

**Richland Creek Stream
Restoration Monitoring Report
EEP Project # 304
Monitoring Year – 02
2006**



Submitted to:



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

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Monitoring Firm



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EXECUTIVE SUMMARY

The Richland Creek Stream Restoration site is located adjacent to the RBC Center in Wake County, North Carolina. The project is broken up into three separate reaches. Two reaches are associated with the two sides of Richland Creek as it flows under Collector Road and the other reach is located immediately upstream of the Edwards Mill Road Extension culvert on Richland Creek. The watershed is located within USGS 14-digit HUC 03020201080020 and NCDWQ Sub-basin 03-04-02 of the Neuse River Basin. The restoration was designed to correct problems concerning lack of habitat, an unstable streambed, and debris blockages. This site is made up of three small reaches; therefore traditional stream monitoring has been replaced by visual monitoring and the establishment of two (2) vegetation monitoring plots. This report is a description of the findings of the second year monitoring that took place in 2006.

The restoration consisted of replanting measures along the stream banks, within the riparian buffer, and along the adjacent slopes. The first year vegetation monitoring plots were established in October of 2005. The two plots are not surveyed, but their approximate locations are depicted in the monitoring plan view. The corners of these plots were marked with metal conduit, three-foot (3') wooden stakes, and flagging. The second year monitoring counted an average of 760 stems per acre.

A visual inspection of the stream reaches found them to be functioning well. The cross vanes appeared to be working as designed, although the cross vane in reach 2 had some bank scour around the vane. Reach 2 also had an isolated section of bank erosion. The conditions of the stream can be evaluated by comparing the yearly monitoring photos from the established photo stations and the tables within the report. These photo stations were not surveyed, but their approximate locations are depicted in the monitoring plan view.

1.0 PROJECT BACKGROUND

1.1 Project Objectives

The Richland Creek Stream Restoration Project does not have any previously defined project objectives.

1.2 Project Structure, Restoration Type, and Approach

Previously unstable and debris clogged Richland Creek was restored where the stream flows into and out of a culvert under Collector Road and before flowing through a culvert under Edwards Mill Road. Channel profile is maintained through the use of rock cross vanes.

1.3 Location and Setting

This project is located in Raleigh, North Carolina. The surrounding land use is mixed use, including residential, commercial, and agricultural areas. There is the potential for the watershed to become more developed over time.

1.4 Project History and Background

Table 1. Project Mitigation Structure and Objectives								
Project Number and Name: 304 - Richland Creek								
Segment / Reach ID	Existing Linear Feet	Type	Approach	Linear Feet	Mitigation Ratio	Mitigation Units	Stationing	Comment
Reach 1	N/A	R	P2/3	100	1.0	100	10+00 - 11+00	
Reach 2	N/A	R	P2/3	140	1.0	140	20+00 - 21+40	
Reach 3	N/A	R	P2/3	175	1.0	175	30+00 - 31+75	
Mitigation Unit Summations								
Stream (lf)	Riparian Wetland (Ac)	Nonriparian Wetland (Ac)	Total Wetland (Ac)	Buffer (Ac)	Comment			
415								

R = Restoration

P2/3 = Combination of Priority II and III

DIRECTIONS TO RICHLAND CREEK SITE:
 From Interstate I-40 take exit 289 for Edwards Mill Rd. Turn south on Edwards Mill Rd. Approximately 1,200 feet on the left where Richland Creek flows under Edwards Mill Rd. is one part of the site. To access the second part of the site, continue on Edwards Mill Rd. and take the first left onto Collector Rd. There is a small parking lot for the greenway on the left. From this parking lot, there is access to Richland Creek, before and after it flows under Collector Rd. The other part of the project can be accessed by walking back out to Edwards Mill Rd., or by parking along the shoulder of Edwards Mill Rd. where the creek flows under the road.

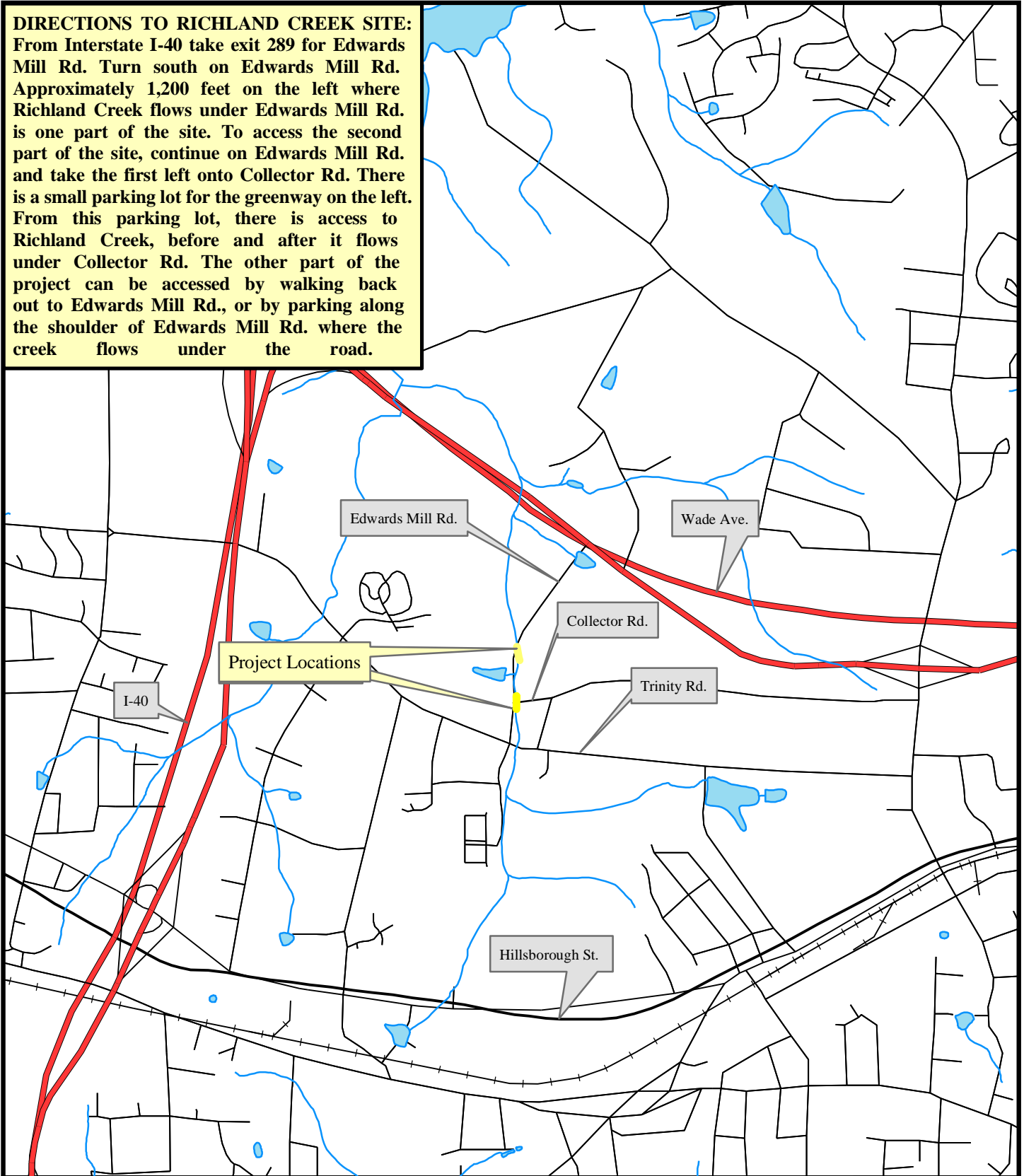


Figure 1. Site Vicinity Map
Richland Creek, Wake County, EEP Project # 304 - MY02



Date: 1/02/07

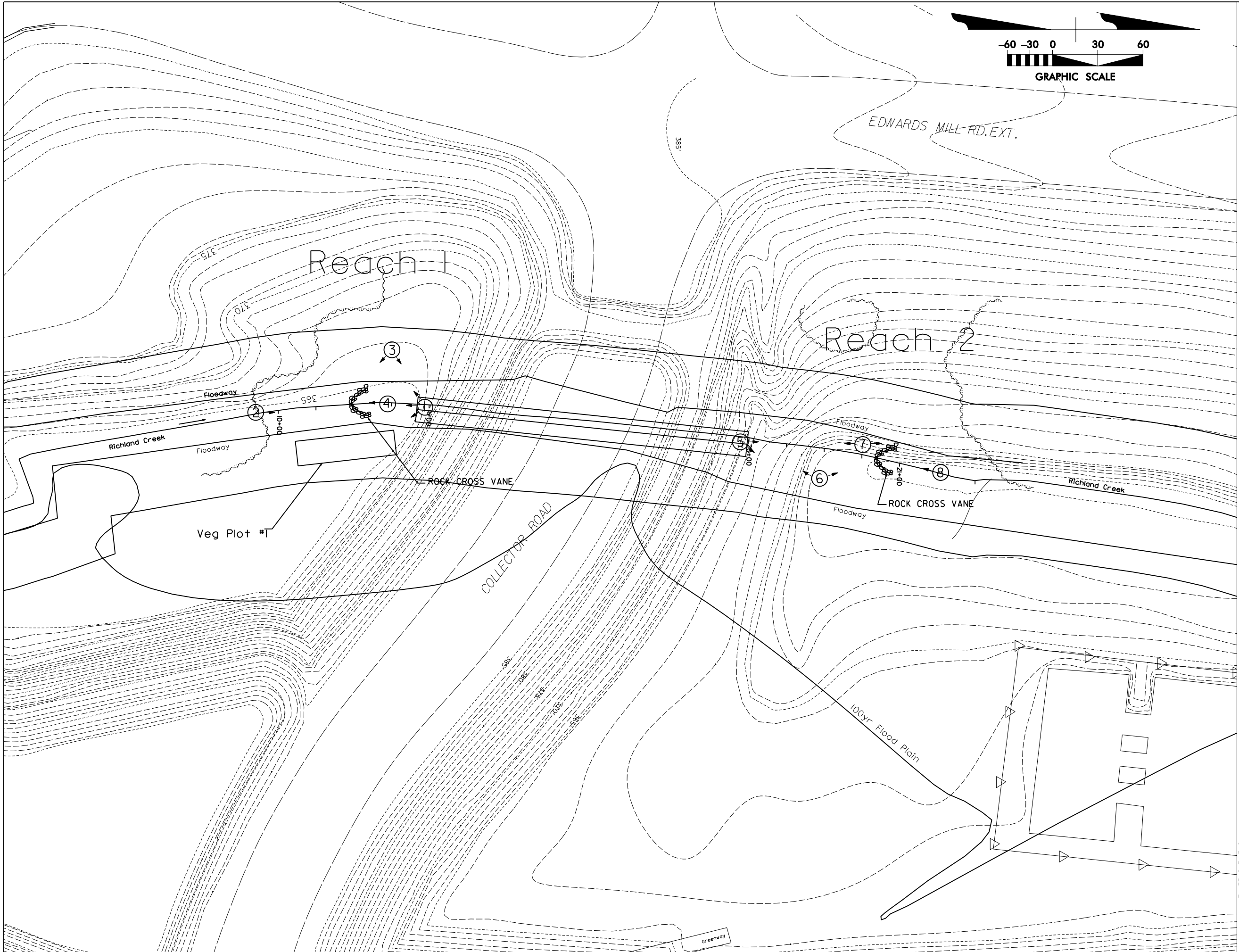


Table 2. Project Activity and Reporting History		
Project Number and Name: 304 - Richland Creek		
Activity or Report	Data Collection Complete	Actual Completion or Delivery
Restoration Plan	NA	NA
Final Design - 90%	NA	NA
Construction	NA	2002
Riparian Buffer Planting	NA	2003
Stream Maintenance and Planting	NA	NA
Year 1 Monitoring	October 2005	January 2006
Year 2 Monitoring	May 2006	January 2007

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

Table 3. Project Contact Table	
Project Number and Name: 304 - Richland Creek	
Design Firms	Earth Tech 701 Corporate Center Dr., Suite 475 Raleigh, North Carolina 27607 Contact: Ms. Jan Patterson and Mr. George Lankford Phone: (919) 854-6200 Fax: (919) 854-6259
Construction Contractor	North State Environmental, Inc. 2889 Lowery St., Suite B Winston Salem, North Carolina 27101 Contact: Mr. Darrell Westmoreland Phone: (336) 725-2010 Fax: (336) 725-2405
Monitoring Performers	
MY-01, MY-02	KCI Associates of NC Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 783-9214 Fax: (919) 783-9266

Table 4. Project Background Table	
Project Number and Name: 304 – Richland Creek	
Project County	Wake County
Drainage Area	N/A
Drainage Impervious Cover Estimate (%)	N/A
Stream Order	Second Order
Physiographic Region	Piedmont
Ecoregion	Northern Outer Piedmont
Rosgen Classification of As-built	N/A
Dominant Soil Types	Chewacla
Reference Site ID	N/A
USGS HUC for Project and Reference	3020201080020
NCDWQ Sub-basin for Project and Reference	03-04-02
NCDWQ Classification for Project and Reference	C-NSW
Any portion of the project segment 303d listed?	No - not rated
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%



MATCHLINE SHEET 2

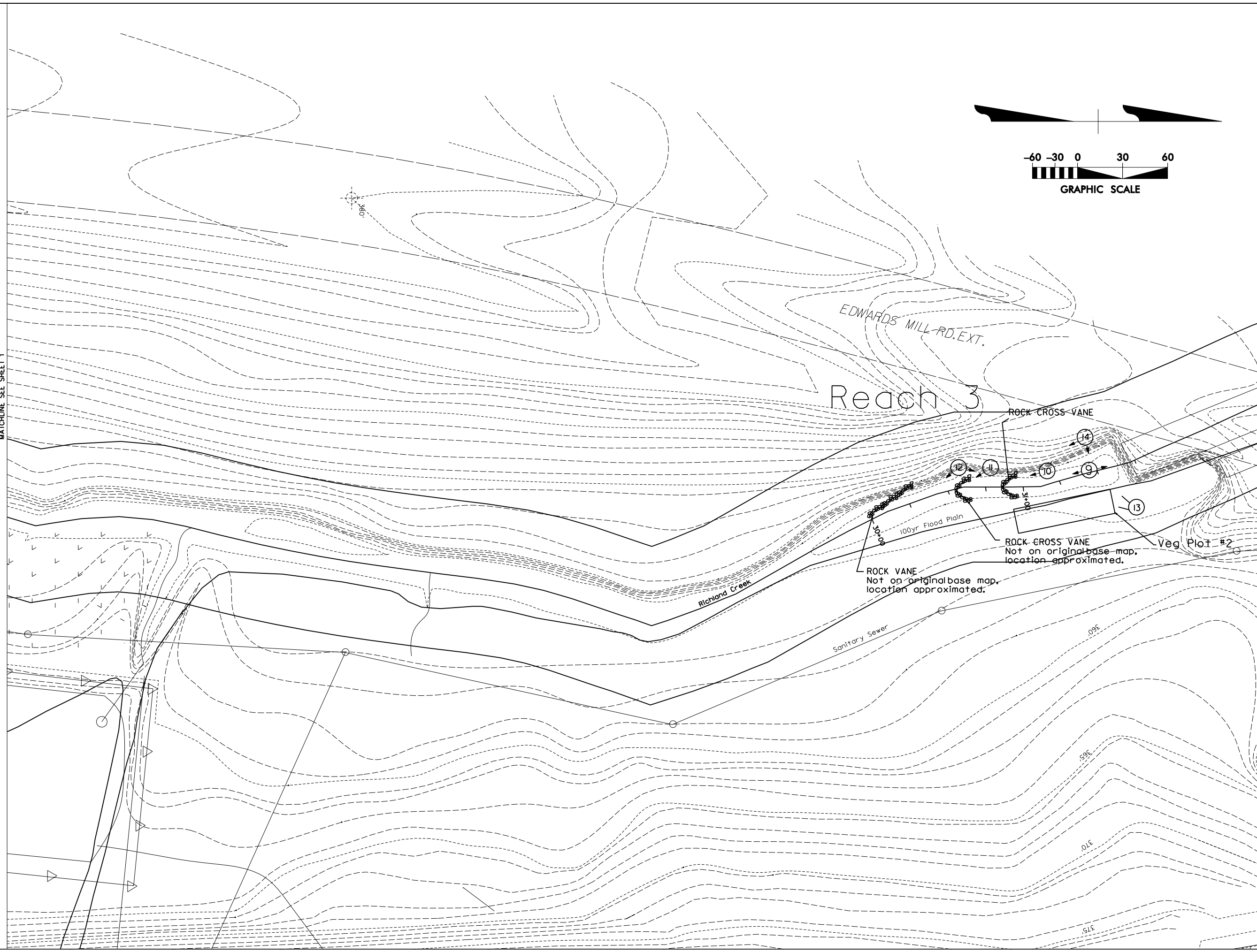
SYMBOL	DESCRIPTION	DATE	APPROVED



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**RICHLAND CREEK
MONITORING PLAN VIEW
WAKE COUNTY
EEP PROJECT NUMBER 304 - MY02**

MATCHLINE SEE SHEET 1



SYMBOL	DESCRIPTION	DATE	APPROVED



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4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

**RICHLAND CREEK
MONITORING PLAN VIEW
WAKE COUNTY
EEP PROJECT NUMBER 304 - MY02**

DATE: MARCH 2006
SCALE: SEE SHEET
MONITORING PLAN VIEW SHEET 2
SHEET 2 OF 2

2.0 PROJECT CONDITIONS AND MONITORING RESULTS

2.1 Vegetation Assessment

See vegetation assessment in Appendix A.

2.1.1 Vegetative Problem Areas

See Table A3. Vegetative Problem Areas in Appendix A.

2.1.2 Vegetative Problem Area Plan View

N/A

2.2 Stream Assessment

2.2.1 Bankfull Event and Bank Stability Assessment

2.2.1.a Verification of Bankfull Events Table

Table 5. Verification of Bankfull Events			
Project Number and Name: 304 - Richland Creek			
Date of Data Collection	Date of Occurance	Method	Photo Number
06/15/06	06/14/06	Site visit to evaluate evidence at site after storm event	

2.2.1.b BEHI and Sediment Export Table

Table 6. BEHI and Sediment Export Estimates
Project Number and Name: 304 – Richland Creek
Visual monitoring only, BEHI will not be conducted on this project

2.2.2 Stream Problem Areas

See Stream Problem Areas Table and Photos in Appendix B.

2.2.3 Stability Assessment Table

Table 7a. Categorical Stream Feature Visual Stability Assessment						
Project Number and Name: 304 – Richland Creek						
Segment/Reach: Reach 1						
Feature	Initial	MY - 01	MY - 02	MY - 03	MY - 04	MY - 05
A. Riffles	100%	100%	100%			
B. Pools	100%	100%	100%			
C. Thalweg	100%	100%	100%			
D. Meanders	N/A	N/A	N/A			
E. Bed General	100%	100%	100%			
F. Vanes	100%	100%	100%			

Table 7b. Categorical Stream Feature Visual Stability Assessment						
Project Number and Name: 304 – Richland Creek						
Segment/Reach: Reach 2						
Feature	Initial	MY - 01	MY - 02	MY - 03	MY - 04	MY - 05
A. Riffles	100%	100%	100%			
B. Pools	100%	100%	100%			
C. Thalweg	100%	100%	100%			
D. Meanders	100%	100%	90%			
E. Bed General	100%	100%	100%			
F. Vanes	100%	75%	75%			

Table 7c. Categorical Stream Feature Visual Stability Assessment						
Project Number and Name: 304 – Richland Creek						
Segment/Reach: Reach 3						
Feature	Initial	MY - 01	MY - 02	MY - 03	MY - 04	MY - 05
A. Riffles	100%	100%	100%			
B. Pools	100%	100%	100%			
C. Thalweg	100%	100%	100%			
D. Meanders	100%	100%	100%			
E. Bed General	100%	100%	100%			
F. Vanes	100%	100%	100%			

2.2.4 Quantitative Measures Summary Table

Table 8. Baseline Morphology and Hydraulic Summary
Project Number and Name: 304 – Richland Creek
N/A

Table 9. Morphology and Hydraulic Monitoring Summary
Project Number and Name: 304 – Richland Creek
No cross sections established for monitoring

Appendix A

Vegetation Raw Data

App A1 - Vegetation Data Tables

Table A1. Stem counts for each species arranged by plot						
Project Number and Name: 304 – Richland Creek						
Species	Plots		Initial Totals	Year 1 Totals	Year 2 Totals	Survival %*
	1	2				
Shrubs						
<i>Sambucus canadensis</i>	3	9	N/A	9	12	130%
<i>Cornus amomum</i>	9	10	N/A	18	19	106%
<i>Alnus serrulata</i>		4	N/A	5	4	80%
Trees						
<i>Betula nigra</i>	3		N/A	3	3	100%

* In some cases survival of stems is greater than 100% due to some trees either resprouting after having died back or being overlooked in the previous monitoring year.

Table A2. Stem Density by Plot								
Project Number and Name: 304 - Richland Creek								
Date : 5/5/06								
Crew : A. Spiller								
Plot #	River Birch <i>Betula nigra</i>	Silky Dogwood <i>Cornus amomum</i>	Elderberry <i>Sambucus canadensis</i>	Tag Alder <i>Alnus serrulata</i>	Total (Year 2)	Density (Trees/Acre)		
1	3	9	3		15	600		
2		10	9	4	23	920		
Average						760		

Table A3. Vegetative Problem Areas			
Project Number and Name: 304 – Richland Creek			
Feature/Issue	Station # / Range	Probable Cause	Photo #
N/A	N/A	See Photo Log and Narrative	

Both vegetation plots are located within the streamside assemblage planting zones. The streamside assemblage zone is the only part of the planting plan that appeared to be planted at a density aimed at a successful number of stems per acre. The hardwood zones are made up of only balled and burlap trees that are not planted at a density high enough to attain traditional success criteria. The monitoring plots are rectangular in shape (measuring 5 meters by 20 meters) due to their location in the streamside assemblage zone. Within the streamside area, the plants appear to be in good condition. In some cases there were more trees found in monitoring year 2 than in monitoring year 1. This is because some individual plants, which appeared dead the year before,

sprouted new growth from their roots. As noted during the previous monitoring year, some beaver activity was apparent at the site, but there was no evidence of a beaver dam in the immediate stream area. The hardwood ball and burlap trees that had been stressed by the previous dry summer have leafed out and most appear to be healthy. Volunteer trees noted throughout the site include a large number of sweetgum (*Liquidambar styraciflua*) and loblolly pine (*Pinus taeda*) and a smaller number of yellow poplar (*Liriodendron tulipifera*). Invasive species did not appear to be a major problem at the site, but multiflora rose (*Rosa multiflora*), Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*) and Russian olive (*Elaeagnus angustifolia*) were scattered throughout, with the honeysuckle being the most widely distributed.

App A2 - Vegetation Monitoring Plot Photos



Plot 1 Photo – Taken from photo station 3 looking to center of vegetation plot across stream.
Note rock cross vane in foreground. 5/5/06 - MY 02.



Plot 2 Photo – Taken from photo station 14 looking to center of vegetation plot across stream.
5/5/06 - MY 02.

Appendix B

Geomorphologic Raw Data

App B1 –Stream Problem Area Tables

Table B1a. Stream Problem Areas			
Project Number and Name: 304 – Richland Creek			
Segment/Reach: Reach 1			
Feature Issue	Station numbers	Suspected Cause	Photo #
No Visible Problems	N/A	N/A	

Table B1b. Stream Problem Areas			
Project Number and Name: 304 – Richland Creek			
Segment/Reach: Reach 2			
Feature Issue	Station numbers	Suspected Cause	Photo #
Bank erosion	20+50 – 20+65	unknown	SP1
Cross Vane – back or arm scour	20+85	unknown	SP2

Table B1c. Stream Problem Areas			
Project Number and Name: 304 – Richland Creek			
Segment/Reach: Reach 3			
Feature Issue	Station numbers	Suspected Cause	Photo #
No Visible Problems	N/A	N/A	

App B2 –Representative Stream Problem Area Photos



SP 1 (Reach 2) – Stream bank erosion on inside of upstream meander.



SP 2 (Reach 2) – Back arm scour on left arm of cross vane.

App B3 –Stream Photo-Station Photos



Photo Station 1 (Reach 1) – View looking southwest at the left bank and the slope above.



Photo Station 1 (Reach 1) – View looking southeast at the right bank and vegetation monitoring plot 1.



Photo Station 1 (Reach 1) – View looking upstream with rock cross vane in center of photo.



Photo Station 2 (Reach 1) – View looking downstream with culvert under Collector Rd. in center of photo.



Photo Station 3 (Reach 1) – View looking northeast, towards culvert under Collector Rd.



Photo Station 3 (Reach 1) – View looking southeast, with rock cross vane in center of photo.



Photo Station 4 (Reach 1) – View looking upstream, with rock cross vane in center of photo.



Photo Station 5 (Reach 2) – View looking north.



Photo Station 5 (Reach 2) – View looking northeast, towards greenway trail and water impoundment.



Photo Station 6 (Reach 2) – View looking downstream, towards rock cross vane.



Photo Station 6 (Reach 2) – View looking upstream, towards culvert under Collector Rd.



Photo Station 7 (Reach 2) – View looking downstream, with rock cross vane in foreground of photo.



Photo Station 7 (Reach 2) – View looking upstream, towards culvert under Collector Rd.



Photo Station 8 (Reach 2) – View looking upstream at rock cross vane, note loss of back fill material in front of cross vane arm on right side of photo.



Photo Station 9 (Reach 3) – View looking downstream towards culvert under Edwards Mill Rd.



Photo Station 9 (Reach 3) – View looking upstream towards two rock cross vanes.



Photo Station 10 (Reach 3) – View looking upstream at rock cross vane.



Photo Station 11 (Reach 3) – View looking upstream at rock cross vane.



Photo Station 12 (Reach 3) – View looking downstream towards culvert under Edwards Mill Rd.



Photo Station 12 (Reach 3) – View looking upstream.



Photo Station 13 (Reach 3) – View looking southwest towards left bank with Edwards Mill Rd. at the top of the photo.



Photo Station 14 (Reach 3) – View looking east towards right bank with vegetation monitoring plot 2 in lower right corner of photo.



Photo Station 14 (Reach 3) – View looking south.

App B4 –Qualitative Visual Stability Assessment

Table B2. Qualitative Visual Stability Assessment

Project Number 304 – Richland Creek (415 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?	6	6	N/A	100	
	2. Armor stable (e.g. no displacement)?	6	6	N/A	100	
	3. Facet grade appears stable?	6	6	N/A	100	
	5. Minimal evidence of embedding/fining?	6	6	N/A	100	
	6. Length appropriate?	6	6	N/A	100	100
B. Pools	1. Present? (e.g. no severe aggradation)	7	7	N/A	100	
	2. Sufficiently deep (Dmax pool:Mean Bkf > 1.6?)	7	7	N/A	100	
	6. Length appropriate?	N/A	N/A	N/A	N/A	100
C. Thalweg	1. Upstream of meander bend centering?	2	2	N/A	100	
	2. Downstream of meander centering?	2	2	N/A	100	100
D. Meanders	1. Outer bend in state of limited/controlled erosion?	2	2	N/A	100	
	2. Of those eroding, # w/ concomitant point bar formation?	2	2	N/A	100	
	3. Apparent Rc within spec?	N/A	N/A	N/A	N/A	
	4. Sufficient floodplain access and relief?	2	2	N/A	100	100
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	1/15	98	98
F. Vanes	1. Free of back or arm scour?	4	5	N/A	80	
	2. Height appropriate?	5	5	N/A	100	
	3. Angle and geometry appear appropriate?	5	5	N/A	100	
	4. Free of piping or other structural failures?	5	5	N/A	100	95