

ANNUAL REPORT FOR 2001



Mashoes Road Mitigation Site

Dare County

Project No. 8.T051402

TIP No. R-2551WM



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MASHOES ROAD MITIGATION SITE 2001 REPORT – EXECUTIVE SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Mashoes Road Mitigation Site. Construction began on this site in 1998. The west side of Mashoes Road was completed in early 1999 and was planted with trees; this area was replanted in the Winter of 2000-01. The east side of Mashoes Road was completed in the fall of 1999 but was not planted due to *Phragmites* control. The site was planted with marsh grass in the spring of 2001. Monitoring activities in 2001 represent the first year of monitoring at the mitigation site. The site must demonstrate hydrologic and vegetation success for a minimum of five years or until the project is deemed successful.

The site contains nine groundwater monitoring gauges on the west side, ten surface gauges on the east side and one rain gauge. On the east side, there are a total of 167 random vegetation plots, while the west side has five permanent vegetation plots.

This year, rainfall data has been acquired primarily from an onsite gauge. Also, daily rainfall was used for comparison from the Manteo Airport, maintained by the NC State Climate Office.

Hydrologic monitoring indicated that the site is continuing toward success. Under normal conditions for 2001, all nine of the groundwater gauges met the jurisdictional hydrologic success for at least 12.5% of the growing season. All ten of the surface gauges showed steady tidal influence that maintained a water elevation above zero under normal conditions for at least 25% of the growing season.

Vegetation monitoring on the west side of the restoration area yielded 649 trees per acre, above the 320 tree requirement. On the east side, a frequency of 46.4% for the targeted vegetative species was found. A frequency of 70% is required. A vegetative scale value of 3.2 was recorded. A scale value of 5 is required by year 5.

Based on the monitoring results for this growing season, NCDOT proposes to continue hydrologic and vegetation monitoring.

1.0 INTRODUCTION

1.1 Project Description

The Mashoes Road Wetland Mitigation Site is located north of Manns Harbor in Dare County (Figure 1). It is bounded by US 64-264 to the south, the Alligator River National Wildlife Refuge to the west, the Croatan Sound to the east, and is bisected into east/west by SR 1113 (Mashoes Road).

A significant portion of the site (254 acres) was classified as a coastal marsh and fell under the jurisdiction of the N.C. Division of Coastal Management. Another portion (107 acres) was classified as forested wetlands. The remainder of the site was comprised of a 15-acre pond, borrow pits and cleared uplands from a sand mining operation, and some forested uplands.

The site encompasses approximately 399 acres and is designed as a mitigation site primarily for the new Croatan Sound Bridge between Manns Harbor and Manteo , TIP Projects R-2551 and K-4003 (USACE Action ID No. 199502334).

1.2 Purpose

In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for a minimum of five years or until success criteria are fulfilled. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrologic conditions and vegetation survival. The following report details the results of hydrologic and vegetative monitoring during 2001 at the Mashoes Road Mitigation Site.

Activities in 2001 reflect the first year of monitoring at the mitigation site. 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

Winter 1999	West Side Construction Complete
Spring 1999	Wetland Trees Planted (West Side)
Spring 1999	East Side Construction Complete
March 1999	Monitoring Gauges Installed (Entire Site)
March – November 1999	Hydrologic Monitoring (Entire Site, Year 1)
October 1999	Vegetation Monitoring (West Side, Year 1)
March – November 2000	Hydrologic Monitoring (Entire Site, Year 2)
October 2000	Vegetation Monitoring (West Side, Year 2)
March – November 2001	Hydrologic Monitoring (Entire Site, Restart Year 1)
April 2001	<i>Phragmites</i> Treated
May 2001	Marsh Grasses Planted
August 2001	Tree Vegetation Monitoring (Restart Year 1)
August 2001	Marsh Vegetation Monitoring (Year 1)

1.4 Debit Ledger

Because of its size, Mashoes Road will provide mitigation for several highway projects. Table 1 shows the projects that this site is providing mitigation for through November 2001.

Table 1
Mashoes Road Debit Ledger

Habitat	Acres at Start	Acres Remaining	TIP Debit R-2551	TIP Debit K-4003
SVM Restoration	13.1	0	13.1	0
Forest Wetlands Restoration	8	0	8	0
SVM Preservation	253.86	130.96	122.9	0
Forest Wetland Preservation	106.88	29.32	76.2	1.36
Open Water	15.53	15.53	0	0
Upland Hummocks	1.48	1.48	0	0
Total:	398.85	177.29	220.2	1.36

1.5 Permit Requirements

The Mashoes Road Mitigation Site was constructed primarily to compensate for impacts to TIP Project R-2551 (USACE Action ID No. 199502334). Permit commitments stated that *Phragmites australis* would be totally controlled in the marsh area.

The permit was modified in 2000, which allowed for marsh planting to be extended to the spring of 2001. This gave NCDOT additional time to further treat for phragmites.

The site was treated for *Phragmites* in 2000. The planting of marsh grass at the site was completed in spring 2001.

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 in the forested wetland (west side) states that the area must be inundated or saturated (within 12 inches of the surface) by surface or ground water for at least 12.5% of the growing season. Areas inundated less than 5% of the growing season are always classified as non-wetlands. Areas inundated between 5% - 12.5% of the growing season can be classified as wetlands depending upon other factors, such as the presence of hydrophytic vegetation and hydric soils.

In the coastal marsh wetland (east side), success criteria include saturation or inundation within 12 inches of the surface for at least 25% of the growing season, or statistically the same as the reference ecosystem.

The growing season in Dare County begins March 13 and ends November 25. The dates correspond to a 50% probability that temperatures will drop to 28° F or lower after March 13 and before November 25.¹ The growing season is 258 days; therefore the optimum duration for wetland hydrology is 32 days. Also, local climate must represent average conditions for the area.

2.2 Hydrologic Description

Historically, the wetlands on this tract were part of the coastal marsh of the surrounding area. The primary sources of hydrology are tidal flushing of the system and groundwater. After an extensive study of the site's hydrology, it was concluded that filling of the ponds, and grading down of the upland areas would elevate soils to a level that would saturate the soil stratum within the required twelve inches or even flood the area during high tides. It was predicted that this would be sufficient to restore wetland hydrology.

Six groundwater monitoring gauges, eight surface gauges, and one rain gauge were installed in 1999 (Figure 2). Three more groundwater monitoring gauges were installed during 2001 to evaluate potential drainage by the side canal. Also, two additional surface gauges were added to the coastal marsh wetland area. The rain gauges and monitoring gauges recorded daily readings of rainfall and depth to groundwater, respectively. The surface gauges record tidal conditions eight times daily; however, only one representative reading was used for graphing and statistical purposes in this report.

¹ Natural Resources Conservation Service, Soil Survey of Dare County, North Carolina, p.69.

This year, rainfall data has been primarily from an onsite gauge. Also, daily rainfall was used for comparison from the Manteo Airport, maintained by the NC State Climate Office.

**MASHOES ROAD MITIGATION SITE
DARE COUNTY**

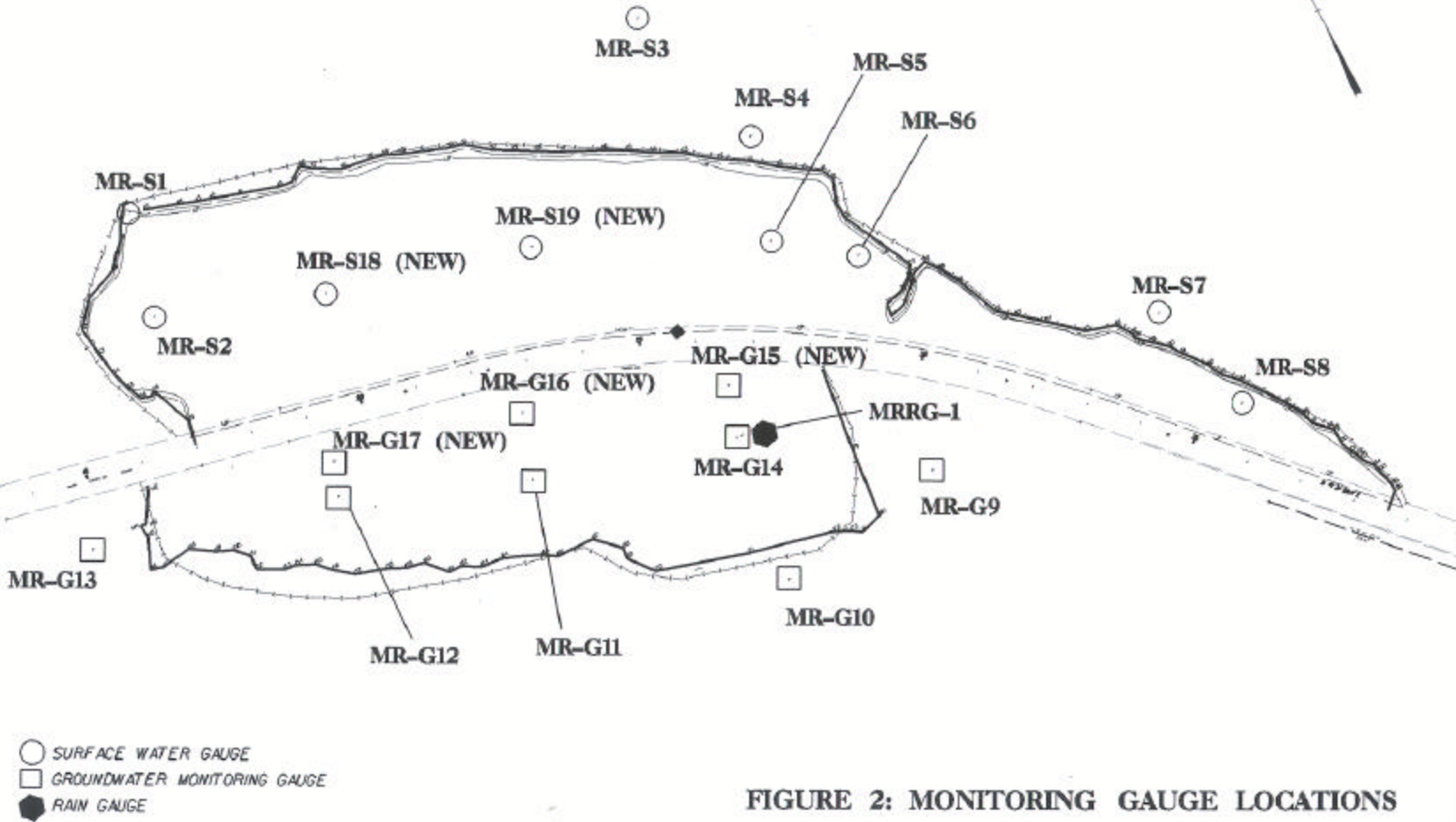


FIGURE 2: MONITORING GAUGE LOCATIONS

2.3 Results of Hydrologic Monitoring

2.3.1 Site Data

For groundwater monitoring gauges on the west side of the mitigation site, the maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each gauge. For surface gauges, the ground surface was used (elevation zero) to give a better representation that the east side of Mashoes Road was receiving daily tidal flooding. This number was converted into a percentage of the 256-day growing season. Table 2 presents the 2001 results. In the table, "MR" refers to Mashoes Road Mitigation Site, "S" refers to surface gauges, and "G" refers to groundwater gauges. Reference gauges and new gauges are indicated.

In order to meet the success criteria for hydrology, the surface water gauges needed to show groundwater levels within 12 inches of the surface for at least 25% of the growing season. Since the criteria in the mitigation plan were unclear whether hydrology should be met in consecutive days or total days, the table shows both sets of data.

Appendix A contains a plot of the groundwater depth for each monitoring gauge. The maximum number of consecutive days that the gauge met success above this 12-inch depth is noted on each graph. Data determined to be erroneous was omitted; therefore, some gaps appear in the plots.

Precipitation events are included on each graph as bars.

Table 2
2001 HYDROLOGIC MONITORING RESULTS
(MARCH 13 – NOVEMBER 25)

Monitoring Gauge	< 5% (<13 dy)	5 - 8% (13-20 dy)	8 – 12.5% (21-32 dy)	> 12.5% (>32 dy)	Actual Consecutive %	Actual Cumulative %	Dates Meeting Success
MR-S1 (ref)				✓	20.9%	79.8%	3/13-5/5
MR-S2				✓	76.7%	94.1%	5/12-11/25
MR-S3 (ref)				✓	100%	100%	3/13-11/25
MR-S4 (ref)				✓	100%	100%	3/13-11/25
MR-S5				✓	14.7%	64.7%	5/29-7/5, 7/29-9/2 (both 38 days)
MR-S6				✓	100%	100%	3/13-11/25
MR-S7 (ref)				✓	100%	100%	3/13-11/25
MR-S8				✓	100%	100%	3/13-11/25
MR-G9 (ref)				✓	48.4%	--	3/13-7/15
MR-G10 (ref)				✓	100%	--	3/13-11/25
MR-G11				✓	21.3%	--	3/13-5/6
MR-G12				✓	100%	--	3/13-4/28
MR-G13 (ref)				✓	63.6%	--	3/13-8/23
MR-G14				✓	22.0%	--	5/12-7/7
MR-G15				✓	13.6%	--	7/30-9/2
MR-G16				✓	14.3%	--	7/26-9/4
MR-G17				✓	18.2%	--	7/24-9/14
MS-S18				✓	99.2%	--	3/28-11/25
MS-S19				✓	99.2%	--	3/28-9/21

Notes: "MR" denotes Mashoes Road site gauges.

"S" denotes surface gauges.

"G" denotes groundwater gauges.

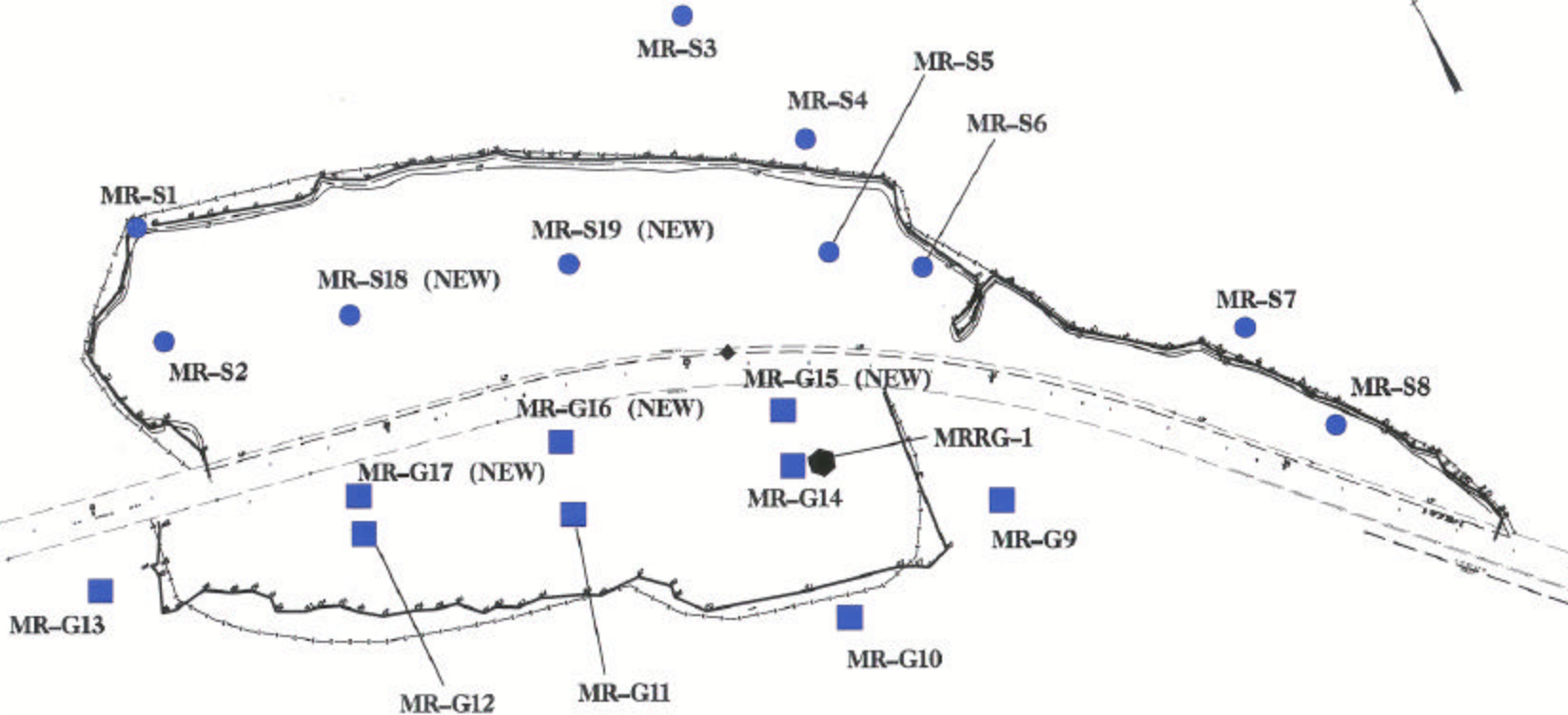
"ref" denotes gauges in reference wetlands.

Figure 3 is a graphical representation of the hydrologic monitoring results for this year. A blue dot (or square) represents wetland hydrology for more than 12.5% of the season; a red dot/square indicates hydrology between 8% and 12.5%; a green dot/square represents hydrology between 5% and 8%.

For this time period from March to November, all nine groundwater gauges met the jurisdictional hydrologic success of at least 12.5% during the growing season.

It is unclear whether the surface gauge criteria should be met in consecutive days or total days, so the table shows both sets of data. When considering the total consecutive days, eight of the ten surface gauges recorded that flooding occurred at least 25% of the growing season. However, if the cumulative days are considered, all ten gauges met the hydrologic requirements.

**MASHOES ROAD MITIGATION SITE
DARE COUNTY**



- | | |
|--|---|
| < 5% HYDROLOGY (GROUNDWATER) | SURFACE WATER GAUGE |
| 5% - 8% HYDROLOGY (GROUNDWATER) | GROUNDWATER MONITORING GAUGE |
| 8% - 12.5% HYDROLOGY (GROUNDWATER) | RAIN GAUGE |
| > 12.5% HYDROLOGY (GROUNDWATER) | |
| < 25% HYDROLOGY (SURFACE) | |
| >= 25% HYDROLOGY (SURFACE) | |

FIGURE 3: 2001 HYDROLOGIC 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 2001 with that of historical rainfall (data collected between 1931 and 1999). All rainfall data was collected from the NC State Climate Office. The graph shows 2000 rainfall totals recorded at the Manteo Airport from September through December; the graphs also shows 2001 rainfall totals recorded at the Manteo Airport through July. Information from the Manteo Airport for the months of August through December was not available at this writing of this report. Rainfall data for August through December 2001 will be presented in the 2002 Annual Monitoring Report. On-site rain gauge information is also shown for the duration of the growing season (March through November).

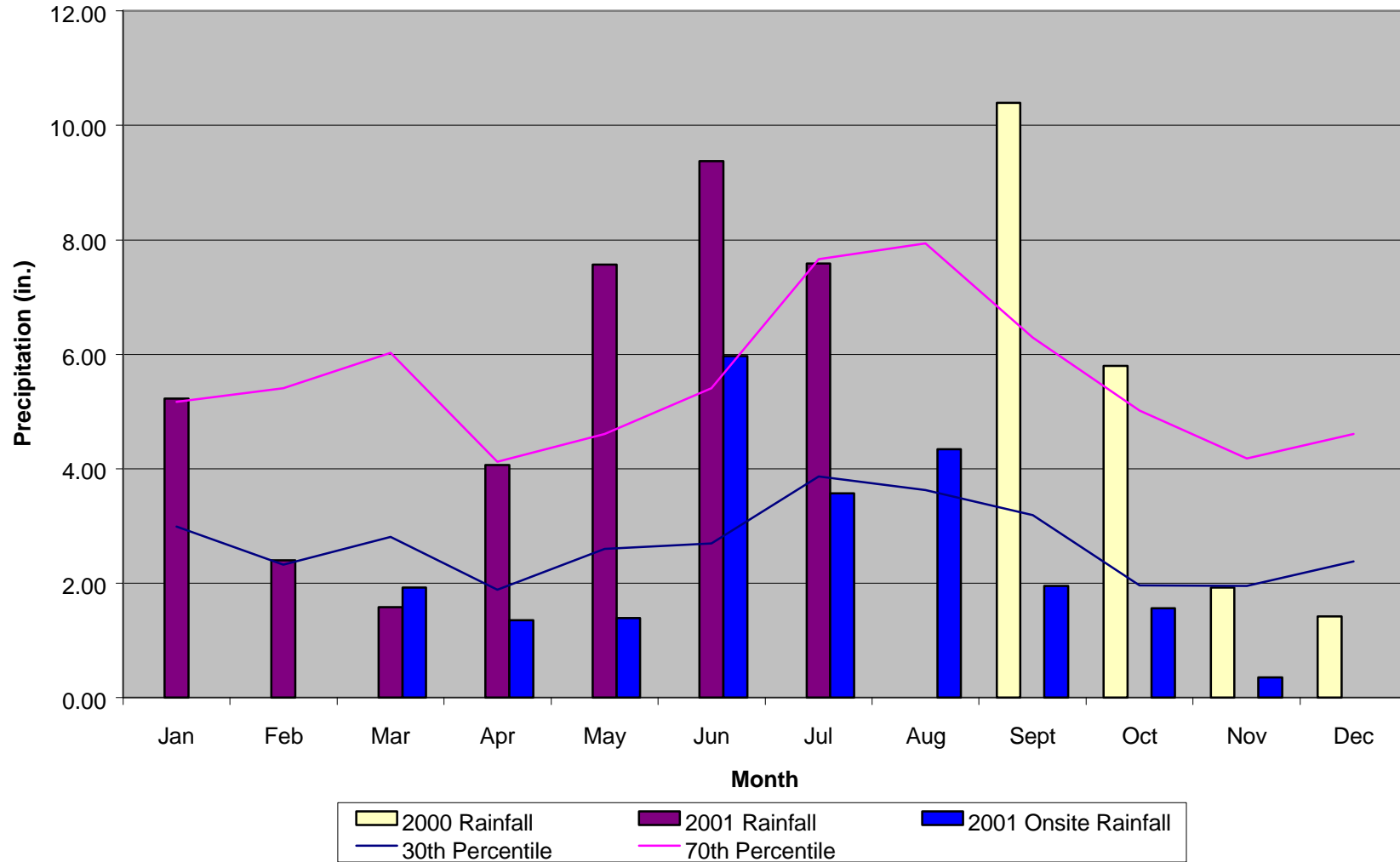
According to the on-site rain gauge, 2001 has been a dry year overall. Most readings fall below or barely within the 30th percentile. However, the rainfall data obtained from the Manteo airport shows that rainfall was average to above average for 2001. Figure 5 shows a discrepancy between monthly totals on site versus the data from the Manteo airport. For 2001, March was below normal, whereas, May and June were higher than normal. Overall so far, 2001 has been an average year in terms of precipitation.

2.4 Conclusions

2001 represents the third full growing season (but the first official season) that the hydrologic data has been examined. All nine groundwater monitoring gauges met the jurisdictional wetland hydrology for 12.5% of the growing season; when considering cumulative days, all ten surface gauges met the 25% requirement of daily flooding the site during this same period.

The overall monitoring results show that the site performed adequately from a hydrological standpoint.

**FIGURE 4: Mashoes Road 30-70 Percentile Graph
Dare County**



3.0 VEGETATION (YEAR 1 OF 5)

3.1 Success Criteria

The following section discusses the vegetative success criteria outlined in the mitigation plan for Mashoes Road mitigation site.

3.1.1 Success Criteria (Trees / West Side)

NCDOT will monitor the site for five years or until success criteria is met. 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 species will not exceed 20% of the total number of plants of all species planted.

3.1.2 Success Criteria (Marsh Grasses / East Side)

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 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.

3.2 Description of Species

The following species were planted in the Wetland Restoration Area:

Zone 1: Wetland Tree Reforestation (2.7 acres)

Taxodium distichum, Bald Cypress

Quercus phellos, Willow Oak

Nyssa sylvatica, Black Gum

Fraxinus pennsylvanica, Green Ash

Quercus nigra, Water Oak

Zone 2: Wetland Tree Reforestation (4.3 acres)

Taxodium distichum, Bald Cypress

Fraxinus pennsylvanica, Green Ash

Quercus nigra, Water Oak

Quercus phellos, Willow Oak

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

Zone 1: (approximately 11.92 acres)

Cladium jamaicense, Sawgrass

Zone 2: (approximately 0.42 acres)

Juncus roemerianus, Black Needle Rush

3.3 Results of Vegetative Monitoring

Table 3 shows the results of vegetative monitoring on the west side of Mashoes Road for the year 2001. Table 4 shows similar results for the vegetative monitoring on the east side of Mashoes Road.

Table 3

2001 VEGETATIVE MONITORING RESULTS (WEST SIDE)

ZONE	Plot #	Green Ash	Willow Oak	Bald Cypress	Blackgum	Water Oak	Total (1 yr.)	Total (at planting)	Density (trees/acre)
1	1	17	3	5	4	3	32	40	544
	2	18	7	9	4	2	40	40	680
ZONE 1 AVERAGE									612
2	3	8	1	36		4	49	49	680
	4	10	5	13		3	31	32	659
	5	5	15	10		5	35	35	680
ZONE 2 AVERAGE									673
TOTAL AVERAGE									649

Table 4
2001 VEGETATIVE MONITORING RESULTS (EAST SIDE)

ZONE	Plot #	Scale Factor	Black Needle Rush	Sawgrass	Frequency	Notes
	1	5.0		✓	✓	<i>Scirpus americanus</i> , Cattail
	2	3.0				Barnyard grass
	3	2.0		✓	✓	<i>S. americanus</i> , Barnyard grass
	4	5.0				<i>S. americanus</i> , Barnyard grass
	5	5.0		✓	✓	Barnyard grass
	6	5.0		✓	✓	Barnyard grass
	7	3.0		✓	✓	Barnyard grass, <i>S. americanus</i> , <i>Distichlis spicata</i>
	8	5.0		✓	✓	<i>S. americanus</i>
	9	2.0		✓	✓	Barnyard grass, Phragmites
	10	5.0				Barnyard grass
	11	2.0		✓	✓	Barnyard grass
	12	5.0				<i>S. americanus</i> , Barnyard grass, 2" water
	13	5.0				<i>S. americanus</i> , Barnyard grass
	14	5.0				Barnyard grass
	15	5.0				Barnyard grass, 2" water
	16	4.0				Barnyard grass, <i>S. americanus</i> , <i>D. spicata</i> , 2" water
	17	2.0				Barnyard grass
	18	5.0		✓	✓	Barnyard grass, 2" water
	19	3.0		✓	✓	Barnyard grass, <i>S. americanus</i> , <i>D. spicata</i>
	20	4.0				Barnyard grass
	21	4.0		✓	✓	Barnyard grass, <i>Juncus</i> sp.
	22	4.0		✓	✓	<i>S. americanus</i>
	23	2.0				<i>D. spicata</i> , 4" water
	24	5.0		✓	✓	<i>S. americanus</i>
	25	5.0				Barnyard grass, Sicklepod, Smartweed
	26	2.0				Barnyard grass
	27	4.0				Barnyard grass, 2" water
	28	5.0				<i>S. americanus</i>
	29	5.0				<i>S. americanus</i> , Barnyard grass, 1" water
	30	5.0		✓	✓	Barnyard grass
	31	3.0				<i>S. americanus</i> , Barnyard grass
	32	4.0				<i>S. americanus</i>
	33	4.0		✓	✓	<i>S. americanus</i> , <i>D. spicata</i> , Phragmites
	34	3.0				<i>S. americanus</i> , Barnyard grass
	35	5.0				<i>S. americanus</i>
	36	2.0				Barnyard grass, Phragmites
	37	4.0		✓	✓	Barnyard grass, <i>D. spicata</i> , Phragmites
	38	2.0		✓	✓	<i>D. spicata</i> , Phragmites
	39	2.0				<i>D. spicata</i> , 4" water
	40	5.0				Barnyard grass
	41	5.0		✓	✓	Barnyard grass
	42	3.0		✓	✓	Barnyard grass
	43	5.0		✓	✓	<i>S. americanus</i> , <i>Scirpus robustus</i> , Cattail
	44	5.0				Barnyard grass, 2" water
	45	1.0				<i>S. americanus</i> , 4" water
	46	5.0				Barnyard grass, 1" water

Table 4 continued...

ZONE	Plot #	Scale Factor	Black Needle Rush	Sawgrass	Frequency	Notes
	47	4.0				Barnyard grass, <i>Distichlis spicata</i>
	48	3.0				Barnyard grass, Cattail
	49	0.0				Bare ground
	50					4" water
	51	1.0		✓	✓	
	52	2.0		✓	✓	Cattail, Phragmites
	53	0.0				Bare ground
	54	5.0				<i>S. americanus</i> , Barnyard grass
	55	3.0				<i>S. americanus</i>
	56	3.0		✓	✓	<i>S. americanus</i> , Barnyard grass
	57	5.0				<i>S. americanus</i> , Barnyard grass, <i>Juncus romerianus</i>
	58	1.0				Barnyard grass, Phragmites
	59	2.0				<i>S. americanus</i>
	60	3.0				<i>S. americanus</i> , Barnyard grass
	61	3.0				<i>S. americanus</i>
	62	4.0		✓	✓	Barnyard grass, <i>Distichlis spicata</i>
	63	5.0				<i>S. americanus</i> , Barnyard grass, 4" water
	64	3.0				<i>D. spicata</i> , Barnyard grass, <i>Juncus romerianus</i> , Phragmites
	65	5.0		✓	✓	Barnyard grass
	66	4.0		✓	✓	Barnyard grass
	67	0.0				Bare ground
	68	3.0				<i>S. americanus</i> , Barnyard grass
	69	2.0		✓	✓	<i>S. americanus</i> , <i>D. spicata</i> , Phragmites
	70	2.0		✓	✓	
	71	2.0		✓	✓	<i>D. spicata</i>
	72	3.0		✓	✓	<i>S. americanus</i> , Barnyard grass
	73	0.0				Bare ground
	74	5.0		✓	✓	Barnyard grass
	75	2.0				<i>D. spicata</i> , Barnyard grass, Phragmites
	76	2.0		✓	✓	<i>D. spicata</i> , Phragmites
	77	4.0				Cattail, Barnyard grass, <i>S. americanus</i> , 6" water
	78					Phragmites
	79	4.0				<i>S. americanus</i> , <i>Eleocharis</i> sp., Woolgrass
	80					Outside Boundary
	81	2.0				<i>S. americanus</i> , Barnyard grass
	82	5.0				<i>S. americanus</i> , Barnyard grass
	83	2.0		✓	✓	Barnyard grass, 1" water
	84	2.0				Cattail, Barnyard grass
	85	1.0		✓	✓	Barnyard grass, 6" water
	86	2.0		✓	✓	Barnyard grass
	87	2.0		✓	✓	<i>D. spicata</i> , Phragmites
	88	2.0		✓	✓	
	89	5.0				Barnyard grass
	90	4.0		✓	✓	Barnyard grass, <i>D. spicata</i> , <i>S. americanus</i>
	91	3.0		✓	✓	Barnyard grass, Cattail, Phragmites
	92	0.5		✓	✓	

Table 4 Continued...

ZONE	Plot #	Scale Factor	Black Needle Rush	Sawgrass	Frequency	Notes
	93	2.0		✓	✓	<i>S. americanus</i> , <i>Phragmites</i>
	94	1.0				Barnyard grass, <i>Phragmites</i>
	95	1.0		✓	✓	
	96	2.0		✓	✓	<i>S. americanus</i> , 4" water
	97	2.0				<i>D. spicata</i>
	98	2.0		✓	✓	<i>D. spicata</i> , <i>S. americanus</i> , <i>Phragmites</i>
	99	1.0				Barnyard grass
	100	5.0		✓	✓	Barnyard grass, Smartweed, Fennel, <i>Aster</i> sp.
	101	4.0		✓	✓	<i>D. spicata</i> , <i>S. americanus</i> , <i>Phragmites</i>
	102	5.0				Barnyard grass
	103	5.0				Barnyard grass
	104	2.0		✓	✓	<i>D. spicata</i> , <i>Phragmites</i>
	105	4.0				<i>S. americanus</i> , Barnyard grass, 6" water
	106	5.0		✓	✓	<i>S. americanus</i> , Barnyard grass, Smartweed
	107	5.0				Barnyard grass
	108	4.0				Barnyard grass
	109	5.0		✓	✓	<i>S. americanus</i> , <i>Phragmites</i>
	110	5.0				Barnyard grass
	111	2.0				Barnyard grass
	112	0.0				Bare ground
	113	2.0		✓	✓	
	114	0.0				Bare ground
	115	1.0		✓	✓	Barnyard grass
	116	0.5		✓	✓	
	117	2.0		✓	✓	Barnyard grass
	118	2.0		✓	✓	<i>D. spicata</i> , <i>Phragmites</i>
	119	4.0				<i>S. americanus</i> , Barnyard grass
	120	2.0		✓	✓	Barnyard grass
	121	2.0		✓	✓	<i>D. spicata</i> , <i>Phragmites</i>
	122	3.0		✓	✓	<i>S. americanus</i> , Barnyard grass
	123	5.0				Barnyard grass, 2" water
	124	1.0				Barnyard grass, <i>S. americanus</i> , <i>Phragmites</i>
	125	5.0				<i>S. americanus</i> , Barnyard grass, 1" water
	126	5.0		✓	✓	<i>S. americanus</i>
	127	2.0		✓	✓	Cattail, <i>Phragmites</i>
	128	2.0		✓	✓	<i>S. americanus</i> , Barnyard grass
	129	0.5		✓	✓	4" water
	130	1.0		✓	✓	<i>Phragmites</i>
	131	2.0				Cattail, Barnyard grass, 2" water
	132	4.0				<i>Eleocharis</i> sp., Smartweed, Barnyard grass, <i>Juncus</i> sp.
	133	5.0				<i>Juncus roemerianus</i> , Cattail, <i>S. robustus</i>
	134	2.0				<i>Juncus roemerianus</i> , Cattail, Barnyard
	135	5.0				<i>S. robustus</i>
	136	5.0				<i>S. robustus</i> , <i>Eleocharis</i> sp., <i>Juncus</i> sp., <i>Cyperus</i> sp.
	137	5.0				<i>S. americanus</i> , Cattail
	138	5.0				<i>Eleocharis</i> sp., 1" water

Site Notes: Other species noted: *Scirpus americanus*, sawgrass, black needle rush, *Bidens* sp., ragweed, *Baccharis halimifolia*, fennel, phragmites, redbay, cattail, red maple, and *Pluchea* sp. Trees were difficult to find in plot 1 due to thick grasses.

3.4 Conclusions

(West Side)

Of the 399 acres on this site, approximately 7 acres involved tree planting. This side of the site has also become extremely well vegetated with marsh grasses. There were 5 plots established throughout the planting areas, encompassing all plant communities. The 2001 vegetation monitoring revealed an average density of 649 trees per acre, which is much higher than the 320 trees per acre required by the success criteria.

(East Side)

During the 2001 monitoring of the vegetation on the east side, a frequency of 46.4% for the targeted species was found. A frequency of 70% is required. A vegetative scale value of 3.2 was recorded. A scale value of 5 is required by year 5.

Of the 399 acres on this site, approximately 12.34 acres involved marsh grass planting. There were 167 random plots established throughout the planting areas, encompassing all plant communities. These plots were located with GPS. The northern side of the site was treated for phragmites in April 2001.

Dr. Stratford H. Kay, Aquatic and Noncropland Weed Management Specialist with North Carolina State University, is currently working on a grant to study phragmites on this site and other potential NCDOT mitigation sites.

4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS

2001 represents the third full growing season (but the first official season) that the hydrologic data has been examined. All nine groundwater monitoring gauges met the jurisdictional wetland hydrology for 12.5% of the growing season; when considering cumulative days, all ten surface gauges met the 25% requirement of daily flooding the site during this same period. The overall monitoring results show that the site performed adequately from a hydrological standpoint.

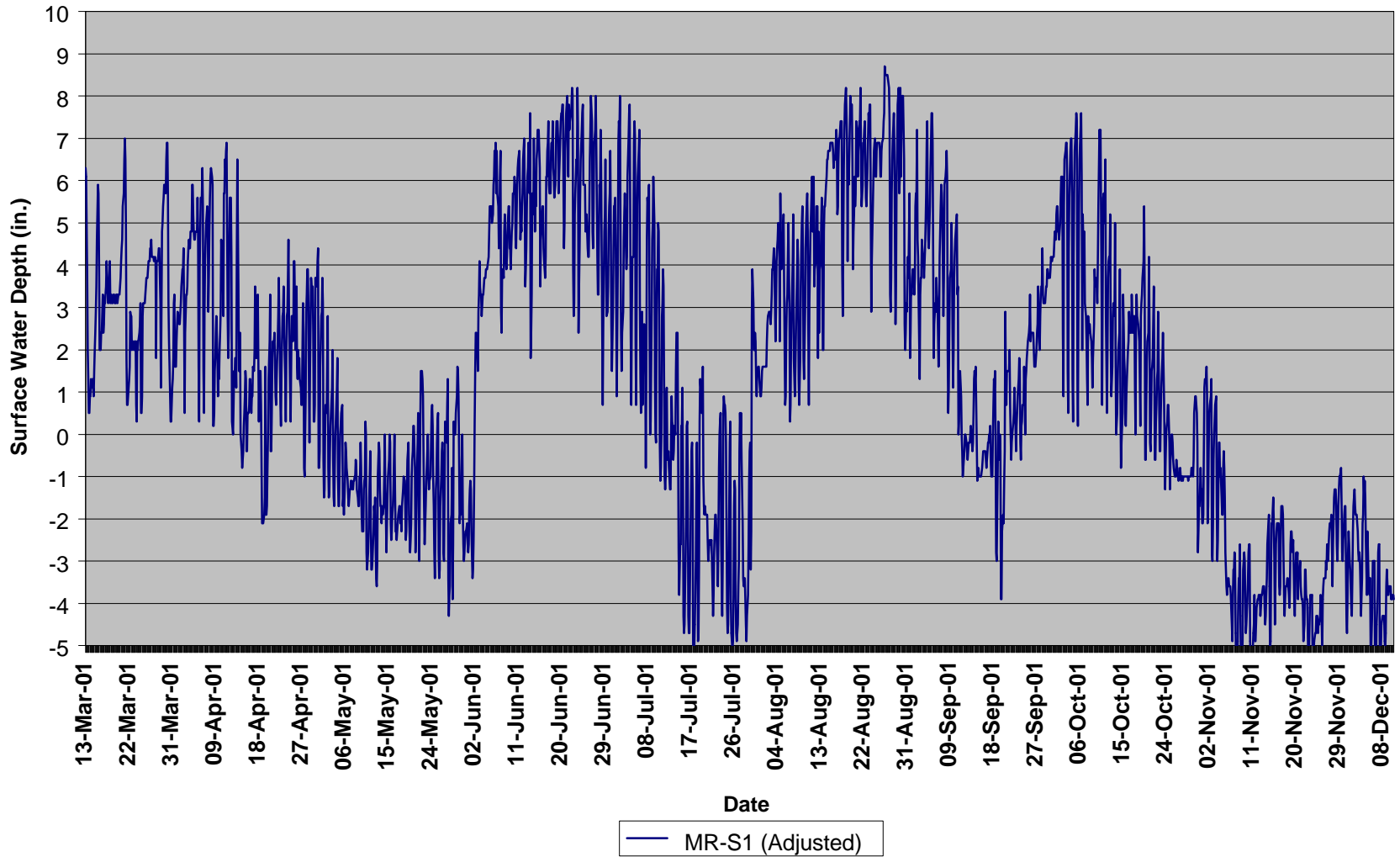
Vegetation monitoring on the west side of the restoration area yielded 649 trees per acre, above the 320 tree requirement. On the east side, a frequency of 46.4% for the targeted vegetative species was found. A frequency of 70% is required. A vegetative scale value of 3.2 was recorded. A scale value of 5 is required by year 5.

NCDOT will continue to monitor the site for both hydrologic and vegetation success.

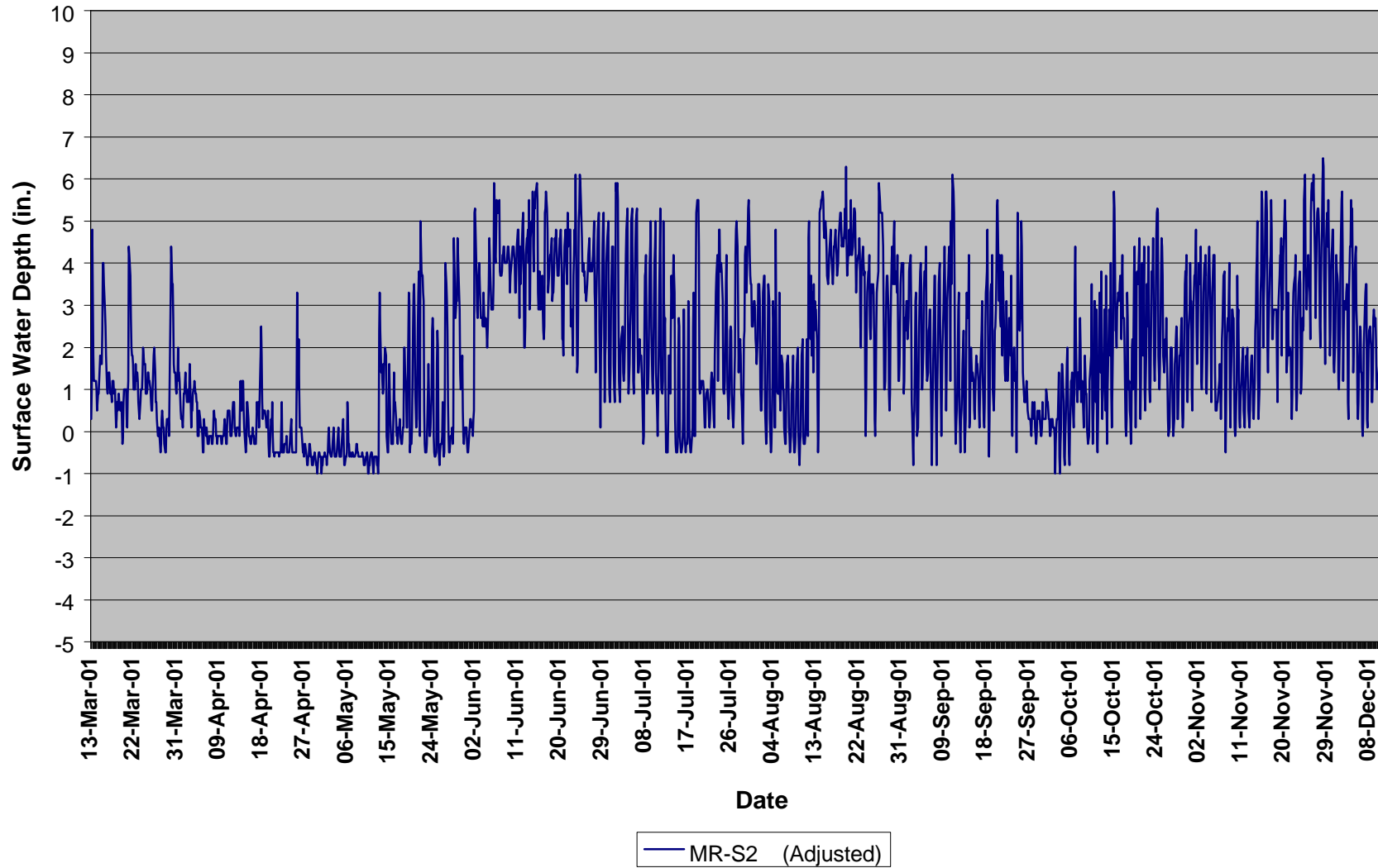
APPENDIX A

DEPTH TO GROUNDWATER GRAPHS

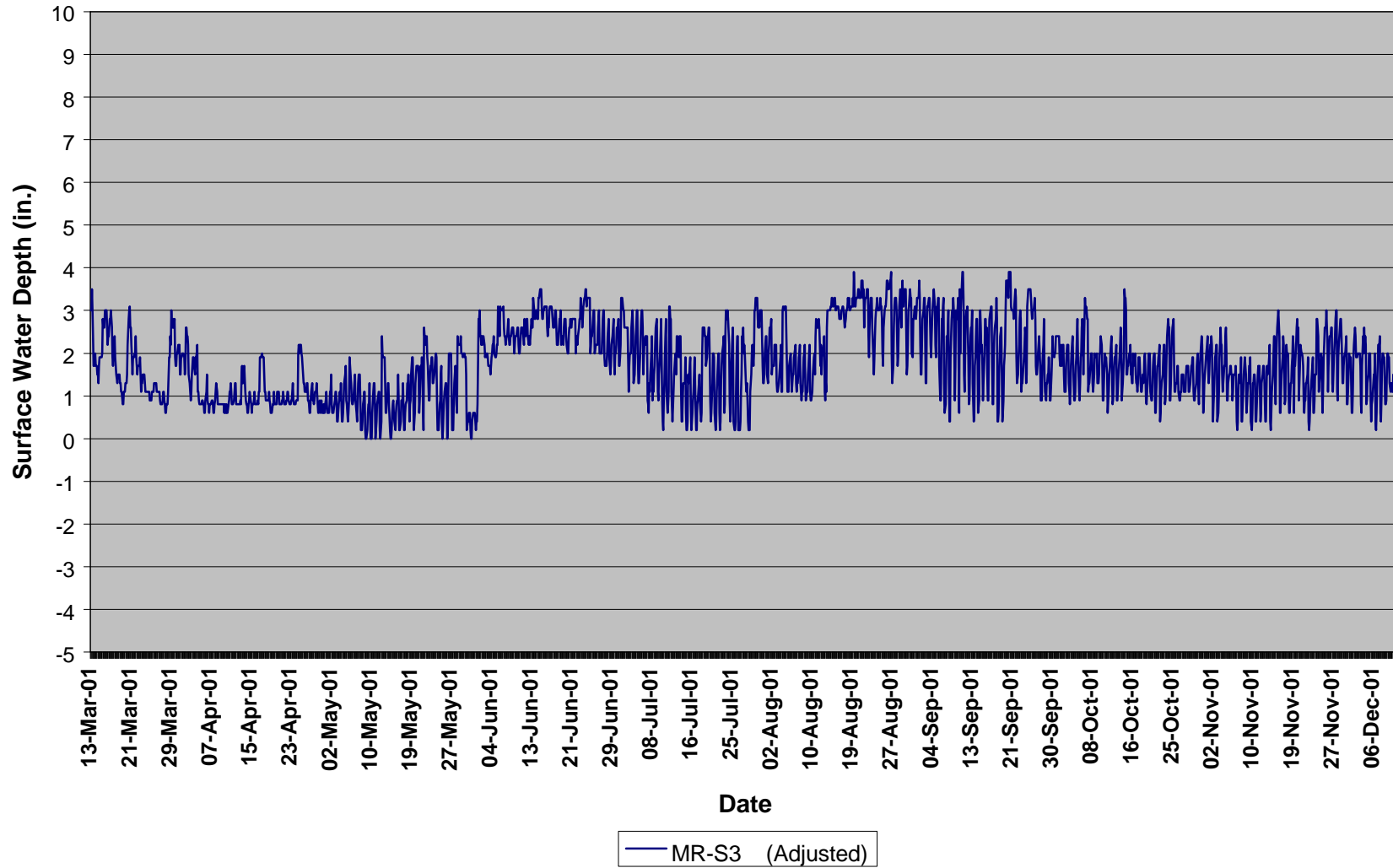
Mashoes Road - Surface Gauge S1



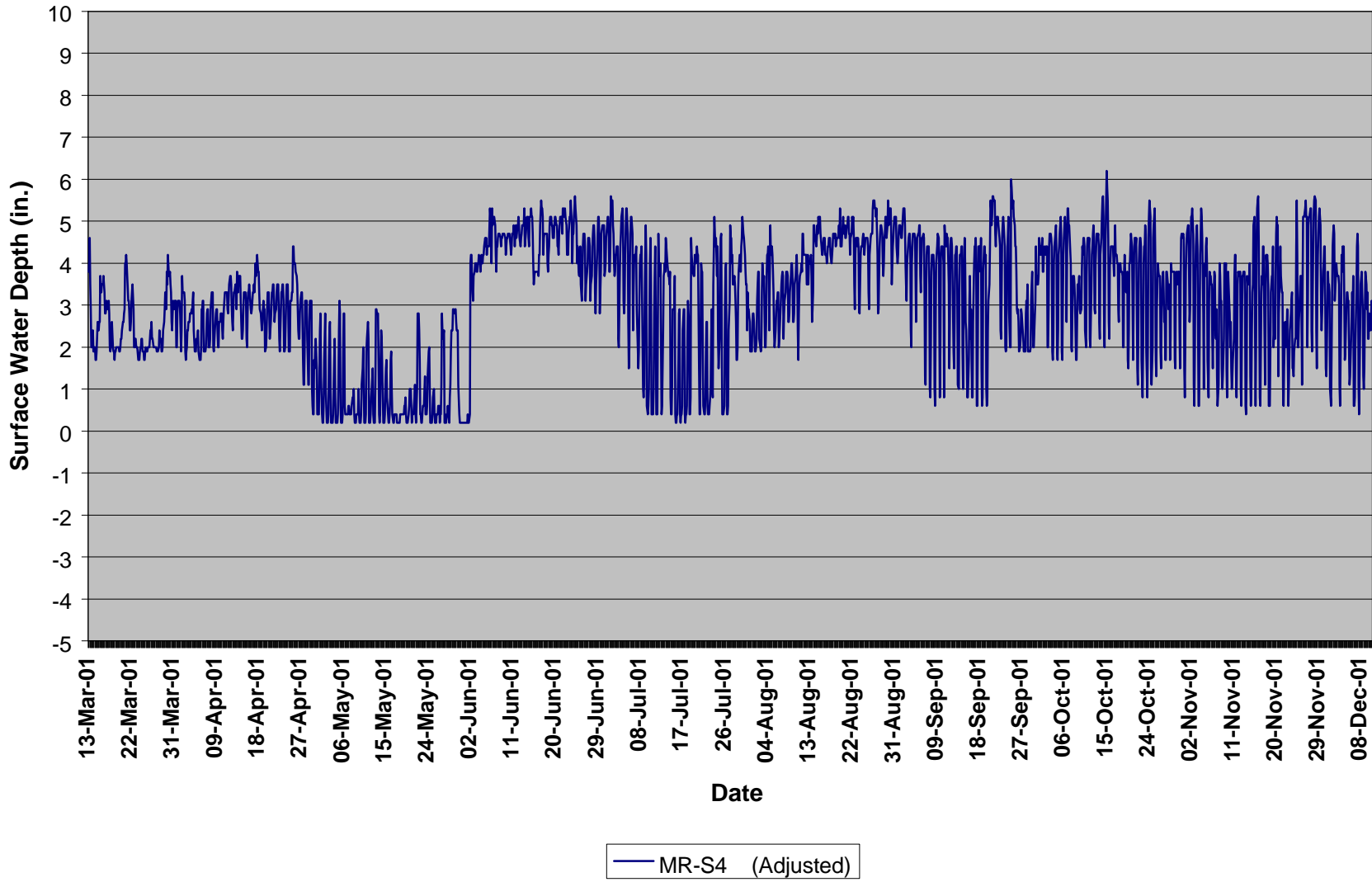
Mashoes Road - Surface Gauge S2



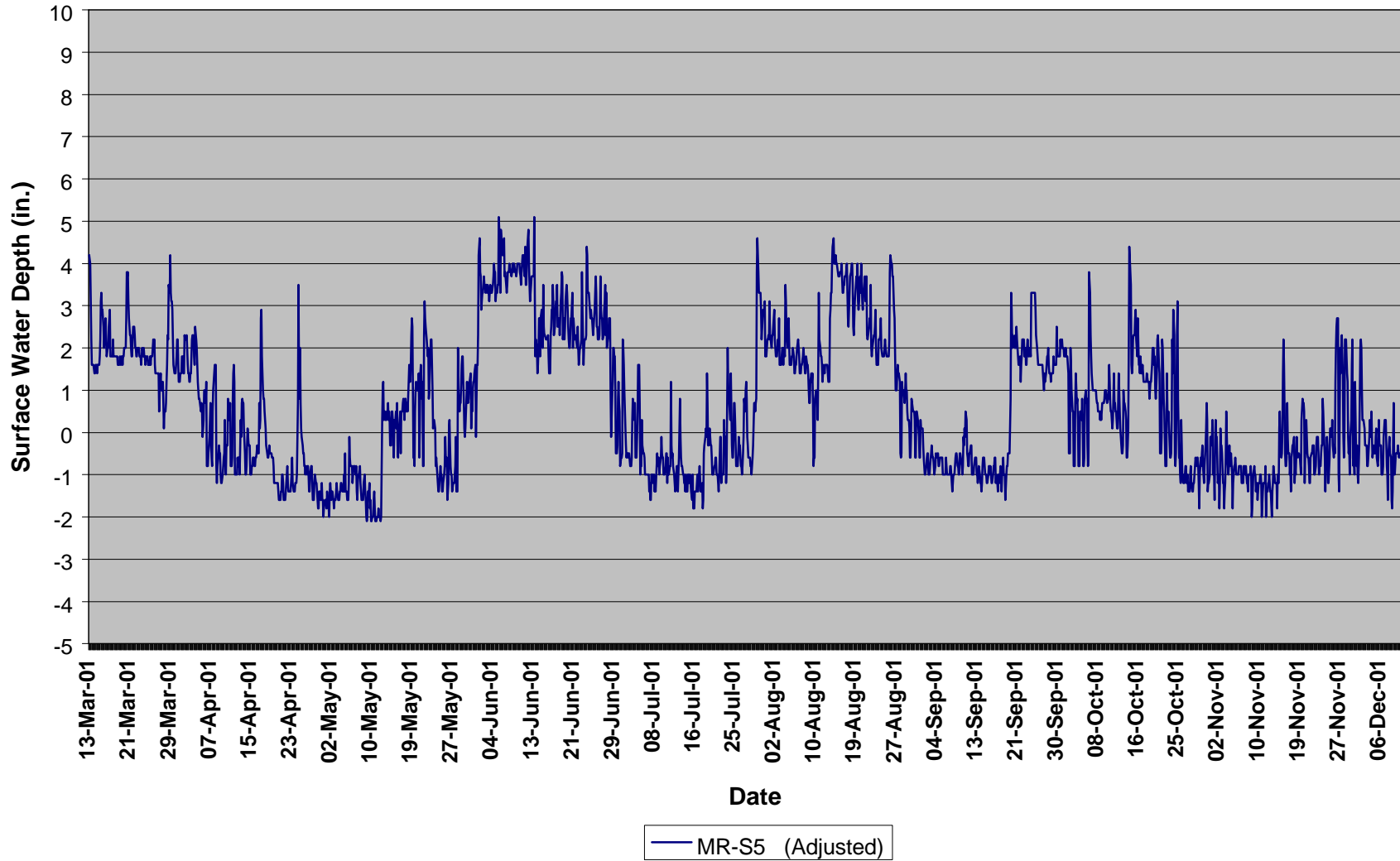
Mashoes Road - Surface Gauge S3



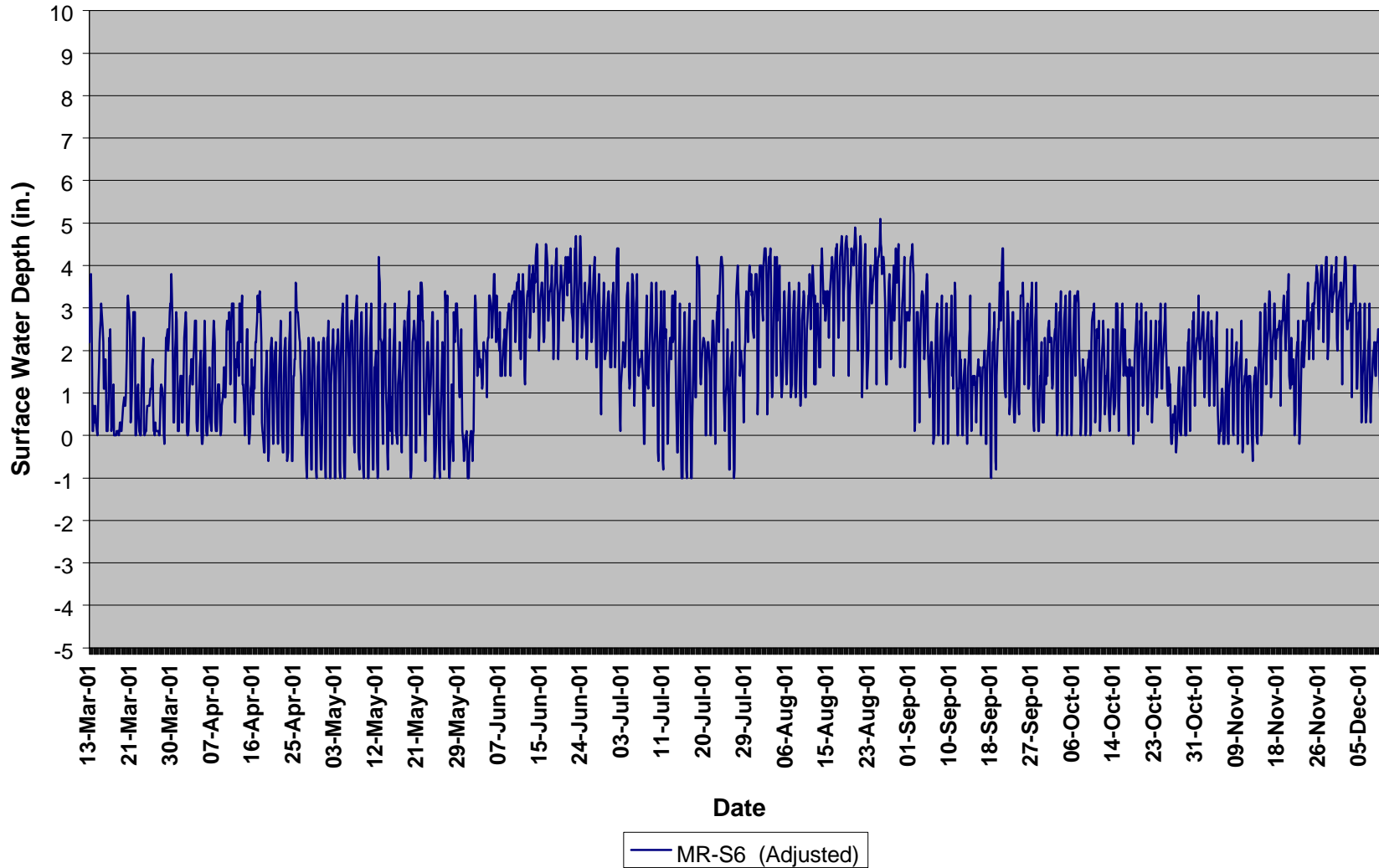
Mashoes Road - Surface Gauge S4



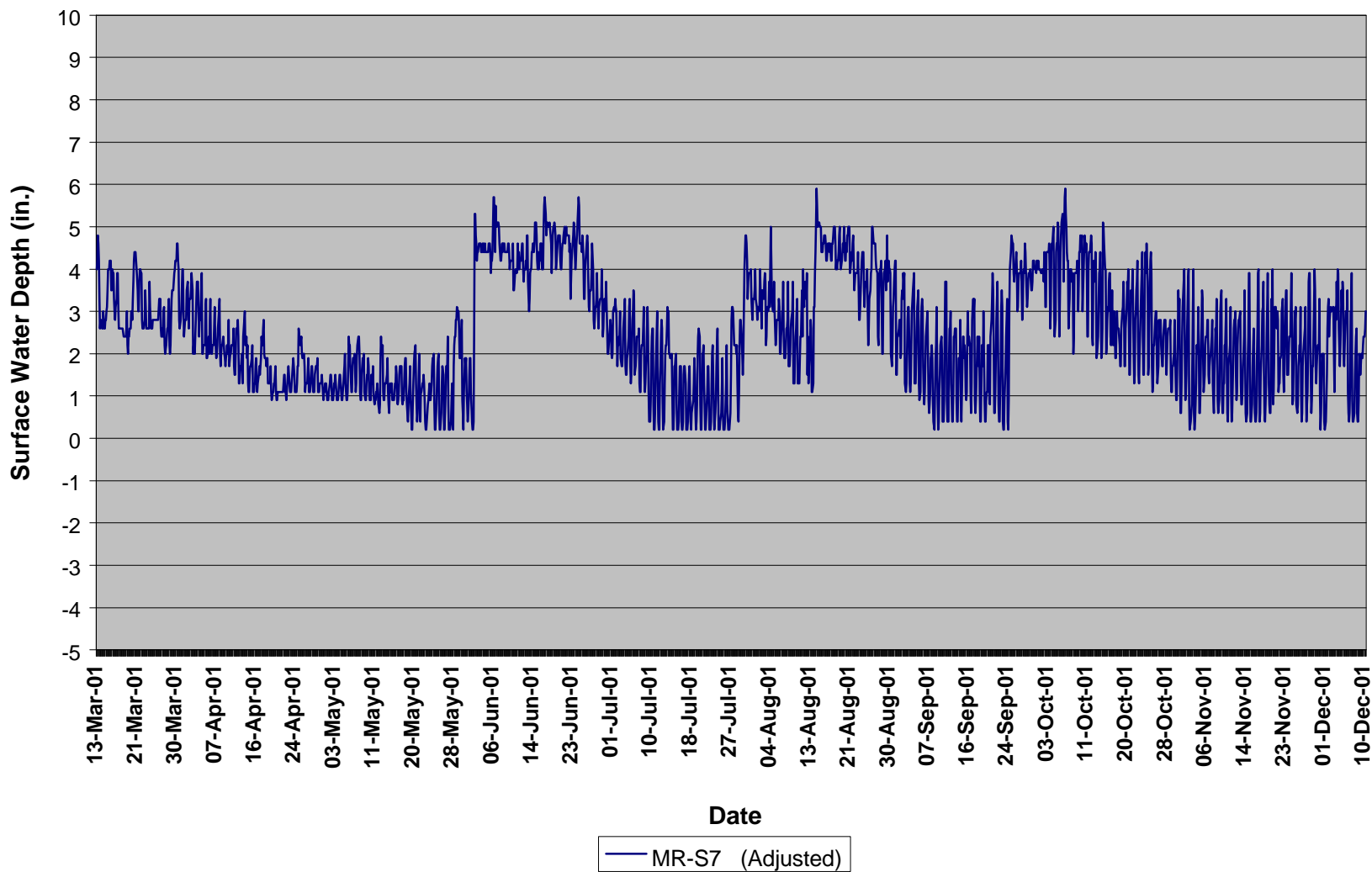
Mashoes Road - Surface Gauge S5



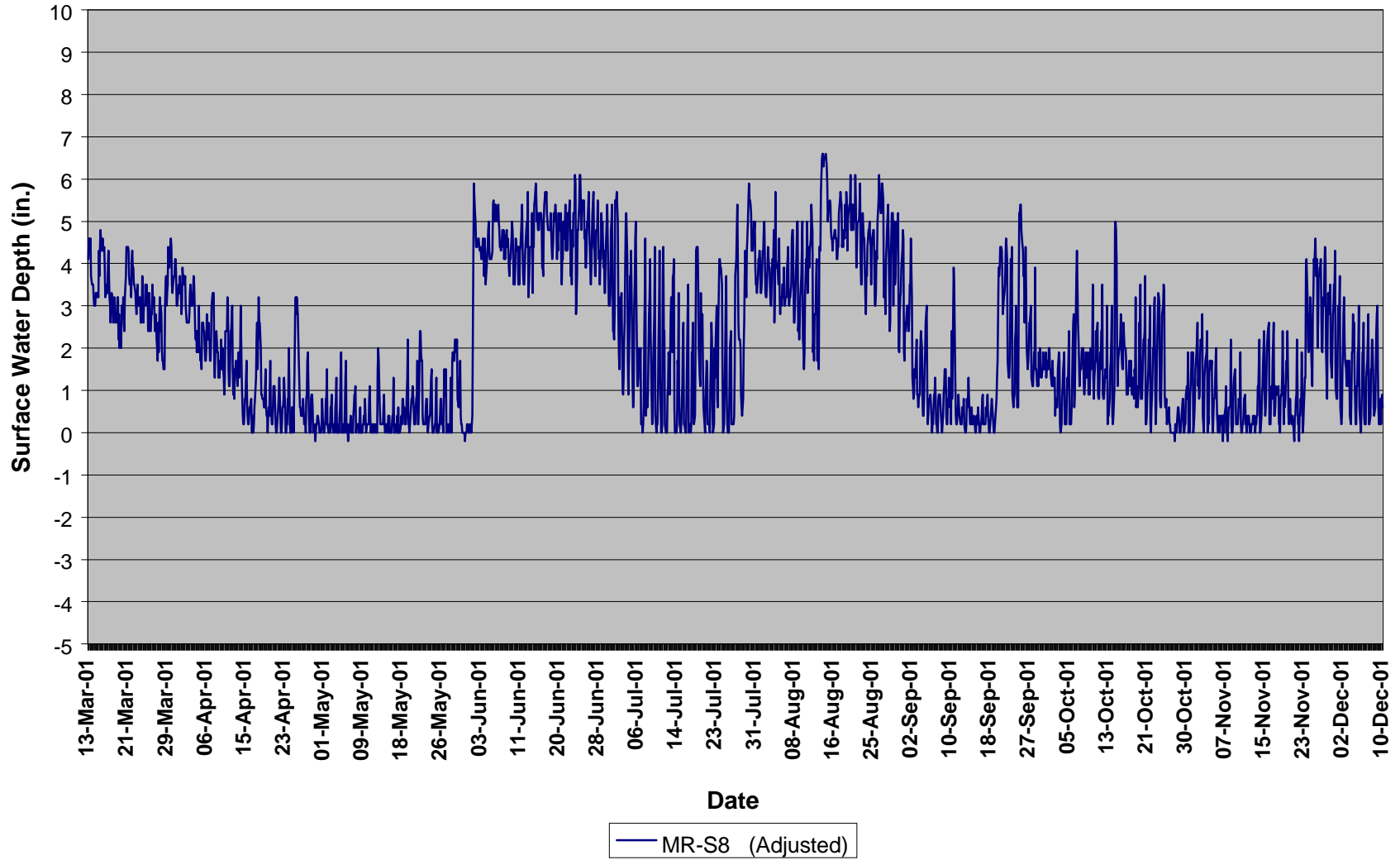
Mashoes Road - Surface Gauge S6



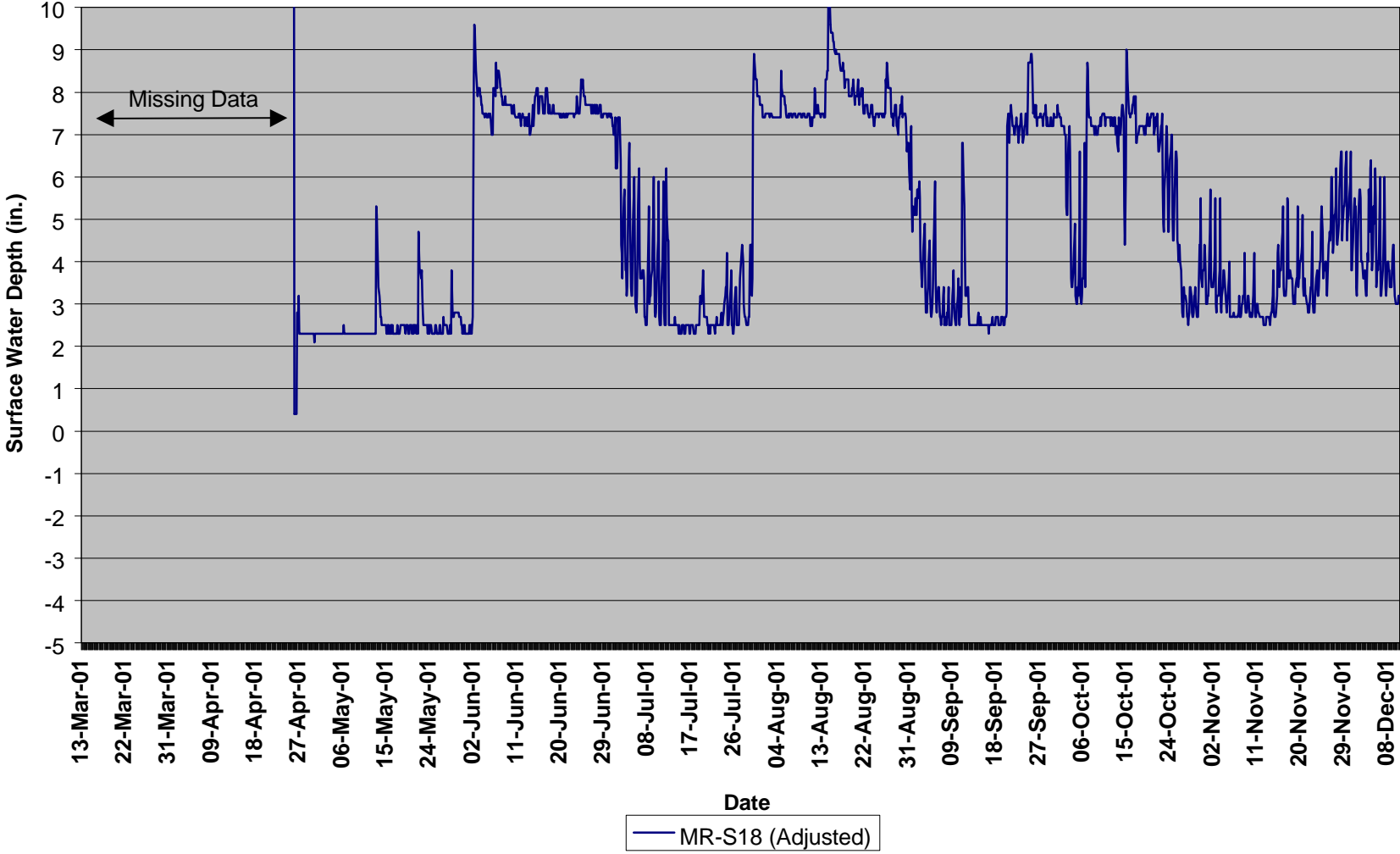
Mashoes Road - Surface Gauge S7



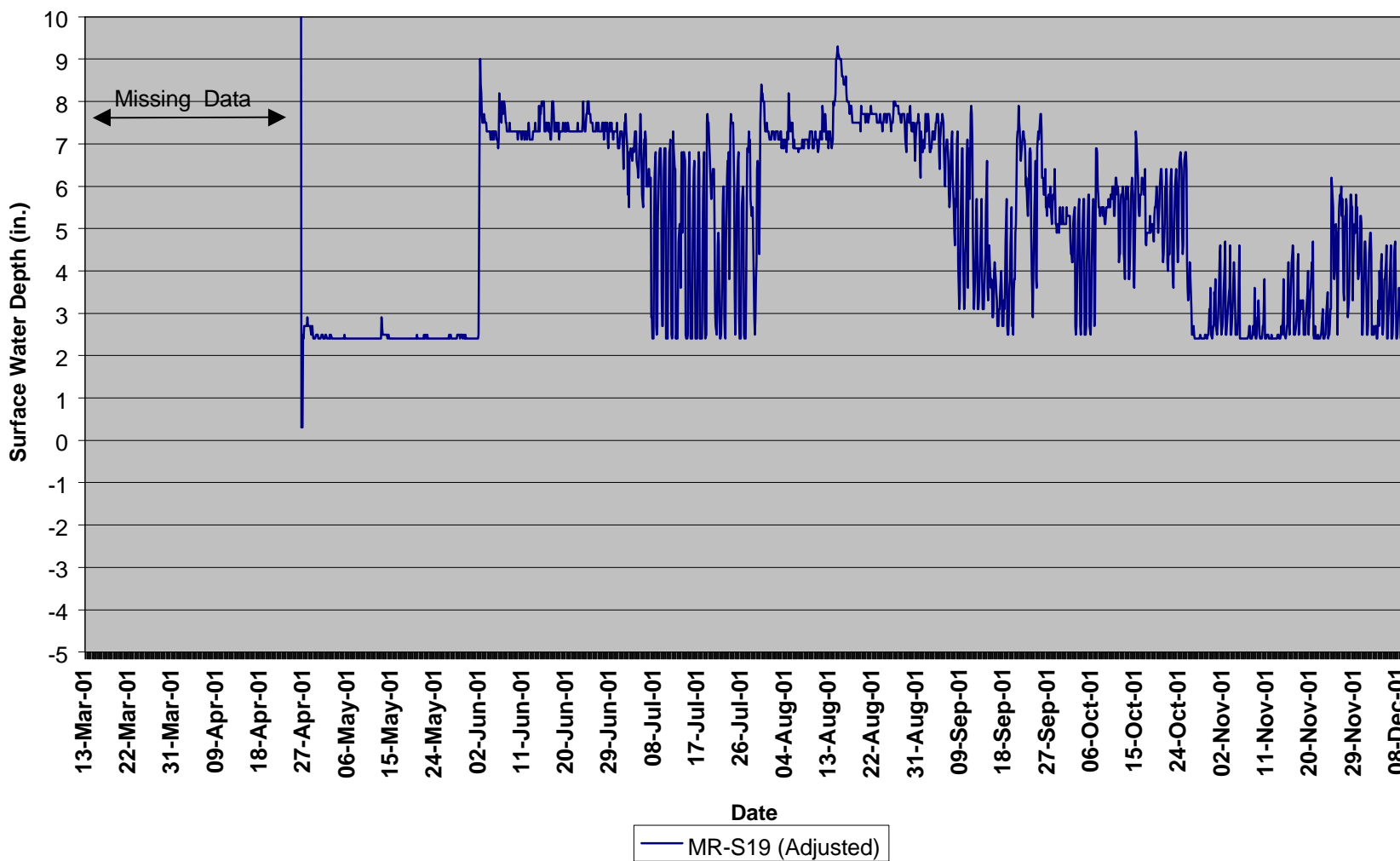
Mashoes Road - Surface Gauge S8



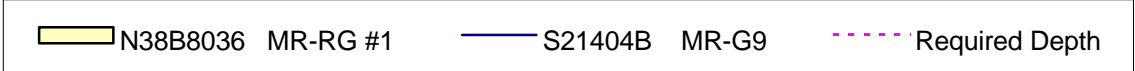
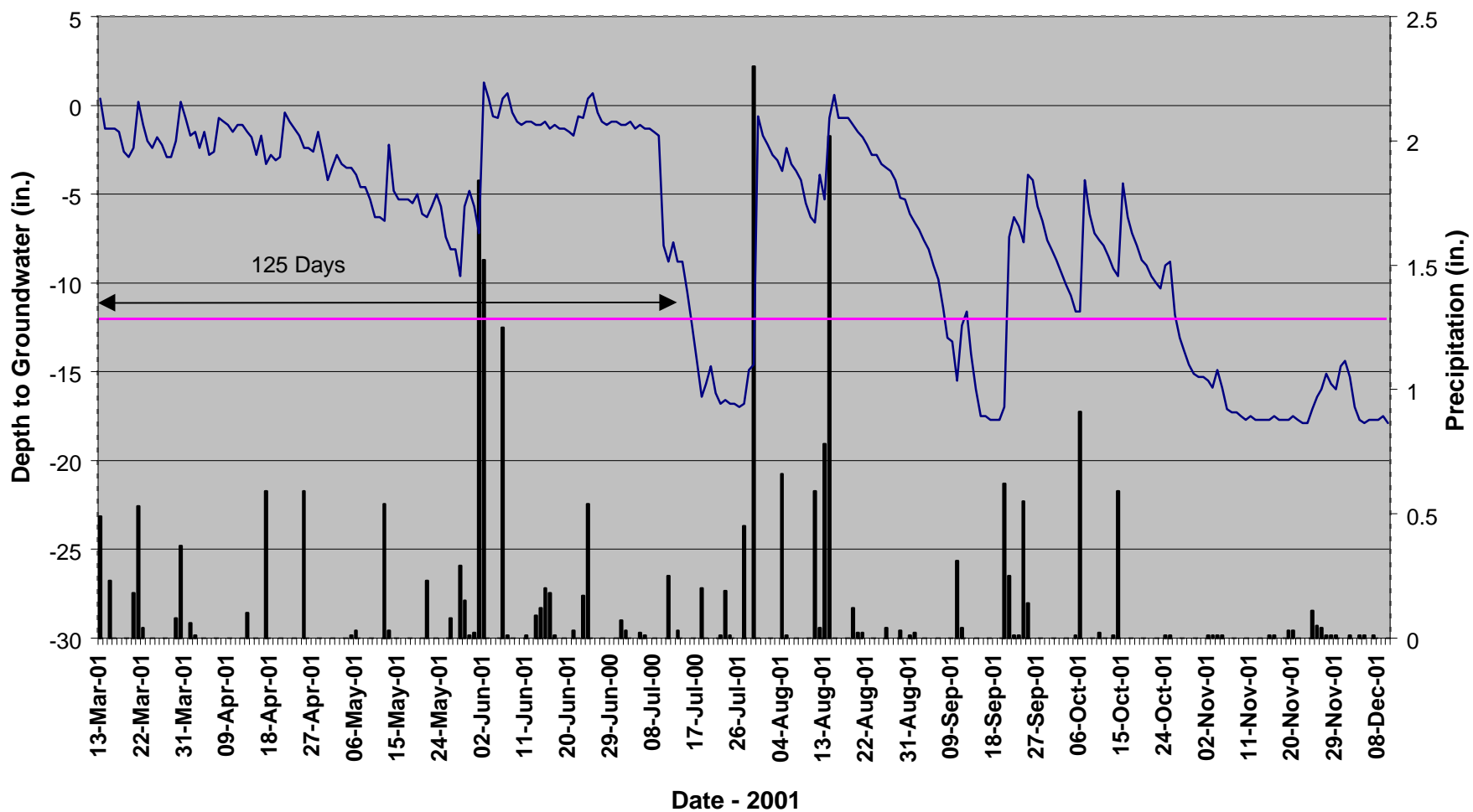
Mashoes Road - Surface Gauge S18



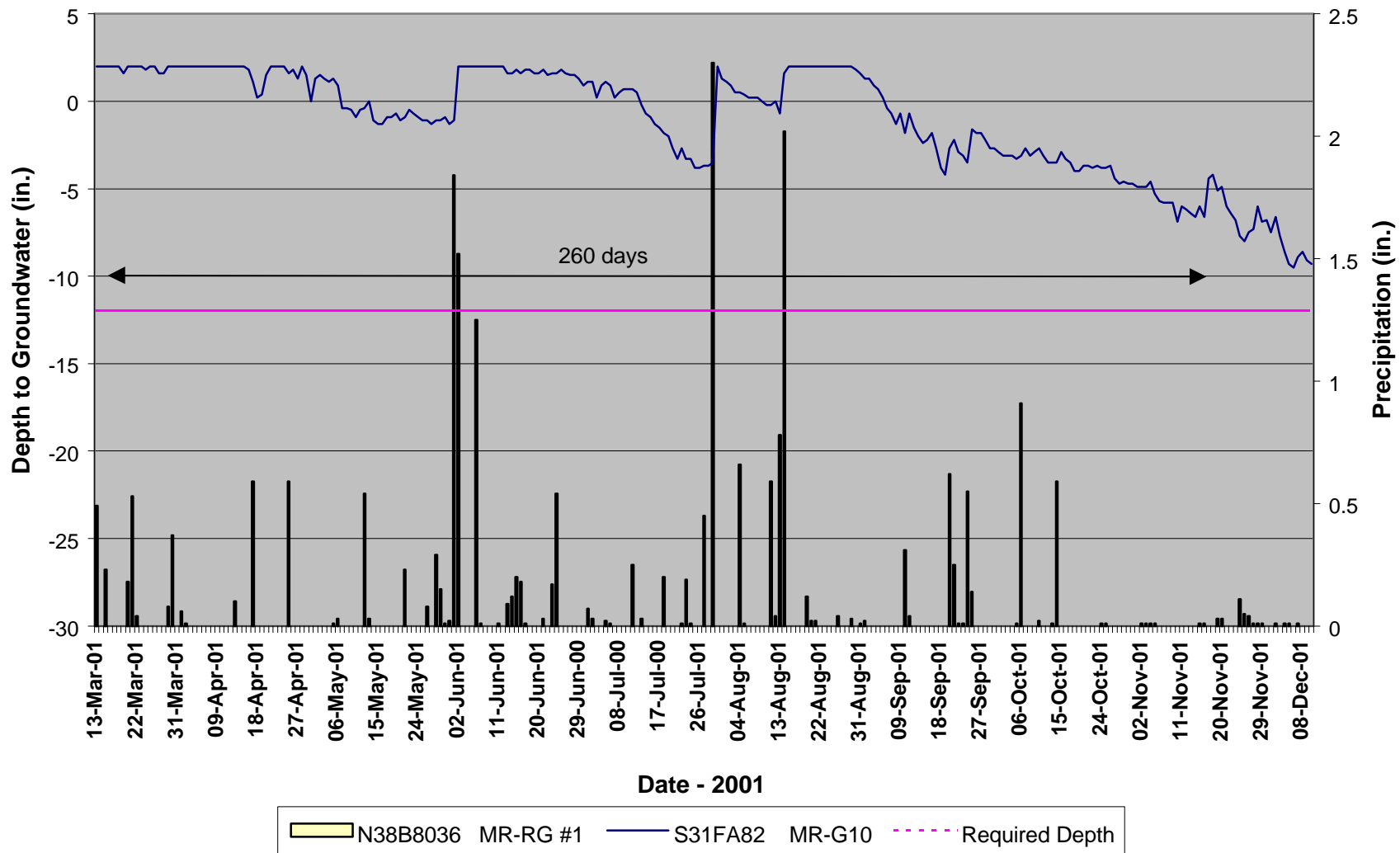
Mashoes Road - Surface Gauge S19



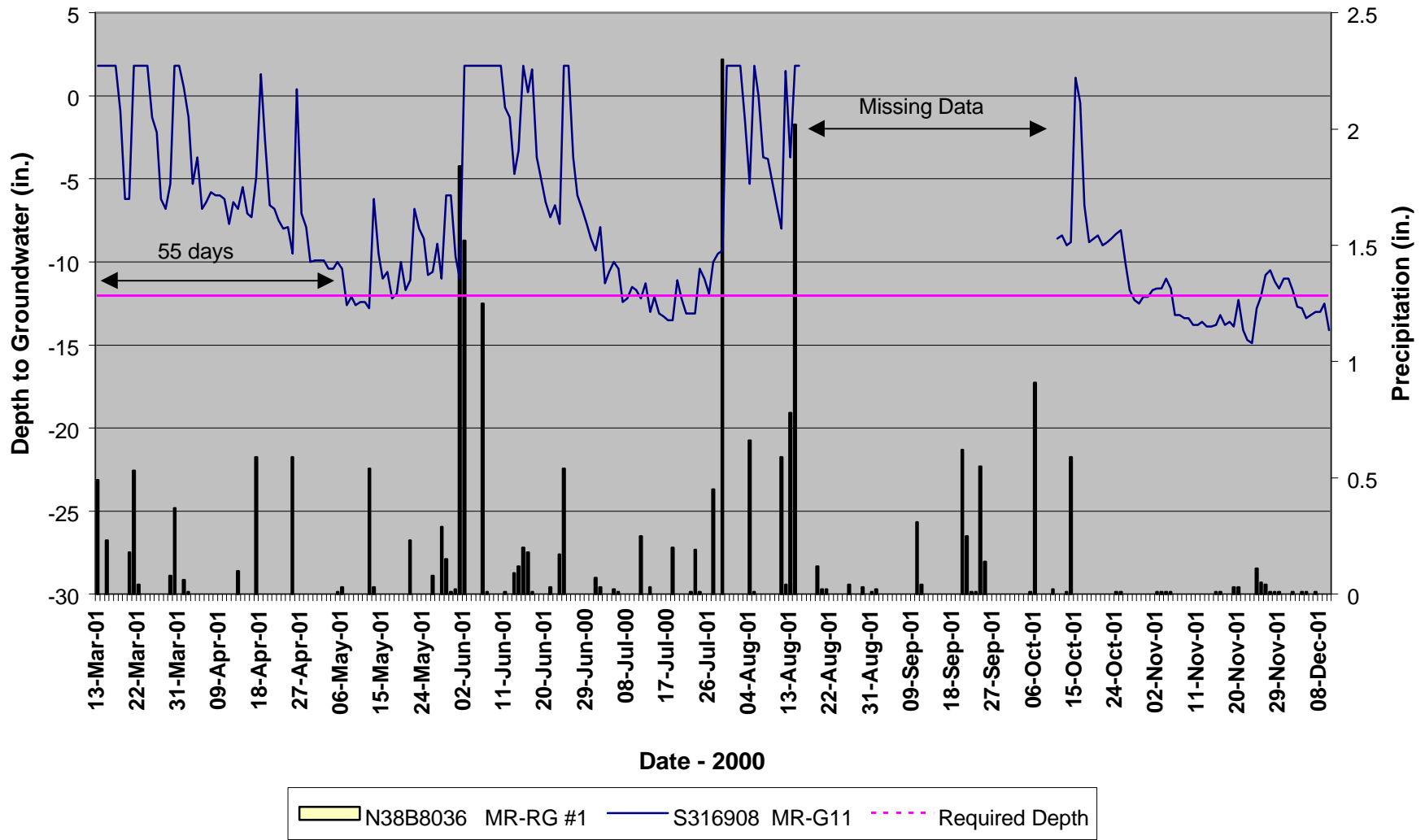
Mashoes Road - Gauge G9



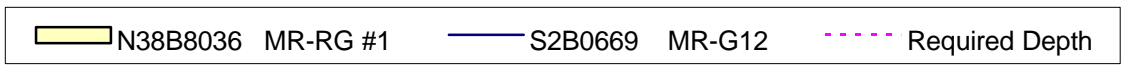
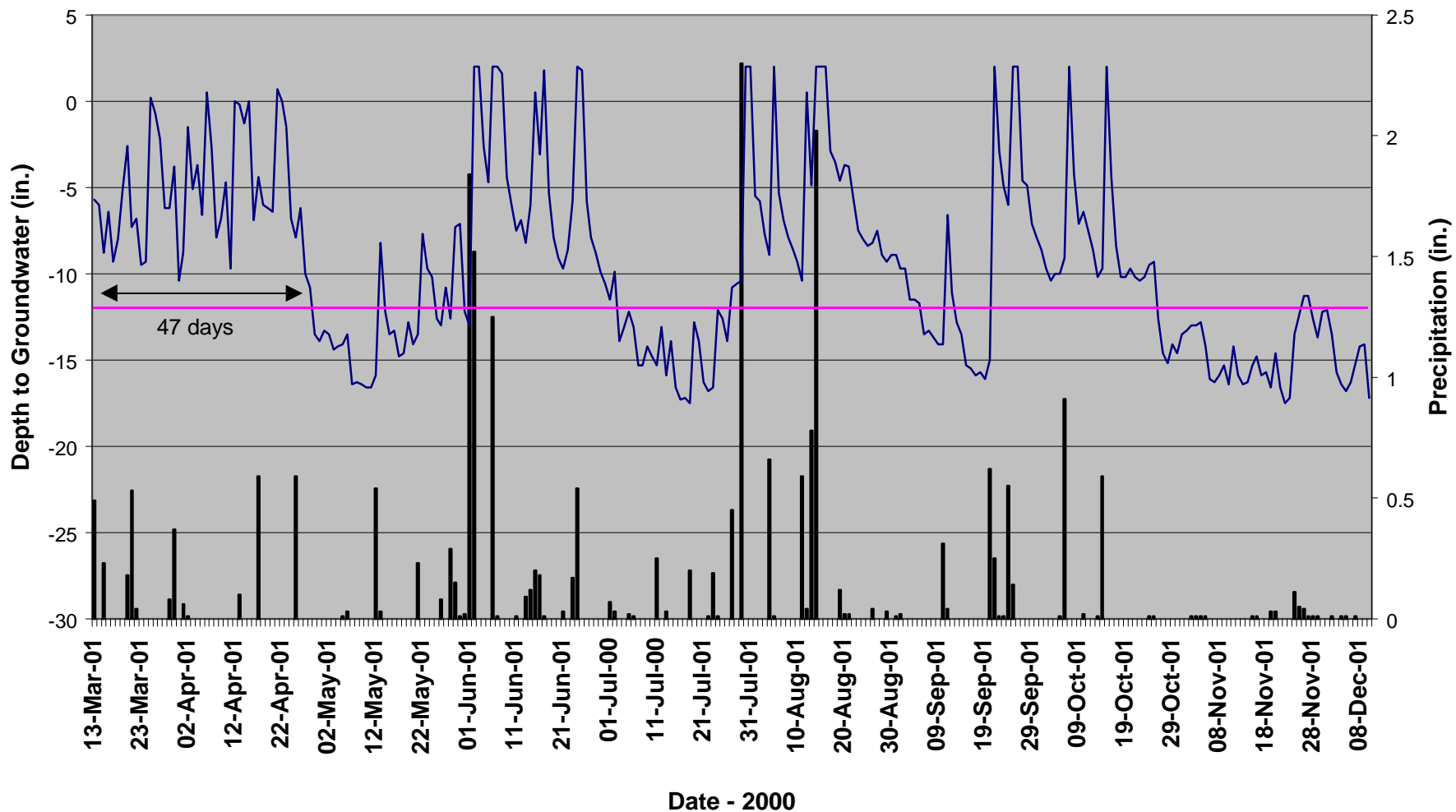
Mashoes Road - Gauge G10



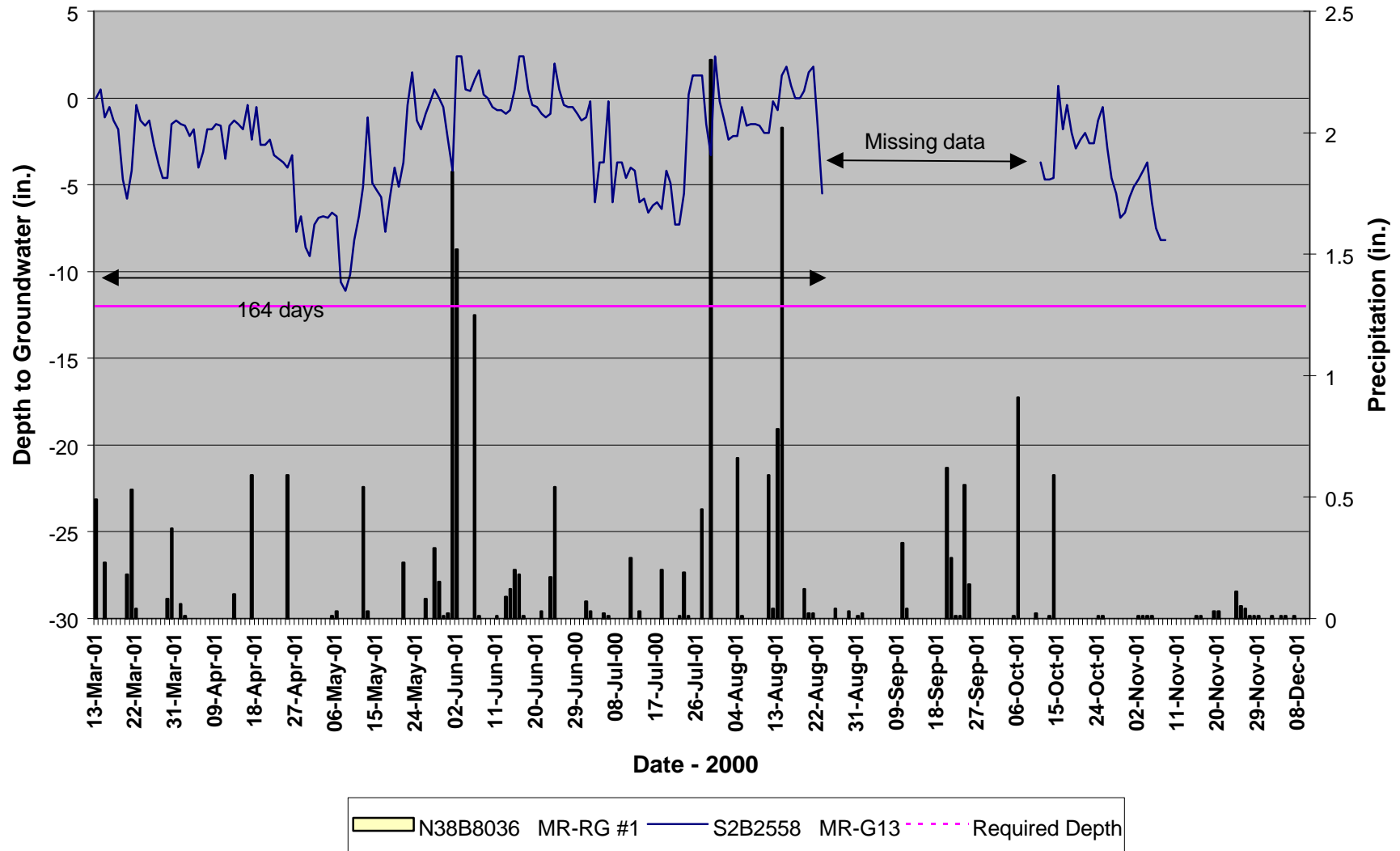
Mashoes Road -Gauge G-11



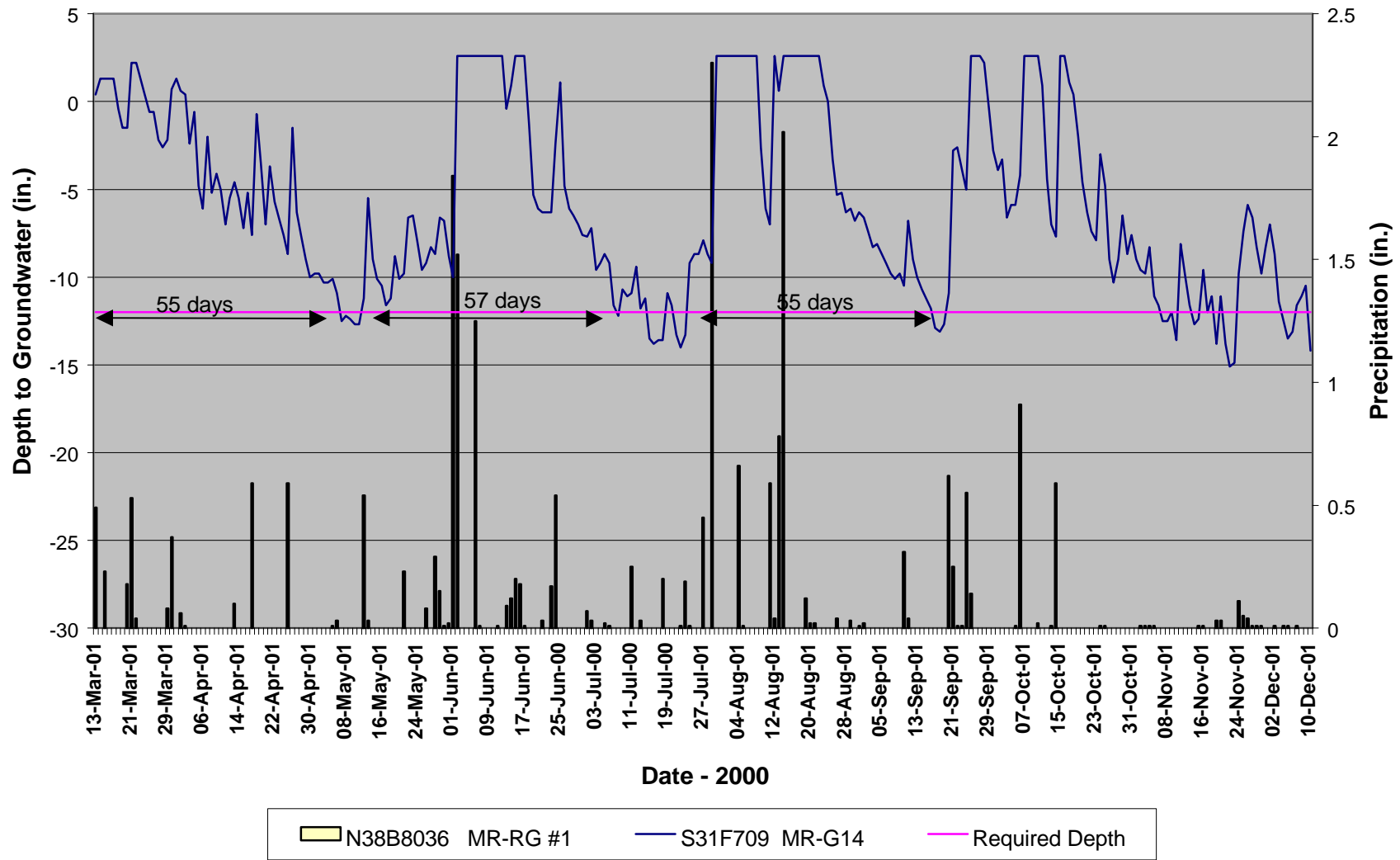
Mashoes Road - Gauge G12



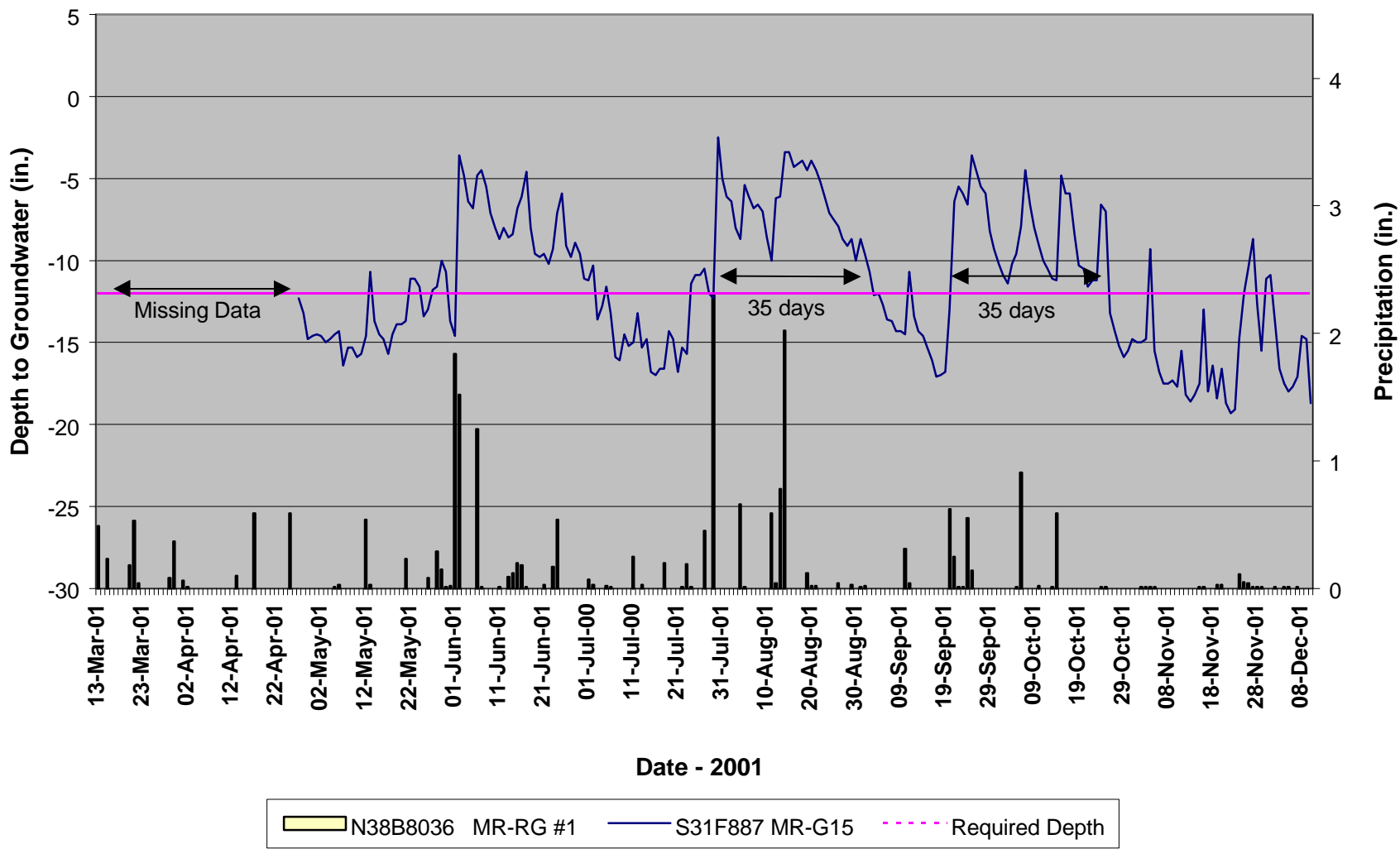
Mashoes Road - Gaugel G13



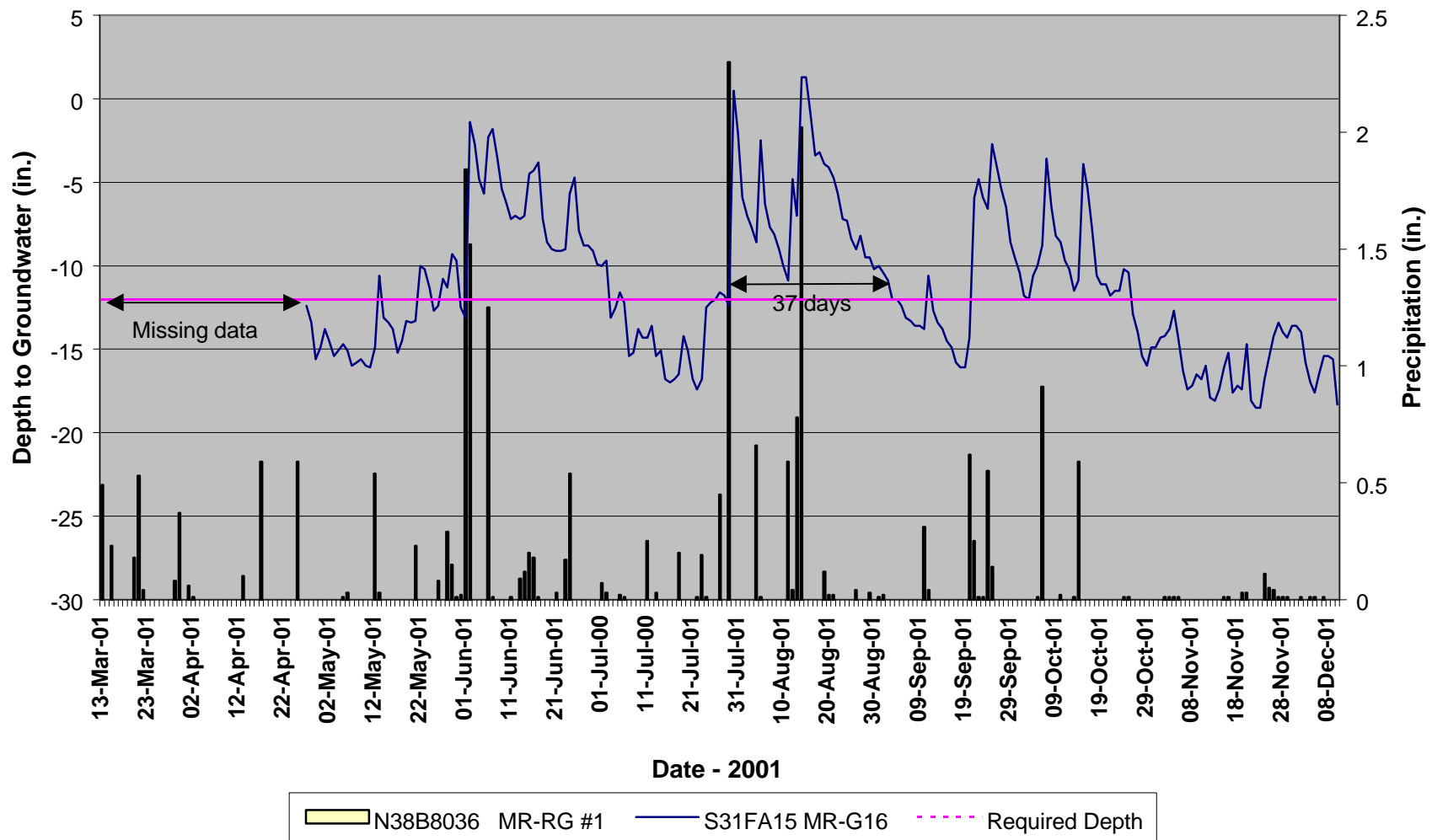
Mashoes Road - Gauge G14



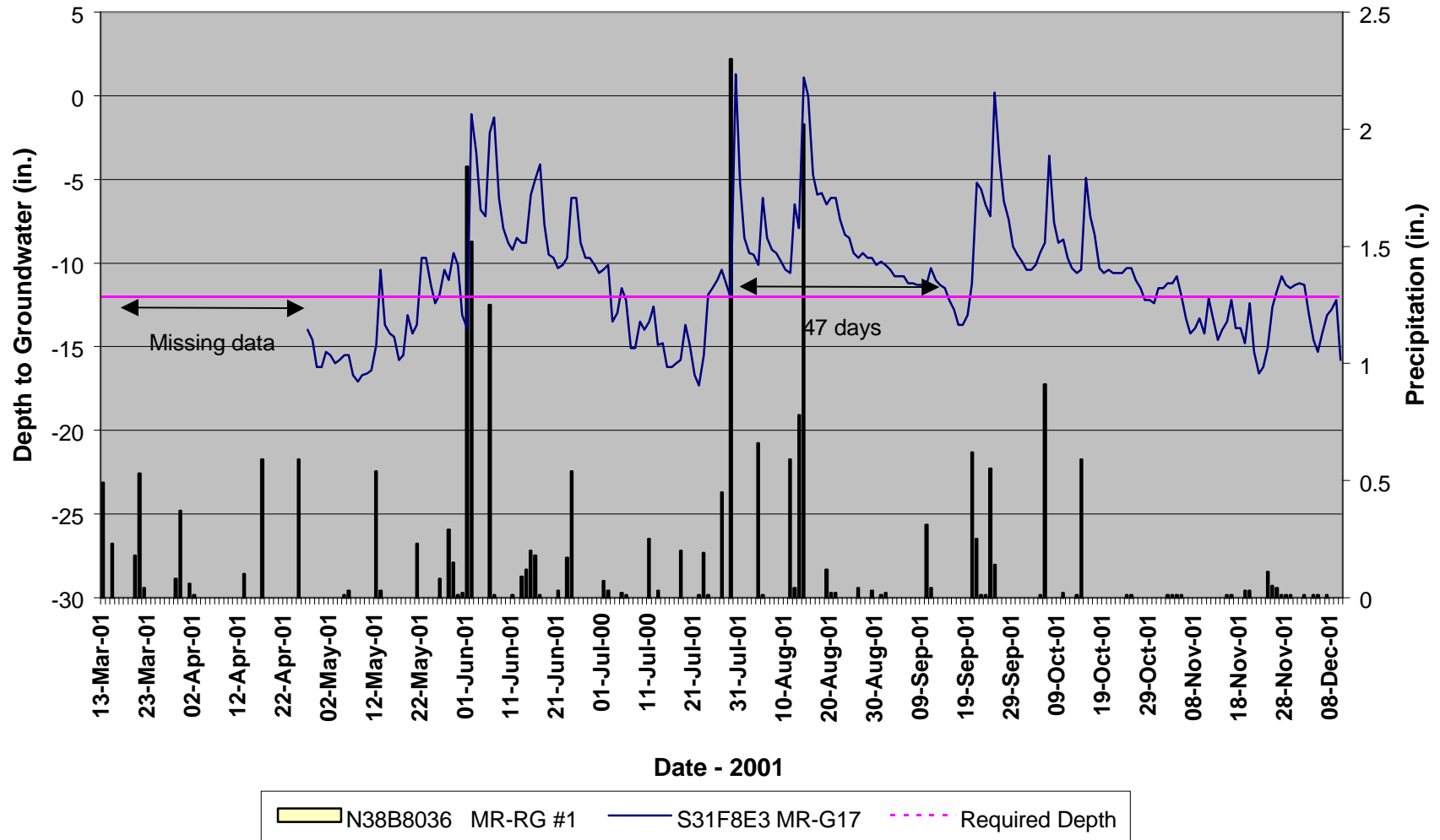
Mashoes Road - Well G15



Mashoes Road - Gauge G16



Mashoes Road - Gauge G17





APPENDIX B

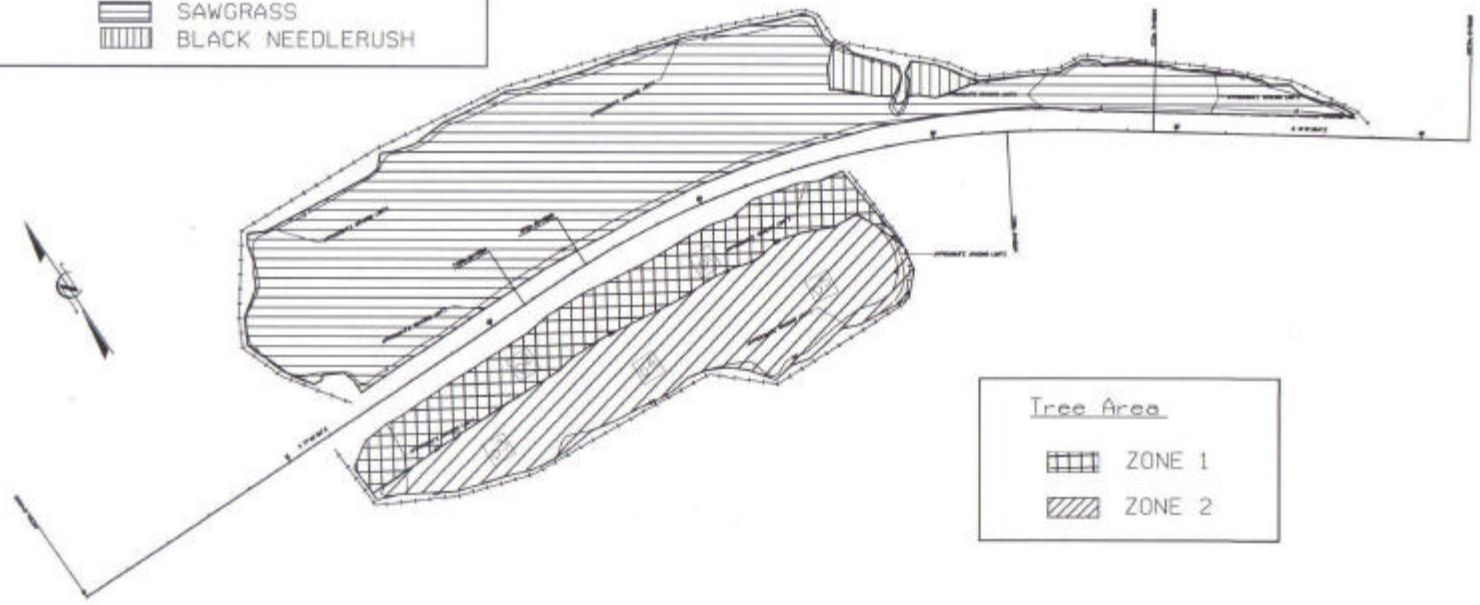
**PHOTO AND VEGETATION PLOT LOCATIONS,
SITE PHOTOS**

Dare County, North Carolina
 Mashoes Road Mitigation Site
 Planting Plan



PROJ. DISTANCE NO.	SHEET NO.	TOTAL SHEETS
6.231010A	10A.1	
STATE PROJECT NO.	F.R. PROJ. NO.	DESCRIPTION

Marsh Area

-  SAWGRASS
-  BLACK NEEDLERUSH

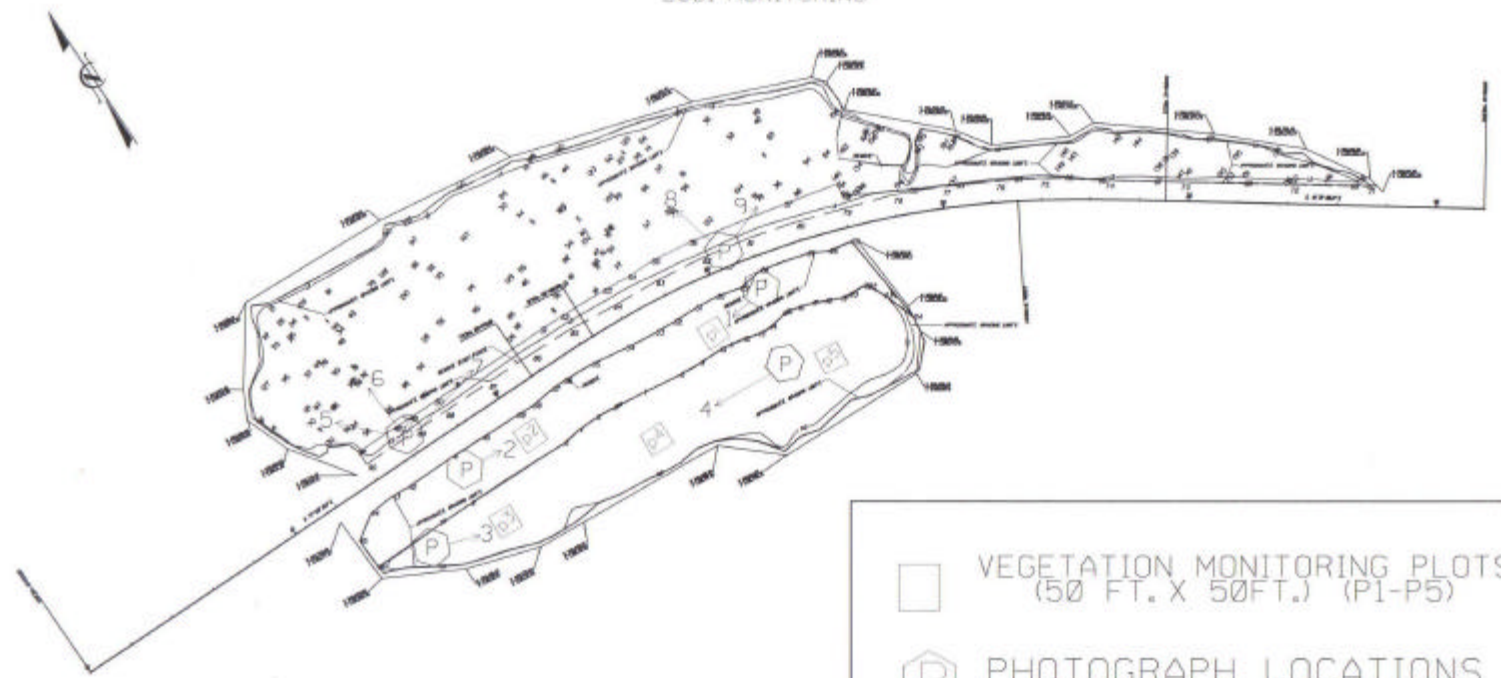


Tree Area

-  ZONE 1
-  ZONE 2

DARE COUNTY, NORTH CAROLINA
 MASHOES ROAD MITIGATION SITE
 Photo and Vegetation Plot Locations
 2001 MONITORING

PROJ. REFERENCE NO.	SHEET NO.	TOTAL SHEETS
R-230100A	10/11	
STATE PROJECT NO.	F.R. PROJ. NO.	DESCRIPTION



	VEGETATION MONITORING PLOTS (50 FT. X 50 FT.) (P1-P5)
	PHOTOGRAPH LOCATIONS

Mashoes Road - Photos



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6

Mashoes Road - Photos



Photo 7



Photo 8



Photo 9