

# ANNUAL REPORT FOR 2003



**Mashoes Road Mitigation Site**  
**Dare County**  
**Project No. 8.T051402**  
**TIP No. R-2551WM**



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## 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 attempts to control *Phragmites*. The east side of the site was planted with marsh grass in the spring of 2001. 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, and the west side has five permanent vegetation plots.

The daily rainfall data depicted on the monitoring gauge graphs is recorded from an on-site rain gauge. Historical rainfall data used for the 30-70 percentile was recorded at the Manteo Rain Gauge, maintained by the NC State Climate Office.

As requested by the resource agencies NCDOT used GPS to survey the slightly elevated section in the center of the east side of the site on December 3, 2003. The GPS survey resulted in an area of 0.19 acres. However, it is noted that some marsh grasses are re-establishing in this area.

Hydrologic monitoring indicated that the site is continuing toward success. Under average conditions for 2003, all nine of the groundwater gauges exceeded the jurisdictional hydrologic success for at least 12.5% of the growing season. Nine of the ten surface gauges showed steady tidal influence that maintained a water elevation above zero under normal conditions for at least 25% of the growing season. Only one gauge did not meet the criteria of 25% (22.3% for Gauge S2).

Vegetation monitoring, on the west side (tree area) of the restoration area, yielded 574 trees per acre; above the 320-tree requirement. A frequency of 77.0% for the targeted vegetative species was identified on the east side of the site (marsh grasses area). A vegetative scale value of 4.5 was recorded in this area.

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 2003 at the Mashoes Road 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)
October 2000	Phragmites Treated
March – November 2001	Hydrologic Monitoring (Entire Site, Restart Year 1)
April 2001	Phragmites Treated
May 2001	Marsh Grasses Planted
August 2001	Tree Vegetation Monitoring (Restart Year 1)
August 2001	Marsh Vegetation Monitoring (Year 1)
March – November 2002	Hydrologic Monitoring (Year 2)
July 2002	Tree Vegetation Monitoring (Year 2)
July 2002	Marsh Vegetation Monitoring (Year 2)
November 2002	Phragmites Treated
March – November 2003	Hydrologic Monitoring (Year 3)
October 2003	Phragmites Treated
October 2003	Tree Vegetation Monitoring (3 yr.)
October 2003	Marsh Vegetation Monitoring (3 yr.)

### 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 are providing mitigation for through November 2003.

**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

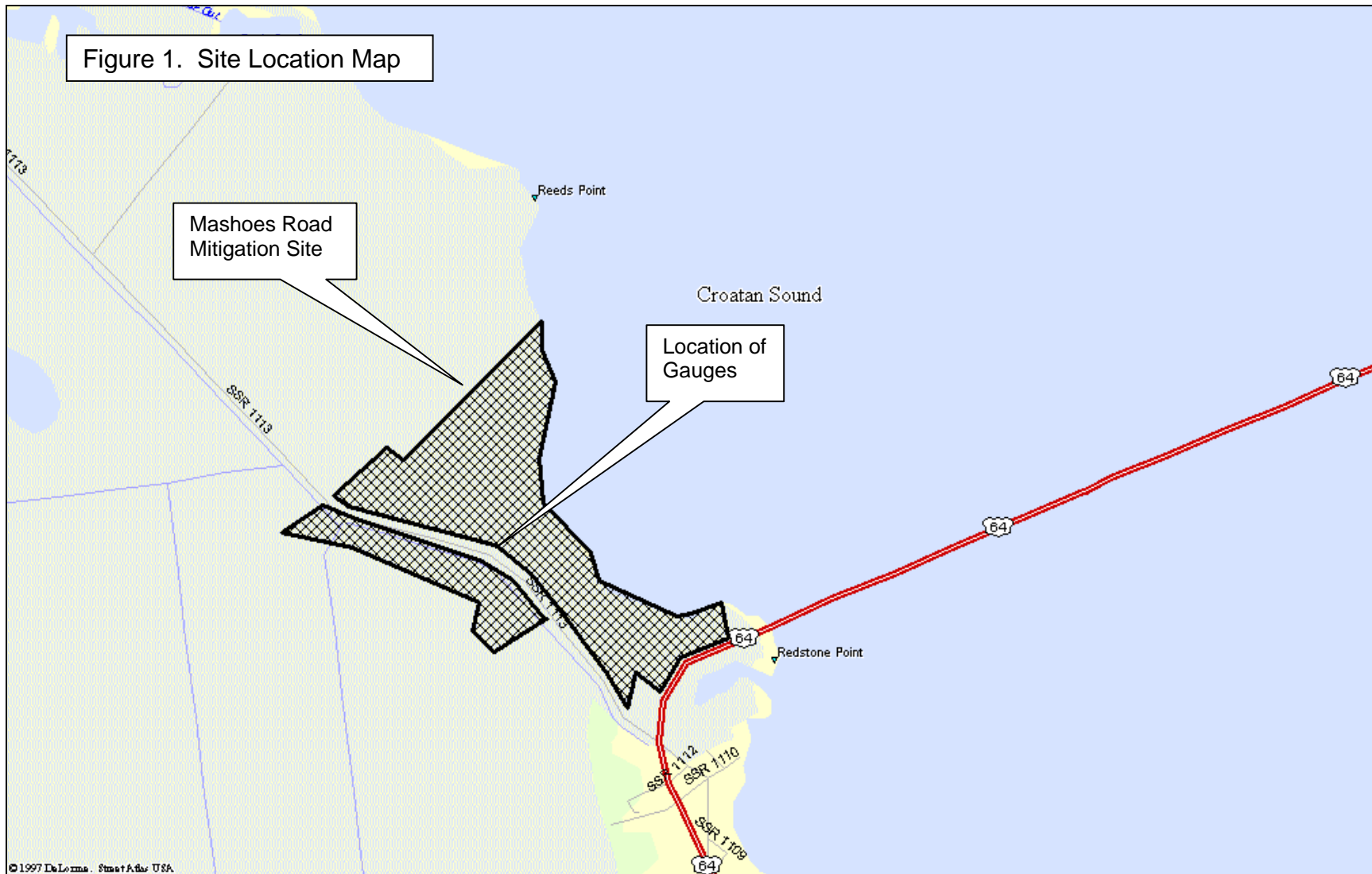
### **1.5 Permit Requirements**

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, 2001, 2002, and 2003. The planting of marsh grasses 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.<sup>1</sup> 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**

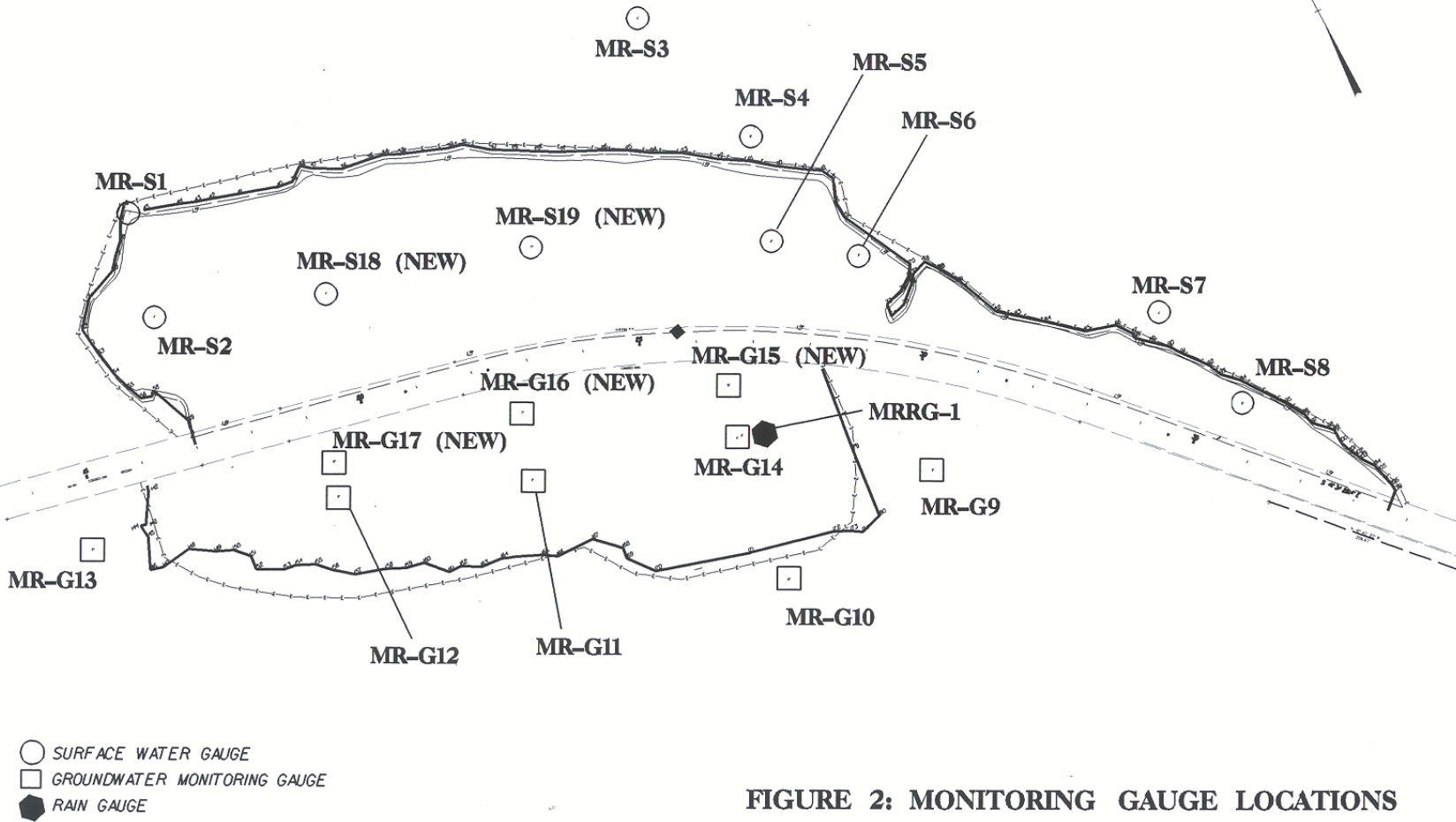
Historically, the wetlands on this tract were part of the coastal marsh of the surrounding area. The primary sources of hydrology are tidal flushing of the system and groundwater. After an extensive study of the site's hydrology, it was concluded that filling of the ponds, and grading down of the upland 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 gauge 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.

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

**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 2003 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 need to maintain a water elevation above 0 for at least 25% of the growing season. Since the criteria in the mitigation plan were unclear whether hydrology should be met in maximum consecutive days or total days, the table (Table 2) shows both sets of data (All ten gauges met the hydrology criteria using maximum consecutive and total days in 2003).

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 the 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. 2003 HYDROLOGIC MONITORING RESULTS**

Monitoring Gauge	< 5%	5 - 8%	8 – 12.5%	> 12.5%	Maximum Consecutive Days >25%	Total Days	Success Dates
MR-S1 (ref)					78.1	97.9	
MR-S2					22.3	78	
MR-S3 (ref)					100	100	
MR-S4 (ref)					100	100	
MR-S5					100	100	
MR-S6					100	100	
MR-S7 (ref)					100	100	
MR-S8					87	87	
MR-G9 (ref)*				×	100		March 13-Nov 25
MR-G10 (ref)*				×	64.7		April 2-Sept 15 Sept 25-Nov 25
MR-G11*				×	100		March 13-Nov 25
MR-G12*				×	89.1		March 13-Oct 28
MR-G13 (ref)*				×	89.1		March 13-Nov 17
MR-G14*				×	100		March 13-Nov 25
MR-G15*				×	100		March 13-Nov 25
MR-G16*				×	100		March 13-Nov 25
MR-G17*				×	100		March 13-Nov 25
MS-S18					100	100	
MS-S19					100	100	

\*Gauge met success criterion during an average rainfall month (March, June, August, and October).

Notes: “MR” denotes Mashoes Road site gauges.

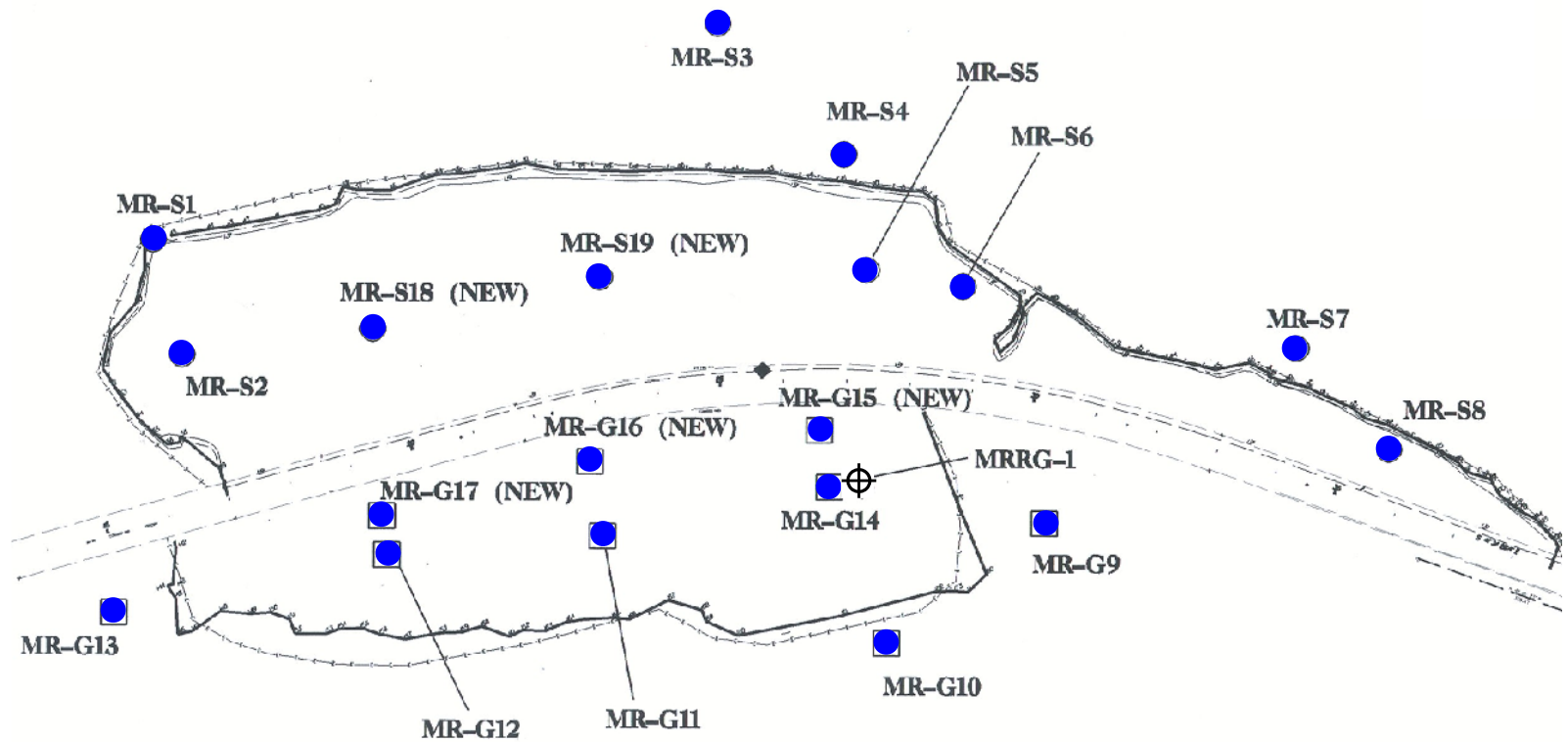
“S” denotes surface gauges.

“G” denotes groundwater gauges.

“ref” denotes gauges in reference wetlands.

During the September download, all groundwater gauges were noted to have (1-3”) of standing water at the gauges.

Figure 3 provides a graphical representation of the hydrologic results. Gauges highlighted in blue indicate wetland hydrology for more than 12.5% of the growing season. Gauges highlighted in red show hydrology between 8% and 12.5% of the season, while those in green indicate hydrology between 5% and 8% of the season.



**Figure 3. 2003 Hydrologic Monitoring Gauge Results**

Hydrology Results

- < 5%
- 5 - 8%
- 8 - 12.5%
- > 12.5%

- ⊕ Rain Gauge
- Surface Gauge

Not to Scale



### **2.3.2 Climatic Data**

Figure 4 represents an examination of the local climate in comparison with historical data in order to determine whether 2003 was “average” in terms of climate conditions. The two lines represent the 30<sup>th</sup> and 70<sup>th</sup> percentiles of monthly precipitation for Manteo, NC. The bars are monthly rainfall totals for 2002 and 2003. The historical data was collected from the State Climate Office of North Carolina.

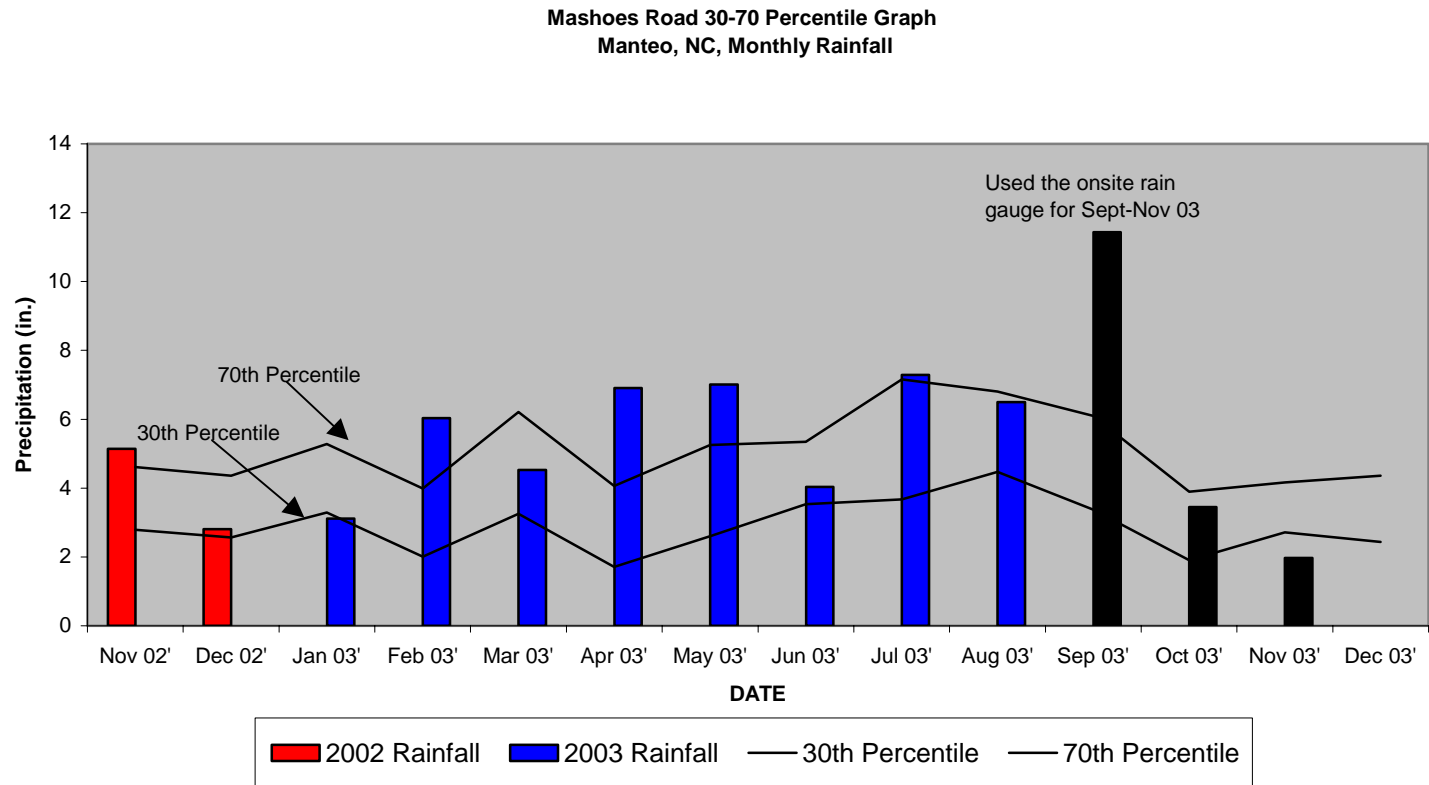
For the 2003-year, January and November experienced below average rainfall. The months of December (02'), March, June, August, and October all recorded average rainfall for the site. November (02'), February, April, May, July, and September experienced above average rainfall. The rainfall data from the onsite rain gauge was used for the months of (September-November). Overall, 2003 experienced an average rainfall year.

### **2.4 Conclusions**

For the 2003 monitoring year, all nine groundwater gauges met the jurisdictional hydrologic success of at least 12.5% of the growing season. Nine of the ten surface gauges showed steady wind tidal influence that maintained a water elevation above zero under normal conditions for at least 25% of the growing season. Only one of the gauges did not meet the criteria of 25% (22.3% for Gauge S2).

The overall monitoring results show that the site performed successfully from a hydrological standpoint in 2003.

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



### **3.0 VEGETATION: MASHOES ROAD MITIGATION SITE (YEAR 3 MONITORING)**

#### **3.1A Success Criteria (Trees)**

NCDOT will monitor the site for five years or until the success criteria are 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.

#### **3.1B Success Criteria (Marsh Grasses)**

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.

#### **3.2A Description of Species**

The following species were planted in the Wetland Restoration Area:

##### **Zone 1: Wetland Tree Reforestation (2.7 acres)**

*Taxodium distichum*, Baldcypress

*Quercus phellos*, Willow Oak

*Nyssa sylvatica* var. *sylvatica*, Blackgum

*Fraxinus pennsylvanica*, Green Ash

*Quercus nigra*, Water Oak

##### **Zone 2: Wetland Tree Reforestation (4.3 acres)**

*Taxodium distichum*, Baldcypress

*Fraxinus pennsylvanica*, Green Ash

*Quercus nigra*, Water Oak

*Quercus phellos*, Willow Oak

### 3.2B Description of Species

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

### 3.3A Results of Vegetation Monitoring

**TABLE 3: 2003 VEGETATIVE MONITORING RESULTS (TREE AREA, WEST SIDE)**

ZONE	Plot #	Green Ash	Willow Oak	Baldcypress	Blackgum	Water Oak	Total (3 year)	Total (at planting)	Density (trees/acre)
1	1	12	4	5	4		25	40	425
	2	17	6	10	7		40	40	680
<b>ZONE 1 AVERAGE</b>									<b>553</b>
2	3	7	4	32			43	49	597
	4	9	5	13		5	32	32	680
	5	4	10	10		1	25	35	486
<b>ZONE 2 AVERAGE</b>									<b>588</b>
<b>TOTAL AVERAGE</b>									<b>574</b>

**Site Notes:** Other species noted: *Scirpus americanus*, sawgrass, black needle rush, *Bidens* sp., ragweed, *Baccharis halimifolia*, fennel, phragmites, redbay, cattail, golden rod, wax myrtle, Atlantic white cedar, red maple, and *Pluchea* sp.

**TABLE 4: 2003 VEGETATIVE MONITORING RESULTS (MARSH GRASS AREA, EAST SIDE)**

ZONE	Plot #	Scale Factor	Black Needle Rush	Sawgrass	Frequency	Notes
	1	4.0				Phragmites, Cattail
	2	5.0		☐	☐	Phragmites
	3	5.0		☐	☐	Phragmites, <i>Juncus</i> sp.
	4	5.0		☐	☐	Phragmites
	5	5.0				Phragmites, Cattail
	6	4.0		☐	☐	<i>Scirpus</i> sp., <i>Cattail</i>
	7	4.0				Phragmites, <i>Scirpus</i> sp.
	8	5.0		☐	☐	Phragmites, Cattail
	9	5.0		☐	☐	<i>Baccharis</i> sp., <i>Spartina patens</i> , Broomsedge
	10	5.0		☐	☐	Phragmites, <i>Scirpus</i> sp.
	11	5.0		☐	☐	Phragmites, dog fennel, Bermuda grass
	12	5.0		☐	☐	<i>Scirpus</i> sp.
	13	5.0		☐	☐	<i>Juncus</i> sp.
	14	5.0		☐	☐	Phragmites
	15	4.0		☐	☐	Phragmites
	16	4.0		☐	☐	Phragmites
	17	2.0				<i>Echinochloa</i> sp.
	18	3.0		☐	☐	Phragmites
	19	0.0				Bare ground
	20	5.0				Phragmites, Cattail
	21	5.0				Phragmites, <i>Scirpus</i> sp., Cattail
	22	5.0		☐	☐	<i>Scirpus</i> sp.
	23	5.0		☐	☐	<i>Scirpus</i> sp.
	24	5.0		☐	☐	<i>Scirpus</i> sp.
	25	5.0		☐	☐	Phragmites, <i>Juncus</i> sp.
	26	5.0		☐	☐	<i>Echinochloa</i> sp.
	27	5.0		☐	☐	Phragmites
	28	5.0				Phragmites
	29	5.0		☐	☐	<i>Baccharis</i> sp., Golden rod, Cattail
	30	3.0				Phragmites
	31	4.0		☐	☐	Cattail
	32	5.0		☐	☐	Phragmites
	33	5.0		☐	☐	Phragmites
	34	5.0				Phragmites, <i>Scirpus</i> sp.
	35	5.0		☐	☐	<i>Scirpus</i> sp.
	36	5.0		☐	☐	<i>Scirpus</i> sp.
	37	3.0				<i>Scirpus</i> sp.
	38	5.0		☐	☐	<i>Scirpus</i> sp., Cattail
	39	2.0				
	40	5.0		☐	☐	Phragmites
	41	5.0		☐	☐	<i>Scirpus</i> sp., Cattail
	42	0.0				Bare ground
	43	5.0		☐	☐	Phragmites, <i>Spartina patens</i>
	44	5.0		☐	☐	
	45	4.0		☐	☐	Phragmites
	46	5.0				Phragmites, <i>Scirpus</i> sp.

ZONE	Plot #	Scale Factor	Black Needle Rush	Sawgrass	Frequency	Notes
	47	5.0		<input type="checkbox"/>	<input type="checkbox"/>	<i>Juncus sp.</i>
	48	5.0		<input type="checkbox"/>	<input type="checkbox"/>	<i>Scirpus sp.</i>
	49	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites
	50	5.0				Phragmites, <i>Juncus sp.</i>
	51	4.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites
	52	0.0				bare ground
	53	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites, <i>Scirpus sp.</i>
	54	5.0				Phragmites, Golden rod, <i>Baccharis sp.</i> , <i>Scirpus sp.</i>
	55	5.0		<input type="checkbox"/>	<input type="checkbox"/>	<i>Spartina patens</i> , <i>Juncus sp.</i>
	56	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites
	57	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites
	58	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	59	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites
	60	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites, <i>Scirpus sp.</i>
	61	5.0		<input type="checkbox"/>	<input type="checkbox"/>	<i>Juncus sp.</i>
	62	5.0				Phragmites, <i>Scirpus sp.</i> , Cattails
	63	4.0				Phragmites, <i>Scirpus sp.</i>
	64	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites, <i>Scirpus sp.</i>
	65	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	66	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites
	67	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites, <i>Scirpus sp.</i>
	68	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites, <i>Scirpus sp.</i>
	69	4.0		<input type="checkbox"/>	<input type="checkbox"/>	<i>Juncus sp.</i>
	70	5.0		<input type="checkbox"/>	<input type="checkbox"/>	<i>Spartina patens</i>
	71	5.0		<input type="checkbox"/>	<input type="checkbox"/>	<i>Scirpus sp.</i>
	72	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites
	73	5.0				Phragmites
	74	5.0		<input type="checkbox"/>	<input type="checkbox"/>	<i>Scirpus sp.</i>
	75	5.0				<i>Scirpus sp.</i> , Cattails
	76	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Cattail, <i>Scirpus sp.</i> , <i>Juncus sp.</i>
	77	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites
	78	4.0				Phragmites
	79	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites, <i>Scirpus sp.</i> , <i>Juncus sp.</i>
	80	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites
	81	5.0				<i>Scirpus sp.</i>
	82	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Broomsedge
	83	0.0				Bare ground
	84	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites, Bermuda grass
	85	4.0				Phragmites, <i>Scirpus sp.</i> , <i>Spartina patens</i>
	86	3.0				Phragmites, <i>Scirpus sp.</i> , <i>Juncus sp.</i>
	87	4.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites, Cattail
	88	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites
	89	4.0				Phragmites, Golden rod
	90	5.0		<input type="checkbox"/>	<input type="checkbox"/>	Phragmites, <i>Scirpus sp.</i>
	91					Open water
	92	5.0				Phragmites, <i>Juncus sp.</i>

ZONE	Plot #	Scale Factor	Black Needle Rush	Sawgrass	Frequency	Notes
	93	5.0				Phragmites, <i>Scirpus</i> sp., <i>Juncus</i> sp.
	94	4.0				Phragmites, <i>Scirpus</i> sp.
	95	5.0				Bermuda grass
	96	4.0				Phragmites, <i>Scirpus</i> sp.
	97	5.0				Phragmites, <i>Scirpus</i> sp.
	98	3.0				Cattail
	99	5.0				Phragmites, <i>Spartina patens</i>
	100	5.0				Phragmites, Cattail
	101	5.0				
	102	5.0				Phragmites, <i>Scirpus</i> sp.
	103	5.0				<i>Scirpus</i> sp., Cattail
	104	5.0				Phragmites
	105	5.0				Phragmites, <i>Scirpus</i> sp.
	106	4.0				Phragmites, <i>Juncus</i> sp.
	107	5.0				<i>Scirpus</i> sp.
	108	5.0				Phragmites
	109	5.0				Phragmites, <i>Juncus</i> sp.
	110	4.0				Phragmites
	111	5.0				Phragmites, <i>Scirpus</i> sp.
	112	4.0				Phragmites
	113	4.0				<i>Scirpus</i> sp.
	114	5.0				Phragmites
	115	5.0				Phragmites, Cattail, <i>Juncus</i> sp.
	116	5.0				<i>Scirpus</i> sp.
	117	4.0				Phragmites
	118	5.0				Phragmites, Cattail
	119	5.0				Phragmites
	120	5.0				Phragmites, <i>Scirpus</i> sp.
	121	5.0				Cattail
	122	4.0				Phragmites, Cattail
	123	5.0				Phragmites, <i>Scirpus</i> sp.
	124	5.0				Phragmites, <i>Scirpus</i> sp.
	125	5.0				Phragmites
	126	5.0				Phragmites, <i>Scirpus</i> sp.
	127	5.0				Phragmites, Cattail
	128	2.0				<i>Echinochloa</i> sp.
	129	5.0				Phragmites, <i>Juncus</i> sp.
	130	2.0				<i>Echinochloa</i> sp.
	131	3.0				Phragmites
	132	5.0				Phragmites
	133	3.0				Phragmites
	134	5.0				
	135	5.0				
	136	2.0				Phragmites, Cattail
	137	3.0				<i>Scirpus</i> sp., Cattail
	138	5.0				Cattail



### 3.4A Conclusions (Tree Area)

Of the 399 acres on this site, approximately 7 acres involved tree planting. This side (Westside) of the site has become well vegetated with marsh grasses. There were 5 plots established throughout the planting areas, encompassing all plant communities. The 2003 vegetation monitoring revealed an average density of 574 trees per acre, which is well above the 320 trees per acre required by the success criteria.

### 3.4B Conclusions (Marsh Area)

- Percent Frequency of Target Species **77.0%**  
Frequency of 70% required.
- Vegetative Cover Scale Value **4.5**  
Scale Value of 5 required for 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 and in October 2003. The vegetative coverage does not currently meet the success criteria. However, the vegetative coverage and frequency do appear to be on track for year three.

Phragmites at the Mashoes Road Mitigation Site has been treated continuously throughout the monitoring cycle. It appears that the herbicide treatments have been somewhat successful in that the percent frequency of target species is above the 70% required at the end of the 5-year monitoring cycle. Phragmites is and will continue to be a nuisance at this site but the target vegetation is present. NCDOT will continue to treat and monitor the phragmites at the Mashoes Road Mitigation Site.

NCDOT will continue vegetation monitoring at the Mashoes Road Mitigation Site.

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

The 2003-year represents the fifth full growing season (the third official season) that the hydrologic data has been examined. All nine groundwater-monitoring gauges exceeded the jurisdictional wetland hydrology for 12.5% of the growing season. When considering maximum cumulative days, nine of the ten surface gauges met the 25% requirement of daily flooding onsite during this same period. Only one of the gauges did not meet the criteria of 25% (22.3% for Gauge S2). The overall monitoring results show that the site performed successfully from a hydrology standpoint.

Vegetation monitoring on the west side (tree area) of the restoration area yielded 574 trees per acre, above the 320-tree requirement. A frequency of 77.0% for the targeted vegetative species was found on the east side (marsh grasses area) of the site. A frequency of 70% is required. A vegetative scale value of 4.5 was recorded (scale value of 5 is required by year 5).

NCDOT will continue to monitor the site for both hydrologic and vegetation success at the Mashoes Road Mitigation Site.

**APPENDIX A**

**GAUGE DATA GRAPHS**



## **APPENDIX B**



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

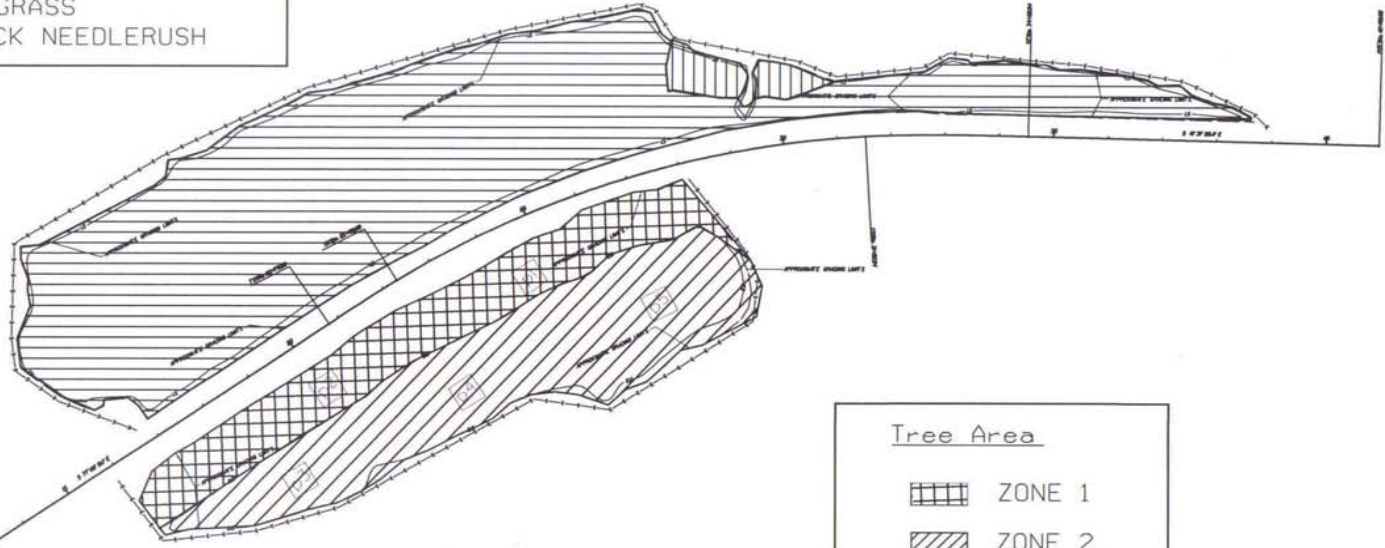


# Dare County, North Carolina Mashoes Road Mitigation Site Planting Plan



PRJ. REFERENCE NO.	SHEET NO.	TOTAL SHEETS
B-2551WM	WM-1	
STATE PROJECT NO.	F.A. PROJ. NO.	DESCRIPTION

Marsh Area

	SAWGRASS
	BLACK NEEDLERUSH



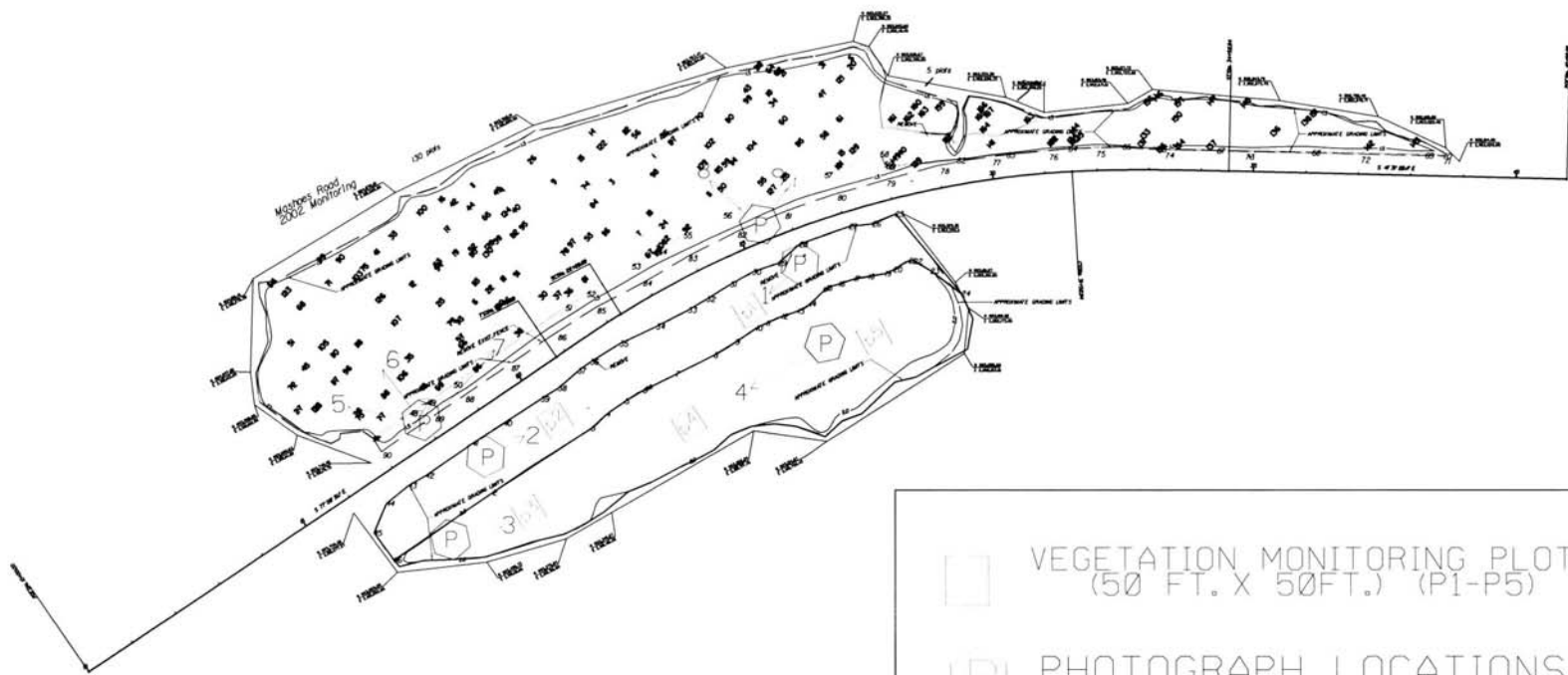
Tree Area

	ZONE 1
	ZONE 2

PROJ. REFERENCE NO.	SHEET NO.	TOTAL SHEETS
R-2551WMA	WM-1	
STATE PROJECT NO.	F.A. PROJ. NO.	DESCRIPTION

DARE COUNTY, NORTH CAROLINA  
MASHOES ROAD MITIGATION SITE

Photo and Vegetation Plot Locations



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

PHOTOGRAPH LOCATIONS



# MASHOES ROAD



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6



Photo 7



Photo 8



Photo 9