ANNUAL REPORT FOR 2001

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

Prepared By:
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North Carolina Department of Transportation
December 2001

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USMC MARSH MITIGATION SITE
2001 REPORT – EXECUTIVE 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 2001 represent the third 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 monitoring gauges, four surface water gauges, one rain gauge, and one tidal gauge. The tidal gauge (Infinity model) was installed in 2001 to determine the high and low tide range.

This year, rainfall data has been acquired from an onsite rain gauge. Also, daily rainfall data recorded from a rain gauge maintained in Trenton (Jones County) by the NC State Climate Office was used for comparison.

Hydrologic monitoring indicates that the site has not met the overall success criteria during the 2001 monitoring year. Although the surface water gauges show inundation, the lack of vegetation and the tidal gauge data all confirm that the site is not being flooded twice daily as required. The groundwater gauges in the shrub area were all successful.

Vegetation monitoring of the shrub area revealed an average density of 613 shrubs per acre, well above the minimum requirement. Vegetation monitoring yielded results below the success criteria in the marsh grass planting transects. The main vegetation success has been in the lowest elevation zone of the central canal.

Based on the monitoring results from the 2001 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 2001-2002 and the site will be replanted in the spring of 2002. All surface water gauges will be replaced with Infinity gauges.

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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, TIP Project U-2107A, B, BA, C, and D (USACE Action ID No. 199402926).

1.2 Purpose

In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for three years (for vegetation) and until success is shown (hydrologic). Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrologic conditions and vegetation survival. The following report details the results of hydrologic and vegetative monitoring during 2001 at the USMC Mitigation Site.

Activities in 2001 reflect the third year of monitoring following construction. Included in this report are analyses of both hydrologic and vegetative monitoring results as well as local climate conditions throughout the growing season.

1.3 Project History

March 1999	Grading Construction
April 1999	Site planted
May 1999	Monitoring Gauges Installed
May- November 1999	Hydrologic Monitoring (Year 1)
October 1999	Vegetation Monitoring (Year 1)
March-November 2000	Hydrologic Monitoring (Year 2)
August 2000	Vegetation Monitoring (Year 2)
March – November 2001	Hydrologic Monitoring (Year 3)
October 2001	Vegetation Monitoring (Year 3)

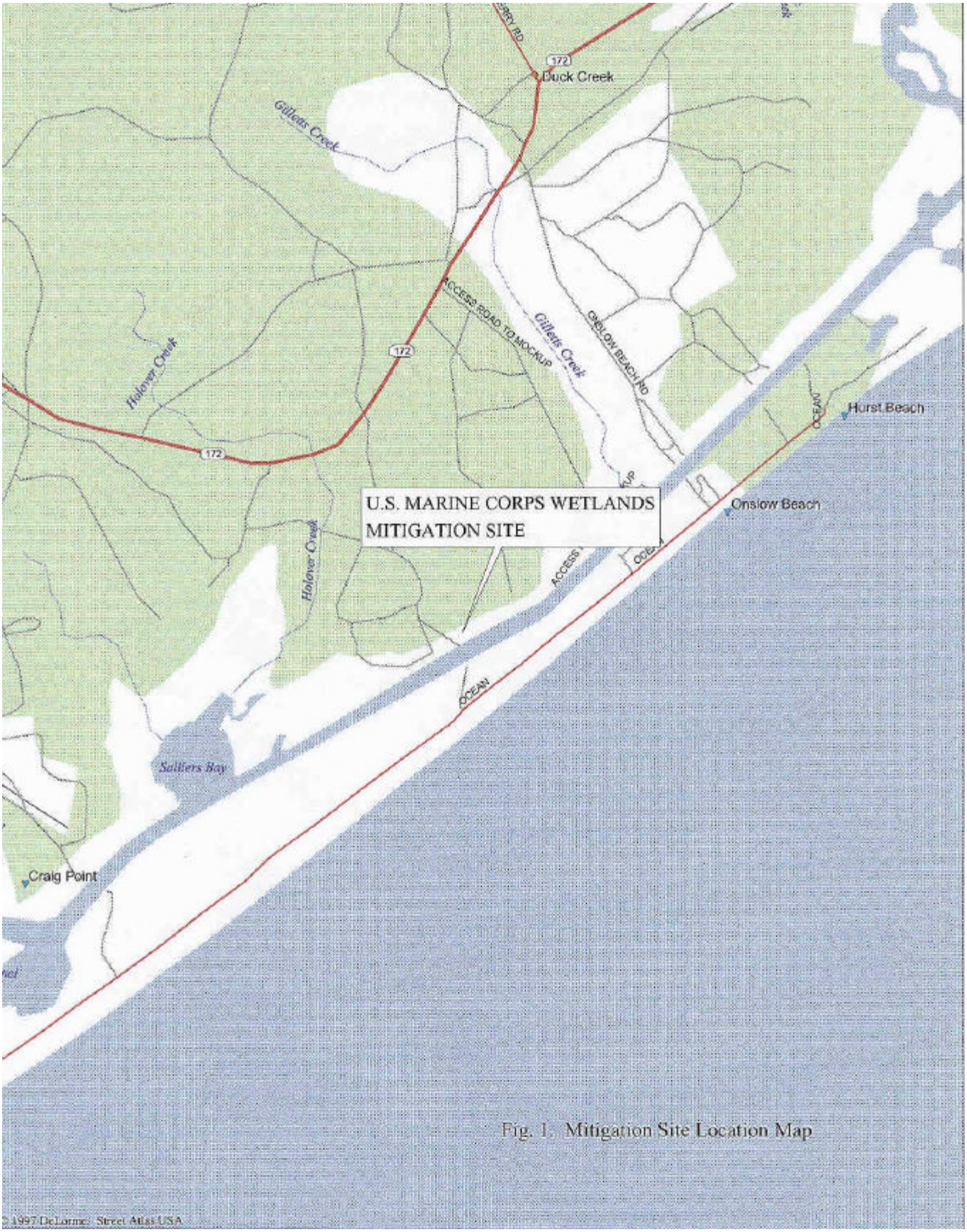


Fig. 1. Mitigation Site Location Map

1.4 Permit Related Requirements

Special conditions of the permit for U-2107 required that NCDOT:

- "3.5 acres of *Spartina alterniflora* and *Juncus roemerianus* marsh shall be restored as described in the Onslow County marsh Mitigation plan dated September 1997. All grading and planting on the site shall be completed no later than June 1, 1999." This site was completed in March 1999. However, due to the elevation problems, the site will be regraded in 2002.

2.0 HYDROLOGY

2.1 Success Criteria

Project specifications require saturation or inundation (within 12 inches of the surface) for at least 12.5% of 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.

For the lower marsh area, the success criteria require daily tidal flooding.

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] The growing season is 212 days; therefore, optimum duration for wetland hydrology is 27 days. Also, local climate conditions must represent average conditions for the area.

2.2 Monitoring Procedure

Three groundwater 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 for groundwater gauges and eight times daily for the surface water gauges. The rain gauge was replaced in the spring of 2000 with an Infinity rain gauge. Also, an Infinity tidal gauge was installed in the spring of 2001, which measures the tide elevation every hour.

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

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.

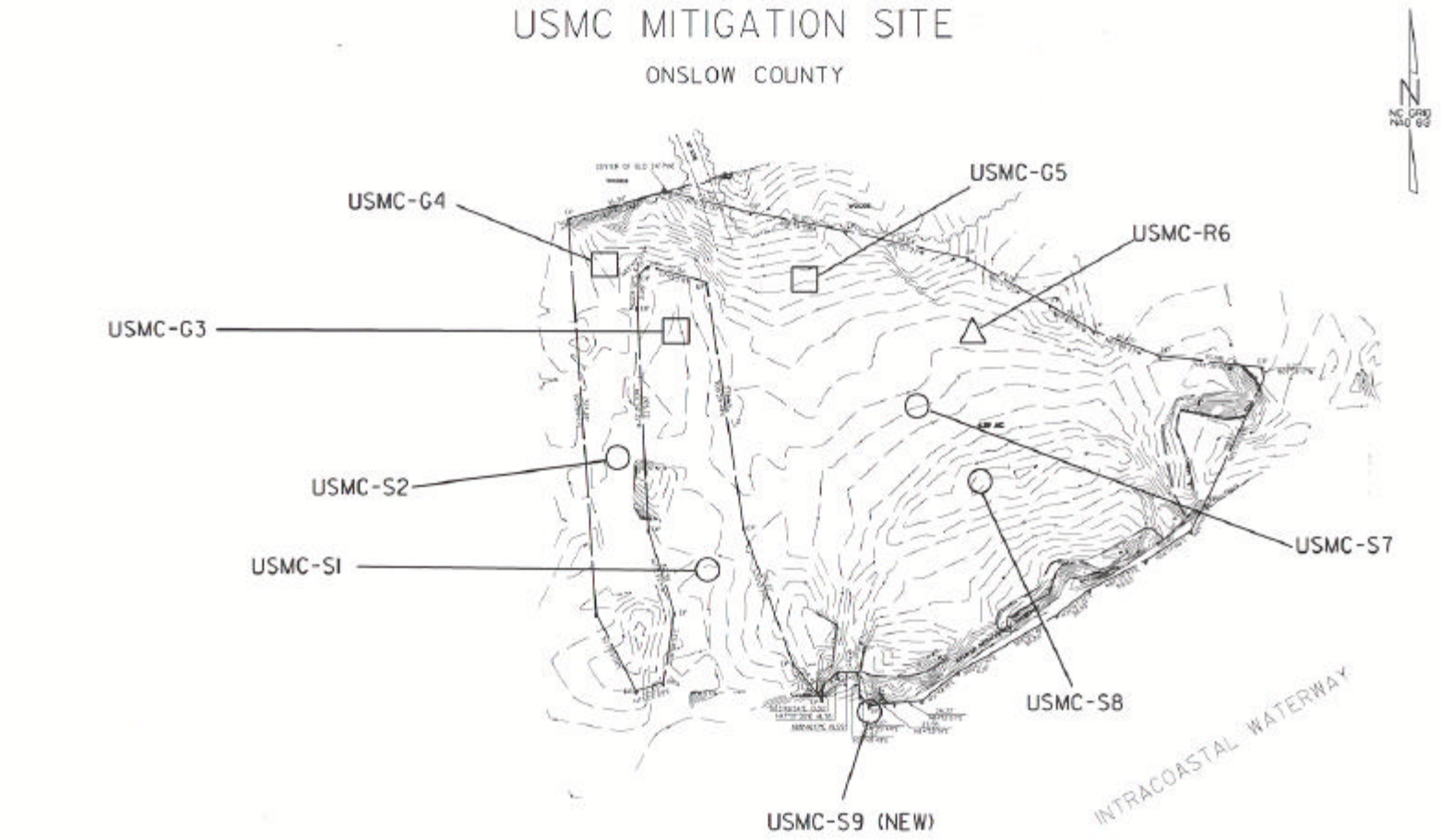


FIGURE 2: MONITORING GAUGE LOCATIONS

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%.

Table 1 presents both the actual consecutive day percentages for each gauge as well as its percentage range.

Table 1
2001 GROUNDWATER HYDROLGIC MONITORING RESULTS

Monitoring Gauge	< 5%	5% - 8%	8% - 12.5%	> 12.5%	Actual %	Success Dates
USMC-G3				✓	100.0	4/8-11/5
USMC-G4				✓	39.6	8/14-11/5
USMC-G5*				✓	25.0	4/8-5/3

'' - Denotes gauges which malfunctioned during the growing season; gauge data is incomplete.*

The groundwater gauges, all three gauges indicate hydrologic data that meets and exceeds project specifications during 2001.

For the surface water gauges, the surface water gauge data was erratic and unreliable in 2000. It was discovered that corrosion in the gauges had affected the data. As a result, all four surface water gauges were replaced with similar units following the 2000 growing season. Unfortunately, the new surface water gauges have also proved unreliable. To supplement the onsite data, an Infinity tidal gauge was installed. All four gauges show consistent inundation but no strong tidal fluctuations that match the reference USMC-9 tide gauge. Despite these problems with the gauges, it is apparent from other observations that the marsh area is not being flooded twice daily.

Figure 3 is a map of the hydrologic monitoring results for 2001. For groundwater gauges 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%; and a green dot indicates hydrology between 5% and 8% of the season. Successful surface water gauges are represented with yellow symbols and unsuccessful surface water gauges are shown

with black symbols. It must be noted that the “successful” surface water gauges are not successful when compared to field conditions.

The entire marsh area will be regraded and replanted in spring 2002 to correct problems. After reconstruction new Infinity style surface water gauges will be installed to correct problems with the old style units.

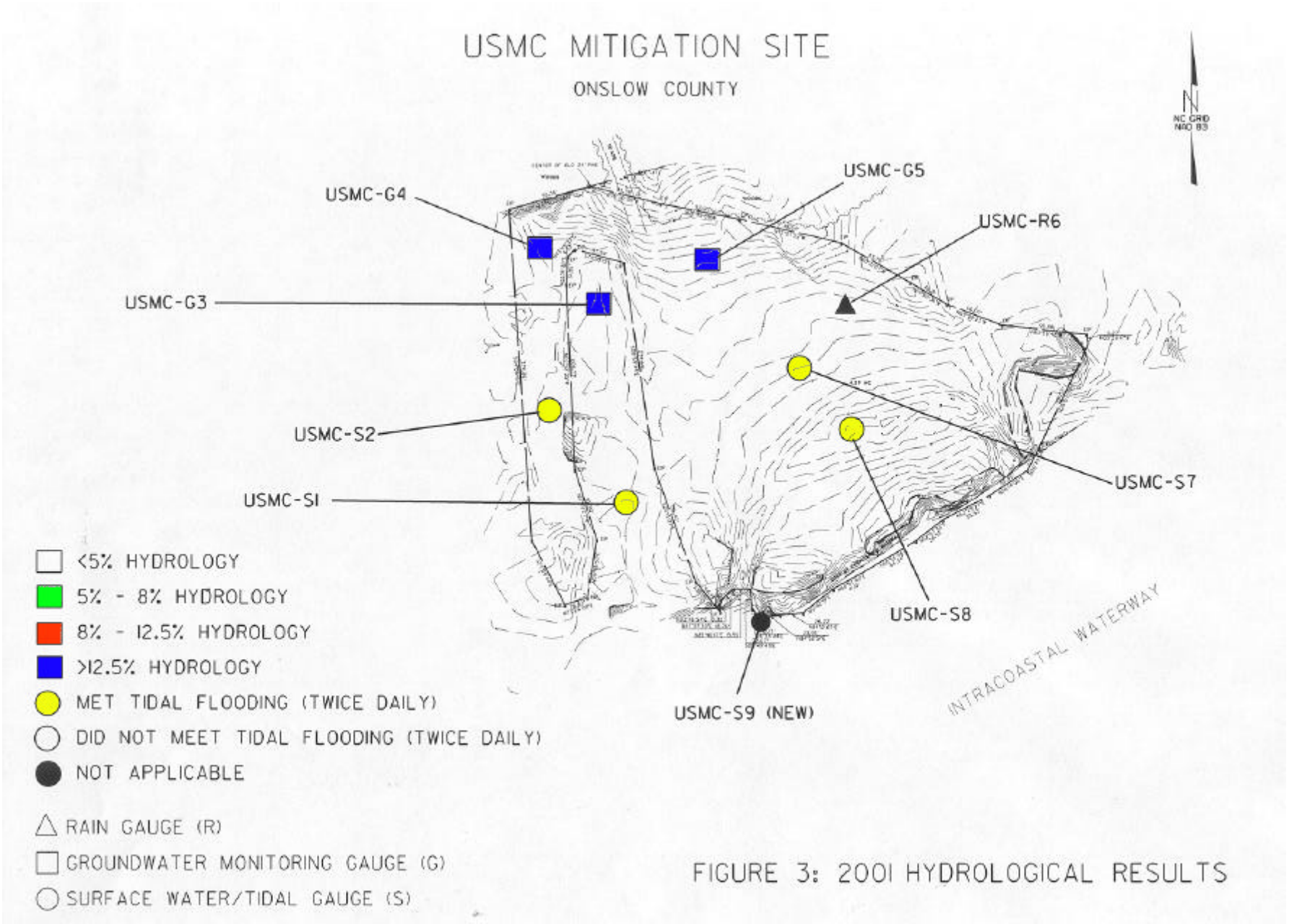


FIGURE 3: 2001 HYDROLOGICAL RESULTS

2.3.2 Climatic Data

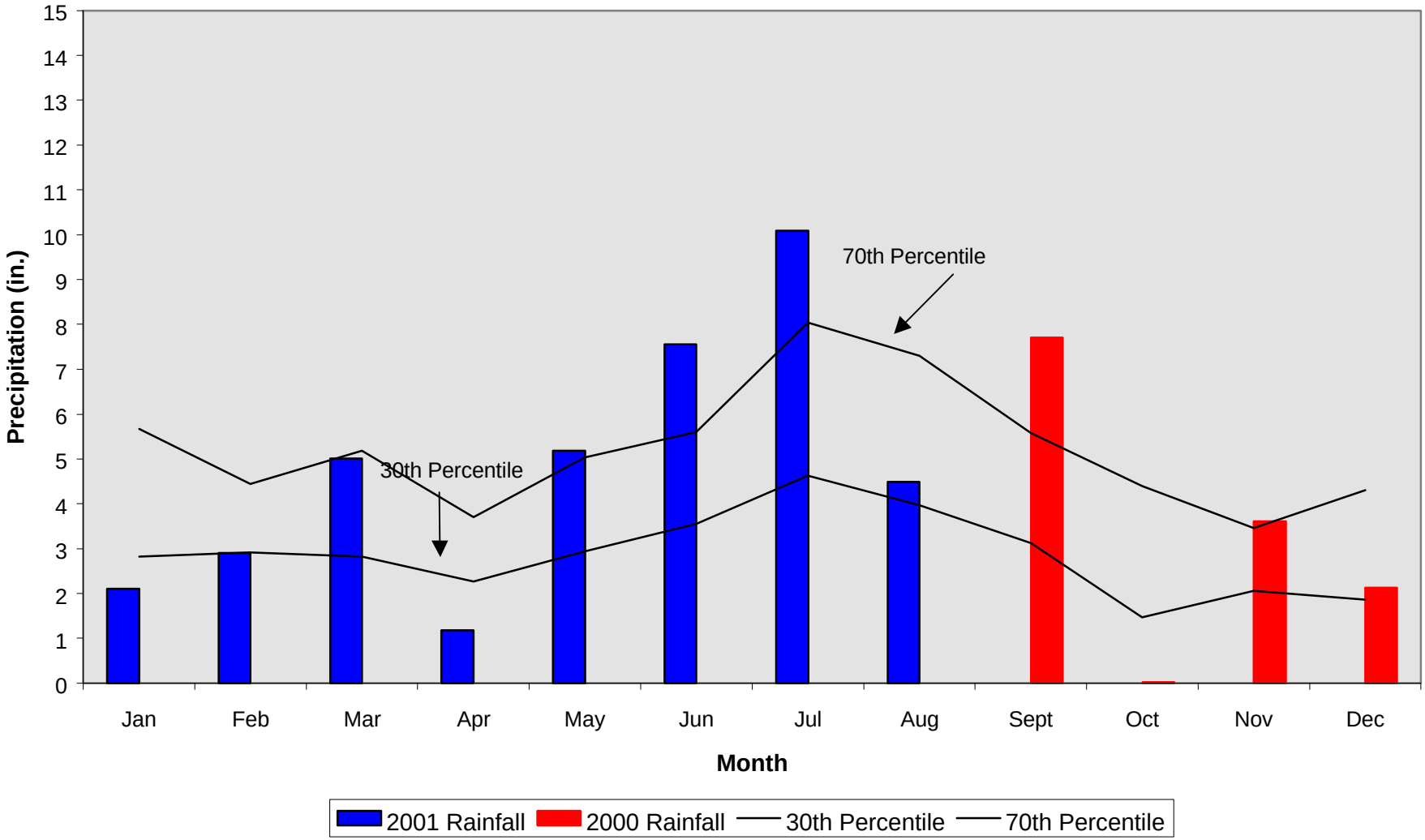
Figure 4 represents an examination of the local climate in comparison with historical data in order to determine whether 2001 was “average” in terms of climate conditions. The figure compares the rainfall from January to August 2001 with that of historical rainfall (data collected between 1931 and 2001). All rainfall data was collected from the NC State Climate Office, Trenton weather station. The graph shows 2000 monthly totals from September to December. Rainfall data for September through December 2001 will be presented in the 2002 Annual Monitoring Report.

For 2000, rainfall was above average in September, below average in October, and within average limits in November and December. For 2001, rainfall was below average in January, February, and April; within average limits in March and August; and above average in May, June, and July.

2.4 Conclusions

2001 represent the third full growing season that the hydrologic monitoring data has been examined. For this year, all three groundwater gauges met the jurisdictional wetland hydrology for 12.5% of the growing season. While the surface gauges show success, the tidal marsh area of the site is not really meeting the success criteria of flooding twice daily, based on tidal gauges information and lack of vegetation.

Figure 4. USMC 30-70 Graph
Trenton, NC



3.0 VEGETATION: USMC MITIGATION SITE (YEAR 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) species.

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 halimifolia, 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 (Year 3) (Shrub Area)

Table 2. Vegetative Monitoring Results (Shrub Area)

Plot #	Wax Myrtle	False Willow	Marsh Elder	Total (3 year)	Total (at planting)	Density (Shrub/Acre)
1	25	8	13	46	51	613
TOTAL DENSITY						**613**

Site Notes: Natural propagation seen in marsh elder and false willow species. Phragmites on the outer fringe of the site was treated in August 2001 and will continue to be evaluated throughout the monitoring period.

3.3B Results of Vegetation Monitoring(Marsh Grass Area)

Table 3. Vegetative Monitoring Results (Marsh Grass Area)

	Plot #	Scale Factor	*Juncus roemerianus*	*Spartina alterniflora*	Frequency	Notes
	1	4.0				*Scirpus* sp., Bermuda, *Aster* sp.
	2	2.0		✓	✓	Wire grass
	3	4.0				Bermuda, Phragmites
	4	5.0	✓		✓	
	5	2.0		✓	✓	Wire grass
	6	0.0				Bare ground
	7					Open water
	8	3.0	✓		✓	*Aster* sp., Cattails
	9	0.0				Bare ground
	10	0.0				Bare ground
	11	3.0		✓	✓	
	12					Out of bounds
	13	5.0	✓		✓	2" water
	14	3.0		✓	✓	*Baccharis* sp., Wax myrtle
	15	5.0		✓	✓	
	16	5.0		✓	✓	2" water
	17	0.0				Bare ground
	18	5.0		✓	✓	
	19	5.0	✓	✓	✓	
	20	5.0		✓	✓	Bermuda, *Aster* sp., Glasswort
	21	1.0		✓	✓	Glasswort
	22	5.0		✓	✓	Glasswort, Wire grass
	23	0.0				Out of bounds
	24	4.0		✓	✓	Glasswort
	25	0.0				Bare ground
	26	4.0		✓	✓	
	27	3.0				*Aster* sp., Wax myrtle, Goldenrod
	28	5.0		✓	✓	1/2" water
	29	0.0				Bare ground
	30	0.0				Bare ground
	31	0.0				Bare ground
	32	4.0		✓	✓	Glasswort
	33	5.0	✓		✓	*Aster* sp., Pigweed,
	34	0.0				Bare ground
	35	4.0		✓	✓	2" water
	36	0.0				Bare ground
	37	5.0			✓	*Baccharis* sp., Bermuda
	38	0.0				Bare ground
	39	4.0		✓	✓	*Baccharis* sp., Wire grass
	40	0.0				Bare ground
	41	3.0		✓	✓	
	42					Out of bounds
	43					Out of bounds
	44					Out of bounds
	45	0.0				Bare ground
	46	5.0				Wire grass
	47	4.0	✓		✓	Wax myrtle
	48	4.0		✓	✓	2" water
	49	0.0				Bare ground
	50	0.0				Bare ground

Frequency/Percentage of			
Plots with Desired Species		56.8%	
Sum Scale Value		116.0	
Total # of Plots Counted		44	
Vegetative Cover (Scale Value)		2.64	

Site Notes: Marsh area has grasses present through portions of the site, and coverage is increasing in these areas.

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 2001 vegetation monitoring of the planted area revealed an average density of 613 shrubs per acre, which is well above the minimum requirement of 320 shrubs per acre. The marsh elder and false willow shrubs are spreading by natural propagation throughout the shrub area.

3.4B Conclusions (Marsh Grass Area)

- Percent Frequency of Target Species (Black needle rush and Smooth Cordgrass)
  Frequency of 70% required. **55.3%**

- Vegetative Cover Scale Value **2.6**
  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 50 random plots established throughout the planting area and located using GPS. The vegetative coverage and frequency do not meet the success criteria. NCDOT will regrade portions of the site in 2002. The marsh portion of the site will be replanted once this work has been done. The target date for this replanting is April-May 2002.

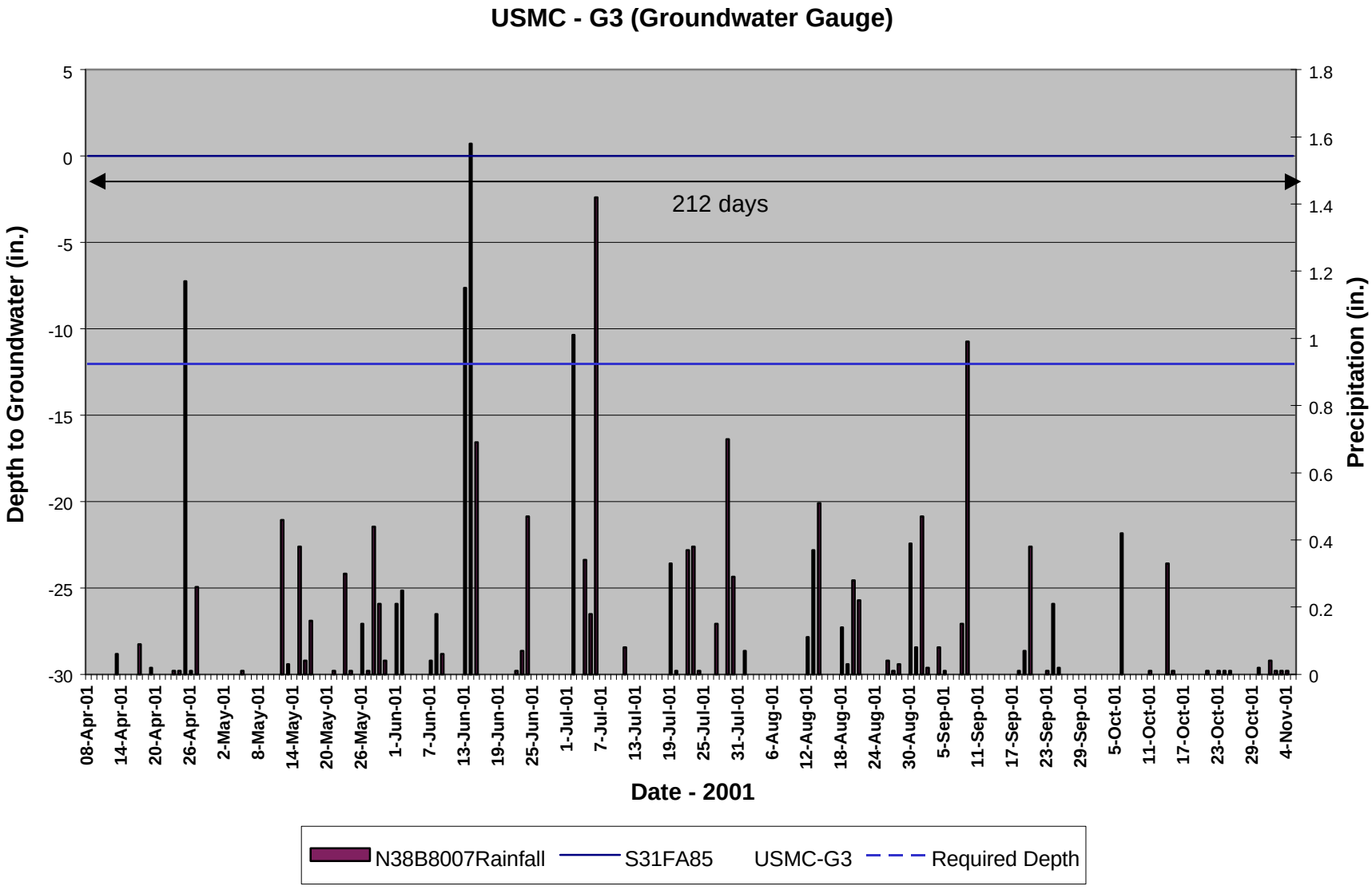
4.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

Hydrologic monitoring indicates that the site has not met the overall success criteria during the 2001 monitoring year. Although the surface water gauges show inundation, the lack of vegetation and the tidal gauge data all confirm that the site is not being flooded twice daily as required. The groundwater gauges in the shrub area were all successful.

Vegetation monitoring of the shrub area revealed an average density of 613 shrubs per acre, well above the minimum requirement. Vegetation monitoring yielded results below the success criteria in the marsh grass planting transects. The main vegetation success has been in the lowest elevation zone of the central canal.

Based on the monitoring results from the 2001 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 2001-2002 and the site will be replanted in the spring of 2002. All surface water gauges will be replaced with Infinity gauges.

APPENDIX A
DEPTH TO GROUNDWATER GRAPHS


USMC - G3 (Groundwater Gauge)
212 days
Depth to Groundwater (in.)
Precipitation (in.)
Date - 2001
5
0
-5
-10
-15
-20
-25
-30
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
08-Apr-01
14-Apr-01
20-Apr-01
26-Apr-01
2-May-01
8-May-01
14-May-01
20-May-01
26-May-01
1-Jun-01
7-Jun-01
13-Jun-01
19-Jun-01
25-Jun-01
1-Jul-01
7-Jul-01
13-Jul-01
19-Jul-01
25-Jul-01
31-Jul-01
6-Aug-01
12-Aug-01
18-Aug-01
24-Aug-01
30-Aug-01
5-Sep-01
11-Sep-01
17-Sep-01
23-Sep-01
29-Sep-01
5-Oct-01
11-Oct-01
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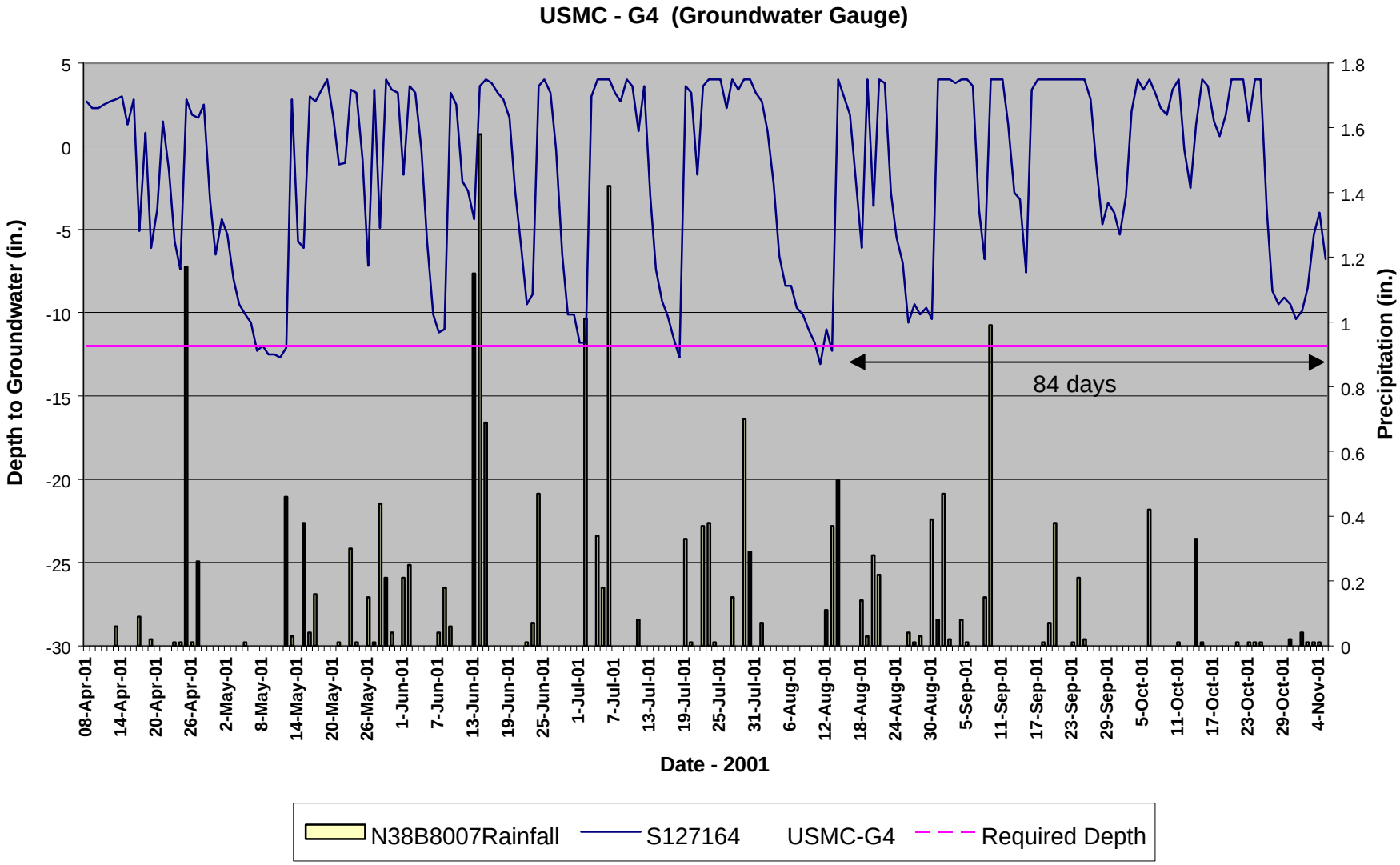
23-Oct-01
29-Oct-01
4-Nov-01
N38B8007Rainfall
S31FA85
USMC-G3
Required Depth


USMC - G4 (Groundwater Gauge)
Depth to Groundwater (in.)
Precipitation (in.)
Date - 2001
84 days
5
0
-5
-10
-15
-20
-25
-30
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
08-Apr-01
14-Apr-01
20-Apr-01
26-Apr-01
2-May-01
8-May-01
14-May-01
20-May-01
26-May-01
1-Jun-01
7-Jun-01
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19-Jun-01
25-Jun-01
1-Jul-01
7-Jul-01
13-Jul-01
19-Jul-01
25-Jul-01
31-Jul-01
6-Aug-01
12-Aug-01
18-Aug-01
24-Aug-01
30-Aug-01
5-Sep-01
11-Sep-01
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5-Oct-01
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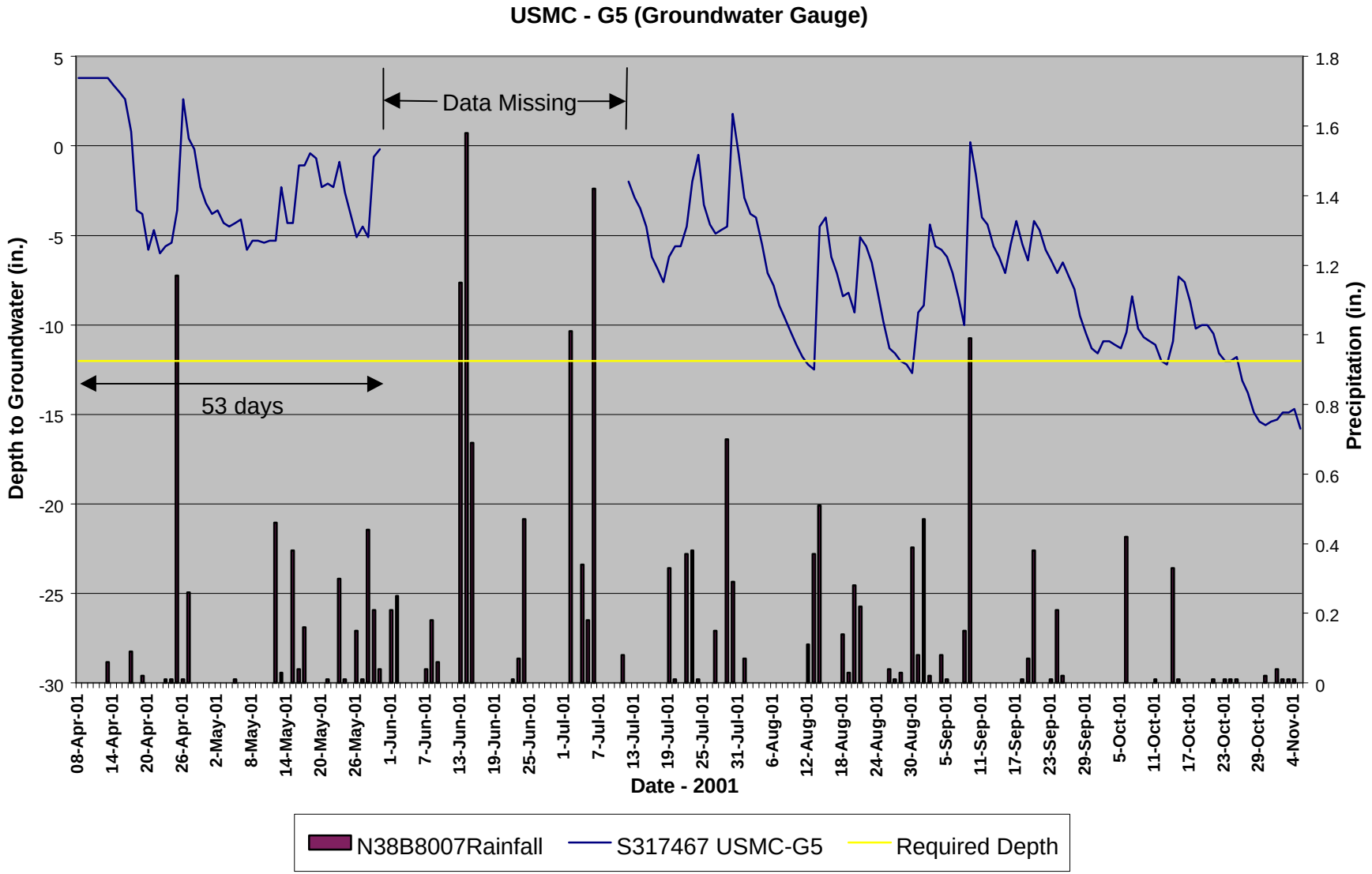
N38B8007Rainfall
S127164
USMC-G4
Required Depth


USMC - G5 (Groundwater Gauge)
Data Missing
53 days
Depth to Groundwater (in.)
Precipitation (in.)
Date - 2001
5
0
-5
-10
-15
-20
-25
-30
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
08-Apr-01
14-Apr-01
20-Apr-01
26-Apr-01
2-May-01
8-May-01
14-May-01
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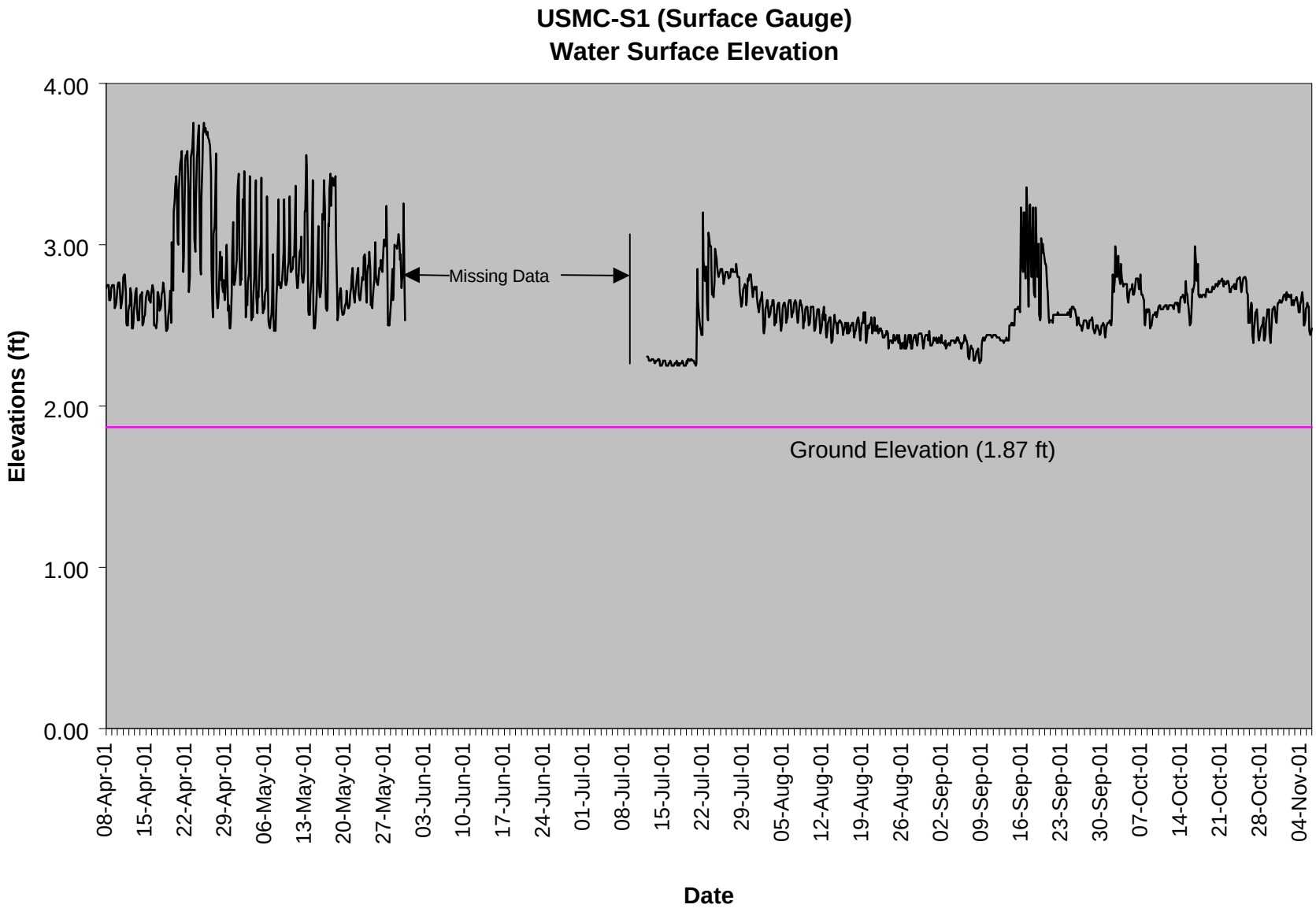
S317467 USMC-G5
Required Depth


USMC-S1 (Surface Gauge)
Water Surface Elevation
Elevations (ft)
4.00
3.00
2.00
1.00
0.00
Missing Data
Ground Elevation (1.87 ft)
08-Apr-01
15-Apr-01
22-Apr-01
29-Apr-01
06-May-01
13-May-01
20-May-01
27-May-01
03-Jun-01
10-Jun-01
17-Jun-01
24-Jun-01
01-Jul-01
08-Jul-01
15-Jul-01
22-Jul-01
29-Jul-01
05-Aug-01
12-Aug-01
19-Aug-01
26-Aug-01
02-Sep-01
09-Sep-01
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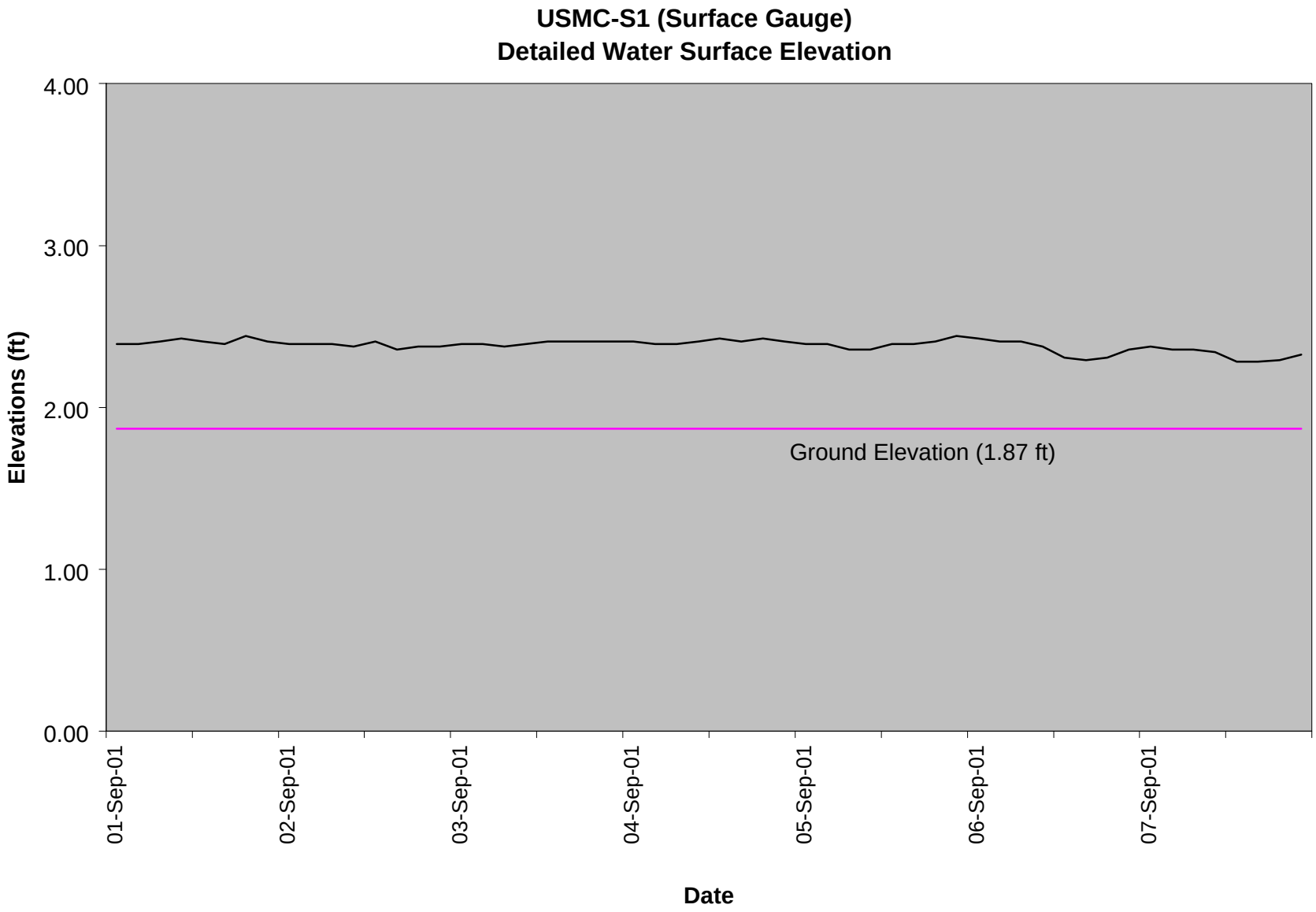
30-Sep-01
07-Oct-01
14-Oct-01
21-Oct-01
28-Oct-01
04-Nov-01
Date


USMC-S1 (Surface Gauge)
Detailed Water Surface Elevation
Elevations (ft)
4.00
3.00
2.00
1.00
0.00
Ground Elevation (1.87 ft)
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02-Sep-01
03-Sep-01
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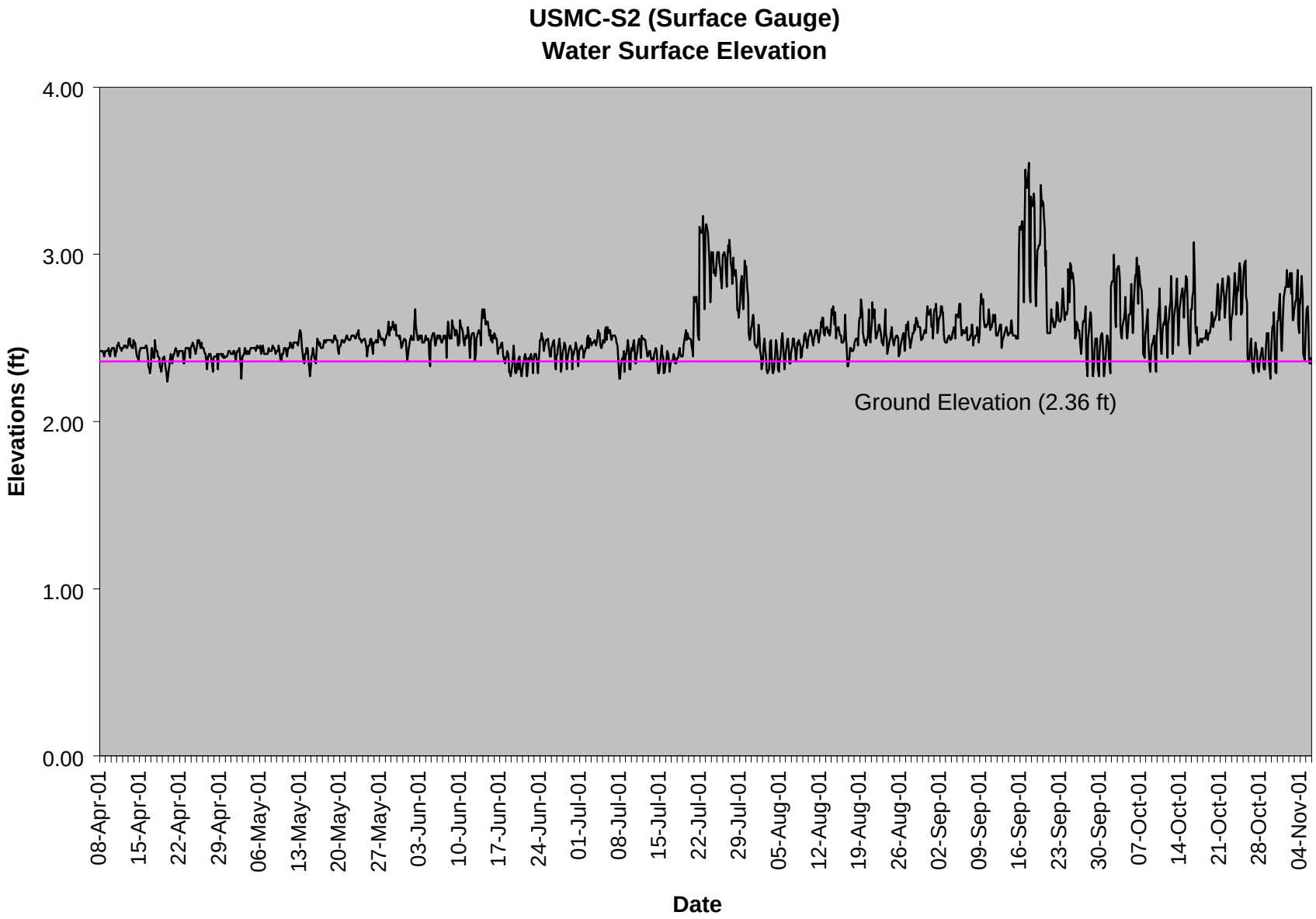
06-Sep-01
07-Sep-01
Date


USMC-S2 (Surface Gauge)
Water Surface Elevation
Elevations (ft)
4.00
3.00
2.00
1.00
0.00
Ground Elevation (2.36 ft)
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15-Apr-01
22-Apr-01
29-Apr-01
06-May-01
13-May-01
20-May-01
27-May-01
03-Jun-01
10-Jun-01
17-Jun-01
24-Jun-01
01-Jul-01
08-Jul-01
15-Jul-01
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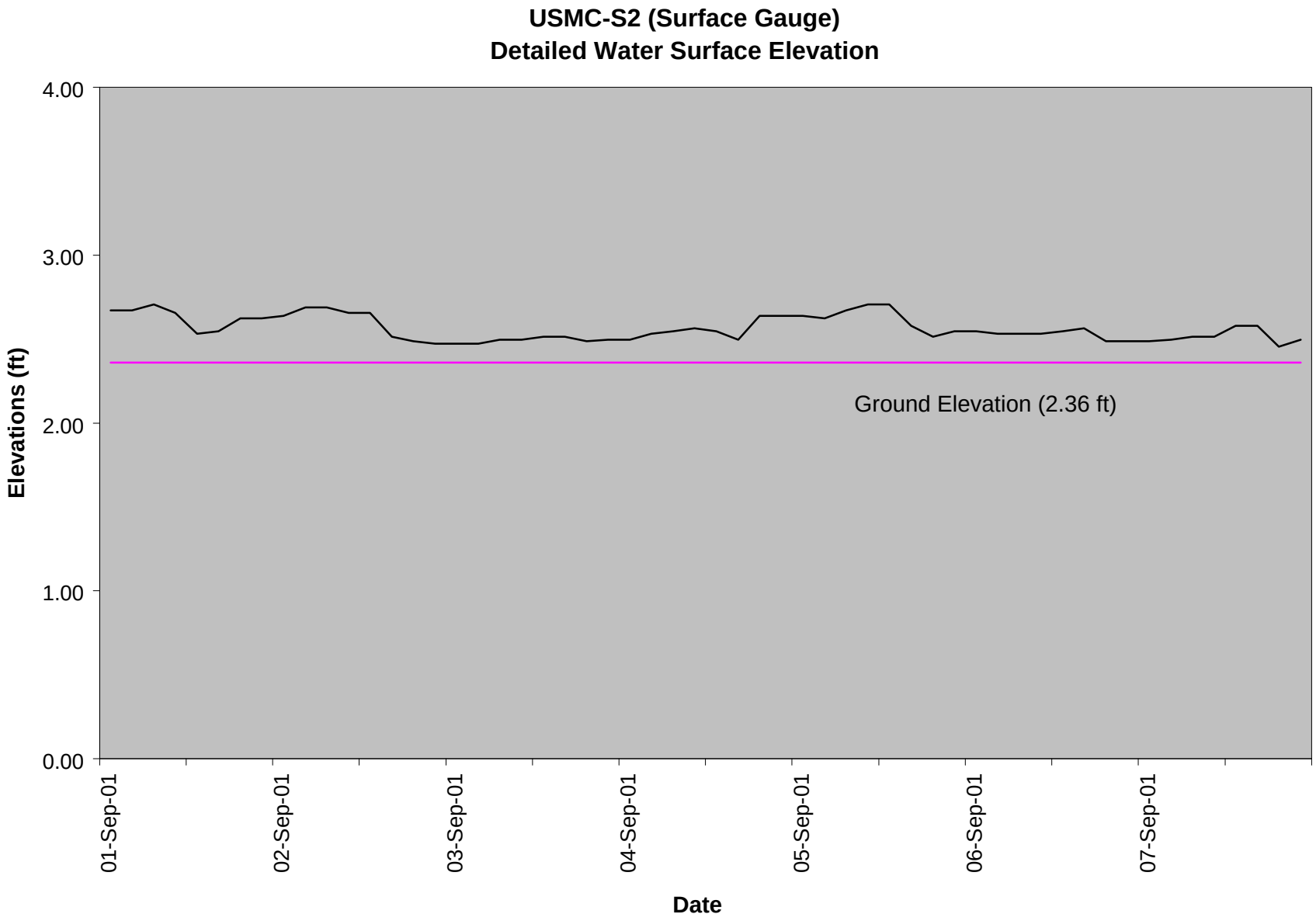
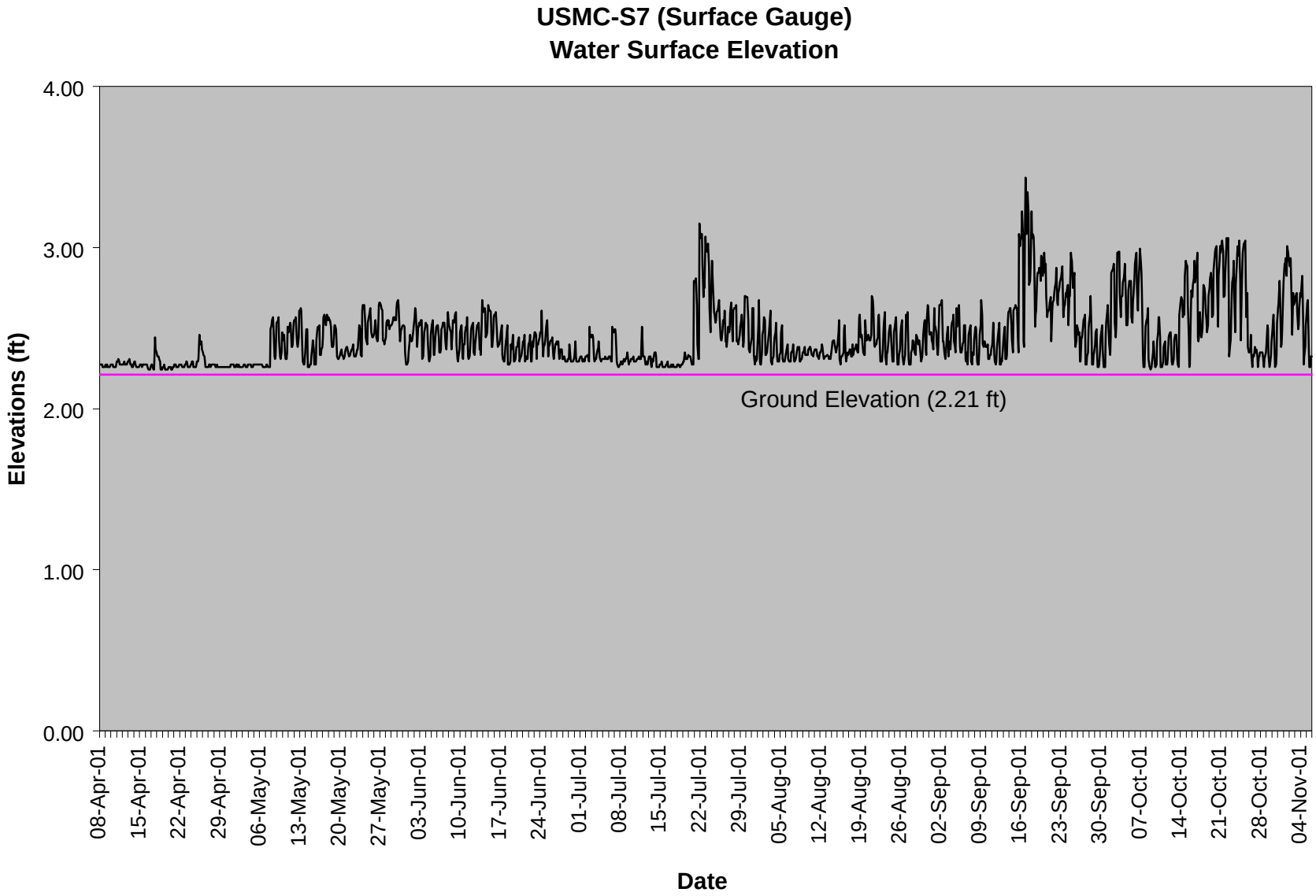
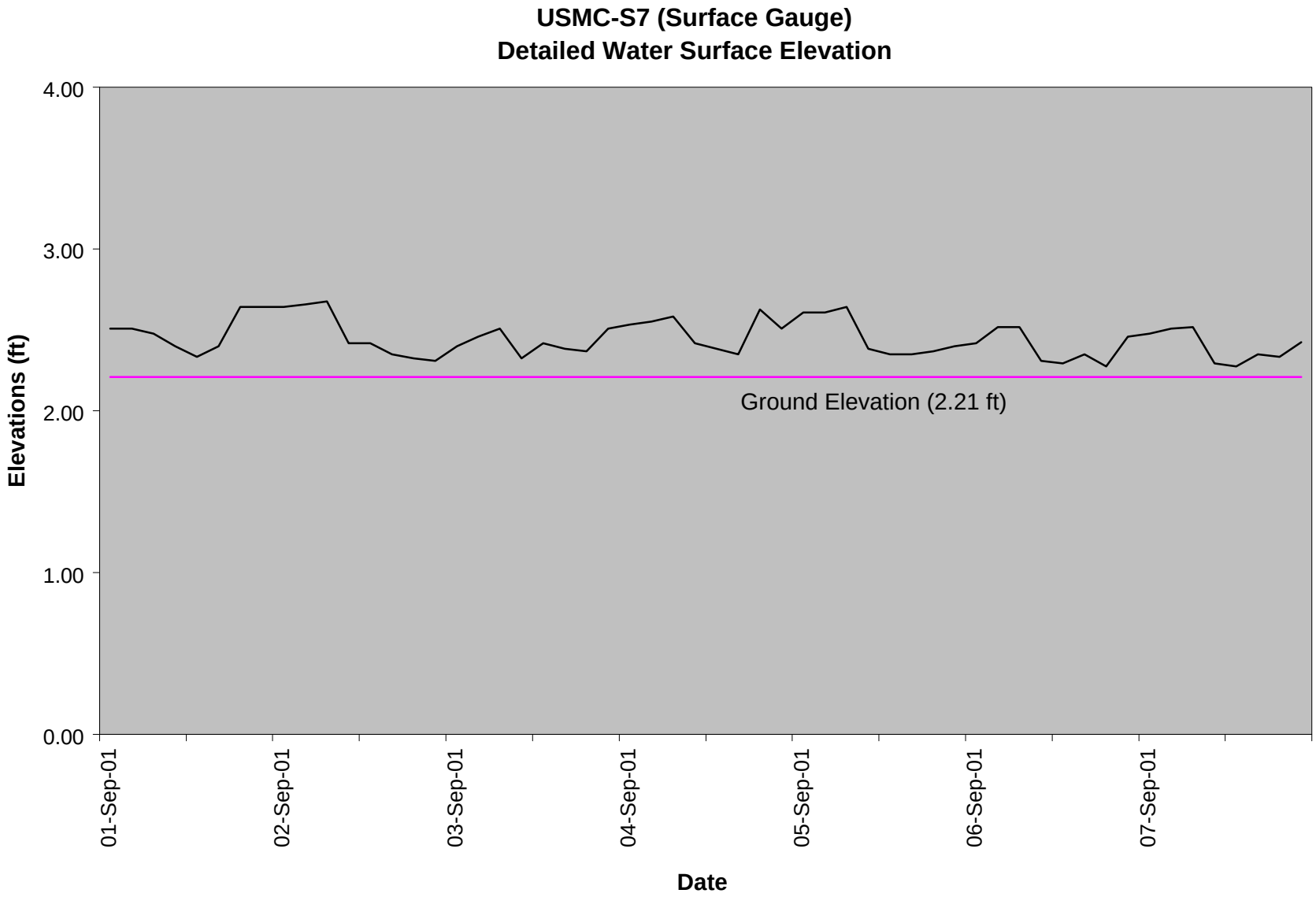
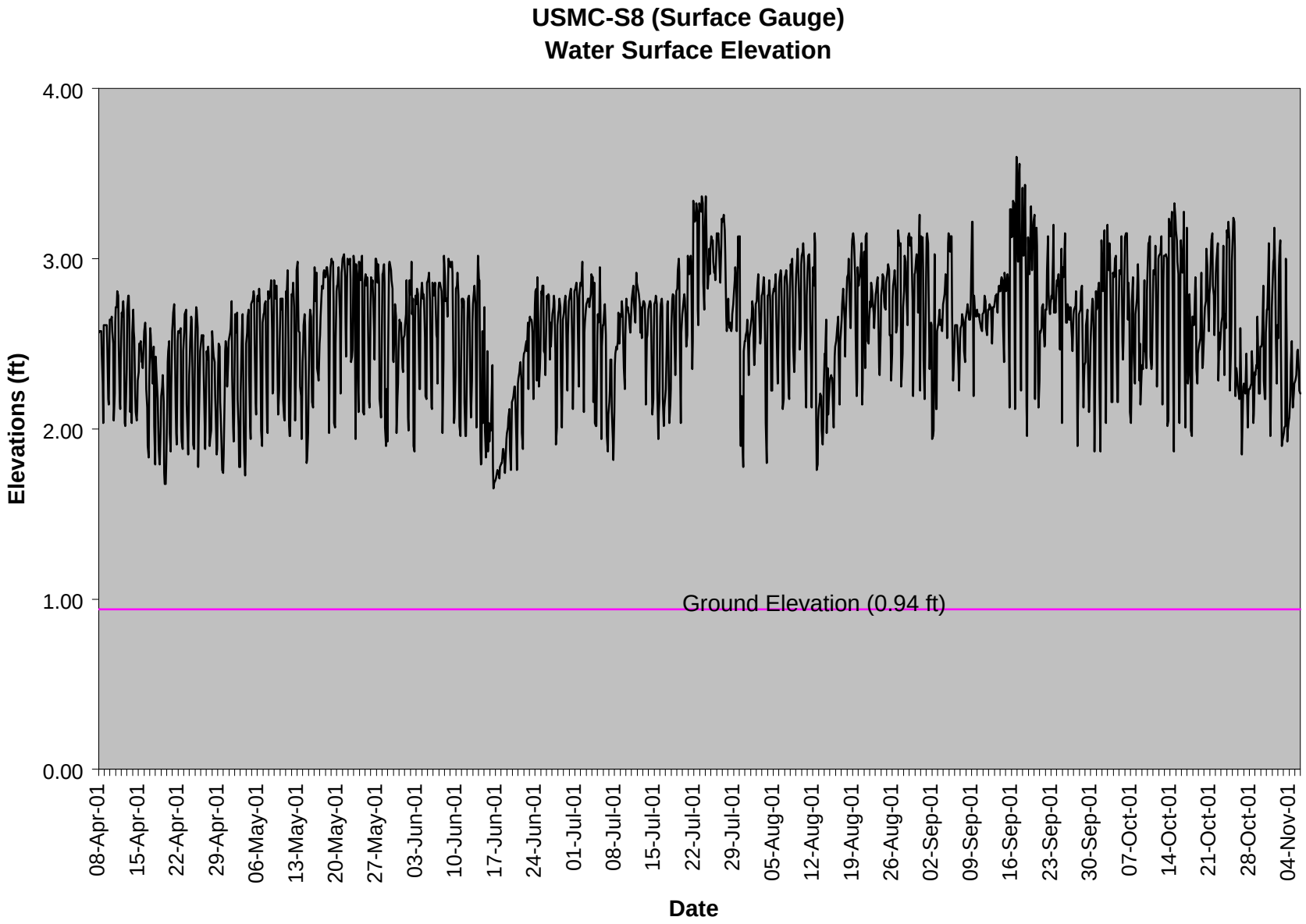
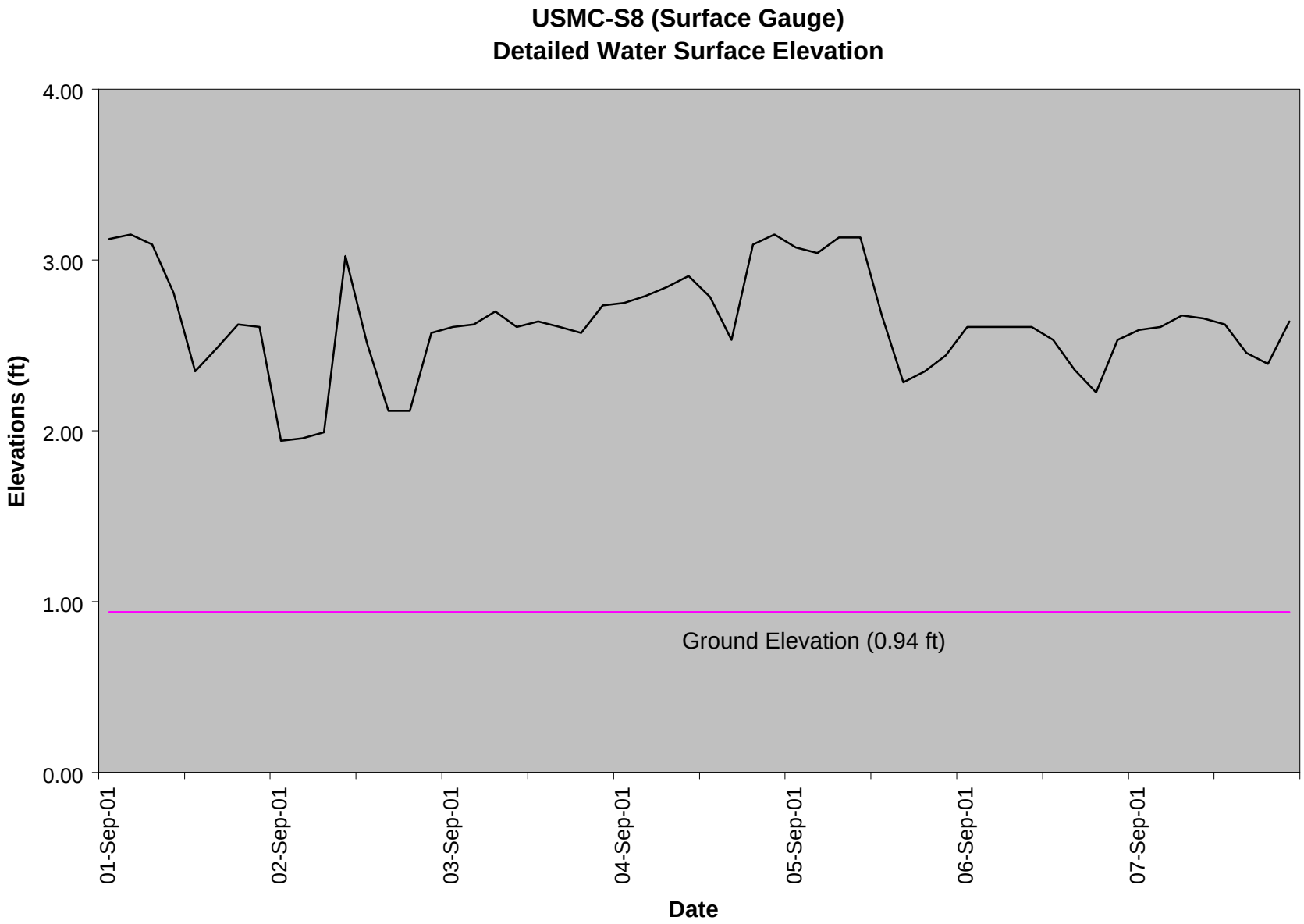
28-Oct-01
04-Nov-01
Date

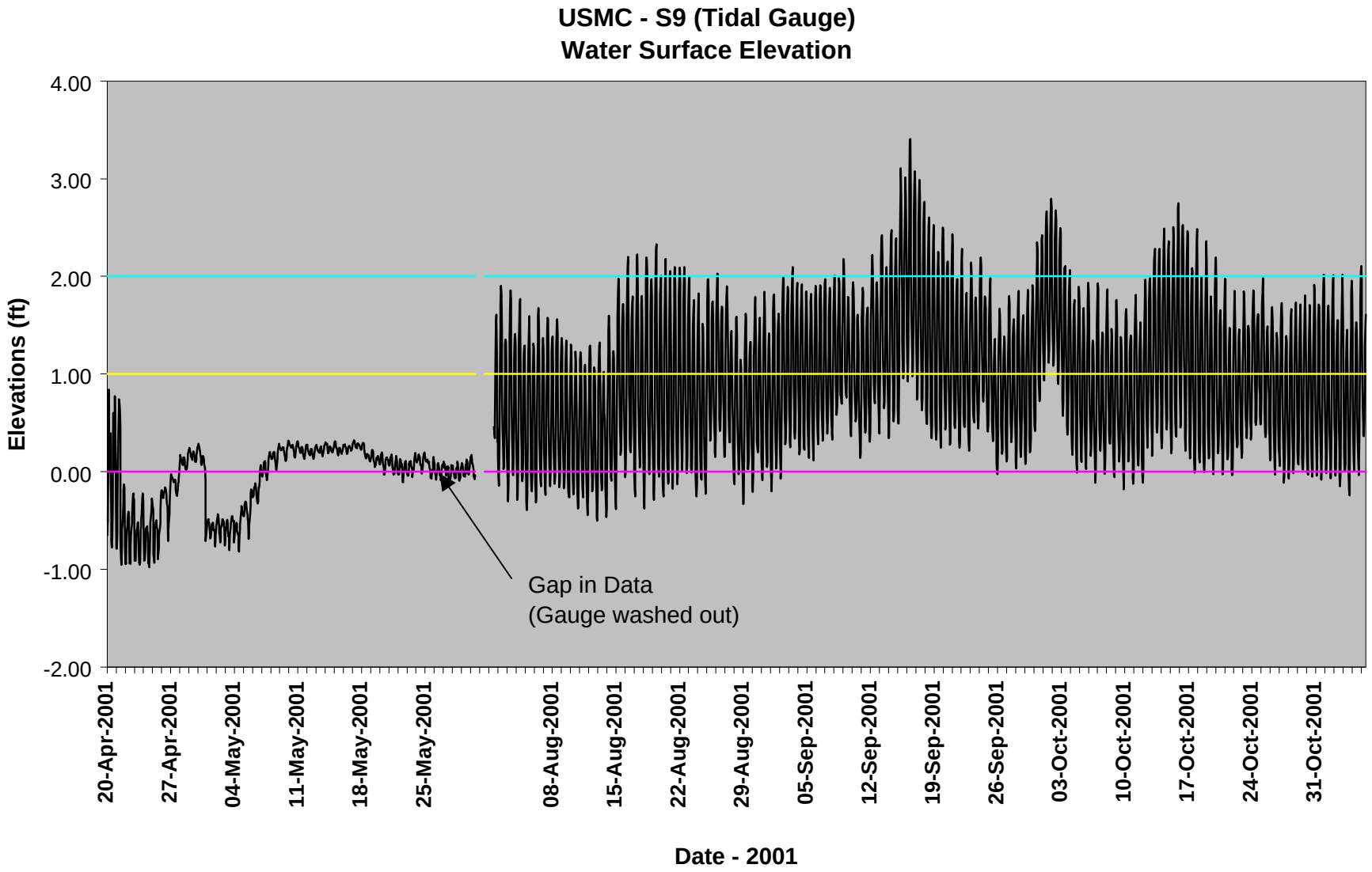

USMC-S2 (Surface Gauge)
Detailed Water Surface Elevation
4.00
3.00
2.00
1.00
0.00
Elevations (ft)
Ground Elevation (2.36 ft)
01-Sep-01
02-Sep-01
03-Sep-01
04-Sep-01
05-Sep-01
06-Sep-01
07-Sep-01
Date


USMC-S7 (Surface Gauge)
Water Surface Elevation
Elevations (ft)
4.00
3.00
2.00
1.00
0.00
Ground Elevation (2.21 ft)
08-Apr-01
15-Apr-01
22-Apr-01
29-Apr-01
06-May-01
13-May-01
20-May-01
27-May-01
03-Jun-01
10-Jun-01
17-Jun-01
24-Jun-01
01-Jul-01
08-Jul-01
15-Jul-01
22-Jul-01
29-Jul-01
05-Aug-01
12-Aug-01
19-Aug-01
26-Aug-01
02-Sep-01
09-Sep-01
16-Sep-01
23-Sep-01
30-Sep-01
07-Oct-01
14-Oct-01
21-Oct-01
28-Oct-01
04-Nov-01
Date

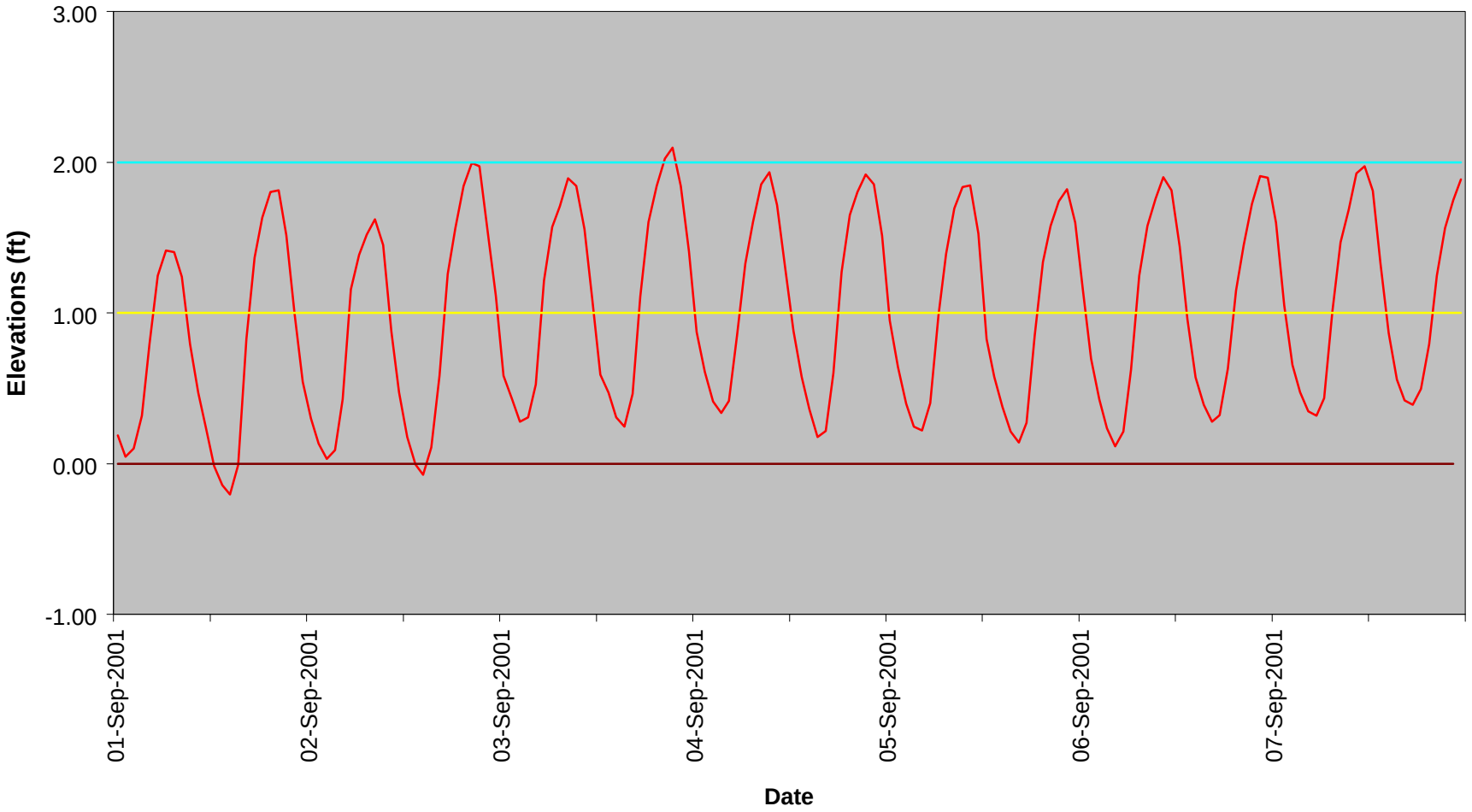

USMC-S7 (Surface Gauge)
Detailed Water Surface Elevation
4.00
3.00
2.00
1.00
0.00
Elevations (ft)
Ground Elevation (2.21 ft)
01-Sep-01
02-Sep-01
03-Sep-01
04-Sep-01
05-Sep-01
06-Sep-01
07-Sep-01
Date


USMC-S8 (Surface Gauge)
Water Surface Elevation
Elevations (ft)
4.00
3.00
2.00
1.00
0.00
Ground Elevation (0.94 ft)
08-Apr-01
15-Apr-01
22-Apr-01
29-Apr-01
06-May-01
13-May-01
20-May-01
27-May-01
03-Jun-01
10-Jun-01
17-Jun-01
24-Jun-01
01-Jul-01
08-Jul-01
15-Jul-01
22-Jul-01
29-Jul-01
05-Aug-01
12-Aug-01
19-Aug-01
26-Aug-01
02-Sep-01
09-Sep-01
16-Sep-01
23-Sep-01
30-Sep-01
07-Oct-01
14-Oct-01
21-Oct-01
28-Oct-01
04-Nov-01
Date


USMC-S8 (Surface Gauge)
Detailed Water Surface Elevation
Elevations (ft)
4.00
3.00
2.00
1.00
0.00
Ground Elevation (0.94 ft)
01-Sep-01
02-Sep-01
03-Sep-01
04-Sep-01
05-Sep-01
06-Sep-01
07-Sep-01
Date


USMC - S9 (Tidal Gauge)
Water Surface Elevation
Elevations (ft)
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
Gap in Data
(Gauge washed out)
20-Apr-2001
27-Apr-2001
04-May-2001
11-May-2001
18-May-2001
25-May-2001
08-Aug-2001
15-Aug-2001
22-Aug-2001
29-Aug-2001
05-Sep-2001
12-Sep-2001
19-Sep-2001
26-Sep-2001
03-Oct-2001
10-Oct-2001
17-Oct-2001
24-Oct-2001
31-Oct-2001
Date - 2001

USMC-S9 - Detailed (Tidal Gauge)
Water Surface Elevation



APPENDIX B
SITE PHOTOS

USMC

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

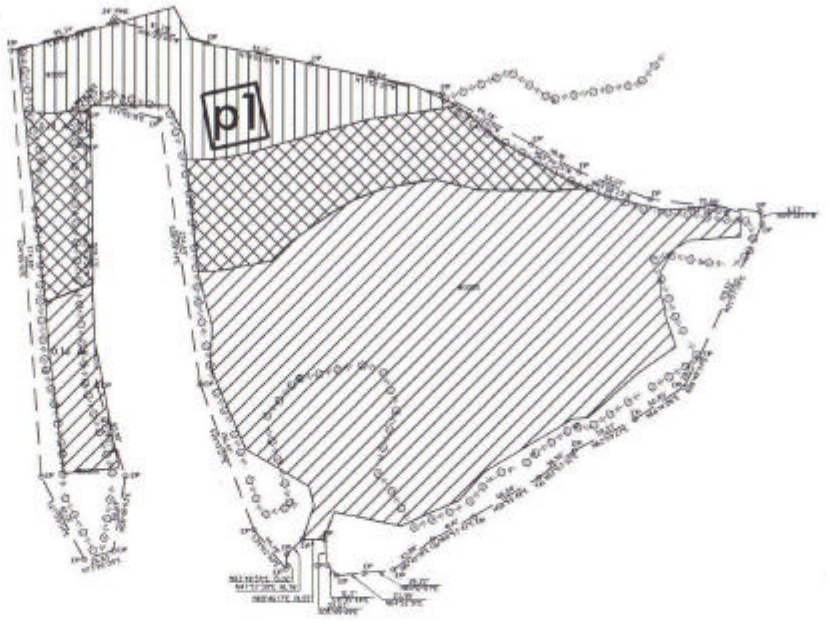
USMC

Photo 7

Photo 8

APPENDIX C
VEGETATION PLANTING PLAN

USMC Marsh/Shrub Site
Onslow County, U–2107 WM
PLANTING PLAN



NC GRID
NAD 83

LEGEND

- Wax Myrtle, False Willow, Marsh Elder
- Blackneedle Rush
- Smooth Cordgrass
- Vegetation Monitoring Plot (50 ft. X 50 ft.)

USMC Marsh/Shrub Site
Onslow County, U-2107 WM
2001 Monitoring

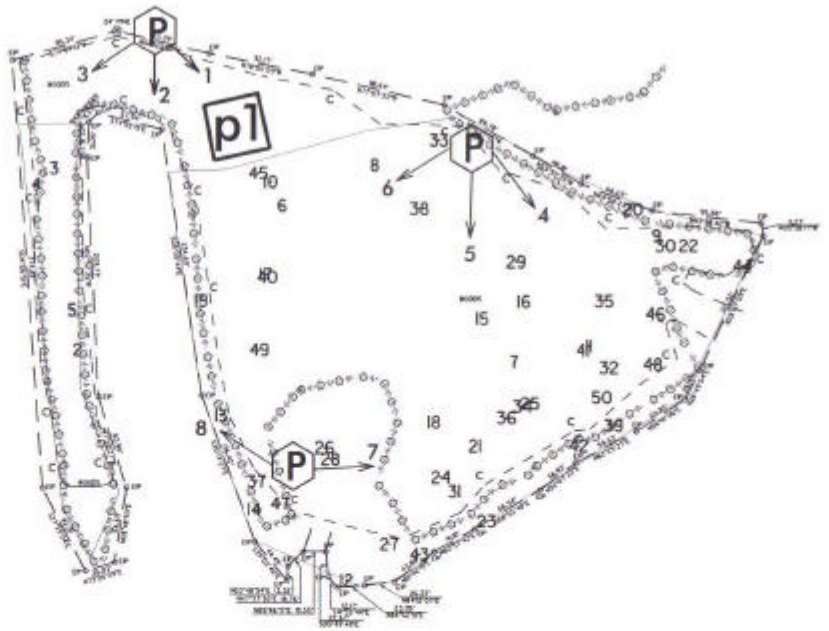


PHOTO AND VEGETATION PLOT LOCATIONS

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