

**BENSON GROVE MITIGATION SITE**  
**2005 Annual Monitoring Report (Year 4)**

Johnson County  
EEP Project No. 32  
Design Firm: Rummel, Klepper & Kahl, LLP

**NCDOT Format**

Prepared for:



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**February 2006**

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**BENSON GROVE MITIGATION SITE  
2005 Annual Monitoring Report (Year 4)**

**SUMMARY**

The Benson Grove Mitigation Site (Site) has been planned as compensatory mitigation for impacts associated with the Northern Wake Expressway (Raleigh Outer Loop, Tip No. R-2000F and R2000G) located in Wake County, North Carolina. Per a letter from the Ecosystem Enhancement Program (EEP) to the North Carolina Department of Transportation (NCDOT) dated August 25, 2004, the EEP has accepted the transfer of all off-site mitigation projects. Therefore, EEP will be responsible for fulfilling the remaining requirements and future remediation for the Benson Grove Site. The NCDOT monitoring report format has been retained for clarity and continuity.

The following report summarizes the monitoring activities that have occurred in the past year at the Benson Grove Mitigation Site (Site). Site construction was completed in March 2002. The 2005 monitoring report represents the fourth year of monitoring for the Site. The Site must demonstrate both hydrologic and vegetation success for a minimum of five years or until the Site is deemed successful.

Site hydrology is being monitored with eleven groundwater monitoring gauges and one on-site rain gauge. Ten vegetation plots are used to evaluate the 31.5 acres reforested within the Site.

**1.0 INTRODUCTION**

**1.1 PROJECT DESCRIPTION**

The Site is located just west of NC 50 on SR 1319 (Zacks Mill Road) in Johnston County (Figure 1, Appendix A). The Site is situated in the Black Creek floodplain within the greater Neuse River Basin (Hydrological Unit 030404). The Site comprises approximately 81.9 acres. Black Creek forms the boundary along the southern edge of the property and upland slopes border the northern boundary. The Site will provide approximately 31.4 acres of forested wetland restoration and approximately 50.5 acres of preservation.

**1.2 PURPOSE**

In order to demonstrate successful wetland mitigation, hydrological and vegetative monitoring must be conducted for a minimum of five consecutive years. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrological conditions and vegetation survival. The following report details the results of hydrological and vegetative monitoring at the Site during the 2005 growing season.

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### 1.3 PROJECT HISTORY

December 2001	Herbicide Application I
February 2002	Herbicide Application II
February 2002	Herbicide Application
March 2002	Site Planted
June 2002	Vegetation Monitoring (1 year)
March-November 2002	Hydrologic Monitoring (1 year)
February 2003	Supplemental Planting
July 2003	Vegetation Monitoring (2 year)
July 2003	On-site agency meeting to discuss nuisance species
March-November 2003	Hydrologic Monitoring (2 year)
June 2004	Vegetation Monitoring (3 year)
March-November 2004	Hydrologic Monitoring (3 year)
October 2005	Vegetation Monitoring (4 year)
March-November 2005	Hydrologic Monitoring (4 year)

## 2.0 HYDROLOGY

### 2.1 SUCCESS CRITERIA

In accordance with federal guidelines for wetland mitigation, the success criteria for hydrology state that the restoration areas must be inundated or saturated (within 12 inches of the surface) by surface water or groundwater for at least 12.5 percent of the growing season (consecutive days) during a normal precipitation year. Areas that have between 5 and 12.5 percent of the growing season may be considered hydric under certain conditions. Areas inundated for less than 5 percent of the growing season are always classified as non-wetlands.

The growing season in Johnston County begins March 21 and ends November 4 (previous reports indicated growing season is March 26 to November 10). These dates correspond to a 50 percent probability that temperatures will not drop to 28 degrees Fahrenheit or lower after March 21 and before November 10 (Natural Resources Conservation Service, Soil Survey of Johnston County). The growing season is 228 days.

### 2.2 HYDROLOGIC DESCRIPTION

In March 2002, eleven (11) Remote Data Systems (RDS) continuous logging groundwater monitoring gauges were installed on-site (Figure 2, Appendix A). The monitoring gauges record daily readings of depth to groundwater and this year's data represents the fourth growing season that the monitoring gauges have been in place. The Site was designed to receive hydrologic inputs from rainfall, groundwater, and surface water from overbanking events.

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## **2.3 RESULTS OF HYDROLOGIC MONITORING**

### **2.3.1 Site Data**

The maximum number of consecutive days that the groundwater was within 12 inches of the surface was calculated for each monitoring gauge and this number was converted into a percentage of the 228-day growing season. The results are presented in Table 1.

Appendix B contains the hydrographs for each monitoring gauge for the current monitoring year. The corresponding rain data collected from the on-site rain gauge is also provided on each hydrograph.

Figure 2 (Appendix A) provides a graphical representation of the hydrologic results. Gauges highlighted in green indicate wetland hydrology for more than 12.5 percent of the growing season. Gauges highlighted in red are those that had wetland hydrology less than 5 percent of the growing season. Gauges with a black circle are gauges that did not function at all during the growing season. Gauges 1, 9, 10, and 11 were found to be non-functional during the initial Site visit. Gauges 1, 9, and 10 were repaired and returned to the Site during the final months of the growing season. The final months for the 2005 growing season for Johnston County were dry overall. Therefore, gauges 1, 9, and 10 did not indicate hydrologic success in the fourth year but may have in previous years and likely will in year 5. Gauge 11 did not function at any time during the growing season.

### **2.3.2 Climatic Data**

Figure 3 provides an evaluation of the local climate in comparison with historical data in order to determine whether 2005 was a year with “average” rainfall. The bars are the monthly rainfall totals for the 2005 hydrologic year. Also represented are the 30<sup>th</sup> and 70<sup>th</sup> percentiles of monthly precipitation for Smithfield located approximately 10 miles east of the Site. The historical data and monthly data were collected from the Southeast Regional Climate Data.

Months with below average rainfall include: January, August, and September. The months of February, March, May, June, and November (in the latter part of November) experienced average rainfall. July received above average rainfall. Through the end of November, the region has experienced a rain deficit of approximately eight inches. A normal yearly rainfall in the area is approximately 47.3 inches.

**Table 1.** Benson Grove Hydrologic Monitoring Results

Monitoring Well	<5%	5-12.5%	>12.5%	Actual %	Success Date
BGGW-1	✓			3.1	
BGGW-2			✓	19.3	March 21 – May 3
BGGW-3			✓	26.8	March 21 – May 20
BGGW-4			✓	19.7	March 21 – May 4
BGGW-5			✓	14.0	March 21 – April 21
BGGW-6			✓	28.9	March 21 – May 25
BGGW-7			✓	42.5	March 21 – June 25
BGGW-8			✓	28.5	March 21- May 24
BGGW-9	✓			1.3	
BGGW-10	✓			0.4	
BGGW-11	Non-Functional				

Wells 1, 9, and 10 were not functional for a majority of the growing season. They were replaced with new gauges on August 11th, 2005. Well 11 was non-functional for the entire growing season and will be replaced prior to the 2006 growing season. All other groundwater gauges met the success criteria for 12.5% for the growing season.

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## **2.4 CONCLUSION**

The current year represents the fourth year for hydrologic monitoring. In general, water levels showed a typical pattern (but with less overall precipitation) of flooding during the spring, followed by a late summer and fall draw down period, punctuated by peaks associated with precipitation events. Seven gauges indicated saturation within 12 inches of the ground surface for greater than 12.5 percent of the growing season. Three gauges indicated saturation within 12 inches of the ground surface for less than 5 percent of the growing season. Gauges 1, 9, and 10 malfunctioned during a significant portion of the 2005 growing season (see Table 1) and gauge 11 did not function at all during the growing season. However, based on monthly visual inspections, gauges 1, 10, and 11 had standing water in the immediate vicinity of the gauge for at least 12.5 percent of the growing season.

## **3.0 VEGETATION**

### **3.1 SUCCESS CRITERIA**

Success criteria states that at least 320 stems per acre must survive after the completion of the third growing season and 240 stems per acre after the fifth growing season. If desired vegetation has not been established, EEP will notify the appropriate agencies and will implement corrective measures. Site photographs are provided in Appendix C.

### **3.2 DESCRIPTION OF SPECIES**

The following tree species were planted in the Wetland Restoration Plan (Appendix D):

*Fraxinus pennsylvanica*, green ash

*Quercus falcata* var. *pagodaefolia*, cherrybark oak

*Quercus laurifolia*, laurel oak

*Quercus lyrata*, overcup oak

*Quercus nigra*, water oak

*Liriodendron tulipifera*, tulip poplar

*Quercus phellos*, willow oak

*Taxodium distichum*, bald cypress

*Nyssa aquatica*, water tupelo

### 3.3 RESULTS OF VEGETATION MONITORING

The following table lists the densities of planted tree species recorded in each established 0.06-acre (50-foot by 50-foot) plots (Figure 4).

**TABLE 2:** Vegetation Monitoring Statistics

Plot Number	1	2	3	4	5	6	7	8	9	10	Total
Green Ash		3	7	7	4	1	2	1	10	15	50
Cherrybark Oak		2			1				3	1	7
Laurel Oak					3						3
Overcup Oak	7	5		5	4			7	2	8	38
Water Oak											0
Tulip Poplar										1	1
Willow Oak	1		1	3				5		7	17
Bald Cypress	2	2	1	8		7	13	7	27	4	71
Water Tupelo		1	8		3	1	3	2	2	1	21
Total (2005)	10	13	17	23	15	9	18	22	44	37	208
Total (2004)	8	22	9	23	24	15	19	28	44	39	231
Total (at Planting)	28	23	31	23	35	32	20	31	46	39	308
Density (2005) (Trees/Acre)	167	217	283	383	250	150	300	367	733	617	
<b>Average 2005 Density (Trees/Acre)</b>											<b>347</b>

Stem counts were made of additional, volunteer woody species within the study plots. These are listed in Table 3.

**TABLE 3:** Volunteer woody stem counts in the study plots.

Plot Number	1	2	3	4	5	6	7	8	9	10	Total
Black Willow ( <i>Salix nigra</i> )	3							3	121		127
Buttonbush ( <i>Cephalanthus occidentalis</i> )							1				1
Groundsel Bush ( <i>Baccharis halimifolia</i> )	9	50	5	31	12			8			115
Persimmon ( <i>Diospyros virginiana</i> )	3							2			5
Red Maple ( <i>Acer rubrum</i> )	105	190	55	27	12	1				5	395
Sweetgum ( <i>Liquidambar styraciflua</i> )	15	74	54	3	3			53	4	2	208
<b>Total</b>	135	314	114	61	27	1	1	66	125	7	851



In addition, herbaceous vegetation and seedlings of woody species were documented by percentage of aerial coverage in the study plots. For example, if a species occupies 45 square feet within a 900-square-foot plot, its coverage is calculated at 5 percent. These species are listed in Table 4.

**Table 4:** Herbaceous vegetation and seedlings listed by coverage in the study plots.

Plot Number	1	2	3	4	5	6	7	8	9	10	Average Coverage (percent)
Blackberry ( <i>Rubus argutus</i> )			0.5		2	2		1		1	1
Broomsedge ( <i>Andropogon virginicus</i> )				5				1			3
Climbing Hempweed ( <i>Mikania scandens</i> )			0.5	0.5	5	5		3	3		3
Common Cattail ( <i>Typha latifolia</i> )	5										5
Curly Dock ( <i>Rumex crispus</i> )			0.5							0.5	1
Dog Fennel ( <i>Eupatorium capillifolium</i> )	3		0.5	3	10	10		5	3	2	5
False Nettle ( <i>Boehmeria cylindrica</i> )									1.0		1
Frost Aster ( <i>Aster dumosus</i> )				30	15	15		5			16
Goldenrod ( <i>Solidago</i> sp.)					10	10		0.5		1	5
Grape ( <i>Vitis</i> sp.)										0.5	1
Horse Nettle ( <i>Solanum carolinense</i> )				0.5				0.5		0.5	1
Jewelweed ( <i>Impatiens capensis</i> )	3										3
Johnson Grass ( <i>Sorghum halapense</i> )	3		0.5	5				1	10		4
Loblolly Pine ( <i>Pinus taeda</i> )				0.5							1
Marsh Dayflower ( <i>Murdannia keisak</i> )	5										5
Marsh Fleabane ( <i>Pluchea</i> sp.)				0.5		0.5		0.5			1
Meadow Beauty ( <i>Rhexia</i> sp.)	3		0.5		1	1		2	3		2
Passion Flower ( <i>Passiflora incarnata</i> )										1	1

Plot Number	1	2	3	4	5	6	7	8	9	10	Average Coverage (percent)
Plume Grass ( <i>Erianthus</i> sp.)					5	5	2				4
Poison Ivy ( <i>Toxicodendron radicans</i> )			0.5								1
Red Maple ( <i>Acer rubrum</i> )				0.5				0.5	3	1	1
Sedge ( <i>Carex</i> sp.)										0.5	1
Seedbox ( <i>Ludwigia alternifolia</i> )			0.5		1	1			3		1
Sericea Lespedeza ( <i>Lespedeza cuneata</i> )				0.5							1
Smartweed ( <i>Polygonum</i> sp.)			0.5	3		1					2
Soft Rush ( <i>Juncus effusus</i> )	75		75	20	15	15	5	5	75	1	32
St. John's Wort ( <i>Hypericum</i> sp.)	3										3
Straw-colored Flatsedge ( <i>Cyperus strigosus</i> )			0.5								1
Swamp Mallow ( <i>Hibiscus moscheutos</i> )			0.5								1
Swamp Sunflower ( <i>Helianthus angustifolius</i> )									1	1	1
Sweetgum ( <i>Liquidambar styraciflua</i> )				0.5							1
Tearthumb ( <i>Polygonum sagittatum</i> )					20	20		10	10	90	30
Trumpet Creeper ( <i>Campsis radicans</i> )			0.5								1
Virginia Creeper ( <i>Parthenocissus quinquefolia</i> )										1	1
Woolgrass ( <i>Scirpus cyperinus</i> )	5		1					3	2		3
Total	105	0	82	70	84	86	7	38	114	101	

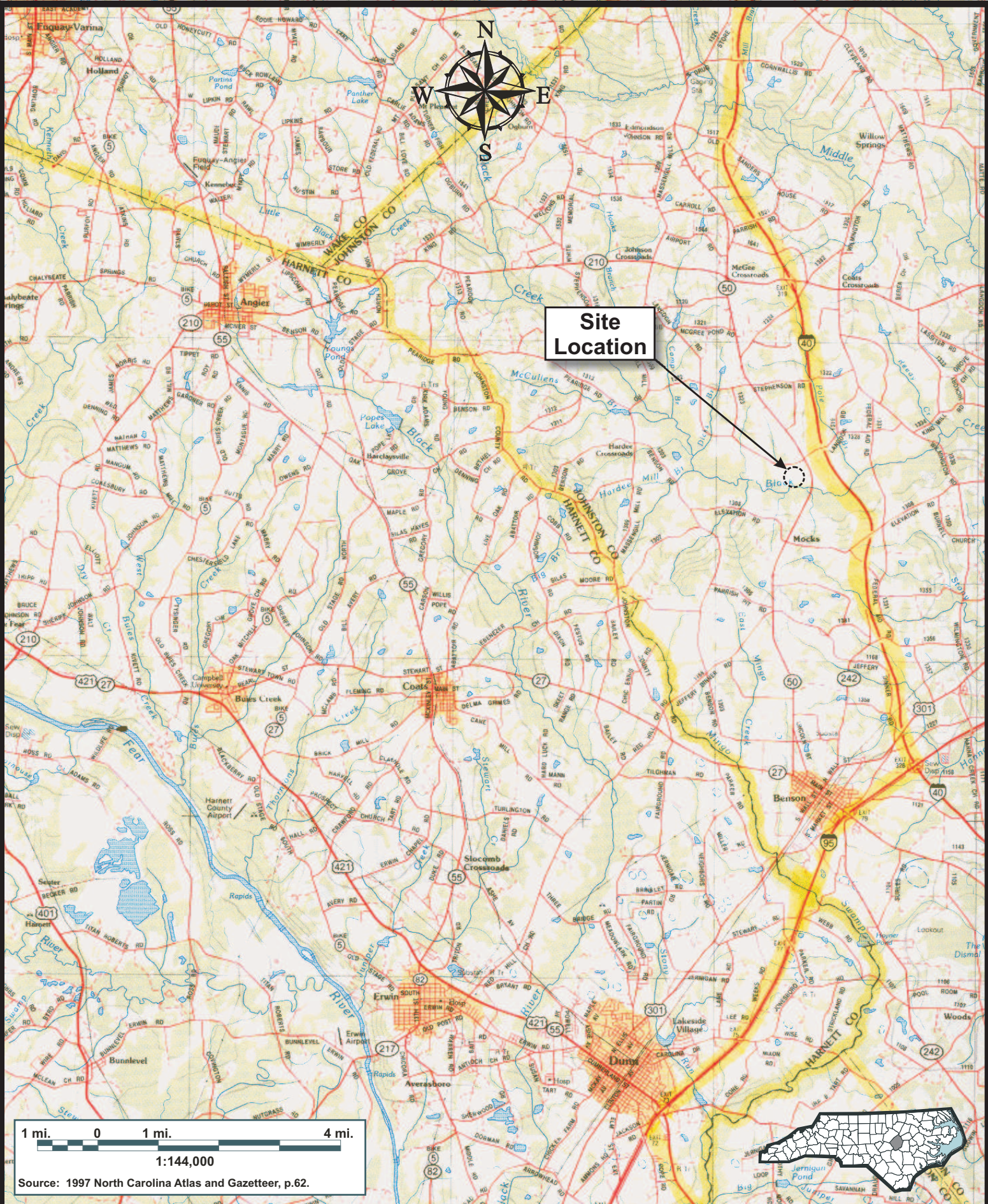
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### **3.4 CONCLUSION**

Of the 81.9 acres on this site, approximately 31.5 acres involved tree planting. Ten vegetation monitoring plots, 50 by 50 feet (0.06 acre) in size, were established throughout the planting areas. The 2005 vegetation monitoring results revealed an average density of 347 trees per acre of planted species. This average is above the minimum success criteria of 320 trees per acre after the third growing season and 240 trees per acre after the fifth growing season.

Nuisance trees such as red maple and sweetgum occur in significant amounts in some areas of the site, as seen in Plots 1, 2, 3, and 8. The increase in stem counts of these species is likely due to site characteristics and proximity to seed sources. However, these occurrences do not appear to have a direct effect on the survivability of planted species on the plots.

**APPENDIX A**  
**FIGURES**



1 mi. 0 1 mi. 4 mi.  
 1:144,000  
 Source: 1997 North Carolina Atlas and Gazetteer, p.62.



**SITE LOCATION**  
**Benson Grove Mitigation Site**  
 Johnston County, North Carolina  
 EEP Project Number 32

Dwn. by: MAF  
 Ckd by: JWJ  
 Date: DEC 2005  
 Project: 05-243.02

FIGURE  
**1**

**LEGEND**

- C/E — RESTORATION BOUNDARY
- CONSERVATION EASEMENT
- EXISTING STREAM
- GAUGE LOCATION
- % of growing season \*
  - > 12.5%
  - < 5%
  - ⊙ NON-FUNCTIONING

\* GAUGES 1, 9, & 10 WERE NON-FUNCTIONING FOR THE MAJORITY OF THE GROWING SEASON. THEY WERE RETURNED TO WORKING ORDER ON AUGUST 11, 2005.

SOURCE: USGS 3.75 MINUTE DIGITAL ORTHO QUARTER QUADRANT COLOR INFRARED 1998

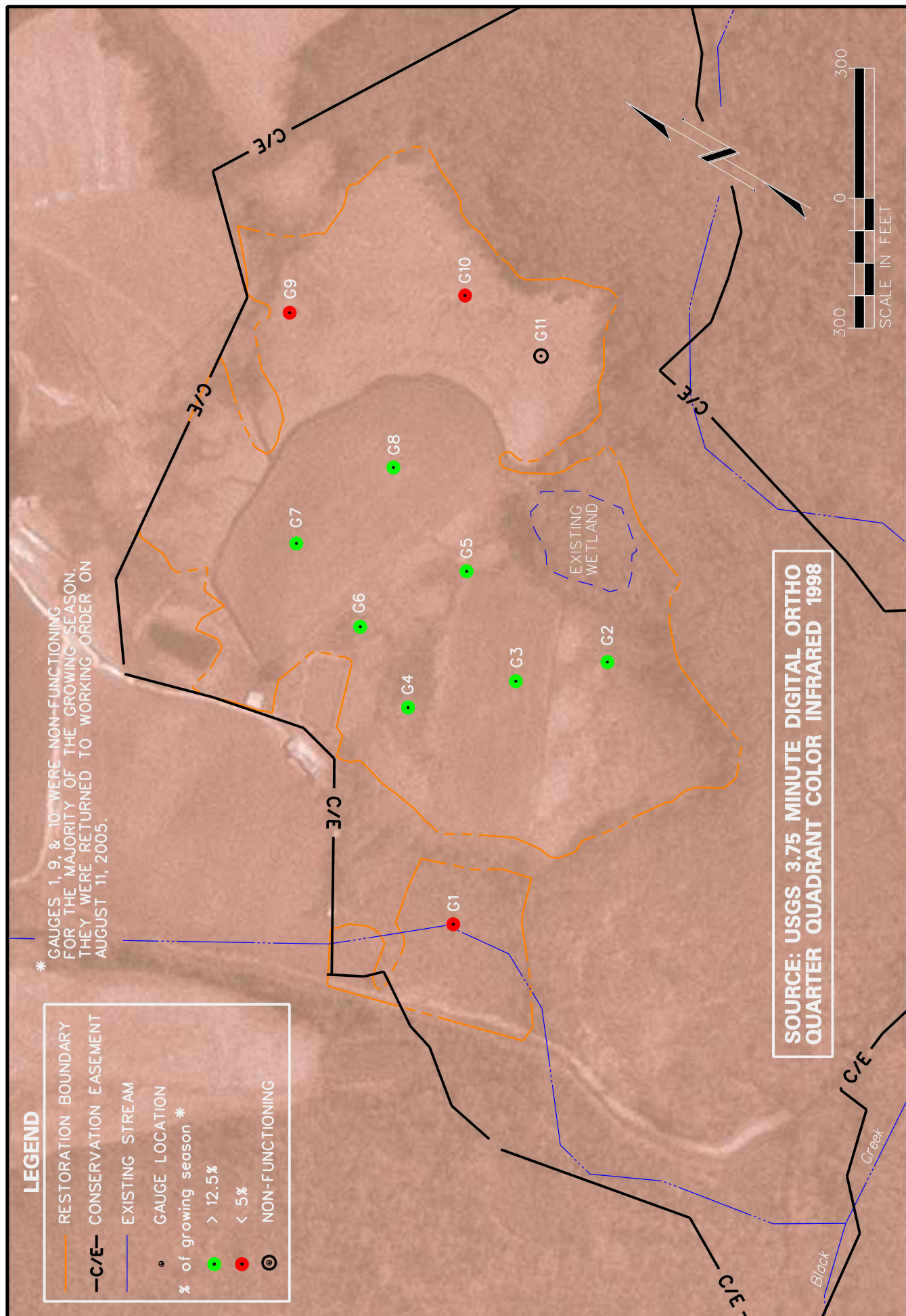


FIGURE  
**2**

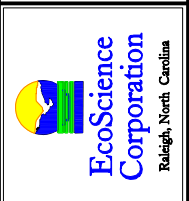
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Checked By:	JWG	Scale:	1" = 300'
ESC Project No.:		05-24.3.02	

**MONITORING GAUGE LOCATIONS AND RESULTS**  
**Benson Grove Mitigation Site**

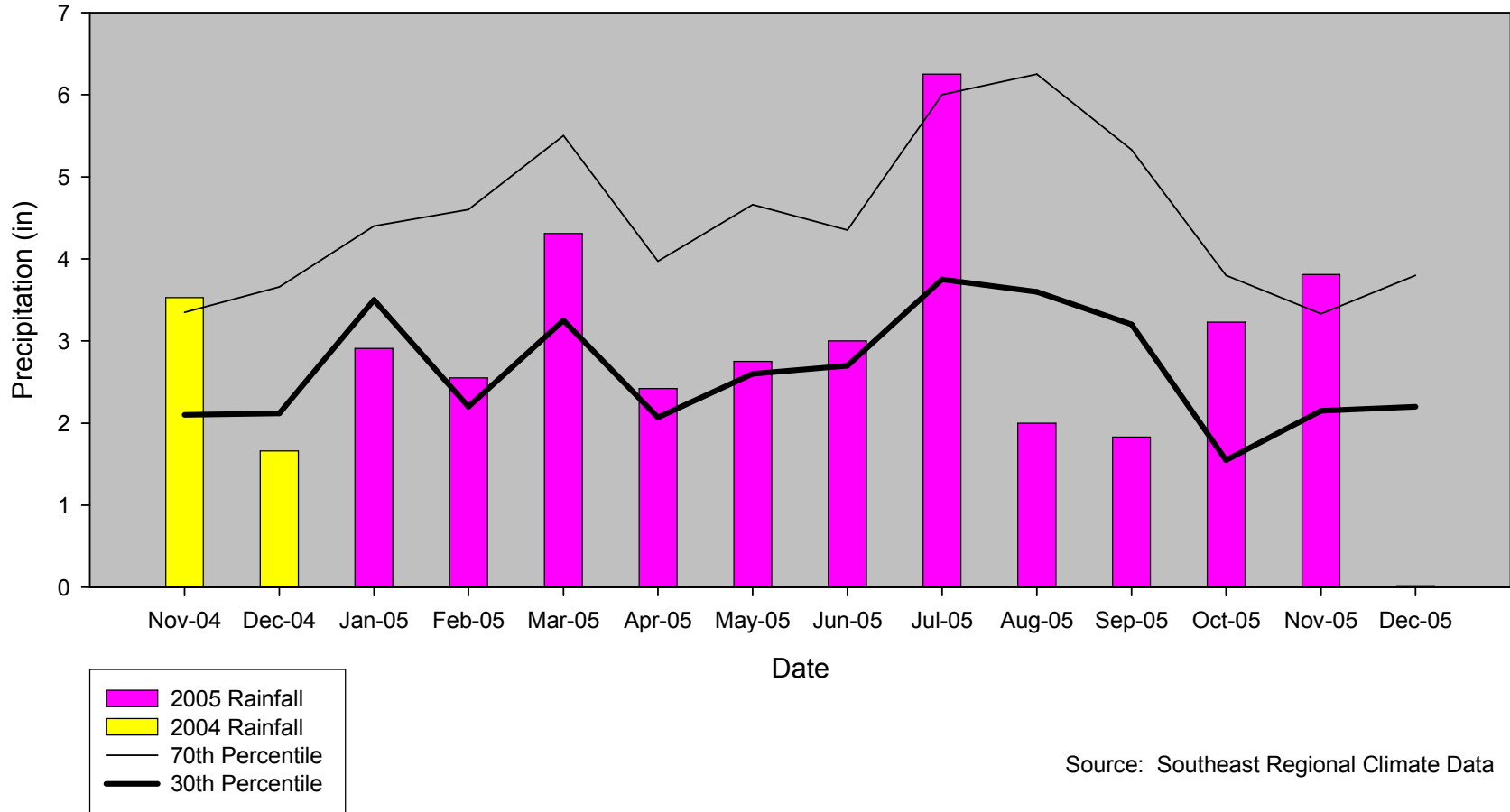
**EEP Project No. 32**

JOHNSTON COUNTY, NORTH CAROLINA

Project:



**Figure 3. Monthly Rainfall and 30-70 Percentile Graph for Smithfield, NC Benson Grove Mitigation Site**

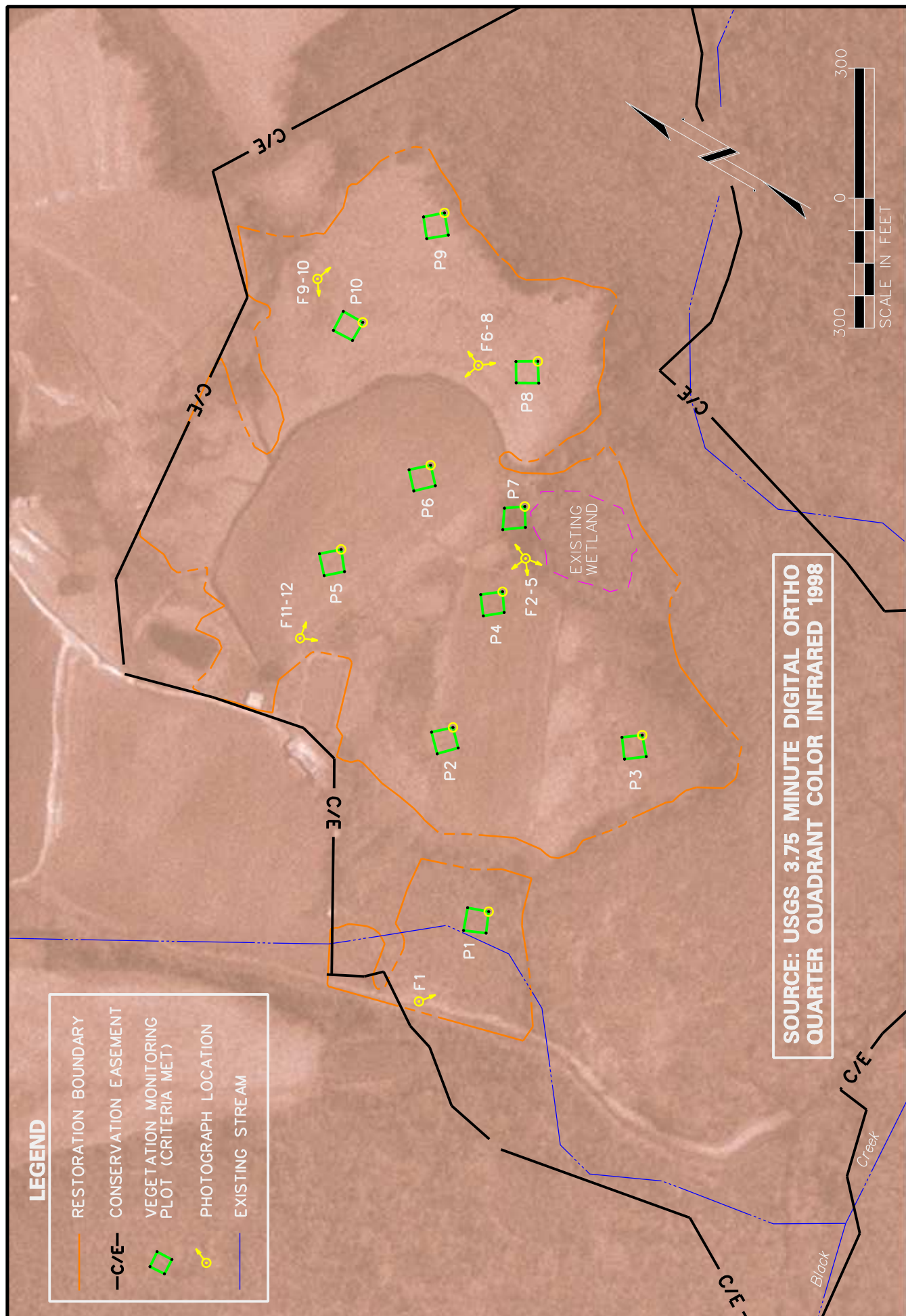


Source: Southeast Regional Climate Data

**LEGEND**

-  RESTORATION BOUNDARY
-  -C/E-
-  VEGETATION MONITORING PLOT (CRITERIA MET)
-  PHOTOGRAPH LOCATION
-  EXISTING STREAM

SOURCE: USGS 3.75 MINUTE DIGITAL ORTHO QUARTER QUADRANT COLOR INFRARED 1998



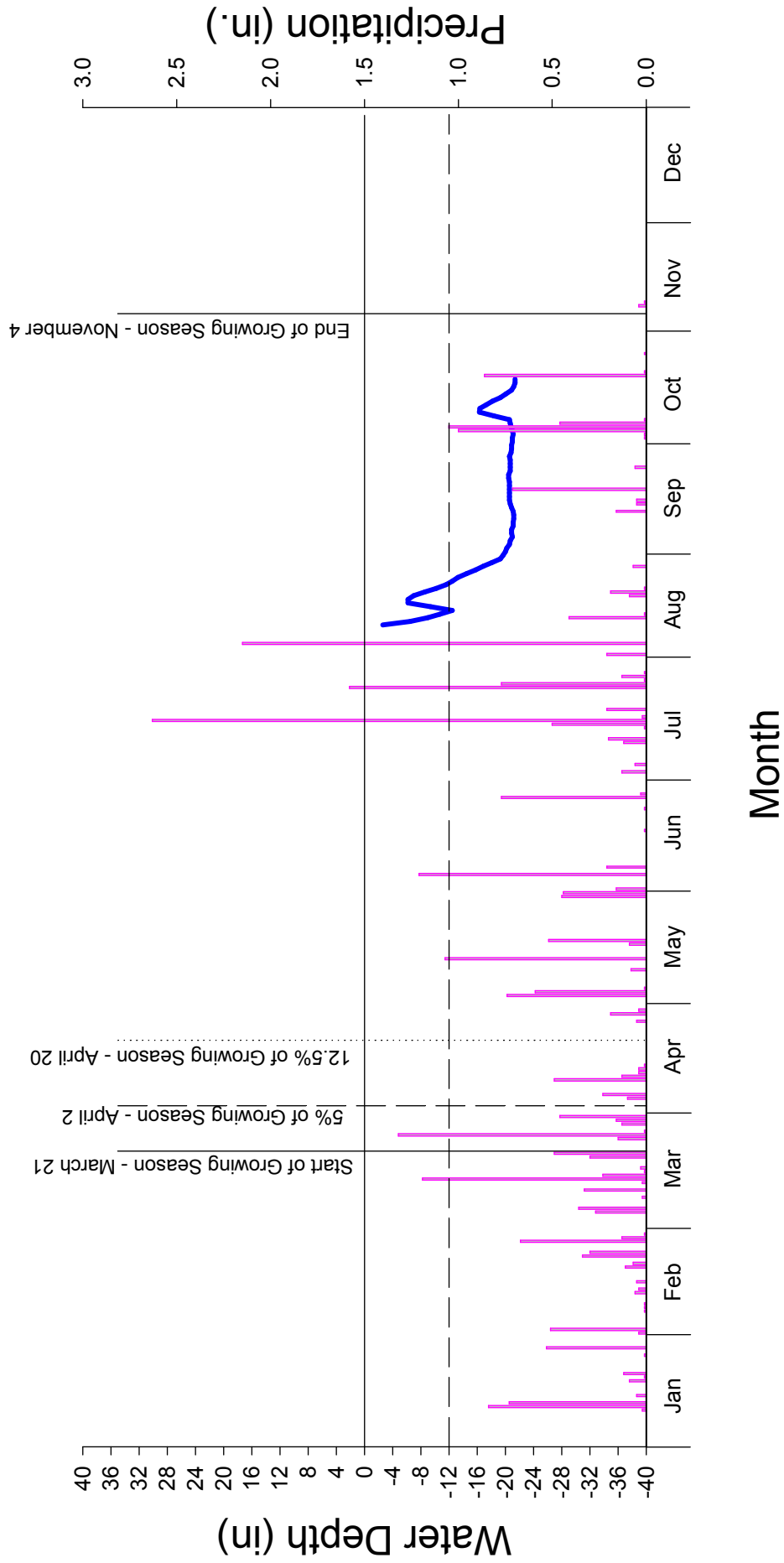
 <p><b>EcoScience Corporation</b> Raleigh, North Carolina</p>	 <p><b>Ecosystem Enhancement PROGRAM</b></p>	<p>Client: <b>VEGETATION MONITORING PLOTS AND PHOTOGRAPH LOCATIONS</b> <b>Benson Grove Mitigation Site</b></p>		<p>Project: <b>EEP Project No. 32</b></p>	<p>JOHNSTON COUNTY, NORTH CAROLINA</p>
		<p>Down By: MAF      Date: DEC 2005</p>		<p>Scale: 1" = 300'</p>	<p>FIGURE <b>4</b></p>
		<p>Chk By: JWG      ESC Project No.: 05-243.02</p>			



**APPENDIX B**  
**GROUNDWATER GAUGE HYDROGRAPHS**

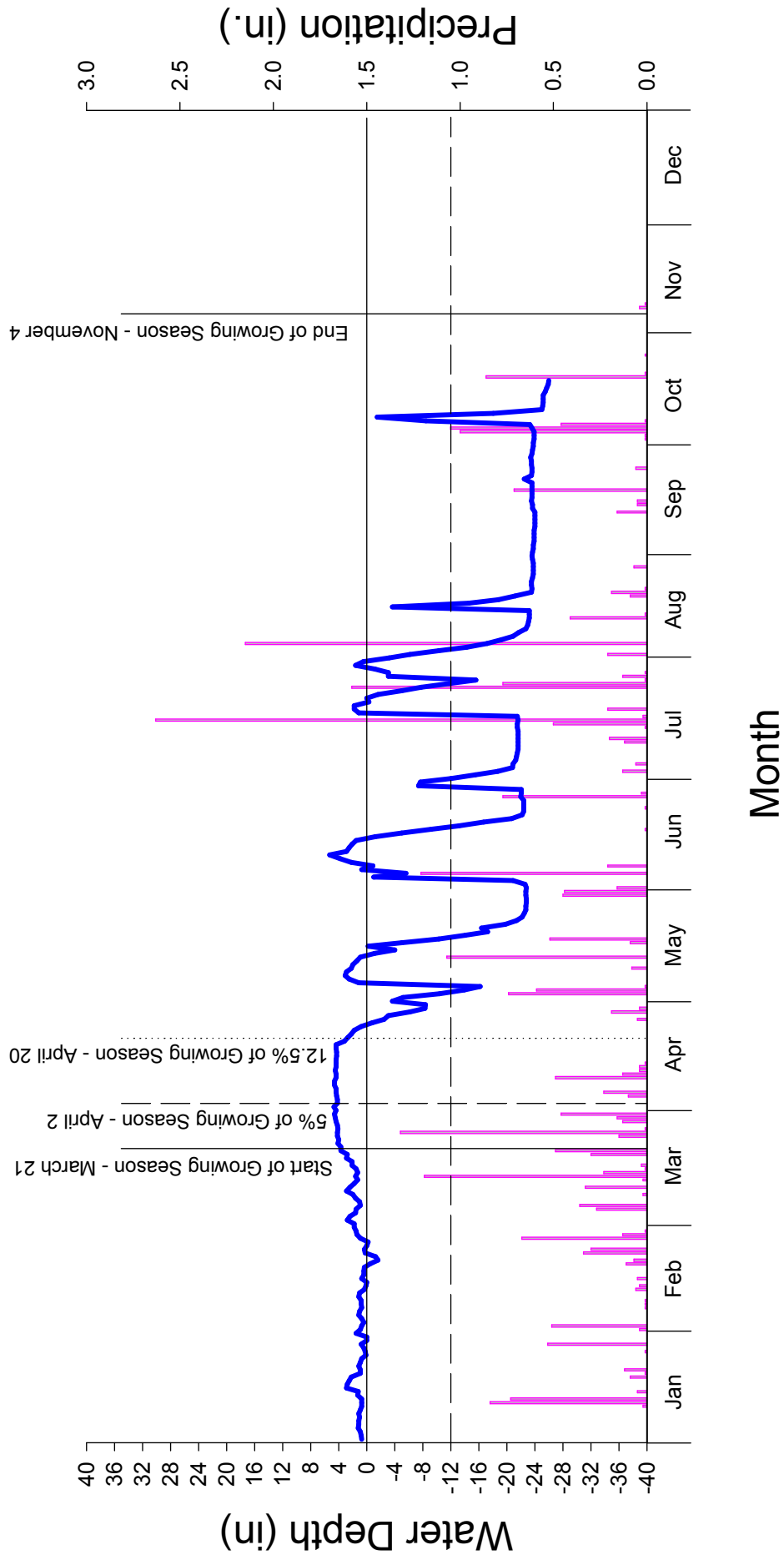
# Benson Grove 2005

## Monitoring Gauge 1 - B6513E9

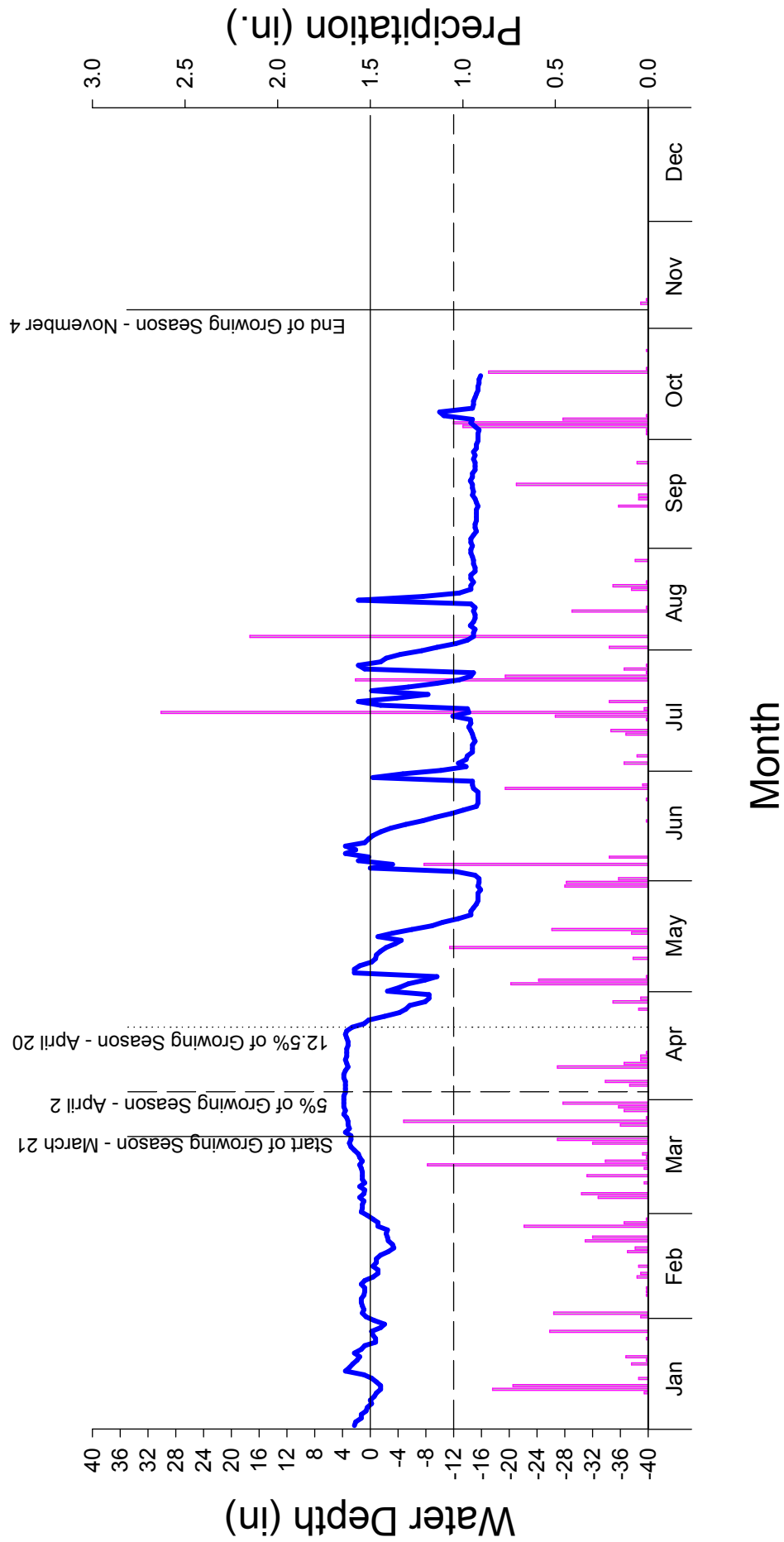


\*Gauge was found to be non-functioning during first site visit in July 2005. Gauge was replaced in August 2005.

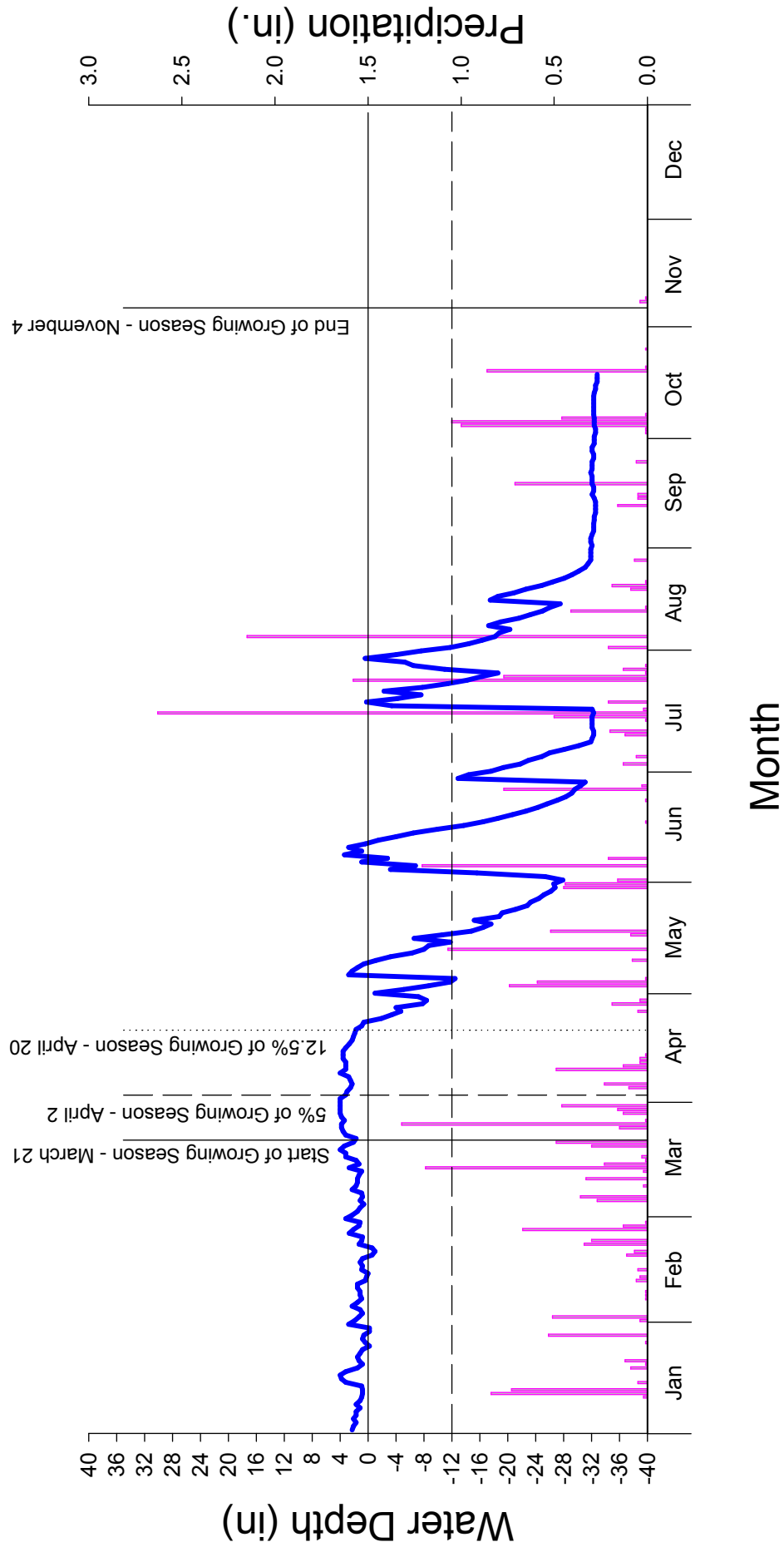
# Benson Grove 2005 Monitoring Gauge 2 - 9BEBE69



# Benson Grove 2005 Monitoring Gauge 3 - 04CDAE8



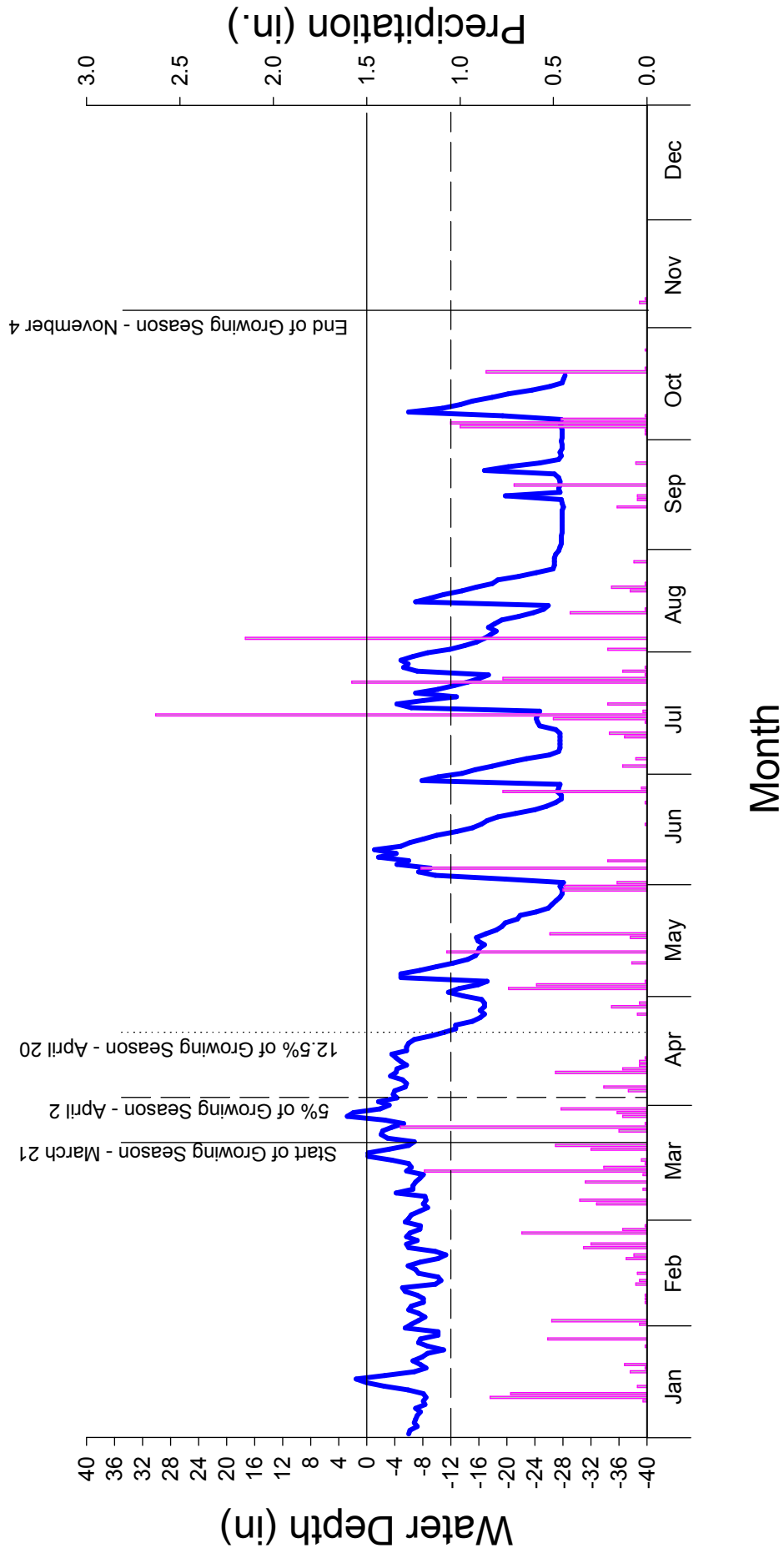
# Benson Grove 2005 Monitoring Gauge 4 - 04CDAAF



# Benson Grove

## 2005

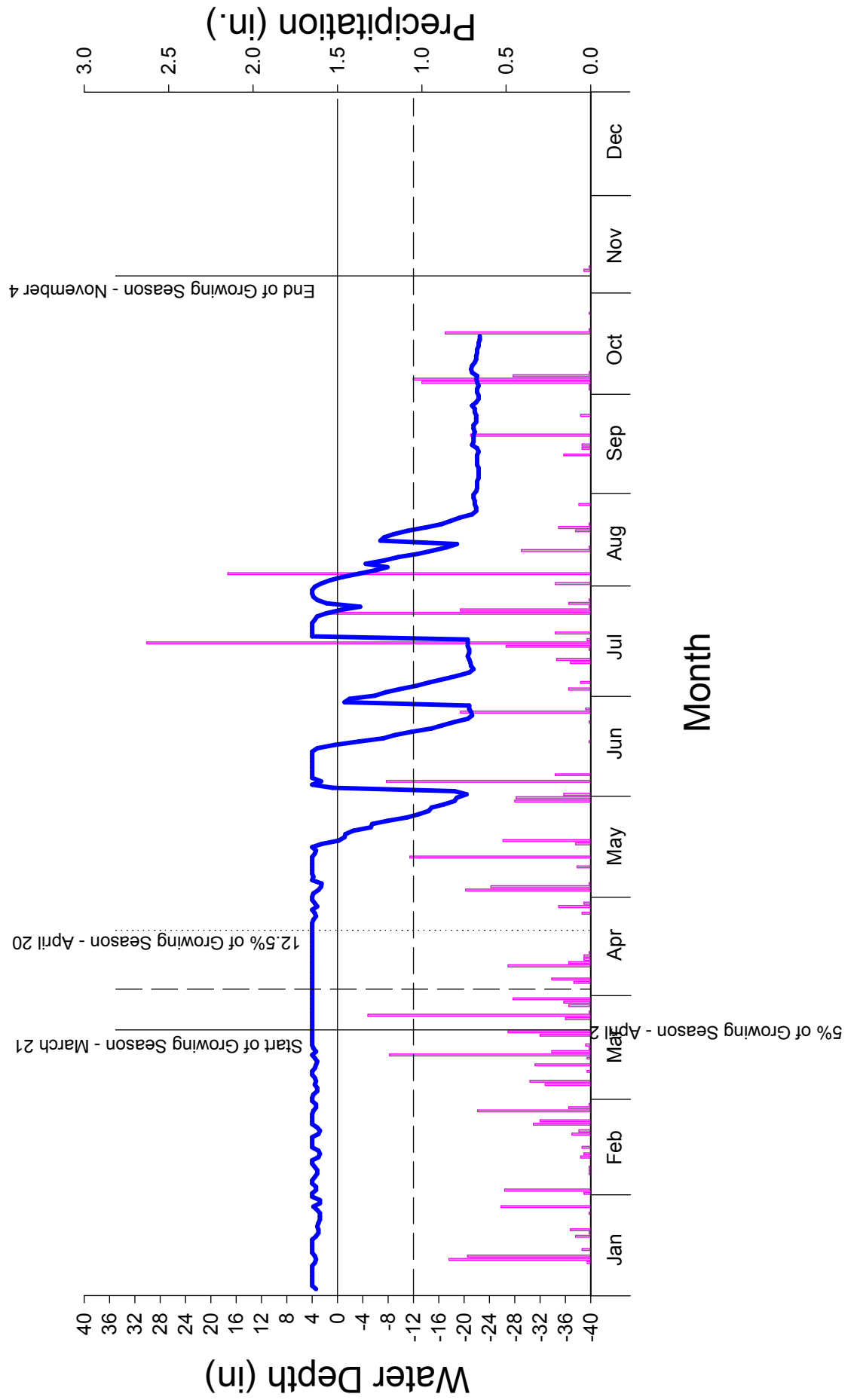
### Monitoring Gauge 5 - 04CD984



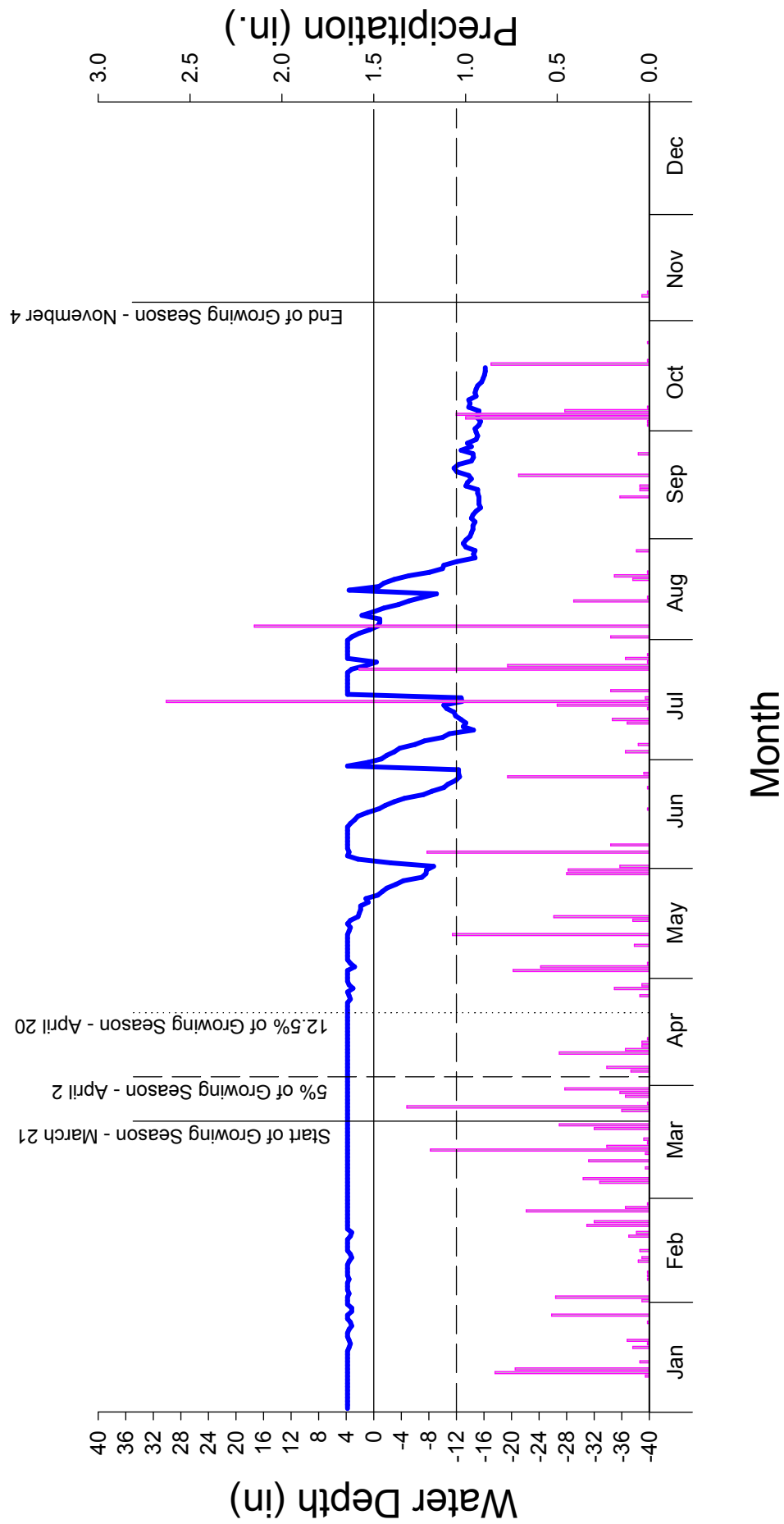
# Benson Grove

2005

## Monitoring Gauge 6 - 04CD8f0

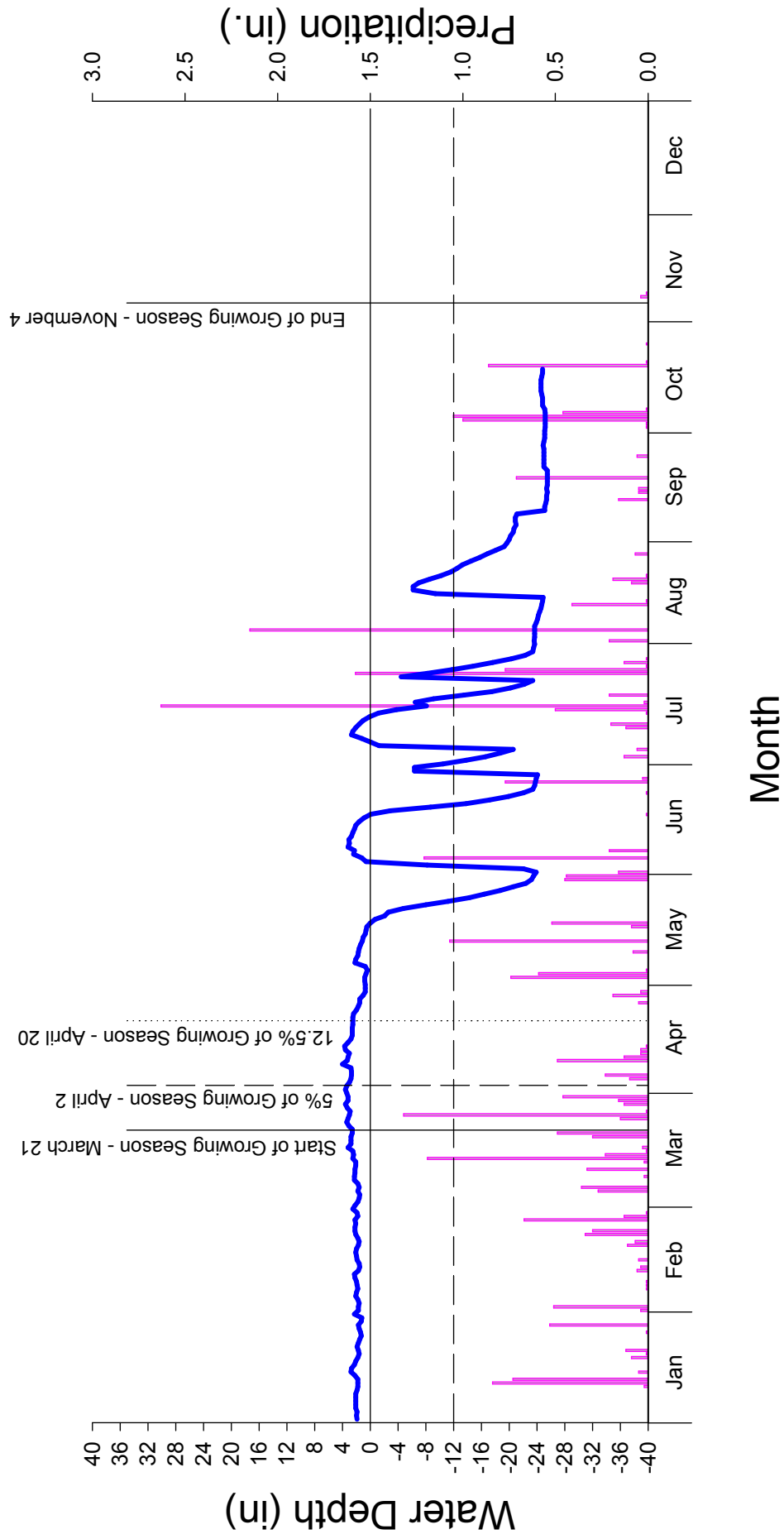


# Benson Grove 2005 Monitoring Gauge 7 - 04CD88CD



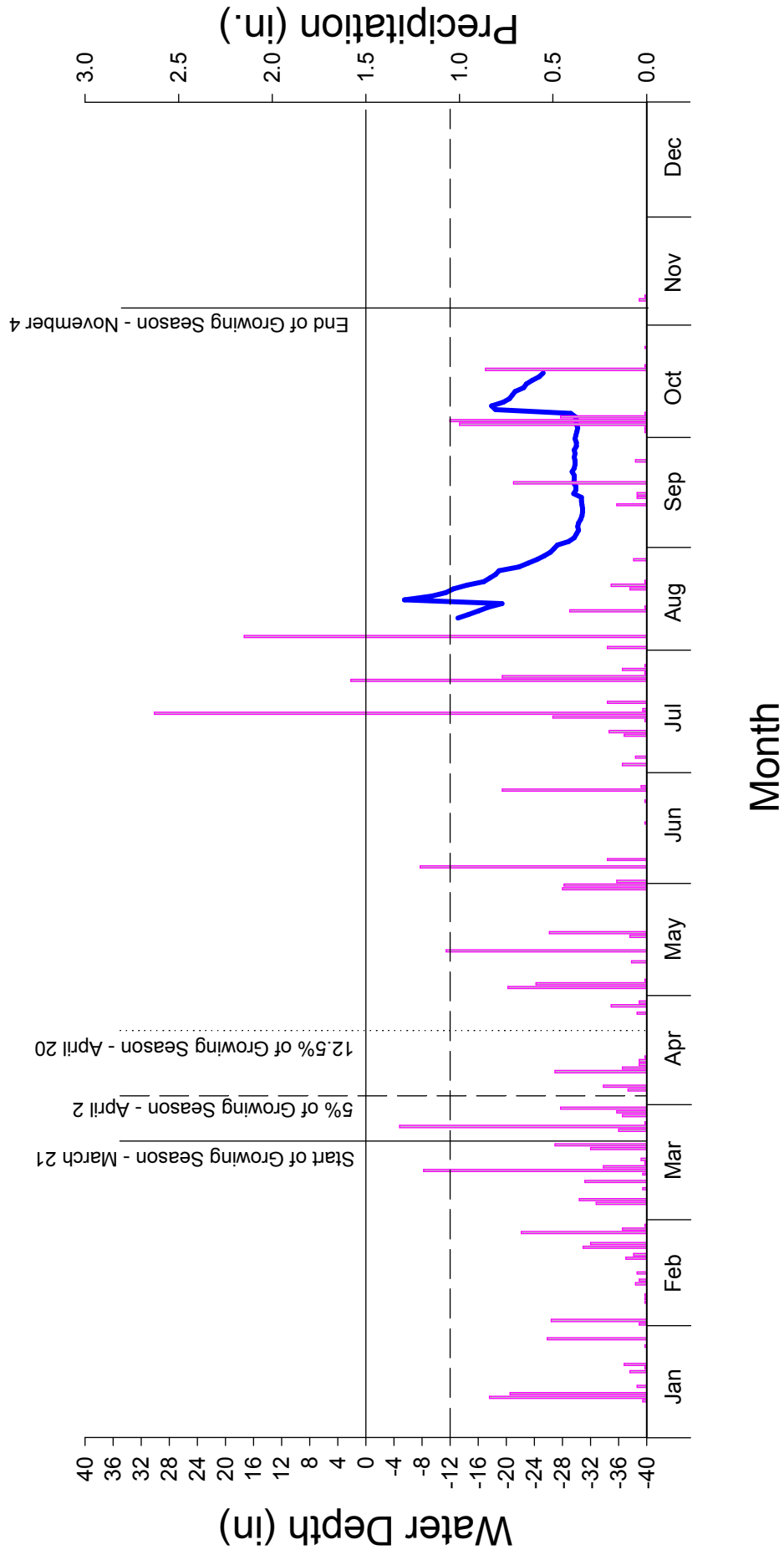


# Benson Grove 2005 Monitoring Gauge 8 - 9D7E820



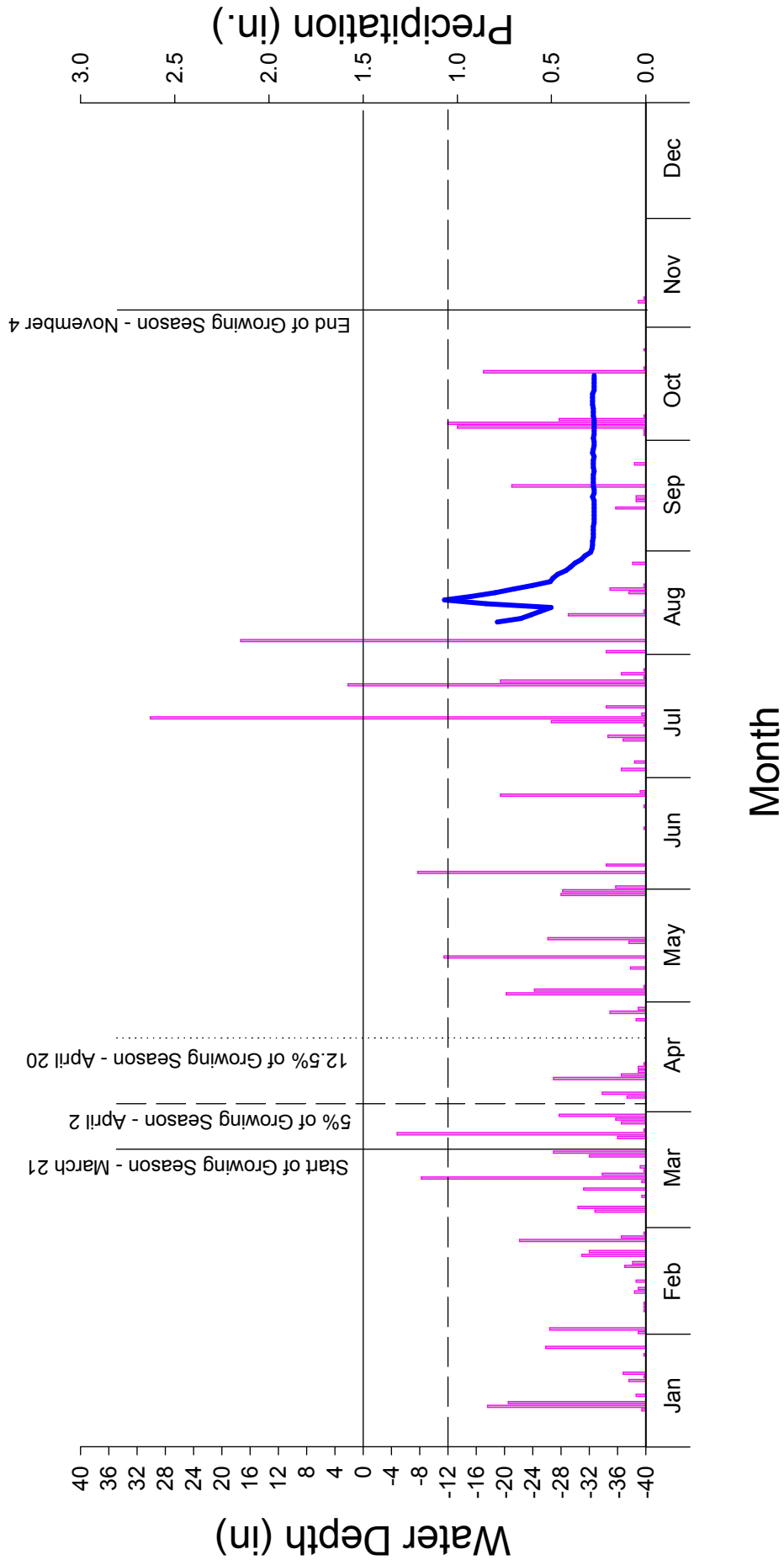
# Benson Grove 2005

## Monitoring Gauge 9 - B6B8E7D



\*Gauge was found to be non-functioning during first site visit in July 2005. Gauge was replaced in August 2005.

# Benson Grove 2005 Monitoring Gauge 10 - B6B4A4B



\*Gauge was found to be non-functioning during first site visit in July 2005. Gauge was replaced in August 2005.

**APPENDIX C**

**SITE PHOTOS**

**Benson Grove  
Fixed Station Photos  
October 13, 2005 – Year 4**



Photo Plot 1



Photo Plot 2



Photo Plot 3



Photo Plot 4



Photo Plot 5



Photo Plot 6



Photo Plot 7



Photo Plot 8



Photo Plot 9



Photo Plot 10

**Benson Grove  
Vegetation Plot Photos  
December 2, 2005 – Year 4**



Plot 1



Plot 2



Plot 3



Plot 4



Plot 5



Plot 6



Plot 7



Plot 8



Plot 9

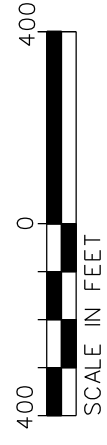
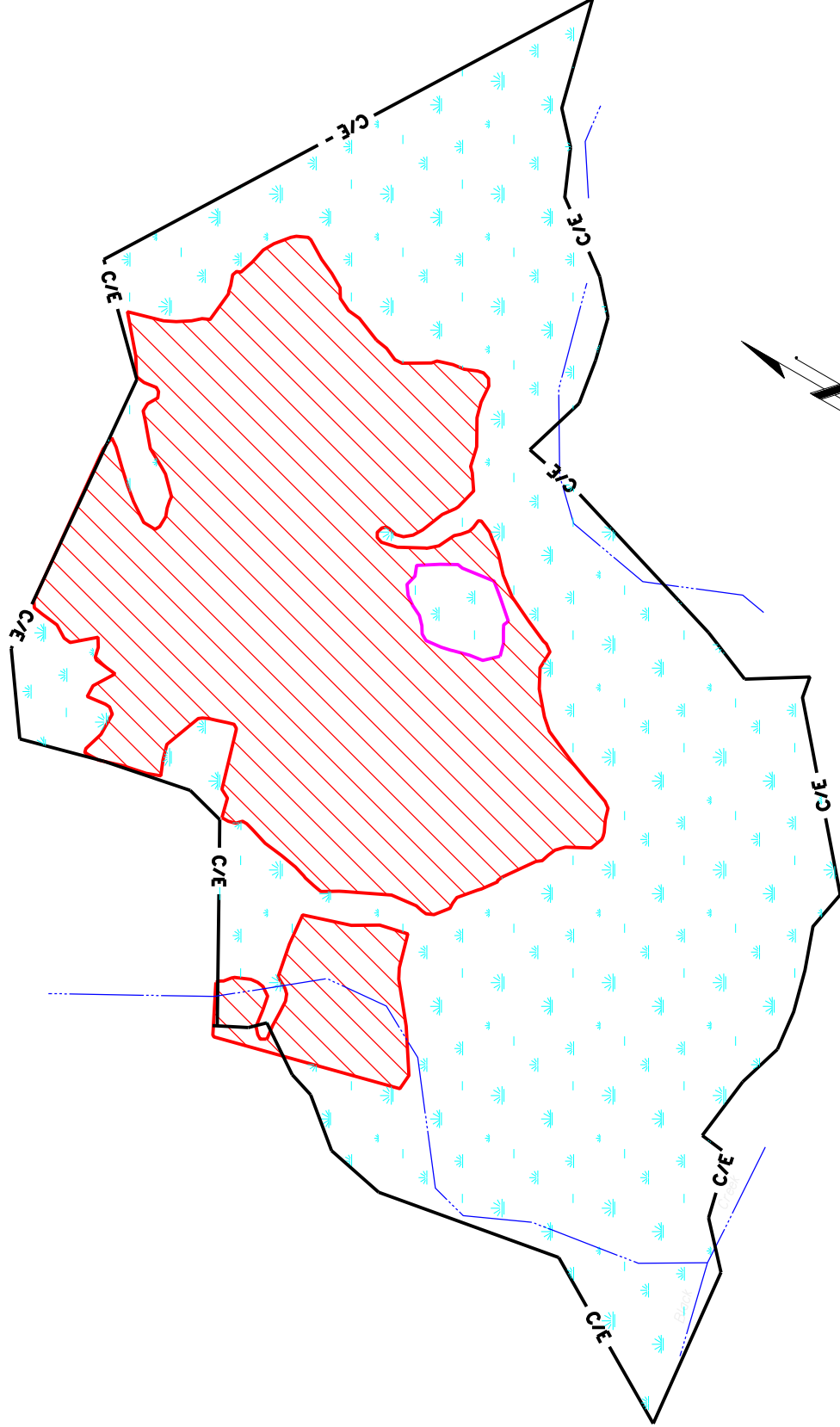


Plot 10



**APPENDIX D**  
**RESTORATION PLAN**

	WETLAND PRESERVATION	50.7 ± ac.
	WETLAND RESTORATION	31.5 ± ac.
	Total	82.2 ± ac.



Client: **WETLAND RESTORATION AREA  
Benson Grove Mitigation Site**

Project: **EEP Project No. 32**  
JOHNSTON COUNTY, NORTH CAROLINA

Drawn By:	MAF	Date:	DEC 2005
Check By:	JWG	Scale:	1" = 400'
ESC Project No.:			05-243.02

FIGURE **D**