

# ANNUAL REPORT FOR 2000



***Mud Creek Mitigation Site  
Henderson County  
Project No. 8.T842404  
TIP No. R-2713***



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## **SUMMARY**

The following report summarizes the monitoring activities that occurred in the past year at the Mud Creek mitigation site. Monitoring activities in 2000 represent the third year of monitoring after construction in late 1997.

Four additional groundwater monitoring gauges were installed in April 2000. The Mud Creek mitigation site contains ten groundwater-monitoring gauges, one surface water gauge and an Infinity rain gauge. Gauges 4, 5 and 6 are located in the on-site wetland. MG-5 and MG-6 exhibited groundwater levels within twelve inches of the surface for a consecutive 12.5% of the growing season. The remaining gauges did not indicate the area met the criteria for wetland hydrology.

The vegetation success criteria were met with an average density of 597 trees per acre. This average is well above the minimum success criteria of 320 trees per acre; however, it has decreased since 1999.

Based on the monitoring results in 2000, NCDOT recommends continuing the monitoring activities on the Mud Creek Mitigation Site. NCDOT plans to evaluate the potential parameters affecting the success of this site and will make recommendations for remediation.

## 1.0 INTRODUCTION

### 1.1 Project Description

The Mud Creek Mitigation Site, in Henderson County, encompasses 39.1 acres. The site is located north of Hendersonville, along SR 1528 (Figure 1). It is designed to mitigate for various projects in the French Broad River Basin. Specifically, the Mud Creek site provides the following:

- 4.1 acres of creation,
- 26.9 acres of enhancement, and
- 3.1 acres of preservation.

### 1.2 Purpose

In order to demonstrate successful mitigation, the Mud Creek Mitigation Site is monitored for both hydrology and vegetation. The 2000 growing season marks the third year of monitoring for the site. The following report describes the results of both hydrologic and vegetative monitoring for 2000.

### 1.3 Project History

November 1997	Grading Construction
February-March 1998	Tree Planting
March 1998	Monitoring Wells Installed
April- October 1998	Hydrologic Monitoring (1 yr)
September 1998	Vegetation Monitoring (1 yr)
April- October 1999	Hydrologic Monitoring (2 yr)
August 1999	Vegetation Monitoring (2 yr)
April – October 2000	Hydrologic Monitoring (3 yr)
September 2000	Vegetation Monitoring (3 yr.)

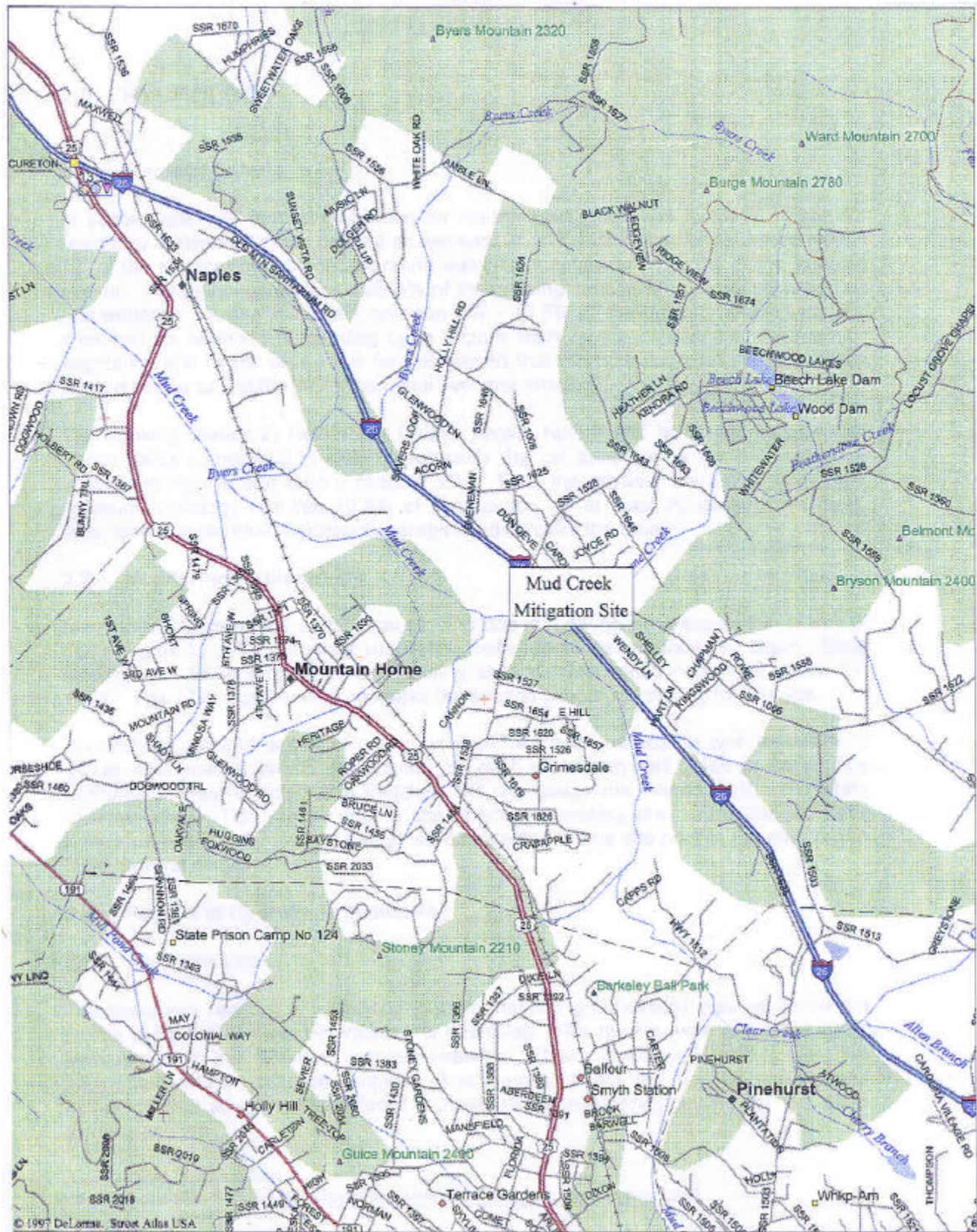


Figure 1 - Site Location Map

## **2.0 HYDROLOGY**

### **2.1 Success Criteria**

In accordance with federal guidelines for wetland mitigation, the success criteria for hydrology states that areas defined as wetlands must be inundated or saturated (within 12" of the surface) by surface or ground water for a consecutive 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% and 12.5% of the growing season can be classified as wetlands, depending upon factors such as the presence of hydrophytic vegetation and hydric soils. It is for this reason that the hydrologic results have been divided further to identify these "marginal" wetland areas.

The growing season in Henderson County begins April 9 and lasts until October 29. These dates correspond to a 50% probability that air temperature will drop to 28° F lower after April 9 and before October 29.<sup>1</sup> Thus the growing season is 204 days; optimum hydrology requires 12.5% of this season, or at least 26 consecutive days. Eight percent of the growing season corresponds to at least 16 consecutive days and 5% corresponds to at least 10 consecutive days. Also, local climate must represent average conditions for the area.

### **2.2 Monitoring Methodology**

Six monitoring gauges, one surface gauge, and one rain gauge were installed in March of 1998 and an additional four monitoring gauges and an Infinity rain gauge were installed in April 2000 (Figure 2). The automatic monitoring gauges and rain gauge record depth to groundwater and rainfall, respectively. Daily readings are taken throughout the growing season. Monitoring began on March 27, 1998. The 2000 growing season marks the third year of monitoring for this site.

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

### **2.3 Results of Hydrologic Monitoring**

#### **2.3.1 Site Hydrology**

The maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each well. This number was converted into a percentage of the 204-day growing season. These monitoring gauge results are segmented into percentage ranges. The ranges reflect the

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<sup>1</sup> Soil Conservation Service, Soil Survey of Henderson County, North Carolina, 1980.

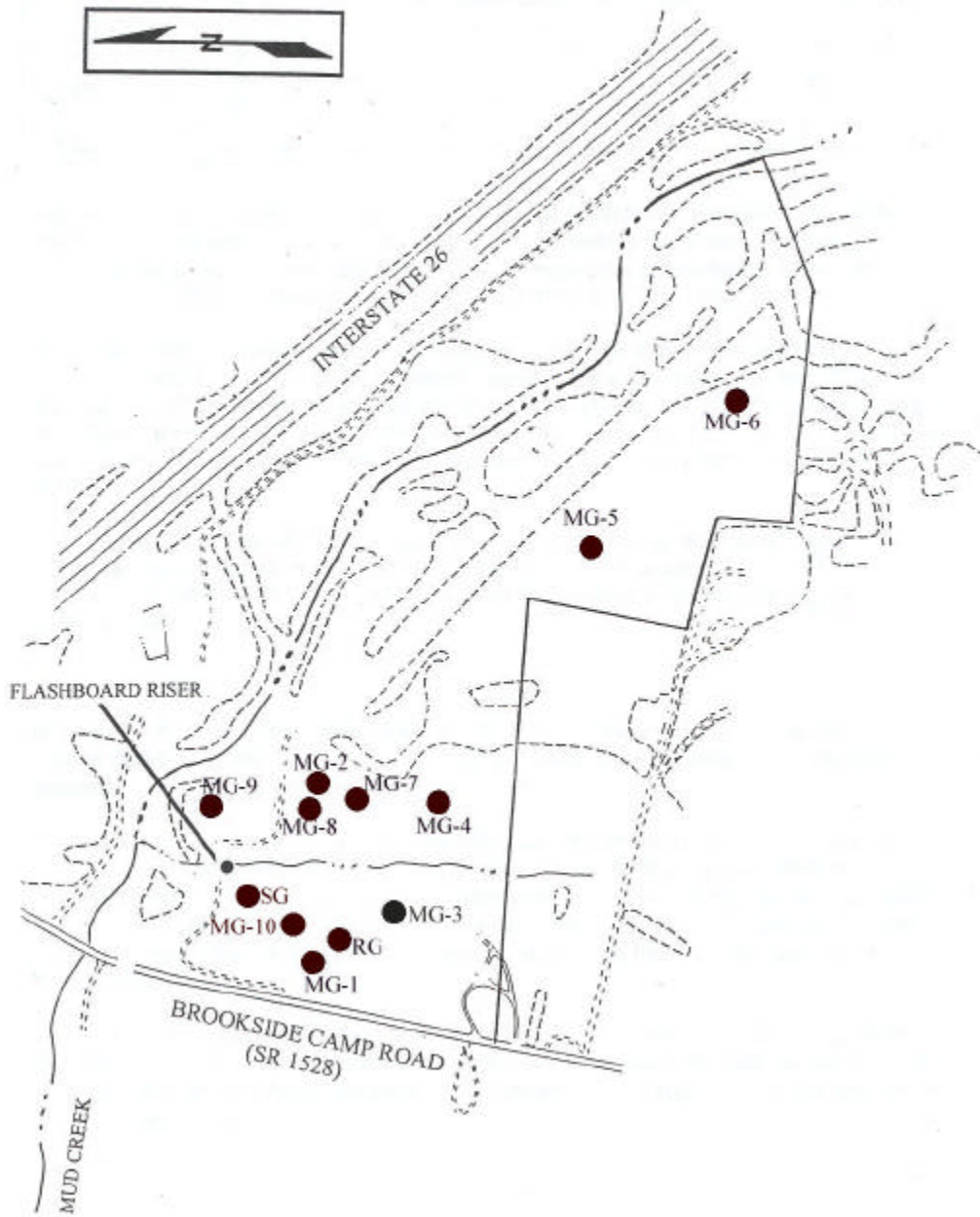


Figure 2  
Monitoring Gauge  
Location Map

degrees of wetland hydrology that are possible. Table 1 presents the monitoring results for the 2000 growing season.

*Table 1*  
HYDROLOGIC MONITORING RESULTS

Monitoring Well	< 5%	5% - 8%	8% - 12.5%	> 12.5%	Actual %
MG-1	✓				2.0
MG-2	✓				0
MG-3	✓				2.9
MG-4	✓				1.0
MG-5 (RG)				✓	13.2
MG-6 (RG)				✓	17.7
MG-7	✓				1.0
MG-8	✓				0
MG-9	✓				0
MG-10		✓			6.9

(RG) indicates a reference gauge.

Figure 3 provides a graphical representation of the hydrologic monitoring results for 2000. Gauges labeled in blue represent optimum hydrology for at least a consecutive 12.5% of the season. Gauges labeled in green recorded the groundwater level within twelve inches of the surface between 5 and 8% of the growing season. Gauges labeled in black recorded the groundwater level within twelve inches of the surface for less than 5% of the growing season.

During the 2000 growing season, groundwater was never within twelve inches of the surface at MG-2, MG-8 and MG-9. Groundwater levels were within twelve inches of the surface less than 5% of the growing season at MG-1 (four days), MG-3 (six days) and MG-4 and MG-7 (two days). Groundwater levels were within twelve inches of the surface less than 8% of the growing season at MG-10 (14 days). Groundwater was present within twelve inches of the surface for 13.2% (27 days) at MG-5 and 17.7% (36 days) at MG-6.

Also of note is that MG-4, MG-5, and MG-6 are located in an area which was delineated as a wetland and confirmed by the USACE on December 6, 1995. In reference to Table 1, MG-4 appears to fall short of meeting “marginal” wetland status.

### **2.3.2 Climatic Data**

In order for the hydrologic data to be considered valid, the area must have experienced normal climatic conditions during the growing season. Precipitation is one climatic indicator.

Figure 4 is a comparison of the 2000 monthly rainfall with the historical rainfall for the area. The lines represent the 30<sup>th</sup> and 70<sup>th</sup> percentiles of monthly precipitation for Hendersonville, North Carolina. These percentiles are based on rainfall data collected between 1966 and 1996 from a National Climatic Data Center official gauge and serve as the historical data for the area. The percentiles create the “normal range” for rainfall for the vicinity.

The bars on the graph represent the total monthly rainfall from January through November of 2000. The 2000 rain data is from North Carolina State Climate Office gauge in Hendersonville, located in northern Henderson County.

Data for Henderson County shows that the area experienced normal rainfall during the months of January, February, March, June, July and September. Henderson County was drier than average during May, August, October and November. April was slightly above average. The December data was not available.

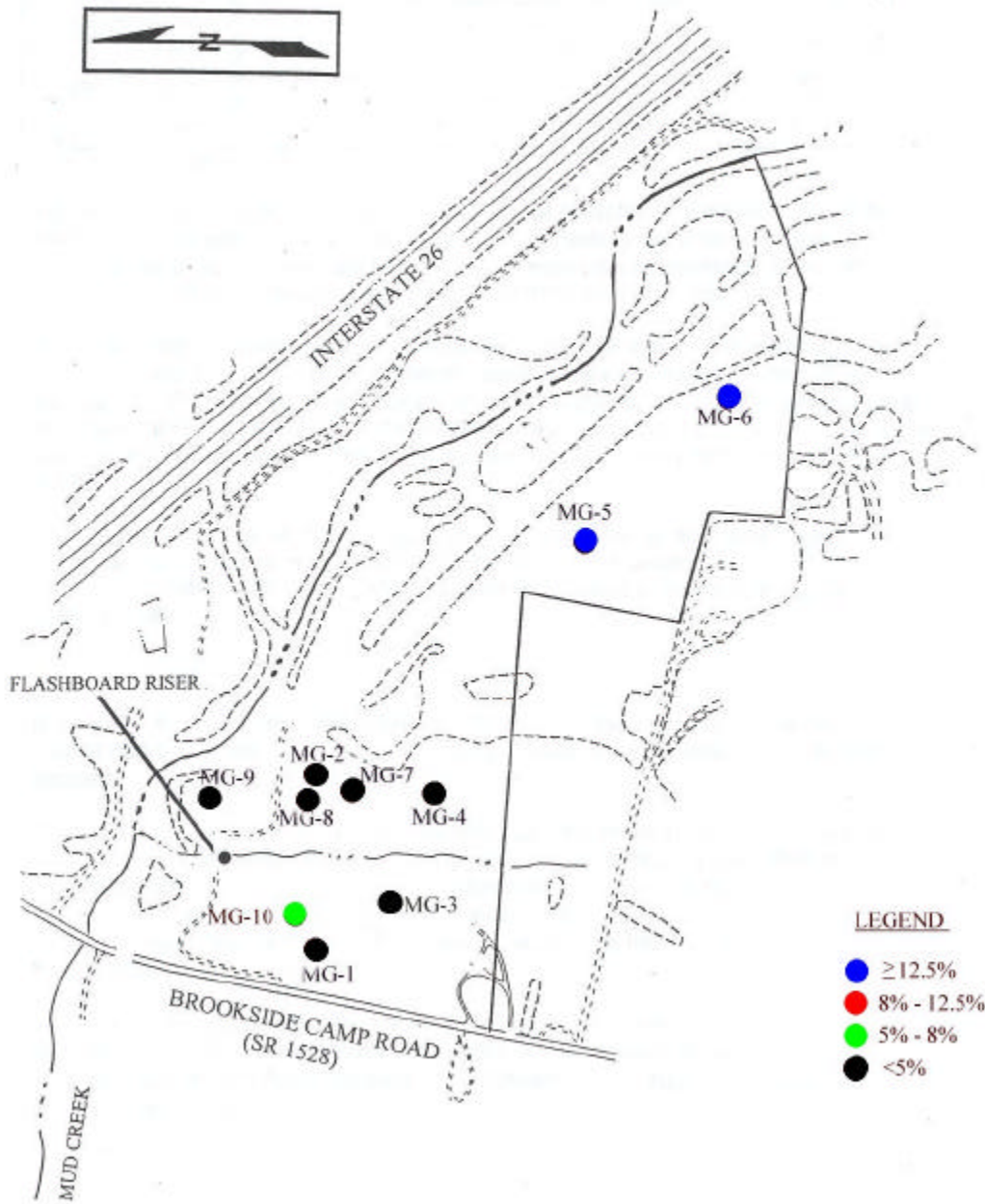
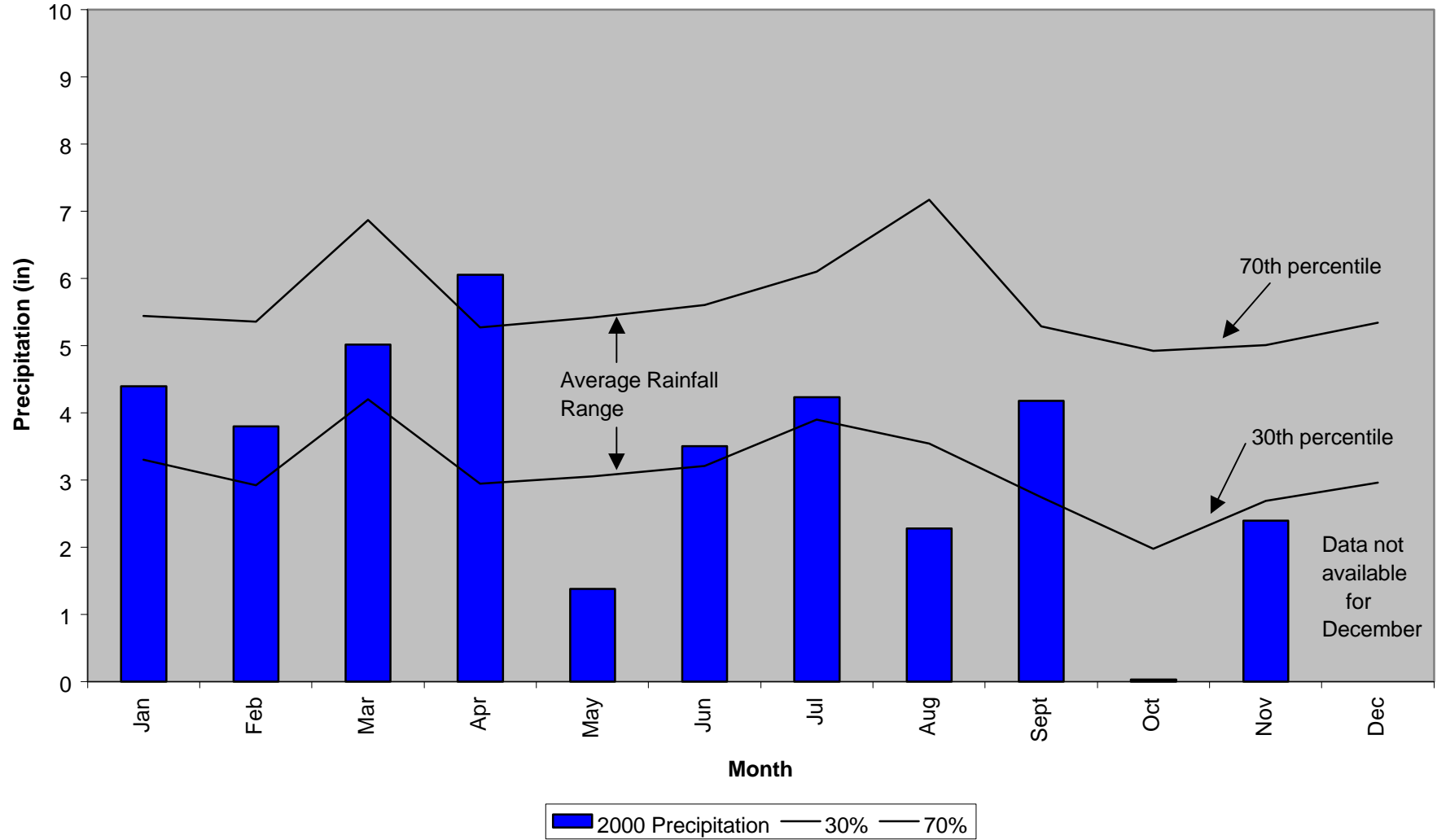


Figure 3  
2000 Hydrologic Map

### Mud Creek 30 - 70 Percentile Graph Hendersonville, NC



## 2.4 Conclusions

Two of the ten monitoring gauges indicated wetland hydrology. MG-5 and MG-6 achieved successful wetland hydrology for a consecutive 12.5% of the growing season. It should be pointed out that these gauges are reference gauges and located in an established wetland that has not been graded or excavated. MG-10 achieved successful hydrology for a consecutive 6.9% of the growing season. The remaining seven gauges did not achieve successful wetland hydrology. Of these wells, MG-1, MG-2, MG-3, MG-7 and MG-8 are located in areas of constructed wetland. MG-4 is located in an existing wetland that has been impacted. MG-9 is located in one of the typically wetter portions of the site.

2000 represents the first year of monitoring with the flashboard riser functioning correctly. Of the six original gauges, three exhibited an increase in successful wetland hydrology, two remained consistent with 1999 monitoring results and one exhibited approximately a 2.5% decrease in successful hydrology.

Rainfall for the year 2000 was in the normal to low range, although wetter in respect to both 1998 and 1999. The gauges showed response to the rainfall events early in the growing season. After early May, the groundwater level had dropped below the level measured by the gauges.

With the flashboard riser repaired and sufficient rainfall, the site still did not meet jurisdictional wetland hydrology. The unsuccessful hydrology exhibited in the constructed wetland is probably a result of insufficient grading. In order to achieve successful hydrology in years of normal rainfall, this area will require corrective grading to a lower elevation.

### 3.0 VEGETATION: MUD CREEK MITIGATION SITE (YEAR 3 OF 3)

#### 3.1 Success Criteria

Success Criteria states that there must be a minimum of 320 trees per acre surviving after three years.

#### 3.2 Description of Species

The following tree species were planted in the Wetland Creation/ Transition Area:

*Betula nigra*, river birch

*Fraxinus pennsylvanica*, green ash

*Nyssa sylvatica*, black gum

*Quercus phellos*, willow oak

*Diospyros virginiana*, persimmon

*Juglans nigra*, black walnut

*Prunus serotina*, black cherry

#### 3.3 Results of Vegetation Monitoring (3rd year)

Plot # (Type)	Green Ash	Blackgum	River Birch	Willow Oak	Persimmon	Black Walnut	Total (3 year)	Total (at planting)	Density (Tree/Acre)
1 (BLH)	11	7	8	11	4	4	45	50	612
2 (BLH)	12	5	12			3	32	35	622
3 (BLH)	13	3	5	4	3		28	28	680
4 (BLH)	12	1	6	6	5		30	30	680
5 (BLH)	16	5		3			24	29	563
6 (BLH)	17	1		10	1		29	37	533
7 (BLH)	3	6	10	8	10		37	41	614
8 (BLH)	7	5	4	4	3		23	33	474
<b>AVERAGE DENSITY</b>									<b>597</b>

To determine tree density, 50' x 50' plots are installed immediately following planting. The actual number 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:** Volunteer species coming in on site include: tag alder, bidens, small maples, aster, swamp dogwood, briars, multiflora rose, trumpet creeper, black gum, juncus, various grasses and sedges, goldenrod, ragweed, Queen Anne's lace, switch grass, lespedeza, river birch, cardinal flower, black willow, broom sedge and box elder. None of the volunteer species appear to be a problem. Trees were difficult to find in plot 8 due to heavy vegetation.

While not required in the monitoring plan, the enhancement area was revisited. The area that was hand-cleared consists of about 30% coverage in privet. The area also contains green ash, swamp chestnut oak and willow oak.

### **3.4 Conclusions**

Of the 39.1 acres on this site, approximately 9.4 acres involved tree planting. There were 8 vegetation monitoring plots established throughout the planting areas. Based on the results of the stem counts for the third year monitoring period, we obtained an average tree density of 597 trees per acre. This average is well above the minimum success criteria of 320 trees per acre. All plots met the success criteria.

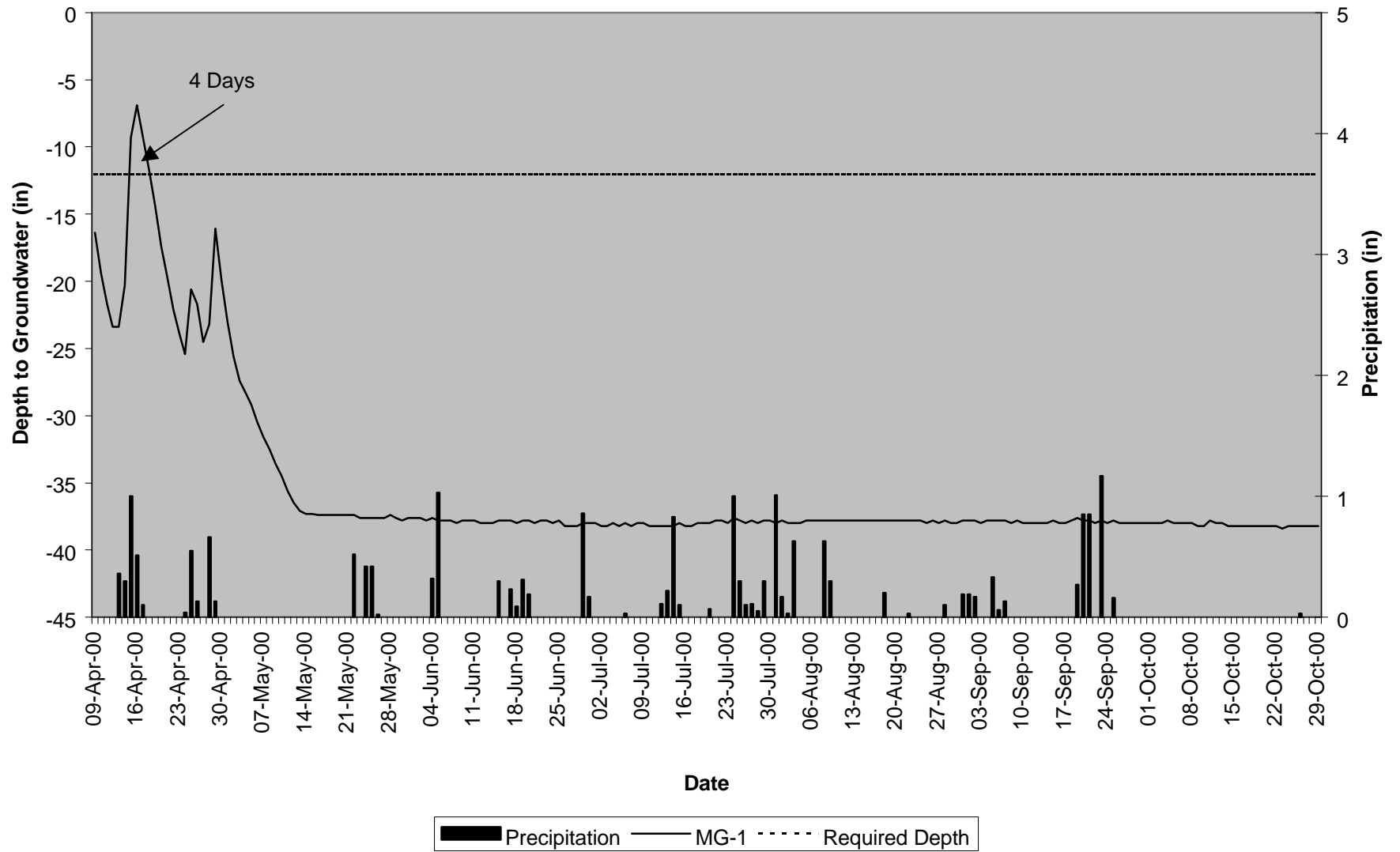
#### **4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS**

From a vegetative standpoint, Mud Creek appears to be very successful. However, the hydrology exhibited on the site does not meet jurisdictional wetland criteria. Remediation measures may include, but are not limited to, excavation of the site, redirection of adjacent runoff onto the site, and other measures deemed appropriate and practicable.

A topographic survey will be conducted of the Mud Creek mitigation site. This information will be compared to original grading plans and the hydrologic data from the past three years. NCDOT will prepare a plan to address the hydrologic issues on the site. A remediation plan will be coordinated with the resource agencies.

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

# Mud Creek MG-1

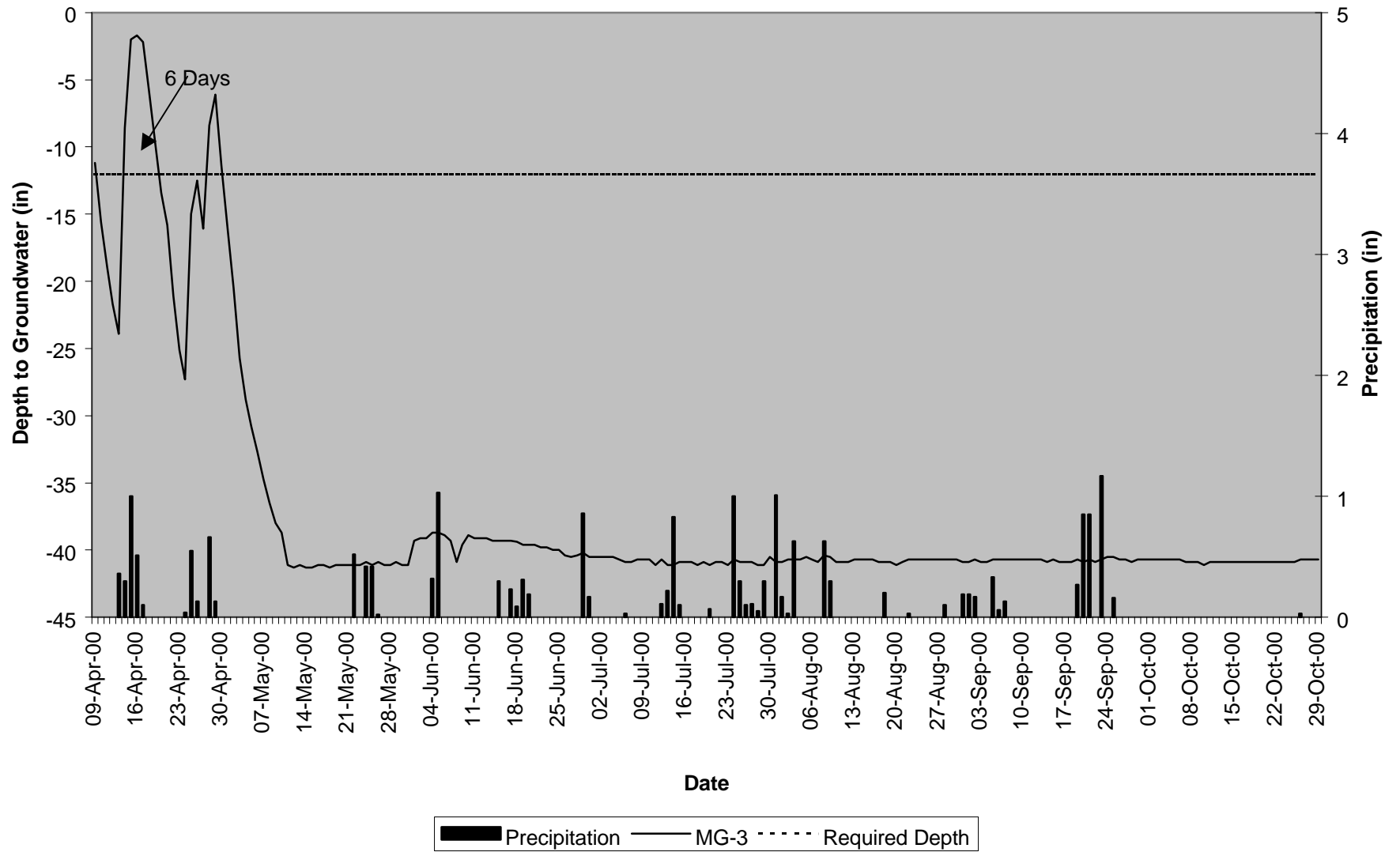


# Mud Creek MG-2

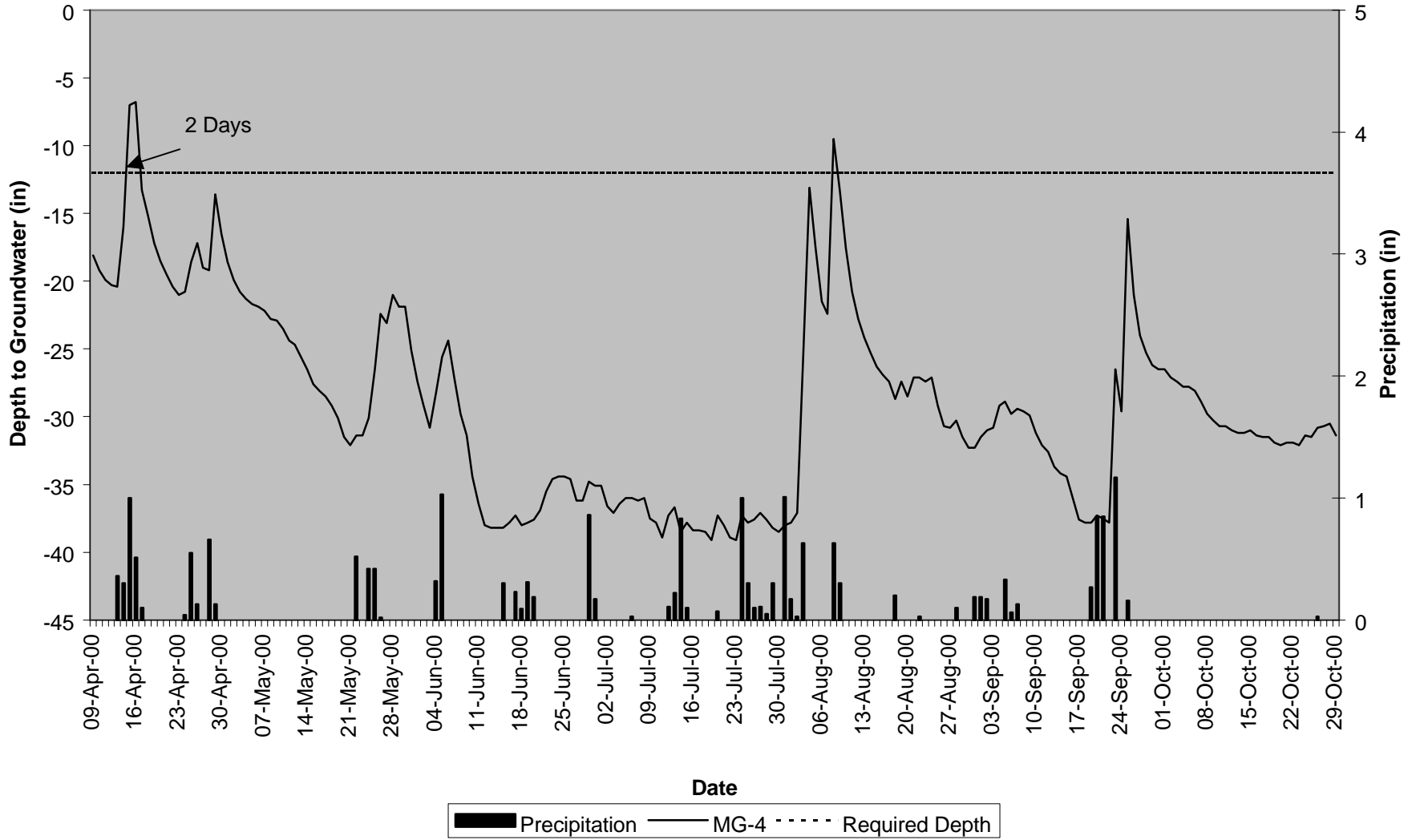


■ Precipitation    — MG-2    - - - - Required Depth

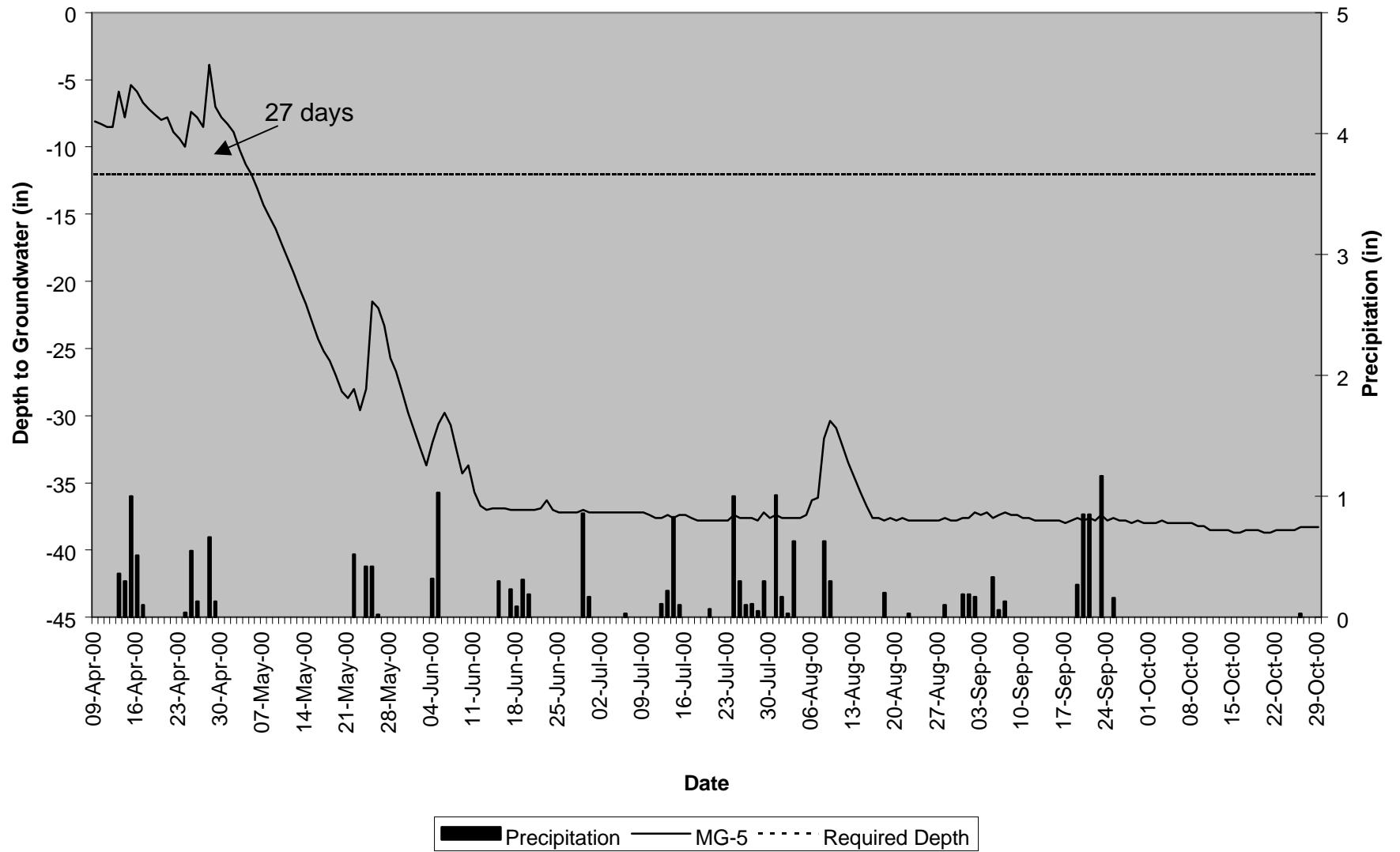
# Mud Creek MG-3



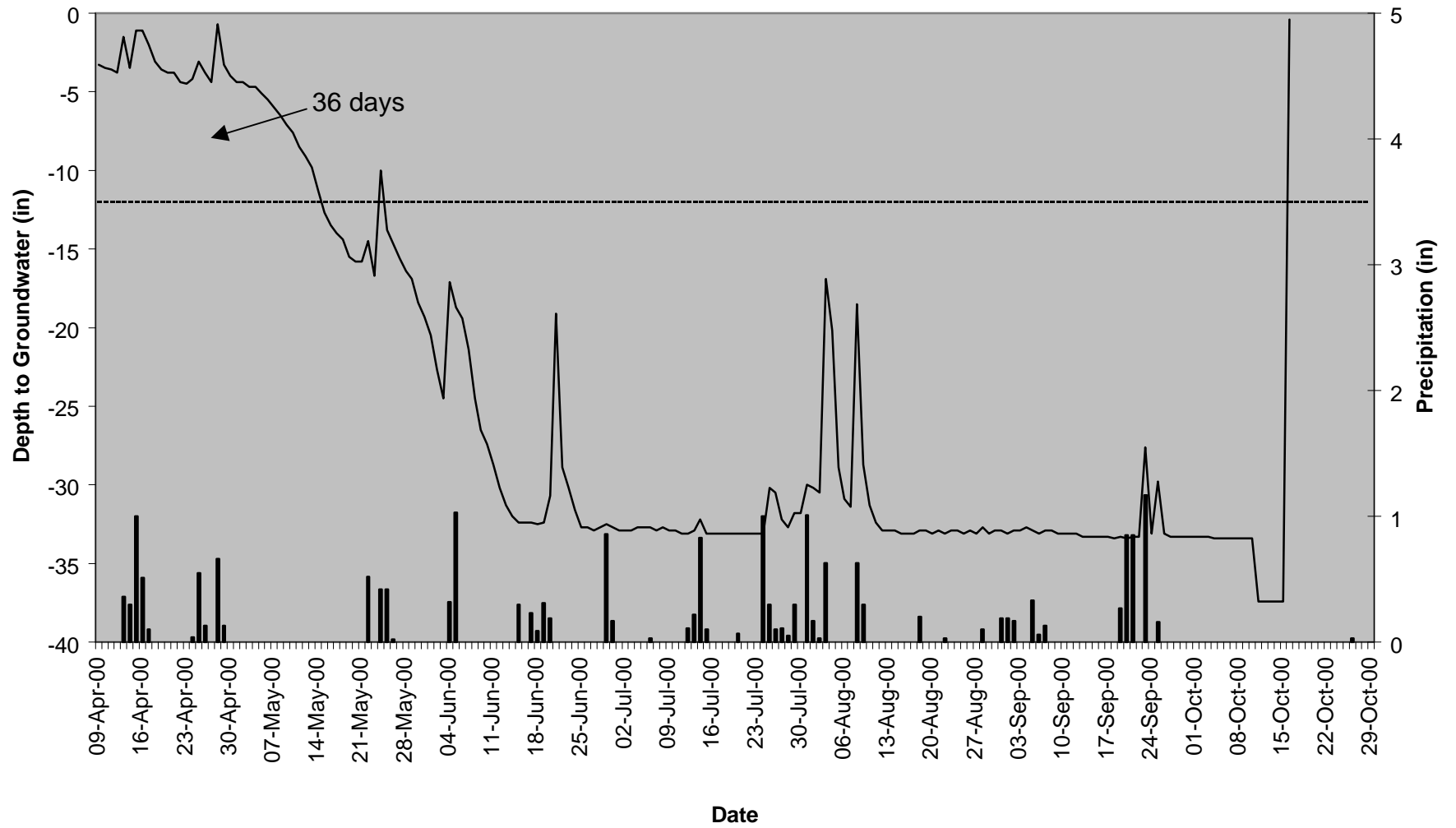
# Mud Creek MG-4



# Mud Creek MG-5

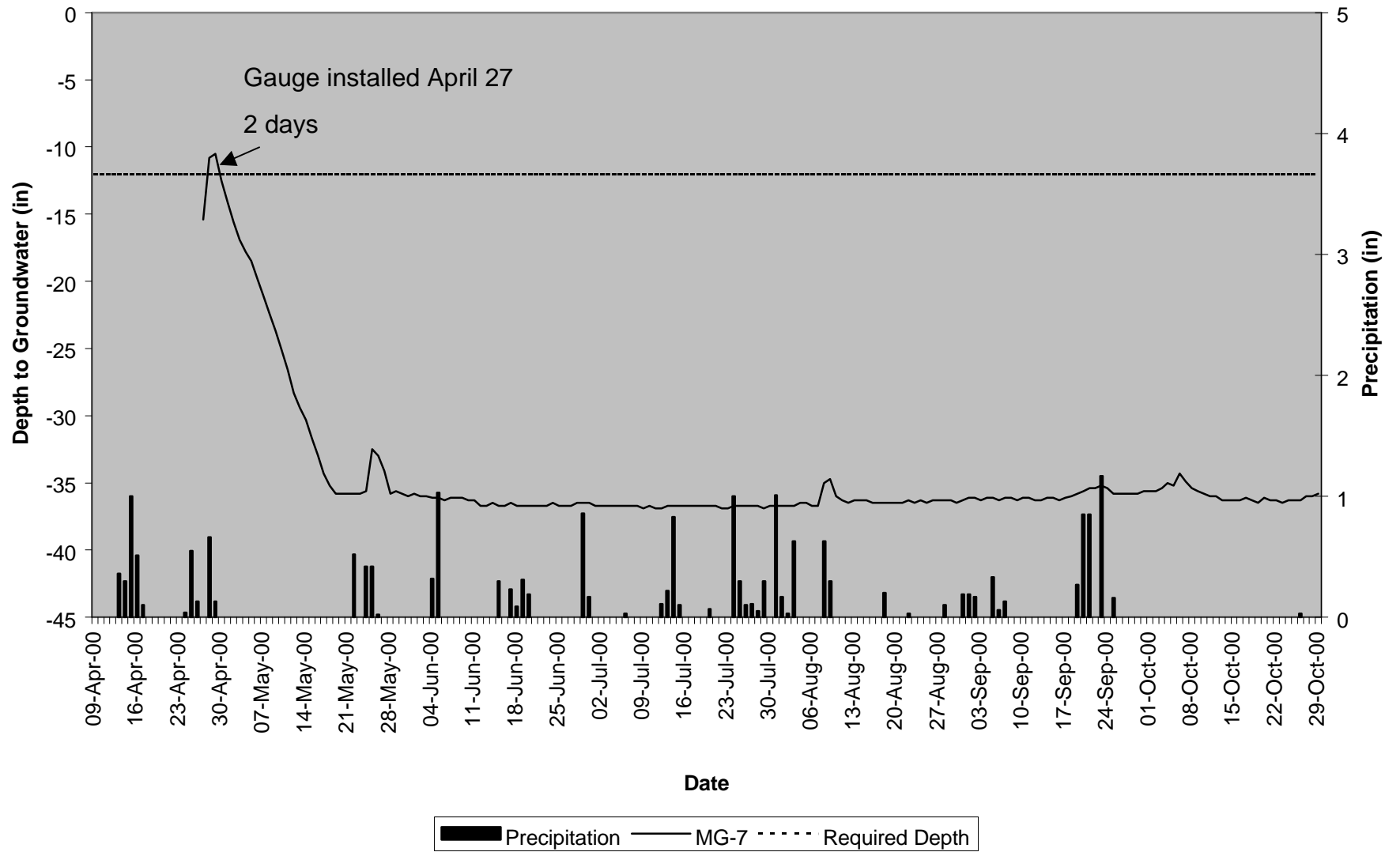


# Mud Creek MG-6

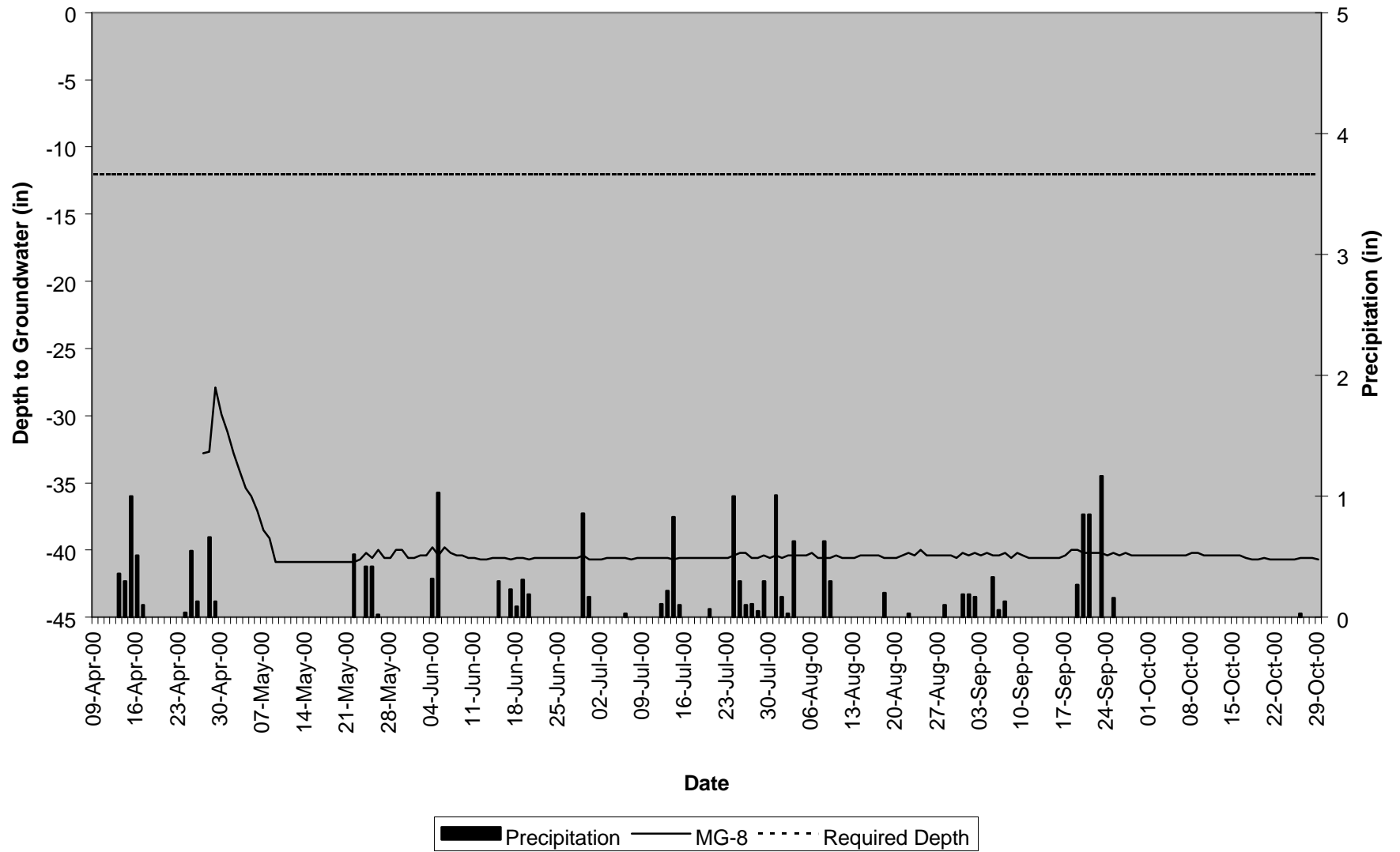


■ Precipitation (in) — MG-6 ····· Required Depth

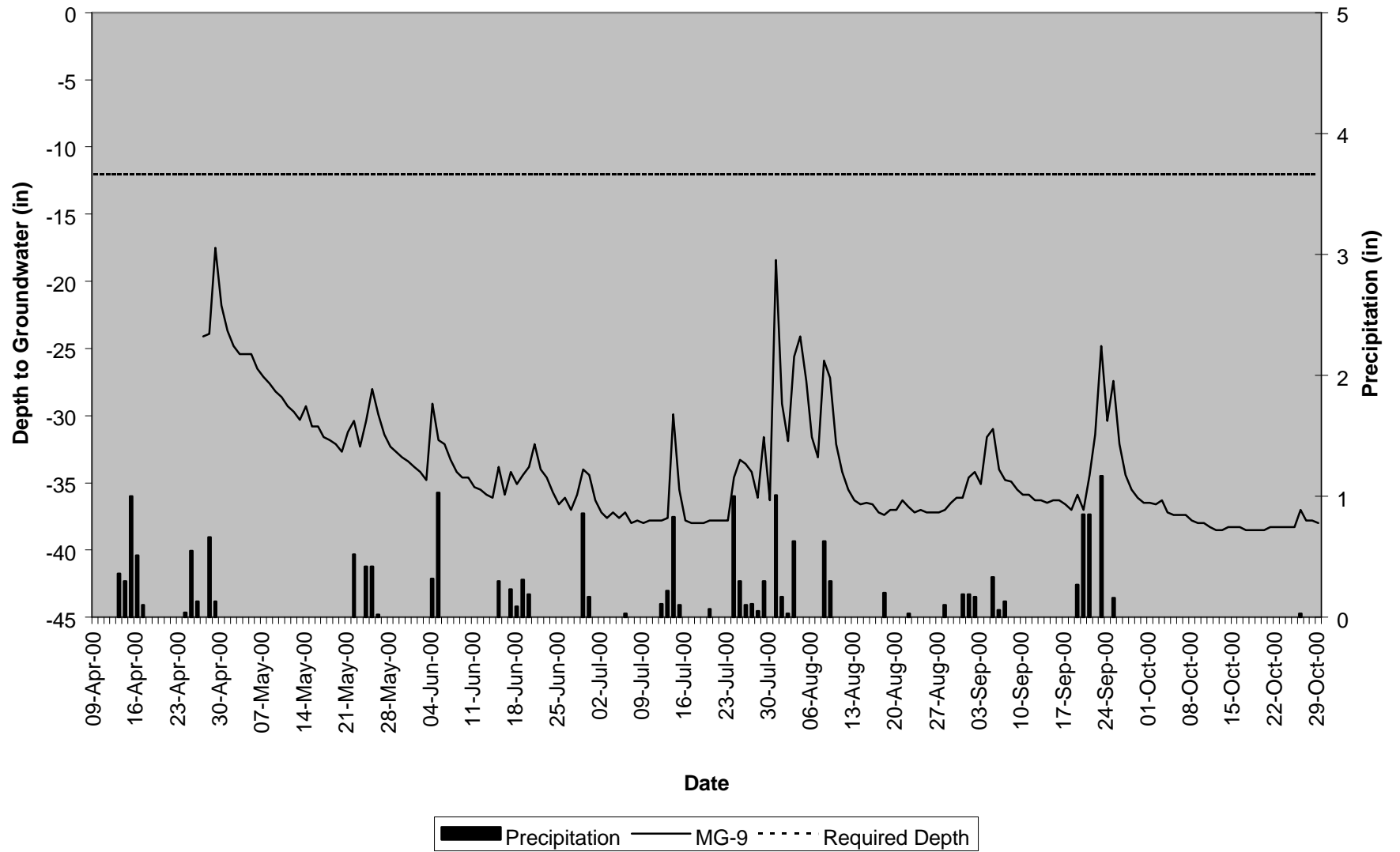
# Mud Creek MG-7



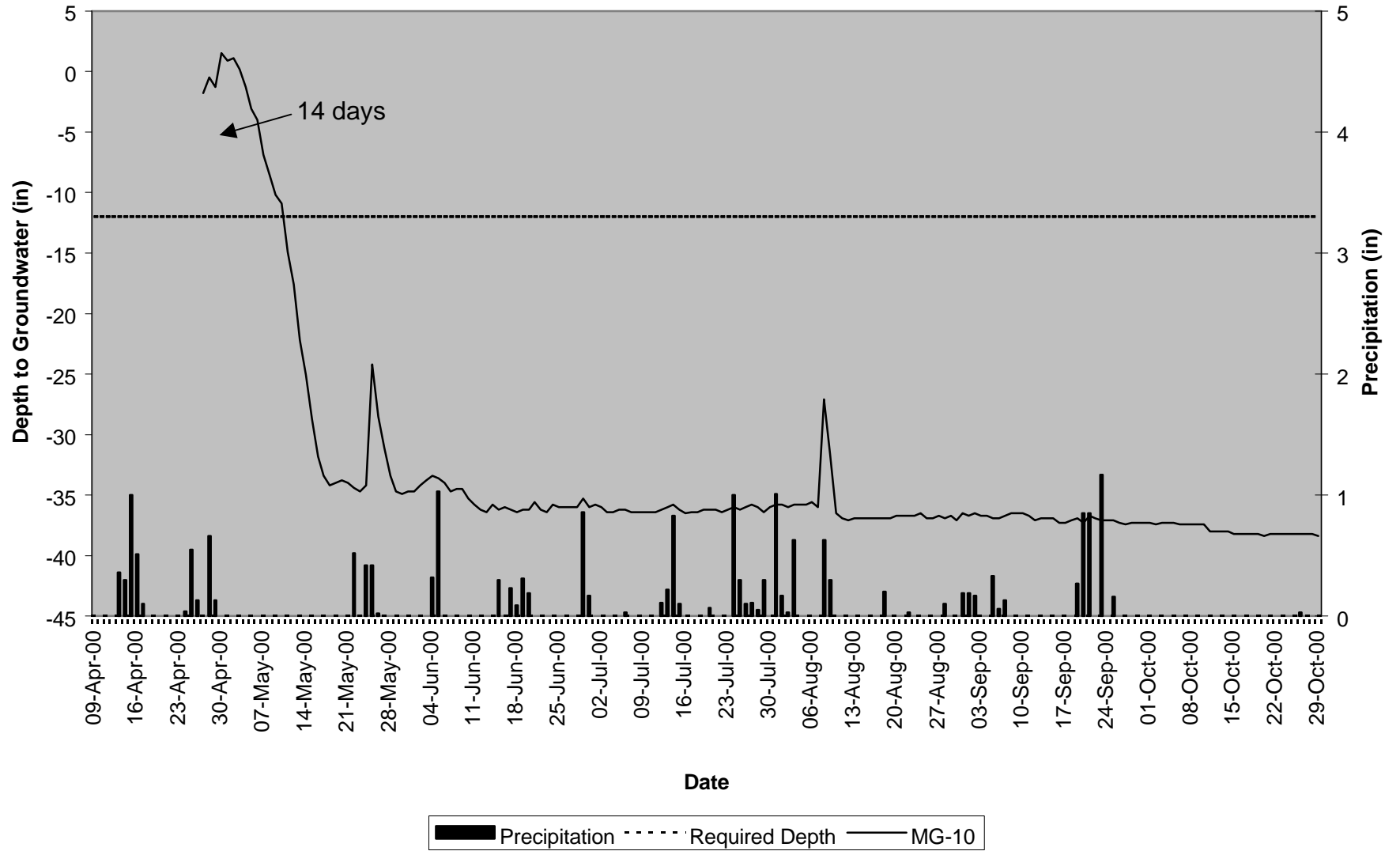
# Mud Creek MG-8



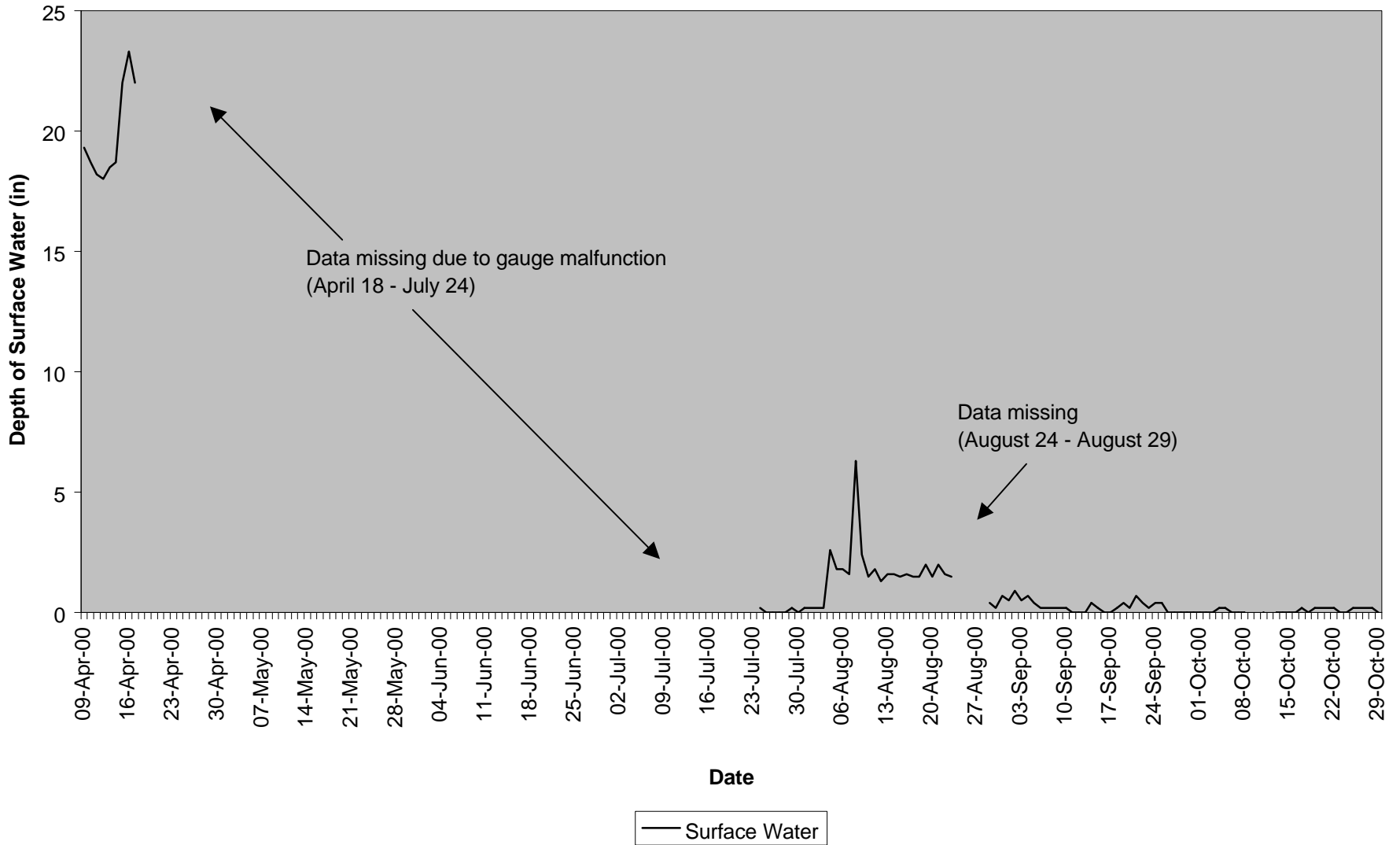
# Mud Creek MG-9



# Mud Creek MG-10



# Mud Creek SG-1





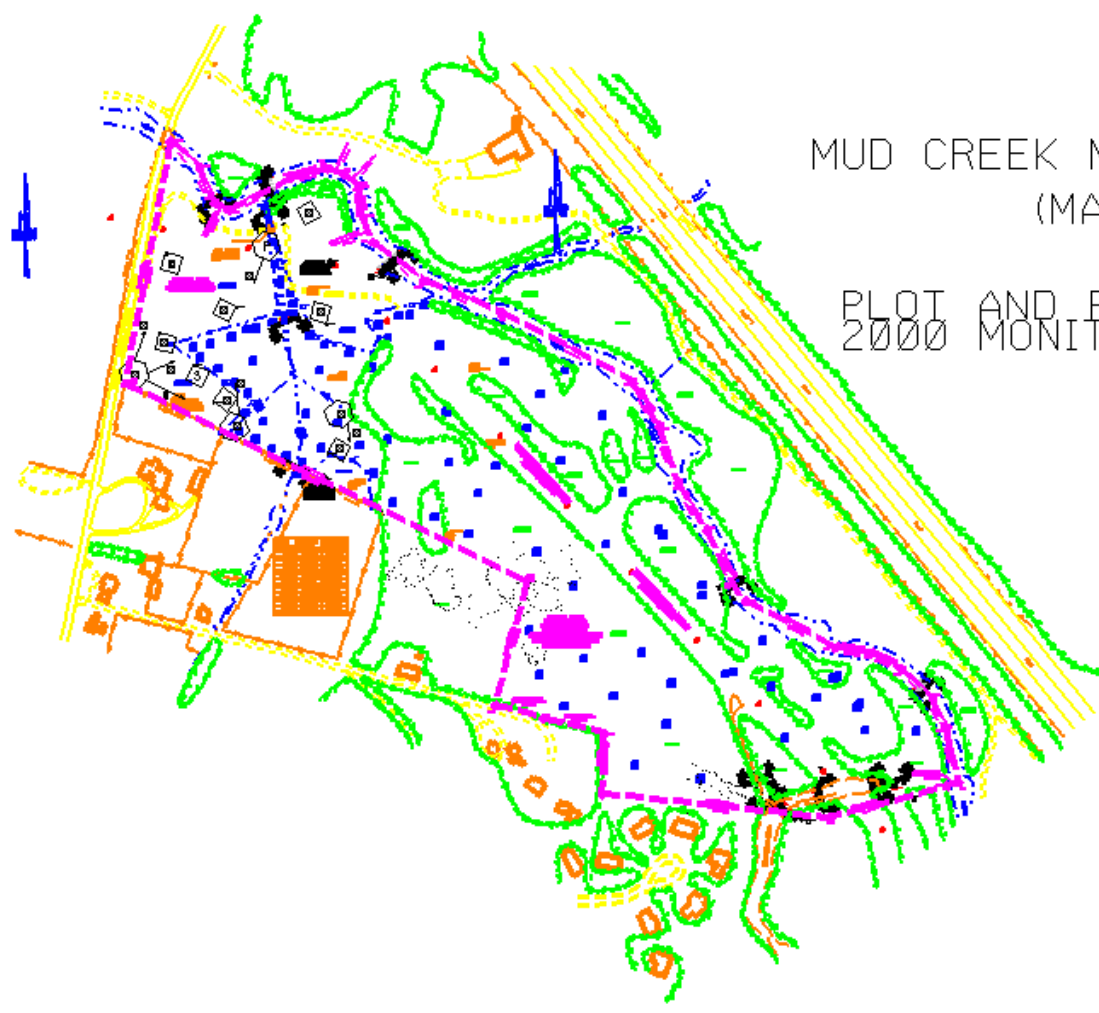
## **APPENDIX B**

### **SITE PHOTOS & VEGETATION PLOT LOCATION MAP**

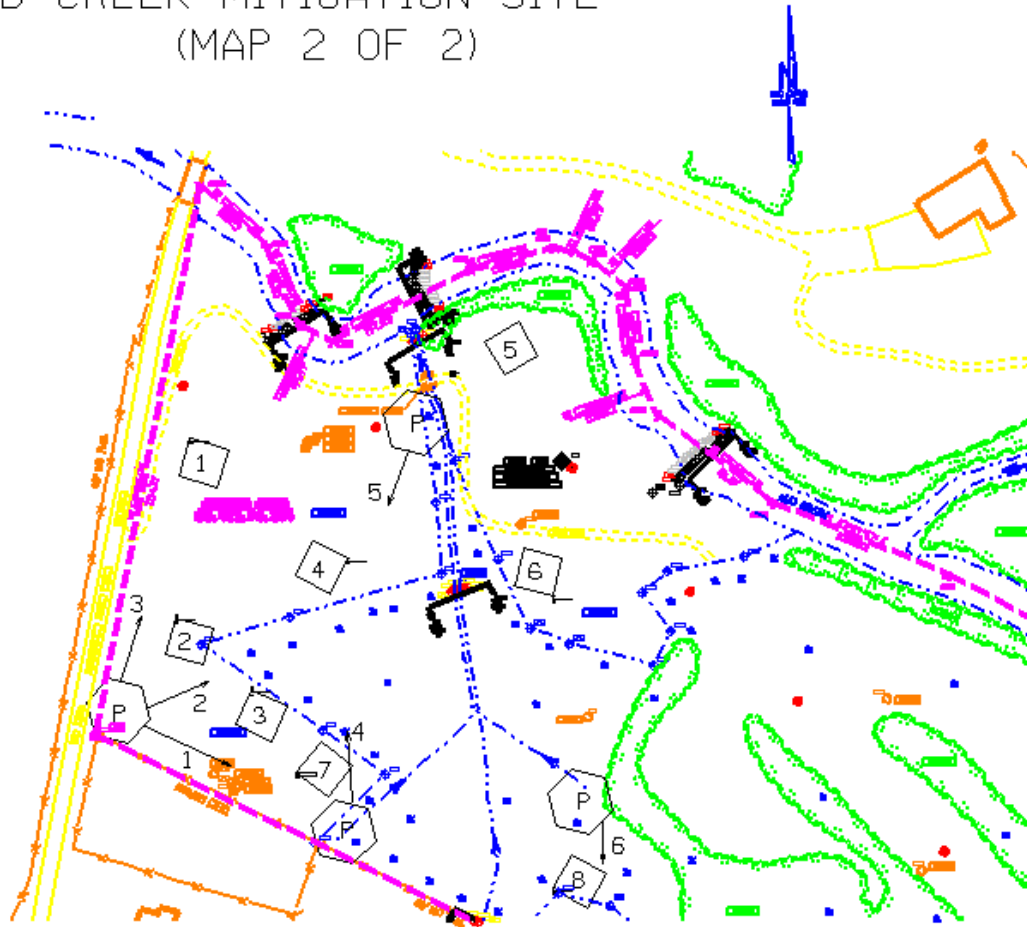
DATE	SCALE

MUD CREEK MITIGATION SITE  
(MAP 1 OF 2)

PLOT AND PHOTO LOCATIONS  
2000 MONITORING



MUD CREEK MITIGATION SITE  
(MAP 2 OF 2)



PLOT AND PHOTO LOCATIONS  
2000 MONITORING



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6