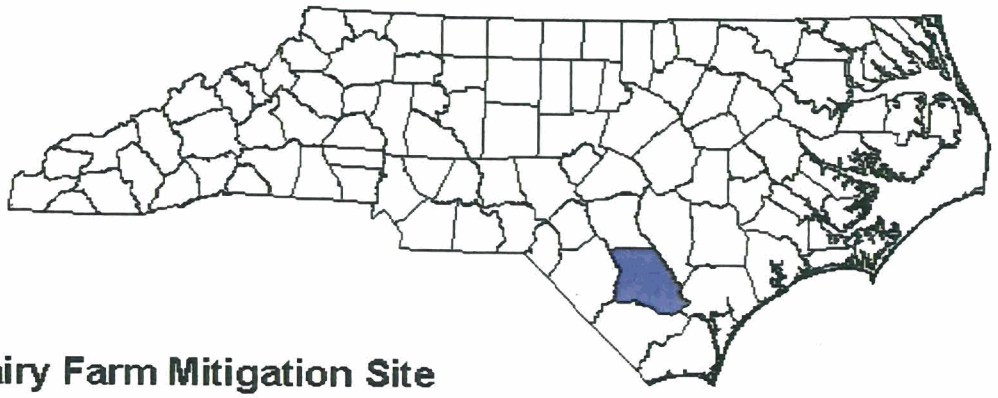
ANNUAL REPORT FOR 1999



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

Prepared By:
Natural Systems Unit &
Roadside Environmental Unit
North Carolina Department of Transportation
December 1999

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SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Dowd Dairy Farm Mitigation Site. Phase 1 of this site was constructed in 1998. Monitoring activities in 1999 represent the first year of monitoring following construction. The site must demonstrate hydrologic and vegetation success for a minimum of five years or until the project is deemed successful.

The site contains thirty-one groundwater monitoring wells and 32 vegetation plots.

One major change in the hydrologic monitoring process is the use of local weather station rainfall data for the site analysis. The daily rainfall on the well data graphs is recorded at a rain gauge at the William O. Huske location (Bladen County), maintained by the NC State Climate Office. This data is being used because past on-site rainfall gauges have proven unreliable. These site gauges will be replaced with more reliable equipment prior to the start of the 2000 growing season.

Hydrologic monitoring indicated that the site is performing poorly. For 1999 under normal conditions, one of 31 wells met jurisdictional hydrologic success of at least 12.5% of the growing season, while thirteen wells met success below 5% of the season. Conditions of hydrologic monitoring did improve considerably due to several hurricanes beginning in September of this year, with twenty-three of the wells meeting success of at least 12.5% of the season. Vegetation monitoring yielded a successful stem count in all of the planting transects; the average density was 550, well above the requirement of 320 trees per acre.

While the results under "normal conditions" are not considered favorable, it must be taken into account that Phase 2 construction (filling of the central canal) will play a critical role in raising the water table on the site.

Based on the monitoring results from the 1999 growing season, NCDOT recommends that hydrologic and vegetation monitoring continue.

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. So far, the site is targeted to provide mitigation for two TIP Projects, R-2238 (USACE Action ID No. 199302820) and R-2562AA/AB (USACE Action ID No. 199304806).

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 1999 at the Dowd Dairy Farm Mitigation Site.

1.3 Project History

Summer 1998	Construction – Phase 1
Spring 1999	Tree Planting – Phase 1
February – April 1999	Installation of Monitoring Wells
July 1999	Construction begins – Phase 2
November 1999	Vegetation Monitoring (1 yr.)

Phase 1 construction consisted of clearing, grubbing, ripping, filling lateral ditches, and adding ditch plugs. Phase 2 construction will consist of filling in the central canal. Construction was originally to be completed by early 2000. However, due to the saturated conditions from the hurricane activity this fall, construction has been delayed. The new anticipated completion date is July 2000.

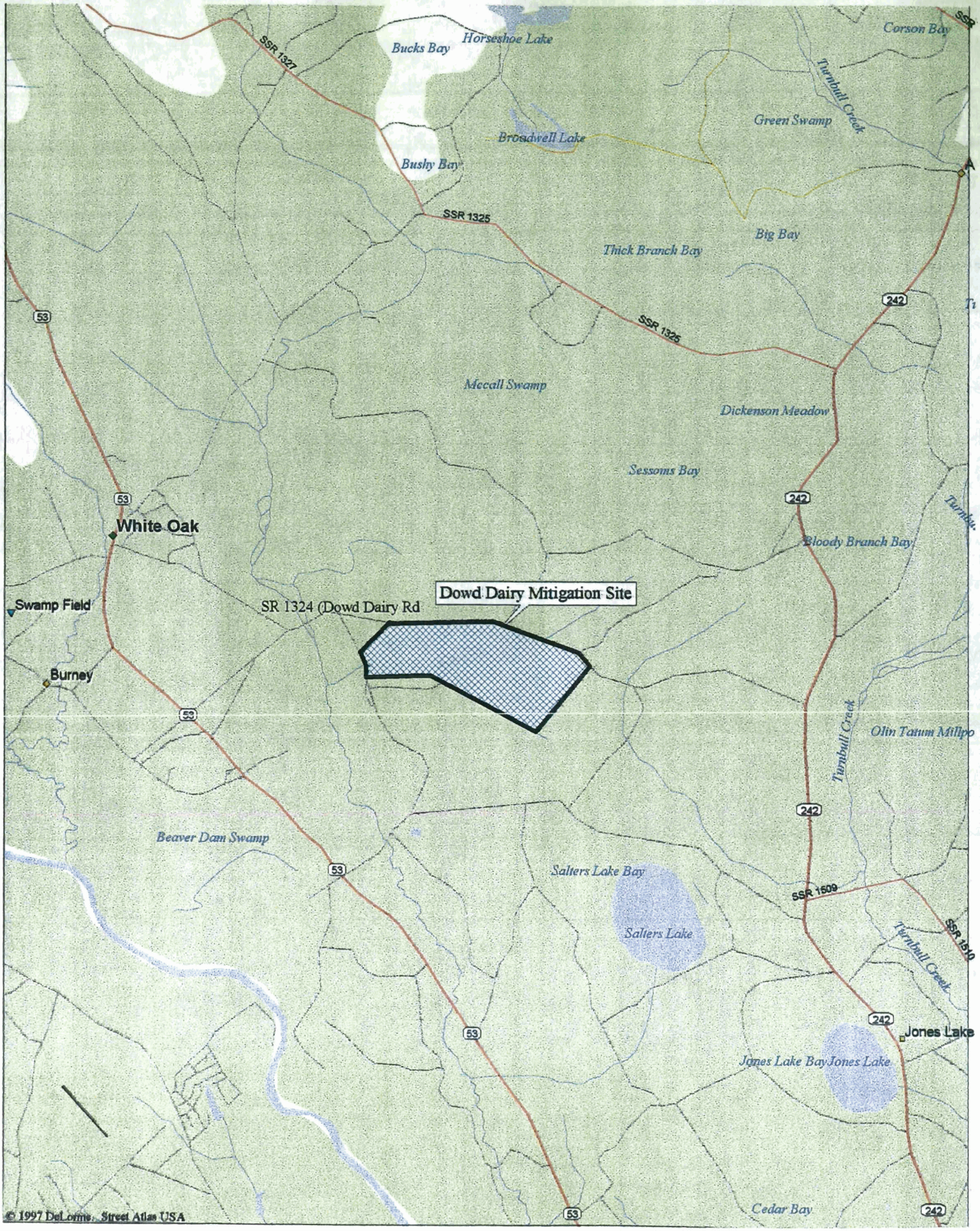

FIGURE 1
SITE LOCATION MAP

2.0 HYDROLOGY

2.1 Success Criteria

In accordance with federal guidelines for wetland mitigation, the success criteria for hydrology states that the area must be inundated or saturated (within 12" of the surface) by surface or ground water 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. The 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 wells and two rain gauges were installed in 1999 (Figure 2). The rain gauges and monitoring wells recorded daily readings of rainfall and depth to groundwater, respectively.

Appendix A contains a plot of the groundwater depth for each monitoring well. Data determined to be erroneous was omitted; therefore, some gaps appear in the plots. Precipitation events are included on each graph as bars. The rainfall plotted is the daily rainfall recorded by a rain gauge located near the Bladen/Cumberland County line, rather than the onsite rain gauges. These onsite gauges will be replaced with more reliable equipment prior to the start of the 2000 growing season.

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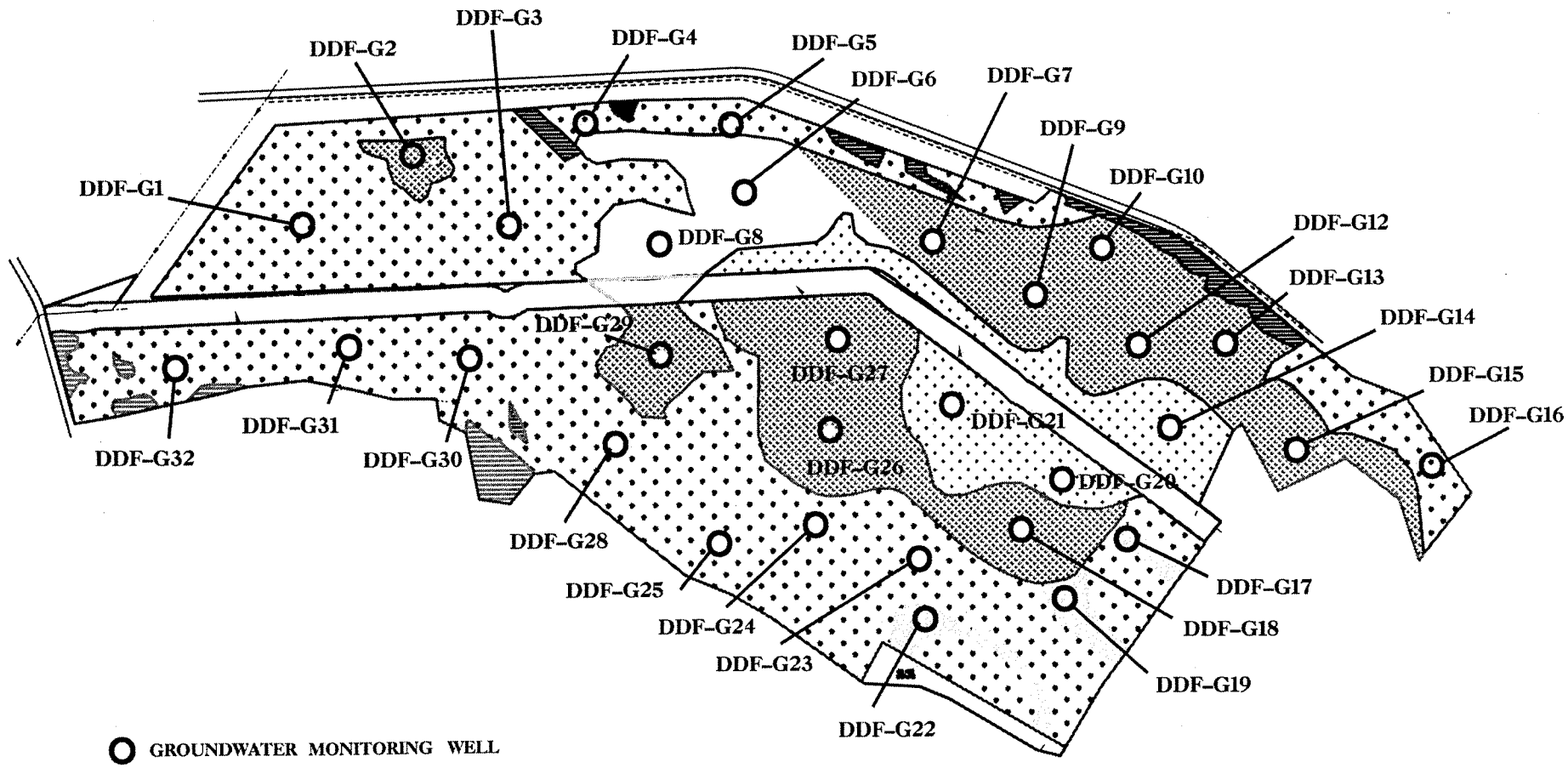
[1] Natural Resources Conversation Service, Soil Survey of Bladen County, North Carolina, p. 123.

FIGURE 2: DOWD DAIRY FARM MITIGATION SITE MONITORING WELL LOCATIONS



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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 well. This number was converted into a percentage of the 243-day growing season. Tables 1A and 1B present the 1999 results.

Appendix A contains a plot of the groundwater depth for each monitoring well and the surface water depth recorded by the surface gauge. The maximum number of consecutive days is noted on each graph.

Several hurricanes inundated the site with precipitation beginning in September of this year. Because this additional precipitation was not considered "normal conditions" and greatly affected the monitoring results, the well data on this site was divided into two time periods: (1) conditions prior to hurricane activity, and (2) conditions during and after hurricane activity. Tables 1A and 1B reflect the two time periods.

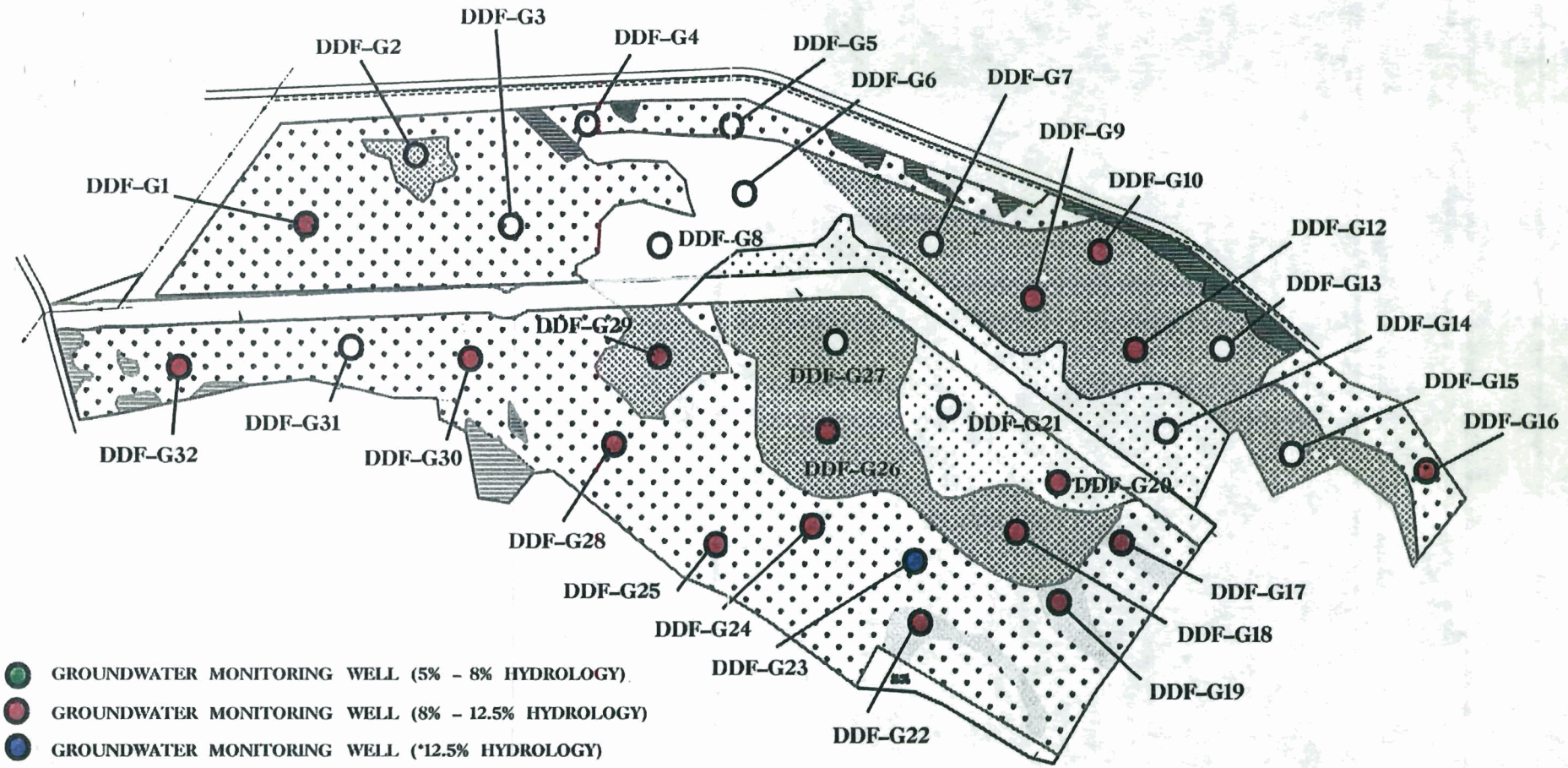
Table 1A

1999 HYDROLOGIC MONITORING RESULTS –
CONDITIONS PRIOR TO HURRICANE ACTIVITY
(MARCH 16,1999 – AUGUST 31,1999)

Monitoring Well	< 5% (<12 dy)	5 - 8% (12-19 dy)	8 – 12.5% (20-30 dy)	> 12.5% (>31 dy)	Actual %	Dates Meeting Success
DDF-G1			✓		11.5	4/30 – 5/27
DDF-G2	✓				.8	5/2 – 5/3
DDF-G3	✓				2.1	5/1 – 5/5
DDF-G4	✓				.8	5/1 – 5/2
DDF-G5	✓				0	
DDF-G6	✓				0	
DDF-G7	✓				2.1	5/1 – 5/5
DDF-G8	✓				.4	5/2
DDF-G9			✓		9.1	4/30 – 5/21
DDF-G10			✓		11.9	3/16 – 4/13
DDF-G12			✓		11.5	3/16 – 4/12
DDF-G13	✓				.8	5/1 – 5/2
DDF-G14	✓				2.1	5/1 – 5/5
DDF-G15	✓				4.5	3/16 – 4/14
DDF-G16			✓		12.3	4/16 – 5/14
DDF-G17			✓		9.1	4/30 – 5/21
DDF-G18			✓		11.5	3/16 – 4/12
DDF-G19			✓		10.7	4/29 – 5/24
DDF-G20			✓		9.1	5/1 – 5/22
DDF-G21	✓				3.7	5/2 – 5/10
DDF-G22			✓		10.7	4/29 – 5/24
DDF-G23				✓	13.6	3/16 – 4/17
DDF-G24			✓		10.7	3/16 – 4/10
DDF-G25			✓		10.7	3/16 – 4/10
DDF-G26			✓		8.6	5/1 – 5/21
DDF-G27	✓				4.1	5/1 – 5/10
DDF-G28			✓		12.3	4/30 – 5/29
DDF-G29			✓		11.9	5/1 – 5/29
DDF-G30			✓		11.5	3/16 – 4/12
DDF-G31	✓				3.7	5/1 – 5/9
DDF-G32			✓		11.5	3/16 – 4/12

Figure 3A is a graphical representation of the hydrologic monitoring results for this earlier time period of 1999. A blue dot represents wetland hydrology for more than 12.5% of the season; a red dot indicates hydrology between 8% and 12.5%; a green dot represents hydrology between 5% and 8%.

FIGURE 3A: DOWD DAIRY FARM MITIGATION SITE
1999 MONITORING RESULTS
CONDITIONS PRIOR TO HURRICANE ACTIVITY



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For this time period from March through August, only one of the thirty-two wells met jurisdictional hydrologic success of at least 12.5% during the growing season. Conversely, thirteen wells met hydrology of less than 5% of the growing season. A majority of the wells (17) fell between 8% and 12.5%.

Table 1B

1999 HYDROLOGIC MONITORING RESULTS –
CONDITIONS DURING AND AFTER HURRICANE ACTIVITY
(SEPTEMBER 1, 1999 – NOVEMBER 14, 1999)

Monitoring Well	< 5% (<12 dy)	5 - 8% (12-19 dy)	8 – 12.5% (20-30 dy)	> 12.5% (>31 dy)	Actual %	Dates Meeting Success
DDF-G1*				✓	12.8	9/1 – 10/1
DDF-G2*			✓		11.9	9/3 – 10/1
DDF-G3		✓			7.4	10/12 – 10/29
DDF-G4	✓				3.2	10/17 – 10/24
DDF-G5			✓		10.2	9/16 – 10/10
DDF-G6				✓	23.0	9/16 – 11/10
DDF-G7				✓	24.7	9/16 – 11/14
DDF-G8				✓	24.7	9/16 – 11/14
DDF-G9				✓	24.7	9/16 – 11/14
DDF-G10				✓	25.1	9/15 – 11/14
DDF-G12				✓	24.7	9/16 – 11/14
DDF-G13	✓				2.5	10/17 – 10/22
DDF-G14				✓	24.7	9/16 – 11/14
DDF-G15			✓		9.1	9/16 – 10/6
DDF-G16				✓	25.1	9/15 – 11/14
DDF-G17				✓	24.7	9/16 – 11/14
DDF-G18				✓	24.7	9/16 – 11/14
DDF-G19				✓	24.7	9/16 – 11/14
DDF-G20				✓	24.7	9/16 – 11/14
DDF-G21				✓	24.7	9/16 – 11/14
DDF-G22				✓	25.1	9/15 – 11/14
DDF-G23				✓	24.7	9/16 – 11/14
DDF-G24				✓	24.7	9/16 – 11/14
DDF-G25				✓	24.7	9/16 – 11/14
DDF-G26				✓	24.7	9/16 – 11/14
DDF-G27				✓	24.7	9/16 – 11/14
DDF-G28*		✓			7.4	10/28 – 11/14
DDF-G29				✓	24.7	9/16 – 11/14
DDF-G30*		✓			7.8	10/27 – 11/14
DDF-G31				✓	24.7	9/16 – 11/14
DDF-G32				✓	25.1	9/15 – 11/14

* Wells that stopped functioning prior October 26 were repaired on that day. Therefore, hurricane data is incomplete for this time period.

Figure 3B is a graphical representation of the hydrologic monitoring results for this later time period of 1999. As mentioned before, a blue dot represents wetland hydrology for more than 12.5% of the season; a red dot indicates hydrology between 8% and 12.5%; a green dot represents hydrology between 5% and 8%.

For this time period from September through November, twenty-three of the thirty-two wells met jurisdictional hydrologic success of at least 12.5% during the growing season. Conversely, two wells met hydrology of less than 5% of the growing season.

2.3.2 Climatic Data

Figure 4 is a comparison of 1999 monthly rainfall to historical precipitation for the area. The two lines represent the 30th and 70th percentiles of monthly precipitation for William O. Huske L&D, NC. The bars are monthly rainfall totals for 1999. The historical data was collected from the National Climatic Data Center while the recent rainfall was provided by the State Climate Office of North Carolina. Because of data availability, the 1999 rainfall encompasses precipitation through November. The 2000 annual monitoring report will include a 30-70 percentile graph with the monthly rainfall from December 1999.

The winter of 1999 on the site was visually quite wet. The precipitation data from January showed it to be much higher than the average for the area. However, February and March were drier than normal. The month of July was the driest month during the summer and was below the historic average. Finally, September experienced an unusually high precipitation due to several hurricanes.

2.4 Conclusions

For the Year 1999, only one of thirty-two monitoring wells indicated optimum hydrologic success of at least 12.5% from March through August, while thirteen wells were below 5%. From September through November, twenty-three of the wells optimum hydrologic success of at least 12.5%, while two wells were below 5%.

While the results under "normal conditions" are not considered favorable, it must be taken into account that Phase 2 construction (filling of the central canal) will play a critical role in raising the water table on the site.

FIGURE 3B: DOWD DAIRY FARM MITIGATION SITE
1999 MONITORING RESULTS
CONDITIONS DURING AND AFTER HURRICANE ACTIVITY

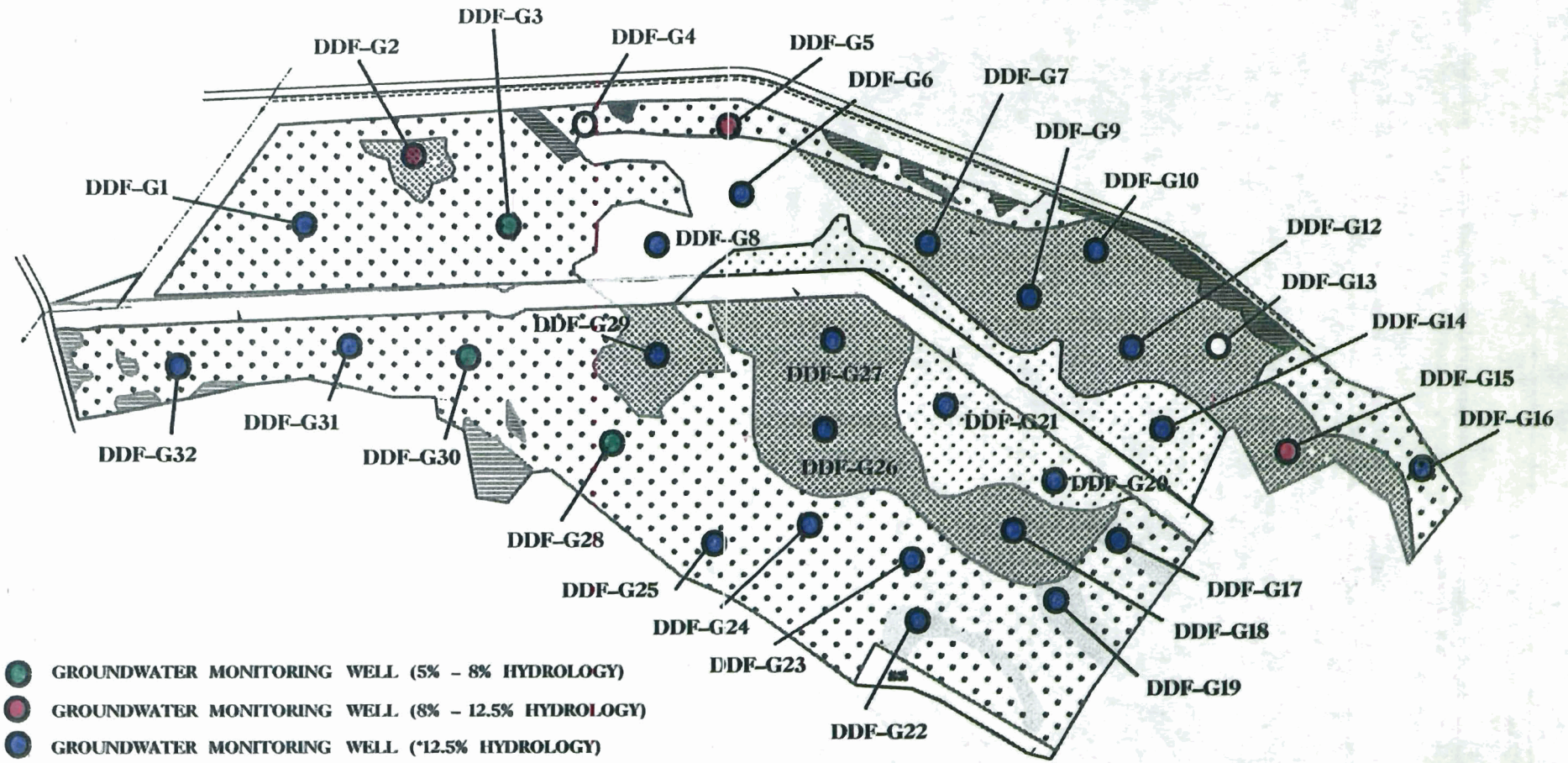

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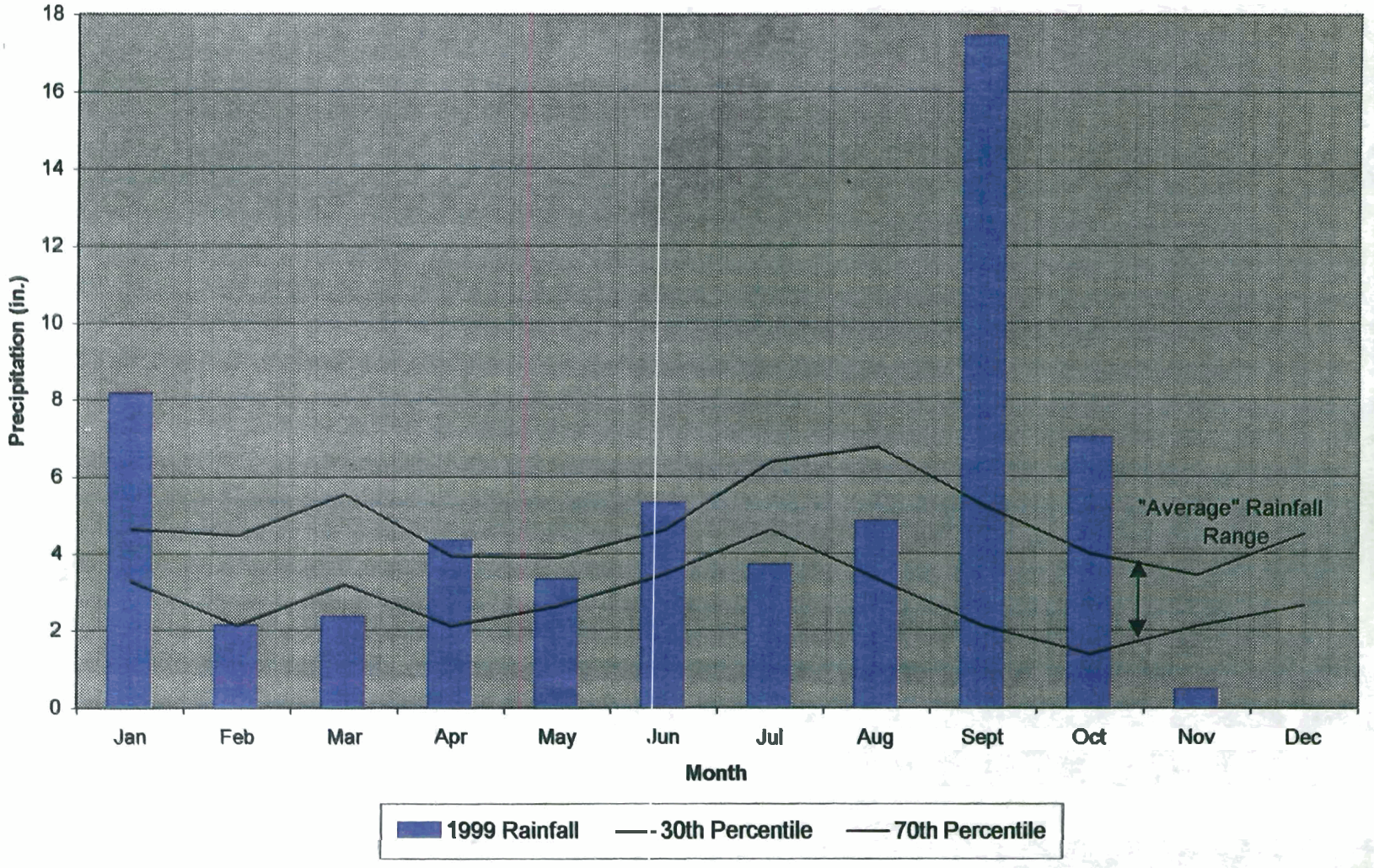
FIGURE 4: Dowd Dairy 30-70 Percentile Graph
Dare County



3.0 VEGETATION

3.1 Success Criteria

Success Criteria states that there must be a minimum of 320 trees per acre living for at least three consecutive years. A minimum of 5 character tree species must be present, with no more than 20% of any one species is also required with the exception of Atlantic White Cedar which may comprise up to 75% in swamp forest restoration. Loblolly Pine cannot comprise of 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 (301.2 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 (17.8 acres)

Juglans nigra, Black Walnut
Nyssa sylvatica, Blackgum
Pinus palustris, Longleaf Pine
Quercus falcata, Southern Red Oak
Quercus nigra, Water Oak
Quercus alba, White Oak
Quercus phellos, Willow Oak
Liriodendron tulipfera, Tulip Poplar

Zone 3: Non-Riverine Swamp Forest (189.4 acres)

Chamaecyparis thyoides, Atlantic White Cedar
Taxodium distichum, Bald Cypress
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

Zone 4: Headwater (Slope) Swamp (12 acres)

Taxodium distichum, Bald Cypress
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 tulipfera, Tulip Poplar

Zone 5: Atlantic White Cedar Slope (55.24 acres)

Chamaecyparis thyoides, Atlantic White Cedar
Taxodium distichum, Bald Cypress
Pinus serotina, Pond Pine
Quercus michauxii, Swamp Chestnut Oak
Nyssa aquatica, Water Tupelo
Quercus phellos, Willow Oak
Liriodendron tulipfera, Tulip Poplar

3.3 Results of Vegetation Monitoring (1 yr.)

Table 2
VEGETATION MONITORING RESULTS- 1999

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	Black Gum	Black Walnut	Tulip Poplar	Bald Cypress	Atlantic White Cedar	Total (4 year)	Total (at planting)	Density (Tree/Acre)
	1			7	8	1		5	7										28	37	515
	3	6	3	7	2	2			8										28	40	476
	4	1		1	9			1	8										20	28	486
	5		2	2	2	6		13	8										33	39	575
	8	4	8	3		1	1	11											28	38	501
	14	4	10	7	15		1												37	39	645
	15	3	2	14	6	1			1										27	32	574
	17	19	3	1	13	1													37	41	614
	19	4	4	2	2	1	2		2										17	35	330
	28	5	1	8	3	2	1	6	2										28	37	515
	29	4	7	2	9			6	10										38	41	630
	30		3	7				19	3										32	39	558
	31	4		5	3			11											23	37	423
	32	8	1	4	4		2	10	4										33	38	591
													ZONE 1 AVERAGE								531
	2			1	8				2	6	4					2			23	24	652
	12			3			3			1	6								13	26	340
													ZONE 2 AVERAGE								496

Table 2 continued.

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	Black Gum	Black Walnut	Tulip Poplar	Bald Cypress	Atlantic White Cedar	Total (4 year)	Total (at planting)	Density (Tree/Acre)
3	6		3	1	8		1	2	2								6	4	27	30	612
	7		1					4	4								17		26	40	442
	9		2	2	4												10	9	27	34	540
	10		2	1	9			1	6								10	1	30	44	464
	11		1	12	3			2	2								7	1	28	28	680
	20		1	4	1			9											15	37	276
	24		3	6	8			3	1								3	7	31	34	620
	25		5	5	11			5	2								1	2	31	31	680
	26		1	2				17	1								7	6	34	35	661
	27		4	2	6	1	7	1	6								4	1	32	36	604
													ZONE 3 AVERAGE								558
4	16	3			3		1		4								12		23	31	505
	18	4	4	1												6	9		24	35	466
													ZONE 4 AVERAGE								485
5	13		7		9			1	4							3			24	24	680
	21	1		1									9			1	17		29	29	680
	22	12		3		1							3				6		25	27	630
	23	2		6		4		1					6			2	11		32	38	573
													ZONE 5 AVERAGE								641
													TOTAL AVERAGE								550

To determine tree density, 50' x 50' plots are installed immediately following planting. The actual numbers of planted trees that occur within the plot are counted. This number is equated to the number within each plot, which represents 680 trees per acre (average). The survival monitoring number is compared to the planted number to obtain survival percentage. This percentage is applied to the 680 trees per acre to obtain an estimated tree per acre for the site.

$$\text{Density} = \frac{\text{monitoring count}}{\text{planted trees}} \times 680 \text{ (trees per acre)}$$

Notes from Report: Phase I of site is complete. Phase II construction is to be completed next year and planted in spring 2001. Grasses and fennel present throughout site. Some plots contained standing water at time of monitoring. Juncus was also present in some plots.

3.4 Conclusions

Of the 658 acres of this site, approximately 575 acres involved tree planting. There were 32 test plots established throughout the planting areas, covering all plant communities. The first year vegetation monitoring of the planted areas revealed an average density to be 550 trees per acre, which is well above the minimum requirement of 320 trees per acre.

The remainder of the site will be planted spring 2001.

4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS

For the Year 1999, only one of thirty-two monitoring wells indicated optimum hydrologic success of at least 12.5% from March through August, while thirteen wells were below 5%. From September through November, twenty-three of the wells optimum hydrologic success of at least 12.5%, while two wells were below 5%.

While the results under "normal conditions" are not considered favorable, it must be taken into account that Phase 2 construction (filling of the central canal) will play a critical role in raising the water table on the site.

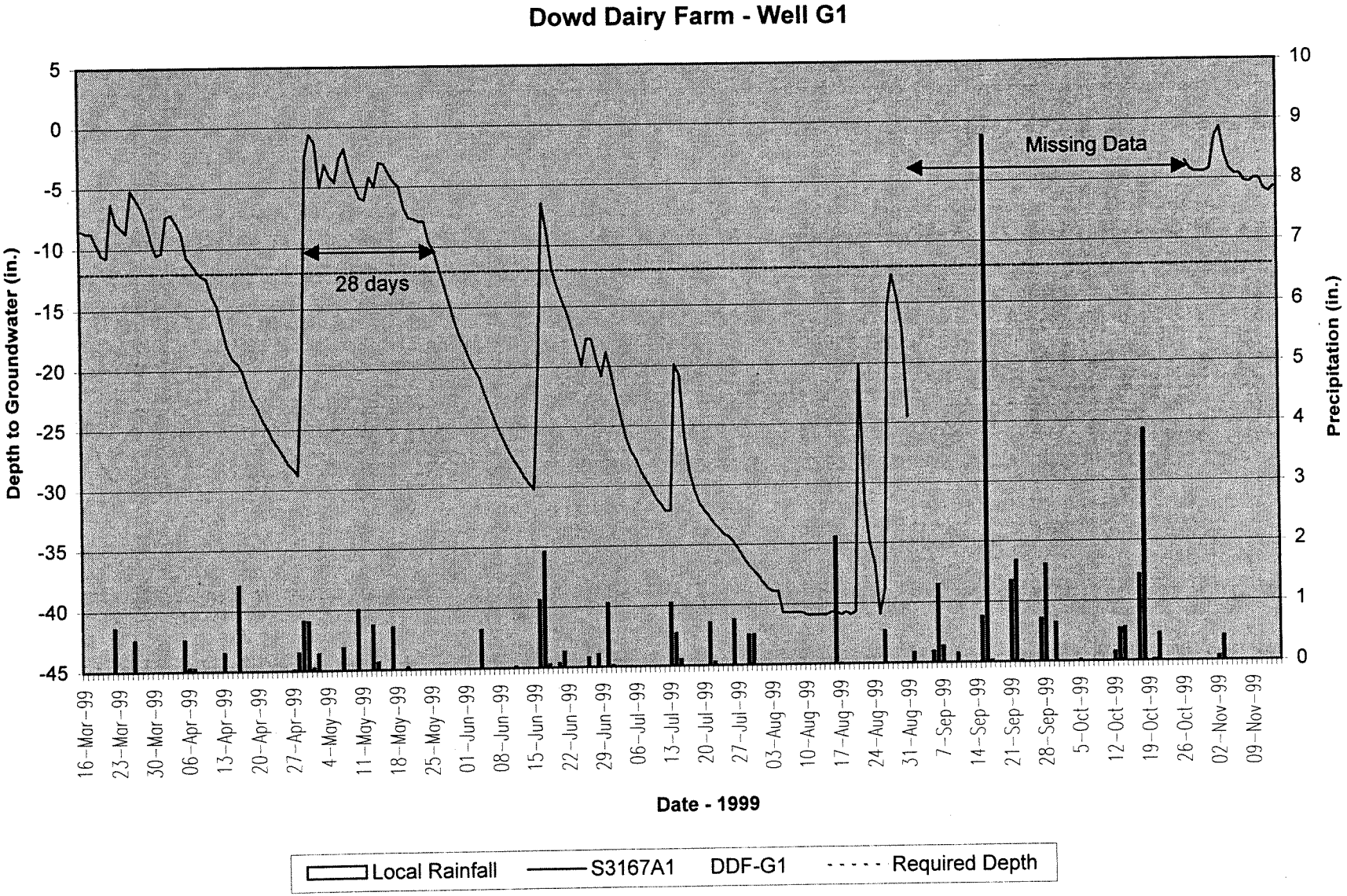
The first year vegetation monitoring of the planted areas revealed an average density to be 550 trees per acre, which is well above the minimum requirement of 320 trees per acre.

NCDOT will complete the Phase 2 construction the Year 2000. Planting will occur during spring 2001.

Meanwhile, NCDOT will continue to monitor both hydrology and site vegetation.

APPENDIX A

DEPTH TO GROUNDWATER PLOTS


Dowd Dairy Farm - Well G1
Depth to Groundwater (in.)
Precipitation (in.)
Date - 1999
28 days
Missing Data
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
10
9
8
7
6
5
4
3
2
1
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5-Oct-99
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02-Nov-99
09-Nov-99
Local Rainfall
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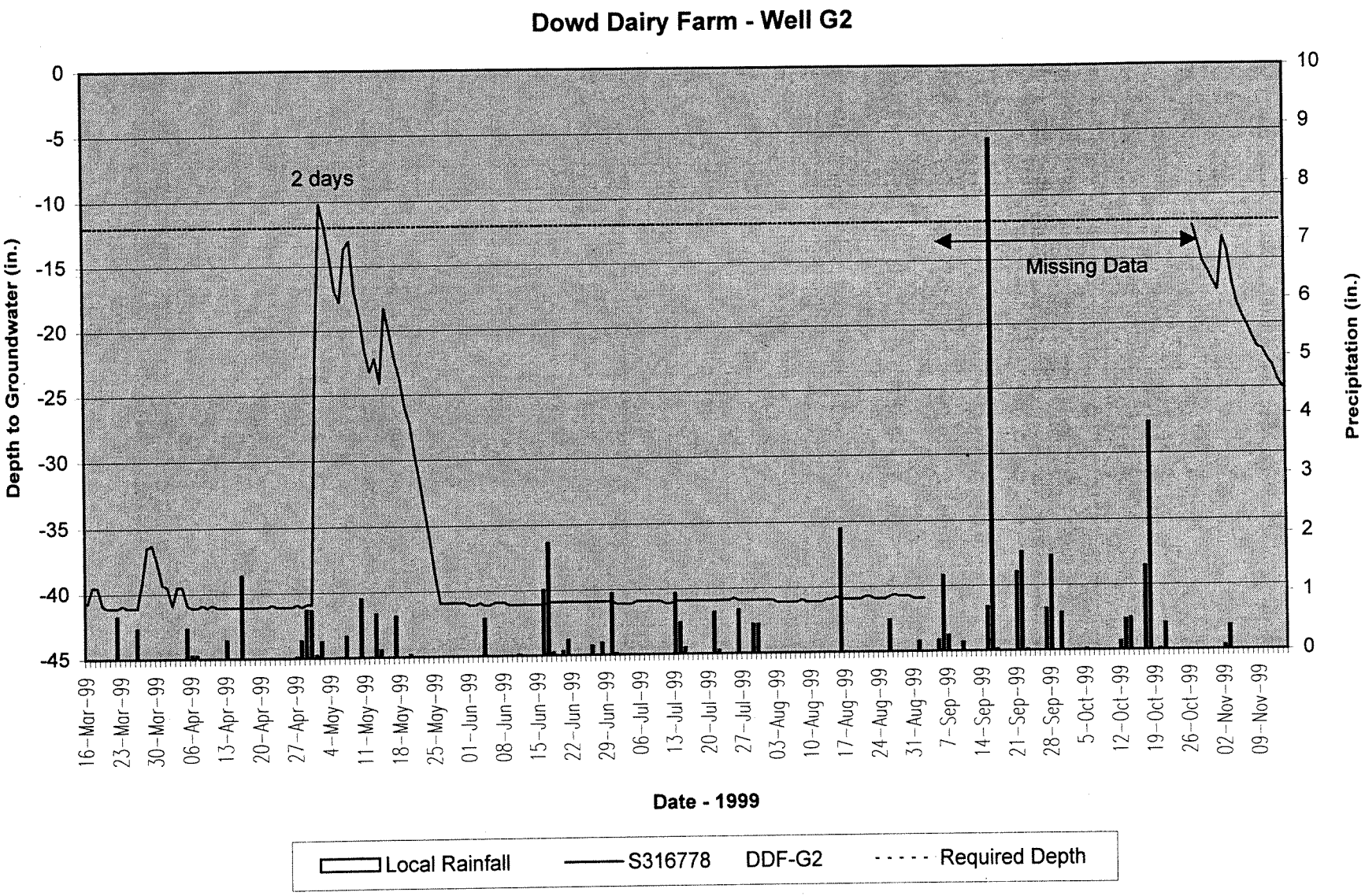
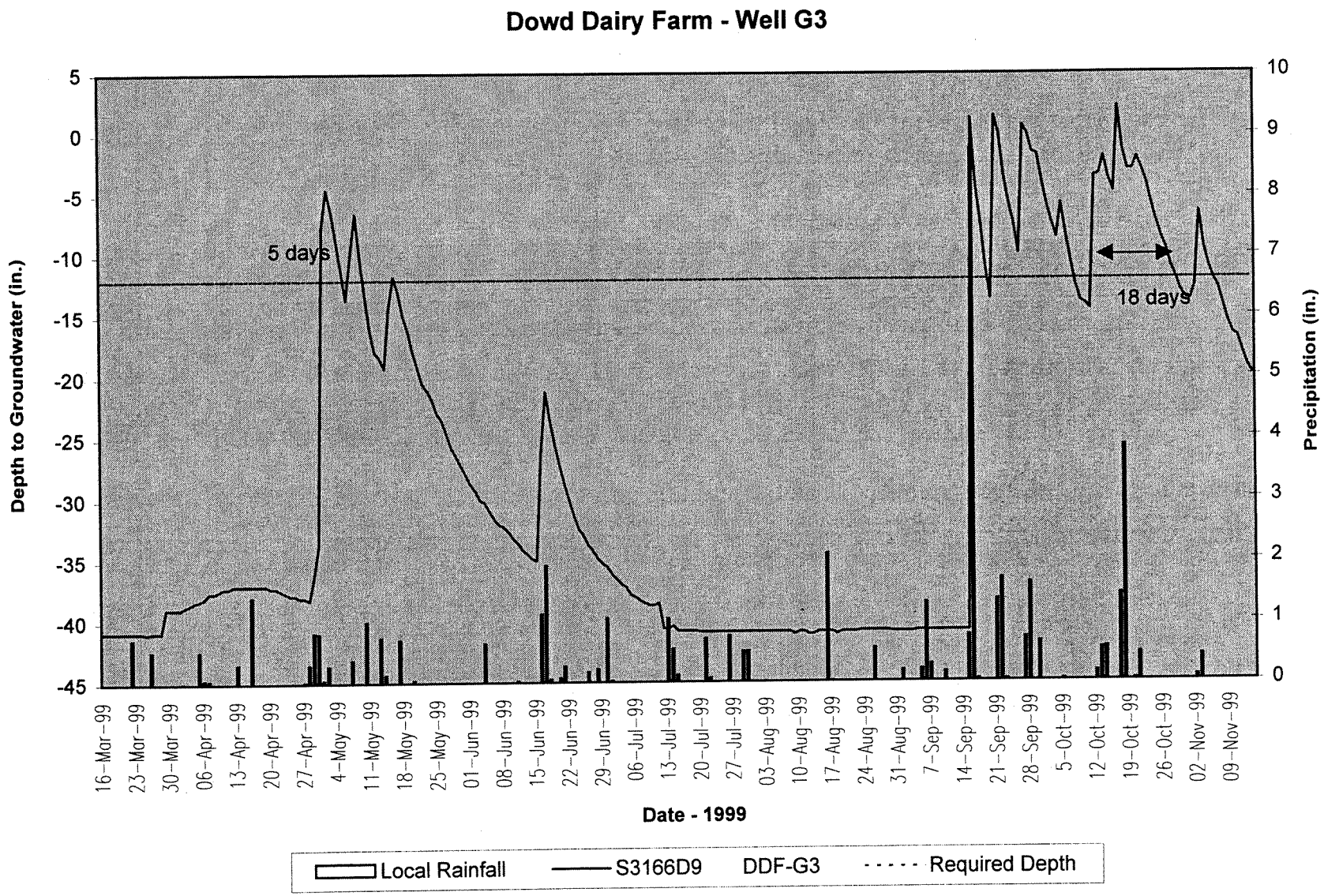
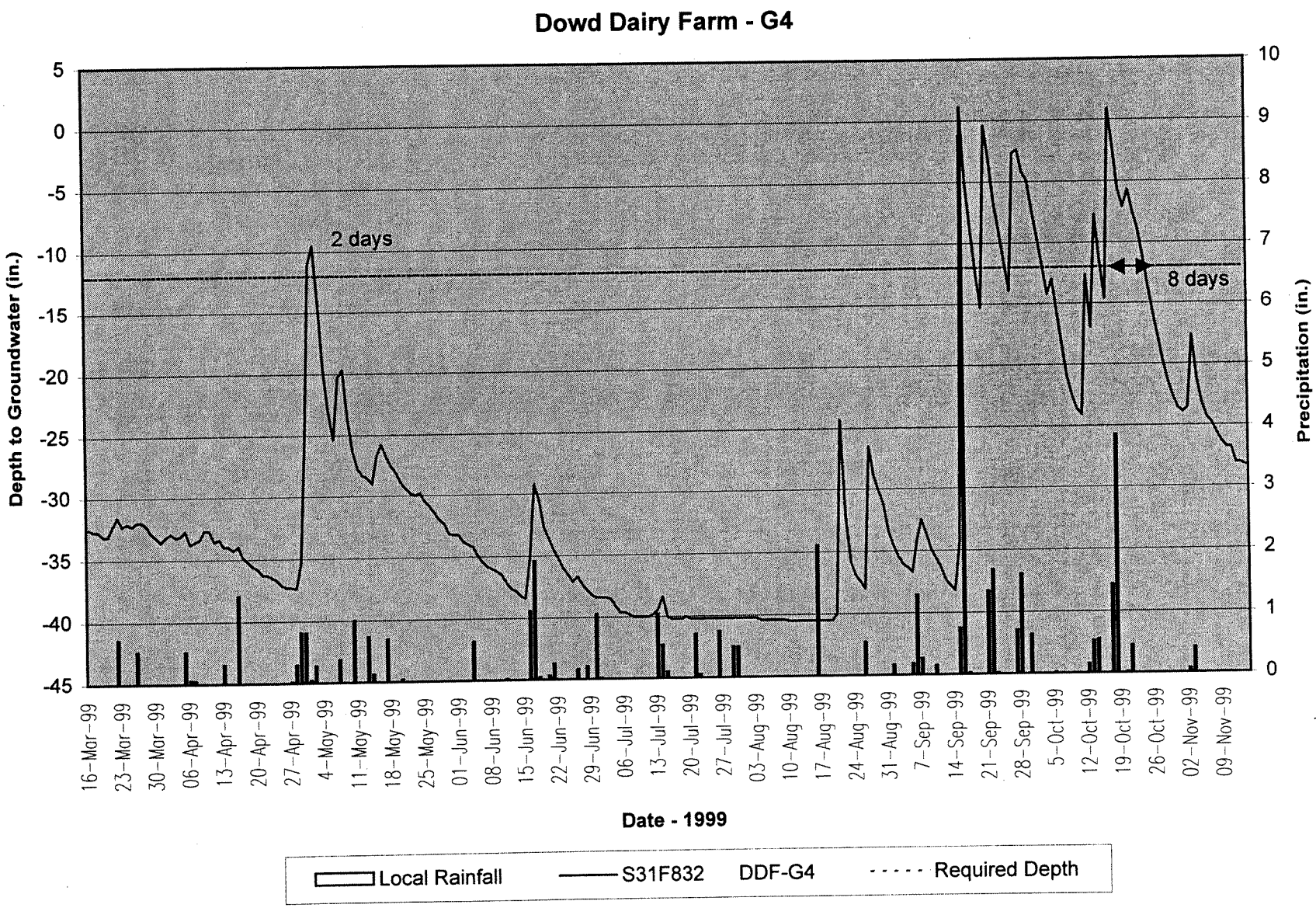
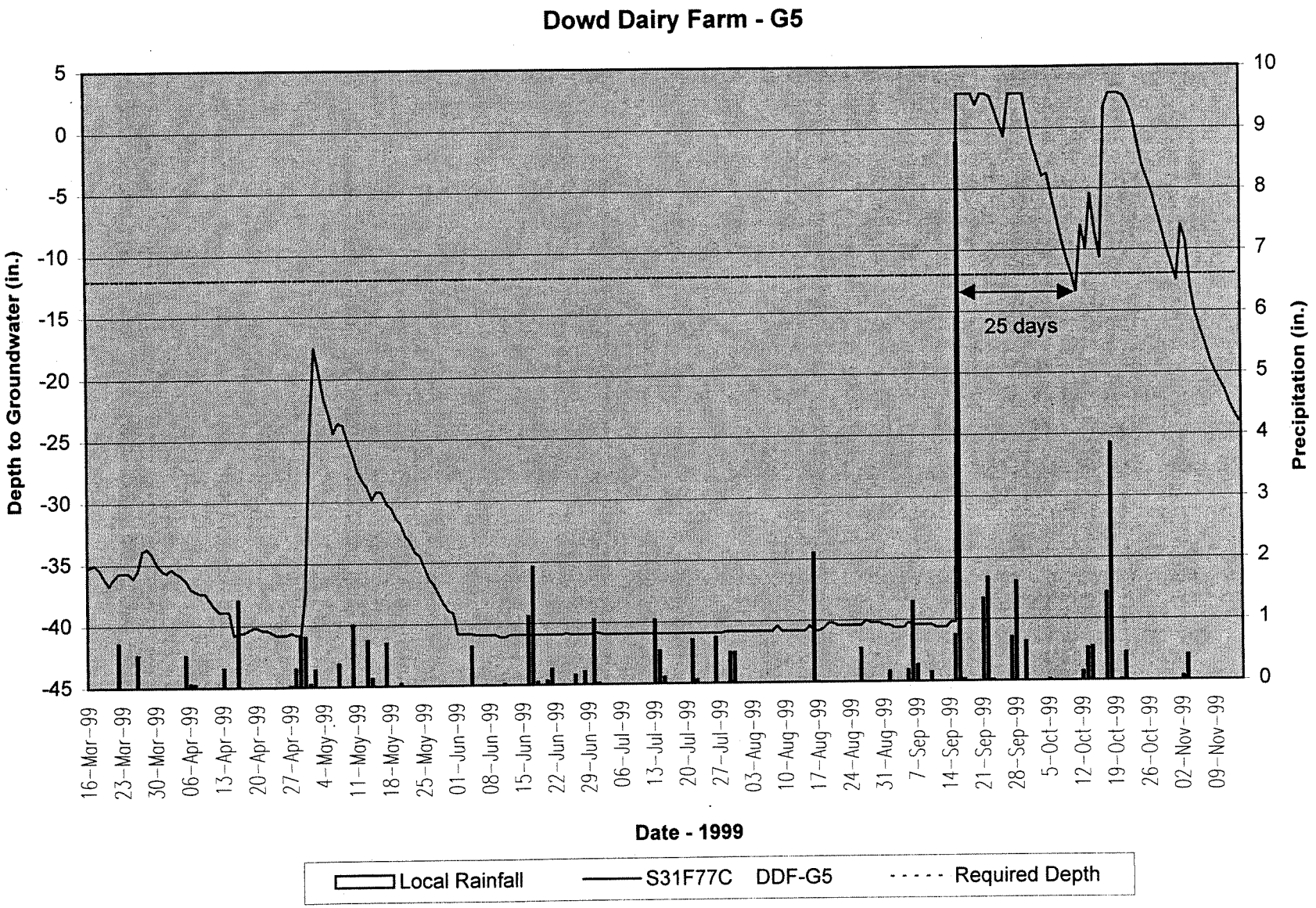
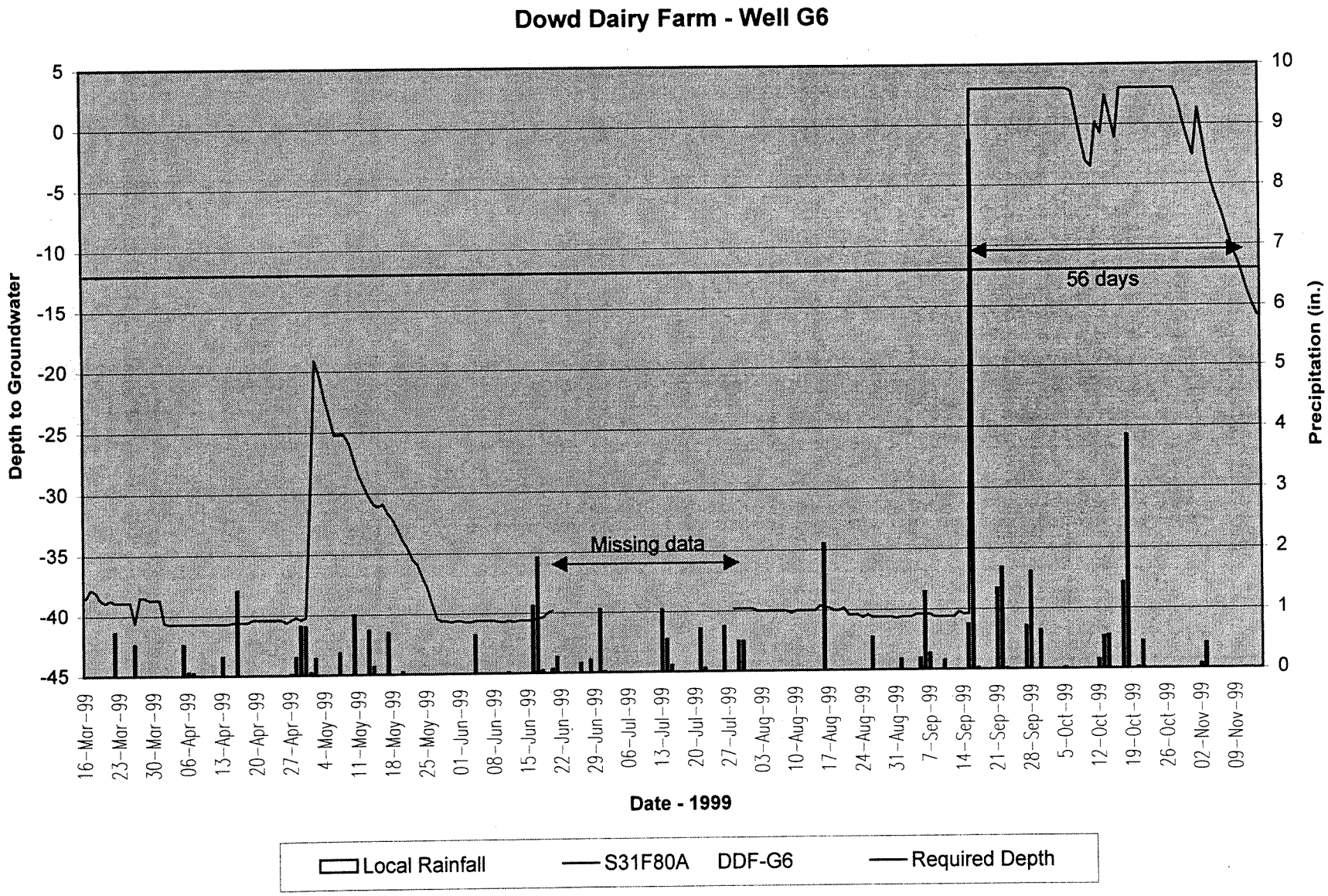
DDF-G1
Required Depth


Dowd Dairy Farm - Well G2
Depth to Groundwater (in.)
Precipitation (in.)
2 days
Missing Data
Date - 1999
Local Rainfall
S316778 DDF-G2
Required Depth

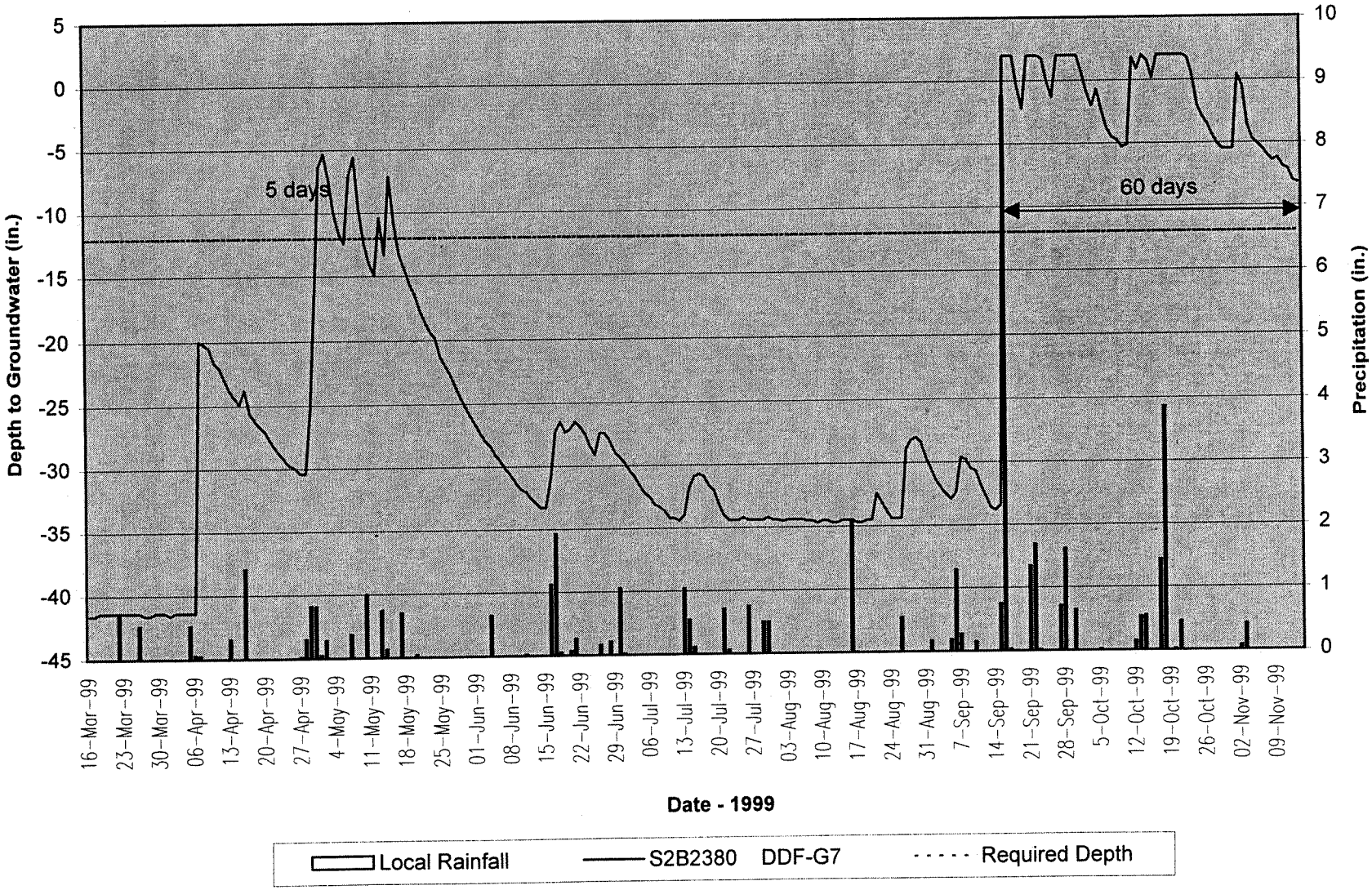

Dowd Dairy Farm - Well G3
Depth to Groundwater (in.)
Precipitation (in.)
5 days
18 days
Date - 1999
Local Rainfall
S3166D9
DDF-G3
Required Depth


Dowd Dairy Farm - G4
Depth to Groundwater (in.)
Precipitation (in.)
2 days
8 days
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
10
9
8
7
6
5
4
3
2
1
0
16-Mar-99
23-Mar-99
30-Mar-99
06-Apr-99
13-Apr-99
20-Apr-99
27-Apr-99
4-May-99
11-May-99
18-May-99
25-May-99
01-Jun-99
08-Jun-99
15-Jun-99
22-Jun-99
29-Jun-99
06-Jul-99
13-Jul-99
20-Jul-99
27-Jul-99
03-Aug-99
10-Aug-99
17-Aug-99
24-Aug-99
31-Aug-99
7-Sep-99
14-Sep-99
21-Sep-99
28-Sep-99
5-Oct-99
12-Oct-99
19-Oct-99
26-Oct-99
02-Nov-99
09-Nov-99
Date - 1999
Local Rainfall
S31F832 DDF-G4
Required Depth

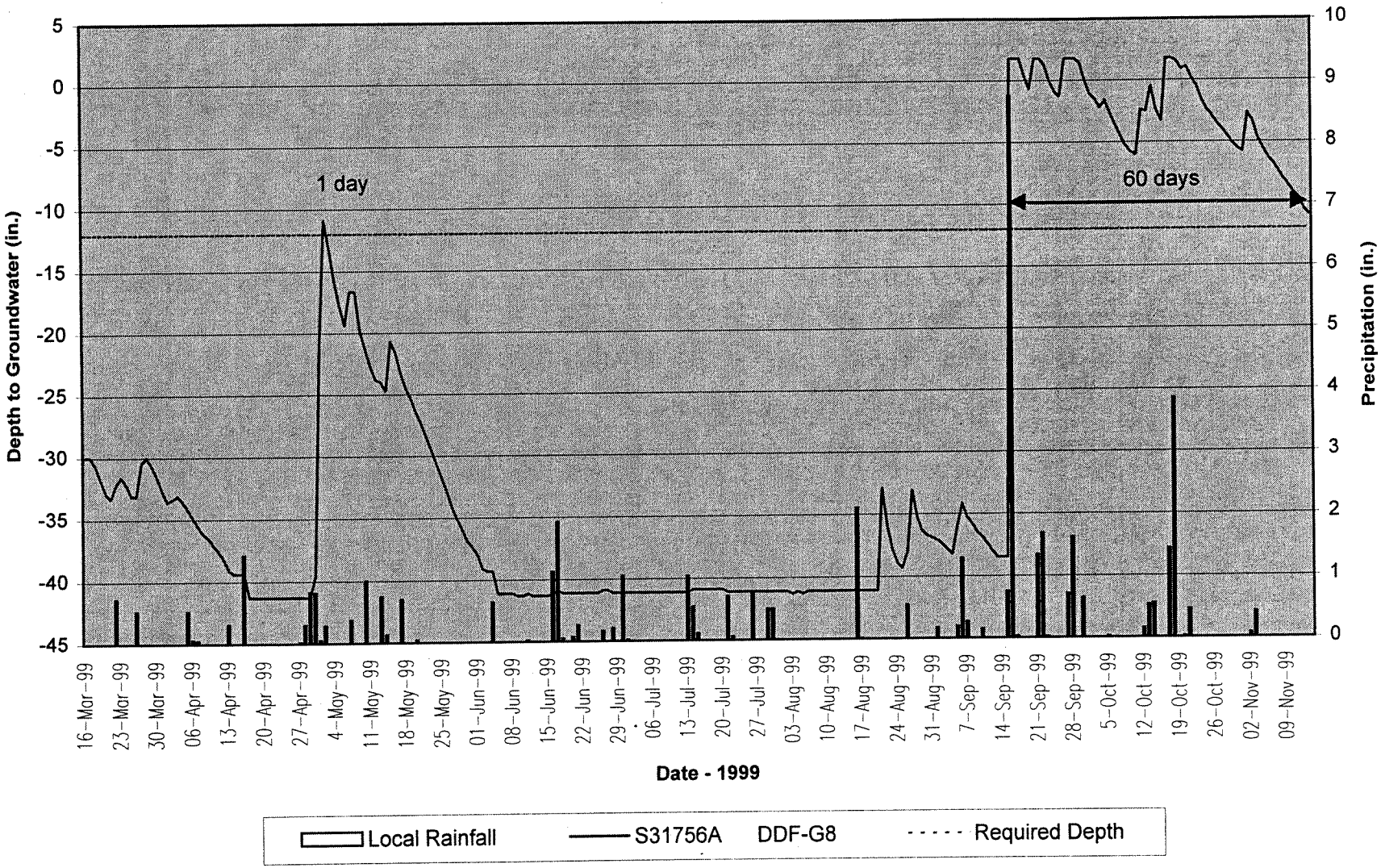

Dowd Dairy Farm - G5
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
10
9
8
7
6
5
4
3
2
1
0
25 days
16-Mar-99
23-Mar-99
30-Mar-99
06-Apr-99
13-Apr-99
20-Apr-99
27-Apr-99
4-May-99
11-May-99
18-May-99
25-May-99
01-Jun-99
08-Jun-99
15-Jun-99
22-Jun-99
29-Jun-99
06-Jul-99
13-Jul-99
20-Jul-99
27-Jul-99
03-Aug-99
10-Aug-99
17-Aug-99
24-Aug-99
31-Aug-99
7-Sep-99
14-Sep-99
21-Sep-99
28-Sep-99
5-Oct-99
12-Oct-99
19-Oct-99
26-Oct-99
02-Nov-99
09-Nov-99
Date - 1999
Local Rainfall
S31F77C DDF-G5
Required Depth


Dowd Dairy Farm - Well G6
Depth to Groundwater
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
10
9
8
7
6
5
4
3
2
1
0
56 days
Missing data
16-Mar-99
23-Mar-99
30-Mar-99
06-Apr-99
13-Apr-99
20-Apr-99
27-Apr-99
4-May-99
11-May-99
18-May-99
25-May-99
01-Jun-99
08-Jun-99
15-Jun-99
22-Jun-99
29-Jun-99
06-Jul-99
13-Jul-99
20-Jul-99
27-Jul-99
03-Aug-99
10-Aug-99
17-Aug-99
24-Aug-99
31-Aug-99
7-Sep-99
14-Sep-99
21-Sep-99
28-Sep-99
5-Oct-99
12-Oct-99
19-Oct-99
26-Oct-99
02-Nov-99
09-Nov-99
Date - 1999
Local Rainfall
S31F80A DDF-G6
Required Depth

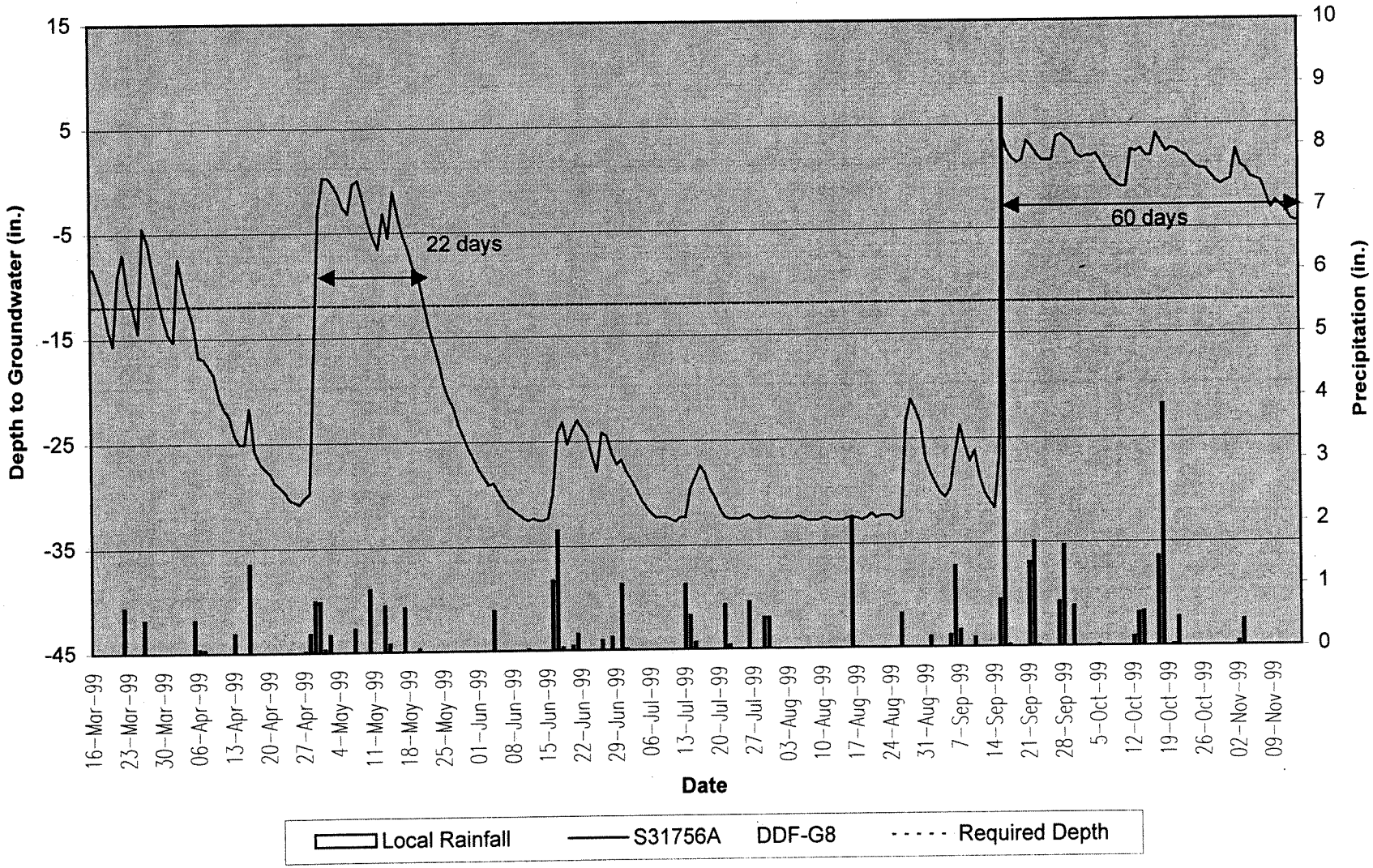
Dowd Dairy Farm - Well G7

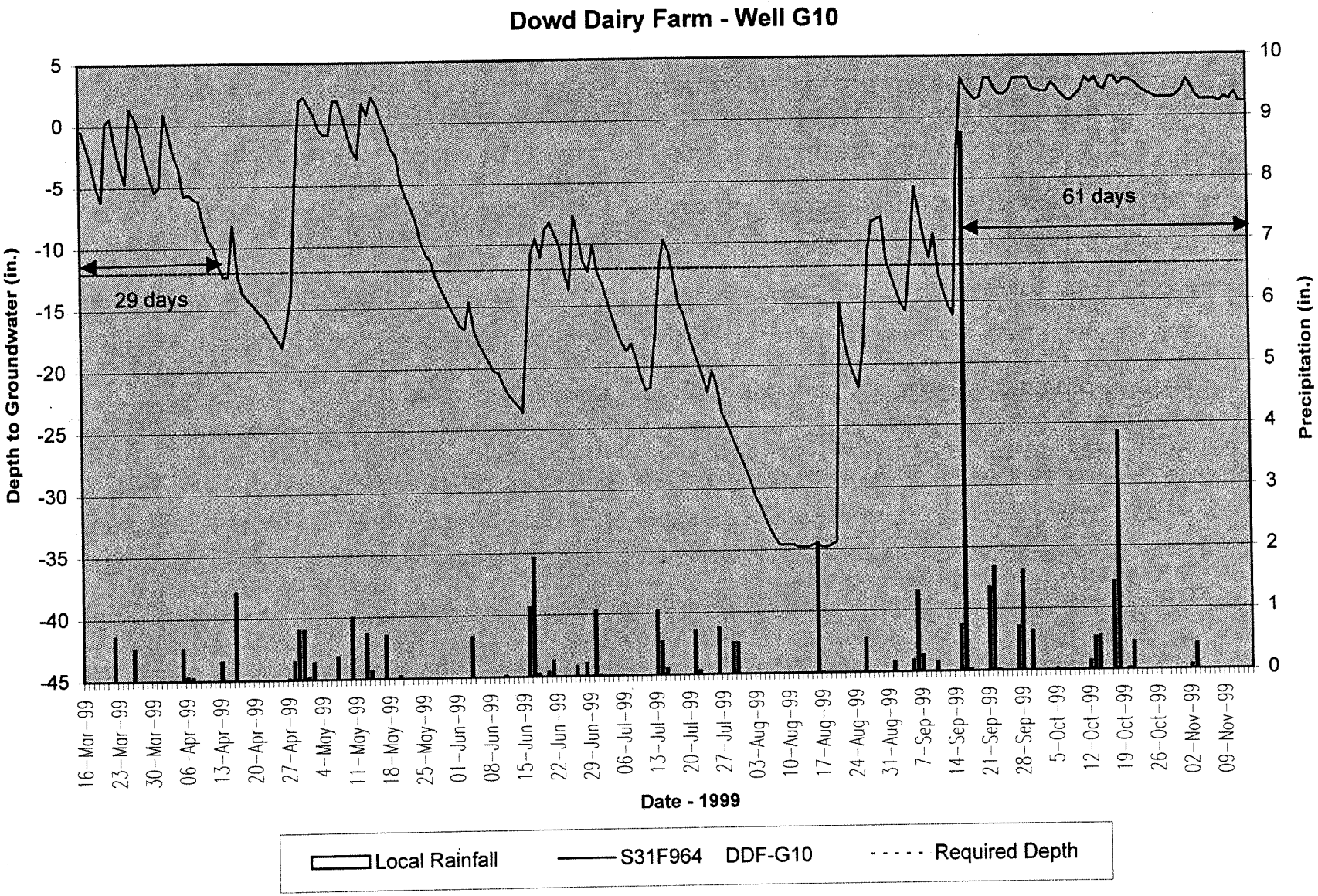


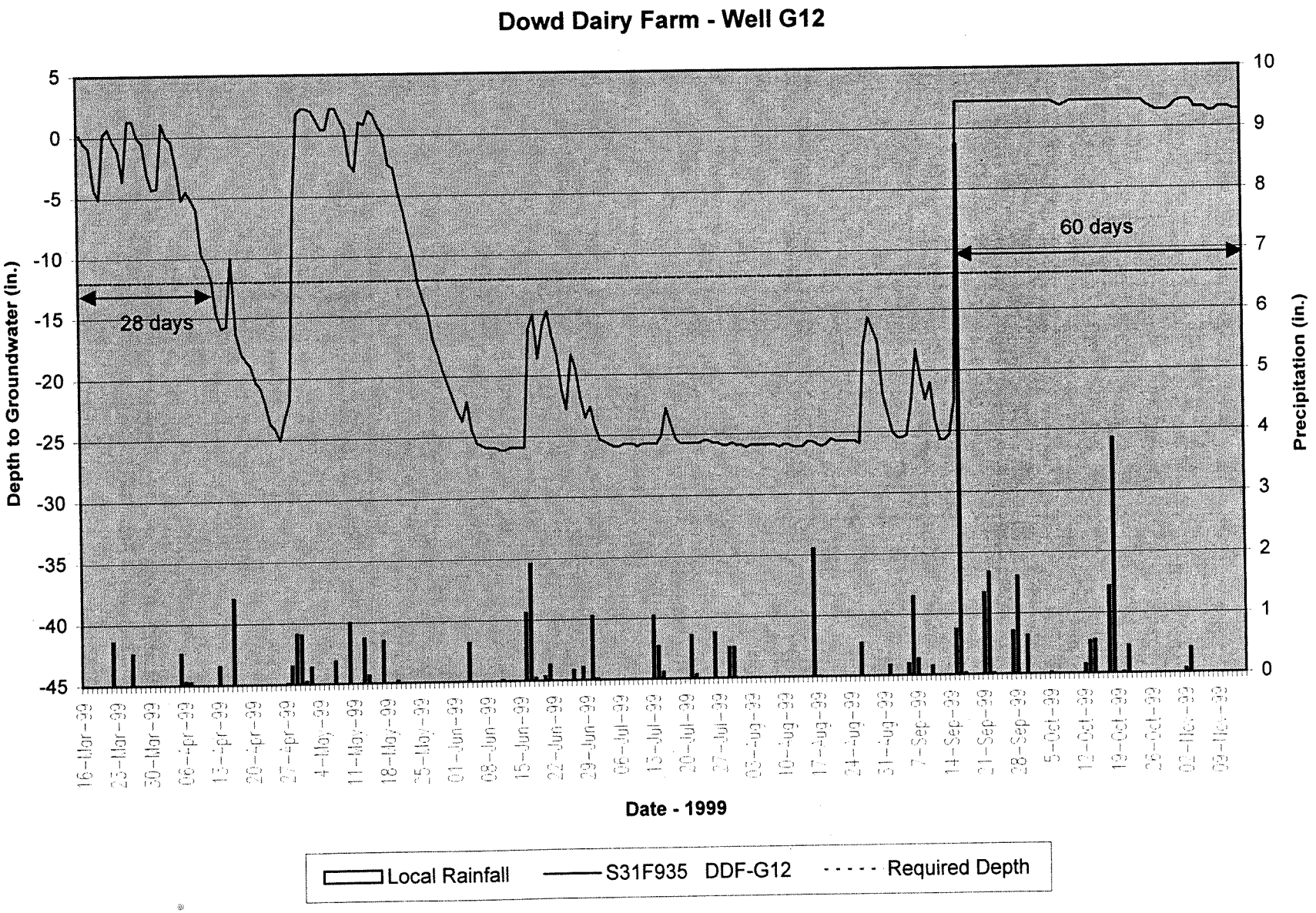
Dowd Dairy Farm - Well G8

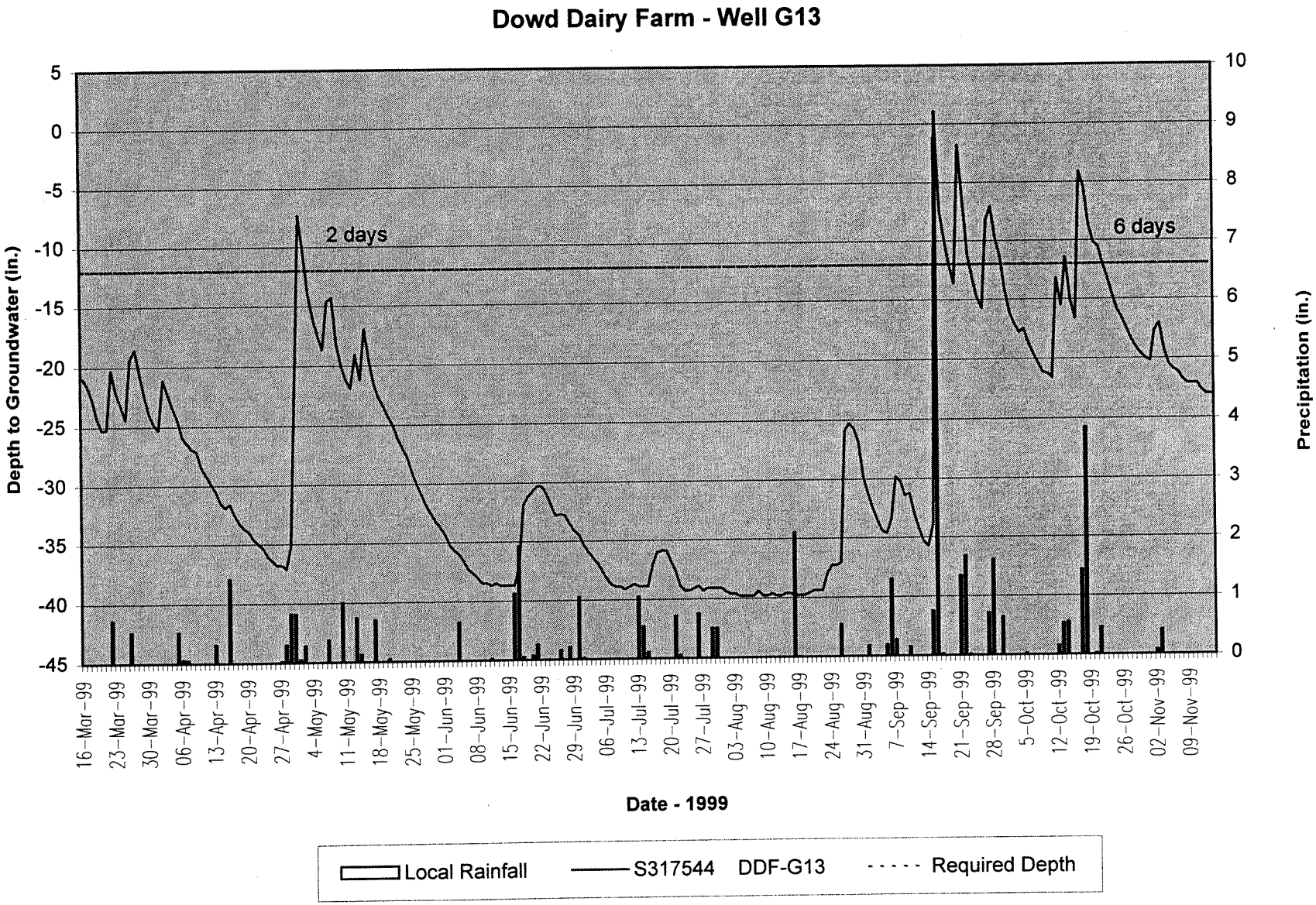


Dowd Dairy Farm - Well G9

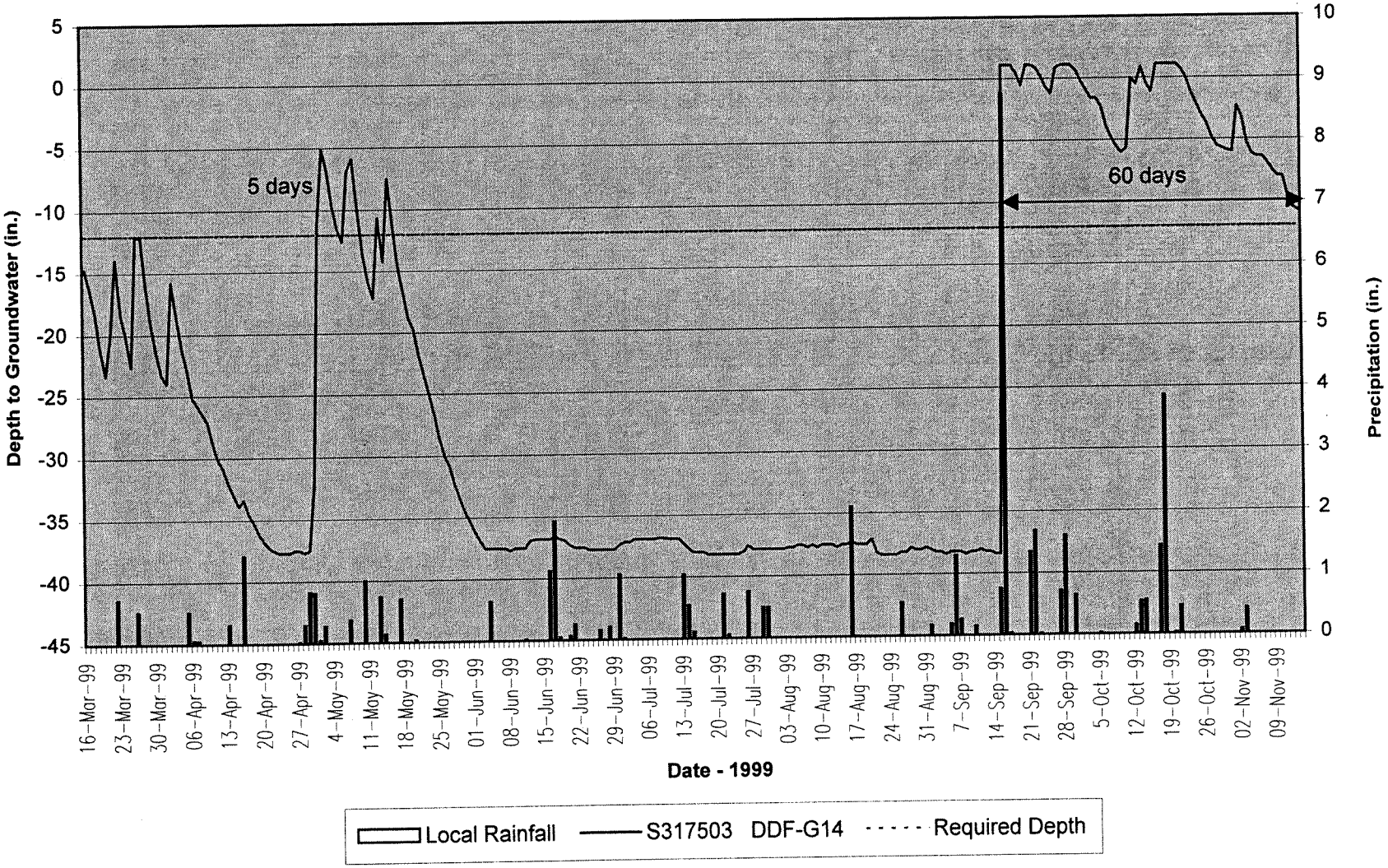



Dowd Dairy Farm - Well G10
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
10
9
8
7
6
5
4
3
2
1
0
29 days
61 days
16-Mar-99
23-Mar-99
30-Mar-99
06-Apr-99
13-Apr-99
20-Apr-99
27-Apr-99
4-May-99
11-May-99
18-May-99
25-May-99
01-Jun-99
08-Jun-99
15-Jun-99
22-Jun-99
29-Jun-99
06-Jul-99
13-Jul-99
20-Jul-99
27-Jul-99
03-Aug-99
10-Aug-99
17-Aug-99
24-Aug-99
31-Aug-99
7-Sep-99
14-Sep-99
21-Sep-99
28-Sep-99
5-Oct-99
12-Oct-99
19-Oct-99
26-Oct-99
02-Nov-99
09-Nov-99
Date - 1999
Local Rainfall
S31F964 DDF-G10
Required Depth

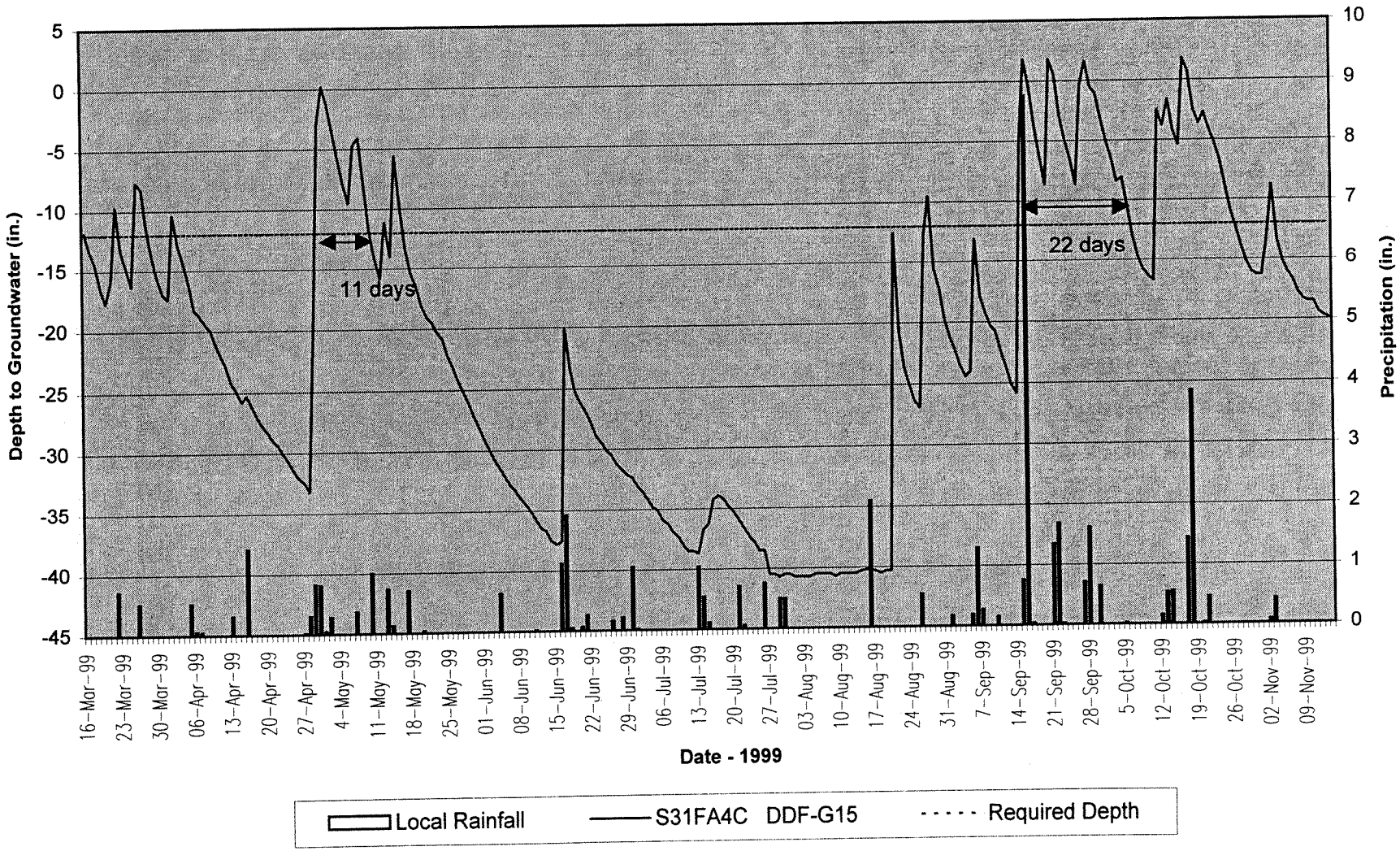

Dowd Dairy Farm - Well G12
Depth to Groundwater (in.)
Precipitation (in.)
28 days
60 days
Date - 1999
Local Rainfall
S31F935 DDF-G12
Required Depth


Dowd Dairy Farm - Well G13
Depth to Groundwater (in.)
Precipitation (in.)
2 days
6 days
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
10
9
8
7
6
5
4
3
2
1
0
16-Mar-99
23-Mar-99
30-Mar-99
06-Apr-99
13-Apr-99
20-Apr-99
27-Apr-99
4-May-99
11-May-99
18-May-99
25-May-99
01-Jun-99
08-Jun-99
15-Jun-99
22-Jun-99
29-Jun-99
06-Jul-99
13-Jul-99
20-Jul-99
27-Jul-99
03-Aug-99
10-Aug-99
17-Aug-99
24-Aug-99
31-Aug-99
7-Sep-99
14-Sep-99
21-Sep-99
28-Sep-99
5-Oct-99
12-Oct-99
19-Oct-99
26-Oct-99
02-Nov-99
09-Nov-99
Date - 1999
Local Rainfall
S317544 DDF-G13
Required Depth

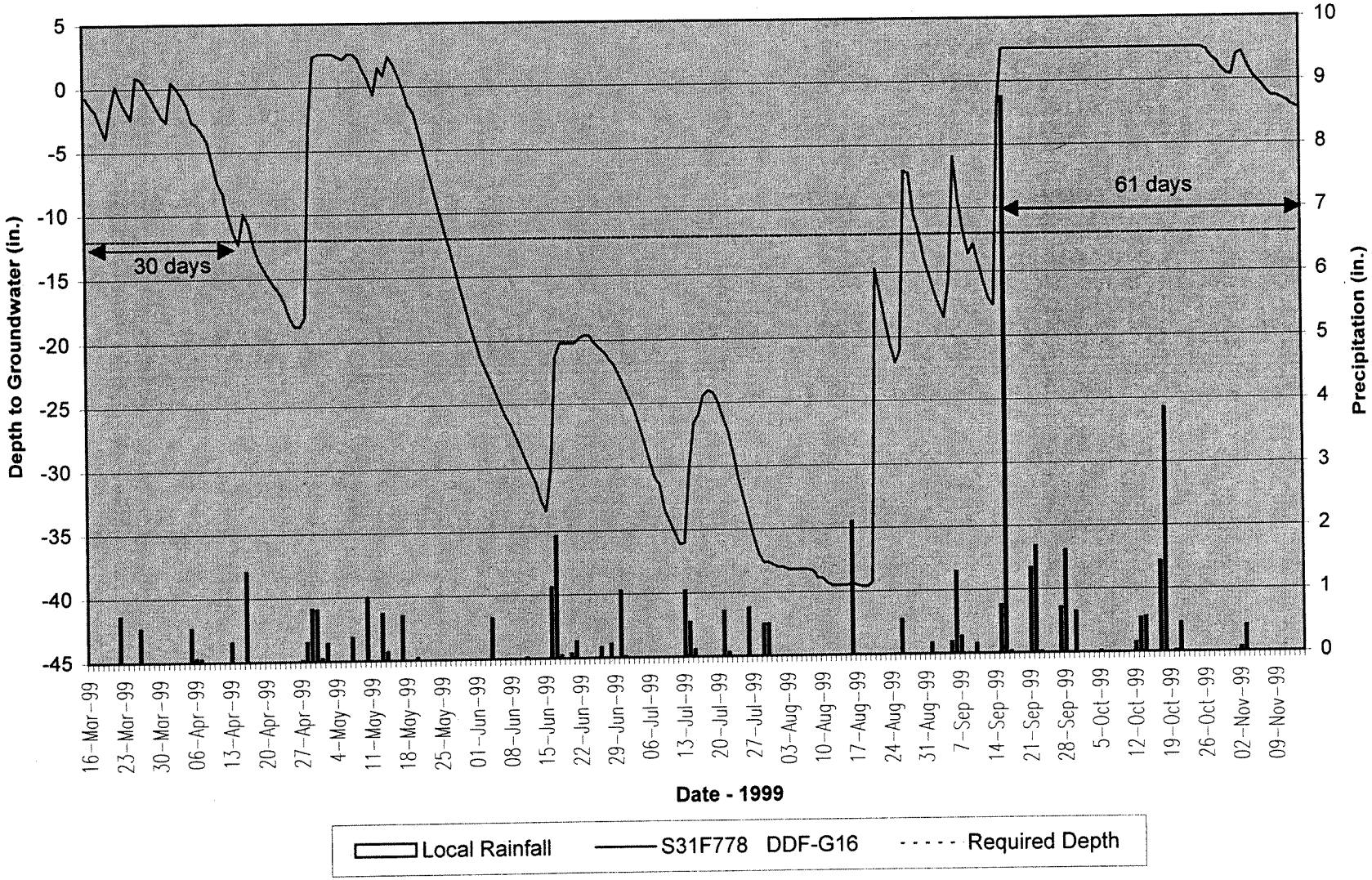
Dowd Dairy Farm - Well G14



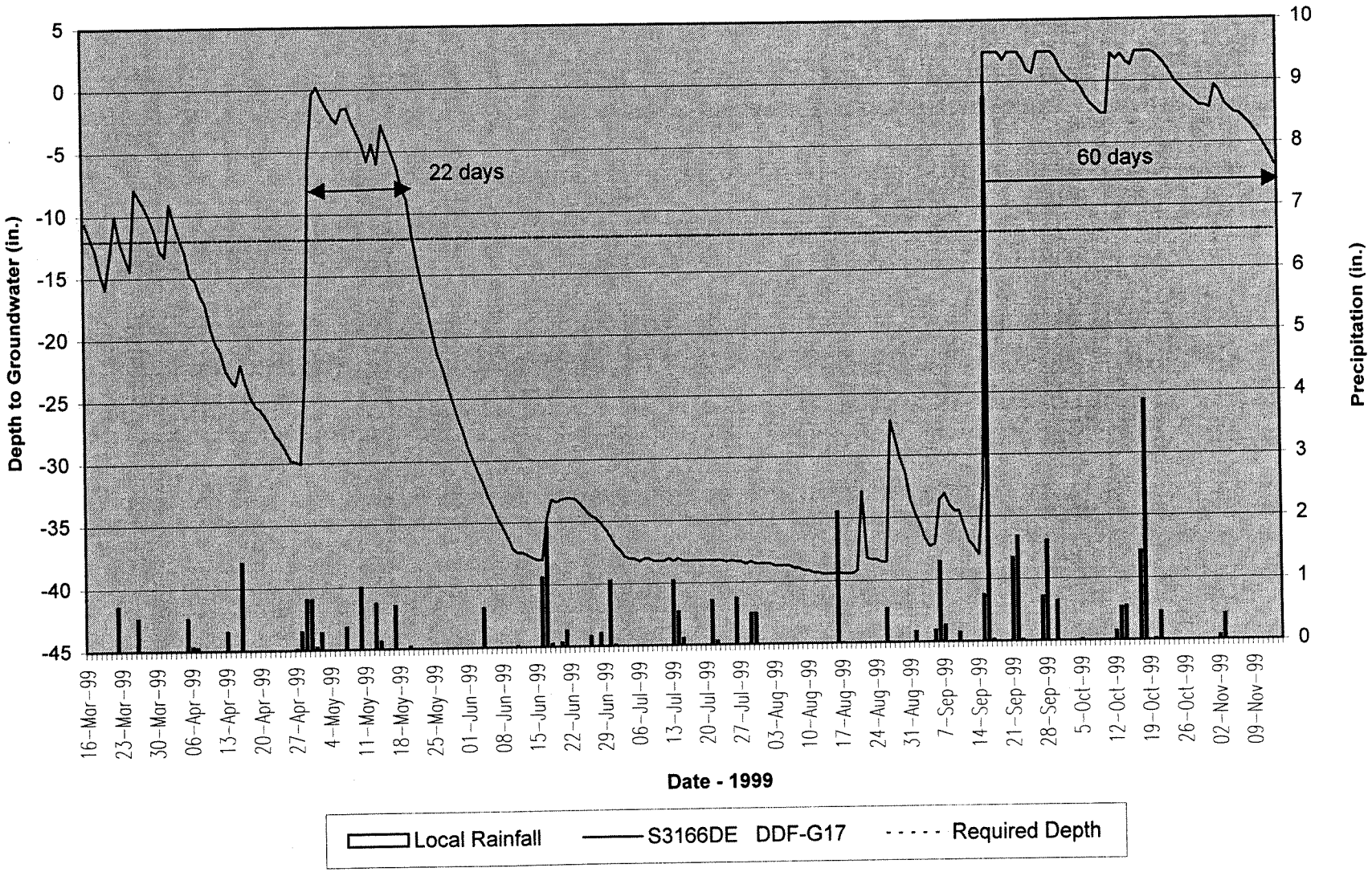
Dowd Dairy Farm - Well G15



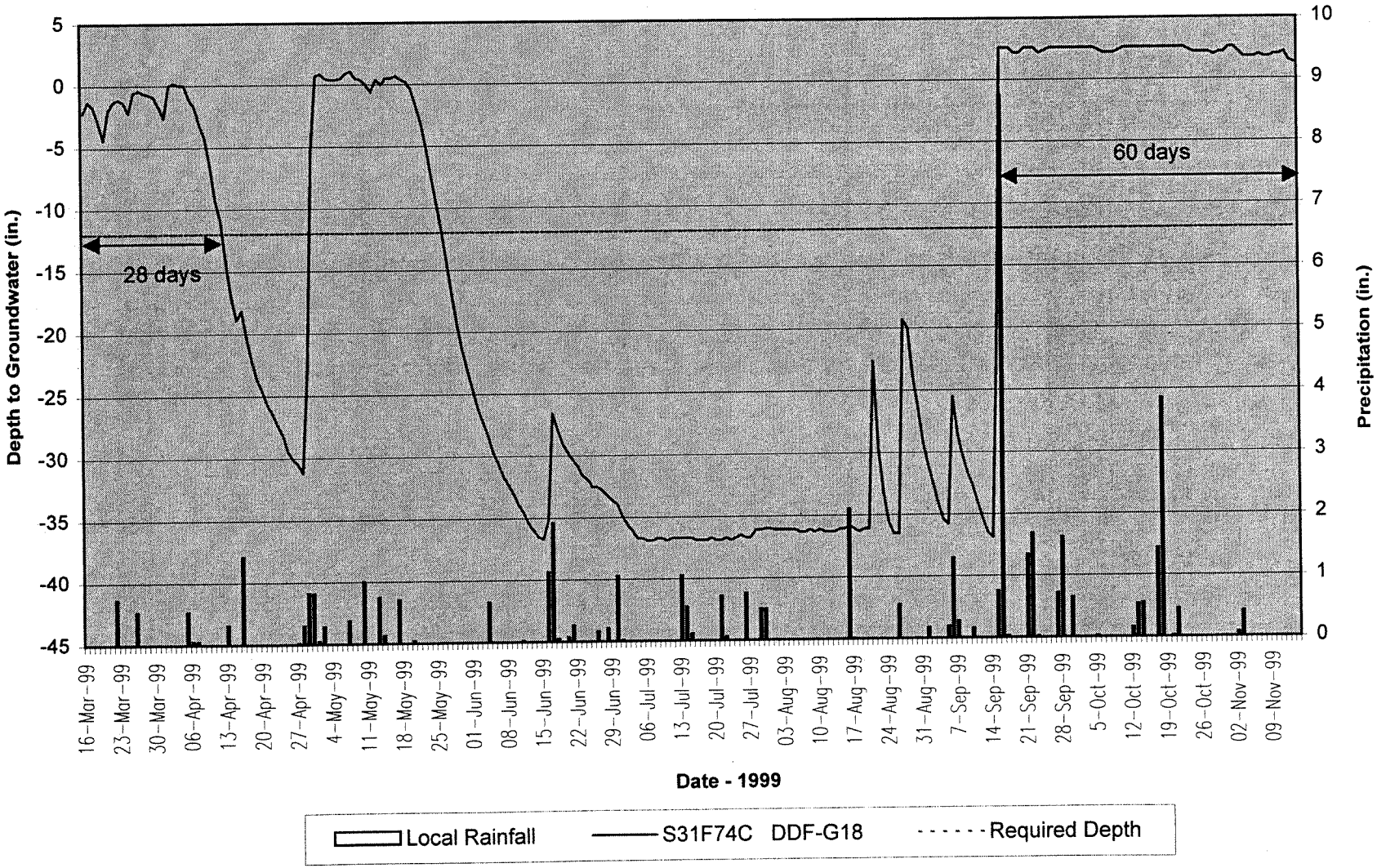
Dowd Dairy Farm - Well G16

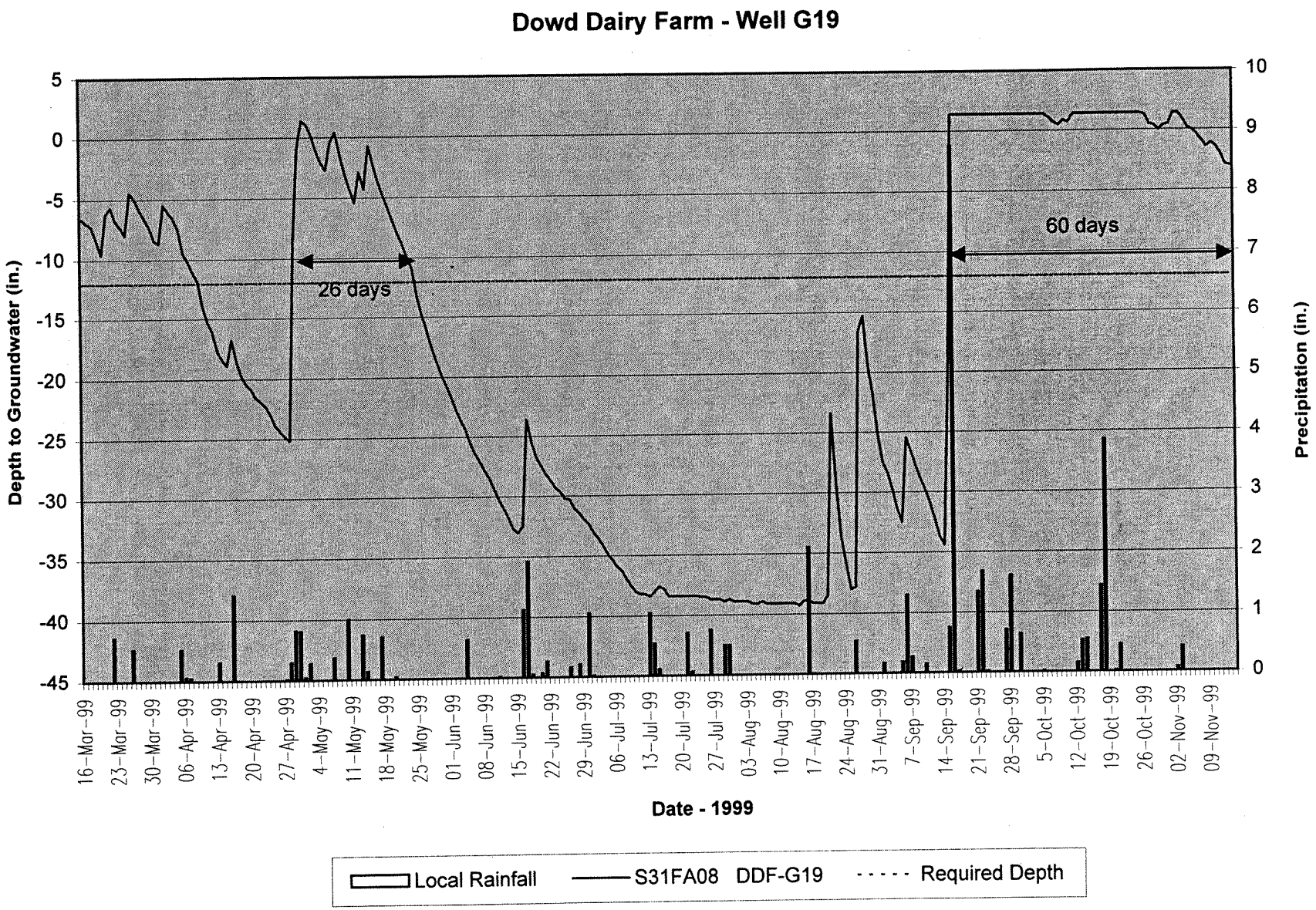


Dowd Dairy Farm - Well G17

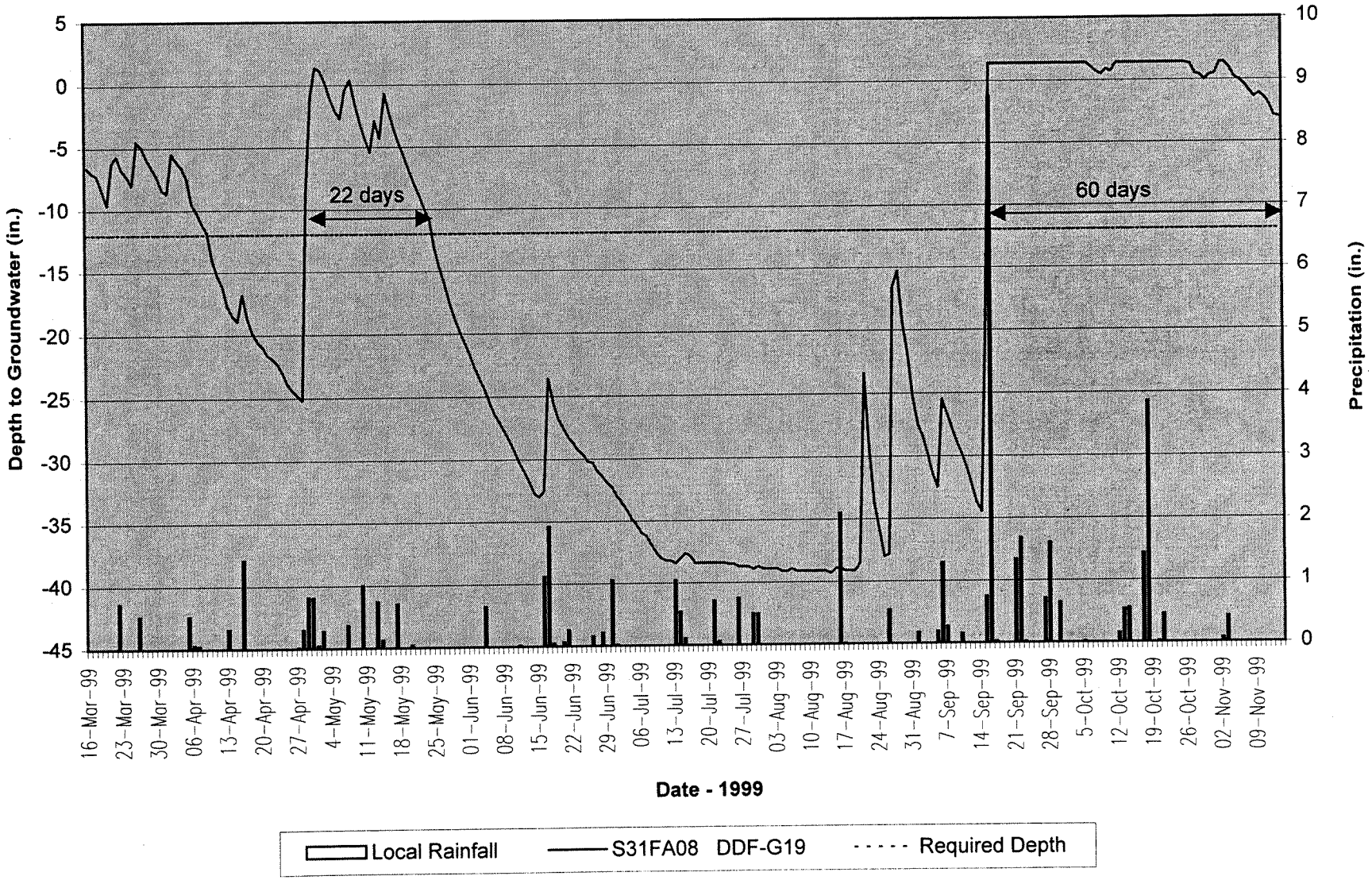


Dowd Dairy Farm - Well G18

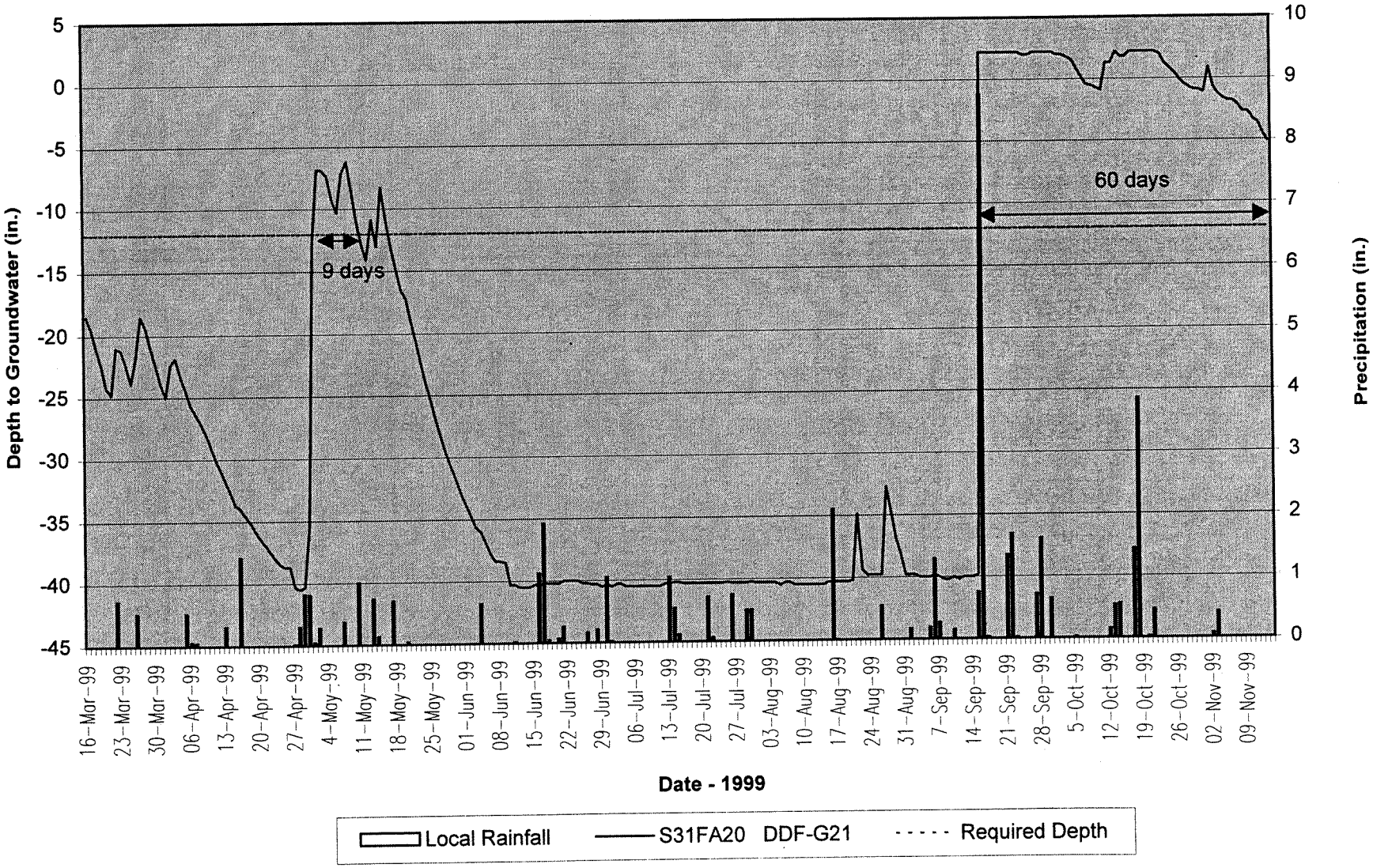


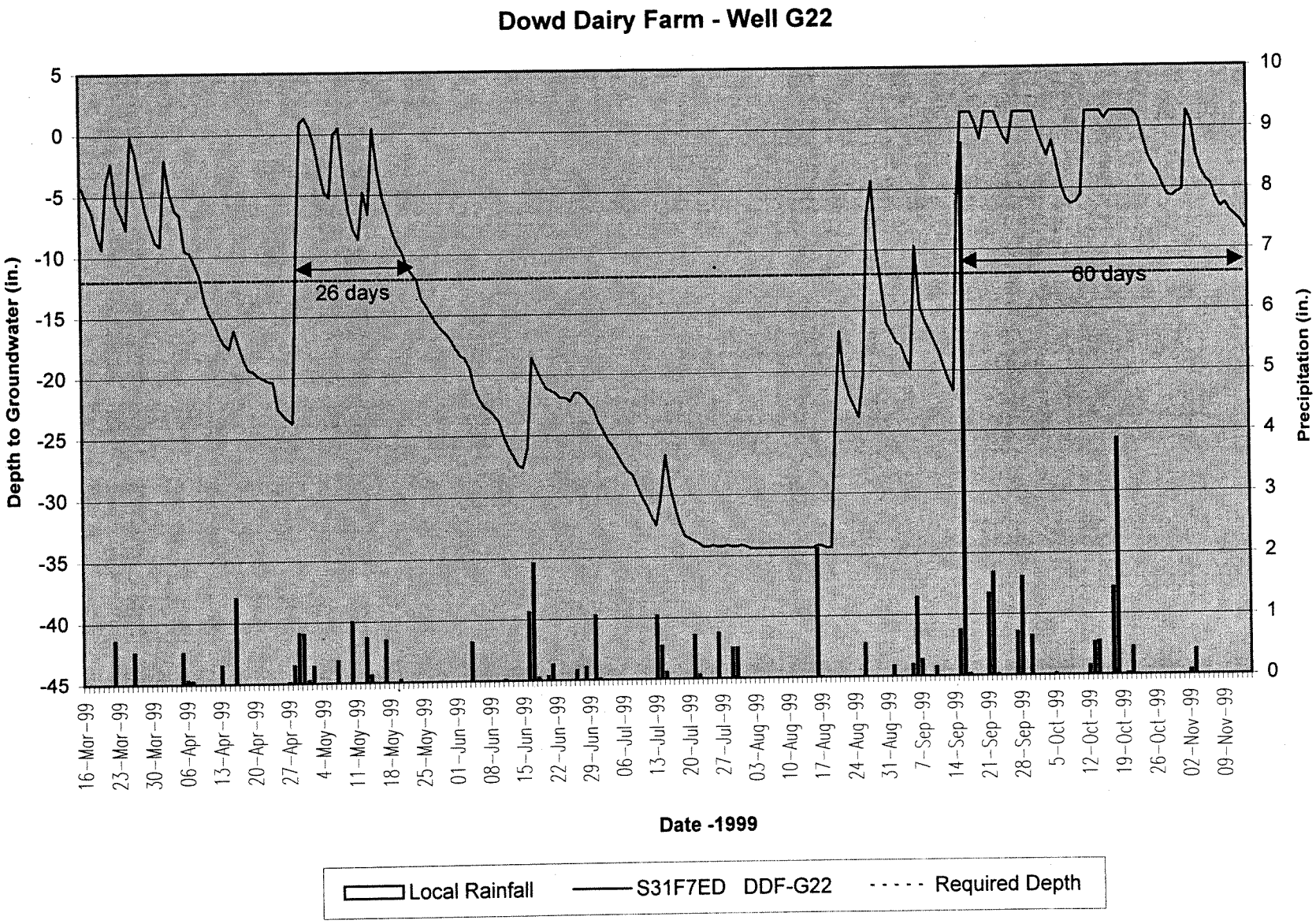

Dowd Dairy Farm - Well G19
Depth to Groundwater (in.)
Precipitation (in.)
26 days
60 days
Date - 1999
Local Rainfall
S31FA08 DDF-G19
Required Depth

Dowd Dairy Farm - Well G20

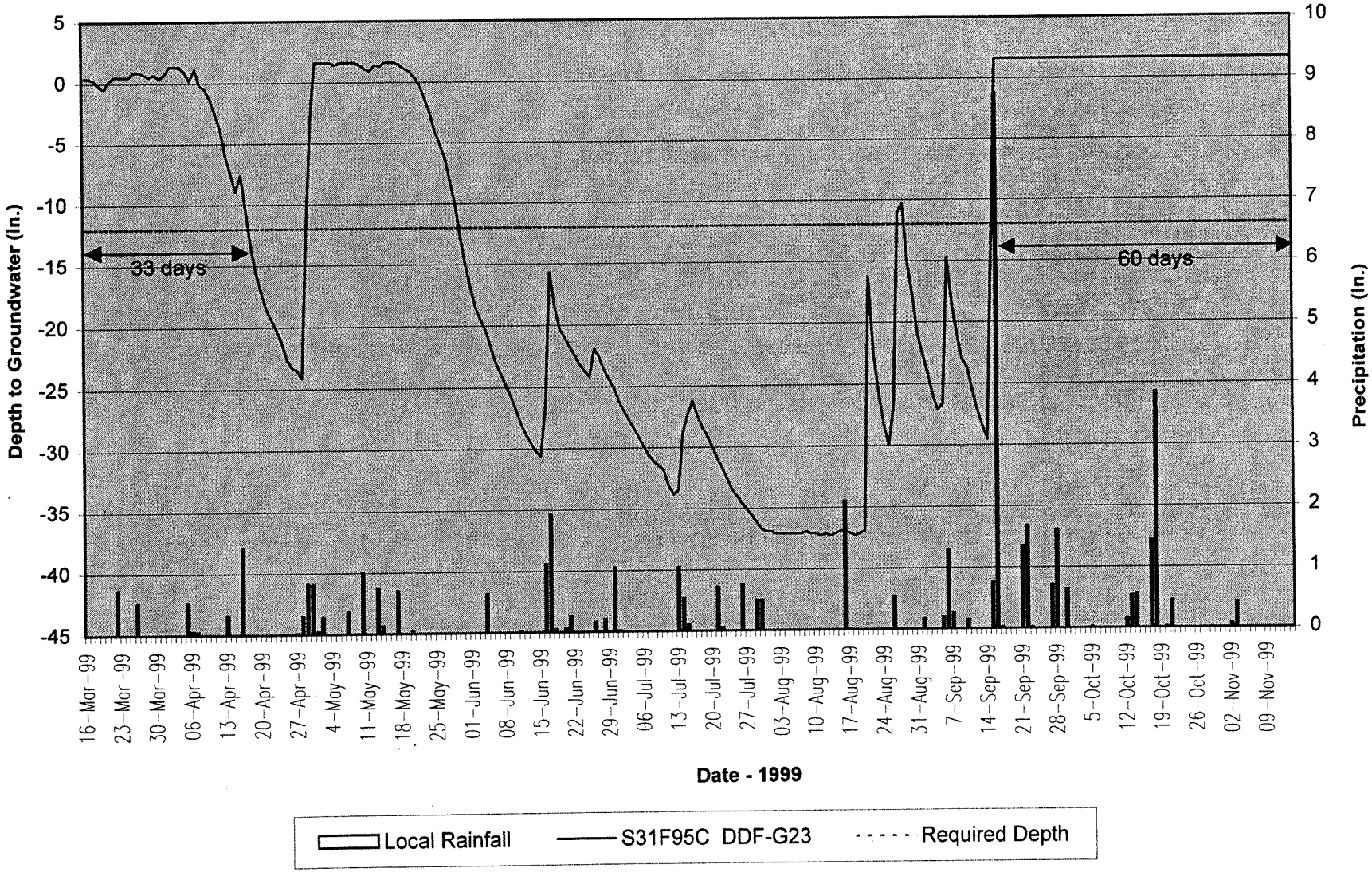


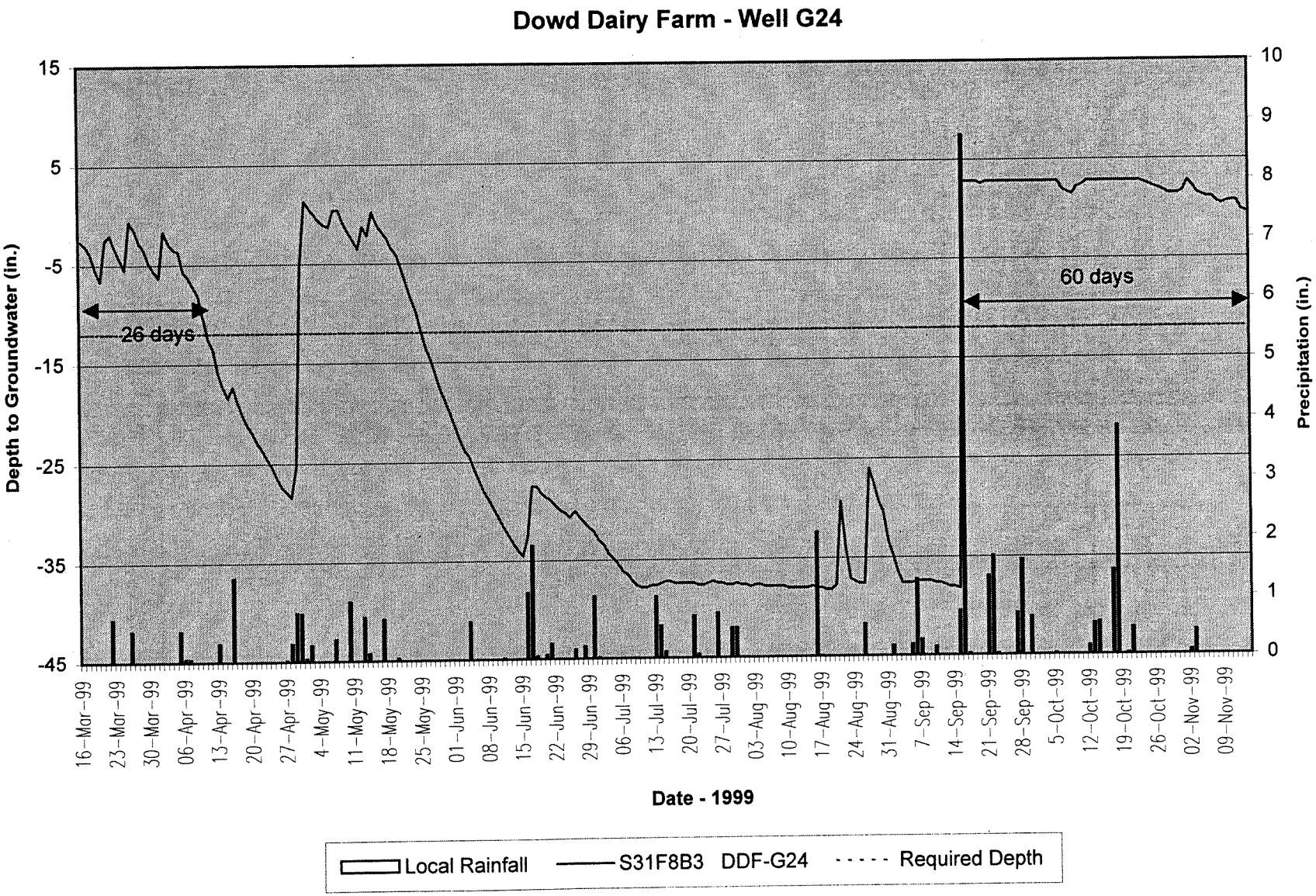
Dowd Dairy Farm - Well G21

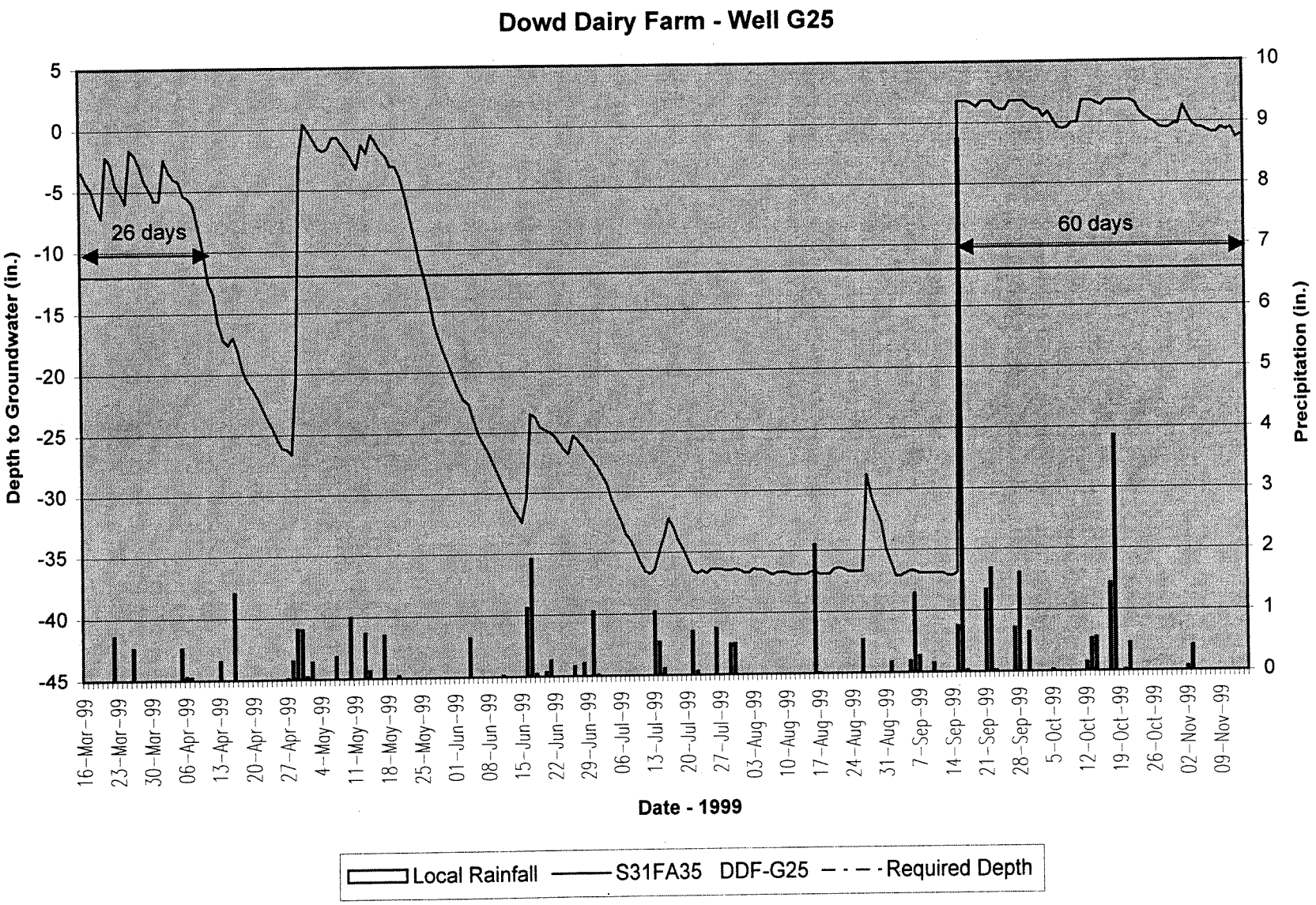



Dowd Dairy Farm - Well G22
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
10
9
8
7
6
5
4
3
2
1
0
26 days
60 days
16-Mar-99
23-Mar-99
30-Mar-99
06-Apr-99
13-Apr-99
20-Apr-99
27-Apr-99
4-May-99
11-May-99
18-May-99
25-May-99
01-Jun-99
08-Jun-99
15-Jun-99
22-Jun-99
29-Jun-99
06-Jul-99
13-Jul-99
20-Jul-99
27-Jul-99
03-Aug-99
10-Aug-99
17-Aug-99
24-Aug-99
31-Aug-99
7-Sep-99
14-Sep-99
21-Sep-99
28-Sep-99
5-Oct-99
12-Oct-99
19-Oct-99
26-Oct-99
02-Nov-99
09-Nov-99
Date -1999
Local Rainfall
S31F7ED DDF-G22
Required Depth

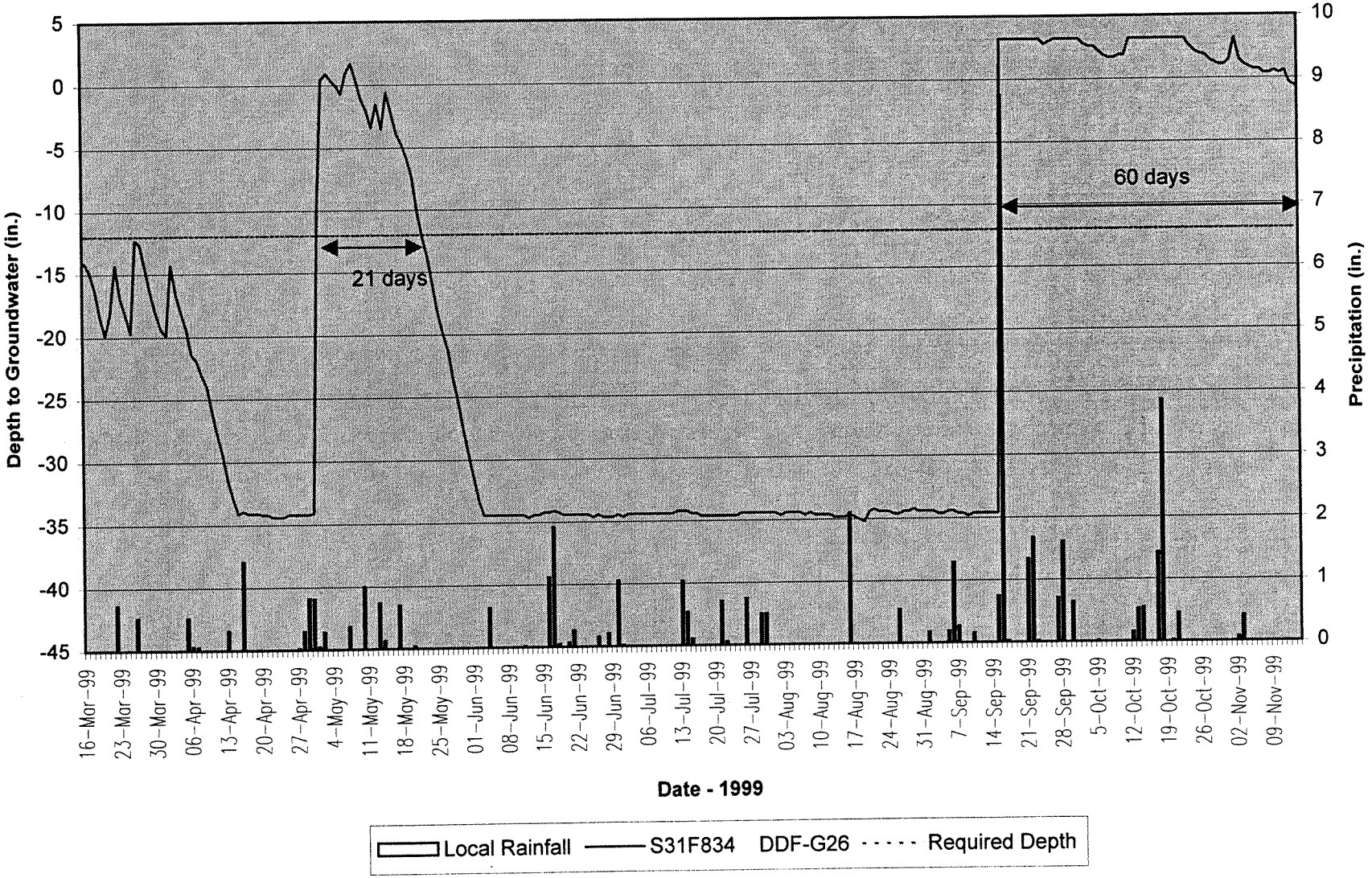
Dowd Dairy Farm - Well G23

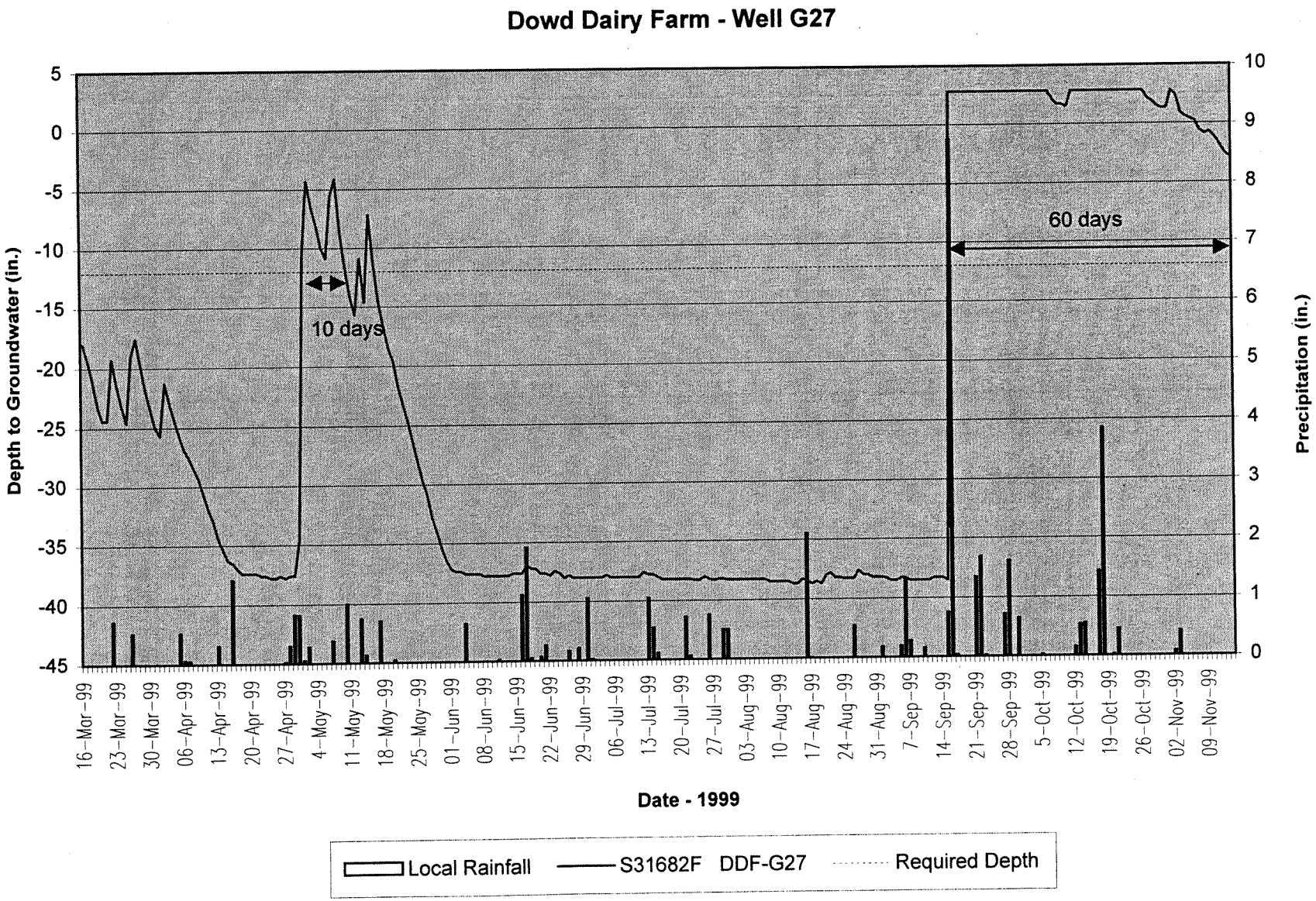


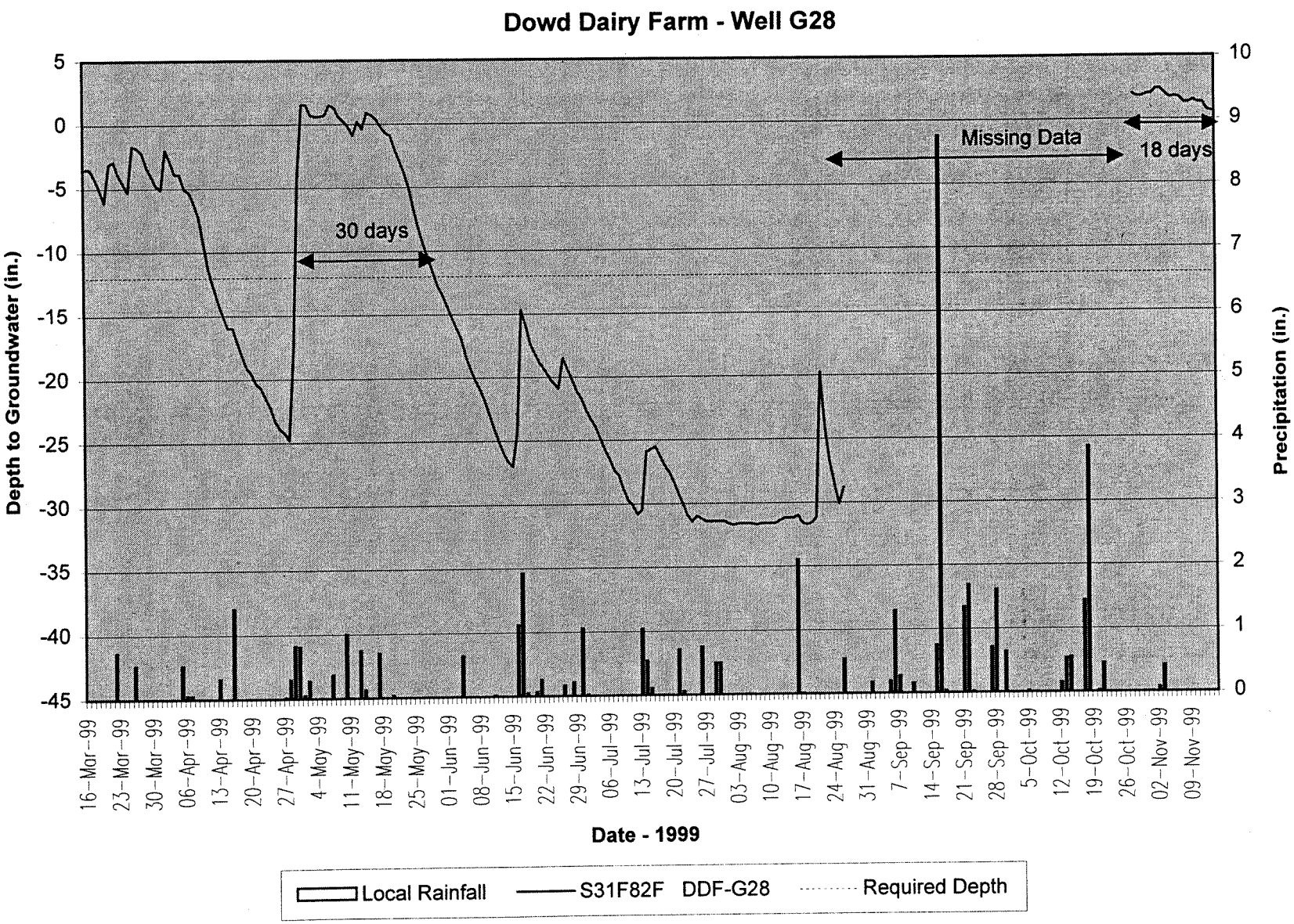

Dowd Dairy Farm - Well G24
Depth to Groundwater (in.)
Precipitation (in.)
15
5
-5
-15
-25
-35
-45
10
9
8
7
6
5
4
3
2
1
0
26 days
60 days
16-Mar-99
23-Mar-99
30-Mar-99
06-Apr-99
13-Apr-99
20-Apr-99
27-Apr-99
4-May-99
11-May-99
18-May-99
25-May-99
01-Jun-99
08-Jun-99
15-Jun-99
22-Jun-99
29-Jun-99
06-Jul-99
13-Jul-99
20-Jul-99
27-Jul-99
03-Aug-99
10-Aug-99
17-Aug-99
24-Aug-99
31-Aug-99
7-Sep-99
14-Sep-99
21-Sep-99
28-Sep-99
5-Oct-99
12-Oct-99
19-Oct-99
26-Oct-99
02-Nov-99
09-Nov-99
Date - 1999
Local Rainfall
S31F8B3 DDF-G24
Required Depth

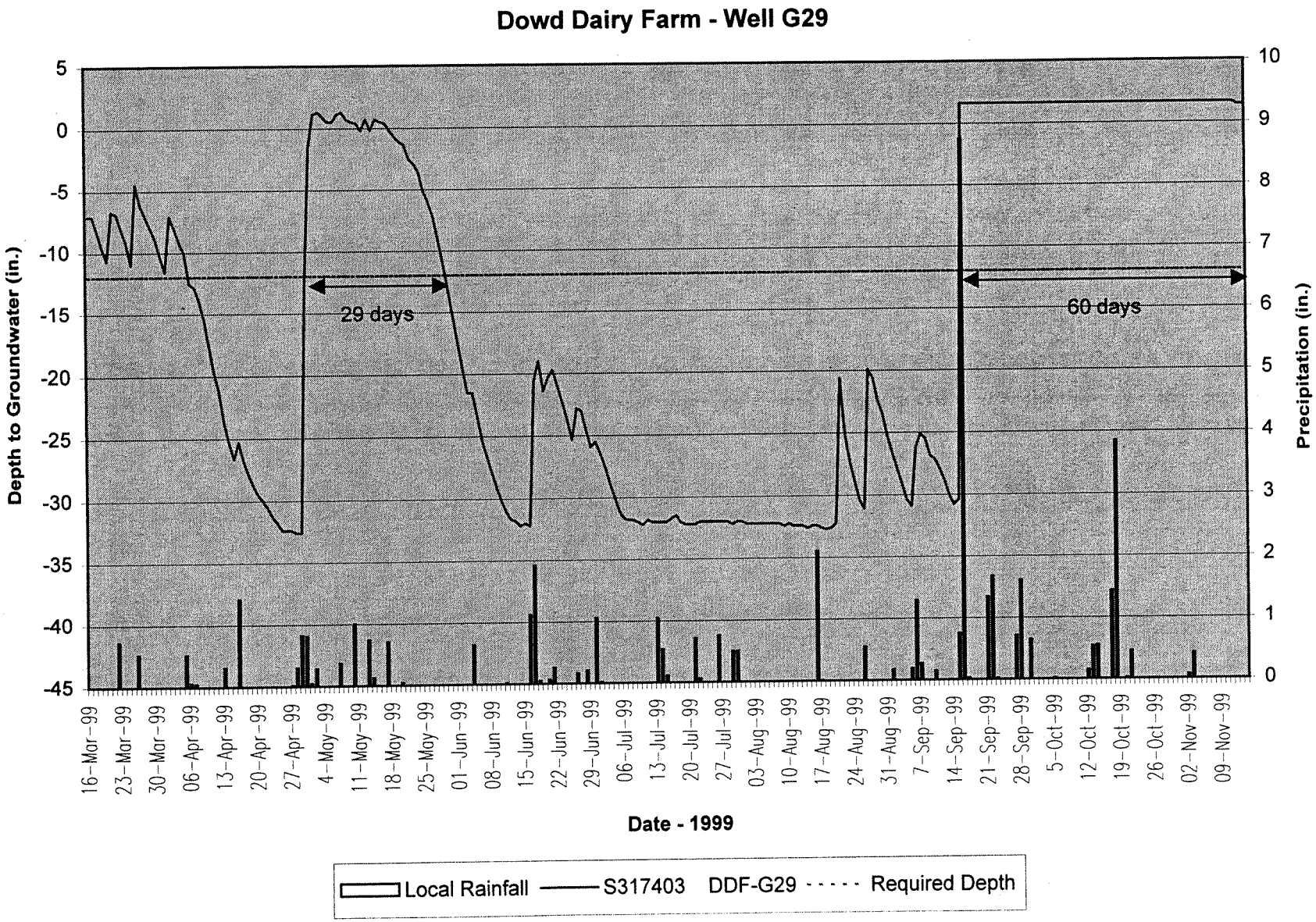

Dowd Dairy Farm - Well G25
Depth to Groundwater (in.)
Precipitation (in.)
26 days
60 days
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
10
9
8
7
6
5
4
3
2
1
0
16-Mar-99
23-Mar-99
30-Mar-99
06-Apr-99
13-Apr-99
20-Apr-99
27-Apr-99
4-May-99
11-May-99
18-May-99
25-May-99
01-Jun-99
08-Jun-99
15-Jun-99
22-Jun-99
29-Jun-99
06-Jul-99
13-Jul-99
20-Jul-99
27-Jul-99
03-Aug-99
10-Aug-99
17-Aug-99
24-Aug-99
31-Aug-99
7-Sep-99
14-Sep-99
21-Sep-99
28-Sep-99
5-Oct-99
12-Oct-99
19-Oct-99
26-Oct-99
02-Nov-99
09-Nov-99
Date - 1999
Local Rainfall
S31FA35 DDF-G25
Required Depth

Dowd Dairy Farm - Well G26

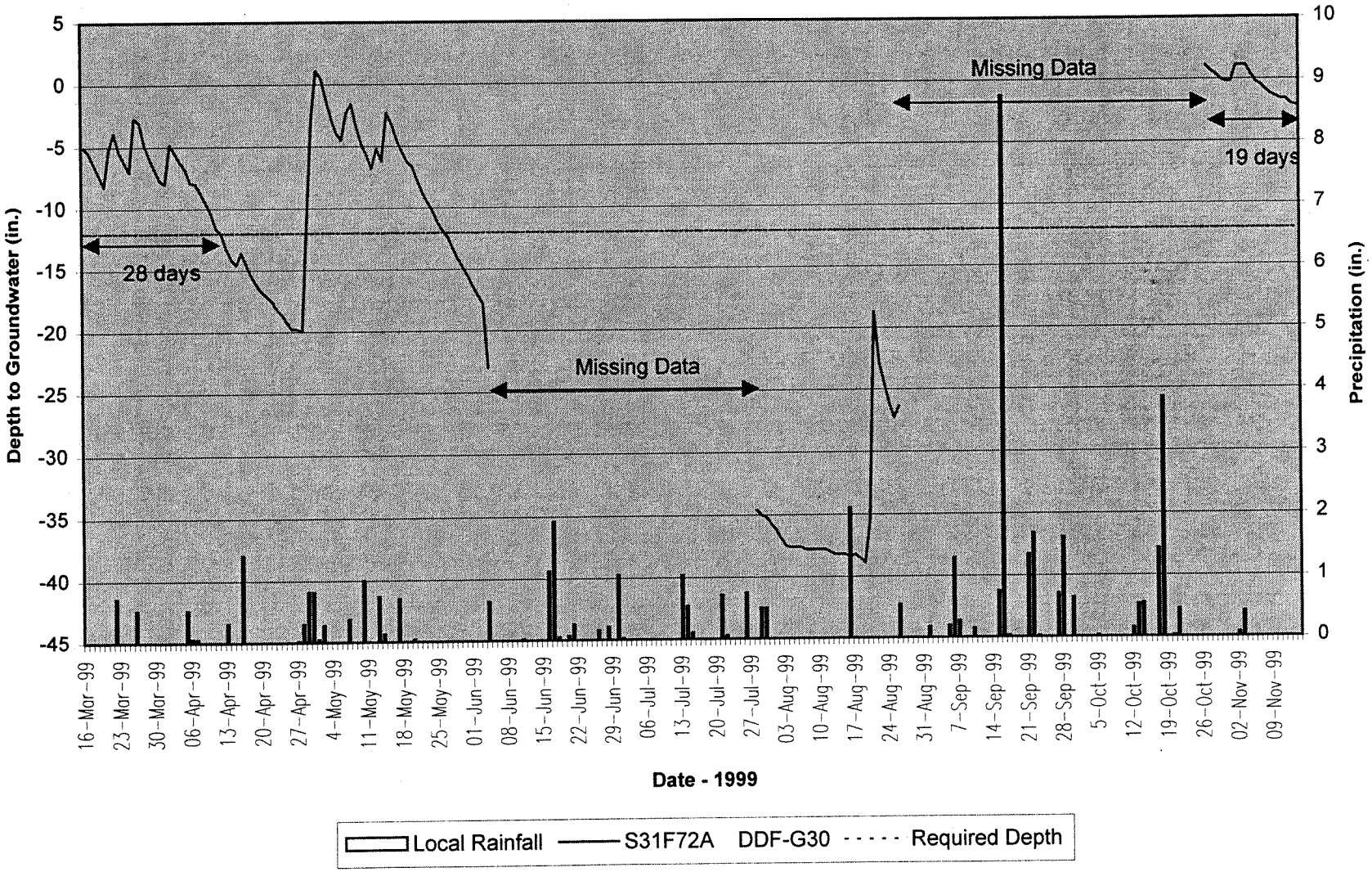


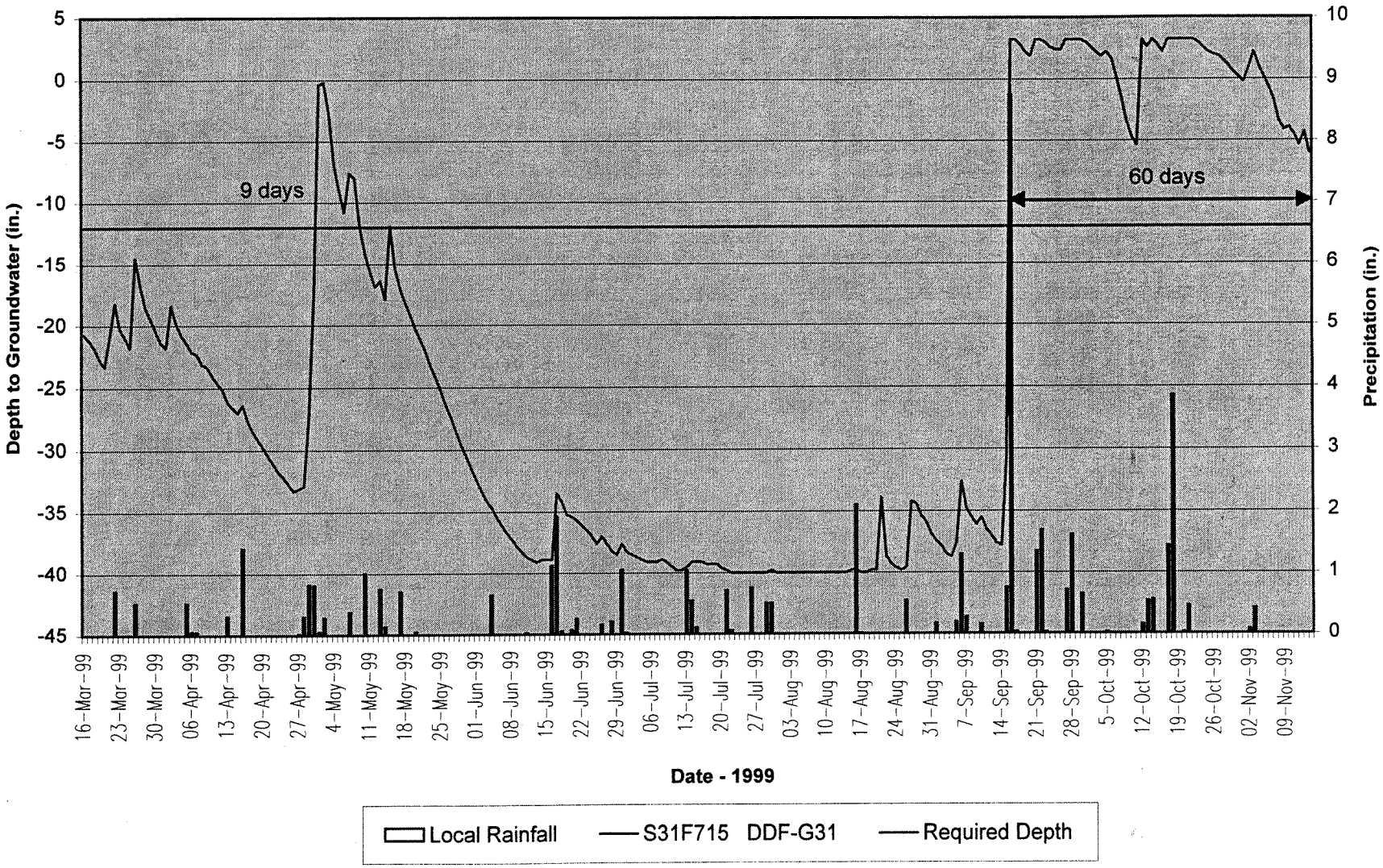

Dowd Dairy Farm - Well G27
Depth to Groundwater (in.)
Precipitation (in.)
10 days
60 days
Date - 1999
Local Rainfall
S31682F DDF-G27
Required Depth

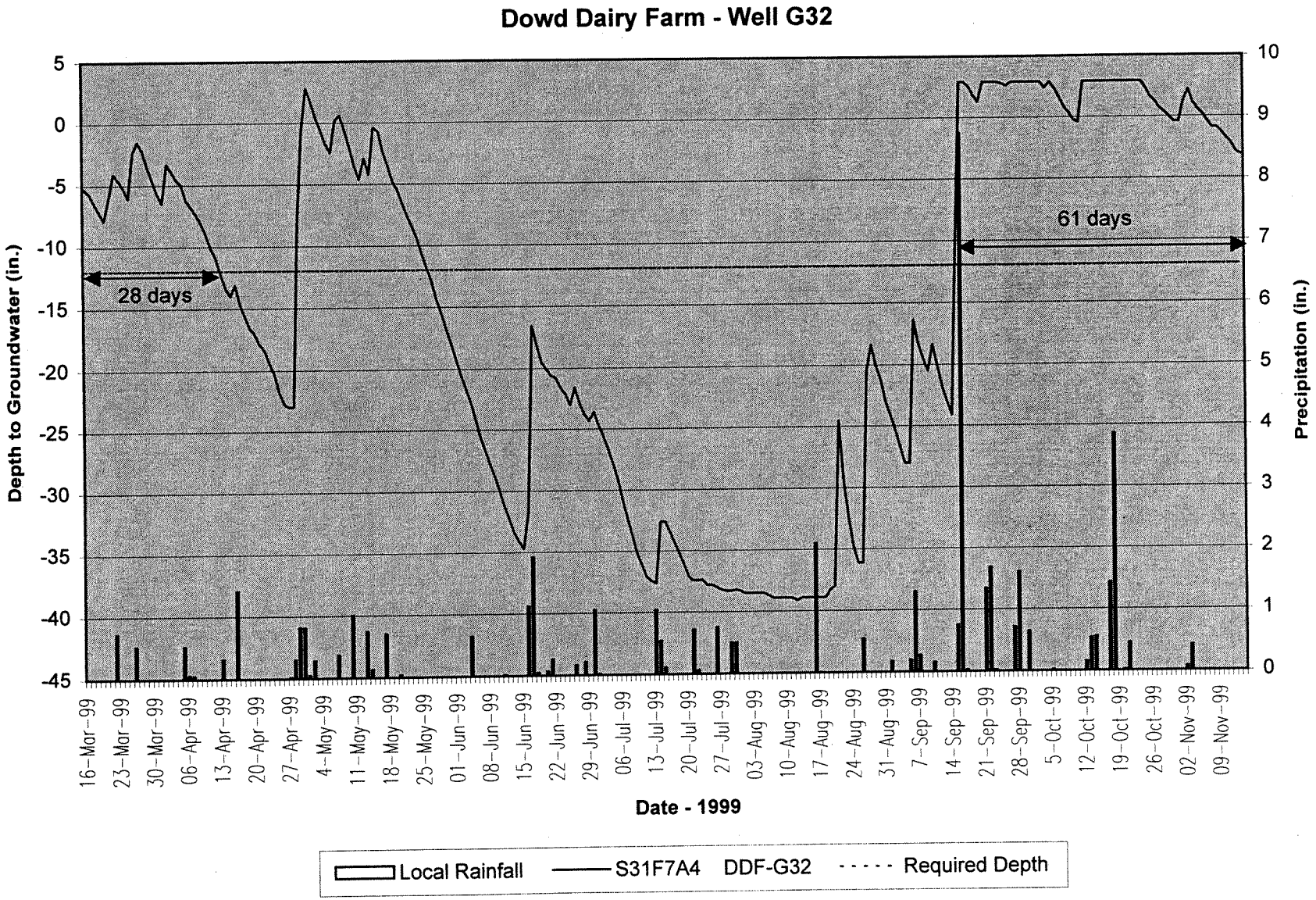

Dowd Dairy Farm - Well G28
Depth to Groundwater (in.)
Precipitation (in.)
30 days
Missing Data
18 days
Date - 1999
Local Rainfall
S31F82F DDF-G28
Required Depth


Dowd Dairy Farm - Well G29
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
10
9
8
7
6
5
4
3
2
1
0
29 days
60 days
16-Mar-99
23-Mar-99
30-Mar-99
06-Apr-99
13-Apr-99
20-Apr-99
27-Apr-99
4-May-99
11-May-99
18-May-99
25-May-99
01-Jun-99
08-Jun-99
15-Jun-99
22-Jun-99
29-Jun-99
06-Jul-99
13-Jul-99
20-Jul-99
27-Jul-99
03-Aug-99
10-Aug-99
17-Aug-99
24-Aug-99
31-Aug-99
7-Sep-99
14-Sep-99
21-Sep-99
28-Sep-99
5-Oct-99
12-Oct-99
19-Oct-99
26-Oct-99
02-Nov-99
09-Nov-99
Date - 1999
Local Rainfall
S317403 DDF-G29
Required Depth

Dowd Dairy Farm - Well G30




Dowd Dairy Farm - Well G31
Depth to Groundwater (in.)
Precipitation (in.)
9 days
60 days
Date - 1999
Local Rainfall
S31F715 DDF-G31
Required Depth


Dowd Dairy Farm - Well G32
Depth to Groundwater (in.)
Precipitation (in.)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
10
9
8
7
6
5
4
3
2
1
0
28 days
61 days
16-Mar-99
23-Mar-99
30-Mar-99
06-Apr-99
13-Apr-99
20-Apr-99
27-Apr-99
4-May-99
11-May-99
18-May-99
25-May-99
01-Jun-99
08-Jun-99
15-Jun-99
22-Jun-99
29-Jun-99
06-Jul-99
13-Jul-99
20-Jul-99
27-Jul-99
03-Aug-99
10-Aug-99
17-Aug-99
24-Aug-99
31-Aug-99
7-Sep-99
14-Sep-99
21-Sep-99
28-Sep-99
5-Oct-99
12-Oct-99
19-Oct-99
26-Oct-99
02-Nov-99
09-Nov-99
Date - 1999
Local Rainfall
S31F7A4 DDF-G32
Required Depth

APPENDIX B

SITE PHOTOS

DOWD DAIRY

Photo Point 1

Photo Point 2

Photo Point 3

Photo Point 4

Photo Point 5

Photo Point 6

1999

DOWD DAIRY

Photo Point 7

Photo Point 8

Photo Point 9

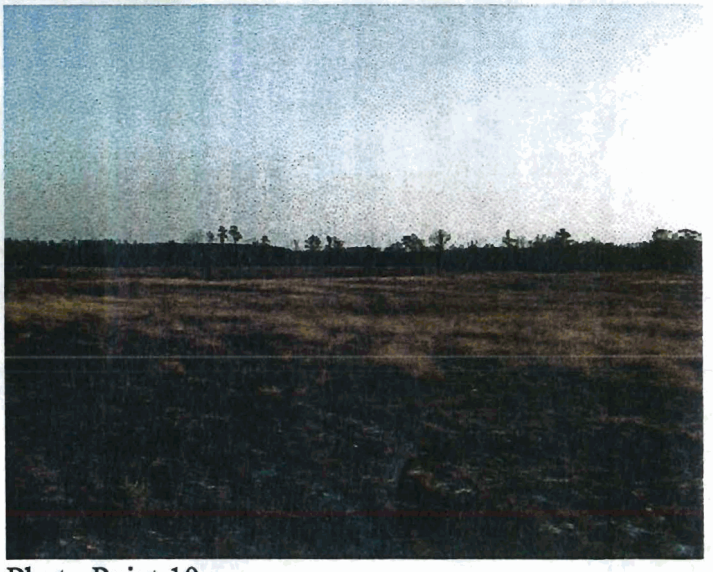


Photo Point 10

Photo Point 11

Photo Point 12

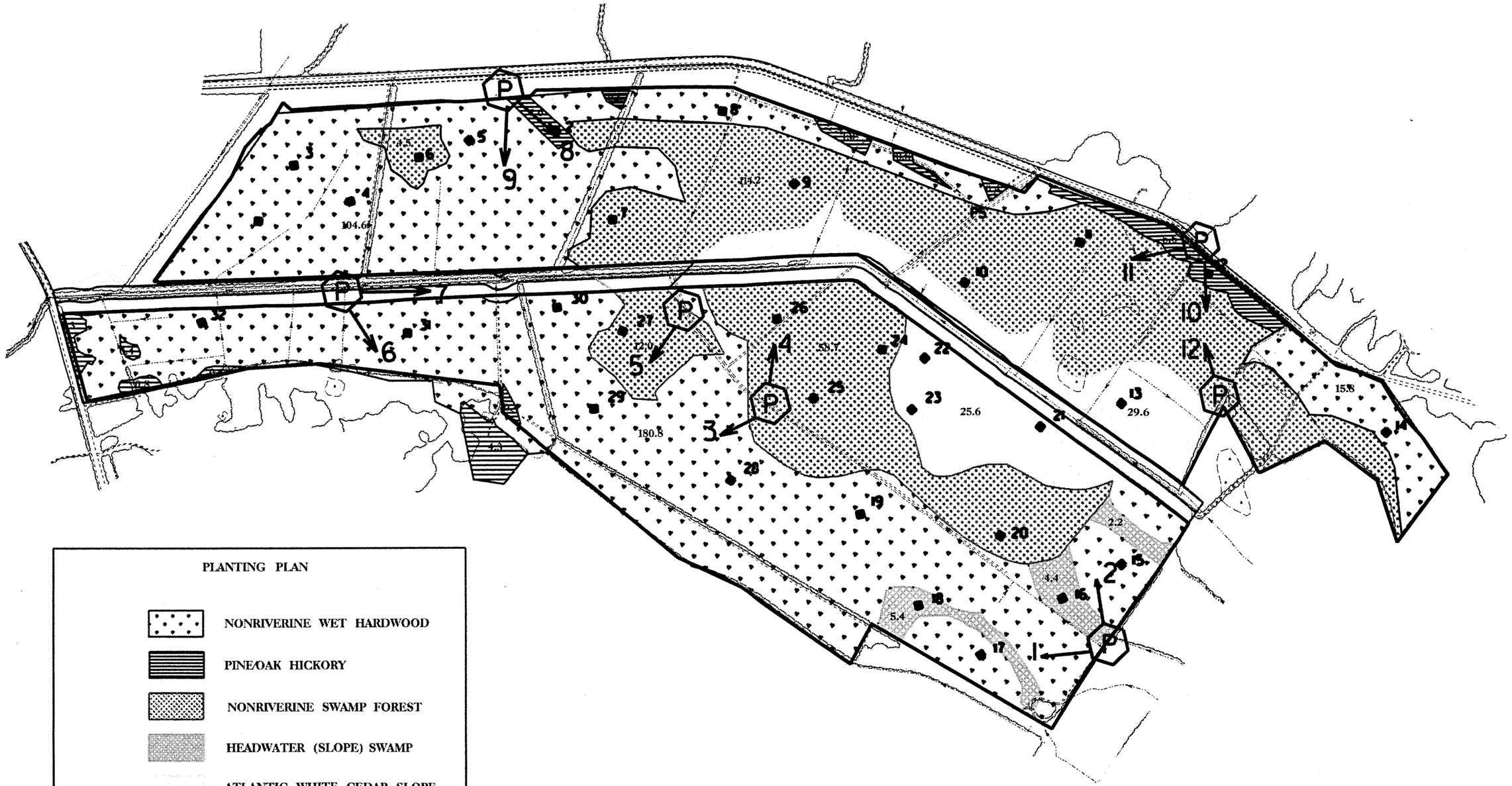
1999

APPENDIX C

PHOTO POINTS AND VEGETATION PLOTS

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

BLADEN COUNTY, NORTH CAROLINA
DOWD DAIRY FARM MITIGATION PLANTING PLAN PHASE I
PHOTO AND VEGETATION PLOT LOCATIONS



PLANTING PLAN

- NONRIVERINE WET HARDWOOD
- PINE/OAK HICKORY
- NONRIVERINE SWAMP FOREST
- HEADWATER (SLOPE) SWAMP
- ATLANTIC WHITE CEDAR SLOPE
- VEGETATION MONITORING PLOTS
- PHOTOGRAPH LOCATIONS (P)

RWGjr 699