Hatchet's Grove Stream and Neuse Riparian Buffer Mitigation Plan and As-built Report

September 2004

Prepared by:

S&EC

Soil & Environmental Consultants, PA

11010 Raven Ridge Road • Raleigh, North Carolina 27614 • Phone: (919) 846-5900 • Fax: (919) 846-9467

www.SandEC.com

On behalf of:

Ecosystem Enhancement PROGRAM

NCEEP, 1652 Mail Service Center, Raleigh, NC 27699-1652

Hatchet's Grove Tributary Stream and Riparian Buffer Mitigation Plan

Introduction
Soil & Environmental Consultants, PA (S&EC) is providing herein the as-built survey of the completion of the Hatchet's Grove Tributary Stream and Neuse Riparian Restoration Plan. The project is located within the Prestonwood Country Club. The project site is specifically located approximately 2,600 feet southwest of the Morrisville-Carpenter Road (SR 3014)/Aviation Parkway (SR 3015) Intersection and 3,000 feet east of Davis Drive (SR 1613), Morrisville, Wake county, North Carolina.

The originally approved plan estimated total stream restoration length to be 3,700 linear feet and included the restoration of 4 acres of Neuse Riparian Buffer. Following the completion of the as-built survey total restoration units were determined to be 4,123 linear feet of stream channel restoration and 5.3 acres of buffer restoration. Partial increase of linear footage of stream restoration is attributed to the addition of an unnamed tributary to Hatchet's Grove which is being referred to as Meadow Creek. The U.S. Army Corps of Engineers and the N.C. Division of Water Quality issued additional permits for the proposed Meadow Creek restoration/relocation plan. The USACE action identification number for the Meadow Creek project is 200420774 and the DWQ project number is 04-0353. Meadow Creek added 295 linear feet to the 3,828 linear feet of Hatchet's Grove restored. The restoration of Meadow Creek although financed by Prestonwood Country Club will be monitored and maintained by EEP. Essentially, the restoration effort as a whole resulted in the additional restoration of 423 linear feet of stream channel and 1.3 acres of riparian buffer beyond original design estimates.

Project construction for the Hatchet's Grove restoration commenced in January 2004 and was completed in May 2004. Project construction for the Meadow Creek restoration commenced in late April 2004 and was completed the first week of May 2004.

Survey data collected included the entire longitudinal channel profile, eight (8) permanently established channel cross-sections, and topography within the constructed nested flood plain (riparian buffer). Photographs were also taken of each permanently established cross-section. Overall channel conditions (bed and bank) and in-channel structures, which included boulder cross-vanes, j-hook vanes and root wads, were inspected during the channel survey to insure proper function and stability. Permanently established vegetation plots will be setup during the year 1 monitoring exercises schedule for spring of 2005.

Supportive visual information included with this mitigation plan includes the following components:

Record Drawings
Cross-Sectional Profiles
Monitoring Photographs

Methodology
The as-built was completed utilizing total station technology, a segmented and calibrated rod, and prism. This method of collection identifies and records the northing, easting, and elevation (x, y, z coordinates) of each survey point taken in the field.

The longitudinal profile was surveyed by starting immediately above the origination point of the stream restoration and continued to the terminus of the project denoted by an existing sewer crossing 50 feet above the confluence with Crabtree Creek. The thalweg was surveyed inclusive of all observed transitional areas including riffles, runs, pools and glides and installed boulder cross-vanes. Cross-vanes

will be utilized in future monitoring surveys as permanent in-stream bench marks, thereby allowing horizontal length adjustment to be made based on the relative location of each cross-vane. Topographic data was taken from the left top of slope of the nested flood plain to the right top slope inclusive of the entire restored buffer.

Permanent cross-section end points were established utilizing two individual sections of ½-inch rebar approximately 2 to 3 foot in length driven vertically into the ground. The pin locations are identified with painted 3-foot grade stakes labeled with the identity of the pin. A total of five (4) nested pairs of cross-sections were established or eight (8) individual cross-sections. Each nested pair is made up of a riffle and pool cross-section. Cross-sections were plotted from left to right facing downstream. Each cross-section is also a designated photographic point that will be taken annually. Each cross-section photograph is oriented facing downstream which is the exact orientation of the plotted cross-section data.

Vegetation

Planted zones relative to the stream restoration consisted of the riparian buffer zone and the active or bankfull channel area. The riparian buffer zone initiates at the top of the bank and continues out perpendicular from the stream. The bankfull channel area initiates at the normal base flow elevation to the top of bank or interface with the flood plain.

The riparian buffer zone was planted with bare root trees and containerized shrubs. As described and depicted in the approved restoration plan, shrub species were planted in play over zones and the bare-root stock was planted on the remaining acreage where future tree height would not affect the field of vision for players.

The bankfull channel area was live staked with black willow (*Salix nigra*), silky dogwood (*Cornus amomum*) and elderberry (*Sambucus canadensis*). Black willow composition was limited to approximately 25% of the total stakes installed.

Approximately 4,000 bare-root trees and 500 containerized shrubs consisting of 16 individual species were planted within the restored riparian zone. The riparian buffer consists of a total of 5.3 acres with an average planted density of approximately 750 trees or shrubs per acre. Bare-root trees were planted on an 8-foot by 8-foot spacing and containerized shrubs were planted at 6-foot by 6-foot spacing. Plant species and quantities are listed below in Table 1.

Table 1.
Planted Species

Species	Quantity
Tulip Tree (*Liriodendron tulipera*)	800
Swamp Chestnut Oak (*Quercus michauxii*)	800
Willow Oak (*Quercus phellos*)	500
Laurel Oak (*Quercus laurifolia*)	800
Water Oak (Quercus nigra)	400
Black Gum (*Nyssa sylvatica*)	400
Persimmon (*Diospyros virginiana*)	200
River Birch (*Betula nigra*)	100
Virginia Willow (*Itea virginica*)	140
Witch-hazel (*Hamamelis virginiana*)	175
Blueberry (*Vaccineum corymbosum*)	120
Elderberrry (*Sambucus canadensis*)	120
Button-bush (*Cephalanthus occidentalis*)	175
Red Chokeberry (*Aronia arbutifolia*)	314
Yellow Root (*Xanthoriza simplicissma*)	314
Silky Dogwood (*Cornus amomum*)	63

Permanent seeding consisted of switch grass (*Panicum virgatum*), black-eyed Susan (*Rudbeckia hirta*), Virginia wild rye (*Elymus virginus*), and Arrow wood (*Viburnum dentatum*).

At a minimum, three vegetation monitoring plots will be established during the first year monitoring exercises. Two of the plots will consist of bare-root trees and at least one of the plots will consist exclusively of one of the shrub zones located within the play over areas.

Vegetation plots will consist of 100 meter square plots and because of the configuration of the riparian buffer (average of 30 foot wide) the plots will be long and thin approximately 2 meters by 50 meters.

Linear embankment plots will be established along the channel to determine species and densities of the viable live stakes installed. Three of these linear plots will be established and each individual plot will be approximately 50 feet in length.

Mitigation Credits

After the completion of the as-built survey, total accrued mitigation credits were tabulated. Field data was gathered utilizing standardized survey practices and the data was subsequently quantified using AutoCADD. Quantified below is the cumulative (main stem of Hatchet's Grove and UT of Hatchet's Grove referred to as Meadow Creek) length of stream channel and Neuse riparian buffer acreage restored onsite.

Mitigation Type	**Total**
Stream Restoration – Hatchet's Grove Tributary	3,828 linear feet
Stream Restoration – Meadow Creek	295 linear feet
Total Stream Length	**4,123 linear feet**
Neuse Riparian Buffer	**5.3 acres**

Year 1 Monitoring

The stream channel monitoring schedule, as outlined in the approved mitigation plan, is to be completed annually for 5 consecutive years initiating one year from the completion of construction. Construction of the restoration work for both streams was completed in May 2004.

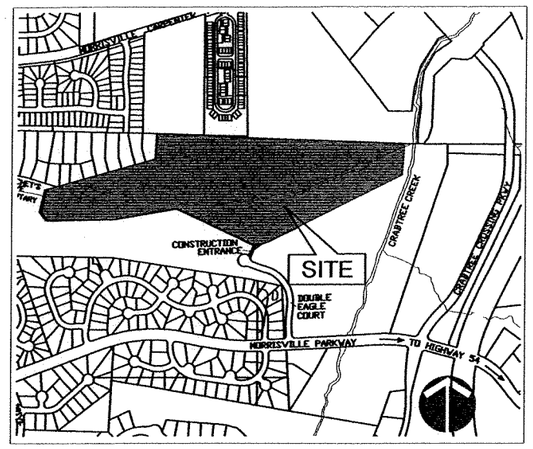
Monitoring will consist of the re-survey of at least 3,000 linear feet of the longitudinal stream profile of Hatchet's Grove and all of Meadow Creek, re-survey of the eight permanently established cross-sections (6 cross-section on Hatchet's Grove and 2 on Meadow Creek), and completion of plant species and density surveys within permanently established 100 meter square plots.

Photographs will provide a visual record of each permanently established cross-sections and vegetation plots along with photographic points established throughout the project site as denoted in the footnotes of each photograph provided herein.

Project Performance and Repair Recommendations

Since the completion of the construction activities in May 2004, the restored stream channel has experience approximately 6 individual bankfull events and 3 out of bank events. Four of these events were caused by precipitation produced by tropical storms Frances, Gaston, Ivan, and Jeanne. Flood flows were estimated to be approximately 2 feet above bankfull on two occasions and 3 foot above bankfull on one occasion. Although the project has only been in the ground for 4 months and located in a

highly urbanized environment, the channel has performed better then would be expected. Although the site has been planted and stabilized with the application of temporary and permanent seed, the vegetation has not completely anchored the surrounding soil profile. Immature vegetation has to a point lead to some minor scour in the near bank regions and within the flood plain. The majority of these scoured areas are beginning to naturally stabilize and fill in with transported substrate deposited by the stream during high flows. It is estimated that less then 1% of the total bankfull channel area has been affected by scour or slumping. At this time, the only segment that S&EC recommends should be repaired is the banks that have failed immediately below pre-existing sewer line outfall. Unfortunately the sewer pipe elevation matches the bankfull elevation resulting in the maximum expected force on the downstream bank due to constriction of maximum cross-section discharge and the subsequent generation of secondary flow vectors due to the pipe orientation and trapped debris. Although the inside of the meander is becoming stable, the outer bend will need some additional stabilization to prevent further bank erosion from occurring. It is our recommendation to slope the banks back to a 2:1 ratio and install a brush mat consisting of willow cuttings, permanent seed mix, straw and coir matting. Root wads are not recommended and were not installed because of existing irrigation lines located in this area.



VICINITY MAP
NOT TO SCALE

RECORD DRAWINGS FOR:

HATCHET'S GROVE TRIBUTARY

STREAM RESTORATION PROJECT

PRESTONWOOD GOLF COURSE

WAKE CO., NC

CONTENTS:

LICENSED SOIL SCIENTIST
JOSEPH MICHAEL ORIOSKY, JR.
STATE OF NORTH CAROLINA
2074

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SOIL & ENVIRONMENTAL CONSULTANTS, PA
Registered Landscape Architectural Corporation
C-144

NORTH CAROLINA
REGISTERED LANDSCAPE ARCHITECT
0813
J. MICHAEL ORTOSKY, JR.

ENVIRONMENTAL DESIGN FIRM:

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Raleigh, NC 27614
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PREPARED FOR:

ECOSYSTEM ENHANCEMENT PROGRAM
1652 Mail Service Center
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Ecosystem Enhancement PROGRAM

Peter A. Jelenevsky
LEAD STREAM DESIGNER

J. Michael Ortosky, ASLA, LSS
NC License No. 0813
NC License No. 1075

Project:	Project No.: 6761
HATCHET'S GROVE at PRESTONWOOD STREAM RESTORATION RECORD DRAWINGS	Designed: PAJ Drawn: EGT, MM
Location: WAKE CO., NC	Client: ECOSYSTEM ENHANCEMENT PROGRAM Scale: NO SCALE
Sheet Title: COVER, CONTENTS, & VICINITY MAP	Sheet No.: 1 OF 9

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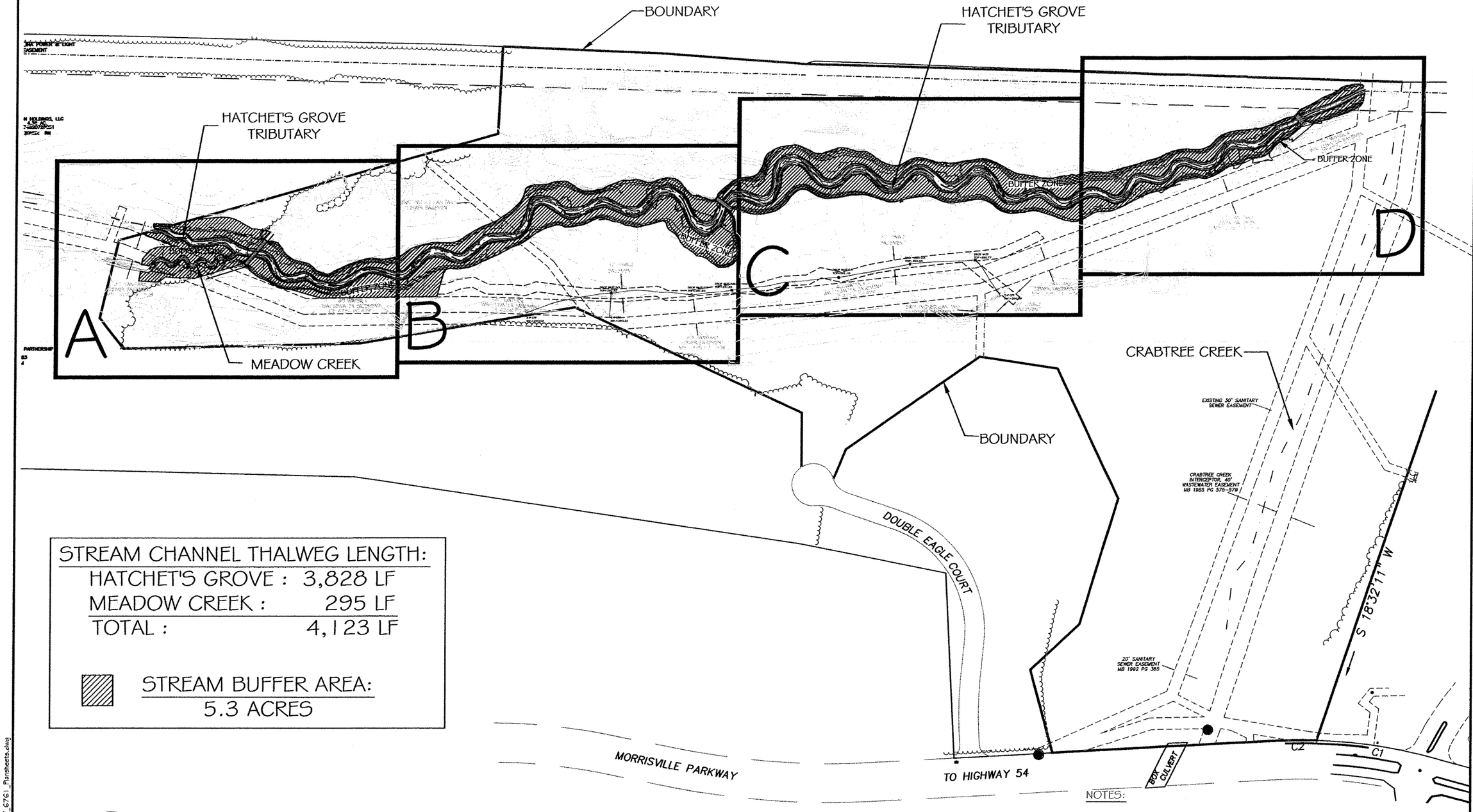

STREAM CHANNEL THALWEG LENGTH:	
HATCHET'S GROVE :	3,828 LF
MEADOW CREEK :	295 LF
TOTAL :	4,123 LF

STREAM BUFFER AREA:
5.3 ACRES

NORTH

SCALE: 1" = 250'

250 125 0 250

CONTOUR INTERVAL = 1'

RESTORATION SITE LAYOUT & KEYSHEET

NOTES:

1) THE PURPOSE OF THIS PLAT IS TO SHOW LOCATION OF RESTORED STREAM CHANNEL WITH CONTOURS AND ELEVATIONS. CONTOURS DO NOT REFLECT PRESTONWOOD GOLF COURSE TOPOGRAPHY. ALL CONTOURS ARE APPROXIMATE.
2) ORIGINAL BOUNDARY AND TOPOGRAPHIC DATA PROVIDED BY WITHERS & RAVENEL, CARY, NC.
3) AS-BUILT SURVEY DATA PROVIDED BY WITHERS & RAVENEL & INCORPORATED INTO SITE PLAT.
4) SEE SHEETS 3-6 FOR CONSTRUCTED SITE FEATURES AND GRADING.
5) FOR CHANNEL THALWEG ELEVATIONS, REFER TO LONGITUDINAL PROFILE.
6) THIS IS NOT A BOUNDARY SURVEY AND IS NOT FOR RECORDATION, CONVEYANCE, OR SALES.

Project: HATCHET'S GROVE at PRESTONWOOD STREAM RESTORATION RECORD DRAWINGS
Location: WAKE CO., NC
Client: ECOSYSTEM ENHANCEMENT PROGRAM
Sheet Title: RESTORATION SITE LAYOUT & KEYSHEET
Project No.: 6761
Designed: PAJ
Drawn: EGT, MM
Scale: 1" = 250'
Sheet No: 2 OF 9

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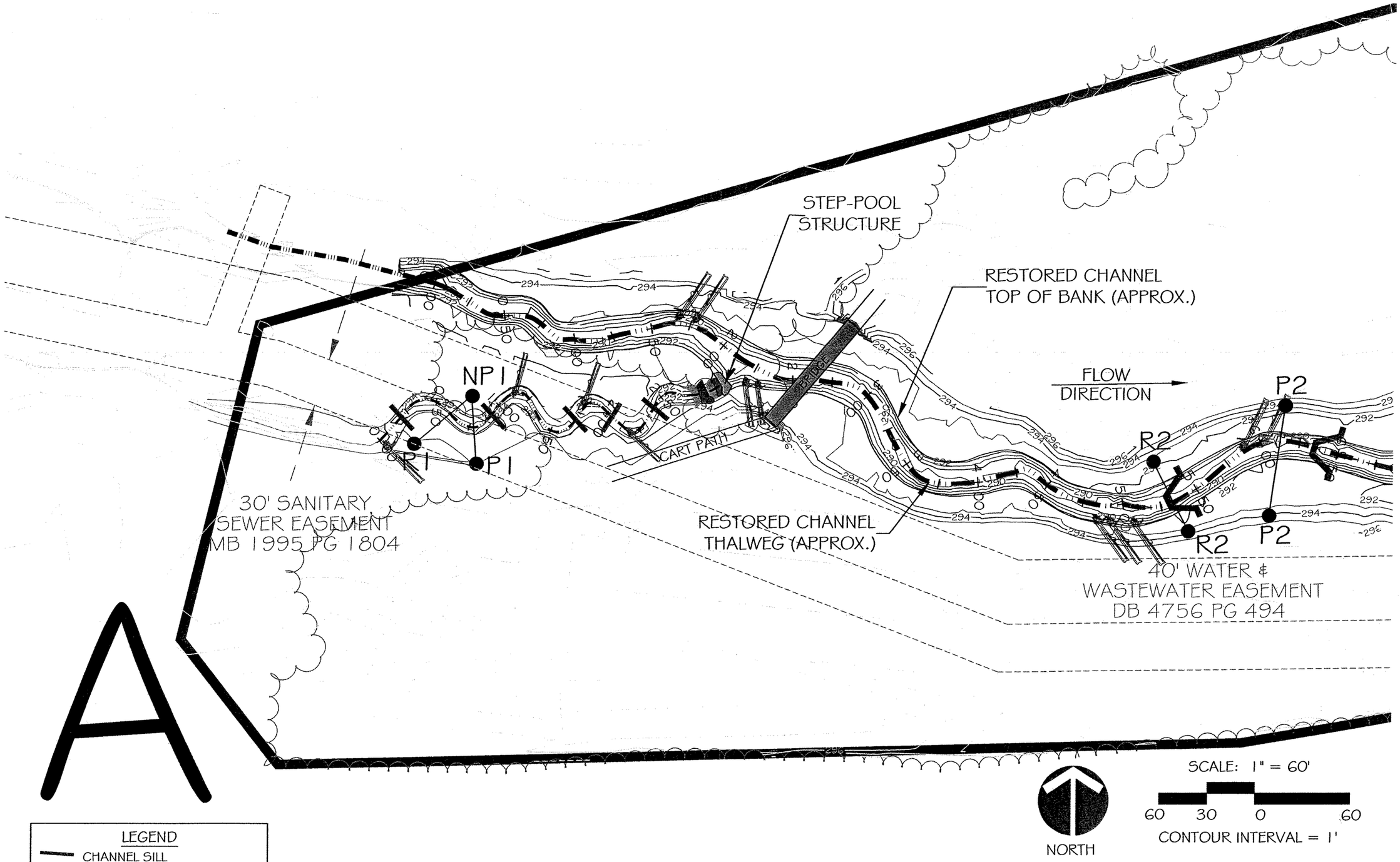

LEGEND

- CHANNEL SILL
- ROCK CROSS-VANE
- ROOT WAD
- P3 — PERMANENT CROSS-SECTION LOCATION

NORTH

SCALE: 1" = 60'

60 30 0 60

CONTOUR INTERVAL = 1'

CONSTRUCTED SITE FEATURES & GRADING - A

NOTES:
1) ALL CONTOURS ARE APPROXIMATE.
2) FOR CHANNEL THALWEG ELEVATIONS, PLEASE REFER TO LONGITUDINAL PROFILE ON SHEET 7.
3) STATIONS DENOTE LENGTH ALONG THALWEG.
4) LOCATIONS OF CROSS-VANES AND ROOT WADS ARE APPROXIMATE.

Project: HATCHET'S GROVE at PRESTONWOOD
STREAM RESTORATION RECORD DRAWINGS

Location: WAKE CO., NC
Client: ECOSYSTEM ENHANCEMENT PROGRAM
Sheet Title: CONSTRUCTED SITE FEATURES & GRADING - A

Project No.: 6761
Designed: PAJ
Drawn: EGT, MM
Scale: 1" = 60'
Sheet No.: 3 OF 9

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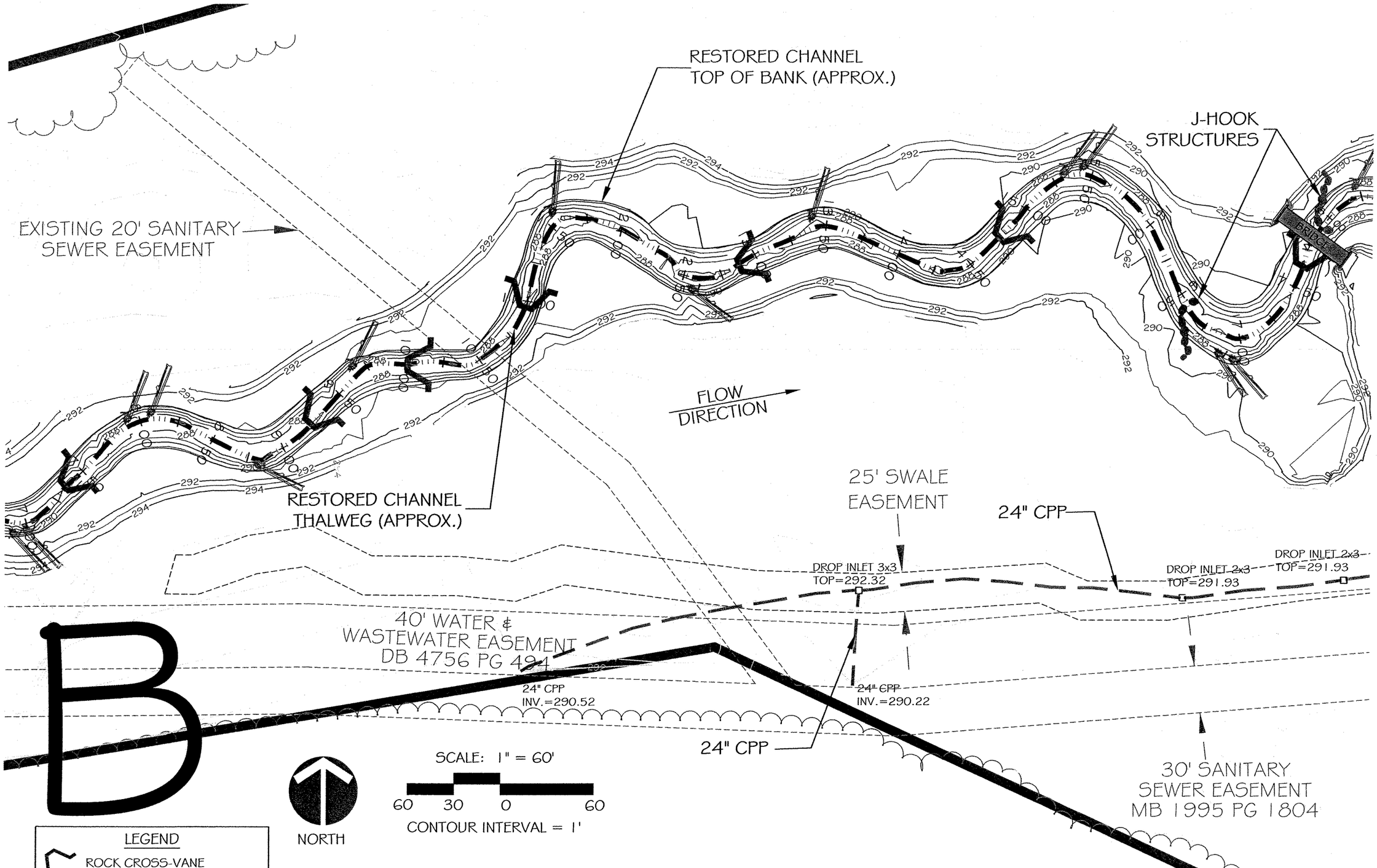

CONSTRUCTED SITE FEATURES & GRADING - B

NOTES:
1) ALL CONTOURS ARE APPROXIMATE.
2) FOR CHANNEL THALWEG ELEVATIONS, PLEASE REFER TO LONGITUDINAL PROFILE ON SHEET 7.
3) STATIONS DENOTE LENGTH ALONG THALWEG.
4) LOCATIONS OF CROSS-VANES AND ROOT WADS ARE APPROXIMATE.

Project: HATCHET'S GROVE at PRESTONWOOD
STREAM RESTORATION RECORD DRAWINGS
Location: WAKE CO., NC
Client: ECOSYSTEM ENHANCEMENT PROGRAM
Sheet Title: CONSTRUCTED SITE FEATURES & GRADING - B
Project No.: 6761
Designed: PAJ
Drawn: EGT, MM
Scale: 1" = 60'
Sheet No.: 4 OF 9

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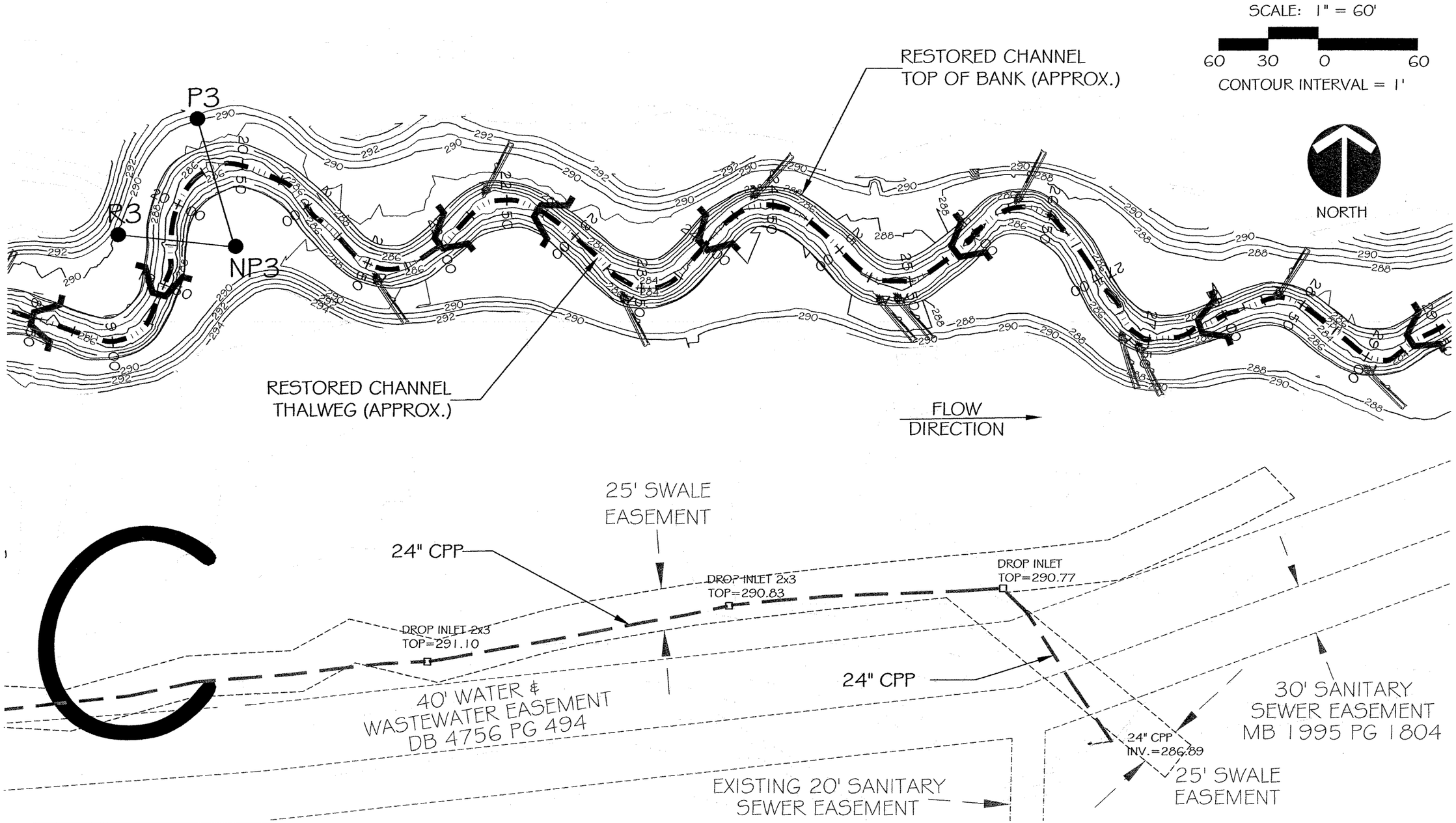

LEGEND

- ROCK CROSS-VANE
- ROOT WAD
- P3 PERMANENT CROSS-SECTION LOCATION

CONSTRUCTED SITE FEATURES & GRADING - C

NOTES:
1) ALL CONTOURS ARE APPROXIMATE.
2) FOR CHANNEL THALWEG ELEVATIONS, PLEASE REFER TO LONGITUDINAL PROFILE ON SHEET 7.
3) STATIONS DENOTE LENGTH ALONG THALWEG.
4) LOCATIONS OF CROSS-VANES AND ROOT WADS ARE APPROXIMATE.

Project: HATCHETS GROVE at PRESTONWOOD STREAM RESTORATION RECORD DRAWINGS
Location: WAKE CO., NC
Client: ECOSYSTEM ENHANCEMENT PROGRAM
Sheet Title: CONSTRUCTED SITE FEATURES & GRADING - C
Project No.: 6761
Designed: PAJ
Drawn: EGT, MM
Scale: 1" = 60'
Sheet No.: 5 OF 9

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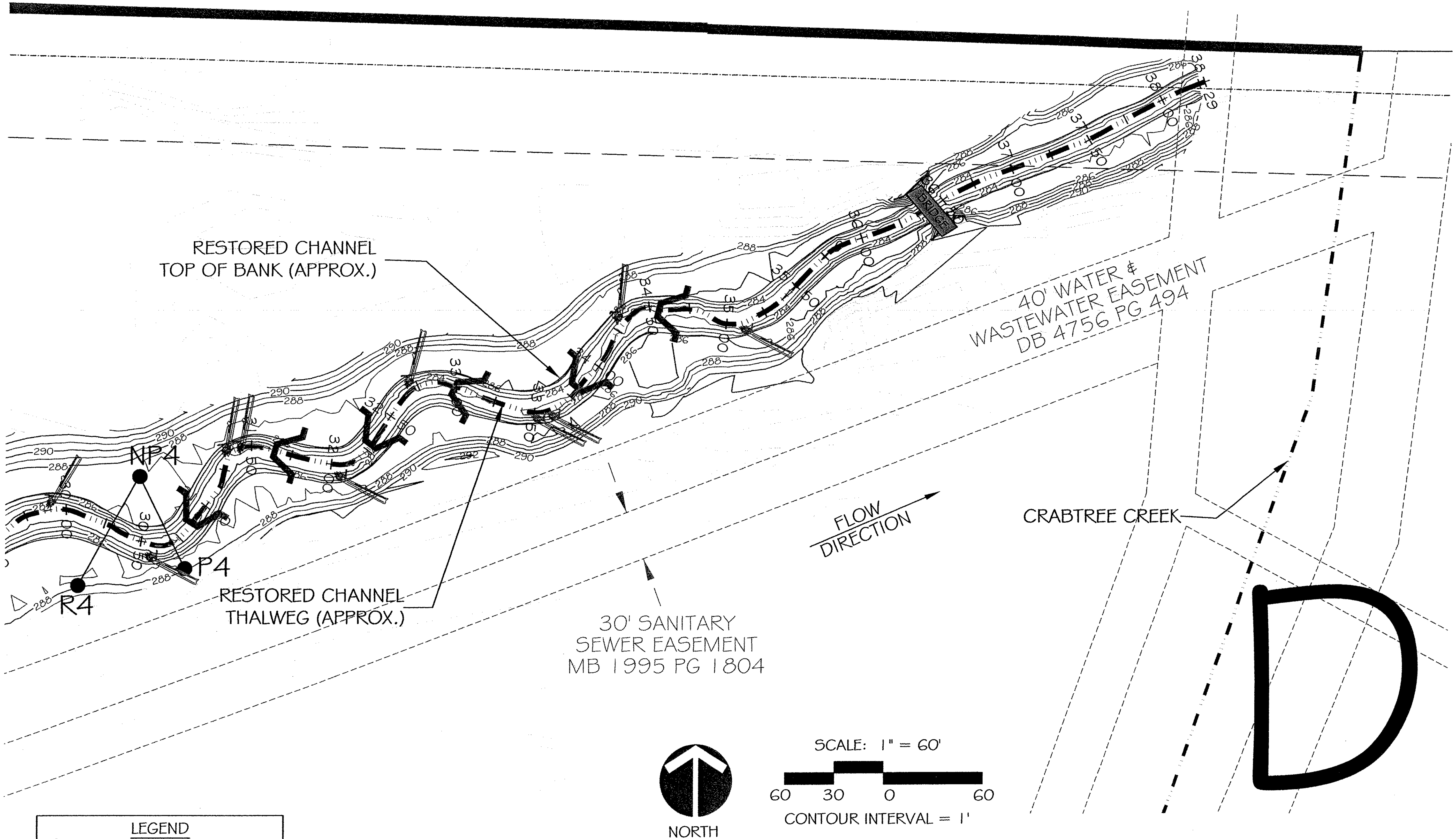

LEGEND

- ROCK CROSS-VANE
- ROOT WAD
- P3 PERMANENT CROSS-SECTION LOCATION

CONSTRUCTED SITE FEATURES & GRADING - A

NOTES:
1) ALL CONTOURS ARE APPROXIMATE.
2) FOR CHANNEL THALWEG ELEVATIONS, PLEASE REFER TO LONGITUDINAL PROFILE ON SHEET 7.
3) STATIONS DENOTE LENGTH ALONG THALWEG.
4) LOCATIONS OF CROSS-VANES AND ROOT WADS ARE APPROXIMATE.

Project: HATCHET'S GROVE at PRESTONWOOD STREAM RESTORATION RECORD DRAWINGS
Location: WAKE CO., NC
Client: ECOSYSTEM ENHANCEMENT PROGRAM
Sheet Title: CONSTRUCTED SITE FEATURES & GRADING - D
Project No.: 6761
Designed: PAJ
Drawn: EGT, MM
Scale: 1" = 60'
Sheet No.: 6 OF 9

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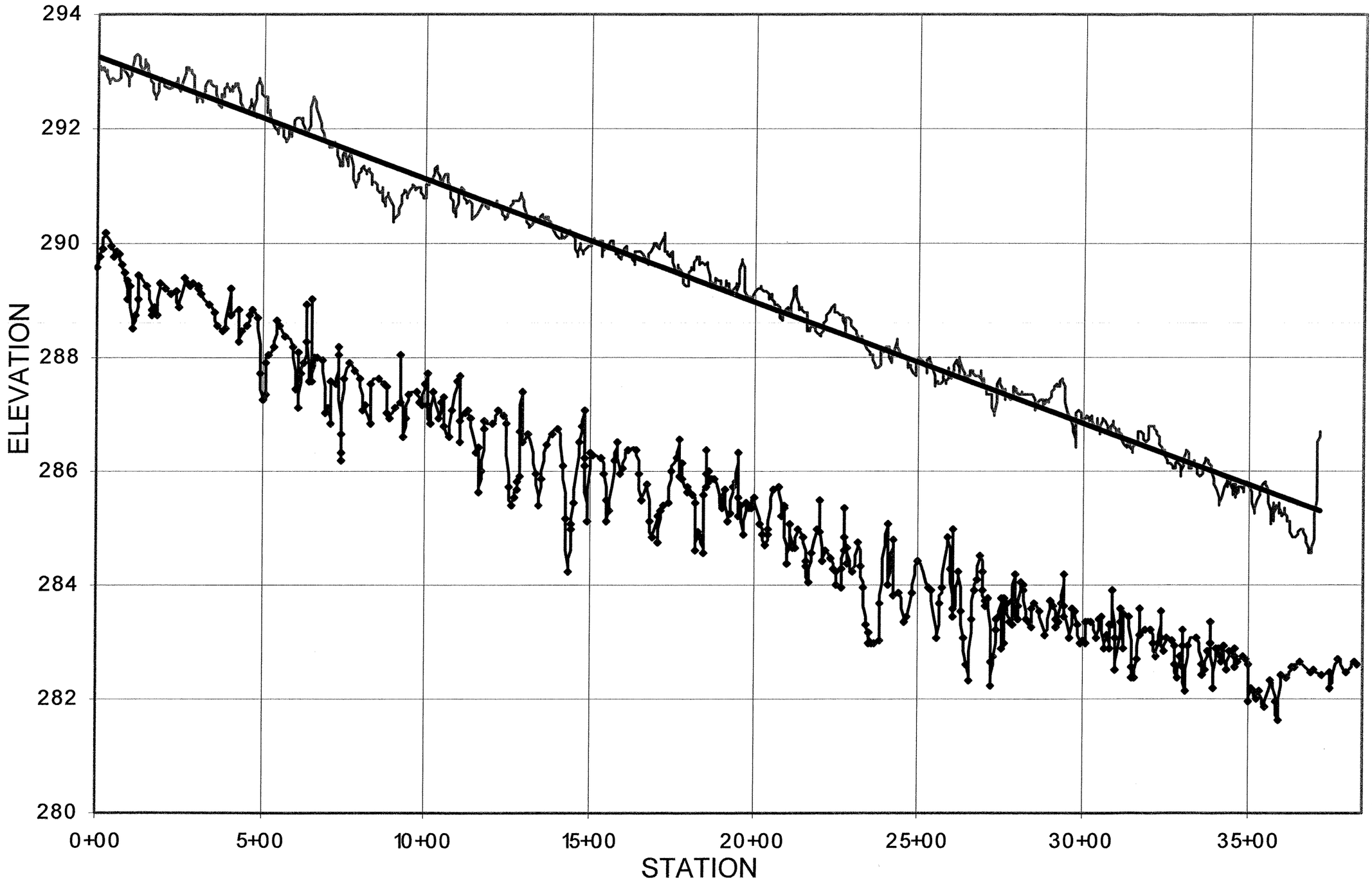

Project: HATCHET'S GROVE at PRESTONWOOD
STREAM RESTORATION RECORD DRAWINGS

Location: WAKE CO., NC
Client: ECOSYSTEM ENHANCEMENT PROGRAM

Sheet Title: LONGITUDINAL PROFILE - HATCHET'S GROVE

Project No.: 676 I
Designed: PAJ
Drawn: EGT, MM
Scale: AS SHOWN
Sheet No.: 7 OF 9

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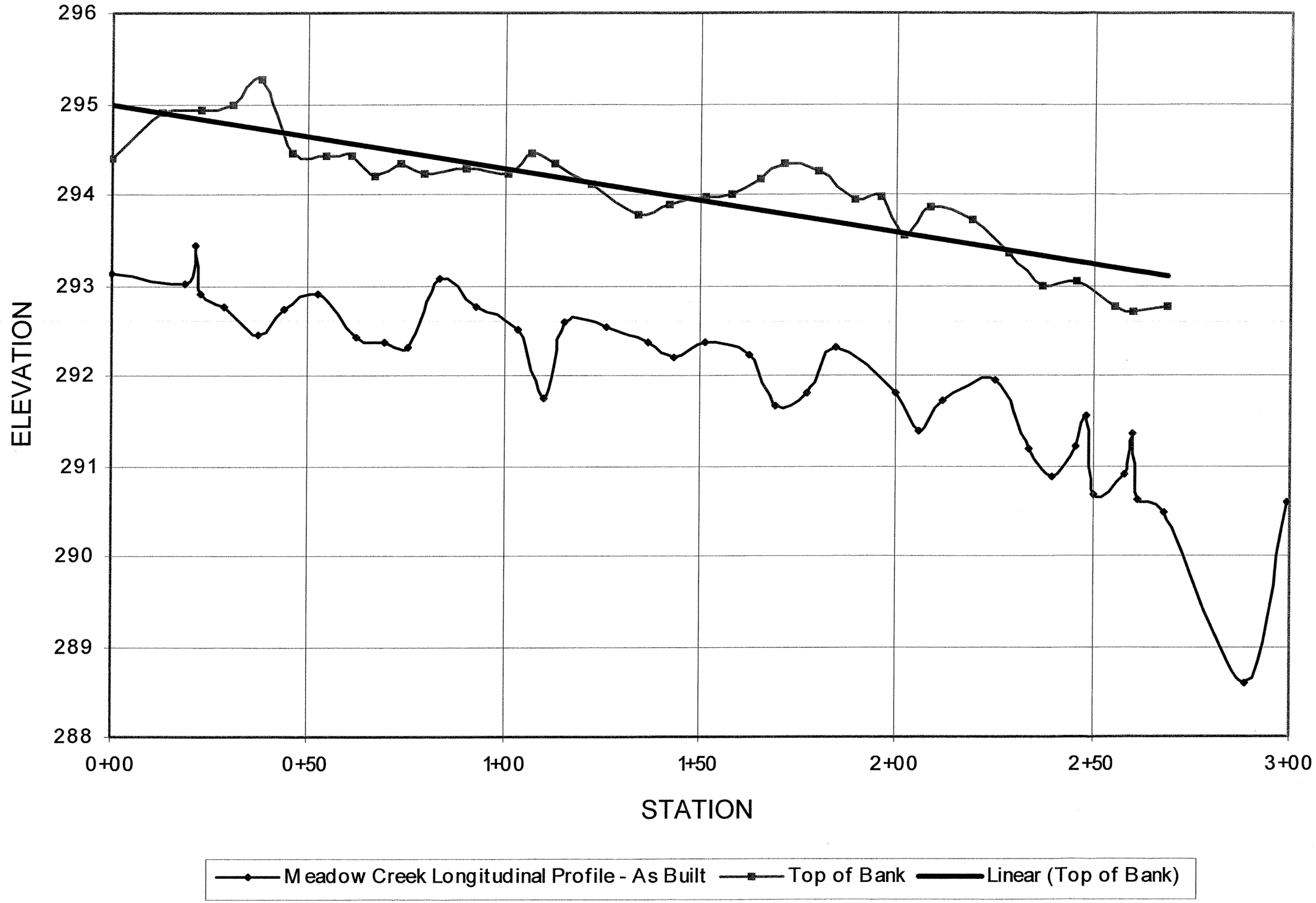

Project: HATCHET'S GROVE at PRESTONWOOD
STREAM RESTORATION RECORD DRAWINGS

Location: WAKE CO., NC

Client: ECOSYSTEM ENHANCEMENT PROGRAM

Sheet Title: LONGITUDINAL PROFILE - MEADOW CREEK

Project No.: 6761
Designed: PAJ
Drawn: EGT, MM
Scale: AS SHOWN
Sheet No.: 8 OF 9

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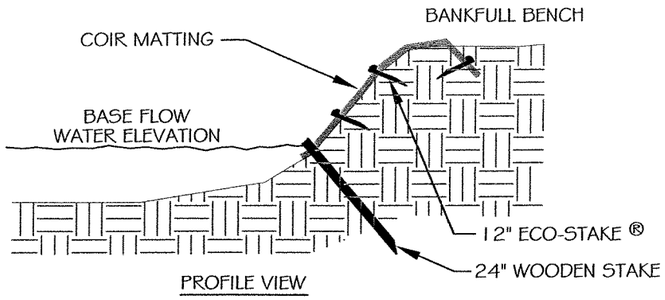
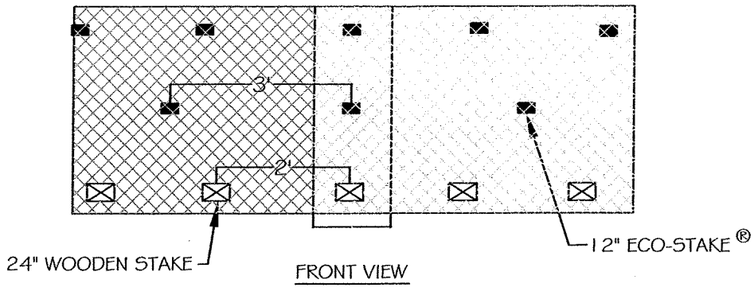
COIR MATTING DETAIL

(NOT TO SCALE)



PROFILE VIEW

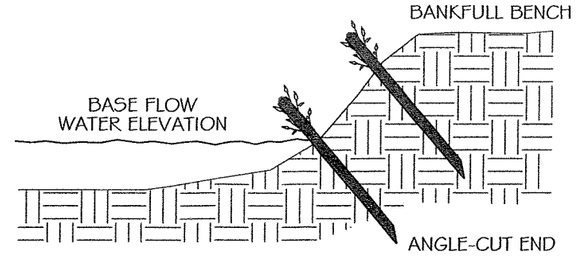


FRONT VIEW

- TRENCHED TOP OF MATTING TO A DEPTH OF AT LEAST 6", STAKED OR STAPLED IN PLACE, & BACKFILL TO DESIGN GRADE
- MINIMUM 24" WOODEN STAKES INSTALLED ALONG TOE OF MATTING (Intercept between water surface and bank)
- MINIMUM 2' CENTERS ALONG BOTTOM
- MINIMUM 1' OVERLAP AT JOINING SECTIONS OF COIR MATTING
- 12" ECO-STAKES®OR 12" STAPLES INSTALLED IN BANK FLUSH WITH COIR MATTING ABOVE BOTTOM ROW OF 24" STAKES
- ECO-STAKES®OR STAPLES SPACED AT MAXIMUM 3' CENTERS (APPROX.)

LIVE STAKE PLANTING DETAIL

(NOT TO SCALE)

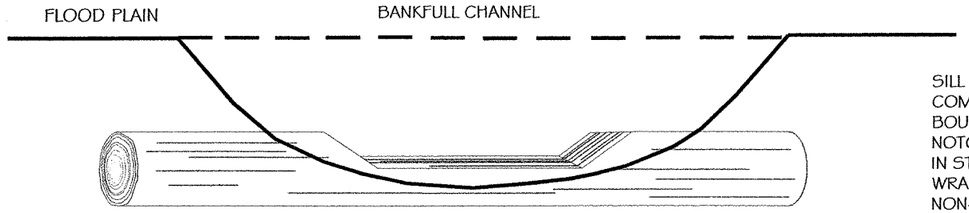


- LIVE STAKES INSTALLED IN BANK WITH DEAD-BLOW HAMMER
- 4/5 OF STAKE IN GROUND
- BUDS ORIENTED UPWARDS
- 3' CENTERS (APPROX.)
- CUT EXPOSED END OF LIVE STAKE AFTER INSTALLATION IF DAMAGED DUE TO INSTALLATION (i.e. damaged bark, split ends, etc.)

CHANNEL SILL

TYPICAL CROSS-SECTION

(NOT TO SCALE)

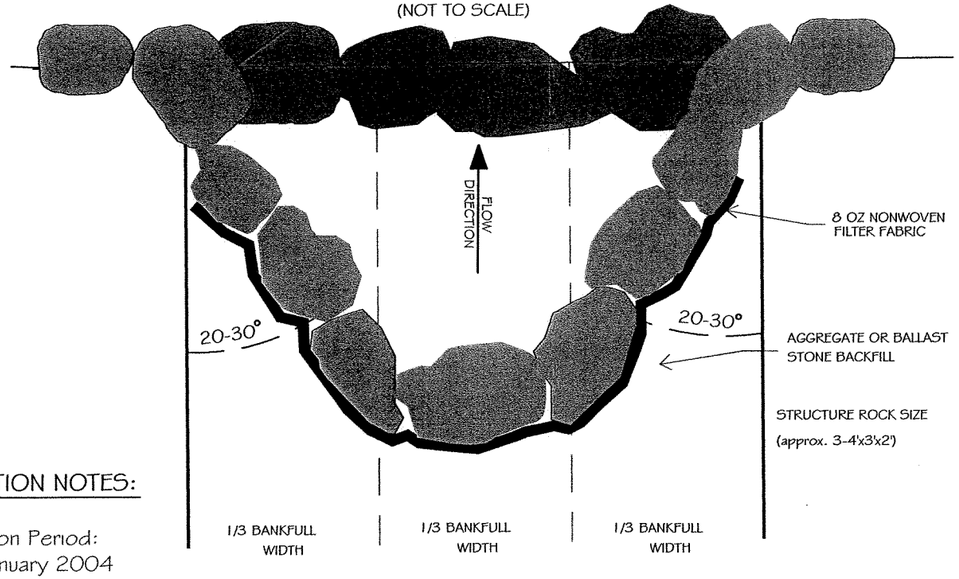


SILL MAY BE COMPOSED OF BOULDERS OR A NOTCHED LOG BEDDED IN STONE AGGREGATE WRAPPED WITH NON-WOVEN FABRIC

ROCK CROSS-VANE DETAIL

TYPICAL PLAN VIEW

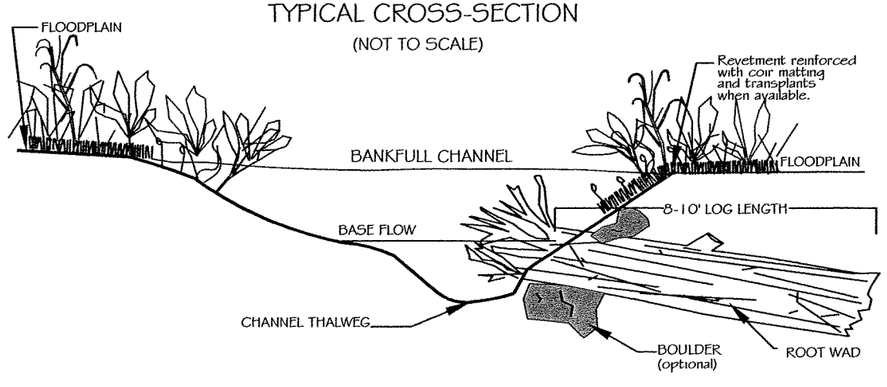
(NOT TO SCALE)



ROOT WAD REVETMENT

TYPICAL CROSS-SECTION

(NOT TO SCALE)



CONSTRUCTION NOTES:

1) Construction Period:
   Start - January 2004
   Finish - May 2004

2) Soil & Environmental Consultants, PA. performed daily inspections of site during construction period to ensure construction was performed in general accordance with construction documents.

TYPICAL FEATURE DETAILS

Project: HATCHETS GROVE at PRESTONWOOD STREAM RESTORATION RECORD DRAWINGS
Location: WAKE CO., NC
Client: ECOSYSTEM ENHANCEMENT PROGRAM
Sheet Title: TYPICAL FEATURE DETAILS
Project No.: 6761
Designed: PAJ
Drawn: EGT, MM
Scale: AS SHOWN
Sheet No.: 9 OF 9

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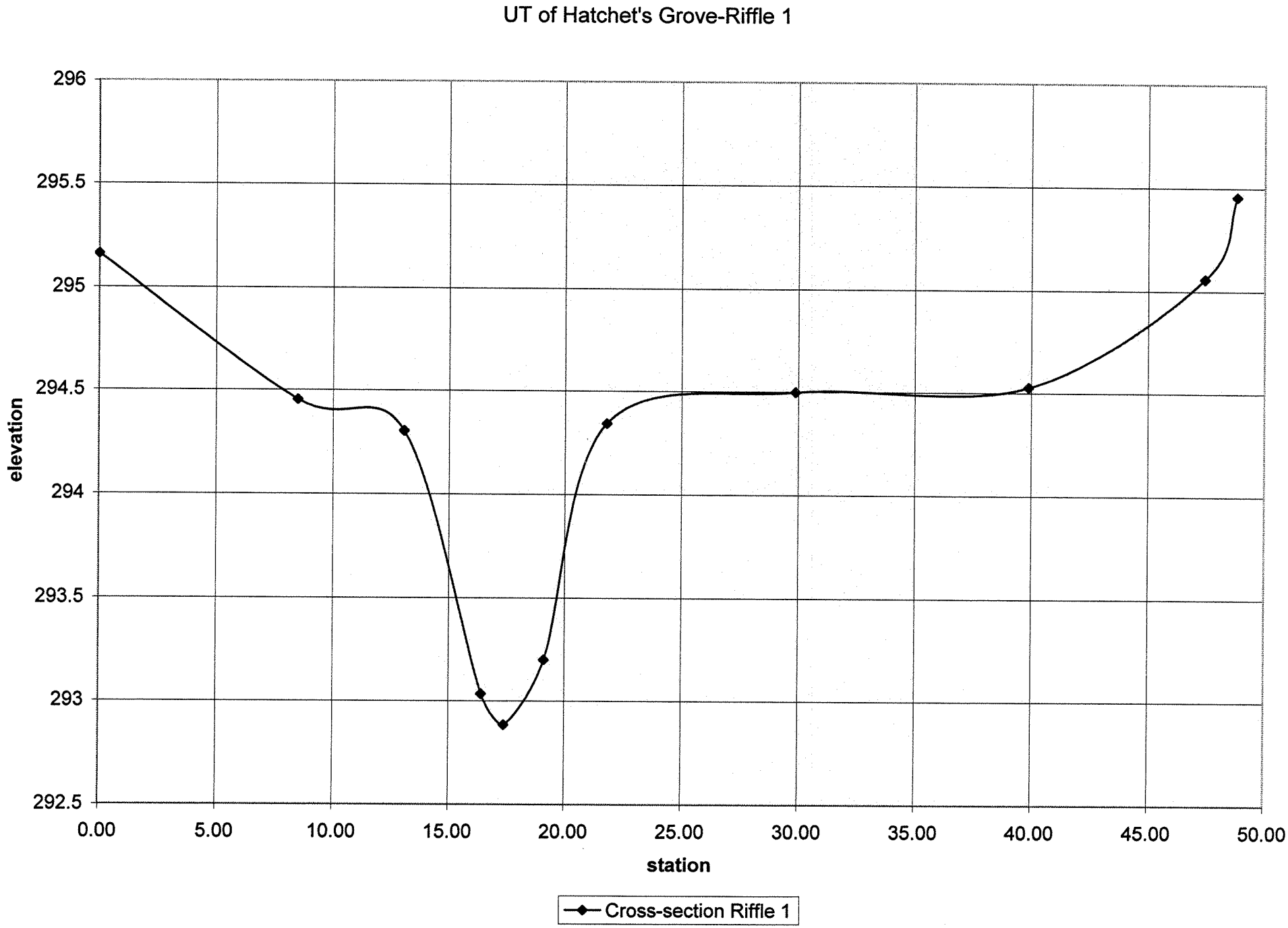
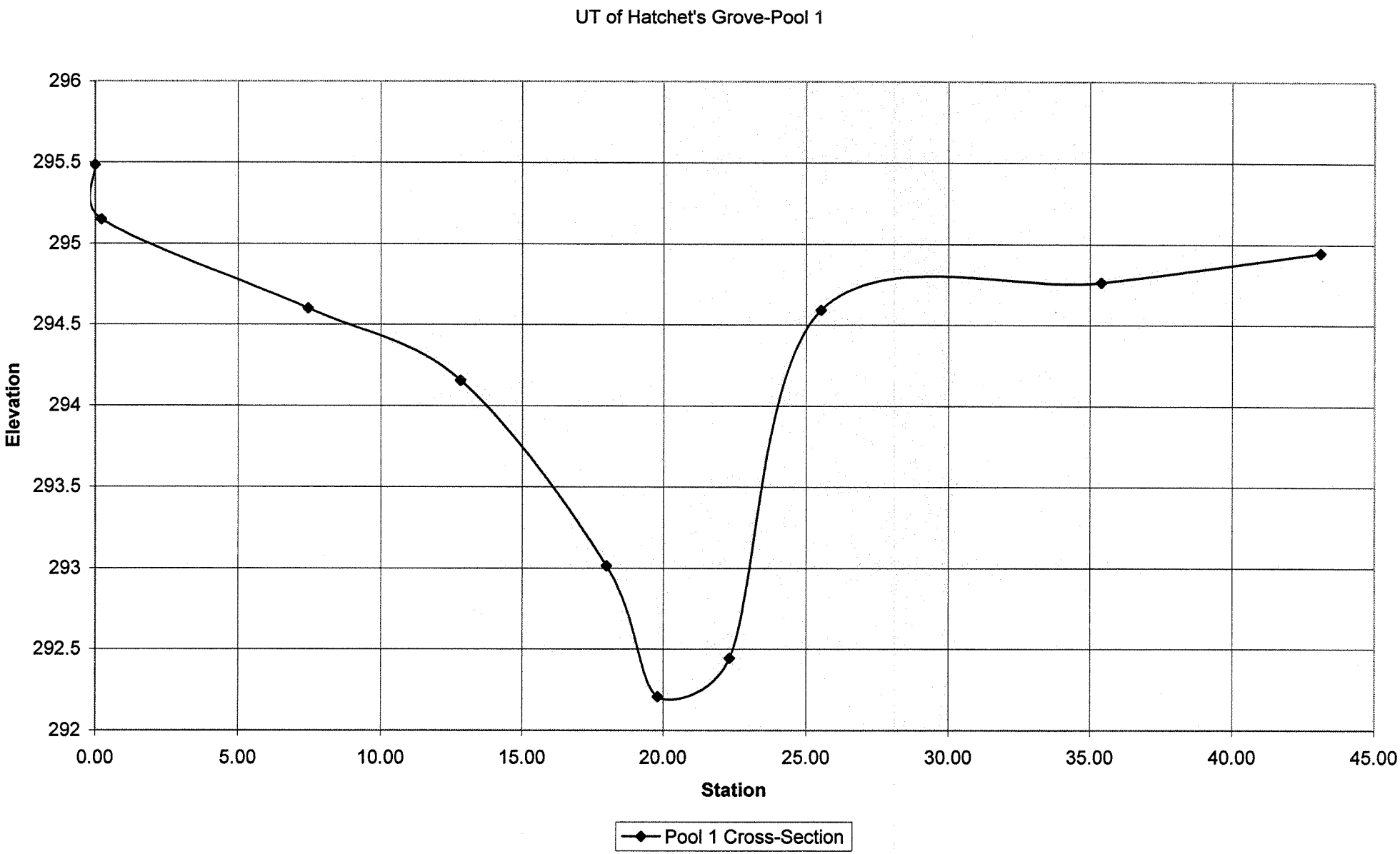

UT of Hatchet's Grove-Riffle 1
296
295.5
295
294.5
294
293.5
293
292.5
elevation
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
station
Cross-section Riffle 1

UT of Hatchet's Grove at Prestonwood CC - As-built

Riffle 1

Pt. Number	Northing	Easting	Elevation	Description	Location		
7773	2048244	751630.1	295.1614	NG	R1	0.00	0.00
7774	2048238	751624.5	294.4539	NG	R1	8.50	0+08.5
7775	2048234	751621.4	294.303	TOP	R1	4.57	0+13.1
7776	2048232	751619.4	293.0335	TOE	R1	3.35	0+16.4
7777	2048231	751618.9	292.8854	CL	R1	0.98	0+17.4
7778	2048229	751617.7	293.1984	TOE	R1	1.73	0+19.1
7779	2048227	751616	294.3418	TOP	R1	2.67	0+21.8
7780	2048221	751611.4	294.4979	NG	R1	8.08	0+29.9
7781	2048213	751605.2	294.5265	NG	R1	10.00	0+39.9
7782	2048208	751599.8	295.0581	NG	R1	7.55	0+47.4
7783	2048207	751598.5	295.4552	REBAR R1	R1	1.38	0+48.8

Width	Depth	Area		
3.35	0.63	2.13	**max depth**	1.42
0.98	1.34	1.31	**Bkfl.width**	8.73
1.73	1.26	2.18	**Ave depth**	0.81
2.67	0.53	1.42	**w/d**	10.82
			Floodprone elevation	295.72
			floodprone width	90
			entrenchment ratio	10.31
Cross-sectional Area		**7.05**		


UT of Hatchet's Grove-Pool 1
296
295.5
295
294.5
294
293.5
293
292.5
292
Elevation
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
Station
Pool 1 Cross-Section

UT of Hatchet's Grove at Prestonwood CC - As-built

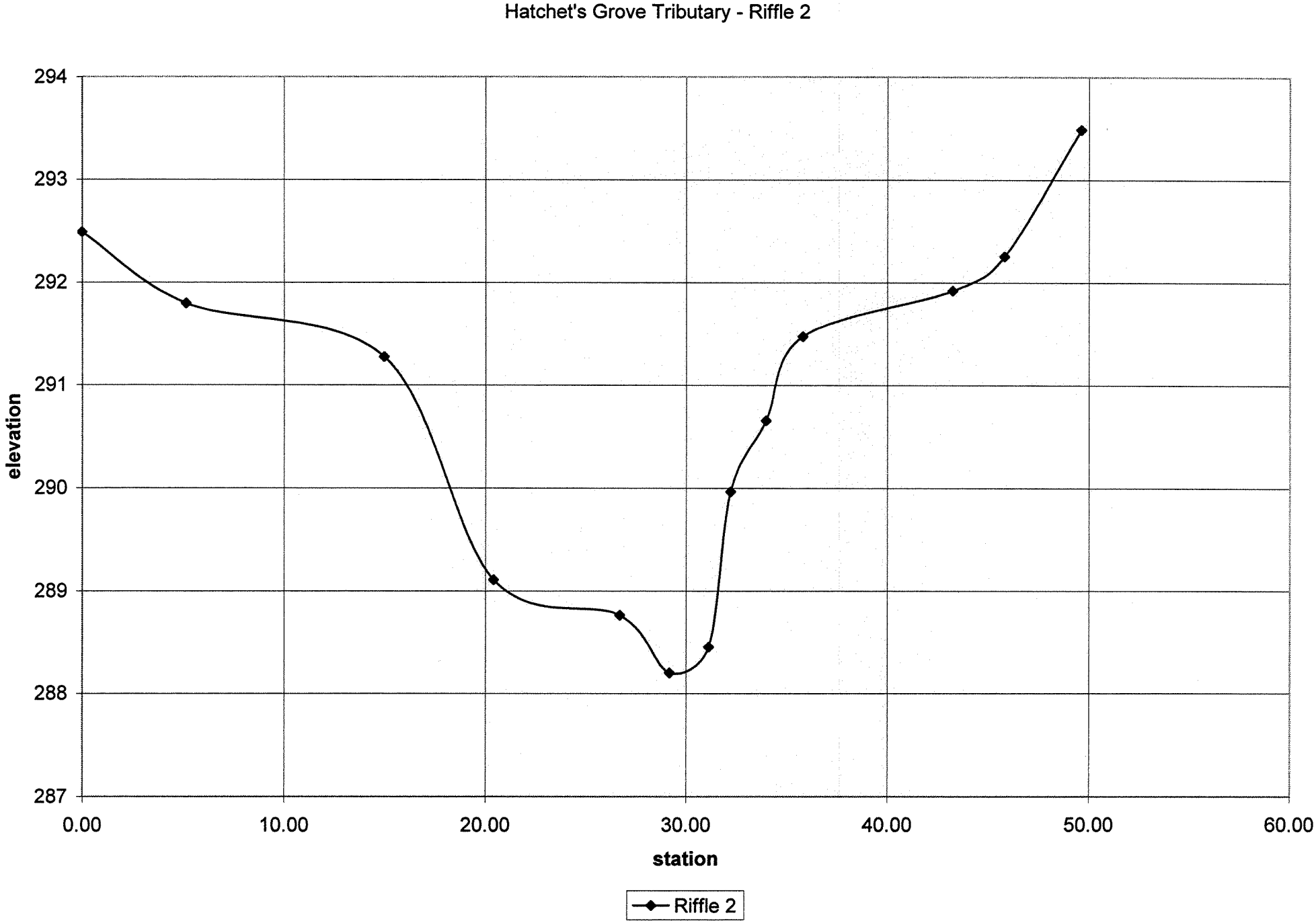
Construction Completed June 2004

Pool 1

Pt. Number	Northing	Easting	Elevation	Description	Location		
7762	2048244	751630.2	295.483	REBAR NP1	R1	0.00	0.00
7763	2048244	751630	295.149	NG	R1	0.23	0+00.2
7764	2048245	751622.8	294.5986	NG	R1	7.23	0+07.5
7765	2048245	751617.4	294.1524	TOP	R1	5.37	0+12.8
7766	2048245	751612.2	293.0148	TOE	R1	5.17	0+18.0
7767	2048245	751610.4	292.2066	CL	R1	1.82	0+19.8
7768	2048246	751608	292.4422	TOE	R1	2.52	0+22.3
7769	2048246	751604.8	294.5896	TOP	R1	3.19	0+25.5
7770	2048247	751595	294.7636	NG	R1	9.87	0+35.4
7771	2048247	751587.3	294.948	NG	R1	7.71	0+43.1

Width	Depth	Area		
			max depth	1.95
5.17	0.57	2.94	**Bkfl.width**	12.70
1.82	1.54	2.80	**Ave depth**	0.97
2.52	1.83	4.60	**w/d**	13.02
3.19	0.64	2.03		

Cross-sectional Area **12.38**

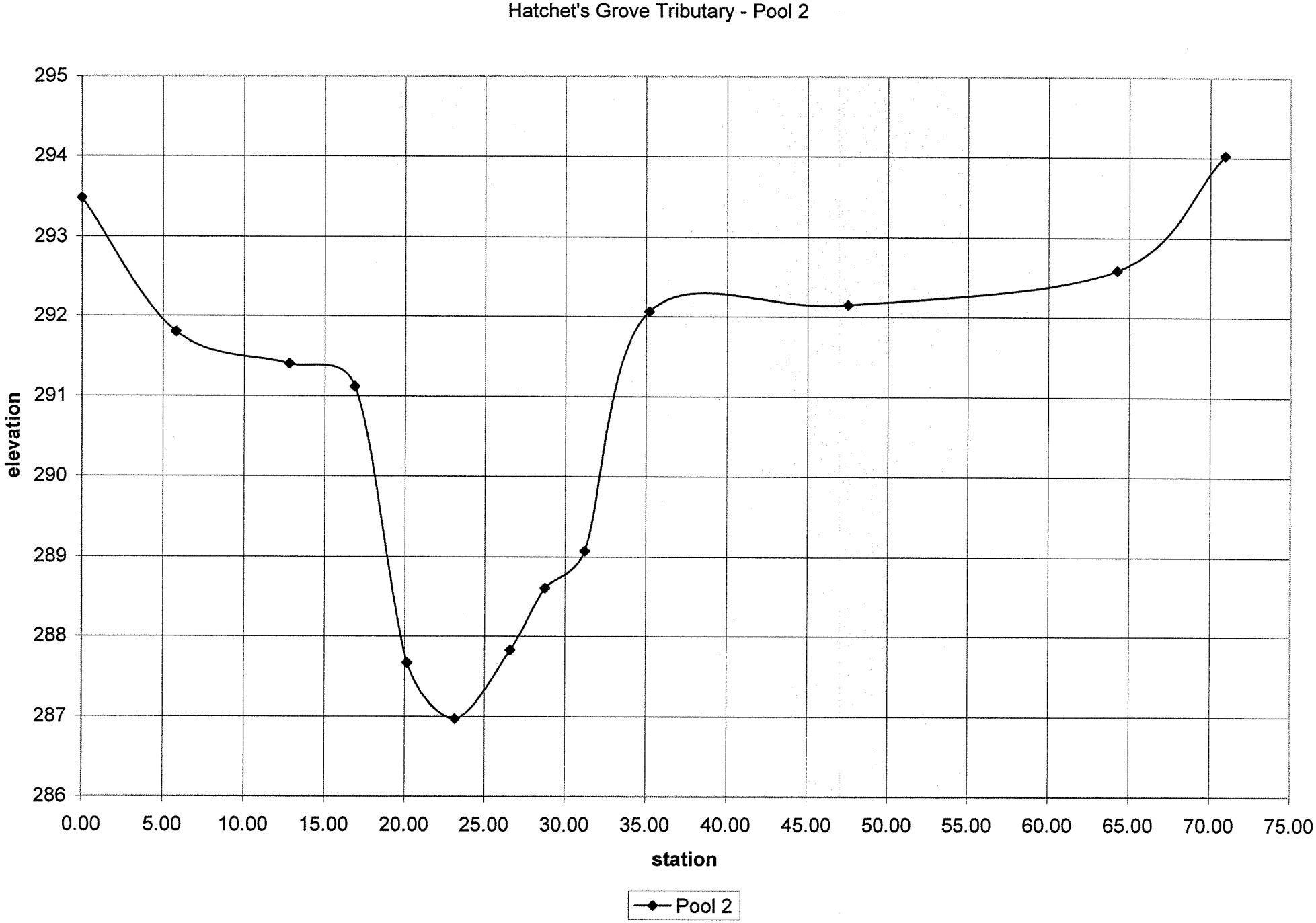

Hatchet's Grove Tributary - Riffle 2
294
293
292
291
290
289
288
287
elevation
0.00
10.00
20.00
30.00
40.00
50.00
60.00
station
Riffle 2

Hatchet's Grove Tributary at Prestonwood CC - As-built

Riffle 2

Pt. Number	Northing	Easting	Elevation	Description	Location		
8498	2048673	751588.1	292.49	NG	R2	0.00	0.00
8499	2048675	751583.3	291.7963	NG	R2	5.17	0+05.2
8500	2048679	751574.1	291.2721	TOP	R2	9.82	0+15.0
8501	2048682	751570	289.1087	TOE	R2	5.44	0+20.4
8502	2048686	751564.7	288.7627	TOE	R2	6.28	0+26.7
8503	2048687	751562.5	288.2	CL	R2	2.48	0+29.2
8504	2048688	751560.7	288.4536	TOE	R2	1.94	0+31.1
8505	2048688	751559.7	289.9654	TOP	R2	1.09	0+32.2
8506	2048689	751558.4	290.6553	TOE	R2	1.76	0+34.0
8507	2048691	751557.1	291.4743	TOP	R2	1.83	0+35.8
8508	2048693	751550	291.9222	NG	R2	7.44	0+43.3
8509	2048694	751547.6	292.2575	NG	R2	2.57	0+45.8
8510	2048695	751544.1	293.4869	NG	R2	3.80	0+49.6

Width	Depth	Area		
5.44	1.08	5.89	**max depth**	3.07
6.28	2.34	14.68	**Bkfl.width**	20.82
2.48	2.79	6.91	**Ave depth**	1.80
1.94	2.95	5.72	**w/d**	11.56
1.09	2.06	2.25	**Floodprone elevation**	294.34
1.76	0.96	1.69	**floodprone width**	60
1.83	0.21	0.38	**entrenchment ratio**	2.88
Cross-sectional Area		**37.51**		


Hatchet's Grove Tributary - Pool 2
295
294
293
292
291
290
289
288
287
286
elevation
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
55.00
60.00
65.00
70.00
75.00
station
Pool 2

Hatchet's Grove Tributary at Prestonwood CC - As-built

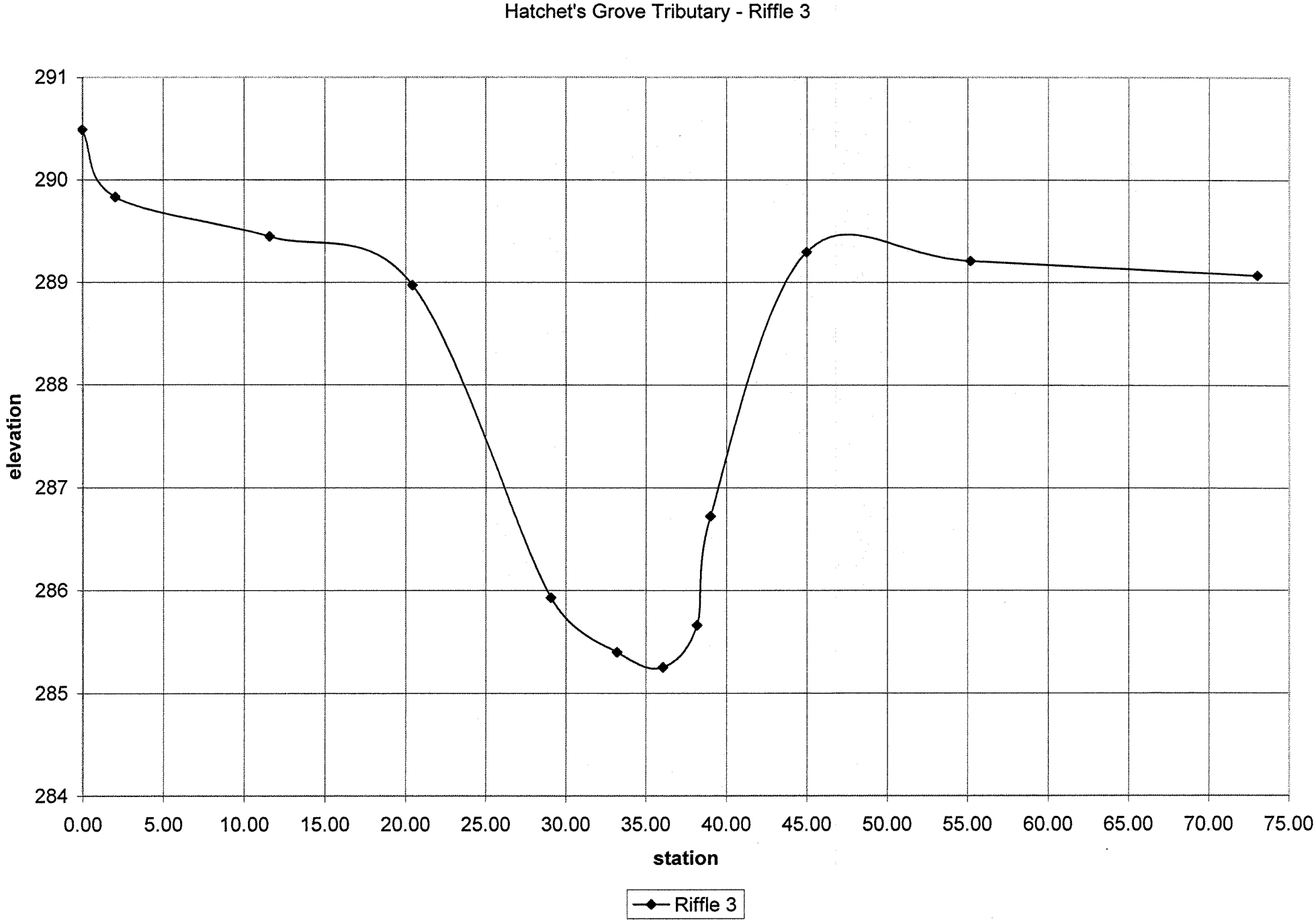
Pool 2

Pt. Number	Northing	Easting	Elevation	Description	Location		
8513	2048756	751623.4	293.4776	NG	P2	0.00	0.00
8514	2048756	751617.5	291.7959	NG	P2	5.82	0+05.8
8515	2048753	751611.2	291.3975	NG	P2	7.00	0+12.8
8516	2048753	751607.1	291.1149	TOP	P2	4.08	0+16.9
8517	2048752	751603.9	287.6655	TOE	P2	3.29	0+20.2
8518	2048752	751601	286.9693	CL	P2	2.99	0+23.2
8519	2048751	751597.6	287.8249	TOE	P2	3.43	0+26.6
8520	2048752	751595.4	288.6018	TOP	P2	2.15	0+28.8
8521	2048750	751593.3	289.0729	TOE	P2	2.48	0+31.2
8522	2048750	751589.3	292.0637	TOP	P2	3.97	0+35.2
8523	2048748	751577.2	292.1501	NG	P2	12.30	0+47.5
8524	2048746	751560.6	292.5902	NG	P2	16.75	0+64.3
8525	2048746	751554	294.0242	NG	P2	6.65	0+70.9

Width	Depth	Area
3.29	1.72	5.68
2.99	3.80	11.36
3.43	3.72	12.75
2.15	2.90	6.24
2.48	2.28	5.65
3.97	0.55	2.17

Cross-sectional Area **43.87**

max depth	4.15
Bkfl.width	18.32
Ave depth	2.39
w/d	7.65


Hatchet's Grove Tributary - Riffle 3
291
290
289
288
287
286
285
284
elevation
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
55.00
60.00
65.00
70.00
75.00
station
Riffle 3

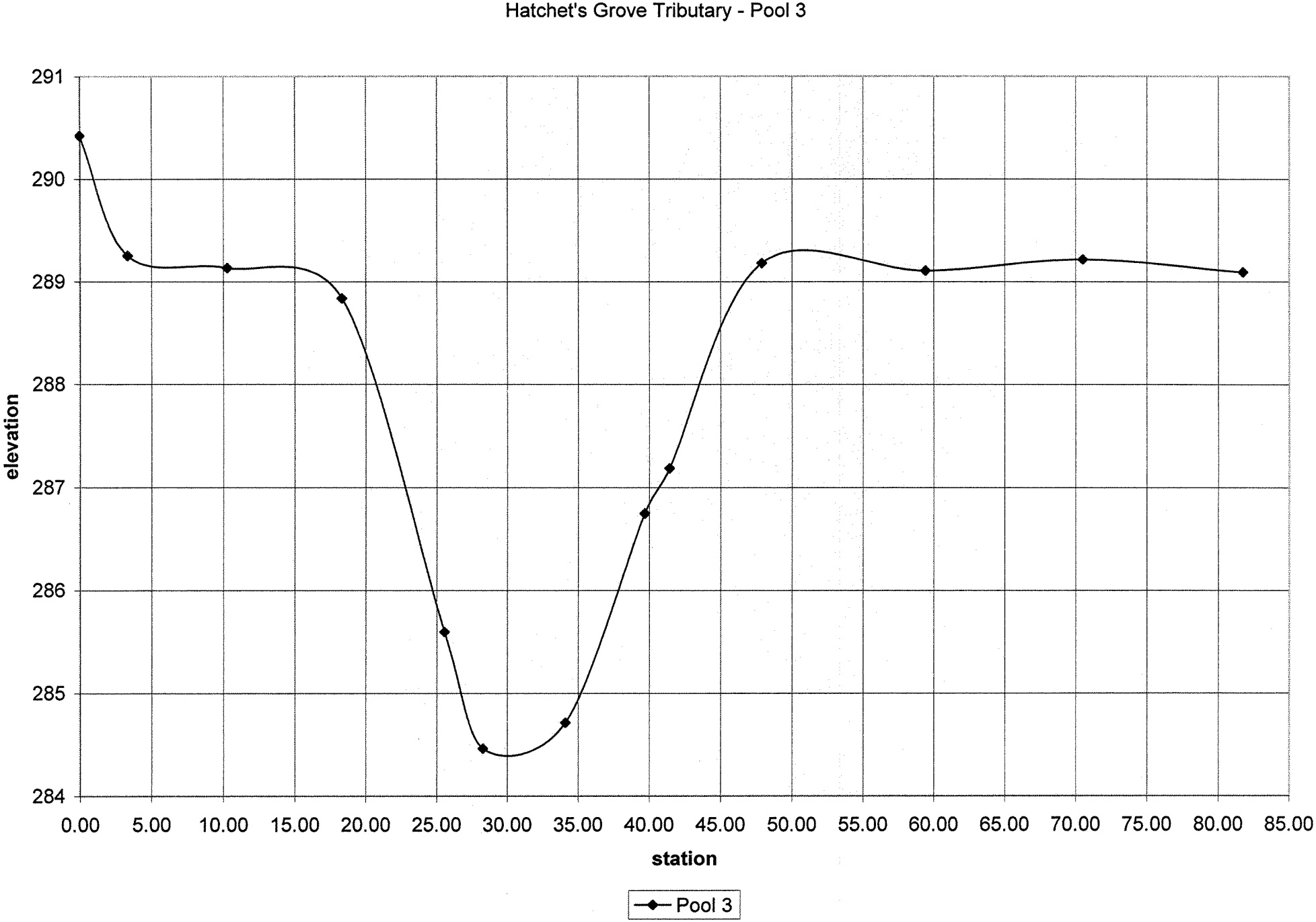
Hatchet's Grove Tributary at Prestonwood CC - As-built

Riffle 3

Pt. Number	Northing	Easting	Elevation	Description	Location		
8485	2049764	751836.4	290.4858	NG	R3	0.00	0.00
8486	2049765	751835.8	289.8331	NG	R3	2.05	0+02.1
8487	2049775	751834.9	289.447	NG	R3	9.55	0+11.6
8488	2049784	751833.3	288.9708	TOP	R3	8.86	0+20.5
8489	2049792	751831	285.9276	TOE	R3	8.64	0+29.1
8490	2049796	751830.7	285.3964	TOE	R3	4.13	0+33.2
8491	2049799	751830.3	285.2494	CL	R3	2.85	0+36.1
8492	2049801	751830.3	285.6596	TOE	R3	2.11	0+38.2
8493	2049802	751830.3	286.7241	TOP	R3	0.83	0+39.0
8494	2049808	751829.8	289.2973	TOP	R3	5.98	0+45.0
8495	2049818	751828.7	289.2092	NG	R3	10.18	0+55.2
8496	2049836	751828.5	289.0696	NG	R3	17.84	0+73.0

Width	Depth	Area		
8.64	1.52	13.14	**max depth**	3.72
4.13	3.31	13.66	**Bkfl.width**	24.53
2.85	3.65	10.38	**Ave depth**	2.15
2.11	3.52	7.40	**w/d**	11.43
0.83	2.78	2.31	**Floodprone elevation**	292.69
5.98	0.96	5.74	**floodprone width**	100
			entrenchment ratio	4.08

Cross-sectional Area **52.64**

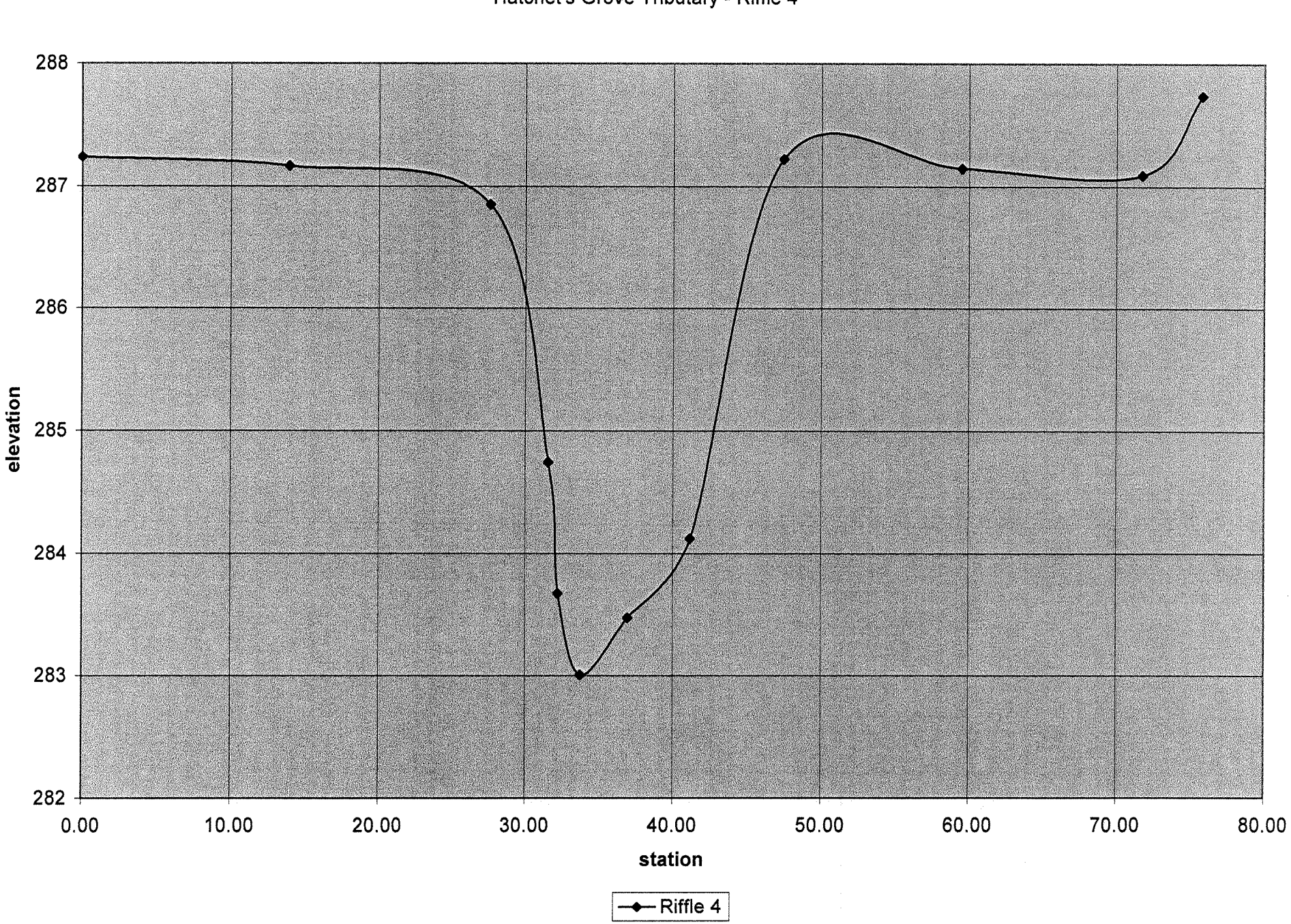

Hatchet's Grove Tributary - Pool 3
291
290
289
288
287
286
285
284
elevation
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
55.00
60.00
65.00
70.00
75.00
80.00
85.00
station
Pool 3

Hatchet's Grove Tributary at Prestonwood CC - As-built

Pool 3

Pt. Number	Northing	Easting	Elevation	Description	Location		
8470	2049813	751905.6	290.418	NG	P3	0.00	0.00
8471	2049814	751902.4	289.2534	NG	P3	3.37	0+03.4
8472	2049815	751895.6	289.1341	NG	P3	6.94	0+10.3
8473	2049817	751887.7	288.8341	NG	P3	8.04	0+18.3
8474	2049817	751880.5	285.5945	TOE	P3	7.23	0+25.6
8475	2049819	751878.3	284.4604	CL	P3	2.74	0+28.3
8476	2049823	751874.2	284.712	TOE	P3	5.81	0+34.1
8477	2049824	751868.8	286.7496	TOP	P3	5.59	0+39.7
8478	2049825	751867.1	287.1841	TOE	P3	1.74	0+41.4
8479	2049825	751860.7	289.181	TOP	P3	6.46	0+47.9
8480	2049829	751849.8	289.1081	NG	P3	11.52	0+59.4
8481	2049832	751839.4	289.218	NG	P3	11.10	0+70.5
8482	2049836	751828.8	289.0949	NG	P3	11.23	0+81.7

Width	Depth	Area		
7.23	1.62	11.70	**max depth**	4.37
2.74	3.81	10.42	**Bkfl.width**	29.55
5.81	4.25	24.67	**Ave depth**	2.42
5.59	3.10	17.34	**w/d**	12.20
1.74	1.87	3.25		
6.46	0.65	4.21		
Cross-sectional Area		**71.58**		


Hatchet's Grove Tributary - Riffle 4
288
287
286
285
284
283
282
elevation
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
station
Riffle 4

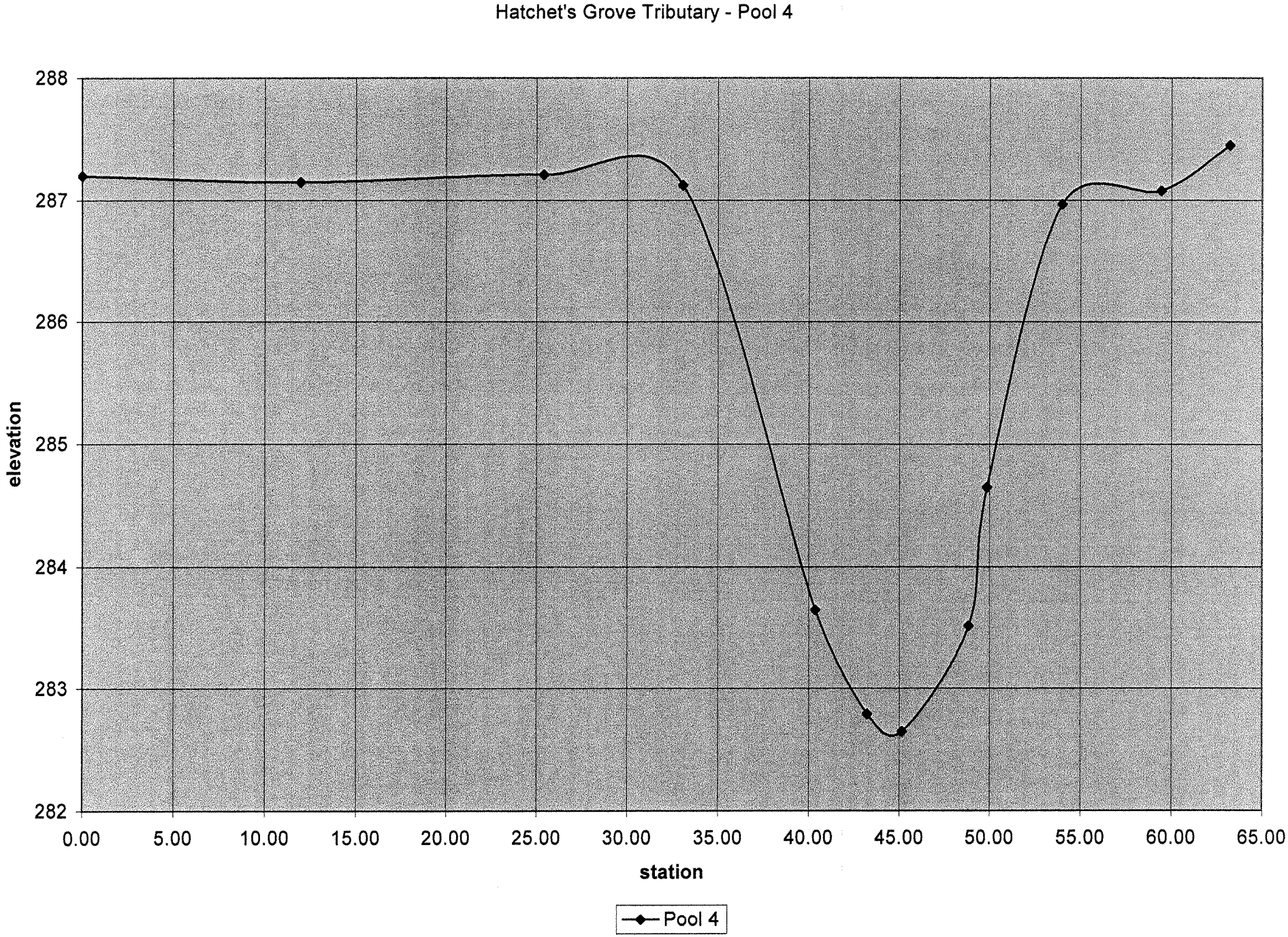
Hatchet's Grove Tributary at Prestonwood CC - As-built

Riffle 4

Pt. Number	Northing	Easting	Elevation	Description	Location		
8531	2050653	751818.6	287.239	NG	R4	0.00	0.00
8532	2050646	751806.4	287.1674	NG	R4	13.94	0+13.9
8533	2050640	751794.3	286.8531	TOP	R4	13.65	0+27.6
8534	2050638	751790.8	284.7483	TOE	R4	3.99	0+31.6
8535	2050638	751790.3	283.6757	TOE	R4	0.65	0+32.2
8536	2050637	751788.8	283.01	CL	R4	1.53	0+33.7
8537	2050636	751785.7	283.4737	TOP	R4	3.21	0+37.0
8538	2050634	751781.9	284.1229	TOE	R4	4.21	0+41.2
8539	2050631	751776.8	287.223	TOP	R4	6.26	0+47.4
8540	2050624	751766.7	287.1502	NG	R4	12.10	0+59.5
8541	2050618	751756.3	287.0907	NG	R4	12.22	0+71.7
8542	2050616	751752.7	287.7352	NG	R4	4.06	0+75.8

Width	Depth	Area		
3.99	1.05	4.20	**max depth**	3.84
0.65	2.64	1.71	**Bkfl.width**	19.84
1.53	3.51	5.37	**Ave depth**	2.17
3.21	3.61	11.60	**w/d**	9.13
4.21	3.05	12.86	**Floodprone elevation**	290.70
6.26	1.18	7.39	**floodprone width**	100
			entrenchment ratio	5.04

Cross-sectional Area **43.11**


Hatchet's Grove Tributary - Pool 4
288
287
286
285
284
283
282
elevation
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
55.00
60.00
65.00
station
Pool 4

Hatchet's Grove Tributary at Prestonwood CC - As-built

Pool 4

Pt. Number	Northing	Easting	Elevation	Description	Location		
8544	2050653	751818.7	287.1999	NG	P4	0.00	0.00
8545	2050658	751807.9	287.1491	NG	P4	11.98	0+12.0
8546	2050664	751795.9	287.2073	NG	P4	13.42	0+25.4
8547	2050668	751789	287.1245	TOP	P4	7.67	0+33.1
8548	2050671	751782.3	283.6443	TOE	P4	7.29	0+40.4
8549	2050672	751779.8	282.7928	TOE	P4	2.87	0+43.2
8550	2050673	751778.1	282.6513	CL	P4	1.92	0+45.2
8551	2050673	751774.5	283.5128	TOE	P4	3.67	0+48.8
8552	2050673	751773.5	284.6522	TOP	P4	1.02	0+49.8
8553	2050675	751770.4	286.9665	TOP	P4	4.14	0+54.0
8554	2050679	751766.4	287.0773	NG	P4	5.46	0+59.4
8555	2050681	751762.8	287.4491	NG	P4	3.77	0+63.2

Width	Depth	Area
7.29	1.74	12.69
2.87	3.91	11.20
1.92	4.40	8.44
3.67	4.04	14.83
1.02	3.04	3.09
4.14	1.32	5.45
Cross-sectional Area		**55.70**

max depth	4.47
Bkfl.width	20.91
Ave depth	2.66
w/d	7.85

Hatchet's Grove Stream and Neuse Riparian Buffer Restoration Project

As-built Photographs

Nested Pair #1

Meadow Creek Riffle 1-Oriented upstream of cross-section

Meadow Creek Pool 1-Oriented upstream of cross-section

Nested Pair #2

Hatchet's Grove Riffle 2 -Oriented upstream of cross-section

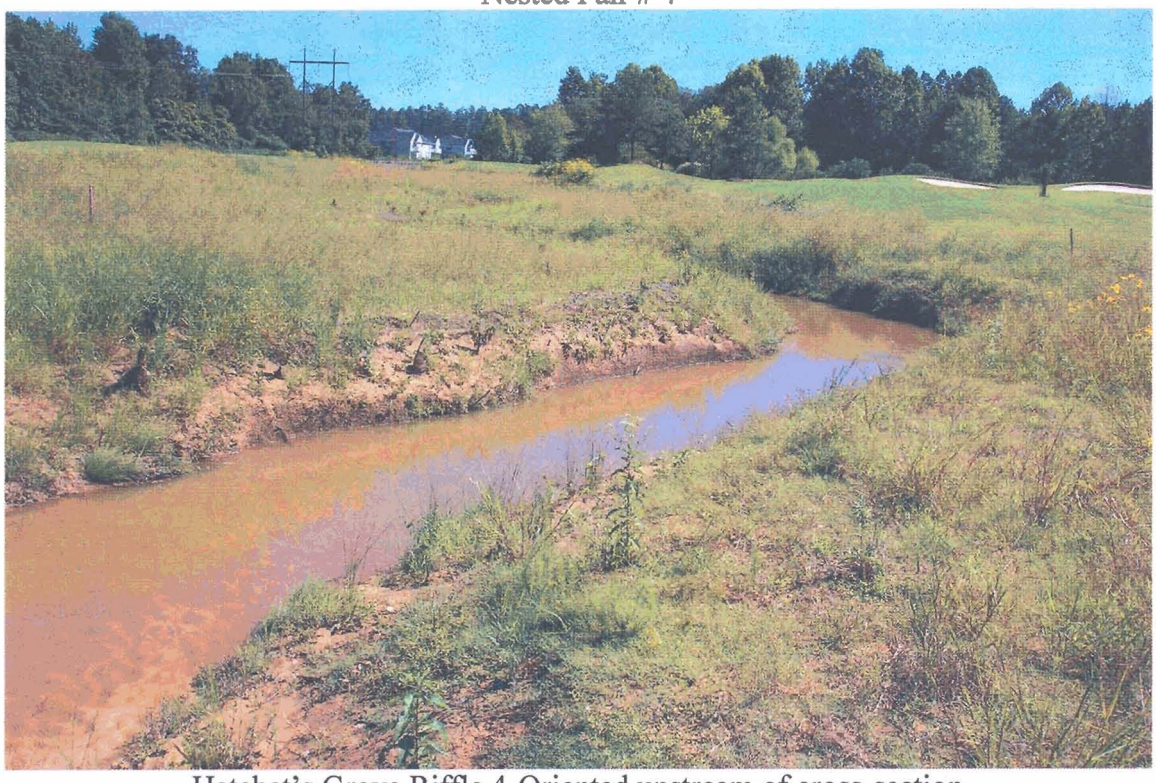
Hatchet's Grove Pool 2-Oriented upstream of cross-section

Nested Pair # 3

Hatchet's Grove Riffle 3 -Oriented upstream of cross-section

Hatchet's Gove Pool 3-Oriented upstream of cross-section

Nested Pair # 4



Hatchet's Grove Riffle 4-Oriented upstream of cross-section

Hatchet's Grove Pool 4-Oriented upstream of cross-section

Hatchet's Grove

Lower 300 feet of Restoration Oriented Upstream; Sewer Pipe is the Project Terminus

Upper 300 feet of Hatchet's Grove and Confluence with Meadow Creek Oriented Downstream and Taken from 80-foot Cart Bridge

80-foot Span Cart Bridge

Photograph Taken at 80-foot Span Bridge Looking Downstream

Photograph Taken Below 80-foot Span Bridge

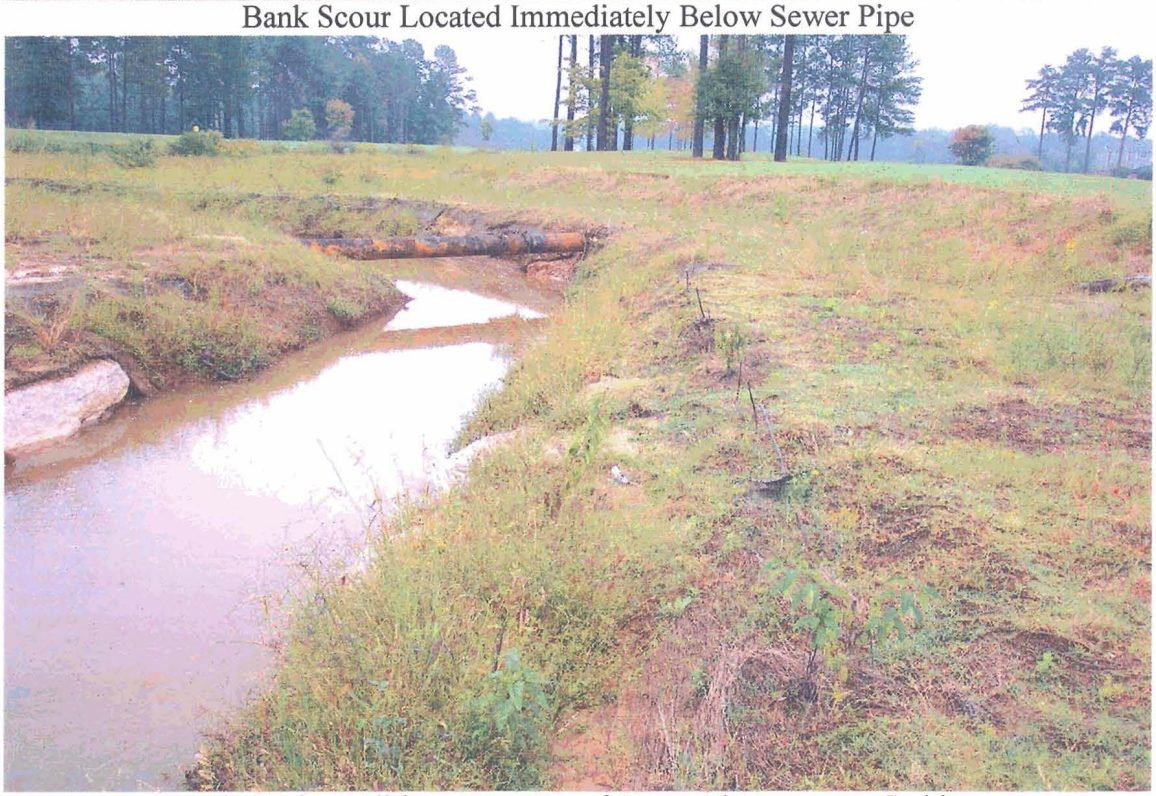
Tropical Storm Gaston

Confluence of Hatchet's Grove and Meadow Creek after Flooding Receded

Nested Flood Plain Inundated with Approximately 1-foot of Water Below Station 20+00

Recommended Repair Area

Bank Scour Located Immediately Below Sewer Pipe



Channel Condition Upstream of Sewer Pipe Appears Stable