

**Brown Farm Wetland Restoration
Monitoring Report – MY05
Orange and Durham Counties, NC
Basin 03030002 – Contract # D050011-2**



Submitted to:



NCEEP, 1652 Mail Service Center, Raleigh, NC 27699-1652

Construction Completed: November 2006

Data Collection: 2011

Submitted: December 2011

Monitoring and Design Firm



**Landmark Center II, Suite 220
4601 Six Forks Road
Raleigh, NC 27609
Phone: (919) 278-2509
Fax: (919) 783-9266**

**Project Contact: Adam Spiller
Email: adam.spiller@kci.com
KCI Project No: 12054252**

TABLE OF CONTENTS

1.0	PROJECT BACKGROUND	1
1.1	Project Objectives	1
1.2	Project Structure, Restoration Type, and Approach	1
1.3	Location and Setting	1
1.4	Project History and Background.....	1
2.0	PROJECT CONDITIONS AND MONITORING RESULTS.....	6
2.1	Vegetation Assessment	6
2.2	Wetland Criteria Attainment Tables	6

LIST OF TABLES

Table 1.	Project Restoration Components.....	1
Table 2.	Project Activity and Reporting History	3
Table 3.	Project Contact Table.....	3
Table 4.	Project Background Table.....	3
Table 5.	Hydrologic Monitoring Results	6
Table 6.	Hydroperiod History	6

LIST OF FIGURES

Figure 1.	Vicinity Map.....	2
Figure 2.	Site Map.....	4
Figure 3.	Monitoring Plan View.....	5

APPENDIX A – VEGETATION DATA

APPENDIX B – HYDROLOGIC MONITORING AND HYDROPERIOD

APPENDIX C – PHOTO LOG

EXECUTIVE SUMMARY

The Brown Farm Wetland Restoration Project restored 24.6 acres and enhanced 3.3 acres of riparian wetland. New Hope Creek, which runs adjacent to the site, has a contributing drainage area of 33.3 square miles (21,331 acres) at the downstream limits of the site and is located within USGS 8-digit HUC 03030002 and NCDWQ Sub-basin 03-06-05 of the Cape Fear River Basin. The 46.1-acre project site is located on an active floodplain of New Hope Creek along the Orange-Durham County line. The restoration was completed to achieve the following objectives:

- Restore aquatic/terrestrial habitat
- Improve water quality
- Increase groundwater recharge
- Enhance nutrient cycling
- Restore a native bottomland hardwood community

Project construction occurred in November 2006. Construction involved plugging and filling ditches, installing level spreaders, and creating microtopography. The site was planted with native trees and shrubs common to Piedmont Bottomland Hardwood communities. Following construction and planting, baseline data collection occurred in February 2007. This report describes the fifth year of monitoring that took place in 2011.

Vegetation was planted at densities of approximately 436 and 100-200 stems per acre in the restored and enhanced wetlands, respectively. Twenty vegetation plots are monitored to assess planted vegetation survivability, growth, and vigor. The fifth year of monitoring counted an average of 310 planted stems/acre, with the site averaging 2,284 total stems/acre, which includes woody volunteers in the monitoring plots excluding red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*). Supplemental planting with large stock bare root trees was conducted at the site in the winter of 2009/2010. An assessment of the site's vegetation found Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), and multiflora rose (*Rosa multiflora*) on the outskirts of the site with sparsely scattered Chinese lespedeza (*Lespedeza cuneata*) and thistle (*Cirsium* sp.) observed in the site. Fifth-year monitoring found the vegetation component of the project to be on track to meeting the success criteria.

The hydrology success criterion states that groundwater must be within 12 inches of the soil surface in excess of 12 consecutive days (5% of the growing season) at each well. During 2011, wetland hydrology was achieved at all seven wells in the restoration area, with all having hydroperiods longer than 12.5% of the growing season.

The daily rainfall data depicted on the gauge data graphs were obtained from the on-site precipitation gauge. The precipitation gauge was installed in 2006 prior to project implementation. Daily rainfall data were obtained from the State Climate Office of North Carolina for Durham, North Carolina to confirm on-site precipitation data. The combined precipitation data show that the site experienced normal precipitation during the 2011 growing season.

Site photographs were taken from permanent photo points established throughout the site. Photo documentation facilitates the qualitative evaluation of wetland conditions. The photo point locations were selected in order to document representative site conditions.

The results of the fifth year of monitoring of the Brown Farm Wetland Restoration Project indicate that the site has met the project's success criteria.

1.0 PROJECT BACKGROUND

1.1 Project Objectives

- Restore aquatic/terrestrial wildlife habitat
- Improve water quality
- Increase groundwater recharge
- Enhance nutrient cycling
- Restore a native bottomland hardwood community

1.2 Project Structure, Restoration Type, and Approach

Before restoration, the land use was primarily agricultural for at least the past 50 years. The wetland was restored by plugging and filling drainage ditches throughout the site, removing ditch spoil from wooded areas to restore natural drainage patterns, placing water diversion features to redistribute the surface hydrology, recreating microtopography across the site to enhance surface water retention and storage, and planting the site with Piedmont Bottomland Hardwood Forest species.

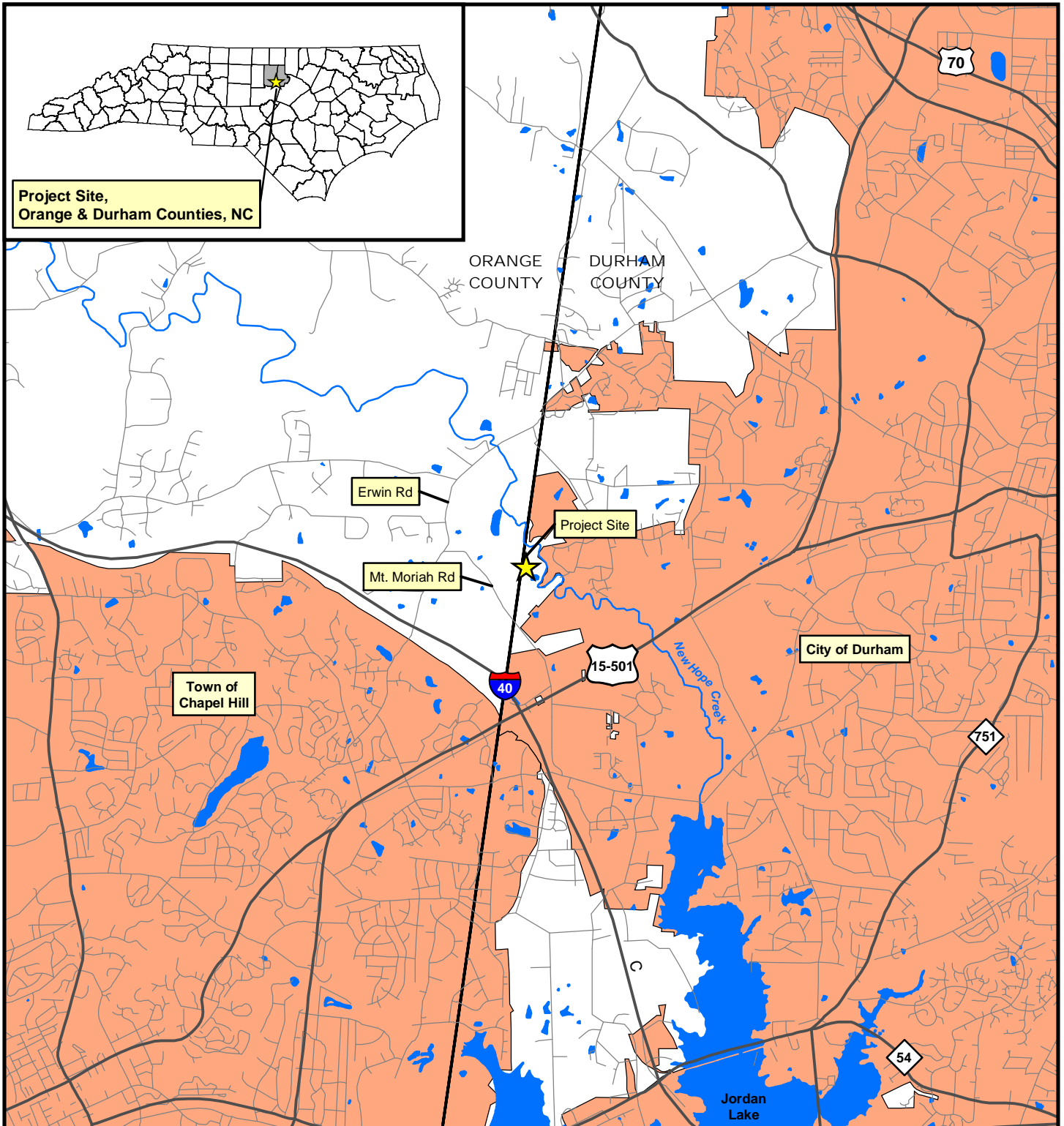
1.3 Location and Setting

The Brown Farm Wetland Restoration Site is located within the 03030002 (Upper Cape Fear 02) Watershed Cataloging Unit (8-digit HUC) and North Carolina Division of Water Quality (NCDWQ) Sub-basin 03-06-05 (Figure 1). New Hope Creek, which runs adjacent to the site, has a contributing drainage area of 33.3 square miles (21,331 acres) at the downstream limits of the project. Jordan Lake is approximately 11 miles downstream of the site. The project watershed is located within the Piedmont physiographic province and is part of the Triassic Basins Level IV Ecoregion.

1.4 Project History and Background

Table 1. Project Restoration Components						
Project Name: Brown Farm Wetland Restoration						
Segment / Reach ID	Existing Feet/A cres	Type	Approach	Acreage	Mitigation Ratio	Mitigation Units
Brown Farm	24.6	R	-	24.6	1.0	24.6
Brown Farm	3.3	E	-	3.3	0.5	1.7
Mitigation Unit Summations						
Stream (lf)	Riparian Wetland (Ac)	Nonriparian Wetland (Ac)	Total Wetland (Ac)	Buffer (Ac)	Comment	
	26.3					

R = Restoration E = Enhancement



Project Site,
Orange & Durham Counties, NC

ORANGE COUNTY DURHAM COUNTY

Erwin Rd

Mt. Moriah Rd








Project Site

Town of Chapel Hill

City of Durham

Jordan Lake

Figure 1. Vicinity Map

-  Project Location
-  Major Streams and Rivers
-  Lakes and Reservoirs
-  Municipalities
-  Counties
-  Major Roads
-  Other Roads



1:63,360
1 inch equals 1 miles

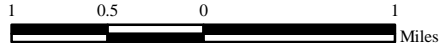


Table 2. Project Activity and Reporting History		
Project Name: Brown Farm Wetland Restoration		
Activity or Report	Data Collection Complete	Actual Completion or Delivery
Restoration Plan	May 06	Jun 06
Construction	N/A	Nov 06
Mitigation Plan	Feb 07	Mar 07
Year 1 Monitoring	Sep 07	Nov 07
Herbicide Sprayed for Invasive Species Control	N/A	Jun 08
Year 2 Monitoring	Sep 08	Dec 08
Year 3 Monitoring	Nov 09	Dec 09
Supplemental Planting	Feb 10	Feb 10
Year 4 Monitoring	Oct 10	Dec 10
Year 5 Monitoring	Aug 11	Dec 11

Table 3. Project Contact Table	
Project Name: Brown Farm Wetland Restoration	
Design, Monitoring, and Maintenance Firm	KCI Associates of NC Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266
Construction Contractor	KCI Environmental Technologies and Construction, Inc. Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Phone: (919) 783-9214 Fax: (919) 783-9266
Nursery	Cill Ide Native Plant Nursery 621 Starburst Lane Raleigh, North Carolina 27603 Contact: Mr. George T. Swearingen Phone: (919) 302-6900 Fax: (509) 351-5324

Table 4. Project Background Table	
Project Name: Brown Farm Wetland Restoration	
Project County	Durham and Orange Counties
Project Area	46.1 Acres
Drainage impervious cover	17%
Physiographic Region	Piedmont
Ecoregion	Triassic Basin
Dominant soil types	Wehadkee
USGS HUC for project and reference	03030002
NCDWQ Sub-basin for project and reference	03-06-05
% of project easement fenced	65%

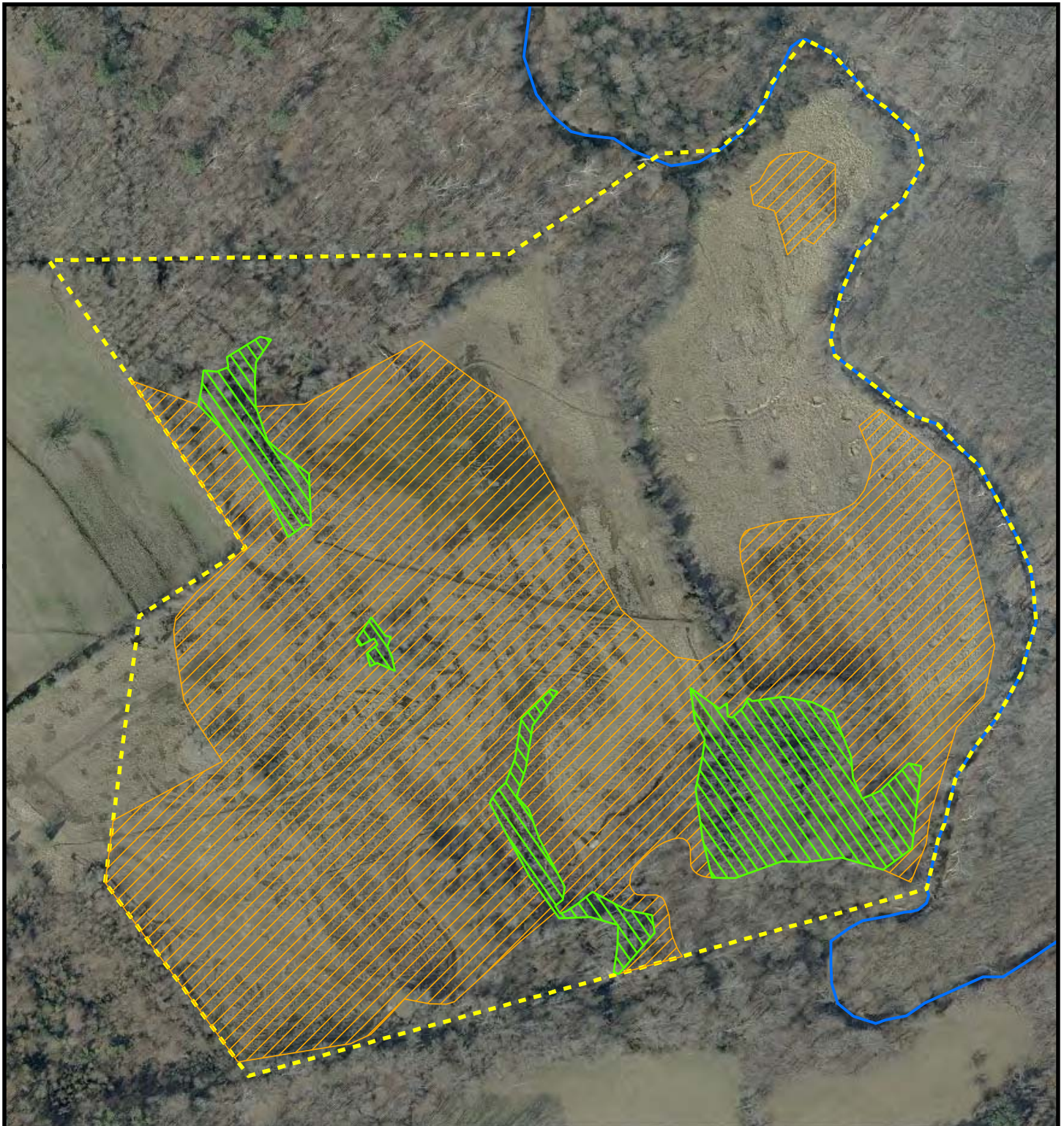




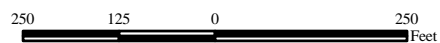


Figure 2. Site Map

-  Wetland Enhancement (3.3 acres)
-  Wetland Restoration (24.6 acres)
-  Project Site Boundary
-  New Hope Creek



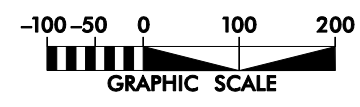
1:3,000
1 inch = 250 feet



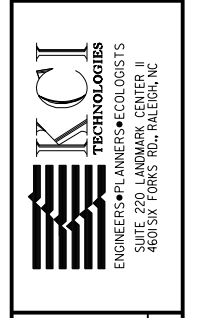
*Image Source: Orange County
Orthoimagery, 2008*



SITE PLAN LEGEND			
	EXISTING EASEMENT LINE		GROUNDWATER WELL
	EXISTING 1.0' CONTOUR LINES		RAIN GAUGE / BAROLOGGER
	EXISTING 0.5' CONTOUR LINES		PHOTO POINT
	DRAINAGE DITCH		VEGETATION PLOT
	TREE LINE		
	LEVEL SPREADER		
	ROCK STABILIZED OUTLET		



REVISIONS		
SYL	DATE	APPROVED



**BROWN FARM - NEW HOPE CREEK
WETLAND RESTORATION PROJECT**
ORANGE / DURHAM COUNTY, NORTH CAROLINA

DATE: DEC 2009
SCALE: 1"=100'
MONITORING PLAN VIEW
SHEET 1 OF 1

2.0 PROJECT CONDITIONS AND MONITORING RESULTS

2.1 Vegetation Assessment

The site is immediately adjacent to well-developed wetlands within the New Hope Creek floodplain with extensive wetland vegetation. These surrounding areas have helped seed the site, contributing to a large number of volunteers in the monitoring plots. There was an increase in the site average of planted stems/acre during the fifth monitoring year. This reflects the addition of planted trees during the 2010 monitoring year as well as trees that had been counted as dead resprouting. The mortality of the planted stems is primarily related to deer browse and competition from dense herbaceous vegetation. The volunteer plants that were counted during the 2011 monitoring include: green ash (*Fraxinus pennsylvanica*), buttonbush (*Cephalanthus occidentalis*), willow oak (*Quercus phellos*), cherrybark oak (*Quercus pagoda*), overcup oak (*Quercus lyrata*), swamp chestnut oak (*Quercus michauxii*), American elm (*Ulmus americana*), sycamore (*Platanus occidentalis*), eastern baccharis (*Baccharis halimifolia*), and slippery elm (*Ulmus rubra*). Red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*) were also counted, but since they are common successional species, they were not included in the density calculations for this report. The fifth year of monitoring found an average of 310 planted stems/acre and 2,284 total stems/acre for the site based on the monitored vegetation plots. Even though there has been some mortality of the planted stems, the site is on track to meeting the vegetation success criterion.

The qualitative vegetation assessment of the site found that there were many woody stems throughout the site and that there is a healthy mix of wetland herbaceous vegetation covering the site as well. For additional data on the counted stems, volunteer stems, and photos of the vegetation plots, see Appendix A.

2.2 Wetland Criteria Attainment Tables

Well #	Hydroperiod				Max. No. of Consecutive Days	Dates Meeting Success
	<5%	5% - 8%	8% - 12.5%	>12.5%		
1				X	40	3/24/11-5/3/11
2				X	126	3/24/11-7/28/11
3				X	60	3/24/11-5/22/11
4				X	37	3/24/11-4/29/11
5				X	92	3/24/11-6/24/11
6				X	64	3/24/11-5/26/11
7				X	79	3/24/11-6/10/11
Ref. Wetland					3	Gauge Malfunction

Well #	Pre-Restoration	Year 1	Year 2	Year 3	Year 4	Year 5
1	<5%	13%	13%	15%	6%	18%
2	<5%	24%	35%	44%	19%	56%
3	<5%	7%	32%	43%	21%	27%
4	<5%	5%	15%	18%	9%	16%
5	<5%	12%	34%	45%	19%	41%
6	<5%	8%	30%	26%	14%	28%
7	<5%	9%	30%	29%	16%	35%
Ref. Well		6%	20%	16%	16%	*

* Gauge Malfunction

The wetland wells used to monitor site hydrology were installed in early 2007. The maximum number of consecutive days that the groundwater was within 12 inches of the surface was determined for each groundwater gauge. This number was converted into a percentage of the 223-day growing season. Wetland hydrology was achieved at all of the gauges on the site in 2011 (Table 5). Based on these data, the site has exceeded the minimum duration of 12 consecutive days with the water table within 12 inches of the soil surface for the 2011 growing season (Appendix B). In addition, all of the gauges exceeded 12.5% saturation. Table 5 presents the hydrological monitoring results for 2011. Climatic data for the 2011 growing season were analyzed in comparison to historical data to determine whether 2011 was a normal year in terms of climatic conditions as a precursor to validating the results of the wetland monitoring. The historical data were collected from the NRCS, Water and Climate Center, "Climate Analysis for Wetlands by County" website. This evaluation concluded that 2011 was a normal year for rainfall during the growing season. Rainfall was within the 30th to 70th percentiles for the months of February, March, April, June, July, August, October, and November. Rainfall was less than the 30th percentile threshold in January and was greater than the 70th percentile threshold in May and September (Appendix B).

To illustrate that the site is a riverine system, a stream gauge was installed on New Hope Creek to document overbank flooding. This gauge was installed in February 2008. Since installation, the gauge has recorded 40 overbank flooding events (over 253.8' elevation). These events typically flood approximately 75% or more of the site.

Appendix A

Vegetation Data

Appendix A - Vegetation Data Tables

Table A1. Planted stem counts for each species arranged by plot													
Project Name: Brown Farm Wetland Restoration													
Species	Plots										Initial Totals	Year 5 Totals	Survival % ⁺
	1*	2	3	4 ⁺	5	6	7	8	9	10			
Trees													
<i>Diospyros virginiana</i>		1									1	1	100%
<i>Fraxinus pennsylvanica</i>	6	3			5	4	1		3	1	23	23	100%
<i>Liriodendron tulipifera</i>											6	0	0%
<i>Quercus laurifolia</i>							1		1	2	7	4	57%
<i>Quercus lyrata</i>	1	4	2	2	2		1				9	12	133%
<i>Quercus michauxii</i>	1	5	3	1		1	4				23	15	65%
<i>Quercus pagoda</i>	1	1	3	3	2	1	2		2	2	23	17	74%
<i>Quercus phellos</i>			2				1			2	9	5	56%
Unknown											44	0	0%

*Plot 1 was moved in MY02 ⁺ Additional trees from February '10 supplemental planting

Table A1 cont. Planted stem counts for each species arranged by plot													
Project Name: Brown Farm Wetland Restoration													
Species	Plots										Initial Totals	Year 5 Totals	Survival %
	11	12	13	14	15	16 ⁺	17	18	19 ⁺	20			
Trees													
<i>Fraxinus pennsylvanica</i>	1	2	1			1	6	1	2	3	25	17	68%
<i>Liriodendron tulipifera</i>											5	0	0%
<i>Nyssa sylvatica</i>											1	0	0%
<i>Quercus laurifolia</i>	1								1		7	2	29%
<i>Quercus lyrata</i>	6	3	4	3	4		1		4	4	28	29	104%
<i>Quercus michauxii</i>	1		1			2		2	1	1	8	8	100%
<i>Quercus pagoda</i>	3		5			3		1	3	1	22	16	73%
<i>Quercus phellos</i>						6					8	6	75%
Unknown											30	0	0%

⁺ Additional trees from February '10 supplemental planting

Table A2. Planted Stem Density By Plot

Project Name: Brown Farm Wetland Restoration

Date : 8/4/11 to 8/9/11

Crew : T. Seelinger, A. Helms

Plot #	Persimmon <i>Diospyros virginiana</i>	Green Ash <i>Fraxinus pennsylvanica</i>	Tulip Poplar <i>Liriodendron tulipifera</i>	Water Tupelo <i>Nyssa sylvatica</i>	Laurel Oak <i>Quercus laurifolia</i>	Overcup Oak <i>Quercus lyrata</i>	Swamp Chestnut Oak <i>Quercus michauxii</i>	Cherrybark Oak <i>Quercus pagoda</i>	Willow Oak <i>Quercus phellos</i>	Total	Density
1		6				1	1	1		9	360
2	1	3				4	5	1		14	560
3						2	3	3	2	10	400
4						2	1	3		6	240
5		5				2		2		9	360
6		4					1	1		6	240
7		1			1	1	4	2	1	10	400
8										0	0
9		3			1			2		6	240
10		1			2			2	2	7	280
11		1			1	6	1	3		12	480
12		2				3				5	200
13		1				4	1	5		11	440
14						3				3	120
15						4				4	160
16		1					2	3	6	12	480
17		6				1				7	280
18		1					2	1		4	160
19		2			1	4	1	3		11	440
20		3				4	1	1		9	360
Total Average Density											310

Table A3. Vegetation History: Stems/Acre Planted and Total with Volunteers**Project Name: Brown Farm Wetland Restoration**

Plot #	Year 0	Year 1	Year 2	Year 3		Year 4		Year 5	
	planted	planted	planted	planted	total	planted	total	planted	total
1	640	560	360	360	400	360	360	360	600
2	760	720	600	600	800	600	640	560	1,760
3	680	560	520	440	1,040	400	960	400	2,040
4	520	240	240	120	1,120	240	1,720	240	5,400
5	640	520	360	360	560	360	560	360	1,880
6	400	320	160	160	800	240	880	240	3,800
7	680	680	480	400	960	400	920	400	1,840
8	560	280	80	0	840	0	640	0	3,480
9	440	360	280	240	840	240	920	240	1,360
10	480	480	320	320	520	320	1,680	280	3,440
11	640	520	480	480	680	480	1,040	480	4,280
12	520	240	200	200	240	200	480	200	920
13	640	560	480	480	1,200	440	1,280	440	1,560
14	720	480	400	160	720	120	1,280	120	3,080
15	320	320	200	160	360	160	1,080	160	2,120
16	480	440	320	320	480	480	880	480	920
17	600	560	520	520	1,760	280	1,920	280	1,680
18	320	280	160	160	2,000	160	1,520	160	2,120
19	480	480	260	240	320	280	360	440	640
20	640	600	520	440	1,920	440	1,920	360	2,760
Site Average	558	460	347	308	878	310	1,052	310	2,284

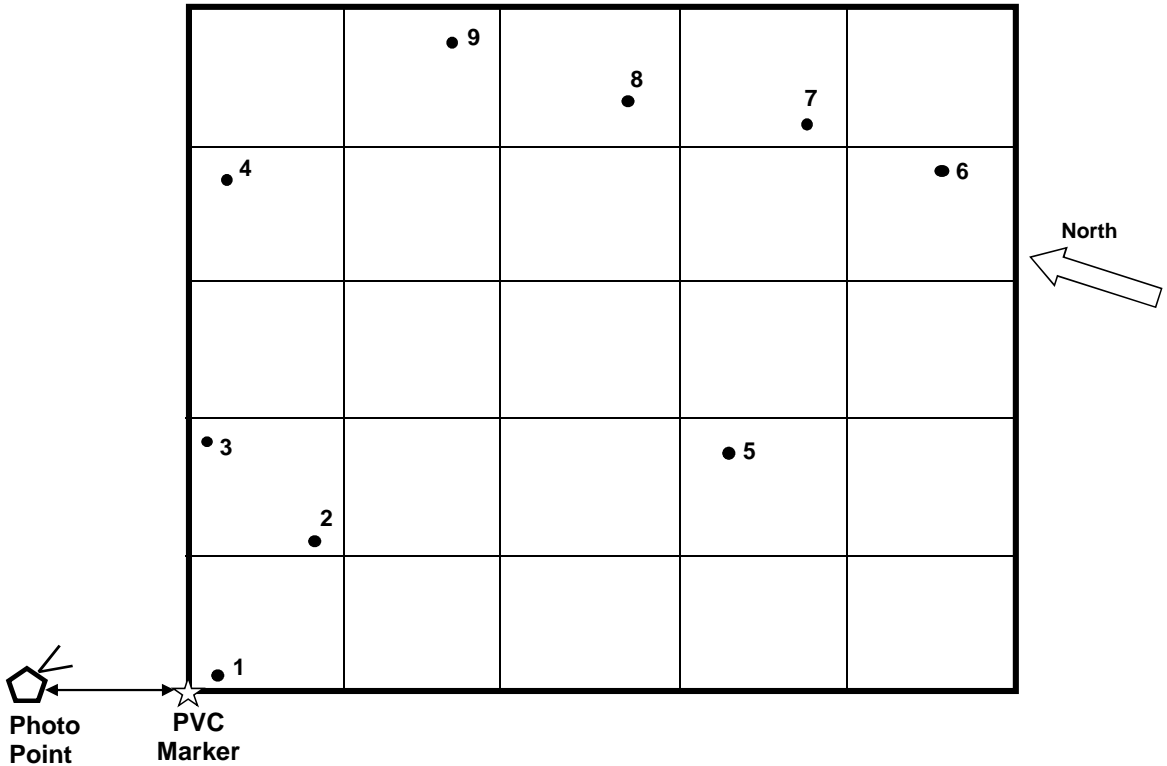
Notes: –Plot 1 was moved in monitoring year 02.

–Total stems includes all volunteer woody stems except for red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*).

Vegetation Monitoring Worksheet

Site: Brown Plot: 1 Date: 8/5/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Overcup Oak (<i>Quercus lyrata</i>)	2.46	4	
2	Green Ash (<i>Fraxinus pennsylvanica</i>)	1.64	4	
3	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.73	4	
4	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1.03	4	Top died back
5	Cherrybark Oak (<i>Quercus pagoda</i>)	1.58	4	
6	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.62	4	Browsed
7	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.89	4	Browsed
8	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.60	4	Browsed
9	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.45	3	

*Plot was moved in MY02 Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Green Ash (<i>Fraxinus pennsylvanica</i>)	66.7%
Overcup Oak (<i>Quercus lyrata</i>)	11.1%
Southern Red Oak (<i>Quercus falcata</i>)	11.1%
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	11.1%

Density:

Total Number of Planted Stems 9 / 0.025 acres = 360 stems / acre

Total Number of Desirable Stems* 15 / 0.025 acres = 600 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 9 / 9 trees x 100 = 100 % survivability



4th Year Monitoring



5th Year Monitoring

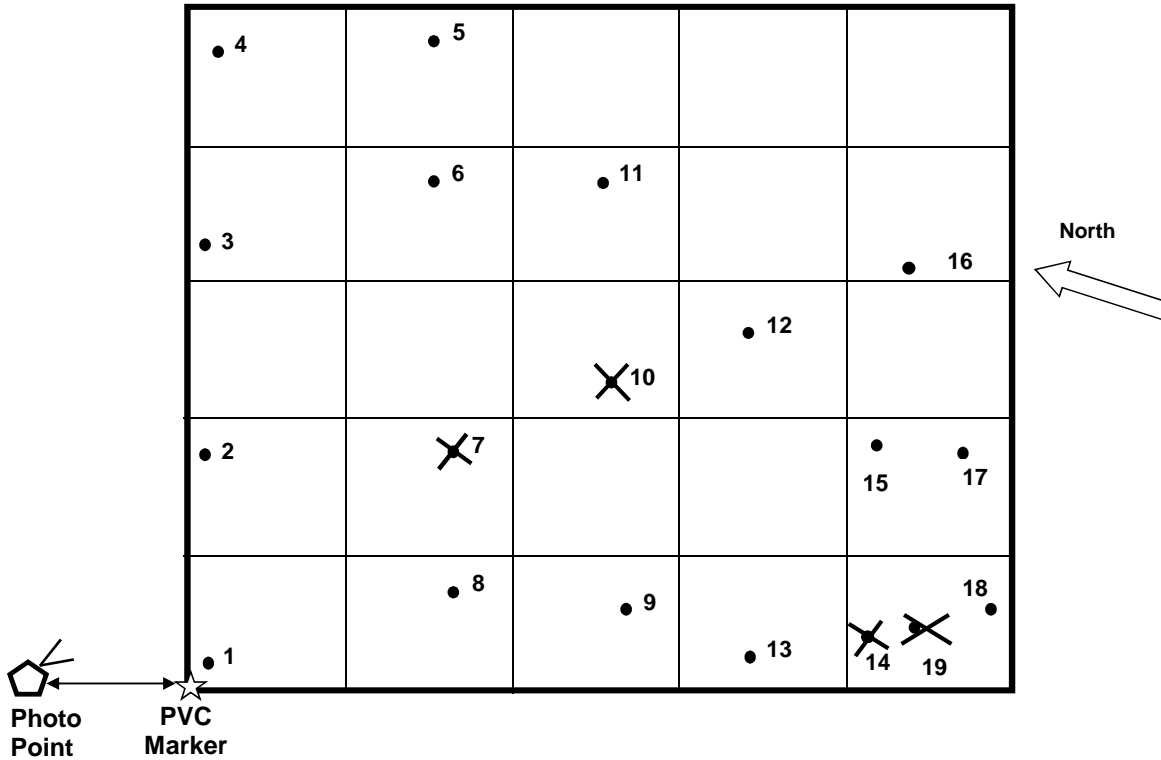
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Slippery Elm (<i>Ulmus rubra</i>)	1			
Green Ash (<i>Fraxinus pennsylvanica</i>)	2	1		
Eastern Baccharis (<i>Baccharis halimifolia</i>)		1		
Eastern Sycamore (<i>Platanus occidentalis</i>)				1
Sweetgum (<i>Liquidambar styraciflua</i>)	1			
Total	4	2		1

Vegetation Monitoring Worksheet

Site: Brown Plot: 2 Date: 8/5/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.65	3	
2	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	2.05	4	
3	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	2.08	4	
4	Overcup Oak (<i>Quercus lyrata</i>)	1.64	4	
5	Overcup Oak (<i>Quercus lyrata</i>)	1.29	4	
6	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1.12	4	
7	Swamp Chestnut Oak (<i>Quercus michauxii</i>)			Dead
8	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.53	4	
9	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	4.00*	4	
10	Unknown			Dead
11	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.28	3	Top died, browsed
12	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1.32	4	
13	Overcup Oak (<i>Quercus lyrata</i>)	1.93	4	
14	Unknown			Dead
15	Green Ash (<i>Fraxinus pennsylvanica</i>)			Missing
16	Cherrybark Oak (<i>Quercus pagoda</i>)	2.04	4	
17	Persimmon (<i>Diospyros virginiana</i>)	2.29	4	
18	Overcup Oak (<i>Quercus lyrata</i>)	1.32	4	
19	Unknown			Dead

*=estimated Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Green Ash (<i>Fraxinus pennsylvanica</i>)	21.4%
Overcup Oak (<i>Quercus lyrata</i>)	28.6%
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	35.7%
Persimmon (<i>Diospyros virginiana</i>)	7.1%
Cherrybark Oak (<i>Quercus pagoda</i>)	7.1%

Density:

Total Number of Planted Stems 14 / 0.025 acres = 560 stems / acre

Total Number of Desirable Stems* 44 / 0.025 acres = 1760 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 14 / 19 trees x 100 = 74 % survivability



4th Year Monitoring



5th Year Monitoring

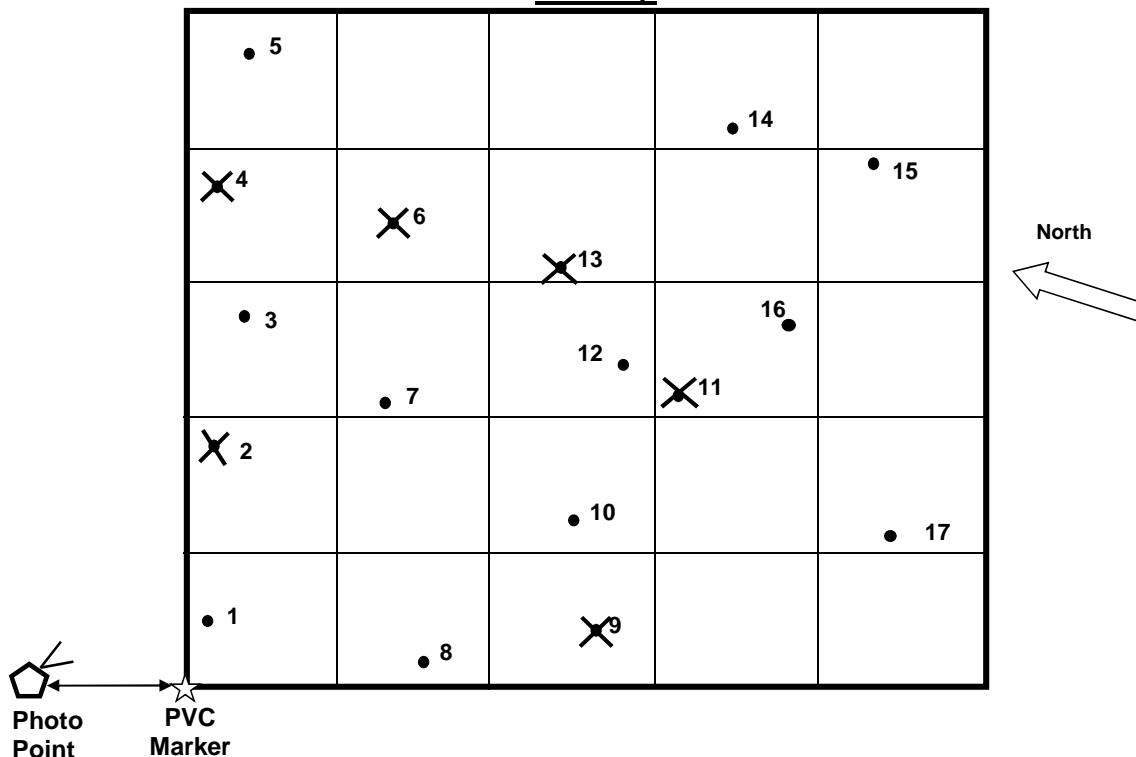
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Slippery Elm (<i>Ulmus rubra</i>)	8	4		
Green Ash (<i>Fraxinus pennsylvanica</i>)	9	4	1	
Buttonbush (<i>Cephalanthus occidentalis</i>)	1	2		
Cherrybark Oak (<i>Quercus pagoda</i>)	1			
Sweetgum (<i>Liquidambar styraciflua</i>)	2			
Total	21	10	1	

Vegetation Monitoring Worksheet

Site: Brown Plot: 3 Date: 8/5/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Cherrybark Oak (<i>Quercus pagoda</i>)	1.88	4	
2	Unknown			Dead
3	Overcup Oak (<i>Quercus lyrata</i>)	1.33	4	
4	Unknown			Dead
5	Willow Oak (<i>Quercus phellos</i>)	0.69	3	
6	Swamp Chestnut Oak (<i>Quercus michauxii</i>)			Dead
7	Cherrybark Oak (<i>Quercus pagoda</i>)	0.48	1	
8	Swamp Chestnut Oak (<i>Quercus michauxii</i>)			Missing
9	Unknown			Dead
10	Overcup Oak (<i>Quercus lyrata</i>)	1.35	4	
11	Unknown			Dead
12	Willow Oak (<i>Quercus phellos</i>)	2.41	4	
13	Swamp Chestnut Oak (<i>Quercus michauxii</i>)			Dead
14	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1.35	4	
15	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	0.70	4	
16	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1.03	4	
17	Cherrybark Oak (<i>Quercus pagoda</i>)	1.32	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Willow Oak (<i>Quercus phellos</i>)	20.0%
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	30.0%
Cherrybark Oak (<i>Quercus pagoda</i>)	30.0%
Overcup Oak (<i>Quercus lyrata</i>)	20.0%

Density:

Total Number of Planted Stems 10 / 0.025 acres = 400 stems / acre

Total Number of Desirable Stems* 51 / 0.025 acres = 2040 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 10 / 17 trees x 100 = 59 % survivability



4th Year Monitoring



5th Year Monitoring

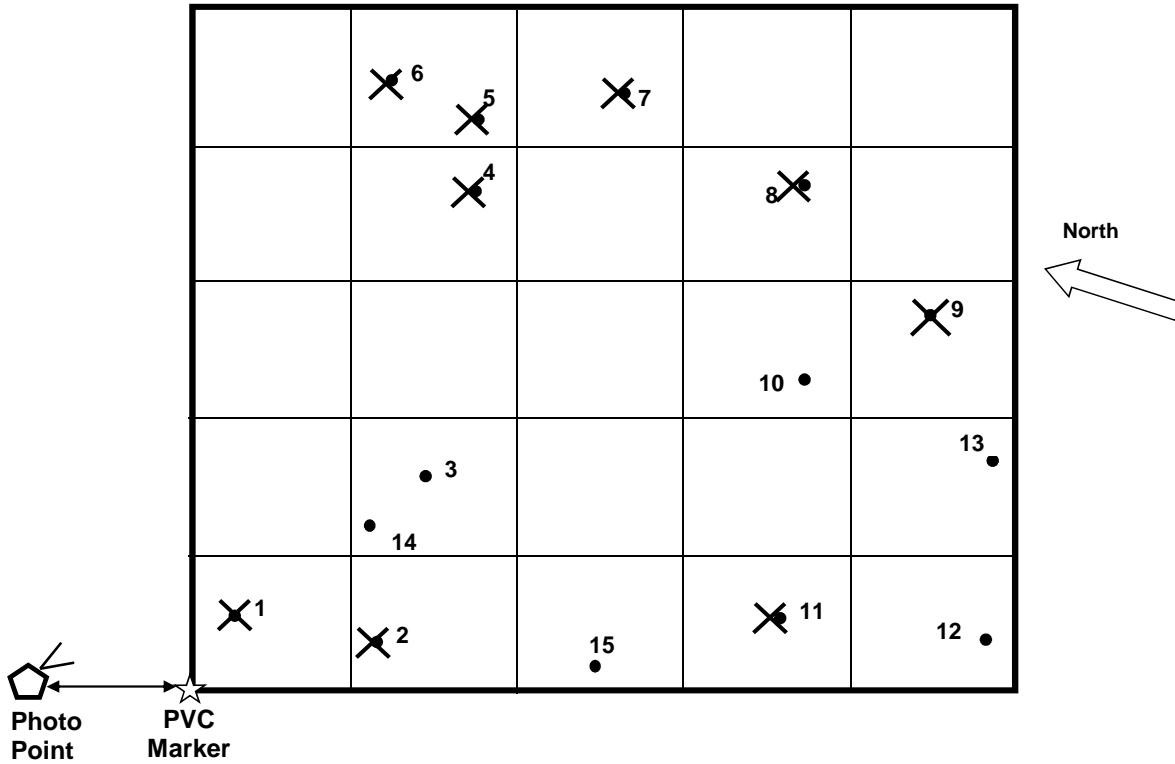
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Buttonbush (<i>Cephalanthus occidentalis</i>)	4	14	1	
Green Ash (<i>Fraxinus pennsylvanica</i>)	3	6	2	
Slippery Elm (<i>Ulmus rubra</i>)	5	6		
Sweetgum (<i>Liquidambar styraciflua</i>)		1		
Total	12	27	3	

Vegetation Monitoring Worksheet

Site: Brown Plot: 4 Date: 8/4/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown			Dead
2	Cherrybark Oak (<i>Quercus pagoda</i>)			Dead
3	Overcup Oak (<i>Quercus lyrata</i>)	1.59	4	
4	Unknown			Dead
5	Unknown			Dead
6	Unknown			Dead
7	Tulip Poplar (<i>Liriodendron tulipifera</i>)			Dead
8	Unknown			Dead
9	Unknown			Dead
10	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1.72	4	
11	Unknown			Dead
12	Cherrybark Oak (<i>Quercus pagoda</i>)	1.92	4	Browsed
13	Cherrybark Oak (<i>Quercus pagoda</i>)	1.35	4	
14	Overcup Oak (<i>Quercus lyrata</i>)	0.78	4	Browsed
15	Cherrybark Oak (<i>Quercus pagoda</i>)	1.05	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Cherrybark Oak (<i>Quercus pagoda</i>)	50.0%
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	16.7%
Overcup Oak (<i>Quercus lyrata</i>)	33.3%

Density:

Total Number of Planted Stems 6 / 0.025 acres = 240 stems / acre

Total Number of Desirable Stems* 135 / 0.025 acres = 5400 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 6 / 15 trees x 100 = 40 % survivability



4th Year Monitoring



5th Year Monitoring

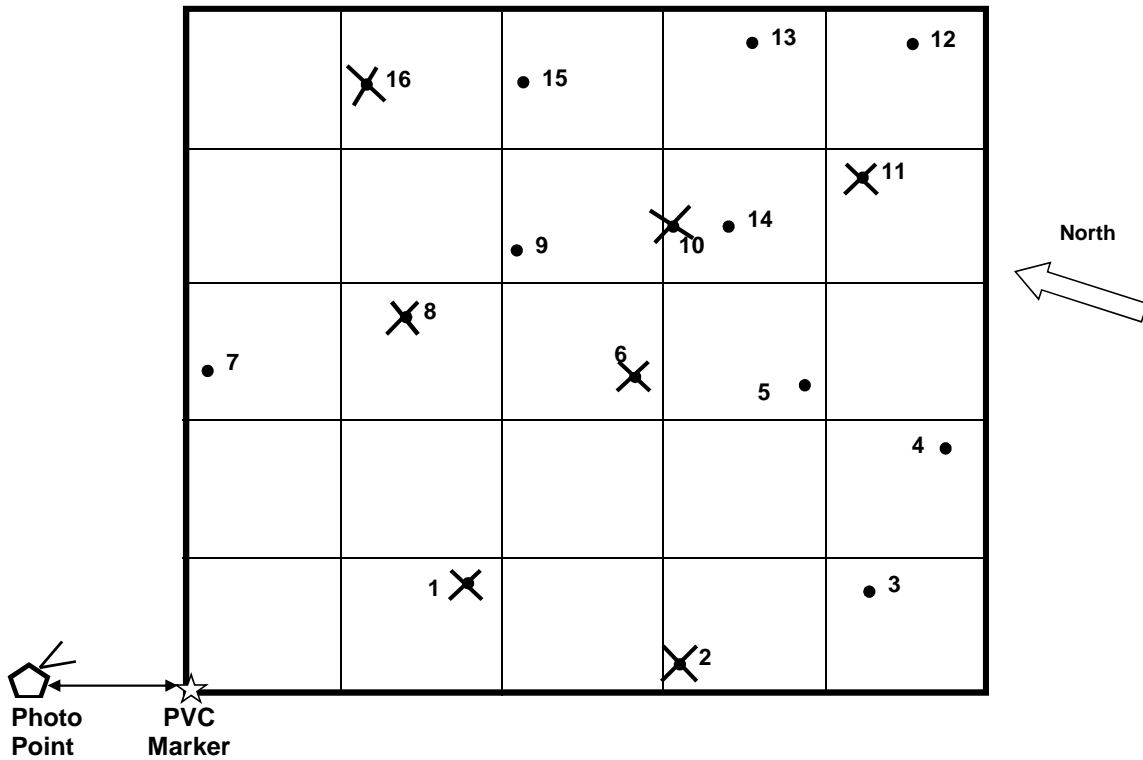
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Buttonbush (<i>Cephalanthus occidentalis</i>)	22	54	24	1
Green Ash (<i>Fraxinus pennsylvanica</i>)	7	9	4	
Slippery Elm (<i>Ulmus rubra</i>)	1	4	2	
Cherrybark Oak (<i>Quercus pagoda</i>)		1		
Red Maple (<i>Acer rubrum</i>)		1		
Sweetgum (<i>Liquidambar styraciflua</i>)			1	
Total	30	69	31	1

Vegetation Monitoring Worksheet

Site: Brown Plot: 5 Date: 8/5/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown			Dead
2	Overcup Oak (<i>Quercus lyrata</i>)			Dead
3	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.51	4	
4	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.78	4	Browsed
5	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.73	4	
6	Unknown			Dead
7	Overcup Oak (<i>Quercus lyrata</i>)	1.17	4	
8	Unknown			Dead
9	Overcup Oak (<i>Quercus lyrata</i>)	1.31	4	
10	Unknown			Dead
11	Willow Oak (<i>Quercus phellos</i>)			Dead
12	Cherrybark Oak (<i>Quercus pagoda</i>)	1.75	4	
13	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.69	4	
14	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.82	4	Browsed
15	Cherrybark Oak (<i>Quercus pagoda</i>)	1.66	4	
16	Swamp Chestnut Oak (<i>Quercus michauxii</i>)			Dead

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Overcup Oak (<i>Quercus lyrata</i>)	22.2%
Green Ash (<i>Fraxinus pennsylvanica</i>)	55.6%
Cherrybark Oak (<i>Quercus pagoda</i>)	22.2%

Density:

Total Number of Planted Stems 9 / 0.025 acres = 360 stems / acre

Total Number of Desirable Stems* 47 / 0.025 acres = 1880 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 9 / 16 trees x 100 = 56 % survivability



4th Year Monitoring



5th Year Monitoring

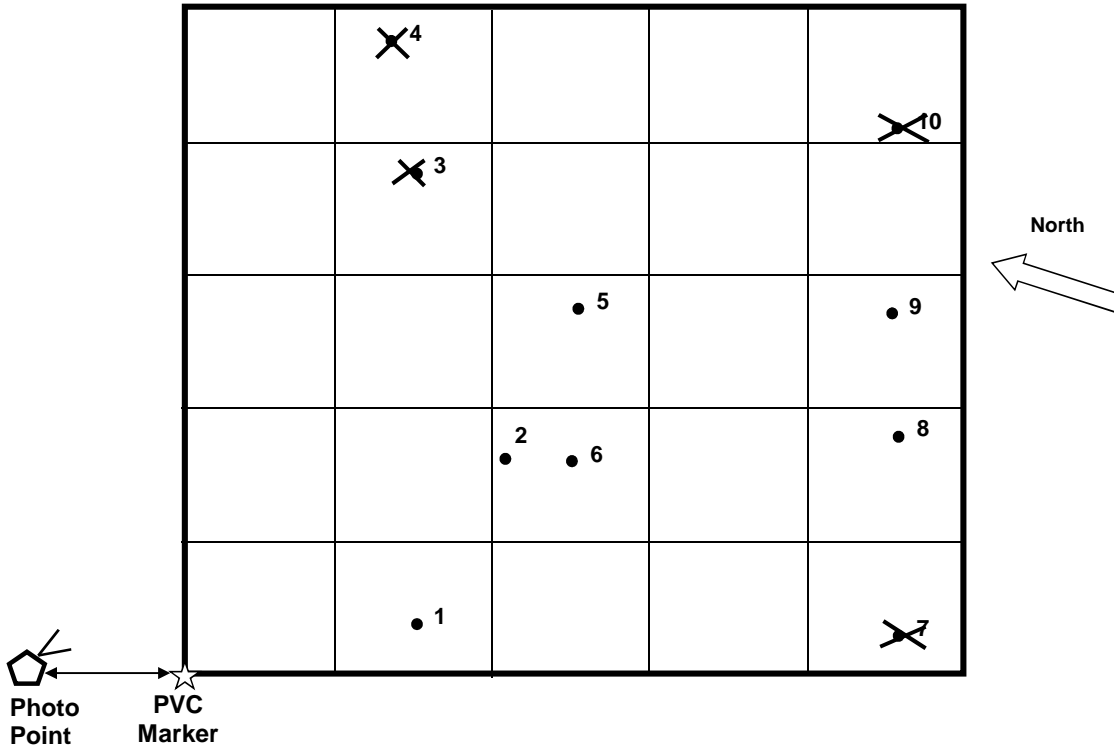
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Green Ash (<i>Fraxinus pennsylvanica</i>)	8	26	3	
Willow Oak (<i>Quercus phellos</i>)		1		
Total	8	27	3	

Vegetation Monitoring Worksheet

Site: Brown Plot: 6 Date: 8/5/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.76	3	
2	Cherrybark Oak (<i>Quercus pagoda</i>)	1.09	4	
3	Tulip Poplar (<i>Liriodendron tulipifera</i>)			Dead
4	Unknown			Dead
5	Green Ash (<i>Fraxinus pennsylvanica</i>)	1.38	4	
6	Green Ash (<i>Fraxinus pennsylvanica</i>)	1.20	4	
7	Swamp Chestnut Oak (<i>Quercus michauxii</i>)			Dead
8	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.85	4	Top died, browsed
9	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	0.79	4	
10	Swamp Chestnut Oak (<i>Quercus michauxii</i>)			Dead

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Green Ash (<i>Fraxinus pennsylvanica</i>)	66.7%
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	16.7%
Cherrybark Oak (<i>Quercus pagoda</i>)	16.7%

Density:

Total Number of Planted Stems 6 / 0.025 acres = 240 stems / acre

Total Number of Desirable Stems* 95 / 0.025 acres = 3800 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 6 / 10 trees x 100 = 60 % survivability



4th Year Monitoring



5th Year Monitoring

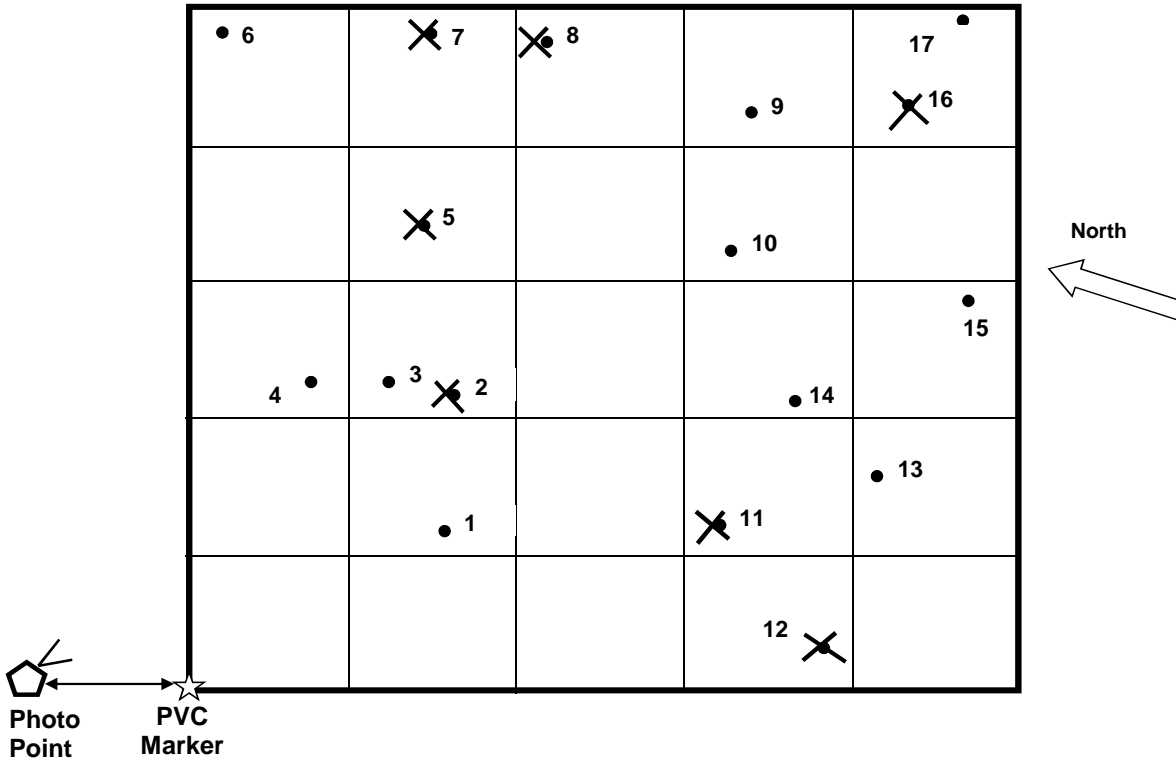
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Green Ash (<i>Fraxinus pennsylvanica</i>)	12	41	15	6
Slippery Elm (<i>Ulmus rubra</i>)	5	6		
Willow Oak (<i>Quercus phellos</i>)			1	
Eastern Sycamore (<i>Platanus occidentalis</i>)			1	
Overcup Oak (<i>Quercus lyrata</i>)		1		
Buttonbush (<i>Cephalanthus occidentalis</i>)		1		
Red Maple (<i>Acer rubrum</i>)	1			
Sweetgum (<i>Liquidambar styraciflua</i>)	1	1		
Total	19	50	17	6

Vegetation Monitoring Worksheet

Site: Brown Plot: 7 Date: 8/9/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Overcup Oak (<i>Quercus lyrata</i>)	1.77	4	
2	Willow Oak (<i>Quercus phellos</i>)			Dead
3	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	0.76	4	
4	Laurel Oak (<i>Quercus laurifolia</i>)	2.17	4	
5	Swamp Chestnut Oak (<i>Quercus michauxii</i>)			Dead
6	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	2.05	4	
7	Willow Oak (<i>Quercus phellos</i>)			Dead
8	Laurel Oak (<i>Quercus laurifolia</i>)			Dead
9	Willow Oak (<i>Quercus phellos</i>)	1.98	4	
10	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1.75	4	
11	Unknown			Dead
12	Green Ash (<i>Fraxinus pennsylvanica</i>)			Dead
13	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1.38	4	
14	Cherrybark Oak (<i>Quercus pagoda</i>)	1.28	4	
15	Cherrybark Oak (<i>Quercus pagoda</i>)	1.37	4	
16	Unknown			Dead
17	Green Ash (<i>Fraxinus pennsylvanica</i>)	1.41	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Willow Oak (<i>Quercus phellos</i>)	10.0%
Green Ash (<i>Fraxinus pennsylvanica</i>)	10.0%
Cherrybark Oak (<i>Quercus pagoda</i>)	20.0%
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	40.0%
Laurel Oak (<i>Quercus laurifolia</i>)	10.0%
Overcup Oak (<i>Quercus lyrata</i>)	10.0%

Density:

Total Number of Planted Stems 10 / 0.025 acres = 400 stems / acre

Total Number of Desirable Stems* 46 / 0.025 acres = 1840 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 10 / 17 trees x 100 = 59 % survivability



4th Year Monitoring



5th Year Monitoring

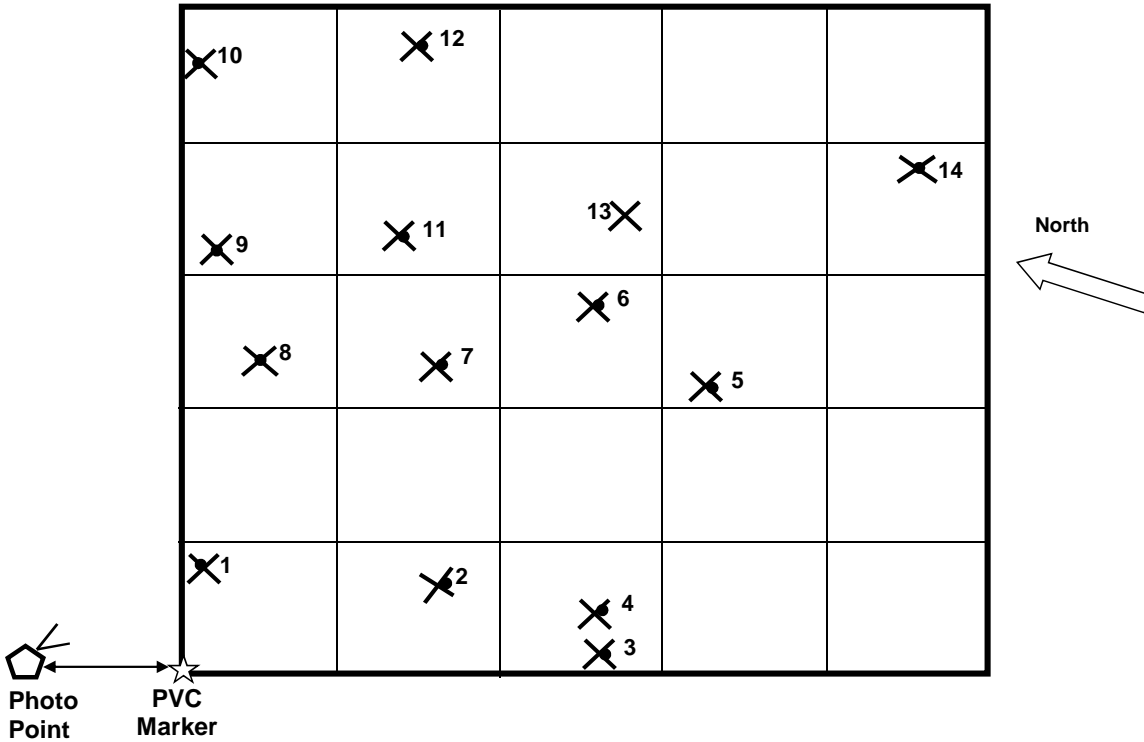
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Buttonbush (<i>Cephalanthus occidentalis</i>)		5	2	
Green Ash (<i>Fraxinus pennsylvanica</i>)	5	19	3	
Slippery Elm (<i>Ulmus rubra</i>)		1		
Sycamore (<i>Platanus occidentalis</i>)				1
Total	5	25	5	1

Vegetation Monitoring Worksheet

Site: Brown Plot: 8 Date: 8/5/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown			Dead
2	Unknown			Dead
3	Unknown			Dead
4	Unknown			Dead
5	Unknown			Dead
6	Unknown			Dead
7	Unknown			Dead
8	Unknown			Dead
9	Laurel Oak (<i>Quercus laurifolia</i>)			Dead
10	Unknown			Dead
11	Unknown			Dead
12	Unknown			Dead
13	Unknown			Dead
14	Swamp Chestnut Oak (<i>Quercus michauxii</i>)			Dead

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total

Density:

Total Number of Planted Stems 0 / 0.025 acres = 0 stems / acre

Total Number of DesirableStems* 87 / 0.025 acres = 3480 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*), and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 0 / 14 trees x 100 = 0 % survivability



4th Year Monitoring



5th Year Monitoring

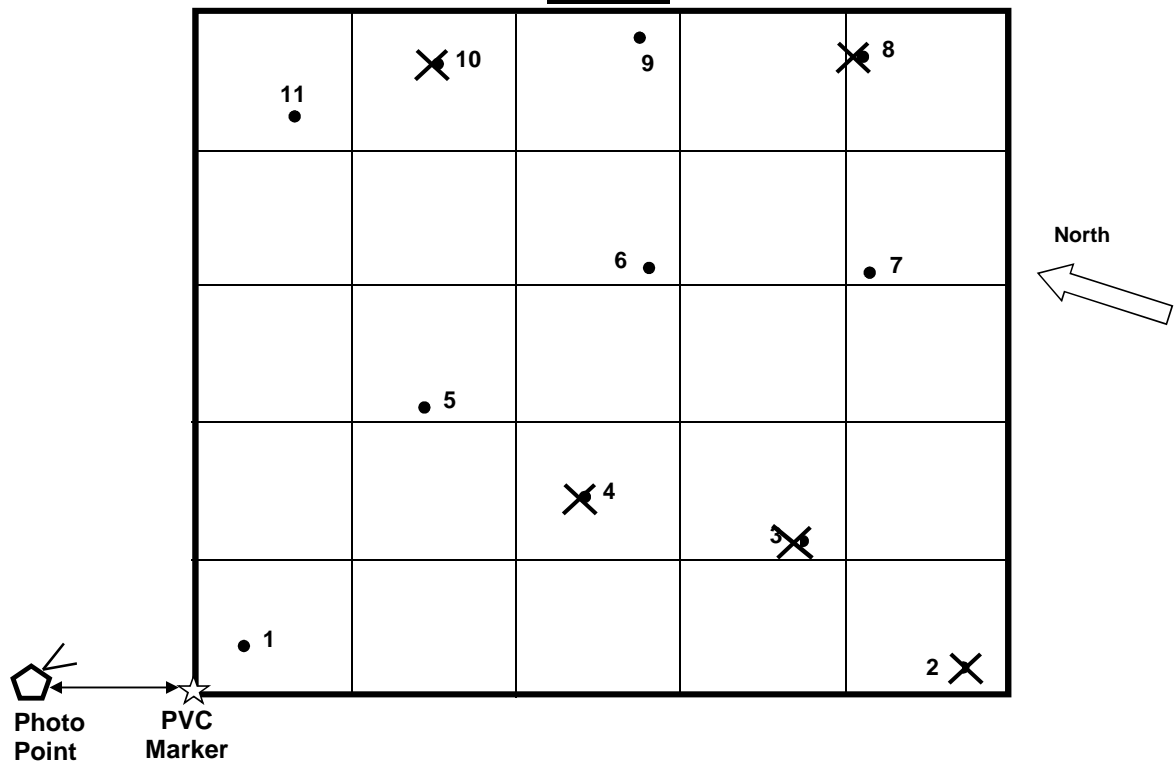
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Buttonbush (<i>Cephalanthus occidentalis</i>)		13	12	
Eastern Sycamore (<i>Platanus occidentalis</i>)			1	
Slippery Elm (<i>Ulmus rubra</i>)	23	7	4	
Green Ash (<i>Fraxinus pennsylvanica</i>)	6	13	6	
Cherrybark Oak (<i>Quercus pagoda</i>)	1			
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1			
Sweetgum (<i>Liquidambar styraciflua</i>)			1	
Red Maple (<i>Acer rubrum</i>)	2	1		
Total	33	34	24	

Vegetation Monitoring Worksheet

Site: Brown Plot: 9 Date: 8/4/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.76	4	Browsed
2	Cherrybark Oak (<i>Quercus pagoda</i>)			Dead
3	Unknown			Dead
4	Unknown			Dead
5	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.58	4	Browsed, top died
6	Cherrybark Oak (<i>Quercus pagoda</i>)	1.03	4	
7	Green Ash (<i>Fraxinus pennsylvanica</i>)	1.54	4	
8	Unknown			Dead
9	Laurel Oak (<i>Quercus laurifolia</i>)	1.50	4	
10	Unknown			Dead
11	Cherrybark Oak (<i>Quercus pagoda</i>)	1.26	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Green Ash (<i>Fraxinus pennsylvanica</i>)	50.0%
Laurel Oak (<i>Quercus laurifolia</i>)	16.7%
Cherrybark Oak (<i>Quercus pagoda</i>)	33.3%

Density:

Total Number of Planted Stems 6 / 0.025 acres = 240 stems / acre

Total Number of Desirable Stems* 34 / 0.025 acres = 1360 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 6 / 11 trees x 100 = 55 % survivability



4th Year Monitoring



5th Year Monitoring

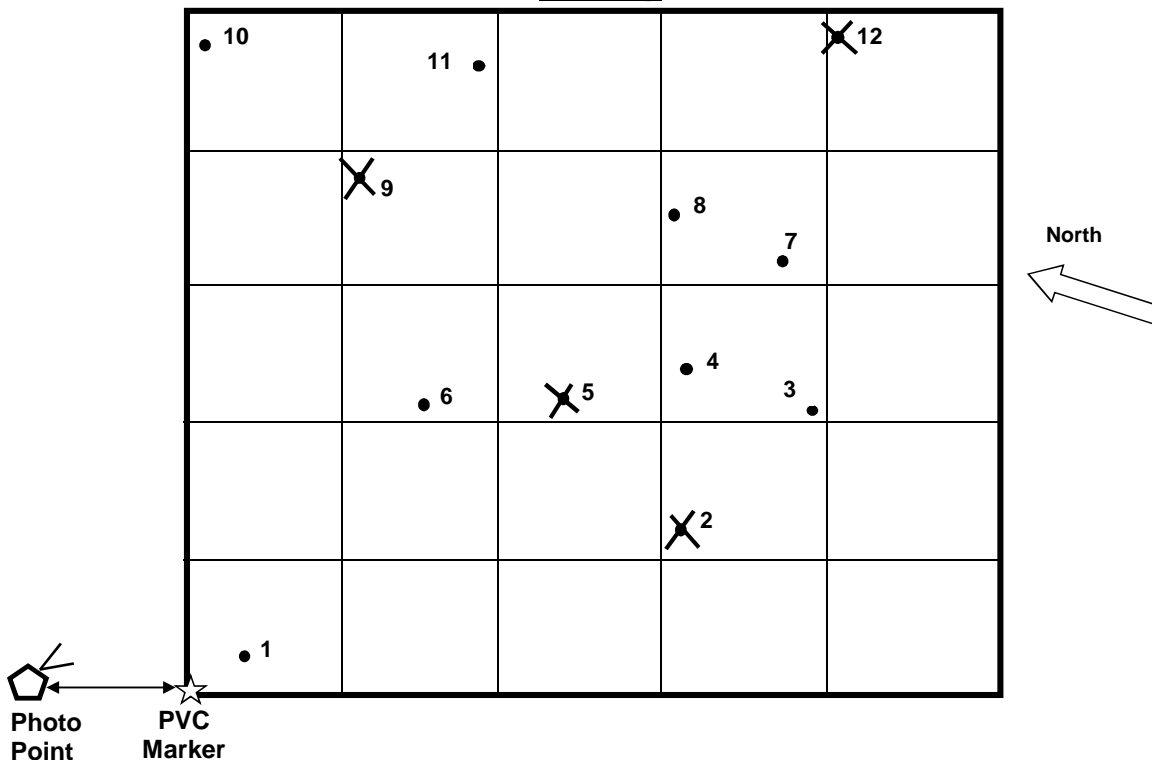
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Green Ash (<i>Fraxinus pennsylvanica</i>)	7	12	4	
Buttonbush (<i>Cephalanthus occidentalis</i>)		3		
American Elm (<i>Ulmus americana</i>)	1	1		
Red Maple (<i>Acer rubrum</i>)	1			
Sweetgum (<i>Liquidambar styraciflua</i>)		2	4	
Total	9	18	8	

Vegetation Monitoring Worksheet

Site: Brown Plot: 10 Date: 8/9/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Laurel Oak (<i>Quercus laurifolia</i>)	0.90	4	
2	Unknown			Dead
3	Cherrybark Oak (<i>Quercus pagoda</i>)	1.89	4	
4	Willow Oak (<i>Quercus phellos</i>)	1.65	4	
5	Unknown			Dead
6	Willow Oak (<i>Quercus phellos</i>)	2.08	4	
7	Cherrybark Oak (<i>Quercus pagoda</i>)	0.63	4	
8	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.74	3	Resprout
9	Willow Oak (<i>Quercus phellos</i>)			Dead
10	Laurel Oak (<i>Quercus laurifolia</i>)	1.44	4	
11	Green Ash (<i>Fraxinus pennsylvanica</i>)			Missing
12	Unknown			Dead

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Willow Oak (<i>Quercus phellos</i>)	28.6%
Green Ash (<i>Fraxinus pennsylvanica</i>)	14.3%
Cherrybark Oak (<i>Quercus pagoda</i>)	28.6%
Laurel Oak (<i>Quercus laurifolia</i>)	28.6%

Density:

Total Number of Planted Stems 7 / 0.025 acres = 280 stems / acre

Total Number of Desirable Stems* 86 / 0.025 acres = 3440 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 7 / 12 trees x 100 = 58 % survivability



4th Year Monitoring



5th Year Monitoring

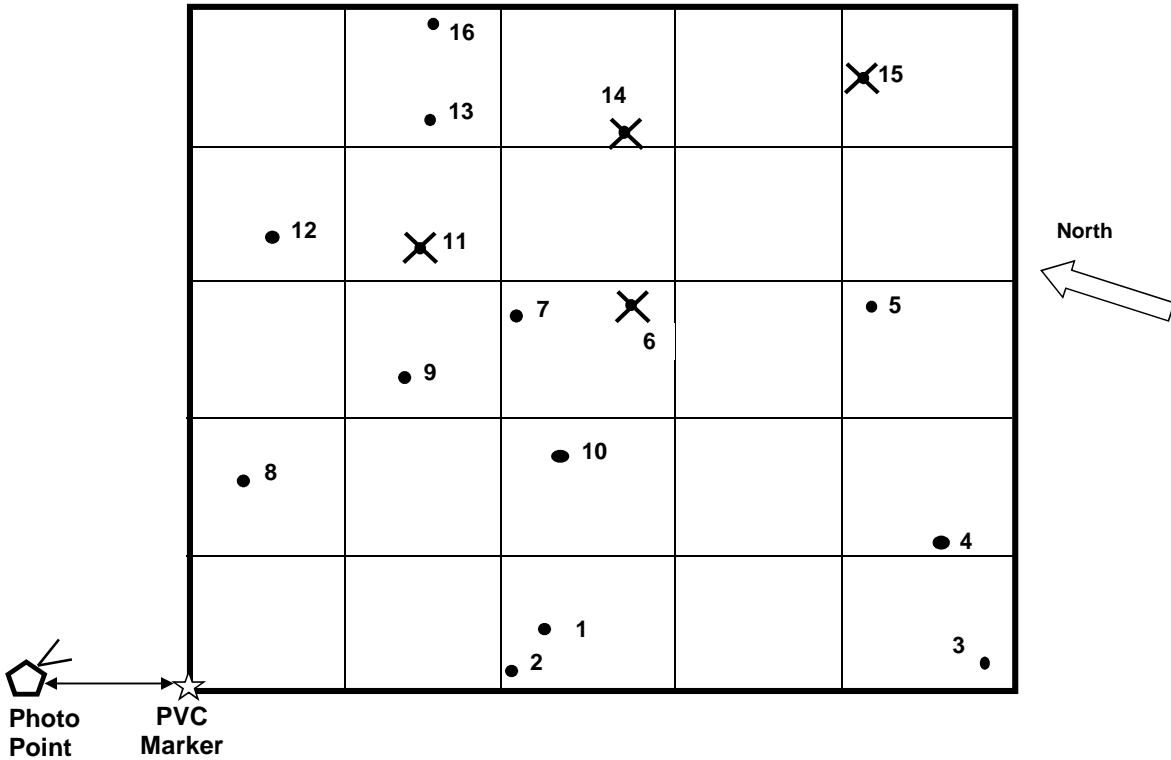
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Green Ash (<i>Fraxinus pennsylvanica</i>)	23	31	8	
Slippery Elm (<i>Ulmus rubra</i>)	7	4	2	
Cherrybark Oak (<i>Quercus pagoda</i>)		1		
Eastern Sycamore (<i>Platanus occidentalis</i>)	1	2		
Red Maple (<i>Acer rubrum</i>)	1	1		
Chinese Privet (<i>Ligustrum sinense</i>)		2		
Sweetgum (<i>Liquidambar styraciflua</i>)		2		1
Total	32	43	10	1

Vegetation Monitoring Worksheet

Site: Brown Plot: 11 Date: 8/9/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Cherrybark Oak (<i>Quercus pagoda</i>)	1.49	4	
2	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	1.24	4	
3	Cherrybark Oak (<i>Quercus pagoda</i>)	2.90*	4	
4	Overcup Oak (<i>Quercus lyrata</i>)	2.53	4	
5	Cherrybark Oak (<i>Quercus pagoda</i>)	1.42	4	
6	Unknown			Dead
7	Overcup Oak (<i>Quercus lyrata</i>)	2.04	4	
8	Overcup Oak (<i>Quercus lyrata</i>)	2.15	4	
9	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.63	4	Top died
10	Laurel Oak (<i>Quercus laurifolia</i>)	1.61	4	
11	Unknown			Dead
12	Overcup Oak (<i>Quercus lyrata</i>)	1.68	4	
13	Overcup Oak (<i>Quercus lyrata</i>)	1.32	4	
14	Unknown			Dead
15	Unknown			Dead
16	Overcup Oak (<i>Quercus lyrata</i>)	1.28	4	

*=estimated

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Overcup Oak (<i>Quercus lyrata</i>)	50.0%
Green Ash (<i>Fraxinus pennsylvanica</i>)	8.3%
Laurel Oak (<i>Quercus laurifolia</i>)	8.3%
Cherrybark Oak (<i>Quercus pagoda</i>)	25.0%
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	8.3%

Density:

Total Number of Planted Stems 12 / 0.025 acres = 480 stems / acre

Total Number of Desirable Stems* 107 / 0.025 acres = 4280 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 12 / 16 trees x 100 = 75 % survivability



4th Year Monitoring



5th Year Monitoring

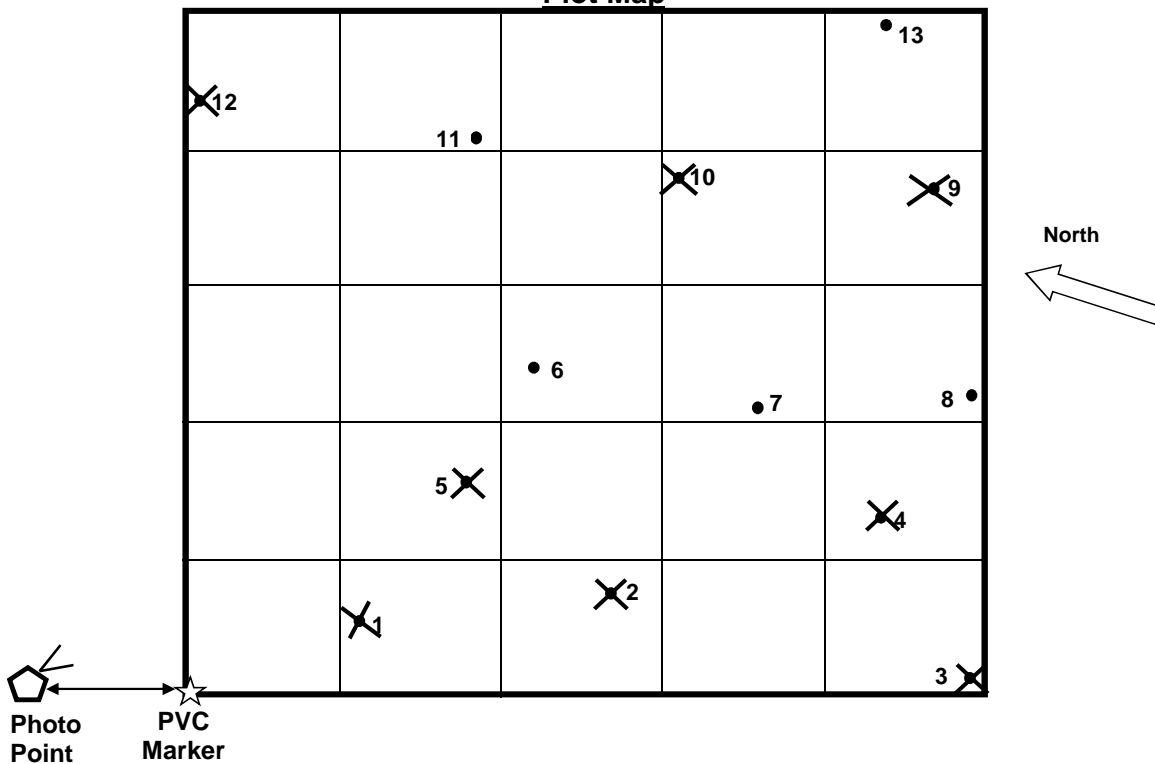
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Sycamore (<i>Platanus occidentalis</i>)	5	5	9	3
Willow Oak (<i>Quercus phellos</i>)			1	
Green Ash (<i>Fraxinus pennsylvanica</i>)	29	27	6	
Slippery Elm (<i>Ulmus rubra</i>)	10			
Red Maple (<i>Acer rubrum</i>)	7			
Sweetgum (<i>Liquidambar styraciflua</i>)		1	1	
Total	51	33	17	3

Vegetation Monitoring Worksheet

Site: Brown Plot: 12 Date: 8/5/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Tulip Poplar (<i>Liriodendron tulipifera</i>)			Dead
2	Unknown			Dead
3	Unknown			Dead
4	Unknown			Dead
5	Unknown			Dead
6	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.97	4	
7	Overcup Oak (<i>Quercus lyrata</i>)	1.95	4	
8	Overcup Oak (<i>Quercus lyrata</i>)	2.11	4	
9	Unknown			Dead
10	Unknown			Dead
11	Overcup Oak (<i>Quercus lyrata</i>)	2.10	4	
12	Unknown			Dead
13	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.83	3	Browsed

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Green Ash (<i>Fraxinus pennsylvanica</i>)	40.0%
Overcup Oak (<i>Quercus lyrata</i>)	60.0%

Density:

Total Number of Planted Stems 5 / 0.025 acres = 200 stems / acre

Total Number of Desirable Stems* 23 / 0.025 acres = 920 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 5 / 13 trees x 100 = 38 % survivability



4th Year Monitoring



5th Year Monitoring

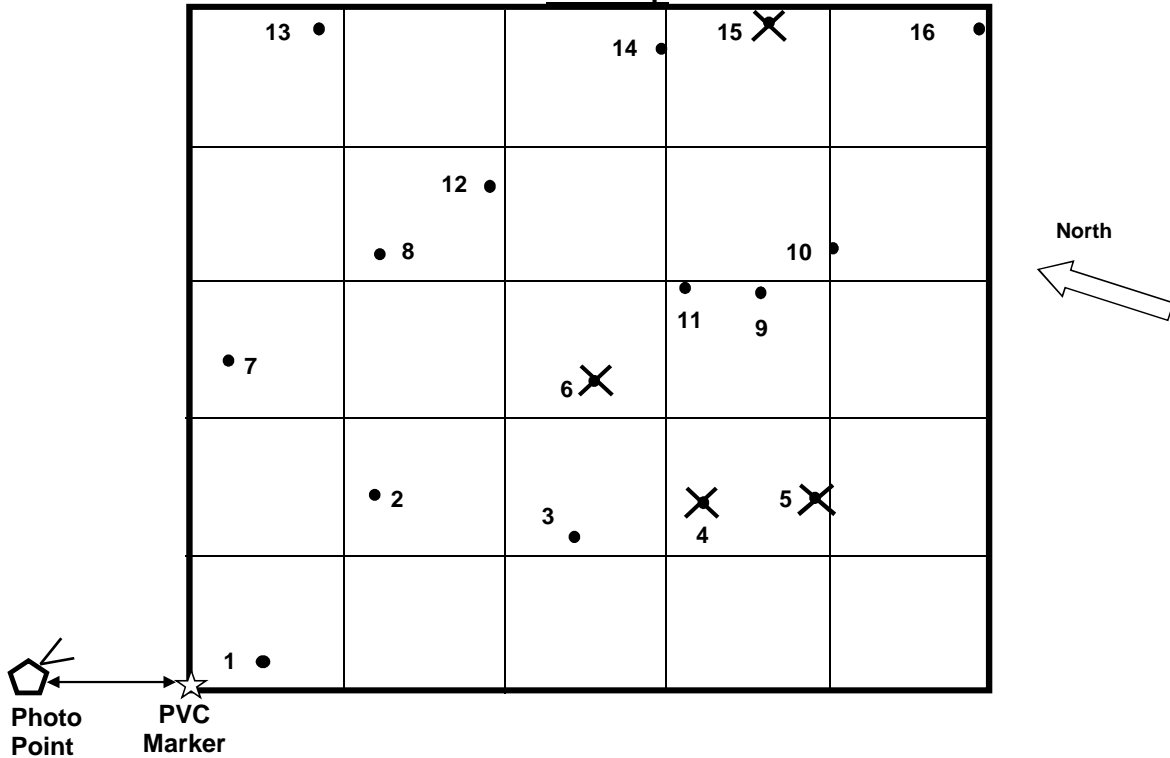
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Slippery Elm (<i>Ulmus rubra</i>)			3	
Green Ash (<i>Fraxinus pennsylvanica</i>)		2	2	1
Overcup Oak (<i>Quercus lyrata</i>)		2		
Buttonbush (<i>Cephalanthus occidentalis</i>)		1	4	
Black Willow (<i>Salix nigra</i>)				1
Laurel Oak (<i>Quercus laurifolia</i>)			2	
Total		5	11	2

Vegetation Monitoring Worksheet

Site: Brown Plot: 13 Date: 8/5/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Overcup Oak (<i>Quercus lyrata</i>)	2.52	4	
2	Cherrybark Oak (<i>Quercus pagoda</i>)	3.80*	4	
3	Overcup Oak (<i>Quercus lyrata</i>)	3.70*	4	
4	Unknown			Dead
5	Tulip Poplar (<i>Liriodendron tulipifera</i>)			Dead
6	Unknown			Dead
7	Cherrybark Oak (<i>Quercus pagoda</i>)	2.39	4	
8	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	2.98	4	
9	Overcup Oak (<i>Quercus lyrata</i>)	3.00*	4	
10	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.65	1	
11	Cherrybark Oak (<i>Quercus pagoda</i>)	1.91	4	
12	Cherrybark Oak (<i>Quercus pagoda</i>)	2.13	4	
13	Swamp Chestnut Oak (<i>Quercus michauxii</i>)			Missing
14	Overcup Oak (<i>Quercus lyrata</i>)	3.20*	4	
15	Unknown			Dead
16	Cherrybark Oak (<i>Quercus pagoda</i>)	3.00*	4	

*=estimated

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Green Ash (<i>Fraxinus pennsylvanica</i>)	9.1%
Overcup Oak (<i>Quercus lyrata</i>)	36.4%
Cherrybark Oak (<i>Quercus pagoda</i>)	45.5%
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	9.1%

Density:

Total Number of Planted Stems 11 / 0.025 acres = 440 stems / acre

Total Number of Desirable Stems* 39 / 0.025 acres = 1560 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 11 / 16 trees x 100 = 69 % survivability



4th Year Monitoring



5th Year Monitoring

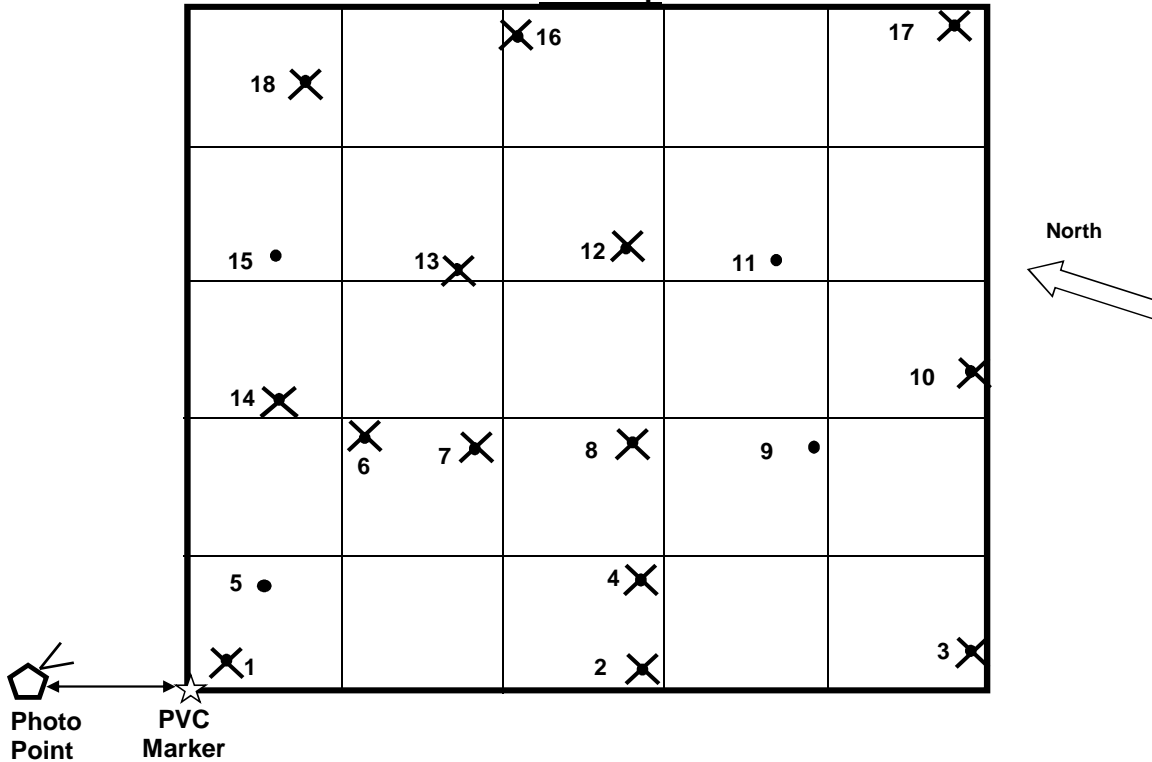
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Eastern Baccharis (<i>Baccharis halimifolia</i>)				2
Green Ash (<i>Fraxinus pennsylvanica</i>)	3	4	3	3
Eastern Sycamore (<i>Platanus occidentalis</i>)			1	6
Cherrybark Oak (<i>Quercus pagoda</i>)				1
Slippery Elm (<i>Ulmus rubra</i>)	2	3		
Total	5	7	4	12

Vegetation Monitoring Worksheet

Site: Brown Plot: 14 Date: 8/5/2011

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Cherrybark Oak (<i>Quercus pagoda</i>)			Dead
2	Unknown			Dead
3	Unknown			Dead
4	Overcup Oak (<i>Quercus lyrata</i>)			Dead
5	Overcup Oak (<i>Quercus lyrata</i>)	2.38	4	Rodent Damage
6	Cherrybark Oak (<i>Quercus pagoda</i>)			Dead (Rodent)
7	Cherrybark Oak (<i>Quercus pagoda</i>)			Dead (Rodent)
8	Overcup Oak (<i>Quercus lyrata</i>)			Dead (Rodent)
9	Overcup Oak (<i>Quercus lyrata</i>)			Missing
10	Unknown			Dead
11	Overcup Oak (<i>Quercus lyrata</i>)	2.06	4	
12	Unknown			Dead
13	Unknown			Dead
14	Unknown			Dead
15	Overcup Oak (<i>Quercus lyrata</i>)	0.71	4	Browsed
16	Overcup Oak (<i>Quercus lyrata</i>)			Dead (Rodent)
17	Overcup Oak (<i>Quercus lyrata</i>)			Dead (Rodent)
18	Cherrybark Oak (<i>Quercus pagoda</i>)			Dead

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Overcup Oak (<i>Quercus lyrata</i>)	100.0%

Density:

Total Number of Planted Stems 3 / 0.025 acres = 120 stems / acre

Total Number of Desirable Stems* 77 / 0.025 acres = 3,080 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 3 / 18 trees x 100 = 17 % survivability



4th Year Monitoring



5th Year Monitoring

Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Eastern Baccharis (<i>Baccharis halimifolia</i>)			2	4
Green Ash (<i>Fraxinus pennsylvanica</i>)	5	29	8	
Eastern Sycamore (<i>Platanus occidentalis</i>)		6	4	7
Slippery Elm (<i>Ulmus rubra</i>)	4	4		
Overcup Oak (<i>Quercus lyrata</i>)		1		
Sweetgum (<i>Liquidambar styraciflua</i>)			1	
Total	9	40	15	11

Species	Percent of Total
Overcup Oak (<i>Quercus lyrata</i>)	100.0%

Density:

Total Number of Planted Stems 4 / 0.025 acres = 160 stems / acre

Total Number of Desirable Stems* 53 / 0.025 acres = 2120 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 4 / 8 trees x 100 = 50 % survivability



4th Year Monitoring



5th Year Monitoring

Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Green Ash (<i>Fraxinus pennsylvanica</i>)	6	29	9	1
Overcup Oak (<i>Quercus lyrata</i>)	1			
Slippery Elm (<i>Ulmus rubra</i>)	2	1		
Total	9	30	9	1

Species	Percent of Total
Willow Oak (<i>Quercus phellos</i>)	50.0%
Green Ash (<i>Fraxinus pennsylvanica</i>)	8.3%
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	16.7%
Cherrybark Oak (<i>Quercus pagoda</i>)	25.0%

Density:

Total Number of Planted Stems 12 / 0.025 acres = 480 stems / acre

Total Number of Desirable Stems* 23 / 0.025 acres = 920 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 12 / 16 trees x 100 = 75 % survivability



4th Year Monitoring



5th Year Monitoring

Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Buttonbush (<i>Cephalanthus occidentalis</i>)	1	2		
Green Ash (<i>Fraxinus pennsylvanica</i>)	1	5		
Slippery Elm (<i>Ulmus rubra</i>)	1	1		
Red Maple (<i>Acer rubrum</i>)	1	1		
Sweetgum (<i>Liquidambar styraciflua</i>)	3	2		
Total	7	11		

Species	Percent of Total
Green Ash (<i>Fraxinus pennsylvanica</i>)	85.7%
Overcup Oak (<i>Quercus lyrata</i>)	14.3%

Density:

Total Number of Planted Stems 7 / 0.025 acres = 280 stems / acre

Total Number of Desirable Stems* 42 / 0.025 acres = 1,680 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*) and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 7 / 15 trees x 100 = 47 % survivability



4th Year Monitoring



5th Year Monitoring

Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Green Ash (<i>Fraxinus pennsylvanica</i>)		8	12	13
Eastern Sycamore (<i>Platanus occidentalis</i>)	1			
Slippery Elm (<i>Ulmus rubra</i>)		1		
Red Maple (<i>Acer rubrum</i>)		4	5	2
Sweetgum (<i>Liquidambar styraciflua</i>)	1			
Total	2	13	17	15

Species	Percent of Total
Green Ash (<i>Fraxinus pennsylvanica</i>)	25.0%
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	50.0%
Cherrybark Oak (<i>Quercus pagoda</i>)	25.0%

Density:

Total Number of Planted Stems 4 / 0.025 acres = 160 stems / acre

Total Number of Desirable Stems* 53 / 0.025 acres = 2120 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*), and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 4 / 8 trees x 100 = 50 % survivability



4th Year Monitoring



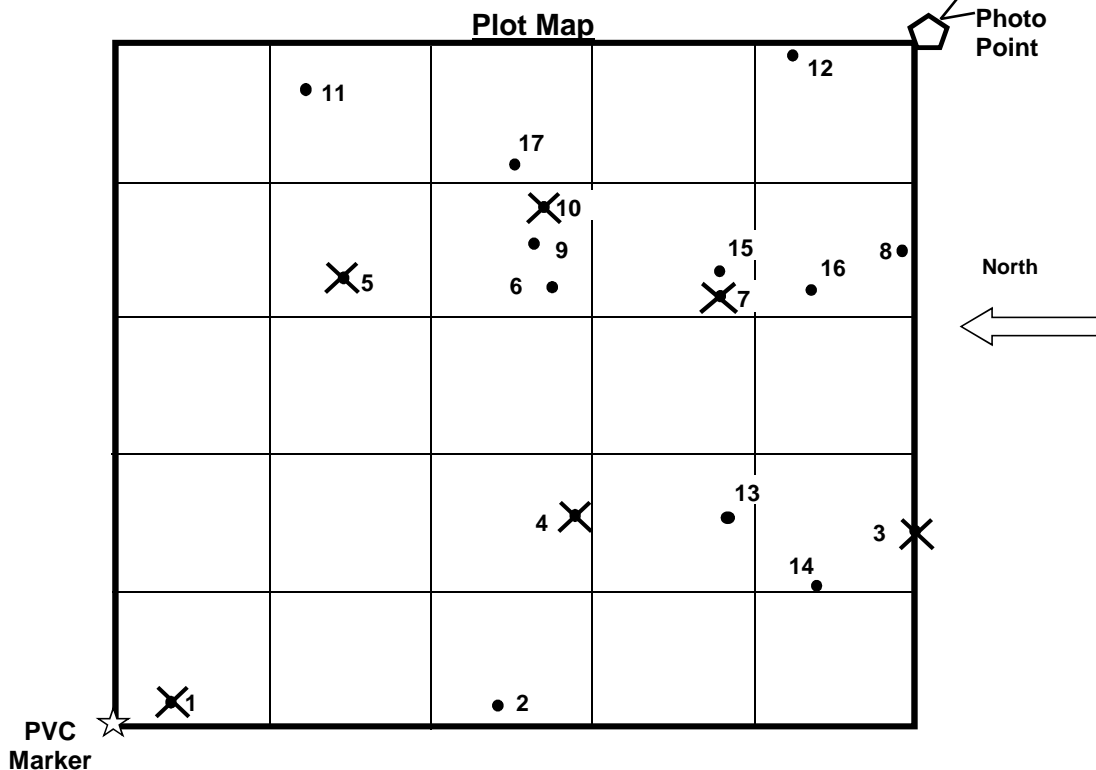
5th Year Monitoring

Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Sycamore (<i>Platanus occidentalis</i>)			1	
Green Ash (<i>Fraxinus pennsylvanica</i>)	4	14	5	20
Buttonbush (<i>Cephalanthus occidentalis</i>)		1		
Overcup Oak (<i>Quercus lyrata</i>)	1			
Slippery Elm (<i>Ulmus rubra</i>)	1	2		
Red Maple (<i>Acer rubrum</i>)	1	6		
Sweetgum (<i>Liquidambar styraciflua</i>)		1	3	3
Total	7	24	9	23

Vegetation Monitoring Worksheet

Site: Brown Plot: 19 Date: 8/4/2011



ID	Species	Height (m)	Vigor	Comment
1	Willow Oak (<i>Quercus phellos</i>)			Dead
2	Green Ash (<i>Fraxinus pennsylvanica</i>)	1.26	3	
3	Unknown			Dead
4	Willow Oak (<i>Quercus phellos</i>)			Dead
5	Willow Oak (<i>Quercus phellos</i>)			Dead
6	Cherrybark Oak (<i>Quercus pagoda</i>)	2.79	4	
7	Green Ash (<i>Fraxinus pennsylvanica</i>)			Dead
8	Overcup Oak (<i>Quercus lyrata</i>)	2.11	4	
9	Green Ash (<i>Fraxinus pennsylvanica</i>)	0.77	1	
10	Water Tupelo (<i>Nyssa aquatica</i>)			Dead
11	Cherrybark Oak (<i>Quercus pagoda</i>)	3.38	4	
12	Laurel Oak (<i>Quercus laurifolia</i>)	2.24	4	
13	Cherrybark Oak (<i>Quercus pagoda</i>)	0.76	4	
14	Overcup Oak (<i>Quercus lyrata</i>)	0.83	4	New
15	Overcup Oak (<i>Quercus lyrata</i>)	0.69	4	New
16	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	0.88	4	New
17	Overcup Oak (<i>Quercus lyrata</i>)	0.79	4	New

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Green Ash (<i>Fraxinus pennsylvanica</i>)	18.2%
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	9.1%
Cherrybark Oak (<i>Quercus pagoda</i>)	27.3%
Laurel Oak (<i>Quercus laurifolia</i>)	9.1%
Overcup Oak (<i>Quercus lyrata</i>)	36.4%

Density:

Total Number of Planted Stems 11 / 0.025 acres = 440 stems / acre

Total Number of Desirable Stems* 16 / 0.025 acres = 640 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*), and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 11 / 17 trees x 100 = 65 % survivability



4th Year Monitoring



5th Year Monitoring

Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Green Ash (<i>Fraxinus pennsylvanica</i>)	1	2		
Sycamore (<i>Platanus occidentalis</i>)				1
Loblolly Pine (<i>Pinus taeda</i>)				1
Sweetgum (<i>Liquidambar styraciflua</i>)			5%*	15%*
Total	2	2	>20	>20

*= cover % estimated

Species	Percent of Total
Swamp Chestnut Oak (<i>Quercus michauxii</i>)	11.1%
Cherrybark Oak (<i>Quercus pagoda</i>)	11.1%
Green Ash (<i>Fraxinus pennsylvanica</i>)	33.3%
Overcup Oak (<i>Quercus lyrata</i>)	44.4%

Density:

Total Number of Planted Stems 9 / 0.025 acres = 360 stems / acre

Total Number of Desirable Stems* 69 / 0.025 acres = 2760 stems / acre

* This includes all volunteers listed below except Red Maple (*Acer rubrum*), and Sweetgum (*Liquidambar styraciflua*)

Survivability:

Total Number of Planted Stems 9 / 16 trees x 100 = 56 % survivability



4th Year Monitoring



5th Year Monitoring

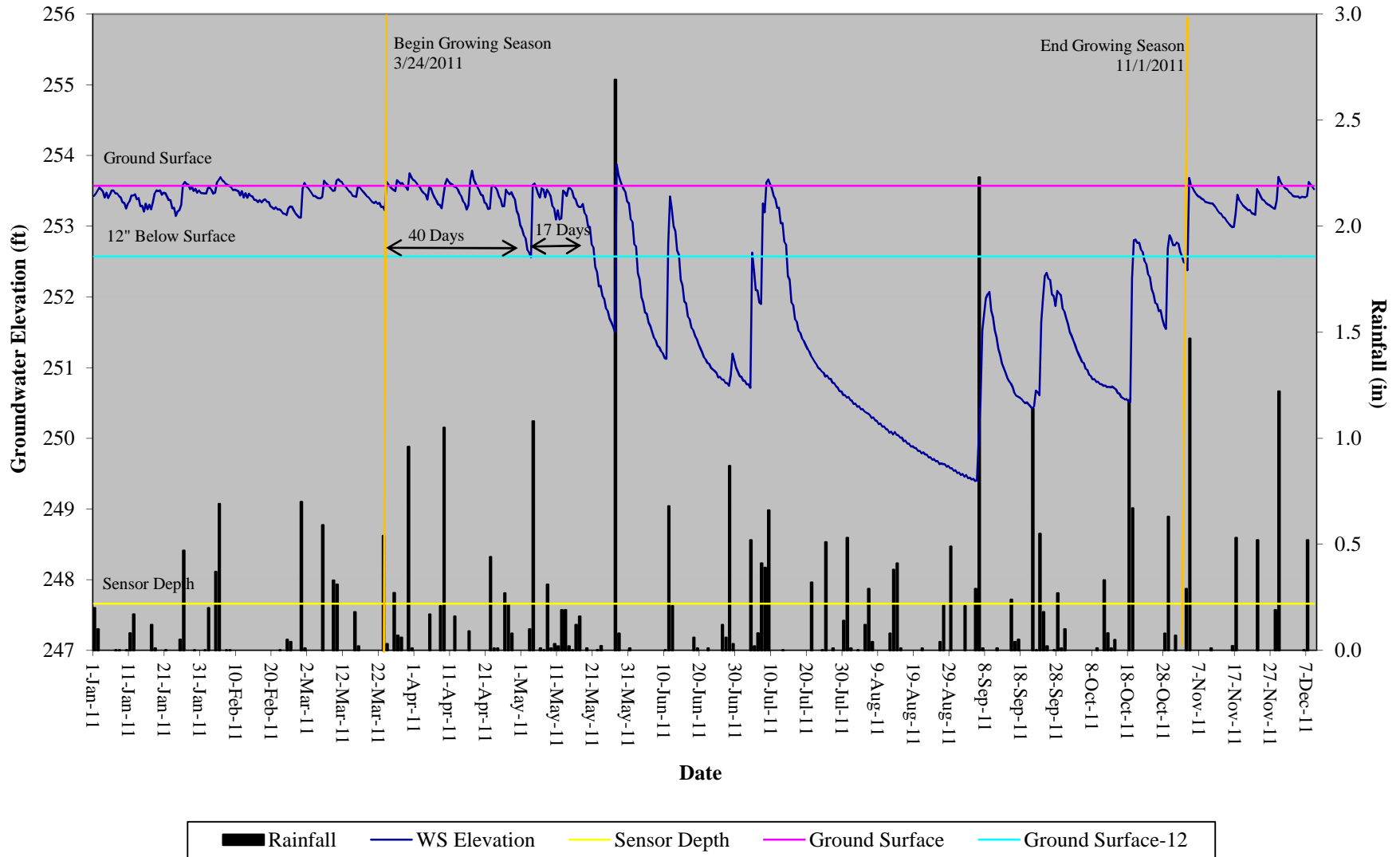
Volunteers:

Species	10-50 cm	50-100 cm	100-150 cm	>150 cm
Sycamore (<i>Platanus occidentalis</i>)			4	
Green Ash (<i>Fraxinus pennsylvanica</i>)		8	32	16
Total		8	36	16

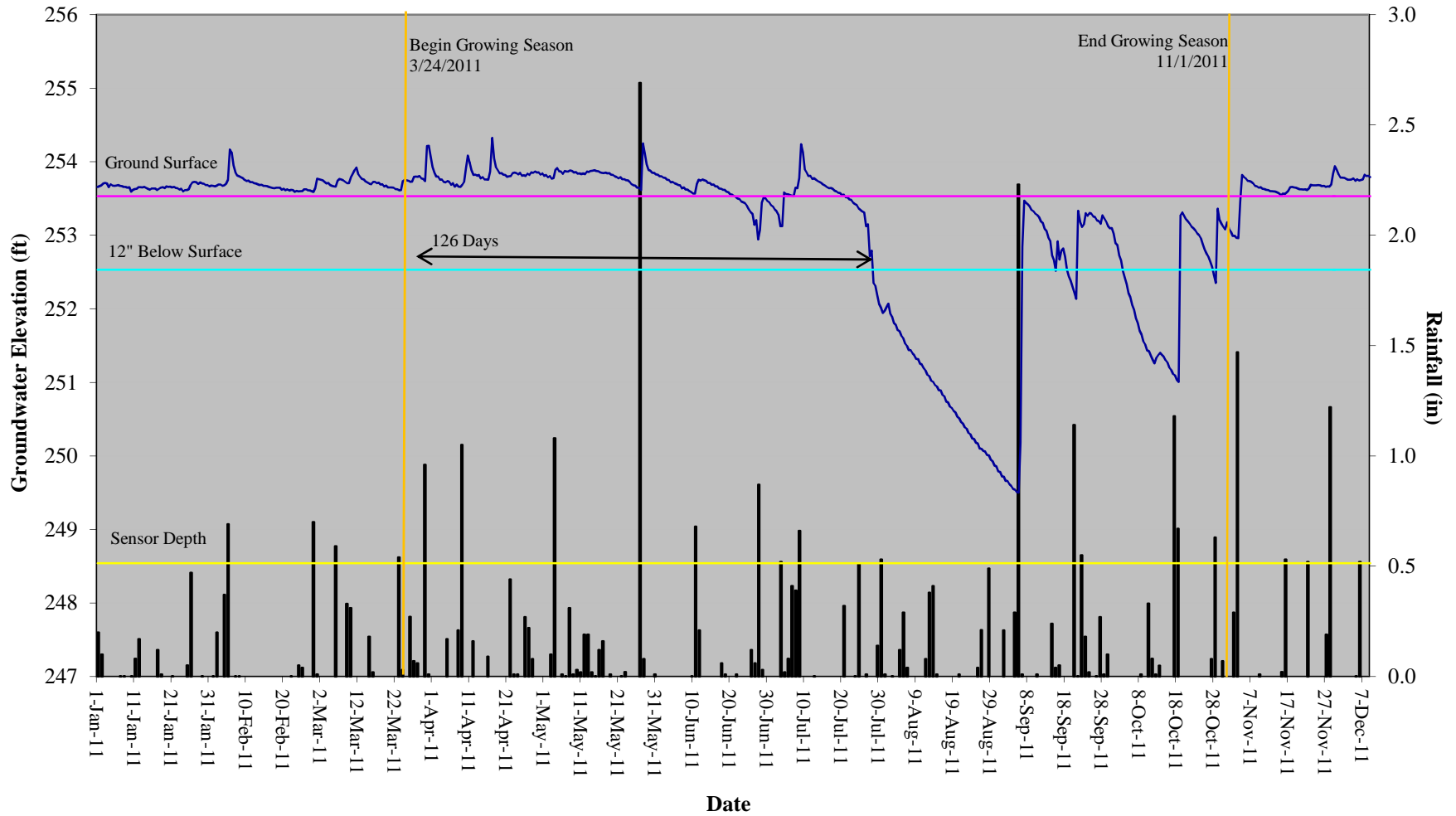
Appendix B

Hydrologic Monitoring and Hydroperiod

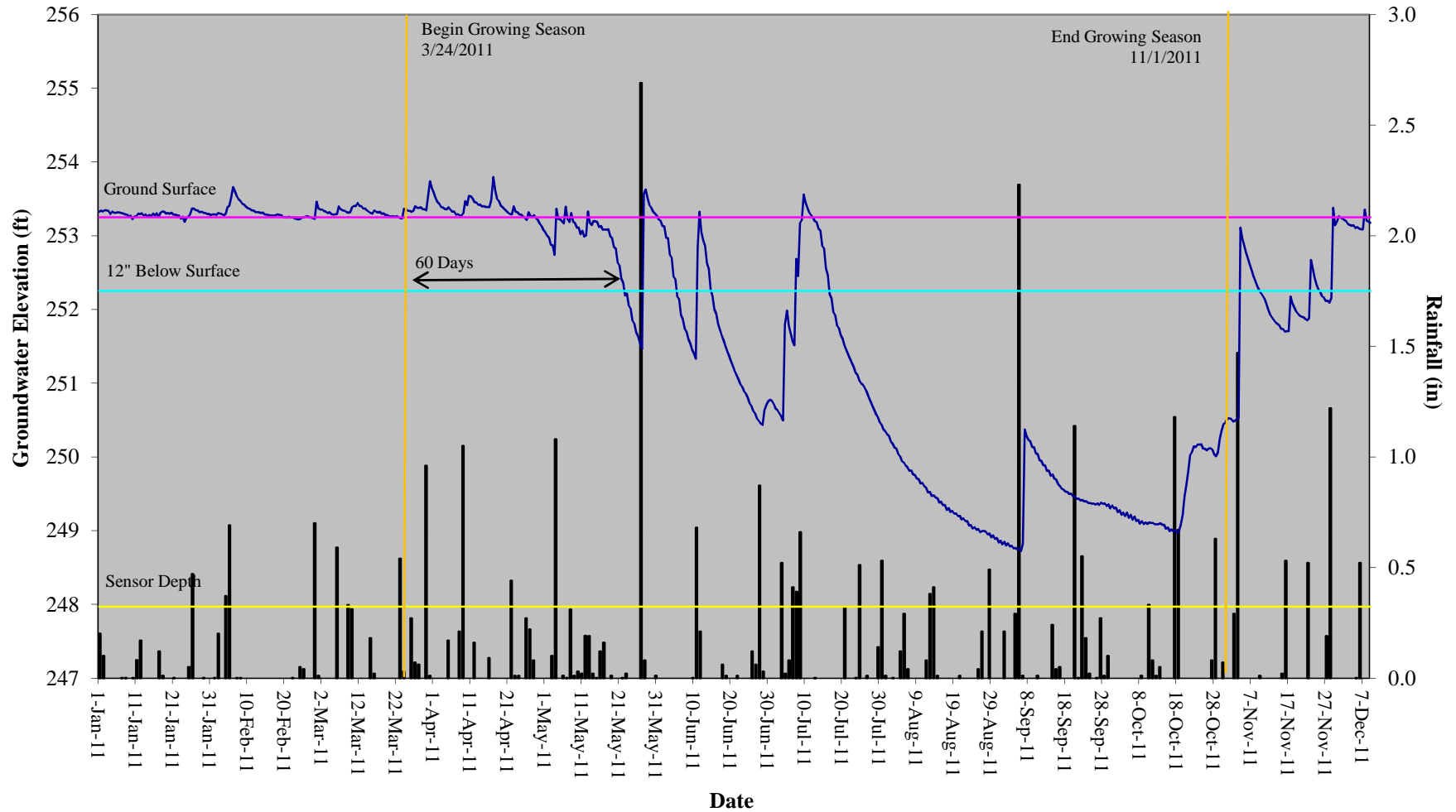
Brown Farm Gauge 1 Hydrograph 1/1/11 to 12/9/11



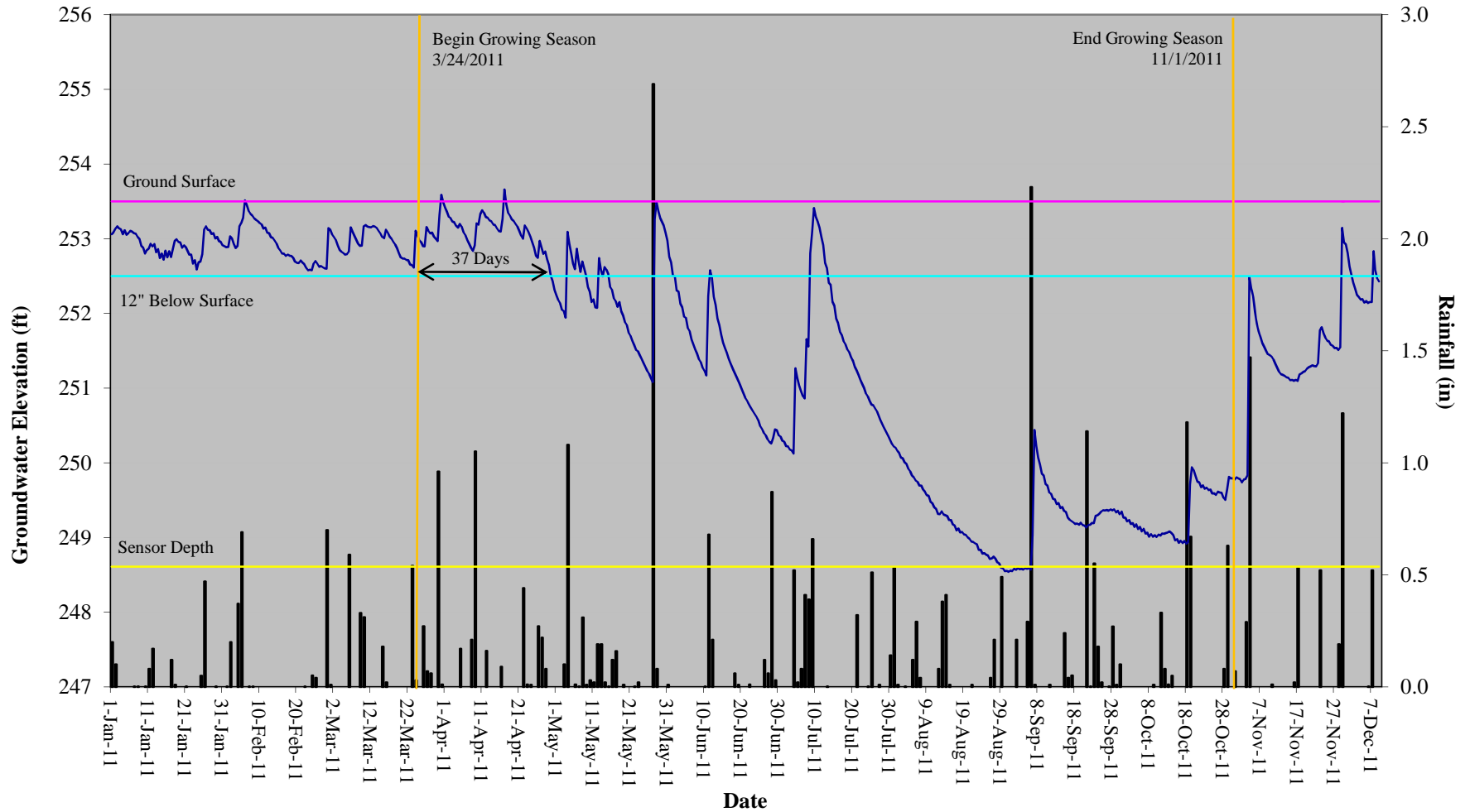
Brown Farm Gauge 2 Hydrograph 1/1/11 to 12/9/11



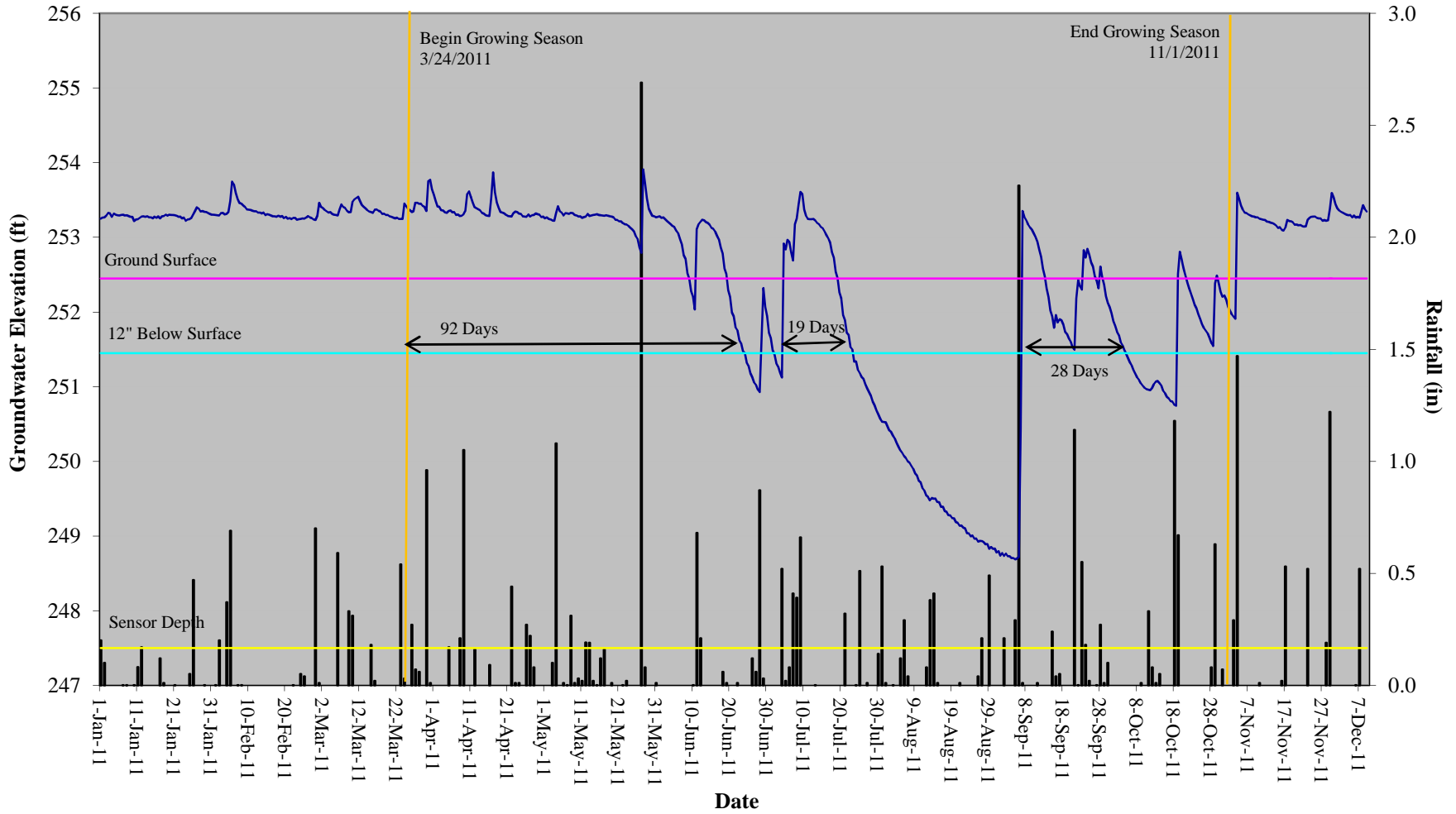
Brown Farm Gauge 3 Hydrograph 1/1/11 to 12/9/11



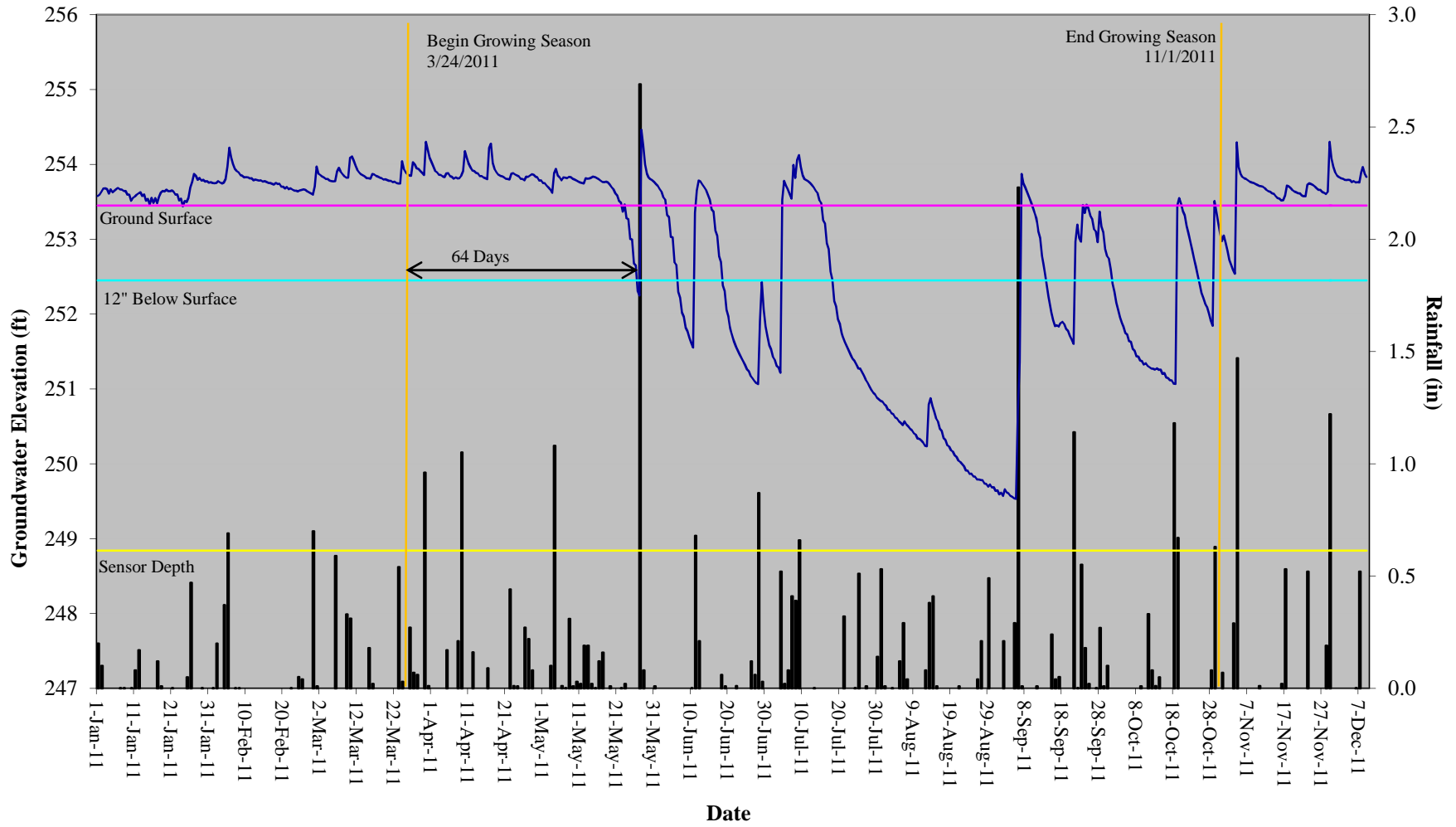
Brown Farm Gauge 4 Hydrograph 1/1/11 to 12/9/11



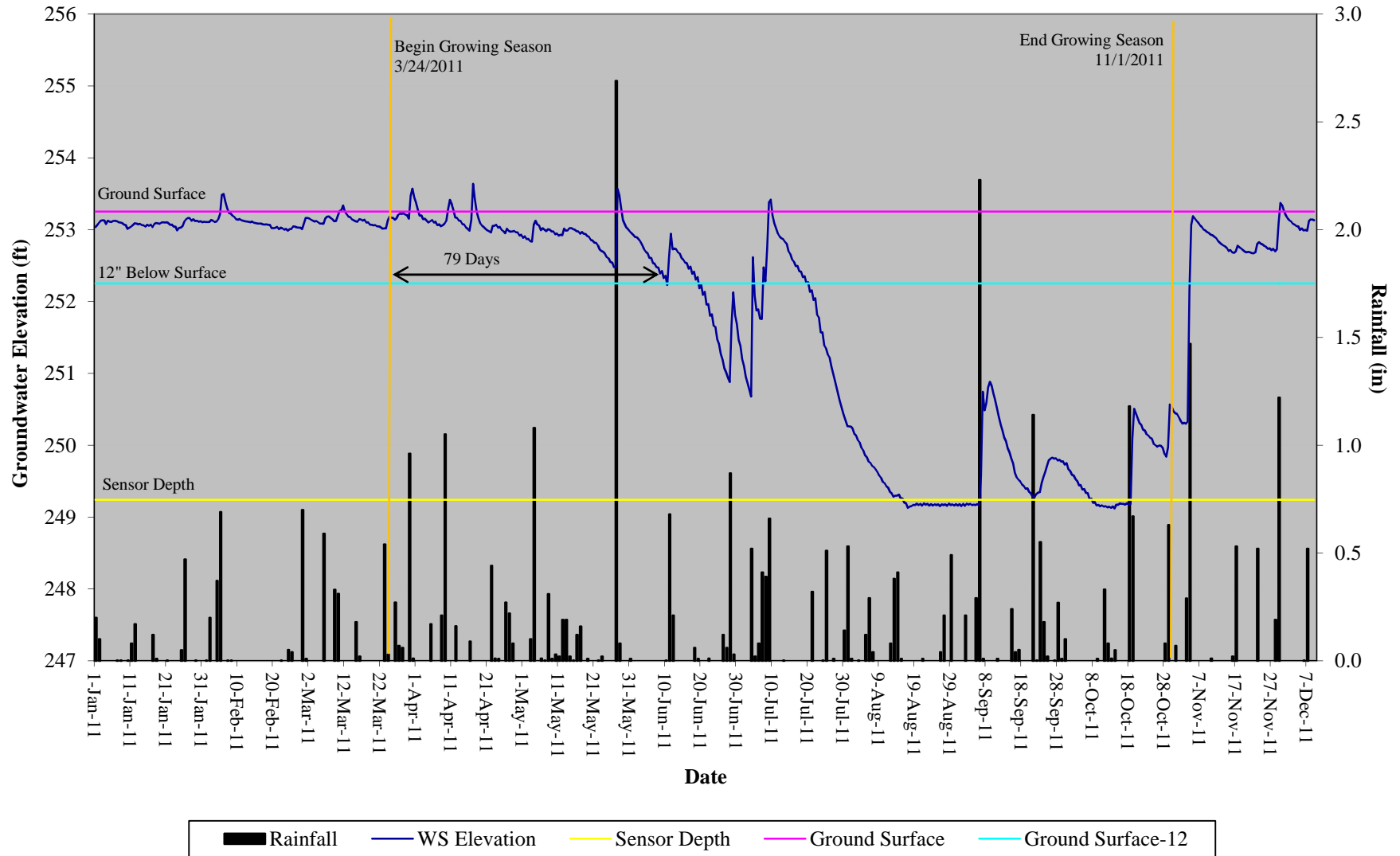
Brown Farm Gauge 5 Hydrograph 1/1/11 to 12/9/11



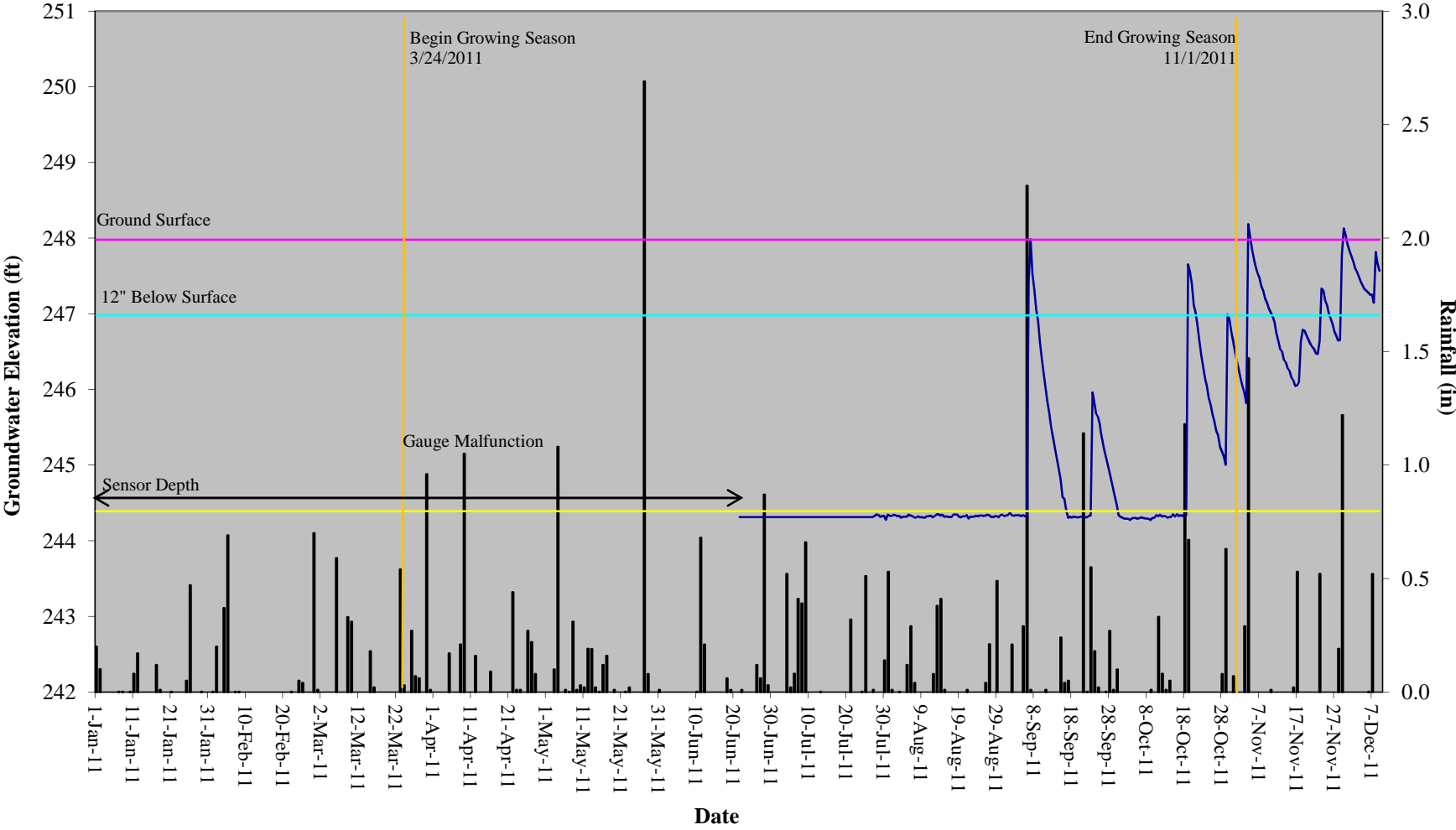
Brown Farm Gauge 6 Hydrograph 1/1/11 to 12/9/11



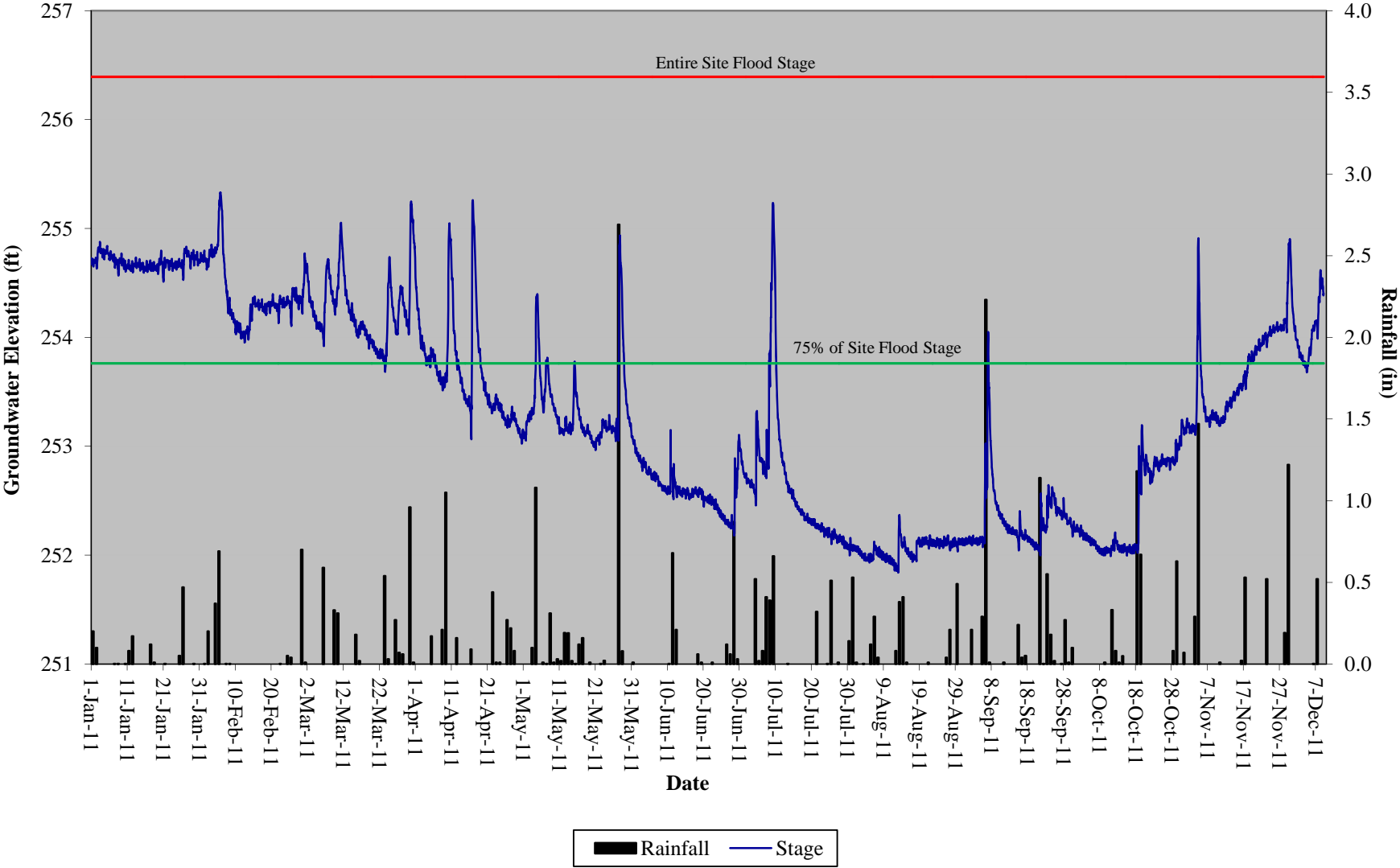
Brown Farm Gauge 7 Hydrograph 1/1/11 to 12/9/11



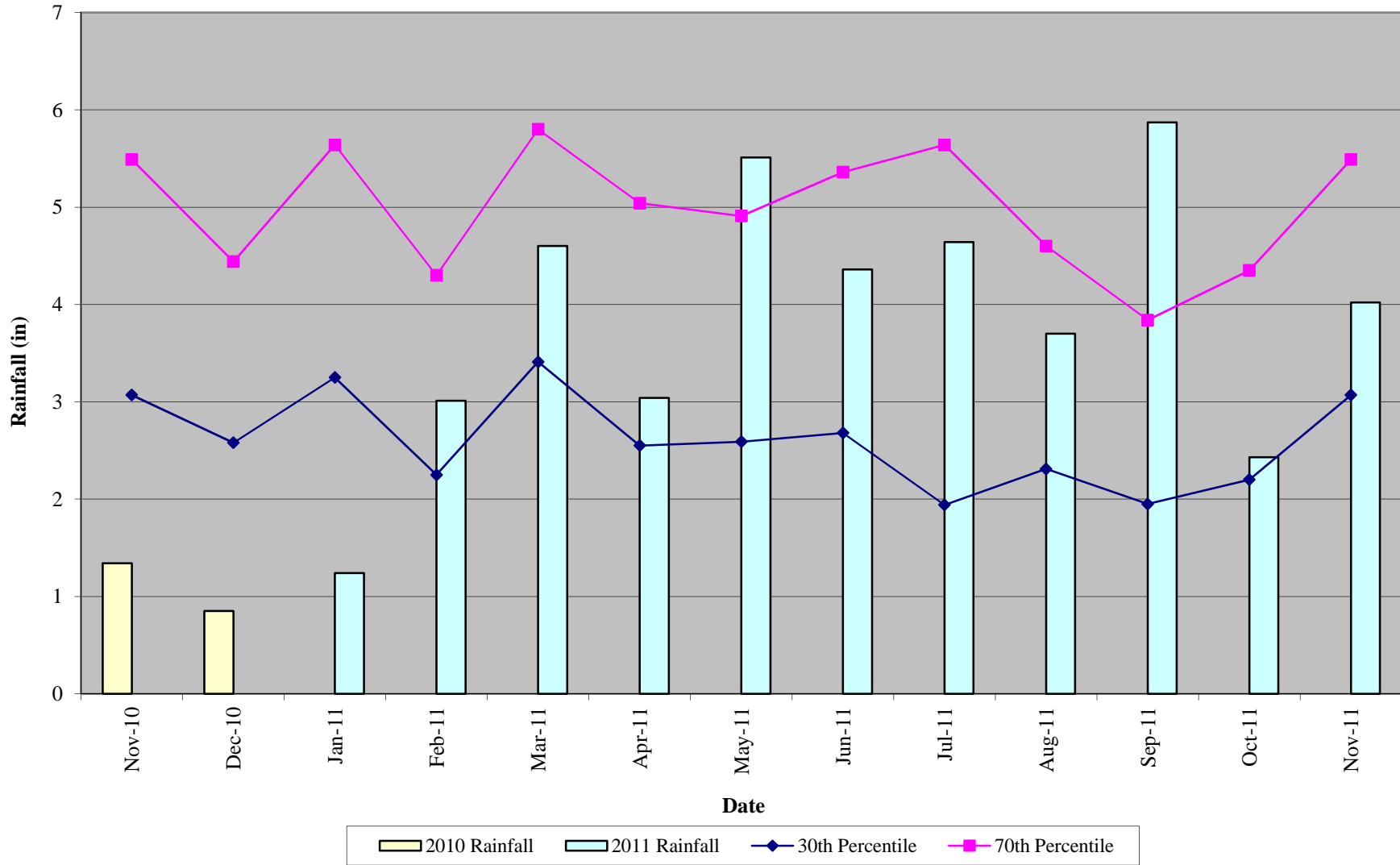
Brown Farm Reference Gauge Hydrograph 1/1/11 to 12/9/11



Brown Farm Wetland Restoration Site
New Hope Creek Stage
1/1/11 to 12/9/11



Brown Farm 30-70 Percentile Graph 2010-2011
Durham, NC Monthly Rainfall



Appendix C

Photo Log



Photo Point 1A: View looking east towards vegetation plot #1. 8/5/11 – MY-05



Photo Point 1B: View looking northeast toward vegetation plot #5. 8/5/11 – MY-05



Photo Point 2: View looking north toward vegetation plot # 3. 8/5/11 – MY-05



Photo Point 3: View looking north with vegetation plot #10 on left. 8/5/11 – MY-05



Photo Point 4: View looking north toward vegetation plot #17. 8/5/11 – MY-05



Photo Point 5: View looking north from the far eastern part of the project site. 8/5/11 – MY-05



Photo Point 6: View looking south toward vegetation plot #20. 8/5/11 – MY-05



Photo Point 7: View looking south. 8/5/11 – MY-05