Kentwood Park (Bushy Branch)
Stream Restoration Monitoring Report
EEP Project # 205
Monitoring Year – 05
2009

Submitted to:

Ecosystem Enhancement PROGRAM

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

December 2009

Monitoring Firm

Landmark Center II, Suite 220
4601 Six Forks Road
Raleigh, NC 27609
Phone: (919) 278-2514
Fax: (919) 783-9266

Project Contact: Adam Spiller
Email: adam.spiller@kci.com
KCI Project No: 12071067B_KP

Design Firm

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT 1

2.0 METHODOLOGY 3

3.0 REFERENCES 3

APPENDIX A – GENERAL FIGURES AND PLAN VIEW

Figure 1. Vicinity Map 5
Figure 2. Current Condition Plan View 6

APPENDIX B – GENERAL PROJECT TABLES

Table 1. Project Restoration Components 8
Table 2. Project Activity and Reporting History 8
Table 3. Project Contacts Table 9
Table 4. Project Attribute Table 10

APPENDIX C – VEGETATION ASSESSMENT DATA

Table 5. Vegetation Plot Mitigation Success Summary Table 12
Table 6. Stem Counts for Each Species Arranged by Plot 12
Table 7. Planted Stem Density By Plot 13
Vegetation Monitoring Plot Photos 14

APPENDIX D – STREAM ASSESSMENT DATA

Stream Station Photos 18
Table 8 Visual Morphological Stability Assessment 24
Table 9. Verification of Bankfull Events 24
Cross-Section Plots
Longitudinal Profile Plot
Pebble Count Plots

1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

Bushy Branch and an unnamed tributary in Raleigh, North Carolina's Kentwood Park were identified as a restoration project in 2000. The project restored approximately 1,400 linear feet of channel, 1,070 feet on Bushy Branch and 350 feet on an unnamed tributary to Bushy Branch (UT to Bushy Branch). Construction was completed in 2002. The project goals and objectives are listed below.

Goals

- Stabilize the project streams.
- Enhance the riparian corridor.
- Improve water quality and aquatic habitat.

Objectives

- Installation of in-stream structures to define additional bed features.
- Relocate a section of the stream in order to restore stream pattern.
- Grade severely eroding banks and excavate new bankfull benches.
- Install root wads to promote bank stability.
- Revegetate the adjacent banks to promote the establishment of native plant communities.

The restoration plan called for the removal of all existing problem vegetation along the stream banks and within the riparian buffer. The as-built survey found the original planting of native vegetation to be unsuccessful. To correct the initial failure, a remedial vegetation plan was designed and implemented in 2004. Remedial vegetation was planted at a density of 4,840 stems per acre in the streamside community and 680 stems per acre in the bottomland hardwood community. Three vegetation monitoring plots were established during the as-built survey. The fifth year of monitoring calculated an average of 1,740 planted stems/acre in the streamside community based on Plots 1 and 2 and 1,200 stems/acre in the bottomland hardwood community based on plot 3. The use of the park's disc golf course has had an effect on the vegetation along the west side of the upper 200 feet of Bushy Branch. There are large, mature trees along this bank, but the impacts from frequent trampling have suppressed understory vegetation and led to compaction and poor cover in the near bank region. EEP implemented a supplemental planting effort earlier in the project's history that included this area, but foot traffic remained high even with subsequent signage installed later. While the aesthetic and vegetation density of the near bank region in this area is clearly not as good as that further down the project's extent, the large hardwood trees left in place provide a very significant stabilizing root mass. The initial condition of the banks in this area, which were somewhat steep in large part because these trees were saved had also exhibited some steepness and scour from the outset, but have not changed significantly over the monitoring period. Recently, EEP reported to KCI that they met again with the City of Raleigh and the staff responsible for its management to discuss the disc golf pressures and encroachment in some locations by park maintenance staff in order to reinforce protections moving into stewardship. In 2010 the city installed a closely spaced line of boulders and additional EEP signage on the easement boundary in this area. Microstegium (*Microstegium vimineum*) and kudzu (*Pueraria montana*) are present and are scattered over the project's extent with a more concentrated area of kudzu near vegetation plot 3 at the lower end of the site. EEP has established a contract to control/suppress the kudzu during the spring/summer of 2010 with a follow up treatment in 2011. Aside from these invasive populations, the fifth year monitoring found the vegetation component of the project to be on track to meeting success criteria.

The stream assessment completed during the fifth year of monitoring found Bushy Branch to be functioning as designed. Channel dimensions based on repeat cross-sections have not changed significantly over the monitoring period. There has been some localized bank erosion during the monitoring period, but the majority of these areas of bank erosion have not continued to degrade over the monitoring period. UT to Bushy Branch shows isolated areas of bed degradation, but exhibits stability across most of the tributary. Most of the in-stream structures are functioning across the project site, but

several have experienced stress evidenced by some erosion around vane arms. The structures that have been compromised are not in danger of causing wide-spread instability throughout the project.

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the mitigation and restoration plan documents available on the EEPs website. All raw data supporting the tables and figures in the appendices are available upon request.

2.0 METHODOLOGY

The EEP 2004 Stem Counting Protocol was used to collect vegetation data from Kentwood Park this year, the fifth year of monitoring.

3.0 REFERENCES

Weakley, A. S. 2006. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas. (http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora_2006-Jan.pdf)

Appendix A

General Figures and Plan Views

DIRECTIONS TO KENTWOOD PARK SITE:
From Interstate 440 take exit 2A to Western Boulevard. From Western Boulevard, turn right (south) onto Kent Street. At a traffic light at the end of Kent Street, turn right (west) onto Kaplan Drive. Kentwood Park parking will be on the left (south) side of Kaplan Drive.

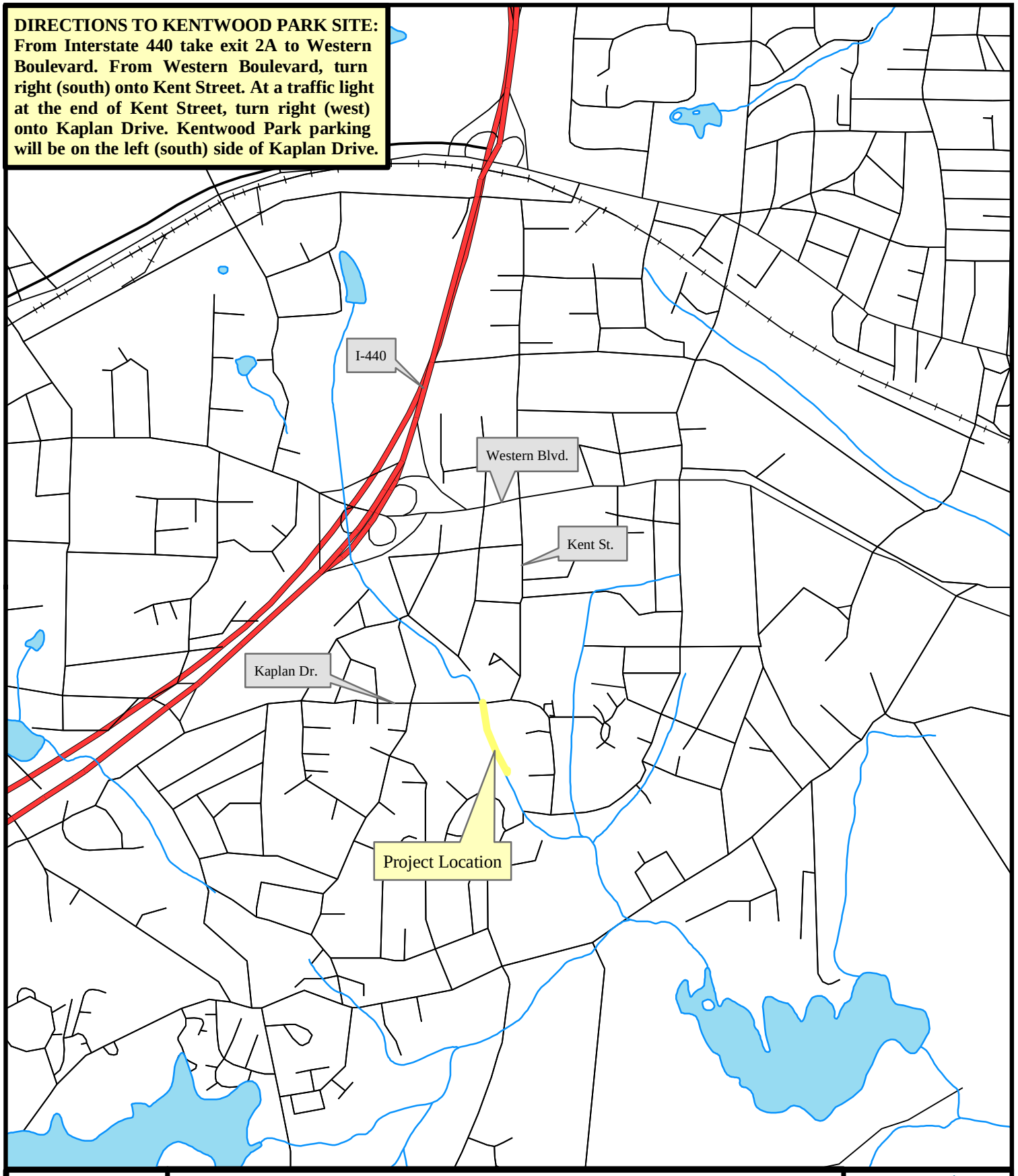
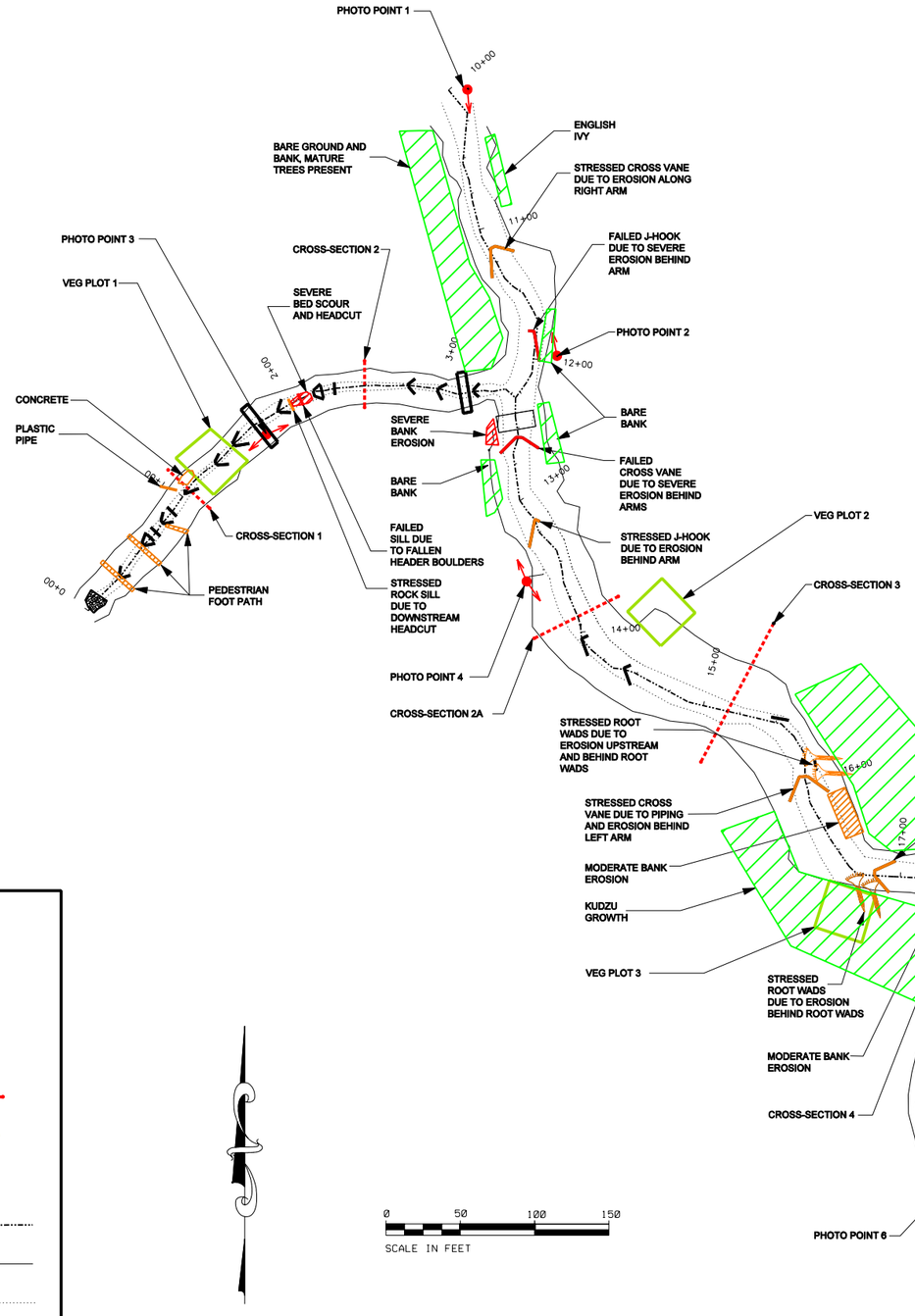


Figure 1. Site Vicinity Map
Kentwood Park, Wake County, EEP Project # 205

0.25 0.125 0 0.25 0.5
Miles

Ecosystem Enhancement Program

KCI ASSOCIATES OF NC



MONITORING FEATURE COORDINATES

(ASSUMED COORDINATE SYSTEM FROM MONITORING SURVEY)

		NORTHING	EASTING
CROSS-SECTION #1	LB	4926.60	4867.91
	RB	4900.65	4895.52
CROSS-SECTION #2	LB	5000.00	5000.00
	RB	4968.67	5000.00
CROSS-SECTION #2A	LB	4841.45	5170.71
	RB	4813.25	5114.21
CROSS-SECTION #3	LB	4820.56	5259.23
	RB	4723.49	5219.47
CROSS-SECTION #4	LB	4651.82	5430.88
	RB	4611.46	5389.46
VEGETATION PLOT #1		4931.15	4873.69
		4954.36	4896.34
		4909.86	4898.86
		4932.60	4921.73
VEGETATION PLOT #2		4819.84	5161.42
		4823.76	5206.52
		4844.74	5182.31
		4798.86	5185.63
VEGETATION PLOT #3		4619.82	5305.75
		4651.83	5312.74
		4644.35	5344.63
		4612.48	5338.48

LEGEND

- AS-BUILT STRUCTURE
- AS-BUILT ROOT WAD
- RIP RAP
- CROSS-SECTION
- VEGETATION PLOT
- PHOTO POINT
- AS-BUILT THALWEG
- AS-BUILT TOP OF BANK
- AS-BUILT CHANNEL BOUNDARY

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

KENTWOOD PARK (BUSHY BRANCH)
WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 205 - MY05

DATE: DECEMBER 2009
SCALE: SEE SHEET

CURRENT CONDITION PLAN VIEW

SHEET 1 OF 1

Appendix B

General Project Tables

Table 1. Project Restoration Components Project Number and Name: 205 - Kentwood Park (Bushy Branch)						
Segment / Reach ID	**Existing Linear Feet**	**Type**	**Approach**	**Linear Feet**	**Stationing**	**Comment**
Bushy Branch	N/A	R	P1/2/3	965	10+00 - 20+70	Beginning 105 feet deleted from project due to no work done, and DOT right-of-way.
UT to Bushy Branch	N/A	EII	P3	338	00+00 - 03+50	Reduction in linear feet credit due to disc golf course

R = Restoration P1/2/3 = Combination of Priority 1, 2, and 3
EII = Enhancement II P3 = Priority 3

Table 2. Project Activity and Reporting History Project Number and Name: 205 - Kentwood Park (Bushy Branch)		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	Apr-00	Mar-02
Permits		Jun-02
Final Design - 90%		
Construction		2002
Stream Maintenance Plan		Feb-04
Stream Repair and Maintenance Seeding		2004
As-Built Report		Feb-05
Year 1 Monitoring	Jul-05	Jan-06
Year 2 Monitoring	Jun-06	Jan-07
Year 3 Monitoring	Nov-07	Jan-08
Year 4 Monitoring	Oct-08	Jan-09
Year 5 Monitoring	Nov-09	Dec-09

Table 3. Project Contacts Table Project Number and Name: 205 - Kentwood Park (Bushy Branch)	
Design Firm	Arcadis G&M of North Carolina, Inc. 2301 Rexwoods Dr., Suite 102 Raleigh, North Carolina 27607 Contact: Mr. William Scott Hunt, III Phone: (919) 782-5511 Fax: (919) 782-5905
Construction Contractor	Shamrock Environmental Group 6106 Corporate Park Dr. Brown Summit, North Carolina 27214 Contact: Mr. Bill Wright Phone: (336) 375-1989 Fax: (336) 375-1801
Vegetation Design Firm (2004 Vegetation and Stream Maintenance Plan)	EcoScience Corporation 1101 Haynes St., Suite 101 Raleigh, North Carolina 27604 Contact: Mr. Jens Geratz Phone: (919) 828-3433 Fax: (919) 828-3518
Supplemental Vegetation and Structure Repair Contractor	Seal Brothers P.O. Box 86 Dobson, North Carolina 27017 Contact: Mr. Brian Seal Phone: (336) 710-3560
Monitoring Performer MY-01, 02, 03, 04, 05	KCI Associates of NC 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 4. Project Attribute Table **Project Number and Name: 205 – Kentwood Park (Bushy Branch)**	
Project County	Wake County
Drainage Area	1.4 sq. mi. (Bushy Branch)
	0.06 sq. mi. (UT to Bushy Branch)
Drainage Impervious Cover Estimate	45%
Stream Order	Second Order (Bushy Branch)
	First Order (UT to Bushy Branch)
Physiographic Region	Piedmont
Ecoregion	Northern Outer Piedmont
Rosgen Classification of As-built	C4/B4
Dominant Soil Types	Wehadkee and Bibb Soils (Bushy Branch)
	Wehadkee and Bibb Soils (UT to Bushy Branch)
Reference Site ID	UT to Lake Wheeler
	UT to Mine Creek
USGS HUC for Project and Reference	03020201090010 (Bushy Branch)
	03020201110010 (UT to Lake Wheeler)
	03020201080020 (UT to Mine Creek)
NCDWQ Sub-basin for Project and Reference	03-04-02 (Bushy Branch)
	03-04-02 (UT to Lake Wheeler)
	03-04-02 (UT to Mine Creek)
NCDWQ Classification for Project and Reference	C - NSW (Bushy Branch)
	N/A (UT to Lake Wheeler)
	N/A (UT to Mine Creek)
Any portion of the project segment 303d listed?	No
Any portion of the project segment upstream of a 303d listed segment?	N/A
Reasons for 303d Listing or Stressor	N/A
% of Project Easement Fenced	0%

Appendix C

Vegetation Assessment Data

Table 5. Vegetation Plot Mitigation Success Summary Table Project Number and Name: 205 - Kentwood Park (Bushy Branch)		
Vegetation Plot ID	**Monitoring Year 05 Planted Stem Density (stems/acre)**	**Vegetation Survival Threshold Met?**
1	1,880	Yes
2	1,600	Yes
3	1200	Yes

Table 6. Stem counts for each species arranged by plot
Project Number and Name: 205 – Kentwood Park (Bushy Branch)

Species	Plot			Initial Totals	Year 1 Totals	Year 2 Totals	Year 3 Totals	Year 4 Totals	Year 5 Totals	Survival %
	1	2	3							
Shrubs										
Ilex verticillata	1	6		16	10	7	7	7	7	44%
Euonymus americana	1			6	3	4	3	1	1	17%
Lindera benzoin	2			4	4	4	3	2	2	50%
Sambucus canadensis				7	3	1	0	0	0	0%
Cornus amomum		15	2	34	24	20	19	19	17	50%
Alnus serrulata		4	1	14	11	7	7	7	5	36%
Trees										
Quercus michauxii	6		12	23	22	20	20	20	18	78%
Quercus phellos			5	4	5	5	5	5	5	125%
Quercus alba			2	2	2	2	2	2	2	100%
Fraxinus pennsylvanica	10			10	11	10	10	10	10	100%
Nyssa sylvatica	13			13	13	14	14	13	13	100%
Oxydendrum arboreum	3			8	4	3	3	3	3	38%
Betula nigra	8	12		18	16	21	20	20	20	111%
Cornus florida	1			1	1	1	1	1	1	100%
Platanus occidentalis		3		8	4	3	3	3	3	38%
Liriodendron tulipifera			4	6	4	4	4	4	4	67%
Acer negundo			3	4	4	3	3	3	3	75%
Ulmus americana			1	2	2	2	2	2	1	50%
Hamamelis virginiana	2			3	1	3	3	2	2	67%

Table 7. Planted Stem Density By Plot
Project Number and Name: 205 -Kentwood Park (Bushy Branch)
Date : 7/9/09
Crew : B. Roberts, C. Carter

Plot #	Winterberry *Ilex verticillata*	Swamp Chestnut Oak *Quercus michauxii*	Green Ash *Fraxinus pennsylvanica*	Black Gum *Nyssa sylvatica*	Witch Hazel *Hamamelis virginiana*	Sourwood *Oxydendrum arboreum*	Hearts-a-busting *Euonymus americana*	Spice Bush *Lindera benzoin*	River Birch *Betula nigra*	Flowering Dogwood *Cornus florida*	Elderberry *Sambucus canadensis*	Silky Dogwood *Cornus amomum*	Sycamore *Platanus occidentalis*	Tag Alder *Alnus serrulata*	Willow Oak *Quercus phellos*	Tulip Poplar *Liriodendron tulipifera*	White Oak *Quercus alba*	Box Elder *Acer negundo*	American Elm *Ulmus americana*	Total (Year 5)	Density (Trees/Acre)
1	1	6	10	13	2	3	1	2	8	1										47	1,880
2	6								12			15	3	4						40	1,600
3		12										2		1	5	4	2	3	1	30	1,200
															Streamside Community (Plots 1 and 2)					1,740	
															Bottomland Hardwood Community (Plot 3)					1,200	

Vegetation Monitoring Plot Photos

Vegetation Plot 1 Photo – Taken looking south from the northern corner. 7/9/09 - MY 05

Vegetation Plot 1 Supplemental Photo – Taken looking upstream toward the center of the plot from established Photo Point #3. 7/9/09 - MY 05

Vegetation Plot 2 Photo – Taken looking south from the northern corner. 7/9/09 - MY 05

Vegetation Plot 2 Supplemental Photo – Taken looking at center of plot from the top of the right bank across the stream from the vegetation plot. 7/9/09 - MY 05

Vegetation Plot 3 Photo – Taken looking east from the western corner. 7/9/09 - MY 05

Appendix D

Stream Assessment Data

Stream Station Photos

Photo Point 1 – Taken looking downstream from bridge on Kaplan Drive. 11/5/09 - MY 05

Photo Point 1, supplemental – Taken looking downstream from streambed in front of bridge on Kaplan Drive. 11/5/09 - MY 05

Photo Point 2 – Taken looking upstream. 11/5/09 - MY 05

Photo Point 3 – Taken looking upstream. 11/5/09 - MY 05

Photo Point 3 – Taken looking downstream. 11/5/09 - MY 05

Photo Point 4 – Taken looking upstream. 11/5/09 - MY 05

Photo Point 4 – Taken looking downstream. 11/5/09 - MY 05

Photo Point 5 – Taken looking upstream. 11/5/09 - MY 05

Photo Point 5 – Taken looking downstream. 11/5/09 - MY 05

Photo Point 6 – Taken looking upstream. 11/5/09 - MY 05

Photo Point 6 – Taken looking downstream. 11/5/09 - MY 05

Table 8. Visual Morphological Stability Assessment
Project Number and Name: 205 – Kentwood Park (Bushy Branch)
Segment/Reach: Bushy Branch (1,070 ft.)

Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total Number per As-built *	Total Number / feet in unstable state	% Perform. in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	12	12	N/A	100%	
	2. Armor stable (e.g. no displacement)?	12	12	N/A	100%	
	3. Facet grade appears stable?	12	12	N/A	100%	
	4. Minimal evidence of embedding/fining?	12	12	N/A	100%	
	5. Length appropriate?	12	12	N/A	100%	**100%**
B. Pools	1. Present? (e.g. no severe aggradation)	12	12	N/A	100%	
	2. Sufficiently deep (Dmax pool:Mean Bkf > 1.6?)	12	12	N/A	100%	
	3. Length appropriate?	12	12	N/A	100%	**100%**
C. Thalweg	1. Upstream of meander bend centering?	6	8	N/A	75%	
	2. Downstream of meander centering?	6	8	N/A	75%	**75%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	6	8	N/A	75%	
	2. Of those eroding, # w/ concomitant point bar formation?	2	2	N/A	100%	
	3. Apparent Rc within spec?	8	8	N/A	100%	
	4. Sufficient floodplain access and relief?	5	8	N/A	63%	**81%**
E. Bed General	1.General channel bed aggradation areas (bar formation)	N/A	N/A	0/0	100%	
	2. Channel bed degradation - areas of increasing down cutting or head cutting?	N/A	N/A	0/0	100%	**100%**
F. Bank	1. Actively eroding, wasting, or slumping bank	N/A	N/A	7/170	92%	**92%**
G. Vanes	1. Free of back or arm scour?	10	17	N/A	59%	
	2. Height appropriate?	15	17	N/A	88%	
	3. Angle and geometry appear appropriate?	15	17	N/A	88%	
	4. Free of piping or other structural failures?	15	17	N/A	88%	**81%**
H. Wads / Boulders	1. Free of scour?	0	2	N/A	0%	
	2. Footing stable?	1	2	N/A	50%	**25%**

* Total number of features per as-built estimated from as-built profile and planview sheets.

Table 9. Verification of Bankfull Events
Project Number and Name: 205 - Kentwood Park (Bushy Branch)

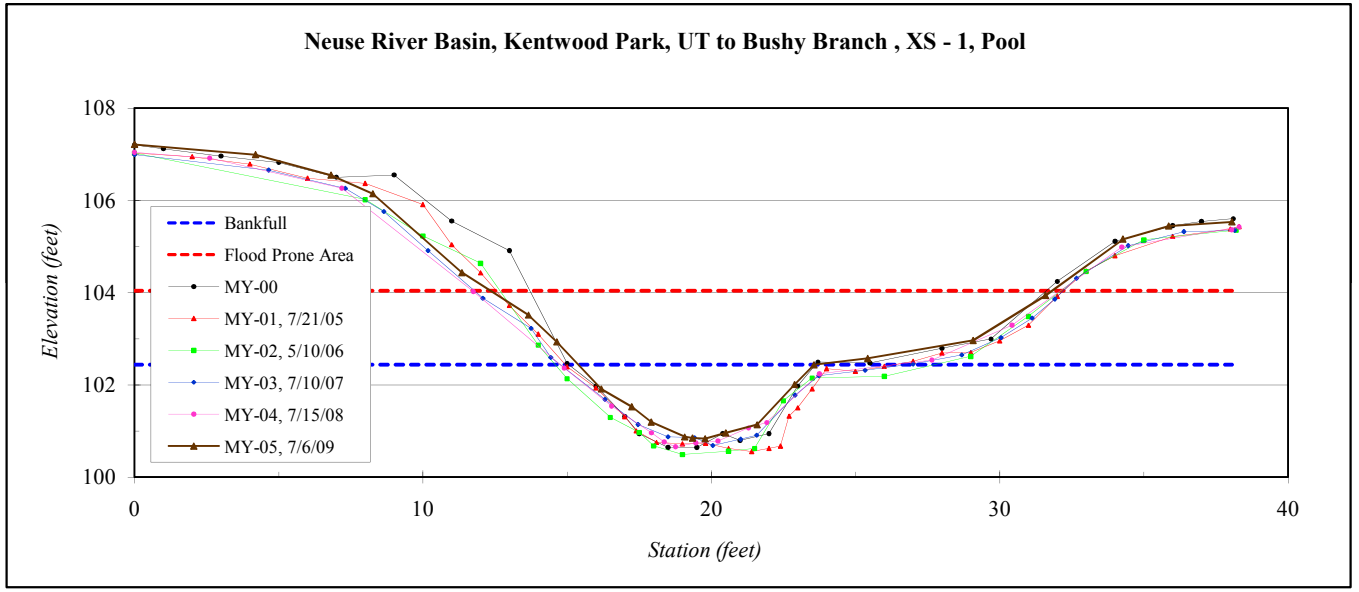
Date of Data Collection	Date of Occurrence	Method	Photo Number
06/15/06	06/14/06	Site visit to evaluate stage indicators after storm event	N/A
07/11/07	06/03/07	Crest Gauge	N/A
11/12/07	07/17/07	Crest Gauge	N/A
10/28/2008	09/07/08	Crest Gauge	N/A
6/16/2009	11/9/2009	Evaluation of rain data	N/A

Cross-Section Plots

River Basin:	Neuse
Watershed:	Kentwood Park, UT to Bushy Branch
XS ID	XS - 1, Pool
Drainage Area (sq mi):	0.06
Date:	7/6/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	107.21
4.2	106.99
6.8	106.55
8.3	106.14
11.4	104.43
13.7	103.51
14.6	102.93
16.2	101.91
17.2	101.52
17.9	101.19
19.1	100.87
19.3	100.85
19.8	100.83
20.5	100.95
21.6	101.13
22.9	102.01
23.6	102.43
25.4	102.57
29.1	102.96
31.6	103.94
34.3	105.16
35.9	105.44
38.1	105.53

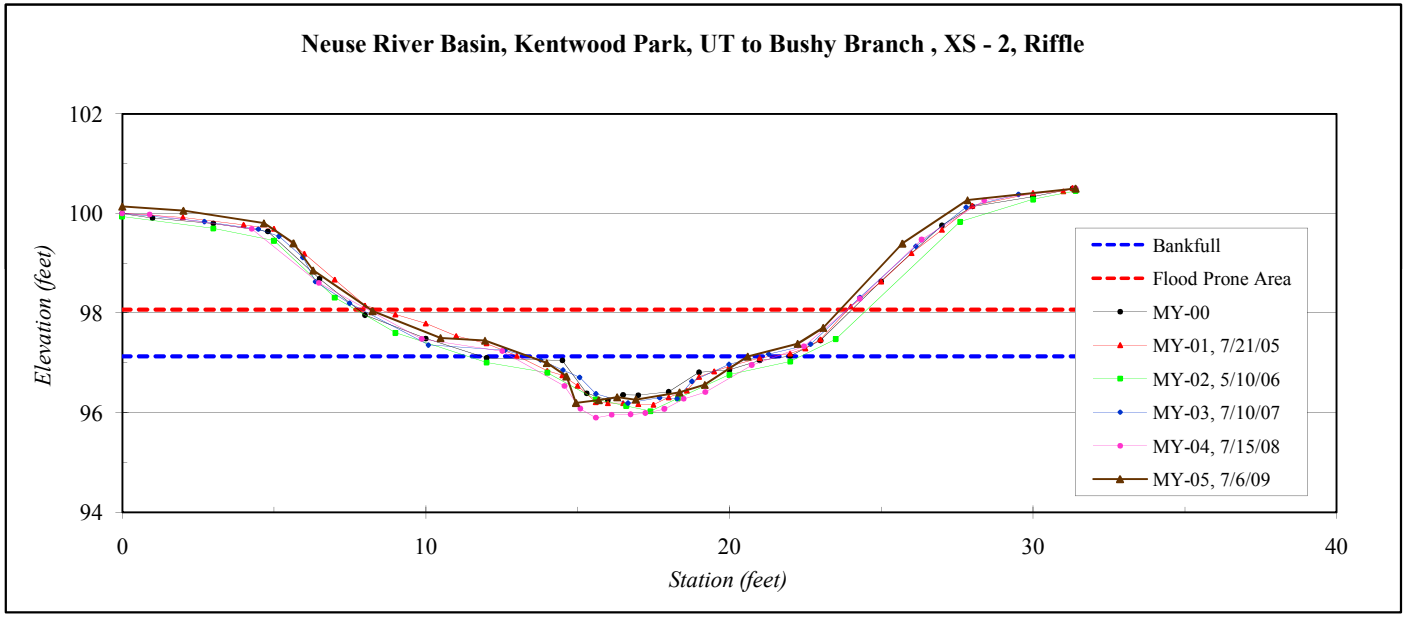
SUMMARY DATA	
Bankfull Elevation:	102.4
Bankfull Cross-Sectional Area:	8.3
Bankfull Width:	8.2
Flood Prone Area Elevation:	104.0
Flood Prone Width:	20
Max Depth at Bankfull:	1.6
Mean Depth at Bankfull:	1.0
W / D Ratio:	8.1
Entrenchment Ratio:	2.4
Bank Height Ratio:	1.0



River Basin:	Neuse
Watershed:	Kentwood Park, UT to Bushy Branch
XS ID	XS - 2, Riffle
Drainage Area (sq mi):	0.06
Date:	7/6/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	100.14
2.0	100.05
4.7	99.80
5.6	99.40
6.3	98.86
8.2	98.04
10.5	97.50
11.9	97.44
14.0	97.00
14.6	96.73
14.9	96.19
15.7	96.25
16.3	96.31
16.9	96.26
18.4	96.41
19.2	96.56
20.6	97.13
22.2	97.38
23.1	97.70
25.7	99.40
27.8	100.27
31.4	100.50

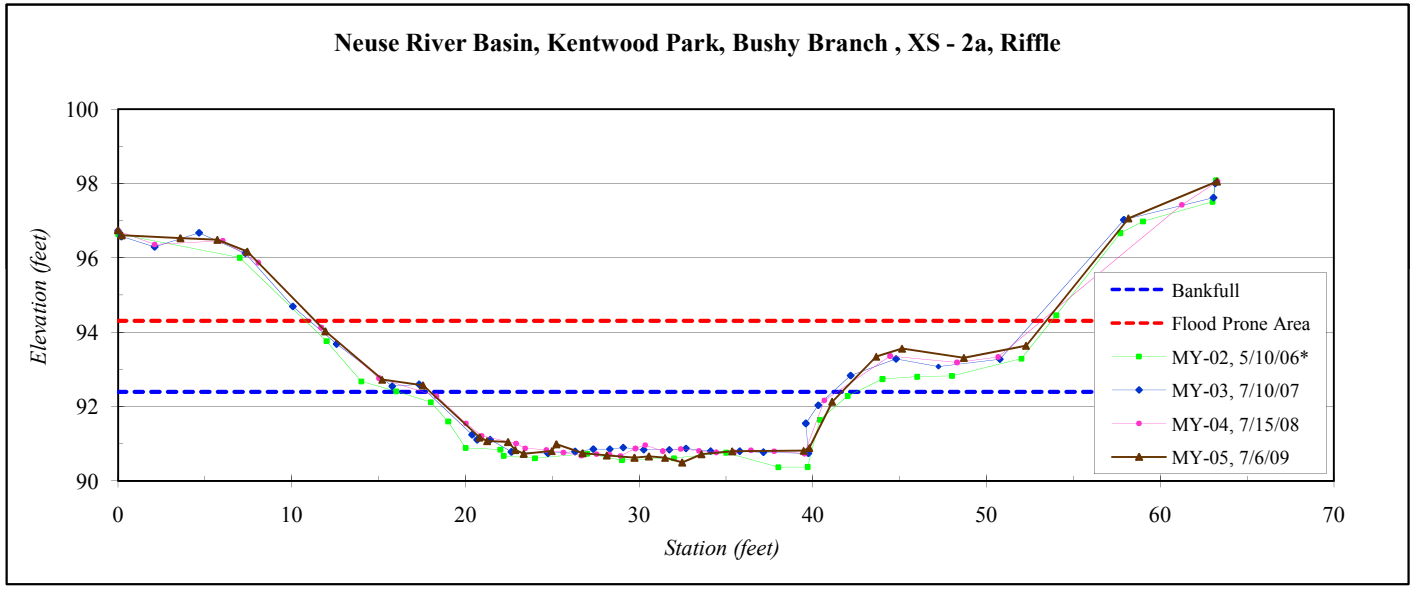
SUMMARY DATA	
Bankfull Elevation:	97.1
Bankfull Cross-Sectional Area:	4.2
Bankfull Width:	7.2
Flood Prone Area Elevation:	98.1
Flood Prone Width:	16
Max Depth at Bankfull:	0.9
Mean Depth at Bankfull:	0.6
W / D Ratio:	12.3
Entrenchment Ratio:	2.2
Bank Height Ratio:	1.0



River Basin:	Neuse
Watershed:	Kentwood Park, Bushy Branch
XS ID	XS - 2a, Riffle
Drainage Area (sq mi):	1.27
Date:	7/6/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	96.75
0.2	96.61
3.6	96.53
5.7	96.49
7.4	96.17
11.9	94.03
15.2	92.72
17.6	92.57
20.8	91.17
21.3	91.07
22.5	91.05
22.9	90.83
23.4	90.73
25.0	90.80
25.2	90.99
26.7	90.75
28.1	90.69
29.7	90.63
30.6	90.66
31.5	90.62
32.5	90.50
33.6	90.72
35.4	90.80
39.5	90.81
39.8	90.89
41.1	92.13
43.7	93.34
45.1	93.56
48.7	93.31
52.3	93.64
58.2	97.06
63.3	98.05

SUMMARY DATA	
Bankfull Elevation:	92.4
Bankfull Cross-Sectional Area:	33.9
Bankfull Width:	23.7
Flood Prone Area Elevation:	94.3
Flood Prone Width:	42
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.4
W / D Ratio:	16.6
Entrenchment Ratio:	1.8
Bank Height Ratio:	1.5

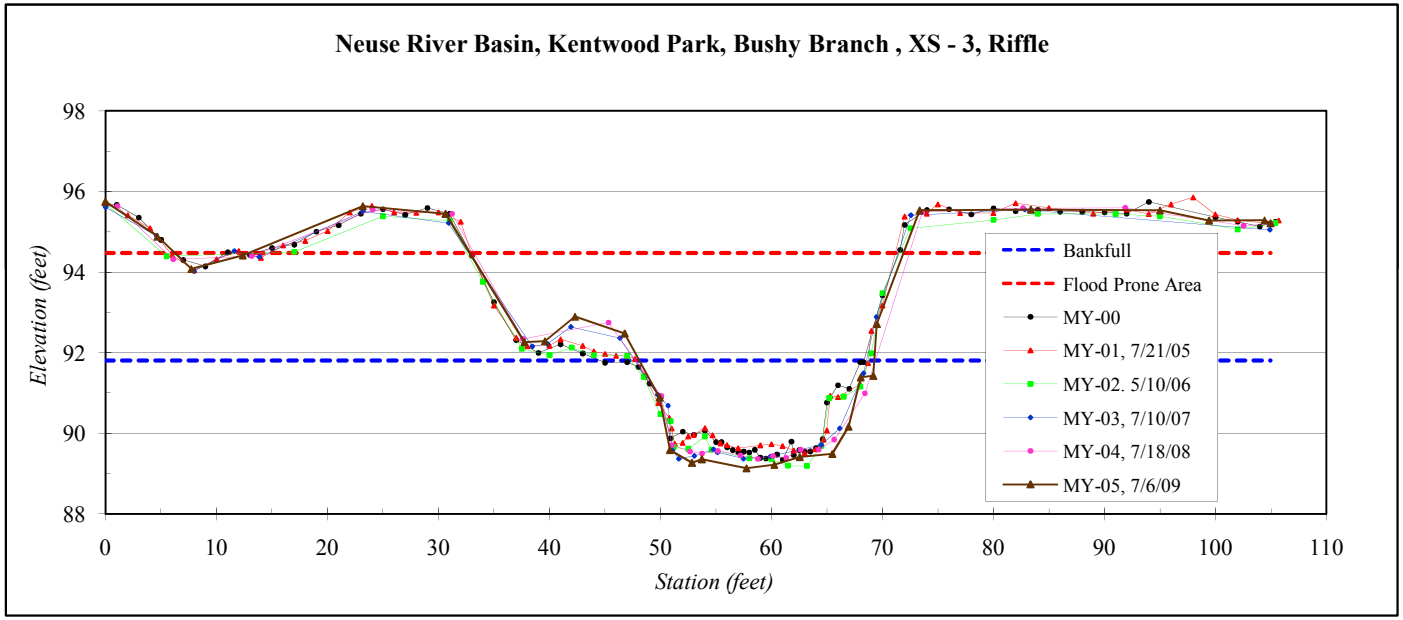


*Supplemental Cross-Section, installed MY02

River Basin:	Neuse
Watershed:	Kentwood Park, Bushy Branch
XS ID	XS - 3, Riffle
Drainage Area (sq mi):	1.27
Date:	7/6/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	95.73
4.7	94.88
7.7	94.07
12.4	94.41
23.2	95.63
30.6	95.44
37.7	92.26
39.6	92.28
42.3	92.89
46.8	92.47
49.9	90.88
50.9	89.58
52.8	89.27
53.7	89.35
57.8	89.13
60.3	89.21
62.6	89.41
65.5	89.48
66.9	90.16
68.1	91.38
69.2	91.42
69.5	92.71
73.4	95.53
83.4	95.55
95.0	95.53
99.4	95.28
104.4	95.28
105.0	95.21

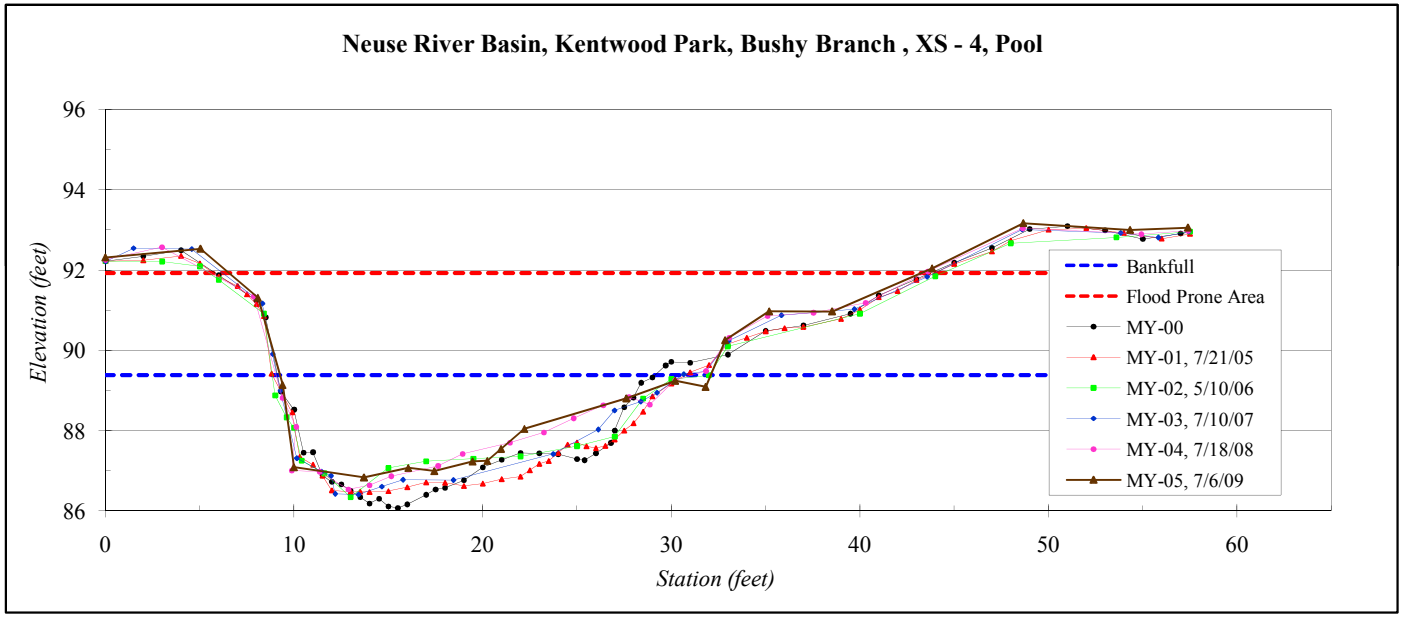
SUMMARY DATA	
Bankfull Elevation:	91.8
Bankfull Cross-Sectional Area:	43.2
Bankfull Width:	21.2
Flood Prone Area Elevation:	94.5
Flood Prone Width:	38
Max Depth at Bankfull:	2.7
Mean Depth at Bankfull:	2.0
W / D Ratio:	10.4
Entrenchment Ratio:	1.8
Bank Height Ratio:	1.3



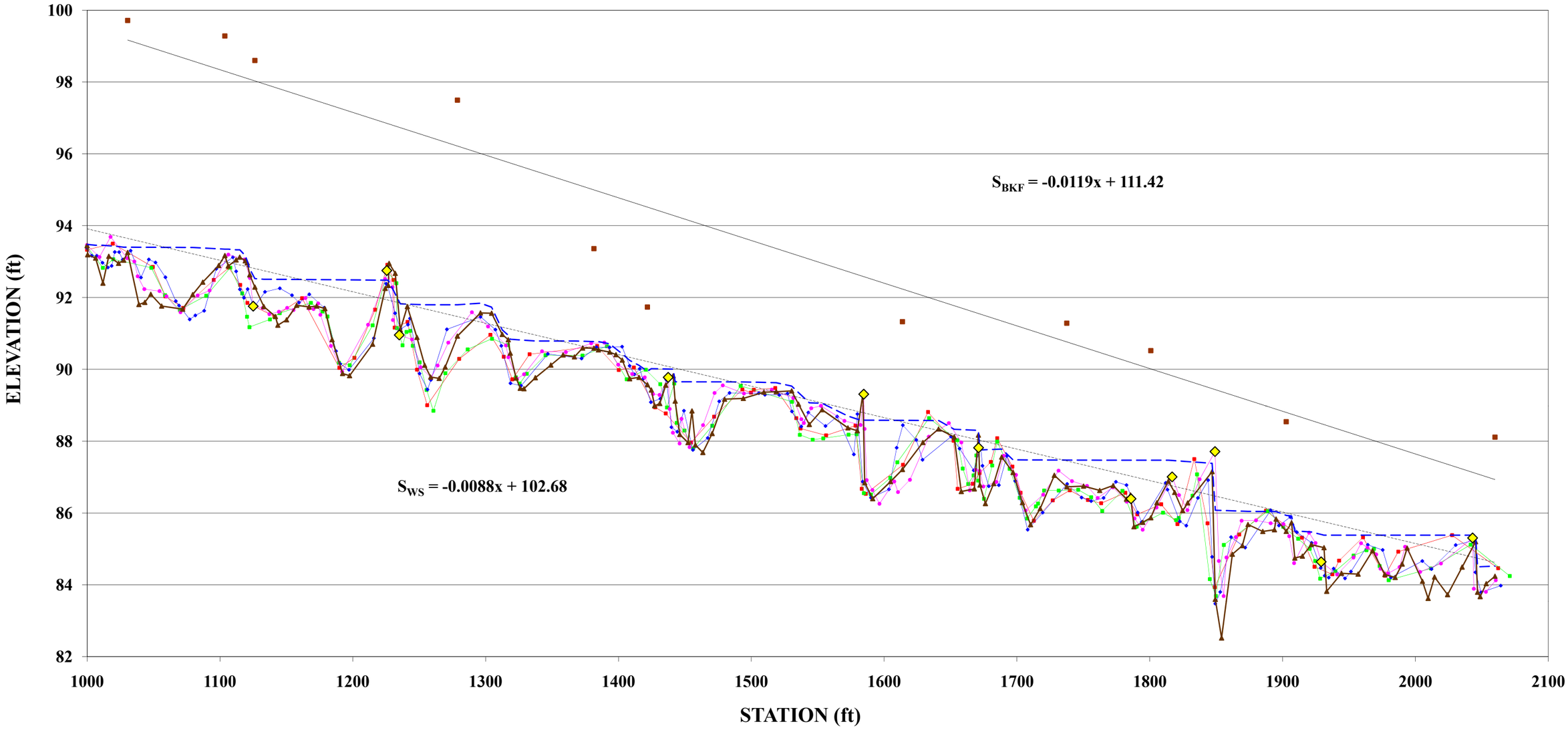
River Basin:	Neuse
Watershed:	Kentwood Park, Bushy Branch
XS ID	XS - 4, Pool
Drainage Area (sq mi):	1.27
Date:	7/6/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	92.31
5.0	92.53
8.1	91.31
9.4	89.14
10.0	87.09
13.7	86.83
16.1	87.07
17.4	86.99
19.5	87.23
20.2	87.25
21.0	87.55
22.2	88.04
27.6	88.80
30.2	89.24
31.8	89.09
32.9	90.25
35.2	90.97
38.5	90.97
43.8	92.04
48.7	93.17
54.3	93.00
57.4	93.06

SUMMARY DATA	
Bankfull Elevation:	89.4
Bankfull Cross-Sectional Area:	35.3
Bankfull Width:	22.9
Flood Prone Area Elevation:	91.9
Flood Prone Width:	37
Max Depth at Bankfull:	2.5
Mean Depth at Bankfull:	1.5
W / D Ratio:	14.9
Entrenchment Ratio:	1.6
Bank Height Ratio:	1.0



Longitudinal Profile for Bushy Branch
Kentwood Park, Wake County
EEP Project Number 205 - MY05

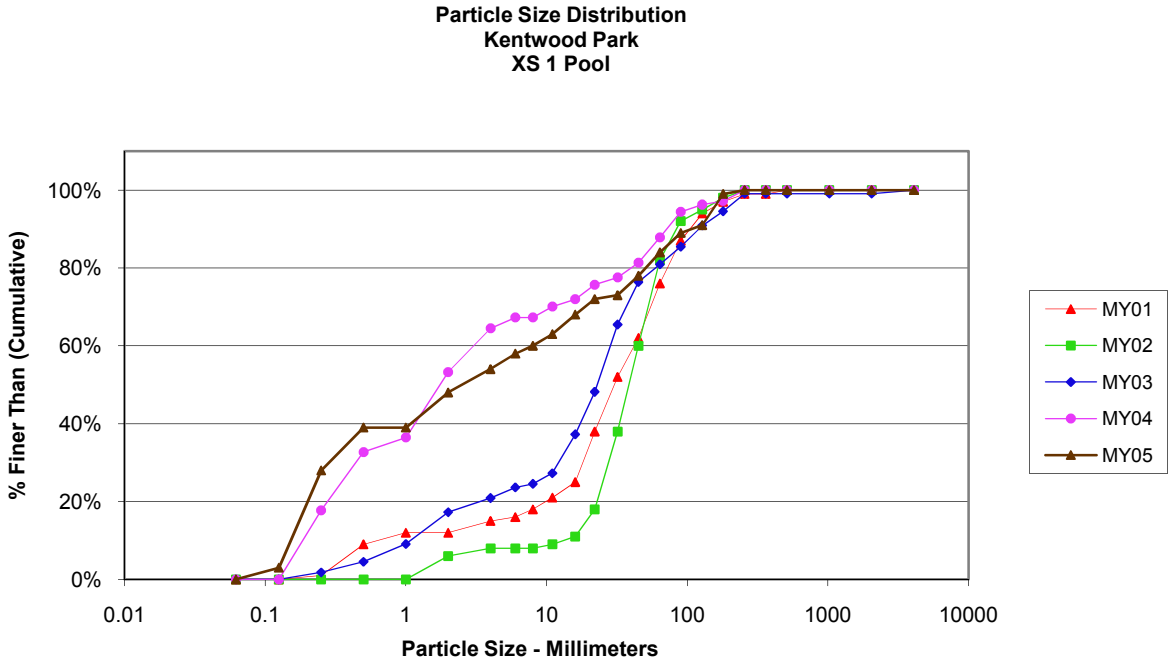


Longitudinal Profile for UT to Bushy Branch
Kentwood Park, Wake County
EEP Project Number 205 - MY05

Pebble Count Plots

Cross-Section 1 Pool - MY05			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	3
Fine	.125 - .25	A	25
Medium	.25 - .50	N	11
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	9
Very Fine	2 - 4		6
Fine	4 - 5.7	G	4
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	3
Medium	11.3 - 16	V	5
Coarse	16 - 22.6	E	4
Coarse	22.6 - 32	L	1
Very Coarse	32 - 45	S	5
Very Coarse	45 - 64		6
Small	64 - 90	C	5
Small	90 - 128	O	2
Large	128 - 180	B	8
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	100

Note:



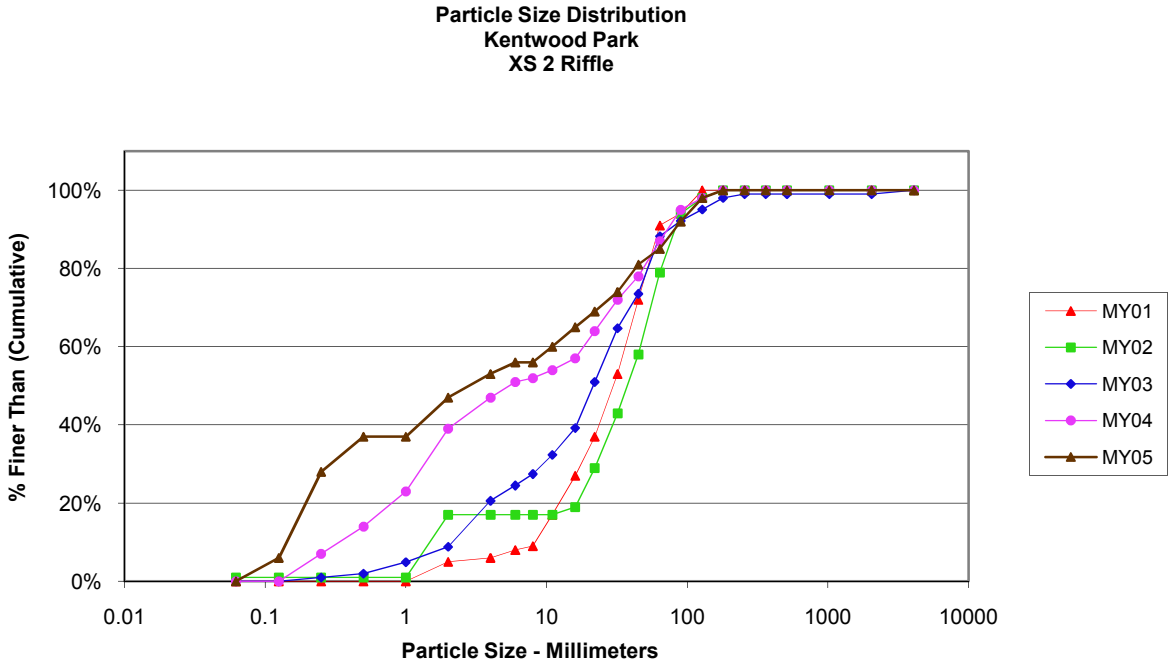
Size (mm)	
D16	0.18
D35	0.39
D50	2.5
D65	13
D84	64
D95	150

Size Distribution	
mean	3.4
dispersion	19.7
skewness	0.08

Type	
silt/clay	0%
sand	48%
gravel	36%
cobble	16%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 2 Riffle - MY05			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	6
Fine	.125 - .25	A	22
Medium	.25 - .50	N	9
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	10
Very Fine	2 - 4		6
Fine	4 - 5.7	G	3
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	4
Medium	11.3 - 16	V	5
Coarse	16 - 22.6	E	4
Coarse	22.6 - 32	L	5
Very Coarse	32 - 45	S	7
Very Coarse	45 - 64		4
Small	64 - 90	C	7
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:



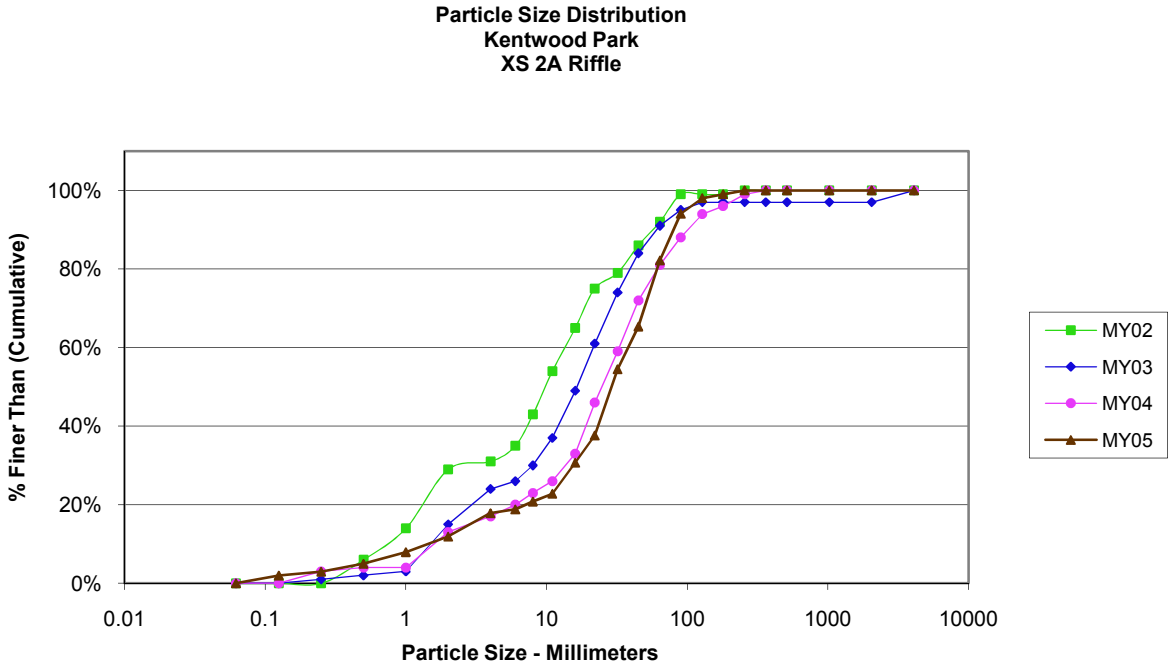
Size (mm)	
D16	0.17
D35	0.43
D50	2.8
D65	16
D84	59
D95	110

Size Distribution	
mean	3.2
dispersion	18.8
skewness	0.03

Type	
silt/clay	0%
sand	47%
gravel	38%
cobble	15%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 2A Riffle - MY05			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	2
Fine	.125 - .25	A	1
Medium	.25 - .50	N	2
Coarse	.50 - 1	D	3
Very Coarse	1 - 2	S	4
Very Fine	2 - 4		6
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	2
Medium	11.3 - 16	V	8
Coarse	16 - 22.6	E	7
Coarse	22.6 - 32	L	17
Very Coarse	32 - 45	S	11
Very Coarse	45 - 64		17
Small	64 - 90	C	12
Small	90 - 128	O	4
Large	128 - 180	B	1
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	101

Note:



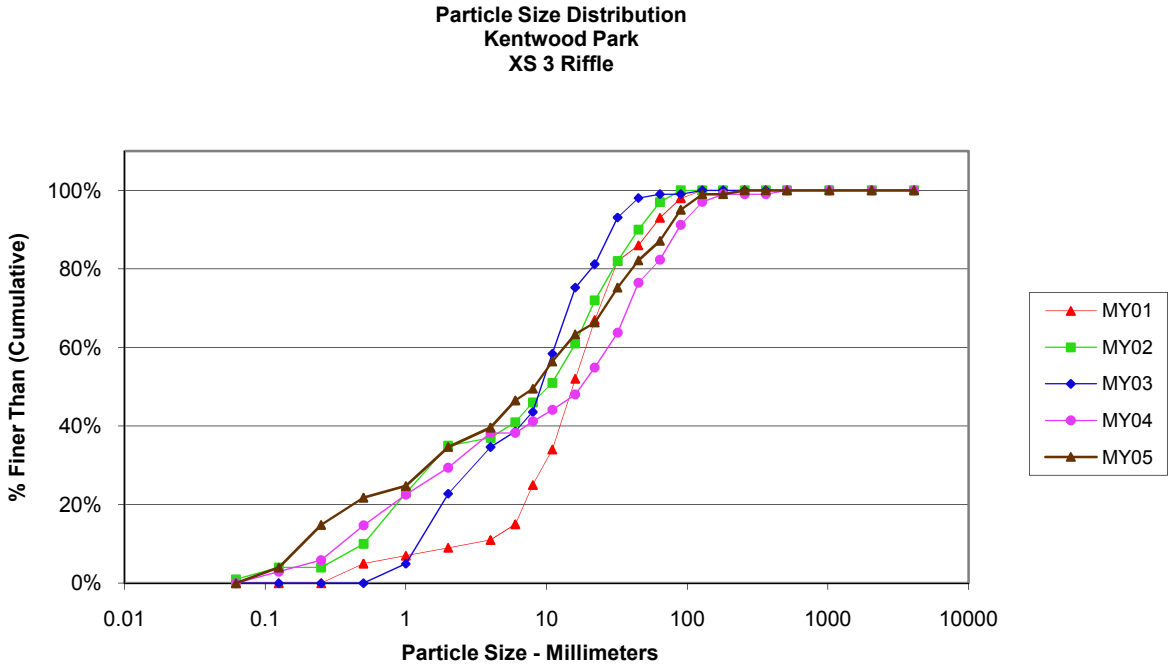
Size (mm)	
D16	3.2
D35	20
D50	29
D65	45
D84	67
D95	98

Size Distribution	
mean	14.6
dispersion	5.7
skewness	-0.26

Type	
silt/clay	0%
sand	12%
gravel	70%
cobble	18%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 3 Riffle - MY05			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	4
Fine	.125 - .25	A	11
Medium	.25 - .50	N	7
Coarse	.50 - 1	D	3
Very Coarse	1 - 2	S	10
Very Fine	2 - 4		5
Fine	4 - 5.7	G	7
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	7
Medium	11.3 - 16	V	7
Coarse	16 - 22.6	E	3
Coarse	22.6 - 32	L	9
Very Coarse	32 - 45	S	7
Very Coarse	45 - 64		5
Small	64 - 90	C	8
Small	90 - 128	O	4
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	101

Note:



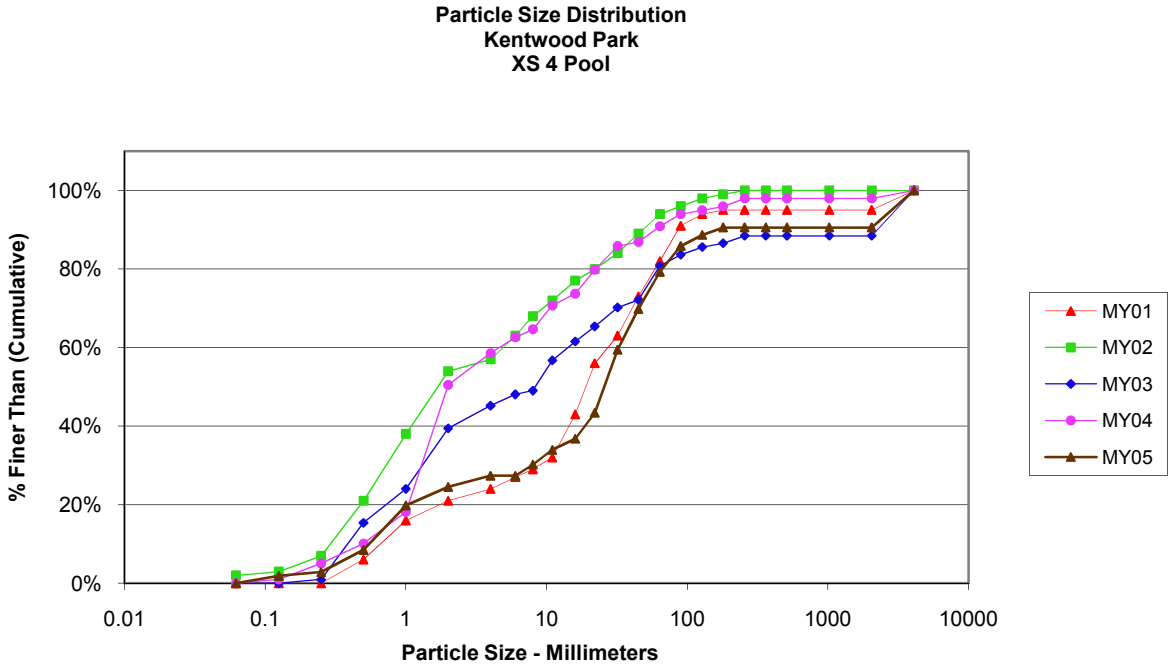
Size (mm)	
D16	0.28
D35	2.1
D50	8.2
D65	19
D84	51
D95	90

Size Distribution	
mean	3.8
dispersion	17.8
skewness	-0.22

Type	
silt/clay	0%
sand	35%
gravel	52%
cobble	13%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 4 Pool - MY05			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	2
Fine	.125 - .25	A	1
Medium	.25 - .50	N	6
Coarse	.50 - 1	D	12
Very Coarse	1 - 2	S	5
Very Fine	2 - 4		3
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	4
Medium	11.3 - 16	V	3
Coarse	16 - 22.6	E	7
Coarse	22.6 - 32	L	17
Very Coarse	32 - 45	S	11
Very Coarse	45 - 64		10
Small	64 - 90	C	7
Small	90 - 128	O	3
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	10
		Total	106

Note:



Size (mm)	
D16	0.72
D35	9.1
D50	23
D65	32
D84	57
D95	92

Size Distribution	
mean	6.4
dispersion	17.2
skewness	-0.40

Type	
silt/clay	0%
sand	25%
gravel	55%
cobble	11%
boulder	0%
bedrock	9%
hardpan	0%
wood/det	0%
artificial	0%