Year One Monitoring Report

Unnamed Tributary to Bear Swamp Creek

Prepared for:
North Carolina Department of the Environment and Natural Resources
Ecosystem Enhancement Program

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1. Introduction

1.1 Project Description

The North Carolina Department of Environment and Natural Resources, Wetlands Restoration Program (NCWRP), now the North Carolina Ecosystem Enhancement Program (EEP), retained ARCADIS to conduct stream restoration using natural channel design methodologies on an unnamed tributary to Bear Swamp Creek in central Franklin County. The site is at the Murphy Hay Farm immediately south of Dyking Road near the town of Louisburg. Mr. Glenn Murphy owns the property.

Construction was completed in July 2002, and approximately 1,435 linear feet of the unnamed tributary to Bear Swamp Creek were restored. Restoration included excavating a new channel, grading existing stream banks, constructing in-stream boulder structures and root wads, and planting native vegetation. A corrugated-metal-pipe arch culvert and two 24-inch reinforced concrete pipe culverts were installed to serve as a driveway crossing.

A baseline survey of the constructed stream channel and planted vegetation was conducted in August 2002. The survey documented the restored channel location, location of all in-stream structures, vegetation monitoring plots, and vegetation within the plots.

1.2 Goals and Objectives

The goal of the stream restoration is to improve water quality in the Tar-Pamlico River Basin. An estimated 34 tons of sediment were generated from the project area annually prior to construction. This estimate is conservative, given that fewer than 600 linear feet of the 1,500 linear feet of stream bank were studied. By stabilizing the streambed and stream banks, the restoration will ultimately improve water quality by reducing the amount of sediment contributed to the watershed. Nutrient input should decrease through the establishment of a permanent riparian buffer. The buffer will shade the stream, reducing water temperatures and providing additional wildlife habitat to the site.

Stream stability and vegetation development are being monitored. Stability is being monitored by comparing annual stream channel surveys with the baseline survey. Documenting the survival rate of bare-root seedlings and live stakes planted on site is monitoring woody vegetation establishment.

2. Summary

2.1 Site Description and Land Use

The unnamed tributary originates at a small pond approximately 500 feet east of Dyking Road and 1,000 feet east of the project. Land uses in the watershed consist of agriculture, pastureland, forest, and single-family residence. Within the project limits, the unnamed tributary flows from the northeast to the southwest through pastureland. Cattle previously had access to the tributary, thus limiting the type and amount of vegetation throughout the riparian zone. Grasses dominate the area, with only a few mature sweet gum (*Liquidambar styraciflua*), red maple (*Acer rubrum*) and sycamore (*Platanus occidentalis*) trees located along the stream. This first-order stream was incised, with near-vertical banks along most of the reach. The stream was approximately 10 feet wide at the top of bank and approximately 4 feet deep. In some areas, the banks were nearly 6 feet tall with no bank protection present.

Stream restoration onsite was a Priority II and Priority III restoration for the site (Rosgen 1997). The degraded "F5" and "G5c" stream types were restored to a stable "B5c" (step-pool) stream type (Rosgen 1994). This scenario fit both the stream evolution for the site (C5 or B5c→G5→F5→B5c) and the valley type (Type II) (Rosgen and Silvey 1998; Rosgen 1997; Rosgen 1996). Approximately 780 feet of new channel were created, and 680 linear feet of stream were stabilized in place. The width-to-depth ratio was increased to reduce shear stress. Stresses in the near-bank region were reduced by the installation of boulder cross vanes. The boulder cross vanes also stabilized the streambed and improved in-stream habitat by creating plunge pools. Root wads were used to help protect the stream banks, mainly where the existing channel was abandoned, and to provide additional aquatic habitat diversity. The establishment of vegetation will also stabilize the stream banks. Locations of the root wads and boulder cross vanes are shown in Sheets 1 through 3.

The existing 16-inch pipe under the driveway was replaced with a 73-inch by 55-inch corrugated metal pipe arch culvert and two 24-inch reinforced concrete pipes at higher elevations to drain the flood plain. Hydraulic analysis showed the proposed culvert design will lower the water surface of the 10-year storm event approximately 0.6 foot. Two crossings were constructed, one upstream and one downstream of the new culverts. The crossings provide access to the pastures on both sides of the stream while keeping cattle and farm machinery out of the stream.

A 50-foot buffer from the bankfull was created. The buffer comprises 30 feet of trees and 20 feet of grass. Cattle are excluded from the 30-foot buffer. Piedmont alluvial forest species (Schafale and Weakley 1990) were planted in the buffer in March 2003 and include silky dogwood (*Cornus amomum*), red mulberry (*Morus rubra*), black walnut (*Juglans nigra*), black willow (*Salix nigra*), tag alder (*Alnus serrulata*), cherry bark oak (*Quercus pagoda*), swamp chestnut oak (*Q. michauxii*), river birch (*Betula nigra*), elderberry (*Sambucus canadensis*), green ash (*Fraxinus pennsylvanica*), iron wood (*Carpinus caroliniana*), winterberry holly (*Ilex verticillata*) and eastern hop-hornbeam (*Ostrya virginiana*). Red maple, box elder (*A. negundo*), and sycamore currently exist onsite and are expected to reestablish on their own. The property owner requested that the view of the barn from his house not be obstructed. Therefore, the area between Station 16+50 and Station 19+00 was planted with shrub species. The larger trees were planted on 8-foot to 15-foot centers and the smaller trees on 6-foot to 8-foot centers. This will give densities of 4 to 15 and 15 to 25 per 1,000 square feet, respectively. Black willow and silky dogwood were planted along the stream banks as live stakes.

3. Methodology

Location surveys of the constructed features were conducted to monitor the performance of the stream restoration. These surveys were conducted in September 2003, approximately one year after the baseline survey. Total station survey equipment was used. A longitudinal profile, and five permanent cross sections were surveyed. Modified Wolman pebble counts, photographs, and vegetation assessments were also made. Proposed, baseline, year one, and reference reach data are presented in Table 1.

3.1 Longitudinal Profile

The longitudinal profile of the restored stream was surveyed for its entire length. The same protocols used in the baseline monitoring were followed. The heads of riffles, pools and steps, and maximum pool features were surveyed in the longitudinal profile. Surveying these features allows the calculation of water surface slope at each feature, average water surface slope, pool length, and pool-to-pool spacing. At each feature, locations were determined for the thalweg, left and right edges of water, left and right bankfull elevations, and left and right tops of bank. These locations enabled the creation of a plan view of the restored stream. Stream pattern (i.e., meander length, radius of curvature, belt width, and sinuosity) are measured from the plan view.

3.2 Permanent Cross Sections

Five permanent cross sections were surveyed. Two riffles and one pool upstream of the driveway culvert complex and one riffle and one pool downstream of the driveway culvert complex were selected. The cross sections are located where pre-restoration cross sections were taken. The beginning and end of each permanent cross section are marked with wooden stakes labeled with the cross section number. Cross sections extend from fence to fence and are perpendicular to the stream flow. The cross section survey noted all grade breaks, tops of banks, left and right bankfull, edges of water, and thalweg. The cross sections were plotted and the bankfull cross-sectional area calculated. The area will be compared with the *Regional Curves for Rural Piedmont North Carolina* (Harmen, et al 1999) (Appendix A). The bankfull mean depth was calculated by dividing the bankfull cross sectional area by the bankfull width. The width-to-depth ratio was calculated by dividing the bankfull width by the bankfull mean depth. The stream will be classified using the Rosgen system of stream classification (Rosgen 1994).

3.3 Pebble Count

In order to document shifts in the stream substrate, a modified Wolman pebble count (Rosgen 1993) was taken at each permanent cross section. Fifty samples were taken below bankfull. The cumulative percent was graphed and the D16, D35, D50, D84, and D95 calculated.

3.4 Photo Documentation

Photographs were taken at permanent photo points. Photographs of the site will provide valuable visual information as a complement to the figures and narrative material included in the monitoring reports. Photographs will record any events that may have a significant effect on the success of the restoration, such as flood, fire, drought, or vandalism. The photo points were established during the baseline survey and were selected to show reaches of the stream as well as the buffer. The locations of the photo points are shown on the plan view.

3.5 Vegetation

A survey of planted bare-root seedlings and live stakes was conducted in September 2003. The vegetation was monitored in the established 20-foot by 45-foot vegetation plots. All live woody stems were counted. Planted stems were differentiated from volunteers. At this time the vegetation plots appear to be of adequate size to collect a representative sample of planted vegetation.

4. Results

4.1 Bankfull Events

A stream gage had not been installed on the site prior to the year-one survey. The property owner stated that the water has been to the top of the arch culvert several times since construction. The top of the arch culvert is above bankfull, so at least one bankfull event occurred during the first year.

A crest-stage monitoring gage was installed on site during the year-one monitoring survey. The location of the crest-stage gage is shown on the sheets 3 and 6.

4.2 Longitudinal Profile

Parameters that were identified in the Mitigation Plan as success criteria are discussed below. All information regarding the longitudinal profile is shown on sheets 5-7 and presented in Table 1.

The average water slope for the length of the reach is 0.0161 ft/ft, with a range from 0.0161 – 0.0164 ft/ft; pool-to-pool spacing (measured from head of pool to head of next pool) ranged from 17.7 ft to 69.3 ft, with an average of 41.6 ft.

4.3 Channel Dimension

Parameters that were identified in the Mitigation Plan as success criteria are discussed below. All information regarding the channel dimensions is shown on sheet 7 and presented in Table 1.

Three riffle cross sections were measured. The bankfull cross-sectional area at the three locations ranged from 7.6 to 11.5 square feet, with an average of 9.4 square feet; bankfull width ranged from 7.9 feet to 11.0 feet, with an average of 9.9 feet; bankfull mean depth ranged from 0.9 feet to 1.0 feet, with an average of 1.0 feet; the bankfull width to bankfull mean depth ratio ranged from 7.9 to 11.9, with an average of 10.3. The NC Piedmont Rural Regional Curve cross-sectional area is 8.57 square feet.

Two pool cross sections were measured. The bankfull cross sectional area at the pool cross sections ranged from 16.2 square feet to 16.8 square feet, with an average of 16.5 square feet; bankfull width at the pools ranged from 12.0 feet to 13.0 feet, with an

average of 12.5 feet; the maximum bankfull depth at pools ranged from 2.5 feet to 6.2 feet, with an average of 4.2 feet.

4.4 Pattern

The channel sinuosity is 1.1. Sinuosity was calculated by dividing the stream length by the valley length.

4.5 Bed Material

The D16 was determined to be 0.1 mm, the D35 0.3 mm, the D50 1.0 mm, the D84 9.4 mm and the D95 3010 mm. The results of all the pebble counts are presented in Appendix B and Table 1.

4.6 Photographic Documentation

The photographs show thick, healthy, early succession vegetation establishing throughout the easement area. No significant changes to the new channel or to in-stream structures are observed. All photographs are shown in Appendix A.

4.7 Vegetation

Bare-root seedlings as well as live stakes were planted. At the time of installation (February 2002), the seedlings were dormant. The seedlings were not labeled when they were installed. Subsequently, based on their size, some of the seedlings are very difficult to identify. The contractor provided a list of the species planted. However, it appears that the list is not accurate. It will be easier to identify the tree species as the trees mature. Best professional judgment was used in identifying tree species on site. Those that could not be accurately identified are listed as unknown. A copy of the planting list is included in Appendix C.

Base on year-one surveys, the count of surviving bare-root seedling stems is 320 per acre. When live stakes are included in the calculation, the density increases to 640 stems per acres. If all volunteer species are included, the number of stems per acre increases to 3,950. Vegetation information is included in Table 2.

5. Discussion

5.1 Longitudinal Profile

The average water-surface slope of the bankfull channel increased slightly. The increase is not considered significant and is more than likely the result of channel measurements not taken in the exact locations used for the baseline survey. For example, on Sheet 7, the baseline survey shows a structure at station 23+86. The year-one survey shows the same structure at station 23+75. The same shift can be seen at other locations on the profile. The structure did not move 11 feet upstream. The length of the survey was shorter. This slight difference in stream length is the cause of the increase in average water-surface slope.

The pool-to-pool spacing decreased from the baseline survey but is in line with the design spacing. During construction, some of the pools filled with sediment and could not be cleaned out with construction equipment. It appears that the pools have cleaned themselves out. The spacing is not exactly the design spacing due to the development of small pools upstream of two boulder cross vane structures (stations 18+06 and 19+60). The establishment of these pools is not considered significant, since they are not compromising the boulder structures and the pool-to-pool spacing is still close to the design ranges.

5.2 Channel Dimension

The channel bankfull dimension at the permanent riffle cross sections has not significantly changed. The average bankfull width is 0.1 feet narrower than the designed bankfull width and 0.3 feet wider that the baseline width. The bankfull mean depth is 0.2 feet deeper than the proposed mean depth and the same as the baseline mean depth. The year-one bankfull width to bankfull mean depth (W/R) is slightly lower than the proposed W/R but nearly identical to the baseline W/R. This appears to indicate that the stream channel has a stable dimension. The channel was not built to the exact proposed dimensions but did retain the constructed dimensions. The average bankfull cross-sectional area is 0.8 square feet larger than the designed cross-sectional area and 0.1 square feet larger than the baseline survey. This also reflects the channel stability as discussed above.

5.3 Pattern

The channel sinuosity did not change from design to baseline to year-one survey. Plan sheets 2-4 show the year-one channel overlaid with the baseline channel. No significant difference is observed. Table 1 shows a change in the channel meander length, radius of curvature, and belt width between proposed reach, baseline channel and year-one monitoring. The change is attributed to the difference in the method of measuring these parameters and not a change in the stream pattern. As mentioned above, the channel plan view shows no significant change in the channel pattern.

5.4 Bed Material

The D16 and D35 remained relatively the same. There was a very slight increase in the D50 from 0.4 mm to 1.0 mm. The D84 decreased from 16.0 mm to 9.4 mm, while the D95 increased from 2363 mm to 3010 mm. The results of all the pebble counts are presented in Appendix B.

It is very difficult to make comparisons in the channel bed material this early in the development of a riparian buffer. At some of the locations where pebble counts were performed, there is emergent vegetation (mainly smart weed) for the entire width of the channel. The vegetation is catching fine sediment, and this may be skewing the results of the year-one data. Data collected in years four and five may be more representative. This will give the vegetation time to establish and shade out the smart weed in the channel.

5.5 Photographic Documentation

The restoration site is meeting the established success criteria for photographic documentation. Subsequent years' photographs should show the succession of the vegetation and development of a woody buffer.

5.6 Vegetation

The site is meeting the established success criteria for vegetation when using just bare-root seedling and live stakes. When volunteer species are included in the calculation, the density is extremely high. This is not an accurate calculation due to the fact that the majority of the volunteer species are considered nuisance species (i.e. loblolly pine [*Pinus taeda*], red maple, and sweet gum). At the time of the survey, the nuisance species are seedlings and not fully established. If it appears during subsequent surveys

that the nuisance species are becoming established and overrunning the site, measures will be taken to reduce their composition to 20 percent or less.

6. Recommendations

The restoration activities appear to be successful when the year-one survey information is compared with the proposed and baseline survey information. Subsequent annual channel and vegetation surveys will provide valuable information to confirm the restoration success. The installation and monitoring of streambed scour chains and bank pins would help validate further survey information and visual observations. The scour-chain data would also provide information about the dynamics of sand-bed streams.

Scour chains also may identify the cause of the pools developing upstream of the boulder cross vane. Attention should be paid to these areas in future monitoring.

Annual stream and vegetation surveys are recommended for a minimum of four more years. The crest-stage monitoring gage should be read a minimum of every three months and repaired as needed. Scour chains and bank pins should be installed as early as possible.

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Unnamed Tributary to Bear Swamp Creek Year One Monitoring Report

Tables

Table 1

MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL
WITH GAGE STATION AND REFERENCE REACH DATA
(Adapted from Rosgen, 1996)

Restoration Site: Unnamed Tributary to Bear Swamp Creek, Baseline Survey, Louisburg, Franklin County, NC
Reference Reach: Unnamed Tributary to Crooked Creek near Rolesville, Wake County, NC

Variables	Proposed Reach	Baseline Channel	Year 1	Reference Reach
1. Stream Type	B5c	B5c	B5c	B5c
2. Drainage Area (sq. mi)	0.26	0.26	0.26	0.49
3. Bankfull Width (Wbkf) ft	Mean: 10 Range:	Mean: 9.6 Range: 8.1 - 10.7	Mean: 9.9 Range: 7.9 - 11.0	Mean: 11.4 Range: 11.0 - 11.8
4. Bankfull Mean Depth (dbkf) ft	Mean: 0.8 Range:	Mean: 1.0 Range: 0.9 - 1.0	Mean: 1.0 Range: 0.9 - 1.0	Mean: 1.1 Range: 0.9 - 1.2
5. Width/Depth Ratio (Wbkf/dbkf)	Mean: 12 Range:	Mean: 10 Range: 8.2 - 11.4	Mean: 10.3 Range: 7.9 - 11.9	Mean: 10.7 Range: 11.0 - 11.8
6. Bankfull Cross-Sectional Area (Abkf) sq ft	Mean: 8.6 Range:	Mean: 9.3 Range: 8.1 - 10.7	Mean: 9.4 Range: 7.6 - 11.5	Mean: 12.1 Range: 10.3 - 14.0
7. Bankfull Mean Velocity (Vbkf) fps	Mean: 4.2 Range:	Mean: 5.5 Range: 3.2 - 7.3	Mean: 5.0 Range: 3.0 - 7.4	Mean: 3.6 Range: 3.1 - 4.2
8. Bankfull Discharge, cfs (Qbkf)	Mean: 33.1 Range: 20.8 - 45.4	Mean: 51.2 Range: 29.8 - 67.9	Mean: 47.0 Range: 28.2 - 69.6	Mean: 43.8 Range: 37.1 - 50.4
9. Maximum Bankfull Depth (dmax) ft	Mean: 1.6 Range: 1.4 - 1.8	Mean: 1.6 Range: 1.5 - 1.7	Mean: 2.4 Range: 1.8 - 3.2	Mean: 2.1 Range: 1.9 - 2.4
10. Ratio of Low Bank Height to Max. Bankfull	Mean: N/A Range:	Mean: N/A Range:	Mean: N/A Range:	Mean: N/A Range:
11. Width of Flood Prone Area (Wfpa) ft	Mean: 18 Range: 14.0 - 22.0	Mean: 11.4 Range: 13.5 - 19.0	Mean: 18.0 Range: 13.4 - 22.1	Mean: 40.6 Range: 25.5 - 80.0
12. Entrenchment Ratio (Wfpa/Wbkf)	Mean: 1.8 Range: 1.4 - 2.2	Mean: 1.7 Range: 1.7 - 1.8	Mean: 1.8 Range: 1.7 - 2.1	Mean: 2.3 Range: 2.2 - 2.4
13. Meander Length (Lm) ft	Mean: 40 Range: 18.0 - 77.0	Mean: 121.3 Range: 42.4 - 236.9	Mean: 57.0 Range: 19.2 - 112.4	Mean: 46 Range: 21.0 - 88.0
14. Ratio of Meander Length to Bankfull Width (Lm/Wbkf)	Mean: 4 Range: 1.8 - 7.7	Mean: 12.6 Range: 4.4 - 24.7	Mean: 5.8 Range: 1.9 - 11.4	Mean: 4 Range: 1.8 - 7.7
15. Raduis of Curvature (Rc) ft	Mean: 199 Range: 55.0 - 342.0	Mean: 77.8 Range: 11.0 - 221.0	Mean: 158.5 Range: 40.0 - 500.0	Mean: 240 Range: 63.0 - 390.0
16. Ratio of Radius of Curvature to Bankfull Width	Mean: 19.9 Range: 5.5 - 34.2	Mean: 8.1 Range: 1.1 - 23.0	Mean: 16 Range: 4.0 - 50.5	Mean: 19.9 Range: 5.5 - 34.2
17. Belt Width (Wblt) ft	Mean: 37 Range: 20.0 - 80.0	Mean: 31.3 Range: 5.5 - 82.5	Mean: 33.2 Range: 13.3 - 62.7	Mean: 7 Range: 6.0 - 8.0
18. Meander Width Ratio (Wblt/Wbkf)	Mean: 3.7 Range: 2.0 - 8.0	Mean: 3.3 Range: 0.6 - 8.6	Mean: 3.4 Range: 1.3 - 6.3	Mean: 0.6 Range: 0.5 - 0.7
19. Sinuosity (Stream length/valley distance) (k)	Mean: 1.1 Range:	Mean: 1.11 Range:	Mean: 1.1 Range:	Mean: 1.1 Range:
20. Valley Slope (ft/ft)	Mean: 0.017 Range:	Mean: 0.0168 Range:	Mean: 0.0167 Range:	Mean: 0.017 Range:
21. Average Water Surface Slope or Bankful Slope for	Mean: 0.0157 Range:	Mean: 0.0154 Range: 0.0152 - 0.0156	Mean: 0.0161 Range: 0.0160 - 0.0164	Mean: 0.016 Range:
22. Pool Slope (Spool) ft / ft	Mean: 0.033 Range: 0.0 - 0.066	Mean: 0.0042 Range: 0.0 - 0.0084	Mean: 0.0053 Range: 0.0004 - 0.0113	Mean: 0.029 Range: 0.0 - 0.07
23. Ratio of Pool Slope to Average Slope (Spool/Sbkf)	Mean: 1.8 Range: 0.0 - 4.4	Mean: 0.3 Range: 0.0 - 0.5	Mean: 0.3 Range: 0.0 - 0.7	Mean: 1.8 Range: 0.0 - 4.4
24. Maximum Pool Depth (dpool) ft	Mean: 2.4 Range: 2.3 - 2.6	Mean: 3.3 Range: 2.6 - 4.1	Mean: 4.2 Range: 2.5 - 6.2	Mean: 3.2 Range: 3.1 - 3.4
25. Ratio of Maximum Pool Depth to Bankfull Mean	Mean: 3 Range: 2.9 - 3.3	Mean: 3.3 Range: 2.6 - 4.1	Mean: 4.2 Range: 2.5 - 6.2	Mean: 3 Range: 2.9 - 3.2

Table 1 (Continued)

MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL
WITH GAGE STATION AND REFERENCE REACH DATA
(Adapted from Rosgen, 1996)

Restoration Site: Unnamed Tributary to Bear Swamp Creek, Baseline Survey, Louisburg, Franklin County, NC
Reference Reach: Unnamed Tributary to Crooked Creek near Rolesville, Wake County, NC

Variables	Proposed Reach		Baseline Channel		Year 1		Reference Reach	
26. Pool Width (Wpool) ft	Mean:	8	Mean:	10.5	Mean:	12.5	Mean:	8.8
	Range:	7.0 - 8.0	Range:	10.7 - 11.3	Range:	12.0 - 13.0	Range:	8.0 - 9.5
27. Ratio of Pool Width to Bankfull Width	Mean:	0.8	Mean:	1.1	Mean:	1.3	Mean:	0.8
	Range:	0.7 - 0.8	Range:	1.1 - 1.2	Range:	1.2 - 1.3	Range:	0.7 - 0.8
28. Bankfull Cross-sectional Area at Pool (Apool) sq ft	Mean:	11.2	Mean:	17.8	Mean:	16.5	Mean:	15.4
	Range:	6.5 - 12.9	Range:	17.0 - 18.6	Range:	16.2 - 16.8	Range:	15.2 - 15.6
29. Ratio of Pool Area to Bankfull Area (Apool/Abkf)	Mean:	1.3	Mean:	1.9	Mean:	1.8	Mean:	1.3
	Range:	1.1 - 1.5	Range:	1.8 - 2.0	Range:	1.7 - 1.8	Range:	1.1 - 1.5
30. Pool to Pool Spacing (p-p) ft	Mean:	37	Mean:	53.5	Mean:	41.6	Mean:	42
	Range:	19.0 - 61.0	Range:	31.7 - 115.5	Range:	17.7 - 69.3	Range:	22.0 - 69.0
31. Ratio of Pool-to-Pool Spacing to Bankfull Width (p-	Mean:	3.7	Mean:	5.6	Mean:	4.2	Mean:	3.7
	Range:	1.9 - 6.1	Range:	3.3 - 12.0	Range:	1.8 - 7.0	Range:	1.9 - 6.1
32. Pool Length (Lp) ft	Mean:	8.0	Mean:	11.1	Mean:	12.6	Mean:	9.3
	Range:	6.0 - 11.0	Range:	3.9 - 30.6	Range:	3.7 - 23.9	Range:	7.0 - 13.0
33. Ratio of Pool Length to Bankfull Width (Lp/Wbkf)	Mean:	0.8	Mean:	1.1	Mean:	1.3	Mean:	0.8
	Range:	0.6 - 1.1	Range:	0.4 - 3.2	Range:	0.4 - 2.4	Range:	0.6 - 1.1
34. Riffle Slope (Sriff) ft / ft	Mean:	0.067	Mean:	0.0108	Mean:	0.0197	Mean:	0.04
	Range:	0.0015 - 0.132	Range:	0.0026 - 0.0238	Range:	0.0024 - 0.0487	Range:	0.001 - 0.14
35. Ratio of Riffle Slope to Average Slope (Sriff/Sbkf)	Mean:	2.5	Mean:	0.7	Mean:	1.2	Mean:	2.5
	Range:	0.1 - 8.8	Range:	0.2 - 1.5	Range:	0.1 - 3.0	Range:	0.1 - 8.8
36. Maximum Riffle Depth (driff) ft	Mean:	1.6	Mean:	1.6	Mean:	2.4	Mean:	2.1
	Range:	1.4 - 1.8	Range:	1.5 - 1.7	Range:	1.8 - 3.2	Range:	1.9 - 2.4
37. Ratio of Riffle Depth to Bankfull Mean Depth	Mean:	2	Mean:	1.6	Mean:	2.4	Mean:	2
	Range:	1.8 - 2.2	Range:	1.5 - 1.7	Range:	1.8 - 3.2	Range:	1.8 - 2.2
38. Run Slope (Srun) ft / ft	Mean:	0.027	Mean:	0.0093	Mean:	N/A	Mean:	0.042
	Range:	0.003 - 0.051	Range:	0.0088 - 0.0097	Range:		Range:	0.034 - 0.057
39. Ratio of Run Slope to Average Slope (Srun/Sbkf)	Mean:	1.8	Mean:	0.6	Mean:	N/A	Mean:	1.8
	Range:	0.2 - 3.4	Range:	0.6 - 0.6	Range:		Range:	0.2 - 3.4
40. Maximum Run Depth (drun) ft	Mean:	1.5	Mean:	1.7	Mean:	N/A	Mean:	2.1
	Range:	1.2 - 1.7	Range:	1.6 - 2.0	Range:		Range:	1.7 - 2.4
41. Ratio of Run Depth to Bankfull Mean Depth	Mean:	1.9	Mean:	1.7	Mean:	N/A	Mean:	1.9
	Range:	1.5 - 2.2	Range:	1.6 - 2.0	Range:		Range:	1.5 - 2.2
42. Slope of Glide (Sgl) ft / ft	Mean:	0.017	Mean:	0.0189	Mean:	0.0071	Mean:	0.019
	Range:	0.0015 - 0.032	Range:	0.0 - 0.0382	Range:	0.0011 - 0.0142	Range:	0.002 - 0.034
43. Ratio of Glide Slope to Average Water Surface Slope	Mean:	1.1	Mean:	1.2	Mean:	0.4	Mean:	1.1
	Range:	0.1 - 2.1	Range:	0.0 - 2.4	Range:	0.1 - 0.9	Range:	0.1 - 2.1
44. Maximum Glide Depth (dgl) ft	Mean:	1.8	Mean:	2.9	Mean:	3.7	Mean:	2.4
	Range:	1.7 - 1.9	Range:	2.2 - 3.6	Range:	2.2 - 5.3	Range:	2.3 - 2.6
45. Ratio of Glide Depth to Bankfull Mean Depth	Mean:	2.3	Mean:	2.9	Mean:	3.7	Mean:	2.3
	Range:	2.1 - 2.4	Range:	2.2 - 3.6	Range:	2.2 - 5.3	Range:	2.1 - 2.4
46. Step Slope (Sst)	Mean:	0.4098	Mean:	0.3418	Mean:	0.3399	Mean:	0.41
	Range:	0.3799 - 0.4396	Range:	0.0120 - 1.3511	Range:	0.0384 - 0.9958	Range:	0.38 - 0.44
47. Ratio of Step Slope to Average Water Surface Slope	Mean:	26.1	Mean:	21.9	Mean:	21.1	Mean:	26.1
	Range:	24.2 - 28.0	Range:	0.8 - 86.6	Range:	2.4 - 61.9	Range:	24.2 - 28.0
48. Maximum Step Depth (dst)	Mean:	1.3	Mean:	1.5	Mean:	1.9	Mean:	1.6
	Range:	1.1 - 1.5	Range:	1.1 - 2.0	Range:	1.3 - 2.5	Range:	1.4 - 1.9
49. Ratio of Step Depth to Bankfull Mean Depth	Mean:	1.6	Mean:	1.5	Mean:	1.9	Mean:	1.6
	Range:	1.4 - 1.9	Range:	1.1 - 2.0	Range:	1.3 - 2.5	Range:	1.4 - 1.9

Table 1 (Continued)

MORPHOLOGICAL CHARACTERISTICS OF THE EXISTING AND PROPOSED CHANNEL
WITH GAGE STATION AND REFERENCE REACH DATA
(Adapted from Rosgen, 1996)

Restoration Site: Unnamed Tributary to Bear Swamp Creek, Baseline Survey, Louisburg, Franklin County, NC
Reference Reach: Unnamed Tributary to Crooked Creek near Rolesville, Wake County, NC

Variables	Proposed Reach	Baseline Channel	Year 1	Reference Reach
Materials:				
Particle Size Distribution of Channel Material (mm)				
D16	N/A	0.07	0.08	0.1
D35	0.1	0.2	0.26	0.2
D50	0.2	0.4	1.0	3
D84	2.9	16	9.4	49.7
D95	10.3	2363	3010	252.1
Particle Size Distribution of Bar Material				
D16	NOT SAMPLED	NOT SAMPLED	NOT SAMPLED	
D35	NOT SAMPLED	NOT SAMPLED	NOT SAMPLED	
D50	NOT SAMPLED	NOT SAMPLED	NOT SAMPLED	
D84	NOT SAMPLED	NOT SAMPLED	NOT SAMPLED	
D95	NOT SAMPLED	NOT SAMPLED	NOT SAMPLED	
Largest Size Particle on Bar	NOT SAMPLED	NOT SAMPLED	NOT SAMPLED	

Sediment Transport:			
Sediment Transport Validation (Based on Bankfull Shear Stress)	**Proposed**	**Baseline**	**Year 1**
Calculated value (mm) from curve	10	50	60
Value from Shields Curve (lb/ft2)	0.11	0.5	0.8
Critical dimensionless shear stress	0.03	Not Calculated. No bar sample collected	Not Calculated. No bar sample collected
Minimal mean dbkf (ft) calculated using critical dimensionless shear stress equations	0.4	Not Calculated. No bar sample collected	Not Calculated. No bar sample collected

Table 2

UT to Bear Swamp Creek
Vegetation Monitoring Plot* Results

PLOT #1

Bare Root		Live Stakes		Volunteers	
Unknown	2	Black Willow	9	Loblolly Pine	82
Swamp Chestnut Oak	1	Silky Dogwood	8	Red Maple	17
Eastern Hop Hornbeam	2			Smooth Sumac	2
Black Walnut	1			Winged Sumac	1
Total	6	Total	17	Total	102
Density (stems per acre)	300				
Total Bare Root + Live Stakes	23				
Density (stems per acre)	1,150				
Total Bare Root + Live Stakes + Volunteers	125				
Density (stems per acre)	6,250				

PLOT #2

Bare Root		Live Stakes			
Green Ash	5	Black Willow	2	Volunteers	
Black Walnut	1			Loblolly Pine	69
Unknown	1				
Total	7	Total	2	Total	69
Density (stems per acre)	350				
Total Bare Root + Live Stakes	9				
Density (stems per acre)	450				
Total Bare Root + Live Stakes + Volunteers	78				
Density (stems per acre)	3,900				

PLOT #3

Bare Root	
Unknown	2
Green Ash	1
Red Mulberry	1
Unknown	1
Ironwood	1
Unknown	1
Total	7
Density (stems per acre)	350

Total	
Bare Root + Live Stakes	7
Density (stems per acre)	350

Total	
Bare Root + Live Stakes + Volunteers	39
Density (stems per acre)	1,950

Volunteers	
Loblolly Pine	32
Total	32

PLOT #4

Bare Root	
Green Ash	1
Eastern Hop Hornbeam	2
Black Walnut	1
Unknown	1
Swamp Chestnut Oak	1
Unknown	1
Total	7
Density (stems per acre)	350

Total	
Bare Root + Live Stakes	20
Density (stems per acre)	1,000

Total	
Bare Root + Live Stakes + Volunteers	94
Density (stems per acre)	4,700

Live Stakes	
Black Willow	8
Silky Dogwood	5
Total	13

Volunteers	
Loblolly Pine	39
Yellow Popular	5
Red Maple	30
Total	74

PLOT #5

Bare Root	
Eastern Hop Hornbeam	1
Cherry Bark Oak	1
Unknown	1
Green Ash	1
Swamp Chestnut Oak	1
Total	5
Density (stems per acre)	250

Volunteers	
Loblolly Pine	28
Sweet Gum	20
Red Maple	4
Yellow Popular	2
Total	54

Total	
Bare Root + Live Stakes	5
Bare Root + Live Stakes	250

Total	
Bare Root + Live Stakes + Volunteers	59
Density (stems per acre)	2,950

TOTAL

Bare Root	32
Density (stems per acre)	320
Bare Root + Live Stakes	64
Density (stems per acre)	640
Bare Root + Live Stakes + Volunteers	395
Density (stems per acre)	3,950

*All plots are 900ft^2 (0.02 acre)

Unnamed Tributary to Bear Swamp Creek Year One Monitoring Report

Sheets

Appendix A

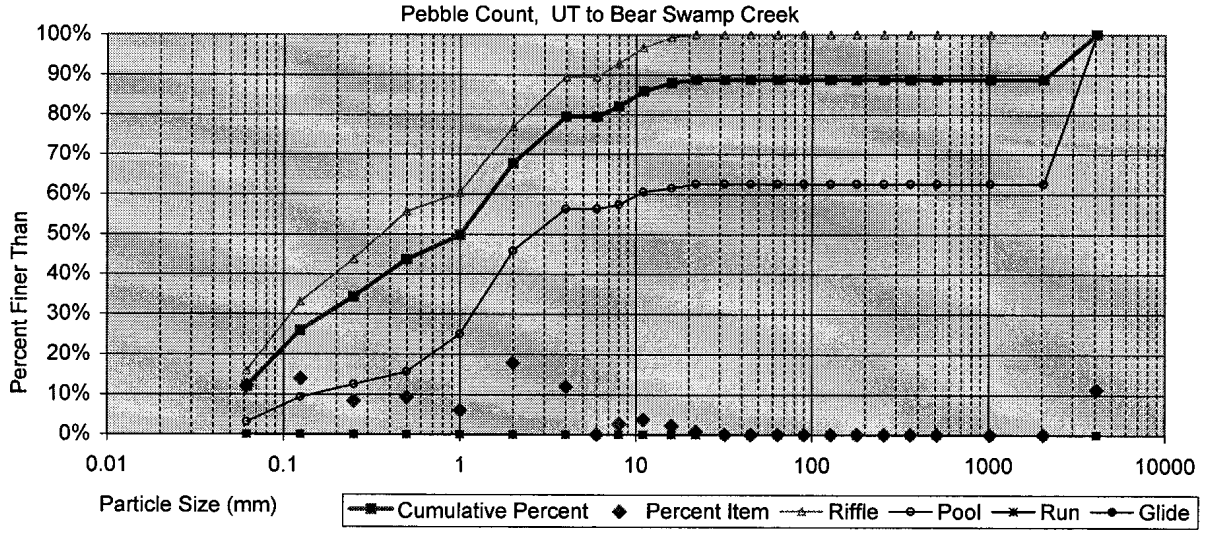
Pebble Count Data

Weighted Pebble Count

Percent Riffle:	70	Percent Run:	
Percent Pool:	30	Percent Glide:	

Pebble Count,
UT to Bear Swamp Creek
Tar River basin
Murphy Hay Farm, Louisburg
Note: **WEIGHTED**

Material	Size Range (mm)		Total #	
silt/clay	0	0.062	12.1	#
very fine sand	0.062	0.13	13.9	#
fine sand	0.13	0.25	8.4	#
medium sand	0.25	0.5	9.3	#
coarse sand	0.5	1	6.1	#
very coarse sand	1	2	17.8	#
very fine gravel	2	4	11.9	#
fine gravel	4	6	0.0	#
fine gravel	6	8	2.6	#
medium gravel	8	11	3.7	#
medium gravel	11	16	2.2	#
coarse gravel	16	22	0.8	#
coarse gravel	22	32	0.0	#
very coarse gravel	32	45	0.0	#
very coarse gravel	45	64	0.0	#
small cobble	64	90	0.0	#
medium cobble	90	128	0.0	#
large cobble	128	180	0.0	#
very large cobble	180	256	0.0	#
small boulder	256	362	0.0	#
small boulder	362	512	0.0	#
medium boulder	512	1024	0.0	#
large boulder	1024	2048	0.0	#
very large boulder	2048	4096	11.3	#
bedrock			0.0	#
		Weighted Count:	100	
		True Total Particle Count:	247	



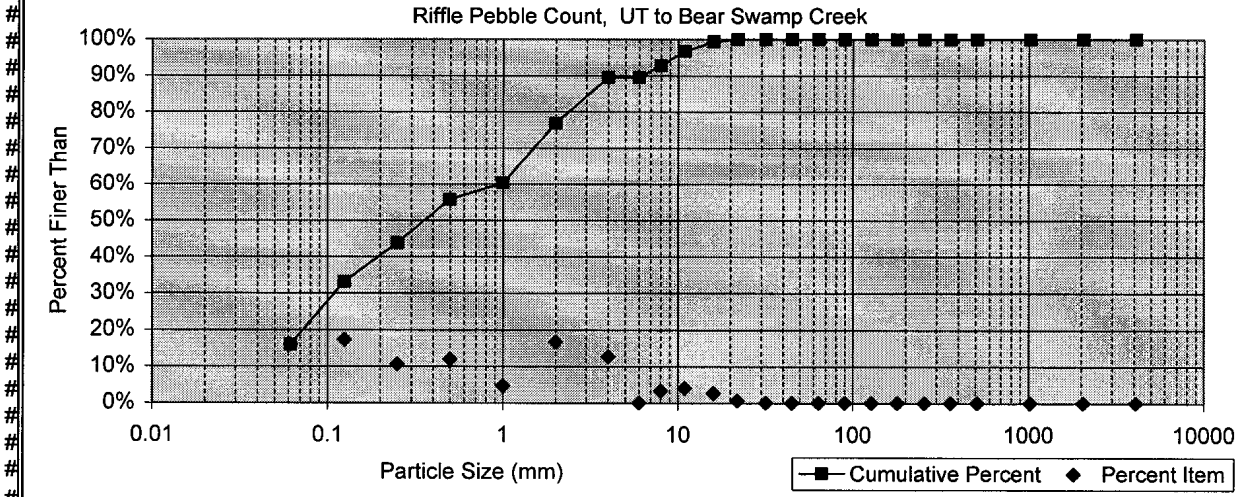
Size percent less than (mm)				
D16	D35	D50	D84	D95
0.076	0.26	1.0	9.4	3010.0

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
12%	55%	21%	0%	11%	0%

Riffle Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	**24**
very fine sand	0.062	0.13	**26**
fine sand	0.13	0.25	**16**
medium sand	0.25	0.5	**18**
coarse sand	0.5	1	**7**
very coarse sand	1	2	**25**
very fine gravel	2	4	**19**
fine gravel	4	6	
fine gravel	6	8	**5**
medium gravel	8	11	**6**
medium gravel	11	16	**4**
coarse gravel	16	22	**1**
coarse gravel	22	32	
very coarse gravel	32	45	
very coarse gravel	45	64	
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
	Total Particle Count:		151

Riffle Pebble Count,
UT to Bear Swamp Creek
Tar River basin
Murphy Hay Farm, Louisburg
Note: **Cross Section #1 #2 and #5 Riffle**



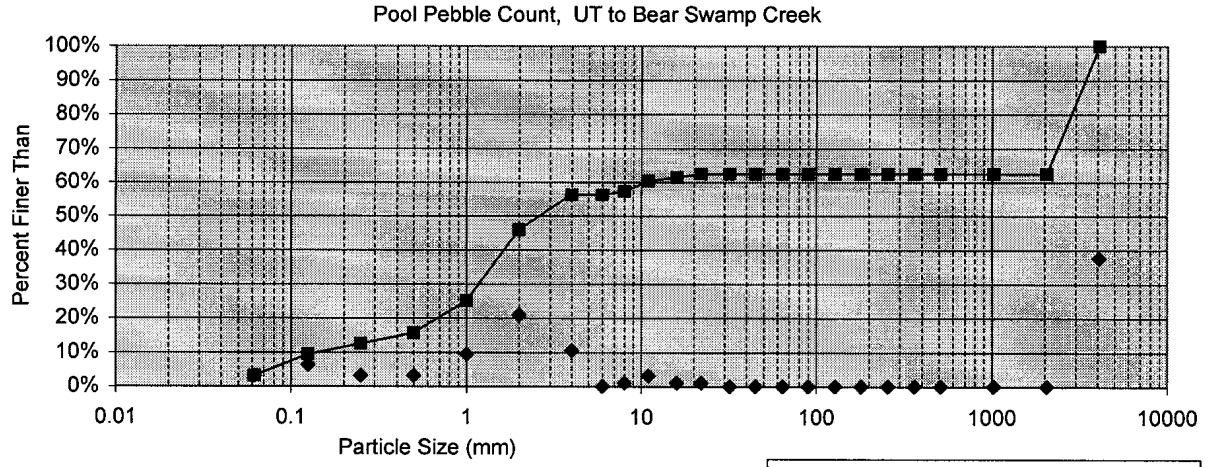
Size percent less than (mm)				
D16	D35	D50	D84	D95
0.062	0.14	0.4	3	10

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
16%	61%	23%	0%	0%	0%

Pool Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	**3**
very fine sand	0.062	0.13	**6**
fine sand	0.13	0.25	**3**
medium sand	0.25	0.5	**3**
coarse sand	0.5	1	**9**
very coarse sand	1	2	**20**
very fine gravel	2	4	**10**
fine gravel	4	6	
fine gravel	6	8	**1**
medium gravel	8	11	**3**
medium gravel	11	16	**1**
coarse gravel	16	22	**1**
coarse gravel	22	32	
very coarse gravel	32	45	
very coarse gravel	45	64	
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	**36**
bedrock			
Total Particle Count:			96

Pool Pebble Count,
UT to Bear Swamp Creek
Tar River basin
Murphy Hay Farm, Louisburg
Note: **Cross Section #3 and #4 Pool**



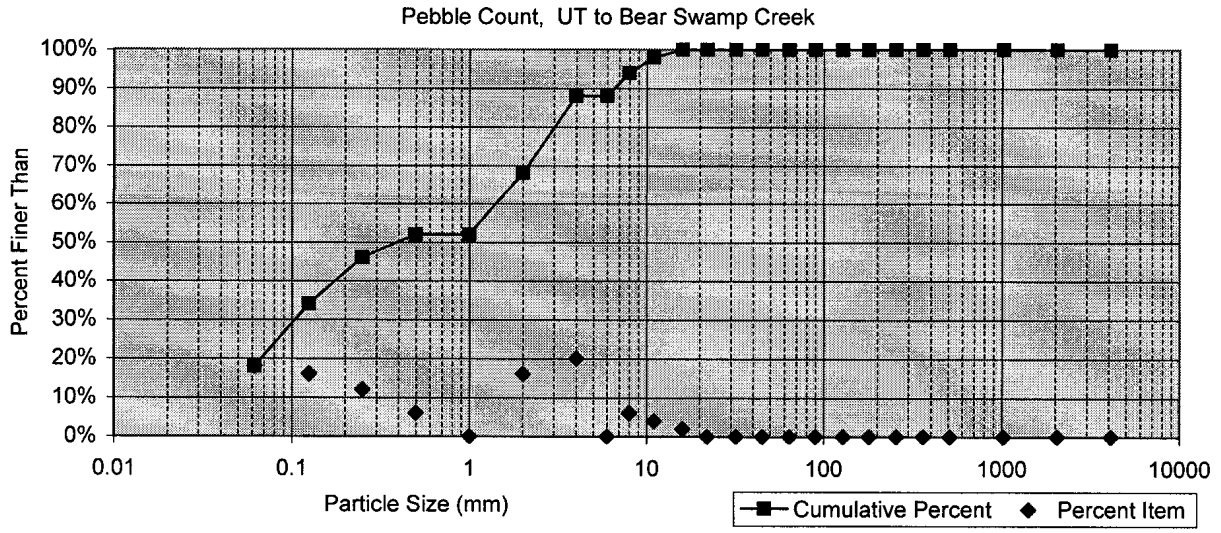
Size percent less than (mm)				
D16	D35	D50	D84	D95
0.514	1.39	2.6	3047	3734

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
3%	43%	17%	0%	38%	0%

Pebble Count

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**9**	# #
very fine sand	0.062	0.13	**8**	# #
fine sand	0.13	0.25	**6**	# #
medium sand	0.25	0.5	**3**	# #
coarse sand	0.5	1		# #
very coarse sand	1	2	**8**	# #
very fine gravel	2	4	**10**	# #
fine gravel	4	6		# #
fine gravel	6	8	**3**	# #
medium gravel	8	11	**2**	# #
medium gravel	11	16	**1**	# #
coarse gravel	16	22		# #
coarse gravel	22	32		# #
very coarse gravel	32	45		# #
very coarse gravel	45	64		# #
small cobble	64	90		# #
medium cobble	90	128		# #
large cobble	128	180		# #
very large cobble	180	256		# #
small boulder	256	362		# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock				#
	Total Particle Count:		50	

Pebble Count,
UT to Bear Swamp Creek
Tar River basin
Murphy Hay Farm, Louisburg
Note: **Cross Section #1 Riffle**



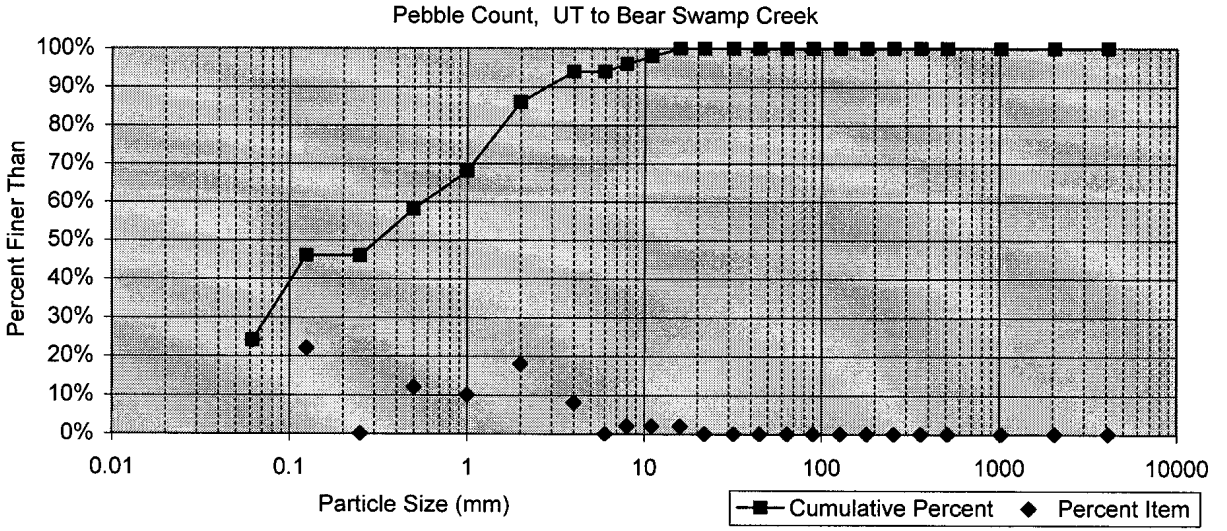
Size percent less than (mm)				
D16	D35	D50	D84	D95
#N/A	0.13	0.4	3	9

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
18%	50%	32%	0%	0%	0%

Pebble Count

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**12**	# #
very fine sand	0.062	0.13	**11**	# #
fine sand	0.13	0.25		# #
medium sand	0.25	0.5	**6**	# #
coarse sand	0.5	1	**5**	# #
very coarse sand	1	2	**9**	# #
very fine gravel	2	4	**4**	# #
fine gravel	4	6		# #
fine gravel	6	8	**1**	# #
medium gravel	8	11	**1**	# #
medium gravel	11	16	**1**	# #
coarse gravel	16	22		# #
coarse gravel	22	32		# #
very coarse gravel	32	45		# #
very coarse gravel	45	64		# #
small cobble	64	90		# #
medium cobble	90	128		# #
large cobble	128	180		# #
very large cobble	180	256		# #
small boulder	256	362		# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock				#
	Total Particle Count:		50	

Pebble Count,
UT to Bear Swamp Creek
Tar River basin
Murphy Hay Farm, Louisburg
Note: **Cross Section #2 Riffle**

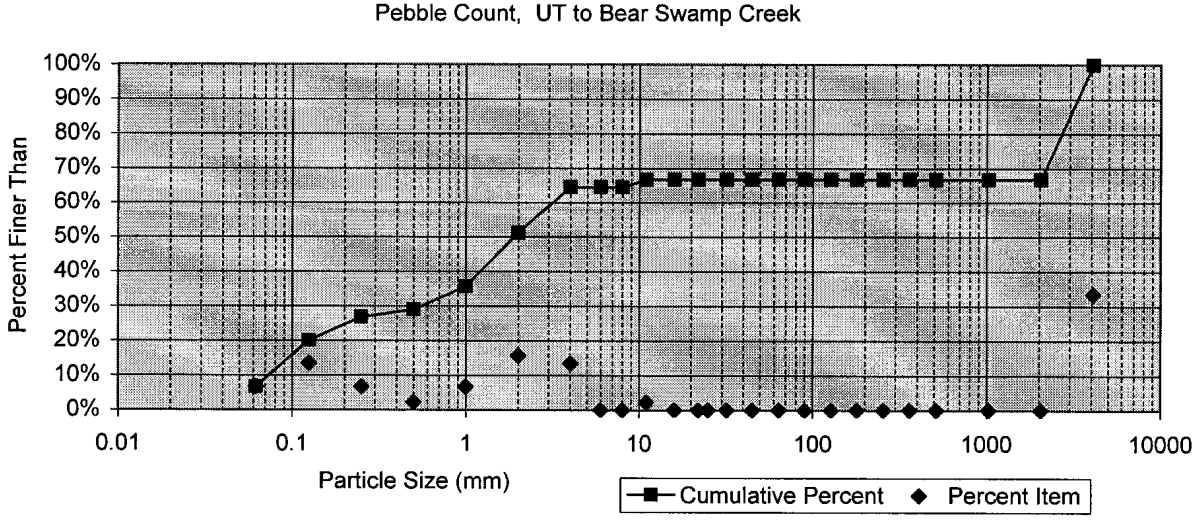


Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
#N/A	0.09	0.3	2	7	24%	62%	14%	0%	0%	0%

Pebble Count

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

Pebble Count,
UT to Bear Swamp Creek
Tar River basin
Murphy Hay Farm, Louisburg
Note: **Cross Section #3 Pool**



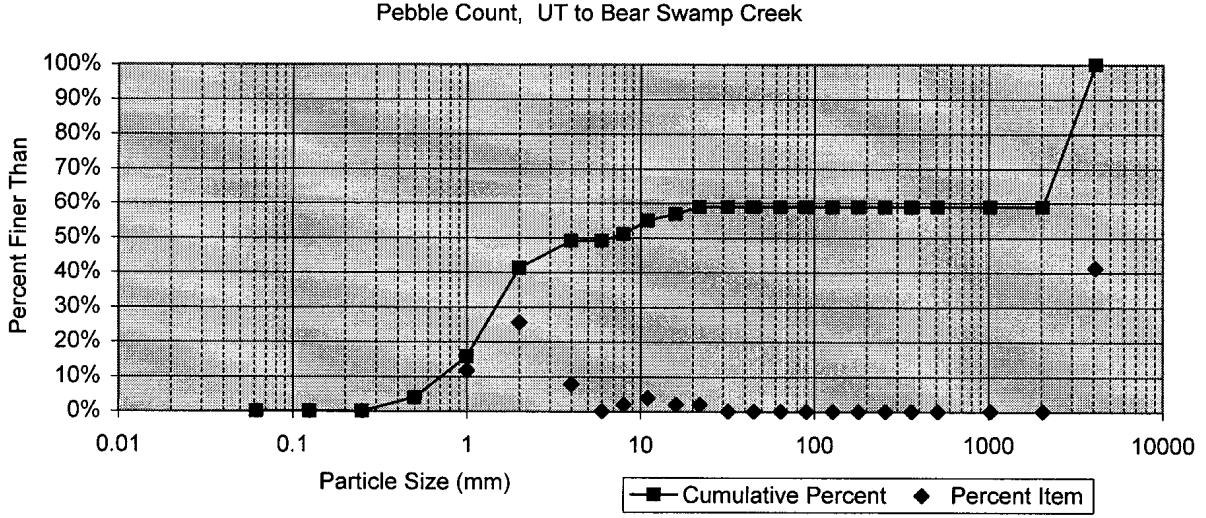
Size percent less than (mm)				
D16	D35	D50	D84	D95
0.101	0.94	1.9	2937	3692

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
7%	44%	16%	0%	33%	0%

Pebble Count

Material	Size Range (mm)		Count	
silt/clay	0	0.062		# #
very fine sand	0.062	0.13		# #
fine sand	0.13	0.25		# #
medium sand	0.25	0.5	**2**	# #
coarse sand	0.5	1	**6**	# #
very coarse sand	1	2	**13**	# #
very fine gravel	2	4	**4**	# #
fine gravel	4	6		# #
fine gravel	6	8	**1**	# #
medium gravel	8	11	**2**	# #
medium gravel	11	16	**1**	# #
coarse gravel	16	22	**1**	# #
coarse gravel	22	32		# #
very coarse gravel	32	45		# #
very coarse gravel	45	64		# #
small cobble	64	90		# #
medium cobble	90	128		# #
large cobble	128	180		# #
very large cobble	180	256		# #
small boulder	256	362		# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096	**21**	# #
bedrock				#
	Total Particle Count:		51	

Pebble Count,
UT to Bear Swamp Creek
Tar River basin
Murphy Hay Farm, Louisburg
Note: **Cross Section #4 Pool**

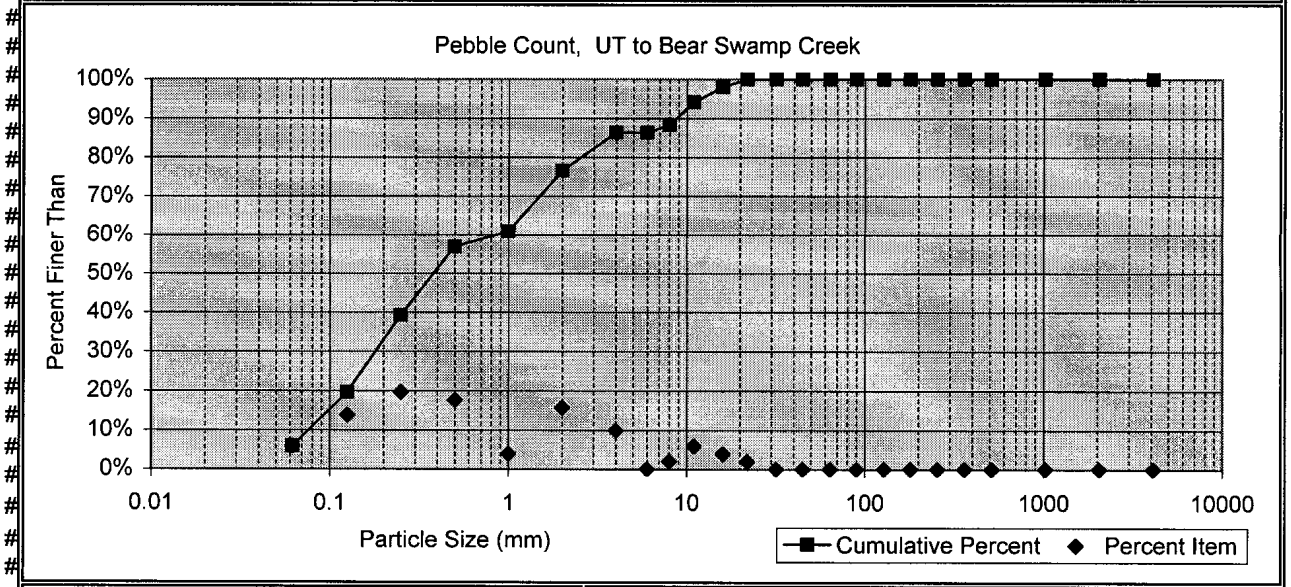


Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
1.009	1.69	6.9	3129	3765	0%	41%	18%	0%	41%	0%

Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	**3**
very fine sand	0.062	0.13	**7**
fine sand	0.13	0.25	**10**
medium sand	0.25	0.5	**9**
coarse sand	0.5	1	**2**
very coarse sand	1	2	**8**
very fine gravel	2	4	**5**
fine gravel	4	6	
fine gravel	6	8	**1**
medium gravel	8	11	**3**
medium gravel	11	16	**2**
coarse gravel	16	22	**1**
coarse gravel	22	32	
very coarse gravel	32	45	
very coarse gravel	45	64	
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
Total Particle Count:		51	

Pebble Count,
UT to Bear Swamp Creek
Tar River basin
Murphy Hay Farm, Louisburg
Note: **Cross Section #5 Riffle**



Size percent less than (mm)				
D16	D35	D50	D84	D95
0.104	0.22	0.4	3	12

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
6%	71%	24%	0%	0%	0%

Appendix B

Vegetation Planting List

UT to Bear Swamp Creek
Planting List
Provided by North State Environmental 2/3/2003

100	River Birch
100	Elderberry
100	Tag Alder
100	Black Willow
100	Green Ash
100	Swamp Chestnut Oak
100	Black Walnut
100	Cherry Bark Oak
100	Iron Wood
100	Winterberry Holly
100	Eastern Hop Hornbeam
25	Red Mulberry

Appendix C

Photographs

Photograph Point #1 Looking downstream. 9/24/03

Photograph Point #2 Looking upstream. 9/24/03

Photograph Point #3 Looking upstream. 9/24/03

Photograph Point #3 Looking downstream. 9/24/03

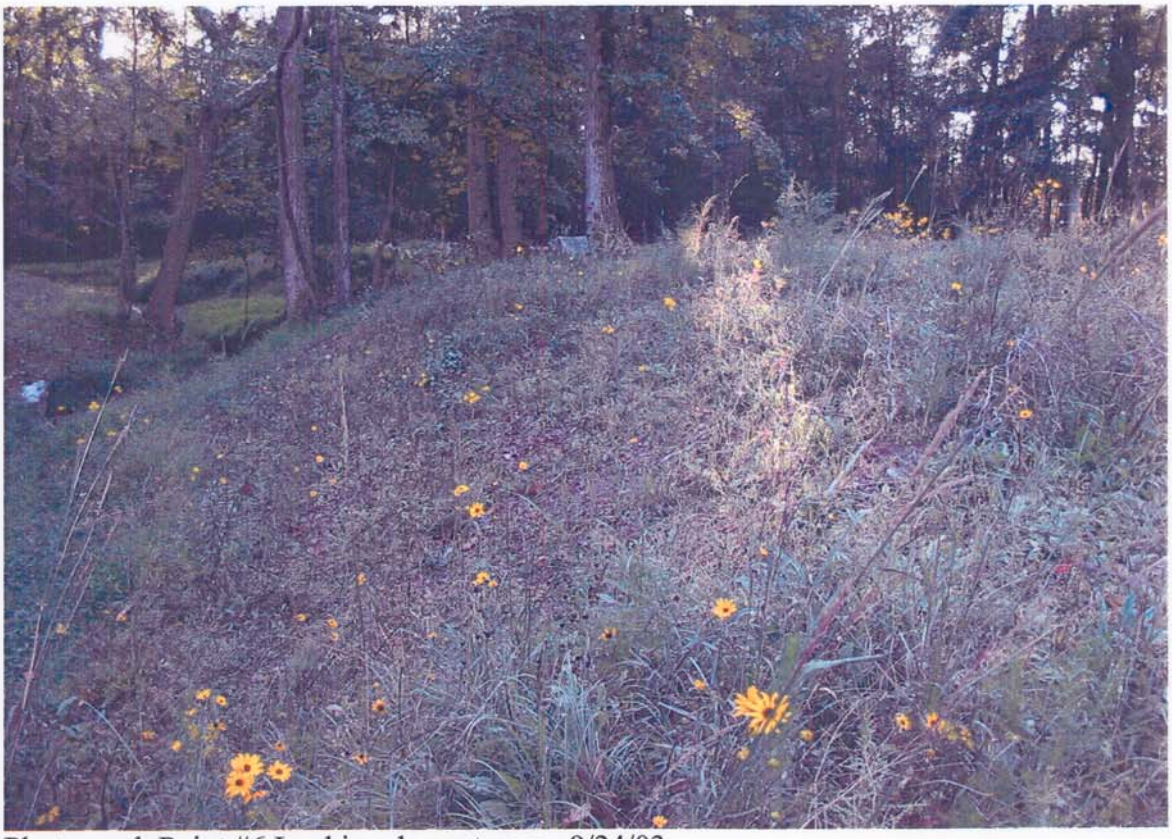
Photograph Point #4 Looking upstream. 9/24/03

Photograph Point #4 Looking downstream. 9/24/03

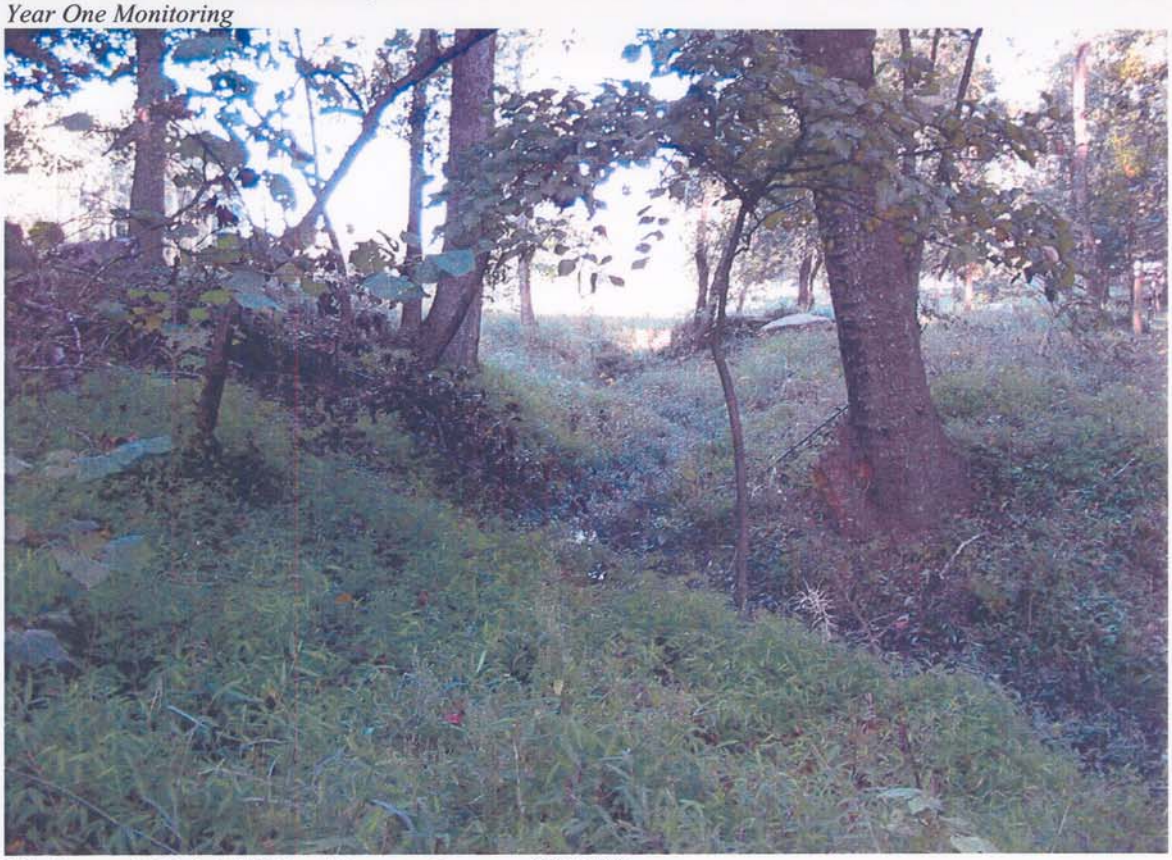
Photograph Point #5 Looking upstream. 9/24/03

Photograph Point #5 Looking downstream. 9/24/03

Photograph Point #6 Looking upstream. 9/24/03



Photograph Point #6 Looking downstream. 9/24/03



Photograph Point #7 Looking upstream. 9/24/03

Photograph Point #7 Looking downstream. 9/24/03

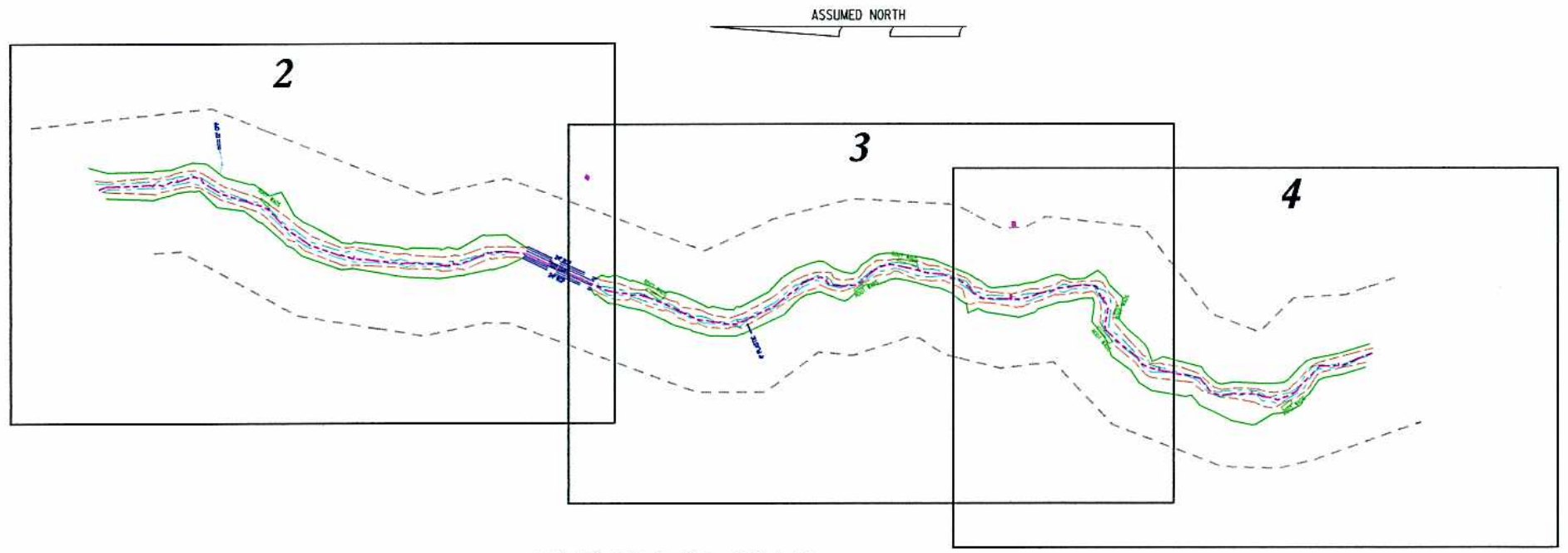
NC DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

ECOSYSTEM ENHANCEMENT PROGRAM

NATURAL CHANNEL DESIGN STREAM RESTORATION PROJECT

UT TO BEAR SWAMP CREEK AT MURPHY FARM

FRANKLIN COUNTY, NORTH CAROLINA



VICINITY MAP

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01.16.04

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INDEX OF SHEETS

SHEETS NO.	***CONTENTS***
1	*TITLE SHEET*
2 – 4	*PLAN SHEETS*
5 – 7	*PROFILE SHEETS*
X–1	*CROSS SECTIONS*

G:\Tra\60030_MurphyFarm\Vegetation\Year 1 monitoring\TitleYR1.TSH
01/16/2004

TBM 1
N 5000.000000
E 5138.705083
EL=109.1151

TBM 2
N 5000.000000
E 5000.000000
EL=100.0000
(ASSUMED)

TBM 116
N 4945.978667
E 4684.923917
EL=91.6841

ASSUMED NORTH

BOULDER VANE (TYP.)

XSC 1

XSC 2

XSC 3

12" CPP

PHOTO POINT

ROOT WADS

EXISTING TREES RETAINED (TYP.)

BOULDER VANE (TYP.)

PHOTO POINT 3

PHOTO POINT 2

GATE

GATE

PLOT #1

VEGETATION MONITORING PLOT, TYP.

APPROXIMATE BOUNDARY OF EASEMENT

APPROXIMATE BOUNDARY OF EASEMENT

GRAVEL CATTLE CROSSING

PAVED ROAD

24" RCP

36" CMPA

24" RCP

MATCH LINE TO SHEET 3 STA. 15+50

KEY	
	YEAR 1 THALWEG
	YEAR 1 EDGE OF WATER
	YEAR 1 BANKFULL
	YEAR 1 TOP OF BANK
	BASELINE THALWEG
	BASELINE EDGE OF WATER
	BASELINE BANKFULL
	BASELINE TOP OF BANK
	FENCE LINE
	CROSS-SECTIONS
	EASEMENT BOUNDARY

10' 0 20'
SCALE

NOTE: ALL COORDINATES AND ELEVATIONS ARE BASED ON AN ASSUMED DATUM. SEE TBM 2.

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
01.16.04

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Raleigh, NC 27607-5073
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DESIGN ENGINEER

RECORD DRAWING FOR MONITORING PURPOSES ONLY
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	BY	DATE	DESCRIPTION OF REVISION
5	AJW	01/16/2004	MONITORING-YEAR 1
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2	AJW	03/11/2002	SUBMIT TO LAND QUALITY FOR PERMITTING
1	AJW	01/23/2002	SUBMIT TO NCRP FOR REVIEW & COMMENT

NC DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

ECOSYSTEM ENHANCEMENT PROGRAM

UT TO BEAR SWAMP CREEK AT MURPHY FARM

FRANKLIN COUNTY, NORTH CAROLINA

SHEET NO. 2

G:\Tra\60l030_MurphyFarm\Ustation\Year 1monitoring\sheet02YRLPSH
01/16/2004

ASSUMED NORTH

BOULDER VANE (TYP.)

APPROXIMATE BOUNDARY OF EASEMENT

EXISTING TREES RETAINED (TYP.)

CREST STAGE MONITORING GAGE

MATCH LINE TO SHEET 2 STA. 15+50

PLOT #2

PLOT #3

PLOT #4

PLOT #5

ROOT WADS

BOULDER VANE (TYP.)

4" PLASTIC

PHOTO POINT 4

PHOTO POINT 5

VEGETATION MONITORING PLOT, TYP.

EXISTING TREE RETAINED (TYP.)

APPROXIMATE BOUNDARY OF EASEMENT

MATCH LINE TO SHEET 4 STA. 21+50

KEY	
	YEAR 1 THALWEG
	YEAR 1 EDGE OF WATER
	YEAR 1 BANKFULL
	YEAR 1 TOP OF BANK
	BASELINE THALWEG
	BASELINE EDGE OF WATER
	BASELINE BANKFULL
	BASELINE TOP OF BANK
	FENCE LINE
	CROSS-SECTIONS
	EASEMENT BOUNDARY

10' 0 20'
SCALE

NOTE: ALL COORDINATES AND ELEVATIONS ARE BASED ON AN ASSUMED DATUM. SEE TBM 2.

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ECOSYSTEM ENHANCEMENT PROGRAM

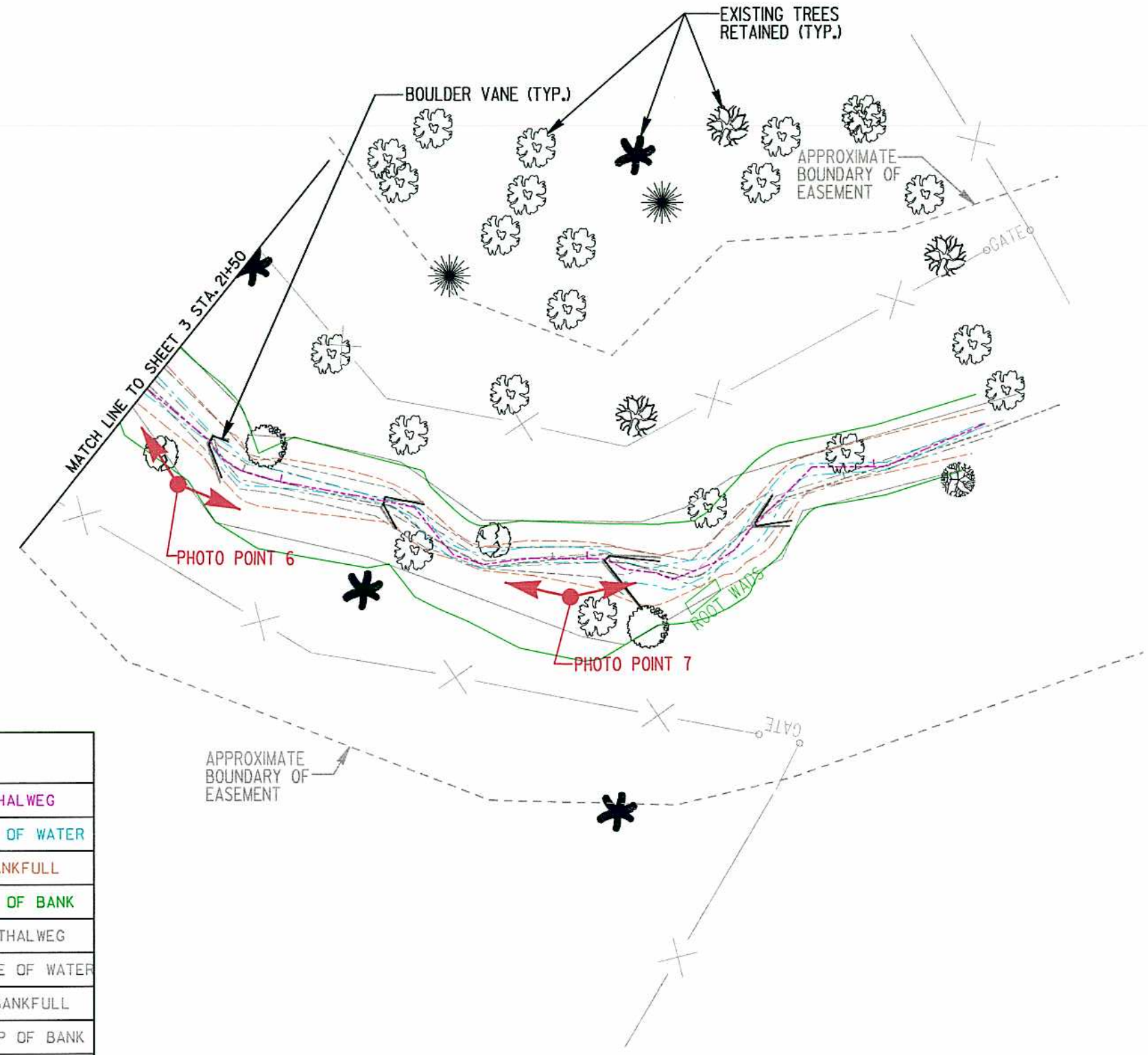
UT TO BEAR SWAMP CREEK AT MURPHY FARM

FRANKLIN COUNTY, NORTH CAROLINA

SHEET NO. 3

G:\Tra\60030.MurphyFarm\Ustation\Year 1monitoring\sheet03YR1.PSH
01/16/2004

ASSUMED NORTH



KEY	
	YEAR 1 THALWEG
	YEAR 1 EDGE OF WATER
	YEAR 1 BANKFULL
	YEAR 1 TOP OF BANK
	BASELINE THALWEG
	BASELINE EDGE OF WATER
	BASELINE BANKFULL
	BASELINE TOP OF BANK
	FENCE LINE
	CROSS-SECTIONS
	EASEMENT BOUNDARY

10' 0 20'
SCALE

NOTE: ALL COORDINATES AND ELEVATIONS ARE BASED ON AN ASSUMED DATUM. SEE TBM 2.

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ECOSYSTEM ENHANCEMENT PROGRAM

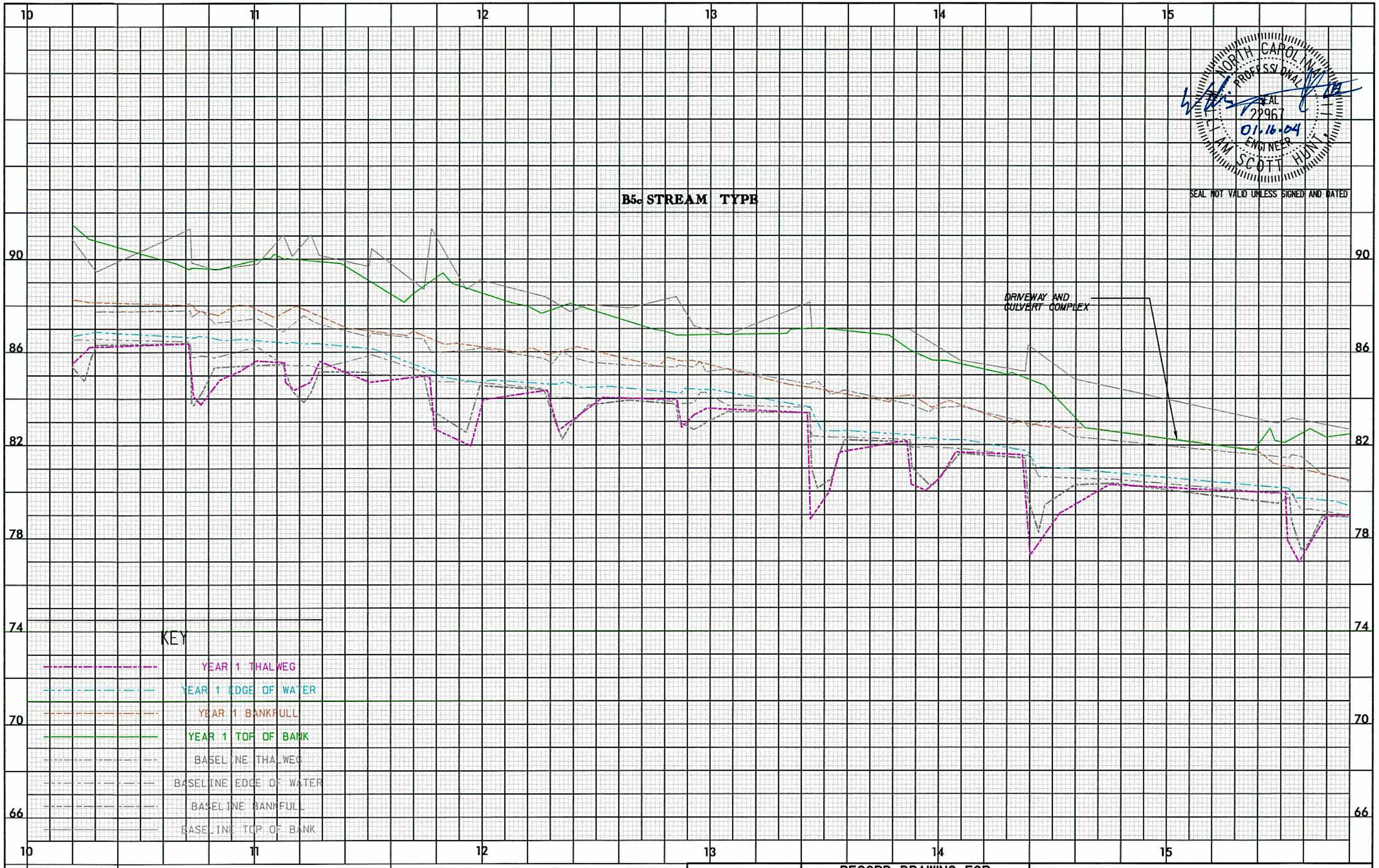
UT TO BEAR SWAMP CREEK AT MURPHY FARM

FRANKLIN COUNTY, NORTH CAROLINA

SHEET NO. 4

G:\Tra\60030.MurphyFarm\Ustation\Year 1monitoring\sheet04YR1.PSH
01/16/2004

B5c STREAM TYPE



10' 0 20'
HORIZON. SCALE

1' 0 2'
VERTICAL SCALE

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1	AJW	03/06/2002	SUBMITTED TO NCWRP FOR REVIEW AND PERMITTING

NC DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

ECOSYSTEM ENHANCEMENT PROGRAM

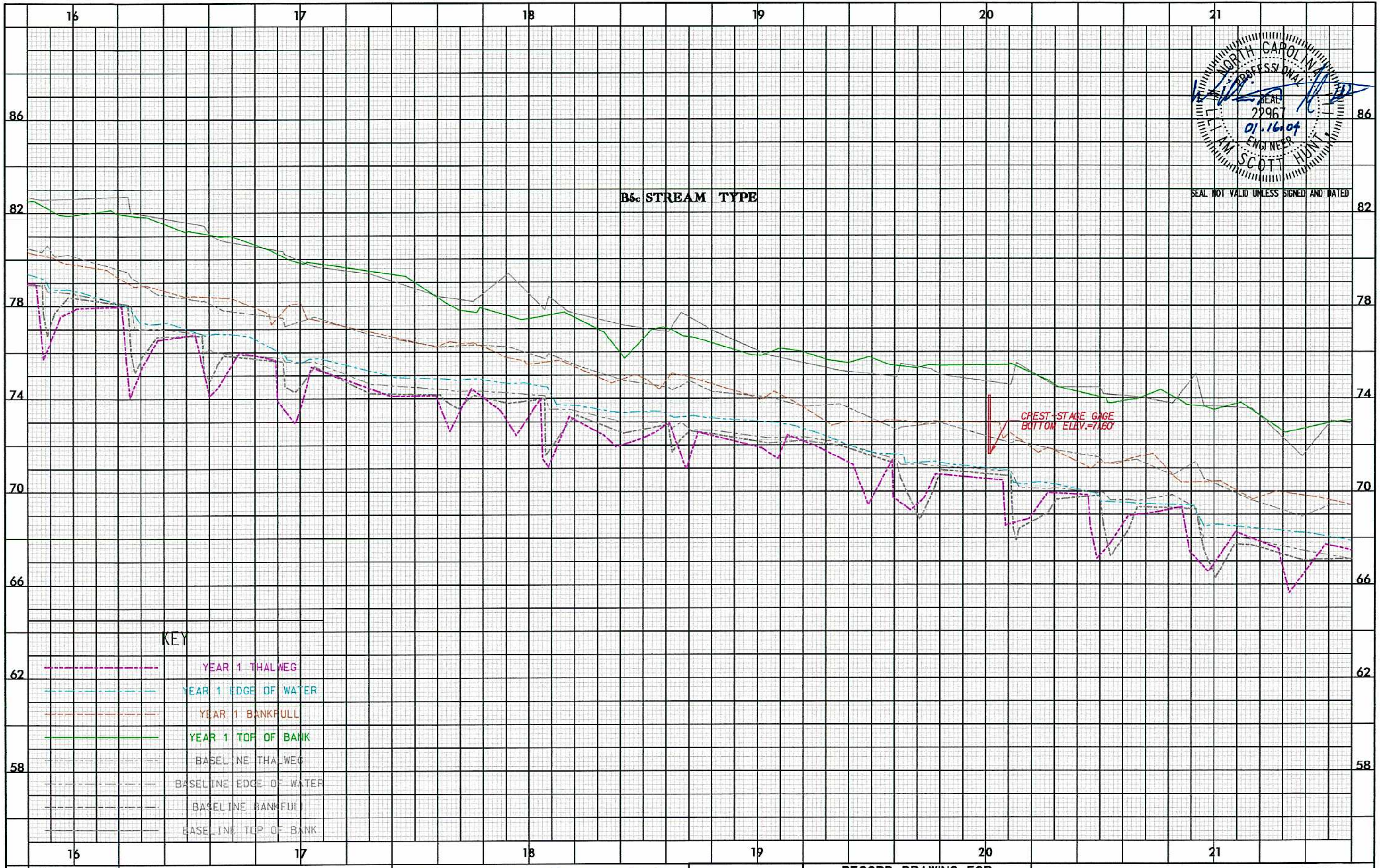
UT TO BEAR SWAMP CREEK AT MURPHY FARM

FRANKLIN COUNTY, NORTH CAROLINA

SHEET NO. 5

G:\Tra\60l030_MurphyFarm\Ustation\Year 1monitoring\sheet05YR1.PFL
01/16/2004

B5c STREAM TYPE



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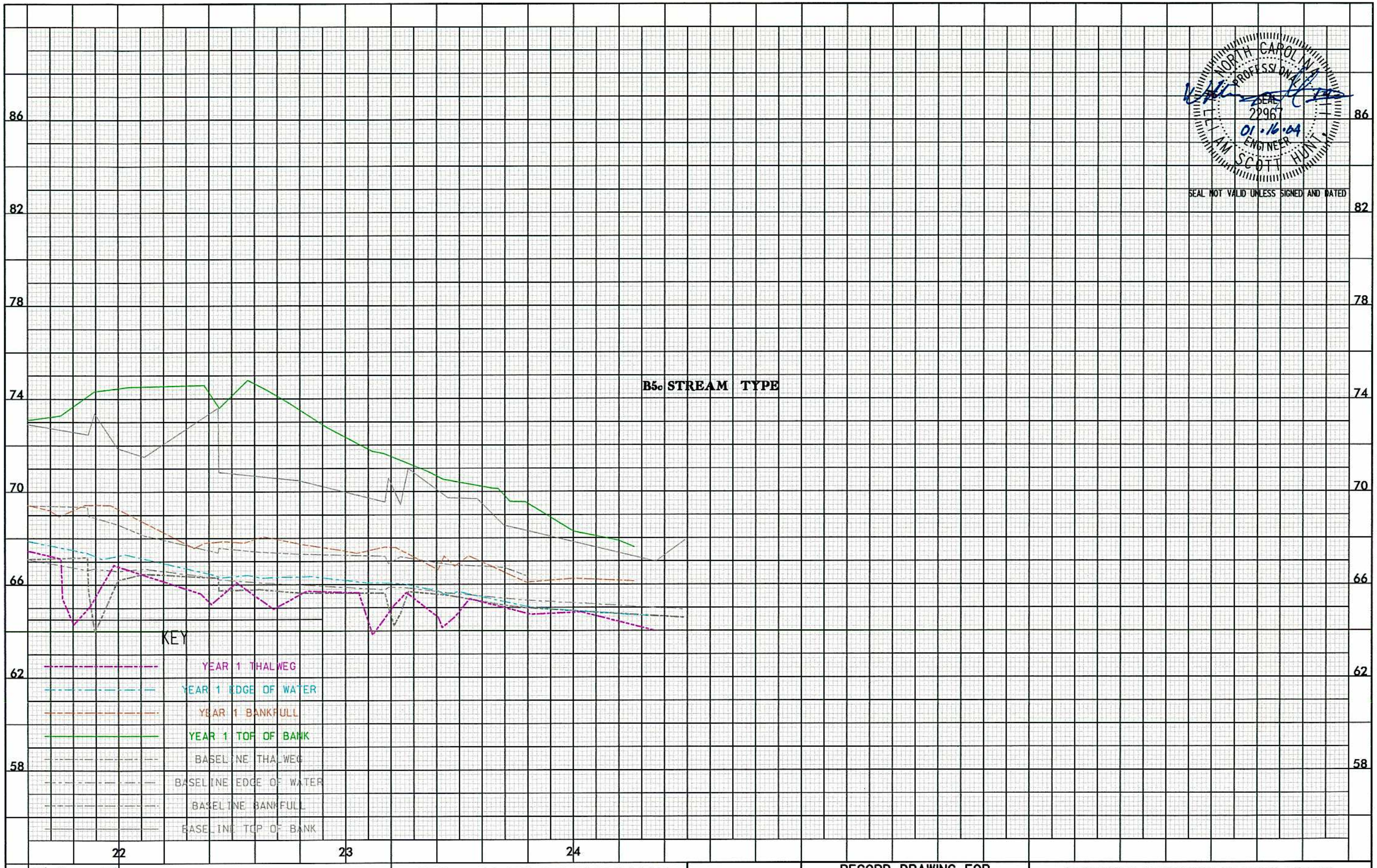
UT TO BEAR SWAMP CREEK AT MURPHY FARM

FRANKLIN COUNTY, NORTH CAROLINA

SHEET NO. 6

G:\Tra\60030-MurphyFarm\Ustation\Year 1monitoring\sheet06YR1.PFL
01/16/2004



10' 0 20'
HORIZON. SCALE

1' 0 2'
VERTICAL SCALE

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01-16-04

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NC DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

ECOSYSTEM ENHANCEMENT PROGRAM

UT TO BEAR SWAMP CREEK AT MURPHY FARM

FRANKLIN COUNTY, NORTH CAROLINA

SHEET NO. 7

G:\Tra\60l030_MurphyFarm\Ustation\Year 1monitoring\sheet07YR1.PFL
01/16/2004

SHEET NO.	TOTAL SHEETS
X-1	1

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

01.16.04

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XSC 5 RIFFLE
20+76.21

XSC 4 POOL
20+09.05

XSC 3 POOL
12+94.16

XSC 2 RIFFLE
11+52.13

XSC 1 RIFFLE
11+01.17

flood prone elev.
bankfull

0 5'

YEAR 1
BASELINE
BANKFULL ELEV.
FLOOD PRONE ELEV.

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5			
4			
3			
2	AJW	01/16/2004	MONITORING-YEAR 1
1	AJW	06/06/2003	MONITORING BASELINE
	BY	DATE	DESCRIPTION OF REVISION

NC DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

ECOSYSTEM ENHANCEMENT PROGRAM

UT TO BEAR SWAMP CREEK AT MURPHY FARM

FRANKLIN COUNTY, NORTH CAROLINA

YR 1 MONITOR