Northgate Park (Ellerbe Creek) Stream Restoration Site

DMS Project #272 **DWQ 404 # N/A**
Contract #6230 **USACE Action ID #200620453**

Monitoring Year 05/Closeout

Project Type: Stream Restoration

Submitted: November 2016

Data collected for this report (2016) was collected eight (8) years after construction (8 years elapsed – MY8), but is the 5th year where measurements were made as per the monitoring plan. Measurements were suspended for repairs and repair evaluation in 2011 - 2013

Table 1a. Project Setting and Classifications **Northgate Park (Ellerbe Creek) Stream Restoration Site** **Meeting XY Coordinates: 35.980931º N, 80.046549º W**	
County	Durham
General Location	City of Durham
Basin	Upper Neuse
Physiographic Region	Piedmont
USGS Hydro Unit	03020201050010
NCDWQ Sub-basin	03-04-01
Trout Water	No
Project Performers	
Source Agency	NCDMS
Provider	NCDMS
Designer	URS Corporation
Monitoring Firm	KCI Associates of NC
Planting	HARP
Construction Contractor	Environmental Quality Resources, LLC
Invasive Treatment Contractor	HARP
Repair Designer	KCI Associates of NC
Repair Contractor	Carolina Environmental Contacting, Inc.
Property Interest Holder	State of NC
Site Stewardship	DEQ Stewardship Program

Table 1b. Project Activity and Reporting History **Northgate Park (Ellerbe Creek) Stream Restoration Site**	
Milestone	**Date Completed**
Concept Plan	Jan 06
Restoration Plan	Jun 06
Final Design - 90%	May 07
Construction	Dec 08
As-Built Survey	Jan 09
Live Stake Planting	Mar 09
Riparian Buffer Planting	Nov 09
Year 1 Monitoring	May 10
Year 2 Monitoring	Dec 10
Invasive Treatment	2013-2015
Repair	Mar 14
Year 3 Monitoring	Jan 15
Year 4 Monitoring	Dec 15
Site-wide supplemental planting	Jan 16
Beaver Management	May 2016 - Present
Year 5 Monitoring	Nov 16

1.0 PROJECT SETTING AND BACKGROUND SUMMARY

In 2008, the North Carolina Division of Mitigation Services (DMS) restored and enhanced a reach of Ellerbe Creek, an Unnamed Tributary to Ellerbe Creek (UT 3), and stream buffer within Northgate Park in Durham County, NC. The project also included the creation of two stormwater wetlands with outfalls to the project streams. The 5.9-mi^2 project watershed is located in US Geological Survey Hydrologic Unit 03020201-05-0010 (NC Division of Water Resources Sub-basin 03-04-01) of the Neuse River Basin. This Hydrologic Unit is within DMS' *Ellerbe Creek Local Watershed Plan* (2003) area and is also listed as a Targeted Local Watershed (TLW) in DMS' *Neuse River Basin Priorities Plan* (2010). This project is within the Falls Lake watershed, a drinking supply reservoir for the City of Raleigh. The drainage area for the site is urban residential land. The State has a permanent conservation easement of 7.5 acres and the project is located entirely within Northgate Park, which is a City of Durham public park. The project stream begins at the pedestrian bridge near the baseball diamond and flows 2,284 linear feet to the culvert under Acadia Street. The project goals and objectives are listed below.

Construction was completed at the site in December 2008. In March 2009, live stakes were planted along the stream and the stormwater wetlands were planted. The planting of the riparian buffer was delayed until November 2009, when the rest of the site was planted with tublings and containerized plants. After planting, six vegetation plots were installed following the CVS-EEP vegetation monitoring procedure, five in buffer restoration areas and one in the planted stream riparian zone. Repairs were conducted at the site beginning in late 2013 and ending in March 2014. Once construction was completed the newly repaired banks were planted with live stakes and disturbed construction areas were planted with native transplants. The site also received a site-wide supplemental planting in early 2016.

2.0 PROJECT GOALS AND OBJECTIVES

The goal of the restoration project is to improve the water quality and biological habitat of the site's streams and wetlands and enhance flood attenuation through the following objectives:

- Restoring the Project Reach to a stable urban stream channel that will retain its dimension, pattern, and profile over time, and that is capable of transporting watershed flows and sediment load efficiently.
- Using Priority II restoration to change Ellerbe Creek from a G5c type stream channel to an E type channel.
- Enhancing the capacity of the site to mitigate flood flows by improving the connection of the stream to its floodplain.
- Improving aquatic habitat by establishing a heterogeneous bed morphology with riffle-pool sequences supported by in-stream structures.
- Restoring the riparian buffer from park grasses and herbaceous vegetation to Piedmont Bottomland Forest to provide filtration of nutrients and organic matter inputs into the stream, to improve wildlife habitat, and to provide shade for the stream channel.
- Reducing sediment inputs from localized streambank erosion by re-establishing stream geometry and by stabilizing and revegetating the stream banks.
- Installing three stormwater wetland best management practices (BMPs) to reduce stormwater pollutants (namely nitrogen and phosphorus) and improve water quality prior to discharging into the stream.

3.0 SUCCESS CRITERIA

Table 2. Success Criteria
Northgate Park (Ellerbe Creel) Stream Restoration Site

Feature	Success Criteria
Stream	Minimal changes to the measured stream characteristics, demonstrating system stability. At least two bankfull events occurring in separate years over the course of the monitoring period.
Vegetation	Average of 260 stems/acre for steam riparian zone, average of 320 stems/acre for buffer restoration zone, as indicated by permanent vegetation plots after 5 years of monitoring.

Table 3a. Project Assets							
North Gate Park (Ellerbe Creek) Stream Restoration Site							
Project Streams							
Project Segment	**Existing (Linear Feet)**	**Restoration Level**	**Approach**	**As-Built (Linear Feet/ Acres)**	**Stationing**	**Mitigation Ratio**	**Mitigation Units (SMU/RBMU)**
Reach 1	1,520	Enhancement I	PII	1,247	10+00 – 25+20	1.5:1	831
Reach 2	646	Restoration	PII	750	25+20 – 32+70	1:1	750
UT3	104	Restoration	PII	117	100+00 – 101+17	1:1	117
TOTAL				**2,114**			**1,698**
Project Buffer							
Buffer		Restoration		3.63		1:1	158,172
Buffer		Enhancement		0.23		3:1	3,333
TOTAL				**3.86**			**161,505**

Table 3b. Length and Area Summations by Mitigation Category Northgate Park (Ellerbe Creek) Stream Restoration Site					
Restoration Level	**Stream (linear feet)**	**Riparian Wetland (acres)**		**Non-riparian Wetland (acres)**	**Credited Buffer (square feet)**
		Riverine	Non-Riverine		
Restoration	867	-	-	-	158,172
Enhancement		-	-	-	9,999
Enhancement I	1,247				
Enhancement II	-				
Creation		-	-	-	-
Preservation	-	-	-	-	-
High Quality Preservation	-	-	-	-	-
Total	**2,144**	-	**-**	**-**	**168,171**

Table 3c. Overall Assets Summary Northgate Park (Ellerbe Creek) Stream Restoration Site	
Asset Category	**Overall Credits**
Stream	1,698 lf
Riparian Wetland	-
Non-riparian Wetland	-
Buffer	168,171 sq ft

REVISIONS

DESCRIPTION	DATE

NCDEQ DIVISION OF MITIGATION SERVICES

KCI ASSOCIATES OF NC
ENGINEERS PLANNERS SCIENTISTS
4505 FALLS OF NEUSE ROAD
RALEIGH, NORTH CAROLINA 27609

NORTHGATE PARK (ELLERBE CREEK) STREAM RESTORATION PROJECT

DURHAM, DURHAM COUNTY, NORTH CAROLINA

DATE: NOV 2016
SCALE: GRAPHIC

ASSET MAP

FIGURE 1

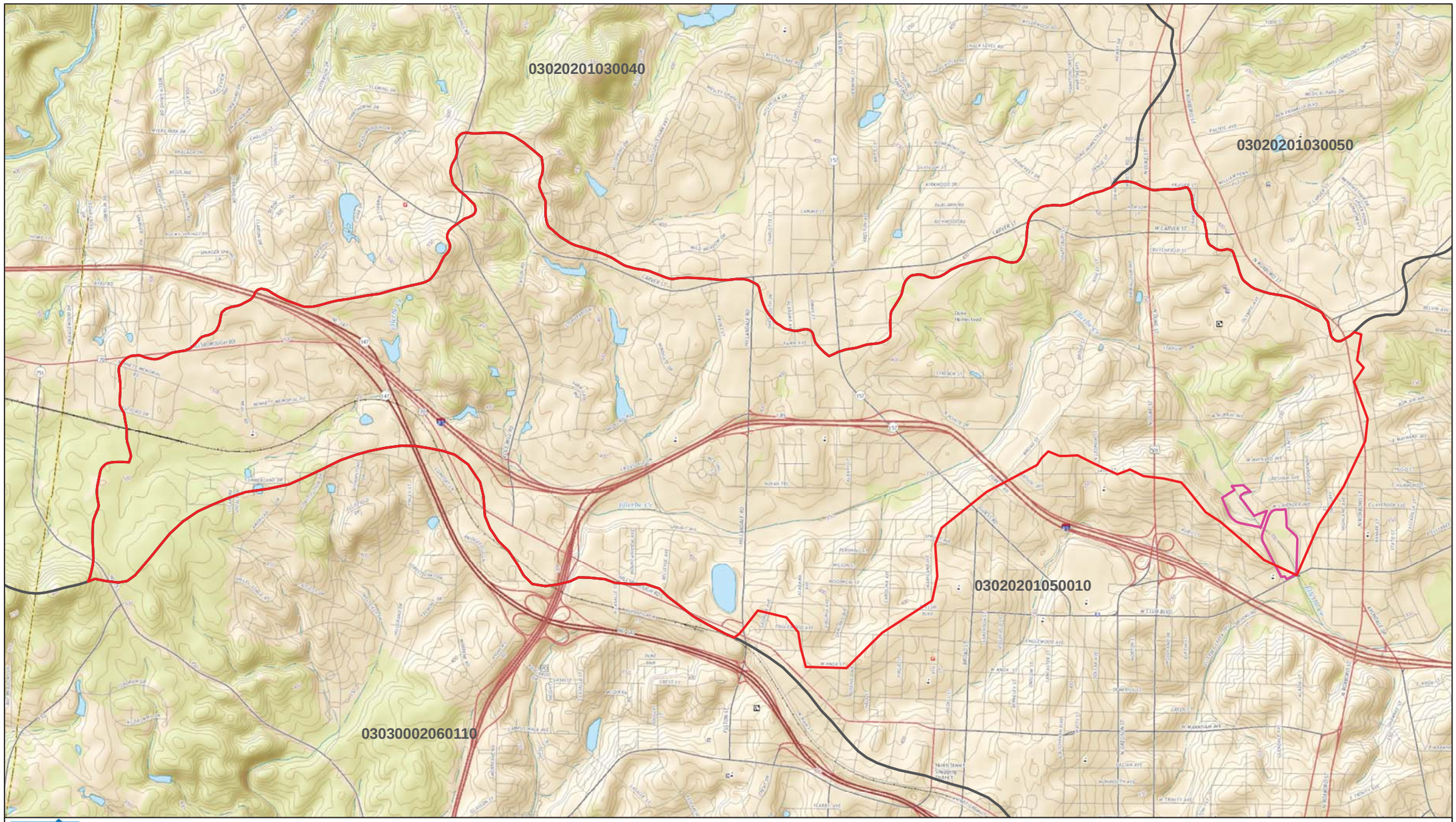

Figure 2. Project Site Watershed Map
Northgate Park (Ellerbe Creek) Stream Restoration
Durham County, NC

Project Easeent
Project Watershed (5.81 sq. mi.)
14-Digit HUC Boundary

N
W E
S

2,000 1,000 0 2,000
Feet

Map created: November 2016
Source: USGS TNM Topo Base Map

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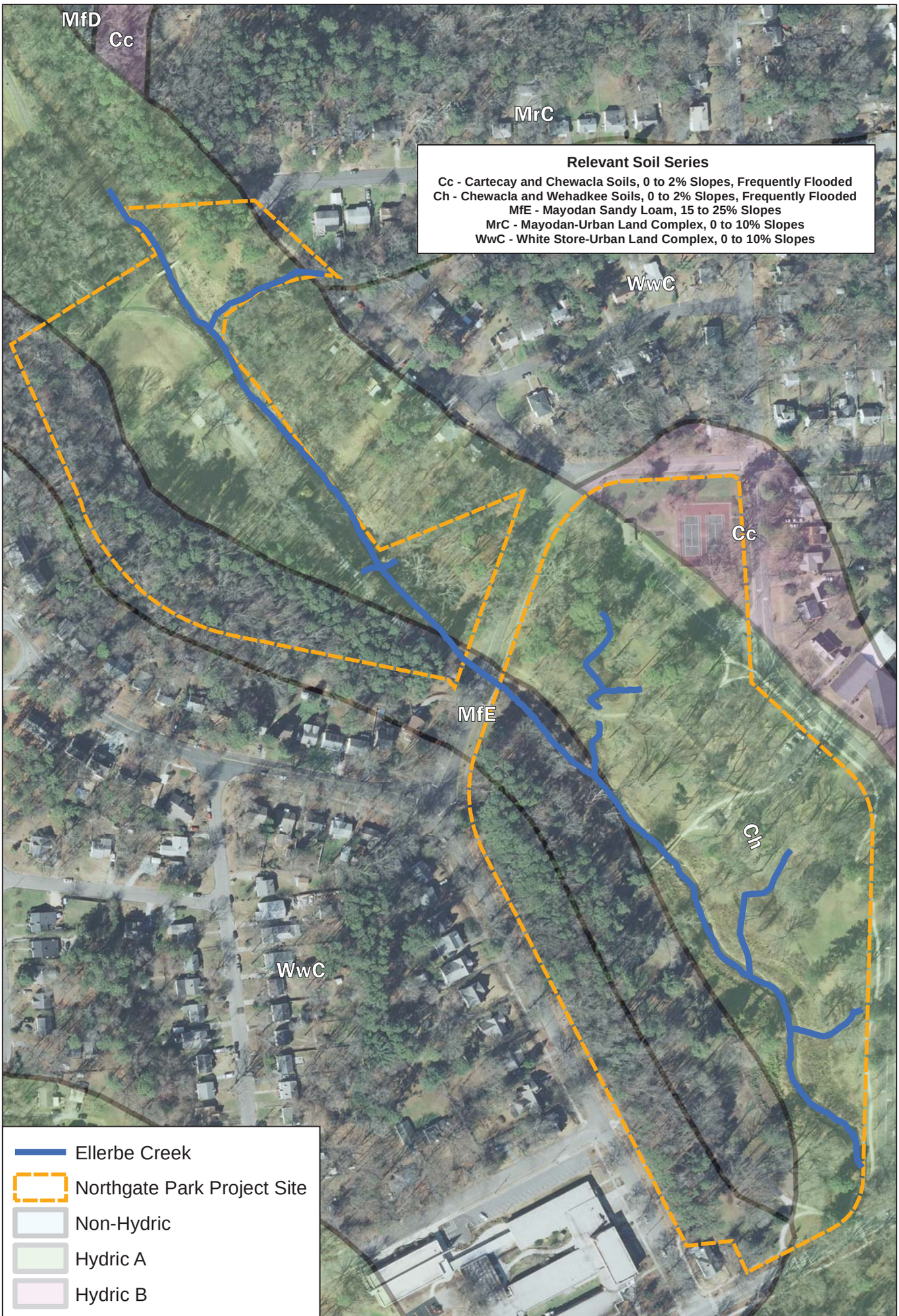

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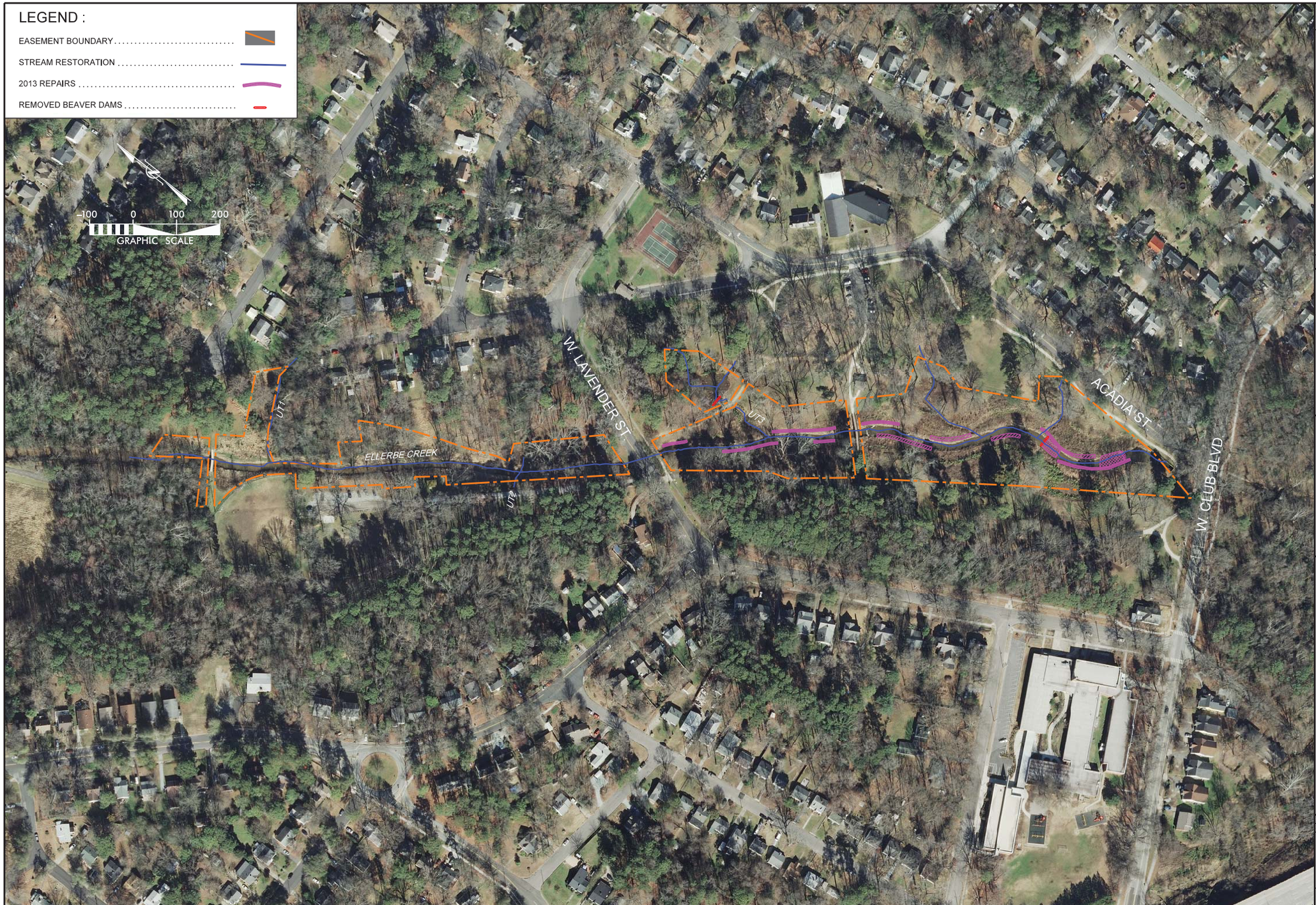
Figure 3. Project Site NRCS Soil Survey Map
Northgate Park (Ellerbe Creek) Stream Restoration
Durham County, NC

N
W E
S

170 85 0 170
Feet

Map Created: November 2016
Image Source: NC Statewide Orthoimagery, 2013



NO.	DESCRIPTION	DATE
	REVISIONS	

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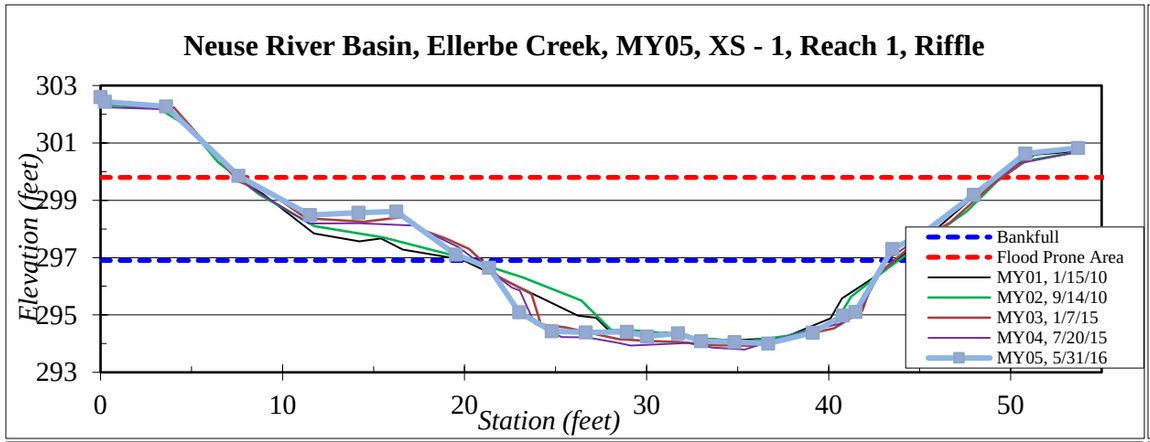
NORTHGATE PARK (ELLERBE CREEK) STREAM RESTORATION PROJECT

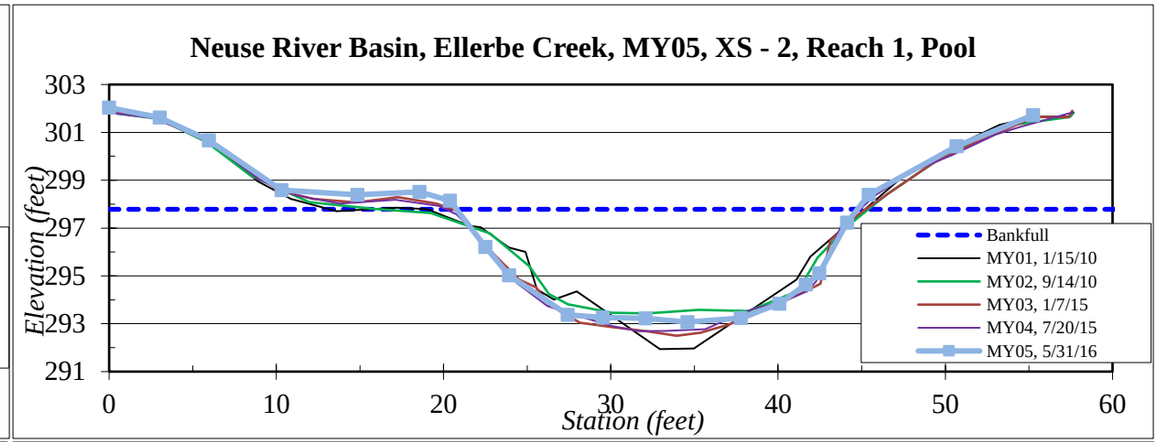
DURHAM, DURHAM COUNTY, NORTH CAROLINA

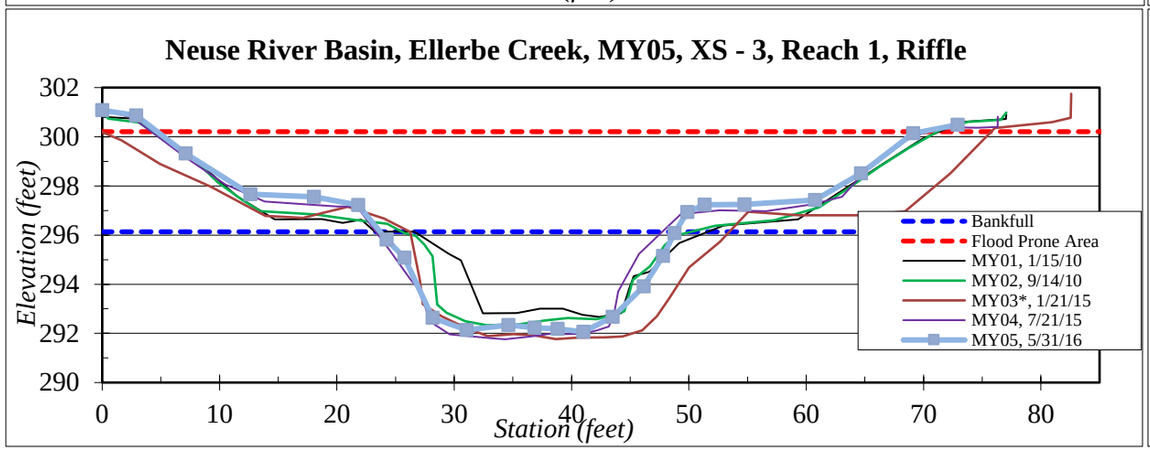
DATE: NOV 2016
SCALE: GRAPHIC

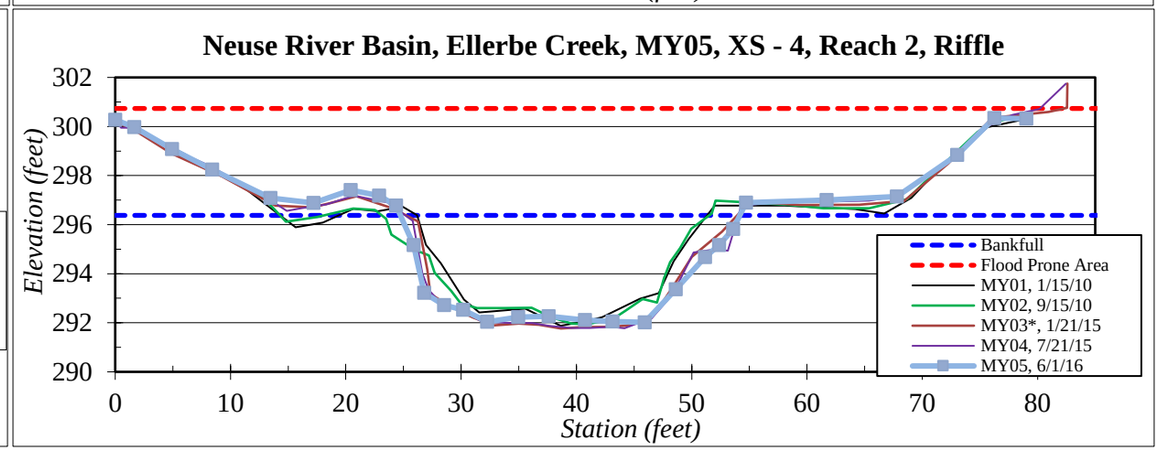
REMEDIATION MAP

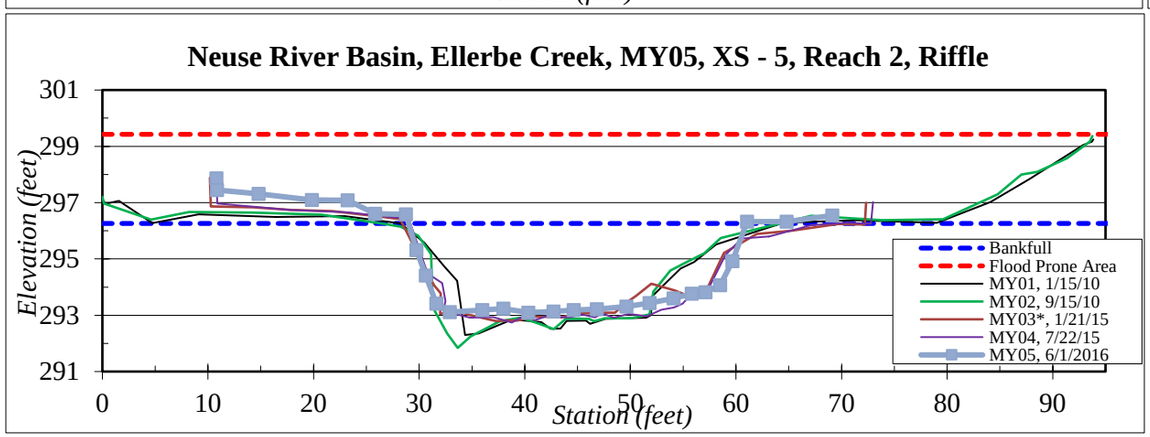
FIGURE 4





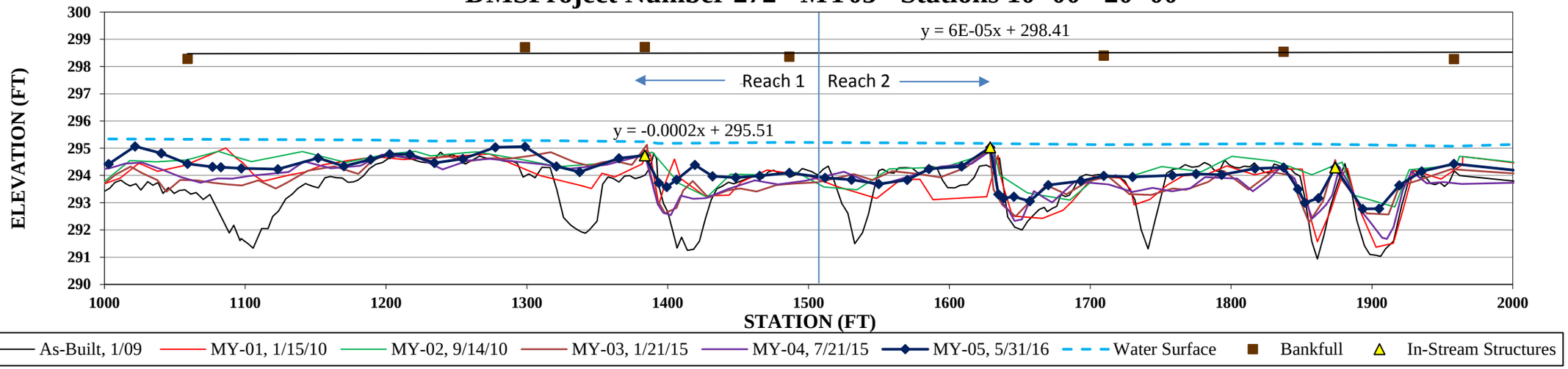






*=pins reset for MY03 due to construction activity on site

Longitudinal Profile: Ellerbe Creek
DMSProject Number 272 - MY05 - Stations 10+00 - 20+00



Longitudinal Profile: Ellerbe Creek
DMSProject Number 272 - MY05 - Stations 20+00 - 33+00

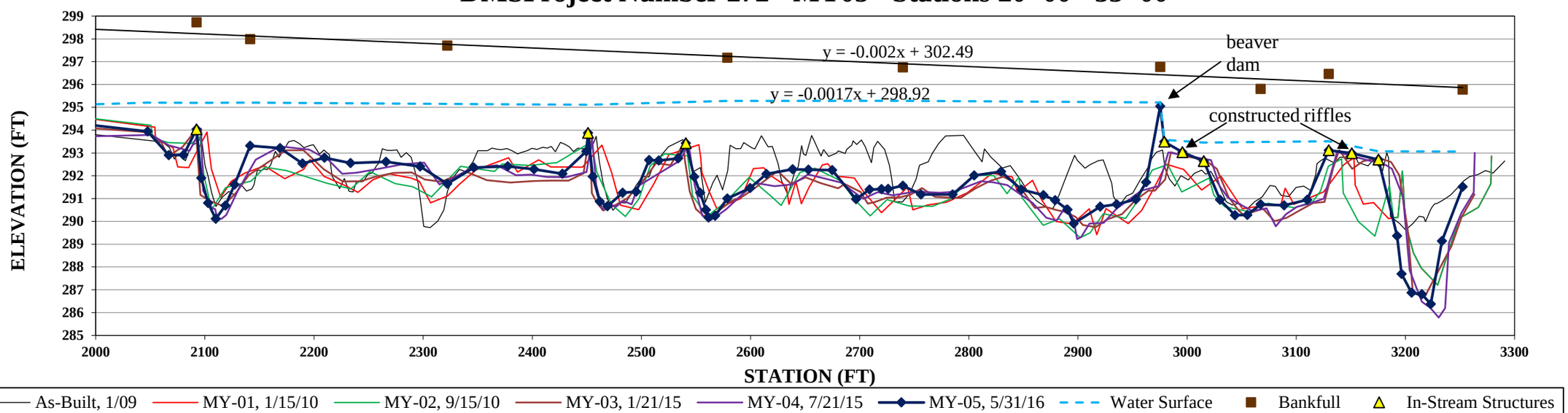


Table 4. Morphology and Hydraulic Monitoring Summary
Northgate Park (Ellerbe Creek) Stream Restoration Site
Segment Reach: Reach 1 (1,520 ft.) and Reach 2 (750 ft.)

Parameter	Cross-Section 1 Riffle - Reach 1						Cross-Section 2 Pool - Reach 1						Cross-Section 3 Riffle - Reach 1					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3*	MY4	MY5
Record Elevation (datum) used		296.9	296.9	296.9	296.9	296.9		297.8	297.8	297.8	297.8	297.8		296.1	296.1	296.1	296.1	296.1
Bankfull Width (ft)		24.0	23.8	22.8	22.5	23.0		28.5	29.2	24.7	24.7	24.0		25.0	23.8	28.7	25.1	25.2
Floodprone Width (ft)		42.0	42.0	42.7	42.5	41.8		-	-	-	-	-		62.0	62.0	74.6	71.7	65.1
Bankfull Cross-Sectional Area (ft^2)		45.0	43.1	51.4	52.6	51.0		82.4	77.3	89.1	87.9	85.0		53.4	63.4	98.5	77.4	76.5
Bankfull Mean Depth (ft)		1.9	1.8	2.3	2.3	2.2		2.9	2.6	3.6	3.6	3.5		2.1	2.7	3.4	3.1	3.0
Bankfull Maximum Depth (ft)		2.8	2.8	3.0	3.1	2.9		5.8	4.3	5.3	5.1	4.7		3.4	3.8	4.4	4.4	4.1
Width/Depth Ratio		12.8	13.1	10.1	9.7	10.4		-	-	-	-	-		11.7	8.9	8.4	8.1	8.3
Entrenchment Ratio		1.8	1.8	1.9	1.9	1.8		-	-	-	-	-		2.5	2.6	2.6	2.9	2.6
Bank Height Ratio		1.0	1.0	1.0	1.0	1.0		-	-	-	-	-		1.0	1.0	1.0	1.0	1.0
Cross-Sectional Area Between End Pins (ft^2)		-	188.5	178.6	280.8	186.8		-	250.3	262.5	268.7	242.2		-	327.4	326.1	322.6	329.4
d50 (mm)		1.2	0.35	24	6.90	2.20		0.08	0.33	43	0.96	0.46		0.06	0.39	0.38	0.62	0.67

Parameter	Cross-Section 4 Riffle - Reach 2						Cross-Section 5 Riffle - Reach 2					
Dimension	MY0	MY1	MY2	MY3*	MY4	MY5	MY0	MY1	MY2	MY3*	MY4	MY5
Record Elevation (datum) used		296.4	296.4	296.4	296.4	296.4		296.3	296.3	296.3	296.3	296.3
Bankfull Width (ft)		25.2	28.4	28.7	28.9	29.4		36.1	26.9	33.5	31.3	32.0
Floodprone Width (ft)		>75	>75	>75	>75	>75		>90	>90	>90	62.2	58.3
Bankfull Cross-Sectional Area (ft^2)		80.2	84.9	98.5	101.9	100.2		82.0	81.2	87.4	87.6	85.7
Bankfull Mean Depth (ft)		3.2	3.0	3.4	3.5	3.4		2.3	3.0	2.6	2.8	2.7
Bankfull Maximum Depth (ft)		4.5	4.4	4.6	4.6	4.4		4.0	4.4	3.5	3.5	3.2
Width/Depth Ratio		7.9	9.5	8.4	8.2	8.7		15.9	8.9	12.8	11.2	12.0
Entrenchment Ratio		>3.0	>3.0	>3.0	2.8	2.7		>2.5	>2.5	>2.5	2.0	1.8
Bank Height Ratio		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0
Cross-Sectional Area Between End Pins (ft^2)		-	326.9	330.7	369.7	330.7		-	151.8	124.7	160.8	163.8
d50 (mm)		0.06	0.06	0.28	0.35	0.67		0.06	0.06	71.00	27.00	70.00

*=Cross-sections 3, 4, and 5 reset in October 2014, before MY3 survey

Table 5. Hydrological (Bankfull) Verifications Northgate Park (Ellerbe Creek) Stream Restoration Site			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo Number**
6/14/2009	6/11/2009	Site visit to evaluate indicators of stage after storm event	N/A
11/11/2009	11/11/2009	Site visit to evaluate indicators of stage after storm event	N/A
12/25/2009	12/25/2009	Eye-witness account	N/A
1/25/2010	1/25/2010	Site visit to evaluate indicators of stage after storm event	N/A
5/17/2010	5/17/2010	Site visit to evaluate indicators of stage after storm event	N/A
9/30/2010	9/30/2010	Site visit to evaluate indicators of stage after storm event	N/A
6/30/2013	6/30/2013	Site visit to evaluate indicators of stage after storm event	1-2
9/24/2014	9/24/2014	Site visit to evaluate indicators of stage after storm event	3-4
12/23/2015	12/23/2015	Site visit to evaluate indicators of stage after storm event	5-6
2/16/2016	2/16/2016	USGS Gage located just downstream of the project	7
3/14/2016	3/14/2016	USGS Gage located just downstream of the project	7
7/15/2016	7/15/2016	USGS Gage located just downstream of the project	7
7/31/2016	7/31/2016	USGS Gage located just downstream of the project	7
9/18/2016	9/18/2016	USGS Gage located just downstream of the project	7
10/8/2016	10/8/2016	USGS Gage located just downstream of the project	7

Photo 1. Bankfull event 6/30/2013

Photo 2. Bankfull event 6/30/2013

Photo 3. Bankfull event 9/24/2014

Photo 4. Bankfull event 9/24/2014

Photo 5. Bankfull event 12/23/2015

Photo 6. Bankfull event 12/23/2015

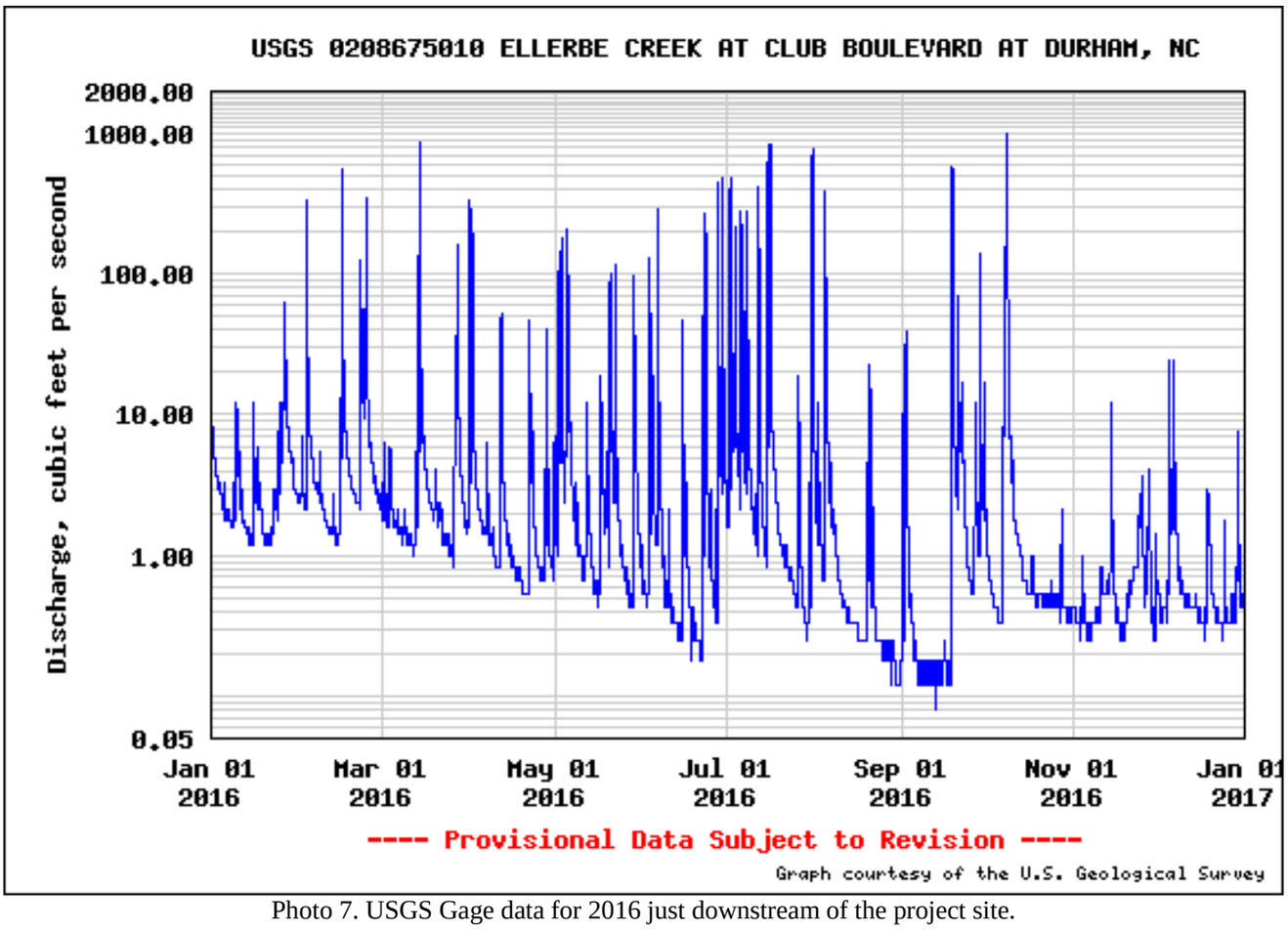


Photo 7. USGS Gage data for 2016 just downstream of the project site.

Table 6. Vegetation History (stems/acre)
Northgate Park (Ellerbe Creek) Stream Restoration Site

Plot Number	MY-01		MY-02		MY-03		MY-04		MY-05	
	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
1	769	769	607	4,168	162	5,625	121	5,342	162	5,787
2	567	567	486	1,295	283	3764	283	3,197	283	3,885
3	769	769	364	1,781	0	6,192	0	5,099	0	6,151
4	607	607	81	6,475	81	2469	40	3,116	40	3,197
5	486	486	445	445	243	1,255	243	1,578	243	7,649
6	405	405	324	445	324	2550	324	2,469	324	2,388

Figure 7. Vegetation plot data
Northgate Park (Ellerbe Creek) Stream Restoration Site

			Current Plot Data (MY5 2016)																		Annual Means														
			E272-A-0001			E272-A-0002			E272-A-0003			E272-A-0004			E272-A-0005			E272-A-0006			MY5 (2016)			MY4 (2015)			MY3 (2014)			MY2 (2010)			MY1 (2009)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer	maple	Tree																															5	5	5
Acer floridanum	Southern Sugar Mapl	Tree			1																		1													
Acer negundo	boxelder	Tree			1						1			1						1			4			2			1							
Acer rubrum	red maple	Tree															2			5			7			3			6			1				
Acer saccharinum	silver maple	Tree															1						1													
Acer saccharum	sugar maple	Tree				3	3	3													3	3	3	3	3	6	3	3	6	4	4	5				
Alnus incana ssp. rugosa	speckled alder				1						3			17									21													
Alnus serrulata	hazel alder	Shrub																								16	1	1	15			54	3	3	3
Aronia arbutifolia	Red Chokeberry	Shrub																												1	1	1	1	1	1
Baccharis	baccharis	Shrub																								1										
Baccharis halimifolia	eastern baccharis	Shrub																											1							
Betula nigra	river birch	Tree			3						1												4			3			6			15				
Celtis laevigata	sugarberry	Tree			6			6						1									13			4			5	8	8	8	9	9	9
Cercis canadensis	eastern redbud	Tree																2	2	2	2	2	2	2	2	2	2	2	2						
Cornus	dogwood	Shrub or Tree																															3	3	3
Cornus amomum	silky dogwood	Shrub									1									3			4			2			2	4	4	6	2	3	3
Diospyros virginiana	common persimmon	Tree				3	3	3			5			1	4	4	8			1	7	7	18	7	7	13	7	7	12	10	10	10	2	2	2
Fraxinus pennsylvanica	green ash	Tree			32			7			9						1			3			52			28			33	1	1	30	1	1	1
Ilex cornuta	Chinese holly	Exotic																								1			1						
Juglans nigra	black walnut	Tree			2			21			1			2			1						27			11			8						
Juniperus virginiana	eastern redcedar	Tree	1	1	2			23			3			1	2	2	4				3	3	33	3	3	27	3	3	31	5	5	6	5	5	5
Liquidambar styraciflua	sweetgum	Tree			62						72			38			169			11			352			239			189			144			
Liriodendron tulipifera	tuliptree	Tree			16			2			6			6				2	2	3	2	2	33	2	2	30	2	2	36	4	4	9	5	5	5
Morus rubra	red mulberry	Tree																											6						
Oxydendrum arboreum	sourwood	Tree																												1	1	1	1	1	1
Physocarpus	ninebark	Shrub																																1	1
Pinus taeda	loblolly pine	Tree			8			20			36			5						19			88			81			126			4			
Platanus occidentalis	American sycamore	Tree			6			2			7			2									17			17			18	1	1	30	1	1	1
Prunus serotina var. serot	black cherry	Tree																								2									
Prunus virginiana	chokecherry	Shrub																											1						
Quercus	oak	Tree																														4			
Quercus coccinea	scarlet oak	Tree				1	1	6						4							1	1	10	1	1	10	1	1	9	1	1	1	4	4	4
Quercus lyrata	overcup oak	Tree																1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1
Quercus michauxii	swamp chestnut oak	Tree	2	2	2													3	3	4	5	5	6	5	5	5	6	6	6	9	9	9	12	12	12
Quercus pagoda	cherrybark oak	Tree																								1				1	1	1			
Quercus palustris	pin oak	Tree	1	1	1															1	1	1	2												
Quercus phellos	willow oak	Tree									2												2			2			3	3	3	4	3	3	3
Quercus rubra	northern red oak	Tree						1			1												2						2						
Salix nigra	black willow	Tree										1	1	1						5	1	1	6	1	1	9	1	1	5			2		2	2
Sambucus canadensis	Common Elderberry	Shrub																								3			2	1	1	11	1	1	1
Sambucus nigra	European black elder	Shrub									4												4												
Spiraea	spirea	Shrub																															11	11	11
Symphoricarpos orbiculat	coralberry	Shrub															2						2			11			1			1	1	1	1
Taxodium distichum	bald cypress	Tree						2															2			2			2						
Ulmus	elm	Tree																														1			
Ulmus americana	American elm	Tree															1						1			4			3						
Ulmus parvifolia	Chinese elm																									2			1						
Unknown		Shrub or Tree																												2	2	2	14	14	14
		Stem count	4	4	143	7	7	96	0	0	152	1	1	79	6	6	189	8	8	59	26	26	718	25	25	539	27	27	540	57	57	361	85	89	89
		Size (ares)	1			1			1			1			1			1			6			6			6			6			6		
		Size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.15			0.15			0.15			0.15			0.15		
		Species count	3	3	14	3	3	12	0	0	15	1	1	12	2	2	9	4	4	13	10	10	29	9	9	30	10	10	31	17	17	26	20	22	22
		Stems per ACRE	161.9	161.9	5787	283.3	283.3	3885	0	0	6151	40.47	40.47	3197	242.8	242.8	7649	323.7	323.7	2388	175.4	175.4	4843	168.6	168.6	3635	182.1	182.1	3642	384.5	384.5	2435	573.3	600.3	600.3

4.0 DMS RECOMMENDATIONS AND CONCLUSIONS

The Northgate Park Stream Restoration Site is has developed into a stable, well vegetated, urban stream restoration project. There were no areas of active erosion noted during the MY-05 end of year site walk.

Based on the six monitoring plots, the fifth-year monitoring counted an average of 175 planted stems/acre across the site. Plots 1, 3, 4 and 5 have a planted stem density less than the year five success criteria of 260 stems/acre for riparian stream restoration areas and 320 stems/acre for buffer restoration areas. This is largely due to the lack of stems identifiable as planted and not a lack of desirable woody stems growing on the site. The site's average stem density including volunteers is 4,843 stems/acre, with all plots averaging over 2,000 stems/acre. Overall the site is well vegetated and all areas are growing well.

Overall the stream and the site's vegetation condition indicate that it is on a path to success. The DMS recommends that this site be closed out.

5.0 CONTINGENCIES

None

Pre-Construction Photos (2006)

Reach 1 looking upstream from Lavender Street

Beginning of Reach 1

Reach 1 looking downstream from Lavender Street

End of Reach 1

Beginning of Reach 2

End of Reach 2

UT1’s confluence with Reach 1

UT3

Post-Construction Photos MY-05

Reach 1 looking upstream from Lavender Street

Beginning of Reach 1

Reach 1 looking downstream from Lavender Street

End of Reach 1

Beginning of Reach 2

End of Reach 2

UT1's confluence with Reach 1

UT3

Appendix A
Watershed Planning Summary

To be completed by the DMS Watershed Planner.

Appendix B
Land Ownership and Protection

To be completed by the DMS Property Section.

Appendix C
Debit Ledger

Closeout Coordinator to obtain.

Appendix D
Additional Data