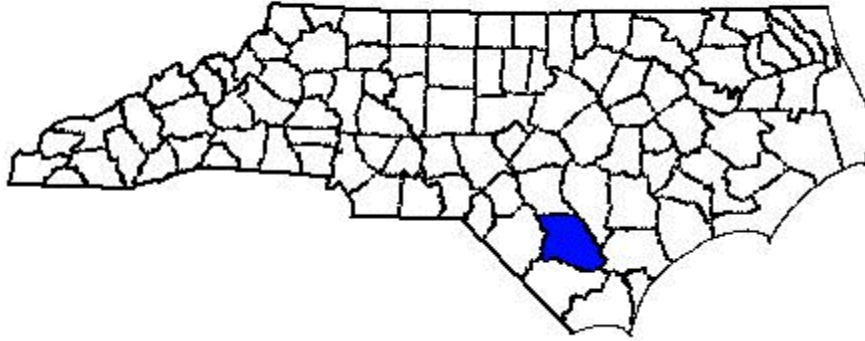


ANNUAL REPORT FOR 2003



Dowd Dairy Farm Mitigation Site
Bladen County
Project No. 8.1241802
TIP No. R-2204WM



Prepared By:
Office of Natural Environment & Roadside Environmental Unit
North Carolina Department of Transportation
December 2003

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EXECUTIVE SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Dowd Dairy Farm Mitigation Site. Phase I of this site was constructed in 1998 and Phase II was completed in 2000. Monitoring of the site began in 1999 following Phase I site construction. The monitoring activities in 2003 represent the third official year of monitoring following completion of the entire site. The site must demonstrate hydrologic and vegetation success for a minimum of five years or until the project is deemed successful.

The site is being monitored with thirty-eight groundwater-monitoring gauges, two rain gauges, and thirty-eight vegetation plots.

In May 2003, NCDOT and agency representatives met to conduct an onsite review. Two additional groundwater gauges were installed in June 2003 to record hydrology near groundwater gauge (G1).

Rainfall data has been acquired from an onsite rain gauge. Also, monthly rainfall data recorded from a rain gauge maintained by the NC State Climate Office in Elizabethtown was used for the historical data.

For 2003, hydrologic monitoring indicated that twenty-nine gauges met jurisdictional hydrologic success of at least 12.5% during the growing season; conversely, six gauges met hydrology less than 12.5% of the growing season. Several gauges were replaced or misplaced during the 2003-growing season, therefore these gauges may not contain the correct gauge serial number or the data may be missing. These gauges are noted in Table 2.

The 2003 vegetation monitoring of the 619 acres of planted areas revealed an average density of 499 trees per acre, which is above the minimum requirement of 320 trees per acre. NCDOT also monitored the site for nuisance species such as pine and sweetgum. NCDOT recognizes that a problem may exist in some areas and proposes waiting until year five of monitoring to address any concerns in a comprehensive manner. At that time, a contract will be let to address the situation, if warranted.

Based on the monitoring results from the 2003 growing season, NCDOT will continue to monitor hydrology and vegetation on the Dowd Dairy Mitigation Site.

1.0 INTRODUCTION

1.1 Project Description

The Dowd Dairy Farm Wetland Mitigation Site is located 7 miles north of Elizabethtown and 2 miles east of White Oak in Bladen County (Figure 1). It is bounded by SR 1324 (Dowd Dairy Farm Road) to the north, SR 1332 (Oak Grove Church Road) to the west, and dense forest to the south and east. The site represents a Coastal Plain interstream divide converted for agricultural use. The site receives drainage from elevated sandy terraces and discharges into Ellis Creek and Panther Branch, tributaries of the Cape Fear River.

The site encompasses approximately 658 acres and is designed as a mitigation site for the Cape Fear River Basin.

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 on the Dowd Dairy Farm Mitigation Site.

Activities in 2003 reflect the third year of monitoring following the construction of Phase II at the site. Included in this report are analyses of both hydrologic and vegetative monitoring results, as well as local climate conditions throughout the growing season.

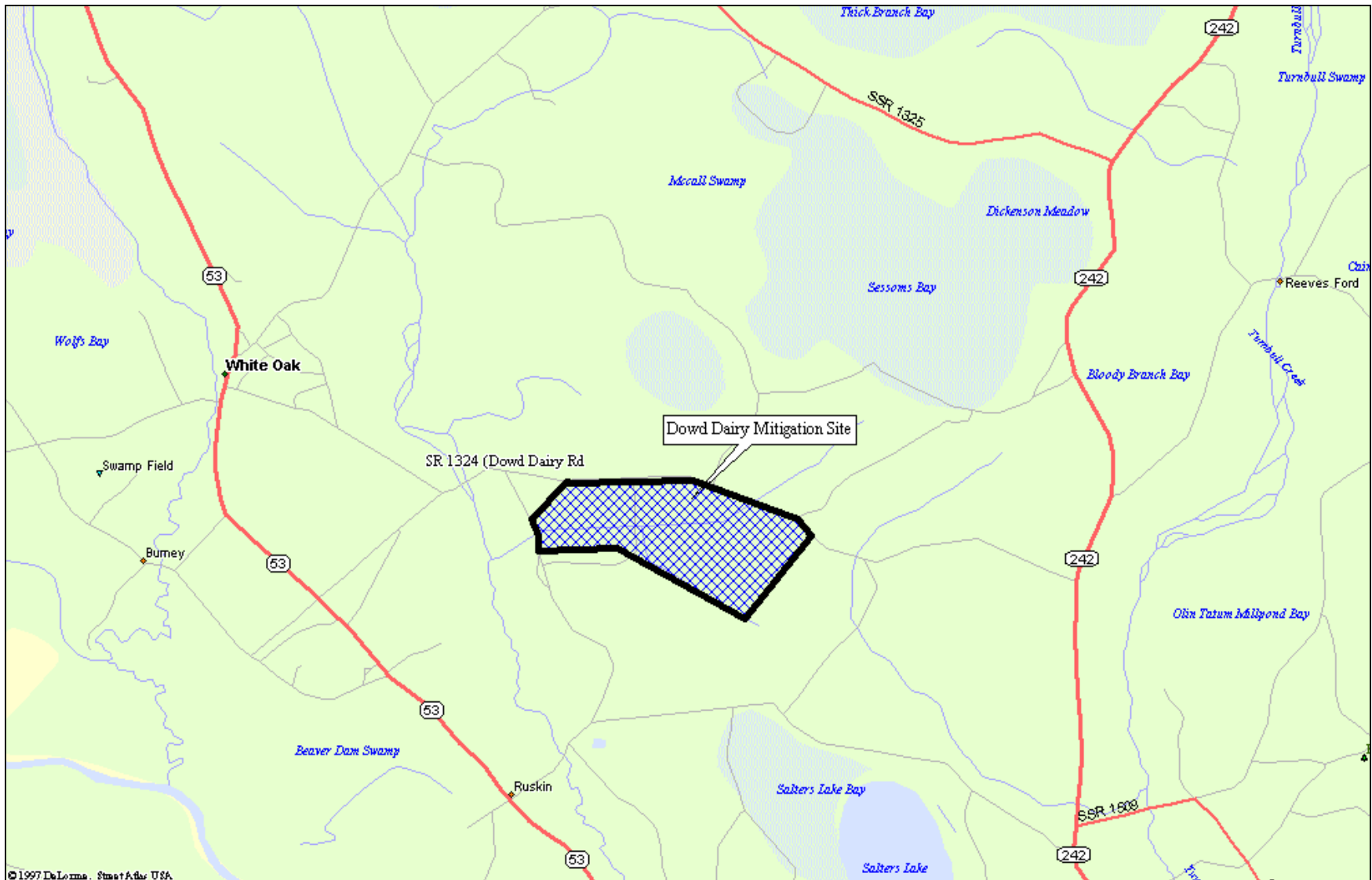


FIGURE 1: SITE LOCATION MAP

1.3 Project History

Summer 1998	Construction – Phase I
Spring 1999	Tree Planting – Phase I
February – April 1999	Installation of Monitoring Gauges
March – November 1999	Hydrologic Monitoring (Year 1)
September 1999	Construction Begins – Phase II
November 1999	Vegetation Monitoring (Year 1)
March – November 2000	Hydrologic Monitoring (Year 2)
June 2000	Construction Completed – Phase II
November 2000	Vegetation Monitoring (Year 2)
February 2001	Tree Planting – Phase II
March – November 2001	Hydrologic Monitoring (Restart Year 1)
October 2001	Vegetation Monitoring (Restart Year 1)
August 2002	Vegetation Monitoring (Year 2)
March – November 2002	Hydrologic Monitoring (Year 2)
May 2003	Onsite Agency Meeting
August 2003	Vegetation Monitoring (Year 3)
March – November 2003	Hydrologic Monitoring (Year 3)

Phase I construction consisted of clearing, grubbing, ripping, filling lateral ditches, and adding ditch plugs. Phase II construction consisted of filling in the central canal. Completion of the site was delayed to June 2000 due to the saturated conditions from the hurricane activity in the fall of 1999.

1.4 Debit Ledger

Because of its size, Dowd Dairy Farm will provide mitigation for several highway projects. Table 1 shows the projects that this site is providing mitigation for as of November 2003.

Table 1. Dowd Dairy Debit Ledger

	Headwater Swamp (Riverine)	Nonriverine Swamp Forest	Nonriverine Wet Hardwood Forest	Wetland/ Upland Restoration	Nonriverine Atlantic White Cedar	Total
Acres at Start	13	198	357	20	70	658
TIP Project Debits						
R-2204A	0	17	0	0	0	17
R-2238AA	0.6	5.8	2.5	0	0	8.9
R-2562AA/AB	5.8	0	16.4	0	0	22.2
B-3412	0	1.18	0	0	0	1.18
B-3413	0	1.17	0	0	0	1.17
B-3409	0.8	0	0	0	0	0.8
Remaining Acres	5.8	172.85	338.1	20	70	606.75

1.5 Permit Requirements

As shown on the ledger, the Dowd Dairy Mitigation Site has been debited to compensate for impacts to TIP Project Numbers R-2204A (USACE Action ID number 199602560), R-2562 AA/BB (USACE Action ID number 199304806), R-2238 AA (USACE Action ID Number 199302820), B-3412 (USACE Action ID Number 200200729), B-3413 (USACE Action ID Number 200200716) and B-3409 (USACE Action ID Number 200201004).

The permits for project R-2562AA/AB and R-2238AA stated that grading on the restoration site should be completed no later than August 1, 2000, and all planting should be completed by March 1, 2001. All grading and planting have been completed.

The permit for project R-2204A stated that the annual monitoring reports should describe the overall success of the entire mitigation site and any recommended remedial actions that may become necessary. This report summarizes the findings for 2003.

The permits for projects B-3409, B-3412 and B-3413 contained no special conditions pertaining to the success criteria of the site that must be met in order for the site to be deemed successful.

2.0 HYDROLOGY

2.1 Success Criteria

In accordance with federal guidelines for wetland mitigation, the success criteria for hydrology state that the area must be inundated or saturated (within 12" of the surface) by surface or groundwater 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.

The growing season in Bladen County begins March 16 and ends November 14. The dates correspond to a 50% probability that temperatures will drop to 28° F or lower after March 16 and before November 14.¹ The growing season is 243 days; therefore the optimum duration for wetland hydrology is 31 days. Also, local climate must represent average conditions for the area.

2.2 Hydrologic Description

Historically, wetlands on the tract were created by a combination of radial groundwater and surface water flow from adjacent terraces, as well as precipitation and vertical groundwater fluctuations maintained within the site. After an extensive study of the site's hydrology, it was concluded that blocking and filling the drainage ditches within the site would elevate the groundwater to a level that would saturate the soil stratum within the required twelve inches. It was predicted that this, in addition to surface water and runoff would be sufficient to restore wetland hydrology.

Thirty-one groundwater-monitoring gauges, and two rain gauges were installed in 1999 (Figure 2). Five additional gauges were installed in transects along the main channel in 2001 to examine potential drainage effects of the large remaining canal. In June 2003, two additional groundwater gauges were installed. The rain gauges and groundwater monitoring gauges record daily readings of rainfall and depth to groundwater, respectively.

¹ Natural Resources Conversation Service, Soil Survey of Bladen County, North Carolina, p. 123.

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 groundwater gauge. This number was converted into a percentage of the 243-day growing season. Table 2 presents the hydrologic monitoring results for 2003.

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 growing season, while those in green indicate hydrology between 5% and 8%. Gauges highlighted in black indicate no wetland hydrology (less than 5% of the growing season).

Appendix A contains a plot of the groundwater depth for each monitoring gauge. Daily rainfall is included on each graph as bars (recorded by rain gauges located on the site). The maximum number of consecutive days that the groundwater was within 12 inches of the surface is noted on each graph.

Table 2. 2003 HYDROLOGIC MONITORING RESULTS

Monitoring Gauge	< 5%	5 - 8%	8 – 12.5%	> 12.5%	Actual %	Dates Meeting Success
DDF-G1+				×	43	March 17-June 28
DDF-G2			×		8.3	March 17-April 5
DDF-G3		×			7.4	March 17-April 3
DDF-G4	×				4.1	
DDF-G5+				×	38.4	March 17-May 17 May 23-Aug 23
DDF-G6*+				×	69.8	March 17-Sept 1
DDF-G7*+				×	14.5	March 17-April 20
DDF-G8				×	24.0	March 17-May 13 May 18-June 23
DDF-G9+				×	42.6	April 25-Aug 5 Sept 14-Nov 12
DDF-G10+				×	17.8	July 15-Aug 26
DDF-G12+				×	68.2	March 17-Aug 28
DDF-G13	×				2.5	
DDF-G14+				×	21.9	May 24-June 26 July 21-Aug 22
DDF-G15+				×	65.7	March 17-Aug 22 Sept 19-Nov 13
DDF-G16+				×	66.9	March 17-Aug 25
DDF-G17+				×	76.4	March 17-Sept 17
DDF-G18+				×	79.3	March 17-Sept 24
DDF-G19+				×	41.3	May 23-Aug 30
DDF-G20*					-	
DDF-G21+				×	61.5	April 29-Sept 25
DDF-G22+				×	20.5	March 17-April 23 July 2-Aug 20
DDF-G23+				×	75.5	March 17-Sept 14
DDF-G24+				×	69.7	March 17-Sept 1
DDF-G25+				×	44.3	March 17-June 4 June 7-Sept 22
DDF-G26+				×	91	March 17-Oct 23
DDF-G27+				×	32.0	March 18-June 3
DDF-G28+				×	100	March 17-Nov 14
DDF-G29+				×	100	March 17-Nov 14
DDF-G30+				×	43.0	March 17-June 28 July 1-Sept 1
DDF-G31+				×	73.4	March 17-Sept 10
DDF-G32+				×	27.5	March 17-May 21 July 1- Aug 31
DDF-G34				×	23.4	March 17-May 11
DDF-G35*					-	
DDF-G36*					-	
DDF-G37				×	15.6	March 17-April 22

DDF-G38				×	24.6	March 17-May 14 July 3-Aug 11
DDF-39			×		7.8	
DDF-40			×		7.8	

* Gauges have been replaced or misplaced without proper documentation.
Gauge data is not available.

+ Gauges met the success criterion during an average rainfall month (May, August, and September).

Specific Gauge Problems:

- For the 2003 monitoring year, several gauges were replaced or misplaced. Therefore these gauges may not contain the correct gauge serial number or the data may be missing for the entire growing season. These gauges are noted in Table 2.

2.3.2 Climatic Data

Figure 4 represents an evaluation 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 30th and 70th percentiles of monthly precipitation for Elizabethtown, NC. The bars are monthly rainfall totals for 2002 and 2003. The historical data was collected from the State Climate Office of North Carolina.

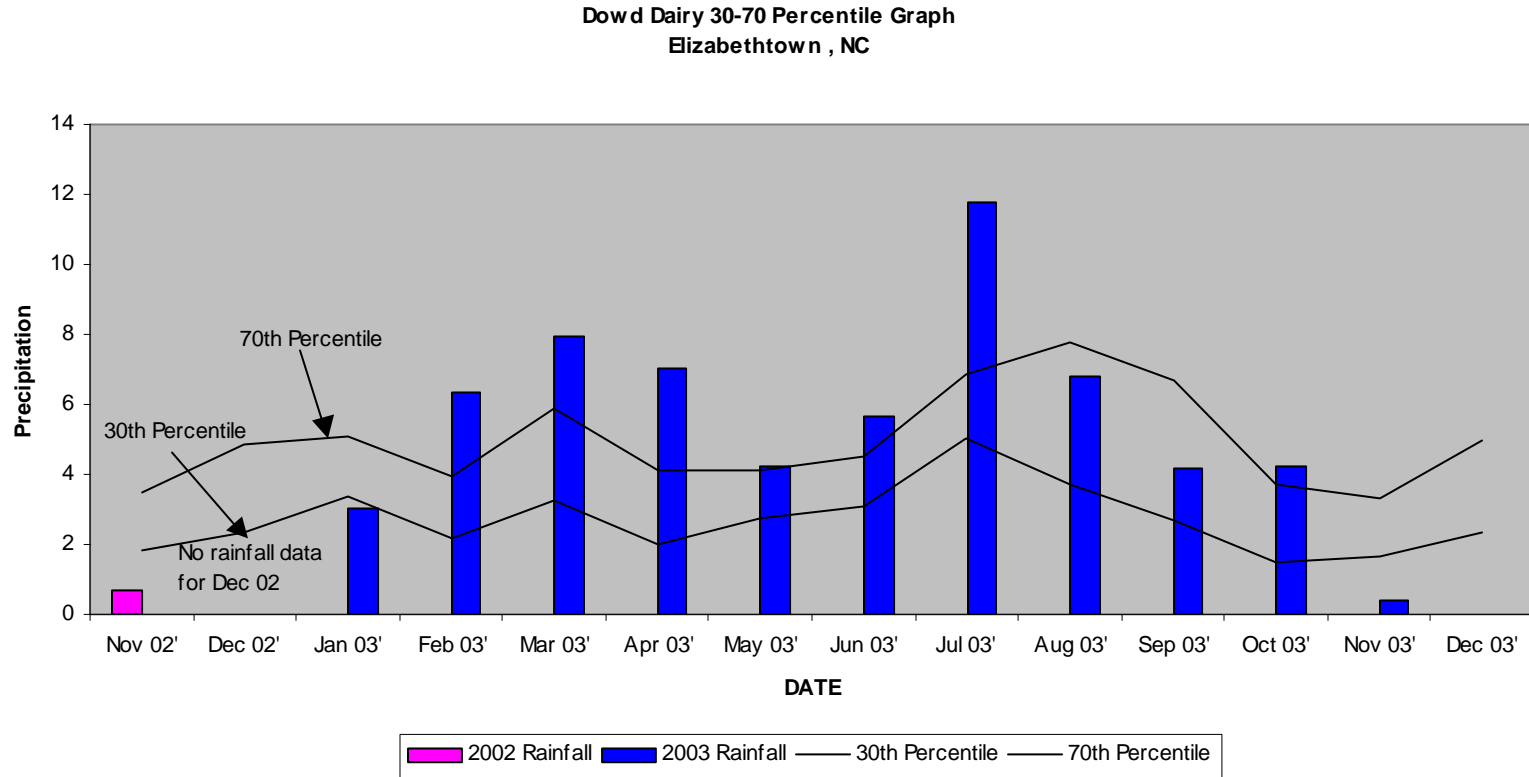
For the 2003-year, February, March, April, June, July, and October experienced above average rainfall. The months of November (02’), January and November recorded below average rainfall for the site. May, August, and September experienced average rainfall. The rainfall data for November 2002 was not included in the graph. Overall, 2003 experienced an average to above average rainfall year.

2.4 Conclusions

For the 2003 monitoring year, twenty-nine gauges met jurisdictional hydrologic success of at least 12.5% during the growing season; conversely, six gauges met hydrology less than 12.5% of the growing season. Several gauges were replaced or misplaced during the 2003-growing season, therefore these gauges may not contain the correct gauge serial number or the data may be missing. These gauges are noted in Table 2.

NCDOT will plan a site visit to correctly identify all gauges and their corresponding serial number prior to the 2004-monitoring season.

FIGURE 4. 30-70 PERCENTILE GRAPH



3.0 VEGETATION: DOWD DAIRY MITIGATION SITE (YEAR 3 MONITORING)

3.1 Success Criteria

Success criteria state that there must be a minimum of 320 trees per acre living for at least three consecutive years. A minimum of five character tree species must be present, with no more than 20% of any one species present, with the exception of Atlantic White Cedar, which may comprise up to 75% of the swamp forest restoration. Loblolly Pine cannot comprise more than 10% of the 320 trees per acre requirement.

3.2 Description of Species

The following tree species were planted in the Wetland Planting Areas:

Zone 1: Non-Riverine Wet Hardwood Forest (320.25 acres)

Quercus falcata var. *pagodaefolia*, Cherrybark Oak

Fraxinus pennsylvanica, Green Ash

Quercus laurifolia, Laurel Oak

Quercus lyrata, Overcup Oak

Quercus michauxii, Swamp Chestnut Oak

Nyssa aquatica, Water Tupelo

Quercus nigra, Water Oak

Quercus phellos, Willow Oak

Zone 2: Pine/Oak Hickory (17.68 acres)

Juglans nigra, Black Walnut

Nyssa sylvatica var. *sylvatica*, Blackgum

Pinus palustris, Longleaf Pine

Quercus falcata var. *falcata*, Southern Red Oak

Quercus nigra, Water Oak

Quercus alba, White Oak

Quercus phellos, Willow Oak

Liriodendron tulipifera, Tulip Poplar

Quercus lyrata, Overcup Oak

Zone 3: Non-Riverine Swamp Forest (201.2 acres)

Chamaecyparis thyoides, Atlantic White Cedar
Taxodium distichum, Baldcypress
Quercus falcata var. *pagodaefolia*, Cherrybark Oak
Fraxinus pennsylvanica, Green Ash
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Quercus nigra, Water Oak
Quercus phellos, Willow Oak
Nyssa aquatica, Water Tupelo

Zone 4: Headwater (Slope) Swamp (12.05 acres)

Taxodium distichum, Baldcypress
Quercus falcata var. *pagodaefolia*, Cherrybark Oak
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Quercus michauxii, Swamp Chestnut Oak
Quercus nigra, Water Oak
Quercus phellos, Willow Oak
Liriodendron tulipifera, Tulip Poplar

Zone 5: Atlantic White Cedar Slope (67.76 acres)

Chamaecyparis thyoides, Atlantic White Cedar
Taxodium Distichum, Baldcypress
Pinus serotina, Pond Pine
Quercus michauxii, Swamp Chestnut Oak
Nyssa aquatica, Water Tupelo
Quercus phellos, Willow Oak
Liriodendron tulipifera, Tulip Poplar
Quercus falcata var. *pagodaefolia*, Cherrybark Oak
Fraxinus pennsylvanica, Green Ash
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak

3.3 Results of Vegetation Monitoring

ZONE	Plot #	Swamp Chestnut Oak	Laurel Oak	Willow Oak	Cherrybark Oak	Water Tupelo	Water Oak	Green Ash	Overcup Oak	White Oak	Southern Red Oak	Longleaf Pine	Pond Pine	Blackgum	Black Walnut	Tulip Poplar	Baldcypress	Atlantic White Cedar	Total (3 year)	Total (at planting)	Density (Trees/Acre)
1	1			8	1			6	10										25	37	459
	3	5		5		1			4										15	40	255
	4	3	1	2		2		1	19										28	28	680
	5		5	3		4	1	9	12										34	39	593
	8	4	1	3		4		9											21	38	376
	14	5	3	6	9														23	39	401
	15	2	2	10	1	1													16	32	340
	17	14	3		7				1										25	41	415
	19	4	2	2		1			2										11	35	214
	28	3		10		3		8	3										27	37	496
	29	4	2	2				6	19										33	41	547
	30		3	10				18	2										33	39	575
	31	14			1	2		5	5										27	37	496
	32	6		5		2		9	3										25	38	447
	33		5		1			24	14										44	44	680
	34	7	3	1		6		6	10										33	39	575
																			ZONE 1 AVERAGE		472
2	2			1	1				21						1	1			25	25	680
	12			4			1				9								14	26	366
																			ZONE 2 AVERAGE		523

ZONE	Plot #	Swamp Chestnut Oak	Laurel Oak	Willow Oak	Cherrybark Oak	Water Tupelo	Water Oak	Green Ash	Overcup Oak	White Oak	Southern Red Oak	Longleaf Pine	Pond Pine	Blackgum	Black Walnut	Tulip Poplar	Baldcypress	Atlantic White Cedar	Total (3 year)	Total (at planting)	Density (Trees/Acre)
3	6		5	1	5		1	2	3								8	5	30	30	680
	7							10	2								20		32	40	544
	9			4													10	5	19	34	380
	10		5		3		2		10								12	1	33	44	510
	11		2	12	2				4								7	1	28	28	680
	20		1	2				10											13	37	239
	24		1	4	1				3								4	5	18	34	360
	25			6	6				6	6							1	6	31	31	680
	26			2					20	1							6	5	34	35	661
	27		1	6					1	10							4		22	36	416
	35				1	3			6	3							1		14	37	257
	36		4	6	1				3								2		16	36	302
		ZONE 3 AVERAGE																		476	
4	16	3			1				5								12		21	31	461
	18	7	3	1					1							1	9		22	35	427
			ZONE 4 AVERAGE																		444
5	13		2	1	7			4	3										17	24	482
	21			6									10				13		29	29	680
	22	8		2		4							1				8	2	25	27	630
	23	1		9		5							6				13		34	38	608
	37	12		9		5							6				15		47	47	680
	38	21		12					4				2	8			3		50	50	680
		ZONE 5 AVERAGE																		627	
		TOTAL AVERAGE																		499	

Site Notes:

Zone 1: Other species noted: goldenrod, briars, red maple, broomsedge, pine, sweetgum, stinkweed, sicklepod, trumpet creeper, *Juncus* sp., *Aster* sp., switchgrass, giant foxtail, fennel, sassafras, ragweed, *Baccharis halimifolia*, *Panicum* sp., woolgrass, cattail, and *Bidens* sp.

Zone 2: Other species noted: ragweed, *Aster* sp., *Juncus* sp., broomsedge, pine, goldenrod, *Panicum* sp., and cacti.

Zone 3: Other species noted: fennel, broomsedge, goldenrod, winged sumac, *Baccharis halimifolia*, cattail, stinkweed, *Juncus* sp., black willow, foxtail, sweetgum, briars, sassafras, ragweed, smartweed, sicklepod, bahia, winged sumac, woolgrass, and *Aster* sp. Planted green ash (10 ft. tall) noted outside of plot 9.

Zone 4: Other species noted: sweetgum, briars, fennel, red maple, broomsedge, *Aster* sp., and *Juncus* sp.

Zone 5: Other species noted: fennel, briars, sweetgum, red maple, bermuda grass, *Juncus* sp., cattail, *Aster* sp., winged sumac, and broomsedge.

3.4 Conclusions

Of the 658 acres on this site, approximately 619 acres involved tree planting. There were thirty-eight test plots established throughout the planting areas, covering all plant communities. The 2003 vegetation monitoring of the planted areas revealed an average density of 499 trees per acre, which is above the minimum requirement of 320 trees per acre. It should be noted that since this was a phased project, the majority of the plots contain 4-year old trees. The site was extremely wet at the time of monitoring.

NCDOT also monitored the site for nuisance species such as pine and sweetgum. These species were abundant around the perimeter of the site toward the woods and in the cut over area. NCDOT recognizes that a problem may exist in some areas and proposes waiting until year five of monitoring to address any concerns in a comprehensive manner. At that time, a contract will be let to address the situation, if warranted.

NCDOT will continue vegetation monitoring on the Dowd Dairy Mitigation Site.

4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS

Hydrologic monitoring for the 2003-monitoring year indicated that twenty-nine gauges met jurisdictional hydrologic success of at least 12.5% during the growing season; conversely, six gauges met hydrology less than 12.5% of the growing season. Several gauges were replaced or misplaced during the 2003-growing season, therefore these gauges may not contain the correct gauge serial number or the data may be missing. These gauges are noted in Table 2. NCDOT will plan a site visit to correctly identify all gauges and their serial numbers prior to the 2004 monitoring season.

The third year of vegetation monitoring (of the 619 acres planted in trees), revealed an average density of 499 trees per acre, which is above the minimum requirement of 320 trees per acre. NCDOT also monitored the site for nuisance species such as pine and sweetgum. NCDOT recognizes that a problem may exist in some areas and proposes waiting until year five of monitoring to address any concerns in a comprehensive manner. At that time, a contract will be let to address the situation, if warranted.

NCDOT will continue to monitor the Dowd Dairy Mitigation Site for hydrology and vegetation.

APPENDIX A
GAUGE DATA GRAPHS

APPENDIX B

SITE PHOTOS PHOTO AND VEGETATION PLOT LOCATIONS

DOWD DAIRY



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6

2003

DOWD DAIRY



Photo 7



Photo 8



Photo 9



Photo 10



Photo 11



Photo 12

DOWD DAIRY



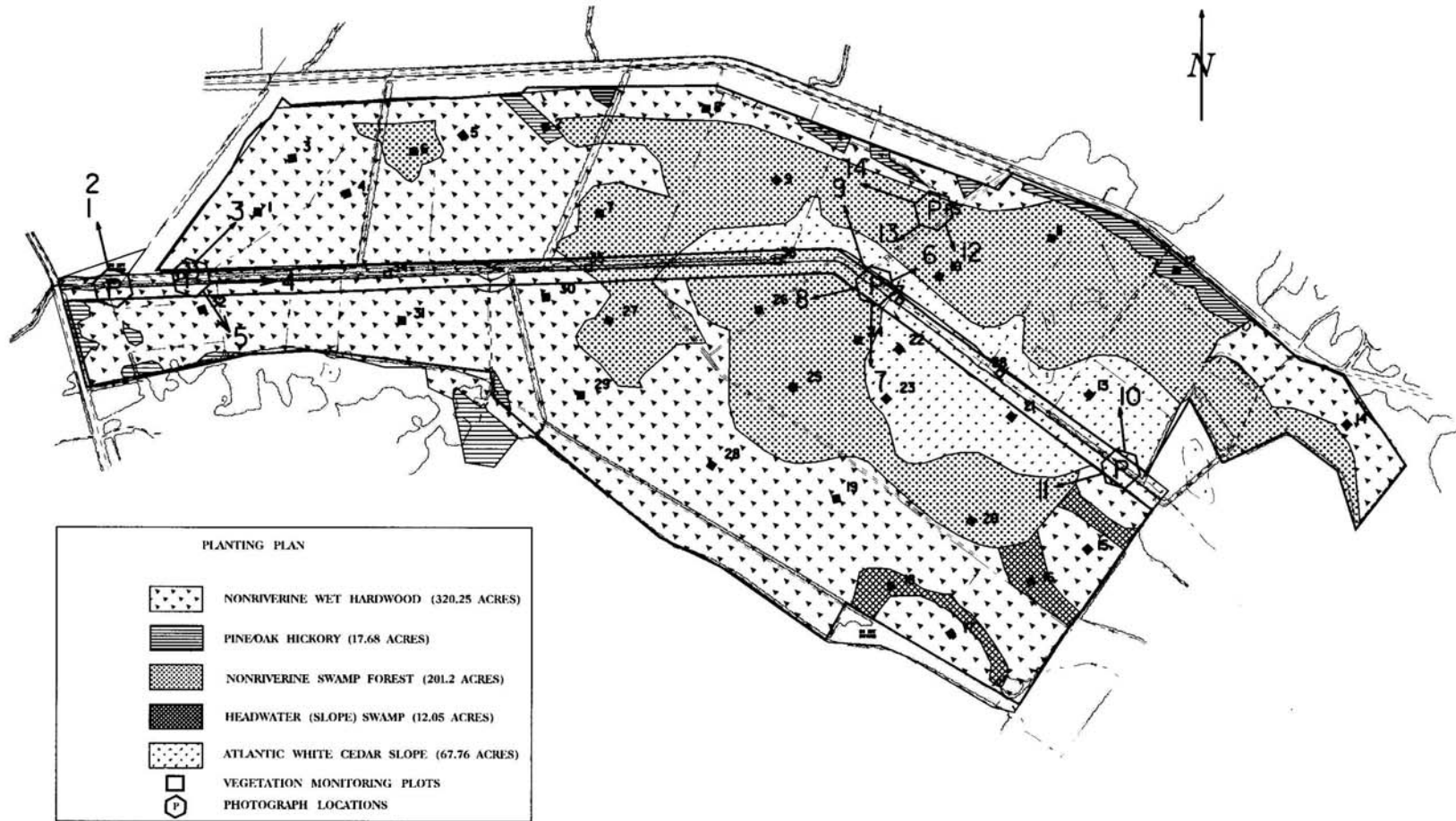
Photo 13



Photo 14

PROJECT REFERENCE NO. R-2204W	SHEET NO. MAP-1
RDW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

**BLADEN COUNTY, NORTH CAROLINA
DOWD DAIRY FARM MONITORING
PLANTING ZONES, VEGETATION PLOT, AND PHOTO LOCATIONS**



DATE PLOTTED: 11/11/11