Armstrong Property Wetland and Stream Mitigation Project
Hyde County, NC

2008 Annual Monitoring Report
Year 1

NCEEP Project Number D06012-A
Tar-Pamlico River Basin

Submitted to
NCDENR/Ecosystem Enhancement Program
2728 Capital Blvd.
Raleigh, NC 27604

Date: December, 2008

Monitoring:
Albemarle Restorations, LLC
P. O. Box 176
Fairfield, NC 27826

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Executive Summary

The Armstrong Property Wetland Mitigation Site is a riverine wetland and stream mitigation project located just east of State Route 45 near its intersection with State Route 264, in Hyde County, North Carolina. It was constructed by Albemarle Restorations, LLC, under contract with EEP to provide compensatory wetland mitigation credits in the Tar-Pamlico River Basin. Construction activities, in accordance with the approved restoration plan, began October 1, 2007, and were completed on November 30, 2007. Tree and shrub planting on the project site occurred on January 28 and 29, 2008. An emergent wetland seed mixture was sown shortly afterward. With the exception of increased planting density, all planting was done in accordance with the approved restoration plan.

Five water level monitoring gauges were installed on January 29, 2008 at varying elevations throughout the site to measure subsurface water elevations. Two additional gauges were installed in the riparian headwater stream (swamp run) in June of 2008, to help monitor flow and water level within the stream. Two more gauges were installed at the reference site. None of the five gauges in the riverine wetland area met the hydrologic success criterion of maintained groundwater levels within 12 inches of the soil surface for 21 consecutive days during the growing season. The cumulative rainfall deficit during the 2008 growing season was 8.08 inches which had an adverse impact on the levels of groundwater. The two gauges located within the run did meet the success criterion and indicated surface water in the run for the majority of the growing season.

In order to document flow in the swamp run 3 wrack lines were installed that would capture debris during times of peak water movement. Three permanent cross sections were also installed to monitor changes in the contour of the channel. One event of flow in April, 2008 was documented by photos and video that are included in the supporting documents. Another flow event was visually documented in August, 2008. Data from that event are analyzed and presented in this report as a means empirical evidence of flow in the swamp run.

Four vegetative monitoring plots were installed in the riverine wetland areas and permanently monumented, one coincident with monitoring gauges 1 through 4. There are also two plots installed within the swamp run, each similarly situated and referenced at the two run monitoring gauges. Each plot is a 10m X 10m square, as recommended by the CVS-EEP Protocol for recording vegetation sampling. Two of the plots in the riverine wetland area met the 3-year survival success criteria of 320 stems per acre. Since heavy herbaceous cover was the likely cause of inadequate survival, site maintenance and replanting is scheduled for 2009. This heavy herbaceous cover was also a problem in the swamp run where neither of the vegetation plots met the 3-year survival criteria. Supplemental planting and site maintenance is scheduled for that area as well.

Table ES-1 shows the levels of success attained by each of the water level monitoring gauges and the vegetation plots since monitoring began. Success criteria for the vegetation plots is the year 3 level of survival (320 stems per acre).

Table ES-1. Project Success Summary															
	Gauge							Percent	Vegetation Plot						Percent
	1	2	3	4	5	R1	R2	Success	1	2	3	4	R1	R2	Success
Year 1 (2008) Success	N	N	N	N	N	Y	Y	29%	Y	Y	N	N	N	N	33%

I. Project Background

1.0 Project Objectives

The goal of the Armstrong Property Mitigation Project was to create a riverine wetland system typically found in the middle to upper reaches of first or zero order tributary systems. The project is to serve as compensation for wetland loss in the Tar-Pamlico River Basin. The restoration plan was developed and implemented to eliminate pattern drainage and restore topography and hydrology that more closely resembled that of similar undisturbed land. Construction resulted in the development of a broad, frequently flooded swamp run following an historical path as evidenced by archived aerial photographs and signature topography. Subsequent planting was designed to restore a wetland forest ecosystem that is typically found in the immediate area characteristic of similar soils, topography and hydrology.

Ecological benefits of the restored riparian headwater system and its associated riverine wetlands are the following:

1. Water quality improvements, including nutrient, toxicant and sediment retention and reduction, increasing dissolved oxygen levels, as well as reducing excessive algae growth, and reducing surface water temperatures in receiving waters by providing permanent shading in the form of a shrub/scrub and forested headwater wetland system.
2. Wildlife habitat enhancement by adding to the existing adjacent forested areas creating a continuous travel corridor between habitat blocks and providing a wide range of habitat areas (open water, emergent, shrub/scrub and forested) for amphibians, reptiles, birds, insects and mammals.
3. Flood flow attenuation during storm events which reduces sedimentation and erosion downstream, and improves long term water quality within the Pungo River.
4. Passive outdoor recreation and educational opportunities for the landowner and the surrounding community.

2.0 Project Structure, Restoration Type, and Approach

Table I lists the estimated wetland acreage to be restored on the Armstrong Property. The mitigation plan provides for the restoration of 20.0 acres of riverine wetlands and 2,200 linear feet of stream (swamp run) restoration. Prior to construction, the easement area was used entirely for row crop agriculture, primarily soy beans, corn and cotton. The agricultural fields were drained by several ditches that traversed the site with outfall into Clark Mill Creek. Construction activities, in accordance with the approved restoration plan, began in October, 2007 and were completed in November of 2007. Native tree and shrub species were planted in January of 2008. The resulting riverine system is designed to emulate natural swamp run systems found within the Pungo River Basin.

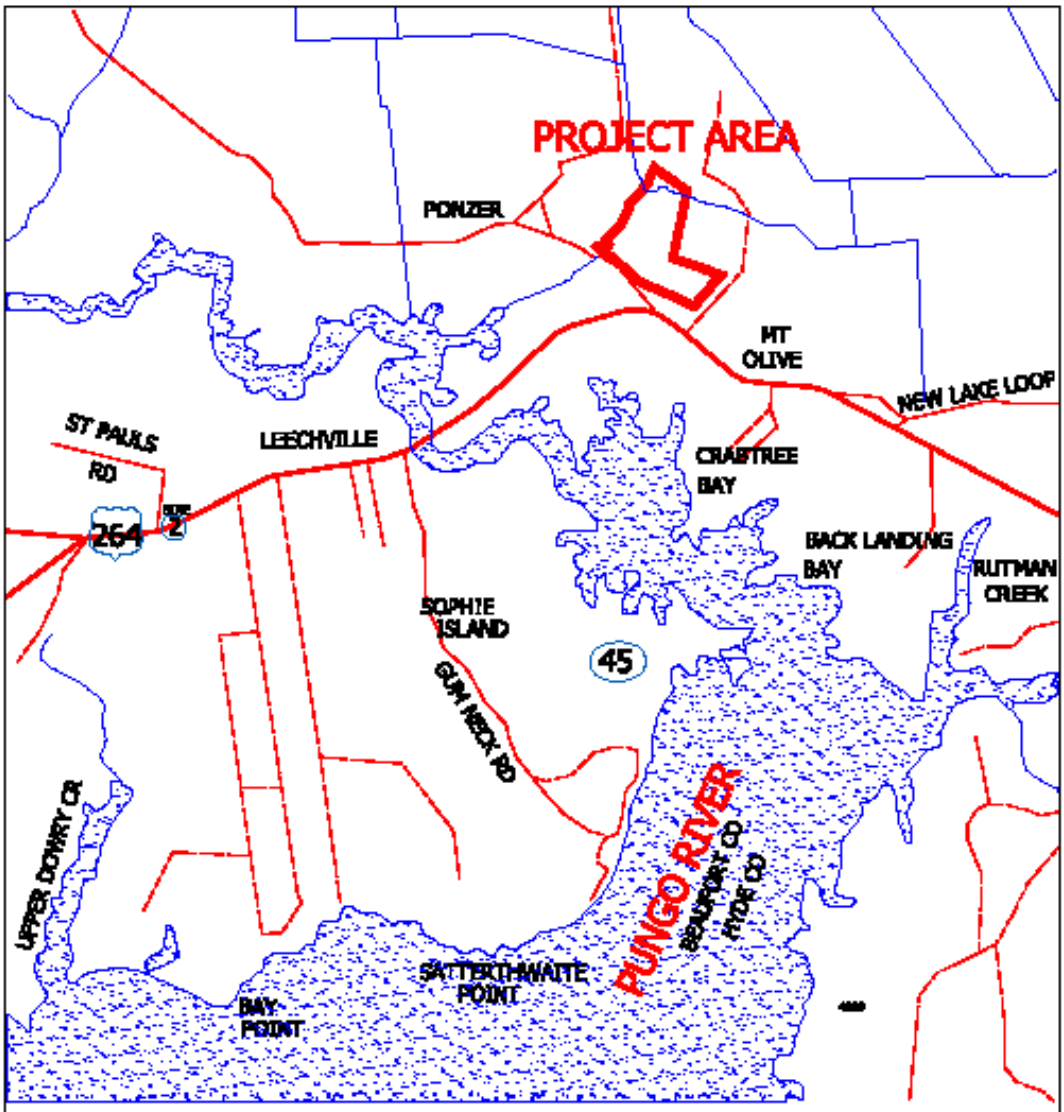
Table 1. Project Restoration Components

Restoration Type	Pre-Existing Acres/Linear Feet	Post Construction Acres/ Linear Feet	Credit Ratio (Restoration : WMU)	Total WMUs/ SMUs
Riverine Wetland	0.0 acres	20.0 acres	1:1	20.0 WMUs
Stream (Swamp Run)	0.0 linear feet	2,200 linear feet	1:1	2,200 SMUs

3.0 Location and Setting

The Armstrong Property Mitigation Site is located in Hyde County, between Ponzer and Mt. Olive on the north side of State Route 45 near its intersection with US Hwy 264. The easement area is situated in the middle of the Armstrong property and adds contiguous swamp run and forested wetlands to those of Clark Mill Creek, a tributary of the Pungo River which is less than a mile to the south. The surrounding area is primarily forest and agricultural land with residential properties as a minor component.

Figure 1 is a location map for the project site. Directions to the site are as follows: from Belhaven, travel east on US Hwy 264 approximately 10 miles and turn left (north) on State Route 45. Access to the site is approximately .25 miles north of intersection on right.


PROJECT AREA
PONZER
MT OLIVE
NEW LAKE LOOP
ST PAULS RD
LEECHVILLE
CRABTREE BAY
264
BACK LANDING BAY
RUTMAN CREEK
SOPHIE ISLAND
45
GUM NECK RD
UPPER DOWRY CR
PUNGO RIVER
BEAUFORT CR
HYDE CO
SATTERTHWAITE POINT
BAY POINT
FIGURE 1
SCALE
ECOTONE, INC.
Environmental Consulting, Permitting & Design.
Forest & Wetland Creation &
Stream Restoration.
Vicinity Map
ARMSTRONG PROPERTY
RIVERINE WETLAND & STREAM RESTORATION
MITIGATION MONITORING
Scale: 1" = 4000'
11/2008
Drawn By: LMS

4.0 Project History and Background

Table II provides the history of data collection and actual completion of various milestones of the Armstrong Property Wetland Mitigation Site.

Table II. Project Activity and Reporting History Armstrong Property Wetland Mitigation Project/EEP #D06012-A		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	June 2007	July 2007
Final Design -90%	June 2007	July 2007
Construction	N/A	November 2007
Temporary S & E mix applied to entire project area	N/A	February 2008
Permanent seed mix applied to entire project area	N/A	February 2008
Containerized and Bare Root Planting	N/A	January 2008
Mitigation Plan/As-built (Year 1 monitoring - baseline)	March 2008	December 2008
Year 2 monitoring		
Year 3 monitoring		
Year 4 monitoring		
Year 5 monitoring		

Points of contact for the various phases of the APWMS are provided in Table III.

Table III. Project Contacts Armstrong Property Wetland Mitigation Site/EEP #D06012-A	
Designer Primary Project design POC	Ecotone, Inc. 1204 Baldwin Mill Road Jarrettsville, MD 21804 Scott McGill (410-692-7500)
Construction Contractor Construction contractor POC	Armstrong, Inc. P. O. Box 96 25852 US Hwy 64 Pantego, NC 27860 Tink Armstrong (252-943-2082)
Planting Contractor Planting contractor POC	Carolina Silvics, Inc. 908 Indian Trail Road Edenton, NC 27932 Mary-Margaret McKinney (252-482-8491)
Seeding Contractor Seed planting contractor POC	Armstrong, Inc. P. O. Box 96 Pantego, NC 27860 Tink Armstrong (252-943-2082)
Seed mix sources	Earnst Conservation Seeds, LLP, Meadville, PA
Nursery stock suppliers	International Paper, Inc., et. al.
Monitoring Consultants Wetland and Vegetation POC	Woods, Water and Wildlife, Inc. P. O. Box 176 Fairfield, NC 27826 Ashby Brown (800-509-0190)

Project background information for the APWMS is provided in Table IV.

Table IV. Project Background Armstrong Property Wetland Mitigation Site/EEP #D06012-A	
Project County	Hyde County
Drainage Area	25.0 acres within easement boundary
Drainage impervious cover estimate (%)	0
Physiographic Region	Coastal Plain
Ecoregion	8.5.1 Middle Atlantic Coastal Plain
Rosgen Classification of As-built	N/A
Cowardin Classification	PEM, PSS, PFO
Dominant Soil Types	Acredale Silt Loam
Reference site ID	Clark Mill Creek, Hyde County, NC
USGS HUC for Project and Reference	03020104
NCDWQ Sub-basin for Project and Reference	03-03-07
NCDWQ classification for Project and Reference	C
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	Yes, Pungo River
Reasons for 303d listing or stressor?	WWTP, ag, urban runoff, marinas
% of project easement fenced	0

5.0 Monitoring Plan View

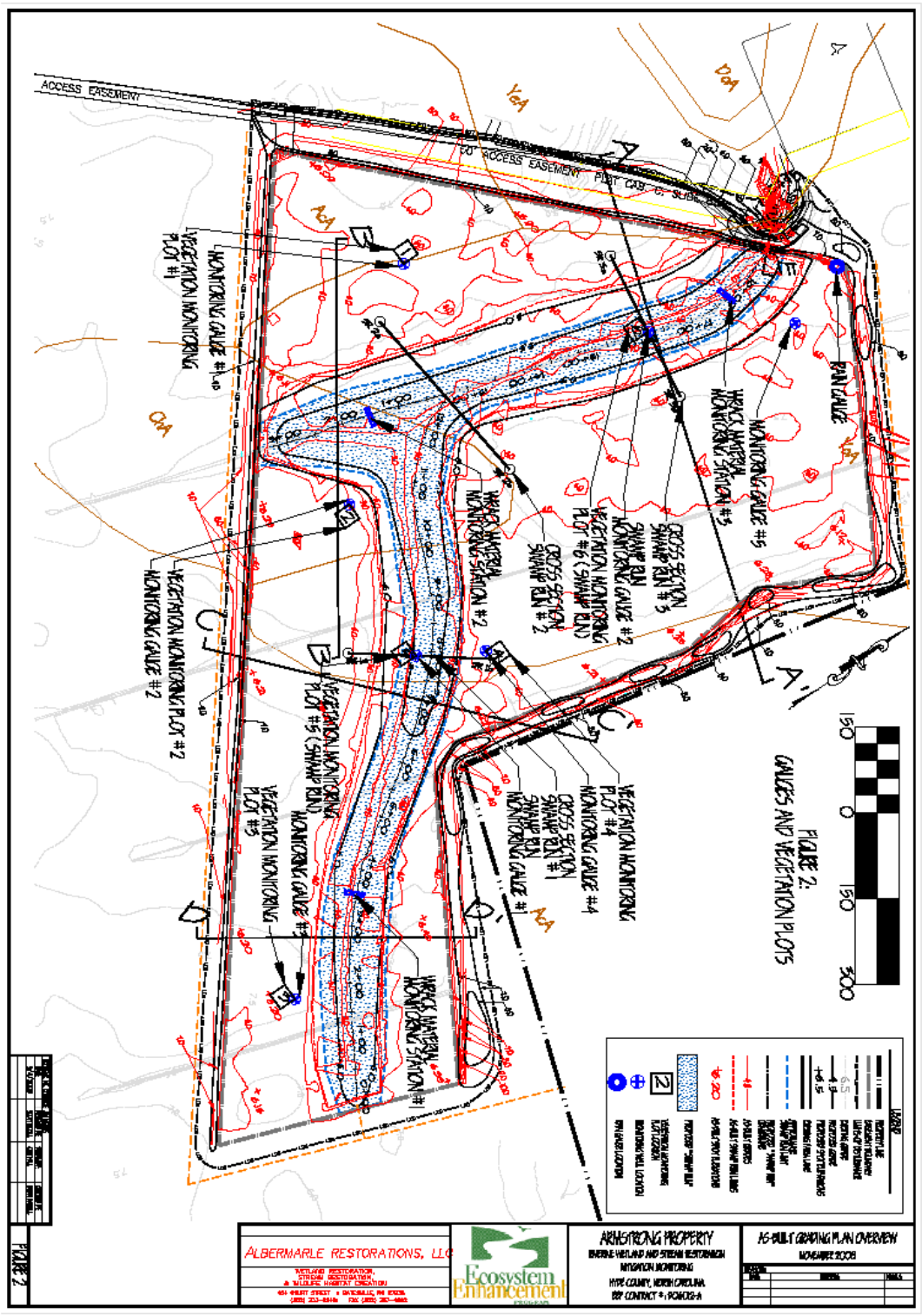
There are five water level monitoring gauges installed at key locations across the project. These gauges are suspended in two-inch pvc pipe that is set approximately four feet vertically into the ground. The gauges have been located to assess the groundwater levels throughout the year at various elevations and topographies within the site. Two more gauges are installed in an offsite wetland area to serve as references to naturally functioning wetlands. In addition, there is a rain gauge onsite to capture and record precipitation.

Vegetation monitoring is accomplished by surveying the six permanent sampling plots. Each plot is referenced by a monitoring gauge which serves as the plot origin and as a photo station for that plot. The plots are ten meters square and are situated to give an accurate sample of the planted and natural woody vegetation. For each site, the data recorded matches that required of the *CVS-EEP Protocol for Recording Vegetation, v 4.0, 2006,* level 1-2.

Three permanent cross sections were installed at different locations along the swamp run to help monitor the condition of the swamp run. Any changes in the cross sections due to scouring or sedimentation should be identified by resurvey of these cross sections during the five-year monitoring period.

Three wrack lines were also installed as an aid in monitoring flow in the swamp run. They were designed and located to capture debris during periods of high water as evidence of water movement within the site.

Figures 2 and 3 provide plan views of the site showing the location of all monitoring features including gauges, sampling plots and the rain gauge.


ACCESS EASEMENT
VEGETATION MONITORING PLOT #1
VEGETATION MONITORING GAUGE #1
VEGETATION MONITORING PLOT #2
VEGETATION MONITORING PLOT #3
VEGETATION MONITORING GAUGE #3
VEGETATION MONITORING PLOT #4
VEGETATION MONITORING GAUGE #4
VEGETATION MONITORING PLOT #5 (SWAMP RUN)
CROSS SECTION SWAMP RUN #1
CROSS SECTION SWAMP RUN #2
CROSS SECTION SWAMP RUN #3
VEGETATION MONITORING PLOT #6 (SWAMP RUN)
SWAMP RUN MONITORING GAUGE #2
WRACK MATERIAL MONITORING STATION #1
WRACK MATERIAL MONITORING STATION #2
WRACK MATERIAL MONITORING STATION #3
RAIN GAUGE
MONITORING GAUGE #5
FIGURE 2: GAUGES AND VEGETATION PLOTS
150 0 150 300
ALBEMARLE RESTORATIONS, LLC
Ecosystem Enhancement
ARMSTRONG PROPERTY
AS-BUILT GRADING PLAN OVERVIEW
NOVEMBER 2008

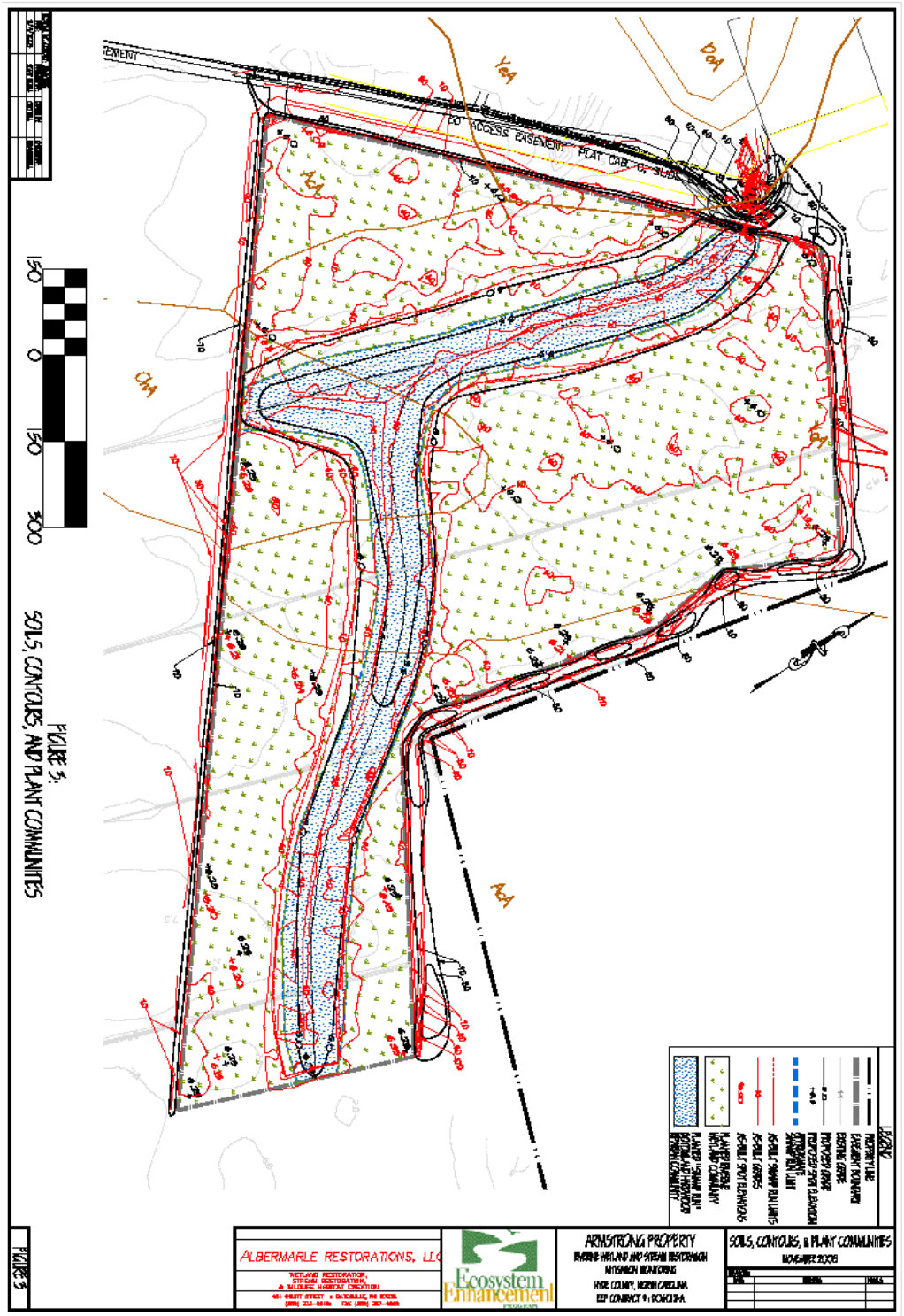


FIGURE 3:
SOILS, CONTOURS, AND PLANT COMMUNITIES
ALBEMARLE RESTORATIONS, LLC
Ecosystem Enhancement
ARMSTRONG PROPERTY
SOILS, CONTOURS, & PLANT COMMUNITIES
NOVEMBER 2008
LEGEND

II. Project Condition and Monitoring Results

1.0 Vegetation Assessment

The vegetation success criterion was developed in accordance with the CVS-EEP protocol. The Armstrong project was designed to include both riverine and bottomland hardwood plant communities. The project was planted with a mixture of tree and shrub species that would resemble that of naturally occurring swamp runs and adjacent riverine wetlands in the local area. The run and area immediately adjacent were planted heavily to cypress, oaks and tupelo. The riverine wetland zone beyond the swamp run is populated by a broader mix of native hydrophytic tree and shrub species. The photos in Appendix A show the colonization of the project area by hydrophytic vegetation. The species mix was based on the vegetation noted at the reference site and all species are classified from FAC to OBL (Table V). The site was planted at a rate of 430 stems per acre in the winter of 2008. Due to poor survival attributed to heavy herbaceous competition, site maintenance, replacement planting and supplemental planting is scheduled for the winter of 2009. The species to be replanted were chosen from Table V.

Table V. Species by Community Type		
Armstrong Property Wetland Mitigation Project/EEP #D06012-A		
Tree/Shrub Planting Schedule - 25.0 acres		
Common Name	**Scientific Name**	**Wetland Indicator Status**
Bald Cypress	Taxodium distichum	OBL
Water Tupelo	Nyssa aquatica	OBL
Swamp Black Gum	Nyssa biflora	FAC
Swamp Chestnut Oak	Quercus michauxii	FACW-
Pin Oak	Quercus palustris	FACW
Willow Oak	Quercus phellos	FACW-
Swamp White Oak	Quercus bicolor	FACW+
Water Oak	Quercus nigra	FAC
Sweetgum	Liquidambar styraciflua	FAC+
Swamp Cyrilla	Cyrilla racemiflora	FACW
Sweet Pepperbush	Clethera alnifolia	FACW
Virginia Sweetspire	Itea virginica	FACW+
Button Bush	Cephalanthus occidentalis	OBL
Wax Myrtle	Myrica cerifera	FAC+
Highbush Blueberry	Vaccinium corymbosum	FACW
Sweetbay	Magnolia virginiana	FACW+
Swamp Bay	Persea palustris	FACW

1.1 Vegetation Discussion and Problem Areas

Two of the four plots in the riverine community met the Year 3 success criteria of a minimum of 320 stems per acre after the second growing season. Neither of the plots in the swamp run met the success criteria possibly due to the extended period of inundation and competition from

heavy herbaceous cover. Over the entire project, the survival rate averaged 276 live stems per acre. The survival rate for the riverine area was 313 live stems per acre.

Rainfall data collected at the project show the rainfall drought continues. During the 2008 growing season, there was a cumulative rainfall deficit of 8 inches (according to the normal averages per the WETS table for Belhaven, NC). Seedling development was excellent very early in the year as observed while walking the project in April. By July, when the project was inspected again, it was apparent that lack of rainfall during May and June caused significant seedling loss. Also, as can be seen in site photos in Appendix A, the project area developed a complete and heavy ground cover of herbaceous material that contributed to the poor survival of planted woody material through competition for scarce soil moisture in the root zone of the very upper soil horizon.

1.2 Vegetation Monitoring Plan View (Integrated)

Figure 4 in Appendix D illustrates the wetter areas of the site (shaded in yellow) where the herbaceous cover is much heavier. This area supports a complete and dense cover of cattails (*T. latifolia*) and other herbaceous vegetation that is a direct and severe competitor to the trees and shrubs planted there. Seedling survival in these areas was poor (plots 3, 4, R1 and R2). Plots 1 and 2 which are on drier areas had a less dense herbaceous cover which likely allowed better tree survival. Replacement planting followed by site maintenance is scheduled for the winter of 2009. It is anticipated that the vegetative community will continue to be dominated by early successional herbaceous species so maintenance will be designed to control that factor. As the site matures there will be a gradual transition toward woody species as the dominant vegetative community.

2.0 Wetland Assessment

The hydrologic success criterion is to achieve a minimum of 21 consecutive days where the groundwater level is within 12 inches of the soil surface during the growing season. The growing season for this site is from March 11 to November 27, a period of 261 days (WETS Table for Belhaven, NC). Success for any particular monitoring location is to show soil saturation to within 12 inches of the surface for 21 consecutive days during that period.

There are five continuous water level monitoring gauges deployed across the site (Gauges 1-5) to monitor fluctuations in the water table within the project area. A rain gauge is also kept onsite and its data are compared to that collected at the NOAA cooperator site in Belhaven, NC. To further monitor the affect of seasonal and annual variations in precipitation in restored wetlands, hydrologic success of the site was assessed in relation to the reference wetland site where two more monitoring gauges are installed (Gauge 6 as a Swamp Run reference & Gauge7 as a Riverine reference).

Of particular note is the area near the outfall end of the project, the area in close proximity to Run Gauge 2. This area captured and held water for a sufficient length of time and at a sufficient depth as to support vertebrate aquatic life. During the monitoring data collection effort in September 2008, the presence of turtles and small fish were observed in the swamp run which

exemplifies some of the ecological benefits provided by this project as outlined in Section I, 1.0 of this report.

2.1 Wetland Discussion and Problem Areas

Rainfall from March through June was very sporadic and without one particular rainfall event in April totaling 4.28", those four months would have experienced a deficit of over 9". It is anticipated that the likelihood of hydrologic success would be high early in the growing season since temperatures are cool and normal rainfall is adequate to keep the groundwater table elevated. Some of the hydrographs confirm this in that recharge rates and durations are greater and more sensitive to precipitation early and late in the growing season, and less so in the height of summer. The normal precipitation pattern has not been prevalent at the project site for at least the past two years.

The wetland problem areas are generally the riverine wetland areas well out beyond the swamp run. Gauges 1 and 2, which are at vegetation plots 1 and 2, indicated the driest areas of the project which coincides with the sparsest herbaceous cover and best tree and shrub survival. Gauges 3, 4 and 5 indicated better recharge after rainfall, maintained better water levels and are in areas of much heavier herbaceous cover, dominated by cattails (*Typha latifolia)*, which coincides with poorer tree survival. The average number of days that these five gauges measured groundwater at or above the -12" level was 37 days. Reference Gauge 7, which is in a riverine landscape position similar to gauges 1-5, measured 45 days of groundwater level at -12" or higher. Reference Gauge 7 did not meet the hydrology success of 21 days. This comparison implies that the riverine portion of the project is functioning similarly to a natural riverine area.

Both of the swamp run gauges, R1 and R2, met the hydrology success criteria even though they were deployed mid-way through the growing season. Reference Gauge 6 is in a similar landscape position as the on-site swamp run gauges and it too met the success criteria. Comparison of the hydrographs for gauges R1, R2 and Reference 6 indicate that these three gauges are measuring very similar groundwater patterns.

2.15 Flow

Refer to Figures F1 and F2 for the following discussion of evidence of flow within the swamp run. Figure F1 compares the water level in the two run gauges to the water level in two gauges adjacent to and closest to the swamp run (gauges 3 and 5). A period of rainfall between August 9 and September 4 resulted in flow on-site that was visually confirmed. Events A, B and C in Figure F1 are separate rainfall events that caused flooding and flow in the riverine wetland areas, subsequent drainage into the swamp run, and flow downstream thru the downvalley terminus of the project.

The water levels in riverine wetland Gauges 3 and 5 corroborate the flow in that they maintain above-ground water levels for various lengths of time until runoff gradually depletes their excess water into the swamp run. The change in water level shown in Gauge 5, which is nearest the outfall is well correlated to that in Run Gauge 2 which is also nearest the outfall end. Run Gauge 1, which is farthest from the outfall, mirrors the trend measured at Run Gauge 2 indicating

increased above-ground water levels that slowly dissipate over a period of days. Gauge 3, which is in the riverine wetland area at the uppermost reaches of the project also illustrated the same trend of short-lived above ground flooding which indicates flow downstream toward Run Gauge 1.

Figure F2 compares the above-ground water level at both of the Swamp Run Gauges to the inlet level of the outfall pipe. Keep in mind when viewing this graph that it illustrates the *absolute* level of water above or below the outfall pipe which includes differences in ground level elevations. Run Gauge 2 can be compared directly to the level of the outfall pipe, which in Figure F2 is "Water Level" 0 feet. Since the ground level at Run Gauge 1 is higher than the outfall pipe, it must be compared to its own ground level, +.1' (this line is omitted for clarity). The most compelling evidence of flow is found at the beginning of Event A, where water levels at both run gauges continued to rise after rainfall had ceased. Rainfall data collected onsite confirms this. The rise was small and quickly leveled off as would be expected, but it indicates flow from the riverine areas into the swamp run and eventually offsite. This occurs again during Events B and C, but to lesser degrees.

In an attempt to capture further evidence of water movement across the site, three wrack lines were installed at various positions in the swamp run. However, due to very heavy cattail growth, these wrack lines were rendered non-functional. As another means of assessing flow, or more exactly, evidence of channel formation, scouring of sedimentation, three permanent cross sections were installed at different positions along the run and monitored to assess changes in profile across the run. The baseline measurements were taken in the spring of 2008 and the cross sections were remeasured in September of 2008 to see what changes in the swamp run channel might have occurred. Figure F3 compares the baseline data to the remeasurements which indicated no evidence of macro changes in the stream channel.

Included in the photos in Appendix A are photos of offsite flow during April, 2008 prior to installation of the run gauges. Also included in the supporting electronic documents is a short video of this same event.

Onsite flow is occurring, but due to the limited changes in elevation across the length of the project, it lacks sufficient velocity and is impeded to such an extent by volunteer herbaceous vegetation, dominated by cattails (*Typha latifolia*), as to be nearly immeasurable at any location other than in close proximity to the outfall pipe. But the data captured by the gauges does show water movement from the riverine wetland areas toward the swamp run during periods of sufficient rainfall.

Figure F1
Comparison of Gauges for Flow

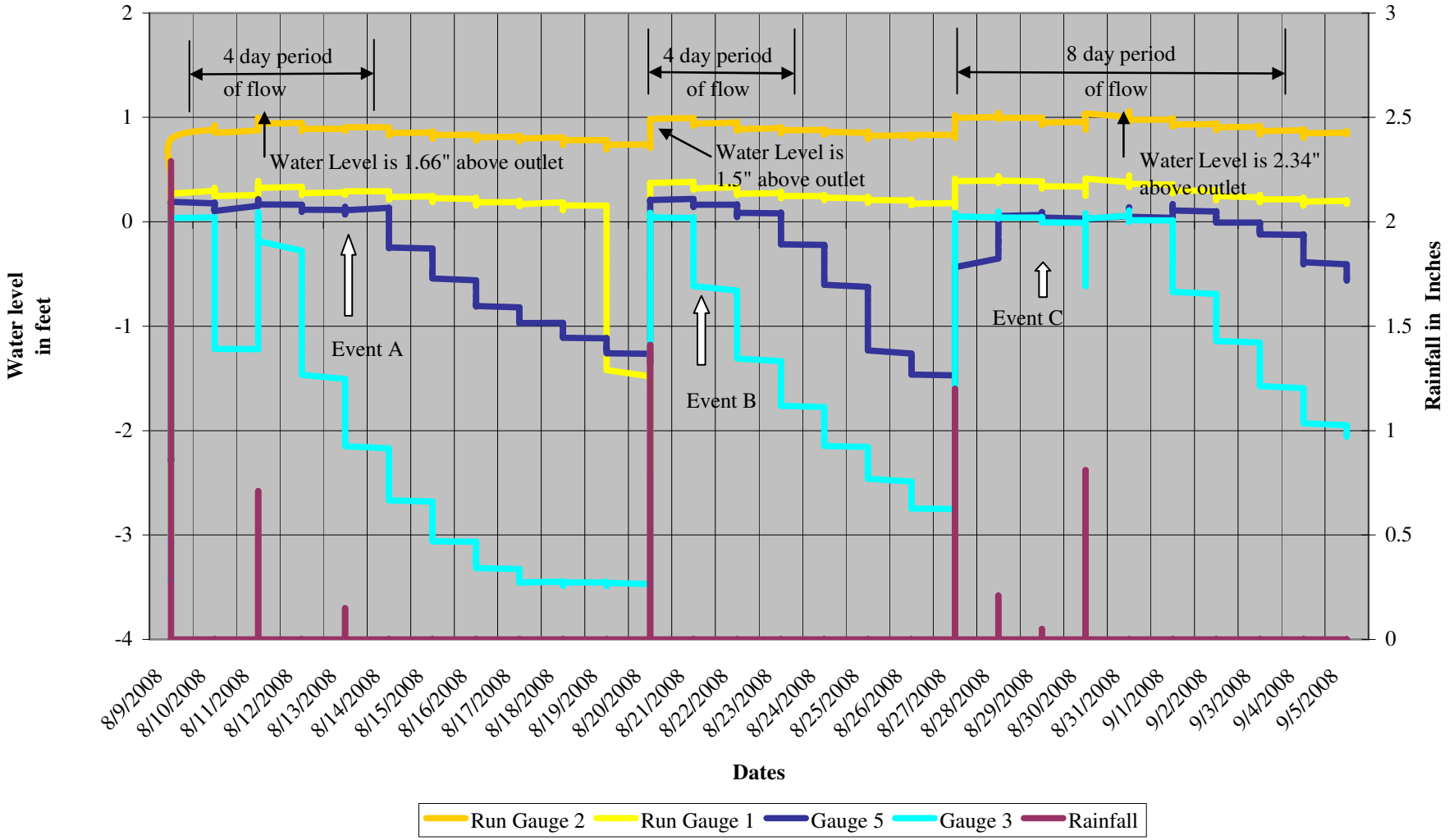
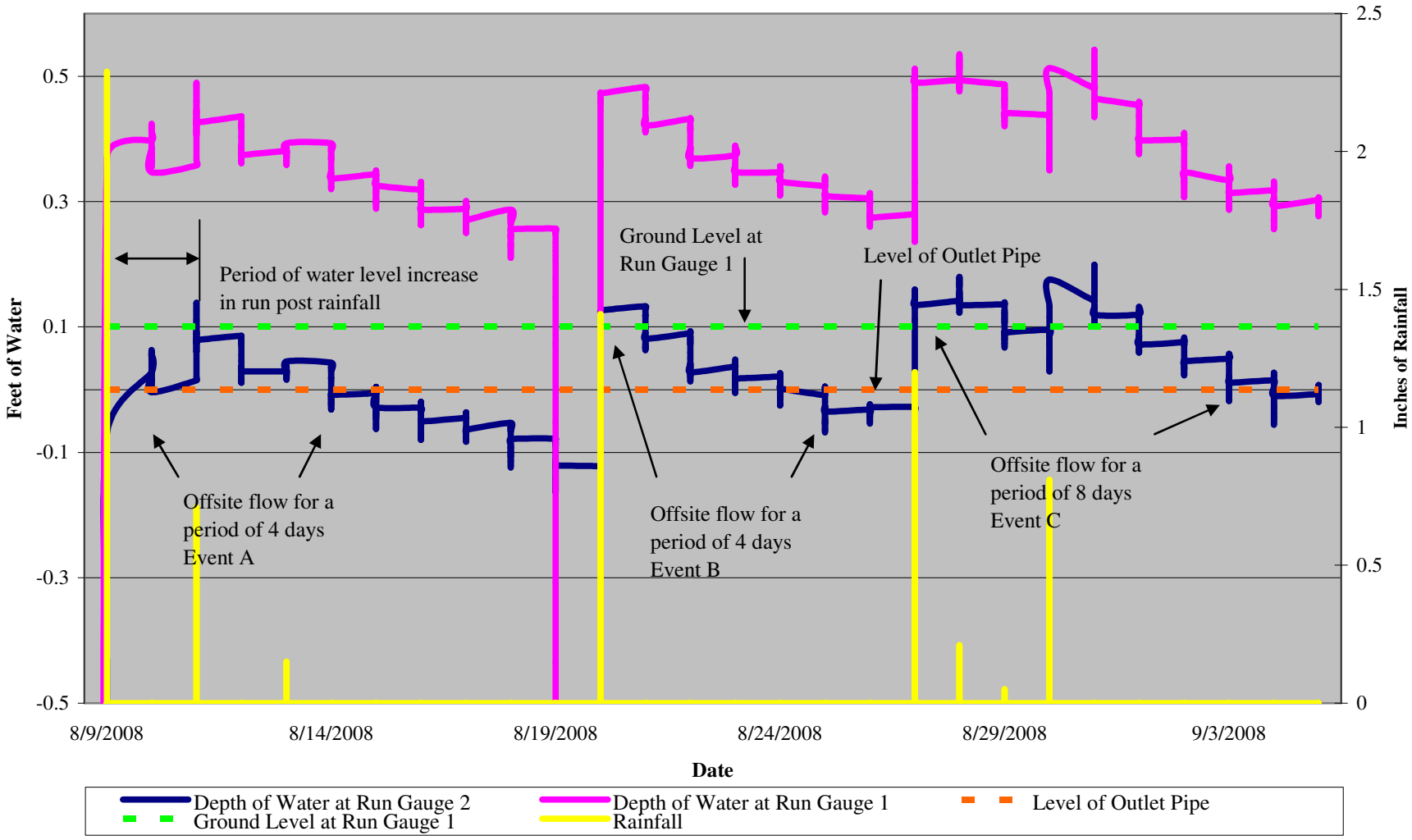
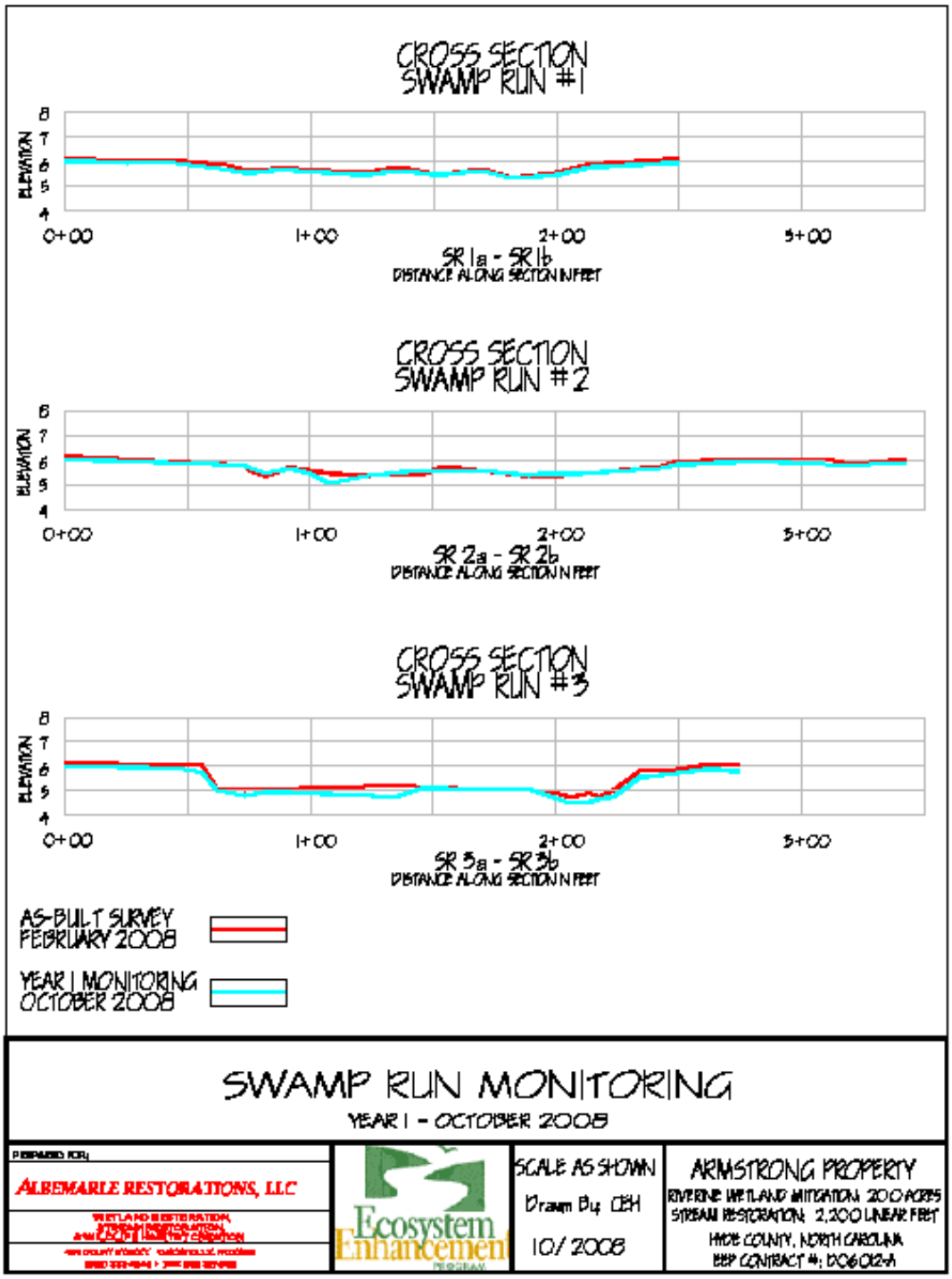


Figure F2
Run Gauge Levels as Evidence of Flow




CROSS SECTION
SWAMP RUN #1
ELEVATION
8
7
6
5
4
0+00
1+00
2+00
3+00
SR 1a - SR 1b
DISTANCE ALONG SECTION IN FEET
CROSS SECTION
SWAMP RUN #2
ELEVATION
8
7
6
5
4
0+00
1+00
2+00
3+00
SR 2a - SR 2b
DISTANCE ALONG SECTION IN FEET
CROSS SECTION
SWAMP RUN #3
ELEVATION
8
7
6
5
4
0+00
1+00
2+00
3+00
SR 3a - SR 3b
DISTANCE ALONG SECTION IN FEET
AS-BUILT SURVEY
FEBRUARY 2008
YEAR 1 MONITORING
OCTOBER 2008
SWAMP RUN MONITORING
YEAR 1 - OCTOBER 2008
PREPARED FOR:
ALBEMARLE RESTORATIONS, LLC
WETLAND RESTORATION
STREAM RESTORATION
Ecosystem Enhancement
PROGRAM
SCALE AS SHOWN
Drawn By: CEH
10/ 2008
ARMSTRONG PROPERTY
RIVERINE WETLAND MITIGATION: 200 ACRES
STREAM RESTORATION: 2,200 LINEAR FEET
HYDE COUNTY, NORTH CAROLINA
EEP CONTRACT #: D06012-A

2.2 Wetland Monitoring Plan View (Integrated)

Figure 4 in Appendix D provides an overview of the hydrologic problem areas. Much of the riverine wetland zone was flooded for a short length of time early in the growing season as evidenced by the site photos in Appendix A. For most of the summer however, the site suffered droughty conditions. Vegetation problem areas coincided with the very wettest areas of the site where dense herbaceous cover resulted in poor survival of planted seedlings.

Table VI. Hydrology and Vegetation Criteria Success by Plot
Armstrong Property Wetland Mitigation Project/EEP #D06012-A

Gauge	Hydrology Success Met	Hydrology Mean	Vegetation Plot	Vegetation Success Met	Vegetation Mean
1	N	33%	1	Y	33%
2	N		2	Y	
3	N		3	N	
4	N		4	N	
5	N		N/A	N/A	
R-1	Y		R-1	N	
R-2	Y		R-1	N	
6 (Ref)*	Y		N/A	N/A	
7 (Ref)*	N		N/A	N/A	

* Gauges 6 & 7 are reference gauges on the reference site and are not included in the success percentages

3.0 Project Success Discussion

After one year of monitoring, the wetland hydrology of the Armstrong project has shown indications of successful restoration. Specifically, the hydrology within the swamp run has been restored and the project is beginning to function like a natural riparian headwater system. Despite a year of moderate to severe rainfall drought, soils within the swamp run remained inundated or saturated for most of the growing season, due to onsite flow after rainfall events that were confirmed by both visual and empirical evidence.

The cumulative rainfall deficit during the 2008 growing season was 8.08". Because of this deficit, hydrology in the riverine wetland area suffered, even though gauges in that area indicated rapid recharge of groundwater following rainfall events. This rapid response to rainfall indicates improved riverine wetland hydrology and the site's overall ability to function as a headwater riparian stream system. The reference gauges appear to be measuring very similar groundwater patterns as those measured on the project site confirming the effects of the droughty conditions on natural headwater systems.

The droughty conditions may have actually been the reason for better tree survival in portions of the riverine wetland area due to lighter observed herbaceous cover. The wetter areas, primarily

in and adjacent to the swamp run, supported much heavier early successional herbaceous vegetation that was competition for the planted trees and shrubs. Better survival is expected after maintenance and replanting in 2009.

III. Methodology Section

Year 2 monitoring for the Armstrong project occurred in 2008. Monitoring and vegetation sampling procedures were established in the mitigation plan for this project and no deviations were made.

Appendix A

Vegetation Data Tables

Vegetation Photos

1. Vegetation Data Tables

Table 1. Vegetation Metadata	
Report Prepared By	Ashby B. Brown
Date Prepared	10/6/2008 15:41
database name	cvs-eep-entrytool-v2.2.5.mdb
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	D06012A
project Name	Armstrong
Description	Armstrong Wetland Mitigation project
River Basin	
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	6

Table 2. Vegetation Vigor by Species								
	Species	**4**	**3**	**2**	**1**	**0**	**Missing**	**Unknown**
	Cephalanthus occidentalis	1	4					
	Itea virginica		2	2				
	Liquidambar styraciflua		4	4				
	Quercus bicolor		3	2				
	Quercus phellos		4	3				
	Taxodium distichum		4	3				
	Unknown			1	1			
	Myrica cerifera	1	2					
TOT:	**8**	**2**	**23**	**15**	**1**			

Table 3. Vegetation Damage by Species				
	Species	**All Damage Categories**	**(no damage)**	**Site Too Dry**
	Cephalanthus occidentalis	5	5	
	Itea virginica	4	4	
	Liquidambar styraciflua	8	7	1
	Myrica cerifera	3	3	
	Quercus bicolor	5	5	
	Quercus phellos	7	6	1
	Taxodium distichum	7	5	2
	Unknown	2	2	
TOT:	**8**	**41**	**37**	**4**

Table 4. Vegetation Damage by Plot				
	plot	**All Damage Categories**	**(no damage)**	**Site Too Dry**
	D06012A-ABET-0001	9	5	4
	D06012A-ABET-0002	12	12	
	D06012A-ABET-0003	6	6	
	D06012A-ABET-0004	4	4	
	D06012A-ABET-R1	4	4	
	D06012A-ABET-R2	6	6	
TOT:	**6**	**41**	**37**	**4**

Table 5. Stem Count by Plot and Species										
					plot D06012A-ABET-					
	Species	**Total Planted Stems**	**# plots**	**avg# stems**	**1**	**2**	**3**	**4**	**R1**	**R2**
	Cephalanthus occidentalis	5	1	5						5
	Itea virginica	4	2	2				2	2	
	Liquidambar styraciflua	8	4	2	1	5	1	1		
	Myrica cerifera	3	2	1.5		1	2			
	Quercus bicolor	5	3	1.67		3	1		1	
	Quercus phellos	7	3	2.33	2	3	2			
	Taxodium distichum	7	2	3.5	6					1
	Unknown	2	2	1				1	1	
TOT:	**8**	**41**	**8**		**9**	**12**	**6**	**4**	**4**	**6**
		Stems per Acre			364	486	243	162	162	243

Table 6. Vegetation Problem Areas			
Feature/Issue	Plot	Probable Cause	Photo #
Herbaceous competition/Poor to moderate growth	3, 4, R1, R2	Dense herbaceous cover and/or insufficient rainfall	VPA 1, 2 and 3

VPA 1
Heavy herbaceous cover at plot 3

VPA 2
Heavy herbaceous cover at plot 4

VPA 3
Heavy cattails in swamp run
Plots R1 and R2

Plot 1

Plot 2

Plot 3

Plot 4

Plot R1

Plot R2

Early Season Flooding
April 2008

Wrack line during early flooding

Wrack line in September, 2008
Heavy cattail cover in swamp run

Appendix B

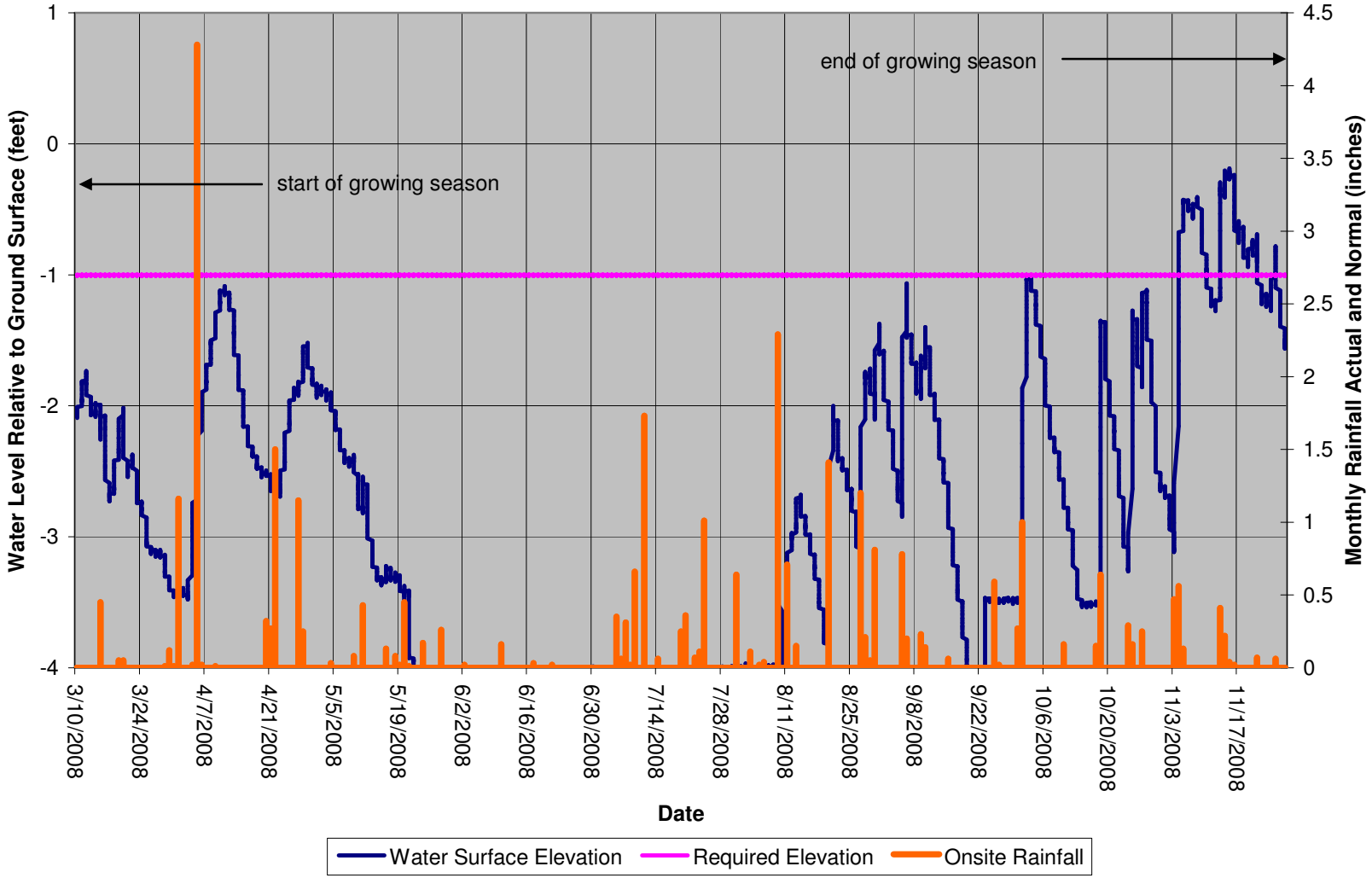
Geomorphologic Raw Data

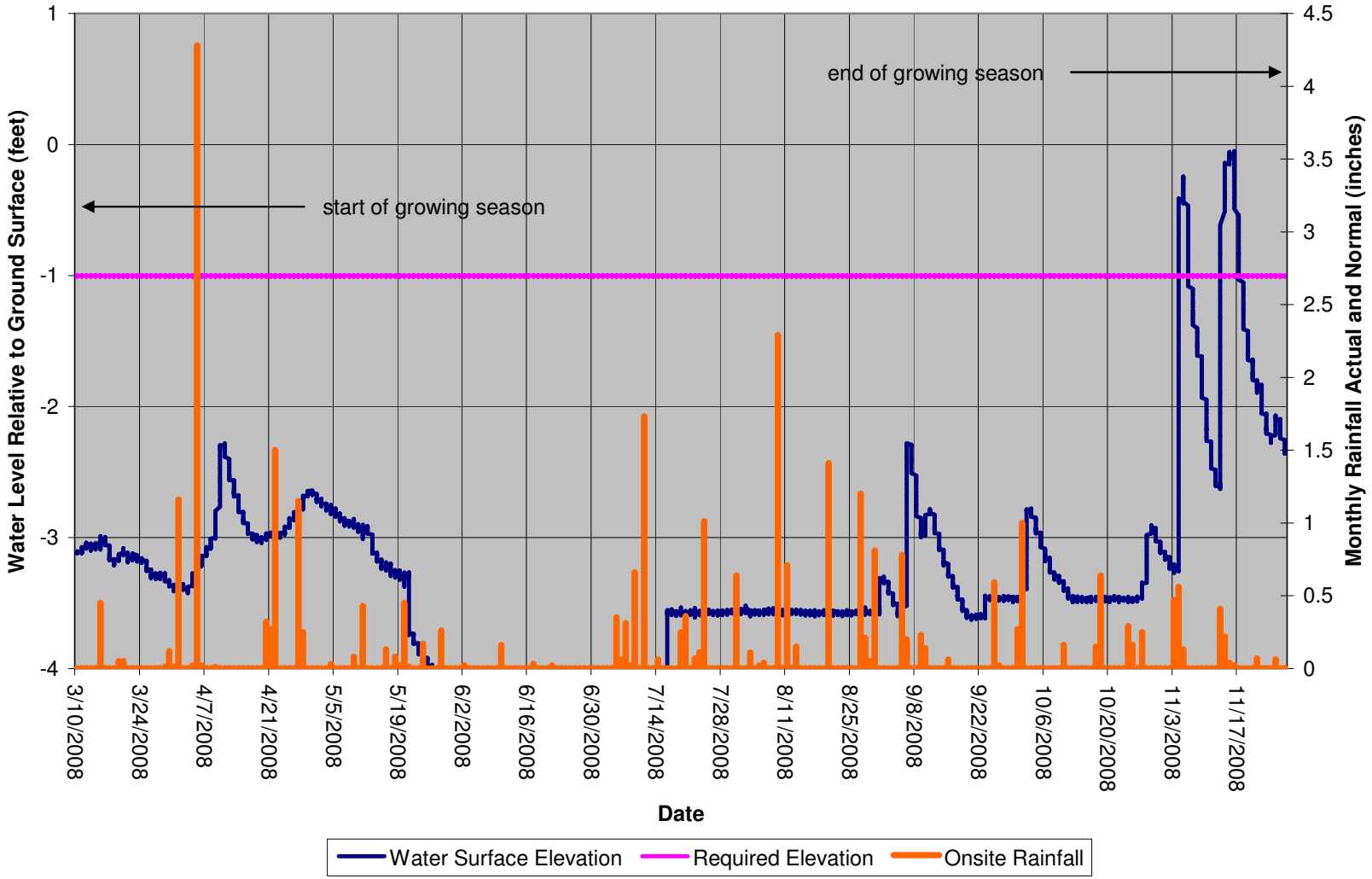
Not used in this report

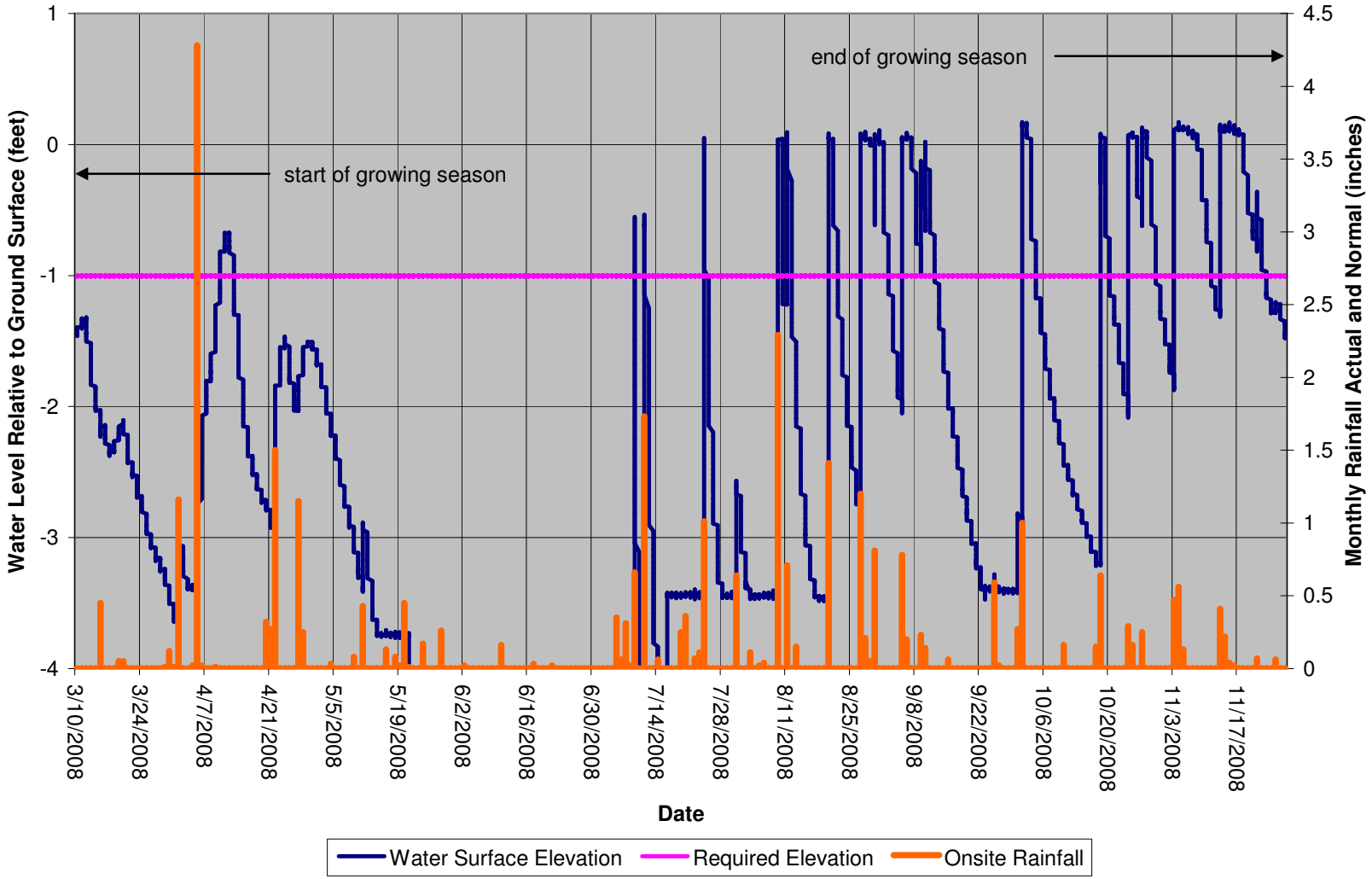
Appendix C

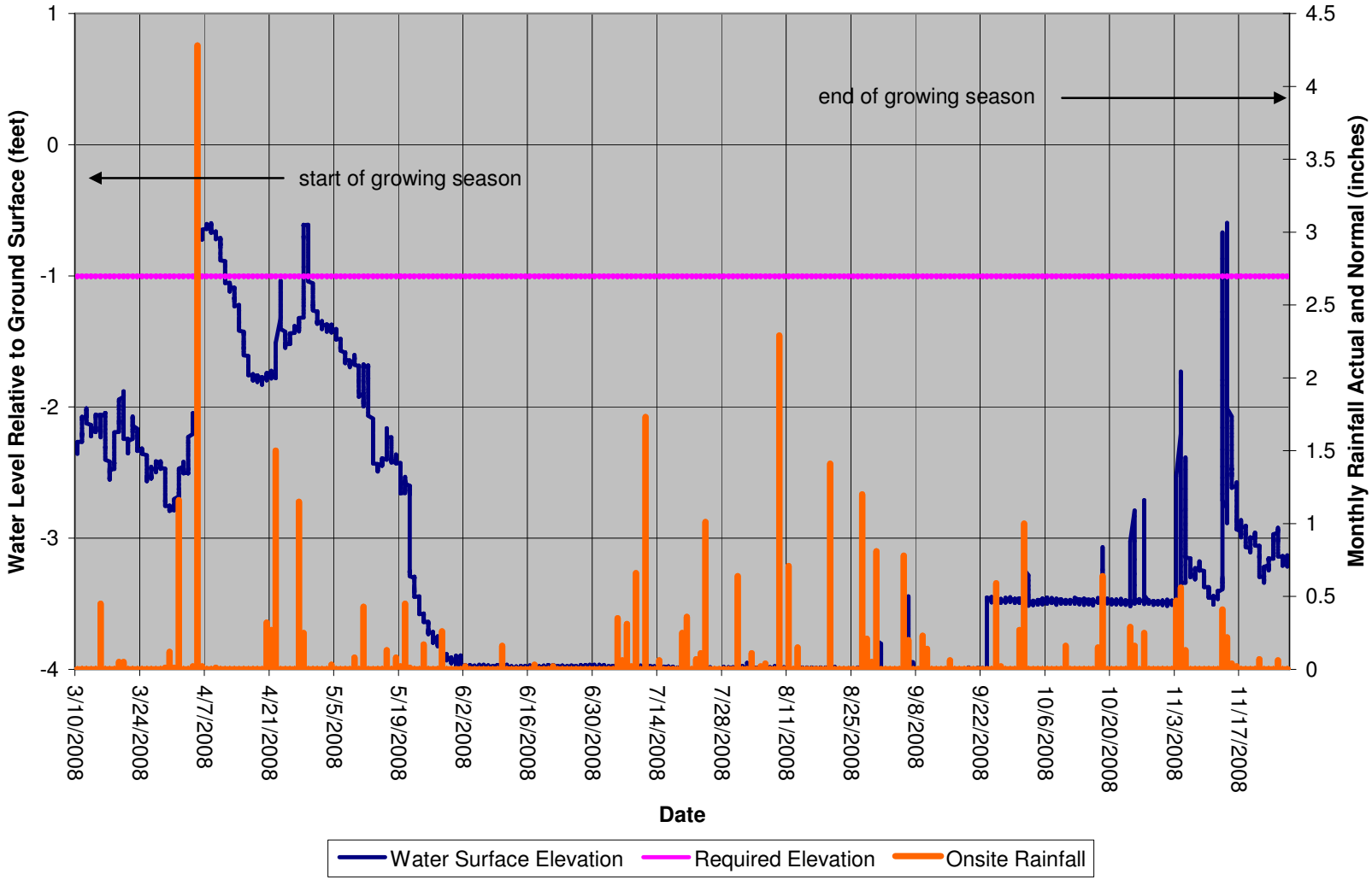
Hydrologic Data Tables

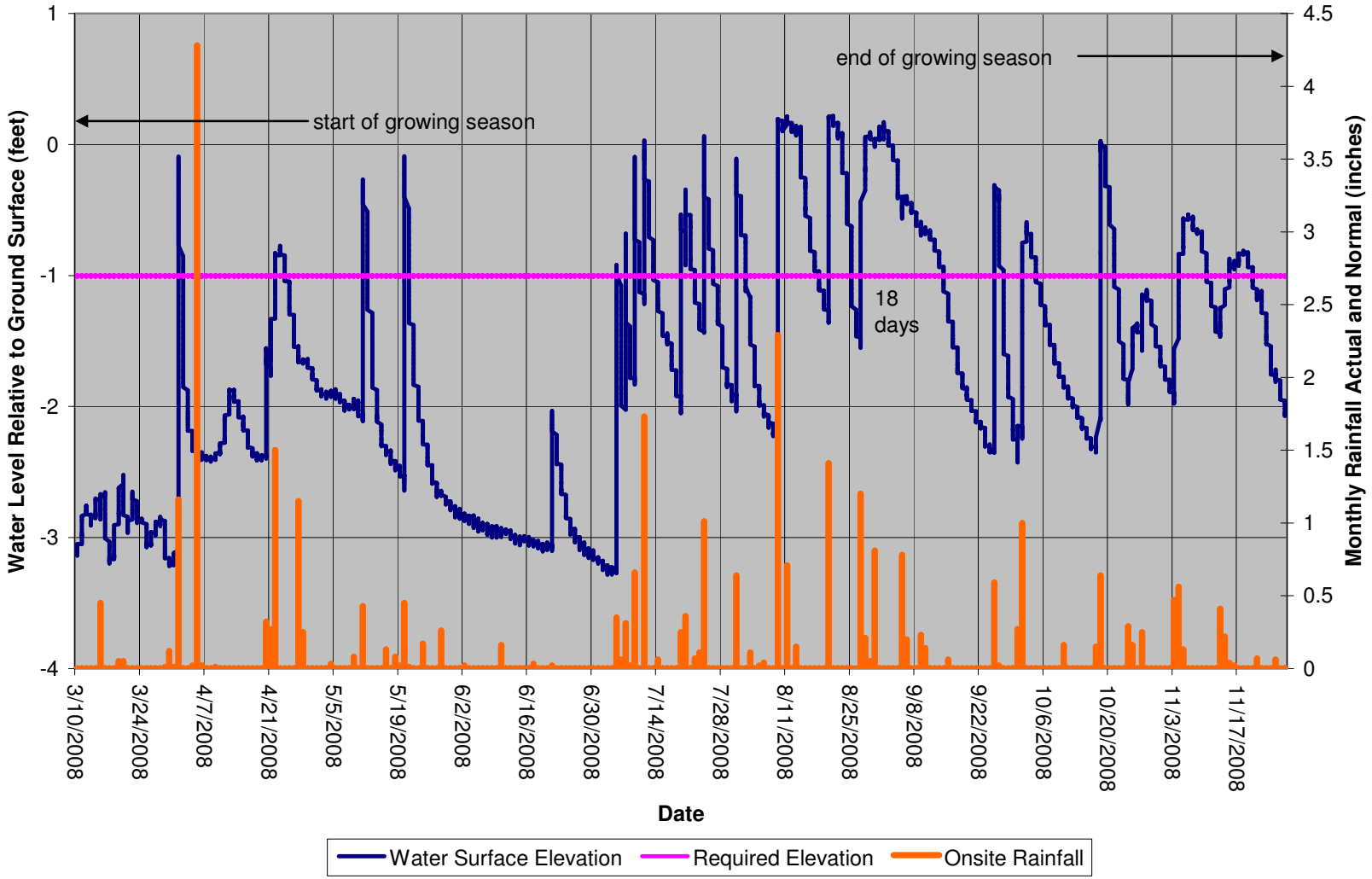
Armstrong Monitoring Gauge #1 (1272308)

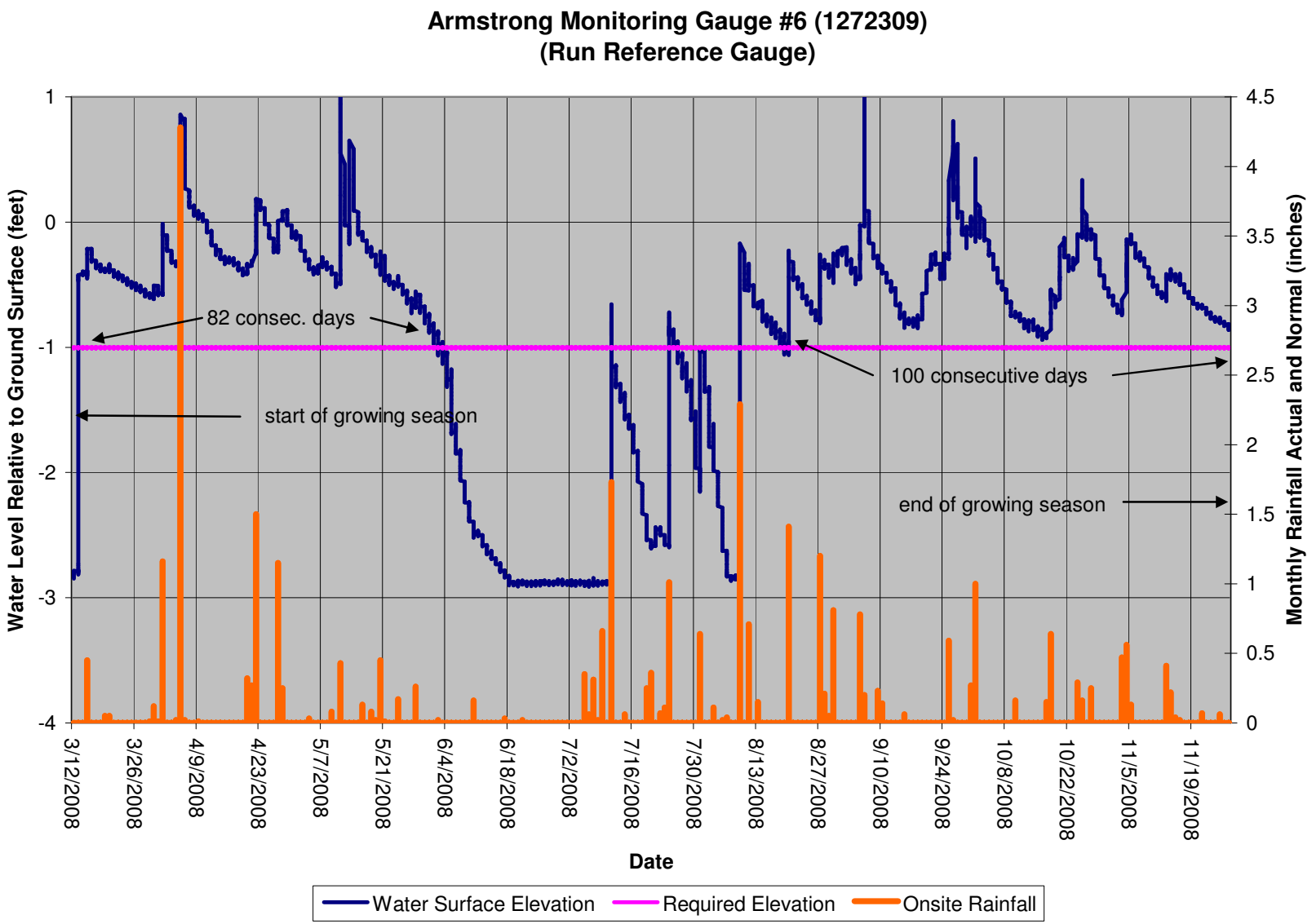


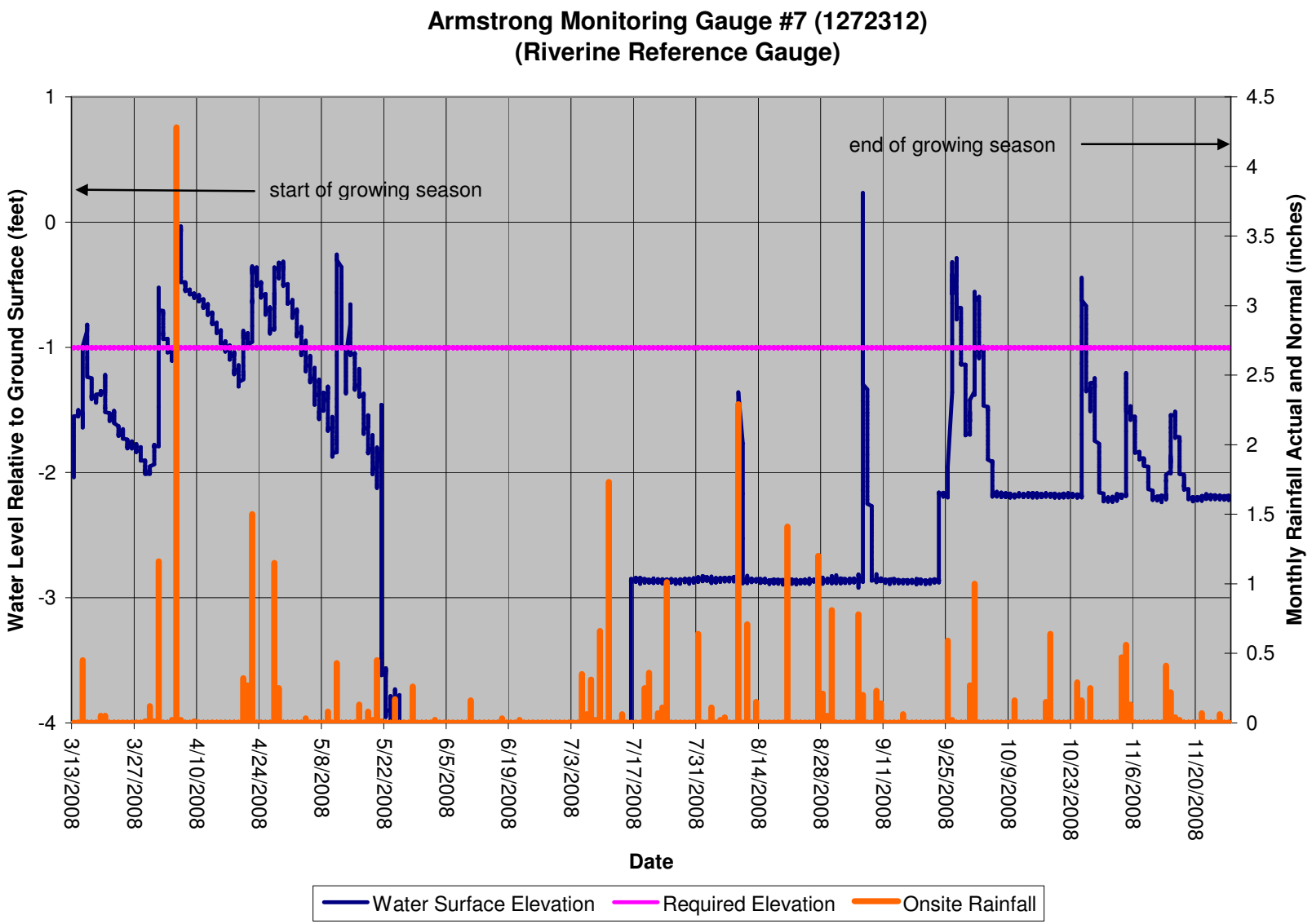

Armstrong Monitoring Gauge #2 (1272306)
Water Level Relative to Ground Surface (feet)
Monthly Rainfall Actual and Normal (inches)
end of growing season
start of growing season
1
0
-1
-2
-3
-4
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
3/10/2008
3/24/2008
4/7/2008
4/21/2008
5/5/2008
5/19/2008
6/2/2008
6/16/2008
6/30/2008
7/14/2008
7/28/2008
8/11/2008
8/25/2008
9/8/2008
9/22/2008
10/6/2008
10/20/2008
11/3/2008
11/17/2008
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall

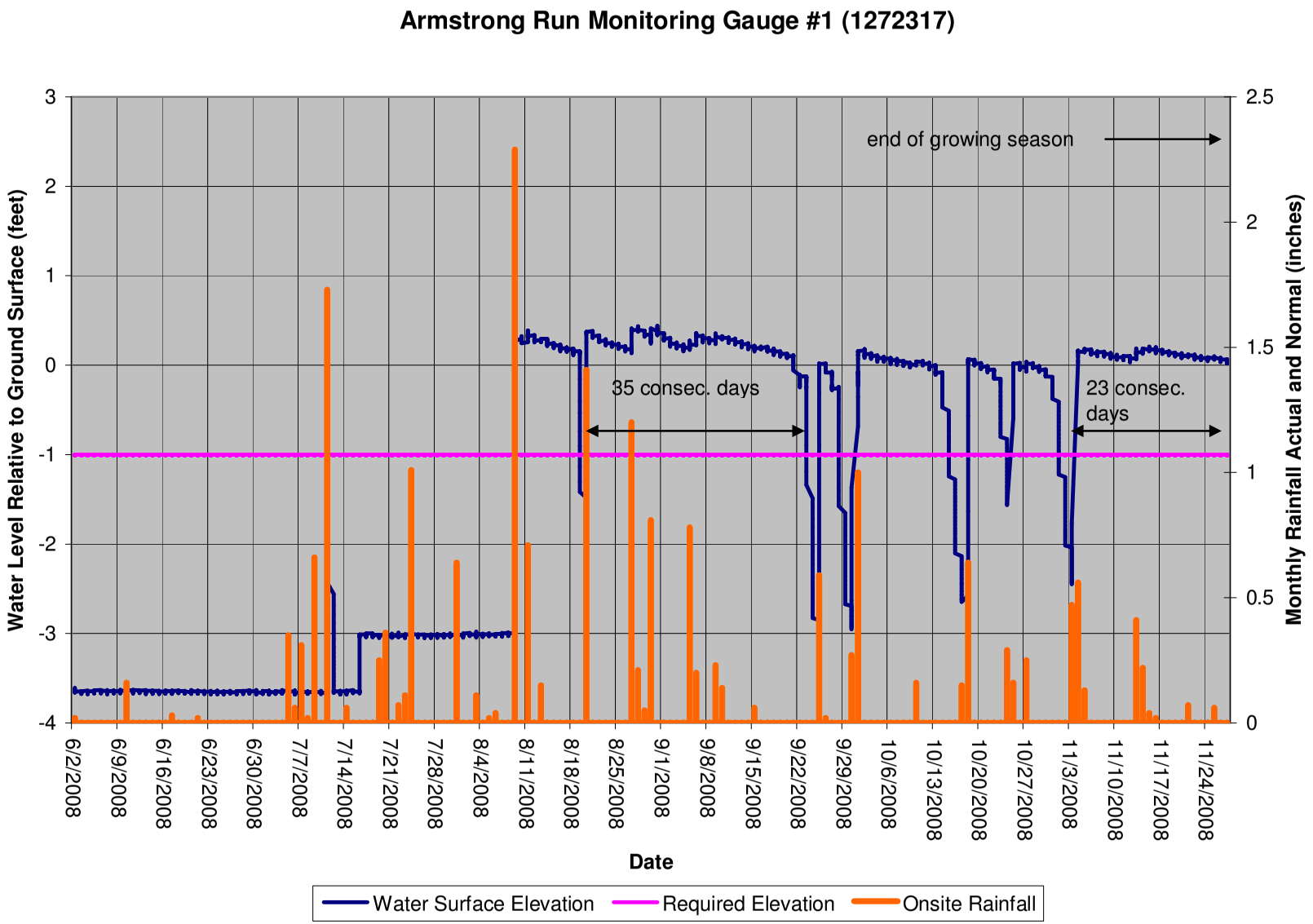

Armstrong Monitoring Gauge #3 (1272305)
Water Level Relative to Ground Surface (feet)
Monthly Rainfall Actual and Normal (inches)
start of growing season
end of growing season
1
0
-1
-2
-3
-4
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
3/10/2008
3/24/2008
4/7/2008
4/21/2008
5/5/2008
5/19/2008
6/2/2008
6/16/2008
6/30/2008
7/14/2008
7/28/2008
8/11/2008
8/25/2008
9/8/2008
9/22/2008
10/6/2008
10/20/2008
11/3/2008
11/17/2008
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall

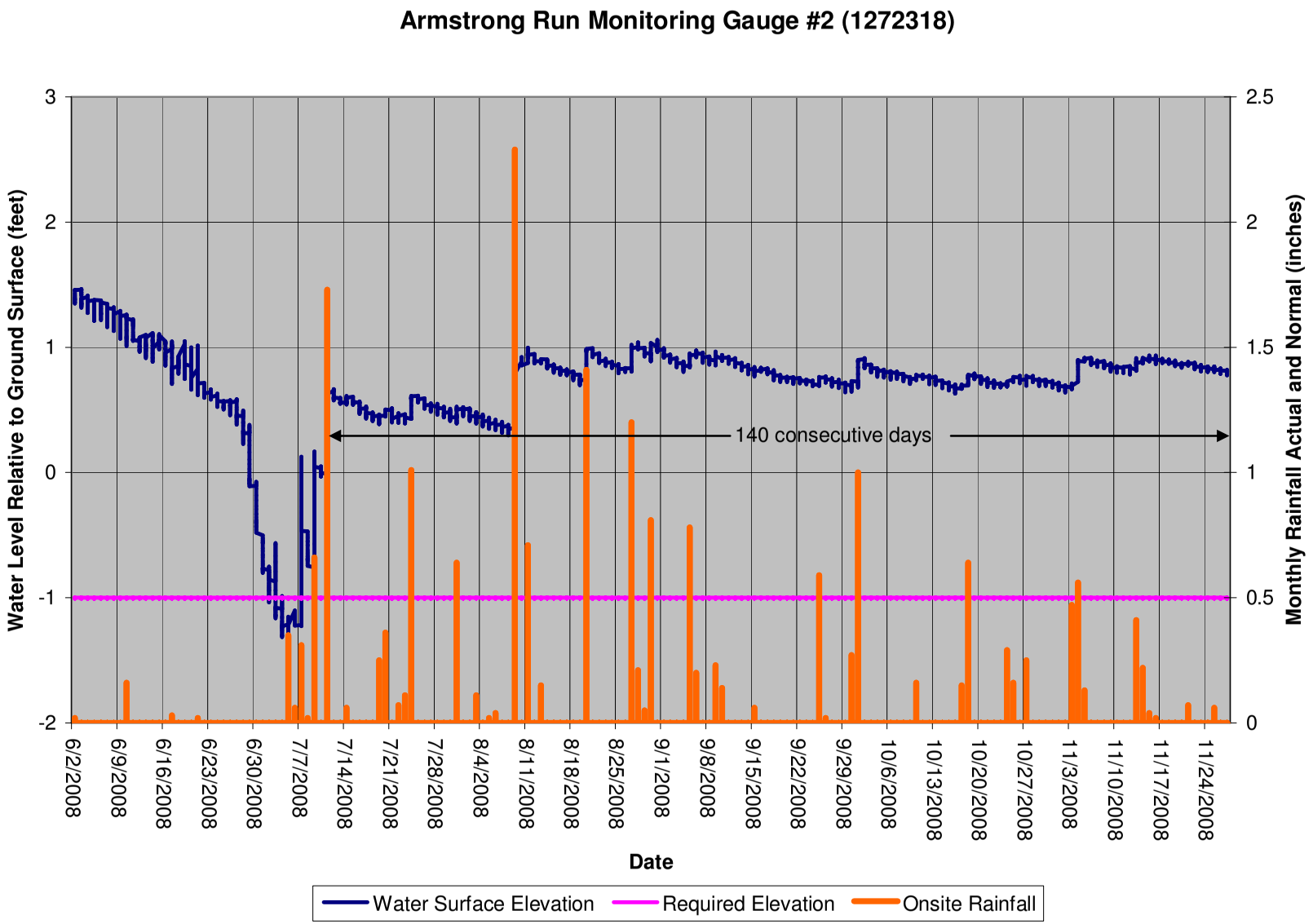

Armstrong Monitoring Gauge #4 (1272310)
Water Level Relative to Ground Surface (feet)
Monthly Rainfall Actual and Normal (inches)
start of growing season
end of growing season
1
0
-1
-2
-3
-4
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
3/10/2008
3/24/2008
4/7/2008
4/21/2008
5/5/2008
5/19/2008
6/2/2008
6/16/2008
6/30/2008
7/14/2008
7/28/2008
8/11/2008
8/25/2008
9/8/2008
9/22/2008
10/6/2008
10/20/2008
11/3/2008
11/17/2008
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Armstrong Monitoring Gauge #5 (1272311)
Water Level Relative to Ground Surface (feet)
Monthly Rainfall Actual and Normal (inches)
start of growing season
end of growing season
18
days
1
0
-1
-2
-3
-4
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
3/10/2008
3/24/2008
4/7/2008
4/21/2008
5/5/2008
5/19/2008
6/2/2008
6/16/2008
6/30/2008
7/14/2008
7/28/2008
8/11/2008
8/25/2008
9/8/2008
9/22/2008
10/6/2008
10/20/2008
11/3/2008
11/17/2008
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Armstrong Monitoring Gauge #6 (1272309)
(Run Reference Gauge)
Water Level Relative to Ground Surface (feet)
Monthly Rainfall Actual and Normal (inches)
1
0
-1
-2
-3
-4
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
82 consec. days
start of growing season
100 consecutive days
end of growing season
3/12/2008
3/26/2008
4/9/2008
4/23/2008
5/7/2008
5/21/2008
6/4/2008
6/18/2008
7/2/2008
7/16/2008
7/30/2008
8/13/2008
8/27/2008
9/10/2008
9/24/2008
10/8/2008
10/22/2008
11/5/2008
11/19/2008
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall

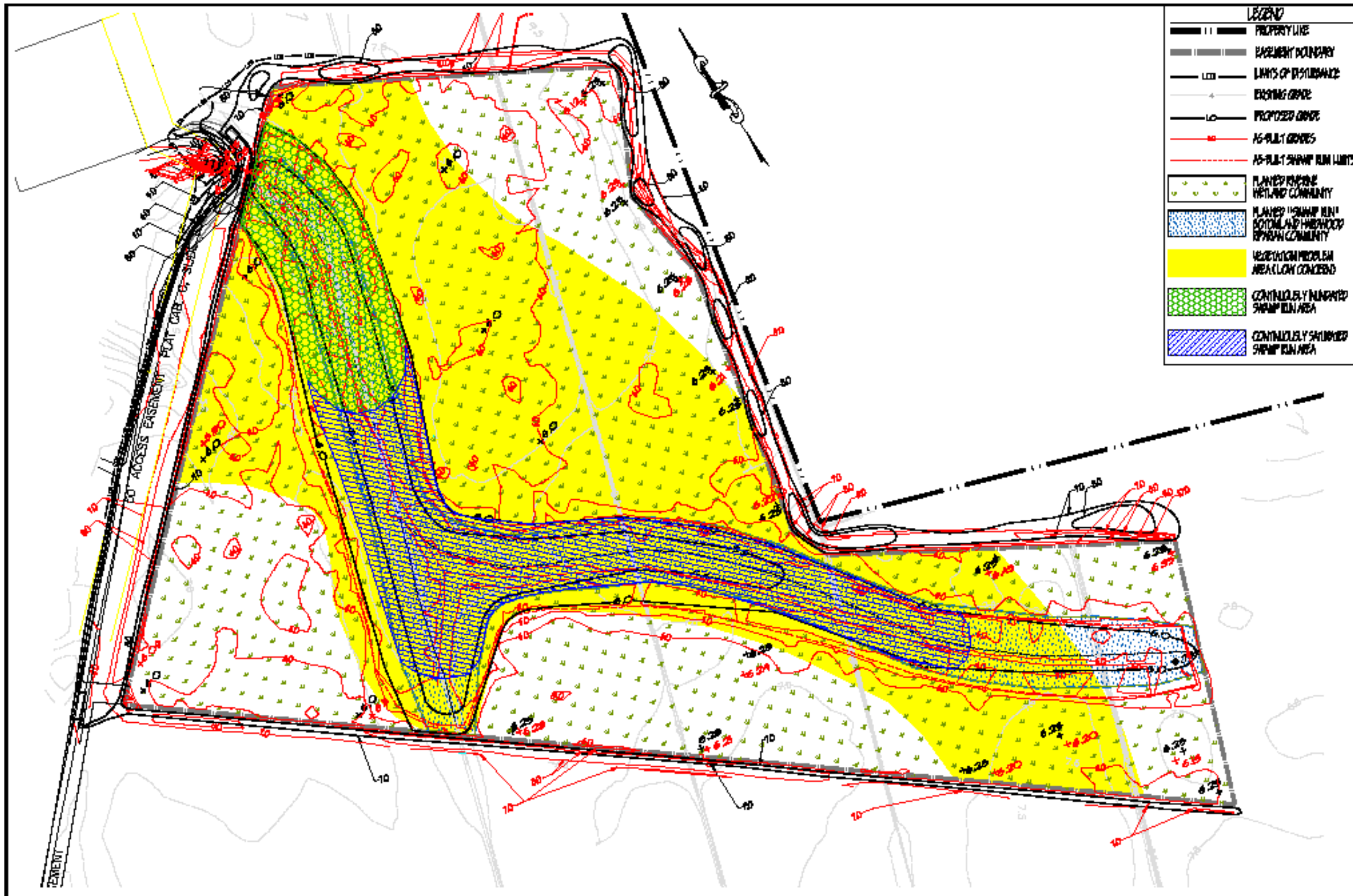

Armstrong Monitoring Gauge #7 (1272312)
(Riverine Reference Gauge)
start of growing season
end of growing season
Water Level Relative to Ground Surface (feet)
Monthly Rainfall Actual and Normal (inches)
1
0
-1
-2
-3
-4
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
3/13/2008
3/27/2008
4/10/2008
4/24/2008
5/8/2008
5/22/2008
6/5/2008
6/19/2008
7/3/2008
7/17/2008
7/31/2008
8/14/2008
8/28/2008
9/11/2008
9/25/2008
10/9/2008
10/23/2008
11/6/2008
11/20/2008
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Armstrong Run Monitoring Gauge #1 (1272317)
Water Level Relative to Ground Surface (feet)
Monthly Rainfall Actual and Normal (inches)
end of growing season
35 consec. days
23 consec. days
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Armstrong Run Monitoring Gauge #2 (1272318)
Water Level Relative to Ground Surface (feet)
Monthly Rainfall Actual and Normal (inches)
3
2
1
0
-1
-2
2.5
2
1.5
1
0.5
0
140 consecutive days
6/2/2008
6/9/2008
6/16/2008
6/23/2008
6/30/2008
7/7/2008
7/14/2008
7/21/2008
7/28/2008
8/4/2008
8/11/2008
8/18/2008
8/25/2008
9/1/2008
9/8/2008
9/15/2008
9/22/2008
9/29/2008
10/6/2008
10/13/2008
10/20/2008
10/27/2008
11/3/2008
11/10/2008
11/17/2008
11/24/2008
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall

Appendix D

Problem Areas Plan View (Integrated)



APPENDIX D: INTEGRATED PROBLEM AREAS
MONITORING REPORT YEAR #1

VEGETATION ASSESSMENT
NOVEMBER 2008

ARMSTRONG PROPERTY
RIVERINE WETLAND AND STREAM RESTORATION
MITIGATION MONITORING
HYDE COUNTY, NORTH CAROLINA

Ecosystem Enhancement

ALBERMARLE RESTORATIONS, LLC
WETLAND RESTORATION, STREAM RESTORATION, & WILDLIFE HABITAT CREATION

FIGURE 4