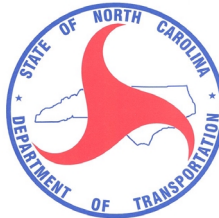


# ANNUAL REPORT FOR 2000



**Ballance Farm Mitigation Site  
Currituck County  
Project No. 6.049008T  
TIP No. R-2228WM**



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## SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Ballance Farm Mitigation Site. This is the second year the site has been monitored for vegetation and hydrologic success. The site must demonstrate both hydrologic and vegetation success for a minimum of five years.

The Ballance Farm site contains 28 groundwater monitoring gauges and 11 surface gauges. This reflects a change from 17 groundwater monitoring gauges and 14 surface gauges from last year's monitoring report. The original 17 gauges were placed soon after the site was constructed. The site was extremely wet and gauges were installed in the drier, and therefore higher, locations across the site. This along with a drier than average year in 1999 resulted in 5 of the 17 gauges recording success for 12.5% of the 1999 growing season. NCDOT installed an additional 11 groundwater gauges across the site at more elevation-representative locations. The original 17 gauges remained in place and in use for the 2000 monitoring period. Of the surface gauges installed in 1999, three (BFSG-4, -6, and -10) were removed because they were located in areas outside the marsh creation area and at such a high elevation that they did not record inundation except during Hurricane Floyd. Surface gauges BFSG-2, -3, -12, and -13 were relocated at varying distances from the centerline of the constructed channel to better record inundation. The surface gauges not pulled or relocated remained in place and in use for the 2000 monitoring period. The site also contains 21 plots monitoring trees and 221 plots monitoring the marsh area.

In 1999 the local weather station rainfall data was used for the site analysis. The daily rainfall on was recorded at Elizabeth City as reported by the NC State Climate Office (NCSCO). This data was used in 1999 because the on-site rainfall gauges installed in 1999 proved to be unreliable. An Infinities tipping bucket rain gauge was installed in May 2000 and it is expected to provide reliable data for all future monitoring reports beginning in 2001. Rain data from the NCSCO was used for the year 2000-site analysis.

Success criteria are based on federal guidelines for wetland mitigation (as well as a comparison to the hydrology of an undisturbed coastal marsh reference ecosystem located along Tull Creek and an undisturbed forested wetland reference ecosystem referred to as the Richard's property). These guidelines stipulate criteria for both hydrologic conditions and vegetation survival. Unfortunately, the groundwater monitoring gauges were not installed at the Richard's property, however this forested wetland reference ecosystem exhibited evidence of extended saturation on two visits to the site. Gauges will be installed at this reference ecosystem prior to the 2001-monitoring season. Surface gauges BFSG-2 and BFSG-9 are located in the reference coastal marsh onsite at Ballance Farm located along Tull Creek.

Hydrologic monitoring indicated that of the 28 groundwater gauges on site, 19 showed saturation for over 12.5% of the growing season, 6 gauges showed saturation between 8 – 12.5% of the growing season, and gauge BF-10 did not

show saturation to within 12 inches of the surface for the entire growing season. Eight of the 11 surface gauges recorded inundation for greater than 12.5% of the growing season, one recorded inundation between 8% and 12.5% of the growing season, and 2 showed inundation between 5% and 8% of the growing season. BFSG-1 had no data for the last month of the growing season.

This is the second year of vegetative monitoring for the forested restoration areas. Of the 430 acres of this site, approximately 223 involved tree planting. There were 21 (50' x 50' plots established throughout the planting areas, encompassing all plant communities. The vegetation monitoring of the planted area revealed the average density to be 466 trees per acre, which is well above the 320 trees per acre required by the minimum success criteria for three years.

Of the 430 acres of this site, approximately 48 acres involved marsh grass planting. There were 500 random (1m x 1m) plots established throughout the planting areas, encompassing all plant communities. These plots were located with GPS. The marsh was replanted in June. The percent frequency of target specie (planted species) is 54.5% as monitored. As expected, the vegetative coverage and frequency of target species does not meet the success criteria of 70%; however the coverage has increased since planting. The initial plantings are continuing to increase in cover. The vegetative cover scale value is 1.84, and the required vegetative scale value for year 5 is 5.

Based on the hydrologic and vegetation monitoring, the Ballance Farm Mitigation Site met success criteria across the majority of the site during the 2000-growing season. NCDOT recommends that monitoring continue.

## 1.0 INTRODUCTION

### 1.1 Project Description

The Ballance Farm Mitigation Site is located in Currituck County (Figure 1). The property was originally a 469-acre site out of which NCDOT purchased 430 acres. The mitigation site consisted of 297 acres of agricultural fields, 50 acres of tidal freshwater marsh, 51 acres of forested wetland, 5.3 acres of forested uplands, and 26 acres of roads, ditches and so on. It was designed to mitigate for the widening of NC 168 (TIP Project R-2228); the project includes the creation of coastal marsh wetland and the preservation of forested wetlands and forested upland areas. According to the Ballance Farm Mitigation Plan, implementation of the site was to provide 61 acres of marsh creation, 236 acres of forested wetland restoration, 51 acres of forested wetland preservation, 50 acres of coastal marsh preservation, and 5.3 acres of upland habitat preservation. However, based on recent GPS data and ground observation, approximately 13 acres of the zone C1 marsh creation area appears to have been graded incorrectly. NCDOT will obtain controlled aerial photography of the mitigation site to determine the as-built condition of the site.

The Final Mitigation Plan for this site was issued on April 1, 1996. Initial construction was completed in late 1998. The site was planted and monitoring gauges installed in early 1999. This monitoring report presents the second year results of both hydrologic and vegetation monitoring.

### 1.2 Purpose

In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for a minimum of five consecutive years. Success criteria are based on federal guidelines for wetland mitigation (as well as a comparison to the hydrology of an undisturbed coastal marsh reference ecosystem and an undisturbed-forested wetland reference ecosystem). These guidelines stipulate criteria for both hydrologic conditions and vegetation survival. The following report details the results of hydrologic and vegetative monitoring during the year 2000 at the Ballance Farm Mitigation Site as well as local climate conditions throughout the growing season.

### 1.3 Project History

Fall 1998	Site Constructed
Spring 1999	Site Planted
November 1999	Vegetation Monitoring (1 yr.)
March 2000	Hardwood Herbicide Treatment
June 2000	Marsh Re-planted
October 2000	Hardwood Vegetation Monitoring (2 yr.)
October-November 2000	Marsh Vegetation Monitoring (1 yr.)

## **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 groundwater for at least a consecutive 12.5% of the growing season. Areas inundated or saturated for less than 5% of the growing season are always classified as non-wetlands. Areas inundated or saturated between 5% - 12.5% of the growing season can be classified as wetlands depending upon factors such as the presence of wetland vegetation and hydric soils.

The growing season in Currituck County begins March 20 and ends November 13. These dates correspond to a 50% probability that temperatures will drop to 28°F or lower after March 20 and before November 13.<sup>1</sup> The growing season is 239 days; therefore, optimum hydrology requires 12.5% of this season, or at least 30 consecutive days. Local climate must also represent average conditions for the area.

Based on the Ballance Farm Mitigation Plan, hydrologic success of the created coastal marsh is dependent on the groundwater levels occurring at depths similar to those in the adjoining reference coastal marsh.

Based on coordination with the Corps of Engineers after completion of the Ballance Farm Mitigation Plan, the created forested wetland will be considered successful if hydrology on-site is consistent with reference ecosystem referred to as the Richards' property.

### **2.2 Hydrologic Description**

In early 1999, seventeen monitoring gauges, one rain gauge, and fourteen surface water gauges were installed. In early 2000, eleven additional groundwater-monitoring gauges were installed, and seven surface water gauges were either removed or relocated to more adequately monitor the marsh area. The number of surface water gauges on-site is eleven (Figure 2). The automatic monitoring gauges record daily readings of groundwater depth and the surface gauges record daily readings of surface water depth.

The Ballance Farm site involved the construction and planting of a tidal marsh system by grading the site to match the topography of the existing system located along Tull Creek and by constructing large channels connecting Roland Creek, Tull Creek, and a tributary to Tull Creek. This connectivity will allow for tidal flushing of the constructed coastal marsh. This work created a 400-foot wide band of coastal marsh area that resulted in approximately 61 acres of coastal marsh created. In the existing agricultural fields, the field crowns were

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<sup>1</sup> Natural Resources Conservation Service, Soil Survey of Currituck County, North Carolina, p.71.

graded down, the field ditches were filled and plugged, and this area planted resulting in the restoration of approximately 236 acres of forested wetlands.

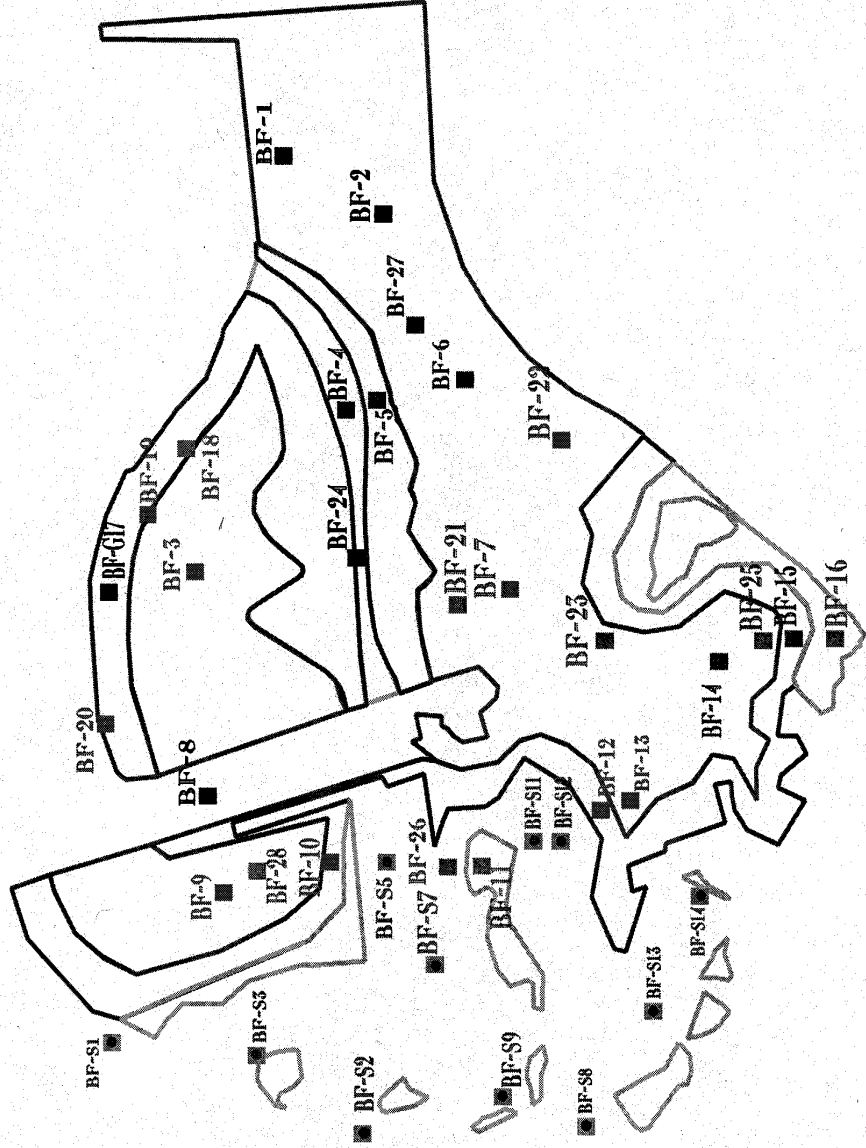
This should provide adequate hydrologic input from the adjacent creeks and rainfall to sustain the necessary hydrology for this site. The hydrologic monitoring should show the reaction of the groundwater level to specific tidal and rainfall events.





**FIGURE 1: VICINITY MAP**

**BALLANCE FARM GAUGE LOCATIONS**



**FIGURE 2**

## 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 239-day growing season. The results are presented in Tables 1A and 1B. Appendix A contains a plot of the groundwater depth for each monitoring gauge and the surface water depth recorded by the surface gauge. The maximum number of consecutive days is noted on each graph. The individual precipitation events, shown on the monitoring gauge graphs as bars, represent data collected from an Elizabeth City weather station. This data was provided by the NC State Climate Office. The Infinities rain gauge that is currently located on the site will be utilized for the 2001 monitoring season, thus eliminating the need to use official rainfall information on the monitoring gauge graphs. Figure 3 is a graphical representation of the hydrologic monitoring results.

Table 1A  
HYDROLOGIC MONITORING RESULTS (GROUNDWATER GAUGES)

Monitoring Gauge	< 5%	5% - 8%	8% - 12.5%	> 12.5%	Actual %	Success Dates
BF-1				✓	93.7	Mar. 20 - Oct. 29
BF-2				✓	32.6	Jul. 23 - Oct. 8
BF-3			✓		9.6	Apr. 16 - May 8
BF-4				✓	94.6	Mar. 20 - Oct. 31
BF-5			✓		10.0	Apr. 15 - May 8
BF-6				✓	17.2	Aug. 28 - Oct. 7
BF-7			✓		9.2	Apr. 16 - May 7
BF-8				✓	22.2	Mar. 20 - May 11
BF-9			✓		9.6	Apr. 15 - May 7
BF-10	✓				0	None
BF-11			✓		9.6	Apr. 15 - May 7
BF-12			✓		10.0	Apr. 16 - May 9
BF-13				✓	30.2	Jul. 23 - Oct. 9
BF-14				✓	30.2	Jul. 23 - Oct. 9
BF-15				✓	100.0	Mar. 20 - Nov. 13
BF-16				✓	17.2	July 23 - Sept. 1
BF-17				✓	32.6	Jul. 25 - Oct. 10
BF-18				✓	21.3	Mar. 24 - May 13
BF-19				✓	33.9	Jul. 23 - Oct. 11
BF-20				✓	34.3	Jul. 25 - Oct. 14
BF-21				✓	17.2	Aug. 28 - Oct. 7
BF-22				✓	32.6	Jul. 23 - Oct. 8
BF-23		✓				Battery problems
BF-24				✓	35.6	Jul. 23 - Oct. 15
BF-25				✓	32.2	Jul. 23 - Oct. 7
BF-26				✓	96.2	Mar. 29 - Nov. 13
BF-27				✓	32.6	Jul. 24 - Oct. 9
BF-28				✓	36.8	Mar. 26 - Mar. 31

The gauges above are located in the created forested wetland areas of the Ballance Farm site with the exception of gauges BF-8 and BF-26 which are

located in the preserved forested wetland areas. The elevations taken in the vicinity of each gauge in the created-forested wetland ranged from 3.3 feet to 6.2 feet with the majority of the elevations in the 4.5-foot range. Of the 28 gauges installed, 20 gauges showed saturation for at least 12.5% of the growing season, 6 gauges showed saturation for at least 9.2 % of the growing season, 1 gauge (BF-10) showed no saturation within 12 inches of the surface, and gauge BF-23 malfunctioned three times causing data loss. Gauge BF-23 was replaced in November 2000.

It is interesting to note that the majority of the 6 gauges showing saturation between 8% and 12.5% of the growing season were located at elevations in the 4.6 to 6.2 foot range. The gauges at elevations in the 4.1 to 4.5-foot range, showed saturation between the 17% and 30% of the growing season. Generally, the gauges at elevations less than 4.1 feet showed saturation greater than 30% of the growing season.

Gauge BF-10 is situated at a 5.5-foot elevation and the groundwater was recorded consistently at 20 inches below the surface. This is consistent with its 1999 performance. Reviewing the closest adjacent gauges, BF-9 and BF-28, BF-9 is at elevation 5.1 feet and recorded groundwater within 12 inches of the surface for 9.2% of the growing season. BF-28 is at elevation 4.4 feet and recorded groundwater within 12 inches of the surface for 36.8% of the growing season. There is a difference in elevation of 13 inches between BF-10 and BF-28. BF-28 is situated at an elevation that is more representative of the surrounding area where BF-10 is situated in a locally high area that is not representative of the surrounding area. On one site visit it was noted that flooded conditions were noted in the vicinity of gauges BF-1, BF-4, BF-18, BF-19, BF-20, BF-24, BF-26, and BF-28.

As noted previously, the reference ecosystem (the Richards' property) for the created-forested wetland will have gauges installed prior to the 2001-monitoring season. On two trips to the property, the site has exhibited evidence of soil saturation over an extended period of time in excess of the 12.5% of the growing season standard; that is, the reference ecosystem is very wet.

Table 1B  
HYDROLOGIC MONITORING RESULTS (SURFACE GAUGES)

Monitoring Gauge	< 5%	5% - 8%	8% - 12.5%	> 12.5%	Actual %	Success Dates
BFSG-1				✓	40.6	May 18 – Aug. 22
BFSG-2				✓	31.4	June 9 – Aug. 22
BFSG-3				✓	59.8	June 8 – Oct. 28
BFSG-5		✓			7.1	Mar. 20 - Oct. 31
BFSG-7				✓	40.6	May 16 – Aug. 20
BFSG-8		✓			6.3	July 29 – Aug. 12
BFSG-9				✓	100.0	Mar. 20 – Nov. 13
BFSG-11				✓	46.9	June 10 – Sept. 29
BFSG-12				✓	63.2	May 17 – Oct. 14
BFSG-13				✓	97.8	Mar. 26 – Nov. 13
BFSG-14			✓		9.2	July 25 – Aug. 15

The surface gauges are located in the existing and created coastal marsh. Of the surface gauges installed in 1999, three (BFSG-4, -6, and -10) were removed because they were located in areas outside the marsh creation area and at such a high elevation that they did not record inundation except during Hurricane Floyd. Surface gauges BFSG-2, -3, -12, and -13 were relocated at varying distances from the centerline of the constructed channel to better record inundation. The surface gauges not pulled or relocated remained in place and in use for the 2000 monitoring period.

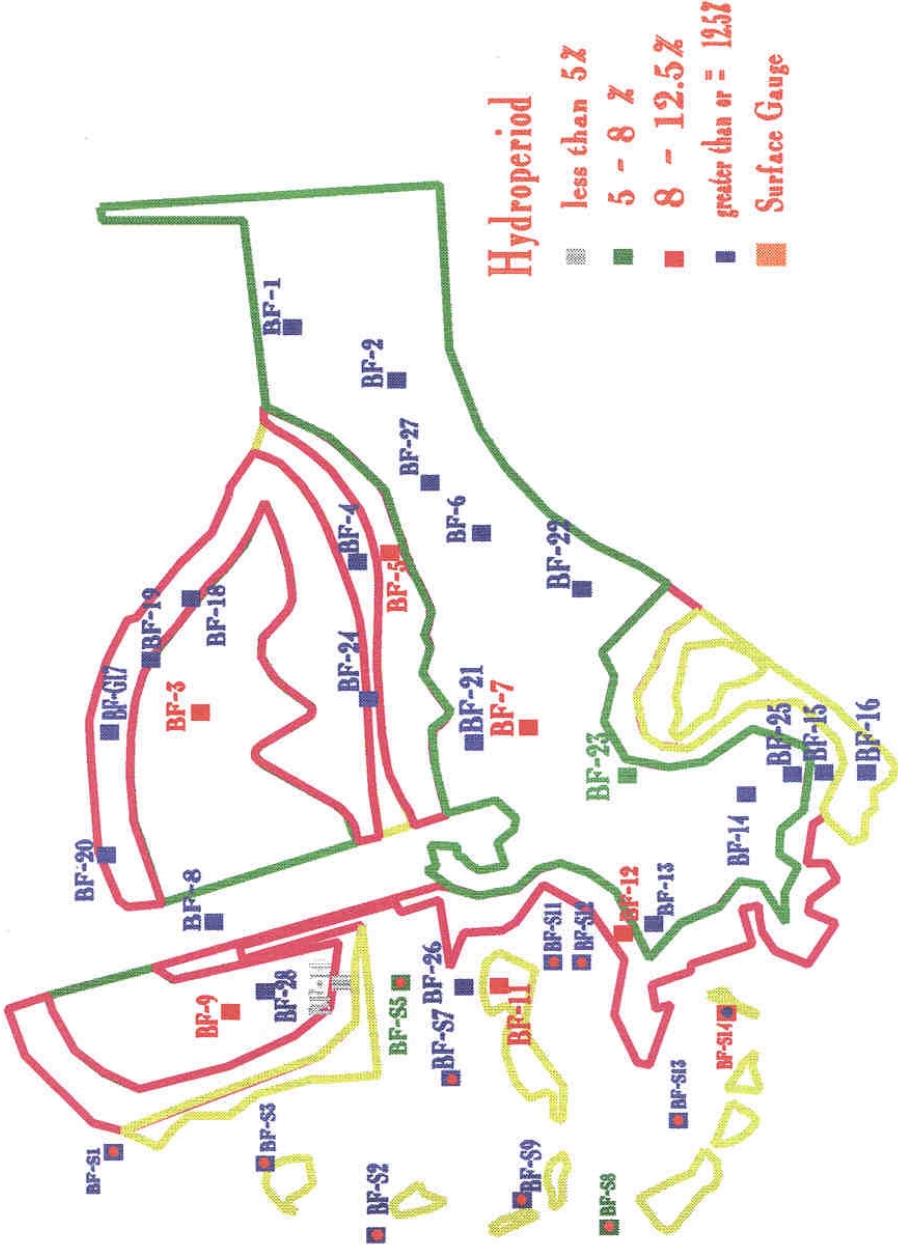
*Specific problems:* BF-23 experienced battery problems on three occasions and did not record data for the part of the growing season. BFSG -1 did not record data for the last month of the growing season. It was replaced in late November 2000. No problems other than the occasional dead battery or lack of access to gauges due to flooding were experienced.

### **2.3.2 Climatic Data**

Figure 4 represents an examination of the local climate in comparison with historical data to determine whether 2000 was “normal” in terms of climate conditions. The figure compares the rainfall from 2000 with that of historical rainfall (data collected between 1948 and 1996). All rainfall data was collected from the NC State Climate Office. The graph shows 2000 rainfall totals from January 2000 through the end of November 2000 which includes the growing season for this site. In the year 2000, February, March, and October had extremely below normal rainfall; July and November were below normal. May and June, showed significantly above average rainfall.

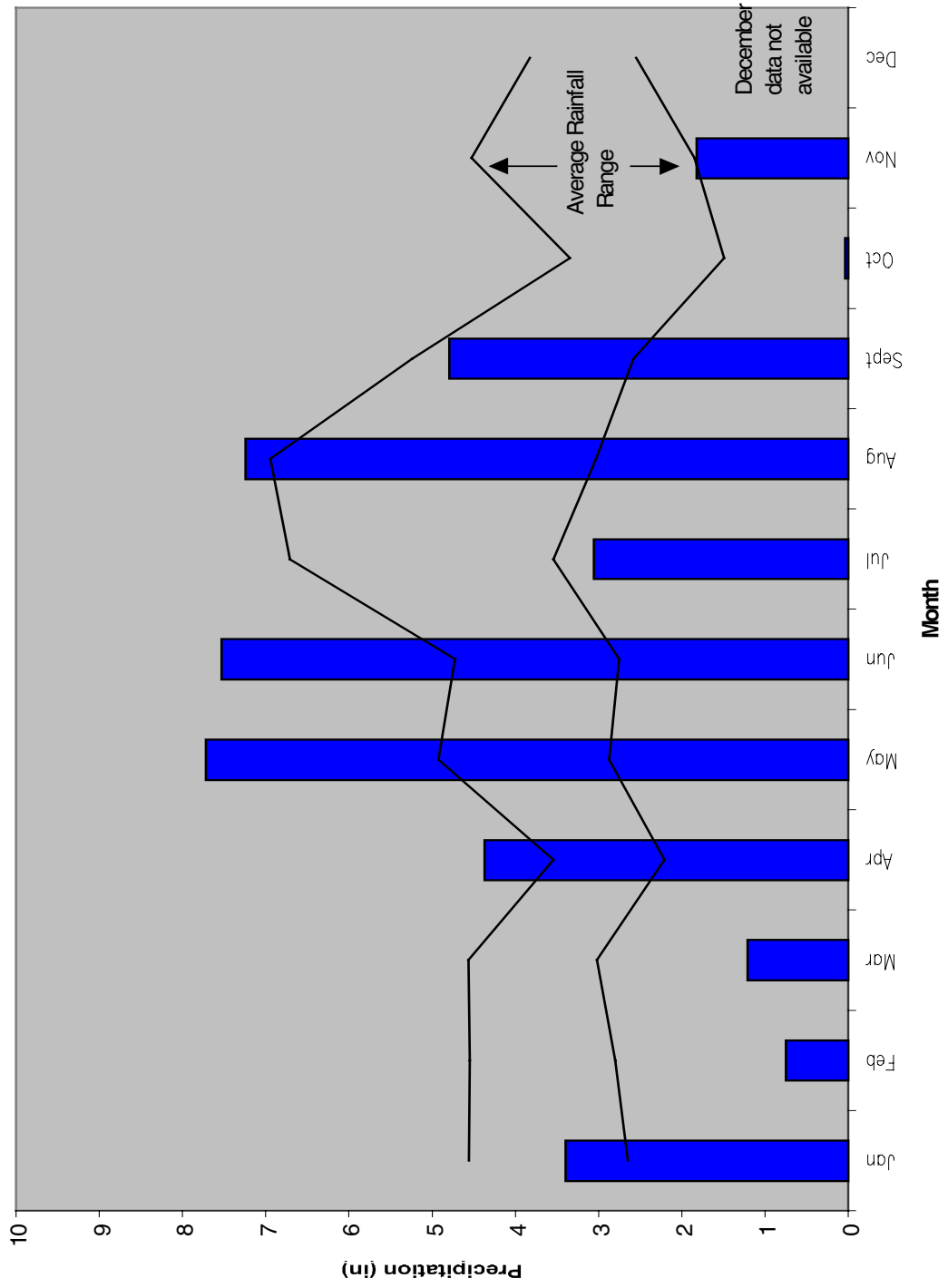
In 1999, 5 of 17 groundwater-monitoring gauges showed groundwater within 12 inches of the surface for 12.5% of the growing season during a below average rainfall year. In 2000, 10 of these same 17 gauges recorded groundwater within 12 inches of the surface for at least 12.5% of the growing season, while 5 of the 7 remaining gauges recorded at least 9.2%. Of the eleven additional groundwater gauges installed in 2000, all except BF-23 recorded groundwater elevation within 12 inches of the surface for at least 12.5% of the growing season. This is a marked improvement during a 9-month 2000-monitoring period that experienced 4 above average rainfall months, 4 below average rainfall months, and 1 average rainfall month. Also consider that a majority of the 1999 gauges are situated in locally elevated areas of the site that are not representative of the surrounding topography. The months of April, May, June, and August exhibited rainfall at or above the normal range with the May and June data being substantially above normal. These results contributed to the longer periods of saturation exhibited by the gauges. However, groundwater levels were maintained through the more normal rainfall periods of July, August and September and even into the low rainfall periods during October and November.

**BALANCE FARM GAUGE LOCATIONS  
2000 HYDROLOGIC MONITORING RESULTS**



**FIGURE 3**

**Balance Farm 30 - 70 Percentile Graph  
Elizabeth City, NC**



**FIGURE 4: 30-70 Percentile Graph**

2000 Rain 30% 70%



## **2.4 Conclusions**

The year 2000 represents the second growing season that the hydrologic data has been examined. The majority of the monitoring gauges on site have shown saturation and inundation for long periods of time. Hydrologic monitoring data in 2000 met or exceeded the success criteria for jurisdictional wetland hydrology. The hydrology in the created coastal marsh is consistent with the hydrology in the coastal marsh reference ecosystem. Jurisdictional hydrology was achieved in the created-forested wetland at 20 of the 28-groundwater gauge locations. Groundwater monitoring gauges will be installed at the forested wetland reference ecosystem located on the Richards' property prior to the 2001 monitoring period. Hydrology of the reference ecosystem will be incorporated into the 2001 monitoring report. Gauges will continue to be closely monitored during subsequent field trips.

### **3.0 VEGETATION: BALLANCE FARM MITIGATION SITE (YEAR 2 OF 5)**

#### **3.1A Success Criteria**

##### **(Bottomland Hardwood Area)**

NCDOT will monitor the site for five years. A 320 stems per acre survival criterion for planted seedlings will be used to determine success for the first three years. The required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (i.e., for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5). The number of plants of one specie will not exceed 20% of the total number of plants of all species planted.

#### **3.1B Success Criteria**

##### **(Marsh Grass Area)**

The vegetative marsh success of the wetland site will be determined in accordance with NMFS Guidelines. Monitoring plots found to be located within the open water channel will not be evaluated, and will not count to the final count of plots. The vegetation component of the wetland site will be deemed successful if the following criteria are met.

1. At year five, the average of all plots should have a scale value of 5 (75% vegetative cover) consisting of wetland herbaceous species, not including any invasive species.
2. A minimum of 70% of the plots shall contain the target (planted) specie.

#### **3.2A Description of Planted Areas**

The following plant communities were planted in the Bottomland Hardwood Area:

##### **Zone 1: (approximately 44 acres)**

Quercus falcata var. pagodaefolia, Cherrybark Oak  
Fraxinus pennsylvanica, Green Ash  
Quercus lyrata, Overcup Oak  
Quercus michauxii, Swamp Chestnut Oak  
Quercus nigra, Water Oak  
Quercus phellos, Willow Oak

##### **Zone 2: (approximately 67 acres)**

Fraxinus pennsylvanica, Green Ash  
Quercus falcata var. pagodaefolia, Cherrybark Oak  
Quercus michauxii, Swamp Chestnut Oak  
Quercus phellos, Willow Oak  
Quercus nigra, Water Oak

Quercus laurifolia, Laurel Oak  
Quercus lyrata, Overcup Oak

**Zone 3: (approximately 27 acres)**

Taxodium distichum, Bald Cypress  
Fraxinus pennsylvanica, Green Ash  
Quercus lyrata, Overcup Oak  
Nyssa aquatica, Tupelo Gum

**3.2B Description of Planted Areas**

The following plant communities were planted in the Marsh Grass Area:

**Zone 1: (approximately 44 acres in zone 1 and 2)**

Scirpus cyperinus, Woolgrass  
Juncus effusus, Soft rush

**Zone 2:**

Cladium jamaicense, Sawgrass  
Juncus roemerianus, Black Needle Rush  
Scirpus americanus  
Scirpus atrovirens  
Carex lurida, Shallow Sedge  
Carex vulpinoides, Fox Sedge  
Scirpus robustus  
Scirpus pogens  
Juncus gerardi, Blackgrass  
Distichlis spicata, Spikegrass

**Zone 3: (approximately 4 acres)**

Spartina cynosuroides, Big Cordgrass

### 3.3A Results of Vegetation Monitoring (Bottomland Hardwood Area)

ZONE	Plot #	Overcup Oak	Tupelo Gum	Green Ash	Bald Cypress	Willow Oak	Laurel Oak	Cherrybark Oak	Sw. Chestnut Oak	Water Oak	Total	Total (at planting)	Density (Tree/Acre)
<b>1</b>	4	2		5		1	4	11	2		25	39	436
	5	3		4		6	2	12	1	2	30	40	510
	8			12				3	5		20	44	309
	9	13		3		3		8	1		28	39	488
	11	5				7		10	6	1	29	38	519
	12	4		1		6	2	8	4		25	42	405
	15			3		6		8	8		25	37	459
	16	2	1	1		10		7	13	1	35	41	580
	17	10				7	3	7	9	1	37	41	614
	20	4		2		1		3	1		11	45	166
	21	4		3		3		4	5		19	39	331
<b>ZONE 1 AVG.</b>												<b>438</b>	

<b>2</b>	3	4		3		2	7	11	4		31	39	541
	6			7		6		2	1		16	38	286
	10			6		3	1	2	13		25	36	472
	13	1				10	8	3	6		28	41	464
	14					7	5	3	7		22	37	404
	18	1		11		3	6	1	9		31	39	541
<b>ZONE 2 AVG.</b>												<b>451</b>	

<b>3</b>	1		11	6	20						37	40	629
	2		8	11	13						32	36	604
	7	2		26		7					35	37	643
	19	11		2							13	23	384
<b>ZONE 3 AVG.</b>												<b>565</b>	

<b>TOTAL AVG.</b>												<b>466</b>
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To determine tree density, 50' x 50' plots are installed immediately following planting. The actual numbers of planted trees, which 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. (Density = monitoring count / planted trees x 680)

**Site Notes:**

Zone 1: Other species noted: sedges, broomsedge, various grasses, cattails, juncus, foxtail, trumpet creeper, scirpus, rushes, fennel, giant foxtail, briars, baccharis, and sweetgum. Plot 4 very overgrown with 3-foot sedges making trees difficult to find. Plot 5 has 2 inches of standing water and half the plot showed signs of inundation.  $\frac{3}{4}$  of plot 8 is in 6-8 inches of water. The trees are doing well in shallower water.  $\frac{1}{2}$  of plot 9 in 3 inches of standing water.  $\frac{1}{3}$  of plot 11 and 12 is under 4 inches of water.  $\frac{2}{3}$  of plot 16 is under 3 inches of water. Plot 20 had saturated ground and evidence of standing water. Plot 21 had 2 inches of standing water. The grasses made the small trees difficult to find.

Zone 2: Other species noted: sedge, foxtail, baccharis, various grasses, scirpus robustus, few volunteer red maple and sweetgum, trumpet creeper, panicum grass, broomsedge, rushes and a few pine.  $\frac{1}{3}$  of plot 6 was standing in water. The small oaks have drowned; however, trees immediately outside of plot are doing well.

Zone 3: Other species noted: broomsedge, false willow, various grasses and sedges, foxtail, fennel, dog bane, cattails, algae, juncus and few red maple. Plot 7 has standing water around plot and in the back corner. Plot 19 has 6 inches of standing water.

### **3.3B Results of Vegetation Monitoring**

#### **(Marsh Grass Area)**

(Shown on the following pages)

Plot #	Scale Factor	Juncus effusus	Scirpus cyperinus	Juncus roemerianus	Scirpus robustus	Scirpus pugnans	Scirpus americanus	Scirpus atrovirens	Cladium jamaicense	Juncus gerardi	Distichlis spicata	Carex lupida	Carex vulpinoidea	Spartina cynosuroides	Frequency
1	2.0	✓													✓
2	5.0									✓					✓
3	5.0									✓					✓
4	2.0	✓			✓										✓
5	1.0														
6	2.0								✓						✓
7	2.0				✓										✓
8	2.0		✓												✓
9	2.0														
10	0.5														
11	5.0	✓	✓												✓
12	0.0														
13	4.0		✓												✓
14	2.0		✓												✓
15	1.0														
16	3.0	✓													✓
17	2.0			✓											✓
18	0.5								✓						✓
19	2.0			✓											✓
20	0.0														
21	2.0	✓			✓										✓
22	0.0														
23	2.0										✓				✓
24	2.0														
25	2.0										✓				✓
26	2.0														
27	2.0													✓	✓
28	3.0			✓											✓
29	3.0														
30	5.0	✓													✓
31	2.0														
32	3.0			✓	✓										✓
33	2.0			✓											✓
34	0.0														
35	2.0				✓										✓
36	2.0				✓						✓				✓
37	0.0														
38															
39															
40	2.0			✓											✓
41	3.0														
42	3.0														
43	3.0								✓						✓
44	0.0														
45															
46	3.0				✓										✓
47	0.0														
48	0.5										✓				✓
49	0.5								✓						✓
50	2.0								✓				✓		✓
51	0.0														
52	3.0		✓												✓
53	2.0	✓													✓
54	2.0	✓		✓											✓
55	2.0								✓		✓				✓
56	3.0														
57	2.0														
58	1.0			✓											✓
59	3.0														
60	2.0								✓						✓

Plot #	Scale Factor	Juncus effusus	Scirpus cyperinus	Juncus roemerianus	Scirpus robustus	Scirpus pugnans	Scirpus americanus	Scirpus atrovirens	Cladium jamaicense	Juncus gerardi	Distichlis spicata	Carex lupida	Carex vulpinoidea	Spartina cynosuroides	Frequency
61	5.0														
62	2.0														
63	2.0														
64	0.0														
65	2.0				✓										✓
66	2.0	✓							✓						✓
67	3.0	✓													✓
68	2.0		✓												✓
69	5.0	✓													✓
70	2.0														
71	2.0				✓										✓
72	2.0	✓		✓											✓
73	2.0								✓	✓					✓
74	2.0						✓							✓	✓
75	4.0	✓													✓
76	5.0	✓	✓												✓
77	2.0				✓										✓
78	4.0	✓							✓	✓					✓
79	2.0		✓												✓
80	1.0			✓											✓
81	1.0								✓						✓
82	3.0				✓										✓
83	2.0								✓						✓
84	2.0								✓						✓
85	2.0				✓										✓
86	2.0														
87	2.0				✓										✓
88	2.0	✓													✓
89	3.0			✓											✓
90	0.1								✓						✓
91	4.0	✓													✓
92	4.0	✓													✓
93	1.0	✓			✓										✓
94	0.0														
95	0.5	✓							✓						✓
96															
97	0.5								✓						✓
98	0.0														
99	5.0	✓													✓
100	2.0														
101	2.0														
102	2.0	✓													✓
103	0.0														OW
104	0.0														
105	0.0														
106	0.0														
107	0.0														
108	2.0			✓											✓
109	0.0														
110															
111	4.0	✓													✓
112	2.0				✓										✓
113															
114	3.0								✓						✓
115	0.0														
116	2.0		✓								✓				✓
117	0.0														
118	2.0								✓						✓
119	0.0														
120	2.0									✓					✓



Plot #	Scale Factor	Juncus effusus	Scirpus cyperinus	Juncus roemerianus	Scirpus robustus	Scirpus pugnans	Scirpus americanus	Scirpus atrovirens	Cladium jamaicense	Juncus gerardi	Distichlis spicata	Carex lupida	Carex vulpinoidea	Spartina cynosuroides	Frequency
121	3.0			✓	✓										✓
122															
123	2.0								✓						✓
124	3.0														
125	1.0				✓										✓
126	5.0		✓												✓
127	3.0										✓				✓
128	4.0			✓											✓
129	5.0		✓												✓
130	3.0														
131															
132	2.0														
133	0.0														
134	2.0								✓						✓
135	2.0								✓						✓
136	3.0		✓												✓
137	2.0								✓						✓
138	3.0	✓													✓
139	1.0				✓										✓
140	0.0														
141	2.0								✓						✓
142	2.0			✓											✓
143	3.0	✓													✓
144	2.0		✓						✓						✓
145	2.0			✓											✓
146	0.5														
147	1.0								✓						✓
148	2.0														
149	4.0			✓	✓										✓
150	5.0		✓	✓											✓
151	2.0	✓	✓												✓
152	2.0			✓											✓
153	4.0								✓						✓
154	0.0														
155	2.0			✓	✓										✓
156	0.0														
157	3.0	✓													✓
158	1.0														
159	2.0				✓				✓						✓
160	0.5														
161	2.0								✓						✓
162	0.0														
163	0.5														
164	1.0										✓				✓
165	2.0	✓							✓	✓					✓
166	3.0														
167	2.0	✓								✓					✓
168	0.0														
169	1.0														
170	2.0		✓		✓										✓
171	2.0												✓		✓
172	1.0										✓				✓
173	0.0														
174	2.0														
175	2.0														
176	2.0														
177	2.0														
178	2.0														
179	0.0														
180	0.0														OW

Plot #	Scale Factor	Juncus effusus	Scirpus cyperinus	Juncus roemerianus	Scirpus robustus	Scirpus pugens	Scirpus americanus	Scirpus atrovirens	Cladium jamaicense	Juncus gerardi	Distichlis spicata	Carex lupida	Carex vulpinoidea	Spartina cynosuroides	Frequency
181	0.1			✓											✓
182	2.0														
183	2.0	✓													✓
184	0.0														OW
185	2.0														
186	0.0														OW
187	2.0								✓						✓
188	2.0				✓										✓
189	2.0		✓												✓
190	2.0				✓										✓
191	0.5														
192	2.0										✓				✓
193	2.0				✓										✓
194	2.0									✓					✓
195	0.0														
196	1.0														
197	0.5														
198	3.0		✓												✓
199	2.0									✓					✓
200	2.0				✓		✓								✓
201	3.0													✓	✓
202	2.0														
203	0.0														OW
204	3.0				✓										✓
205	2.0	✓													✓
206	0.0														
207	2.0				✓										✓
208	4.0				✓					✓					✓
209	1.0														
210	2.0				✓										✓
211	4.0														
212	0.0														
213	0.0														
214	2.0								✓	✓					✓
215	1.0													✓	✓
216	0.0														
217	0.0														
218	0.5														
219	2.0														
220	2.0														
221	2.0								✓						✓
222	0.0														
223	2.0				✓										✓
224	0.0														OW
225	3.0														
226	2.0								✓						✓
227	2.0	✓			✓										✓
228															
229	0.0														
230	2.0			✓	✓						✓				✓
231	2.0		✓												✓
232	3.0	✓													✓
233	1.0								✓						✓
234	5.0		✓												✓
235	5.0		✓												✓
236	4.0														
237	2.0	✓													✓
238	2.0			✓											✓
239	2.0														
240	2.0								✓						✓

Plot #	Scale Factor	Juncus effusus	Scirpus cyperinus	Juncus roemerianus	Scirpus robustus	Scirpus pugnans	Scirpus americanus	Scirpus atrovirens	Cladium jamaicense	Juncus gerardi	Distichlis spicata	Carex lupida	Carex vulpinoidea	Spartina cynosuroides	Frequency
241	0.0														
242	2.0													✓	✓
243	0.0														OW
244	2.0	✓													✓
245	1.0								✓						✓
246	2.0	✓													✓
247	3.0														
248	2.0		✓												✓
249	3.0	✓													✓
250	2.0														
251	2.0														
252	2.0														
253	2.0				✓					✓					✓
254	2.0		✓												✓
255	2.0	✓													✓
256	0.0														
257	3.0				✓										✓
258	2.0														
259	0.0														
260	2.0														
261	2.0			✓											✓
262	3.0														
263	0.5														
264	0.0														
265	0.0														
266	2.0														
267	1.0								✓						✓
268	0.5														
269	2.0			✓											✓
270	2.0				✓										✓
271	2.0								✓						✓
272	5.0														
273	0.0														
274	2.0								✓						✓
275	2.0														
276	2.0								✓						✓
277	2.0														
278															
279	2.0														
280	0.0														
281	3.0			✓											✓
282	0.5														
283	2.0			✓											✓
284	3.0								✓						✓
285	0.0														
286	2.0				✓										✓
287	3.0		✓												✓
288	3.0														
289	0.0														
290	3.0			✓											✓
291															
292	2.0												✓		✓
293	0.1														
294	3.0				✓										✓
295	2.0	✓													✓
296	2.0	✓													✓
297	5.0				✓					✓					✓
298	2.0														
299	2.0	✓							✓						✓
300	2.0														

Plot #	Scale Factor	Juncus effusus	Scirpus cyperinus	Juncus roemerianus	Scirpus robustus	Scirpus pogens	Scirpus americanus	Scirpus atrovirens	Cladium jamaicense	Juncus gerardi	Distichlis spicata	Carex lupida	Carex vulpinoidea	Spartina cynosuroides	Frequency
301	1.0				✓										✓
302	0.0														OW
303	2.0														✓
304	0.5														
305	0.0														
306	3.0	✓													✓
307	2.0			✓											✓
308	3.0				✓										✓
309	2.0				✓										✓
310	3.0			✓											✓
311	2.0				✓										✓
312	2.0				✓										✓
313	3.0			✓											✓
314	4.0								✓						✓
315	0.0														
316	2.0								✓						✓
317	3.0				✓										✓
318	0.0														
319	0.0														
320	2.0														
321	0.0														
322	2.0														
323	0.0														
324	0.5														
325	0.5								✓						✓
326	2.0														
327	2.0														
328	0.5								✓						✓
329	2.0														
330	2.0	✓		✓					✓						✓
331	2.0														
332	0.0														
333	4.0	✓													✓
334	2.0														
335	0.0														
336	2.0								✓						✓
337	2.0								✓						✓
338	0.5														
339	0.5								✓						✓
340	2.0	✓													✓
341	0.0														
342	3.0			✓					✓						✓
343	1.0												✓		✓
344	0.0														
345	2.0			✓											✓
346	2.0	✓			✓										✓
347	0.0														
348	2.0														
349	1.0												✓		✓
350	0.0														
351	2.0														
352	0.0														
353	0.0														
354	3.0														
355	3.0								✓						✓
356	2.0				✓										✓
357	4.0				✓										✓
358	2.0								✓						✓
359	2.0								✓						✓
360	2.0								✓						✓

Plot #	Scale Factor	Juncus effusus	Scirpus cyperinus	Juncus roemerianus	Scirpus robustus	Scirpus pugnans	Scirpus americanus	Scirpus atrovirens	Cladium jamaicense	Juncus gerardi	Distichlis spicata	Carex lupida	Carex vulpinoidea	Spartina cynosuroides	Frequency
361	2.0			✓						✓					✓
362	2.0								✓	✓					✓
363	0.5														
364	2.0						✓								✓
365	0.0														
366	2.0								✓						✓
367	0.0														
368	0.0														
369	3.0	✓													✓
370	0.0														
371	0.0														OW
372	2.0														
373	0.5	✓													✓
374	2.0	✓			✓									✓	✓
375	3.0	✓	✓												✓
376	5.0	✓													✓
377	2.0	✓													✓
378	2.0				✓										✓
379	0.0														
380	2.0														
381	0.0														
382	2.0														
383	0.0														
384	0.0														OW
385	2.0		✓												✓
386	2.0													✓	✓
387	1.0														
388	0.0														
389	0.5								✓						✓
390	4.0														
391	2.0	✓													✓
392	3.0			✓											✓
393	3.0										✓				✓
394	3.0								✓					✓	✓
395	3.0	✓													✓
396	3.0											✓			✓
397	2.0														
398	2.0														
399	2.0														
400	2.0			✓											✓
401	2.0														
402	2.0													✓	✓
403	2.0	✓							✓						✓
404	3.0														
405	2.0														
406	3.0								✓						✓
407	5.0	✓	✓												✓
408															
409	2.0								✓						✓
410	2.0	✓													✓
411	5.0	✓	✓												✓
412	2.0								✓						✓
413	2.0				✓										✓
414															
415	2.0														
416	5.0	✓								✓					✓
417	2.0											✓			✓
418	2.0										✓				✓
419	2.0														
420	2.0														

Plot #	Scale Factor	Juncus effusus	Scirpus cyperinus	Juncus roemerianus	Scirpus robustus	Scirpus pugens	Scirpus americanus	Scirpus atrovirens	Cladium jamaicense	Juncus gerardi	Distichlis spicata	Carex lupida	Carex vulpinoidea	Spartina cynosurides	Frequency
421	5.0	✓													✓
422	1.0														
423	3.0														
424	3.0	✓								✓					✓
425	2.0														
426	0.0														
427	2.0	✓													✓
428	5.0														
429	0.0														
430	3.0										✓				✓
431	0.0														
432	1.0														
433	5.0		✓												✓
434	2.0														
435	1.0	✓													✓
436	2.0														
437	5.0	✓													✓
438	1.0								✓						✓
439	0.0														
440	3.0	✓													✓
441	3.0										✓				✓
442	3.0	✓													✓
443	5.0	✓													✓
444	2.0	✓							✓						✓
445	2.0														
446	0.0														
447	4.0									✓					✓
448	2.0														
449	2.0	✓													✓
450	2.0	✓													✓
451	2.0			✓											✓
452															
453	2.0														
454	3.0	✓													✓
455	0.0														
456	0.0														
457	1.0								✓						✓
458	0.0														
459	1.0	✓													✓
460	3.0														
461	0.0														
462	1.0														
463	5.0	✓													✓
464	5.0	✓									✓				✓
465	4.0														
466	5.0														
467	0.0														
468	0.0														
469															
470	1.0														
471	2.0														
472															
473	2.0	✓													✓
474	5.0		✓												✓
475	5.0	✓													✓
476	0.0														
477	2.0								✓						✓
478	5.0														
479	3.0														
480	2.0										✓				✓

Plot #	Scale Factor	Juncus effusus	Scirpus cyperinus	Juncus roemerianus	Scirpus robustus	Scirpus pugnans	Scirpus americanus	Scirpus atrovirens	Cladium jamaicense	Juncus gerardi	Distichlis spicata	Carex lupida	Carex vulpinoides	Spartina cynosurides	Frequency
481	3.0										✓				✓
482	1.0														
483	2.0														
484	0.0														
485	2.0	✓													✓
486	2.0														
487	3.0														
488	0.0														
489	0.0														
490	1.0														
491	2.0														
492	5.0	✓													✓
493	2.0	✓													✓
494	0.0														
495	3.0	✓													✓
496	2.0														
497	0.0														
498	1.0														
499	3.0														
500	1.0	✓													✓

**Site Notes:** The following species were also noted in the monitoring plots. The percentage of plots the specie was found in is following the species in parentheses (i.e. 38% of the plots contain panicum).

Panicum (38), aster (36), juncus sp. (28), euphorium (4), rotella (7), barnyard grass (24), red maple (2), smartweed (7), cypress (1), pluchea (2), eleocharis (1), saint john's wart (1), ptilimnium (1), eryngium aquaticum (.2), ludwigia palustrus (.2), duck potato (2), pickeral weed (1), cassia (.4), pine (1), plume (.4), spike rush (4), bahia (.4), hydrocautle (.2), foxtail (5), scirpus (2), baccharis (2), fennel (1), scientilla (2), crab grass (.4), goldenrod (6), cattail (2), sagitaria (.4), lenchata (.2), cyperus (2), hypericum (.4), carex (.2), bull rush (.6), phragmites (1), knotweed (.4), ramcoster (.2), broomstraw (.6), rose (.2), pennywort (.2), thistle (.2) and water lilly (.2).

### 3.4A Conclusions

Of the 430 acres of this site, approximately 223 involved tree planting. There were 21 plots established throughout the planting areas, encompassing all plant communities. The vegetation monitoring of the planted area revealed the average density to be 466 trees per acre, which is well above the 320 trees per acre required by the minimum success criteria.

### 3.4B Conclusions

Percent Frequency of Target Specie (planted species) **54.5%**  
Frequency of 70% required.

- Vegetative Cover Scale Value **1.84**

Scale Value of 5 required for year 5.

Of the 430 acres of this site, approximately 48 acres involved marsh grass planting. There were 500 random plots established throughout the planting areas, encompassing all plant communities. These plots were located with GPS. The marsh was replanted in June. As expected, the vegetative coverage and frequency of target species does not meet the success criteria; however the coverage has increased since planting. The initial plantings are continuing to increase in cover.

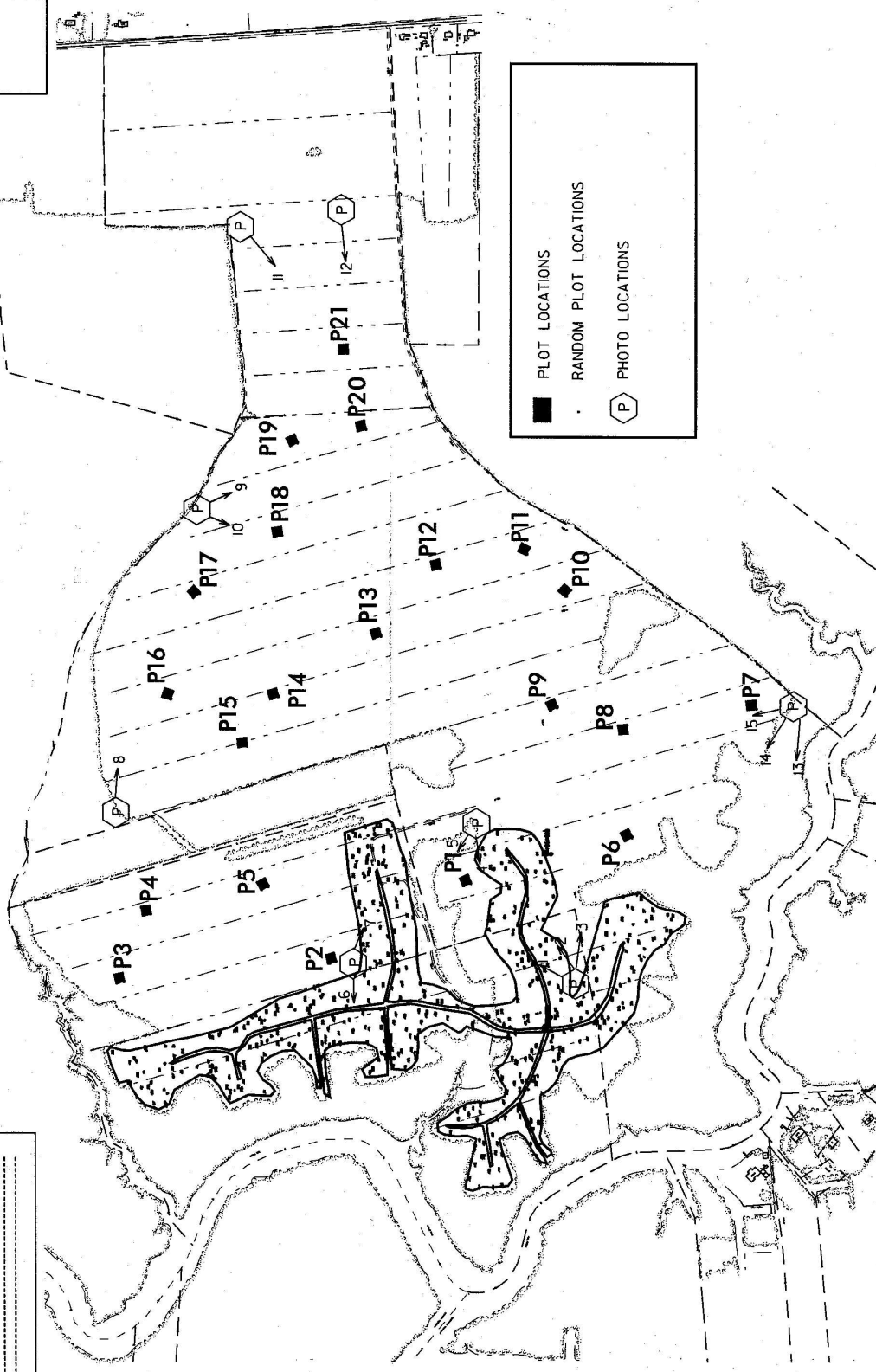




PROJECT REFERENCE NO.	P-2225W/M	SHEET NO.	WM-1
DATE	12/20/07	DRAWN BY	JAMES P. HARRIS
CHECKED BY		IN CHARGE	
		ENGINEER	

BALANCE FARM MITIGATION SITE  
 PHOTO AND PLOT LOCATIONS  
 2000 MONITORING

REVISIONS



## 4.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

NCDOT will obtain controlled aerial photography of the mitigation site to determine the as-built condition of the site.

The year 2000 represents the second growing season that the hydrologic data has been examined. The majority of the monitoring gauges on site have shown saturation and inundation for long periods of time. Hydrologic monitoring data in 2000 met or exceeded the success criteria for jurisdictional wetland hydrology. The hydrology in the created coastal marsh is consistent with the hydrology in the coastal marsh reference ecosystem. Jurisdictional hydrology was achieved in the created forested wetland at 20 of the 28 groundwater gauge locations. Groundwater monitoring gauges will be installed at the forested wetland reference ecosystem located on the Richards' property prior to the 2001 monitoring period. Hydrology of the reference ecosystem will be incorporated into the 2001 monitoring report.

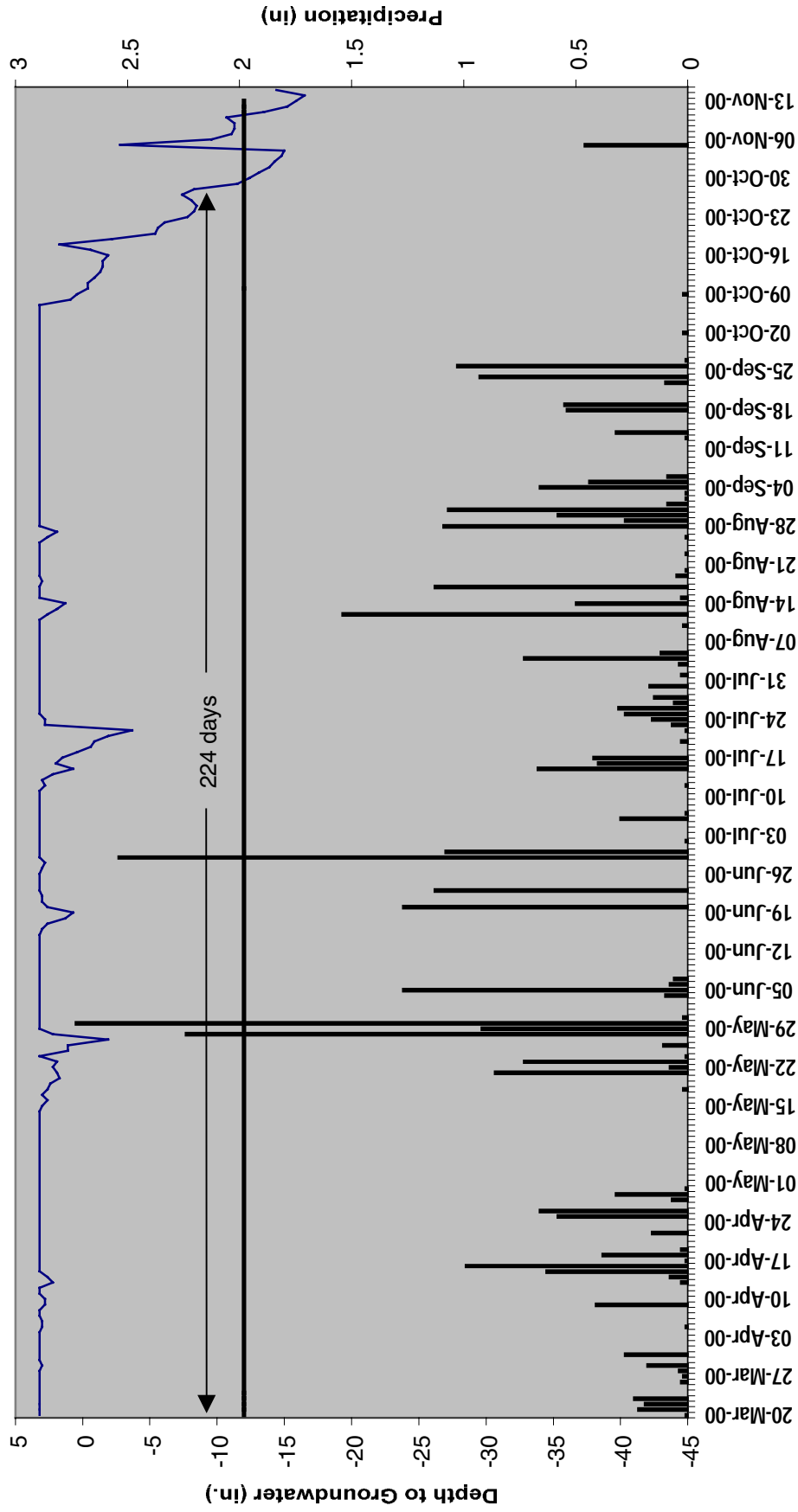
Gauge BF-23 malfunctioned multiple times during the year despite numerous maintenance efforts and was replaced. Gauge BFSG-1 did not record data for the last month of the growing season. Gauges will continue to be closely monitored during subsequent field trips and will be replaced if the need arises.

Of the 430 acres of this site, approximately 223 involved tree planting. There were 21 plots established throughout the planting areas, encompassing all plant communities. The vegetation monitoring of the planted area revealed the average density to be 466 trees per acre, which is well above the 320 trees per acre required by the minimum success criteria.

Of the 430 acres of this site, approximately 48 acres involved coastal marsh grass planting. There were 500 random plots established throughout the planting areas, encompassing all plant communities. These plots were located with GPS. The marsh was replanted in June. The percent frequency of target specie (planted species) is 54.5% as monitored. As expected, the vegetative coverage and frequency of target species does not meet the success criteria of 70%; however the coverage has increased since planting. The initial plantings are continuing to increase in cover. The vegetative cover scale value is 1.84, and the required vegetative scale value for year 5 is 5.

**APPENDIX A**  
**DEPTH TO GROUNDWATER PLOTS**

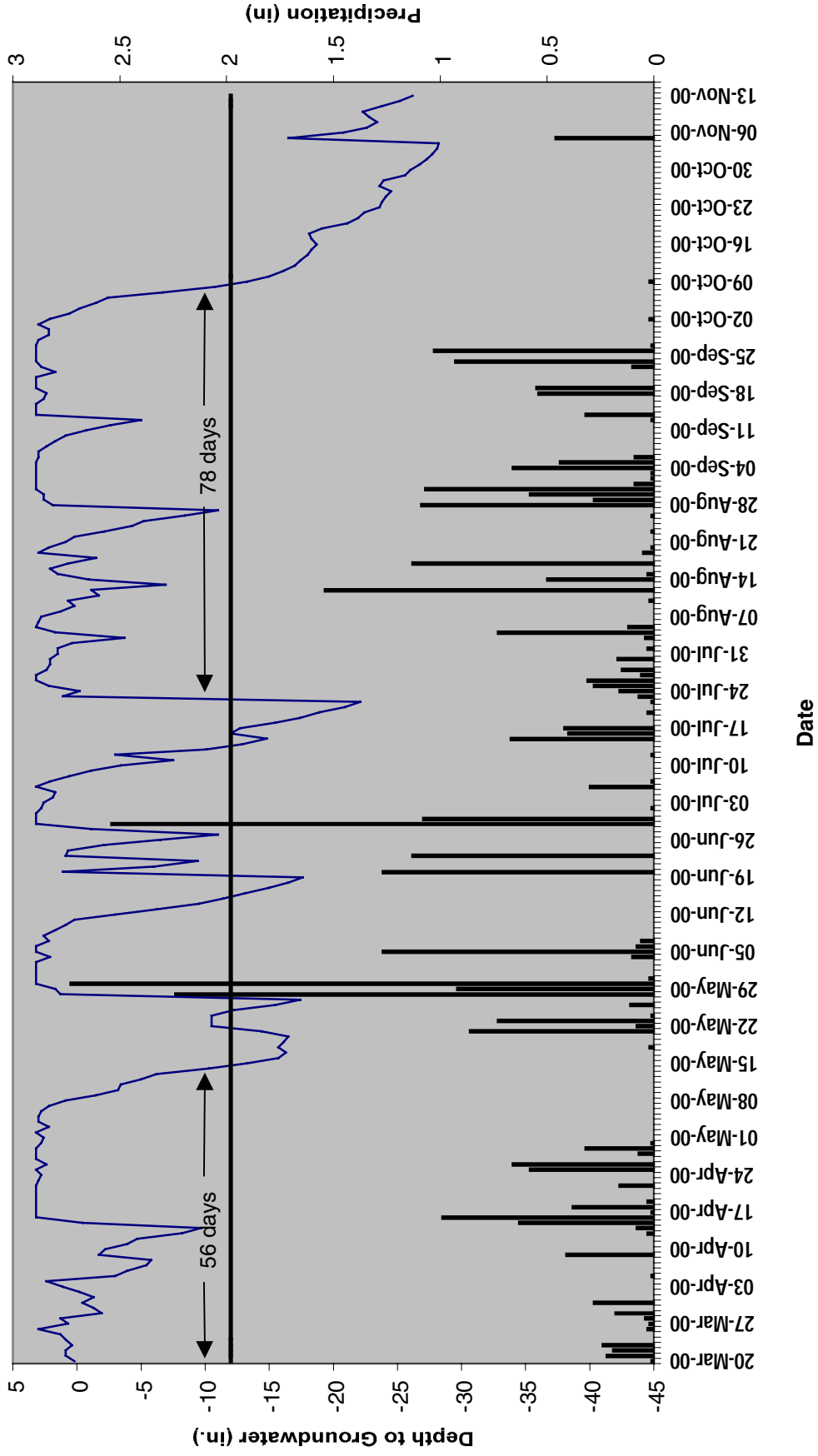
# Ballance Farm BF1



Date

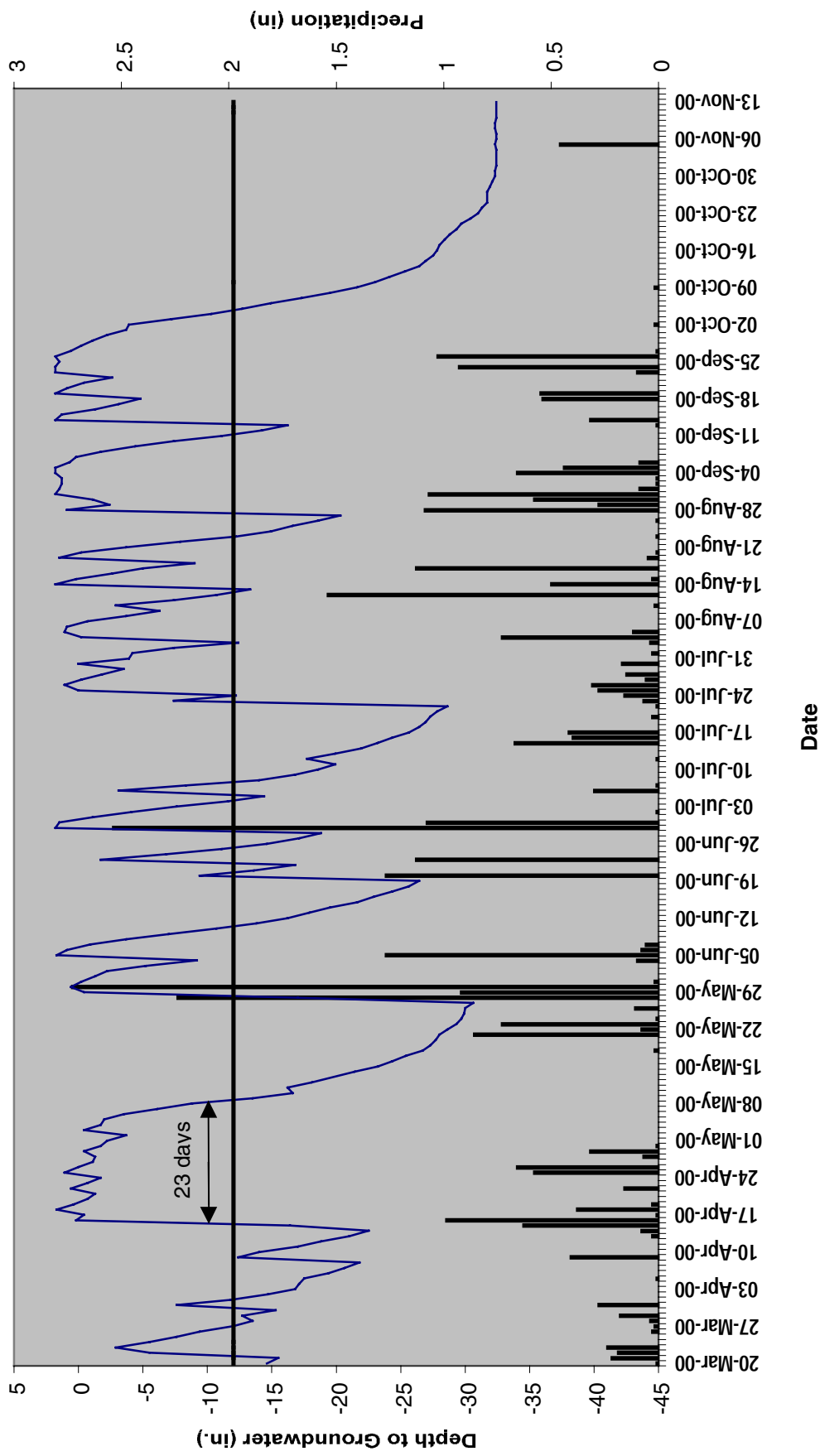
■ RAINFALL — BF-1 S31F74E — REQUIRED DEPTH

# Ballance Farm BF-2





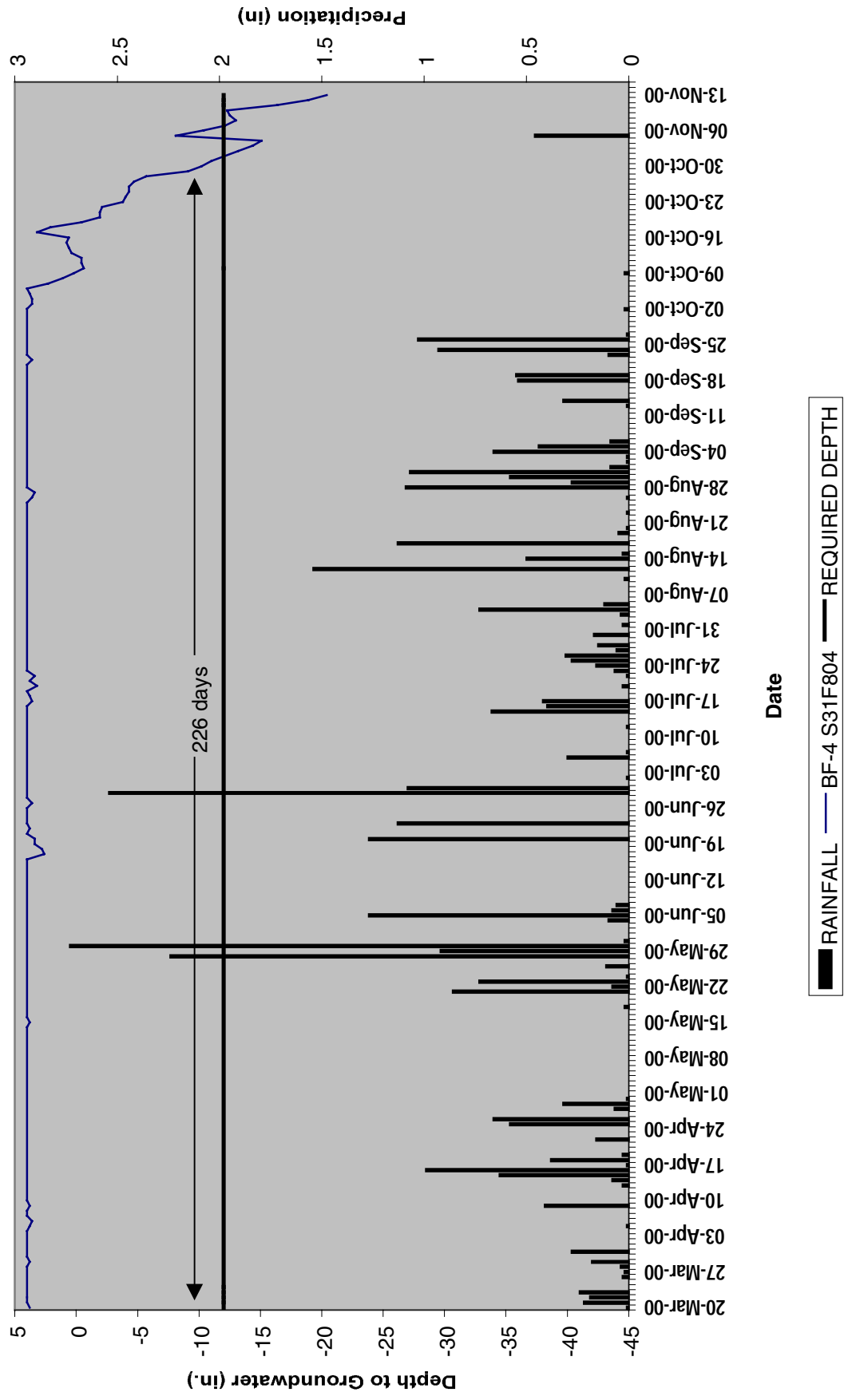
# Ballance Farm BF-3



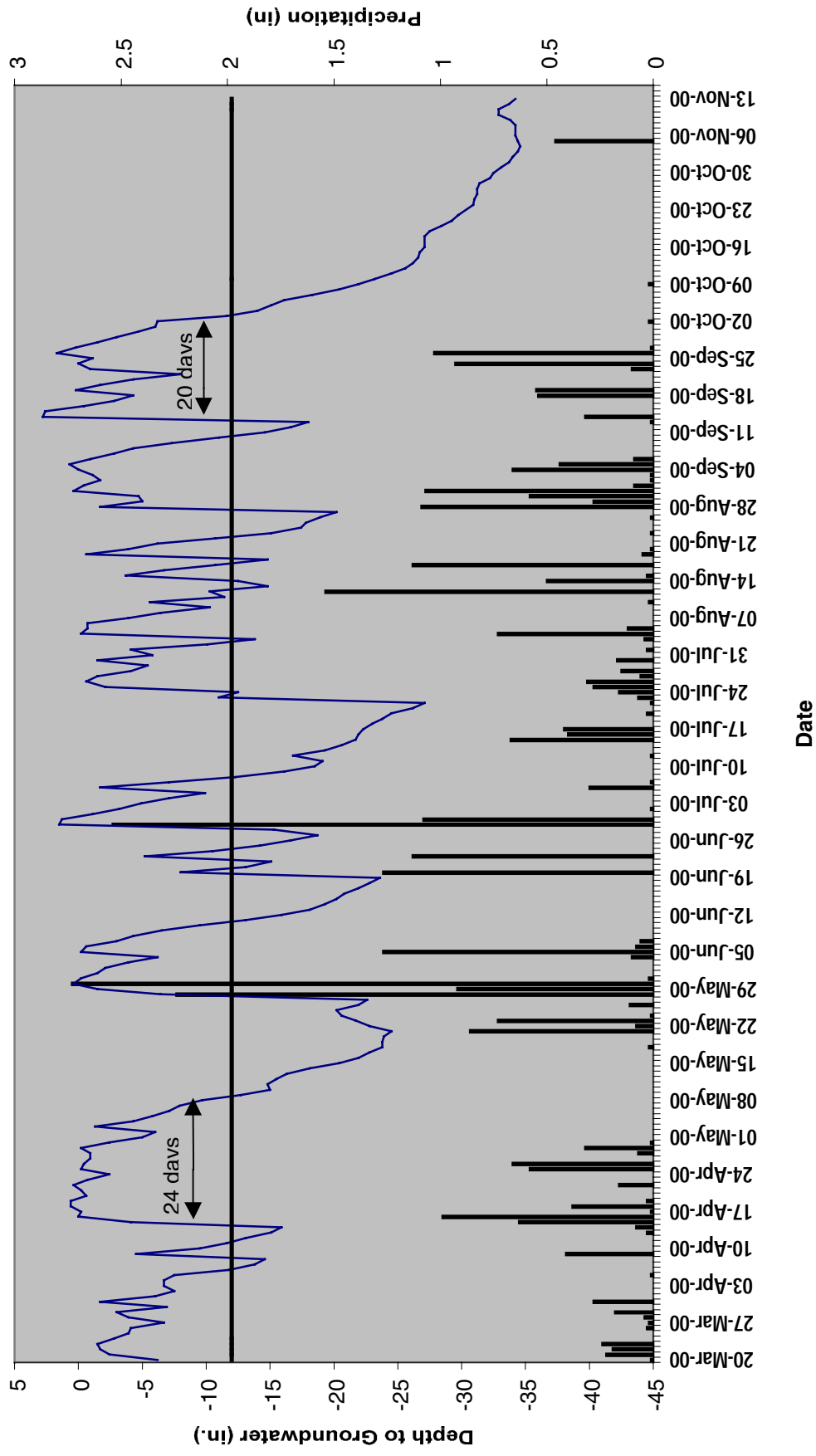
Legend:   
 ■ RAINFALL   
 — BF-3 S2140AB   
 — REQUIRED DEPTH



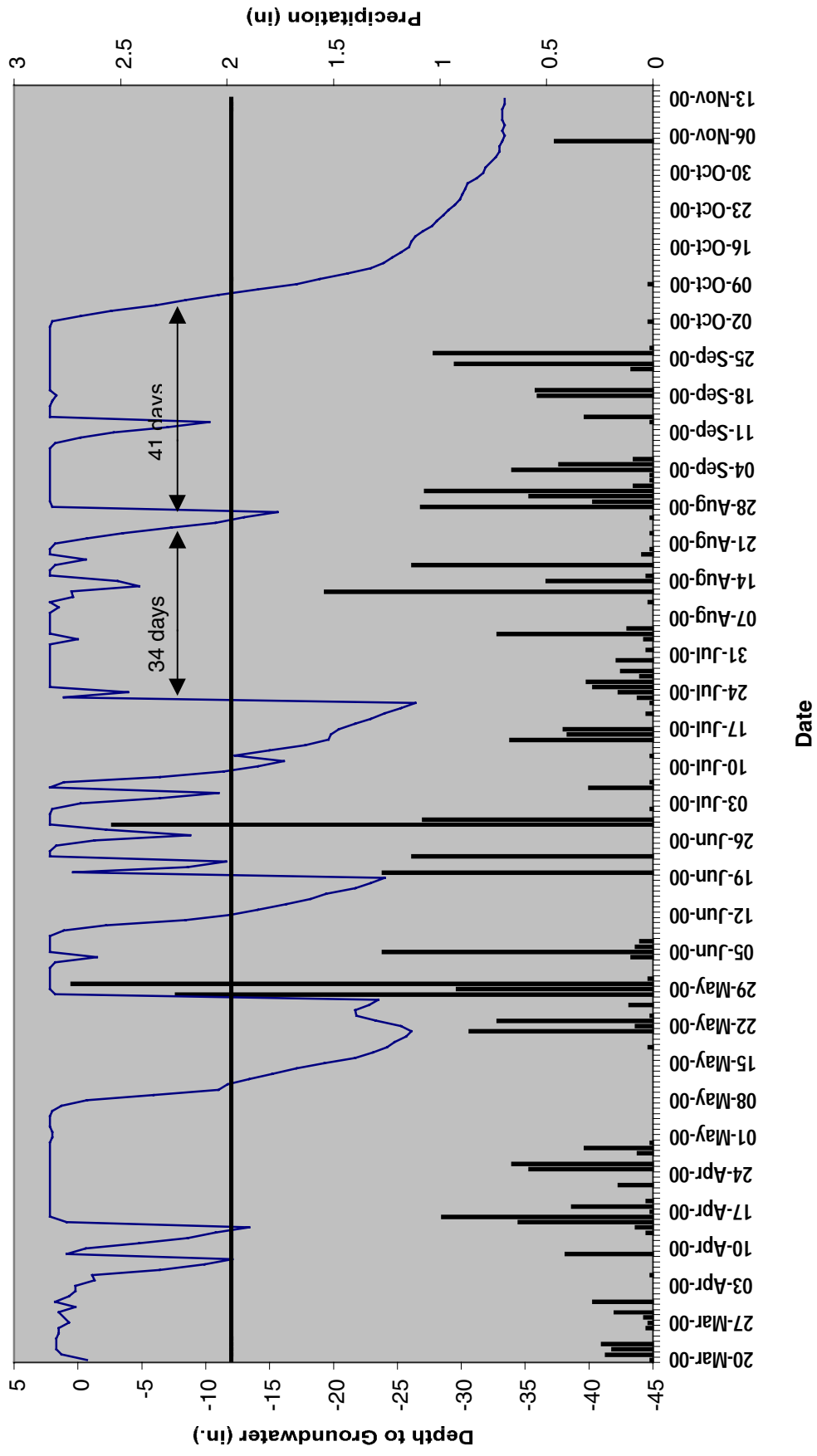
# Ballance Farm BF-4



# Ballance Farm BF-5

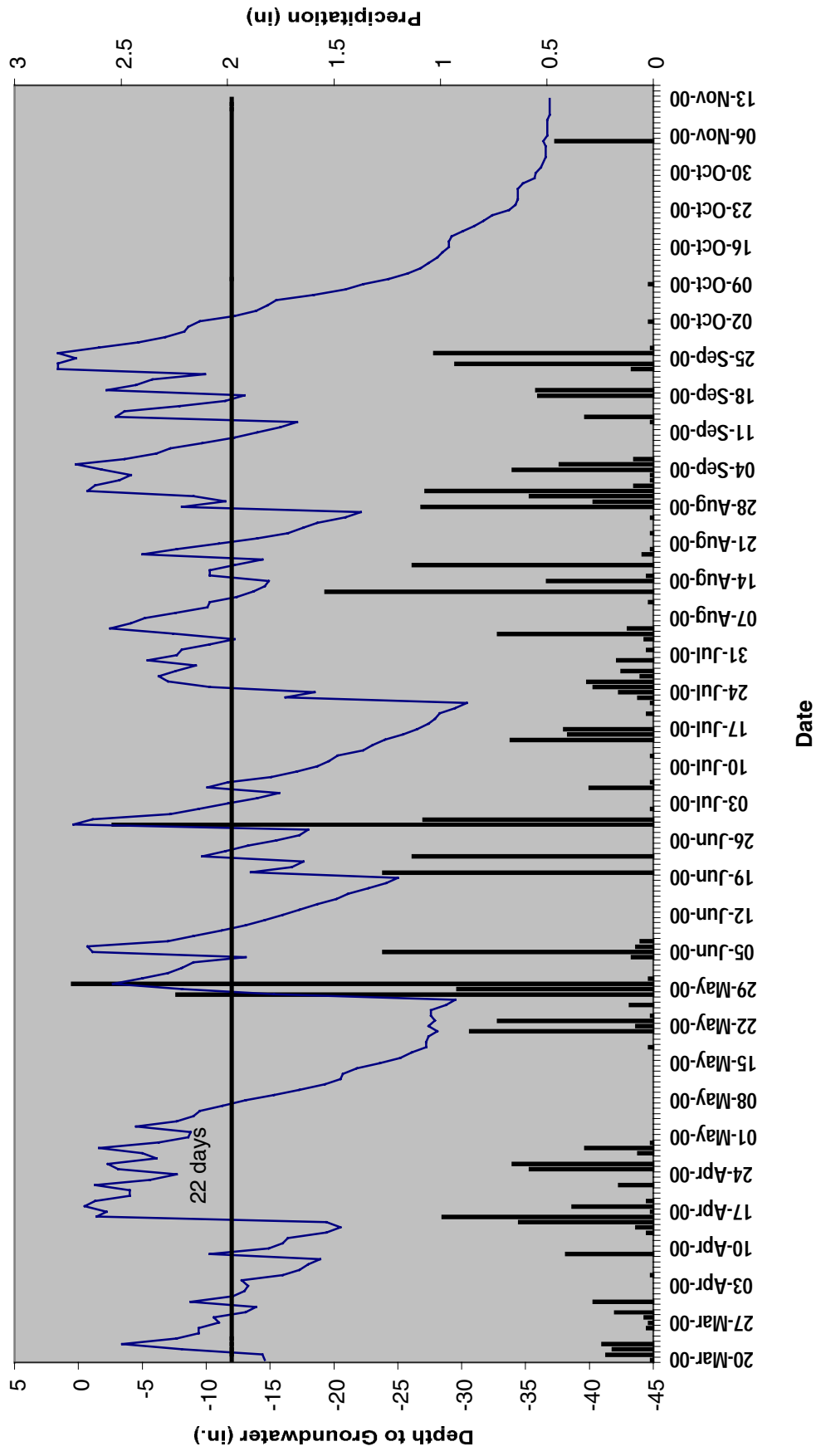


# Ballance Farm BF-6

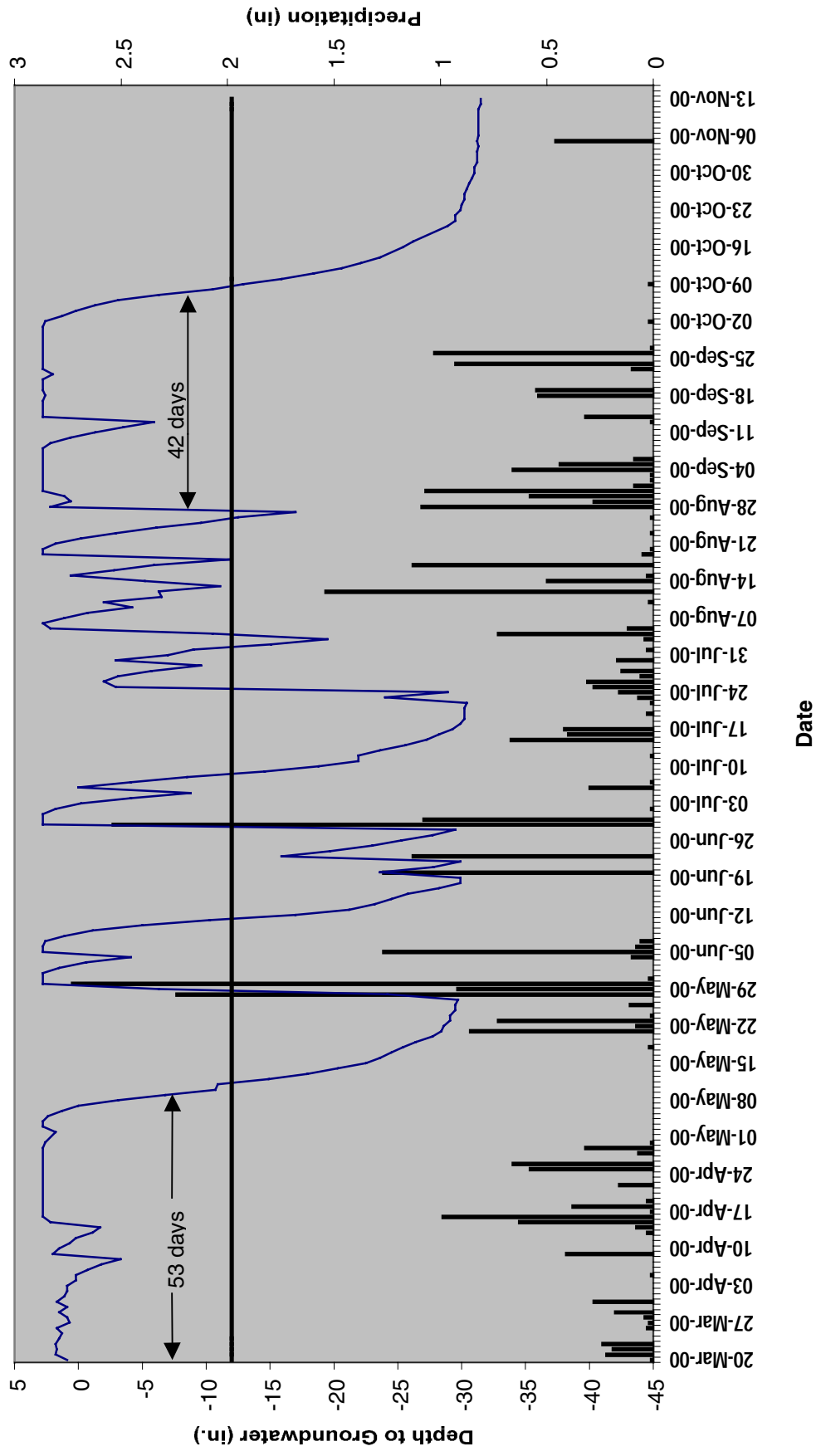


RAINFALL
  BF-6 S2B220F
  REQUIRED DEPTH

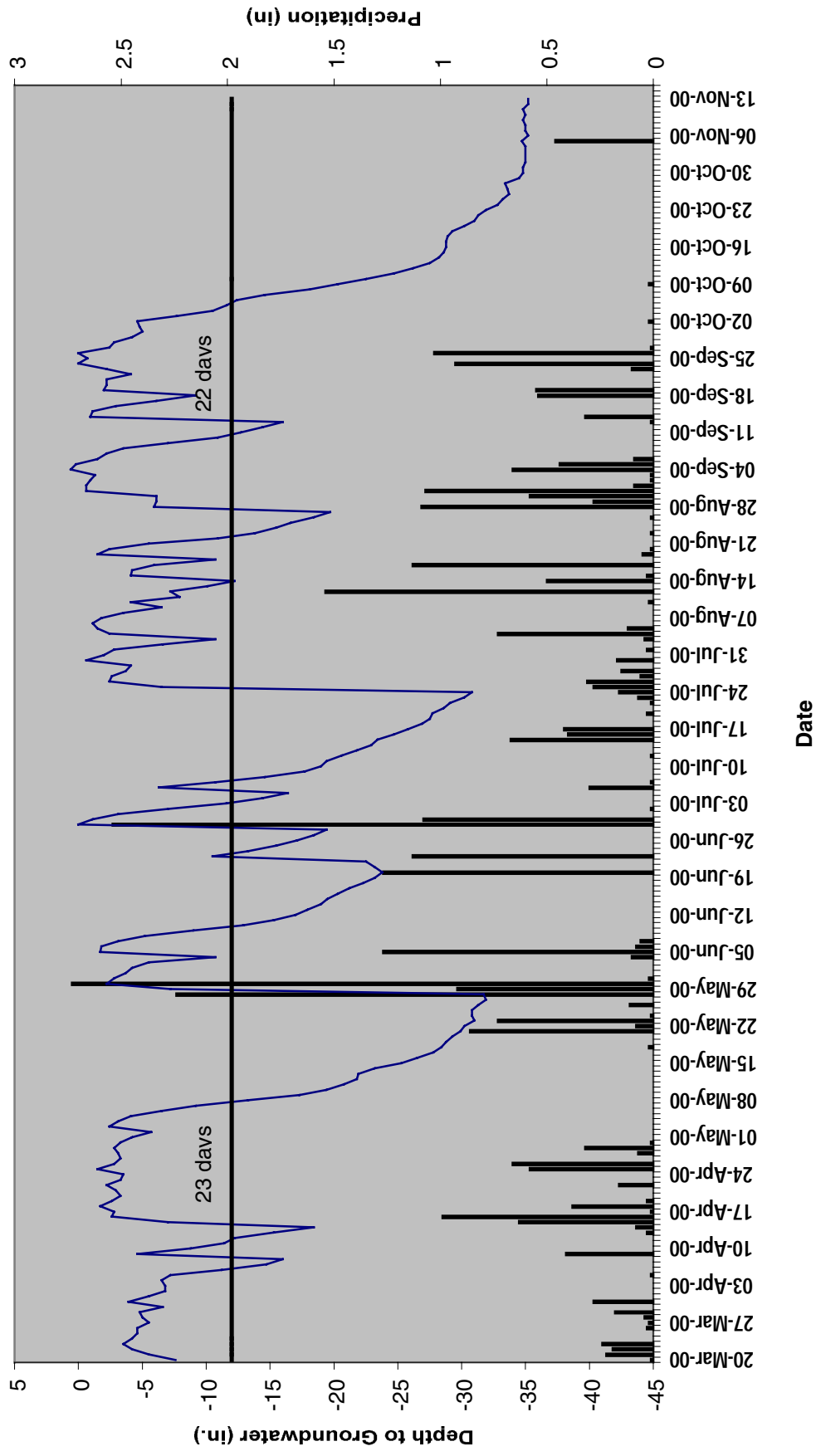
# Ballance Farm BF-7



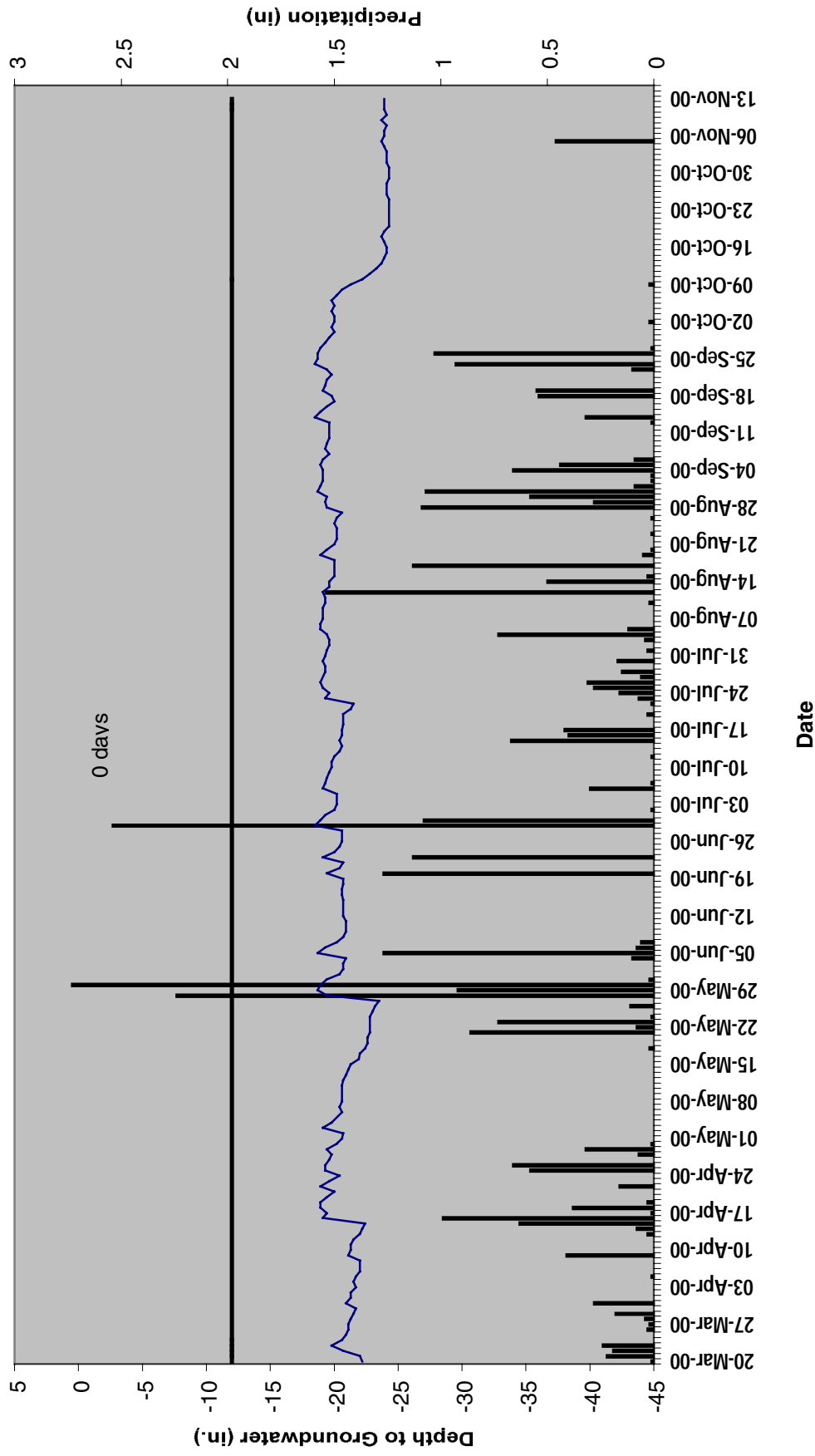
# Ballance Farm BF-8



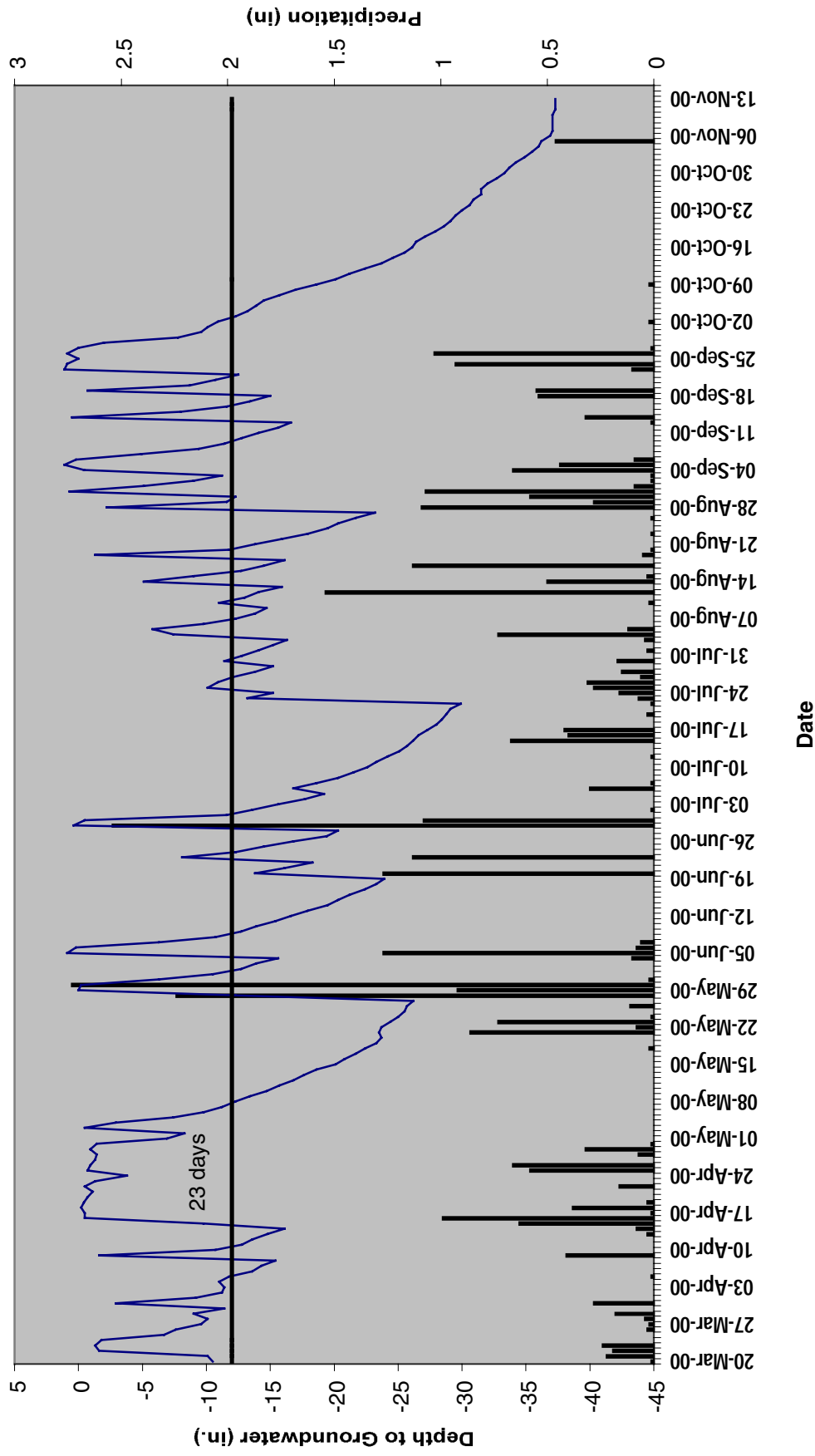
# Ballance Farm BF-9



# Ballance Farm BF-10

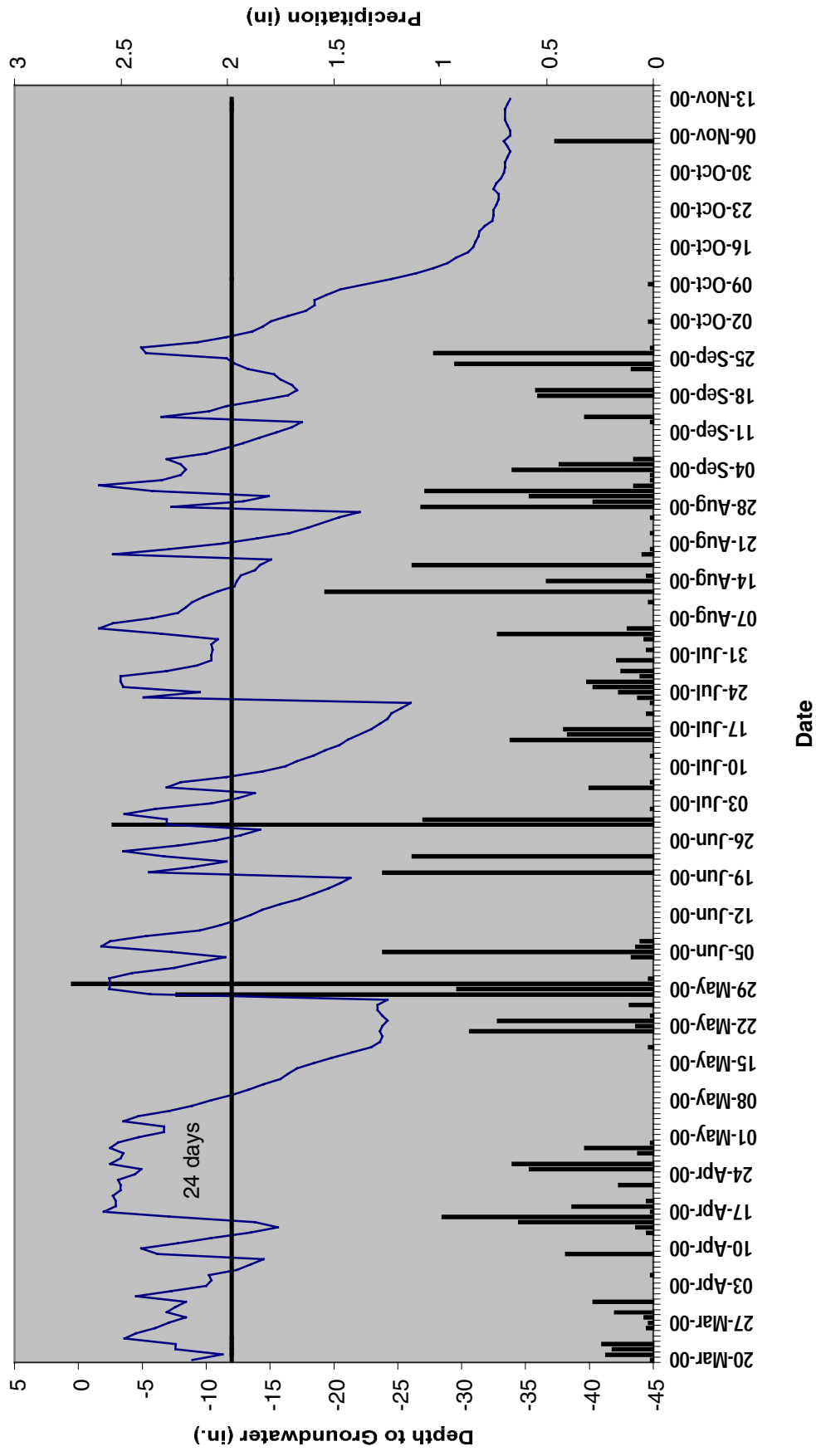


# Ballance Farm BF-11



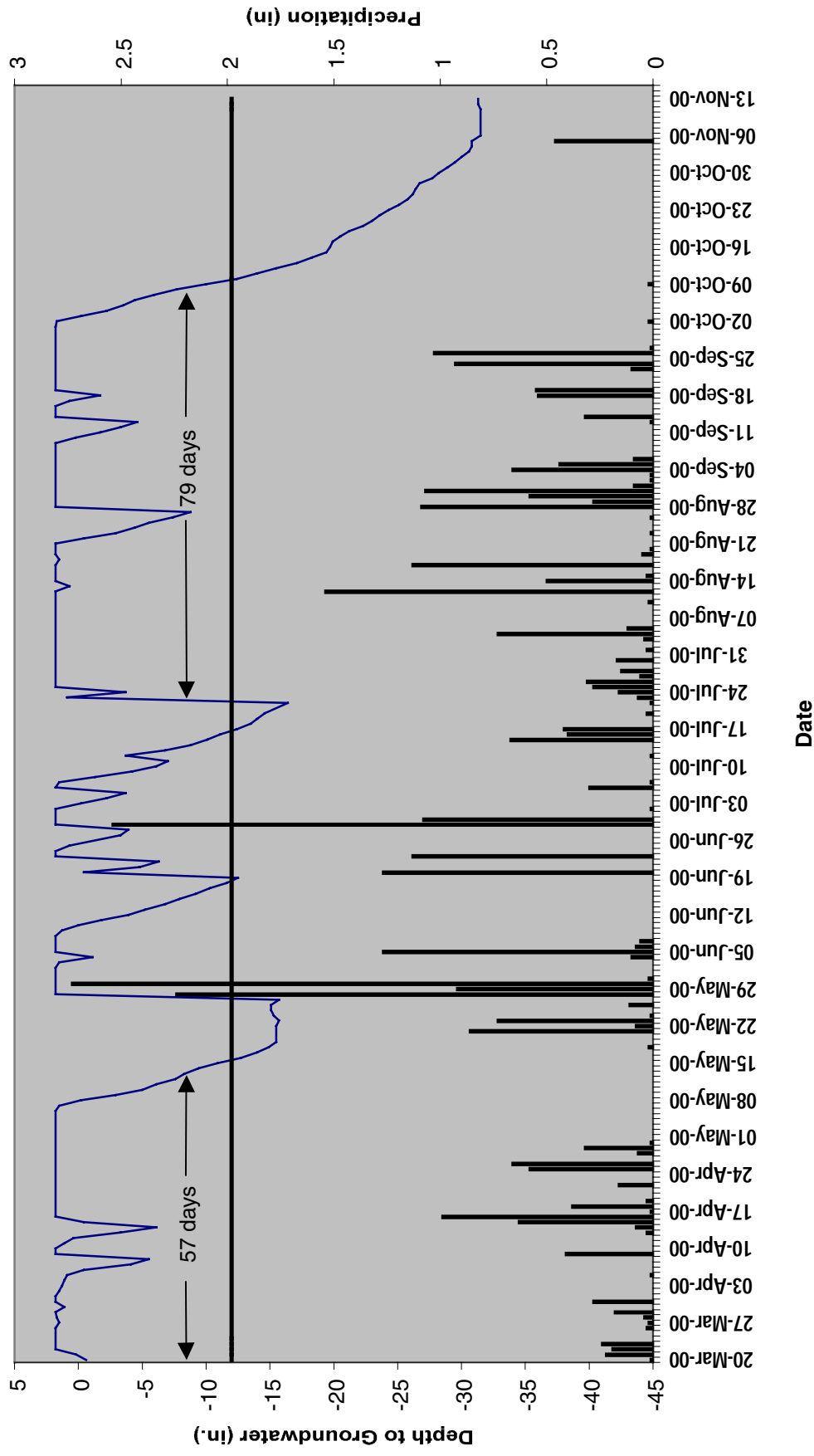


# Ballance Farm BF-12

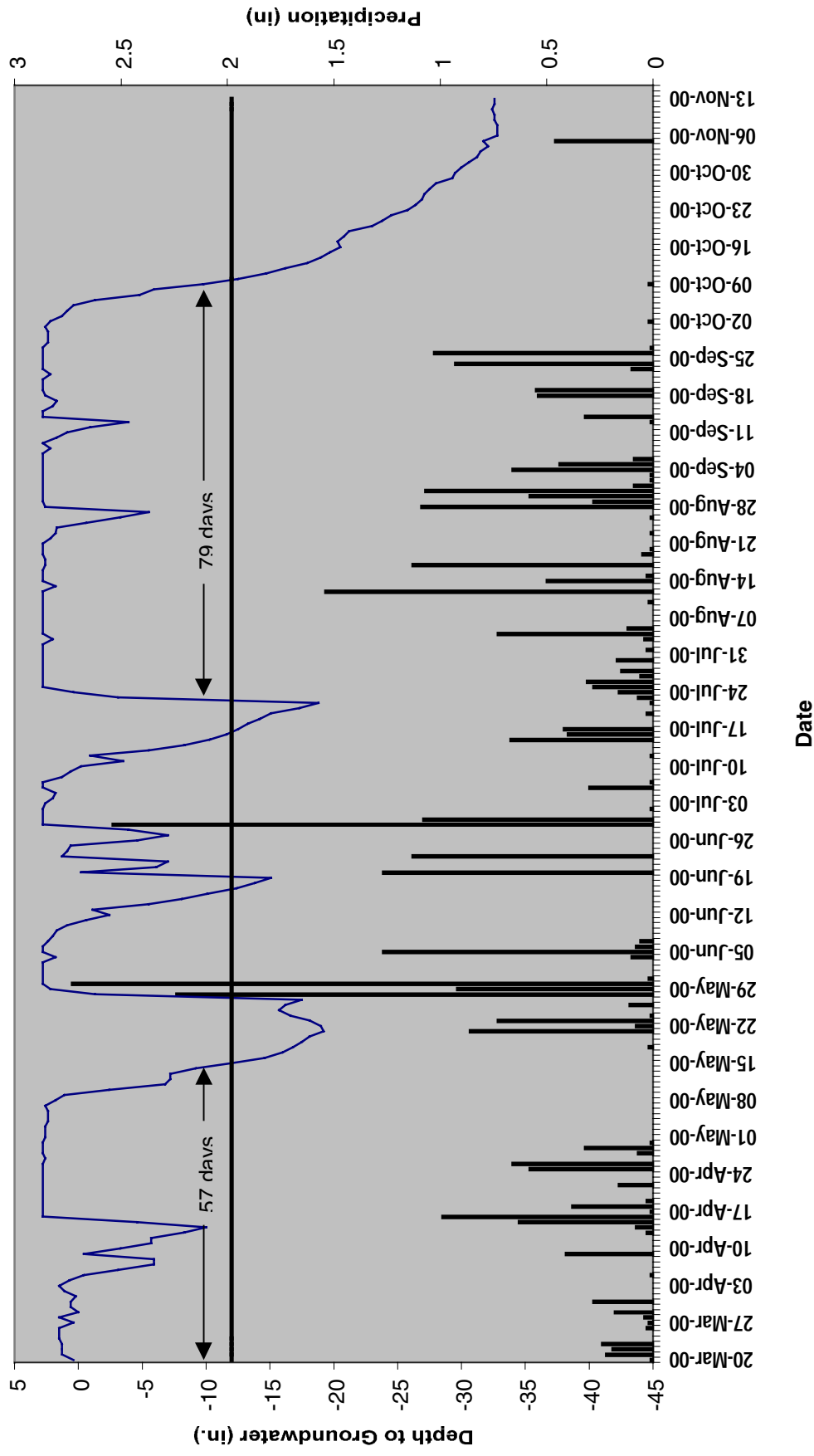


■ RAINFALL — BF-12 S31F7A1 — REQUIRED DEPTH

# Ballance Farm BF-13

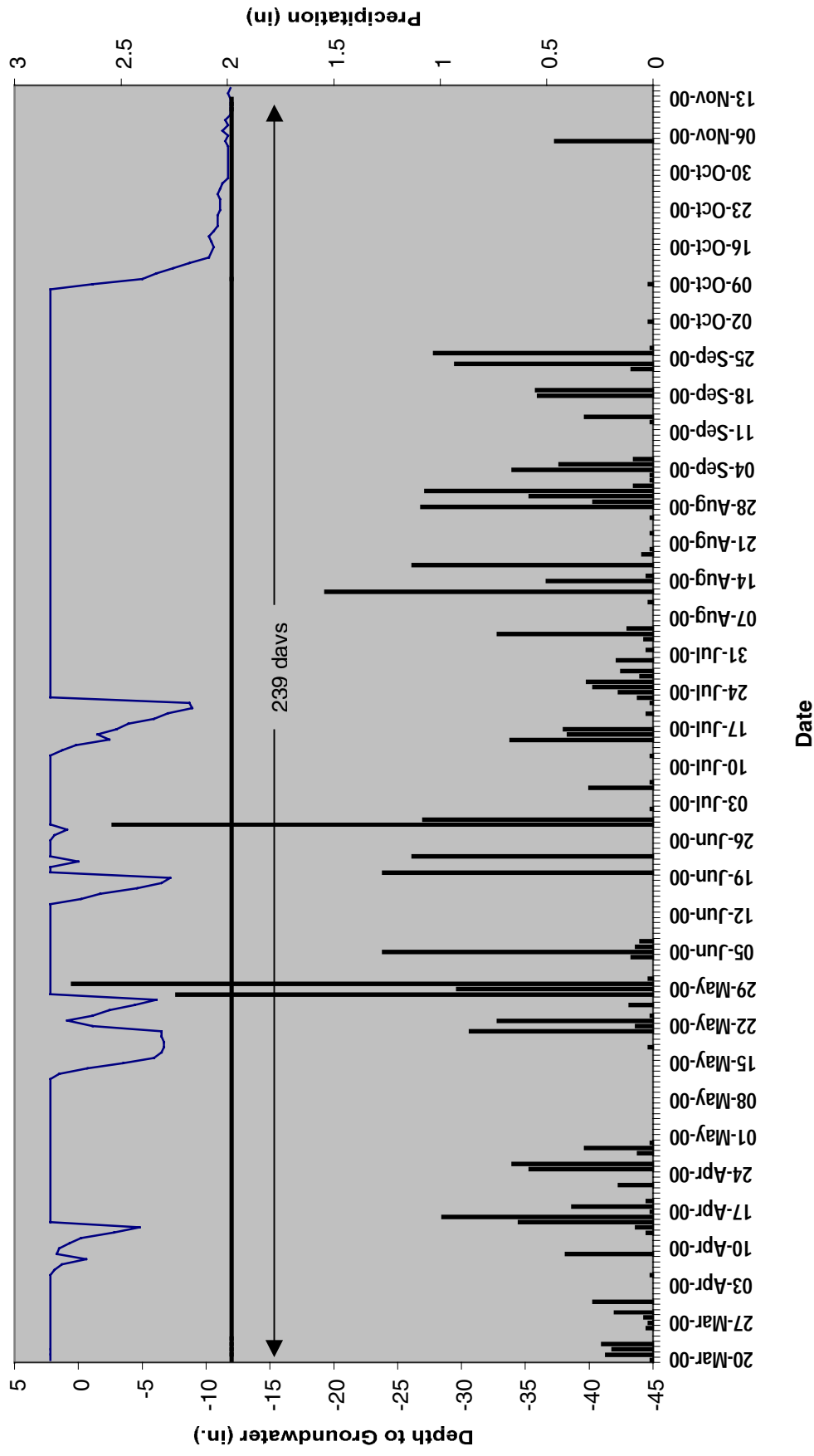


# Ballance Farm BF-14



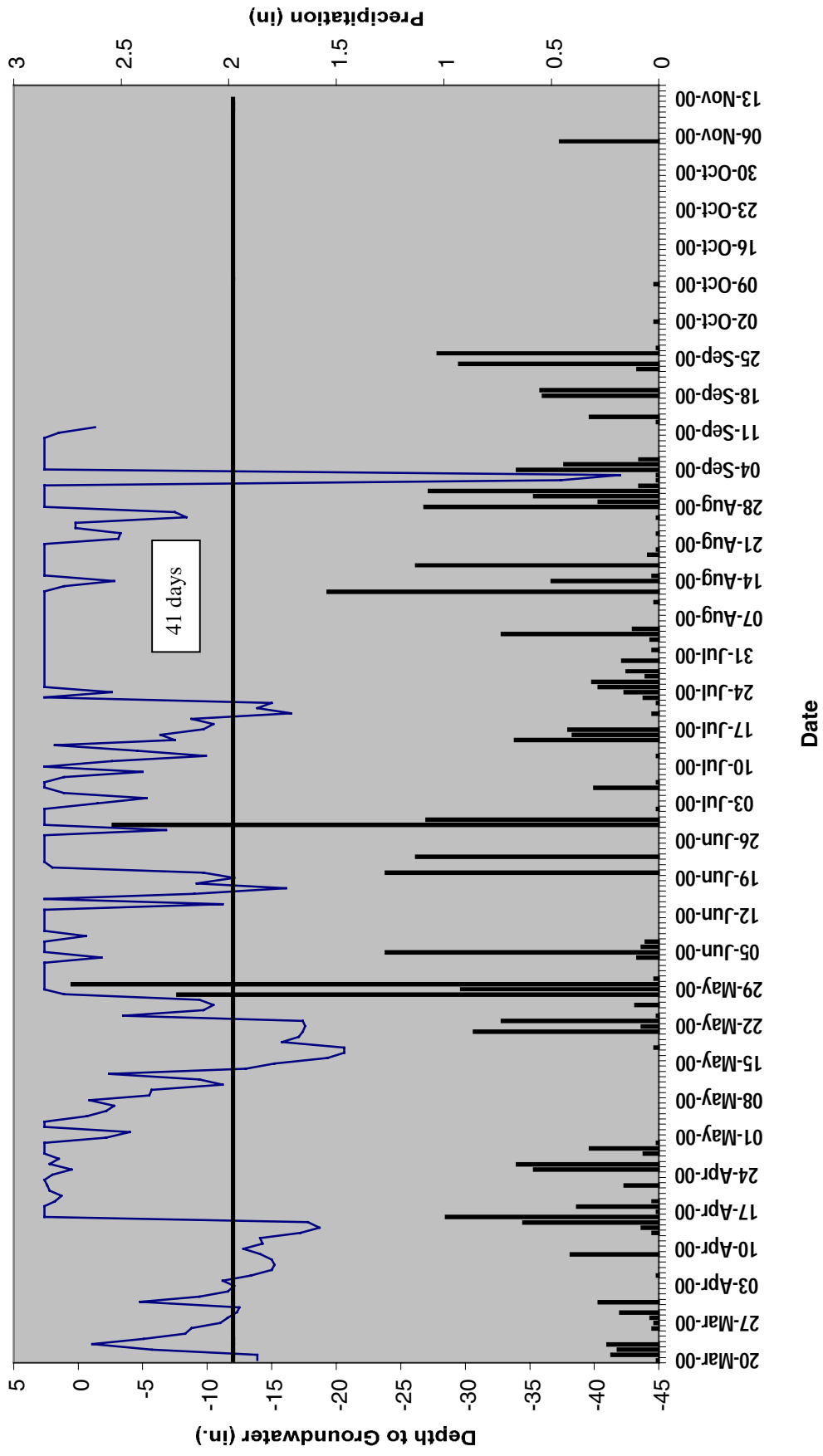
■ RAINFALL — BF-14 S2B2369 — REQUIRED DEPTH

# Ballance Farm BF-15

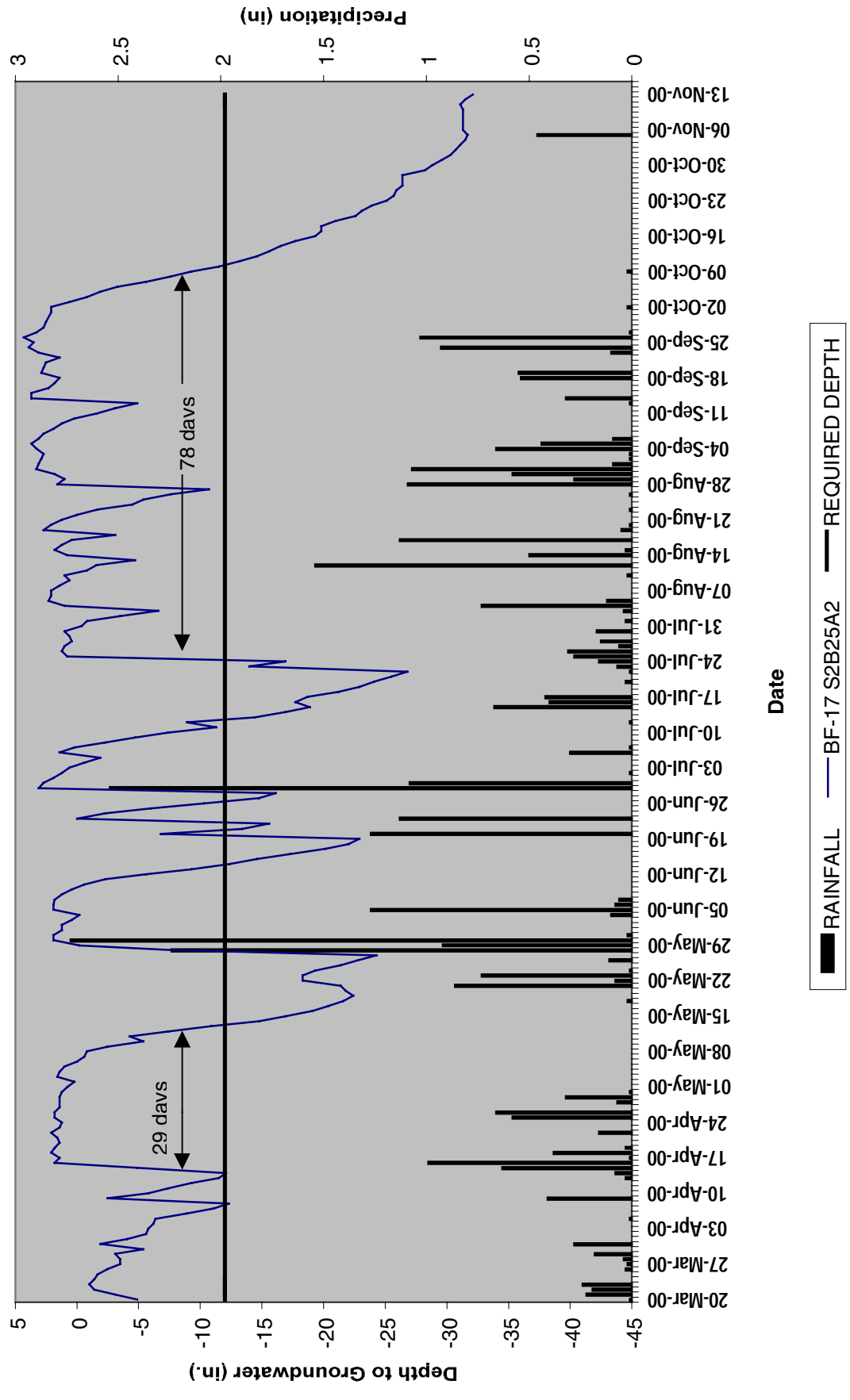


RAINFALL
  BF-15 S213E37
  REQUIRED DEPTH

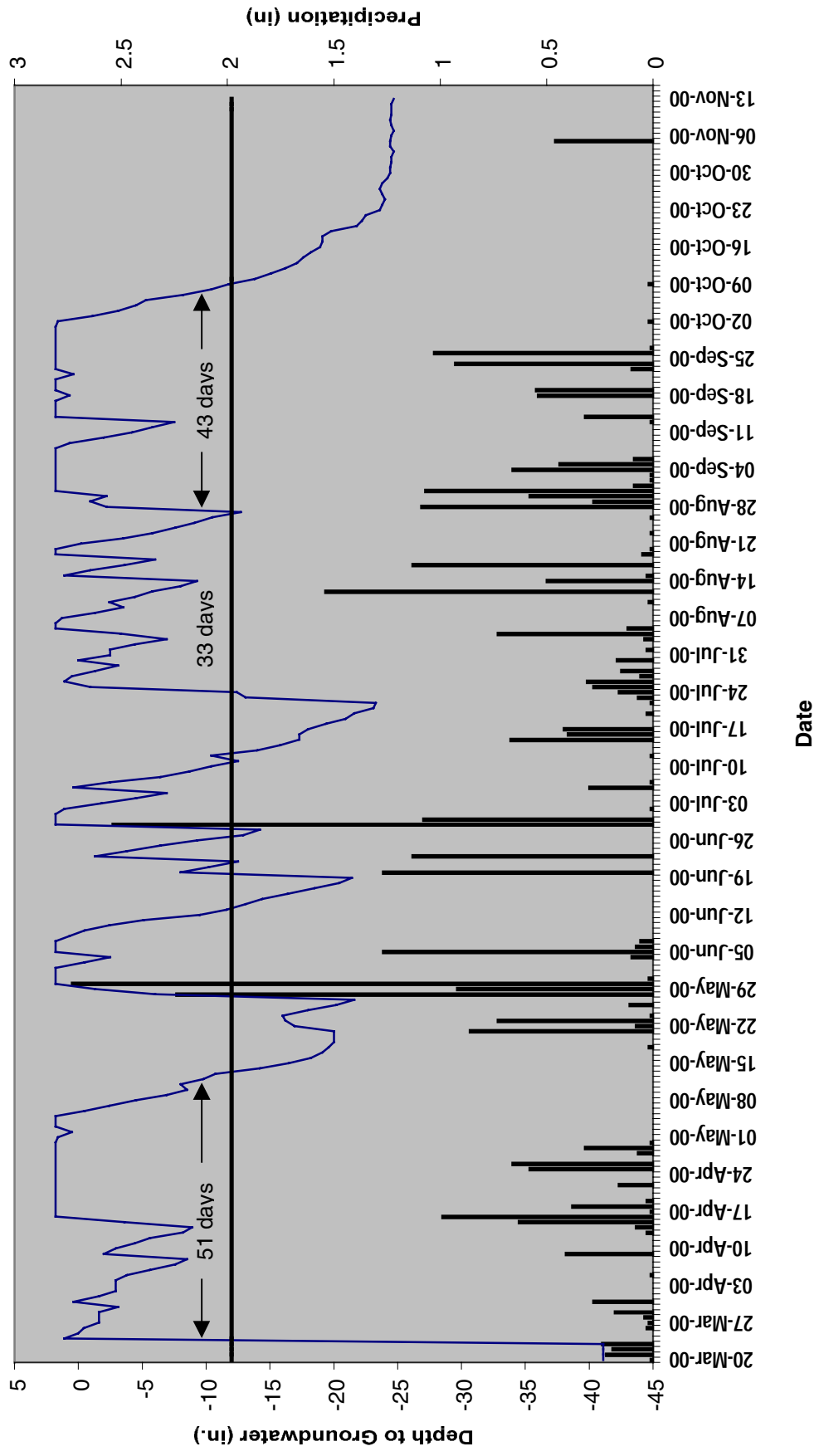
# Ballance Farm BF-16



# Ballance Farm BF-17

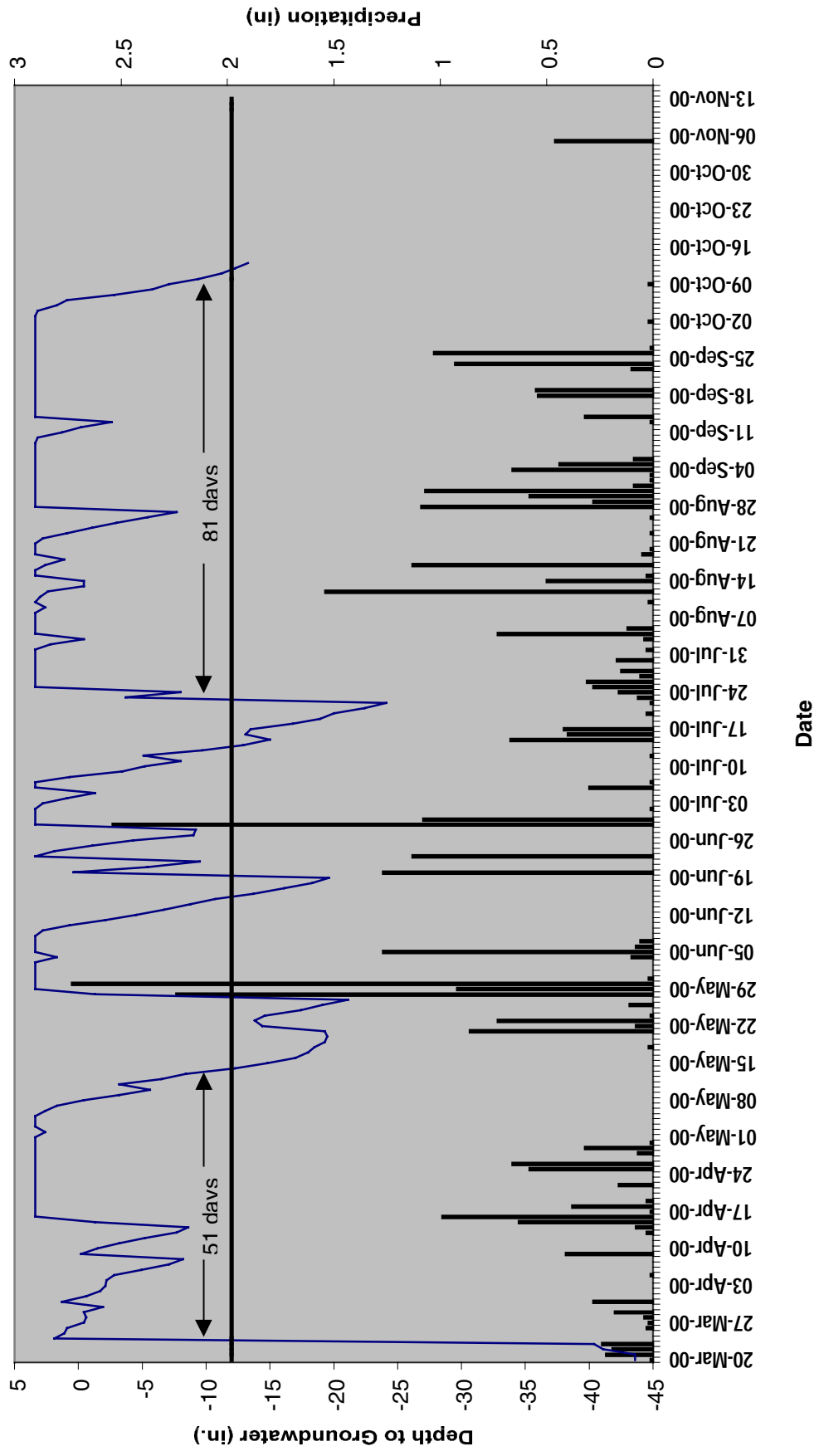


# Ballance Farm BF-18



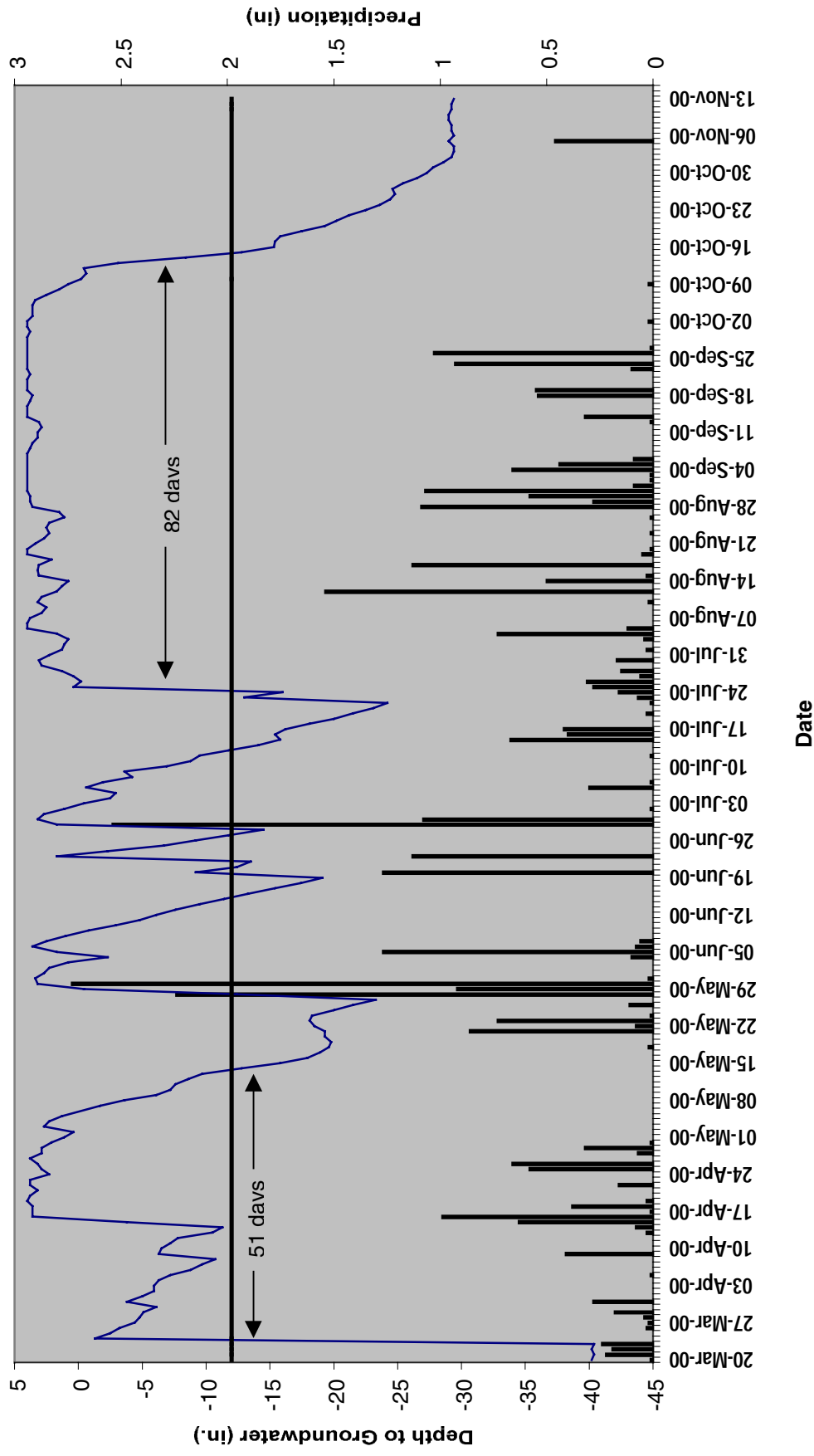
■ RAINFALL — BF-18 S31FA10 — REQUIRED DEPTH

# Ballance Farm BF-19

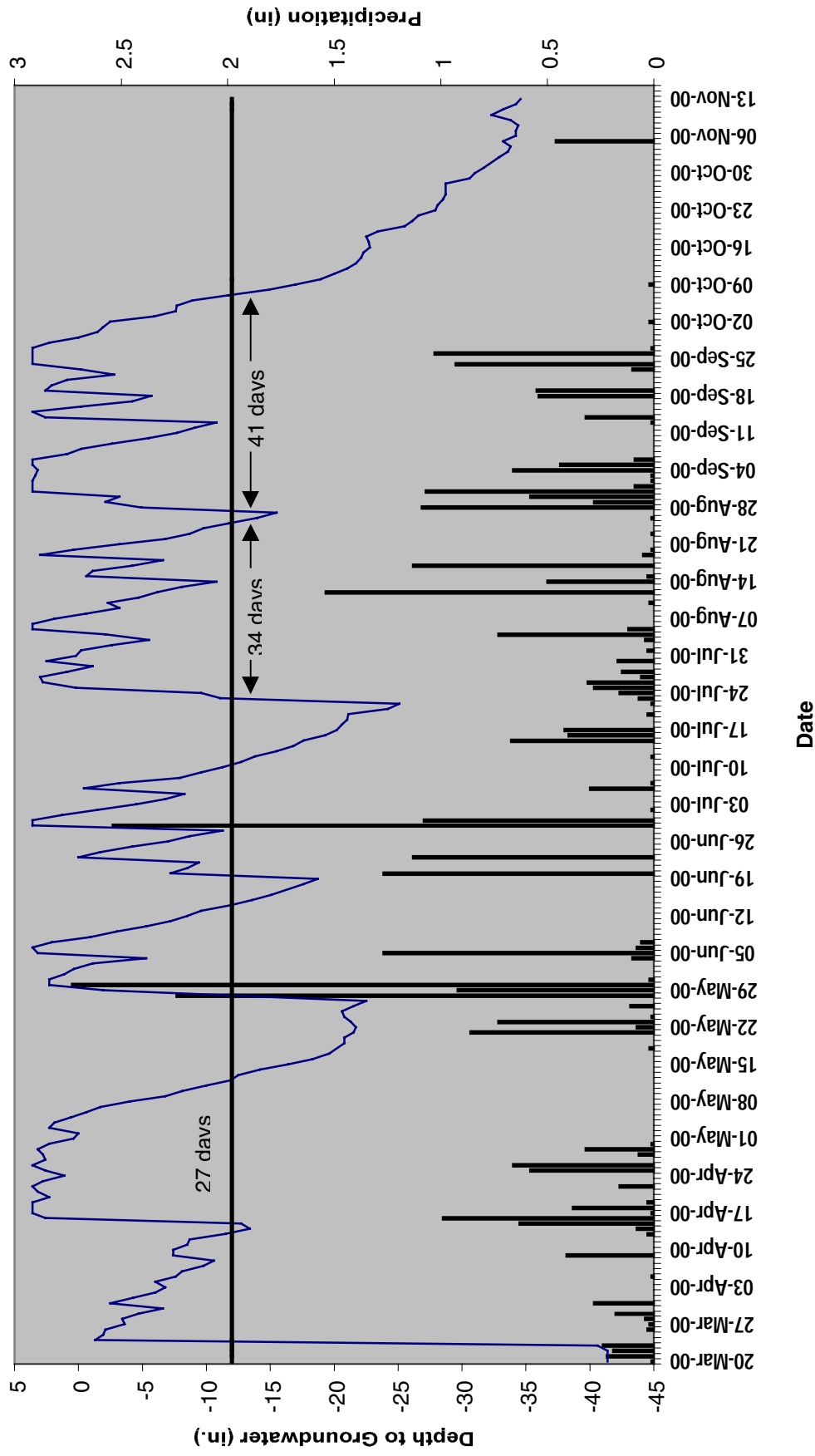




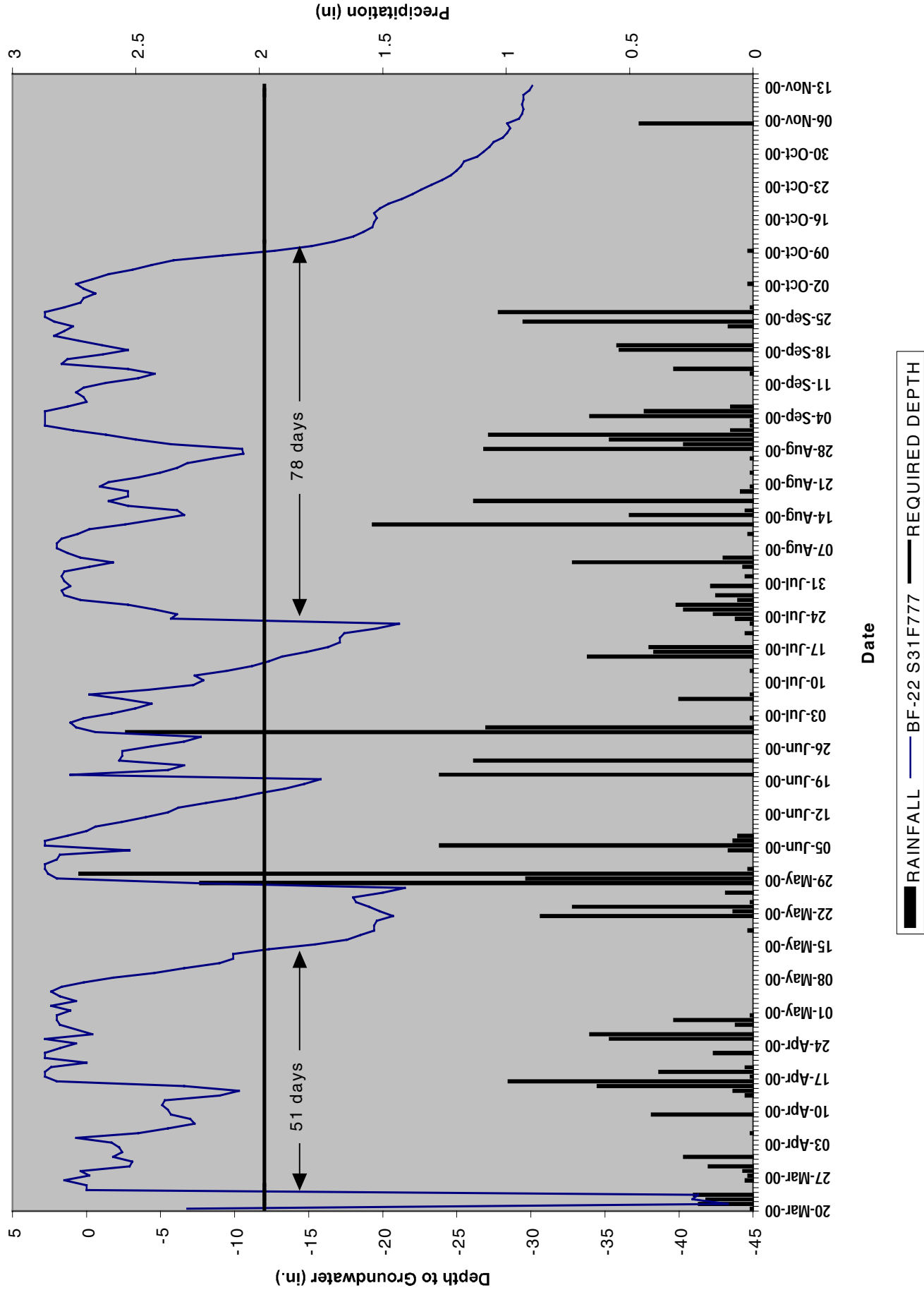
# Ballance Farm BF-20



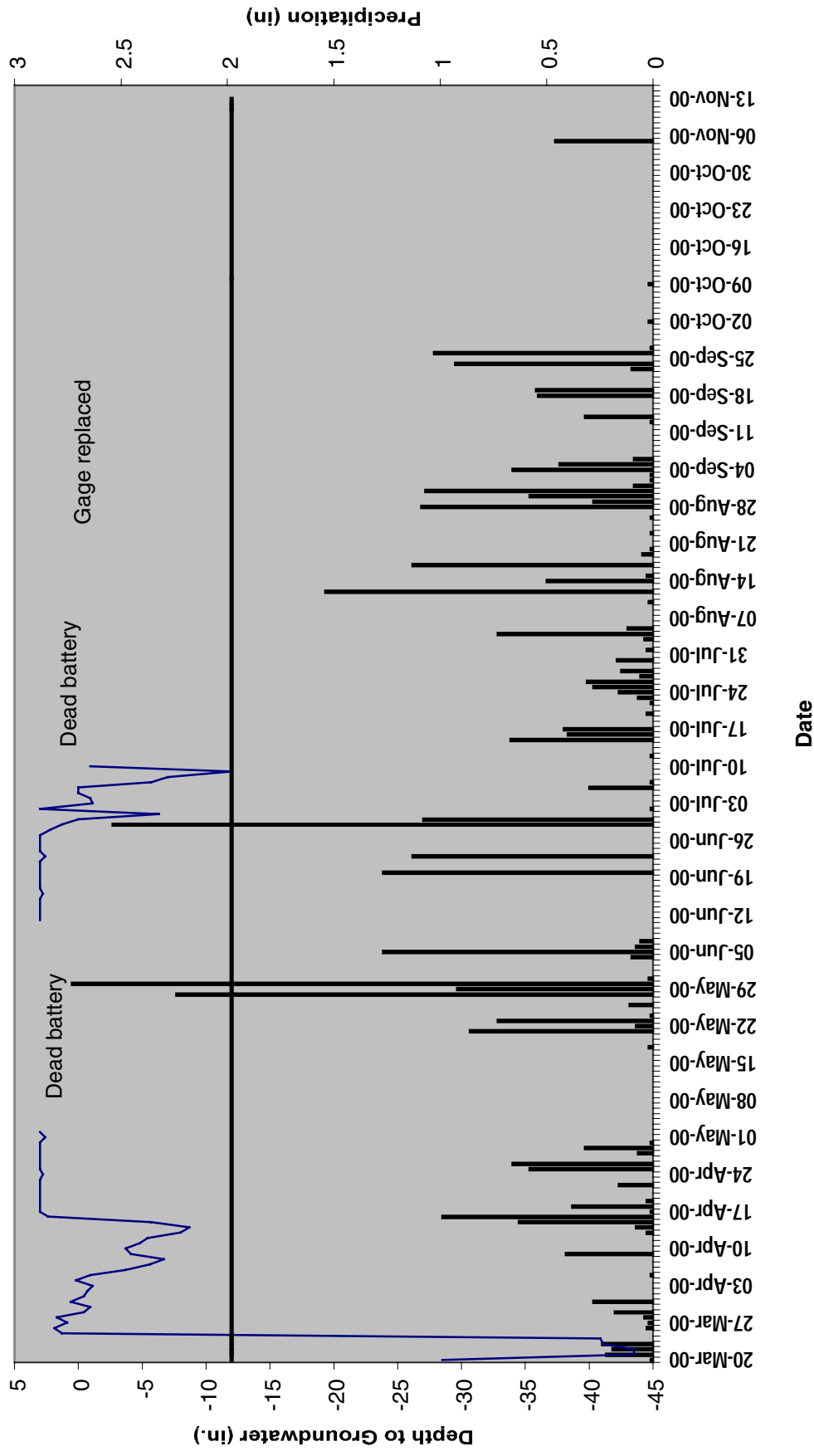
# Ballance Farm BF-21



# Ballance Farm BF-22

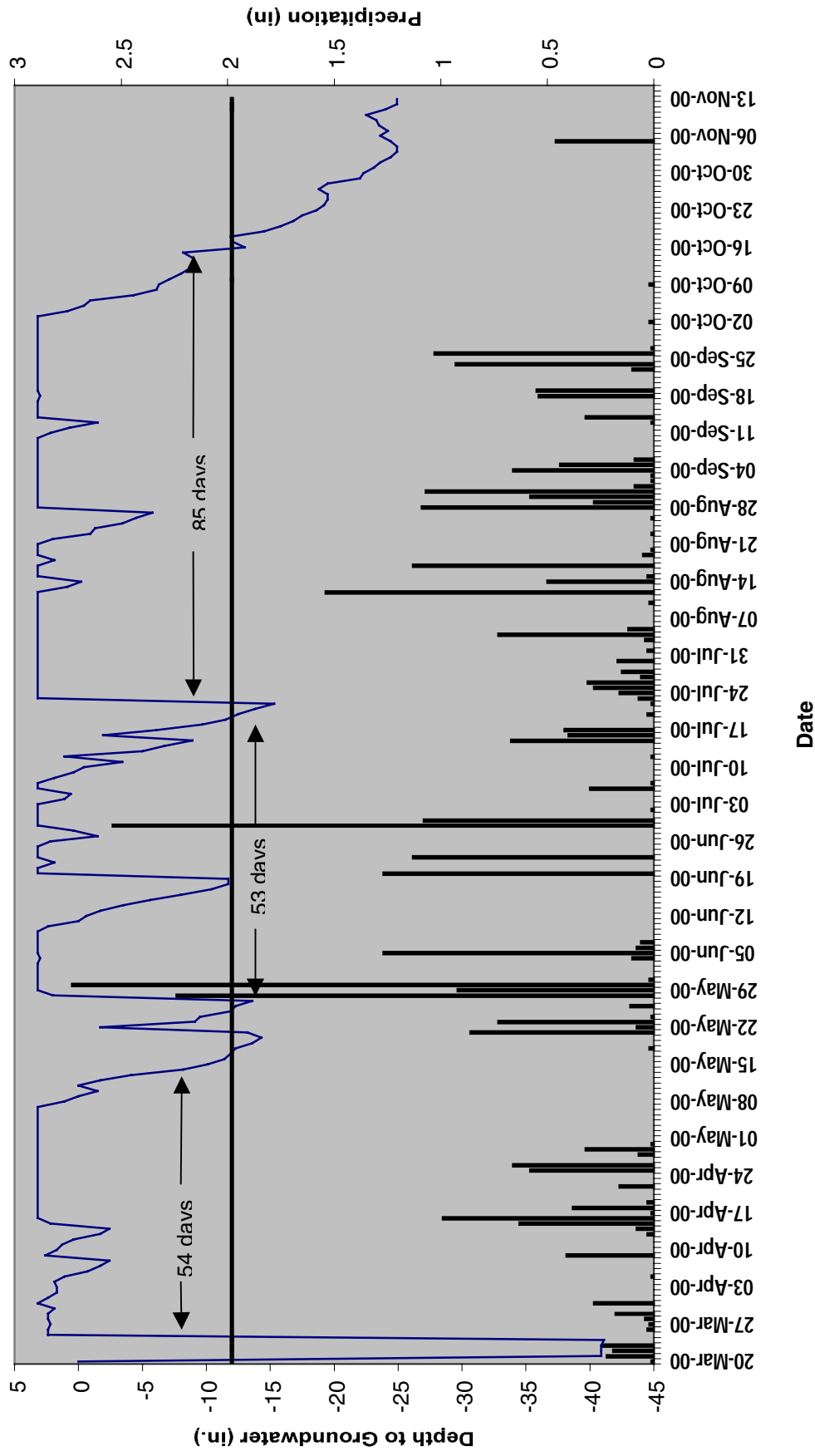


# Ballance Farm BF-23



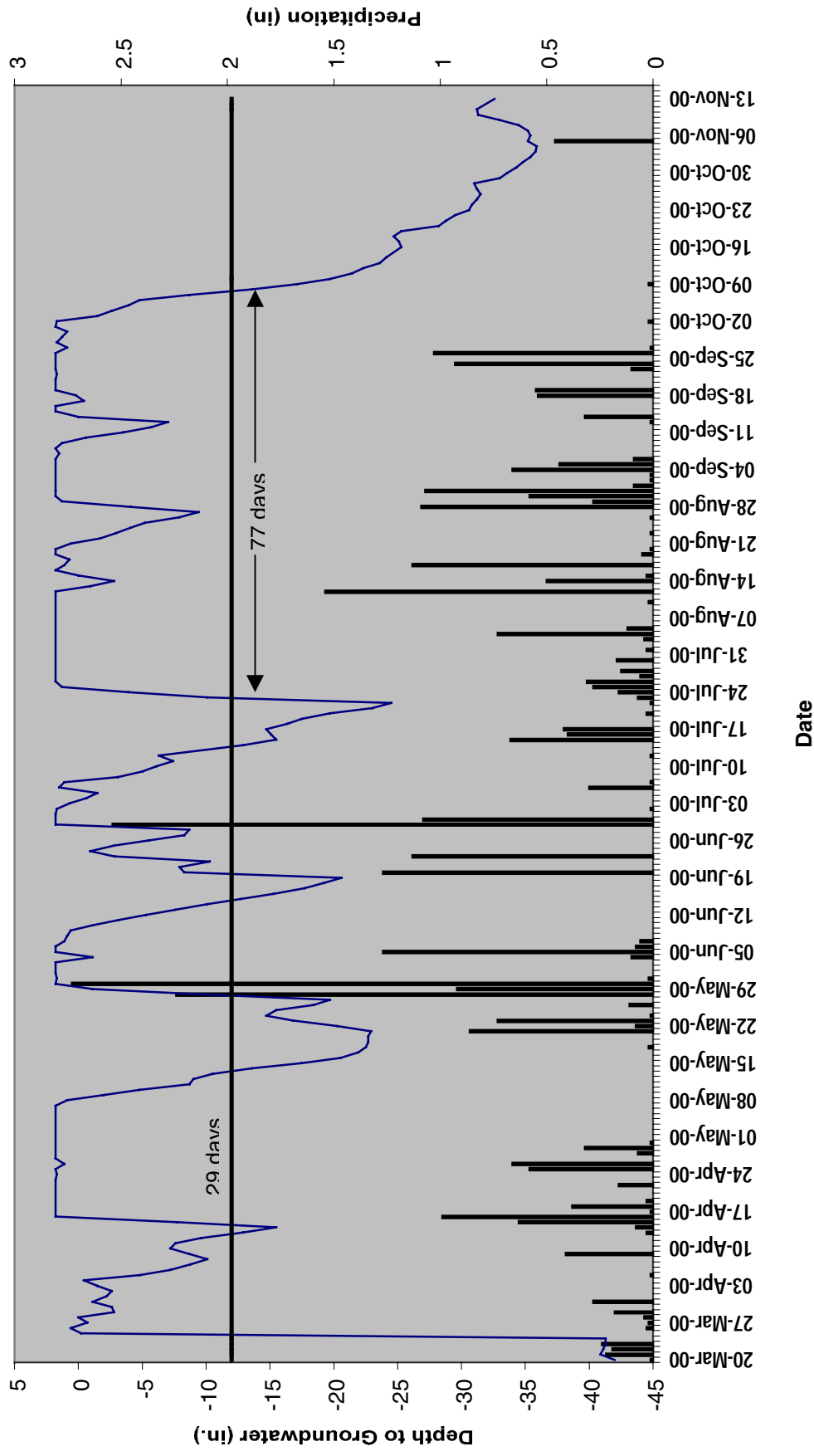
■ RAINFALL — BF-23 S31F888 — REQUIRED DEPTH

# Ballance Farm BF-24

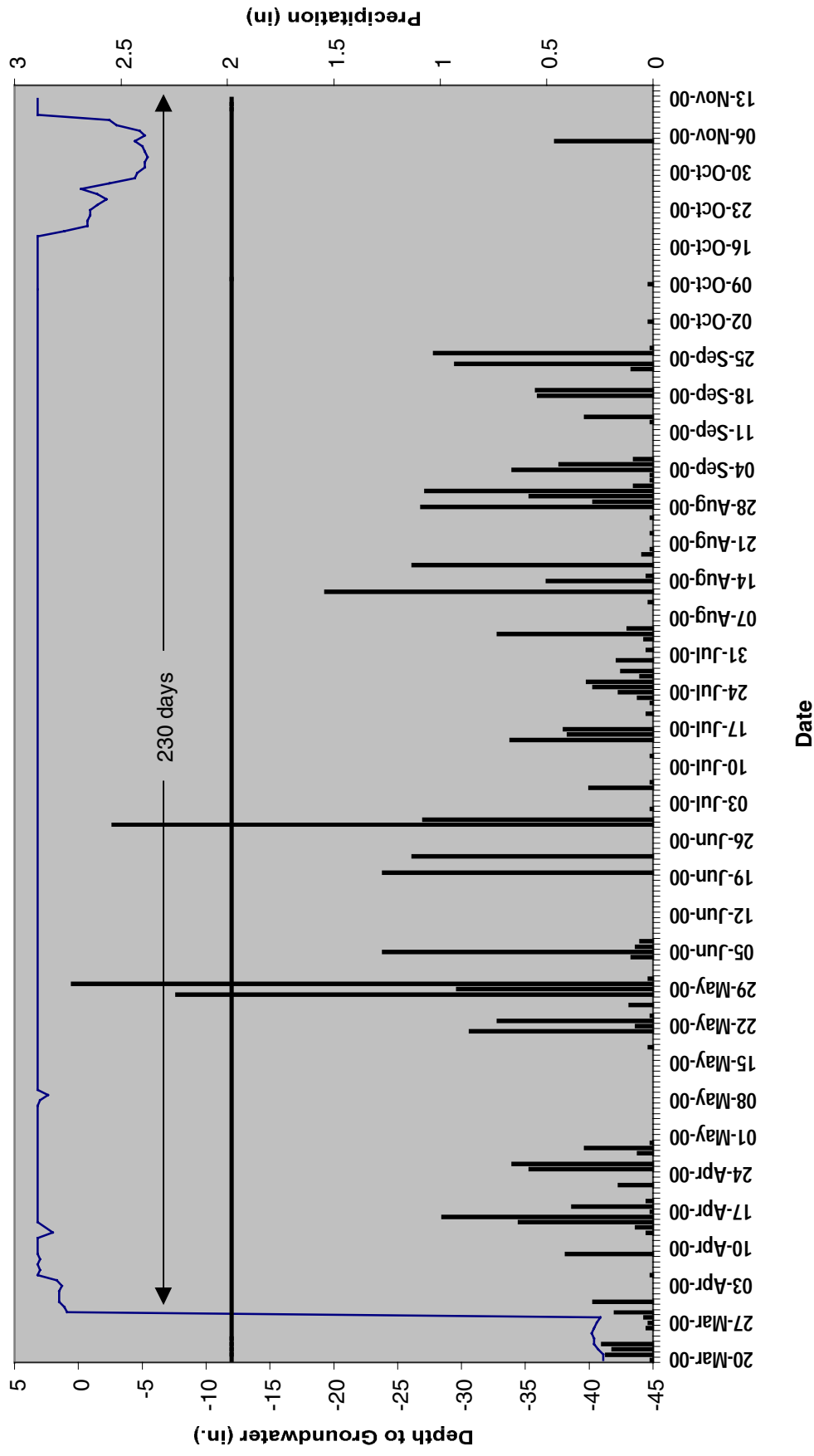


■ RAINFALL — BF-24 S31F8E2 — REQUIRED DEPTH

# Ballance Farm BF-25

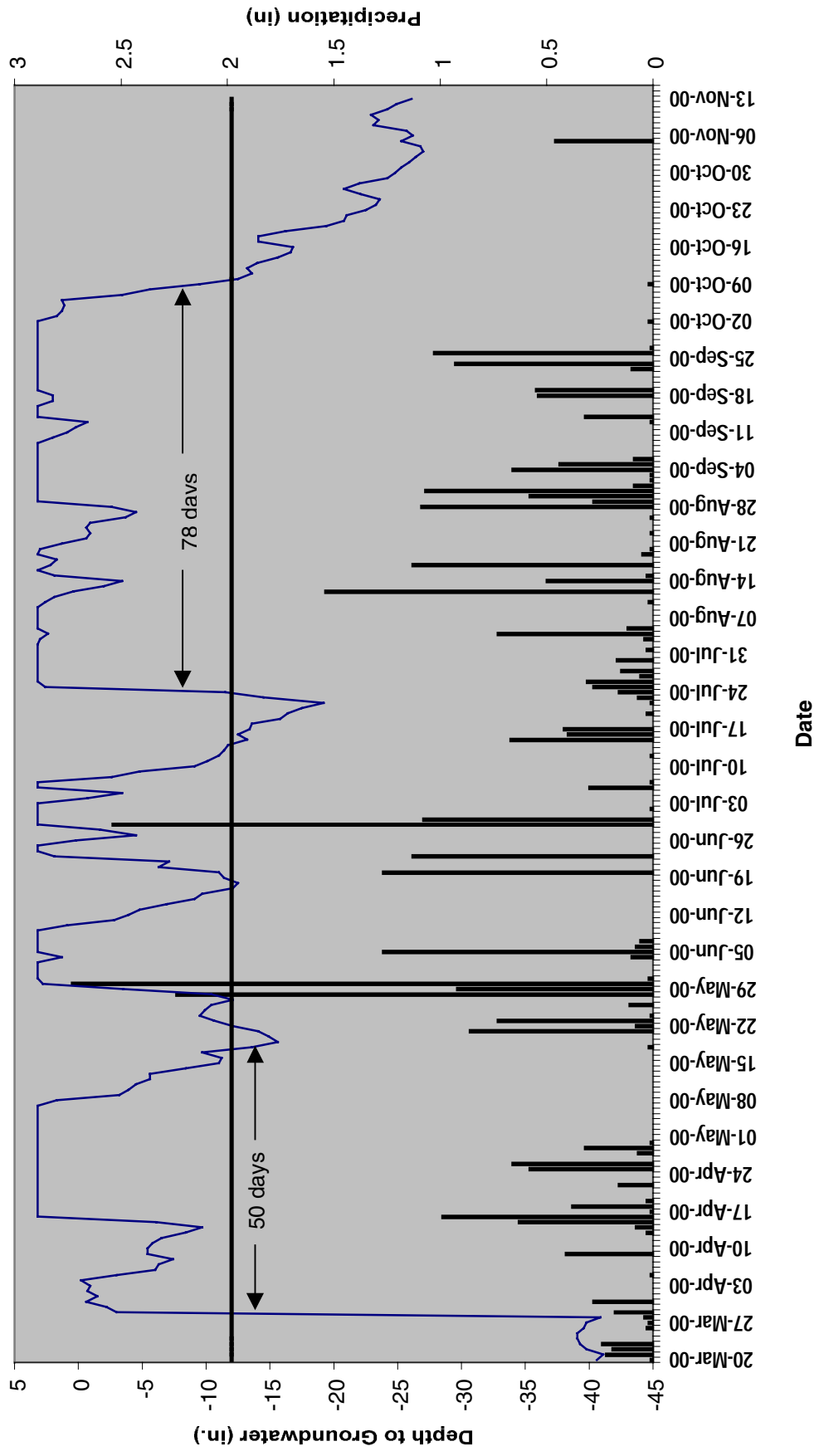


# Ballance Farm BF-26



■ RAINFALL — BF-26 S31F72D — REQUIRED DEPTH

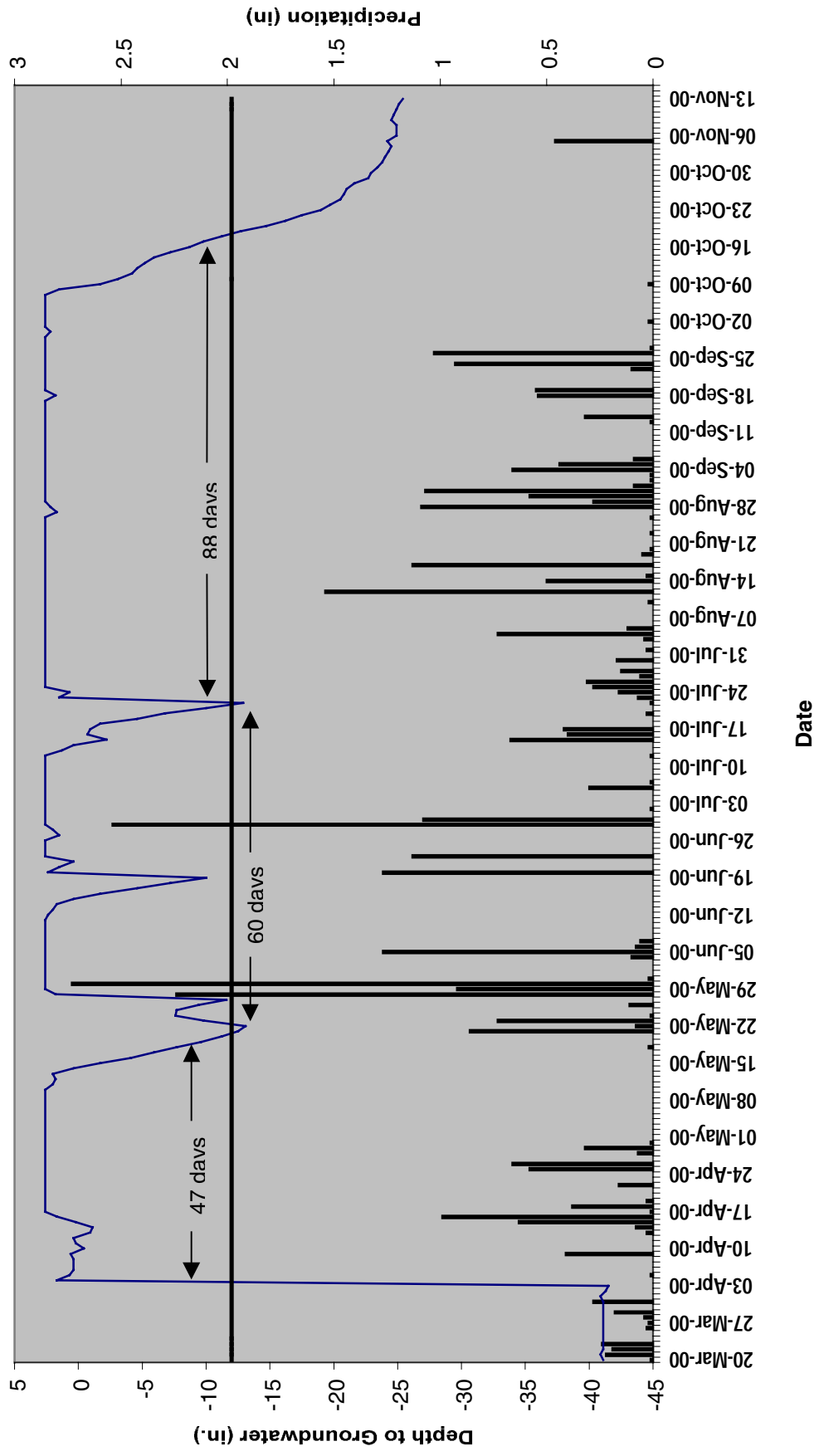
# Ballance Farm BF-27



■ RAINFALL — BF-27 S31FA18 — REQUIRED DEPTH

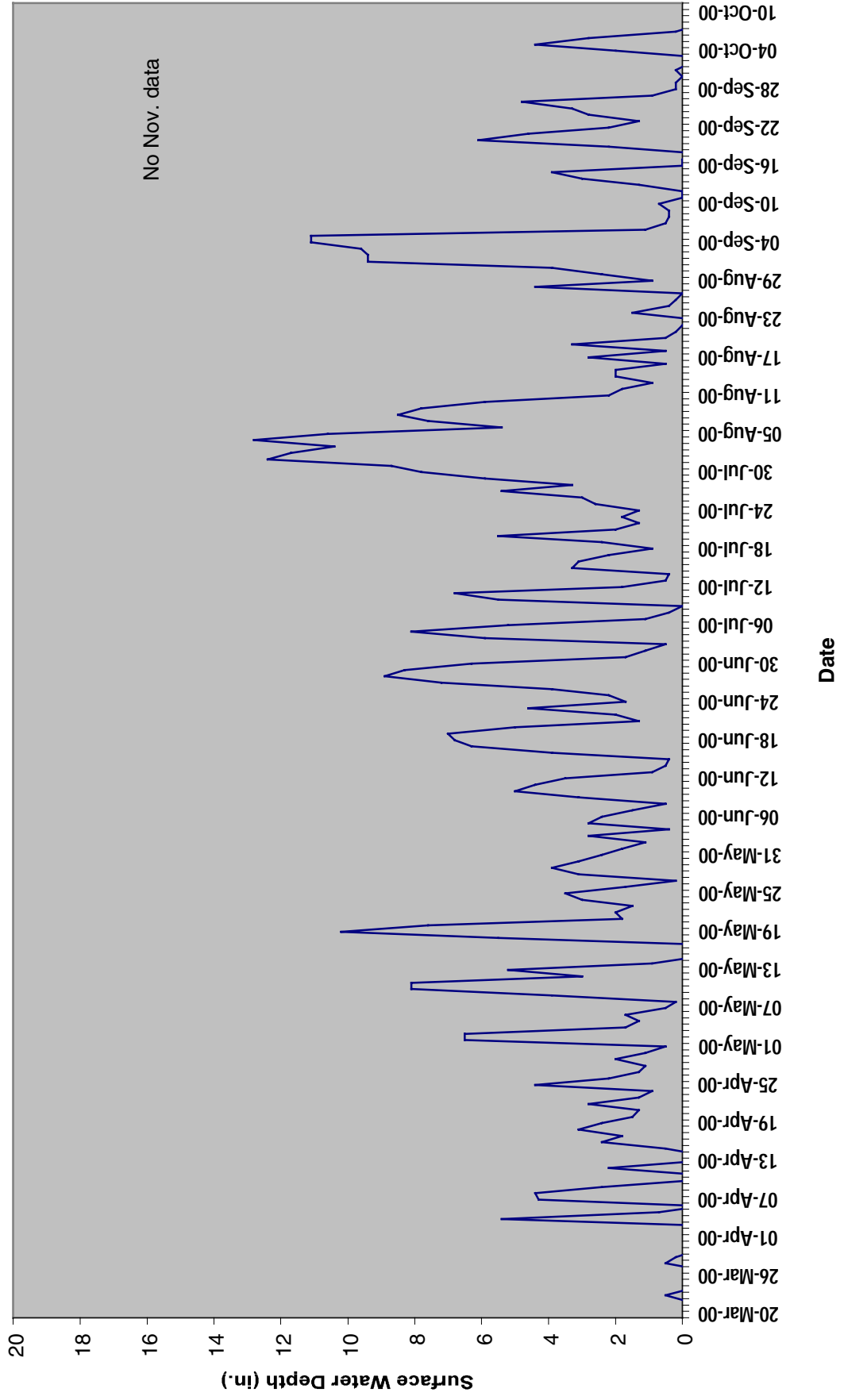


# Ballance Farm BF-28

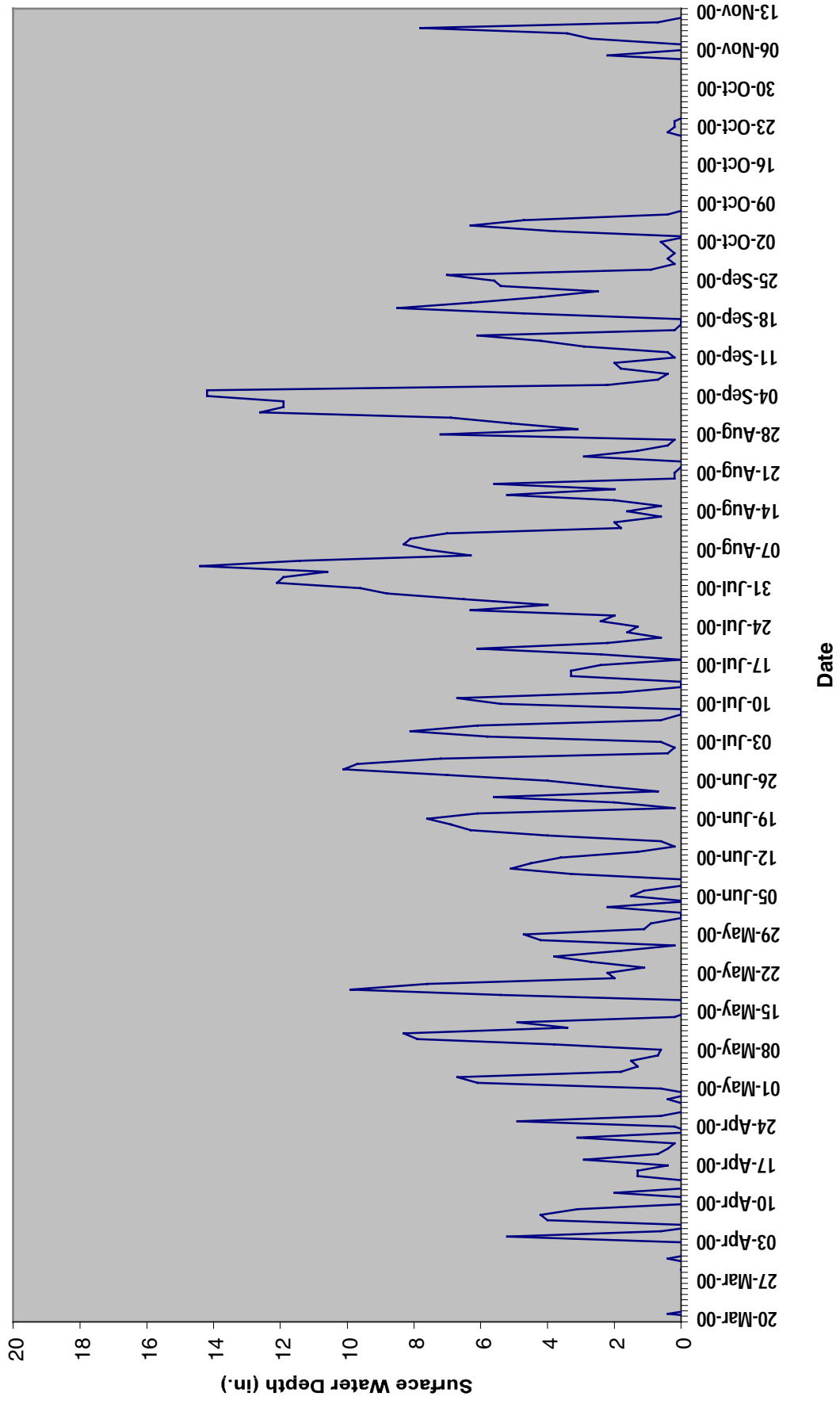


Legend:  
 ■ RAINFALL  
 — BF-28 S213E3C  
 — REQUIRED DEPTH

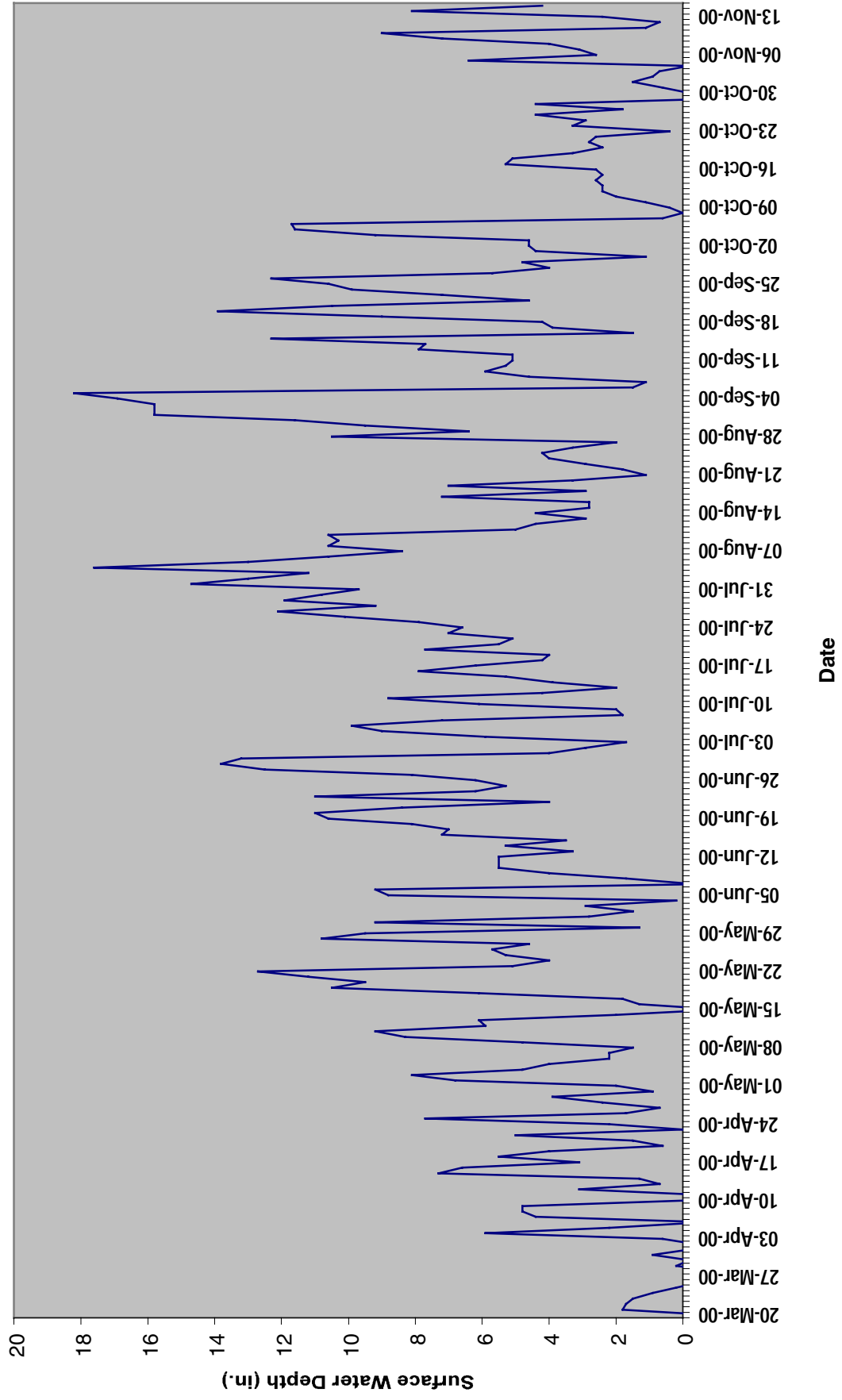
### Ballance Farm BFSG-1



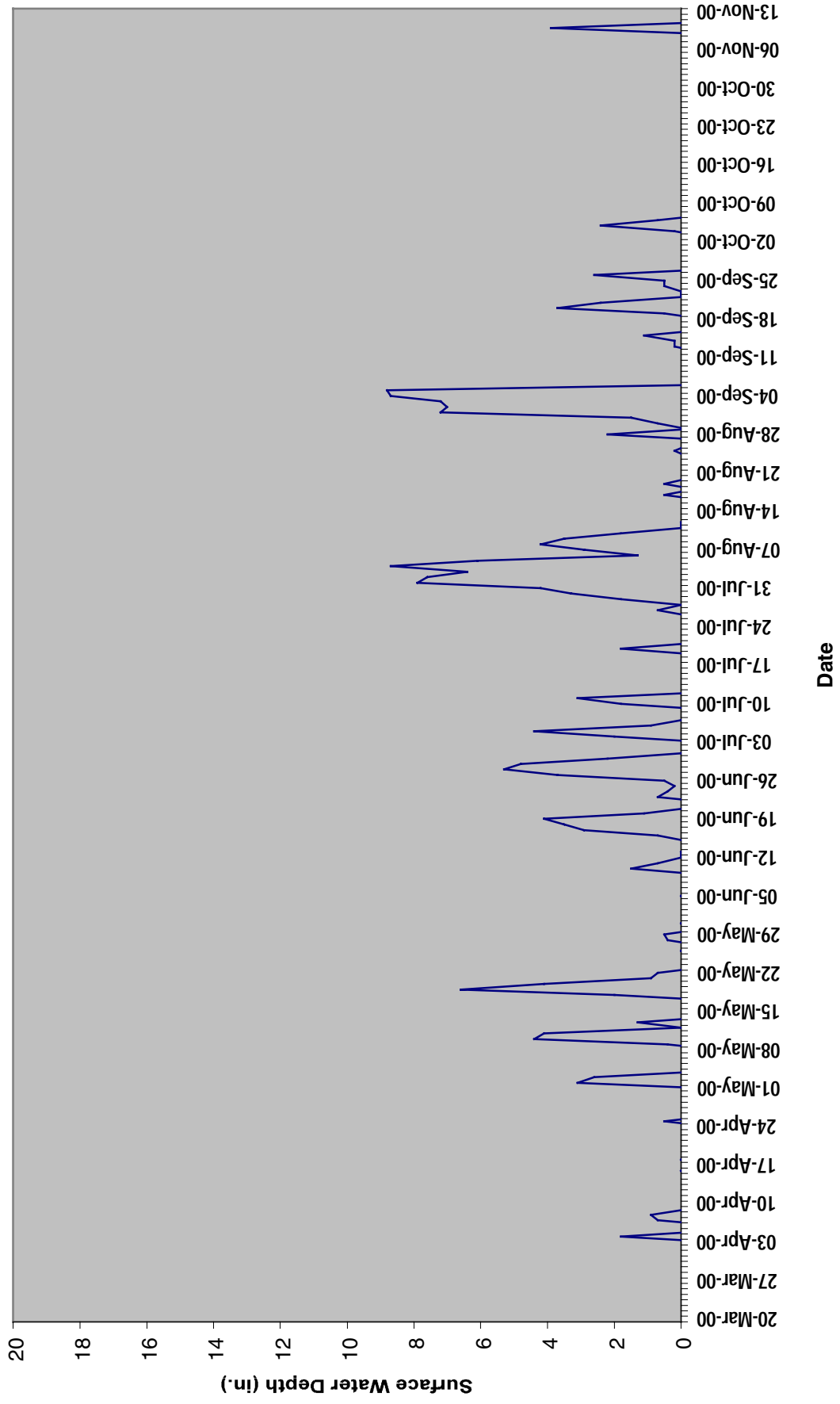
# Ballance Farm BFSG-2



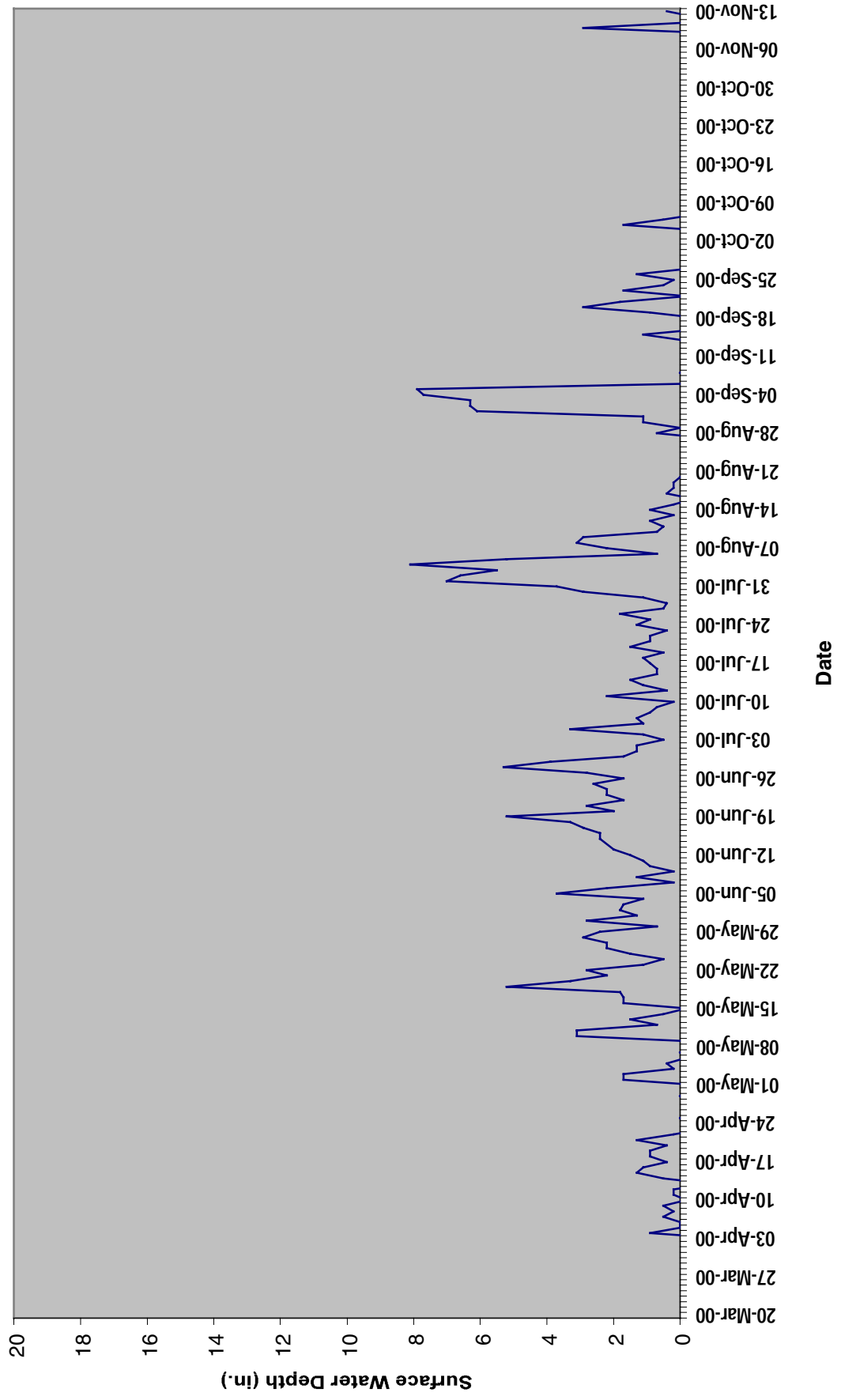
### Ballance Farm BFSG-3



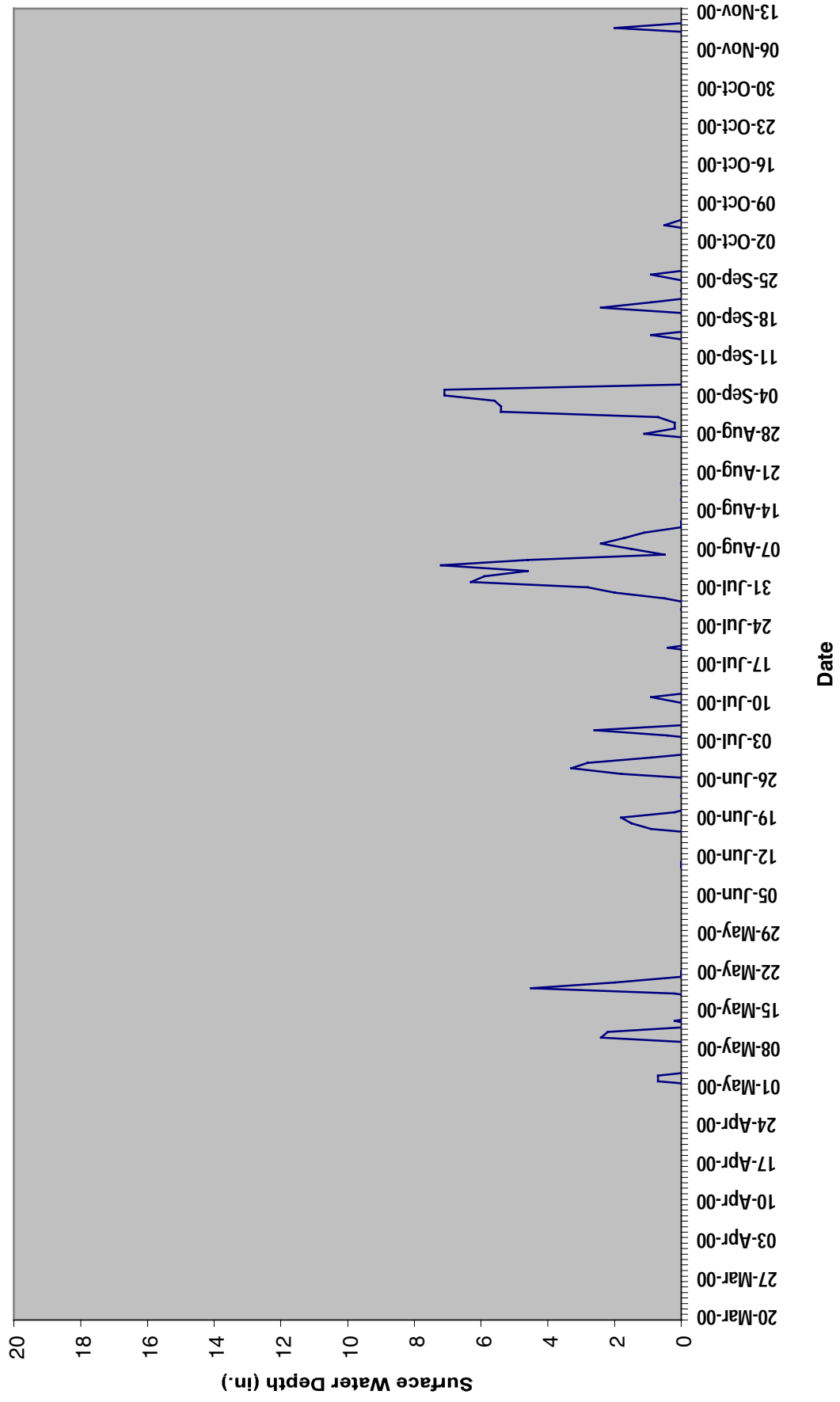
# Ballance Farm BFSG-5



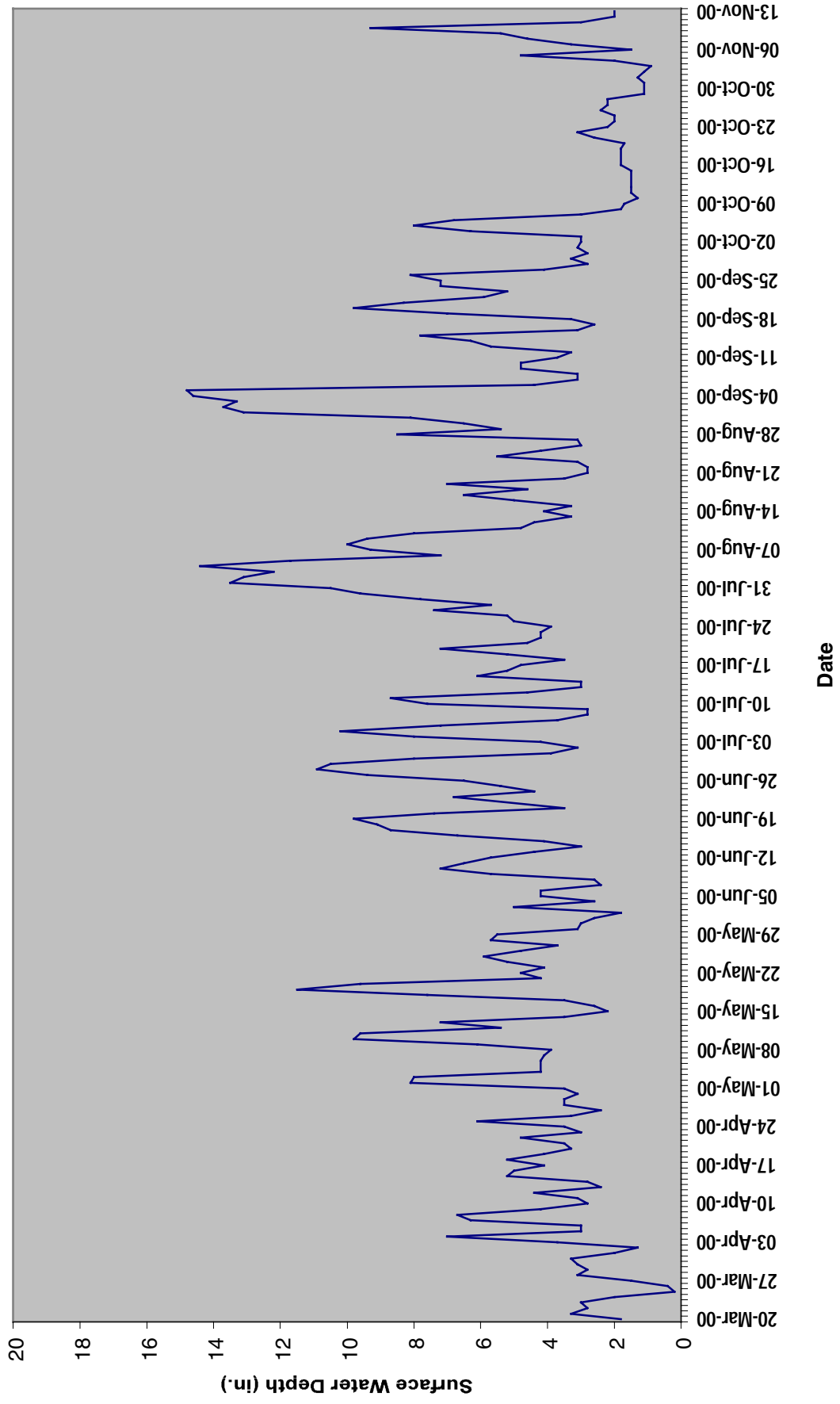
### Ballance Farm BFSG-7



### Ballance Farm BFSG-8

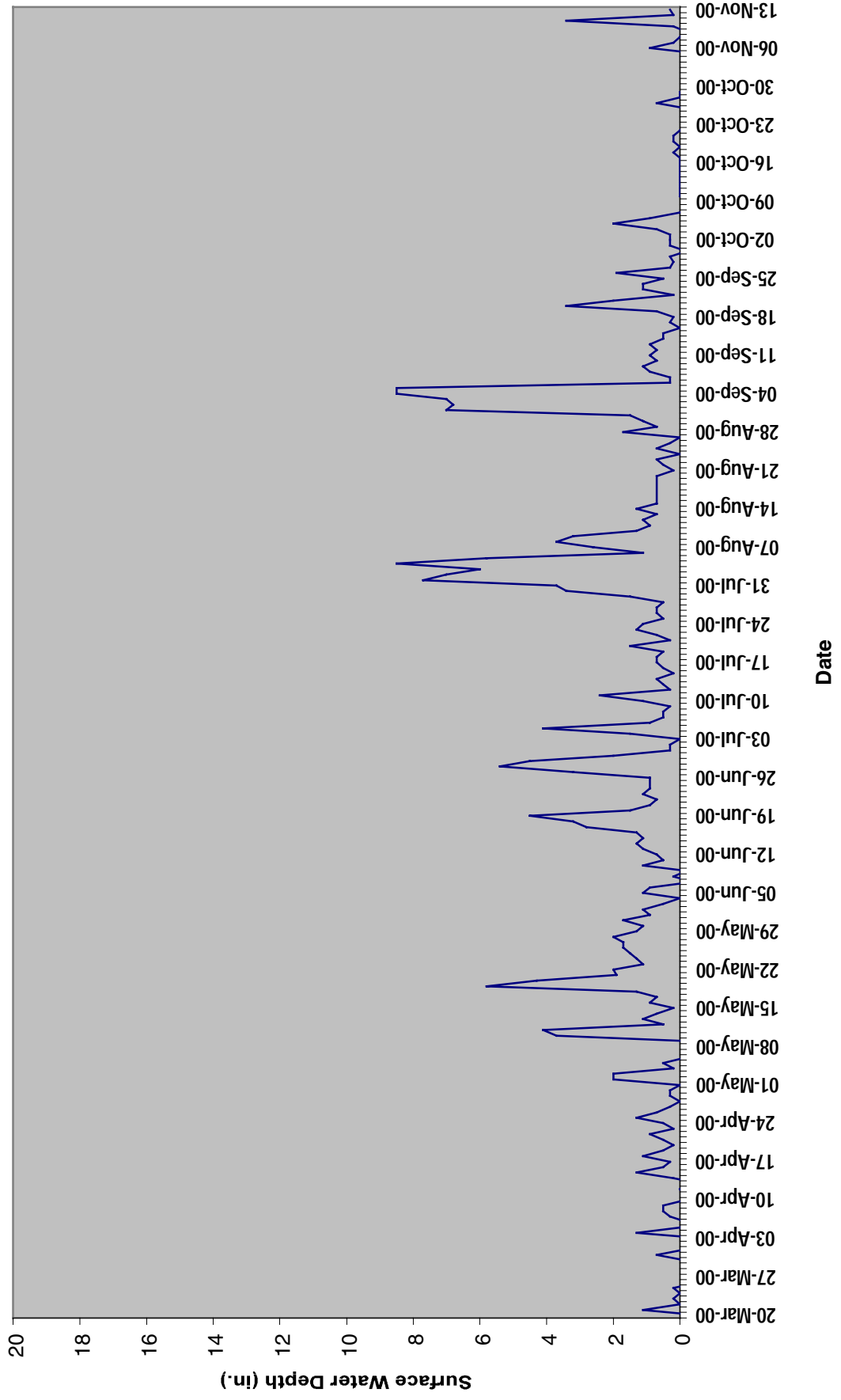


### Ballance Farm BFSG-9

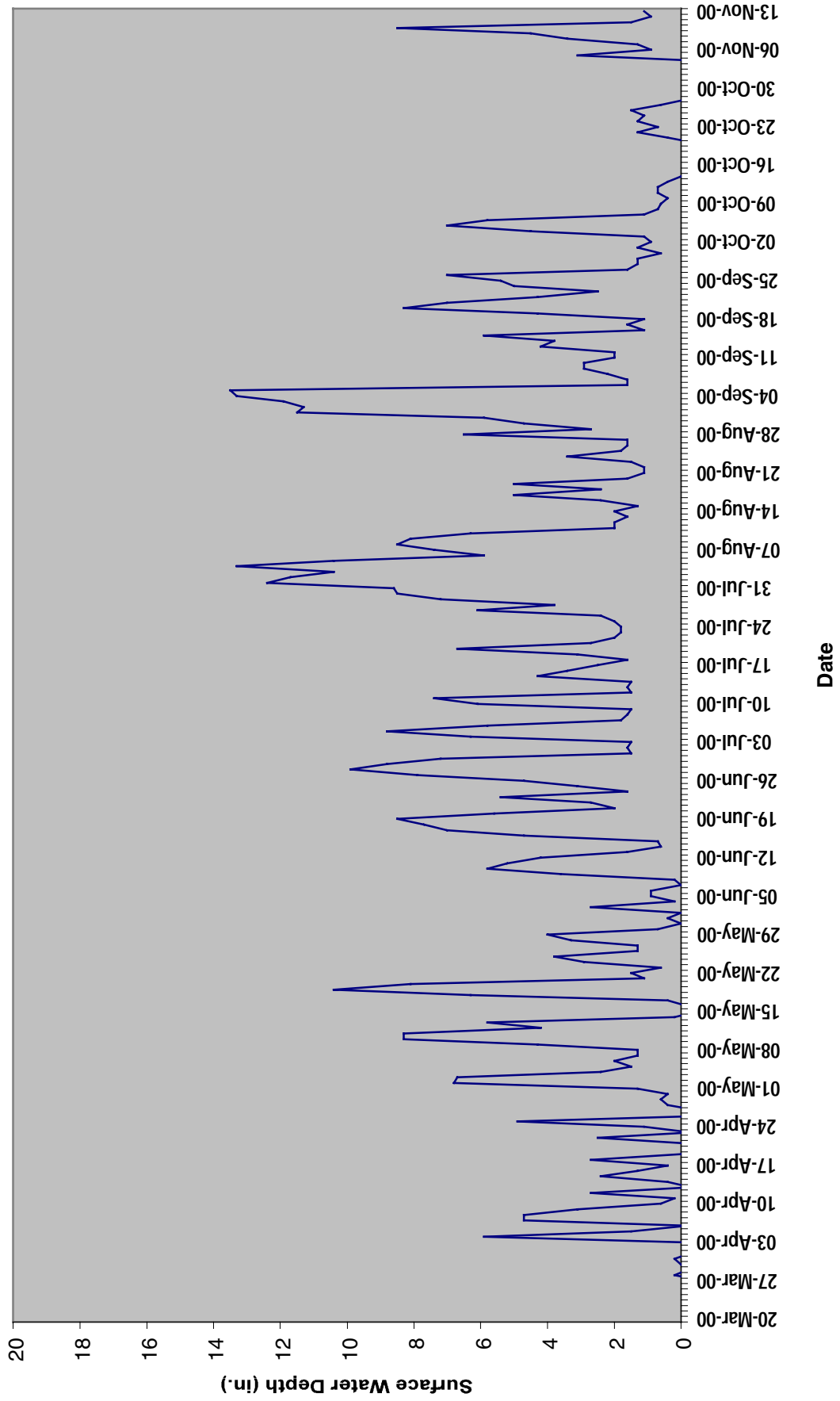




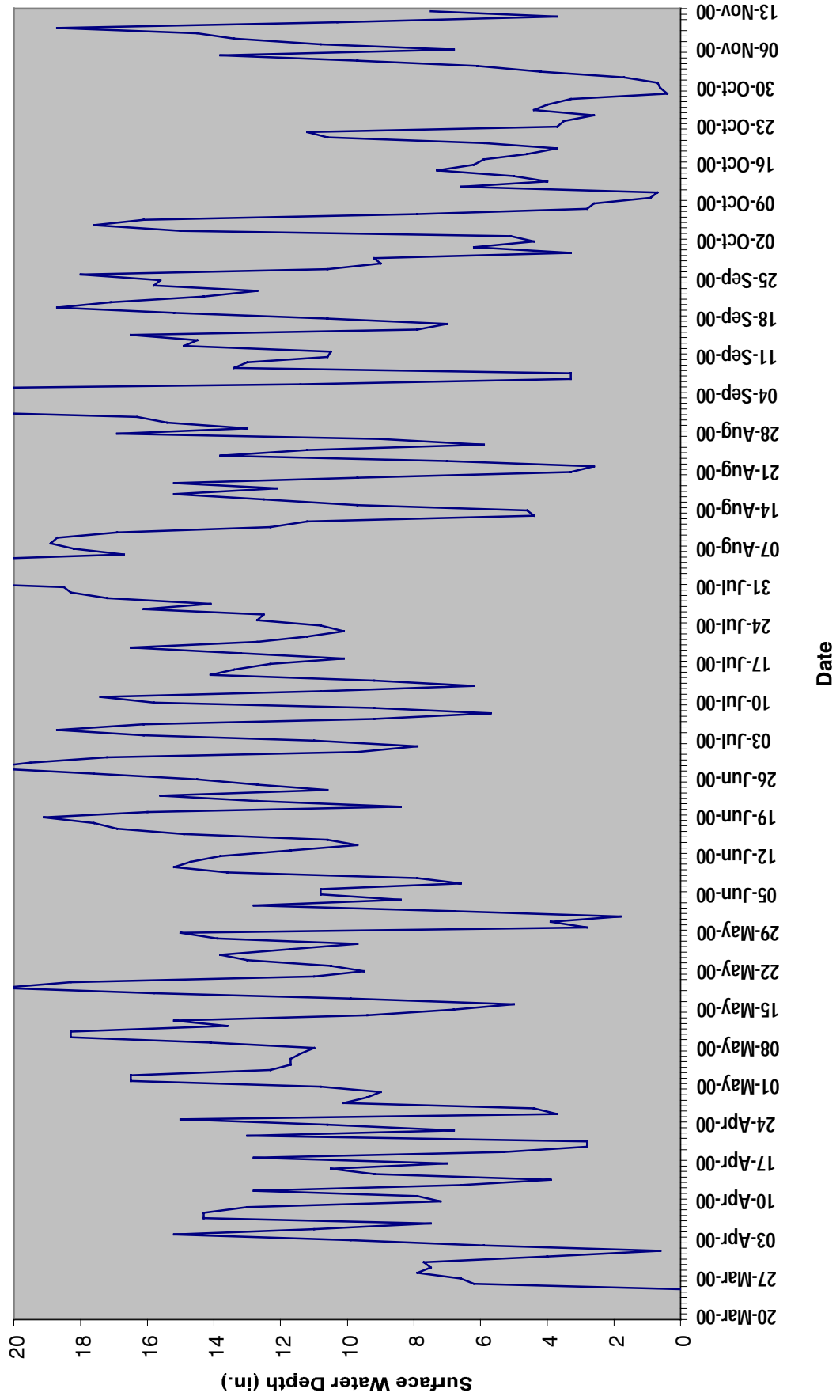
# Ballance Farm BFSG-11



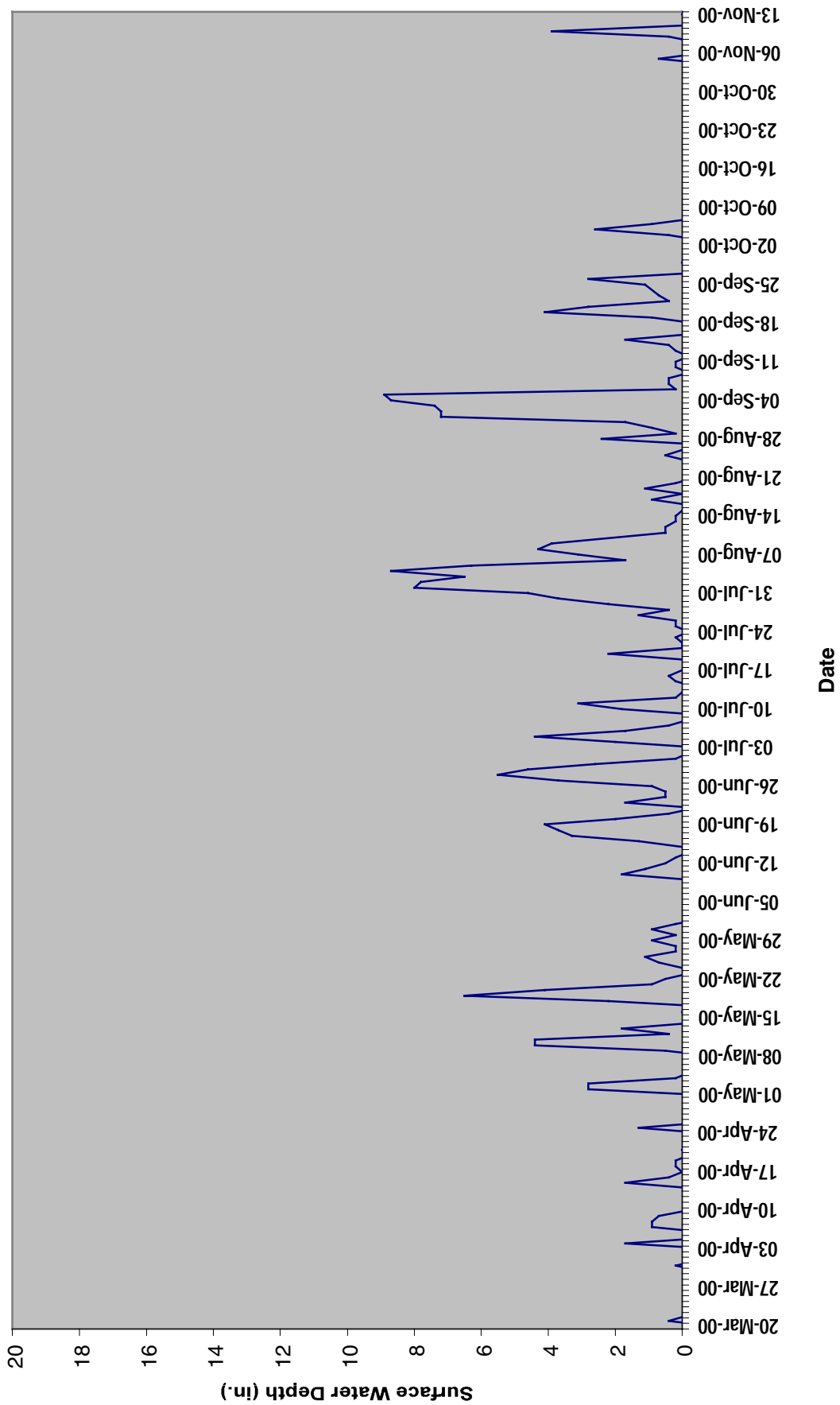
# Ballance Farm BFGG-12



### Ballance Farm BFGG-13



# Ballance Farm BFSG-14





**APPENDIX B  
SITE PHOTOS**



# BALLANCE FARM



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6



# BALLANCE FARM



Photo 7



Photo 8



Photo 9



Photo 10



Photo 11



Photo 12

# BALLANCE FARM



Photo 13



Photo 14



Photo 15