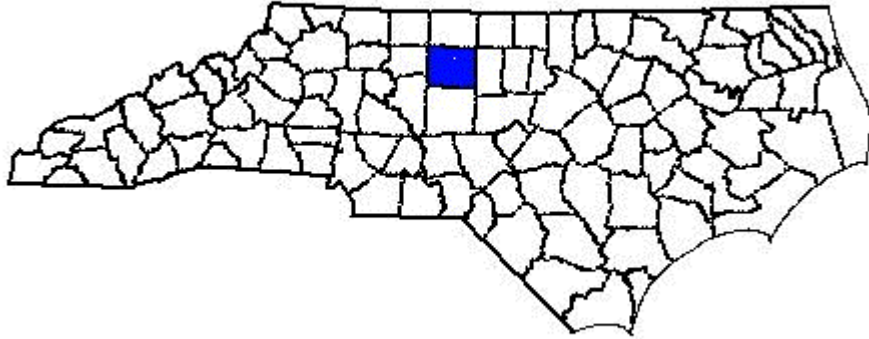


# ANNUAL REPORT FOR 2003



**South Buffalo Creek Mitigation Site  
Guilford County  
Project No. 8.U493501  
TIP No. I-2402 WM**



Prepared By:  
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North Carolina Department of Transportation  
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## **SUMMARY**

The following report summarizes the monitoring activities that have occurred in 2003 at the South Buffalo Creek Mitigation Site. The 2003-year represents the fifth year of hydrologic monitoring. Vegetation monitoring began in 1999 but was restarted with the additional requirement of monitoring the existing preservation area; therefore, 2003 represents the fourth year of vegetation monitoring.

The site is equipped with seven groundwater-monitoring gauges, two surface gauges, and one rain gauge that were installed in July 2000. Data from the onsite rain gauge (automatic recording tipping bucket) was used for the groundwater plots. Rainfall data from the State Climate Office was used for the 30-70 Percentile Graphs (historical analysis).

For the 2003-year, hydrologic monitoring resulted in six of the seven monitoring gauges recording saturation within 12" of the soil surface for more than 12.5 % of the growing season, during an above average rainfall year.

Variations resulting from microtopography are present throughout the wetland mitigation site. Hummock areas, like that represented by gauge (G4, 6.6%) tended to report lower saturation percentages, thus affecting whether it met the success criteria. Gauge (G4) did not retain water for any length of time after rainfall events. Gauge (G8), which is representative of the lower elevations on the site, reported saturation (consecutive) for 48.2% of the growing season.

Surface water gauge (S5) indicated inundation throughout the growing season. Surface gauge (S1) experienced a malfunction for the entire growing season; therefore there is no data available for this gauge. Groundwater gauge (G2), which is located adjacent to surface gauge (S1), met the success criteria showing inundation throughout the growing season (100%).

The fourth year of vegetation monitoring showed that the three vegetation-monitoring plots met the vegetation success criteria in 2003 with an average density of 614 trees per acre. This is well above the minimum 290 trees per acre required by the success criteria for the fourth year.

The 2003-year represents the fifth year of hydrologic monitoring and the fourth year of vegetation monitoring. NCDOT will continue to monitor the South Buffalo Creek Mitigation Site for hydrology and vegetation.

## **1.0 INTRODUCTION**

### **1.1 Project Description**

The South Buffalo Creek Mitigation Site is located in Guilford County, west of the NC 6 interchange with I-85 on the southeast side of Greensboro (Figure 1). Approximately 58 acres in size, the site serves as compensatory mitigation for several highway projects, including the Eastern Greensboro Bypass (I-2402), the Northeastern Urban Loop (U-2525) and the widening of I-40 (I-2201 F/E). The Debit Ledger (Section 1.4) illustrates the acreage used by projects, as well as the acreage remaining. Site construction involved the installation of a subsurface impervious wall to retard groundwater flow in support of swamp and bottomland hardwood forest communities.

### **1.2 Purpose**

In order to demonstrate successful mitigation, the South Buffalo Creek Mitigation Site is monitored for both hydrologic and vegetation restoration success as established in the mitigation plan. The site was first monitored in 1999. Section 1.3 depicts the history of the South Buffalo Creek Mitigation Site since its implementation.

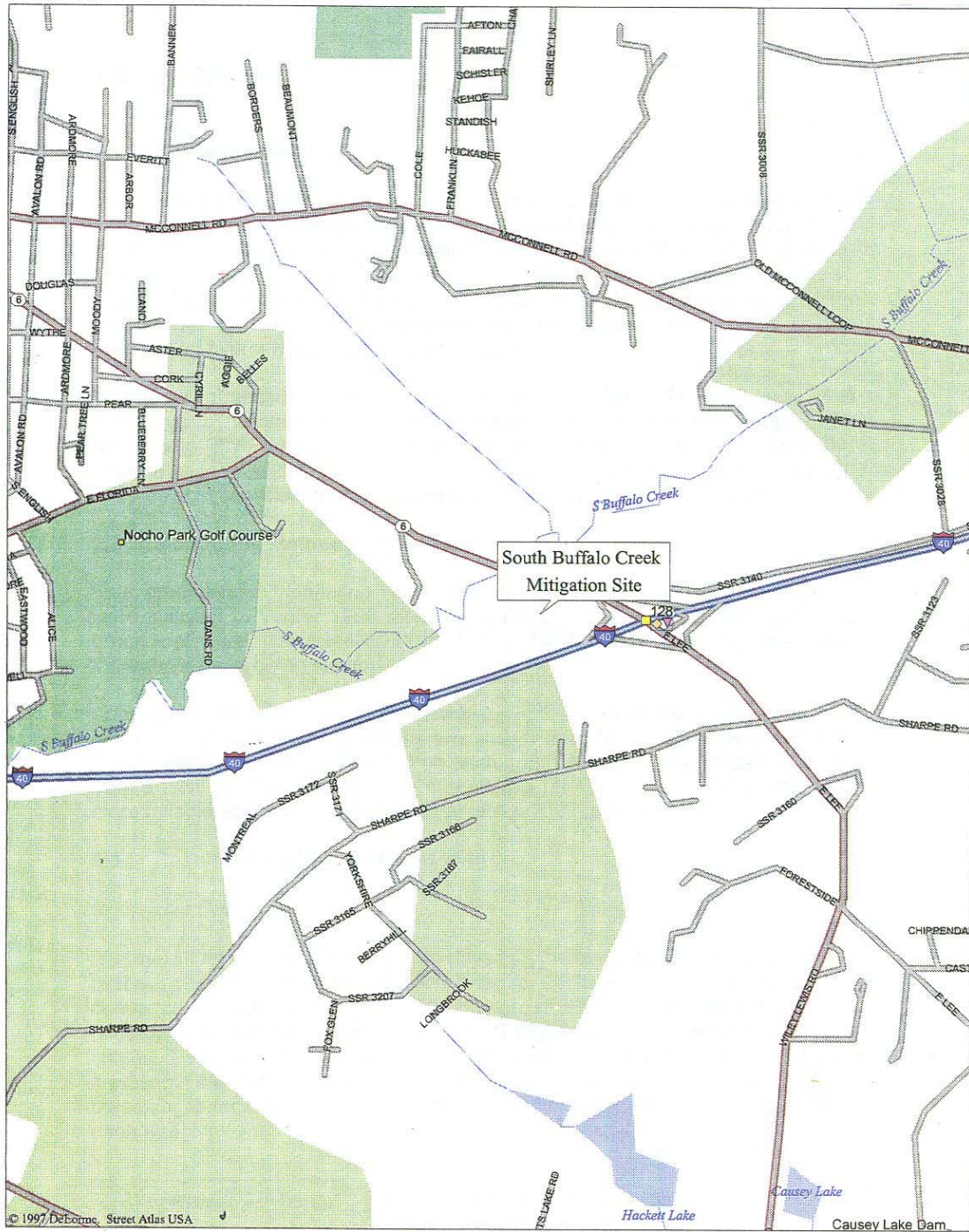


FIGURE 1 - Site Location Map

### 1.3 Project History

August – December 1998	Site Construction
February 1999	Site Planted
March – November 1999	Hydrologic Monitoring (Year 1)
August 1999	Vegetation Monitoring (Year 1)
March – November 2000	Hydrologic Monitoring (Year 2)
November 2000	Infinities Rain Gauge Installed
February 2000	Existing Forest Area Monitored (Year 1)
November 2000	Vegetation Monitoring (Year 1- Restart)
March - November 2001	Hydrologic Monitoring (Year 3)
September 2001	Vegetation Monitoring (Year 2)
March – November 2002	Hydrologic Monitoring (Year 4)
July 2002	Vegetation Monitoring (Year 3)
July 2002	Existing Forest Area Monitored (Year 3)
March – November 2003	Hydrologic Monitoring (Year 5)
July 2003	Vegetation Monitoring (Year 4)
July 2003	Existing Forest Area Monitoring (Year 4)

## 1.4 Debit Ledger

South Buffalo Creek	Mit. Plan			TIP DEBIT	TIP DEBIT	TIP DEBIT	TIP DEBIT	TIP DEBIT	TIP DEBIT
Habitat	Acres at Start:	Acres Remaining	%	U2525A&I2402D	I-2201 F	I-2402 D mod	I-2201 E	Mit Work	R-2000 AA/AB
BLH Restoration 2:1	15.53	4.03	25.95	9.1	0.96	0.35		0.14	0.95
BLH Preservation 7:1	16.2	2.21	13.64	9.4	3.36	1.23			
TOTAL	31.73	6.24	19.67	18.5	4.32	1.58		0.14	0.95

## 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 a consecutive 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 factors such as the presence of hydrophytic vegetation and hydric soils.

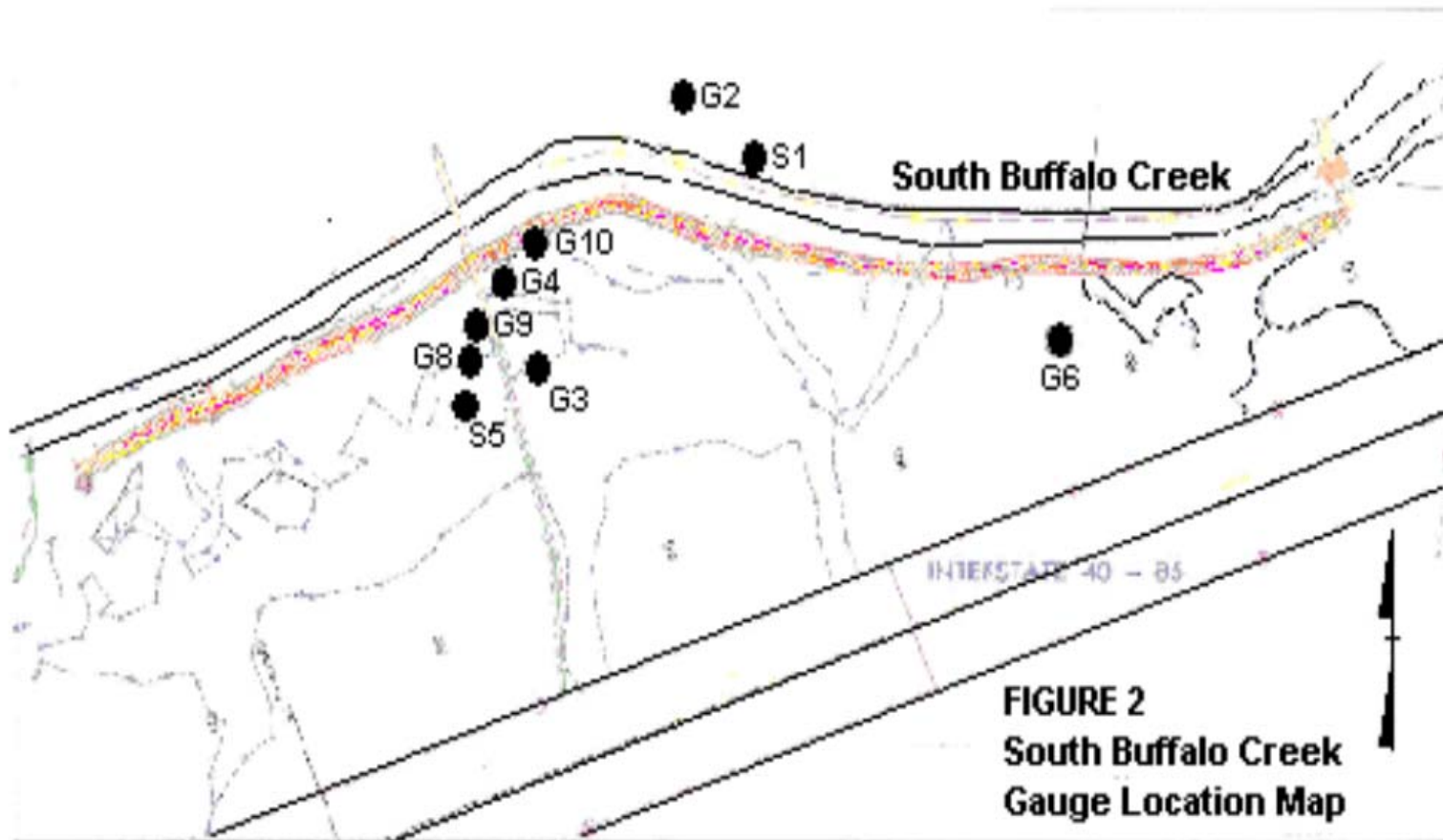
The growing season in Guilford County begins March 26 and lasts until November 6. These dates correspond to a 50% probability that air temperature will drop to 28° F or lower after March 26 and before November 6.<sup>1</sup> Thus the growing season is 224 days; optimum hydrology requires 12.5% of this season, or 28 days. Local climate must represent average conditions for the area.

### 2.2 Monitoring Methodology

Four groundwater-monitoring gauges, two surface gauges, and one rain gauge were installed in Winter 1998 after site construction (Figure 2). An additional groundwater gauge was installed in early May 1999 and two 40-inch groundwater gauges were installed in February 2000. An Infinity rain gauge replaced the original rain gauge in July 2000. Daily readings were taken throughout the growing season.

Appendix A contains a plot of the water depth for each groundwater monitoring gauge and surface gauge. Monitoring results are shown from March 26 to November 6, 2003. Daily precipitation data from the onsite (Infinity) rain gauge is provided on each graph.

<sup>1</sup> Soil Conservation Service, Soil Survey of New Hanover County, North Carolina, 1977.



## 2.3 Results of Hydrologic Monitoring

### 2.3.1 Site Hydrology

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 224-day growing season. The monitoring gauge results are segmented into percentage ranges. Table 1 presents the monitoring results for the 2003 growing season as a range of percentages, actual percentages, and success dates of the longest consecutive hydroperiod at that gauge location. Figure 3 depicts the location and hydrologic monitoring results of the groundwater gauges.

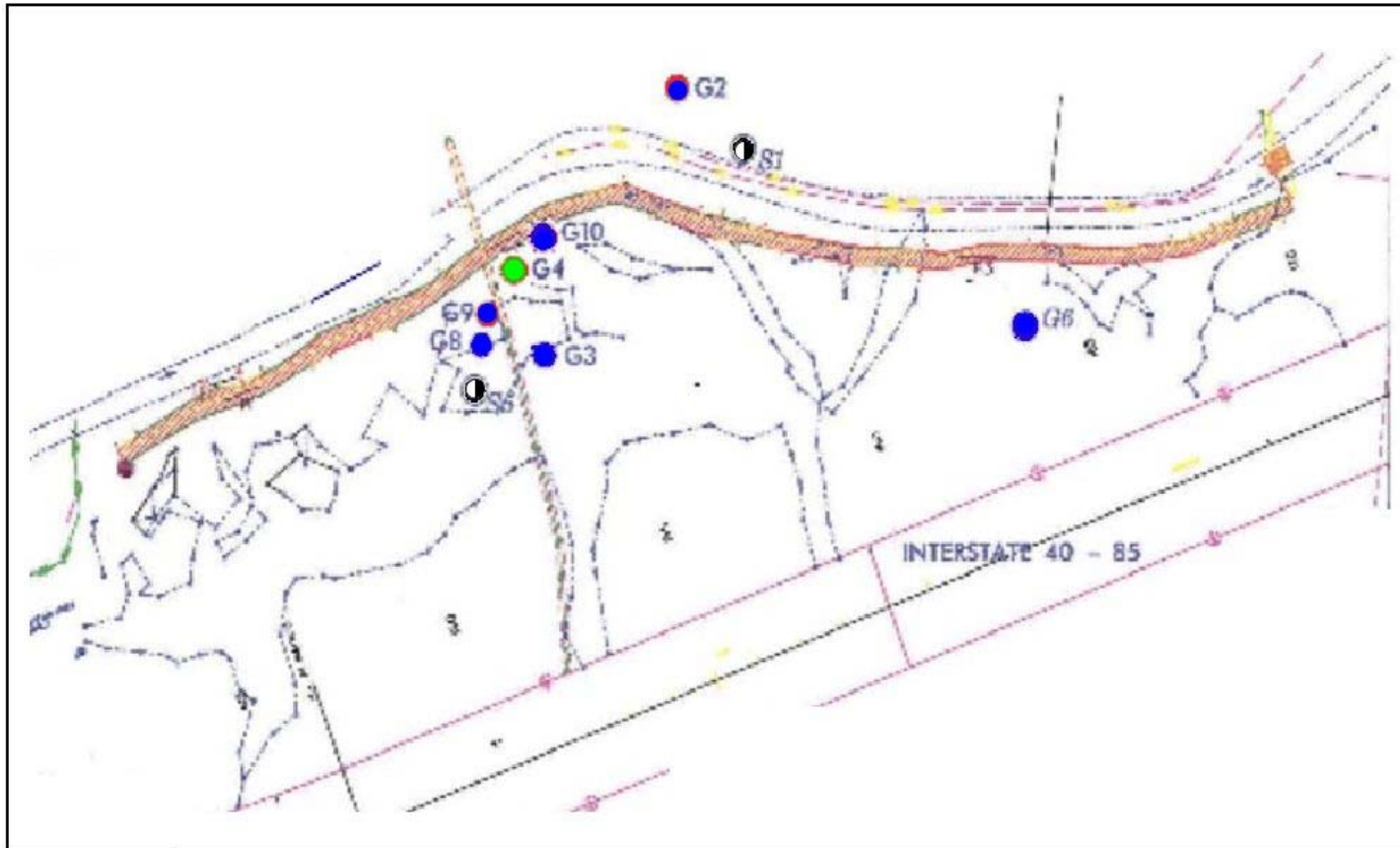
**Table 1. 2003 HYDROLOGIC MONITORING RESULTS**

Monitoring Gauge	< 5%	5 - 8%	8 - 12.5%	> 12.5%	Actual %	Dates Meeting Success
G2 (ref)				×	100	March 26-Nov 6
G3				×	100	March 26-Nov 6
G4		×			6.6	May 16-May 30
G6				×	22.1	March 26-May 14 May 16-June 25
G8				×	48.2	March 26-July 12 Aug 30-Oct 15
G9				×	25.7	March 26-May 13 May 16-July 12
G10				×	59.7	March 26-Aug 7

The 2003 growing season experienced an above average rainfall year.

#### *Specific Gauge Problems:*

- Gauges (G9 and G10) could not be downloaded from August 8 through the end of the growing season due to inundation in those areas.
- Surface gauge (S1) experienced a malfunction for the entire growing season; therefore there is no monitoring data available for this gauge.



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



Hydrology Results

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

- ⊕ Rain Gauge
- Surface Gauge



### **2.3.2 Climatic Data**

Figure 4 represents an evaluation of 2003 rainfall in comparison with historical rainfall data in order to determine whether 2003 was “average” in terms of precipitation. The historical rainfall data was collected from 1972 through 2003 (30 years). All rainfall data was collected from the NC State Climate Office, Greensboro weather station.

The monthly rainfall totals for the period of November 2002 through November 2003 are shown in Figure 4. The data for this period shows above average rainfall for November (02'), December (02'), February, March, April, May, June, July, August, and September. January, October, and November experienced below average rainfall. Overall, 2003 experienced an above average rainfall year.

### **2.4 Conclusions**

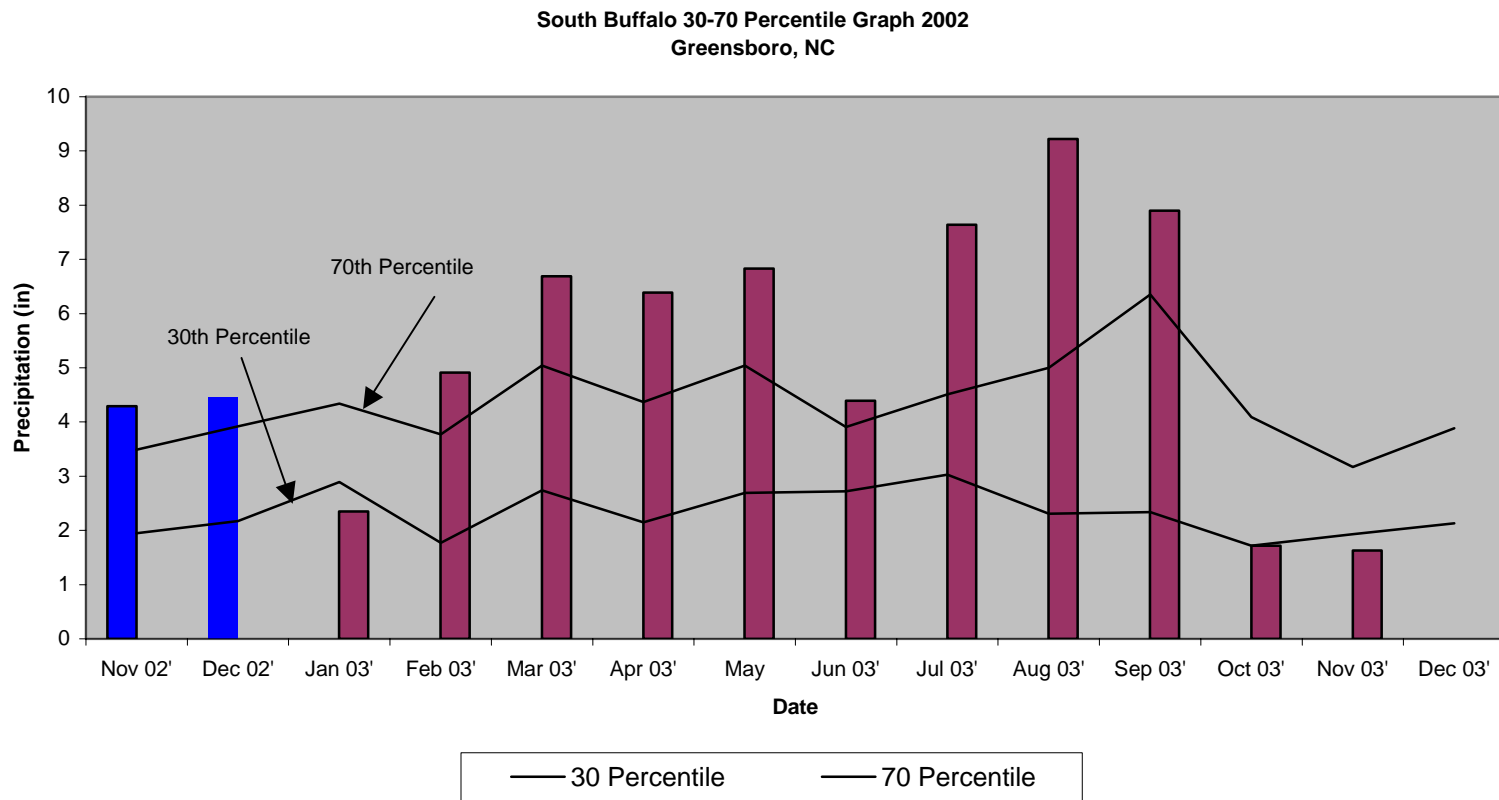
For the 2003-monitoring year, six of the seven-groundwater gauges exceeded the success criteria of saturation within 12” of the surface for more than 12.5% of the growing season, during an above average rainfall year.

Variations resulting from microtopography are present throughout the wetland mitigation site. Hummock areas, like that represented by gauge (G4, 6.6%) tended to report lower saturation percentages, thus affecting whether it met the success criteria. Gauge (G4) did not retain water for any length of time after rainfall events. Gauge (G8), which is representative of the lower elevations on the site, reported saturation (consecutive) for 48.2% of the growing season.

Surface water gauge (S5) indicated inundation throughout the growing season. Surface gauge (S1) experienced a malfunction for the entire growing season; therefore there is no data available for this gauge. Groundwater gauge (G2), which is located adjacent to surface gauge (S1), met the success criteria showing inundation throughout the growing season.

NCDOT will continue to monitor hydrology at the South Buffalo Creek Mitigation Site.

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



### **3.0 VEGETATION: SOUTH BUFFALO CREEK MITIGATION SITE (YEAR 4 MONITORING)**

#### **3.1 Success Criteria**

Success criteria states that within the poly-wall corridor there must be a minimum mean density of 320 trees per acre of approved target species surviving 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).

Success criteria for the existing forested areas of the mitigation site will depend on the lack of a negative effect to the randomly selected trees in the restoration and preservation areas on the site. The existing forested sections of the site will be successful if 75% of the monitored wet-tolerant trees show a lack of a negative impact from the increased water levels.

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

The following tree species were planted in the Wetland Restoration Area:

- Fraxinus pennsylvanica*, Green Ash
- Platanus occidentalis*, American Sycamore
- Quercus lyrata*, Overcup Oak
- Quercus michauxii*, Swamp Chestnut Oak
- Quercus phellos*, Willow Oak
- Quercus falcata* var. *pagodaefolia*, Cherrybark Oak

The following trees were marked in the existing forested Wetland Preservation and Restoration Areas on the site:

- Liriodendron tulipifera*, Tulip Poplar
- Fraxinus occidentalis*, Green Ash
- Ulmus americana*, American Elm
- Quercus phellos*, Willow Oak
- Acer rubrum*, Red Maple
- Quercus michauxii*, Swamp Chestnut Oak
- Carya ovata*, Shagbark Hickory
- Liquidambar styraciflua*, Sweetgum
- Acer saccharum*, Sugar Maple
- Fagus grandifolia*, Beech
- Ulmus alata*, Winged Elm
- Diospyros virginiana*, Persimmon
- Quercus lyrata*, Overcup Oak
- Quercus stellata*, Post Oak

The following trees were marked in the existing forested Wetland Reference Area of the site:

- Fraxinus pennsylvanica*, Green Ash
- Betula nigra*, River Birch
- Platanus occidentalis*, Sycamore
- Ulmus americana*, American Elm
- Salix nigra*, Black Willow
- Carpinus caroliniana*, Iron Wood

### 3.3 Results of Vegetation Monitoring

**Table 2.** Vegetation Monitoring Results

Plot #	Green Ash	Sycamore	Overcup Oak	Swp. Chestnut Oak	Willow Oak	Cherrybark Oak	Total (4 year)	Total (at planting)	Density (Trees/Acre)
1	13	3	10		1	12	39	41	647
2	12	17	3	1		1	34	45	514
3	18	9	7		1	1	36	36	680
<b>AVERAGE DENSITY</b>									<b>614</b>

**Site Notes:** Other species noted: Boxelder, cardinal flower, *Juncus* sp., smartweed, Japanese grass, fescue, jewelweed, cattail, woolgrass, *Bidens* sp., pokeweed, green briars, pawpaw, sweetgum, green ash, sycamore, black willow, poison ivy, blackberry, lespedeza, elm, tulip poplar, and hickory.

**Table 3: Randomly Selected Trees (Restoration and Preservation Areas)**

#	Species	2002 DBH	2003 DBH	#	Species	2002 DBH	2003 DBH
1	Green Ash	4.4	4.5	26	Sugar Maple	9.2	9.5
2	Green Ash	2.7	2.8	27	American Elm	9.0	9.2
3	River Birch	6.3	6.3	28	American Elm	15.3	15.6
4	Sycamore	8.9	8.9	29	Green Ash	8.5	8.7
5	American Elm	11.3	11.5	30	American Elm	11.8	12
6	Sycamore	12.6	13.0	31	Green Ash	14.4	14.5
7	Black Willow	7.8	7.8	32	Green Ash	7.9	8.0
8	American Elm	15.3	15.5	33	Beech	11	11.2
9	American Elm	7.8	7.9	34	Beech	5.4	5.5
10	Iron Wood	5.9	6.0	35	Swamp Chestnut Oak	6.5	6.7
11	Tulip Poplar	5.4	6.0	36	Beech	7.6	7.7
12	Green Ash	6.8	7.0	37	Winged Elm	10.7	10.8
13	American Elm	8.3	8.5	38	Persimmon	11.6	11.7
14	Willow Oak	11.4	11.5	39	Overcup Oak	8.3	8.5
15	Green Ash	12.6	12.7	40	Overcup Oak	3.4	3.5
16	Red Maple	9.2	9.3	41	Green Ash	7.7	7.8
17	Green Ash	10.8	11.0	42	Overcup Oak	8.4	8.5
18	Swamp Chestnut Oak	9.5	9.5	43	Swamp Chestnut Oak	4.3	4.5
19	Shagbark Hickory	9.5	9.6	44	Beech	3.0	3.2
20	Willow Oak	14.1	14.2	45	Swamp Chestnut Oak	6.4	6.8
21	Sweetgum	9.3	9.4	46	Winged Elm	3.1	3.2
22	Swamp Chestnut Oak	4.6	4.7	47	Winged Elm	4.3	4.4
23	Red Maple	13.3	13.5	48	Winged Elm	4.8	5.0
24	Green Ash	12.8	13.0	49	Post Oak	3.1	3.2
25	American Elm	9.6	9.8	50	Post Oak	6.9	7.0

Numbers 1-10 are in the reference area. Numbers 11-50 are in the preservation area.

All trees measured at diameter at breast height (DBH, 4.5 feet above ground). All trees appear to remain healthy and have increased in diameter. No negative effects that can be attributed to the increased water levels were observed in the existing forested areas.

### 3.4 Conclusions

This site involved the planting of approximately five acres of bottomland hardwood forest. There were three plots established throughout the planting area, encompassing all plant communities. The 2003 vegetation monitoring revealed an average density of 614 trees per acre, which is well above the minimum of 290 trees per acre required by the success criteria at the fourth year.

NCDOT will continue vegetation monitoring at the South Buffalo Creek Mitigation Site.

## **4.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS**

The fifth year of hydrology monitoring indicated that six of the seven-groundwater gauges exceeded the success criteria of saturation within 12" of the surface for more than 12.5% of the growing season, during an above average rainfall year.

Variations resulting from microtopography are present throughout the wetland mitigation site. Hummock areas, like that represented by gauge (G4, 6.6%) tended to report lower saturation percentages, thus affecting whether it met the success criteria. Gauge (G4) did not retain water for any length of time after rainfall events. Gauge (G8), which is representative of the lower elevations on the site, reported saturation (consecutive) for 48.2% of the growing season.

Surface water gauge (S5) indicated inundation throughout the growing season. Surface gauge (S1) experienced a malfunction for the entire growing season; therefore there is no data available for this gauge. Groundwater gauge (G2), which is located adjacent to surface gauge (S1), met the success criteria showing inundation throughout the growing season (100%).

The fourth year of vegetation monitoring showed that the three vegetation-monitoring plots met the vegetation success criteria in 2003 with an average density of 614 trees per acre. This is well above the minimum 290 trees per acre required by the success criteria for the fourth year.

The 2003-year represents the fifth year of hydrologic monitoring and the fourth year of vegetation monitoring. NCDOT will continue to monitor the South Buffalo Creek Mitigation Site for hydrology and vegetation.

**APPENDIX A**

**GAUGE DATA GRAPHS**

**APPENDIX B**

**SITE PHOTOS & PLOT LOCATIONS**

# South Buffalo Creek



Photo 1



Photo 2



Photo 3



Photo 4

REVISIONS

# SOUTH BUFFALO CREEK MITIGATION SITE PHOTO AND PLOT LOCATION



PROJECT REFERENCE NO. 1.2407004	SHEET NO. 1
RAW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

- PI-P3 (VEG PLOTS)
- PHOTO POINTS
- PLANTING AREA

NOTE: VEG. PLOTS 85 FT. X 30 FT.

$PI\ Sta\ 11+9.52$   
 $\Delta = 37^{\circ}54'08.9''\ (LT)$   
 $D = 27^{\circ}55'05.9''$   
 $L = 139.20'$   
 $T = 71.46'$   
 $R = 250.00'$

