Goodman Property Stream Restoration Project
Lenoir County, NC

2010 Annual Monitoring Report
Year 2

NCEEP Project Number D000616
Neuse River Basin

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

Date: November, 2010

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

Ecosystem Enhancement PROGRAM

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Executive Summary

The Goodman Stream Restoration Site is located on Pruitt Road approximately 5 miles west of Kinston in Lenoir County, North Carolina. It was constructed by Albemarle Restorations, LLC, under contract with EEP to provide compensatory stream mitigation credits in the Neuse River Basin. Construction activities in accordance with the approved restoration plan began February 11, 2009 and were completed on March 26, 2009. Tree and shrub planting on the site occurred on March 27, 2009. An emergent wetland seed mixture was sown the same day. All planting was done in accordance with the approved restoration plan

Eight water level monitoring gauges are installed in pairs at strategic positions throughout the site to measure surface and subsurface water levels. Two additional gauges are installed in the stream preservation area to act as reference gauges and to provide for a comparison of water levels and flow in a naturally occurring riparian headwater system. A rain gauge is installed on the site and checked against cooperator data from the Kinston area. Total rainfall deficit through September, 2010 was 2.67", an amount that would have otherwise been much greater if not for a storm event late in September that produced over 11" of rain.

Two separate flow events were video documented, one in January and another in September, 2010. The first event in January was a sustained event that produced consistent flow throughout the project for a period of over five months. The second event, documented in September was shorter in duration, the product of the heavy, week-long rainfall event late in the month. The data from the water level monitoring gauges coincides with and confirms the flow of water through the site.

Six vegetative monitoring plots are installed in the project area and permanently monumented. The plots are situated in such a way as to provide vegetation survival data within the swamp run and upslope from it. Each plot is a 10m X 10m square, as recommended by the CVS-EEP protocol for recording vegetation sampling. The success criterion for the first year of monitoring is 320 stems per acre and 4 of the six plots were successful in 2010.

Table ES-1 shows the levels of success attained by each of the vegetation plots.

Table ES-1. Project Success Summary

	Vegetation Plot						Percent
	1	2	3	4	5	6	Success
Year 1 (2009) Success	Y	Y	Y	Y	Y	Y	100%
Year 2 (2010) Success	Y	Y	N	N	Y	Y	67%

I. Project Background

1.0 Project Objectives

The goal of the Goodman Property Stream Mitigation Project was to restore a diverse riparian headwater swamp run system typically found in the middle to upper reaches of first or zero order tributary systems. The project is to serve as compensation for stream loss in the Neuse River Basin. The restoration plan was developed and implemented to restore topography and hydrology that more closely resembled that of similar undisturbed land. The original swamp run had been channelized and straightened to improve drainage from the agricultural land surrounding it. Restoration resulted in the development of a swamp run that followed a historical and more natural path. Tree and shrub planting was designed to restore a wetland forest ecosystem that is typically found in the immediate area characteristic of similar soils, topography and hydrology.

The specific objective of the project was to restore a diverse riparian headwater swamp run system to provide the following ecological benefits:

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 to create a continuous travel corridor between habitat blocks and provide 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 to help reduce sedimentation and erosion downstream, and improve long term water quality within the Neuse 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 linear feet of stream restored and preserved on the Goodman Property. The mitigation plan provides for the **restoration** of 4,325 linear feet of swamp run and the **preservation** of 3,205 linear feet of existing swamp run. Prior to restoration, the 20.6 acre easement area was used entirely for agriculture production, primarily tobacco, corn, soybeans and cotton. Construction activities, in accordance with the approved Restoration Plan, began February 11, 2009 and were completed on March 27, 2009. A mix of native trees and shrubs were planted on site on March 27, 2009 to restore habitat and create a species diverse swamp run system. Additionally, an emergent wetland seed mixture was applied concurrent with the finish grading to provide immediate habitat and water quality benefits. All planting and grading was conducted in accordance with the approved restoration plan.

Table I. Project Restoration Components Goodman Property Stream Mitigation Site/EEP #000616				
Restoration Type	**Pre-Existing Linear Feet**	**Post Construction Linear Feet**	**Credit Ratio (Restoration/Preservation: WMU's)**	**Total WMU's/SMU's**
Stream Restoration (Swamp Run)	0.0 linear feet	4,325 linear feet	1:1	4,325 SMU's
Stream Preservation (Swamp Run)	0.0 linear feet	3,205 linear feet	1:5	641 SMU's

3.0 Location and Setting

The Goodman Stream Restoration Site is located on Pruitt Road a mile south of U. S. Rte. 70 and approximately 5 miles west of Kinston in Lenoir County, North Carolina. The easement area is situated in the middle of the Goodman property and replaces channelized pattern drainage that previously ran through the property. This channelized drain connected naturally occurring headwaters to Falling Creek. With the newly restored system, the headwaters flowing into the project will be slowed providing erosion control and sediment retention. Once the vegetation canopy becomes established, water quality and temperature will be protected for the entire length of the drainage into Falling Creek. The project area is surrounded by agricultural land with very few residential units.

Figure 1 is a location map for the project site. Directions to the site are as follows: from Kinston, travel west on US Hwy 70 approximately 5 miles and turn left (south) on Pruitt Rd. Access to the site is approximately 1 mile south of intersection on right. Access is closed by a padlocked yellow metal pipe gate.

Figure 1. Goodman Stream Restoration Site Location west of Kinston, NC

4.0 Project History and Background

Table II provides the history of data collection and actual completion of various milestones of the Goodman Property Stream Restoration Site.

Table II. Project Activity and Reporting History Goodman Property Stream Mitigation Project/EEP #000616		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	August 2008	October 2008
Final Design -90%	August 2008	October 2008
Construction	N/A	March 2009
Temporary S & E mix applied to entire project area	N/A	February 2009
Permanent seed mix applied to entire project area	N/A	March 2009
Containerized and Bare Root Planting	N/A	March 2009
Mitigation Plan/As-built	May 2009	June 2009
Year 1 monitoring	September 2009	February 2010
Year 2 monitoring	September 2010	November 2010
Year 3 monitoring		
Year 4 monitoring		
Year 5 monitoring		

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

Table III. Project Contacts Goodman Property Stream Mitigation Site/EEP #000616	
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

Background information for the Goodman Stream Project is provided in Table IV.

Table IV. Project Background Goodman Property Stream Mitigation Site/EEP #000616	
Project County	Lenoir County
Drainage Area	20.6 acres w/in easmt. bndy. (+/-246 total)
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	Portsmouth, Wickham, Keenansville
Reference site ID	Falling Creek, Lenoir County
USGS HUC for Project and Reference	03020202
NCDWQ Sub-basin for Project and Reference	03-04-05
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?	No
Reasons for 303d listing or stressor?	N/A
% of project easement fenced	Gate at access path

5.0 Monitoring Plan View

Eight water level monitoring gauges have been installed at key locations across the project suspended in two-inch pvc pipe that is set approximately three feet vertically in the ground. The gauges have been situated in pairs to assess the groundwater levels throughout the year and to help substantiate evidence of water flowing through the restored swamp run. Two more gauges are installed in the preservation area to serve as references to a naturally functioning swamp run system. In addition, there is a rain gauge onsite to record precipitation.

Six permanent vegetation sampling plots are installed, each 10 meters square according to the CVS-EEP protocol for vegetation sampling. The plots are situated in such a way as to provide for tree and shrub sampling within the swamp run and upslope from it as well. These plots will provide tree and shrub survival data across the site's varying elevations and soil conditions. Vegetation monitoring is accomplished through annual surveys of the six permanent sampling plots. For each site, the data recorded matches that required of the *CVS-EEP Protocol for Recording Vegetation, v 4.2, 2008, 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.

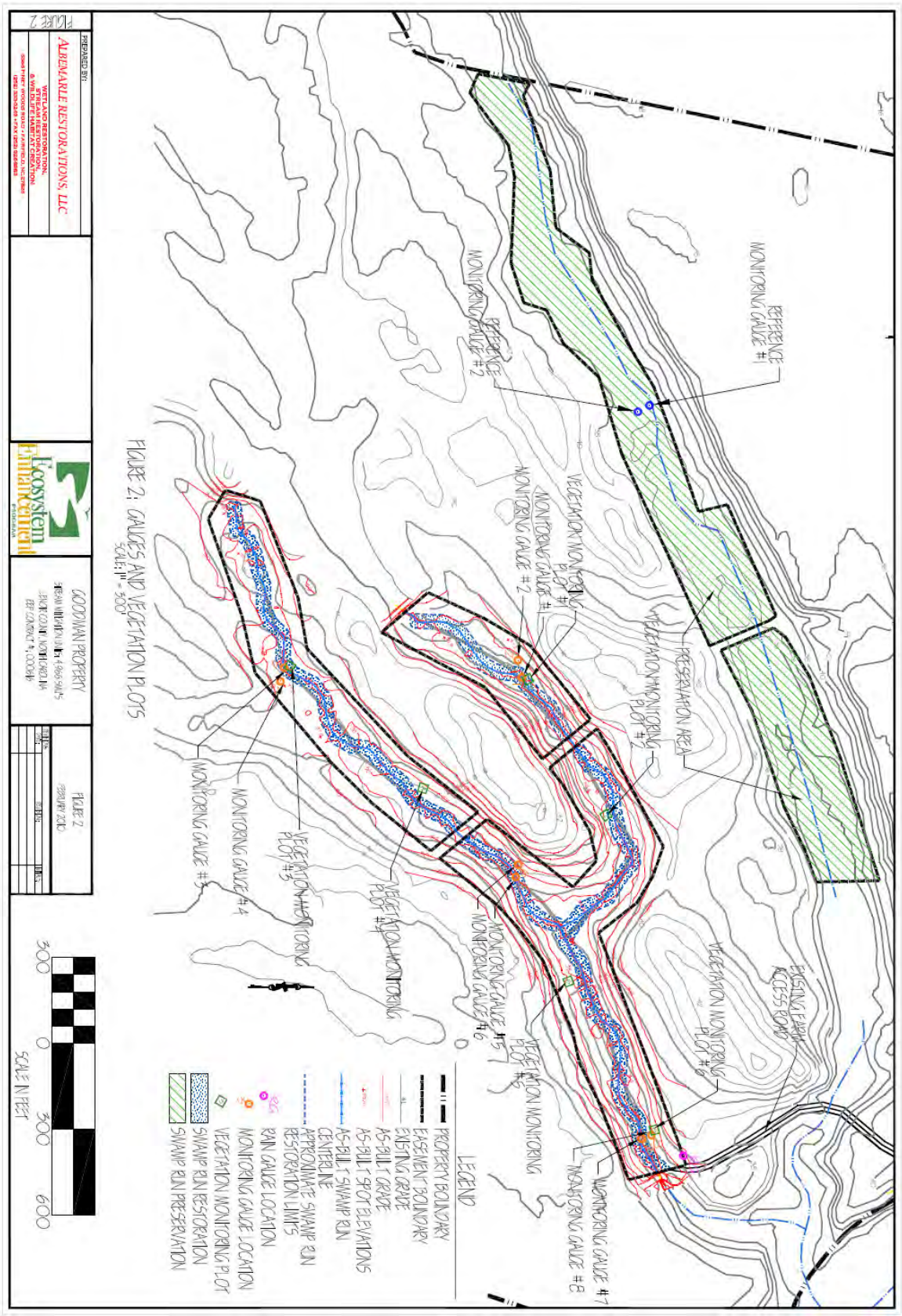


FIGURE 2
PREPARED BY:
ALBEMARLE RESTORATIONS, LLC
WETLAND RESTORATION,
STREAM RESTORATION,
& WATERSHED IMPROVEMENT
GOODMAN PROPERTY
FIGURE 2
FEBRUARY 2010
Ecosystem Enhancement Program
FIGURE 2: GAUGES AND VEGETATION PLOTS
SCALE: 1" = 300'
REFERENCE MONITORING GAUGE #1
REFERENCE MONITORING GAUGE #2
MONITORING GAUGE #2
VEGETATION MONITORING PLOT #1
PRESERVATION AREA
VEGETATION MONITORING PLOT #2
MONITORING GAUGE #3
MONITORING GAUGE #4
VEGETATION MONITORING PLOT #3
VEGETATION MONITORING PLOT #4
MONITORING GAUGE #5
MONITORING GAUGE #6
VEGETATION MONITORING PLOT #5
VEGETATION MONITORING PLOT #6
EXISTING FARM ACCESS ROAD
MONITORING GAUGE #7
MONITORING GAUGE #8
LEGEND
PROPERTY BOUNDARY
EASEMENT BOUNDARY
EXISTING GRADE
AS-BUILT GRADE
AS-BUILT SPOT ELEVATIONS
AS-BUILT SWAMP RUN CENTERLINE
APPROXIMATE SWAMP RUN RESTORATION LIMITS
RAIN GAUGE LOCATION
MONITORING GAUGE LOCATION
VEGETATION MONITORING PLOT
SWAMP RUN RESTORATION
SWAMP RUN PRESERVATION
300 0 300 600
SCALE IN FEET

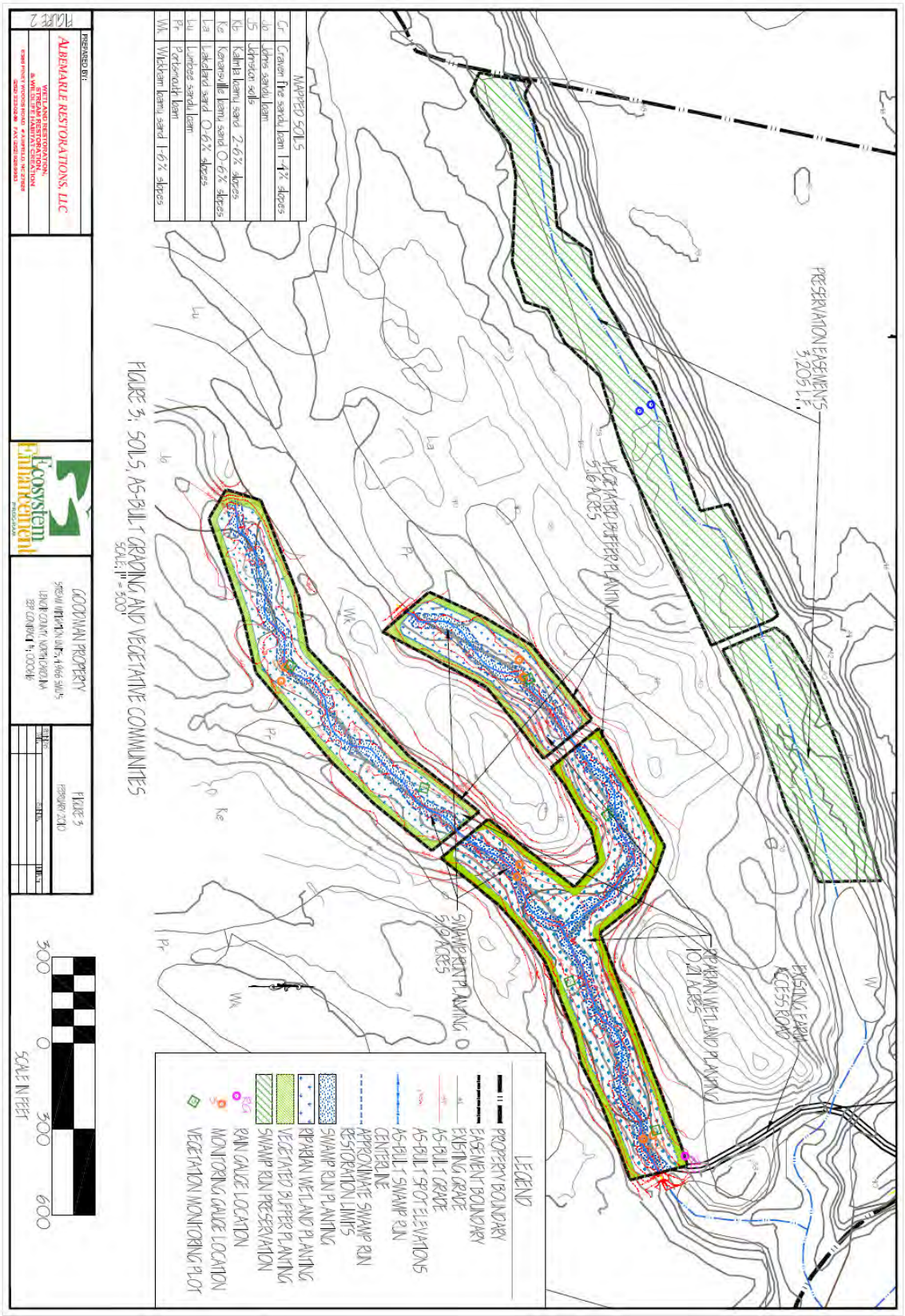


FIGURE 3: SOILS, AS-BUILT GRADING AND VEGETATIVE COMMUNITIES
SCALE: 1" = 300'
MAPPED SOILS
Cr Craven fine sandy loam 1-4% slopes
Jo Johns sandy loam
JS Johnston soils
Kb Kalmia loamy sand 2-6% slopes
Ke Kenansville loamy sand 0-6% slopes
La Lakeland sand 0-6% slopes
Lu Lumbee sandy loam
Pr Portsmouth loam
Wk Wickham loamy sand 1-6% slopes
PRESERVATION EASEMENT 3,205 L.F.
VEGETATIVE BUFFER PLANTING 5.16 ACRES
SWAMP RUN PLANTING 5.90 ACRES
RIPARIAN WETLAND PLANTING 10.21 ACRES
EXISTING FARM ACCESS ROAD
LEGEND
PROPERTY BOUNDARY
EASEMENT BOUNDARY
EXISTING GRADE
AS-BUILT GRADE
AS-BUILT SPOT ELEVATIONS
AS-BUILT SWAMP RUN CENTERLINE
APPROXIMATE SWAMP RUN RESTORATION LIMITS
SWAMP RUN PLANTING
RIPARIAN WETLAND PLANTING
VEGETATED BUFFER PLANTING
SWAMP RUN PRESERVATION
RAIN GAUGE LOCATION
MONITORING GAUGE LOCATION
VEGETATION MONITORING PLOT
300 0 300 600
SCALE IN FEET
GOODMAN PROPERTY
FIGURE 3
PREPARED BY:
ALBEMARLE RESTORATIONS, LLC
WETLAND RESTORATION
STREAM RESTORATION
& WILDLIFE HABITAT CREATION
ecosystem enhancement program
FIGURE 2

II. Project Condition and Monitoring Results

1.0 Vegetation Assessment

The vegetation success criterion was developed in accordance with the CVS-EEP protocol. The Goodman project was designed to function as a bottomland hardwood plant community. 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 upper banks were planted heavily to oaks with tupelo, cypress and other tree and shrub species in the mix. The site was also seeded immediately after construction with an approved wetland seed mix. The tree and shrub species mix was based on the vegetation found at the reference site and all species are classified from FAC to OBL (Table V). The average survival rate for the project in 2010 was 371 stems per acre.

Table V. Species by Community Type		
Goodman Property Stream Mitigation Project/EEP #000616		
Forested Wetland 20.6 Acres		
Trees		
Common Name	**Scientific Name**	**Wetland Indicator Status**
Bald Cypress	Taxodium distichum	OBL
Water tupelo	Nyssa aquatica	OBL
Swamp Black Gum	Nyssa biflora	FAC
Willow Oak	Quercus phellos	FACW-
Swamp Chestnut Oak	Quercus michauxii	FACW-
Water Oak	Quercus nigra	FAC
River Birch	Betula nigra	FACW
Green Ash	Fraxinus pennsylvanica	FACW
Shrubs		
Common Name	**Scientific Name**	**Wetland Indicator Status**
Button Bush	Cephalanthus occidentalis	OBL
Virginia Sweetspire	Itea virginica	FACW+
Wax Myrtle	Myrica cerifera	FAC+

1.1 Vegetation Discussion

The survival rates on Plots 3 and 4 were slightly less than the year-three criterion of a minimum of 320 stems per acre. Stocking levels on the other four plots well exceeded 320 stems per acre. Both plots 3 and 4 suffer from extremely dense, very tall herbaceous competition, primarily dog fennel (*Eupatorium capillifolium)* which created a tall dense, pernicious canopy over the young trees. Trees on these plots were very difficult to locate while completing survival checks in 2010. Light supplemental planting will be done during the fall/winter of 2010-2011 on the portion of the project around Plots 3 and 4 to bring the stocking up to adequate levels (greater than 320 stems per acre). Future survival will be closely monitored on these two plots and their surrounding area to be sure stocking is adequate to reach the long-term success criteria.

2.0 Flow Assessment

Refer to Figures F1 through F5 for the following discussion of evidence of flow within the swamp runs. These charts contain combined data for each of the four pairs of gauges set up in the project site and the pair in the reference area. For each pair, one gauge is set in the stream channel and the other is set upslope to capture water levels and runoff from higher elevations as it drains downslope into the stream channel. Gauges 7 and 8 are the exception; due to soil conditions at the time of installation, gauge 7 could not be set up in the channel and is located approximately three feet outside the channel and approximately six inches higher in elevation than the bottom of the stream channel.

Each of the four pairs of gauges in the project area indicate prolonged, continuous flow from November, 2009 until April, 2010. This period of flow is supported by video documentation in January and again in April. There are snapshots of flow at various points in the project included in Appendix A that were derived from the videos taken during site visits. The videos are included on the CD copy of this report and show good flow throughout the entire project in January.

Other photos in Appendix A illustrate high water marks and vegetation matting during the winter and spring of 2010. Site flooding near the confluence of the two branches (near Plot 5) extended from the center of the run outward approximately 20 feet on both sides during the site inspection in January, 2010.

There was a cumulative rainfall deficit of 9.15" through most of September, 2010. A coastal storm late in the month dropped over eleven inches of rain over a five-day period which was enough to produce flow which was video documented and included on the CD.

The area of the project around Plot 3 continues to be fed by runoff from the adjoining agricultural field in at least two locations. Given the heavy herbaceous cover along the southern branch, this portion of the project is providing a necessary buffer to any runoff from the field. The Plan View in Appendix D gives some indication as to the areas where runoff from the field enters the project.

Figure F1.
Goodman Monitoring Gauges #1 and #2

Gauge #1 is located in the stream channel. Gauge #2 is located up slope out of the channel.

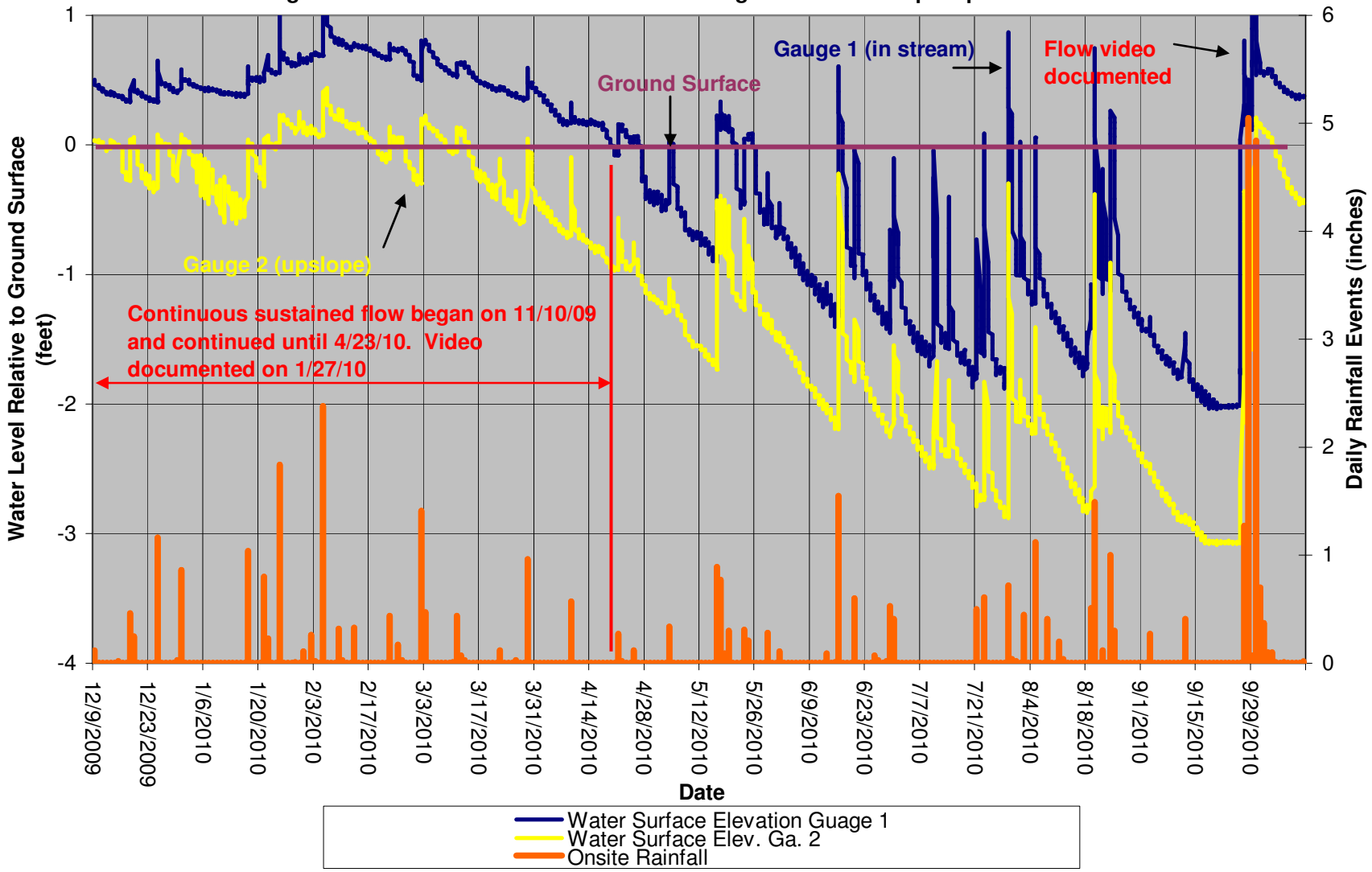


Figure F2.
Goodman Monitoring Gauges #3 and #4
Gauge #3 is located in the stream channel. Gauge #4 is located up slope out of the channel.

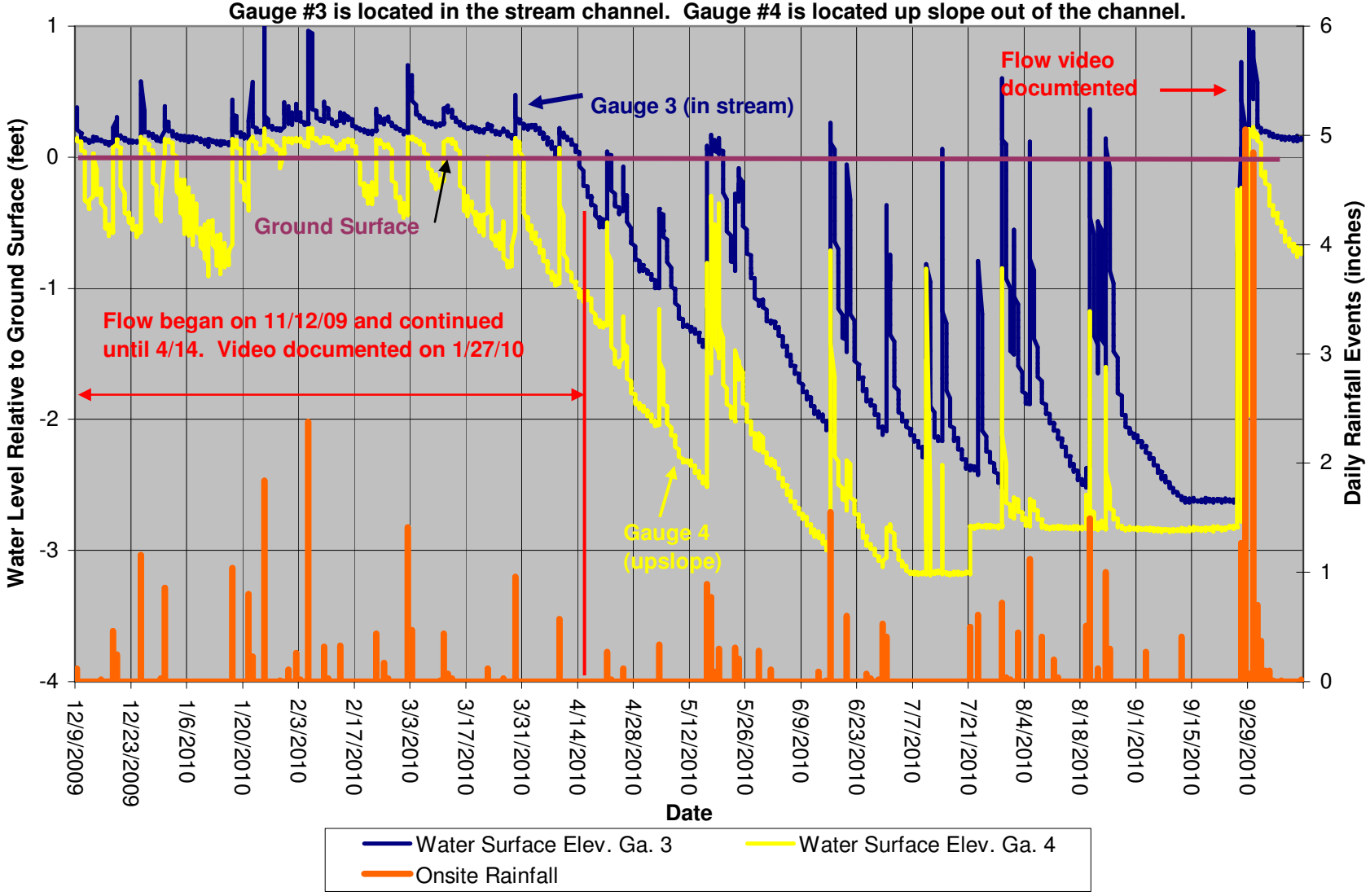


Figure F3.
Goodman Monitoring Gauges #5 and #6
Gauge #5 is located in the stream channel. Gauge #6 is located up slope out of the channel.

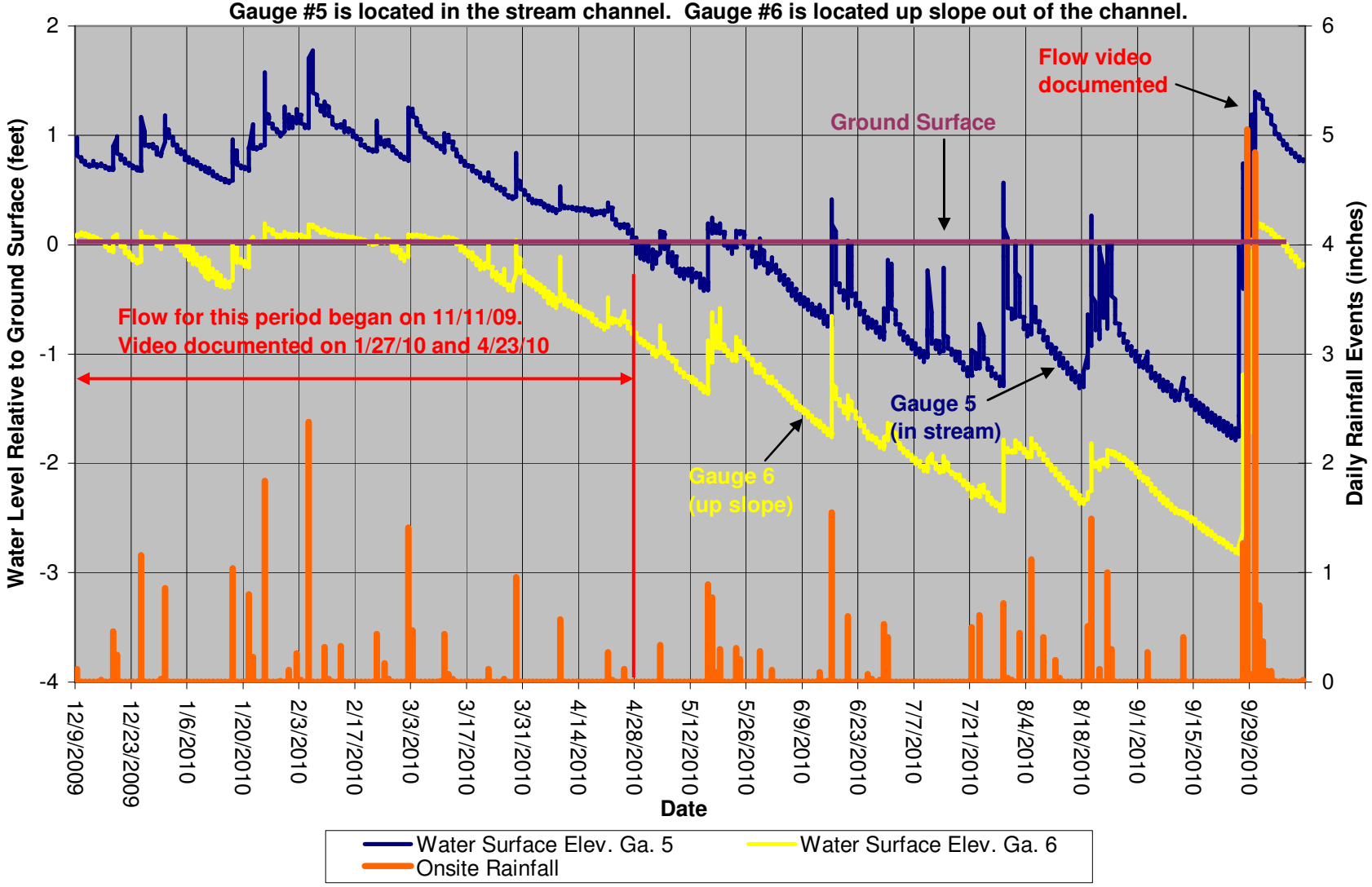


Figure F4.
Goodman Monitoring Gauges #7 and #8
Gauge #7 is located just out of the channel. Gauge #8 is located upslope from the stream channel.

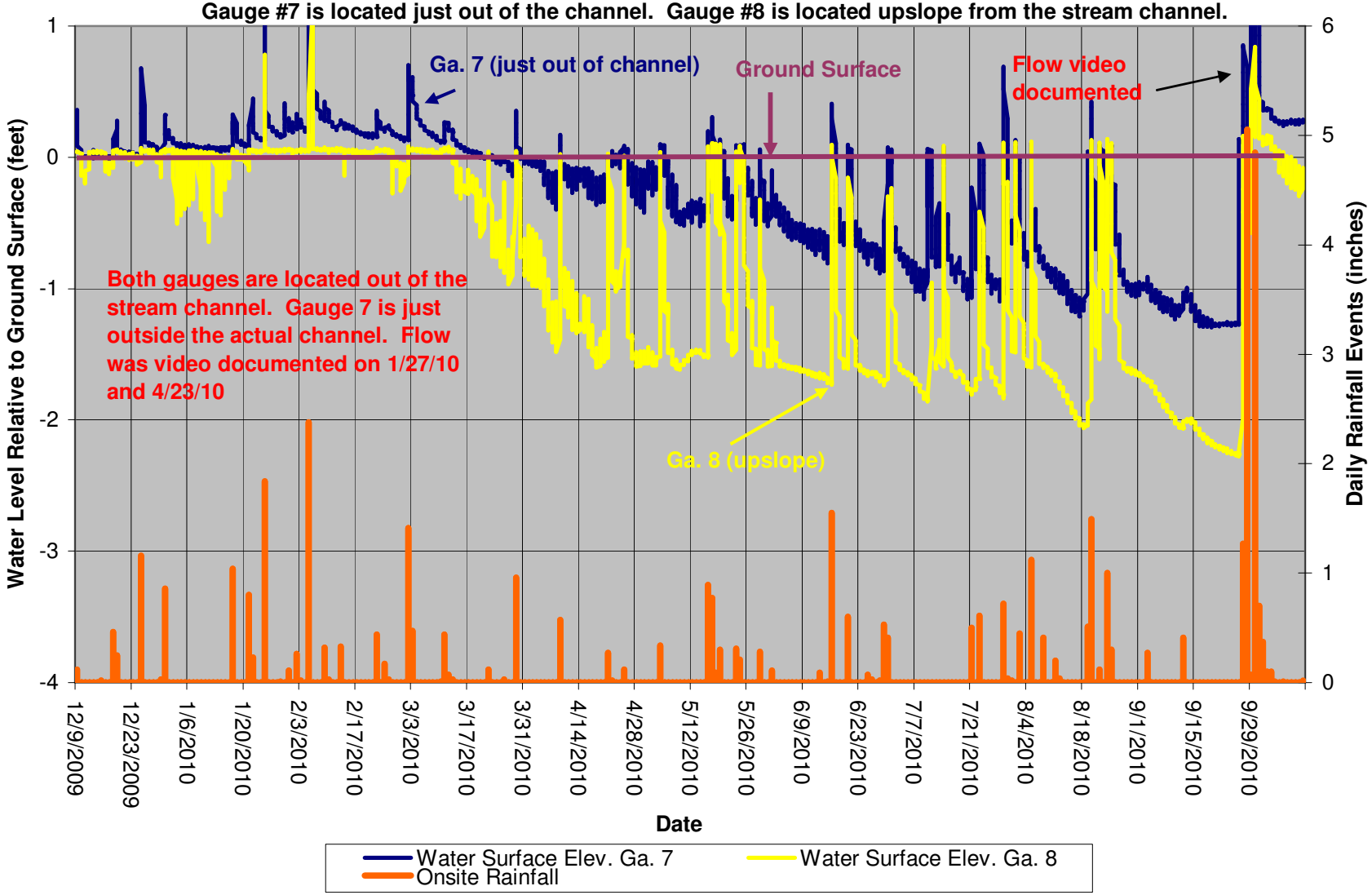
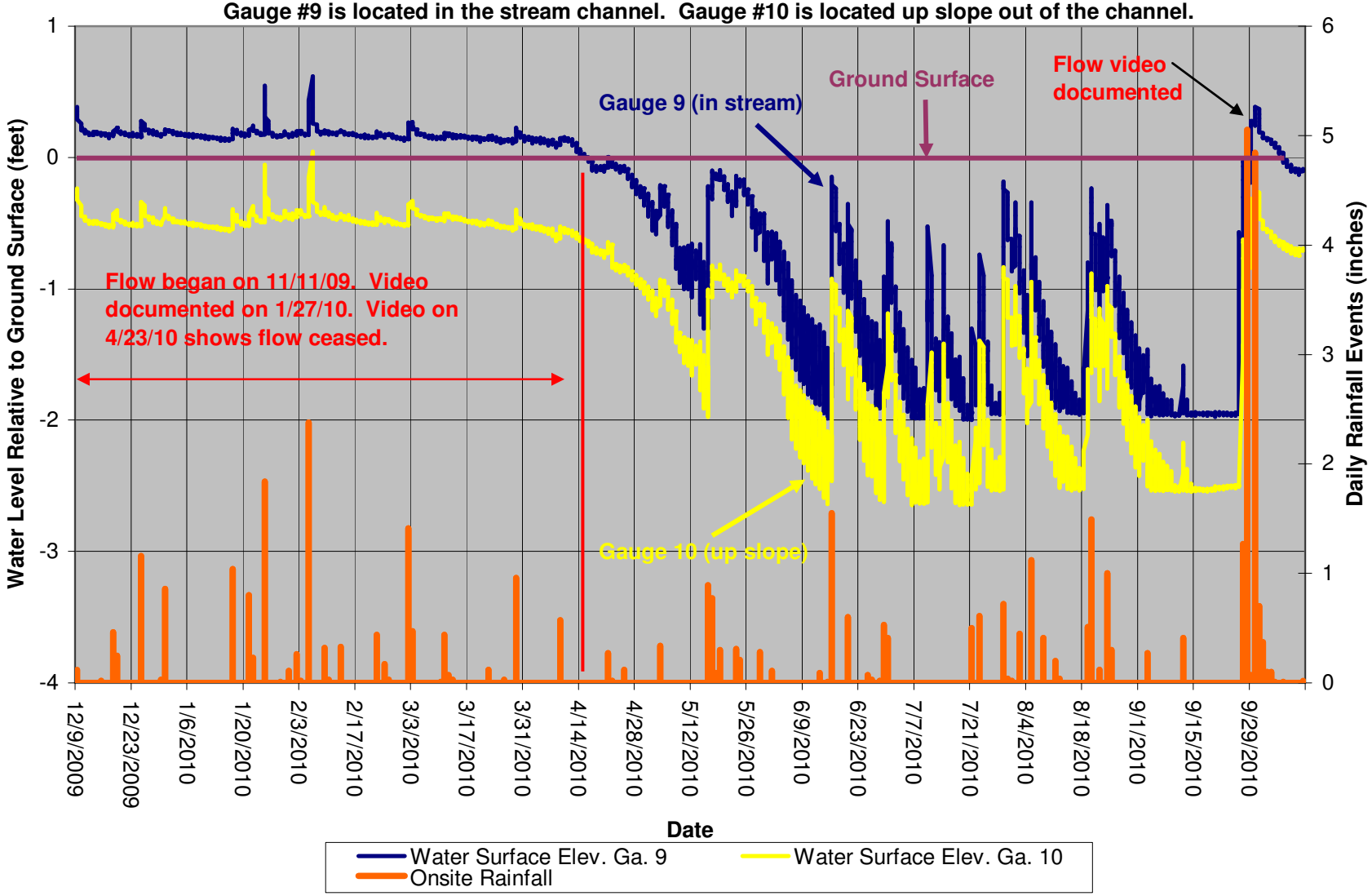


Figure F5.
Goodman Monitoring Gauges #9 and #10
Gauge #9 is located in the stream channel. Gauge #10 is located up slope out of the channel.



2.1 Monitoring Plan View

Figure 4 in Appendix D provides an overview of the watershed success of the project. The northern branch is directly connected to an existing, functioning swamp run upstream, but the southern branch relies solely on rainfall and field drainage. Drainage from the field into the southern branch has been noted in at least two different locations as shown on the Plan View. The portion of the project around Plots 3 and 4 will receive supplemental planting to bring stocking levels up to a minimum of 320 stems per acre.

Table VI. Vegetation Criteria Success by Plot
Goodman Property Wetland Mitigation Project/EEP #D000616

Vegetation Plot	Vegetation Success Met	Stems per Acre	Vegetation Mean
1	Y	412	67% Success
2	Y	330	
3	N	247	
4	N	289	
5	Y	454	
6	Y	495	

3.0 Project Success Discussion

The second year of monitoring on the Goodman project saw a more normal rainfall pattern that produced excellent flow for the first quarter of the year. Tree survival over most of the project is adequate and tree growth is good. Overall, the project is functioning as designed and intended. Listed below are the success indicators from the Mitigation Plan. Those shown in ***blue*** were observed and video or photo documented in 2010.

- **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 and matted vegetation were noted and photographed during the spring after prolonged high water and extended flow in the winter and spring. Channel and bank development are more pronounced at the end of the second year of monitoring. There are small areas of shelf formation, scouring, minor sediment deposits and lateral channel formation that are all indicators of successful stream development. Submerged aquatic vegetation developed along some portions of the stream channel during the spring of 2010 while water levels remained high enough to support it.

III. Methodology Section

Year 2 monitoring for the Goodman project occurred in 2010. 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. Vegetation Metadata

Report Prepared By	Ashby Brown
Date Prepared	10/15/2010 16:01
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	D000616
project Name	Goodman
Description	Goodman Stream Mitigation
River Basin	Roanoke
Sampled Plots	0

Table 2. Vegetation Vigor by Species

	Species	4	3	2	1	0	Missing	Unknown
	Cephalanthus occidentalis	3		1		3		
	Fraxinus pennsylvanica		2	3	1		2	
	Itea virginica		1	4	1			
	Nyssa biflora		3	2		1		
	Quercus bicolor		1					
	Quercus phellos	6		2				
	Taxodium distichum	12	7	1			1	
	Myrica	1	1					
	Unknown			2			5	
TOT:	**9**	**22**	**15**	**15**	**2**	**4**	**8**	

Table 3. Vegetation Damage by Species

	Species	All Damage Categories	(no damage)
	Cephalanthus occidentalis	7	7
	Fraxinus pennsylvanica	8	8
	Itea virginica	6	6
	Myrica	2	2
	Nyssa biflora	6	6
	Quercus bicolor	1	1
	Quercus phellos	8	8
	Taxodium distichum	21	21
	Unknown	7	7
TOT:	**9**	**66**	**66**

Table 4. Vegetation Damage by Plot

	plot	All Damage Categories	(no damage)
	000616-AB-0001-year:2	11	11
	000616-AB-0002-year:2	12	12
	000616-AB-0003-year:2	8	8
	000616-AB-0004-year:2	8	8
	000616-AB-0005-year:2	14	14
	000616-AB-0006-year:2	13	13
TOT:	**6**	**66**	**66**

Table 5. Planted Stems by Plot and Species

					Plot					
	Species	**Total Planted Stems**	**# plots**	**avg# stems**	**1**	**2**	**3**	**4**	**5**	**6**
	Cephalanthus occidentalis	4	3	1.33	1			2	1	
	Fraxinus pennsylvanica	6	2	3					5	1
	Itea virginica	6	3	2		2		3		1
	Myrica	2	1	2	2					
	Nyssa biflora	5	1	5		5				
	Quercus bicolor	1	1	1				1		
	Quercus phellos	8	4	2	4	1		1		2
	Taxodium distichum	20	4	5	3		6		3	8
	Unknown	2	1	2					2	
TOT:	**9**	**54**	**9**		**10**	**8**	**6**	**7**	**11**	**12**
	Average Stems per Acre				**412**	**330**	**247**	**289**	**454**	**495**
Average Stems per Acre for the Project : 371										

Table 6. Vegetation Problem Areas

Feature/Issue	Plot	Probable Cause	Photo #
None to report	N/A	N/A	N/A

Tree survival is good in beginning of 2010 (April)

Grey colored ground/vegetation shows extent of high water in spring of 2010

Another view of the extent of high water in the middle reaches of the project

Matted vegetation in October 2010 after September's heavy rain

Another view of matted vegetation in October after heavy rain in September

Sparse herbaceous competition in April 2010

Herbaceous competition has become much more intense at end of season (October)

Photo of flowing water and aquatic vegetation in January at outlet end

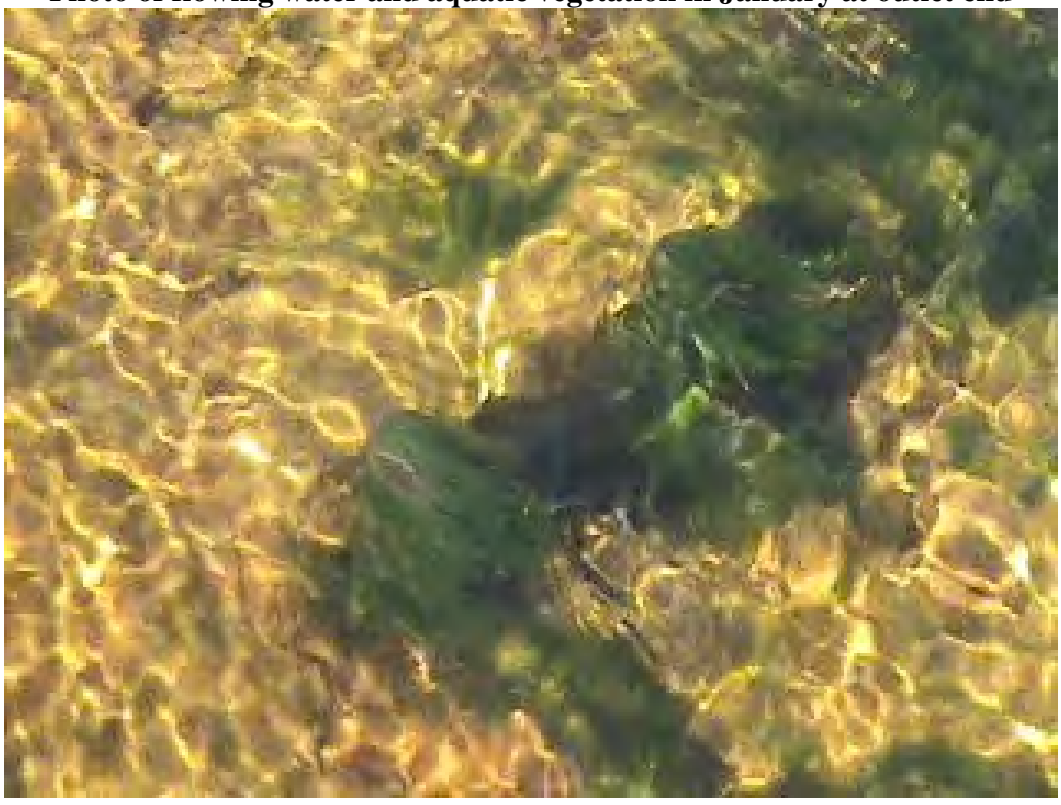


Photo of flow in January near confluence of two branches (near plot 5)

Photo of inflow to the project in January

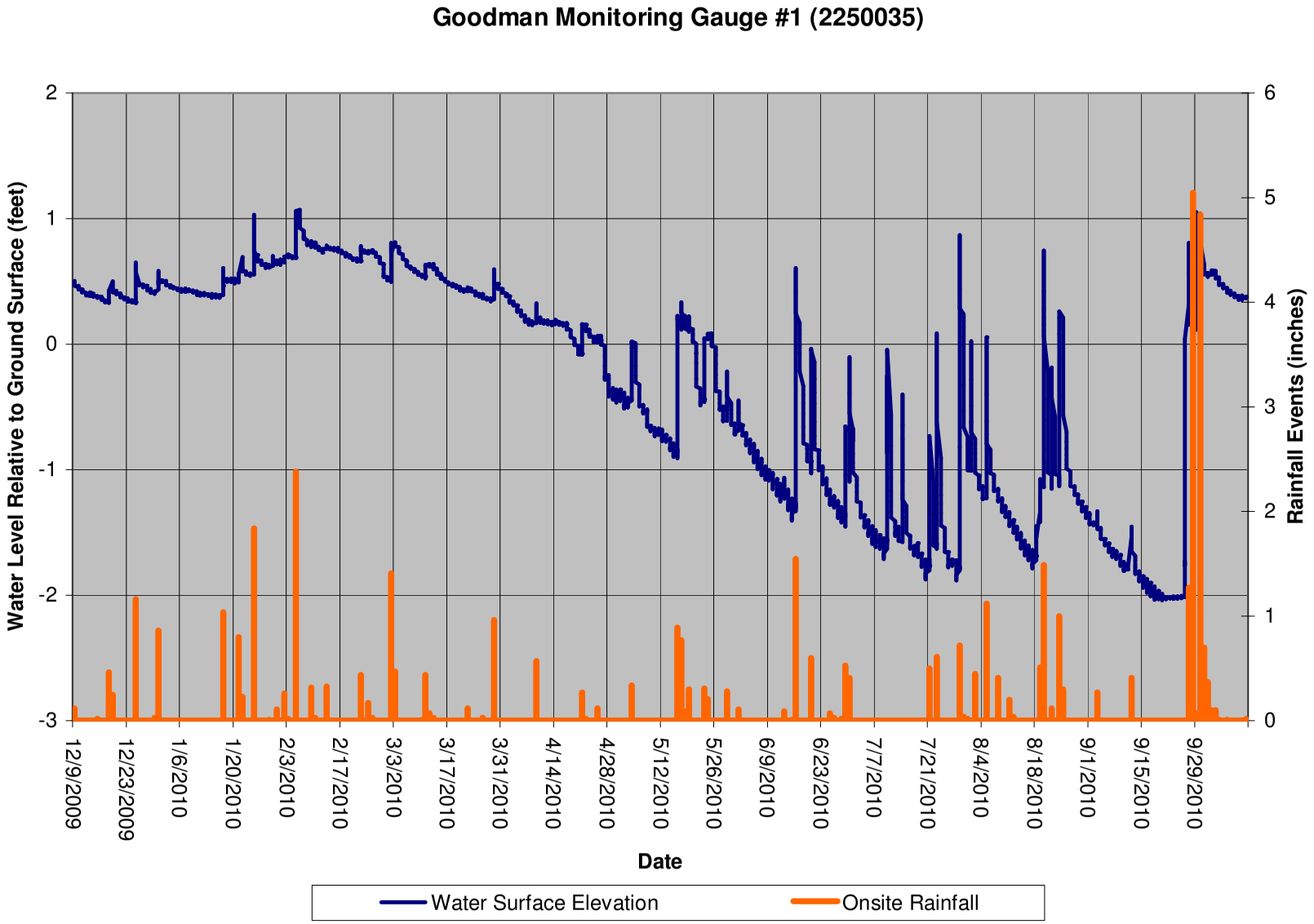
Appendix B

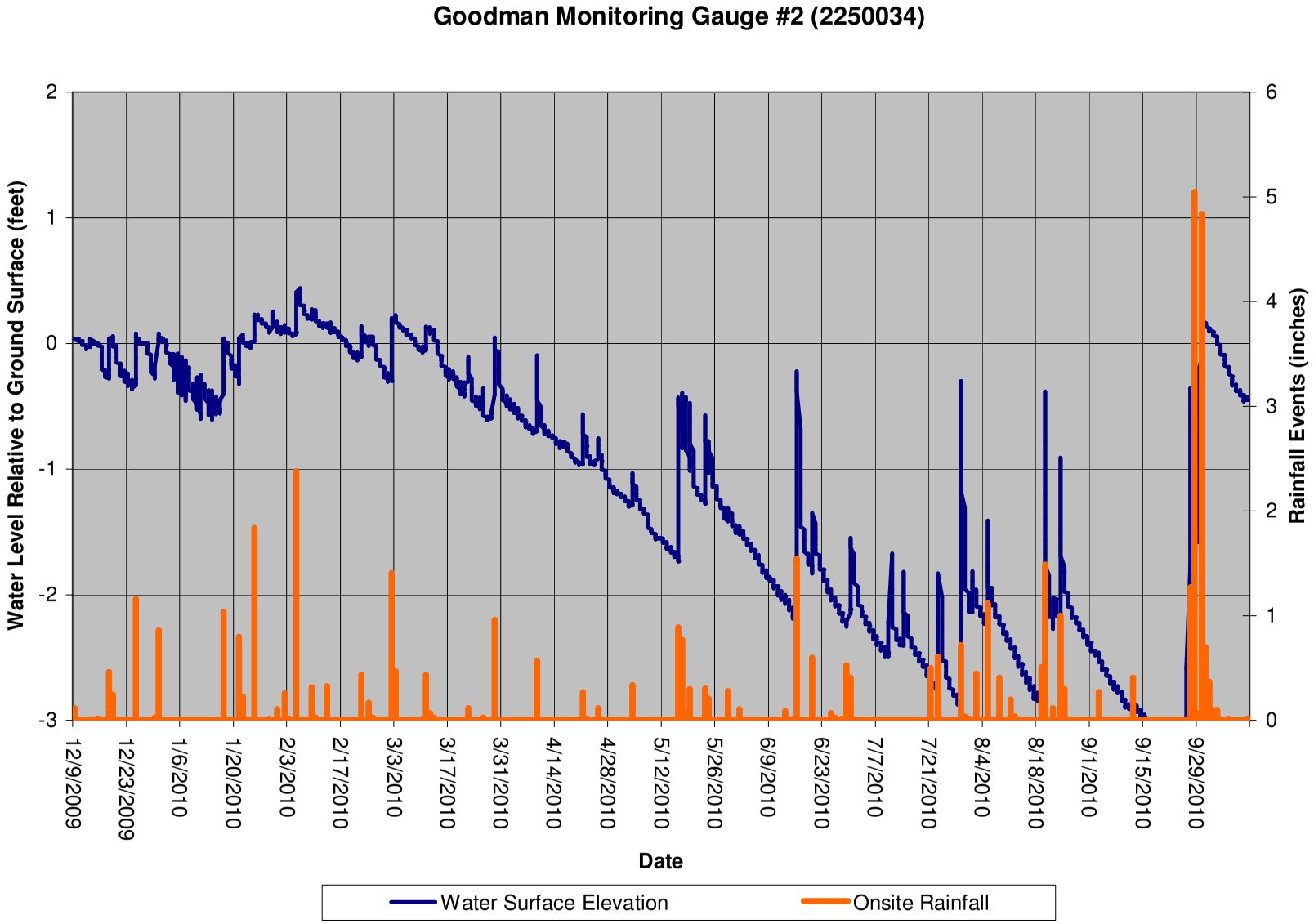
Geomorphologic Raw Data

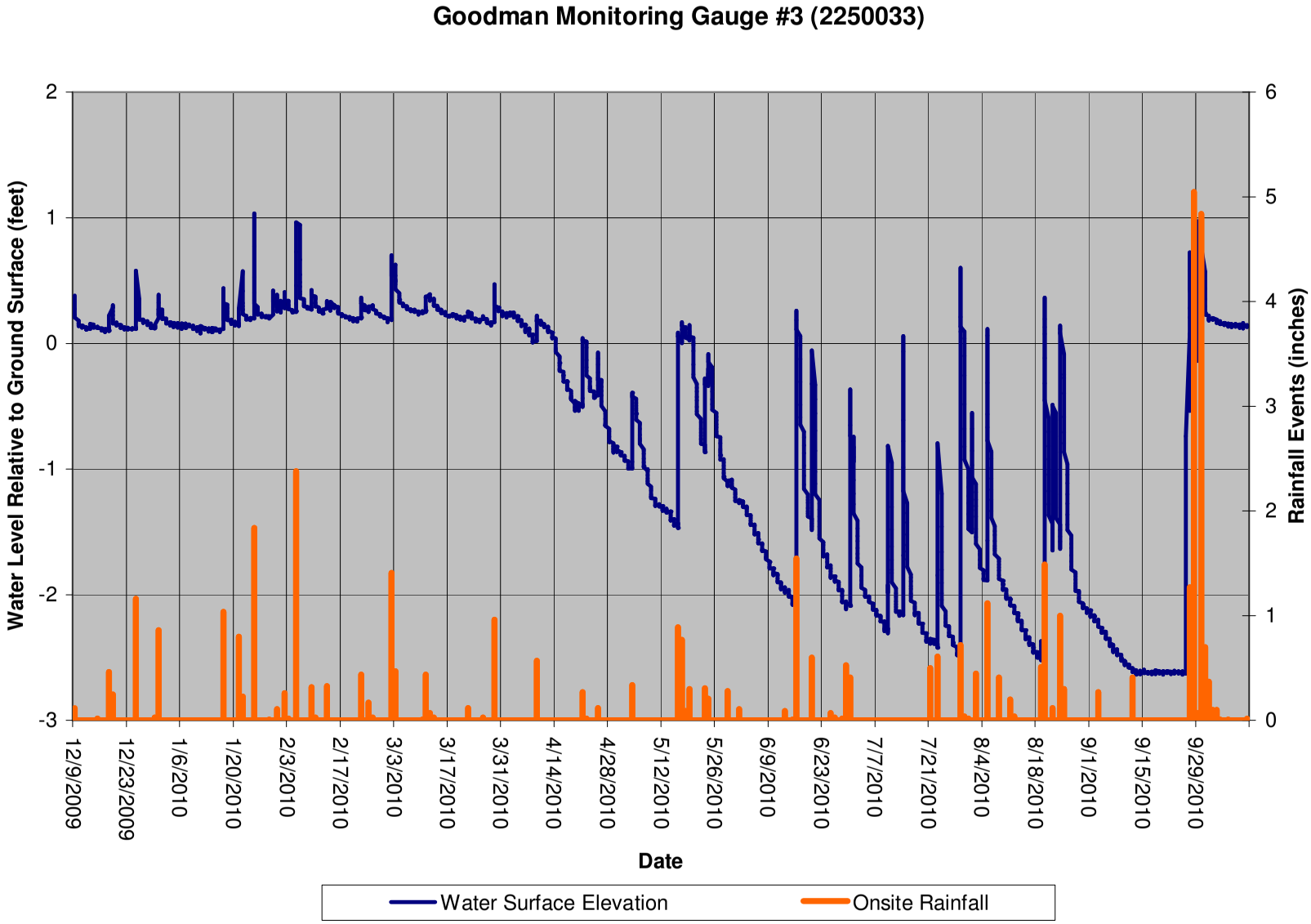
Not used in this report

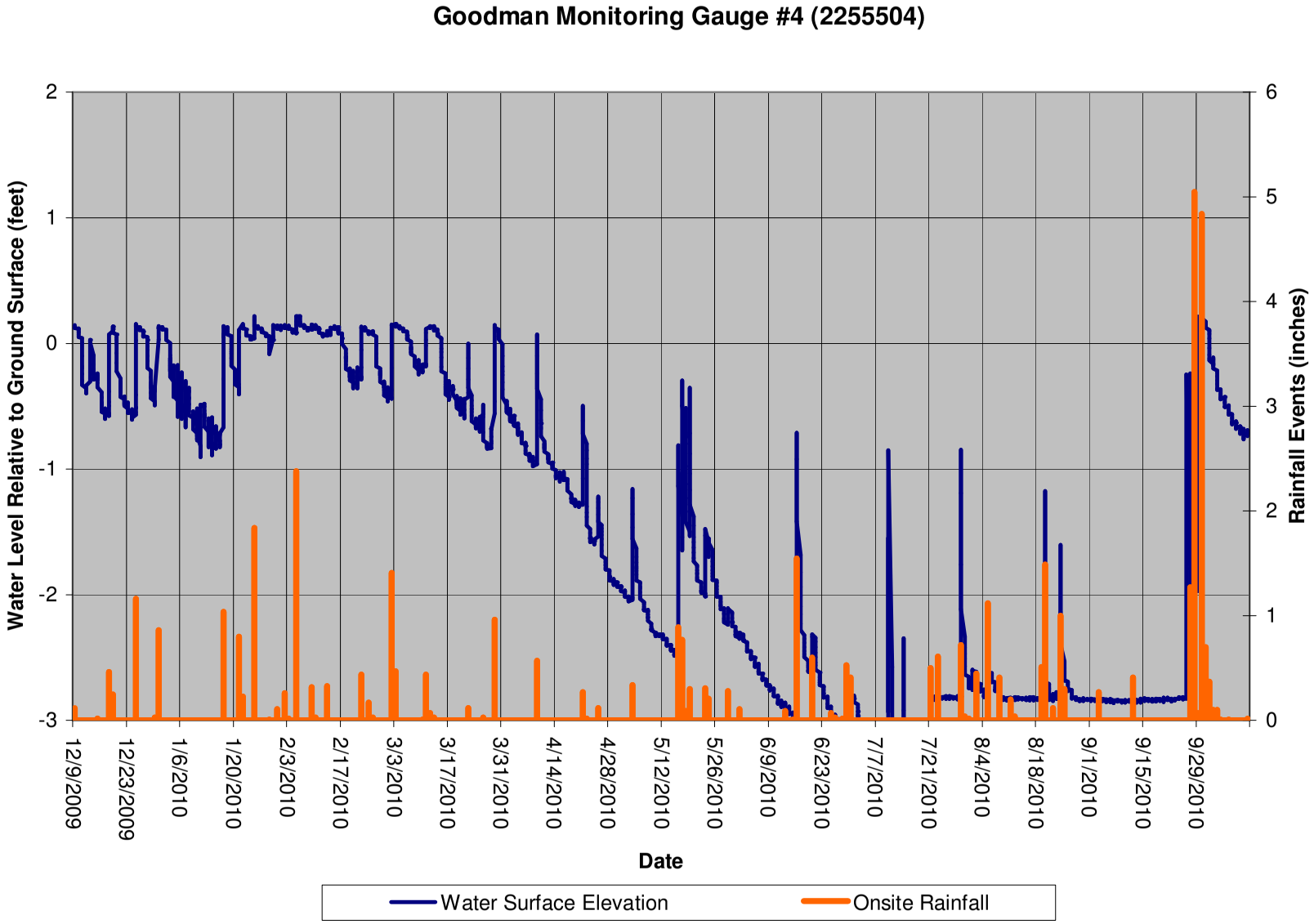
Appendix C

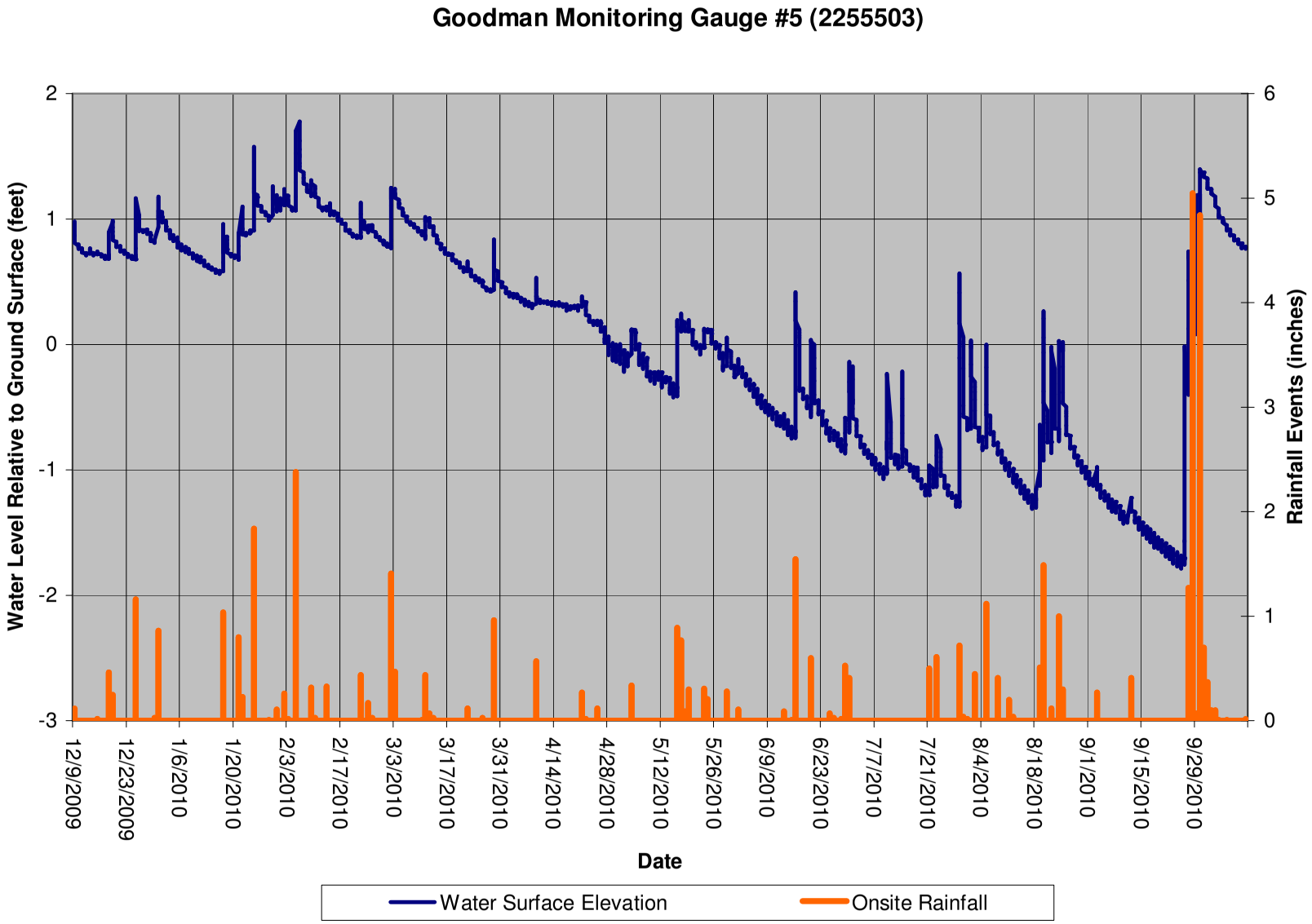
Hydrologic Data Tables

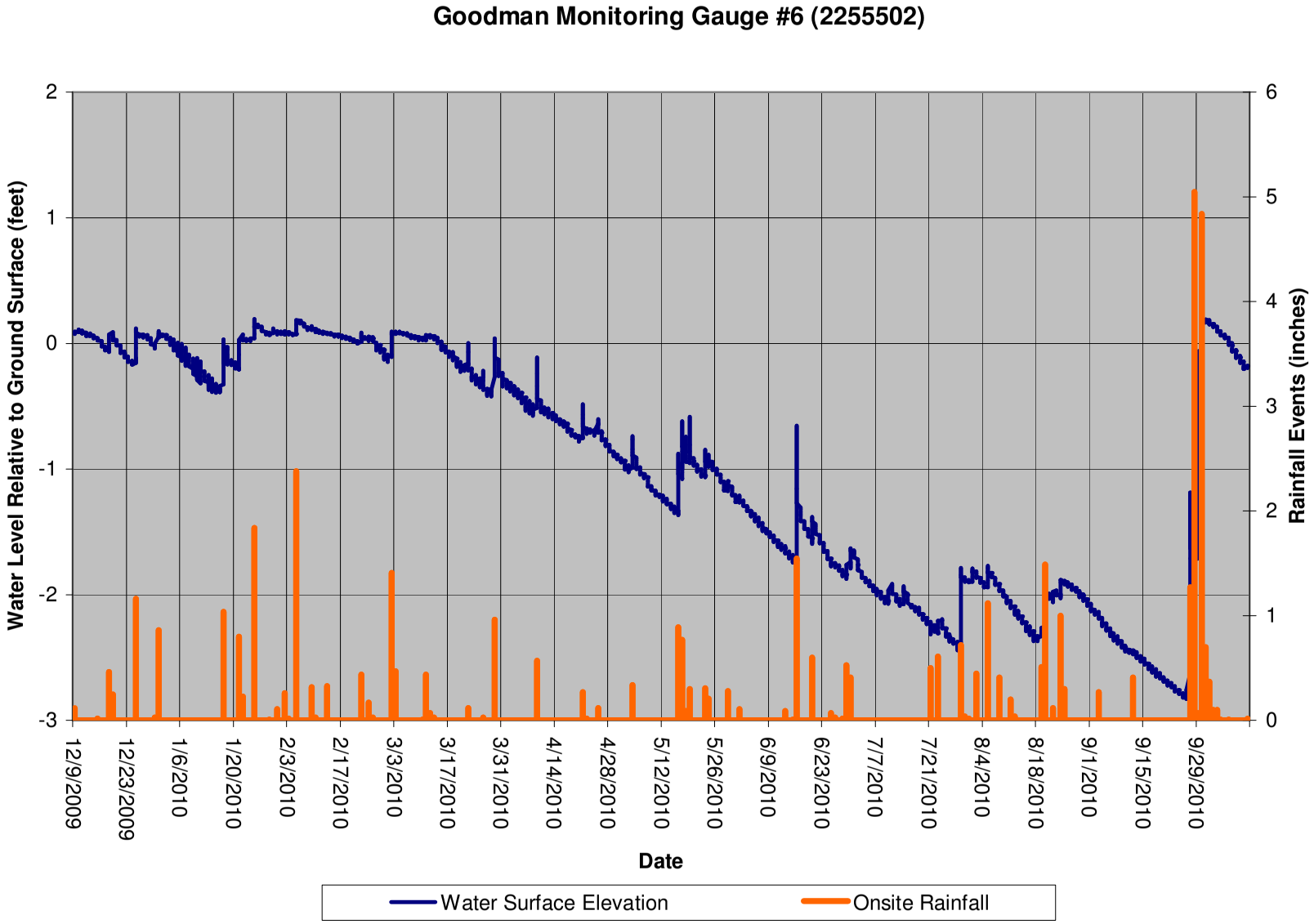

Goodman Monitoring Gauge #1 (2250035)
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
2
1
0
-1
-2
-3
6
5
4
3
2
1
0
12/9/2009
12/23/2009
1/6/2010
1/20/2010
2/3/2010
2/17/2010
3/3/2010
3/17/2010
3/31/2010
4/14/2010
4/28/2010
5/12/2010
5/26/2010
6/9/2010
6/23/2010
7/7/2010
7/21/2010
8/4/2010
8/18/2010
9/1/2010
9/15/2010
9/29/2010
Date
Water Surface Elevation
Onsite Rainfall

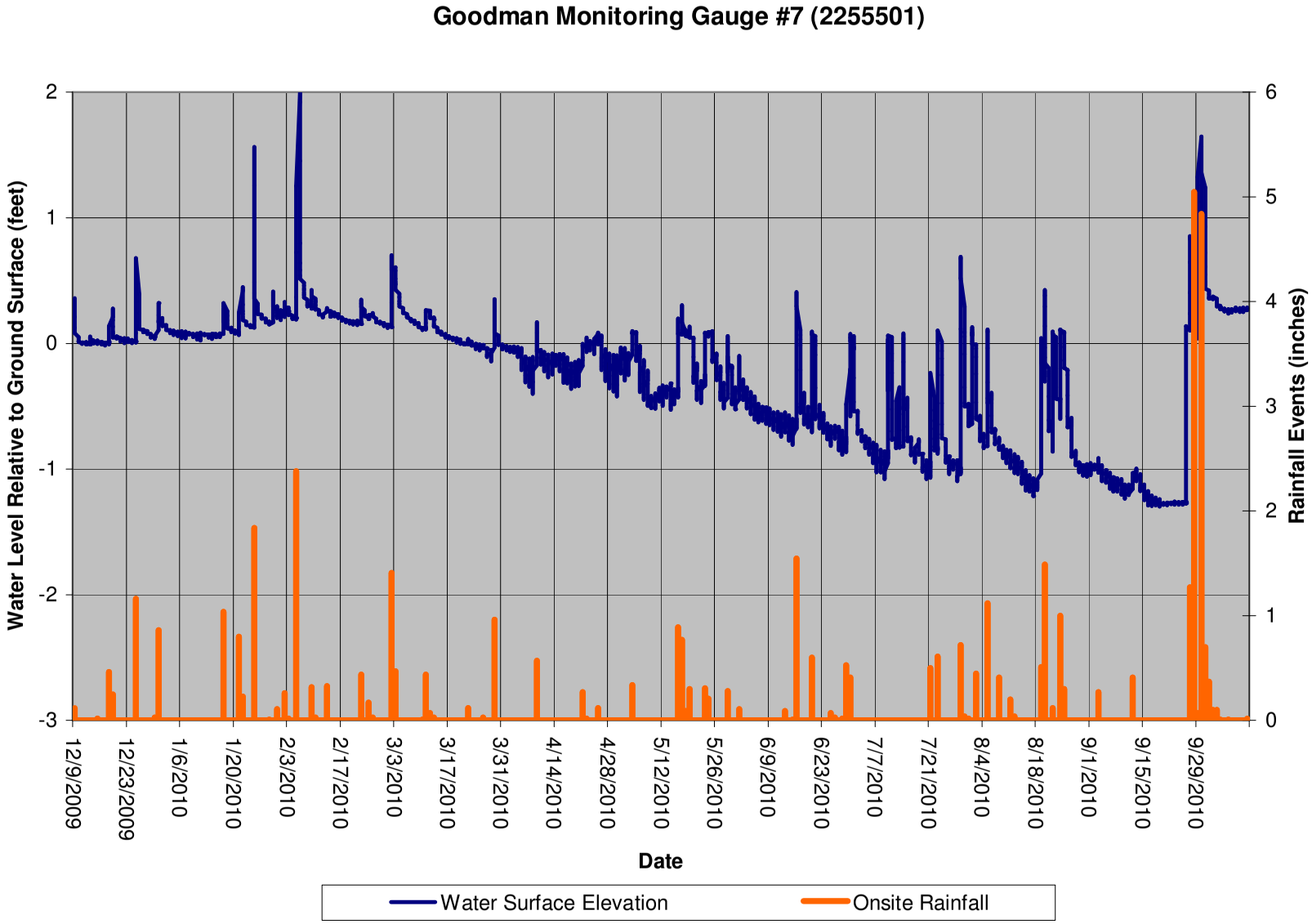

Goodman Monitoring Gauge #2 (2250034)
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
2
1
0
-1
-2
-3
6
5
4
3
2
1
0
12/9/2009
12/23/2009
1/6/2010
1/20/2010
2/3/2010
2/17/2010
3/3/2010
3/17/2010
3/31/2010
4/14/2010
4/28/2010
5/12/2010
5/26/2010
6/9/2010
6/23/2010
7/7/2010
7/21/2010
8/4/2010
8/18/2010
9/1/2010
9/15/2010
9/29/2010
Date
Water Surface Elevation
Onsite Rainfall

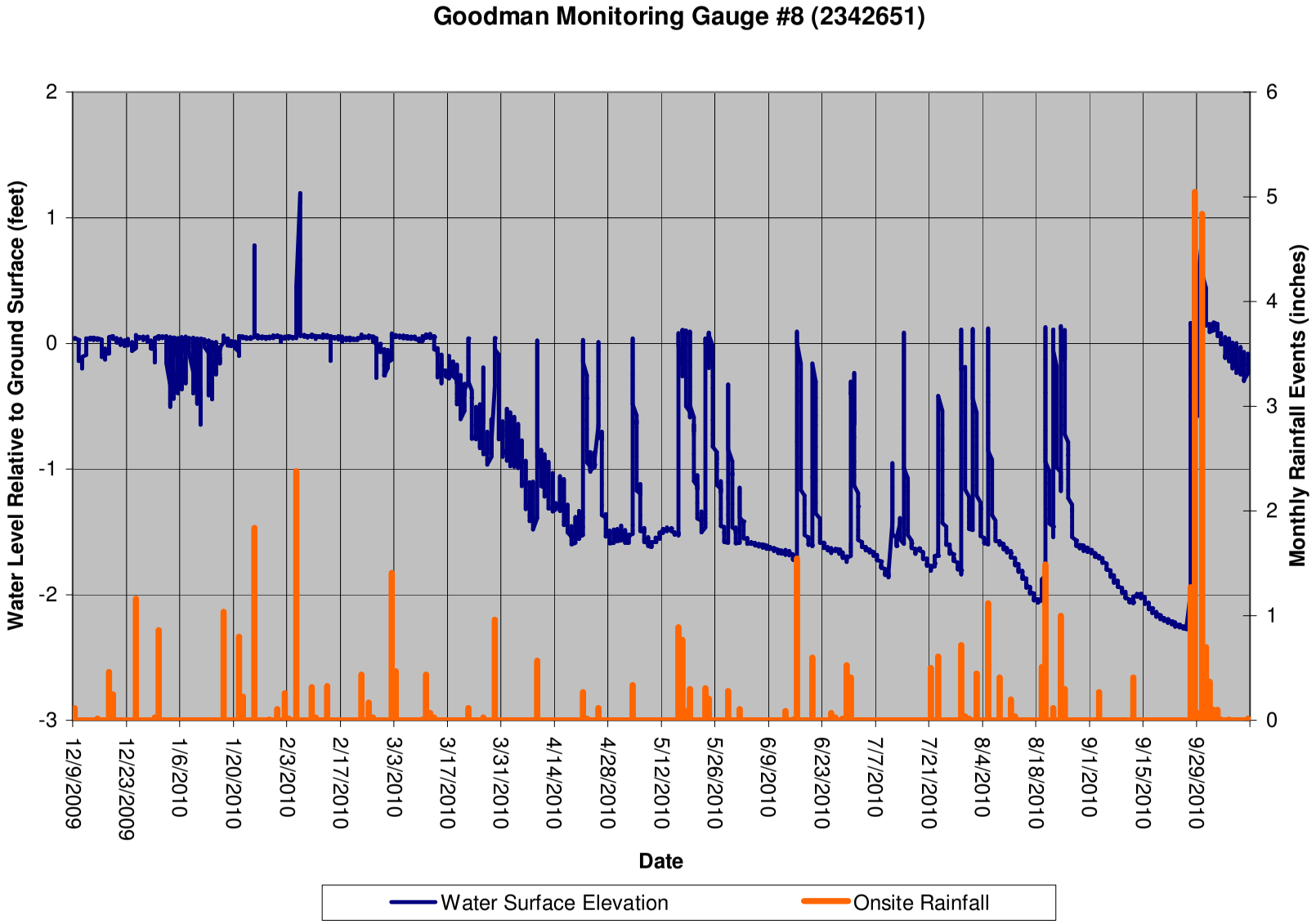

Goodman Monitoring Gauge #3 (2250033)
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
2
1
0
-1
-2
-3
6
5
4
3
2
1
0
12/9/2009
12/23/2009
1/6/2010
1/20/2010
2/3/2010
2/17/2010
3/3/2010
3/17/2010
3/31/2010
4/14/2010
4/28/2010
5/12/2010
5/26/2010
6/9/2010
6/23/2010
7/7/2010
7/21/2010
8/4/2010
8/18/2010
9/1/2010
9/15/2010
9/29/2010
Date
Water Surface Elevation
Onsite Rainfall

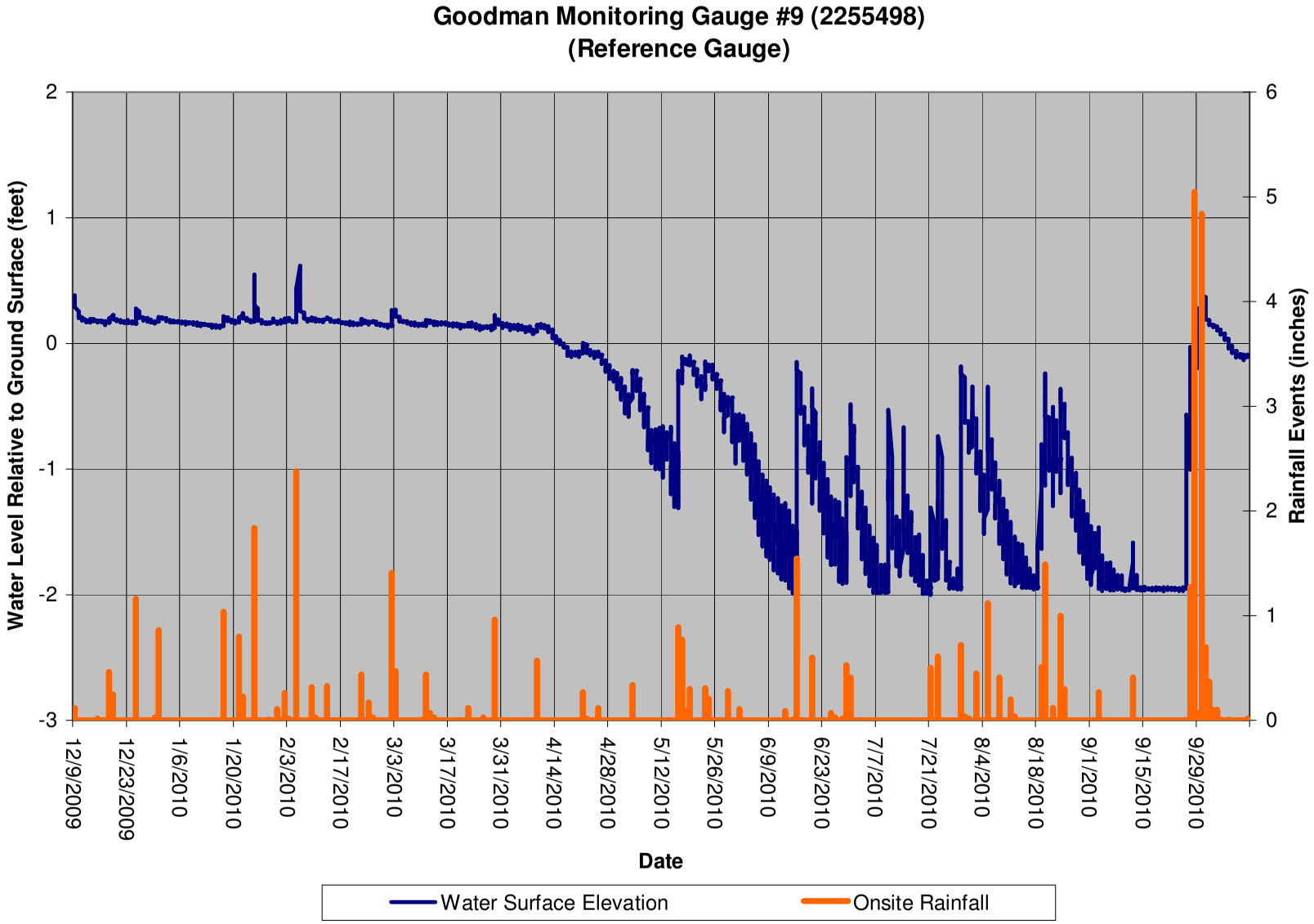

Goodman Monitoring Gauge #4 (2255504)
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
2
1
0
-1
-2
-3
6
5
4
3
2
1
0
12/9/2009
12/23/2009
1/6/2010
1/20/2010
2/3/2010
2/17/2010
3/3/2010
3/17/2010
3/31/2010
4/14/2010
4/28/2010
5/12/2010
5/26/2010
6/9/2010
6/23/2010
7/7/2010
7/21/2010
8/4/2010
8/18/2010
9/1/2010
9/15/2010
9/29/2010
Date
Water Surface Elevation
Onsite Rainfall


Goodman Monitoring Gauge #5 (2255503)
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
2
1
0
-1
-2
-3
6
5
4
3
2
1
0
12/9/2009
12/23/2009
1/6/2010
1/20/2010
2/3/2010
2/17/2010
3/3/2010
3/17/2010
3/31/2010
4/14/2010
4/28/2010
5/12/2010
5/26/2010
6/9/2010
6/23/2010
7/7/2010
7/21/2010
8/4/2010
8/18/2010
9/1/2010
9/15/2010
9/29/2010
Date
Water Surface Elevation
Onsite Rainfall


Goodman Monitoring Gauge #6 (2255502)
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
2
1
0
-1
-2
-3
6
5
4
3
2
1
0
12/9/2009
12/23/2009
1/6/2010
1/20/2010
2/3/2010
2/17/2010
3/3/2010
3/17/2010
3/31/2010
4/14/2010
4/28/2010
5/12/2010
5/26/2010
6/9/2010
6/23/2010
7/7/2010
7/21/2010
8/4/2010
8/18/2010
9/1/2010
9/15/2010
9/29/2010
Date
Water Surface Elevation
Onsite Rainfall


Goodman Monitoring Gauge #7 (2255501)
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
2
1
0
-1
-2
-3
6
5
4
3
2
1
0
12/9/2009
12/23/2009
1/6/2010
1/20/2010
2/3/2010
2/17/2010
3/3/2010
3/17/2010
3/31/2010
4/14/2010
4/28/2010
5/12/2010
5/26/2010
6/9/2010
6/23/2010
7/7/2010
7/21/2010
8/4/2010
8/18/2010
9/1/2010
9/15/2010
9/29/2010
Date
Water Surface Elevation
Onsite Rainfall


Goodman Monitoring Gauge #8 (2342651)
Water Level Relative to Ground Surface (feet)
Monthly Rainfall Events (inches)
2
1
0
-1
-2
-3
6
5
4
3
2
1
0
12/9/2009
12/23/2009
1/6/2010
1/20/2010
2/3/2010
2/17/2010
3/3/2010
3/17/2010
3/31/2010
4/14/2010
4/28/2010
5/12/2010
5/26/2010
6/9/2010
6/23/2010
7/7/2010
7/21/2010
8/4/2010
8/18/2010
9/1/2010
9/15/2010
9/29/2010
Date
Water Surface Elevation
Onsite Rainfall


Goodman Monitoring Gauge #9 (2255498)
(Reference Gauge)
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
2
1
0
-1
-2
-3
6
5
4
3
2
1
0
12/9/2009
12/23/2009
1/6/2010
1/20/2010
2/3/2010
2/17/2010
3/3/2010
3/17/2010
3/31/2010
4/14/2010
4/28/2010
5/12/2010
5/26/2010
6/9/2010
6/23/2010
7/7/2010
7/21/2010
8/4/2010
8/18/2010
9/1/2010
9/15/2010
9/29/2010
Date
Water Surface Elevation
Onsite Rainfall

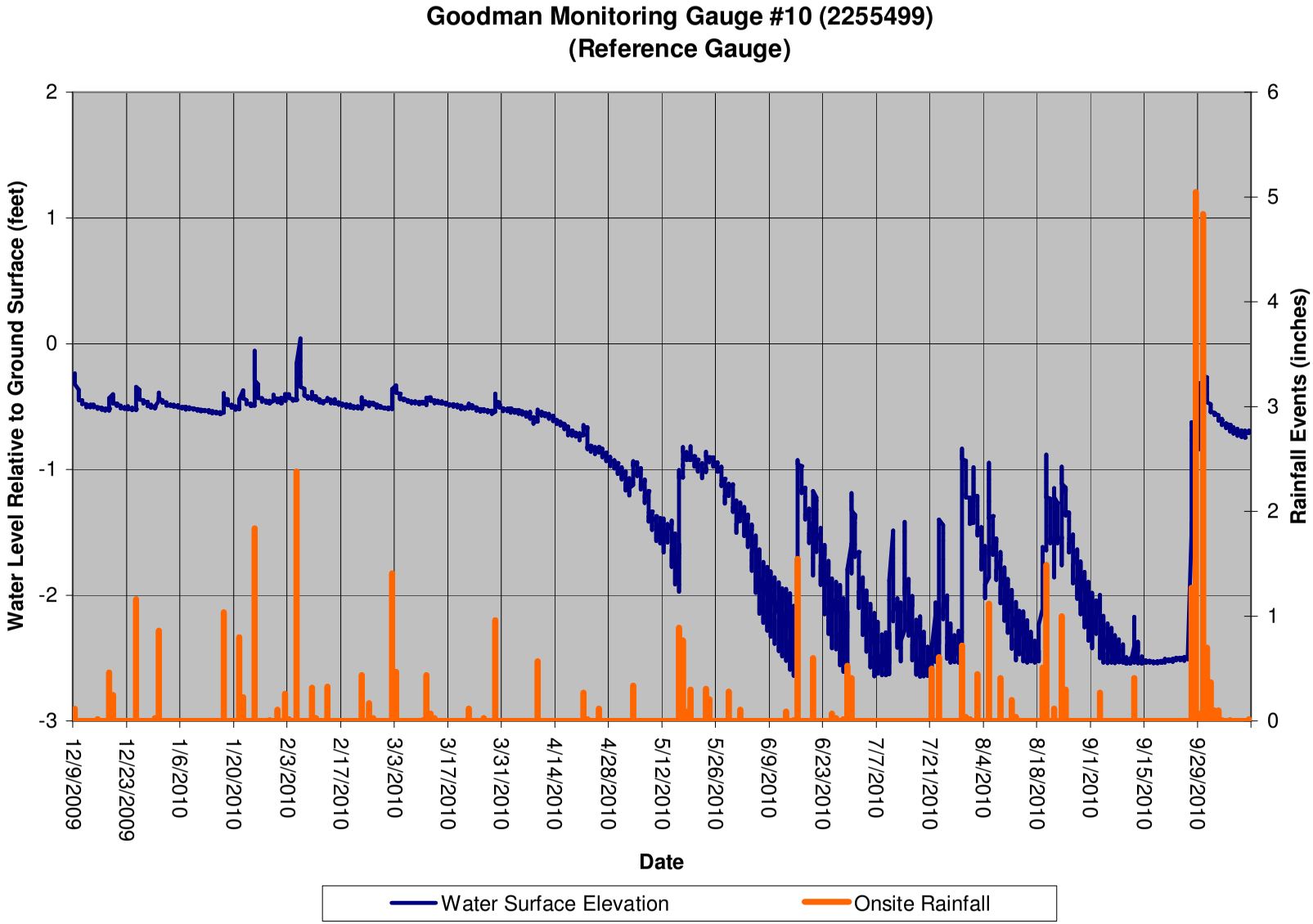
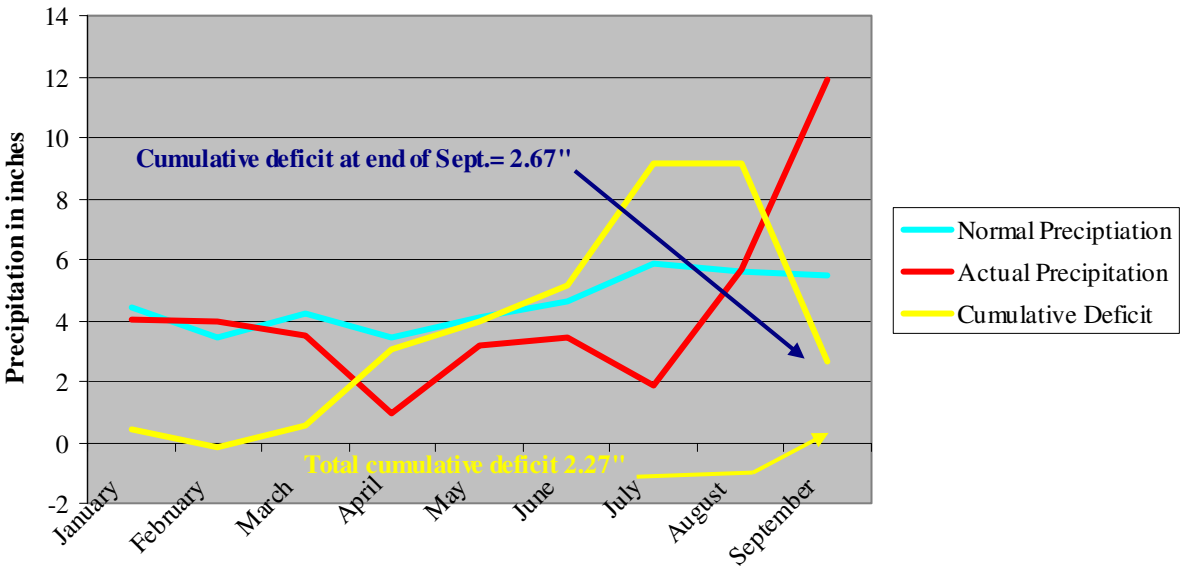

Goodman Monitoring Gauge #10 (2255499)
(Reference Gauge)
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
2
1
0
-1
-2
-3
6
5
4
3
2
1
0
12/9/2009
12/23/2009
1/6/2010
1/20/2010
2/3/2010
2/17/2010
3/3/2010
3/17/2010
3/31/2010
4/14/2010
4/28/2010
5/12/2010
5/26/2010
6/9/2010
6/23/2010
7/7/2010
7/21/2010
8/4/2010
8/18/2010
9/1/2010
9/15/2010
9/29/2010
Date
Water Surface Elevation
Onsite Rainfall

Figure P-1
2010 Reference Precipitation



Accumulated rainfall deficit through September 2010 was 2.67 inches. The deficit in July and August was slightly over 9 inches but was relieved in late September by a storm that dropped over 11 inches of rain during a 5 day period.

Appendix D

Problems/Success Plan View

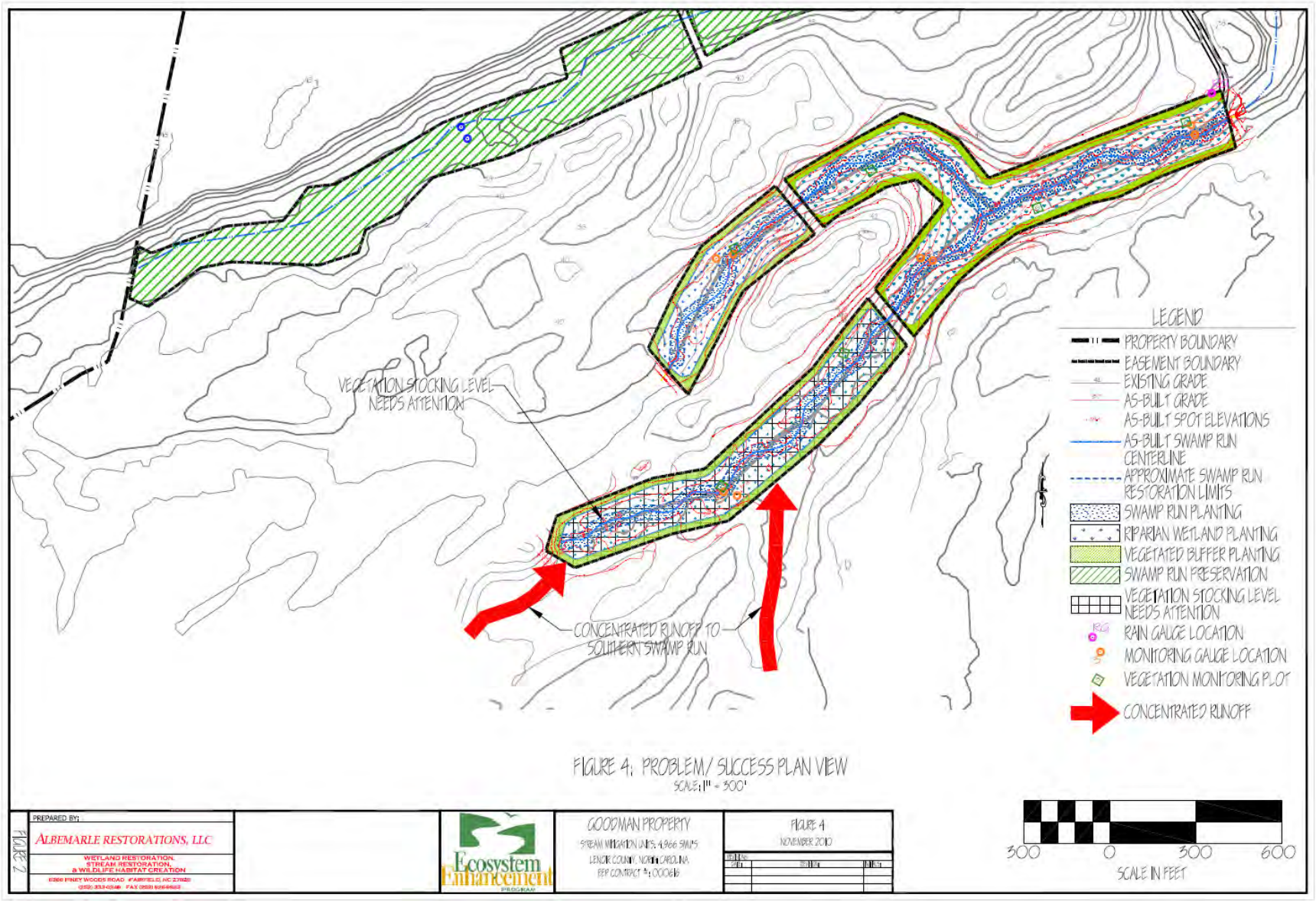


FIGURE 4: PROBLEM/ SUCCESS PLAN VIEW
SCALE: 1" = 300'

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6260 PINEY WOODS ROAD FAIRFIELD, NC 27826
(252) 353-0346 FAX (252) 926-6622

Ecosystem Enhancement Program

GOODMAN PROPERTY
STREAM MITIGATION UNITS: 4,966 SMUS
LENOIR COUNTY, NORTH CAROLINA
EEP CONTRACT #: 003618

FIGURE 4
NOVEMBER 2010