

ANNUAL MONITORING REPORT HOWELL WOODS

WETLAND RESTORATION JOHNSTON COUNTY, NORTH CAROLINA (EEP Project Number 183)

Monitoring Year 5 of 6 (2006)



Submitted to:
North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
Raleigh, North Carolina

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February 2007

EXECUTIVE SUMMARY/PROJECT ABSTRACT

The Howell Woods Wetland Restoration Site (Site) is located within the United States Geological Survey (USGS) Hydrologic Unit 03020201 (North Carolina Division of Water Quality [NCDWQ] subbasin 03-04-04) of the Neuse River Basin. The Site includes an approximately 140-acre tract, located approximately 8.5 miles southeast of the Town of Smithfield in southern Johnston County (Figure 1). The Site is contained within an approximately 2000-acre tract of land managed by Johnston County Community College as part of the Howell Woods Environmental Learning Center.

The primary goals of the project included the following.

1. Enhance water quality functions in the Gar Gut Creek and Mill Creek watersheds.
2. Reestablish a functioning backwater slough system, which extends through developing bottomland hardwood forests.
3. Provide educational opportunities to show the importance of wetlands for water quality.
4. Maximize the area returned to historic wetland function.

Five vegetation plots had been previously established by North Carolina State University. The plots are 10 meters square and are located randomly within the Site. These plots were surveyed in late June and early July 2006 for the 2006 (year 5) monitoring season. Based on the number of stems counted, the average plot density was measured at 1101 planted stems per acre, or 27 planted stems per plot for 2006 (year 5) monitoring, which is well-above the required 260 stems per acre for success. The dominant species identified at the Site were elm species (*Ulmus rubra* and *Ulmus americana*) and green ash (*Fraxinus pennsylvanica*). Four out of the five individual vegetation plots were well above the success criteria with 1093 to 1700 planted stems per acre. Vegetation plot 1 was low with 162 planted stems per acre present; however, natural recruits comprised an additional 148 stems for the plot (approximately 5992 stems per acre).

Vegetation problem areas include an area within the northwestern portion of the Site that had been burned and partially bush hogged prior to year-5 (2006) monitoring. Burning resulted in some dieback; however, the majority of the burned or cut stems are resprouting. This area is expected to recover as long as burning and bush hogging activities are not resumed. In addition, vegetation on the outer rim of the southeastern littoral shelf is sparse and survival of planted vegetation is poor, most likely resulting from soil infertility due to the removal of nutrient rich surface soils during site construction.

No wetland problem areas have been identified during the year-5 (2006) monitoring year. Groundwater hydrology within 12 inches of the soil surface is occurring for greater than 12.5 percent of the growing season for year-5 (2006) at Gauges 1, 4-7, and 9-12 and greater than 5 percent of the growing season at Gauges 2 and 8. Groundwater hydrology was within 12 inches of the soil surface for less than 5 percent of the growing season for Gauge 3; however, this gauge is located on the margin of an upland area. In addition, all groundwater gauges have a presence of hydrophytic wetland vegetation based on criteria set forth in the *Corps of Engineers Wetland Delineation Manual*.

In summary, the restoration site achieved success criteria for hydrology and vegetation in the Fifth Monitoring Year (2006). In addition, based on available data the site achieved success criteria for hydrology and vegetation over the entire 5-year monitoring period. However, the Site was not constructed until mid-way through the first year growing season; therefore, the Site will be monitored for a sixth growing season.

Table of Contents

EXECUTIVE SUMMARY/PROJECT ABSTRACT i
1.0 PROJECT BACKGROUND..... 1
 1.1 Location and Setting 1
 1.2 Mitigation Structure and Objectives 1
 1.3 Project History and Background..... 6
 1.4 Monitoring Plan View..... 7
2.0 PROJECT CONDITION AND MONITORING RESULTS 8
 2.1 Vegetation Assessment 8
 2.1.1 Soil Data..... 8
 2.1.2 Vegetative Problem Areas 8
 2.1.3 Stem Counts..... 10
 2.1.4 Vegetation Plot Photos 11
 2.2 Wetland Assessment 11
 2.2.1 Wetland Problem Area Plan View 13
 2.2.2 Wetland Criteria Attainment 13
3.0 FIVE-YEAR MONITORING ASSESSMENT 14
4.0. REFERENCES 15

List of Figures

Figure 1. Site Location 2
Figure 2. DRAINMOD Revised Mitigation Unit Calculations..... 4
Figure 3. Monitoring Plans 5
Figure 4. Vegetation Problem Areas 9

List of Tables

Table 1. Project Mitigation Structures and Objectives 3
Table 2. Project Activity and Reporting History..... 6
Table 3. Project Contact Table..... 7
Table 4. Project Background Table 7
Table 5. Preliminary Soil Data..... 8
Table 6. Vegetation Problem Areas..... 10
Table 7. Stem Counts for Planted Species Arranged by Plot..... 10
Table 8. Summary of Groundwater Gauge Results for Years 1 through 5 12
Table 9. Wetland Criteria Attainment 13

Appendices

- APPENDIX A. VEGETATION PLOT PHOTOGRAPHS
- APPENDIX B. GROUNDWATER GAUGE GRAPHS
- APPENDIX C. GROUNDWATER GAUGE RAW DATA
- APPENDIX D. CVS LEVELS 1 & 2 DATA FORMS
- APPENDIX E. GAUGE VEGETATION LISTS
- APPENDIX F. YEAR 1 (2002) GROUNDWATER GAUGE GRAPHS
- APPENDIX G. YEAR 2 (2003) GROUNDWATER GAUGE DATA
- APPENDIX H. YEAR 3 (2004) GROUNDWATER GAUGE GRAPHS
- APPENDIX I. YEAR 4 (2005) GROUNDWATER GAUGE GRAPHS

1.0 PROJECT BACKGROUND

1.1 Location and Setting

The Howell Woods Wetland Restoration Site (Site) is located within the United States Geological Survey (USGS) Hydrologic Unit 03020201 (North Carolina Division of Water Quality [NCDWQ] subbasin 03-04-04) of the Neuse River Basin. The Site includes an approximately 140-acre tract, located approximately 8.5 miles southeast of the Town of Smithfield in southern Johnston County (Figure 1). The Site is contained within an approximately 2000-acre tract of land managed by Johnston County Community College as part of the Howell Woods Environmental Learning Center.

Directions to the Site:

From Highway 70 Business in Smithfield

- Travel south on Route 701 for approximately 15 miles
- Turn left/southeast on Devil's Racetrack Road for approximately 10 miles
- Turn left into the Howell Woods Environmental Learning Center
- See Jaime Sasser or Kinchon Taylor at the Center office for a gate key and directions into the Site

The Site is located in the Southeastern Plains Physiographic Province, within the Southeastern Floodplains and Low Terraces ecoregion and is immediately east of the fall line of the Coastal Plain and Piedmont regions of North Carolina.

The Site is situated within the Gar Gut watershed (slough-like tributary to the Neuse River) in the outer perimeter of the Neuse River floodplain at the base of the escarpment between the Neuse River floodplain and an elevated river terrace. Ponded depressions, swamps, and sloughs occur throughout the 3.5-mile wide floodplain and are characterized by cypress-gum associations. Elevated, well-drained portions of the floodplain support bottomland hardwood and mesic upland slope forests dominated by oaks and ashes.

1.2 Mitigation Structure and Objectives

Prior to implementation of wetland restoration activities, the Site was characterized by agriculture, fallow fields, and forest. Land use activities in the drainage area and adjacent tracts are limited due to frequent flooding from the Neuse River and poorly drained soils. Onsite land use was characterized by farming (agricultural row crops), hunting, and recreational activities associated with the Howell Woods Environmental Learning Center.

The primary restoration feature at the Site included 5400 linear feet of a dredged and straightened canal and associated ditch network system that drained the majority of the Site. The canal was dredged along the toe of slope at the outer floodplain edge. This area historically supported a backwater slough, as evidenced by relict channel reaches within forested sections of the Site situated adjacent to the excavated canal.

Wetland/backwater slough restoration at the Site entailed 1) ditch cleaning prior to backfill, 2) impervious ditch plug construction, 3) ditch/canal backfilling, 4) access road improvements, 5) littoral shelf creation, and 6) pond outfall structural upgrades. In addition to hydrology alterations associated with ditch backfilling, a primary component of the project entailed restoring surface water flows through the abandoned backwater slough channel.



Directions to the Site:
 From Highway 70 Business in Smithfield
 Travel south on Route 701 for approximately 15 miles
 Turn left/southeast on Devil's Racetrack Road
 for approximately 10 miles
 Turn left into the Howell Woods Environmental
 Learning Center
 See Jaime Sasser or Kinchon Taylor at the Center office
 for a gate key and directions into the Site

**APPROX.
 SITE
 LOCATION**



0 1 mi. 4 mi.
 1:158,400
 Source: 1977 North Carolina Atlas and Gazetteer, p.63.




2126 Rowland Pond Dr
 Willow Spring, NC 27592
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 (919) 341-3839 fax

SITE LOCATION
HOWELL WOODS RESTORATION SITE
Project Number 183
Year 5 (2006) Monitoring Report
 Johnston County, North Carolina

Dwn. by: WGL
 Ckd by: WGL
 Date: NOV 2006
 Project: 06-002

FIGURE
1

Based on an October 2001 Detailed Wetland Restoration Plan, the primary goals of the project included 1) maximizing the area returned to historic wetland function, 2) enhancing the water quality functions in Gar Gut Creek and Mill Creek, and 3) reestablishing a functioning backwater slough system, which extends through developing bottomland hardwood forests. Project structures and objectives are summarized in Tables 1 and 2.

Table 1. Project Mitigation Structures and Objectives						
Project Name/Number: Howell Woods (EEP Project Number 183)						
Project Segment or Reach ID	Mitigation Type**	Approach	Linear Footage or Acreage	Revised Linear Footage or Acreage	Stationing	Comment
Howell Woods	R	---	24 acres	34 acres	---	Areas Effectively Drained by Historic Ditch/Canal
Howell Woods	E	---	74 acres	64 acres	---	Areas with Hydrology Effected by Ditches/Canal, but not Drained Below Jurisdictional Threshold
Howell Woods	C	---	4 acres	4 acres	---	Littoral Shelf Excavation
Howell Woods	R	---	--	5251 feet	*	Passive Backwater Slough Restoration

* No stationing along the reach, linear footage is based on down valley distance of the braided stream channel, as based on inter agency guidance (USACE et. al. 2005)

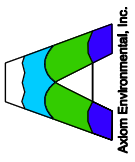
**R = Restoration

E = Enhancement

C = Creation

At the time of project completion, stream restoration projects entailed traditional alterations to channel dimension, pattern, and profile, as outlined in *Applied River Morphology* (Rosgen 1996). However, recent guidance (USACE et al. 2005) for the restoration of backwater sloughs in low-slope settings (outer Coastal Plain) indicates that stream restoration may be achieved through the reestablishment of braided stream morphology through passive measures, including ditch filling and natural progression of the stream through historic sloughs, braids, and channels. Under this scenario, stream restoration success criteria may include the successful restoration of hydrology within areas previously drained by ditching or other hydrology alterations. Using this guidance, approximately 5251 linear feet of backwater slough stream channel has been restored within the Site (Figure 2).

Wetland restoration acreages and locations were determined in the October 2001 Detailed Wetland Restoration Plan. Wetland restoration areas were defined as portions of the Site that were hydrologically impacted (hydrology below 12 inches of the ground surface for most of the growing season) by drainage ditch excavation. Wetland restoration areas were determined utilizing DRAINMOD computer simulations to predict the effect Site drainage features had on the adjacent groundwater table. However, the abandoned backwater slough channel, which served as an approximately 2 to 3 foot deep drainage feature prior to restoration activities, was not included in the original DRAINMOD model simulations. Utilizing drainage effect estimates from the October 2001 Detailed Wetland Restoration Plan, the abandoned backwater slough channel drained an additional 10 acres of wetland at the Site prior to restoration activities. These revised acreages are depicted on Figure 2 and are described in Table 1 (Project Mitigation Structures and Objectives).



REVISIONS

NO.	DESCRIPTION	DATE

Client:
WETLANDS RESTORATION PROGRAM
Raleigh, North Carolina

Project:

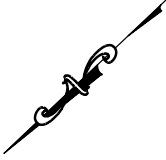
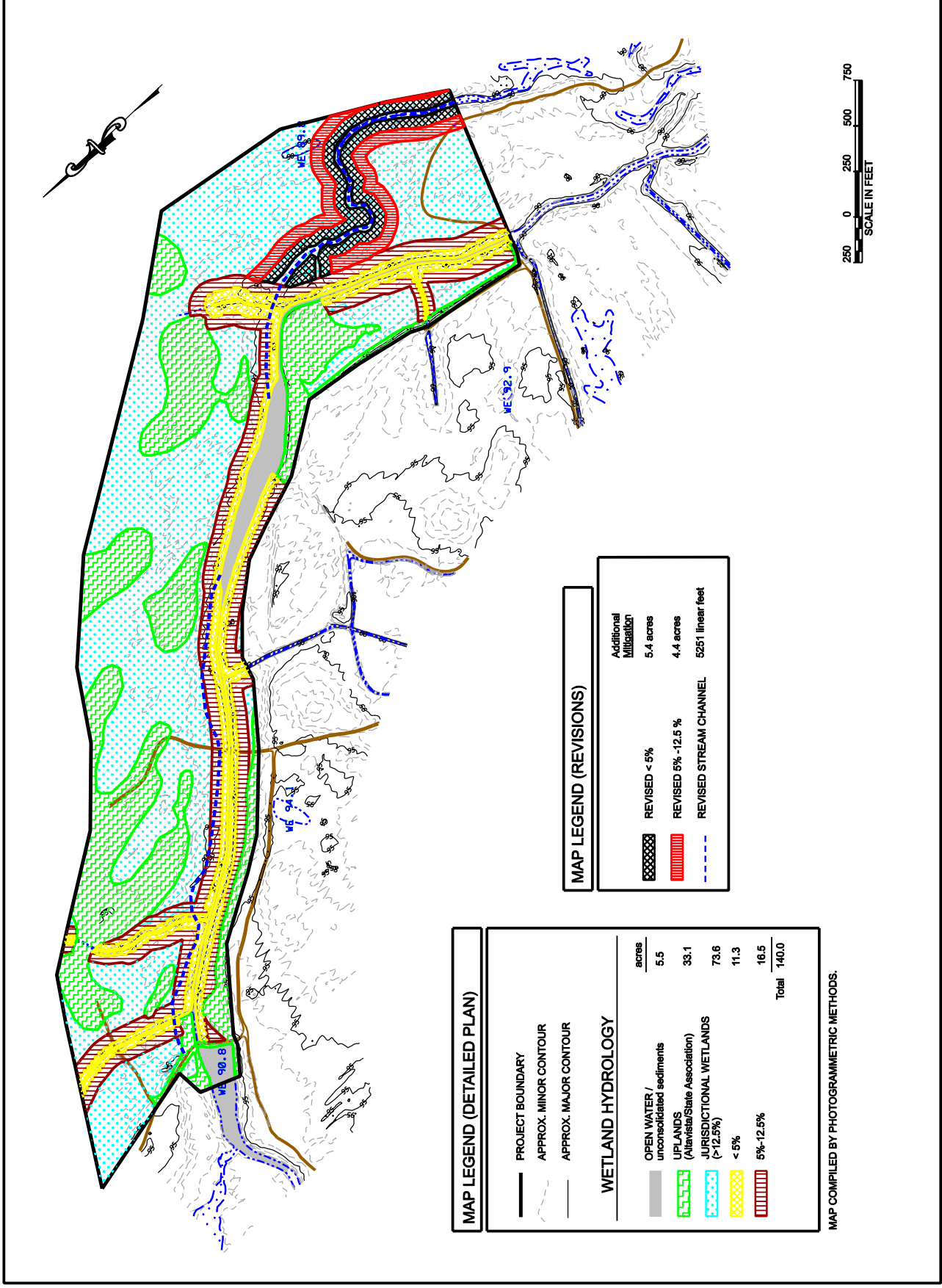
Project:
HOWELL WOODS RESTORATION SITE
Project Number: 183
Year: 5 (2006 Monitoring Report)

Title:
DRAINMOD REVISED MITIGATION UNIT CALCULATIONS

Drawn By: WGL
Date: OCT 2008
Scale: 1" = 500'

Card By: WGL
AXE Project No.: 06-002

FIGURE
2



MAP LEGEND (DETAILED PLAN)

	PROJECT BOUNDARY
	APPROX. MINOR CONTOUR
	APPROX. MAJOR CONTOUR

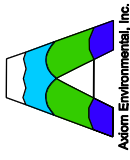
WETLAND HYDROLOGY

Symbol	Description	Acres
	OPEN WATER / unconsolidated sediments	5.5
	UPLANDS (Altavista/State Association)	33.1
	JURISDICTIONAL WETLANDS (>12.5%)	73.6
	< 8%	11.3
	5%-12.5%	18.5
Total		140.0

MAP LEGEND (REVISIONS)

Symbol	Description	Additional Mitigation
	REVISED < 5%	5.4 acres
	REVISED 5% -12.5 %	4.4 acres
	REVISED STREAM CHANNEL	5251 linear feet

MAP COMPILED BY PHOTOGRAMMETRIC METHODS.



REVISIONS	

Client:
 WETLANDS RESTORATION PROGRAM
 Raleigh, North Carolina

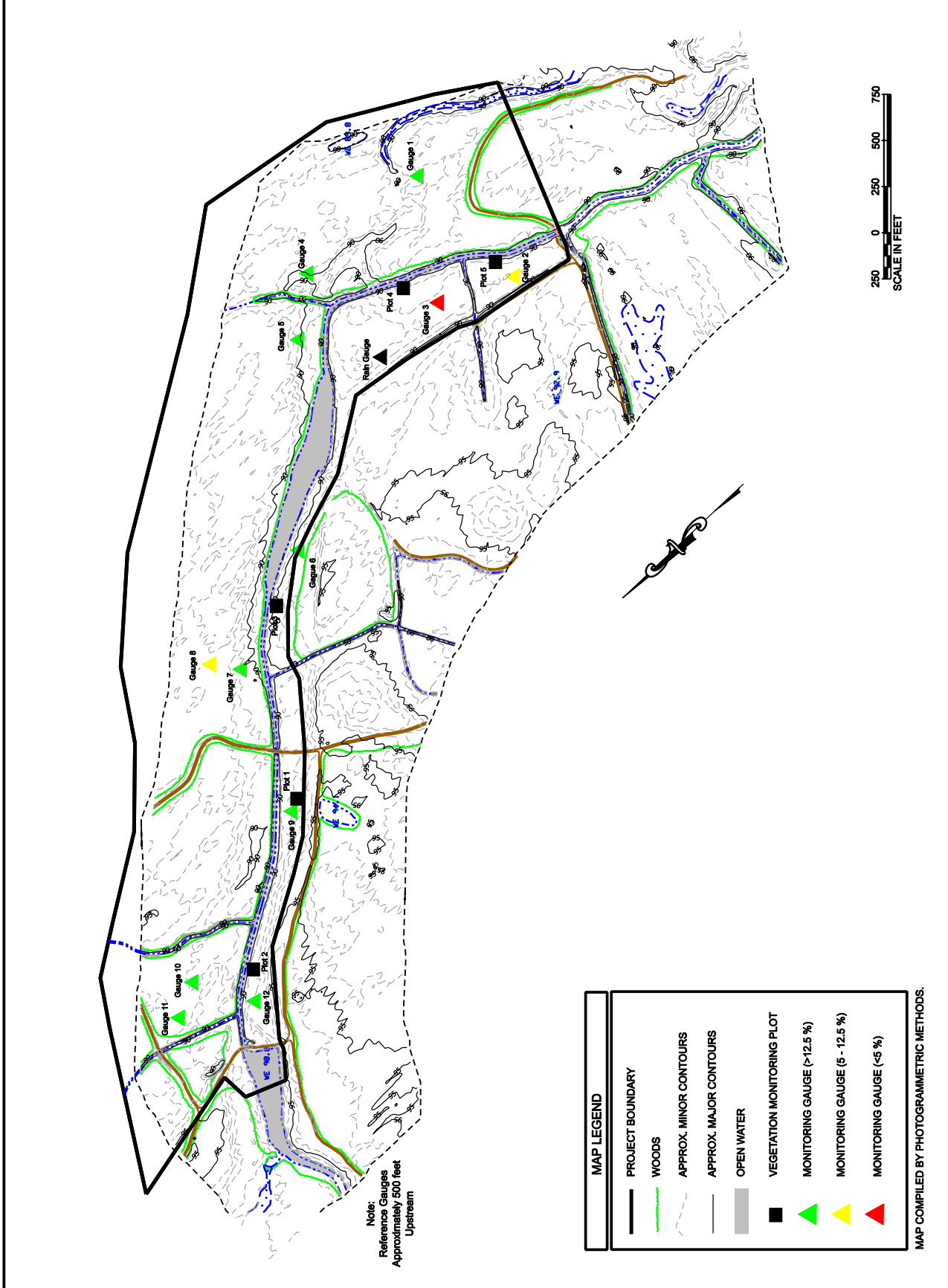
Project:
 HOWELL WOODS RESTORATION SITE
 Project Number: 183
 Year: 5 (2006 Monitoring Report)

JOHNSTON COUNTY, NORTH CAROLINA

Title:
 MONITORING PLAN

Date: OCT 2001
Drawn By: WGL
Checked By: WGL
Scale: 1" = 500'
AVE Project No.: 06-002

FIGURE
 3



Note:
 Reference Gauges
 Approximately 500 feet
 Upstream

MAP LEGEND	
	PROJECT BOUNDARY
	WOODS
	APPROX. MINOR CONTOURS
	APPROX. MAJOR CONTOURS
	OPEN WATER
	VEGETATION MONITORING PLOT
	MONITORING GAUGE (~12.5 %)
	MONITORING GAUGE (6 - 12.5 %)
	MONITORING GAUGE (<5 %)

MAP COMPILED BY PHOTOGRAMMETRIC METHODS.

1.3 Project History and Background

In the spring of 1999, a preliminary feasibility study was conducted at the Site, which included the following activities: 1) property boundary surveys, 2) aerial photography and topographic mapping, 3) soil mapping, 4) hydraulic conductivity estimates, 5) groundwater and surface water elevation monitoring, and 6) planting plan development. A feasibility report was prepared in April 1999 that described the results of these studies and presented mitigation options for the Site.

A mitigation alternatives analysis was subsequently conducted in the spring of 2000. The alternatives analysis outlined five mitigation options for the Site. These mitigation options included 1) no action, 2) stream restoration on new location, 3) in-canal structures and ford construction, 4) in-canal structures and road elevation, and 5) backwater slough/passive stream restoration.

In March 2000 approximately 19 acres of agricultural fields within the Site were revegetated with native, wetland-adapted tree species. Approximately 9600 tree seedlings were purchased and planted on 10 foot centers. Monitoring of planted species occurred in the fall of 2001.

In an effort to expand the Site boundaries, additional acreage was acquired by the North Carolina Wetland Restoration Program and an expanded Compensatory Wetland Mitigation Design Plan was prepared for the Site in October 2001. Upon completion of the detailed plan the project was bid on May 17, 2002. Backwater Environmental, a subsidiary of Osborne Co. Inc., was awarded the construction contract and work initiated on June 18, 2002. Earthwork associated with the project was completed within 4 weeks and the Site was planted in the winter of 2002.

Completed project activities, reporting history, and completion dates are summarized in Table 2.

Table 2. Project Activity and Reporting History			
Project Name/Number: Howell Woods (EEP Project Number 183)			
Activity or Report	Scheduled Completion	Data Collection Completion	Actual Completion or Delivery
Initial Feasibility Report	---	---	Apr 1999
Mitigation Alternatives Analysis	Spring 2000	---	Spring 2000
Initial Site Planting (approximately 19 acres)	Mar 2000	---	Mar 2000
Year 1 Monitoring (2001)	Fall 2002	---	Nov 2002
Additional Property Acquisition	---	---	*
Compensatory Wetland Mitigation Design Plan	Oct 2001	---	Oct 2001
Site Implementation (Wetland/Backwater Slough)	Fall 2002	---	Jul 2002
Site Planting (approximately 12 acres)	Dec 2002	---	Dec 2002
Year 2 Monitoring (2003)	Dec 2003	---	Dec 2003
Year 3 Monitoring (2004)	Dec 2004	---	Dec 2004
Year 4 Monitoring (2005)	Dec 2005	---	Dec 2005
Year 5 Monitoring (2006)	Dec 2006	Oct 2006	Nov 2006

Contact information regarding project designer, construction, planting contractor, and monitoring personnel are summarized in Table 3 and relevant project background information is summarized in Table 4.

Table 3. Project Contact Table	
Project Name/Number: Howell Woods (EEP Project Number 183)	
Designer	EcoScience Corporation 1101 Haynes Street, Suite 101 Raleigh, North Carolina 27604 Jerry McCrain (919) 828-3433
Construction Contractor	Backwater Environmental PO Box 1654 Pittsboro, North Carolina 27312 Wes Newell (919) 523-4375
Planting Contractor	Carolina Silvics 908 Indian Trail Road Edenton, North Carolina 27932 Dwight McKinney
Monitoring Performers	Axiom Environmental, Inc. 2126 Rowland Pond Dr. Willow Spring, NC 27592
Monitoring Point of Contact	Grant Lewis 919-215-1693

Table 4. Project Background Table	
Project Name/Number: Howell Woods (EEP Project Number 183)	
Project County	Johnston County, North Carolina
Drainage Area	Primary Neuse River - 1870 square miles Secondary Gar Gut - 9.8 square miles
Drainage impervious cover estimate (%)	< 5
Stream Order	second
Physiographic Region	Coastal Plain
Ecoregion	Southeastern Floodplains and Low Terraces
Rosgen Classification of As-built	D-type
Cowardin Classification	PF01
Dominant Soil Types	Altavista, State, Wehadkee, and Chastain
Reference Site ID	Onsite
USGS HUC for Project and Reference	Project and Reference – 03020201
NCDWQ Subbasin for Project and Reference	Project and Reference – 03-04-04
Any portion of any project segment 303d listed?	No (Stream Index #27-52-7)
Any portion of any project segment upstream of a 303d listed segment?	Yes, reach of the Neuse River in Subbasin 03-04-05 – Stream Index # 27-(56b)
Reasons for 303d listing or stressor	Mercury Level in Fish
% of project easement fenced	0

1.4 Monitoring Plan View

Monitoring activities for the Site, including relevant structures and utilities, project features, specific project structures, and monitoring features are detailed in Figure 3.

Site features have been monitored through the use of continuous recording groundwater gauges, permanently monumented vegetation plots, an onsite rain gauge, and photographic documentation. The Site contains 14 groundwater gauges including two reference gauges and 12 mitigation area gauges. Several gauges malfunctioned over the past few years and were replaced. The current groundwater monitoring scheme is depicted in Figure 3. Gauge manufacturer and types include Remote Data Systems (RDS) WL 40, RDS Ecotone, and Infinities.

There are five vegetation plots on the Site that have been permanently monumented with five-foot metal fence posts, driven into each of the four corners of the plot, with PVC pipe attached for ease in plot location identification.

2.0 PROJECT CONDITION AND MONITORING RESULTS

2.1 Vegetation Assessment

In the fall of 2001, vegetation monitoring plots were randomly established within the Site. Each sample plot was composed of two-300-foot transects extending from a central point, usually a groundwater monitoring gauge. The Site was monitored for the as-built and the 2002 (year 1) growing season utilizing this methodology with vegetation success achieved.

During the 2003 (year 2) monitoring period, North Carolina State University implemented a revised vegetation monitoring procedure based on the *Draft Vegetation Monitoring Plan for NCWRP Riparian Buffer and Wetland Restoration Projects* document (undated). Five-10 meter by 10 meter plots were established and permanently marked with pipe. The location of each vegetation monitoring plot is depicted on Figure 3.

2.1.1 Soil Data

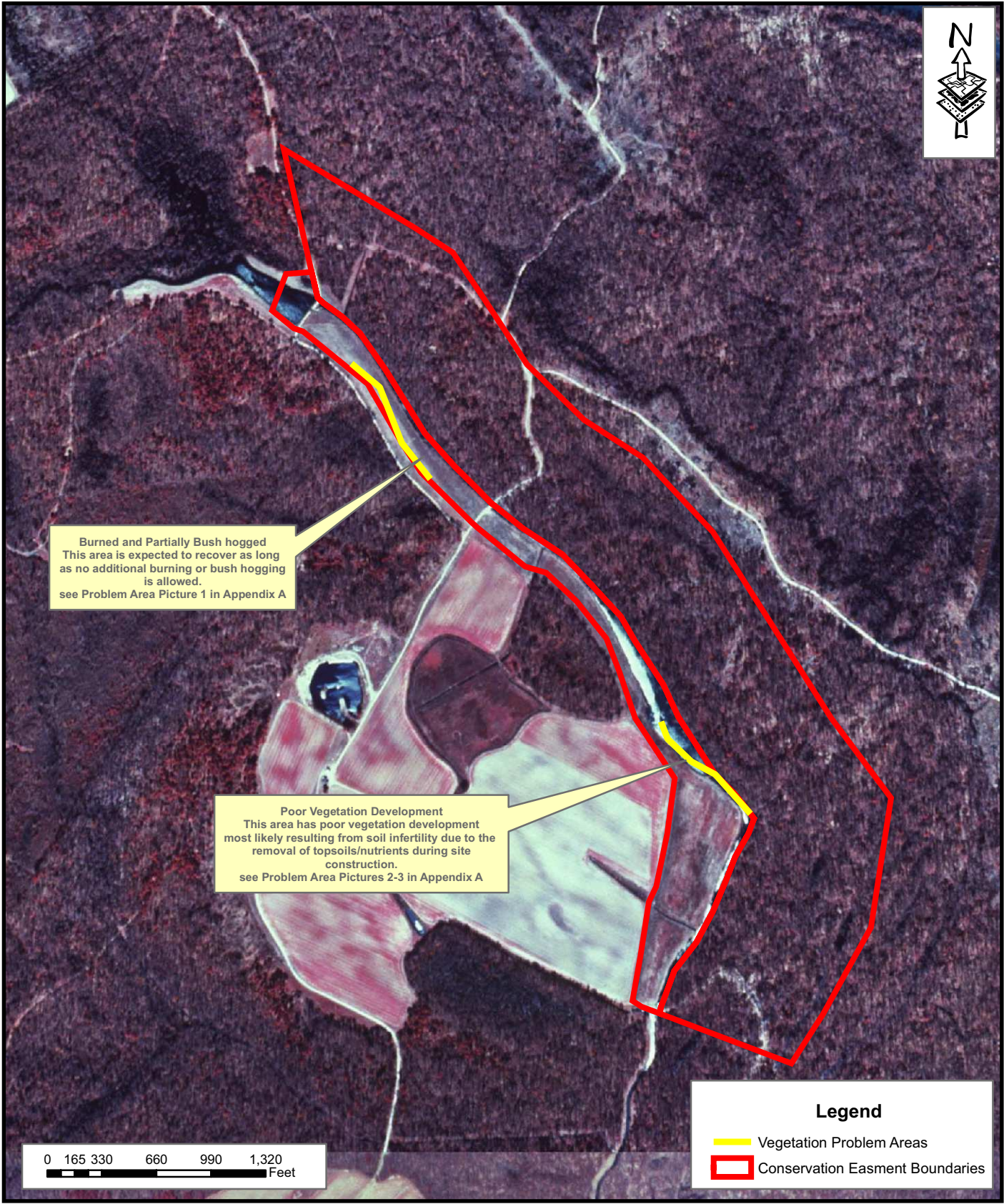
General soil conditions found onsite, including level of erosion and percentage of organic matter, are summarized in Table 5.

Table 5. Preliminary Soil Data					
Project Name/Number: Howell Woods (EEP Project Number 183)					
Series	Max Depth (inches)	% Clay on Surface	K	T	OM %
Altavista	+60	10 - 20	0.24	5	0.5 - 3
State	+60	5 - 15	0.28	5	<2
Wehadkee	+60	5 - 20	0.24	5	2 - 5
Chastain	+72	27 - 50	0.28	5	1 - 6

Agricultural activities and excavation associated with Site implementation resulted in the exposure of subsurface soil horizons; therefore, a reduction in percent clay and organic matter in the soil surface layers occurred. In addition, erosion factors are calculated based on the percentage of silt, sand, and organic matter and are likely to have been affected by Site development and implementation as well. Values of erosion factors K and T have likely been elevated above the amount published in the Johnston County Soil Survey (USDA 1994).

2.1.2 Vegetative Problem Areas

Vegetation problem areas within the Site are depicted on Figure 4 and are outlined in Table 6. An area within the northwestern portion of the Site had been burned and partially bush hogged prior to year 5



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VEGETATION PROBLEM AREAS
HOWELL WOODS RESTORATION SITE
Project Number 183
Year 5 (2006) Monitoring Report
Johnston County, North Carolina

Dwn. by:	CLF
Date:	Nov 2006
Project:	06-002.02

FIGURE
4

(2006) monitoring. Burning resulted in some dieback; however, the majority of the burned or cut stems are resprouting. This area is expected to recover as long as burning and bush hogging activities are ceased. In addition, vegetation on the outer rim of the southeastern littoral shelf is sparse and survival of planted vegetation is poor, most likely resulting from soil infertility due to the removal of nutrient rich surface soils during site construction.

Project Name/Number: Howell Woods (EEP Project Number 183)			
Feature/Issue	Location	Probable Cause	Photo
Weak vigor	Northwestern Portion of Site	Burning and partial bush hogging	Problem Area Photo 1 (Appendix A)
Poor vegetation development	Littoral Shelves	Removal of top soil/soil nutrients during construction	Problem Area Photos 2-3 (Appendix A)

The Site is characterized by planted seedlings exhibiting various degrees of vigor. Overall, vigor was noted as good, although a few seedlings appeared to be lacking vigor as the result of burning and bush hogging activities. Most seedlings within Plot 1 were natural recruits, and many seedlings within Plot 2 exhibited weak vigor due to the burning and bush hogging.

2.1.3 Stem Counts

Five vegetation plots had been previously established by North Carolina State University as depicted in Figure 3. The plots are 10 meters square and are located randomly within the Site. These plots were surveyed in late June and early July 2006 for the 2006 (year 5) monitoring season; results are included in Table 7. No reference area was studied; therefore no comparisons could be made to reference conditions.

Project Name/Number: Howell Woods (EEP Project Number 183)										
Species	Year 5 (2006) Individual Plot Data (0.0247 acre each)					Year 2 (2003) Totals	Year 3 (2004) Totals	Year 4 (2005) Totals	Year 5 (2006) Totals	% Survival
	1	2	3	4	5					
<i>Cephalanthus occidentalis</i>	0	0	0	0	0	6	0	0	0	0
<i>Crataegus</i> sp.	0	3	0	5	0	*	0	0	8	*
<i>Diospyros virginiana</i>	0	1	0	1	0	*	0	0	2	*
<i>Fraxinus pennsylvanica</i>	0	14	0	5	0	22	21	28	19	86
<i>Ilex deciduas</i>	0	0	0	1	0	*	0	0	1	*
<i>Platanus occidentalis</i>	1	0	0	2	2	4	3	3	5	125
<i>Populus heterophylla</i>	0	1	0	0	0	*	0	0	1	*
<i>Quercus lyrata</i>	0	0	0	1	0	0	0	0	1	--
<i>Quercus nigra</i>	0	0	0	0	0	1	1	1	0	0
<i>Quercus pagoda</i>	1	0	1	0	0	4	5	4	2	50
<i>Quercus phellos</i>	1	5	2	0	0	7	7	6	8	114
<i>Quercus</i> sp.	0	2	0	0	0	0	0	0	2	--
<i>Taxodium distichum</i>	0	0	1	0	1	1	1	1	2	200
<i>Ulmus americana</i>	0	0	0	0	1	*	0	0	1	*
<i>Ulmus rubra</i>	1	0	2	1	0	*	0	0	4	*
<i>Ulmus</i> sp.	0	1	36	16	27	*	185	130	80	*
Total Stems Per Plot	4	27	42	32	31	45*	223	173	136	*
Stems Per Acre	162	1093	1700	1296	1255	364	1806	1401	1101	

* - Historical project documents necessary to provide this data were unavailable at the time of this report submission.

Due to the revised monitoring protocol during the second year of vegetation surveys, no comparisons of as-built or 2002 (year 1) can be made to the subsequent monitoring years. Therefore, planted species have been based upon previous annual monitoring reports and percent survival is based on a comparison of 2003 (year 2) totals where possible. The phased planting schedule made it difficult to determine planted trees from naturally recruited trees; therefore, the number of “planted” species was based on the experience and judgment of the monitoring team, and counts for planted species may be influenced by naturally recruited stems. During preparation of the 2006 (year 5) monitoring report, no as-built mitigation plan or data for 2002 (year 1) totals were available and therefore, are not included in the table.

Based on the number of stems counted, the average plot density monitored at this Site is greater than 260 stems per acre and is considered successful. The average plot density has been measured at 1101 stems per acre, or 27 stems per plot for 2006 (year 5) monitoring. The dominant species identified at the Site were elm species (*Ulmus rubra* and *Ulmus americana*) and green ash (*Fraxinus pennsylvanica*). Four out of the five individual vegetation plots were well above the success criteria with 1093 to 1700 planted stems per acre. Vegetation plot 1 was low with 162 planted stems per acre; however, natural recruits including various elms, sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), hawthorne (*Crataegus* sp.), cherrybark oak (*Quercus pagoda*), and loblolly pine (*Pinus taeda*) comprised an additional 148 stems for the plot (approximately 5992 stems per acre).

Several new species were recorded this year: 1) hawthorn (*Crataegus* sp.), 2) persimmon (*Diospyros virginiana*), 3) possumhaw (*Ilex decidua*), 4) swamp cottonwood (*Populus heterophylla*), and 5) overcup oak (*Quercus lyrata*). This is likely due to an earlier sampling time and subsequent lower densities of vigorous herbs and vines.

Shrub diversity is not particularly high within plots; however, various species would be expected to colonize the Site over time. Species documented within the shrub layer include possumhaw (*Ilex decidua*), hawthorn (*Crataegus* sp.), and crimson-eyed rosemallow (*Hibiscus moscheutos*). Other plant species found on the Site can be found in Appendix E in the gauge vegetation lists.

2.1.4 Vegetation Plot Photos

Photographs were taken at all permanent photo points and are included in Appendix A. The photographs show that vegetation is generally growing well and consists of a good combination of woody and herbaceous species.

2.2 Wetland Assessment

Fourteen groundwater monitoring gauges have been maintained and monitored throughout the year-5 (2006) growing season. Twelve are located within the restoration areas and two are located within the reference wetlands immediately northwest of the Site. The groundwater gauges record daily readings of groundwater depth. Daily rainfall data recorded from a rain gauge maintained and monitored on the Site was used for seasonal comparison; however, the gauge malfunctioned and rain data after August 14, 2006 could not be recovered. Graphs of groundwater hydrology and precipitation are included in Appendix B.

Success criteria for wetland hydrology require that the area be inundated or saturated within 12 inches of the ground surface for a consecutive period of 12.5 percent of the growing season. The growing season in Johnston County begins March 21 and ends November 4 (229 days). Areas inundated less than 5 percent of the growing season (11 days) are classified as nonwetlands. Areas inundated between 5 percent and 12.5 percent of the growing season can be classified as wetlands depending upon factors such as the presence of hydrophytic vegetation and hydric soils. In order to attain hydrologic success, saturation within 12 inches of the ground surface is required for at least 11 consecutive days (5 percent of the growing season) or 29 consecutive days (12.5 percent of the growing season).

Table 8. Summary of Groundwater Gauge Results for Years 1 through 5

Project Name/Number: Howell Woods (EEP Project Number 183)

Gauge	Historic Description	Serial Number	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)				
			Year 1 (2002)^	Year 2 (2003)*	Year 3 (2004)**	Year 4 (2005)	Year 5 (2006)
1	RDSA	S2C9894	Yes/ >12.5%	No Data	No Data	No Data	Yes/ 34 days (14.8 %)
2	RDSB	B6522D1	Yes/ >12.5%	No Data	No Data	Malfunctioned ***	Yes/ 25 days (11.0 %)
3	RDSC	B6B6E09	No/ <5%	No Data	No Data	Malfunctioned ***	No/ 8 days (3.9 %)
4	INF6	A279A59	Malfunctioned	No Data	No Data	No Data	Yes/ 76 days (33.2%)
5	INF5	A28984F	Malfunctioned <5%	No Data	No Data	No Data	Yes/ 229 days (100 %)
6	RSDS	B6B4FB9	Malfunctioned <5%	No Data	No Data	Malfunctioned ***	Yes/ 33 days (14.4 %)
7	INF1/ JG6	EBD85C9	Yes/ 5-12.5%	Yes/73 days (31.9%)	No Data	Yes/ 36 days (15.7 %)	Yes/ 168 days (73.4 %)
8	INF2	A3C095A	Malfunctioned	Malfunctioned	No Data	No Data	Yes/ 19 days (8.3 %)
9	RDSE	B652374	No/ <5%	No Data	No Data	Malfunctioned/ 4 days (1.7 %) ***	Yes/ 29 days (12.7 %)
10	INF4	A286A2D	Malfunctioned <5%	Yes/54 days (23.6%)	No Data	No Data	Yes/ 68 days (29.7 %)
11	INF3	AB36608	Malfunctioned <5%	Yes/54 days (23.6%)	No Data	No Data	Yes/ 32 days (14.0 %)
12	RDSF	B652408	No/ <5%	No Data	No Data	Malfunctioned/ 4 days (1.7 %) ***	Yes/ 52 days (22.7 %)
Ref1	REF1	N386A9F1	Yes/ >12.5%	Yes/70 days (30.6%)	No Data	No Data	Yes/ 34 days (14.8 %)
Ref2	REF2	N3B6AA64	Yes/ >12.5%	Yes/74 days (32.3%)	No Data	No Data	Yes/ 72 days (31.4 %)

^ - Gauges malfunctioned for the majority of the growing season. Site construction did not occur until mid-growing season; therefore, gauges will be monitored for a sixth growing season.

* - Data for most of the end of the growing season was unavailable.

** - Graph is included in the year 3 (2004) report for one of the Infinities gauges; however, it does not indicate which one.

*** - Gauges malfunctioned for the first several months of the growing season.

Groundwater gauge graphs or data for years 1 (2002) through year 4 (2005) are included in Appendices F through I, respectively. Table 8 summarizes success criteria achievement for groundwater gauges over the 5-year monitoring period.

Groundwater hydrology within 12 inches of the soil surface occurred for greater than 12.5 percent of the growing season for the year-5 (2006) growing season at Gauges 1, 4-7, and 9-12 and greater than 5 percent of the growing season at Gauges 2 and 8. Groundwater hydrology was within 12 inches of the soil surface for less than 5 percent of the growing season for Gauge 3; however, this gauge is located on the margin of an upland area as depicted on Figure 2 of this document and within the Detailed Restoration Plan. In addition, all groundwater gauges had a presence of hydrophytic wetland vegetation based on criteria set forth in the *Corps of Engineers Wetland Delineation Manual*. Vegetation lists for each gauge can be found in Appendix E.

2.2.1 Wetland Problem Area Plan View

No wetland problem areas have been identified during the year-5 (2006) monitoring year. As depicted in Appendix B, all gauges are currently functioning and recorded groundwater hydrology within 12 inches of the ground surface for greater than 5 percent of the growing season with a presence of hydrophytic vegetation except for Gauge 3, which is located along an upland margin as depicted on Figure 2 and in the Detailed Restoration Plan.

2.2.2 Wetland Criteria Attainment

All monitored gauges within restoration areas met success criteria of inundation/saturation within 12 inches of the surface for at least 5 percent of the growing season with a presence of hydrophytic vegetation except for Gauge 3, which is located along an upland margin (Table 9). Hydrographs containing precipitation data and raw data for each gauge can be found in Appendices B and C, respectively. Photographs and CVS Levels 1 & 2 Data Forms for vegetation plots can be found in Appendices A and D, respectively.

Table 9. Wetland Criteria Attainment						
Project Name/Number: Howell Woods (EEP Project Number 183)						
Gauge ID	Hydrology Threshold Met?	Hydrophytic Vegetation Criteria Met?	Site Mean	Vegetation Plot ID	Vegetation Survival Threshold Met?	Site Mean
1	Yes	Yes	92 %	1	Yes	100 %
2	Yes	Yes		2	Yes	
3	No	Yes		3	Yes	
4	Yes	Yes		4	Yes	
5	Yes	Yes		5	Yes	
6	Yes	Yes				
7	Yes	Yes				
8	Yes	Yes				
9	Yes	Yes				
10	Yes	Yes				
11	Yes	Yes				
12	Yes	Yes				

3.0 FIVE-YEAR MONITORING ASSESSMENT

In summary, the restoration site achieved success criteria for vegetation and hydrology for all restoration area groundwater gauges with the exception of a gauge (Gauge 3) located along an upland margin in the Fifth Monitoring Year (2006).

Results from vegetation surveys exceeded success criteria with 346, 1806, 1401, and 1101 planted stems per acre present in years 2 through 5, respectively with an increase in species diversity over the 5-year monitoring period. No data was available for year 1 monitoring.

Vegetative problem areas within the Site include a burned and partially bush hogged area that is expected to recover, and an area of poor vegetation development along the outer rim of one of the littoral shelves.

Groundwater hydrology within 12 inches of the soil surface occurred for greater than 12.5 percent of the growing season for the year-5 (2006) growing season at Gauges 1, 4-7, and 9-12 and greater than 5 percent of the growing season at Gauges 2 and 8. Groundwater hydrology was within 12 inches of the soil surface for less than 5 percent of the growing season for Gauge 3; however, this gauge is located on the margin of an upland area as depicted on Figure 2 of this document and within the Detailed Restoration Plan. Vegetation documented in the vicinity of each of the twelve restoration area groundwater gauges was considered hydrophytic wetland vegetation. In addition, wetland criteria set forth in the *Corps of Engineers Wetland Delineation Manual* were met with the presence of the three criteria, 1) hydric soils, 2) hydrophytic vegetation, and 3) wetland hydrology at Gauges 1-2 and 4-12.

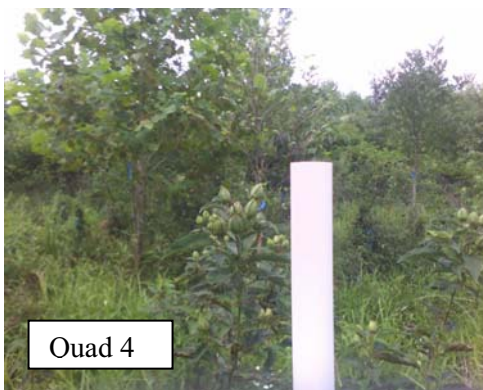
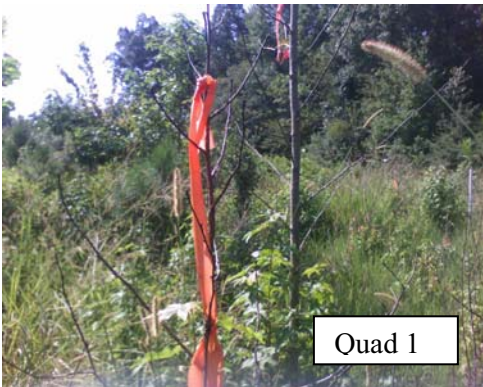
In summary, the restoration site achieved success criteria for hydrology and vegetation in the Fifth Monitoring Year (2006). Based on available data, the site achieved success criteria for hydrology and vegetation over the entire 5-year monitoring period. However, the Site was not constructed until mid-way through the first year growing season; therefore, the Site will be monitored for a sixth growing season.

4.0. REFERENCES

- Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. United States Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.
- North Carolina Wetlands Restoration Program (NCWRP). Undated. Draft Internal Guidance for Vegetation Monitoring Plans for NCWRP Riparian Buffer and Wetland Restoration Projects. North Carolina Department of Environment and Natural Resources, Raleigh, North Carolina.
- Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology (Publisher). Pagosa Springs, Colorado.
- United States Army Corps of Engineers (USACE) and North Carolina Department of Environment and Natural Resources. 2005. Information Regarding Stream Restoration in the Outer Coastal Plain of North Carolina. Available: <http://h2o.enr.state.nc.us/ncwetlands/documents/CoastalPlainStreamMitigationFinalDraftPolicyNov28.doc> [October 30, 2006].
- United States. Department of Agriculture (USDA). 1994. Soil Survey of Johnston County, North Carolina. United States Department of Agriculture.

APPENDIX A
VEGETATION PHOTOGRAPHS

Appendix A
Vegetation Plot Photographs



Appendix A
Vegetation Problem Area Photographs



Picture 1: Burned area;
currently resprouting



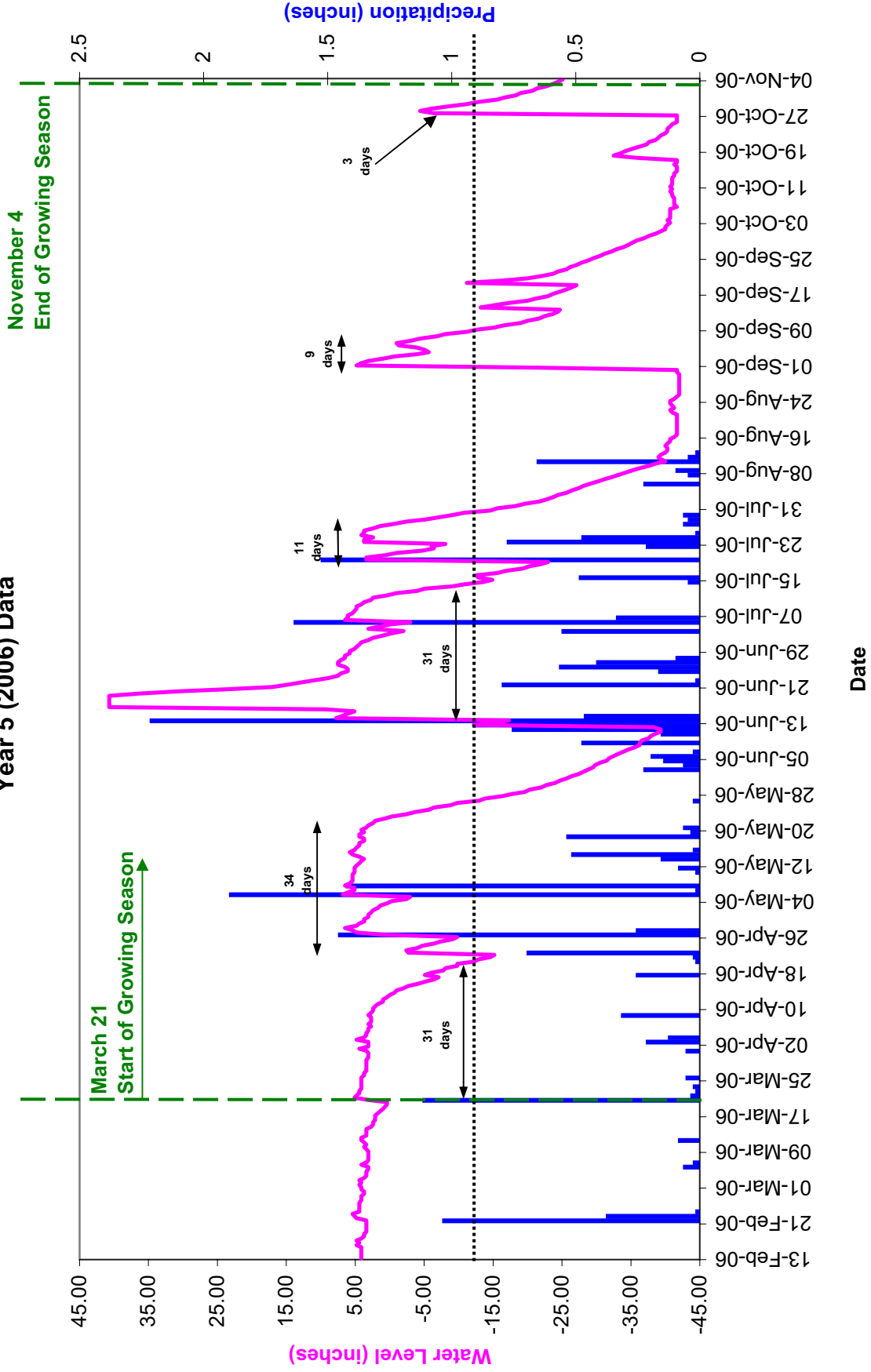
Picture 2: Poor growth;
rim of littoral shelf



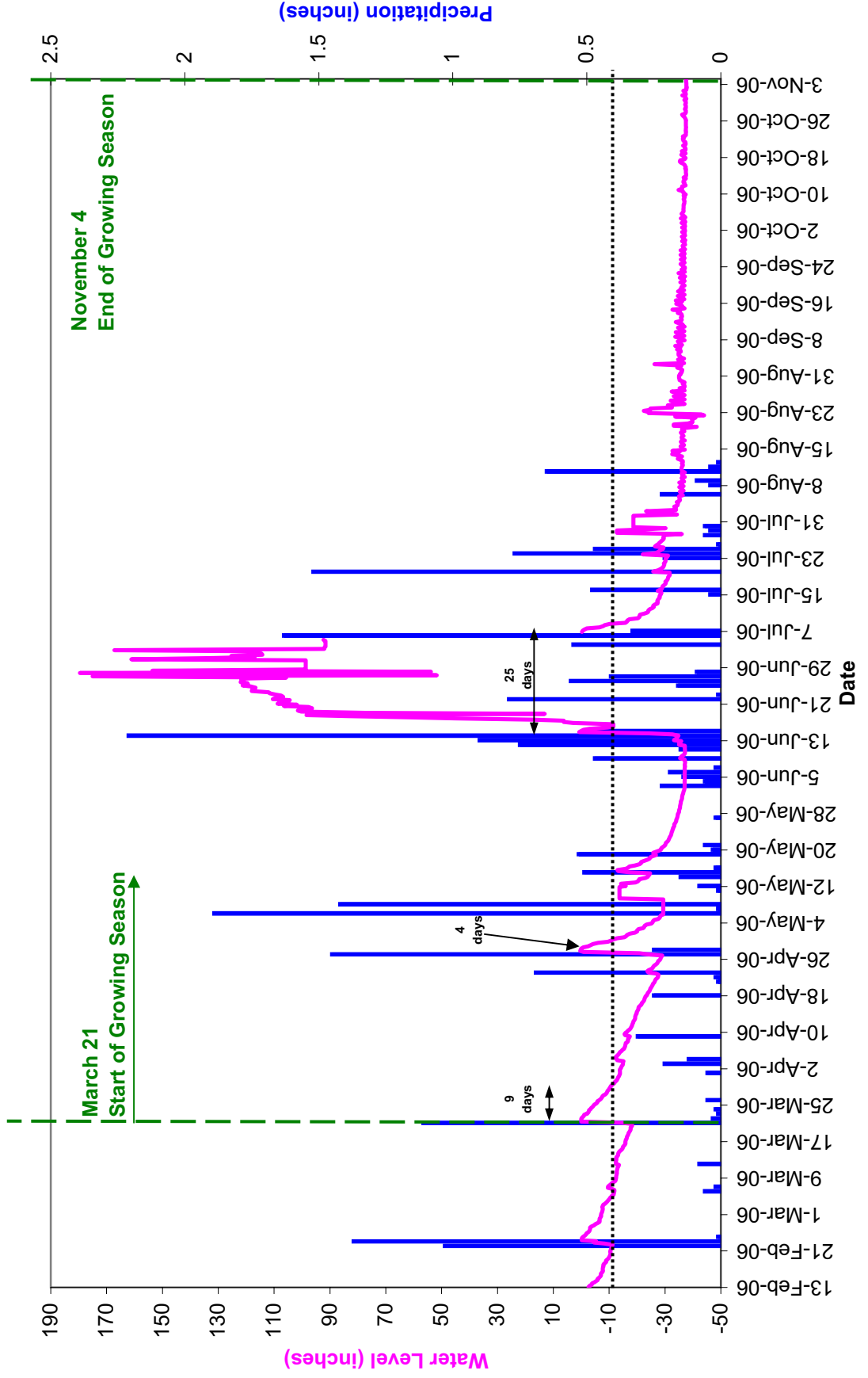
Picture 3: Poor growth;
rim of littoral shelf

APPENDIX B
GROUNDWATER GAUGE GRAPHS

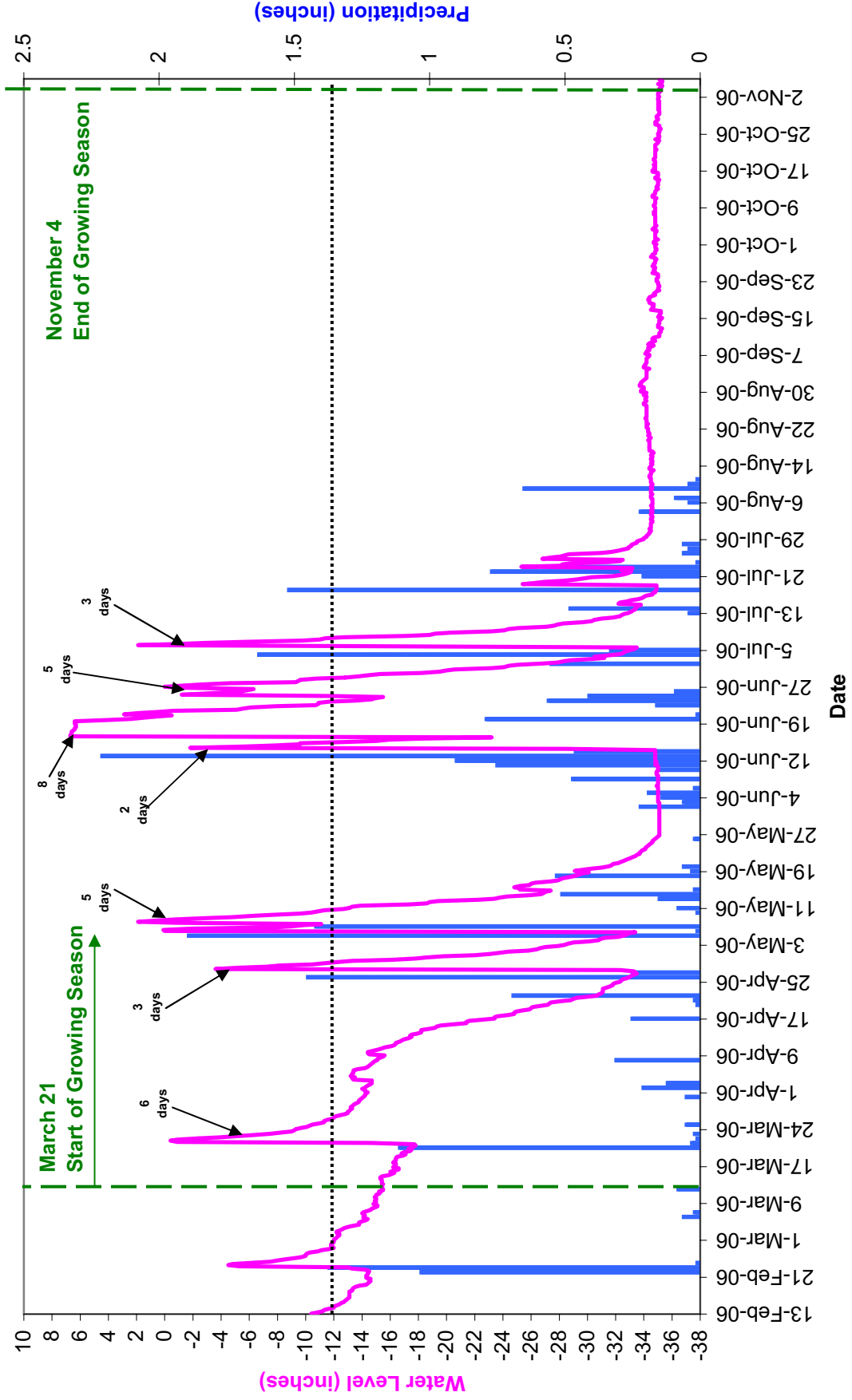
Gauge 1 Year 5 (2006) Data



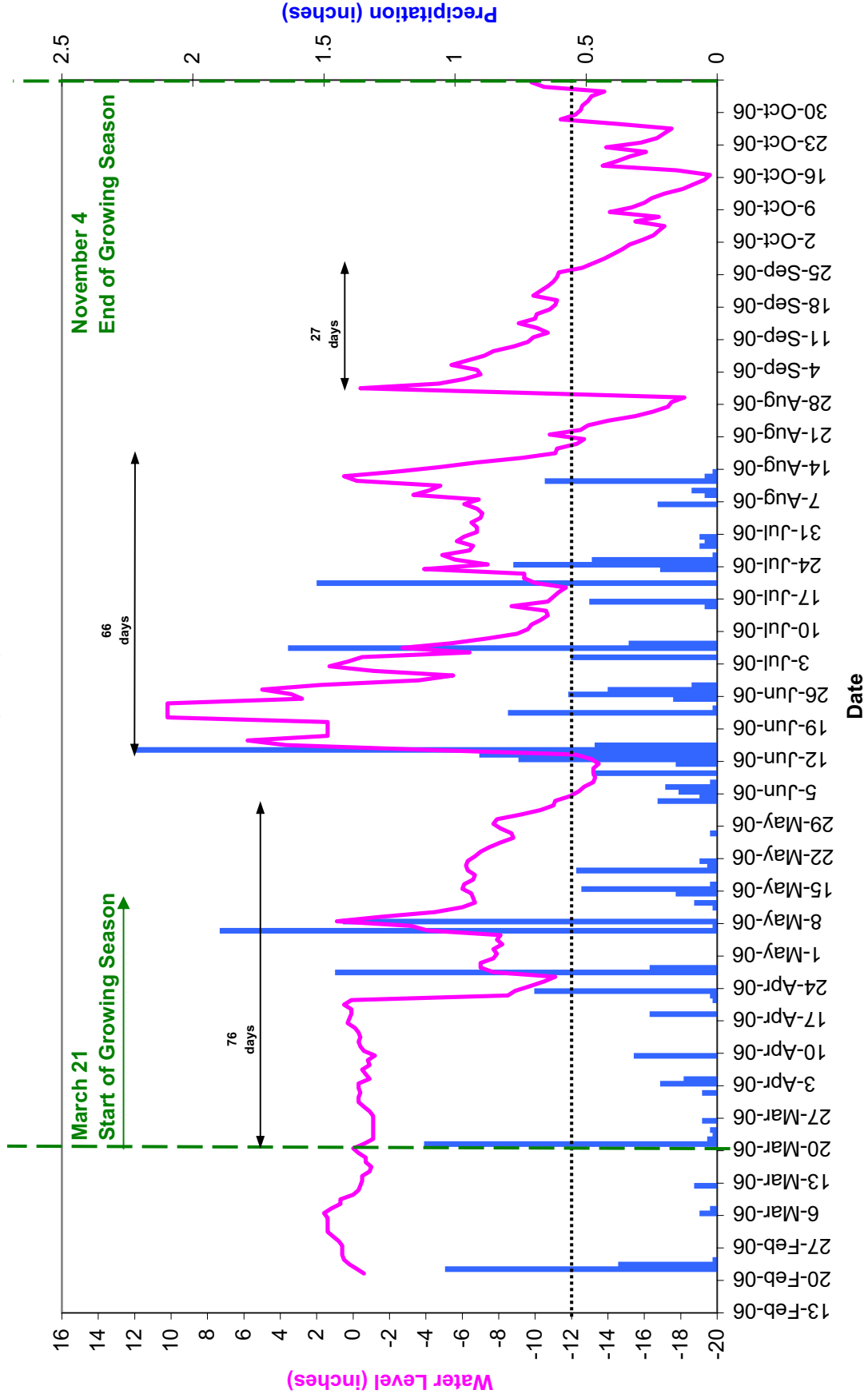
Gauge 2 Year 5 (2006) Data



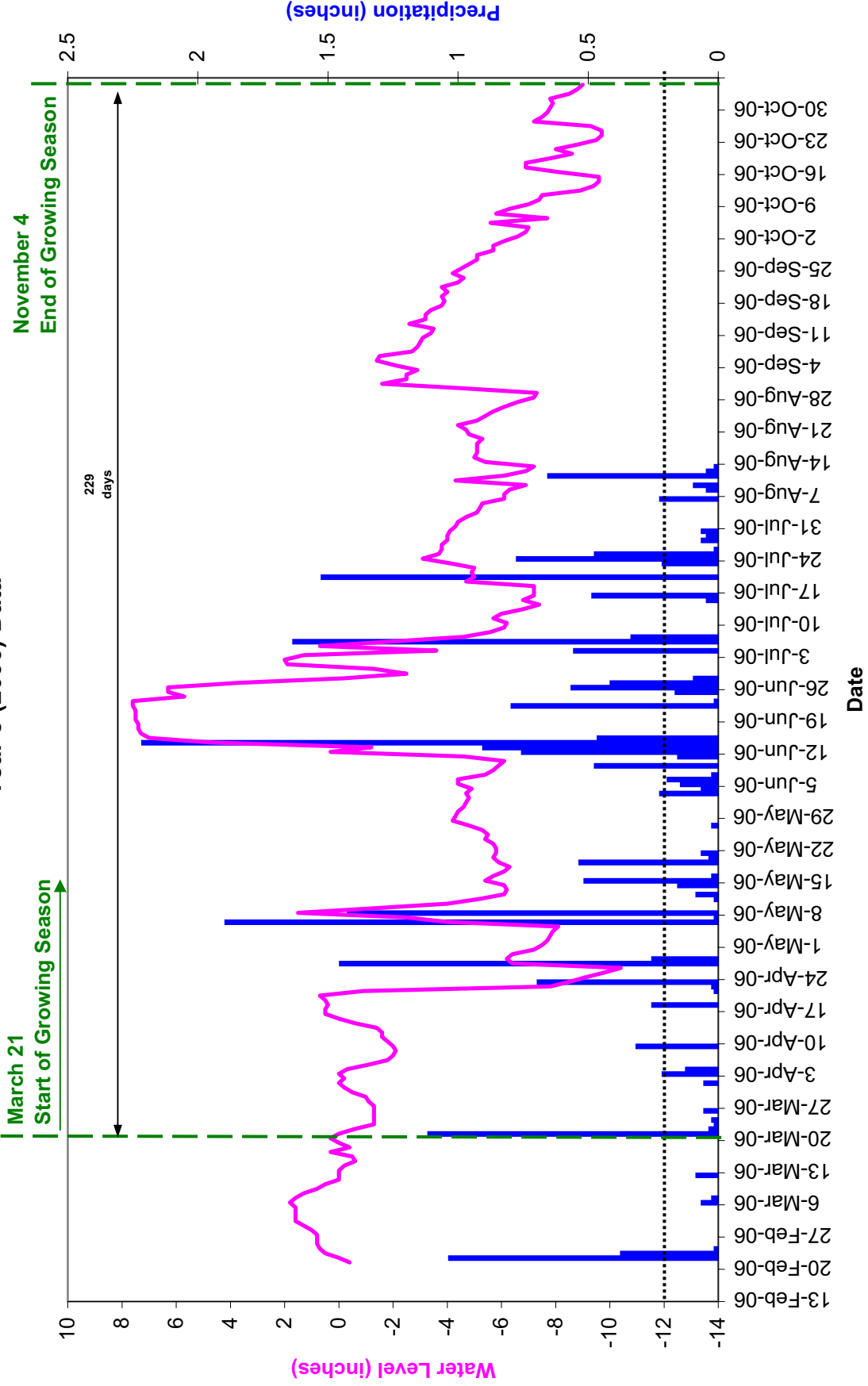
Gauge 3 Year 5 (2006) Data



Gauge 4 Year 5 (2006) Data

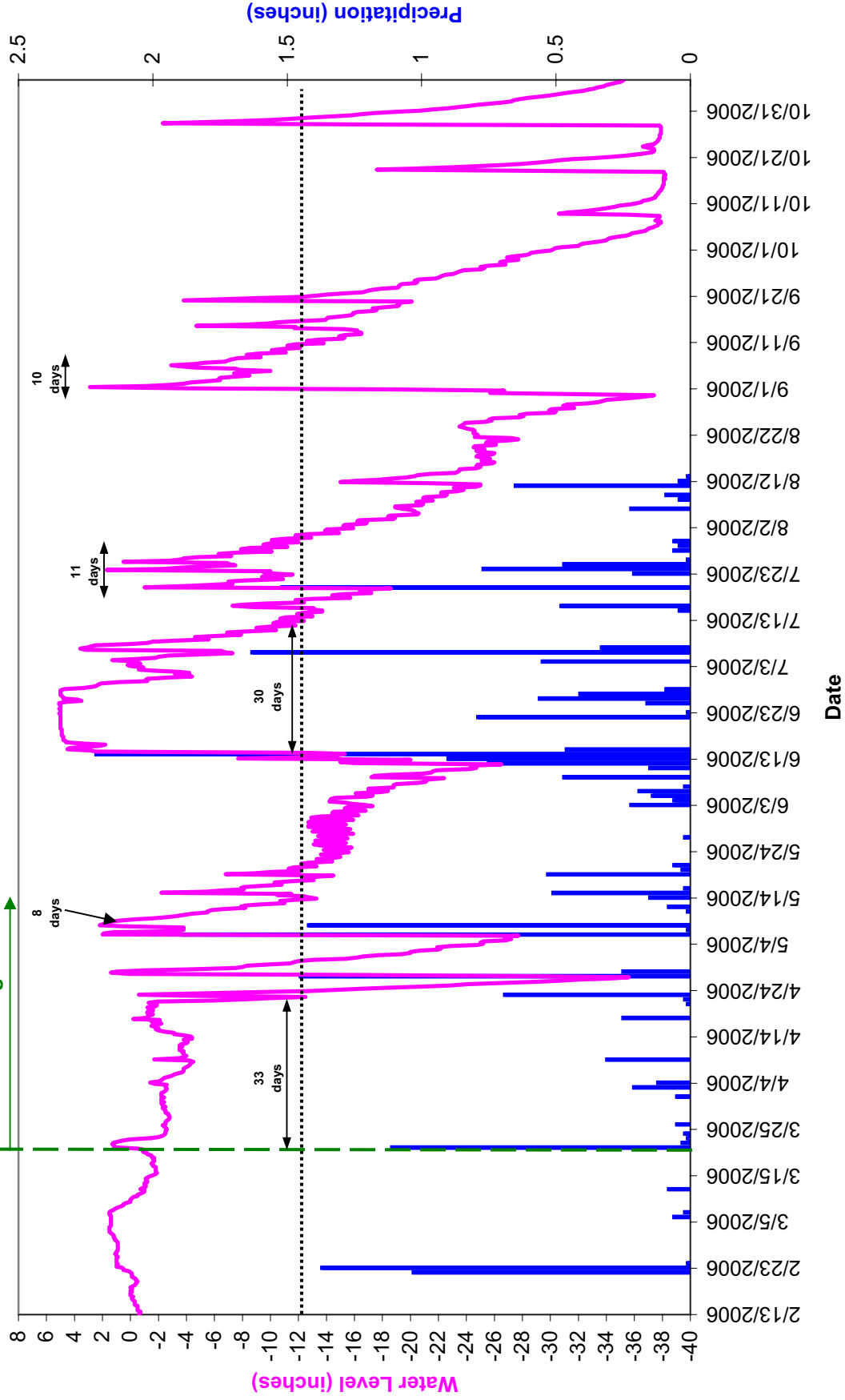


Gauge 5 Year 5 (2006) Data

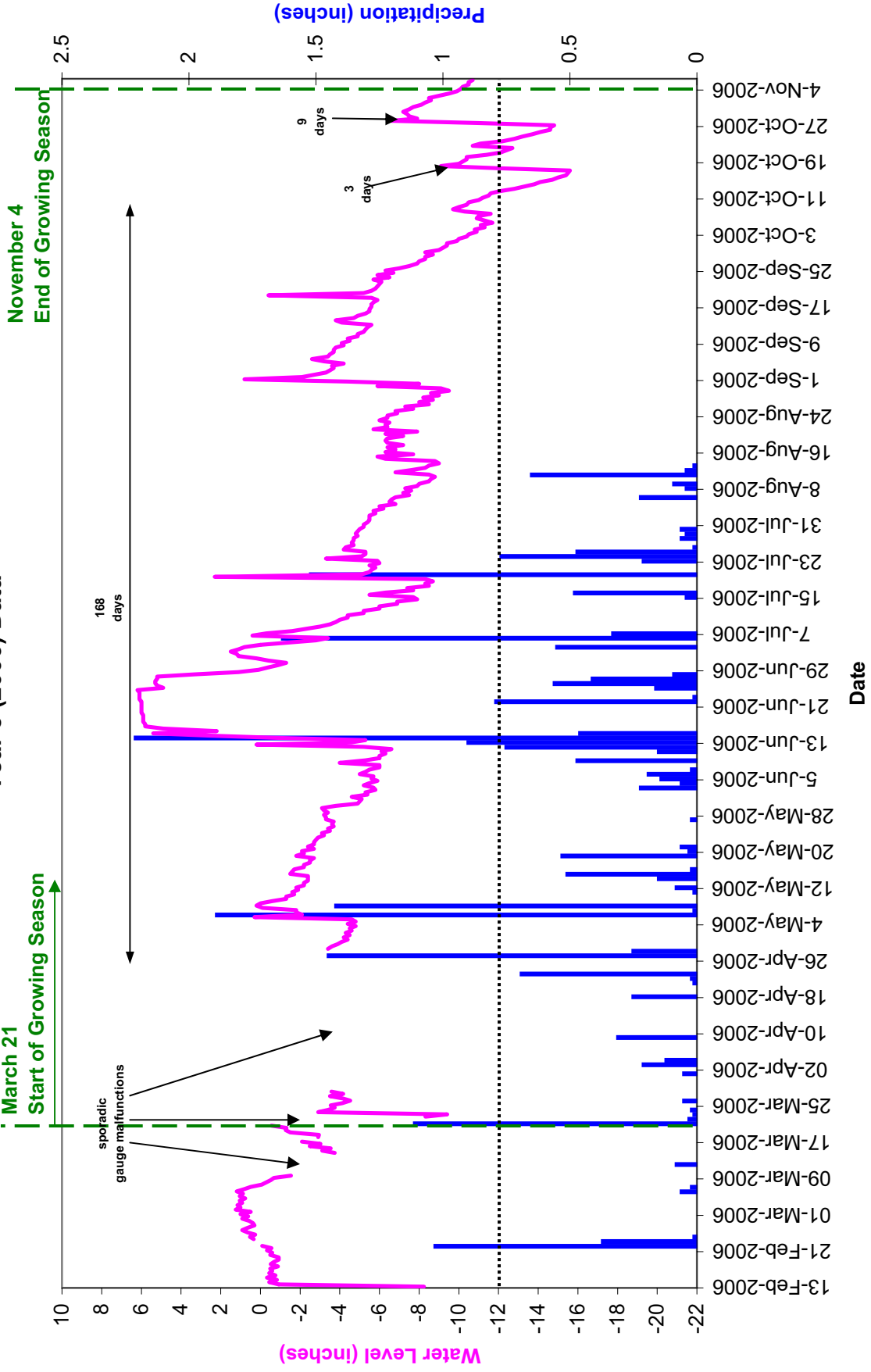


Gauge 6 Year 5 (2006) Data

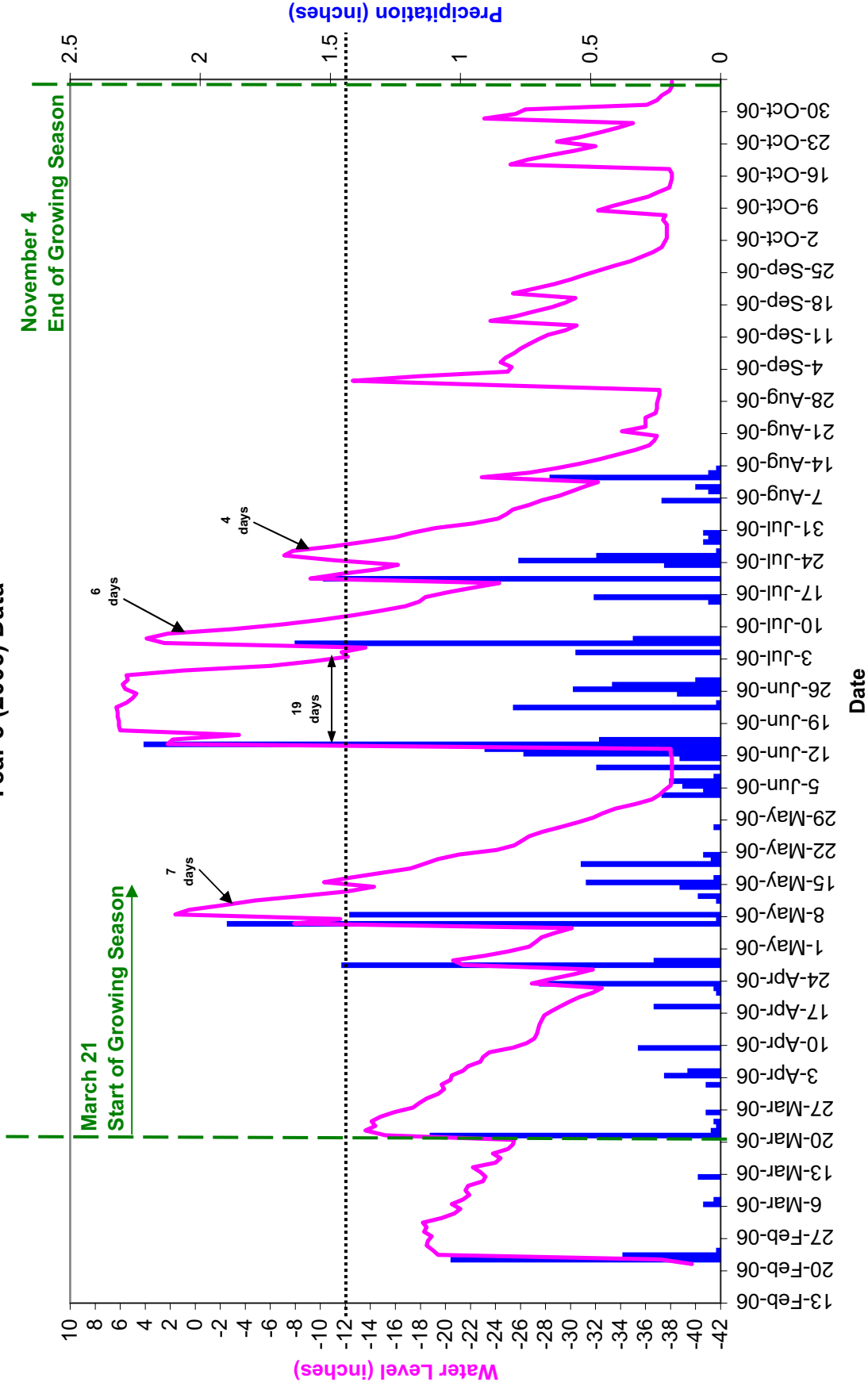
March 21
Start of Growing Season



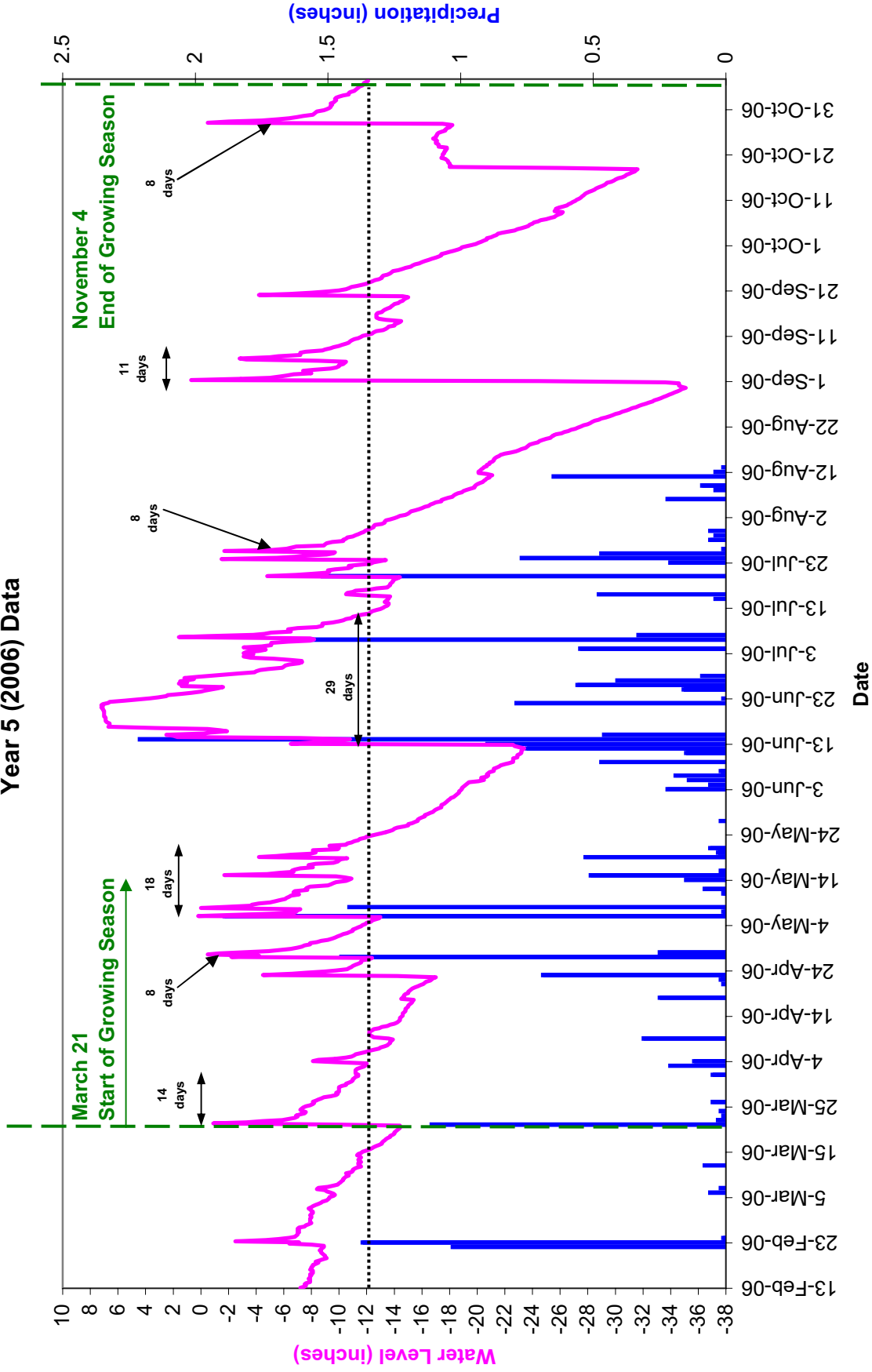
Gauge 7 Year 5 (2006) Data



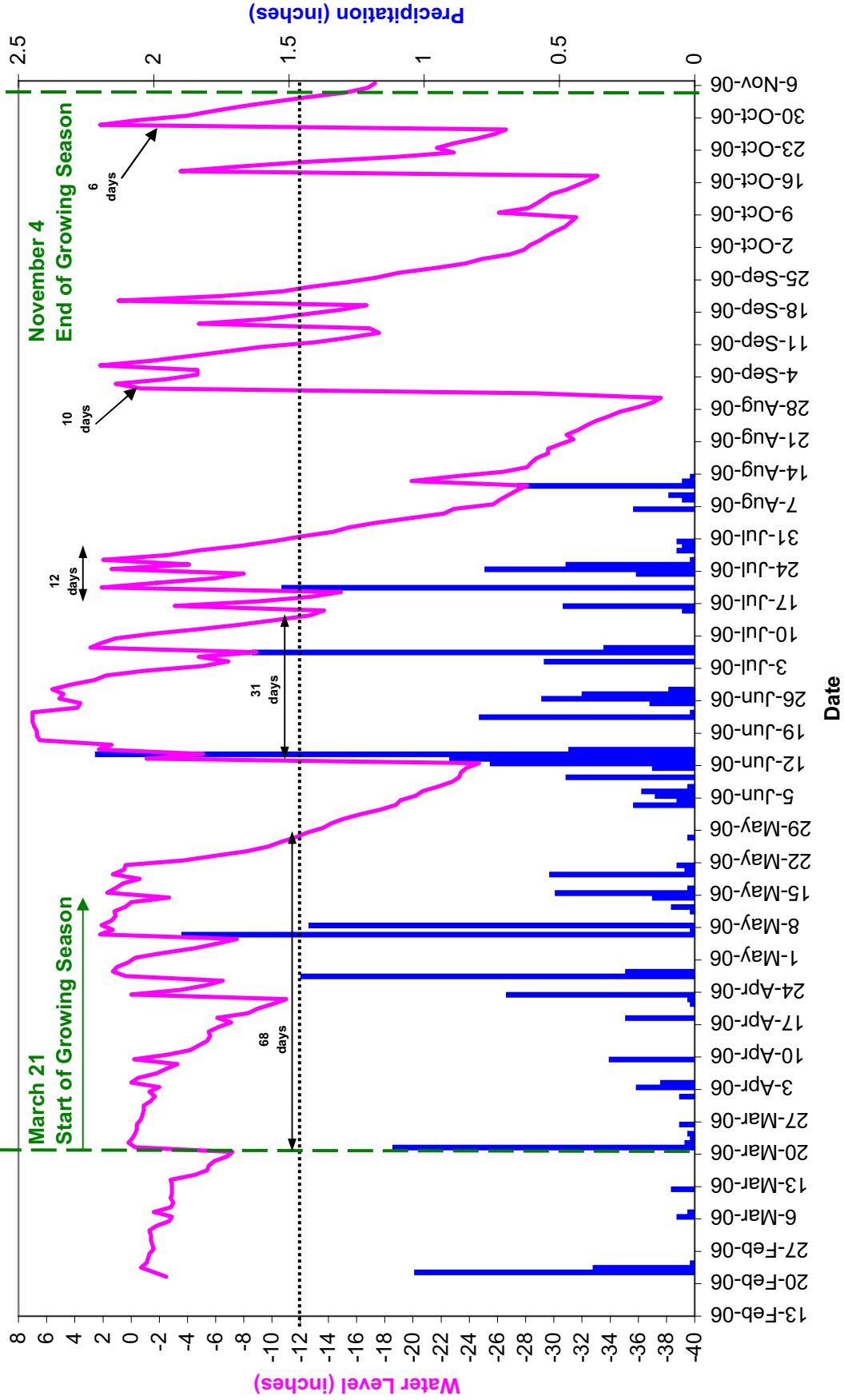
Gauge 8 Year 5 (2006) Data



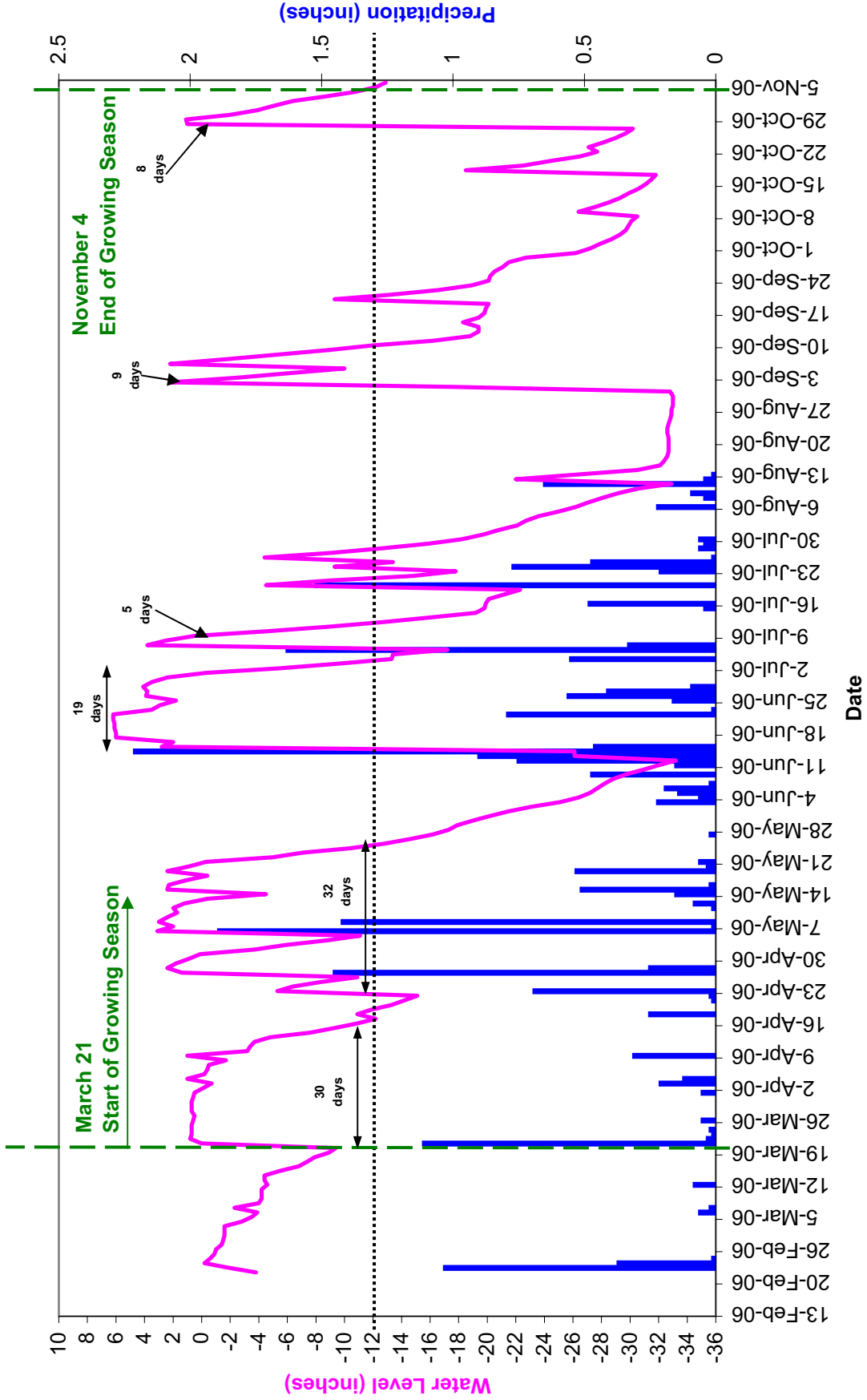
Gauge 9 Year 5 (2006) Data



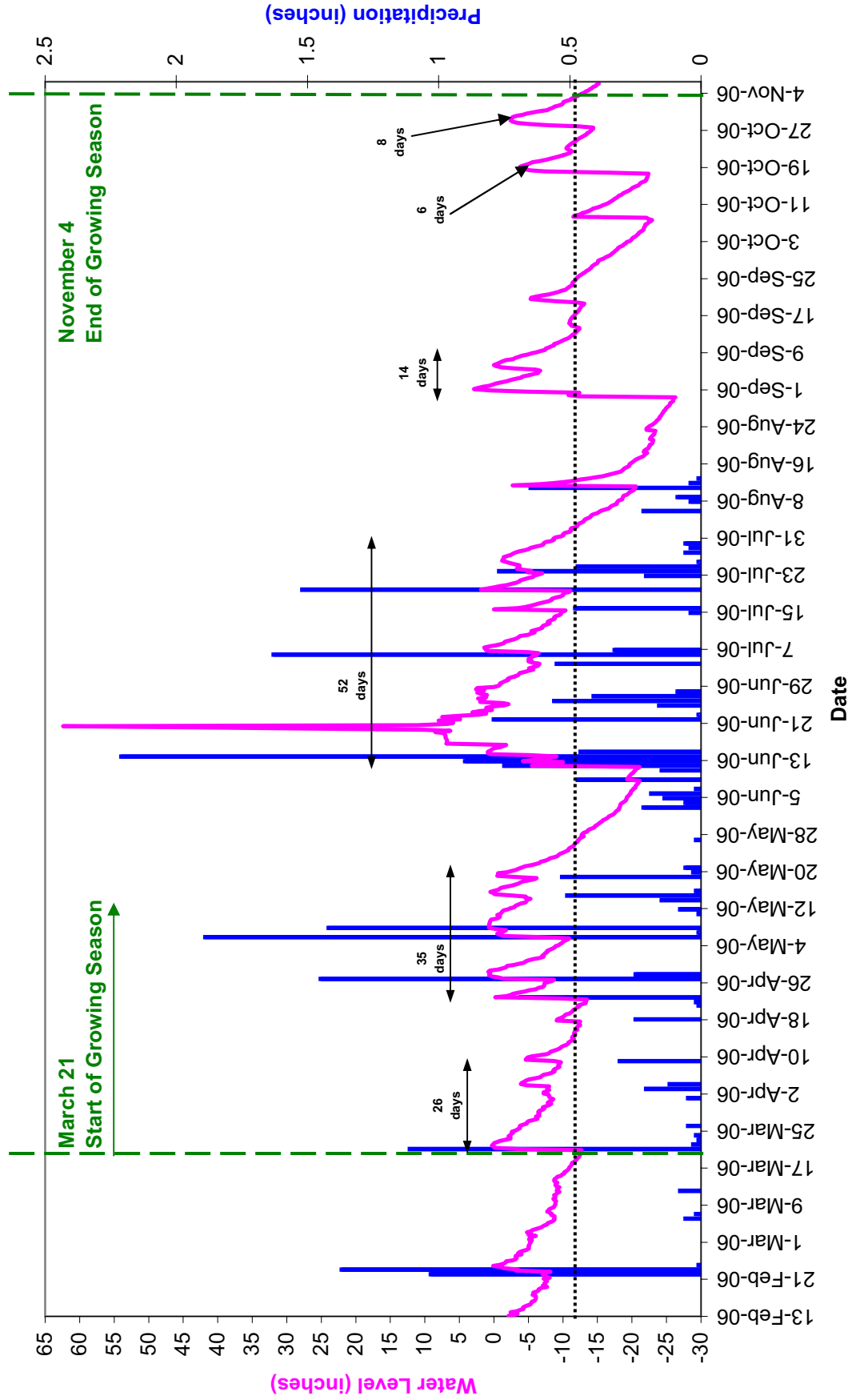
Gauge 10 Year 5 (2006) Data



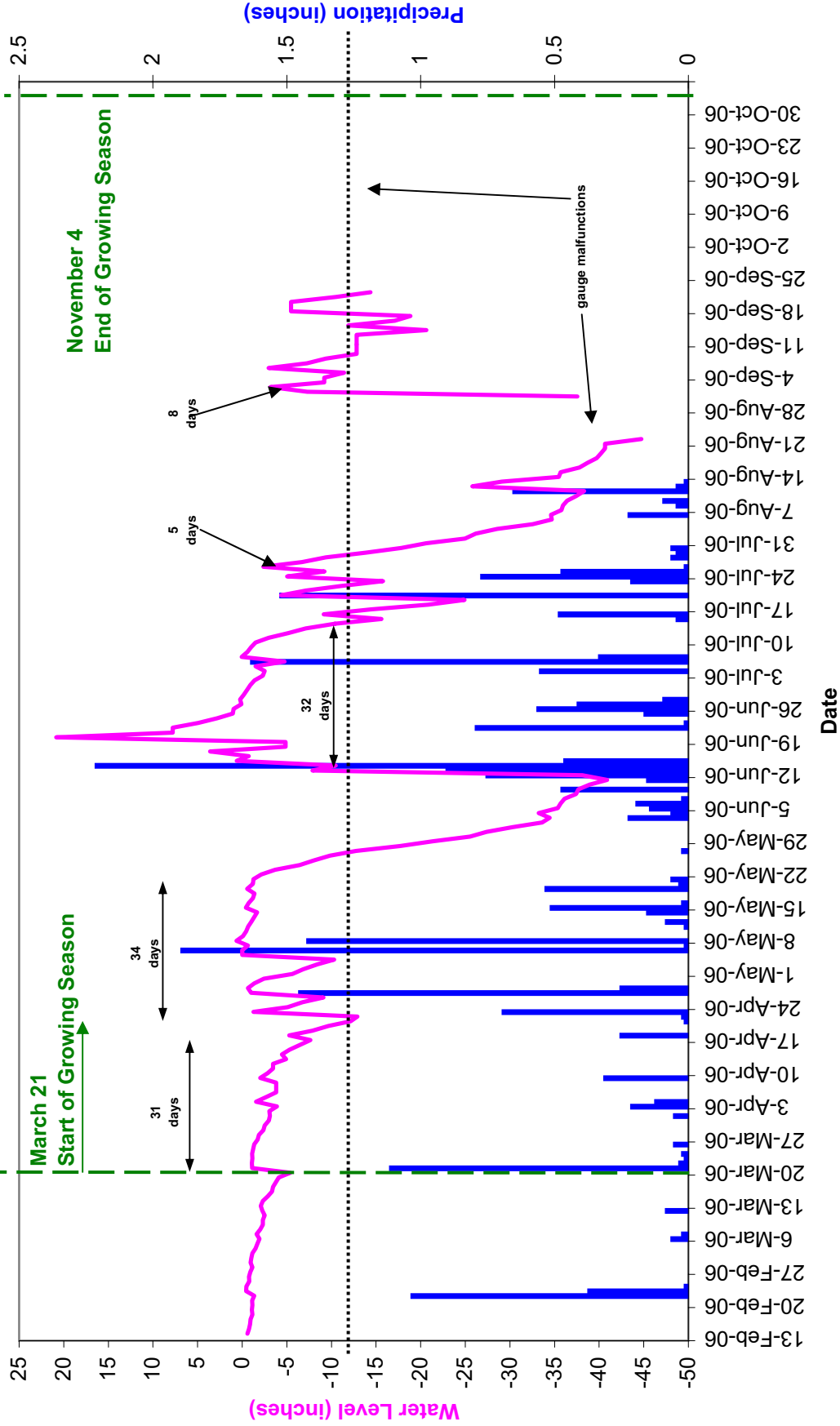
Gauge 11 Year 5 (2006) Data



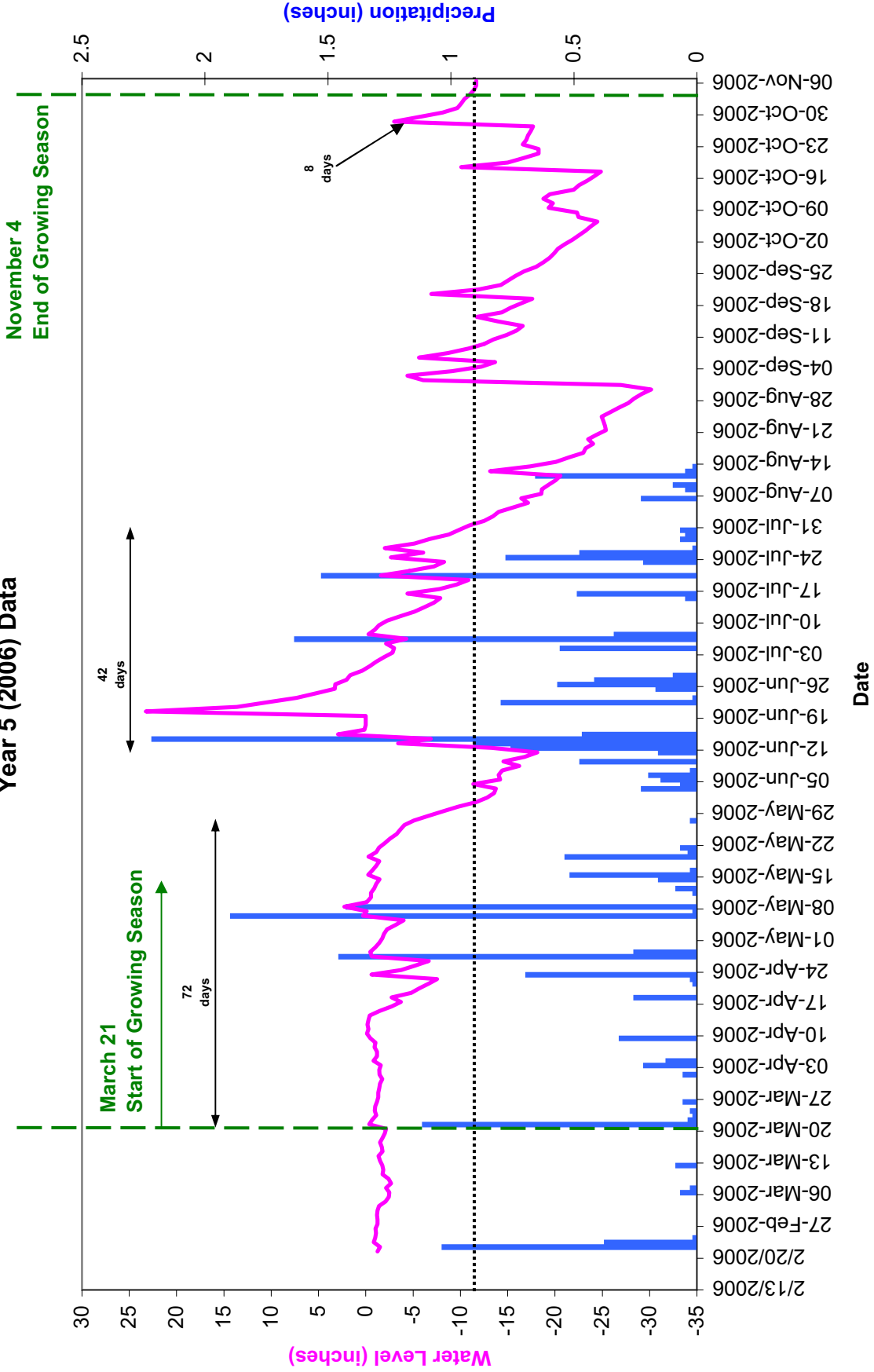
Gauge 12 Year 5 (2006) Data



Reference Gauge 1 Year 5 (2006) Data



Reference Gauge 2 Year 5 (2006) Data



APPENDIX C
GROUNDWATER GAUGE RAW DATA

Gauge: 6

Data Acquired: November 6, 2006

Serial Number: B6B4FB9

CD: Consecutive Days Saturation (within 12 inches of the soil surface) During the Growing Season

JD: Days During the Growing Season

					(continued)						(continued)					
Date	Time	Water Level (inches)	CD	JD	Date	Time	Water Level (inches)	CD	JD	Date	Time	Water Level (inches)	CD	JD		
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1-Jan-06	6:00:00	-1.5			19-Jan-06	6:00:00	-0.6			6-Feb-06	6:00:00	0				
1-Jan-06	12:00:00	-2			19-Jan-06	12:00:00	-0.7			6-Feb-06	12:00:00	0				
1-Jan-06	18:00:00	-2.1			19-Jan-06	18:00:00	-0.7			6-Feb-06	18:00:00	0				
2-Jan-06	0:00:00	-2.2			20-Jan-06	0:00:00	-0.6			7-Feb-06	0:00:00	0.1				
2-Jan-06	6:00:00	-2.2			20-Jan-06	6:00:00	-0.6			7-Feb-06	6:00:00	0.1				
2-Jan-06	12:00:00	-2.2			20-Jan-06	12:00:00	-0.8			7-Feb-06	12:00:00	0.1				
2-Jan-06	18:00:00	-0.3			20-Jan-06	18:00:00	-0.8			7-Feb-06	18:00:00	0.1				
3-Jan-06	0:00:00	-0.4			21-Jan-06	0:00:00	-0.8			8-Feb-06	0:00:00	0				
3-Jan-06	6:00:00	0.8			21-Jan-06	6:00:00	-0.8			8-Feb-06	6:00:00	-0.1				
3-Jan-06	12:00:00	0.8			21-Jan-06	12:00:00	-1			8-Feb-06	12:00:00	-0.1				
3-Jan-06	18:00:00	0.7			21-Jan-06	18:00:00	0			8-Feb-06	18:00:00	-0.2				
4-Jan-06	0:00:00	0.6			22-Jan-06	0:00:00	-0.2			9-Feb-06	0:00:00	-0.3				
4-Jan-06	6:00:00	0.5			22-Jan-06	6:00:00	-0.5			9-Feb-06	6:00:00	-0.3				
4-Jan-06	12:00:00	0.4			22-Jan-06	12:00:00	-0.7			9-Feb-06	12:00:00	-0.4				
4-Jan-06	18:00:00	0.3			22-Jan-06	18:00:00	-0.7			9-Feb-06	18:00:00	-0.4				
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5-Jan-06	12:00:00	0.2			23-Jan-06	12:00:00	-0.7			10-Feb-06	12:00:00	-0.8				
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8-Jan-06	18:00:00	-0.3			26-Jan-06	18:00:00	-0.5			13-Feb-06	18:00:00	-0.5				
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9-Jan-06	12:00:00	-0.5			27-Jan-06	12:00:00	-0.7			14-Feb-06	12:00:00	-0.5				
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12-Jan-06	6:00:00	-0.4			30-Jan-06	6:00:00	-0.6			17-Feb-06	6:00:00	0				
12-Jan-06	12:00:00	-0.2			30-Jan-06	12:00:00	-0.5			17-Feb-06	12:00:00	0				
12-Jan-06	18:00:00	-0.3			30-Jan-06	18:00:00	-0.6			17-Feb-06	18:00:00	-0.1				
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14-Jan-06	18:00:00	-0.7			1-Feb-06	18:00:00	-0.3			19-Feb-06	18:00:00	-0.4				
15-Jan-06	0:00:00	-1			2-Feb-06	0:00:00	-0.2			20-Feb-06	0:00:00	-0.5				
15-Jan-06	6:00:00	-1.3			2-Feb-06	6:00:00	-0.3			20-Feb-06	6:00:00	-0.4				
15-Jan-06	12:00:00	-1.5			2-Feb-06	12:00:00	-0.3			20-Feb-06	12:00:00	-0.4				
15-Jan-06	18:00:00	-1.5			2-Feb-06	18:00:00	-0.3			20-Feb-06	18:00:00	-0.3				
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16-Jan-06	18:00:00	-1.5			3-Feb-06	18:00:00	-0.2			21-Feb-06	18:00:00	-0.1				
17-Jan-06	0:00:00	-1.5			4-Feb-06	0:00:00	0			22-Feb-06	0:00:00	0				
17-Jan-06	6:00:00	-1.3			4-Feb-06	6:00:00	0.1			22-Feb-06	6:00:00	0.1				
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18-Jan-06	6:00:00	0.4			5-Feb-06	6:00:00	0.2			23-Feb-06	6:00:00	1				
18-Jan-06	12:00:00	-0.1			5-Feb-06	12:00:00	0.1			23-Feb-06	12:00:00	1				
18-Jan-06	18:00:00	-0.5			5-Feb-06	18:00:00	0.1			23-Feb-06	18:00:00	0.9				

Gauge: 9

Data Acquired: November 6, 2006

Serial Number: B652374

CD: Consecutive Days Saturation (within 12 inches of the soil surface) During the Growing Season

JD: Days During the Growing Season

					(continued)						(continued)					
Date	Time	Water Level (inches)	CD	JD	Date	Time	Water Level (inches)	CD	JD	Date	Time	Water Level (inches)	CD	JD		
1-Jan-06	0:00:00	-6.6			19-Jan-06	0:00:00	-6.4			6-Feb-06	0:00:00	-7.9				
1-Jan-06	6:00:00	-7			19-Jan-06	6:00:00	-6.8			6-Feb-06	6:00:00	-8				
1-Jan-06	12:00:00	-7			19-Jan-06	12:00:00	-6.8			6-Feb-06	12:00:00	-8.1				
1-Jan-06	18:00:00	-7			19-Jan-06	18:00:00	-6.8			6-Feb-06	18:00:00	-8				
2-Jan-06	0:00:00	-7			20-Jan-06	0:00:00	-6.9			7-Feb-06	0:00:00	-8				
2-Jan-06	6:00:00	-7			20-Jan-06	6:00:00	-7			7-Feb-06	6:00:00	-7.8				
2-Jan-06	12:00:00	-6.7			20-Jan-06	12:00:00	-7			7-Feb-06	12:00:00	-7.9				
2-Jan-06	18:00:00	-3			20-Jan-06	18:00:00	-7			7-Feb-06	18:00:00	-8				
3-Jan-06	0:00:00	-4			21-Jan-06	0:00:00	-7			8-Feb-06	0:00:00	-8.1				
3-Jan-06	6:00:00	-4.4			21-Jan-06	6:00:00	-7			8-Feb-06	6:00:00	-8.4				
3-Jan-06	12:00:00	-5.1			21-Jan-06	12:00:00	-7.1			8-Feb-06	12:00:00	-8.5				
3-Jan-06	18:00:00	-5.1			21-Jan-06	18:00:00	-5.8			8-Feb-06	18:00:00	-8.4				
4-Jan-06	0:00:00	-5.5			22-Jan-06	0:00:00	-5.2			9-Feb-06	0:00:00	-8.5				
4-Jan-06	6:00:00	-5.5			22-Jan-06	6:00:00	-6.1			9-Feb-06	6:00:00	-8.6				
4-Jan-06	12:00:00	-5.5			22-Jan-06	12:00:00	-6.4			9-Feb-06	12:00:00	-8.7				
4-Jan-06	18:00:00	-5.2			22-Jan-06	18:00:00	-6.6			9-Feb-06	18:00:00	-8.8				
5-Jan-06	0:00:00	-5.4			23-Jan-06	0:00:00	-6.7			10-Feb-06	0:00:00	-8.8				
5-Jan-06	6:00:00	-5.4			23-Jan-06	6:00:00	-6.7			10-Feb-06	6:00:00	-8.9				
5-Jan-06	12:00:00	-5.5			23-Jan-06	12:00:00	-6.7			10-Feb-06	12:00:00	-9.1				
5-Jan-06	18:00:00	-5.5			23-Jan-06	18:00:00	-6.3			10-Feb-06	18:00:00	-8.9				
6-Jan-06	0:00:00	-5.5			24-Jan-06	0:00:00	-5.2			11-Feb-06	0:00:00	-8.9				
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7-Jan-06	0:00:00	-5.4			25-Jan-06	0:00:00	-6			12-Feb-06	0:00:00	-5.1				
7-Jan-06	6:00:00	-5.7			25-Jan-06	6:00:00	-6.4			12-Feb-06	6:00:00	-6.2				
7-Jan-06	12:00:00	-5.7			25-Jan-06	12:00:00	-6.7			12-Feb-06	12:00:00	-6.7				
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9-Jan-06	18:00:00	-6.1			27-Jan-06	18:00:00	-7.6			14-Feb-06	18:00:00	-7.9				
10-Jan-06	0:00:00	-6.1			28-Jan-06	0:00:00	-7.6			15-Feb-06	0:00:00	-7.8				
10-Jan-06	6:00:00	-6.4			28-Jan-06	6:00:00	-7.7			15-Feb-06	6:00:00	-7.9				
10-Jan-06	12:00:00	-6.4			28-Jan-06	12:00:00	-7.8			15-Feb-06	12:00:00	-7.9				
10-Jan-06	18:00:00	-6.4			28-Jan-06	18:00:00	-7.8			15-Feb-06	18:00:00	-8				
11-Jan-06	0:00:00	-6.2			29-Jan-06	0:00:00	-7.7			16-Feb-06	0:00:00	-7.9				
11-Jan-06	6:00:00	-6.1			29-Jan-06	6:00:00	-7.7			16-Feb-06	6:00:00	-8.1				
11-Jan-06	12:00:00	-6.2			29-Jan-06	12:00:00	-7.7			16-Feb-06	12:00:00	-8.1				
11-Jan-06	18:00:00	-6.3			29-Jan-06	18:00:00	-7.6			16-Feb-06	18:00:00	-8.1				
12-Jan-06	0:00:00	-6.2			30-Jan-06	0:00:00	-7.6			17-Feb-06	0:00:00	-7.9				
12-Jan-06	6:00:00	-6.6			30-Jan-06	6:00:00	-7.5			17-Feb-06	6:00:00	-8				
12-Jan-06	12:00:00	-6.7			30-Jan-06	12:00:00	-7.6			17-Feb-06	12:00:00	-8				
12-Jan-06	18:00:00	-6.6			30-Jan-06	18:00:00	-7.6			17-Feb-06	18:00:00	-8.1				
13-Jan-06	0:00:00	-6.7			31-Jan-06	0:00:00	-7.4			18-Feb-06	0:00:00	-8.1				
13-Jan-06	6:00:00	-6.8			31-Jan-06	6:00:00	-5.8			18-Feb-06	6:00:00	-8.3				
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14-Jan-06	0:00:00	-6.4			1-Feb-06	0:00:00	-6.7			19-Feb-06	0:00:00	-8.6				
14-Jan-06	6:00:00	-5.4			1-Feb-06	6:00:00	-7			19-Feb-06	6:00:00	-8.8				
14-Jan-06	12:00:00	-6.3			1-Feb-06	12:00:00	-7.1			19-Feb-06	12:00:00	-9.1				
14-Jan-06	18:00:00	-6.8			1-Feb-06	18:00:00	-7			19-Feb-06	18:00:00	-9				
15-Jan-06	0:00:00	-7.1			2-Feb-06	0:00:00	-7			20-Feb-06	0:00:00	-9				
15-Jan-06	6:00:00	-7.3			2-Feb-06	6:00:00	-7.2			20-Feb-06	6:00:00	-8.9				
15-Jan-06	12:00:00	-7.4			2-Feb-06	12:00:00	-7.2			20-Feb-06	12:00:00	-8.8				
15-Jan-06	18:00:00	-7.4			2-Feb-06	18:00:00	-7.1			20-Feb-06	18:00:00	-8.7				
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16-Jan-06	6:00:00	-7.5			3-Feb-06	6:00:00	-7			21-Feb-06	6:00:00	-8.6				
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17-Jan-06	0:00:00	-7.5			4-Feb-06	0:00:00	-7			22-Feb-06	0:00:00	-8.9				
17-Jan-06	6:00:00	-7.5			4-Feb-06	6:00:00	-6.8			22-Feb-06	6:00:00	-8.9				
17-Jan-06	12:00:00	-7.6			4-Feb-06	12:00:00	-6.7			22-Feb-06	12:00:00	-8				
17-Jan-06	18:00:00	-7.4			4-Feb-06	18:00:00	-6.8			22-Feb-06	18:00:00	-6.4				
18-Jan-06	0:00:00	-7.3			5-Feb-06	0:00:00	-7			23-Feb-06	0:00:00	-7.1				
18-Jan-06	6:00:00	-3			5-Feb-06	6:00:00	-7.4			23-Feb-06	6:00:00	-2.5				
18-Jan-06	12:00:00	-4.4			5-Feb-06	12:00:00	-7.5			23-Feb-06	12:00:00	-4.7				
18-Jan-06	18:00:00	-5.7			5-Feb-06	18:00:00	-7.6			23-Feb-06	18:00:00	-5.6				

Gauge: 12

Data Acquired: November 6, 2006

Serial Number: B652408

CD: Consecutive Days Saturation (within 12 inches of the soil surface) During the Growing Season

JD: Days During the Growing Season

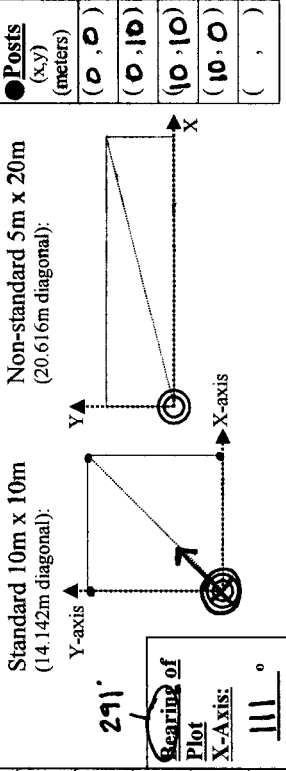
					(continued)						(continued)					
Date	Time	Water Level (inches)	CD	JD	Date	Time	Water Level (inches)	CD	JD	Date	Time	Water Level (inches)	CD	JD		
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1-Jan-06	6:00:00	-4			19-Jan-06	6:00:00	-1.9			6-Feb-06	6:00:00	-4.4				
1-Jan-06	12:00:00	-4.7			19-Jan-06	12:00:00	-2			6-Feb-06	12:00:00	-5.4				
1-Jan-06	18:00:00	-2.5			19-Jan-06	18:00:00	-2.2			6-Feb-06	18:00:00	-5.1				
2-Jan-06	0:00:00	-3.7			20-Jan-06	0:00:00	-3.7			7-Feb-06	0:00:00	-6.2				
2-Jan-06	6:00:00	-4			20-Jan-06	6:00:00	-3.5			7-Feb-06	6:00:00	-6.4				
2-Jan-06	12:00:00	-2.4			20-Jan-06	12:00:00	-3.3			7-Feb-06	12:00:00	-6.5				
2-Jan-06	18:00:00	-0.2			20-Jan-06	18:00:00	-3.1			7-Feb-06	18:00:00	-5				
3-Jan-06	0:00:00	0			21-Jan-06	0:00:00	-3.7			8-Feb-06	0:00:00	-5				
3-Jan-06	6:00:00	-0.3			21-Jan-06	6:00:00	-4.7			8-Feb-06	6:00:00	-5.4				
3-Jan-06	12:00:00	-0.5			21-Jan-06	12:00:00	-2.4			8-Feb-06	12:00:00	-5.8				
3-Jan-06	18:00:00	-0.6			21-Jan-06	18:00:00	-0.2			8-Feb-06	18:00:00	-6				
4-Jan-06	0:00:00	-2.3			22-Jan-06	0:00:00	-0.5			9-Feb-06	0:00:00	-5.7				
4-Jan-06	6:00:00	-1.2			22-Jan-06	6:00:00	-1.5			9-Feb-06	6:00:00	-6				
4-Jan-06	12:00:00	-0.9			22-Jan-06	12:00:00	-3.1			9-Feb-06	12:00:00	-6.4				
4-Jan-06	18:00:00	-2			22-Jan-06	18:00:00	-3.5			9-Feb-06	18:00:00	-6.7				
5-Jan-06	0:00:00	-0.7			23-Jan-06	0:00:00	-3.5			10-Feb-06	0:00:00	-6.8				
5-Jan-06	6:00:00	-2.5			23-Jan-06	6:00:00	-2.6			10-Feb-06	6:00:00	-7.1				
5-Jan-06	12:00:00	0.4			23-Jan-06	12:00:00	0.3			10-Feb-06	12:00:00	-7.5				
5-Jan-06	18:00:00	-1.2			23-Jan-06	18:00:00	1.1			10-Feb-06	18:00:00	-7.8				
6-Jan-06	0:00:00	-2.8			24-Jan-06	0:00:00	3.5			11-Feb-06	0:00:00	-7.7				
6-Jan-06	6:00:00	-0.9			24-Jan-06	6:00:00	4.2			11-Feb-06	6:00:00	-8.7				
6-Jan-06	12:00:00	0.3			24-Jan-06	12:00:00	8.5			11-Feb-06	12:00:00	-8.6				
6-Jan-06	18:00:00	-1.8			24-Jan-06	18:00:00	-0.6			11-Feb-06	18:00:00	-1.6				
7-Jan-06	0:00:00	-1.1			25-Jan-06	0:00:00	0.3			12-Feb-06	0:00:00	-1.8				
7-Jan-06	6:00:00	-1.5			25-Jan-06	6:00:00	-2.9			12-Feb-06	6:00:00	-2				
7-Jan-06	12:00:00	-1.4			25-Jan-06	12:00:00	-1.8			12-Feb-06	12:00:00	-1.9				
7-Jan-06	18:00:00	-1.5			25-Jan-06	18:00:00	-2.5			12-Feb-06	18:00:00	-1.4				
8-Jan-06	0:00:00	-2.2			26-Jan-06	0:00:00	-3.7			13-Feb-06	0:00:00	-2.1				
8-Jan-06	6:00:00	-2.5			26-Jan-06	6:00:00	-3.3			13-Feb-06	6:00:00	-3.1				
8-Jan-06	12:00:00	-2			26-Jan-06	12:00:00	-3.4			13-Feb-06	12:00:00	-3.4				
8-Jan-06	18:00:00	-2.1			26-Jan-06	18:00:00	-3.3			13-Feb-06	18:00:00	-2.4				
9-Jan-06	0:00:00	-4			27-Jan-06	0:00:00	-3.7			14-Feb-06	0:00:00	-3.3				
9-Jan-06	6:00:00	-4.2			27-Jan-06	6:00:00	-4.4			14-Feb-06	6:00:00	-3.8				
9-Jan-06	12:00:00	-2.8			27-Jan-06	12:00:00	-5			14-Feb-06	12:00:00	-4.3				
9-Jan-06	18:00:00	-2.5			27-Jan-06	18:00:00	-3.9			14-Feb-06	18:00:00	-4.2				
10-Jan-06	0:00:00	-3.8			28-Jan-06	0:00:00	-4.4			15-Feb-06	0:00:00	-4.4				
10-Jan-06	6:00:00	-4.7			28-Jan-06	6:00:00	-5.1			15-Feb-06	6:00:00	-4.9				
10-Jan-06	12:00:00	-3.4			28-Jan-06	12:00:00	-5.5			15-Feb-06	12:00:00	-5.3				
10-Jan-06	18:00:00	-3.1			28-Jan-06	18:00:00	-5.6			15-Feb-06	18:00:00	-5.4				
11-Jan-06	0:00:00	-4.2			29-Jan-06	0:00:00	-5.9			16-Feb-06	0:00:00	-5.5				
11-Jan-06	6:00:00	-4.2			29-Jan-06	6:00:00	-6.7			16-Feb-06	6:00:00	-5.9				
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11-Jan-06	18:00:00	-2.8			29-Jan-06	18:00:00	-5.2			16-Feb-06	18:00:00	-6.1				
12-Jan-06	0:00:00	-3.7			30-Jan-06	0:00:00	-5.1			17-Feb-06	0:00:00	-6.1				
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12-Jan-06	18:00:00	-3			30-Jan-06	18:00:00	-4.4			17-Feb-06	18:00:00	-5.9				
13-Jan-06	0:00:00	-3.9			31-Jan-06	0:00:00	-5.3			18-Feb-06	0:00:00	-5.7				
13-Jan-06	6:00:00	-4.8			31-Jan-06	6:00:00	1.9			18-Feb-06	6:00:00	-6.2				
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13-Jan-06	18:00:00	-3.2			31-Jan-06	18:00:00	-0.6			18-Feb-06	18:00:00	-6.5				
14-Jan-06	0:00:00	-2.7			1-Feb-06	0:00:00	-2.6			19-Feb-06	0:00:00	-6.9				
14-Jan-06	6:00:00	-0.6			1-Feb-06	6:00:00	-2			19-Feb-06	6:00:00	-7.7				
14-Jan-06	12:00:00	-1.3			1-Feb-06	12:00:00	-2.1			19-Feb-06	12:00:00	-7.1				
14-Jan-06	18:00:00	-2.8			1-Feb-06	18:00:00	-2.3			19-Feb-06	18:00:00	-7.4				
15-Jan-06	0:00:00	-4.1			2-Feb-06	0:00:00	-2.9			20-Feb-06	0:00:00	-7.3				
15-Jan-06	6:00:00	-5			2-Feb-06	6:00:00	-3.3			20-Feb-06	6:00:00	-7.5				
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16-Jan-06	18:00:00	-4.7			3-Feb-06	18:00:00	-2.7			21-Feb-06	18:00:00	-7.4				
17-Jan-06	0:00:00	-5.7			4-Feb-06	0:00:00	-3.9			22-Feb-06	0:00:00	-7				
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17-Jan-06	12:00:00	-6.7			4-Feb-06	12:00:00	-2.3			22-Feb-06	12:00:00	-8.2				
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18-Jan-06	0:00:00	-4.7			5-Feb-06	0:00:00	-2.9			23-Feb-06	0:00:00	-3.5				
18-Jan-06	6:00:00	0.3			5-Feb-06	6:00:00	-4.2			23-Feb-06	6:00:00	-1.4				
18-Jan-06	12:00:00	0.1			5-Feb-06	12:00:00	-3.4			23-Feb-06	12:00:00	-1.2				
18-Jan-06	18:00:00	-0.6			5-Feb-06	18:00:00	-3.4			23-Feb-06	18:00:00	0.1				

APPENDIX D
CVS LEVELS 1 & 2 DATA FORMS

Plot Data: CVS Levels 1 & 2

GENERAL INFORMATION		LOCATION	
Project Label: <u>Howell Woods</u>		General: <u>Environmental Learning Center</u>	
Project Name:		State: <u>NC</u> County: <u>Johnston</u>	
Team: <u>1</u>		Quadrangle: <u>Four oaks NE</u>	
Plot: <u>Quad 1</u>		Place Names: 1)	
<input type="checkbox"/> Level 1 (planted stems only)		2)	
<input checked="" type="checkbox"/> Level 2 (planted and natural stems)		3)	
Start Date: <u>JUN / 20 / 2006</u> e.g. JAN / 15 / 2006		Land Owner: <u>Johnston County</u>	
End Date (if different): <u>NA</u>		<input checked="" type="checkbox"/> GPS Receiver Location (m): X= _____ Y= _____	
Party	Role**	Datum: <input checked="" type="checkbox"/> NAD83/WGS84 <input type="checkbox"/> NAD27 if UTM's used	
<u>G. Lewis</u>	<u>Plot Leader</u>	Lat: <u>35.38901</u> (or UTM-N) decimal deg. meters e.g. 35.16623 e.g. 3962248	
<u>E. Swab</u>	<u>botan.</u>	Long: <u>78.20423</u> (or UTM-E) e.g. -125.12413 e.g. 710524	
<u>C. Mullan</u>	<u>tech</u>	Coordinate Accuracy (m radius): e.g. 30 <u>submeter</u>	
**Roles: Co-leader, Assistant, Guide, Land owner, Taxonomist, Other		GPS File Name: <u>howell-veg</u>	
Soil Drainage*		SITE CHARACTERISTICS	
<input type="checkbox"/> Excessively drained		Elevation: _____ ± _____ m <input type="checkbox"/> ft.	
<input type="checkbox"/> Somewhat excessively drained		Slope (deg): <u>2</u>	
<input type="checkbox"/> Well drained		Aspect (deg): <u>48°</u>	
<input type="checkbox"/> Moderately well drained		Compass Type: <input checked="" type="checkbox"/> magnetic <input type="checkbox"/> true	
<input type="checkbox"/> Somewhat poorly drained		Plot Placement	
<input type="checkbox"/> Poorly drained		<input checked="" type="checkbox"/> Representative	
<input checked="" type="checkbox"/> Very poorly drained		<input type="checkbox"/> Random	
WATER		Further details of placement can be mentioned in Plot Rationale.	
Percent of Plot Submerged: <u>30</u> %		<input type="checkbox"/> Stratified random	
Mean Water Depth: <u>12</u> cm		<input type="checkbox"/> Transect component	
		<input type="checkbox"/> Systematic (grid)	
		<input type="checkbox"/> Capture specific feature	
TAXONOMIC STANDARD USED FOR PLANT IDENTIFICATION		Plot Rationale: (why location was chosen for the plot)	
Authority: <u>RAB</u> , <u>Publ. Date:</u> <u>1968</u>		Other Notes: (invasive species, erosion, disturbances, etc.)	
		<u>plot was burned/bush hogged.</u>	

Plot Diagram
Fill in ONE of the templates below, using the key to draw GPS location, photos and posts. Edit shape if plot doesn't match one of the templates. Draw any landmarks, such as streams, banks, fences, etc.



Plot Size (area, default=1): 1 **Photo Identifier(s):** 1240
(An "arc" is 100 m²)

NOTES
If more space is needed, check the box and use back of datasheets.
Layout: (anything unusual about plot layout and shape)

Plot Location: (directions to plot, landscape content)
downstream from dam
upstream from ford.

Plot Rationale: (why location was chosen for the plot)

Other Notes: (invasive species, erosion, disturbances, etc.)

TAXONOMIC STANDARD USED FOR PLANT IDENTIFICATION
Authority: RAB, Publ. Date: 1968

Natural Woody Stem Data: CVS Levels 2 & 3

Leader: C. Lewis Project: Howlwoods Team: 1 Plot: 1 Date: JUN/20 / 2004 Area ($=100m^2$): 1 Page 1 of 1
 Height Cut-Off for Stems (all stems shorter than this height are ignored and not tallied): 10cm 50cm 100cm 137cm

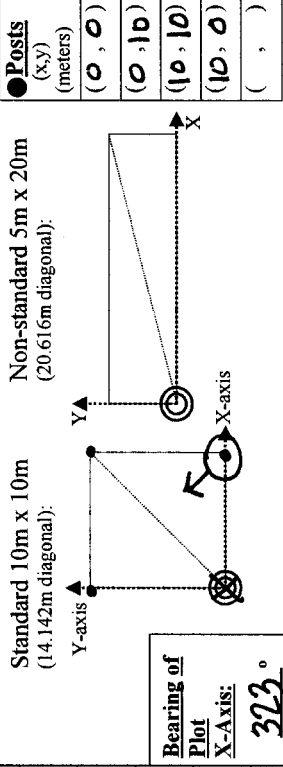
Species Name	SEEDLINGS — HEIGHT CLASSES		SAPLINGS — DBH					TREES — DBH							
	Sub-Seed	10 cm- 50 cm	50 cm- 100 cm	100 cm- 137 cm	Sub-Sapl	0-1 cm	1-2.5 cm	2.5-5	5-10	10-15	15-20	20-25	25-30	30-35	>40 (write dbh)
	Mod*														
<i>Crataegus sp.</i>		□ □ □	□ □ □	□ □											
<i>Liquidambar styrac.</i>		□ □ □	□ □ □	□ □											
<i>Ulmus sp.</i>		□ □ □	□ □ □	□ □											
<i>Acer rubrum</i>		□ □ □	□ □ □	□ □											
<i>Quercus pagoda</i>		□ □ □	□ □ □	□ □											
<i>Ulmus alata</i>		□ □ □	□ □ □	□ □											
<i>Crataegus sp.</i>		□ □ □	□ □ □	□ □											
<i>Pinus taeda</i>		□ □ □	□ □ □	□ □											

Plot Data: CVS Levels 1 & 2

GENERAL INFORMATION		LOCATION	
Project Label: <u>Howell Woods</u>		General: <u>Environmental Learning Center</u>	
Project Name:		State: <u>NC</u> County: <u>Johnston</u>	
Team: <u>1</u>		Quadrangle: <u>Four oaks NE</u>	
Plot: <u>Quad 2</u>		Place Names: (1)	
<input type="checkbox"/> Level 1 (planted stems only)		2)	
<input type="checkbox"/> Level 2 (planted and natural stems)		3)	
Start Date: <u>JUN / 11 / 2006</u> e.g.: JAN / 15 / 2006		Land Owner: <u>Johnston Co.</u>	
End Date (if different): <u>NA</u>		GPS Receiver Location (m): x= y=	
Party	Role**	Datum: <input checked="" type="checkbox"/> NAD83/WGS84 <input type="checkbox"/> NAD27 UTM Zone: _____ if UTM's used	
<u>Ed Swab</u>	<u>Plot Leader</u>	Lat: <u>35.39116</u> (or UTM-N) meters e.g.: 35.16623 e.g.: 3962248	
<u>C. Mahan</u>	<u>tech</u>	Long: <u>78.28578</u> (or UTM-E) e.g.: _____ e.g.: -125.12413 e.g.: 710524	
**Roles: Co-leader, Assistant, Guide, Land owner, Taxonomist, Other		Coordinate Accuracy (m radius): e.g.: 30 <u>Submeter</u>	
Soil Drainage*		GPS File Name: <u>howellveg</u>	
<input type="checkbox"/> Excessively drained		SITE CHARACTERISTICS	
<input type="checkbox"/> Somewhat excessively drained		Elevation: _____ ± _____ □ m □ ft.	
<input type="checkbox"/> Well drained		Slope (deg): _____	
<input type="checkbox"/> Moderately well drained		Aspect (deg): _____	
<input checked="" type="checkbox"/> Somewhat poorly drained		Compass Type: <input checked="" type="checkbox"/> magnetic <input type="checkbox"/> true	
<input type="checkbox"/> Poorly drained		Plot Placement	
<input type="checkbox"/> Very poorly drained		<input checked="" type="checkbox"/> Representative	
WATER		<input type="checkbox"/> Random	
Percent of Plot Submerged: <u>0</u> %		<input type="checkbox"/> Stratified random	
Mean Water Depth: <u>NA</u> cm		<input type="checkbox"/> Transect component	
		<input type="checkbox"/> Systematic (grid)	
		<input type="checkbox"/> Capture specific feature	
TAXONOMIC STANDARD USED FOR PLANT IDENTIFICATION		Further details of placement can be mentioned in Plot Rationale.	
Authority: <u>RAB</u> , <u>Publ. Date: 1968</u>			

PLOT DIAGRAM

Fill in ONE of the templates below, using the key to draw GPS location, photos and posts. Edit shape if plot doesn't match one of the templates. Draw any landmarks, such as streams, banks, fences, etc.



Plot Size (ares, default=1): 1 Photo Identifier(s): 1301
(An "are" is 100 m²)

NOTES
If more space is needed, check the box and use back of datasheets.
Layout: (anything unusual about plot layout and shape)

Plot Location: (directions to plot, landscape content) □ more...

Plot Rationale: (why location was chosen for the plot) □ more...

Other Notes: (invasive species, erosion, disturbances, etc.)
Possibly burned; flooded in June 2006

TAXONOMIC STANDARD USED FOR PLANT IDENTIFICATION
Authority: RAB, Publ. Date: 1968 □ more...

Planted Woody Stem Data: CVS Levels 1 & 2

Leader: <u>Ed Swab</u>		Project: <u>Howell Woods</u>		Team: <u>1</u>	Plot: <u>Quad 2</u>	Date: <u>JULY / 11 / 2006</u>	Page <u>1</u> of <u>1</u>	
Species Name	Source	Coordinates		ddh (mm)	Height (cm)	DBH (cm)	Vigor	Damage
		X (m)	Y (m)					
<i>Quercus phellos</i>	-	0.4	7.0	3	30	-	2	dieback
<i>Crataegus</i>	-	2.9	8.5	1	30	-	2	resprout
<i>Fraxinus pennsylvanica</i>	-	2.7	8.0	2	25	-	2	resprout
<i>Ulmus sp.</i>	-	1.0	8.0	1	25	-	2	resprout
<i>Populus heterophylla</i>	-	3.5	9.5	9	55	-	2	resprout
<i>Fraxinus pennsylvanica</i>	-	4.0	9.0	12	55	-	2	resprout
<i>Fraxinus pennsylvanica</i>	-	4.2	8.6	2	30	-	2	resprout
<i>Ulmus sp.</i>	-	5.0	9.5	8	60	-	3	-
<i>Diospyros virginiana</i>	-	5.0	8.0	11	90	-	3	resprout
<i>Quercus phellos</i>	-	6.5	5.5	1	30	-	2	resprout
<i>Fraxinus pennsylvanica</i>	-	6.5	4.0	1	30	-	2	resprout
<i>Quercus sp.</i>	-	3.5	4.0	1	10	-	2	resprout
<i>Fraxinus pennsylvanica</i>	-	6.5	3.8	1	20	-	2	resprout
<i>Fraxinus pennsylvanica</i>	-	4.0	2.0	1	40	-	2	resprout
<i>Quercus phellos</i>	-	4.0	0.6	3	40	-	2	resprout
<i>Fraxinus pennsylvanica</i>	-	9.5	1.6	11	65	-	3	grazed
<i>Fraxinus pennsylvanica</i>	-	9.9	1.6	14	70	-	3	grazed
<i>Crataegus</i>	-	8.5	2.0	4	60	-	2	resprout
<i>Fraxinus pennsylvanica</i>	-	9.7	4.0	10	70	-	3	grazed
<i>Fraxinus pennsylvanica</i>	-	8.2	4.5	1	20	-	2	grazed
<i>Fraxinus pennsylvanica</i>	-	7.5	4.4	1	25	-	2	grazed
<i>Crataegus</i>	-	7.5	8.5	1	30	-	2	resprout
<i>Fraxinus pennsylvanica</i>	-	8.1	9.0	9	60	-	3	-
<i>Quercus sp.</i>	-	9.9	9.0	2	20	-	2	-
<i>Quercus phellos</i>	-	9.9	9.0	29	230	1.2	4	-
<i>Fraxinus pennsylvanica</i>	-	8.9	9.9	15	110	-	3	grazed
<i>Fraxinus pennsylvanica</i>	-	8.8	9.8	12	70	-	3	grazed
<i>Quercus phellos</i>	-	9.0	9.9	18	120	-	2	grazed

Source: Cultivated, Transplant, Live stake,
Ball and Burlap, Pot, Bare Root

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year,
0=Dead, Missing.



Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled,
Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

Natural Woody Stem Data: CVS Levels 2 & 3

Leader: Ed Swab Project: Hoveall Woods Team: 1 Plot: Quad 2 Date: July 11 / 2006 Area (=100m²): 1 Page 1 of 1
 Height Cut-Off for Stems (all stems shorter than this height are ignored and not tallied): 10cm 50cm 100cm 137cm

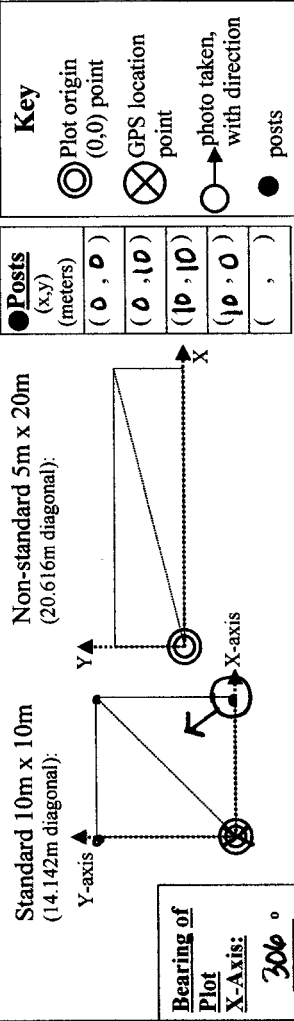
Species Name	Sub-Mod*	SEEDLINGS — HEIGHT CLASSES				SAPLINGS — DBH				TREES — DBH						
		10 cm- 50 cm	50 cm- 100 cm	100 cm- 137 cm	Sub-Seed	0-1 cm	1-2.5 cm	2.5-	5-	10-	15-	20-	25-	30-	35-	>40 (write dbh)
		20 15 .. 10 5 11 10	—	—	—	—	—	—	—	—	—	—	—	—
<u>Acer rubrum</u>	<input type="checkbox"/>				—											
<u>Ulmus sp.</u>	<input type="checkbox"/>				—											
<u>Acer rubrum</u>	<input type="checkbox"/>	30 5			—											
<u>Liquidambar styr.</u>	<input type="checkbox"/>				—											
	<input type="checkbox"/>				—											
	<input type="checkbox"/>				—											
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Plot Data: CVS Levels 1 & 2

GENERAL INFORMATION		LOCATION
Project Label: <u>Howell Woods</u>		General: <u>Environmental Learning Center</u>
Project Name:		State: <u>NC</u> County: <u>Johnston</u>
Team: <u>1</u>		Quadrangle: <u>Four Oaks NE</u>
Plot: <u>Quad 3</u>		Place Names: 1)
<input type="checkbox"/> Level 1 (planted stems only)		2)
<input checked="" type="checkbox"/> Level 2 (planted and natural stems)		3)
Start Date: <u>July / 7 / 2006</u> e.g.: JAN / 15 / 2006		Land Owner: <u>Johnston Co.</u>
End Date (if different): <u>NA/</u>		<input checked="" type="checkbox"/> <u>GPS Receiver Location</u> (m): x= y=
Party	Role**	Datum: <input checked="" type="checkbox"/> NAD83/WGS84 <input type="checkbox"/> NAD27 if UTM's used
<u>E. Swab</u>	<u>Plot Leader</u>	Lat: decimal deg. <u>35.38719</u> (or UTM-N) e.g. 35.16623 meters e.g. 3962248
<u>C. Mahan</u>	<u>tech</u>	Long: e.g. <u>-78.20131</u> (or UTM-E) e.g. -125.12413 710524
**Roles: Co-leader, Assistant, Guide, Land owner, Taxonomist, Other		Coordinate Accuracy (m radius): e.g. 30 <u>submeter</u>
Soil Drainage*		GPS File Name: <u>howell-veg</u>
<input type="checkbox"/> Excessively drained		SITE CHARACTERISTICS
<input type="checkbox"/> Somewhat excessively drained		Elevation: <input type="checkbox"/> m <input type="checkbox"/> ft.
<input type="checkbox"/> Well drained		Slope (deg):
<input type="checkbox"/> Moderately well drained		Aspect (deg):
<input type="checkbox"/> Somewhat poorly drained		Compass Type: <input checked="" type="checkbox"/> magnetic <input type="checkbox"/> true
<input type="checkbox"/> Poorly drained		Plot Placement
<input checked="" type="checkbox"/> Very poorly drained		<input checked="" type="checkbox"/> Representative Further details of placement can be mentioned in Plot Rationale.
WATER		<input type="checkbox"/> Random
Percent of Plot Submerged: <u>10</u> %		<input type="checkbox"/> Stratified random
Mean Water Depth: <u>3</u> cm		<input type="checkbox"/> Transect component
		<input type="checkbox"/> Systematic (grid)
		<input type="checkbox"/> Capture specific feature
TAXONOMIC STANDARD USED FOR PLANT IDENTIFICATION		
Authority: <u>RAB</u> , Publ. Date: <u>1968</u>		
Required Fields in <u>Bold and Underlined</u> .		

PLOT DIAGRAM

Fill in ONE of the templates below, using the key to draw GPS location, photos and posts. Edit shape if plot doesn't match one of the templates. Draw any landmarks, such as streams, banks, fences, etc.



Plot Size (area, default=1): 1 Photo Identifier(s): 1357
(An "area" is 100 m²)

NOTES
If more space is needed, check the box and use back of datasheets.

Layout: (anything unusual about plot layout and shape)

Plot Location: (directions to plot, landscape content)

Plot Rationale: (why location was chosen for the plot)

Other Notes: (invasive species, erosion, disturbances, etc.)

* Note: Almost all ulmus look like they have been grazed.

Planted Woody Stem Data: CVS Levels 1 & 2

Leader: E. Swab Project: Howell Woods Team: 1 Plot: Quad 3 Date: July 17 / 2006 Page 1 of 2

Species Name	Source	Coordinates		ddh (mm)	Height (cm)	DBH (cm)	Vigor	Damage
		X (m)	Y (m)					
Ulmus sp.	-	0.75	2.0	11	100	-	3	-
Taxodium distichum	-	1.0	4.0	52	210	1.4	4	Rodents
Ulmus sp.	-	2.2	9.8	11	70	-	3	-
Ulmus sp.	-	2.2	9.7	9	50	-	3	deer
Ulmus sp.	-	1.0	9.2	10	100	-	3	-
Ulmus sp.	-	1.1	9.2	8	100	-	3	-
Ulmus sp.	-	3.3	9.2	12	95	-	3	-
Ulmus sp.	-	0	9.2	13	75	-	3	-
Ulmus sp.	-	4.5	0.6	11	75	4-	3	-
Quercus pagoda	-	6.0	2.0	28	270	1.1	3	-
Ulmus sp.	-	4.5	4.0	9	80	-	3	-
Ulmus sp.	-	6.0	4.5	11	75	-	3	-
Ulmus sp.	-	4.5	5.0	17	130	-	3	-
Ulmus sp.	-	3.5	5.0	12	65	-	3	-
Ulmus sp.	-	6.0	6.0	10	65	-	3	-
Ulmus sp.	-	6.3	6.2	25	100	-	3	-
Quercus phellos	-	4.5	7.0	31	250	1.8	4	-
Ulmus sp.	-	4.5	8.0	7	70	-	3	-
Ulmus sp.	-	4.8	8.1	12	100	-	3	-
Ulmus sp.	-	4.6	8.2	22	110	-	3	-
Ulmus sp.	-	5.0	8.2	12	75	-	3	-
Ulmus sp.	-	3.5	9.2	20	80	-	3	-
Ulmus sp.	-	6.5	9.5	11	70	-	3	-
Ulmus sp.	-	9.5	0.5	18	80	-	3	-
Ulmus sp.	-	9.5	0.3	18	130	-	3	deer
Ulmus sp.	-	9.1	1.0	11	70	-	3	-
Ulmus sp.	-	8.0	1.5	13	100	-	3	-
Ulmus rubra	-	8.0	3.0	16	175	0.3	3	-
Ulmus sp.	-	9.0	3.5	10	70	-	3	-
Quercus phellos	-	9.8	3.5	33	70	-	3	-
Ulmus sp.	-	7.0	6.0	10	75	-	2	beaver cut
Ulmus sp.	-	8.5	8.0	4	85	-	3	-
Ulmus sp.	-	8.5	8.4	15	100	-	3	-
Ulmus sp.	-	8.0	8.5	14	90	-	3	-

Source: Cultivated, Transplant, Live stake, Ball and Burlap, Pot, Bare Root

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year, 0=Dead, Missing.



Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

Planted Woody Stem Data: CVS Levels 1 & 2

Leader: E. Swab Project: Howell Woods Team: 1 Plot: Quad 3 Date: July 17, 2006 Page 2 of 2

Species Name	Source	Coordinates		ddh (mm)	Height (cm)	DBH (cm)	Vigor	Damage
		X (m)	Y (m)					
Ulmus sp.	-	8.5	8.0	11	60	-	3	-
Ulmus sp.	-	9.0	8.1	15	95	-	3	-
Ulmus sp.	-	9.5	9.0	14	75	-	3	-
Ulmus sp.	-	9.0	9.5	15	80	-	3	-
Ulmus sp.	-	8.5	9.0	13	130	-	3	-
Ulmus sp.	-	8.5	9.0	10	80	-	3	-
Ulmus rubra	-	7.5	9.5	15	200	0.3	3	-
Ulmus sp.	-	7.5	9.7	11	100	-	3	-

Source: Cultivated, Transplant, Live stake, Ball and Burlap, Pot, Bare Root Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Discased, Vine Strangulation, Unknown, specify other.

Plot Data: CVS Levels 1 & 2

GENERAL INFORMATION	LOCATION	PLOT DIAGRAM	KEY
Project Label: <u>Howell Woods</u> Project Name: Team: <u>1</u> Plot: <u>Quad 4</u> <input type="checkbox"/> Level 1 (planted stems only) <input type="checkbox"/> Level 2 (planted and natural stems) Start Date: <u>July / 11 / 2006</u> <small>e.g.: JAN / 15 / 2006</small> End Date (if different): <u>NA</u>	General: <u>Environment Learning Center</u> State: <u>NC</u> County: <u>Johnston</u> Quadrangle: <u># Four Oaks NE</u> Place Names: (1) (2) <u>3)</u> Land Owner: <u>Johnston Co.</u> GPS Receiver Location (m): X= <u> </u> Y= <u> </u>		Key <input type="checkbox"/> Plot origin (0,0) point <input checked="" type="checkbox"/> GPS location point <input type="checkbox"/> photo taken, with direction <input type="checkbox"/> posts
Party: <u>Ed. Swab</u> Role:** <u>tech</u> Plot Leader: <u>C. Mahan</u>	Datum: <input checked="" type="checkbox"/> NAD83/WGS84 <input type="checkbox"/> NAD27 <input type="checkbox"/> UTM Zone: <small>if UTM's used</small> Lat: <u>35.38258</u> <small>(or UTM-N)</small> <small>decimal deg. e.g. 35.16623 meters</small> Long: <u>-78.27871</u> <small>(or UTM-E)</small> <small>e.g. -125.12413 e.g. 710524</small> Coordinate Accuracy (m radius): <u>30</u> <small>e.g. 30 submeter</small> GPS File Name: <u>howell-veg</u>	Plot Size (ares, default=1): <u>1</u> <small>(An "are" is 100 m²)</small> Photo Identifier(s): <u>0947</u> NOTES If more space is needed, check the box and use back of datasheets. Layout: (anything unusual about plot layout and shape)	Plot Location: (directions to plot, landscape content) <input type="checkbox"/> more... Plot Rationale: (why location was chosen for the plot) <input type="checkbox"/> more... Other Notes: (invasive species, erosion, disturbances, etc.) <input type="checkbox"/> more...
**Roles: Co-leader, Assistant, Guide, Land owner, Taxonomist, Other Soil Drainage* <input type="checkbox"/> Excessively drained <input type="checkbox"/> Somewhat excessively drained <input type="checkbox"/> Well drained <input type="checkbox"/> Moderately well drained <input checked="" type="checkbox"/> Somewhat poorly drained <input type="checkbox"/> Poorly drained <input type="checkbox"/> Very poorly drained	SITE CHARACTERISTICS Elevation: <u> </u> ± <u> </u> <small>□m □ft.</small> Slope (deg): Aspect (deg): Compass Type: <input checked="" type="checkbox"/> magnetic <input type="checkbox"/> true	Plot Placement <input checked="" type="checkbox"/> Representative <input type="checkbox"/> Random <input type="checkbox"/> Stratified random <input type="checkbox"/> Transect component <input type="checkbox"/> Systematic (grid) <input type="checkbox"/> Capture specific feature <small>Further details of placement can be mentioned in Plot Rationale.</small>	WATER Percent of Plot Submerged: <u>0</u> % Mean Water Depth: <u> </u> cm
TAXONOMIC STANDARD USED FOR PLANT IDENTIFICATION Authority: <u>RAB</u> , Publ. Date: <u>1968</u> *Definitions and/or values are in the Definitions section of the CVS Field Guide.			

Planted Woody Stem Data: CVS Levels 1 & 2

Leader: Ed Suab		Project: Howell Woods		Team: 1	Plot: Quad 4	Date: July / 11 / 2000	Page 1 of 1		
Species Name	Source	Coordinates		ddh (mm)	Height (cm)	DBH (cm)	Vigor	Damage	
		X (m)	Y (m)						
Quercus lyrata	-	2.7	0.4	34	100	120	4	-	
Ulmus sp.	-	1.0	2.0	12	75	-	3	deer	
Crateagus sp.	-	0.5	2.5	20	100	-	3	deer	
Ulmus sp.	-	0.3	3.5	5	95	-	3	deer	
Ulmus sp.	-	2.0	4.0	4	100	-	3	deer	
Ulmus sp.	-	2.5	4.5	6	75	-	3	-	
Crateagus sp.	-	1.4	4.8	15	110	-	3	-	
Ulmus sp.	-	1.1	4.0	14	100	-	3	-	
Ulmus sp.	-	0.9	4.7	13	85	-	3	-	
Fraxinus pennsylvanica	-	1.5	6.0	48	300	2.4	4	-	
Ulmus sp.	-	0.9	7.0	14	70	-	3	deer	
Ulmus sp.	-	1.5	7.0	16	70	-	3	deer	
Fraxinus pennsylvanica	-	1.4	7.2	25	110	-	3	deer	
Ulmus sp.	-	1.5	8.0	14	95	-	3	deer	
Ulmus rubra	-	0.5	8.5	23	250	1.7	4	-	
Crateagus sp.	-	3.0	8.5	29	100	-	4	grazed	
Ulmus sp.	-	1.1	9.5	11	75	-	3	deer	
Crateagus sp.	-	1.0	9.8	25	130	-	3	grazed	
Platanus occidentalis	-	0.75	9.8	93	500	6.1	4	-	
Flex decidua	-	1.7	9.8	9	40	-	2	grazed	
Ulmus sp.	-	3.7	1.7	17	80	-	3	grazed	
Ulmus sp.	-	3.5	2.0	12	75	-	3	grazed	
Ulmus sp.	-	4.0	2.4	8	70	-	3	grazed	
Ulmus sp.	-	4.7	2.4	18	105	-	3	grazed	
Platanus occidentalis	-	6.0	3.6	66	7300	4.1	4	-	
Fraxinus pennsylvanica	-	6.3	3.1	12	75	-	3	grazed	
Diospyros virginiana	-	6.5	4.5	31	200	1.4	4	-	
Crateagus sp.	-	4.5	5.0	17	70	-	3	grazed	
Ulmus sp.	-	4.9	4.5	11	70	-	3	grazed	
Fraxinus pennsylvanica	-	3.6	4.7	54	7300	2.7	4	-	
Fraxinus pennsylvanica	-	4.0	4.7	36	240	1.6	4	-	
Ulmus sp.	-	4.0	5.1	15	130	-	3	grazed	

Source: Cultivated, Transplant, Live stake,
Ball and Burlap, Pot, Bare Root

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year,
0=Dead, Missing.

↓

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled,
Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

Natural Woody Stem Data: CVS Levels 2 & 3

Leader: Ed Swab Project: Howell woods Team: 1 Plot: Quad 4 Date: July 11 / 2006 Area (=100m²): 1 Page 1 of 1
 Height Cut-Off for Stems (all stems shorter than this height are ignored and not tallied): 10cm 50cm 100cm 137cm

Species Name	SEEDLINGS — HEIGHT CLASSES					SAPLINGS — DBH					TREES — DBH					≥40 (write dbh)
	Sub-Seed	10 cm- 50 cm	50 cm- 100 cm	100 cm- 137 cm	Sub-Sapl	0-1 cm	1-2.5 cm	2.5-	5-	10-	15-	20-	25-	30-	35-	
<u>Acer rubrum</u>			..	.												
<u>Diospyros virginiana</u>			..													
<u>Virus sp.</u>																

Plot Data: CVS Levels 1 & 2

GENERAL INFORMATION Project Label: <u>Howell woods</u> Project Name: Team: <u>1</u> Plot: <u>Quad 5</u> <input type="checkbox"/> Level 1 (planted stems only) <input checked="" type="checkbox"/> Level 2 (planted and natural stems) Start Date: <u>JUN / 30 / 2004</u> <small>e.g.: JAN / 15 / 2006</small> End Date (if different): <u>NA /</u>	LOCATION General: <u>Environmental Learning center</u> State: <u>NC</u> County: <u>Johnston</u> Quadrangle: <u>Four Oaks NE</u> Place Names: (1) 2) _____ 3) _____ Land Owner: <u>Johnston County</u>	Plot Diagram Fill in ONE of the templates below, using the key to draw GPS location, photos and posts. Edit shape if plot doesn't match one of the templates. Draw any landmarks, such as streams, banks, fences, etc. <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> Standard 10m x 10m <small>(14.142m diagonal):</small> </div> <div style="text-align: center;"> Non-standard 5m x 20m <small>(20.616m diagonal):</small> </div> </div> <div style="margin-top: 10px;"> Key <input checked="" type="checkbox"/> Plot origin (0,0) point <input checked="" type="checkbox"/> GPS location point <input checked="" type="checkbox"/> photo taken, with direction <input checked="" type="checkbox"/> posts </div>	Plot Size (ares, default=1): <u>1</u> Photo Identifier(s): <u>0913</u> <small>(An "are" is 100 m²)</small> NOTES If more space is needed, check the box and use back of datasheets. Layout: (anything unusual about plot layout and shape)
GPS Receiver Location (m): X= _____ Y= _____ Datum: <input checked="" type="checkbox"/> NAD83/WGS84 <input type="checkbox"/> NAD27 UTM Zone: <small>if UTM's used</small> Lat: <u>35.38124</u> (or <u>UTM-N</u>) <small>decimal deg. e.g. 35.16623 meters</small> Long: <u>-78.27954</u> (or <u>UTM-E</u>) <small>e.g. -125.12413 e.g. 710524</small>	Coordinate Accuracy (m radius): e.g. 30 <u>Submeter</u>	GPS File Name: <u>howell-veg</u> SITE CHARACTERISTICS Elevation: _____ <small>□m □ft</small> Slope (deg): _____ Aspect (deg): _____ Compass Type: <input checked="" type="checkbox"/> magnetic <input type="checkbox"/> true	Plot Placement <input checked="" type="checkbox"/> Representative Further details of placement can be mentioned in Plot Rationale. <input type="checkbox"/> Random <input type="checkbox"/> Stratified random <input type="checkbox"/> Transect component <input type="checkbox"/> Systematic (grid) <input type="checkbox"/> Capture specific feature
Party <u>E. Swab</u> Role** <u>C. Mahan</u> Plot Leader <u>tch.</u> **Roles: Co-leader, Assistant, Guide, Land owner, Taxonomist, Other	Soil Drainage* <input type="checkbox"/> Excessively drained <input type="checkbox"/> Somewhat excessively drained <input type="checkbox"/> Well drained <input type="checkbox"/> Moderately well drained <input type="checkbox"/> Somewhat poorly drained <input checked="" type="checkbox"/> Poorly drained <input type="checkbox"/> Very poorly drained	WATER Percent of Plot Submerged: <u>10</u> % Mean Water Depth: <u>1</u> cm	TAXONOMIC STANDARD USED FOR PLANT IDENTIFICATION Authority: <u>RAB</u> , Publ. Date: <u>1968</u> *Definitions and/or values are in the Definitions section of the CVS Field Guide.

Planted Woody Stem Data: CVS Levels 1 & 2

Leader: E. Swab Project: Howell Woods Team: 1 Plot: Quads 5 Date: JULY / 4 / 2006 Page 1 of 1

Species Name	Source	Coordinates		ddh (mm)	Height (cm)	DBH (cm)	Vigor	Damage
		X (m)	Y (m)					
Taxodium distichum	-	1.5	1.5	33	110	-	4	-
Ulmus sp.	-	0.5	7.5	13	85	-	4	-
Ulmus sp.	-	2.1	8.0	10	50	-	3	-
Platanus occidentalis	-	2.5	7.5	33	250	1.5	4	-
Ulmus sp.	-	3.0	8.0	7	60	-	3	-
Ulmus sp.	-	3.0	9.2	14	50	-	3	-
Ulmus sp.	-	2.5	9.5	9	90	-	3	-
Ulmus sp.	-	0	9.0	8	100	-	3	-
Ulmus sp.	-	1.0	9.5	4	50	-	3	-
Platanus occident.	-	1.0	9.7	64	7300	2.8	4	-
Liquidambar styr.	-	2.5	9.9	34	200	2.4	4	-
Ulmus sp.	-	2.5	9.8	8	90	-	3	-
Ulmus sp.	-	6.0	9.0	8	50	-	3	-
Ulmus sp.	-	6.1	9.1	7	60	-	3	-
Ulmus sp.	-	6.3	9.1	9	65	-	3	-
Ulmus sp.	-	6.3	9.1	6	65	-	3	-
Ulmus sp.	-	6.3	9.5	8	60	-	3	-
Ulmus sp.	-	6.4	9.8	7	70	-	3	-
Ulmus sp.	-	6.3	9.9	8	75	-	3	-
Ulmus sp.	-	6.3	9.9	7	75	-	3	-
Ulmus sp.	-	7.5	9.5	8	75	-	3	-
Ulmus sp.	-	8.5	1.5	8	45	-	3	-
Ulmus sp.	-	9.5	5.0	7	75	-	3	-
Ulmus sp.	-	8.0	9.0	9	110	-	3	-
Ulmus sp.	-	7.8	9.0	5	80	-	3	-
Ulmus sp.	-	8.2	9.5	12	90	-	3	-
Ulmus sp.	-	7.5	9.3	8	100	-	3	-
Ulmus sp.	-	8.0	9.4	11	100	-	4	-
Ulmus sp.	-	8.2	9.4	9	90	-	3	-
Ulmus sp.	-	8.0	9.7	11	70	-	3	-
Ulmus americana	-	9.3	9.7	23	7300	1.7	4	-
Ulmus sp.	-	9.3	9.1	8	90	-	3	-

Source: Cultivated, Transplant, Live stake, Ball and Burlap, Pot, Bare Root Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

Natural Woody Stem Data: CVS Levels 2 & 3

Leader: E. Swab Project: Howell Woods Team: 1 Plot: Qvad 5 Date: July / 6 / 2004 Area (=100m²): 1 Page 1 of 1
 Height Cut-Off for Stems (all stems shorter than this height are ignored and not tallied): 10cm 50cm 100cm 137cm

Species Name	Mod*	SEEDLINGS — HEIGHT CLASSES				SAPLINGS — DBH										TREES — DBH				
		Sub-Seed	10 cm- 50 cm	50 cm- 100 cm	100 cm- 137 cm	Sub-Sapl	0-1 cm	1-2.5 cm	2.5-	5-	10-	15-	20-	25-	30-	35-	≥40 (write dbh)			
<u>Ulmus sp.</u>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>														
<u>Liquidambar styrac.</u>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>														
<u>Acer rubrum</u>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>														
<u>Diospyros virgin.</u>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>														
<u>Crataegus sp.</u>																				

APPENDIX E
GAUGE VEGETATION LISTS

YEAR 5 (2006)
GAUGE VEGETATION LISTS
HOWELL WOODS RESTORATION SITE
October 18, 2006

GAUGE 1

	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Quercus phellos</i></u>	Canopy	FACW-
2.	<u><i>Fraxinus pennsylvanica</i></u>	Canopy	FACW
3.	<u><i>Liquidambar styraciflua</i></u>	Canopy	FAC+
4.	<u><i>Ulmus americana</i></u>	Canopy	FACW
5.	<u><i>Celtis laevigata</i></u>	Canopy	FACW
6.	<u><i>Ulmus rubra</i></u>	Sapling	FAC
7.	<u><i>Carpinus caroliniana</i></u>	Sapling	FAC
8.	<u><i>Ilex decidua</i></u>	Shrub	FACW-
9.	<u><i>Carya illinoensis</i></u>	Shrub	FAC+
10.	<u><i>Carex</i> spp.</u>	Herb	FAC to OBL
11.	<u><i>Commelina virginica</i></u>	Herb	FACW
12.	<u><i>Leersia lenticularis</i></u>	Herb	OBL

Percent of Dominant Species that are OBL, FACW, or FAC
(except FAC-). Include species noted (*) as showing
morphological adaptations to wetlands = **100%**

GAUGE 2

	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Ulmus alata</i></u>	Canopy	FACU+
2.	<u><i>Fraxinus pennsylvanica</i></u>	Canopy	FACW
3.	<u><i>Liquidambar styraciflua</i></u>	Canopy	FAC+
4.	<u><i>Ulmus</i> sp.</u>	Canopy	FAC to FACW
5.	<u><i>Platanus occidentalis</i></u>	Canopy	FACW-
6.	<u><i>Quercus pagoda</i></u>	Canopy	FAC
7.	<u><i>Crataegus</i> sp.</u>	Canopy	FAC to OBL
8.	<u><i>Dulichium arundinaceum</i></u>	Herb	OBL
9.	<u><i>Juncus effusus</i></u>	Herb	FACW+
10.	<u><i>Carex luridalcomosa</i></u>	Herb	OBL

Percent of Dominant Species that are OBL, FACW, or FAC
(except FAC-). Include species noted (*) as showing
morphological adaptations to wetlands = **90%**

GAUGE 3

	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Ulmus alata</i></u>	Canopy	FACU+
2.	<u><i>Fraxinus pennsylvanica</i></u>	Canopy	FACW
3.	<u><i>Liquidambar styraciflua</i></u>	Canopy	FAC+
4.	<u><i>Acer rubrum</i></u>	Canopy	FAC
5.	<u><i>Carex</i> spp.</u>	Herb	FAC to OBL
6.	<u><i>Parthenocissus quinquefolia</i></u>	Herb	FAC
7.	<u><i>Toxicodendron radicans</i></u>	Herb	FAC

Percent of Dominant Species that are OBL, FACW, or FAC
(except FAC-). Include species noted (*) as showing
morphological adaptations to wetlands = **86%**

GAUGE 4

	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Nyssa biflora</i></u>	Canopy	OBL
2.	<u><i>Ulmus americana</i></u>	Canopy	FACW
3.	<u><i>Acer rubrum</i></u>	Canopy	FAC
4.	<u><i>Ilex decidua</i></u>	Shrub	FAC-
5.	<u><i>Carex</i> spp.</u>	Herb	FAC to OBL
6.	<u><i>Leersia lenticularis</i></u>	Herb	OBL
7.	<u><i>Boehmeria cylindrica</i></u>	Herb	FACW+
8.	<u><i>Saururus cernuus</i></u>	Herb	OBL
9.	<u><i>Quercus lyrata</i></u>	Herb	OBL
10.	<u><i>Polygonum virginianum</i></u>	Herb	FAC

Percent of Dominant Species that are OBL, FACW, or FAC (except FAC-). Include species noted (*) as showing morphological adaptations to wetlands = **90%**

GAUGE 5

	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Ulmus americana</i></u>	Canopy	FACW
2.	<u><i>Nyssa biflora</i></u>	Canopy	OBL
3.	<u><i>Liquidambar styraciflua</i></u>	Canopy	FAC+
4.	<u><i>Celtis laevigata</i></u>	Sapling	FACW
5.	<u><i>Crataegus</i> sp.</u>	Sapling	FAC to OBL
6.	<u><i>Fraxinus pennsylvanica</i></u>	Shrub	FACW
7.	<u><i>Ilex decidua</i></u>	Shrub	FACW-
8.	<u><i>Boehmeria cylindrica</i></u>	Herb	FACW+
9.	<u><i>Carex</i> spp.</u>	Herb	FAC to OBL
10.	<u><i>Populus deltoides</i></u>	Herb	FAC+
11.	<u><i>Acer rubrum</i></u>	Herb	FAC
12.	<u><i>Saururus cernuus</i></u>	Herb	OBL
13.	<u><i>Dulichium arundinaceum</i></u>	Herb	OBL
14.	<u><i>Arundinaria gigantea</i></u>	Herb	FACW

Percent of Dominant Species that are OBL, FACW, or FAC (except FAC-). Include species noted (*) as showing morphological adaptations to wetlands = **100%**

GAUGE 6

	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Ulmus alata</i></u>	Canopy	FACU+
2.	<u><i>Ulmus rubra</i></u>	Canopy	FAC
3.	<u><i>Liquidambar styraciflua</i></u>	Canopy	FAC+
4.	<u><i>Acer rubrum</i></u>	Canopy	FAC
5.	<u><i>Carex</i> spp.</u>	Herb	FAC to OBL
6.	<u><i>Campsis radicans</i></u>	Herb	FAC
7.	<u><i>Boehmeria cylindrica</i></u>	Herb	FACW+
8.	<u><i>Dulichium arundinaceum</i></u>	Herb	OBL

Percent of Dominant Species that are OBL, FACW, or FAC (except FAC-). Include species noted (*) as showing morphological adaptations to wetlands = **88%**

GAUGE 7

	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Nyssa biflora</i></u>	Canopy	OBL
2.	<u><i>Celtis laevigata</i></u>	Canopy	FACW
3.	<u><i>Acer rubrum</i></u>	Canopy	FAC
4.	<u><i>Fraxinus pennsylvanica</i></u>	Canopy	FACW
5.	<u><i>Liquidambar styraciflua</i></u>	Canopy	FAC+
6.	<u><i>Ulmus rubra</i></u>	Sapling	FAC
7.	<u><i>Ilex decidua</i></u>	Shrub	FACW-
8.	<u><i>Carex</i> spp.</u>	Herb	FAC to OBL
9.	<u><i>Quercus lyrata</i></u>	Herb	OBL
10.	<u><i>Polygonum</i> sp.</u>	Herb	FAC to OBL
11.	<u><i>Boehmeria cylindrica</i></u>	Herb	FACW+

Percent of Dominant Species that are OBL, FACW, or FAC (except FAC-). Include species noted (*) as showing morphological adaptations to wetlands = **100%**

GAUGE 8

	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Quercus phellos</i></u>	Canopy	FACW-
2.	<u><i>Liquidambar styraciflua</i></u>	Canopy	FAC+
3.	<u><i>Ulmus americana</i></u>	Canopy	FACW
4.	<u><i>Acer rubrum</i></u>	Canopy	FAC
5.	<u><i>Carpinus caroliniana</i></u>	Sapling	FAC
6.	<u><i>Fraxinus pennsylvanica</i></u>	Shrub	FACW
7.	<u><i>Carya cordiformis</i></u>	Shrub	FAC
8.	<u><i>Carex</i> spp.</u>	Herb	FAC to OBL
9.	<u><i>Commelina virginica</i></u>	Herb	FACW
10.	<u><i>Boehmeria cylindrica</i></u>	Herb	FACW+

Percent of Dominant Species that are OBL, FACW, or FAC (except FAC-). Include species noted (*) as showing morphological adaptations to wetlands = **100%**

GAUGE 9

	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Hibiscus moscheutos</i></u>	Herb	OBL
2.	<u><i>Aster vimineus</i></u>	Herb	FAC
3.	<u><i>Boehmeria cylindrica</i></u>	Herb	FACW+
4.	<u><i>Carex</i> spp.</u>	Herb	FAC to OBL
5.	<u><i>Polygonum punctatum</i></u>	Herb	FACW+
6.	<u><i>Juncus effusus</i></u>	Herb	FACW+
7.	<u><i>Scirpus cyperinus</i></u>	Herb	OBL
8.	<u><i>Rhynchospora corniculata</i></u>	Herb	OBL
9.	<u><i>Salix nigra</i></u>	Herb	OBL
10.	<u><i>Acer rubrum</i></u>	Herb	FAC

Percent of Dominant Species that are OBL, FACW, or FAC (except FAC-). Include species noted (*) as showing morphological adaptations to wetlands = **100%**

GAUGE 10

	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Carpinus caroliniana</i></u>	Canopy	FAC
2.	<u><i>Fraxinus pennsylvanica</i></u>	Canopy	FACW
3.	<u><i>Liquidambar styraciflua</i></u>	Canopy	FAC+
4.	<u><i>Acer rubrum</i></u>	Canopy	FAC
5.	<u><i>Carex</i> spp.</u>	Herb	FAC to OBL
6.	<u><i>Saururus cernuus</i></u>	Herb	OBL
7.	<u><i>Leersia lenticularis</i></u>	Herb	OBL

Percent of Dominant Species that are OBL, FACW, or FAC (except FAC-). Include species noted (*) as showing morphological adaptations to wetlands = **100%**

GAUGE 11

	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Ulmus</i> sp.</u>	Canopy	FAC to FACW
2.	<u><i>Nyssa biflora</i></u>	Canopy	OBL
3.	<u><i>Acer rubrum</i></u>	Canopy	FAC
4.	<u><i>Carpinus caroliniana</i></u>	Sapling	FAC
5.	<u><i>Ilex decidua</i></u>	Sapling	FACW-
6.	<u><i>Quercus lyrata</i></u>	Shrub	OBL
7.	<u><i>Liquidambar styraciflua</i></u>	Shrub	FAC+
8.	<u><i>Smilax rotundifolia</i></u>	Shrub	FAC
9.	<u><i>Carex</i> spp.</u>	Herb	FAC to OBL
10.	<u><i>Commelina virginica</i></u>	Herb	FACW
11.	<u><i>Boehmeria cylindrica</i></u>	Herb	FACW+
12.	<u><i>Leersia lenticularis</i></u>	Herb	OBL

Percent of Dominant Species that are OBL, FACW, or FAC (except FAC-). Include species noted (*) as showing morphological adaptations to wetlands = **100%**

GAUGE 12

	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Hibiscus moscheutos</i></u>	Herb	OBL
2.	<u><i>Aster vimineus</i></u>	Herb	FAC
3.	<u><i>Setaria geniculata</i></u>	Herb	FAC
4.	<u><i>Cuphea carthagenesis</i></u>	Herb	FACW
5.	<u><i>Polygonum cespitosum</i></u>	Herb	FACW-
6.	<u><i>Acalypha rhomboidea</i></u>	Herb	FAC-
7.	<u><i>Echinochloa crusgalli</i></u>	Herb	FACW-
8.	<u><i>Panicum agrostoides</i></u>	Herb	FACW

Percent of Dominant Species that are OBL, FACW, or FAC (except FAC-). Include species noted (*) as showing morphological adaptations to wetlands = **88%**

REFERENCE GAUGE 1

	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Quercus lyrata</i></u>	Canopy	OBL
2.	<u><i>Nyssa biflora</i></u>	Canopy	OBL
3.	<u><i>Ulmus americana</i></u>	Canopy	FACW
4.	<u><i>Acer rubrum</i></u>	Canopy	FAC
5.	<u><i>Liquidambar styraciflua</i></u>	Sapling	FAC+
6.	<u><i>Ilex decidua</i></u>	Shrub	FACW-
7.	<u><i>Commelina virginica</i></u>	Herb	FACW
8.	<u><i>Carex</i> spp.</u>	Herb	FAC to OBL
9.	<u><i>Leersia lenticularis</i></u>	Herb	OBL
10.	<u><i>Boehmeria cylindrica</i></u>	Herb	FACW+
11.	<u><i>Saururus cernuus</i></u>	Herb	OBL

Percent of Dominant Species that are OBL, FACW, or FAC
(except FAC-). Include species noted (*) as showing
morphological adaptations to wetlands = **100%**

REFERENCE GAUGE 2

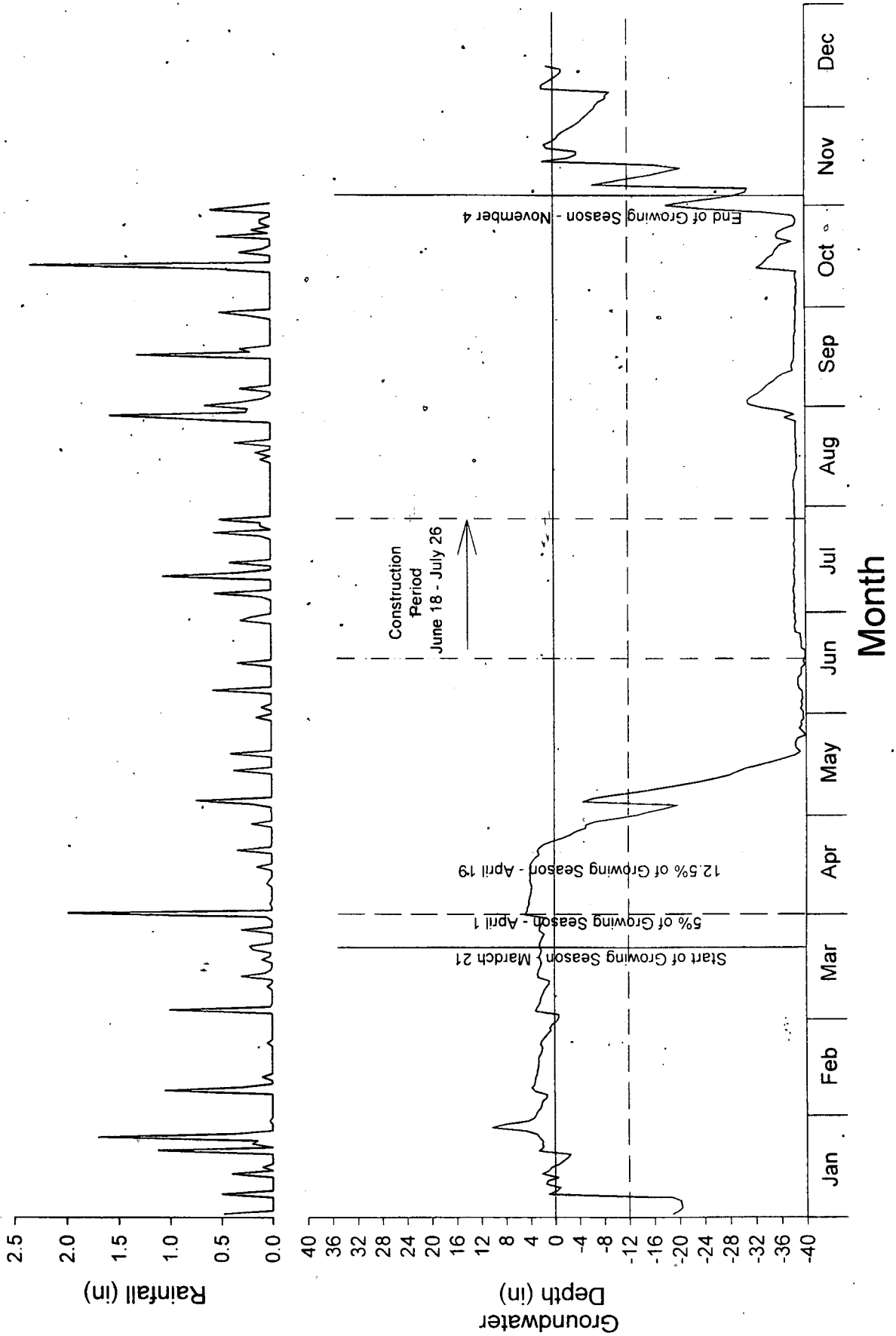
	<u>Dominant Plant Species</u>	<u>Stratum</u>	<u>Indicator</u>
1.	<u><i>Quercus lyrata</i></u>	Canopy	OBL
2.	<u><i>Quercus phellos</i></u>	Canopy	FACW-
3.	<u><i>Acer rubrum</i></u>	Canopy	FAC
4.	<u><i>Liquidambar styraciflua</i></u>	Canopy	FAC+
5.	<u><i>Carpinus caroliniana</i></u>	Sapling	FAC
6.	<u><i>Ulmus rubra</i></u>	Sapling	FAC
7.	<u><i>Ilex decidua</i></u>	Shrub	FACW-
8.	<u><i>Crataegus</i> sp.</u>	Shrub	FAC to OBL
9.	<u><i>Carex</i> spp.</u>	Herb	FACW+
10.	<u><i>Fraxinus pennsylvanica</i></u>	Herb	FACW
11.	<u><i>Commelina virginica</i></u>	Herb	FACW
12.	<u><i>Saururus cernuus</i></u>	Herb	OBL

Percent of Dominant Species that are OBL, FACW, or FAC
(except FAC-). Include species noted (*) as showing
morphological adaptations to wetlands = **100%**

APPENDIX F
YEAR 1 (2002) GROUNDWATER GAUGE GRAPHS

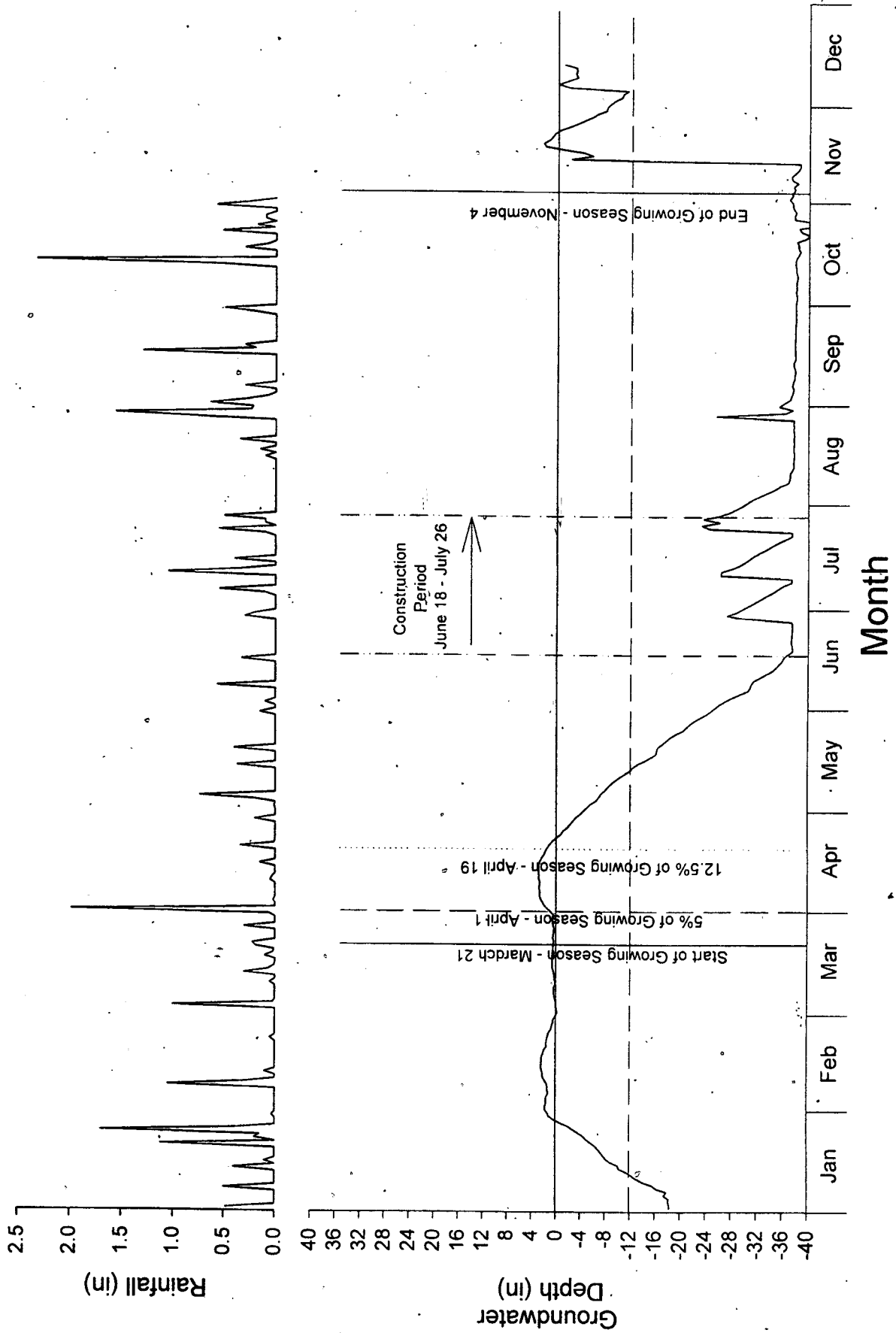
Howell Woods Wells 2002

Infinity - Reference Well 1 N3B6A9F1



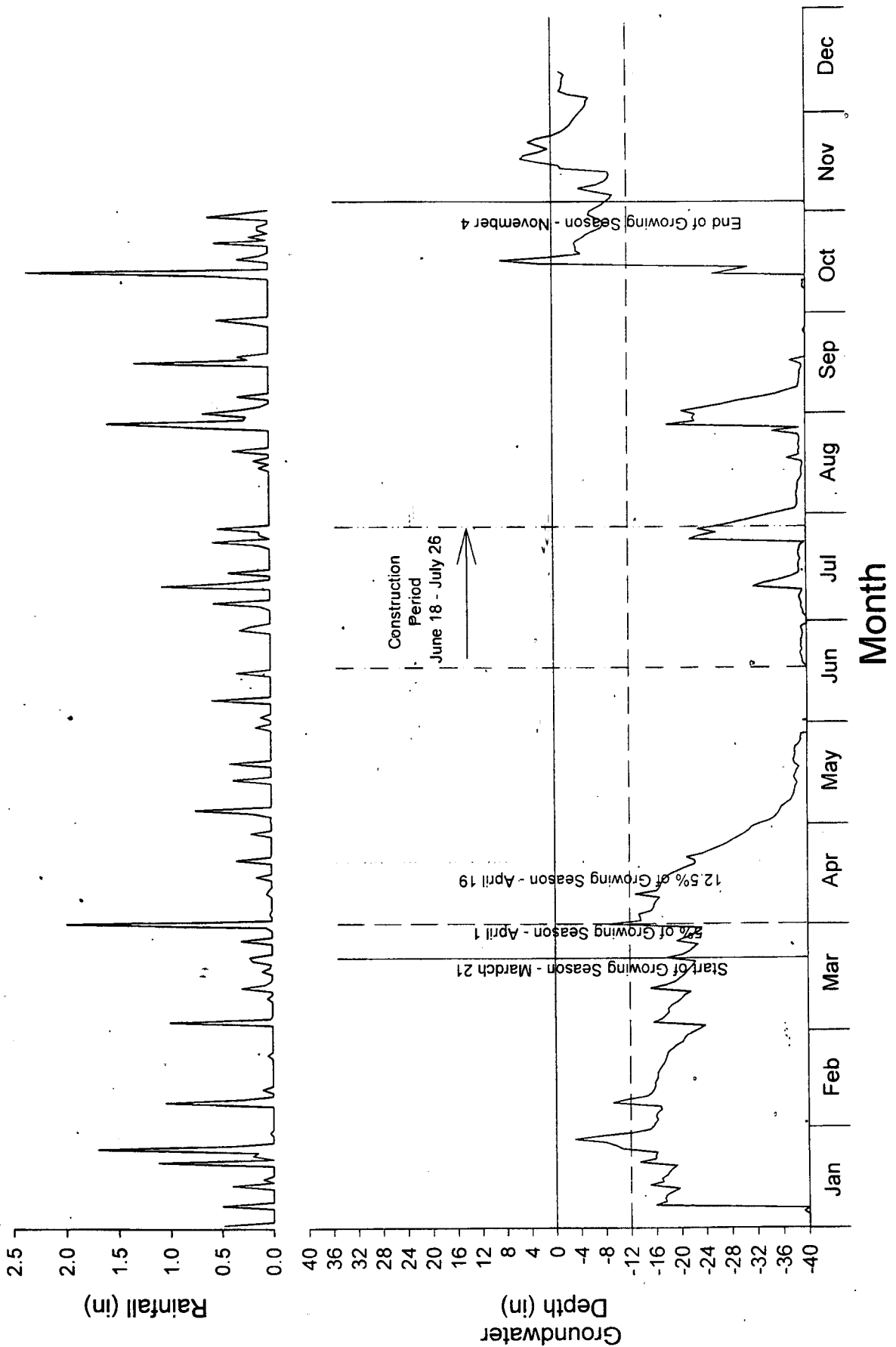
Howell Woods Wells 2002

Infinity - Reference Well 2 N3B6AA64



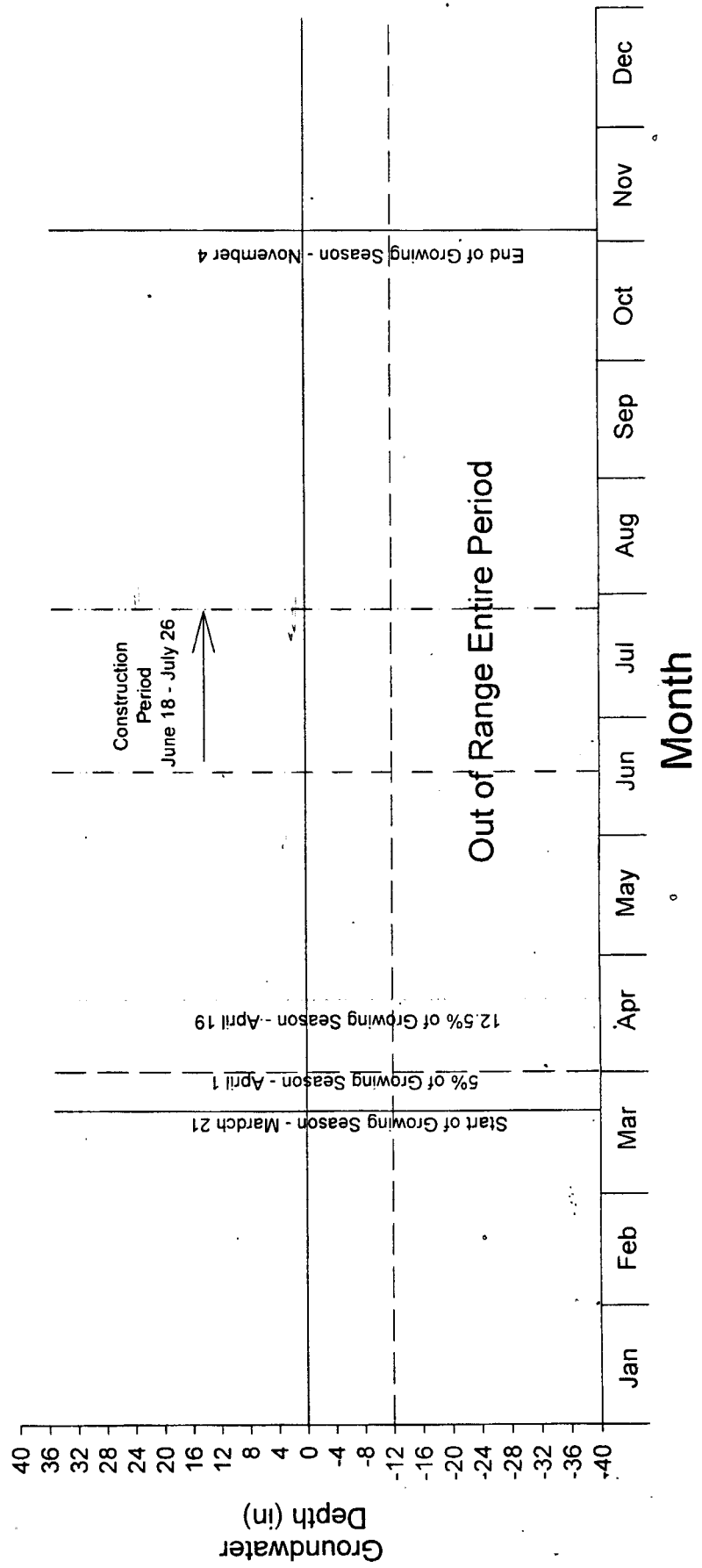
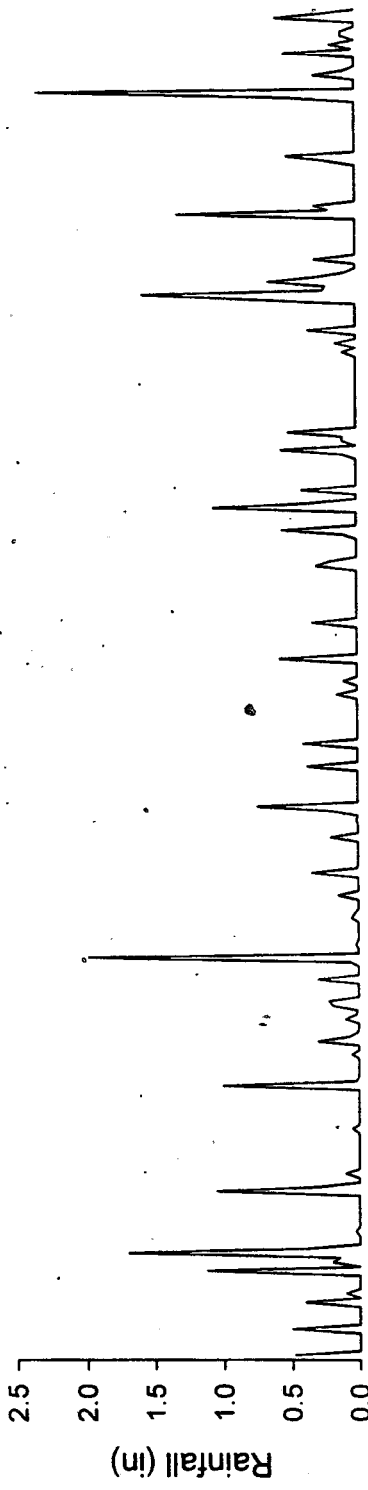
Howell Woods Wells 2002

Infinity - Well 1 N38F3506



Howell Woods Wells 2002

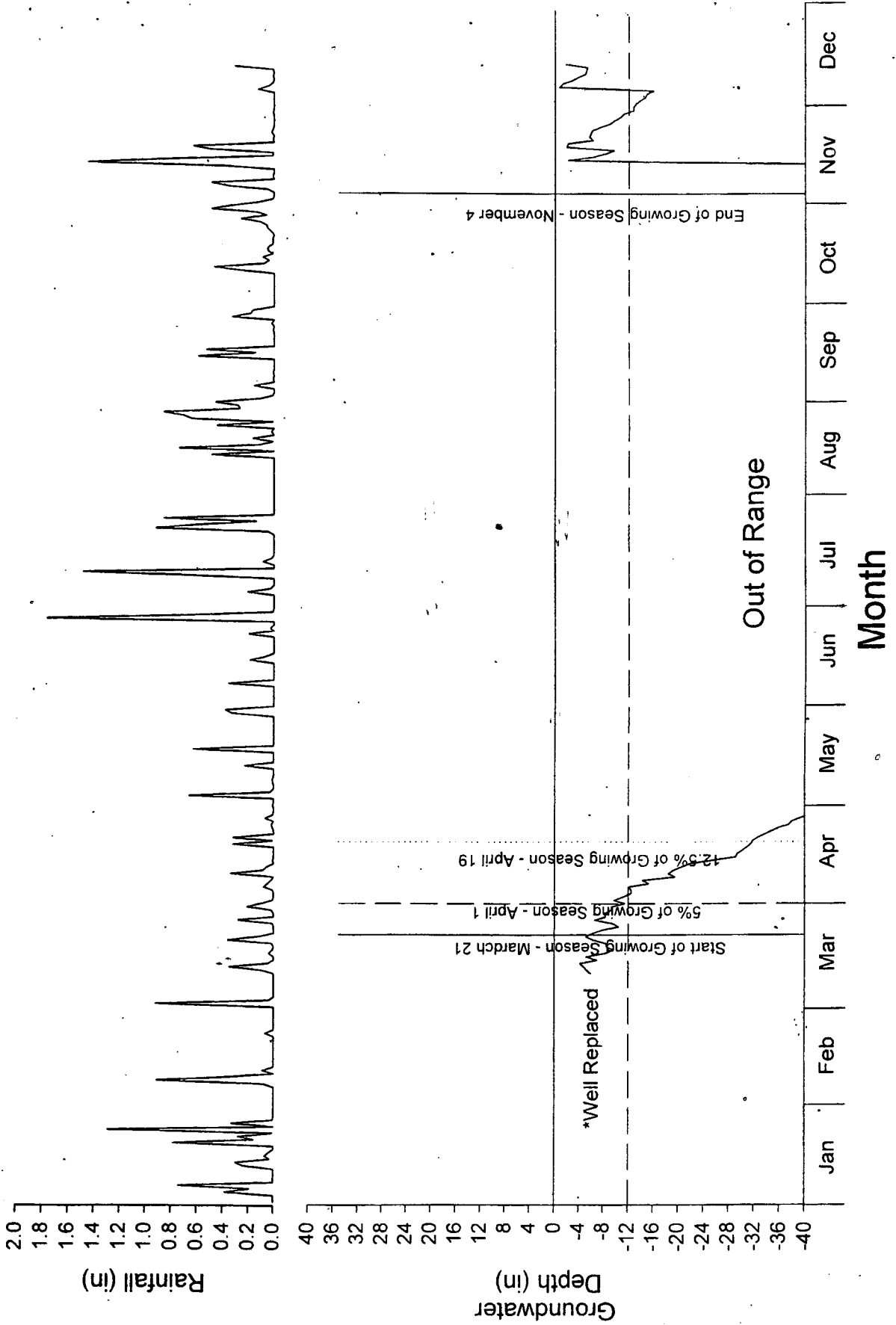
Infinity - Well 2 N38E2621



Month

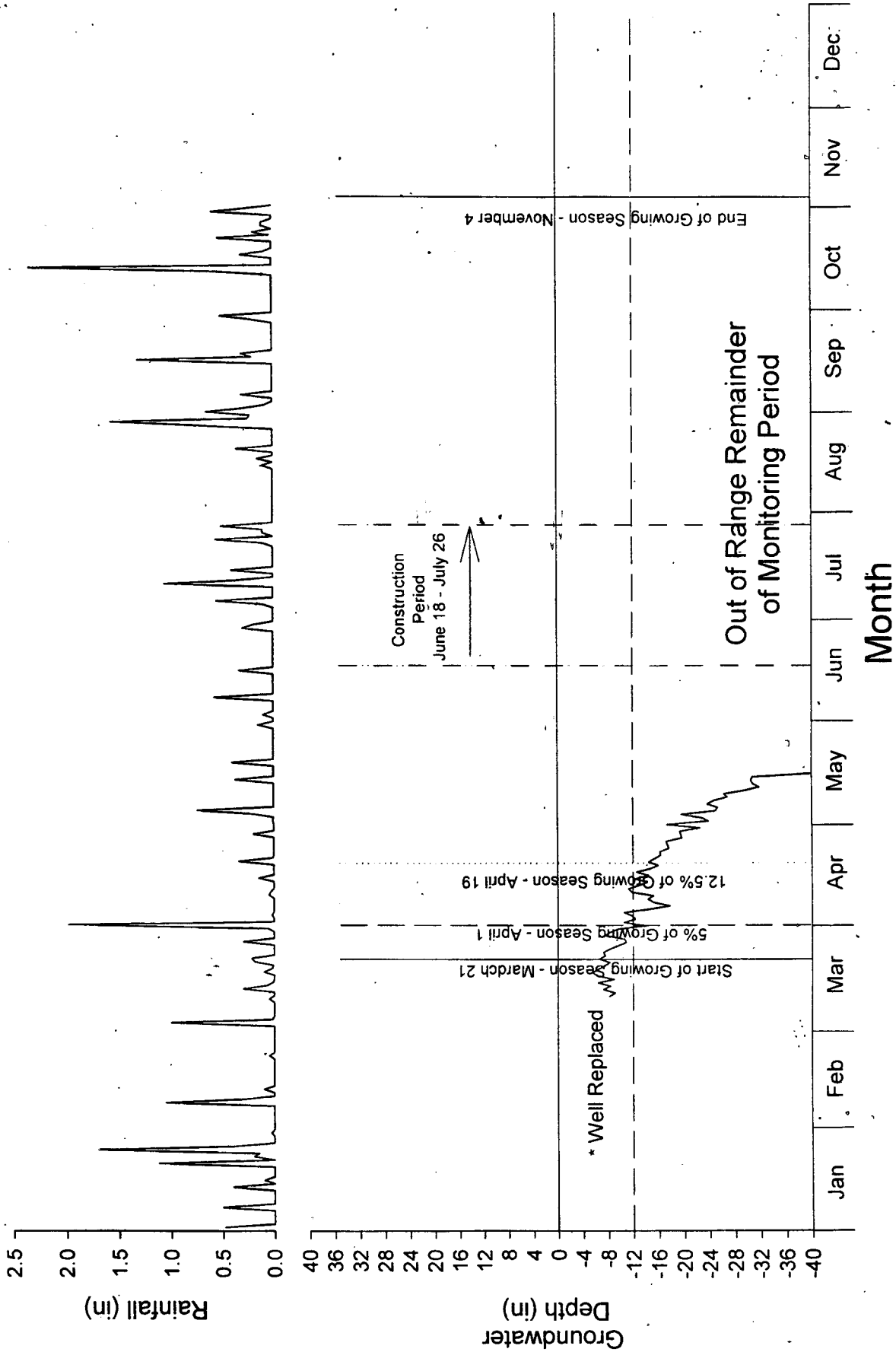
Howell Woods Wells 2002

Infinity - Well 3 N3830091



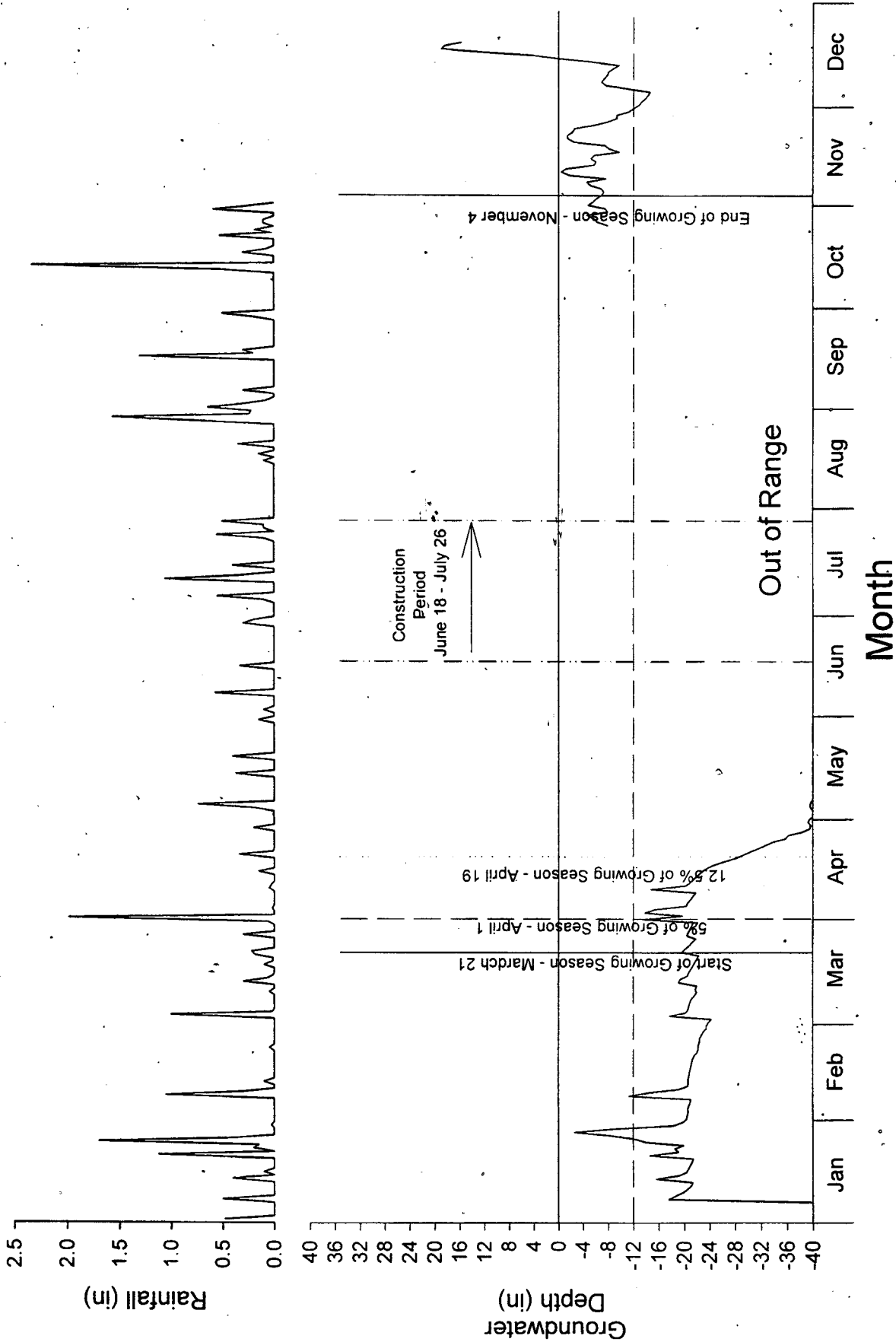
Howell Woods Wells 2002

Infinity - Well 4 N384E842



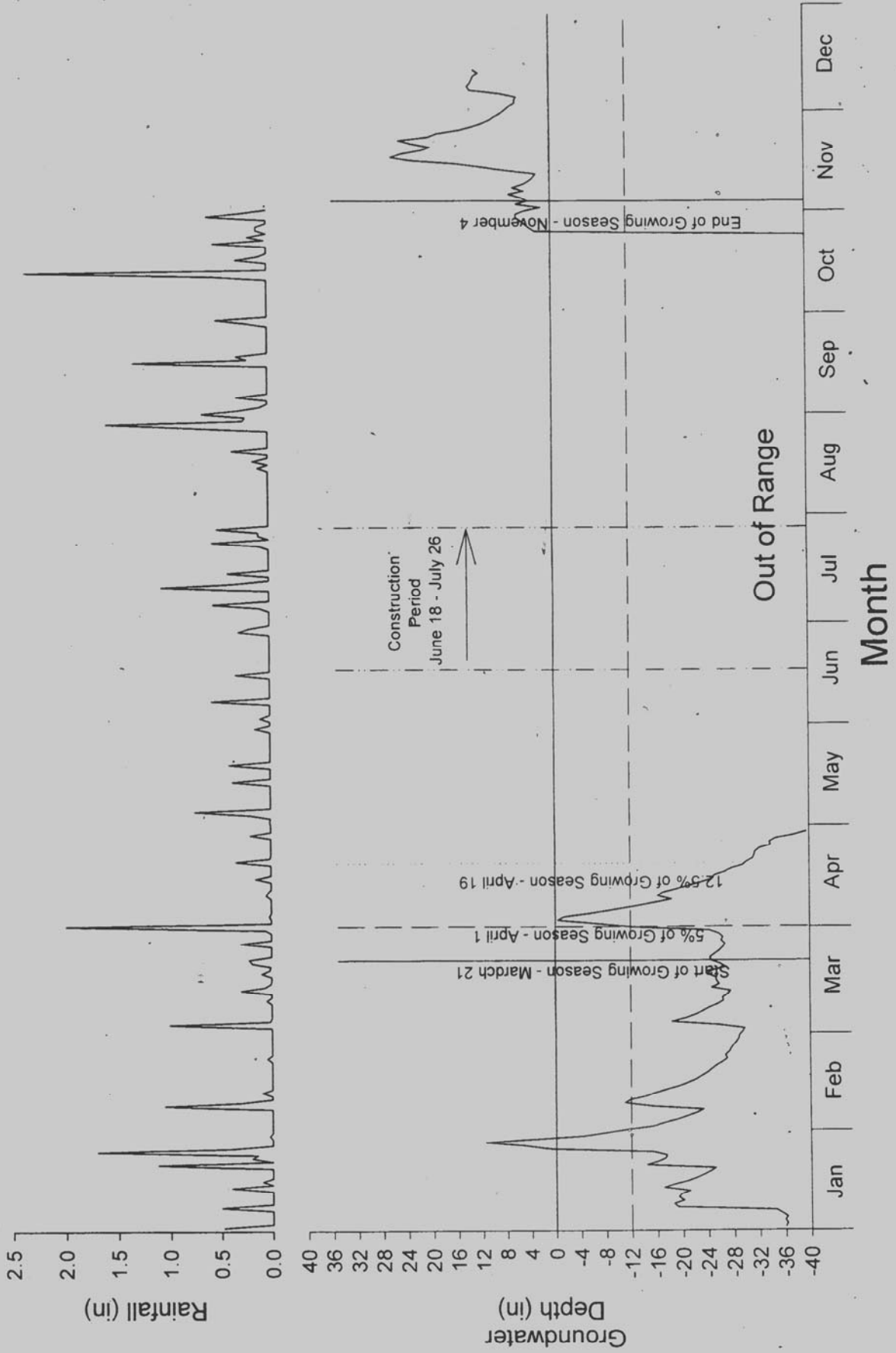
Howell Woods Wells 2002

Infinity - Well 5 N31E5851



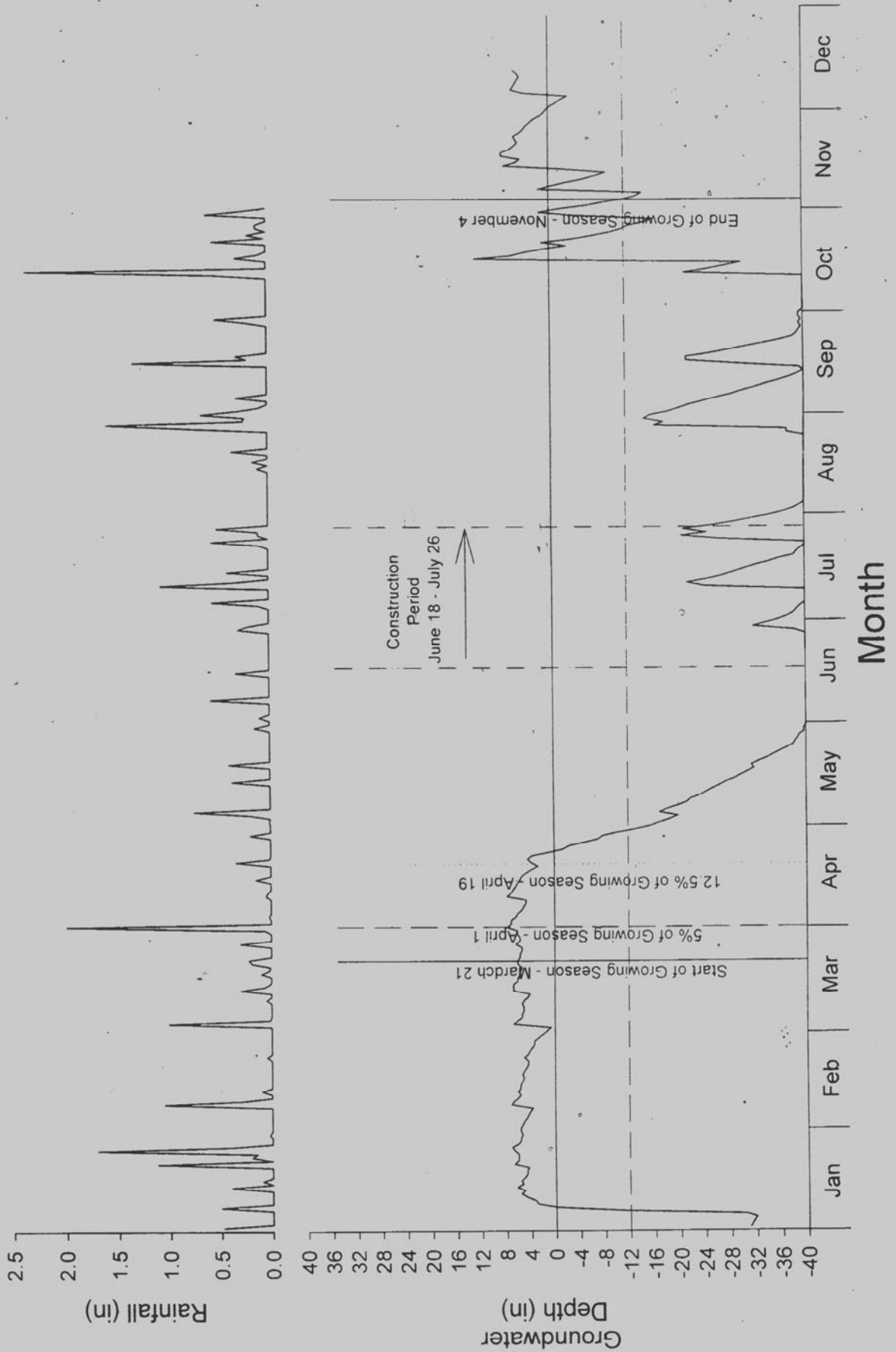
Howell Woods Wells 2002

Infinity - Well 6 N38E4C8E



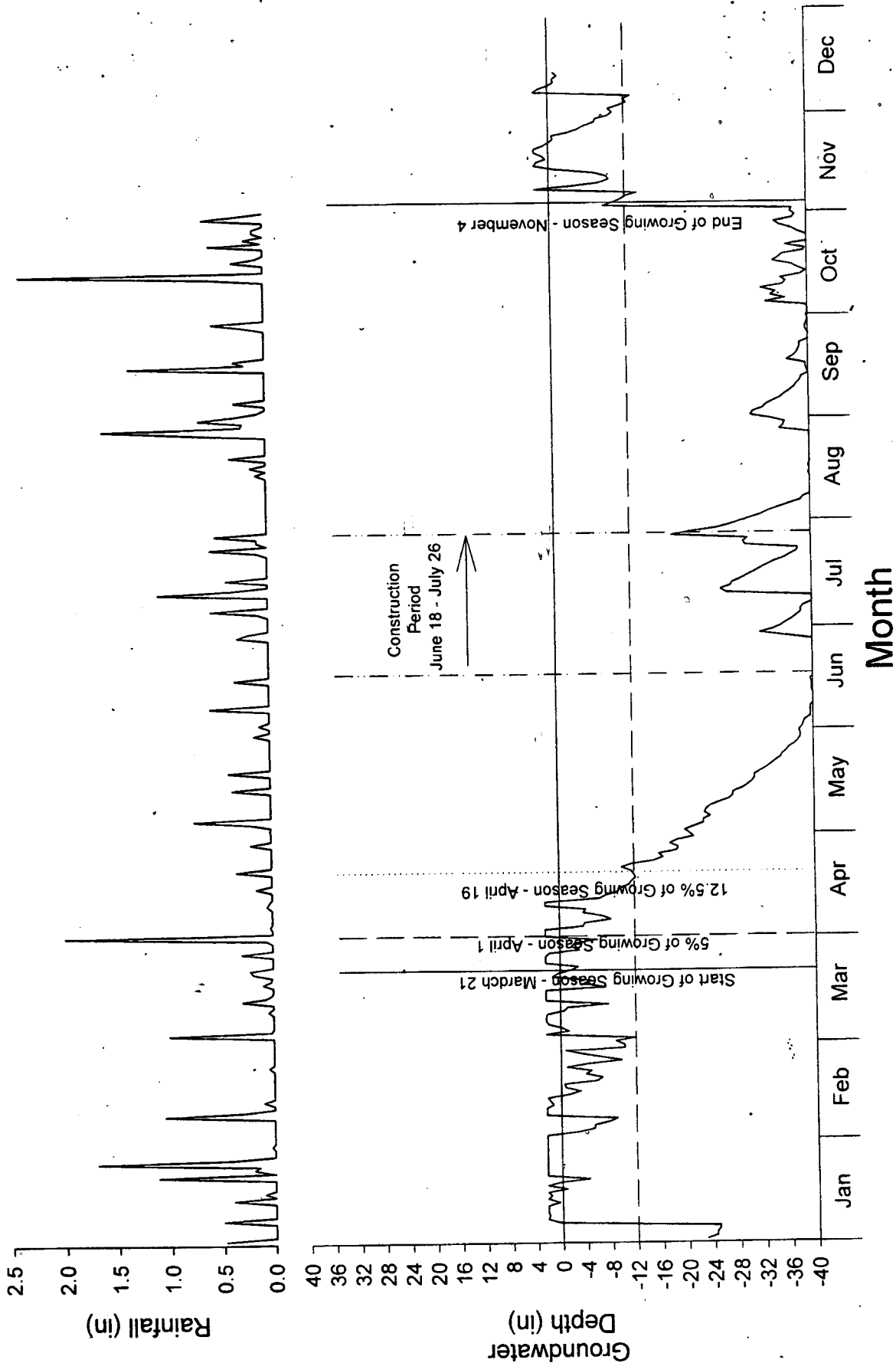
Howell Woods Wells 2002

RDS - Well A S2C9894



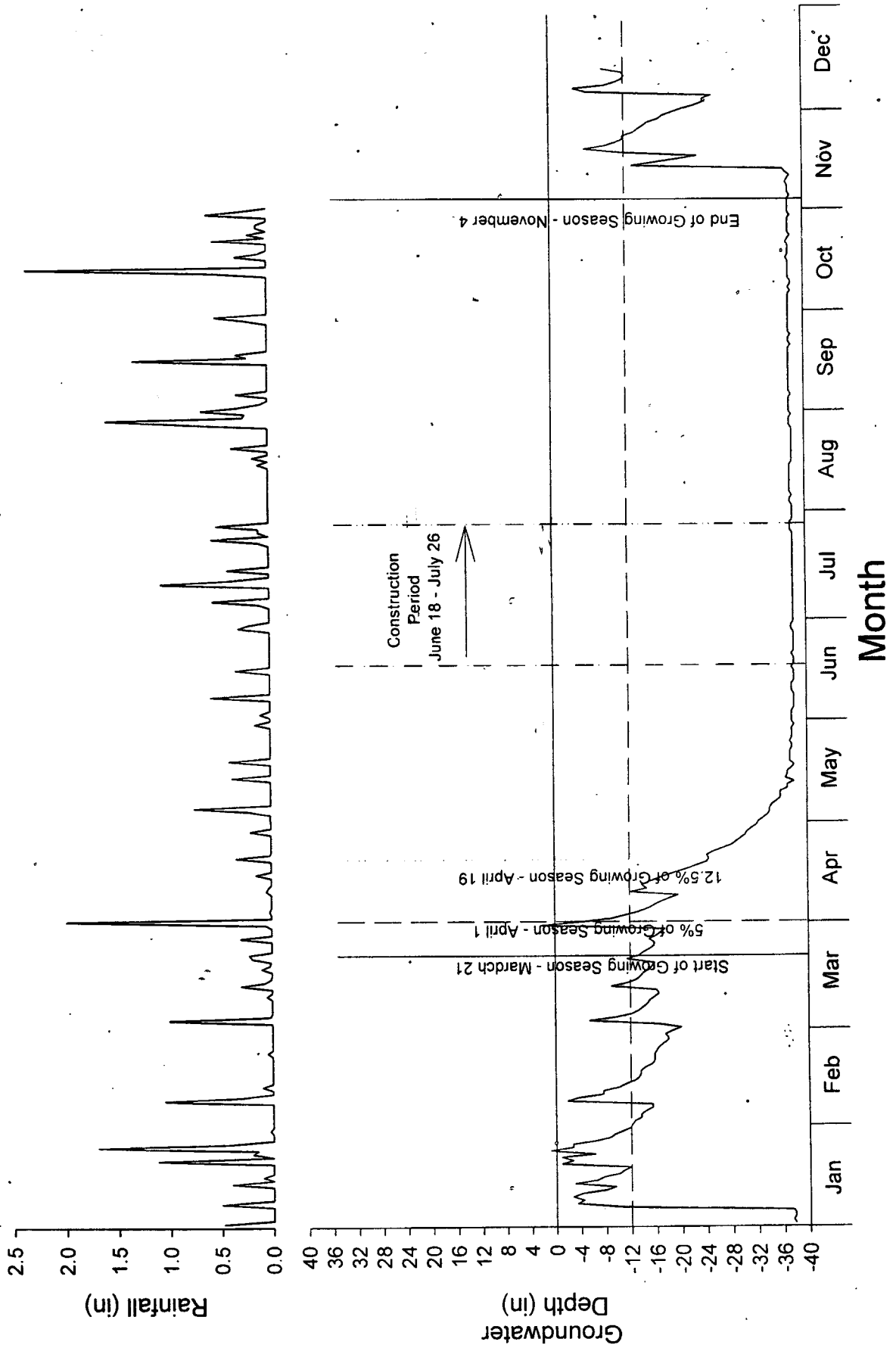
Howell Woods Wells 2002

RDS - Well B S2EAD22



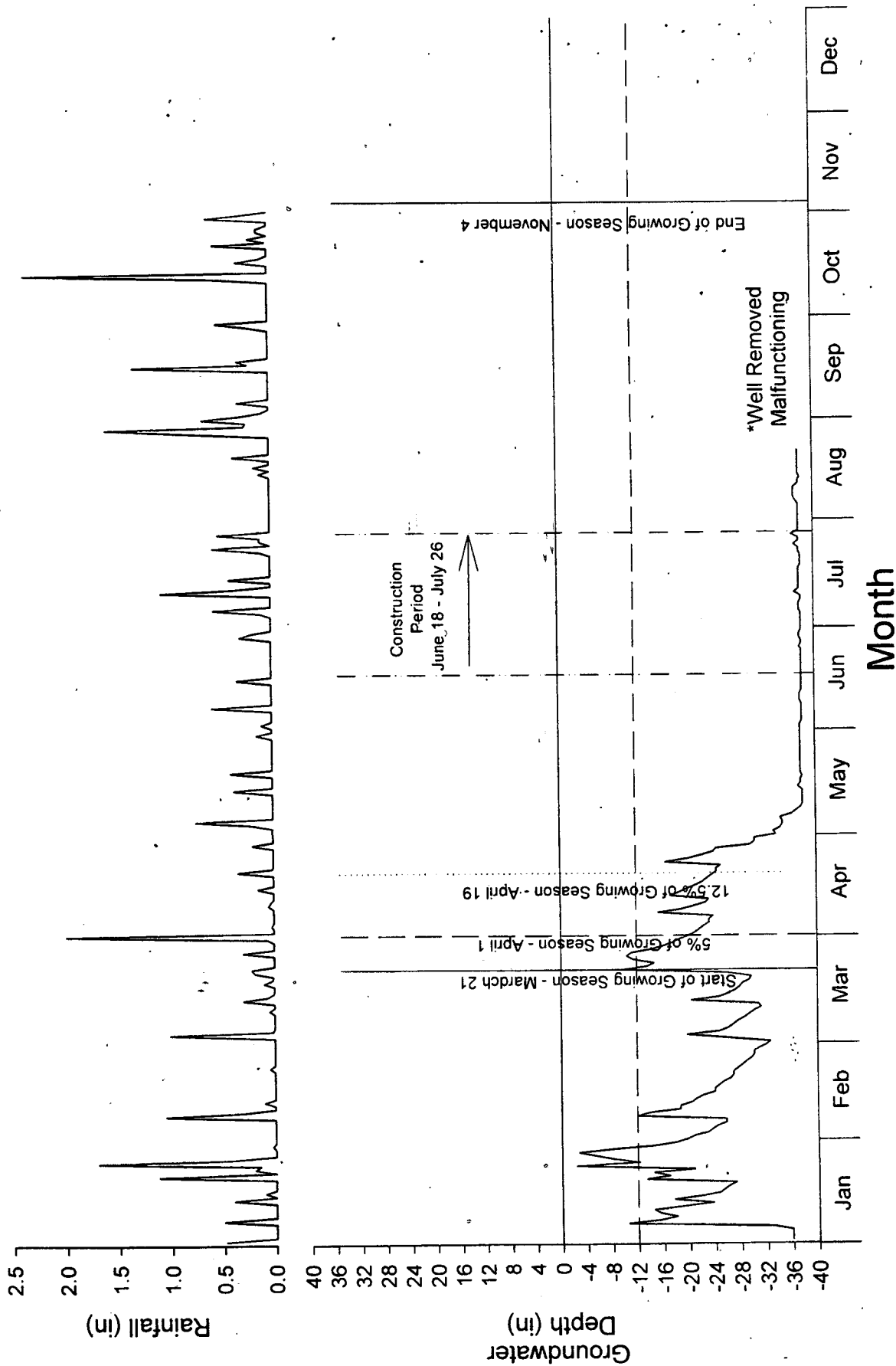
Howell Woods Wells 2002

RDS - Well C S32EAD39



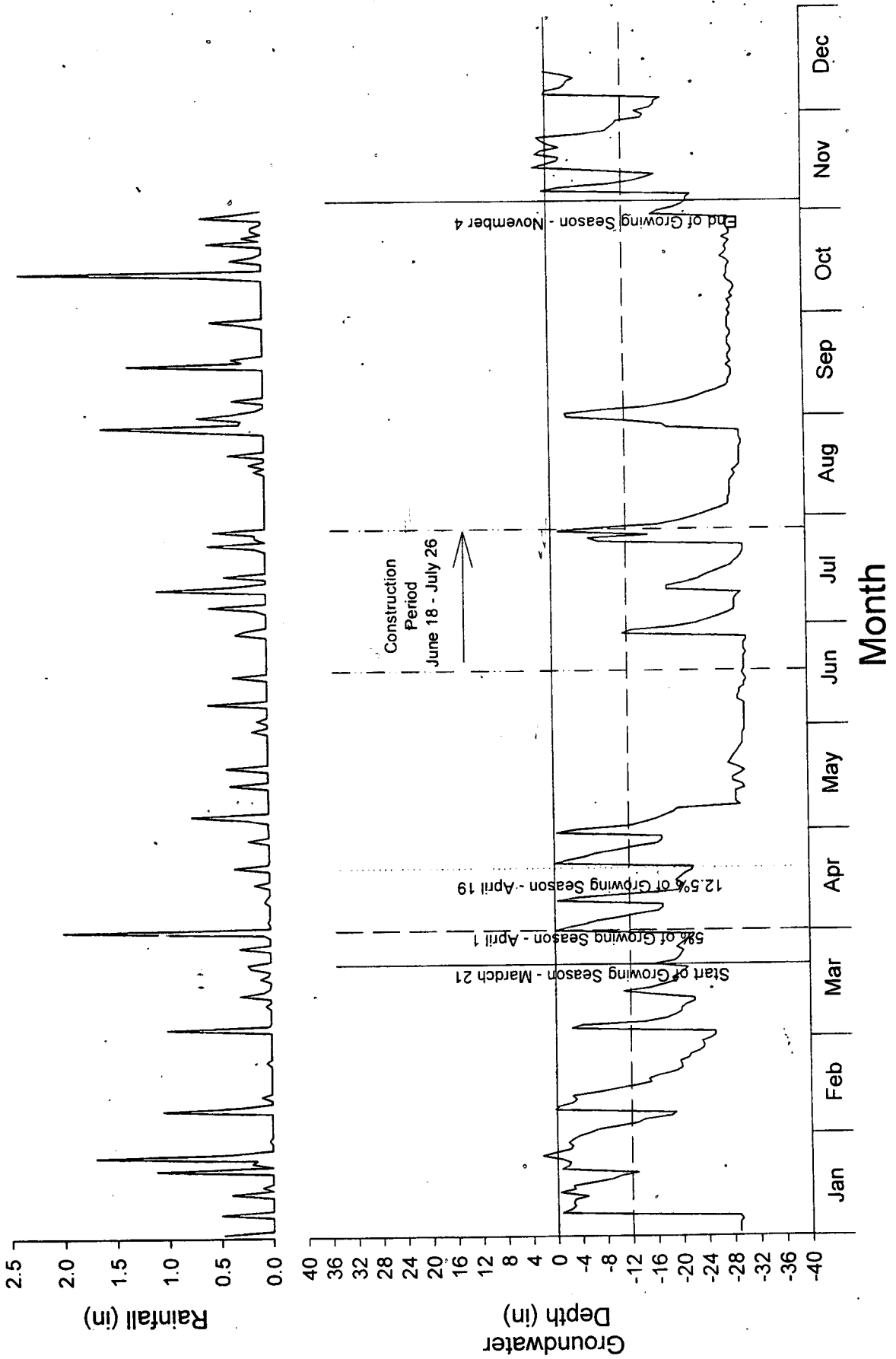
Howell Woods Wells 2002

RDS - Well D S32883A



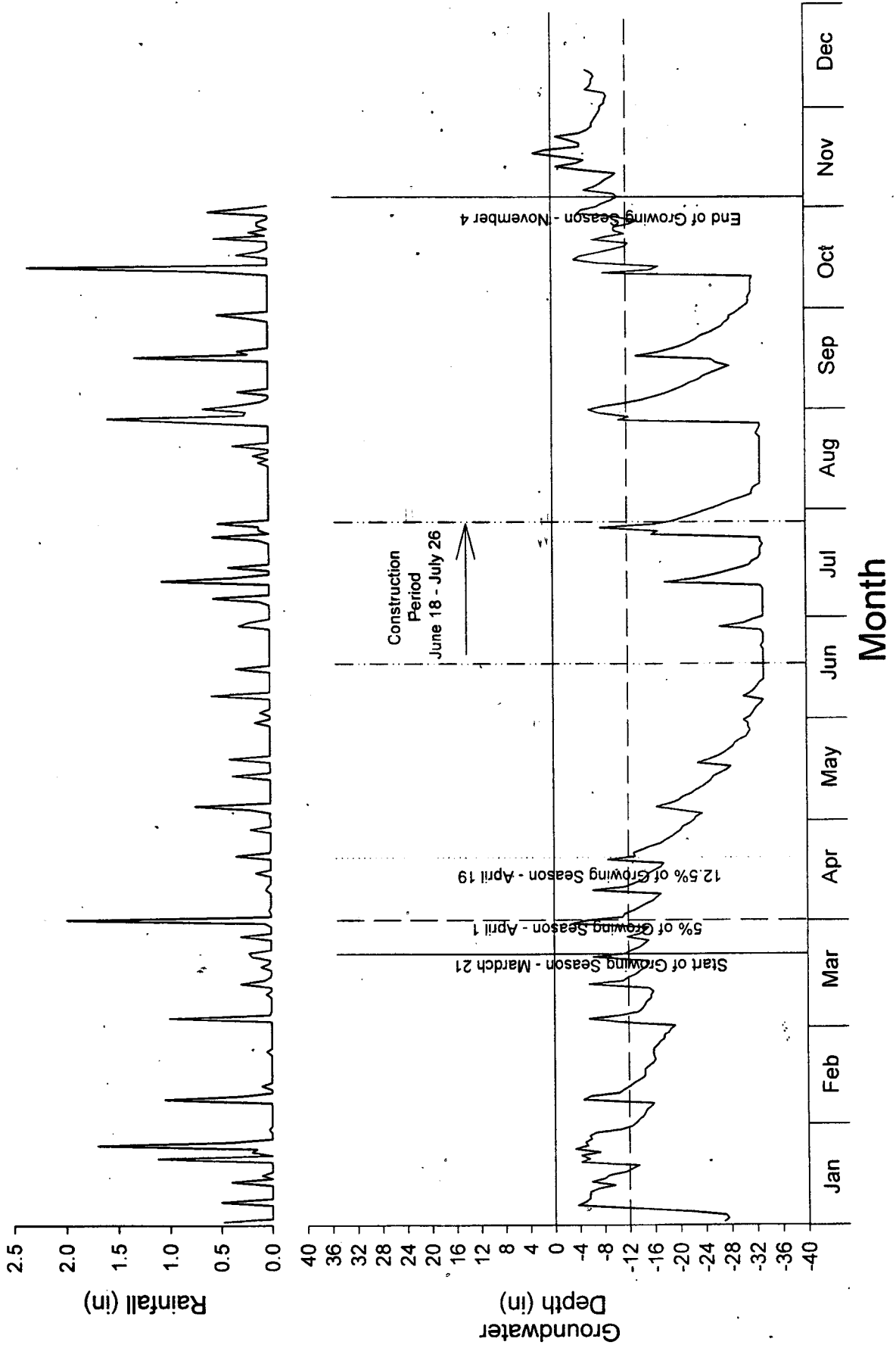
Howell Woods Wells 2002

RDS - Well E S2EAC06



Howell Woods Wells 2002

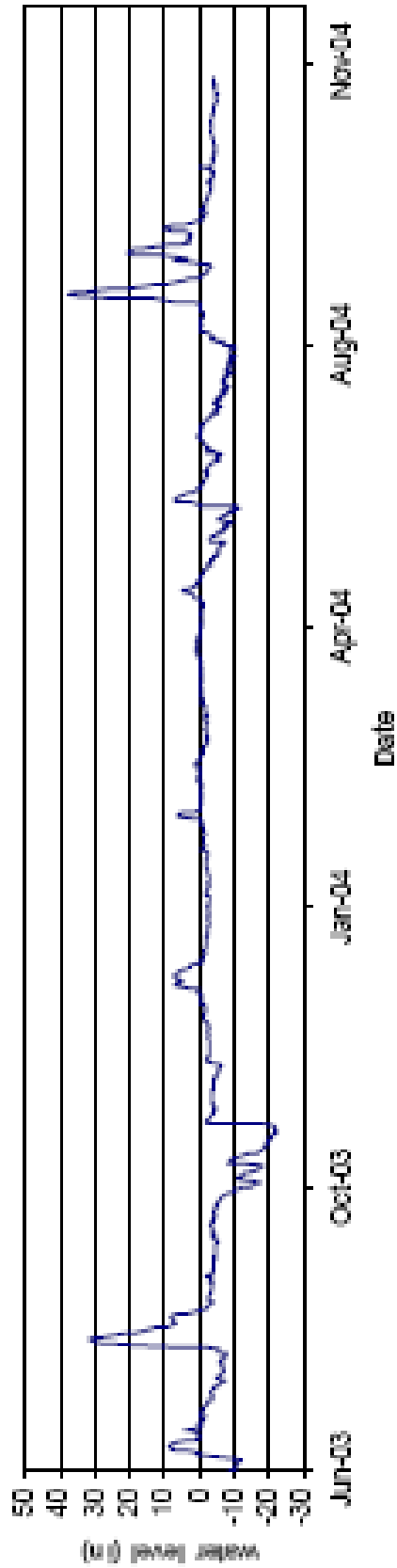
RDS - Well F S2C981D



Appendix G
(Click here)

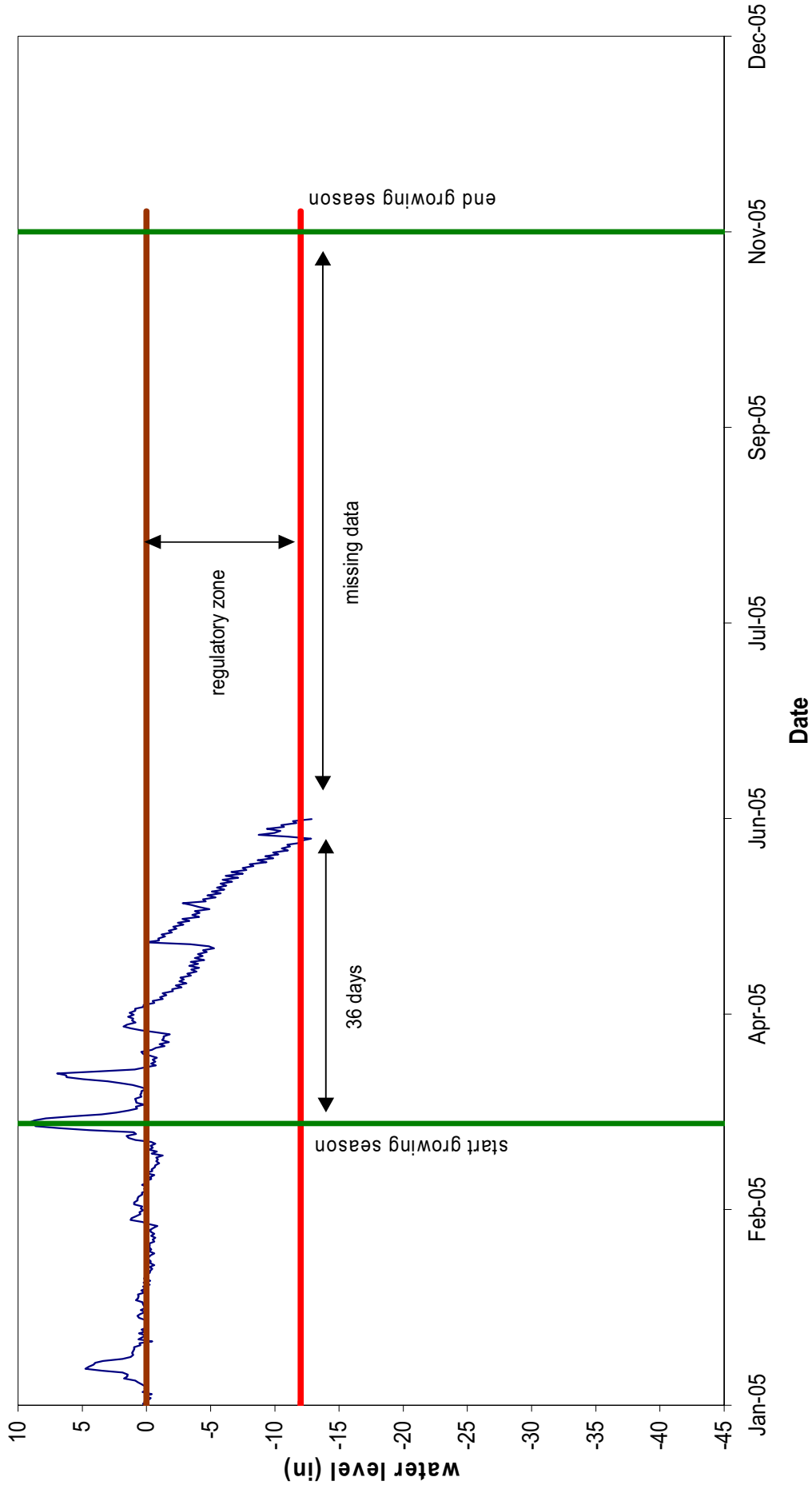
APPENDIX G
YEAR 3 (2004) GROUNDWATER GAUGE DATA

Water Table Depth Data
Howell Woods Site - 2004

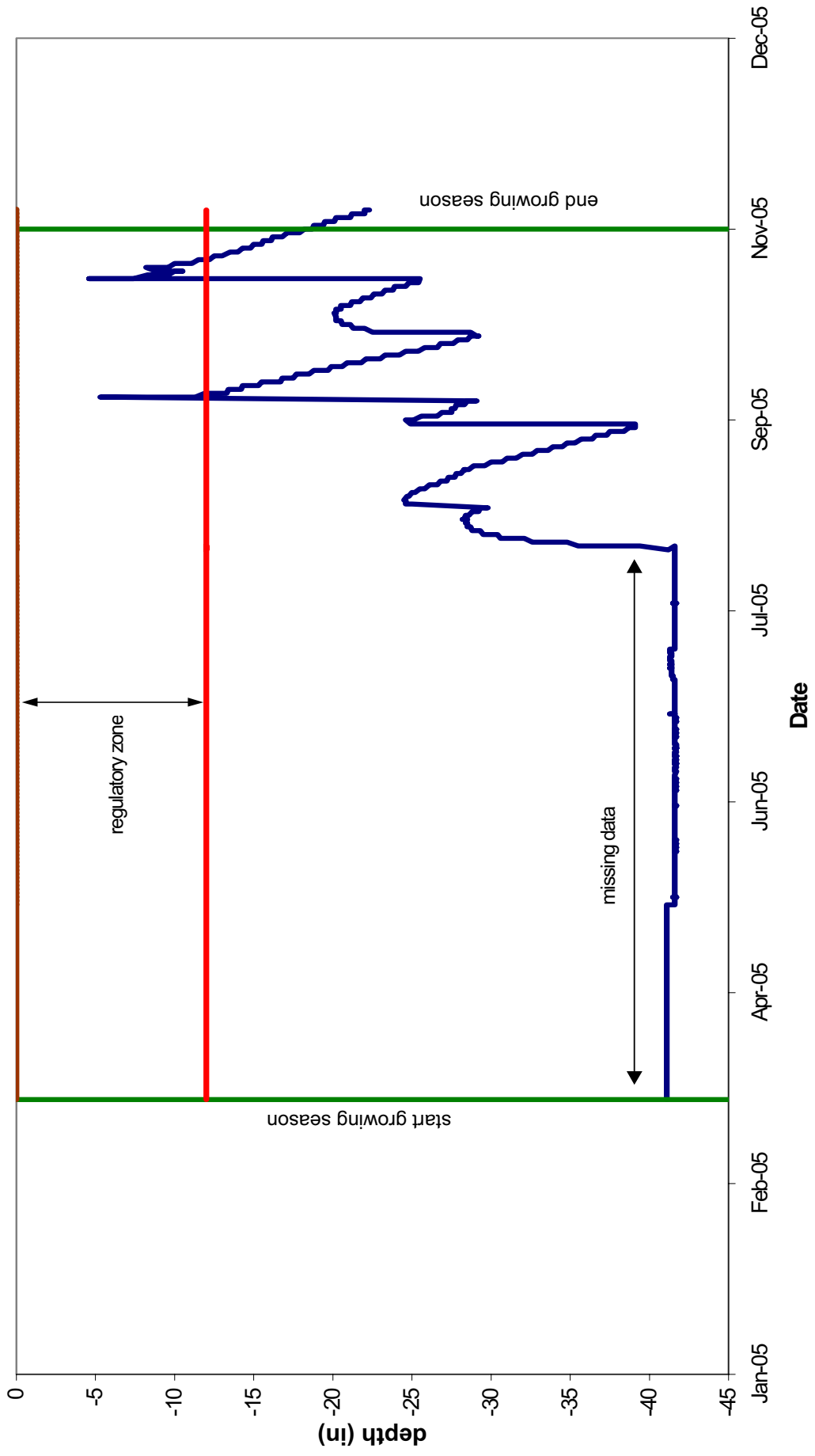


APPENDIX H
YEAR 4 (2005) GROUNDWATER GAUGE GRAPH

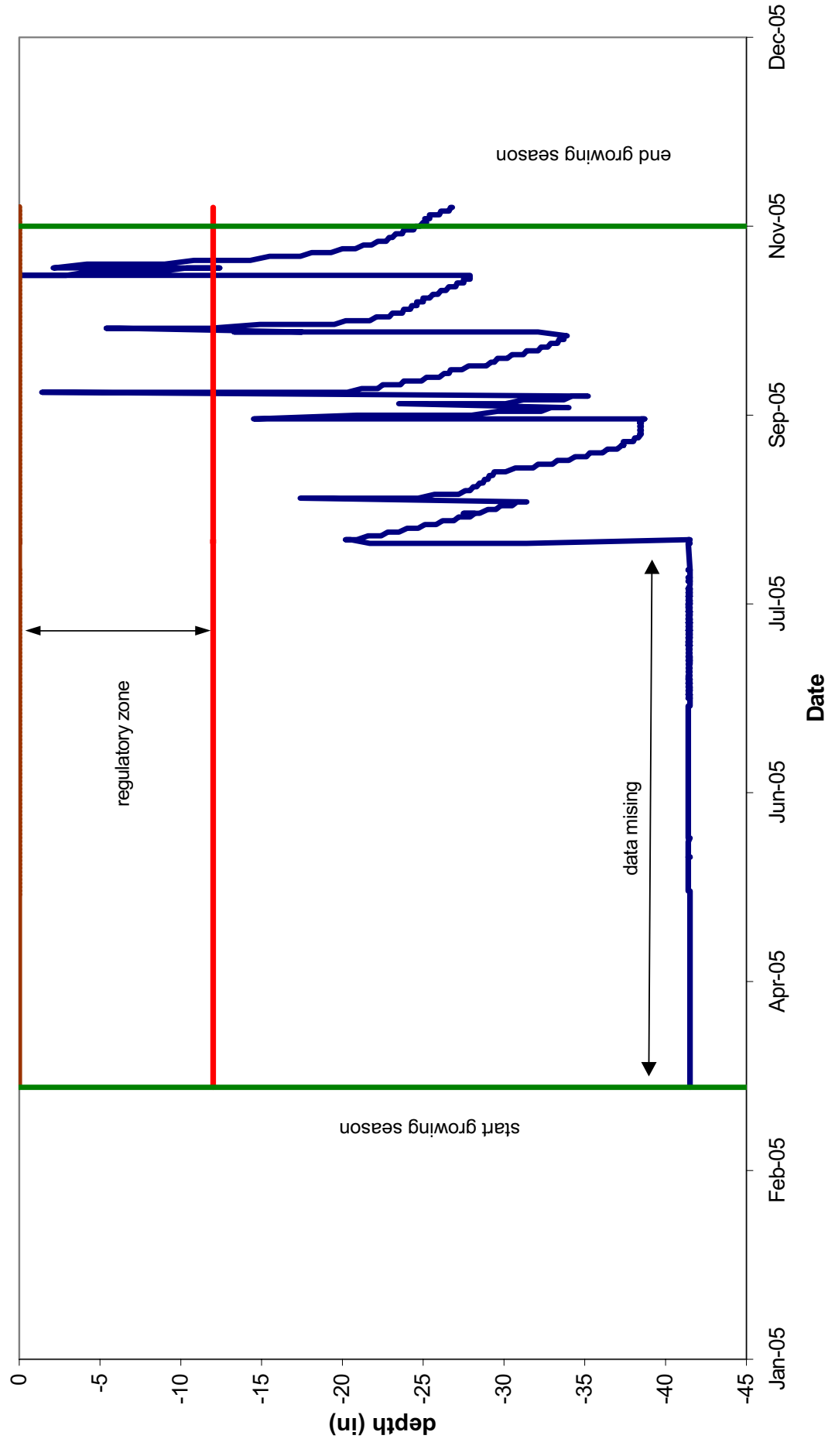
Water Table Depth Data - JG6
Howell Woods Site - 2005



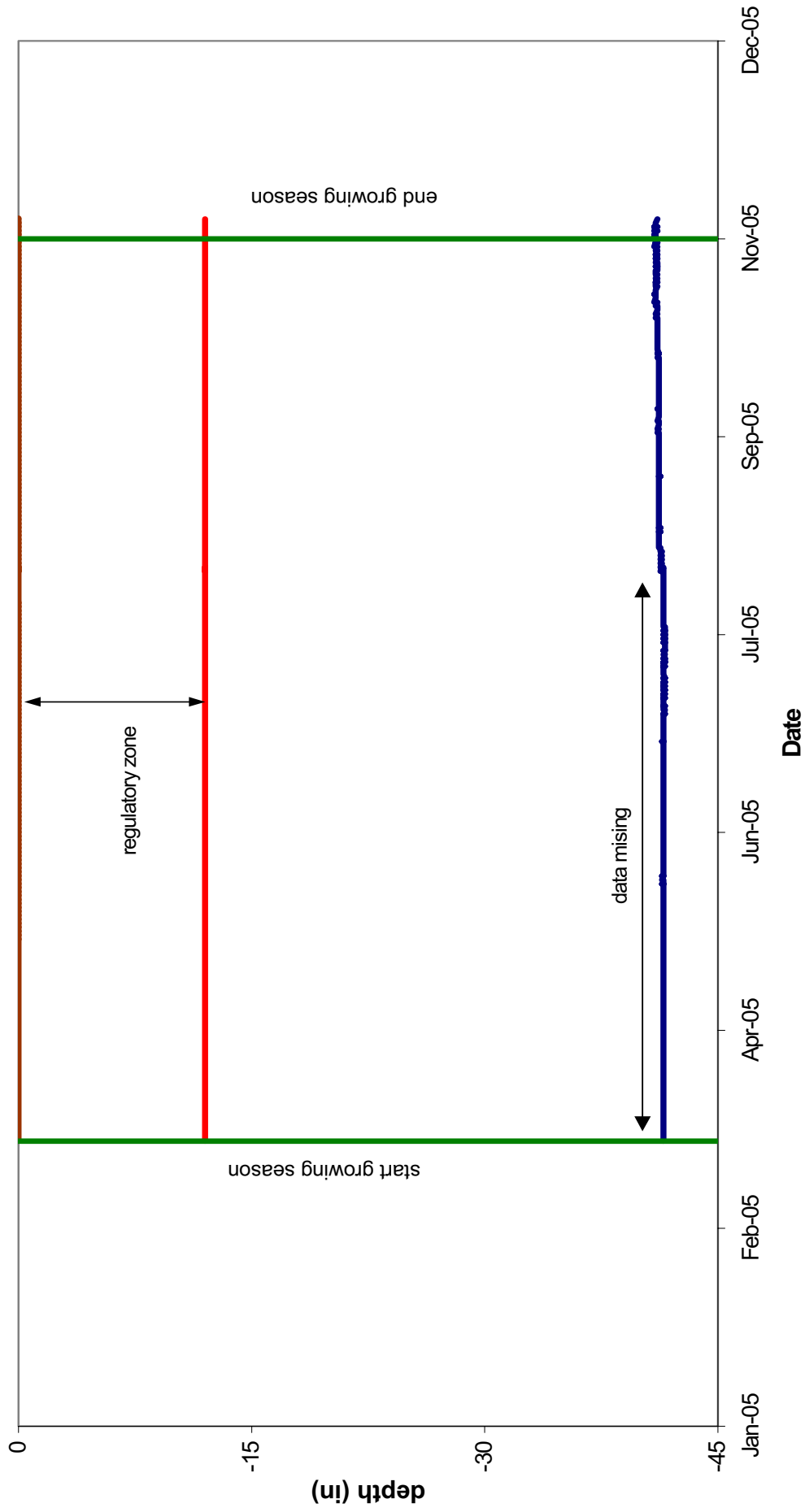
Water Table Depth Data - Howell 1
Howell Woods - 2005



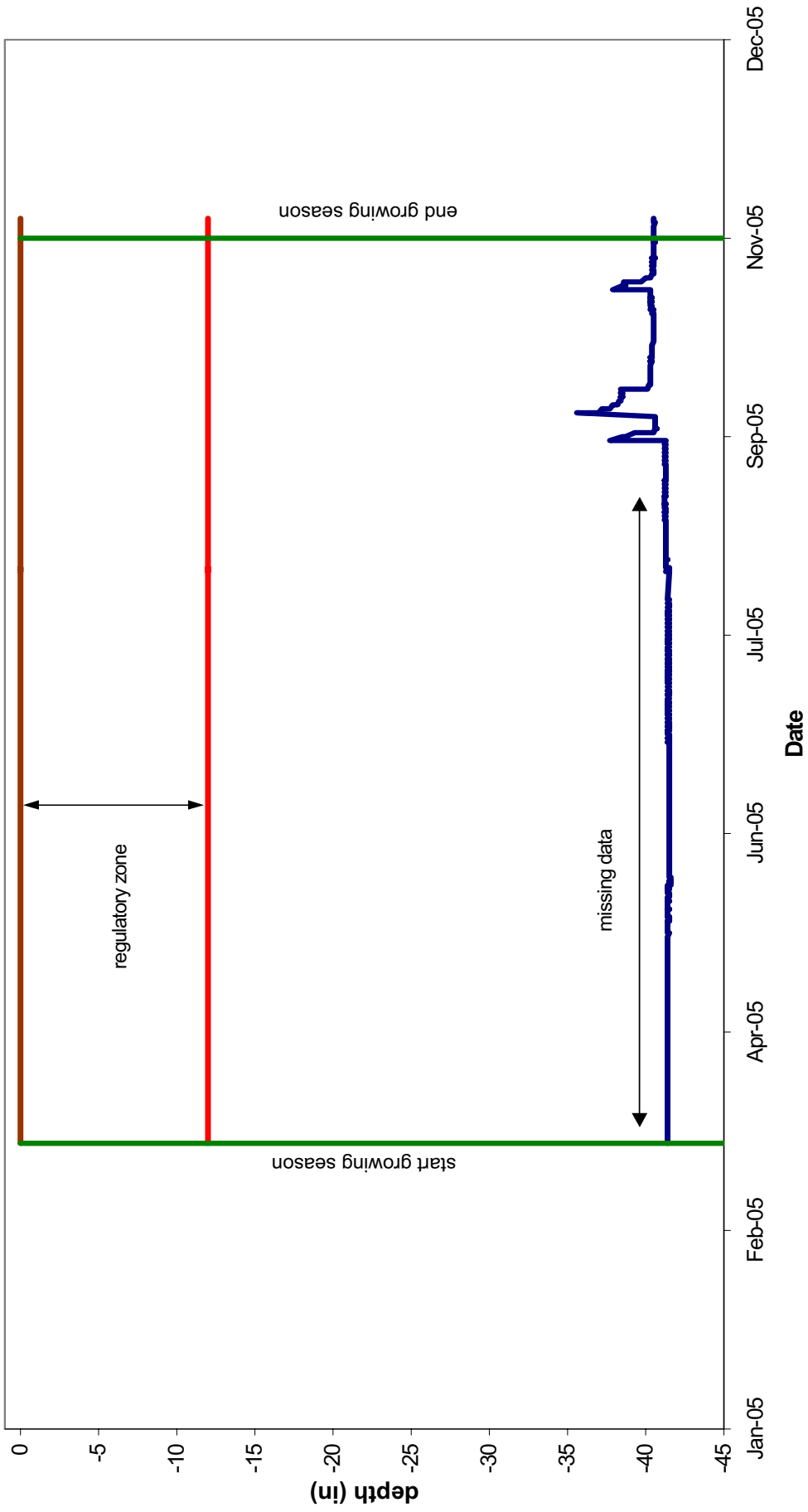
Water Table Depth Data - Howell 2
Howell Woods - 2005



Water Table Depth Data - Howell 3
Howell Woods - 2005



Water Table Depth Data - Howell 4
Howell Woods - 2005



Water Table Depth Data - Howell 5
Howell Woods - 2005

