Powell Property Wetland and Stream Mitigation Project
Bertie County, NC

2009 Annual Monitoring Report
Year 1

NCEEP Project Number D06065-B
Chowan River Basin
USGS Catalog Unit 03010203

Submitted to
NCDENR/Ecosystem Enhancement Program
2728 Capital Blvd.
Raleigh, NC 27604

Date: March, 2010

Monitoring:
Albemarle Restorations, LLC
P. O. Box 176
Fairfield, NC 27826

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Executive Summary

The Powell Property Wetland and Stream Mitigation Site is a headwater riverine wetland and stream mitigation project located southeast of Powellsville, in Bertie County, North Carolina. It was constructed by Albemarle Restorations, LLC, under contract with EEP to provide 48.4 acres of riverine wetland mitigation credits and 3,310 linear feet of stream mitigation credits in the Chowan River Basin. Construction activities, in accordance with the approved restoration plan, began in June of 2008, and were completed in January of 2009. Tree and shrub planting on the project site occurred immediately afterward in January of 2009. An emergent wetland seed mixture was sown shortly afterward.

Ten water level monitoring gauges are located at varying elevations throughout the riverine wetland and stream valley areas of the site to measure surface and subsurface water elevations. Two additional gauges are located in the headwater stream reference area to help monitor flow and water level within the reference stream system. Of the ten gauges deployed across the project site, seven indicated successful wetland hydrology by showing water levels within 12 inches of the ground surface for a minimum of 5% of the growing season. The three gauges that did not show successful hydrology were all located in the riverine wetland areas of the project. There was a cumulative rainfall surplus of 14 inches during 2009, though much of the above average precipitation fell outside the dates of the growing season. It is anticipated that wetland hydrology will continue to equilibrate over the next year as soil structure develops and precipitation patterns normalize. Two separate flow events were video documented during the 2009 growing season. The data from the water level monitoring gauges coincides with and confirms the video evidence of water flowing through and off the site.

A total of ten vegetation monitoring plots are located on the site, seven in the riverine wetland areas and three more situated to monitor the swamp run vegetation. One plot is entirely within the boundaries of the swamp run and two more are located so as to share both land forms, making a total of ten plots. Each plot is a 10m X 10m square, as recommended by the CVS-EEP protocol for recording vegetation sampling. All ten plots met the third year survival success criterion of a minimum of 320 stems per acre.

Table ES-1 shows the levels of success attained by each of the water level monitoring gauges and the vegetation plots. The success criterion for hydrology is maintained groundwater levels within 12 inches of the soil surface for 5% to 8% of the growing season (12 to 19 consecutive days). Table C-1 in Appendix C has a detailed breakdown of hydrologic success. The success criterion for the vegetation plots is the third year level of survival (320 stems per acre).

Table ES-1. Project Success Summary

Success		1	2	3	4	5	6	7	8	9	10	Percent Success
Year 1	Gauges	Y	Y	Y	N	Y	N	N	Y	Y	Y	70%
	Veg. Plots	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%

I. Project Background

1.0 Project Objectives

The goal of the Powell Property Mitigation Project was to create a riverine wetland system typically found in the middle to upper reaches of first or zero order tributary systems. The project is to serve as compensation for wetland loss in the Chowan River Basin. The restoration plan was developed and implemented to eliminate pattern drainage and restore topography and hydrology that more closely resembled that of similar undisturbed land. Construction resulted in the development of a broad, branched, frequently flooded swamp run following a historical path as evidenced by archived aerial photographs and signature topography. Subsequent planting was designed to restore a wetland forest ecosystem that is typically found in the immediate area characteristic of similar soils, topography and hydrology.

Ecological benefits of the restored riparian headwater system and its associated riverine wetlands are the following:

1. Water quality improvements, including nutrient, toxicant and sediment retention and reduction, increasing dissolved oxygen levels, as well as reducing excessive algae growth, and reducing surface water temperatures in receiving waters by providing permanent shading in the form of a shrub/scrub and forested headwater wetland system.
2. Wildlife habitat enhancement by adding to the existing adjacent forested areas creating a continuous travel corridor between habitat blocks and providing a wide range of habitat areas (open water, emergent, shrub/scrub and forested) for amphibians, reptiles, birds, insects and mammals.
3. Flood flow attenuation during storm events which reduces sedimentation and erosion downstream, and improves long term water quality within the Chowan River.
4. Passive outdoor recreation and educational opportunities for the landowner and the surrounding community.

2.0 Project Structure, Restoration Type, and Approach

Table I lists the estimated wetland acreage to be restored on the Powell Property. The mitigation plan provides for the restoration of 48.4 acres of riverine wetlands and 3,310 linear feet of stream (swamp run) restoration. Prior to construction, the easement area was used entirely for row crop agriculture, primarily soy beans, corn and cotton and tobacco. The agricultural fields were drained by several ditches that traversed the site and one main drainage ditch that emptied into Quioccosin Swamp. Construction was done in accordance with the approved restoration plan and completed in January of 2009. Native tree and shrub species were planted in January of 2009 and the resulting riverine system is designed to emulate natural swamp run systems found within the Chowan River Basin.

Table I. Project Restoration Components Powell Wetland and Stream Mitigation Site/EEP #D06065-B				
Restoration Type	**Pre-Existing Acres/Linear Feet**	**Post Construction Acres/ Linear Feet**	**Credit Ratio (Restoration : WMU)**	**Total WMU's/SMU's**
Riverine Wetland	0.0 acres	48.4 acres	1:1	48.4 WMUs
Stream (Swamp Run)	0.0 linear feet	3,310 linear feet	1:1	3,310 SMUs

3.0 Location and Setting

The Powell Property Mitigation Site is located in Bertie County, just north of Buzzard's Crossroads on Meadow Road (approximately 4.6 miles southeast of Powellsville). The easement area is situated on the eastern portion of the Powell farm and adds contiguous swamp run and forested wetlands to Quioccosin Swamp which flows to the Wiccacon River, a tributary of the Chowan River. The surrounding area is primarily forest and agricultural land with residential properties as a minor component.

Figure 1 is a location map for the project site. Directions to the site are as follows: from Powellsville (Hwy. 42), travel south on Sally Freeman Rd., turn left on Dilday Rd., right on Luther Brown Rd., then right on Meadow Rd. Access to the site is approximately 2 miles from this intersection, on the right.

VICINITY MAP

Scale: 1" = 4000'

4/ 2008

Drawn By: LMS

PREPARED FOR:

ALBEMARLE RESTORATIONS, LLC

WETLAND RESTORATION,
STREAM RESTORATION,
& WILDLIFE HABITAT CREATION

494 COURT STREET • GATESVILLE, NC 27938
(252) 333-9248 • FAX (252) 357-4892

SCALE

0 4,000' 8,000'

POWELL PROPERTY

RIVERINE WETLAND RESTORATION
48.4 ACRES (48.4 WMU'S)

STREAM RESTORATION
3,310 LINEAR FEET (3,310 SMU'S)

BERTIE COUNTY, NORTH CAROLINA
CONTRACT # 16-006065-B

4.0 Project History and Background

Table II provides the history of data collection and actual completion of various milestones of the Powell Property Wetland Mitigation Site.

Table II. Project Activity and Reporting History Powell Wetland and Stream Mitigation Project/EEP #D06065-B		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	January 2008	May 2008
Final Design -90%	January 2008	May 2008
Construction	N/A	January 2009
Temporary S & E mix applied to entire project area	N/A	January 2009
Permanent seed mix applied to entire project area	N/A	January 2009
Containerized and Bare Root Planting	N/A	January 2009
Mitigation Plan/As-built	April 2009	June 2009
Year 1 monitoring	September 2009	March 2010
Year 2 monitoring		
Year 3 monitoring		
Year 4 monitoring		
Year 5 monitoring		

Points of contact for the various phases of the Powell Project are provided in Table III.

Table III. Project Contacts Powell Wetland and Stream Mitigation Site/EEP #D06065-B	
Designer Primary Project design POC	Ecotone, Inc. (Scott McGill 410-692-7500) 1204 Baldwin Mill Road Jarrettsville, MD 21804
Construction Contractor Construction contractor POC	Armstrong, Inc. (Tink Armstrong 252-943-2082) P. O. Box 96 25852 US Hwy 64 Pantego, NC 27860
Planting Contractor Planting contractor POC	Carolina Silvics, Inc. 908 Indian Trail Road Edenton, NC 27932 Mary-Margaret McKinney (252-482-8491)
Seeding Contractor Seed planting contractor POC	Armstrong, Inc. (Tink Armstrong 252-943-2082) P. O. Box 96 25852 US Hwy 64 Pantego, NC 27860
Seed mix sources	Ernst Conservation Seeds, LLP, Meadville, PA
Nursery stock suppliers	Arborgen, Blenheim, SC, Native Roots, Clinton, NC
Monitoring Performers Wetland and Vegetation POC	Woods, Water and Wildlife, Inc. (Ashby Brown 757-651-3162) P. O. Box 176 Fairfield, NC 27826

Project background information for the Powell project is provided in Table IV.

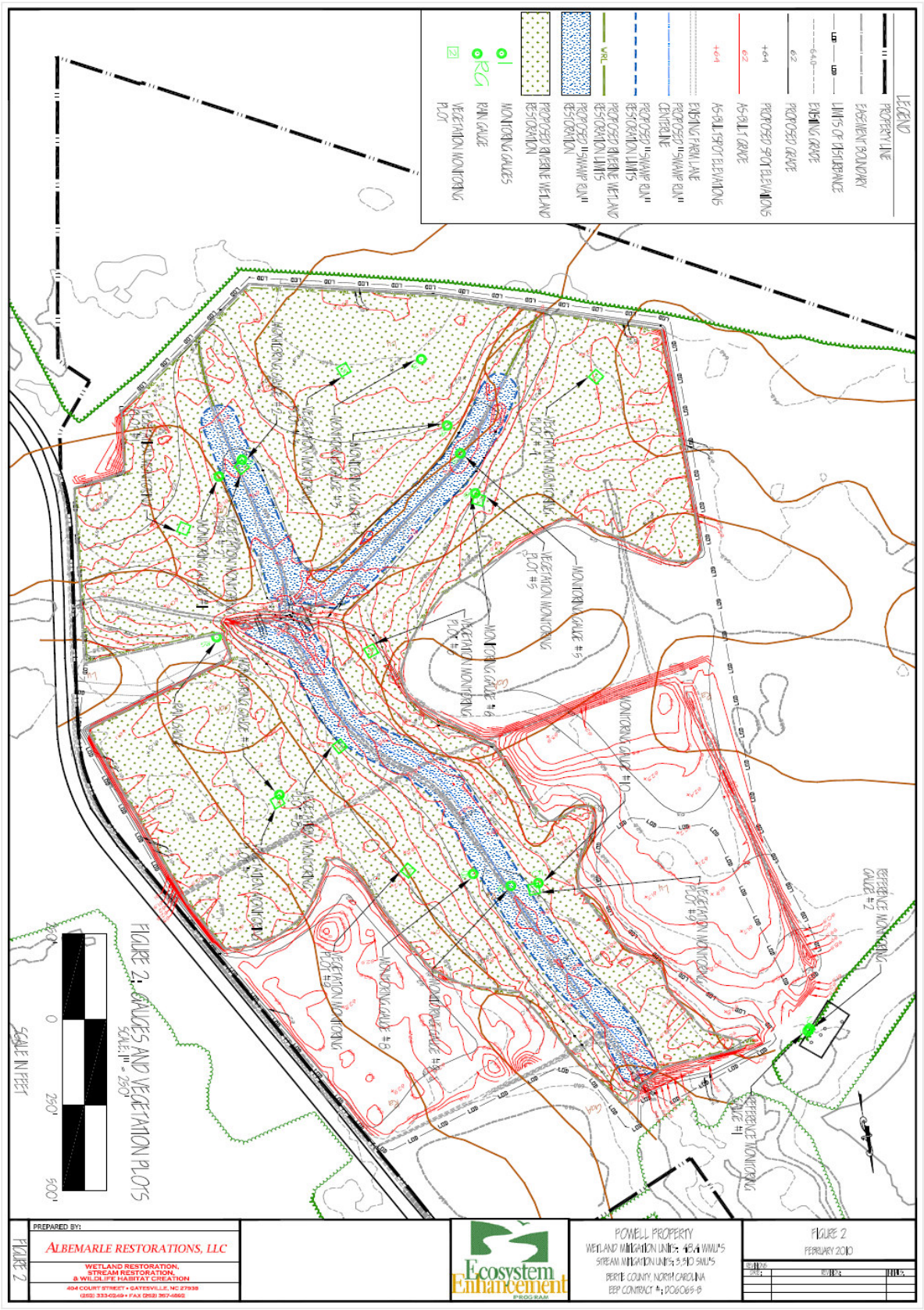
Table IV. Project Background Powell Wetland and Stream Mitigation Site/EEP #D06065-B	
Project County	Bertie County
Drainage Area	Approximately 871 Acres
Drainage impervious cover estimate (%)	0
Physiographic Region	Coastal Plain
Ecoregion	8.3.5 Southeastern Plains
Rosgen Classification of As-built	N/A
Cowardin Classification	PSS, PFO
Dominant Soil Types	Goldsboro, Lynchburg
Reference site ID	Quioccosin Swamp
USGS HUC for Project and Reference	03010203
NCDWQ Sub-basin for Project and Reference	03-01-01
NCDWQ classification for Project and Reference	C
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	Yes, Wiccacon River
Reasons for 303d listing or stressor?	Non-Point Source
% of project easement fenced	None

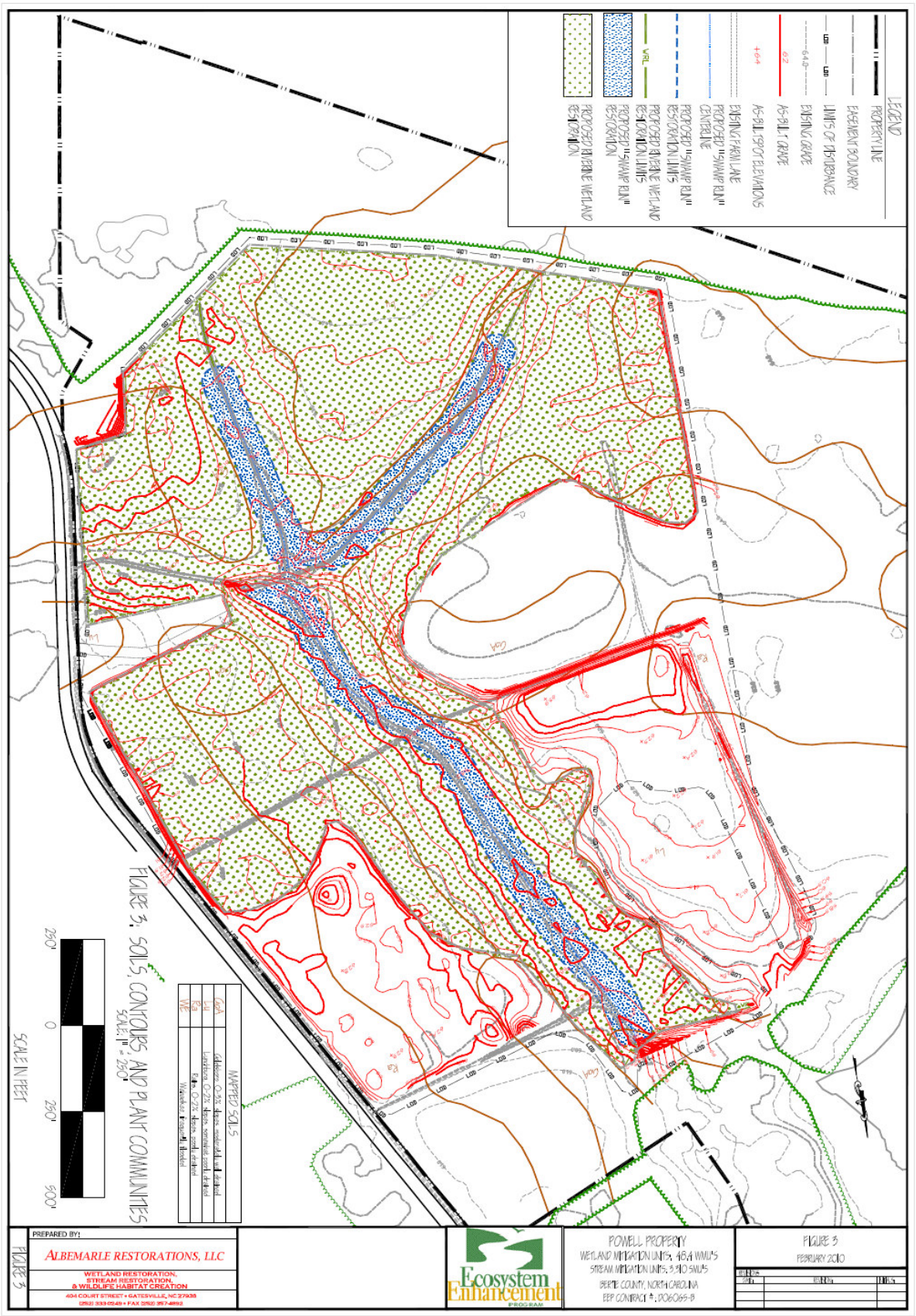
5.0 Monitoring Plan View

A total of ten water level monitoring gauges are installed across the site. These gauges are suspended in two-inch pvc pipe that is set from two to four feet vertically in the ground. The gauges have been located to assess the groundwater levels throughout the year at various elevations and topographies within the site. Two more gauges are installed in an offsite riverine wetland area to serve as references for a naturally functioning riverine wetland and headwater swamp run. In addition, there is a rain gauge onsite to capture and record precipitation.

Vegetation monitoring is accomplished by surveying the ten permanent sampling plots. The plots are ten meters square and are situated to give an accurate sample of the planted and natural woody vegetation in both the riverine and swamp run communities. For each site, the data recorded matches that required of the *CVS-EEP Protocol for Recording Vegetation, v 4.0, 2006,* level 1-2.

Figures 2 and 3 provide plan views of the site showing the location of all monitoring features including gauges, sampling plots and the rain gauge as well as the vegetative communities.


LEGEND
PROPERTY LINE
EASEMENT BOUNDARY
LIMITS OF DISTURBANCE
EXISTING GRADE
PROPOSED GRADE
PROPOSED SPOT ELEVATIONS
AS-BUILT GRADE
AS-BUILT SPOT ELEVATIONS
EXISTING FARM LANE
PROPOSED "SWAMP RUN" CENTERLINE
PROPOSED "SWAMP RUN" RESTORATION LIMITS
PROPOSED RIPARIAN WETLAND RESTORATION LIMITS
PROPOSED "SWAMP RUN" RESTORATION
PROPOSED RIPARIAN WETLAND RESTORATION
MONITORING GAUGES
RAIN GAUGE
VEGETATION MONITORING PLOT
MONITORING GAUGE #1
MONITORING GAUGE #2
MONITORING GAUGE #3
MONITORING GAUGE #4
MONITORING GAUGE #5
MONITORING GAUGE #6
MONITORING GAUGE #7
MONITORING GAUGE #8
MONITORING GAUGE #9
MONITORING GAUGE #10
VEGETATION MONITORING PLOT #1
VEGETATION MONITORING PLOT #2
VEGETATION MONITORING PLOT #3
VEGETATION MONITORING PLOT #4
VEGETATION MONITORING PLOT #5
VEGETATION MONITORING PLOT #6
REFERENCE MONITORING GAUGE #1
REFERENCE MONITORING GAUGE #2
FIGURE 2: GAUGES AND VEGETATION PLOTS
SCALE 1" = 250'
SCALE IN FEET
0
250'
500'
PREPARED BY:
ALBEMARLE RESTORATIONS, LLC
WETLAND RESTORATION, STREAM RESTORATION, & WILDLIFE HABITAT CREATION
404 COURT STREET • GATESVILLE, NC 27938
(252) 333-0249 • FAX (252) 357-1662
FIGURE 2
Ecosystem Enhancement PROGRAM
POWELL PROPERTY
WETLAND MITIGATION UNITS: 18.6 WMU'S
STREAM MITIGATION UNITS: 3,810 SMU'S
BERTIE COUNTY, NORTH CAROLINA
EEP CONTRACT #: D06066-B
FIGURE 2
FEBRUARY 2010


LEGEND
PROPERTY LINE
EASEMENT BOUNDARY
LIMITS OF DISTURBANCE
EXISTING GRADE
AS-BUILT GRADE
AS-BUILT SPOT ELEVATIONS
EXISTING FARM LANE
PROPOSED "HSWAMP RUN" CENTERLINE
PROPOSED "HSWAMP RUN" RESTORATION LIMITS
PROPOSED RIVERINE WETLAND RESTORATION LIMITS
PROPOSED "HSWAMP RUN" RESTORATION
PROPOSED RIVERINE WETLAND RESTORATION
MAPPED SOILS
FIGURE 3, SOILS, CONTOURS AND PLANT COMMUNITIES
SCALE: 1" = 250'
SCALE IN FEET
250' 0 250' 500'
PREPARED BY:
ALBEMARLE RESTORATIONS, LLC
WETLAND RESTORATION, STREAM RESTORATION, & WILDLIFE HABITAT CREATION
404 COURT STREET • GATESVILLE, NC 27938
(252) 339-0249 • FAX (252) 357-4892
Ecosystem Enhancement PROGRAM
POWELL PROPERTY
WETLAND MITIGATION UNITS: 16.4 WMU'S
STREAM MITIGATION UNITS: 3,910 SMUS
BERTIE COUNTY, NORTH CAROLINA
EEP CONTRACT #: D06065-B
FIGURE 3
FEBRUARY 2010

II. Project Condition and Monitoring Results

1.0 Vegetation Assessment

The vegetation success criterion was developed in accordance with the CVS-EEP protocol. The Powell project was designed to include both riverine and bottomland hardwood plant communities. The project was planted with a mixture of tree and shrub species that would resemble that of naturally occurring swamp runs and adjacent riverine wetlands in the local area. The run and area immediately adjacent were planted heavily with cypress, willow and tupelo. The riverine wetland zone beyond the swamp run is populated by a broader mix of native hydrophytic tree and shrub species. The photos in Appendix A show the colonization of the project area by hydrophytic vegetation. The species mix was based on the vegetation noted at the reference site and all species are classified from FAC to OBL (Table V). The site was planted at a rate of 600 stems per acre in January of 2009.

Table V. Species by Community Type
Powell Wetland and Stream Mitigation Project/EEP #D06065-B
Total Forested Wetland 55.9 Acres

Common Name	Scientific Name	Wetland Indicator Status
Trees		
Bald Cypress	Taxodium distichum	OBL
Water tupelo	Nyssa aquatica	OBL
Swamp Black Gum	Nyssa biflora	FAC
Willow Oak	Quercus phellos	FACW-
Swamp White Oak	Quercus bicolor	FACW+
Pin Oak	Quercus palustris	FACW
Water Oak	Quercus nigra	FAC
Swamp Chestnut Oak	Quercus michauxii	FACW-
Shrubs		
Staggerbush	Lyonia mariana	FAC
Tag Alder	Alnus serrulata	FACW+
Highbush Blueberry	Vaccinium corymbosum	FACW
Sweet Pepperbush	Clethra alnifolia	FACW
Virginia Sweetspire	Itea virginica	FACW+
Button Bush	Cephalanthus occidentalis	OBL
Swamp Bay	Persea palustris	FACW
Inkberry	Ilex glabra	FACW
Wax Myrtle	Myrica cerifera	FAC+
Black Willow	Salix nigra	OBL
Sweetbay Magnolia	Magnolia virginiana	FACW+

1.1 Vegetation Discussion and Problem Areas

All ten plots met the Year 3 success criterion of a minimum of 320 stems per acre. Over the entire project, the survival rate averaged 470 live stems per acre. Though mortality was relatively light, herbaceous competition appears to have been the leading cause. Survival was

more than adequate to ensure a well stocked, diverse community and the overall growth rate and health of the stand is good.

2.0 Wetland Assessment

The hydrologic success criterion for any gauge is to achieve a minimum of 12 to 19 consecutive days where the groundwater level is within 12 inches of the soil surface during the growing season. This represents 5% to 8% of the growing season which for this site runs from March 22 to November 8, a period of 231 days (WETS Table for Lewiston, NC).

Three of the ten monitoring gauges deployed across the site are located at or near the center of the swamp runs in order to assist with documenting flow (gauges 2, 5 and 9). The other seven gauges are installed in the riverine portion of the project, some in a perpendicular pattern to the swamp runs to assist in documenting flow and to assess hydrology in the riverine wetlands. A rain gauge is also kept onsite and its data are compared to that collected at the NOAA cooperator sites in Murfreesboro and Lewiston, NC. To further monitor the affect of seasonal and annual variations in precipitation in restored wetlands, hydrologic success of the site was assessed in relation to the reference wetland site where two more monitoring gauges are installed (gauge 11 as a riverine wetland reference and & gauge 12 as a swamp run reference).

2.1 Wetland Discussion and Problem Areas

Rainfall from late March through early November was close to normal in 2009 with the exception of heavier than normal rainfall in July. Four of the riverine gauges met hydrologic success as did the three located in the swamp runs. Three of the gauges in the riverine wetlands failed to meet hydrologic success at 5% of the growing season (12 days).

Although rainfall during April and May was very near normal compared to the WETS table for Lewiston, North Carolina, changes in subsurface hydrology are often slow to develop, especially in heavy clay soils. It is anticipated that wetland hydrology will continue to develop across the entire site as the soils are able to equilibrate and build structure. These three gauges will be assessed in early 2010 to ensure that they are functioning properly. If they are deemed to be malfunctioning, new wells and gauges will be installed.

The three gauges located within the swamp runs showed successful hydrology in 2009 as would be expected considering rainfall amounts. Gauges 2, 5 and 9 are set in the swamp runs as is reference gauge 11. All show similar patterns of prolonged above-ground water levels during periods of heavy rainfall, followed by gradual runoff, and numerous short-term flood and drain events during the remainder of the season.

2.15 Flow

Refer to Figures F1, F2 and F3 which are composite charts for gauges 2, 5 & 9, for the following discussion of evidence of flow within the swamp runs. Figure F1 is a composite chart showing the water level during a period in April when flow in the swamp runs was visually confirmed and recorded on video. This flow event was very early in the life of the project, occurring in April,

only two and a half months after the project was completed. Gauge 9, at the lower end of the project wasn't inundated above the ground line so flow at that gauge is not identified as it is at the two upstream gauges. It is important to note that the channelization that can be seen in the early stage photos in Appendix A were developed by this flow event.

Figure F2 illustrates several small flow events that occurred during the growing season during periods of heavier rainfall. By this time, all three gauges were successfully registering the rise and fall of above ground water indicating water flow.

Figure F3 illustrates a major flow event that took place just at the end of the 2009 growing season. The accompanying video shows the water coming onto the site quickly fanning out and flooding the entire upper portion of the project area. There was substantial overbank flooding from the midpoint down to the outlet where water that was forced back toward the outlet increased in velocity and matted the existing herbaceous vegetation.

The following three figures successfully measure flow across the site, but as evidence are not nearly as impressive as the actual video that they are intended to corroborate. The heavy rainfall in November at the end of the growing season created high water marks in the swamp runs, matted vegetation and created more braided channels. The water exiting the project appeared to be clear and sediment free, filtered by the heavy herbaceous cover in the swamp runs. Observations, video evidence, rainfall records and natural evidence all support the fact that a substantial amount of water moved through the project in 2009.

Figure F1.
Monitoring Gauges 2, 5 & 9 Correlated
to Video Evidence of Flow in April 2009

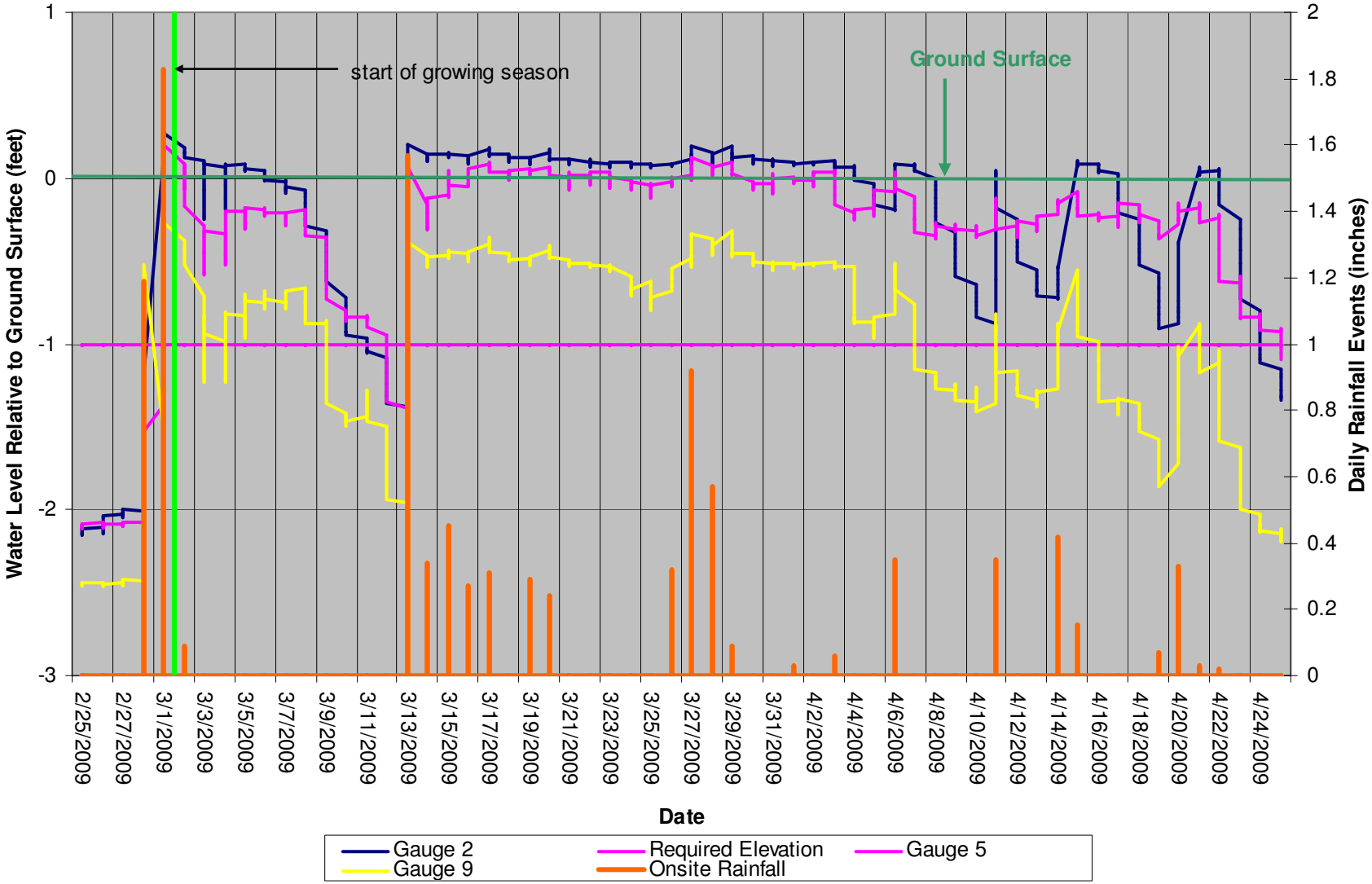


Figure F2.
Minor Flow Events During Summer 2009

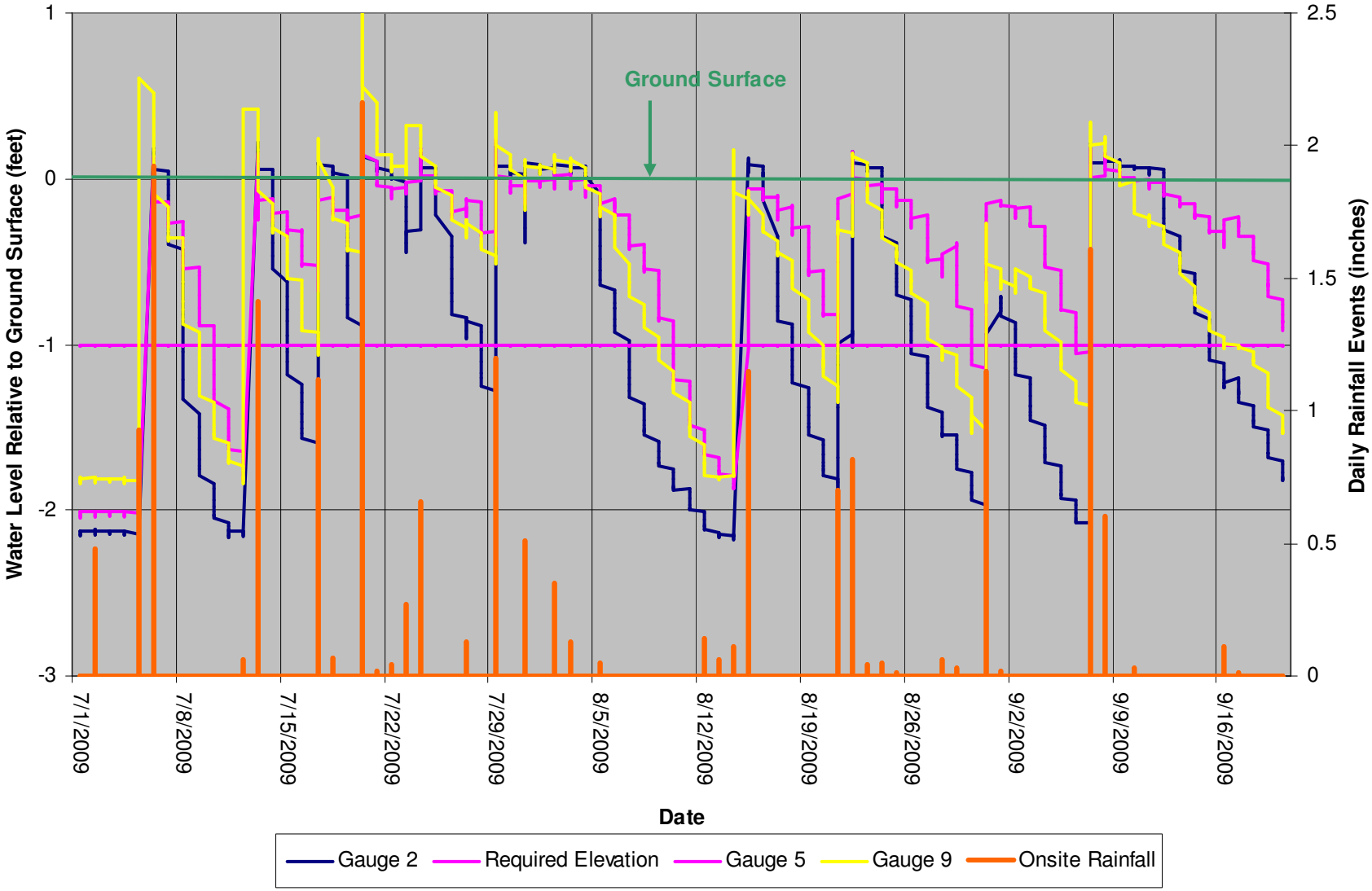
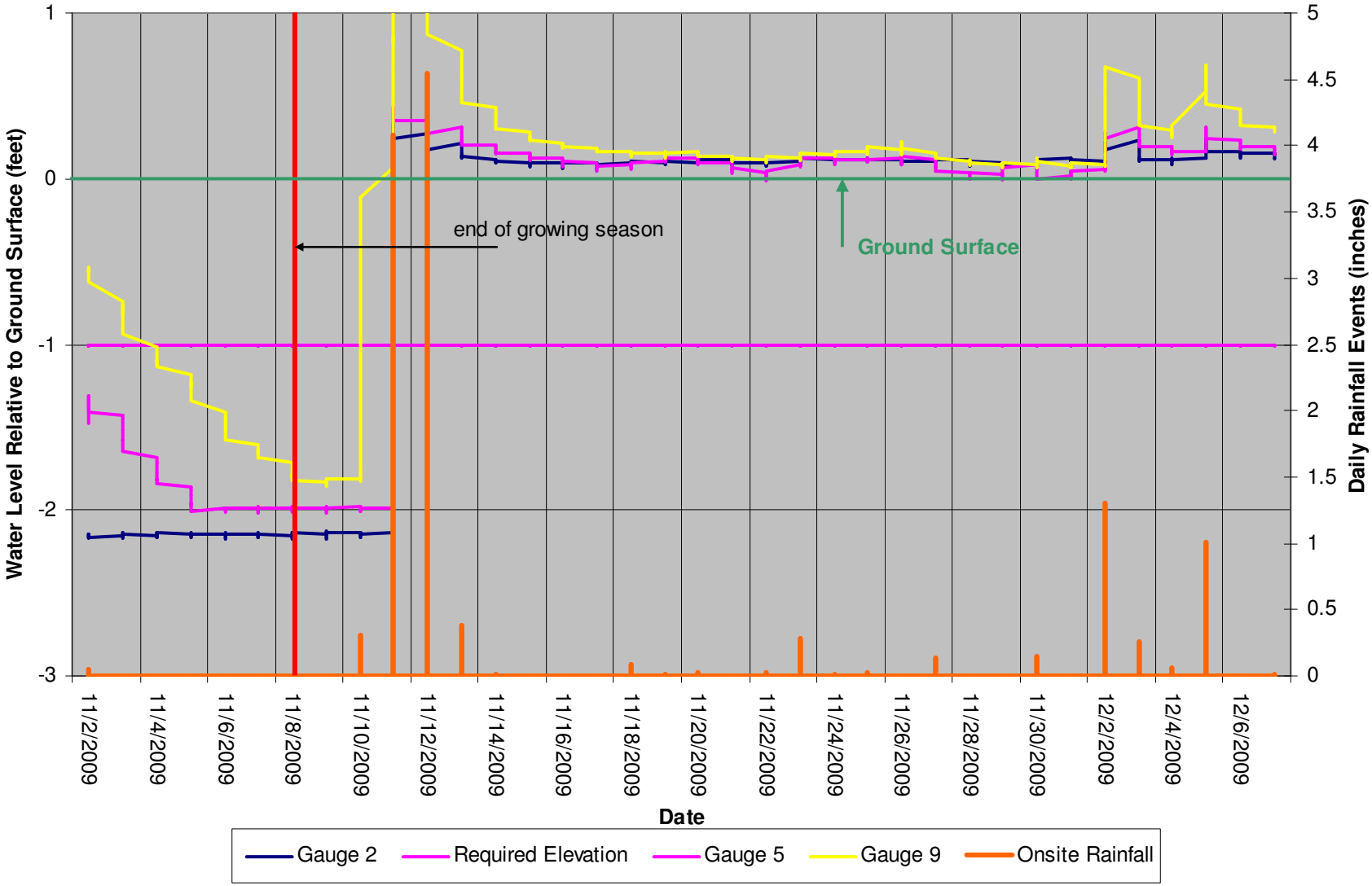


Figure F3.
Monitoring Gauges 2, 5 & 9 Correlated
to Video Evidence of Flow in November 2009



2.2 Wetland Monitoring Plan View (Integrated)

Figure 4 in Appendix D provides an overview of the areas where hydrology is still developing. Much of the riverine wetland zone was flooded for a short length of time early and late in the growing season as evidenced by the site photos in Appendix A.

Table VI. Hydrology and Vegetation Criteria Success by Plot
Powell Wetland and Stream Mitigation Project/EEP #D06065-B

Gauge	Hydrology Success Met	Hydrology Mean	Vegetation Plot	Vegetation Success Met	Vegetation Mean
1	Y	70%	1	Y	100%
2	Y		2	Y	
3	Y		3	Y	
4	N		4	Y	
5	Y		5	Y	
6	N		6	Y	
7	N		7	Y	
8	Y		8	Y	
9	Y		9	Y	
10	Y		10	Y	
11 (Ref)*	Y				
12 (Ref)*	Y				

* Gauges 11 & 12 are reference gauges and not included in the hydrology mean

3.0 Project Success Discussion

After the first year of monitoring and a season of nearly normal rainfall, the wetland hydrology on the Powell project shows indications of successful restoration. Specifically, the hydrology within the swamp run has been restored and the project is already beginning to function like a natural riparian headwater system. Flow of water across the site was successfully measured and documented on at least two separate occasions in 2009.

The reference gauges are measuring very similar above- and below-ground water patterns at the reference site as those measured on the project, confirming that the site is beginning to function like a natural system. Overall tree survival is good; growth in the first year was good due to site maintenance and adequate rainfall.

Listed below are the field indicators from the approved mitigation plan that are to be used to help substantiate flow. Those shown in ***blue*** were observed and/or video or photo documented in 2009.

- A natural line impressed on the bank
- Shelving
- Changes in soil characteristics

- **Destruction of terrestrial vegetation**
- Presence of litter and debris
- Wracking
- **Vegetation matted down or absent**
- Sediment sorting
- Leaf litter disturbed or washed away
- **Scour**
- Deposition
- **Bed and bank formation**
- **Water staining**
- Change in plant community

High water marks on bank vegetation were noted and photographed during December after heavy rainfall. Channel development was visually and video documented during the first year of monitoring, including scouring and minor sediment deposition. Water staining could be seen after the heavy flow in November receded and the herbaceous vegetation at several points along the runs was severely matted. Early indications are the site will successfully function as a headwater stream system.

III. Methodology Section

Year 1 monitoring for the Powell project occurred in 2009. Monitoring and vegetation sampling procedures were established in the mitigation plan for this project and no deviations were made.

Appendix A

Vegetation Data Tables

Site Photos

1. Vegetation Data Tables

Table 1. Project Metadata

Report Prepared By	Ashby Brown
Date Prepared	10/9/2009 11:25
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT--	
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	D06065B
project Name	Powell
Description	Powell wetland and stream mitigation
River Basin	Chowan
Sampled Plots	10

Table 2. Vegetation Vigor by Species

	Species	4	3	2	1	0	Missing	Unknown
	Alnus serrulata	1						
	Cephalanthus occidentalis	2	3	1				
	Itea virginica	1	7	14				
	Nyssa biflora		5	1				
	Persea palustris			1				
	Quercus bicolor		3	1				
	Quercus michauxii		4	3				
	Quercus phellos		19	2				
	Salix nigra		5					
	Taxodium distichum	16	10	3	2			
	Vaccinium corymbosum			1				
	Unknown			4	5			
TOT:	**12**	**20**	**56**	**31**	**7**			

Table 3. Vegetation Damage by Species

	Species	All Damage Categories	(no damage)	Game
	Alnus serrulata	1	1	
	Cephalanthus occidentalis	6	6	
	Itea virginica	22	22	
	Nyssa biflora	6	6	
	Persea palustris	1	1	
	Quercus bicolor	4	4	
	Quercus michauxii	7	7	
	Quercus phellos	21	21	
	Salix nigra	5	5	
	Taxodium distichum	31	30	1
	Unknown	9	9	
	Vaccinium corymbosum	1	1	
TOT:	**12**	**114**	**113**	**1**

Table 4. Vegetation Damage by Plot

	Plot	All Damage Categories	(no damage)	Game
	D06065B-AB-0001	14	14	
	D06065B-AB-0002	10	10	
	D06065B-AB-0003	12	11	1
	D06065B-AB-0004	11	11	
	D06065B-AB-0005	10	10	
	D06065B-AB-0006	9	9	
	D06065B-AB-0007	9	9	
	D06065B-AB-0008	17	17	
	D06065B-AB-0009	11	11	
	D06065B-AB-0010	11	11	
TOT:	**10**	**114**	**113**	**1**

Table 5. Stem count by plot and species

				Plot									
Species	**Total Planted Stems**	**# spp**	**avg# stems**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alnus serrulata	1	1	1			1							
Cephalanthus occidentalis	6	2	3	3							3		
Itea virginica	22	7	3.14	3		2	2	5		1	8		1
Nyssa biflora	6	4	1.5			1	2		2		1		
Persea palustris	1	1	1							1			
Quercus bicolor	4	3	1.33		1				1	2			
Quercus michauxii	7	3	2.33		2					2			3
Quercus phellos	21	5	4.2	7	4	5			4	1			
Salix nigra	5	1	5								5		
Taxodium distichum	31	6	5.17			2	7	5		2		10	5
Unknown	9	5	1.8	1	3				2			1	2
Vaccinium corymbosum	1	1	1			1							
Totals:	**114**	**12**		**14**	**10**	**12**	**11**	**10**	**9**	**9**	**17**	**11**	**11**
Average per Acre				**577**	**412**	**495**	**454**	**412**	**371**	**371**	**701**	**454**	**454**

Table 6. Problem Areas

Feature/Issue	Gauge	Probable Cause
Inadequate Hydrology	4, 6 and 7	Under Investigation

Project beginning to green up in May after construction

Development of braided channels (May) created by flow event in April

Further early channelization (May) near midpoint of project

Site completely greened up and stabilized (July)

Early seedling development (cypress) near Gauge 7 (July)

Substantial vegetation matting at outflow end (Dec)

Heavy flow at outfall end (Dec)

Steady inflow from watershed above project (Dec)

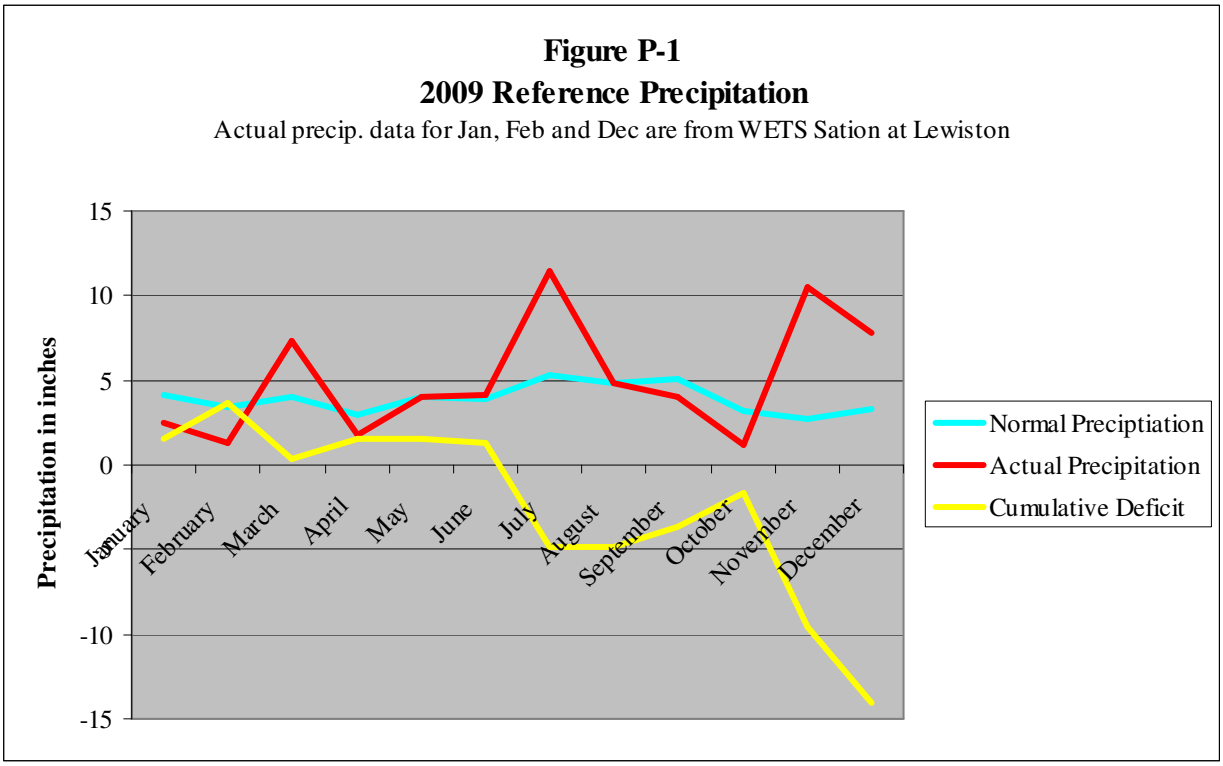
Water fans out after entering upper end of project (Dec)

Table C-1 Longest Consecutive Successful Hydrologic Period in Days and Success at 5% and 8% of Growing Season															
	Year 1			Year 2			Year 3			Year 4			Year 5		
Gauge	Days	5%	8%	Days	5%	8%	Days	5%	8%	Days	5%	8%	Days	5%	8%
1	14	Y	N												
2	34	Y	Y												
3	15	Y	N												
4	4	N	N												
5	35	Y	Y												
6	4	N	N												
7	7	N	N												
8	39	Y	Y												
9	24	Y	Y												
10	14	Y	N												
11 (Ref)	53	Y	Y												
12 (Ref)	39	Y	Y												

5% of growing season is 12 days, 8% is 19 days

Hydrology is deemed successful if longest consecutive hydrologic period meets minimum of 5% of the growing season

Figure P-1
2009 Reference Precipitation
Actual precip. data for Jan, Feb and Dec are from WETS Sation at Lewiston



Because of heavy rainfall in November and December, total annual precipitation on the Powell project was 14" above normal.

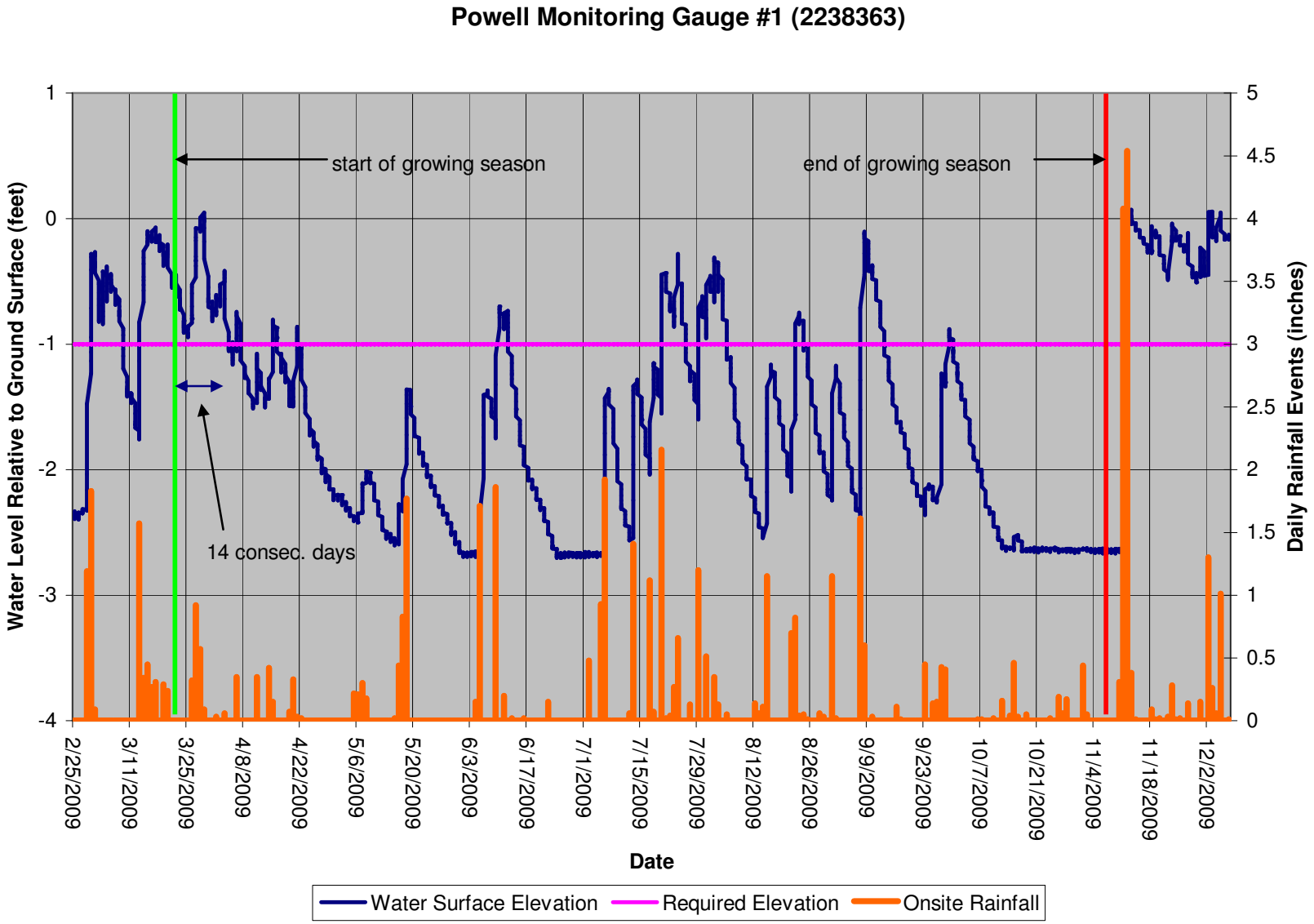
Appendix B

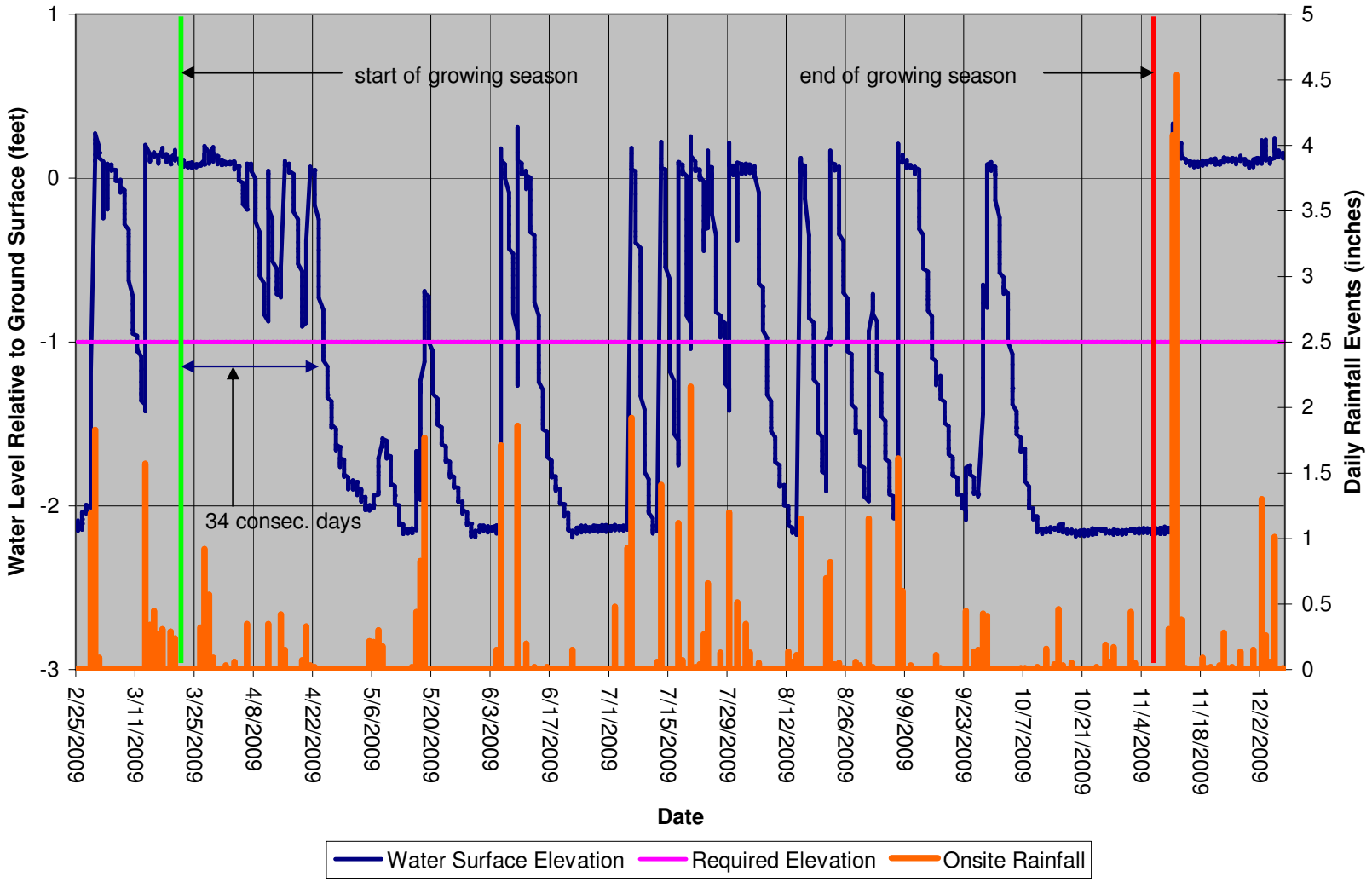
Geomorphologic Raw Data

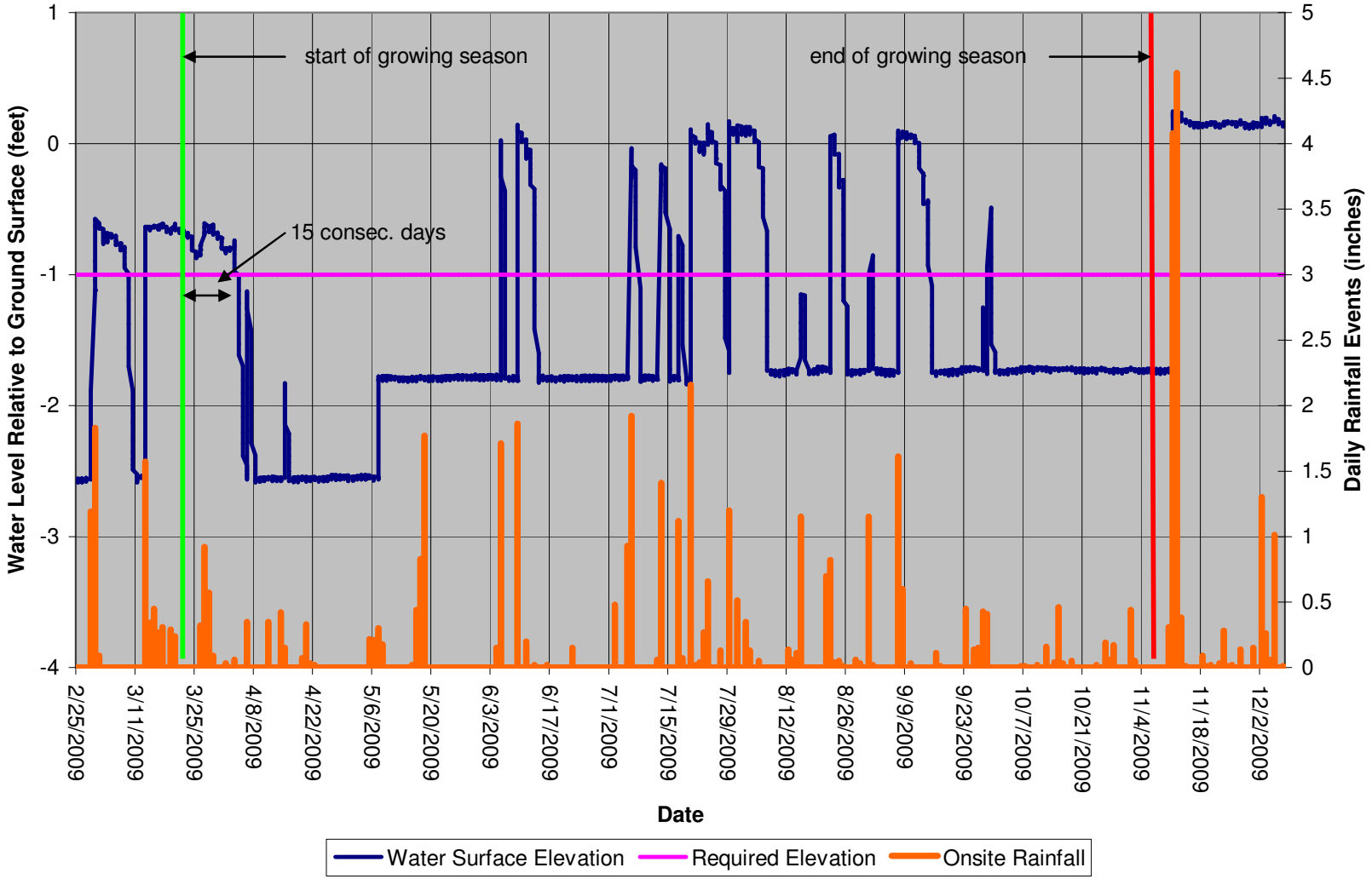
Not used in this report

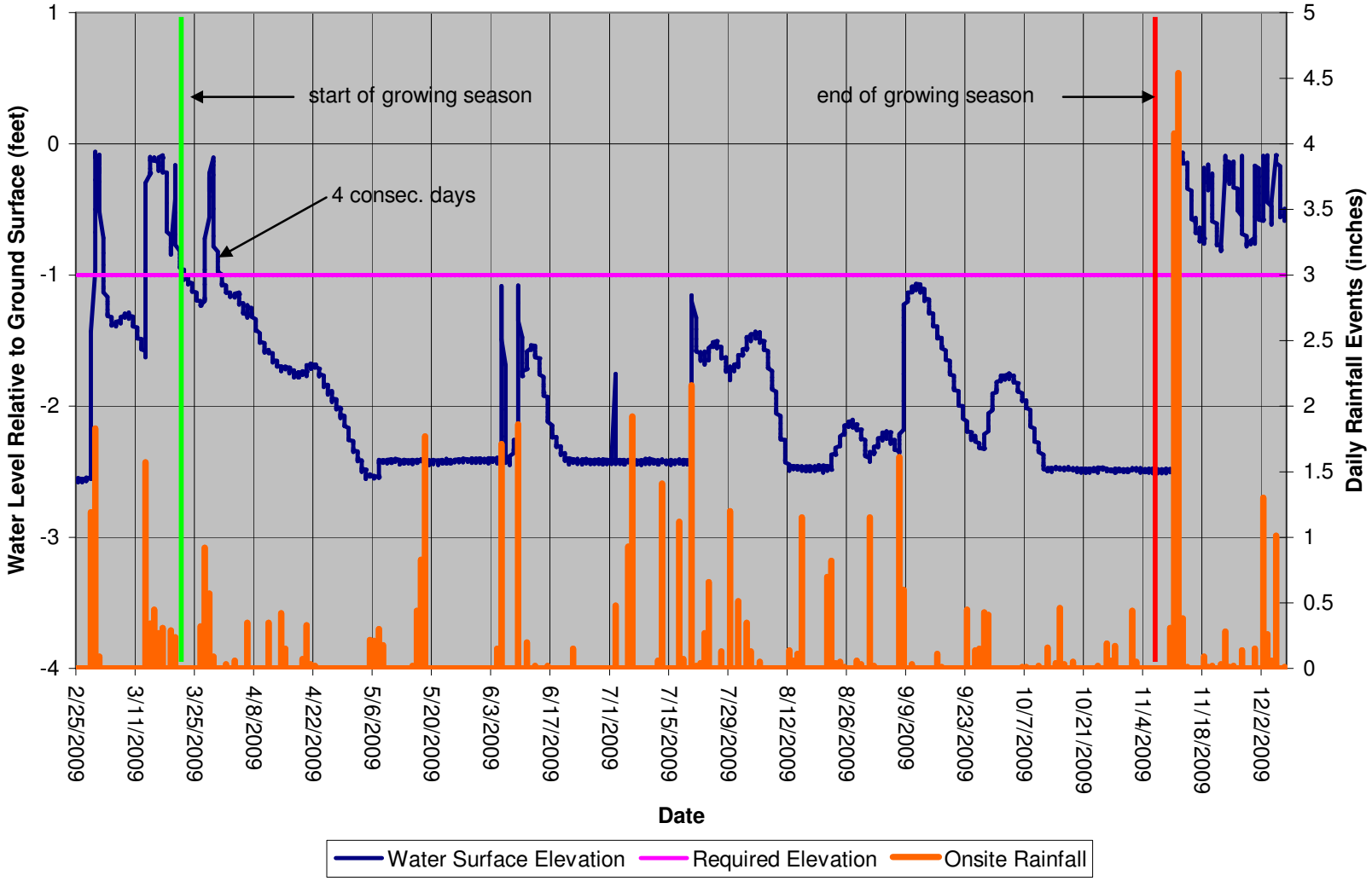
Appendix C

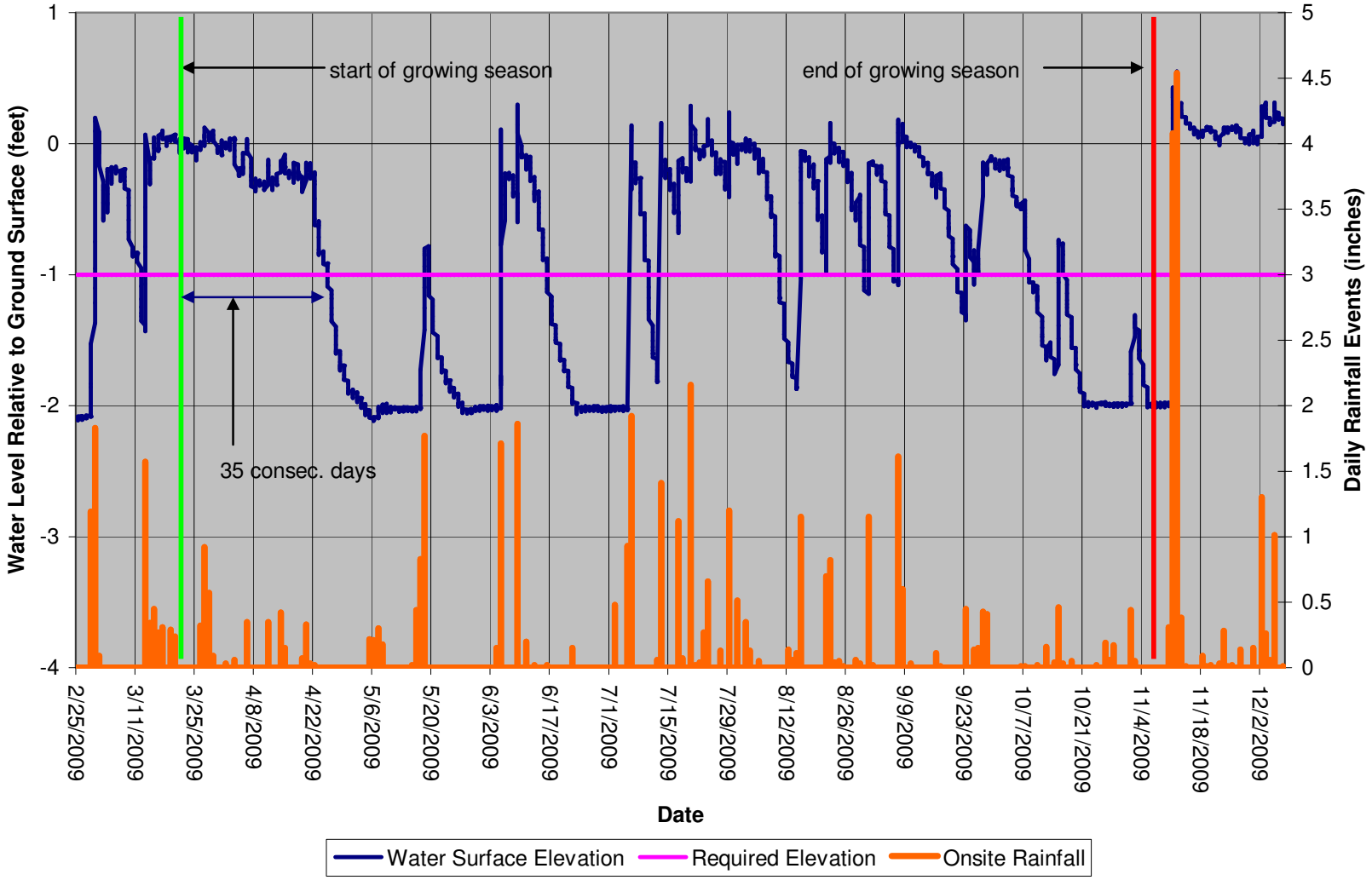
Hydrologic Data Tables

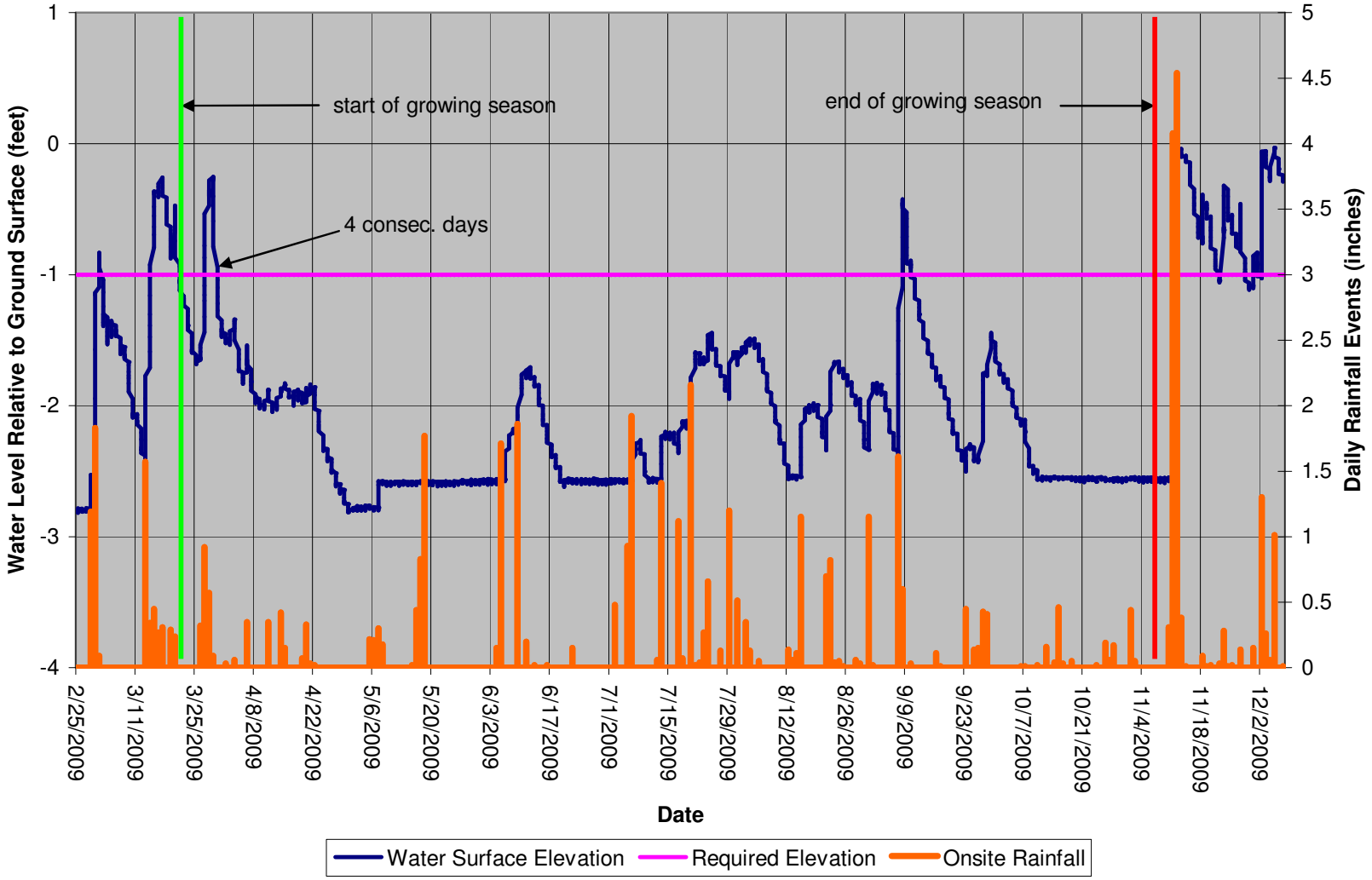

Powell Monitoring Gauge #1 (2238363)
start of growing season
end of growing season
14 consec. days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Date
1
0
-1
-2
-3
-4
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/25/2009
3/11/2009
3/25/2009
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Water Surface Elevation
Required Elevation
Onsite Rainfall

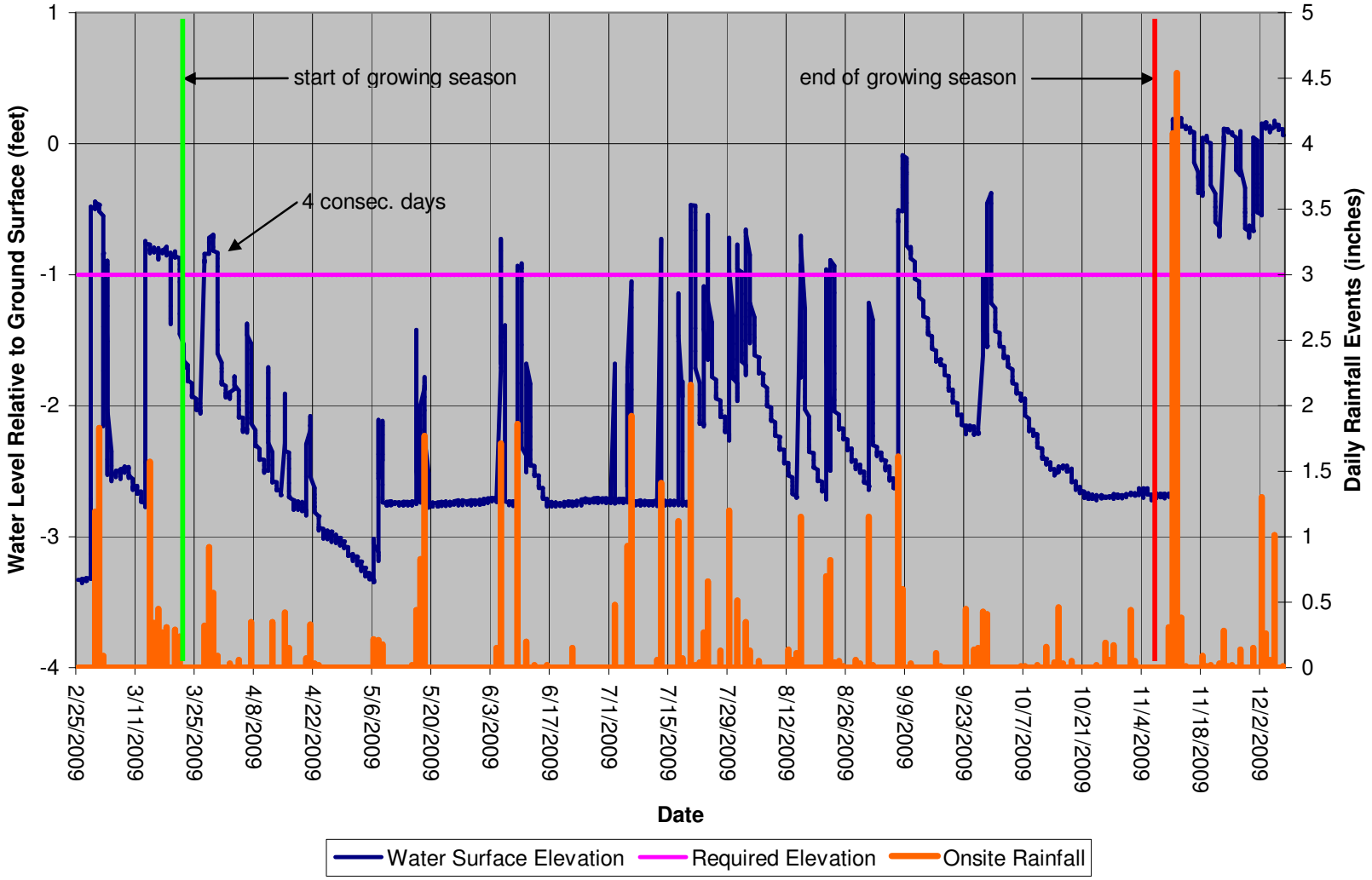

Powell Monitoring Gauge #2 (2238364)
start of growing season
end of growing season
34 consec. days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Date
1
0
-1
-2
-3
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/25/2009
3/11/2009
3/25/2009
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Water Surface Elevation
Required Elevation
Onsite Rainfall

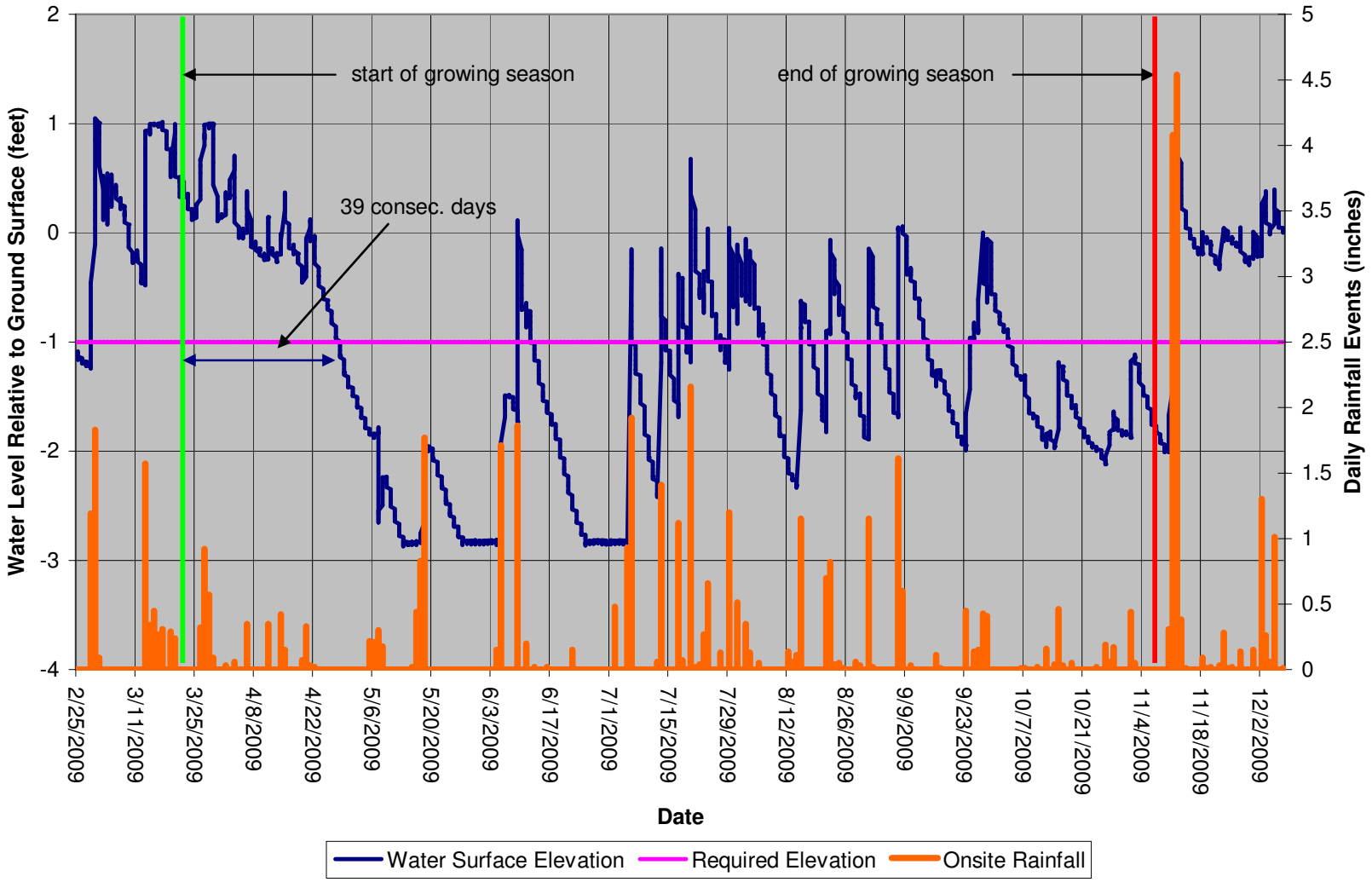

Powell Monitoring Gauge #3 (2238365)
start of growing season
end of growing season
15 consec. days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
-4
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/25/2009
3/11/2009
3/25/2009
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall

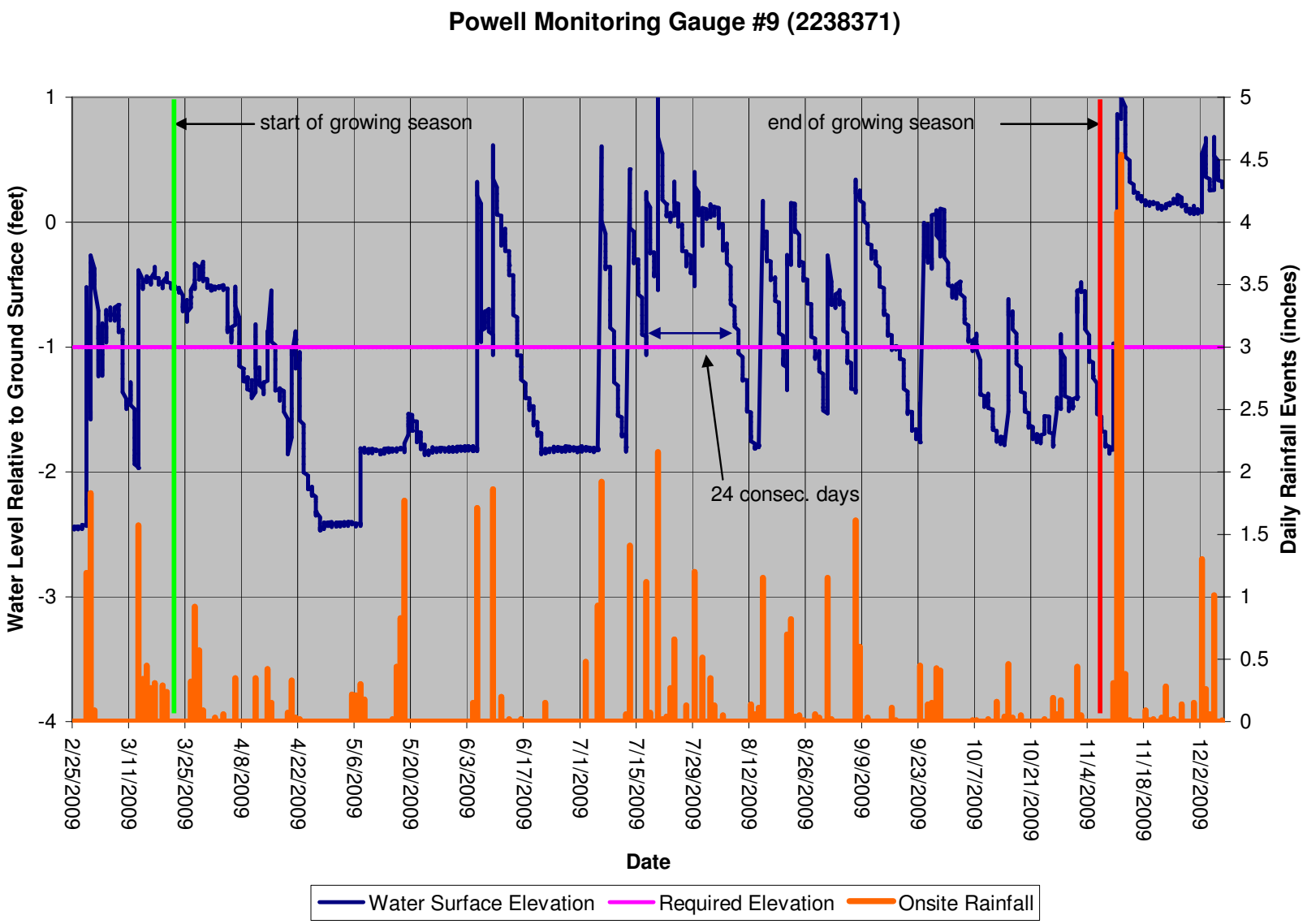

Powell Monitoring Gauge #4 (2238366)
start of growing season
end of growing season
4 consec. days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Date
1
0
-1
-2
-3
-4
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/25/2009
3/11/2009
3/25/2009
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Water Surface Elevation
Required Elevation
Onsite Rainfall

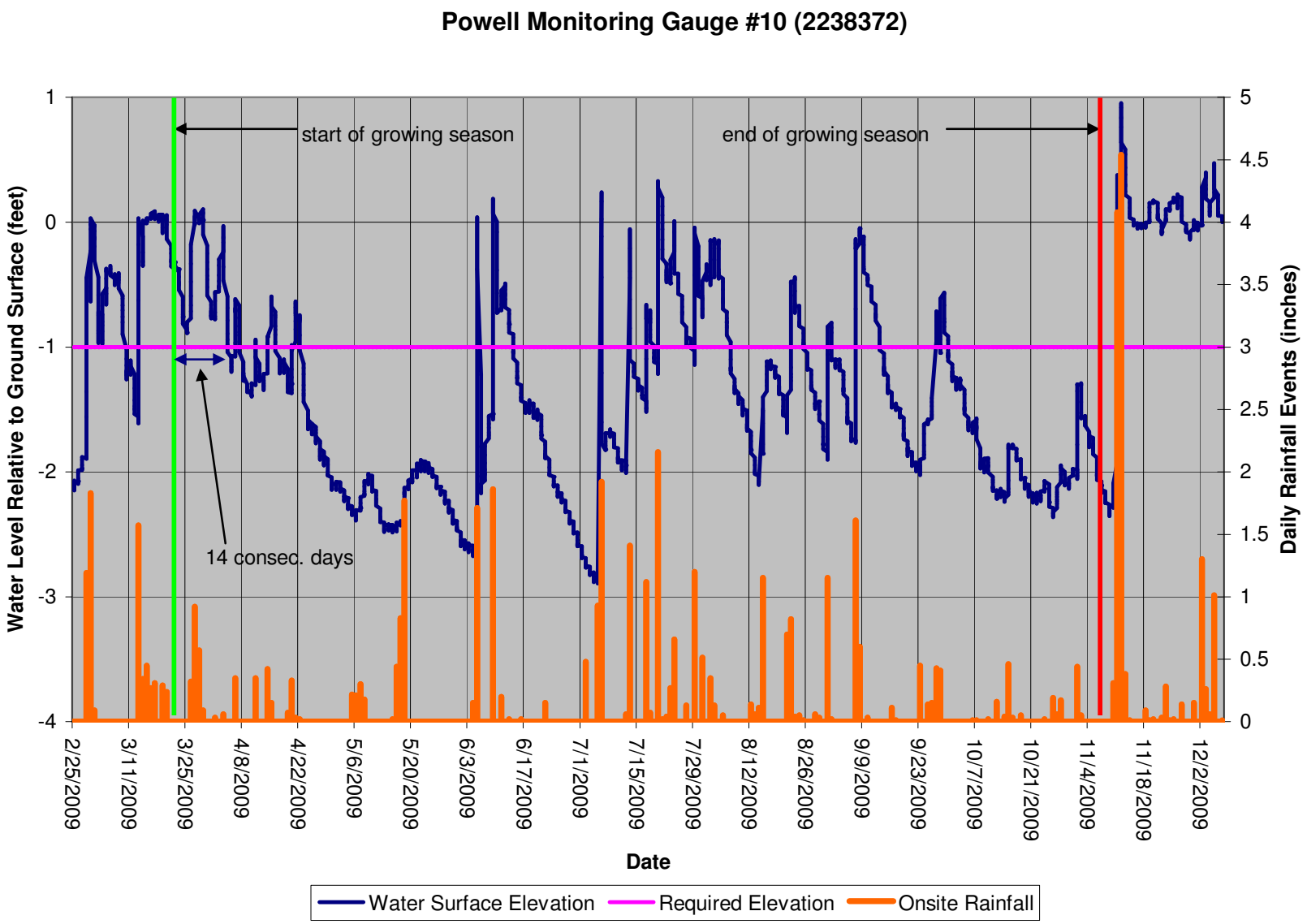

Powell Monitoring Gauge #5 (2238367)
start of growing season
end of growing season
35 consec. days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Date
1
0
-1
-2
-3
-4
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/25/2009
3/11/2009
3/25/2009
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Water Surface Elevation
Required Elevation
Onsite Rainfall

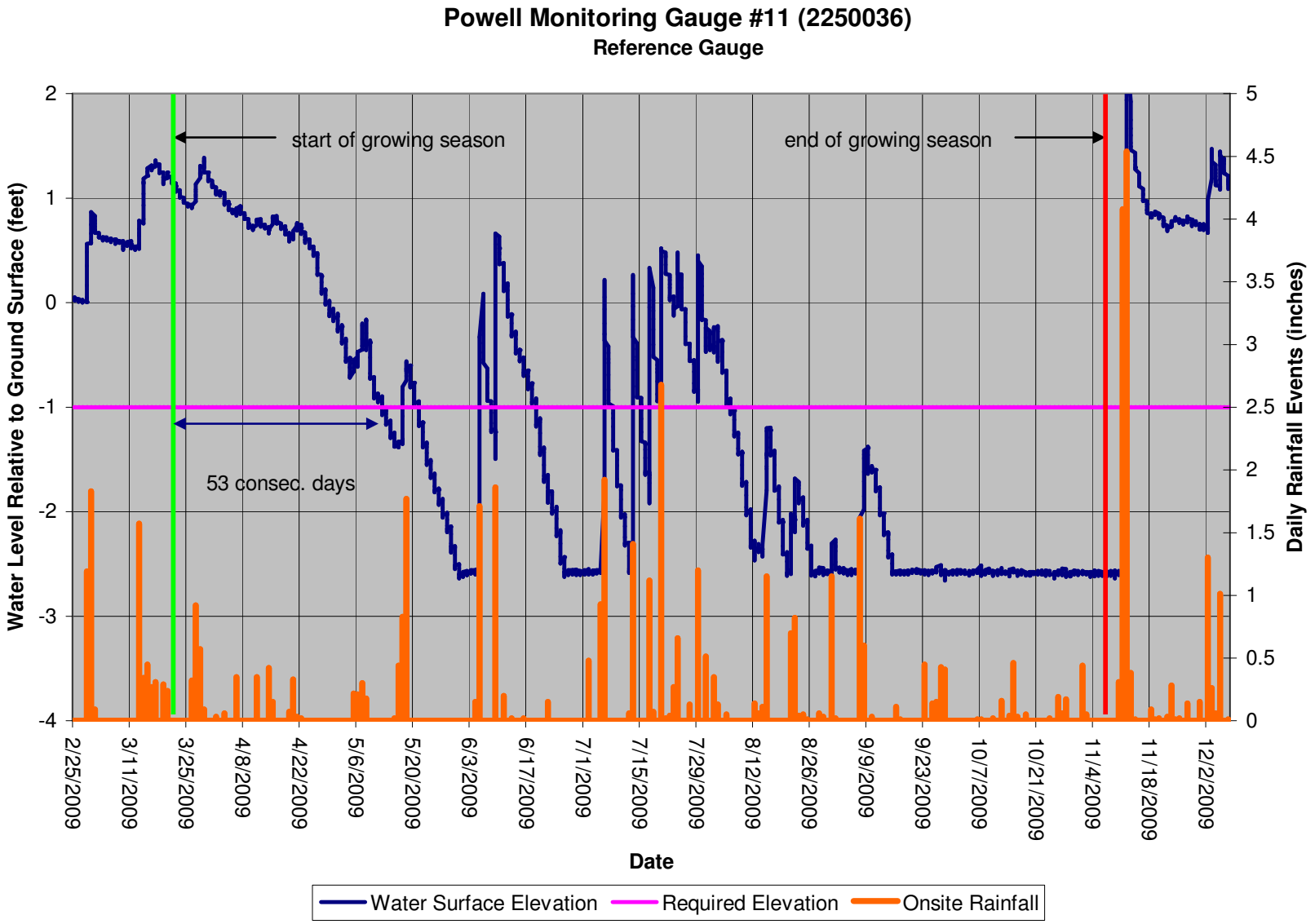

Powell Monitoring Gauge #6 (2238368)
start of growing season
end of growing season
4 consec. days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Date
1
0
-1
-2
-3
-4
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/25/2009
3/11/2009
3/25/2009
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Water Surface Elevation
Required Elevation
Onsite Rainfall

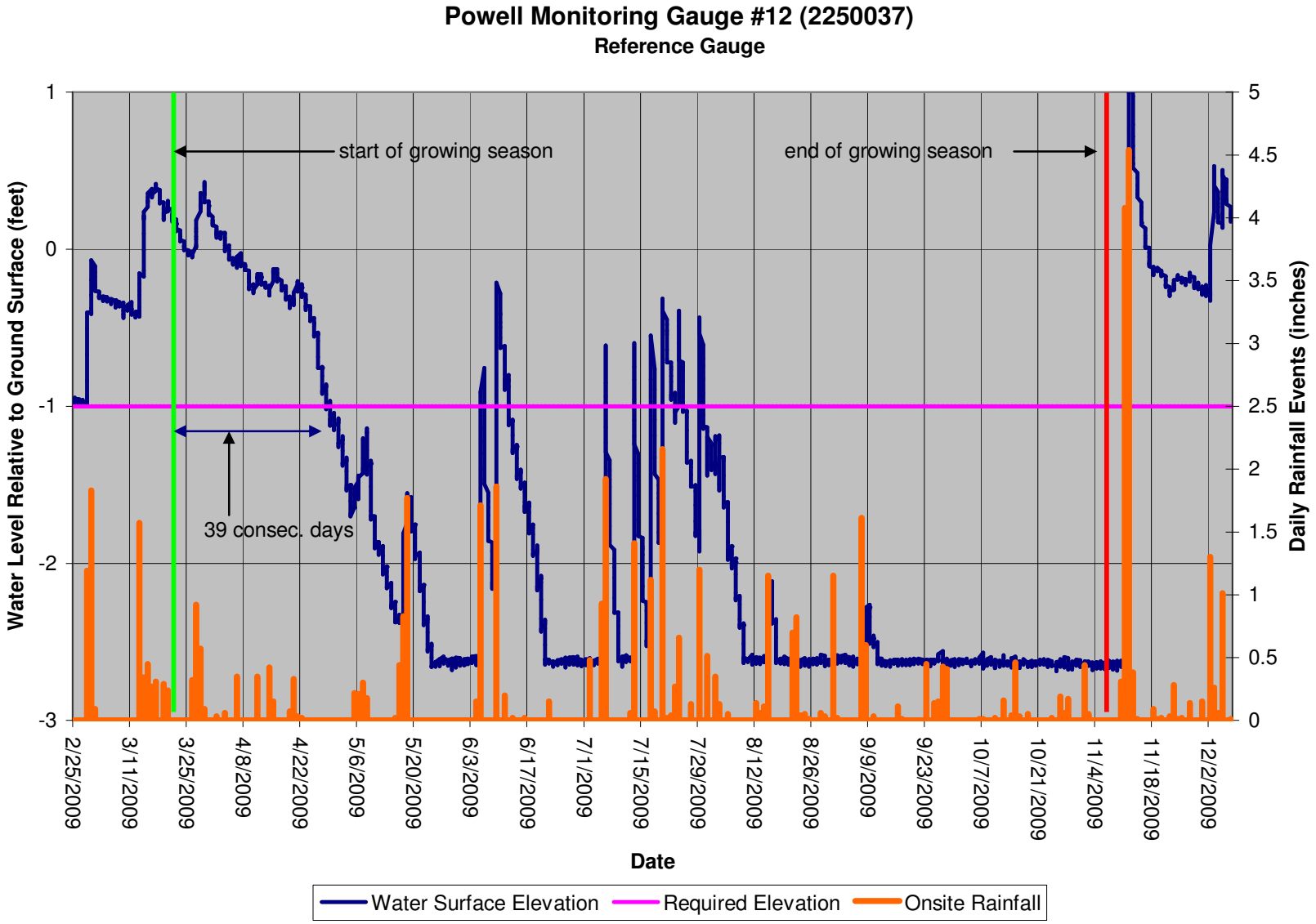

Powell Monitoring Gauge #7 (2238369)
start of growing season
end of growing season
4 consec. days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
-4
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/25/2009
3/11/2009
3/25/2009
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Powell Monitoring Gauge #8 (2238370)
start of growing season
end of growing season
39 consec. days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Date
2
1
0
-1
-2
-3
-4
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/25/2009
3/11/2009
3/25/2009
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Water Surface Elevation
Required Elevation
Onsite Rainfall


Powell Monitoring Gauge #9 (2238371)
start of growing season
end of growing season
24 consec. days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
-4
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/25/2009
3/11/2009
3/25/2009
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Powell Monitoring Gauge #10 (2238372)
start of growing season
end of growing season
14 consec. days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Date
1
0
-1
-2
-3
-4
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/25/2009
3/11/2009
3/25/2009
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Water Surface Elevation
Required Elevation
Onsite Rainfall


Powell Monitoring Gauge #11 (2250036)
Reference Gauge
start of growing season
end of growing season
53 consec. days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Date
2
1
0
-1
-2
-3
-4
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/25/2009
3/11/2009
3/25/2009
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Water Surface Elevation
Required Elevation
Onsite Rainfall


Powell Monitoring Gauge #12 (2250037)
Reference Gauge
start of growing season
end of growing season
39 consec. days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall
1
0
-1
-2
-3
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/25/2009
3/11/2009
3/25/2009
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009

Appendix D

Problem Areas Plan View (Integrated)

Figure 4 goes here