

# ANNUAL REPORT FOR 2004



**ABC Wetland Mitigation Site  
Beaufort County  
Project No. 8.T221801  
TIP No. R-2510WM**



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North Carolina Department of Transportation  
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## **SUMMARY**

The following report summarizes the monitoring activities that have occurred in the past year at the ABC Mitigation Site. The site must be monitored to show successful mitigation and must demonstrate both vegetation and hydrologic success for a minimum of five years or until the site is deemed successful. Completed in January 2001, the 187-acre site will serve as mitigation for wetland impacts within the coastal plain region of the Tar-Pamlico River Basin and provides non-riverine wet hardwood forest restoration. In order to restore wetland conditions, the existing site was altered by constructing depressions and installing ditch plugs as well as by backfilling material and scarifying wetland soil surfaces. Trees were planted to facilitate establishment of natural communities.

Twenty-nine groundwater-monitoring gauges are used to record daily hydrologic conditions. Eight of these gauges are situated within an offsite reference area; data from these reference gauges are used as a comparison if data from the restored area does not meet jurisdictional success criteria. An onsite rain gauge records daily rainfall events to monitor the site's response to rainfall. Monthly rainfall data, measured at the closest official weather station, was compared to historical rainfall totals in order to determine relative climate conditions during the growing season.

For the 2004 monitoring year, twenty-five of the twenty-nine groundwater gauges showed saturation in excess of the 12.5% hydrologic success criterion. Overall, onsite gauges exhibited similar results or exceeded the saturation periods recorded in the reference community.

Approximately 140.7 acres of the site were planted with wetland vegetation. Thirteen permanent vegetation plots are used in annual vegetation monitoring; success criteria state that at least 320 trees/acre must be surviving after three years, with at least 260 trees/ acre surviving at the end of year five. For 2004, the thirteen permanent vegetation plots revealed an average density of 493 trees per acre, which is well above the minimum success criteria of 290 trees per acre.

Per the letter from the Ecosystem Enhancement Program (EEP) to NCDOT dated August 25, 2004, the EEP has accepted the transfer of all off-site mitigation projects. The EEP will be responsible for fulfilling the remaining monitoring requirements and future remediation for this project.

# **1.0 INTRODUCTION**

## **1.1 Project Description**

The North Carolina Department of Transportation (NCDOT) established the ABC Wetland Mitigation Site to provide up-front wetland mitigation for unavoidable transportation-related wetland impacts in the coastal plain region of the Tar-Pamlico River Basin. The 75-hectare (184-acre) tract is situated northeast of Washington in Beaufort County, North Carolina (Figure 1).

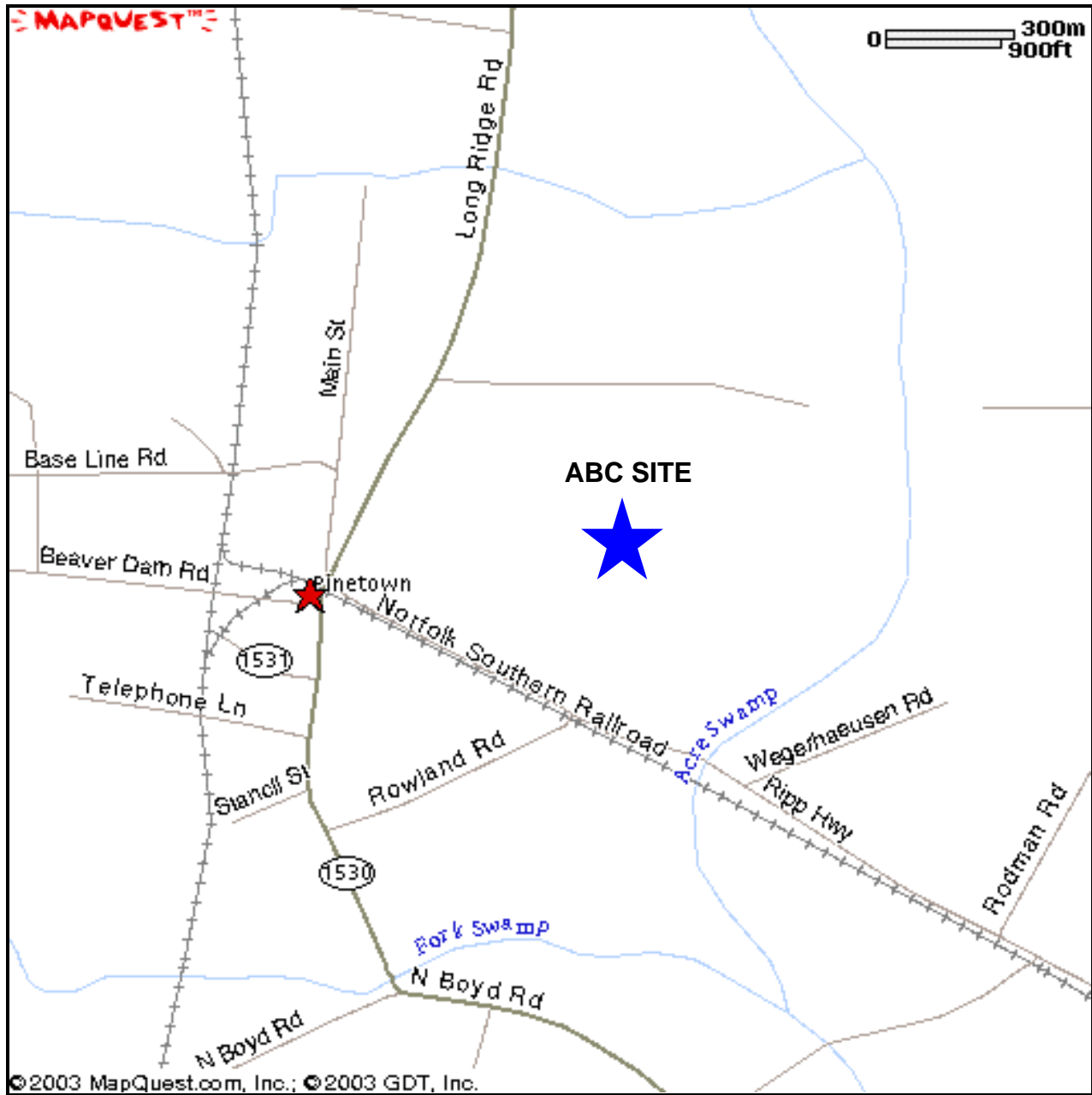
The site had been cleared, ditched, and drained, with wetlands effectively removed to facilitate agricultural production and to convey runoff into Acre Swamp located along the southeastern border of the site. Wetland mitigation activities were designed to restore wetland features and functions similar to those exhibited by reference wetlands in the region. Site alterations, designed to restore characteristic wetland soil features and groundwater wetland hydrology, include depression construction (B-horizon contouring), impervious ditch plug construction, ditch backfilling, field crown removal, and ripping/scarification of wetland soil surfaces. Following construction, the site was planted with native vegetation characteristic of the target ecosystem.

Pre-construction investigations suggested that the site would support the following communities: 37 hectares (92 acres) of restored non-riverine forested wetlands; 7 hectares (19 acres) of enhanced non-riverine wetland systems; and approximately 1,252 meters (4,107 feet) of stream enhancement (including streamside plantings and riparian forest buffer restoration). In addition, groundwater recharge was expected to improve within the remaining 31 hectares (76 acres) of uplands and streamside management areas. These areas were estimated based on soil types, local topographic features, elevation and slope, landscape position, and groundwater model forecast (DRAINMOD).

## **1.2 Purpose**

In order to demonstrate successful mitigation, a site must be monitored for at least five years or until success criteria are met. Monitoring is conducted by installing both groundwater and surface water gauges to establish a hydrologic record, by placing permanent vegetation sampling plots to record establishment of woody vegetation, and by utilizing photographs as visual documentation of the site. This document summarizes the results of the monitoring program activities at the ABC Wetland Mitigation Site for the 2004 growing season, the fourth year that monitoring has been conducted on the site.

Figure 1. ABC Site Location Map



### 1.3 Project History

January 1997	Site Identification
June 1999	Detailed Mitigation Design Study
Sept. 2000-Jan. 2001	Site Construction
March 2001	Site Planted
March-November 2001	Hydrologic Monitoring (1 yr.)
August 2001	Vegetation Monitoring (1 yr.)
March- November 2002	Hydrologic Monitoring (2 yr.)
August 2002	Vegetation Monitoring (2 yr.)
March – November 2003	Hydrologic Monitoring (3 yr.)
June 10, 2003	Agency Site Visit
August 2003	Vegetation Monitoring (3 yr.)
March- November 2004	Hydrologic Monitoring (4 yr.)
September 2004	Vegetation Monitoring (4 yr.)

## **2.0 HYDROLOGY**

### **2.1 Success Criteria**

Hydrologic success criteria for the ABC Mitigation Site are based on federal guidelines for mitigation as described in the 1987 U.S. Army Corps of Engineers (COE) Wetlands Delineation manual. These guidelines suggest that an area must be inundated or saturated (within 12 inches of the surface) by surface or groundwater for 12.5% of the growing season (32 consecutive days). However, areas inundated between 5% and 12.5% of the growing season may warrant jurisdictional classification depending upon factors such as the presence of hydrophytic vegetation and hydric soils.

The average wetland hydroperiod for this site is expected to exhibit a gradual increase from 8% of the growing season, immediately after the farm land is abandoned and the drainage structures are removed, to as much as 20% under steady state forest conditions. Evaluation of success criteria will be supplemented by sampling and data comparison between reference wetland sites. One reference community was monitored during 2004 and is located approximately 0.20 miles north of the site.

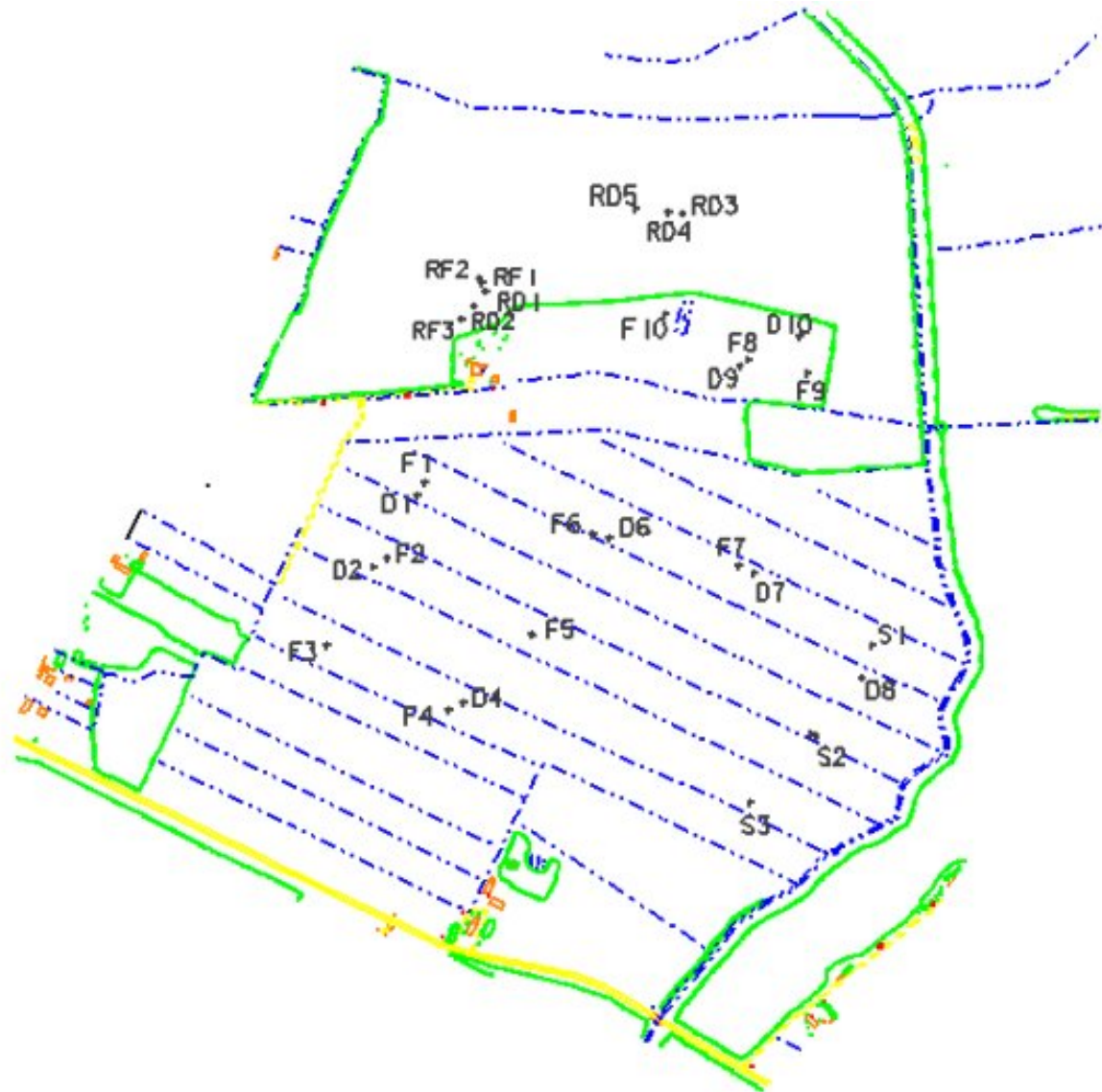
The growing season for Beaufort County is defined in the Beaufort County Soil Survey as the period between March 13 and November 25 (256 days, USDA 1995). In order to meet minimum hydrologic regulatory success (12.5% of the growing season), the groundwater table must remain within 12 inches of the surface for 32 consecutive days. In the event that the site does not meet jurisdictional success criteria, the hydrologic data from the site will be compared to that from the reference wetland.

### **2.2 Hydrologic Description**

Following construction, twenty-one groundwater gauges were placed on the site in accordance with the specifications in U.S. Army Corps of Engineers', Installing Monitoring Recorders/Piezometers in Wetlands (WRP Technical Note HY-IA-3.1, August 1993). Sixteen monitoring gauges were installed in 2001 to provide representative coverage within each of the wetland physiographic landscape areas on the site. In 2002, eight additional groundwater gauges were installed on site; three of those gauges were installed in the reference wetland. Currently, eight of the twenty-nine groundwater-gauges are located within the reference wetland, approximately 0.2 miles north of the mitigation site (Figure 2). The groundwater gauges record daily groundwater levels across the site. In addition, an onsite rain gauge records daily rainfall totals; this data is used to see how the groundwater table responds to rainfall events.



Figure 2. Monitoring Gauge Location Map



Micro-topographical features, such as semi-permanently inundated/saturated depressions and swales of various sizes, were created for the purpose of water storage, as well as habitat diversity. Eleven gauges (D1, D2, D4, D6, D7, D8, D9, D10, S1, S2, and S3) were placed within saturated depressions, while nine gauges (F1, F2, F3, F4, F5, F6, F7, F8, and F9) were placed in non-depressional areas throughout the site at ground elevation. Eight gauges were placed in similar landscape positions within the reference community. Reference gauges RD1, RD2, RD3, RD4, and RD5 were placed in depressions while gauges RF1, RF2, and RF3 were placed at base elevation.

## **2.3 Results of Hydrologic Monitoring**

### **2.3.1 Site Data**

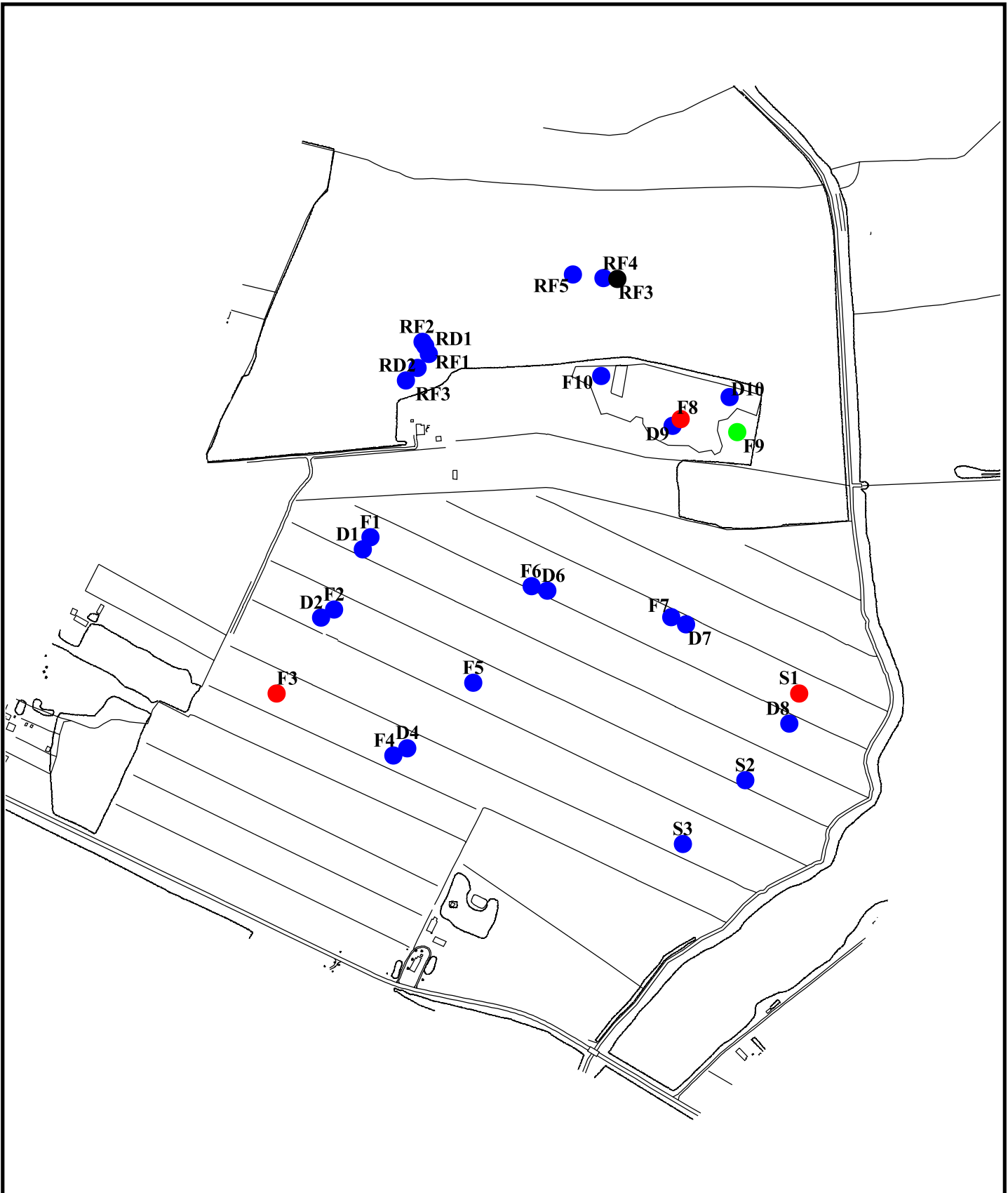
The maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each gauge. This number was converted into a percentage of the 256-day growing season. Table 1 shows the hydrologic results for the 2004 growing season; these results are illustrated in Figure 3.

Appendix A contains a plot of the groundwater depth readings at each monitoring gauge location. The maximum number of consecutive days that the gauge met success above the 12-inch depth is noted on each graph. Data determined to be erroneous was omitted; therefore, some gaps appear in the plots. Precipitation events, recorded at the onsite rain gauge, are included on each graph as bars.

**Table 1. 2004 Hydrologic Monitoring Results**

Monitoring Gauges		<5%	5%-8%	8%-12.5%	> 12.5%	Actual %	Success Dates
Depressions	D1+				×	100	March 13-Nov 25
	D2+				×	100	March 13-Nov 25
	D4+				×	100	March 13-Nov 25
	D6+				×	100	March 13-Nov 25
	D7+				×	100	March 13-Nov 25
	D8+				×	34.8	March 13-May 13 Aug 27-Nov 23
	D9+				×	27.3	March 13-May 21
	D10				×	27	March 13-May 20 Sept 7-Sept 27
	S1			×		10.5	March 13-April 8
	S2+				×	39.8	March 13-April 28 May 14-July 7 Aug 14-Nov 25
	S3+				×	100	March 13-Nov 25
Base Elevation	F1+				×	53.9	March 13-July 28 Aug 27-Nov 25
	F2+				×	27.3	March 13-May 21 Sept 7-Oct 11
	F3			×		10.9	March 13-April 9
	F4+				×	27	March 13-May 20 Sept 7-Oct 8
	F5+				×	100	March 13-Nov 25
	F6+				×	25	March 13-May 15 Sept 7-Oct 6
	F7+				×	30.9	March 13-May 30 Sept 7-Oct 6
	F8			×		10.2	March 13-April 7
	F9		×			5.1	April 27-May 9
	F10+				×	12.5	March 13-April 6 April 12-May 13
Reference	RD1+				×	100	March 13-Nov 25
	RD2+				×	100	March 13-Nov 25
	RD3+				×	25.8	March 13-May 17
	RD4+				×	24.2	March 13-May 13
	RD5+				×	24.2	March 13-May 13
	RF1+				×	24.6	March 13-May 14
	RF2+				×	24.6	March 13-May 14
	RF3+				×	25	March 13-May 15

+ Gauge met the success criterion during an average rainfall month (February, April, May, August, October, and November).



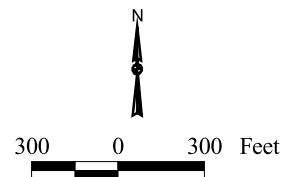
**Figure 3. 2004 Hydrologic Monitoring Gauge Results**



Hydrology Results

- < 5%
- 5 - 8%
- 8 - 12.5%
- > 12.5%

- ⊕ Rain Gauge
- Surface Gauge



### **2.3.2 Climatic Data**

The majority of the ABC Site is characterized as a precipitation driven system; the wetland hydroperiod is completely dependent upon local weather patterns. Figure 4 is a comparison of monthly rainfall for the period of November 2003 through November 2004 to historical precipitation (collected between 1973 and 2004) for Washington, North Carolina. The rainfall data for May-July 2004 was collected from the onsite rain gauge. This comparison gives an indication of how 2004 relates to historical data in terms of climate conditions. The NC State Climate Office provided all local rainfall information.

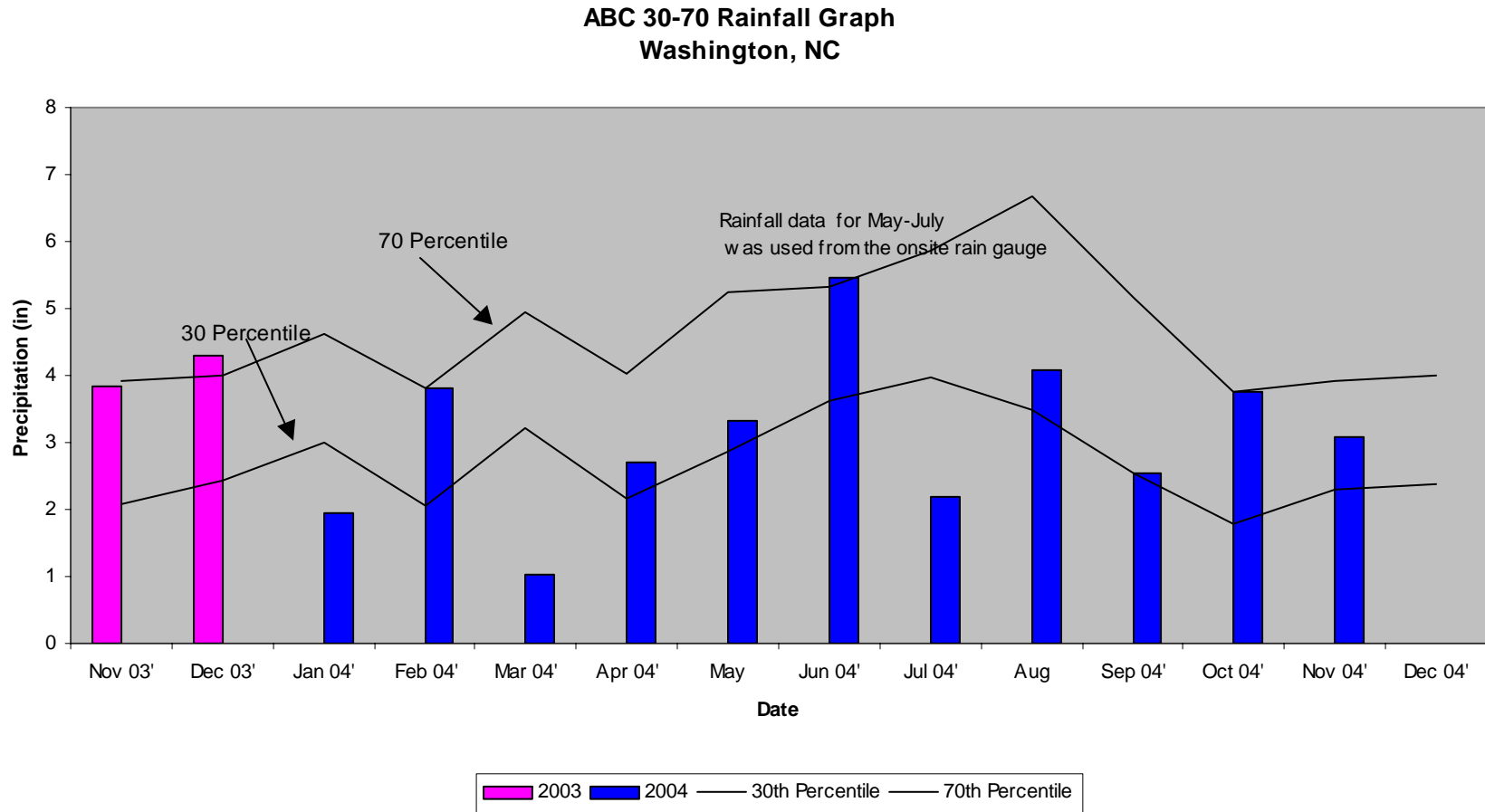
For 2004, December (03') and June experienced above average rainfall. The months of January, March, and July recorded below average rainfall for the site. November (03'), February, April, May, August, September, October, and November experienced average rainfall. Overall, 2004 experienced an average rainfall year.

### **2.4 Conclusions**

Hydrologic data for 2004 indicates that twenty-five of the twenty-nine monitoring gauges (both onsite and reference) exceeded the success criteria of 12.5% of the growing season during an average rainfall year. The site data also correlated well with similar data collected on the reference wetland.

EEP will begin monitoring the hydrology at the ABC Mitigation Site for the 2005 monitoring year.

Figure 4. 30-70 Percentile Graph



### **3.0 VEGETATION: ABC MITIGATION SITE (YEAR 4 MONITORING)**

#### **3.1 Success Criteria**

The success criteria state that there must be a minimum of 320 trees per acre living for at least three consecutive years. A minimum of 290 trees per acre must be living at year 4 and a minimum of 260 trees per acre must be living at year 5.

#### **3.2 Description of Species**

The following tree species were planted in the Wetland Restoration Area:

##### **Zone 1: Levee/Streambank Forest**

*Taxodium distichum*, Baldcypress

*Nyssa sylvatica* var. *biflora*, Swamp Blackgum

*Quercus laurifolia*, Laurel Oak

*Quercus lyrata*, Overcup Oak

*Quercus phellos*, Willow Oak

*Betula nigra*, River Birch

##### **Zone 2: Riverine Swamp Forest**

*Taxodium distichum*, Baldcypress

*Quercus laurifolia*, Laurel Oak

*Quercus lyrata*, Overcup Oak

*Quercus phellos*, Willow Oak

*Fraxinus pennsylvanica*, Green Ash

*Quercus michauxii*, Swamp Chestnut Oak

##### **Zone 3: Mesic Hardwood Forest**

*Fraxinus pennsylvanica*, Green Ash

*Quercus michauxii*, Swamp Chestnut Oak

*Quercus falcata* var. *pagodaefolia*, Cherrybark Oak

*Liriodendron tulipifera*, Tulip Poplar

*Quercus rubra*, Northern Red Oak

*Quercus alba*, White Oak

**Zone 4: Non-Riverine Wet Hardwood Forest**

*Nyssa sylvatica* var. *biflora*, Swamp Blackgum

*Quercus laurifolia*, Laurel Oak

*Quercus lyrata*, Overcup Oak

*Quercus phellos*, Willow Oak

*Fraxinus pennsylvanica*, Green Ash

*Quercus michauxii*, Swamp Chestnut Oak

**Zone 5: Dry Mesic Oak/Hickory Forest**

*Quercus rubra*, Northern Red Oak

*Quercus alba*, White Oak

*Carya tomentosa*, Mockernut Hickory

*Nyssa sylvatica* var. *sylvatica*, Blackgum

*Carya glabra* var. *glabra*, Pignut Hickory

*Quercus falcata* var. *falcata*, Southern Red Oak



### 3.3 Results of Vegetation Monitoring

ZONE	Plot #	Baldcypress	Swp. Blackgum	Laurel Oak	Overcup Oak	Willow Oak	River Birch	Green Ash	Swp. Chestnut Oak	Cherrybark Oak	Tulip Poplar	Northern Red Oak	White Oak	Mockernut Hickory	Blackgum	Pignut Hickory	Southern Red Oak	Total (4 year)	Total (at planting)	Density (Tree/Acre)
1	12	11			1		1		16			3						32	32	680
	13		1	7	11	5			7									31	35	602
<b>ZONE 1 AVERAGE DENSITY</b>																			<b>641</b>	
2	10	1			8	4				2								15	32	319
	11	17			6			10										33	33	680
<b>ZONE 2 AVERAGE DENSITY</b>																			<b>499</b>	
3	8							7		2		4	6					19	33	392
	9									12		3						15	31	329
<b>ZONE 3 AVERAGE DENSITY</b>																			<b>360</b>	
4	1		1	2	6	20		1										30	31	658
	2		5			7		2	13									27	34	540
	3	5			7	5		1	6									24	31	526
	4	1			19	4		13	1									38	39	663
	5		1		10	1		15										27	35	525
<b>ZONE 4 AVERAGE DENSITY</b>																			<b>582</b>	
5	6										4		1					5	31	110
	7				1	4					1	2					10	18	32	383
<b>ZONE 5 AVERAGE DENSITY</b>																			<b>246</b>	
<b>TOTAL AVERAGE DENSITY</b>																			<b>493</b>	

**Site Notes:**

**Zone 1:** Other species noted: Goldenrod, *Aster* sp., and fennel. Plots 12 and 13 are 100' x 25' due to the size of the zone.

**Zone 2:** Other species noted: smartweed, foxtail, fennel, *Aster* sp., ragweed, *Juncus* sp., and *Scirpus* sp. Cattails and standing water were noted in the swales.

**Zone 3:** Other species noted: pine, lespedeza, fennel, foxtail, briars, and broomsedge.

**Zone 4:** Other species noted: goldenrod, briars, woolgrass, foxtail, black willow, smartweed, lespedeza, blackberry, fennel, ragweed, *Juncus* sp., *Aster* sp., *Baccharis* sp., *Panicum* sp., and *Eleocharis* sp.

**Zone 5:** Other species noted: volunteer overcup oak, fennel, broomsedge, and ragweed.

### **3.4 Conclusions**

Of the 187 acres that comprise this site, approximately 140.7 acres involved tree planting. There were thirteen vegetation-monitoring plots established throughout the planting areas. The 2004 vegetation monitoring of the planted areas revealed an average density of 493 trees per acre. This is well above the minimum success criteria of 290 trees per acre.

EEP will begin monitoring the vegetation at the ABC Mitigation Site for the 2005 monitoring year.

### **4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS**

Twenty-five of the twenty-nine groundwater gauges showed saturation in excess of the 12.5% hydrologic success criterion. Overall, onsite gauges exhibited similar results or exceeded the saturation periods recorded in the reference community.

For the 2004 vegetation-monitoring year, the thirteen permanent vegetation plots revealed an average density of 493 trees per acre, which is well above the minimum success criteria of 290 trees per acre.

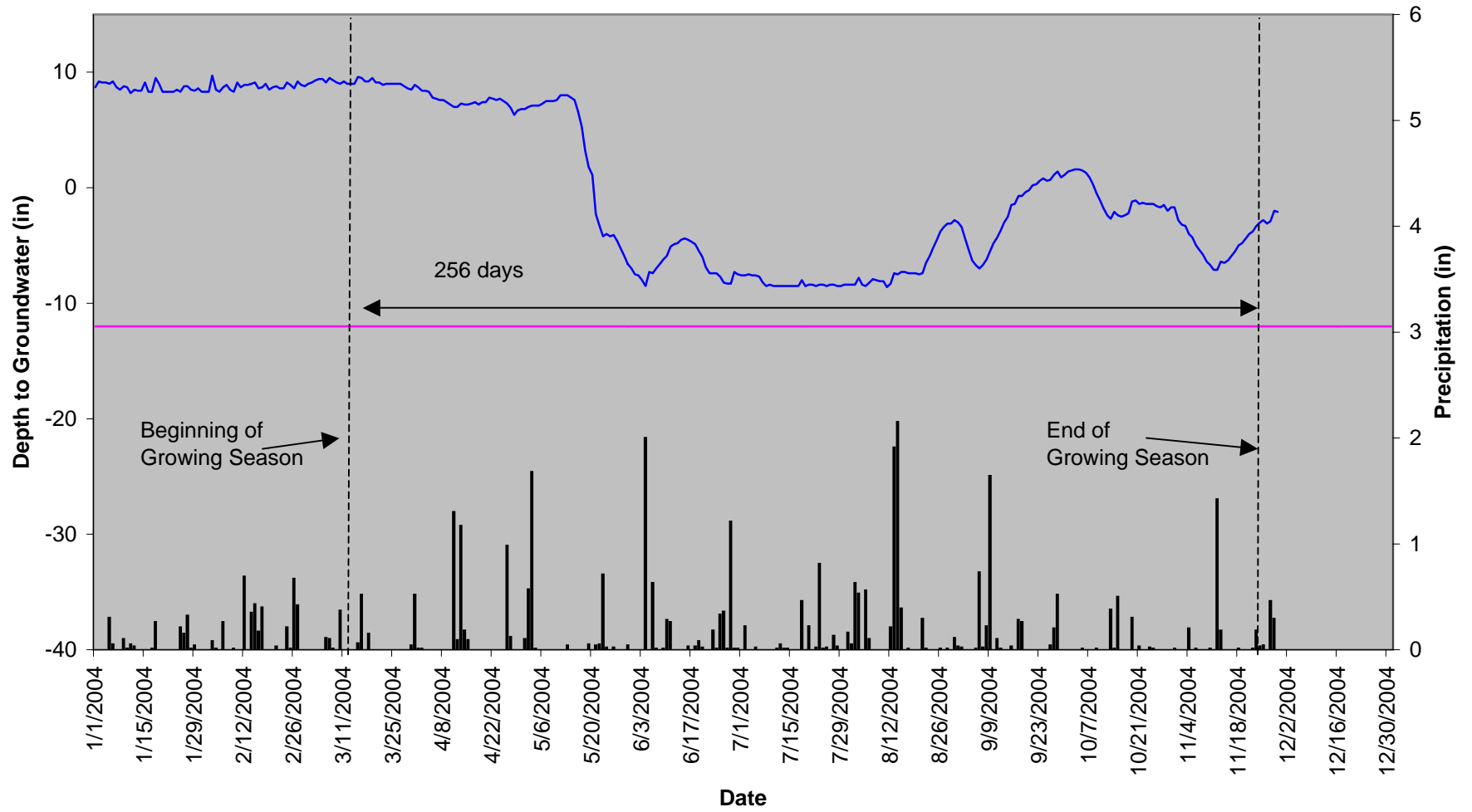
In summary, the ABC Mitigation Site met the success criteria for hydrology at 86% of the onsite monitoring locations (18 out of 21), as well as the vegetation criteria in the 2004-monitoring year. The site also exhibits wetland characteristics similar to those in the reference wetland.

Per the letter from the Ecosystem Enhancement Program (EEP) to NCDOT dated August 25, 2004, the EEP has accepted the transfer of all off-site mitigation projects. The EEP will be responsible for fulfilling the remaining monitoring requirements and future remediation for this project.

## **APPENDIX A**

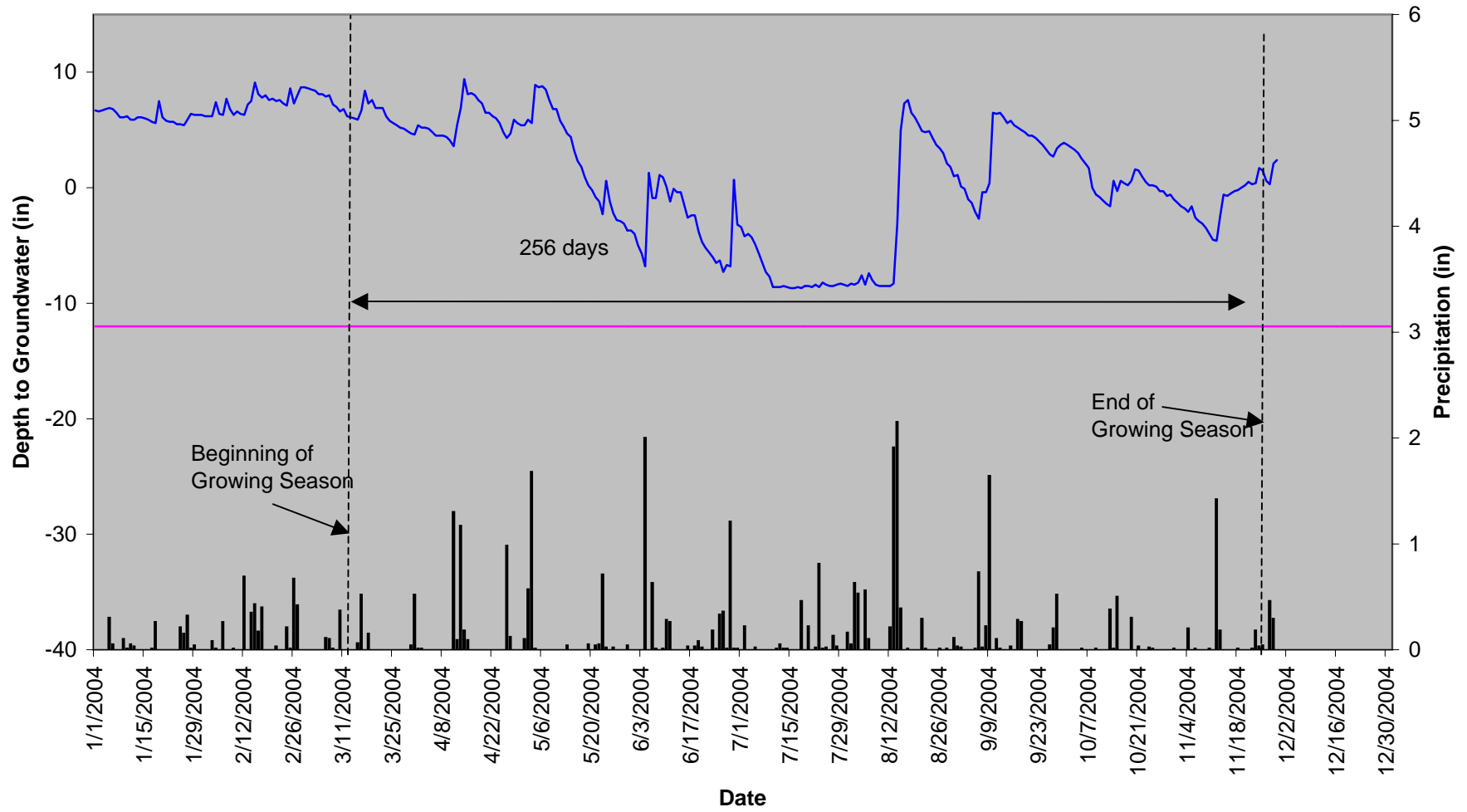
### **Gauge Data Graphs**

### ABC D1 (20" Surface & Groundwater Gauge)



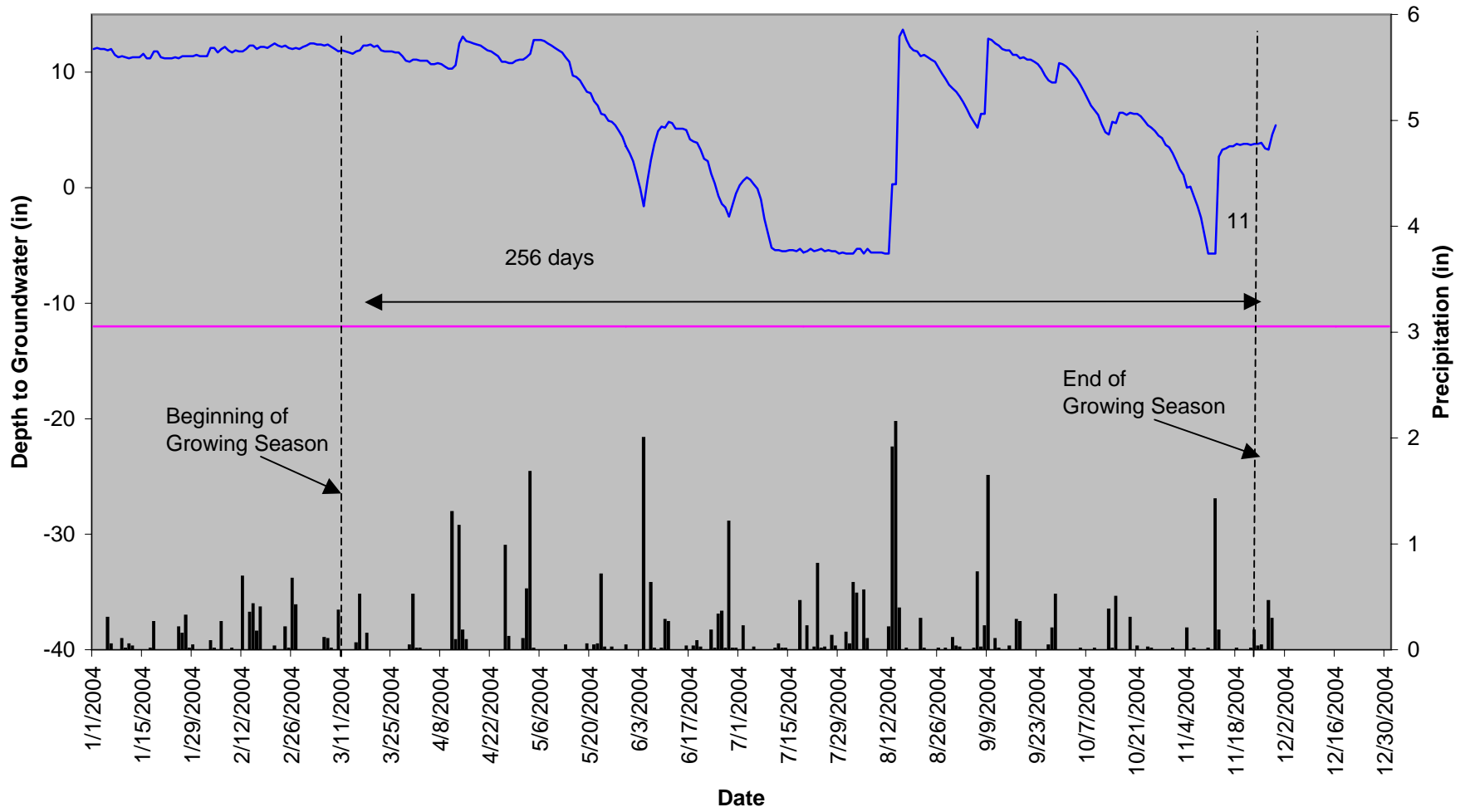
■ N38B7F95 ABC-RG1 — S320671 ABC-D1 — Required Depth

### ABC D2 (20" Surface & Groundwater Gauge)



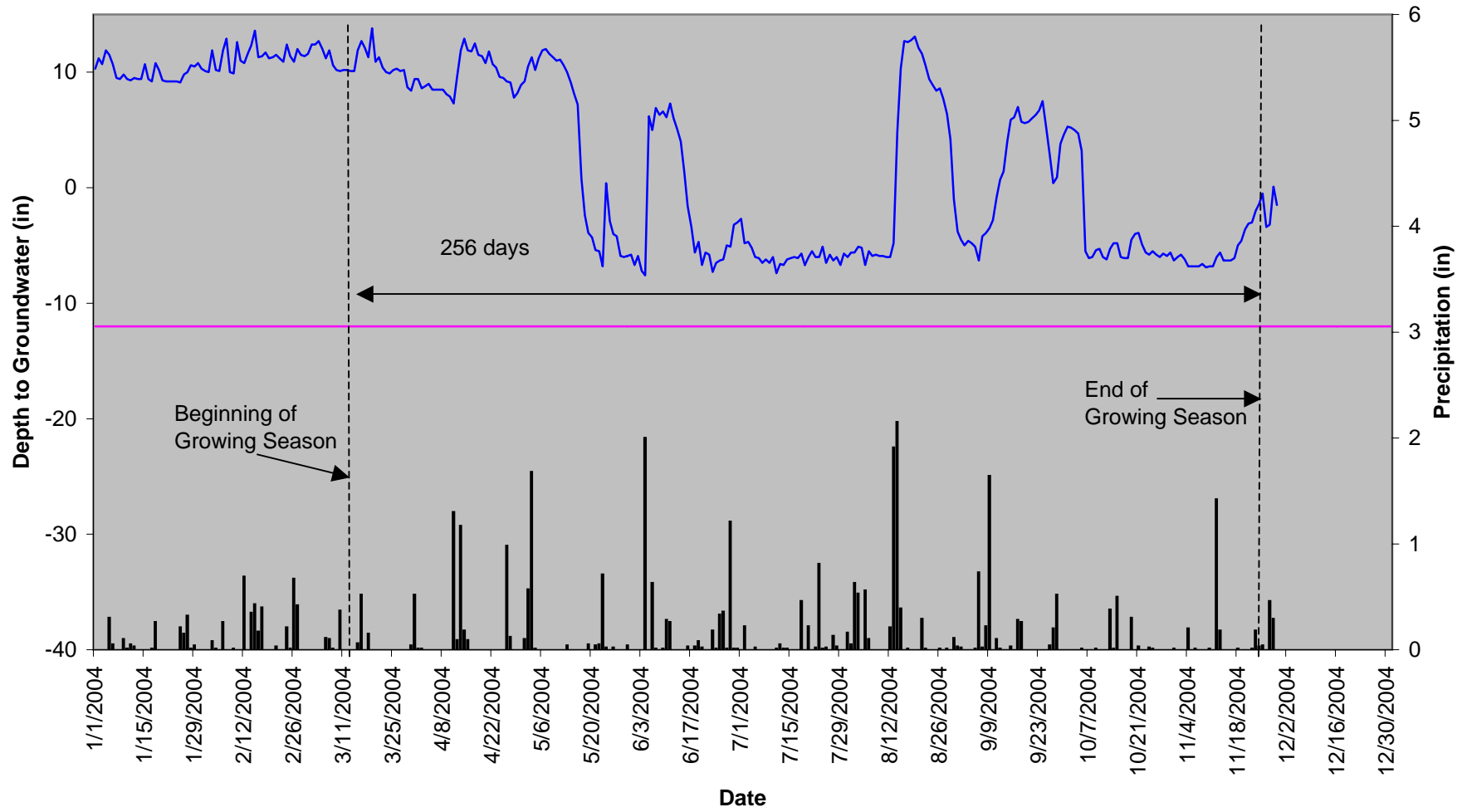
■ N38B7F95 ABC-RG1    — S3538FF ABC-D2    — Required Depth

### ABC D4 (20" Surface & Groundwater Gauge)



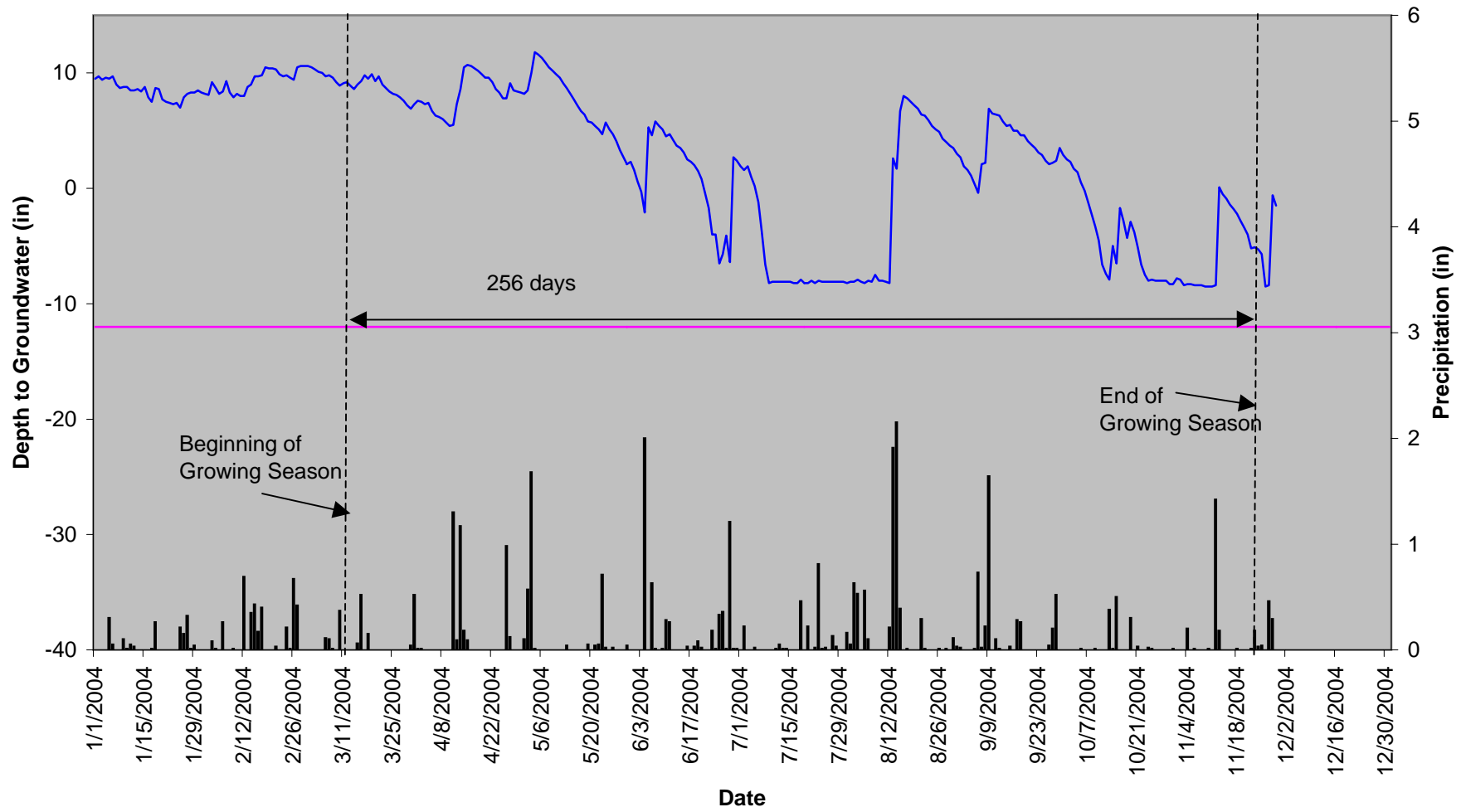
■ N38B7F95 ABC-RG1    — S353894 ABC-D4    — Required Depth

### ABC D6 (20" Surface & Groundwater Gauge)



■ N38B7F95 ABC-RG1    — S353954 ABC-D6    — Required Depth

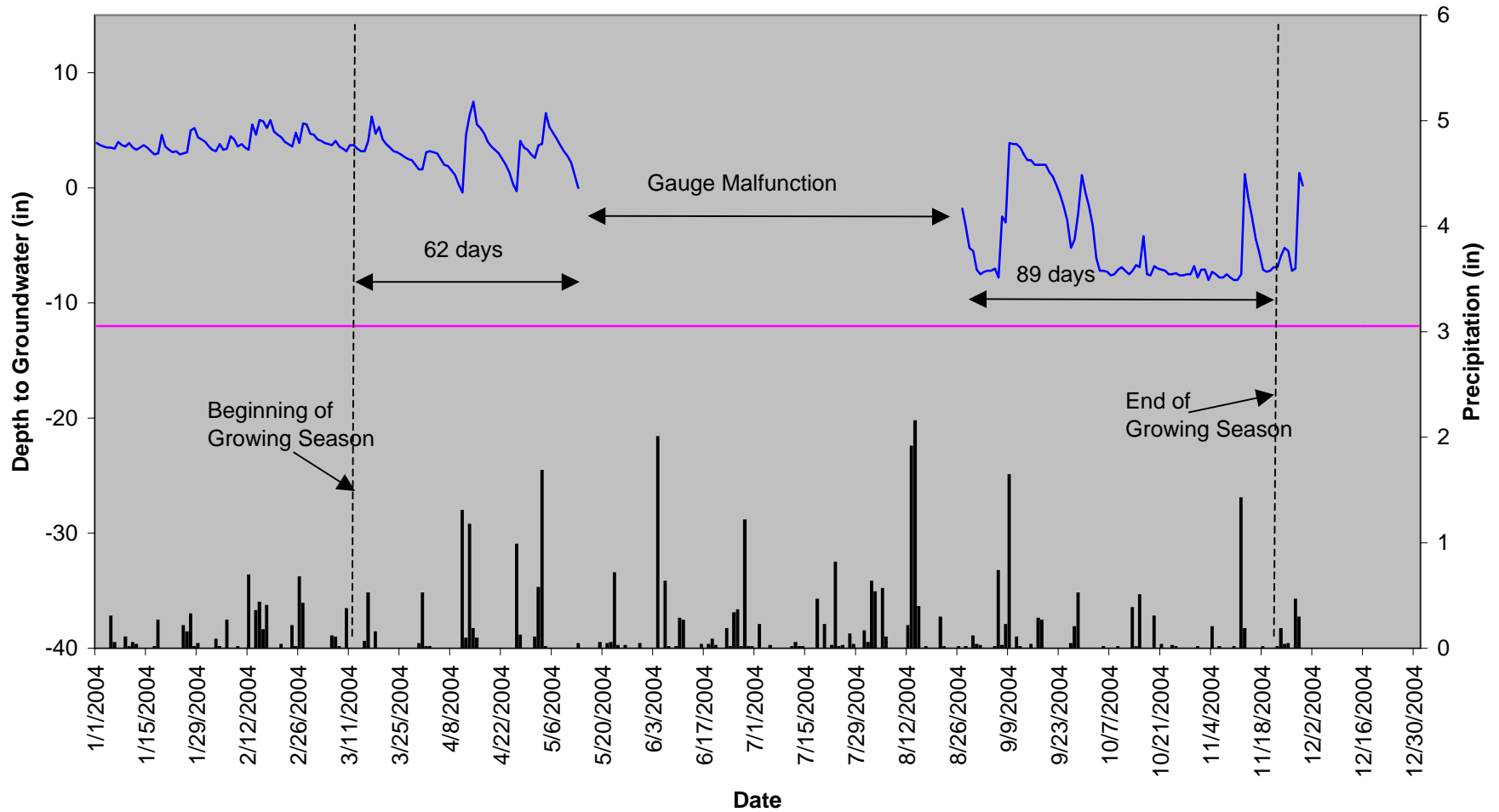
### ABC D7 (20" Surface & Groundwater Gauge)



■ N38B7F95 ABC-RG1    — S2EAB45 ABC-D7    — Required Depth

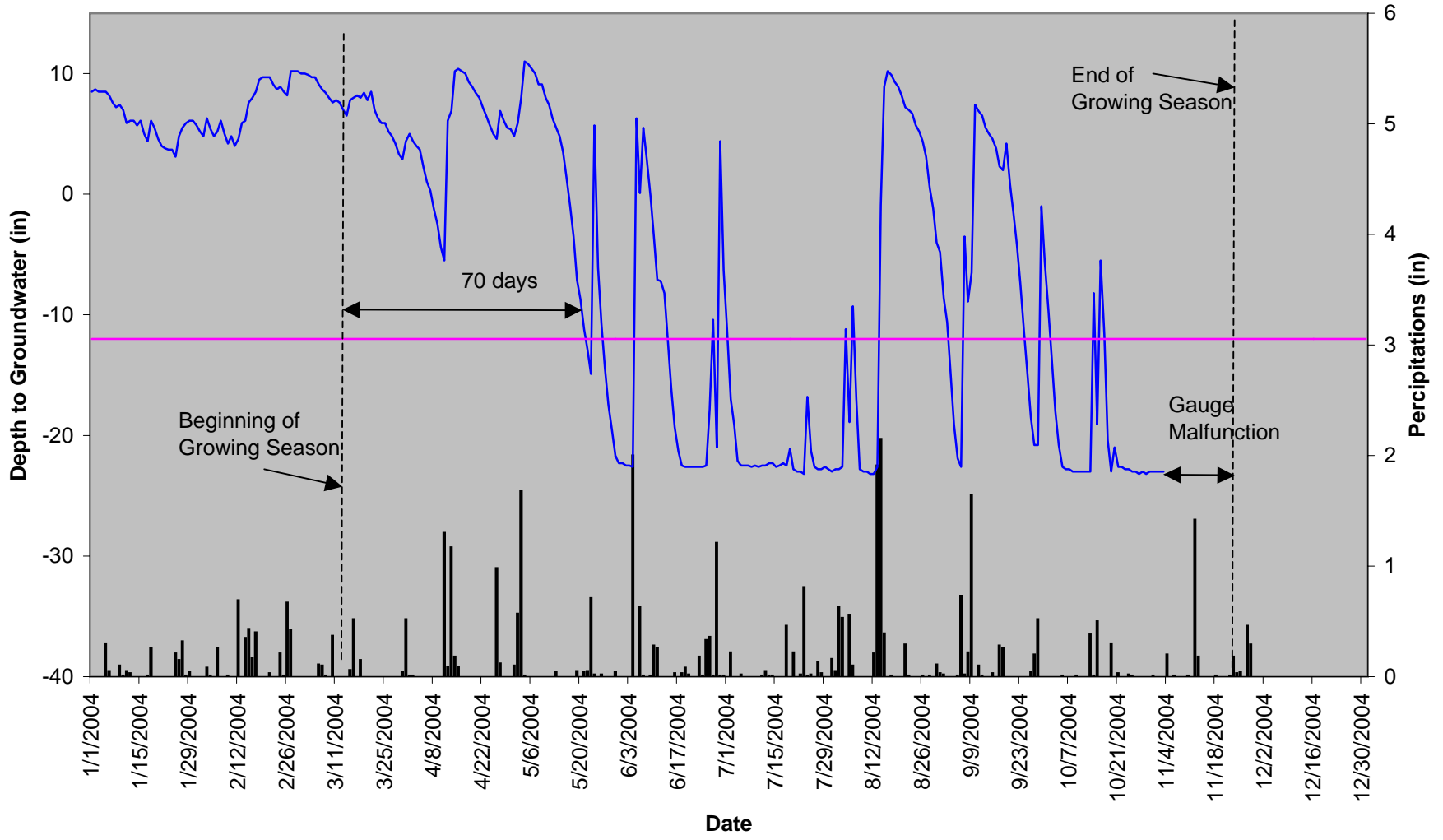


### ABC D8 (20" Surface & Groundwater Gauge)



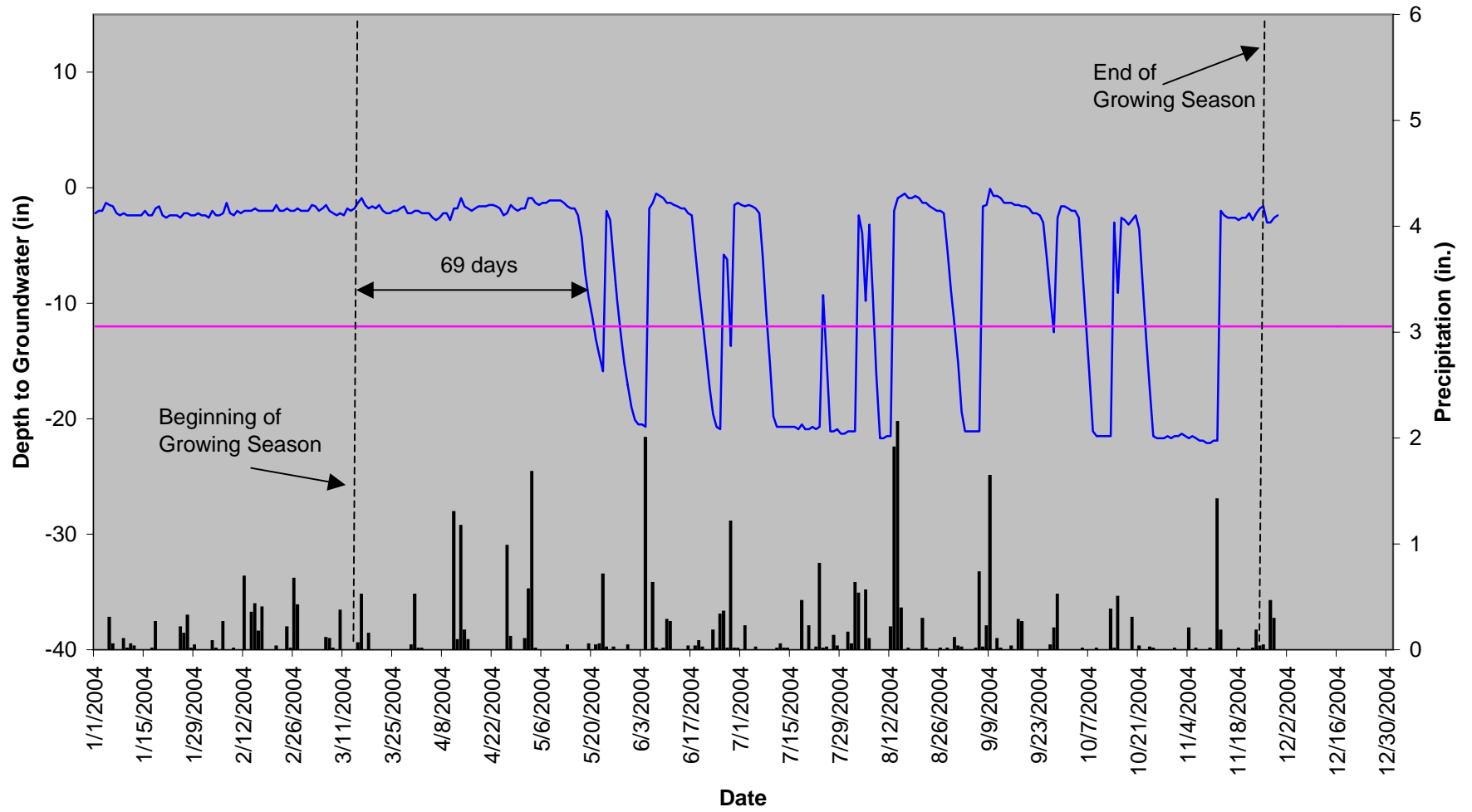
N38B7F95 ABC-RG1  
  S213DAD ABC-D8  
  Required Depth

### ABC D9 (40" Surface & Groundwater Gauge)



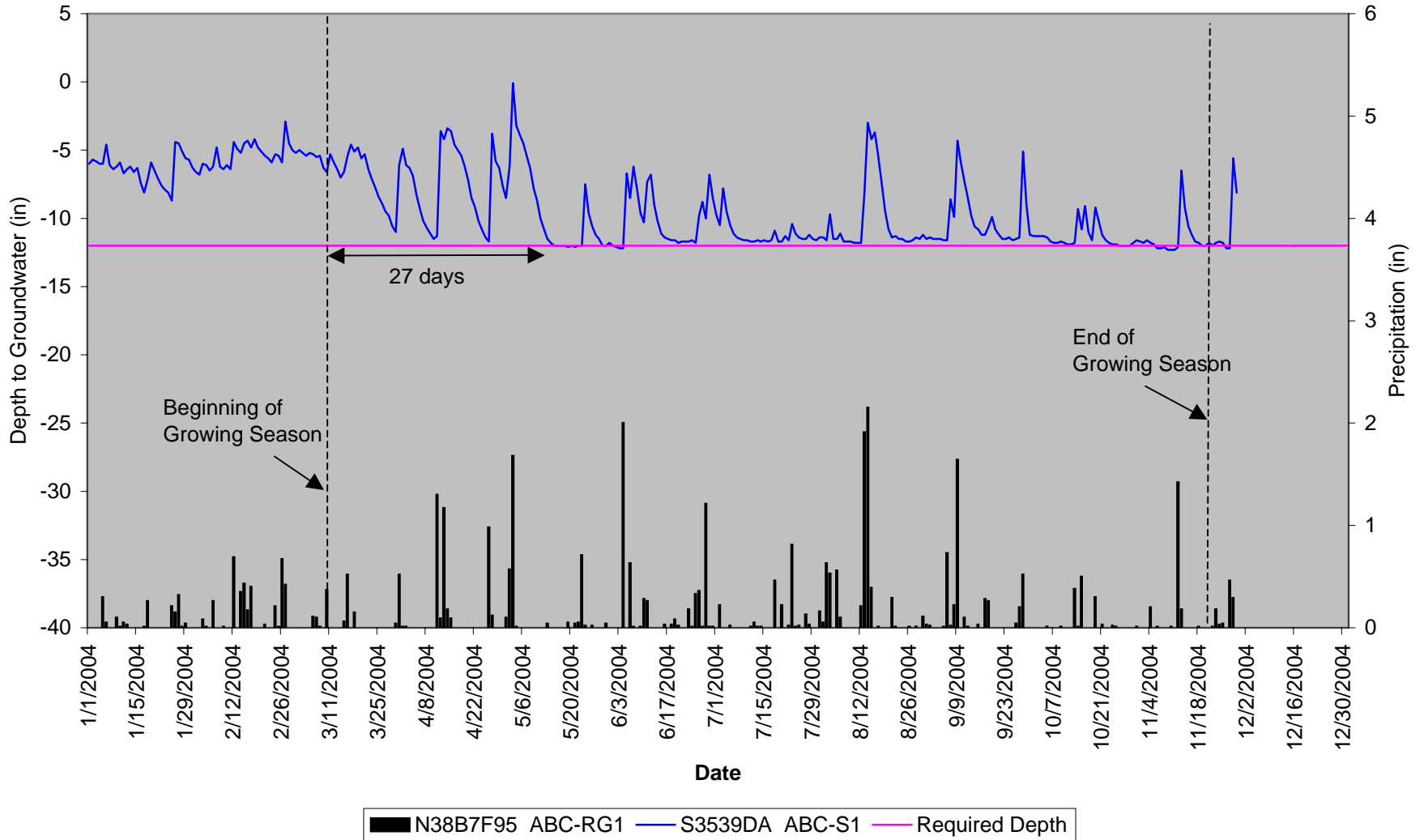
N38B7F95 ABC-RG1
  S4F53E5 ABC-D9
  Required Depth

### ABC D10 (40" Surface & Groundwater Gauge)

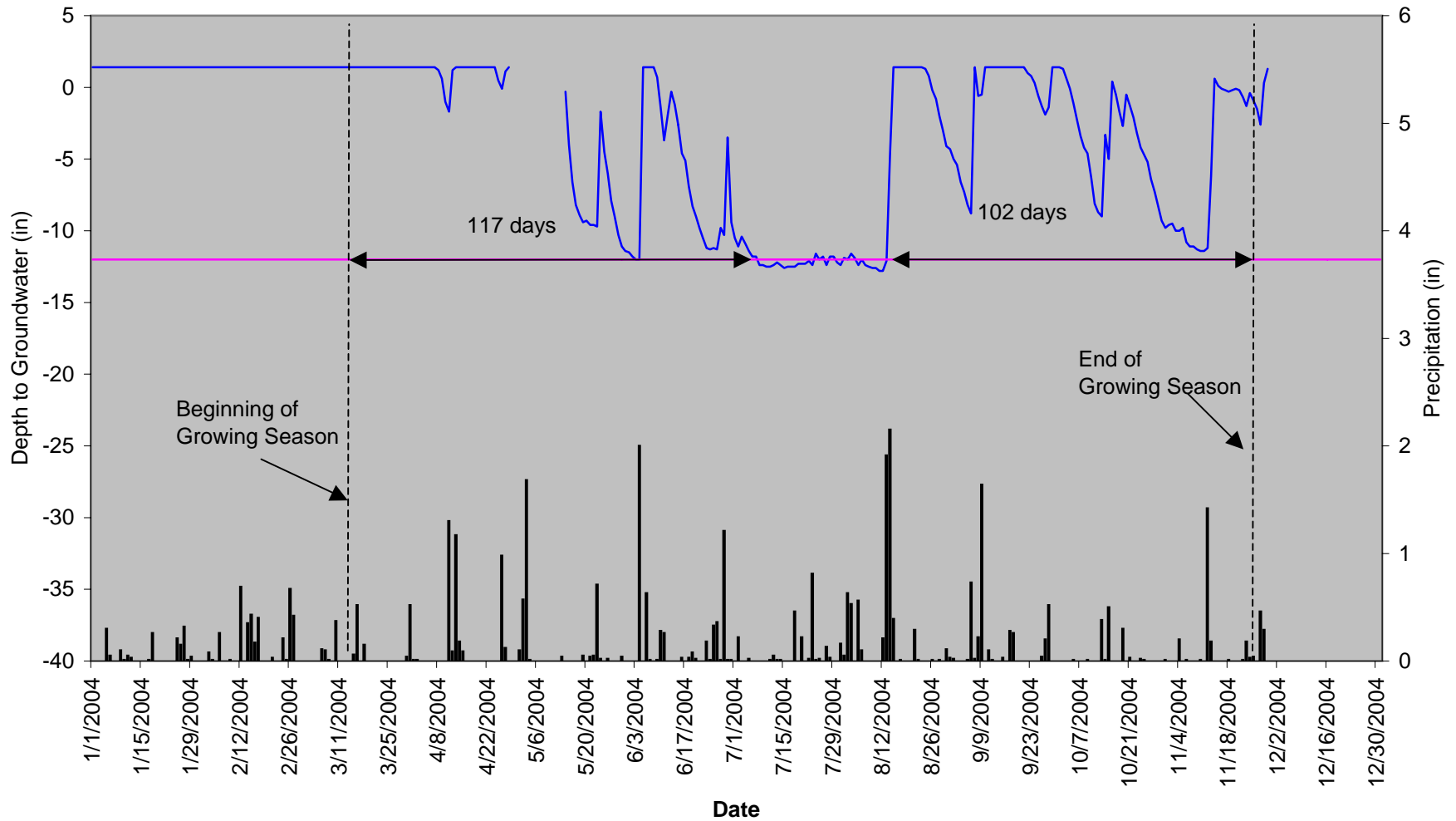


■ N38B7F95 ABC-RG1    — S4F5885 ABC-D10    — Required Depth

### ABC S1 (20" Groundwater Gauge)

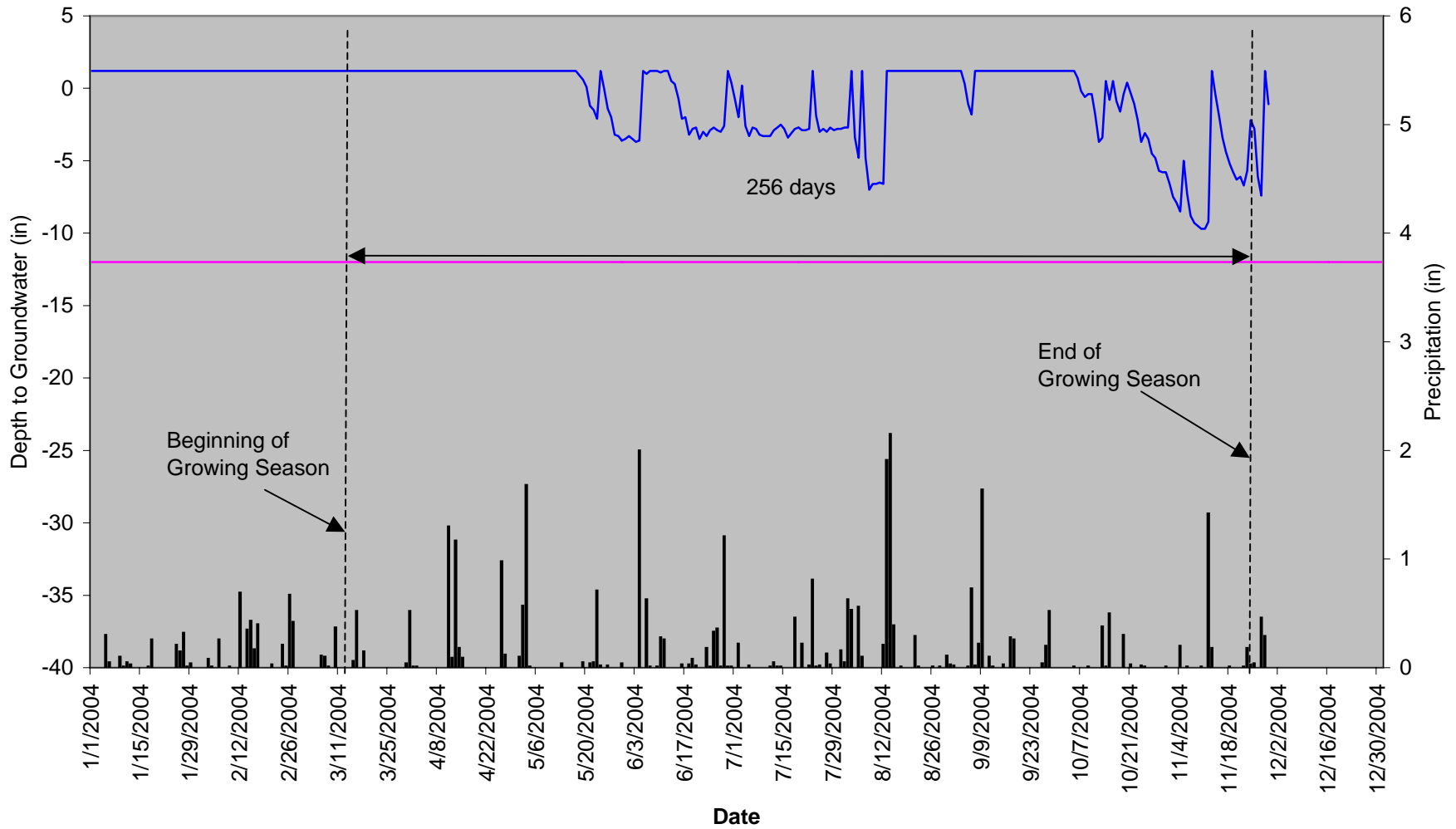


### ABC S2 (20" Groundwater Gauge)



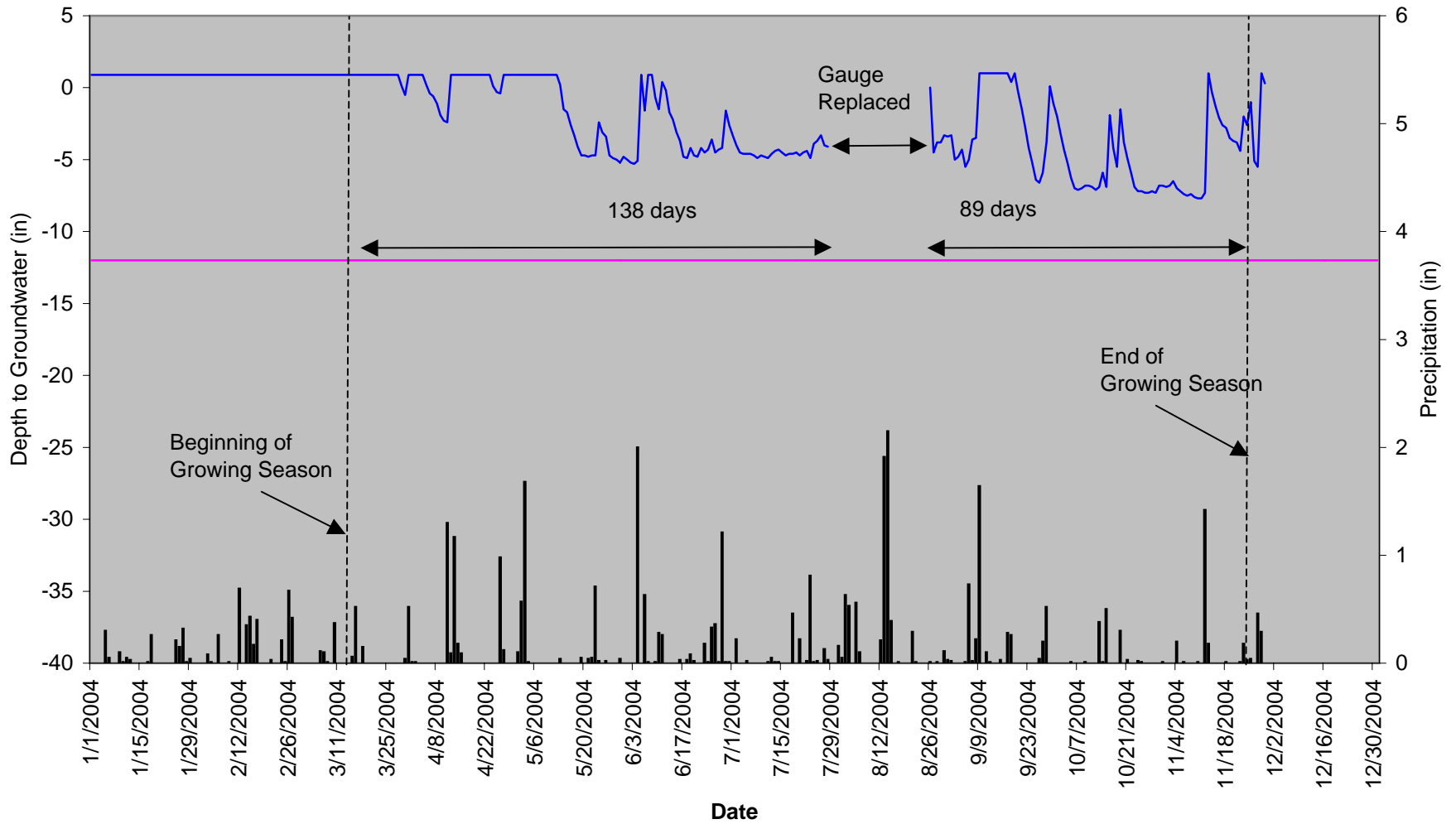
■ N38B7F95 ABC-RG1 — S320691 ABC-S2 — Required Depth

### ABC S3 (20" Groundwater Gauge)



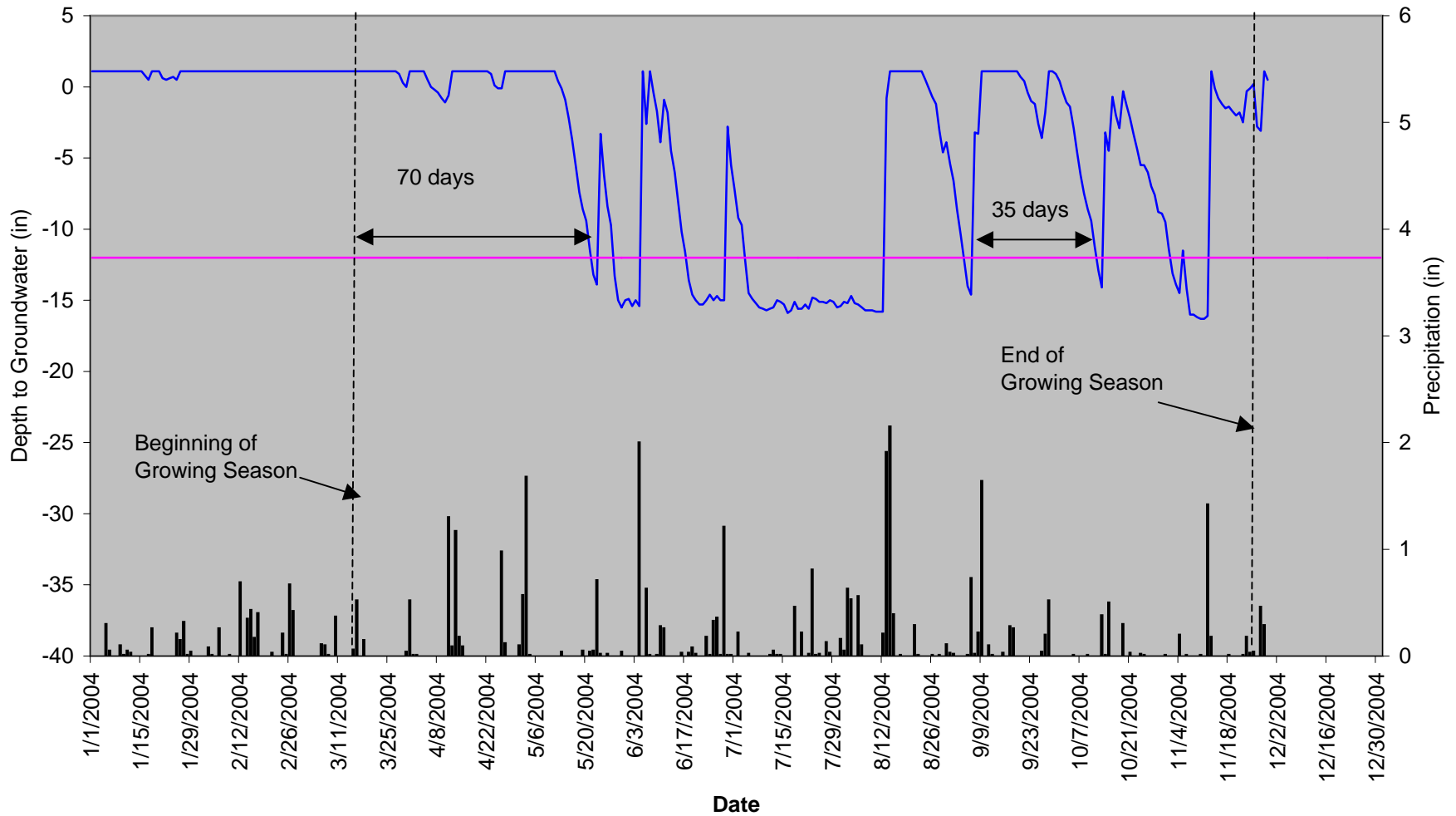
■ N38B7F95 ABC-RG1    — S353B52 ABC-S3    — Required Depth

### ABC F1 (20" Groundwater Gauge)



N38B7F95 ABC-RG1
  S4F5659 ABC-F1
  Required Depth

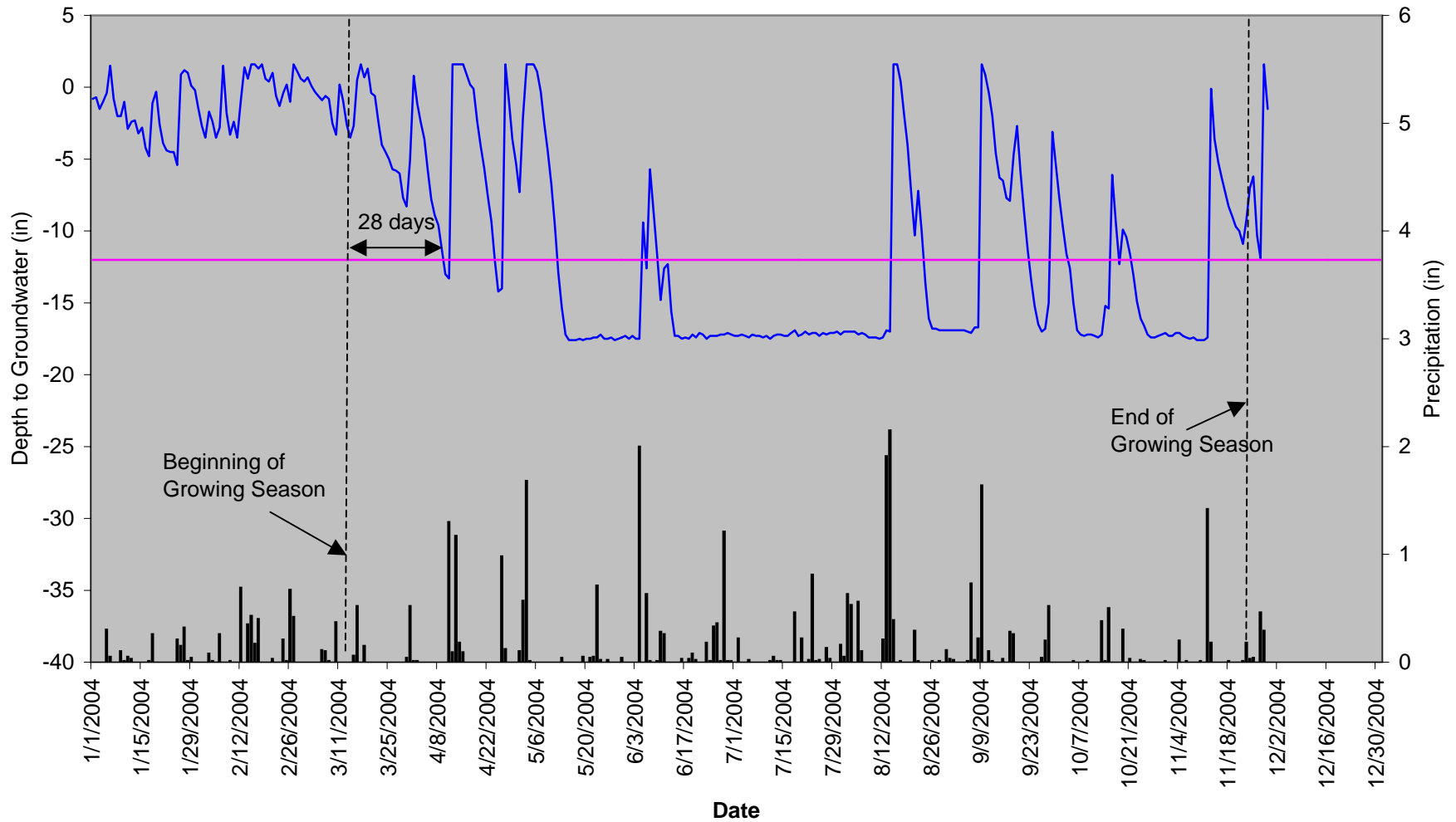
### ABC F2 (20" Groundwater Gauge)



■ N38B7F95 ABC-RG1    — S2EAAF1 ABC-F2    — Required Depth

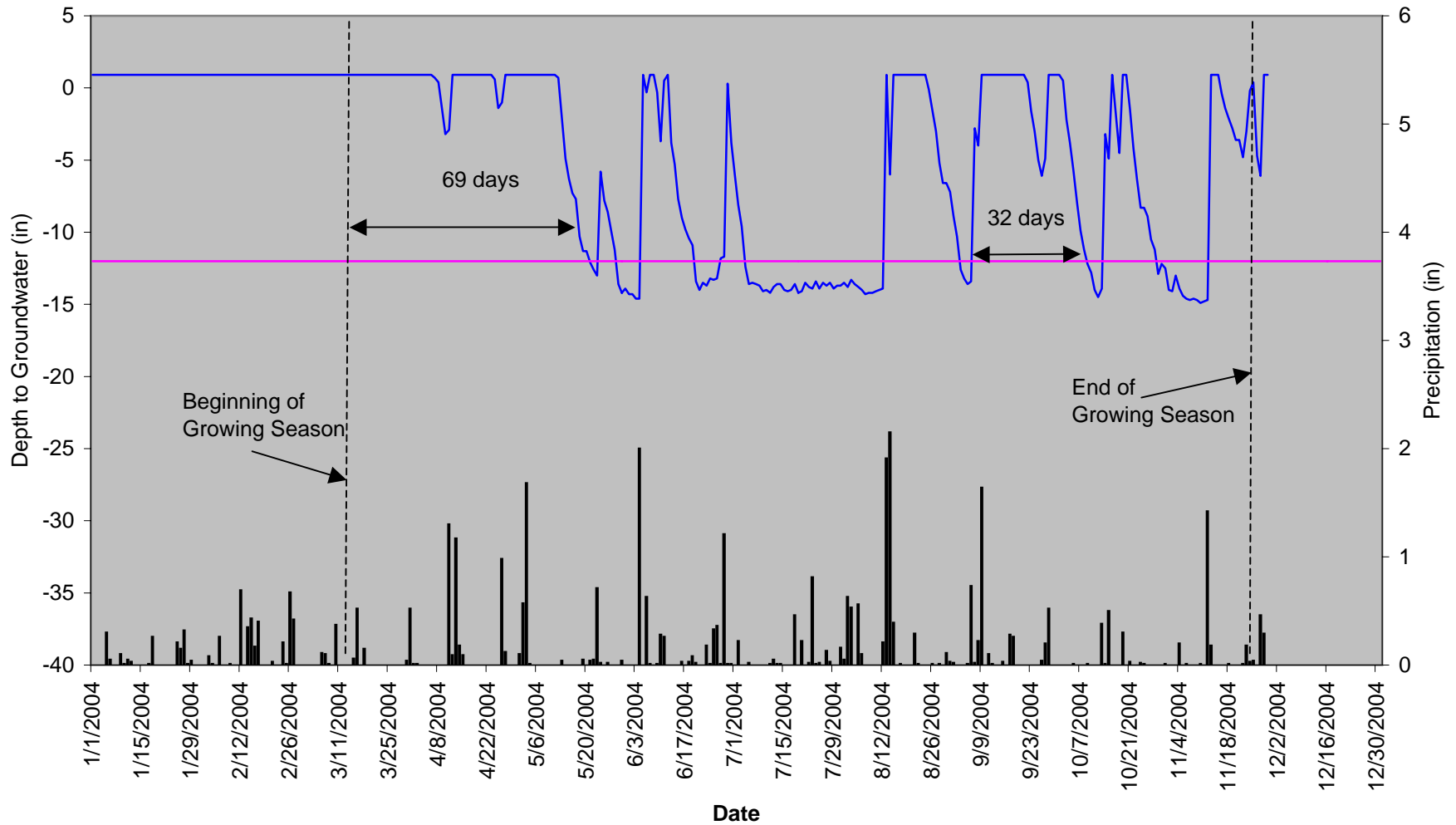


### ABC F3 (20" Groundwater Gauge)



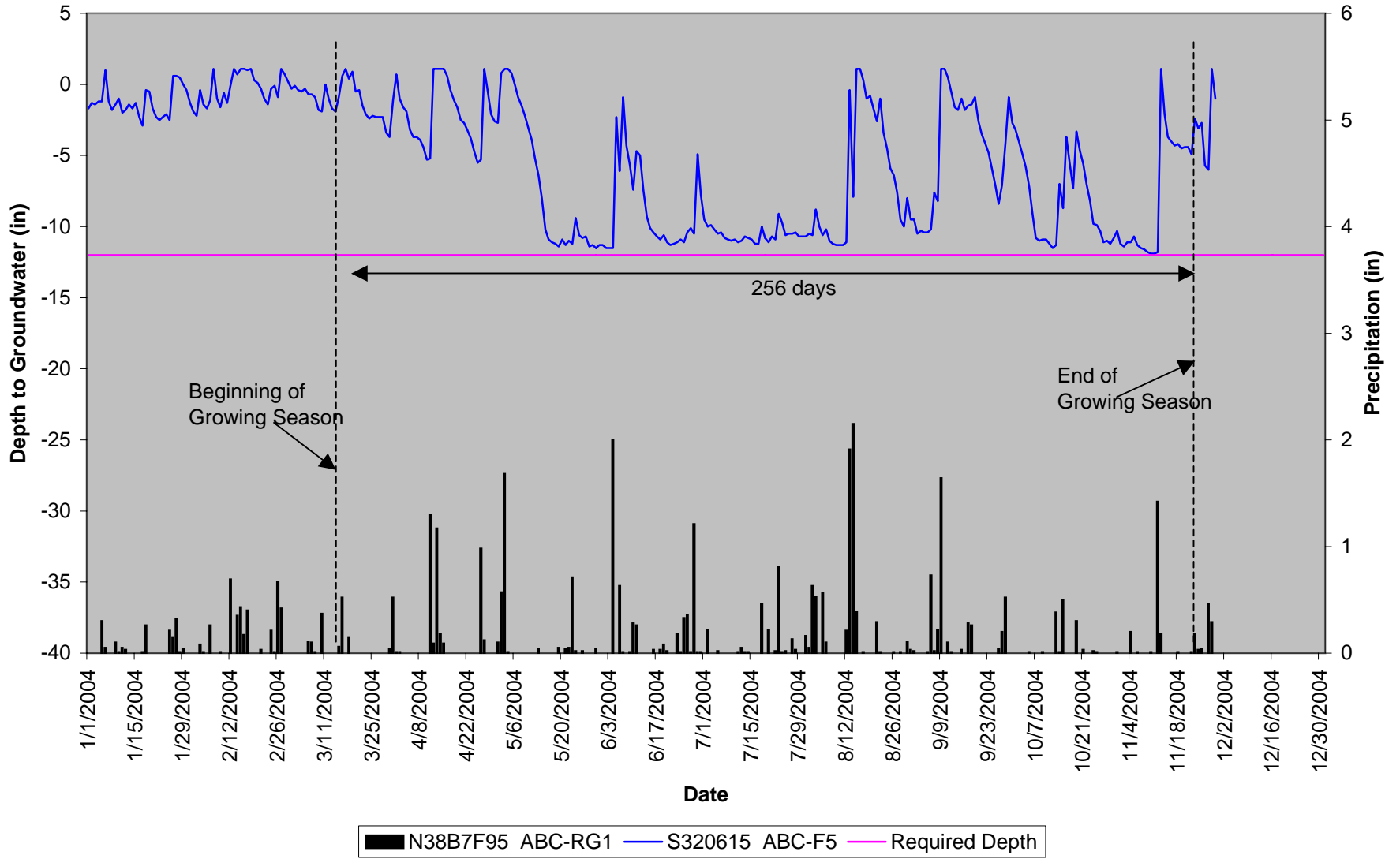
■ N38B7F95 ABC-RG1 — S32062A ABC-F3 — Required Depth

### ABC F4 (20" Groundwater Gauge)

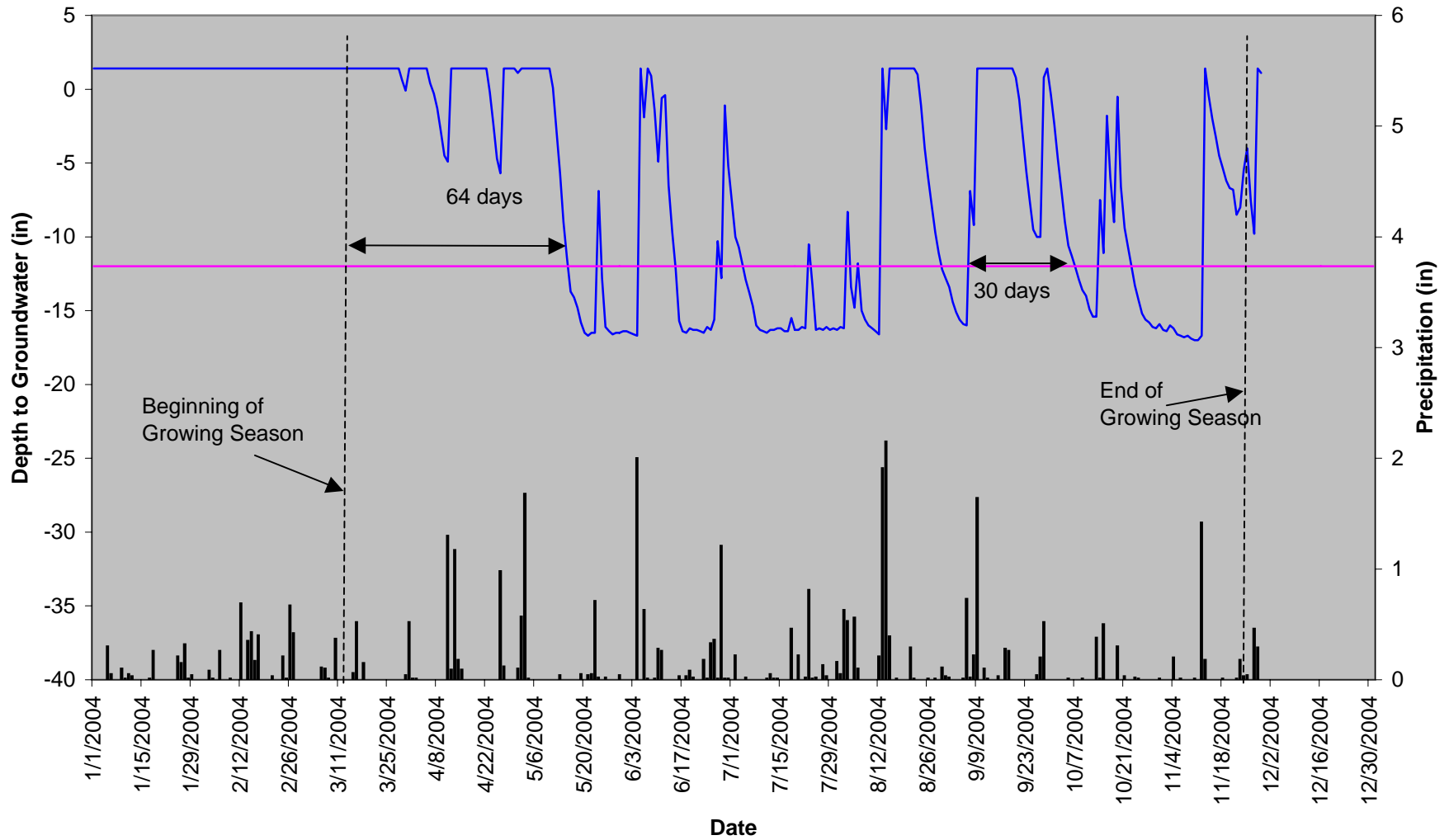


■ N38B7F95 ABC-RG1    — S3288CE ABC-F4    — Required Depth

### ABC F5 (20" Groundwater Gauge)

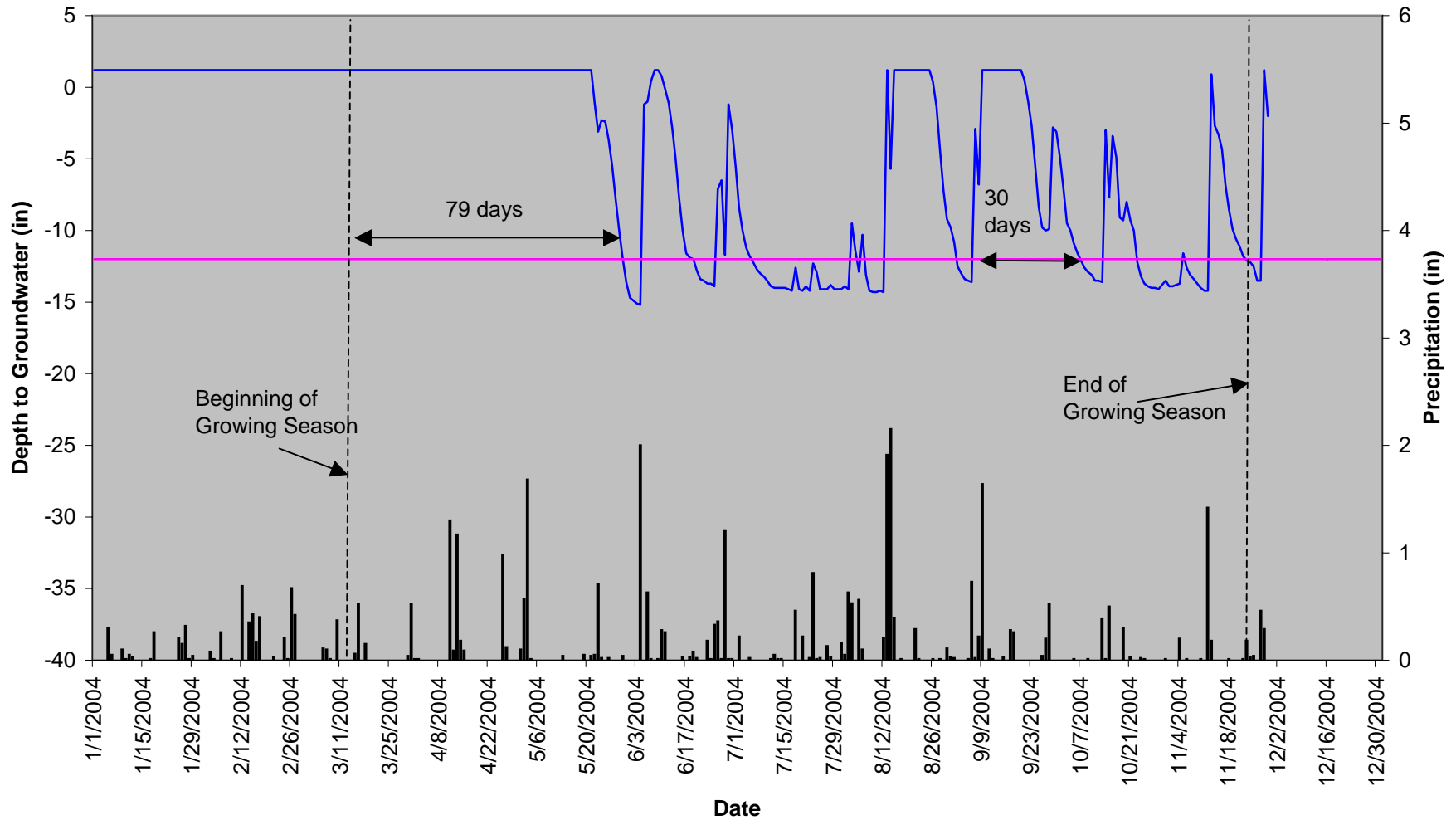


### ABC F6 (20" Groundwater Gauge)



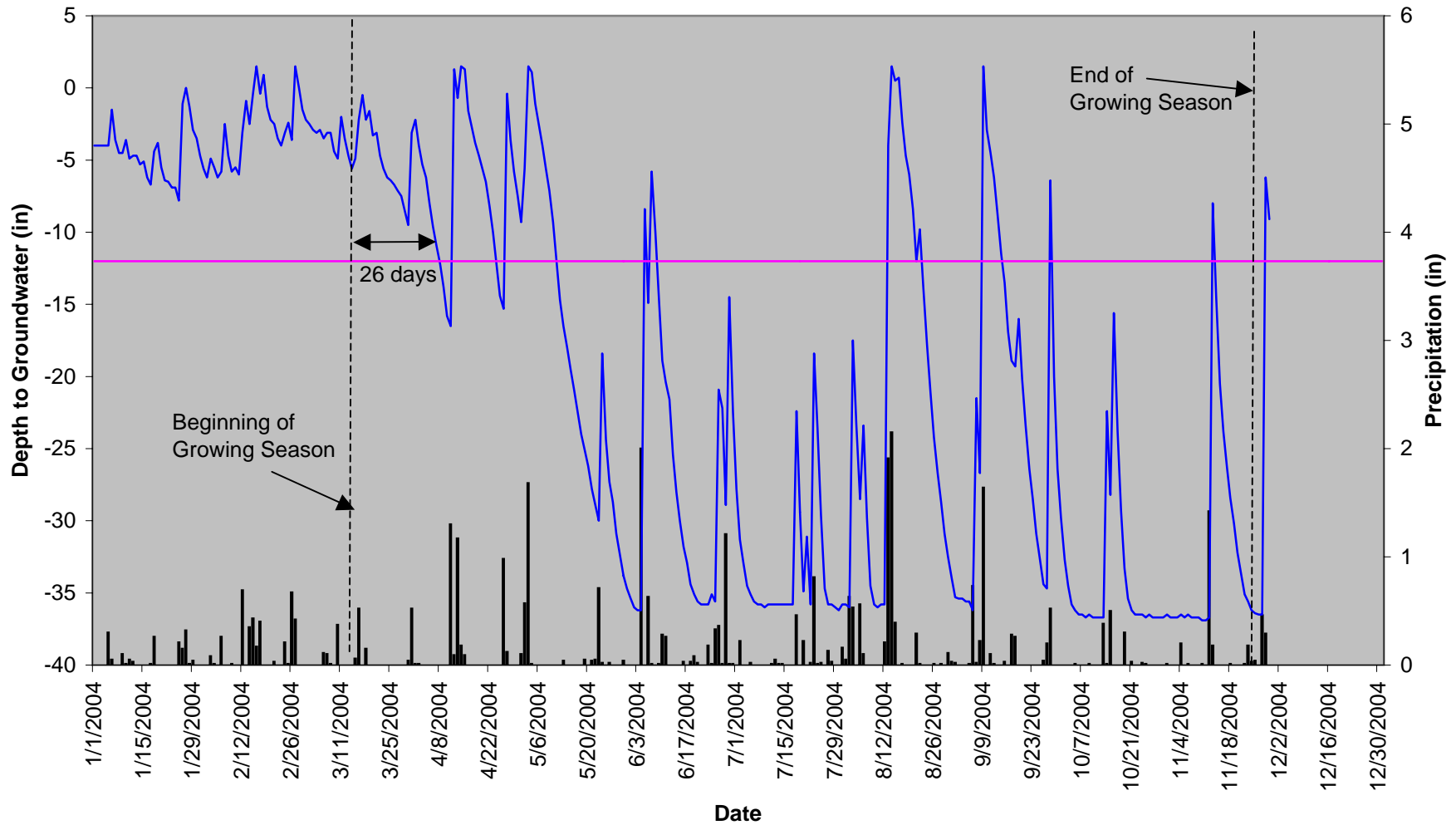
■ N38B7F95 ABC-RG1    — S2EAAB1 ABC-F6    — Required Depth

### ABC F7 (20" Groundwater Gauge)



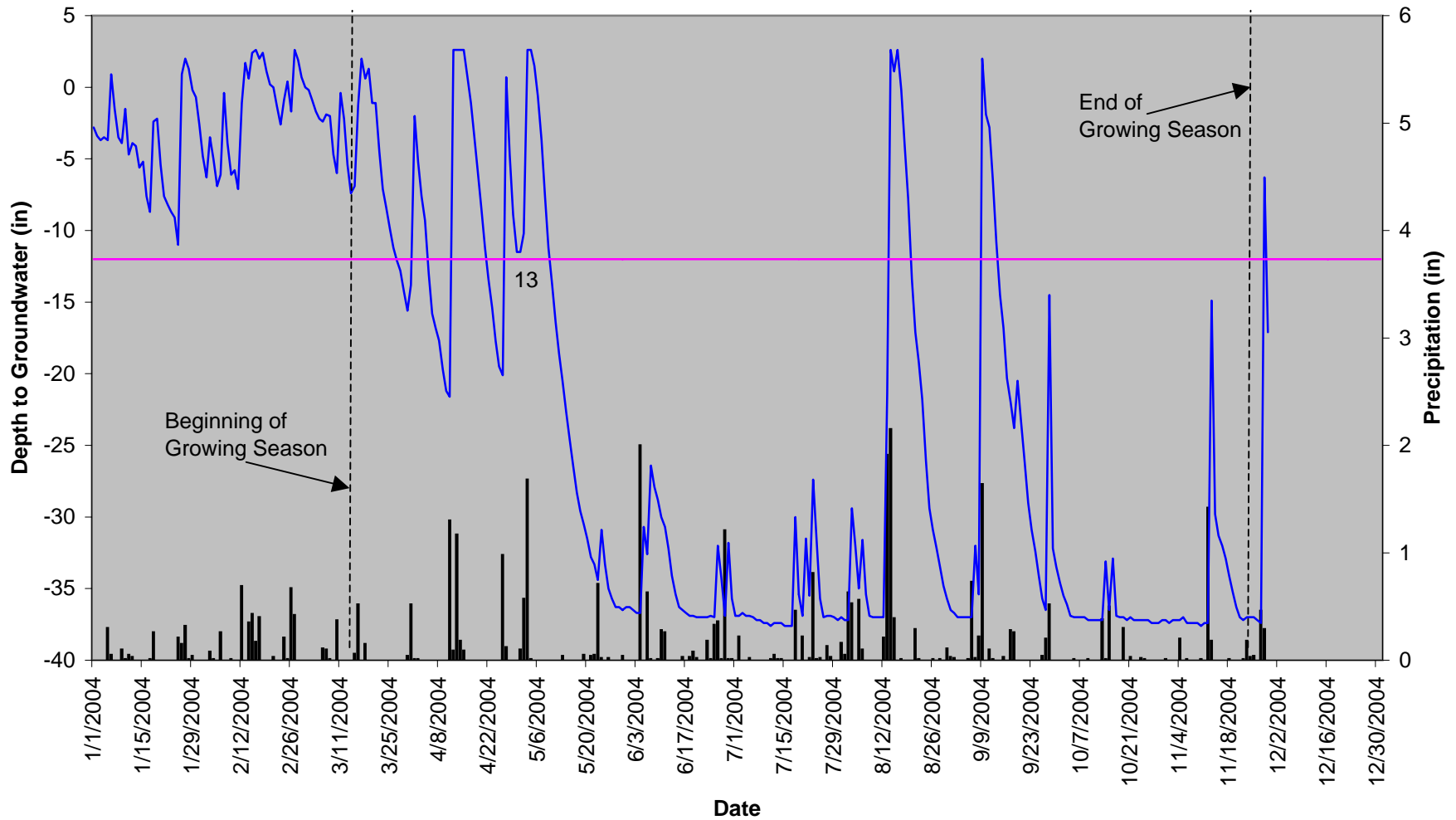
■ N38B7F95 ABC-RG1 — S353A93 ABC-F7 — Required Depth

### ABC F8 (40" Groundwater Gauge)



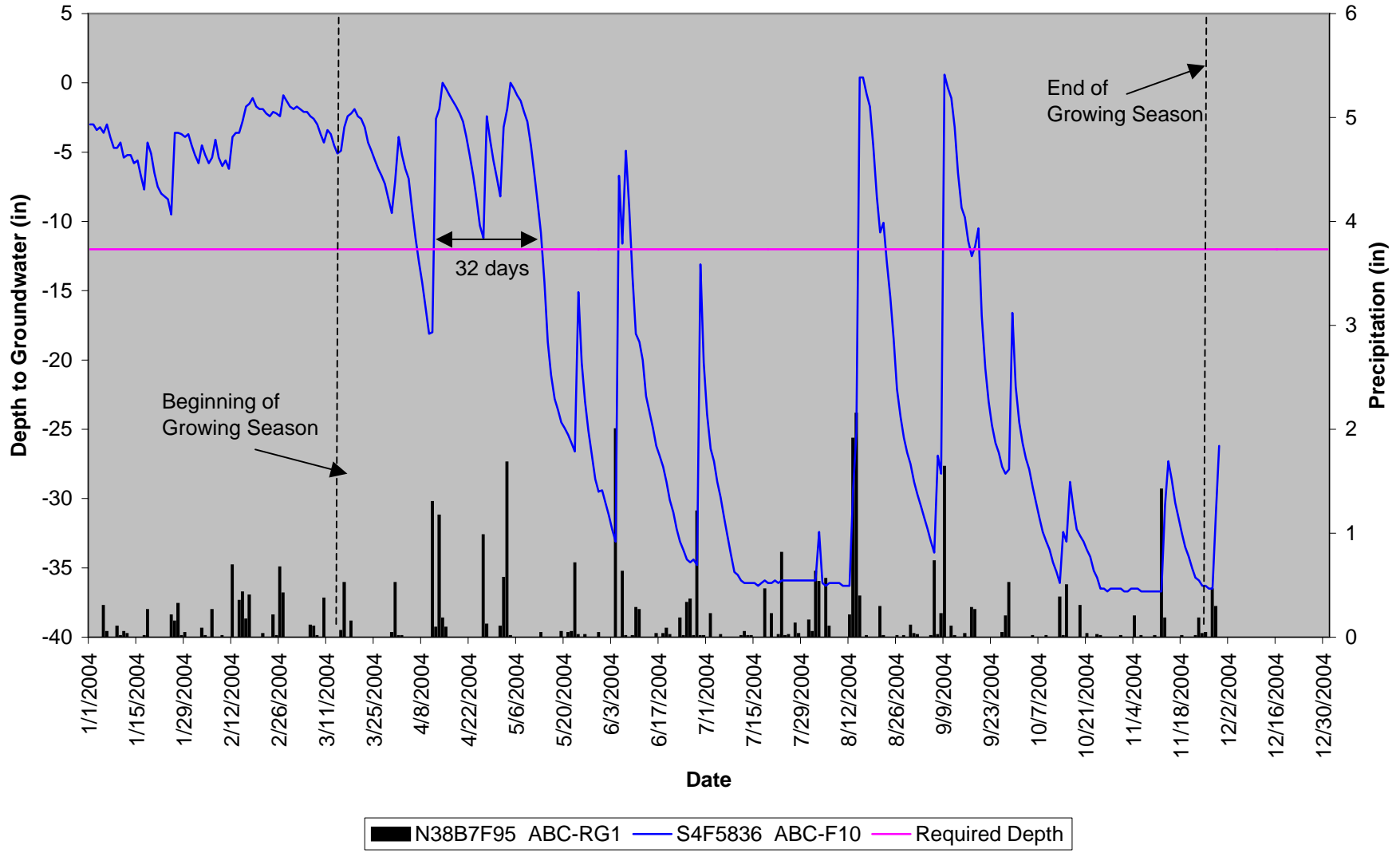
■ N38B7F95 ABC-RG1    — S213DA1 ABC-F8    — Required Depth

### ABC F9 (40" Groundwater Gauge)



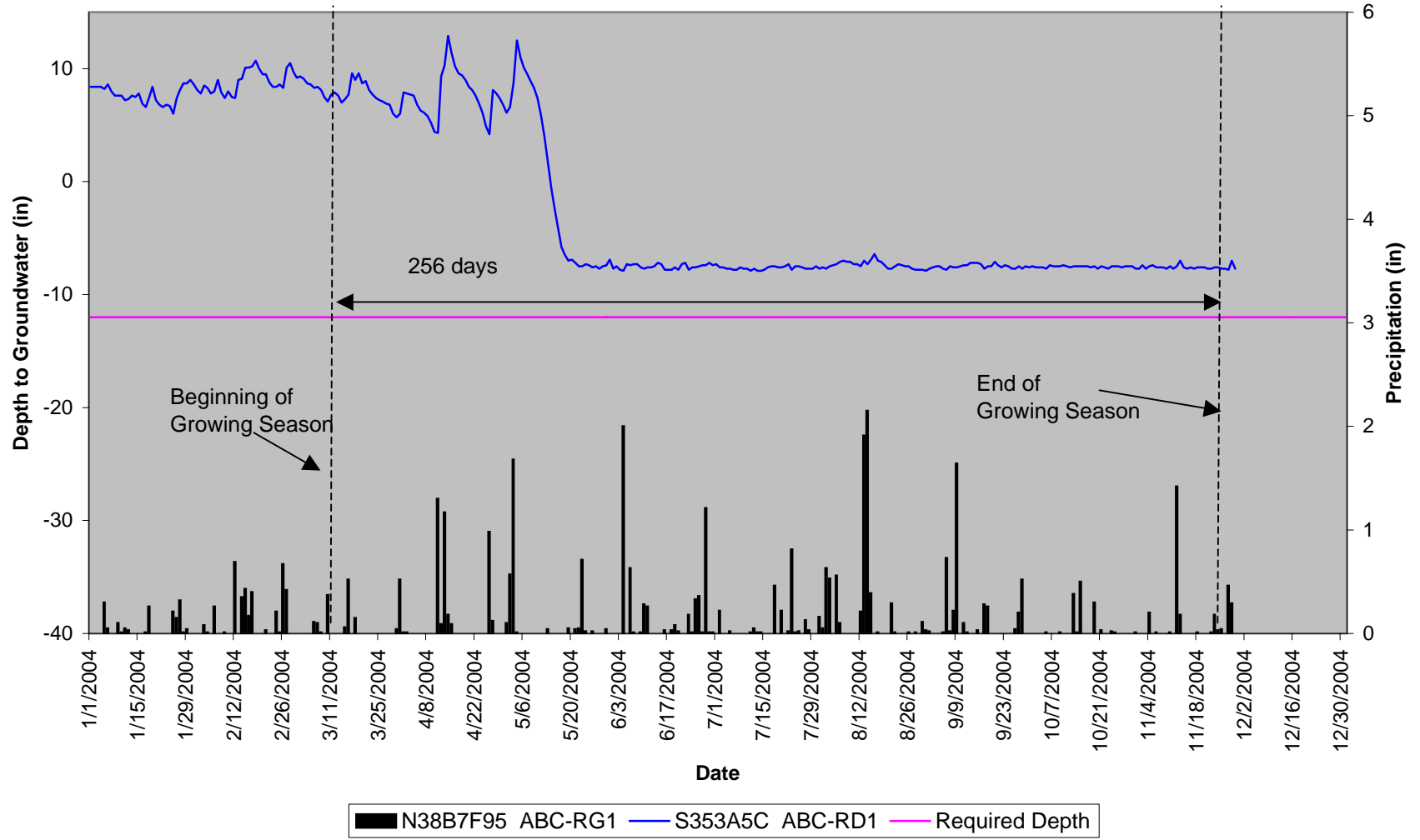
■ N38B7F95 ABC-RG1 — S213DA1 ABC-F8 — Required Depth

### ABC F10 (40" Groundwater Gauge)

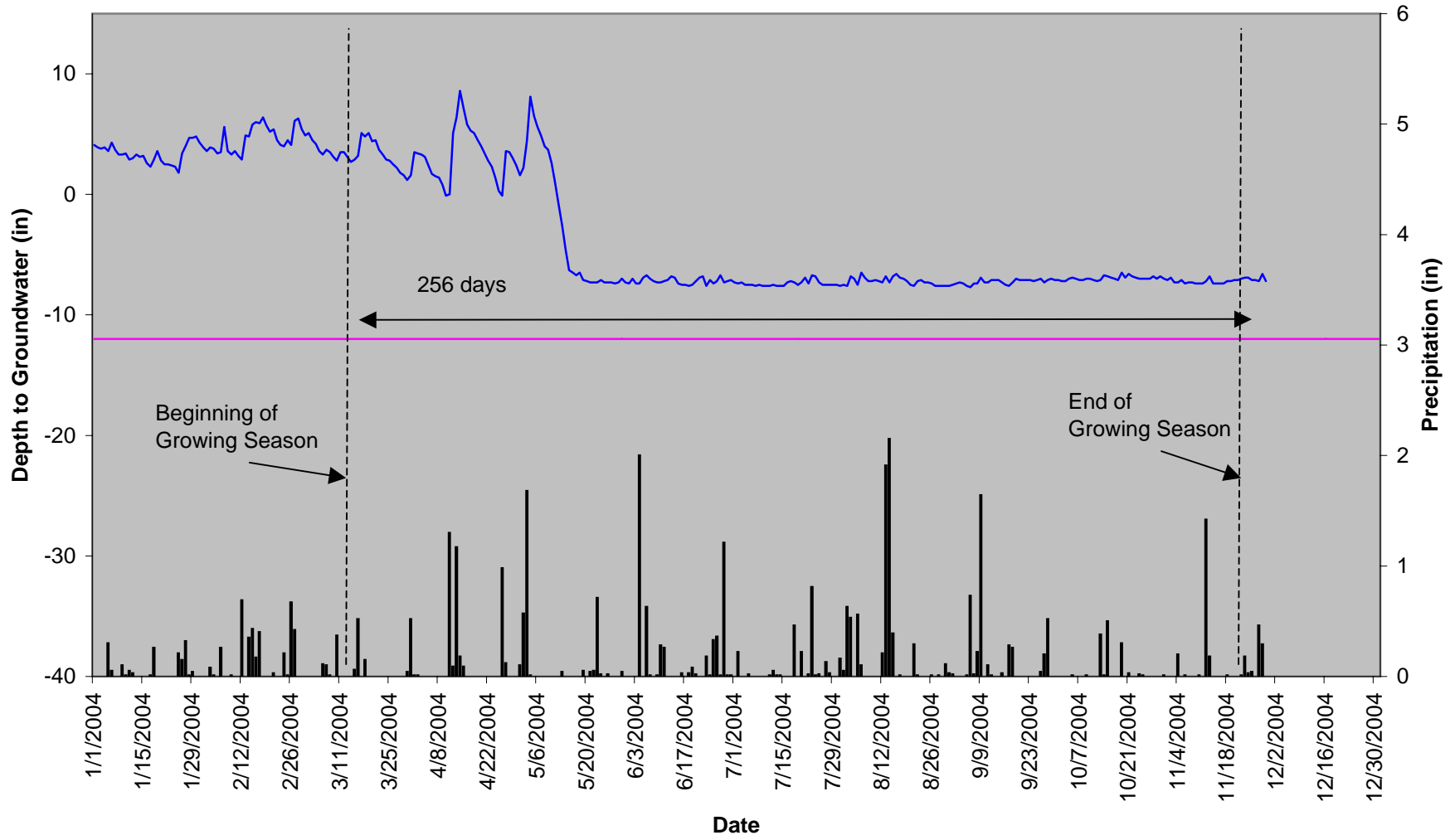




# ABC RD1 (20" Surface & Groundwater Gauge)

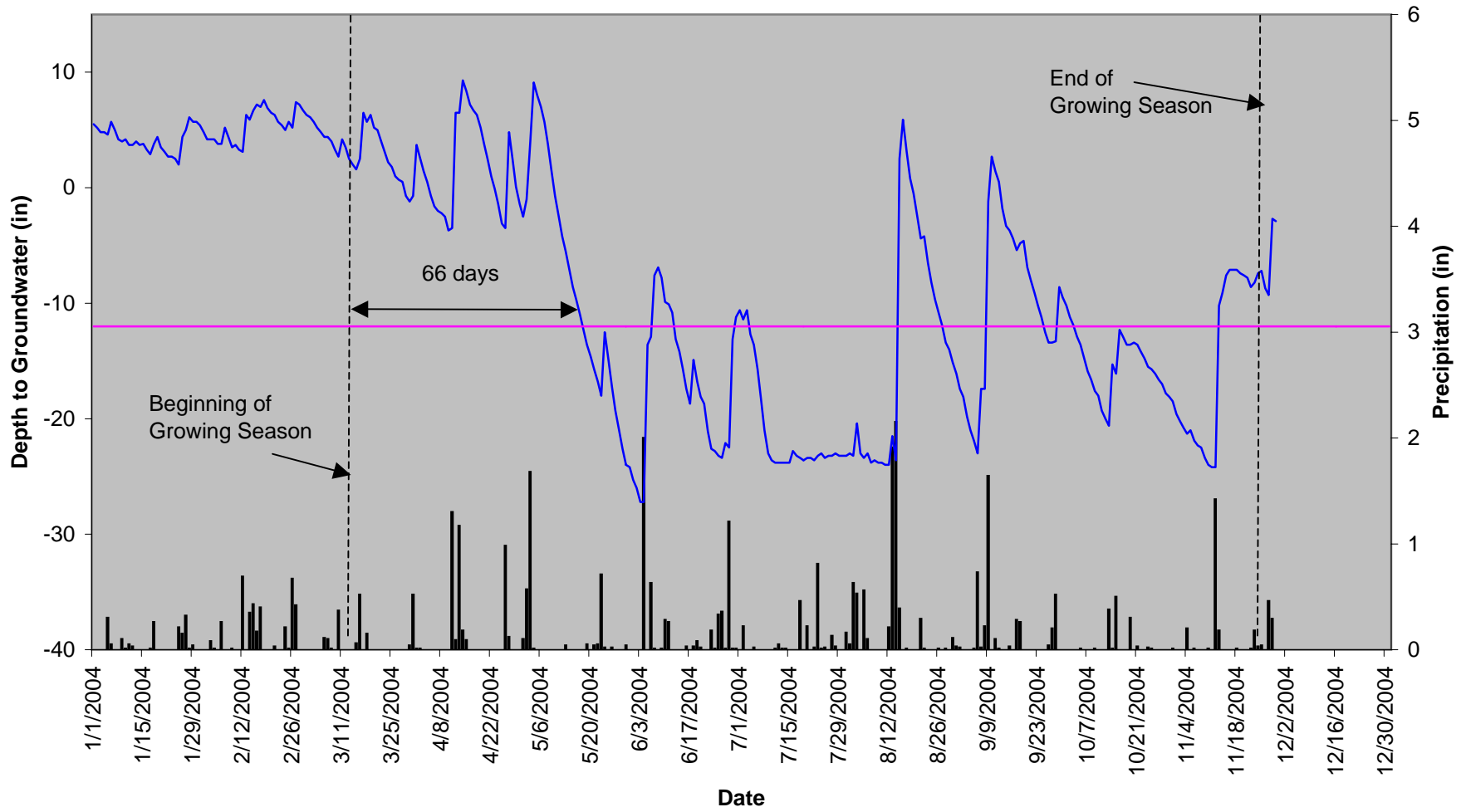


### ABC RD2 (20" Surface & Groundwater Gauge)



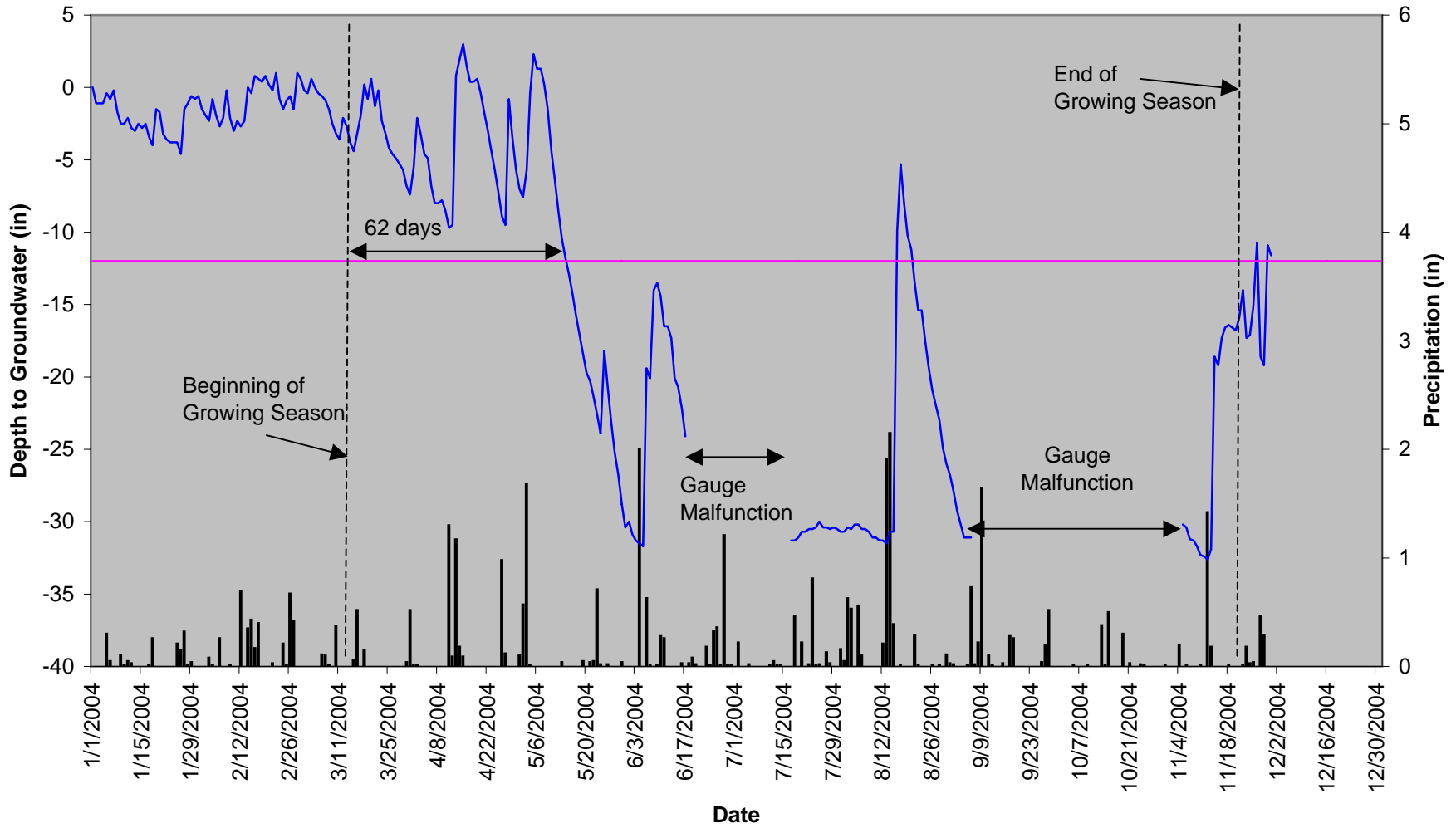
■ N38B7F95 ABC-RG1    — S353B94 ABC-RD2    — Required Depth

### ABC RD3 (40" Surface & Groundwater Gauge)



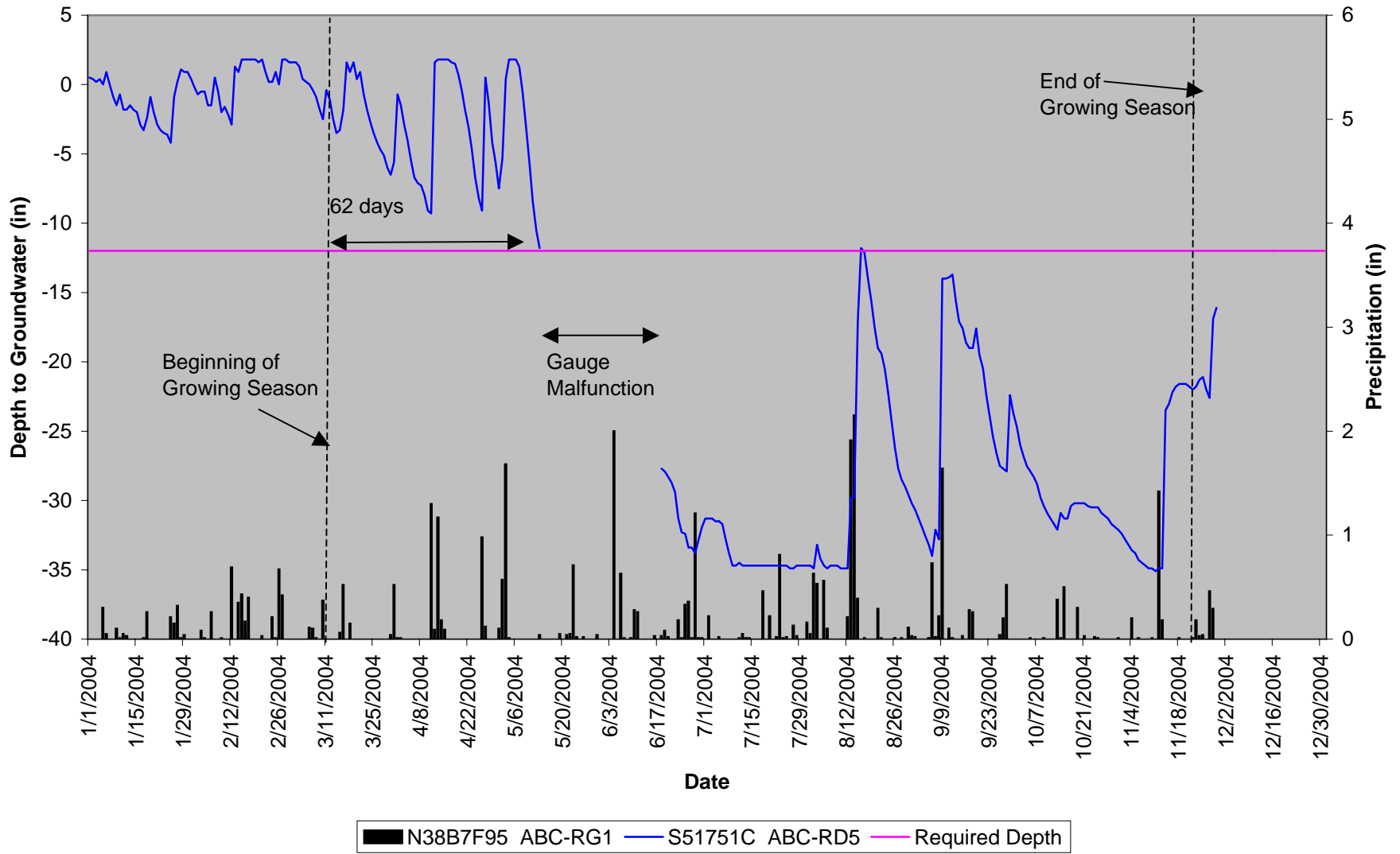
N38B7F95 ABC-RG1    
  S44894D ABC-RD3    
  Required Depth

### ABC RD4 (40" Groundwater Gauge)

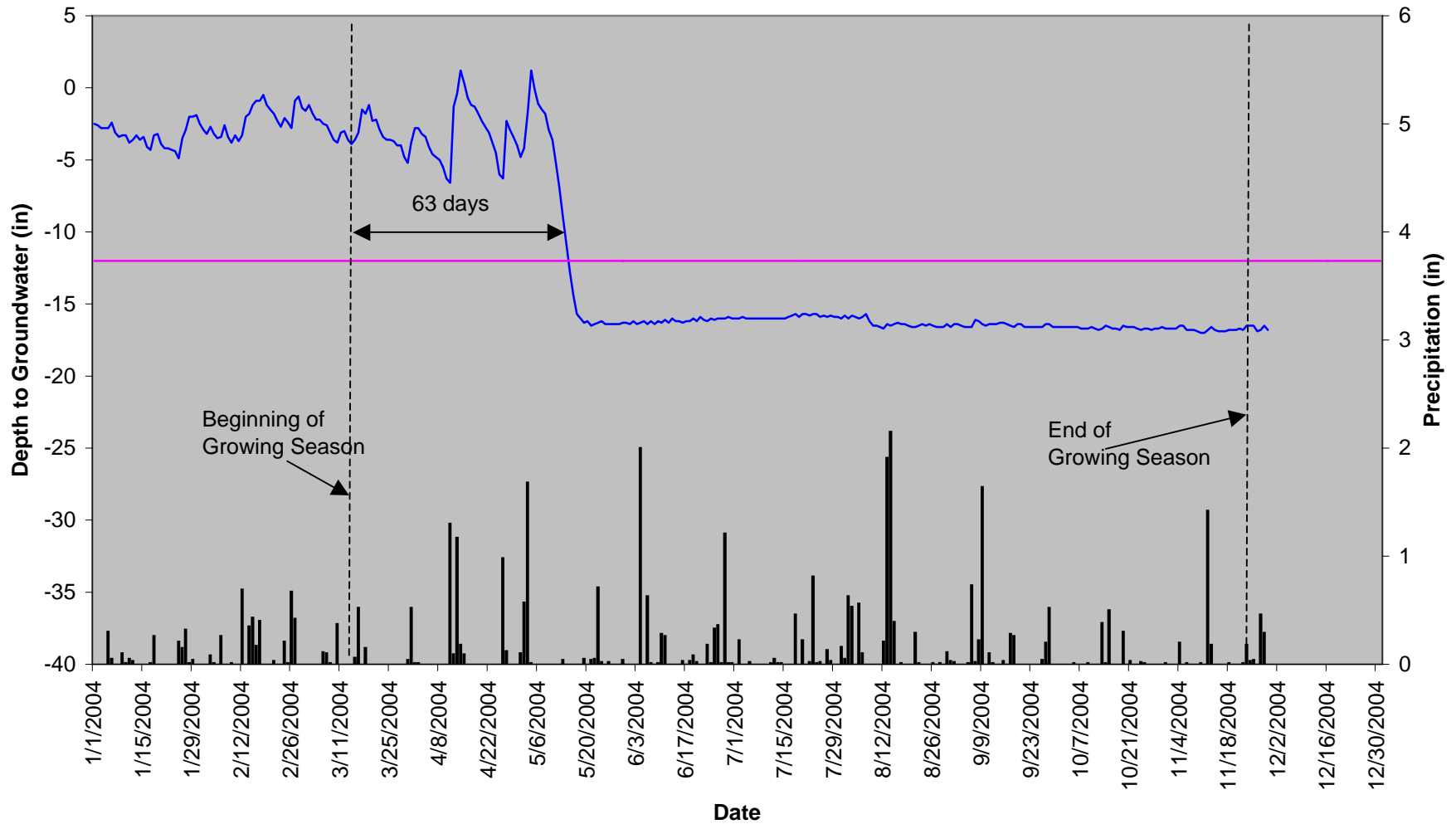


■ N38B7F95 ABC-RG1    — S214059 ABC-RD4    — Required Depth

### ABC RD5 (40" Groundwater Gauge)

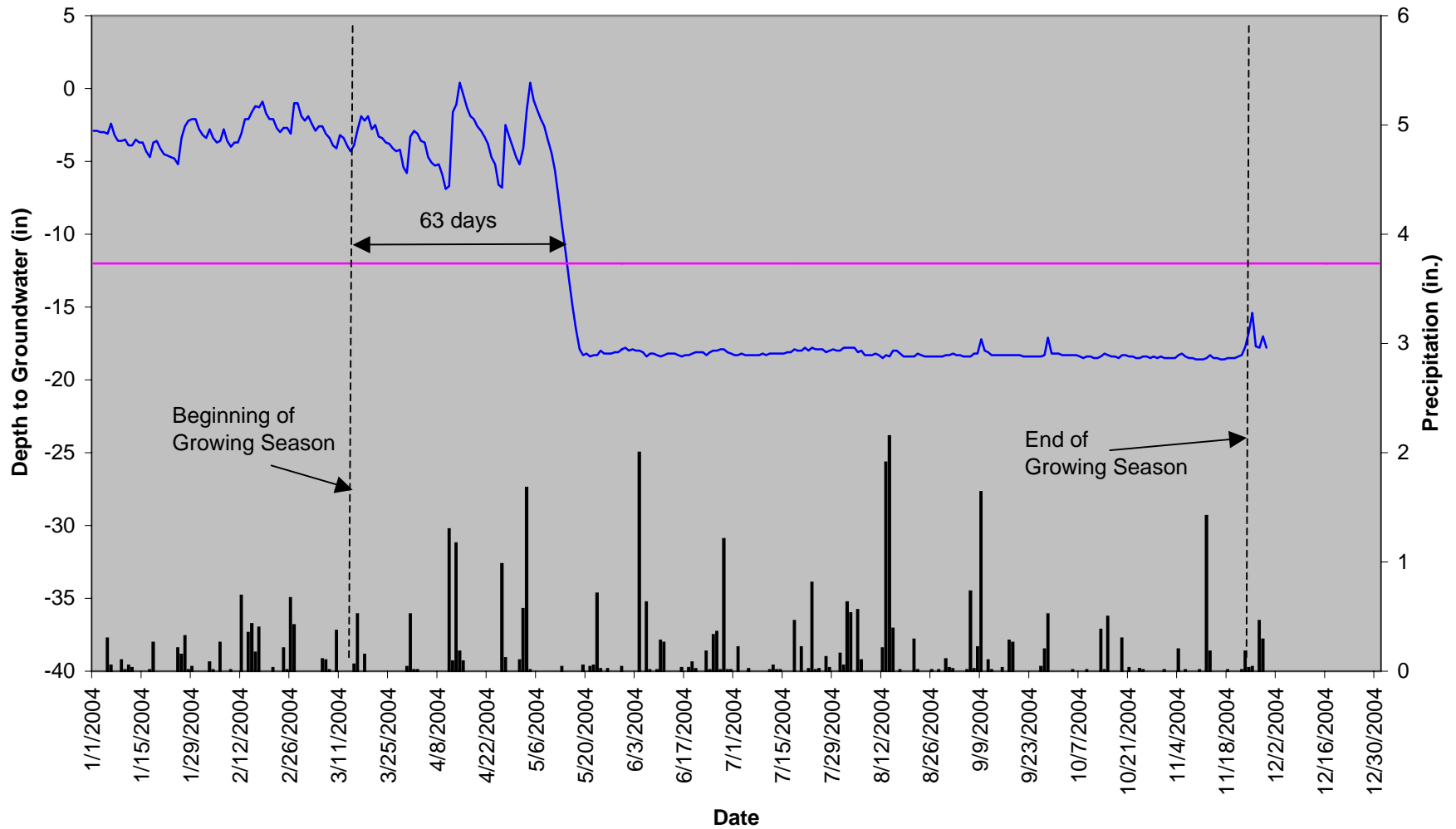


### ABC RF1 (20" Groundwater Gauge)



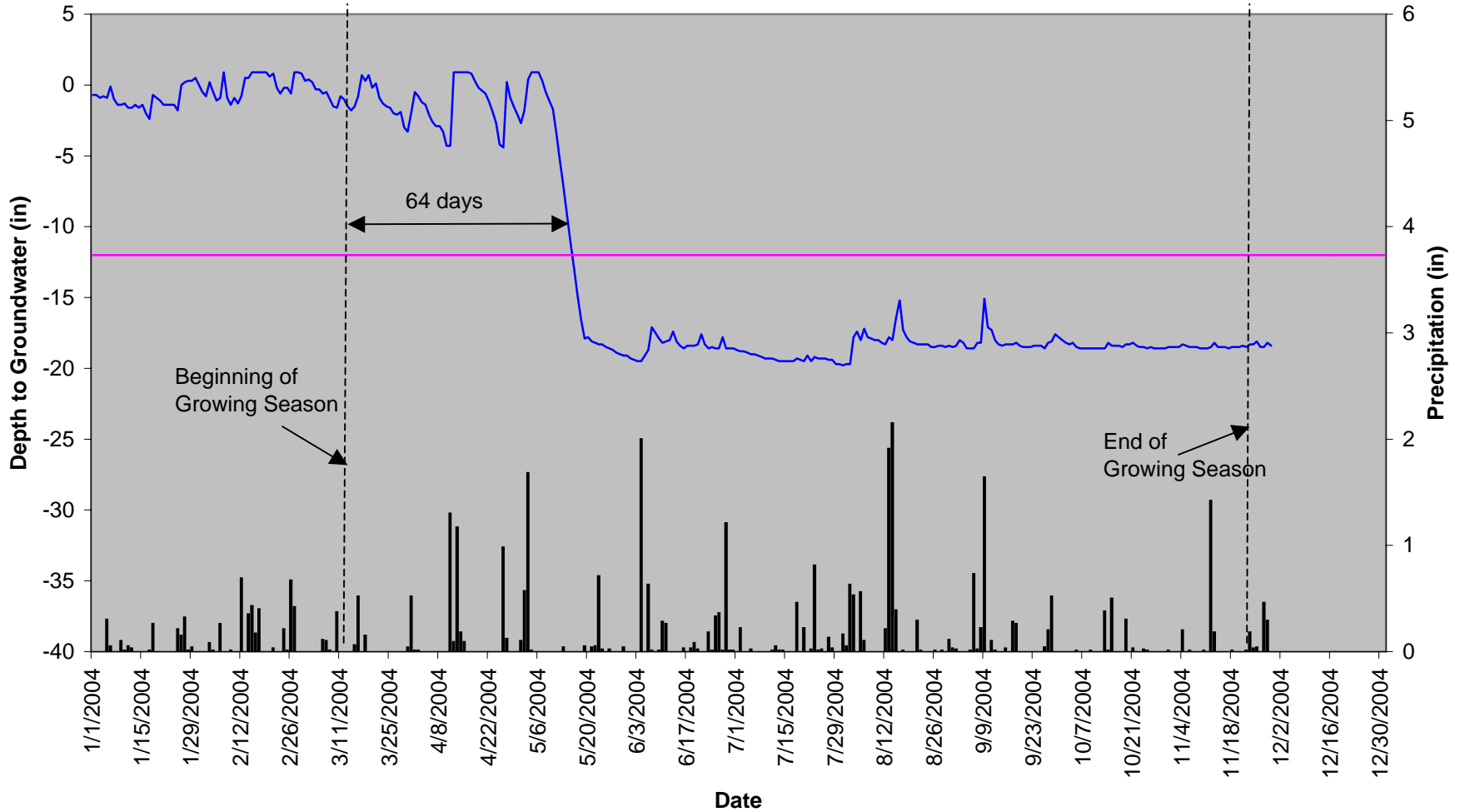
■ N38B7F95 ABC-RG1    — S353AB8 ABC-RF1    — Required Depth

### ABC RF2 (20" Groundwater Gauge)



■ N38B7F95 ABC-RG1 — S126F99 ABC-RF2 — Required Depth

### ABC RF3 (20" Groundwater Gauge)



■ N38B7F95 ABC-RG1    — S3288BB ABC-RF3    — Required Depth



## **APPENDIX B**

### **Site Photos & Vegetation Plot Map**

# ABC Mitigation Site



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6





Photo 7



Photo 8

# ABC MITIGATION SITE

## PLANT COMMUNITIES

-  LEVEE/STREAMBANK FOREST
-  RIVERINE SWAMP FOREST
-  MESIC HARDWOOD FOREST
-  NON-RIVERINE WET HARDWOOD
-  DRY MESIC OAK/HICKORY FOREST
-  EXISTING FORESTED COMMUNITY
-  NON-RIVERINE SWAMP FOREST
-  VEGETATION MONITORING PLOTS
-  PHOTO LOCATIONS

