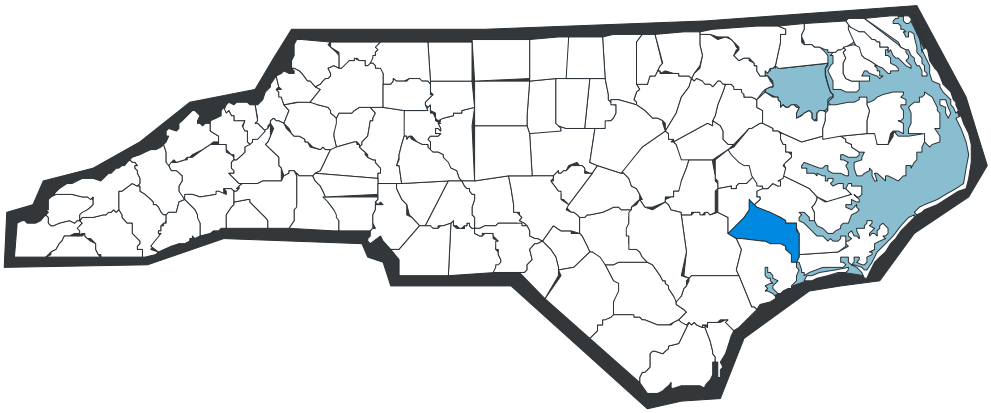
ANNUAL MONITORING REPORT FOR 2009
CLAYHILL FARMS



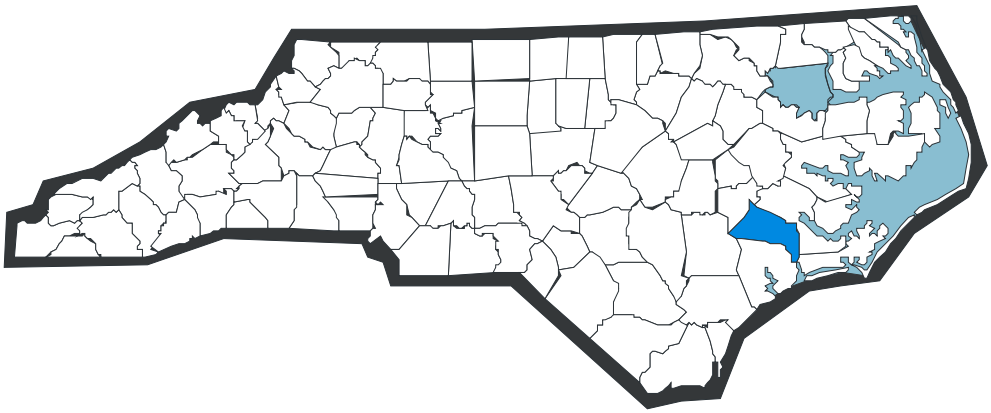
CLAYHILL FARMS MITIGATION SITE
JONES COUNTY, NORTH CAROLINA
TIP No. R-2105 WM
(EEP Project Number .00018)
2009 Annual Monitoring Report (Year 4 of 5)

Submitted to:
North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
Raleigh, North Carolina

Design Firm:
Office of Natural Environment & Roadside Environmental Unit
North Carolina Department of Transportation
Raleigh, North Carolina

November 2009

ANNUAL MONITORING REPORT FOR 2009
CLAYHILL FARMS



CLAYHILL FARMS MITIGATION SITE
JONES COUNTY, NORTH CAROLINA
TIP No. R-2105 WM
(EEP Project Number .00018)
2009 Annual Monitoring Report (Year 4 of 5)

Axiom Environmental, Inc.

Ecosystem Enhancement PROGRAM

Submitted to:
North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
Raleigh, North Carolina

Prepared by:
Axiom Environmental, Inc.
20 Enterprise Street, Suit7
Raleigh, North Carolina 27607

Design Firm:
Office of Natural Environment & Roadside Environmental Unit
North Carolina Department of Transportation
Raleigh, North Carolina

November 2009

EXECUTIVE SUMMARY

The Clayhill Farms Stream and Wetland Restoration Site (Site) is located in southern Jones County, approximately 1 mile north of the Town of Kuhns and 0.75 mile north of the Carteret County/Jones County line. The Site is located east of Highway 58 and is bordered by the Croatan National Forest to the north, east, and west and by various forested and residential parcels to the south. Site streams, Billy's Branch and other unnamed tributaries to Hunters Creek, bisect the Site. The project is located within the White Oak River Basin in United States Geological Survey (USGS) 14-digit Hydrologic Unit 03020106010060 (North Carolina Division of Water Quality [NCDWQ] subbasin 03-05-01). This document serves as the 2009 Year Four Annual Monitoring Report.

Twenty groundwater gauges were maintained and monitored for the year 4 (2009) growing season. Groundwater hydrology within 12 inches of the soil surface is occurring for greater than 12.5 percent of the growing season for year 4 (2009) at Gauges GW1-GW9, GW14-GW15, and GW18. The remainder of the gauges were saturated or inundated for less than 12.5 percent of the growing season (Gauges GW10-GW13, GW16-GW17, and GW19-GW20). Gauges currently below 12.5 percent of the growing season are located within the lower half of the Site near the restored stream channel. Gauges will continue to be monitored closely; a jurisdictional wetland delineation may be necessary at the end of the five-year monitoring period to accurately quantify successful wetlands within this portion of the Site.

Ten 10-meter square vegetation plots were monitored for the year 4 (2009) season. Based on stem counts, the average plot density monitored at this Site is greater than 290 stems per acre and is considered successful. The average plot density has been measured at 680 planted stems per acre for 2009 (year 4) monitoring. Dominant species identified at the Site were overcup oak (*Quercus lyrata*), tupelo species (*Nyssa biflora* and *Nyssa* sp.), and green ash (*Fraxinus pennsylvanica*). Nine out of the ten individual vegetation plots were above success criteria with 364 to 1619 planted stems per acre. Planted stems were not documented during planting making it difficult to determine planted trees from naturally recruited trees. Therefore, the number of "planted" species was based on the experience and judgment of the monitoring team, and counts for planted species may be influenced by naturally recruited stems. In addition, the range of variation for survival between individual plots may be influenced by varied planting densities throughout the Site. Vegetation plot 9 was low with 40 planted stems per acre; however, when including additional pine (*Pinus* sp.) natural recruits, the stem count increases to 2388 stems per acre.

One vegetation problem area noted during year 4 (2009) monitoring consisted of a large area of poor planted stem survival adjacent to the restored stream (near Reach 1). Poor survival most likely has resulted from soil infertility. Similarly, herbaceous vegetation on the lower half of the Site adjacent to the restored stream is not establishing well.

Based on visual observation during the year 4 (2009) monitoring, channel geometry compares favorably with the emulated, stable E/C stream type as set forth in the detailed mitigation plan. The current monitoring observations demonstrate that dimension, pattern, and profile were stable over the course of the year 4 (2009) monitoring period.

Two stream problem areas were noted during year 4 (2009) monitoring. Both problem areas are stressed cross-vanes with failing right bank arms resulting from a lack of footers. Additional inspections and monitoring of bed and banks up and downstream of compromised structures is recommended prior to initiation of proactive maintenance measures.

In summary, the Site achieved success criteria for vegetation and stream attributes in the Fourth Monitoring Year (2009). The upper half of the Site achieved hydrology success criteria for the Fourth Monitoring Year (2009).

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1.0 PROJECT BACKGROUND

1.1 Project Description

The Clayhill Farms Stream and Wetland Restoration Site (Site) is located in southern Jones County, approximately 1 mile north of the Town of Kuhns and 0.75 mile north of the Carteret County/Jones County line. The Site is located east of Highway 58 and is bordered by the Croatan National Forest to the north, east, and west and by various forested and residential parcels to the south. Site streams, Billy's Branch and other unnamed tributaries to Hunters Creek, bisect the Site (Figure 1). The project is located within the White Oak River Basin in United States Geological Survey (USGS) 14-digit Hydrologic Unit 03020106010060 (North Carolina Division of Water Quality [NCDWQ] subbasin 03-05-01).

Directions to the Site:
From Raleigh, North Carolina

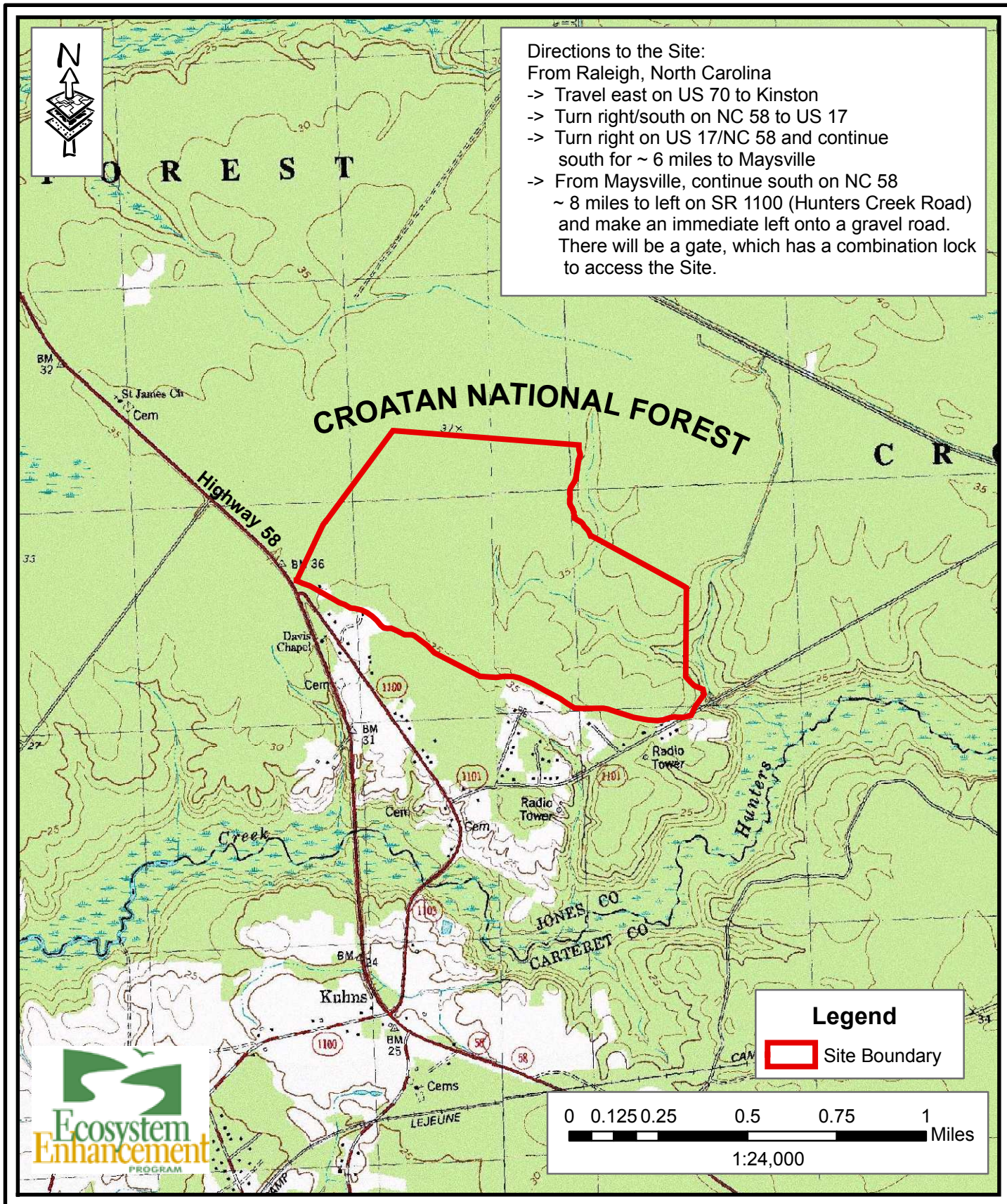
- Travel east on US Highway 70 to Kinston
- Turn right and go south on NC 58 to US 17
- Turn right on US 17/NC 58 and continue south approximately 6 miles to Maysville
- From Maysville, continue south on NC 58 approximately 8 miles to left on SR 1100 (Hunters Creek Road)
- Then make an immediate left onto a gravel road with a gate. The gate has a combination lock to access the Site

1.2 Purpose

In order to demonstrate successful mitigation, hydrologic, vegetative, and stream monitoring must be conducted for five years or until success criteria are achieved. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for hydrologic conditions, vegetation survival, and stream morphology. The following report details the results of monitoring for the 2009 (year 4) growing season at the Clayhill Farms Stream and Wetland Restoration Site.

1.3 Project History

September 2005	Mitigation Plan
2006	Final Design (90%)
2006	Site Construction
2006	Planting
November 2006	Vegetation Monitoring (Year 1)
March-November 2006	Hydrologic Monitoring (Year 1)
January-March 2007	Stream Monitoring (Year 1)
July 2007	Vegetation Monitoring (Year 2)
March –November 2007	Hydrologic Monitoring (Year 2)
July 2007	Stream Monitoring (Year 2)
August 2008	Vegetation Monitoring (Year 3)
March –November 2008	Hydrologic Monitoring (Year 3)
October 2008	Stream Monitoring (Year 3)
August 2009	Vegetation Monitoring (Year 4)
March –November 2009	Hydrologic Monitoring (Year 4)
July 2009	Stream Monitoring (Year 4)



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20 Enterprise Street
Suite 7
Raleigh, NC 27607
(919) 215-1693

SITE LOCATION
CLAYHILL FARMS RESTORATION SITE
EEP Project Number .00018
Year 4 (2009) Monitoring Report
Jones County, North Carolina

CLF	FIGURE 1
Date: Nov 2009	
Project: 08-002	

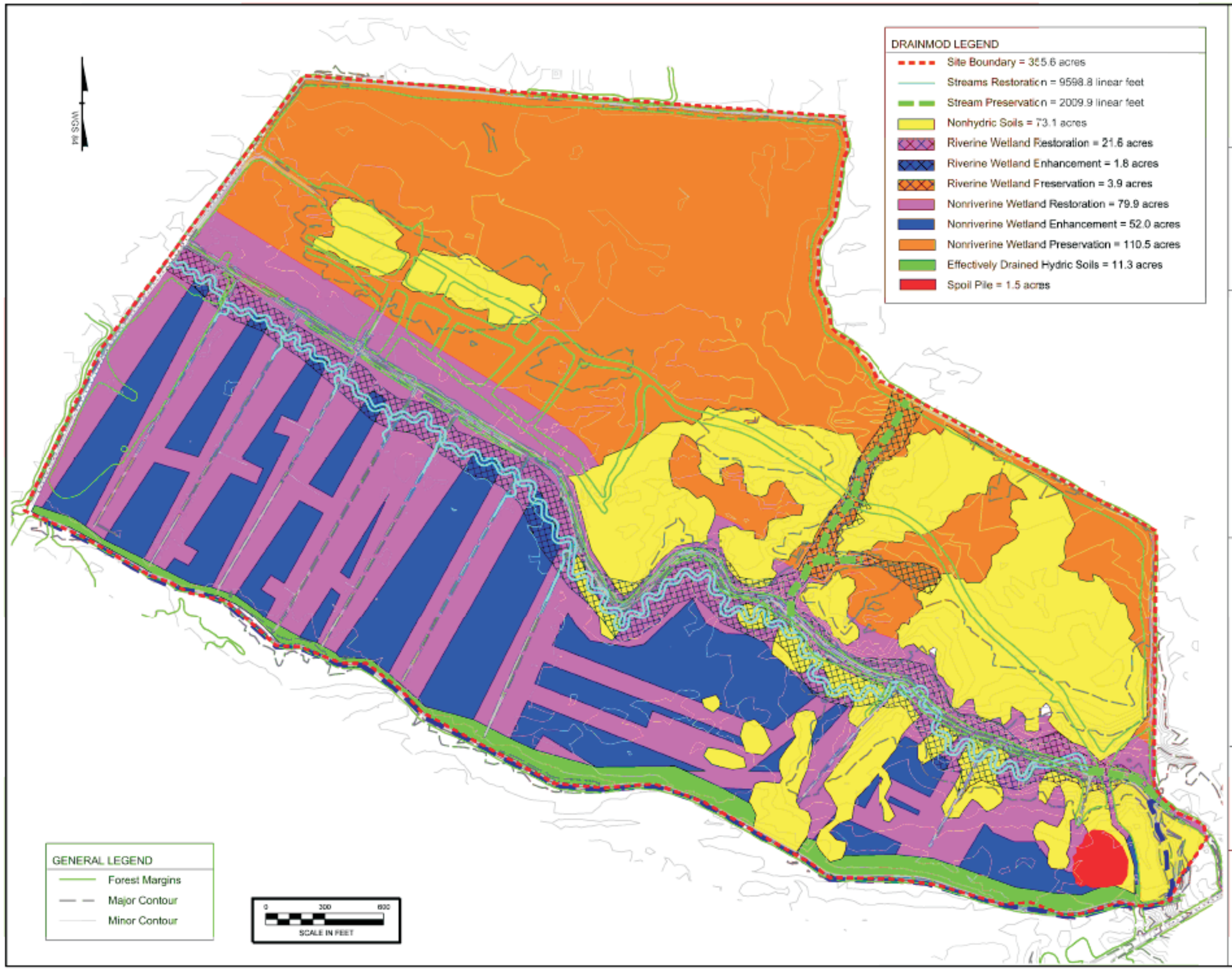
1.4 Mitigation Structure and Objectives

In the early 1970s the Site was logged and portions of the Site were converted to agricultural land. At that time, perimeter and interior drainage ditches were excavated and Site streams were channelized in support of land uses.

The primary mitigation activities at the Site included restoration of previously ditched and filled wetlands, vegetative enhancement of previously cleared wetlands within agricultural fields, preservation of the forested wetlands, restoration of channelized stream channel, and preservation of secondary tributaries within forested wetlands.

Restoration activities at the Site entailed 1) plugging and filling of feeder ditches, 2) removal of crowning within fields, 3) clearing and grading to prepare for creation of the new stream alignment, 4) construction of a stable channel, 5) filling of the abandoned stream channel with onsite materials excavated from the floodplain and other upland areas, 6) installation of a grade control structure at the downstream end of the restoration reach, 7) removal of the bridge crossing of Billy's Branch within the southeast portion of the Site, and 8) ripping/scarifing soils to prepare for planting.

The primary goals of the project include 1) maximizing the area returned to historic wetland function; 2) establishing stable dimension, pattern, and profile along Billy's Branch; 3) expanding, enhancing, and preserving 355.6 acres adjacent to the Croatan National Forest; 4) protecting the Site with a conservation easement in perpetuity; 5) providing valuable habitat to a diverse assemblage of terrestrial and aquatic flora and fauna; 6) serving as a wildlife corridor; and 7) providing numerous wetland values including water storage, pollutant removal, aquatic/wildlife habitat, recreation, and education. Project structures and objectives are summarized in Table 1 and are depicted on Figure 2.



Axiom Environmental, Inc.

Ecosystem Enhancement Program

NOTES/REVISIONS

Project:

Clayhill Farms Restoration Site

Project No. 18.00018
As-built Mitigation Report
Jones County
North Carolina

Title:

DRAINMOD Post Construction Conditions

Scale:	FIGURE NO.
1 in. = 490 ft.	2
Date: FEB 2007	
Project No.: 06-021	

Table 1. Project Mitigation Structures and Objectives

Clayhill Farms (EEP Project Number .00018)

Project Segment or Reach ID	Mitigation Type*	Approach**	Linear Footage or Acreage	Stationing	Comment
Billy's Branch	R	P2	7931	0+00 to 79+31	Includes 7931 linear feet of excavation of new channel within a floodplain bench
Secondary Tributaries	R	P1&P2	1667.8	---	Includes 1667.8 linear feet of eight secondary tributaries
Secondary Tributary	P	--	2009.9	---	Preserving forested secondary tributaries
Downstream end of Billy's Branch	P	--			Preserving forested downstream reach of Billy's Branch
Riverine Wetland Restoration	R	--	21.6	---	Filling ditches, removing field crowns, and planting agricultural fields.
Riverine Wetland Enhancement	E	--	1.8	---	Planting within agricultural fields.
Riverine Wetland Preservation	P	--	3.9	---	Preserving forested riverine wetlands.
Nonriverine Wetland Restoration	R	--	79.9	---	Filling ditches, removing field crowns, and planting agricultural fields.
Nonriverine Wetland Enhancement	E	--	52.0	---	Planting within agricultural fields.
Nonriverine Wetland Preservation	P	--	110.5	---	Preserving forested nonriverine wetlands within the interstream flat.

* R = Restoration
E = Enhancement
P = Preservation

** P1 = Priority I
P2 = Priority II
P3 = Priority III

2.0 HYDROLOGY

2.1 Success Criteria

Success criteria for wetland hydrology at Clayhill Farms require inundation or saturation within 12 inches of the ground surface for a consecutive period of 12.5 percent of the growing season, or if the hydroperiod is within 20 percent of an approved reference wetland hydroperiod within drought years. The growing season for Jones County begins March 15 and ends November 11 (242 days). In order to attain hydrologic success, saturation within 12 inches of the ground surface is required for at least 30 consecutive days (12.5 percent of the growing season).

2.2 Hydrologic Description

Twenty groundwater monitoring gauges have been maintained and monitored throughout the year 4 (2009) growing season (Figures 3A-3B). Daily rainfall data recorded from a rain gauge maintained and monitored on the Site was used for seasonal comparison. Graphs of groundwater hydrology and precipitation are included in Appendix A.

LATITUDE	LONGITUDE	VEG. PLOT/TYPE
77.12442	34.80796	p1 mesic pine flatwoods
77.12335	34.80683	p2 mesic pine flatwoods
77.12629	34.80637	p3 nonriverine wet hardwood
77.12560	34.80832	p4 nonriverine wet hardwood
77.13168	34.80919	p5 headwater swamp
77.12943	34.81004	p6 headwater swamp
77.13004	34.80805	p7 headwater swamp
77.12384	34.80544	p8 nonriverine wet hardwoods
77.11757	34.80511	p9 mixed mesic hardwood
77.11664	34.80417	p10 mixed mesic hardwood

LATITUDE	LONGITUDE	REACH 4
77.12649	34.80966	benchmark 4
77.12571	34.80948	end reach 4
77.12607	34.80956	xs1 right bank
77.12603	34.80966	xs1 left bank
77.12621	34.80964	xs2 left bank
77.12617	34.80954	xs2 right bank
77.12688	34.80994	xs3 right bank
77.12678	34.81000	xs3 left bank
77.12679	34.81003	xs4 left bank
77.12690	34.81006	xs4 right bank
77.12728	34.81015	end reach 4

LATITUDE	LONGITUDE	REACH 3
77.12285	34.80777	end of reach 3
77.12296	34.80769	xs1 left bank
77.12282	34.80765	xs1 right bank
77.12293	34.80747	xs2 right bank
77.12301	34.80758	xs2 left bank
77.12370	34.80726	xs3 right bank
77.12361	34.80723	xs3 left bank
77.12363	34.80738	xs 4 left bank
77.12367	34.80734	xs4 right bank
77.12337	34.80682	benchmark 3
77.12396	34.80739	start reach 3

LATITUDE	LONGITUDE	REACH 5
77.12825	34.81067	start reach 5
77.12851	34.81077	xs1 right bank
77.12847	34.81086	xs1 left bank
77.12849	34.81091	xs2 left bank
77.12860	34.81086	xs2 right bank
77.12895	34.81117	benchmk 5
77.12918	34.81132	xs3 left bank
77.12924	34.81121	xs3 right bank
77.12958	34.81147	xs4 left bank
77.12946	34.81150	xs4 right bank
77.12955	34.81155	start reach 5

GENERAL LEGEND
- Forest Margins
- Major Contour
- Minor Contour

DRAINMOD LEGEND
- Site Boundary = 355.6 acres
- Streams Restoration = 9598.8 linear feet
- Stream Monitoring Reach (minimum 600 ft. in length)
- Permanently Monumented Cross Section
- Vegetation Monitoring Plot (> 320 Stems Per Acre)
- Vegetation Monitoring Plot (< 320 Stems Per Acre)
- Groundwater Gauge (> 12.5% of Growing Season)
- Groundwater Gauge (5% to 12.5 % of Growing Season)
- Groundwater Gauge (< 5% of Growing Season)
- Benchmark
- Photograph Location
- Cross-vane (Functional)
- Cross-vane (Stressed)

WGS 84

REACH 5
REACH 4
REACH 3
Benchmark 5
Benchmark 4
X Sec 1
X Sec 2
X Sec 3
X Sec 4
GW1
GW2
GW3
GW4
GW5
GW6
GW8
GW9
GW11
GW12
GW13
Plot 1
Plot 4
Plot 5
Plot 6
Plot 7
20
19
18
17
16
15

0 300 600
SCALE IN FEET

Axiom Environmental, Inc.

Ecosystem Enhancement Program

NOTES/REVISIONS

Project:
Clayhill Farms Restoration Site

Project No. .00018
Year 4 (2009) Monitoring Report
Jones County
North Carolina

Title:
Monitoring Plan

Scale: 1 in. = 270 ft.
Date: Nov 2009
Project No.: 08-002

FIGURE NO.
3A

LATITUDE	LONGITUDE	VEG. PLOT/TYPE
77.12442	34.80796	p1 mesic pine flatwoods
77.12335	34.80683	p2 mesic pine flatwoods
77.12629	34.80637	p3 nonriverine wet hardwood
77.12560	34.80832	p4 nonriverine wet hardwood
77.13168	34.80919	p5 headwater swamp
77.12943	34.81004	p6 headwater swamp
77.13004	34.80805	p7 headwater swamp
77.12384	34.80544	p8 nonriverine wet hardwoods
77.11757	34.80511	p9 mixed mesic hardwood
77.11654	34.80417	p10 mixed mesic hardwood

LATITUDE	LONGITUDE	REACH 3
77.12285	34.80777	end of reach 3
77.12296	34.80769	xs1 left bank
77.12282	34.80765	xs1 right bank
77.12293	34.80747	xs2 right bank
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77.12370	34.80726	xs3 right bank
77.12361	34.80723	xs3 left bank
77.12363	34.80738	xs 4 left bank
77.12367	34.80734	xs4 right bank
77.12337	34.80682	benchmark 3
77.12396	34.80739	start reach 3

LATITUDE	LONGITUDE	REACH 5
77.12825	34.81067	start reach 5
77.12851	34.81077	xs1 right bank
77.12847	34.81086	xs1 left bank
77.12849	34.81091	xs2 left bank
77.12860	34.81086	xs2 right bank
77.12895	34.81117	benchmk 5
77.12918	34.81132	xs3 left bank
77.12924	34.81121	xs3 right bank
77.12958	34.81147	xs4 right bank
77.12946	34.81150	xs4 left bank
77.12955	34.81155	start reach 5

LATITUDE	LONGITUDE	REACH 4
77.12649	34.80966	benchmark 4
77.12571	34.80948	end reach 4
77.12607	34.80956	xs1 right bank
77.12603	34.80966	xs1 left bank
77.12621	34.80964	xs2 left bank
77.12617	34.80954	xs2 right bank
77.12688	34.80994	xs3 right bank
77.12678	34.81000	xs3 left bank
77.12679	34.81003	xs4 left bank
77.12690	34.81006	xs4 right bank
77.12728	34.81015	end reach 4

DRAINMOD LEGEND

- Site Boundary = 355.6 acres
- Streams Restoration = 9598.8 linear feet
- Stream Monitoring Reach (minimum 600 ft. in length)
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- Vegetation Monitoring Plot (> 320 Stems Per Acre)
- Vegetation Monitoring Plot (< 320 Stems Per Acre)
- Groundwater Gauge (> 12.5% of Growing Season)
- Groundwater Gauge (5% to 12.5 % of Growing Season)
- Groundwater Gauge (< 5% of Growing Season)
- Benchmark
- Photograph Location
- Cross-vane (Functional)
- Cross-vane (Stressed)
- Vegetation Problem Area (Bare)

REACH 1

REACH 2

REACH 3

Plot 1 Plot 2 Plot 8 Plot 9 Plot 10

GW10 GW11 GW12 GW13 GW14 GW15 GW16 GW17 GW18 GW19 GW20

Benchmark 1 Benchmark 2 Benchmark 3

X Sec 1 X Sec 2 X Sec 3 X Sec 4

Spoil Pile

GENERAL LEGEND

- Forest Margins
- Major Contour
- Minor Contour

WGS 84

0 300 600

SCALE IN FEET

Axiom Environmental, Inc.

Ecosystem Enhancement PROGRAM

NOTES/REVISIONS

Project:

Clayhill Farms Restoration Site

Project No. .00018
Year 4 (2009) Monitoring Report
Jones County
North Carolina

Title:

Monitoring Plan

Scale: 1 in. = 270 ft.

Date: Nov 2009

Project No.: 08-002

FIGURE NO.

3B

2.3 Results of Hydrologic Monitoring

2.3.1 Site Data

Twenty gauges were maintained and monitored for the year 4 (2009) growing season. Groundwater hydrology within 12 inches of the soil surface is occurring for greater than 12.5 percent of the growing season for year 4 (2009) at Gauges GW1-GW9, GW14-GW15, and GW18. The remainder of the gauges were saturated or inundated for less than 12.5 percent of the growing season (Gauges GW10-GW13, GW16-GW17, and GW19-GW20). Gauges currently below 12.5 percent of the success criteria are located within the lower half of the Site near the restored stream channel.

The following table summarizes success criteria achievement for Site gauges.

Table 2. Summary of Groundwater Gauge Results for Years 1 through 5
Clayhill Farms (EEP Project Number .00018)

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)				
	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)
GW1	Yes/34 days (14.0 percent)	Yes/79 days (32.6 percent)	Yes/94 days (38.8 percent)	Yes/118 days (48.8 percent)	
GW2	Yes/68 days (28.1 percent)	Yes/50 days (20.7 percent)	Yes/91 days (37.6 percent)	Yes/80 days (33.1 percent)	
GW3	Yes/81 days (33.5 percent)	Yes/78 days (32.3 percent)	Yes/93 days (38.4 percent)	Yes/118 days (48.8 percent)	
GW4	Yes/81 days (33.5 percent)	Yes/77 days (31.8 percent)	Yes/91 days (37.6 percent)	Yes/80 days (33.1 percent)	
GW5	Yes/66 days (27.3 percent)	Yes/50 days (20.7 percent)	Yes/91 days (37.6 percent)	Yes/79 days (32.6 percent)	
GW6	Yes/37 days (15.3 percent)	No/23 days (9.5 percent)	Yes/88 days (36.4 percent)	Yes/48 days (19.8 percent)	
GW7	Yes/69 days (28.5 percent)	Yes/50 days (20.7 percent)	Yes/90 days (37.2 percent)	Yes/80 days (33.1 percent)	
GW8	Yes/68 days (28.1 percent)	Yes/50 days (20.7 percent)	Yes/89 days (36.8 percent)	Yes/67 days (27.7 percent)	
GW9	Yes/38 days (15.7 percent)	No/24 days (9.9 percent)	Yes/89 days (36.8 percent)	Yes/60 days (24.8 percent)	
GW10	No/7 days (2.9 percent)	No/5 days (2.1 percent)	No/14 days (5.8 percent)	No/12 days (5.0 percent)	
GW11	No/2 days (0.8 percent)	No/1 day (0.4 percent)	No/4 days (1.7 percent)	No/3 days (1.2 percent)	
GW12	No/5 days (2.1 percent)	No/5 days (2.1 percent)	No/8 days (3.3 percent)	No/8 days (3.3 percent)	
GW13	No/6 days (2.5 percent)	No/1 day (0.4 percent)	No/9 day (3.7 percent)	No/7 days (2.9 percent)	

Table 2. Summary of Groundwater Gauge Results for Years 1 through 5 (continued)					
Gauge	**Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)**				
	Year 1 (2006)	**Year 2 (2007)**	**Year 3 (2008)**	**Year 4 (2009)**	**Year 5 (2010)**
GW14	No/18 days (7.4 percent)	No/14 days (5.8 percent)	Yes/54 days (22.3 percent)	Yes/44 days (18.2 percent)	
GW15	No/24 days (9.9 percent)	No/14 days (5.8 percent)	Yes/74 days (30.6 percent)	Yes/44 days (18.2 percent)	
GW16	No/0 days (0 percent)	No/2 days (0.8 percent)	No/9 day (3.7 percent)	No/9 day (3.7 percent)	
GW17	No/7 days (2.9 percent)	No/3 days (1.2 percent)	No/13 days (5.4 percent)	No/11 days (4.5 percent)	
GW18	No/5 days (2.1 percent)	No/2 days (0.8 percent)	No/15 days (6.2 percent)	Yes/66 days (27.3 percent)	
GW19	No/6 days (2.5 percent)	No/4 days (1.7 percent)	No/7 days (2.9 percent)	No/8 days (3.3 percent)	
GW20	No/11 days (4.5 percent)	No/17 days (7.0 percent)	No/10 days (4.1 percent)	No/11 days (4.5 percent)	

2.3.2 Climatic Data

Climatic data for the year 4 (2009) growing season is compared to previous monitoring years growing season data and precipitation probabilities from 30-year historical data at the New Bern Craven County Airport station (Figure 4) (NOAA 2004). The Site experienced slightly above average rainfall for the year 4 (2009) growing season totaling 38.1 inches for the months of March to October compared to the mean 30-year historic total for rainfall of approximately 34.6 inches.

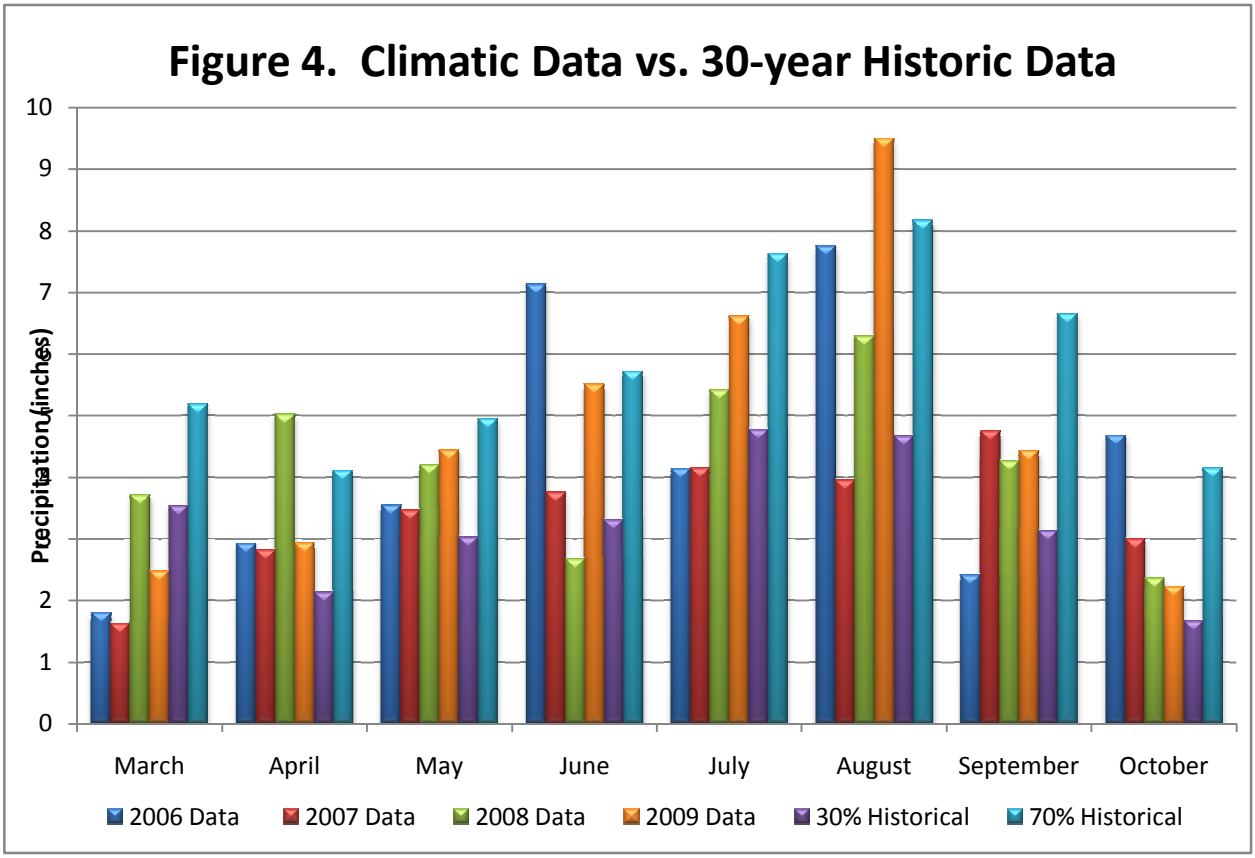
2.4 Hydrologic Conclusions

Twenty gauges were maintained and monitored for the year 4 (2009) growing season; gauge results are depicted on Figures 3A-3B and graphs for each gauge can be found in Appendix A. Twelve of the twenty monitored gauges met success criteria of inundation/saturation within 12 inches of the surface for at least 12.5 percent of the growing season with a presence of hydrophytic vegetation. Gauges will continue to be monitored closely; a jurisdictional wetland delineation may be necessary at the end of the five-year monitoring period to accurately quantify successful wetlands within the Site.

3.0 VEGETATION

3.1 Success Criteria

Wetland vegetation success criteria at Clayhill Farms require an average across the Site of 320 stems per acre of approved target species surviving for the first three years of monitoring, 290 stems per acre in year four, and 260 stems per acre in year five.



3.2 Description of Planted Areas

According to the 2006 *Revised Wetland and Stream Mitigation Plan for the Clayhill Farms Property*, planted species were to include the following communities as described in Schafale and Weakley (1990):

1. Coastal Plain Small Stream Swamp
2. Nonriverine Wet Hardwoods Forest
3. Mesic Pine Flatwoods
4. Mixed-Mesic Hardwood Forest (Coastal Plain subtype)
5. Coastal Plain Bottomland Hardwood Forest (Blackwater subtype)

3.3 Results of Vegetation Monitoring

Ten 10-meter square vegetation plots were established as depicted in Figures 3A-3B in November 2006. Plots were surveyed in August 2009 for the year 4 (2009) monitoring season using 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 Table 3 and pictures are included in Appendix B. The taxonomic standard for vegetation used for this document was *Flora of the Carolinas, Virginia,Georgia, and Surrounding Areas* (Weakley 2007). No reference area was studied; therefore, no comparisons could be made to reference conditions. Three plots (Plots 5, 6, and 7) were established in the Headwater Swamp, three plots (Plots 4, 3, and 8) in the Nonriverine Wet Hardwood Forest, two plots (Plots 1 and 2) in the Mesic Pine Flatwoods, and two plots (Plots 9 and 10) in the Mixed-Mesic Hardwood Forest restoration areas.

Based on stem counts, the average plot density monitored at the Site is greater than 290 stems per acre and is considered successful. The average plot density has been measured at 680 planted stems per acre

for 2009 (year 4) monitoring. Dominant species identified at the Site were overcup oak (*Quercus lyrata*), tupelo species (*Nyssa biflora* and *Nyssa* sp.), and green ash (*Fraxinus pennsylvanica*). Nine out of the ten individual vegetation plots were above success criteria with 364 to 1619 planted stems per acre. Planted stems were not documented during planting making it difficult to determine planted trees from naturally recruited trees. Therefore, the number of "planted" species was based on the experience and judgment of the monitoring team, and counts for planted species may be influenced by naturally recruited stems. In addition, the range of variation for survival between individual plots may be influenced by varied planting densities throughout the Site. Vegetation plot 9 was low with 40 planted stems per acre; however, when including additional pine (*Pinus* sp.) natural recruits, the stem count increases to 2388 stems per acre.

3.4 Vegetation Conclusions

Based on the number of stems counted, the average plot density monitored at this Site is greater than 290 stems per acre and is considered successful for 2009 (year 4) monitoring. The average plot density has been measured at 680 planted stems per acre. Planted seedlings exhibited various degrees of vigor at the Site. Overall, vigor was noted as good.

One vegetation problem area was documented within the Site and is depicted on Figure 3B. The area consists of poor planted stem survival adjacent to the restored stream (near Reach 1); photographs of this area are included in Appendix B. Poor survival most likely has resulted from soil infertility. In addition, herbaceous vegetation on the lower half of the Site adjacent to the restored stream is not establishing well.

4.0 STREAM ASSESSMENT

4.1 Success Criteria

Success criteria dictate that based on visual observations there should be little or no change in the as-built cross-sections. If a change takes place it should be determined if the change is to a more unstable condition (downcutting, erosion) or to a more stable condition (settling, increase in riparian vegetation, deposition along the banks, decrease in the width-depth ratio, decrease in cross-sectional area). The as-built longitudinal profile should show that bed features are neither aggrading nor degrading based on visual observation; however, short-term aggradation/degradation may occur depending on the peak annual discharge. Bed features should be consistent with those observed in typical E- and C-type channels. The as-built pattern should not change and the riffle-pool sequence should remain constant. A significant coarsening of bed materials is not expected due to the sand/silt/clay substrate; therefore, bed materials will not be analyzed for stream success.

4.2 Stream Assessment Results

4.3.1 Visual Stream Observations

Based on visual observation during the year 4 (2009) monitoring, channel geometry compares favorably with the emulated, stable E/C stream type as set forth in the detailed mitigation plan. The current monitoring observations demonstrate that dimension, pattern, and profile were stable over the course of the year 4 (2009) monitoring period.

Table 3. Stem Counts for Planted Species Arranged by Plot

Clayhill Farms (EEP Project Number .00018)

Species	Year 4 (2009) Individual Plots (0.0247 acre each)										Year 4 (2009) Totals	Year 3 (2008) Totals	Year 2 (2007) Totals	Year 1 (2006) Totals
	1	2	3	4	5	6	7	8	9	10				
Betula nigra	-	-	1	2	-	-	-	3	-	-	6	6	6	3
Fraxinus pennsylvanica	-	-	1	6	8	5	2	-	-	2	24	22	20	7
Fraxinus sp.	-	-	-	-	-	-	1	-	-	-	1	1	4	1
Nyssa biflora	-	-	6	9	-	-	-	-	-	-	15	15	9	9
Nyssa sp.	-	-	16	17	-	-	4	-	-	-	37	36	32	16
Pinus palustris	10	3	-	-	-	-	-	-	-	-	13	13	13	13
Pinus sp.	-	6	-	-	-	-	-	-	-	3	9	9	9	9
Quercus lyrata	-	-	9	3	12	4	-	8	-	7	43	42	39	41
Quercus nigra	-	-	-	-	-	-	-	-	-	1	1	4	6	5
Quercus pagoda	-	-	-	3	-	-	-	-	-	3	6	6	6	5
Quercus phellos	-	-	-	-	-	-	-	-	1	-	1	1	1	1
Quercus sp.	-	-	-	-	-	-	-	-	-		0	1	-	-
Taxodium distichum	-	-	-	-	-	7	5	-	-	-	12	10	10	6
Total Stems Per Plot	**10**	**9**	**33**	**40**	**20**	**16**	**12**	**11**	**1**	**16**	**168**	**166**	**155**	**116**
Stems Per Acre	**405**	**364**	**1335**	**1619**	**809**	**647**	**486**	**445**	**40**	**647**	**680**	**672**	**628**	**470**

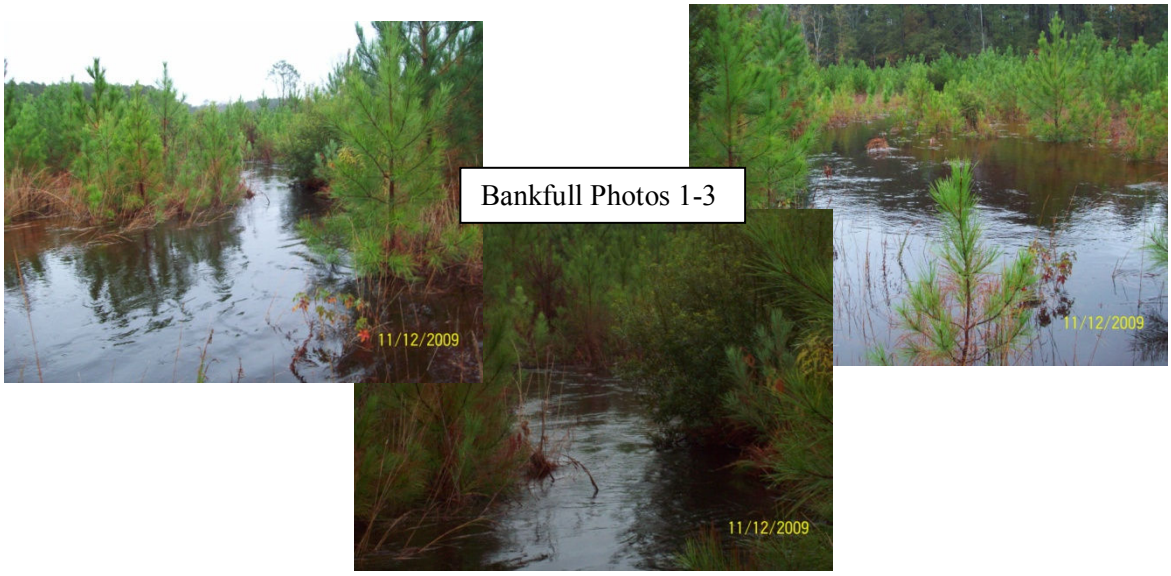
4.3.2 Bankfull Events

Documented bankfull events are included in Table 4.

Table 4. Verification of Bankfull Events

Clayhill Farms (EEP Project Number .00018)

Date of Data Collection	Date of Occurrence	Method	Photo (if available)
September 1, 2006	September 1, 2006	Total of 4.74 inches of rain documented by the onsite rain gauge over a two-day period from August 31 (4.06 inches) to September 1, 2006 (0.68 inches).	--
August 13, 2008	August 13, 2008	Total of 4.0 inches of rain documented by the onsite rain gauge over a seven-day period from August 7-13, 2008.	--
August 14, 2009	August 14, 2009	Total of 6.6 inches of rain documented at a nearby rain station over a four-day period from August 11-14, 2009.	--
November 12, 2009	November 12, 2009	Visual observations of bankfull as the result of Tropical Storm Ida	1-3



Bankfull Photos 1-3

4.3 Stream Assessment Conclusions

Based on stream observations, the channel geometry compares favorably with the emulated, stable E/C type stream reaches as set forth in the detailed mitigation plan. The current monitoring observations demonstrate that dimension, pattern, and profile were stable over the course of the year 4 (2009) monitoring period.

Stream problem areas within the Site are depicted on Figures 3A through 3B. Two problem areas were noted for the year 4 (2009) monitoring period. Both problem areas are stressed cross-vanes with failing right bank arms resulting from a lack of footers; photographs of each are included in Appendix C. Additional inspections and monitoring of bed and banks up and downstream of compromised structures is recommended prior to initiation of proactive maintenance measures.

5.0 OVERALL CONCLUSIONS/RECOMMENDATIONS

Twenty gauges were maintained and monitored for the year 4 (2009) growing season. Twelve of the twenty monitored gauges met success criteria of inundation/saturation within 12 inches of the surface for at least 12.5 percent of the growing season with a presence of hydrophytic vegetation. Gauges will continue to be monitored closely; a jurisdictional wetland delineation may be necessary at the end of the five-year monitoring period to accurately quantify successful wetlands within the Site.

Based on the number of stems counted, the average plot density monitored at the Site is greater than 290 stems per acre and is considered successful for 2009 (year 4) monitoring. The average plot density has been measured at 680 planted stems per acre.

One vegetation problem area documented within the Site consists of a large area of poor planted stem survival adjacent to the restored stream (near Reach 1). Poor survival most likely has resulted from soil infertility. Similarly, herbaceous vegetation on the lower half of the Site adjacent to the restored stream is not establishing well.

Based on stream observations, channel geometry compares favorably with the emulated, stable E/C type stream reaches as set forth in the detailed mitigation plan. The current monitoring observations demonstrate that dimension, pattern, and profile were stable over the course of the year 4 (2009) monitoring period.

Stream problem areas within the Site included two stressed cross-vanes with failing right bank arms resulting from a lack of footers. Additional inspections and monitoring of bed and banks up and downstream of compromised structures is recommended prior to initiation of proactive maintenance measures.

In summary, the Site achieved success criteria for vegetation and stream attributes in the Fourth Monitoring Year (2009). The upper half of the Site achieved hydrology success criteria for the Fourth Monitoring Year (2009).

6.0. REFERENCES

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

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North Carolina Department of Transportation (NCDOT). 2006. Revised Wetland and Stream Mitigation Plan for the Clayhill Farms Property, Jones County, North Carolina, TIP No. R-2105 WM. Office of Natural Environment & Roadside Environmental Unit.

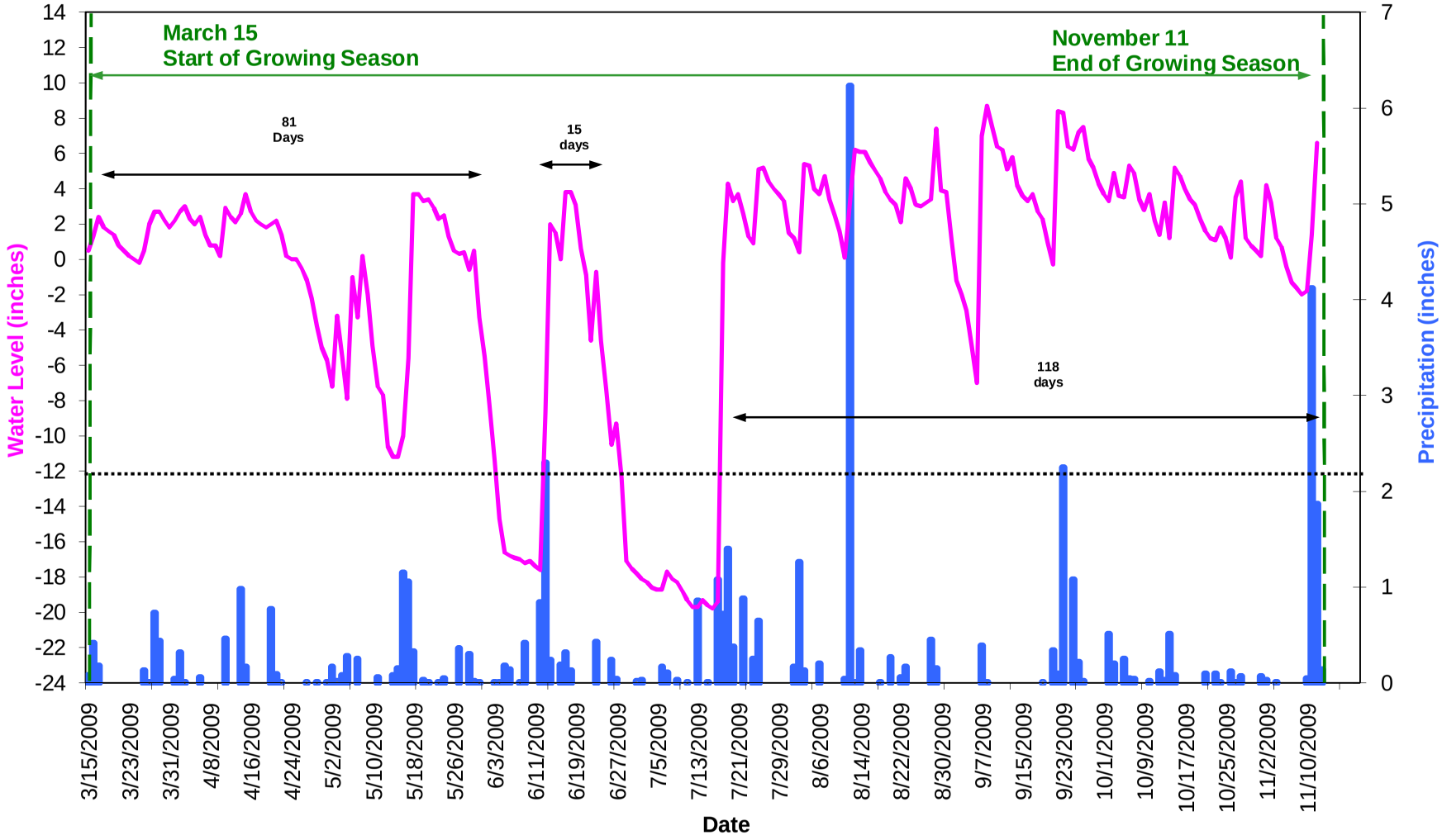
Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina: Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, North Carolina Department of Environment, Health, and Natural Resources. Raleigh, North Carolina.

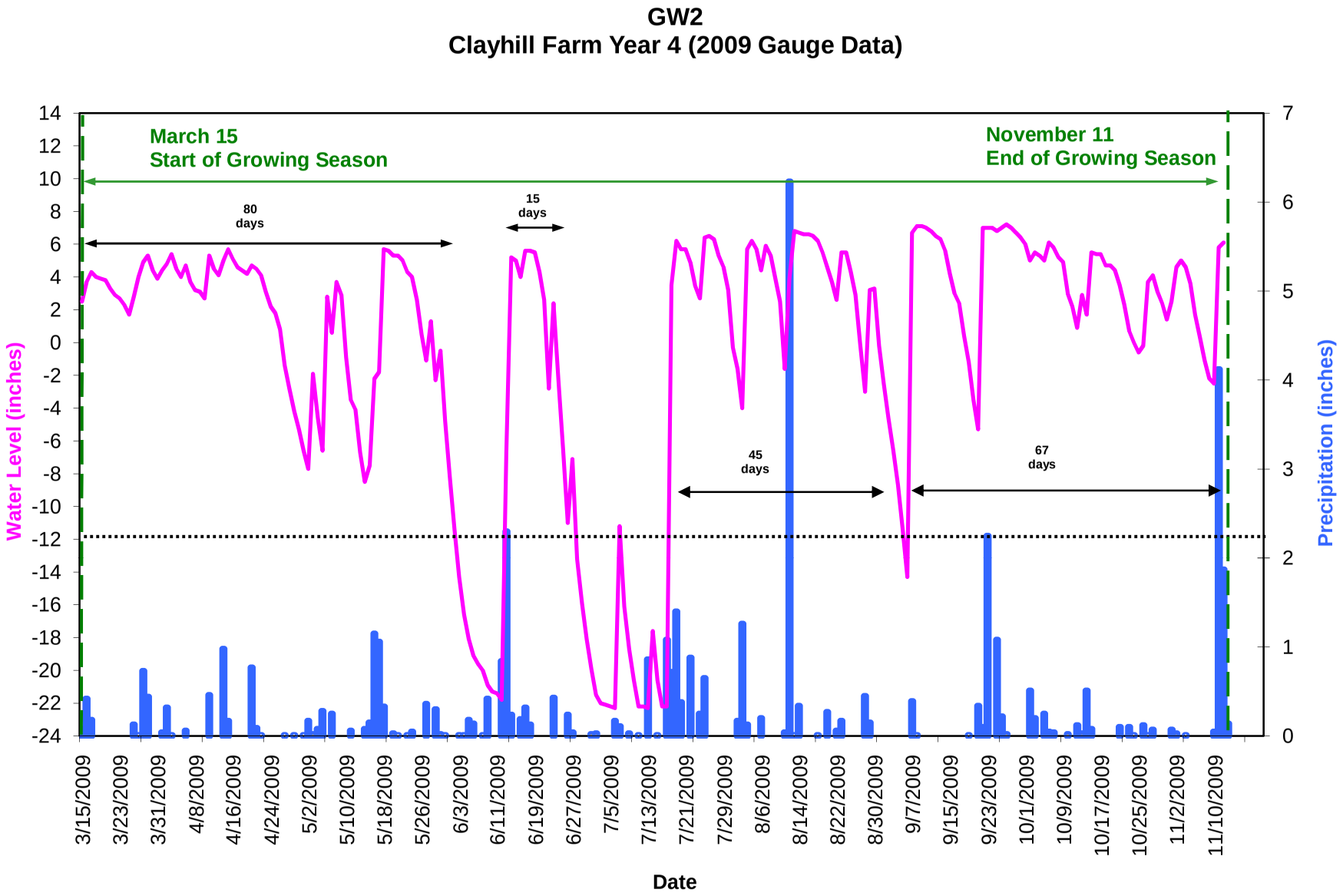
Weakley, Alan S. 2007. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas (online). Available: http://www.herbarium.unc.edu/WeakleysFlora.pdf [February 1, 2008]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

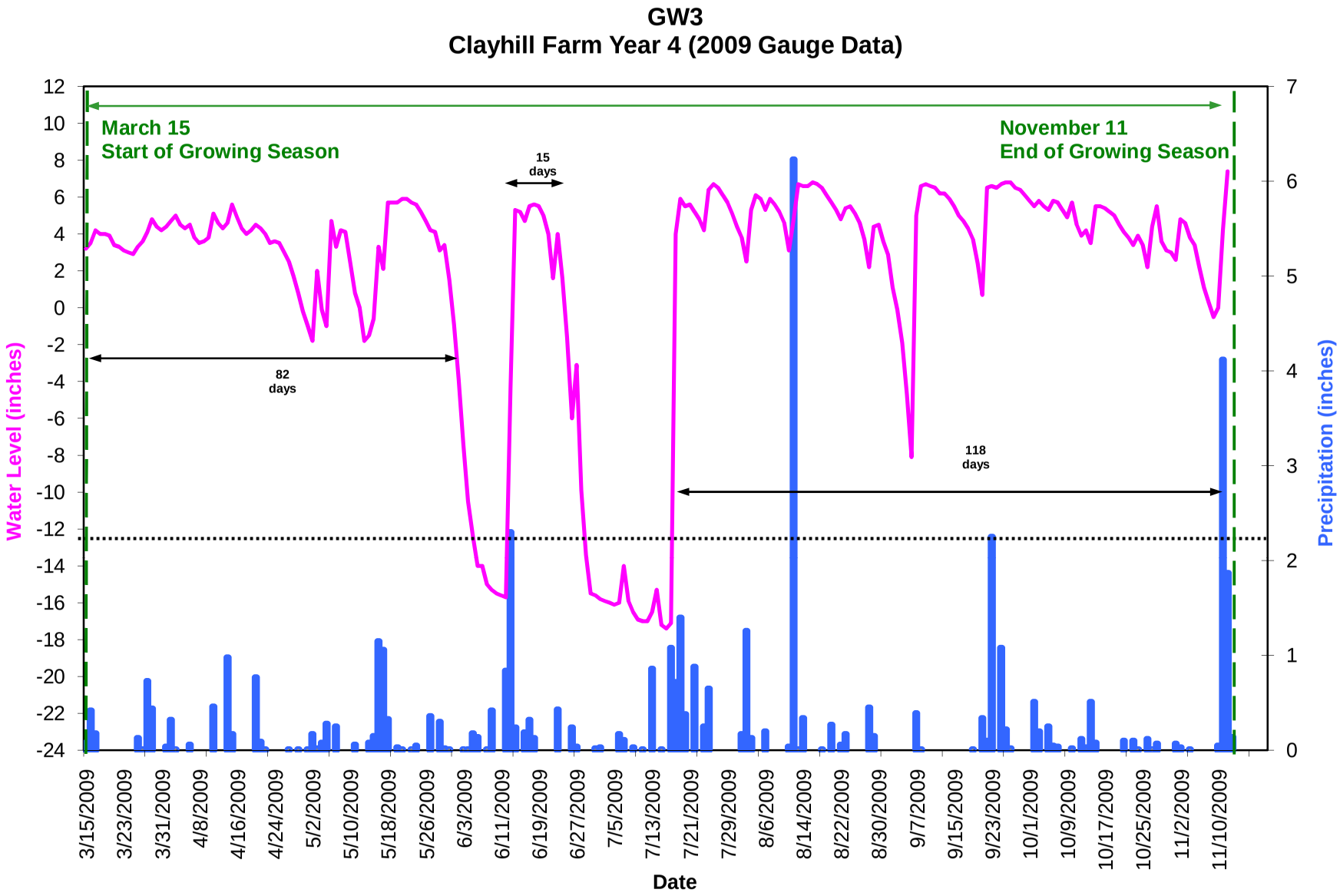
APPENDIX A

YEAR 4 (2009) GROUNDWATER/SURFACEWATER GAUGE GRAPHS

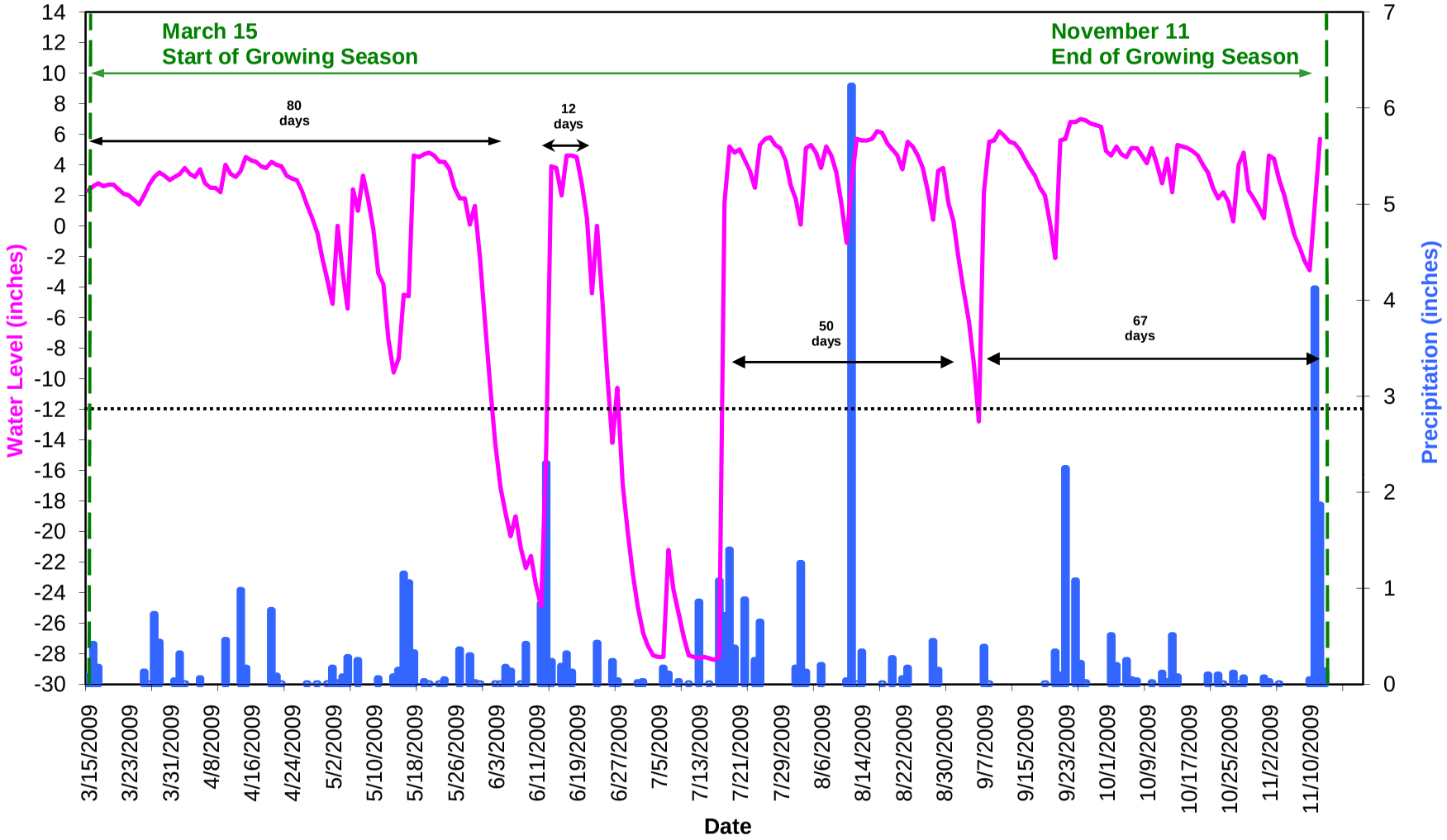
GW1
Clayhill Farm Year 4 (2009 Gauge Data)



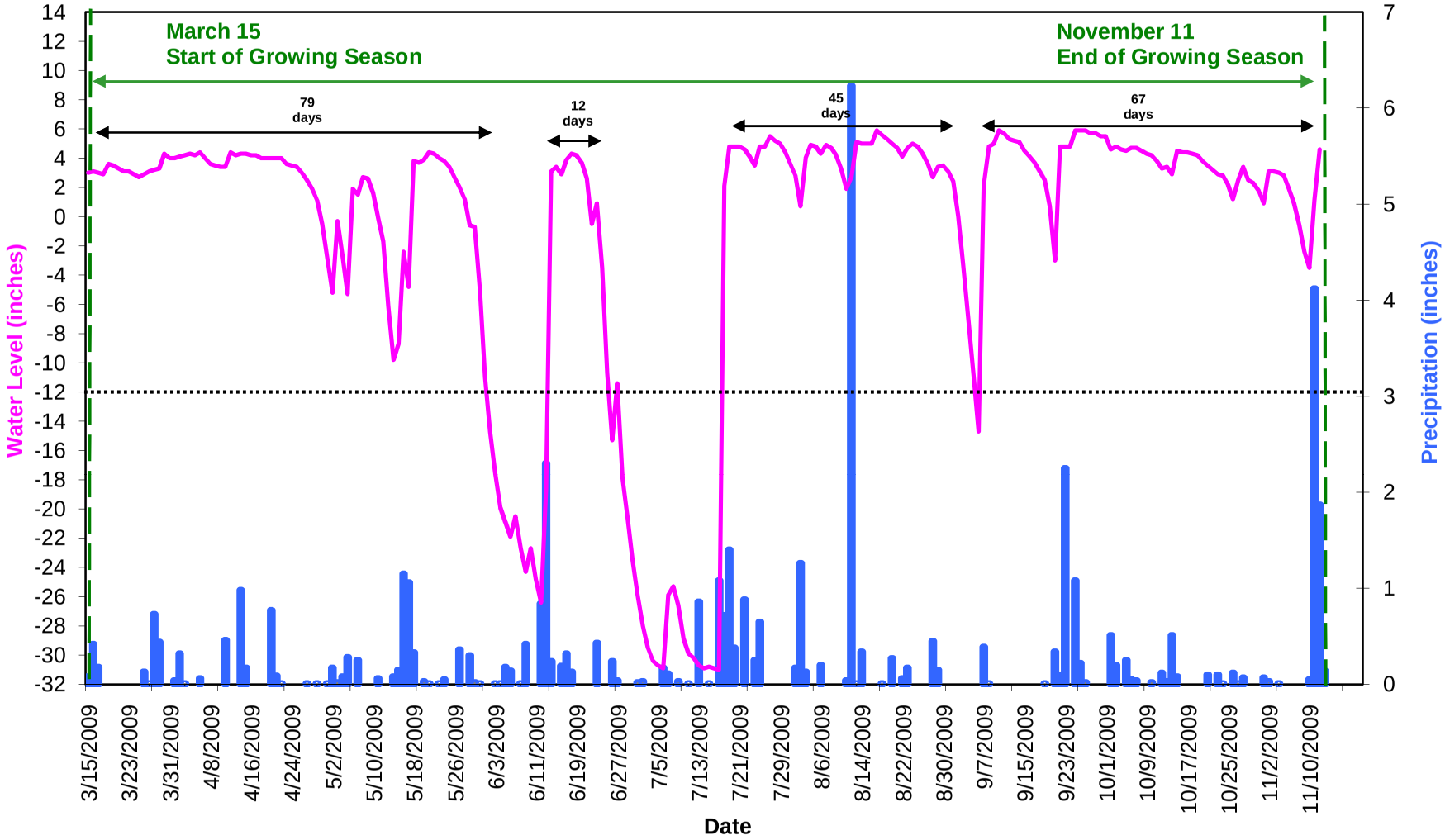

GW2
Clayhill Farm Year 4 (2009 Gauge Data)
March 15
Start of Growing Season
November 11
End of Growing Season
80
days
15
days
45
days
67
days
Water Level (inches)
Precipitation (inches)
Date
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
7
6
5
4
3
2
1
0
3/15/2009
3/23/2009
3/31/2009
4/8/2009
4/16/2009
4/24/2009
5/2/2009
5/10/2009
5/18/2009
5/26/2009
6/3/2009
6/11/2009
6/19/2009
6/27/2009
7/5/2009
7/13/2009
7/21/2009
7/29/2009
8/6/2009
8/14/2009
8/22/2009
8/30/2009
9/7/2009
9/15/2009
9/23/2009
10/1/2009
10/9/2009
10/17/2009
10/25/2009
11/2/2009
11/10/2009


GW3
Clayhill Farm Year 4 (2009 Gauge Data)
March 15
Start of Growing Season
November 11
End of Growing Season
15
days
82
days
118
days
Water Level (inches)
Precipitation (inches)
Date
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
7
6
5
4
3
2
1
0
3/15/2009
3/23/2009
3/31/2009
4/8/2009
4/16/2009
4/24/2009
5/2/2009
5/10/2009
5/18/2009
5/26/2009
6/3/2009
6/11/2009
6/19/2009
6/27/2009
7/5/2009
7/13/2009
7/21/2009
7/29/2009
8/6/2009
8/14/2009
8/22/2009
8/30/2009
9/7/2009
9/15/2009
9/23/2009
10/1/2009
10/9/2009
10/17/2009
10/25/2009
11/2/2009
11/10/2009

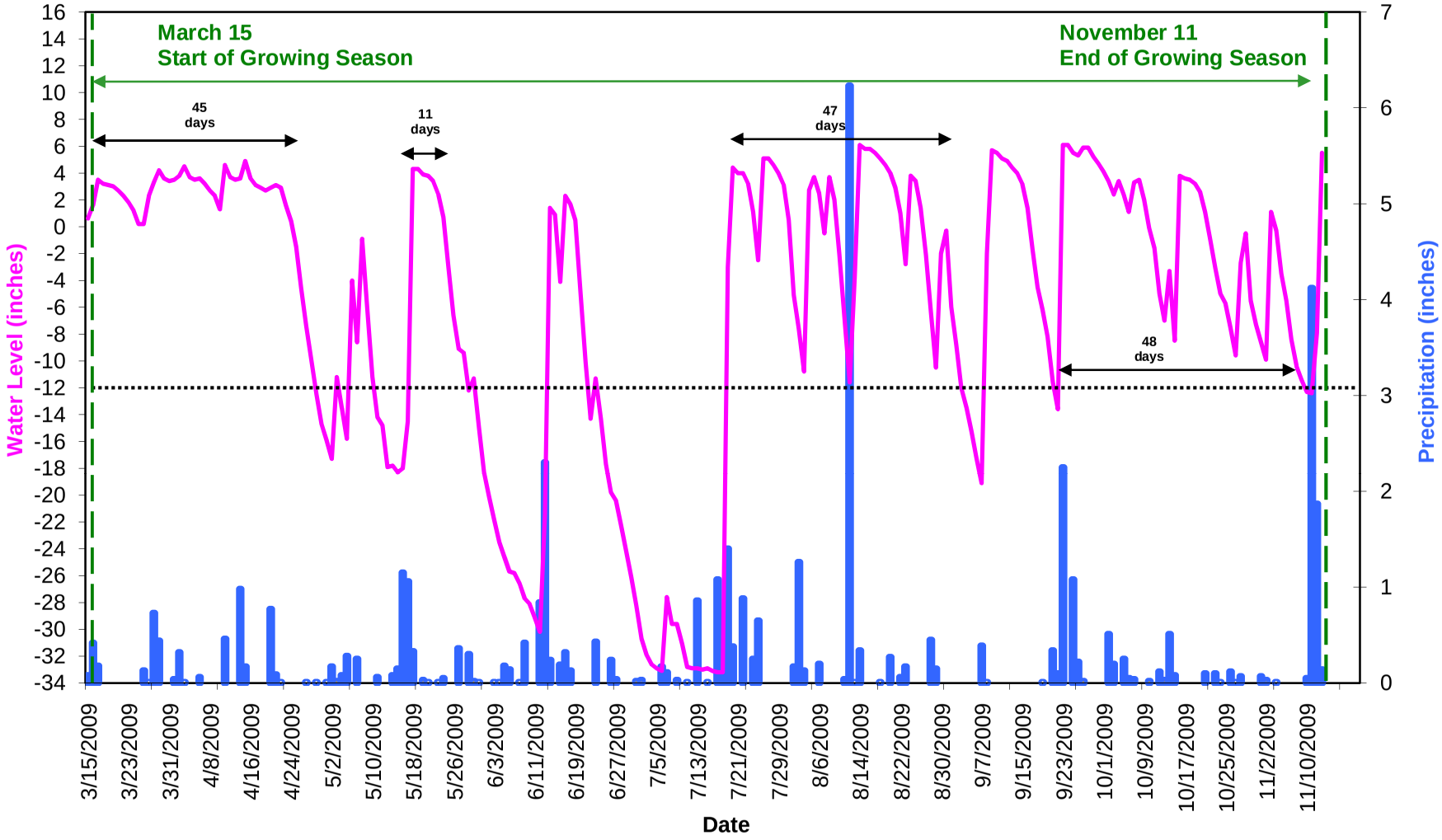
GW4
Clayhill Farm Year 4 (2009 Gauge Data)

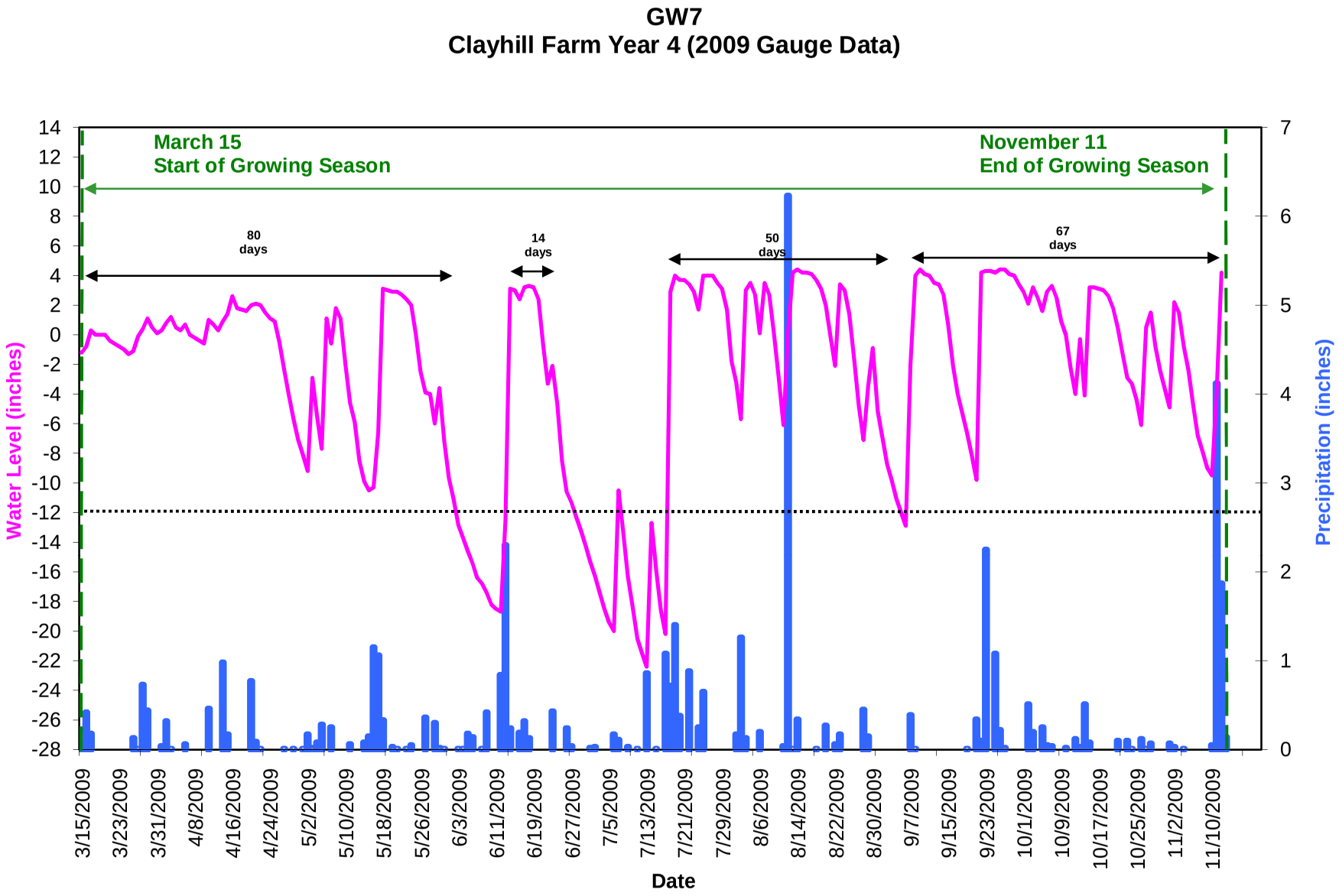


GW5
Clayhill Farm Year 4 (2009 Gauge Data)



GW6
Clayhill Farm Year 4 (2009 Gauge Data)




GW7
Clayhill Farm Year 4 (2009 Gauge Data)
March 15
Start of Growing Season
November 11
End of Growing Season
80 days
14 days
50 days
67 days
Water Level (inches)
Precipitation (inches)
Date
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
7
6
5
4
3
2
1
0
3/15/2009
3/23/2009
3/31/2009
4/8/2009
4/16/2009
4/24/2009
5/2/2009
5/10/2009
5/18/2009
5/26/2009
6/3/2009
6/11/2009
6/19/2009
6/27/2009
7/5/2009
7/13/2009
7/21/2009
7/29/2009
8/6/2009
8/14/2009
8/22/2009
8/30/2009
9/7/2009
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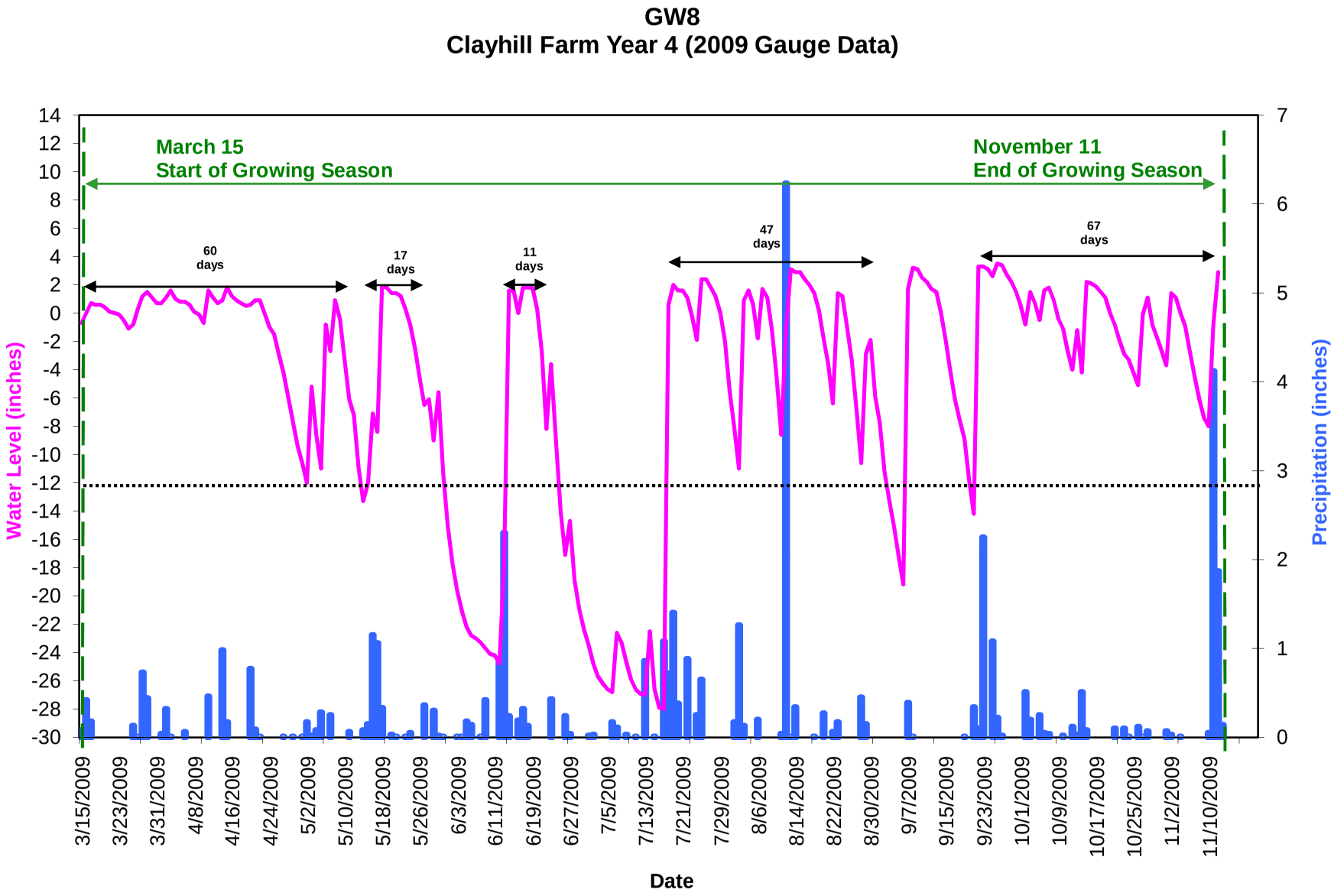
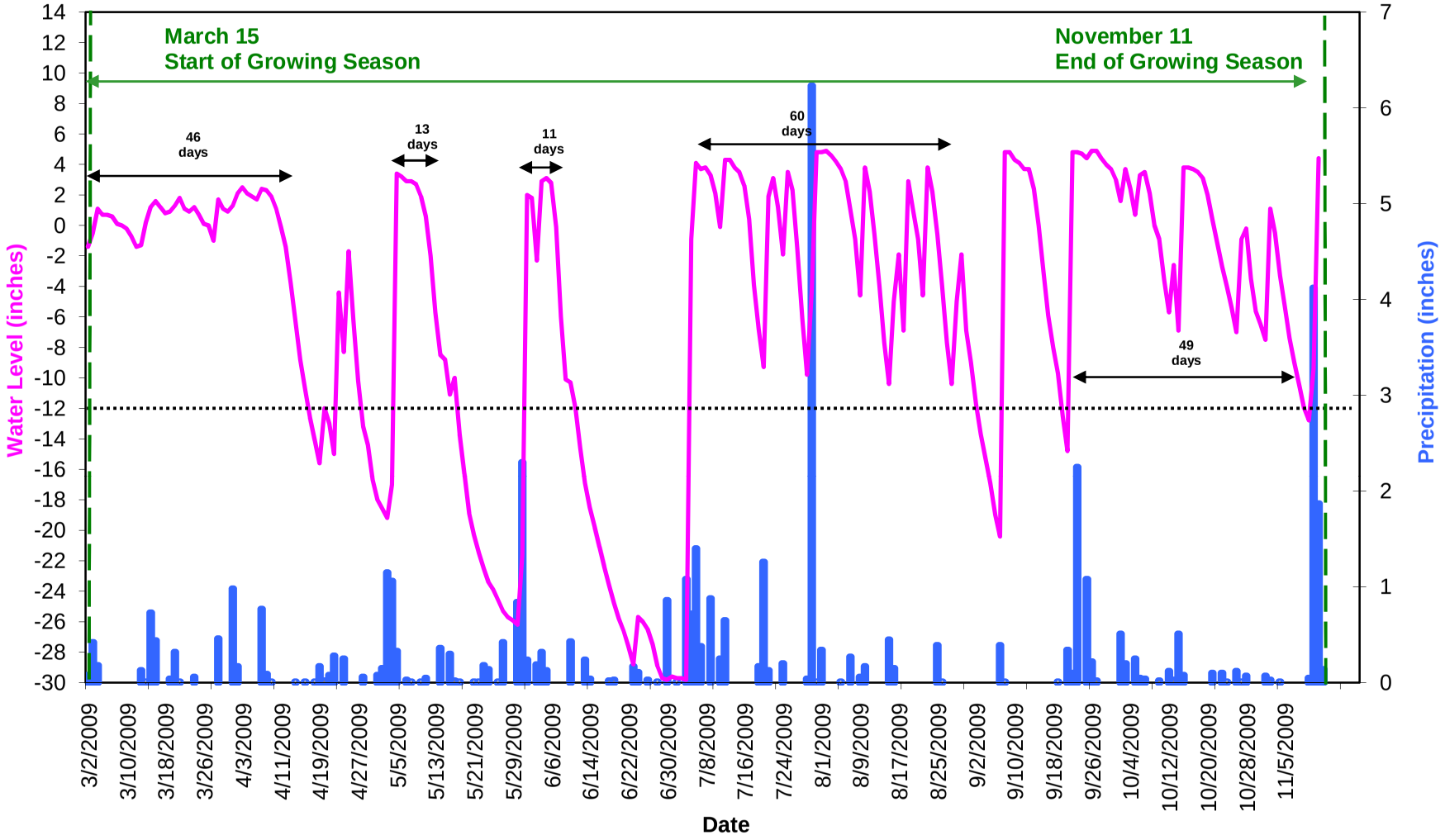
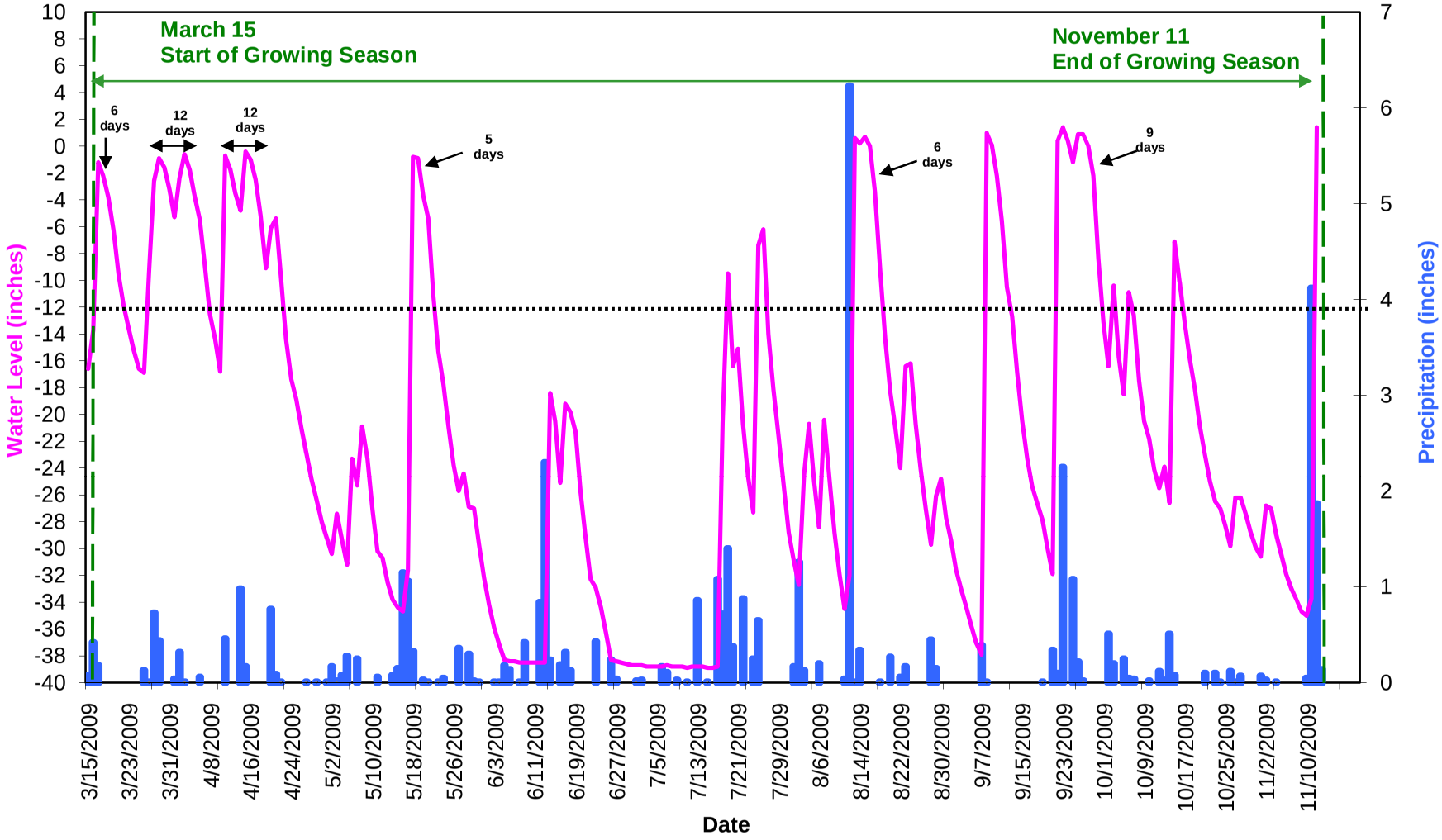
10/1/2009
10/9/2009
10/17/2009
10/25/2009
11/2/2009
11/10/2009


GW8
Clayhill Farm Year 4 (2009 Gauge Data)
March 15
Start of Growing Season
November 11
End of Growing Season
60 days
17 days
11 days
47 days
67 days
Water Level (inches)
Precipitation (inches)
Date
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
7
6
5
4
3
2
1
0
3/15/2009
3/23/2009
3/31/2009
4/8/2009
4/16/2009
4/24/2009
5/2/2009
5/10/2009
5/18/2009
5/26/2009
6/3/2009
6/11/2009
6/19/2009
6/27/2009
7/5/2009
7/13/2009
7/21/2009
7/29/2009
8/6/2009
8/14/2009
8/22/2009
8/30/2009
9/7/2009
9/15/2009
9/23/2009
10/1/2009
10/9/2009
10/17/2009
10/25/2009
11/2/2009
11/10/2009

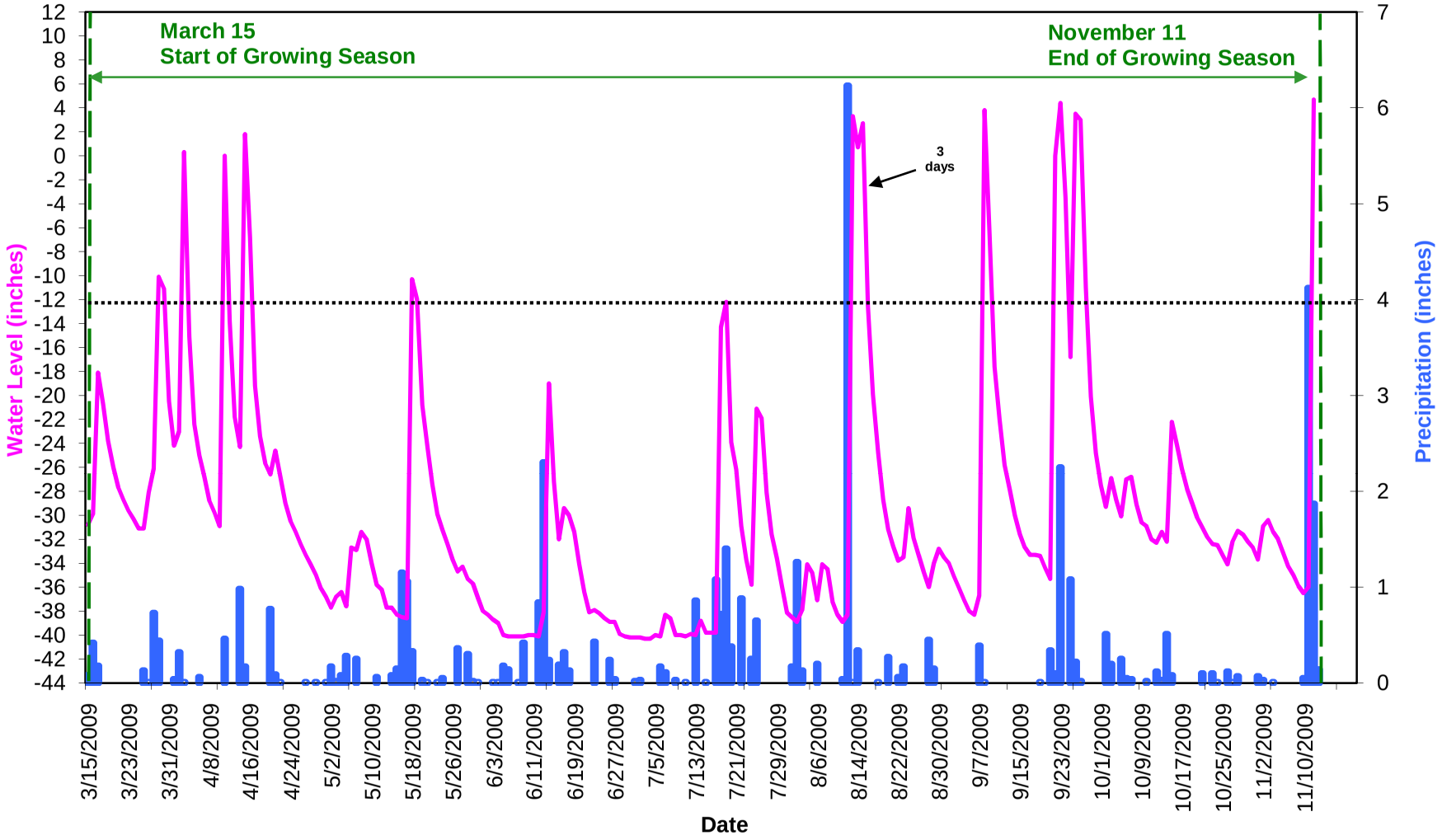
GW9
Clayhill Farm Year 4 (2009 Gauge Data)



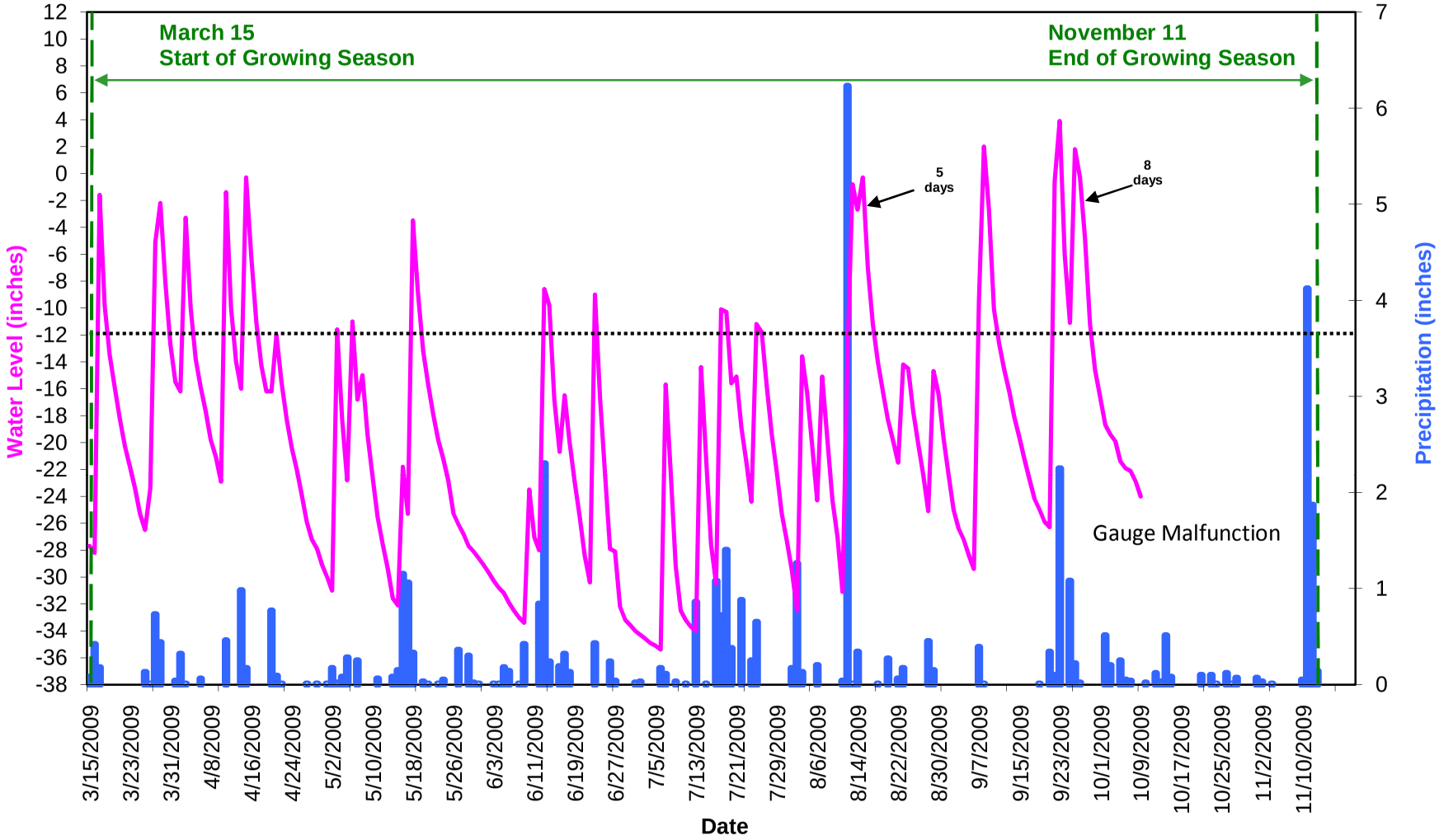
GW10
Clayhill Farm Year 4 (2009 Gauge Data)

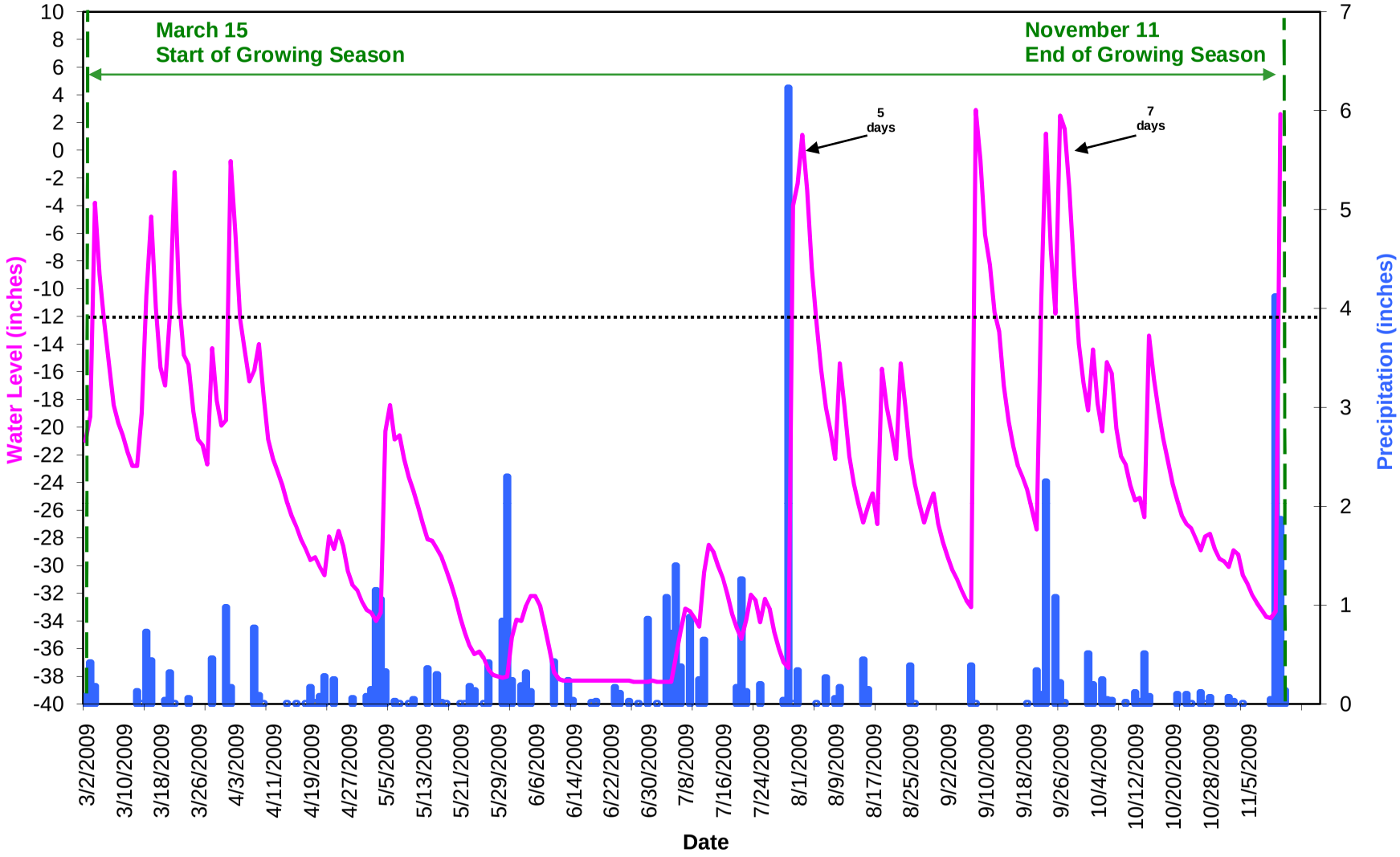


GW11
Clayhill Farm Year 4 (2009 Gauge Data)



GW12
Clayhill Farm Year 4 (2009 Gauge Data)




GW13
Clayhill Farm Year 4 (2009 Gauge Data)
March 15
Start of Growing Season
November 11
End of Growing Season
5
days
7
days
Water Level (inches)
Precipitation (inches)
Date
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
7
6
5
4
3
2
1
0
3/2/2009
3/10/2009
3/18/2009
3/26/2009
4/3/2009
4/11/2009
4/19/2009
4/27/2009
5/5/2009
5/13/2009
5/21/2009
5/29/2009
6/6/2009
6/14/2009
6/22/2009
6/30/2009
7/8/2009
7/16/2009
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8/17/2009
8/25/2009
9/2/2009
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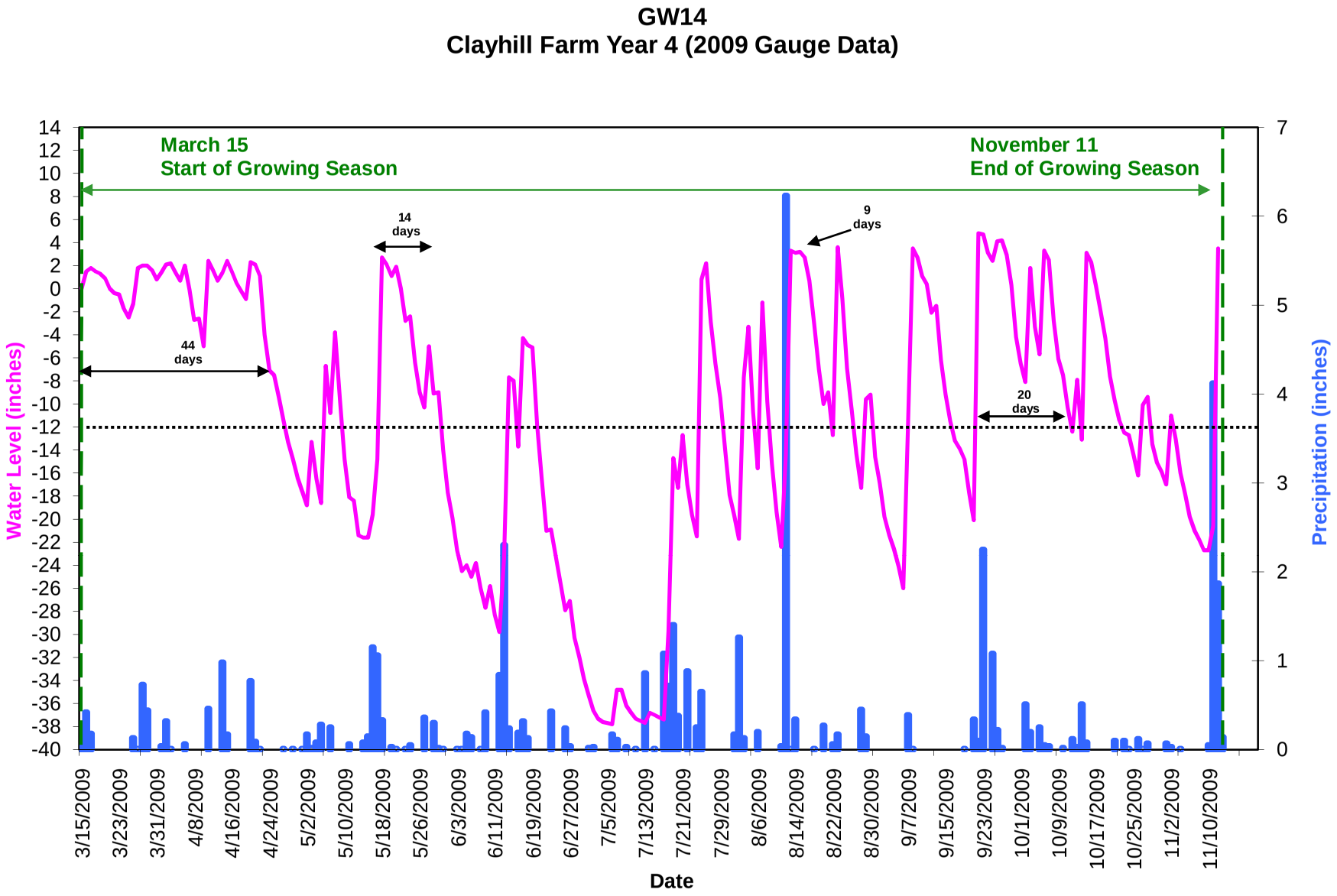
9/26/2009
10/4/2009
10/12/2009
10/20/2009
10/28/2009
11/5/2009


GW14
Clayhill Farm Year 4 (2009 Gauge Data)
March 15
Start of Growing Season
November 11
End of Growing Season
44 days
14 days
9 days
20 days
Water Level (inches)
Precipitation (inches)
Date
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
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1
0
3/15/2009
3/23/2009
3/31/2009
4/8/2009
4/16/2009
4/24/2009
5/2/2009
5/10/2009
5/18/2009
5/26/2009
6/3/2009
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6/19/2009
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8/14/2009
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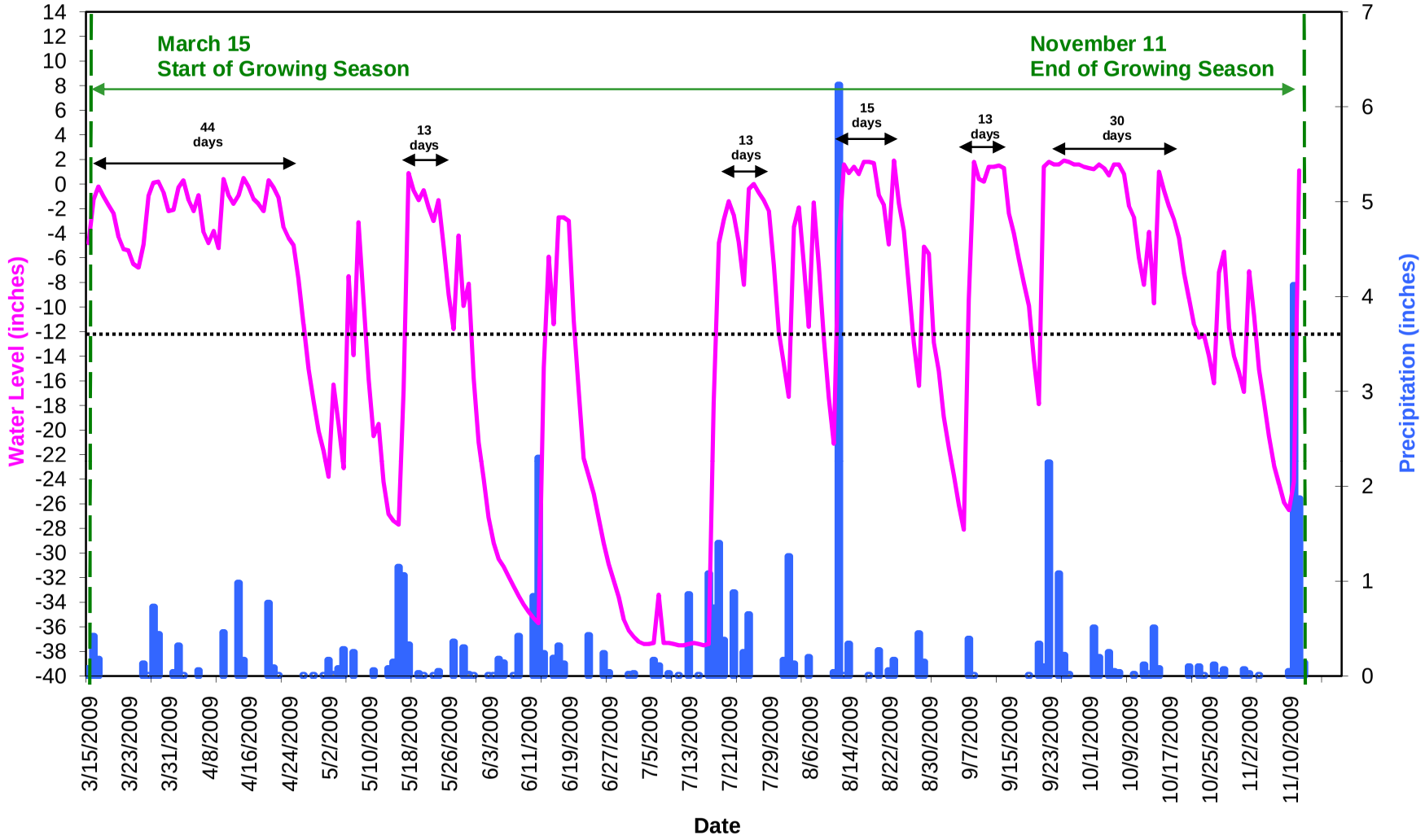
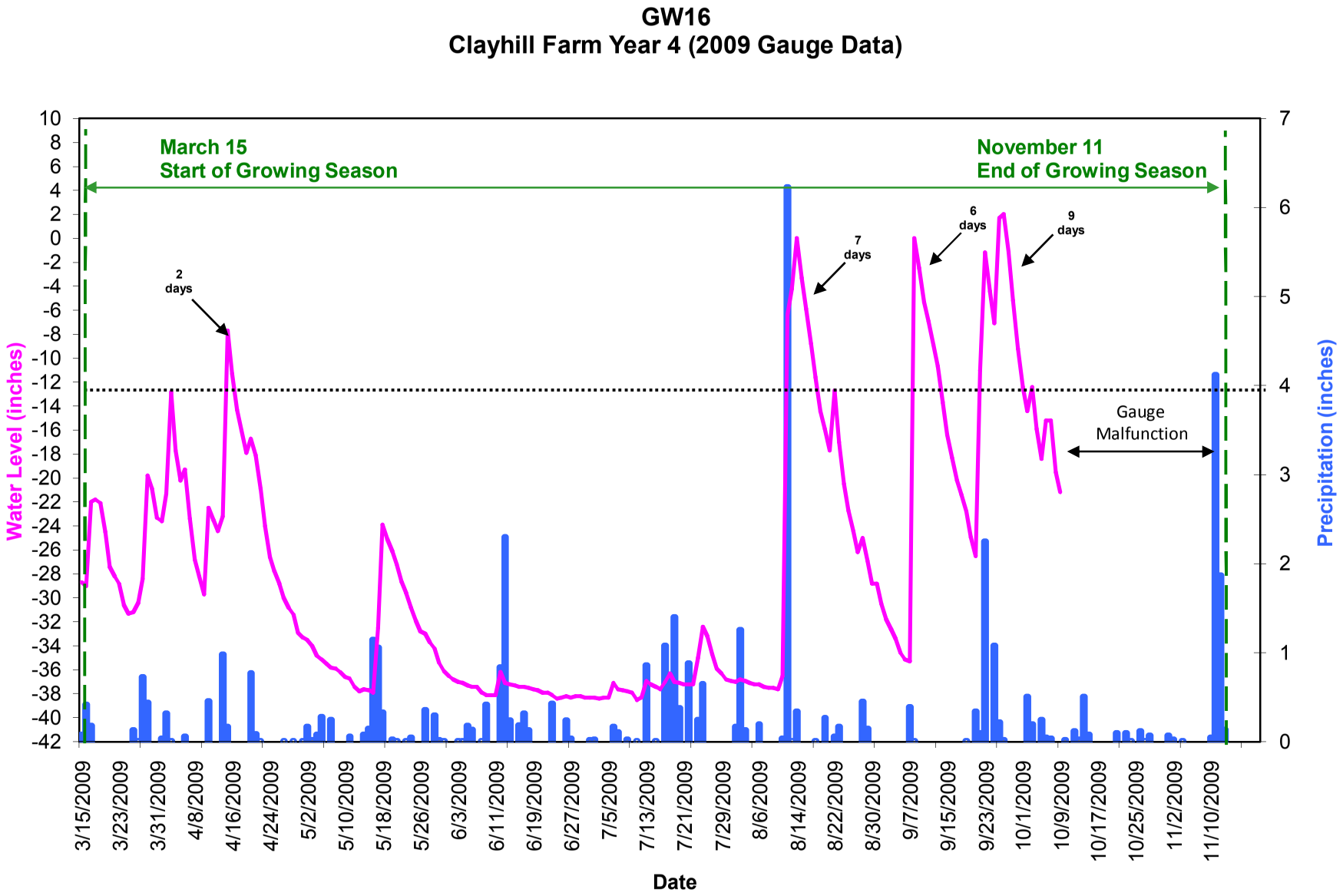
8/30/2009
9/7/2009
9/15/2009
9/23/2009
10/1/2009
10/9/2009
10/17/2009
10/25/2009
11/2/2009
11/10/2009

GW15
Clayhill Farm Year 4 (2009 Gauge Data)




GW16
Clayhill Farm Year 4 (2009 Gauge Data)
March 15
Start of Growing Season
November 11
End of Growing Season
2 days
7 days
6 days
9 days
Gauge Malfunction
Water Level (inches)
Precipitation (inches)
Date
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
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7
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5
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1
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5/10/2009
5/18/2009
5/26/2009
6/3/2009
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7/13/2009
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8/14/2009
8/22/2009
8/30/2009
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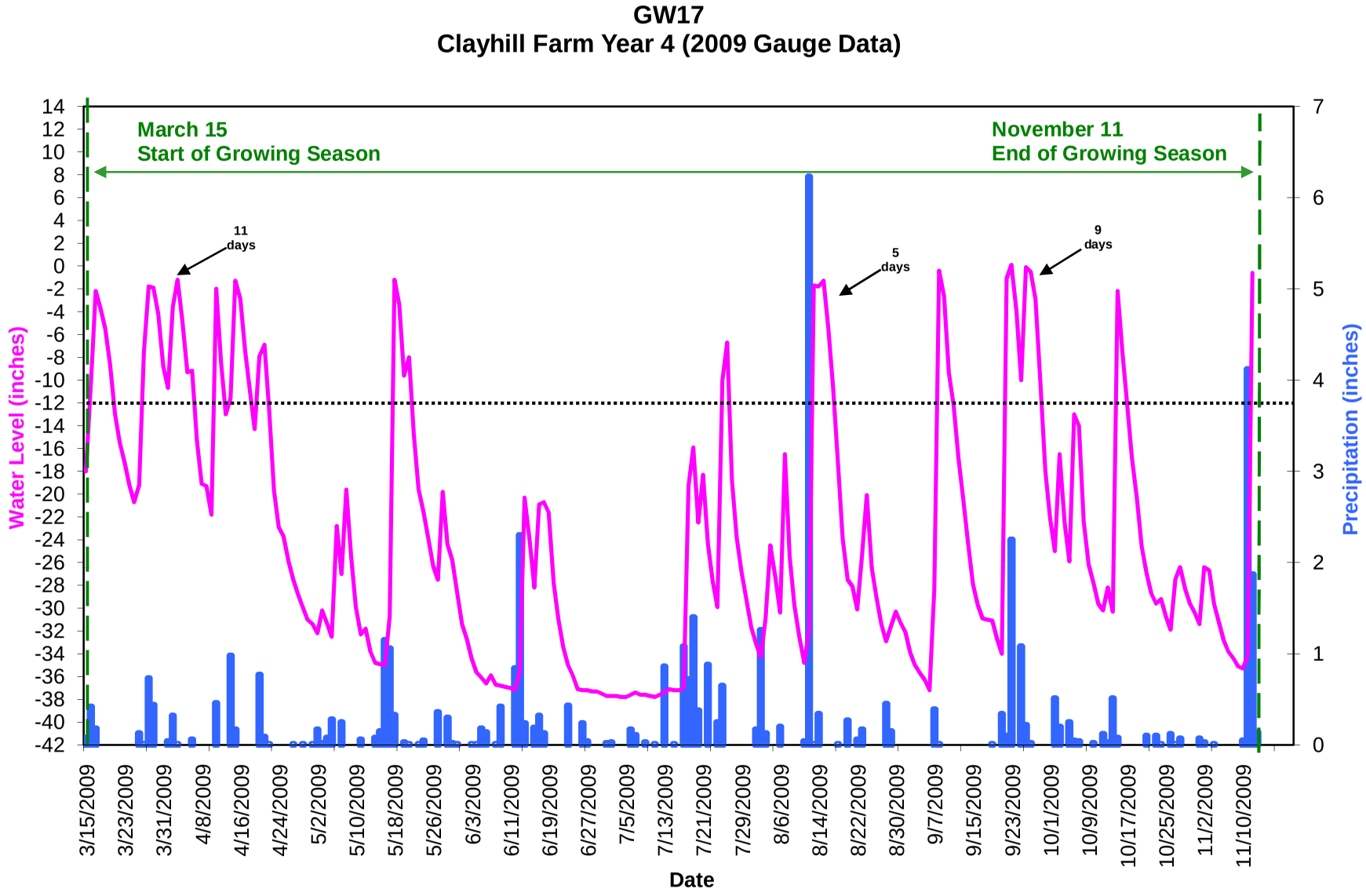
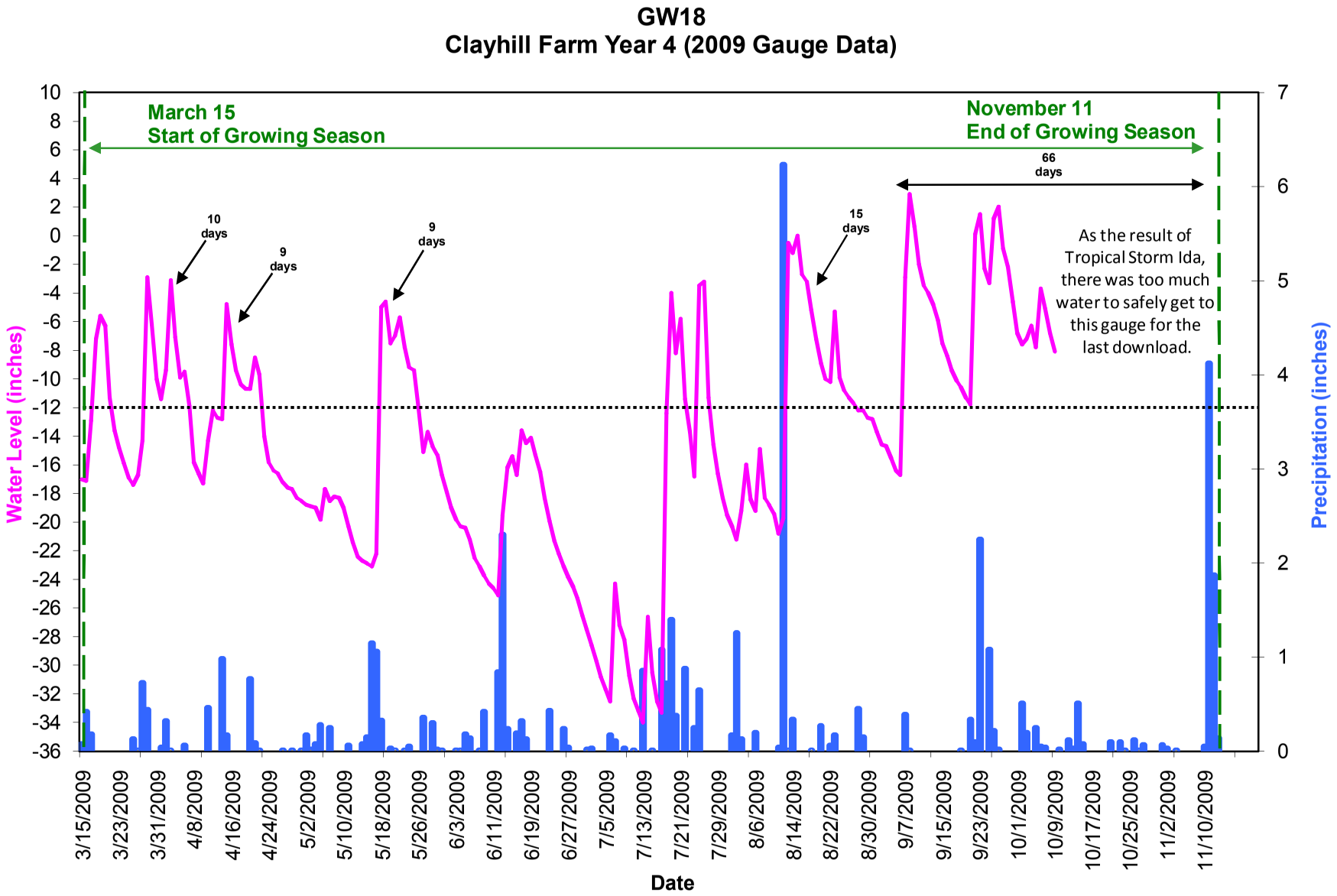
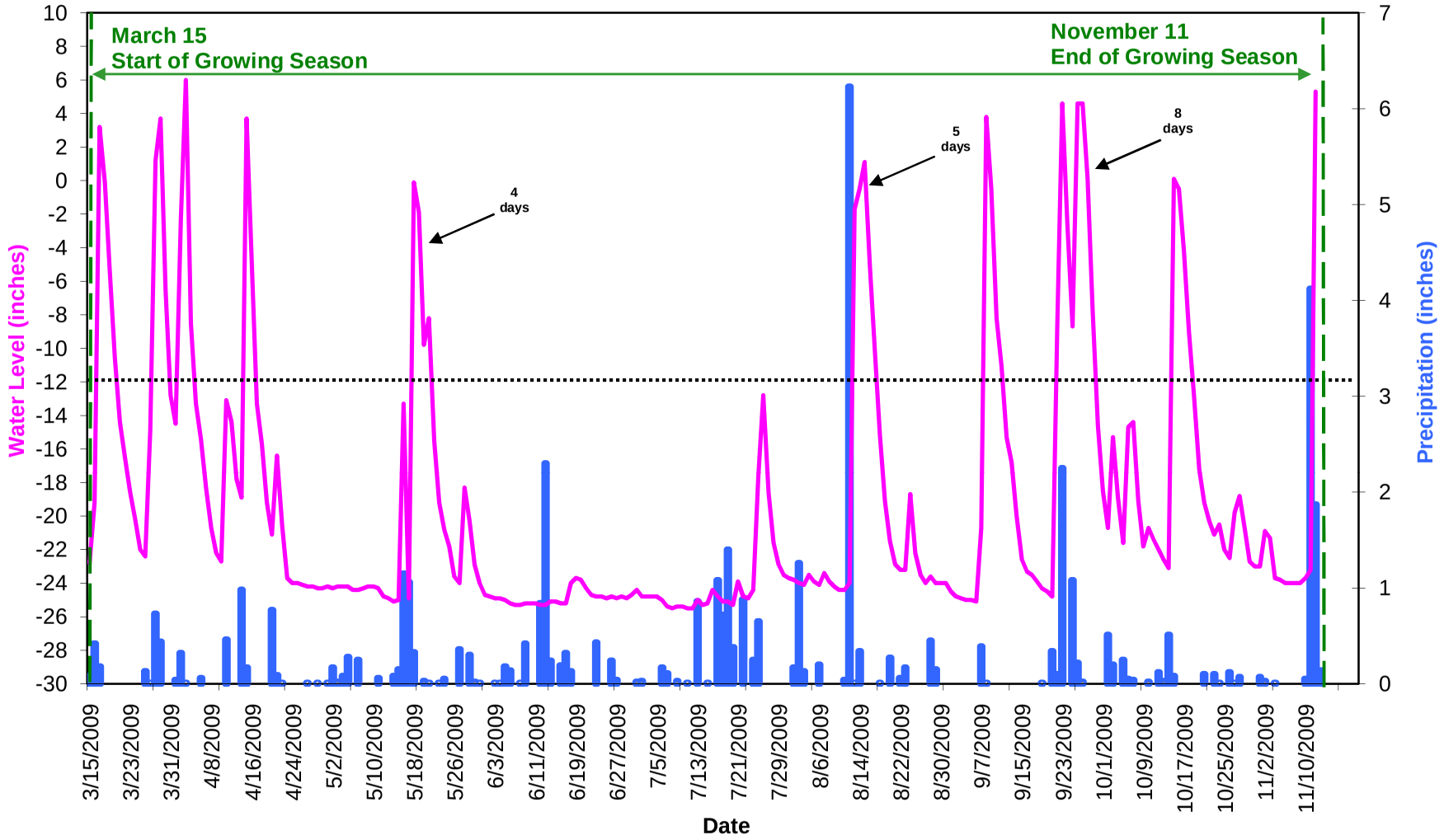
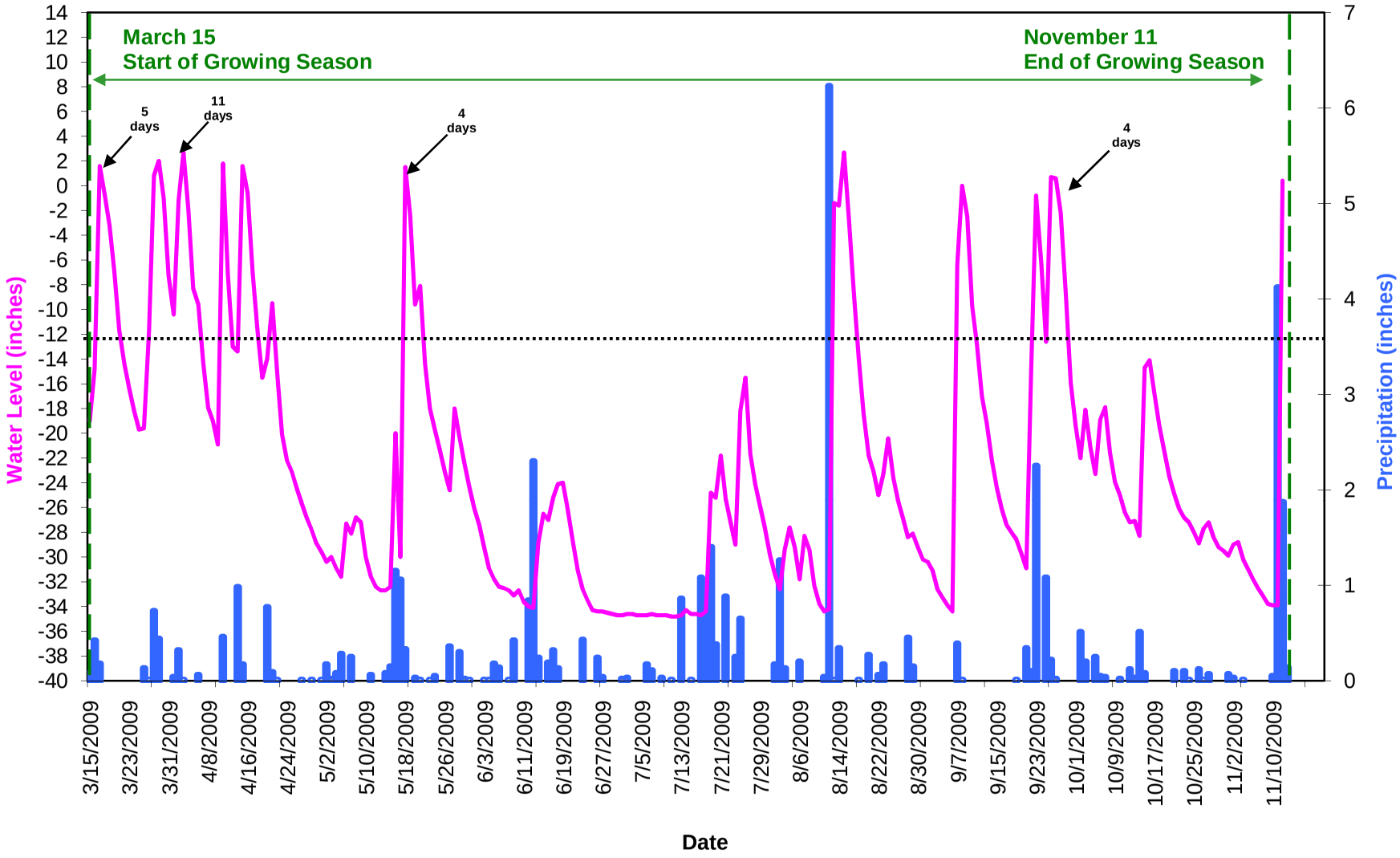
10/9/2009
10/17/2009
10/25/2009
11/2/2009
11/10/2009


GW17
Clayhill Farm Year 4 (2009 Gauge Data)
March 15
Start of Growing Season
November 11
End of Growing Season
11 days
5 days
9 days
Water Level (inches)
Precipitation (inches)
Date
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
-38
-40
-42
7
6
5
4
3
2
1
0
3/15/2009
3/23/2009
3/31/2009
4/8/2009
4/16/2009
4/24/2009
5/2/2009
5/10/2009
5/18/2009
5/26/2009
6/3/2009
6/11/2009
6/19/2009
6/27/2009
7/5/2009
7/13/2009
7/21/2009
7/29/2009
8/6/2009
8/14/2009
8/22/2009
8/30/2009
9/7/2009
9/15/2009
9/23/2009
10/1/2009
10/9/2009
10/17/2009
10/25/2009
11/2/2009
11/10/2009


GW18
Clayhill Farm Year 4 (2009 Gauge Data)
March 15
Start of Growing Season
November 11
End of Growing Season
10 days
9 days
9 days
15 days
66 days
As the result of Tropical Storm Ida, there was too much water to safely get to this gauge for the last download.
Water Level (inches)
Precipitation (inches)
Date
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
7
6
5
4
3
2
1
0
3/15/2009
3/23/2009
3/31/2009
4/8/2009
4/16/2009
4/24/2009
5/2/2009
5/10/2009
5/18/2009
5/26/2009
6/3/2009
6/11/2009
6/19/2009
6/27/2009
7/5/2009
7/13/2009
7/21/2009
7/29/2009
8/6/2009
8/14/2009
8/22/2009
8/30/2009
9/7/2009
9/15/2009
9/23/2009
10/1/2009
10/9/2009
10/17/2009
10/25/2009
11/2/2009
11/10/2009

GW19
Clayhill Farm Year 4 (2009 Gauge Data)




GW20
Clayhill Farm Year 4 (2009 Gauge Data)
March 15
Start of Growing Season
November 11
End of Growing Season
5 days
11 days
4 days
4 days
Water Level (inches)
Precipitation (inches)
Date
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
-38
-40
7
6
5
4
3
2
1
0
3/15/2009
3/23/2009
3/31/2009
4/8/2009
4/16/2009
4/24/2009
5/2/2009
5/10/2009
5/18/2009
5/26/2009
6/3/2009
6/11/2009
6/19/2009
6/27/2009
7/5/2009
7/13/2009
7/21/2009
7/29/2009
8/6/2009
8/14/2009
8/22/2009
8/30/2009
9/7/2009
9/15/2009
9/23/2009
10/1/2009
10/9/2009
10/17/2009
10/25/2009
11/2/2009
11/10/2009

APPENDIX B

VEGETATION MONITORING PHOTOGRAPHS

Clayhill Farms

Vegetation Monitoring Plot Photographs

Year 4 (2009) Annual Monitoring

Pictures Taken August 2009

Clayhill Farms

Vegetation Monitoring Plot Photographs

Year 4 (2009) Annual Monitoring

Pictures Taken August 2009

(continued)

Clayhill Farms

Vegetation Problem Area Photographs

Year 4 (2009) Annual Monitoring

Pictures Taken July 2009

Problem Area Photo 1

Problem Area Photo 2

Problem Area Photo 3

Problem Area Photo 4

APPENDIX C

STREAM MONITORING PHOTOGRAPHS

Clayhill Farms

Stream Monitoring Fixed-Photo and Problem Area Photographs

Year 4 (2009) Annual Monitoring

Pictures Taken July 2009

Stream Photo 1

Stream Photo 2

Stream Photo 3

Stream Photo 4

Stream Photo 5

Clayhill Farms

Stream Monitoring Fixed-Photo and Problem Area Photographs

Year 4 (2009) Annual Monitoring

Pictures Taken July 2009

(continued)

Stream Photo 6

Stream Photo 7

Stream Photo 8

Stream Photo 9 and Stream Problem Area (moderately stressed cross-vane)

Stream Photo 10

Clayhill Farms

Stream Monitoring Fixed-Photo and Problem Area Photographs

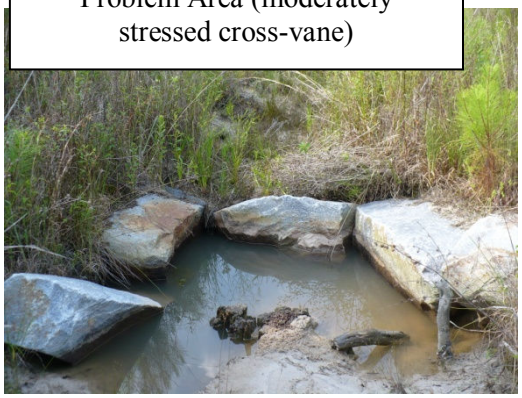
Year 4 (2009) Annual Monitoring

Pictures Taken July 2009

(continued)

Stream Photo 11

Stream Photo 12 and Stream Problem Area (moderately stressed cross-vane)



Stream Photo 13

Stream Photo 14

Stream Photo 15

Clayhill Farms

Stream Monitoring Fixed-Photo and Problem Area Photographs

Year 4 (2009) Annual Monitoring

Pictures Taken July 2009

(continued)