Hillsdale Park (Buffalo Creek) Stream Restoration
Greensboro, North Carolina
Annual Monitoring Report
Monitoring Year 2005

Monitoring Year: 2005
Measurement Year 2
As-Built Date: 2004
NCEEP Project Number 177

February 2006

Project Designed by Buck Engineering
8000 Regency Parkway
Suite 200
Cary, NC 27511

Monitoring by:
Earth Tech
701 Corporate Center Drive
Suite 475
Raleigh, NC, 27607

Submitted to:
NCDENR EEP
1619 Mail Service Center
Raleigh, NC 27699-1619

HILLSDALE PARK (BUFFALO CREEK) STREAM RESTORATION
2005 MONITORING REPORT

CONDUCTED FOR THE NORTH CAROLINA DEPARTMENT
OF
ENVIRONMENT AND NATURAL RESOURCES

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I. EXECUTIVE SUMMARY/PROJECT ABSTRACT

The Hillsdale Park Stream Restoration Site includes 5,302 linear feet of South Buffalo Creek and 529 linear feet of a tributary within the City of Greensboro, Guilford County, North Carolina. The site was constructed in February and March 2004. The following report provides the Year 2 2005 Monitoring.

Overall, the project is doing well with a few minor erosion areas and several sections where coir matting has pulled away from the bank. The problem areas need to be watched and remediation options developed if they get worse.

The vegetation monitoring of the site revealed an average tree density of 322 trees per acre. This average is at the minimum criteria of at least 320 stems per acre after 3 years. Seedlings from natural recruitment are very low. No additional plantings are recommended at this time, but close monitoring of future survivorship may indicate additional plantings are needed. It is recommended that action be taken to control and eradicate the porcelainberry at the site.

II. PROJECT BACKGROUND

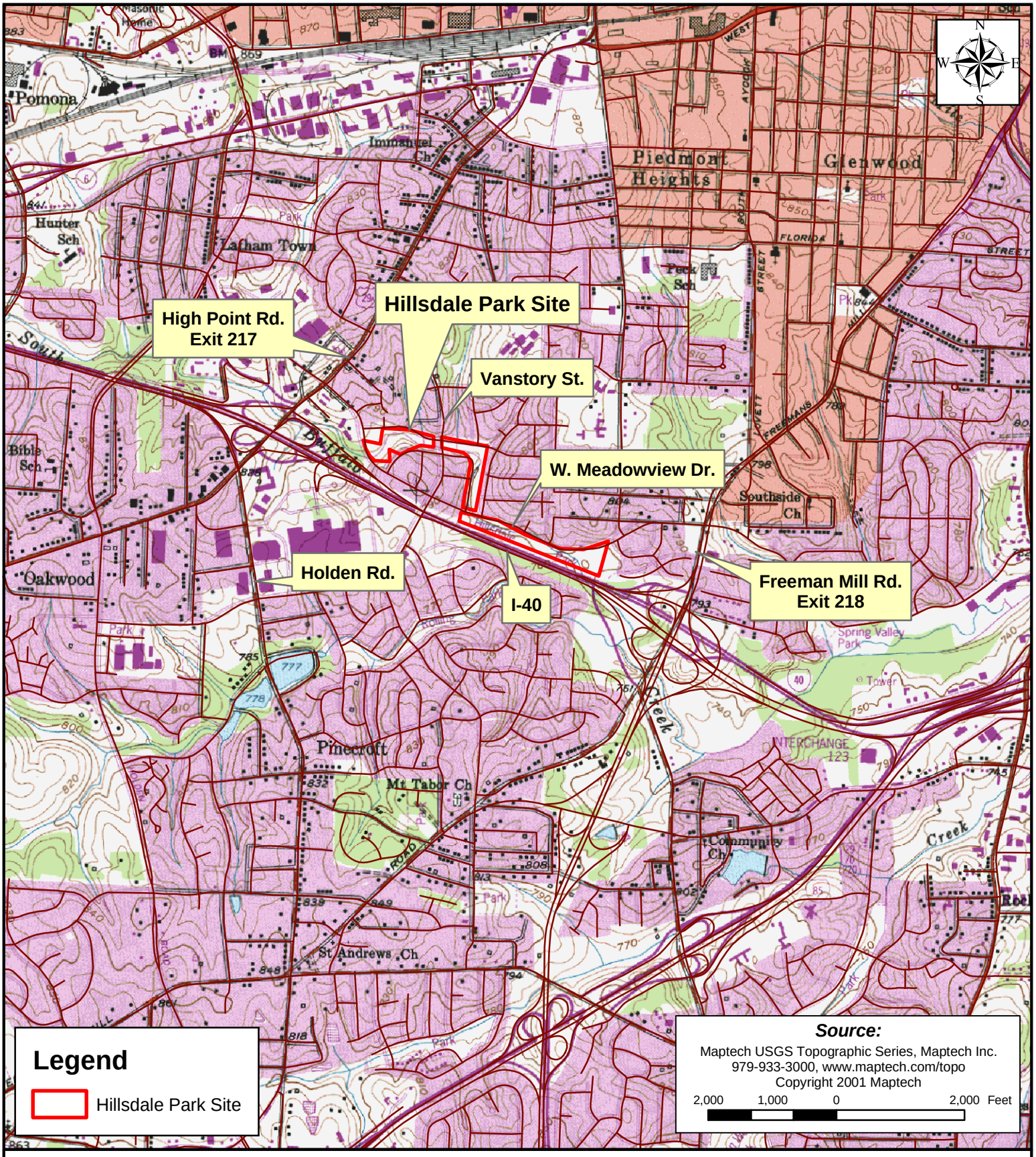
A. Location and Setting

The Hillsdale Park Stream Restoration Site includes 5,302 linear feet of South Buffalo Creek and 529 linear feet of a tributary referred to as Tributary HR3. The site is located in the City of Greensboro near the intersection of Interstate 40 and High Point Road (US Highway 29A) in Guilford County, North Carolina (See Figure 1).

B. Structure and Objectives

South Buffalo Creek and its unnamed tributary (HR3), are located in Hillsdale Park, a community park in the City of Greensboro. The existing stream channels had low sinuosity and varying levels of incision due to historic channelization. The alternative of creating a stable meandering channel with bankfull stage located at the existing floodplain elevation was evaluated. However, in these streams, topographic and development restrictions did not allow for a new channel pattern to be established. The existing incised channels were enhanced by excavating new floodplain benches at the bankfull stage and installing structures to improve bed features and control channel grade.

The mitigation plan consisted of a Priority 3 restoration of South Buffalo Creek along with establishment of a 25-foot vegetated buffer on both banks of Reach 1 and on the left bank in Reach 2. Stream bank stabilization was performed on Reach 2. Three rock cross vanes were constructed to stabilize the channel of Tributary HR3 upstream of its confluence with Reach 2.



Ecosystem Enhancement PROGRAM

FIGURE 01
VICINITY MAP

Hillsdale Park Stream Restoration Site
Greensboro, North Carolina
Guilford County

Map Produced: February 2006

Q:\86566\GIS\Hillsdale_Park_vicinity.mxd 2_06

Table I. Project Mitigation Structure and Objectives Table Hillsdale Park Stream Restoration Site/ Project Number 177					
Project Segment/Reach ID	**Mitigation Type**	**Approach**	**Linear Footage or Acreage**	**Stationing**	**Comment**
Reach HR1	Enhancement	Priority 3	3037	10+00-40+45	Bankfull benches and rock cross vanes
Reach HR2	Stabilization	Priority 3	2265	40+45-62+12	Root wads and stabilization
Tributary HR3	Stabilization		138		Stabilization using rock cross vanes

C. Project History and Background

Table II. Project Activity and Reporting History Hillsdale Park Stream Restoration Site/ Project Number 177			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion Date**
Restoration Plan	NA	NA	February 2005
Final Design - 90%	NA	NA	NA
Construction	NA	NA	March 15, 2004
Temporary S&E mix applied to entire project area	NA	NA	NA n
Permanent seed mix applied to reach/segments 1,2,&3	NA	NA	NA
Containerized and B&B plantings	NA	NA	March 15, 2004
Mitigation Plan / As-built (Year 0 Monitoring - baseline)	NA	NA	February 2005
Year 1 Monitoring	NA	April 2005	April 2005
Year 2 Monitoring	NA	October 2005	November 2005
Year 3 Monitoring	Fall 2006		
Year 4 Monitoring	Fall 2007		
Year 5 Monitoring	Fall 2008		

* Historical project documents necessary to provide this data were unavailable at the time of this report submission.

Table III. Project Contact Table Hillsdale Park Stream Restoration Site/ Project Number 177	
Designer POC	Buck Engineering 8000 Regency Parkway, Suite 200 Cary, NC 27511 Mr. Mike Rooney (919) 463-5490
Construction Contractor POC	LJ, Incorporated Point of Contact - Mr. Arden Reiser P.O. Box 3188 Mooresville, North Carolina 28117 (704)799-2670
Planting Contractor POC	NA
Seeding Contractor POC	NA
Seed Mix Sources	NA
Nursery Stock Suppliers	NA
Monitoring Performers	Earth Tech 701 Corporation Center Drive, Suite 475 Raleigh, NC 27607 Mr. Ron Johnson (919) 854-6210
Stream Monitoring	Ron Johnson
Vegetation Monitoring	Ron Johnson
Wetland Monitoring	NA

* Historical project documents necessary to provide this data were unavailable at the time of this report submission.

Table IV. Project Background Table Hillsdale Park Stream Restoration Site/ Project Number 177	
Project County	Guilford
Drainage Area	
South Buffalo Creek	10 sq mi
Tributary	0.29 sq mi
Drainage impervious cover estimate (%)	> 20 %
Stream Order	
South Buffalo Creek	3rd order
Tributary	1st order
Physiographic Region	Piedmont
Ecoregion	Southern Outer Piedmont
Rosgen Classification of As-Built	B4c
Cowardin Classification	NA
Dominant Soil Types	Congaree loam
	Enon-Urban land complex
	Mecklenburg-Urban land complex
Reference site ID	E5, Ut Lake Jeanette (Guilford), McClintock 1 & 2 (Mecklenburg); B4c, DuHart (Gaston), Silas (Forsyth), Morgan (Orange)
USGS HUC for Project	03030002
USGS HUC for Reference	Ut Lake Jeanette 03030002, McClintock 03050103, DuHart 03050102, Silas 03040101, Morgan 03030002
NCDWQ Sub-basin for Project	030602
NCDWQ Sub-basin for Reference	Ut Lake Jeanette 030602, McClintock 030834, DuHart 030836, Silas 030704. Morgan 030606
NCDWQ Classification for Project	C,NSW
NCDWQ Classification for Reference	Ut Lake Jeanette-WSIII,NSW; McClintock C, DuHart WS-V ,Silas C, Morgan WS-II, HQW, NSW, CA
Any portion of any project segment 303D listed?	Yes - All of South Buffalo Creek
Any portion of any project segment upstream of a 303D listed segment?	Yes South Buffalo Creek to confluence with Buffalo Creek
Reasons for 303D listing or stressor	Impaired biological stressor, stressor not identified, Urban runoff - storm sewers
% of project easement fenced	None

Figure 2 Monitoring Plan View

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Feature	Northing	Easting
X1 LPIN	835752.138	1753147.886
X1 RPIN	835703.79	1753201.363
X2 LPIN	835970.763	1753243.501
X2 RPIN	835943.612	1753324.756
X3 LPIN	836094.585	1753384.276
X3 RPIN	836019.898	1753399.713
X4 LPIN	835945.247	1753757.608
X4 RPIN	835853.049	1753669.33
BLP	835681.41	1752978.587

MATCHLINE - SHEET 2b

MATCHLINE - SHEET 2b

MURRAY HILL RD

WEST MEADOW VIEW RD

EMERALD DR

FAWN ST

VANSTORY ST

X-SECTION 1

X-SECTION 2

X-SECTION 3

X-SECTION 4

X-SECTION 5

X-SECTION 6

REACH 1 STATION 10+00
BEGIN CONSTRUCTION

BEGIN LONGITUDINAL PROFILE

10+00

11+00

12+00

13+00

14+00

15+00

16+00

17+00

18+00

19+00

20+00

21+00

22+00

23+00

24+00

25+00

PHOTO POINT 1

PHOTO POINT 2

PHOTO POINT 3

PHOTO POINT 4

PHOTO POINT 5

PHOTO POINT 6

PHOTO POINT 7

PHOTO POINT 8

PHOTO POINT 9

PHOTO POINT 10

PHOTO POINT 11

PHOTO POINT 12

PHOTO POINT 13

PHOTO POINT 14

PHOTO POINT 15

PHOTO POINT 16

BEDROCK

Text

VEG PLOT #1
25' X 100'

LEGEND

- Double-Wing Deflector
- Boulder Cluster
- Rootwad
- Single-Arm Deflector
- Easement
- Drop Cross-Vane
- Outlet Basin
- Constructed Riffle
- J-Hook
- Bedrock

Ecosystem Enhancement PROGRAM

N

0 50 100 Feet

ROCKINGHAM
STOKES
CASWELL
FORSYTH
GUILFORD
ALAMANCE
DAVIDSON
RANDOLPH

FIGURE 2a
MONITORING PLAN VIEW
YEAR-2 MONITORING REPORT
HILLSDALE PARK STREAM RESTORATION
Buffalo Creek Watershed
Greensboro, North Carolina **FEB 2006**

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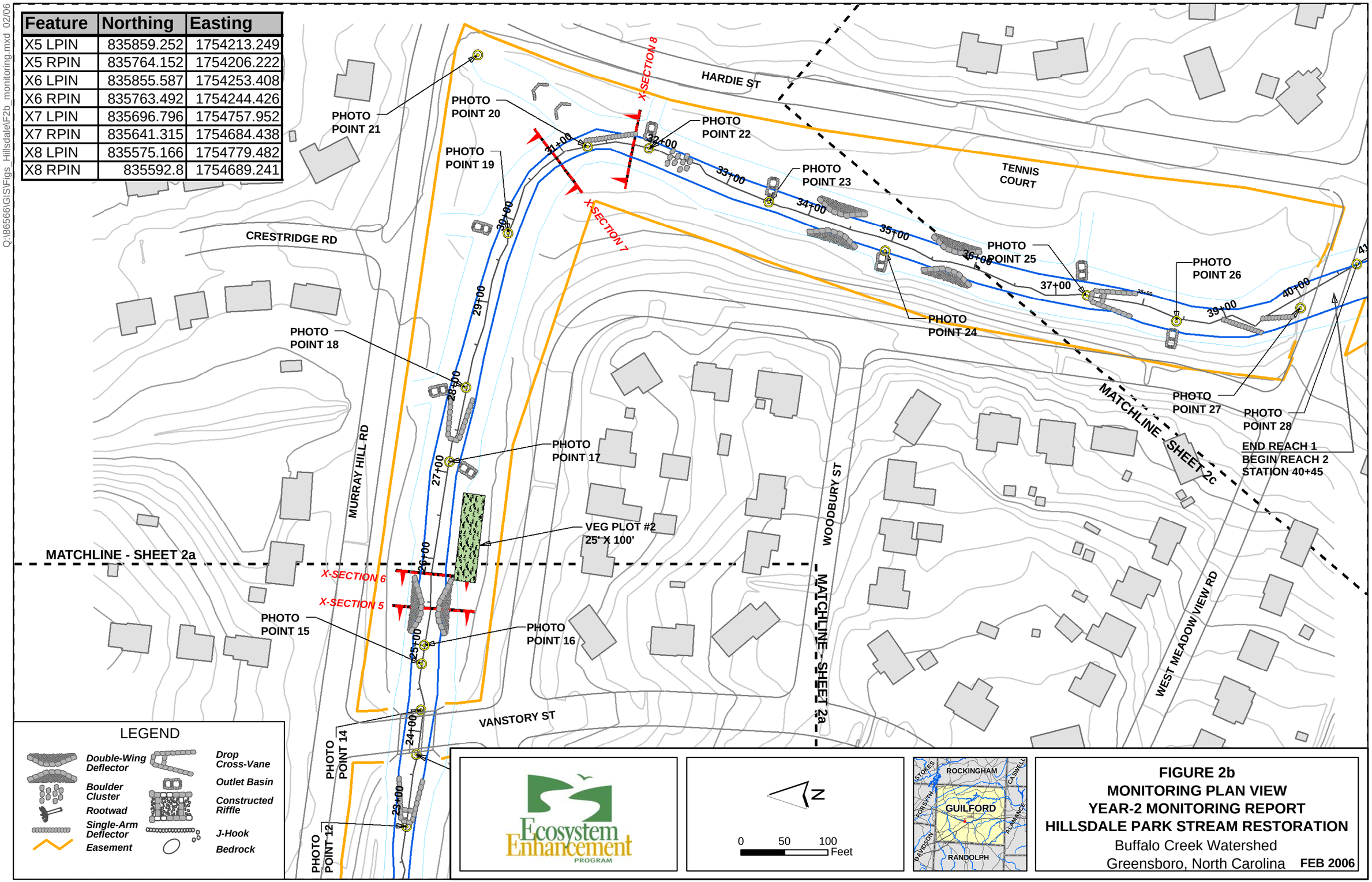
Feature	Northing	Easting
X5 LPIN	835859.252	1754213.249
X5 RPIN	835764.152	1754206.222
X6 LPIN	835855.587	1754253.408
X6 RPIN	835763.492	1754244.426
X7 LPIN	835696.796	1754757.952
X7 RPIN	835641.315	1754684.438
X8 LPIN	835575.166	1754779.482
X8 RPIN	835592.8	1754689.241



LEGEND

- Double-Wing Deflector
- Boulder Cluster
- Rootwad
- Single-Arm Deflector
- Easement
- Drop Cross-Vane
- Outlet Basin
- Constructed Riffle
- J-Hook
- Bedrock

Ecosystem Enhancement PROGRAM

N

0 50 100 Feet

FIGURE 2b
MONITORING PLAN VIEW
YEAR-2 MONITORING REPORT
HILLSDALE PARK STREAM RESTORATION
Buffalo Creek Watershed
Greensboro, North Carolina **FEB 2006**

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Feature	Northing	Easting
X9 LPIN	834577.45	1754875.487
X9 RPIN	834487.036	1754839.223
X10 LPIN	834527.127	1754957.206
X10 RPIN	834447.626	1754928.289

MATCHLINE - SHEET 2b

MATCHLINE - SHEET 2d

MATCHLINE - SHEET 2b

MATCHLINE - SHEET 2d

EMERYWOOD RD

TENNIS COURT

WEST MEADOW VIEW RD

X-SECTION 9

X-SECTION 10

PHOTO POINT 25

PHOTO POINT 26

PHOTO POINT 27

PHOTO POINT 28

PHOTO POINT 29

PHOTO POINT 30

PHOTO POINT 31

PHOTO POINT 32

PHOTO POINT 33

PHOTO POINT 34

PHOTO POINT 35

PHOTO POINT 36

PHOTO POINT 37

PHOTO POINT 38

BEDROCK

BEDROCK

BEDROCK

36+00

37+00

39+00

40+00

41+00

42+00

43+00

44+00

45+00

46+00

47+00

48+00

49+00

50+00

51+00

52+00

53+00

54+00

END REACH 1
BEGIN REACH 2
STATION 40+45

I-40

LEGEND

- Double-Wing Deflector
- Boulder Cluster
- Rootwad
- Single-Arm Deflector
- Easement
- Drop Cross-Vane
- Outlet Basin
- Constructed Riffle
- J-Hook
- Bedrock

Ecosystem Enhancement PROGRAM

N

0 50 100 Feet

FIGURE 2c
MONITORING PLAN VIEW
YEAR-2 MONITORING REPORT
HILLSDALE PARK STREAM RESTORATION
Buffalo Creek Watershed
Greensboro, North Carolina **FEB 2006**

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Feature	Northing	Easting
X11 LPIN	834214.332	1755828.635
X11RPIN	834164.409	1755812.226
X12 RPIN	834139.915	1755855.799
X12LPIN	834204.39	1755873.728
ELP	833831.534	1756361.815

MATCHLINE - SHEET 2c

EMERYWOOD RD

MATCHLINE - SHEET 2c

WEST MEADOW VIEW RD

REACH 3

BEDROCK

50+00 51+00 52+00 53+00 54+00 55+00 56+00 57+00 58+00 59+00 60+00 61+00 62+00 63+00

X-SECTION 12

X-SECTION 11

BEDROCK

PHOTO POINT 35

PHOTO POINT 36

PHOTO POINT 37

PHOTO POINT 38

PHOTO POINT 39

PHOTO POINT 40

PHOTO POINT 41

PHOTO POINT 42

PHOTO POINT 43

PHOTO POINT 44

PHOTO POINT 45

PHOTO POINT 46

END LONGITUDINAL PROFILE

REACH 2 STATION 62+12
END CONSTRUCTION

LEGEND

- Double-Wing Deflector
- Boulder Cluster
- Rootwad
- Single-Arm Deflector
- Easement
- Drop Cross-Vane
- Outlet Basin
- Constructed Riffle
- J-Hook
- Bedrock

Ecosystem Enhancement Program

N

0 50 100 Feet

STOKES ROCKINGHAM CASWELL FORSYTH GUILFORD ALAMANCE DAVIDSON RANDOLPH

FIGURE 2d
MONITORING PLAN VIEW
YEAR-2 MONITORING REPORT
HILLSDALE PARK STREAM RESTORATION
Buffalo Creek Watershed
Greensboro, North Carolina **FEB 2006**

III. PROJECT CONDITION AND MONITORING RESULTS

Monitoring Results are shown below. An initial visual survey was conducted on June 9, 2005 with a more detailed 2005 monitoring survey (evaluation of vegetation plots) conducted on November 1, 2005.

A. Vegetation Assessment

1. Soil Data

Table V. Preliminary Soil Data
Hillsdale Park Stream Restoration Site/ Project Number 177

Series	Max Depth (in.)	% Clay on Surface	K	T	OM %
Congaree loam	80	5-15	0.28	5	1-4
Enon-Urban land complex	75	5-20	0.28-0.37	2	0-2
Mecklenburg-Urban land complex	60	8-25	0.32	2	0-1.0

2. Vegetative Problem Areas

Table VI. Vegetative Problem Areas
Hillsdale Park Stream Restoration Site/ Project Number 177

Feature/Issue	Station # /Range	Probable Cause	Photo #
Invasive/Exotic Populations			
	16+00	*Ampelopsis* encroachment from outside	VPA 1

Several areas with minimum vegetation were observed on June 9, 2005 and seven exotic and invasive species were observed within the plots during the vegetation sampling. These include autumn olive (*Elaeagnus umbellata*), Chinese lespedeza (*Lespedeza cuneata*), common wormwood (*Artemisia vulgaris*), Japanese honeysuckle (*Lonicera japonica*), mimosa (*Albizia julibrissin*), multiflora rose (*Rosa multiflora*), and porcelainberry (*Ampelopsis brevipedunculata*).

The site, especially Plot 1 (Station 16+00), is heavily covered in porcelainberry. This woody perennial vine is very aggressive and has a tendency to grow over vegetation, including small shrubs and trees. It has currently covered a number of the small seedling and live stake plantings. It is recommended that action be taken to control and eradicate the porcelainberry at this site.

3. Stem Counts

Stem counts were conducted on November 1, 2005. Vegetation monitoring at Hillsdale Park consist of two plots 100 feet in length and 25 feet in width along the right bank of the channel. Two vegetation survival plots were located at Station 17+00 and Station 26+00. The width of

the plot included the live stakes planted along the channel banks. The live stakes were counted only along the right bank in the plots. Plot 1 live stakes were not recorded in the Year 1 Monitoring.

In addition to percent survival of planted stems an estimate of bare root stems per acre is provided. It is based upon using the number of stems per plot size and extrapolating to stems per acre. This allows a more useful assessment of the current conditions and will help decide if further action is necessary. Live stakes planted at the site include silky dogwood (*Cornus amomum*), elderberry (*Sambucus canadensis*), and tag alder (*Alnus serrulata*). Bare root species planted at the site include; green ash (*Fraxinus pennsylvanicum*), river birch (*Betula nigra*), willow oak (*Quercus phellos*), and American sycamore (*Platanus occidentalis*). While the Year 1 Monitoring Report provides total numbers of stems and live stakes planted, it does not break the number down by species.

The bare root plantings at Hillsdale Park appear to have increased from the Year 1 count. The stem count shows an increase in estimated stems per acre (200 in Year 1 to 322 in Year 2). New stems from natural seed sources were not actively counted and were uncommon. Many of the stems are short and are hidden beneath the vegetative cover of weeds and vines. This may explain the lower numbers counted previously. Stems were also absent near the edge of the easement. This may be a result of the aggressive mowing previously described in the Year 1 monitoring report. The aggressive mowing was not evident during the current monitoring period. Recent signs of human intrusion were not observed in either plot. The heavy growth of porcelainberry in Plot 1 can be expected to reduce bare root survival and vigor.

The survival rate is estimated to be 47% of the initial number planted. In 2004 the initial planting was reduced to 46% of the planted total and in 2005 is estimated to be 47% of the total planted. This minor difference is attributable to three additional stems counted in 2005. The additional stems may be previously uncounted stems or stems that have sprouted since 2004. There are an estimated 479 bare root stems per acre based on the sample plots.

The live stake planting shows a 32 percent survival in Year 2 or the monitoring. This is on average one live stake every 3 feet along the channel bank. The live stake plantings at Hillsdale still show a decline. The initial planting was reduced in 2004 to 67% of the planted total and in 2005 is reduced to 56% of the total planted.

The 2005 vegetation monitoring of the site revealed an average tree density of 322 trees per acre. This average is at the minimum criteria of at least 320 stems per acre after 3 years. Seedlings from natural recruitment are very low. No additional plantings are recommended at this time, but close monitoring of future survivorship may indicate additional planting needs at this site. It is again recommended that action be taken to control and eradicate if possible the porcelainberry at this site.

Table VII. Stem Counts for Each Species Arranged by Plot Hillsdale Park Stream Restoration Site/ Project Number 177						
Species	**Plots**		**Initial Totals**	**Year 1 Totals**	**Year 2 Totals**	**Survival %**
	1	**2**				
Trees						
Fraxinus pennsylvanicum	8	11	NA	NA	19	NA
Betula nigra	7	1	NA	NA	8	NA
Quercus phellos	2	1	NA	NA	3	NA
Platanus occidentalis	4	3	NA	NA	7	NA
Live Stakes						
Cornus amomum	19	17	NA	NA	36	NA
Sambucus canadensis	4	13	NA	NA	17	NA
Alnus serrulata	0	2	NA	NA	2	NA

* Data not collected by species.

Note: According to the Year 1 Monitoring Report, 38 bare root stems were planted in Plot 1 and 53 bare root stems and 98 live stakes were planted in Plot 2. Plot 1 did not contain any live stakes.

4. Vegetation Plot Photos

Photos of the vegetation plots are located in Appendix A.

B. Stream Assessment

Earth Tech personnel performed an initial site visit at Hillsdale Park on June 9, 2005. During the field visit notes were made regarding the condition of the stream restoration project. Overall, the project is doing well with a few minor erosion areas or areas of minimal vegetation.

Cross section and longitudinal surveys were performed on November 2 and 3, 2005. Twelve cross sections and approximately 5,169 linear feet of stream were surveyed. Photographs were taken at all permanent photo points. The photographs show that vegetation is generally growing well and is a good combination of woody and herbaceous growth. Banks are stable with no unusual bank erosion. A bed material analysis was not performed since this is a sand/small gravel stream. No significant coarsening is expected over time. The photographs show that vegetation is generally growing well and is a good combination of woody and herbaceous growth. Banks are stable with no unusual bank erosion. Vegetative problem areas are described in Table VI and stream problem areas are described in Table X.

No crest gauges are installed at this site to document bankfull events. Therefore, potential occurrence was extrapolated based on USGS stream gauge discharge data for South Buffalo Creek at US 220 (approximately 2 miles downstream of project site) with a drainage area of 15.4 square miles. Bankfull events were determined by comparing the stream discharge cubic feet per second (cfs) against the drainage area on the urban piedmont regional curve. According to the urban piedmont regional curve a bank full event occurs on a stream with a 15.4 mi^2 drainage area when the discharge is between 1,538 and 1,704 cfs. Based on USGS data and the piedmont-

urban regional curves, no bankfull events occurred in 2005. However, there may have been one bankfull event on December 10, 2004 when the maximum discharge reached 1,700 cfs for one day. Two high flow events were recorded for 2005. On January 14 and March 28 maximum discharge was recorded at 1,040 and 1,140 cfs respectively.

Figure 3. USGS Stream gauge data for South Buffalo Creek at US 220.

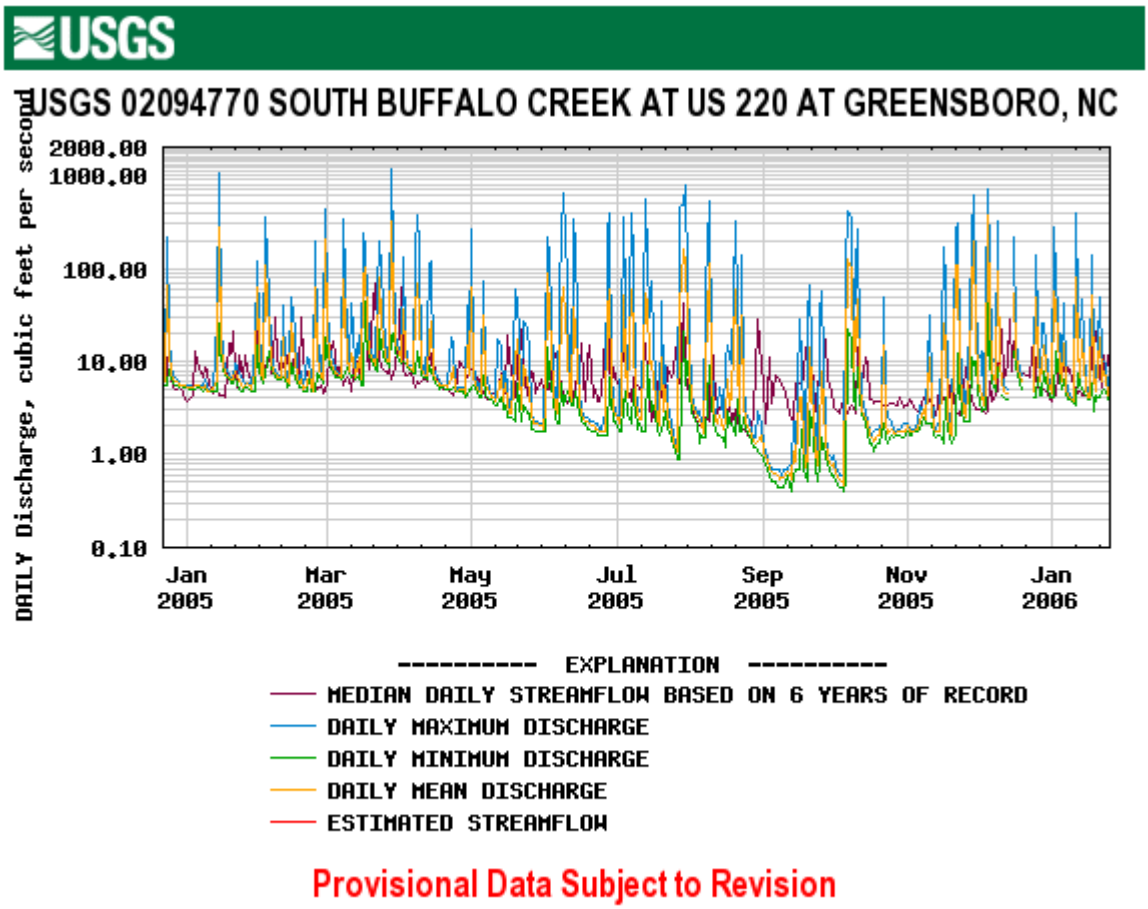

Table VIII. Verification of Bankfull Events Hillsdale Park Stream Restoration Site/ Project Number 177			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo # (if available)**
2004	12-10-2004	Proximal USGS gauge resource	NA
2005	None	Proximal USGS gauge resource	NA

Table IX BEHI and Sediment Export Estimates only apply to Monitoring years 3 and 5 so were not performed this year.

Table X. Stream Problem Areas Hillsdale Park Stream Restoration Site/ Project Number 177			
Feature/Issue	**Station # /Range**	**Probable Cause**	**Photo #**
Bank Scour/Bare Bank	11+50	Minimum vegetation	SP 1
	12+20	Minimum vegetation	SP 1
	14+00	Minimum vegetation	SP 1
	25+00	Minimum vegetation	SP 1
	27+00	Minimum vegetation	SP 1
	28+50-31+00	Minimum vegetation	SP 1
	30+00-31+00	Channel forming on right bankfull bench	NA
	42+50	30 feet of matting peeled off left bank	SP1
	38+00-39+00	Minimum vegetation, loose matting	SP1
	59+20-62+00	Minimum vegetation	SP 1
	61+50	Matting peeled off left bank	SP 1
Engineered Structures	23+60	Debris jam on the upstream side of the culvert for Vanstory Street	SP 2
	Photo point 21 HR3	Pipe joint separating	NA
	42+50	Upstream area behind J-hook has washed out (right side)	NA

Table XI. Categorical Stream Feature Visual Stability Assessment Hillsdale Park Stream Restoration Site/ Project Number 177 Reach HR1 (3037 ft.)					
Feature	Initial	MY-01	MY-02	MY-03	MY-04
A. Riffles	100%	100%	100%		
B. Pools	100%	95%	100%		
C. Thalweg	100%	100%	50%		
D. Meanders	100%	100%	96.7%		
E. Bed General	100%	100%	96.7%		
F. Vanes/J Hooks etc.	100%	100%	100%		
G. Wads and Boulders	100%	100%	100%		
Reach HR2 (2265 ft.)					
Feature	Initial	MY-01	MY-02	MY-03	MY-04
A. Riffles	100%	100%	100%		
B. Pools	100%	95%	100%		
C. Thalweg	100%	100%	NA		
D. Meanders	100%	100%	NA		
E. Bed General	100%	100%	100%		
F. Vanes/J Hooks etc.	100%	100%	100%		
G. Wads and Boulders	100%	100%	93.8%		

Note: The Year 1 estimates are Earth Tech's estimate based upon review of text within the Buck Engineering Year 1 Monitoring Report.

Table XII. Baseline Morphology and Hydraulic Summary-- Reach HR1 (3037 feet)
Hillsdale Park Stream Restoration Site/ Project Number 177

Parameter	USGS Data			Regional Curve Interval (urban)			Pre-Existing condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BF Width (ft)				46	59	52	36	44	NA*	25.6	46	33.5	36	44	NA	28	40.2	37.95
BF Cross Sectional Area (ft^2)				255	283	269	103	113	NA	43.5	122	80	103	113	NA	70.7	154.4	117.55
BF Mean Depth (ft)				4.5	6.0	5.2	2.6	2.9	NA	1.7	2.6	2.4	2.6	2.9	NA	2.5	3.9	3.2
BF Max Depth (ft)							3.7	4.0	NA	NA	NA	NA	3.7	4.0	NA	3.4	5.9	5
Width/Depth Ratio							12.2	17.3	NA	14.0	17.0	15.1	12.2	17.3	NA	8.8	14.7	10.9
Entrenchment Ratio							1.5	2.4	NA	NA	NA	NA	2.3	2.3	NA	1.8	3.3	2.5
Wetted Perimeter (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	33	47.2	43.35
Hydraulic radius (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	2.14	3.27	2.71
Pattern																		
Channel Beltwidth (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Radius of Curvature (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Meander Wavelength							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Meander Width ratio							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Profile																		
Riffle length (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Riffle slope (ft/ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pool length (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pool spacing (ft)							NA	NA	NA	NA	NA	NA	76	152	NA	NA	NA	NA
Substrate																		
d50 (mm)							NA	NA	NA	3.0	64.0	19.1	NA	NA	NA	NA	NA	NA
d84 (mm)							NA	NA	NA	77	180	bedrock	NA	NA	NA	NA	NA	NA
Additional Reach Parameters																		
Valley Length (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Channel Length (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sinuosity							NA	NA	1.1	NA	NA	1.1	NA	NA	1.1	NA	NA	NA
Water Surface Slope (ft/ft)							NA	NA	.0016	NA	NA	NA	.0016	.0016	NA	NA	NA	NA
BF slope (ft/ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rosgen Classification							NA	NA	E4/B4c	NA	NA	B4c	NA	NA	E4/B4c	NA	NA	NA
Habitat Index							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Macrobenthos							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

*Historical documents necessary to provide this information were unavailable at the time of the report submission.

Table XII Continued. Baseline Morphology and Hydraulic Summary-- Reach HR2 (2265 feet)
Hillsdale Park Stream Restoration Site/ Project Number 177

Parameter	USGS Data			Regional Curve Interval (urban			Pre-Existing condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BF Width (ft)				46	59	52	66	66	NA*	25.6	46	33.5	NA	NA	66	19.7	52.4	41.1
BF Cross Sectional Area (ft^2)				255	283	269	166	166	NA	43.5	122	80	NA	NA	166	72.6	242.3	112.9
BF Mean Depth (ft)				4.5	6.0	5.2	NA	NA	2.5	1.7	2.6	2.4	NA	NA	2.5	2.3	5	3.4
BF Max Depth (ft)							NA	NA	3.6	NA	NA	NA	NA	NA	3.6	2.9	7.4	4.75
Width/Depth Ratio							NA	NA	26.4	14.0	17.0	15.1	NA	NA	26.4	5.3	22.6	10.3
Entrenchment Ratio							NA	NA	1.1	NA	NA	NA	NA	NA	2.3	1.5	4.3	2.15
Wetted Perimeter (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	27.1	58.6	48.4
Hydraulic radius (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	2.13	4.13	2.65
Pattern																		
Channel Beltwidth (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Radius of Curvature (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Meander Wavelength							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Meander Width ratio							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Profile																		
Riffle length (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Riffle slope (ft/ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pool length (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pool spacing (ft)							NA	NA	NA	NA	NA	NA	76	152	NA	NA	NA	NA
Substrate																		
d50 (mm)							NA	NA	NA	3.0	64.0	19.1	NA	NA	NA	NA	NA	NA
d84 (mm)							NA	NA	NA	77.0	Bedrock	157.5	NA	NA	NA	NA	NA	NA
Additional Reach Parameters																		
Valley Length (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Channel Length (ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sinuosity									1.1			1.1			1.1	NA	NA	NA
Water Surface Slope (ft/ft)							NA	NA	.0035	NA	NA	NA	NA	NA	.0035	NA	NA	NA
BF slope (ft/ft)							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rosgen Classification							NA	NA	E4/Bc	NA	NA	B4c	NA	NA	E4B4c	NA	NA	NA
Habitat Index							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Macrobenthos							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

*Historical documents necessary to provide this information were unavailable at the time of the report submission.

Table XIII. Morphology and Hydraulic Monitoring Summary--Reach HR1 (3037 feet)
Hillsdale Park Stream Restoration Site/ Project Number 177

Parameter	**Cross Section 1**			**Cross Section 2**			**Cross Section 3**			**Cross Section 4**			**Cross Section 5**			**Cross Section 6**		
	~12+01 Pool			**~14+61 Riffle**			**~16+31 Pool**			**~20+31**			**~25+43 Riffle**			**~25+82 Pool**		
Dimension	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2
BF Width (ft)	33.5	32.8	38.3	38.0	37.5	38.5	33.8	36.9	37.3	37.9	40.1	41.7	40.2	41.1	44.5	39.4	38.4	47.8
Floodprone Width (ft) (approx)	95	95	>85	68	68	74.4	110	110	NA*	75	75	89	73	73	NA	110	110	NA
BF Cross Sectional Area (ft^2)	127.0	125.5	177.8	104.7	102.6	108.6	114.2	138.6	165.5	97.8	104.2	110.2	120.9	128.0	133.0	154.4	159.5	223.9
BF Mean Depth (ft)	3.8	3.8	4.6	2.8	2.7	2.8	3.4	3.8	4.4	2.6	2.6	2.6	3	3.1	3.0	3.9	4.2	4.7
BF Max Depth (ft)	5.8	5.7	7.1	3.8	4.1	3.9	5.5	6.4	7.2	3.4	3.7	3.7	4.5	4.7	5.5	5.5	6.0	7.8
Width/Depth Ratio	8.8	8.6	8.3	13.8	13.7	13.7	10.0	9.8	8.4	14.7	15.4	15.8	13.4	13.2	14.9	10.1	9.2	10.2
Entrenchment Ratio	2.8	2.9	>2.2	1.8	1.8	1.9	3.3	3.0	NA	2.0	1.9	2.1	1.8	1.8	NA	2.8	2.9	NA
Wetted Perimeter (ft)	41.1		47.58	43.6	NA	44.14	40.6	NA	46.17	43.1	NA	46.99	46.2	NA	50.48	47.2	NA	57.17
Hydraulic radius (ft)	3.09		3.74	2.40	NA	2.46	2.81	NA	3.58	2.27	NA	2.35	2.62	NA	2.63	3.27	NA	3.92
Substrate																		
d50 (mm)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
d84 (mm)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Parameter	**MY-01 (2004)**			**MY-02 (2005)**			**MY-03 (2006)**			**MY-04 (2007)**			**MY-05 (2008)**			**MY+ (2009)**		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	NA	NA	NA	NA	NA	NA												
Radius of Curvature (ft)	NA	NA	NA	NA	NA	NA												
Meander Wavelength (ft)	NA	NA	NA	NA	NA	NA												
Meander Width Ratio	NA	NA	NA	NA	NA	NA												
Profile																		
Riffle Length (ft)	NA	NA	NA	6	434	26												
Riffle Slope (ft/ft)	NA	NA	NA	0	0.0197	0.0003												
Pool length (ft)	NA	NA	NA	10	140	28												
Pool spacing (ft)	NA	NA	NA	25	613	144												
Additional Reach Parameters																		
Valley Length (ft)	NA			2720														
Channel Length (ft)	NA			3045														
Sinuosity	NA			1.1195														
Water Surface Slope (ft/ft)	NA			0.00199														
BF Slope (ft/ft)	NA			0.00181														
Rosgen Classification	NA			Bc														
Habitat Index*	NA			NA														
Macrobenthos*	NA			NA														

* Historical documents necessary to provide this information were unavailable at the time of the report submission

Table XIII Continued. Morphology and Hydraulic Monitoring Summary-- Reach HR1 (3037 feet)
Hillsdale Park Stream Restoration Site/ Project Number 177

Parameter	Cross Section 7			Cross Section 8														
	~30+89 Riffle			~31+81 Pool														
Dimension	MY0	MY1	MY2	MY0	MY1	MY2												
BF Width (ft)	28.0	28.1	33.4	38.9	35.7	42												
Floodprone Width (ft) (approx)	62	62	70.5	130	130	NA*												
BF Cross Sectional Area (ft^2)	70.7	71.3	82.0	142.1	128.0	171.7												
BF Mean Depth (ft)	2.5	2.5	2.5	3.7	3.6	4.1												
BF Max Depth (ft)	3.8	3.8	4.0	5.9	5.6	6.6												
Width/Depth Ratio	11.1	11.1	13.6	10.7	10.0	10.3												
Entrenchment Ratio	2.2	2.2	2.1	3.3	3.6	1.4												
Wetted Perimeter (ft)	33	NA	38.31	46.3	NA	50.18												
Hydraulic radius (ft)	2.14	NA	2.14	3.07	NA	3.42												
Substrate																		
d50 (mm)	NA	NA	NA	NA	NA	NA												
d84 (mm)	NA	NA	NA	NA	NA	NA												

Parameter	MY-01 (2005)			MY-02 (2005)			MY-03 (2006)			MY-04 (2007)			MY-05 (2008)			MY+ (2009)		
Pattern	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Channel Beltwidth (ft)																		
Radius of Curvature (ft)																		
Meander Wavelength (ft)																		
Meander Width Ratio																		
Profile																		
Riffle Length (ft)																		
Riffle Slope (ft/ft)																		
Pool length (ft)																		
Pool spacing (ft)																		
Additional Reach Parameters																		
Valley Length (ft)																		
Channel Length (ft)																		
Sinuosity																		
Water Surface Slope (ft/ft)																		
BF Slope (ft/ft)																		
Rosgen Classification																		
Habitat Index*																		
Macrobenthos*																		

* Historical documents necessary to provide this information was unavailable at the time of the report submission

Table XIII. Morphology and Hydraulic Monitoring Summary-- Reach HR2 (2265 feet)
Hillsdale Park Stream Restoration Site/ Project Number 177

Parameter	Cross Section 9			Cross Section 10			Cross Section 11			Cross Section 12								
	~44+41 Riffle			~45+39 Pool			~54+96 Riffle			~55+43 Pool								
Dimension	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2						
BF Width (ft)	52.4	53.6	49.1	48.6	47.8	53.3	33.6	36.9	34.0	19.7	20.3	21.1						
Floodprone Width (ft) (approx)	80	80	67.6	210	210	NA*	55	55	>53	53	53	NA						
BF Cross Sectional Area (ft^2)	121.5	122.1	93.8	242.3	240.6	256.2	104.3	107.2	103.3	72.6	87.1	89.1						
BF Mean Depth (ft)	2.3	2.3	1.9	5.0	5.0	4.8	3.1	2.9	3.0	3.7	4.3	4.2						
BF Max Depth (ft)	2.9	2.9	2.2	7.4	7.0	7.4	4.4	4.4	4.2	5.1	5.6	5.4						
Width/Depth Ratio	22.6	23.6	25.7	9.8	9.5	11.1	10.8	12.7	11.2	5.3	4.7	5.0						
Entrenchment Ratio	1.5	1.5	1.4	4.3	4.4	NA	1.6	1.5	NA	2.7	2.6	NA						
Wetted Perimeter (ft)	57	NA	52.92	58.6	NA	62.91	39.8	NA	40.07	27.1	NA	29.55						
Hydraulic radius (ft)	2.13	NA	1.77	4.13	NA	4.07	2.62	NA	2.58	2.68	NA	3.02						
Substrate																		
d50 (mm)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA						
d84 (mm)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA						

Parameter	MY-01 (2005)			MY-02 (2005)			MY-03 (2006)			MY-04 (2007)			MY-05 (2008)			MY+ (2009)		
Pattern	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Channel Beltwidth (ft)	NA	NA	NA	NA	NA	NA												
Radius of Curvature (ft)	NA	NA	NA	NA	NA	NA												
Meander Wavelength (ft)	NA	NA	NA	NA	NA	NA												
Meander Width Ratio	NA	NA	NA	NA	NA	NA												
Profile																		
Riffle Length (ft)	NA	NA	NA	11	194	50												
Riffle Slope (ft/ft)	NA	NA	NA	0	0.014792	0.004292												
Pool length (ft)	NA	NA	NA	8	104	67												
Pool spacing (ft)	NA	NA	NA	108	443	180												
Additional Reach Parameters																		
Valley Length (ft)	NA			2115														
Channel Length (ft)	NA			2167														
Sinuosity	NA			1.025														
Water Surface Slope (ft/ft)	NA			0.00391786														
BF Slope (ft/ft)	NA			0.003645593														
Rosgen Classification	NA			Bc														
Habitat Index*	NA			NA														
Macrobenthos*	NA			NA														

*Historical documents necessary to provide this information were unavailable at the time of the report submission

C. Wetland Assessment

There is no wetland restoration associated with this site. Table XIV is not applicable to this project.

Click on the Desired Link Below

Appendix A

Appendix B