

**Moore Property  
Monitoring Report  
FINAL  
Year 5 (2015)**

**Johnston County, North Carolina**

**USGS HUC: 03020201**

**NCDMS Project ID #725**

NCDMS Project Manager: Lindsay Crocker



Submitted to:

**NCDEQ - Division of Mitigation Services**

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Submitted February 2016

## **Executive Summary**

### **General**

The project site is located in the USGS Hydrologic Unit Code 03020201. In 2003, the restoration of the site was initiated by the North Carolina Department of Transportation (NCDOT), and the property owner (Michael Todd Moore) conveyed an 84.2-acre conservation easement in perpetuity to NCDOT in March 2003. NCDOT conducted a Mitigation Feasibility in May 2003, followed by a Mitigation Plan in January 2005.

Upon completion of the Mitigation Plan, the project was transitioned to the North Carolina Division of Mitigation Services (NCDMS). Construction Plans were prepared by Kimley-Horn in March 2009, and Environmental Quality Resources, LLC (EQR) completed construction of the project in July 2011.

The primary goals for the Site were to restore wetland hydrology and an appropriate water table hydroperiod of the floodplain wetland (i.e. elevated water table levels and longer duration of saturation of the upper soil surface during the growing season) through the removal of drainage ditches and field crowns; re-vegetation of species to establish the native wetland, upland, and riparian vegetation communities; provide habitat protection for federally protected species in Swift Creek through the establishment of a permanent conservation easement along the west bank of Swift Creek through the project area; generally improve water quality and flood storage capacity functions within the restoration area by providing longer residence time and filtering for runoff through the wetland area prior to entering Swift Creek; and minimize permanent open water habitat to reduce avian hazards for the adjacent airport. These goals were accomplished through the following objectives:

- Re-graded the Site to remove the field crowns and drainage ditch system.
- Redistributed topsoil for wetland vegetation establishment.
- Planted riparian buffer and wetland vegetation to restore the area back to natural riparian floodplain and wetland communities.

The conservation area for riparian buffer along Swift Creek is 200 feet wide and measures from the top of the stream bank within the project area. The Site also contains two (2) distinct areas with two different primary hydrologic inputs. The eastern area nearest to Swift Creek, mapped by the Natural Resources Conservation Service (NRCS) Soil Survey of Johnston County as Wehadkee loam (shown on Figure 2 as WED), is a likely historic remnant of Swift Creek, and is now a wetter depression in the floodplain. The primary hydrologic inputs for this area will be backwater affect from Swift Creek and precipitation. The western area, mapped by NRCS as Tomotely sandy loam (shown on Figure 2 as TOM), is located further from Swift Creek along the toe of slope of the floodplain and receives hydrologic inputs from Swift Creek and runoff from the adjacent watershed area west of the Site (approximately 0.2 square miles). The following table lists the different assets included in the Site's restoration.

Project Asset Table		
Project Asset	Restoration Area	Mitigation Ratio
Riparian Wetland	51.5 acres	1:1
Riparian Buffer Restoration or Nutrient Offset	248,292 square feet	1:1

Kimley-Horn performed wetland monitoring throughout 2015 for the Year 5 Monitoring Report with site visits occurring on March 4, May 20, July 9, November 12, and November 17. Site monitoring field work included Carolina Vegetation Survey (CVS) level 2 assessment, groundwater well data collection, and visual assessment of the vegetation and wetland restoration components of the project. The following table details the rainfall by month for the site for the 2015 monitoring year.

Rainfall by Month for 2015 Monitoring Year (Year 5)							
Month	Year	Rainfall* (in)	Average Rainfall** (in)	Month	Year	Rainfall* (in)	Average Rainfall** (in)
November	2014	4.01	3.14	May	2015	2.07	3.76
December	2014	5.86	3.15	June	2015	4.54***	3.74
January	2015	5.54	4.17	July	2015	8.04***	5.04
February	2015	4.45	3.66	August	2015	2.17***	4.56
March	2015	4.33	4.23	September	2015	6.31	4.35
April	2015	7.89	3.00	October	2015	3.9	3.14
Total for Monitoring Year = 64.57 inches							
*Data from station CLA2 in Clayton, NC (5 mi. NW of site)							
**Historical period of record ranges from 1971-2000							
***Data from station CLAY due to data being unavailable at the CLA2 station from June to August							

Summary information/data related to the occurrence of items such as encroachment and statistics related to performance of various project and monitoring elements can be found in the table and figures in the report appendices. Narrative background and supporting information is provided in the 2011 As-Built and Baseline Monitoring Report and in the 2008 Restoration Plan documents available on NCDMS's website (<http://portal.ncdenr.org/web/eep>).

## Hydrology

The restored wetland area was visually assessed and wetland gauge data was downloaded and analyzed as part of the Year 5 monitoring. The downloaded wetland gauge data is shown graphically against local precipitation data in Appendix D for monitoring locations shown in the Current Conditions Plan View (CCPV). As described in the 2008 Restoration Plan, success of the restoration of wetland hydrology will be determined by meeting U.S. Army Corps of Engineers (USACE) minimum criteria and providing water table at or near the surface consistent with frequency and duration of reference wetlands. For years 1 through 3, successful wetland hydrology is defined as saturation of soils for a period equal to or greater than 50% of the period measured in the reference wetlands. For year 4 and beyond until success criteria is met, successful wetland hydrology is defined as saturation of soils for a period equal to or greater than

80% of the period measured in the reference wetlands. The minimum success criteria for MY 5 was calculated as 36 days, equivalent to 15% of the hydroperiod in 2015. As shown in Table 10b, 11 of the 21 gauges installed on the site met the required hydroperiod. The following observations were made regarding the hydrologic conditions during the Year 5 Monitoring site visits:

- As shown in the monthly rainfall totals for the site, 2015 had multiple high rainfall events throughout the growing season. Of particular note were April and September, which saw peak flows in Swift Creek. The site did not experience a flood event similar to that which occurred in 2014, but the site did receive many days of steady rain both early and late in the growing season. Much of the site, aside from the central upland ridge, was inundated with at least 1”-6” of water during each of the site visits conducted in MY5.
- Similar to MY4, ponded water was observed throughout the drainage swales and within the lower elevations of the site during each site visit in MY5. Indicating that water is remaining on the site for extended periods after rainfall or flooding events.
- Much of the wetland appears to be meeting the design goals. The site was observed at the end of the growing season and the site hydrology and vegetation community appeared to be functioning as intended.
- Beaver activity was observed in and around the outlet ditch along the southern site border during the May 20 and July 9, 2015 site visit. The outlet ditch was impounded by a beaver dam and the beaver was observed sitting on the dam during the May site visit. The beaver dam was not observed during the November site visit due to high water.
- A US Geological Survey ambient water quality monitoring station is located approximately 6 miles upstream on Swift Creek at Barber Mill Road, in Clayton, NC (USGS 0208773375). During this monitoring year, the peak readings on the gauge on Swift Creek were 12.6’ in mid-January (1/13/2015), 8.9’ in both April (4/11/2015) and October (10/5/2015), and 9.6’ in November (11/11/2015) before the final site visit. There was no evidence of Swift Creek flooding into the site during the MY5 growing season. However, ponding water was observed within the drainage swales throughout much of the year, especially at the beginning and end of the growing season due to a combination of the drainage swales functioning as designed and periods of steady and consistent rainfall during these periods.

Per the Natural Resource Conservation Service (NRCS) Soil Survey of Johnston County, the growing season in Johnston County is from March 21 until November 16 (241 total days). Eleven of the twenty-one groundwater gauges indicate that the wetland is exceeding the minimum success wetland hydrology criteria for the site. Ten of the gauges did not meet minimum success criteria for wetland hydrology (Gauges D2, E2, F2, C4, E4, F4, N1, N2, N3, and N4). Eight of the gauges (D2, E2, E4, F4, N1, N2, N3, and N4) that did not meet minimum criteria are located along the wetland fringes adjacent to the upland ridge that run north to south through the middle of the site. Hydrology at these locations would be expected to be highly



variable, both seasonally and year-to-year depending on rainfall and flood events from Swift Creek. (see Tables 10a and 10b for more detail).

The remaining gauges that did not meet minimum criteria are F2 and C4. Gauge F2 is located at the upper end of the drainage swale carrying flood flows from Swift Creek. This gauge was not inundated by flooding during the growing season in MY5 as had occurred during MY4. However, it is anticipated that through future flooding events within Swift Creek and continued natural expansion of the berm breaches, Gauge F2 will see more regular and sustained wetland hydrology. Gauge C4 failed from the beginning of the growing season until being and did not collect any groundwater data for that period, but was successfully replaced early in July. Water levels at gauge C4 were near the ground surface towards the end of the growing season, but not for a long enough period to meet the minimum success criteria.

In MY5, six gauges (A3, C4, B5, REF-B, REF-C, and REF-D) experienced failures resulting in data loss. Gauges A3 and B5 experienced failures in the later months of the growing season, but still met success criteria March 21 and late June. Gauge C4 failed from the beginning of the growing season until July, and did show water levels near the ground surface towards the end of the growing season but did not meet the minimum success criteria.

### **Vegetation**

The minimum success criteria has been established by NCDMS to verify that the re-established wetland and riparian buffer vegetation includes an appropriate species composition for the target wetland community type. In addition, the minimum success criteria include the density and growth of characteristic forest species. For wetlands, a minimum mean density of 260 woody stems (planted and volunteer stems) per acre must be surviving for five years after initial planting. Similarly, in riparian buffers a minimum mean density of 260 native hardwood tree species (planted and volunteer stems) per acre must be surviving for five years after initial planting. These minimum requirements are according to the North Carolina Administrative Code 15A NCAC 02B.0295 (Mitigation Program Requirements for Protection and Maintenance of Riparian Buffers). Based on MY5 data, all sixteen of the vegetation plots (4 riparian buffer plots and 12 wetland plots) are meeting minimum success criteria.

This site was instituted prior to October 2007 and, therefore, will generate Riparian Buffer Restoration credit within the conservation easement where planted or volunteer native hardwood stem density requirements are met AND there is a minimum of 50' and a maximum of 200' from the top of bank of Swift Creek. Herbaceous vegetation was assessed visually during the site assessment for ground cover and target species.

During the monitoring process, Kimley-Horn conducted a CVS Level 2 assessment of sixteen vegetation plots and a visual assessment of the vegetation community. Refer to the Appendices B and C of this report for the collected vegetation data and assessment summary data. The following observations were made regarding the vegetation condition during the Year 4 Monitoring site visit on November 12 and 17, 2015:

- All of the four riparian vegetation plots (VQ-11, VQ-12, VQ-14, and VQ-16) are meeting the minimum success criteria of 260 woody stems/acre.

- All of the twelve wetland vegetation plots (VQ-1, VQ-2, VQ-3, VQ-4, VQ-5, VQ-6, VQ-7, VQ-8, VQ-9, VQ-10, VQ-13, and VQ-15) are meeting the minimum success criteria of 260 woody stems/acre.
- Based on the MY5 CVS assessment, the average woody stem count per acre within the wetland area of the site is 460 stems/acre, and the total average for the riparian area of the site is 820 stems/acre.
- As shown on the Current Conditions Plan View, cattails (*Typha latifolia*) have established in the vicinity of the wetland seep, the constructed wetland swale, and in the historic agricultural ditch location. The boundary of the cattail populations appear to increased slightly from the previous year. However, numerous bald-cypresses (*Taxodium distichum*), buttonbushes (*Cephalanthus occidentalis*), and red maples (*Acer rubrum*) are establishing within the cattail dominated areas. With time, it is likely that these trees and shrubs will overtop and shade out much of the cattail population.
- Lespedeza (*Lespedeza cuneata*) remains established in the southwestern portion of the site, between vegetation plots 8 and 9, and small clusters of marsh dayflower (*Murdannia keisak*) continue to thrive at the northern inlet and southern outlet swales on the western half of the site. Chinese privet (*Ligustrum sinense*) was observed in the riparian area in small numbers. Large numbers of Bradford pear (*Pyrus calleryana*) were observed throughout the site as individual stems.
- In November 2015, a targeted herbicide application was conducted to remove Chinese privet and Bradford pear from the site. Carolina Silvics, Inc. staff used backpack pump sprayers treat all observed Chinese privet and Bradford pear stems via a foliar application using Triclopyr as the active herbicide ingredient.
- The herbaceous vegetation has continued to vigorously propagate throughout the project site, and is likely a result of the temporary or permanent seed mix planted throughout the site with the exception of the invasive or unfavorable species previous discussed.
- Previous encroachment areas along the eastern site boundary appear to be revegetating and successfully re-establishing as a wooded riparian area.
- The historically wooded tract northwest of the site that separates the site from the horse farm was clear-cut between the July and November site visits.

## Soils

Hydric soils were present throughout the site during the site assessment. There are indicators of ponding and saturation at the surface and infiltration rates are low for several days after rain events as referenced in multiple groundwater monitoring wells.

## References

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. United States Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

LeGrand, H.E. and S.P. Hall.

Lee, Michael T., Peet, Robert K., Roberts, Steven D., Wentworth, Thomas R. 2006. CVS-EEP Protocol for Recording Vegetation, All Levels of Sampling, Version 4.0.

SCO Station CLA2 – DAQ Clayton Profiler

Daily Precipitation Data

<http://www.nc-climate.ncsu.edu/cronos/?station=CLA2>

WETS Station CLAYTON 3 W, NC1820

Average Monthly Precipitation Data

[http://www.wcc.nrcs.usda.gov/climate/wets\\_doc.html](http://www.wcc.nrcs.usda.gov/climate/wets_doc.html)

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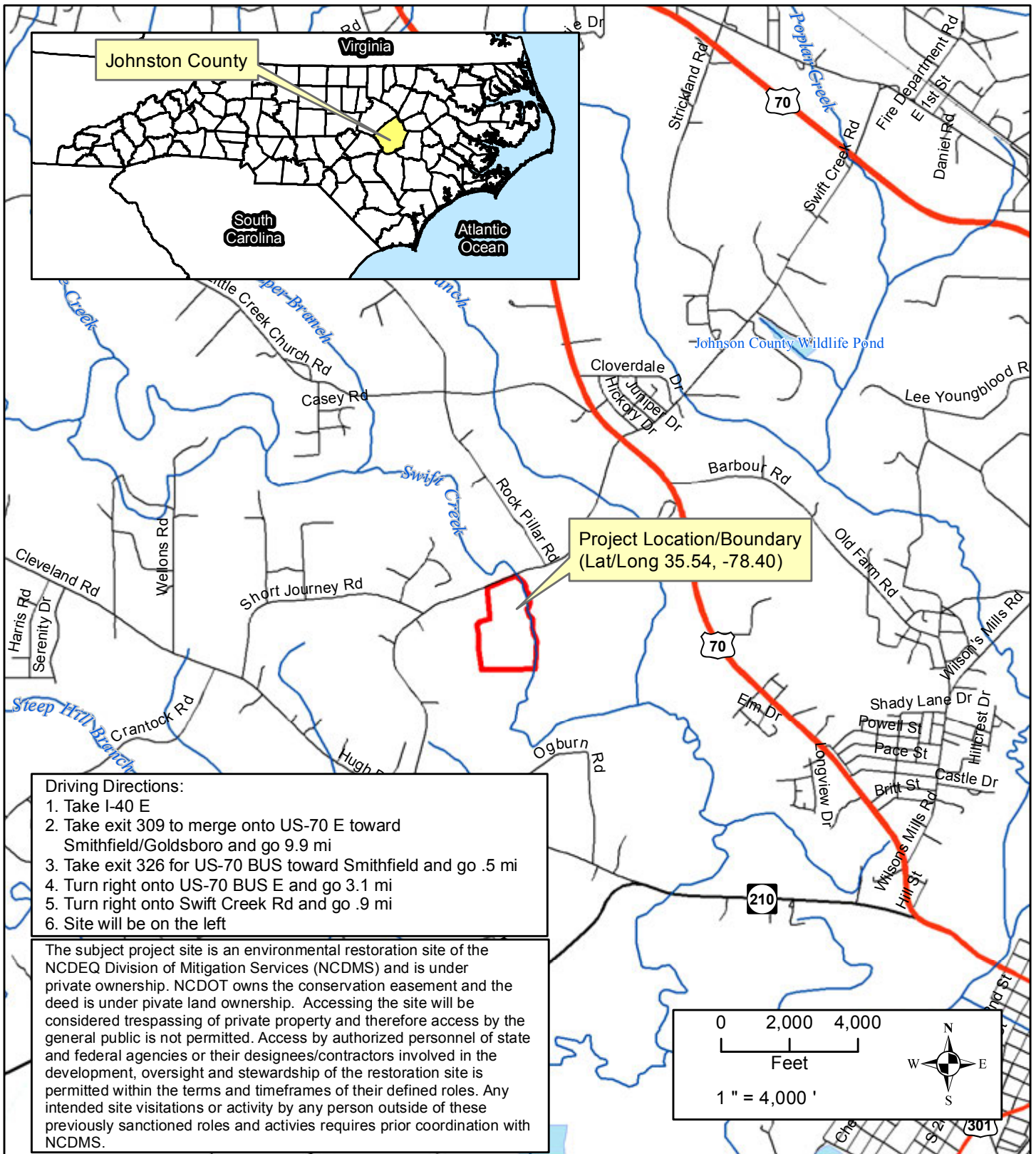
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APPENDIX A  
PROJECT VICINITY  
AND BACKGROUND TABLES



Title		Vicinity Map		
Prepared For: 	<b>Project</b>	Moore Property Monitoring (725) 2015 - Year 5 Johnston County, North Carolina		
	<b>Date</b>	11/25/2015	<b>KHA Project Number</b>	011795033
			<b>Figure</b>	1



**Table 1. Project Components and Mitigation Credits**

**Moore Property/725**

**Mitigation Credits**

Type	Stream		Riparian Wetland		Non-riparian Wetland		Neuse Riparian Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
	R	RE	R	RE	R	RE			
<b>Totals</b>			51.5	0			248,292		

**Project Components**

Project Component -or- Reach ID	Stationing/Location	Existing Footage/Acreage	Approach (PI, PII, etc.)	Restoration or- Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio
RPN				Restoration	5.7	1:1
WED				Restoration	10.4	1:1
TOM				Restoration	41.1	1:1

**Component Summation**

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration		51.5	0		248,292	
Enhancement						
Enhancement I						
Enhancement II						
Creation						
Preservation						
High Quality Preservation						

RPN = Riparian  
WED = Whadkee loam  
TOM = Tomotely sandy loam

**Table 2. Project Activity and Reporting History  
Moore Property/725**

<b>Activity or Deliverable</b>	<b>Data Collection Complete</b>	<b>Completion or Delivery</b>
Restoration Plan	NA	March 2008
Final Design – Construction Plans	NA	May 2009
Containerized, bare root and B&B plantings	NA	January 2011
Construction	NA	July 2011
As-Built & Baseline Monitoring Report	January 2011	July 2011
Monitoring Year 1	November 2011	January 2012
Monitoring Year 2	October 2012	February 2013
Monitoring Year 3	November 2013	December 2013
Monitoring Year 4	November 2014	December 2014
<b>Replant in Encroachment Area</b>		<b>May 2015</b>
<b>Invasive Plant Treatment</b>		<b>November 2015</b>
Monitoring Year 5	November 2015	January 2016
<b>Invasive Plant Treatment</b>		<b>May 2016</b>

- Bolded items are examples of those items that are not standard, but may come up and should be included

- Non-bolded items represent events that are standard components over the course of a typical project.

- The above are obviously not the extent of potential relevant project activities, but are just provided as example as part of this exhibit.

**Table 3. Project Contacts Table  
Moore Property/725**

<b>Designer</b>	Kimley-Horn and Associates, Inc. 3001 Weston Parkway Cary, NC 27513
Primary project design POC	Daren Pait (757) 355-6677
<b>Construction Contractor</b>	Environmental Quality Resources, LLC 1405 Benson Ct Arbutus, MD 21227
Construction contractor POC	John Talley (443) 304-3310
<b>Survey Contractor</b>	Turner Land Surveying, PLLC 3201 Glenridge Dr Raleigh, NC 27604
Survey contractor POC	David Turner (919) 875-1378
<b>Planting Contractor</b>	Natives, Inc. 550 E. Westinghouse Blvd Charlotte, NC 28273
Planting contractor POC	Gregg Antemann (704) 527-1177
<b>Seeding Contractor</b>	Natives, Inc. 550 E. Westinghouse Blvd Charlotte, NC 28273
Contractor point of contact	Gregg Antemann (704) 527-1177
<b>Seed Mix Sources</b>	Natives, Inc. Gregg Antemann (704) 527-1177
<b>Nursery Stock Suppliers</b>	Natives, Inc. Gregg Antemann (704) 527-1177
<b>Monitoring Performers</b>	Kimley-Horn and Associates, Inc. 3001 Weston Parkway Cary, NC 27513
Stream Monitoring POC	N/A
Vegetation Monitoring POC	Ross Sullivan (919) 677-2104
Wetland Monitoring POC	Jason Hartshorn (919) 678-4155

**Table 4. Project Attribute Table  
Moore Property/725**

Project County	Johnston
Physiographic Region	Coastal Plain
Ecoregion	Rolling Coastal Plain
Project River Basin	Neuse
USGS HUC for Project (14 digit)	3020201110070
NCDWQ Sub-basin for Project	03-04-02
Within extent of DMS Watershed Plan?	No
WRC Hab Class (Warm, Cool, Cold)	Warm
% of project easement fenced or demarcated	100
Beaver activity observed during design phase?	No

**Restoration Component Attribute Table**

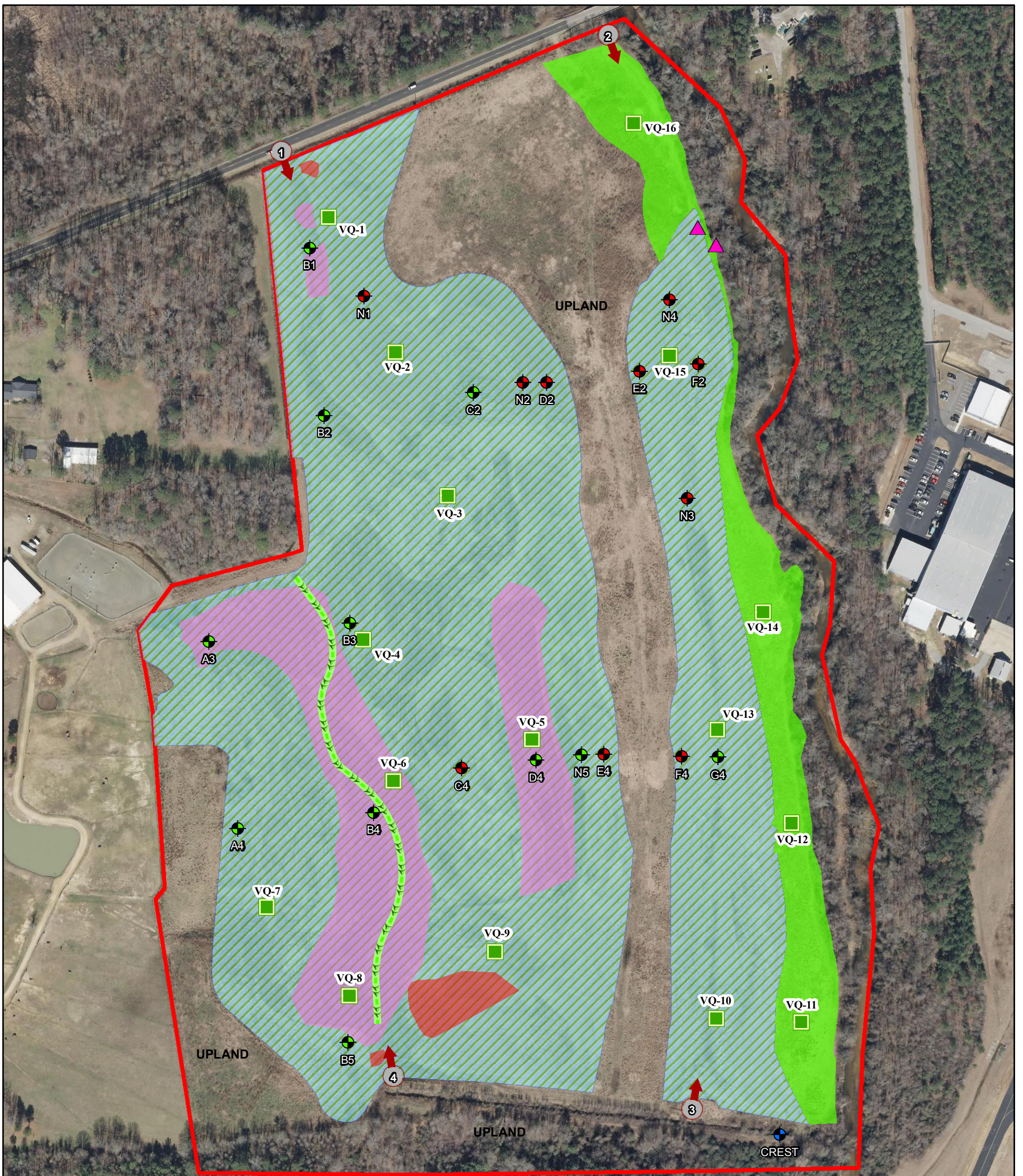
	RPN	WED	TOM	Swift Creek *
Drainage area	N/A	0.03 sq. mi.	0.2 sq. mi.	145.2 sq. mi.
Stream order	N/A	N/A	N/A	4th
Restored length (feet)	N/A	N/A	N/A	N/A
Perennial or Intermittent	N/A	N/A	N/A	Perennial
Watershed type (Rural, Urban, Developing etc.)		Rural	Rural	Developing
Watershed LULC Distribution (e.g.)				
Residential		2%	2%	20%
Ag-Row Crop		69%	69%	40%
Ag-Livestock		0%	0%	0%
Forested		29%	29%	40%
Etc.		0%	0%	0%
Watershed impervious cover (%)		0%	0%	15%
NCDWQ AU/Index number	N/A	N/A	N/A	27-43-(8)
NCDWQ classification	N/A	N/A	N/A	C; Sw; NSW
303d listed?	N/A	N/A	N/A	No
Upstream of a 303d listed segment?	N/A	N/A	N/A	Yes
Reasons for 303d listing or stressor	N/A	N/A	N/A	WS-III; NSW; CA
Total acreage of easement	84.2	84.2	84.2	N/A
Total vegetated acreage within the easement	84.2	84.2	84.2	N/A
Total planted acreage as part of the restoration	5.7	10.4	41.1	N/A
Rosgen classification of pre-existing	N/A	N/A	N/A	N/A
Rosgen classification of As-built	N/A	N/A	N/A	N/A
Valley type	N/A	N/A	N/A	N/A
Valley slope	N/A	N/A	N/A	N/A
Valley side slope range (e.g. 2-3.%)	N/A	N/A	N/A	N/A
Valley toe slope range (e.g. 2-3.%)	N/A	N/A	N/A	N/A
Cowardin classification	N/A	N/A	N/A	N/A
Trout waters designation	N/A	N/A	N/A	No
Species of concern, endangered etc.? (Y/N)	No	No	No	Yes
Dominant soil series and characteristics	Altavista	Wehadkee	Tomotley	N/A
Series	AaA	Wt	To	N/A
Depth	60 inches	63 inches	60 inches	N/A
Clay%	10-35	5-20	5-35	N/A
K	0.24	0.24	0.2	N/A
T	5	5	5	N/A

Use N/A for items that may not apply. Use "--" for items that are unavailable and "U" for items that are unknown

\*There is no restoration of Swift Creek involved with this project

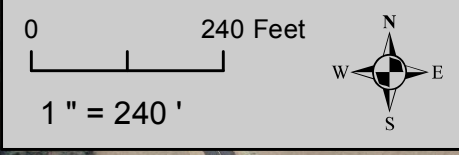
APPENDIX B  
VISUAL ASSESSMENT DATA





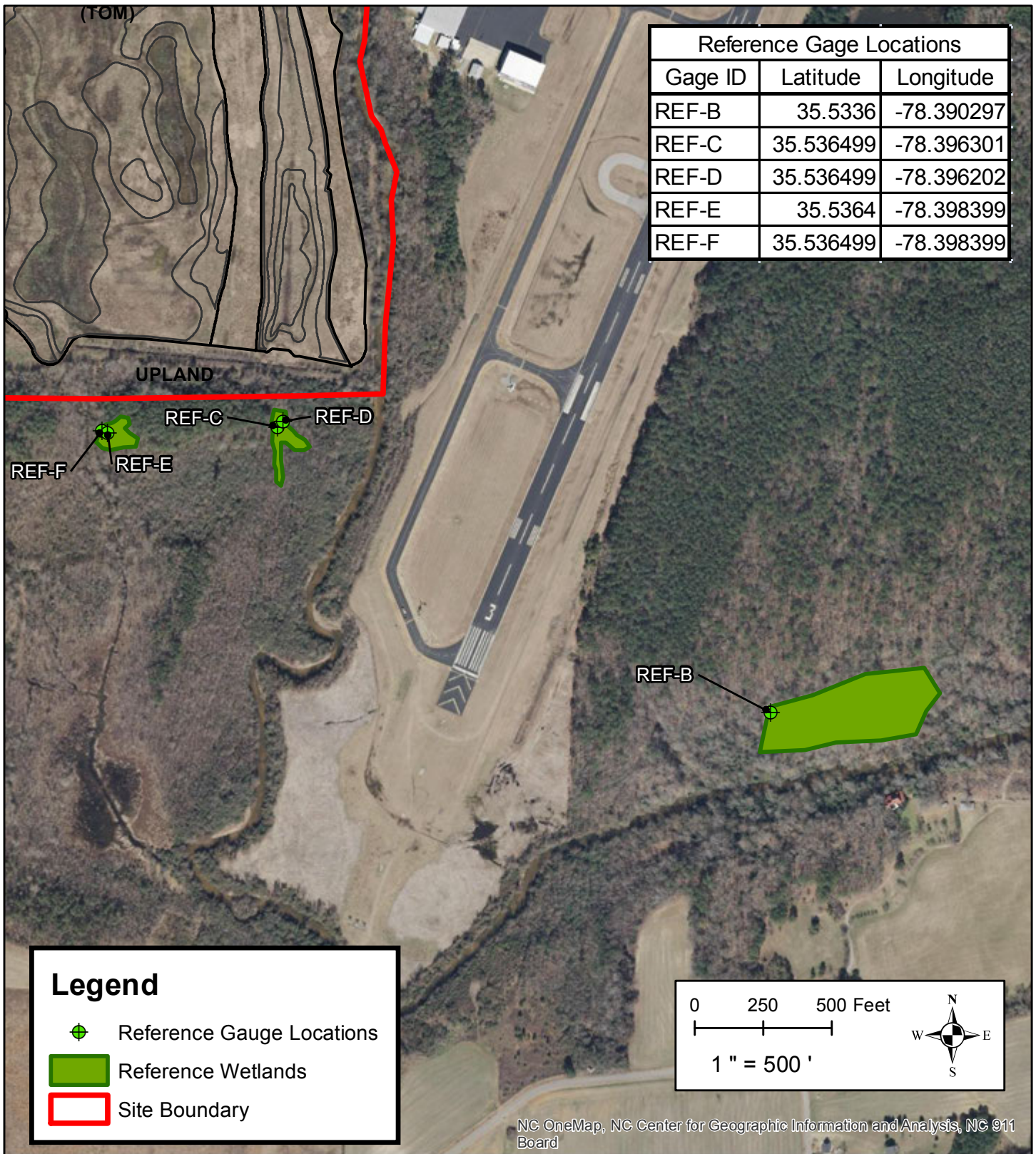
**Legend**

Photo Point	Wetland Swale	<b>Vegetation Areas of Concern</b>
<b>Monitoring Locations</b>	<b>Monitoring Vegetation Plots</b>	Nonnative Invasive Area of Concern
Groundwater Gauge - Meets Criteria	All have Met Success Criteria	Cattail Dominated Area
Groundwater Gauge - Does Not Meet Criteria	<b>Proposed Restoration Areas</b>	Site Boundary
Crest Gauge	Riparian Buffer (248,292 sq. ft.)	MY4 Berm Breach
	Riparian Wetlands (51.5 ac.)	




<b>Title</b>	<b>Current Conditions Plan View (2014 Aerial)</b>		
<b>Prepared For:</b>		<b>Project</b>	Moore Property Monitoring (725) 2015 - Year 5 Johnston County, NC
		<b>Date</b>	1/31/2016
		<b>KHA Project Number</b>	011795033
		<b>Figure</b>	2





Reference Gauge Locations		
Gage ID	Latitude	Longitude
REF-B	35.5336	-78.390297
REF-C	35.536499	-78.396301
REF-D	35.536499	-78.396202
REF-E	35.5364	-78.398399
REF-F	35.536499	-78.398399

<b>Title</b>		<b>Reference Gauge Locations (2014 Aerial)</b>		
Prepared For: 	<b>Project</b>	Moore Property Monitoring (725) 2015 - Year 5 Johnston County, North Carolina		
	<b>Date</b>	11/25/2015	<b>KHA Project Number</b>	011795033
				<b>Figure</b> 3

**Table 6** **Vegetation Condition Assessment**

**Planted Acreage<sup>1</sup>** **56.9**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	2	1.55	2.7%
<b>Total</b>				2	1.55	2.7%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
<b>Cumulative Total</b>				2	1.55	2.7%

**Easement Acreage<sup>2</sup>** **84.4**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern <sup>3</sup>	Areas or points (if too small to render as polygons at map scale).	1000 SF	Pattern and Color	3	0.65	0.8%

<sup>1</sup> = Enter the planted acreage within the easement. This number is calculated as the easement acreage minus any existing mature tree stands that were not subject to supplemental planting of the understory, the channel acreage, crossings or any other elements not directly planted as part of the project effort.

<sup>2</sup> = The acreage within the easement boundaries.

<sup>3</sup> = Invasives may occur in or out of planted areas, but still within the easement and will therefore be calculated against the overall easement acreage. Invasives of concern/interest are listed below. The list of high concern species are those with the potential to directly outcompete native, young, woody stems in the short-term (e.g. monitoring period or shortly thereafter) or affect the community structure for existing, more established tree/shrub stands over timeframes that are slightly longer (e.g. 1-2 decades). The low/moderate concern group are those species that generally do not have this capacity over the timeframes discussed and therefore are not expected to be mapped with regularity, but can be mapped, if in the judgement of the observer their coverage, density or distribution is suppressing the viability, density, or growth of planted woody stems. Decisions as to whether remediation will be needed are based on the integration of risk factors by DMS such as species present, their coverage, distribution relative to native biomass, and the practicality of treatment. For example, even modest amounts of Kudzu or Japanese Knotweed early in the projects history will warrant control, but potentially large coverages of Microstegium in the herb layer will not likely trigger control because of the limited capacities to impact tree/shrub layers within the timeframes discussed and the potential impacts of treating extensive amounts of ground cover. Those species with the "watch list" designator in gray shade are of interest as well, but have yet to be observed across the state with any frequency. Those in *red italics* are of particular interest given their extreme risk/threat level for mapping as points where isolated specimens are found, particularly early in a projects monitoring history. However, areas of discreet, dense patches will of course be mapped as polygons. The symbology scheme below was one that was found to be helpful for symbolizing invasives polygons, particularly for situations where the condition for an area is somewhere between isolated specimens and dense, discreet patches. In any case, the point or polygon/area feature can be symbolized to describe things like high or low concern and species can be listed as a map inset, in legend items if the number of species are limited or in the narrative section of the executive summary.





PP1 (November 12, 2015)



PP2 (November 12, 2015)



PP3 (November 12, 2015)



PP4 (November 12, 2015)





WP1 (November 12, 2015)  
Reference wetland well Ref-B



WP2 (November 12, 2015)  
Reference wetland wells Ref-C and Ref-D were inundated earlier in the year, but not in November 2015.





WP3 (November 12, 2015)

Bald cypress trees are beginning to overtop cattail colonies in the wetter areas of the Site-



WP4 (November 12, 2015)

High water in outlet ditch due to Swift Creek flooding. Crest gauge has been inundated multiple times in MY5.





WP5 (November 12, 2015)  
Site access barrier constructed in MY5 by NCDMS.



WP6 (November 12, 2015)  
Secondary barrier constructed in easement encroachment





WP7 (November 12, 2015)

The adjacent tract has historically been a remnant mature floodplain forest, however the tract was timbered in MY5. Site 725 is located along the tree line visible at the back of the photo.



WP8 (November 12, 2015)

Woody vegetation is establishing well in the wetland swale in the southeastern quadrant of site.





VQ1 (November 17, 2015)

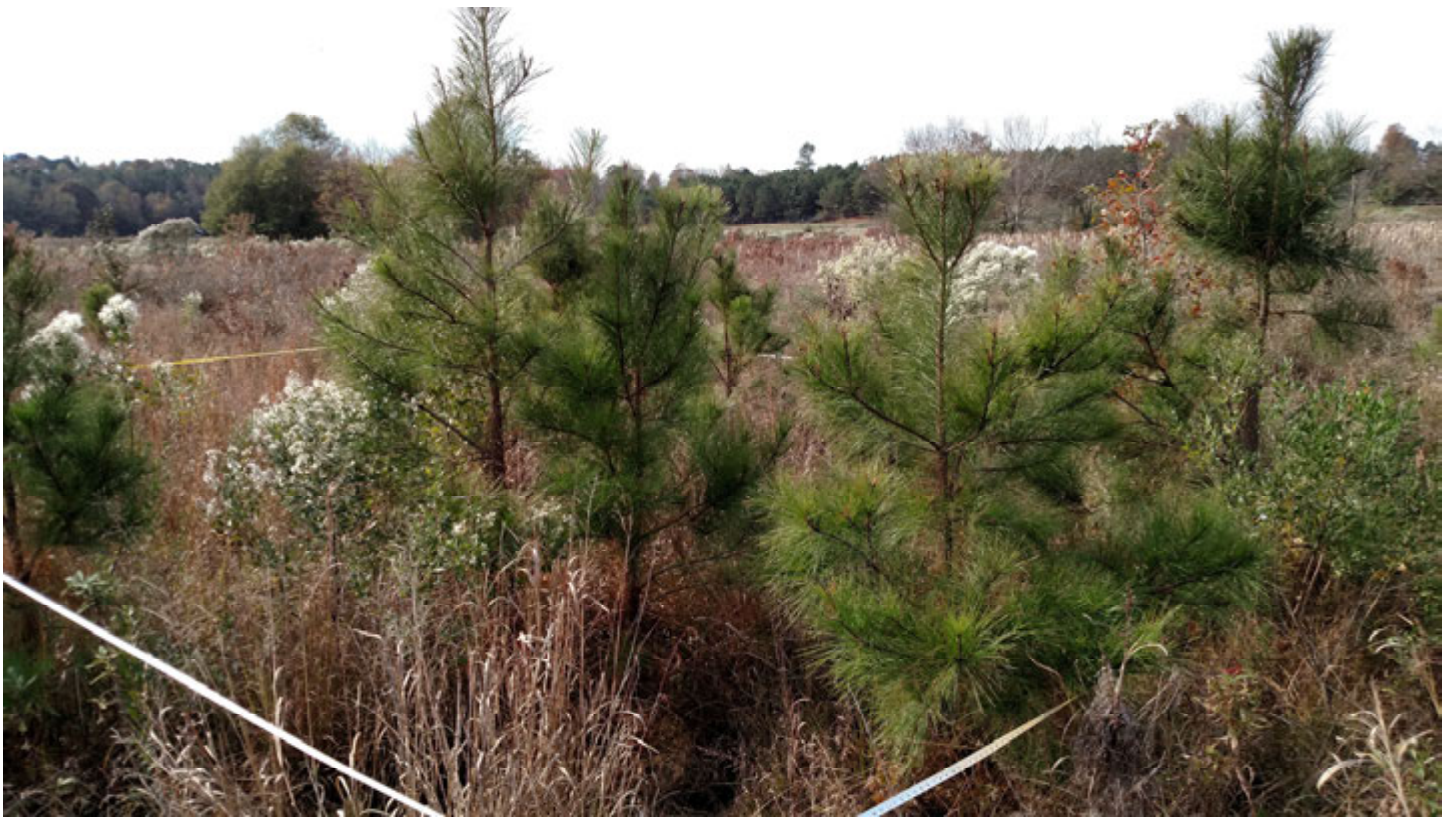


VQ2 (November 17, 2015)





VQ3 (November 17, 2015)



VQ4 (November 17, 2015)





VQ5 (November 17, 2015)



VQ6 (November 17, 2015)





VQ7 (November 17, 2015)



VQ8 (November 17, 2015)





VQ9 (November 17, 2015)



VQ10 (November 17, 2015)





VQ11 (November 17, 2015)



VQ12 (November 17, 2015)





VQ13 (November 17, 2015)



VQ14 (November 17, 2015)





VQ15 (November 17, 2015)



VQ16 (November 12, 2015)

APPENDIX C  
VEGETATION PLOT DATA

**Table 7. Vegetation Plot Criteria Attainment  
Moore Property/725**

Vegetation Plot ID	Vegetation Community	MY1		MY2		MY3		MY4		MY5	
		Vegetation Survival Threshold (320 stems/acre) Met?	Tract Mean	Vegetation Survival Threshold (320 stems/acre) Met?	Tract Mean	Vegetation Survival Threshold (320 stems/acre) Met?	Tract Mean	Vegetation Survival Threshold (260 stems/acre) Met?	Tract Mean	Vegetation Survival Threshold (260 stems/acre) Met?	Tract Mean
VQ1	Coastal Plain Brownwater Bottomland	N	50%	N	25%	Y	63%	Y	63%	Y	100%
VQ2		N		N		Y		N		Y	
VQ3		N		N		N		N		Y	
VQ4		Y		Y		Y		Y		Y	
VQ7		Y		N		N		N		Y	
VQ9		N		N		N		Y		Y	
VQ13		Y		Y		Y		Y		Y	
VQ15		Y		N		Y		Y		Y	
VQ5		Coastal Plain Brownwater Swamp		Y		100%		Y		75%	
VQ6	Y		Y	Y	Y		Y				
VQ8	Y		Y	N	N		Y				
VQ10	Y		N	Y	Y		Y				
VQ11	Coastal Plain Brownwater Levee (Riparian)	N	50%	N	50%	N	25%	Y	75%	Y	100%
VQ12		Y		Y		Not Surveyed		Not Surveyed		Y	
VQ14		N		N		N		Y		Y	
VQ16		Y		Y		Y		Y		Y	



**Table 8. CVS Vegetation Plot Metadata  
Moore Property/725**

<b>Report Prepared By</b>	Jason Hartshorn
<b>Date Prepared</b>	11/24/2015 10:11
<b>database name</b>	Moore Property_cvs-eep-entrytool-v2.3.1.mdb
<b>database location</b>	K:\RAL_Environmental\011795 Moore Property Monitoring\Vegetation Data
<b>computer name</b>	DL82758
<b>file size</b>	54837248

**DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----**

<b>Metadata</b>	Description of database file, the report worksheets, and a summary of project(s) and project data.
<b>Proj, planted</b>	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
<b>Proj, total stems</b>	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
<b>Plots</b>	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
<b>Vigor</b>	Frequency distribution of vigor classes for stems for all plots.
<b>Vigor by Spp</b>	Frequency distribution of vigor classes listed by species.
<b>Damage</b>	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
<b>Damage by Spp</b>	Damage values tallied by type for each species.
<b>Damage by Plot</b>	Damage values tallied by type for each plot.
<b>Planted Stems by Plot and Spp</b>	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.

**PROJECT SUMMARY-----**

<b>Project Code</b>	725
<b>project Name</b>	Moore Property
<b>Description</b>	Wetland Restoration
<b>River Basin</b>	Neuse
<b>length(ft)</b>	N/A
<b>stream-to-edge width (ft)</b>	N/A
<b>area (sq m)</b>	341,718 (0.13 square miles)
<b>Required Plots (calculated)</b>	30
<b>Sampled Plots</b>	16*

\* As approved by DMS

**Table 9 Planted & Total Stem Counts**

		Current Plot Data (MY5 2015)												
Scientific Name	Common Name	Species Type	000-01-0001			000-01-0002			000-01-0003			000-01-0004		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<b>Acer rubrum</b>	red maple	Tree			1						3			1
<b>Betula nigra</b>	river birch	Tree	1	1	2			1						
Baccharis halimifolia	eastern baccharis	Shrub												
Callicarpa americana	American beautyberry	Shrub												1
<b>Carpinus caroliniana</b>	<b>American hornbeam</b>	Tree	1	1	1									
<b>Carya aquatica</b>	<b>water hickory</b>	Tree				1	1	1						
<b>Carya illinoensis</b>	<b>pecan</b>	Tree												
<b>Celtis laevigata</b>	<b>sugarberry</b>	Tree									1			
<b>Celtis occidentalis</b>	<b>common hackberry</b>	Tree												
Cephalanthus occidentalis	common buttonbush	Shrub												
Cercis canadensis	eastern redbud	Tree												
Cornus amomum	silky dogwood	Shrub												
Crataegus phaenopyrum	Washington hawthorn	Shrub Tree				4	4	4						
<b>Diospyros virginiana</b>	<b>common persimmon</b>	Tree									1			
<b>Fraxinus pennsylvanica</b>	<b>green ash</b>	Tree							1	1	1			
Lindera benzoin	northern spicebush	Shrub												
<b>Liquidambar styraciflua</b>	<b>sweetgum</b>	Tree			2			1			1			1
<b>Liriodendron tulipifera</b>	<b>tuliptree</b>	Tree				3	3	3	1	1	1			
<b>Nyssa aquatica</b>	<b>water tupelo</b>	Tree												
<b>Nyssa biflora</b>	<b>swamp tupelo</b>	Tree												
Pinus taeda	loblolly pine	Tree			3			1			1			1
<b>Platanus occidentalis</b>	<b>American sycamore</b>	Tree												
<b>Populus deltoides</b>	<b>eastern cottonwood</b>	Tree												
Pyrus calleryana	Callery pear	Exotic												
<b>Quercus laurifolia</b>	<b>laurel oak</b>	Tree												
<b>Quercus lyrata</b>	<b>overcup oak</b>	Tree										7	7	7
<b>Quercus michauxii</b>	<b>swamp chestnut oak</b>	Tree			1									
<b>Quercus nigra</b>	<b>water oak</b>	Tree												
<b>Quercus pagoda</b>	<b>cherrybark oak</b>	Tree												
<b>Quercus phellos</b>	<b>willow oak</b>	Tree												
<b>Taxodium distichum</b>	<b>bald cypress</b>	Tree												
<b>Ulmus alata</b>	<b>winged elm</b>	Tree			2									
<b>Ulmus americana</b>	<b>American elm</b>	Tree			1			2			2			2
<b>Totals</b>		Stem count	2	2	13	8	8	13	2	2	11	7	7	13
		size (ares)	1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02		
		Species count	2	2	8	3	3	7	2	2	8	1	1	6
		Stems per ACRE	80.93713	80.93713	526.0913	323.7485	323.7485	526.0913	80.93713	80.93713	445.1542	283.2799	283.2799	526.0913
<b>Riparian Buffer Success Criteria</b>		Stem count	N/A			N/A			N/A			N/A		
		size (ares)	N/A			N/A			N/A			N/A		
		size (ACRES)	N/A			N/A			N/A			N/A		
		Species count	N/A			N/A			N/A			N/A		
		Stems per ACRE	N/A			N/A			N/A			N/A		

\***Bolded** hardwood tree species are counted toward riparian buffer success criteria

Color Key for Density
Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

PnoLS = Planted excluding livestakes  
P-all = All planted stems including livestakes  
T = All planted and natural recruit stems including livestakes  
Total includes natural recruit stems

**Table 9 Planted and Total Stem Counts (Species by Plot with Annual Means)**

		Current Plot Data (MY5 2015)																		
Scientific Name	Common Name	Species Type	000-01-0005			000-01-0006			000-01-0007			000-01-0008			000-01-0009			000-01-0010		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<b>Acer rubrum</b>	red maple	Tree						2			3									
<b>Betula nigra</b>	river birch	Tree																		
Baccharis halimifolia	eastern baccharis	Shrub									3									
Callicarpa americana	American beautyberry	Shrub																		
<b>Carpinus caroliniana</b>	<b>American hornbeam</b>	Tree												1	1	1			1	
<b>Carya aquatica</b>	<b>water hickory</b>	Tree																		
<b>Carya illinoensis</b>	<b>pecan</b>	Tree																		
<b>Celtis laevigata</b>	<b>sugarberry</b>	Tree																		
<b>Celtis occidentalis</b>	<b>common hackberry</b>	Tree																		
Cephalanthus occidentalis	common buttonbush	Shrub	10	10	10	9	9	9				12	12	12				6	6	9
Cercis canadensis	eastern redbud	Tree																		
Cornus amomum	silky dogwood	Shrub																		
Crataegus phaenopyrum	Washington hawthorn	Shrub Tree													3	3	3			
<b>Diospyros virginiana</b>	<b>common persimmon</b>	Tree								1	1	1								
<b>Fraxinus pennsylvanica</b>	<b>green ash</b>	Tree													2	2	2			
Lindera benzoin	northern spicebush	Shrub																		
<b>Liquidambar styraciflua</b>	<b>sweetgum</b>	Tree																		
<b>Liriodendron tulipifera</b>	<b>tuliptree</b>	Tree																		
<b>Nyssa aquatica</b>	<b>water tupelo</b>	Tree																		
<b>Nyssa biflora</b>	<b>swamp tupelo</b>	Tree													1	1	1			
Pinus taeda	loblolly pine	Tree																		
<b>Platanus occidentalis</b>	<b>American sycamore</b>	Tree													2	2	2			
<b>Populus deltoides</b>	<b>eastern cottonwood</b>	Tree																		
Pyrus calleryana	Callery pear	Exotic								1	1	1								
<b>Quercus laurifolia</b>	<b>laurel oak</b>	Tree																		
<b>Quercus lyrata</b>	<b>overcup oak</b>	Tree																		
<b>Quercus michauxii</b>	<b>swamp chestnut oak</b>	Tree																		
<b>Quercus nigra</b>	<b>water oak</b>	Tree																		
<b>Quercus pagoda</b>	<b>cherrybark oak</b>	Tree																		
<b>Quercus phellos</b>	<b>willow oak</b>	Tree													1	1	1			
<b>Taxodium distichum</b>	<b>bald cypress</b>	Tree	2	2	2	1	1	1												
<b>Ulmus alata</b>	<b>winged elm</b>	Tree																		
<b>Ulmus americana</b>	<b>American elm</b>	Tree																		
<b>Totals</b>	<b>Stem count</b>		12	12	12	10	10	12	2	2	8	12	12	12	10	10	10	6	6	10
	<b>size (ares)</b>		1			1			1			1			1			1		
	<b>size (ACRES)</b>		0.02			0.02			0.02			0.02			0.02			0.02		
	<b>Species count</b>		2	2	2	2	2	3	2	2	4	1	1	1	6	6	6	1	1	2
	<b>Stems per ACRE</b>		485.6228	485.6228	485.6228	404.6856	404.6856	485.6228	80.93713	80.93713	323.7485	485.6228	485.6228	485.6228	404.6856	404.6856	404.6856	242.8114	242.8114	404.6856
<b>Riparian Buffer Success Criteria</b>	<b>Stem count</b>		N/A			N/A			N/A			N/A			N/A			N/A		
	<b>size (ares)</b>		N/A			N/A			N/A			N/A			N/A			N/A		
	<b>size (ACRES)</b>		N/A			N/A			N/A			N/A			N/A			N/A		
	<b>Species count</b>		N/A			N/A			N/A			N/A			N/A			N/A		
	<b>Stems per ACRE</b>		N/A			N/A			N/A			N/A			N/A			N/A		

\***Bolded** hardwood tree species are counted toward riparian buffer success criteria

Color Key for Density
Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

PnoLS = Planted excluding livestakes  
P-all = All planted stems including livestakes  
T = All planted and natural recruit stems including livestakes  
Total includes natural recruit stems

**Table 9 Planted and Total Stem Counts (Species by Plot with Annual Means)**

		Current Plot Data (MY5 2015)																			
Scientific Name	Common Name	Species Type	000-01-0011			000-01-0012			000-01-0013			000-01-0014			000-01-0015			000-01-0016			
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	
<b>Acer rubrum</b>	red maple	Tree																			
<b>Betula nigra</b>	river birch	Tree				3	3	3	3	3	3							1	1	1	
Baccharis halimifolia	eastern baccharis	Shrub																			
Callicarpa americana	American beautyberry	Shrub																			
<b>Carpinus caroliniana</b>	<b>American hornbeam</b>	Tree				7	1	1	1	2	2	2	4	4	11	3	3	3	1	1	1
<b>Carya aquatica</b>	<b>water hickory</b>	Tree					1	1	1	1	1	1							1	1	1
<b>Carya illinoensis</b>	<b>pecan</b>	Tree																			
<b>Celtis laevigata</b>	<b>sugarberry</b>	Tree				1	1	1	1												6
<b>Celtis occidentalis</b>	<b>common hackberry</b>	Tree																4	4	4	4
Cephalanthus occidentalis	common buttonbush	Shrub																			
Cercis canadensis	eastern redbud	Tree				1															
Cornus amomum	silky dogwood	Shrub																			
Crataegus phaenopyrum	Washington hawthorn	Shrub Tree																2	2	2	2
<b>Diospyros virginiana</b>	<b>common persimmon</b>	Tree				1							1	1	1						
<b>Fraxinus pennsylvanica</b>	<b>green ash</b>	Tree					1	1	1				3	3	3						1
Lindera benzoin	northern spicebush	Shrub																			
<b>Liquidambar styraciflua</b>	<b>sweetgum</b>	Tree													1						4
<b>Liriodendron tulipifera</b>	<b>tuliptree</b>	Tree																			
<b>Nyssa aquatica</b>	<b>water tupelo</b>	Tree																			
<b>Nyssa biflora</b>	<b>swamp tupelo</b>	Tree																			
Pinus taeda	loblolly pine	Tree																			4
<b>Platanus occidentalis</b>	<b>American sycamore</b>	Tree				3	11	11	11	2	2	2	4	4	4	2	2	2	1	1	1
<b>Populus deltoides</b>	<b>eastern cottonwood</b>	Tree																			
Pyrus calleryana	Callery pear	Exotic																			
<b>Quercus laurifolia</b>	<b>laurel oak</b>	Tree																			
<b>Quercus lyrata</b>	<b>overcup oak</b>	Tree				1															
<b>Quercus michauxii</b>	<b>swamp chestnut oak</b>	Tree								1	1	1									
<b>Quercus nigra</b>	<b>water oak</b>	Tree																			
<b>Quercus pagoda</b>	<b>cherrybark oak</b>	Tree																	5	5	5
<b>Quercus phellos</b>	<b>willow oak</b>	Tree								3	3	3				3	3	3			
<b>Taxodium distichum</b>	<b>bald cypress</b>	Tree																			
<b>Ulmus alata</b>	<b>winged elm</b>	Tree																1	1	1	5
<b>Ulmus americana</b>	<b>American elm</b>	Tree											3	3	3						
<b>Totals</b>	Stem count size (ares) size (ACRES) Species count Stems per ACRE		N/A			N/A			12	12	12	N/A			8	8	12	N/A			
			1			1			0.02			1			0.02			1			
			6			6			6	6	6	6			3	3	4	4			
			485.6228			485.6228			485.6228	485.6228	485.6228	485.6228			323.7485	323.7485	485.6228	485.6228			
<b>Riparian Buffer Success Criteria</b>	Stem count size (ares) size (ACRES) Species count Stems per ACRE		0	0	12	18	18	18	N/A			15	15	23	N/A			14	14	29	
			1			1			N/A			1			N/A			1			
			0.02			0.02			N/A			0.02			N/A			0.02			
			0	0	4	6	6	6	N/A			5	5	6	N/A			7	7	10	
		0	0	485.6228	728.4342	728.4342	728.4342	N/A			607.0285	607.0285	930.777	N/A			566.5599	566.5599	1173.588		

\***Bolded** hardwood tree species are counted toward riparian buffer success criteria

Color Key for Density
Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

PnoLS = Planted excluding livestakes  
P-all = All planted stems including livestakes  
T = All planted and natural recruit stems including livestakes  
Total includes natural recruit stems



Table 9 Planted and Total Stem Counts (Species by Plot with Annual Means)

Scientific Name	Common Name	Species Type	Annual Means																	
			MY5 (2015)			MY4 (2014)			MY3 (2013)			MY2 (2012)			MY1 (2012)			MY0 (2011)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<b>Acer rubrum</b>	red maple	Tree			11			1			10			7			3			
<b>Betula nigra</b>	river birch	Tree	8	8	9	4	4	4	8	8	10	16	16	40	11	11	17	23	23	23
Baccharis halimifolia	eastern baccharis	Shrub			3															
Callicarpa americana	American beautyberry	Shrub			1			1	0	0	1	2	2	2	8	8	8	17	17	17
<b>Carpinus caroliniana</b>	<b>American hornbeam</b>	Tree	13	13	28	11	11	27						1						
<b>Carya aquatica</b>	<b>water hickory</b>	Tree	4	4	4			1			4									
<b>Carya illinoensis</b>	<b>pecan</b>	Tree			1			1	0	0	0									
<b>Celtis laevigata</b>	<b>sugarberry</b>	Tree	1	1	8															
<b>Celtis occidentalis</b>	<b>common hackberry</b>	Tree	4	4	4	4	4	5	4	4	4									
Cephalanthus occidentalis	common buttonbush	Shrub	37	37	40	12	12	12	37	37	40	31	31	41	8	8	8	36	36	36
Cercis canadensis	eastern redbud	Tree			1			1			1	3	3	10	6	6	6	6	6	6
Cornus amomum	silky dogwood	Shrub									0			4						
Crataegus phaenopyrum	Washington hawthorn	Shrub Tree	9	9	9	3	3	3							2	2	2	2	2	2
<b>Diospyros virginiana</b>	<b>common persimmon</b>	Tree	2	2	4	11	11	13	2	2	4	4	4	4	38	38	38	41	41	41
<b>Fraxinus pennsylvanica</b>	<b>green ash</b>	Tree	7	7	8	3	3	5	7	7	8			5						
Lindera benzoin	northern spicebush	Shrub						1	0	0	0	3	3	22	9	9	9	11	11	11
<b>Liquidambar styraciflua</b>	<b>sweetgum</b>	Tree			10			2				5	5	17						
<b>Liriodendron tulipifera</b>	<b>tuliptree</b>	Tree	4	4	4	3	3	4	4	4	4									
<b>Nyssa aquatica</b>	<b>water tupelo</b>	Tree													3	3	3	4	4	4
<b>Nyssa biflora</b>	<b>swamp tupelo</b>	Tree	1	1	1	2	2	2	1	1	1	8	8	9	10	10	10	17	17	17
Pinus taeda	loblolly pine	Tree			10			8	0	0	10	16	16	28	22	22	23	24	24	24
<b>Platanus occidentalis</b>	<b>American sycamore</b>	Tree	22	22	25	6	6	13			25	1	1	3						
<b>Populus deltoides</b>	<b>eastern cottonwood</b>	Tree							0	0	0	5	5	6						
Pyrus calleryana	Callery pear	Exotic	1	1	1	1	1	1												
<b>Quercus laurifolia</b>	<b>laurel oak</b>	Tree																		
<b>Quercus lyrata</b>	<b>overcup oak</b>	Tree	7	7	8	6	6	7												
<b>Quercus michauxii</b>	<b>swamp chestnut oak</b>	Tree	2	2	3	5	5	5												
<b>Quercus nigra</b>	<b>water oak</b>	Tree																		
<b>Quercus pagoda</b>	<b>cherrybark oak</b>	Tree	5	5	5	3	3	3												
<b>Quercus phellos</b>	<b>willow oak</b>	Tree	7	7	7	8	8	8												
<b>Taxodium distichum</b>	<b>bald cypress</b>	Tree	3	3	3	2	2	2	3	3	3	2	2	2						
<b>Ulmus alata</b>	<b>winged elm</b>	Tree	1	1	7	1	1	2												
<b>Ulmus americana</b>	<b>American elm</b>	Tree	3	3	10	3	3	9												
<b>Totals</b>	<b>Stem count</b>		91	91	138	71	71	88	80	80	107	96	96	204	117	117	127	181	181	181
	<b>size (ares)</b>		12			12			12			12			12			12		
	<b>size (ACRES)</b>		0.30			0.30			0.30			0.30			0.30			0.30		
	<b>Species count</b>		20	20	26	18	18	26	13	13	18	12	12	17	10	10	11	10	10	10
<b>Stems per ACRE</b>		303.3	303.3	460.0	239.4	239.4	296.8	269.8	269.8	360.8	320.0	320.0	680.0	390.0	390.0	423.3	603.3	603.3	603.3	
<b>Riparian Buffer Success Criteria</b>	<b>Stem count</b>		47	47	82	17	17	51	15	72	53	96	96	195	117	117	127	181	181	181
	<b>size (ares)</b>		4			4			4			4			4			4		
	<b>size (ACRES)</b>		0.10			0.10			0.10			0.10			0.10			0.10		
	<b>Species count</b>		0	0	4	10	10	17	9	9	12	12	12	15	10	10	11	10	10	10
<b>Stems per ACRE</b>		470.0	470.0	820	172.0	172.0	515.9742	150.0	720.0	530.0	960.0	960.0	1950.0	1170.0	1170.0	1270.0	1810.0	1810.0	1810.0	

\***Bolded** hardwood tree species are counted toward riparian buffer success criteria

Color Key for Density
Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

PnoLS = Planted excluding livestakes  
P-all = All planted stems including livestakes  
T = All planted and natural recruit stems including livestakes  
Total includes natural recruit stems

APPENDIX D  
HYDROLOGIC DATA

**Table 10a. Reference Groundwater Gauge Summary  
Moore Property/725**

	Ground Elevation*	2009	2010	MY1 2011	MY2 2012	MY3 2013	MY4 2014	MY5 2015	Notes
<b>Groundwater Gauge REF-B</b>	124'	34	29	44	2	35	53	15	Floodplain depression, depends on flood events from Swift Creek, which appears to have occurred multiple times during 2015. Sediment deposits on trees adjacent to the reference wells indicate inundation of 2-3' in the wetland interior. Gauge REF-B failed from March 5-July 10.
<b>Consecutive days within range<sup>1</sup></b>		14.11%	12.03%	18.26%	0.83%	14.52%	21.99%	6.22%	
<b>% of growing season<sup>2</sup></b>		Y	Y	Y	N	Y	Y	Y	
<b>Criteria met<sup>3</sup>?</b>									
<b>Groundwater Gauge REF-C</b>	124'	35	30	45	2	33	53	56	Gauge REF-C was inundated through the end of 2014 until early late April 2015. The gauge failed after July 9, 2015 and no data was collected for the remainder of the year.
<b>Consecutive days within range</b>		14.52%	12.45%	18.67%	0.83%	13.69%	21.99%	23.24%	
<b>% of growing season</b>		Y	Y	Y	N	Y	Y	Y	
<b>Criteria met?</b>									
<b>Groundwater Gauge REF-D</b>	124'	43	--	--	22	62	91	57	Gauge REF-C was inundated through the end of 2014 until early late April 2015. The gauge failed after July 9, 2015 and no data was collected for the remainder of the year.
<b>Consecutive days within range</b>		17.84%	--	--	9.13%	25.73%	37.76%	23.65%	
<b>% of growing season</b>		Y	--	--	Y	Y	Y	Y	
<b>Criteria met?</b>									
<b>Groundwater Gauge REF-E</b>	123'	33	--	--	22	19	49	47	Water table was at or above the surface from November 2014 through mid-May 2015. Water levels dipped below the 12" USACE wetland criteria in mid-May and did not rise above again until November.
<b>Consecutive days within range</b>		13.69%	--	--	9.13%	7.88%	20.33%	19.50%	
<b>% of growing season</b>		Y	--	--	Y	Y	Y	Y	
<b>Criteria met?</b>									
<b>Groundwater Gauge REF-F</b>	123'	34	27	39	23	28	49	47	Water table was at or above the surface from November 2014 through early May 2015. Water levels dipped below the 12" USACE wetland criteria in early May and did not rise above again until October.
<b>Consecutive days within range</b>		14.11%	11.20%	16.18%	9.54%	11.62%	20.33%	19.50%	
<b>% of growing season</b>		Y	Y	Y	Y	Y	Y	Y	
<b>Criteria met?</b>									
<b>Average reference hydroperiod</b>		36	29	43	15	36	59	45	
<b>Consecutive number of days needed to meet the deviation success criteria (50% for Years 1-3, 20% for Years 4+)</b>		18	15	22	8	18	48	36	
1- The Army Corps of Engineers states that the range is within 12 inches of the ground surface 2- The growing season for the site is 241 days long. 3- The minimum success criteria states that the water table must be within the USACE range for at least 5% (12 days) of the growing season consecutively. * Ground elevations recorded using county topographic GIS data.									



**Table 10b. Restoration Groundwater Gauge Summary  
Moore Property/725**

	Ground Elevation*	MY1 2011	MY2 2012	MY3 2013	MY4 2014	MY5 2015	Notes
Percentage of monitoring gauges with criteria met		50.00%	68.75%	68.75%	38.10%	52.38%	
<b>Groundwater Gauge B1</b>							
Consecutive days within range <sup>1</sup>	124.1'	68	89	174	110	64	Gauge located in wet swale that receives runoff from upslope property and roadside drainage. Water level is sustained above the ground surface during long periods during 2015, but does drop below 12" for much of August and September.
% of growing season <sup>2</sup>		28.22%	36.93%	72.2%	45.6%	26.6%	
Criteria met <sup>3</sup> ?		Y	Y	Y	Y	Y	
<b>Groundwater Gauge B2</b>							
Consecutive days within range	124.0'	50	27	39	53	60	Water level is at or above the ground surface for much of the Winter and Spring, but dips below the upper 12" after mid-May and stays below until October.
% of growing season		20.75%	11.20%	16.2%	22.0%	24.9%	
Criteria met?		Y	Y	Y	Y	Y	
<b>Groundwater Gauge C2</b>							
Consecutive days within range	124.5'	47	28	91	51	60	Water levels are sustained above the ground surface through most of the spring, with a draw down occurring in late May. Water levels returned above the ground surface periodically between July and November.
% of growing season		19.50%	11.62%	37.8%	21.2%	24.9%	
Criteria met?		Y	Y	Y	Y	Y	
<b>Groundwater Gauge D2</b>							
Consecutive days within range	125.7'	0	1	5	5	8	Located near the wetland boundary along the upland ridge. Water levels are within the upper 24" during the growing season and peak in response to rainfall events.
% of growing season		0.00%	0.41%	2.1%	2.1%	3.3%	
Criteria met?		N/A	N	N	N	N	
<b>Groundwater Gauge E2</b>							
Consecutive days within range	124.8'	0	1	7	8	12	The water level at E2 rose above and fell below the 12" USACE wetland criteria multiple times during the first couple months of the growing season. The water level was drawn down below 12" by mid-May and only briefly came back into the upper 12" three times through the end of the growing season.
% of growing season		0.00%	0.41%	2.9%	3.3%	5.0%	
Criteria met?		N/A	N	N	N	N	
<b>Groundwater Gauge F2</b>							
Consecutive days within range	124.2'	4	6	2	8	7	Gauge F2 indicates frequent and rapid variation in response to rainfall events, with ten peaks recorded above the 12" USACE wetland criteria throughout the growing season.
% of growing season		1.66%	2.49%	0.8%	3.3%	2.9%	
Criteria met?		N	N	N	N	N	
<b>Groundwater Gauge A3</b>							
Consecutive days within range	123.8'	103	93	231	237	148	Gauge A3 failed at some point towards the end of May. The water levels were sustained above the ground surface until the gauge failed. Surface water was observed to depths of 2'-4" at this gauge during every site visit during monitoring year 2015.
% of growing season		42.74%	38.59%	95.9%	98.3%	61.4%	
Criteria met?		Y	Y	Y	Y	Y	
<b>Groundwater Gauge B3</b>							
Consecutive days within range	123.7'	45	21	25	48	46	Water level at gauge B3 was sustained at or above the ground surface through early May, but was drawn down below 12" USACE wetland criteria depth by early May. Water level peaked above the 12" mark six times through the remainder of the growing season.
% of growing season		18.67%	8.71%	10.4%	19.9%	19.1%	
Criteria met?		Y	Y	Y	Y	Y	
<b>Groundwater Gauge A4</b>							
Consecutive days within range	124.6'	20	23	42	22	47	Water level is at or above the ground surface through early-May. Water table draw down occurred from mid-May until early October.
% of growing season		8.30%	9.54%	17.4%	9.1%	19.5%	
Criteria met?		N	Y	Y	N	Y	
<b>Groundwater Gauge B4</b>							
Consecutive days within range	123.0'	75	82	178	241	94	Water level is above the ground surface throughout most of the growing season except for several prolonged drawdowns in August, September, and October when the water level dipped below the 12" USACE wetland criteria depth.
% of growing season		31.12%	34.02%	73.9%	100.0%	39.0%	
Criteria met?		Y	Y	Y	Y	Y	
<b>Groundwater Gauge C4</b>							
Consecutive days within range	124.3'	20	8	10	15	10	Gauge C4 failed for much of the year and data was only collected from July 10 through the remainder of the growing season. Gauge C4 was near ground level during the end of the growing season.
% of growing season		8.30%	3.32%	4.1%	6.2%	4.1%	
Criteria met?		N	Y	N	N	N	
<b>Groundwater Gauge D4</b>							
Consecutive days within range	123.3'	75	92	232	122	92	Water levels sustained above the ground surface for large portions of the growing season. The water level dipped below the 12" USACE wetland criteria for an extended period from late July until mid-September.
% of growing season		31.12%	38.17%	96.3%	50.6%	38.2%	
Criteria met?		Y	Y	Y	Y	Y	
<b>Groundwater Gauge E4</b>							
Consecutive days within range	124.8'	4	3	8	17	15	The water table at gage F4 was in the upper 12" for much of the first couple of months of the growing season. Water level dipped below the 12" mark sometime in mid-May and stayed below until peaking above 12" three times late in the growing season.
% of growing season		1.66%	1.24%	3.3%	7.1%	6.2%	
Criteria met?		N	N	N	N	N	
<b>Groundwater Gauge F4</b>							
Consecutive days within range	124.8'	4	1	18	16	19	Highly variable water levels were noted during the beginning months of the growing season corresponding with rainfall. Water levels were near the ground surface for much of this period. However, draw down was noted from mid-May through the remainder of the growing season.
% of growing season		1.66%	0.41%	7.5%	6.6%	7.9%	
Criteria met?		N	N	Y	N	N	
<b>Groundwater Gauge G4</b>							
Consecutive days within range	123.5'	11	8	25	25	48	The water table at gage G4 was at or above the ground surface for much of the first few months in the growing season. Water level dipped below the 12" mark in mid-May and stayed below until peaking above 12" two times late in the growing season.
% of growing season		4.56%	3.32%	10.4%	10.4%	19.9%	
Criteria met?		N	Y	Y	N	Y	
<b>Groundwater Gauge B5</b>							
Consecutive days within range	123.4'	6	26	66	52	62	Gauge B5 failed and no data was recorded after July 9. However, water level was mostly above ground level until mid-May.
% of growing season		2.49%	10.79%	27.4%	21.6%	25.7%	
Criteria met?		N	Y	Y	Y	Y	
<b>Groundwater Gauge N1</b>							
Consecutive days within range	126'	N1 installed spring MY4			4	3	Water levels were low throughout the year, with water levels peaking briefly above the 12" USACE wetland criteria only three times during the growing season.
% of growing season					1.7%	1.2%	
Criteria met?					N	N	
<b>Groundwater Gauge N2</b>							
Consecutive days within range	126.3'	N2 installed spring MY4			16	17	Water levels were highly variable with rainfall events during the first two months of the growing season. The water levels were below the 12" USACE wetland criteria from mid-May until briefly peaking several times late in the growing season.
% of growing season					6.6%	7.1%	
Criteria met?					N	N	
<b>Groundwater Gauge N3</b>							
Consecutive days within range	124'	N3 installed spring MY4			22	27	Water levels were sustained within 12" during the beginning months of the growing season, with a draw down occurring mid-May and lasting until the end of the growing season.
% of growing season					9.1%	11.2%	
Criteria met?					N	N	
<b>Groundwater Gauge N4</b>							
Consecutive days within range	124.8'	N4 installed spring MY4			N/A	18	Water levels at Gauge N4 fluctuated frequently during the first two months of the growing season with a couple of prolonged periods in which water was above ground level. Water levels dipped below 12" towards the end of May and did not return above 12" until the end of September/early October.
% of growing season					N/A	7.5%	
Criteria met?					N/A	N	
<b>Groundwater Gauge N5</b>							
Consecutive days within range	124'	N5 installed spring MY4			25	62	The water table at gage N5 was at or above the ground surface for much of the first two months in the growing season. Water level dipped below the 12" mark in mid-May and stayed below until peaking above 12" late in the growing season.
% of growing season					10.4%	25.7%	
Criteria met?					N	Y	

1- The Army Corps of Engineers states that the range is within 12 inches of the ground surface

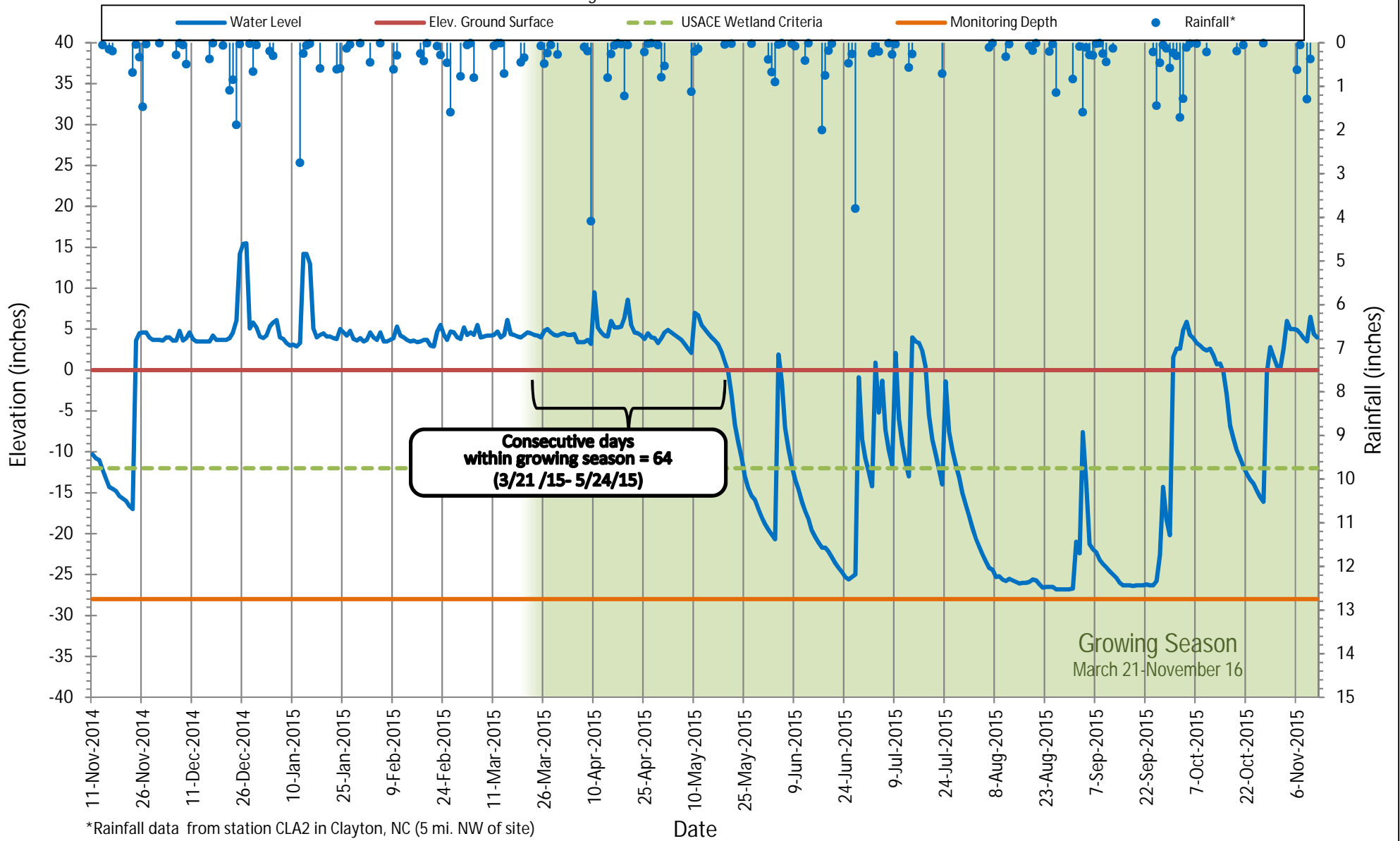
2- The growing season for the site is 241 days long.

3- For years one (1) through three (3), successful wetland hydrology is defined as saturation of soils for a period equal to or greater than 50% of the period measured in the reference wetlands. For year four (4) and beyond until success criteria is met, successful wetland hydrology is defined as saturation of soils for a period equal to or greater than 80% of the period measured in the reference wetlands. (see Table 10a).

\* Ground elevations recorded by Kimley-Horn using a Trimble VRS unit. Elevations are not certified by a professional surveyor.

# Shallow Water Table Gauge B1

November 11, 2014 - November 12, 2015  
 Growing Season: March 21 - November 16

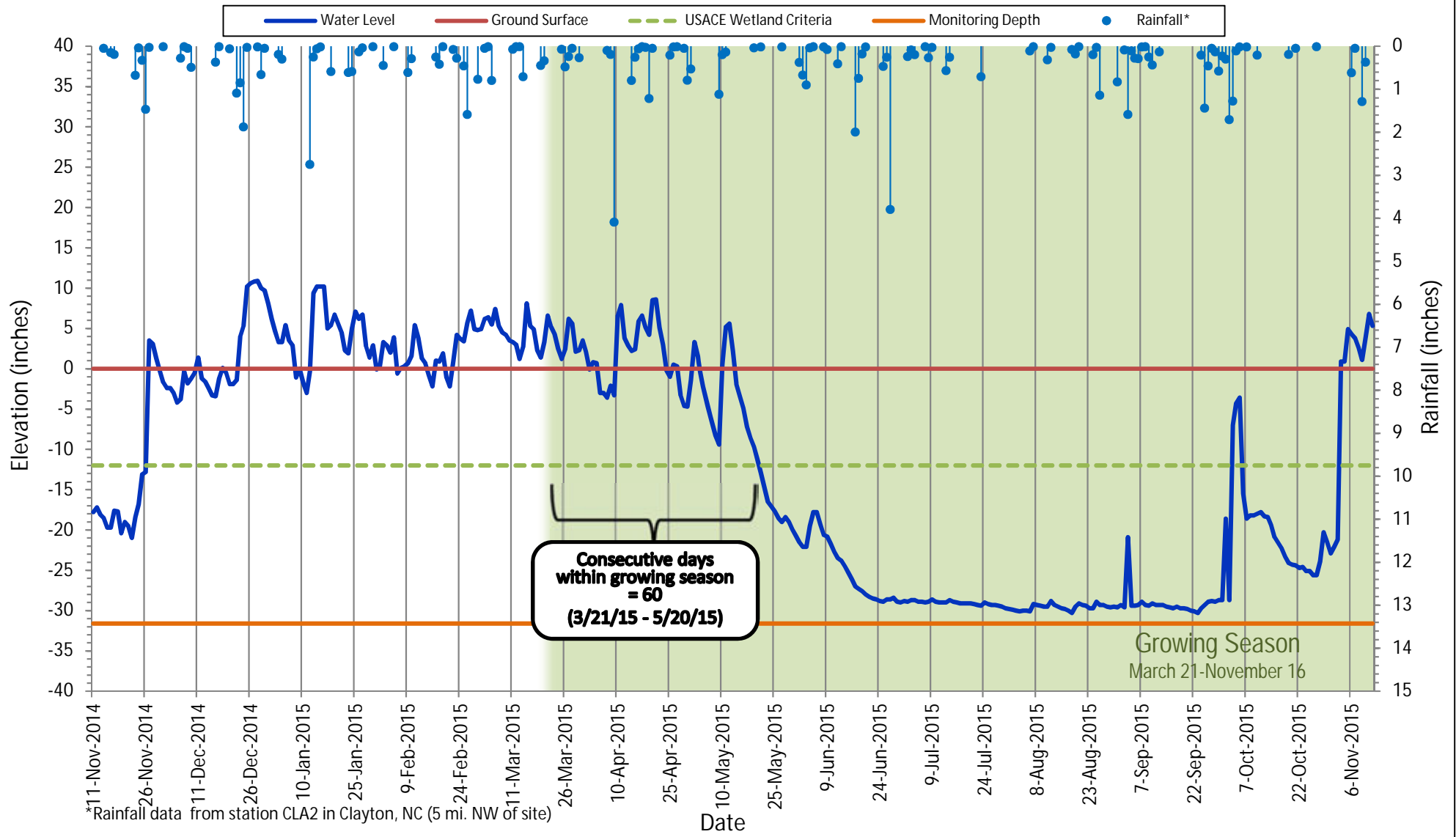


\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)



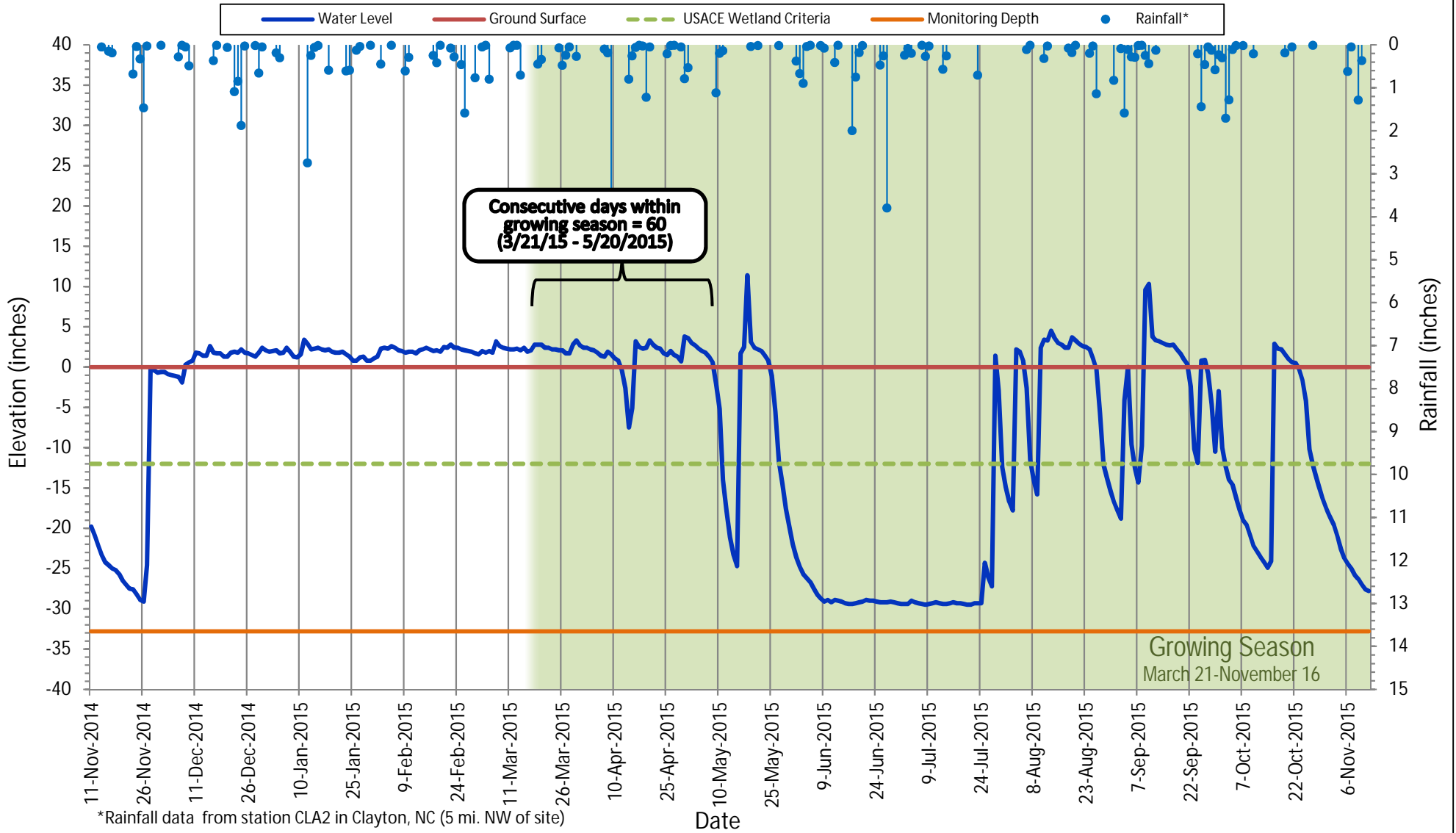
# Shallow Water Table Gauge B2

November 11, 2015 - November 12, 2015  
Growing Season: March 21 - November 16



# Shallow Water Table Gauge C2

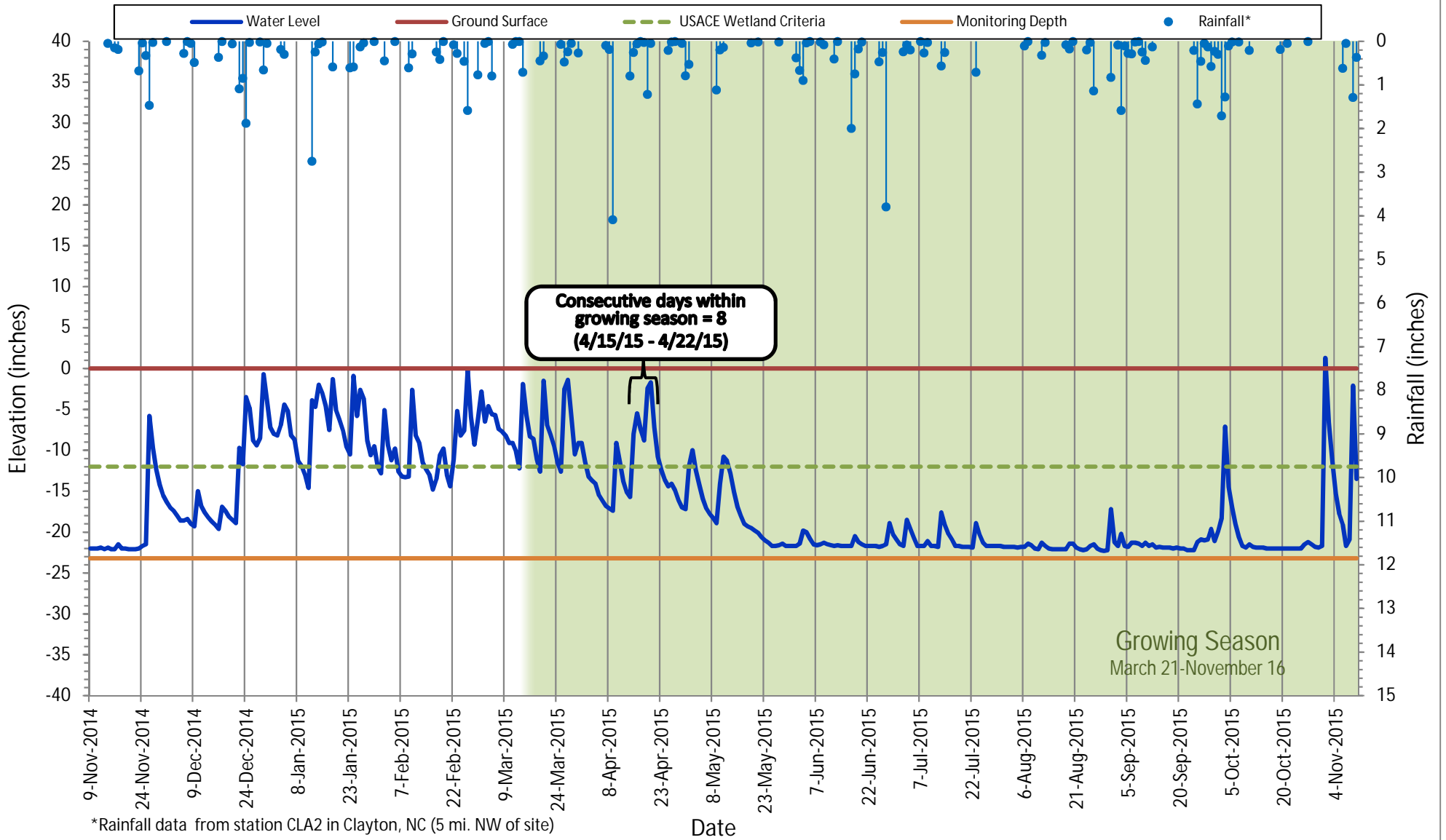
November 11, 2014 - November 12, 2015  
Growing Season: March 21 - November 16





# Shallow Water Table Gauge D2

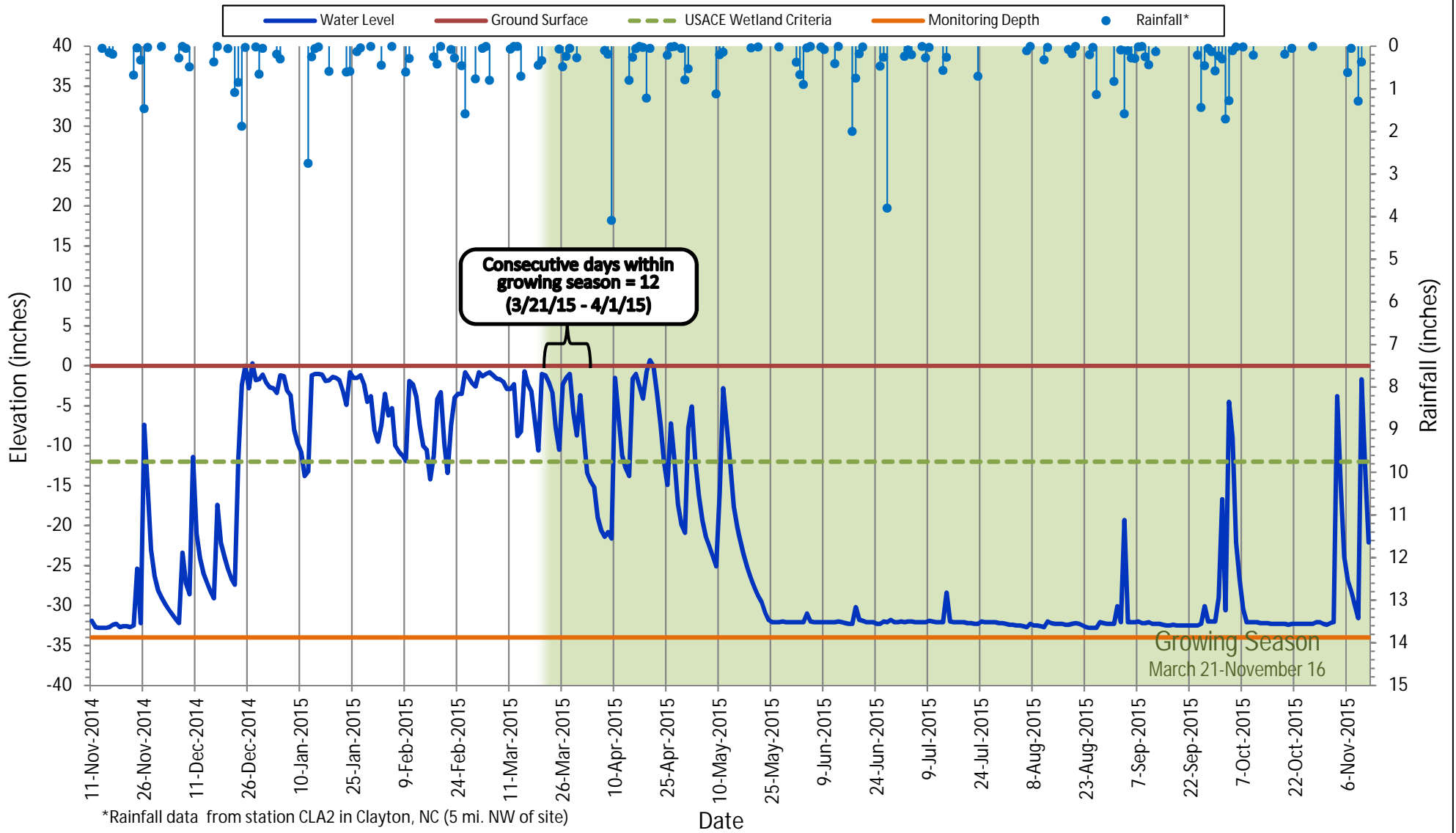
November 9, 2014 - November 10, 2015  
 Growing Season: March 21 - November 16



\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)

# Shallow Water Table Gauge E2

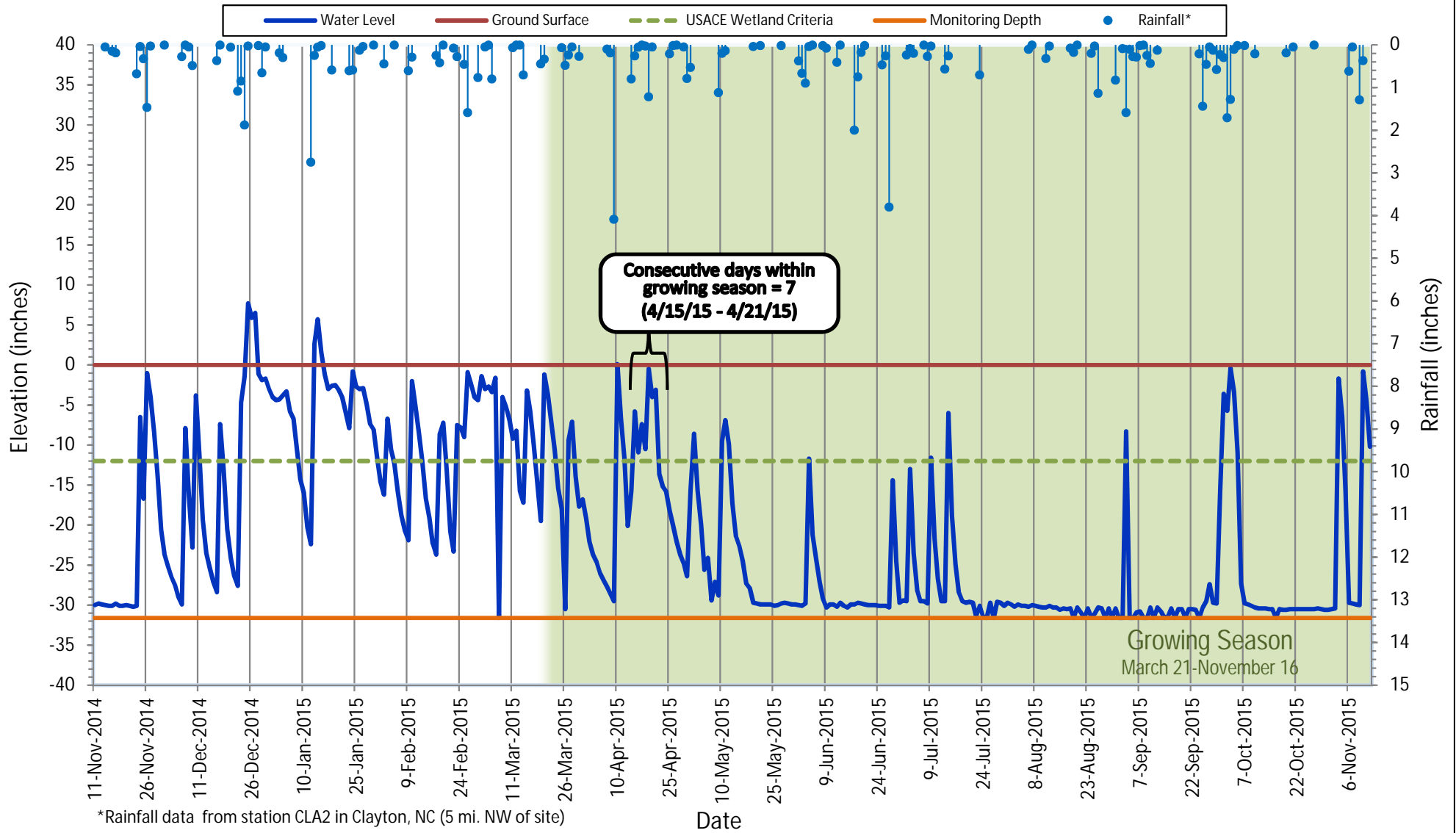
November 11, 2014 - November 12, 2015  
Growing Season: March 21 - November 16





# Shallow Water Table Gauge F2

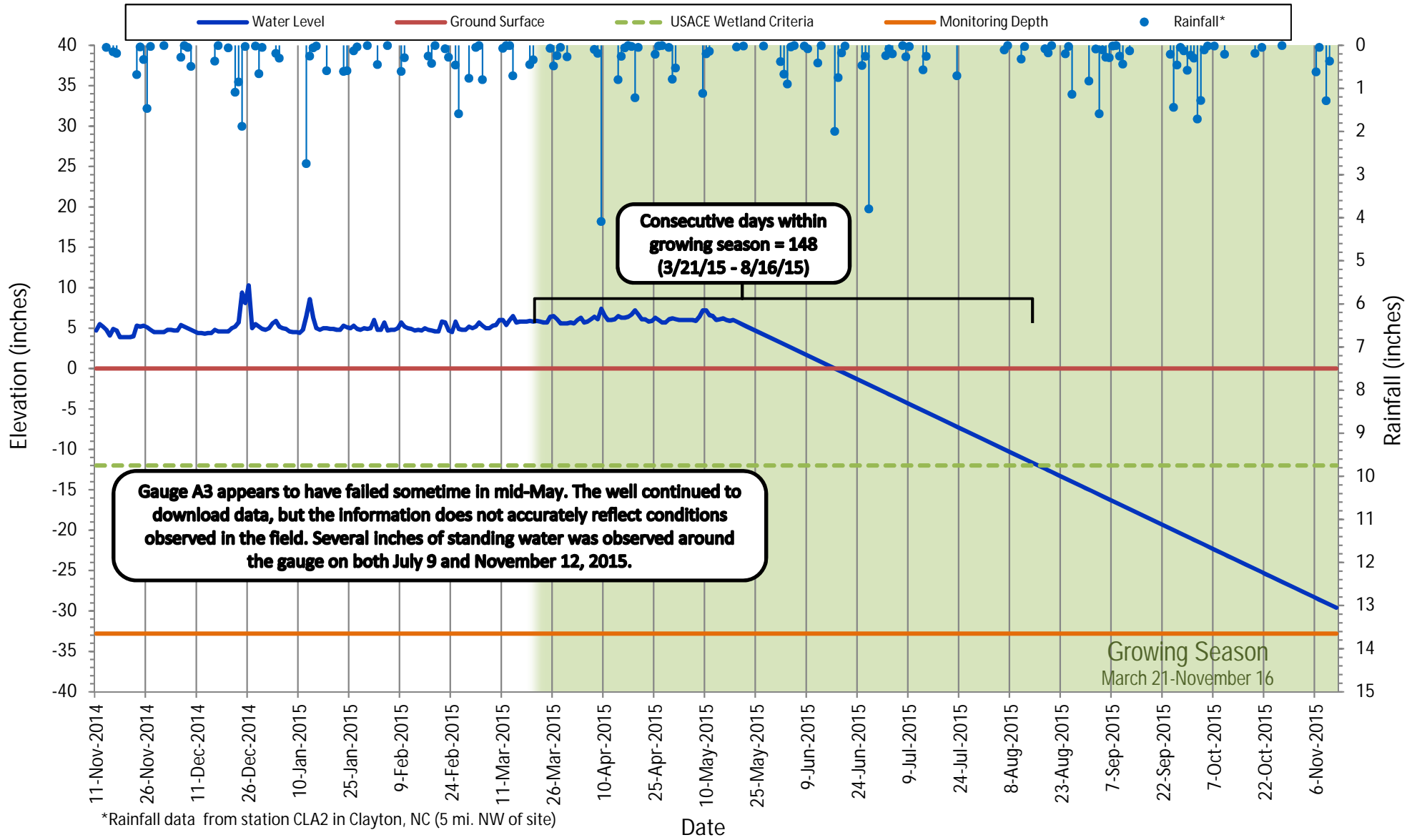
November 11, 2014 - November 12, 2015  
 Growing Season: March 21 - November 16



\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)

# Shallow Water Table Gauge A3

November 11, 2014 - November 12, 2015  
 Growing Season: March 21 - November 16

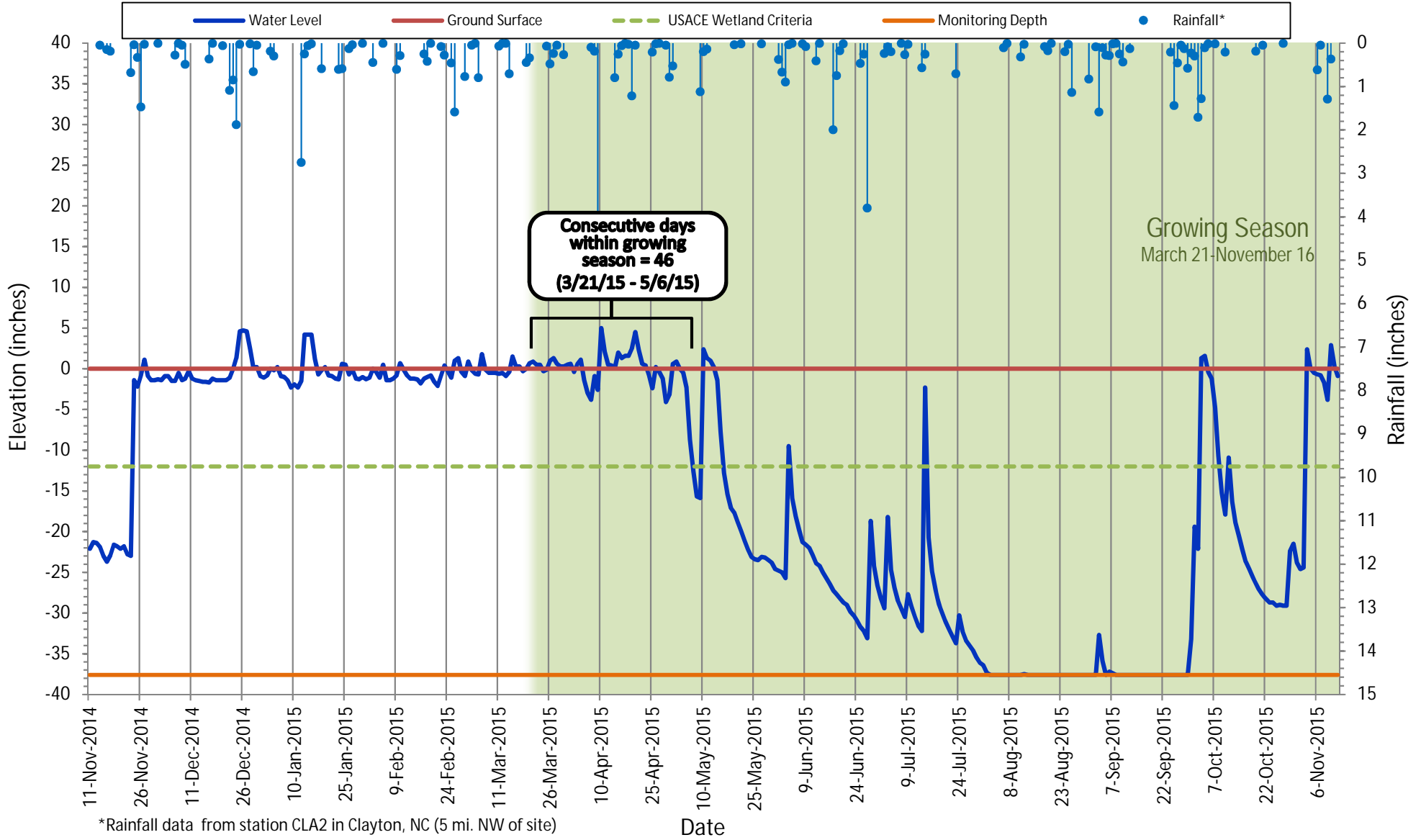


\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)



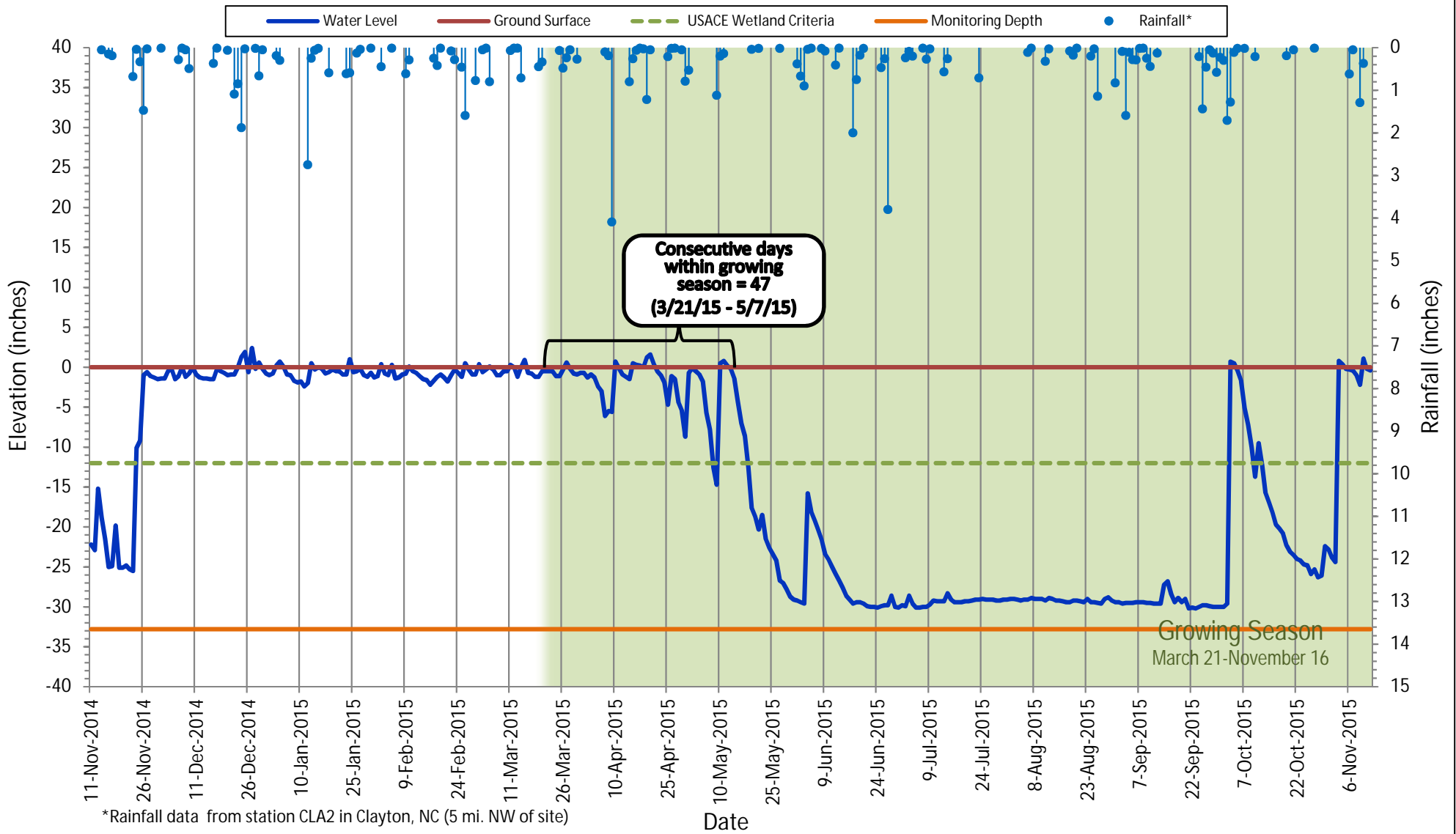
# Shallow Water Table Gauge B3

November 11, 2014 - November 12, 2015  
Growing Season: March 21 - November 16



# Shallow Water Table Gauge A4

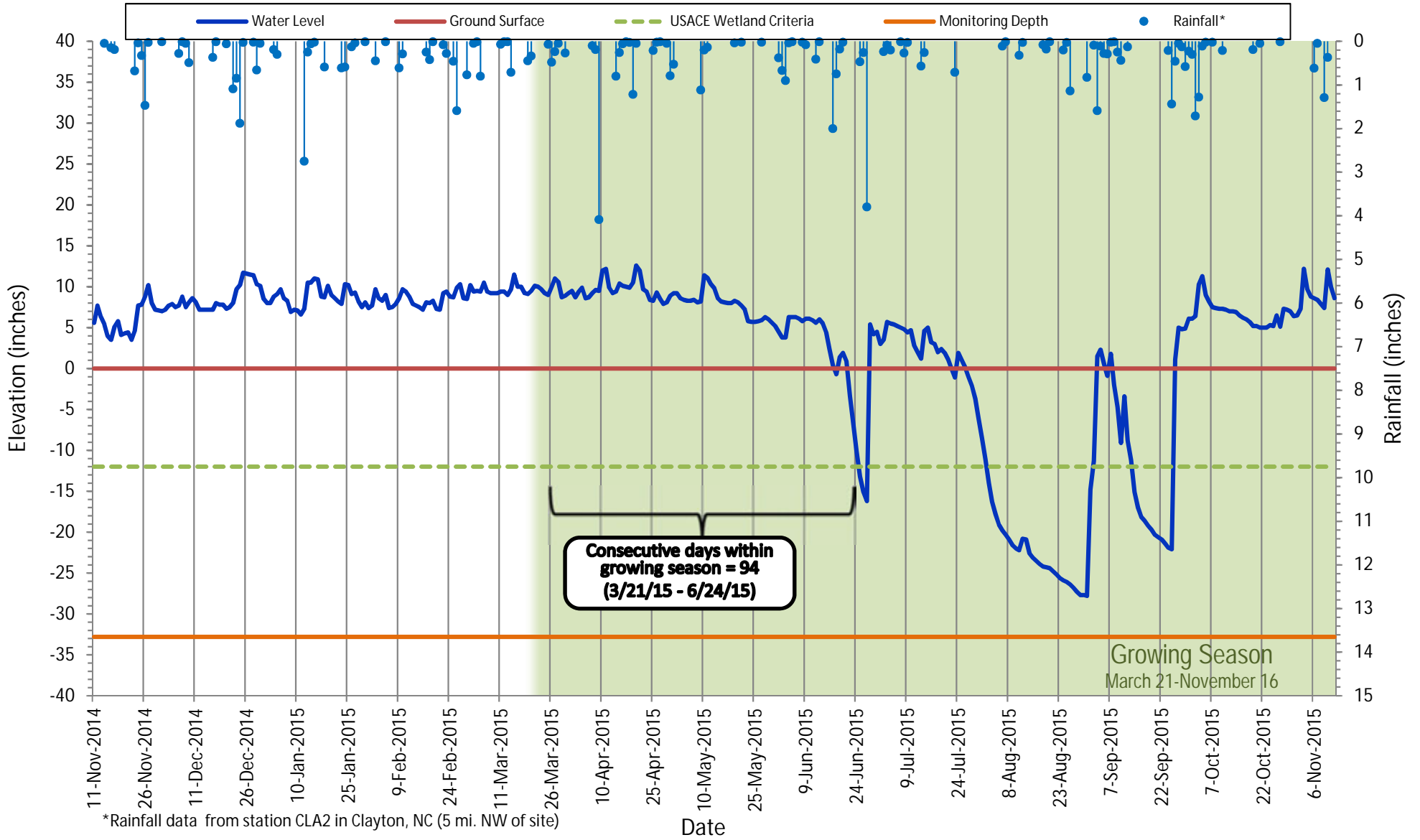
November 11, 2014 - November 12, 2015  
Growing Season: March 21 - November 16





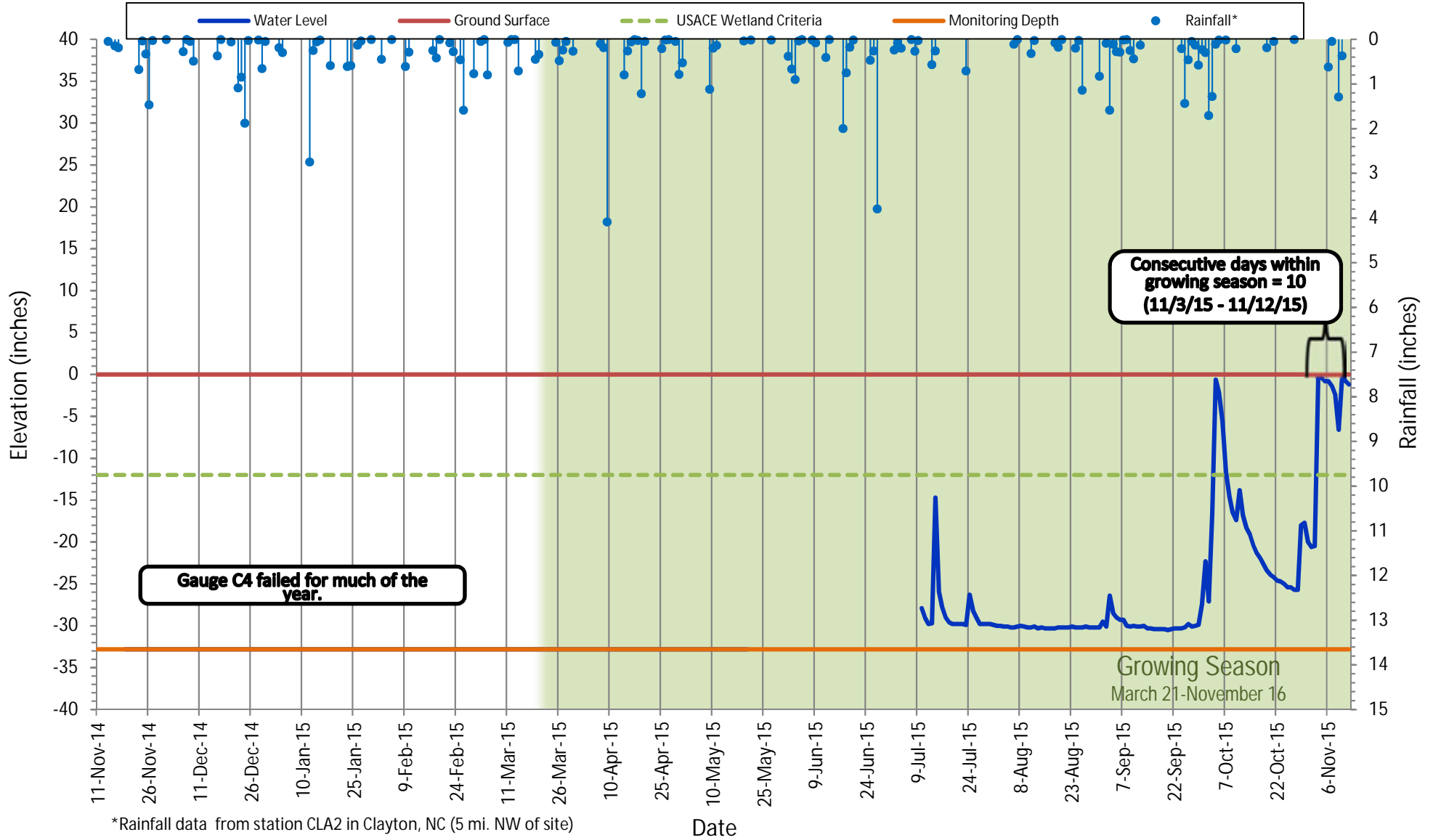
# Shallow Water Table Gauge B4

November 11, 2014 - November 12, 2015  
Growing Season: March 21 - November 16



# Shallow Water Table Gauge C4

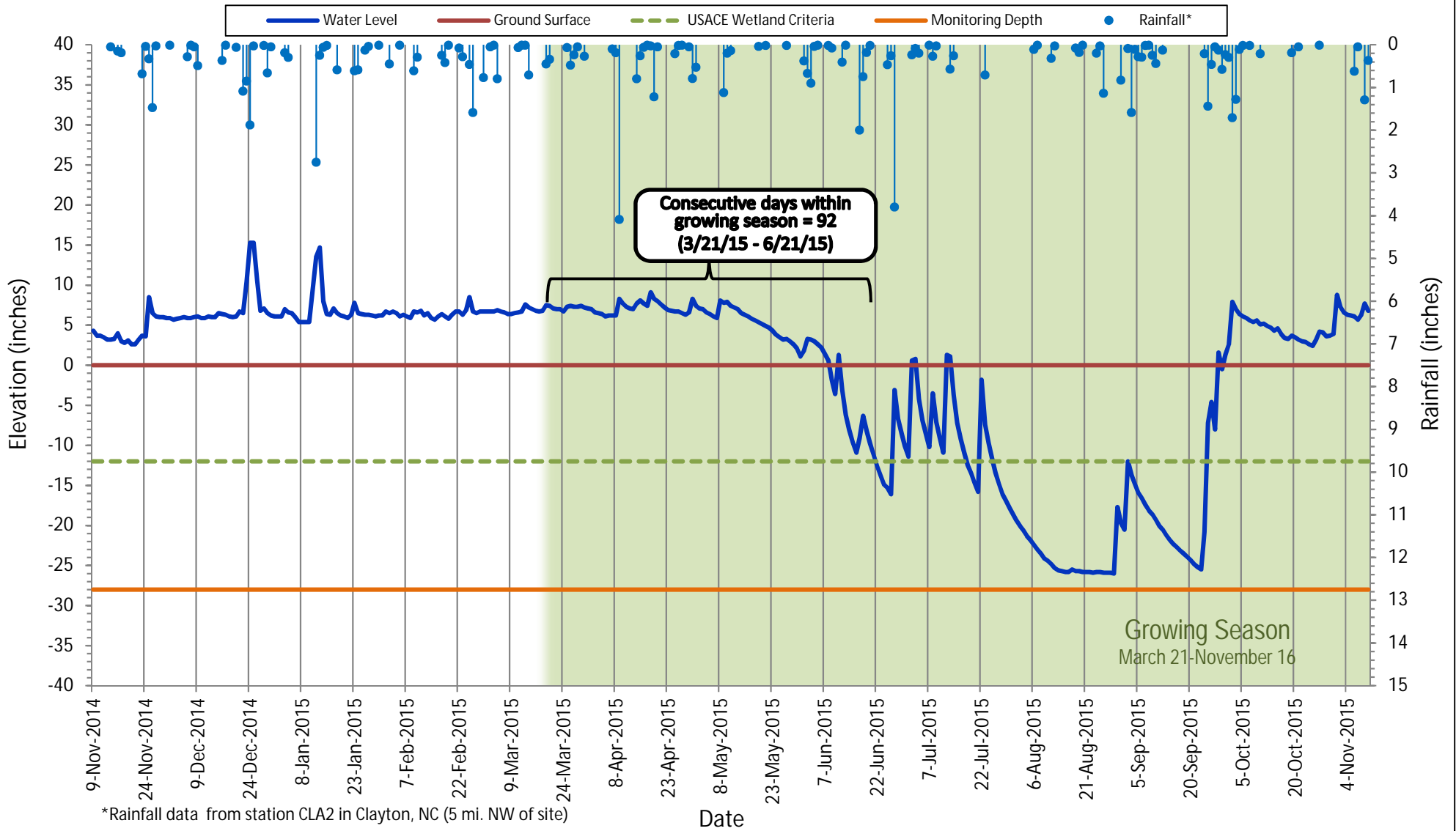
November 11, 2014 - November 12, 2015  
 Growing Season: March 21 - November 16



\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)

# Shallow Water Table Gauge D4

November 9, 2014 - November 10, 2015  
 Growing Season: March 21 - November 16

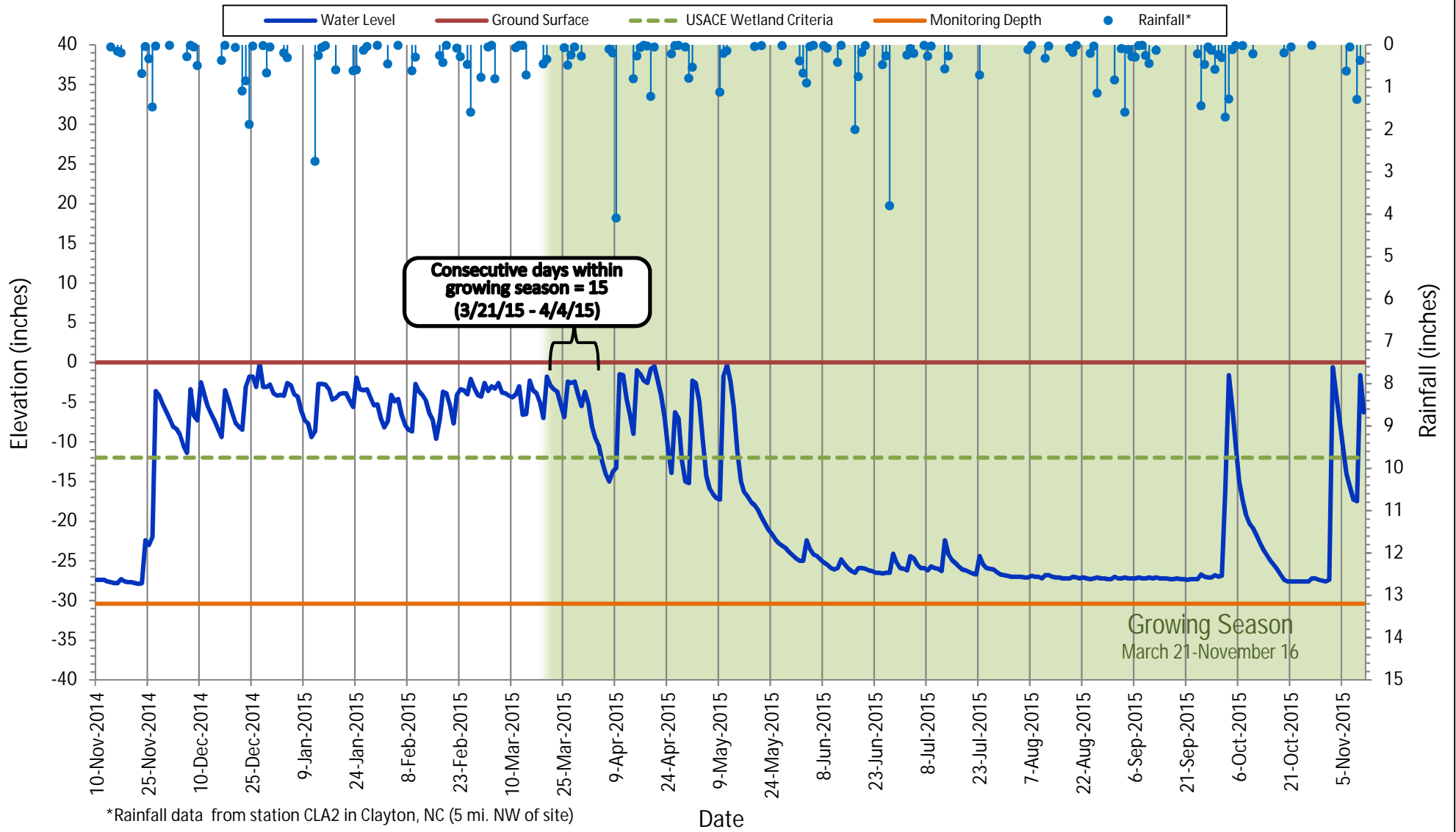


\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)



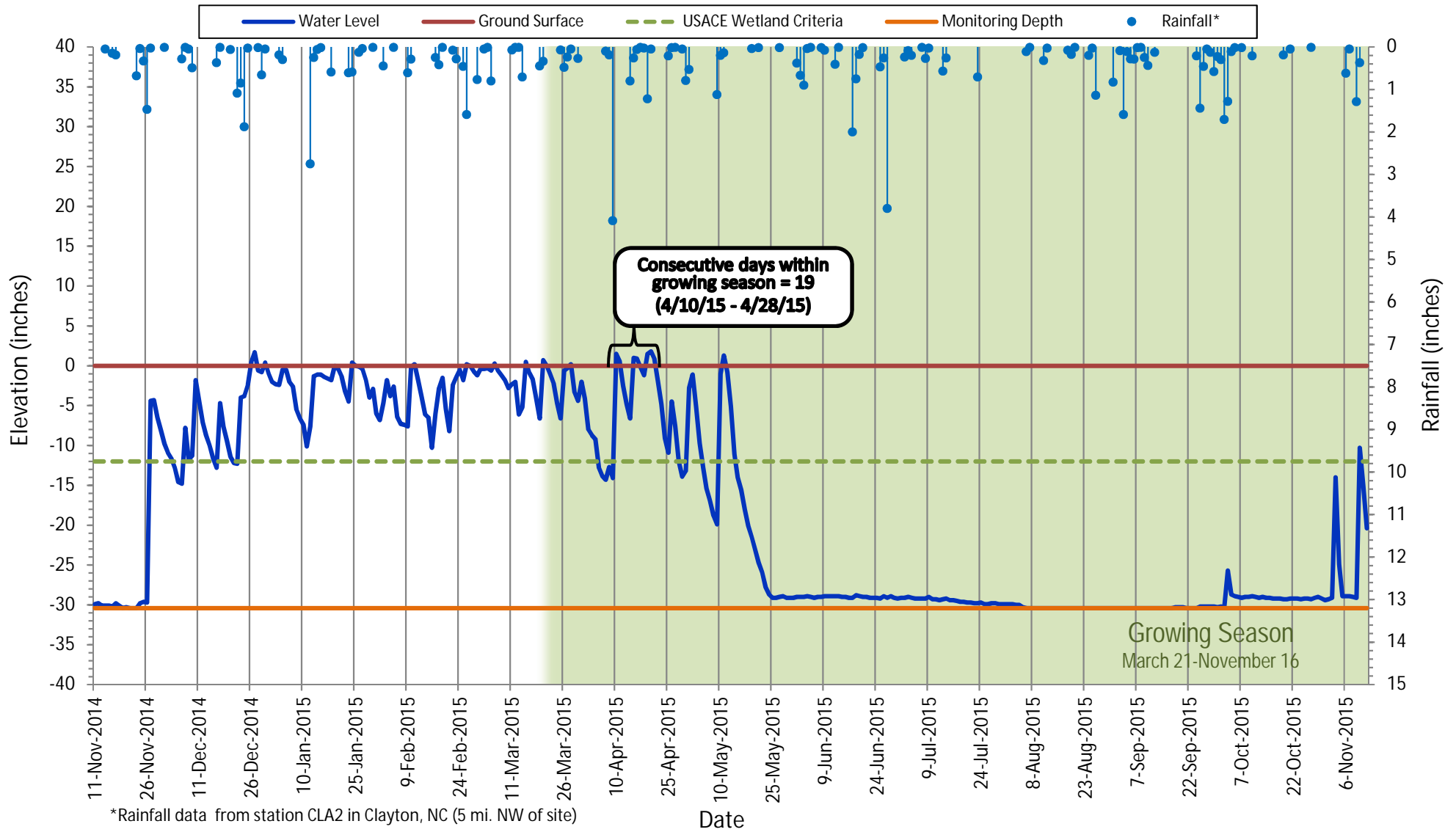
# Shallow Water Table Gauge E4

November 10, 2014 - November 11, 2015  
 Growing Season: March 21 - November 16



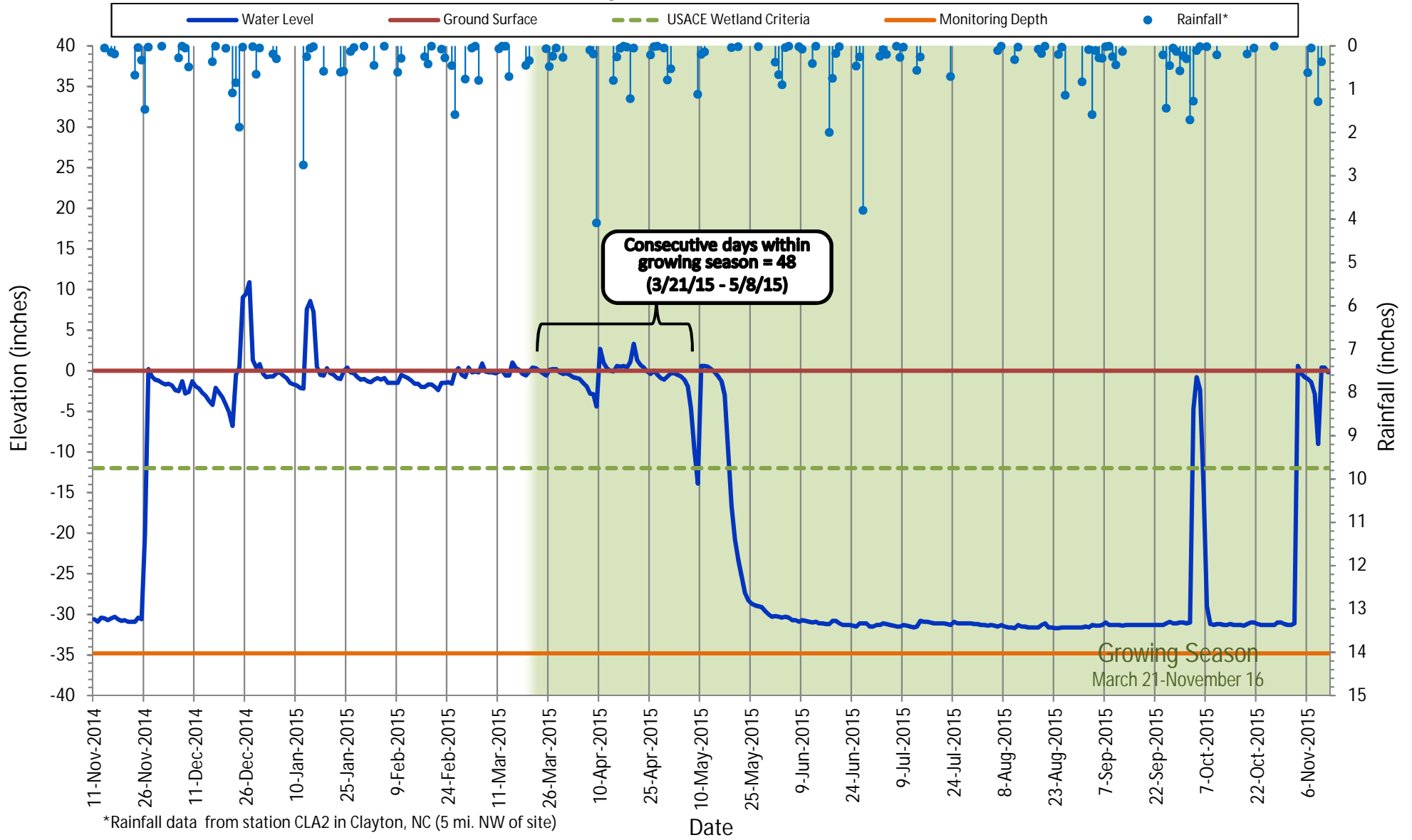
# Shallow Water Table Gauge F4

November 11, 2014 - November 12, 2015  
 Growing Season: March 21 - November 16



# Shallow Water Table Gauge G4

November 11, 2014 - November 12, 2015  
Growing Season: March 21 - November 16

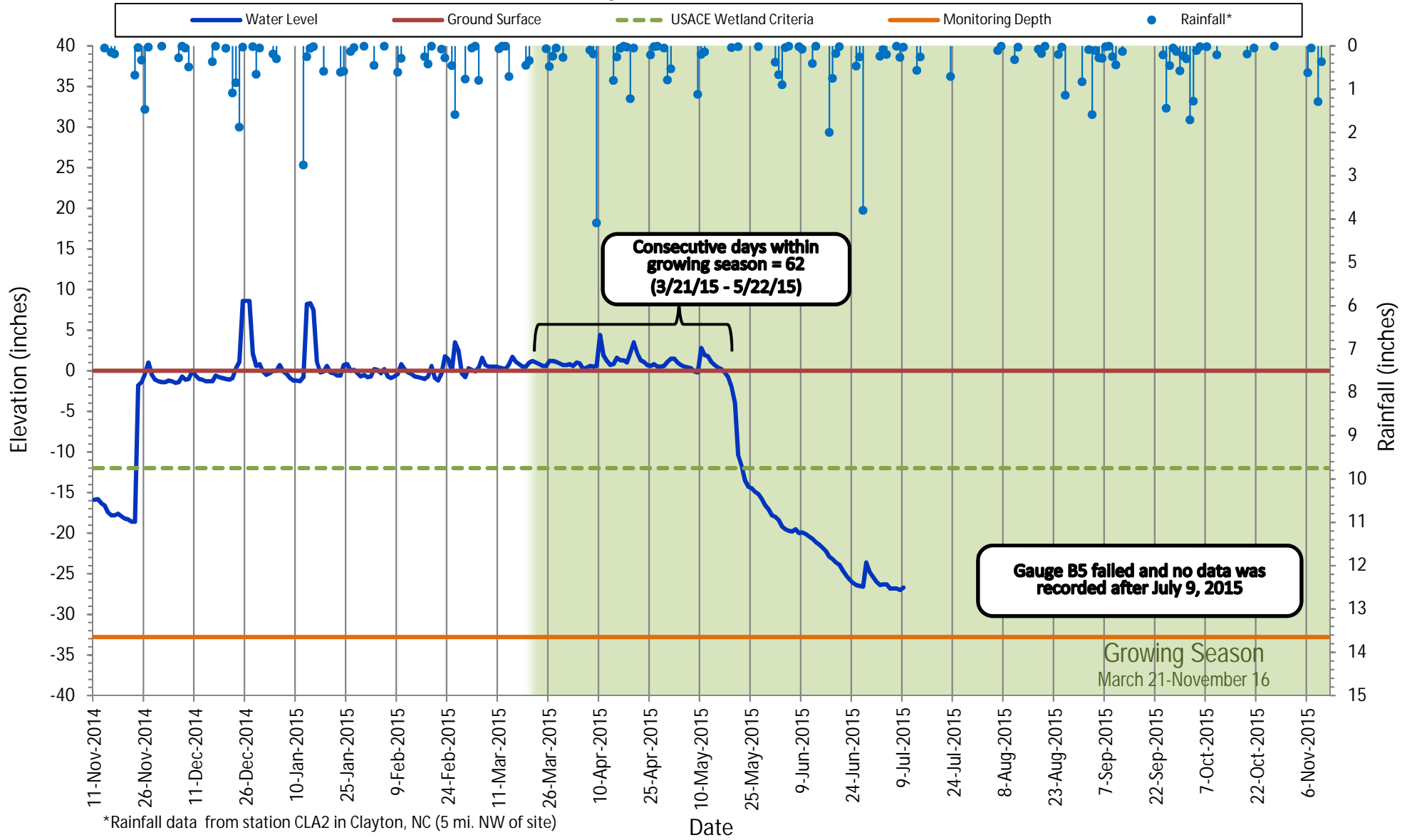


\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)



# Shallow Water Table Gauge B5

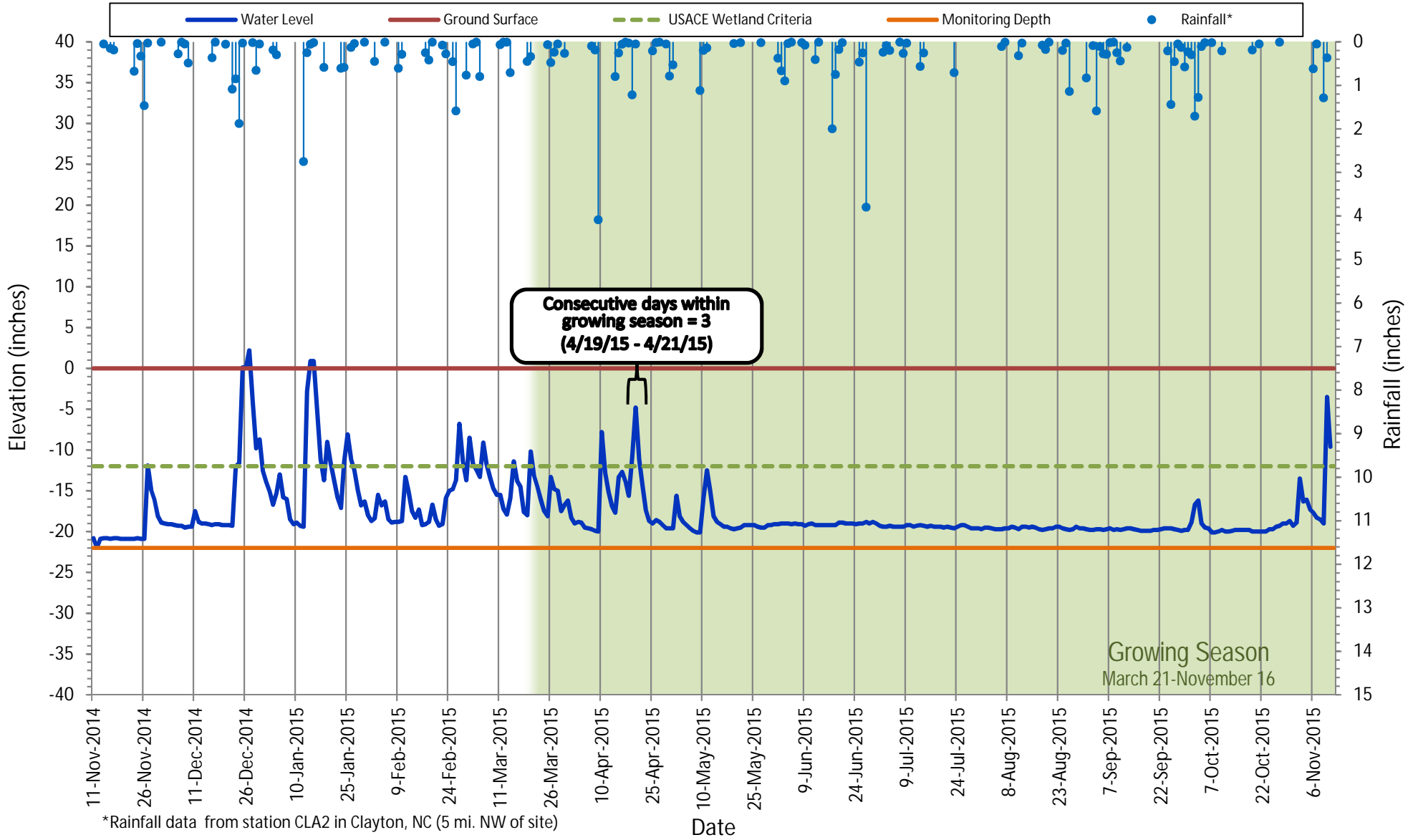
November 11, 2014 - November 12, 2015  
 Growing Season: March 21 - November 16



\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)

# Shallow Water Table Gauge N1

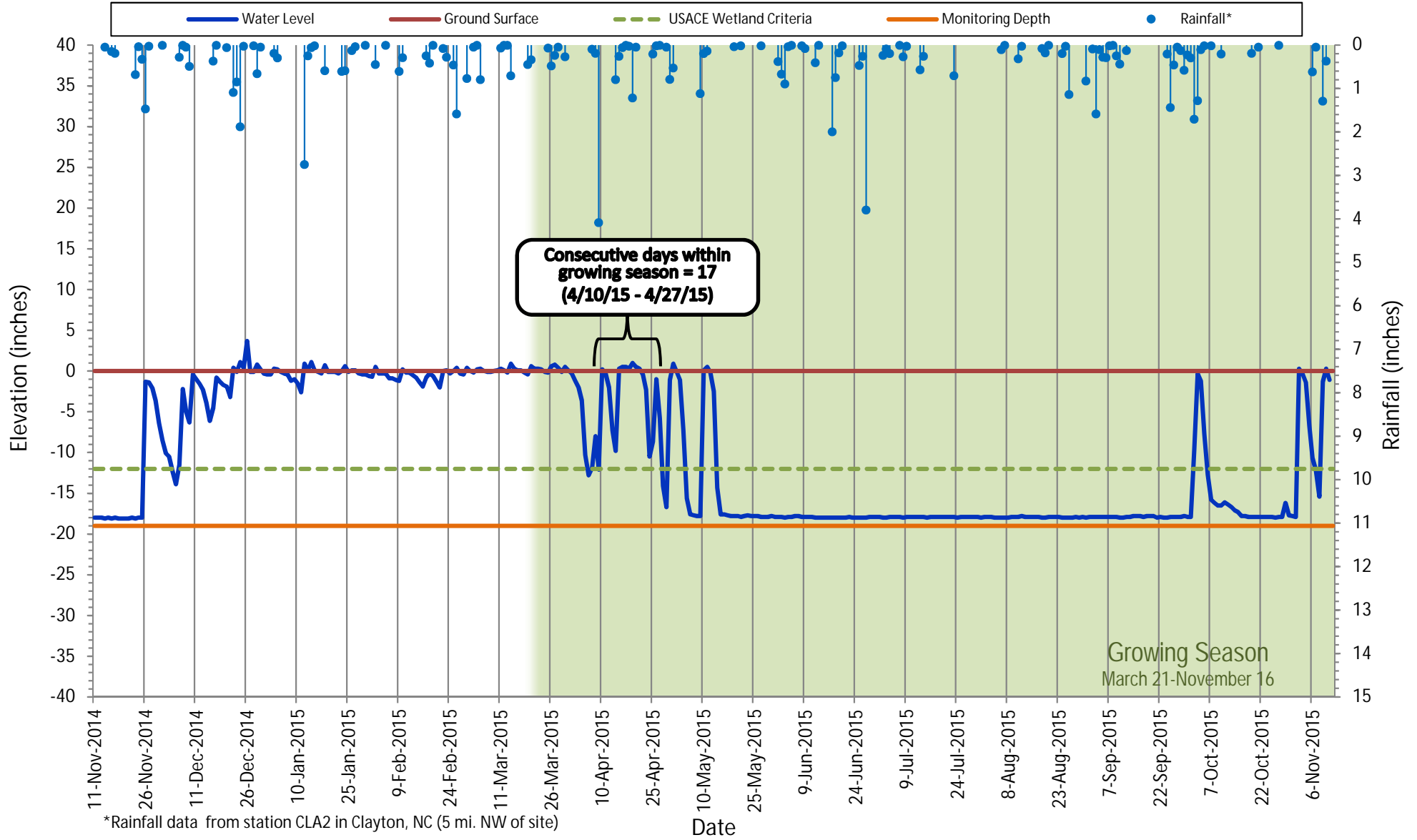
November 11, 2014 - November 12, 2015  
 Growing Season: March 21 - November 16



\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)

# Shallow Water Table Gauge N2

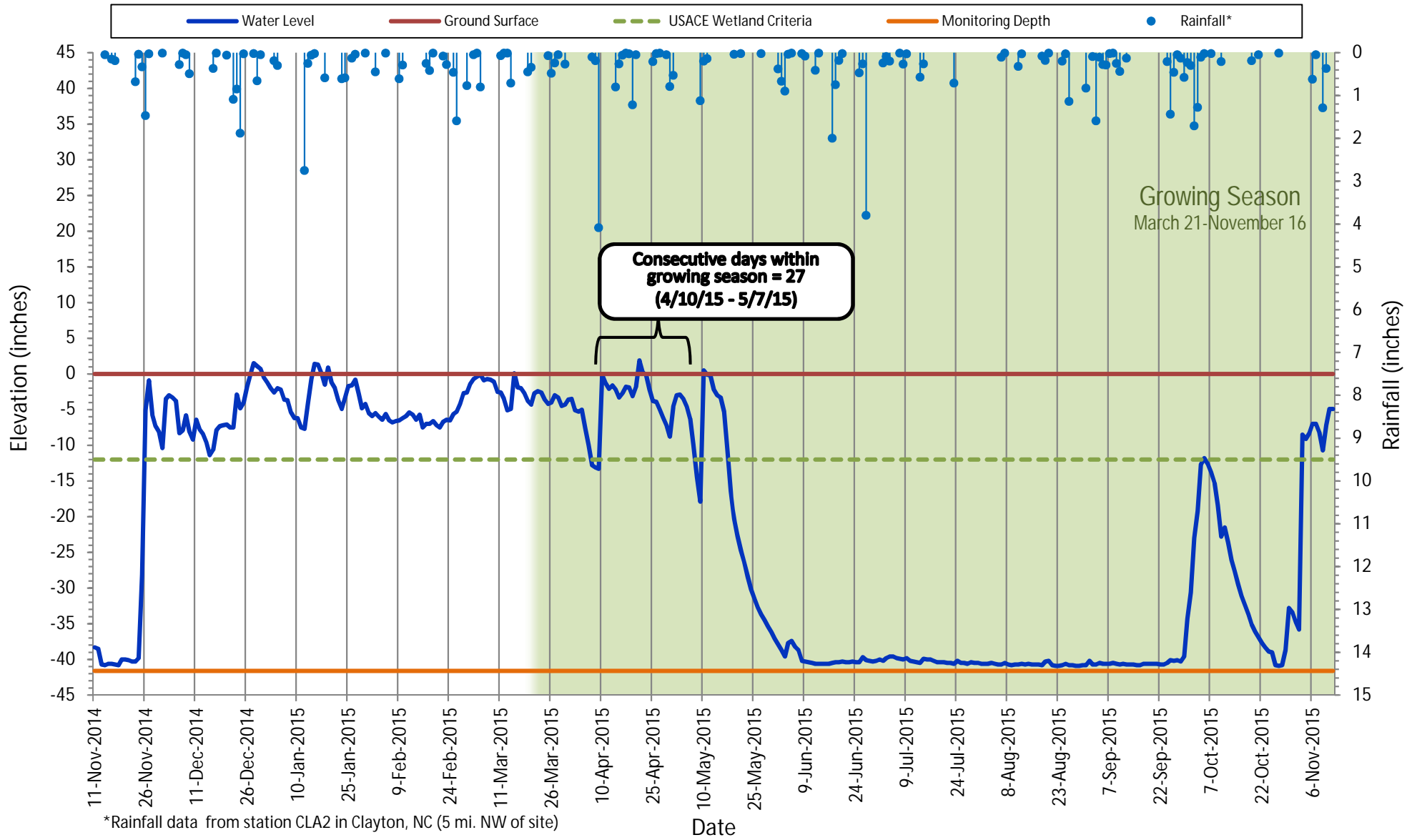
November 11, 2014 - November 12, 2015  
Growing Season: March 21 - November 16





# Shallow Water Table Gauge N3

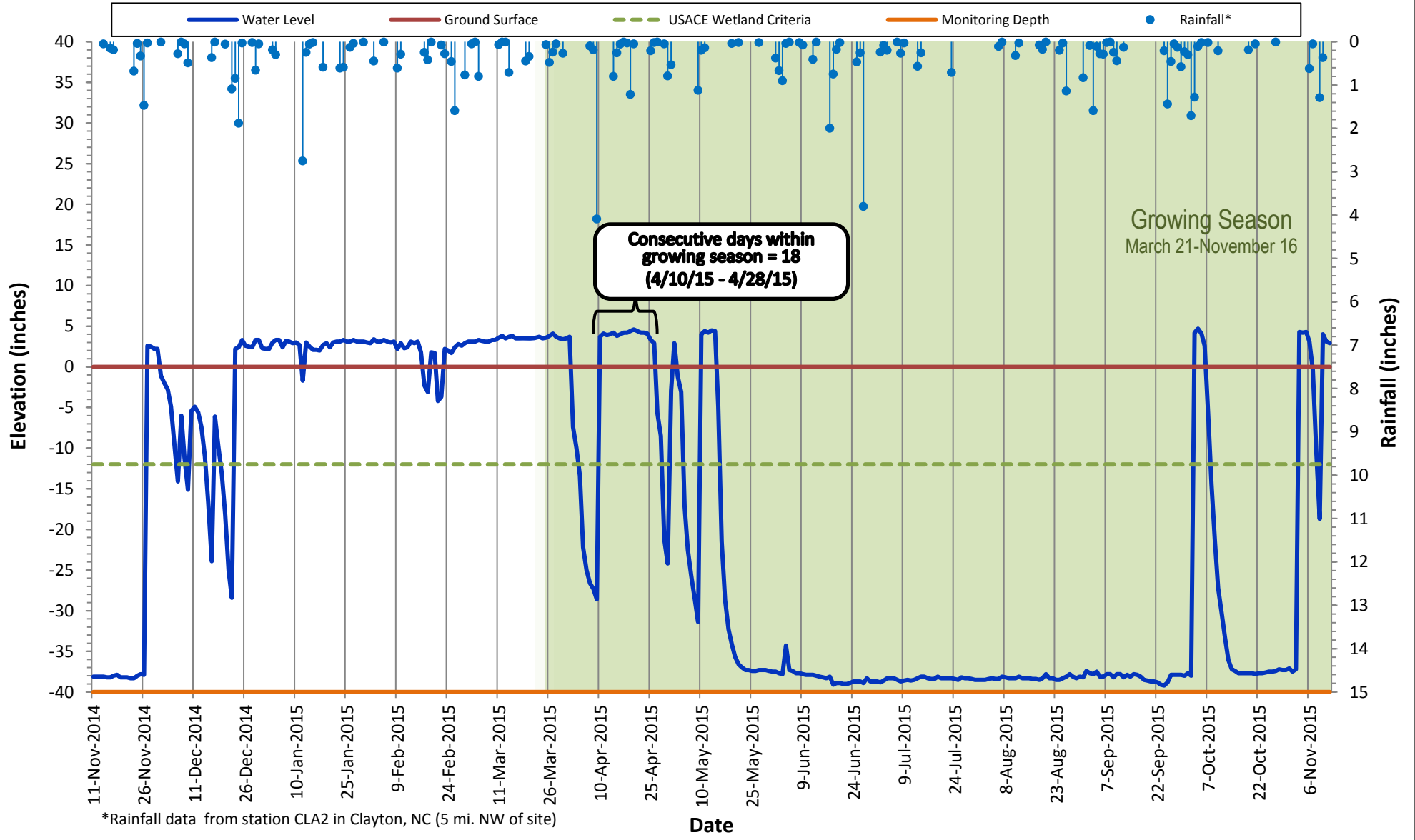
November 11, 2014 - November 12, 2015  
Growing Season: March 21 - November 16



\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)

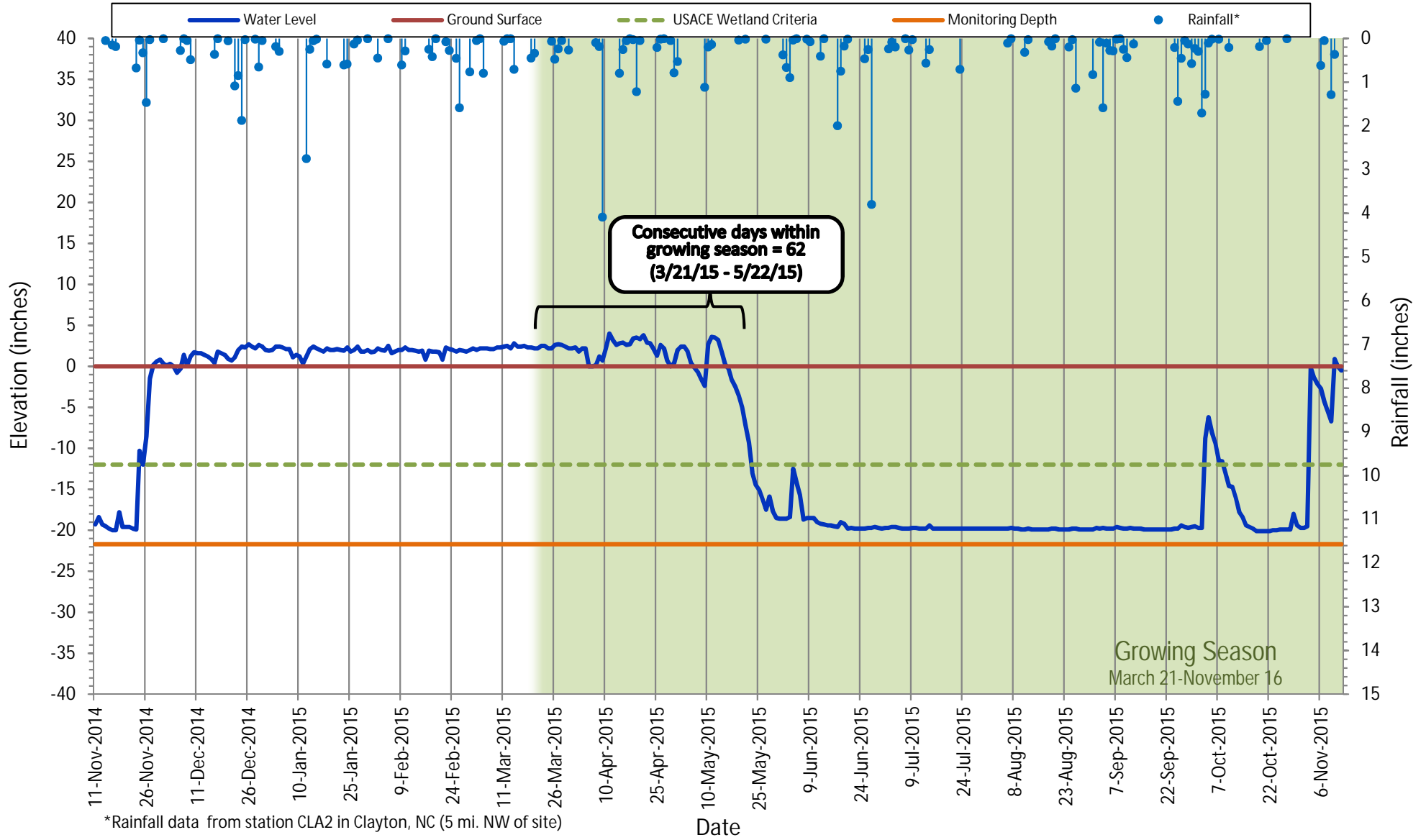
## Shallow Water Table Gauge N4

November 11, 2014 - November 12, 2015  
 Growing Season: March 21 - November 16



# Shallow Water Table Gauge N5

November 11, 2014 - November 12, 2015  
 Growing Season: March 21 - November 16

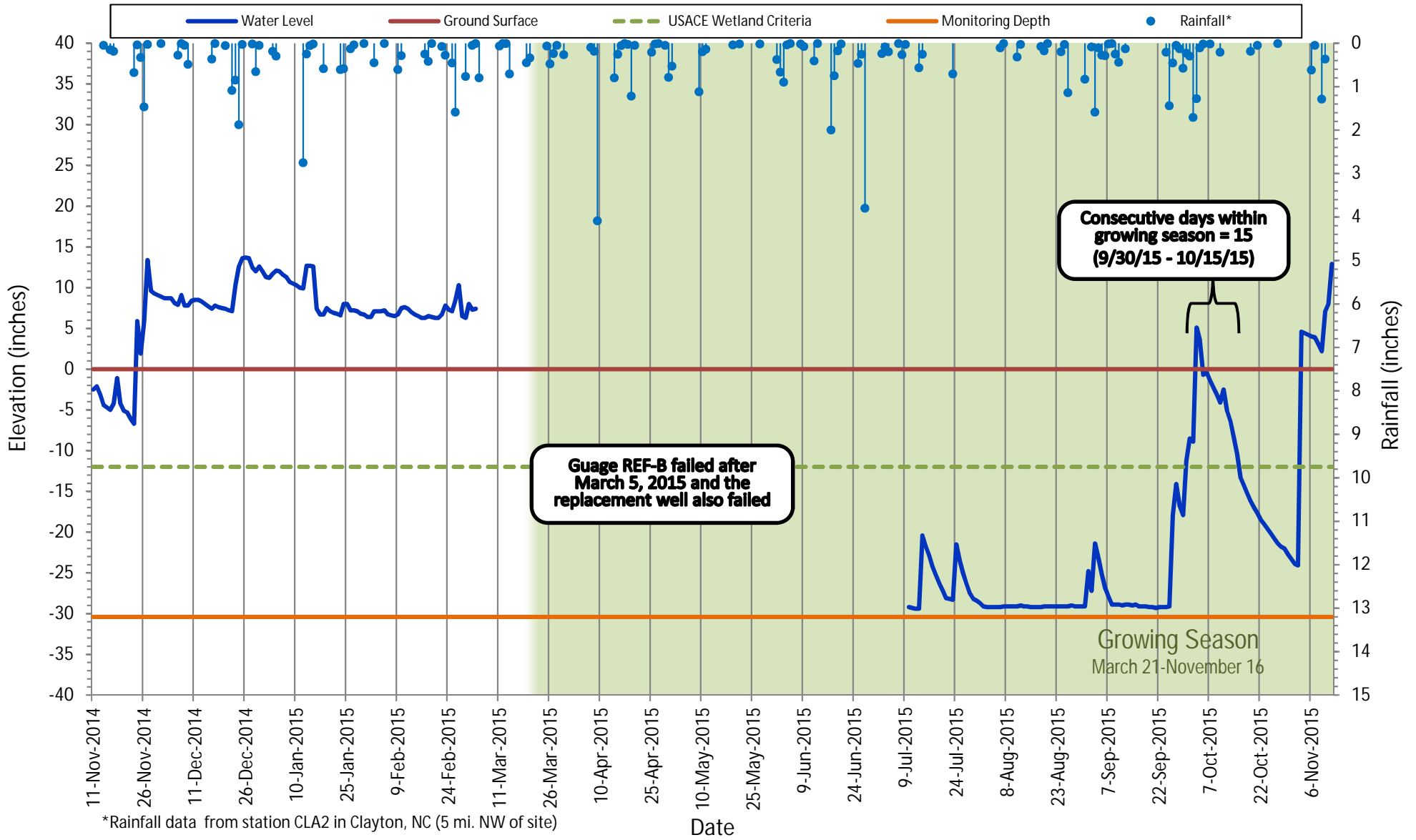


\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)



# Shallow Water Table Gauge REF-B

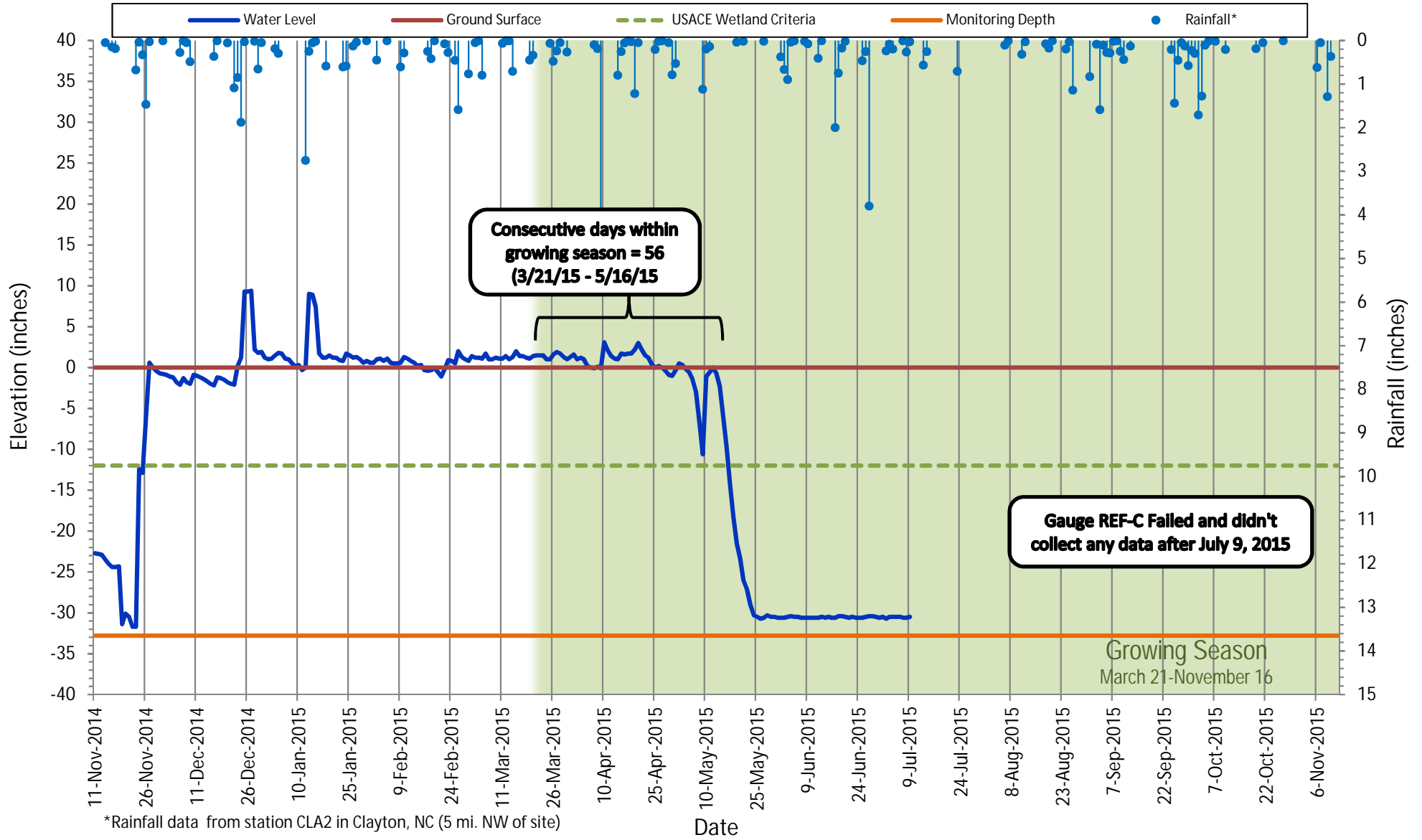
November 11, 2014 - November 12, 2015  
Growing Season: March 21 - November 16



\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)

# Shallow Water Table Gauge REF-C

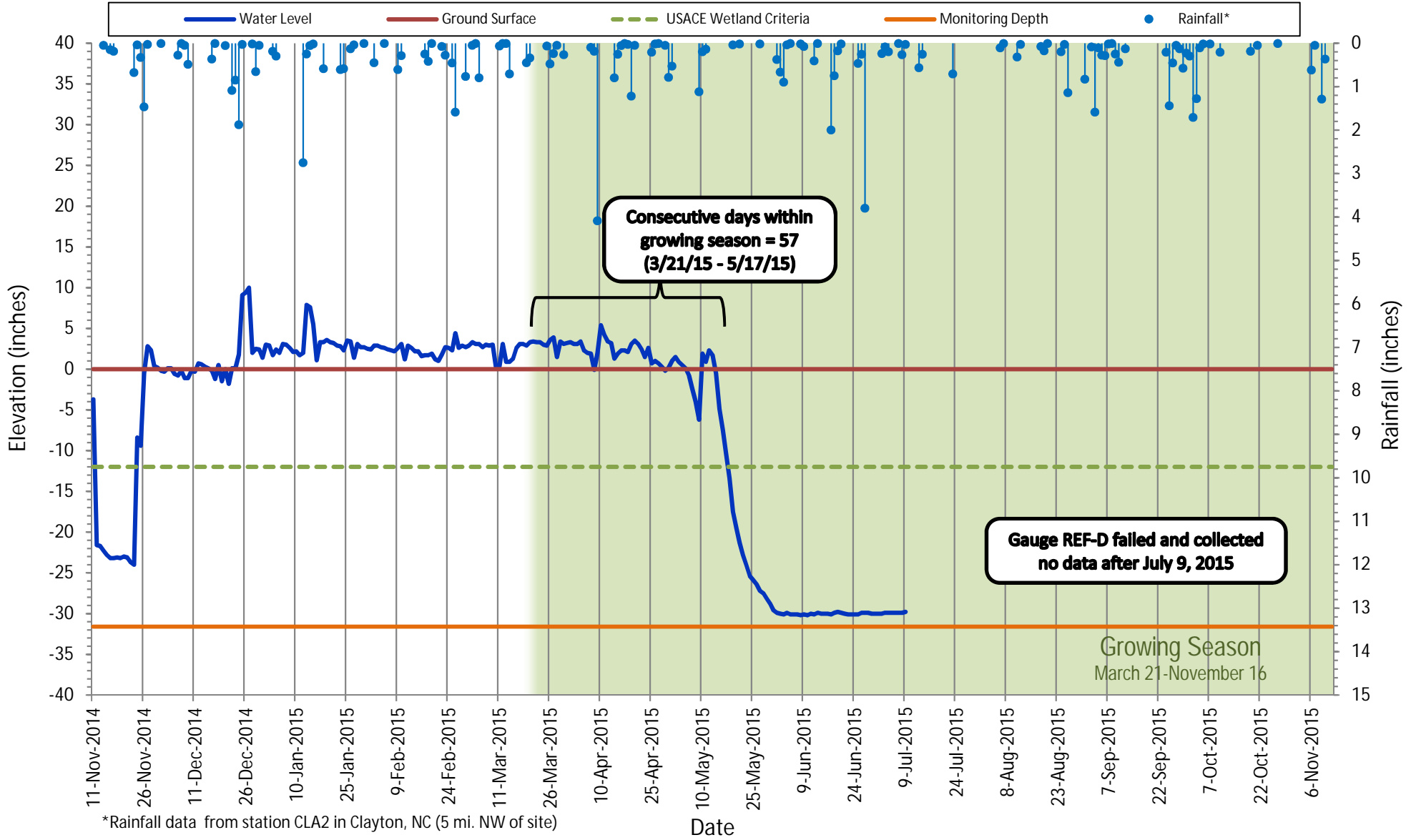
November 11, 2014 - November 12, 2015  
Growing Season: March 21 - November 16



\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)

# Shallow Water Table Gauge REF-D

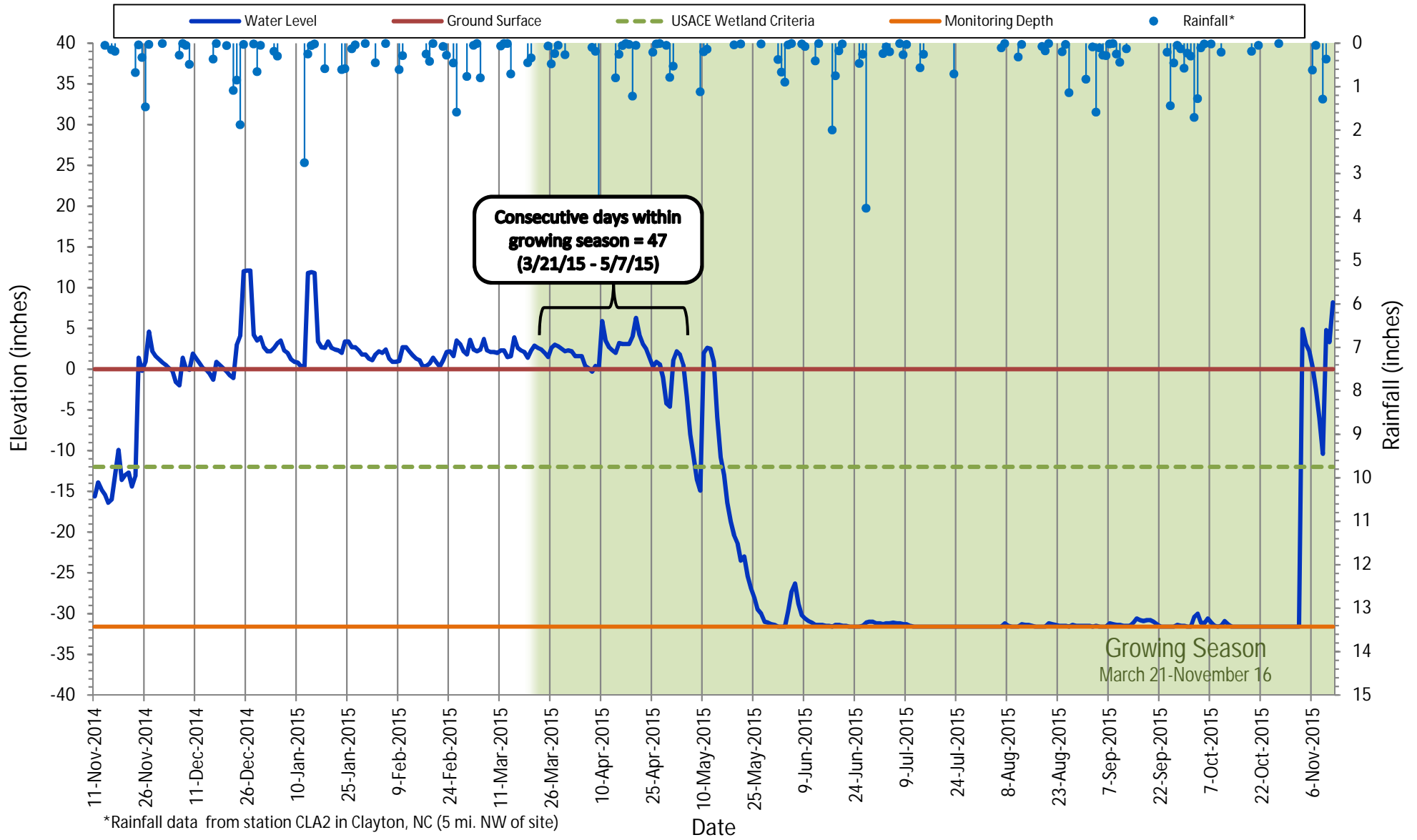
November 11, 2014 - November 12, 2015  
Growing Season: March 21 - November 16





# Shallow Water Table Gauge REF-E

November 11, 2014 - November 12, 2015  
Growing Season: March 21 - November 16



\*Rainfall data from station CLA2 in Clayton, NC (5 mi. NW of site)

# Shallow Water Table Gauge REF-F

November 11, 2014 - November 12, 2015  
Growing Season: March 21 - November 16

