ANNUAL WETLAND MONITORING REPORT
YEAR 5 (2009)

SLEEPY CREEK
WETLAND AND RIPARIAN BUFFER MITIGATION SITE
LENOIR COUNTY, NORTH CAROLINA

Prepared for:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
ECOSYSTEM ENHANCEMENT PROGRAM
RALEIGH, NORTH CAROLINA

and

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
RALIEGH, NORTH CAROLINA

Prepared by:

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October 2009

EXECUTIVE SUMMARY

Restoration Systems established the Sleepy Creek Wetland and Riparian Buffer Mitigation Site (Project) in the Coastal Plain region of the Neuse River Basin (United States Geological Survey Hydrologic Unit 03020202). The Project will provide compensatory mitigation for in-kind, unavoidable wetland and riparian buffer impacts associated with development in the river basin. Mitigation generated by this project will be used by the North Carolina Ecosystem Enhancement Program and North Carolina Department of Transportation to ensure no net loss of wetland functions associated with transportation improvement projects in the region.

The Project comprises 534 acres within four parcels distributed within the floodplains of Bear Creek and the Neuse River. The 534-acre Project includes a 153.58-acre Core Restoration Site northwest of the Town of LaGrange in Lenoir County and approximately 380 acres of additional wetland management and preservation areas within the Bear Creek/Neuse River regional wetland corridor located near the City of Kinston.

A Detailed Wetland Restoration Plan was completed for the Core Restoration Site in July 2002. The plan outlined methods designed to restore agricultural fields that had been ditched, drained, and cleared for row crop production to pristine riverine wetlands. The plan outlined wetland restoration procedures including 1) ditch/canal backfill, 2) ditch outlet plugs, 3) slough/drainageway construction, 4) embankment construction, 5) depressional wetland excavation, and 6) drainage control outlets.

The objectives of the Detailed Wetland Restoration Plan included the following.

- Establish a backwater cypress-tupelo swamp,
- Provide a perennial source for groundwater recharge through restored bottomland hardwood forest, and
- Facilitate nutrient reduction goals in the Neuse River Basin.

As constructed, the Core Restoration Site provides 96.4 acres of riverine wetland restoration, 39.2 acres of riverine wetland enhancement, and 18.0 acres of upland riparian buffer. In addition, the three wetland management and preservation areas provide 380 acres of riverine wetland preservation.

The Site achieved the defined (or targeted) success criteria for hydrology for 10 of 13 groundwater gauges within bottomland hardwood areas and all of the groundwater gauges within swamp forest areas in the Fifth Monitoring Year (Year 2009) (Table 1). A total of approximately 26.03 inches of rain was documented near the Site at a rain station in Goldsboro (Weather Underground 2009) from March to September 2009, which is 6 inches below the 30-year historic (1971-2000) average normal rainfall for the same months (March to September) of 32.07 inches in Goldsboro (NOAA 2004).

As a whole, vegetation plots across the Site were well above the required 260 stems/acre with an average of 545 tree stems per acre within bottomland hardwood areas and 549 tree stems per acre within swamp forest areas in the Fifth Monitoring Year (Year 2009).

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SLEEPY CREEK WETLAND AND RIPARIAN BUFFER RESTORATION BANK
ANNUAL MONITORING REPORT
YEAR 5 (2009)
LENOIR COUNTY, NORTH CAROLINA

1.0 INTRODUCTION

Restoration Systems established the Sleepy Creek Wetland and Riparian Buffer Mitigation Site (Project) in the Coastal Plain region of the Neuse River Basin (United States Geological Survey Hydrologic Unit 03020202). The Project will provide compensatory mitigation for in-kind, unavoidable wetland and riparian buffer impacts associated with development in the river basin. Mitigation generated by this project will be used by the North Carolina Ecosystem Enhancement Program (NCEEP) and North Carolina Department of Transportation (NCDOT) to ensure no net loss of wetland functions associated with transportation improvement projects (TIPs) in the region.

The Project comprises 534 acres within four parcels distributed within the floodplains of Bear Creek and the Neuse River. The 534-acre Project includes a 153.58-acre Core Restoration Site northwest of the Town of LaGrange in Lenoir County (Figure 1) and approximately 380 acres of additional wetland management and preservation areas within the Bear Creek/Neuse River regional wetland corridor located near the City of Kinston.

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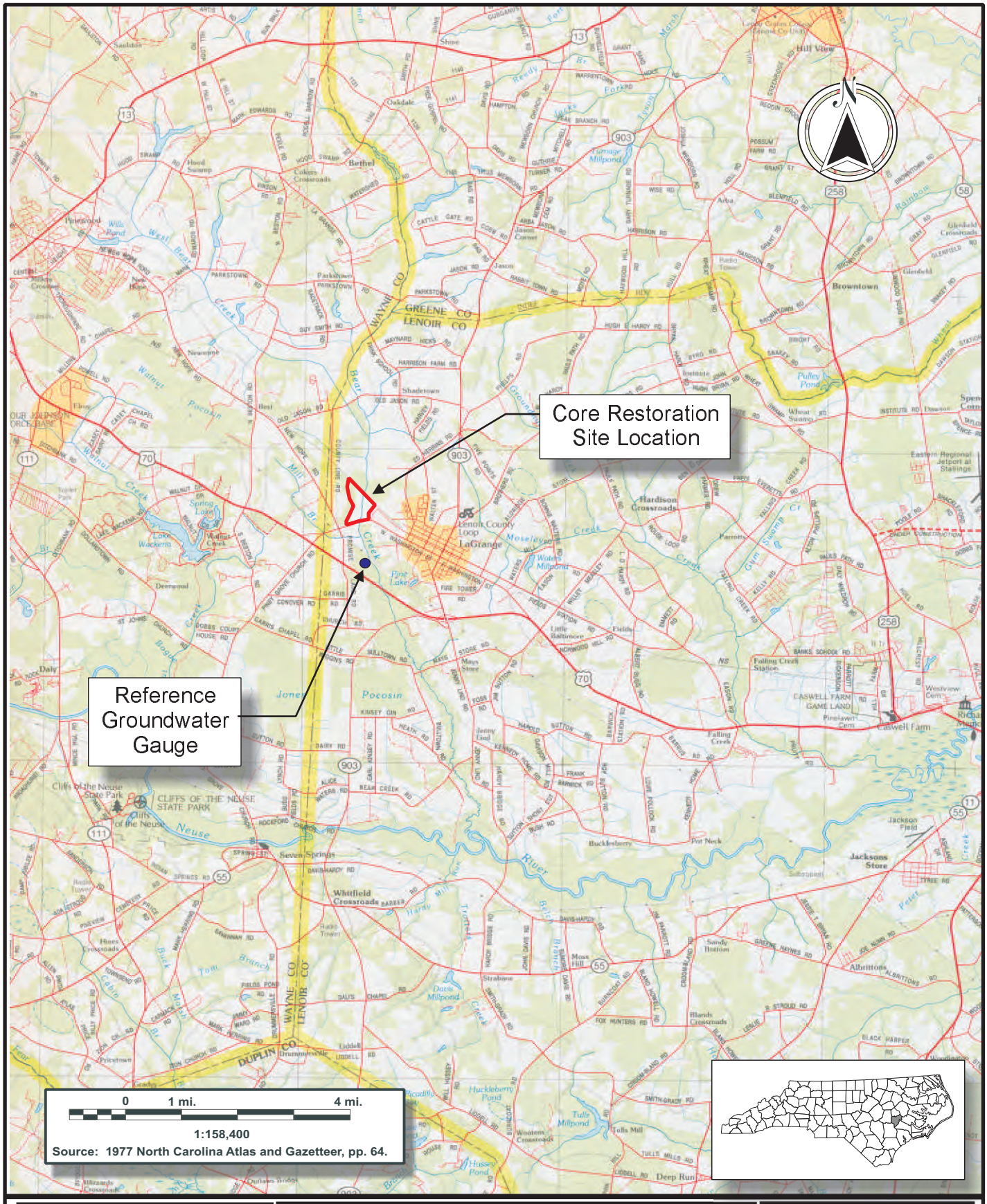
A final amended Detailed Wetland and Riparian Buffer Restoration Plan was completed for the project in July 2004 with final issuance of permits occurring in September 30, 2002, conditioned upon approval of the Detailed Wetland and Riparian Buffer Restoration Plan (approved June 29, 2004). Upon completion of the detailed plan and issuance of permits, construction plans were developed and construction was initiated in October 15, 2004. Backwater Environmental, a subsidiary of Osborne Co. Inc., completed earthwork and grading at the Site on April 27, 2005. Carolina Silvics completed planting of the Site from April 1 through 15, 2005. Axiom Environmental, Inc. completed as-built mitigation plan and as-built construction drawings in July 2006.



Axiom Environmental
2126 Rowland Pond Dr
Willow Spring, NC 27592
(919) 215-1693
(919) 341-3839 fax

SITE LOCATION
SLEEPY CREEK MITIGATION SITE
Lenoir County, North Carolina

Dwn. by:	WGL
Ckd by:	WGL
Date:	Nov 2008
Project:	08-007

FIGURE
1

Information on project managers, owners, and contractors follows:

Owner Information
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Carolina Silvics
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908 Indian Trail Road
Edenton, North Carolina 27932
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As outlined in the Detailed Wetland and Riparian Buffer Restoration Plan, this project was designed and constructed based upon reference (relatively undisturbed) wetlands downstream of the Site within the Bear Creek – Neuse River Regional Wetland Corridor (Figure 1).

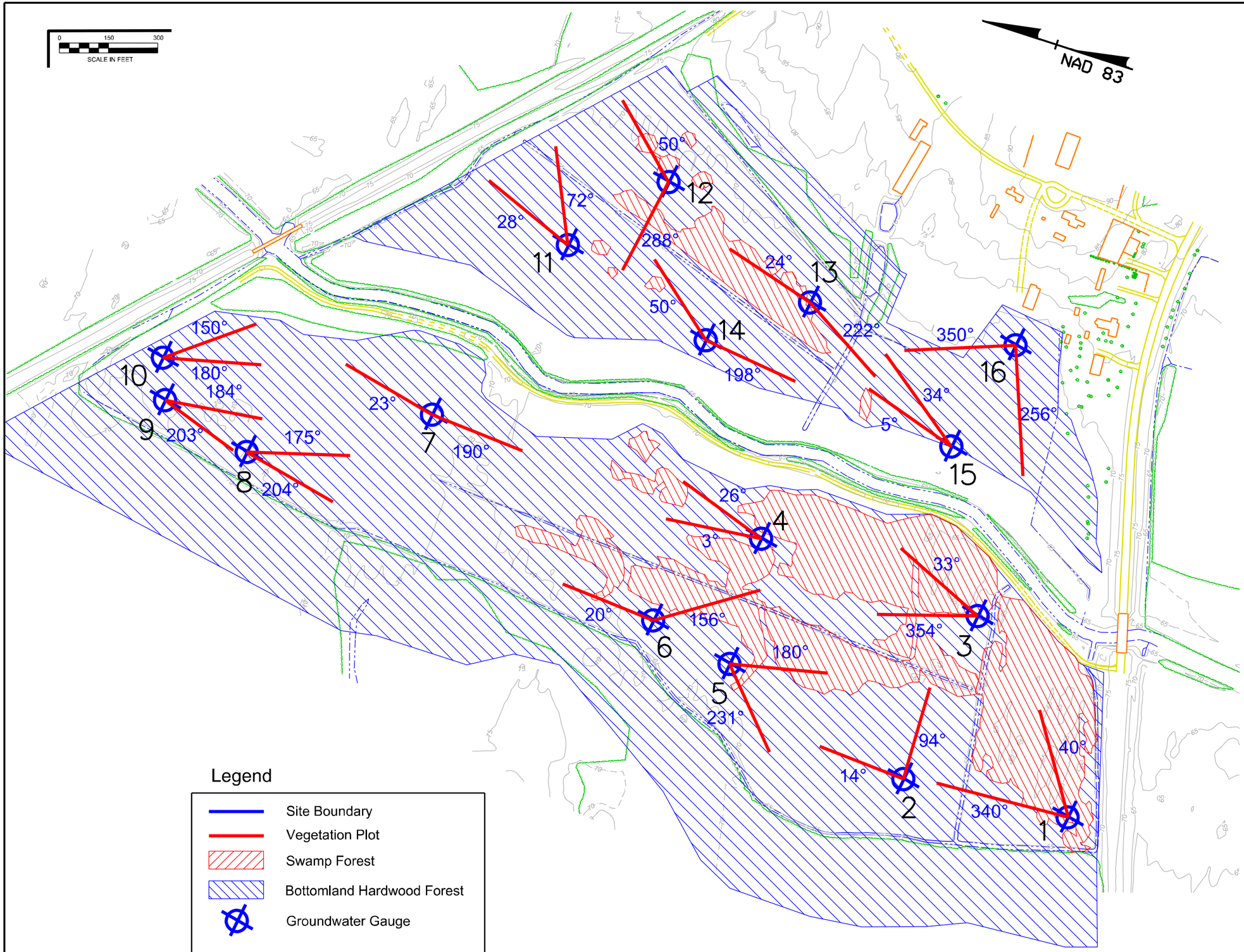
This report represents the Fifth Year Annual Monitoring Report. Monitoring activities were performed throughout Year 2009, including recording groundwater table elevations and plant species densities.

2.0 MONITORING PROGRAM

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

The Core Restoration Site has been subdivided into two monitoring areas including swamp forest and bottomland hardwood forest as depicted in Figure 2. Bottomland hardwood forest areas include floodplain flats adjacent to Bear Creek that are characterized by elevated groundwater tables and a rich diversity of vegetative species. Swamp forest areas are characterized by backwater sloughs that are semipermanently impounded and composed primarily of cypress-tupelo vegetation. The margins between bottomland hardwood forest and swamp forest areas were delineated and located utilizing Global Positions System equipment with reported submeter accuracy.

Swamp forest areas are expected to aggrade due to organic matter accumulation, sediment deposition, and vegetation mat formation and may fluctuate in location and extent throughout the monitoring period. Similarly, bottomland hardwood forest areas may be affected by beaver activity, changes in upstream watershed land use, storm flows, and/or climactic variations. Therefore, provisions for reclassification of bottomland hardwood and swamp forest areas represented an important component to be observed throughout the monitoring period.



RESTORATION SYSTEMS, LLC
Natural Resources Restoration & Conservation

RESTORATION SYSTEMS
1101 HAYNES STREET, STE 107
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NOTES/REVISIONS

Project:

Sleepy Creek Wetland Restoration Site

Lenoir County
North Carolina

Title:

MONITORING PLAN

Scale:	SHEET NO.
1" = 300'	2
Date: Oct 2008	
Project No.: 08-007	

2.1 Wetland Hydrology

2.1.1 Hydrology Monitoring Procedure

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

Sixteen monitoring gauges were installed in wetland restoration areas to provide representative coverage within each physiographic landscape area (Figure 2). In addition, a monitoring gauge was installed in a reference area in a similar landscape position (Figure 1). The growing season dictated by the *Soil Survey of Lenoir County, North Carolina* (USDA 1977) indicates that the beginning and ending dates of the period between the last date in spring and the first date in the fall, on which the probability is 5 years in 10 that the air temperature at 5 feet above the ground surface will fall to 28 degrees Fahrenheit is March 12 through November 15. The Sleepy Creek Wetland and Riparian Restoration Plan dictated a growing season from February 25 to November 29; however, this was incorrectly based on a probability of 5 years in 10 that the air temperature will fall to 24 degrees Fahrenheit. Therefore, hydrologic sampling will be carried out in restoration areas during the growing season (March 12 to November 15) at daily intervals necessary to satisfy hydrology success criteria.

2.1.2 Hydrologic Success Criteria

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

Regulatory Wetland Hydrology Criteria

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

Reference Wetland Site

A monitoring gauge was placed in a reference wetland area located in the vicinity of the Site to provide reference hydroperiods for the bottomland hardwood forest areas.

Based on the *Sleepy Creek Wetland and Riparian Buffer Restoration Plan – Revised* (2004), under normal climatic conditions, the hydrologic success criteria require saturation (free water) within 1 foot of the soil surface for a minimum of 7.5 percent of the growing season for bottomland forest areas depicted in Figure 2 (Bottomland Hardwood Forest). The swamp forest areas as depicted in Figure 2 must support saturation (free water) within 1 foot of the soil surface for a minimum of 15 percent of the growing season (Swamp Forest). This hydroperiod translates to saturation for a minimum, 19-day (7.5 percent) to 37-day (15 percent) consecutive period during the growing season, which extends from March 12 to November 15 (249 days) (USDA 1977).

In drought years, the hydroperiod must exceed 75 percent of the hydroperiod exhibited by the reference gauges located within the same physiographic landscape area.

2.1.3 Hydrological Monitoring Results and Comparison with Success Criteria

Hydrographs for each monitoring location are provided in Appendix A along with daily rainfall totals for 2009 at a rain station in Goldsboro, North Carolina (Weather Underground 2009). Hydrographs show data up to October 9, 2009 for the growing season from March 12 through November 15.

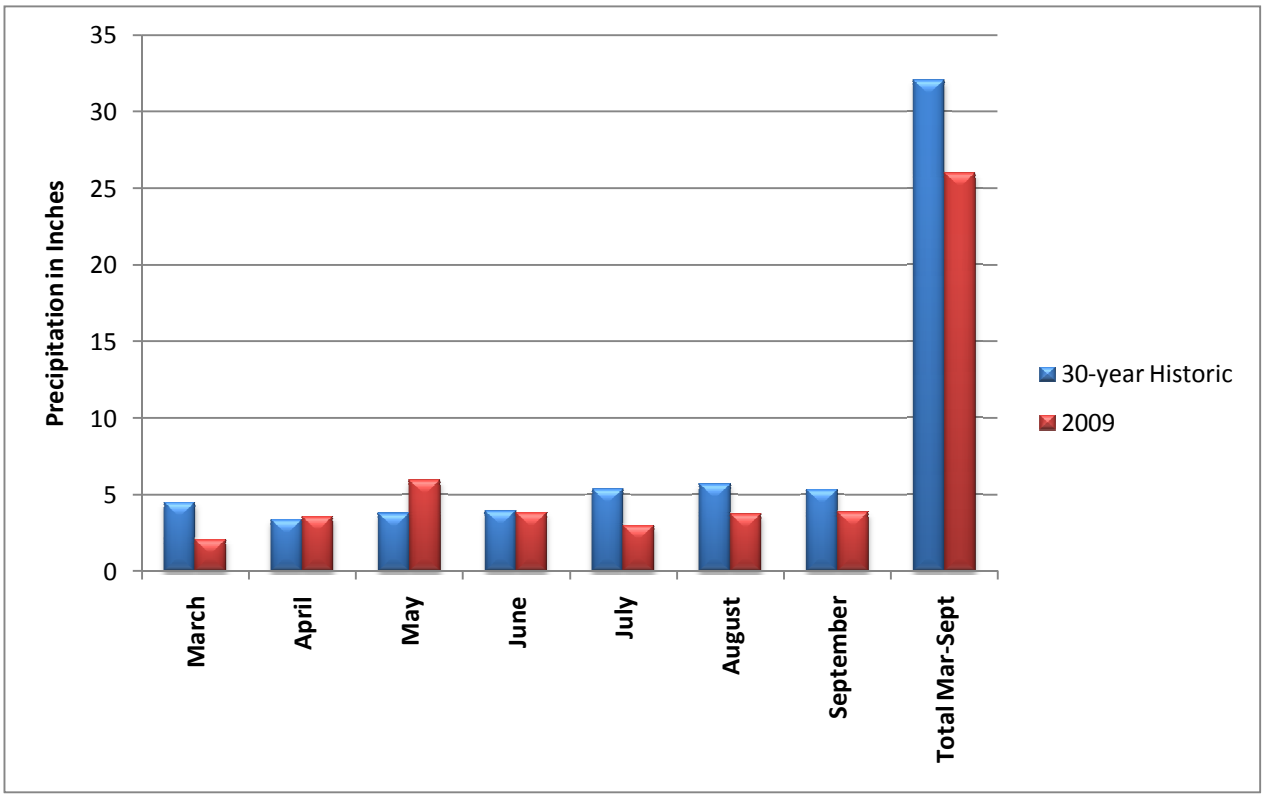
The Site achieved the defined (or targeted) success criteria for hydrology for 10 of 13 groundwater gauges within bottomland hardwood areas and all of the groundwater gauges within swamp forest areas in the Fifth Monitoring Year (Year 2009) (Table 1). A total of approximately 26.03 inches of rain was documented near the Site at a rain station in Goldsboro (Weather Underground 2009) from March to September 2009, which is 6 inches below the 30-year historic (1971-2000) average normal rainfall for the same months (March to September) of 32.07 inches in Goldsboro (NOAA 2004).

Table 1. 2009 (Year 5) Groundwater Gauge Results

Gauge	Community	Max Consecutive Days Saturated During Growing Season (Percent)*	Defined (or Targeted) Success Criteria Achieved
2	bottomland hardwood forest	140 days (56.2 %)	Yes
4	bottomland hardwood forest	45 days (18.1 %)	Yes
5	bottomland hardwood forest	81 days (32.5 %)	Yes
6	bottomland hardwood forest	84 days (33.7 %)	Yes
7	bottomland hardwood forest	11 days (4.4 %)	No
8	bottomland hardwood forest	41 days (16.5 %)	Yes
9	bottomland hardwood forest	49 days (19.7 %)	Yes
10	bottomland hardwood forest	12 days (4.8 %)	No
11	bottomland hardwood forest	84 days (33.7 %)	Yes
12	bottomland hardwood forest	82 days (32.9 %)	Yes
14	bottomland hardwood forest	16 days (6.4 %)	No
15	bottomland hardwood forest	41 days (16.5 %)	Yes
16	bottomland hardwood forest	48 days (19.3 %)	Yes
Ref BH100	bottomland hardwood forest	43 days (17.3 %)	Yes
1	swamp forest	56 days (22.5 %)	Yes
3	swamp forest	45 days (18.1 %)	Yes
13	swamp forest	52 days (20.9 %)	Yes

*Data has been downloaded through October 9, 2009; data for the remainder of the growing season will continue to be collected and will be available upon request.

Figure 3. 2009 Climatic Data



2.2 Vegetation

2.2.1 Vegetation Monitoring Procedure

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

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

Sixteen sample plots were installed within planted areas of the Site to equally represent the various hydrologic regimes and plant communities (Figure 2). Each transect is 600 feet in length and 8 feet in width (0.11 acre) centered on each of the 16 groundwater monitoring gauges. In each sample plot, vegetation parameters to be monitored include species composition and species density. Visual observations of the percent cover of shrub and herbaceous species will also be recorded but not used for vegetative success criteria. Photographs of the 16 vegetation plots are included in Appendix B.

2.2.2 Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for floodplain forest development. Success criteria are dependent upon the density and growth of characteristic forest species. Additional success criteria are dependent upon density and growth of "Character Tree Species," which include planted species, species listed by Schafale and Weakley (1990) as occurring in bottomland and swamp forests, and species identified in the reference forest ecosystems (RFE's). All canopy tree species planted and identified in the reference forest ecosystem will be utilized to define "Character Tree Species" as termed in the success criteria (Table 2).

The vegetation success criteria have been designed to evaluate bottomland hardwood forest and riverine swamp forest separately. This division in success criteria by community type has been applied because bottomland hardwood forests typically contain relatively high tree species diversity while backwater swamp forests are characterized by relatively low diversity, sometimes dominated by one or two tree species.

Bottomland Hardwood Forest

The bottomland hardwood forest areas are depicted in Figure 2. For these vegetative monitoring transects, a minimum mean density of 320 character trees per acre must be surviving for 3 years after initial planting. Subsequently, 290 character trees per acre must be surviving in year 4 and 260 character trees per acre in year 5. In addition, at least five character tree species must be present, and no species can comprise more than 20 percent of the 320 stem per acre total. For species with stem counts above the 20 percent threshold, the excess stems will be discarded from the statistical analysis.

Riverine Swamp Forest

The riverine swamp forest areas are depicted in Figure 2. For these vegetative monitoring transects, an average density of 320 character tree species per acre must be surviving in the first three monitoring years. Subsequently, 290 character tree species per acre must be surviving in year 4 and 260 character tree species per acre in year 5. One planted species may represent up to 100 percent of the required stem per acre total (most likely bald cypress, water tupelo, and/or swamp tupelo).

If vegetation success criteria are not achieved based on average density calculations by community type, the individual plots that do not meet the stem per acre requirement will be identified. Supplemental planting will be performed in those vegetative community areas, as needed, until achievement of vegetation success criteria. Alternatively, that plot, or area adjacent to the plot, may be mapped and reclassified as riverine bottomland hardwood forest or riverine swamp forest habitat.

Table 2. Inventory of Reference Wetland Tree Species in the Neuse River Corridor, Lenoir County

Scientific Name	Common Name	Scientific Name	Common Name
Acer rubrum[1]	Red Maple[1]	*Platanus occidentalis*	American Sycamore
Acer negundo	Box Elder	*Populus heterophylla*	Swamp Cottonwood
Betula nigra	River Birch	*Prunus serotina*	Black Cherry
Carpinus caroliniana	Ironwood	*Quercus alba*	White Oak
Carya aquatica	Water Hickory	*Quercus laurifolia*	Laurel Oak
Carya tomentosa	Mockernut Hickory	*Quercus lyrata*	Overcup Oak
Celtis laevigata	Hackberry	*Quercus michauxii*	Swamp Chestnut Oak
Chamaecyparis thyoides	Atlantic White Cedar	*Quercus nigra*	Water Oak
Cornus spp.	Dogwood	*Quercus pagoda*	Cherrybark Oak
Fagus grandifolia	American Beech	*Quercus phellos*	Willow Oak
Fraxinus caroliniana	Carolina Ash	*Quercus rubra*	Northern Red Oak
Fraxinus pennsylvanica	Green Ash	*Salix caroliniana*[1]	Carolina Willow[1]
Fraxinus profunda	Pumpkin Ash	*Salix nigra*[1]	Black Willow[1]
Gordonia lasianthus	Loblolly Bay	*Symplocus tinctoria*	Horse Sugar
Ilex opaca	American Holly	*Taxodium distichum*	Bald Cypress
Juglans nigra	Black Walnut	*Ulmus alata*	Winged Elm
Juniperus virginiana	Eastern Red Cedar	*Ulmus americana*	American Elm
Liquidambar styraciflua[1]	Sweet Gum[1]	*Ulmus rubra*	Slippery Elm
Liriodendron tulipifera	Tulip Poplar		
Magnolia virginiana	Sweet Bay		
Morus rubra	Red Mulberry		
Nyssa aquatica	Water Tupelo		
Nyssa biflora	Swamp Tupelo		
Nyssa sylvatica	Black Gum		
Oxydendrum arboreum	Sourwood		
Persea palustris	Red Bay		
Pinus serotina	Pond Pine		
Pinus taeda[1]	Loblolly Pine[1]		

1: Loblolly pine, red maple, sweet gum, and willow species have been excluded as character elements by the Mitigation Banking Review Team.

2.2.3 Vegetation Sampling Results and Comparison to Success Criteria

Quantitative sampling of vegetation was conducted in July 2009. Results are provided in Table 3. Vegetation success criteria for year 5 (260 tree stems per acre) were exceeded for the 2009 annual monitoring year with 545 tree stems per acre for bottomland hardwood transects and 549 tree stems per acre for swamp forest transects across the Site. Each individual vegetation plot met success criteria with the exception of bottomland hardwood plots 2 and 5. These plots had decent species diversity and a total number of trees per acre of 227 and 173, respectively counting towards success criteria. Planted species survival may have been reduced within these plots as a result of the extended drought that immediately followed planting.

3.0 CONCLUSIONS

The Site achieved the defined (or targeted) success criteria for hydrology for 10 of 13 groundwater gauges within bottomland hardwood areas and all of the groundwater gauges within swamp forest areas in the Fifth Monitoring Year (Year 2009) (Table 1). A total of approximately 26.03 inches of rain was documented near the Site at a rain station in Goldsboro (Weather Underground 2009) from March to September 2009, which is 6 inches below the 30-year historic (1971-2000) average normal rainfall for the same months (March to September) of 32.07 inches in Goldsboro (NOAA 2004). Groundwater data over the entire monitoring period is summarized in Table 4.

TABLE 3

2009 VEGETATION MONITORING DATA AND RESULTS

Note: Each plot totals 0.11 acre in size.

Community	**Bottomland Hardwood Forest**																**Swamp Forest**					
Species	**Plot 2**	**Plot 4**	**Plot 5**	**Plot 6**	**Plot 7**	**Plot 8**	**Plot 9**	**Plot 10**	**Plot 11**	**Plot 12**	**Plot 14**	**Plot 15**	**Plot 16**	**Totals**	**Total/ Acre**	**Total Tree Stems/Acre Counting Towards Success Criteria***	**Plot 1**	**Plot 3**	**Plot 13**	**Totals**	**Total/ Acre**	**Total Tree Stems/Acre Counting Towards Success Criteria***
Acer rubrum (red maple)	210	100	220	230	14	120	150	48	80	260	250	1	13	1696	1186	0	70	2	300	372	1127	0
Baccharis halimifolia (eastern baccharis)	26	5	26	70	23	130	50	5	55	280	140	38	40	888	621	0	14	1	40	55	167	0
Betula nigra (river birch)	1	410	0	32	43	46	8	3	76	31	560	300	390	1900	1329	52	2	144	260	406	1230	52
Carya cordiformis (bitternut hickory)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carya illinoinensis (pecan)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carya sp. (hickory)	0	0	0	0	0	0	13	0	0	0	0	2	7	22	15	15	0	0	2	2	6	6
Cornus amomum (silky dogwood)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diospyros virginiana (persimmon)	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
Fraxinus pennsylvanica (green ash)	0	2	0	0	4	7	16	3	15	2	11	5	3	68	48	48	0	2	0	2	6	6
Ilex opaca (American holly)	0	0	0	0	1	0	0	0	0	2	0	0	3	6	4	4	0	0	0	0	0	0
Juniperus virginiana (eastern red cedar)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	6	0
Ligustrum sinense (Chinese privet)	0	0	0	0	0	0	0	0	0	2	0	9	10	21	15	0	0	0	0	0	0	0
Liquidambar styraciflua (sweetgum)	17	0	2	12	12	230	80	32	90	270	70	64	9	888	621	0	6	1	110	117	355	0
Liriodendron tulipifera (tulip poplar)	0	0	0	0	2	1	1	0	2	0	0	0	2	8	6	6	0	0	0	0	0	0
Morella sp. (wax myrtle)	0	0	0	0	0	0	0	1	0	0	0	0	1	2	1	1	0	0	0	0	0	0
Morus sp. (mulberry)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myrica cerifera (wax myrtle)	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0
Nyssa aquatica (water tupelo)	19	0	12	18	0	7	1	0	4	19	17	2	0	99	69	52	6	3	16	25	76	76
Nyssa biflora (swamp tupelo)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nyssa sp. (swamp/water tupelo)	19	62	13	9	7	14	9	2	5	4	3	15	6	168	117	52	7	7	3	17	52	52
Pinus taeda (loblolly pine)	69	0	33	32	24	340	480	40	3	2	2	1	7	1033	722	0	0	0	3	3	9	0
Platanus occidentalis (American sycamore)	0	5	0	1	6	2	11	6	4	9	3	4	40	91	64	52	0	0	0	0	0	0
Populus heterophylla (cottonwood)	0	0	0	0	0	0	0	0	0	0	1	0	1	2	1	1	0	0	1	1	3	3
Prunus angustifolia (chickasaw plum)	0	0	0	0	0	0	0	0	3	0	0	0	0	3	2	2	0	0	0	0	0	0
Prunus serotina (black cherry)	0	0	0	1	2	0	0	0	2	0	0	0	2	7	5	5	0	0	0	0	0	0
Quercus coccinea (scarlet oak)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quercus falcata (northern red oak)	0	1	0	0	0	0	1	1	0	0	1	0	0	4	3	3	0	0	0	0	0	0
Quercus laurfiolia (laurel oak)	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
Quercus lyrata (overcup oak)	0	9	0	0	3	9	20	3	9	6	4	14	10	87	61	52	0	4	2	6	18	18
Quercus michauxii (swamp chestnut oak)	0	20	0	1	1	0	1	5	2	0	3	1	0	34	24	24	0	4	0	4	12	12
Quercus nigra (water oak)	5	9	0	1	6	16	13	4	6	1	1	2	3	67	47	47	6	2	4	12	36	36
Quercus pagoda (cherrybark oak)	0	1	0	0	1	1	0	1	0	3	5	0	2	14	10	10	0	0	0	0	0	0
Quercus phellos (willow oak)	0	19	0	5	10	16	7	18	5	9	1	10	13	113	79	52	1	2	3	6	18	18
Quercus sp. (oak)	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	2	2	6	6
Rhus copallinum (winged sumac)	9	0	5	2	54	15	4	0	0	0	0	4	0	93	65	0	0	0	20	20	61	0
Rhus glabra (smooth sumac)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salix caroliniana (coastal plain willow)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salix nigra (black willow)	0	0	0	0	0	1	0	0	1	0	0	0	0	2	1	0	0	0	0	0	0	0
Salix sp. (willow)	0	9	1	4	2	0	0	0	5	56	73	20	64	234	164	0	3	28	29	60	182	0
Sassafras albidum (sassafras)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taxodium distichum (bald cypress)	10	5	15	18	9	14	9	0	25	0	0	23	17	145	101	52	42	14	31	87	264	264
Ulmus sp. (elm)	0	8	0	0	2	0	1	2	0	1	0	0	1	15	10	10	0	0	0	0	0	0
Ulmus rubra (slippery elm)	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0
TOTAL	**386**	**666**	**328**	**436**	**226**	**969**	**875**	**174**	**393**	**958**	**1145**	**515**	**644**	**7715**	**5395**		**158**	**214**	**827**	**1199**	**3633**	
TOTAL COUNTING TOWARDS SUCCESS CRITERIA	**25**	**57**	**19**	**33**	**52**	**52**	**59**	**37**	**58**	**44**	**40**	**46**	**60**				**64**	**44**	**70**			
TOTAL/ACRE COUNTING TOWARDS SUCCESS CRITERIA	**227**	**518**	**173**	**300**	**473**	**473**	**536**	**336**	**527**	**400**	**364**	**418**	**545**			**545**	**582**	**400**	**636**			**549**

* Success criteria requires that within bottomland hardwood areas no species may make up more than 20 percent of the 260 stem/acre total. Using this criteria, no species can provide more than 52 stems/acre towards success criteria (or 6 stems/0.11 acre plot).
Within swamp forest areas, success criteria dictates that one species may make up 100 percent of the 260 stem/acre requirement, most likely bald cypress, swamp tupelo, or water tupelo.

Table 4. Summary of Groundwater Gauge Results

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)				
	Year 1 (2005)	Year 2 (2006)	Year 3 (2007)	Year 4 (2008)	Year 5 (2009)***
Bottomland Hardwood					
2	Yes/102 days (41.0 percent)	Yes/81 days (33 percent)	Yes/249 days (100 percent)	Yes/87 days (34.9 percent)	Yes/140 days (56.2 %)
4	Yes/42 days (16.9 percent)	Yes/28 days (11 percent)	Yes/77 days (30.9 percent)	Yes/66 days (26.5 percent)	Yes/45 days (18.1 %)
5	Yes/97 days (39.0 percent)	Yes/77 days (31 percent)	Yes/157 days (63.1 percent)	Yes/84 days (33.7 percent)	Yes/81 days (32.5 %)
6	Yes/80 days (32.1 percent)	Yes/82 days (33 percent)	Yes/157 days (63.1 percent)	Yes/81 days (32.5 percent)	Yes/84 days (33.7 %)
7	Yes/26 days (10.4 percent)	No/6 days (2 percent)	No**/17 days (6.8 percent)	Yes/21 days (8.4 percent)	No/11 days (4.4 %)
8	No/18 days (7.2 percent)	No/12 days (5 percent)	Yes/77 days (30.9 percent)	Yes/45 days (18.1 percent)	Yes/41 days (16.5 %)
9	No/16 days (6.4 percent)	Yes/19 days (8 percent)	Yes/57 days (22.9 percent)	Yes/61 days (24.5 percent)	Yes/49 days (19.7 %)
10	Yes/25 days (10.0 percent)	No/12 days (5 percent)	Yes/43 days (17.3 percent)	No/8 days (3.2 percent)	No/12 days (4.8 %)
11	Yes/50 days (20.1 percent)	Yes/29 days (11 percent)	Yes/31 days (12.4 percent)	No/13 days (5.2 percent)	Yes/84 days (33.7 %)
12	Yes/249 days (100 percent)	Yes/100 days (40 percent)	Yes/157 days (63.1 percent)	Yes/84 days (33.7 percent)	Yes/82 days (32.9 %)
14	Yes/50 days (20.1 percent)	No/12 days (5 percent)	Yes/30 days (12.0 percent)	No/13 days (5.2 percent)	No/16 days (6.4 %)
15	No/11 days (4.4 percent)	No/12 days (5 percent)	Yes/34 days (13.7 percent)	No/6 days (2.4 percent)	Yes/41 days (16.5 %)
16	Yes/81 days (32.5 percent)	Yes/78 days (31 percent)	Yes/113 days (45.4 percent)	Yes/73 days (29.3 percent)	Yes/48 days (19.3 %)
Ref BH100	No/3 days (1.2 percent)*	Yes/89 days (36 percent)	Yes/86 days (34.5 percent)	Yes/46 days (18.5 percent)	Yes/43 days (17.3 %)
Swamp Forest					
1	Yes/100 days (40.2 percent)	Yes/81 days (33 percent)	Yes/249 days (100 percent)	Yes/104 days (41.8 percent)	Yes/56 days (22.5 %)
3	Yes/32 days (12.9 percent)	Yes/77 days (31 percent)	Yes/111 days (44.6 percent)	Yes/66 days (26.5 percent)	Yes/45 days (18.1 %)
13	Yes/36 days (14.5 percent)	Yes/82 days (33 percent)	Yes/144 days (57.8 percent)	Yes/80 days (32.1 percent)	Yes/52 days (20.9 %)

*Gauge malfunctioned April 10, 2005. Data only available for March 12 through April 10, 2005 for the 2005 growing season.

**Gauge readings were irratic and gauge was replaced prior to year 4 (2008) monitoring.

***Data has been downloaded through October 9, 2009; data for the remainder of the growing season will continue to be collected and will be available upon request.

As a whole, vegetation plots across the Site were well above the required 260 stems/acre with an average of 545 tree stems per acre within bottomland hardwood areas and 549 tree stems per acre within swamp forest areas in the Fifth Monitoring Year (Year 2009). Vegetation data over the entire monitoring period is summarized in the following table.

Table 5. Summary of Vegetation Plot Results

Plot	Stems/Acre Counting Towards Success Criteria				
	Year 1 (2005)	Year 2 (2006)	Year 3 (2007)	Year 4 (2008)	Year 5 (2009)
Bottomland Hardwoods					
2	273	291	309	273	227
4	455	700	655	573	518
5	227	191	255	173	173
6	218	345	446	336	300
7	436	527	382	445	473
8	327	600	564	555	473
9	291	564	592	518	536
10	264	509	391	409	336
11	382	673	646	773	527
12	473	464	400	373	400
14	336	518	428	364	364
15	300	582	410	536	418
16	400	600	755	818	545
Average Bottomland Hardwood Plots	**433**	**734**	**624**	**568**	**545**
Swamp Forest					
1	527	564	501	382	582
3	255	418	774	382	400
13	436	645	1829	591	636
Average Swamp Forest Plots	**419**	**581**	**1032**	**472**	**549**

2009 represents the fifth and final year of monitoring activities at the Sleepy Creek Wetland Restoration Site. Over the course of the monitoring period, all groundwater gauges met hydrological success (Table 4) with the exception of a few scattered gauges during different years due to their position along the wetland/upland margin and/or low rainfall during the growing season or a gauge malfunction. All vegetation transects, with the exception of Transects 2 and 5, were above the targeted density of 260 stems/acre during all monitoring years (Table 5). Although Transects 2 and 5 were slightly below the target density, native woody vegetation within the Site is developing very well and is being colonized by woody and herbaceous perennial shrubs and forbs and increasing numbers of woody stems.

4.0 REFERENCES

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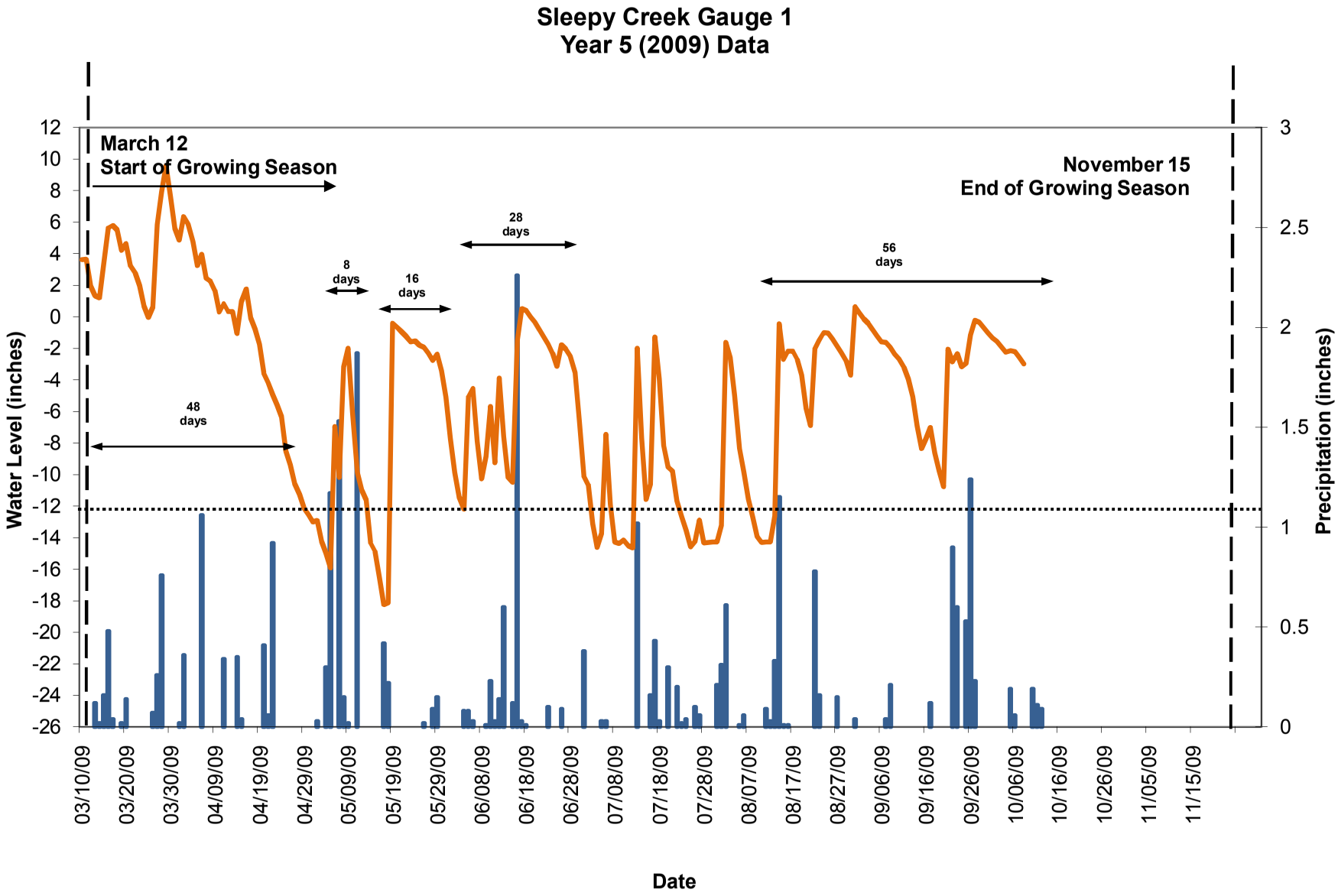
APPPENDIX A
2009 GAUGE DATA


Sleepy Creek Gauge 1
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
48 days
8 days
16 days
28 days
56 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
-26
3
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2
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0.5
0
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03/20/09
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04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
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07/18/09
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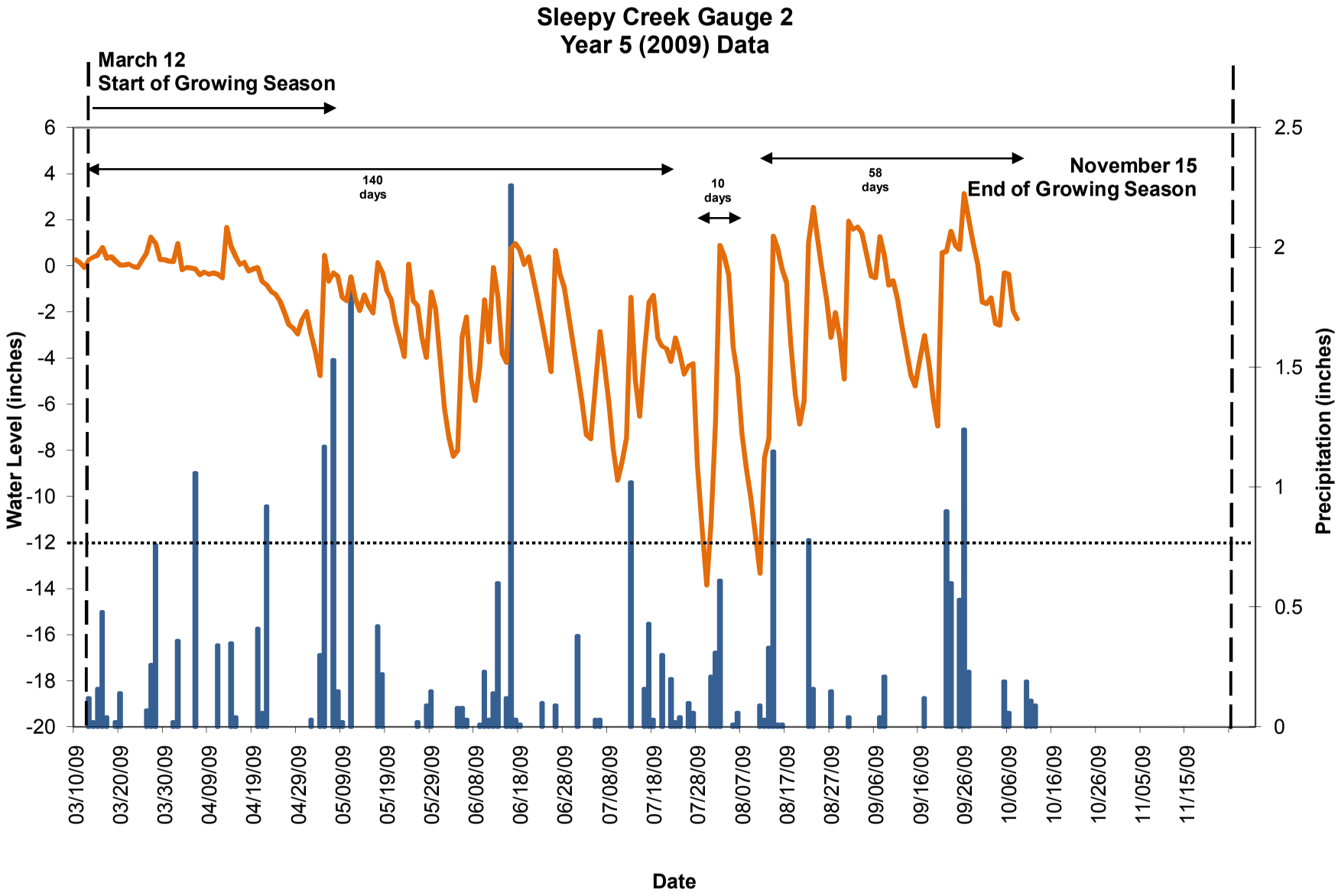
11/15/09


Sleepy Creek Gauge 2
Year 5 (2009) Data
March 12
Start of Growing Season
140
days
10
days
58
days
November 15
End of Growing Season
Water Level (inches)
Precipitation (inches)
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
06/08/09
06/18/09
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07/08/09
07/18/09
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08/17/09
08/27/09
09/06/09
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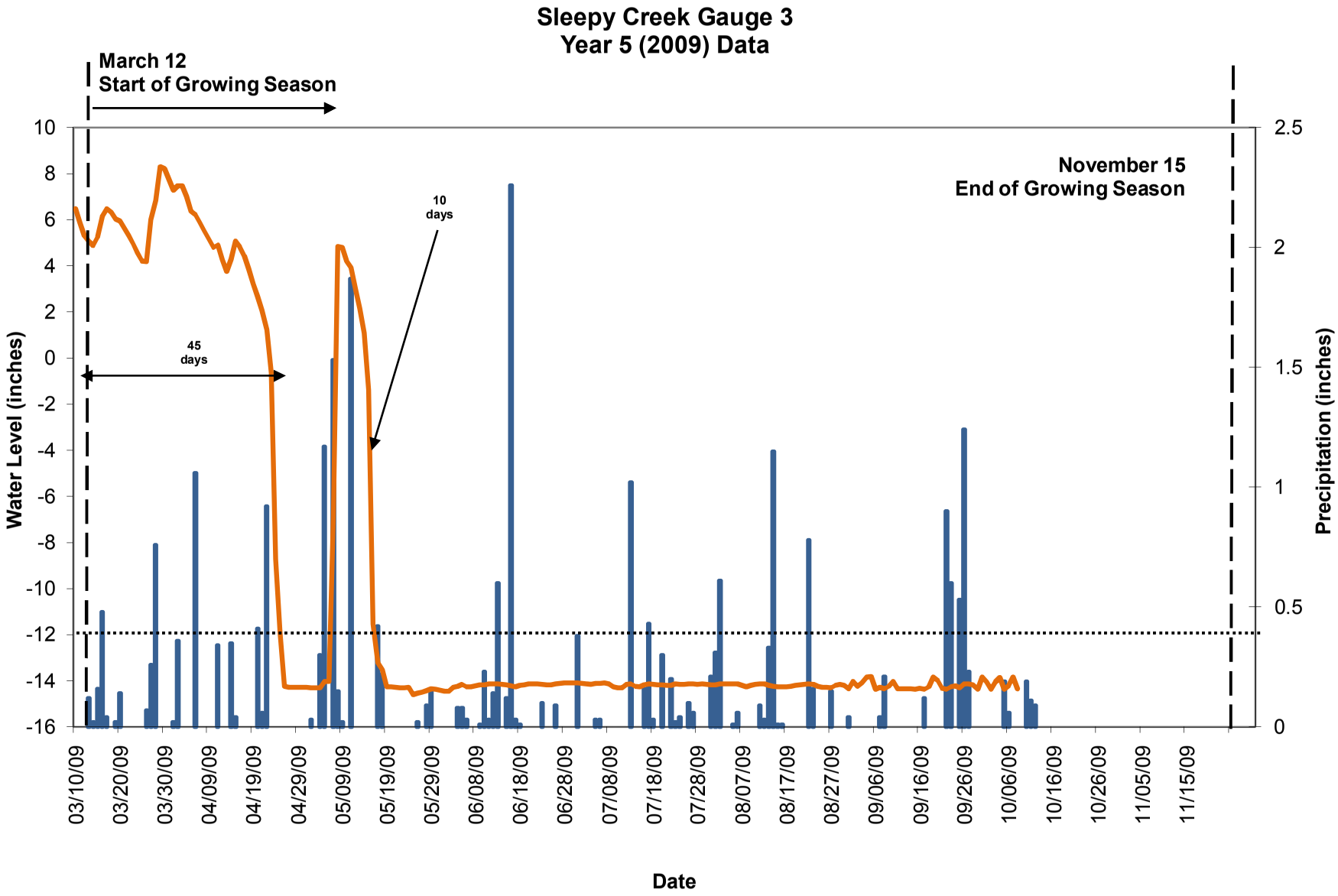
09/26/09
10/06/09
10/16/09
10/26/09
11/05/09
11/15/09
Date


Sleepy Creek Gauge 3
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
10
days
45
days
Water Level (inches)
Precipitation (inches)
Date
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
06/08/09
06/18/09
06/28/09
07/08/09
07/18/09
07/28/09
08/07/09
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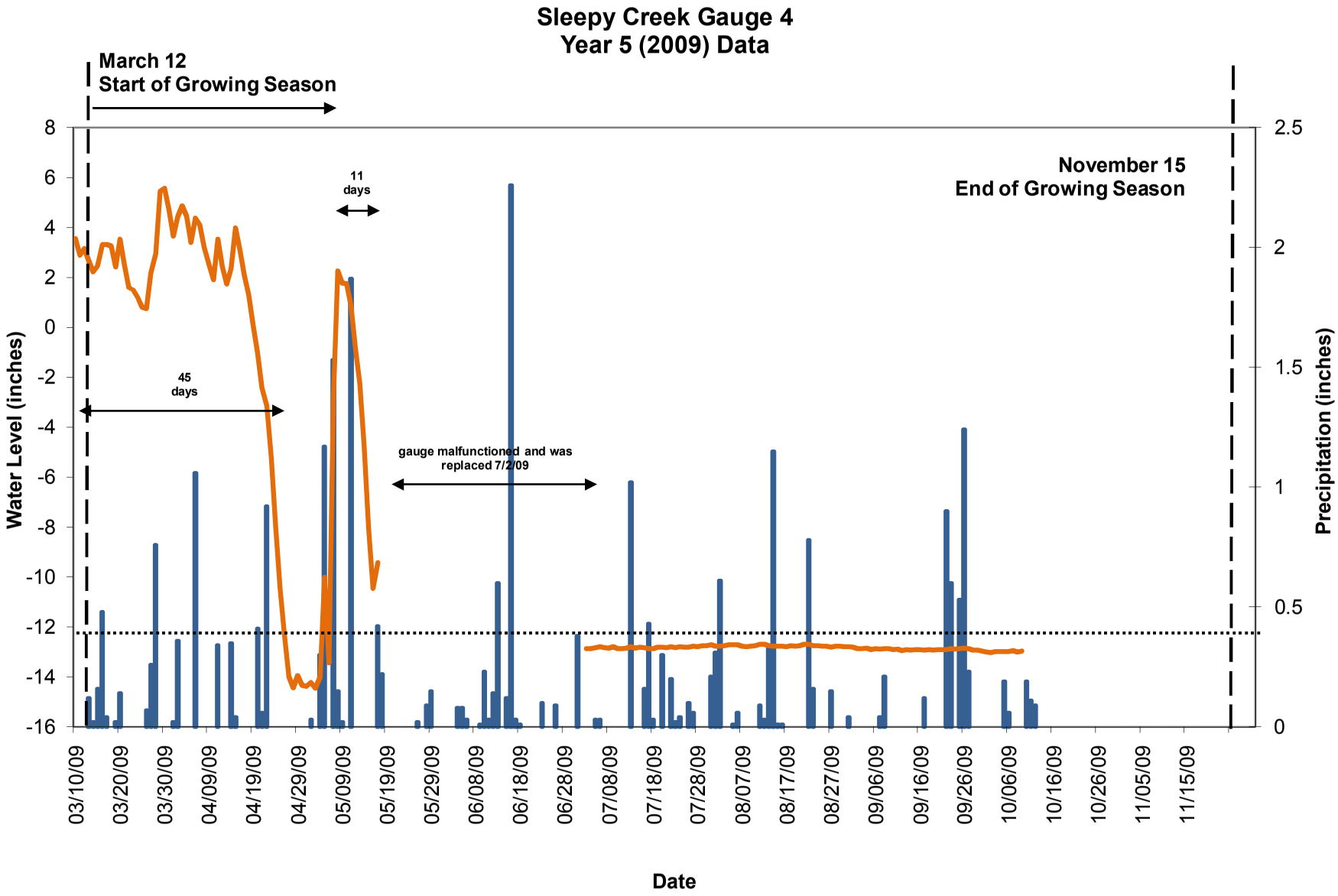
10/16/09
10/26/09
11/05/09
11/15/09


Sleepy Creek Gauge 4
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
11
days
45
days
gauge malfunctioned and was
replaced 7/2/09
Water Level (inches)
Precipitation (inches)
Date
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
06/08/09
06/18/09
06/28/09
07/08/09
07/18/09
07/28/09
08/07/09
08/17/09
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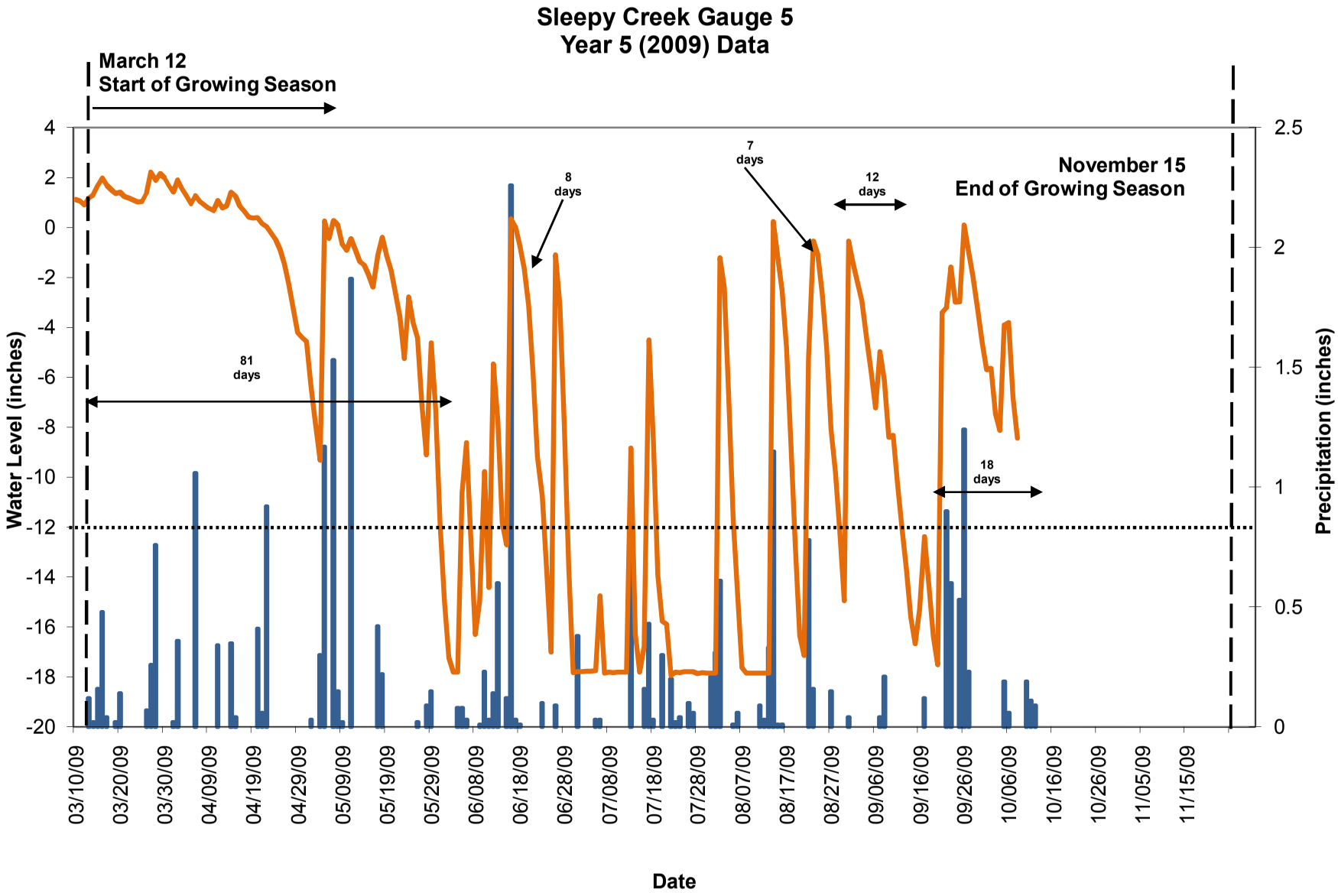
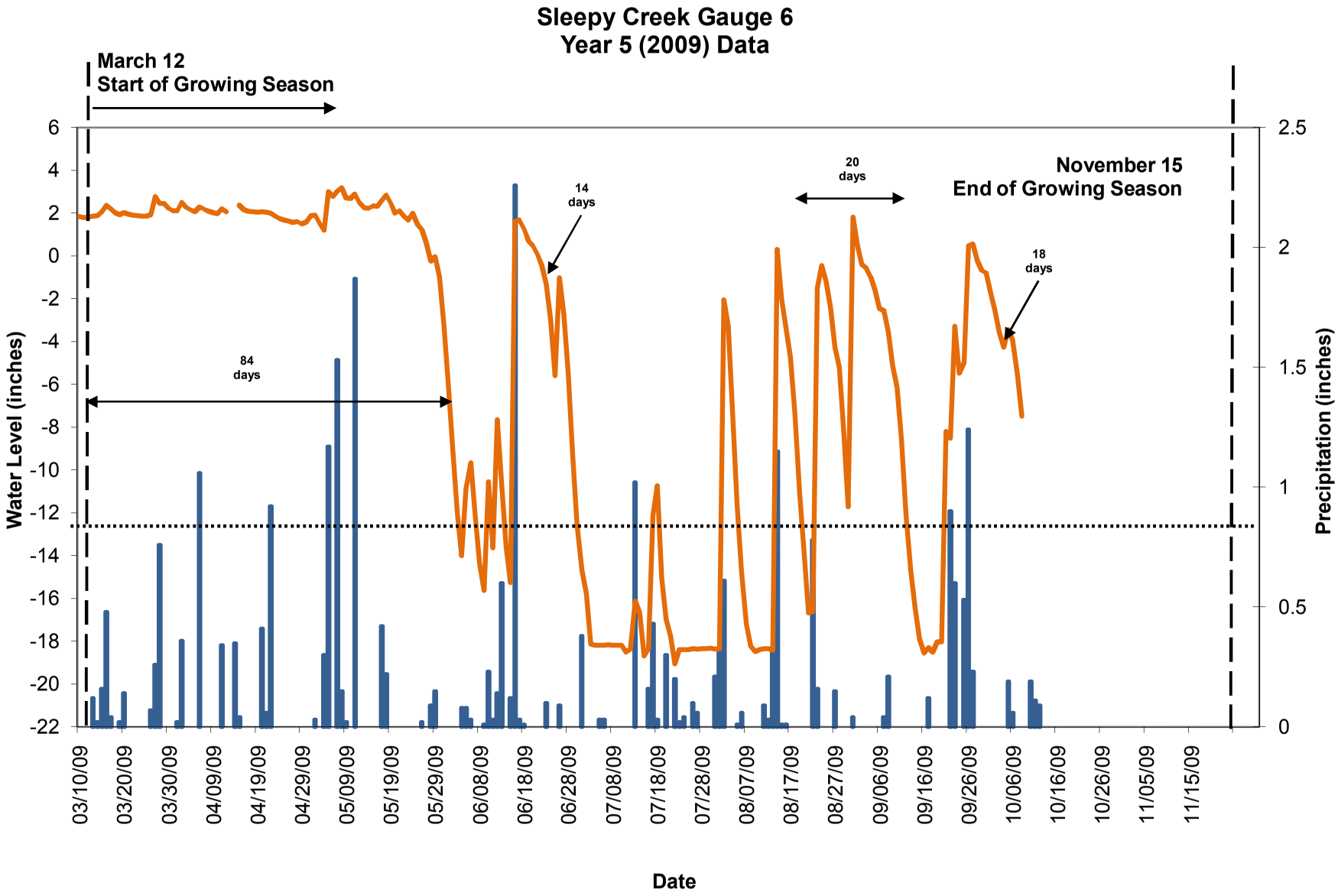
10/16/09
10/26/09
11/05/09
11/15/09


Sleepy Creek Gauge 5
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
81
days
8
days
7
days
12
days
18
days
Water Level (inches)
Precipitation (inches)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
06/08/09
06/18/09
06/28/09
07/08/09
07/18/09
07/28/09
08/07/09
08/17/09
08/27/09
09/06/09
09/16/09
09/26/09
10/06/09
10/16/09
10/26/09
11/05/09
11/15/09
Date


Sleepy Creek Gauge 6
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
84
days
14
days
20
days
18
days
Water Level (inches)
Precipitation (inches)
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
06/08/09
06/18/09
06/28/09
07/08/09
07/18/09
07/28/09
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08/27/09
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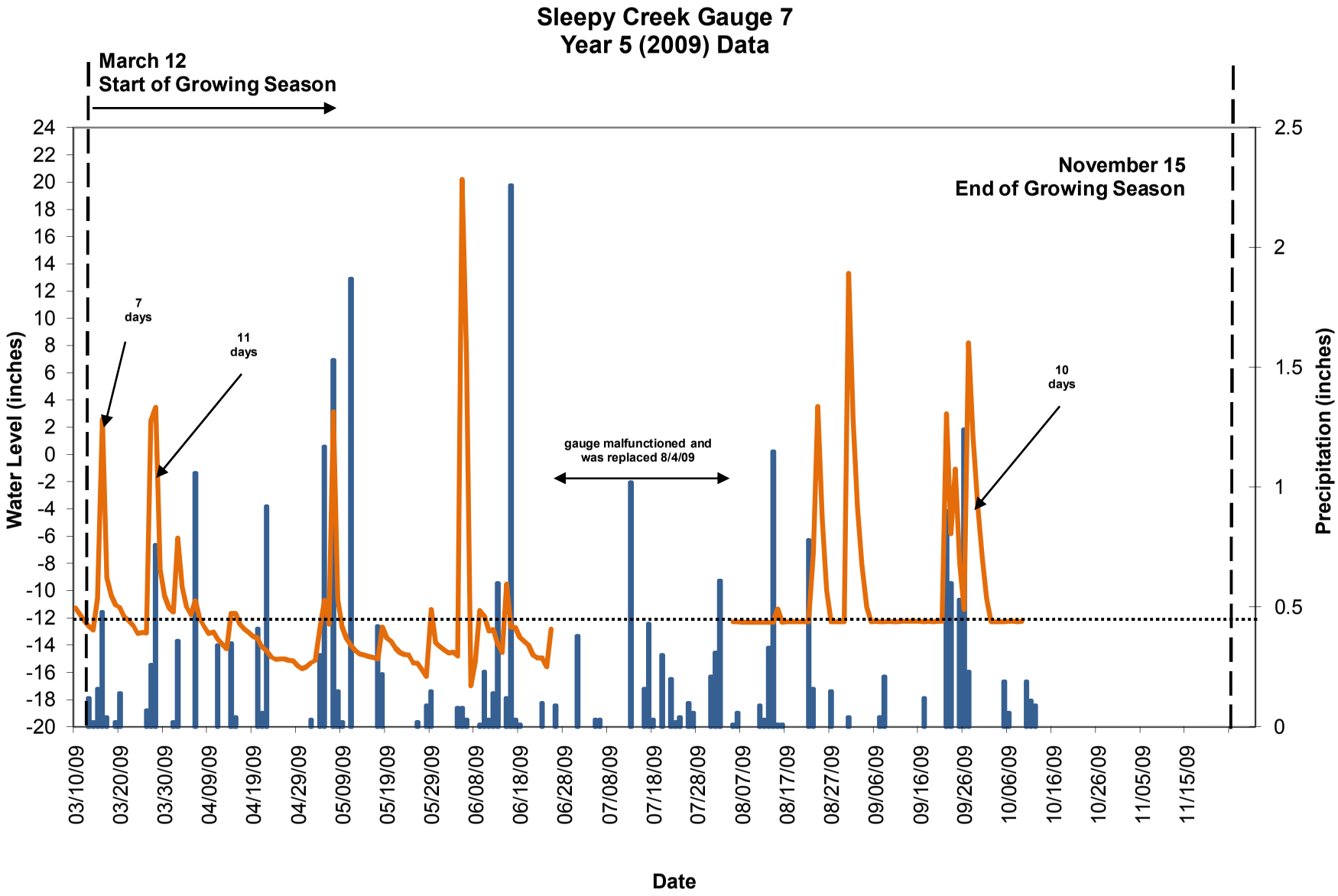
11/15/09
Date


Sleepy Creek Gauge 7
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
7
days
11
days
10
days
gauge malfunctioned and
was replaced 8/4/09
Water Level (inches)
Precipitation (inches)
Date
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
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06/28/09
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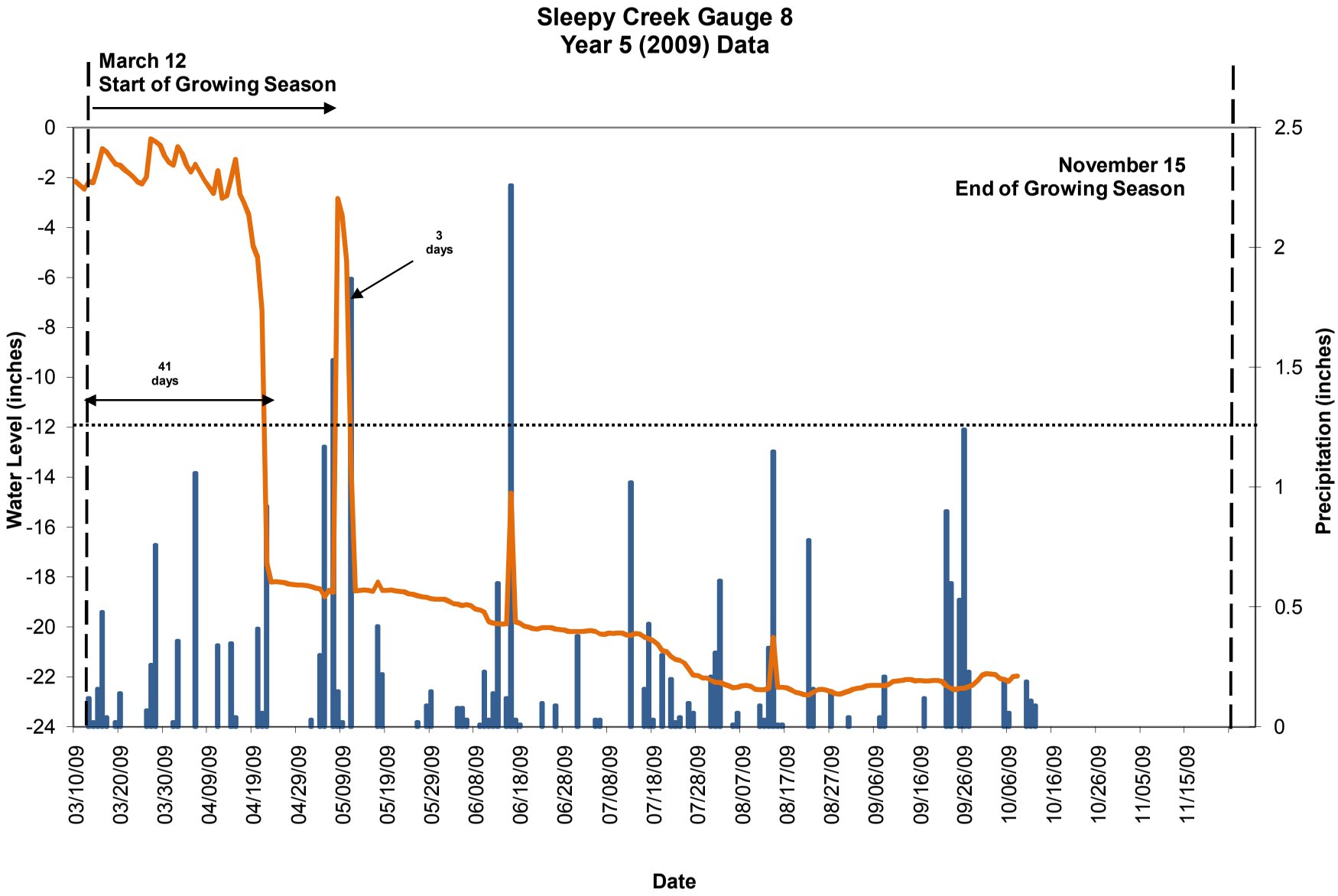
11/15/09


Sleepy Creek Gauge 8
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
3
days
41
days
Water Level (inches)
Precipitation (inches)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
2.5
2
1.5
1
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08/27/09
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10/26/09
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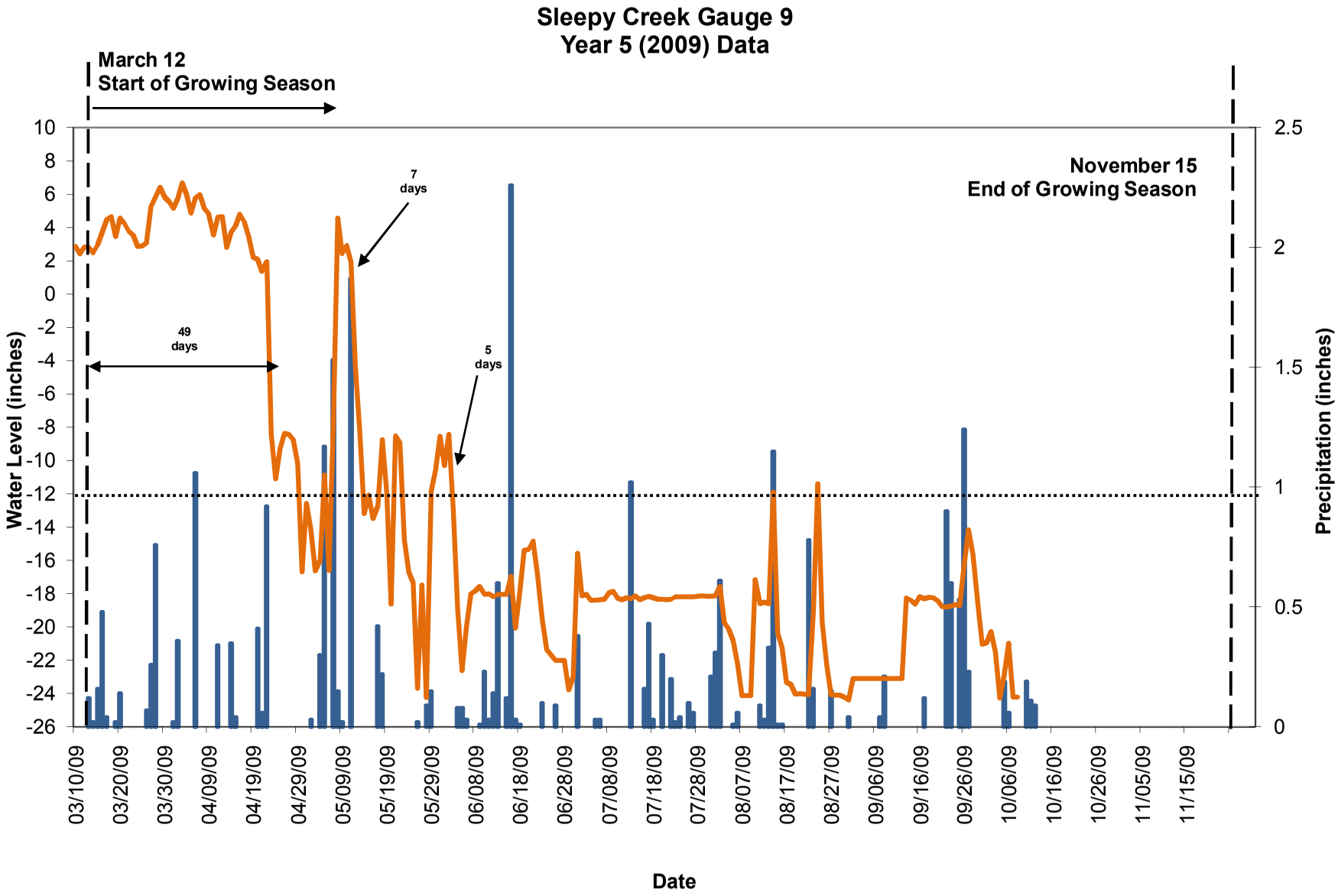
11/15/09
Date


Sleepy Creek Gauge 9
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
49
days
7
days
5
days
Water Level (inches)
Precipitation (inches)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
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08/27/09
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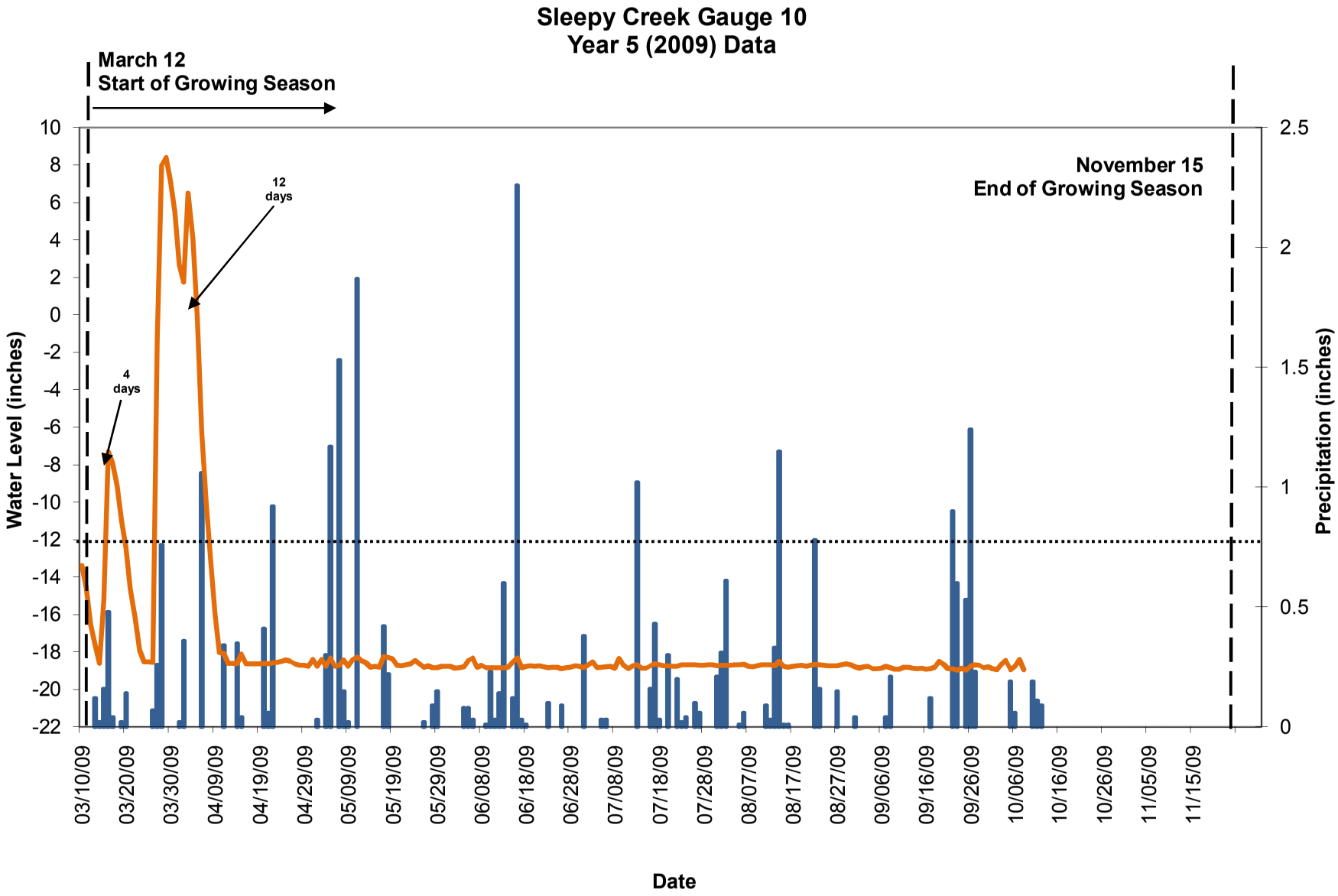
10/26/09
11/05/09
11/15/09
Date


Sleepy Creek Gauge 10
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
12
days
4
days
Water Level (inches)
Precipitation (inches)
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
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08/27/09
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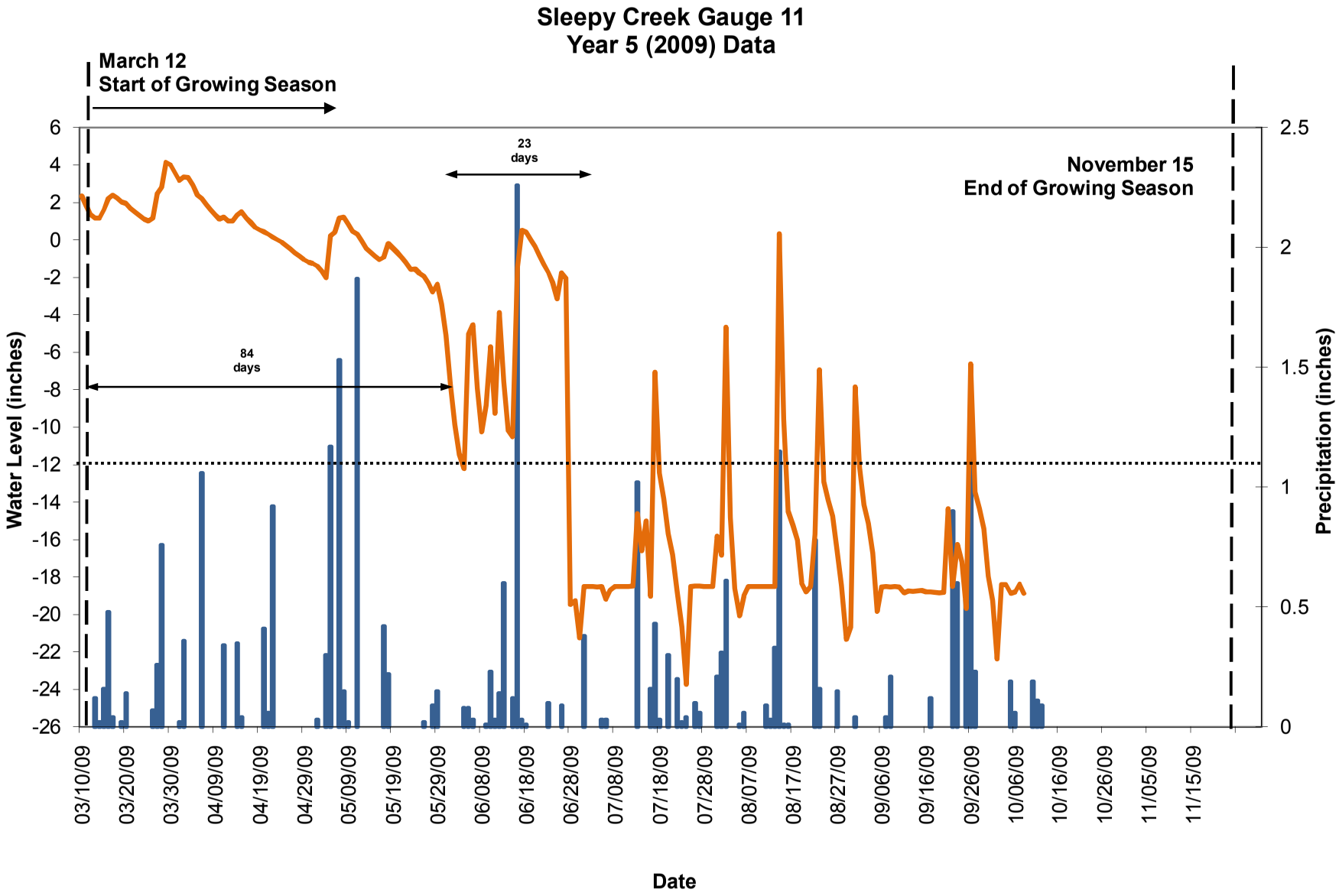
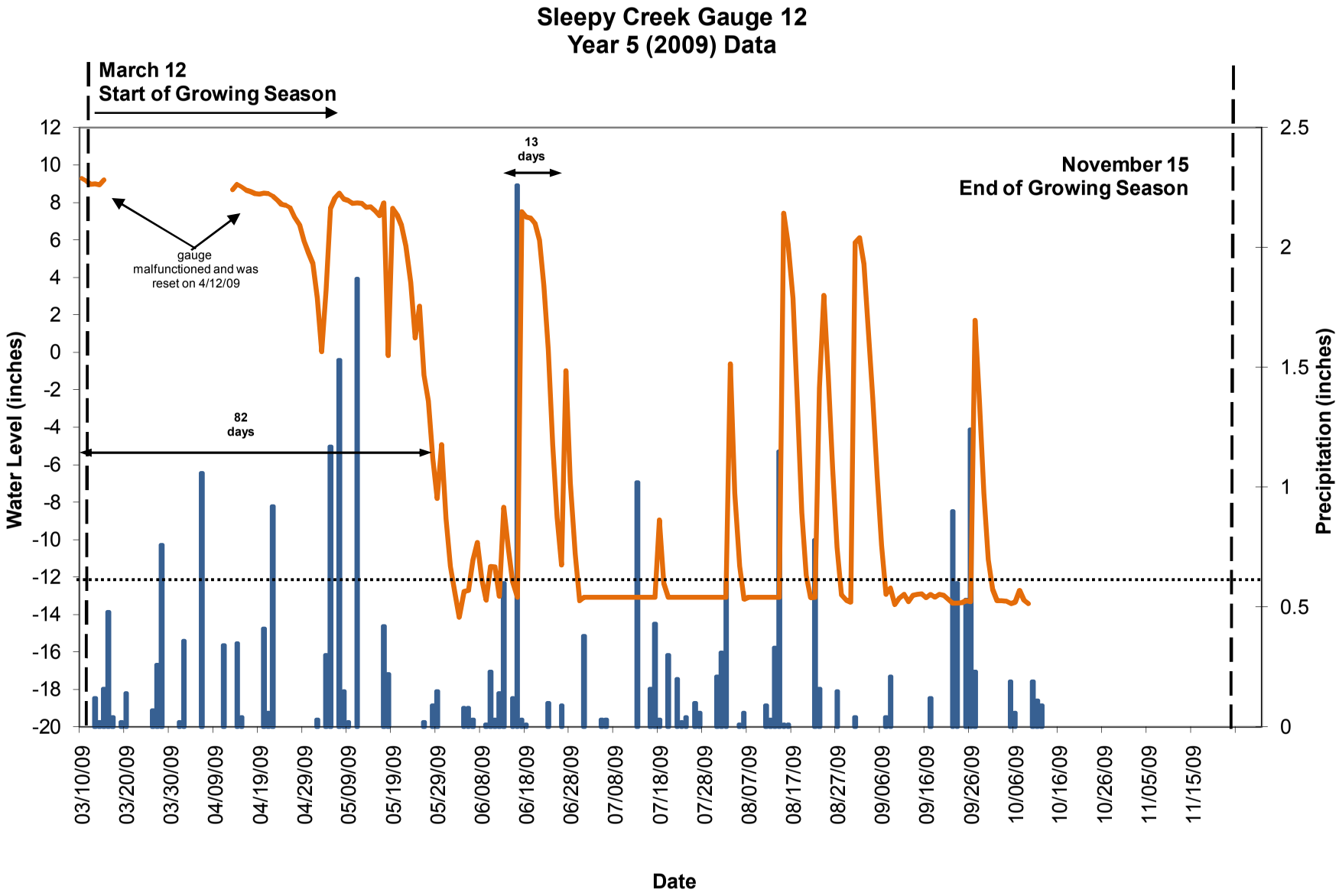
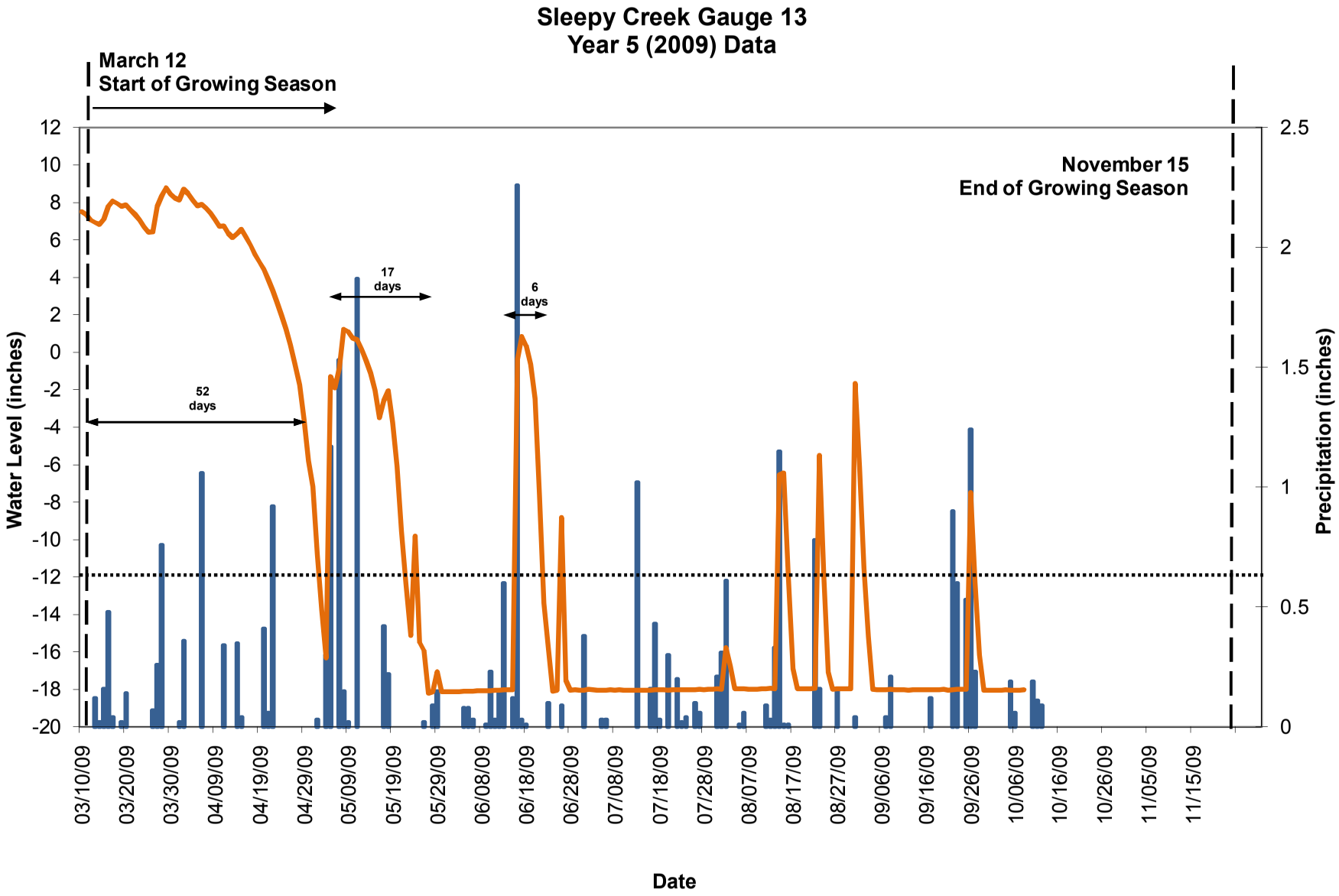
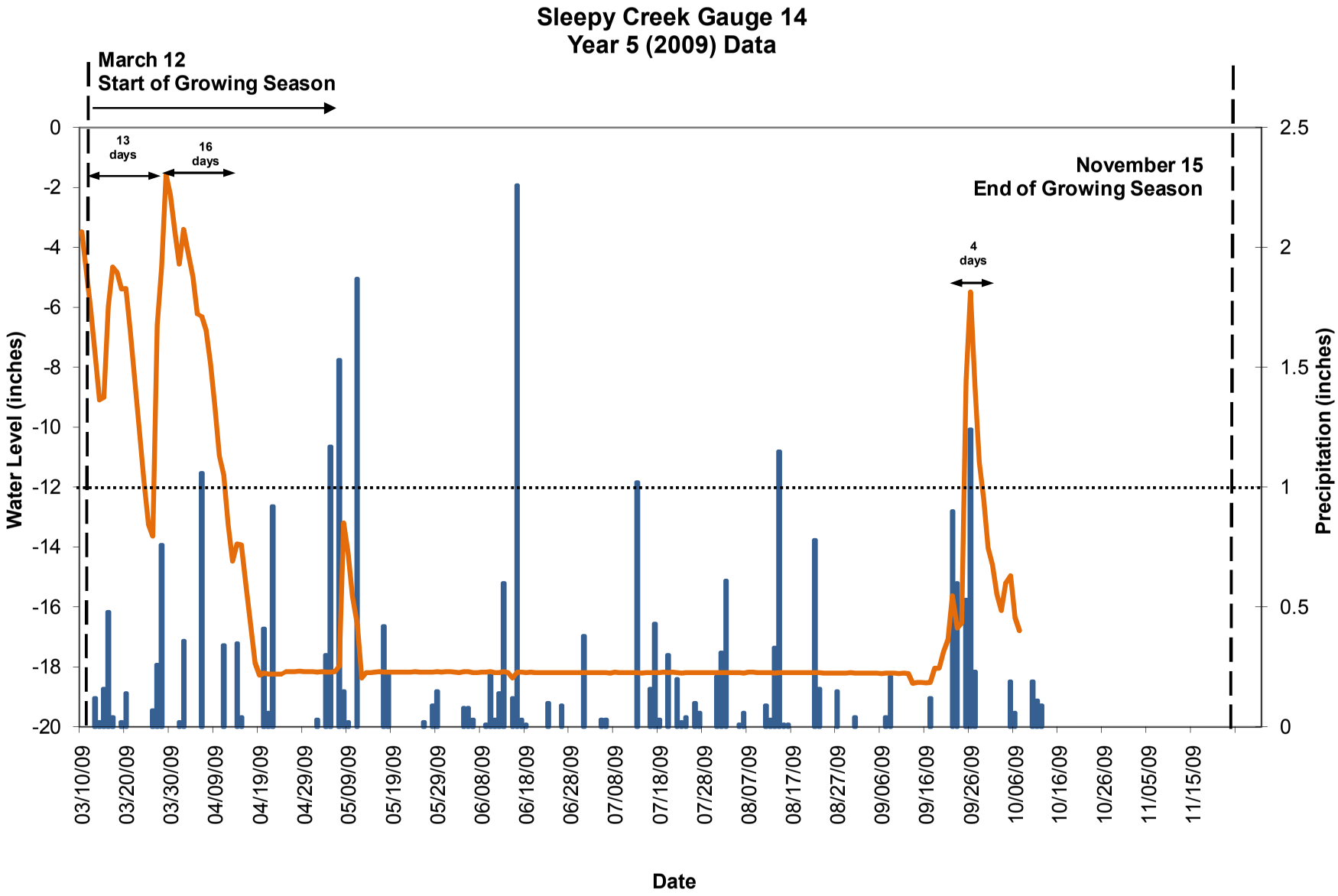
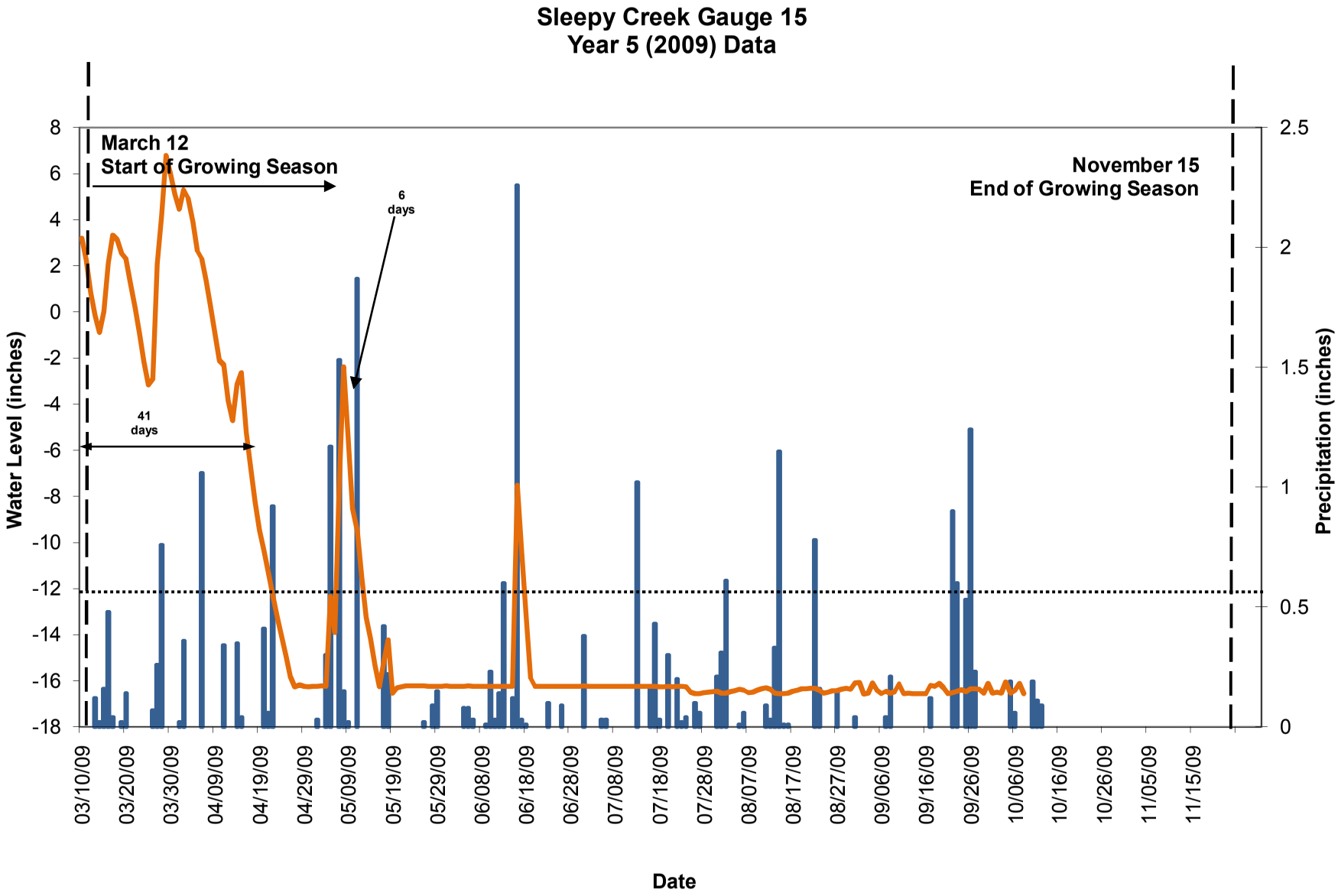
Date

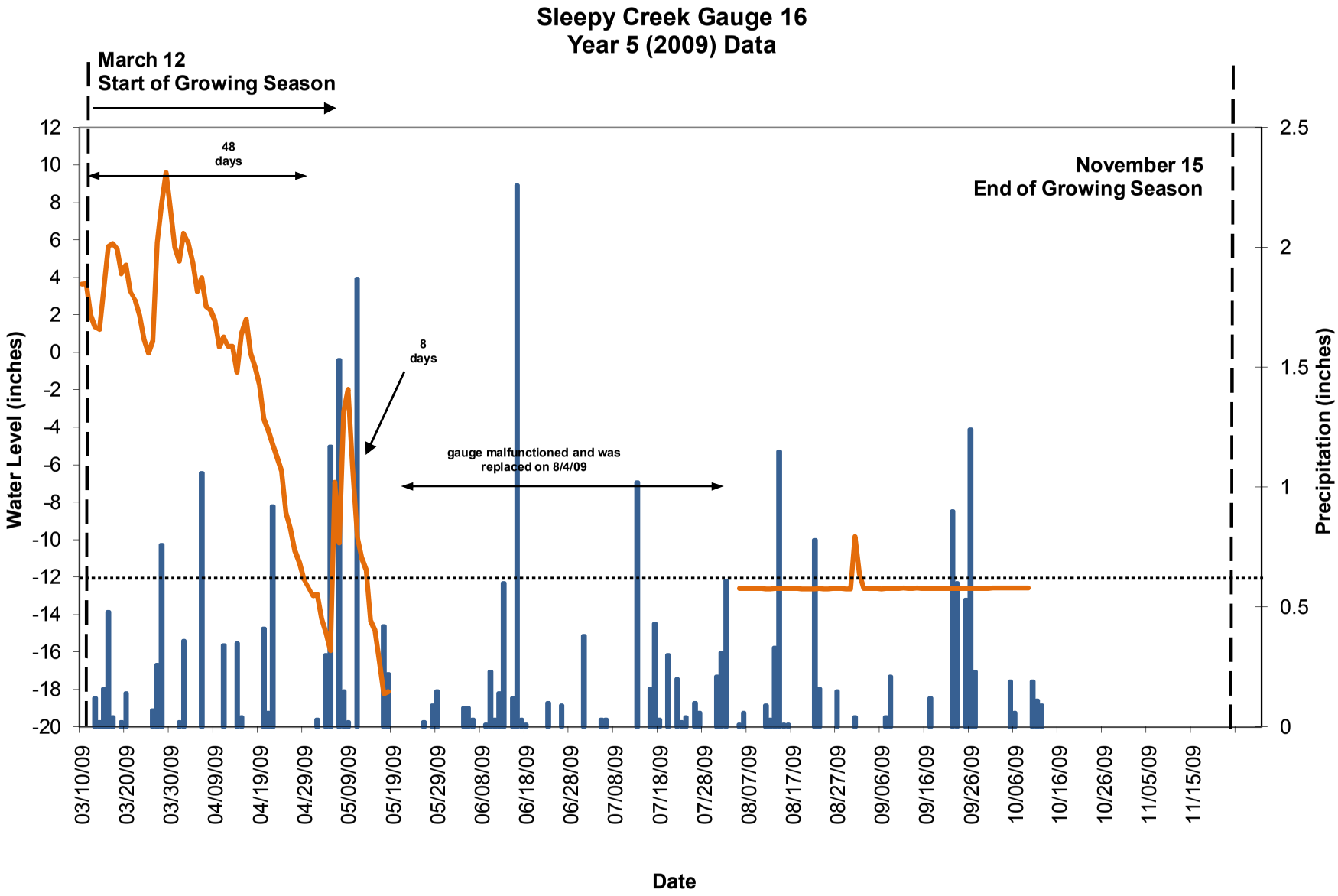

Sleepy Creek Gauge 11
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
84
days
23
days
Water Level (inches)
Precipitation (inches)
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
06/08/09
06/18/09
06/28/09
07/08/09
07/18/09
07/28/09
08/07/09
08/17/09
08/27/09
09/06/09
09/16/09
09/26/09
10/06/09
10/16/09
10/26/09
11/05/09
11/15/09
Date


Sleepy Creek Gauge 12
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
13
days
82
days
gauge
malfunctioned and was
reset on 4/12/09
Water Level (inches)
Precipitation (inches)
Date
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
06/08/09
06/18/09
06/28/09
07/08/09
07/18/09
07/28/09
08/07/09
08/17/09
08/27/09
09/06/09
09/16/09
09/26/09
10/06/09
10/16/09
10/26/09
11/05/09
11/15/09


Sleepy Creek Gauge 13
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
52 days
17 days
6 days
Water Level (inches)
Precipitation (inches)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
06/08/09
06/18/09
06/28/09
07/08/09
07/18/09
07/28/09
08/07/09
08/17/09
08/27/09
09/06/09
09/16/09
09/26/09
10/06/09
10/16/09
10/26/09
11/05/09
11/15/09
Date


Sleepy Creek Gauge 14
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
13 days
16 days
4 days
Water Level (inches)
Precipitation (inches)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
06/08/09
06/18/09
06/28/09
07/08/09
07/18/09
07/28/09
08/07/09
08/17/09
08/27/09
09/06/09
09/16/09
09/26/09
10/06/09
10/16/09
10/26/09
11/05/09
11/15/09
Date


Sleepy Creek Gauge 15
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
6
days
41
days
Water Level (inches)
Precipitation (inches)
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
06/08/09
06/18/09
06/28/09
07/08/09
07/18/09
07/28/09
08/07/09
08/17/09
08/27/09
09/06/09
09/16/09
09/26/09
10/06/09
10/16/09
10/26/09
11/05/09
11/15/09
Date


Sleepy Creek Gauge 16
Year 5 (2009) Data
March 12
Start of Growing Season
48
days
8
days
gauge malfunctioned and was
replaced on 8/4/09
November 15
End of Growing Season
Water Level (inches)
Precipitation (inches)
Date
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
06/08/09
06/18/09
06/28/09
07/08/09
07/18/09
07/28/09
08/07/09
08/17/09
08/27/09
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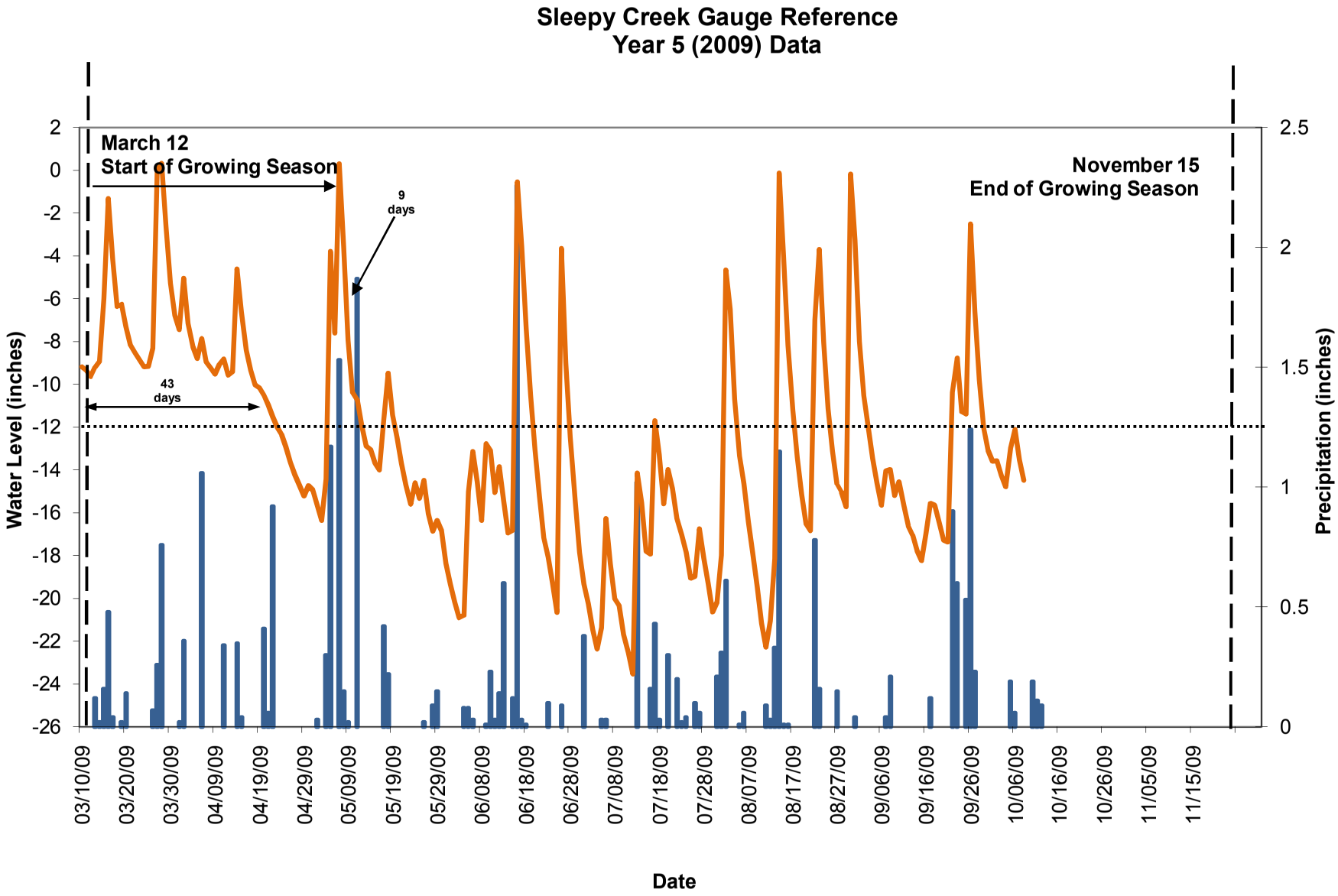
10/16/09
10/26/09
11/05/09
11/15/09


Sleepy Creek Gauge Reference
Year 5 (2009) Data
March 12
Start of Growing Season
November 15
End of Growing Season
9
days
43
days
Water Level (inches)
Precipitation (inches)
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
2.5
2
1.5
1
0.5
0
03/10/09
03/20/09
03/30/09
04/09/09
04/19/09
04/29/09
05/09/09
05/19/09
05/29/09
06/08/09
06/18/09
06/28/09
07/08/09
07/18/09
07/28/09
08/07/09
08/17/09
08/27/09
09/06/09
09/16/09
09/26/09
10/06/09
10/16/09
10/26/09
11/05/09
11/15/09
Date

APPPENDIX B
VEGETATION PLOT PHOTOGRAPHS

Sleepy Creek Restoration Site
Vegetation Plot Photographs
Year 5 (2009) Annual Monitoring
Photos taken July 2009

Sleepy Creek Restoration Site
Vegetation Plot Photographs
Year 5 (2009) Annual Monitoring
Photos taken July 2009 (continued)