

ANNUAL REPORT FOR 2004



**Dowd Dairy Farm Mitigation Site
Bladen County
Project No. 8.1241802
TIP No. R-2204WM**



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North Carolina Department of Transportation
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EXECUTIVE SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Dowd Dairy Farm Mitigation Site. Phase I of this site was constructed in 1998 and Phase II was completed in 2000. Monitoring of the site began in 1999 following Phase I site construction. The monitoring activities in 2004 represent the fourth official year of monitoring following completion of the entire site. The site must demonstrate hydrologic and vegetation success for a minimum of five years or until the project is deemed successful.

The site is being monitored with thirty-eight groundwater-monitoring gauges, two rain gauges, and thirty-eight vegetation plots.

Rainfall data has been collected from an onsite rain gauge. Also, monthly rainfall data recorded from a rain gauge maintained by the NC State Climate Office in Elizabethtown was used for the historical data.

For the 2004 monitoring year, twenty-nine of thirty-eight gauges met the jurisdictional hydrologic success of at least 12.5% during the growing season; conversely, nine gauges recorded hydrology for less than 12.5% of the growing season.

The 2004 vegetation monitoring of the 619 acres of planted areas revealed an average density of 474 trees per acre, which is above the minimum requirement of 320 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 offsite 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 Dowd Dairy Farm Wetland Mitigation Site is located 7 miles north of Elizabethtown and 2 miles east of White Oak in Bladen County (Figure 1). It is bounded by SR 1324 (Dowd Dairy Farm Road) to the north, SR 1332 (Oak Grove Church Road) to the west, and dense forest to the south and east. The site represents a Coastal Plain interstream divide converted for agricultural use. The site receives drainage from elevated sandy terraces and discharges into Ellis Creek and Panther Branch, tributaries of the Cape Fear River.

The site encompasses approximately 658 acres and is designed as a mitigation site for the Cape Fear River Basin.

1.2 Purpose

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. 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 vegetative monitoring during 2004 on the Dowd Dairy Farm Mitigation Site.

Activities in 2004 reflect the fourth year of monitoring following the construction of the Phase II portion of the site. Included in this report are analyses of both hydrologic and vegetative monitoring results, as well as local climate conditions throughout the growing season.

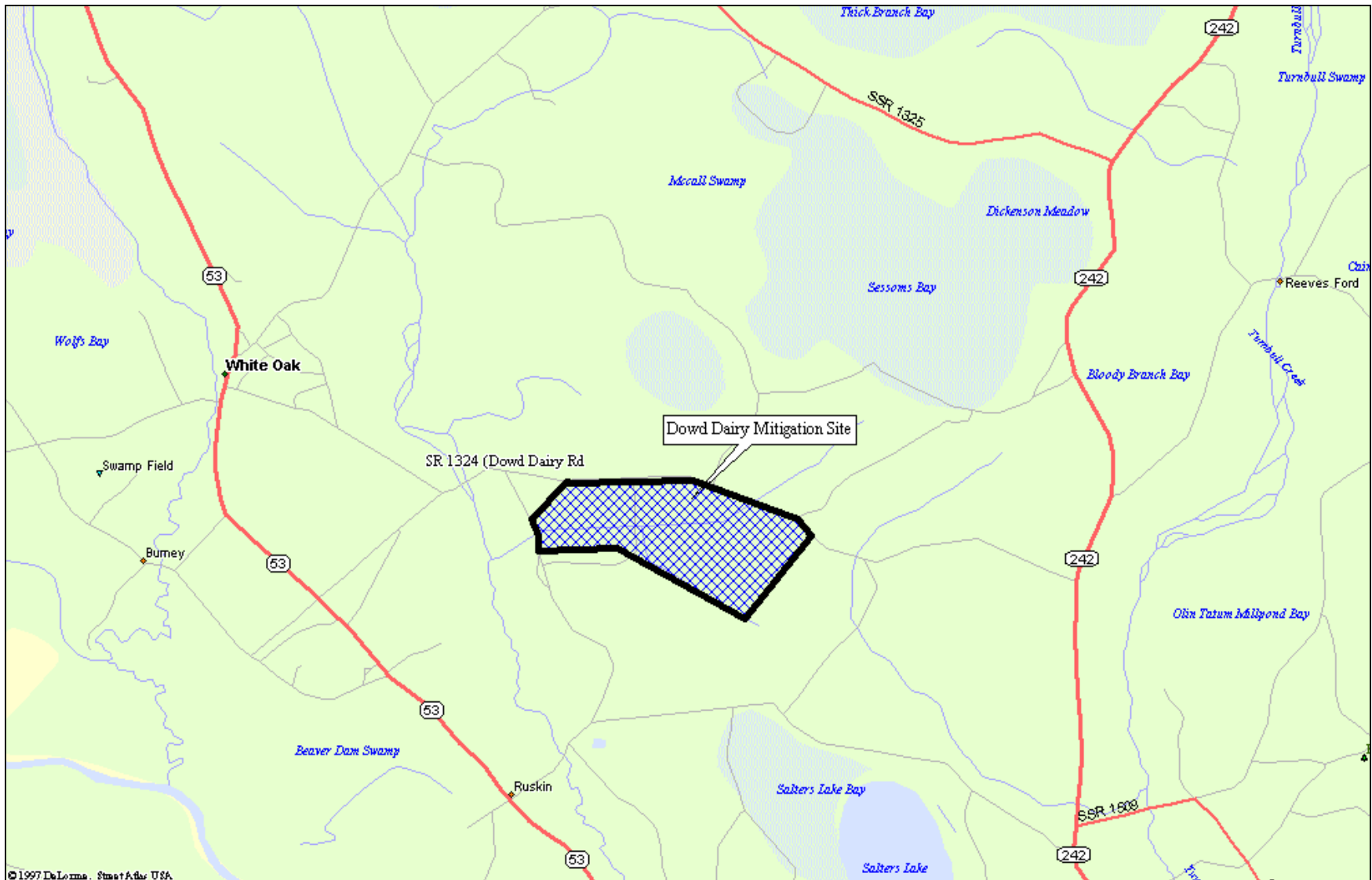


FIGURE 1: SITE LOCATION MAP

1.3 Project History

Summer 1998	Construction – Phase I
Spring 1999	Tree Planting – Phase I
February – April 1999	Installation of Monitoring Gauges
March – November 1999	Hydrologic Monitoring (Year 1)
September 1999	Construction Begins – Phase II
November 1999	Vegetation Monitoring (Year 1)
March – November 2000	Hydrologic Monitoring (Year 2)
June 2000	Construction Completed – Phase II
November 2000	Vegetation Monitoring (Year 2)
February 2001	Tree Planting – Phase II
March – November 2001	Hydrologic Monitoring (Restart Year 1)
October 2001	Vegetation Monitoring (Restart Year 1)
August 2002	Vegetation Monitoring (Year 2)
March – November 2002	Hydrologic Monitoring (Year 2)
May 2003	Onsite Agency Meeting
August 2003	Vegetation Monitoring (Year 3)
March – November 2003	Hydrologic Monitoring (Year 3)
July 2004	Vegetation Monitoring (Year 4)
March – November 2004	Hydrologic Monitoring (Year 4)

Phase I construction consisted of clearing, grubbing, ripping, filling lateral ditches, and adding ditch plugs. Phase II construction consisted of filling in the central canal. Completion of the site was delayed until June 2000 due to the saturated conditions from the hurricane activity in the fall of 1999.

2.0 HYDROLOGY

2.1 Success Criteria

In accordance with federal guidelines for wetland mitigation, the success criteria for hydrology state that the area must be inundated or saturated (within 12" of the surface) by surface or groundwater for at least 12.5% of the growing season. Areas inundated less than 5% of the growing season are always classified as non-wetlands. Areas inundated between 5% - 12.5% of the growing season can be classified as wetlands depending upon other factors, such as the presence of hydrophytic vegetation and hydric soils.

The growing season in Bladen County begins March 16 and ends November 14. These dates correspond to a 50% probability that temperatures will drop to 28° F or lower after March 16 and before November 14.¹ The growing season is 243 days; therefore the optimum duration for wetland hydrology is 31 days. Also, local climate must represent average conditions for the area.

2.2 Hydrologic Description

Historically, wetlands on the tract were created by a combination of radial groundwater and surface water flow from adjacent terraces, as well as precipitation and vertical groundwater fluctuations maintained within the site. After an extensive study of the site's hydrology, it was concluded that blocking and filling the drainage ditches within the site would elevate the groundwater to a level that would saturate the soil stratum within the required twelve inches. It was predicted that this, in addition to surface water and runoff would be sufficient to restore wetland hydrology.

Thirty-one groundwater-monitoring gauges and two rain gauges were installed in 1999 (Figure 2). Five additional gauges were installed in transects along the main channel in 2001 to examine potential drainage effects of the large remaining canal. In June 2003, two additional groundwater gauges were installed. The rain gauges and groundwater monitoring gauges record daily readings of rainfall and depth to groundwater, respectively.

¹ Natural Resources Conversation Service, Soil Survey of Bladen County, North Carolina, p. 123.

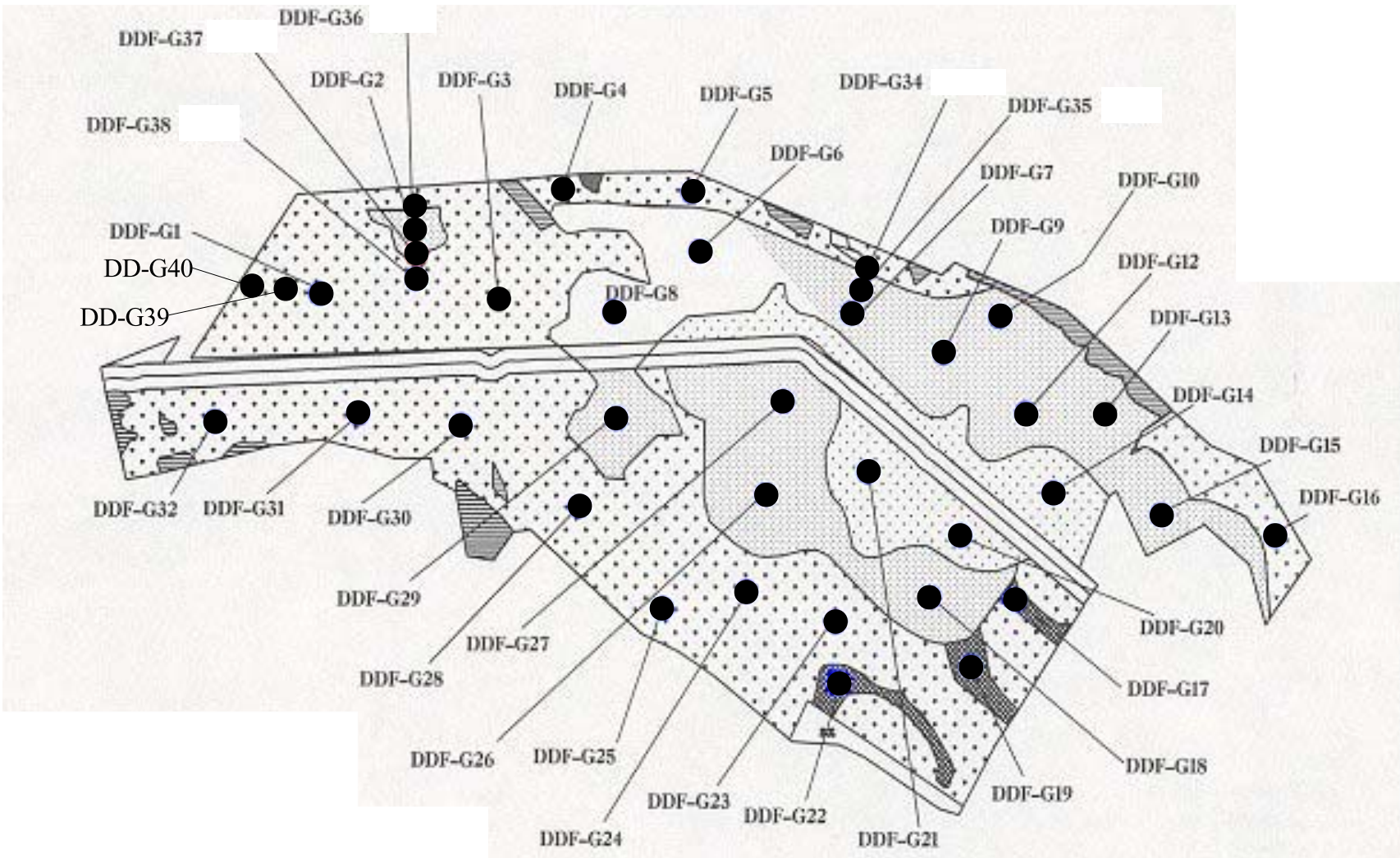


Figure 2. Gauge Location Map



↑
Not to Scale

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 groundwater gauge. This number was converted into a percentage of the 243-day growing season. Table 1 presents the hydrologic monitoring results for 2004.

Figure 3 provides a graphical representation of the hydrologic results. Gauges highlighted in blue indicate wetland hydrology for more than 12.5% of the growing season. Gauges highlighted in red show hydrology between 8% and 12.5% of the growing season, while those in green indicate hydrology between 5% and 8%. Gauges highlighted in black indicate no wetland hydrology (less than 5% of the growing season).

Appendix A contains a plot of the groundwater depth for each monitoring gauge. Daily rainfall is included on each graph as bars (recorded by rain gauges located on the site). The maximum number of consecutive days that the groundwater was within 12 inches of the surface is noted on each graph.

It should also be noted that the following gauges malfunctioned during the 2004-growing season: G2, G6, G18, G22, G29, G30. These interruptions prevented accurate determinations of the percentage of the growing season that the site met the saturation criteria.

Table 1. 2004 HYDROLOGIC MONITORING RESULTS

Monitoring Gauge	< 5%	5 - 8%	8 – 12.5%	> 12.5%	Actual %	Dates Meeting Success
DDF-G1+				×	42.6	March 16-June 26
DDF-G2		×			5.0	
DDF-G3		×			5.0	
DDF-G4	×				2.9	
DDF-G5+				×	22.3	April 11-June 3
DDF-G6+				×	46.3	March 16-July 5
DDF-G7+				×	16.9	April 11-May 21
DDF-G8+				×	22.3	April 11-June 3
DDF-G9+				×	40.9	March 16-June 22
DDF-G10+				×	47.5	March 16-July 8 Aug 30-Oct 4
DDF-G12+				×	47.5	March 16-July 8 Aug 30-Oct 6
DDF-G13	×				2.5	
DDF-G14+				×	33.1	March 16-June 3
DDF-G15+				×	48.3	March 16-July 10 Aug 13-Nov 14
DDF-G16+				×	28.1	March 16-May 22 Aug 15-Oct 18
DDF-G17+				×	51.7	March 16-July 18
DDF-G18+				×	20.2	Aug 15-Oct 2
DDF-G19+				×	38.4	April 6-July 7 Aug 14-Oct 3
DDF-G20+				×	45.5	April 6-July 24 Aug 12-Oct 9
DDF-G21+				×	25.0	March 16-May 15 Aug 14-Oct 5
DDF-G22			×		10.2	
DDF-G23+				×	24.2	May 1-June 28
DDF-G24+				×	45.1	March 16-July 3
DDF-G25+				×	45.9	March 16-July 5
DDF-G26+				×	36.5	March 16-June 12
DDF-G27+				×	27.5	March 16-May 21
DDF-G28+				×	47.1	March 16-July 8
DDF-G29+				×	29.1	March 25-June 3
DDF-G30+				×	20.5	March 16-May 4
DDF-G31+				×	45.5	March 16-July 4
DDF-G32+				×	32.8	March 16-June 3
DDF-G34+				×	15.6	April 11-May 18
DDF-G35			×		8.6	
DDF-G36	×				2.0	
DDF-G37		×			5.3	
DDF-G38+				×	27.0	March 16-May 20
DDF-39		×			6.1	
DDF-40+				×	21.7	April 11-June 2

+ Gauges met the success criterion during an average rainfall month (May, June, July, September, October, and November).

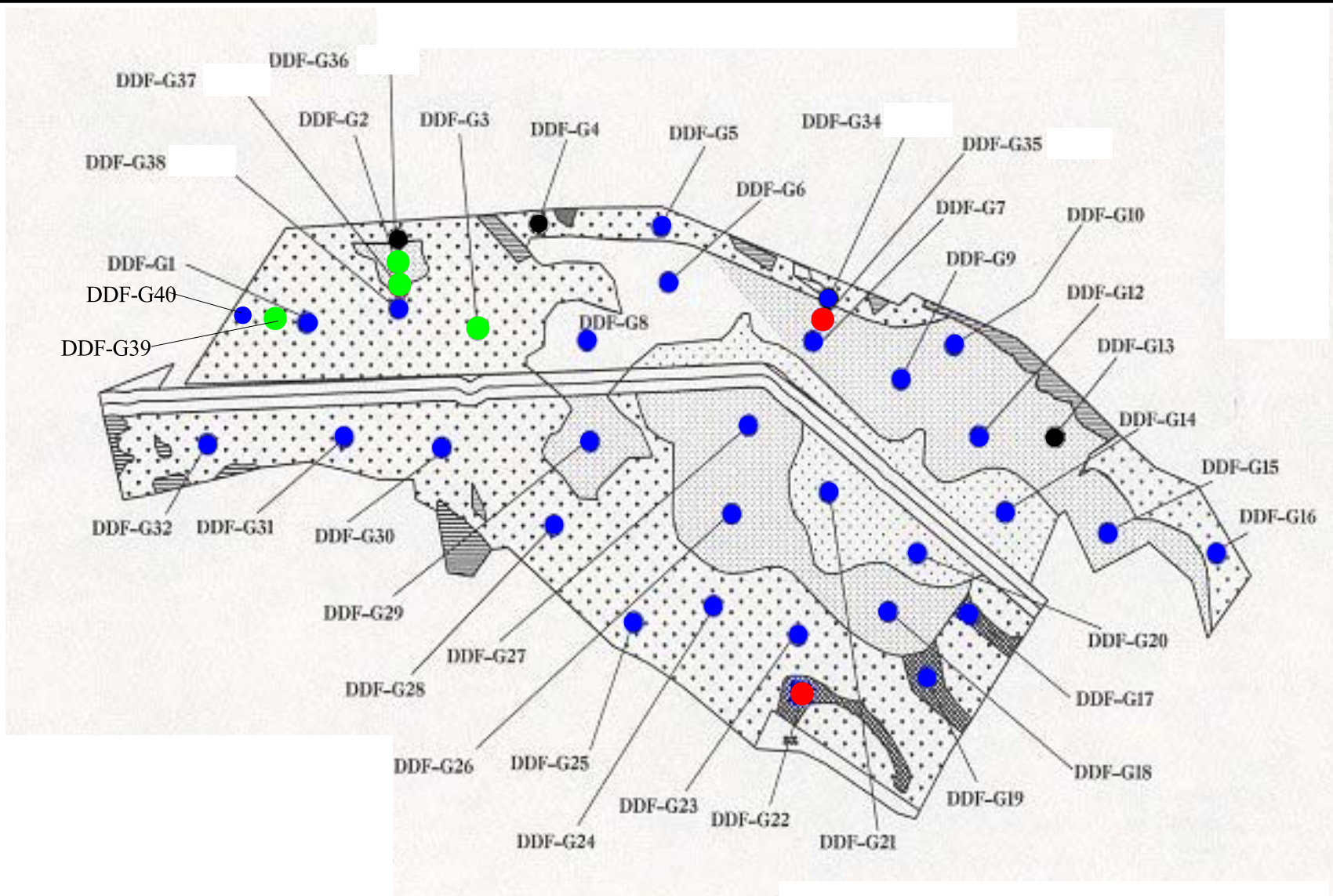


Figure 3. 2004 Hydrologic Monitoring Gauge Results

Hydrology Results

- < 5%
- 5 - 8%
- 8 - 12.5%
- > 12.5%
- ⊕ Rain Gauge
- ◐ Surface Gauge
- Not Applicable



2.3.2 Climatic Data

Figure 4 provides an evaluation of the local climate in comparison with historical data in order to determine whether 2004 was “average” in terms of climate conditions. The two lines represent the 30th and 70th percentiles of monthly precipitation for Elizabethtown, NC. The bars are monthly rainfall totals for 2003 and 2004. The historical data was collected from the State Climate Office of North Carolina.

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

2.4 Conclusions

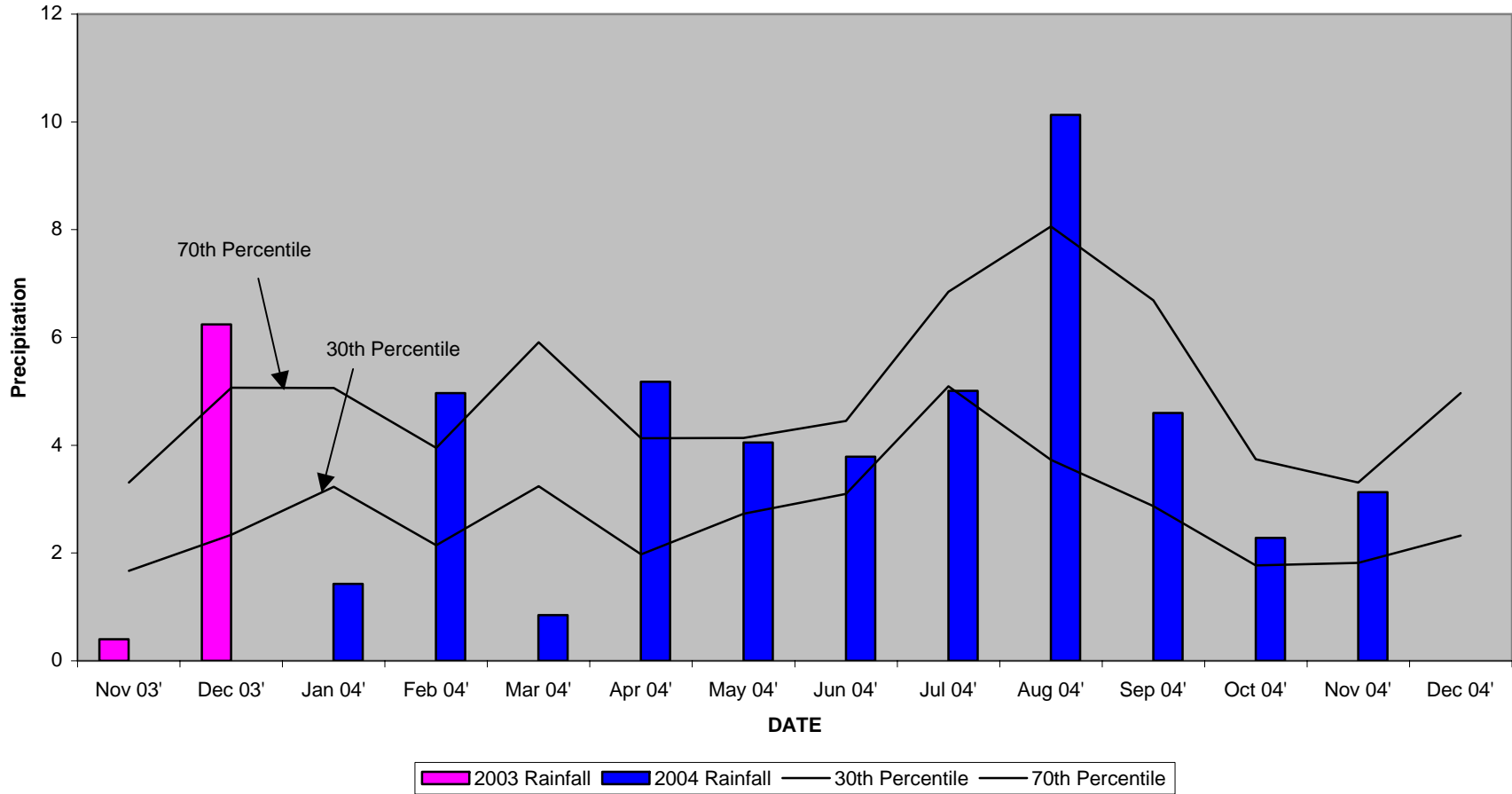
For the 2004 monitoring year, twenty-nine of thirty-eight gauges met jurisdictional hydrologic success of saturation in the upper twelve inches for at least 12.5% (consecutive) during the growing season; conversely, nine gauges recorded hydrology for less than 12.5% of the growing season.

The majority of the gauges not meeting the criteria are located in the northwest portion of the subject property. These gauges include G2 (5%), G4 (2.9%) & G36 (2%). It is likely that the perimeter canal that is located adjacent to these gauges likely caused them to fail.

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

FIGURE 4. 30-70 PERCENTILE GRAPH

Dowd Dairy 30-70 Percentile Graph
Elizabethtown , NC



3.0 VEGETATION: DOWD DAIRY MITIGATION SITE (YEAR 4)

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 five character tree species must be present, with no more than 20% of any one species, with the exception of Atlantic White Cedar, which may comprise up to 75% of the swamp forest restoration. Loblolly Pine cannot comprise more than 10% of the 320 trees per acre requirement.

3.2 Description of Species

The following tree species were planted in the Wetland Planting Areas:

Zone 1: Non-Riverine Wet Hardwood Forest (320.25 acres)

Quercus falcata var. *pagodaefolia*, Cherrybark Oak

Fraxinus pennsylvanica, Green Ash

Quercus laurifolia, Laurel Oak

Quercus lyrata, Overcup Oak

Quercus michauxii, Swamp Chestnut Oak

Nyssa aquatica, Water Tupelo

Quercus nigra, Water Oak

Quercus phellos, Willow Oak

Zone 2: Pine/Oak Hickory (17.68 acres)

Juglans nigra, Black Walnut

Nyssa sylvatica var. *sylvatica*, Blackgum

Pinus palustris, Longleaf Pine

Quercus falcata var. *falcata*, Southern Red Oak

Quercus nigra, Water Oak

Quercus alba, White Oak

Quercus phellos, Willow Oak

Liriodendron tulipifera, Tulip Poplar

Quercus lyrata, Overcup Oak

Zone 3: Non-Riverine Swamp Forest (201.2 acres)

Chamaecyparis thyoides, Atlantic White Cedar
Taxodium Distichum, Baldcypress
Quercus falcata var. *pagodaefolia*, Cherrybark Oak
Fraxinus pennsylvanica, Green Ash
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Quercus nigra, Water Oak
Quercus phellos, Willow Oak
Nyssa aquatica, Water Tupelo

Zone 4: Headwater (Slope) Swamp (12.05 acres)

Taxodium Distichum, Baldcypress
Quercus falcata var. *pagodaefolia*, Cherrybark Oak
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Quercus michauxii, Swamp Chestnut Oak
Quercus nigra, Water Oak
Quercus phellos, Willow Oak
Liriodendron tulipifera, Tulip Poplar

Zone 5: Atlantic White Cedar Slope (67.76 acres)

Chamaecyparis thyoides, Atlantic White Cedar
Taxodium Distichum, Baldcypress
Pinus serotina, Pond Pine
Quercus michauxii, Swamp Chestnut Oak
Nyssa aquatica, Water Tupelo
Quercus phellos, Willow Oak
Liriodendron tulipifera, Tulip Poplar
Quercus falcata var. *pagodaefolia*, Cherrybark Oak
Fraxinus pennsylvanica, Green Ash
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak

3.3 Results of Vegetation Monitoring

ZONE	Plot #	Swamp Chestnut Oak	Laurel Oak	Willow Oak	Cherrybark Oak	Water Tupelo	Water Oak	Green Ash	Overcup Oak	White Oak	Southern Red Oak	Longleaf Pine	Pond Pine	Blackgum	Black Walnut	Tulip Poplar	Baldcypress	Atlantic White Cedar	Total (4 year)	Total (at planting)	Density (Trees/Acre)
1	1			8	2			6	10										26	37	478
1	3	4		6		1			3										14	40	238
	4	3	1	3		2		1	18										28	28	680
	5		6	3		4	1	9	12										35	39	610
	8	4	1	3		4		9											21	38	376
	14	5	3	6	9														23	39	401
	15	1	2	10		1													14	32	298
	17	13	3	1	6				1										24	41	398
	19	4	2	2		1			1										10	35	194
	28	2		10		3		8	4										27	37	496
	29	4	2	2				5	18										31	41	514
	30		3	10				18	2										33	39	575
	31	16			1	1		5	5										28	37	515
	32	6		3		1		10	3										23	38	412
	33		3		4			23	14										44	44	680
	34	4	3	1		5		7	10										30	39	523
																				ZONE 1 AVERAGE	
2	2			1	1				21					1	1				25	25	680
	12			4			1				9								14	26	366
																			ZONE 2 AVERAGE		523

ZONE	Plot #	Swamp Chestnut Oak	Laurel Oak	Willow Oak	Cherrybark Oak	Water Tupelo	Water Oak	Green Ash	Overcup Oak	White Oak	Southern Red Oak	Longleaf Pine	Pond Pine	Blackgum	Black Walnut	Tulip Poplar	Baldcypress	Atlantic White Cedar	Total (4 year)	Total (at planting)	Density (Trees/Acre)
3	6		2	1	5		1	2	4								8	7	30	30	680
	7							10	3								20		33	40	561
	9			4													10	4	18	34	360
	10		5		3		2		10								12	1	33	44	510
	11		2	12	2				4								7	1	28	28	680
	20		1	2				10											13	37	239
	24		1	4					3								4		12	34	240
	25			4	5				6	5							1	6	27	31	592
	26			2					20	1							6	2	31	35	602
	27		1	5					1	10							4		21	36	397
	35				1	4			6	2							1		14	37	257
	36		4	5	1				3								2		15	36	283
ZONE 3 AVERAGE																			450		
4	16	3			1				5								12		21	31	461
	18	7	3	1					2								9		22	35	427
	ZONE 4 AVERAGE																			444	
5	13		1	1	5			4	3										14	24	397
	21			4									6				16		26	29	610
	22	2		2		3											8		15	27	378
	23	1		9		5							5				13		33	38	591
	37	12		10		4							2				15		43	47	622
	38	21		12					4				2	8			3		50	50	680
ZONE 5 AVERAGE																			546		
TOTAL AVERAGE																			474		

Site Notes:

Zone 1: Other species noted: goldenrod, briars, red maple, broomsedge, pine, sweetgum, stinkweed, sicklepod, trumpet creeper, *Juncus* sp., *Aster* sp., switchgrass, giant foxtail, fennel, sassafras, ragweed, *Baccharis halimifolia*, *Panicum* sp., woolgrass, cattail, and *Bidens* sp.

Zone 2: Other species noted: ragweed, *Aster* sp., *Juncus* sp., broomsedge, pine, goldenrod, *Panicum* sp., and cacti.

Zone 3: Other species noted: fennel, broomsedge, goldenrod, winged sumac, *Baccharis halimifolia*, cattail, stinkweed, *Juncus* sp., black willow, foxtail, sweetgum, briars, sassafras, ragweed, smartweed, sicklepod, bahia, winged sumac, woolgrass, and *Aster* sp. Planted green ash noted outside of plot 9.

Zone 4: Other species noted: sweetgum, briars, fennel, red maple, broomsedge, *Aster* sp., and *Juncus* sp.

Zone 5: Other species noted: fennel, briars, sweetgum, red maple, bermuda grass, *Juncus* sp., cattail, *Aster* sp., winged sumac, and broomsedge.

3.4 Conclusions

The Dowd Dairy Farm Mitigation Site included 619-acres (out of 658 acres) of tree planting. There were thirty-eight test plots established throughout the planting areas, covering all of the plant communities. The 2004 vegetation monitoring of the planted areas revealed an average density of 474 trees per acre, which is well above the minimum requirement of 320 trees per acre. It should be noted that since this was a phased project the majority of the plots contain 5-year old trees. Sweetgum, red maple, and pine are more abundant around the perimeter of the site towards the woods and in the cut over area, however they are not out competing the planted species.

EPP will begin monitoring the vegetation at the Dowd Dairy Mitigation Site for the 2005 monitoring year.

4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS

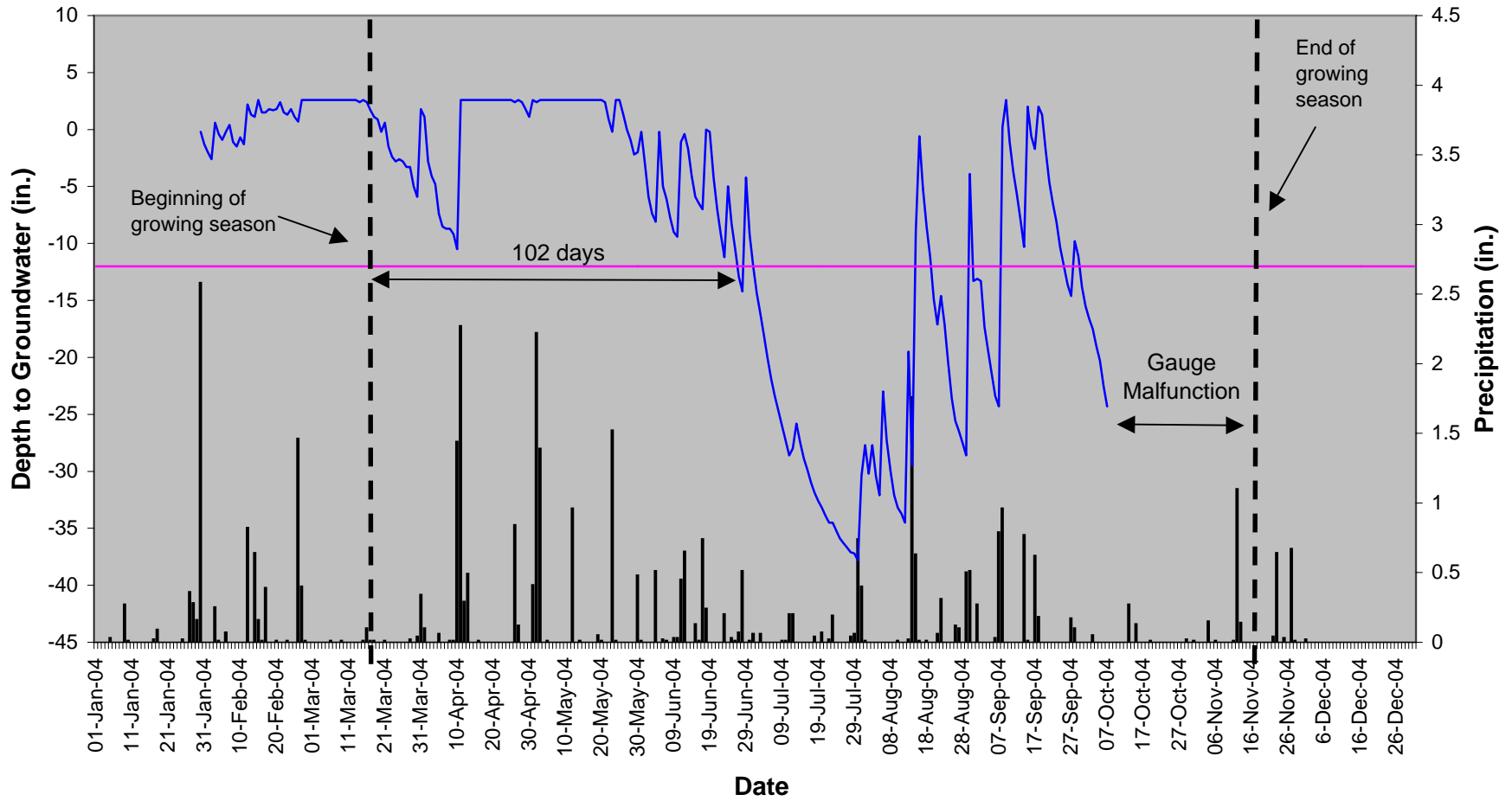
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The fourth year of vegetation monitoring (of the 619 acres planted in trees), revealed an average density of 474 trees per acre, which is above the minimum requirement of 320 trees per acre. Sweetgum, red maple, and pine are more abundant around the perimeter of the site towards the woods and in the cut over area, but are not out competing the planted species.

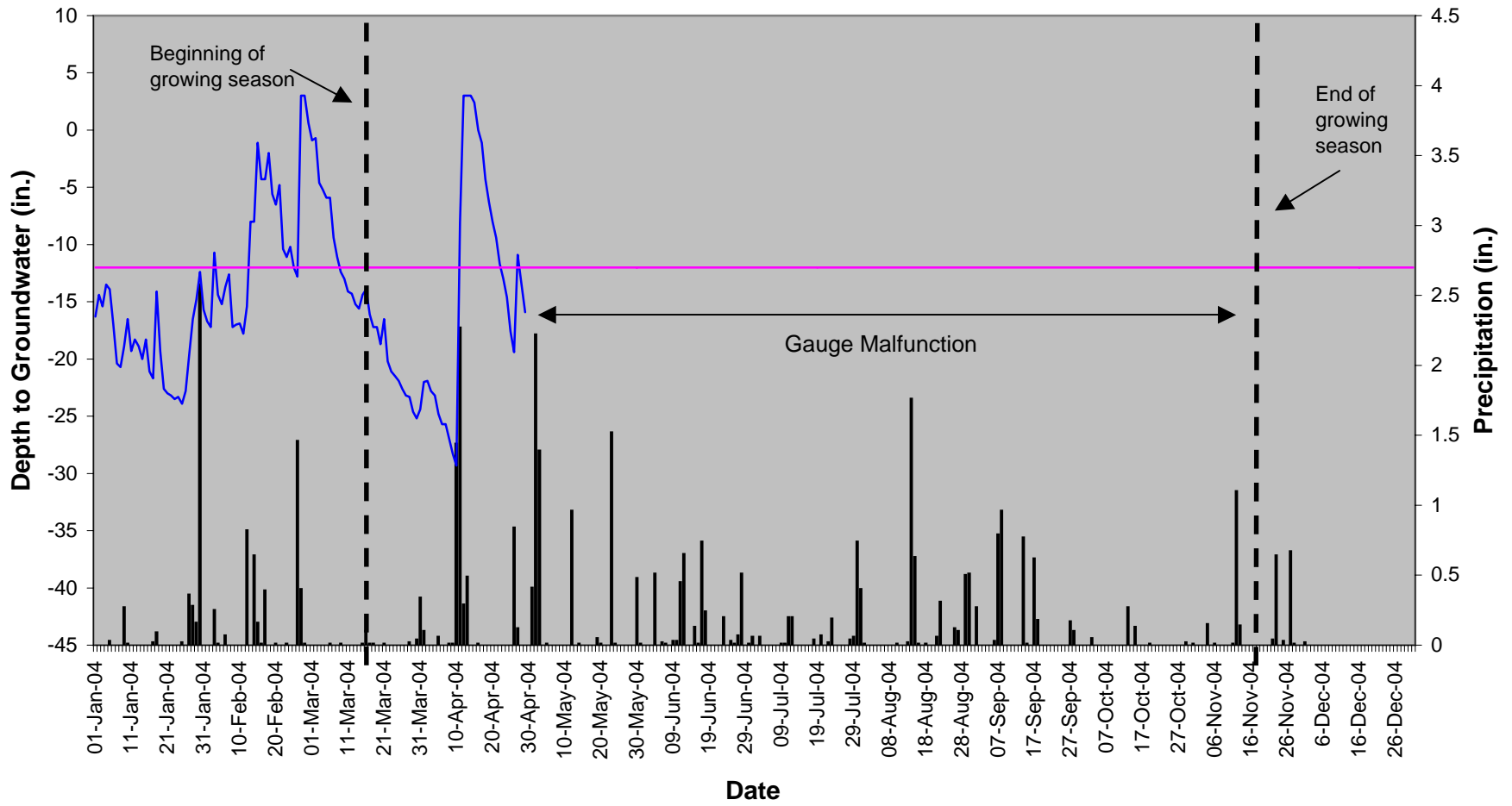
Per the letter from the Ecosystem Enhancement Program (EEP) to NCDOT dated August 25, 2004, the EEP has accepted the transfer of all off-site mitigation projects. The EEP will be responsible for fulfilling the remaining monitoring requirements and future remediation for this project.

APPENDIX A
GAUGE DATA GRAPHS

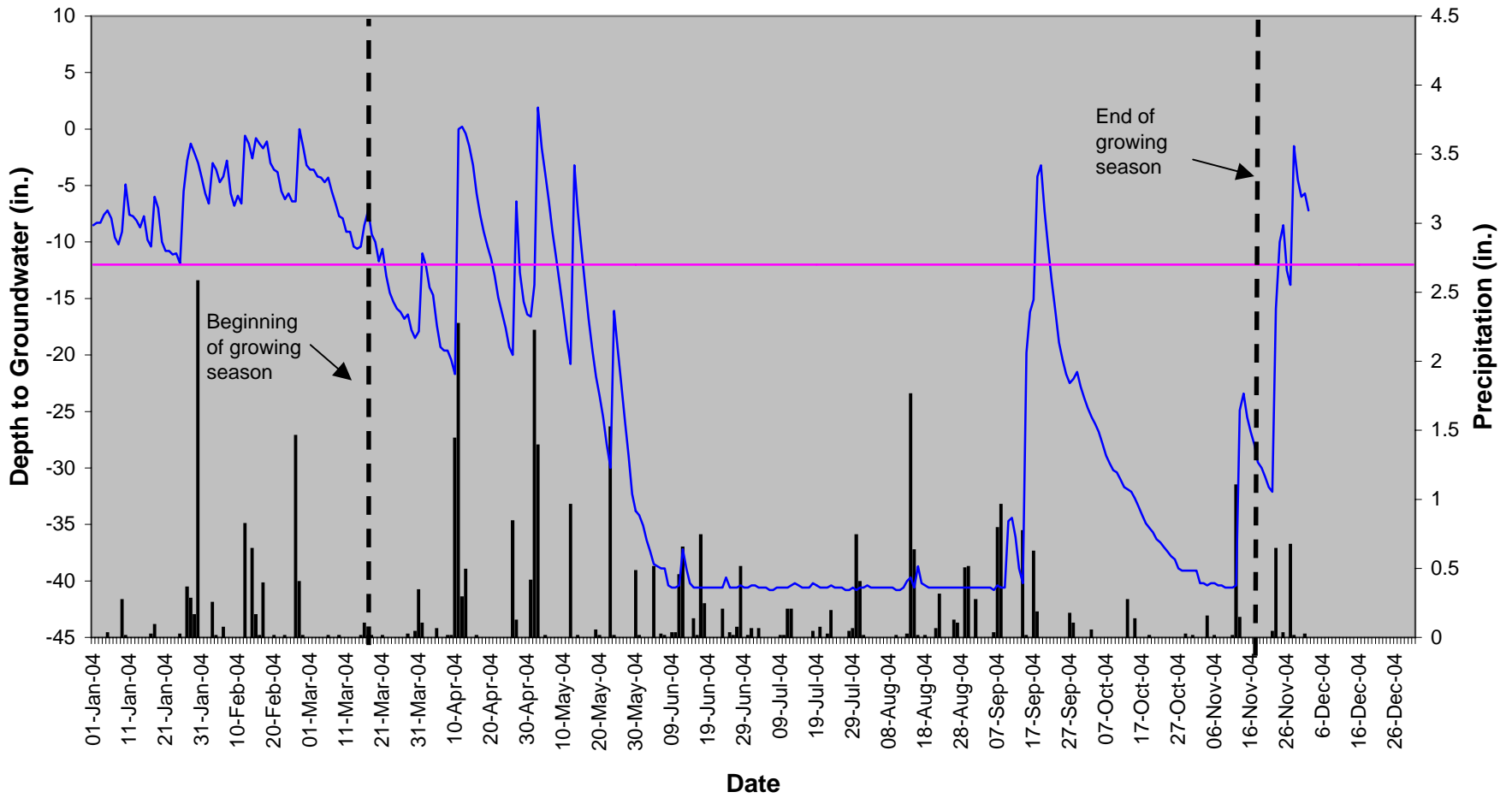
Dowd Dairy Farm - Gauge G1



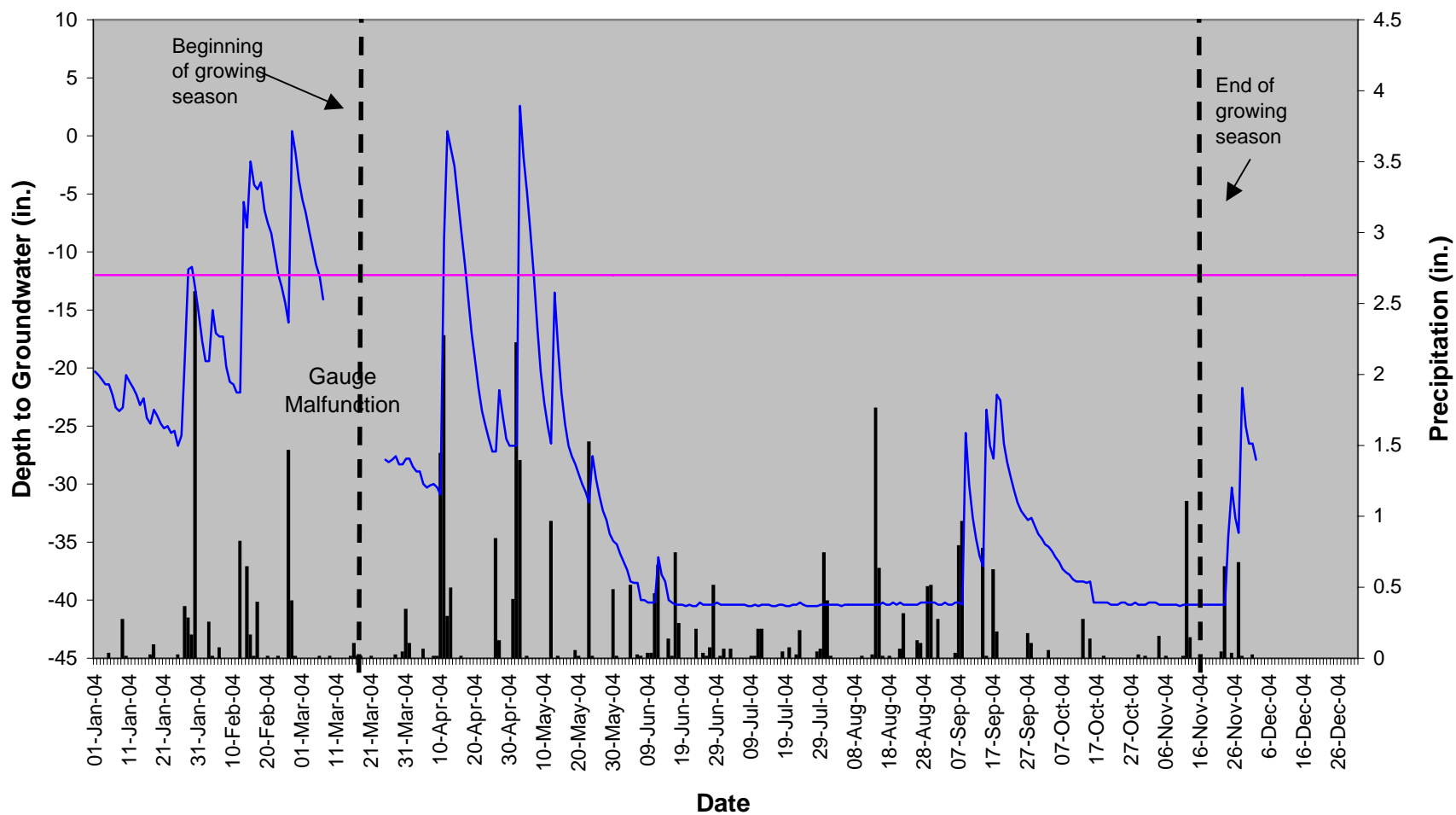
Dowd Dairy Farm - Gauge G2



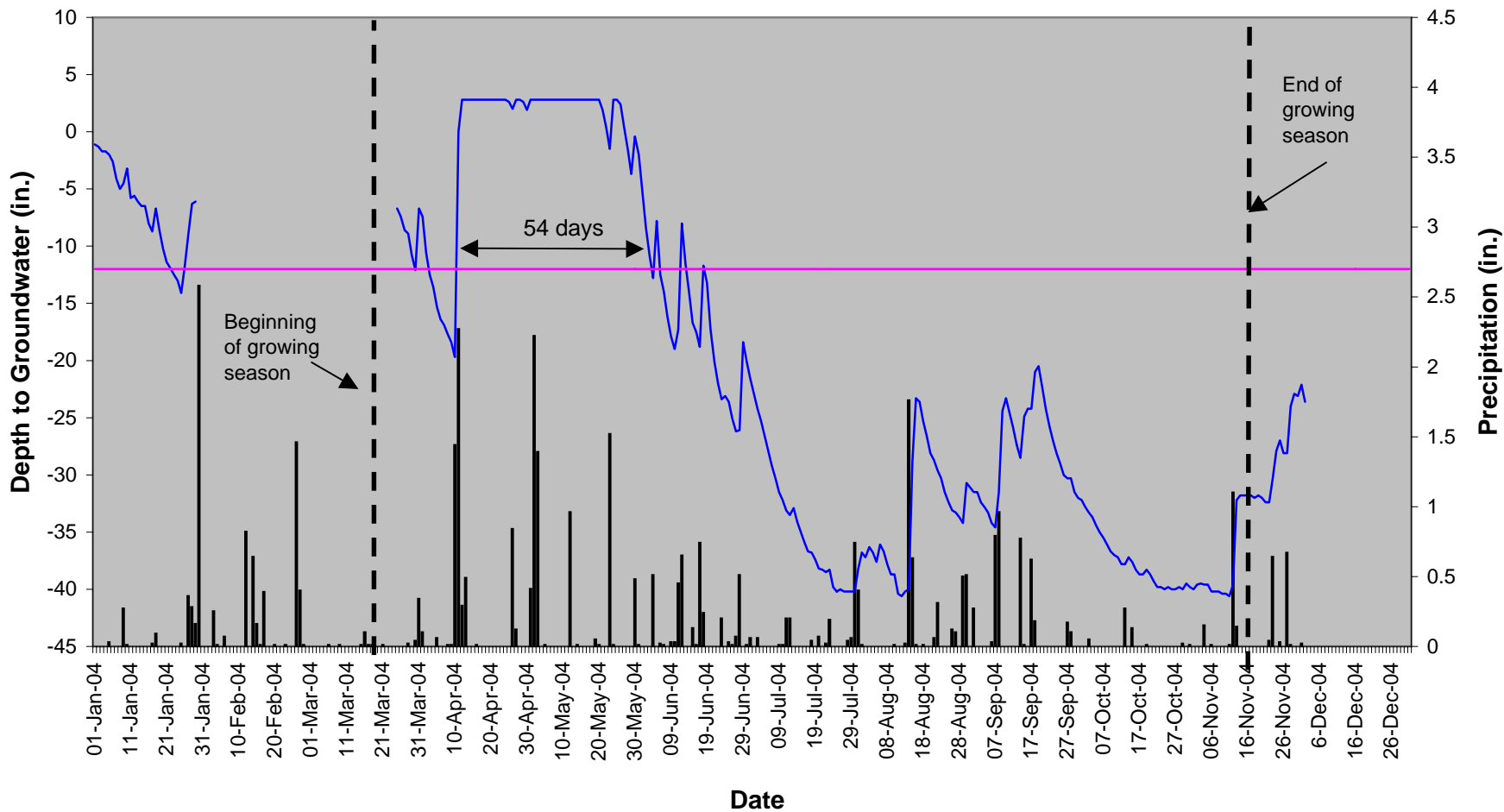
Dowd Dairy Farm - Gauge G3



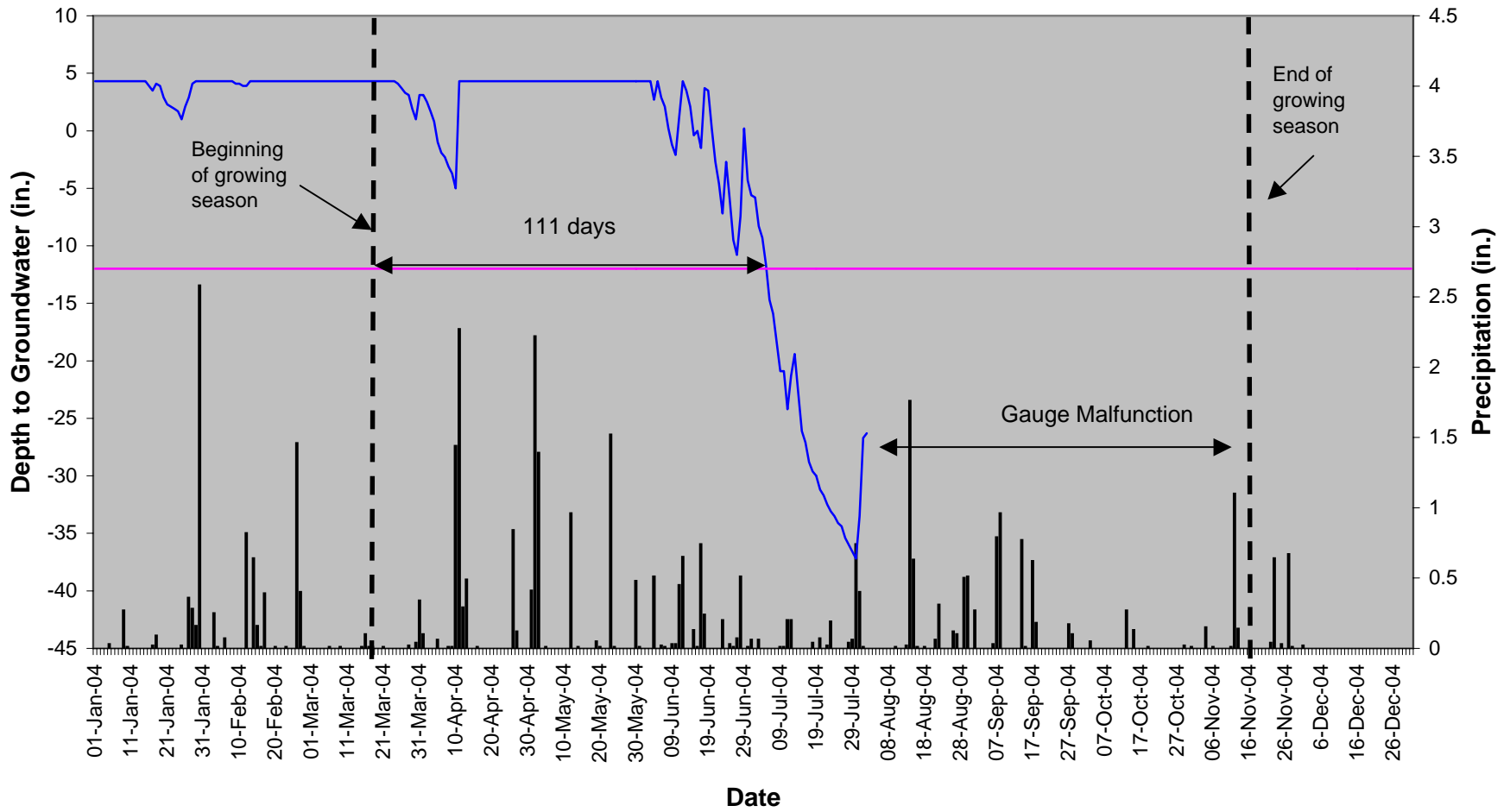
Dowd Dairy Farm - Gauge G4



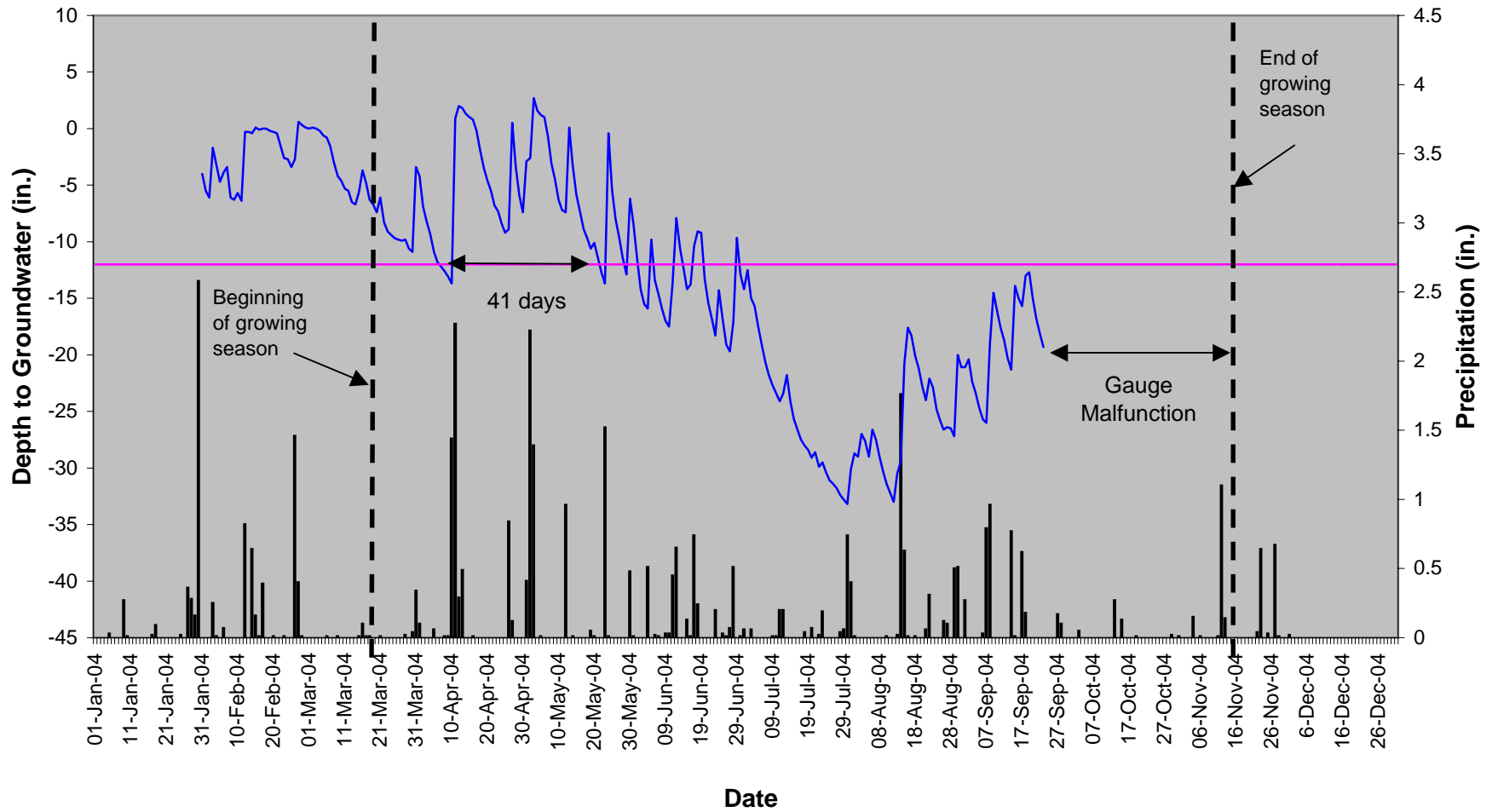
Dowd Dairy Farm - Gauge G5



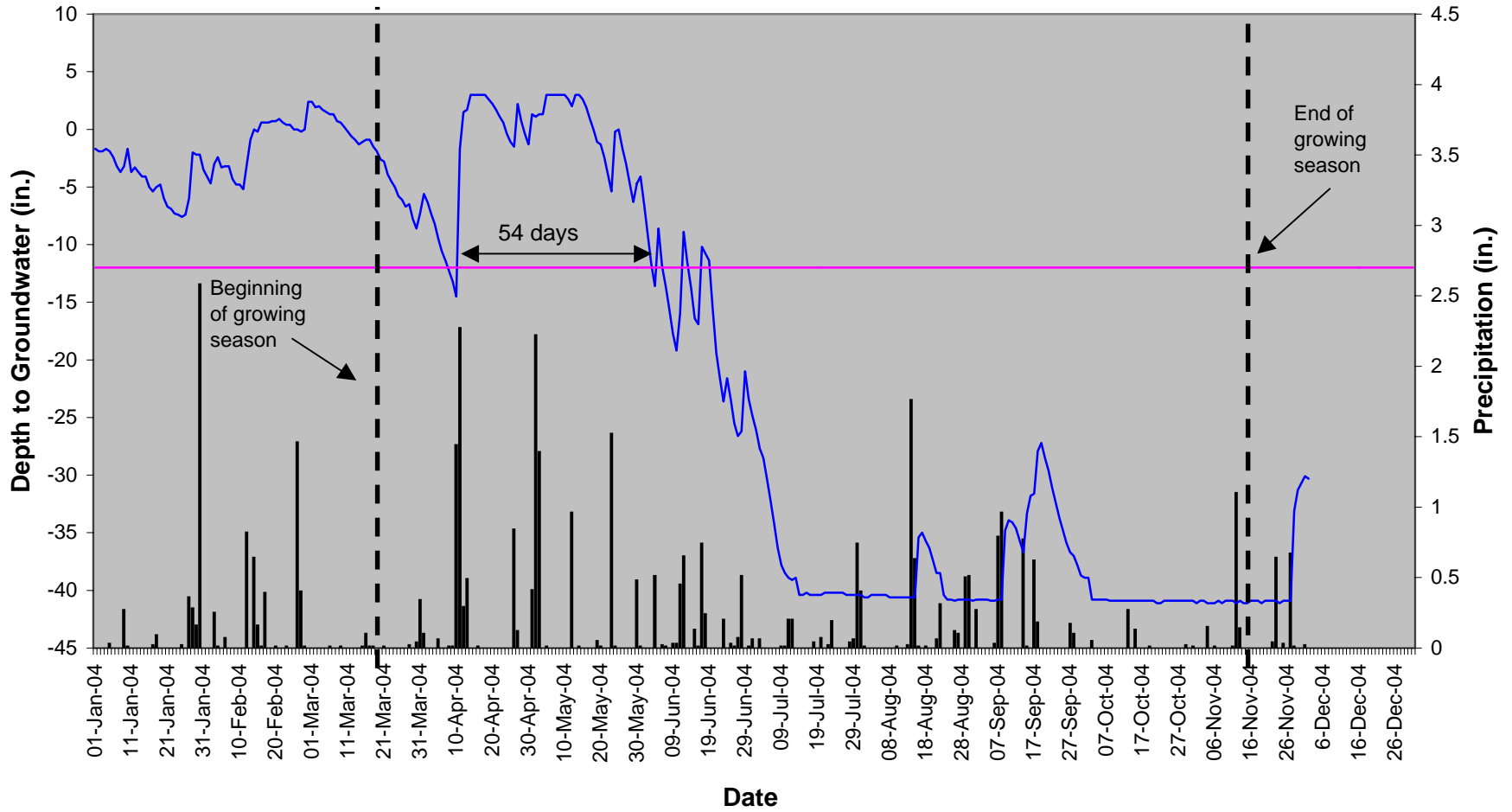
Dowd Dairy Farm - Gauge G6



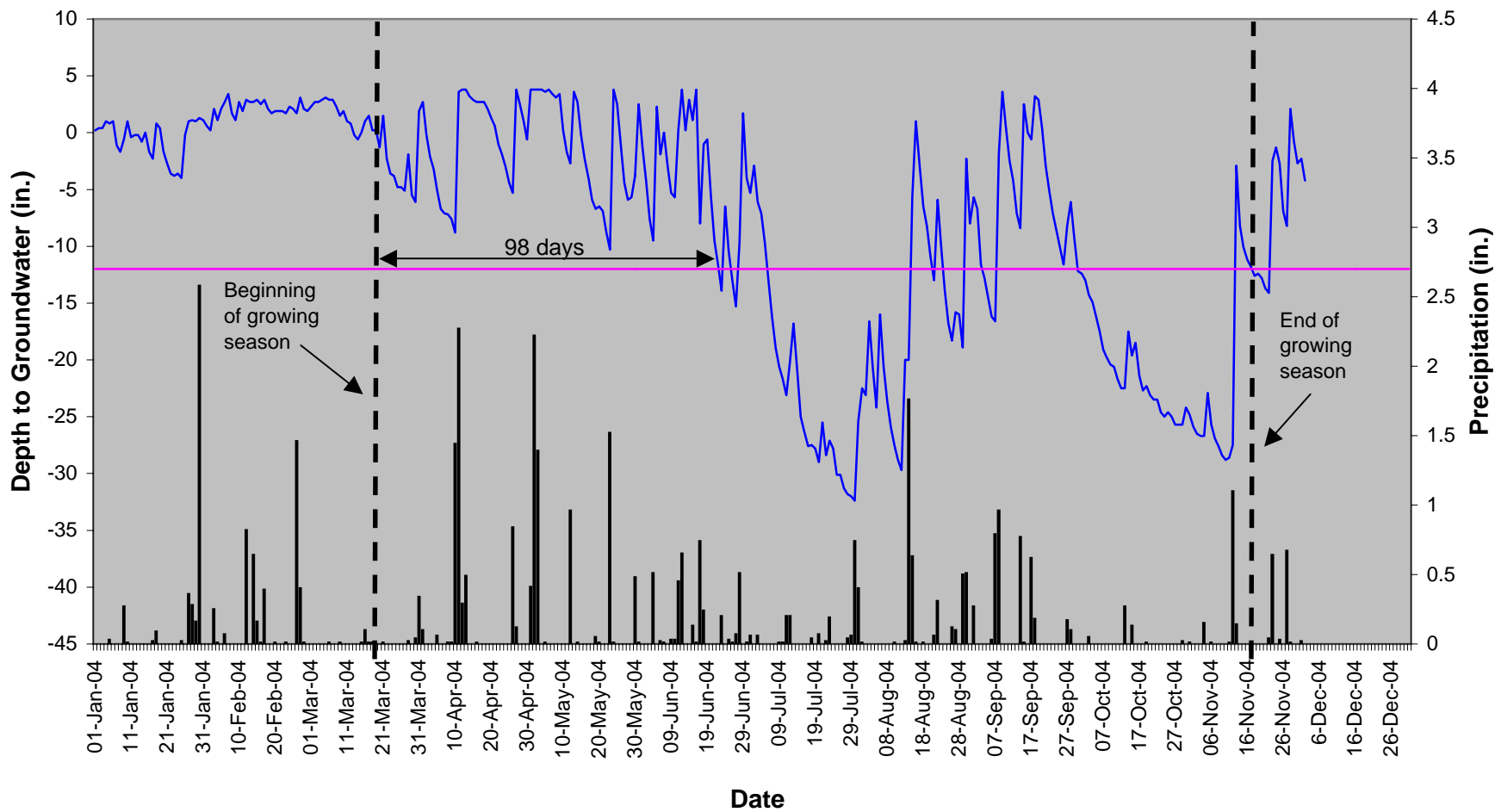
Dowd Dairy Farm - Gauge G7



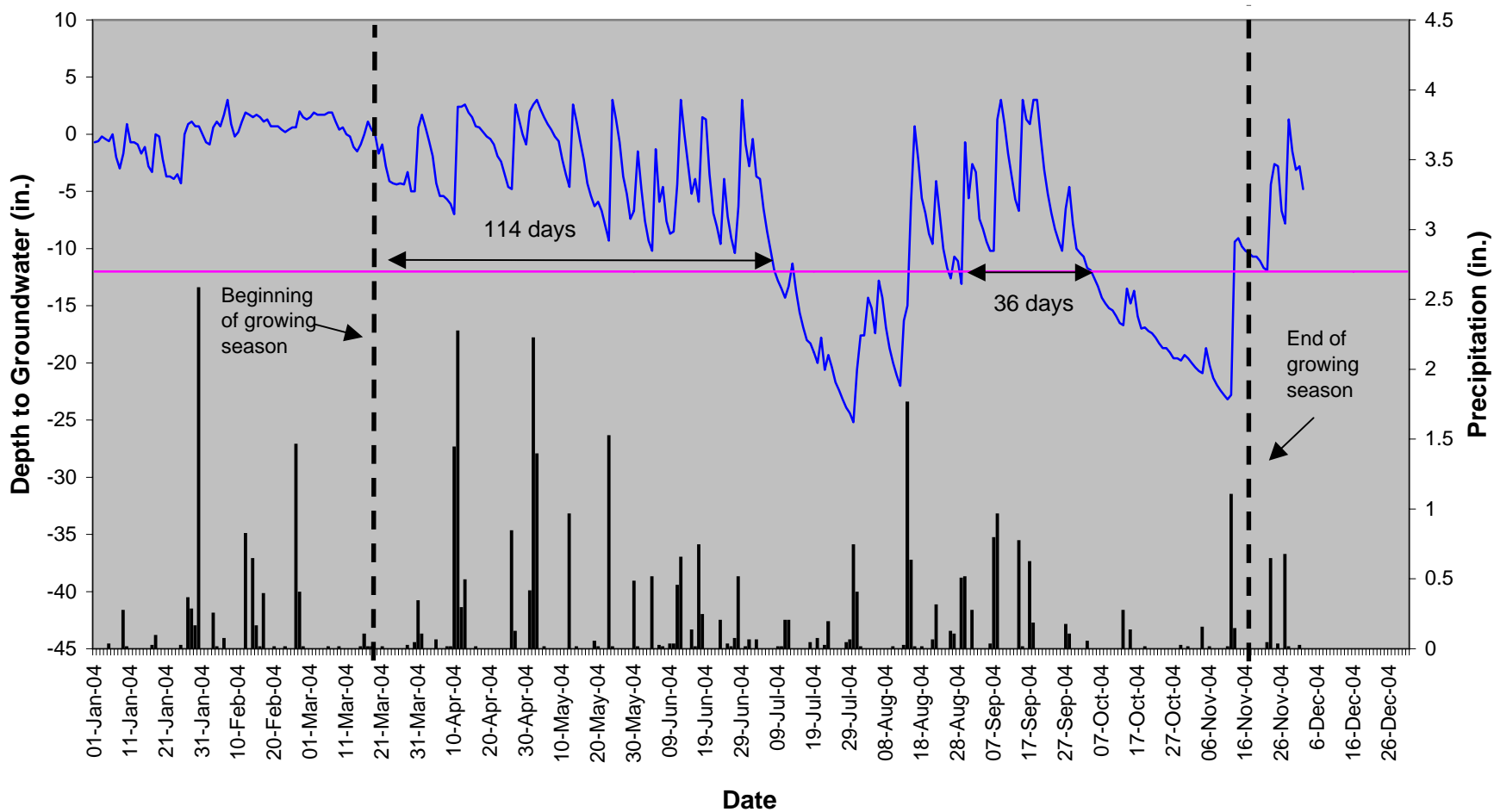
Dowd Dairy Farm - Gauge G8



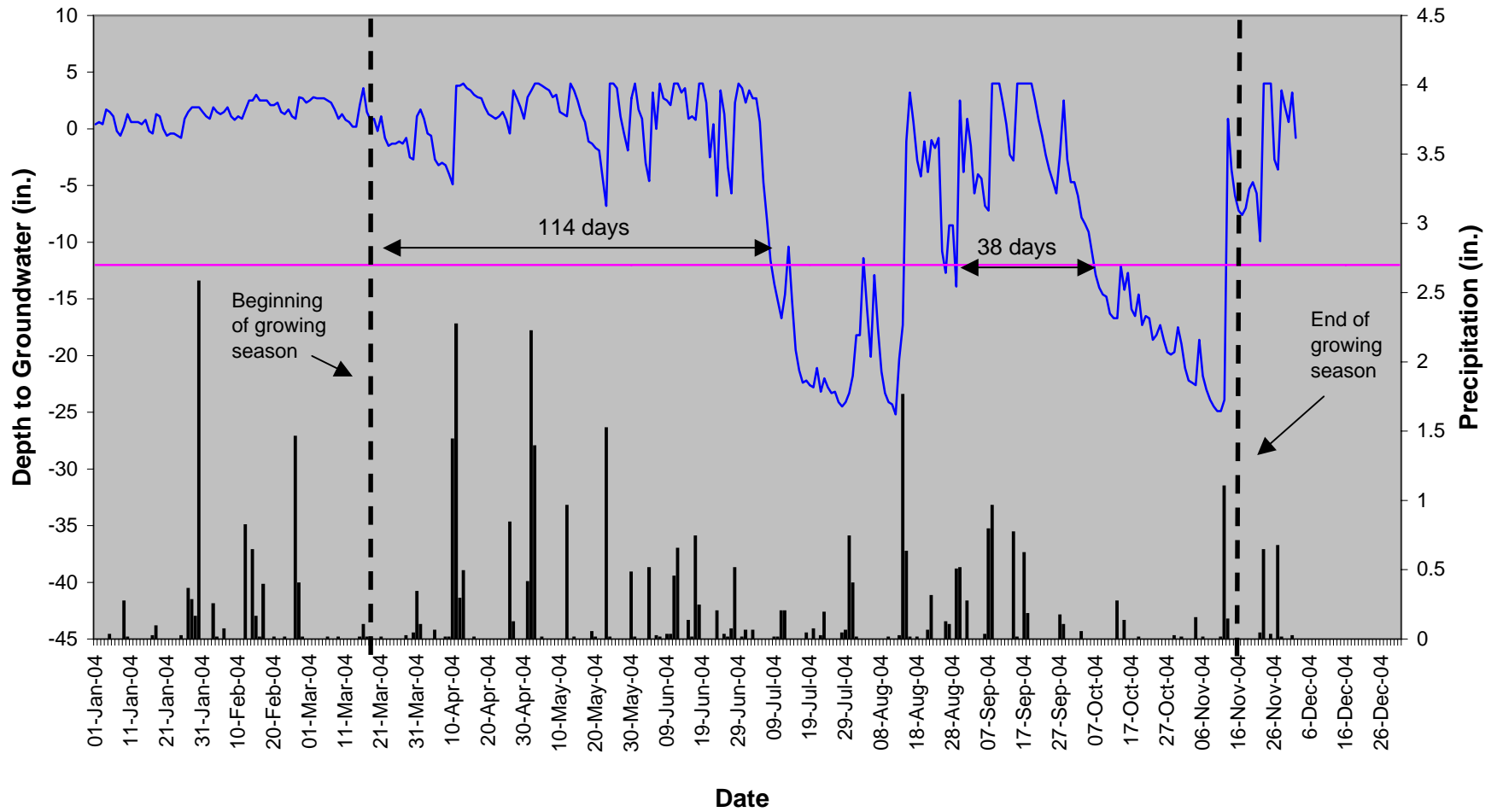
Dowd Dairy Farm -Gauge G9



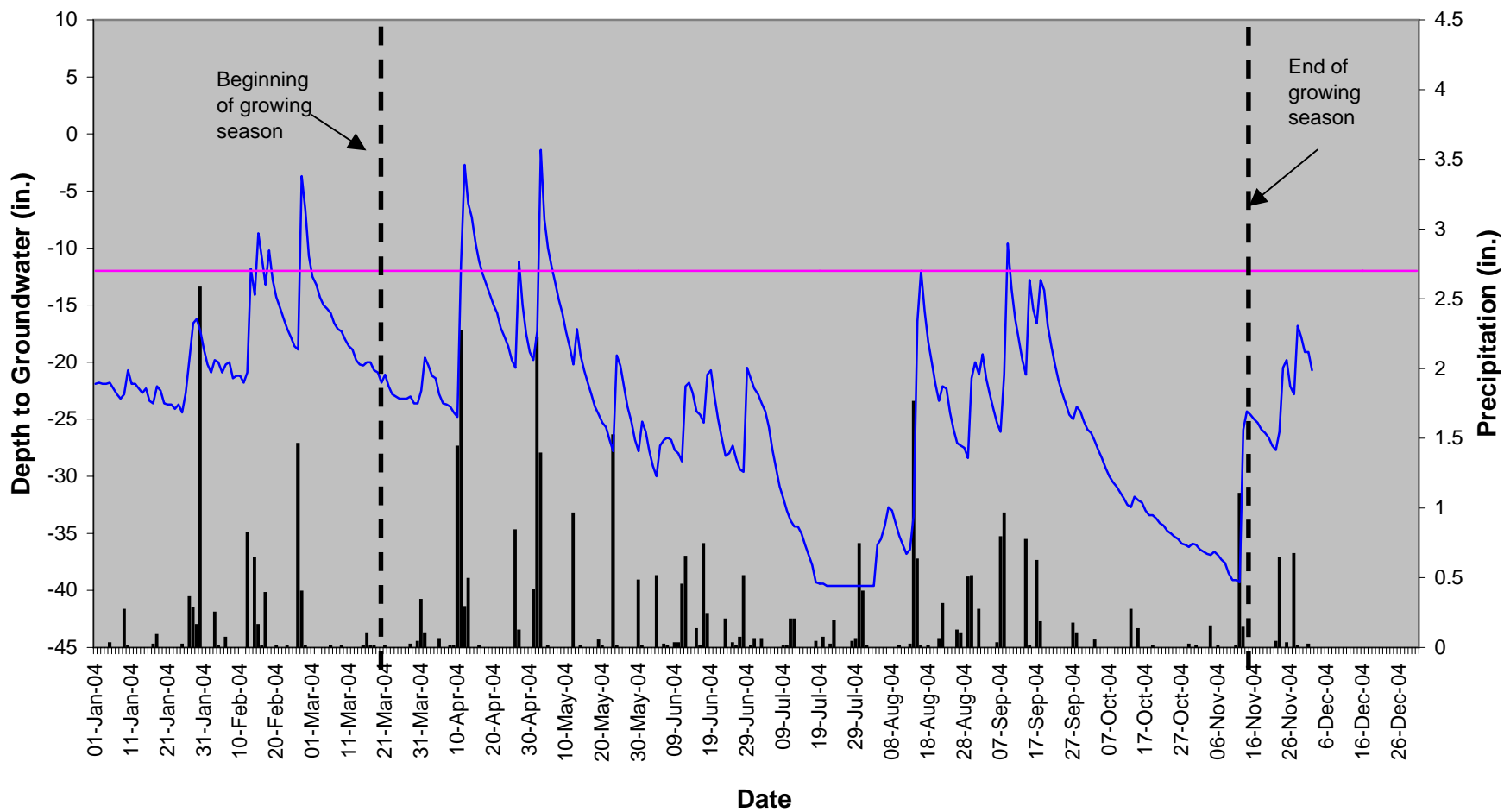
Dowd Dairy Farm - Gauge G10



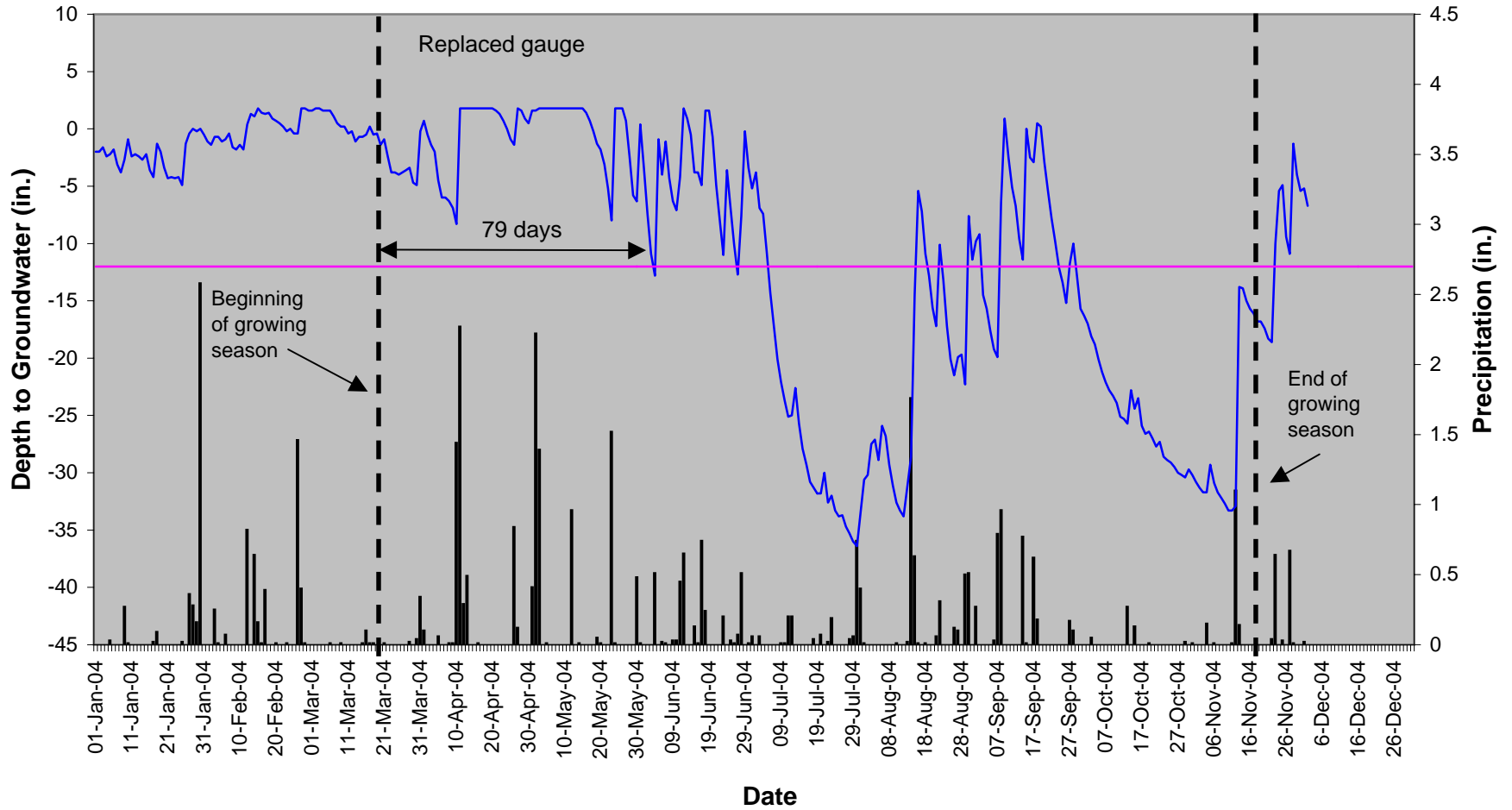
Dowd Dairy Farm - Gauge G12



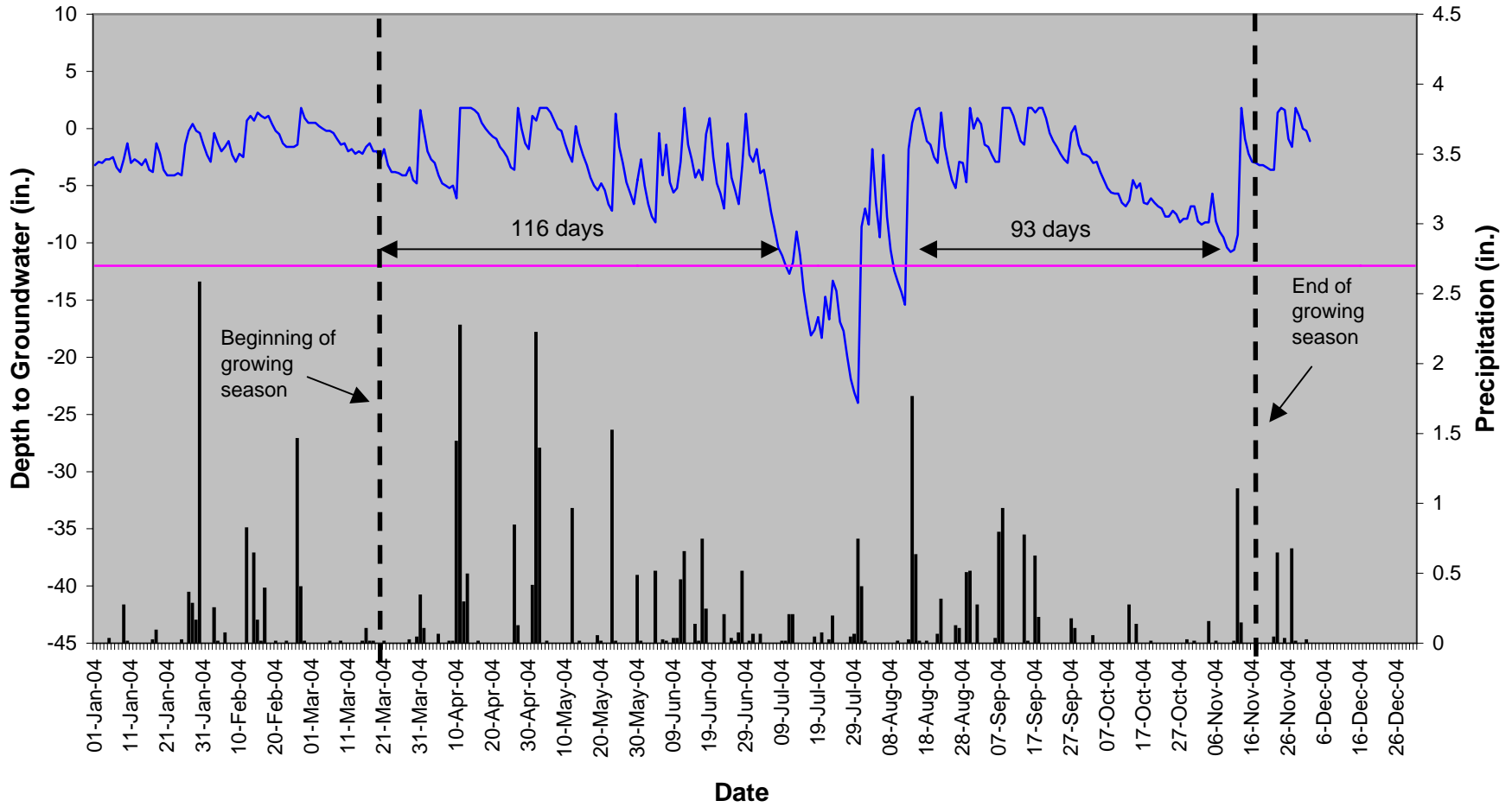
Dowd Dairy Farm - Gauge G13



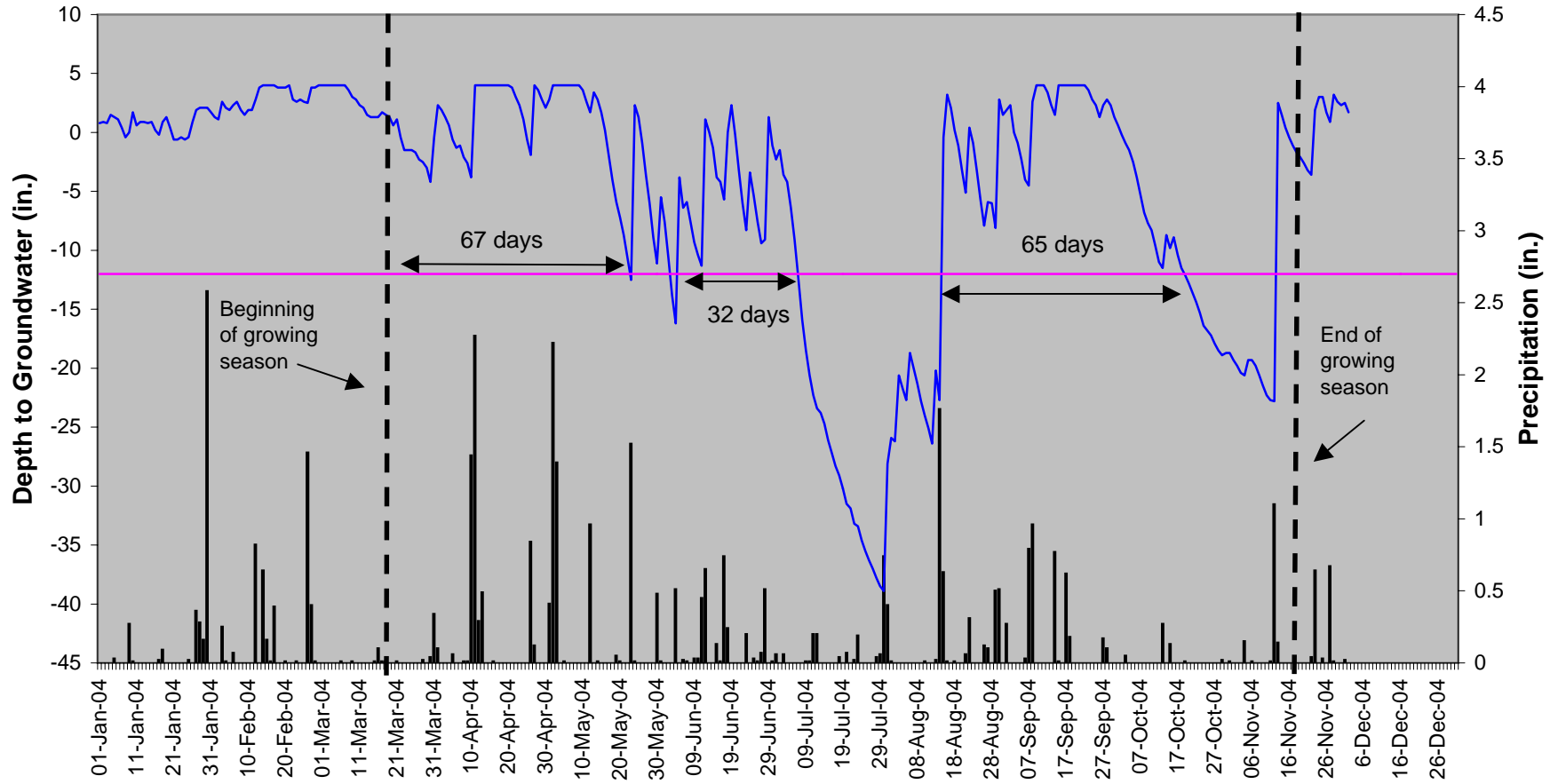
Dowd Dairy Farm - Gauge G14



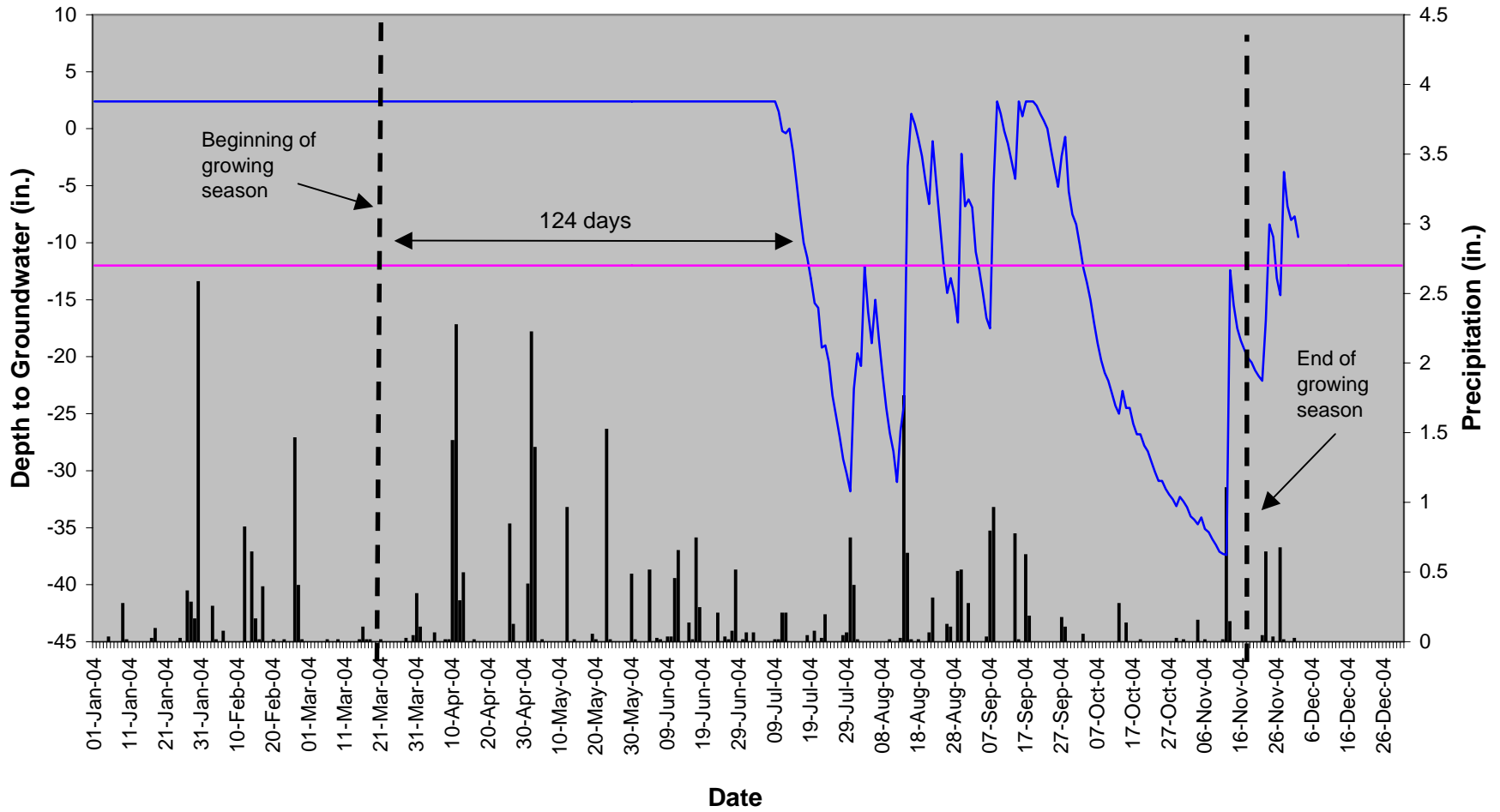
Dowd Dairy Farm - Gauge G15



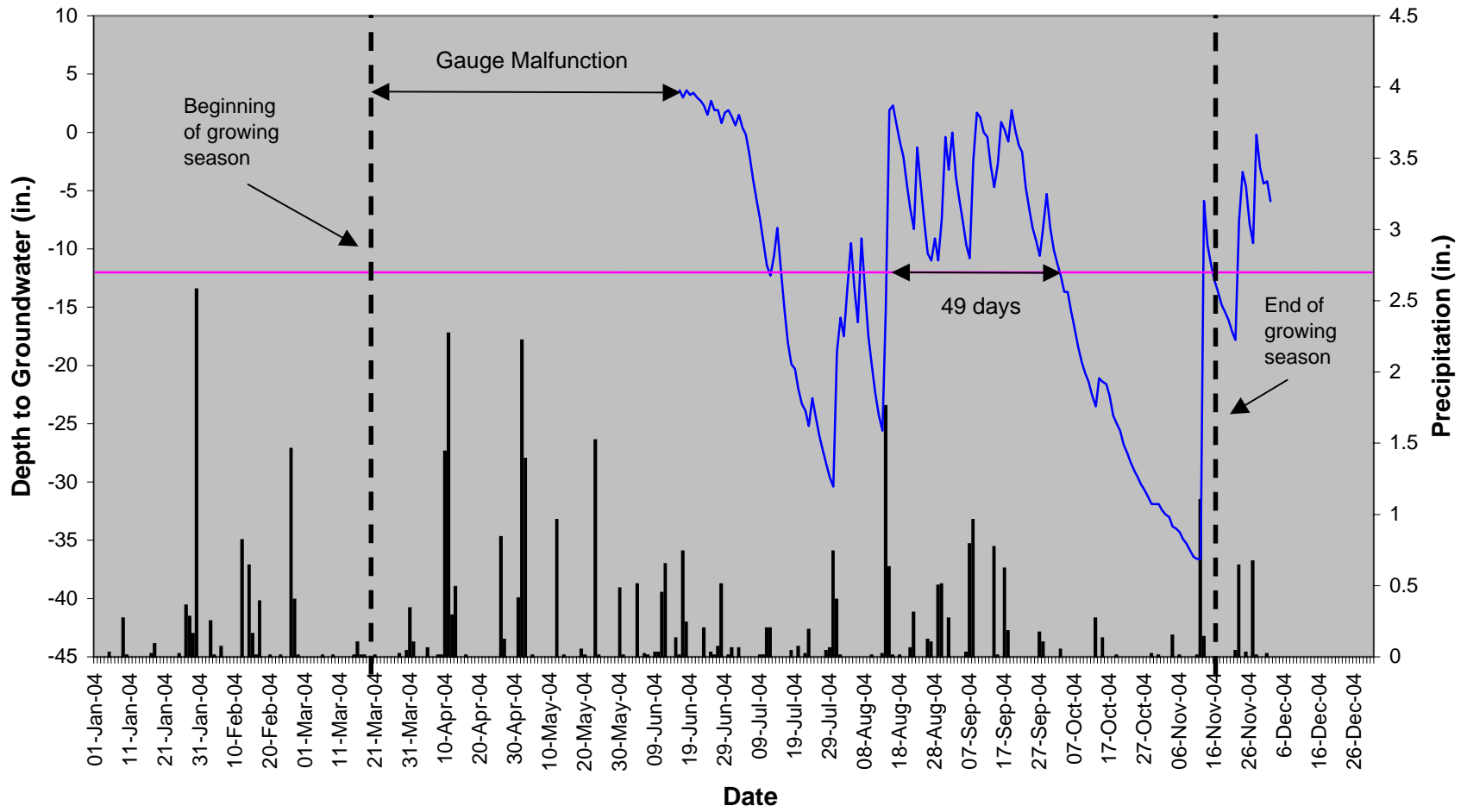
Dowd Dairy Farm - Gauge G16



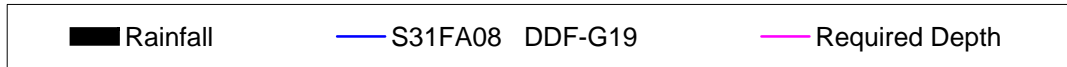
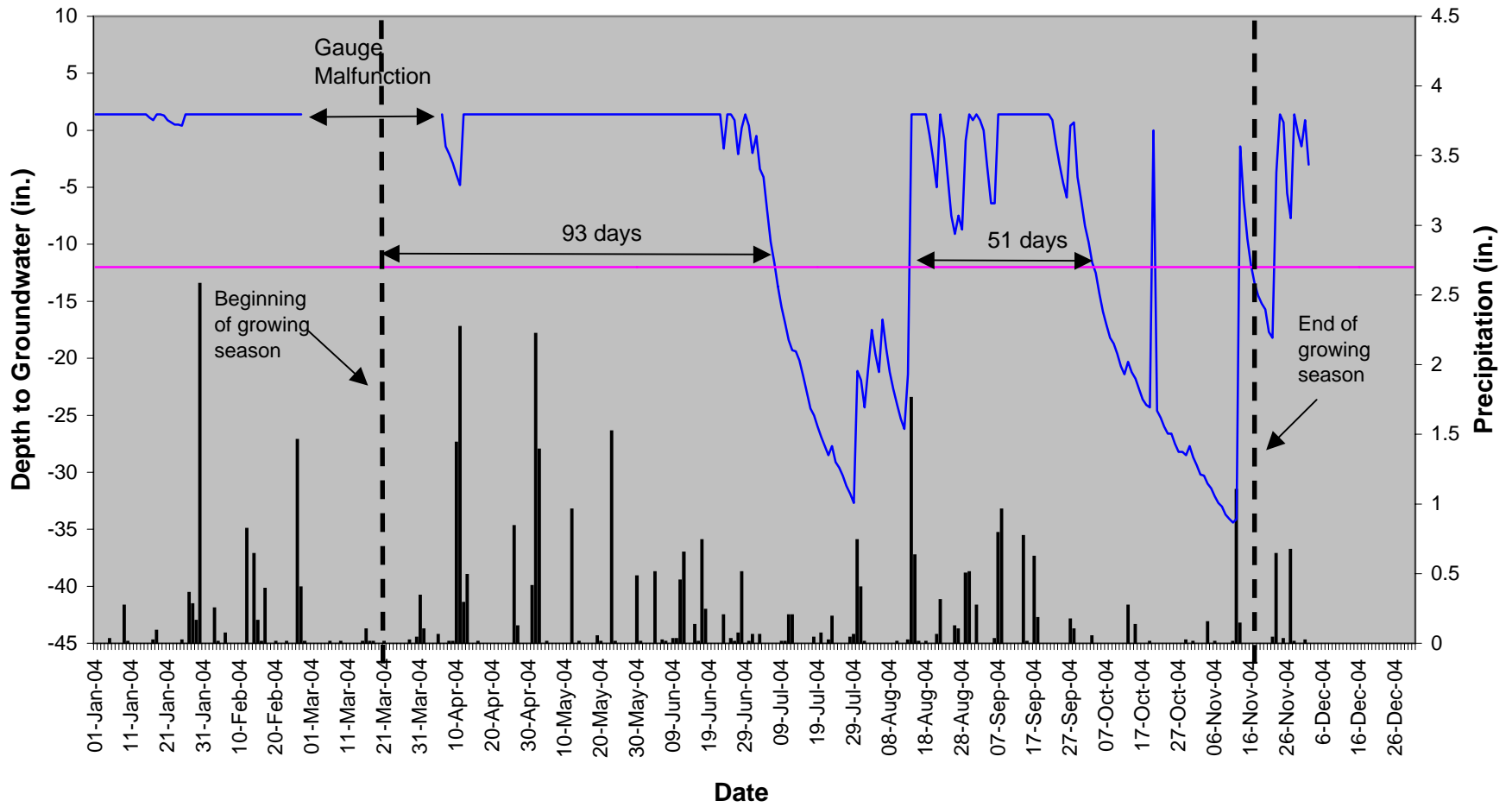
Dowd Dairy Farm - Gauge G17



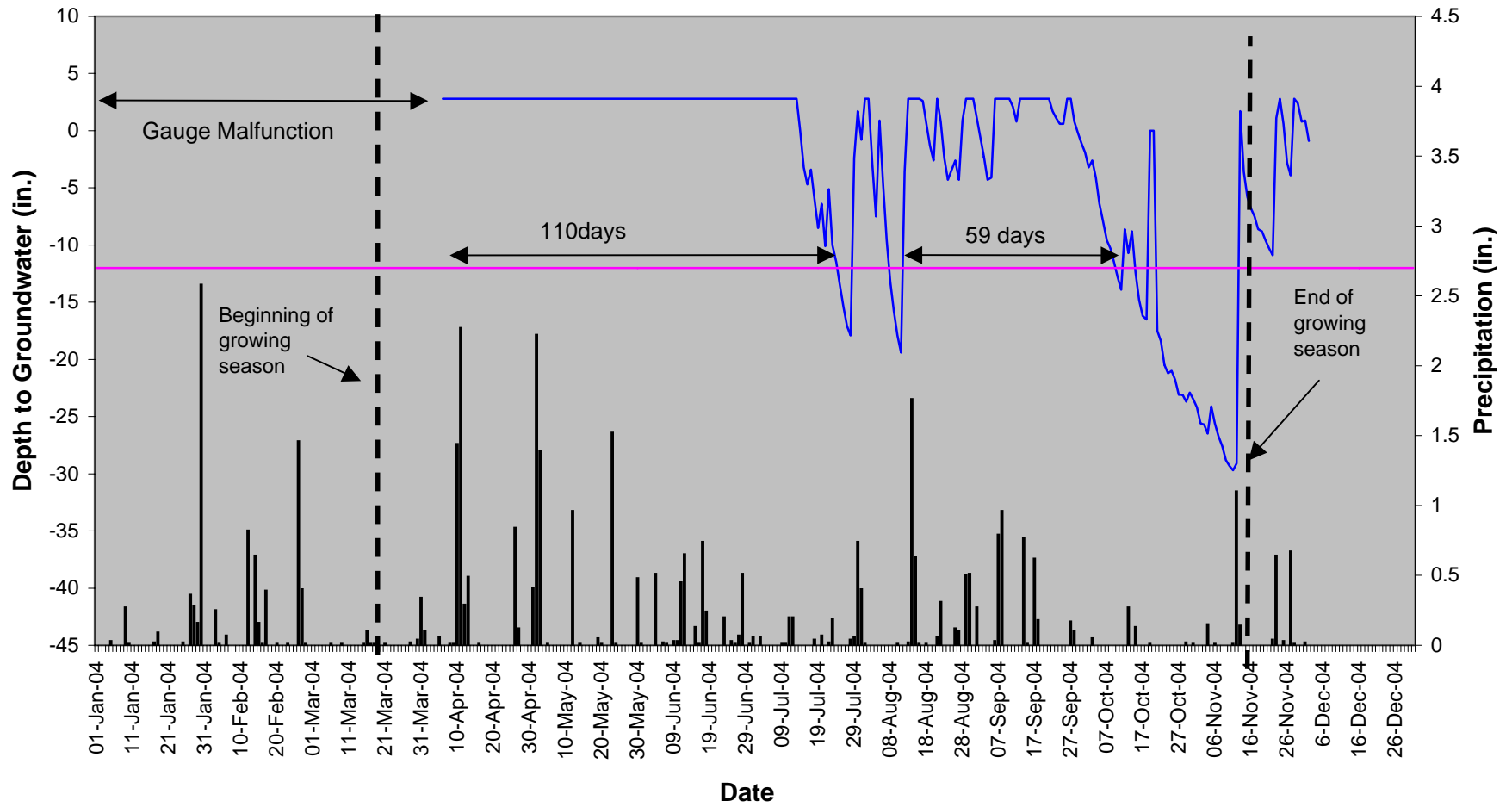
Dowd Dairy Farm - Gauge G18



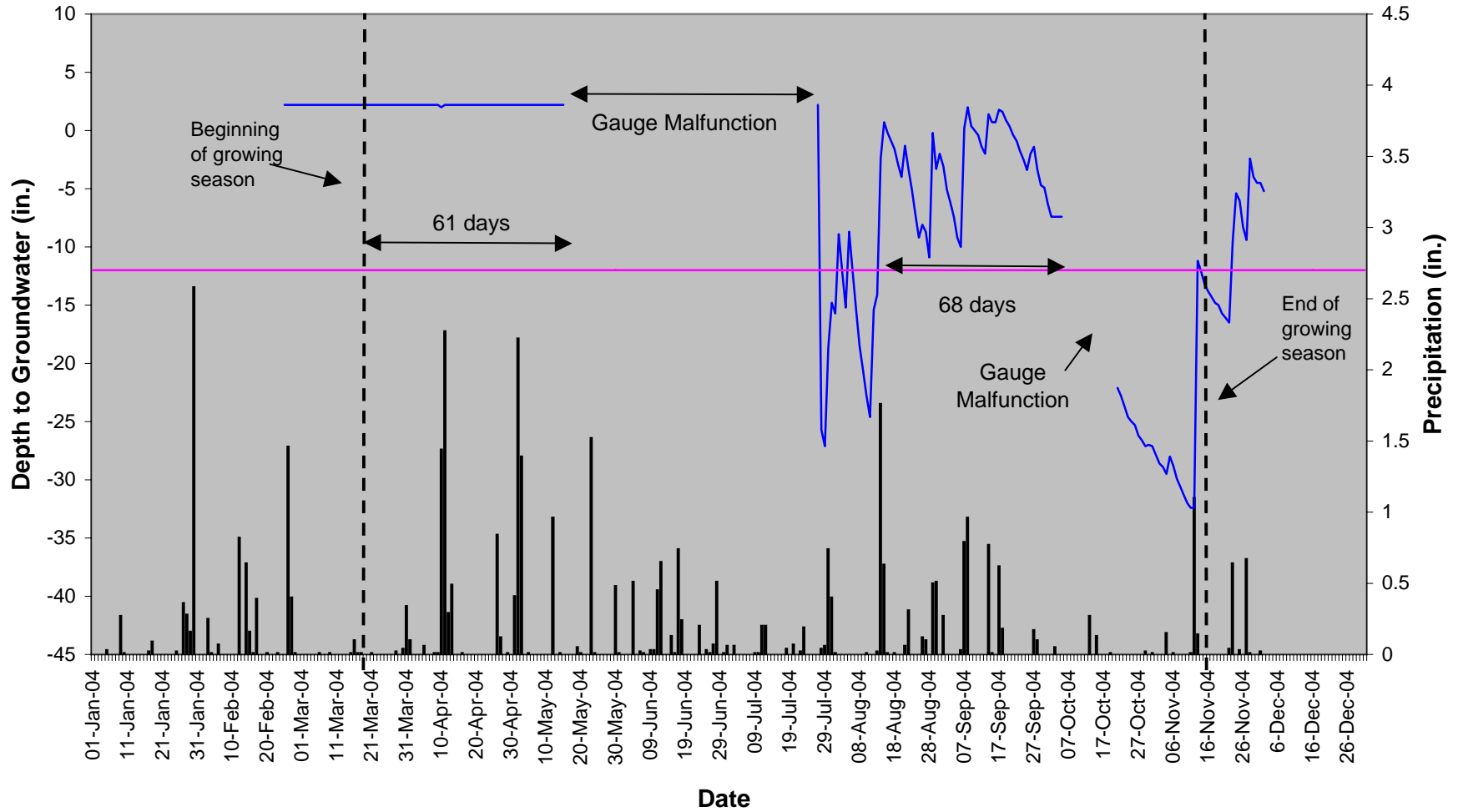
Dowd Dairy Farm - Gauge G19



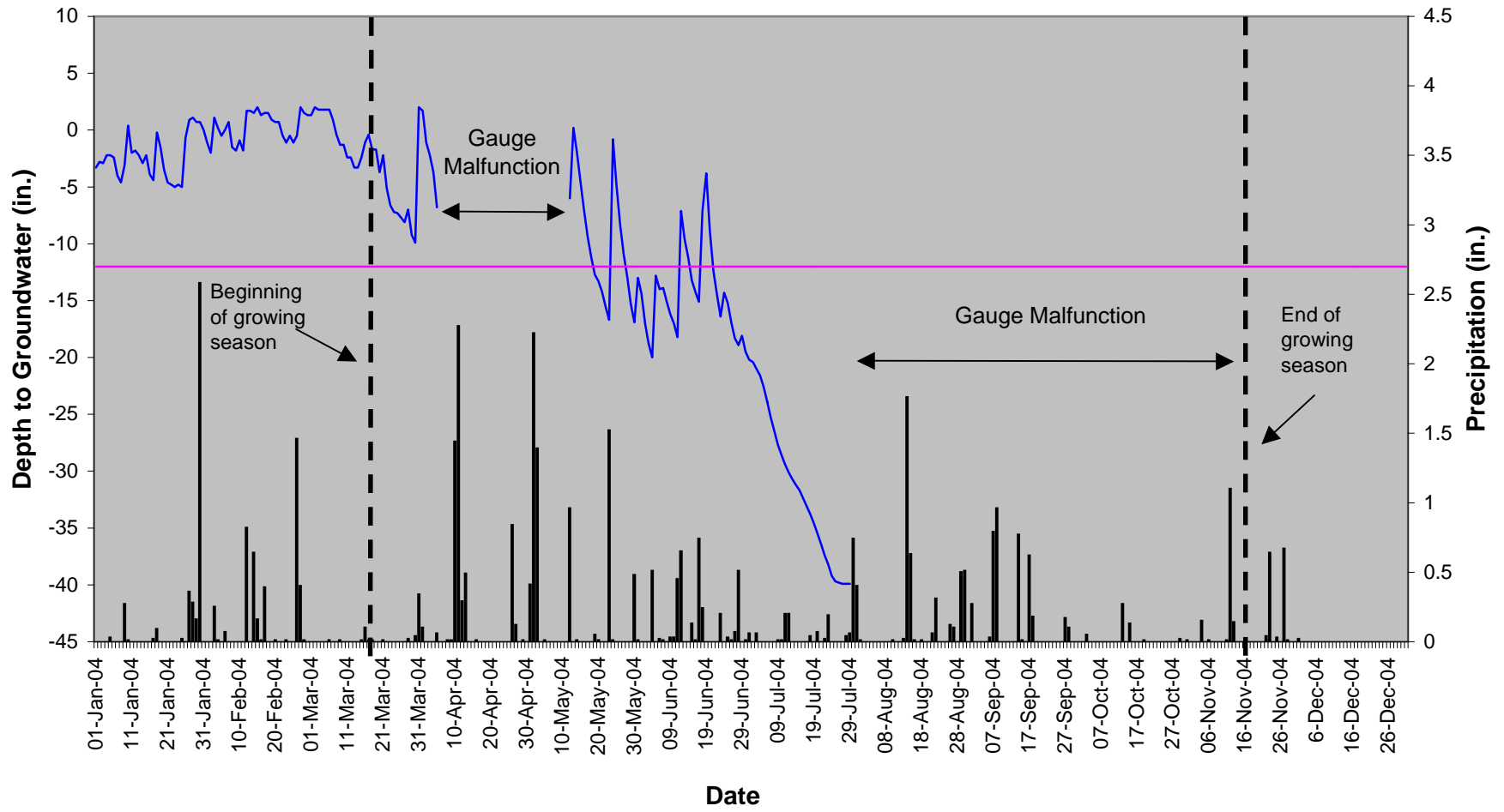
Dowd Dairy Farm - Gauge G20



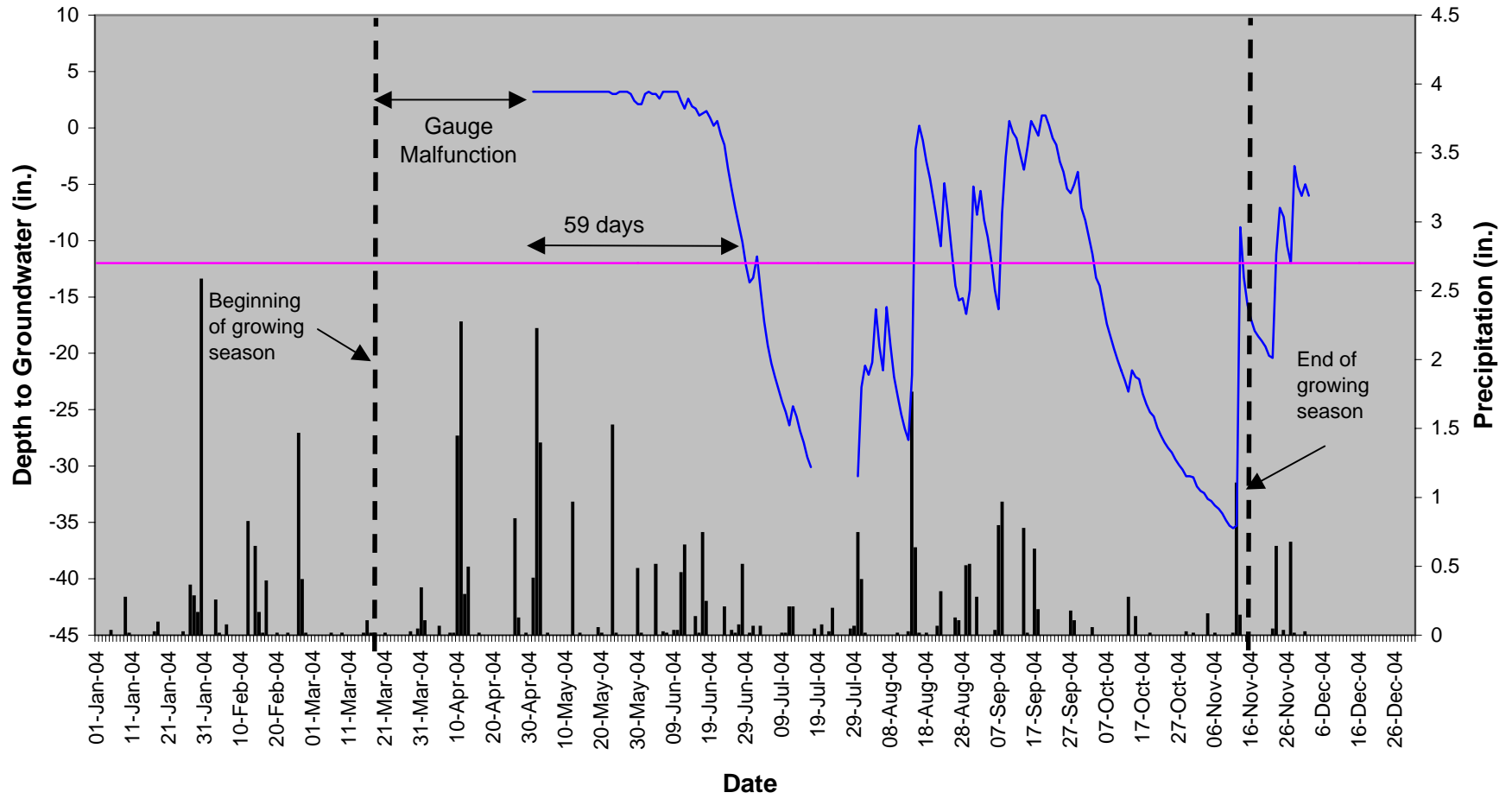
Dowd Dairy Farm - Gauge G21



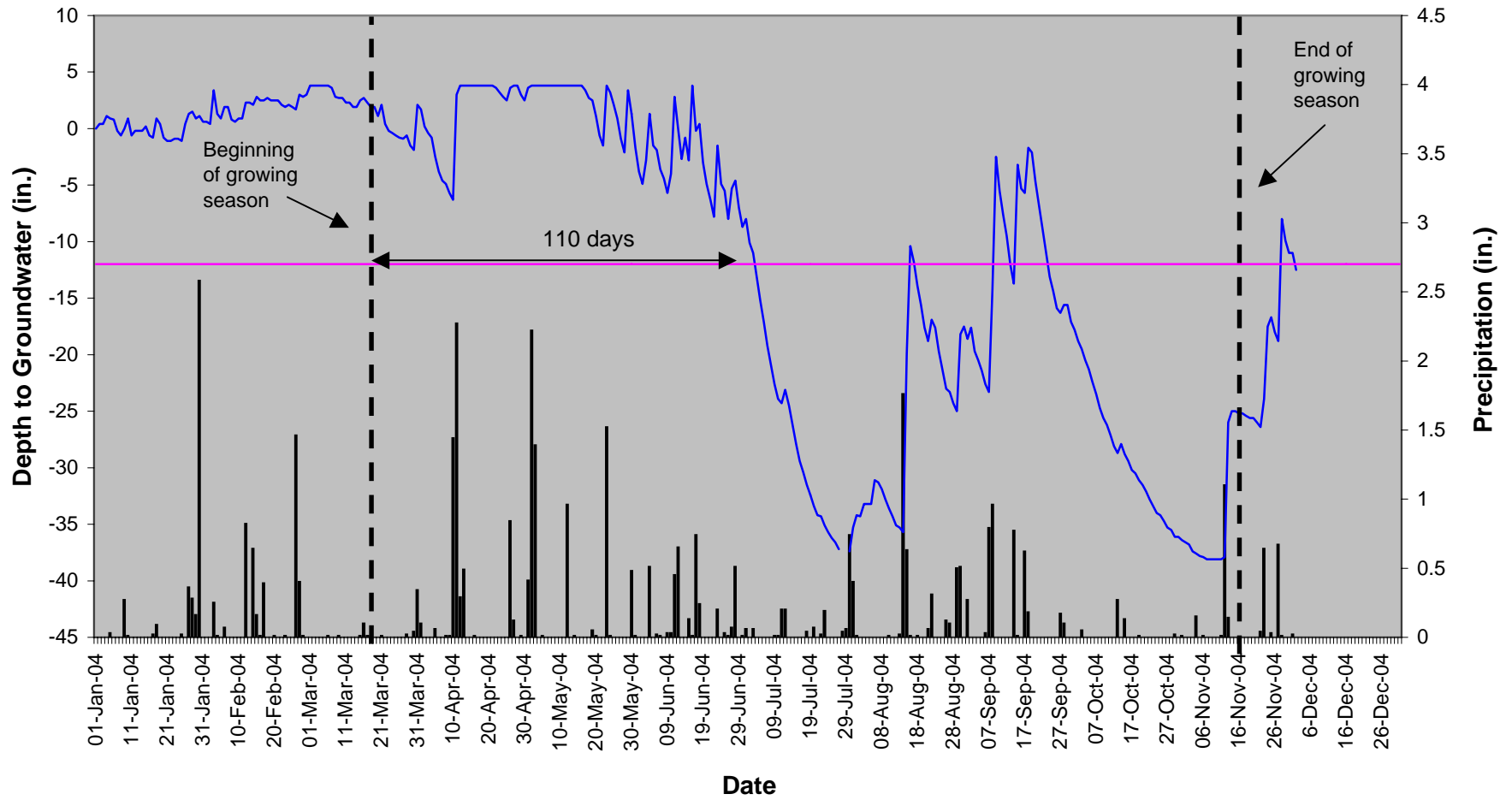
Dowd Dairy Farm - Gauge G22



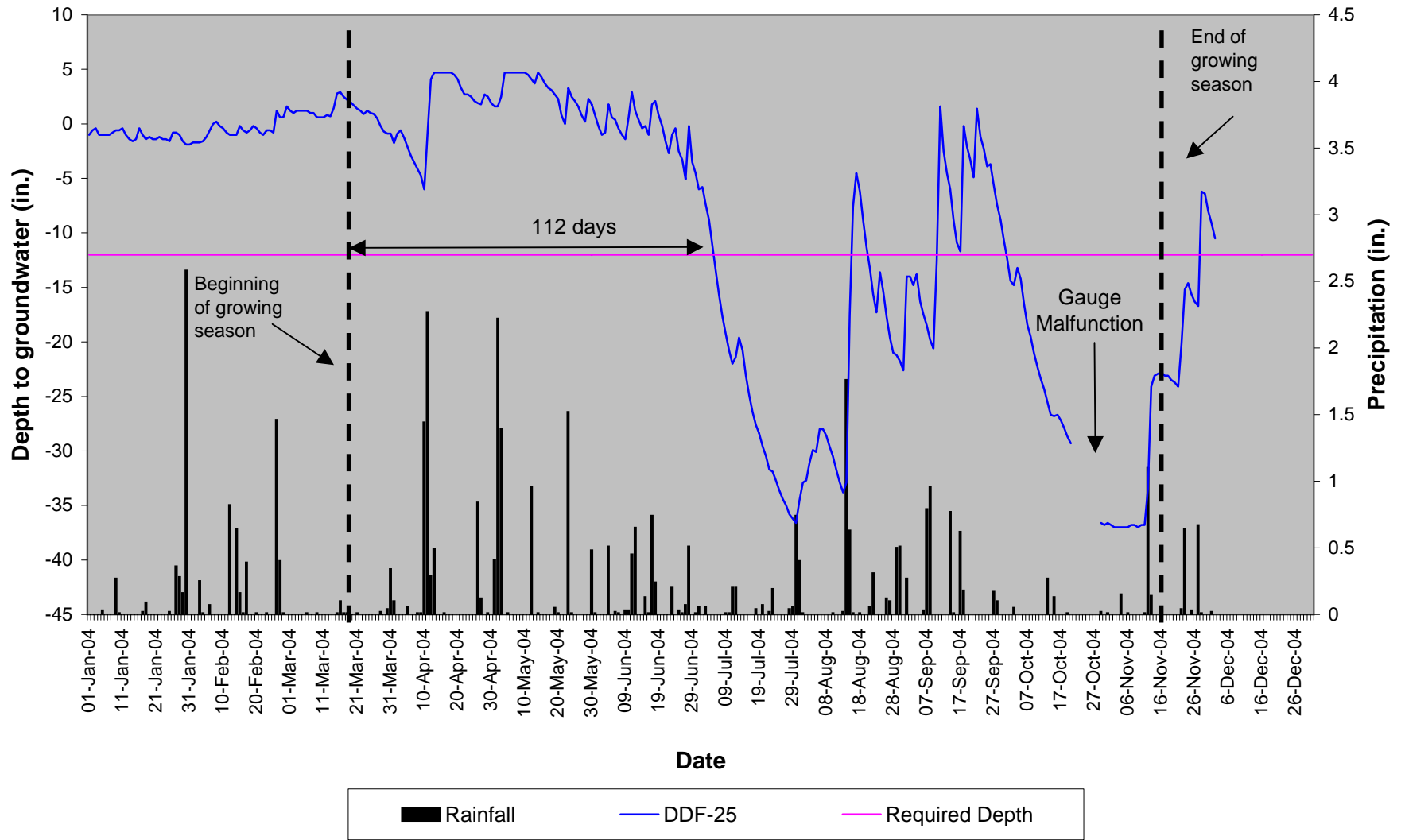
Dowd Dairy Farm - Gauge G23



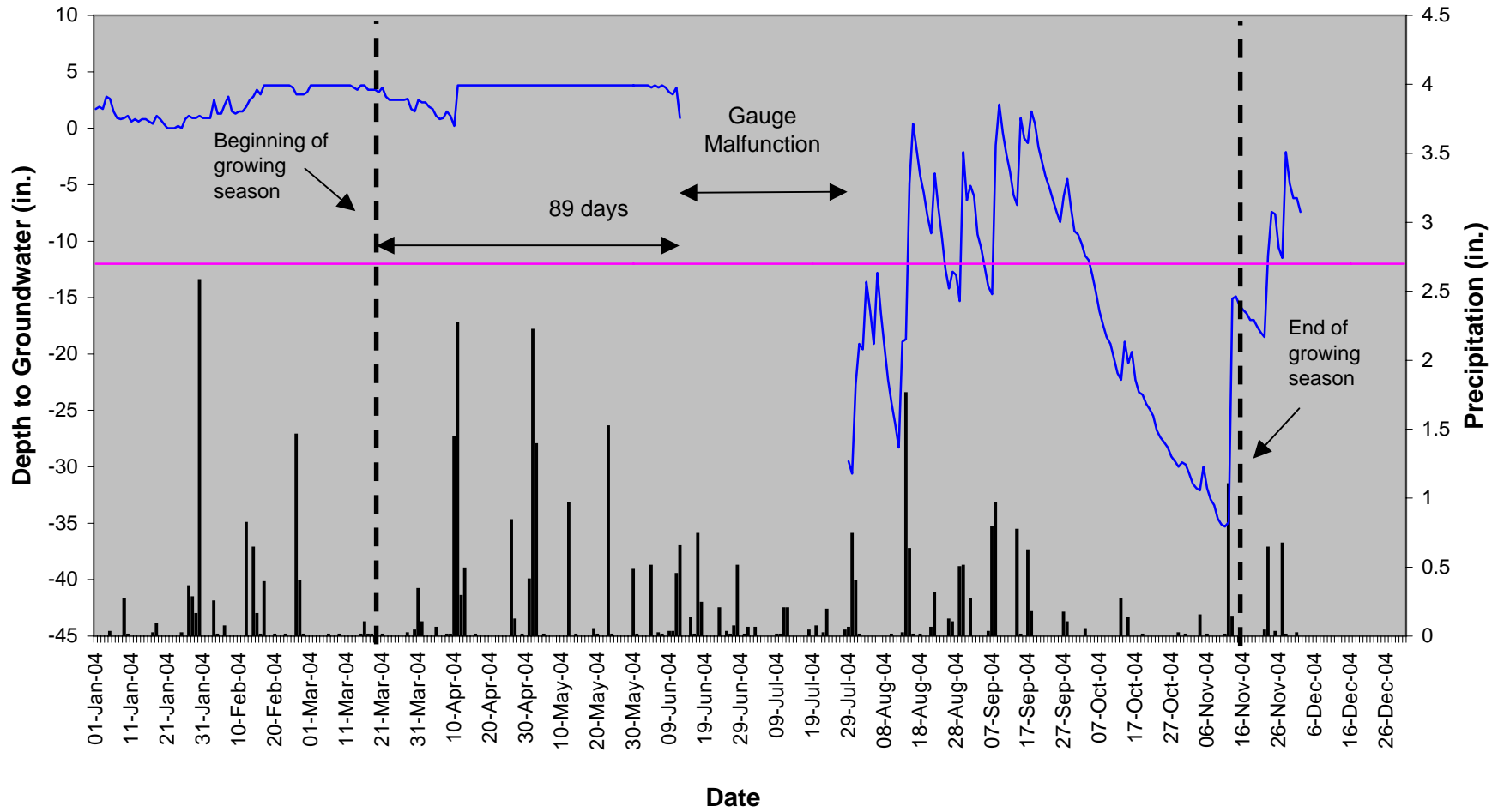
Dowd Dairy Farm - Gauge G24



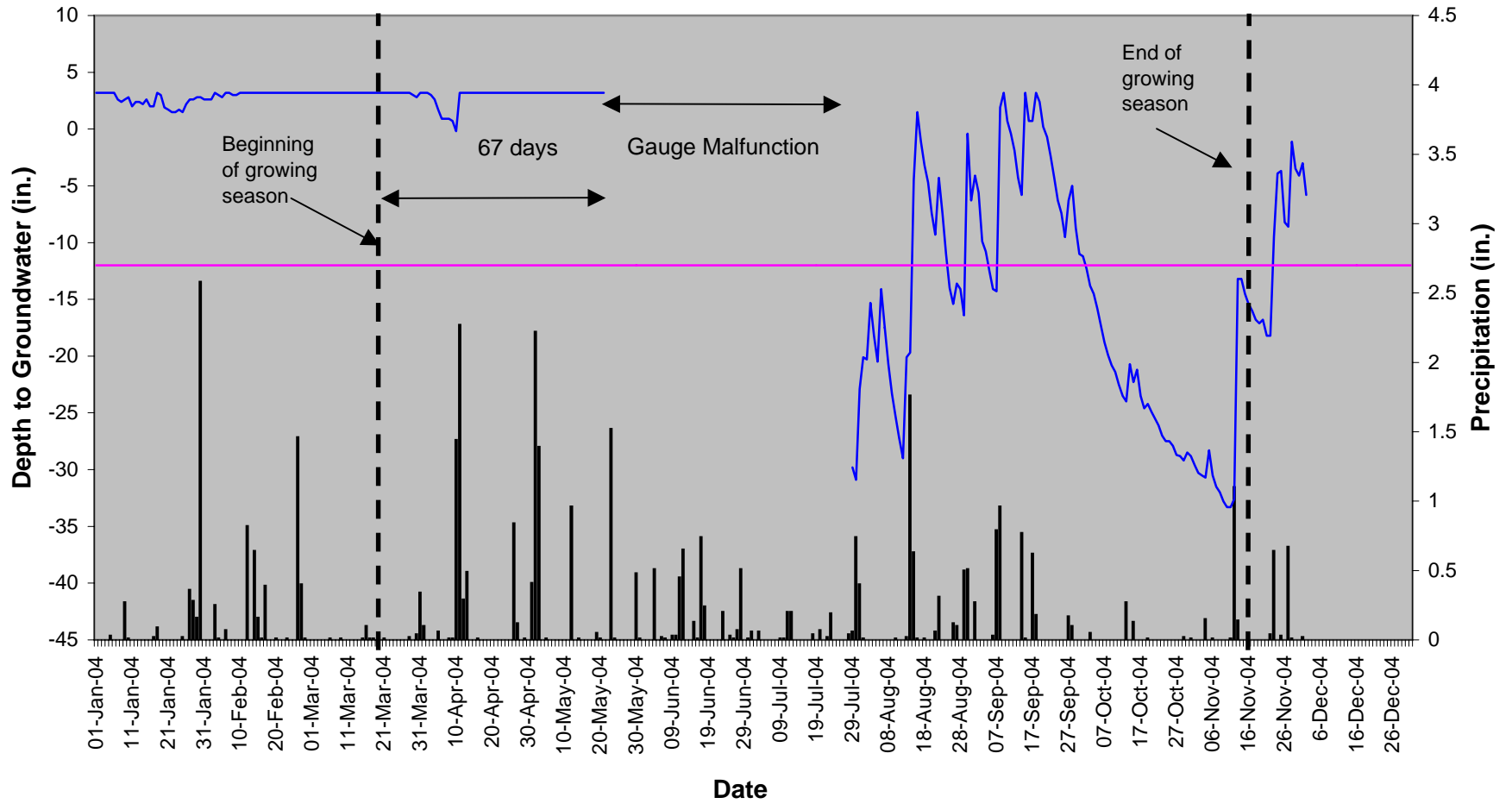
Dowd Dairy Farm - Gauge G25



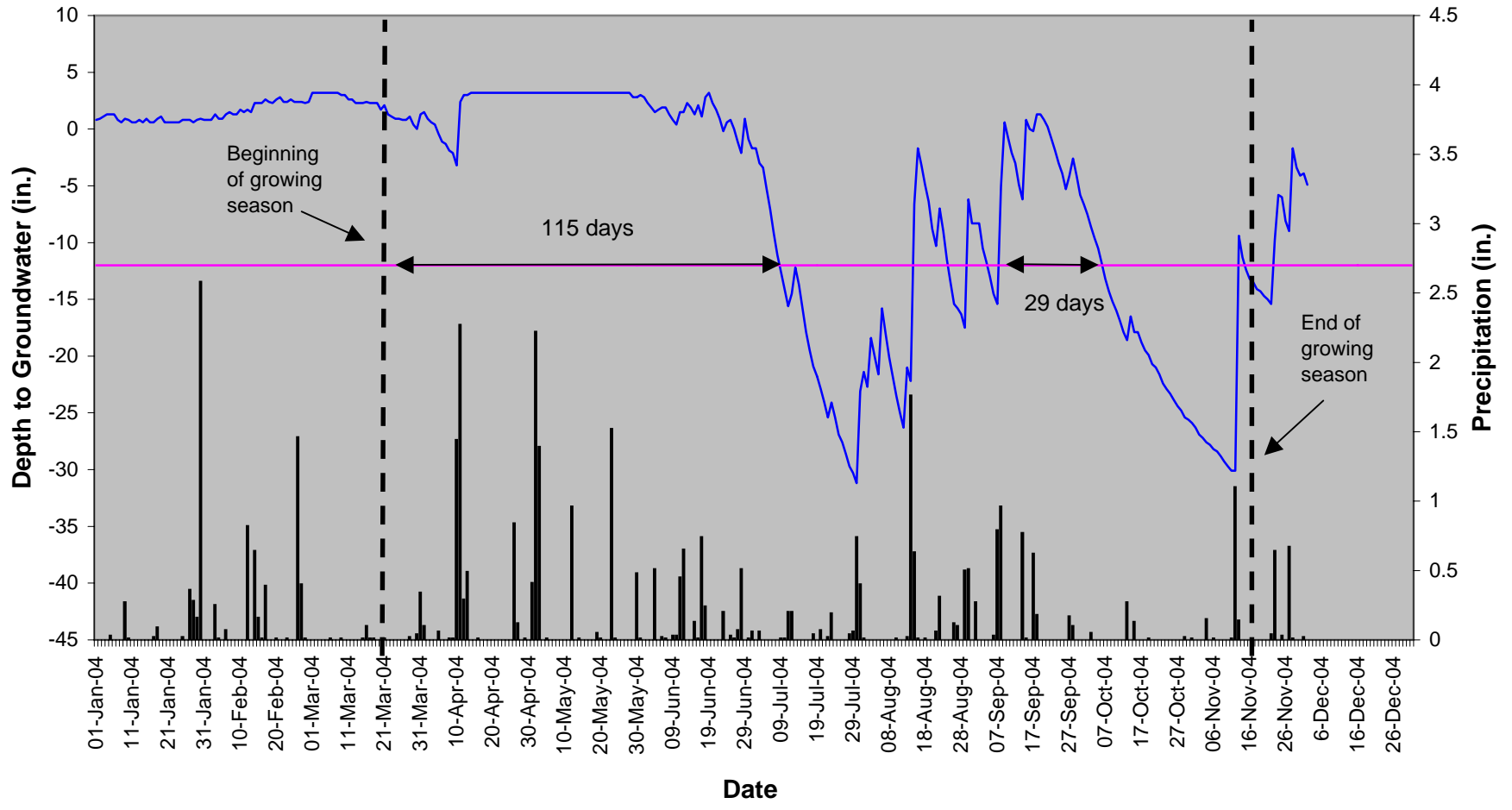
Dowd Dairy Farm - Gauge G26



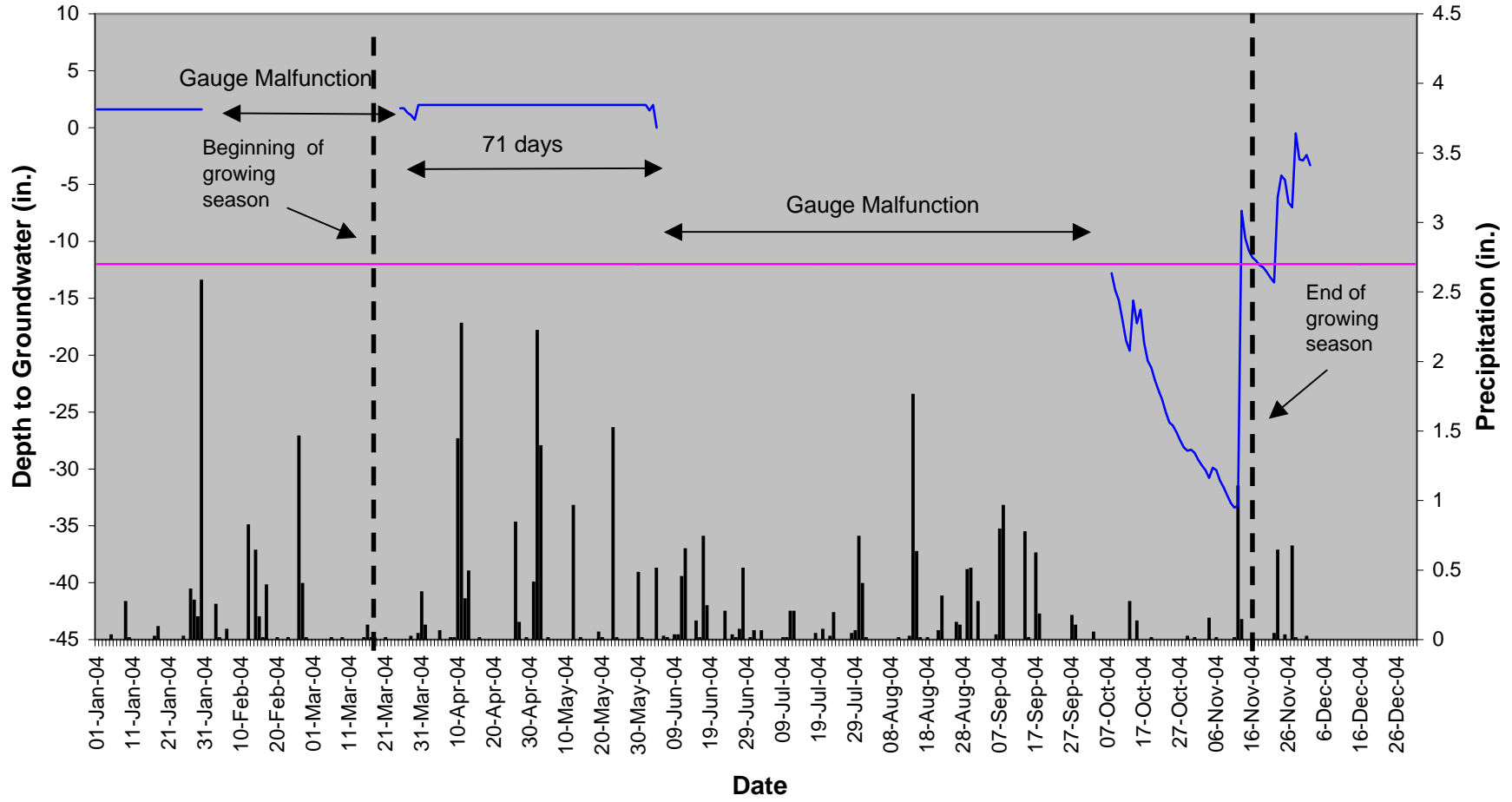
Dowd Dairy Farm - Gauge G27



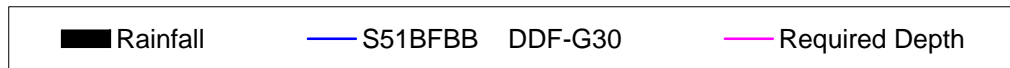
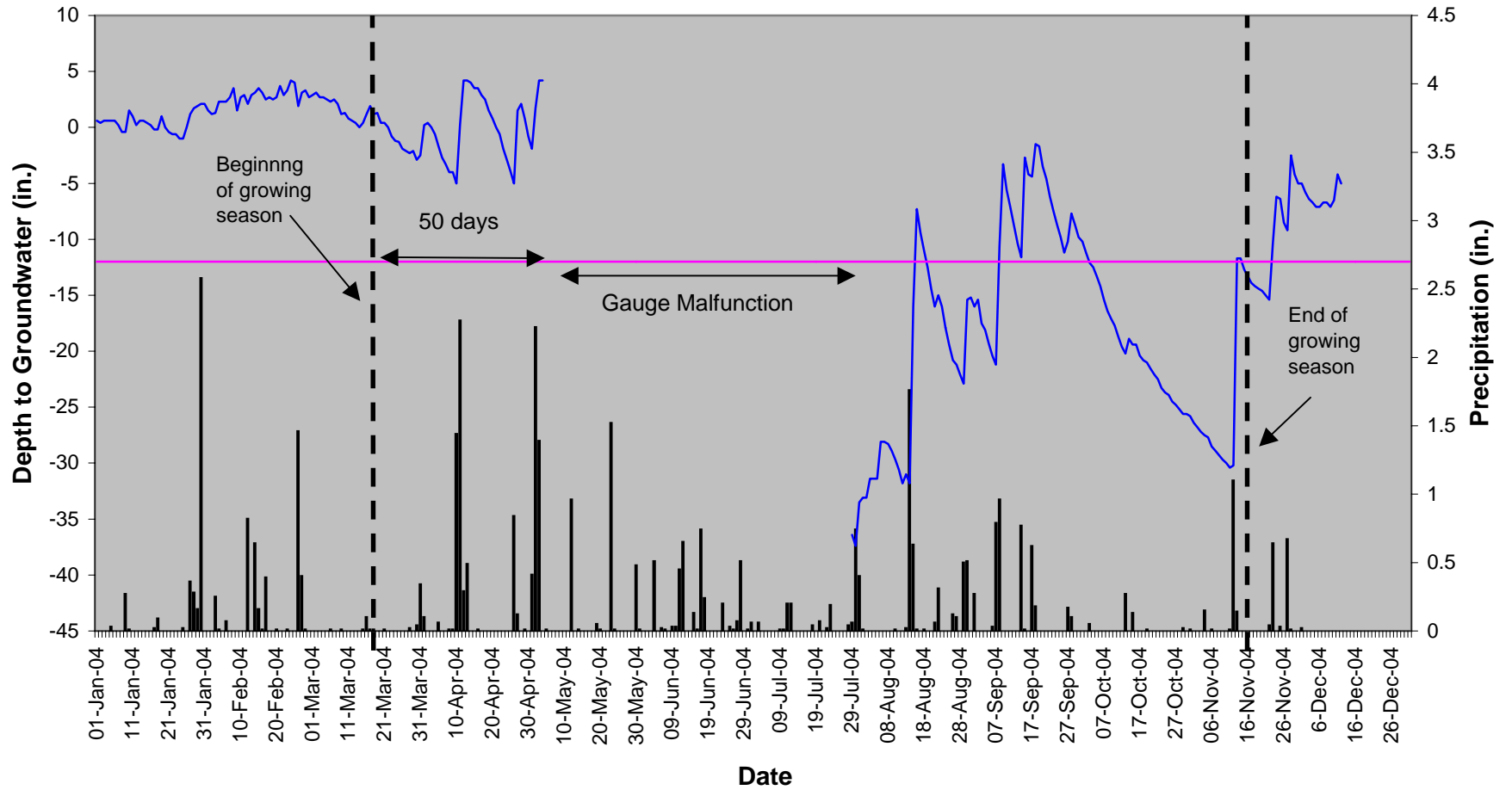
Dowd Dairy Farm - Gauge G28



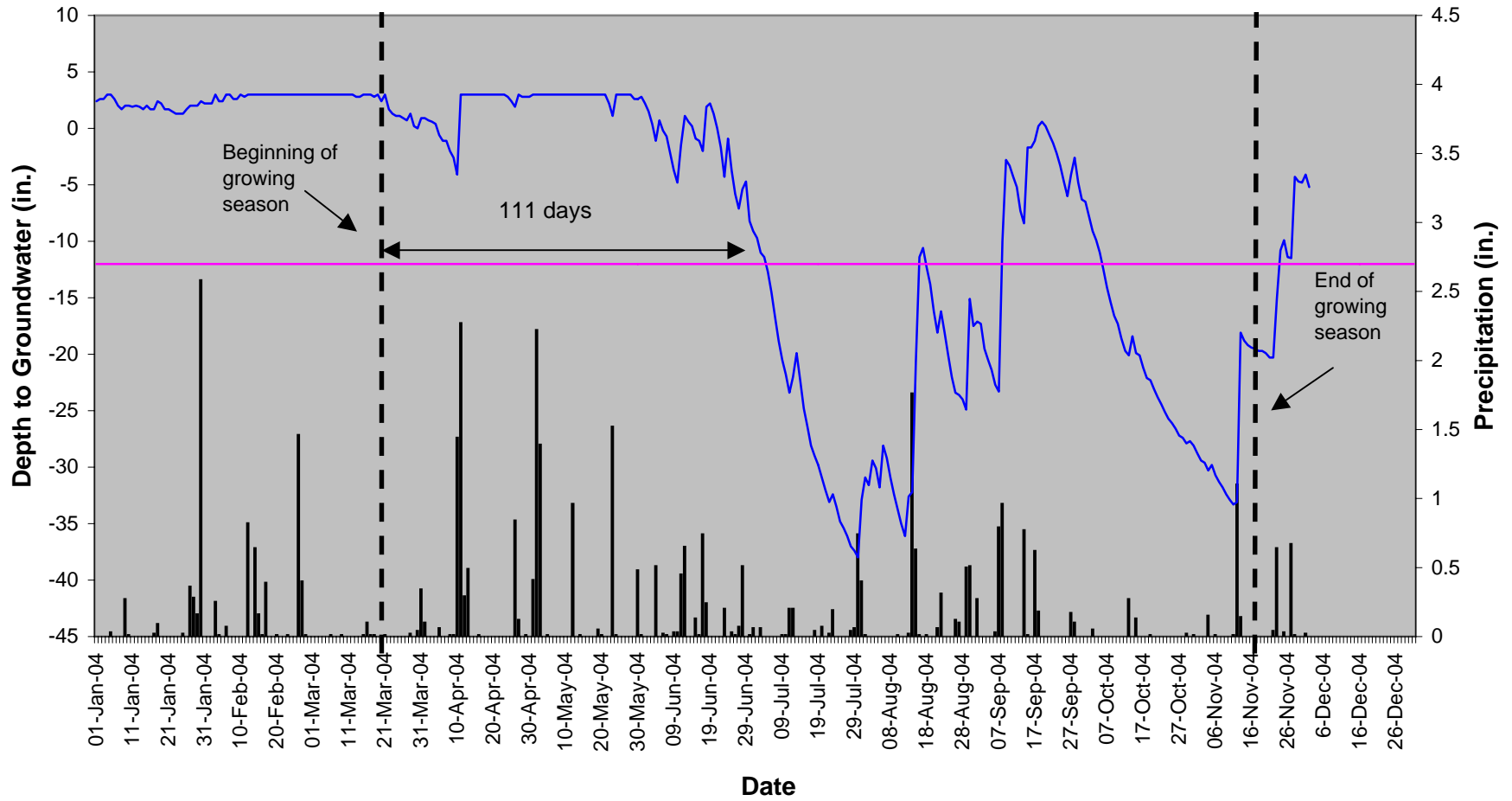
Dowd Dairy Farm - Gauge G29



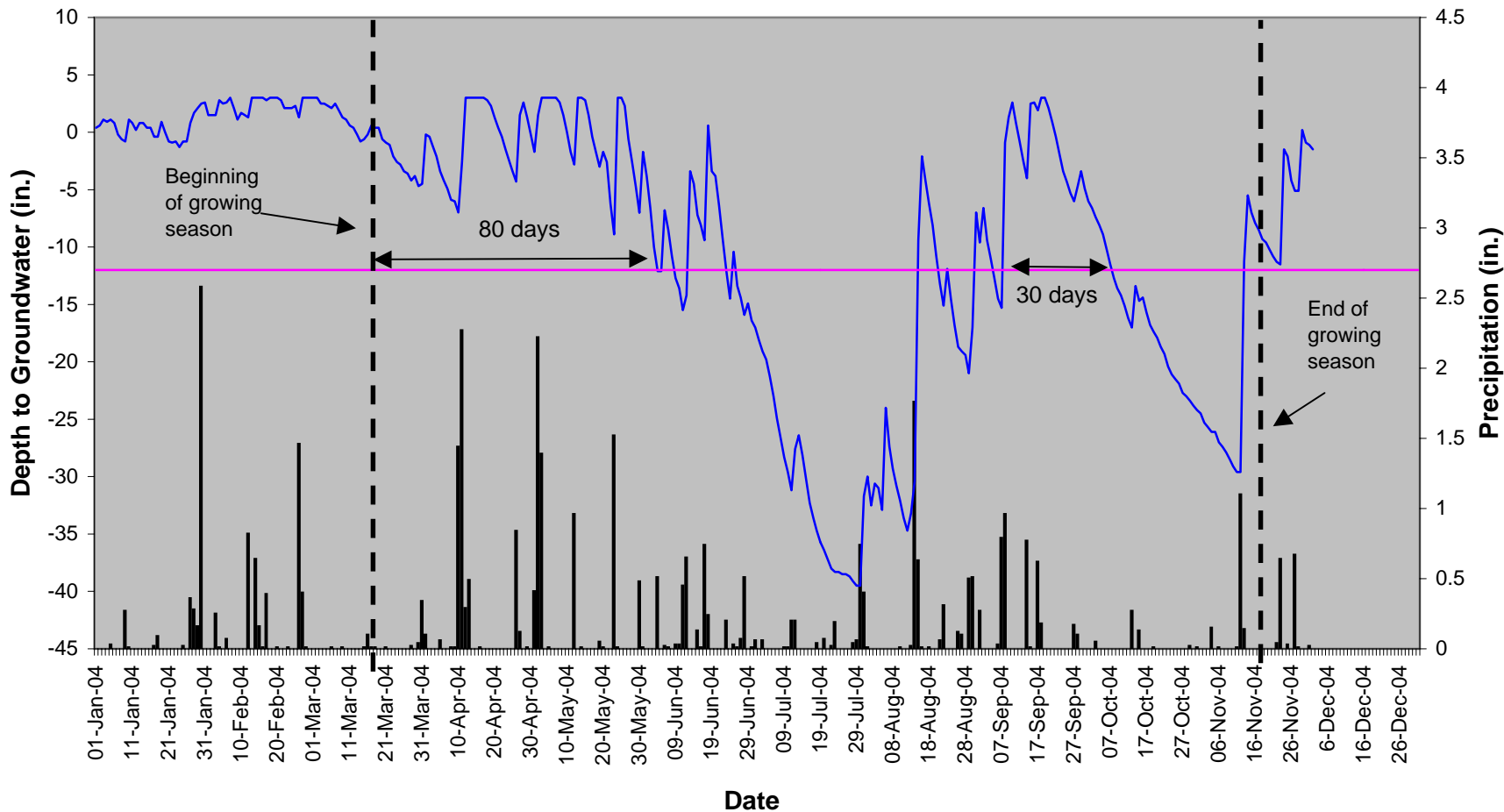
Dowd Dairy Farm - Gauge G30



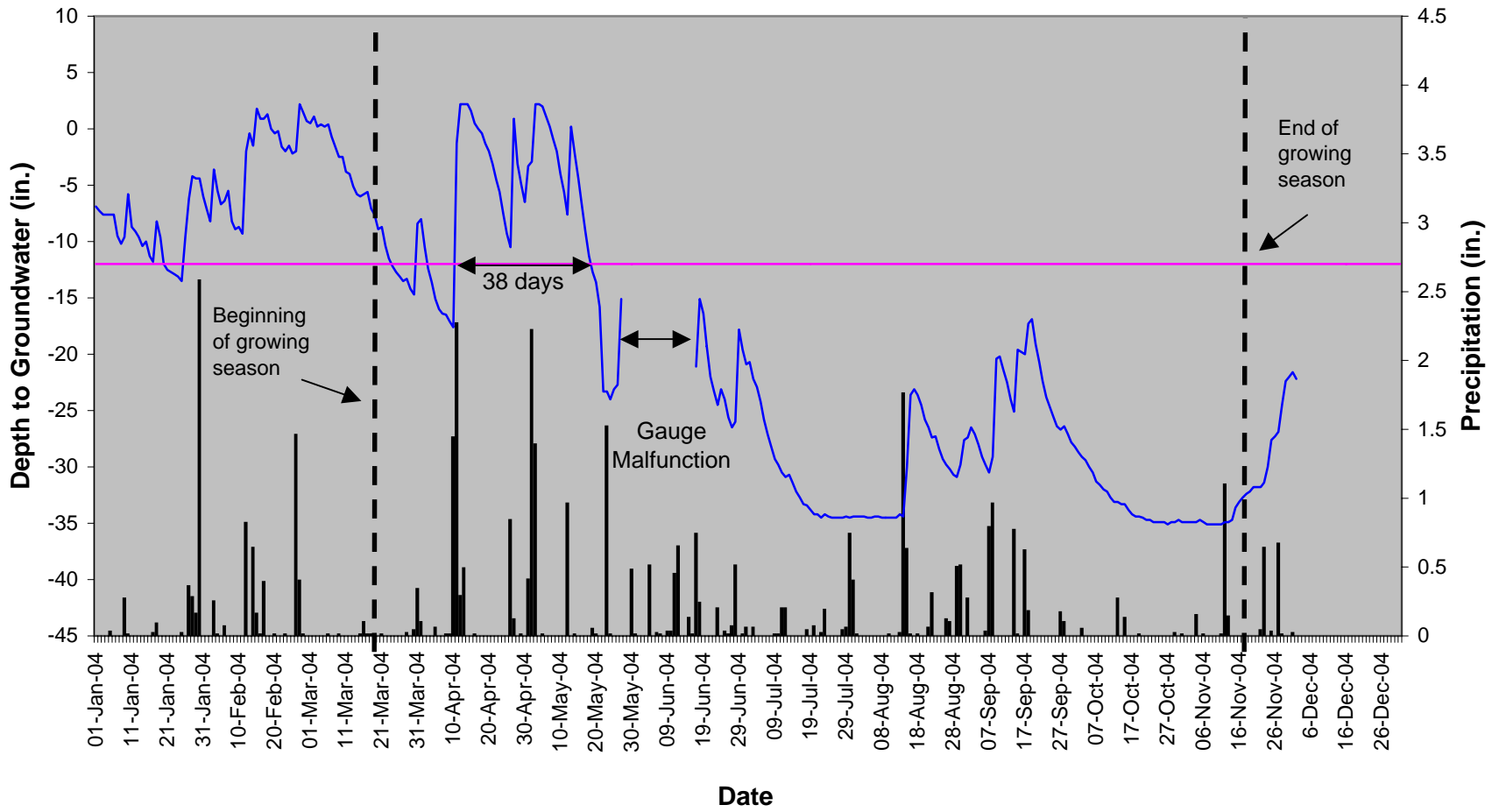
Dowd Dairy Farm - Gauge G31



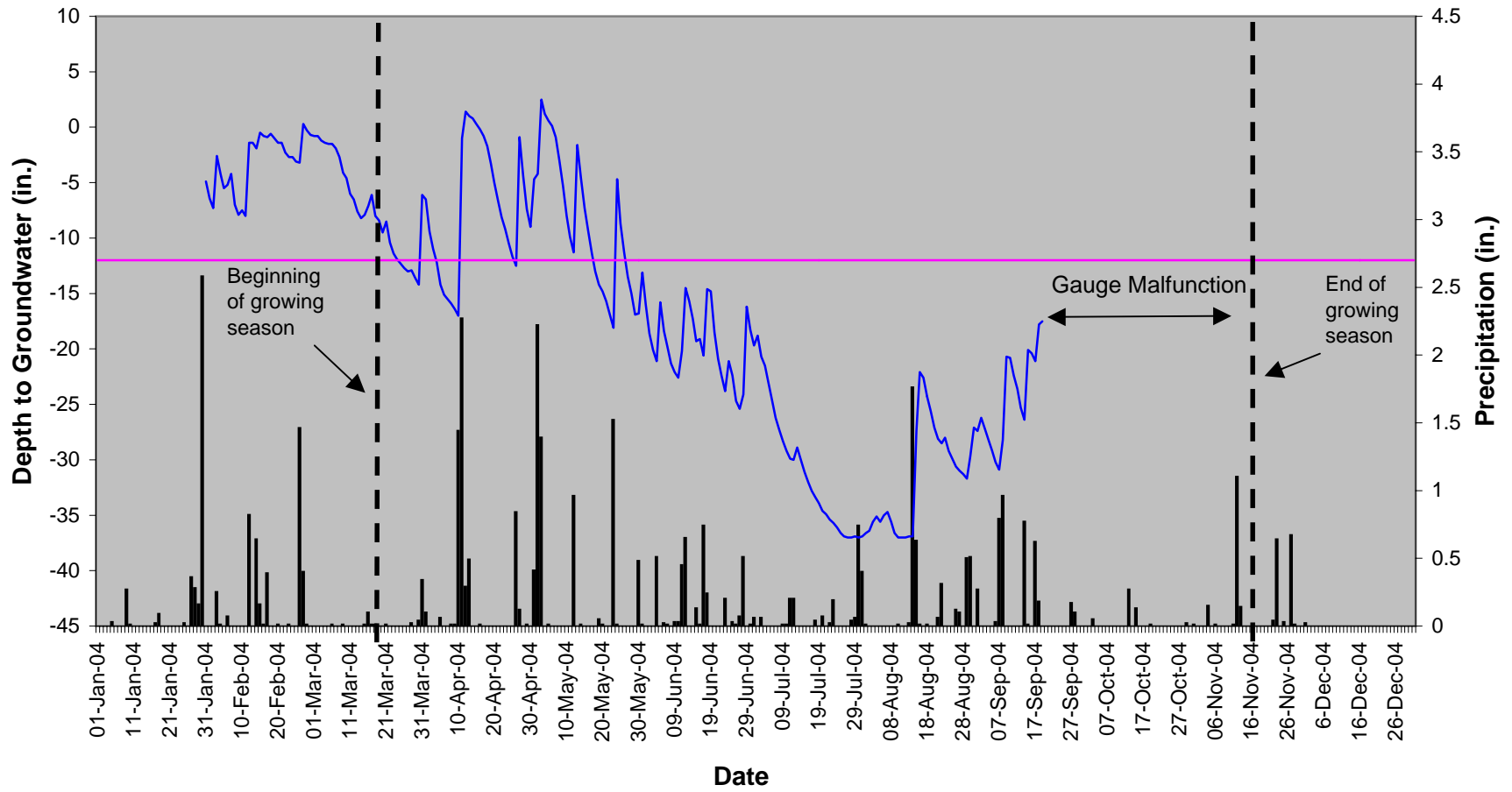
Dowd Dairy Farm - Gauge G32



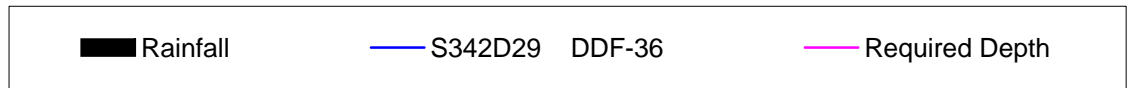
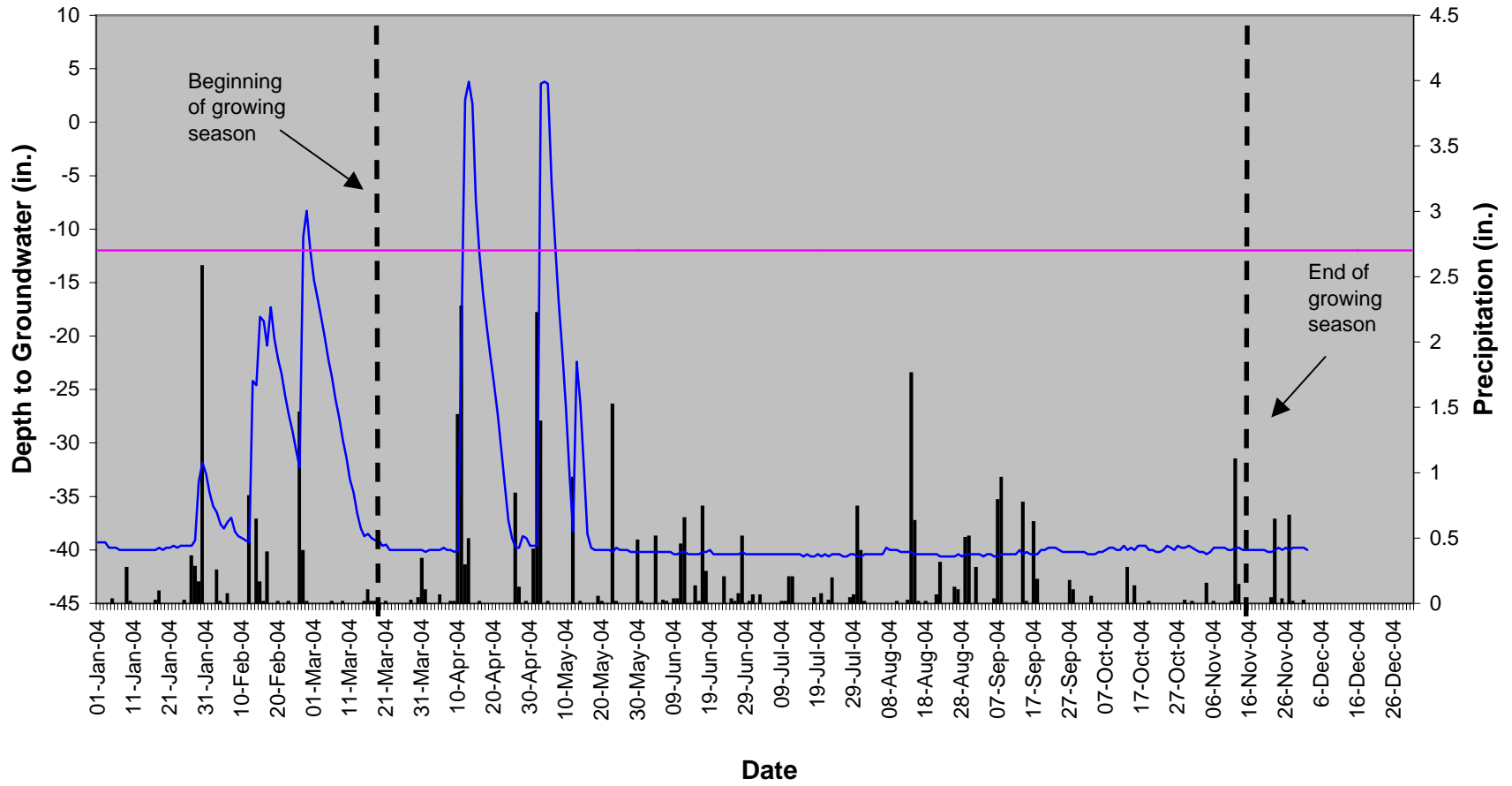
Dowd Dairy Farm - Gauge G34



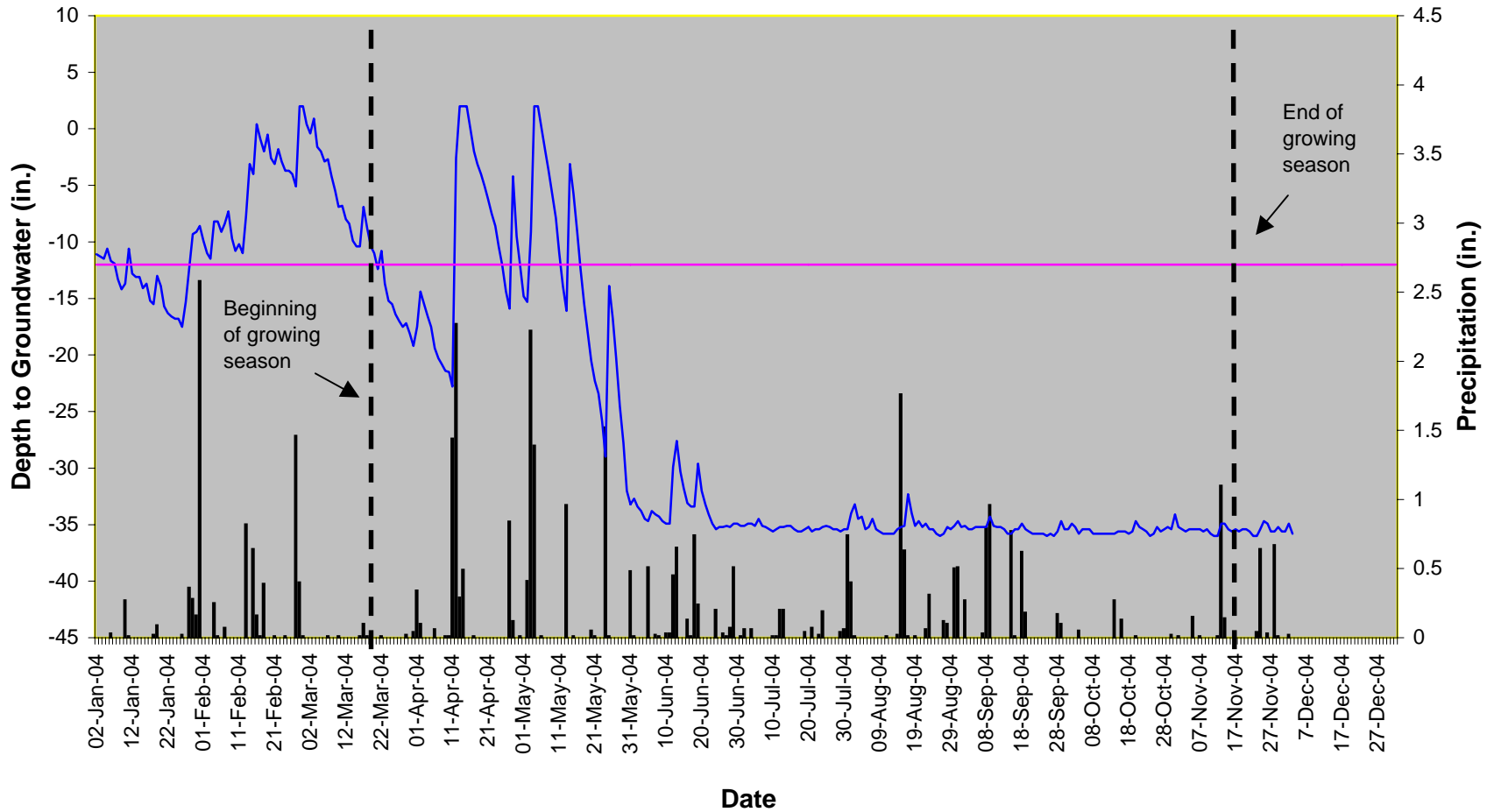
Dowd Dairy Farm - Gauge G35



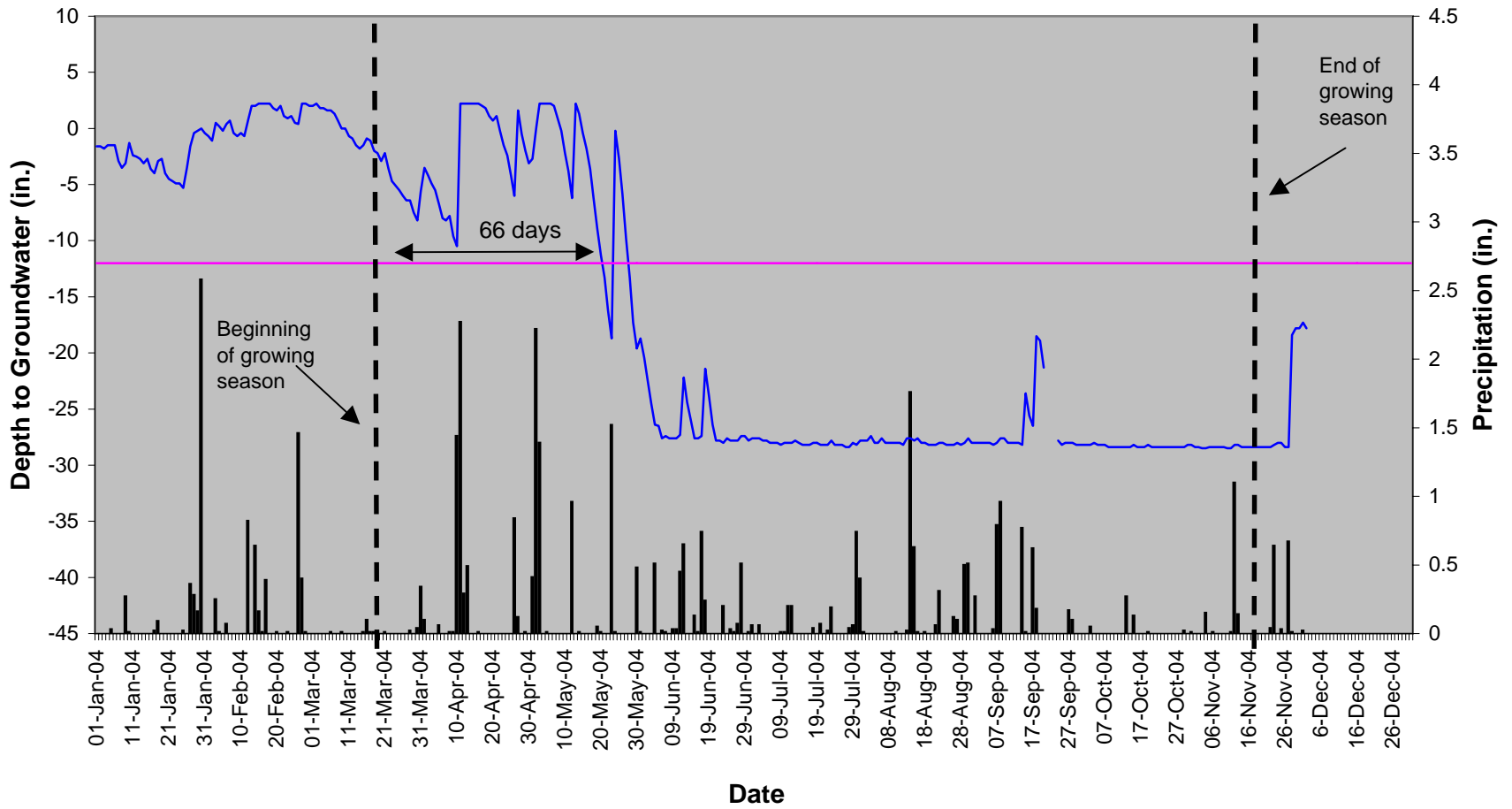
Dowd Dairy Farm - Gauge G36



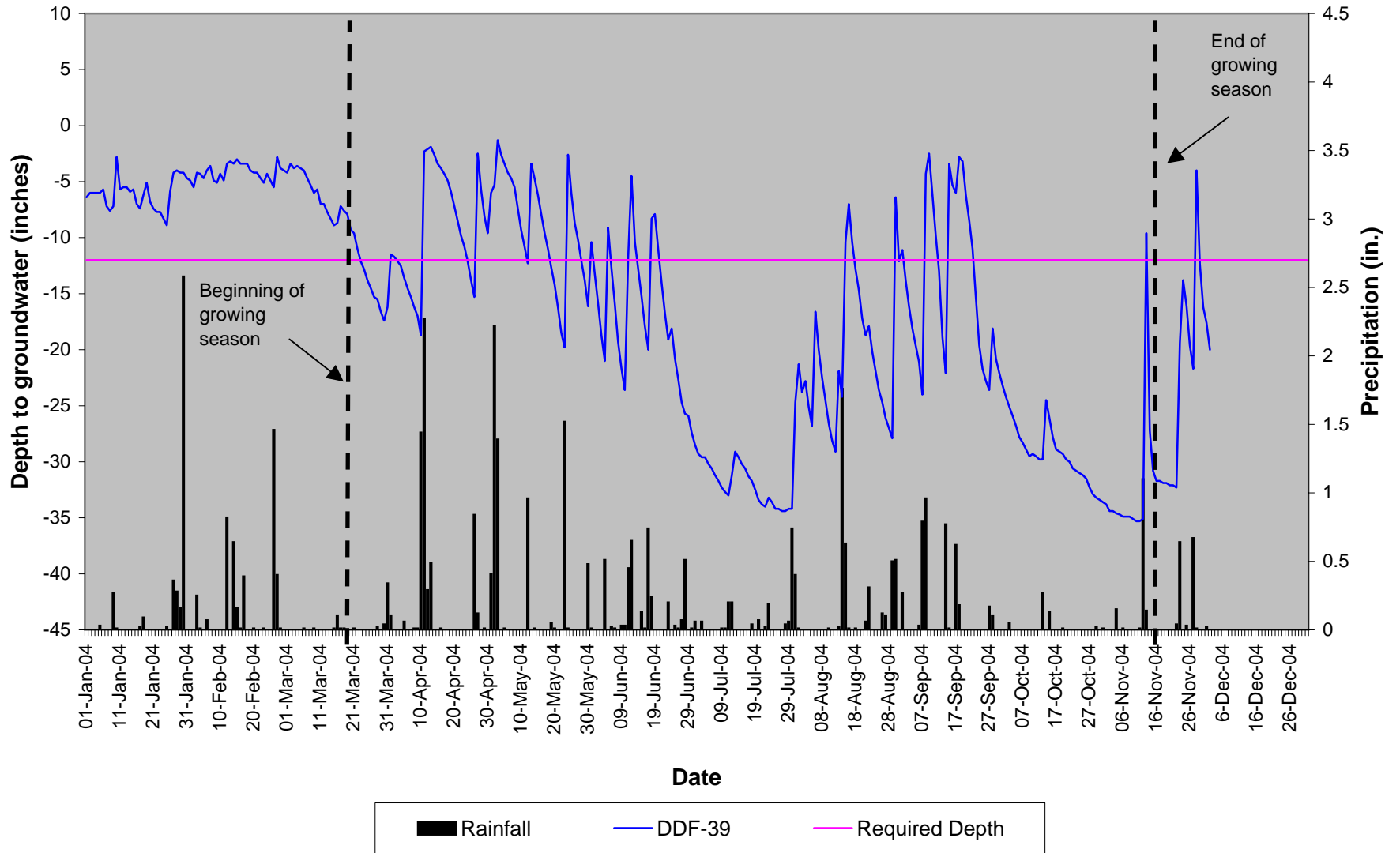
Dowd Dairy Farm - Gauge G37



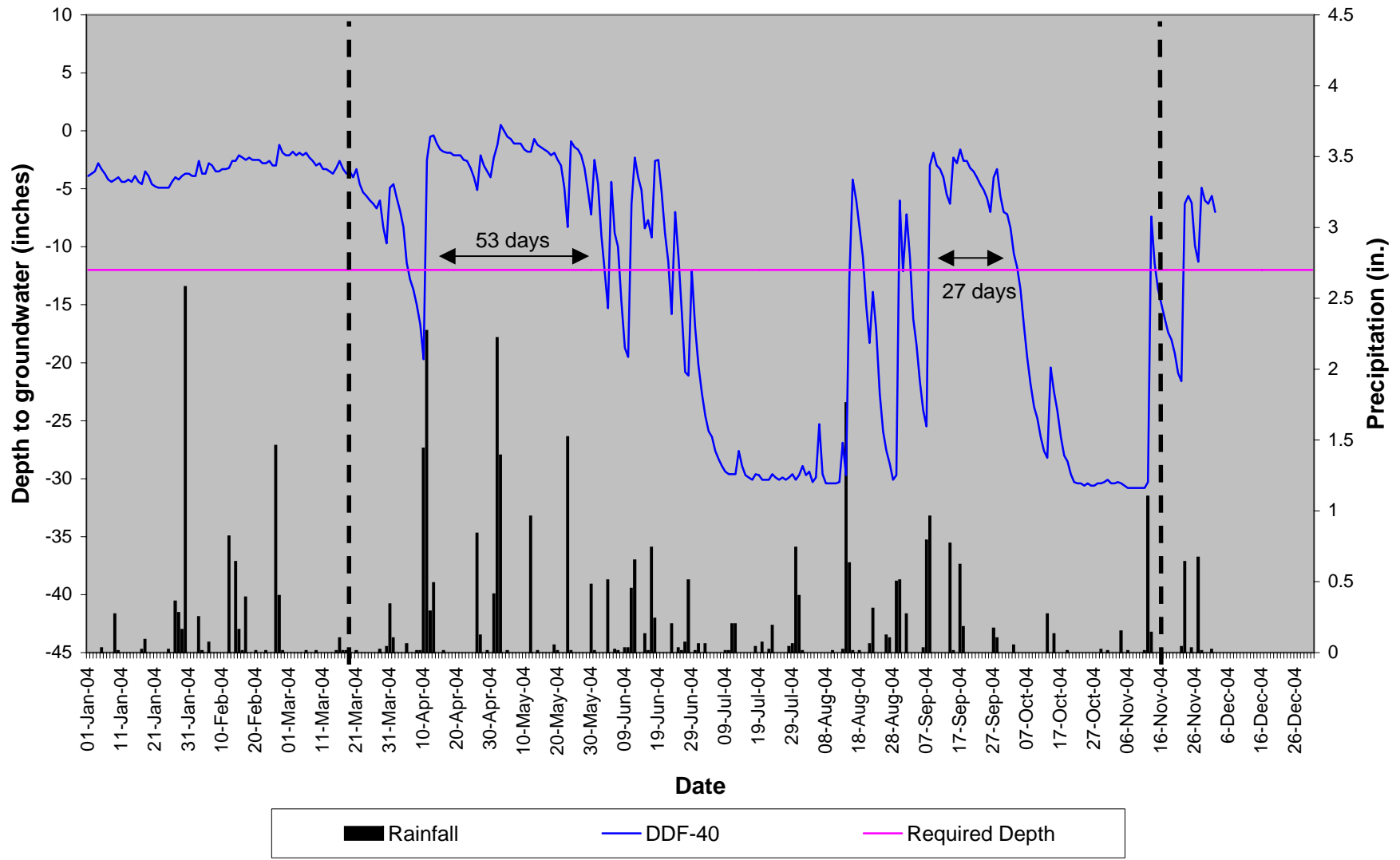
Dowd Dairy Farm - Gauge G38



Dowd Dairy Farm - Gauge G39



Dowd Dairy Farm - Gauge G40



APPENDIX B

SITE PHOTOS PHOTO AND VEGETATION PLOT LOCATIONS

DOWD DAIRY



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6

2004

DOWD DAIRY



Photo 7



Photo 8



Photo 9



Photo 10



Photo 11



Photo 12

DOWD DAIRY



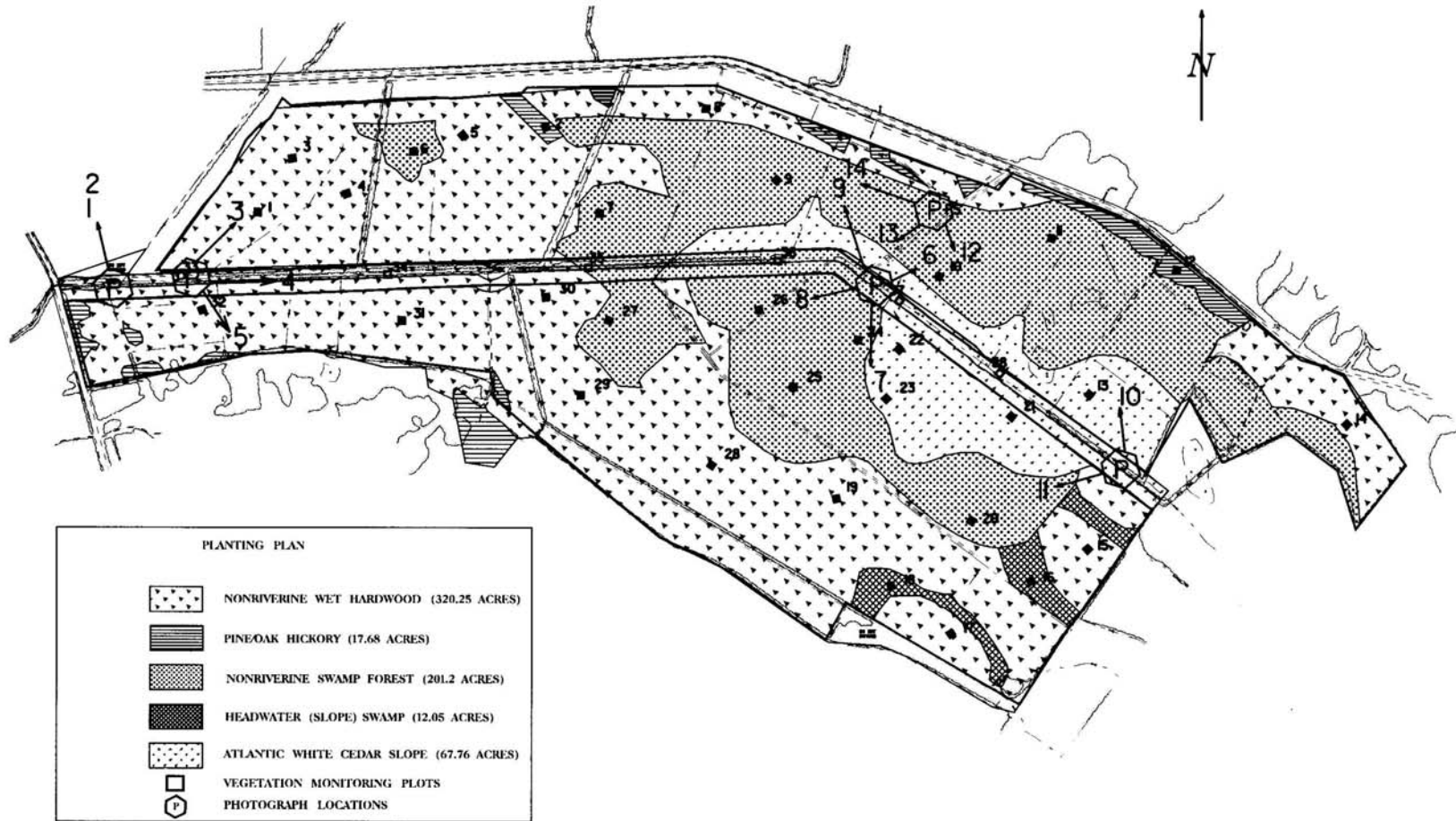
Photo 13



Photo 14

PROJECT REFERENCE NO. R-2204W	SHEET NO. MAP-1
RDW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

**BLADEN COUNTY, NORTH CAROLINA
DOWD DAIRY FARM MONITORING
PLANTING ZONES, VEGETATION PLOT, AND PHOTO LOCATIONS**



DATE PLOTTED: 11/11/11