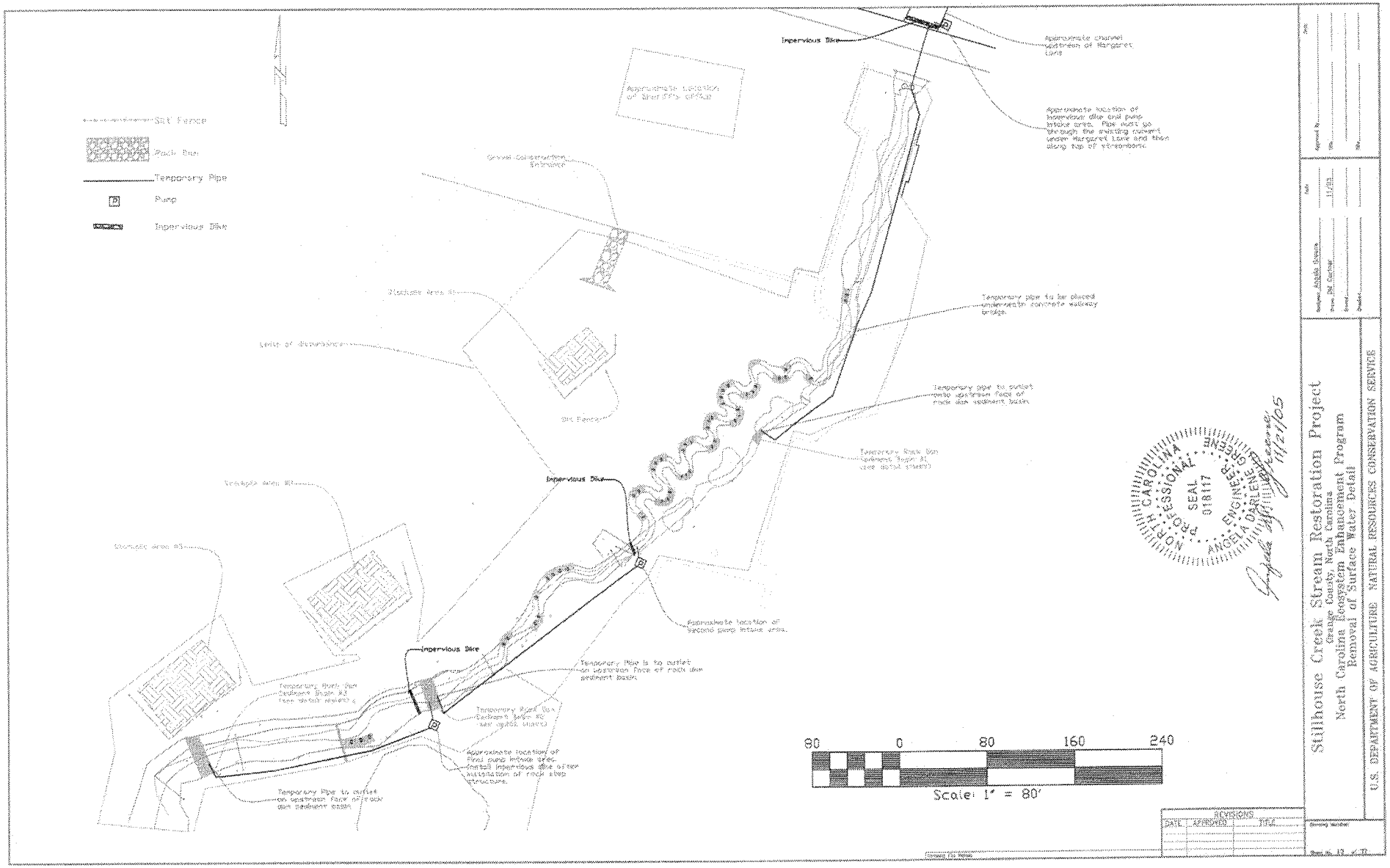

30-Inch RCP Pipe
4.5-Ft. RCP Pipes
Centerline Sta. 1+00
Temporary Benchmark Elev. 100.0
1+00
See detail for Rock Step Structure w/ Rock Cros Vane
12-Inch RCP
Approximate Location of Sheriff's office
Planned Top Bank
See Survey by Riley Surveying for utility types. This may not be all inclusive. Call Before You Dig 1800632-4949
Gravel Construction Entrance
Parking Lot
2+00
Edge of Building
Rock Vane or J-hook Vane
1+00
Brush Mattress w/ fascine
3+00
6-Inch Ductile Iron Pipe
Rock Cross Vane
Stockpile Area #1
30 0 30 60 90
Scale: 1" = 30'
REVISIONS
DATE APPROVED
Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Plan View Sheet #1
U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE



Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Plan View Sheet #2

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE


Stockpile Area #1
Stockpile Area #2
Planned Thalweg
Step-pool structure
For side channel
(See detail sheet)
Existing Tree
Rock Vane or J-hook Vane
Existing log
footbridge
(one to be relocated)
Rock Step Structure
in bed rock
Temporary Rock Dam
Sediment Basin #2
(see detail sheet)
18-Inch Sanitary
Sewer Line
13+00
05+50
11+50
Rock Cross Vane
Rock Vane
L3+91.8229
Temporary Rock Dam
Sediment Basin #3
(see detail sheet)
Woods Line
Indian Village
30 0 30 60 90
Scale: 1" = 30'
Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Plan View Sheet #3
U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE
REVISIONS
DATE APPROVED TITLE



NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ANGELA DARLENE GREENE

11/21/05

Stillhouse Creek Stream Restoration Project

Orange County, North Carolina

North Carolina Ecosystem Enhancement Program

Removal of Surface Water Detail

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

REVISIONS		
DATE	APPROVED	SITE

Drawing Number

Sheet 15 of 22

Gravel Construction Entrance/Exit Detail

Definition A graveled area or pad located at points where vehicles enter and leave a construction site.

Purpose To provide a buffer area where vehicles can drop their mud and sediment to avoid transporting it onto public roads, to control erosion from surface runoff, and to help control dust.

Conditions Where Practice Applies Wherever traffic will be leaving a construction site and moving directly onto a public road or other paved off-site area. Construction plans should limit traffic to properly constructed entrances.

Design Criteria **Aggregate Size**—Use 2-3 inch washed stone.

Dimensions of gravel pad—
Thickness: 6 inches minimum
Width: 12-ft minimum or full width at all points of the vehicular entrance and exit area, whichever is greater
Length: 50-ft minimum

Location—Locate construction entrances and exists to limit sediment from leaving the site and to provide for maximum utility by all construction vehicles (Figure 6.06a). Avoid steep grades and entrances at curves in public roads.

Washing—If conditions at the site are such that most of the mud and sediment are not removed by vehicles traveling over the gravel, the tires should be washed. Washing should be done on an area stabilized with crushed stone that drains into a sediment trap or other suitable disposal area. A wash rack may also be used to make washing more convenient and effective.

Construction Specifications

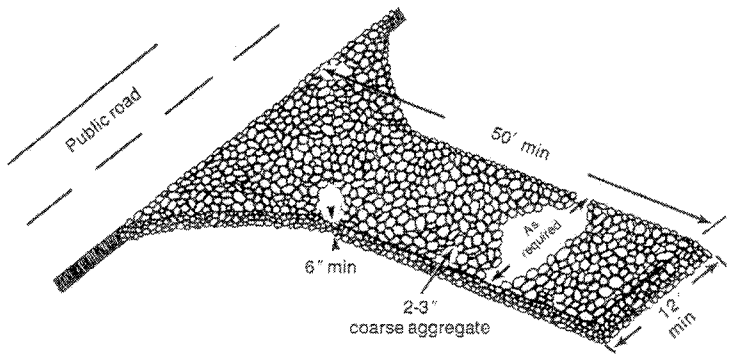
1. Clear the entrance and exit area of all vegetation, roots, and other objectionable material and properly grade it.

2. Place the gravel to the specific grade and dimensions shown on the plans, and smooth it.

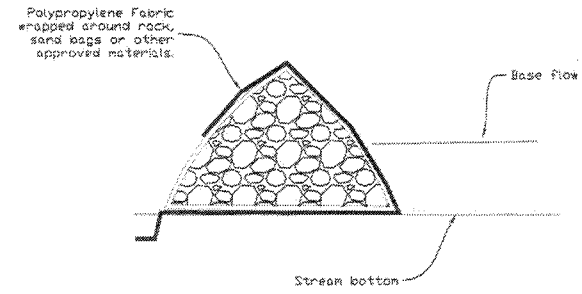
3. Provide drainage to carry water to a sediment trap or other suitable outlet.

4. Use geotextile fabrics because they improve stability of the foundation in locations subject to seepage or high water table.

Maintenance Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site. This may require periodic topdressing with 2-inch stone. After each rainfall, inspect any structure used to trap sediment and clean it out as necessary. Immediately remove all objectionable materials spilled, washed, or tracked onto public roadways.



Impervious Dike Detail



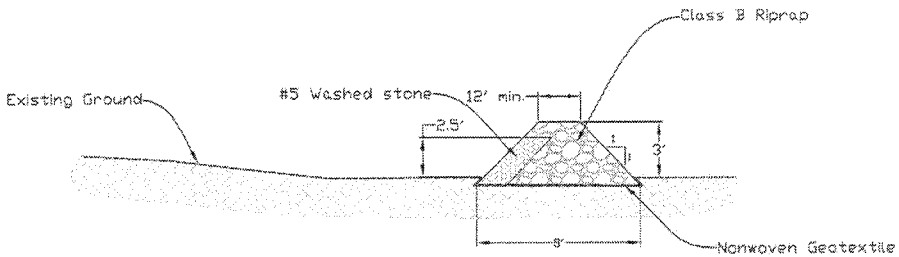
REVISIONS
DATE | APPROVED | TITLE

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Erosion & Sedimentation Control Details

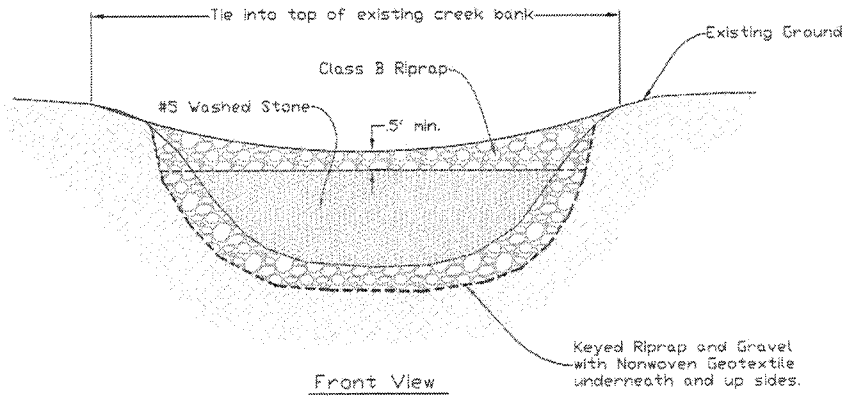
U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

Drawing Number:

Sheet No. 34 of 37



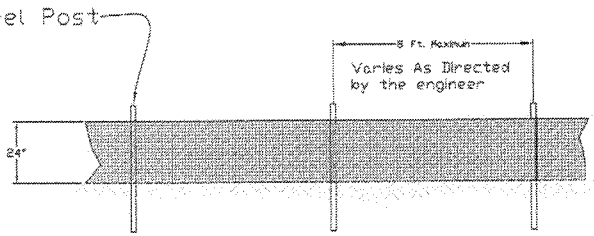
Side View



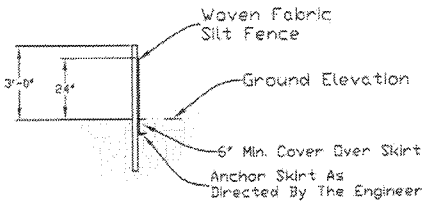
Front View

Rock Dam Sediment Basin

NTS



Front View



Side View

NOTES:
1. Use silt fence in areas shown on the plan drawings and as directed by the engineer.
2. The maximum spacing between post shall be eight (8) feet.
3. The steel post shall be of heavy duty of the self fastener type. They shall be five (5) feet long with a minimum of two (2) feet installed into the ground.
4. The silt fence fabric shall have minimum thickness of 10 mil., minimum weight of 4.0 ounces per sq. yd., minimum burst strength of 210 psi., minimum elongation of 30% and an equivalent opening size to allow a minimum flow rate of 40 gals/min. The fabric shall be a minimum of 36" wide with a minimum of 12 inches securely anchored in the ground.
5. The silt fence fabric shall be securely fastened to the steel post.

Temporary Silt Fence

NTS

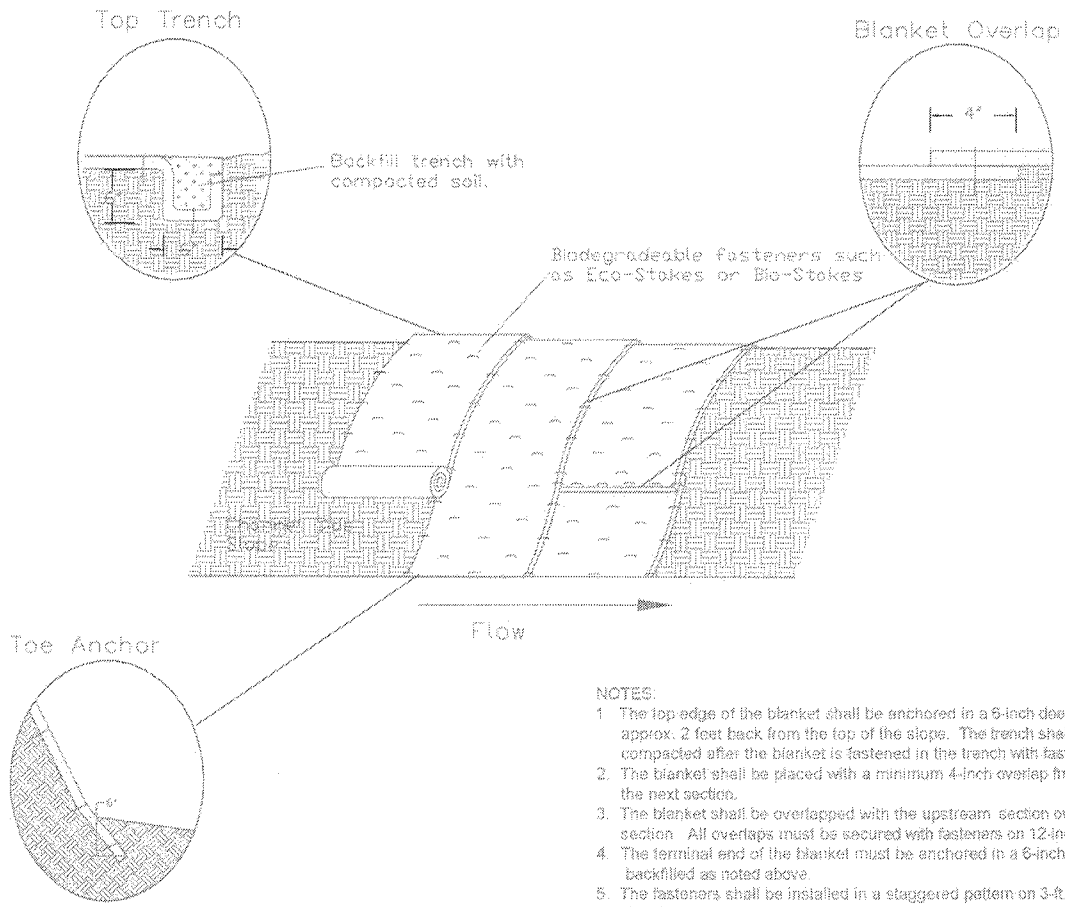
NORTH CAROLINA REGISTERED PROFESSIONAL ENGINEER SEAL 018117 ANGELA DARLENE GREENE

11/21/05

REVISIONS		
DATE	APPROVED	TITLE

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Sediment and Erosion Control Details

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE



NOTES:

1. The top edge of the blanket shall be anchored in a 6-inch deep by 6 inch wide trench approx. 2 feet back from the top of the slope. The trench shall be backfilled and compacted after the blanket is fastened in the trench with fasteners (on 12-inch spacing).
2. The blanket shall be placed with a minimum 4-inch overlap from one section of blanket to the next section.
3. The blanket shall be overlapped with the upstream section overlapping the downstream section. All overlaps must be secured with fasteners on 12-inch spacing.
4. The terminal end of the blanket must be anchored in a 6-inch deep trench and secured and backfilled as noted above.
5. The fasteners shall be installed in a staggered pattern on 3-ft. spacing along the row and 2-ft. spacing between rows.

EROSION CONTROL BLANKET DETAILS

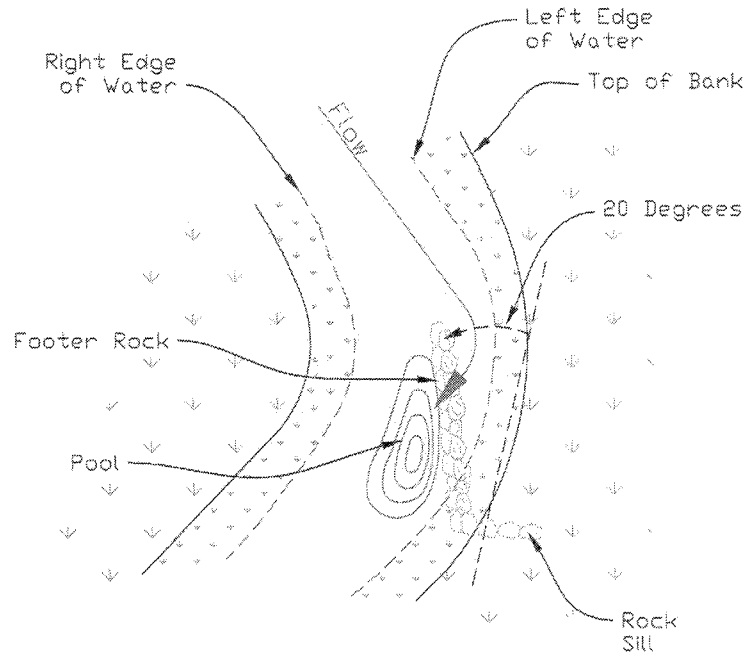
NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ANGELA DARLENE GREENE
11/21/16

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Erosion Control Blanket Detail

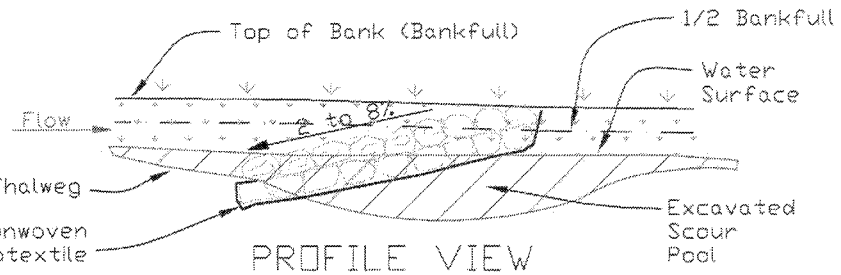
U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

REVISIONS

ROCK VANE

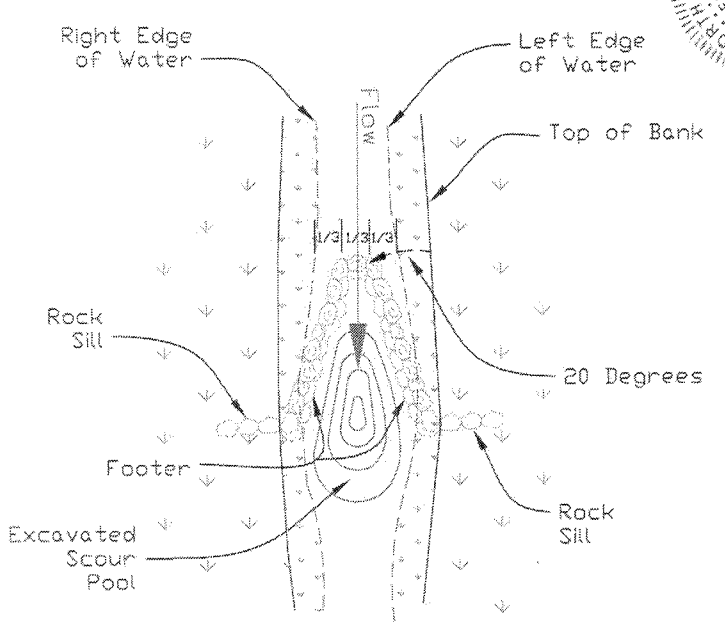


PLAN VIEW

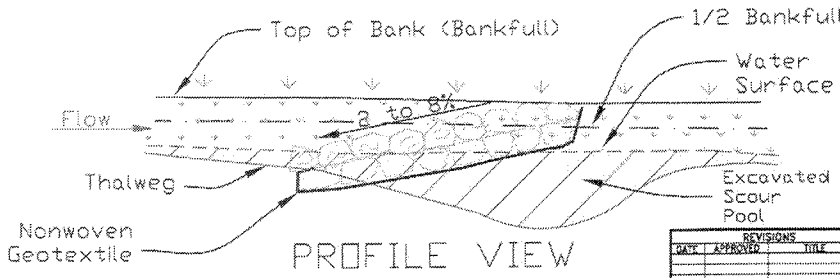


PROFILE VIEW

ROCK CROSS VANE



PLAN VIEW



PROFILE VIEW

REVISIONS

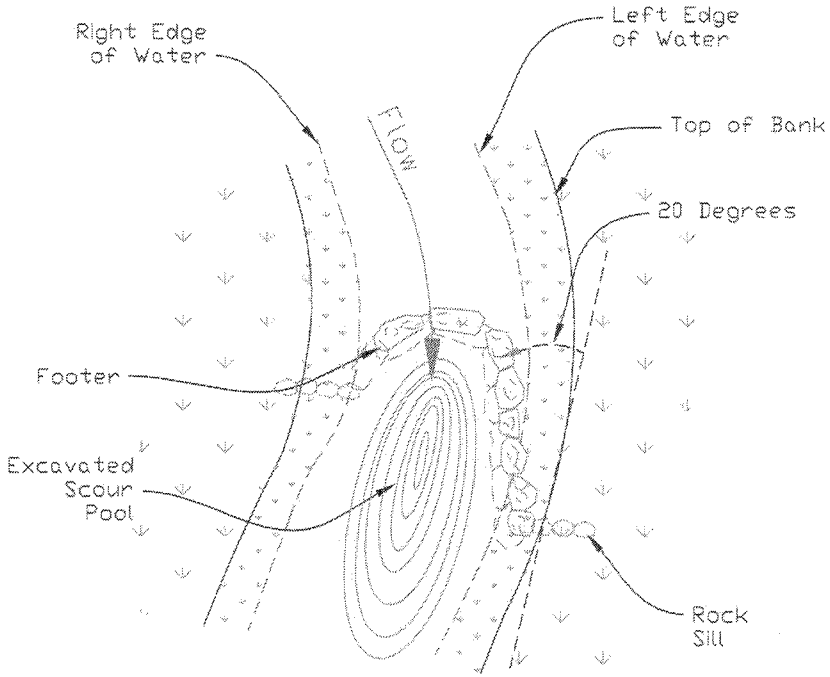
DATE	APPROVED	TITLE

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Typical Rock Structure Detail Rock Vane & Cross Vane (D Rosgen)
U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

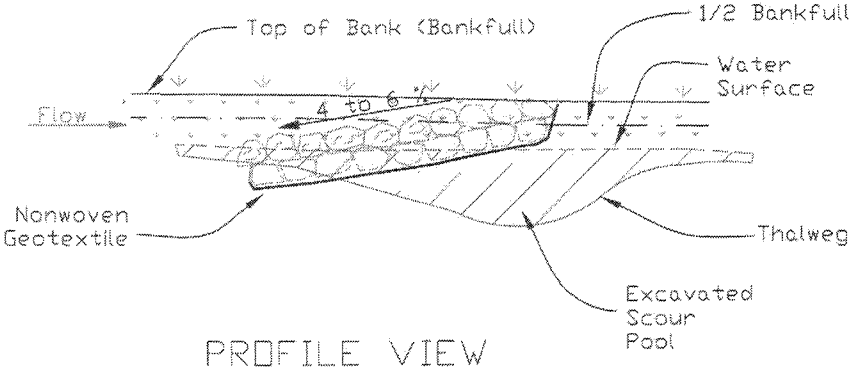
Drawing Number

Sheet No. 17 of 37

J-HOOK VANE



PLAN VIEW



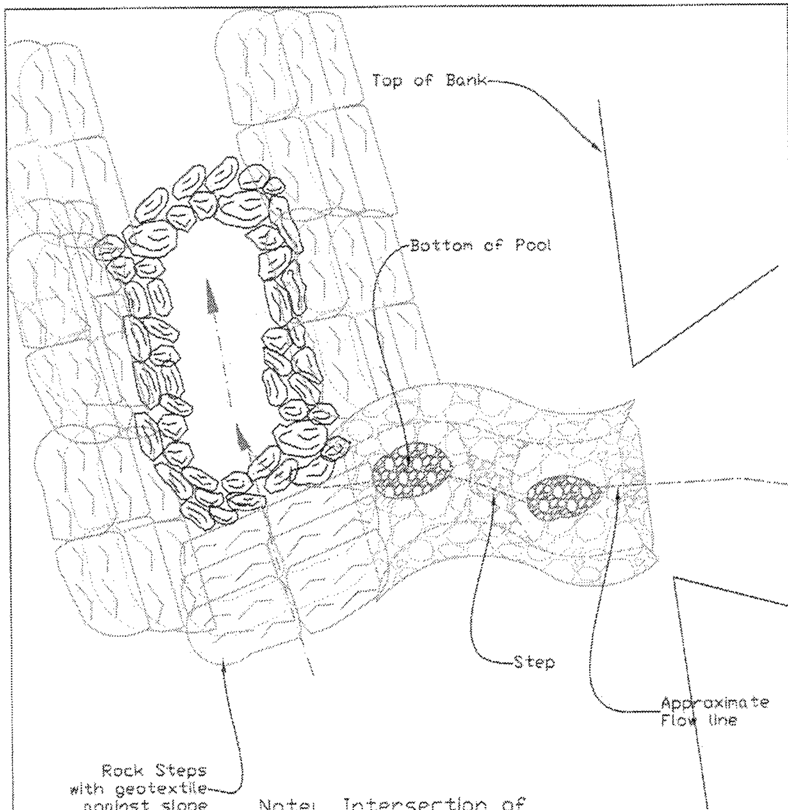
PROFILE VIEW

NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ANGELA DARLENE GEER
11/21/05

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Wetland Restoration Program
Typical Rock Structure Detail J-Hook Vane (D Rosgen)

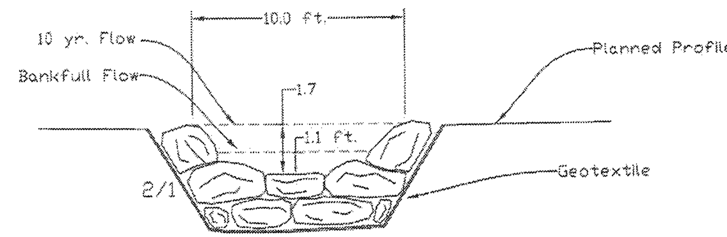
U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

REVISIONS		
DATE	APPROVED	TITLE

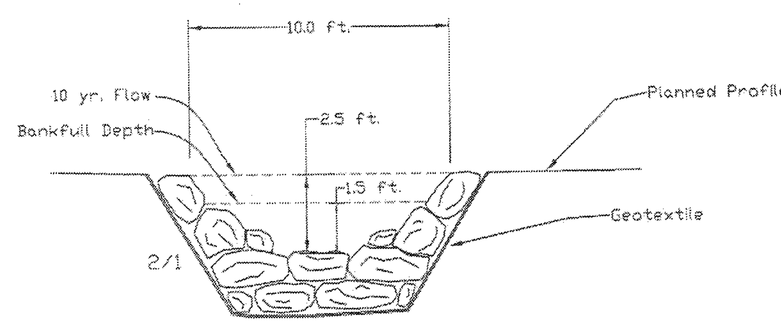


Note: Intersection of surface rocks will be mortared to normal flow depths. Mortar will match the color of the rock.

Rock Step Structures (Sta 10+58 to Sta 10+90) (NTS)



Typical Step Cross-section--Side Tributary (NTS)



Typical Pool Cross-section--Side Tributary (NTS)

REVISIONS		
DATE	APPROVED	TITLE

Stillhouse Creek Stream Restoration Project

Orange County, North Carolina

North Carolina Ecosystem Enhancement Program

Step-Pool Channel Details @ Sta. 10+60

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

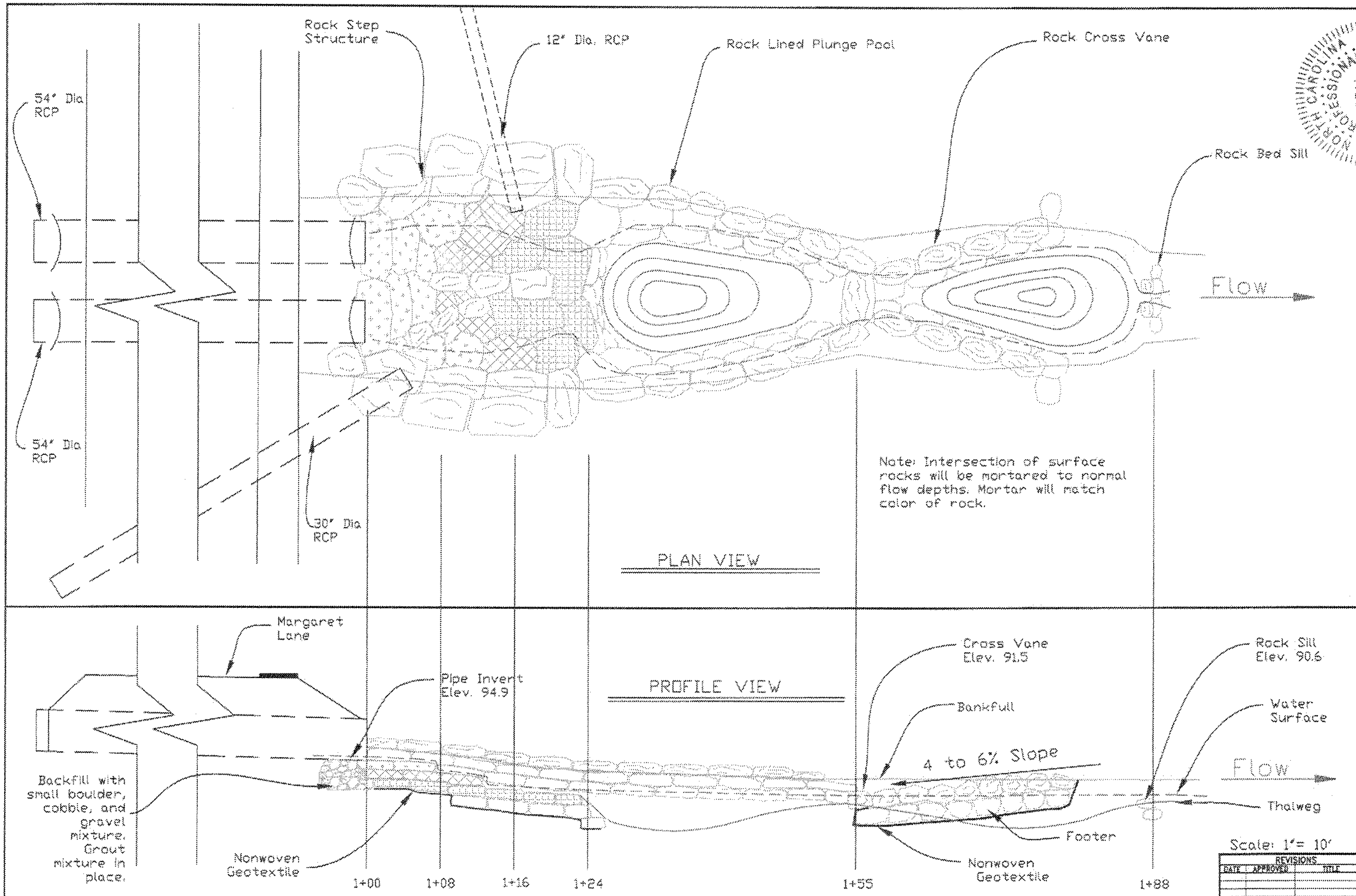
Designed Angela Greene 5/05

Drawn DM Cartner 8/05

NORTH CAROLINA PROFESSIONAL SEAL 016117 ENGINEER ANGELA DARLENE GREENE

Angela D. Greene 11/21/05

Sheet No. 18 of 37



REVISIONS		
DATE	APPROVED	TITLE

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Rock Step & Cross Vane Structures (Sta. 1+00 to 1+88)

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

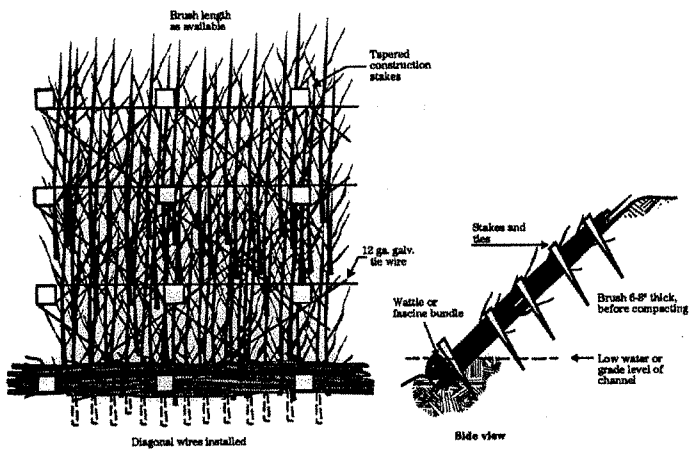
Designed: Angela Greene 05/03
Drawn: T. Burchette 05/03
Checked:
Approved:

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 018117 ANGELA DARLENE GREENE

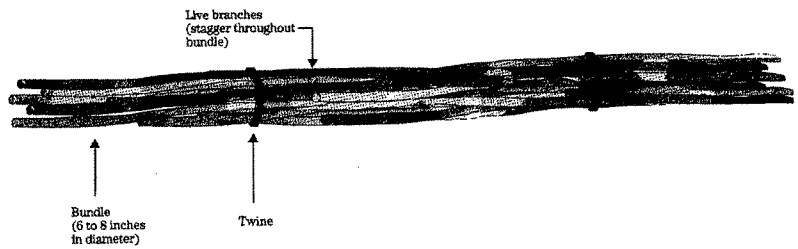
Angela D. Greene 11/21/05

Sheet No. 30 of 37

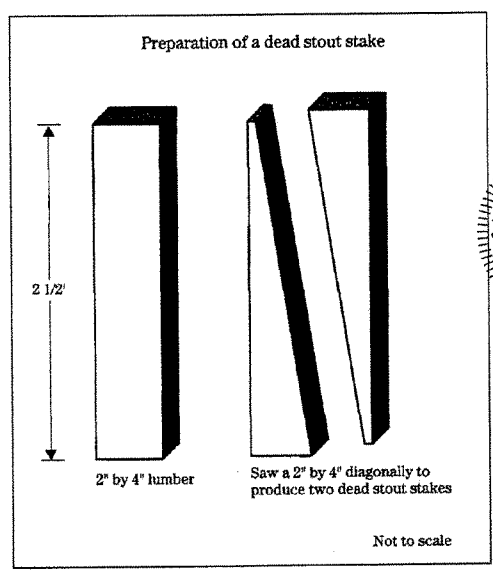
Brushmattress



Live Fascine



Dead Stout Stakes



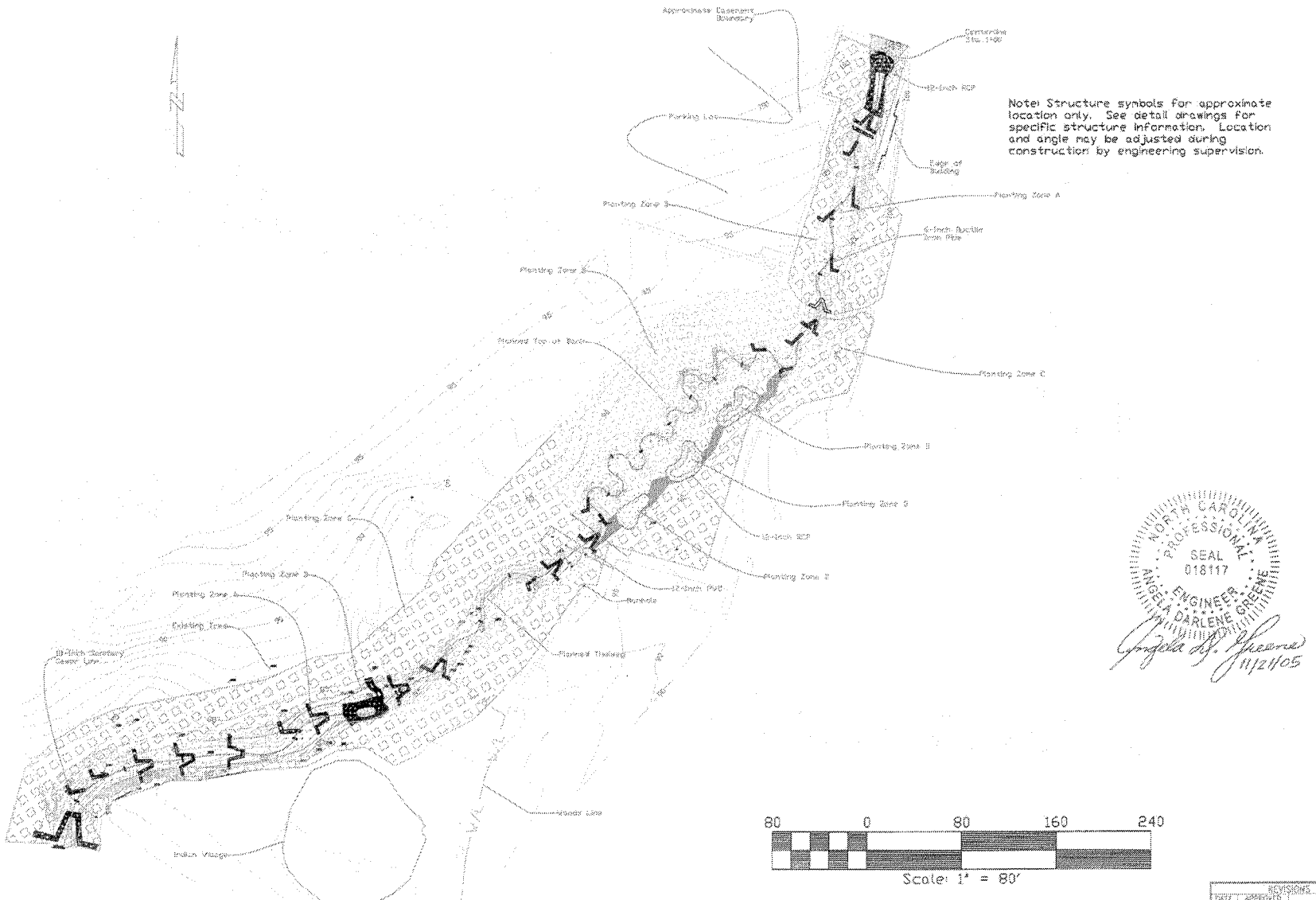
NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ANGELA DARLENE GREENE 11/21/05

REVISIONS

DATE	APPROVED	TITLE

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Brushmattress, Fascine, and Dead Stout Stake Details

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE



NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ANGELA DARLENE GREENE

Angela D. Greene 1/12/05

Stillhouse Creek Stream Restoration Project

Orange County, North Carolina

North Carolina Ecosystem Enhancement Program

Planned Site Features w/ Planting Plan

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

Designed: Angela Greene
Drawn: CM Cather
Checked:

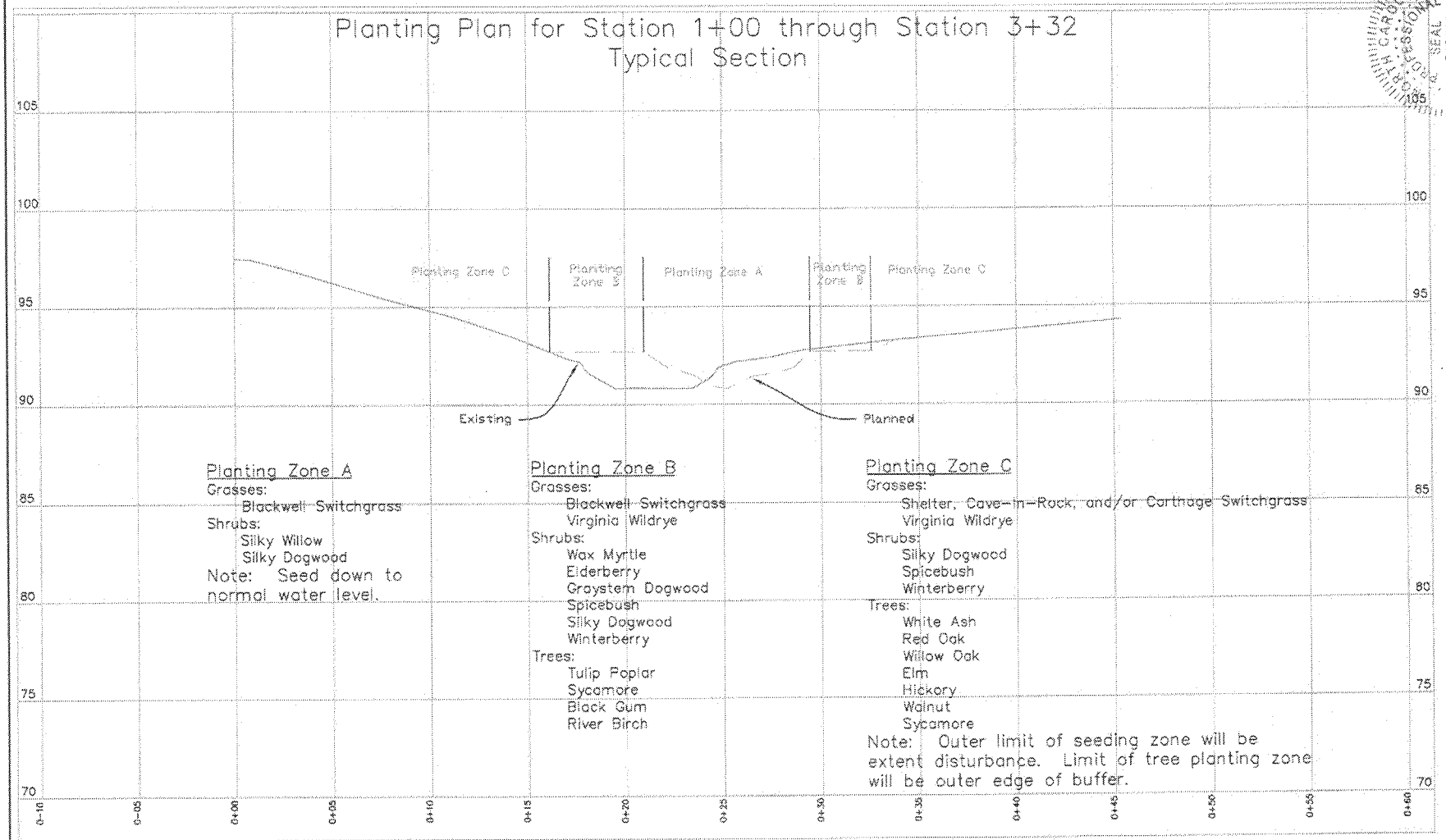
Date: 5/05
Scale: 1"=80'

Approved By:
Date:
By:
Title:

REVISIONS
DATE | APPROVED | TITLE

Drawing No.
Sheet No. 22 of 27

Planting Plan for Station 1+00 through Station 3+32
Typical Section



Planting Zone A
Grasses:
- Blackwell Switchgrass

Shrubs:
- Silky Willow
- Silky Dogwood

Note: Seed down to normal water level.

Planting Zone B
Grasses:
- Blackwell Switchgrass
- Virginia Wildrye

Shrubs:
- Wax Myrtle
- Elderberry
- Graystem Dogwood
- Spicebush
- Silky Dogwood
- Winterberry

Trees:
- Tulip Poplar
- Sycamore
- Black Gum
- River Birch

Planting Zone C
Grasses:
- Shelter, Cave-in-Rock, and/or Carthage Switchgrass
- Virginia Wildrye

Shrubs:
- Silky Dogwood
- Spicebush
- Winterberry

Trees:
- White Ash
- Red Oak
- Willow Oak
- Elm
- Hickory
- Walnut
- Sycamore

Note: Outer limit of seeding zone will be extent disturbance. Limit of tree planting zone will be outer edge of buffer.

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 018442

REVISIONS

DATE	APPROVED	TITLE

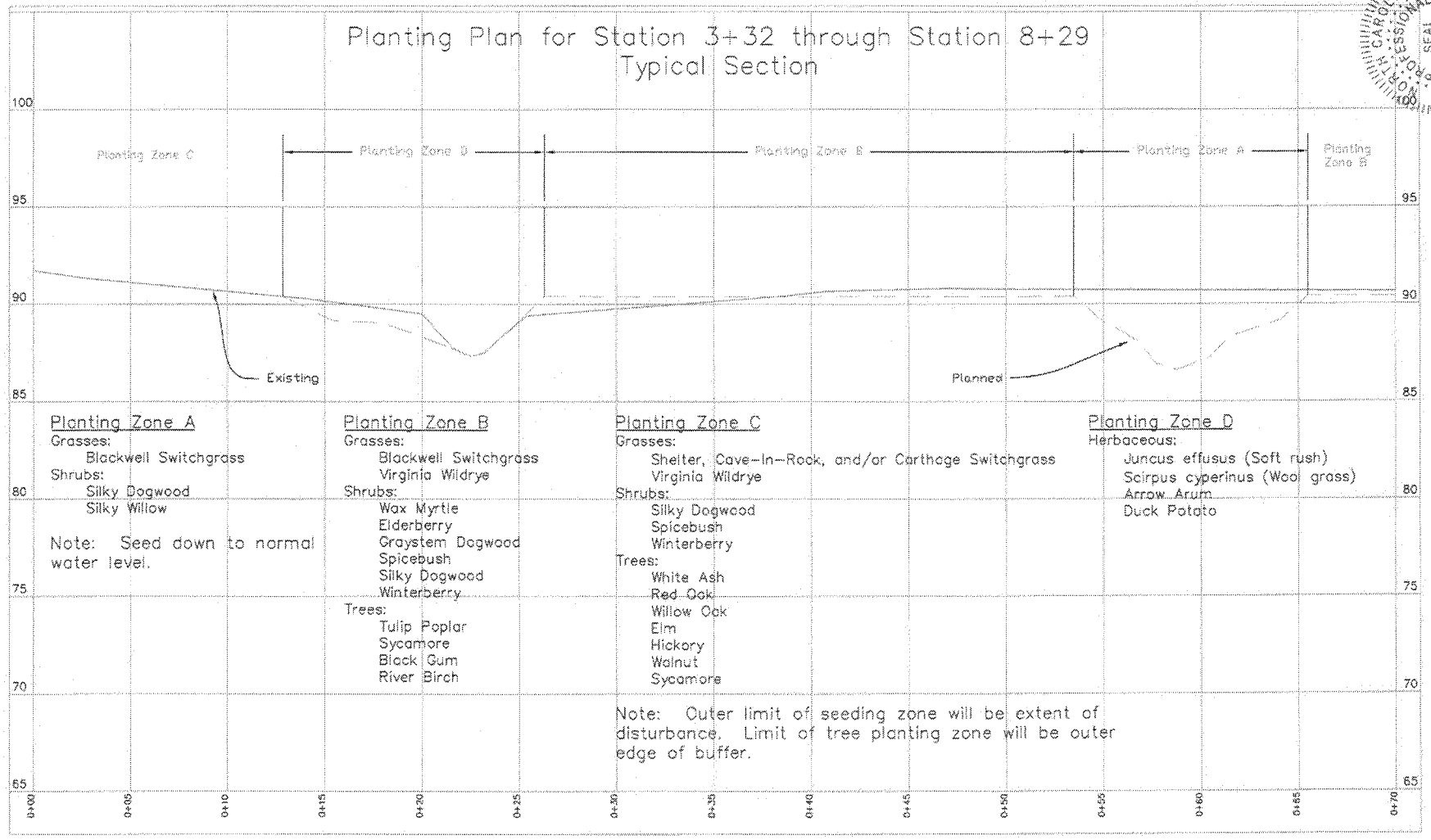
Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Planting Plan

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

Drawing Number

Sheet No. 23 of 27

Planting Plan for Station 3+32 through Station 8+29
Typical Section



Planting Zone A
Grasses:
- Blackwell Switchgrass

Shrubs:
- Silky Dogwood
- Silky Willow

Note: Seed down to normal water level.

Planting Zone B
Grasses:
- Blackwell Switchgrass
- Virginia Wildrye

Shrubs:
- Wax Myrtle
- Elderberry
- Graystem Dogwood
- Spicebush
- Silky Dogwood
- Winterberry

Trees:
- Tulip Poplar
- Sycamore
- Black Gum
- River Birch

Planting Zone C
Grasses:
- Shelter, Cave-In-Rock, and/or Carthage Switchgrass
- Virginia Wildrye

Shrubs:
- Silky Dogwood
- Spicebush
- Winterberry

Trees:
- White Ash
- Red Oak
- Willow Oak
- Elm
- Hickory
- Walnut
- Sycamore

Note: Outer limit of seeding zone will be extent of disturbance. Limit of tree planting zone will be outer edge of buffer.

Planting Zone D
Herbaceous:
- Juncus effusus (Soft rush)
- Scirpus cyperinus (Wool grass)
- Arrow Arum
- Duck Potato

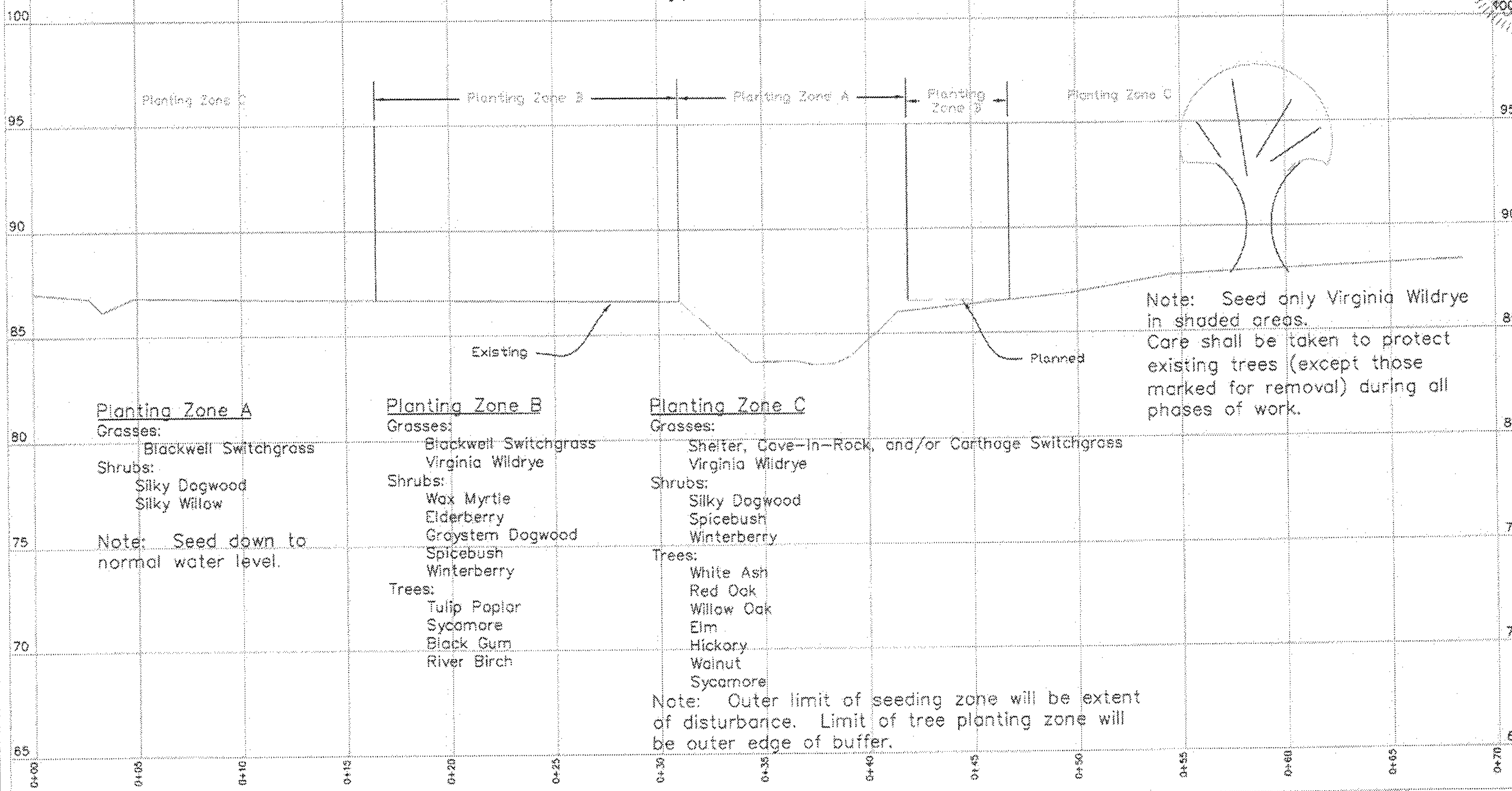
REVISIONS

DATE	APPROVED	TITLE

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Planting Plan

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

Planting Plan for Station 8+29 through Station 10+78
Typical Section



Note: Seed only Virginia Wildrye in shaded areas.
Care shall be taken to protect existing trees (except those marked for removal) during all phases of work.

Planting Zone A

Grasses:
- Blackwell Switchgrass

Shrubs:
- Silky Dogwood
- Silky Willow

Note: Seed down to normal water level.

Planting Zone B

Grasses:
- Blackwell Switchgrass
- Virginia Wildrye

Shrubs:
- Wax Myrtle
- Elderberry
- Graystem Dogwood
- Spicebush
- Winterberry

Trees:
- Tulip Poplar
- Sycamore
- Black Gum
- River Birch

Planting Zone C

Grasses:
- Shelter, Cave-In-Rock, and/or Carthage Switchgrass
- Virginia Wildrye

Shrubs:
- Silky Dogwood
- Spicebush
- Winterberry

Trees:
- White Ash
- Red Oak
- Willow Oak
- Elm
- Hickory
- Walnut
- Sycamore

Note: Outer limit of seeding zone will be extent of disturbance. Limit of tree planting zone will be outer edge of buffer.

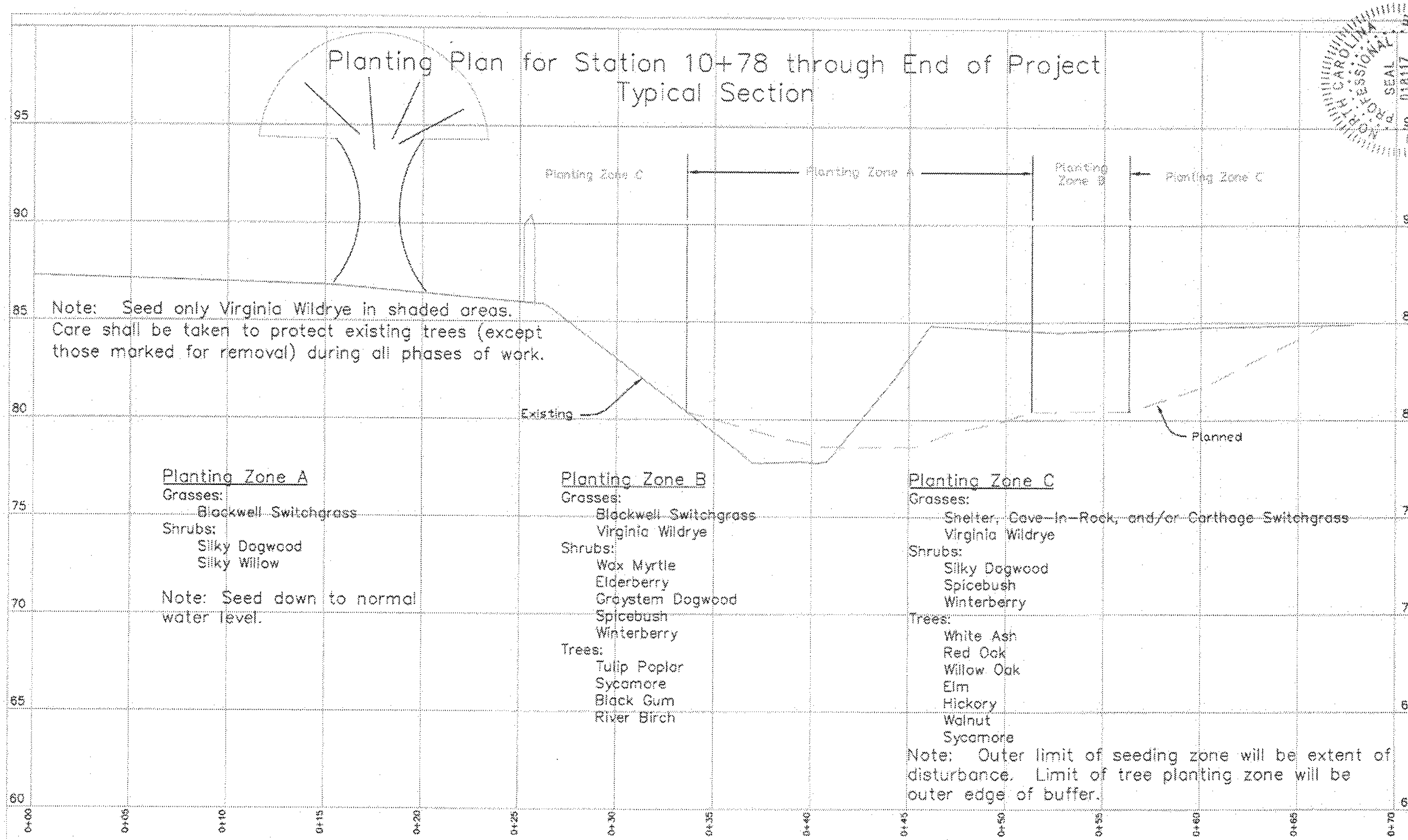
Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Planting Plan

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

Designed A. Greene/R. Hansard 7/03
Drawn A. Greene/D. Cartner 7/03

REVISIONS
DATE	APPROVED	TITLE

Planting Plan for Station 10+78 through End of Project
Typical Section



Note: Seed only Virginia Wildrye in shaded areas.
Care shall be taken to protect existing trees (except those marked for removal) during all phases of work.

Planting Zone A
Grasses:
- Blackwell Switchgrass

Shrubs:
- Silky Dogwood
- Silky Willow

Note: Seed down to normal water level.

Planting Zone B
Grasses:
- Blackwell Switchgrass
- Virginia Wildrye

Shrubs:
- Wax Myrtle
- Elderberry
- Graystem Dogwood
- Spicebush
- Winterberry

Trees:
- Tulip Poplar
- Sycamore
- Black Gum
- River Birch

Planting Zone C
Grasses:
- Shelter, Cave-In-Rock, and/or Carthage Switchgrass
- Virginia Wildrye

Shrubs:
- Silky Dogwood
- Spicebush
- Winterberry

Trees:
- White Ash
- Red Oak
- Willow Oak
- Elm
- Hickory
- Walnut
- Sycamore

Note: Outer limit of seeding zone will be extent of disturbance. Limit of tree planting zone will be outer edge of buffer.

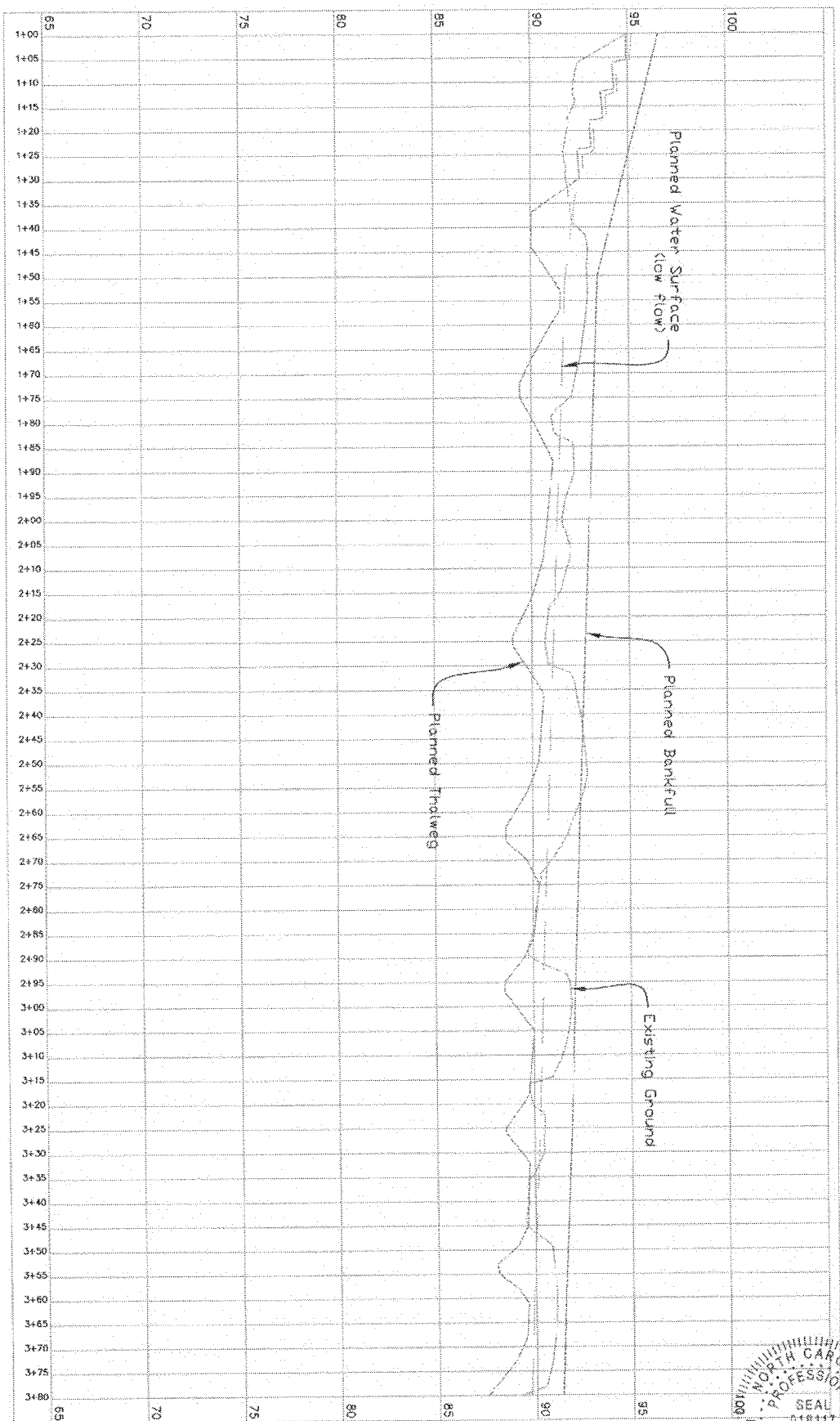
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 018117 ANGELA D. GREENE

REVISIONS		
DATE	APPROVED	TITLE

Designed: A. Greene/R. Hansard — 7/03
Drawn: A. Greene/D. Carther — 7/03

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Planting Plan

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE



REVISIONS		
	APPROVED	DATE

Stillhouse Creek Stream Restoration Project

Orange County, North Carolina

North Carolina Ecosystem Enhancement Program

Profile of Planned Thalweg

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

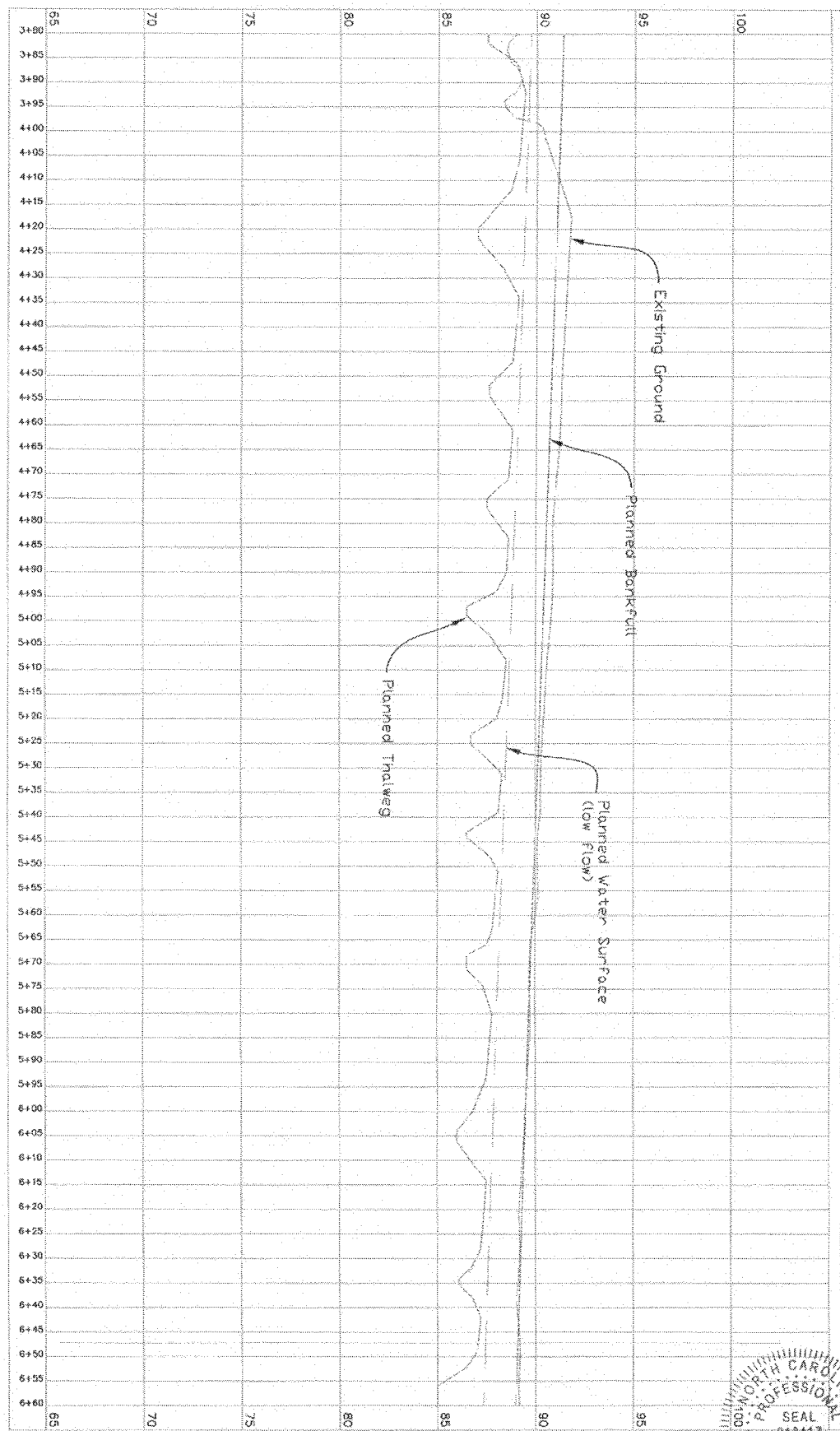
		Date
Designed	Angela Greene	5/03
Drawn	AG Greene/BM Cartner	5/03
Traced		
Checked		

NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ANGELA DARLENE GREENE

Approved by

Title

Date 11/21/05



DATE	APPROVED	REVISIONS	TITLE

Stillhouse Creek Stream Restoration Project

Orange County, North Carolina

North Carolina Ecosystem Enhancement Program

Profile of Planned Thalweg

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

Designed: Angela Greene 5/03

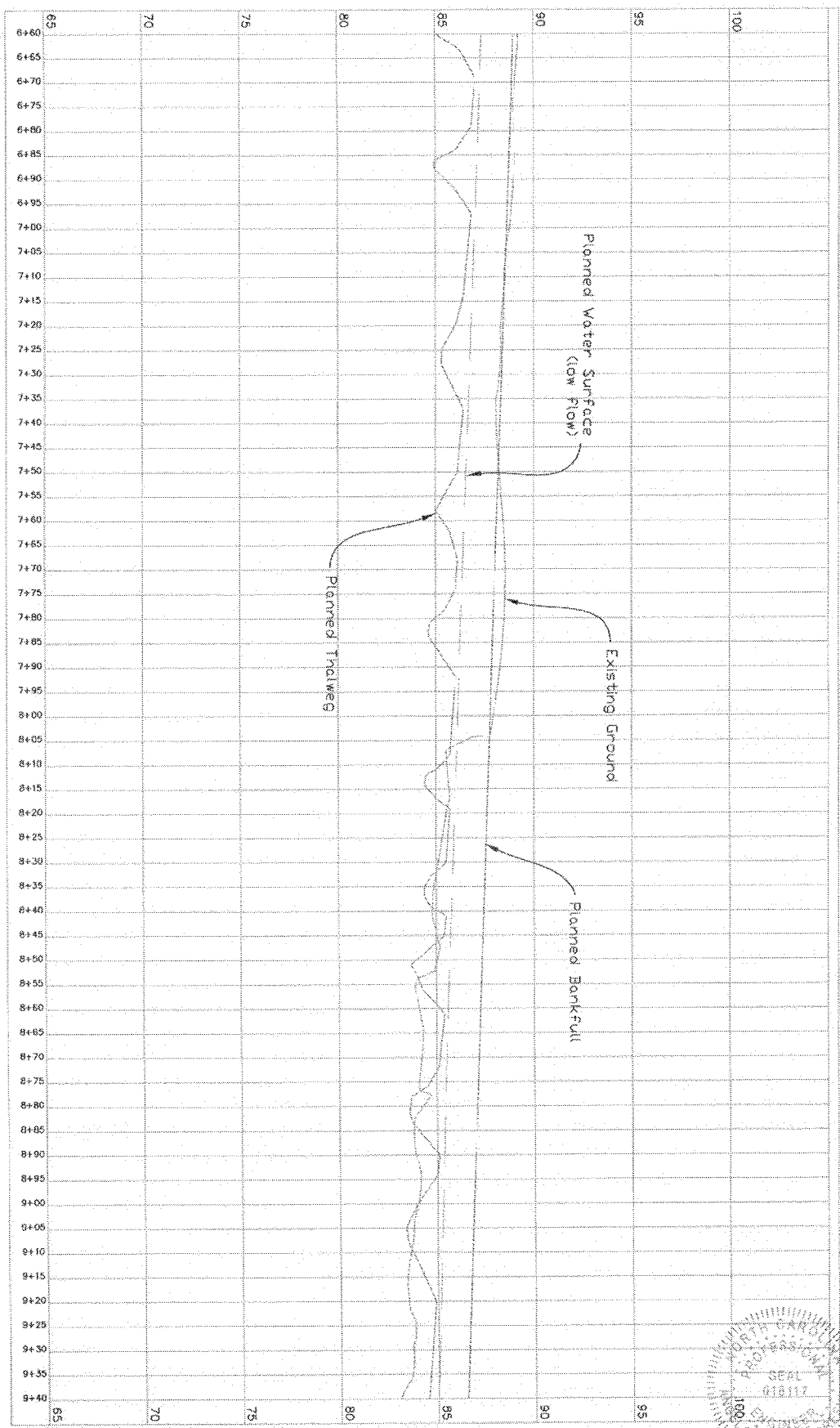
Drawn: AG Greene/DM Cartner 5/03

Checked:

Approved: NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER DARLENE GRIFFIN

Title:

Date: 11/21/05



Stillhouse Creek Stream Restoration Project

Orange County, North Carolina

North Carolina Ecosystem Enhancement Program

Profile of Planned Thalweg

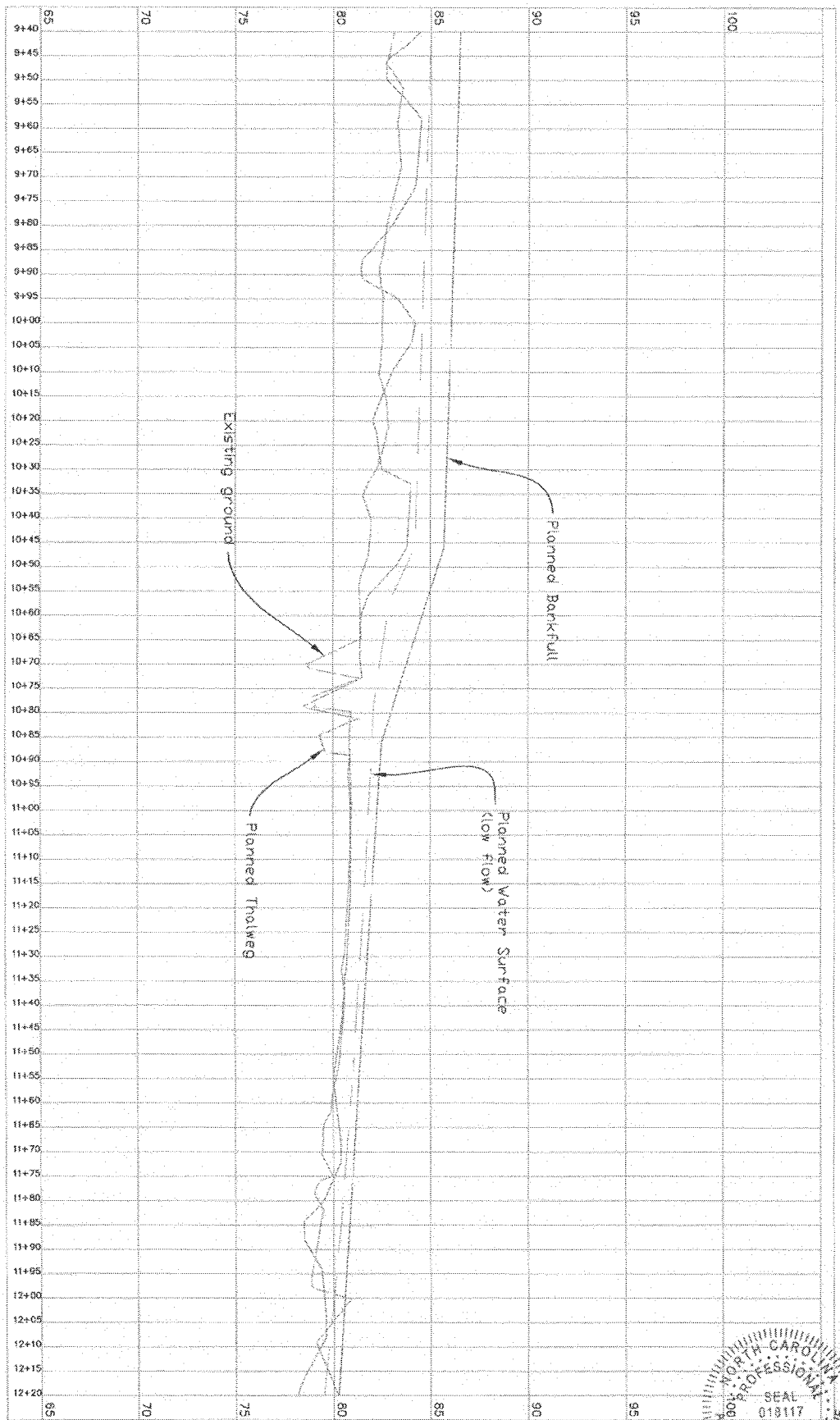
U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

	Name	Date
Designed	Angela Greene	5/03
Drawn	AG Greene/DM Cartner	5/03
Traced		
Checked		

Approved By: Angela J. Greene Date: 11/21/05

NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ANGELA J. GREENE

NO.	REVISIONS	DATE	APPROVED



REVISIONS

DATE	APPROVED	TITLE

Stillhouse Creek Stream Restoration Project

Orange County, North Carolina

North Carolina Ecosystem Enhancement Program

Profile of Planned Thalweg

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

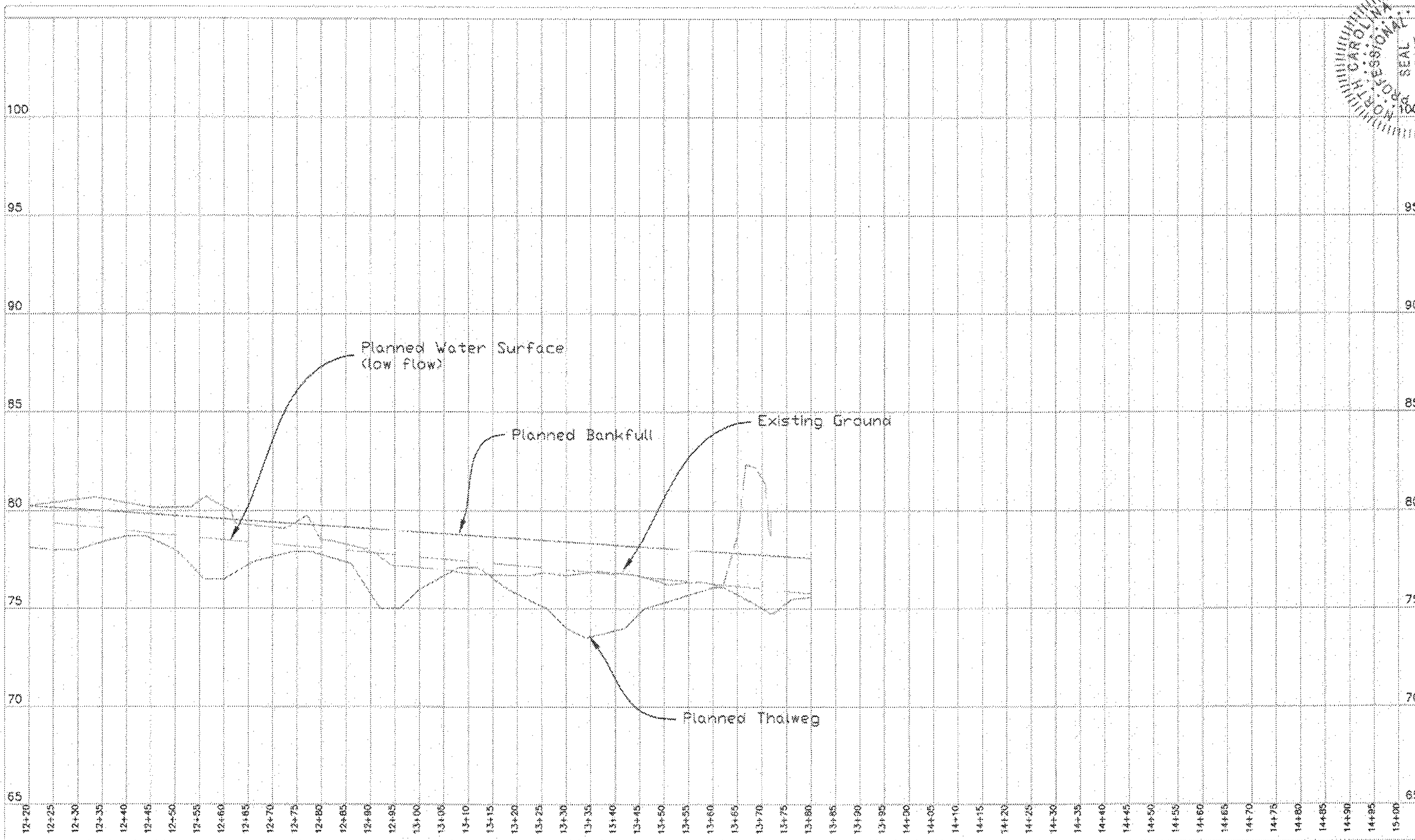
		Date
Designed	Angela Greene	5/05
Drawn	Ad Greene/DN Corliner	5/05
Traced		
Checked		

Approved by: DARLENE GREENE, P.E.

Title:

Date: 11/21/05

NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER DARLENE GREENE



NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER

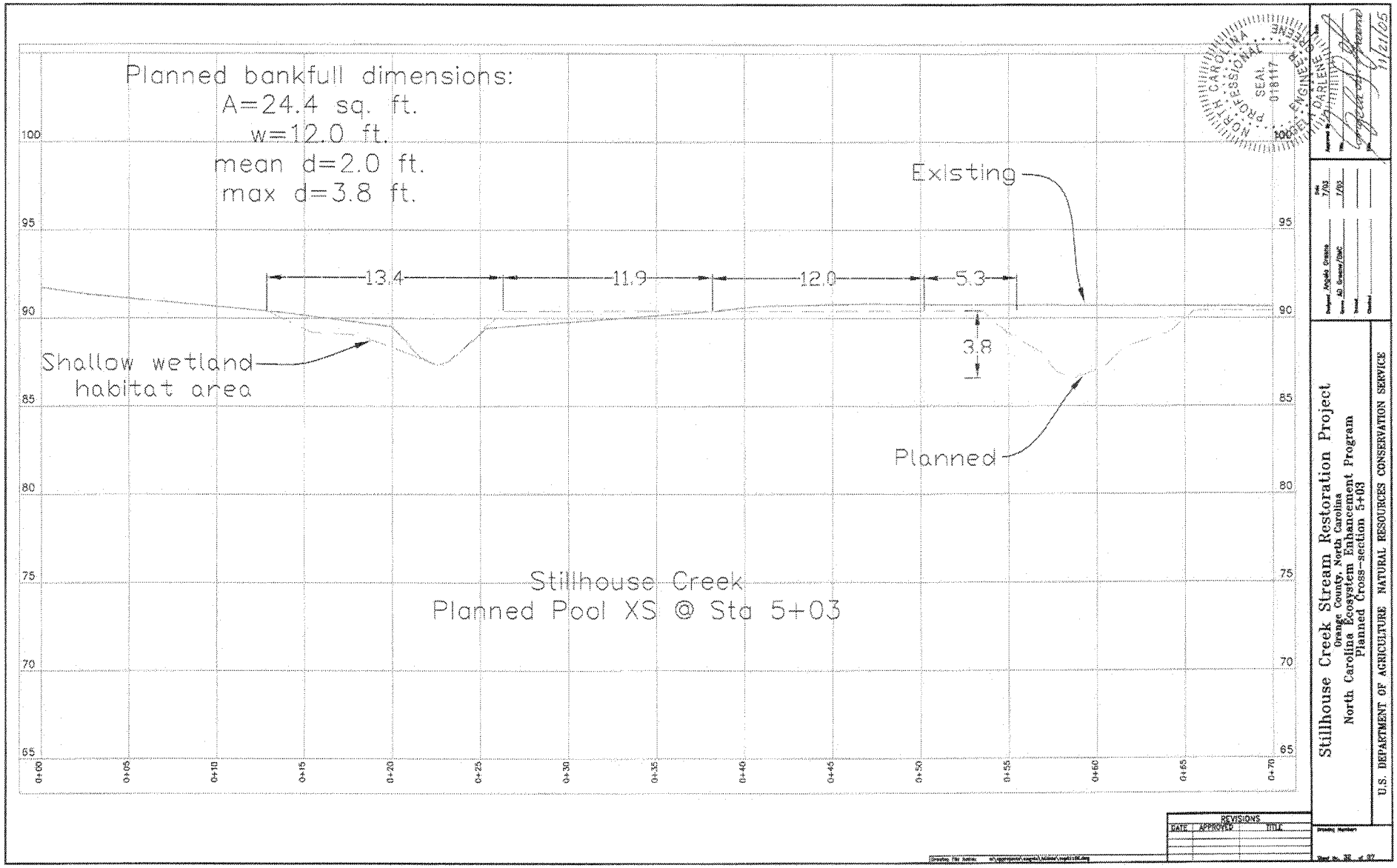
Designed Angela Greene 5/03
Drawn AD Greene/DM Cortner 5/03

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Profile of Planned Thalweg

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

REVISIONS		
DATE	APPROVED	TITLE

Sheet No. 31 of 37



NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 018417

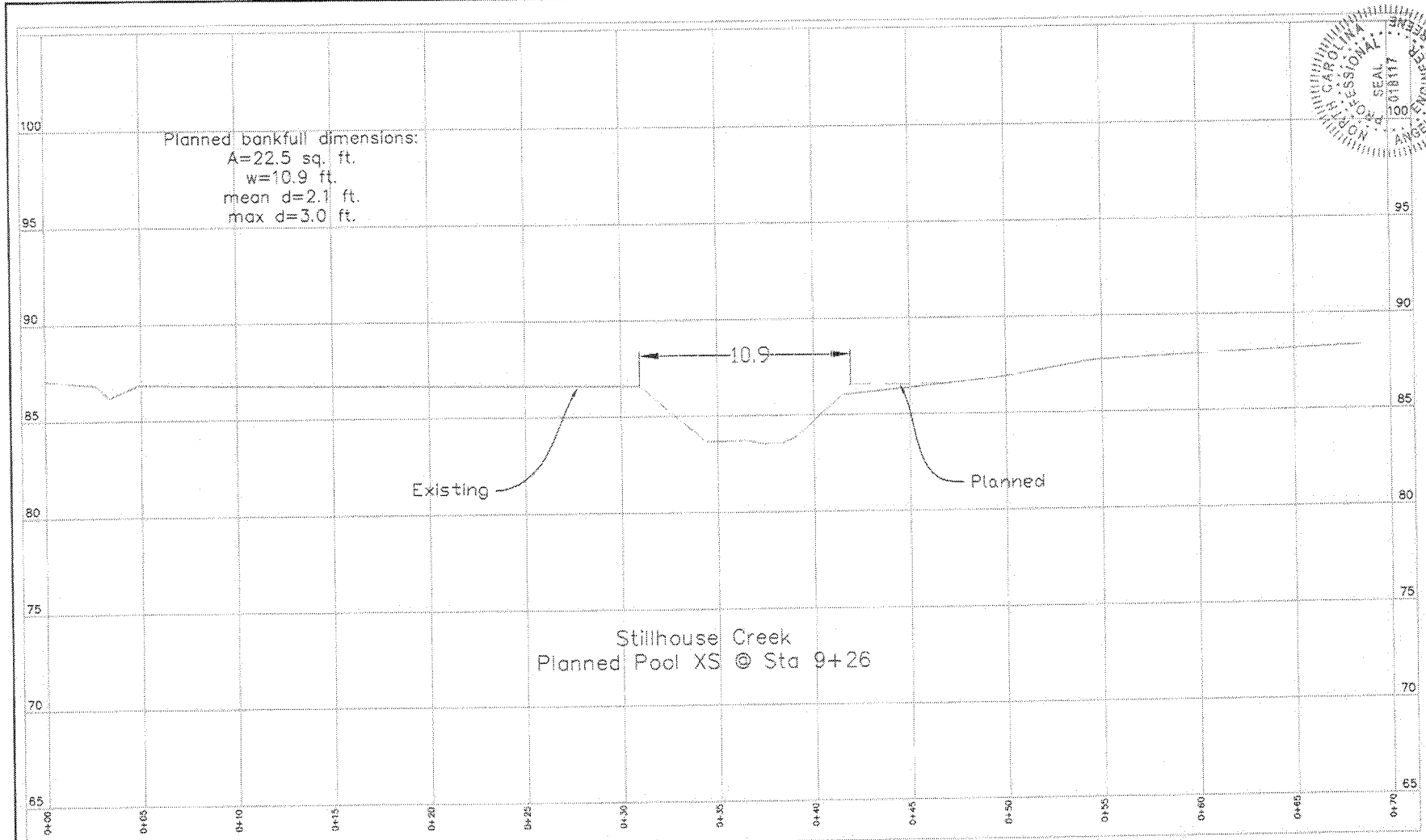
11/21/05

Stillhouse Creek Stream Restoration Project
North Carolina Ecosystem Enhancement Program
Orange County, North Carolina
Planned Cross-section 5+03

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

REVISIONS

DATE	APPROVED	TITLE

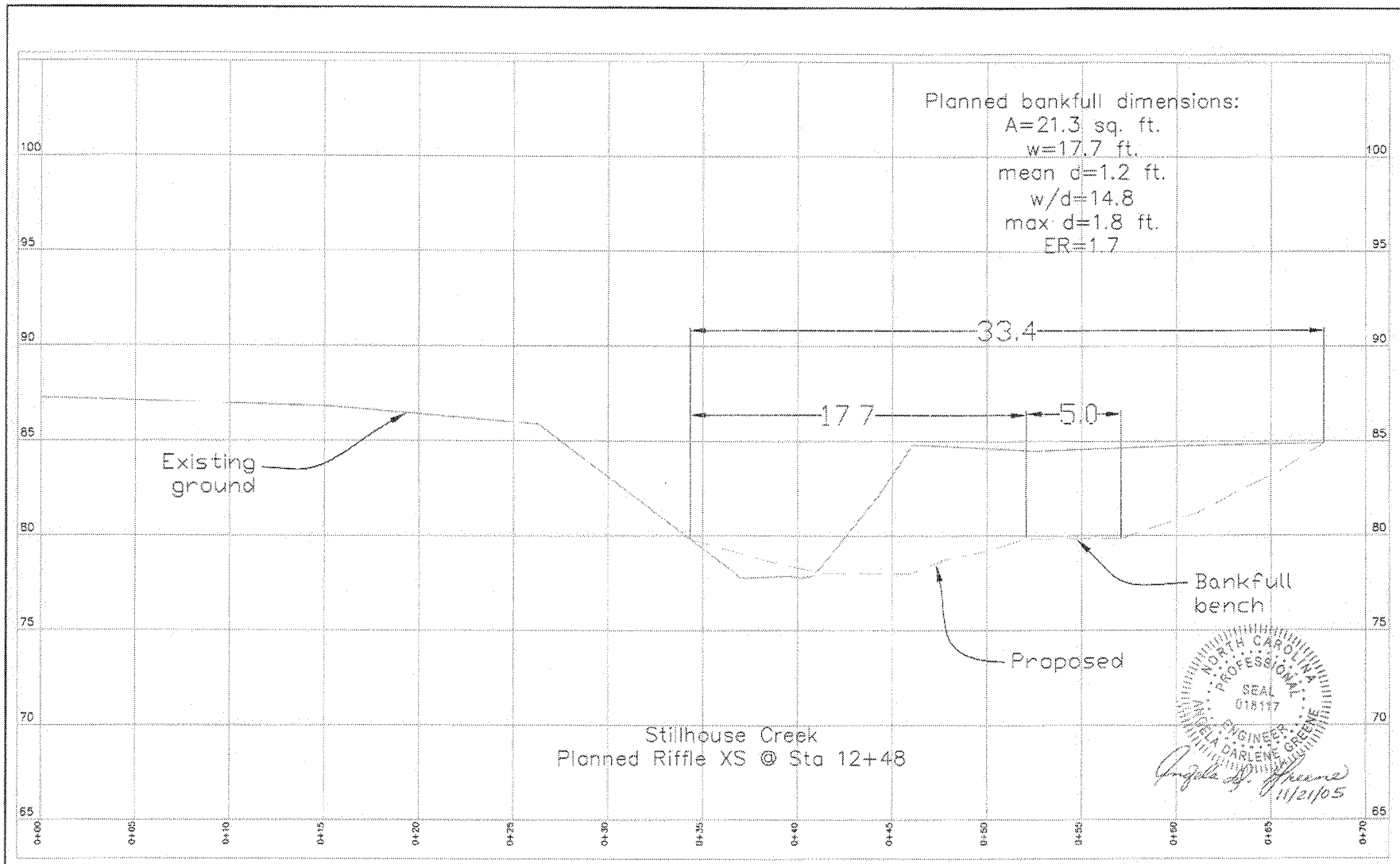


NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER DARLENE ANGLE

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Planned Cross-Section 9+26

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

REVISIONS		
DATE	APPROVED	TITLE

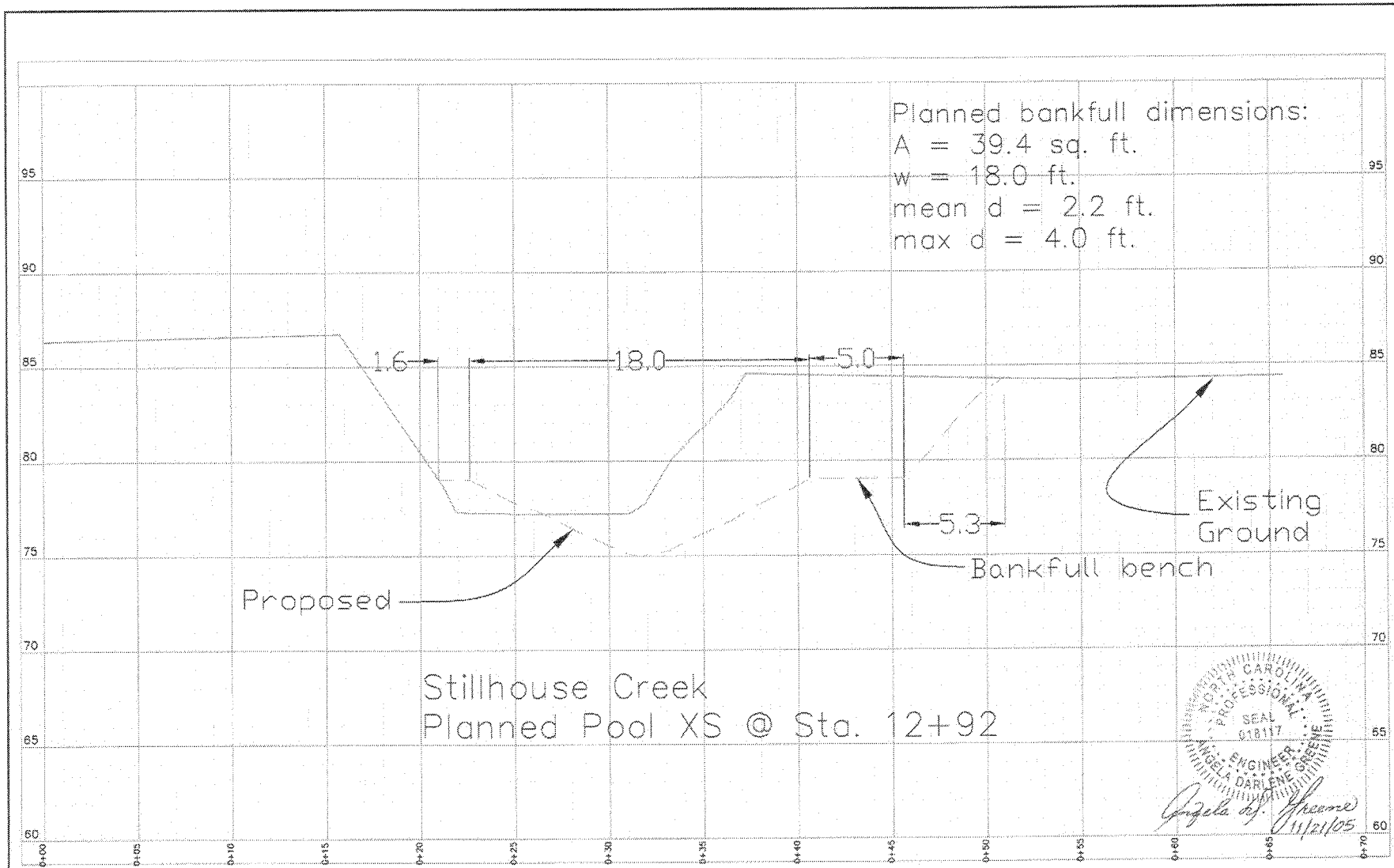


REVISIONS

DATE	APPROVED	TITLE

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Planned Cross-section 12+48

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE



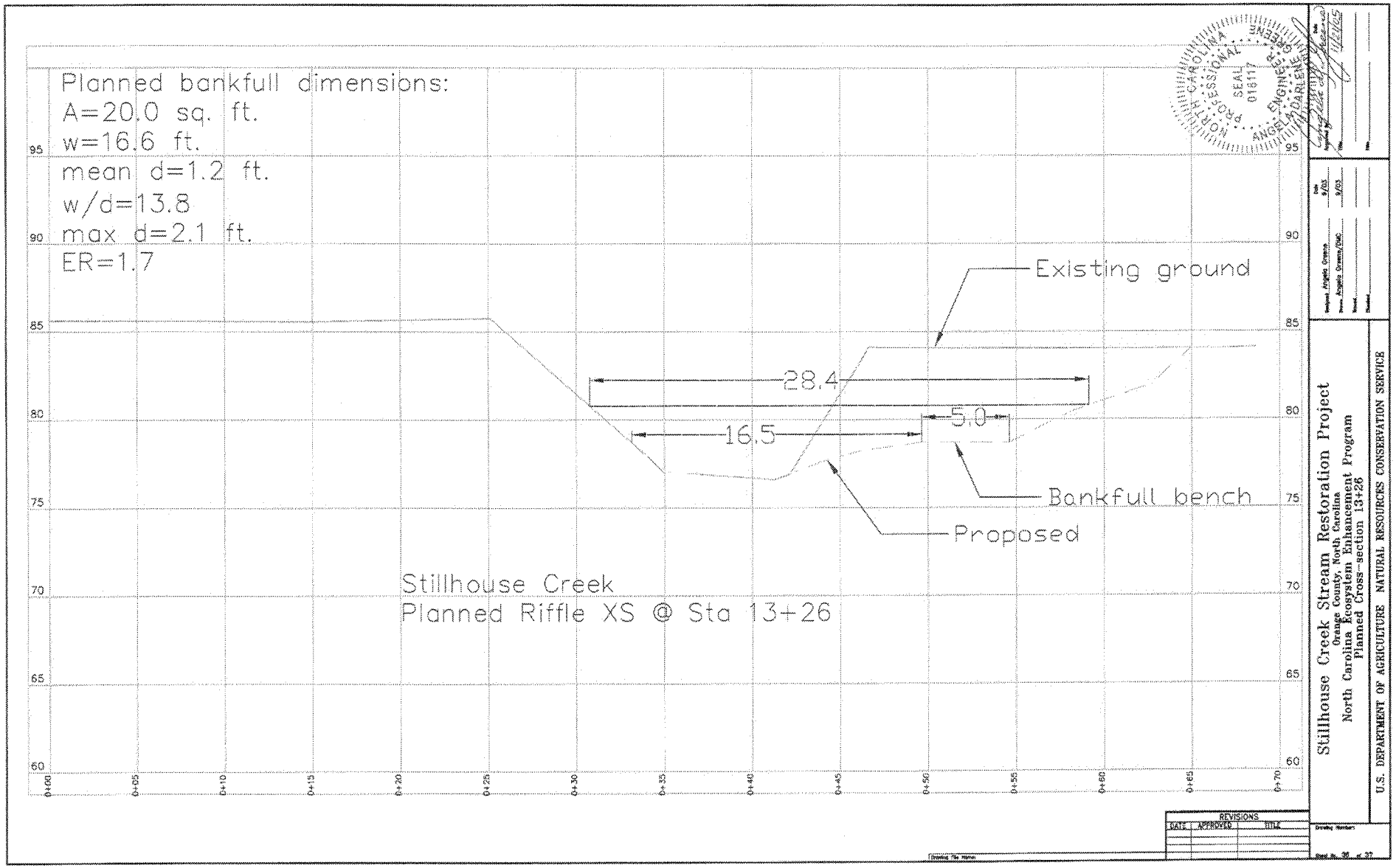
NORTH CAROLINA PROFESSIONAL SEAL 018117 ENGINEER ANGELA DARLENE GREENE
Angela D. Greene 11/21/05

REVISIONS
DATE | APPROVED | TITLE

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
Piedmont Ecosystem Enhancement Program
Planned Cross-section 12+92

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

Designed Angela Greene Date 7-05
Drawn AD Greene/JKeither 12-05
Traced
Checked
Approved By
Title
Date
Title
Drawing Number
Sheet No. 35 of 37

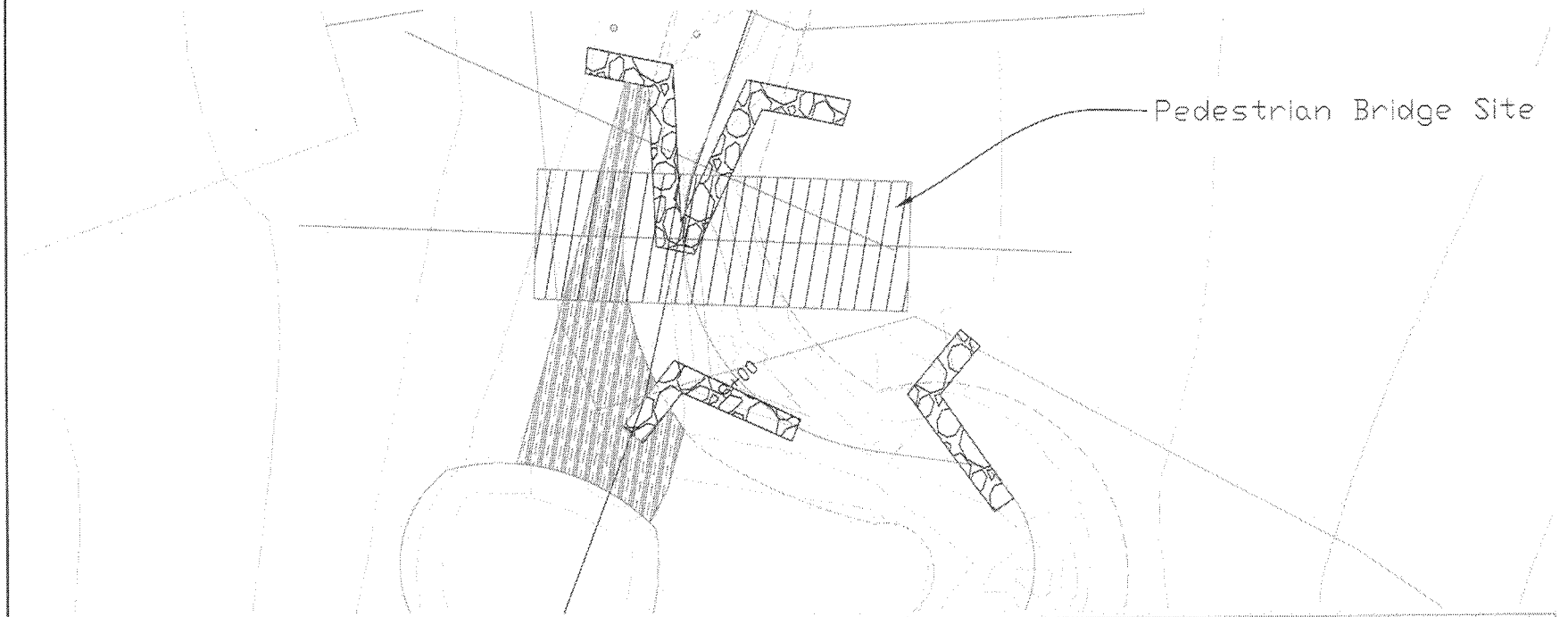


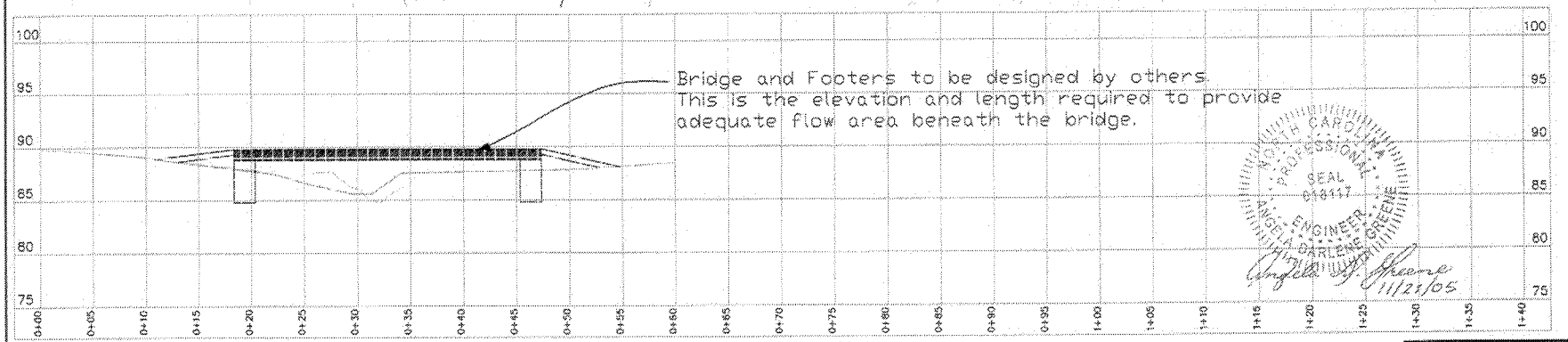
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 016119 ANGELA DARLENE

Stillhouse Creek Stream Restoration Project
Orange County, North Carolina
North Carolina Ecosystem Enhancement Program
Planned Cross-section 13+26

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

REVISIONS		
DATE	APPROVED	TITLE





NORTH CAROLINA PROFESSIONAL SEAL 018417 ENGINEER ANGELA DARLENE GREENE
11/23/05

REVISIONS

DATE	APPROVED	TITLE

Stillhouse Creek Stream Restoration Project

Orange County, North Carolina

North Carolina Ecosystem Enhancement Program

Pedestrian Bridge Detail Sheet (Bridge to be design by others)

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

Designed: Date:

Drawn: Checked:

Approved By: Date:

Title:

Drawing Number:

Sheet No. 27 of 27