# CUTAWHISKIE CREEK STREAM AND WETLAND RESTORATION SITE
# 2009 ANNUAL MONITORING REPORT (YEAR 2)

**HERTFORD COUNTY, NORTH CAROLINA**
**NCEEP CONTRACT NO. D06066-A**

**PREPARED FOR:**
**NCDENR – ECOSYSTEM ENHANCEMENT PROGRAM**
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## 1.0 EXECUTIVE SUMMARY

The Cutawhiskie Creek Restoration Site (hereafter referred to as the "Site") was constructed for the North Carolina Ecosystem Enhancement Program (EEP) to provide compensatory stream and wetland mitigation in the Chowan River Basin. This restoration project is located on an unnamed tributary (UT) to Cutawhiskie Creek on a 23.9 acre Site located in Hertford County (Figure 1). The project includes stream restoration (Priority 1) and preservation, as well as riparian wetland restoration and enhancement.

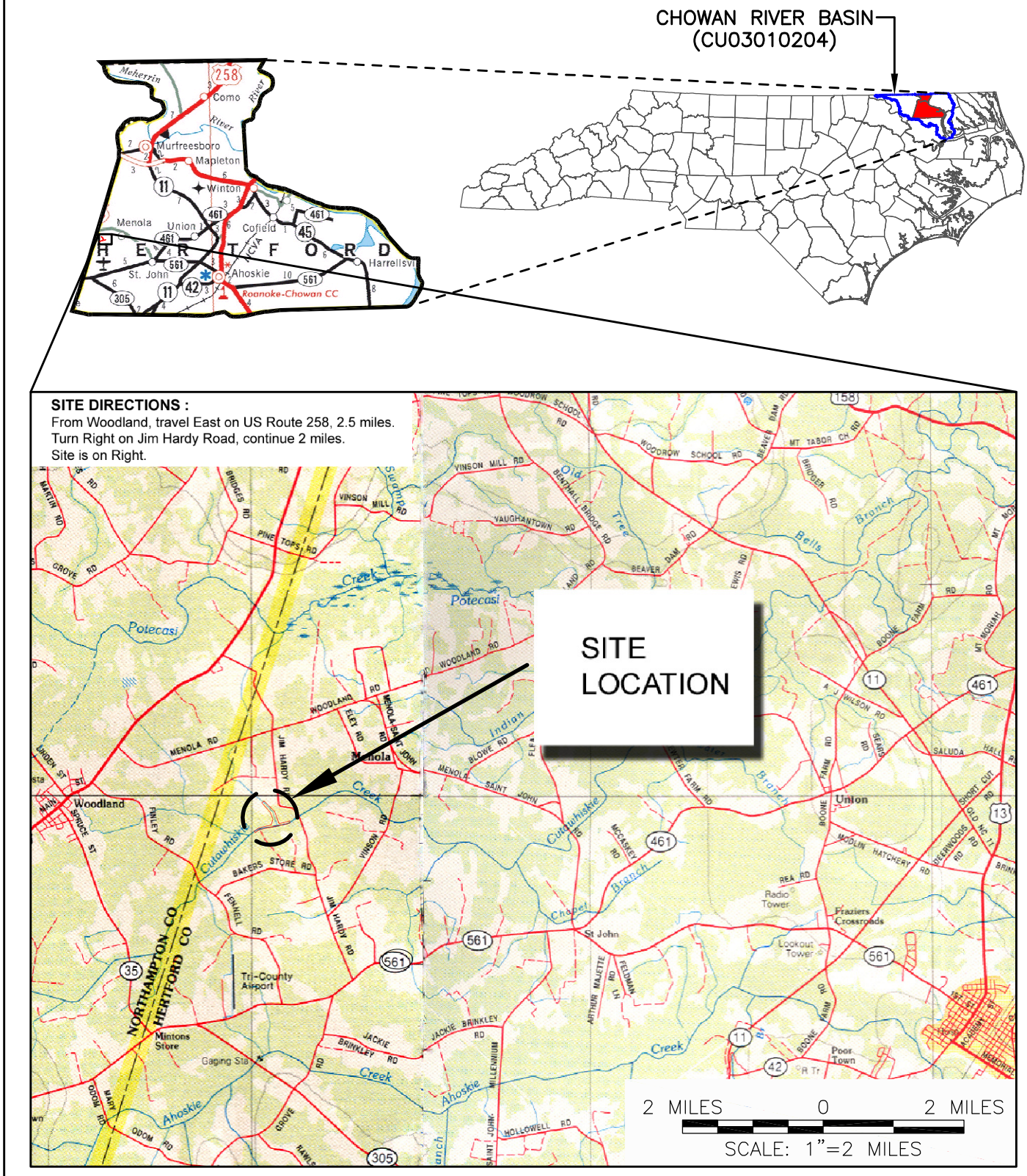
The following report summarizes the monitoring activities that have occurred in the second year of project monitoring (2009) at the Site. Site construction began and was completed in November 2007. As-built surveys for the Site were performed in February 2008, and first year monitoring was conducted throughout the growing season of 2008. The Site must demonstrate vegetative and hydrologic success criteria and a stable restored stream channel for a minimum of five years or until the Site is deemed successful. The following paragraphs summarize the results of the 2009 monitoring.

**Vegetation Monitoring**
Vegetation monitoring for Year 2 was performed based on the Carolina Vegetation Survey (CVS) Levels 1 and 2 (Lee et al. 2006). CVS methodology determines density and survival of planted species, and individuals resulting from natural regeneration. Plot locations are shown in Figures 2A and 2b (Appendix D) and are 10m x 10m each. The taxonomic standard for vegetation follows *Flora of the Carolinas, Virginia, Georgia, and surrounding areas* (Weakley, 2007).

Vegetative monitoring success will be achieved by plot data indicating an average number of planted stems per acre exceeding 320 stems/acre after the third year of monitoring and 260 stems/acre after the fifth and final year of project monitoring. Based on Year 2 surveys, the average count of the surviving planted species is 599 stems per acre. If volunteer species are included, the total number of stems increases to 3861 stems per acre. The Site meets and exceeds the established success criteria for vegetation based on the survival of the planted species.

**Stream Monitoring**
Success criteria for the restored stream reach has been established to confirm that no significant changes have occurred to the dimension, pattern, profile, and bed material over the 5-year monitoring period. Location surveys of the constructed features were conducted to verify the performance of the stream. A total station survey was performed to describe the stream longitudinal profile and six permanent stream cross-sections (3 riffles and 3 pools). Overall, the stream channel bed form and banks are stable. Based on the cross-sections, longitudinal profile and visual observations, the channel dimensions have not changed compared to as-built conditions.

**Wetland Hydrology Monitoring**
The 2009 hydrologic monitoring results indicate moderate hydrologic success within the Site. Two of the on-Site gauges (Gauges 3 and 4) exhibited saturation within 12 inches of the ground surface for at least 12.5 percent (consecutive days) of the growing season (March 28 – November 7 or 225 days). Gauges 1 and 5 exhibited saturation within 12 inches of the ground surface for 5 to 12.5 percent of the growing




| | | | |
|---|---|---|---|
| Prepared by: EcoScience, A division of PBS&J | Project: SITE LOCATION<br>CUTAWHISKIE CREEK RESTORATION SITE MONITORING REPORT YEAR-1<br>Hertford County, North Carolina | Dwn. By: TAL / Ckd By: JWG<br>Date: NOV 2008<br>Scale: AS SHOWN<br>ESC Project No.: 06-306 | FIGURE 1 |

season. Due to the unsuccessful results of Gauge 2 this year (saturation within 12 inches of the ground surface for less than 5 percent of the growing season) and last year, the gauge will be moved. Gauge 2 is believed to be influenced by its close proximity to the stream channel and the subsequent lowering of ground water levels. A new location further from the stream channel will eliminate any dewatering influence the stream might have towards the water table. The new location of Gauge 2 will be established prior to the beginning of the 2010 (Year 3) growing season and will be included in the 2010 monitoring report.

## 2.0 PROJECT BACKGROUND

### 2.1 Project Objectives

Site restoration activities included the excavation of a new stream channel, limited floodplain excavation, removal of stumps and debris, existing channel backfilling, on-Site drainage ditch removal, and final grading and soil preparation within the adjacent floodplain. These activities were proposed to reintroduce surface water flood hydrodynamics from a 0.9-square mile watershed along the newly restored length of stream and floodplain. The new channel was constructed to reflect regional stream characteristics and accommodate bankfull flows. Characteristic wetland soil features, groundwater wetland hydrology, and hydrophytic vegetation communities are expected develop in areas adjacent to the constructed channel. Wetland and adjacent slope soil surfaces were restored and the Site reforested to riparian and upland slope hardwood communities. Plant community associations were designed to mimic various communities described by Schafale and Weakley (1990), including Coastal Plain Levee Forest, Cypress-Gum Swamp, Mesic–Mixed Hardwood Forest, and Coastal Plain Small Stream Swamp.

Specific ecological benefits anticipated as a result of on-Site restoration activities are as follows:

- Stream channel restoration will reintroduce stable bankfull dimension, pattern, and profile along restored stream reaches, which is expected to greatly enhance lotic habitat quality and stream function.
- Floodplain excavation adjacent to restored streams will restore the characteristic flood regime as well as provide a lateral hydrologic input to restored wetland areas adjacent to the UT and within the greater Cutawhiskie Creek floodplain.
- Restored and enhanced wetland areas will help to improve water quality via nutrient removal, increase local vegetative biodiversity, provide wildlife habitat, and serve as a forested corridor, linking the Site with adjacent forested areas.

### 2.2 Project Structure, Restoration Type, and Approach

The primary restoration features within the Site include the UT to Cutawhiskie Creek and approximately 12.9 acres of drained, hydric soils. The UT has been dredged and straightened, such that it no longer retained stable dimension, pattern, and profile. Side-cast material (spoil piles) from dredging was deposited along the west bank of the channel. A moderate headcut (approximately 2 foot drop in elevation over 20 linear feet of stream channel) was observed near the upstream (north) extent of the Site boundary, indicating vertical instability. Due to its high level of entrenchment because of dredging/incision, large flooding events were confined within the channel at its current dimension.

On-Site restoration activities provide the following project mitigation units:

| Table I: Project Restoration Components<br>Cutawhiskie Creek Restoration Site – EEP Contract No. D06066-A | | | | | |
|---|---|---|---|---|---|
| **Project Segment or Reach ID** | **Mitigation Type** | **Approach** | **Mitigation Units Linear Footage (LF) or Acreage (AC)** | **Stationing** | **Comment** |
| UT to Cutawhiskie Creek (active restoration) | R | P1 | 2,540 LF | 0+00 – 25+40 | |
| UT to Cutawhiskie Creek (passive restoration) | R | NA | 359 LF | NA | Passive restoration through floodplain not stationed. Braided reach measured as straight line distance |
| Stream Preservation (Cutawhiskie Creek) | P | NA | 519 LF | NA | 2593 LF actual design units, however only 20 percent is available for SMU |
| Riparian Wetland Restoration | R | NA | 11.9 AC | NA | |
| Riparian Wetland Enhancement | WE | NA | 0.6 AC | NA | 1.1 AC actual design units, however only 0.6 LF available as WMU |
| *R = Restoration*<br>*P = Preservation*<br>*WE = Wetland Enhancement* | | | *P1 = Priority 1*<br>*NA = Not applicable* | | |

## 2.3 Location and Setting

Land uses in the vicinity of the Site consist primarily of agriculture, forest, pastureland, roadside shoulders, and residential lots. Row crops including soybeans, cotton, and corn were actively cultivated on the Site and surrounding areas. The Site is immediately adjacent to a farm and timberland. There is no livestock or poultry production in the vicinity. Timber is actively harvested from adjacent forested areas. A large, contiguous bottomland hardwood stand was harvested just west of the Site along the Cutawhiskie floodplain in the spring of 2006. The Site encompasses approximately 23.9 acres of primary and secondary floodplain associated with Cutawhiskie Creek. The Site includes a UT that flows into Cutawhiskie Creek from the north (Figure 1). Portions of the Site had been logged prior to restoration activities, while other areas within the Site were actively managed for timber or agricultural production. Prior to restoration, the Site vegetation was generally characterized by bottomland hardwood forests along un-logged areas on the Cutawhiskie Creek floodplain and low terraces, row crops including soybeans and corn, and successional communities associated with cut-over timberland.

## 2.4 History and Background

| Table II. Project Activity and Reporting History<br>Cutawhiskie Creek Restoration Site – EEP Contract No. D06066-A | | | |
|---|---|---|---|
| **Activity Report** | **Scheduled Completion** | **Data Collection Complete** | **Actual Completion or Delivery** |
| Restoration Plan | N/A* | December 2007 | January 2007 |
| Final Design (90%) | N/A* | December 2007 | January 2007 |
| Construction | N/A* | N/A* | November 2007 |
| Temporary S&E mix applied to entire project area | November 2007 | N/A* | November 2007 |
| Permanent seed mix applied to reach/segments | November 2007 | N/A* | November 2007 |
| Bare Root Seedling Installation | February 2008 | N/A* | February 2008 |
| Mitigation Plan | April 2008 | February 2008 | April 2008 |
| Minor repairs made filling small washed out areas | N/A* | N/A* | N/A* |
| Final Report | N/A* | N/A* | N/A* |
| Year 1 Vegetation Monitoring | November 2008 | August 2008 | November 2008 |
| Year 1 Stream Monitoring | November 2008 | September 2008 | November 2008 |
| Year 2 Vegetation Monitoring | November 2009 | September 2009 | December 2009 |
| Year 2 Stream Monitoring | November 2009 | September 2009 | December 2009 |

*N/A- Activities and reporting history for these items are not applicable to this restoration project

| Table III. Project Contacts<br>Cutawhiskie Creek Restoration Site – EEP Contract No. D06066-A | |
|---|---|
| **Prime Contractor** | Restoration Systems, LLC<br>1101 Haynes Street, Suite 211<br>Raleigh, NC 27604<br>(919) 755-9490 |
| **Designer** | PBS&J (previously EcoScience Corporation)<br>1616 East Millbrook Road, Suite 310<br>Raleigh, NC 27609<br>(919) 876-6888 |
| **Construction Contractor** | Anderson Farms<br>179 NC 97 East<br>Tarboro, NC 27886<br>(252) 823-4730 |
| **Planting Contractor** | Carolina Silvics<br>908 Indian Trail Road<br>Edenton, NC 27932<br>(919) 523-4375 |
| **Seeding Contactor** | Anderson Farms<br>179 NC 97 East<br>Tarboro, NC 27886<br>(252) 823-4730 |
| **Seed Mix Sources** | Erosion Supply Company<br>8817 Midway West Rd<br>Raleigh, NC 27617<br>(919) 787-0334 |
| **Nursery Stock Suppliers** | South Carolina Super Tree Nursery Company<br>5594 Highway 38 South<br>Blenheim, SC 29516<br>(800) 222-1290 |
| **Monitoring Performers** | PBS&J<br>1616 East Millbrook Road, Suite 310<br>Raleigh, NC 27609<br>(919) 876-6888 |
| **Stream Monitoring POC** | Jens Geratz |
| **Vegetation Monitoring POC** | Elizabeth Scherrer |

| Table IV. Project Background<br>Cutawhiskie Creek Restoration Site – EEP Contract No. D06066-A | |
|---|---|
| Project County | Hertford |
| Drainage Area | 0.9 square miles |
| Impervious cover estimate (%) | <1 percent |
| Stream Order | 1st order |
| Physiographic Region | Coastal Plain |
| Ecoregion (Griffith and Omernik) | Mid-Atlantic Flatwood |
| Rosgen Classification of As-built | E5 |
| Cowardin Classification | Stream (R3UB2) |
| Dominant soil types | Craven fine sandy loam (*Aquic Hapludults*) |
| | Leaf loam (*Typic Albaquults*) |
| | Wilbanks silty clay loam (*Cumulic Humaquepts*) |
| Reference Site ID | Black Branch, Bullard Branch, UT to Town Creek |
| USGS HUC for Project | 03010204 |
| NCDWQ Sub-basin for Project | 03-01-02 |
| NCDWQ classification for Project | C-NSW |
| Any portion of any project segment 303d listed? | No |
| Any portion of any project segment upstream of a 303d listed segment? | No |
| Reasons for 303d listing or stressor | N/A |
| Percent of project easement fenced | N/A |

## 3.0 PROJECT MONITORING AND RESULTS

### 3.1 Vegetation Assessment

Five vegetation monitoring (10 X 10$m^2$) plots were established to monitor planted vegetation within Site restoration and enhancement areas. Site vegetation was monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey (CVS) (CVS-EEP Protocol for Recording Vegetation, Level 1-2 Plot Sampling Only, Version 4.0, 2006). Established vegetation monitoring plot locations are displayed on the Current Conditions Area Plan View (Appendix D). Vegetative monitoring success will be achieved by plot data indicating an average number of planted stems per acre exceeding 320 stems/acre after the third year of monitoring and 260 stems/acre after the fifth and final year of project monitoring. During Year 2 monitoring, the Site exceeded the vegetation success criteria with an average of 599 planted stems per acre. The following Table V summarizes vegetation plot density for Year 1 and Year 2 monitoring. Refer to Appendix A for vegetation data collected during Year 2 Monitoring. No vegetation problem areas were identified during Year 2 monitoring.

| Table V. Vegetation Plot Summary<br>Planted Stems per Acre<br>Cutawhiskie Creek Restoration Site – EEP Contract No. D06066-A | | | | | |
|---|---|---|---|---|---|
| **Plot** | **MY-01** | **MY-02** | **MY-03** | **MY-04** | **MY-05** |
| 1 | 728 | 688 | | | |
| 2 | 688 | 647 | | | |
| 3 | 688 | 688 | | | |
| 4 | 688 | 486 | | | |
| 5 | 567 | 486 | | | |
| **MEAN** | **672** | **599** | | | |

## 3.2 Stream Assessment

| Table VI Hydrological (Bankfull) Verifications<br>Cutawhiskie Creek Restoration Site – EEP Contract No. D06066-A | | | |
|---|---|---|---|
| **Date of Data Collection** | **Date of Occurrence** | **Method** | **Photo Number** |
| 11-16-09 | 11-14-09 | Photo documentation | 1-2 (Appendix B) |

| Table VII. Categorical Stream Feature Visual Stability Assessment<br>Cutawhiskie Creek Restoration Site – EEP Contract No. D06066-A<br>Segment/Reach: 2,540 feet | | | | | | |
|---|---|---|---|---|---|---|
| **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. Bank Condition | 100% | 100% | 100% | | | |
| G. Rock Vanes | N/A | N/A | N/A | | | |
| H. Root Wads | N/A | N/A | N/A | | | |

To ensure stable bankfull dimension, pattern, and profile along the restored channel, annual stream assessment surveys (longitudinal profile and six channel cross-sections) were undertaken (Current Conditions Area Plan View [Appendix D] ). Profile and cross-section plots are located in Appendix C. Channel geomorphic data is summarized on Tables VIII and IX. Success criteria for stream restoration and Level 1 enhancement will include 1) successful classification of the reach as a functioning system (Rosgen 1996) and 2) channel stability indicative of a stable stream system. During Year 2 monitoring, cross-section data indicates some areas of localized, minor scouring (XS1-2), while XS-3 shows signs of an influx of bed material as sediment was redeposited. Cross-sections XS4-6 are largely unchanged. Overall the stream is stable and free of erosion, with balanced aggradation/degradation processes, and a robust riparian buffer. A bankfull event documented on 11-14-09 further demonstrates stream stability. No stream problem areas were identified during Year 2 monitoring.

**Table VIII. Baseline Morphology and Hydraulic Summary**
**Cutawhiskie Creek Restoration Site – EEP Contract No. D06066-A**

| Parameter | USGS Gage Data | | | Regional Curve Interval | | | Pre-Existing Condition | | | Project Reference Stream | | | Design | | | As-built | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| BF Width (ft) | N/A | N/A | N/A | N/A | N/A | 9.0 | 8.4 | 9.6 | 9.1 | 7.2 | 9.8 | 8.7 | 6.0 | 8.0 | 7.0 | 6.4 | 7.5 | 7.0 |
| Floodprone Width (ft) | N/A | N/A | N/A | N/A | N/A | N/A | 12 | 13 | 12.5 | 175 | 225 | 200 | 150+ | 150+ | 150+ | 150+ | 150+ | 150+ |
| BF Cross Sectional Area ($ft^2$) | N/A | N/A | N/A | N/A | N/A | 9.5 | 64 | 137 | 100.5 | 9 | 11.5 | 10.2 | 7.0 | 11.0 | 9.0 | 6.6 | 10.4 | 8.7 |
| BF Mean Depth (ft) | N/A | N/A | N/A | N/A | N/A | 0.9 | 0.9 | 1.1 | 1.0 | 1.1 | 1.3 | 1.2 | 0.7 | 1.4 | 1.3 | 1.0 | 1.4 | 1.2 |
| BF Max Depth (ft) | N/A | N/A | N/A | N/A | N/A | N/A | 1.5 | 1.7 | 1.6 | 1.5 | 1.9 | 1.7 | 1.5 | 3.5 | 1.8 | 1.5 | 3.1 | 2.4 |
| Width/Depth Ratio | N/A | N/A | N/A | N/A | N/A | 10.0 | 8.7 | 9.3 | 9.0 | 5.5 | 8.4 | 7.4 | 4 | 5.7 | 5.4 | 6.4 | 5.4 | 5.8 |
| Entrenchment Ratio | N/A | N/A | N/A | N/A | N/A | N/A | 1.3 | 1.4 | 1.35 | 20.3 | 23.1 | 21.4 | 1.2 | 5.9 | >18.0 | 1.2 | 5.9 | 4.3 |
| Wetted Perimeter(ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 7.6 | 35.6 | 17.6 |
| Bank Height Ratio | | | | | | | 3.4 | 5.0 | 4.2 | 1.1 | 1.3 | 1.2 | 1.0 | 1.1 | 1.0 | 1.0 | 1.1 | 1.0 |
| Hydraulic radius (ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 0.7 | 1.2 | 0.9 | 0.7 | 1.2 | 0.9 |
| **Pattern** | | | | | | | | | | | | | | | | | | |
| Channel Beltwidth (ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A* | N/A* | N/A* | 12.0 | 113.0 | 38.3 | 28.0 | 49.0 | 40.0 | 28.0 | 49.0 | 40.0 |
| Radius of Curvature (ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A* | N/A* | N/A* | 7.0 | 58.0 | 19.4 | 9.0 | 14.0 | 11.0 | 9.0 | 14.0 | 11.0 |
| Meander Wavelength (ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A* | N/A* | N/A* | 28.0 | 175.0 | 75.7 | 40.0 | 60.0 | 50.0 | 40.0 | 60.0 | 50.0 |
| Meander Width ratio | N/A | N/A | N/A | N/A | N/A | N/A | N/A* | N/A* | N/A* | 2.1 | 21.6 | 8.1 | 5.7 | 10 | 7.9 | 5.7 | 10 | 7.9 |
| **Profile** | | | | | | | | | | | | | | | | | | |
| Riffle length (ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A* | N/A* | N/A* | N/A | N/A | N/A | 3.0 | 25.0 | 12.0 | 3.2 | 21.3 | 11.1 |
| Riffle slope (ft/ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A* | N/A* | N/A* | N/A | N/A | N/A | 0.00 | 0.050 | 0.001 | 0.000 | 0.082 | 0.013 |
| Pool length (ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A* | N/A* | N/A* | 5.0 | 84.0 | 29.8 | 4.0 | 25.0 | 12.0 | 4.1 | 25.6 | 13.4 |
| Pool spacing (ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A* | N/A* | N/A* | 19.0 | 113.0 | 52.6 | 8.0 | 30.0 | 20.0 | 10.4 | 36.3 | 20.0 |
| **Substrate** | | | | | | | | | | | | | | | | | | |
| d50 (mm) | N/A | N/A | N/A | N/A | N/A | N/A | NA | NA | NA | 1.5 | 1.5 | 1.5 | N/A | N/A | N/A | NA | NA | NA |
| d84 (mm) | N/A | N/A | N/A | N/A | N/A | N/A | NA | NA | NA | 1.9 | 1.9 | 1.9 | N/A | N/A | N/A | NA | NA | NA |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | |
| Valley Length (ft) | N/A | | | N/A | | | 2,200 | | | N/A | | | 1,775 | | | 1,775 | | |
| Channel Length (ft) | N/A | | | N/A | | | 2,200 | | | N/A | | | 2,540 | | | 2,540 | | |
| Sinuosity | N/A | | | N/A | | | 1.0 | | | 1.4-1.6 | | | 1.4 | | | 1.4 | | |
| Water Surface Slope (ft/ft) | N/A | | | N/A | | | 0.0031 | | | 0.002 | | | N/A | | | 0.0004 | | |
| BF slope (ft/ft) | N/A | | | N/A | | | N/A | | | 0.004 | | | N/A | | | 0.0005 | | |
| Rosgen Classification | N/A | | | N/A | | | G5 | | | E5 | | | E5 | | | E5 | | |
| Habitat Index / Macrobenthos | NA | | | N/A | | | N/A | | | N/A | | | N/A | | | N/A | | |

* No Distinct Riffles and Pools or Repetitive Channel Pattern due to Dredging and Straightening

**Table IX. Morphology and Hydraulic Monitoring Summary**
**Cutawhiskie Creek Restoration Site – EEP Contract No. D06066-A**

| Parameter | Cross-Section 1 Pool | | | | | | Cross-Section 2 Riffle | | | | | | Cross-Section 3 Pool | | | | | | Cross-Section 4 Riffle | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension** | MY1 | MY2 | MY3 | MY4 | MY5 | MY+ | MY1 | MY2 | MY3 | MY4 | MY5 | MY+ | MY1 | MY2 | MY3 | MY4 | MY5 | MY | MY1 | MY2 | MY3 | MY4 | MY5 | MY |
| BF Width (ft) | 17.4 | 9.2 | | | | | 9.1 | 6.8 | | | | | 26.9 | 15.5 | | | | | 7.9 | 7.7 | | | | |
| Floodprone Width (ft) | 150+ | 150+ | | | | | 150+ | 150+ | | | | | 150+ | 150+ | | | | | 150+ | 150+ | | | | |
| BF Cross Sectional Area ($ft^2$) | 18.9 | 9.2 | | | | | 9.0 | 8.2 | | | | | 26.4 | 11.5 | | | | | 9.4 | 9.4 | | | | |
| BF Mean Depth (ft) | 1.1 | 1.3 | | | | | 1.0 | 1.2 | | | | | 1.0 | 0.7 | | | | | 1.2 | 1.2 | | | | |
| BF Max Depth (ft) | 2.7 | 2.2 | | | | | 1.9 | 1.9 | | | | | 3.1 | 2.3 | | | | | 1.8 | 1.8 | | | | |
| Width/Depth Ratio | 15.9 | 5.5 | | | | | 9.2 | 5.7 | | | | | 27.5 | 22.1 | | | | | 6.6 | 6.4 | | | | |
| Entrenchment Ratio | 8.6 | 20.8 | | | | | 16.5 | 22.0 | | | | | 5.6 | 9.6 | | | | | 19.0 | 19.4 | | | | |
| Wetted Perimeter(ft) | 20.8 | 8.7 | | | | | 10.7 | 8.1 | | | | | 28.8 | 10.1 | | | | | 9.0 | 8.9 | | | | |
| Hydraulic radius (ft) | 0.9 | 0.9 | | | | | 0.8 | 0.8 | | | | | 0.9 | 0.9 | | | | | 1.0 | 1.0 | | | | |
| **Substrate** | | | | | | | | | | | | | | | | | | | | | | | | |
| d50 (mm) | Silt | Silt | | | | | Silt | Silt | | | | | Silt | Silt | | | | | Silt | Silt | | | | |
| d84 (mm) | Silt | Silt | | | | | Silt | Silt | | | | | Silt | Silt | | | | | Silt | Silt | | | | |

| Parameter | MY-01 (2008) | | | MY-02 (2009) | | | MY-03 (2010) | | | MY-04 (2011) | | | MY-05 (2012) | | | MY+ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pattern** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | 28.0 | 49.0 | 40.0 | 28.0 | 49.0 | 40.0 | | | | | | | | | | | | |
| Radius of Curvature (ft) | 9.0 | 14.0 | 11.0 | 9.0 | 14.0 | 11.0 | | | | | | | | | | | | |
| Meander Wavelength (ft) | 40.0 | 60.0 | 50.0 | 40.0 | 60.0 | 50.0 | | | | | | | | | | | | |
| Meander Width ratio | 5.7 | 10 | 7.9 | 5.7 | 10 | 7.9 | | | | | | | | | | | | |
| **Profile** | | | | | | | | | | | | | | | | | | |
| Riffle length (ft) | 4.0 | 21.0 | 11.5 | 4.0 | 21.0 | 11.5 | | | | | | | | | | | | |
| Riffle slope (ft/ft) | 0.000 | 0.074 | 0.007 | 0.000 | 0.074 | 0.007 | | | | | | | | | | | | |
| Pool length (ft) | 1.0 | 23.8 | 12.5 | 1.0 | 23.8 | 12.5 | | | | | | | | | | | | |
| Pool spacing (ft) | 9.6 | 36.0 | 20.6 | 9.6 | 36.0 | 20.6 | | | | | | | | | | | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | |
| Valley Length (ft) | 1,775 | | | 1,775 | | | | | | | | | | | | | | |
| Channel Length (ft) | 2,540 | | | 2,540 | | | | | | | | | | | | | | |
| Sinuosity | 1.4 | | | 1.4 | | | | | | | | | | | | | | |
| Water Surface Slope (ft/ft) | 0.0004 | | | 0.0004 | | | | | | | | | | | | | | |
| BF slope (ft/ft) | 0.0005 | | | 0.0005 | | | | | | | | | | | | | | |
| Rosgen Classification | E5 | | | E5 | | | | | | | | | | | | | | |

**Table IX. cont. Morphology and Hydraulic Monitoring Summary**
**Cutawhiskie Creek Restoration Site – EEP Contract No. D06066-A**

| Parameter | Cross Section 5 Riffle | | | | | | Cross Section 6 Pool | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension** | MY1 | MY2 | MY3 | MY4 | MY5 | MY+ | MY1 | MY2 | MY3 | MY4 | MY5 | MY+ | MY1 | MY2 | MY3 | MY4 | MY5 | MY+ | MY1 | MY2 | MY3 | MY4 | MY5 | MY+ |
| BF Width (ft) | 7.0 | 7.2 | | | | | 15.1 | 13.7 | | | | | | | | | | | | | | | | |
| Floodprone Width (ft) | 150+ | 150+ | | | | | 150+ | 150+ | | | | | | | | | | | | | | | | |
| BF Cross Sectional Area ($ft^2$) | 6.7 | 6.2 | | | | | 16.8 | 14.1 | | | | | | | | | | | | | | | | |
| BF Mean Depth (ft) | 1.0 | 0.8 | | | | | 1.1 | 1.0 | | | | | | | | | | | | | | | | |
| BF Max Depth (ft) | 1.4 | 1.4 | | | | | 2.7 | 2.5 | | | | | | | | | | | | | | | | |
| Width/Depth Ratio | 7.4 | 5.1 | | | | | 13.5 | 13.7 | | | | | | | | | | | | | | | | |
| Entrenchment Ratio | 21.5 | 20.8 | | | | | 10.0 | 10.9 | | | | | | | | | | | | | | | | |
| Wetted Perimeter(ft) | 7.8 | 7.8 | | | | | 17.1 | 16.2 | | | | | | | | | | | | | | | | |
| Hydraulic radius (ft) | 0.9 | 0.9 | | | | | 1.0 | 1.0 | | | | | | | | | | | | | | | | |
| **Substrate** | | | | | | | | | | | | | | | | | | | | | | | | |
| d50 (mm) | Silt | Silt | | | | | Silt | Silt | | | | | | | | | | | | | | | | |
| d84 (mm) | Silt | Silt | | | | | Silt | Silt | | | | | | | | | | | | | | | | |

### 3.3 Wetland Assessment

Success criteria for wetland hydrology require that restored areas be inundated or saturated by groundwater within 12-inches of the ground surface for a period of 12.5% of the growing season. The growing season in Hertford County begins on March 28 and ends on November 7 (225 days). In order to achieve hydrologic success, saturation within 12 inches of the ground surface is required for 29 consecutive days. The results of the Year 2 hydrologic monitoring indicate moderate success within the Site. Two of the on-Site gauges (Gauges 3 and 4) exhibited saturation within 12 inches of the ground surface for at least 12.5 percent (consecutive days) of the growing season while gauges 1 and 5 exhibited saturation within 12 inches of the ground surface for 5 to 12.5 percent of the growing season. Due to the unsuccessful results of Gauge 2 this year (saturation within 12 inches of the ground surface for less than 5 percent of the growing season) and last year, the gauge will be moved. Gauge 2 is believed to be influenced by its close proximity to the stream channel and the subsequent lowering of ground water levels. A new location further from the stream channel will eliminate any dewatering influence the stream might have towards the water table. The new location of Gauge 2 will be established prior to the beginning of the 2010 (Year 3) growing season and will be included in the 2010 monitoring report.
Figure 3 shows the monthly precipitation for Hertford County in 2009 with the 30$^{th}$ and 70$^{th}$ percentile rainfall amounts. Monthly rainfall amounts were below the 30$^{th}$ percentile in three out of the four months of data available for the growing season. Table X summarizes wetland hydrology criteria for Year 2 monitoring.

**Table X. Wetland Criteria Attainment**
**Cutawhiskie Creek Restoration Site – EEP Contract No. D06066-A**

| Tract | Gauge ID | Consecutive Days Saturated (Percentage) | Total Non-consecutive Days Saturated | Tract Mean | Vegetation Plot ID | Vegetation Density Met (320 stems/acre) | Tract Mean |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 11.6% | 54 | 40% | 1 | Yes | 100% |
| 1 | 2 | 3.1% | 32 | | 2 | Yes | |
| 1 | 3 | 12.9% | 54 | | 3 | Yes | |
| 1 | 4 | 14.2% | 59 | | 4 | Yes | |
| 1 | 5 | 9.8% | 39 | | 5 | Yes | |

## 4.0 METHODOLOGY

No unavoidable deviations from initially prescribed methodologies were implemented as part of Year 2 monitoring activities.

## 5.0 REFERENCES

Lee, Michael T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2006 CVS-EEP Protocol for Recording Vegetation, Version 4.0 (http://cvs.bio.unc.edu/methods.htm)

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology (Publisher). Pagosa Springs, Colorado.

Weakley, A.S. 2007. Flora of the Carolinas, Virginia, Georgia, and surrounding areas. Working draft of January 2007. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina. 1015pp.

**APPENDIX A: VEGETATIVE DATA**

**Table 1: Vegetation Metadata**

| | |
|---|---|
| **Report Prepared By** | Jeffrey Siceloff |
| **Date Prepared** | 11/4/2009 15:46 |
| **database name** | cvs-eep-entrytool-v2.2.6.mdb |
| **database location** | C:\Documents and Settings\23508\My Documents |
| **computer name** | RAL5Z0DXF1 |
| **file size** | 41103360 |
| | |
| **DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT** | |
| **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. |
| **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 SUMMARY** | |
| **Project Code** | D04020 |
| **project Name** | Cutawhiskie Stream Restoration |
| **Description** | restoration monitoring |
| **River Basin** | Chowan |
| **length(ft)** | 2,540 |
| **stream-to-edge width (ft)** | |
| **area (sq m)** | |
| **Required Plots (calculated)** | |
| **Sampled Plots** | 5 |

**Table 2 Vegetation Vigor by Species**

| | Species | 4 | 3 | 2 | 1 | 0 | Missing | Unknown |
|---|---|---|---|---|---|---|---|---|
| | Liquidambar styraciflua | | 1 | | | | | |
| | Nyssa biflora | 1 | 18 | 8 | 1 | 1 | | |
| | Quercus lyrata | | 13 | | | 2 | 3 | |
| | Quercus michauxii | | 3 | | | | | |
| | Quercus pagoda | | 4 | | | | | |
| | Quercus phellos | | 6 | | | 1 | | |
| | Taxodium distichum | 3 | 15 | 1 | | | 2 | |
| **TOT:** | **7** | **4** | **60** | **9** | **1** | **4** | **5** | |

**Table 3.Vegetation Damage by Species**

| | Species | All Damage Categories | (no damage) |
|---|---|---|---|
| | Liquidambar styraciflua | 1 | 1 |
| | Nyssa biflora | 29 | 29 |
| | Quercus lyrata | 18 | 18 |
| | Quercus michauxii | 3 | 3 |
| | Quercus pagoda | 4 | 4 |
| | Quercus phellos | 7 | 7 |
| | Taxodium distichum | 21 | 21 |
| **TOT:** | **7** | **83** | **83** |

**Table 4. Vegetation Damage by Plot**

| | plot | All Damage Categories | (no damage) |
|---|---|---|---|
| | D06066a-12345-0001-year:2 | 18 | 18 |
| | D06066a-12345-0002-year:2 | 17 | 17 |
| | D06066a-12345-0003-year:2 | 17 | 17 |
| | D06066a-12345-0004-year:2 | 17 | 17 |
| | D06066a-12345-0005-year:2 | 14 | 14 |
| **TOT:** | **5** | **83** | **83** |

**Table 5. Stem Count by Plot and Species**

| Species | Total Planted Stems | # plots | avg# stems | plot D06066a-12345-0001-year:2 | plot D06066a-12345-0002-year:2 | plot D06066a-12345-0003-year:2 | plot D06066a-12345-0004-year:2 | plot D06066a-12345-0005-year:2 |
|---|---|---|---|---|---|---|---|---|
| Liquidambar styraciflua | 1 | 1 | 1 | | | | 1 | |
| Nyssa biflora | 28 | 4 | 7 | 4 | 10 | 10 | 4 | |
| Quercus lyrata | 13 | 4 | 3.25 | | 1 | 3 | 4 | 5 |
| Quercus michauxii | 3 | 1 | 3 | 3 | | | | |
| Quercus pagoda | 4 | 2 | 2 | | 2 | | | 2 |
| Quercus phellos | 6 | 1 | 6 | 6 | | | | |
| Taxodium distichum | 19 | 5 | 3.8 | 4 | 3 | 4 | 3 | 5 |
| **Total** | **74** | **7** | | **17** | **16** | **17** | **12** | **12** |

**Table 6. All Stems by Plot and Species**

| Species | Total Stems | # plots | avg# stems | D06066a-12345-0001-year:2 | D06066a-12345-0002-year:2 | D06066a-12345-0003-year:2 | D06066a-12345-0004-year:2 | D06066a-12345-0005-year:2 |
|---|---|---|---|---|---|---|---|---|
| Baccharis halimifolia | 4 | 1 | 4 | | | | | 4 |
| Fraxinus pennsylvanica | 56 | 5 | 11.2 | 9 | 8 | 4 | 5 | 30 |
| Ligustrum sinense | 10 | 1 | 10 | | | | 10 | |
| Liquidambar styraciflua | 4 | 2 | 2 | 2 | | | 2 | |
| Lyonia lucida | 2 | 1 | 2 | | | | 2 | |
| Nyssa biflora | 30 | 4 | 7.5 | 5 | 10 | 10 | 5 | |
| Pinus taeda | 97 | 4 | 24.25 | 3 | 1 | 88 | 5 | |
| Quercus lyrata | 16 | 4 | 4 | | 1 | 3 | 7 | 5 |
| Quercus michauxii | 3 | 1 | 3 | 3 | | | | |
| Quercus pagoda | 12 | 5 | 2.4 | 1 | 2 | 2 | 1 | 6 |
| Quercus phellos | 8 | 1 | 8 | 8 | | | | |
| Taxodium distichum | 19 | 5 | 3.8 | 4 | 3 | 4 | 3 | 5 |
| Rhus copallinum | 3 | 1 | 3 | | | 3 | | |
| Platanus occidentalis | 1 | 1 | 1 | | | | 1 | |
| Populus deltoides | 4 | 1 | 4 | | | | | 4 |
| Acer rubrum | 208 | 5 | 41.6 | 2 | 64 | 30 | 46 | 66 |
| **TOT:** | **477** | **16** | | **37** | **89** | **144** | **87** | **120** |

**Table 7: Planted and Volunteer Stems**

| | Current Plot Data (MY2 2009) | | | | | | | | | | | | | | | Annual Means | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 92547-1-0001 | | | 92547-1-0002 | | | 92547-1-0003 | | | 92547-1-0004 | | | 92547-1-0005 | | | MY2 (2009) | | | MY1 (2008) | | |
| **Scientific Name** | **P-LS** | **P-all** | **T** | **P-LS** | **P-all** | **T** | **P-LS** | **P-all** | **T** | **P-LS** | **P-all** | **T** | **P-LS** | **P-all** | **T** | **P-LS** | **P-all** | **T** | **P-LS** | **P-all** | **T** |
| Baccharis halimifolia | | | | | | | | | | | | | | | 4 | | | 4 | | | |
| Fraxinus pennsylvanica | | | 9 | | | 8 | | | 4 | | | 5 | | | 30 | | | 56 | | | 20 |
| Ligustrum sinense | | | | | | | | | | | | 10 | | | | | | 10 | | | |
| Liquidambar styraciflua | | | 2 | | | | | | | | 1 | 2 | | | | | 1 | 4 | | 1 | 3 |
| Lyonia lucida | | | | | | | | | | | | 2 | | | | | | 2 | | | |
| Nyssa biflora | | 4 | 5 | | 10 | 10 | | 10 | 10 | | 4 | 4 | | | | | 28 | 29 | | 29 | 29 |
| Pinus taeda | | | 3 | | | 1 | | | 88 | | | 5 | | | | | | 97 | | | |
| Quercus lyrata | | | | | 1 | 1 | | 3 | 3 | | 4 | 5 | | 5 | 5 | | 13 | 14 | | 18 | 18 |
| Quercus michauxii | | 3 | 3 | | | | | | | | | | | | | | 3 | 3 | | 3 | 3 |
| Quercus pagoda | | | 1 | | 2 | 2 | | | 2 | | | 1 | | 2 | 6 | | 4 | 12 | | 4 | 6 |
| Quercus phellos | | 6 | 7 | | | | | | | | | | | | | | 6 | 7 | | 7 | 8 |
| Sambucus canadensis | | | | | | | | | | | | | | | | | | | | | 21 |
| Taxodium distichum | | 4 | 4 | | 3 | 3 | | 4 | 4 | | 3 | 3 | | 5 | 5 | | 19 | 19 | | 21 | 21 |
| Rhus copallinum | | | | | | | | | 3 | | | | | | | | | 3 | | | |
| Platanus occidentalis | | | | | | | | | | | | 1 | | | | | | 1 | | | 1 |
| Populus deltoides | | | | | | | | | | | | | | | 4 | | | 4 | | | |
| Acer rubrum | | | 2 | | | 64 | | | 30 | | | 46 | | | 66 | | | 208 | | | 24 |
| **Stem count** | 0 | 17 | 36 | 0 | 16 | 89 | 0 | 17 | 144 | 0 | 12 | 84 | 0 | 12 | 120 | 0 | 74 | 473 | 0 | 83 | 154 |
| **size (ares)** | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | | 5 | | | 5 | | |
| **size (ACRES)** | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.12 | | | 0.12 | | |
| **Species count** | 0 | 4 | 9 | 0 | 4 | 7 | 0 | 3 | 8 | 0 | 4 | 11 | 0 | 3 | 7 | 0 | 7 | 16 | 0 | 7 | 11 |
| **Stems per ACRE** | 0 | 688 | 1457 | 0 | 647 | 3602 | 0 | 688 | 5827 | 0 | 486 | 3399 | 0 | 486 | 4856 | 0 | 599 | 3828 | 0 | 672 | 1246 |

**Photo Stations: Year-2 Monitoring**

Photo Station 1

Photo Station 2

Photo Station 3

**Vegetation Plots: Year-2 Monitoring**

Vegetation Plot 1

Vegetation Plot 2

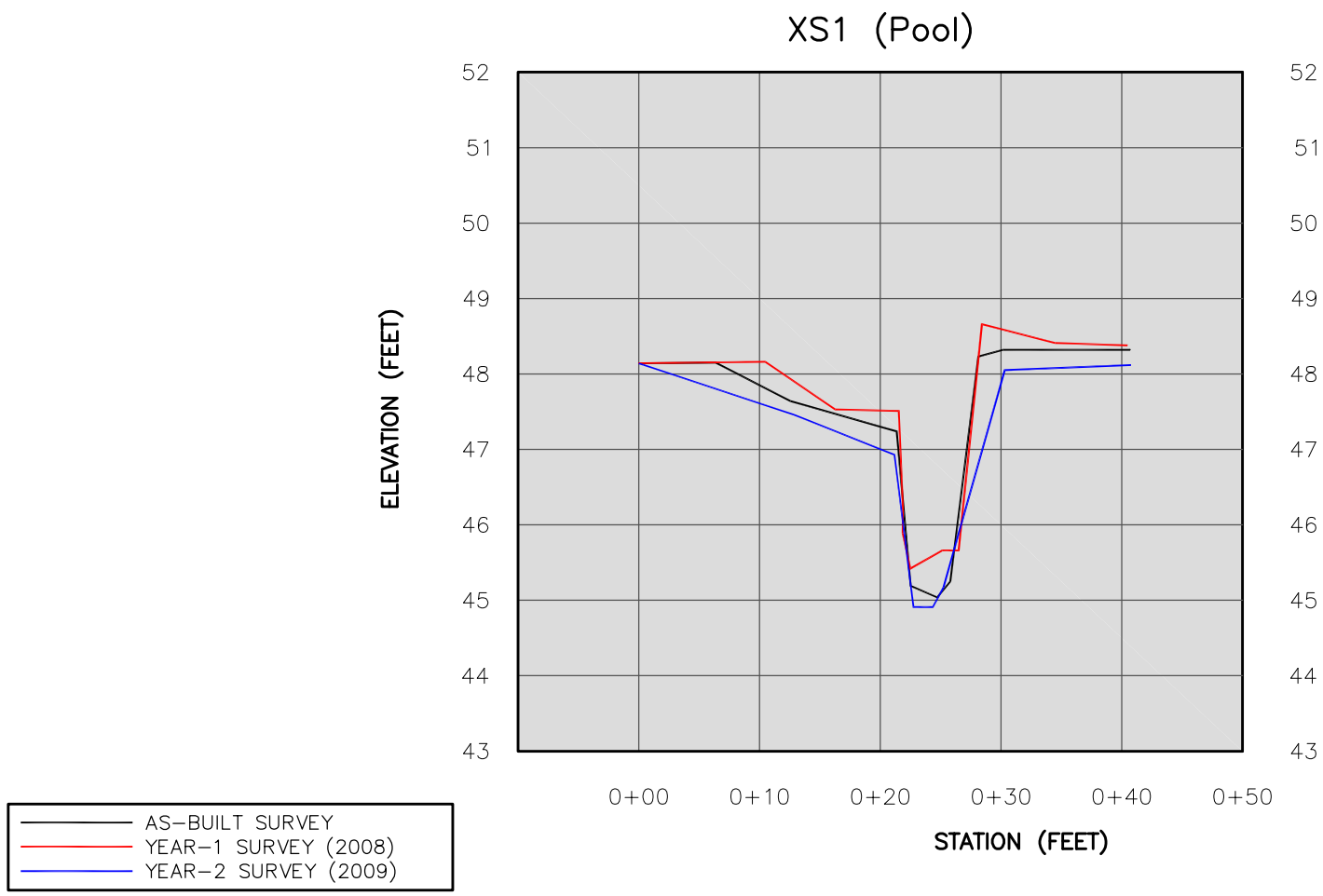
Vegetation Plot 3

Vegetation Plot 4

Vegetation Plot 5

**APPENDIX B: GEOMORPHOLOGIC DATA**

| Table B2. Visual Morphological Stability Assessment<br>Cutawhiskie Creek Restoration Site – EEPContract No. D06066-A<br>2,540 linear feet | | | | | | |
|---|---|---|---|---|---|---|
| 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? | 77 | 77 | N/A | 100 | |
| | 2. Armor stable (e.g. no displacement)? | 77 | 77 | N/A | 100 | |
| | 3. Facet grade appears stable? | 77 | 77 | N/A | 100 | |
| | 4. Minimal evidence of embedding/fining? | 77 | 77 | N/A | 100 | |
| | 5. Length appropriate? | 77 | 77 | N/A | 100 | **100%** |
| | | | | | | |
| B. Pools | 1. Present? (e.g not subject to severe aggrad. or migrat.?) | 76 | 76 | N/A | 100 | |
| | 2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?) | 76 | 76 | N/A | 100 | |
| | 3. Length appropriate? | 76 | 76 | N/A | 100 | **100%** |
| | | | | | | |
| C. Thalweg | 1. Upstream of meander bend (run/inflection) centering? | N/A | N/A | N/A | 100 | |
| | 2. Downstream of meander (glide/inflection) centering? | N/A | N/A | N/A | 100 | **100%** |
| | | | | | | |
| D. Meanders | 1. Outer bend in state of limited/controlled erosion? | N/A | N/A | N/A | 100 | |
| | 2. Of those eroding, # w/concomitant point bar formation? | N/A | N/A | N/A | 100 | |
| | 3. Apparent Rc within spec? | N/A | N/A | N/A | 100 | |
| | 4. Sufficient floodplain access and relief? | N/A | N/A | N/A | 100 | **100%** |
| | | | | | | |
| E. Bed General | 1. General channel bed aggradation areas (bar formation) | N/A | N/A | 0/2540 | 100 | |
| | 2. Channel bed degradation – areas of increasing down-cutting or head cutting? | N/A | N/A | 0/2540 | 100 | **100%** |
| | | | | | | |
| F. Bank | 1. Actively eroding, wasting, or slumping | N/A | N/A | 0/2540 | 100 | **100%** |
| | | | | | | |
| G. Vanes | 1. Free of back or arm scour? | N/A | N/A | N/A | N/A | |
| | 2. Height appropriate? | N/A | N/A | N/A | N/A | |
| | 3. Angle and geometry appear appropriate? | N/A | N/A | N/A | N/A | |
| | 4. Free of piping or other structural failures?[3] | N/A | N/A | N/A | N/A | **N/A** |
| | | | | | | |
| H. Wads/ Boulders | 1. Free of scour? | N/A | N/A | N/A | N/A | |
| | 2. Footing stable? | N/A | N/A | N/A | N/A | **N/A** |




XS1 LEFT BANK LOOKING RIGHT BANK

XS1 LOOKING DOWNSTREAM

## SURVEY DATA

| STATION | ELEVATION | FEATURE | STATION | ELEVATION | FEATURE |
|---|---|---|---|---|---|
| 0 | 48.2 | LPIN | | | |
| 0.39 | 48.18 | | | | |
| 12.85 | 47.52 | | | | |
| 21.17 | 46.99 | | | | |
| 22.75 | 44.97 | | | | |
| 24.36 | 44.97 | | | | |
| 25.23 | 45.23 | | | | |
| 30.31 | 48.11 | | | | |
| 40.76 | 48.18 | RPIN | | | |

## SUMMARY DATA

| | |
|---|---|
| BANKFULL CROSS SECTIONAL AREA | 9.2 SQ. FT. |
| BANKFULL WIDTH | 7.2 FT. |
| BANKFULL MEAN DEPTH | 1.3 FT. |
| BANKFULL MAX DEPTH | 2.2 FT. |
| WIDTH-DEPTH RATIO | 5.5 |
| ENTRENCHMENT RATIO | 20.8 |
| CLASSIFICATION | N/A |

NOTES:

1. All cross-sections facing the downstream direction

| | |
|---|---|
| Survey Date | OCT. 2009 |
| Survey Weather | Sunny |
| Field Team | Geratz, Schmid |
| Location | XS1 |

PBS&J

REVISIONS

Client:

RESTORATION SYSTEMS, LLC
Natural Resources Restoration & Conservation

Project:

**CUTAWHISKIE CREEK RESTORATION SITE**

**YEAR-2 MONITORING REPORT**

HERTFORD COUNTY, NC

Title:

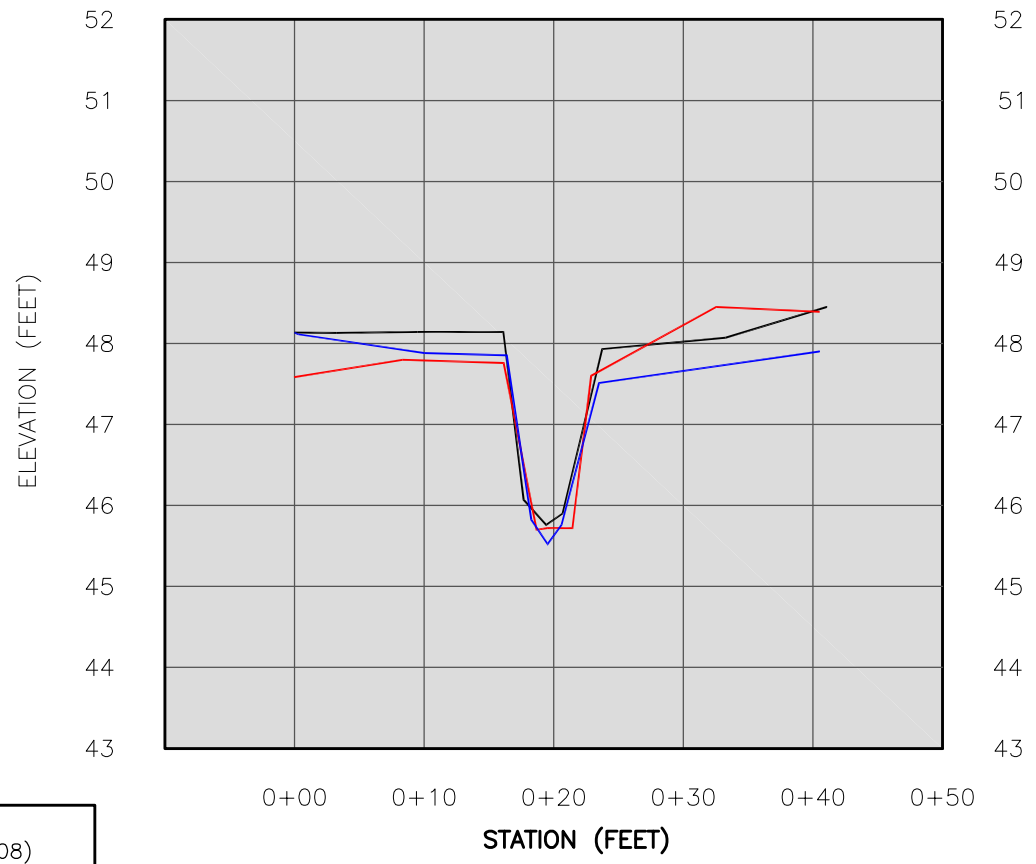
**CROSS SECTION XS1-POOL**

| | |
|---|---|
| Dsn. By: TAL | Dwn. By: TAL |
| Ckd. By: MCG | Date: NOV 2009 |
| Scale: NO SCALE | |
| Project No.: 06-306 | |

SHEET

**B1**

# XS2 (Riffle)




## SURVEY DATA

| STATION | ELEVATION | FEATURE | STATION | ELEVATION | FEATURE |
|---|---|---|---|---|---|
| 0 | 47.51 | LPIN | | | |
| 0.31 | 47.49 | | | | |
| 10.02 | 47.26 | | | | |
| 16.37 | 47.23 | | | | |
| 18.27 | 45.2 | | | | |
| 19.53 | 44.9 | | | | |
| 20.6 | 45.14 | | | | |
| 23.5 | 46.89 | | | | |
| 40.5 | 47.28 | | | | |
| 40.75 | 47.85 | RPIN | | | |

## SUMMARY DATA

| | |
|---|---|
| BANKFULL CROSS SECTIONAL AREA | 8.2 SQ. FT. |
| BANKFULL WIDTH | 6.8 FT. |
| BANKFULL MEAN DEPTH | 1.2 FT |
| BANKFULL MAX DEPTH | 1.9 FT |
| WIDTH-DEPTH RATIO | 5.7 |
| ENTRENCHMENT RATIO | 22.0 |
| CLASSIFICATION | E5 |

XS2 LEFT BANK LOOKING RIGHT BANK

XS2 LOOKING DOWNSTREAM

NOTES:
1. All cross-sections facing the downstream direction

| | |
|---|---|
| Survey Date | OCT. 2009 |
| Survey Weather | Sunny |
| Field Team | Geratz, Schmid |
| Location | XS2 |

PBS&J

REVISIONS

Client:
RESTORATION SYSTEMS, LLC
Natural Resources Restoration & Conservation

Project:
**CUTAWHISKIE CREEK RESTORATION SITE**

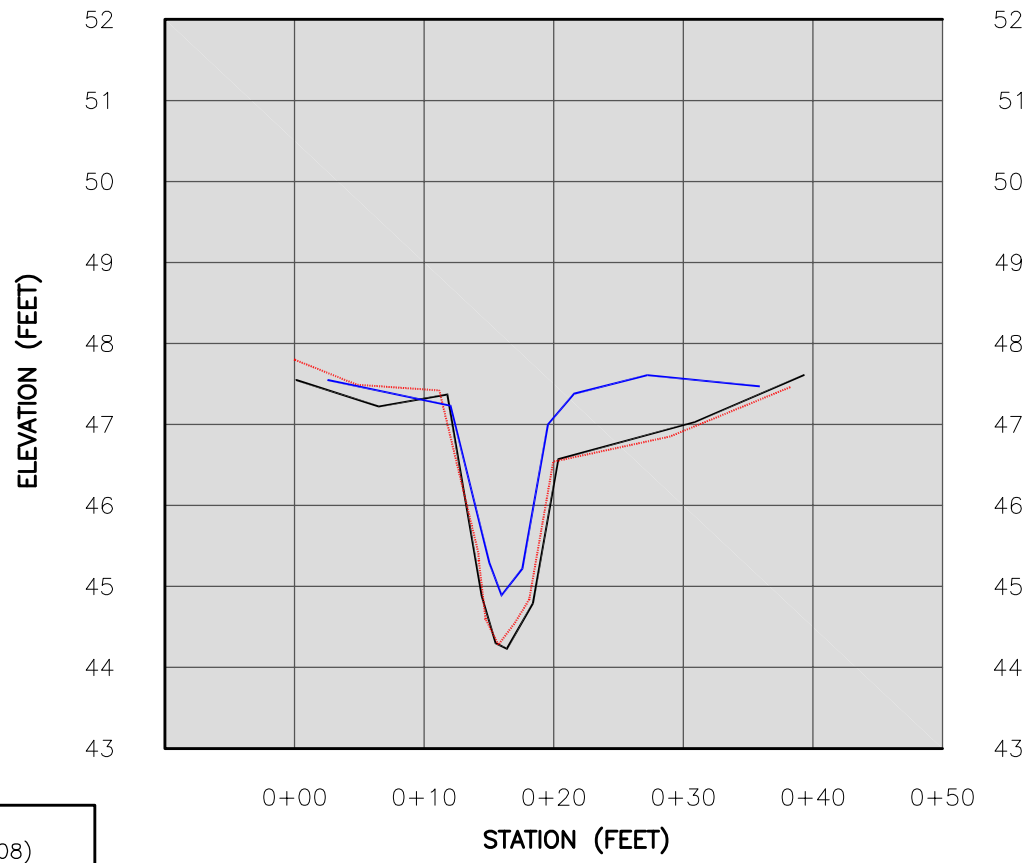
**YEAR-2 MONITORING REPORT**
HERTFORD COUNTY, NC

Title:
**CROSS SECTION XS2-RIFFLE**

| | |
|---|---|
| Dsn. By: TAL | Dwn. By: TAL |
| Ckd. By: MCG | Date: NOV 2009 |
| Scale: NO SCALE | |
| Project No.: 06-306 | |

SHEET
**B2**

## XS3 (Pool)




### SURVEY DATA

| STATION | ELEVATION | FEATURE | STATION | ELEVATION | FEATURE |
|---|---|---|---|---|---|
| 0 | 47.3 | LPIN | | | |
| 8.68 | 47.44 | | | | |
| 14.34 | 47.21 | | | | |
| 16.35 | 46.83 | | | | |
| 18.32 | 45.05 | | | | |
| 19.94 | 44.72 | | | | |
| 20.86 | 45.12 | | | | |
| 23.86 | 47.06 | | | | |
| 33.36 | 47.38 | RPIN | | | |

### SUMMARY DATA

| | |
|---|---|
| BANKFULL CROSS SECTIONAL AREA | 11.5 SQ. FT. |
| BANKFULL WIDTH | 15.5 FT. |
| BANKFULL MEAN DEPTH | 0.7 FT. |
| BANKFULL MAX DEPTH | 2.3 FT. |
| WIDTH-DEPTH RATIO | 22.1 |
| ENTRENCHMENT RATIO | 9.6 |
| CLASSIFICATION | N/A |

XS3 LEFT BANK LOOKING RIGHT BANK

XS3 LOOKING DOWNSTREAM

NOTES:
1. All cross-sections facing the downstream direction

| | |
|---|---|
| Survey Date | OCT. 2009 |
| Survey Weather | Sunny |
| Field Team | Geratz, Schmid |
| Location | XS3 |

PBS&J

REVISIONS

Client:
RESTORATION SYSTEMS, LLC
Natural Resources Restoration & Conservation

Project:
**CUTAWHISKIE CREEK RESTORATION SITE**

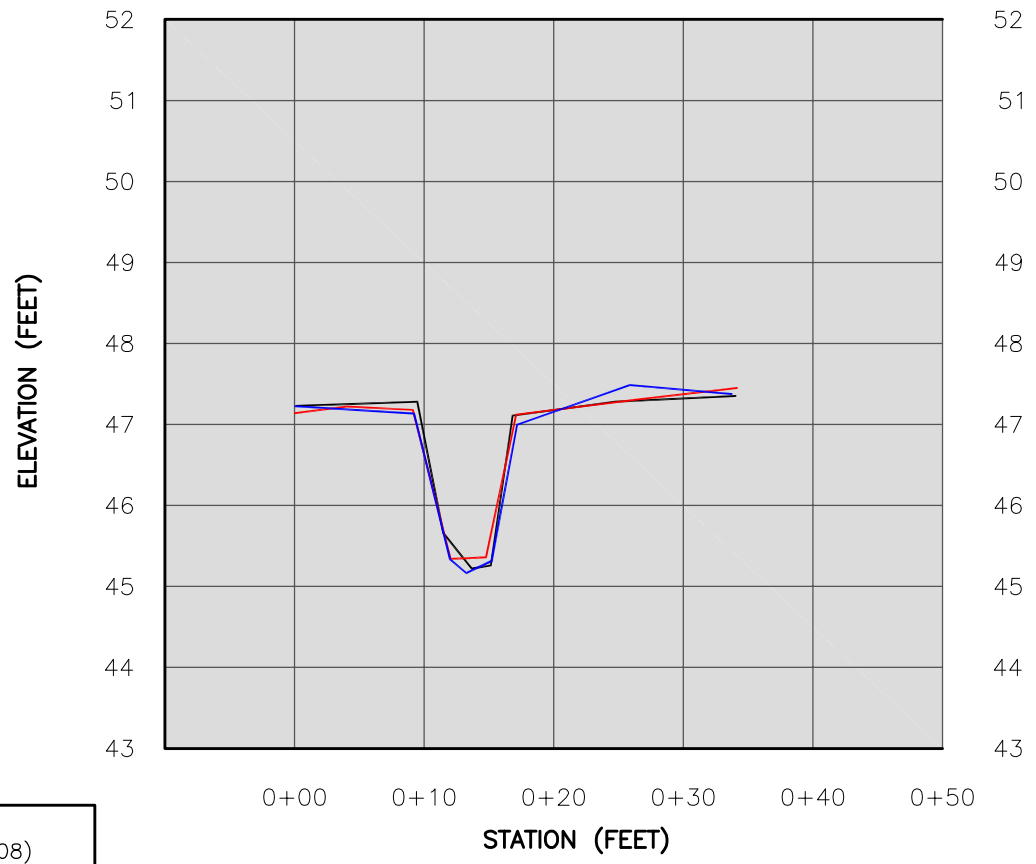
**YEAR-2 MONITORING REPORT**
HERTFORD COUNTY, NC

Title:
**CROSS SECTION XS3-POOL**

| | |
|---|---|
| Dsn. By: TAL | Dwn. By: TAL |
| Ckd. By: MCG | Date: NOV 2009 |
| Scale: NO SCALE | |
| Project No.: 06-306 | |

SHEET
**B3**

## XS4 (Riffle)




### SURVEY DATA

| STATION | ELEVATION | FEATURE | STATION | ELEVATION | FEATURE |
|---|---|---|---|---|---|
| 0 | 47.8 | LPIN | | | |
| 9.12 | 47.71 | | | | |
| 11.9 | 45.91 | | | | |
| 13.16 | 45.74 | | | | |
| 15.11 | 45.89 | | | | |
| 17.07 | 47.57 | | | | |
| 25.76 | 48.06 | | | | |
| 33.65 | 47.95 | | | | |
| 34.09 | 48.07 | RPIN | | | |

### SUMMARY DATA

| | |
|---|---|
| BANKFULL CROSS SECTIONAL AREA | 9.4 SQ. FT. |
| BANKFULL WIDTH | 7.7 FT. |
| BANKFULL MEAN DEPTH | 1.2 FT. |
| BANKFULL MAX DEPTH | 1.8 FT. |
| WIDTH-DEPTH RATIO | 6.4 |
| ENTRENCHMENT RATIO | 19.4 |
| CLASSIFICATION | E5 |

XS4 LEFT BANK LOOKING RIGHT BANK

XS4 LOOKING DOWNSTREAM

NOTES:

1. All cross-sections facing the downstream direction

| | |
|---|---|
| Survey Date | OCT. 2009 |
| Survey Weather | Sunny |
| Field Team | Geratz, Schmid |
| Location | XS4 |

PBS&J

REVISIONS

Client:

RESTORATION SYSTEMS, LLC
Natural Resources Restoration & Conservation

Project:

**CUTAWHISKIE CREEK RESTORATION SITE**

**YEAR-2 MONITORING REPORT**

HERTFORD COUNTY, NC

Title:

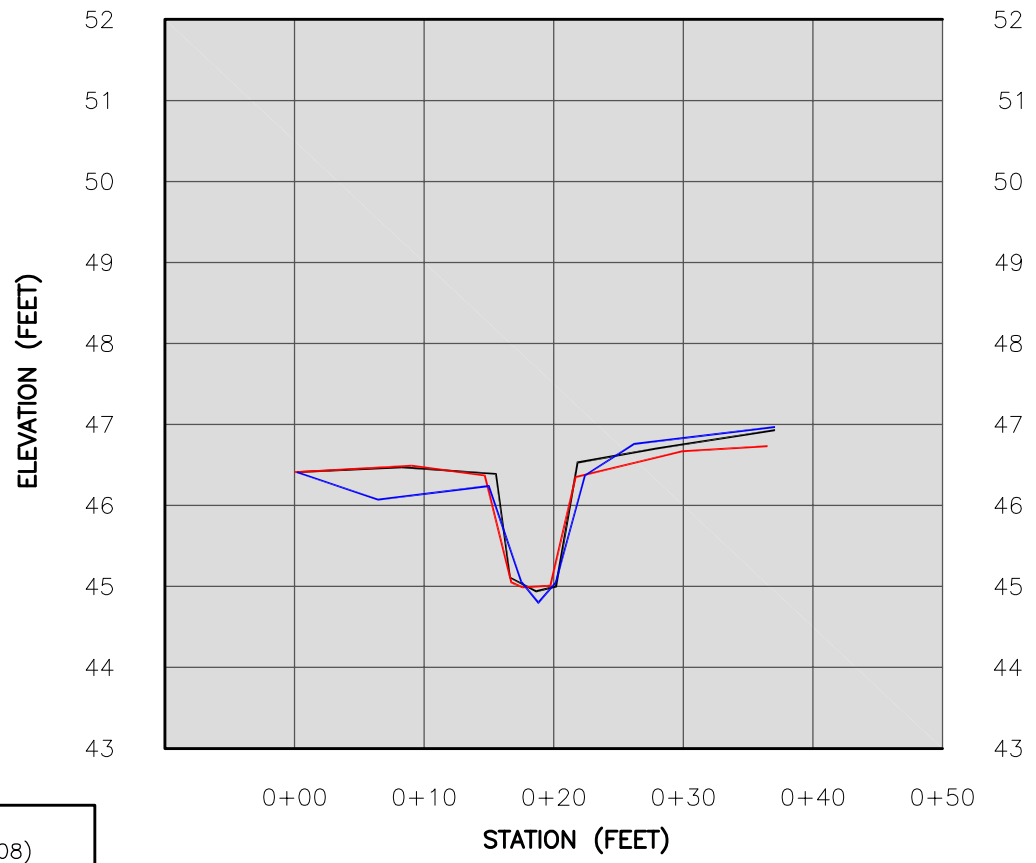
**CROSS SECTION XS4-RIFFLE**

| | |
|---|---|
| Dsn. By: TAL | Dwn. By: TAL |
| Ckd. By: MCG | Date: NOV 2009 |
| Scale: NO SCALE | |
| Project No.: 06-306 | |

SHEET

**B4**

## XS5 (Riffle)

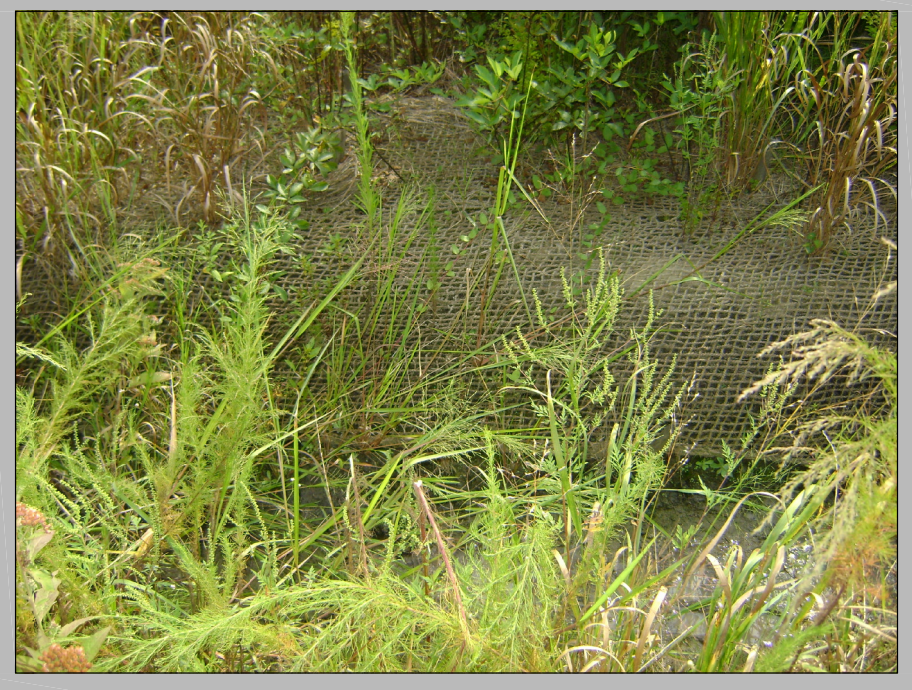



### SURVEY DATA

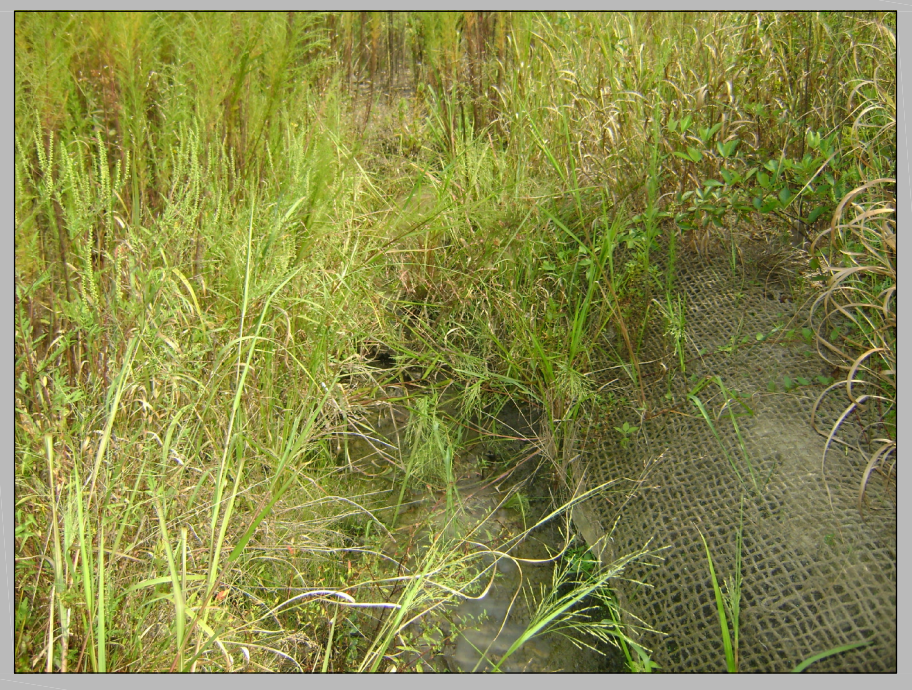
| STATION | ELEVATION | FEATURE | STATION | ELEVATION | FEATURE |
|---|---|---|---|---|---|
| 0 | 46.36 | LPIN | | | |
| 10.87 | 46.15 | | | | |
| 14.67 | 45.76 | | | | |
| 16.91 | 44.44 | | | | |
| 18.25 | 44.19 | | | | |
| 19.57 | 44.45 | | | | |
| 22.08 | 45.63 | | | | |
| 30.63 | 45.46 | | | | |
| 36.88 | 45.8 | RPIN | | | |

### SUMMARY DATA

| | |
|---|---|
| BANKFULL CROSS SECTIONAL AREA | 6.2 SQ. FT. |
| BANKFULL WIDTH | 7.2 FT. |
| BANKFULL MEAN DEPTH | 0.8 FT. |
| BANKFULL MAX DEPTH | 1.4 FT. |
| WIDTH-DEPTH RATIO | 5.1 |
| ENTRENCHMENT RATIO | 20.8 |
| CLASSIFICATION | E5 |



XS5 LEFT BANK LOOKING RIGHT BANK



XS5 LOOKING DOWNSTREAM

NOTES:
1. All cross-sections facing the downstream direction

| | |
|---|---|
| Survey Date | OCT. 2009 |
| Survey Weather | Sunny |
| Field Team | Geratz, Schmid |
| Location | XS5 |

PBS&J

REVISIONS

Client:
RESTORATION SYSTEMS, LLC
Natural Resources Restoration & Conservation

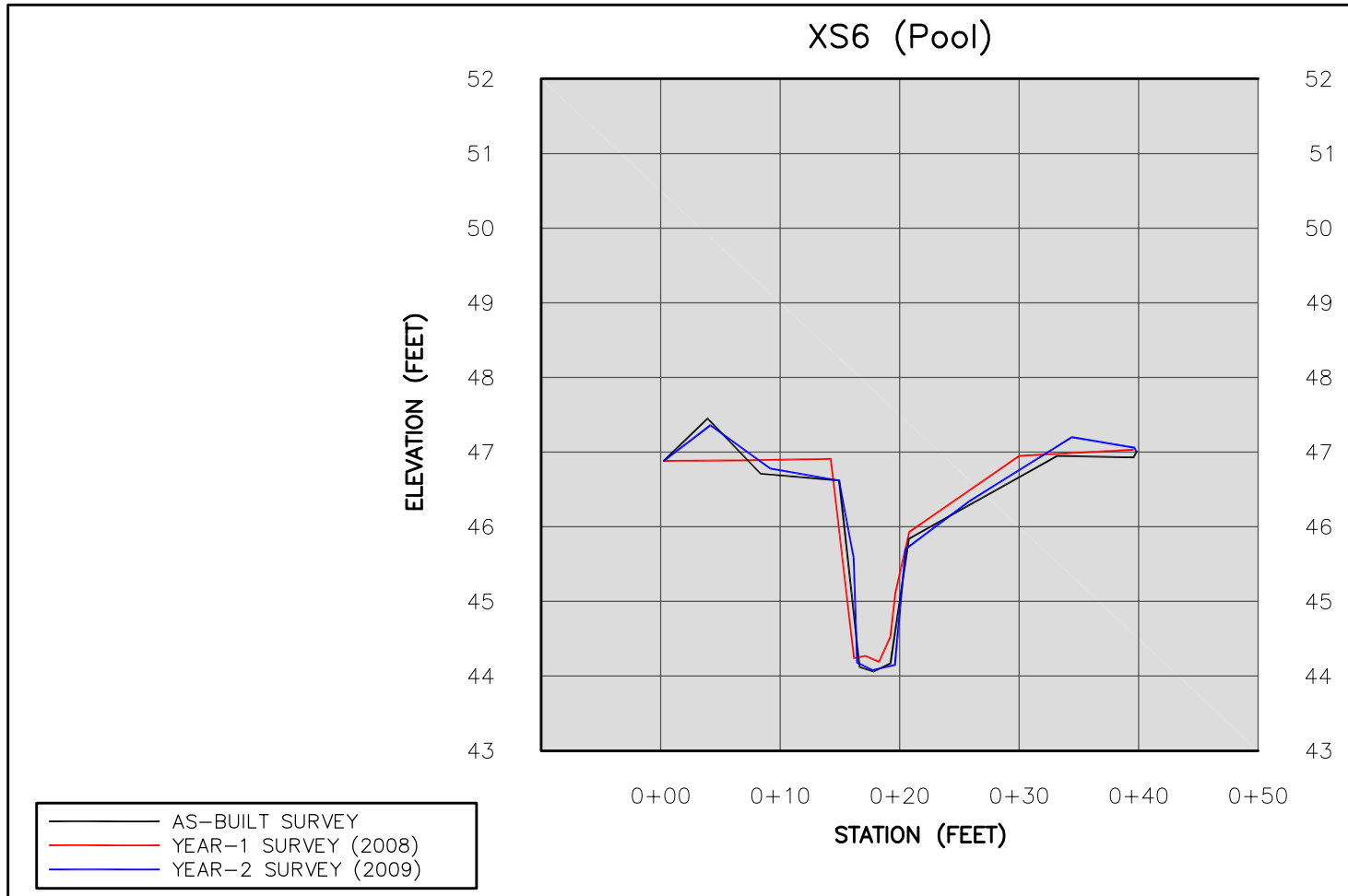
Project:
**CUTAWHISKIE CREEK RESTORATION SITE**

**YEAR-2 MONITORING REPORT**
HERTFORD COUNTY, NC

Title:
**CROSS SECTION XS5-RIFFLE**

| | |
|---|---|
| Dsn. By: TAL | Dwn. By: TAL |
| Ckd. By: MCG | Date: NOV 2009 |
| Scale: NO SCALE | |
| Project No.: 06-306 | |

SHEET
**B5**




## SURVEY DATA

| STATION | ELEVATION | FEATURE | STATION | ELEVATION | FEATURE |
|---|---|---|---|---|---|
| 0 | 46.7 | LPIN | | | |
| 3.91 | 47.18 | | | | |
| 8.93 | 46.6 | | | | |
| 14.68 | 46.44 | | | | |
| 15.9 | 45.41 | | | | |
| 16.19 | 44 | | | | |
| 17.49 | 43.9 | | | | |
| 19.35 | 43.97 | | | | |
| 20.24 | 45.52 | | | | |
| 25.55 | 46.16 | | | | |
| 34.15 | 47.02 | | | | |
| 39.41 | 46.88 | | | | |
| 39.54 | 46.83 | RPIN | | | |

## SUMMARY DATA

| | |
|---|---|
| BANKFULL CROSS SECTIONAL AREA | 14.1 SQ. FT. |
| BANKFULL WIDTH | 13.7 FT. |
| BANKFULL MEAN DEPTH | 1.0 FT. |
| BANKFULL MAX DEPTH | 2.5 FT. |
| WIDTH-DEPTH RATIO | 13.7 |
| ENTRENCHMENT RATIO | 10.9 |
| CLASSIFICATION | N/A |

XS6 LEFT BANK LOOKING RIGHT BANK

XS6 LOOKING DOWNSTREAM

NOTES:
1. All cross-sections facing the downstream direction

| | |
|---|---|
| Survey Date | OCT. 2009 |
| Survey Weather | Sunny |
| Field Team | Geratz, Schmid |
| Location | XS6 |

PBS&J

REVISIONS

Client:
RESTORATION SYSTEMS, LLC
Natural Resources Restoration & Conservation

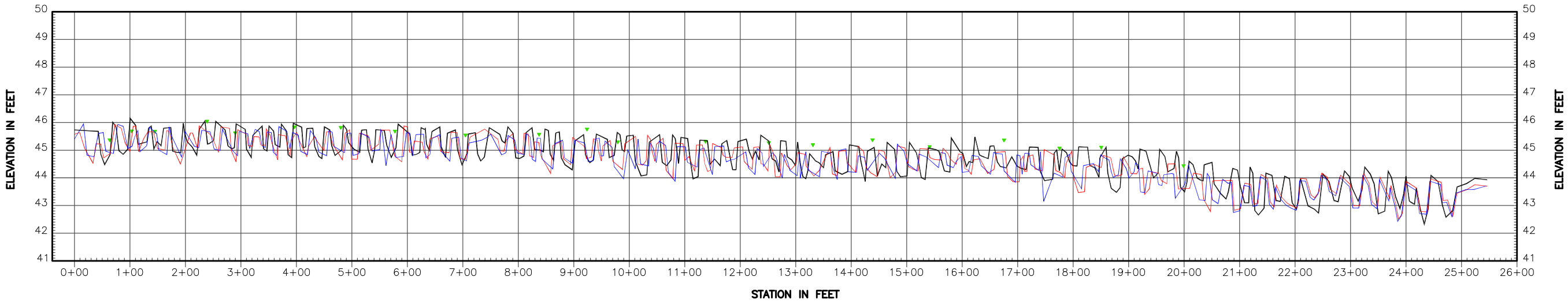
Project:
**CUTAWHISKIE CREEK RESTORATION SITE**

**YEAR-2 MONITORING REPORT**
HERTFORD COUNTY, NC

Title:
**CROSS SECTION XS6-POOL**

| | |
|---|---|
| Dsn. By: TAL | Dwn. By: TAL |
| Ckd. By: MCG | Date: NOV 2009 |
| Scale: NO SCALE | |
| Project No.: 06-306 | |

SHEET
**B6**




PBS&J

| REVISIONS | |
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Client:

RESTORATION SYSTEMS, LLC
Natural Resources Restoration & Conservation

Project:

**CUTAWHISKIE CREEK RESTORATION SITE**

**YEAR-2 MONITORING REPORT**

HERTFORD COUNTY, NC

Title:

**LONGITUDINAL PROFILE**

| Dsn. By: | Dwn. By: |
|---|---|
| TAL | TAL |
| Ckd. By: | Date: |
| MCG | NOV 2009 |

Scale: NO SCALE

Project No.: 06-306

SHEET

**B7**

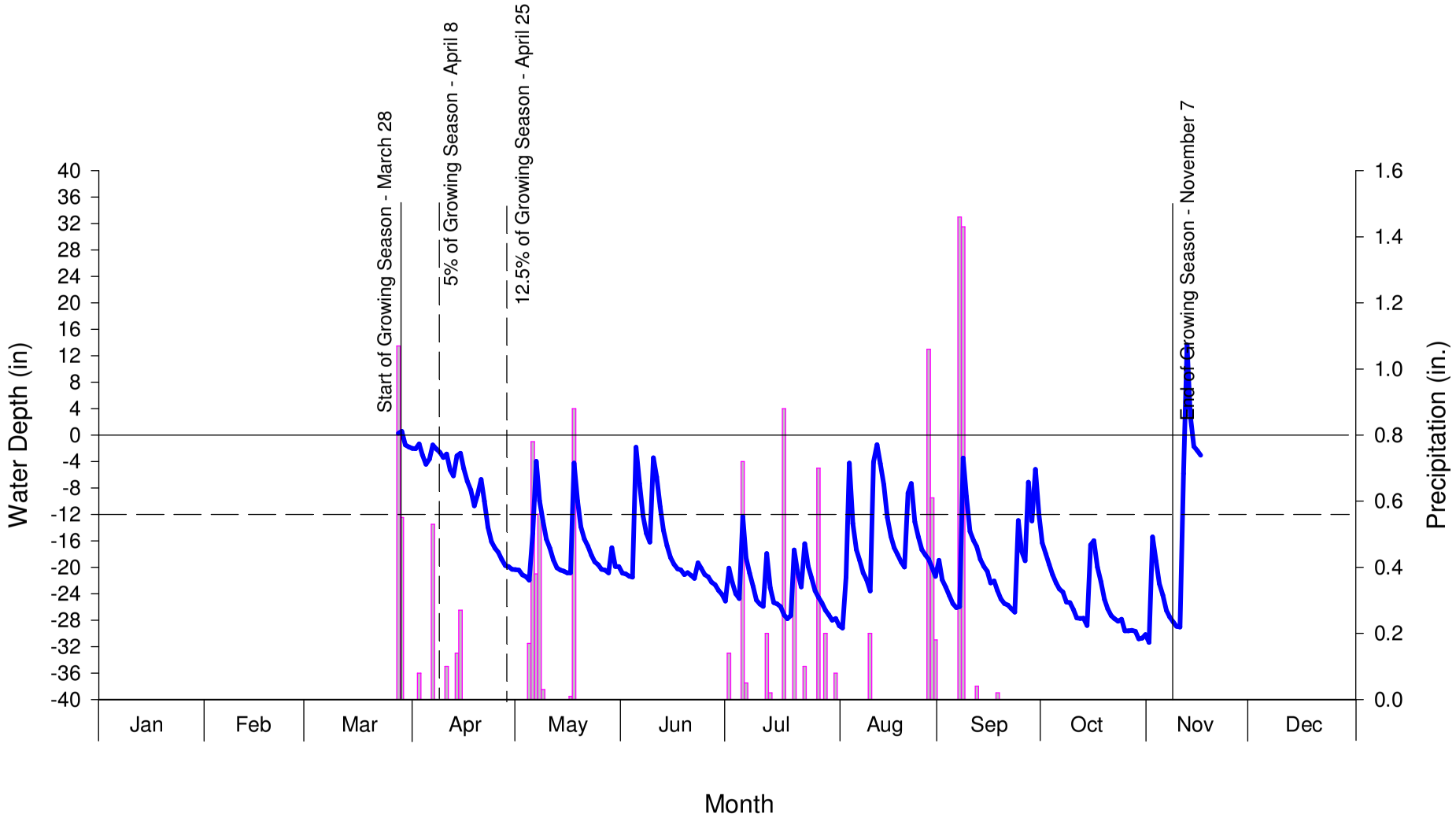
**Bankfull Event 11-14-09: Year-2 Monitoring**

Floodplain wrack line

Water in channel near bankfull. Streamside vegetation matted down along the banks.

**APPENDIX C: WETLAND DATA HYDROGRAPHS**

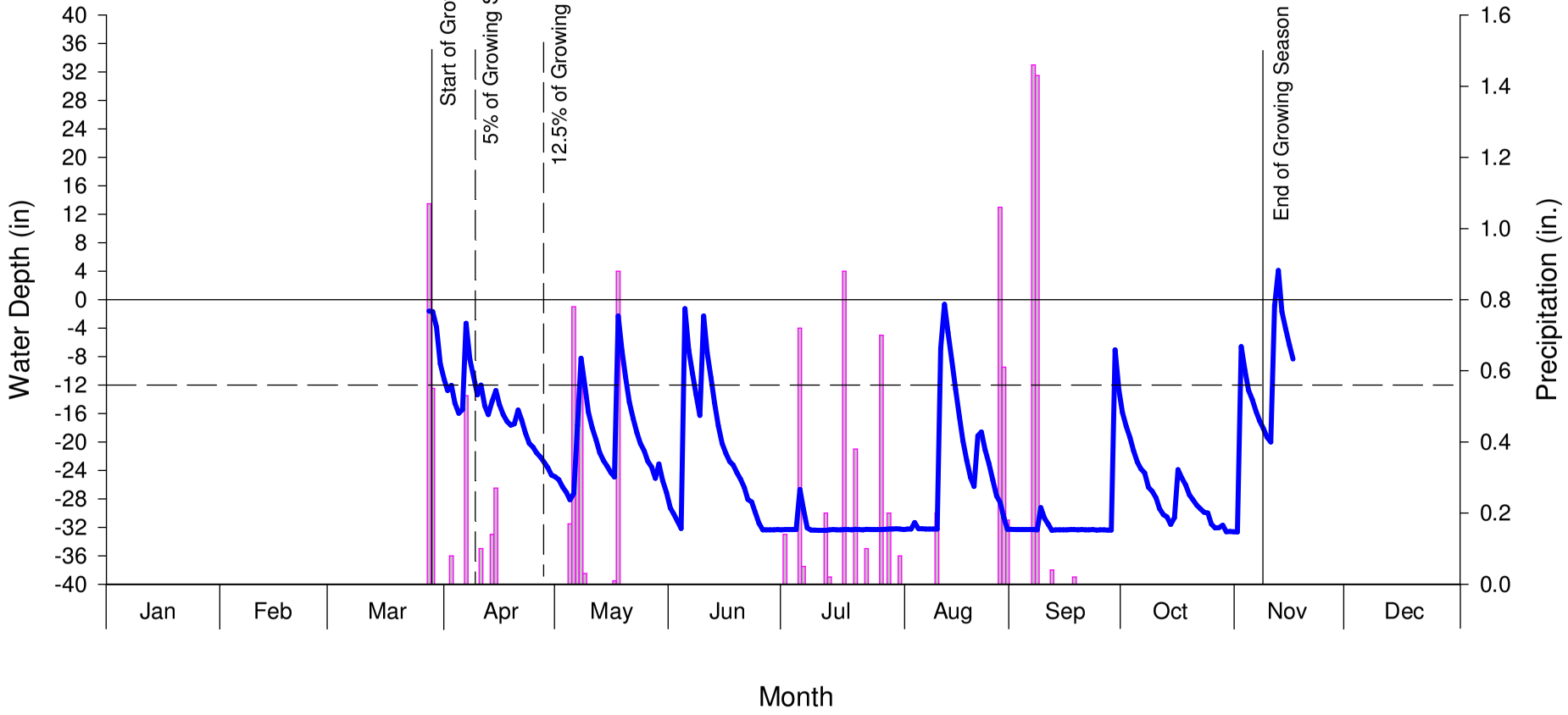
# Cutawhiskie Creek
# Year-2 Monitoring - 2009
# Monitoring Gauge 1: N47BAC28




Data Sources:
Monthly Precipitation- National Climatic Data Center (online)

Extent of available data as of 11-25-09

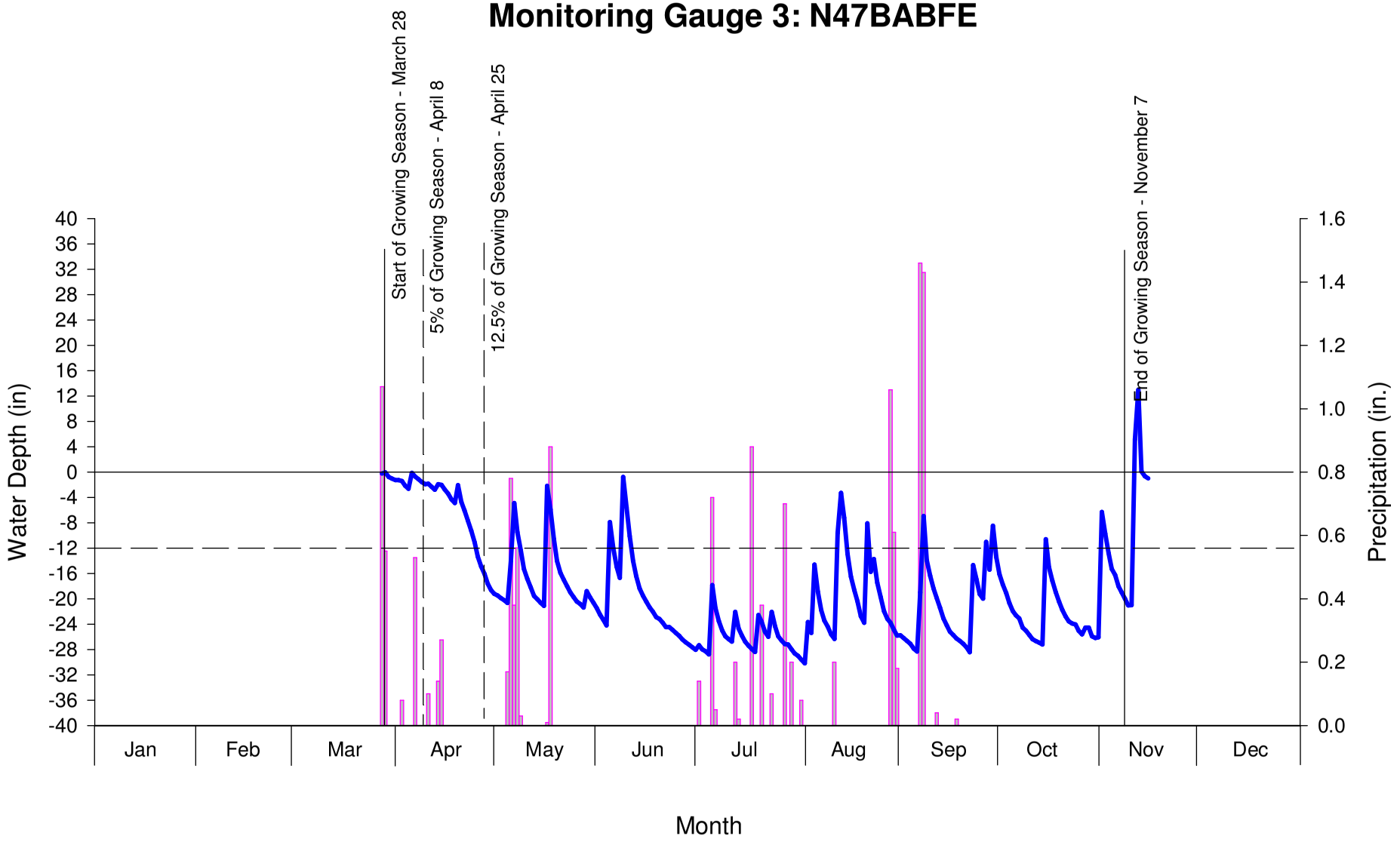
# Cutawhiskie Creek
# Year-2 Monitoring - 2009
# Monitoring Gauge 2: N47BAB81




Data Sources:
Monthly Precipitation- National Climatic Data Center (online)

Extent of available data as of 11-25-09

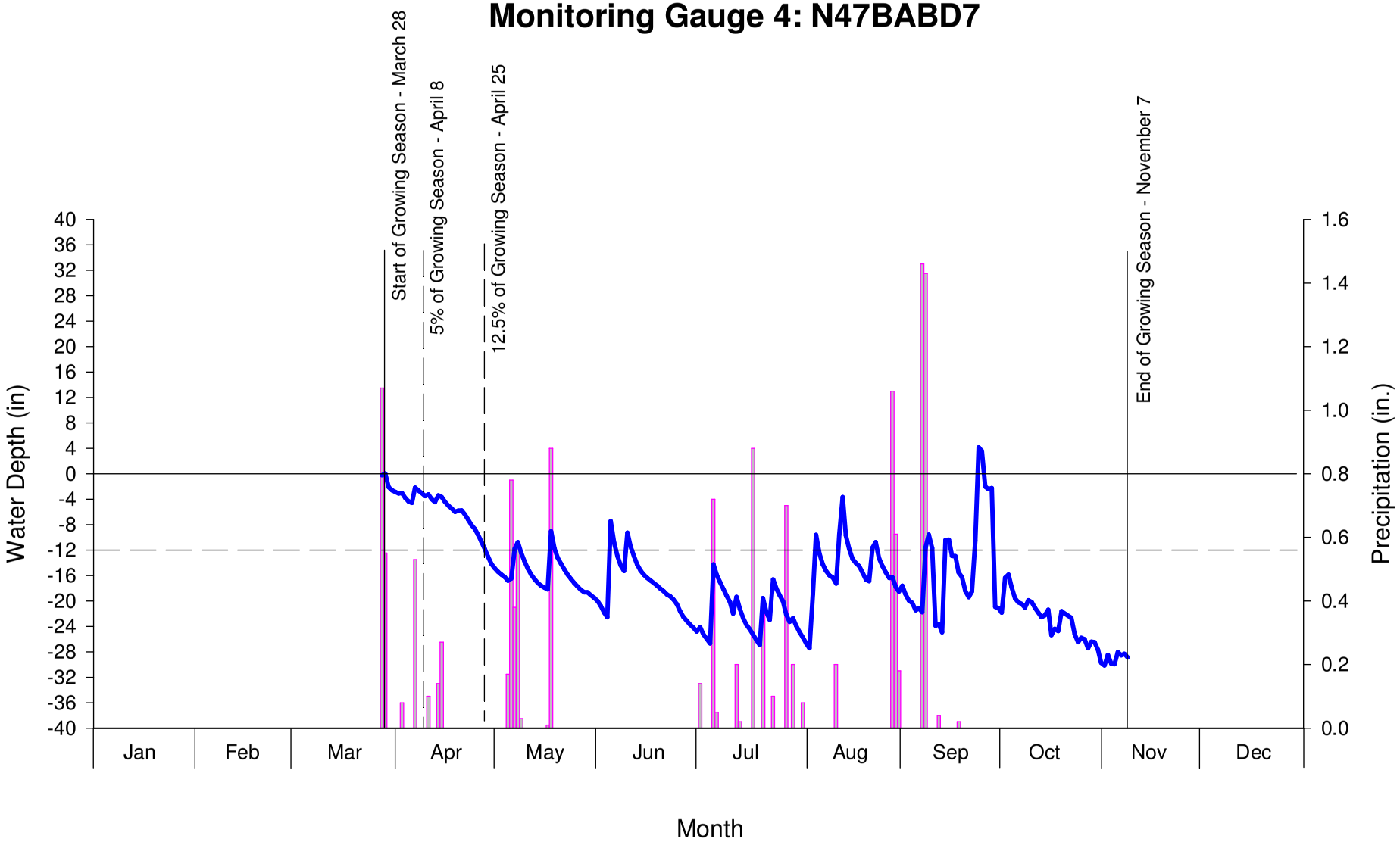
# Cutawhiskie Creek
# Year-2 Monitoring - 2009
# Monitoring Gauge 3: N47BABFE




Data Sources:
Monthly Precipitation- National Climatic Data Center (online)

Extent of available data as of 11-25-09

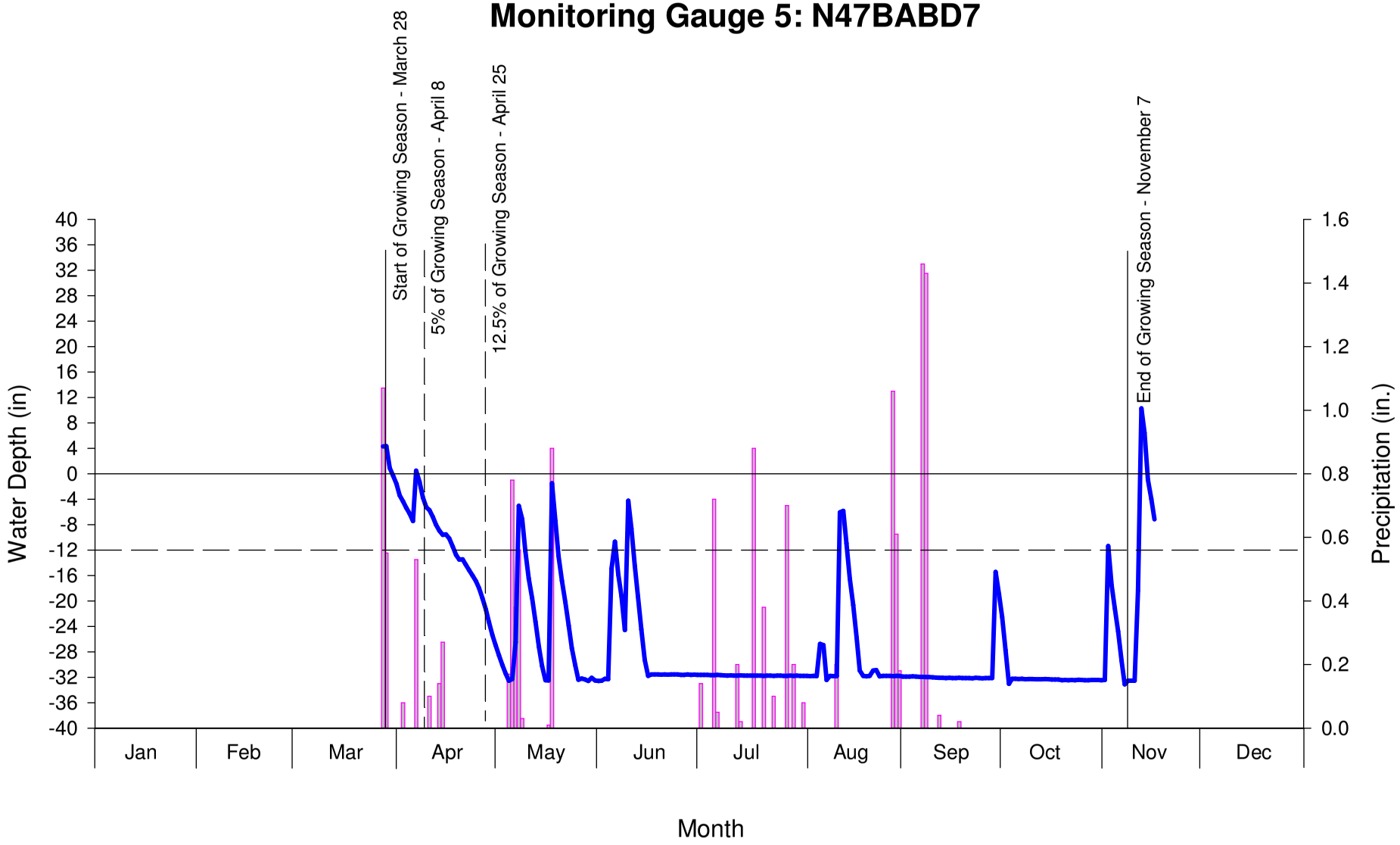
# Cutawhiskie Creek
## Year-2 Monitoring - 2009
## Monitoring Gauge 4: N47BABD7




Data Sources:
Monthly Precipitation- National Climatic Data Center (online)

Extent of available data as of 11-25-09

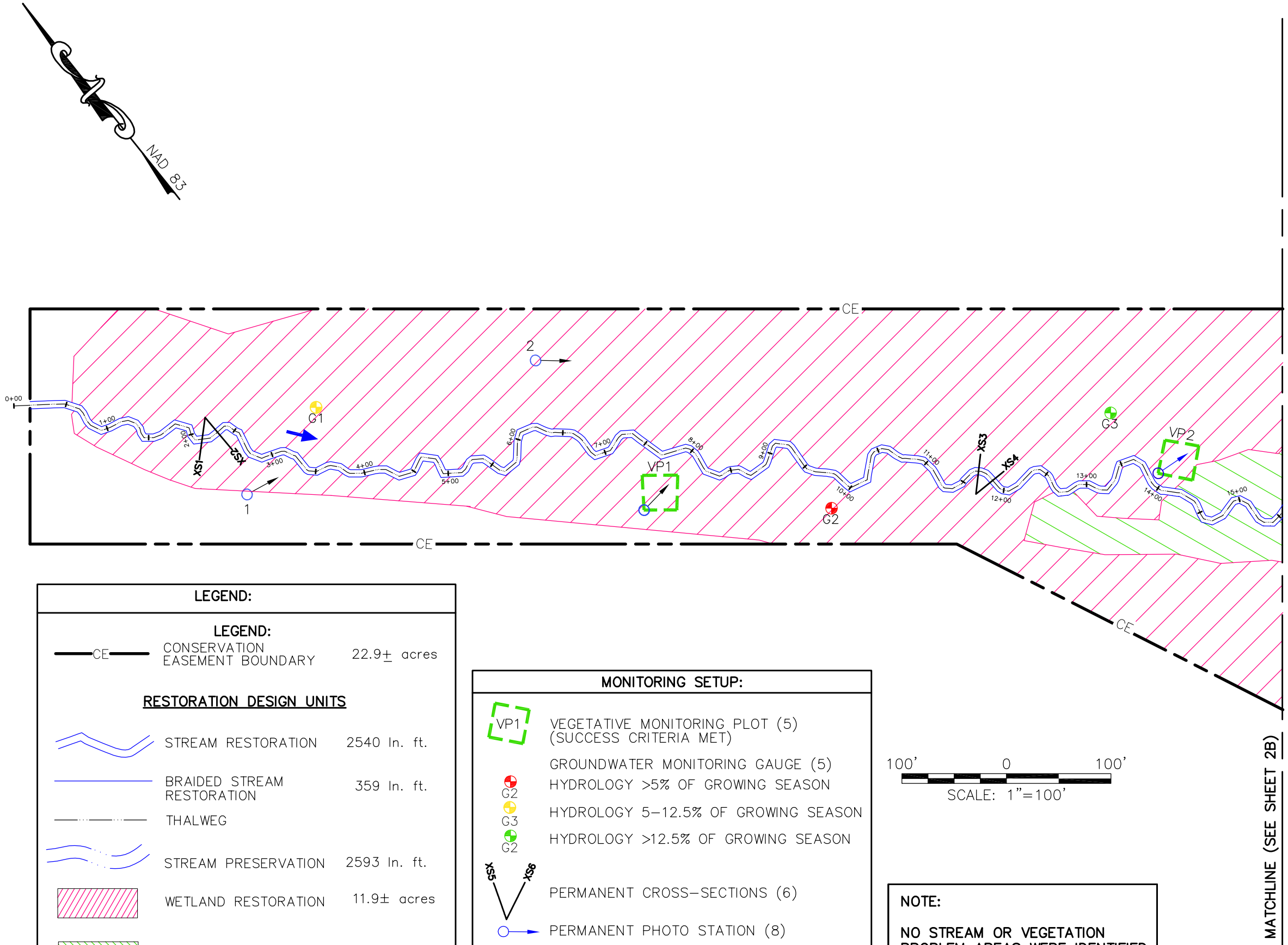
# Cutawhiskie Creek
# Year-2 Monitoring - 2009
# Monitoring Gauge 5: N47BABD7




Data Sources:
Monthly Precipitation- National Climatic Data Center (online)

Extent of available data as of 11-25-09

**APPENDIX D: CURRENT CONDITIONS AREA PLAN VIEW**




**LEGEND:**

**LEGEND:**

| | | |
|---|---|---|
| CE | CONSERVATION EASEMENT BOUNDARY | 22.9± acres |

**RESTORATION DESIGN UNITS**

| | | |
|---|---|---|
| | STREAM RESTORATION | 2540 ln. ft. |
| | BRAIDED STREAM RESTORATION | 359 ln. ft. |
| | THALWEG | |
| | STREAM PRESERVATION | 2593 ln. ft. |
| | WETLAND RESTORATION | 11.9± acres |
| | WETLAND ENHANCEMENT | 1.1± acres |

**MONITORING SETUP:**

| | |
|---|---|
| VP1 | VEGETATIVE MONITORING PLOT (5) (SUCCESS CRITERIA MET) |
| | GROUNDWATER MONITORING GAUGE (5) |
| G2 | HYDROLOGY >5% OF GROWING SEASON |
| G3 | HYDROLOGY 5–12.5% OF GROWING SEASON |
| G2 | HYDROLOGY >12.5% OF GROWING SEASON |
| XSX XSX | PERMANENT CROSS–SECTIONS (6) |
| | PERMANENT PHOTO STATION (8) |
| | STREAM FLOW DIRECTION |

100' 0 100'

SCALE: 1"=100'

**NOTE:**

NO STREAM OR VEGETATION PROBLEM AREAS WERE IDENTIFIED DURING YEAR–1 MONITORING.

PBS&J

REVISIONS

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| | |

Client:

RESTORATION SYSTEMS, LLC
Natural Resources Restoration & Conservation

Project:

CUTAWHISKIE CREEK RESTORATION SITE

YEAR-2 MONITORING REPORT
HERTFORD COUNTY, NC

Title:

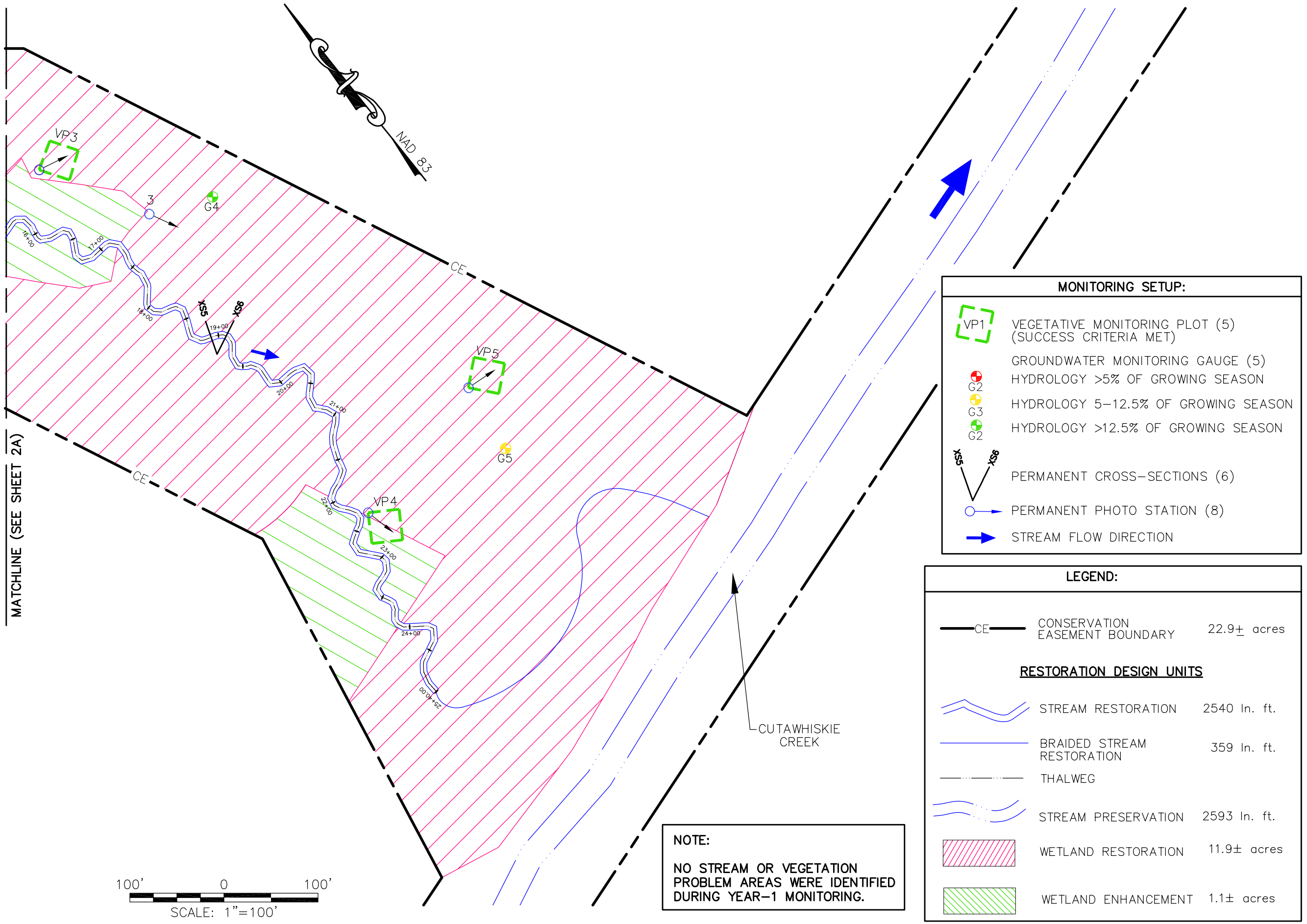
CURRENT CONDITIONS AREA PLAN VIEW

| | |
|---|---|
| Dwn. By: TAL | Ckd. By: JWG |
| Date: NOV 2009 | Scale: AS SHOWN |

ESC Project No.: 06–306

FIGURE

2A




**MONITORING SETUP:**

- VP1 — VEGETATIVE MONITORING PLOT (5) (SUCCESS CRITERIA MET)
- GROUNDWATER MONITORING GAUGE (5)
  - G2 — HYDROLOGY >5% OF GROWING SEASON
  - G3 — HYDROLOGY 5–12.5% OF GROWING SEASON
  - G2 — HYDROLOGY >12.5% OF GROWING SEASON
- XS5 XS6 — PERMANENT CROSS-SECTIONS (6)
- PERMANENT PHOTO STATION (8)
- STREAM FLOW DIRECTION

**LEGEND:**

| | | |
|---|---|---|
| CE | CONSERVATION EASEMENT BOUNDARY | 22.9± acres |

**RESTORATION DESIGN UNITS**

| | | |
|---|---|---|
| | STREAM RESTORATION | 2540 ln. ft. |
| | BRAIDED STREAM RESTORATION | 359 ln. ft. |
| | THALWEG | |
| | STREAM PRESERVATION | 2593 ln. ft. |
| | WETLAND RESTORATION | 11.9± acres |
| | WETLAND ENHANCEMENT | 1.1± acres |

**NOTE:**

NO STREAM OR VEGETATION PROBLEM AREAS WERE IDENTIFIED DURING YEAR-1 MONITORING.

PBS&J

REVISIONS

Client:
RESTORATION SYSTEMS, LLC
Natural Resources Restoration & Conservation

Project:
CUTAWHISKIE CREEK RESTORATION SITE
YEAR-2 MONITORING REPORT
HERTFORD COUNTY, NC

Title:
CURRENT CONDITIONS AREA PLAN VIEW

| Dwn. By: | Ckd. By: |
|---|---|
| TAL | JWG |
| Date: | Scale: |
| NOV 2009 | AS SHOWN |

ESC Project No.: 06-306

FIGURE
2B