YEAR 3 MONITORING REPORT

UT TO NEUSE RIVER (BIG DITCH) STREAM RESTORATION SITE

Wayne County, North Carolina
SCO No.: 090776201
DMS Project No.: 92682
DWR Project Id No.: 10-0343
USACE Action Id No.: SAW-2010-01782

Prepared for:

NCDEQ-Division of Mitigation Services (DMS)
Formerly Ecosystem Enhancement Program (EEP)
217 West Jones St. Suite 3000A
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November 16, 2016

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I HEREBY CERTIFY THAT THE DOCUMENT CONTAINED HEREIN, UT NEUSE RIVER (BIG DITCH) YEAR 3 MONITORING REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION.

SIGNED SEALED, AND DATED THIS 3RD DAY OF NOVEMBER 2016.

Chris L. Smith, PE

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1.0 EXECUTIVE SUMMARY

The following report summarizes the vegetation establishment and stream stability for Year 3 of monitoring at the UT Neuse River (Big Ditch) Stream Restoration Site in Wayne County, North Carolina.

1.1 Goals and Objectives

The primary goals of the UT Neuse River (Big Ditch) stream restoration site include:

- Reducing sediment loading in the UT
- Improving water quality
- Providing/enhancing flood attenuation
- Restoring and enhancing aquatic riparian habitat

These goals will be achieved through the following objectives:

- Restore a stable dimension, pattern and profile to the UT that will deter degradation of side slopes and mass wasting of banks.
- Stabilize the UT by planting live stakes and bare roots along the channel banks to promote root growth.
- Enhancing the capacity of the site to mitigate flood flows by excavating a 5 foot floodplain bench off of each channel bank and sloping terrace side slopes at a 5:1 grade.
- Enhancing in stream habitat by creating an undulating bedform (shallows/deeps) by placing woody structures in the channel that provide shading, natural food sources, and protective areas for propagation.
- Reducing sedimentation and nutrients from adjacent urban areas by establishing a native riparian buffer through existing open/grassed fields that are currently regularly maintained.
- Improve terrestrial habitat by restoring a forested riparian corridor through a highly urbanized environment which has historically experienced vegetation maintenance and forest segmentation.
- Reduce nutrients and other pollutant inputs by retrofitting a contributing conveyance to a stormwater wetland BMP.

1.2 Vegetation

Bare root seedlings of tree species were planted at a density of approximately 680 stems per acre on 8-foot centers. Planted species include river birch (*Betula nigra*), pignut hickory (*Carya glabra*), mockernut hickory (*Carya tomentosa)*, green ash *(Fraxinus pennsylvanica)*, tulip poplar *(Lirodendron tulipifera)*, American sycamore *(Platanus occidentalis)*, scarlet oak *(Quercus coccinea)*, cherry bark oak *(Quercus falcate car pagodafolia)*, water oak *(Quercus nigra)*, southern red oak *(Quercus falcata)*, and persimmon *(Diospyros virginiana)*. Containerized plants included smooth alder

(Alnus serrulata), white fringe tree *(Chioanthus virginicus)*, winter berry *(Ilex verticillata)*, and sweetbay magnolia *(Magnolia virginiana).*

Planted stems continue to underperform across the site after the third monitoring year. When only taking into account planted stems, all plots fail to reach success criteria. A dense community of Johnson grass (*Sorghum halepens*) is out-competing many planted stems throughout the site. This community was noted as a potential problem in Year 2 monitoring and is continuing to hinder maturity of planted trees in Year 3. When including natural stems plots 1, 2, 3, 5, 6, and 7 fail to meet success criteria. The site as a whole meets success criteria when including natural recruits with 367 stems per acre.

Plots 8 and 9 are in close proximity to large bare spots and are also subject to frequent overbank flows. Despite previously noted exposed roots and stunted growth, stems in Plots 8 and 9 have resprouted over the course of the monitoring year and both plots meet success criteria when including natural stems.

A population of morning glory is present within the immediate buffer of the stream for the upstream third of the site and appears to have expanded over the previous year. The presence of morning glory does not appear to be hindering the success of plots.

1.3 Stream Stability

Following three years of monitoring, the majority of the UT to Neuse River Site appears to be stable. Stream profile remains largely consistent with previous monitoring years, with the majority of the scouring occurring in pools. Overall, aggregation and degradation throughout the profile has been minimal.

Overbank sediment deposition is occurring from approximately station 10+00 – 19+50. Additionally, Cross Section 1 is demonstrating a narrowing channel due to sediment deposition along the banks. At Cross Section 4 the channel bed is scouring and sediment is being deposited on the floodplain. Width/Depth ratio remains consistent with Year 2 monitoring data.

Bank erosion has increased from approximately 120 feet along the channel to approximately 300 feet. The majority of this erosion is occurring in areas with poor vegetative cover or thin grass, leaving the banks exposed and prone to erosion. If this trend continues supplemental planting may be necessary.

The site has experienced at least four bankfull flows through the first two years of monitoring. The crest gauge installed on-site was inspected on February 26, 2016 and was found in need of repair due to high flows. The crest gauge was reinstalled on

3/30/2016. Bankfull event records can be seen in Table 13. Additional overbank evidence includes debris and detritus lines, vegetation bent in the downstream direction, and exposed roots within the floodplain and on terrace slopes.

1.4 Wetlands
No wetland monitoring areas were established for this project report.

1.5 Note
Summary information and statistics related to performance of various project and monitoring elements can be found in tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report and in the Mitigation Plan documents available on DMS's website. All raw data supporting tables and figures in the appendices is available from DMS upon request.

2.0 METHODOLOGY
The Year 3 Monitoring survey was completed utilizing total station equipment. Each cross section is marked with two rebar monuments at their beginning and ending points. The rebar has been located vertically and horizontally in NAD 83 State Plane. Surveying these monuments throughout the site ensure proper orientation. The survey data was imported into MicroStation for verification. RIVERMorph and Dan Mecklenburg's The Reference Reach Spreadsheet Version 4.3L was used to analyze the profile and cross section data. Tables and figures were created using Microsoft Excel.

The channel is entirely a sand bed system; therefore, a pebble count was not conducted. It should be noted that the restored channel is dominated by sand, not detritus as was the case in pre-restoration conditions.

Vegetation monitoring was completed using CVS level II methods, for 9, 100 square meter vegetation plots (Lee et al. 2008). The taxonomic standard for vegetation used for this document was Flora of the Southern and Mid-Atlantic States (Weakley 2011).

3.0 REFERENCES
Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation. Version 4.2. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, North Carolina.

NCDENR-Ecosystem Enhancement Program. 2014. Baseline Monitoring Document and As-Built Baseline Report, UT to Neuse River (Big Ditch) Stream Restoration Project, Wayne County, North Carolina.

United States Army Corps of Engineers, United States Environmental Protection Agency, North Carolina Wildlife Resources Commission, North Carolina Division of Water Quality (USACE et al.). 2003. Stream Mitigation Guidelines.

Weakley, Alan S. 2011. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas (online). Available: http://www.herbarium.unc.edu/FloraArchives/Weakley Flora_2006-Jan.pdf [January 6, 2006]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

4.0 APPENDICES

Appendix A. Background Tables

Table 1. Project Components and Mitigation Credits
UT Neuse (Big Ditch) (DMS Project ID No. 92682)

Mitigation Credits										
	Stream	Stream (at sewer crossing)	Total Stream	Riparian Buffer* (square feet)			Nitrogen Buffer Offset			
							Buffer Restoration **			
Type	R	R	R	TOB to 50'	50' to 100'	100' to 200'	Buffer Zone	<= 50'	50'-100'	100' - 200'
Restored LF or FT^2	2,072	60	2,132	157,756	107,778	78,632		157,756	107,778	11,651
Credit Ratio	1:1	2:1	1:1 & 2:1	1:1	1:1	4:1		1:1	1:1	1:1
Totals	2,072	30	2,102	157,756	107,778	19,658	Pound Reduction	0	5,624	4,103

Project Components						
Project Component - or- Reach ID	Stationing/Location	Existing Footage/ Acreage	Approach (PI, PII, etc)	Restoration -or- Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio
UT	10+00 - 31+32	2,113	PII	R	2,132	1:1 (2:1 at 60' sewer crossing)
Riparian Buffers	TOB to 50'	-	-	R	3.62	1:1
	50' - 100'	-	-	R	2.47	1:1
	100'-200'	-	-	R	0.45	4:1

Component Summation			
Restoration Level	Stream (linear feet)	Buffer (square ft.)	Buffer Nitrogen Nutrient Offset
Restoration	2,132	285,192	9,727

BMP Elements				
Element	Size (AC)	Purpose/ Function	1 yr Total Nitrogen Reduction (lbs)	30 yr. Total Nitrogen Reduction (lbs)
Stormwater Wetland	0.253	Water Quality/ Nutrient	49	1,470

* - Riparian Buffer areas may be used for stream & riparian buffer mitigation, or nutrient offset credit (Estimating/Calculating Riparian Buffer Credits, EEP PPPM Section 8.3.1.2).

** - Stream and Riparian Buffer Mitigation Credit Numbers were adjusted based on proposed DWQ guidelines (Draft Regulatory Guidance for the Calculation of Stream and Buffer Mitigation Credit for Buffer width different from standard minimum widths. Version 4.5, July 20, 2010.)

Table 2. Project Activity and Reporting History
UT Neuse (Big Ditch) (DMS Project ID No. 92682)

Activity or Report	Data Collection Complete	Completion or Delivery
Restoration Plan	January 2010	February 2010
Final Design – Construction Plans	January 2011	May 2012
Construction	January 23, 2013	September 5, 2013
Temporary S&E Mix Applied to Entire Project Area	January 23, 2013	September 5, 2013
Permanent Seed Mix Applied to Entire Project Area	January 23, 2013	September 5, 2013
Bare Root, Containerized, and B&B plantings for Entire Project Area	January 14, 2014	January 15, 2014
Mitigation Plan/As-built (Year 0 Monitoring-Baseline)	September 17, 2013	February 28, 2014
Year 1 Monitoring	April 28, 2014	December, 2014
Year 2 Monitoring	August 31, 2015	November, 2015
Year 3 Monitoring	August 23, 2016	November, 2016
Year 4 Monitoring		
Year 5 Monitoring		

Table 3. Project Contacts Table
UT Neuse (Big Ditch) (DMS Project ID No. 92682)

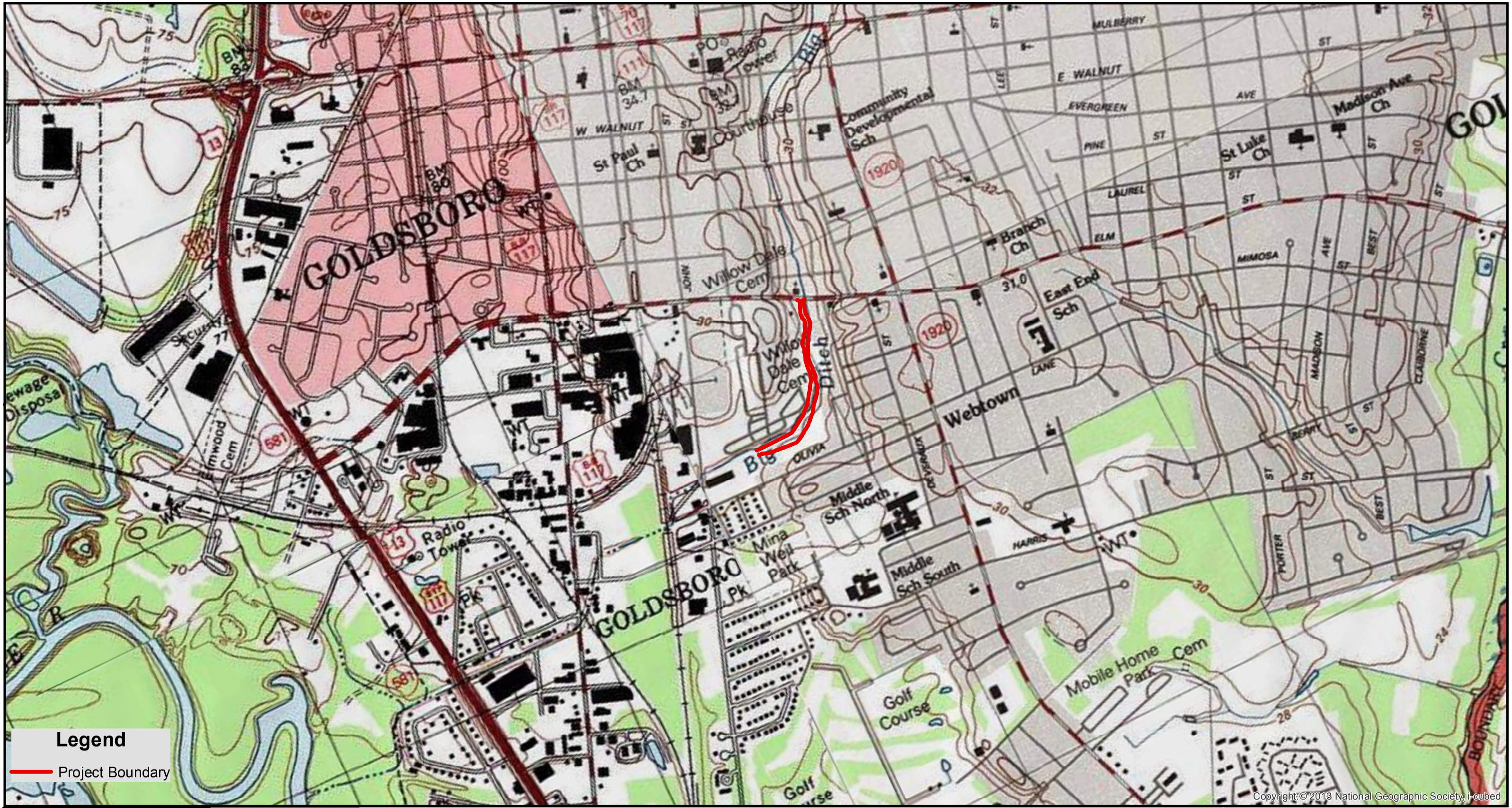
Designer Primary project design POC	ICA Engineering 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Kevin Williams (919) 851-6066
Construction Contractor Construction Contractor POC	Carolina Environmental Contracting, Inc. Joanne Cheatham P.O. Box 1905 Mount Airy, NC 27030 (336) 320-3849
Planting Contractor Planting Contractor POC	Carolina Sylvics, Inc. Mary-Margaret McKinney 908 Indian Trail Road Edenton, North Carolina 27932 (252) 482-8491
Seeding Contractor Seeding Contractor POC	Carolina Environmental Contracting, Inc. Joanne Cheatham P.O. Box 1905 Mount Airy, NC 27030 (336) 320-3849
Seed Mix Sources	Green Resources – Triangle Office
Nursery Stock Suppliers	1) NC Division of Forest Resources 2) Native Roots Nursery
Monitoring Performers	ICA Engineering 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (919) 851-6066
Stream Monitoring POC	ICA Engineering 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (919) 851-6066
Vegetation Monitoring POC	ICA Engineering 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (919) 851-6066

Table 4. Project Attributes Table
UT Neuse (Big Ditch) (DMS Project ID No. 92682)

Project Information	
Project Name	UT Neuse (Big Ditch)
Project County	Wayne
Project Area (acres)	10
Project Coordinates	035º 22' 24" N, 077º 59' 40'' W
Project Watershed Summary Information	
Physiographic Region	Southeastern Plains
Ecoregion	Southeastern Floodplains and Low Terraces
Project River Basin	Neuse
USGS 8-digit HUC	03020201
USGS 14-digit HUC	03020201200040
NCDWQ Subbasin	03-04-12
Project Drainage Area	2.27 sq. mi (at end of restoration reach)
Watershed Land Use	Forested = 20% Cultivated Cropland = 5% Urban = 74% Surface Water = 1%

Reach Summary Information	
Parameters	**UT Neuse (Big Ditch)**
Restored length	2,132
Drainage Area	2.27 sq. mi.
NCDWQ Index Number	27-(56)
NCDWQ Classification	WS-IV, NSW, C
Valley Type/Morphological Description	VIII/B/E5
Dominant Soil Series	Bibb/Norfolk loamy sand
Drainage Class	Bibb – poorly drained; Norfolk – well drained
Soil Hydric Status	Bibb – hydric; Norfolk – non-hydric
Slope	0.0017
FEMA Classification	AE & X
Native Vegetation Community	Coastal Plain Levee Forest

Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the U.S. –Sections 404 and 401	Yes	Yes	Restoration Plan
Endangered Species Act	Yes	Yes	Restoration Plan
Historic Preservation Act	Yes	Yes	Restoration Plan
CZMA/CAMA	No	--	--
FEMA Floodplain Compliance	Yes	In Progress	LOMR
Essential Fisheries Habitat	No	--	--



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Project Vicinity Map

0 0.2 0.4 0.8 1.2 1.6 Miles

Figure 1

Appendix B. Visual Assessment Data

Figures 2.0-2.4 Current Condition Plan View

CONTRACT: UT TO NEUSE (BIG DITCH) DENR# D090525

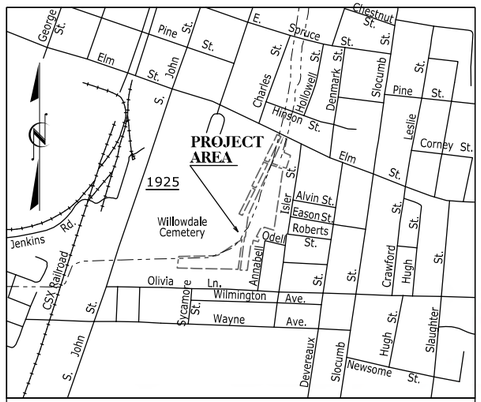
CURRENT CONDITIONS PLAN VIEW (CCPV)
UT TO NEUSE (BIG DITCH)

STATE		FIGURE NO.
N.C.	UT TO NEUSE (BIG DITCH)	2.0

LOCATION: WAYNE COUNTY, NORTH CAROLINA

LAT: 35°22'24" N **LONG: 77°59'40" W**

TYPE OF WORK: CCPV PLANS – YEAR 3



VICINITY MAP

LEGEND

- CONSERVATION EASEMENT
- TOP OF TERRACE
- THALWEG
- BANKFULL
- MONITORING CROSS SECTION
- LOD — LIMITS OF DISTURBANCE
- RIP RAP
- SOIL LIFT AREA
- LOG CROSS VANE
- LOG SILL
- LOG VANE W/SILL

YEAR 4 CONDITIONS

BANK/BED CONDITION
- MODERATE EROSION
- MINOR EROSION
- BANK WIDENING
- HOLE/GULLY

VEGETATION PROBLEM AREAS
- INVASIVE POPULATION
- THIN GRASS
- NO GRASS (BARE)

VEGETATION PLOT CONDITIONS
- CRITERIA MET
- CRITERIA UNMET

DISTURBED AREA = 11.13 AC.

GRAPHIC SCALES

50 25 0 50 100
PLANS

DESIGN DATA

DESIGN STREAM TYPE	=	B/E 6
BANKFULL AREA (FT^2) CROSS-SECTIONED	=	16.3
BANKFULL WIDTH (FT)	=	14.0
MAX DEPTH (FT)	=	1.75
WIDTH /DEPTH RATIO	=	12
DRAINAGE AREA (MI^2)	=	2.05
BANKFULL SLOPE(FT/FT)	=	0.0017

PROJECT LENGTH

EXISTING STREAM LENGTH	=	2,113.9 FT
ASBUILT STREAM LENGTH	=	2,132.2 FT

R. KEVIN WILLIAMS
PROJECT ENGINEER

CHRISTOPHER L. SMITH
PROJECT DESIGNER

RYAN V. SMITH
PROJECT MANAGER

Prepared in the Office of:

HDR | ICA

11/2/2016
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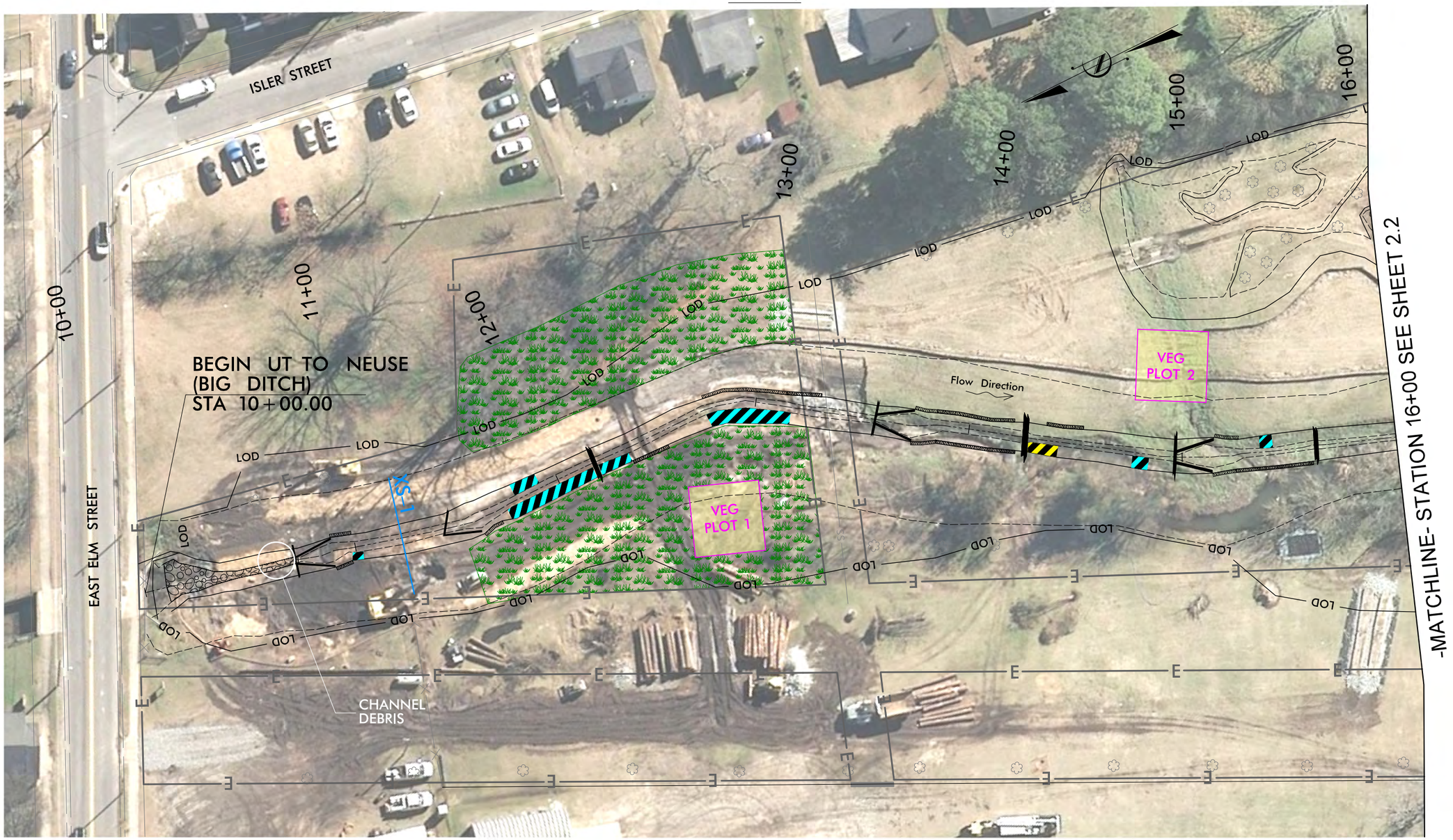
ICA Engineering

CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 3



LEGEND

- CONSERVATION EASEMENT
- TOP OF TERRACE
- THALWEG
- BANKFULL
- LOD — LIMITS OF DISTURBANCE
- MONITORING CROSS SECTION
- RIP RAP
- SOIL LIFT AREA
- LOG CROSS VANE
- LOG SILL
- LOG VANE W/SILL

YEAR 3 CONDITIONS

BANK/BED CONDITION
- MODERATE EROSION
- MINOR EROSION

VEGETATION PROBLEM AREAS
- INVASIVE POPULATION

VEGETATION PLOT CONDITIONS
- CRITERIA MET
- CRITERIA UNMET

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UT TO NEUSE (BIG DITCH)
STREAM RESTORATION PROJECT
WAYNE COUNTY, NORTH CAROLINA
STA 10+00 – STA 16+00

GRAPHIC SCALE
50 25 0 25
PLANS

DATE: 10-05-16

CCPV
YEAR 4

FIGURE
2.1

11/2/2016
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HDR Engineering

CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 3

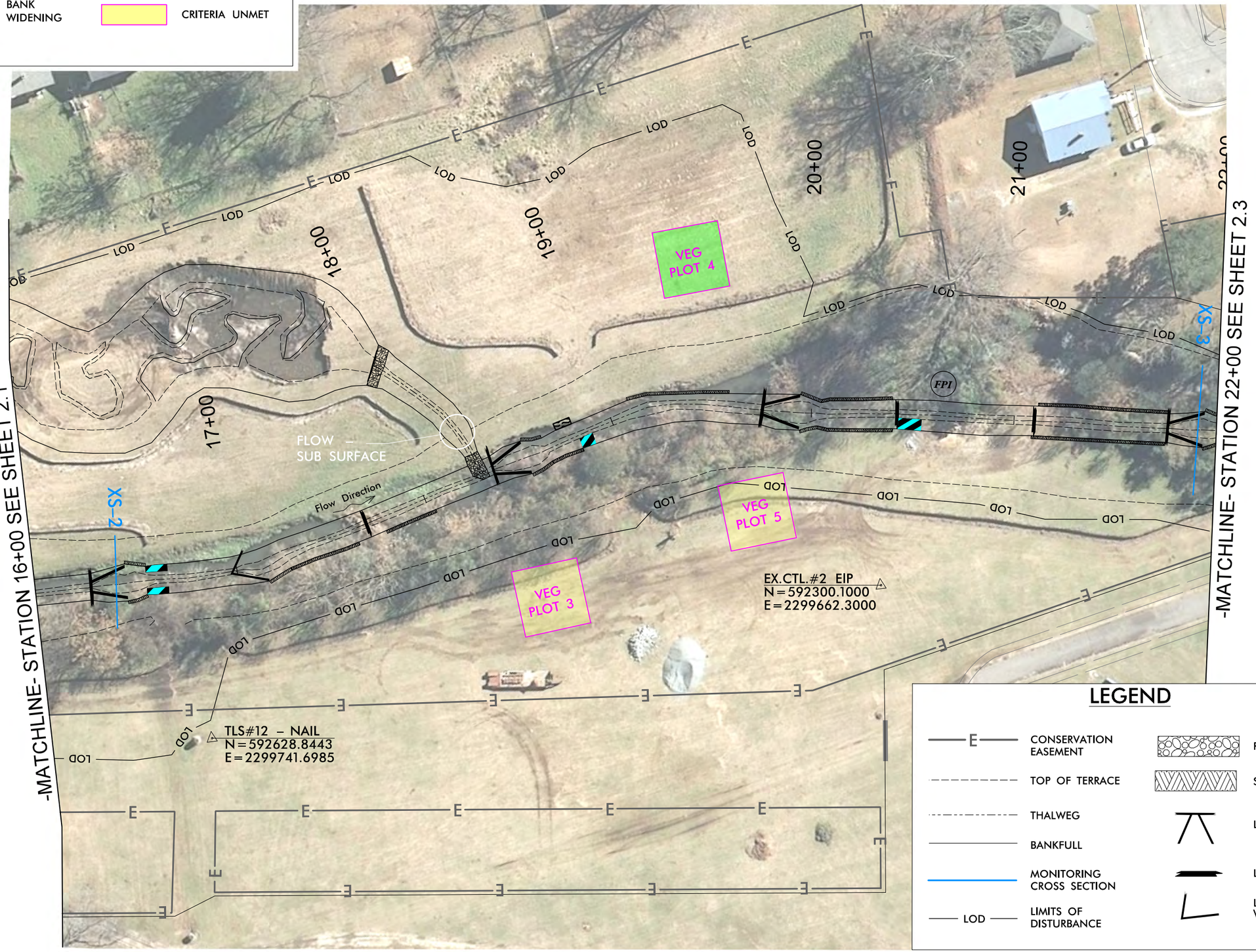
YEAR 4 CONDITIONS

BANK/BED CONDITION

- MINOR EROSION
- BANK WIDENING

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET



LEGEND

- CONSERVATION EASEMENT
- TOP OF TERRACE
- THALWEG
- BANKFULL
- MONITORING CROSS SECTION
- LIMITS OF DISTURBANCE
- RIP RAP
- SOIL LIFT AREA
- LOG CROSS VANE
- LOG SILL
- LOG VANE W/SILL

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UT TO NEUSE (BIG DITCH)
STREAM RESTORATION PROJECT
WAYNE COUNTY, NORTH CAROLINA
STA 16+00 – STA 22+00

GRAPHIC SCALE
50 0 25
PLANS

DATE: 10-05-16

CCPV YEAR 4

FIGURE 2.2

11/2/2016
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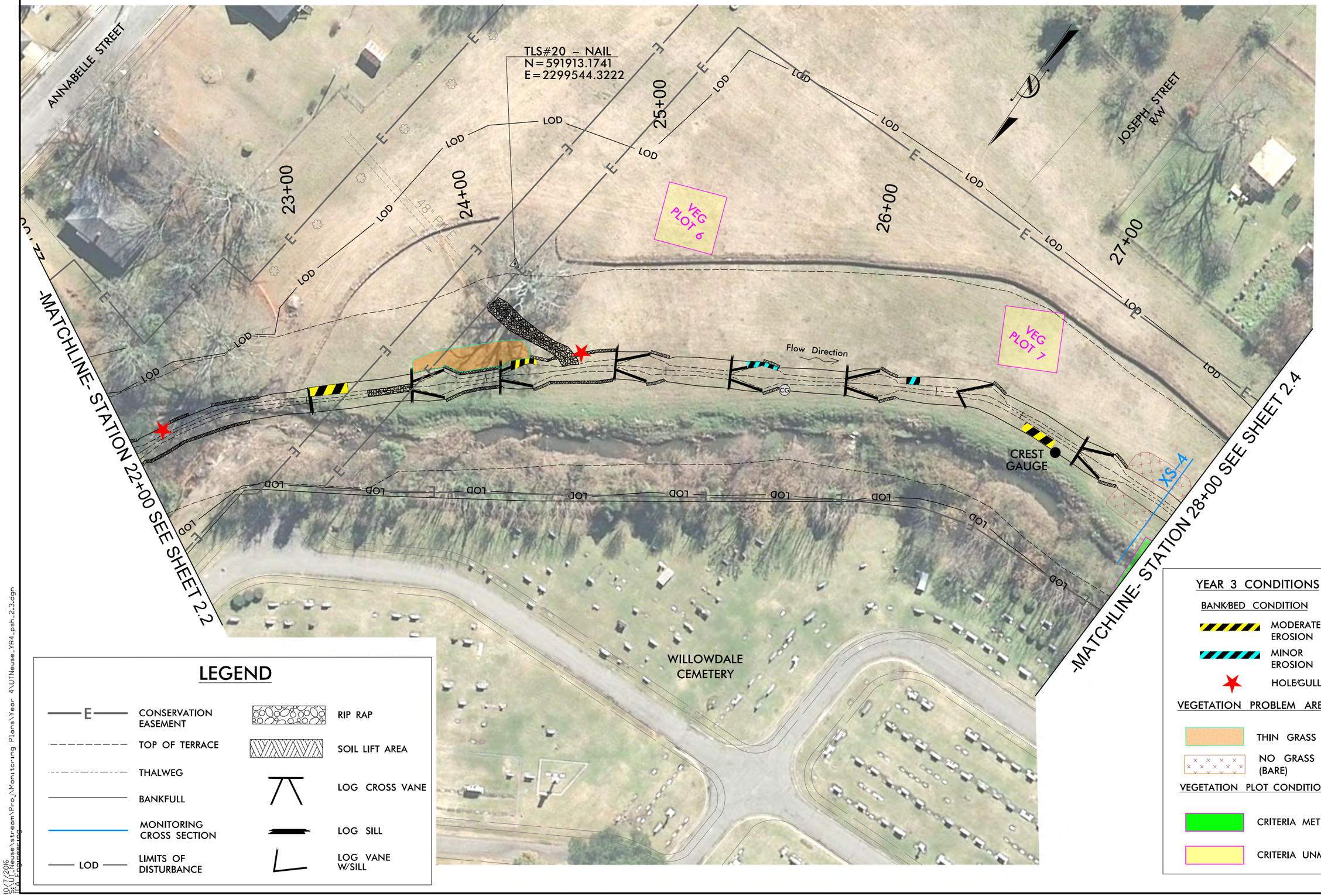
HDR Engineering

CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 3



LEGEND

E — CONSERVATION EASEMENT	RIP RAP
TOP OF TERRACE	SOIL LIFT AREA
THALWEG	LOG CROSS VANE
BANKFULL	LOG SILL
MONITORING CROSS SECTION	LOG VANE W/SILL
LOD — LIMITS OF DISTURBANCE	

YEAR 3 CONDITIONS

BANK/BED CONDITION

- MODERATE EROSION
- MINOR EROSION
- HOLE/GULLY

VEGETATION PROBLEM AREAS

- THIN GRASS
- NO GRASS (BARE)

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET

HDR | ICA

UT TO NEUSE (BIG DITCH)
STREAM RESTORATION PROJECT
WAYNE COUNTY, NORTH CAROLINA
STA 22+00 – STA 28+00

GRAPHIC SCALE
50 0 25
PLANS

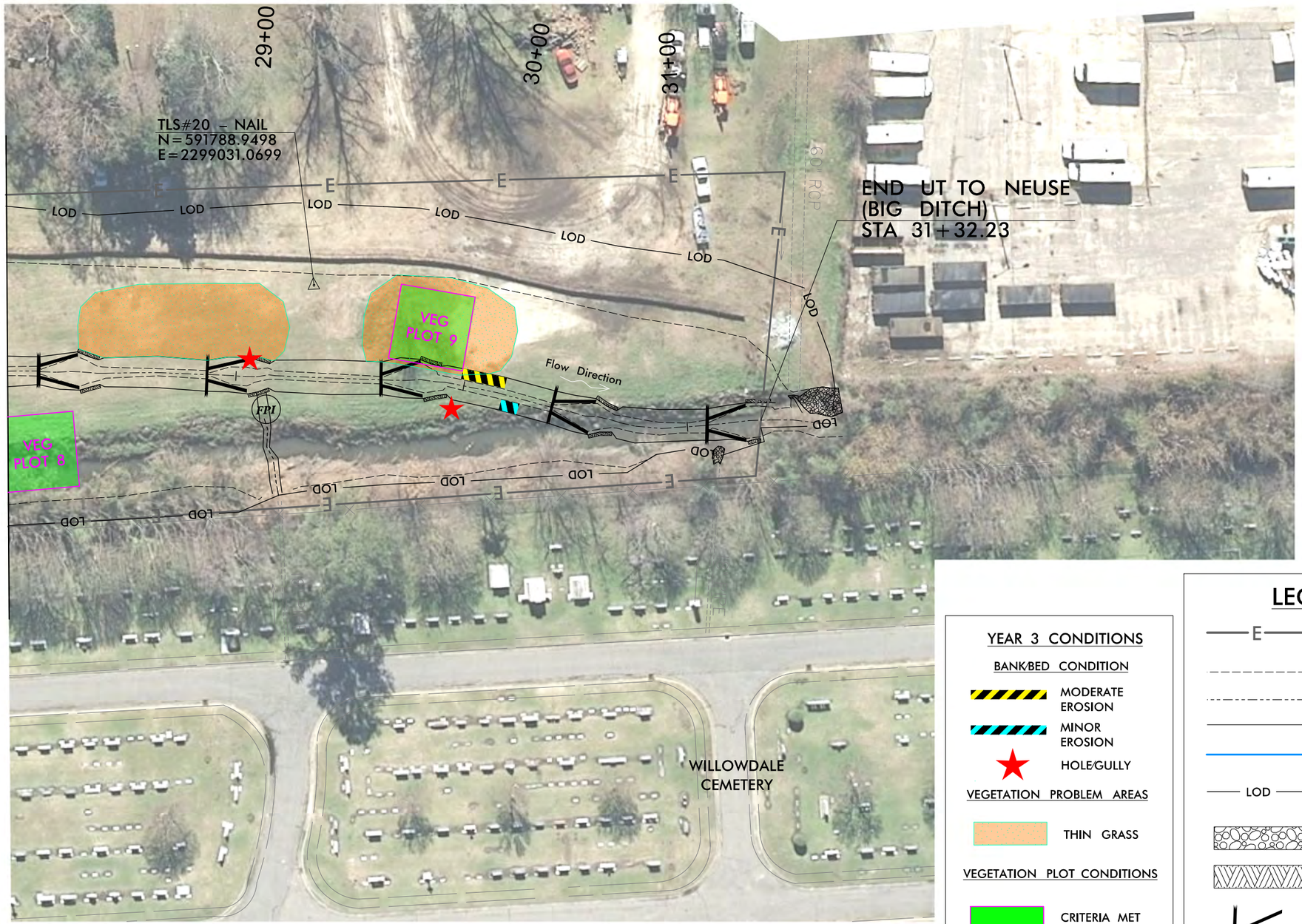
DATE: 10-05-16

CCPV
YEAR 4

FIGURE
2.3

10/7/2016
\\Ica-fs1\Neuse\stream\Proj\Monitoring Plans\Year 4\UTNeuse_YR4_psh_2.3.dgn
ICA Engineering

CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 3



YEAR 3 CONDITIONS

BANK/BED CONDITION

- MODERATE EROSION
- MINOR EROSION
- HOLE/GULLY

VEGETATION PROBLEM AREAS

- THIN GRASS

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET

LEGEND

- E — CONSERVATION EASEMENT
- TOP OF TERRACE
- THALWEG
- BANKFULL
- MONITORING CROSS SECTION
- LOD — LIMITS OF DISTURBANCE
- RIP RAP
- SOIL LIFT AREA
- LOG CROSS VANE

HDR | ICA

UT TO NEUSE (BIG DITCH)
STREAM RESTORATION PROJECT
WAYNE COUNTY, NORTH CAROLINA
STA 28+00 – STA 31+32.23

GRAPHIC SCALE
50 25 0 25
PLANS

DATE: 10-05-16

CCPV
YEAR 4

FIGURE
2.4

10/7/2016
SCI Engineering
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Table 5. Visual Stream Morphology Stability Assessment
UT to Neuse River Site, 09-0776201
UT to Neuse River : 2,132 feet

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	All	N/A			100%			
	3. Meander Pool Condition	1. Depth Sufficient	30	30			100%			
		2. Length appropriate	30	30			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	All	N/A			100%			
		2. Thalweg centering at downstream of meander (Glide)	All	N/A			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			18	292	92.69%	N/A	N/A	N/A
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT included undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	N/A	N/A	N/A
	3. Mass Wasting	Bank slumping, calving, or collaps			0	0	100%	N/A	N/A	N/A
				Totals	18	292	92.69%	N/A	N/A	N/A
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs	28	28			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	7	7			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	3	3			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	18	18			100%			
	4. Habitat	Pool forming structures maintaing ~ Max Pool Depth : Mean Bankfull Depth ratio > 1.6 Rootwads/logs providing some cover at base-flow.	21	21			100%			

Table 6. Vegetation Condition Assessment UT to Neuse River Site, 09-00776201 UT to Neuse River: 2,132 feet						
Planted Acreage = 9.1						
Vegetation Category	**Definitions**	**Mapping Threshold**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreage**	**% of Planted Acreage**
1. Bare Areas	Very limited ground cover (grass).	All bare or sparse areas were mapped.	See legend on CCPV (includes thin grass, no grass, and minor wash areas).	5	0.15	1.6
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	All areas were mapped.	Vegetation Plots 1, 2, 3, 5, 6, 7	6	0.14	1.40
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	None	N/A	N/A	N/A	N/A
Easement Acreage = 9.94 ac						
Vegetation Category	**Definitions**	**Mapping Threshold**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreadge**	**% of Planted Acreage**
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	None	N/A	N/A	N/A	N/A
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	None	N/A	N/A	N/A	N/A

Appendix C. Vegetation Plot Data

Figures 3.0-3.13. Vegetation Plot Photos and Problem Area Photos

3.0 Vegetation Plot 1

3.1 Vegetation Plot 2

3.2 Vegetation Plot 3

3.3 Vegetation Plot 4

3.4 Vegetation Plot 5

3.5 Vegetation Plot 6

3.6 Vegetation Plot 7

3.7 Vegetation Plot 8

3.8 Vegetation Plot 9

3.9 Minor Erosion Station 12+00

3.10 Moderate Erosion Station

3.11 Moderate Erosion Station 14+50

3.12 Gully Station 24+75

3.13 Moderate Erosion Station 30+00

Table 7. Vegetation Plot Mitigation Success Summary

UT Neuse (Big Ditch) (DMS Project ID No. 92682)						
Plot ID	**Community Type**	**Planting Zone ID**	**CVS Level**	**Planted Stems**	**Stems Per Acre**	**Survival Threshold Met?**
1	Coastal Plain Levee Forest	CPLF	II	4	162	No
2	Coastal Plain Levee Forest	CPLF	II	4	162	No
3	Coastal Plain Levee Forest	CPLF	II	2	81	No
4	Coastal Plain Levee Forest	CPLF	II	7	283	Yes
5	Coastal Plain Levee Forest	CPLF	II	7	283	No
6	Coastal Plain Levee Forest	CPLF	II	3	122	No
7	Coastal Plain Levee Forest	CPLF	II	6	243	No
8	Coastal Plain Levee Forest	CPLF	II	7	283	No*
9	Coastal Plain Levee Forest	CPLF	II	5	202	No*
				Average Stems Per Acre	202	

*Plots meet survival threshold when including natural recruits.

Table 8. CVS Vegetation Metadata

Report Prepared By	yvette t mariotte
Date Prepared	8/25/2016 12:36
database name	cvs-eep-entrytool-v2.3.1.mdb
database location	S:\UT_Neuse\Docs\Monitoring
computer name	NC12154
file size	60944384
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
Project Code	92682
project Name	UT NEUSE (BIG DITCH)
Description	STREAM AND RIPARIAN BUFFER MITIGATION
River Basin	Neuse
length(ft)	2127
stream-to-edge width (ft)	80
area (sq m)	31613.56
Required Plots (calculated)	9
Sampled Plots	9

Table 9. Stem Count Total and Planted by Plot and Species																							
EEP Project Code 92682. Project Name: UT NEUSE (BIG DITCH)																							
			Current Plot Data (MY3 2016)																				
			92682-ICA-0001			92682-ICA-0002			92682-ICA-0003			92682-ICA-0004			92682-ICA-0005			92682-ICA-0006			92682-ICA-0007		
Scientific Name	Common Name	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
Acer rubrum	red maple	Tree																					
Amelanchier	serviceberry	Tree																					
Betula nigra	river birch	Tree	1	1	1							1	1	1				1	1	1	1	1	1
Carya	hickory	Tree																					
Carya alba	mockernut hickory	Tree				1	1	1															
Chionanthus virginicus	white fringetree	Shrub	1	1	1																		
Cornus amomum	silky dogwood	Shrub																					
Fraxinus pennsylvanica	green ash	Tree				1	1	1	1	1	1												
Liquidambar styraciflua	sweetgum	Tree													4	4	4						
Liriodendron tulipifera	tuliptree	Tree				1	1	1	1	1	1				1	1	1				1	1	1
Ostrya	hophornbean	Tree																					
Pinus taeda	loblolly pine	Tree																					
Platanus occidentalis	American sycamore	Tree										1	1	1									
Quercus falcata	southern red oak	Tree			1																1	1	1
Quercus laurifolia	laurel oak	Tree	1	1	1																		
Quercus michauxii	swamp chestnut oak	Tree																					
Quercus myrtifolia	myrtle oak	Shrub																					
Quercus nigra	water oak	Tree																			1	1	1
Quercus pagoda	cherrybark oak	Tree				1	1	1				2	2	2				1	1	1	1	1	1
Quercus phellos	willow oak	Tree																			1	1	1
Quercus rubra	northern red oak	Tree	1	1	1							2	2	3	2	2	2	1	1	1			
Salix nigra	black willow	Tree										1	1	1									
	Stem count		4	4	5	4	4	4	2	2	2	7	7	8	7	7	7	3	3	3	6	6	6
	size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02			0.02		
	Species count		4	4	5	4	4	4	2	2	2	5	5	5	3	3	3	3	3	3	6	6	6
	Stems per ACRE		161.9	161.9	202.4	161.9	161.9	161.9	80.97	80.97	80.97	283.4	283.4	323.9	283.4	283.4	283.4	121.5	121.5	121.5	242.9	242.9	242.9

Color for Density

Exceeds requirements by more than 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

PnoLS = Planted excluding livestakes

P-all = Planting including livestakes

T = All planted and natural recruits including livestakes

T includes natural recruits

Table 9. Continued

EEP Project Code 92682. Project Name: UT NEUSE (BIG DITCH)

											Annual Means									
			92682-ICA-0008			92682-ICA-0009			MY3 (2016)			MY2 (2015)			MY1 (2014)			MY0 (2014)		
Scientific Name	Common Name	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
Acer rubrum	red maple	Tree												0.22						
Amelanchier	serviceberry	Tree																0.11	0.11	0.11
Betula nigra	river birch	Tree	1	1	1			1	0.67	0.67	0.67	0.33	0.33	0.44	0.67	0.67	0.67	0.89	0.89	0.89
Carya	hickory	Tree															0.33			
Carya alba	mockernut hickory	Tree	2	2	3				0.33	0.33	0.44	0.33	0.33	0.44	1.00	1.00	1.00	1.44	1.44	1.44
Chionanthus virginicus	white fringetree	Shrub							0.11	0.11	0.11	0.11	0.11	0.11				0.11	0.11	0.11
Cornus amomum	silky dogwood	Shrub												0.56						
Fraxinus pennsylvanica	green ash	Tree							0.22	0.22	0.22	0.11	0.11	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Liquidambar styraciflua	sweetgum	Tree						2	0.44	0.44	0.67			0.11						
Liriodendron tulipifera	tuliptree	Tree							0.44	0.44	0.44	0.78	0.78	1.00	1.56	1.56	1.56	1.89	1.89	1.89
Ostrya	hophornbean	Tree																0.11	0.11	0.11
Pinus taeda	loblolly pine	Tree			5			1			0.67									
Platanus occidentalis	American sycamore	Tree							0.11	0.11	0.11	0.33	0.33	0.33	0.33	0.33	0.44	0.56	0.56	0.56
Quercus falcata	southern red oak	Tree							0.11	0.11	0.22									
Quercus laurifolia	laurel oak	Tree	1	1	1				0.22	0.22	0.22									
Quercus michauxii	swamp chestnut oak	Tree				1	1	1	0.11	0.11	0.11									
Quercus myrtifolia	myrtle oak	Shrub																		
Quercus nigra	water oak	Tree				3	3	3	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.89	0.89	0.89
Quercus pagoda	cherrybark oak	Tree	1	1	1				0.89	0.89	0.89	0.67	0.67	0.78	0.89	0.89	0.89	1.00	1.00	1.00
Quercus phellos	willow oak	Tree			2	1	1	1	0.89	0.89	1.00	0.22	0.22	0.56	0.22	0.22	0.22			
Quercus rubra	northern red oak	Tree	2	2	2				0.89	0.89	1.00	1.33	1.33	1.33	1.78	1.78	1.78	2.33	2.33	2.33
Salix nigra	black willow	Tree							0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11			
	Stem count		7	7	15	5	5	9	5.00	5.00	6.55	4.78	4.78	6.78	7.33	7.33	7.78	9.67	9.67	9.67
	size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02		
	Species count		5	5	7	3	3	6	15	15	16	11	11	14	10	10	11	11	11	11
	Stems per ACRE		283.4	283.4	607.3	202.4	202.4	364.4	202.4	202.4	327.5	238.9	238.9	338.9	366.7	366.7	388.9	483.33	483.33	483.3

Color for Density

Exceeds requirements by more than 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

PnoLS = Planted excluding livestakes

P-all = Planting including livestakes

T = All planted and natural recruits including livestakes

T includes natural recruits

Appendix D. Stream Survey Data
Figure 4.0-4.3 Cross Section Plots

Figure 4.0

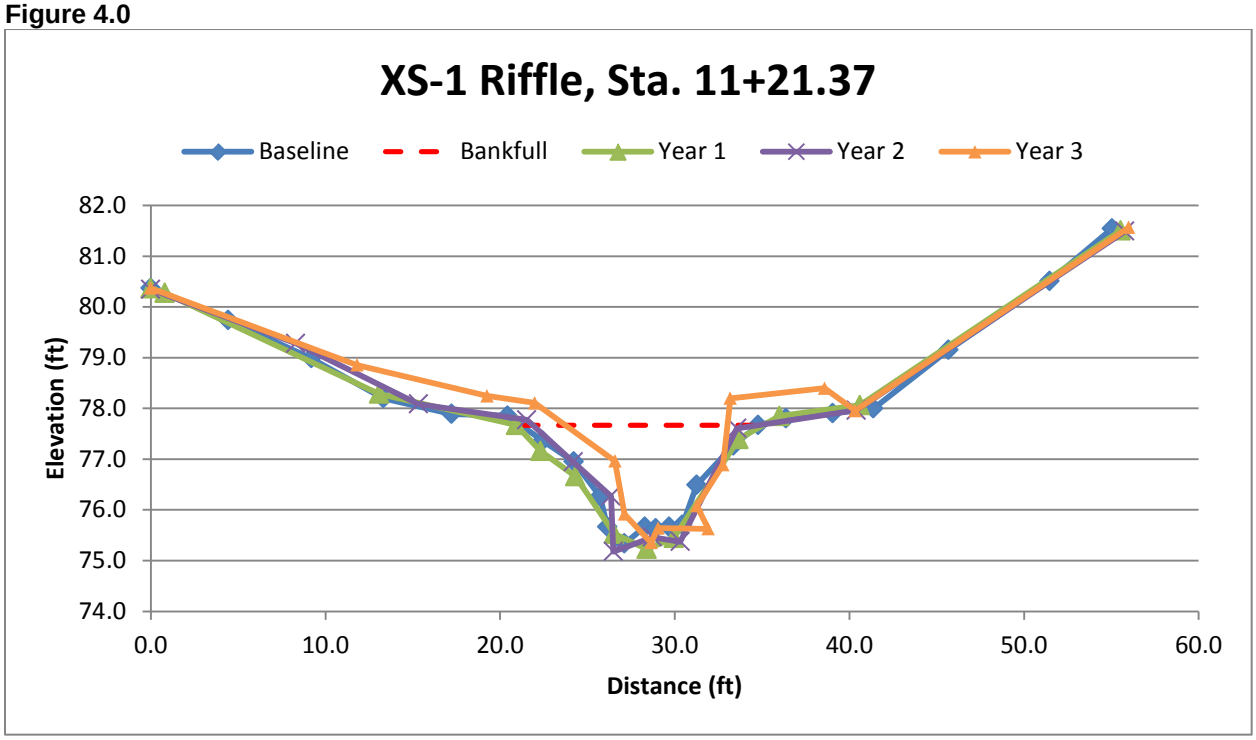
XS-1 Riffle, Sta. 11+21.37
Baseline
Bankfull
Year 1
Year 2
Year 3
82.0
81.0
80.0
79.0
78.0
77.0
76.0
75.0
74.0
Elevation (ft)
0.0
10.0
20.0
30.0
40.0
50.0
60.0
Distance (ft)

Figure 4.1

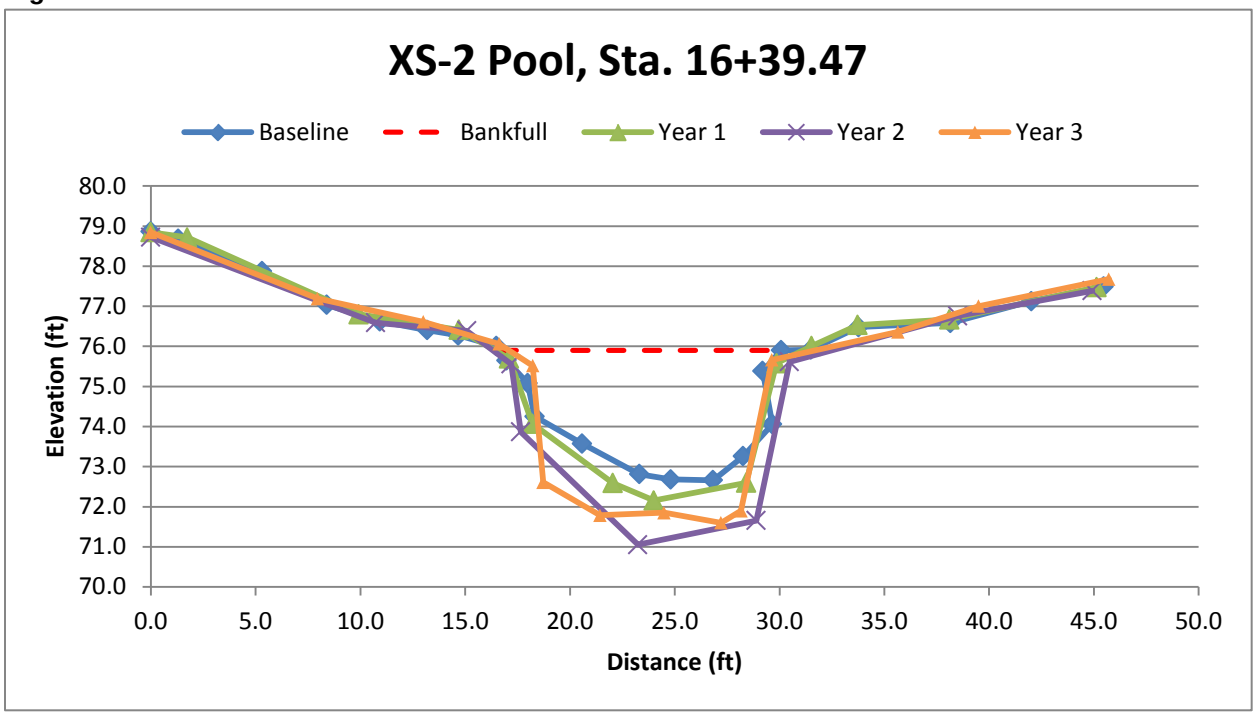
XS-2 Pool, Sta. 16+39.47
Baseline
Bankfull
Year 1
Year 2
Year 3
Elevation (ft)
80.0
79.0
78.0
77.0
76.0
75.0
74.0
73.0
72.0
71.0
70.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
Distance (ft)

Figure 4.2

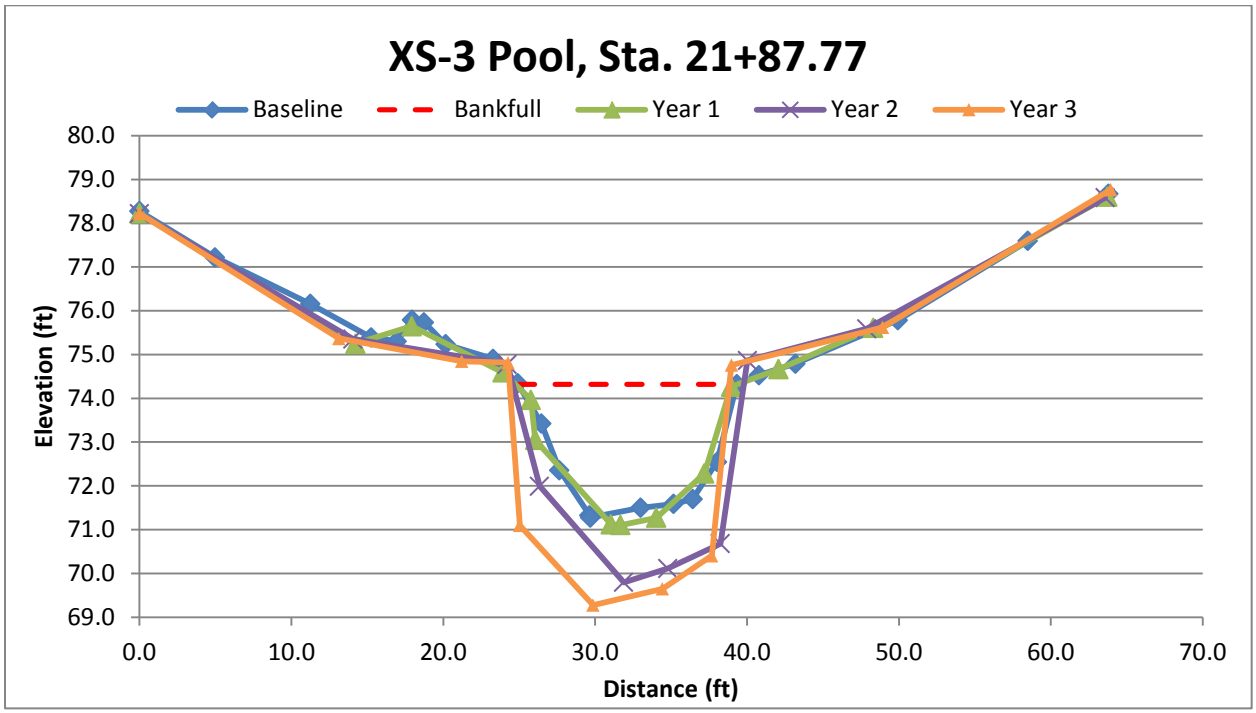
XS-3 Pool, Sta. 21+87.77
Baseline
Bankfull
Year 1
Year 2
Year 3
80.0
79.0
78.0
77.0
76.0
75.0
74.0
73.0
72.0
71.0
70.0
69.0
Elevation (ft)
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
Distance (ft)

Figure 4.3

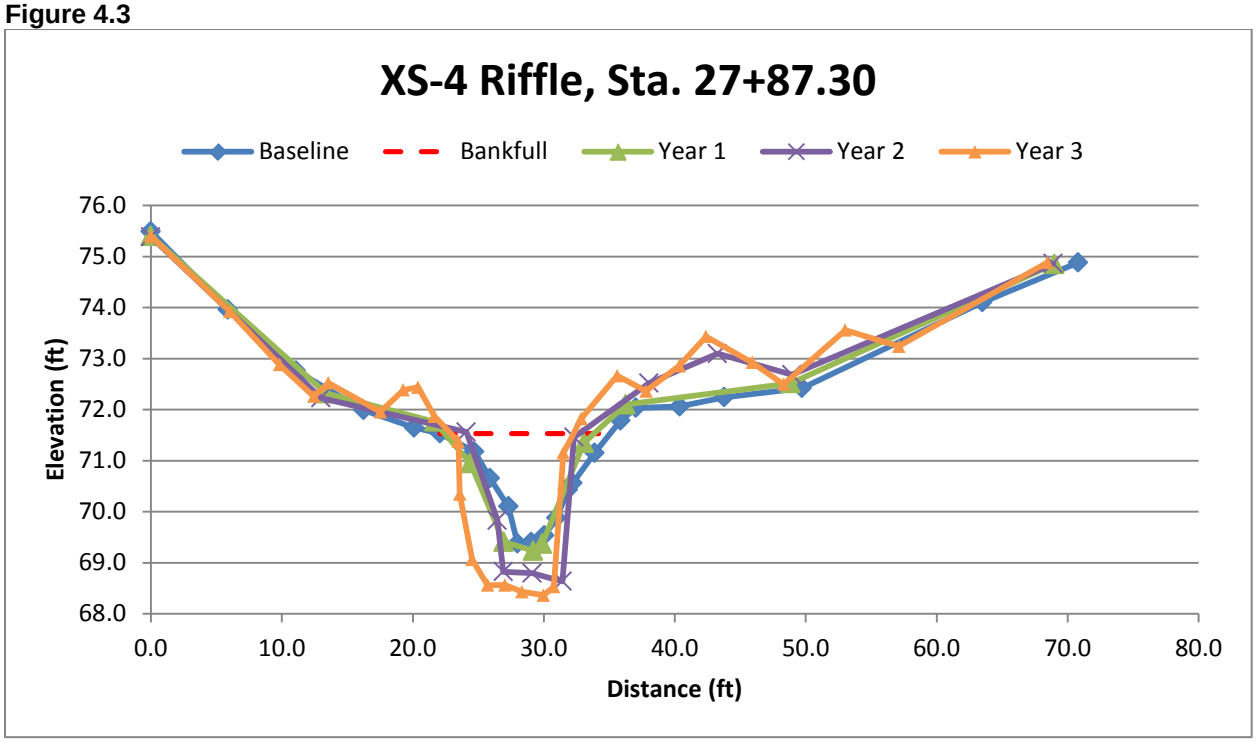
XS-4 Riffle, Sta. 27+87.30
Baseline
Bankfull
Year 1
Year 2
Year 3
Elevation (ft)
76.0
75.0
74.0
73.0
72.0
71.0
70.0
69.0
68.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
Distance (ft)

Figure 5.1-5.2 Longitudinal Profile Plot

Figure 5.1 UT Neuse - Longitudinal Profile

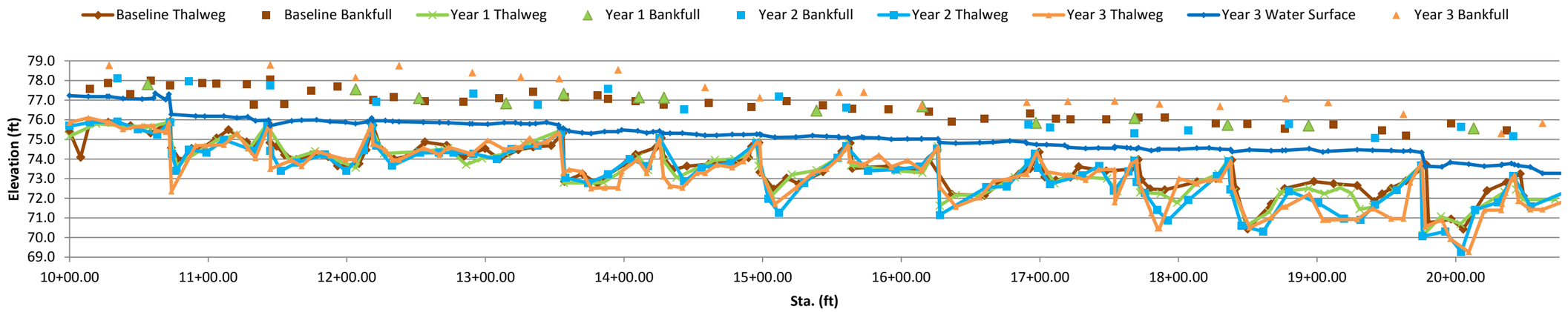

Figure 5.2 UT Neuse - Longitudinal Profile

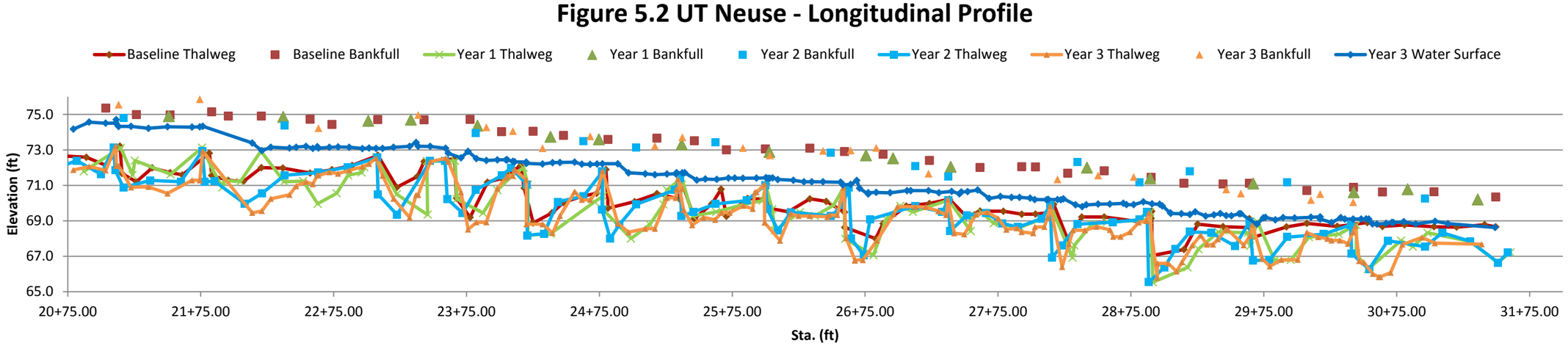

Table 10. Baseline Stream Data Summary
UT Neuse (Big Ditch), DMS Project ID No. 92682
UT Neuse: 2,132 LF

Parameter	Regional Curve			Pre-Existing Condition	Reference - Johnson Mill	Design	As-built/Baseline					
Dimension and Substrate - Riffle	Eq.			Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	14.20			8.90	21.20	14.00	13.00	13.30	13.30	13.60	0.42	2
Floodprone Width (ft)				16.60	34.90	36.00	46.70	49.85	49.85	53.00	4.45	2
Bankfull Mean Depth (ft)	1.60			1.01	2.25	1.17	1.00	1.10	1.10	1.20	0.14	2
Bankfull Max Depth (ft)				1.43	2.42	1.75	2.20	2.25	2.25	2.30	0.07	2
Bankfull Cross Sectional Area (ft^2)	23.30			9.02	47.59	16.30	13.00	14.30	14.30	15.60	1.84	2
Width/Depth Ratio				8.90	9.40	12.00	11.80	12.40	12.40	13.00	0.85	2
Entrenchment Ratio				1.85	1.65	2.60	3.40	3.75	3.75	4.10	0.49	2
Bank Height Ratio				5.80	1.00	1.00	1.00	1.00	1.00	1.00	0.00	2
d50 (mm)				sand	sand	sand						
Profile												
Riffle Length (ft)							38.64	59.42	60.26	82.92	16.99	8
Riffle Slope (ft/ft)				0.0100	0.0010	0.0021	0.0014	0.0021	0.0020	0.0034	0.0007	8
Pool Length (ft)							28.34	48.34	52.08	73.96	12.02	25
Pool Max depth (ft)				1.50	3.56	2.33	2.78	3.86	3.79	5.14	0.64	25
Pool Spacing (ft)				23.14-86.74	91.07-129.97	56.0-84.0	22.39	79.14	73.37	155.21	29.55	24
Pool Cross Sectional Area (ft^2)							31.10	31.15	31.15	31.20	0.07	2
Pattern												
Channel Beltwidth (ft)				Channelized	50-1500	28-980						
Radius of Curvature (ft)				Channelized	43-235	42-70						
Rc: Bankfull Width (ft/ft)				Channelized	2.0-11.1	3.0-5.0						
Meander Wavelength (ft)				Channelized	250-400	140-280						
Meander Width Ratio				Channelized	2.36-70.85	2.0-70.0						
Substrate, bed and transport parameters												
Ri% / P%							36%/46%					
SC% / Sa% / G% / C% / B% / Be%												
d16 / d35 / d50 / d84 / d95/ di^p / di^{sp} (mm)												
Reach Shear Stress (competency) lb/ft^2				0.282	0.116	0.113						
Max part size (mm) mobilized at bankfull												
Unit Stream Power (transport capacity) lbs/ft.s				0.964	0.200	0.193	0.223					
Additional Reach Parameters												
Drainage Area (SM)				2.05	13.50	2.05						
Impervious cover estimate (%)												
Rosgen Classification				G/B 5	B5	B/E 5	E5					
Bankfull Velocity (fps)					1.50	1.70	1.75					
Bankfull Discharge (cfs)				25.00	80.90	25.00	25.00					
Valley length (ft)				2106		2106.00	2106.00					
Channel Thalweg length (ft)				2113		2128.00	2150.00					
Sinuosity (ft)				1.00	1.10	1.01	1.02					
Water Surface Slope (Channel) (ft/ft)				0.0055	0.0010	0.0017	0.0044					
BF slope (ft/ft)						0.0017	0.0044					
Bankfull Floodplain Area (acres)												
Proportion over wide (%)												
Entrenchment Class (ER Range)												
Incision Class (BHR Range)												
BEHI VL% / L% / M% / H% / VH% / E%												
Channel Stability or Habitat Metric												
Biological or Other												

Table 11. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross Section)
UT Neuse (Big Ditch) (DMS Project No. 92682)
UT Neuse: 2,132 LF

	Cross Section 1 (Riffle)							Cross Section 2 (Pool)						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation[1]														
Bankfull Width (ft)	13.60	14.14	11.54	9.32				13.40	15.42	13.42	14.59			
Floodprone Width (ft)	46.70	47.68	47.07	45.90				45.50	45.13	44.92	45.72			
Bankfull Mean Depth (ft)	1.20	1.28	1.33	1.30				2.30	2.45	3.37	2.90			
Bankfull Max Depth (ft)	2.30	2.44	2.43	2.31				3.20	3.85	4.56	4.30			
Bankfull Cross Sectional Area (ft^2)	15.60	18.09	15.37	12.11				31.10	37.82	45.2	42.34			
Bankfull Width/Depth Ratio	11.80	11.05	8.68	7.17				5.80	6.29	3.98	5.03			
Bankfull Entrenchment Ratio	3.40	3.37	4.08	4.93				3.40	2.93	3.35	3.13			
Bankfull Bank Height Ratio	1.00	1.00	1.00	1.11				1.00	1.00	1.00	1.00			
	Cross Section 3 (Pool)							**Cross Section 4 (Riffle)**						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation[1]														
Bankfull Width (ft)	14.40	17.55	17.45	14.45				13.00	13.24	8.09	8.94			
Floodprone Width (ft)	53.10	60.27	63.58	63.94				53.00	59.47	59.04	64.26			
Bankfull Mean Depth (ft)	2.20	2.00	3.37	4.11				1.00	1.30	2.00	2.44			
Bankfull Max Depth (ft)	3.00	3.49	5.07	5.04				2.20	2.53	2.82	3.16			
Bankfull Cross Sectional Area (ft^2)	31.20	35.19	58.73	59.38				13.00	17.22	16.20	21.80			
Bankfull Width/Depth Ratio	6.60	8.78	5.18	3.52				13.00	10.18	4.04	3.66			
Bankfull Entrenchment Ratio	3.70	3.43	3.64	4.43				4.10	4.49	7.30	7.19			
Bankfull Bank Height Ratio	1.00	1.00	1.00	1.04				1.00	1.00	1.00	1.00			

1 = Widths and depths for each resurvey will be based on the baseline bankfull datum regardless of dimensional/depositional development.

Table 12. Monitoring Data - Stream Reach Data Summary

UT to Neuse River Site, DMS Project No. 92682

UT Neuse: 2,132 LF

Parameter	Baseline			MY-1			MY-2			MY-3			MY-4			MY-5		
Dimension and substrate - Riffle only	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	13.00	13.30	13.60	13.24	13.69	14.14	8.09	9.82	11.54	8.94	9.13	9.32						
Floodprone Width (ft)	46.70	49.85	53.00	47.68	53.58	59.47	47.07	53.06	59.04	45.90	55.08	64.26						
Bankfull Mean Depth (ft)	1.00	1.10	1.20	1.28	1.29	1.30	1.33	1.67	2.00	1.30	1.87	2.44						
Bankfull Max Depth (ft)	2.20	2.25	2.30	2.44	2.49	2.53	2.43	2.63	2.82	2.31	2.74	3.16						
Bankfull Cross Sectional Area (ft^2)	13.00	14.30	15.60	17.22	17.66	18.09	15.37	15.79	16.20	12.11	16.96	21.80						
Bankfull Width/Depth Ratio	11.80	12.40	13.00	10.18	10.62	11.05	4.04	6.36	8.68	3.66	5.42	7.17						
Bankfull Entrenchment Ratio	3.40	3.75	4.10	3.37	3.93	4.49	4.08	5.69	7.30	4.93	6.06	7.19						
Bankfull Bank Height Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.06	1.11						
Profile																		
Riffle Length (ft)	38.64	59.42	82.92	11.51	18.03	50.98	19.83	30.74	41.18	5.92	28.20	73.01						
Riffle Slope (ft/ft)	0.0014	0.0021	0.0034	0.01	0.02	0.02	0.01	0.04	0.07	0.01	0.01	0.02						
Pool Length (ft)	28.34	48.34	73.96	42.65	74.83	139.02	27.97	56.61	109.40	60.19	74.91	139.12						
Pool Max Depth (ft)	2.78	3.86	5.14	1.17	2.64	4.10	4.56	4.82	5.07	3.53	4.78	6.12						
Pool Spacing (ft)	22.39	79.14	155.21	47.39	79.56	178.52	43.76	70.24	125.53	67.09	81.96	140.11						
Pattern																		
Channel Beltwidth (ft)	36.50	48.58	79.96															
Radius of Curvature (ft)	143.00	160.16	171.56															
Rc:Bankfull Width (ft/ft)	14.79	18.06	23.16															
Meander Wavelength (ft)	201.80	263.54	346.54															
Meander Width Ratio	2.41	3.33	5.34															
Additional Reach Parameters																		
Rosgen Classification	E5			E5			E5			E5								
Channel Thalweg length (ft)	2,161			2,144			2,132			2,149								
Sinuosity (ft)	1.03			1.03			1.03			1.03								
Water Surface Slope (Channel) (ft/ft)	0.00442			0.00348			0.0035			0.0033								
BF slope (ft/ft)	0.00436			0.00357			0.0037			0.0034								
[3]Ri% / P%	36 / 64			32 / 68			42 / 58			36/64								
[3]SC% / Sa% / G% / C% / B% / Be%																		
[3]d16 / d35 / d50 / d84 / d95																		
[2]% of Reach with Eroding Banks																		
Channel Stability or Habitat Metric																		
Biological or Other																		

Shaded cells indicate that these will typically not be fille in.

1 = The distributions for these paramenters can include information from both thte cross-section surveys and the longitudinal profile.

2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table

3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

4 = Of value/needed only if the n exceeds 3

Appendix E. Hydrologic Data

Table 13. Verification of Bankfull Events

Date	Crest Gauge Info		Gauge Reading (ft)	Gauge Elevation (ft)	Crest Elevation (ft)	Bankfull Elevation (ft)	Height above Bankfull (ft)	Photo
	Site	Sta.						
4/28/2014	XS 4	26+00	1.46	70.8	72.26	71.53	0.73	6.1
8/20/2014	XS 4	26+00	3.04	70.8	73.84	71.53	2.31	6.2
3/13/2015	XS 4	26+00	Visual	Visual	Visual	Debris lines above bankfull	Debris lines above bankfull	6.3
9/02/2015	XS 4	26+00	3.77	70.8	74.57	71.53	3.04	6.4
2/26/2016	XS 4	26+00	Visual	Visual	Visual	Crest gauge damaged by high flow	Crest gauge damaged by high flow	6.5
8/11/2016	XS 4	26+00	3.77	70.8	74.57	71.53	3.04	6.6

Figure 6.1–6.6 Crest Gauge Photos

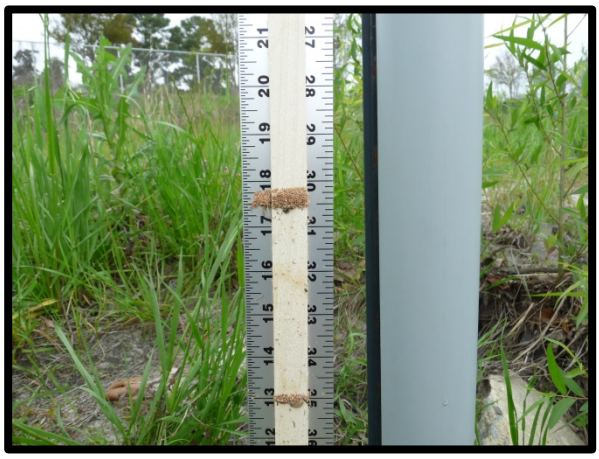

Figure 6.1 Crest Gauge 8/20/2014

Figure 6.2 Crest Gauge 4/28/2014

Figure 6.3 Crest Gauge 3/13/2015

Figure 6.4 Crest Gauge 9/02/2015

Figure 6.5 Damaged Crest Gauge 2/26/2016

Figure 6.6 Crest Gauge 8/11/2016