

ANNUAL REPORT FOR 2001



**Pembroke Creek Mitigation Site
Chowan County
Project No. 8.T010602
TIP No. R-2512**



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SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Pembroke Mitigation Site. In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for a minimum of five years or until success criteria are fulfilled. Site construction began in 1998 and was finished in 1999. The year 2001 represents the third year for hydrology and vegetation monitoring.

The Pembroke Creek Mitigation Site in Chowan County is a bottomland forest site divided into two areas. The site was constructed to mitigate for the wetland impacts from the improvements to US 17 in Bertie and Chowan Counties (R-2512).

Hydrologic success for this site is based on the mean depth to groundwater of the gauges in the restoration area within 20% of the mean depth to groundwater of the gauges in the respective reference area. One of the four gauges was within 20% of reference gauges. Three gauges (PC-1, PC-2, and PC-3) did not meet this criteria. However, each of the gauges recorded the water table within 12 inches of surface for more than 12.5% of the growing season, which meets the federal guidelines for hydrologic criteria. Therefore, monitoring from the 2001-growing season indicates hydrologic success. Vegetation data collected also met all established success criteria for the 2001 season.

Based on the monitoring results from the 2001 growing season, NCDOT will continue hydrologic monitoring until success criteria are met or enough information can be collected on the site that appropriate changes can be made to help in achieving success.

1.0 INTRODUCTION

1.1 Project Description

The site is located adjacent to US 17 in Chowan County (Figure 1). Designed as a bottomland forest. The site was constructed to offset impacts of the improvements to US 17 in Bertie and Chowan Counties (R-2512).

1.2 Purpose

In order to demonstrate successful mitigation, hydrologic, and vegetative monitoring must be conducted for a minimum of five years. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrologic conditions and vegetation survival. The following report details the results of hydrologic and vegetation monitoring during the 2001 growing season at the Pembroke Creek Mitigation Site. Included in this report are analyses of both hydrologic and vegetative monitoring results as gauge as local climate conditions throughout the growing season. The vegetation planted represents Phase I and Phase 2 of the project's construction. Hydrologic monitoring of the site began in March of 1999.

1.3 Project History

November 1997	Site Constructed (Phase I)
January 1998	Site Planted (Phase I)
October 1998	Vegetation Monitoring (1 yr.) (Phase I)
November 1998	Site Constructed (Phase II)
February 1999	Monitoring Gauges Installed
March-November 1999	Hydrologic Monitoring (1 yr.)
March 1999	Site Planted (Phase II)
October 1999	Vegetation Monitoring (1 yr.)
March-November 2000	Hydrologic Monitoring (2 yr.)
August, October 2000	Vegetation Monitoring (2 yr.)
March-November 2001	Hydrologic Monitoring (3 yr.)
July 2001	Vegetation Monitoring (3 yr.)

1.4 Debit Ledger

Pembroke Creek Mitigation Site has provided mitigation for several highway projects. Table 1 shows the projects that this site is providing mitigation for since completion.

Table 1. Pembroke Creek Mitigation Site Debit Ledger

Pembroke Creek I	Mit. Plan		TIP DEBIT	TIP DEBIT
Chowan				
Habitat	Acres at Start:	Acres Remaining	R-2512A/Bmod	
SPH Restoration	4.725	0	4.725	
TOTAL	4.725	0		
Pembroke Creek II	Mit. Plan		TIP DEBIT	TIP DEBIT
Chowan				
Habitat	Acres at Start:	Acres Remaining	R-2512 B mod	R-2404C
SPH Restoration	4.949	0	2.6	2.349
TOTAL	4.949	0		

Figure 1. Site Location Map



2.0 Hydrology

2.1 Success Criteria

In accordance with federal guidelines for wetland mitigation, a site meets hydrologic criteria if it is inundated or saturated (within 12" of the surface) by surface or ground water for at least 12.5% of the growing season. However, discussions between NCDOT and natural resource agencies have determined that, due to the unique character of this site, the normal guidelines for hydrologic success may not apply. Groundwater levels may vary significantly on a daily basis due to a sandy substrate that is in close proximity to a tidally influenced body of water

The growing season in Chowan County begins March 13 and ends December 1. These dates correspond to a 50% probability that air temperatures will drop to 28° or lower after March 13 and before December 1.¹ Thus the growing season is 262 days; optimum wetland hydrology requires 12.5% of this growing season, or 32 days. The site must also experience average climatic conditions in order for the hydrologic data to be considered valid.

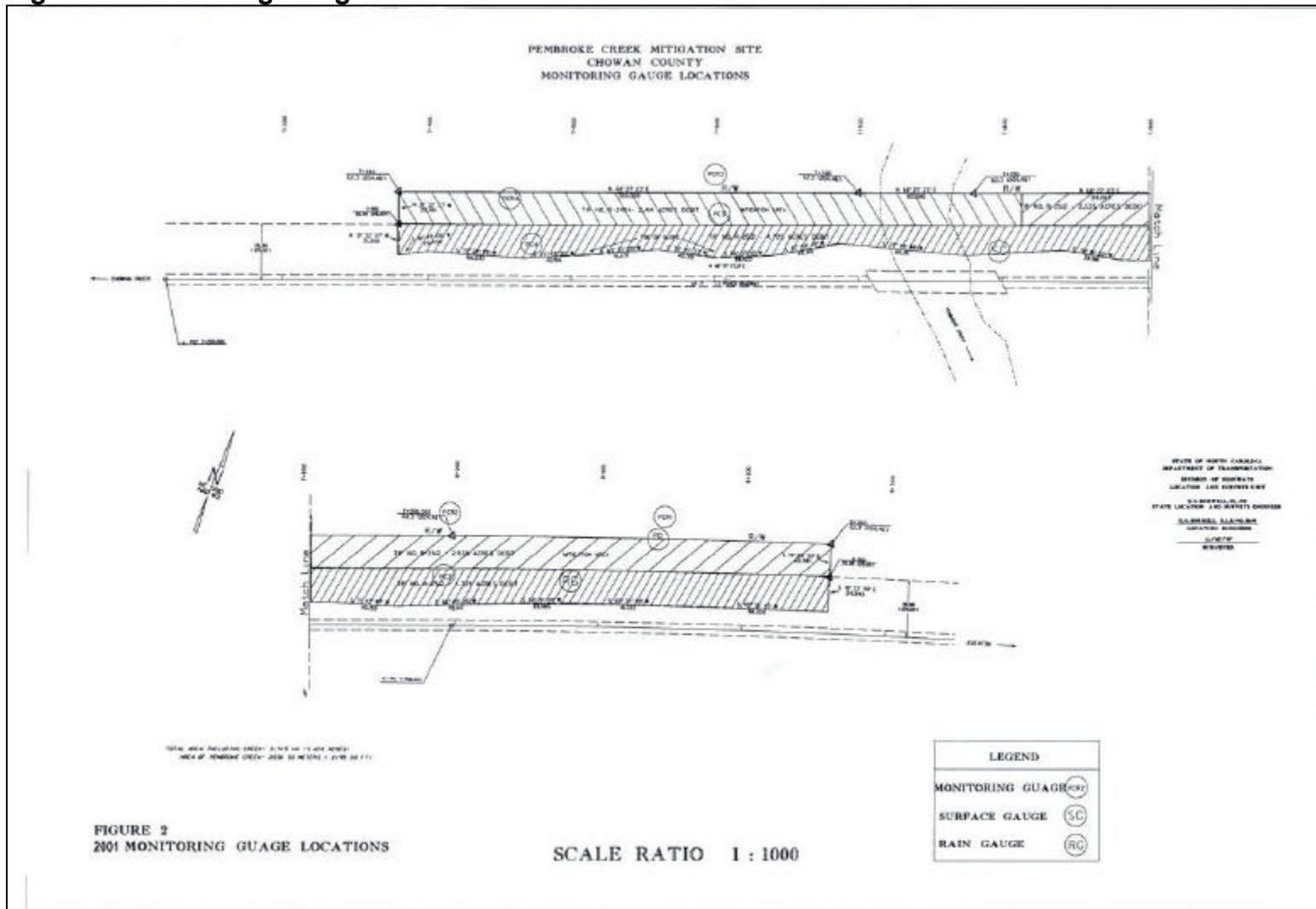
2.2 Hydrologic Description

Eight monitoring gauges (four site gauges, four reference gauges), one rain gauge, and one surface water gauge were installed on site in February 1999 and data was recorded starting in March 1999 (Figure 2). The automatic monitoring gauges and rain gauges record the depth to groundwater and rainfall, respectively. Data was collected on a daily basis throughout the growing season.

Appendix A contains a plot of the water depth for each monitoring gauge and surface water gauge in 2001. Precipitation events are included on each graph as bars.

¹ Soil Conservation Service. Soil Survey of Chowan and Perquimans Counties, North Carolina, p.76.

Figure 2. Monitoring Gauge Locations



2.3 Results of Hydrologic Monitoring

2.3.1 Site Data

The maximum number of consecutive days in which the groundwater was within twelve inches of the surface was determined for each gauge. The number of days was then converted into a percentage of the 262-day growing season. Table 2 gives the results for the 2001 growing season (March 13-December 1).

Table 2. Hydrologic Monitoring Results

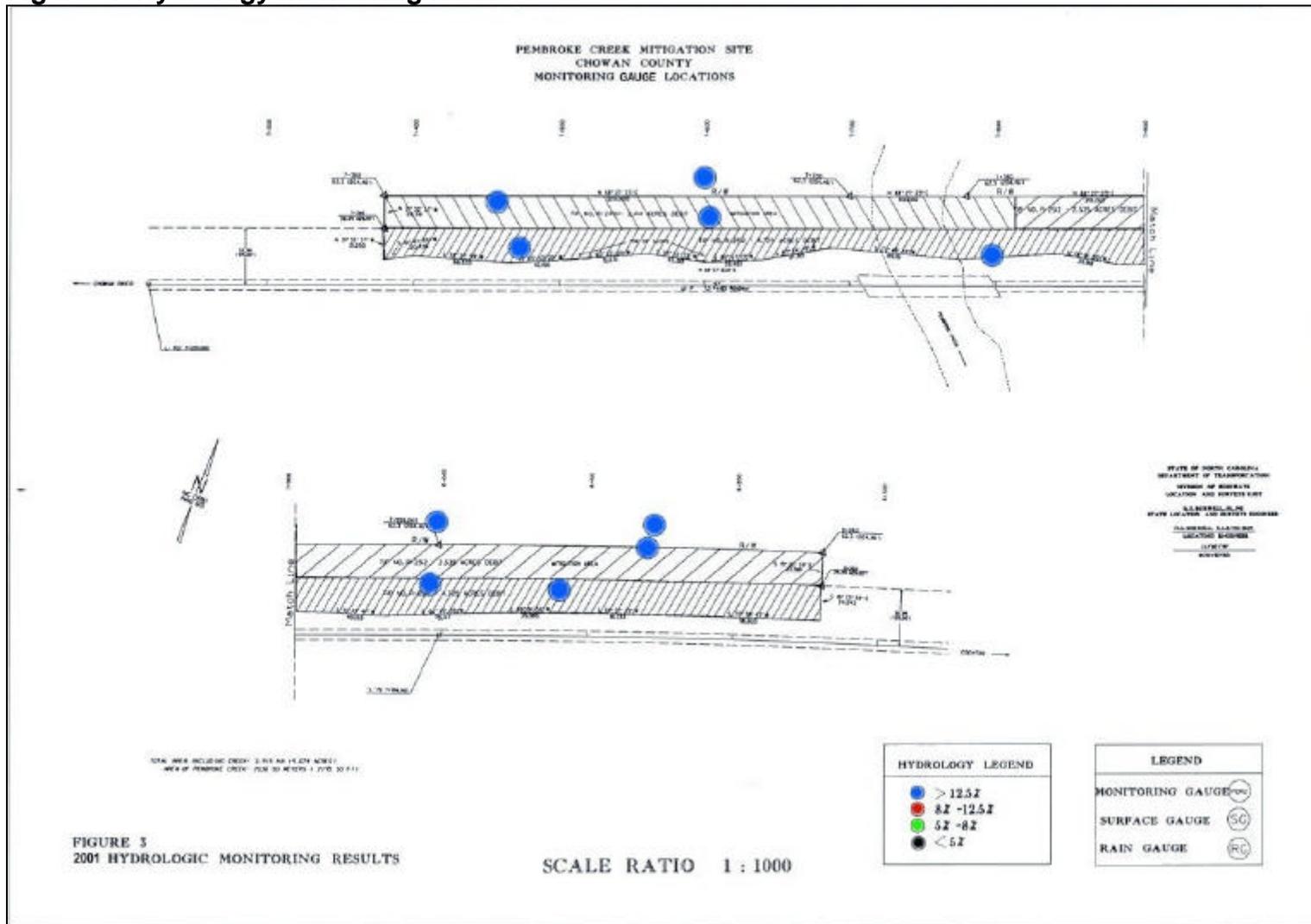
Monitoring Gauge	< 5%	5% - 8%	8% - 12.5%	> 12.5%	Actual %	Dates of Success
PC-1				✓	64%	Mar 13- Aug 28
PC-2				✓	18%	Mar 13- Apr 28
PC-3				✓	100%	Mar 13- Dec 1
PC-4				✓	100%	Mar 13- Dec 1
PCR-1 *				✓	100%	Mar 13- Dec 1
PCR-2 *				✓	100%	Mar 13- Dec 1
PCR-3 *				✓	100%	Mar 13- Dec 1
PCR-4 *				✓	100%	Mar 13- Dec 1

* -Reference gauge

Specific monitoring gauge problems: Gauge number PC-1 (S2140AF) stopped recording data on 8/28/01. The battery was replaced and the gauge was reset to record data at the proper time and interval beginning on 10/9/01.

Figure 3 is a graphical representation of the hydrologic monitoring results.

Figure 3. Hydrology monitoring results



2.3.2 Climatic Data

Figure 4 is a comparison of 2001 monthly rainfall to historical precipitation for the Edenton area. Rainfall data recorded onsite during the growing season was compared to the historical 30-70 percentile trends for the area. It is assumed that if the 2001 rainfall totals, represented by bars, fall between the average precipitation values for each month, then the local climate was experiencing average conditions for that particular region.

As indicated by Figure 4, April, May, and October experienced below normal rainfall totals. Rainfall in March, July, September, and November fell within the average range. Rainfall in June and August was above the normal rainfall totals for those months.

Pembroke Creek 30-70 Percentile Graph
Edenton, NC

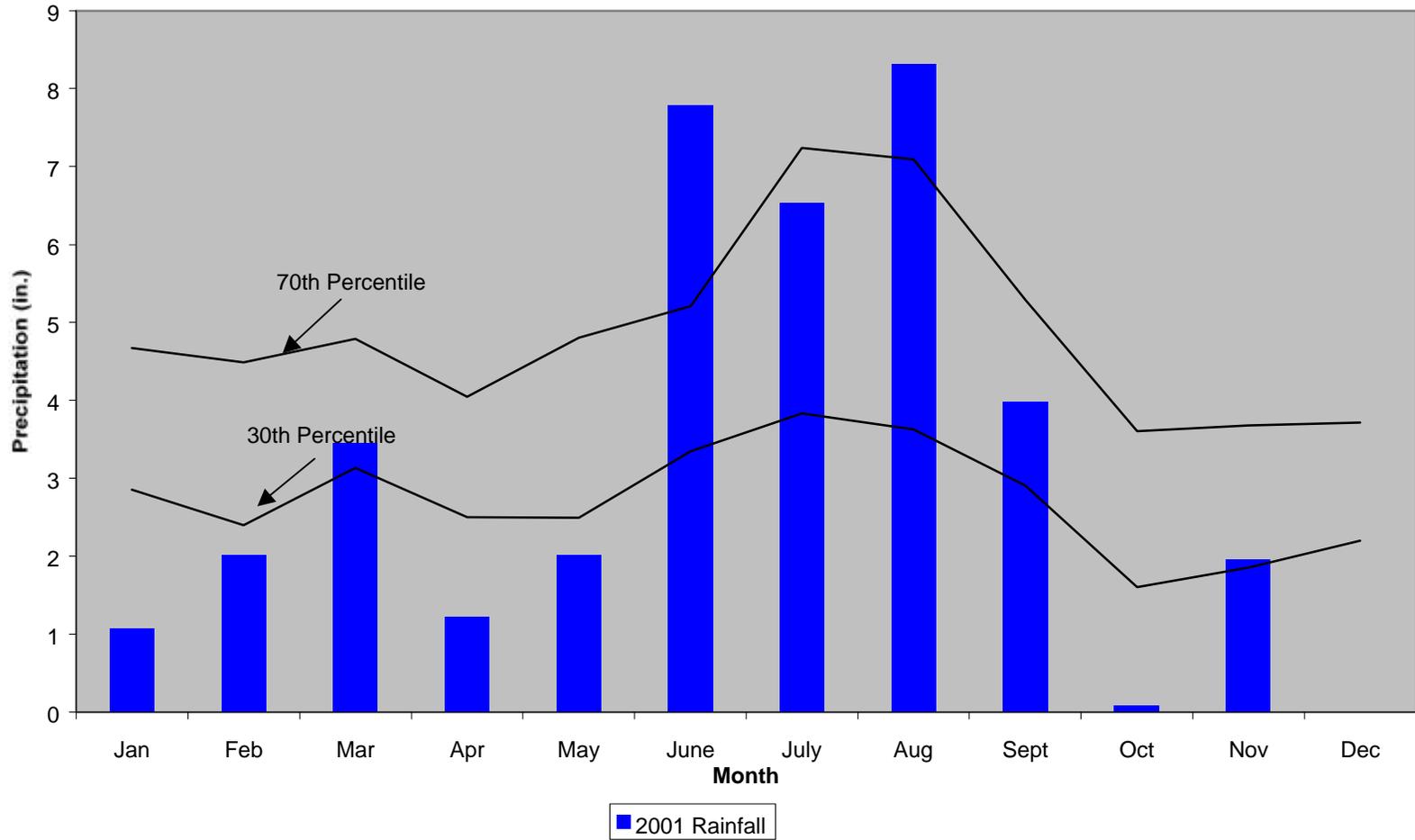


Figure 4. Historical Rainfall Data (30-70 Graph)

3.0 VEGETATION: PEMBROKE MITIGATION SITE (YEAR 3 MONITORING)

3.1 Success Criteria

Success Criteria states that there will be a minimum density of 320 trees per acre of approved target species surviving for at least three consecutive years.

3.2 Description of Species

The following tree species were planted in the Phase I Restoration Area:

Zone 1: (0.854 HA)

Chamaecyparis thyoides, Atlantic white cedar
Taxodium distichum, baldcypress

Zone 2: (0.327 HA)

Nyssa aquatica, tupelo gum
Fraxinus pennsylvanica, green ash
Quercus lyrata, overcup oak
Taxodium distichum, baldcypress

Zone 3: (0.468 HA)

Taxodium distichum, baldcypress
Nyssa aquatica, tupelo gum
Nyssa sylvatica var. *biflora*, swamp blackgum
Fraxinus pennsylvanica, green ash

Phase II was planted in the winter of 1998-99. The following tree species were planted in the Phase II Restoration Area:

Zone 1: (0.88 HA)

Chamaecyparis thyoides, Atlantic white cedar
Taxodium distichum, baldcypress

Zone 2: (0.35 HA)

Nyssa aquatica, tupelo gum
Fraxinus pennsylvanica, green ash
Quercus lyrata, overcup oak
Taxodium distichum, baldcypress

Zone 3: (0.8 HA)

Taxodium distichum, baldcypress
Nyssa aquatica, tupelo gum
Quercus lyrata, overcup oak
Fraxinus pennsylvanica, green ash

3.3 Results of Vegetation Monitoring

Table 3. Vegetation Monitoring Results

	Plot #	Baldcypress	Atlantic White Cedar	Green Ash	Overcup Oak	Tupelo Gum	Swamp Blackgum	Total	Total (at planting)	Density (Tree/Acre)
ZONE 1	1	23	3					26	28	631
	6	13	1					14	33	288
ZONE 1 AVERAGE DENSITY										460
ZONE 2	2			18	5	6		29	30	657
	5	1		14	12	8		35	37	643
ZONE 2 AVERAGE DENSITY										650
ZONE 3	3	10		5		4	3	22	30	499
	4	21			7	11	1	40	43	633
ZONE 3 AVERAGE DENSITY										566
TOTAL AVERAGE DENSITY										559

Site Notes: Other species noted: cattail, woolgrass, arrow, phragmites, *Eleocharis sp.*, *Juncus effusus*, red maple, black willow, *Polygonum sp.*, *Carex sp.*, briars, fennel, *Baccharis sp.*, sycamore, jewelweed, and smartweed.

3.4 Conclusions

The 2001 vegetation monitoring revealed an average density of 460 trees per acre for zone 1, 650 trees per acre for zone 2, 566 for zone 3, and 559 trees per acre for the site's average. All densities are above the minimum of 320 trees per acre required by the success criteria.

4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS

Below average precipitation during April and May may have lead to significant drops in water table depth. Several of the gauges including PC-2 and PCR-2 showed increases in depth to the water table during these months. While the water table was within 12 inches (for PC-2) for more than 12.5% of the growing season, it is likely that the number of consecutive days within 12 inches would have increased had rainfall amounts been closer to average.

PC-1 did not record data during late August through early October due to a dead battery. Based on water table depth before and after that time frame, as well as rainfall during that period, it is likely that the number of consecutive days within 12 inches would have increased had the unit been working properly.

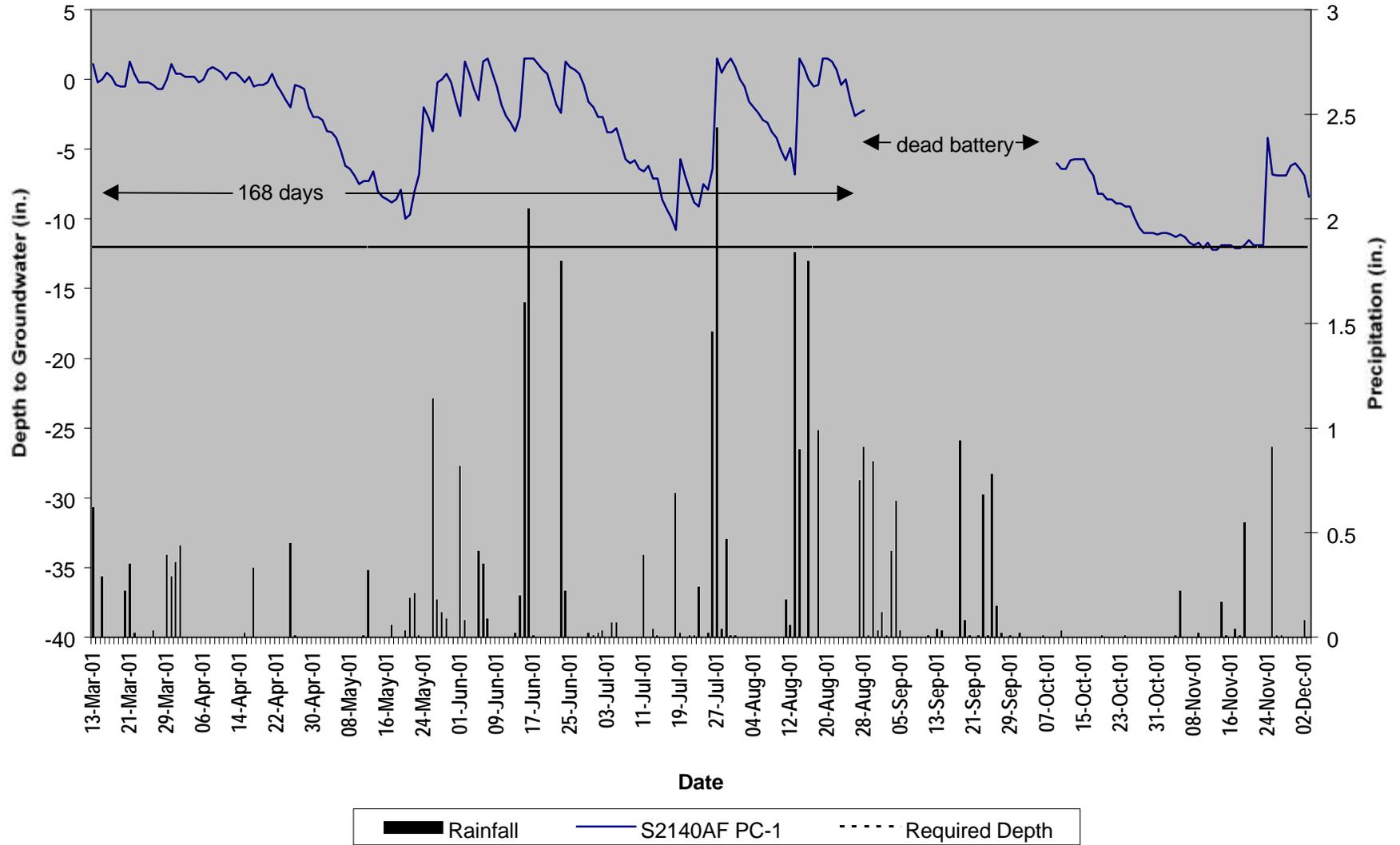
Hydrologic success for this site is based on the mean depth to groundwater of the gauges in the restoration area within 20% of the mean depth to groundwater of the gauges in the respective reference area. One of the four gauges was within 20% of reference gauges. Three gauges (PC-1, PC-2, and PC-3) did not meet this criteria. However, each of the gauges recorded the water table within 12 inches of surface for more than 12.5% of the growing season, which meets the standard hydrologic criteria. Therefore, monitoring from the 2001-growing season indicates success in hydrology based on federal guidelines, however success criteria for this site were not met.

The 2001 vegetation monitoring revealed an average density of 460 trees per acre for zone 1, 650 trees per acre for zone 2, 566 for zone 3, and 559 trees per acre for the site's average. All densities are above the minimum of 320 trees per acre required by the success criteria.

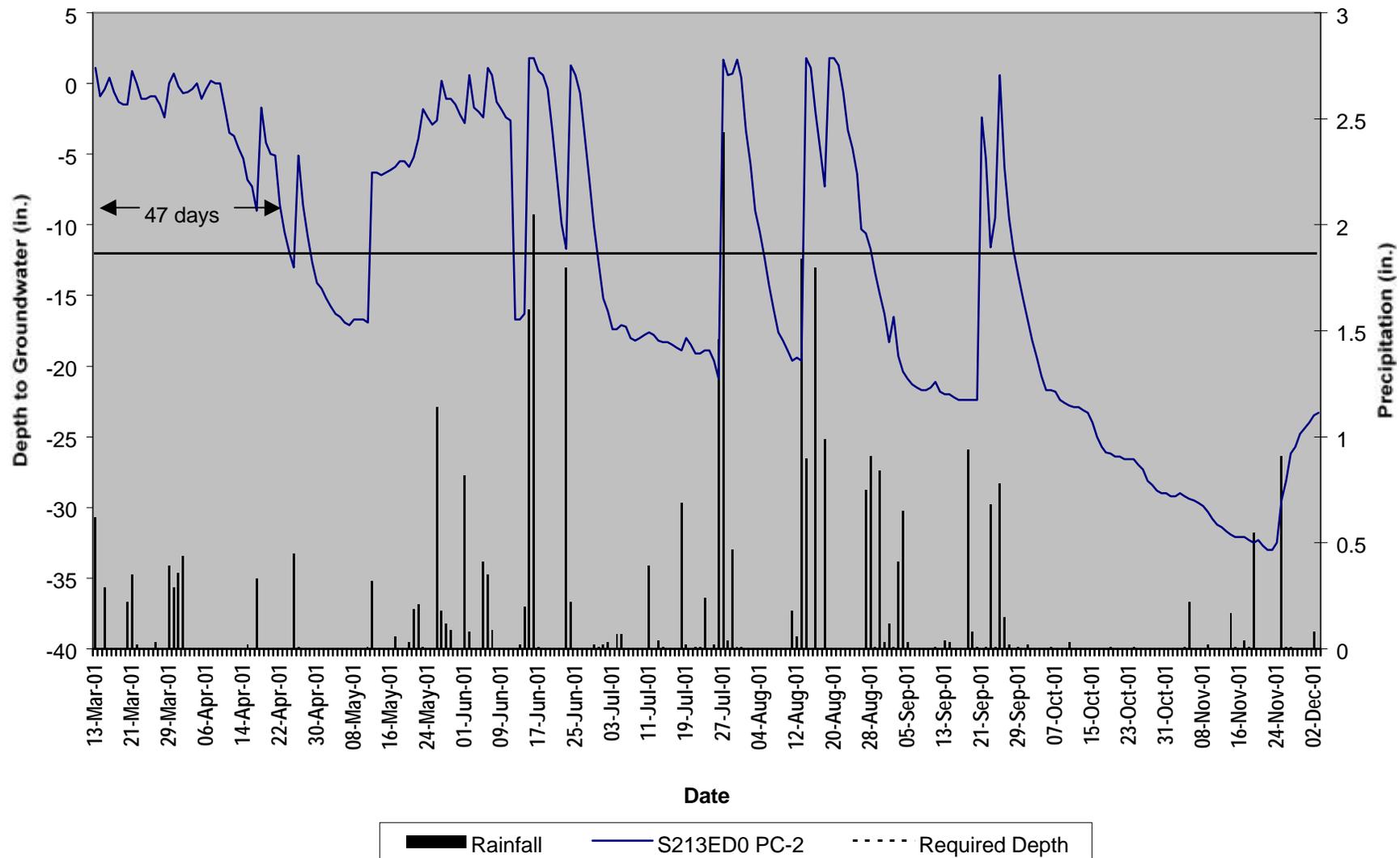
NCDOT intends to continue both hydrologic and vegetation data in 2002.

APPENDIX A. DEPTH TO GROUNDWATER PLOTS

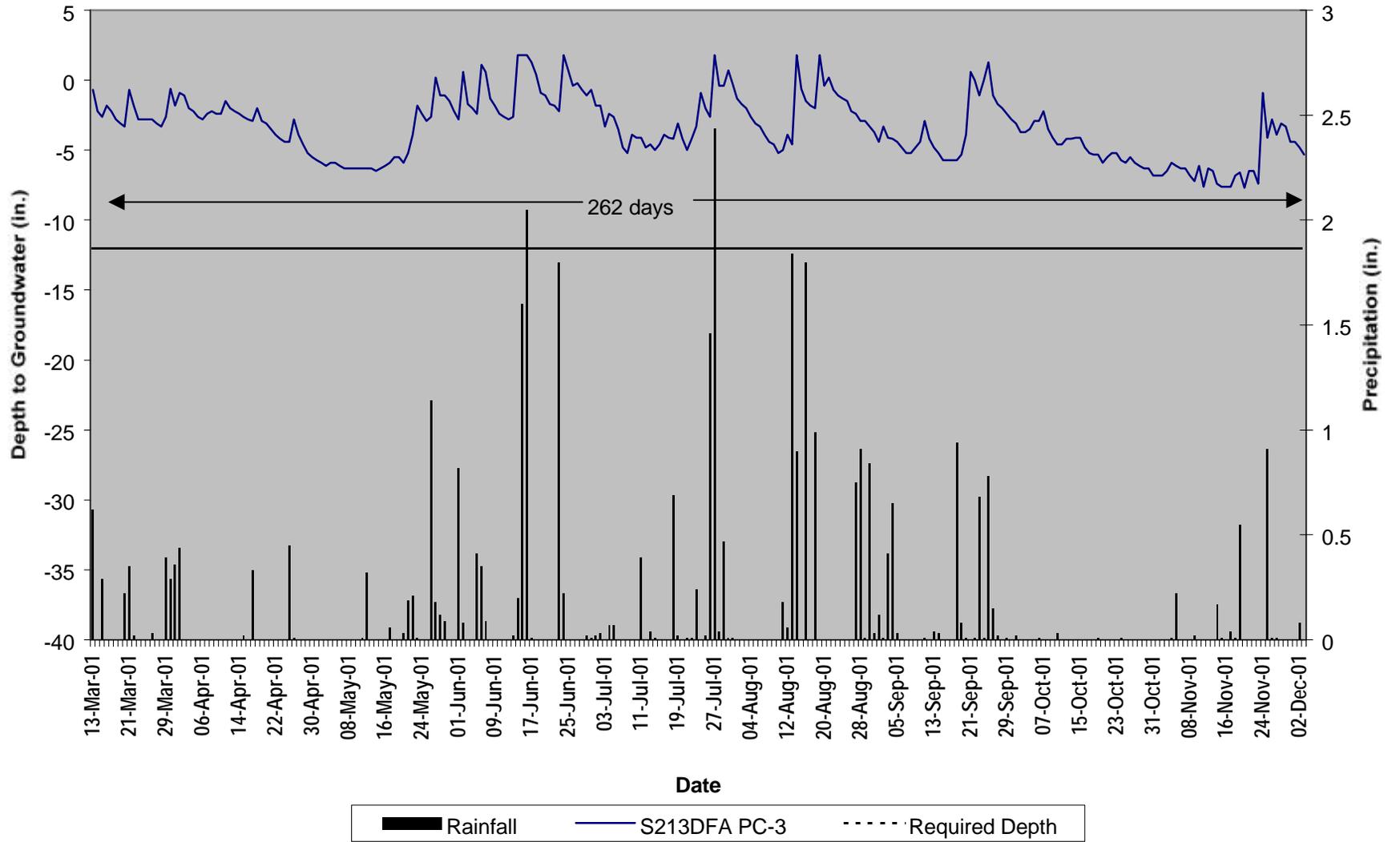
Pembroke Creek PC-1



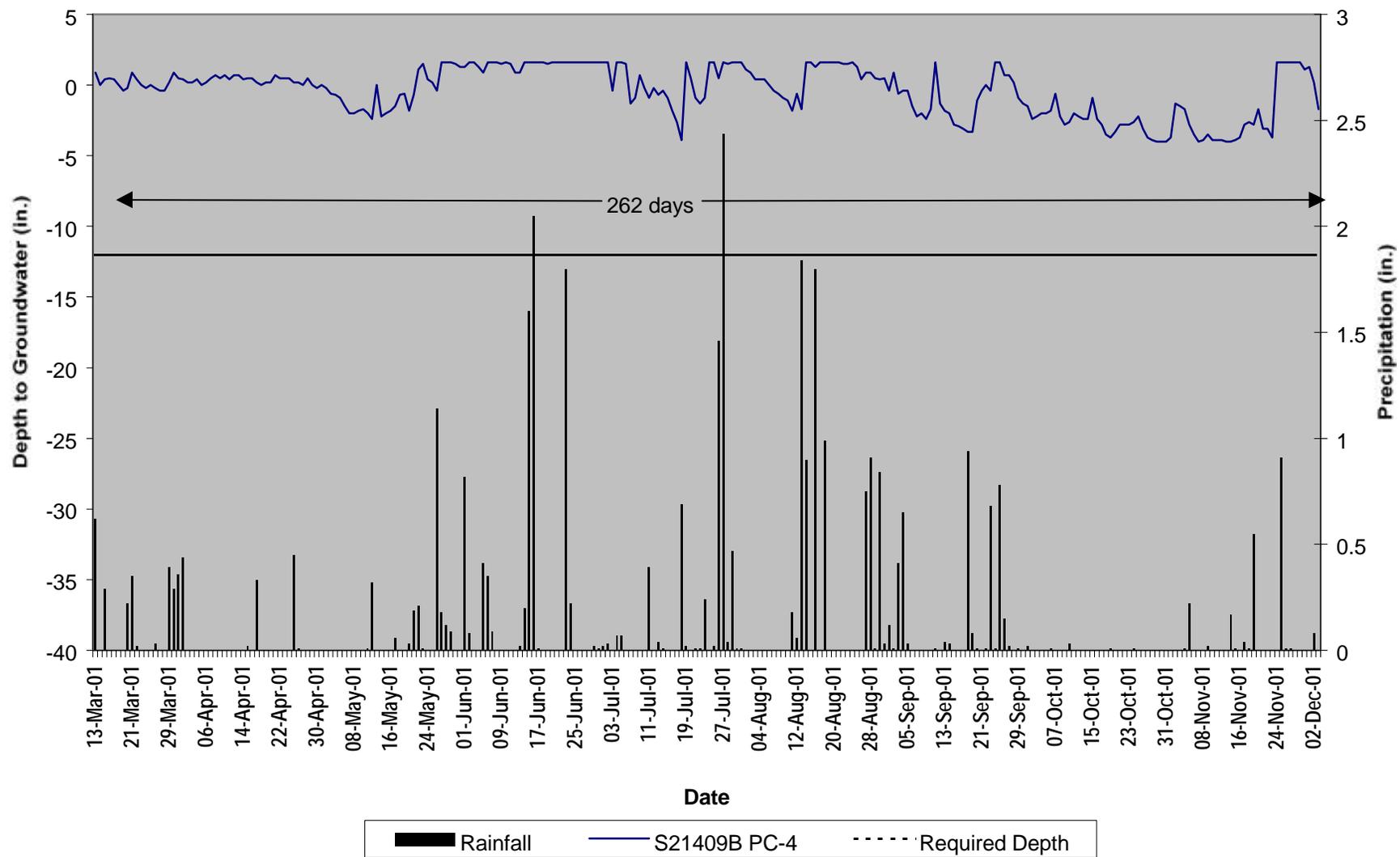
Pembroke Creek PC-2



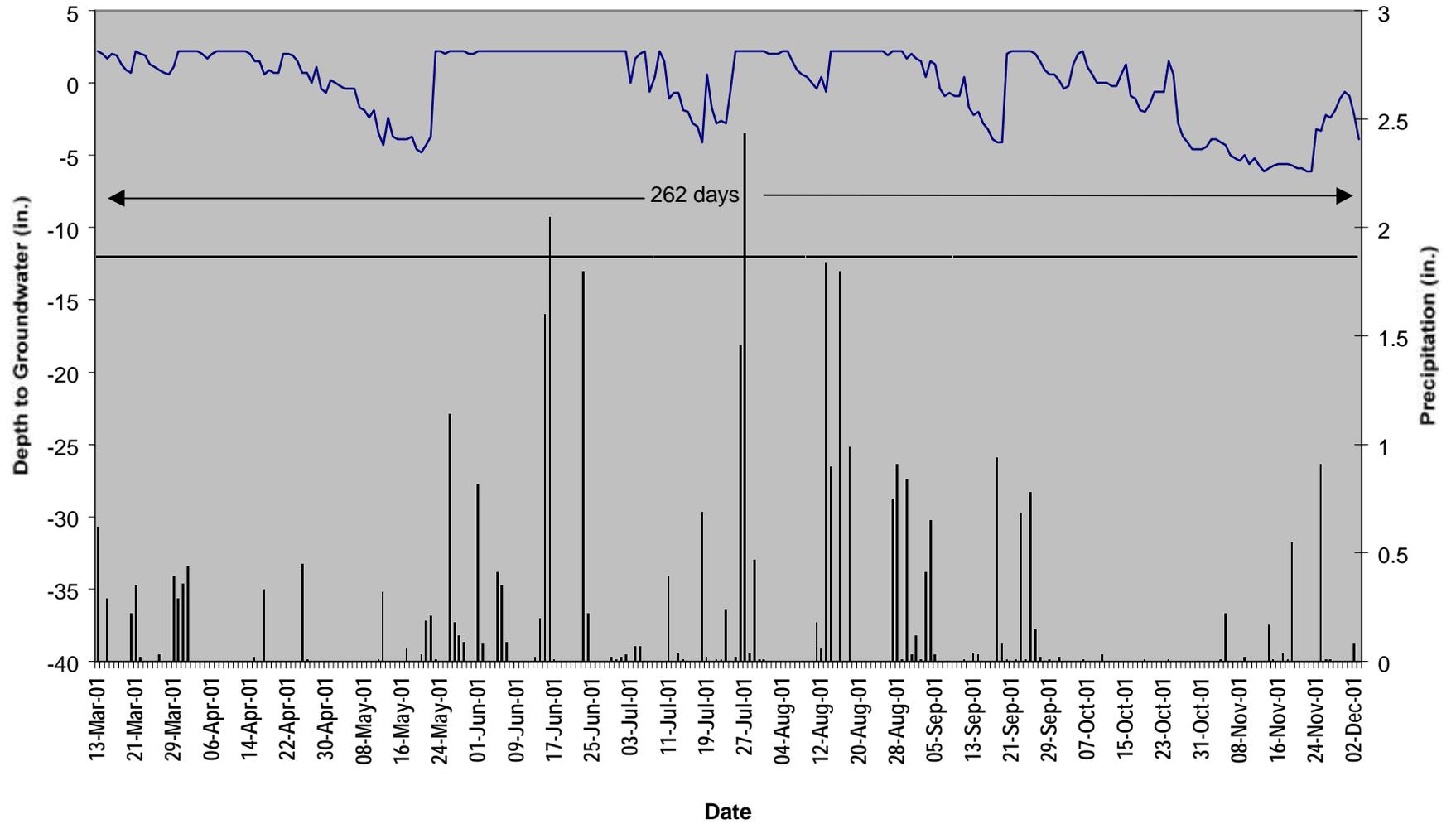
Pembroke Creek PC-3



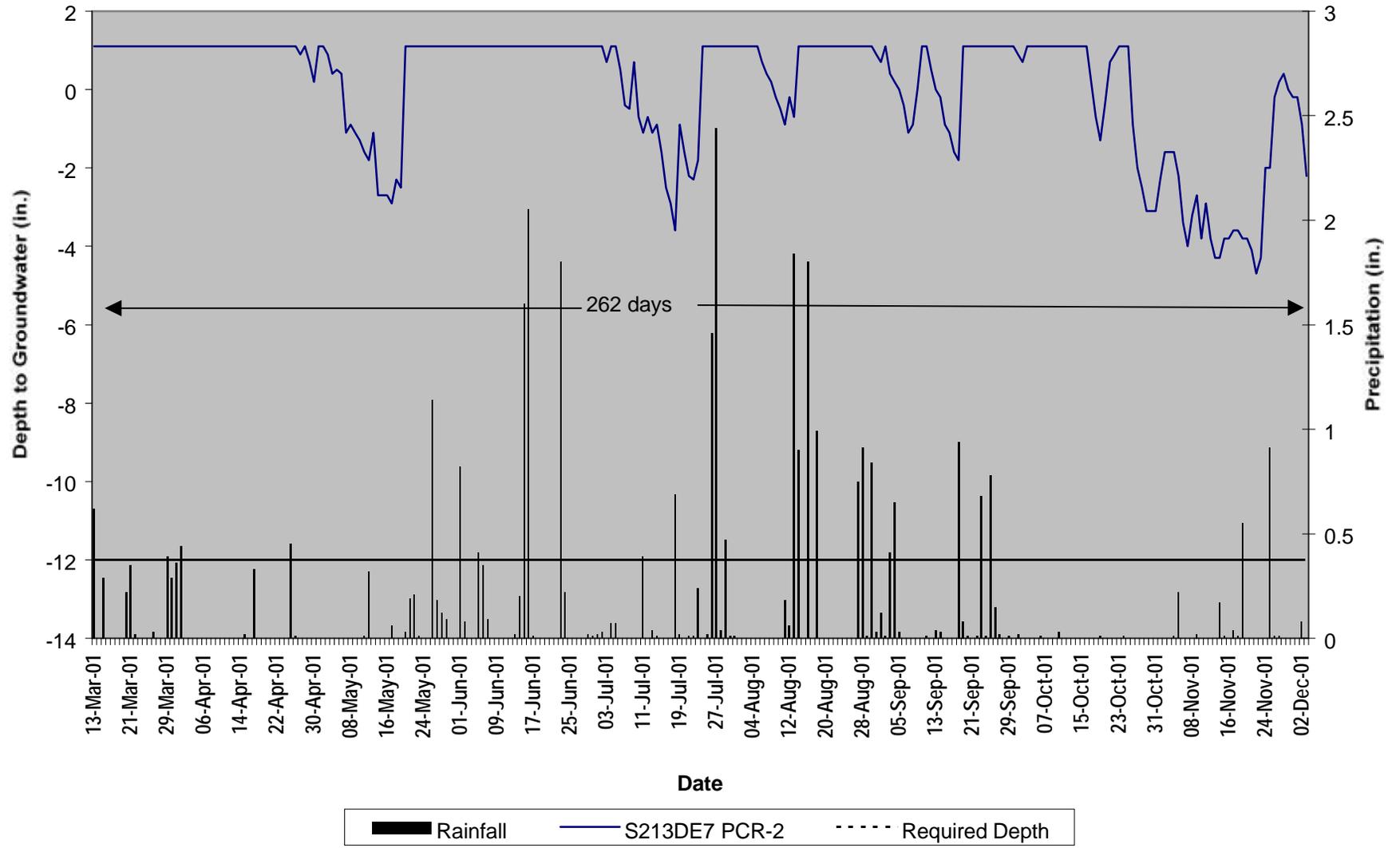
Pembroke Creek PC-4



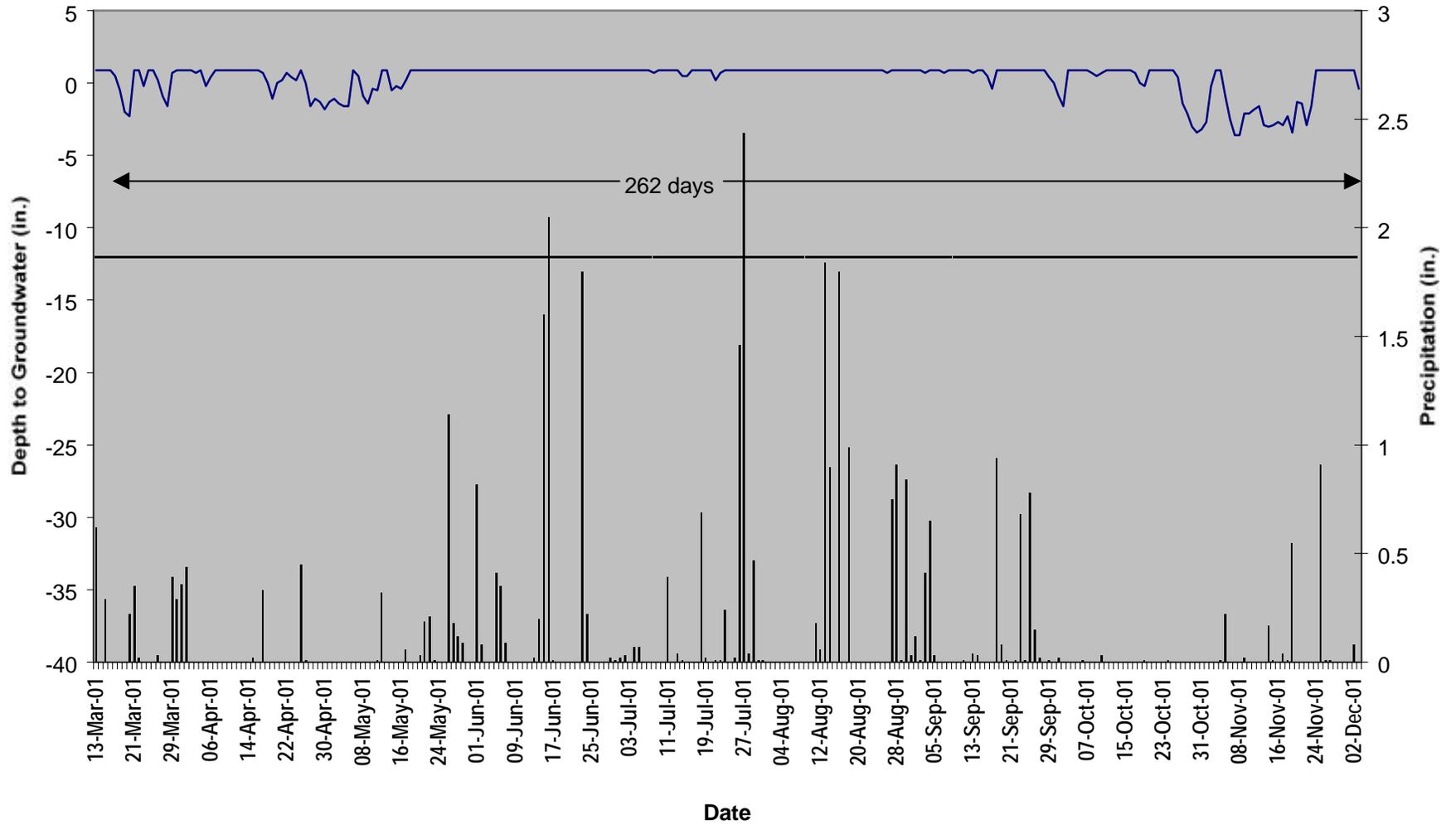
Pembroke Creek PCR-1



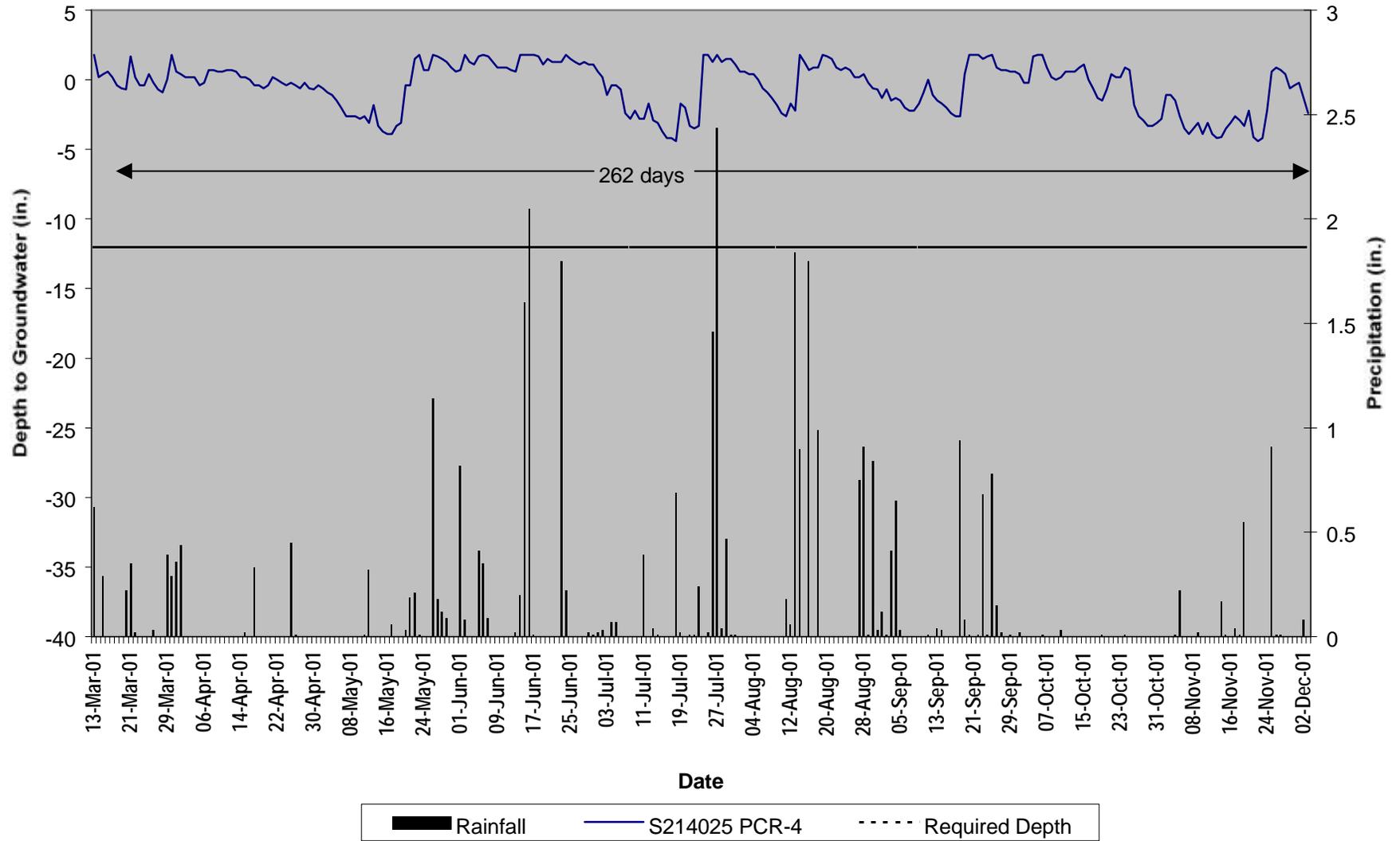
Pembroke Creek PCR-2



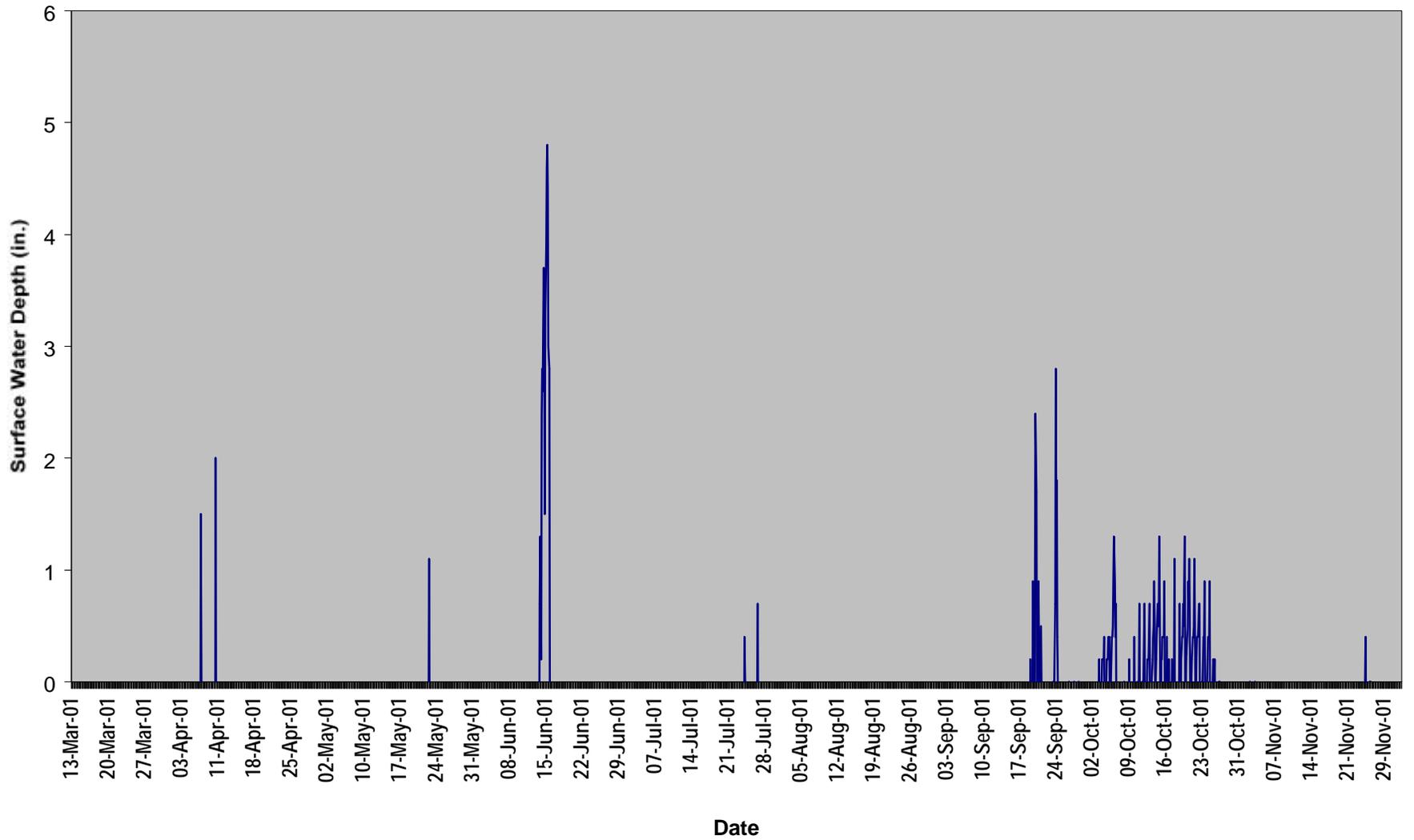
Pembroke Creek PCR-3



Pembroke Creek PCR-4



Pembroke Creek PCSG-1



APPENDIX B. SITE PHOTOS & VEGETATION PLOTS

Pembroke Creek



Photo 1



Photo 2

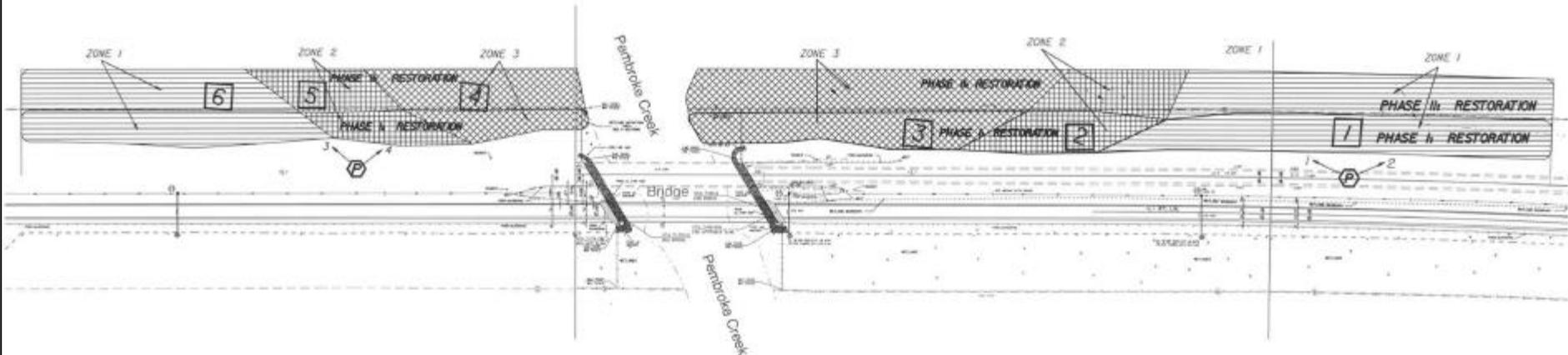


Photo 3



Photo 4

Pembroke Creek
Mitigation Site
Planting Plan, Plot Locations, and Photo Locations
2001



	Plot Locations
	Photo Locations