ANNUAL MONITORING REPORT

YEAR 2 (2008)
CONTRACT D06003-1

LLOYD STREAM AND WETLAND RESTORATION SITE
ONSLOW COUNTY, NORTH CAROLINA

FULL DELIVERY PROJECT
WHITE OAK RIVER BASIN
CATALOGING UNIT 03030001

Prepared for:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
RALEIGH, NORTH CAROLINA

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November 2008

EXECUTIVE SUMMARY

Restoration Systems, L.L.C. has completed restoration of stream and wetlands (riverine and nonriverine) at the Lloyd Stream and Wetland Restoration Site to assist the North Carolina Ecosystem Enhancement Program in fulfilling stream and wetland mitigation goals in the region. The Site is located approximately 1 mile southeast of Richlands and 5 miles northwest of Jacksonville, in Onslow County. The Site is located in United States Geological Survey (USGS) Hydrologic Unit (HU) 03030001010030 (North Carolina Division of Water Quality Subbasin 03-05-02) of the White Oak River Basin and will service the USGS 8-digit CU 03030001. This report serves as the Year 2 (2008) annual monitoring report.

Primary activities at the Site included 1) stream restoration, 2) wetland restoration, 3) soil scarification, and 4) plant community restoration. Project restoration efforts provide a minimum of 4750 Stream Mitigation Units, 3.3 riverine Wetland Mitigation Units, and 3.1 nonriverine Wetland Mitigation Units as outlined in the June 2005 Technical Proposal.

Five vegetation plots (10 meters by 10 meters in size) were established and permanently monumented. These plots were surveyed in late July and mid-September 2008 for the Year 2 (2008) monitoring season. Based on the number of stems present, the average density of all plots was 599 planted stems per acre surviving in Year 2 (2008). The dominant species identified at the Site were planted stems of sycamore (*Platanus americana*), green ash (*Fraxinus pennsylvanica*), and sugarberry (*Celtis laevigata*).

Vegetation sampling across the Site was above the required average density with 599 planted stems per acre with individual plot densities ranging from 364 to 809 planted stems per acre. A small area of poor vegetation growth is located near groundwater monitoring Gauge 4, most likely due to a lack of nutrients in the soil after construction. This area will continue to be monitoring; however, is expected to recover naturally. No other vegetation problem areas were noted during the Year 2 (2008) monitoring season.

Twelve cross-sections and longitudinal profiles within three reaches totaling 3442 linear feet were measured during Year 2 (2008) monitoring. As a whole, monitoring measurements indicate that there have been minimal changes in both the longitudinal profile and cross-sections as compared to as-built data. The as-built channel geometry compares favorably with the emulated, stable E/C type stream reach as set forth in the detailed mitigation plan and construction plans. Current monitoring has demonstrated dimension, pattern, and profile were stable over the course of the monitoring period.

One stream problem area was noted at the forded stream crossing located within Monitoring Reach 1. Heavy trucks used the ford during a logging operation affecting the integrity of the structure and causing water to pond within approximately 100 linear feet of stream channel behind the ford. Restoration Systems will resolve this problem during the winter of 2008-2009. No other stream problem areas were noted within the Site during the Year 2 (2008) monitoring year.

Four restoration Site groundwater gauges and one reference groundwater gauge were operated for the Year 2 (2008) monitoring season. One of the two groundwater gauges within the riverine wetland restoration area was inundated/saturated within 12 inches of the surface for greater than 8 percent of the growing season and none of the two monitored gauges within the nonriverine wetland restoration areas were inundated/saturated within 12 inches of the surface for greater than 10 percent of the growing season. However, rainfall data for the Year 2 (2008) growing season at nearby rain stations was widely

varying and no conclusions could be made. Therefore, comparisons to the reference groundwater gauge were made and of the groundwater gauges should be considered successful for the Year 2 (2008) monitoring period.

In summary, the restoration site achieved success criteria for vegetation, stream, and hydrology attributes in the Second Monitoring Year (2008).

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1.0 PROJECT BACKGROUND

1.1 Location and Setting

Restoration Systems, L.L.C. (Restoration Systems) has completed restoration of stream and wetlands (riverine and nonriverine) at the Lloyd Stream and Wetland Restoration Site (hereafter referred to as the "Site") to assist the North Carolina Ecosystem Enhancement Program (EEP) in fulfilling stream and wetland mitigation goals in the region. The Site is located approximately 1 mile southeast of Richlands and 5 miles northwest of Jacksonville, in Onslow County (Figure 1). The Site is located in United States Geological Survey (USGS) Hydrologic Unit (HU) 03030001010030 (North Carolina Division of Water Quality [NCDWQ] Subbasin 03-05-02) of the White Oak River Basin and will service the USGS 8-digit CU 03030001.

Directions to the Site from Richlands, North Carolina, are as follows:

- Travel east on Highway 24 for approximately 4 miles
- Turn left on Northwest Bridge Road and travel approximately 2 miles
- The Site is on the left

1.2 Project Objectives

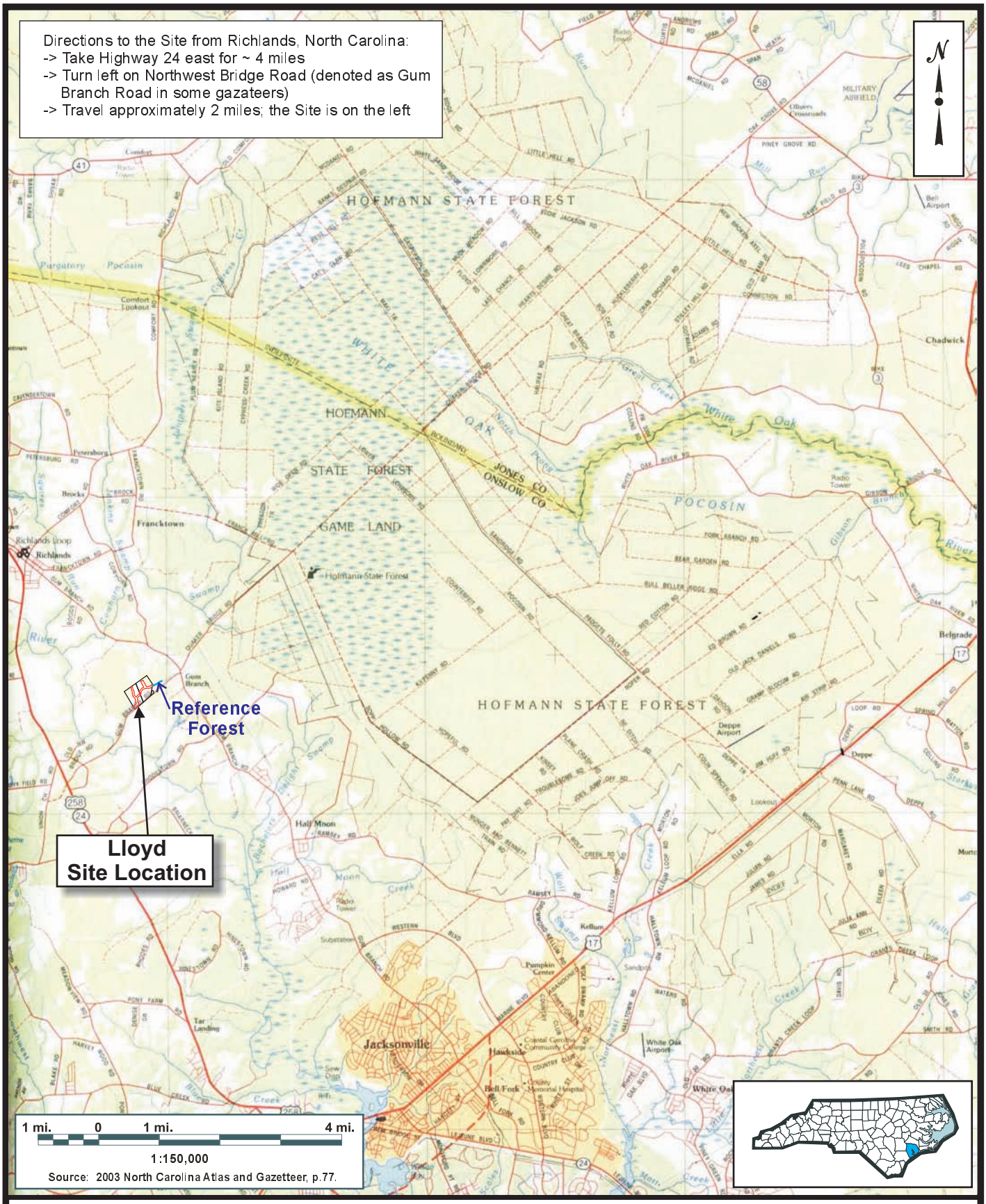
The primary components of the restoration project included 1) construction of a stable, riffle-pool stream channel; 2) enhancement of water quality functions within, upstream, and downstream of the Site 3) creation of a natural vegetated buffer along restored stream channels; 4) restoration of jurisdictional riverine and nonriverine wetlands in the Site; 5) improvement of aquatic habitat and species diversity by enhancing stream bed variability; and 6) restoration of wildlife functions associated with a riparian corridor/stable stream.

1.3 Project Structure, Restoration Type, and Approach

A 24.3-acre conservation easement has been placed on the Site to incorporate all restoration activities. The Site contains 22.5 acres of hydric soil, two unnamed tributaries (UTs) to the New River (main and eastern tributaries), riparian buffer, and upland slopes. The purpose of this project was to restore stable pattern, dimension, and profile to the UTs; restore hydrology to drained riverine and nonriverine wetlands; and revegetate streams, floodplains, and wetlands within the Site. The Site drainage area encompasses approximately 1.4 square miles of land at the downstream Site outfall that is characterized by agricultural land, forest, and low-density residential development.

Prior to construction, the entire Site was characterized by active pasture, fallow fields, and forest stands. Pasture was grazed by livestock including cattle and horses, and livestock had access to the entire Site. No exclusionary barriers were located adjacent to onsite streams or wetlands and livestock contributed to degradation of stream banks, unstable channel characteristics (stream entrenchment, erosion, and bank collapse), degraded water quality, compacted hydric soils, and decreased wetland function. In addition, the eastern tributary didn't receive natural stream flows. A berm had been placed near the eastern property/Site boundary to redirect stream flows into a linear ditch that drained south along the eastern property boundary into roadside ditches along the southern property boundary. The roadside ditch tied into the main tributary in the southwestern portion of the Site.

The primary goals of this stream and wetland restoration project focused on improving water quality, enhancing flood attenuation, and restoring aquatic and riparian habitat and were accomplished by:



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SITE LOCATION
LLOYD STREAM AND WETLAND RESTORATION SITE
Onslow County, North Carolina

Dwn. by: CLF	FIGURE 1
Date: NOV 2008	
Project: 08-007	

- Removing nonpoint sources of pollution associated with agricultural production including a) removal of livestock from streams, stream banks, and floodplains; b) cessation of broadcasting fertilizer, pesticides, and other agricultural materials into and adjacent to Site streams and wetlands; and c) providing a vegetative buffer adjacent to streams and wetlands to treat surface runoff.
- Reducing sedimentation within onsite and downstream receiving waters by a) reducing bank erosion associated with hoof shear, vegetation maintenance, and agricultural plowing to Site streams and b) providing a forested vegetative buffer adjacent to Site streams and wetlands.
- Reestablishing stream stability and the capacity to transport watershed flows and sediment loads by restoring stable dimension, pattern, and profile.
- Promoting floodwater attenuation by a) reconnecting bankfull stream flows to the abandoned floodplain terrace; b) restoring secondary, entrenched tributaries thereby reducing floodwater velocities within smaller catchment basins; c) restoring depressional floodplain wetlands and increasing storage capacity for floodwaters within the Site; and d) revegetating Site floodplains to increase frictional resistance on floodwaters crossing Site floodplains.
- Improving aquatic habitat by enhancing stream bed variability.
- Providing wildlife habitat including a forested riparian corridor within a region of the state highly dissected by agricultural land use.

Primary activities at the Site included 1) belt-width preparation and grading, 2) floodplain bench excavation, 3) channel excavation, 4) installation of channel and ditch plugs, 5) backfilling of the abandoned channel and ditches, 6) ditch rerouting, 7) installation of in-stream structures and a Terracell drop structure at the Site outfall, 8) construction of a piped channel crossing, 9) floodplain soil scarification, and 10) plant community restoration.

Table 1 describes the Site restoration structures and objectives, which have provided a minimum of 4750 Stream Mitigation Units, 3.3 riverine Wetland Mitigation Units, and 3.1 nonriverine Wetland Mitigation Units as outlined in the June 2005 Technical Proposal. Site restoration activities included the following.

- Restored 5858 linear feet of stream within two UTs to the New River by constructing meandering, C/E-type channels.
- Restored 3.3 acres of riverine wetland through filling ditches, removal of spoil castings, eliminating agricultural practices, and/or planting with native forest vegetation.
- Restored 3.1 acres of nonriverine wetland through filling ditches, removal of spoil castings, eliminating agricultural practices, and/or planting with native forest vegetation.
- Reforested the entire floodplain with native forest species.

Table 1. Site Restoration Structures and Objectives

Restoration Segment/ Reach ID	Station Range	Restoration Type/Approach*	Designed Linear Footage/Acreage	SMU/WMUs
Tributary 1	0+00 – 27+96	Restoration/PI	2796	2796
Tributary 2	0+00 – 30+62	Restoration/PI	3062	3062
Riverine Wetlands	--	Restoration	3.3	3.3
Nonriverine Wetlands	--	Restoration	3.1	3.1
Mitigation Unit Summations				
Stream	**Riverine Wetland**	**Nonriverine Wetland**		
5858 SMU	3.3 WMU	3.1 WMU		

*PI=Priority 1

1.4 Project History and Background

Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 2-4.

Table 2. Project Activity and Reporting History

Activity or Report	Data Collection Completion	Actual Completion or Delivery
Restoration Plan	May 2006	June 2006
Construction Completion	NA	March 2007
Site Planting	NA	March 2007
Mitigation Plan/As-builts	March 2007	May 2007 amended July 2007
Year 1 Monitoring (2008)	November 2007	December 2007
Year 2 Monitoring (2008)	November 2008	November 2008

Table 3. Project Contacts Table

Full Delivery Provider	Restoration Systems 1101 Haynes Street, Suite 211 Raleigh, North Carolina 27604 George Howard and John Preyer (919) 755-9490
Construction Contractor	Backwater Environmental PO Box 1654 Pittsboro, North Carolina 27312 Wes Newell (919) 523-4375
Planting Contractor	Carolina Silvics 908 Indian Trail Road Edenton, North Carolina 27932 Dwight McKinney (919) 523-4375
Designer and Year 2 (2008) Monitoring Performer	Axiom Environmental, Inc. 2126 Rowland Pond Dr. Willow Spring, NC 27592 Grant Lewis (919) 215-1693
Year 1 (2007) Monitoring Performer	ARACDIS G&M of North Carolina, Inc. 801 Corporate Center Drive, Suite 300 Raleigh, NC 27607 Ben Furr and Keven Duerr (919) 854-1282

Table 4. Project Background Table

Project County	Onslow County, North Carolina
Drainage Area	1.4 square miles
Drainage impervious cover estimate (%)	< 5
Stream Order	First and Second
Physiographic Region	Coastal Plain
Ecoregion	Carolina Flatwoods
Rosgen Classification of As-built	E-/C-type
Cowardin Classification	Riverine: PFO1J Nonriverine: PF01A
Dominant Soil Types	Rains, Muckalee, Goldsboro, Grifton, Craven
Reference Site ID	Bullard Branch
USGS HUC	Site: 03030001 Reference: 03030007
NCDWQ Subbasin	Site: 03-05-02 Reference: 03-06-22
NCDWQ Classification	C NSW (Stream Index # 19-(1))
Any portion of any project segment 303d listed?	No
Any portion of project upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	Not Applicable
% of project easement fenced	100%

1.5 Monitoring Plan View

Monitoring activities for the Site, including relevant structures and utilities, project features, specific project structures, and monitoring features are detailed in the monitoring plan view in Appendix D. Site features including vegetation, stream dimension (cross-sections), stream profile and pattern, wetland hydrology, and photographic documentation were monitored in Year 2 (2008).

2.0 PROJECT CONDITION AND MONITORING RESULTS

2.1 Vegetation Assessment

Following Site construction, five plots (10 meters by 10 meters in size) were established and monumented with metal fence posts at all plot corners and PVC at each plot origin. Sampling was conducted as outlined in the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee et al. 2006) (http://cvs.bio.unc.edu/methods.htm); results are included in Appendix A. The taxonomic standard for vegetation used for this document was *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas* (Weakley 2007). The locations of vegetation monitoring plots were placed to accurately represent the entire Site and are depicted on the monitoring plan view in Appendix D.

2.1.1 Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for forest development. Success criteria are dependent upon the density and growth of characteristic forest species. Additional success criteria are dependent upon density and growth of "Characteristic Tree Species." Characteristic Tree Species include planted species, species identified through inventory of a reference (relatively undisturbed) forest community used to orient the planting plan, and appropriate Schafale and Weakley (1990) community descriptions (Coastal Plain Small Stream Swamp and Nonriverine Wet Hardwoods Forest). All canopy tree species planted and identified in the reference

forest will be utilized to define "Characteristic Tree Species" as termed in the success criteria. Table 5 below outlines planted and reference forest species.

Table 5. Planted Species and Reference Forest Ecosystem

Planted Species	Reference Species
Pawpaw (*Asimina triloba*)	Red maple (*Acer rubrum*)
River birch (*Betula nigra*)	Ironwood (*Carpinus carolinia*)
Mockernut hickory (*Carya alba*)	Pignut hickory (*Carya glabra*)
Water hickory (*Carya aquatica*)	Dogwood (*Cornus* sp.)
Sugarberry (*Celtis laevigata*)	Ash (*Fraxinus* sp.)
Buttonbush (*Cephalanthus occidentalis*)	American holly (*Ilex opaca*)
Green ash (*Fraxinus pennsylvanica*)	Sweetgum (*Liquidambar styraciflua*)
Black walnut (*Juglans nigra*)	Yellow poplar (*Liriodendron tulipifera*)
Black gum (*Nyssa sylvatica*)	White oak (*Quercus alba*)
Sycamore (*Platanus occidentalis*)	Water oak (*Quercus nigra*)
Cherrybark oak (*Quercus pagodaefolia*)	Laurel oak (*Quercus laurifolia*)
Water oak (*Quercus nigra*)	Swamp chestnut oak (*Quercus michauxii*)
Willow oak (*Quercus phellos*)	Cherrybark oak (*Quercus pagoda*)
American elm (*Ulmus americana*)	

Success criteria dictate that an average density of 320 stems per acre of Character Tree Species must be surviving in the first three monitoring years. Subsequently, 290 Character Tree Species per acre must be surviving in year 4 and 260 Character Tree Species per acre in year 5.

2.1.2 Vegetative Problem Areas

Vegetation sampling across the Site was above the required average density with an overall average of 599 planted stems per acre. A small area of poor vegetation growth is located near groundwater monitoring Gauge 4, most likely due to a lack of nutrients in the soil after construction. This area will continue to be monitoring; however, is expected to recover naturally. In addition, four small (less than 2 feet tall) privet bushes near Station 16+00 of Tributary 1 were treated with a 2% solution of glyphosate herbicide in July. No other vegetation problem areas were noted during the Year 2 (2008) monitoring season.

2.2 Stream Assessment

Twelve permanent cross-sections within three reaches totaling 3442 linear feet were established after construction was completed. Measurements of each cross-section include points at all breaks in slope including top of bank, bankfull, and thalweg. Riffle cross-sections are classified using the Rosgen stream classification system. Longitudinal profile measurements include thalweg, water surface, and bankfull; with each measurement taken at the head of facets (i.e. riffle, run, pool, and glide) in addition to the maximum pool depth.

2.2.1 Stream Success Criteria

Success criteria for stream restoration will include 1) successful classification of the reach as a functioning stream system (Rosgen 1996) and 2) channel variables indicative of a stable stream system.

The channel configuration will be measured on an annual basis in order to track changes in channel geometry, profile, or substrate. These data will be utilized to determine the success in restoring stream channel stability. Specifically, the width-to-depth ratio should characterize an E-type and/or a borderline E-type/C-type channel (≤ 18), bank-height ratios indicative of a stable or moderately unstable channel, and minimal changes in cross-sectional area, channel width, and/or bank erosion along the monitoring reach. In addition, channel abandonment and/or shoot cutoffs must not occur and sinuosity values must remain at approximately 1.3 (thalweg distance/straight-line distance). The field indicator of bankfull will be described in each monitoring year and indicated on a representative channel cross-section figure. If the stream channel is down-cutting or the channel width is enlarging due to bank erosion, additional bank or slope stabilization methods will be employed.

Some areas within the design channel may be expected to form low-slope, braided, stream/swamp complexes similar to Muckalee swamps in the area. These stream/swamp complexes would not be considered unstable; however, footage of stream channel restoration in these reaches will be recalculated from distance along the thalweg (1.3 sinuosity) to distance along the valley (1.0 sinuosity).

Stream substrate is not expected to coarsen over time; therefore, pebble counts are not proposed as part of the stream success criteria.

Visual assessment of in-stream structures will be conducted to determine if failure has occurred. Failure of a structure may be indicated by collapse of the structure, undermining of the structure, abandonment of the channel around the structure, and/or stream flow beneath the structure.

2.2.2 Bankfull Events

No bankfull events were documented during the Year 2 (2008) monitoring period.

Table 6. Verification of Bankfull Events

Date of Data Collection	Date of Occurrence	Method-State Climate Office of North Carolina Precipitation Data		Photo (if available)
		Precipitation Total (inches)	Station	
--	5/18/07	1.1	314471 - Jacksonville	--
--	6/3/07	1.25	314471 - Jacksonville	--
--	6/30/07	1.39	314471 - Jacksonville	--
--	7/21/07	2.05	314471 - Jacksonville	--
--	8/12/07	1.52	314471 - Jacksonville	--
--	8/22/07	1.26	314471 - Jacksonville	--
--	9/20/07	1.54	314144 – Hoffman Forest	--
--	9/21/07	1.54	314144 – Hoffman Forest	--

2.2.3 Stream Problem Areas

One stream problem area was noted at the forded stream crossing located within Monitoring Reach 1. Heavy trucks used the ford during a logging operation affecting the integrity of the structure and causing water to pond within approximately 100 linear feet of stream channel behind the ford; pictures are included in Appendix B. Restoration Systems is currently assessing the problem and will either install a culvert or lower the level of the ford during the winter of 2008-2009. No other stream problem areas were noted within the Site during the Year 2 (2008) monitoring year.

2.2.4 Categorical Stream Feature Visual Stability Assessment

Each stream reach was visually inspected during the Year 2 (2008) monitoring period using eight feature categories and various metrics within each category. Assessment features included riffles, pools, thalweg, meanders, channel bed, structures, and root wads/boulders. Tables for semi-quantitative assessements of each reach are included in Appendix B (Tables B1-B5). The mean percentage of performance for features within each reach are summarized in the tables below.

Table 7A. Categorical Stream Feature Visual Stability Assessment

Lloyd (Reach 1)

Feature	As-built	Year 1 (2007)	Year 2 (2008)	Year 3 (2009)	Year 4 (2010)	Year 5 (2011)
A. Riffles	100%	100%	99%			
B. Pools	100%	90%	100%			
C. Thalweg	100%	100%	100%			
D. Meanders	100%	100%	100%			
E. Bed General	100%	100%	100%			
F. Banks	100%	100%	100%			
G. Vanes / J. Hooks, Etc.	100%	100%	100%			
H. Wads and Boulders	NA	NA	NA			

Table 7B. Categorical Stream Feature Visual Stability Assessment

Lloyd (Reach 2)

Feature	As-built	Year 1 (2007)	Year 2 (2008)	Year 3 (2009)	Year 4 (2010)	Year 5 (2011)
A. Riffles	100%	100%	100%			
B. Pools	100%	100%	99%			
C. Thalweg	100%	100%	100%			
D. Meanders	100%	100%	100%			
E. Bed General	100%	95%	100%			
F. Banks	100%	100%	100%			
G. Vanes / J. Hooks, Etc.	100%	100%	100%			
H. Wads and Boulders	NA	NA	NA			

Table 7C. Categorical Stream Feature Visual Stability Assessment

Lloyd (Reach 3)

Feature	As-built	Year 1 (2007)	Year 2 (2008)	Year 3 (2009)	Year 4 (2010)	Year 5 (2011)
A. Riffles	100%	100%	100%			
B. Pools	100%	90%	98%			
C. Thalweg	100%	100%	100%			
D. Meanders	100%	100%	100%			
E. Bed General	100%	100%	100%			
F. Banks	100%	90%	100%			
G. Vanes / J. Hooks, Etc.	100%	100%	88%			
H. Wads and Boulders	NA	NA	NA			

2.2.5 Quantitative Stream Measurements

During the Year 2 (2008) monitoring period 12 cross-sections and longitudinal profiles within three reaches totaling 3442 linear feet were measured. Permanent cross-sections, longitudinal profiles, and photographs are included in Appendix B. As a whole, monitoring measurements indicate minimal changes in both the longitudinal profile and cross-sections as compared to as-built conditions. Although detailed surveys of as-built conditions weren't conducted immediately following construction, the monitored profiles and cross-sections in Year 1 (2007) match the designed stream channel. Therefore, comparisons for Year 2 (2008) and each subsequent year will be made with Year 1 (2007), which accurately represents the as-built/baseline conditions. The Year 2 (2008) channel geometry compares favorably with the emulated, stable E/C type stream reach as set forth in the detailed mitigation plan and as constructed. Current monitoring has demonstrated dimension, pattern, and profile were stable over the course of the monitoring period. Tables for quantitative assessments are included below; these tables include data from previous years.

2.3 Wetland Assessment

Four groundwater monitoring gauges and one reference groundwater gauge were maintained and monitored throughout the Year 2 (2008) growing season. Graphs of groundwater hydrology and precipitation from a nearby rain station in Kenansville (Weather Underground 2008) are included in Appendix C.

2.3.1 Wetland Success Criteria

Target hydrological characteristics include saturation or inundation for at least 10 percent within Rains soils (nonriverine wetlands) and 8 percent within Muckalee soils (riverine wetlands) of the growing season, during average climatic conditions. The growing season extends from April 8 to November 5 (212 days). This value is based on DRAINMOD simulations for 42 years of rainfall data in an old field stage. These areas are expected to support hydrophytic vegetation. If wetland parameters are marginal as indicated by vegetation and/or hydrology monitoring, a jurisdictional determination will be performed in these areas (Environmental Laboratory 1987).

In atypical dry years, the hydroperiod must exceed 75 percent of the hydroperiod exhibited by the reference gauges. Reference gauge data will be used to compare wetland hydroperiods between the restoration areas and relatively undisturbed reference wetlands. This data will supplement regulatory evaluation of success criteria and also provide information that shall allow interpretation of mitigation success in years not supporting "normal" rainfall conditions.

2.3.2 Wetland Problem Areas

No wetland problem areas were identified within the Site during Year 2 (2008) monitoring.

Table 8. Baseline Morphology and Hydraulic Summary
Entire Project - 5858 lf

Parameter	USGS Gage Data			Preproject Eastern Tributary			Preproject Main Tributary			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)				4.6	7.2	6.5	6.3	8.4	7.1	N/A	N/A	9.3	7.7	11	9.4	7.9	7.9	8.9
Floodprone Width (ft)				7.8	10.2	9	8.7	10.8	9.3	150	250	225	150	250	225	N/A	N/A	N/A
BF Cross Sectional Area (ft2)				6.1	6.2	6.1	6.7	7.2	6.9	N/A	N/A	11.6	6.1	12.1	N/A	N/A	N/A	N/A
BF Mean Depth (ft)				0.8	1.3	1	0.8	1.1	1	N/A	N/A	1.2	0.8	1.2	1	N/A	N/A	N/A
BF Max Depth (ft)				1.2	1.7	1.4	0.9	1.3	1.3	N/A	N/A	2.3	1	2.3	1.6	1.2	1.6	1.3
Width/Depth Ratio				3.5	8.6	6.5	5.9	10.5	7	N/A	N/A	7.4	7	12	10	N/A	N/A	N/A
Entrenchment Ratio				1.3	1.8	1.5	1.1	1.5	1.4	16.1	26.9	24.2	16	27	24	N/A	N/A	N/A
Bank Height Ratio				4.5	9	6.4	4.9	5.2	5.1	N/A	N/A	1	1	1.3	1	N/A	N/A	N/A
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
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	N/A	N/A	N/A
Pattern																		
Channel Beltwidth (ft)				No distinctive pattern due			No distinctive pattern due			21	36	34	15	77	31	N/A	N/A	N/A
Radius of Curvature (ft)				to channel straightening			to channel straightening			13.7	18.6	16.1	15	44	21	18	53	23
Meander Wavelength (ft)				activities			activities			55	82	71	46	154	75	N/A	N/A	N/A
Meander Width Ratio										2.3	3.9	3.7	2	7	4	N/A	N/A	N/A
Profile																		
Riffle Length (ft)				No distinctive repetitive			No distinctive repetitive			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Riffle Slope (ft/ft)				pattern of riffles and pools			pattern of riffles and pools			0.007	0.016	0.0129	0.0007	0.0064	0.0033	N/A	N/A	N/A
Pool Length (ft)				due to channel			due to channel			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pool Spacing (ft)				straightening activities			straightening activities			32	55	43	31	77	47	N/A	N/A	N/A
Substrate																		
d50 (mm)				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
d84 (mm)				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
Additonal Reach Parameters																		
Valley Length (ft)				N/A			N/A			N/A			N/A			N/A		
Channel Length (ft)				N/A			N/A			N/A			5,858			N/A		
Sinuosity				1.02			1.02			1.37			1.3-1.4			N/A		
Water Surface Slope (ft/ft)				0.0043			0.0032			0.004			0.0025			N/A		
BF Slope (ft/ft)				N/A			N/A			N/A			0.0025			N/A		
Rosgen Classification				G5/6			G5/6			E6			E5/6			N/A		

N/A = Not Available

Table 9A. Morphology and Hydraulic Monitoring Summary
Lloyd Reach 1 (1180 linear feet)

Parameter	Cross Section 5 Riffle						Cross Section 6 Max Pool						Cross Section 7 Max Pool						Cross Section 8 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)	8.1	8.6					11.5	11.2					13.4	14.6					7.4	11.2				
Floodprone Width (ft)	39	38					63	----					>100	----					>90	80				
BF Cross Sectional Area (ft2)	6.1	5.4					11.2	11.2					14.6	15.6					5.5	5.6				
BF Mean Depth (ft)	0.8	0.6					1	1					1.1	1.1					0.7	0.5				
BF Max Depth (ft)	1.1	1					2	1.8					2.1	2					1.1	1.1				
Width/Depth Ratio	10.7	13.5					11.8	----					12.3	----					9.9	22.3				
Entrenchment Ratio	4.8	4.4					5.5	----					7.5	----					12.2	7.2				
Bank Height Ratio	1	1					1	----					1	----					1	1				
Wetted Perimeter (ft)	8.7	9					12.4	12					14.3	15.1					7.9	11.5				
Hydraulic Radius (ft)	0.7	0.7					0.9	0.9					1	1					0.7	0.5				
Substrate																								
d50 (mm)	<0.1	----					<0.1	----					<0.1	----					<0.1	----				
d84 (mm)	<0.1	----					<0.1	----					<0.1	----					<0.1	----				

Parameter	MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)			MY-5+ (2012)		
	Min	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Pattern																		
Channel Beltwidth (ft)	15	61	32	15	61	32												
Radius of Curvature (ft)	16	31	21	16	31	21												
Meander Wavelength (ft)	61	111	76	61	111	76												
Meander Width Ratio	2.5	10.2	5.3	2.5	10.2	5.3												
Profile																		
Riffle Length (ft)	7	32	18	12	32	78												
Riffle Slope (ft/ft)				0.00%	0.05%	0.39%												
Pool Length (ft)	8	47	22	13	24	34												
Pool Spacing (ft)	25	66	48	25	66	48												
Additonal Reach Parameters																		
Valley Length (ft)	928			928														
Channel Length (ft)	1180			1180														
Sinuosity	1.3			1.3														
Water Surface Slope (ft/ft)	no water in ch.			0.0002														
BF Slope (ft/ft)	0.0003			0.0003														
Rosgen Classification	E5/6			E5/6														

Table 9B. Morphology and Hydraulic Monitoring Summary
Lloyd Reach 2 (1345 linear feet)

Parameter	Cross Section 1 Max Pool						Cross Section 2 Riffle						Cross Section 3 Max 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)	12.7	15					8.3	8.7					11.7	15.6					7.4	8				
Floodprone Width (ft)	>100	----					>100	150					>150	----					120	150				
BF Cross Sectional Area (ft2)	16.7	17.3					7.3	6.6					22.3	15.6					5.4	5.6				
BF Mean Depth (ft)	1.3	1.2					0.9	0.8					1.9	1					0.7	0.7				
BF Max Depth (ft)	2.7	2.4					1.4	1.2					3.3	2.1					1.2	1.2				
Width/Depth Ratio	9.6	----					9.5	11.4					6.1	----					10.2	11.6				
Entrenchment Ratio	7.9	----					12	17.3					12.8	----					16.2	18.6				
Bank Height Ratio	1	----					1	1					1	----					1	1				
Wetted Perimeter (ft)	14.3	16.3					8.9	9.1					14.1	16.4					7.9	8.7				
Hydraulic Radius (ft)	1.2	0.7					0.8	0.7					1.6	0.9					0.7	0.6				
Substrate																								
d50 (mm)	0.3	----					0.3	----					0.3	----					0.3	----				
d84 (mm)	6	----					6	----					6	----					6	----				

Parameter	MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)			MY-5+ (2012)		
	Min	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Pattern																		
Channel Beltwidth (ft)	17	58	34	17	58	34												
Radius of Curvature (ft)	18	31	21	18	31	21												
Meander Wavelength (ft)	53	113	85	53	113	85												
Meander Width Ratio	2.8	9.7	5.7	2.8	9.7	5.7												
Profile																		
Riffle Length (ft)	6	44	20	11	26	54												
Riffle Slope (ft/ft)	0	0.037	0.01	0.00%	2.15%	0.84%												
Pool Length (ft)	5	66	22	13	24	38												
Pool Spacing (ft)	24	100	54	24	100	54												
Additonal Reach Parameters																		
Valley Length (ft)	1005			1005														
Channel Length (ft)	1343			1343														
Sinuosity	1.3			1.3														
Water Surface Slope (ft/ft)	0.0033			0.0033														
BF Slope (ft/ft)	0.0033			0.0033														
Rosgen Classification	E5			E5														

Table 9C. Morphology and Hydraulic Monitoring Summary
Lloyd Reach 3 (917 linear feet)

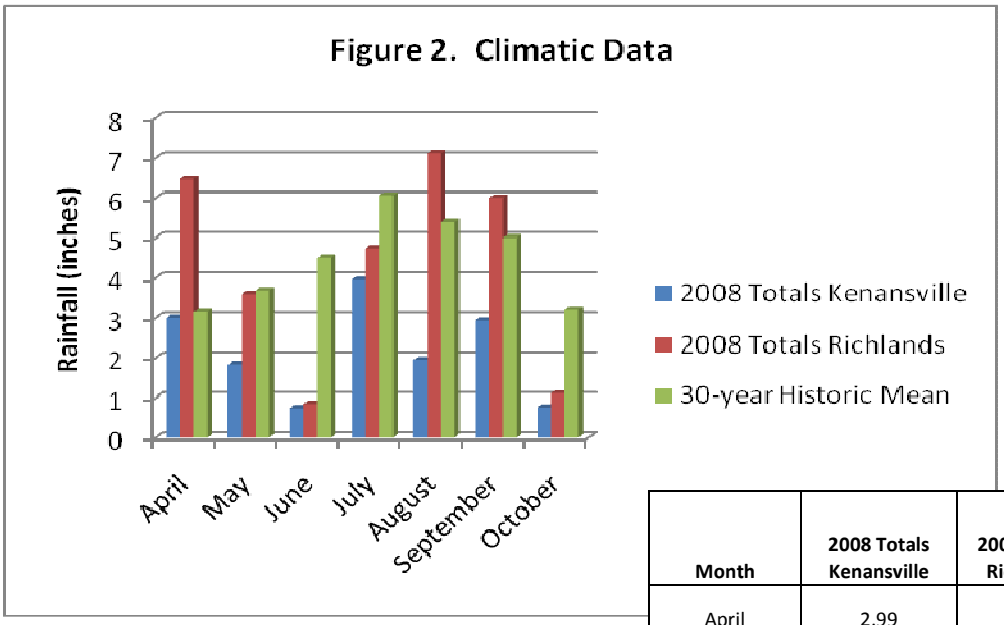
Parameter	Cross Section 9 Max Pool						Cross Section 10 Riffle						Cross Section 11 Max Pool						Cross Section 12 Riffle					
Dimension	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
BF Width (ft)	14.7	17.3					10.9	9.9					13.1	16.9					10.1	12.2				
Floodprone Width (ft)	>200	----					>110	150					>230	----					>170	150				
BF Cross Sectional Area (ft2)	21.2	20.3					11.1	11.4					19.3	23.8					10.6	13.1				
BF Mean Depth (ft)	1.4	1.2					1	1.2					1.5	1.4					1	1.1				
BF Max Depth (ft)	2.9	2.4					1.7	1.6					2.9	3.2					1.7	2.1				
Width/Depth Ratio	10.1	----					10.8	8.6					8.8	----					9.6	11.3				
Entrenchment Ratio	13.6	----					10.1	15.2					17.6	----					16.9	12.3				
Bank Height Ratio	1	----					1	1					1	----					1	1				
Wetted Perimeter (ft)	16.1	18.1					11.5	10.9					14.6	18.8					11	13				
Hydraulic Radius (ft)	1.3	1.1					1	1					1.3	1.3					1	1				
Substrate																								
d50 (mm)	0.1	----					0.1	----					0.1	----					0.1	----				
d84 (mm)	1	----					1	----					1	----					1	----				

Parameter	MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)			MY-5+ (2012)		
	Min	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Pattern																		
Channel Beltwidth (ft)	24	64	43	24	64	43												
Radius of Curvature (ft)	19	33	23	19	33	23												
Meander Wavelength (ft)	64	106	91	64	106	91												
Meander Width Ratio	2.2	5.8	3.9	2.2	5.8	3.9												
Profile																		
Riffle Length (ft)	12	33	19	11	24	54												
Riffle Slope (ft/ft)	0	0.026	0.01	0.00%	2.15%	0.91%												
Pool Length (ft)	15	64	29	24	38	68												
Pool Spacing (ft)	38	83	56	38	83	56												
Additonal Reach Parameters																		
Valley Length (ft)	649			649														
Channel Length (ft)	917			917														
Sinuosity	1.4			1.4														
Water Surface Slope (ft/ft)	0.0034			0.0036														
BF Slope (ft/ft)	0.0029			0.0029														
Rosgen Classification	E5			E5														

2.3.3 Wetland Criteria Attainment

One of the two monitored gauges within the riverine wetland restoration areas was inundated/saturated within 12 inches of the surface for greater than 8 percent of the growing season and none of the two monitored gauges within the nonriverine wetland restoration areas was inundated/saturated within 12 inches of the surface for greater than 10 percent of the growing season, which extends from April 8 to November 5 (212 days) (Table 10). However, rainfall data for the Year 2 (2008) growing season at nearby rain stations was conflicting. Data collected at a station in Kenansville was extremely below normal with 15 inches of rain while data collected at a station in Richlands was just below normal with 29 inches of rain occurring from April to October 2008 compared to the 30-year historic mean rainfall of 31 inches occurring for April to October (Weather Underground 2008, NOAA 2004) (Figure 2). Most of the monthly data collected at the stations in Kenansville and Richlands for 2008 was similar; however, data for the months of April-May and August-September were widely varying, for example in the month of August 2008 1.94 inches of rain was documented in Kenansville while 7.12 inches of rain was documented in Richlands. Since the Year 2 (2008) monitoring season rainfall data was inconclusive, comparisons to the reference groundwater gauge were made. Based on comparisons to reference groundwater gauge data, all groundwater gauges should be considered successful for the Year 2 (2008) monitoring period. Hydrographs containing groundwater and precipitation data for each gauge can be found in Appendix B.

Figure 2. Climatic Data



Month	2008 Totals Kenansville	2008 Totals Richlands	30-year Historic Mean
April	2.99	6.47	3.16
May	1.82	3.59	3.68
June	0.73	0.84	4.49
July	3.95	4.73	6.06
August	1.94	7.12	5.40
September	2.93	6.00	5.00
October	0.75	1.11	3.21
Total	**15.11**	**29.86**	**31.00**

Table 10. Wetland Criteria Attainment for Year 2 (2008)

Gauge ID	Hydrology Threshold Met?	Hydrophytic Vegetation Criteria Met?	Site Mean	Vegetation Plot ID	Vegetation Survival Threshold Met?	Site Mean
1	Yes	Yes	100 %	1	Yes	100 %
2	Yes	Yes		2	Yes	
3	Yes	Yes		3	Yes	
4	Yes	Yes		4	Yes	
				5	Yes	

3.0 CONCLUSIONS

Year 2 (2008) monitoring season rainfall data from nearby rain stations was inconclusive as explained above in Section 2.2.3 (Wetland Criteria Attainment); therefore, comparisons to the reference groundwater gauge were made. Based on comparisons to reference groundwater gauge data, all groundwater gauges within the Site should be considered successful for the Year 2 (2008) monitoring period. A summary of groundwater gauge data for the Year 2 (2008) is included in Table 11. Also, all vegetation plots across the Site were above the required 320 stems per acre with an average of 599 tree stems per acre in the Second Monitoring Year (Year 2008) (Table 12).

Table 11. Summary of Groundwater Gauge Results

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)				
	Year 1 (2007)*	Year 2 (2008)**	Year 3 (2009)	Year 4 (2010)	Year 5 (2011)
1 Riverine	Yes/7 days (3.3 percent)	Yes/12 days (5.7 percent)			
2 Nonriverine	Yes/15 days (7.1 percent)	Yes/10 days (4.7 percent)			
3 Nonriverine	No/2 days (0.9 percent)	Yes/8 days (3.8 percent)			
4 Riverine	Yes/18 days (8.4 percent)	Yes/75 days (35.4 percent)			
Reference	Yes/8 days (3.8 percent)	Yes/9 days (3.8 percent)			

*Annual precipitation to date of this data for the Year 1 (2007) monitoring period was 46.7 inches, 10 inches below the average of 56.4 according to a nearby station (SCONC 2007); therefore, success criteria are based on the reference gauge.

**Annual precipitation to date of this data for the Year 2 (2007) monitoring period was inconclusive at nearby rain stations; therefore, success criteria are based on comparisons to reference gauge data.

Table 12. Summary of Planted Vegetation Plot Results

Plot	Planted Stems/Acre Counting Towards Success Criteria				
	Year 1 (2007)	Year 2 (2008)	Year 3 (2009)	Year 4 (2010)	Year 5 (2011)
1	728	607			
2	728	809			
3	809	769			
4	445	445			
5	364	364			
Average of All Plots (1-5)	**615**	**599**			

4.0 REFERENCES

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APPENDIX A
VEGETATION DATA

1. **Vegetation Survey Data Tables**
2. **Vegetation Monitoring Plot Photos**

Report Prepared By	Corri Faquin
Date Prepared	10/22/2008 10:00

database name	RestorationSystems-2008-Al-v2.2.5.mdb
database location	C:\Business\CVS database
computer name	AXIOM-0A9116A70

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	Lloyd
project Name	Lloyd Restoration Site
Description	Stream and Wetland Restoration Site in Onslow County
River Basin	White Oak

Living planted stems, excluding live stakes, per acre

Project Code	Project Name	River Basin	Year 2
Lloyd	Lloyd Restoration Site	White Oak	599

plot	Plot Level	Year	Latitude/ Northing	Longitude/ Easting	Datum	Date Sampled	Planted Living Stems	Dead/Missing Stems	Planted Living Stems per ACRE	# species
LV1	2	2	34º 51.949'	77º 30.441'	NAD83/WGS84	7/25/2008	15	6	607	3
LV2	2	2	34º 52.036'	77º 30.531'	NAD83/WGS84	7/25/2008	20	2	809	2
LV3	2	2	34º 51.877'	77º 30.697'	NAD83/WGS84	9/17/2008	19	8	769	4
LV4	2	2	34º 51.794'	77º 38.651'	NAD83/WGS84	7/25/2008	11	5	445	3
LV5	2	2	34º 51.658'	77º 30.621'	NAD83/WGS84	9/17/2008	9	6	364	3

Vigor

vigor	Count	Percent
0	3	3
1	1	1
2	36	35.6
3	26	25.7
4	11	10.9
Missing	24	23.8

Damage

Damage	Count	Percent Of Stems
(no damage)	64	63.4
Game	21	20.8
Deer	8	7.9
Unknown	7	6.9
Insects	1	1

Vigor by Species

Species	4	3	2	1	0	Missing
Betula nigra	5	1			2	
Celtis laevigata		2	8			7
Cornus amomum						2
Fraxinus pennsylvanica		3	8			
Nyssa sylvatica			4	1	1	5
Quercus nigra						1
Quercus phellos		2				5
Salix nigra	5					
Carya		7	2			
Platanus occidentalis	1	9	1			
Cephalanthus		2	2			
Ulmus			6			
Ulmus americana			5			1
Unknown						3
Total: 14	**11**	**26**	**36**	**1**	**3**	**24**

Damage by Species

	Species	All Damage Categories	(no damage)	Deer	Game	Insects	Unknown
	Betula nigra	8	8				
	Carya	9	7				2
	Celtis laevigata	17	9	7	1		
	Cephalanthus	4	2	1	1		
	Cornus amomum	2	2				
	Fraxinus pennsylvanica	11	3		7		1
	Nyssa sylvatica	11	6		2		3
	Platanus occidentalis	11	10			1	
	Quercus nigra	1	1				
	Quercus phellos	7	7				
	Salix nigra	5	5				
	Ulmus	6			5		1
	Ulmus americana	6	1		5		
	Unknown	3	3				
TOT:	**14**	**101**	**64**	**8**	**21**	**1**	**7**

Damage by Plot

plot	All Damage Categories	(no damage)	Deer	Game	Insects	Unknown
LV1	21	6	5	8		2
LV2	22	12		7		3
LV3	27	26			1	
LV4	16	7	1	6		2
LV5	15	13	2			
Total	**101**	**64**	**8**	**21**	**1**	**7**

Planted Stems by Plot and Species

Species	Total Planted Stems	# plots	avg# stems	LV1	LV2	LV3	LV4	LV5
Betula nigra	6	2	3			4		2
Carya	9	1	9		9			
Celtis laevigata	10	2	5	6				4
Cephalanthus	4	1	4				4	
Fraxinus pennsylvanica	11	1	11		11			
Nyssa sylvatica	5	2	2.5	4			1	
Platanus occidentalis	11	2	5.5			8		3
Quercus phellos	2	1	2			2		
Salix nigra	5	1	5			5		
Ulmus	6	1	6				6	
Ulmus americana	5	1	5	5				
Total	**74**	**11**		**15**	**20**	**19**	**11**	**9**

All Stems by Plot and Species

Species	Total Stems	# plots	avg# stems	LV1	LV2	LV3	LV4	LV5
Alnus serrulata	1	1	1			1		
Baccharis halimifolia	3	3	1	1	1			1
Betula nigra	8	3	2.67	2		4		2
Celtis laevigata	10	2	5	6				4
Fraxinus pennsylvanica	11	1	11		11			
Liquidambar styraciflua	4	2	2	2	2			
Nyssa sylvatica	6	2	3	5			1	
Pinus taeda	4	2	2	2	2			
Quercus phellos	2	1	2			2		
Salix nigra	5	1	5			5		
Quercus	2	1	2		2			
Carya	9	1	9		9			
Platanus occidentalis	27	2	13.5			24		3
Cephalanthus	4	1	4				4	
Ulmus	6	1	6				6	
Ulmus americana	5	1	5	5				
Total	**107**	**16**		**23**	**27**	**36**	**11**	**10**

Lloyd Stream and Wetland Restoration Site
Year 2 (2008) Annual Monitoring
Vegetation Plot Photos
Taken September and November 2008

Plot 3

Plot 5

APPENDIX B
GEOMORPHOLOGIC DATA

1. **Tables B1-B3. Qualitative Visual Stability Assessment**
2. **Cross-section Plots and Tables**
3. **Longitudinal Profile Plots**
4. **Stream Fixed Station Photos**
5. **Stream Problem Area Photos**

Table B1. Visual Morphological Stability Assessment
Lloyd Reach 1

Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number	Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
	1. Present	21	21	NA	100%	
	2. Armor stable (e.g. no displacement)?	21	21	NA	100%	
	3. Facet grade appears stable?	21	21	NA	100%	
	4. Minimal evidence of embedding / fining?	21	21	NA	100%	
A. Riffles	5. Length appropriate?	20	21	NA	95%	99%
	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	21	21	NA	100%	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	21	21	NA	100%	
B. Pools	3. Length appropriate?	21	21	NA	100%	100%
	1. Upstream of meander bend (run/inflection) centering?	21	21	NA	100%	
C. Thalweg	2. Downstream of meander (glide/inflection) centering?	21	21	NA	100%	100%
	1. Outer bend in state of limited/controlled erosion?	21	21	NA	100%	
	2. Of those eroding, # w/concomitant point bar formation?	NA	NA	0	100%	
	3. Apparent Rc within spec?	21	21	NA	100%	
D. Meanders	4. Sufficient floodplain access and relief?	21	21	NA	100%	100%
	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	
E. Bed General	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	NA	NA	0	100%	100%
F. Bank	1. Actively eroding, wasting, or slumping bank	NA	NA	0	100%	100%
	1. Free of back or arm scour?	NA	NA	NA	NA	
	2. Height appropriate?	NA	NA	NA	NA	
	3. Angle and geometry appear appropriate?	NA	NA	NA	NA	
G. Vanes	4. Free of piping or other structural failures?	NA	NA	NA	NA	NA
	1. Free of scour?	NA	NA	NA	NA	
H. Wads / Boulders	2. Footing stable?	NA	NA	NA	NA	NA

Table B2. Visual Morphological Stability Assessment
Lloyd Reach 2

Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number	Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
	1. Present	26	26	NA	100%	
	2. Armor stable (e.g. no displacement)?	26	26	NA	100%	
	3. Facet grade appears stable?	26	26	NA	100%	
	4. Minimal evidence of embedding / fining?	26	26	NA	100%	
A. Riffles	5. Length appropriate?	26	26	NA	100%	100%
	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	26	26	NA	100%	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	25	26	NA	96%	
B. Pools	3. Length appropriate?	26	26	NA	100%	99%
	1. Upstream of meander bend (run/inflection) centering?	26	26	NA	100%	
C. Thalweg	2. Downstream of meander (glide/inflection) centering?	26	26	NA	100%	100%
	1. Outer bend in state of limited/controlled erosion?	26	26	NA	100%	
	2. Of those eroding, # w/concomitant point bar formation?	NA	NA	0	100%	
	3. Apparent Rc within spec?	26	26	NA	100%	
D. Meanders	4. Sufficient floodplain access and relief?	26	26	NA	100%	100%
	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	
E. Bed General	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	NA	NA	0	100%	100%
F. Bank	1. Actively eroding, wasting, or slumping bank	NA	NA	0	100%	100%
	1. Free of back or arm scour?	1	1	NA	100%	
	2. Height appropriate?	1	1	NA	100%	
	3. Angle and geometry appear appropriate?	1	1	NA	100%	
G. Vanes	4. Free of piping or other structural failures?	1	1	NA	100%	100%
	1. Free of scour?	NA	NA	NA	NA	
H. Wads / Boulders	2. Footing stable?	NA	NA	NA	NA	NA

Table B3. Visual Morphological Stability Assessment
Lloyd Reach 3

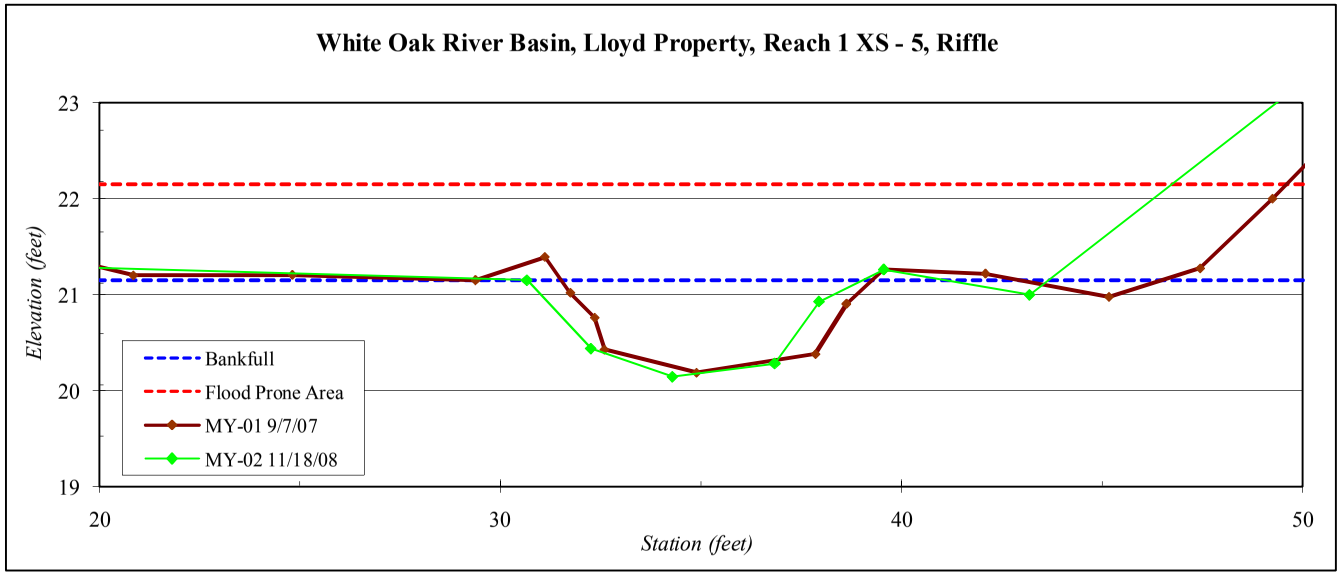
Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number	Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
	1. Present	18	18	NA	100%	
	2. Armor stable (e.g. no displacement)?	18	18	NA	100%	
	3. Facet grade appears stable?	18	18	NA	100%	
	4. Minimal evidence of embedding / fining?	18	18	NA	100%	
A. Riffles	5. Length appropriate?	18	18	NA	100%	100%
	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	18	18	NA	100%	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	18	18	NA	100%	
B. Pools	3. Length appropriate?	17	18	NA	94%	98%
	1. Upstream of meander bend (run/inflection) centering?	18	18	NA	100%	
C. Thalweg	2. Downstream of meander (glide/inflection) centering?	18	18	NA	100%	100%
	1. Outer bend in state of limited/controlled erosion?	18	18	NA	100%	
	2. Of those eroding, # w/concomitant point bar formation?	NA	NA	0	100%	
	3. Apparent Rc within spec?	18	18	NA	100%	
D. Meanders	4. Sufficient floodplain access and relief?	18	18	NA	100%	100%
	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	
E. Bed General	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	NA	NA	0	100%	100%
F. Bank	1. Actively eroding, wasting, or slumping bank	NA	NA	0	100%	100%
	1. Free of back or arm scour?	1	2	NA	50%	
	2. Height appropriate?	2	2	NA	100%	
	3. Angle and geometry appear appropriate?	2	2	NA	100%	
G. Vanes	4. Free of piping or other structural failures?	2	2	NA	100%	88%
	1. Free of scour?	NA	NA	NA	NA	
H. Wads / Boulders	2. Footing stable?	NA	NA	NA	NA	NA

River Basin:	White Oak
Watershed:	Lloyd Property
XS ID	XS - 5, Riffle
Drainage Area (sq mi):	0.55
Date:	11/6/2008
Field Crew:	Adasme, St.Clair

Station	Elevation
3.9	22.85
17.6	21.30
30.7	21.15
32.3	20.43
34.3	20.14
36.8	20.28
37.9	20.92
39.6	21.26
43.2	21.00
52.9	24.15

SUMMARY DATA	
Bankfull Elevation:	21.2
Bankfull Cross-Sectional Area:	5.4
Bankfull Width:	8.6
Flood Prone Area Elevation:	22.2
Flood Prone Width:	25.0
Max Depth at Bankfull:	1.0
Mean Depth at Bankfull:	0.6
W / D Ratio:	13.5
Entrenchment Ratio:	4.4
Bank Height Ratio:	1.0

Stream Type	E/C

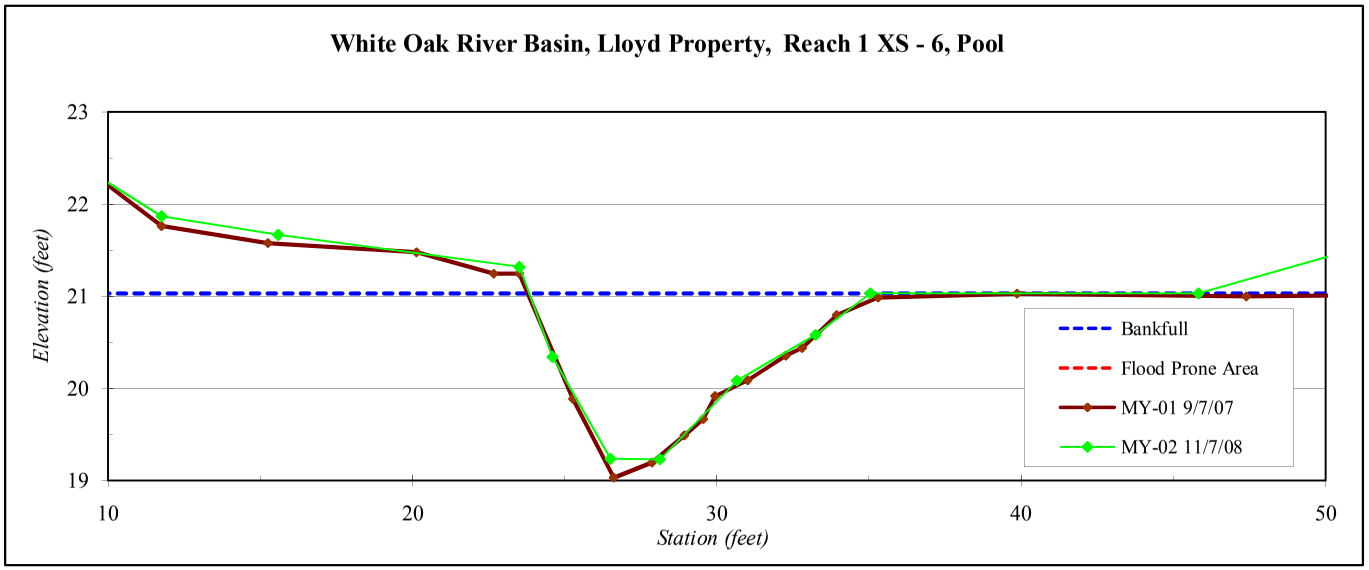


River Basin:	White Oak
Watershed:	Lloyd Property
XS ID	XS - 6, Pool
Drainage Area (sq mi):	0.55
Date:	11/6/2008
Field Crew:	Adasme, St.Clair

Station	Elevation
3.21	23.64
11.75	21.87
15.59	21.67
23.51	21.32
24.60	20.34
26.50	19.24
28.13	19.23
30.66	20.08
33.24	20.58
35.05	21.03
45.83	21.03
73.93	23.66

SUMMARY DATA	
Bankfull Elevation:	21.0
Bankfull Cross-Sectional Area:	11.2
Bankfull Width:	11.2
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.8
Mean Depth at Bankfull:	1.0
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C/E

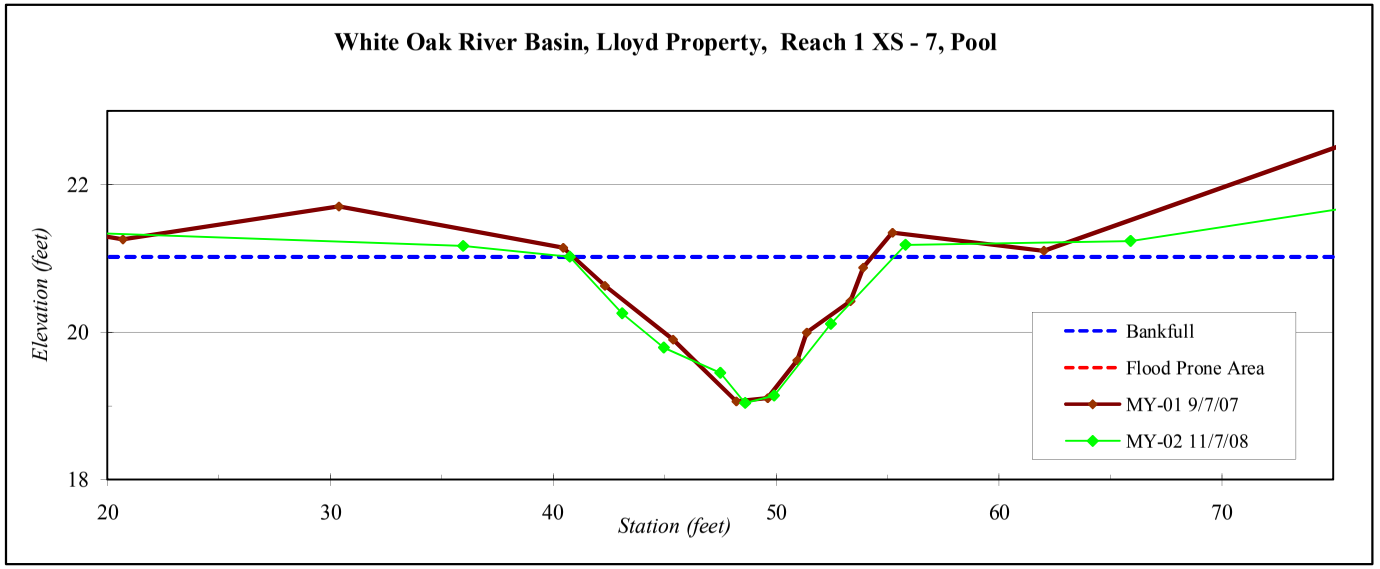


River Basin:	White Oak
Watershed:	Lloyd Property
XS ID	XS - 7, Pool
Drainage Area (sq mi):	0.55
Date:	11/6/2008
Field Crew:	Adasme, St.Clair

Station	Elevation
0.70	22.22
16.14	21.38
35.96	21.17
40.74	21.02
43.09	20.25
44.96	19.79
47.49	19.45
48.61	19.04
49.91	19.14
52.45	20.11
55.80	21.18
65.90	21.24
103.52	22.98

SUMMARY DATA	
Bankfull Elevation:	21.0
Bankfull Cross-Sectional Area:	15.6
Bankfull Width:	14.6
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.0
Mean Depth at Bankfull:	1.1
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	E/C

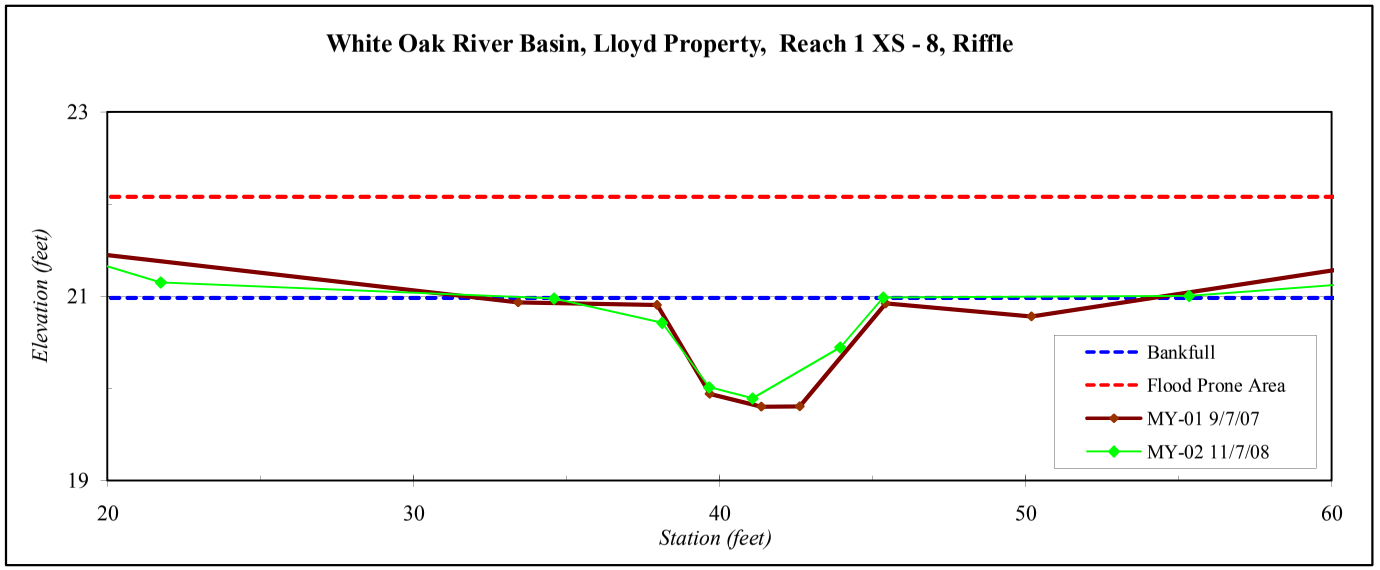


River Basin:	White Oak
Watershed:	Lloyd Property
XS ID	XS - 8, Riffle
Drainage Area (sq mi):	0.55
Date:	11/6/2008
Field Crew:	Adasme, St.Clair

Station	Elevation
0.0	22.6
15.8	21.7
21.7	21.1
34.6	21.0
38.1	20.7
39.7	20.0
41.1	19.9
43.9	20.4
45.4	21.0
55.3	21.0
90.6	21.9

SUMMARY DATA	
Bankfull Elevation:	21.0
Bankfull Cross-Sectional Area:	5.6
Bankfull Width:	11.2
Flood Prone Area Elevation:	22.1
Flood Prone Width:	80.0
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.5
W / D Ratio:	22.3
Entrenchment Ratio:	7.2
Bank Height Ratio:	1.0

Stream Type	C

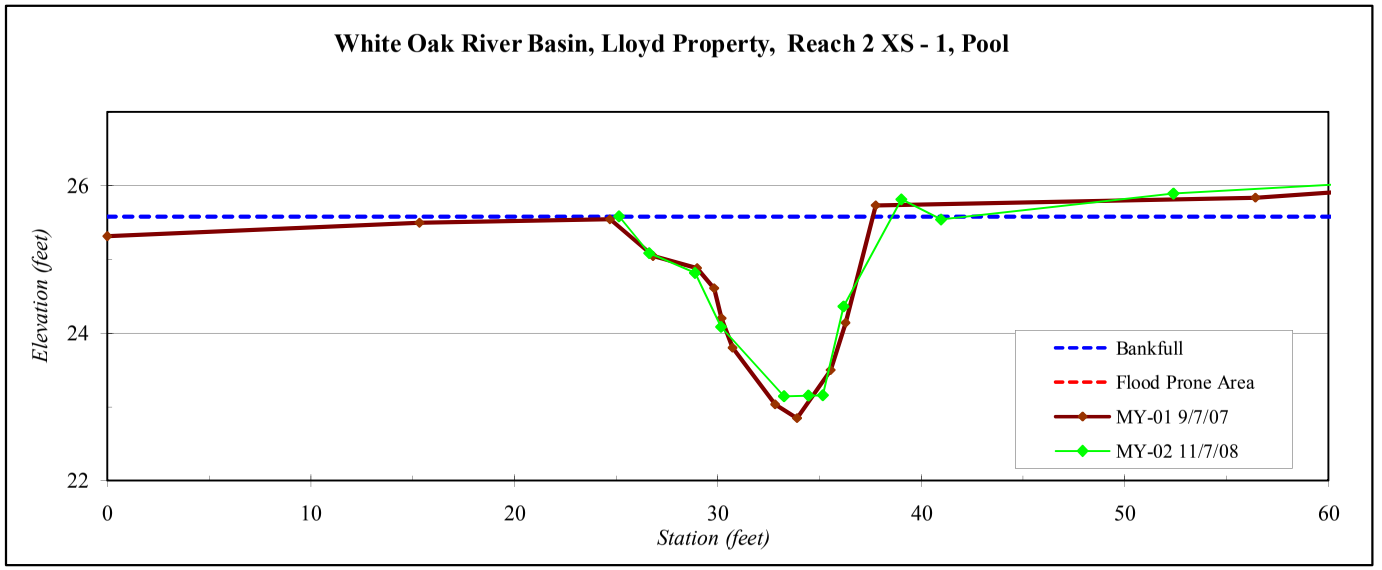


River Basin:	White Oak
Watershed:	Lloyd Property
XS ID	XS - 1, Pool
Drainage Area (sq mi):	0.67
Date:	10/28/2008
Field Crew:	Adasme, St.Clair

Station	Elevation
25.1	25.6
26.6	25.1
28.9	24.8
30.2	24.1
33.3	23.1
34.5	23.2
35.2	23.2
36.2	24.4
39.0	25.8
41.0	25.5
52.4	25.9
85.3	26.4

SUMMARY DATA	
Bankfull Elevation:	25.6
Bankfull Cross-Sectional Area:	17.3
Bankfull Width:	15.0
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.4
Mean Depth at Bankfull:	1.2
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	E/C

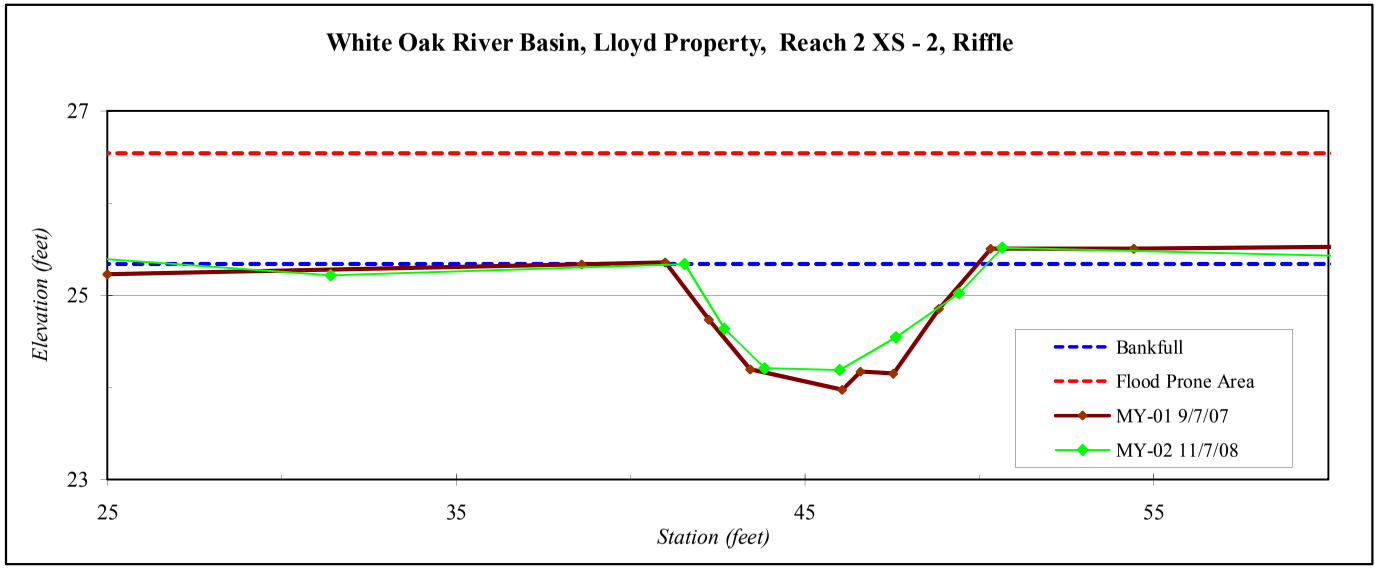


River Basin:	White Oak
Watershed:	Lloyd Property
XS ID	XS - 2, Riffle
Drainage Area (sq mi):	0.67
Date:	10/28/2008
Field Crew:	Adasme, St.Clair

Station	Elevation
0.0	26.1
31.4	25.2
41.5	25.3
42.7	24.6
43.8	24.2
46.0	24.2
47.6	24.5
49.4	25.0
50.7	25.5
62.2	25.4
101.0	25.7

SUMMARY DATA	
Bankfull Elevation:	25.3
Bankfull Cross-Sectional Area:	6.6
Bankfull Width:	8.7
Flood Prone Area Elevation:	26.5
Flood Prone Width:	150.0
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.8
W / D Ratio:	11.4
Entrenchment Ratio:	17.3
Bank Height Ratio:	1.0

Stream Type	E/C

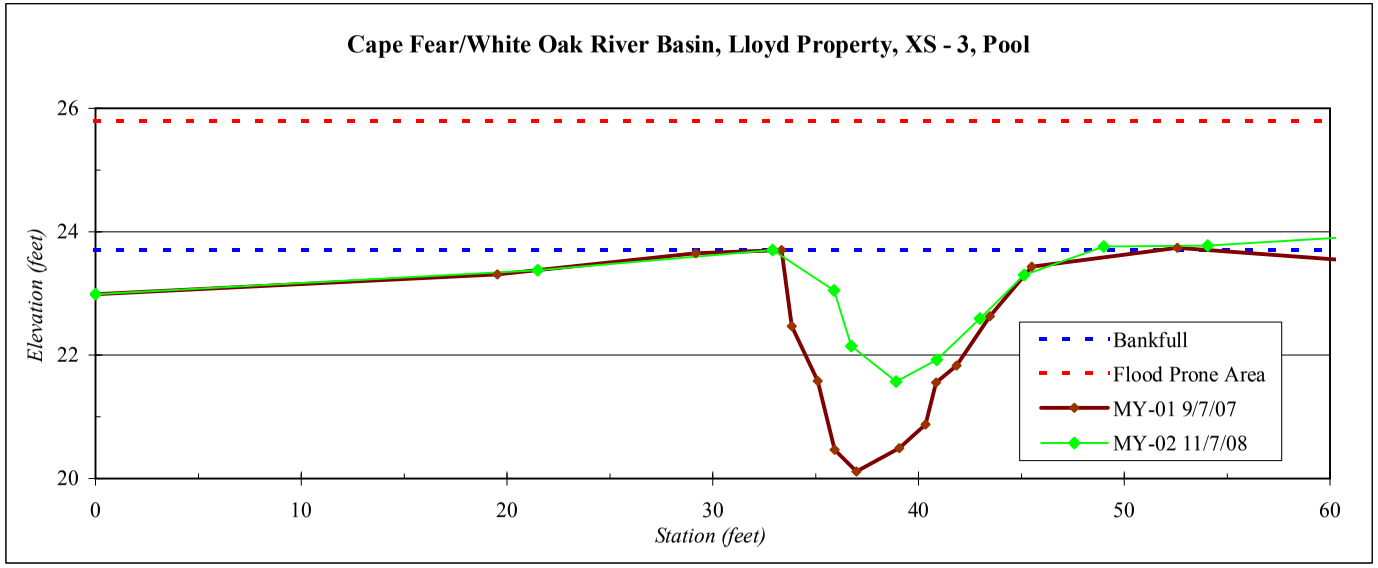


River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 3, Pool
Drainage Area (sq mi):	0.67
Date:	11/6/2008
Field Crew:	Adasme, St.Clair

Station	Elevation
0.0	23.0
21.5	23.4
32.9	23.7
35.9	23.1
36.7	22.1
38.9	21.6
40.9	21.9
43.0	22.6
45.1	23.3
49.0	23.8
54.1	23.8
65.1	24.0
143.4	24.0

SUMMARY DATA	
Bankfull Elevation:	23.7
Bankfull Cross-Sectional Area:	15.1
Bankfull Width:	15.6
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	1.0
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C

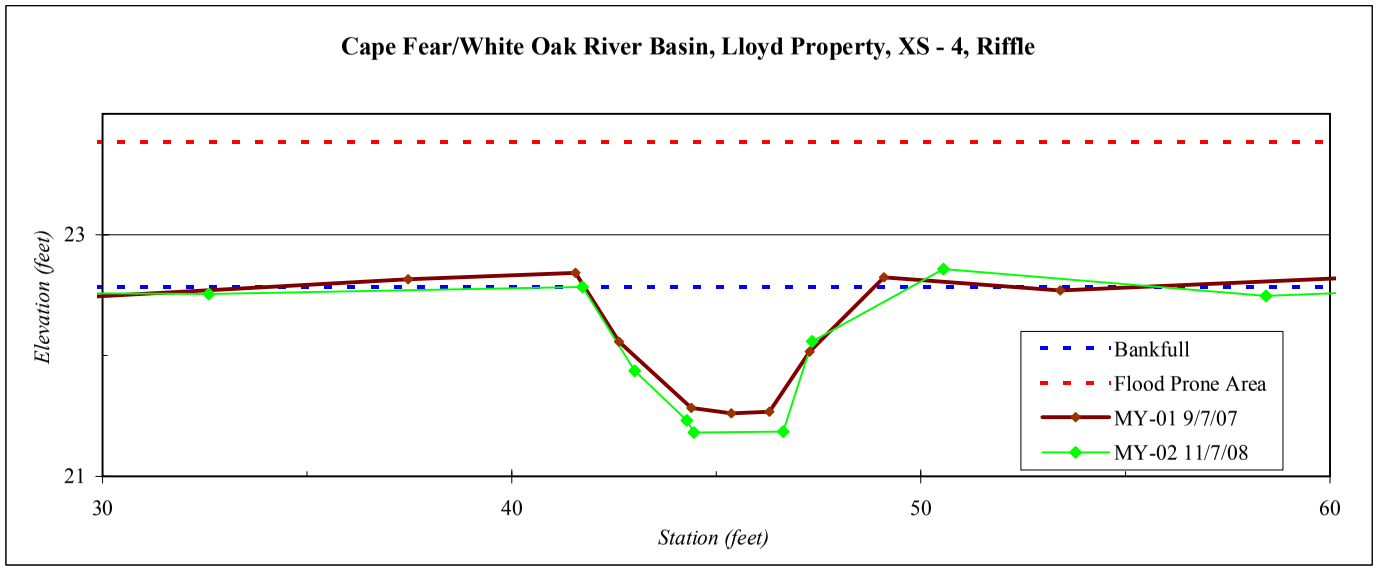


River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 4, Riffle
Drainage Area (sq mi):	0.67
Date:	11/6/2008
Field Crew:	Adasme, St.Clair

Station	Elevation
0.0	22.6
32.6	22.5
41.7	22.6
43.0	21.9
44.3	21.5
44.5	21.4
46.6	21.4
47.3	22.1
50.6	22.7
58.4	22.5
113.9	23.2

SUMMARY DATA	
Bankfull Elevation:	22.6
Bankfull Cross-Sectional Area:	5.6
Bankfull Width:	8.0
Flood Prone Area Elevation:	23.8
Flood Prone Width:	150.0
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.7
W / D Ratio:	11.6
Entrenchment Ratio:	18.6
Bank Height Ratio:	1.0

Stream Type	E/C

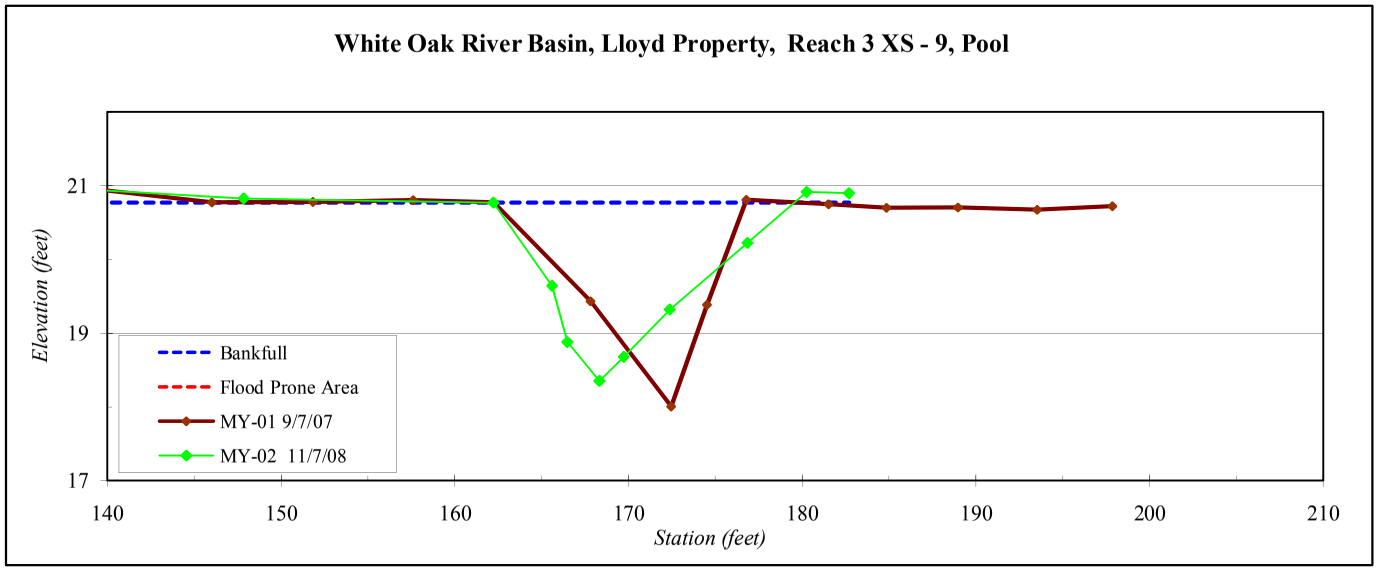


River Basin:	White Oak
Watershed:	Lloyd Property
XS ID	XS - 9, Pool
Drainage Area (sq mi):	1.2
Date:	11/6/2008
Field Crew:	Adasme, St.Clair

Station	Elevation
18.6	22.6
147.9	20.8
162.2	20.8
165.6	19.6
166.5	18.9
168.3	18.4
169.7	18.7
172.4	19.3
176.9	20.2
180.3	20.9
182.7	20.9

SUMMARY DATA	
Bankfull Elevation:	20.8
Bankfull Cross-Sectional Area:	20.3
Bankfull Width:	17.3
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.4
Mean Depth at Bankfull:	1.2
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	E/C

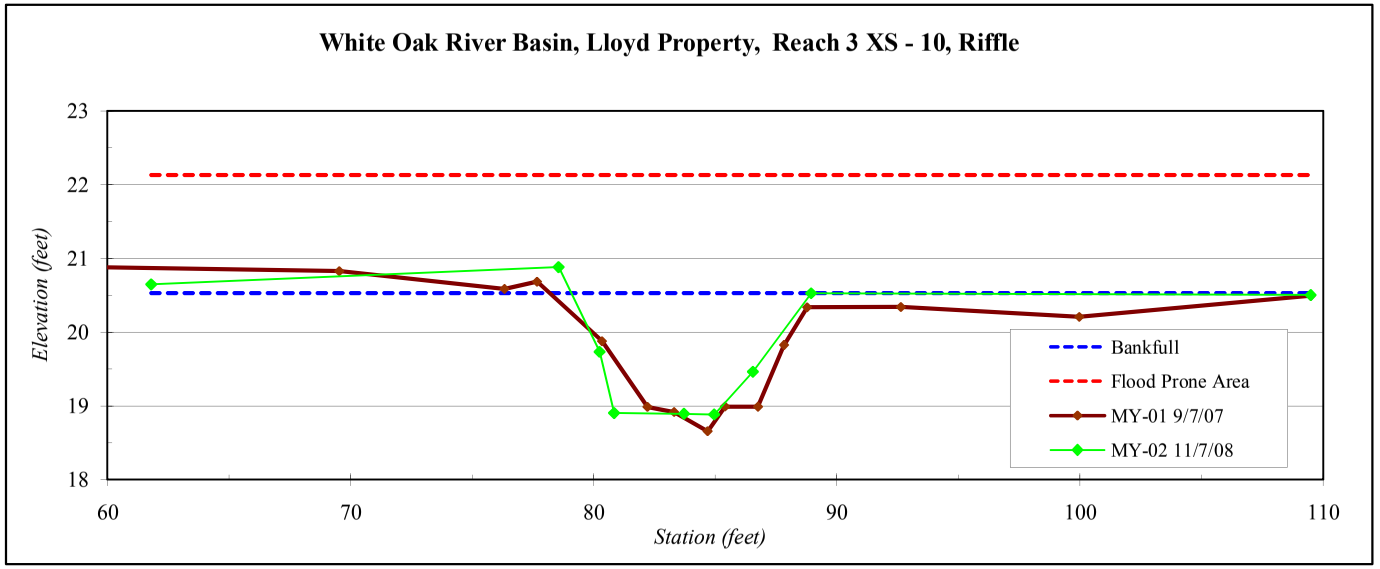


River Basin:	White Oak
Watershed:	Lloyd Property
XS ID	XS - 10, Riffle
Drainage Area (sq mi):	1.2
Date:	11/6/2008
Field Crew:	Adasme, St.Clair

Station	Elevation
61.8	20.6
78.6	20.9
80.2	19.7
80.8	18.9
83.7	18.9
85.0	18.9
86.5	19.5
88.9	20.5
109.5	20.5

SUMMARY DATA	
Bankfull Elevation:	20.5
Bankfull Cross-Sectional Area:	11.4
Bankfull Width:	9.9
Flood Prone Area Elevation:	22.1
Flood Prone Width:	150.0
Max Depth at Bankfull:	1.6
Mean Depth at Bankfull:	1.2
W / D Ratio:	8.6
Entrenchment Ratio:	15.0
Bank Height Ratio:	1.0

Stream Type	E/C

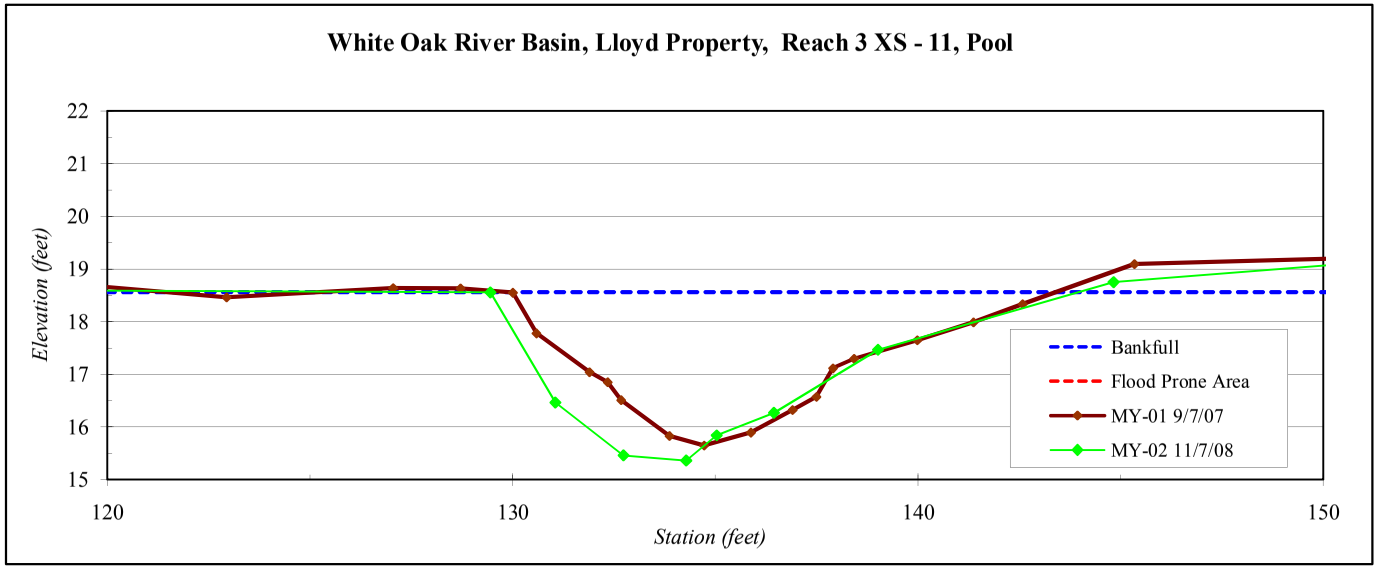


River Basin:	White Oak
Watershed:	Lloyd Property
XS ID	XS - 11, Pool
Drainage Area (sq mi):	1.2
Date:	11/6/2008
Field Crew:	Adasme, St.Clair

Station	Elevation
3.0	19.0
129.5	18.6
131.1	16.5
132.7	15.5
134.3	15.4
135.0	15.8
136.4	16.3
139.0	17.5
144.8	18.7
153.0	19.2

SUMMARY DATA	
Bankfull Elevation:	18.6
Bankfull Cross-Sectional Area:	23.8
Bankfull Width:	16.9
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.2
Mean Depth at Bankfull:	1.4
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	E/C

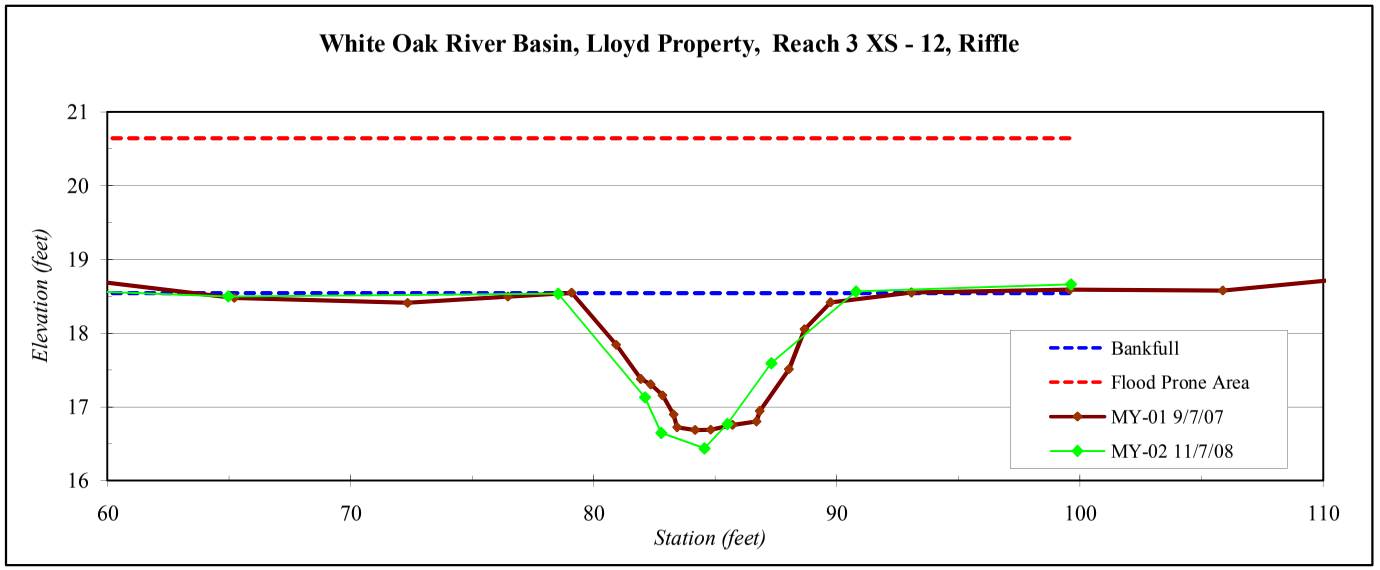


River Basin:	White Oak
Watershed:	Lloyd Property
XS ID	XS - 12, Riffle
Drainage Area (sq mi):	1.2
Date:	11/6/2008
Field Crew:	Adasme, St.Clair

Station	Elevation
0.0	19.3
65.0	18.5
78.5	18.5
82.1	17.1
82.8	16.6
84.6	16.4
85.5	16.8
87.3	17.6
90.8	18.6
99.6	18.7

SUMMARY DATA	
Bankfull Elevation:	18.5
Bankfull Cross-Sectional Area:	13.1
Bankfull Width:	12.2
Flood Prone Area Elevation:	20.6
Flood Prone Width:	150.0
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	1.1
W / D Ratio:	11.4
Entrenchment Ratio:	12.0
Bank Height Ratio:	1.0

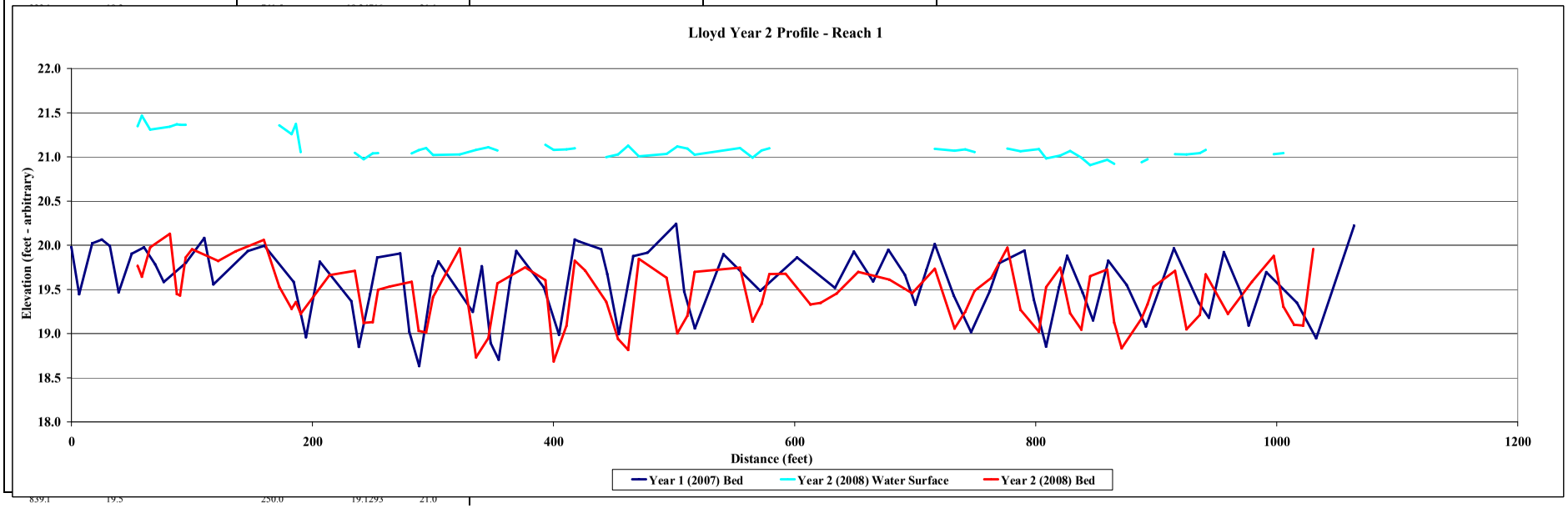
Stream Type	E/C



Project Name	Lloyd Property - Year 2 (2008) Monitoring
Reach	1
Feature	Profile
Date	10/21/08
Crew	Adasme, St.Clair

2007 Year 1 Monitoring \Survey			2008 Year 2 Monitoring \Survey			2009 Year 3 Monitoring \Survey			2010 Year 4 Monitoring \Survey		
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	20.0		1030.4	19.957963							
6.5	19.4		1022.0	19.089303							
17.2	20.0		1014.4	19.098657							
25.3	20.1		1005.5	19.306372	21.0						
31.9	20.0		997.6	19.880162	21.0						
39.3	19.5		979.5	19.586749							
50.1	19.9		959.4	19.224303							
60.3	20.0		941.2	19.67157	21.1						
69.6	19.8		936.3	19.210102	21.0						
76.7	19.6		925.3	19.049415	21.0						
94.9	19.8		915.6	19.711067	21.0						
110.2	20.1		897.7	19.527771							
117.7	19.6		892.8	19.332744	21.0						
146.3	19.9		888.0	19.171506	20.9						
160.1	20.0		871.3	18.833257							
184.4	19.6		865.3	19.127383	20.9						
194.6	19.0		859.3	19.724494	21.0						
206.2	19.8		845.3	19.648321	20.9						
232.2	19.4		837.9	19.043837	21.0						
238.6	18.8		828.5	19.229998	21.1						
247.7	19.4		820.4	19.746595	21.0						
253.7	19.9		808.7	19.526244	21.0						
272.8	19.9		802.8	19.01968	21.1						
280.4	19.0		787.4	19.267396	21.1						
288.5	18.6		776.7	19.971358	21.1						
299.7	19.6		763.0	19.629819							
304.4	19.8		749.3	19.482602	21.1						
839.1	19.5		250.0	19.1293	21.0						

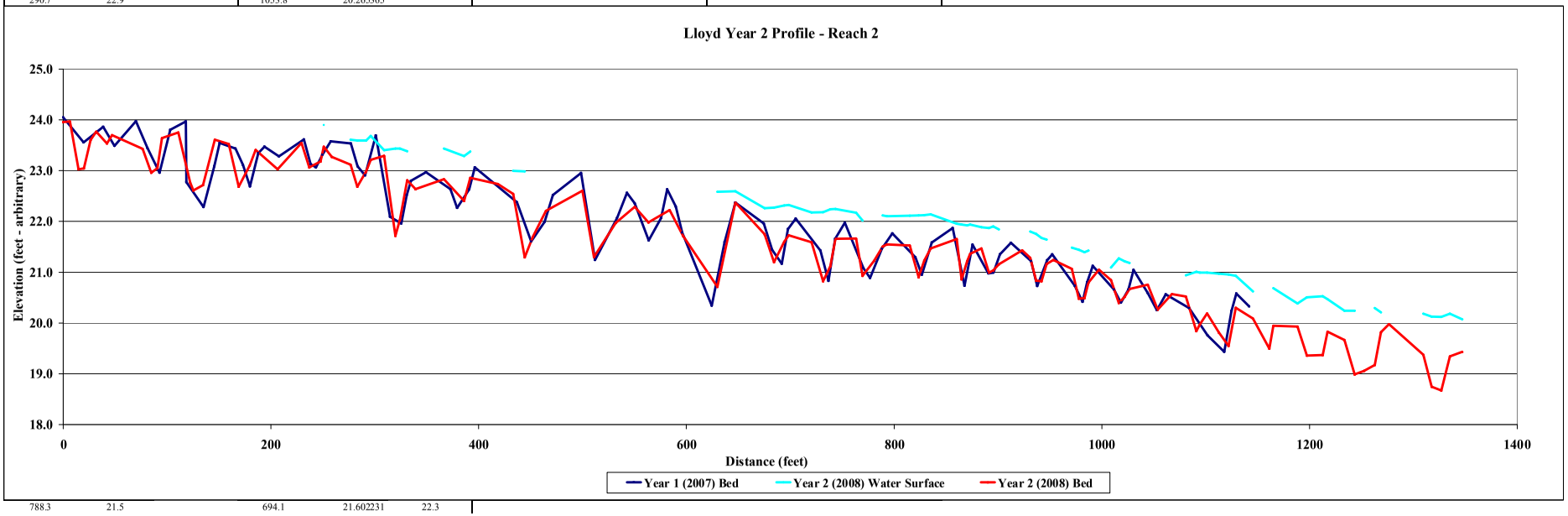
	2007	2008	2009	2010
Avg. Water Surface Slope	----	0.0002		
Riffle Length	18.0	32.0		
Avg. Riffle Slope	-----	0.0005		
Pool Length	22.0	24.0		
Avg. Pool Slope	-----	0.0020		



Project Name	Lloyd Property - Year 2 (2008) Monitoring
Reach	2
Feature	Profile
Date	10/21/08
Crew	Adasme, St.Clair

2007 Year 1 Monitoring \Survey			2008 Year 2 Monitoring \Survey			2009 Year 3 Monitoring \Survey			2010 Year 4 Monitoring \Survey		
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	24.0		1346.9	19.431915	20.1						
19.7	23.6		1335.0	19.344823	20.2						
38.4	23.9		1326.9	18.674051	20.1						
49.4	23.5		1317.6	18.744261	20.1						
69.9	24.0		1309.5	19.372174	20.2						
81.1	23.4		1276.6	19.976686							
92.7	23.0		1268.6	19.818627	20.2						
103.2	23.8		1262.8	19.171138	20.3						
118.1	24.0		1252.6	19.054835							
118.7	22.8		1243.5	18.989212	20.2						
135.2	22.3		1233.7	19.665421	20.2						
145.5	23.1		1217.3	19.827465	20.5						
150.6	23.5		1212.7	19.369562	20.5						
165.8	23.4		1197.6	19.357031	20.5						
173.0	23.1		1188.4	19.929556	20.4						
179.8	22.7		1165.1	19.947378	20.7						
187.8	23.3		1161.2	19.495811							
193.6	23.5		1145.4	20.089523	20.6						
207.7	23.3		1129.1	20.30217	20.9						
231.8	23.6		1122.0	19.547267	21.0						
238.1	23.1		1112.7	19.812051	21.0						
243.3	23.1		1101.3	20.187222	21.0						
249.4	23.3		1094.3	19.972013	21.0						
257.7	23.6		1091.1	19.840234	21.0						
276.9	23.5		1080.9	20.521357	20.9						
283.3	23.1		1067.4	20.569565							
290.7	22.9		1053.8	20.265365							
788.3	21.5		694.1	21.602231	22.3						

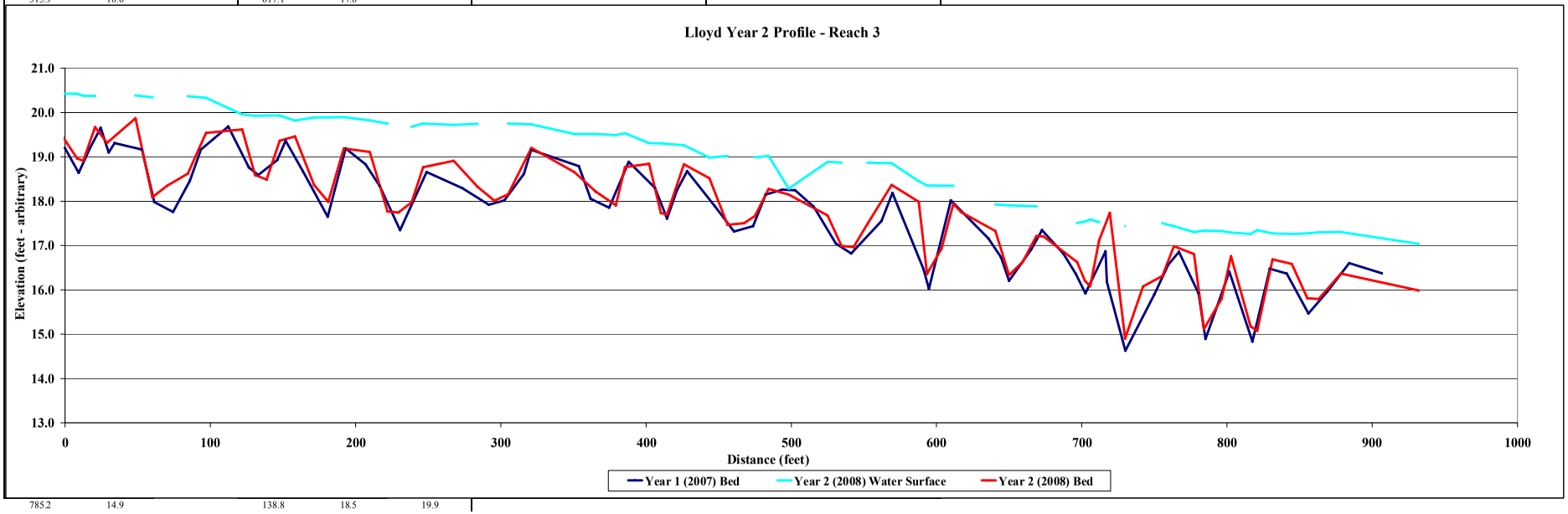
	2007	2008	2009	2010
Avg. Water Surface Slope	0.0033	0.0033		
Riffle Length	20.0	26.0		
Avg. Riffle Slope	0.0110	0.0084		
Pool Length	22.0	24.0		
Avg. Pool Slope	-----	0.0014		



Project Name	Lloyd Property - Year 2 (2008) Monitoring
Reach	3
Feature	Profile
Date	10/21/08
Crew	Adasme, St.Clair

2007 Year 1 Monitoring \Survey			2008 Year 2 Monitoring \Survey			2009 Year 3 Monitoring \Survey			2010 Year 4 Monitoring \Survey		
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	19.2		932.0	16.0	17.0						
9.3	18.6		878.4	16.4	17.3						
17.1	19.2		863.1	15.8	17.3						
24.6	19.7		855.2	15.8	17.3						
30.1	19.1		844.7	16.6	17.3						
34.2	19.3		831.3	16.7	17.3						
53.0	19.2		820.8	15.1	17.3						
61.5	18.0		816.1	15.2	17.3						
74.4	17.8		802.7	16.8	17.3						
85.9	18.5		796.2	15.8	17.3						
93.6	19.2		784.1	15.1	17.3						
112.3	19.7		777.2	16.8	17.3						
126.6	18.8		763.5	17.0	17.4						
133.0	18.6		755.4	16.3	17.5						
146.1	18.9		742.2	16.1							
151.9	19.4		729.8	14.9	17.4						
163.9	18.7		719.4	17.7							
180.8	17.6		712.0	17.1	17.5						
193.3	19.2		705.9	16.1	17.6						
206.8	18.8		702.2	16.2	17.5						
216.7	18.3		696.8	16.6	17.5						
230.7	17.3		673.6	17.2							
249.0	18.7		668.8	17.2	17.9						
273.5	18.3		659.3	16.6	17.9						
291.8	17.9		650.0	16.3	17.9						
302.4	18.0		640.4	17.3	17.9						
315.9	18.6		617.1	17.8							
785.2	14.9		138.8	18.5	19.9						

	2007	2008	2009	2010
Avg. Water Surface Slope	0.0034	0.0036		
Riffle Length	19.0	24.0		
Avg. Riffle Slope	0.0001	0.0091		
Pool Length	29.0	38.0		
Avg. Pool Slope	-----	0.0011		



Lloyd Stream and Wetland Restoration Site
Year 2 (2008) Annual Monitoring
Stream Fixed Photo Stations
Taken November 2008

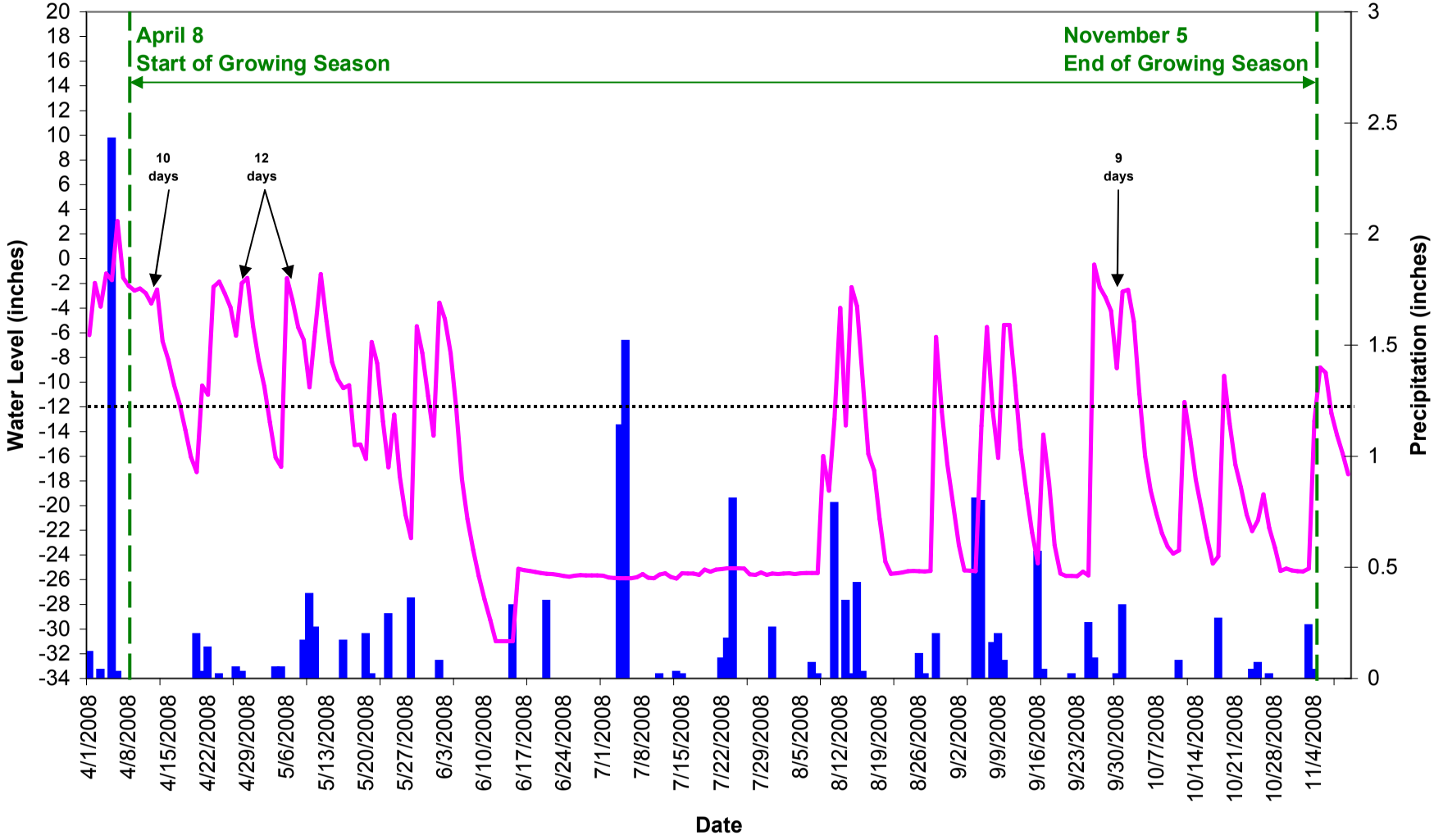
Lloyd Stream and Wetland Restoration Site
Year 2 (2008) Annual Monitoring
Stream Fixed Photo Stations
Taken November 2008 (continued)

Lloyd Stream and Wetland Restoration Site
Year 2 (2008) Annual Monitoring
Stream Problem Area Photos
Taken November 2008

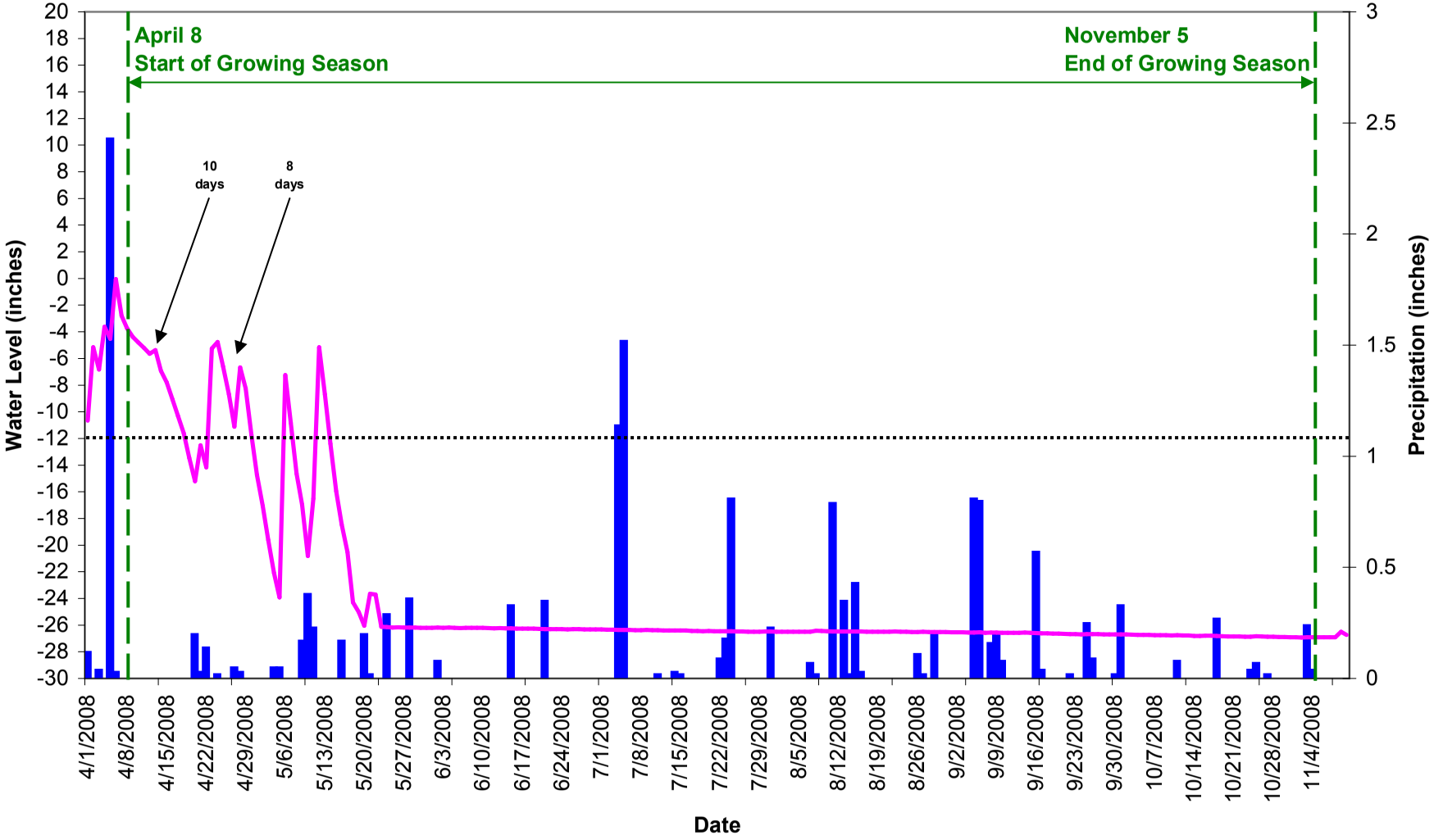
Ford within Reach 2 that was compromised by heavy logging truck use.

APPENDIX C
HYDROLOGY DATA
2008 Groundwater Gauge Graphs

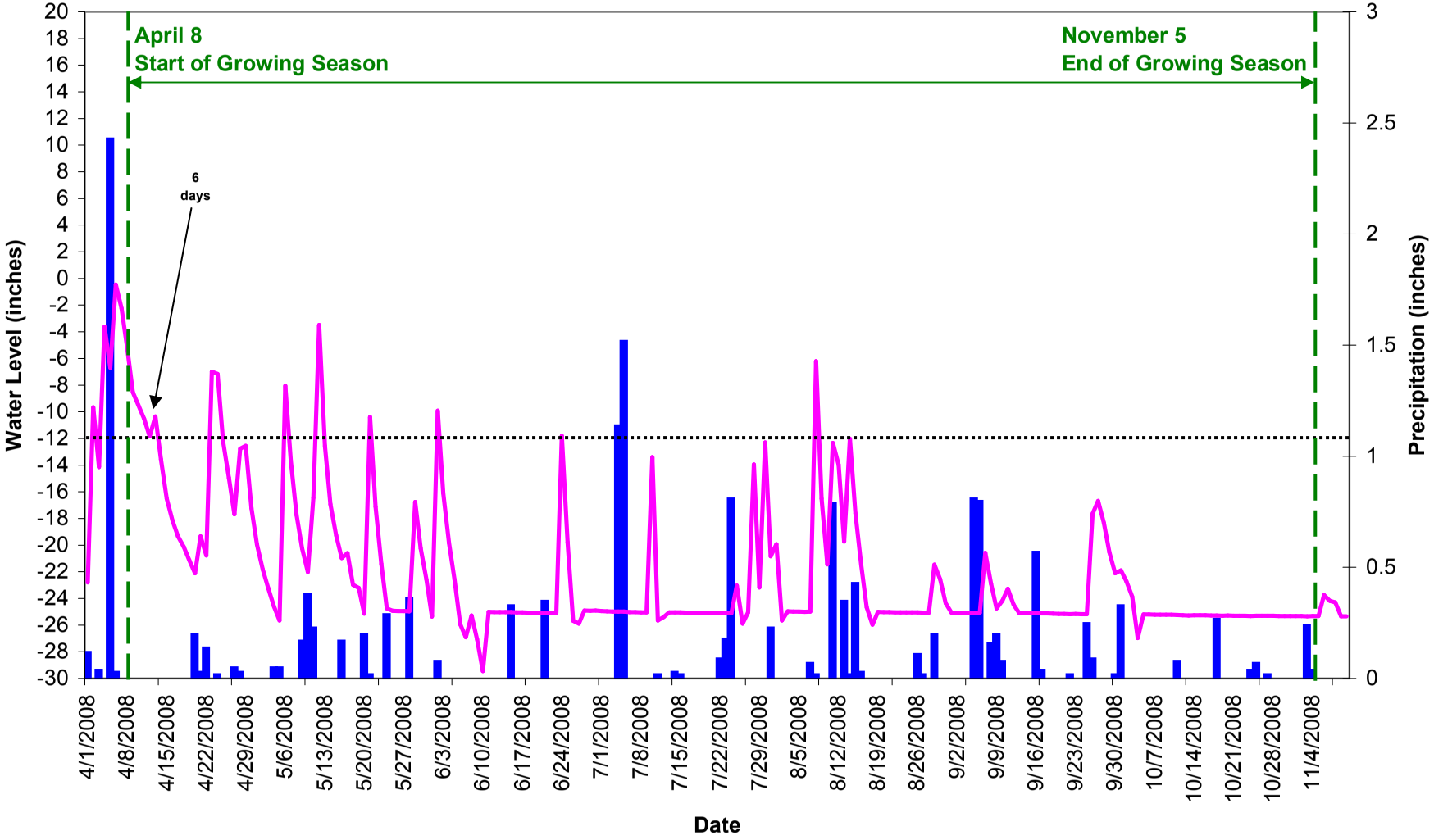
Lloyd Restoration Site - Groundwater Gauge LG1
Year 2 (2008 Data)



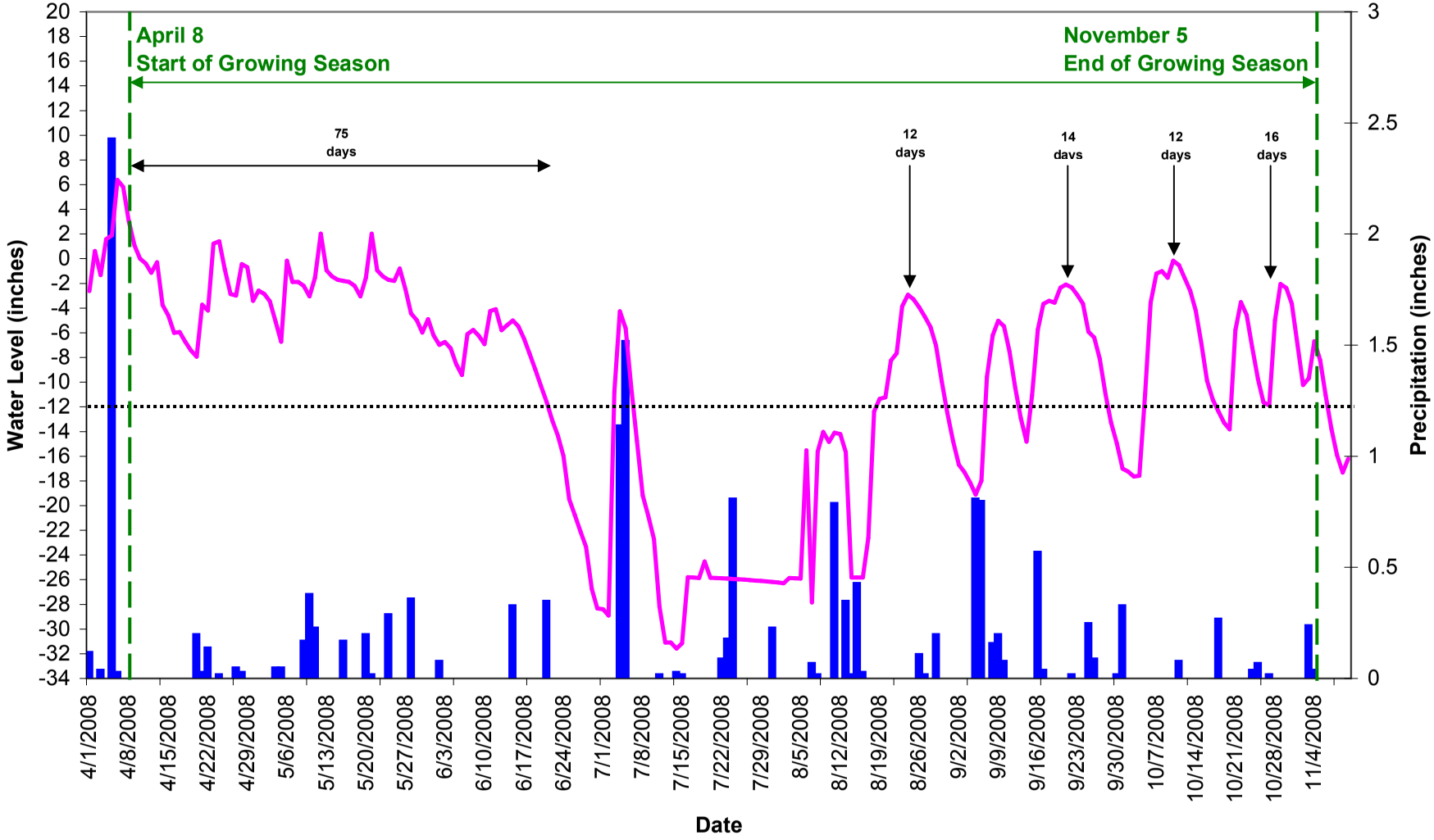
Lloyd Restoration Site - Groundwater Gauge LG2
Year 2 (2008 Data)



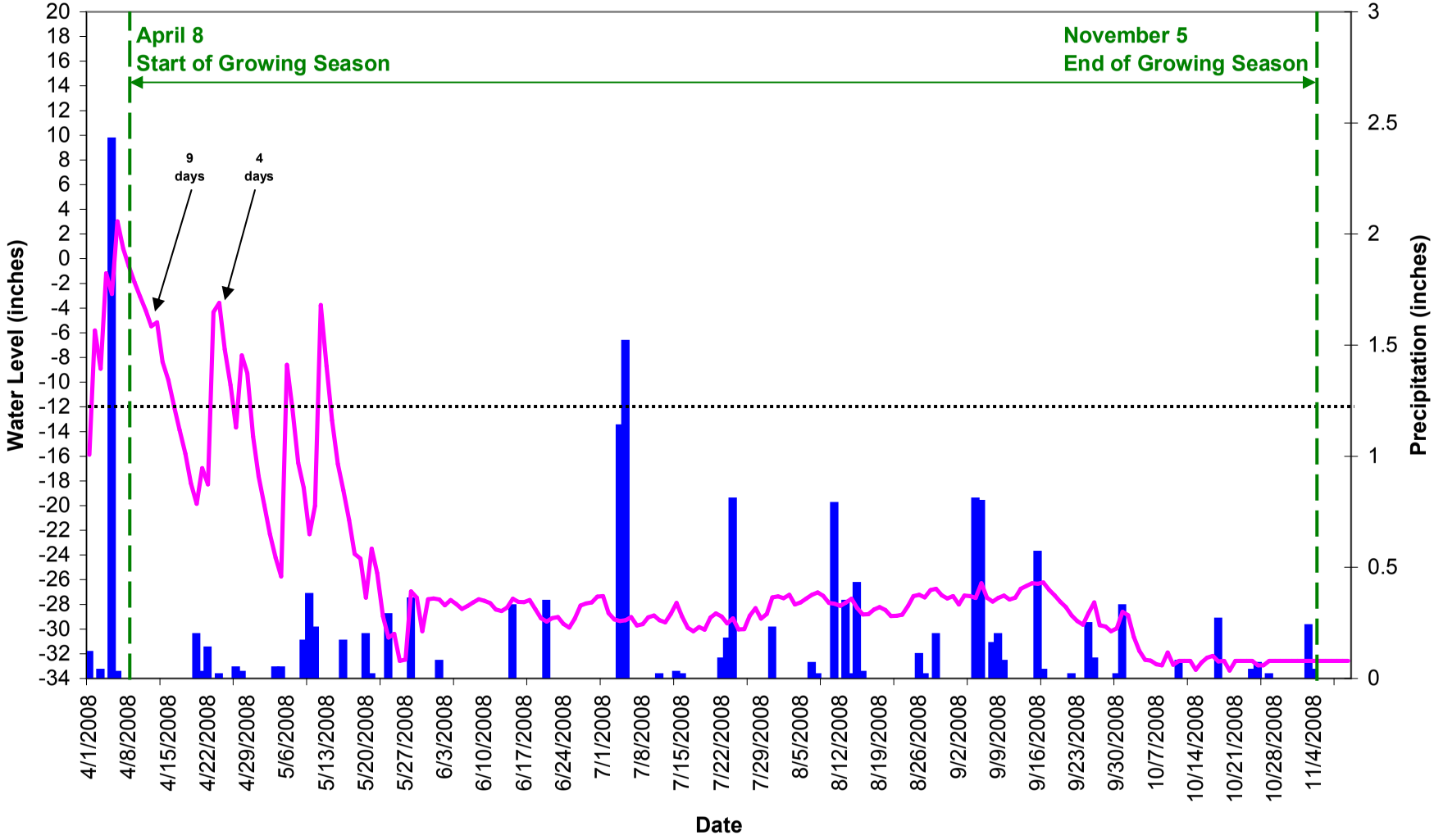
Lloyd Restoration Site - Groundwater Gauge LG3
Year 2 (2008 Data)



Lloyd Restoration Site - Groundwater Gauge LG4
Year 2 (2008 Data)



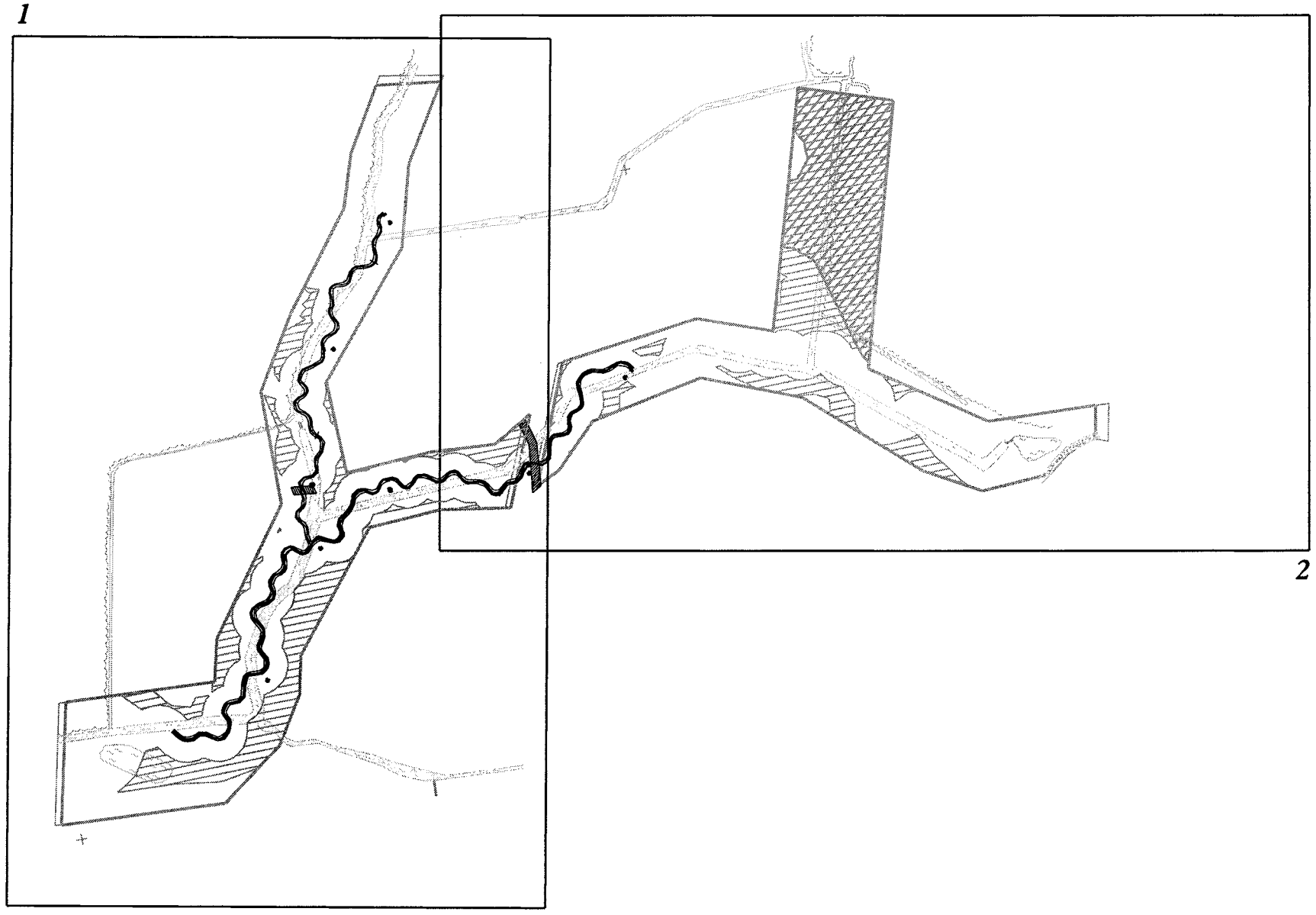
Lloyd Restoration Site - Groundwater Reference Gauge
Year 2 (2008 Data)



APPENDIX D
MONITORING PLAN VIEWS

LLOYD STREAM AND RESTORATION RESTORATION SITE

ONSLOW COUNTY, NORTH CAROLINA
CONTRACT# 16-DO6003-1



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BEN FURR
Project Manager

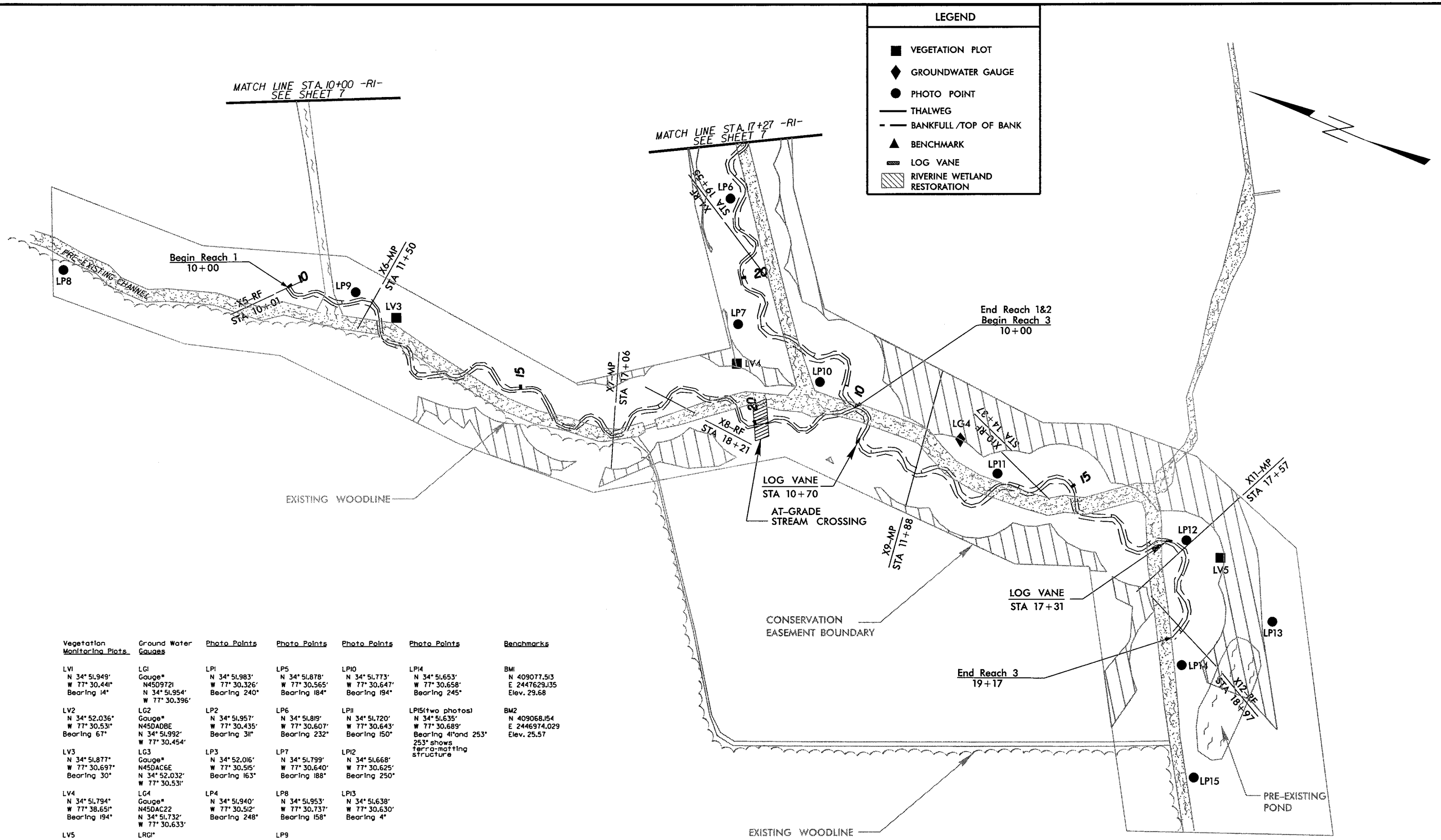
MONITORING PLANS

5			
4			
3			
2			
1	WMD	12/31/07	DATE OF COMPLETION
	BY	DATE	DESCRIPTION OF REVISION

Restoration Systems, LLC
1101 Haynes Street, Suite 107
Raleigh, NC 27604 (919) 755-9490

LLOYD STREAM AND WETLAND RESTORATION SITE
ONSLOW COUNTY, NORTH CAROLINA

Plan Map View



Vegetation Monitoring Plots	Ground Water Gauges	Photo Points	Photo Points	Photo Points	Photo Points	Benchmarks
LV1 N 34° 51.949' W 77° 30.441' Bearing 14°	LG1 Gauge# N45097Z1 N 34° 51.954' W 77° 30.396'	LP1 N 34° 51.983' W 77° 30.326' Bearing 240°	LP5 N 34° 51.878' W 77° 30.565' Bearing 184°	LP10 N 34° 51.773' W 77° 30.647' Bearing 194°	LP14 N 34° 51.653' W 77° 30.658' Bearing 245°	BM1 N 409077.513 E 2447629.135 Elev. 29.68
LV2 N 34° 52.036' W 77° 30.531' Bearing 67°	LG2 Gauge# N45DADBE N 34° 51.992' W 77° 30.454'	LP2 N 34° 51.957' W 77° 30.435' Bearing 311°	LP6 N 34° 51.819' W 77° 30.607' Bearing 232°	LP11 N 34° 51.720' W 77° 30.643' Bearing 150°	LP15(two photos) N 34° 51.635' W 77° 30.689' Bearing 41°and 253° 253° shows terra-matting structure	BM2 N 409068.154 E 2446974.029 Elev. 25.57
LV3 N 34° 51.877' W 77° 30.697' Bearing 30°	LG3 Gauge# N45DAC6E N 34° 52.032' W 77° 30.531'	LP3 N 34° 52.016' W 77° 30.515' Bearing 163°	LP7 N 34° 51.799' W 77° 30.640' Bearing 188°	LP12 N 34° 51.668' W 77° 30.625' Bearing 250°		
LV4 N 34° 51.794' W 77° 38.651' Bearing 194°	LG4 Gauge# N45DAC22 N 34° 51.732' W 77° 30.633'	LP4 N 34° 51.940' W 77° 30.512' Bearing 248°	LP8 N 34° 51.953' W 77° 30.737' Bearing 158°	LP13 N 34° 51.638' W 77° 30.630' Bearing 4°		
LV5 N 34° 51.658' W 77° 30.621' Bearing 320°	LRG1* Gauge# N45DACC9 N 34° 52.037' W 77° 30.470'		LP9 N 34° 51.889' W 77° 30.697' Bearing 210°			

20' 0 80'
SCALE

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BEN FURR
Project Manager

MONITORING PLANS

5			
4			
3			
2			
1	WMD	12/31/07	DATE OF COMPLETION
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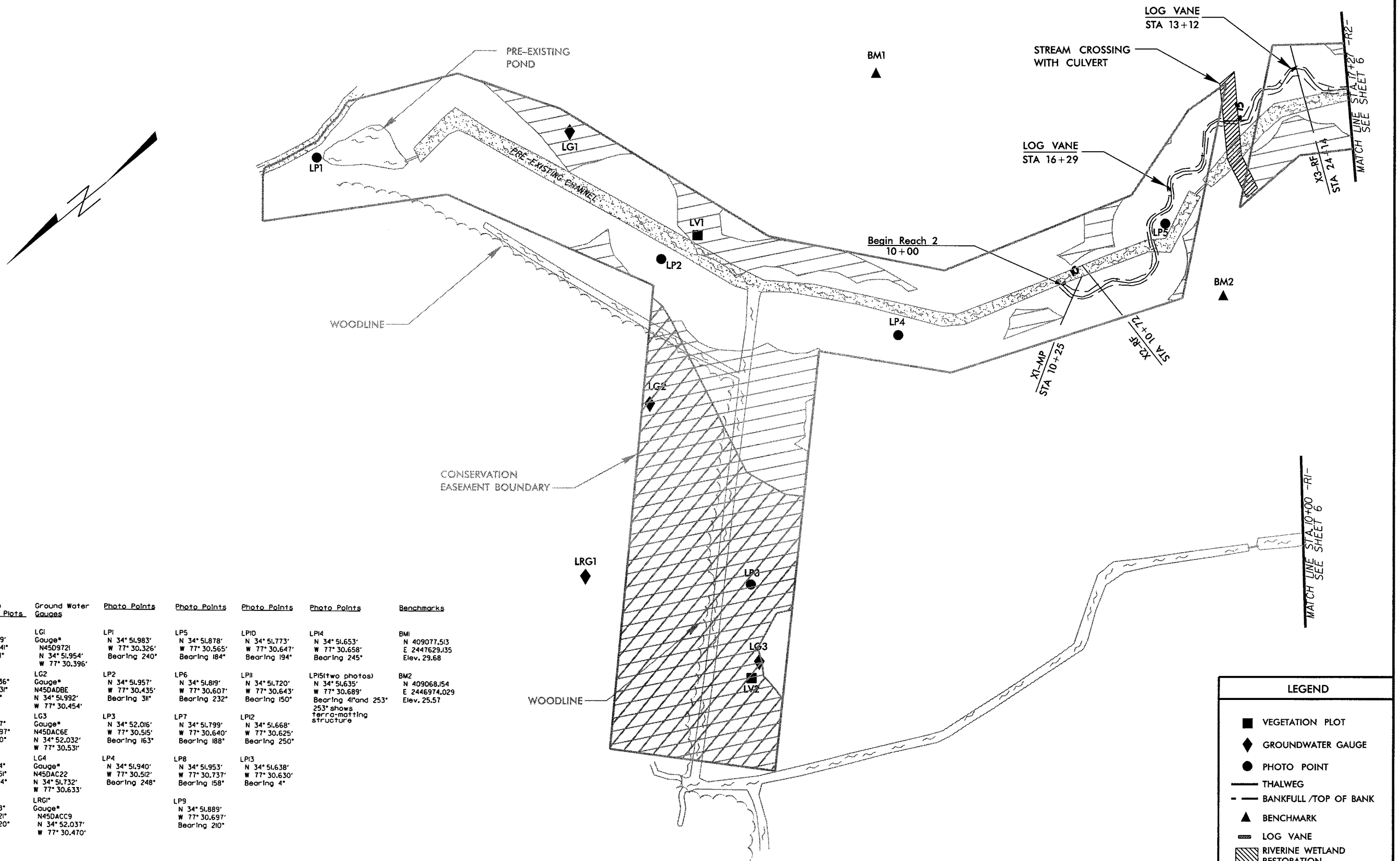
1101 Haynes Street, Suite 107
Raleigh, NC 27604 (919) 755-9490

LLOYD STREAM AND WETLAND RESTORATION SITE

ONSLOW COUNTY, NORTH CAROLINA

Monitoring Devices



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LV2 N 34° 52.036' W 77° 30.531' Bearing 67°	LG2 Gauge# N45DADBE N 34° 51.992' W 77° 30.454'	LP2 N 34° 51.957' W 77° 30.435' Bearing 311°	LP6 N 34° 51.819' W 77° 30.607' Bearing 232°	LP11 N 34° 51.720' W 77° 30.643' Bearing 150°	LP15(two photos) N 34° 51.635' W 77° 30.689' Bearing 41°and 253° 253° shows terra-matting structure	BM2 N 409068.154 E 2446974.029 Elev. 25.57
LV3 N 34° 51.877' W 77° 30.697' Bearing 30°	LG3 Gauge# N45DAC6E N 34° 52.032' W 77° 30.531'	LP3 N 34° 52.016' W 77° 30.515' Bearing 163°	LP7 N 34° 51.799' W 77° 30.640' Bearing 188°	LP12 N 34° 51.668' W 77° 30.625' Bearing 250°		
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LV5 N 34° 51.658' W 77° 30.621' Bearing 320°	LRG1* Gauge# N45DACC9 N 34° 52.037' W 77° 30.470'		LP9 N 34° 51.889' W 77° 30.697' Bearing 210°			

LEGEND

- VEGETATION PLOT
- GROUNDWATER GAUGE
- PHOTO POINT
- THALWEG
- BANKFULL /TOP OF BANK
- BENCHMARK
- LOG VANE
- RIVERINE WETLAND RESTORATION
- NONRIVERINE WETLAND RESTORATION

20' 0 80'
SCALE

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LLOYD STREAM AND WETLAND RESTORATION SITE

ONSLOW COUNTY, NORTH CAROLINA

Monitoring Devices