ANNUAL REPORT FOR 2000

U. S. Marine Corps Mitigation Site
Onslow County
Project No. 6.269010T
TIP No. U-2107 WM

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North Carolina Department of Transportation
December 2000

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SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the U.S. Marine Corps Mitigation Site. This site was constructed in 1999. Monitoring activities in 2000 represent the second year of monitoring. The site must demonstrate vegetation success for three years and hydrologic monitoring must be conducted until success is demonstrated.

The site is monitored with twenty five vegetation plots, three groundwater gauges, four surface gauges, and one rain gauge.

One major change in the hydrologic monitoring process is the installation of an Infinity rain gauge. This gauge was installed because in the past existing on-site rainfall gauges have proven unreliable. Daily rainfall recorded at a Trenton rain gauge, maintained by the NC State Climate Office will be obtained to produce the 30-70 percentile graph. Data from the Infinity rain gauge will be used for comparison on the groundwater gauge graphs.

Hydrologic monitoring indicates that the site has met success criteria during the1999 monitoring year. All three groundwater gauges met criteria for well over 12.5% of the growing season and two of the four surface water gauges have shown standing surface water throughout the growing season. Gauge 1 malfunctioned for most of the growing season and gauge 7 did not show appreciable surface water during the growing season.

Vegetation monitoring of the shrub area revealed an average density of 573 shrubs per acre, well above the minimum requirement. Vegetation monitoring yielded results below the success criteria in the marsh grass planting transects, although has improved since 1999.

Based on the monitoring results from the 2000 season and consulting with resource agencies, NCDOT has determined that remediation of the site is necessary. Grading of the site will take place in the winter of 2002 and the site will be replanted in the spring of 2002. Tidal data will be obtained by recording the presence of surface water on site every hour for one month during the growing season in 2001 to determine whether the site is being flooded twice a day.

1.0 INTRODUCTION

1.1 Project Description

The U.S. Marine Corp Mitigation Site encompasses 3.5 acres and is located in Onslow County on the Intracoastal Waterway southeast of Onslow Beach at the Camp Lejeune Marine Corps Base (Figure 1). Designed as a salt marsh, the site provides compensatory mitigation for the US 17 Bypass of Jacksonville.

1.2 Purpose

In order to demonstrate successful mitigation, USMC is monitored for both wetland vegetation and hydrology. Vegetative monitoring must be conducted for a minimum of three years, and hydrologic monitoring must be conducted until success is demonstrated. The following report details the results of hydrologic and vegetative monitoring during 2000 at the USMC Mitigation Site.

1.3 Project History

March 1999	Grading Construction
April 1999	Site planted
May 1999	Monitoring Wells Installed
March- November 1999	Hydrologic Monitoring (1 yr.)
October 1999	Vegetation Monitoring (1 yr.)
March-November 2000	Hydrologic Monitoring (2 yr.)
August 2000	Vegetation Monitoring (2 yr.)

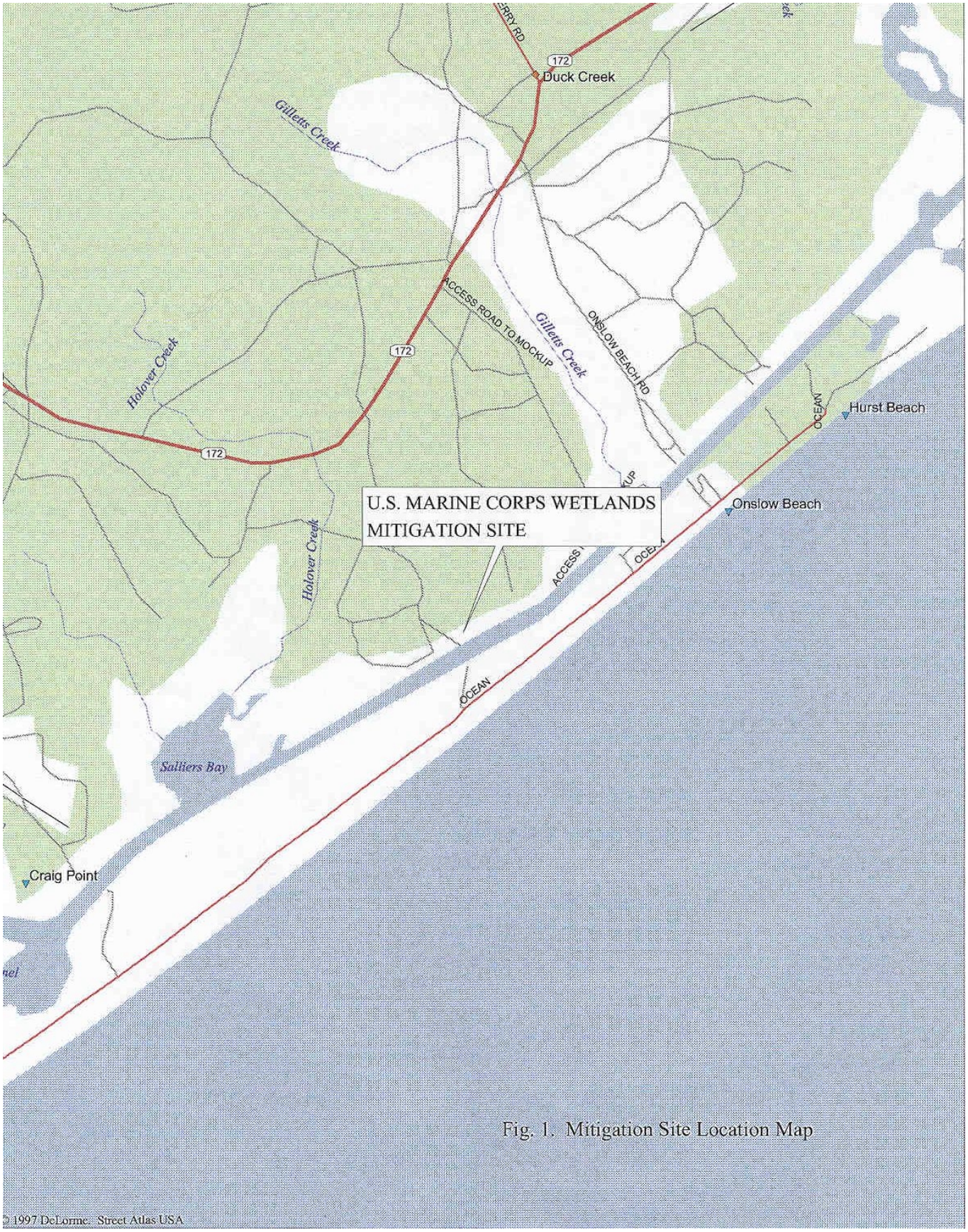


Fig. 1. Mitigation Site Location Map

2.0 HYDROLOGY

2.1 Success Criteria

Project specifications require saturation or inundation (within 12 inches of the surface) for at least 27 consecutive days during the growing season for one year under reasonably average climatic conditions. However, areas may still be classified as wetlands even though the hydrology does not meet optimum wetland criteria.

The growing season in Onslow County begins April 8 and ends November 5. These dates correspond to a 50% probability that air temperatures will drop to 28° F or lower after April 8 and before November 5.[1] Thus, the growing season is 212 days. Also, local climate conditions must represent average conditions for the area.

2.2 Monitoring Procedure

Three monitoring gauges, one rain gauge, and four surface water gauges were installed on-site in 1999 (Figure 2). The automatic groundwater gauges and rain gauges record depth to groundwater and rainfall, respectively. Daily readings are taken throughout the growing season. The rain gauge was replaced in the spring of 2000 with an Infinity rain gauge.

Appendix A contains a plot of the water depth for each groundwater monitoring gauge and surface gauge during the growing season. Precipitation events are included on each groundwater gauge graphs as bars. The precipitation data on each groundwater gauge graph is from the on-site Infinity rain gauge.

2.3 Results of Hydrologic Monitoring

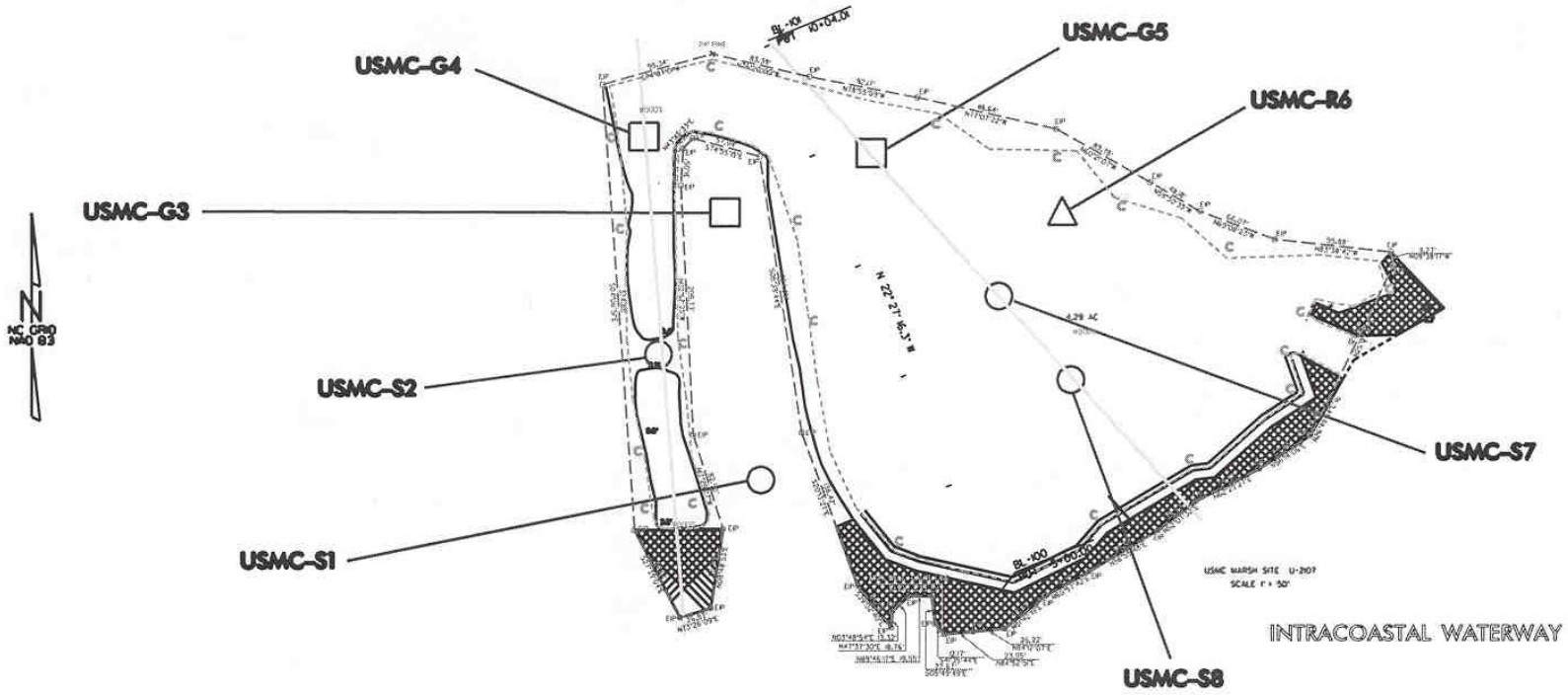
2.3.1 Site Data

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 212-day growing season. Based on project requirements, the optimum percentage, which represents 27 consecutive days of the growing season, is 12.5%.

[1] Soil Conservation Service, Soil Survey of Johnston County, North Carolina, 1994.

USMC MITIGATION SITE

ONSLOW COUNTY



△ RAIN GAUGE (R)

□ GROUNDWATER MONITORING GAUGE (G)

○ SURFACE WATER GAUGE (S)

FIGURE 2: MONITORING GAUGE LOCATIONS

The following table presents both the actual consecutive day percentage for each gauge as well as its percentage range.

Table 1
RESULTS OF HYDROLGIC MONITORING 2000

Monitoring Gauge	< 5%	5% - 8%	8% - 11.5%	> 11.5%	Actual %	Success Dates
G3^				✔	100.0	Apr. 8 – Nov. 5
G4*				✔	100.0	Apr. 8 – Nov. 5
G5*				✔	100.0	Apr. 8 – Nov. 5

'' - Denotes wells which malfunctioned during the growing season; well data is incomplete.*
'^' - Denotes consecutive days extending into the second half of the growing season.

For 2000, all three groundwater gauges indicate hydrologic data that meets and exceeds project specifications. Two of the four surface water gauges on the site have shown appreciable surface water throughout the 2000 growing season. Surface gauge 1 malfunctioned a large portion of the growing season, which rendered the data received invalid. The July download revealed a dead battery for gauge 1, which was replaced. Gauge 1 stopped recording each month after that due to a dead battery and each time the battery was replaced and the gauge reset. On November 7 it was determined that gauge 1 was not functioning properly and at that time the entire gauge was replaced and the monitoring intervals reset. Surface gauge 7 showed minimal surface water throughout the growing season. In order to clearly view daily flooding of the site, a graph for one week out of the growing season in addition to a graph for the entire growing season is included for each surface gauge. Figure 3 is a map of the hydrologic monitoring results for 2000. A blue dot indicates hydrology for greater than 12.5% of the growing season; a red dot means the gauge showed between 8% and 12.5%. A green dot indicates hydrology between 5% and 8% of the season.

2.3.2 Climatic Data

Figure 4 is a comparison of 1999 and 2000 monthly rainfall to historical precipitation for the area. The two lines represent the 30th and 70th percentiles of monthly precipitation for Trenton, NC. These percentiles represent monthly rainfall data collected in Trenton between 1931 and 1998. They are designed to illustrate the "normal range" for rainfall in the area. The bars are the monthly rainfall totals for 1999 and 2000. The historical data was collected from a National Climatic Data Center rain gauge; the current monthly rainfall data was provided by the State Climate Office of North Carolina at NC State University. Because of data availability, the 2000 rainfall encompasses precipitation through October.

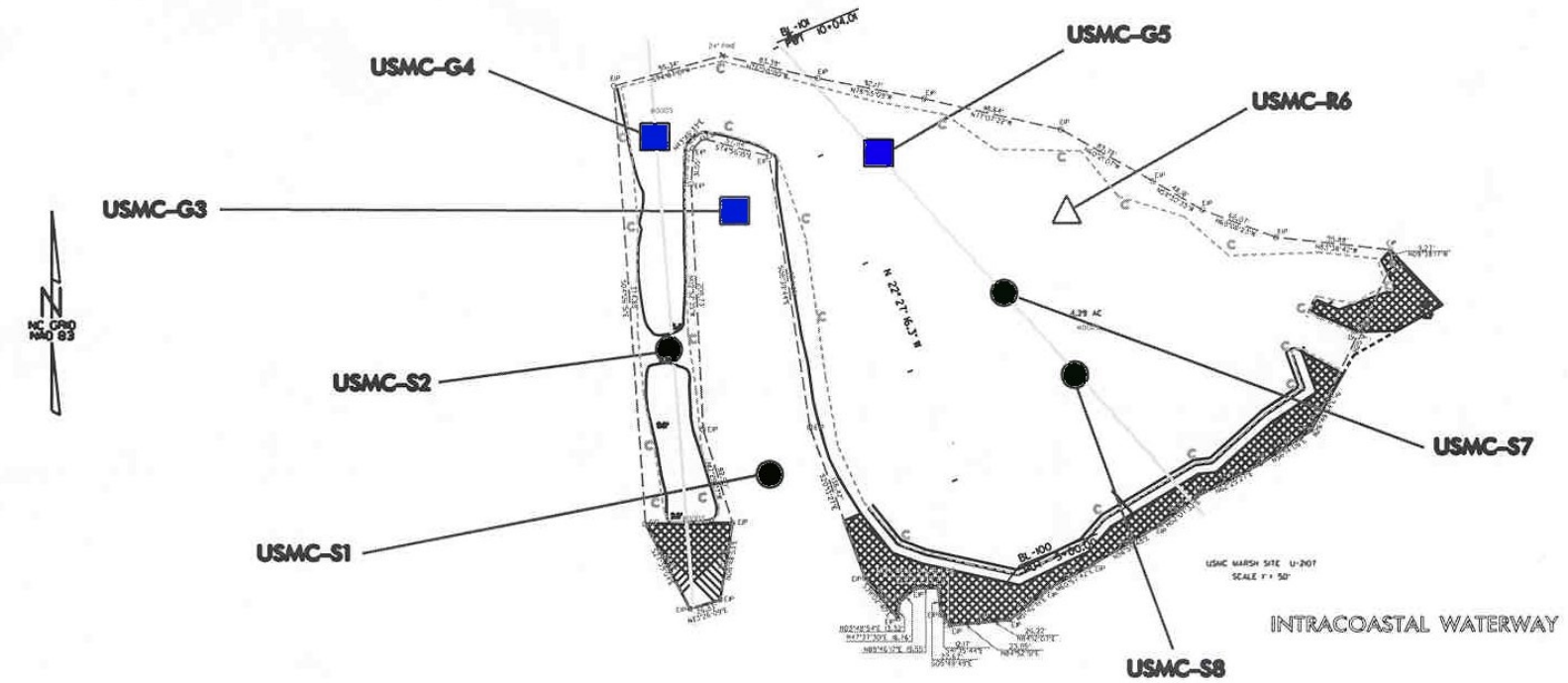
Rainfall during 2000 was for the most part average for the Trenton area. The 2001 Annual Monitoring Report will show precipitation totals for the remaining months of 2000.

2.4 Conclusions

In 2000, all three groundwater gauges exceeded project specifications. Although, according to the surface gauges the site is not receiving substantial flooding to support the desired vegetation and meet the hydrology success criteria.

USMC MITIGATION SITE

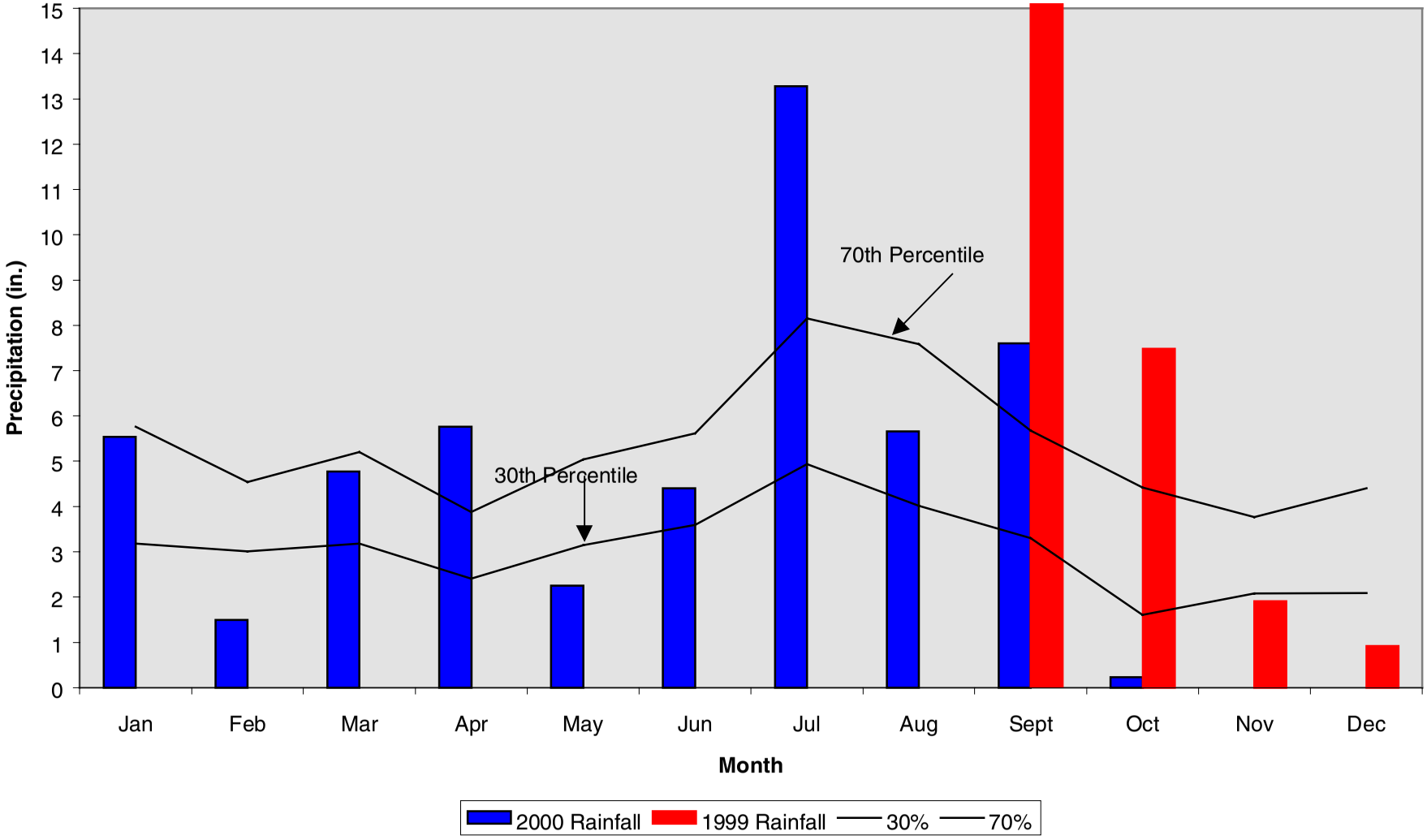
ONSLOW COUNTY



- <5% HYDROLOGY
- 5% - 8% HYDROLOGY
- 8% - 12.5% HYDROLOGY
- >12.5% HYDROLOGY
- MET TIDAL FLOODING (TWICE DAILY)
- DID NOT MEET TIDAL FLOODING (TWICE DAILY)

FIGURE 3: 2000 HYDROLOGICAL RESULTS

USMC 30-70 Graph
Trenton, NC



3.0 VEGETATION: USMC MITIGATION SITE (YEAR 2 OF 3)

3.1A Success Criteria (Shrub Area)

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

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 (Shrub Area)

The following plant communities were planted in the Shrub Area:

Zone 1: (approximately 0.56 acres)

Myrica cerifera, Wax Myrtle

Baccharis halimifloia, False Willow

Iva frutescens, Marsh Elder

3.2B Description of Planted Areas (Marsh Grass Area)

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

Zone 1: (approximately 0.7acres)

Juncus roemerianus, Black Needle Rush

Zone 2: (approximately 2.23 acres)

Spartina alterniflora, Smooth Cordgrass

3.3A Results of Vegetation Monitoring (2 year) (Shrub Area)

Table 2

Plot #	Wax Myrtle	False Willow	Marsh Elder	Total (2 year)	Total (1 year)	Total (at planting)	Density (Shrub/Acre)
1	24	8	11	43	51	51	573
TOTAL DENSITY							**573**

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

Site Notes: Natural propagation seen in Marsh elder species. Wax myrtles have some salt burn. Patens and juncus present in zone. Alterniflora is present in the channel. Phragmities on the outer fringe of the site will be treated.

3.3B Results of Vegetation Monitoring (Marsh Grass Area)

Table 3

ZONE	Plot #	Scale Factor	Juncus roemerianus, Black Needle Rush	Spartina alterniflora, Smooth Cordgrass	Frequency	Notes
2	1	3.0		✔	✔	
2	2	0.5		✔	✔	
1	3	2.0		✔	✔	Side Finger
2	4	2.0		✔	✔	
2	5	0.0				
2	6	0.5		✔	✔	5" Surface Water
2	7	0.0				
2	8	0.0				
1	9	0.0				
2	10	2.0		✔	✔	12" Surface Water
2	11	4.0		✔	✔	8" Surface Water
2	12	2.0		✔	✔	
1	13	5.0				Patens
2	14	5.0		✔	✔	2" Surface Water
2	15	3.0		✔	✔	6" Surface Water
2	16	4.0		✔	✔	6" Surface Water
1	17	3.0	✔		✔	Black Needle Rush & Patens
2	18	0.0				
2	19	0.0				
2	20	5.0		✔	✔	8" Surface Water
2	21	0.0				
2	22	3.0		✔	✔	6" Surface Water
2	23	5.0				Patens
2	24	2.0		✔	✔	6" Surface Water
2	25	0.0				
2	26	0.0				
2	27	4.0		✔	✔	6" Surface Water
2	28	4.0		✔	✔	6" Surface Water
1	29	0.0				
1	30	0.0				
1	31	0.0				
2	32	5.0		✔	✔	6" Surface Water
1	33	2.0	✔		✔	
1	34	2.0	✔		✔	
2	35	0.0				
2	36	1.0		✔	✔	4" Surface Water
1	37	0.0				
2	38	0.0				
2	39	2.0		✔	✔	
1	40	0.0				
2	41	4.0		✔	✔	4" Surface Water
2	42	0.0				
2	43	5.0				Patens
2	44	0.0				
2	45	3.0		✔	✔	
AVG.		**1.8**				
Frequency/Percentage of Plots with Desired Specie					**53.3%**	
Sum B-B Value					**83.0**	
Total # of Plots Counted					**45.00**	
Vegetative Cover (Scale Value)					**1.84**	

Site Notes: Marsh area has grasses present throughout most of the site, and coverage is increasing.

3.4A Conclusions (Shrub Area)

Of the 3.5 acres of this site, approximately 0.56 acres involved shrub planting. There was 1 test plot established in the planting area. The second year vegetation monitoring of the planted area revealed an average density to be 573 shrubs per acre, which is well above the minimum requirement of 320 shrubs per acre. The wax myrtle continue to show slight salt burn and the marsh elder shrubs are spreading by natural propagation throughout the shrub area.

3.4B Conclusions (Marsh Grass Area)

- Percent Frequency of Target Specie (Black needle rush and Smooth Cordgrass)

53.3%

Frequency of 70% required.

- Vegetative Cover Scale Value **1.8**

Scale Value of 5 required for year 5.

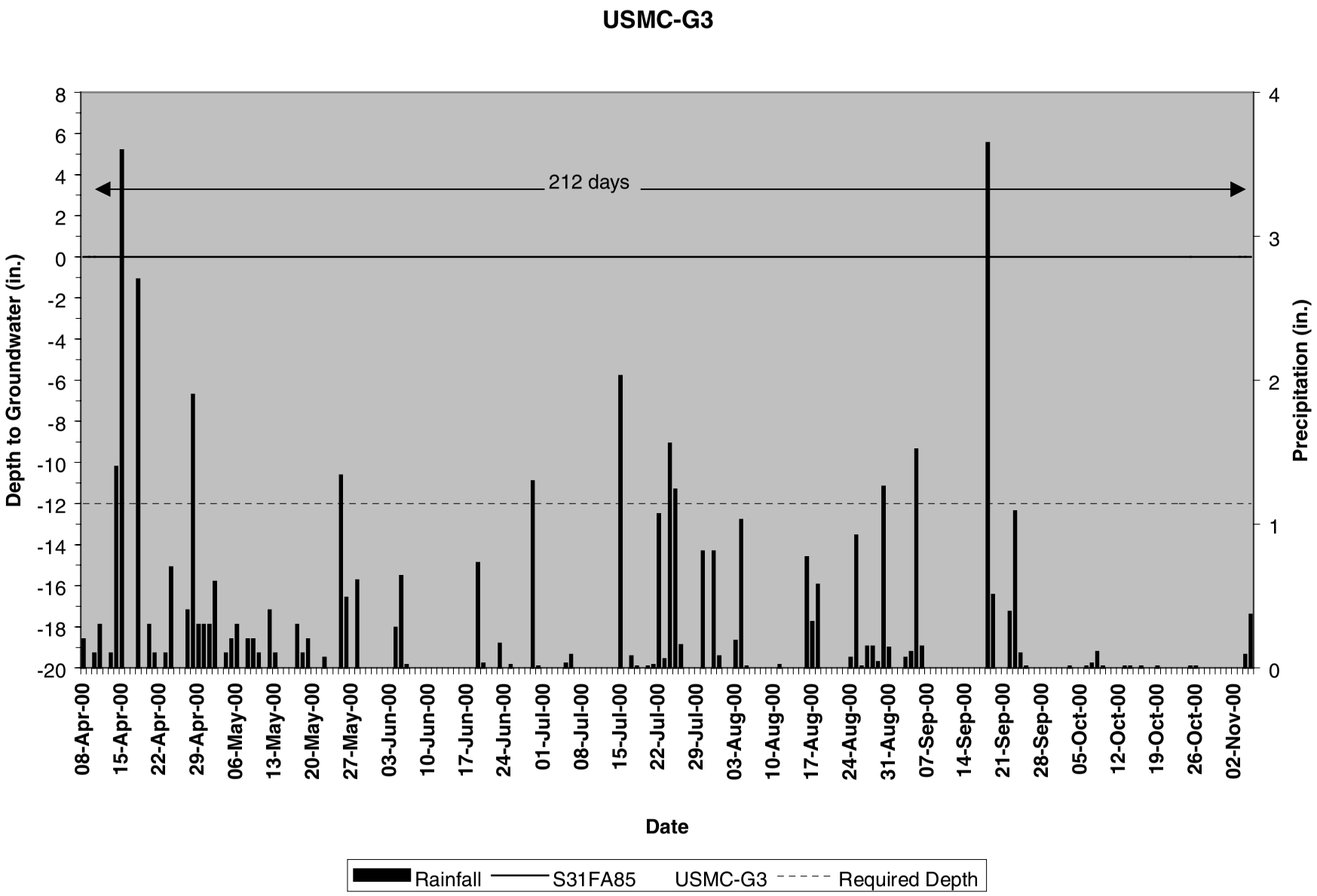
Of the 3.5 acres of this site, approximately 2.93 acres involved marsh grass planting. There were 45 random plots established throughout the planting area and located using GPS. The vegetative coverage and frequency do not meet the success criteria; however, they have significantly increased since planting.

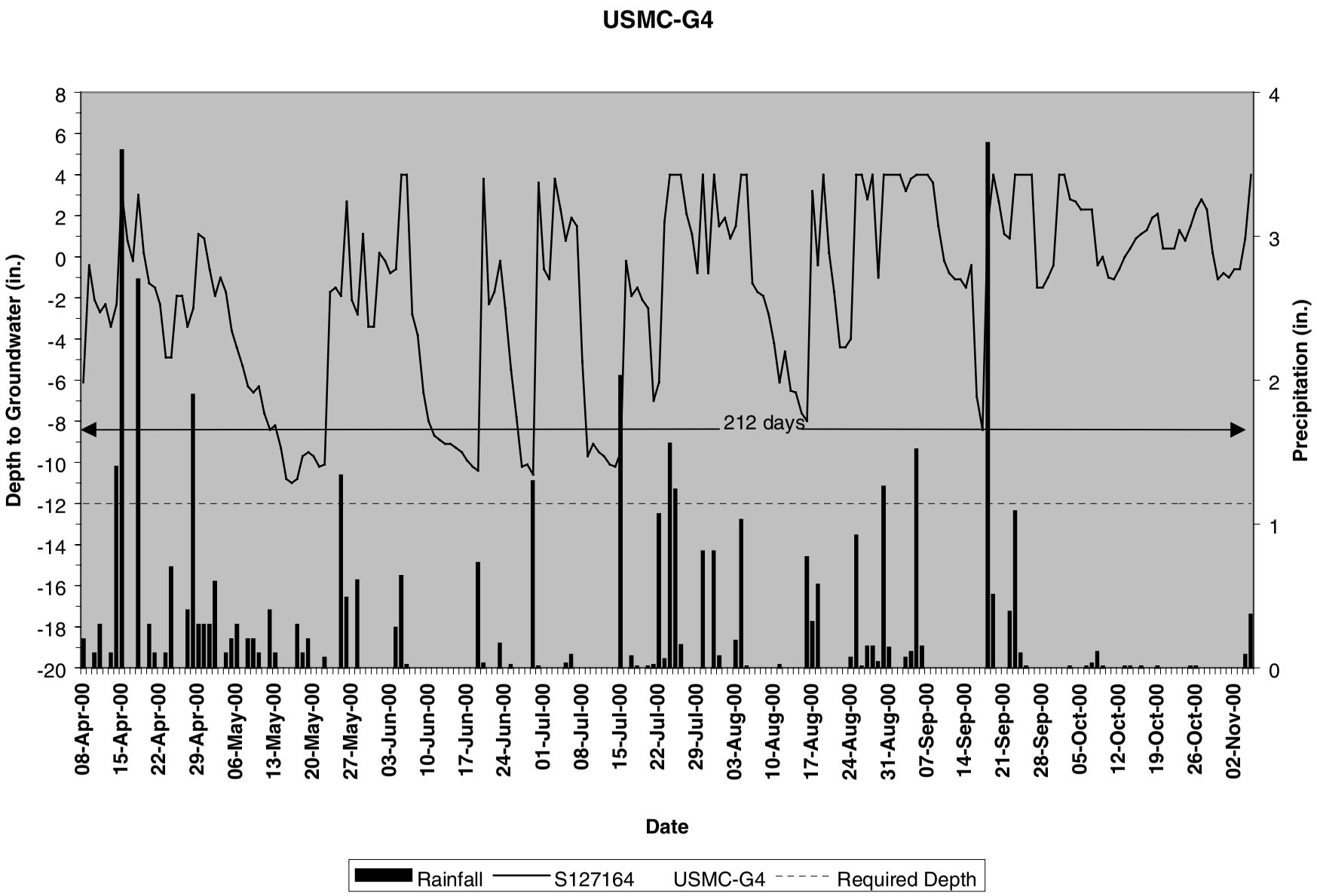
4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS

According to project specifications the hydrology and vegetation of the site have not demonstrated success. This concludes the second year of vegetation and hydrological monitoring for the site.

Based on the monitoring results from the 2000 season and consulting with resource agencies at an on-site meeting November 28, 2000, NCDOT has determined that remediation of the site is necessary. Grading of the site will take place in the winter of 2002 and the site will be replanted in the spring of 2002. Tidal data will be obtained by recording the presence of surface water on site every hour for one month during the growing season in 2001 to determine whether the site is being flooded twice a day. The three year monitoring period will begin when remediaiton efforts are finished

APPENDIX A
DEPTH TO GROUNDWATER PLOTS


USMC-G3
212 days
Depth to Groundwater (in.)
Precipitation (in.)
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
4
3
2
1
0
08-Apr-00
15-Apr-00
22-Apr-00
29-Apr-00
06-May-00
13-May-00
20-May-00
27-May-00
03-Jun-00
10-Jun-00
17-Jun-00
24-Jun-00
01-Jul-00
08-Jul-00
15-Jul-00
22-Jul-00
29-Jul-00
03-Aug-00
10-Aug-00
17-Aug-00
24-Aug-00
31-Aug-00
07-Sep-00
14-Sep-00
21-Sep-00
28-Sep-00
05-Oct-00
12-Oct-00
19-Oct-00
26-Oct-00
02-Nov-00
Date
Rainfall
S31FA85
USMC-G3
Required Depth


USMC-G4
Depth to Groundwater (in.)
Precipitation (in.)
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
4
3
2
1
0
212 days
08-Apr-00
15-Apr-00
22-Apr-00
29-Apr-00
06-May-00
13-May-00
20-May-00
27-May-00
03-Jun-00
10-Jun-00
17-Jun-00
24-Jun-00
01-Jul-00
08-Jul-00
15-Jul-00
22-Jul-00
29-Jul-00
03-Aug-00
10-Aug-00
17-Aug-00
24-Aug-00
31-Aug-00
07-Sep-00
14-Sep-00
21-Sep-00
28-Sep-00
05-Oct-00
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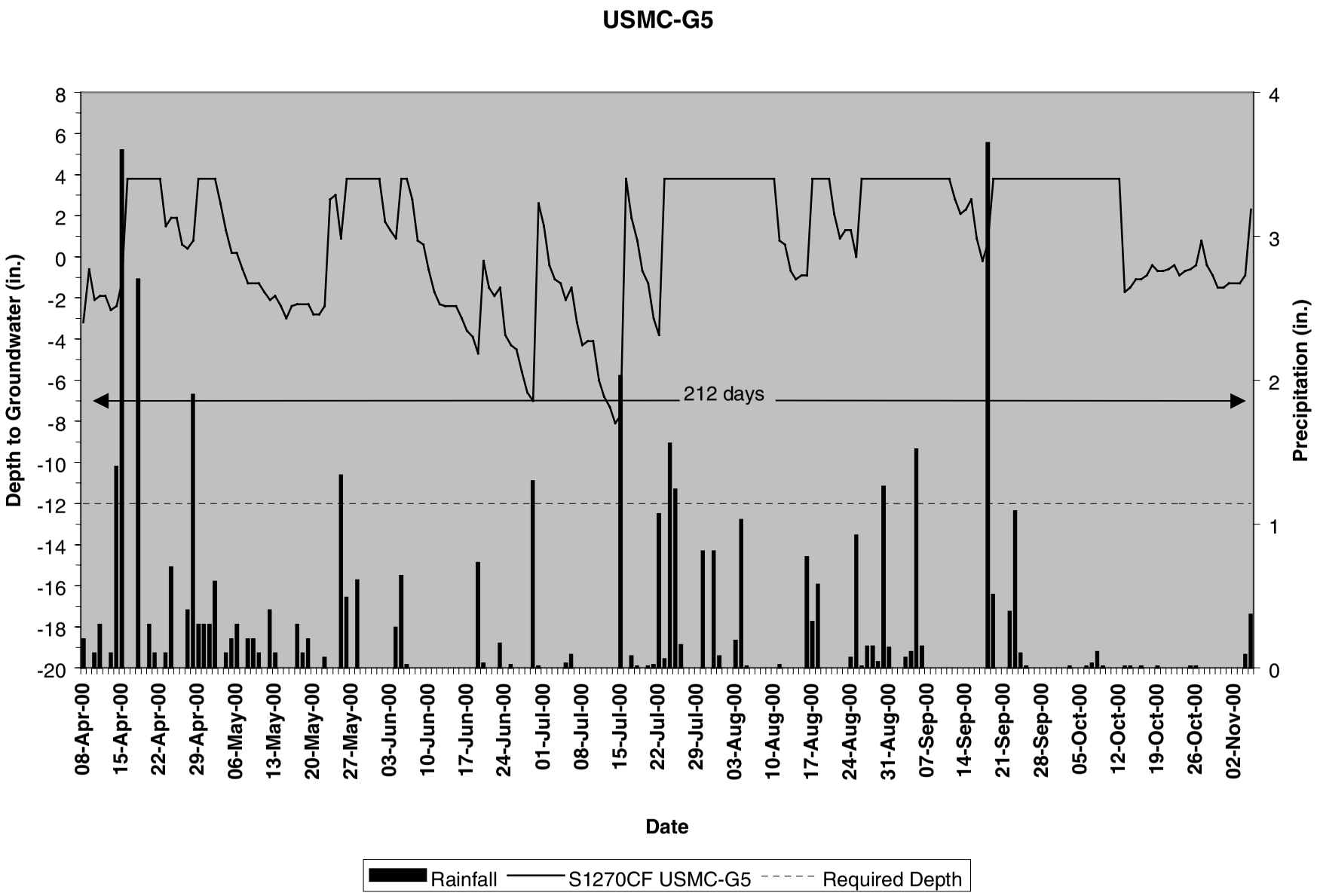
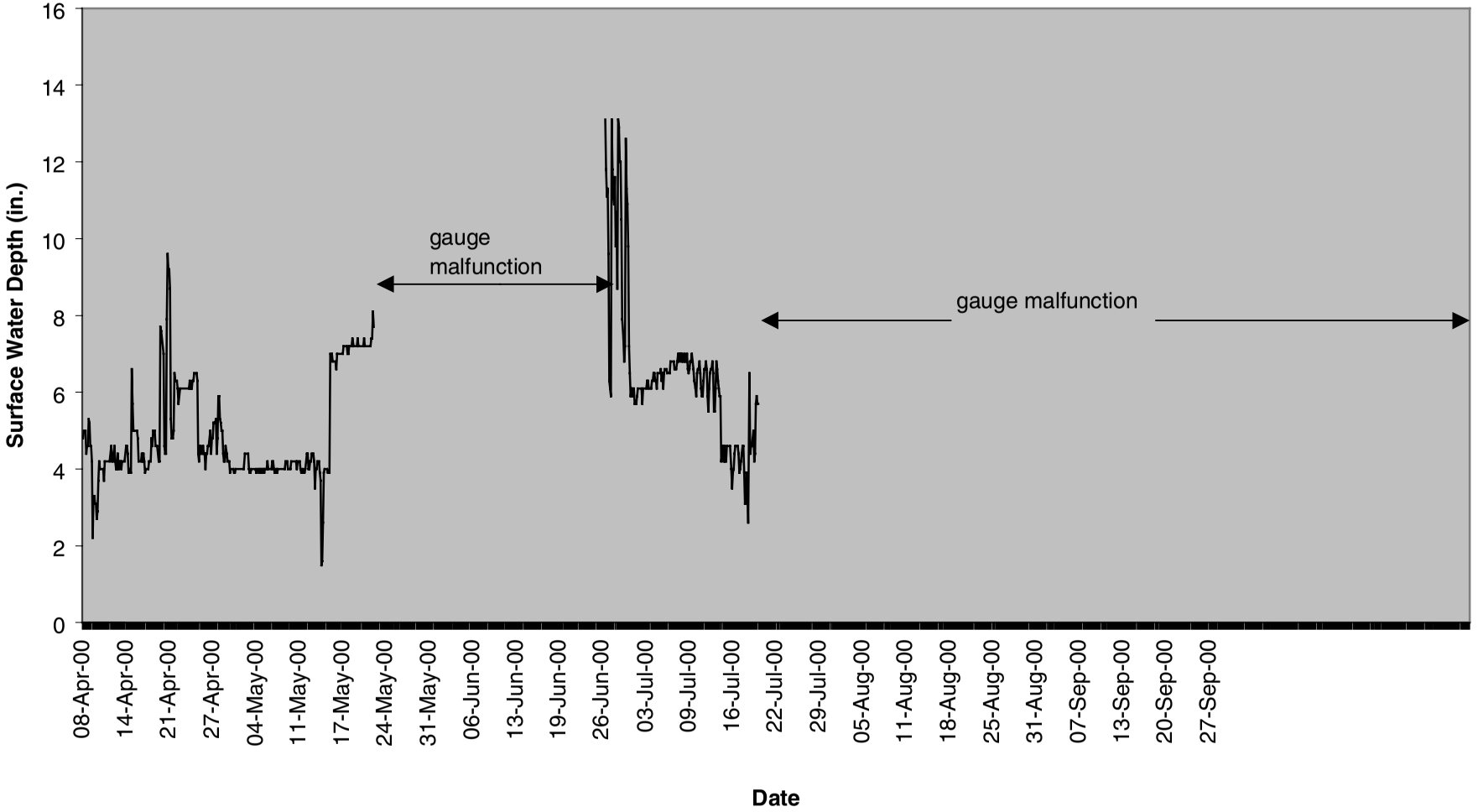
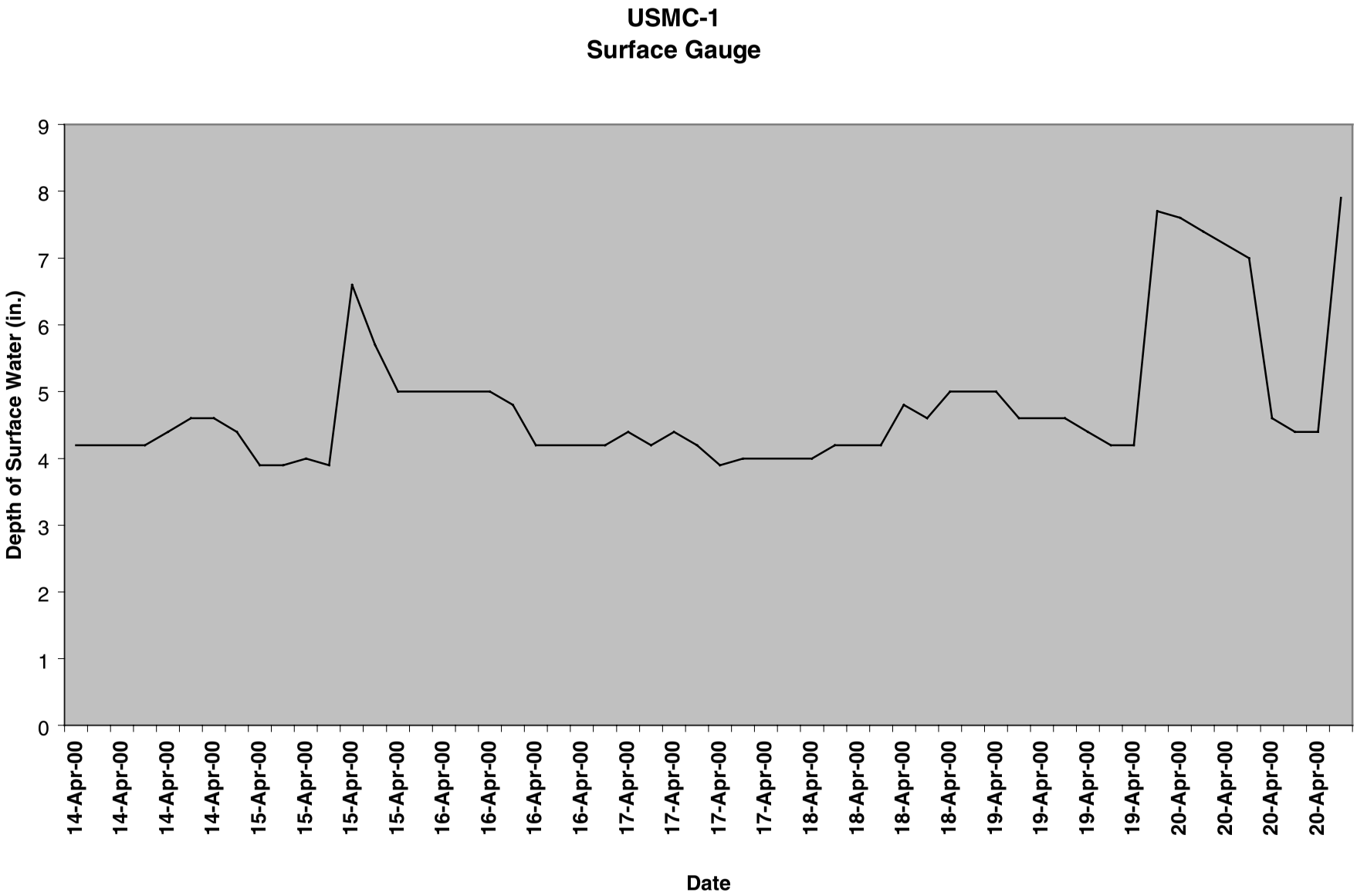
02-Nov-00
Date
Rainfall
S127164
USMC-G4
Required Depth


USMC-G5
Depth to Groundwater (in.)
Precipitation (in.)
212 days
Date
Rainfall
S1270CF USMC-G5
Required Depth

USMC-1
Surface Gauge




USMC-1
Surface Gauge
Depth of Surface Water (in.)
0
1
2
3
4
5
6
7
8
9
14-Apr-00
14-Apr-00
14-Apr-00
14-Apr-00
15-Apr-00
15-Apr-00
15-Apr-00
15-Apr-00
16-Apr-00
16-Apr-00
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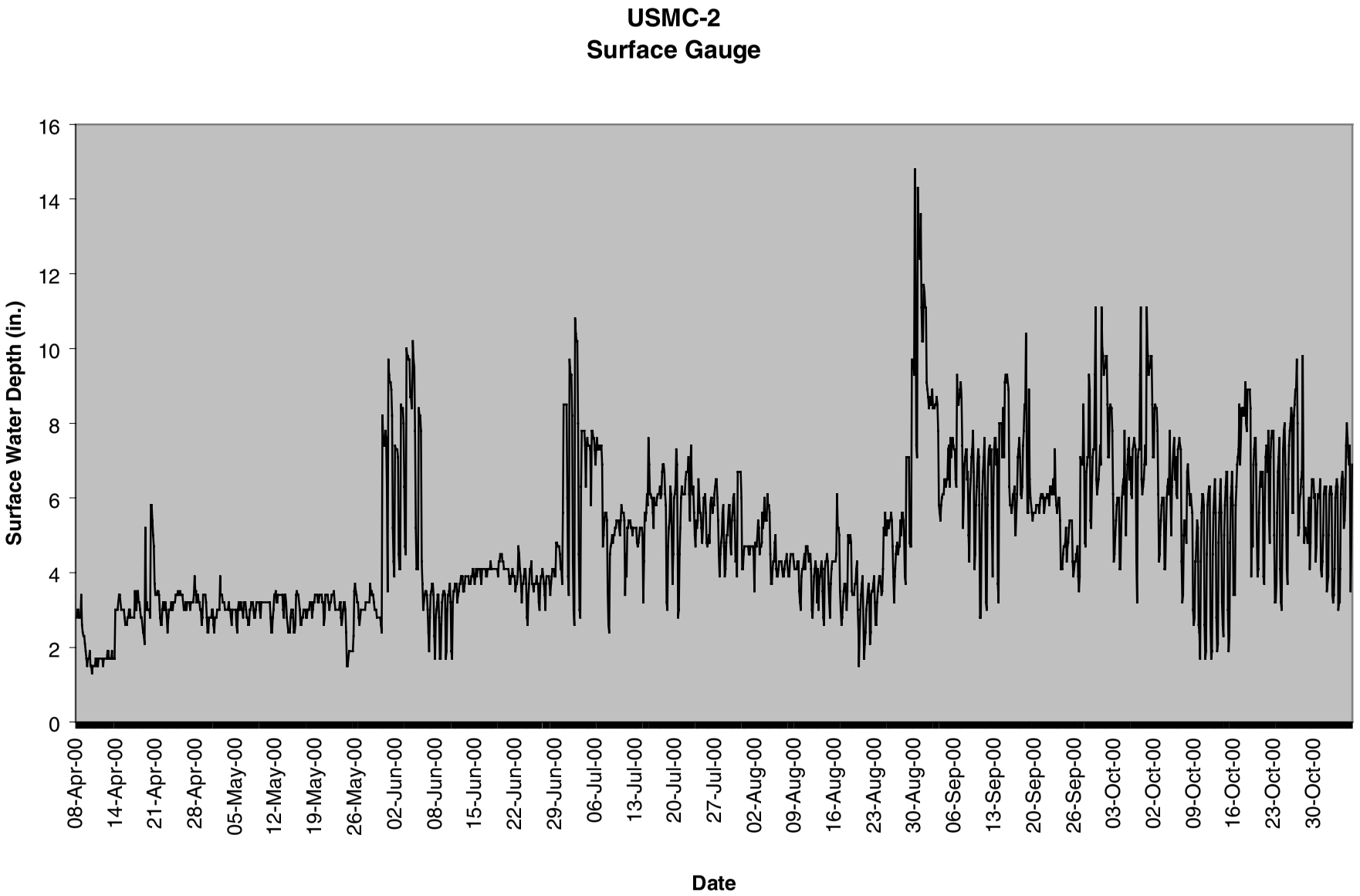
USMC-2
Surface Gauge
Surface Water Depth (in.)
0
2
4
6
8
10
12
14
16
08-Apr-00
14-Apr-00
21-Apr-00
28-Apr-00
05-May-00
12-May-00
19-May-00
26-May-00
02-Jun-00
08-Jun-00
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22-Jun-00
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13-Jul-00
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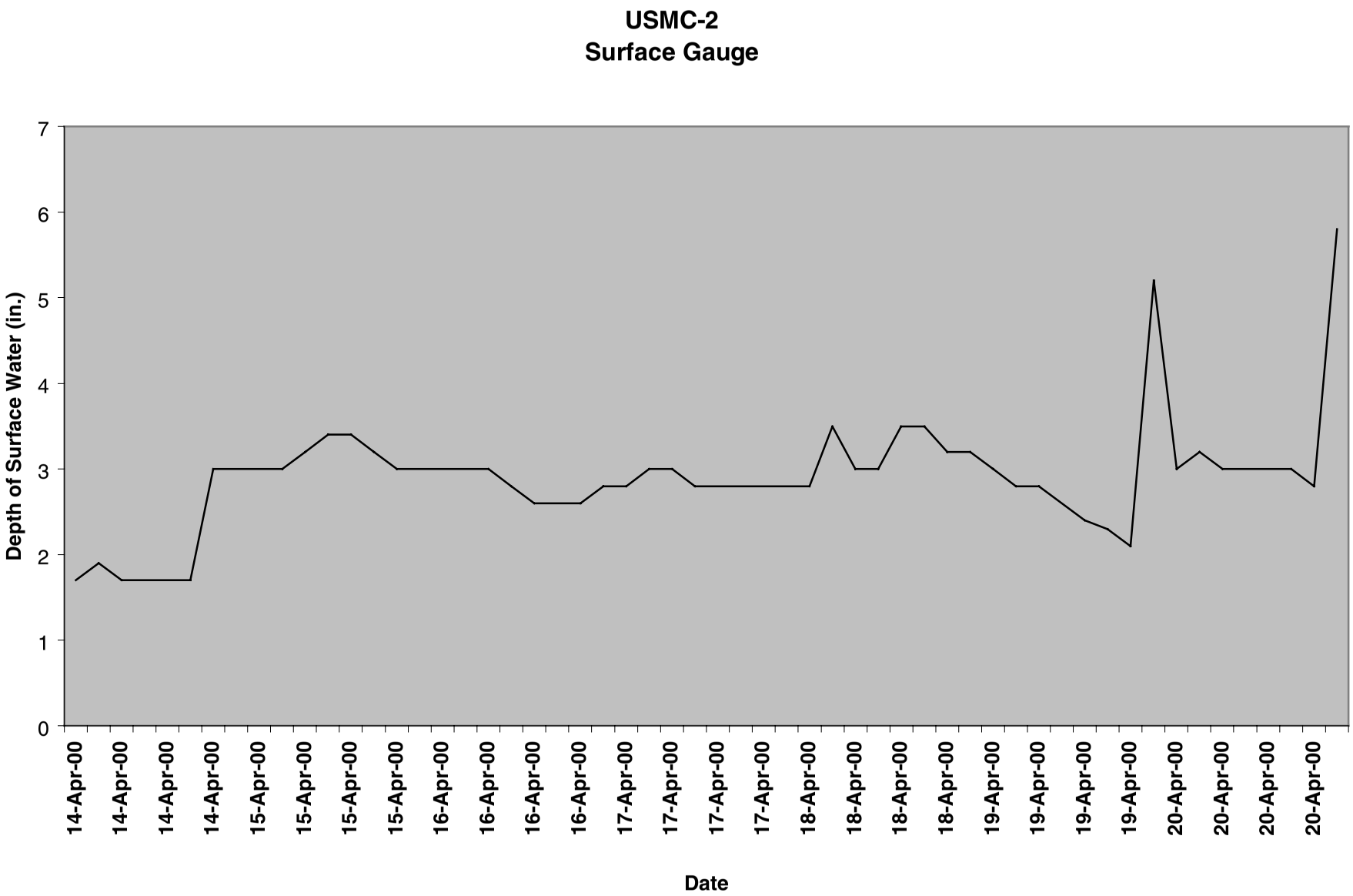
30-Oct-00
Date


USMC-2
Surface Gauge
Depth of Surface Water (in.)
0
1
2
3
4
5
6
7
14-Apr-00
14-Apr-00
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14-Apr-00
15-Apr-00
15-Apr-00
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15-Apr-00
16-Apr-00
16-Apr-00
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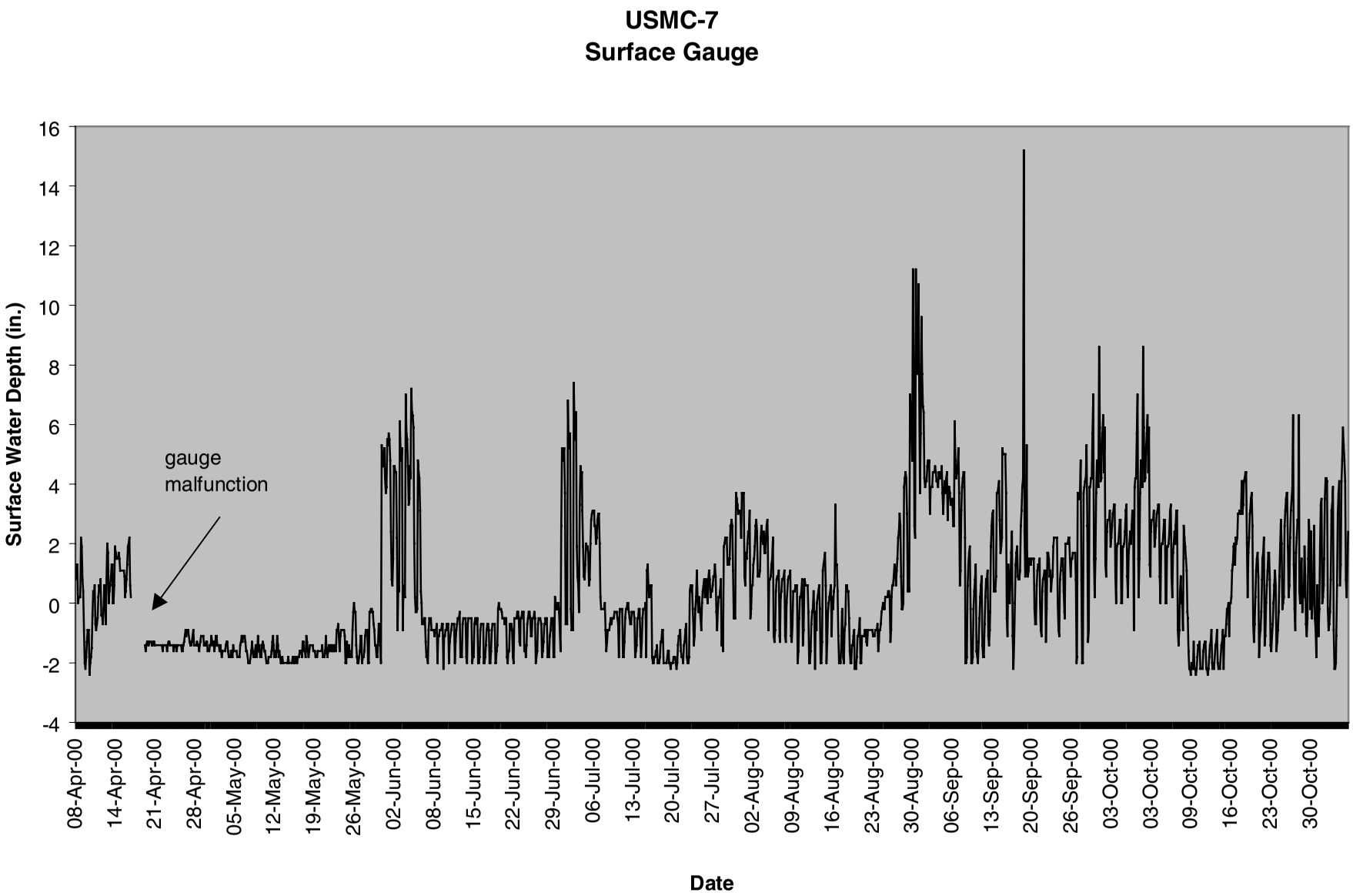
USMC-7
Surface Gauge
Surface Water Depth (in.)
16
14
12
10
8
6
4
2
0
-2
-4
gauge
malfunction
08-Apr-00
14-Apr-00
21-Apr-00
28-Apr-00
05-May-00
12-May-00
19-May-00
26-May-00
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08-Jun-00
15-Jun-00
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09-Aug-00
16-Aug-00
23-Aug-00
30-Aug-00
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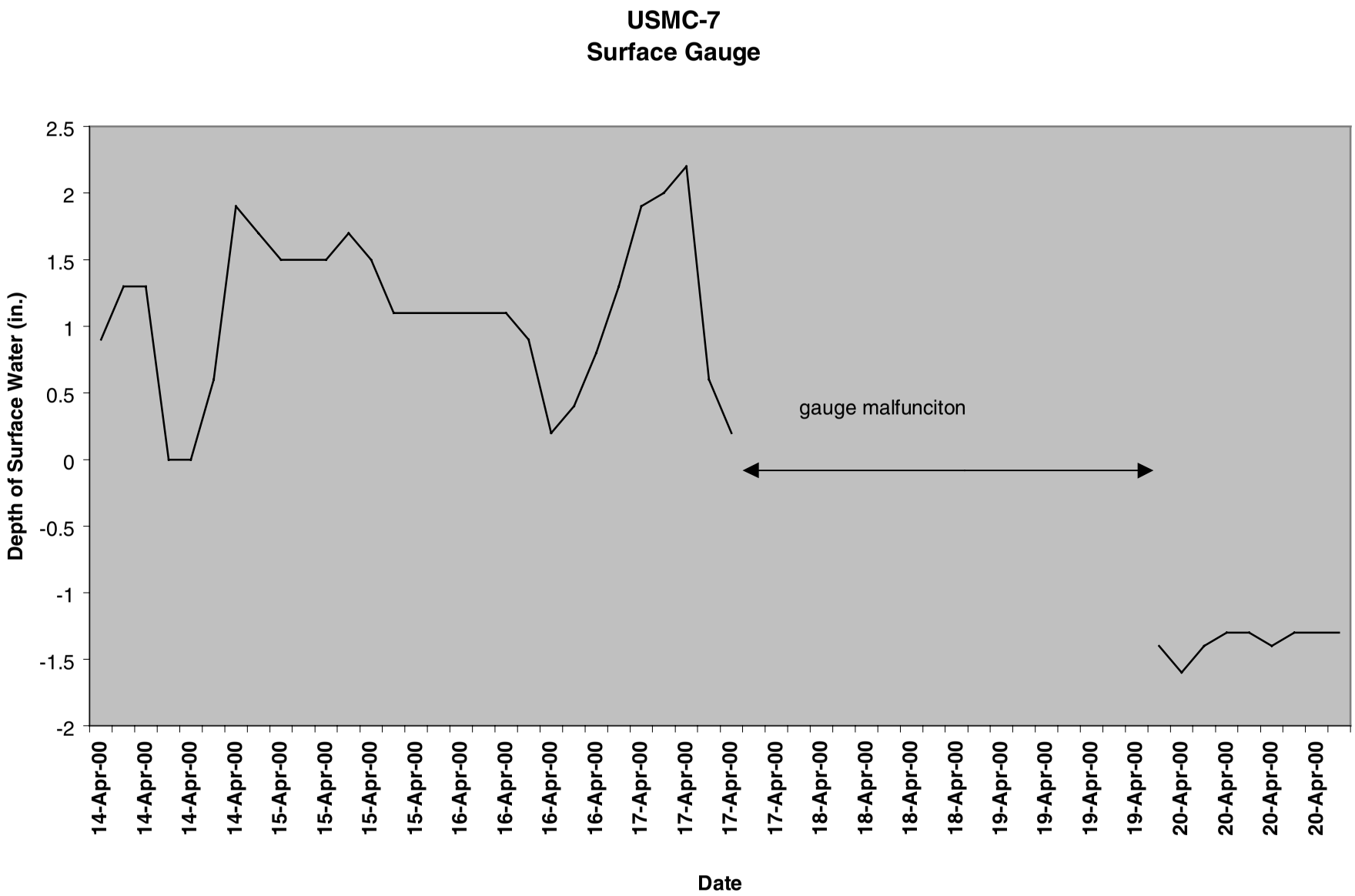
23-Oct-00
30-Oct-00
Date


USMC-7
Surface Gauge
Depth of Surface Water (in.)
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
gauge malfunciton
14-Apr-00
14-Apr-00
14-Apr-00
14-Apr-00
15-Apr-00
15-Apr-00
15-Apr-00
15-Apr-00
16-Apr-00
16-Apr-00
16-Apr-00
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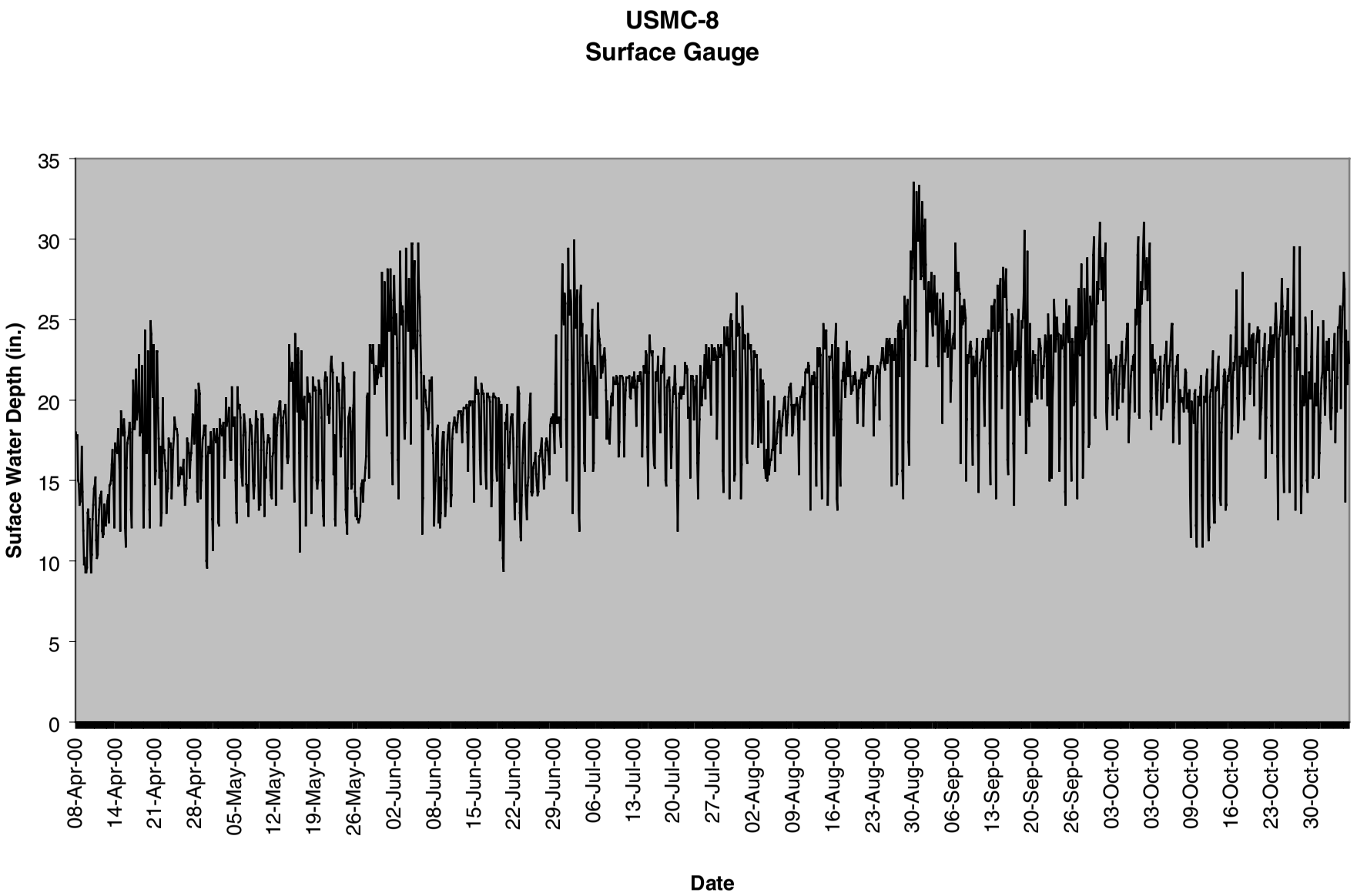
20-Apr-00
Date


USMC-8
Surface Gauge
Suface Water Depth (in.)
35
30
25
20
15
10
5
0
08-Apr-00
14-Apr-00
21-Apr-00
28-Apr-00
05-May-00
12-May-00
19-May-00
26-May-00
02-Jun-00
08-Jun-00
15-Jun-00
22-Jun-00
29-Jun-00
06-Jul-00
13-Jul-00
20-Jul-00
27-Jul-00
02-Aug-00
09-Aug-00
16-Aug-00
23-Aug-00
30-Aug-00
06-Sep-00
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20-Sep-00
26-Sep-00
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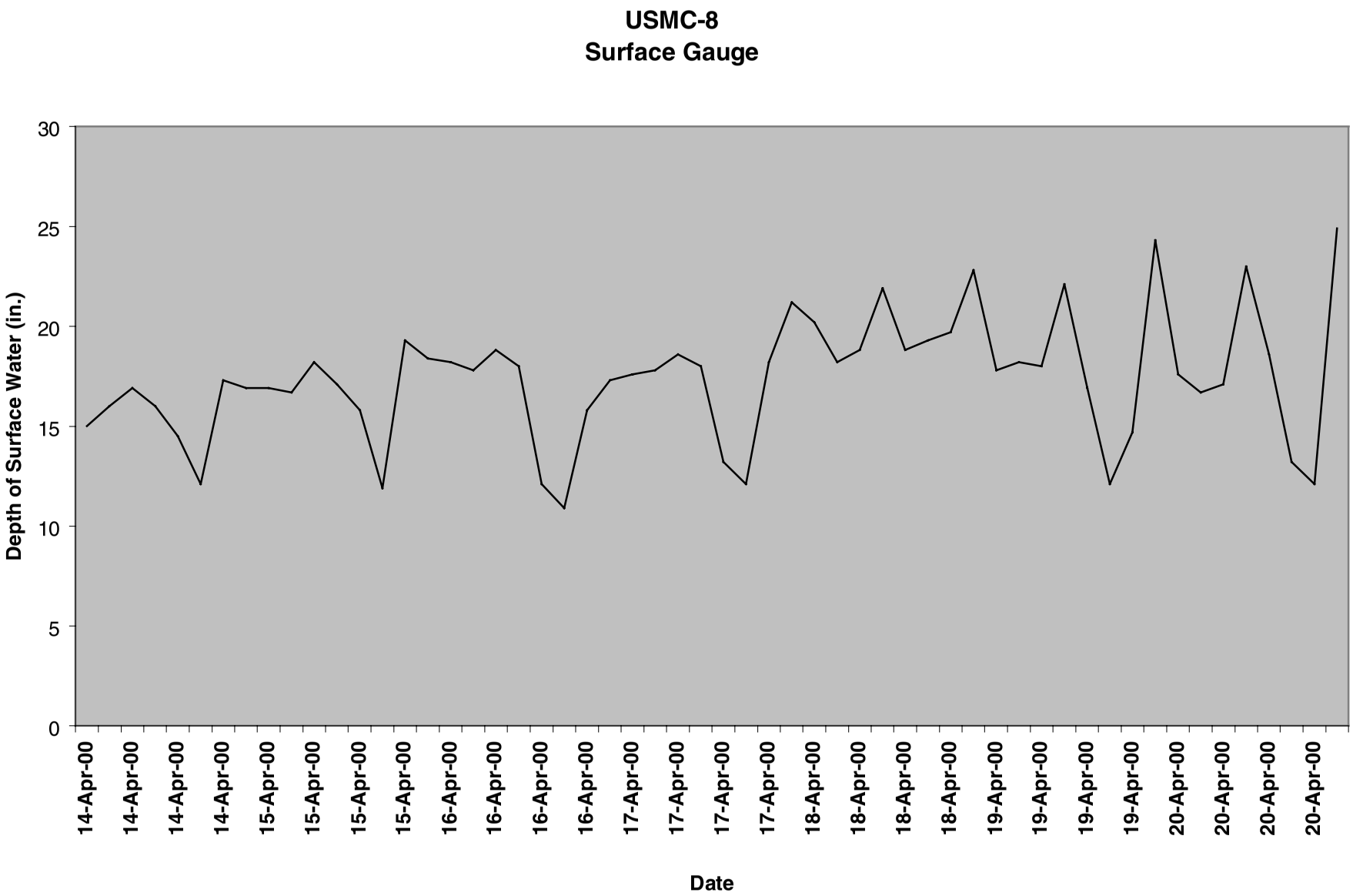
03-Oct-00
09-Oct-00
16-Oct-00
23-Oct-00
30-Oct-00
Date


USMC-8
Surface Gauge
Depth of Surface Water (in.)
30
25
20
15
10
5
0
14-Apr-00
14-Apr-00
14-Apr-00
14-Apr-00
15-Apr-00
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20-Apr-00
20-Apr-00
20-Apr-00
20-Apr-00
Date

APPENDIX B
SITE PHOTOS

USMC

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

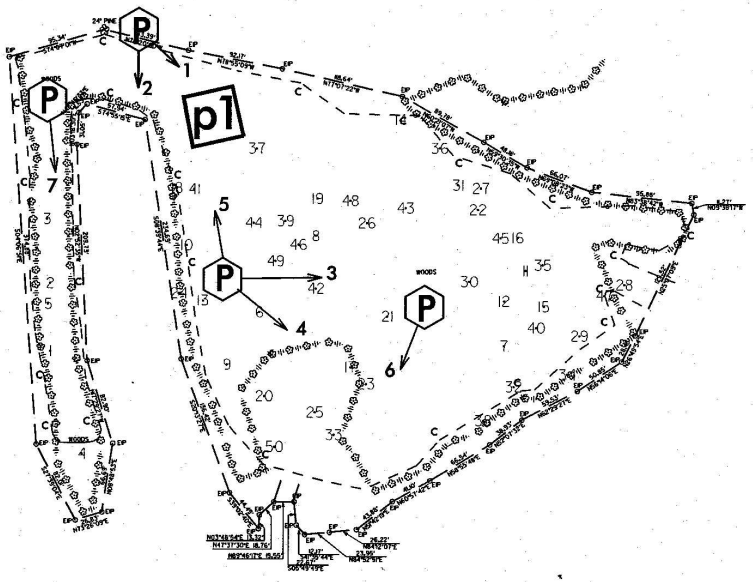
Photo 6

USMC

Photo 7

APPENDIX C
VEGETATION PLANTING PLAN

USMC Marsh/Shrub Site
Onslow County, U–2107 WM
2000 Monitoring



PROJECT REFERENCE NO.	SHEET NO.
U-2107WM	map 1
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PHOTO AND VEGETATION PLOT LOCATIONS

- Random Plots
- (P) Photograph Locations
- Vegetation Monitoring Plot (50 ft. X 50 ft.)