HAW RIVER SWAMP WETLAND RESTORATION SITE
ANNUAL WETLAND MONITORING REPORT
YEAR 5 (YEAR 2009)
GUILFORD AND ROCKINGHAM COUNTIES, NORTH CAROLINA
CONTRACT #'S AW03001 and D04011

RESTORATION SYSTEMS, LLC
Natural Resources
Restoration & Conservation

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August 2009

EXECUTIVE SUMMARY

Restoration Systems, LLC, a private environmental restoration company, has completed the restoration of wetlands at the Haw River Swamp Wetland Restoration Site (hereafter referred to as the "Site") to assist the North Carolina Ecosystem Enhancement Program (EEP) in fulfilling restoration goals in the region. The Site is located in the Cape Fear River basin (United States Geological Survey Hydrologic Unit 03030002) approximately 8 miles north of the Greensboro city limits on the Guilford and Rockingham county line. The Site encompasses 60 acres within the Haw River floodplain and as constructed offers riverine wetland restoration, enhancement, and preservation, with benefits to water quality and wildlife in a rapidly developing watershed.

A Detailed Wetland Restoration Plan outlined methods to restore prior-converted (PC) agricultural fields that had been ditched, drained, and cleared for row crop production to pristine riverine wetlands. The plan outlined restoration procedures including 1) the excavation of a floodplain adjacent to the southern bank of Midway Creek in order to reestablish over-bank flooding, 2) plugging and filling sections of an existing canal/ditch system, and 3) diverting a secondary tributary to force discharge down the Haw River floodplain.

Mitigation objectives at the Site include the following.

1. Remove agricultural activities from the floodplain and banks of the Haw River.
2. Remove the Site from potential land uses associated with encroaching urbanization.
3. Increase flood storage potential within the Cape Fear Basin.
4. Provide floodplain surfaces to the Haw River for natural redevelopment of geomorphological processes.
5. Re-establish anastomosed stream channels and Piedmont swamp and bottomland forest communities within the floodplain ecosystem.
6. Intercept and assimilate nutrient and sediment-laden run-off from adjacent and upstream watersheds.
7. Assist in establishing a continuous wetland bio-reserve (corridor) between Cone and Benaja Swamps and the adjacent bottomland ecosystems.

The monitoring protocol for the Site consists of an analysis of two primary parameters: hydrology and vegetation. Monitoring of restoration efforts will be performed for a minimum of 5 years or until success criteria are fulfilled. Eight groundwater monitoring gauges and eight 0.11-acre vegetation plots were installed in wetland restoration areas to provide representative coverage across the Site.

The Site achieved defined (or targeted) success criteria for hydrology at all eight restoration area groundwater gauges in the Fifth Monitoring Year (Year 2009), with greater than 28 consecutive days (12.5 percent) of saturation during the growing season.

As a whole, vegetation plots across the Site were well above the required 260 stems per acre with an average of 1597 stems per acre in the Fifth Monitoring Year (Year 2009).

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ANNUAL MONITORING REPORT
YEAR 5 (2009)
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1.0 INTRODUCTION

Restoration Systems, LLC, a private environmental restoration company, has completed the restoration of wetlands at the Haw River Swamp Wetland Restoration Site (hereafter referred to as the "Site") to assist the North Carolina Ecosystem Enhancement Program (EEP) in fulfilling restoration goals in the region. The Site is located in the Cape Fear River basin (United States Geological Survey Hydrologic Unit 03030002) approximately 8 miles north of the Greensboro city limits on the Guilford and Rockingham county line (Figure 1). The Site encompasses 60 acres within the Haw River floodplain and, as constructed, offers riverine wetland restoration, enhancement, and preservation as presented in the following table, with benefits to water quality and wildlife in a rapidly developing watershed.

Table 1. Site Acreage as Constructed

Type	Acreage
Riverine Wetland Restoration	26.7
Riverine Wetland Enhancement	2.5
Riverine Wetland Preservation	18.0
Forested Upland Buffer	12.8
TOTAL	**60.0**

The Detailed Wetland Restoration Plan outlined methods designed to restore prior-converted (PC) agricultural fields that had been ditched, drained, and cleared for row-crop production to pristine riverine wetlands. The plan outlined restoration procedures including 1) the excavation of a floodplain adjacent to the southern bank of Midway Creek in order to reestablish over-bank flooding, 2) plugging and filling sections of an existing canal/ditch system, and 3) diverting a secondary tributary to force discharge down the Haw River floodplain.

Mitigation objectives at the Site include the following.

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4. Provide floodplain surfaces to the Haw River for natural redevelopment of geomorphological processes.
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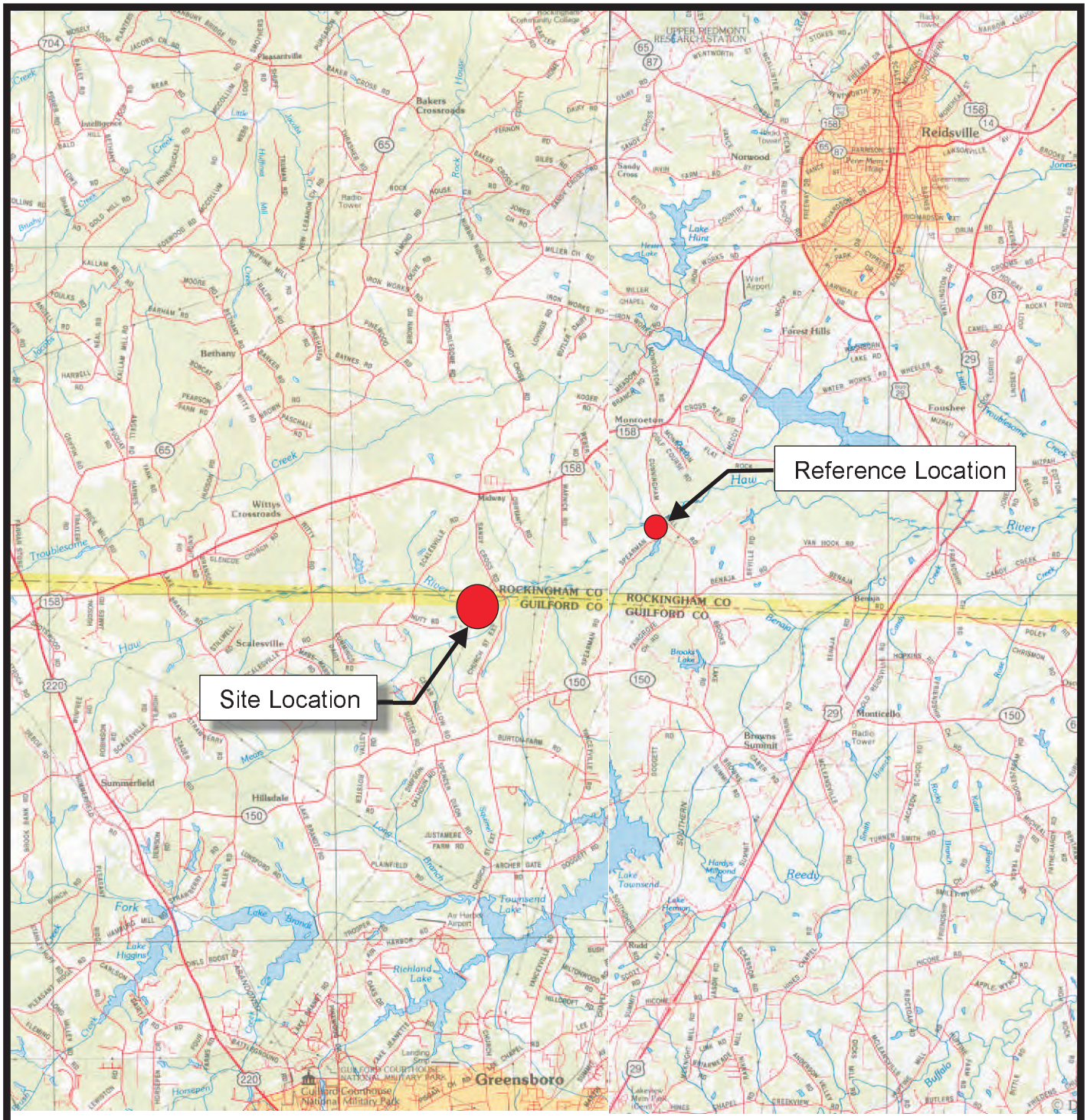
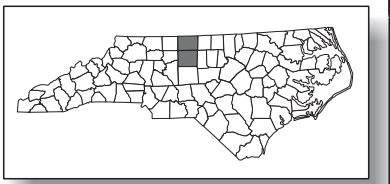
6. Intercept and assimilate nutrient and sediment-laden run-off from adjacent and upstream watersheds.
7. Assist in establishing a continuous wetland bio-reserve (corridor) between Cone and Benaja Swamps and the adjacent bottomland ecosystems.



Source: 2003 North Carolina Atlas and Gazetteer, pp. 17 & 18.



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SITE LOCATION MAP
HAW RIVER WETLAND RESTORATION SITE
Guilford and Rockingham Counties, North Carolina

Dwn. by:	CLF
Ckd by:	WGL
Date:	July 2009
Project:	09-005

FIGURE 1

In February 2003, EEP contracted with Restoration Systems, LLC to complete Phase I (northern half) of the Site. Subsequently, in August 2004, EEP contracted Restoration Systems to complete Phase II (southern half), the remainder of the Site. A combined Detailed Wetland Restoration Plan was completed for both phases of the project with final permits issued in September 2004. Upon completion of the detailed plan and issuance of permits, construction plans were developed and construction was initiated in February 2005. Backwater Environmental, a subsidiary of Osborne Co. Inc., completed earthwork and grading at the Site and as-built construction drawings in late winter/early spring of 2005. Carolina Silvics completed planting of the Site in April 2005. Axiom Environmental, Inc. completed an as-built mitigation plan in June 2005.

Information on project managers, owners, and contractors follows.

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Planting Contractor Information
Carolina Silvics
Dwight McKinney
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As outlined in the Detailed Wetland Restoration Plan, this project was designed and constructed based upon reference (relatively undisturbed) wetlands downstream of the Site (Figure 1). As-Built construction drawings dated May 2005 include Site alterations designed to restore groundwater, surface flow dynamics, and wetland hydrology as follows: 1) installation of ditch plugs, 2) ditch and canal backfilling, 3) wetland depression excavation, 4) installation of log weir outfall structures at outfall points, 5) river levee removal, 6) Midway Creek alterations, 8) unnamed tributary diversion, and 9) planting of 24,950 seedlings.

This report represents the Fifth Year Annual Monitoring Report. Monitoring activities were performed throughout Year 2009, including recording groundwater table elevations and plant species densities.

2.0 MONITORING PROGRAM

The Site monitoring protocol consists of a comparison between reference and restoration areas along with evaluation of jurisdictional wetland criteria (Environmental Laboratory 1987). Monitoring will entail analysis of two primary parameters: hydrology and vegetation. Monitoring of restoration efforts will be performed for a minimum of 5 years or until success criteria are fulfilled. The monitoring program is described below.

The restoration area has been subdivided into swamp forest, bottomland hardwood forest, and mesic forest based on Site construction as depicted in Figure 2. Community patterns continue to develop, with a variety of tree seedlings surviving in local niches along the hydrology gradient. The initial plan was to classify Site vegetation into three broad plant community assemblages based on hydroperiod, primarily as a function of floodplain location. Community classifications included 1) bottomland hardwood forest on floodplain flats, 2) swamp forest in floodplain depressions, and 3) mesic forest on upper floodplain slopes. However, the landscape diversity suggests that the bottomland hardwood forest and swamp forest will be well intermixed across the Site in the future. Therefore, these communities may need to be combined into one group: bottomland hardwood/swamp forest. In addition, several emergent areas may remain permanently inundated and may need to be reclassified. However, this annual monitoring report continues to differentiate between the three community classifications stated above.

2.1 Wetland Hydrology

2.1.1 Hydrology Monitoring Procedure

After hydrological modifications were completed at the Site, continuous recording, groundwater monitoring gauges were installed in accordance with specifications in *Installing Monitoring Wells/Piezometers in Wetlands* (NCWRP 1993). Monitoring gauges were set to a depth of approximately 24 inches below the soil surface. Screened portions of each gauge were surrounded by filter fabric, buried in a sand screen, and sealed with a bentonite cap to prevent siltation and surface flow infiltration during floods.

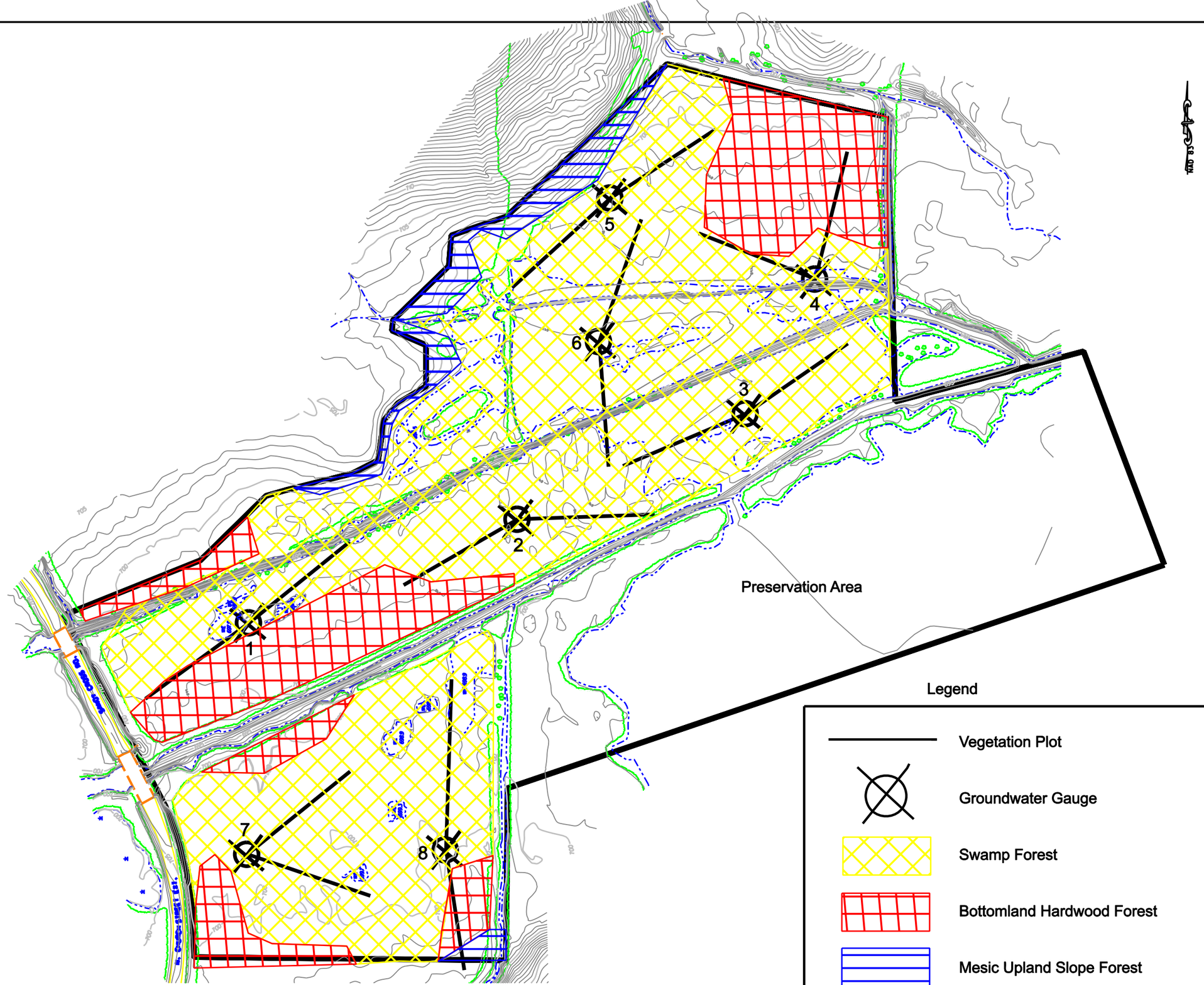
Eight monitoring gauges were installed in wetland restoration areas to provide representative coverage within each community (Figure 2). Hydrologic sampling will be carried out in restoration areas during the growing season (March 26 to November 6, USDA 1977)) at daily intervals necessary to satisfy the hydrology success criteria.

2.1.2 Hydrologic Success Criteria

Target hydrological goals have been developed using regulatory wetland hydrology criteria and reference wetland sites.

Regulatory Wetland Hydrology Criteria

The regulatory wetland hydrology criteria require saturation (free water) within 1 foot of the soil surface for 5 percent of the growing season under normal climatic conditions. In some instances, the regulatory wetland hydroperiod may range from 5-12.5 percent of the growing season.



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NOTES/REVISIONS

Project:

Haw River Swamp Wetland Restoration Site

Guilford and Rockingham Counties
North Carolina

Title:

Monitoring Plan

Scale: 1 inch = 220 feet	Figure 2
Date: November 2005	
Project No.: 05-002.17	

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Based on the Detailed Wetland Restoration Plan, under normal climatic conditions, the hydrologic success criterion requires saturation (free water) within 1 foot of the soil surface for a minimum of 5 percent of the growing season for the floodplain flats (bottomland hardwood forest) areas depicted in Figure 2. The floodplain depressions (swamp forest) must support saturation (free water) within 1 foot of the soil surface for a minimum of 12.5 percent of the growing season. This hydroperiod translates to saturation for a minimum 12-day (5 percent) to 28-day (12.5 percent) consecutive period during the growing season.

2.1.3 Hydrological Monitoring Results and Comparison with Success Criteria

Hydrographs for each monitoring location are provided in Appendix A along with daily rainfall totals for 2009 collected at a nearby rain station in Greensboro, North Carolina (Weather Underground 2009). All gauges achieved hydrology success criteria for the Fifth Year (Year 2009) of annual monitoring with greater than 28 consecutive days (12.5 percent) of saturation during the growing season, as required for swamp forest hydrology (Table 2). Data for 2009 has been collected through July 23, 2009 and will continue to be collected throughout the remainder of the growing season.

Table 2. 2009 (Year 5) Groundwater Gauge Results

Gauge	Community	Max Consecutive Days Saturated During Growing Season (Percent) *	Defined (or Targeted) Success Criteria Achieved
1	swamp forest	67 days (29.6 %)	Yes
2	swamp forest	75 days (33.2 %)	Yes
3	swamp forest	119 days (100 %)	Yes
4	swamp forest	115 days (50.9 %)	Yes
5	swamp forest	31 days (13.7 %)	Yes
6	swamp forest	118 days (100 %)	Yes
7	swamp forest	31 days (13.7 %)	Yes
8	swamp forest	119 days (100 %)	Yes
BH Ref	bottomland hardwoods	--	--
SF Ref	swamp forest	117 days (100 %)	Yes

* Data for 2009 has been collected through July 23, 2009 and will continue to be collected throughout the remainder of the growing season; data will be available upon request.

2.2 Vegetation

2.2.1 Vegetation Monitoring Procedure

Restoration monitoring procedures for vegetation are designed in accordance with guidelines presented in *Mitigation Site Classification* (MiST) documentation (USEPA 1990) and *Compensatory Hardwood Mitigation Guidelines* (USDOA 1993). The following presents a general discussion of the monitoring protocol.

Vegetation will receive visual evaluations during the periodic reading of monitoring gauges to ascertain the general conditions and degree of overtopping of planted elements by weeds. Subsequently, quantitative sampling of vegetation will be performed once annually during the fall for a minimum of 5 years or until vegetation success criteria are achieved. Sampling dates may be modified to accommodate river flood events and plot inundation, if needed.

Sixteen sample transects (8 plots) were installed within planted areas of the Site to represent the various hydrologic regimes and plant communities (Figure 2). Each transect is 300 feet long and 8 feet wide (0.055 acre). Two transects were set up on each of the eight groundwater monitoring gauges for a total of eight, 0.11-acre plots. In each sample plot, monitored vegetation parameters include species composition and density. Visual observations of the percent cover of shrub and herbaceous species will be recorded but not used for vegetative success criteria. Photographs of the 8 vegetation plots are included in Appendix B.

2.2.2 Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for floodplain 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 "Character Tree Species," which include planted species, species listed by Schafale and Weakley (1990) as occurring in Piedmont bottomland and swamp forests, and species identified in the reference forest ecosystems (RFEs). Planted tree species and those identified in the reference forest ecosystem will be used to define "Character Tree Species" as termed in the success criteria (Tables 3 and 4).

Table 3. Reference Forest Plot Summary

Species	Number of Individuals*	Relative Density (Percent)	Relative Basal Area (Percent)	Importance Value
Acer rubrum (red maple)	10	31.3	35.4	0.21
*Fraxinus pennsylvanica (*green ash)	10	31.3	28.0	0.20
Platanus occidentalis (American sycamore)	2	6.3	11.0	0.07
Quercus lyrata (overcup oak)	2	6.3	7.3	0.06
Quercus rubra (northern red oak)	1	3.1	6.9	0.04
Salix nigra (black willow)	1	3.1	6.0	0.04
Acer negundo (box elder)	2	6.3	0.5	0.03
Carya ovata (pignut hickory)	1	3.1	2.4	0.03
Celtis laevigata (hackberry)	1	3.1	1.5	0.03
Fagus grandifolia (American beech)	1	3.1	0.7	0.02
Ulmus americana (American elm)	1	3.1	0.3	0.02
Total	**32**	**100**	**100**	**1**

* Summary of four 0.1-acre plots.

An average density of 320 stems per acre over all sampling transects of Character Tree Species must be surviving at the end of three monitoring years. Subsequently, 280 character tree stems per acre must be surviving in year 4, and 260 character tree stems per acre must be surviving in year 5. Planted species must represent a minimum of 30 percent of the required stem per acre total (96 stems per acre). A total of 24,950 bare root seedlings of 17 species were planted on the Site at a density of 680 trees per acre (Table 4). Each naturally recruited character species may represent up to 10 percent of the required stem per acre total. In essence, seven naturally recruited character species may represent a maximum of 70 percent of the required stem/acre total. Additional stems of naturally recruited species above the 70 percent threshold are discarded from the statistical analysis. The remaining 30 percent are not necessarily removed from the Site, but will be left as a reserve and future seed source for species maintenance during mid-succession phases of forest development.

Table 4. Planted Species and Densities

Species	Number Planted
Ulmus americana (American elm)	2300
Nyssa sylvatica (black gum)	150
Salix nigra (black willow)	1000
Quercus pagoda (cherrybark oak)	3500
Fraxinus pennsylvanica (green ash)	1500
Pinus taeda (loblolly pine)	1200
Carya alba (mockernut hickory)	300
Quercus rubra (northern red oak)	300
Quercus lyrata (overcup oak)	3000
Betula nigra (river birch)	100
Quercus falcata (southern red oak)	400
Celtis laevigata (sugarberry)	1200
Quercus michauxii (swamp chestnut oak)	4800
Platanus occidentalis (American sycamore)	200
Quercus alba (white oak)	400
Quercus phellos (willow oak)	2500
Liriodendron tulipifera (yellow poplar)	2100
Total	**24,950**

2.2.3 Vegetation Sampling Results and Comparison to Success Criteria

Quantitative sampling of vegetation was conducted in June 2009. Results are provided in Table 5. Vegetation success criteria for year 5 (260 tree stems per acre) were exceeded for the 2009 annual monitoring year with an average of 1597 stems per acre across the Site. In addition, each individual vegetation plot met success criteria with the exception of plot number 3. This plot is primarily characterized by herbaceous freshwater emergent vegetation including swamp rosemallow (*Hibiscus moscheutos*), arrowhead (*Sagittaria* sp.), toothcup (*Rotala ramosior*), Pennsylvania smartweed (*Polygonum pensylvanicum*), and various other smartweeds (*Polygonum* spp.). However, the number of woody stems within this plot continues to increase each year with the establishment of natural recruits; this trend is expected to continue.

TABLE 5
2009 VEGETATION MONITORING DATA AND RESULTS

Note: Each plot totals 0.11 acre in size.

Species**	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Totals	Total/ Acre	Total Tree Stems/Acre Counting Towards Success Criteria*
Acer rubrum (red maple)	230	550	4	205	191	95	44	107	1426	1620	26
Acer negundo (box elder)	10			1		1	11	11	34	39	26
Alnus serrulata (tag alder)							11		11	13	13
Betula nigra (river birch)		1	6	3		2	1		13	15	15
Cephalanthus occidentalis (buttonbush)				1					1	1	1
Cornus amomum (silky dogwood)							1		1	1	1
Diospyros virginiana (persimmon)	1			8	3			1	13	15	15
***Fraxinus pennsylvanica* (green ash)**	130	301	7	134	183	31	180	81	1047	1190	1190
Liquidambar styraciflua (sweetgum)	60	30		8	6	4	90	52	250	284	26
***Liriodendron tulipifera* (tulip poplar)**				20	2			2	24	27	27
***Platanus occidentalis* (American sycamore)**	4	3					10	25	42	48	48
Prunus serotina (sourwood)				3					3	3	3
***Quercus lyrata* (overcup oak)**	5	14	7	8	6	8	2	2	52	59	59
***Quercus michauxii* (swamp chestnut oak)**	4	6		7	11	2	3	1	34	39	39
***Quercus pagoda* (cherrybark oak)**		3		4		1	2		10	11	11
***Quercus phellos* (willow oak)**	5	12		3	11	2	3	1	37	42	42
***Salix nigra* (black willow)**					7	2	2	1	12	14	14
Ulmus sp. (elm)	22	99	4	39	68	28	1	4	265	301	26
Ulmus alata (winged elm)	5	2			3				10	11	11
Ulmus rubra (slippery elm)	3								3	3	3
Sambucus canadensis (elderberry)					1				1	1	1
TOTAL	**479**	**1021**	**28**	**444**	**492**	**176**	**361**	**288**	**3288**	**3736**	
TOTAL COUNTING TOWARDS SUCCESS CRITERIA	**164**	**351**	**24**	**194**	**235**	**58**	**227**	**127**			
TOTAL/ACRE COUNTING TOWARDS SUCCESS CRITERIA	**1491**	**3191**	**218**	**1764**	**2136**	**527**	**2064**	**1155**			**1597**

* Success criteria requires that each naturally recruited species make up no more than 10 percent of the 260 stem/acre total. Using this criteria, no naturally recruited species can provide more than 26 stems/acre towards success criteria (3 stems per 0.11 acre plot).

** Planted species are in bold font.

3.0 CONCLUSIONS

In summary, the Site achieved defined (or targeted) success criteria for hydrology at all eight restoration area groundwater gauges during the Fifth Monitoring Year (Year 2009), with greater than 28 consecutive days (12.5 percent) of saturation during the growing season. Groundwater data over the entire monitoring period is summarized in the following table.

Table 6. Summary of Groundwater Gauge Results

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)				
	Year 1 (2005)	**Year 2 (2006)**	**Year 3 (2007)**	**Year 4 (2008)**	**Year 5 (2009)****
1	Yes/90 days (40.0 percent)	Yes/74 days (32.7 percent)	Yes/50 days (22.2 percent)	Yes/76 days (33.6 percent)	Yes/67 days (29.6 %)
2	Yes/23 days (10 percent)	Yes/55 days (24.3 percent)	Yes/34 days (15.1 percent)	Yes/38 days (16.8 percent)	Yes/75 days (33.2 %)
3	Yes/138 days (58 percent)	Yes/226 days (100 percent)	Yes/90 days (39.8 percent)	Yes/94 days (41.6 percent)	Yes/119 days (100 %)
4	Yes/51 days (23 percent)	Yes/154 days (68.1 percent)	Yes/68 days (30.2 percent)	Yes/90 days (39.8 percent)	Yes/115 days (50.9 %)
5	Yes/17 days (8 percent)	Yes/66 days (29.2 percent)	Yes/35 days (15.6 percent)	Yes/41days (18.1 percent)	Yes/31 days (13.7 %)
6	Yes/88 days (39 percent)	Yes/226 days (100 percent)	Yes/90 days (39.8 percent)	Yes/94 days (41.6 percent)	Yes/118 days (100 %)
7	Yes/47days (21 percent)	Yes/55 days (24.3 percent)	No/20 days (8.8 percent)	Yes/125 days (55.3 percent)	Yes/31 days (13.7 %)
8	Yes/140 days (62 percent)	Yes/159 days (70.4 percent)	Yes/64 days (28.4 percent)	Yes/42 days (18.6 percent)	Yes/119 days (100 %)
BH Ref	*	Yes/22 days (9.7 percent)	Yes/19 days (8.4 percent)	--	--
SF Ref	*	Yes/226 days (100 percent)	Yes/120 days (53.3 percent)	Yes/226 days (100 percent)	Yes/117 days (100 %)

* Reference gauges were installed prior to year 2 (2006) monitoring.

** Data for 2009 has been collected through July 23, 2009 and will continue to be collected throughout the remainder of the growing season; data will be available upon request.

As a whole, vegetation plots across the Site were well above the required 260 stems/acre with an average of 1597 stems per acre in the Fifth Monitoring Year (Year 2009). Vegetation data over the entire monitoring period is summarized in the following table.

Table 7. Summary of Vegetation Plot Results

Plot	Stems/Acre Counting Towards Success Criteria				
	Year 1 (2005)	**Year 2 (2006)**	**Year 3 (2007)**	**Year 4 (2008)**	**Year 5 (2009)**
1	1264	1227	965	1018	1491
2	2209	1455	1456	1582	3191
3	100	73	118	164	218
4	1255	1191	1001	645	1764
5	1209	791	719	1791	2136
6	345	209	319	282	527
7	1091	1082	992	1118	2064
8	945	845	810	800	1155
Average for All Plots	**1197**	**962**	**855**	**985**	**1597**

2009 represents the fifth and final year of monitoring activities at the Haw River Swamp Wetland Restoration Site. Over the course of the monitoring period, all groundwater gauges met hydrological success (Table 6) and all vegetation transects, with the exception of Transects 3 and 6, were above the targeted density of 260 stems/acre during all monitoring years (Table 7). The area within and around Transects 3 and 6 received supplemental plantings in January 2007 and again in 2009. This area is consistently the wettest portion of the site and tree mortality was most likely due to hydroperiods that exceeded the tolerance of some of the planted species. Although replanting with species tolerant of prolonged saturation or flooding such as water tupelo and bald cypress might have reduced mortality, the area was replanted only with species outlined in the Restoration Plan. Bald cypress and water tupelo are not native to the Piedmont and are restricted to areas east of the Fall Line. As described in Section 2.2.3, the area is being colonized by woody and herbaceous perennial shrubs and forbs and increasing numbers of woody stems.

4.0 REFERENCES

Environmental Laboratory. 1987. Corps of Engineers Wetland Delineation Manual. Technical Report Y-87-1. United States Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS.

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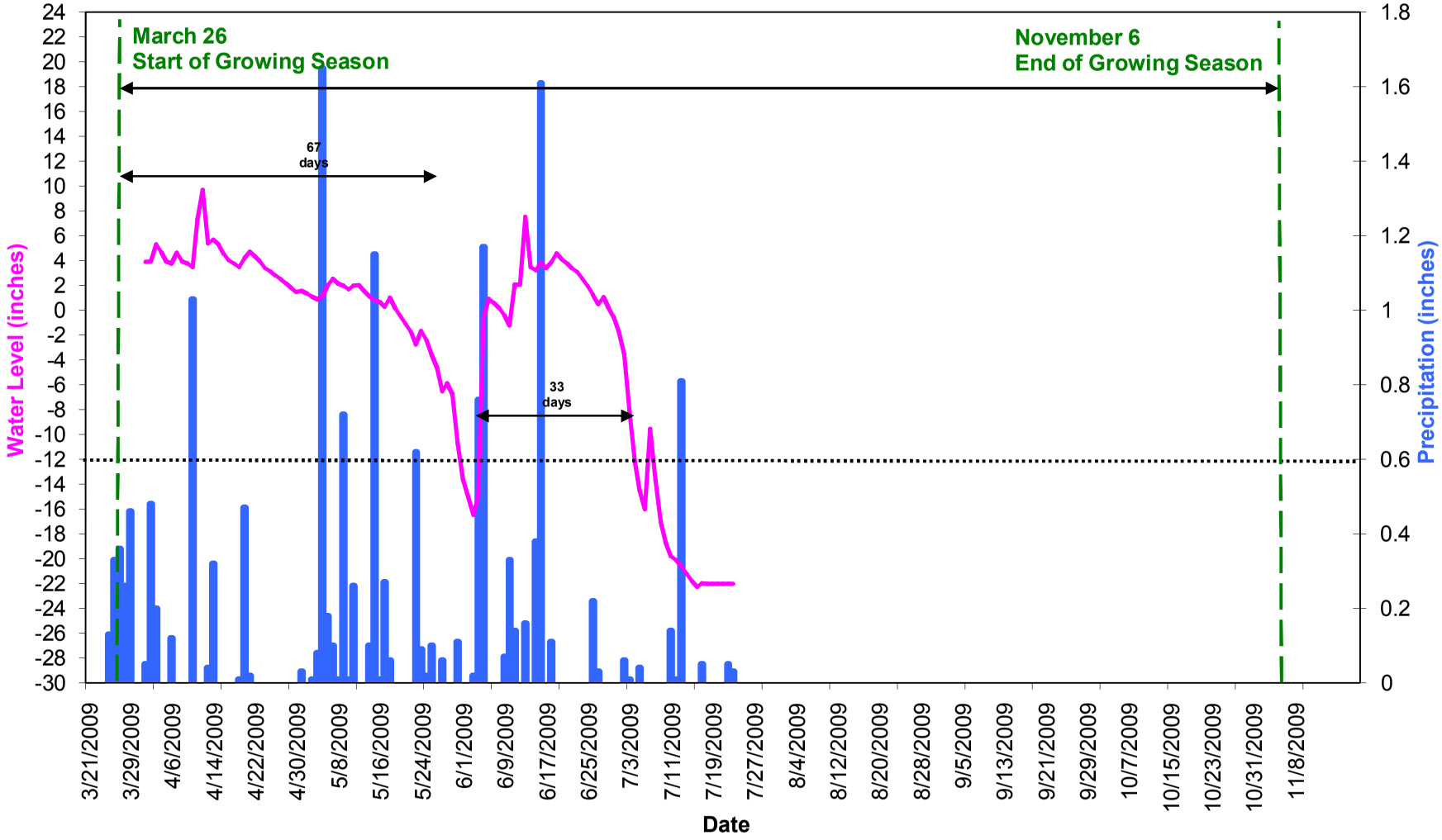
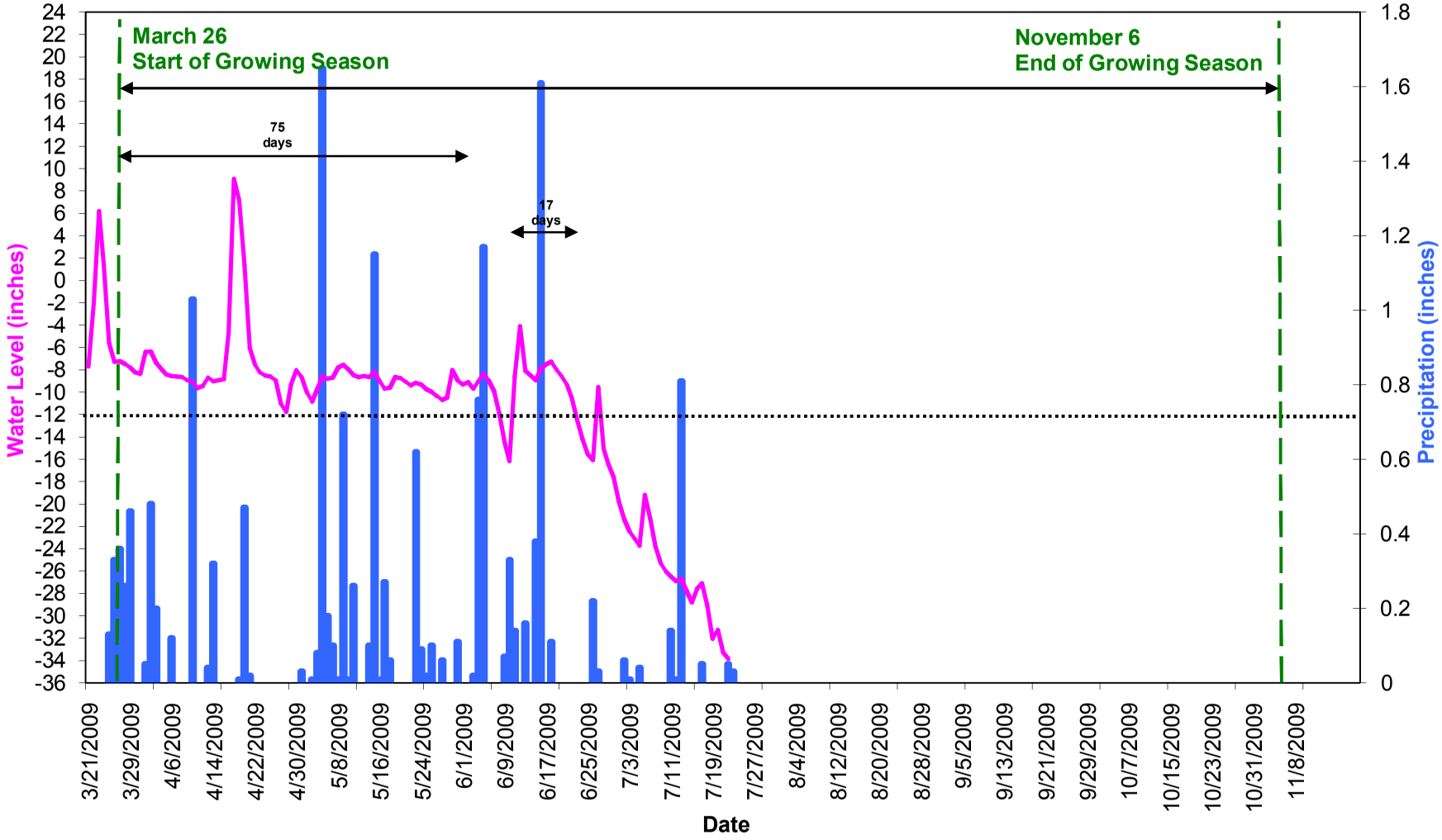
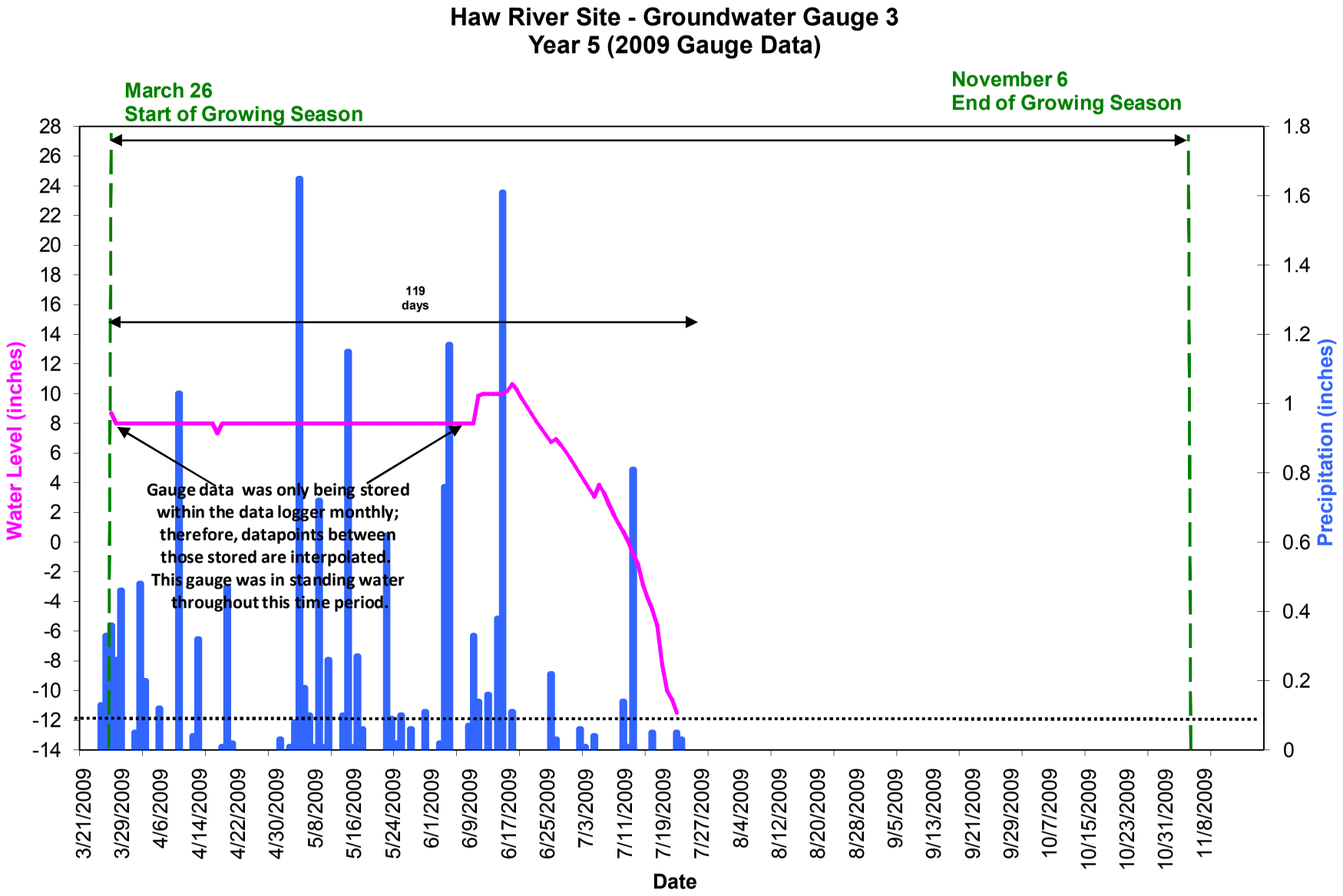
APPPENDIX A
GAUGE DATA

Haw River Site - Groundwater Gauge 1
Year 5 (2009 Gauge Data)

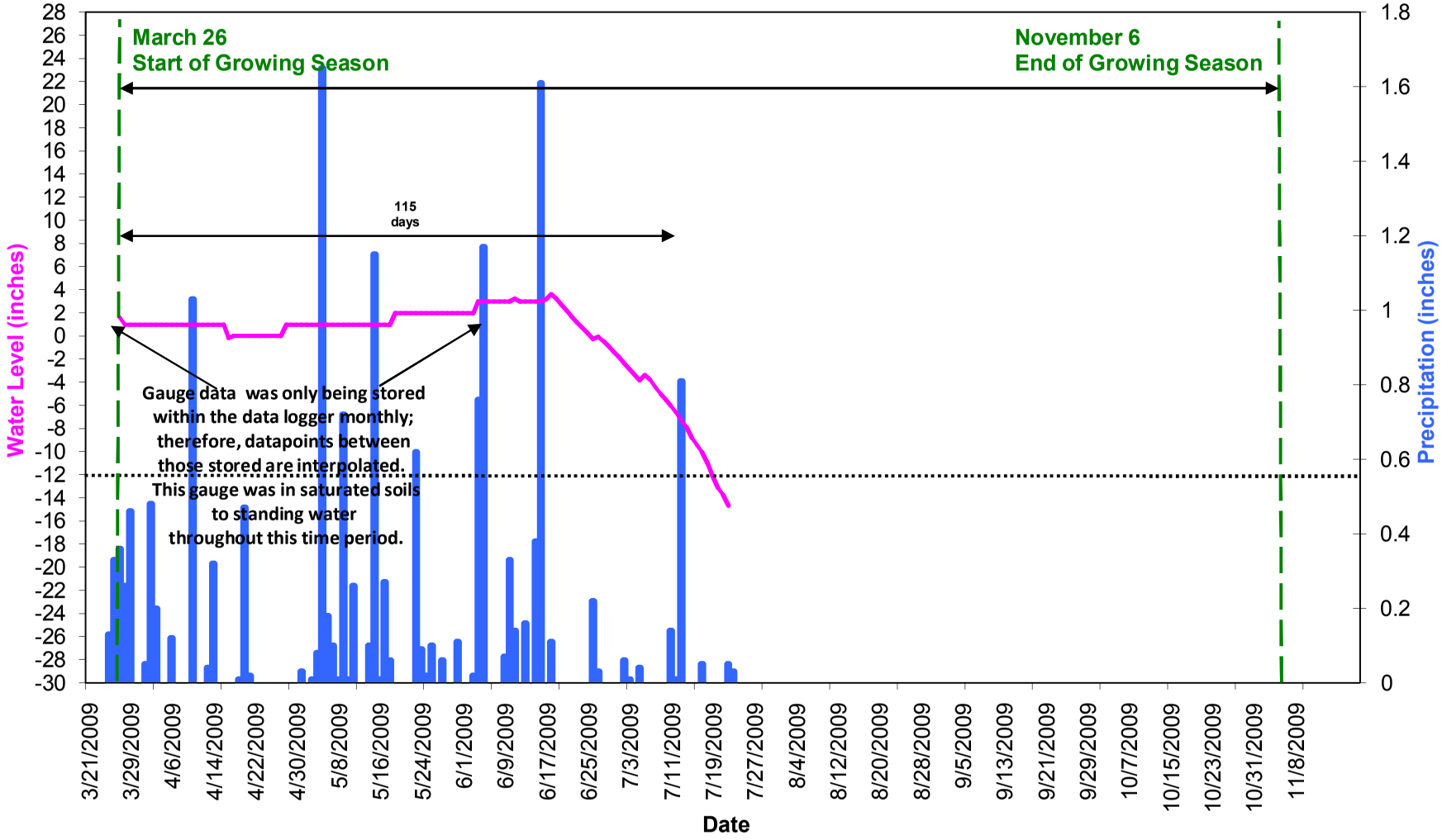


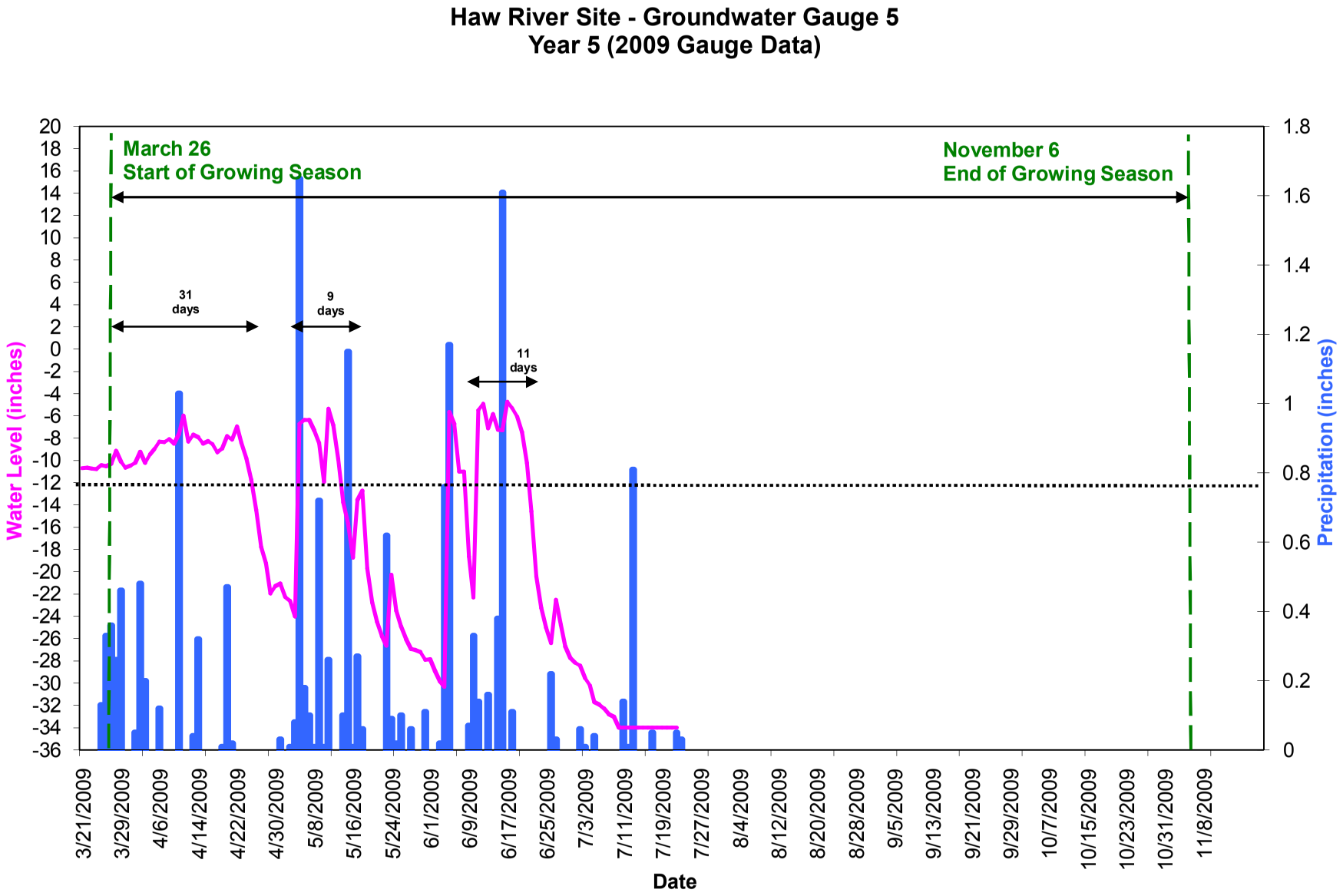
Haw River Site - Groundwater Gauge 2
Year 5 (2009 Gauge Data)



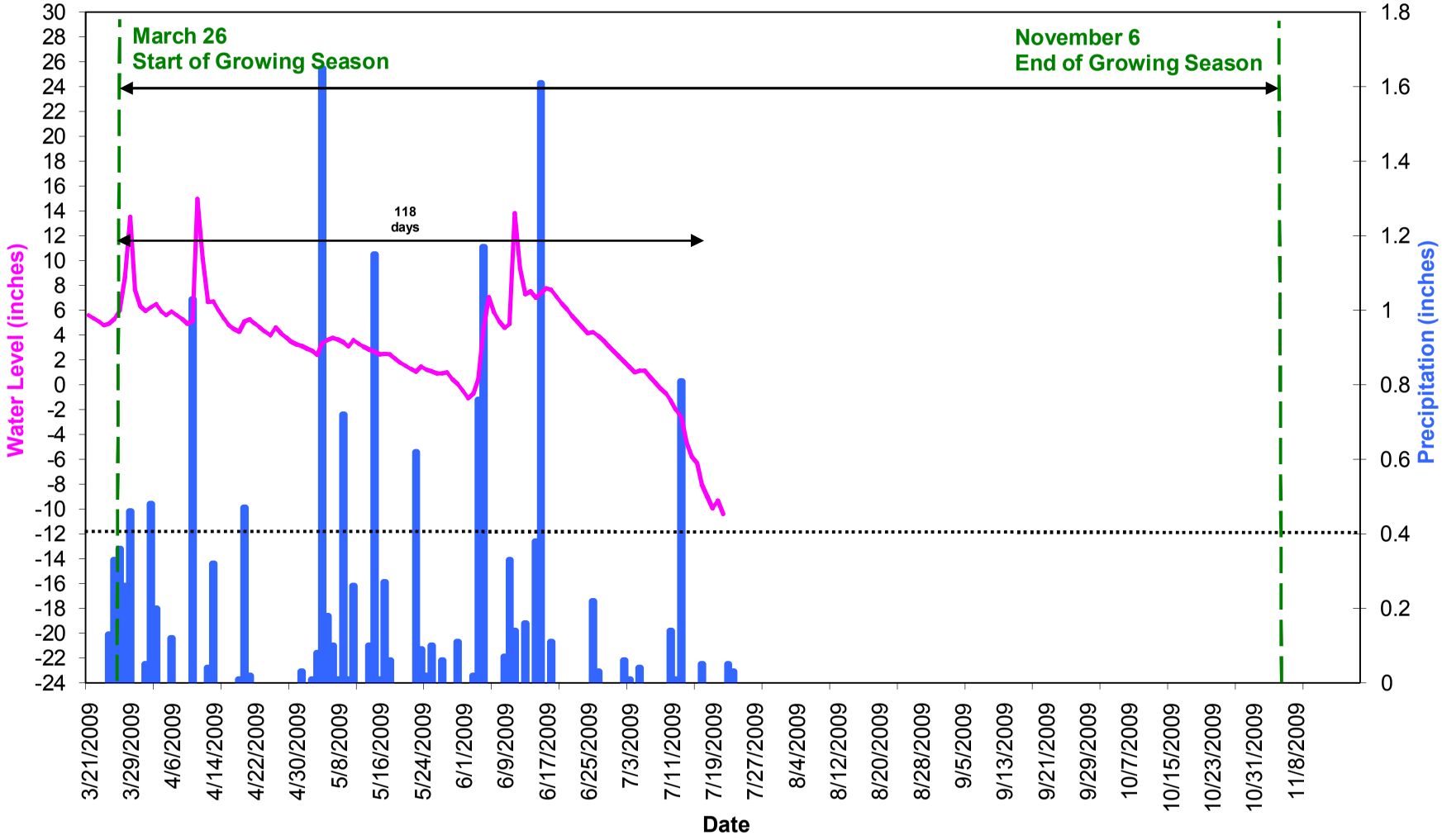

Haw River Site - Groundwater Gauge 3
Year 5 (2009 Gauge Data)
March 26
Start of Growing Season
November 6
End of Growing Season
119
days
Gauge data was only being stored within the data logger monthly; therefore, datapoints between those stored are interpolated. This gauge was in standing water throughout this time period.
Water Level (inches)
Precipitation (inches)
Date
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
3/21/2009
3/29/2009
4/6/2009
4/14/2009
4/22/2009
4/30/2009
5/8/2009
5/16/2009
5/24/2009
6/1/2009
6/9/2009
6/17/2009
6/25/2009
7/3/2009
7/11/2009
7/19/2009
7/27/2009
8/4/2009
8/12/2009
8/20/2009
8/28/2009
9/5/2009
9/13/2009
9/21/2009
9/29/2009
10/7/2009
10/15/2009
10/23/2009
10/31/2009
11/8/2009

Haw River Site - Groundwater Gauge 4
Year 5 (2009 Gauge Data)

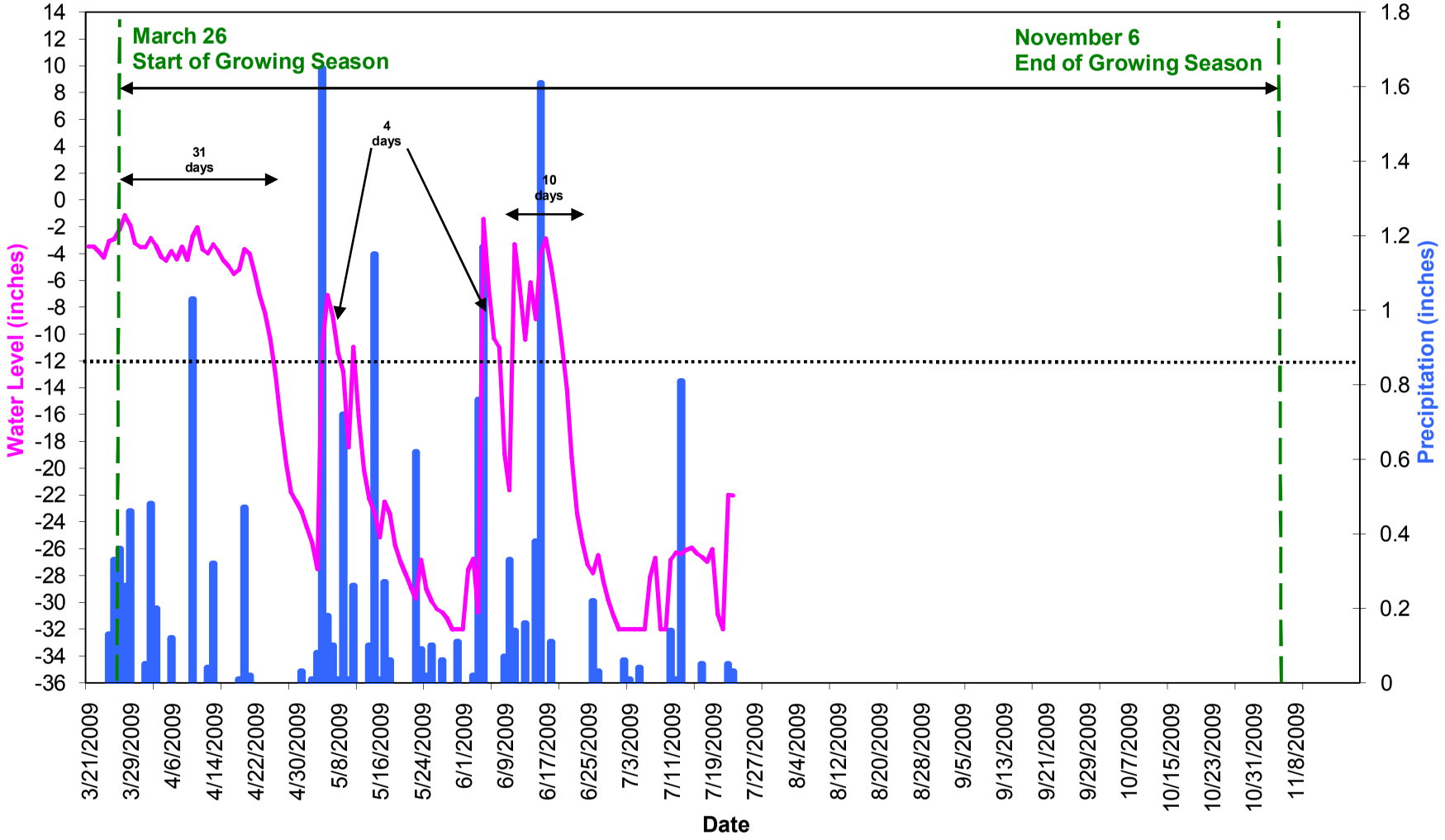



Haw River Site - Groundwater Gauge 5
Year 5 (2009 Gauge Data)
March 26
Start of Growing Season
November 6
End of Growing Season
31
days
9
days
11
days
Water Level (inches)
Precipitation (inches)
Date
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
3/21/2009
3/29/2009
4/6/2009
4/14/2009
4/22/2009
4/30/2009
5/8/2009
5/16/2009
5/24/2009
6/1/2009
6/9/2009
6/17/2009
6/25/2009
7/3/2009
7/11/2009
7/19/2009
7/27/2009
8/4/2009
8/12/2009
8/20/2009
8/28/2009
9/5/2009
9/13/2009
9/21/2009
9/29/2009
10/7/2009
10/15/2009
10/23/2009
10/31/2009
11/8/2009

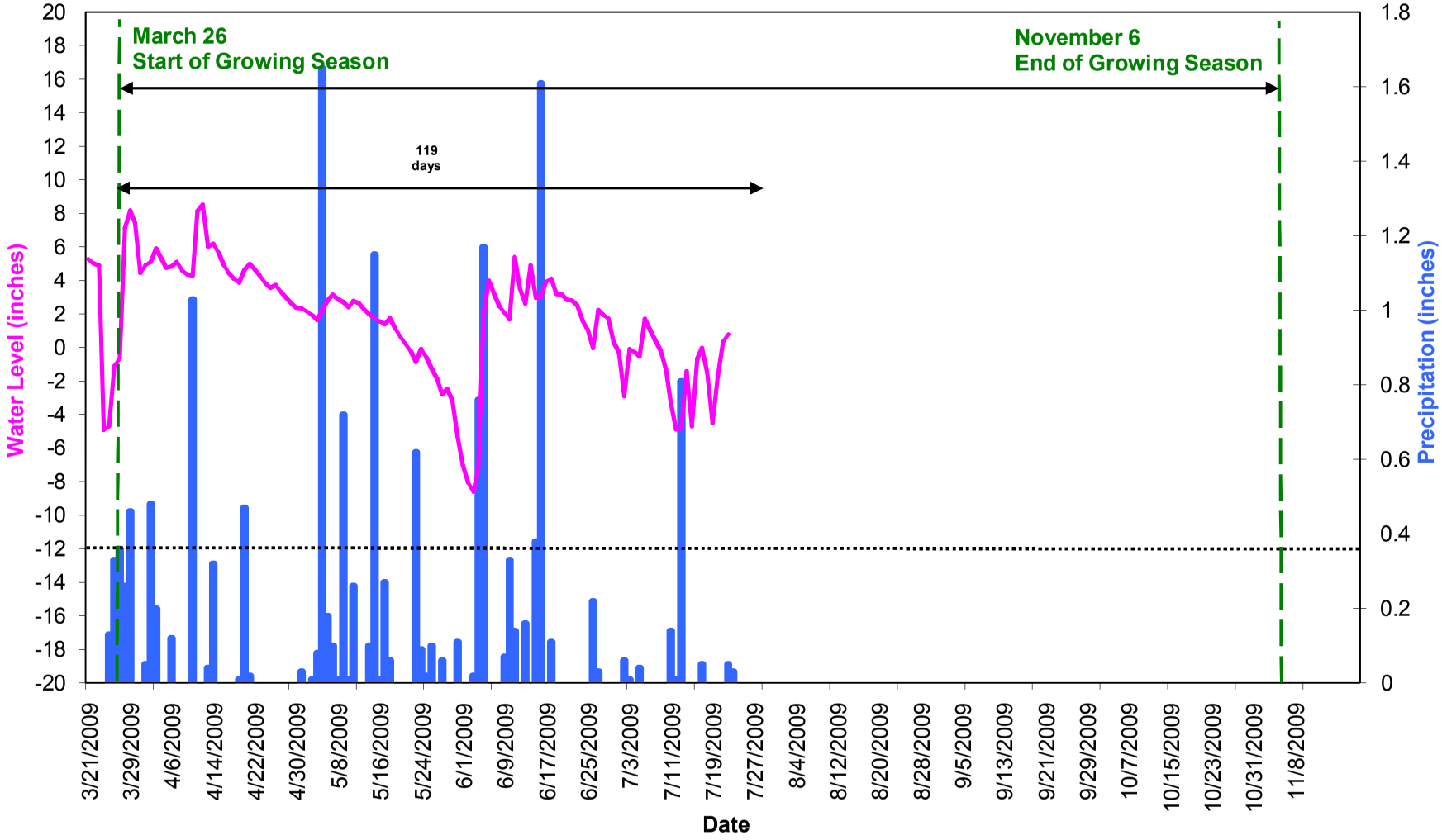
Haw River Site - Groundwater Gauge 6
Year 5 (2009 Gauge Data)



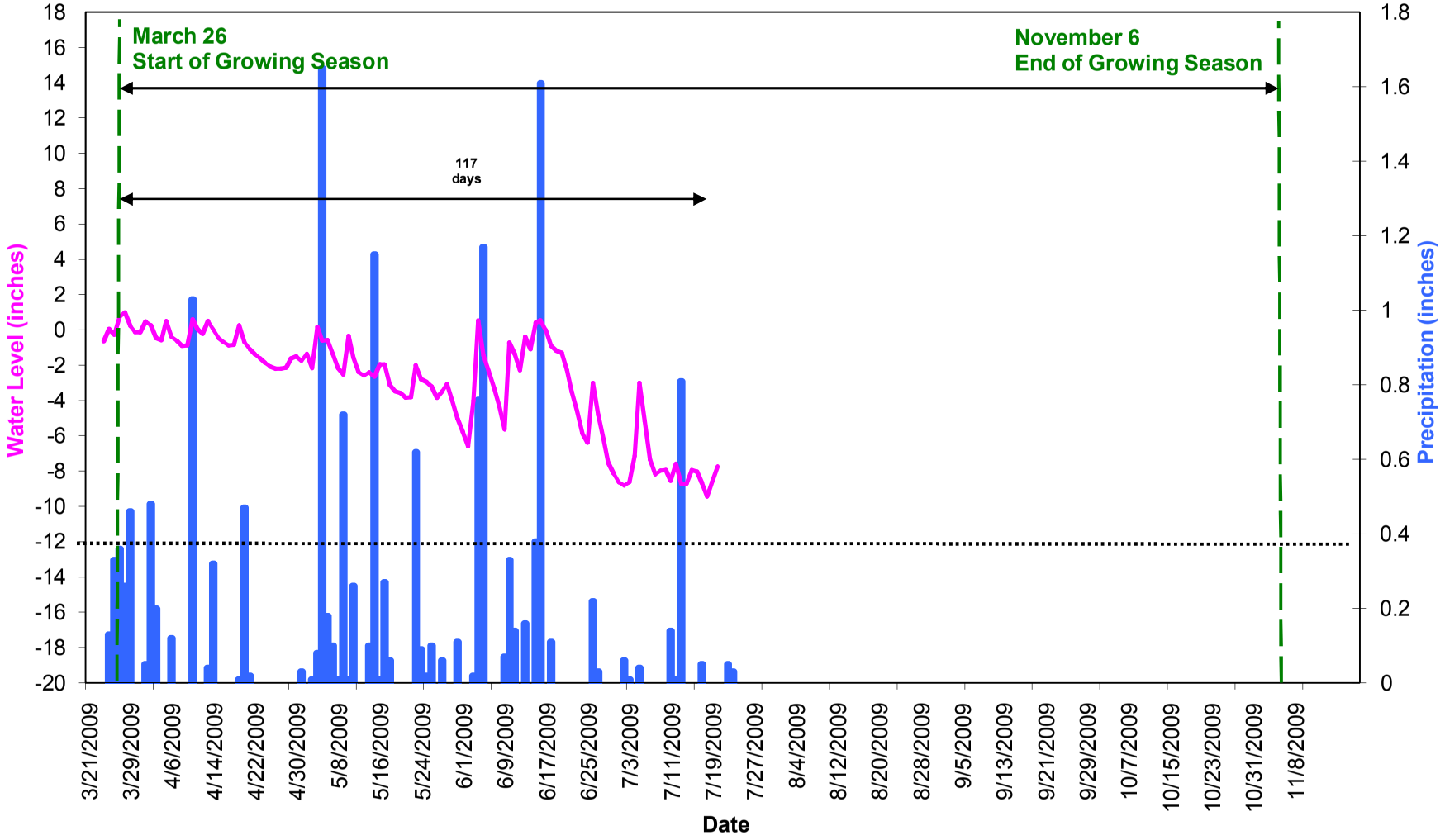
Haw River Site - Groundwater Gauge 7
Year 5 (2009 Gauge Data)

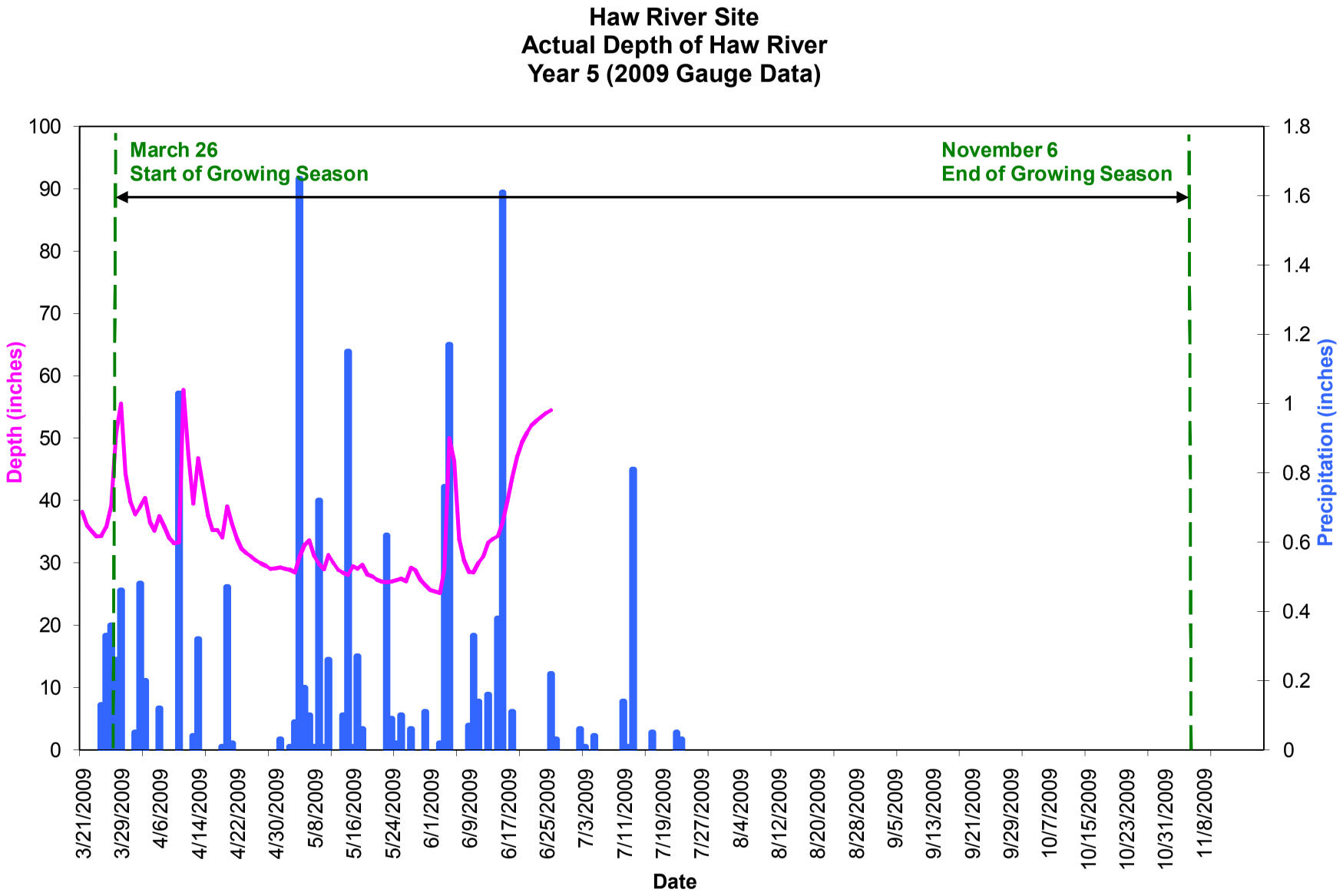


Haw River Site - Groundwater Gauge 8
Year 5 (2009 Gauge Data)



Haw River Site - Groundwater Reference Gauge (Swamp Forest)
Year 5 (2009 Gauge Data)




Haw River Site
Actual Depth of Haw River
Year 5 (2009 Gauge Data)
March 26
Start of Growing Season
November 6
End of Growing Season
Depth (inches)
Precipitation (inches)
Date
100
90
80
70
60
50
40
30
20
10
0
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
3/21/2009
3/29/2009
4/6/2009
4/14/2009
4/22/2009
4/30/2009
5/8/2009
5/16/2009
5/24/2009
6/1/2009
6/9/2009
6/17/2009
6/25/2009
7/3/2009
7/11/2009
7/19/2009
7/27/2009
8/4/2009
8/12/2009
8/20/2009
8/28/2009
9/5/2009
9/13/2009
9/21/2009
9/29/2009
10/7/2009
10/15/2009
10/23/2009
10/31/2009
11/8/2009

APPPENDIX B
VEGETATION PLOT PHOTOGRAPHS

Haw River Swamp Wetland Restoration Site
Year 5 (2009) Annual Monitoring
Vegetation Plot Photographs (Taken June 2009)

Plot 5

No Photograph Available