Glen Raven Stream Restoration
Monitoring Report – MY03
Alamance County, NC
Basin 03030002 - Contract # D05011-1

Submitted to:

Ecosystem Enhancement PROGRAM

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

December 2009

Landmark Center II, Suite 220
4601 Six Forks Road
Raleigh, NC 27609
Phone: (919) 278-2500
Fax: (919) 783-9266

Project Manager: Joseph J. Pfeiffer, P.W.S.
Email: joe.pfeiffer@kci.com

Design Engineer: Gary M. Mryncza, P.H., P.E.
Email: gary.mryncza@kci.com
KCI Project No: 12054253

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX A – VEGETATION DATA

APPENDIX B – GEOMORPHOLOGIC DATA

EXECUTIVE SUMMARY

The Glen Raven Stream Restoration Site is a full-delivery project that was developed for the North Carolina Ecosystem Enhancement Program (EEP). Construction was completed in March 2007 on an unnamed tributary to the Haw River (UTHR) and two of its tributaries (UT1 and UT2). The 697-acre project watershed is located within the USGS 14-digit HUC 03030002030010 and the NCDWQ Sub-basin 03-06-02 in the Cape Fear River Basin. The project restored approximately 3,317 linear feet of channel using a combination of Priority 2 and 3 approaches, and enhanced 450 linear feet using a Priority 2 approach, generating 3,405 stream mitigation units. The design addressed vertical instability problems and a lack of bed variability by stabilizing stream banks, installing in-stream structures, adjusting stream planform, and clearing and replanting the riparian areas with native vegetation. This report describes the results from the findings of the third year of monitoring that took place in 2009.

The riparian buffer was planted with fifteen different species of bare root trees and shrubs and four different species of live stakes. Eight vegetation monitoring plots were established during the as-built survey. Riparian vegetation must meet a minimum survival success rate of 320 stems/acre after five years. The third year of monitoring counted an average of 565 stems per acre. Some invasive species were noted in the restored stream buffer and will continue to be monitored to determine if corrective action is necessary. The third year of monitoring found the vegetation component of the project to be on track to meeting the vegetative success criteria.

The stream assessment completed during third-year monitoring found the stream to be stable and functioning properly. Channel dimensions have not changed significantly from second-year monitoring conditions. Small portions of localized floodplain erosion were noted during the third year of monitoring and the beaver dams reported during the second year of monitoring have been removed. These areas have been documented in the Current Conditions Plan View. The on-site stream gauges have recorded thirteen bankfull events since the beginning of 2008. This includes the over three-inch rain event from by Tropical Storm Hanna, which caused the stream stage to crest at almost three feet above bankfull.

1.0 PROJECT BACKGROUND

1.1 Project Objectives

- Establish a stable C4 stream channel on the UTHR and a B4c stream channel on UT1 and UT2.
- Create a heterogeneous stream bed with distinct pool and riffle features.
- Plant a riparian buffer with site-appropriate native trees and shrubs.

1.2 Project Structure, Restoration Type, and Approach

The project site became degraded as a result of agricultural activities (poor grazing management) and human disturbances (removal of riparian vegetation and development in the watershed). As a result, the ecological diversity and water quality of the site were adversely affected. The project restored 3,317 linear feet of channel using a combination of Priority 2 and 3 approaches, and enhanced 450 linear feet using a Priority 2 approach. UTHR was restored to a Rosgen stream type C4, and UT1 and UT2 were restored to stream type B4c. The riparian buffer was planted with native trees and shrubs.

1.3 Location and Setting

The Glen Raven Stream Restoration Site is located 1.5 miles northwest of Burlington, North Carolina in Alamance County. The land use of the 697-acre project watershed is comprised of suburban residential development, forest, and agriculture. The watershed has a high potential for future development.

From Raleigh, proceed west on Interstate 40 (I-40). Continue on I-40 West/ I-85 South after they merge near Hillsborough. Take Exit 148 and turn right towards Burlington. Proceed to the split of NC-54/49 and NC-87/100. Turn right heading northwest on NC-87/100. Proceed to the split of NC-87 and NC-100 in Glen Raven. Turn right and travel north 0.15 mile on NC-87. Make a left onto Power Line Road and proceed 0.7 mile. The project site begins just downstream of the Power Line Road culvert (Figure 1).

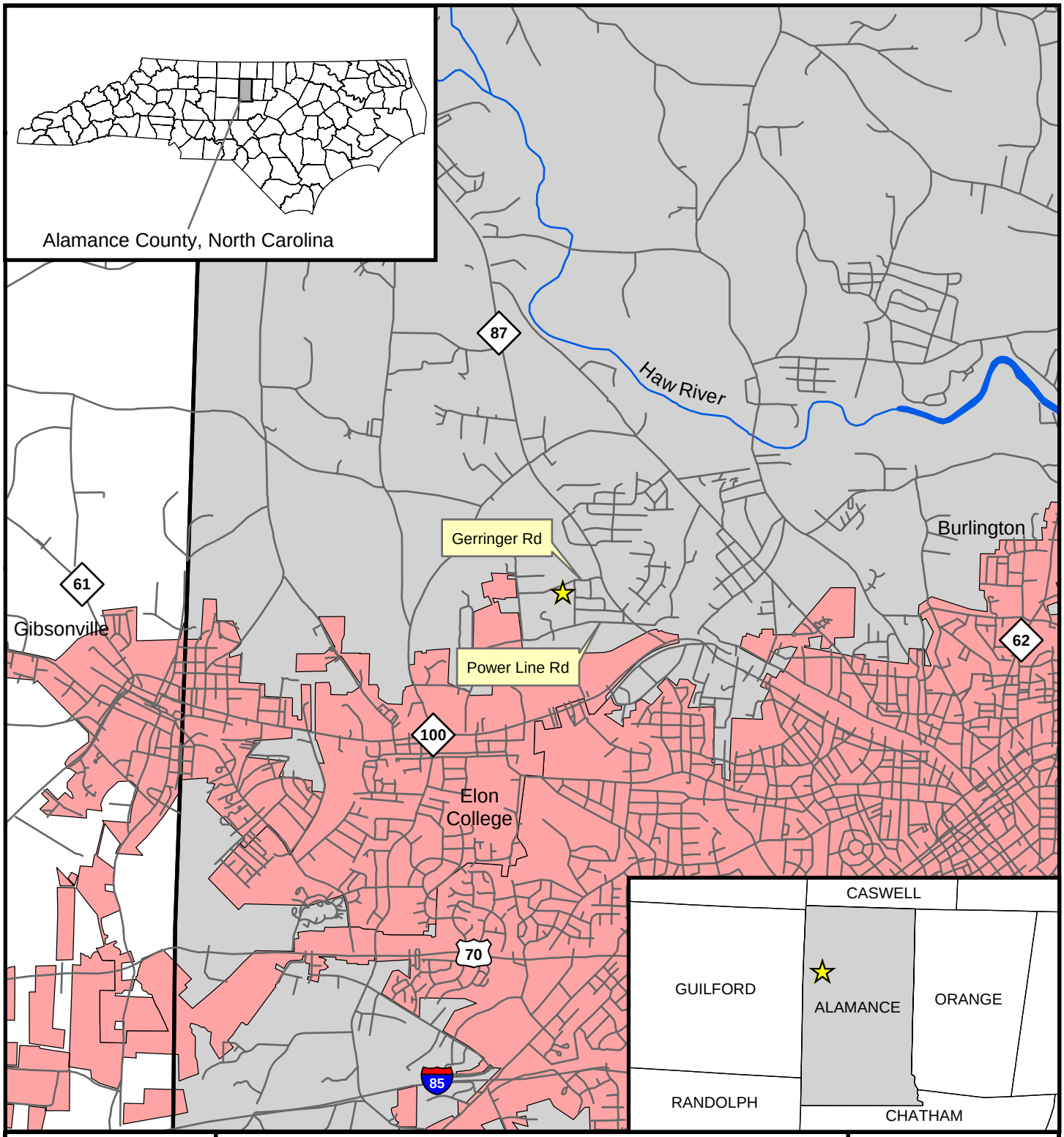


Figure 1. Vicinity Map

- Project Site Location
- Roads
- Major Rivers
- Cities and Towns
- County Boundaries
- Alamance County

N
W E
S

1:63,360
1 inch equals 1 miles

1 0.5 0 1 Miles

KCI TECHNOLOGIES

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

1.4 Project History and Background

Table I. Project Restoration Components
Project Name: Glen Raven

Project Segment / Reach ID	Pre-Restoration Linear Footage	Type	Approach	As-Built Linear Footage	Eligible Footage	Mitigation Ratio	Mitigation Units	Stationing
Reach I	300	R	P2	275 lf	275 lf	1.0	275	10+00 - 12+75
Reach II	483	EI	P2	450 lf	446 lf	1.5	297	12+75 - 17+25
Reach III	1,028	R	P2	1,071 lf	1,014 lf	1.0	1,014	17+25 - 27+96
Reach IV	1,045	R	P2	1,059 lf	1,000 lf	1.0	1,000	27+97 - 38+56
UT 1	524	R	P3	542 lf	501 lf	1.0	501	40+00 - 45+42
UT 2	315	R	P3	370 lf	318 lf	1.0	318	50+00 - 53+70

Mitigation Unit Summations

Stream (lf)	Riparian Wetland	Nonriparian		Total Wetland	Buffer (Ac)
3,405	0	0		0	0

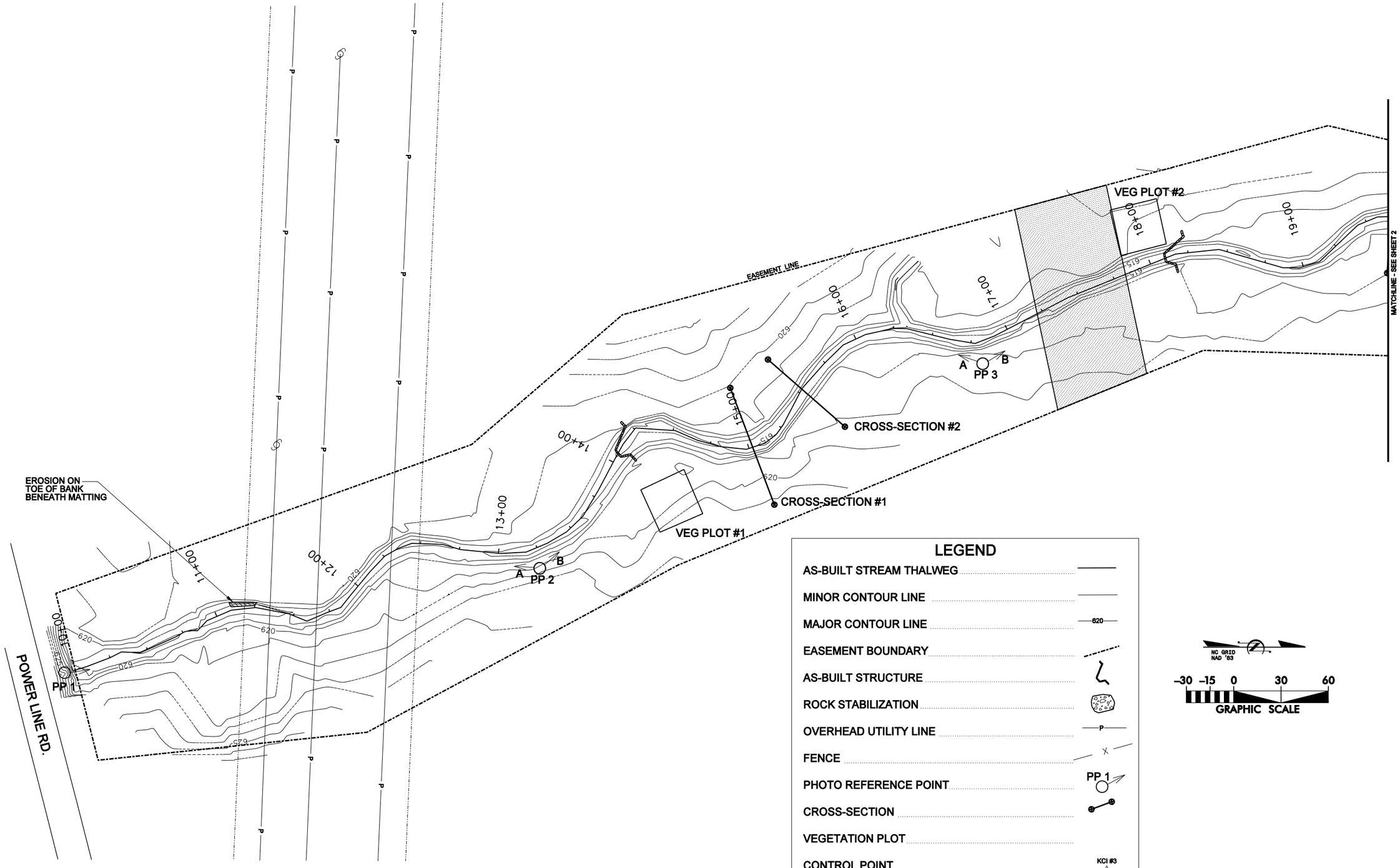
R = Restoration P2 = Priority 2
EI = Enhancement I P3 = Priority 3

Table II. Project Activity and Reporting History
Project Name: Glen Raven

Activity or Report	Data Collection Complete	Completion or Delivery
Restoration Plan	Jan 06	Aug 06
Final Design - Construction Plans	N/A	Oct 06
Construction	N/A	Apr 07
Temporary seed mix applied to entire project area	N/A	Mar 07
Permanent seed mix applied to entire project area	N/A	Apr 07
Tree plantings completed	N/A	Apr 07
Mitigation Plan / As-Built (Year 0 Monitoring - Baseline)	May 07	May 07
Year 1 Monitoring	Oct 07	Nov 07
Year 2 Monitoring	Sep 08	Oct 08
Year 3 Monitoring	Nov 09	Dec 09

Table III. Project Contact Table Project Name: Glen Raven	
Design Firm	KCI Associates of NC, P.A. Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266
Construction Contractor	Environmental Technologies and Construction (ETC) Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Ryan McDavitt Phone: (919) 783-9214 Fax: (919) 783-9266
Planting Contractor	H & J Forest Services PO Box 458 Holly Ridge, NC 28445 Contact: Mr. Brian Jarvenin Phone: (910) 512-6754
Seeding Contractor	N/A
Seed Mix Sources	Evergreen Seed
Nursery Stock Suppliers	International Paper and Cure Nursery
Monitoring Performers	
MY-0 - MY-5	KCI Associates of NC, P.A. Landmark Center, II Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266

Table IV. Project Background Table Project Name: Glen Raven		
Project County		Alamance County
Physiographic Region		Piedmont
Ecoregion		Southern Outer Piedmont
Project River Basin		Cape Fear
USGS HUC for Project and Reference		03030002030010 (Cape Fear) UTHR
		03030002060110 (Cape Fear) Long Branch - Reference
		03030002050100 (Cape Fear) UT to Wilkinson - Reference
NCDWQ Sub-basin for Project and Reference		03-06-02 (Cape Fear) UTHR
		03-06-05 (Cape Fear) Long Branch - Reference
		03-06-04 (Cape Fear) UT to Wilkinson - Reference
Drainage Area		697 Acres
Stream Order		Second Order - UTHR; First Order - UTI & UT2
Watershed Type (Rural, Urban, Developing, etc.)		Developing
Watershed LULC Distribution	Urban	43%
	Agriculture-Row Crop	9%
	Agriculture-Livestock	7%
	Forest	37%
	Water/Wetlands	4%
Watershed impervious cover (%)		43%
Rosgen Classification of As-built		C4 (UTHR); B4c (UT1, UT2)
Reference Site ID		Long Branch Creek, UT to Wilkinson Creek
NCDWQ Classification for Project		Class C, NSW
Within EEP Watershed Plan?		Yes, Travis, Tickle, and Little Alamance WP
Total project acreage of easement		9.6 Acres
Total vegetated acreage within easement		0 Acres
Total planted acreage		9.0 Acres
Dominant Soil Types		Worsham Sandy Loam
Project soil characteristics		Poorly drained soils
% of Project Easement Fenced		0%



LEGEND

- AS-BUILT STREAM THALWEG
- MINOR CONTOUR LINE
- MAJOR CONTOUR LINE (620)
- EASEMENT BOUNDARY
- AS-BUILT STRUCTURE
- ROCK STABILIZATION
- OVERHEAD UTILITY LINE (P)
- FENCE
- PHOTO REFERENCE POINT (PP 1)
- CROSS-SECTION
- VEGETATION PLOT
- CONTROL POINT (KCI #3)

NC GRID
NAD '83

–30 –15 0 30 60
GRAPHIC SCALE

SYM.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

Ecosystem Enhancement Program

KCI TECHNOLOGIES
ENGINEERS • PLANNERS • ECOLOGISTS
SUITE 220 LANDMARK CENTER II
4601 SIX FORKS RD., RALEIGH, NC

GLEN RAVEN - UT TO HAW RIVER STREAM RESTORATION PROJECT

BURLINGTON, ALAMANCE COUNTY, NORTH CAROLINA

STATION 10+00 TO STATION 19+62

DATE: DECEMBER 2009

SCALE: 1"=30'

CURRENT CONDITION PLAN VIEW

NC GRID
NAD '83

–30 –15 0 30 60
GRAPHIC SCALE

CROSS-SECTION #3
CROSS-SECTION #4
EASEMENT LINE
20+00
21+00
22+00
23+00
24+00
25+00
26+00
27+00
28+00
615
620
KCI #4560
KCI #4561
KCI #4555
KCI #4532
KCI #4527
KCI #4564
KCI #4533
A
B
PP 4
PP 5
PP 6
PP 11
VEG PLOT #3
VEG PLOT #4
GERRINGER RD.
40' WIDE EASEMENT EXCEPTION
50' WIDE EASEMENT EXCEPTION
MATCHLINE - SEE SHEET 1
MATCHLINE - SEE SHEET 3
SEE SHEET 4

LEGEND

- AS-BUILT STREAM THALWEG
- MINOR CONTOUR LINE
- MAJOR CONTOUR LINE — 620
- EASEMENT BOUNDARY
- AS-BUILT STRUCTURE
- ROCK STABILIZATION
- OVERHEAD UTILITY LINE — P
- FENCE
- PHOTO REFERENCE POINT — PP 1
- CROSS-SECTION
- VEGETATION PLOT
- CONTROL POINT — KCI #3

SYM.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

Ecosystem Enhancement Program

KCI TECHNOLOGIES
ENGINEERS • PLANNERS • ECOLOGISTS
SUITE 220, LANDMARK CENTER II
4601 SIX FORKS RD., RALEIGH, NC

GLEN RAVEN - UT TO HAW RIVER STREAM RESTORATION PROJECT

BURLINGTON, ALAMANCE COUNTY, NORTH CAROLINA

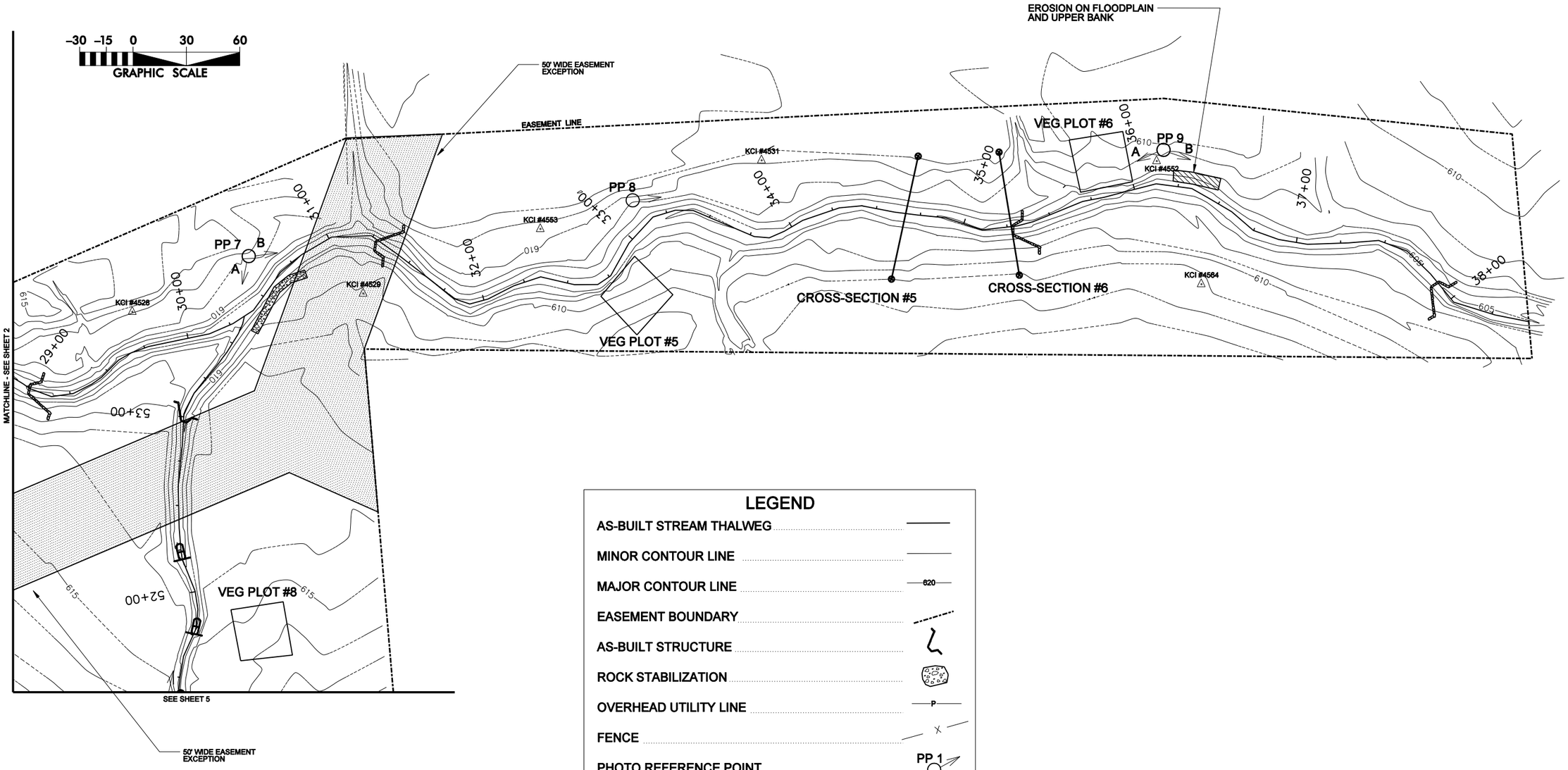
STATION 19+62 TO STATION 28+75

DATE: DECEMBER 2009
SCALE: 1"=30'

CURRENT CONDITION PLAN VIEW

NC GRID
NAD '83

–30 –15 0 30 60
GRAPHIC SCALE



LEGEND

- AS-BUILT STREAM THALWEG
- MINOR CONTOUR LINE
- MAJOR CONTOUR LINE — 620
- EASEMENT BOUNDARY
- AS-BUILT STRUCTURE
- ROCK STABILIZATION
- OVERHEAD UTILITY LINE — P
- FENCE
- PHOTO REFERENCE POINT — PP 1
- CROSS-SECTION
- VEGETATION PLOT
- CONTROL POINT — KCI #3

NO.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

Ecosystem Enhancement Program

KCI TECHNOLOGIES
ENGINEERS • PLANNERS • ECOLOGISTS
SUITE 220, LANDMARK CENTER II
4601 SIX FORKS RD., RALEIGH, NC

GLEN RAVEN - UT TO HAW RIVER STREAM RESTORATION PROJECT

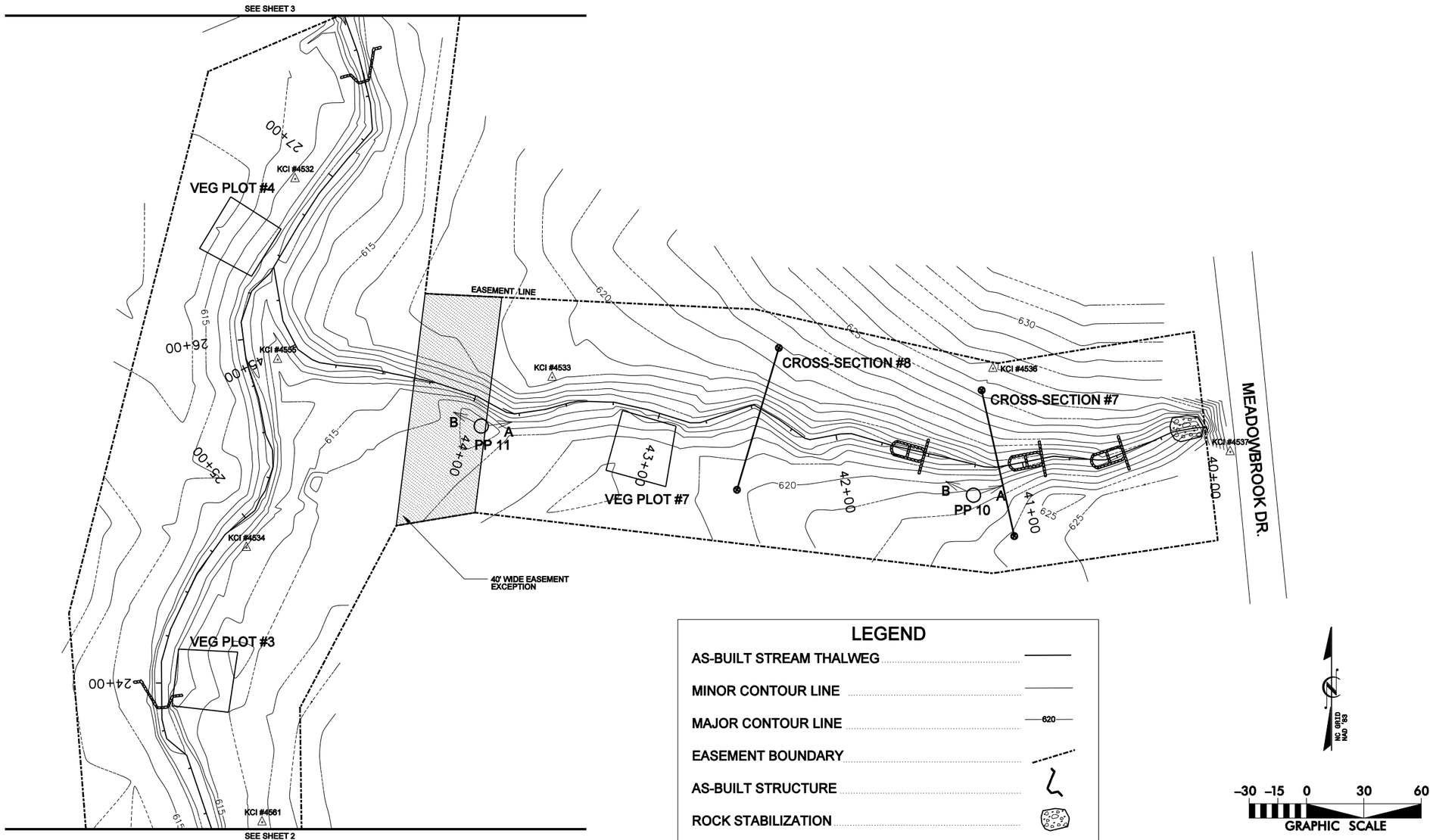
BURLINGTON, ALAMANCE COUNTY, NORTH CAROLINA

STATION 28+75 TO STATION 38+52

DATE: DECEMBER 2009

SCALE: 1"=30'

CURRENT CONDITION PLAN VIEW



LEGEND

- AS-BUILT STREAM THALWEG
- MINOR CONTOUR LINE
- MAJOR CONTOUR LINE — 620
- EASEMENT BOUNDARY
- AS-BUILT STRUCTURE
- ROCK STABILIZATION
- OVERHEAD UTILITY LINE — P
- FENCE — X
- PHOTO REFERENCE POINT — PP 1
- CROSS-SECTION
- VEGETATION PLOT
- CONTROL POINT — KCI #3

NC 6RID NAD '83

–30 –15 0 30 60

GRAPHIC SCALE

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

KCI TECHNOLOGIES
ENGINEERS • PLANNERS • ECOLOGISTS
SUITE 220, LANDMARK CENTER II
4601 SIX FORKS RD., RALEIGH, NC

GLEN RAVEN - UT TO HAW RIVER STREAM RESTORATION PROJECT

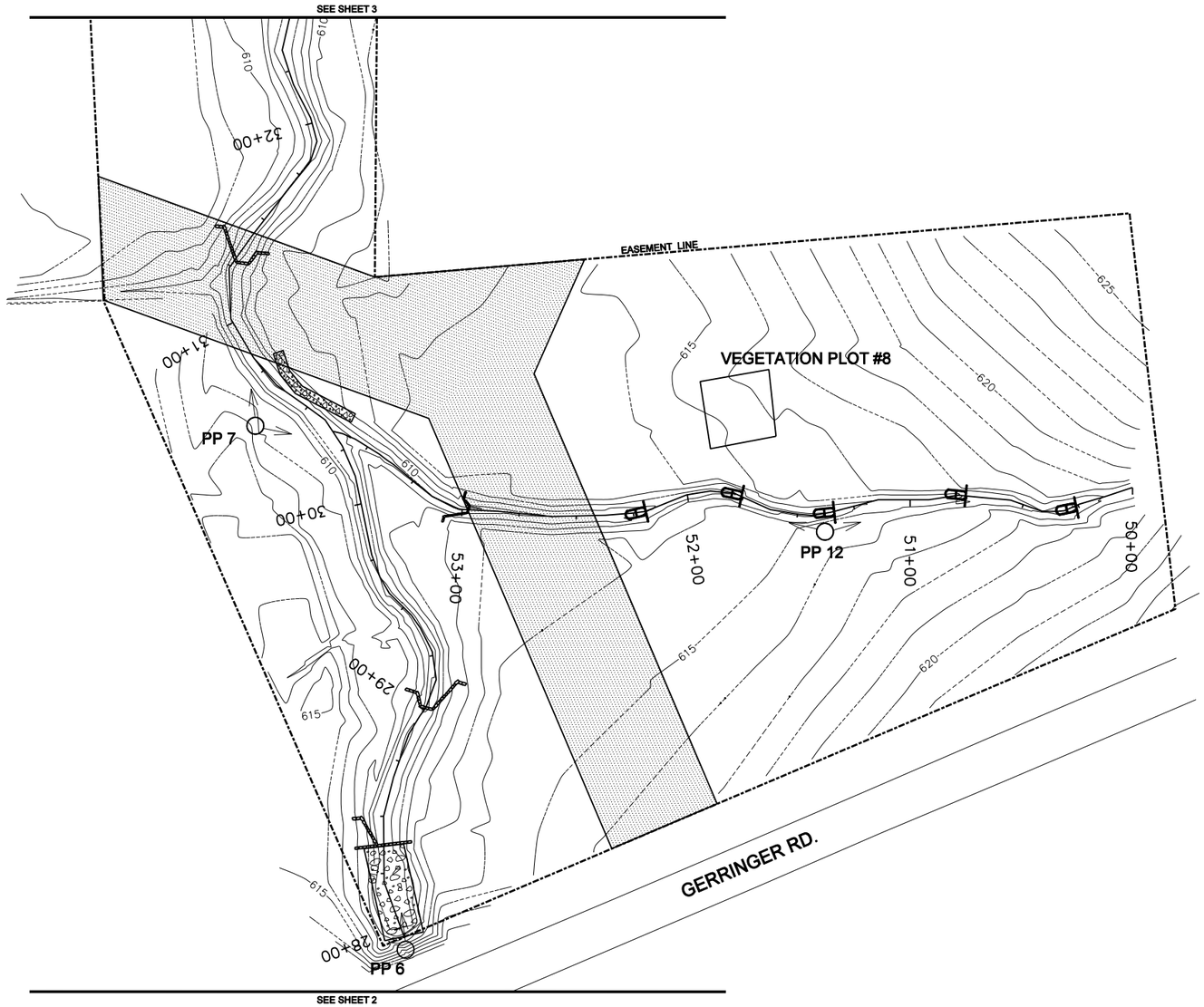
BURLINGTON, ALAMANCE COUNTY, NORTH CAROLINA

STATION 40+00 TO STATION 45+56

DATE: DECEMBER 2009

SCALE: 1"=30'

CURRENT CONDITION PLAN VIEW



LEGEND

- AS-BUILT STREAM THALWEG
- MINOR CONTOUR LINE
- MAJOR CONTOUR LINE (620)
- EASEMENT BOUNDARY
- AS-BUILT STRUCTURE
- ROCK STABILIZATION
- OVERHEAD UTILITY LINE (P)
- FENCE
- PHOTO REFERENCE POINT (PP 1)
- CROSS-SECTION
- VEGETATION PLOT
- CONTROL POINT (KCI #3)

NC GRID NAD '83

–30 –15 0 30 60

GRAPHIC SCALE

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

KCI TECHNOLOGIES
ENGINEERS • PLANNERS • ECOLOGISTS
SUITE 220, LANDMARK CENTER II
4601 SIX FORKS RD., RALEIGH, NC

GLEN RAVEN - UT TO HAW RIVER STREAM RESTORATION PROJECT

BURLINGTON, ALAMANCE COUNTY, NORTH CAROLINA

STATION 50+00 TO STATION 53+70

DATE: DECEMBER 2009

SCALE: 1"=30'

CURRENT CONDITION PLAN VIEW

SHEET 5 OF 5

2.0 PROJECT CONDITIONS AND MONITORING RESULTS

2.1 Vegetation Assessment

The planted vegetation on the site is growing well with high rates of survival. Volunteers have also started to populate the site. Upstream of Gerringer Road, there are many sweetgum (*Liquidambar styraciflua*) volunteer seedlings and downstream of Gerringer Road river birch (*Betula nigra*) seedlings are prevalent. Appendix A contains tables that show the survivability of the planted trees and summarize the data from the permanent monitoring plots. This year's monitoring results reveal high survival rates of the planted stems from last year. Of the 117 planted stems counted during the second monitoring year, only four died in the third monitoring year. Most of the floodplain and stream banks have established vegetation. Invasive species identified on the site include Chinese lespedeza (*Lespedeza cuneata*), multiflora rose (*Rosa multiflora*), Chinese privet (*Ligustrum sinense*), and Japanese honeysuckle (*Lonicera japonica*). Due to the suburban setting of the project site, most of these exotic plants are likely introduced from properties adjacent to the project. The exotic vegetation is not widespread across the project, but these populations will be monitored to determine if control measures will be required in the future. For further vegetation data see, Appendix A.

2.2 Stream Assessment

The third year of monitoring found the physical components of the stream to be stable. The morphological monitoring revealed that the cross-sections and the longitudinal profile have changed only minimally since the second-year monitoring. The changes that have occurred do not indicate a trend toward an unstable condition. There were no new problem areas since last year's monitoring and many of the areas that were previously called out as potential problem areas have stabilized. As reported last year, a few spots within the floodplain have eroded due to large flows accessing the floodplain. These areas have become more stable as they become rooted with vegetation. The beaver dams that were found during the last year's monitoring have been removed, and as of November 2009 there were no beaver dams on the Glen Raven site. For more information on the monitored cross-sections and the longitudinal profile, see Appendix B.

2.2.1 Bankfull Events

Table V. Verification of Bankfull Events
Project Name: Glen Raven

Date of Occurrence	Method	Photo Number
3/4/2008	Automatic Recording Gauge	N/A
4/4/2008	Automatic Recording Gauge	N/A
6/22/2008	Automatic Recording Gauge	N/A
6/30/2008	Automatic Recording Gauge	N/A
7/6/2008	Automatic Recording Gauge	N/A
8/27/2008	Automatic Recording Gauge	N/A
9/6/2008	Automatic Recording Gauge	N/A
9/16/2008	Automatic Recording Gauge	N/A
9/26/2008	Automatic Recording Gauge	N/A
1/7/2009	Automatic Recording Gauge	N/A
6/5/2009	Automatic Recording Gauge	N/A
9/26/2009	Automatic Recording Gauge	N/A
11/13/2009	Evaluation of Rainfall Data	N/A

2.2.2 Quantitative Measures Summary Tables

Table VIa. Baseline UTHR Upstream Summary (10+00 - 27+96)
Project Name: Glen Raven

Parameter	Pre-existing Conditions			Project Reference			Design		As-built		
Dimension	Min	Mean	Max	Min	Mean	Max	Min	Max	Min	Mean	Max
Bankfull Width (ft)	9.5		15.4	14.8		18.8	15.9		15.0	15.8	16.6
Floodprone Width (ft)	>70		>90		>50		>40			>62	
Bankfull Cross-Sectional Area (ft^2)	14.7		23.6		25.0		21.0		21.2	24.7	28.0
Bankfull Mean Depth (ft)	1.3		1.7	1.3		1.8	1.3		1.4	1.6	1.7
Bankfull Max Depth (ft)	1.9		3.0	1.9		2.4	2.4		2.5	2.6	2.7
Width/Depth Ratio	6.1		11.5	9.0		14.0	12.0		9.8	10.2	10.6
Entrenchment Ratio	>5.0		>7.5		>2.5		>2.5			>3.6	
Bank Height Ratio	1.0		1.1				1.0		1.0	1.0	1.0
Pattern											
Channel Beltwidth (ft)	32		58		60		64	80	40		59
Radius of Curvature (ft)	16		43	16		87	48	80	26		84
Meander Wavelength (ft)	86		205	66		191	80	239	93		199
Meander Width Ratio	3.3		6.1		4.1		5	15	6		13
Profile											
Riffle Length (ft)									3.0	20	51
Riffle Slope (ft/ft)	0.004		0.050	0.013		0.035	0.010	0.019	0.001	0.017	0.041
Pool Length (ft)	10		47	14		33	24	40	5	18	45
Pool Spacing (ft)	20		80	50		105	40	119	17	76	241
Substrate											
d50 (mm)									12.1		
d84 (mm)									38.5		
Additional Reach Parameters											
Channel Length (ft)	1,811			N/A			1,779		1,796		
Sinuosity	1.2			1.3			1.3		1.1		
Water Surface Slope (ft/ft)	0.0043			0.005			0.0038		0.0048		
Rosgen Classification	E4/C4			C4			C4		C4		

Table VIb. Baseline UTHR Downstream Summary (27+97 - 38+56) Project Name: Glen Raven											
Parameter	Pre-existing Conditions			Project Reference			Design		As-built		
Dimension	Min	Mean	Max	Min	Mean	Max	Min	Max	Min	Mean	Max
Bankfull Width (ft)	14.6		18.3	14.8		18.8	17.3			20.9	
Floodprone Width (ft)	25		43		>50		>43			>71	
Bankfull Cross-Sectional Area (ft2)	20.8		27.2		25.0		25.0			28.0	
Bankfull Mean Depth (ft)	1.4		1.5	1.3		1.8	1.4			1.3	
Bankfull Max Depth (ft)	1.8		2.5	1.9		2.4	2.7			2.5	
Width/Depth Ratio	10.3		12.3	9.0		14.0	12.0			15.6	
Entrenchment Ratio	1.4		2.9		>2.5		>2.5			>2.5	
Bank Height Ratio	1.0		2.4				1.0			1.0	
Pattern											
Channel Beltwidth (ft)	34		53		60		69	87	31		64
Radius of Curvature (ft)	24		43	16		87	52	87	25		84
Meander Wavelength (ft)	75		112	66		191	87	260	73		136
Meander Width Ratio	2.3		3.6		4.1		4.0	5.0	3.5		6.5
Profile											
Riffle Length (ft)									7	21	44
Riffle Slope (ft/ft)	0.003		0.01	0.013		0.035	0.010	0.019	0.001	0.009	0.029
Pool Length (ft)	6		87	14		33	26	43	6	11	20
Pool Spacing (ft)	20		110	50		105	43	130	32	65	152
Substrate											
d50 (mm)									0.5		
d84 (mm)									28		
Additional Reach Parameters											
Channel length (ft)	1,045						1,073		1,059		
Sinuosity	1.25			1.3			1.3		1.1		
Water Surface Slope (ft/ft)	0.0043			0.005			0.0038		0.0032		
Rosgen Classification	E4/C4/F4			C4			C4		C4		

Table VIc. Baseline UT1
Project Name: Glen Raven

Parameter	Pre-existing Conditions			Project Reference			Design		As-built		
Dimension	Min	Mean	Max	Min	Mean	Max	Min	Max	Min	Mean	Max
Bankfull Width (ft)	2.1		5.5	7.7		10.8	8.4			10.0	
Floodprone Width (ft)	4.0		18.0	13.0		16.0	16.0			24.5	
Bankfull Cross-Sectional Area (ft^2)	0.9		4.9	6.1		8.8	0.8			0.9	
Bankfull Mean Depth (ft)	0.2		0.9	0.7		0.9	1.7			1.6	
Bankfull Max Depth (ft)	0.4		1.8	1.1		1.4	7.0			8.7	
Width/Depth Ratio	4.9		26.7	8.5		11.4	10.0			11.5	
Entrenchment Ratio	1.9		3.5	1.6		2.1	1.9			2.5	
Bank Height Ratio										1.0	
Pattern											
Channel Beltwidth (ft)	8		25		22		17	24	14		22
Radius of Curvature (ft)	28		138	11		23	8	25	12		32
Meander Wavelength (ft)	50		107	49		59	38	65	49		95
Meander Width Ratio	1.5		11.9	2.0		2.9	4.5	7.7	4.9		9.5
Substrate											
d50 (mm)									14		
d84 (mm)									45		
Additional Reach Parameters											
Channel length (ft)	524						556		542		
Sinuosity	1.1			1.2			1.2		1.1		
Water Surface Slope (ft/ft)	0.005			0.012			0.009		0.018		
Rosgen Classification	C4/G4			B4c			B4c		B4c		

Table VIIa. Morphology and Hydraulic Monitoring Summary
Project Name: Glen Raven

Parameter	Cross-Section 1 Pool						Cross-Section 2 Riffle						Cross-Section 3 Pool					
Reach	UTHR (Upstream)						UTHR (Upstream)						UTHR (Upstream)					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	22.7	25.2	21.8	22.0			16.6	16.4	18.6	16.4			20.0	19.7	21.3	20.5		
Floodprone Width (ft)	-	-	-	-			>64	>64	>64	>64			-	-	-	-		
Bankfull Cross-Sectional Area (ft^2)	44.2	45.2	42.9	43.6			28.0	27.4	27.2	26.2			29.6	27.1	27.0	29.0		
Bankfull Mean Depth (ft)	1.9	1.8	2.0	2.0			1.7	1.7	1.5	1.6			1.5	1.4	1.3	1.4		
Bankfull Max Depth (ft)	3.7	3.6	3.7	3.7			2.7	2.7	2.7	2.7			2.9	2.4	2.4	3.0		
Width/Depth Ratio	-	-	-	-			9.8	9.8	12.7	10.3			-	-	-	-		
Entrenchment Ratio	-	-	-	-			>3.6	>3.6	>3.5	>3.5			-	-	-	-		
Bank Height Ratio	-	-	-	-			1.0	1.0	1.0	1.0			-	-	-	-		
Wetted Perimeter (ft)	-	-	-	-			18.1	17.6	19.8	17.7			-	-	-	-		
Hydraulic Radius (ft)	-	-	-	-			1.5	1.6	1.4	1.5			-	-	-	-		
Substrate																		
d50 (mm)	0.4	1.1	1.2	2.3			17	18	16	11			0.6	3.4	6.5	2.0		
d84 (mm)	0.7	5.4	6.6	38			31	32	34	40			12	18	19	11		

Table VIIb. Morphology and Hydraulic Monitoring Summary continued
Project Name: Glen Raven

Parameter	Cross-Section 4 Riffle						Cross-Section 5 Riffle						Cross-Section 6 Pool					
Reach	UTHR (Upstream)						UTHR (Downstream)						UTHR (Downstream)					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	15.0	15.4	15.7	13.3			20.9	20.0	21.0	18.9			20.6	22.2	19.7	20.4		
Floodprone Width (ft)	>62	>62	>62	>62			>71	>71	>71	>71			-	-	-	-		
Bankfull Cross-Sectional Area (ft^2)	21.2	20.7	20.0	17.0			28.0	27.0	26.7	26.1			27.3	26.4	25.5	26.2		
Bankfull Mean Depth (ft)	1.4	1.3	1.3	1.3			1.3	1.4	1.3	1.4			1.3	1.2	1.3	1.3		
Bankfull Max Depth (ft)	2.5	2.5	2.5	2.4			2.5	2.6	2.7	2.7			2.9	2.9	2.8	3.0		
Width/Depth Ratio	10.6	11.5	12.3	10.4			15.6	14.8	16.5	13.7			-	-	-	-		
Entrenchment Ratio	>4	>4	>4	>4			>3	>3	>3	>3			-	-	-	-		
Bank Height Ratio	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			-	-	-	-		
Wetted Perimeter (ft)	-	-	16.7	14.4			21.7	20.8	21.8	19.8			-	-	-	-		
Hydraulic Radius (ft)	-	-	1.2	1.2			1.3	1.3	1.2	1.3			-	-	-	-		
Substrate																		
d50 (mm)	7.1	18	27	2.8			14	5.1	5.1	19			0.6	3.0	2.1	4.3		
d84 (mm)	46	54	64	40			45	45	45	45			18	13	22	26		

Table VIIc. Morphology and Hydraulic Monitoring Summary con't. Project Name: Glen Raven												
Parameter	Cross-Section 7 Riffle						Cross-Section 8 Pool					
Reach	UT1						UT1					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	10.0	9.7	9.7	10.4			14.9	14.6	14.7	13.6		
Floodprone Width (ft)	25	25	23	25			-	-	-	-		
Bankfull Cross-Sectional Area	8.7	9.2	9.2	9.1			14.1	12.7	14.4	12.7		
Bankfull Mean Depth (ft)	0.9	0.9	0.9	0.9			0.9	0.9	1.0	0.9		
Bankfull Max Depth (ft)	1.6	1.6	1.5	1.6			2.0	1.9	2.1	1.9		
Width/Depth Ratio	11.5	10.2	10.2	11.9			-	-	-	-		
Entrenchment Ratio	2.5	2.5	2.6	2.4			-	-	-	-		
Bank Height Ratio	1.0	1.0	1.0	1.0			-	-	-	-		
Wetted Perimeter (ft)	10.6	10.3	9.9	10.9			-	-	-	-		
Hydraulic Radius (ft)	0.8	0.9	0.8	0.8			-	-	-	-		
Substrate												
d50 (mm)	0.5	16	7.8	13			0.49	6.1	14	6.4		
d84 (mm)	28	50	53	52			20	25	41	48		

Table VIId. Morphology and Hydraulic Monitoring Summary cont
Project Name: Glen Raven

UTHR Upstream															
Parameter	MY - 01 (2007)			MY - 02 (2008)			MY - 03 (2009)			MY - 04 (2010)			MY - 05 (2011)		
Pattern*	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	40		59												
Radius of Curvature (ft)	26		84												
Meander Wavelength (ft)	93		199												
Meander Width Ratio	6		13												
Profile															
Riffle Length (ft)	3	49	15	3	73	27	7	72	21						
Riffle Slope (ft/ft)	0.0052	0.0417	0.0154	0.0001	0.1143	0.0079	0.0014	0.0432	0.0127						
Pool Length (ft)	4	41	18	3	74	18	5	81	24						
Pool Spacing (ft)	23	199	74	15	232	81	20	181	76						
Additional Reach Parameters															
Channel Length (ft)	1,796			1,796			1,796								
Sinuosity	1.1			1.1			1.1								
Water Surface Slope (ft/ft)	0.0048			0.0050			0.0045								
Rosgen Classification	C4			C4			C4								

* Pattern measurements will only be taken after MY-01 if it is visually apparent that the pattern has changed.

Table VIIe. Morphology and Hydraulic Monitoring Summary cont
Project Name: Glen Raven

UTHR Downstream															
Parameter	MY - 01 (2007)			MY - 02 (2008)			MY - 03 (2009)			MY - 04 (2010)			MY - 05 (2011)		
Pattern*	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	31		64												
Radius of Curvature (ft)	25		84												
Meander Wavelength (ft)	73		136												
Meander Width Ratio	3.5		6.5												
Profile															
Riffle Length (ft)	3	35	15	7	72	12	4	46	14						
Riffle Slope (ft/ft)	0.0010	0.0710	0.0130	0.0036	0.0277	0.0118	0.0000	0.0345	0.0117						
Pool Length (ft)	7	28	14	8	22	15	3	34	17						
Pool Spacing (ft)	29	195	51	29	237	46	28	215	44						
Additional Reach Parameters															
Channel Length (ft)	1,059			1,059			1,059								
Sinuosity	1.1			1.1			1.1								
Water Surface Slope (ft/ft)	0.0032			0.0033			0.0034								
Rosgen Classification	C4			C4			C4								

* Pattern measurements will only be taken after MY-01 if it is visually apparent that the pattern has changed.

Table VIIf. Morphology and Hydraulic Monitoring Summary cont
Project Name: Glen Raven

UT1																
Parameter	MY - 01 (2007)			MY - 02 (2008)			MY - 03 (2009)			MY - 04 (2010)			MY - 05 (2011)		
Pattern*	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	14		22												
Radius of Curvature (ft)	12		32												
Meander Wavelength (ft)	49		95												
Meander Width Ratio	4.9		9.5												
Profile															
Riffle Length (ft)	**	**	**	8	28	14	7	28	10						
Riffle Slope (ft/ft)	**	**	**	0.0083	0.0601	0.0285	0.0000	0.0803	0.0104						
Pool Length (ft)	2	15	6	3	10	5	4	9	5						
Pool Spacing (ft)	29	56	47	39	98	49	38	198	73						
Additional Reach Parameters															
Channel Length (ft)	542			542			542								
Sinuosity	1.1			1.1			1.1								
Water Surface Slope (ft/ft)	0.018			0.016			0.017								
Rosgen Classification	B4c			B4c			B4c								

* Pattern measurements will only be taken after MY-01 if it is visually apparent that the pattern has changed.

**No riffle measurements due to no stream flow

Appendix A
Vegetation Data

Table A1. Stem counts arranged by plot.
Project Name: Glen Raven

Species	Plots								Initial Totals	Year 1 Totals	Year 2 Totals	Year 3 Totals	Survival %
	1	2	3	4	5	6	7	8					
Shrubs													
Callicarpa americana	2								5	4	2	2	40%
Cephalanthus occidentalis					1				4	4	1	1	25%
Ilex verticillata	2			1	1				6	6	4	4	67%
Lindera benzoin		1		1	1				5	5	3	3	60%
Symphoricarpos orbiculatas	1	1	1	2		1			6	6	6	6	100%
Trees													
Betula nigra	1			1		2			4	4	4	4	100%
Celtis laevigata			1	1					4	4	2	2	50%
Carya ovata							3		4	4	3	3	75%
Cornus amomum			1	1	1	3	2		10	10	9	8	80%
*Diospyros virginiana**	5		1		1		2	2	10	10	11	11	110%
Fraxinus pennsylvanica	1	1	1		6				10	9	9	9	90%
Juglans nigra							8	3	13	13	12	11	85%
Platanus occidentalis			1						4	3	1	1	25%
Quercus falcata								2	2	2	2	2	100%
Quercus michauxii		5	1	2	4	9			23	22	22	21	91%
Quercus pagoda							2		4	4	3	2	50%
Quercus phellos			1	2	3	1			8	8	7	7	88%
Salix nigra			3	2	3				10	10	8	8	80%
Salix sericea			2	1		4	1		8	8	8	8	100%
Unknown									23	12	0	0	0%

* This increase is attributed to a change in identification of a few planted stems and new stems not previously identified in MY-01.

*Plots 4-8 have been renumbered to match the vegetation sampling data to the monitoring paln view

Table A2. Vegetation History (stems/acre)
Project Name: Glen Raven

Plot Number*	MY-00	MY-01	MY-02	MY-03	MY-04	MY-05
1	840	720	480	480		
2	720	440	360	320		
3	1,120	920	520	520		
4	920	720	560	560		
5	880	840	840	840		
6	840	840	800	800		
7	920	920	920	840		
8	600	520	320	280		
Site Average	855	740	600	580		

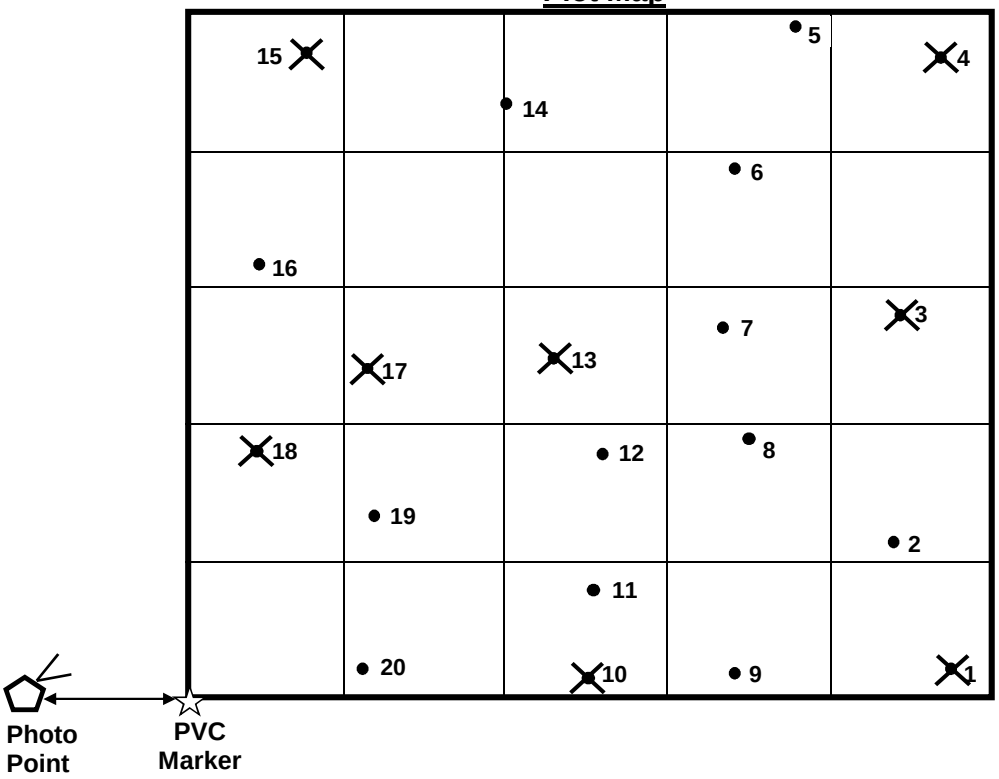
*Plots 4-8 have been renumbered to match the vegetation sampling data to the monitoring plan view.

Vegetation Monitoring Data Sheets

Vegetation Monitoring Worksheet

Site: Glen Raven **Plot:** 1 **Date:** 6/4/2009

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	*Quercus sp.*			Dead
2	Persimmon (*Diospyros virginiana*)	0.28	2	Main stem has died back
3	Unknown			Dead
4	Beautyberry (*Callicarpa americana)*			Dead
5	Coralberry (*Symphoricarpos obiculatas*)	0.51	3	Browsed
6	Persimmon (*Diospyros virginiana*)	0.79	3	
7	Winterberry (*Ilex verticillata*)	0.18	1	No leaves
8	Persimmon (*Diospyros virginiana*)	0.71	4	
9	River Birch (*Betula nigra)*	1.04	4	
10	Green Ash (*Fraxinus pennsylvanica*)			Dead
11	Beautyberry (*Callicarpa americana)*	0.67	3	
12	Winterberry (*Ilex verticillata*)	0.36	3	
13	Unknown			Dead
14	Persimmon (*Diospyros virginiana*)	0.34	2	Main stem has died back
15	Beautyberry (*Callicarpa americana)*			Dead
16	Beautyberry (*Callicarpa americana)*	0.53	2	Very few leaves, resprout
17	Persimmon (*Diospyros virginiana*)			Dead
18	Winterberry (*Ilex verticillata*)			Dead
19	Persimmon (*Diospyros virginiana*)	0.71	3	
20	Green Ash (*Fraxinus pennsylvanica*)	0.51	3	Browsed

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Coralberry (*Symphoricarpos obiculatas*)	8.3%
River Birch (*Betula nigra*)	8.3%
Green Ash (*Fraxinus pennsylvanica*)	8.3%
Beautyberry (*Callicarpa americana*)	16.7%
Winterberry (*Ilex verticillata*)	16.7%
Persimmon (*Diospyros virginiana*)	41.7%

Density:

Total Number of Trees **12** / **0.025 acres** = **480** **trees / acre**

Survivability:

Total Number of Trees **12** / **20 trees** x **100** = **60** **% survivability**

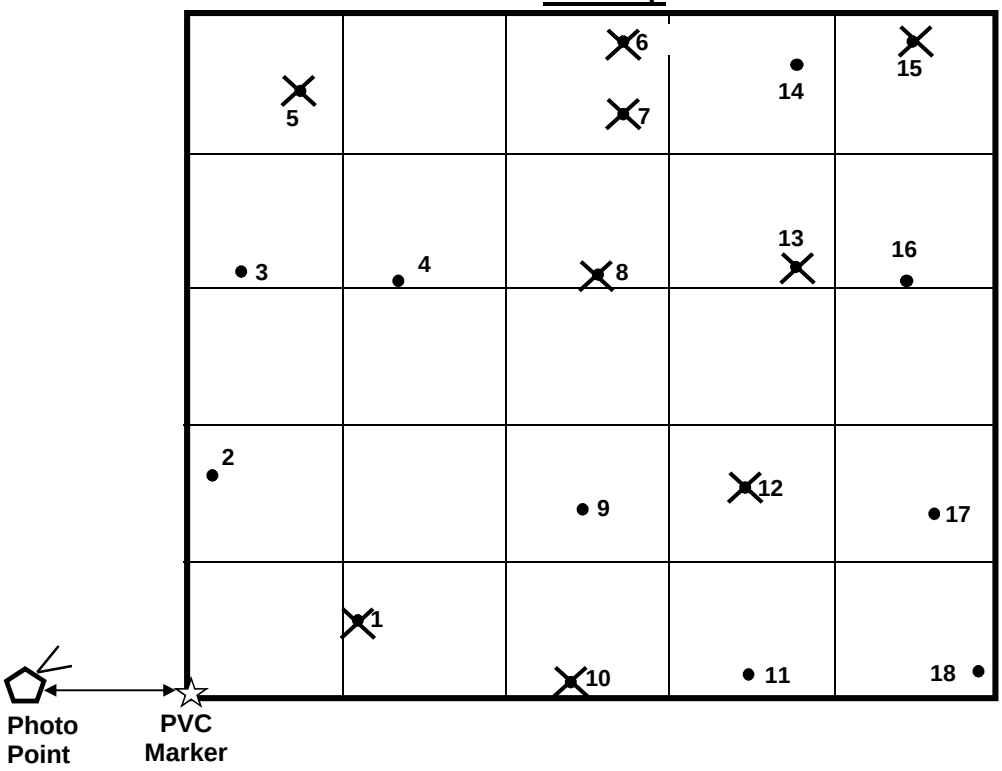
Previous

Current

Vegetation Monitoring Worksheet

Site: Glen Raven **Plot:** 2 **Date:** 6/4/2009

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Winterberry (*Ilex verticillata*)			Missing
2	Swamp Chestnut Oak (*Quercus michauxii*)	0.25	2	Resprout from base
3	Spicebush (*Lindera benzoin*)	0.84	4	
4	Coralberry (*Symphoricarpos obiculatas*)	1.12	4	
5	*Quercus sp.*			Dead
6	*Quercus sp.*			Dead
7	*Quercus sp.*			Dead
8	Swamp Chestnut Oak (*Quercus michauxii*)			Dead
9	Swamp Chestnut Oak (*Quercus michauxii*)	0.79	3	
10	Swamp Chestnut Oak (*Quercus michauxii*)			Dead
11	Unknown			Dead
12	Swamp Chestnut Oak (*Quercus michauxii*)			Dead
13	Green Ash (*Fraxinus pennsylvanica*)			Dead
14	Green Ash (*Fraxinus pennsylvanica*)	0.94	3	Some Insect Damage
15	Unknown			Dead
16	Swamp Chestnut Oak (*Quercus michauxii*)	0.74	3	
17	Swamp Chestnut Oak (*Quercus michauxii*)	0.56	3	
18	Swamp Chestnut Oak (*Quercus michauxii*)	0.79	3	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Green Ash (*Fraxinus pennsylvanica*)	12.5%
Swamp Chestnut Oak (*Quercus michauxii*)	62.5%
Coralberry (*Symphoricarpos obiculatas*)	12.5%
Spicebush (*Lindera benzoin*)	12.5%

Density:

Total Number of Trees **8** / **0.025 acres** = **320** **trees / acre**

Survivability:

Total Number of Trees **8** / **18 trees** x **100** = **44** **% survivability**

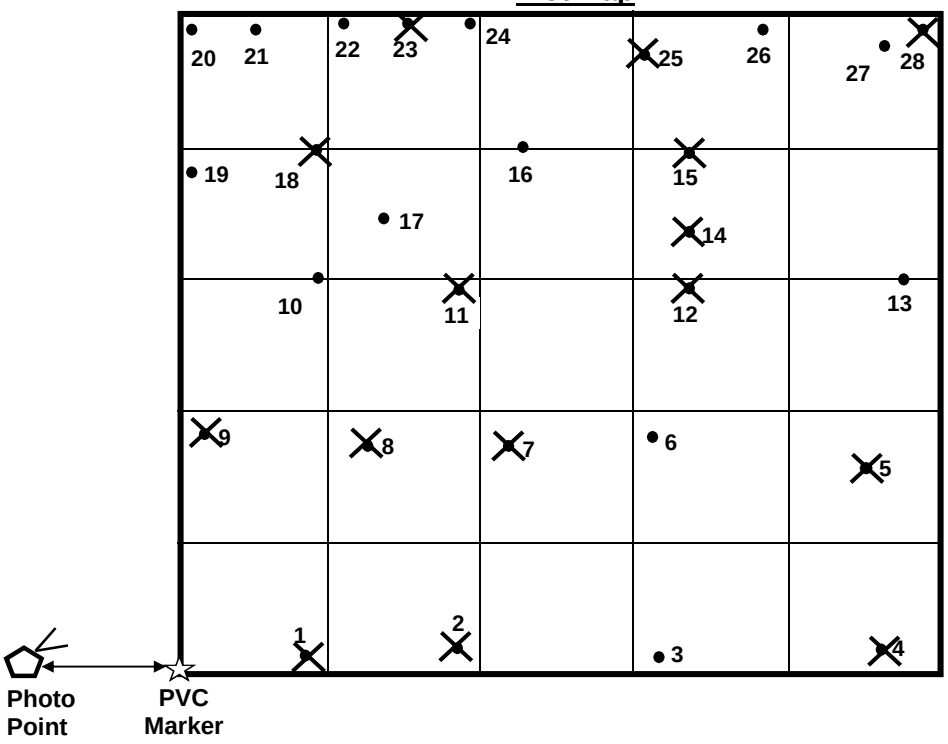
Previous

Current

Vegetation Monitoring Worksheet

Site: Glen Raven **Plot:** 3 **Date:** 6/4/2009

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Sugarberry (*Celtis laevigata*)			Dead
2	Sugarberry (*Celtis laevigata*)			Dead
3	Sugarberry (*Celtis laevigata*)	0.70	3	Resprout
4	Unknown			Dead
5	Persimmon (*Diospyros viginiana*)			Dead
6	Persimmon (*Diospyros viginiana*)	0.58	3	Resprout
7	Unknown			Dead
8	Unknown			Dead
9	Willow Oak (*Quercus phellos*)			Dead
10	Swamp Chestnut Oak (*Quercus michauxii*)	0.75	3	Top has died back
11	Unknown			Dead
12	Unknown			Dead
13	Willow Oak (*Quercus phellos*)	1.14	3	
14	Spicebush (*Lindera benzoin)*			Dead
15	Sycamore (*Platanus occidentalis)*			Dead
16	Sycamore (*Platanus occidentalis)*	1.78	3	
17	Coralberry (*Symphoricarpos orbiculatas)*	1.03	4	
18	Sycamore (*Platanus occidentalis)*			Dead
19	Green Ash (*Fraxinus pennsylvanica)*	1.93	4	
20	Black Willow (*Salix nigra)*	1.91	4	Live Stake
21	Black Willow (*Salix nigra)*	1.17	4	Live Stake
22	Black Willow (*Salix nigra)*	2.18	4	Live Stake
23	Unknown			Dead
24	Silky Dogwood (*Cornus amomum*)	1.37	4	Live Stake
25	Black Willow (*Salix nigra)*			Dead
26	Silky Willow (*Salix sericea)*	1.78	4	Live Stake
27	Silky Willow (*Salix sericea)*	2.21	4	Live Stake
28	Unknown			Dead

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Swamp Chestnut Oak (*Quercus michauxii*)	7.7%
Sycamore (*Platanus occidentalis*)	7.7%
Coralberry (*Symphoricarpos orbiculatas*)	7.7%
Green Ash (*Fraxinus pennsylvanica*)	7.7%
Black Willow (*Salix nigra*)	23.1%
Silky Willow (*Salix sericea*)	15.4%
Persimmon (*Diospyros viginiana*)	7.7%
Silky Dogwood (*Cornus amomum*)	7.7%
Willow Oak (*Quercus phellos*)	7.7%
Sugarberry (*Celtis laevigata*)	7.7%

Density:

Total Number of Trees **13** / **0.025 acres** = **520** **trees / acre**

Survivability:

Total Number of Trees **13** / **28 trees** **x** **100** = **46** **% survivability**

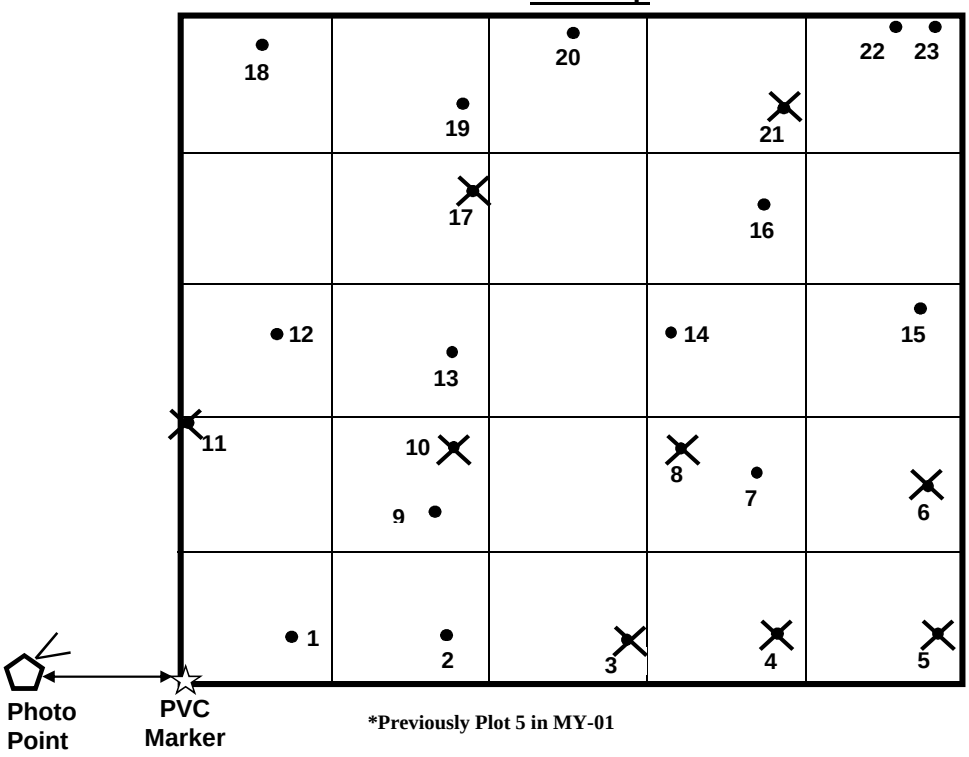
Previous

Current

Vegetation Monitoring Worksheet

Site: Glen Raven **Plot:** 4 **Date:** 6/8/2009

Plot Map



***Previously Plot 5 in MY-01**

ID	Species	Height (m)	Vigor	Comment
1	Willow Oak (*Quercus phellos*)	0.82	4	Resprout
2	River Birch *(Betula nigra)*	0.80	3	Top has died back
3	Unknown			Dead
4	Unknown			Dead
5	Unknown			Dead
6	Unknown			Dead
7	Coralberry *(Symphoricarpos orbiculatas)*	1.00	4	
8	Unknown			Dead
9	Coralberry *(Symphoricarpos orbiculatas)*	0.85	4	Browsed
10	Unknown			Dead
11	Unknown			Dead
12	Sugarberry (*Celtis laevigata*)	0.37	2	Resprout from base
13	Swamp Chestnut Oak (*Quercus michauxii*)	0.67	3	
14	Swamp Chestnut Oak (*Quercus michauxii*)	0.50	3	Some insect damage
15	Spicebush (*Lindera benzoin*)	0.63	3	Resprout from base
16	Willow Oak (*Quercus phellos*)	1.24	3	
17	Unknown			Dead
18	Black Willow *(Salix nigra)*	1.66	3	Live stake
19	Winterberry *(Ilex verticulata)*	0.41	2	
20	Silky Willow *(Salix sericea)*	1.38	3	Live stake
21	Spicebush *(Lindera benzoin)*			Dead
22	Black Willow *(Salix nigra)*	1.25	3	Live stake
23	Silky Dogwood (*Cornus amomum)*	0.54	3	Live stake

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
River Birch (*Betula nigra*)	7.1%
Coralberry (*Symphoricarpos orbiculatas*)	14.3%
Black Willow (*Salix nigra*)	14.3%
Swamp Chestnut Oak (*Quercus michauxii*)	14.3%
Winterberry (*Ilex verticulata*)	7.1%
Silky Willow (*Salix sericea*)	7.1%
Silky Dogwood (*Cornus amomum*)	7.1%
Spicebush (*Lindera benzoin*)	7.1%
Willow Oak (*Quercus phellos*)	14.3%
Sugarberry (*Celtis laevigata*)	7.1%

Density:

Total Number of Trees **14** / **0.025 acres** = **560** **trees / acre**

Survivability:

Total Number of Trees **14** / **23 trees** x **100** = **61** **% survivability**

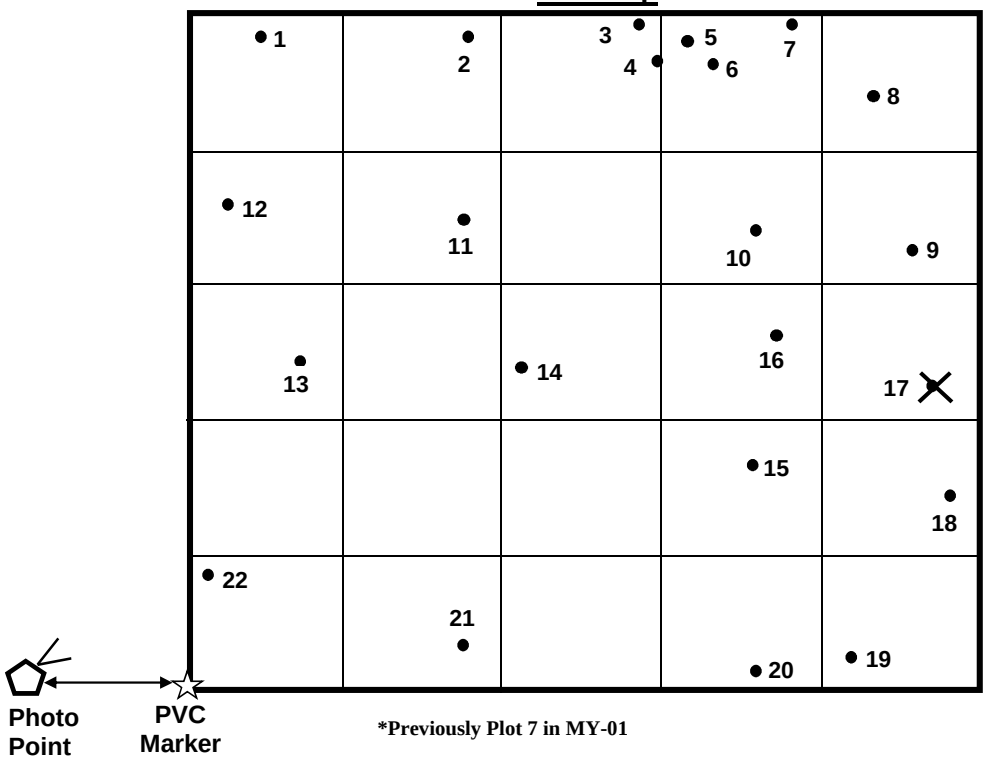
Previous

Current

Vegetation Monitoring Worksheet

Site: Glen Raven **Plot:** 5 **Date:** 6/8/2009

Plot Map



***Previously Plot 7 in MY-01**

ID	Species	Height (m)	Vigor	Comment
1	Willow Oak (*Quercus phellos*)	0.97	4	
2	Swamp Chestnut Oak (*Quercus michauxii*)	0.62	4	
3	Black Willow (*Salix nigra*)	1.15	3	Live stake
4	Black Willow (*Salix nigra*)	0.61	2	Live stake
5	Black Willow (*Salix nigra*)	0.50	2	Live stake
6	Black Willow (*Salix nigra*)	0.49	2	Live stake
7	Silky Dogwood (*Cornus amomum*)	0.79	3	Live stake
8	Winterberry (*Ilex verticulata*)	0.42	2	
9	Green Ash (*Fraxinus pennsylvanica*)	1.44	4	
10	Green Ash (*Fraxinus pennsylvanica*)	0.72	3	Browsed
11	Green Ash (*Fraxinus pennsylvanica*)	0.33	2	Browsed
12	Swamp Chestnut Oak (*Quercus michauxii*)	0.58	3	
13	Green Ash (*Fraxinus pennsylvanica*)	0.77	3	Browsed
14	Willow Oak (*Quercus phellos*)	0.89	4	Browsed
15	Green Ash (*Fraxinus pennsylvanica*)	0.48	2	
16	Swamp Chestnut Oak (*Quercus michauxii*)	0.54	3	
17	Green Ash (*Fraxinus pennsylvanica*)			Missing
18	Willow Oak (*Quercus phellos*)	0.91	4	
19	Spicebush (*Lindera benzoin*)	0.22	2	Resprout
20	Swamp Chestnut Oak (*Quercus michauxii*)	1.39	4	
21	Persimmon (*Diospyros virginiana*)	0.65	3	
22	Green Ash (*Fraxinus pennsylvanica*)	1.20	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Willow Oak (*Quercus phellos*)	14.3%
Green Ash (*Fraxinus pennsylvanica*)	28.6%
Swamp Chestnut Oak (*Quercus michauxii*)	19.0%
Black Willow (*Salix nigra*)	14.3%
Silky Dogwood (*Cornus amomum*)	4.8%
Winterberry (*Ilex verticulata*)	4.8%
Spicebush (*Lindera benzoin*)	4.8%
Buttonbush (*Cephalanthus occidentalius*)	4.8%
Persimmon (*Diospyros virginiana*)	4.8%

Density:

Total Number of Trees **21** / **0.025 acres** = **840** **trees / acre**

Survivability:

Total Number of Trees **21** / **22 trees** x **100** = **95** **% survivability**

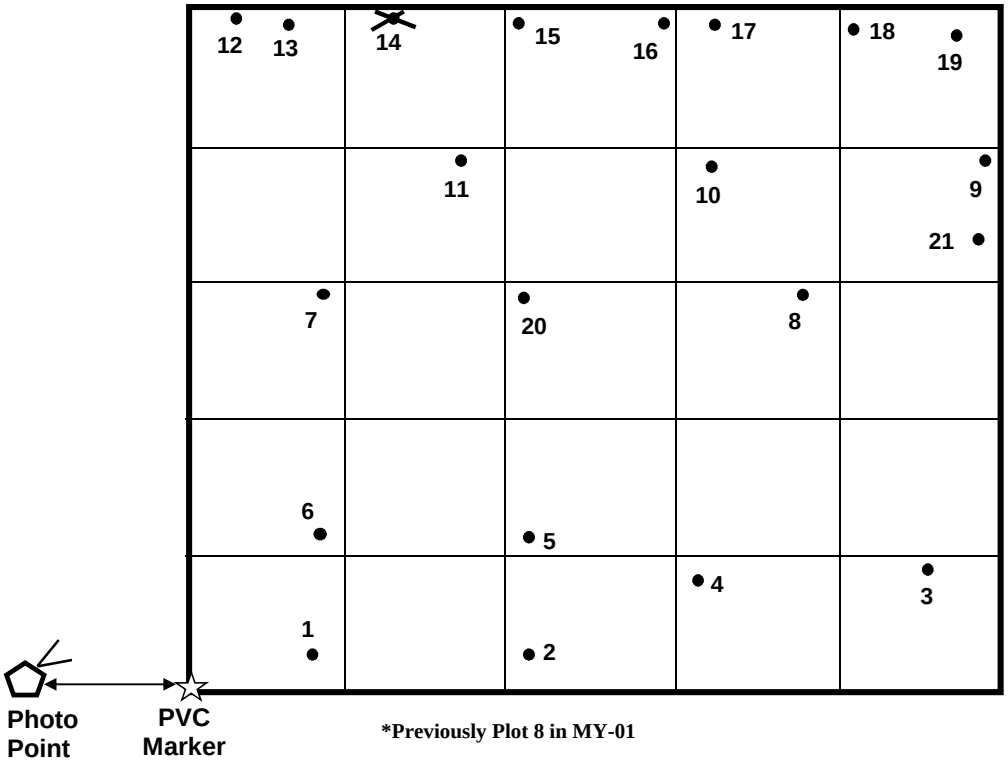
Previous

Current

Vegetation Monitoring Worksheet

Site: Glen Raven **Plot:** 6 **Date:** 6/8/2009

Plot Map



***Previously Plot 8 in MY-01**

ID	Species	Height (m)	Vigor	Comment
1	River Birch (*Betula nigra*)	2.77	4	
2	Willow Oak (*Quercus phellos*)	1.07	4	
3	River Birch (*Betula nigra*)	1.90	4	
4	Swamp Chestnut Oak (*Quercus michauxii*)	0.65	3	Insect damage
5	Swamp Chestnut Oak (*Quercus michauxii*)	1.08	4	
6	Swamp Chestnut Oak (*Quercus michauxii*)	0.79	4	Browsed
7	Swamp Chestnut Oak (*Quercus michauxii*)	0.97	4	
8	Swamp Chestnut Oak (*Quercus michauxii*)	0.50	3	
9	Swamp Chestnut Oak (*Quercus michauxii*)	0.37	3	Top has died back
10	Swamp Chestnut Oak (*Quercus michauxii*)	0.66	4	
11	Swamp Chestnut Oak (*Quercus michauxii*)	0.59	3	Browsed
12	Silky Willow (*Salix sericea*)	1.03	3	Live stake
13	Silky Dogwood (*Cornus amomum*)	0.59	3	Live stake
14	Silky Dogwood (*Cornus amomum*)			Dead
15	Silky Dogwood (*Cornus amomum*)	0.25	1	Live stake; Top has died back
16	Silky Willow (*Salix sericea*)	1.28	4	Live stake
17	Silky Dogwood (*Cornus amomum*)	0.71	2	Live stake
18	Silky Willow (*Salix sericea*)	1.84	4	Live stake
19	Silky Willow (*Salix sericea*)	1.19	3	Live stake; Top has died back
20	Swamp Chestnut Oak (*Quercus michauxii*)	0.59	3	Browsed
21	Coralberry (*Symphoricarpos orbiculatas*)	0.32	2	Top has died back

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
River Birch (*Betula nigra*)	10.0%
Swamp Chestnut Oak (*Quercus michauxii*)	45.0%
Silky Dogwood (*Cornus amomum*)	15.0%
Silky Willow (*Salix sericea*)	20.0%
Willow Oak *(Quercus phellos)*	5.0%
Coralberry (*Symphoricarpos orbiculatas*)	5.0%

Density:

Total Number of Trees **20** / **0.025 acres** = **800** **trees / acre**

Survivability:

Total Number of Trees **20** / **21 trees** **x** **100** = **95** **% survivability**

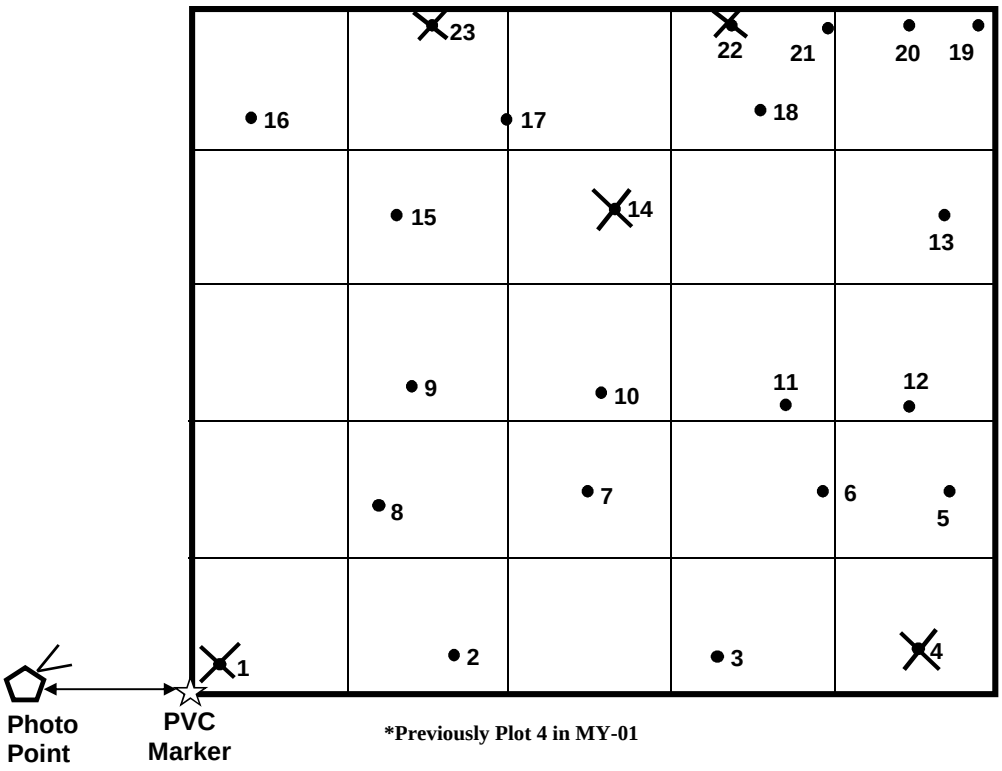
Previous

Current

Vegetation Monitoring Worksheet

Site: Glen Raven **Plot:** 7 **Date:** 6/8/2009

Plot Map



***Previously Plot 4 in MY-01**

ID	Species	Height (m)	Vigor	Comment
1	Cherrybark Oak (*Quercus pagoda*)			Dead
2	Black Walnut (*Juglans nigra)*	0.46	3	
3	Black Walnut (*Juglans nigra)*	0.30	2	Insect damage
4	Cherrybark Oak (*Quercus pagoda*)			Missing
5	Cherrybark Oak (*Quercus pagoda*)	0.43	3	
6	Black Walnut (*Juglans nigra)*	0.51	2	
7	Black Walnut (*Juglans nigra)*	0.67	4	
8	Black Walnut (*Juglans nigra)*	0.60	4	Browsed
9	Shagbark Hickory (*Carya ovata)*	0.25	3	
10	Shagbark Hickory (*Carya ovata*)	0.55	3	
11	Persimmon (*Diospyros virginiana*)	1.15	4	
12	Shagbark Hickory (*Carya ovata)*	0.21	3	
13	Persimmon (*Diospyros virginiana*)	0.86	4	
14	Unknown			Dead
15	Cherrybark Oak (*Quercus pagoda*)	0.53	4	Resprout
16	Black Walnut (*Juglans nigra)*	0.56	3	
17	Black Walnut (*Juglans nigra)*	0.34	3	Resprout
18	Black Walnut (*Juglans nigra)*	0.50	4	Browsed
19	Silky Dogwood (*Cornus amomum*)	0.45	3	Live stake
20	Silky Dogwood (*Cornus amomum*)	0.43	3	Live stake
21	Silky Willow (*Salix sericea)*	1.28	3	Live stake
22	Black Willow (*Salix nigra)*			Missing
23	Silky Dogwood (*Cornus amomum*)			Dead

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Black Walnut (*Juglans nigra*)	44.4%
Shagbark Hickory (*Carya ovata*)	16.7%
Silky Willow (*Salix sericea*)	5.6%
Persimmon (*Diospyros virginiana*)	11.1%
Cherrybark Oak (*Quercus pagoda*)	11.1%
Silky Dogwood (*Cornus amomum*)	11.1%

Density:

Total Number of Trees **18** / **0.025 acres** = **720** **trees / acre**

Survivability:

Total Number of Trees **18** / **23 trees** **x** **100** = **78** **% survivability**

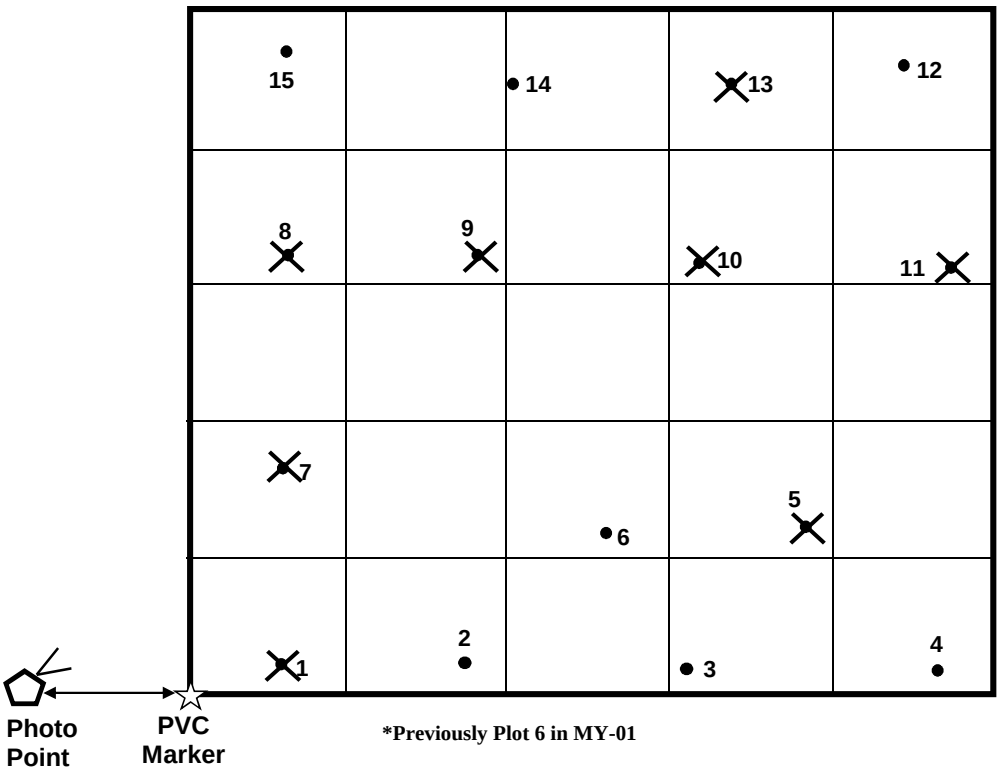
Previous

Current

Vegetation Monitoring Worksheet

Site: Glen Raven **Plot:** 8 **Date:** 6/8/2009

Plot Map



***Previously Plot 6 in MY-01**

ID	Species	Height (m)	Vigor	Comment
1	Buttonbush (*Cephalanthus occidentalis*)			Dead
2	Black Walnut (*Juglans nigra*)	0.44	4	
3	Persimmon (*Diospyros virginiana*)	1.42	4	
4	Black Walnut (*Juglans nigra*)	0.40	3	Top has died back
5	Black Walnut (*Juglans nigra*)			Dead
6	Southern Red Oak (*Quercus falcata*)	0.88	4	
7	Shagbark Hickory (*Carya ovata*)			Missing
8	Unknown			Dead
9	Black Walnut (*Juglans nigra*)			Dead
10	Unknown			Missing
11	Unknown			Dead
12	Black Walnut (*Juglans nigra*)	0.50	3	
13	Unknown			Dead
14	Persimmon (*Diospyros virginiana*)	0.39	3	Top has died back
15	Southern Red Oak (*Quercus falcata*)	0.46	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Black Walnut (*Juglans nigra*)	42.9%
Southern Red Oak (*Quercus falcata*)	28.6%
Persimmon (*Diospyros virginiana*)	28.6%

Density:

Total Number of Trees **7** / **0.025 acres** = **280** **trees / acre**

Survivability:

Total Number of Trees **7** / **15 trees** **x** **100** = **47** **% survivability**

Previous

Current

Appendix B
Geomorphologic Data

Appendix B1: Representative Stream Problem Area Photos

SP1 – Upper bank and floodplain erosion. Stationing 36+20 – 36+50 11/3/09 - MY 03

Appendix B2 –Stream Photo Station Photos

Photo Point 1: View looking north from Power Line Road. 11/3/09 – MY-03

Photo Point 2a: View looking south near Station 13+25. 11/3/09 – MY-03

Photo Point 2b: View looking north near Station 13+25. 11/3/09 – MY-03

Photo Point 3a: View looking south near Station 16+75. 11/3/09 – MY-03

Photo Point 3b: View looking north toward Vegetation Plot #2. 11/3/09 – MY-03

Photo Point 4a: View looking south near Station 22+75. 11/3/09 – MY-03

Photo Point 4b: View looking north toward Vegetation Plot #3. 11/3/09 – MY-03

Photo Point 5: View looking south from Gerringer Road culvert. 11/3/09 – MY-03

Photo Point 6: View looking north from Gerringer Road culvert. 11/3/09 – MY-03

Photo Point 7a: View looking south at confluence of UT2 and UTHR. 11/3/09 – MY-03

Photo Point 7b: View looking north near Station 31+15. 11/3/09 – MY-03

Photo Point 8: View looking north towards Vegetation Plot #6. 11/3/09 – MY-03

Photo Point 9a: View looking south toward Vegetation Plot #6. 11/3/09 – MY-03

Photo Point 9b: View looking north toward end of project. 11/3/09 – MY-03

Photo Point 10a: View looking upstream on UT1 near Station 41+25. 11/3/09 – MY-03

Photo Point 10b: View looking downstream on UT1 near Station 41+25. 11/3/09 – MY-03

Photo Point 11a: View looking east on UT1 with Vegetation Plot #4 on right. 11/3/09 – MY-03

Photo Point 11b: View looking downstream on UT1 before it enters UTHR. 11/3/09 – MY-03

Photo Point 12a: View looking upstream on UT2. 11/3/09 – MY-03

Photo Point 12b: View looking downstream on UT2 before it enters UTHR. 11/3/09 – MY-03

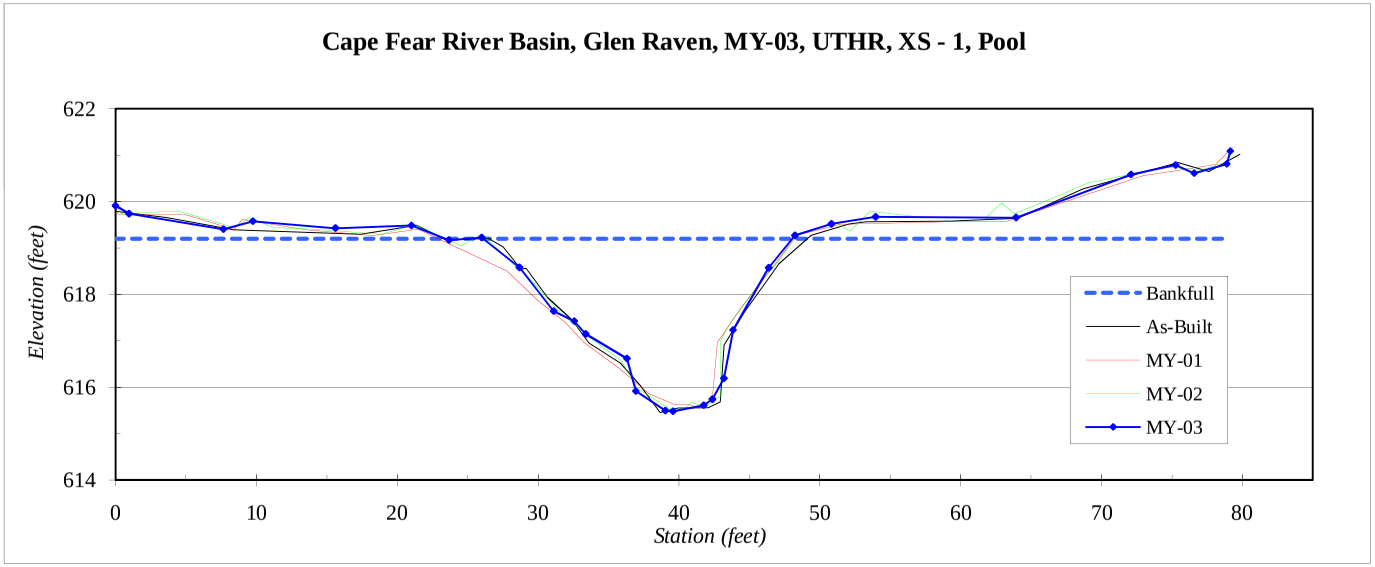
Appendix B3: Cross-Section Plots

River Basin:	Cape Fear
Watershed:	Glen Raven, MY-03, UTHR
XS ID	XS - 1, Pool
Drainage Area (sq mi):	1.09
Date:	6/1/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	619.91
1.0	619.74
7.7	619.40
9.8	619.57
15.6	619.43
21.0	619.48
23.7	619.17
26.0	619.22
28.7	618.58
31.1	617.64
32.6	617.42
33.4	617.14
36.3	616.62
36.9	615.92
39.0	615.49
39.6	615.48
41.8	615.61
42.4	615.74
43.2	616.19
43.8	617.23
46.4	618.57
48.2	619.27
50.8	619.52
54.0	619.67
63.9	619.65
72.1	620.58
75.3	620.78
76.6	620.61
78.9	620.81
79.1	621.08

SUMMARY DATA	
Bankfull Elevation:	619.2
Bankfull Cross-Sectional Area:	43.6
Bankfull Width:	22.0
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.7
Mean Depth at Bankfull:	2.0
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	1.0

Stream Type	C4

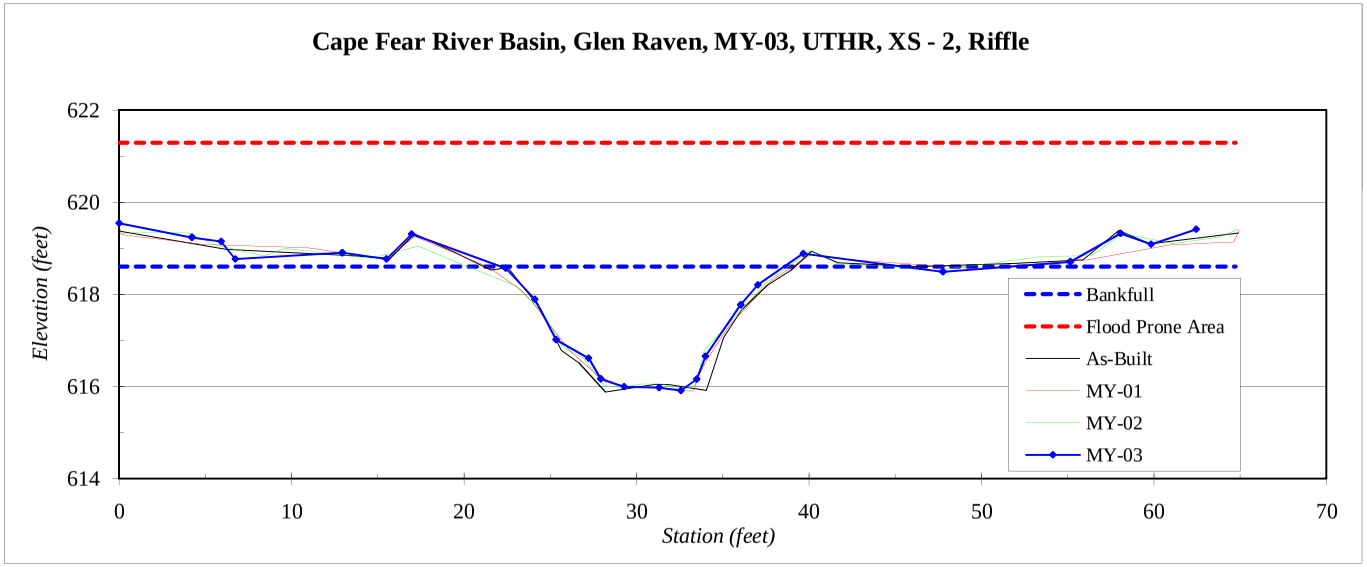


River Basin:	Cape Fear
Watershed:	Glen Raven, MY-03, UTHR
XS ID	XS - 2, Riffle
Drainage Area (sq mi):	1.09
Date:	6/1/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	619.54
4.2	619.23
5.9	619.15
6.7	618.76
12.9	618.90
15.5	618.77
17.0	619.31
22.4	618.57
24.1	617.89
25.3	617.02
27.2	616.61
27.9	616.17
29.3	616.00
31.3	615.97
32.6	615.91
33.5	616.16
34.0	616.66
36.0	617.77
37.0	618.21
39.7	618.89
47.8	618.49
55.2	618.71
58.1	619.32
59.8	619.09
62.5	619.41
64.7	619.42

SUMMARY DATA	
Bankfull Elevation:	618.6
Bankfull Cross-Sectional Area:	26.2
Bankfull Width:	16.4
Flood Prone Area Elevation:	621.3
Flood Prone Width:	>64
Max Depth at Bankfull:	2.7
Mean Depth at Bankfull:	1.6
W / D Ratio:	10.3
Entrenchment Ratio:	>3.5
Bank Height Ratio:	1.0

Stream Type	C4

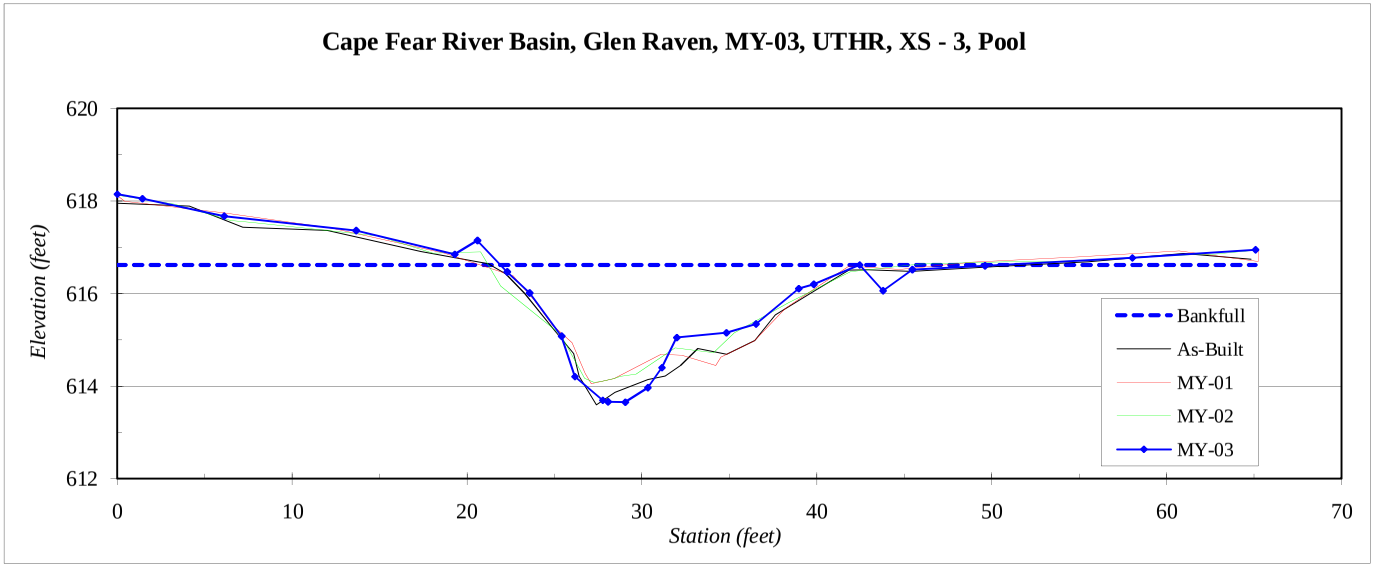


River Basin:	Cape Fear
Watershed:	Glen Raven, MY-03, UTHR
XS ID	XS - 3, Pool
Drainage Area (sq mi):	1.09
Date:	6/15/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	618.15
1.4	618.05
6.1	617.67
13.7	617.36
19.3	616.85
20.6	617.15
22.3	616.47
23.6	616.01
25.4	615.08
26.2	614.21
27.8	613.69
28.1	613.66
29.0	613.65
30.3	613.97
31.1	614.40
32.0	615.05
34.8	615.15
36.5	615.34
39.0	616.11
39.8	616.20
42.4	616.62
43.8	616.06
45.5	616.52
49.6	616.60
58.0	616.77
65.1	616.95

SUMMARY DATA	
Bankfull Elevation:	616.6
Bankfull Cross-Sectional Area:	29.0
Bankfull Width:	20.5
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.0
Mean Depth at Bankfull:	1.4
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	1.0

Stream Type	C4

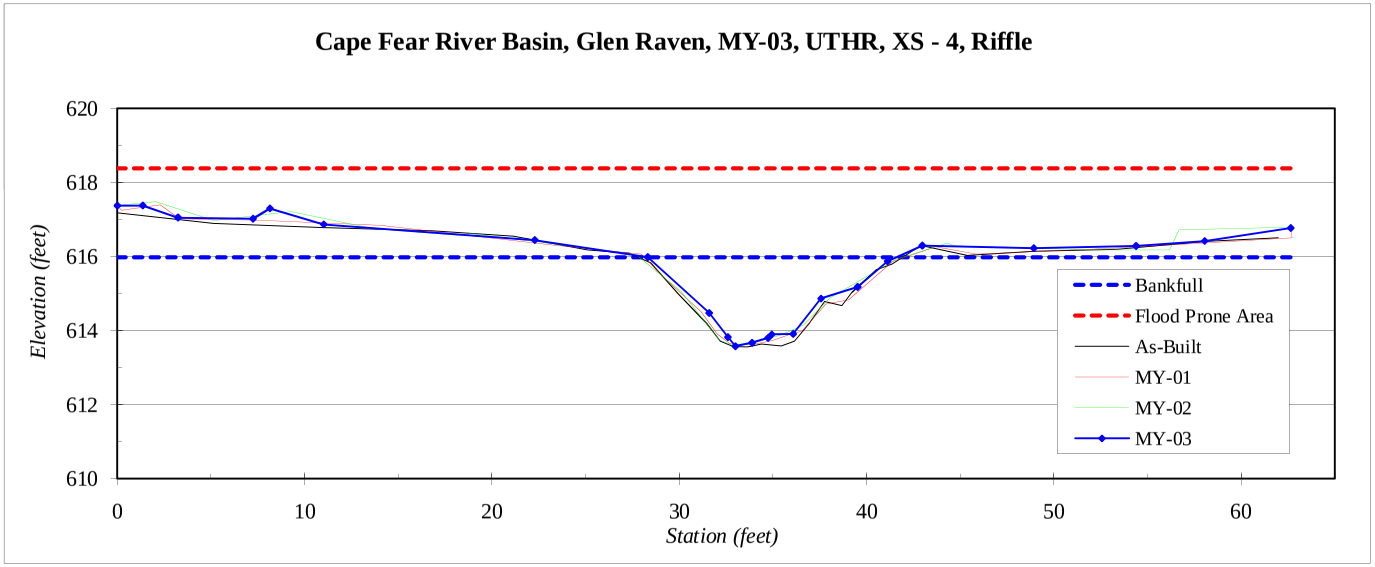


River Basin:	Cape Fear
Watershed:	Glen Raven, MY-03, UTHR
XS ID	XS - 4, Riffle
Drainage Area (sq mi):	1.09
Date:	6/15/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	617.37
1.4	617.38
3.2	617.05
7.2	617.02
8.1	617.30
11.0	616.87
22.3	616.44
28.3	615.98
31.6	614.48
32.6	613.83
33.0	613.58
33.9	613.67
34.7	613.80
34.9	613.90
36.1	613.91
37.6	614.87
39.5	615.18
41.1	615.87
43.0	616.29
48.9	616.22
54.4	616.28
58.1	616.42
62.6	616.77

SUMMARY DATA	
Bankfull Elevation:	616.0
Bankfull Cross-Sectional Area:	17.0
Bankfull Width:	13.3
Flood Prone Area Elevation:	618.4
Flood Prone Width:	>62
Max Depth at Bankfull:	2.4
Mean Depth at Bankfull:	1.3
W / D Ratio:	10.4
Entrenchment Ratio:	>4
Bank Height Ratio:	1.0

Stream Type	C4

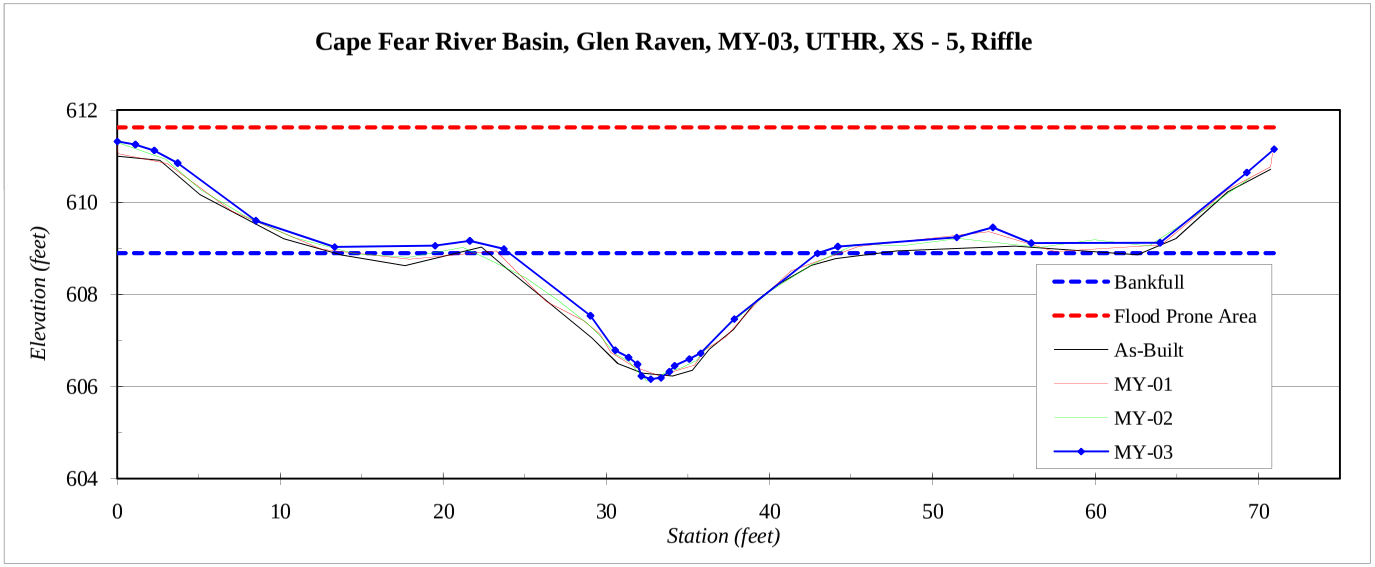


River Basin:	Cape Fear
Watershed:	Glen Raven, MY-03, UTHR
XS ID	XS - 5, Riffle
Drainage Area (sq mi):	1.09
Date:	6/23/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	611.32
1.1	611.25
2.3	611.12
3.7	610.85
8.5	609.60
13.3	609.03
19.5	609.06
21.6	609.16
23.7	608.99
29.0	607.54
30.5	606.79
31.4	606.63
31.9	606.48
32.1	606.23
32.7	606.16
33.3	606.19
33.9	606.32
34.2	606.45
35.1	606.60
35.8	606.72
37.8	607.47
43.0	608.89
44.2	609.04
51.5	609.23
53.7	609.45
56.1	609.11
64.0	609.12
69.3	610.64
71.0	611.15

SUMMARY DATA	
Bankfull Elevation:	608.9
Bankfull Cross-Sectional Area:	26.1
Bankfull Width:	18.9
Flood Prone Area Elevation:	611.6
Flood Prone Width:	>71
Max Depth at Bankfull:	2.7
Mean Depth at Bankfull:	1.4
W / D Ratio:	13.7
Entrenchment Ratio:	>3
Bank Height Ratio:	1.0

Stream Type	C4

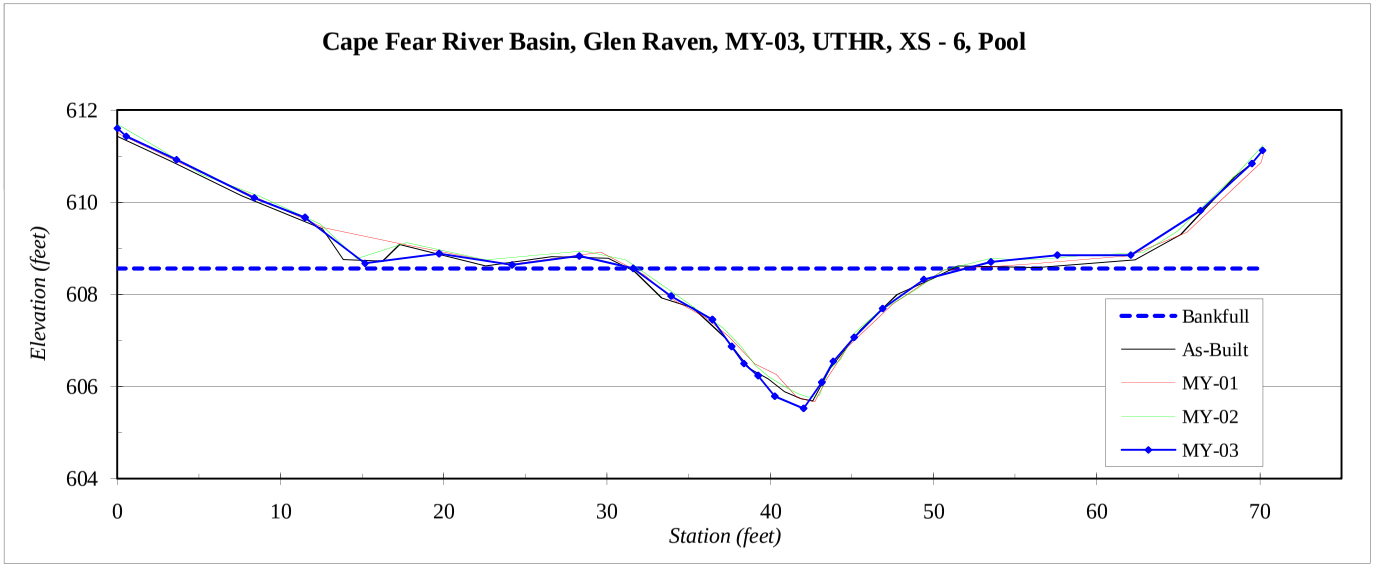


River Basin:	Cape Fear
Watershed:	Glen Raven, MY-03, UTHR
XS ID	XS - 6, Pool
Drainage Area (sq mi):	1.09
Date:	6/24/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	611.60
0.5	611.43
3.6	610.92
8.4	610.09
11.5	609.67
15.2	608.67
19.7	608.88
24.2	608.64
28.3	608.83
31.6	608.56
33.9	607.96
36.5	607.45
37.6	606.87
38.4	606.49
39.3	606.23
40.3	605.79
42.0	605.52
43.2	606.09
43.9	606.55
45.1	607.07
46.9	607.69
49.4	608.32
53.5	608.70
57.6	608.85
62.1	608.85
66.4	609.82
69.5	610.84
70.2	611.12

SUMMARY DATA	
Bankfull Elevation:	608.6
Bankfull Cross-Sectional Area:	26.2
Bankfull Width:	20.4
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.0
Mean Depth at Bankfull:	1.3
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	1.0

Stream Type	C4

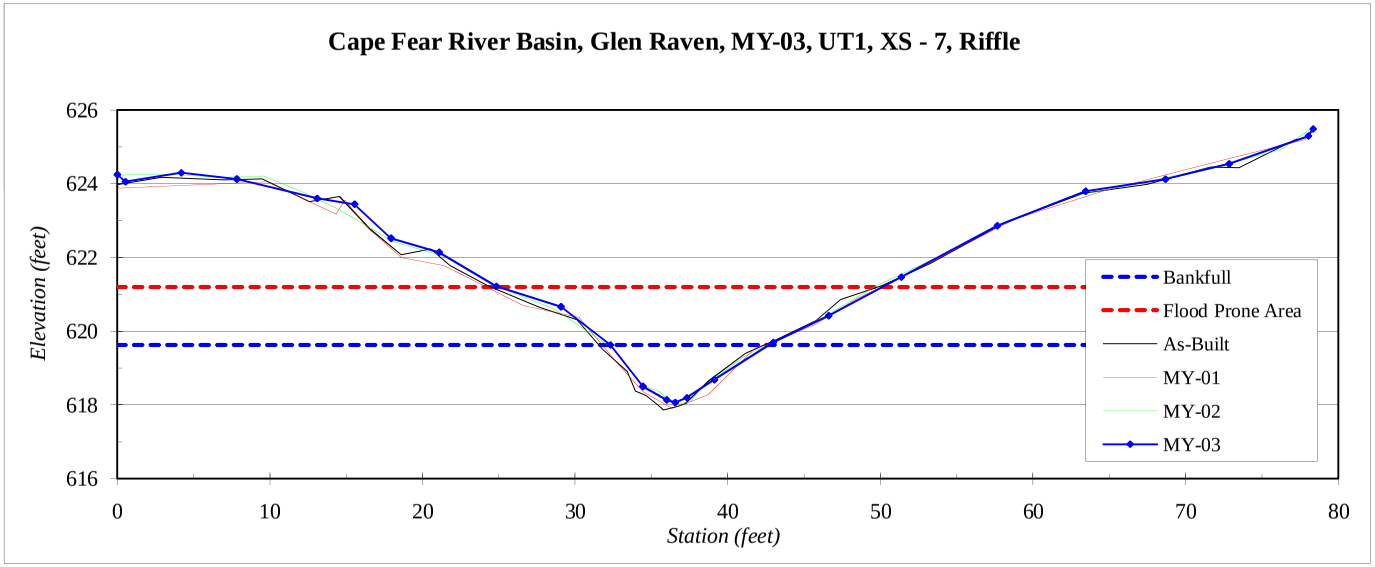


River Basin:	Cape Fear
Watershed:	Glen Raven, MY-03, UT1
XS ID	XS - 7, Riffle
Drainage Area (sq mi):	0.10
Date:	6/22/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	624.25
0.5	624.06
4.2	624.30
7.8	624.13
13.1	623.60
15.5	623.44
17.9	622.52
21.1	622.14
24.8	621.22
29.1	620.66
32.3	619.63
34.4	618.51
36.0	618.14
36.6	618.07
37.3	618.19
39.1	618.69
43.0	619.70
46.6	620.42
51.4	621.47
57.7	622.86
63.4	623.80
68.7	624.12
72.9	624.54
78.0	625.29
78.4	625.49

SUMMARY DATA	
Bankfull Elevation:	619.6
Bankfull Cross-Sectional Area:	9.1
Bankfull Width:	10.4
Flood Prone Area Elevation:	621.2
Flood Prone Width:	25
Max Depth at Bankfull:	1.6
Mean Depth at Bankfull:	0.9
W / D Ratio:	11.9
Entrenchment Ratio:	2.4
Bank Height Ratio:	1.0

Stream Type	B4c

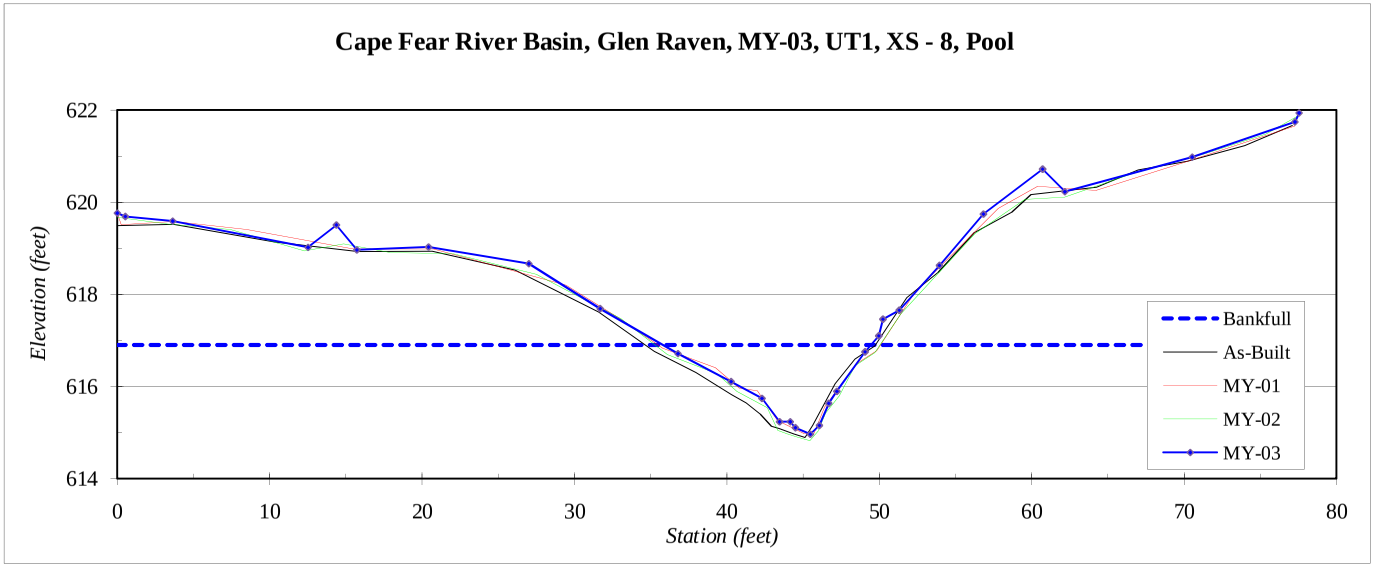


River Basin:	Cape Fear
Watershed:	Glen Raven, MY-03, UT1
XS ID	XS - 8, Pool
Drainage Area (sq mi):	0.10
Date:	6/22/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	619.76
0.5	619.69
3.6	619.59
12.5	619.02
14.4	619.50
15.7	618.96
20.4	619.03
27.0	618.66
31.7	617.69
36.8	616.71
40.3	616.11
42.3	615.74
43.5	615.24
44.2	615.24
44.5	615.11
45.5	614.96
46.1	615.16
46.7	615.63
47.2	615.90
49.1	616.75
50.0	617.10
50.2	617.46
51.3	617.66
54.0	618.62
56.8	619.74
60.7	620.72
62.2	620.23
70.5	620.98
77.3	621.74
77.6	621.94

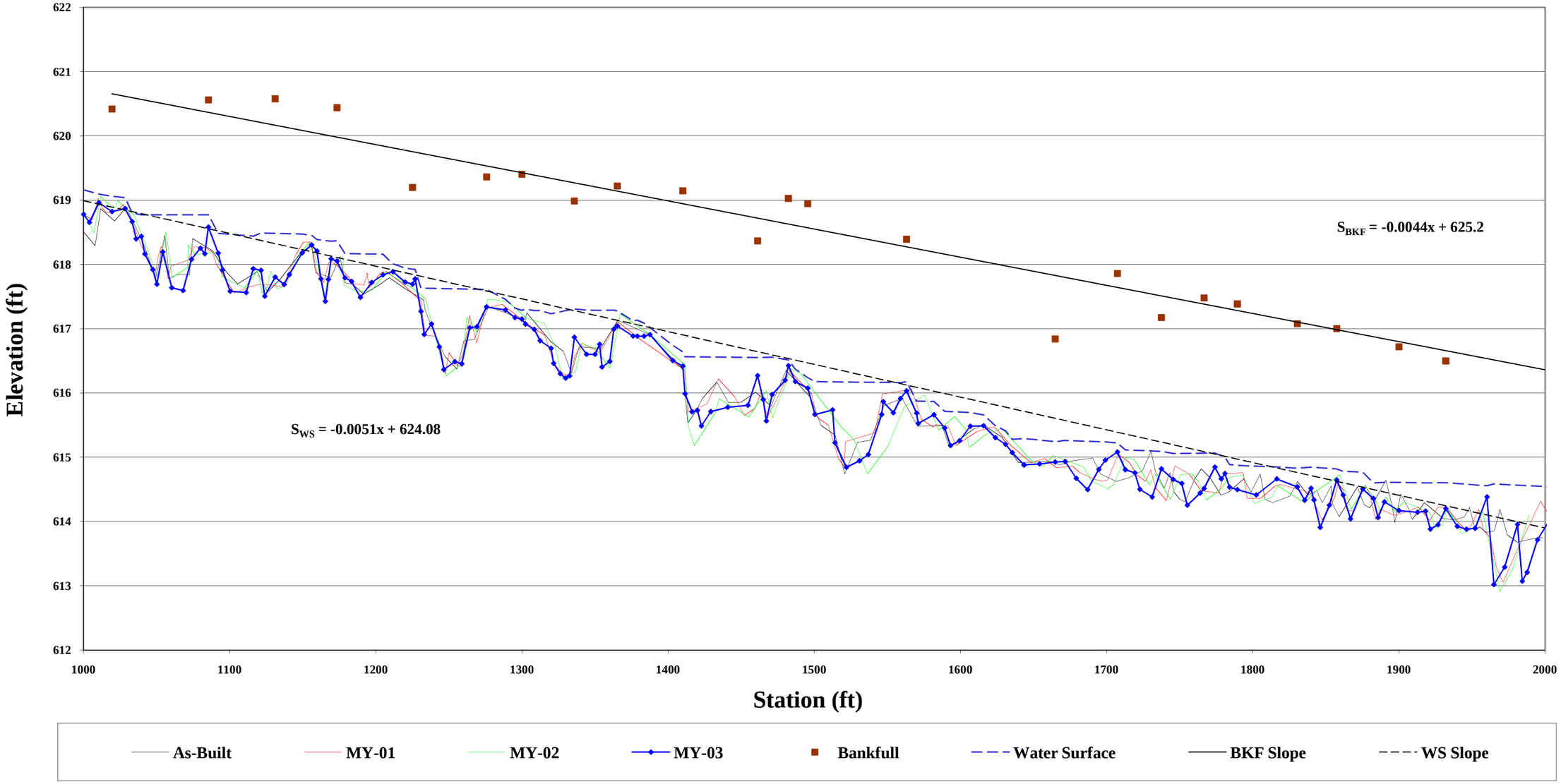
SUMMARY DATA	
Bankfull Elevation:	616.9
Bankfull Cross-Sectional Area:	12.7
Bankfull Width:	13.6
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	0.9
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	1.0

Stream Type	B4c

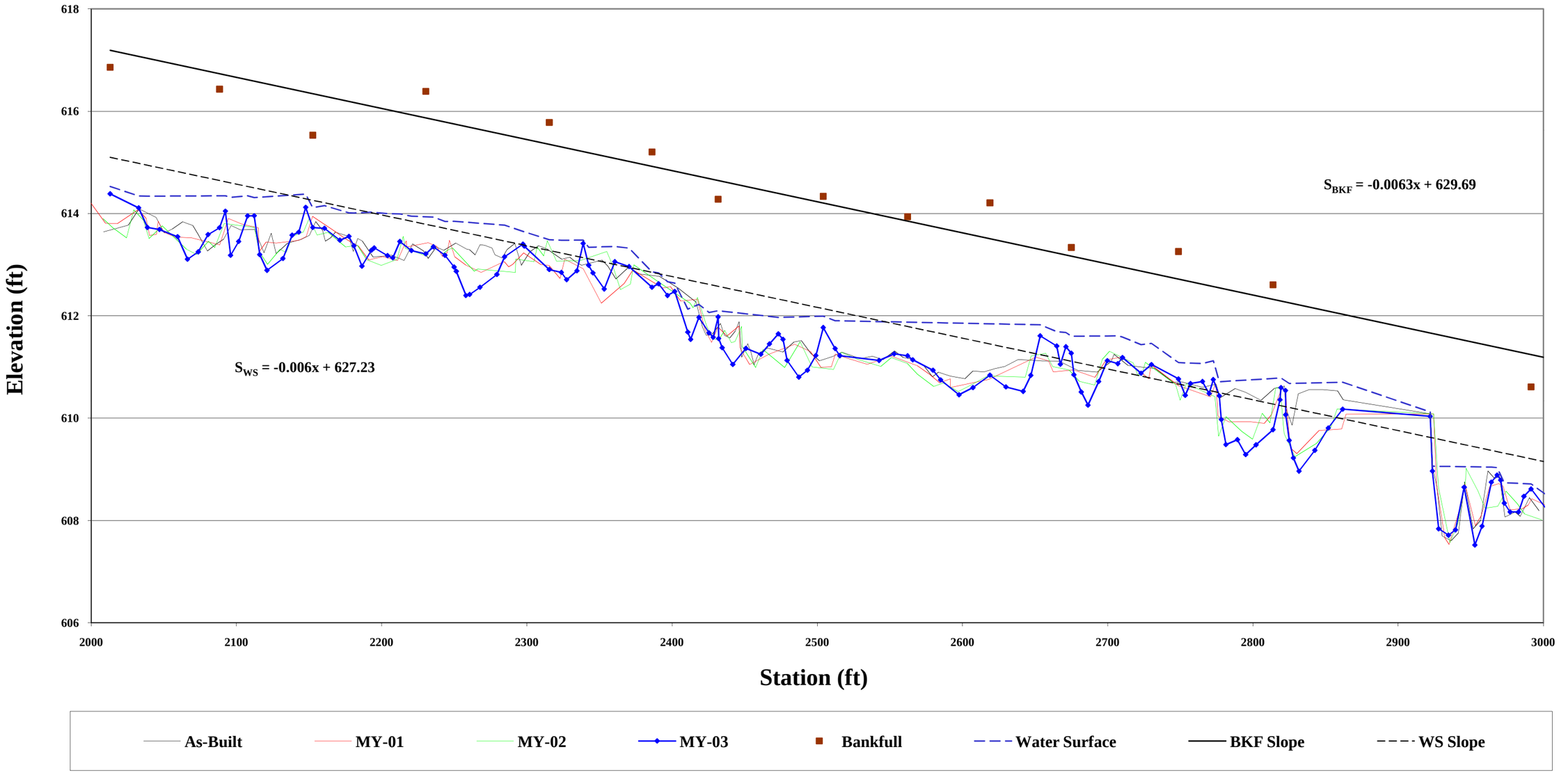


Appendix B4: Longitudinal Profile

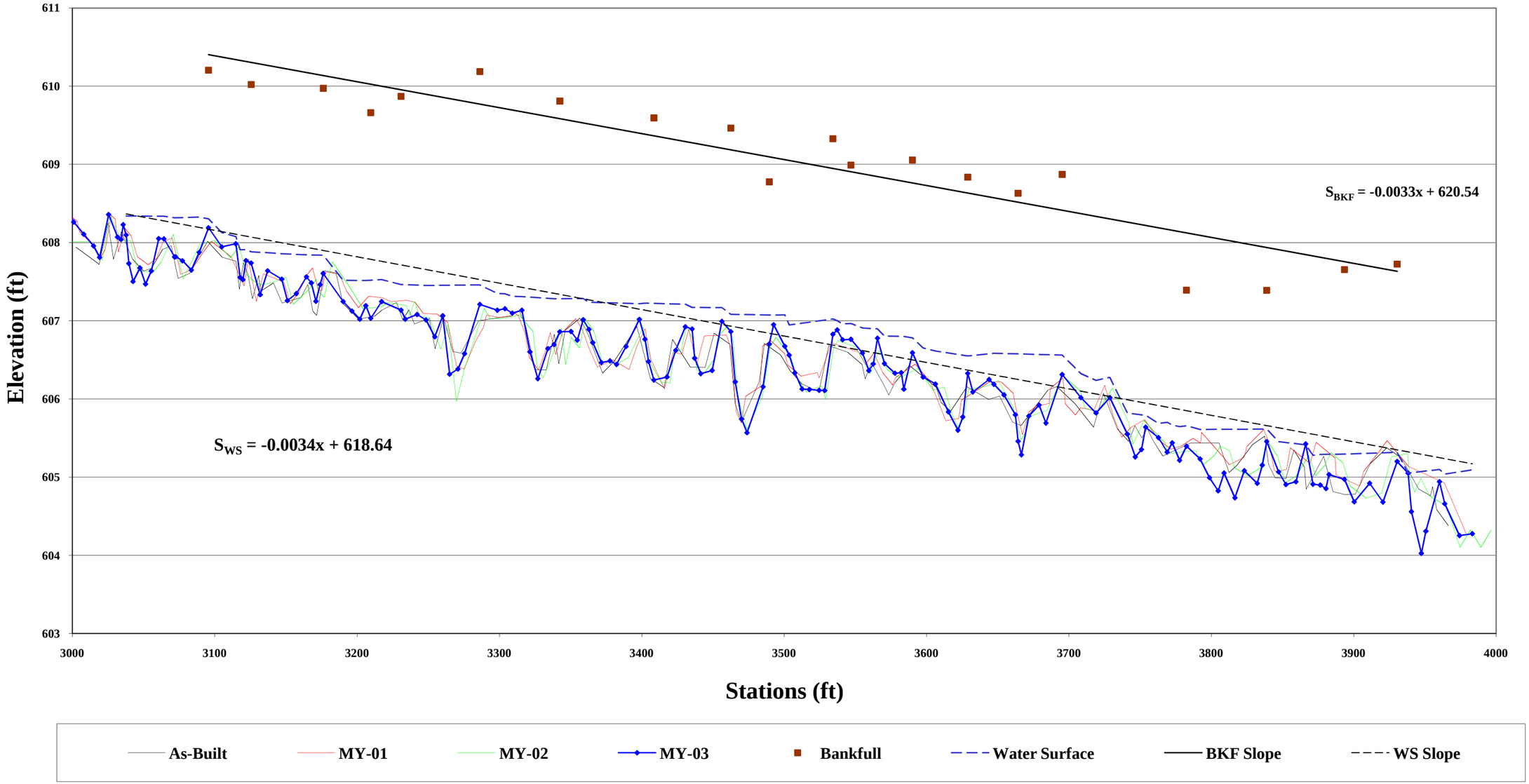
Longitudinal Profile
UTHR MY-03
Stations 10+00 - 20+00



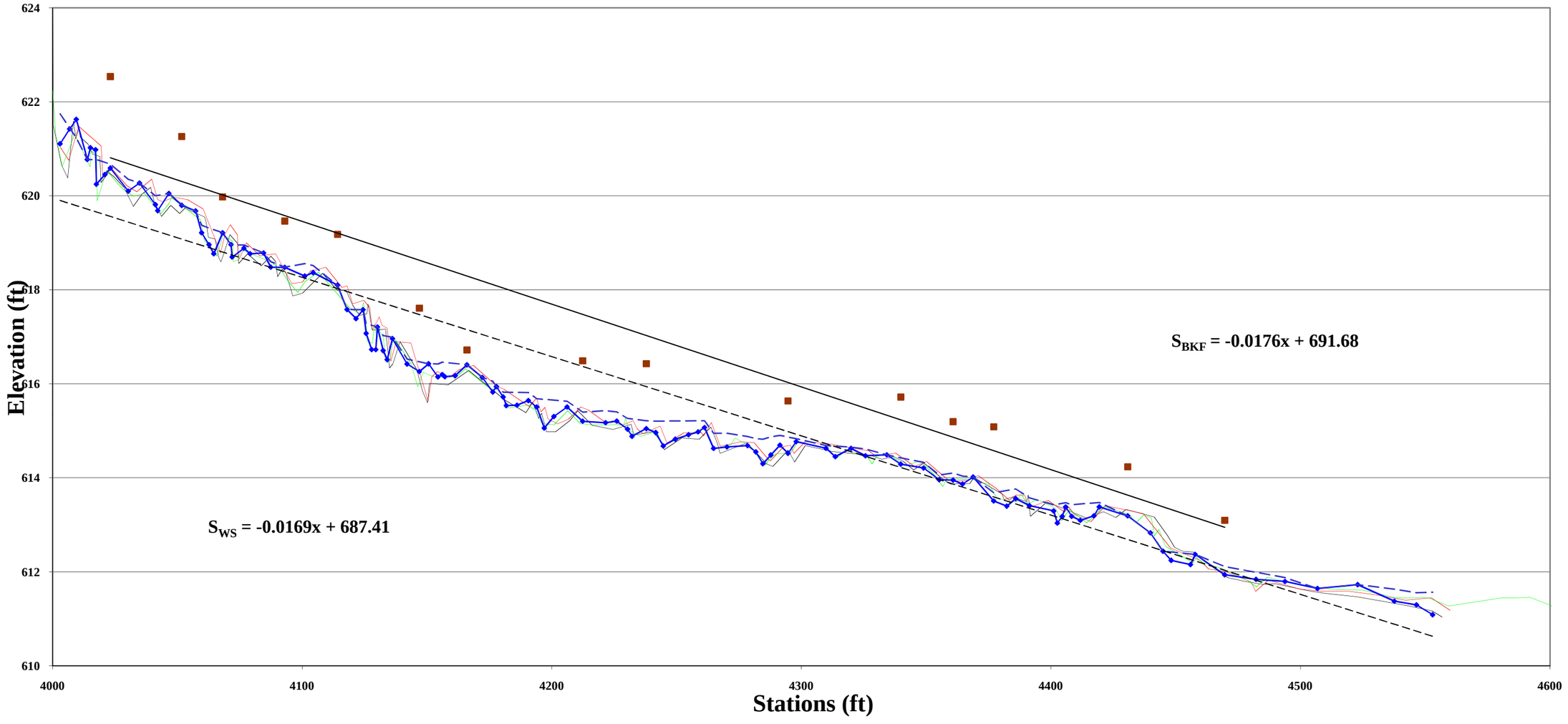
Longitudinal Profile
UTHR MY-03
Stations 20+00 - 30+00



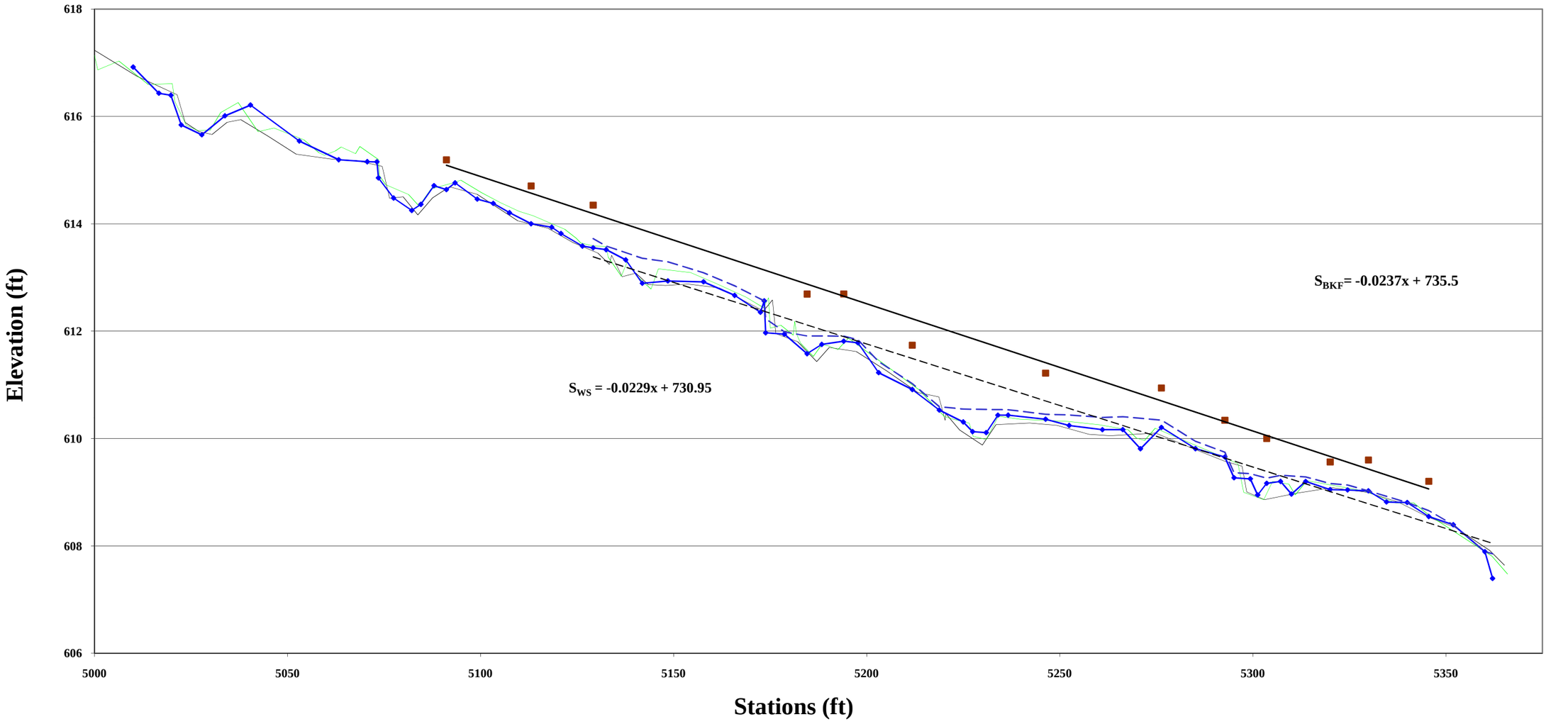
Longitudinal Profile
UTHR MY-03
Stations 30+00 - 40+00



Longitudinal Profile
UT1 MY-03
Stations 40+00 - 46+00



Longitudinal Profile
UT2 MY-03
Stations 50+00 - 53+75

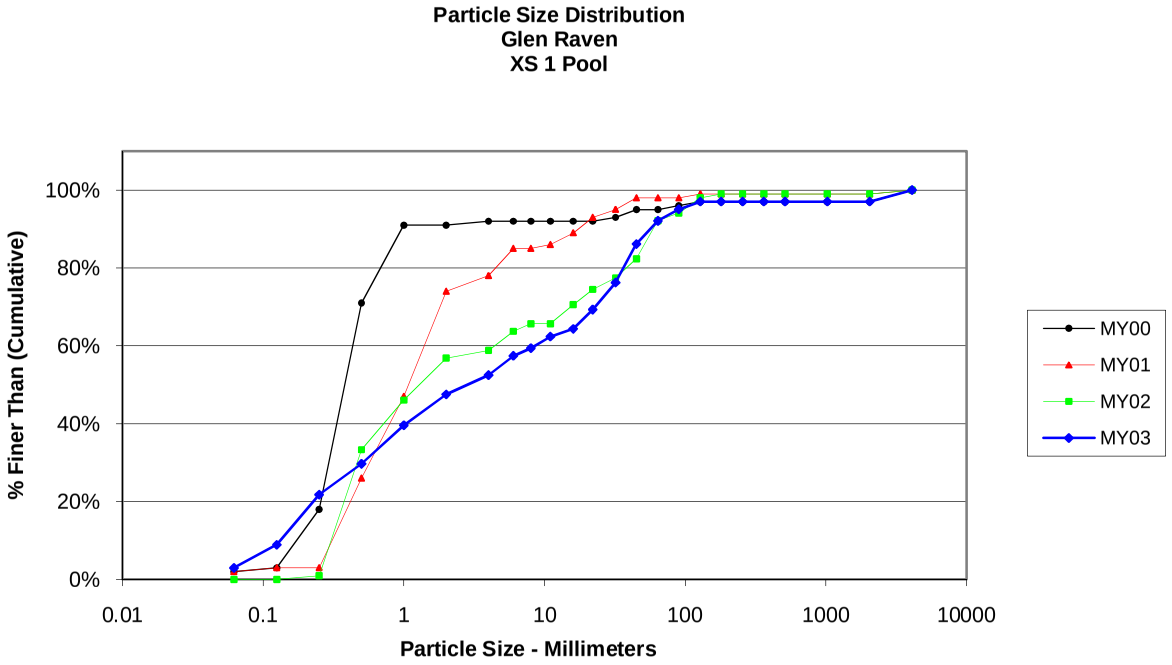


*No survey data taken during MY-01

Appendix B5: Pebble Count Plots

Cross-Section 1 Pool - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	3
Very Fine	.062 - .125	S	6
Fine	.125 - .25	A	13
Medium	.25 - .50	N	8
Coarse	.50 - 1	D	10
Very Coarse	1 - 2	S	8
Very Fine	2 - 4		5
Fine	4 - 5.7	G	5
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	3
Medium	11.3 - 16	V	2
Coarse	16 - 22.6	E	5
Coarse	22.6 - 32	L	7
Very Coarse	32 - 45	S	10
Very Coarse	45 - 64		6
Small	64 - 90	C	3
Small	90 - 128	O	2
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	3
		Total	101

Note:



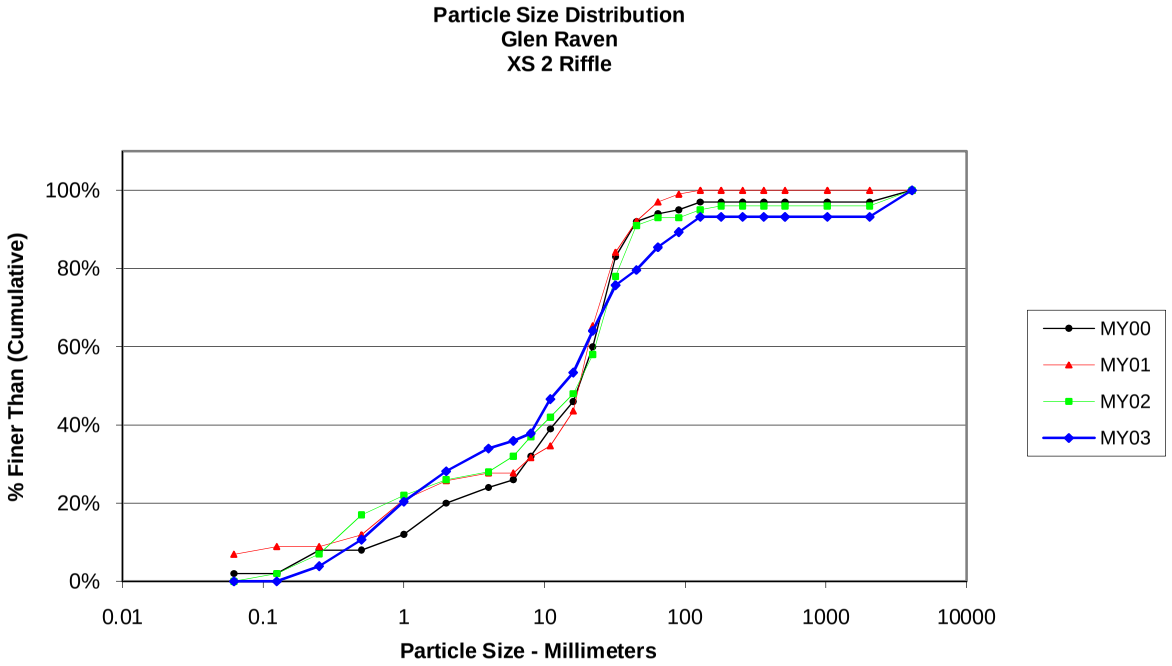
Size (mm)	
D16	0.18
D35	0.67
D50	2.3
D65	13
D84	38
D95	65

Size Distribution	
mean	2.6
dispersion	14.6
skewness	0.04

Type	
silt/clay	3%
sand	45%
gravel	45%
cobble	5%
boulder	0%
bedrock	3%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 2 Riffle - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	4
Medium	.25 - .50	N	7
Coarse	.50 - 1	D	10
Very Coarse	1 - 2	S	8
Very Fine	2 - 4		6
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	9
Medium	11.3 - 16	V	7
Coarse	16 - 22.6	E	11
Coarse	22.6 - 32	L	12
Very Coarse	32 - 45	S	4
Very Coarse	45 - 64		6
Small	64 - 90	C	4
Small	90 - 128	O	4
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	7
		Total	103

Note:



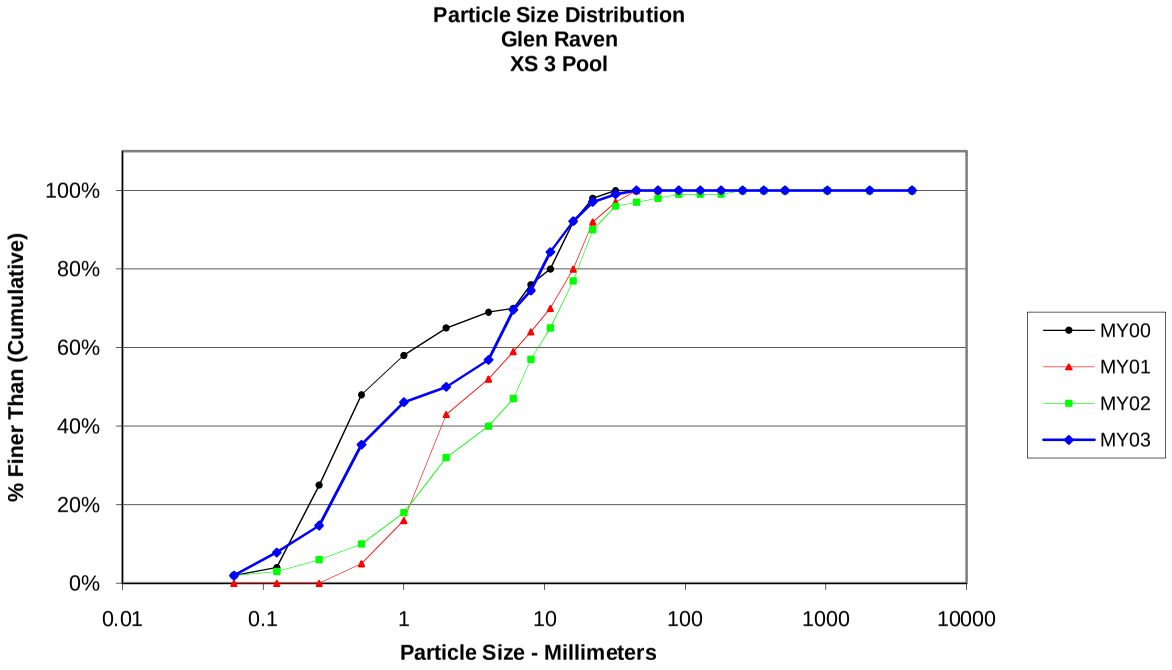
Size (mm)	
D16	0.68
D35	3.4
D50	11
D65	20
D84	40
D95	84

Size Distribution	
mean	5.2
dispersion	9.9
skewness	-0.24

Type	
silt/clay	0%
sand	28%
gravel	57%
cobble	8%
boulder	0%
bedrock	7%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 3 Pool - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	2
Very Fine	.062 - .125	S	6
Fine	.125 - .25	A	7
Medium	.25 - .50	N	21
Coarse	.50 - 1	D	11
Very Coarse	1 - 2	S	4
Very Fine	2 - 4		7
Fine	4 - 5.7	G	13
Fine	5.7 - 8	R	5
Medium	8 - 11.3	A	10
Medium	11.3 - 16	V	8
Coarse	16 - 22.6	E	5
Coarse	22.6 - 32	L	2
Very Coarse	32 - 45	S	1
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	102

Note:



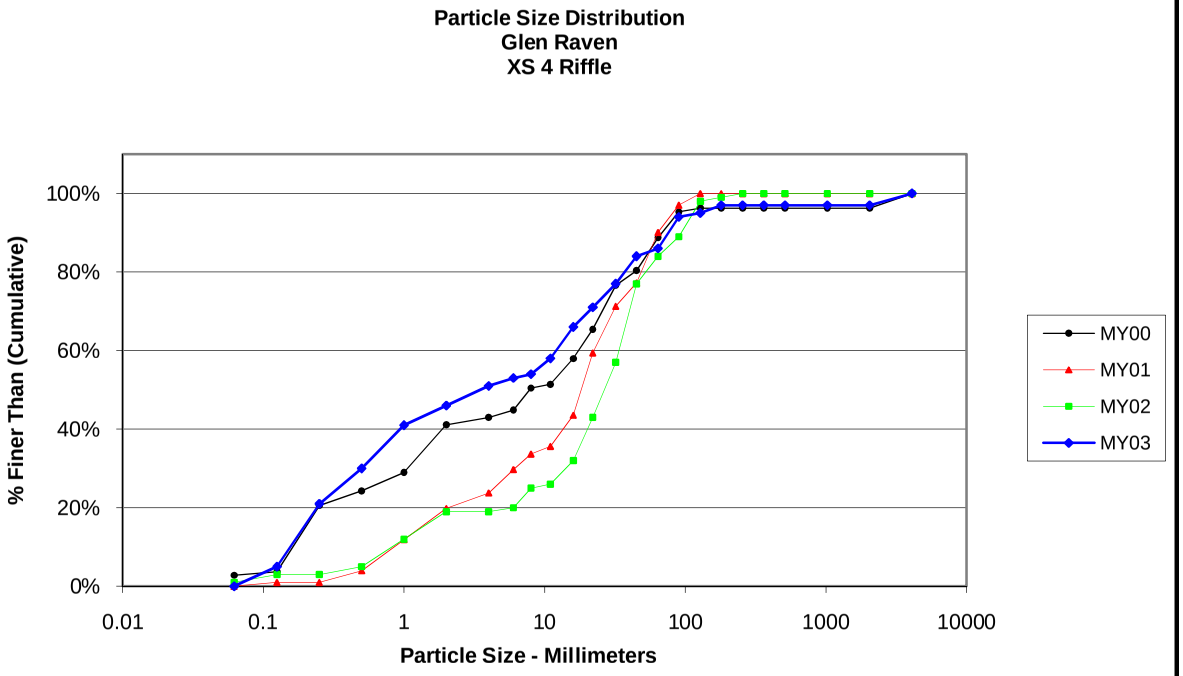
Size (mm)	
D16	0.26
D35	0.5
D50	2
D65	5.2
D84	11
D95	19

Size Distribution	
mean	1.7
dispersion	6.6
skewness	-0.06

Type	
silt/clay	2%
sand	48%
gravel	50%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 4 Riffle - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	5
Fine	.125 - .25	A	16
Medium	.25 - .50	N	9
Coarse	.50 - 1	D	11
Very Coarse	1 - 2	S	5
Very Fine	2 - 4		5
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	4
Medium	11.3 - 16	V	8
Coarse	16 - 22.6	E	5
Coarse	22.6 - 32	L	6
Very Coarse	32 - 45	S	7
Very Coarse	45 - 64		2
Small	64 - 90	C	8
Small	90 - 128	O	1
Large	128 - 180	B	2
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	3
		Total	100

Note:



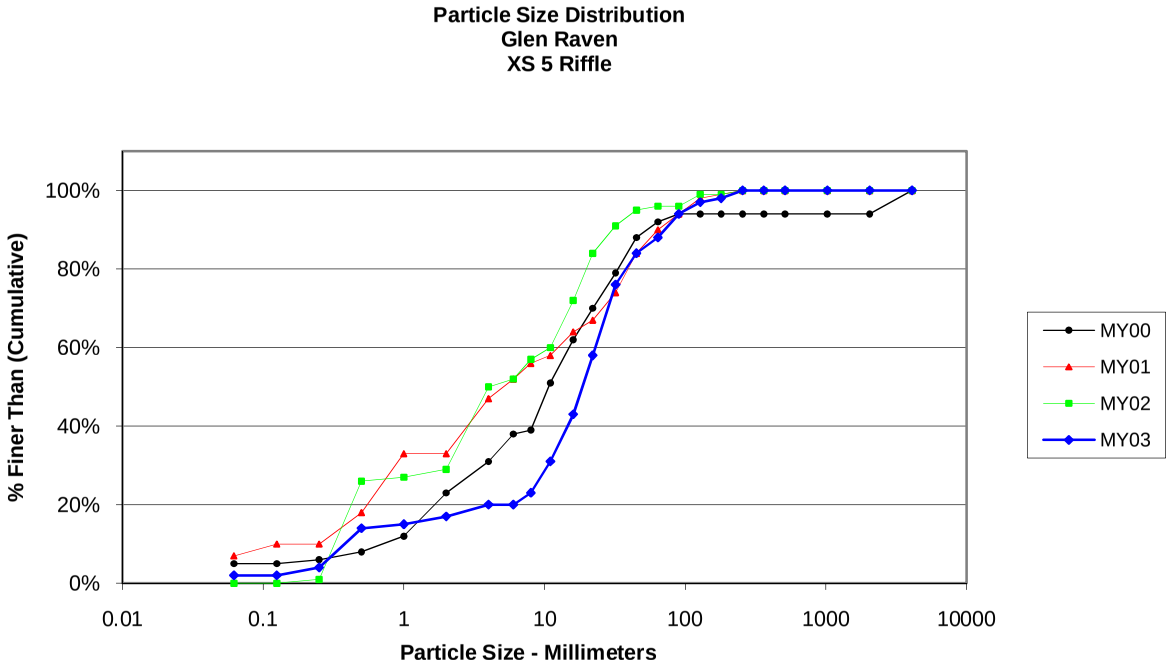
Size (mm)	
D16	0.2
D35	0.64
D50	2.8
D65	14
D84	40
D95	83

Size Distribution	
mean	2.8
dispersion	14.1
skewness	0.00

Type	
silt/clay	0%
sand	46%
gravel	40%
cobble	11%
boulder	0%
bedrock	3%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 5 Riffle - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	2
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	2
Medium	.25 - .50	N	10
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	2
Very Fine	2 - 4		3
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	8
Medium	11.3 - 16	V	12
Coarse	16 - 22.6	E	15
Coarse	22.6 - 32	L	18
Very Coarse	32 - 45	S	8
Very Coarse	45 - 64		4
Small	64 - 90	C	6
Small	90 - 128	O	3
Large	128 - 180	B	1
Large	180 - 256	L	2
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



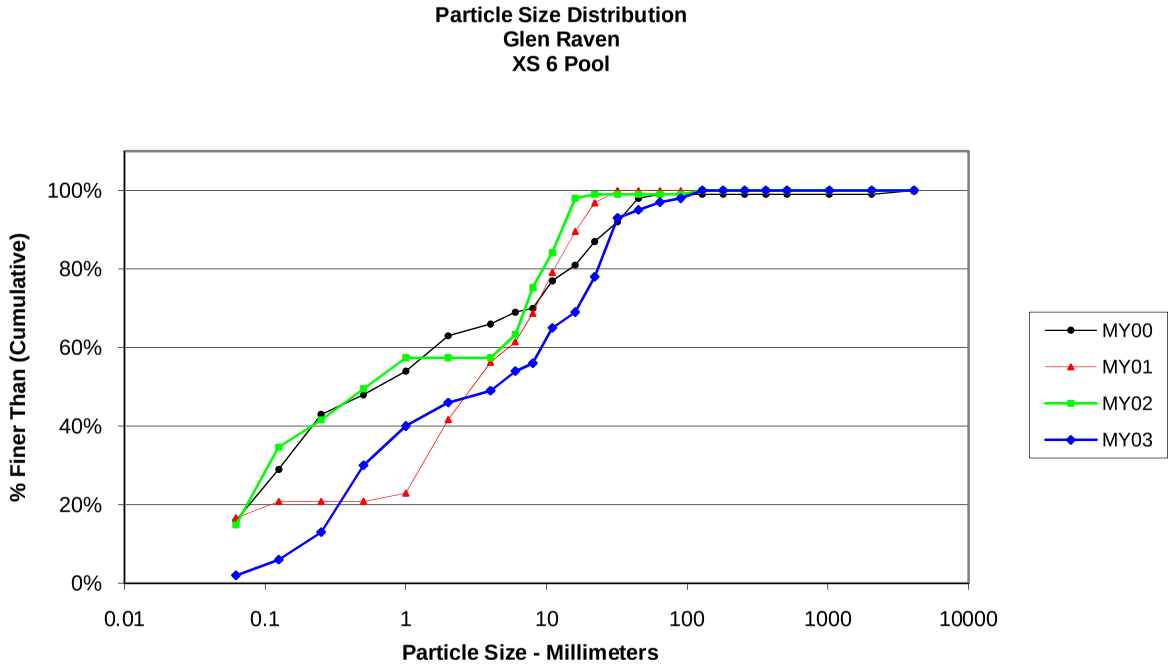
Size (mm)	
D16	1.4
D35	12
D50	19
D65	25
D84	45
D95	100

Size Distribution	
mean	7.9
dispersion	8.0
skewness	-0.31

Type	
silt/clay	2%
sand	15%
gravel	71%
cobble	12%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 6 Pool - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	2
Very Fine	.062 - .125	S	4
Fine	.125 - .25	A	7
Medium	.25 - .50	N	17
Coarse	.50 - 1	D	10
Very Coarse	1 - 2	S	6
Very Fine	2 - 4		3
Fine	4 - 5.7	G	5
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	9
Medium	11.3 - 16	V	4
Coarse	16 - 22.6	E	9
Coarse	22.6 - 32	L	15
Very Coarse	32 - 45	S	2
Very Coarse	45 - 64		2
Small	64 - 90	C	1
Small	90 - 128	O	2
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



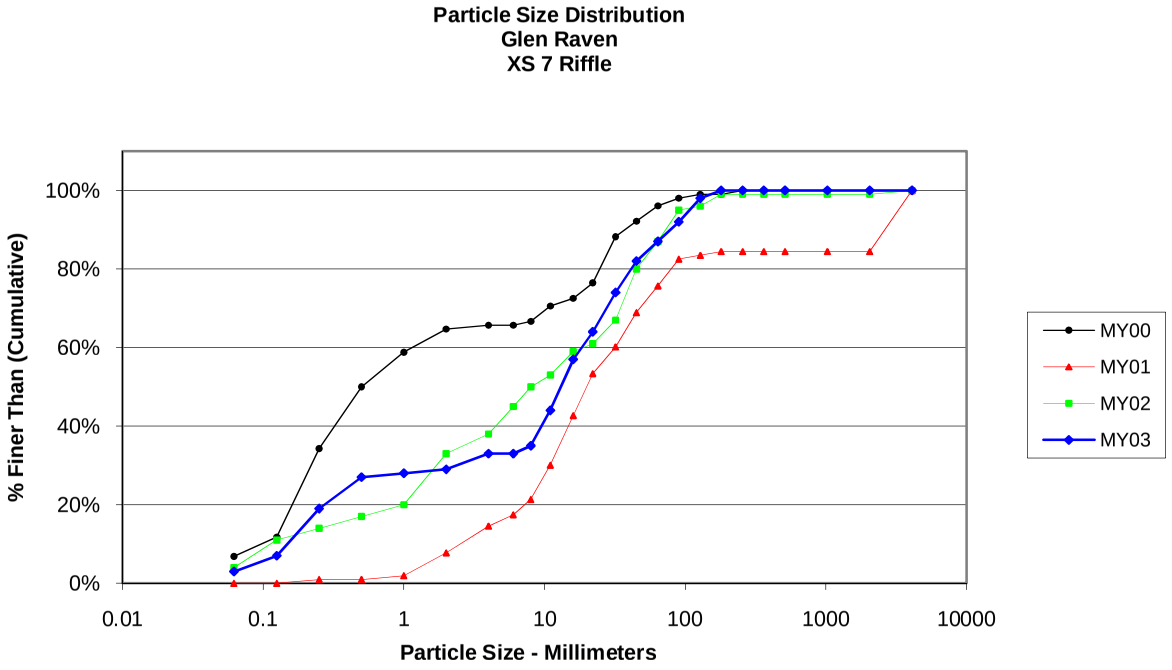
Size (mm)	
D16	0.28
D35	0.71
D50	4.3
D65	11
D84	26
D95	45

Size Distribution	
mean	2.7
dispersion	10.7
skewness	-0.14

Type	
silt/clay	2%
sand	44%
gravel	51%
cobble	3%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 7 Riffle - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	3
Very Fine	.062 - .125	S	4
Fine	.125 - .25	A	12
Medium	.25 - .50	N	8
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	1
Very Fine	2 - 4		4
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	9
Medium	11.3 - 16	V	13
Coarse	16 - 22.6	E	7
Coarse	22.6 - 32	L	10
Very Coarse	32 - 45	S	8
Very Coarse	45 - 64		5
Small	64 - 90	C	5
Small	90 - 128	O	6
Large	128 - 180	B	2
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



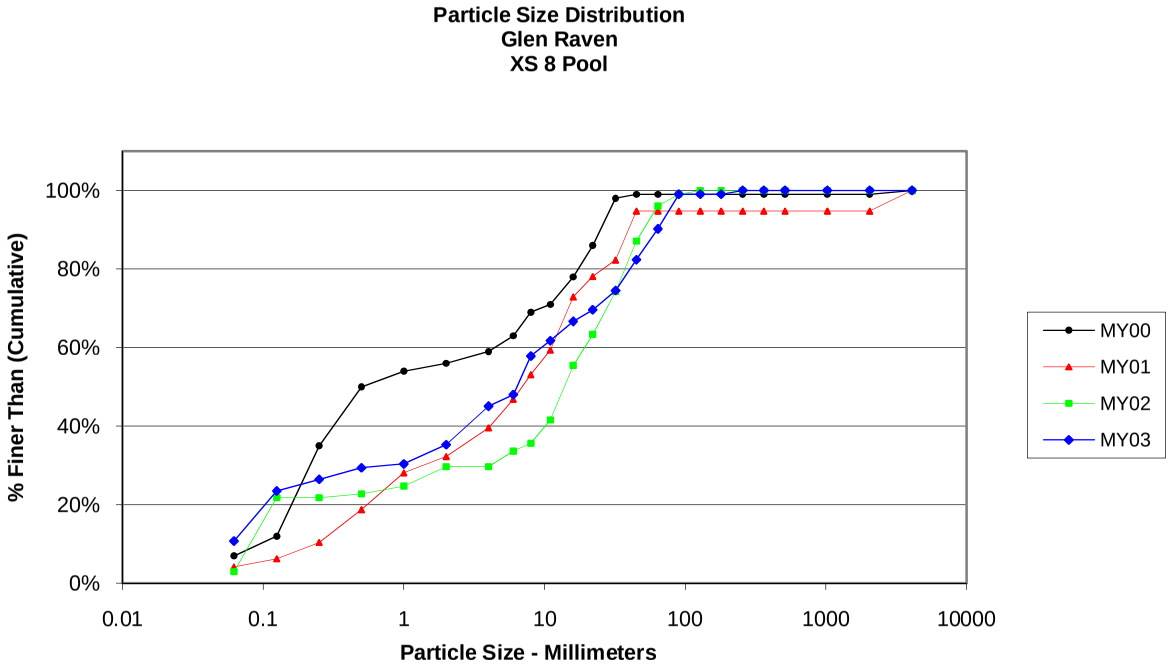
Size (mm)	
D16	0.21
D35	8
D50	13
D65	23
D84	52
D95	110

Size Distribution	
mean	3.3
dispersion	33.0
skewness	-0.38

Type	
silt/clay	3%
sand	26%
gravel	58%
cobble	13%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 8 Pool - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	11
Very Fine	.062 - .125	S	13
Fine	.125 - .25	A	3
Medium	.25 - .50	N	3
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	5
Very Fine	2 - 4		10
Fine	4 - 5.7	G	3
Fine	5.7 - 8	R	10
Medium	8 - 11.3	A	4
Medium	11.3 - 16	V	5
Coarse	16 - 22.6	E	3
Coarse	22.6 - 32	L	5
Very Coarse	32 - 45	S	8
Very Coarse	45 - 64		8
Small	64 - 90	C	9
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	1
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	102

Note:

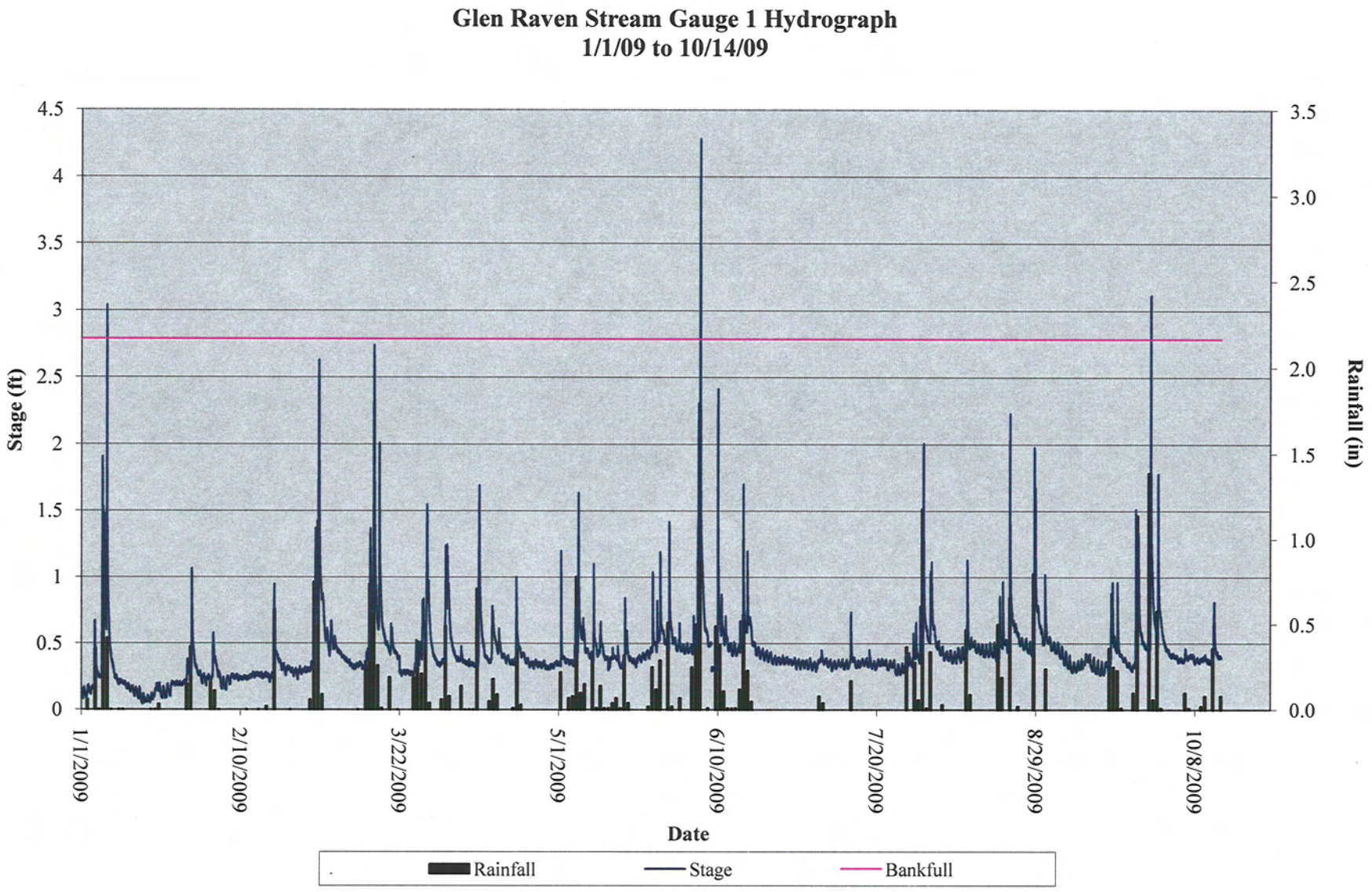


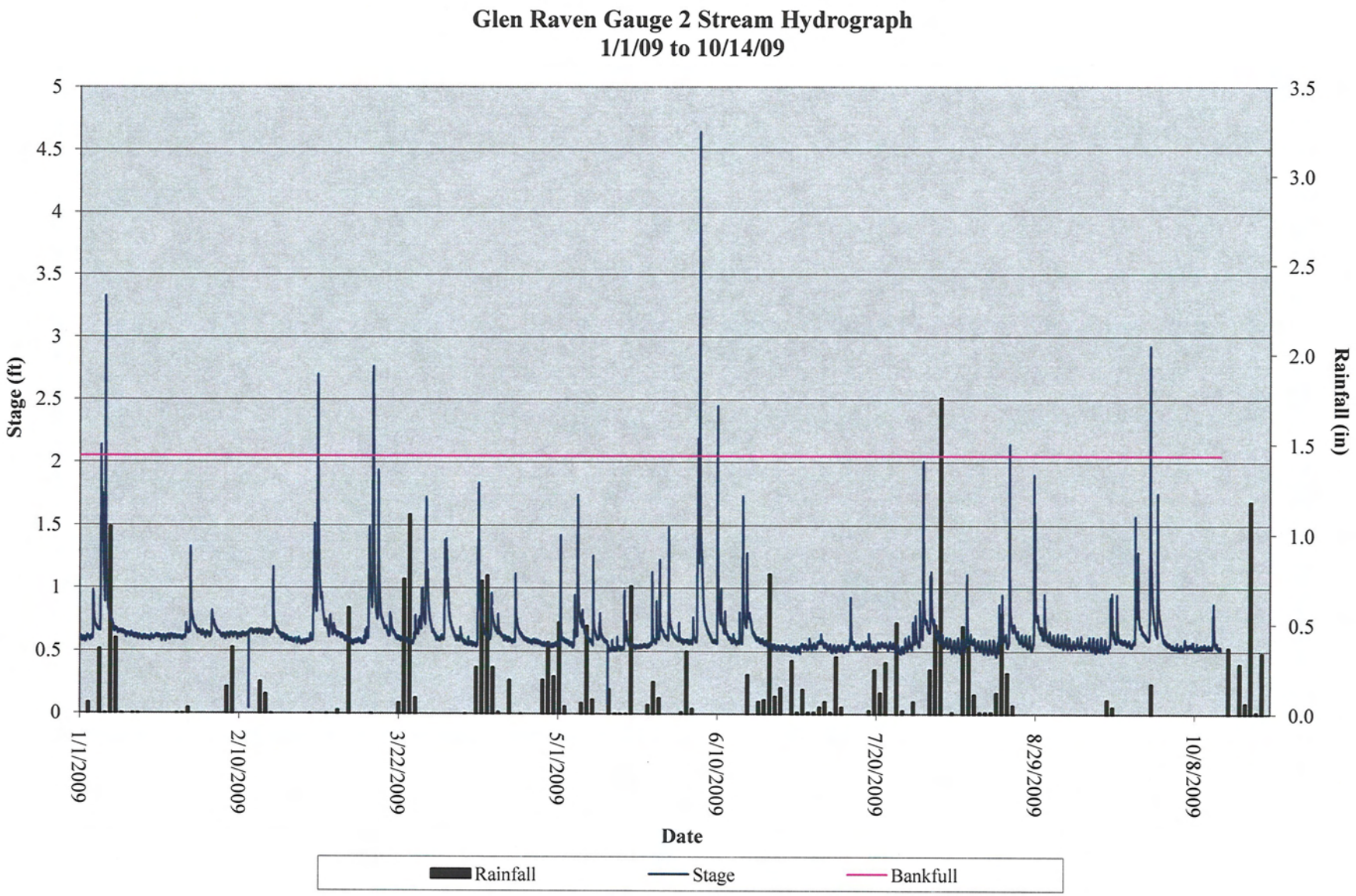
Size (mm)	
D16	0.083
D35	1.9
D50	6.4
D65	14
D84	48
D95	77

Size Distribution	
mean	2.0
dispersion	42.3
skewness	-0.30

Type	
silt/clay	11%
sand	25%
gravel	55%
cobble	10%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Appendix B6 - Stream Hydrographs




Glen Raven Gauge 2 Stream Hydrograph
1/1/09 to 10/14/09
Stage (ft)
Rainfall (in)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/2009
2/10/2009
3/22/2009
5/1/2009
6/10/2009
7/20/2009
8/29/2009
10/8/2009
Date
Rainfall
Stage
Bankfull