Goodman Property Stream Restoration Project
Lenoir County, NC

2009 Annual Monitoring Report
Year 1

NCEEP Project Number D000616
Neuse River Basin

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

Date: February, 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 were installed on April 6, 2009 at strategic positions throughout the site to measure surface and subsurface water levels. Two additional gauges were 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 was installed on the site and checked against cooperator data from the Kinston area. The total annual precipitation in 2009 was very close to normal with a deficit of 2.27". However, the total rainfall deficit through October was nearly 13" prior to a storm in November that produced 8" of rain.

Two separate flow events were documented on DVD during 2009. The first event in March was minor and produced short term flow over the lower half of the site. The second, in November produced sustained, long-term flow over the entire length of the project that continued for the remainder of the year. The data from the water level monitoring gauges coincides with and confirms the flow of water through the site. The heavy rainfall in November recharged the groundwater and the swamp runs upstream of the site which had remained dry for most of the year. The reference site within the preservation area behaved in a similar fashion as evidenced by the photos and groundwater data collected there. Observations and data analysis suggest promising results for restored headwater functions.

Six vegetative monitoring plots were 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 all of the plots were successful in 2009.

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%

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		
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.

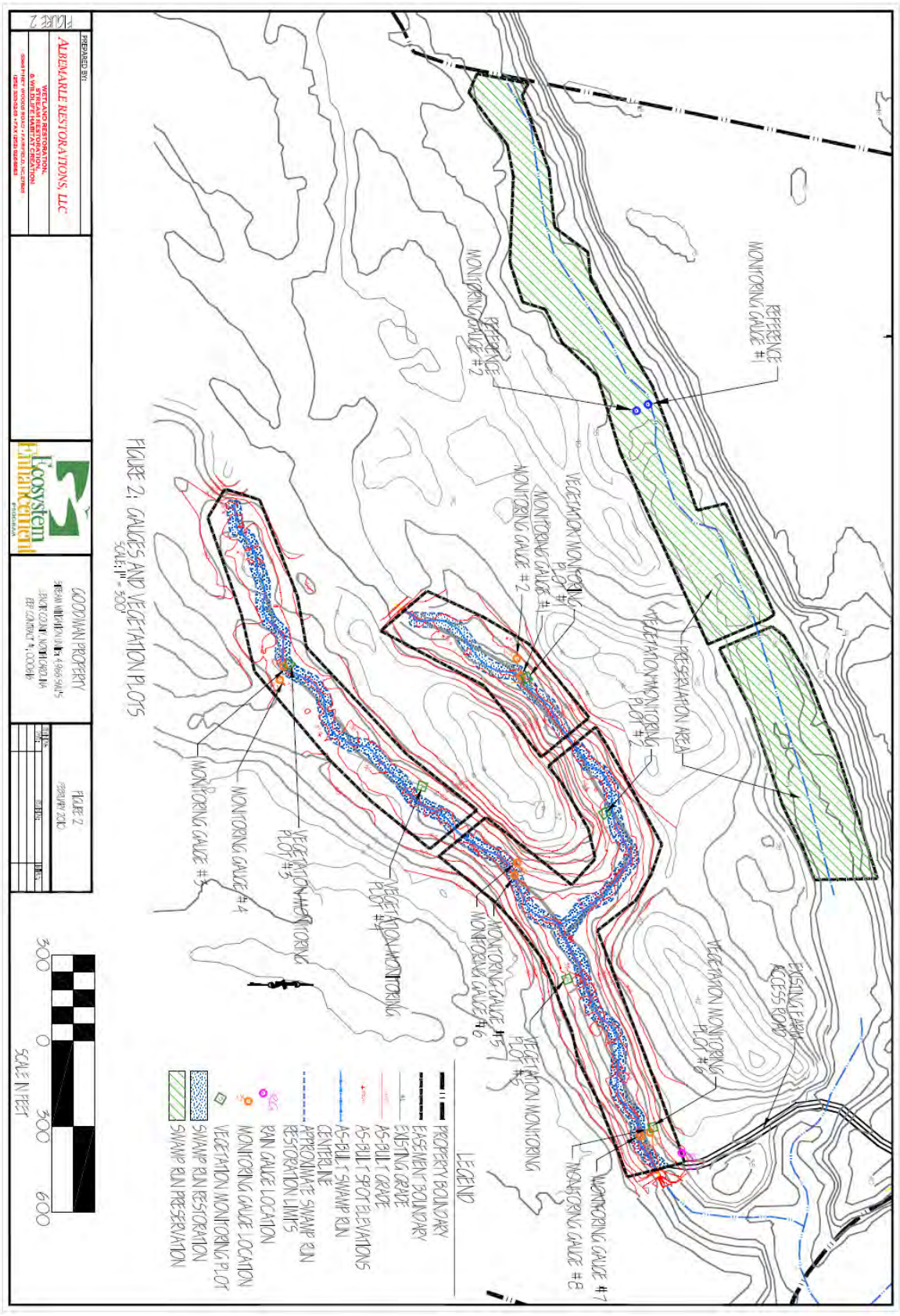


FIGURE 2
PREPARED BY:
ALBEMARLE RESTORATIONS, LLC
WETLAND RESTORATION,
STREAM RESTORATION,
& WILDLIFE HABITAT CREATION
GOODMAN PROPERTY
FIGURE 2
FEBRUARY 2010
FIGURE 2: GAUGES AND VEGETATION PLOTS
SCALE: 1" = 300'
REFERENCE MONITORING GAUGE #1
REFERENCE MONITORING GAUGE #2
VEGETATION MONITORING PLOT #1
MONITORING GAUGE #2
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

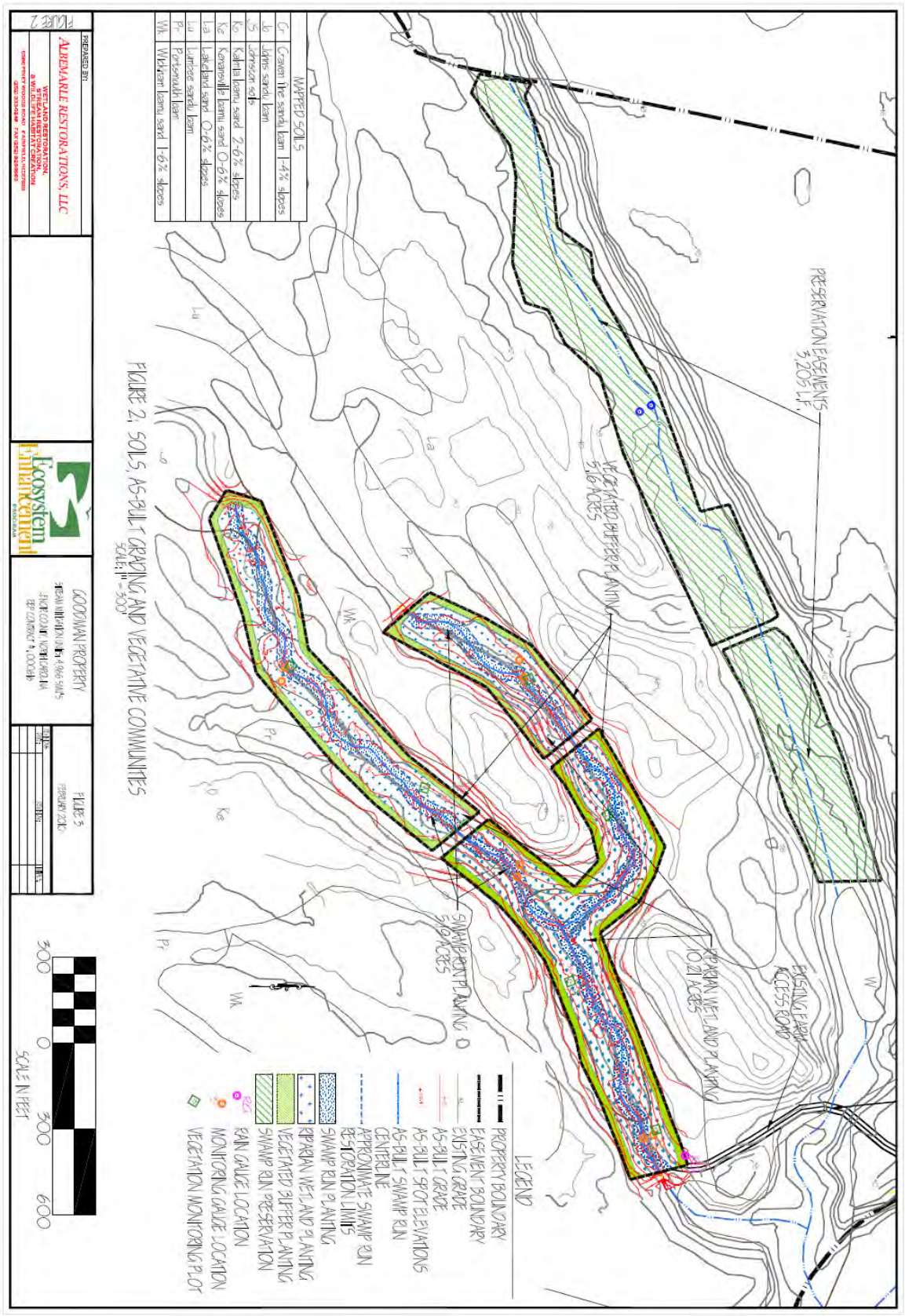


FIGURE 2, SOILS, AS-BUILT GRADING AND VEGETATIVE COMMUNITIES
SCALE: 1" = 300'
MAPPED SOILS
Cr Craven fine sandy loam 1-4% slopes
Jo Johns sandy loam
Js Johnston soils
Ko Kalmia loamy sand 2-6% slopes
Ke Kenansville loamy sand 0-6% slopes
La Lakeland sand 0-6% slopes
Lu Lumbee sandy loam
Pr Portsmouth loam
Wk Wickham loams, sand 1-6% slopes
PRESERVATION EASEMENT 3205 L.F.
VEGETATED BUFFER PLANTING 5.16 ACRES
SWAMP RUN PLANTING 5.96 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 2
FEBRUARY 2010
PREPARED BY:
ALBEMARLE RESTORATIONS, LLC
WETLAND RESTORATION
STREAM RESTORATION
ENVIRONMENTAL CONSULTING
ecosystem enhancement program

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. The site was also seeded immediately after construction with an approved wetland seed mix and the photos in Appendix A show the progression of site colonization. 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 site was planted at a rate of 602 stems per acre near the end of March, 2009. All six vegetation plots indicated tree and shrub survival at levels that exceed the success criterion of a minimum of 320 stems per acre (at year three).

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

All six plots in the project met the success criterion of a minimum of 320 stems per acre. Plots 3 and 4 had the survival of 330 stems per acre; plots 1 and 2 had a survival of 454 stems per acre and plots 5 and 6 had the best survival numbers with 577 and 536 stems per acre respectively. Over the entire project, the survival rate averaged 447 live stems per acre or 74%. The lower survival rate of plots 3 and 4 are not considered to be a problem at this time so no supplemental planting is deemed necessary. It appears that herbaceous cover is much more dense toward the head of the project where plots 1-4 are located which may be the reason survival was lower in those plots.

In 2009 there was a cumulative rainfall deficit of 2.27 inches (according to the normal averages per the WETS table for Kinston, NC). But the deficit through October of 2009 was much more severe, totaling 12.94 inches prior to heavy rainfall in November and December. Tree and shrub survival may have suffered somewhat due to lack of rainfall during the first summer after planting, but overall, the planted material fared well despite droughty conditions.

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 downslope into the stream channel. Gauges 7 and 8 are the exception; due to soil conditions at the time of installation, gauge 8 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.

Figure F1 shows gauges 1 and 2 which are in the northern branch near the inlet pipe from the swamp run above the project. Due to its location, gauge 1 shows prolonged water flow in December which is corroborated by video evidence. Figure F2 illustrates the water flow at gauges 3 and 4 which is less robust, but present nevertheless. Gauges 3 and 4 are located near the head of the southern branch where the stream channel is shallow and the true watershed is the surrounding agricultural field. When rainfall is heavy enough, water does indeed drain from the surrounding field into the project area near these two gauges as well as at the head of this branch. Figure 4 in Appendix D shows how water from the surrounding agricultural field drains into this branch.

Figure F3 illustrates what is probably the most substantial flow data and captured during 2009. It is also perhaps the strongest indication of the project's success. Gauges 5 and 6 are located in the southern branch – which is fed by the same watershed as gauges 3 and 4 (the surrounding field - not the inlet pipe from the upstream swamp run). The data are mirror images and gauge 5 shows water flowing in the channel at a depth of six inches or more during November and December. Gauge 6, located upslope from the channel approximately 50 feet, shows overbank flooding at least to that point in December.

Figure F4 contains the data from gauges 7 and 8 but due the malfunction of the data logger at gauge 8, the data for the first part of the year was not usable. The logger was replaced and the data from November and December show good flow at the outfall end of the project. Since gauge 8 is outside and slightly above the stream channel, each time the water level reaches the zero line (ground surface) it is an indication of overbank flooding. With each rainfall event, the water level at this end of the project rises out of the channel and slowly recedes back as indicated and corroborated with video evidence.

Figure F5 represents the data from the reference area which actually shows less flow due to the dry conditions in 2009. The minor flow event documented on the project in March did not occur in the reference site since the swamp in the reference area was still too dry from the droughty

conditions in 2008. But in November and December, the reference swamp was fully charged and flowing again.

The best evidence of flow through the site is the video captured during site inspections. There is no question the site is functioning properly and acting as a filter for water that might have otherwise been subject to nutrient loading and sedimentation from the surrounding agricultural fields. The water moving through the project is clear, free of obvious silt and sediment and moving at a velocity that does not cause extreme streambed erosion or scouring.

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.

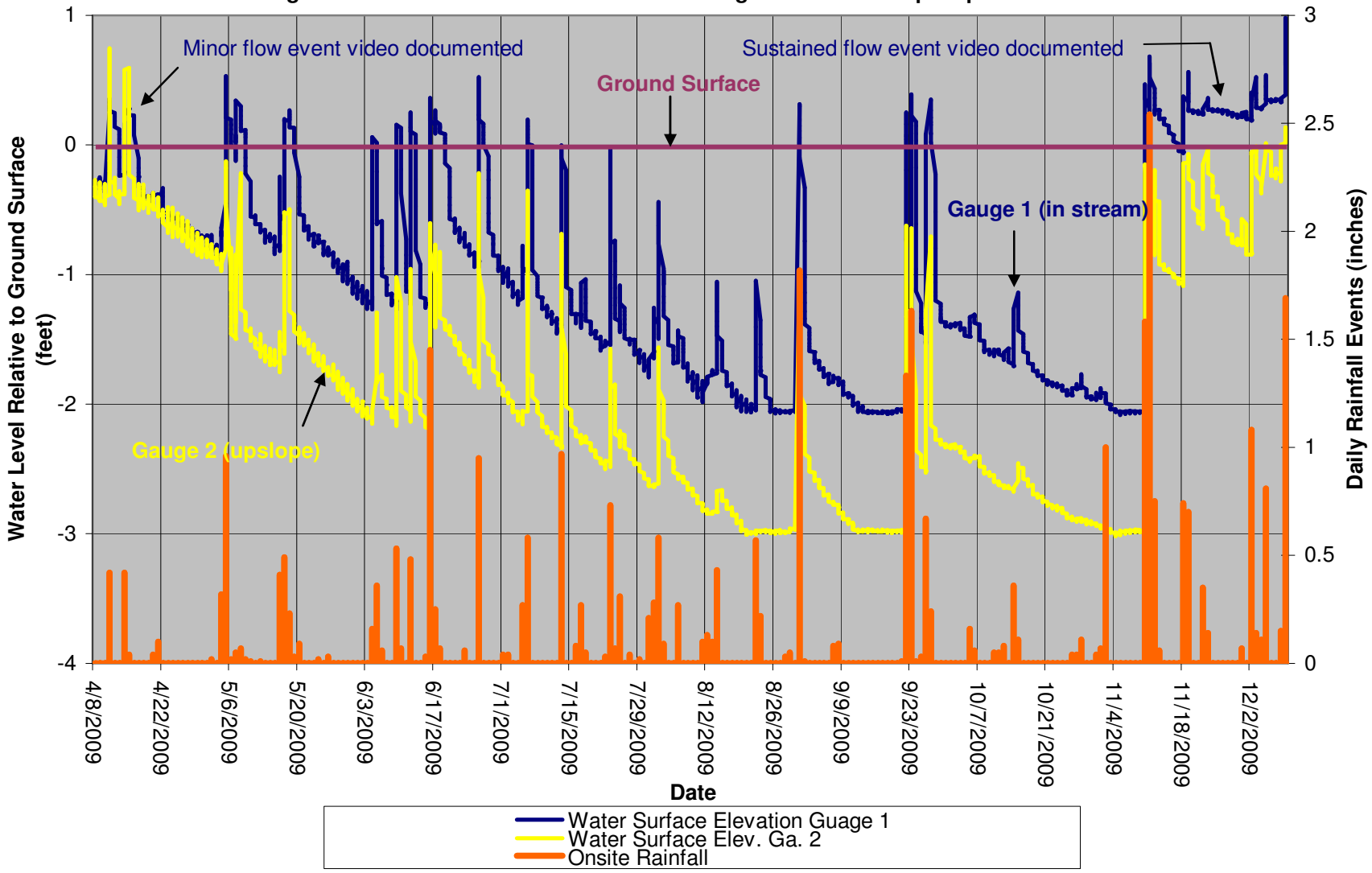


Figure F2.
Goodman Monitoring Gauges #3 and #4
Gauge #3 is located in the stream channel. Gauge #4 is located up slope out of the channel.

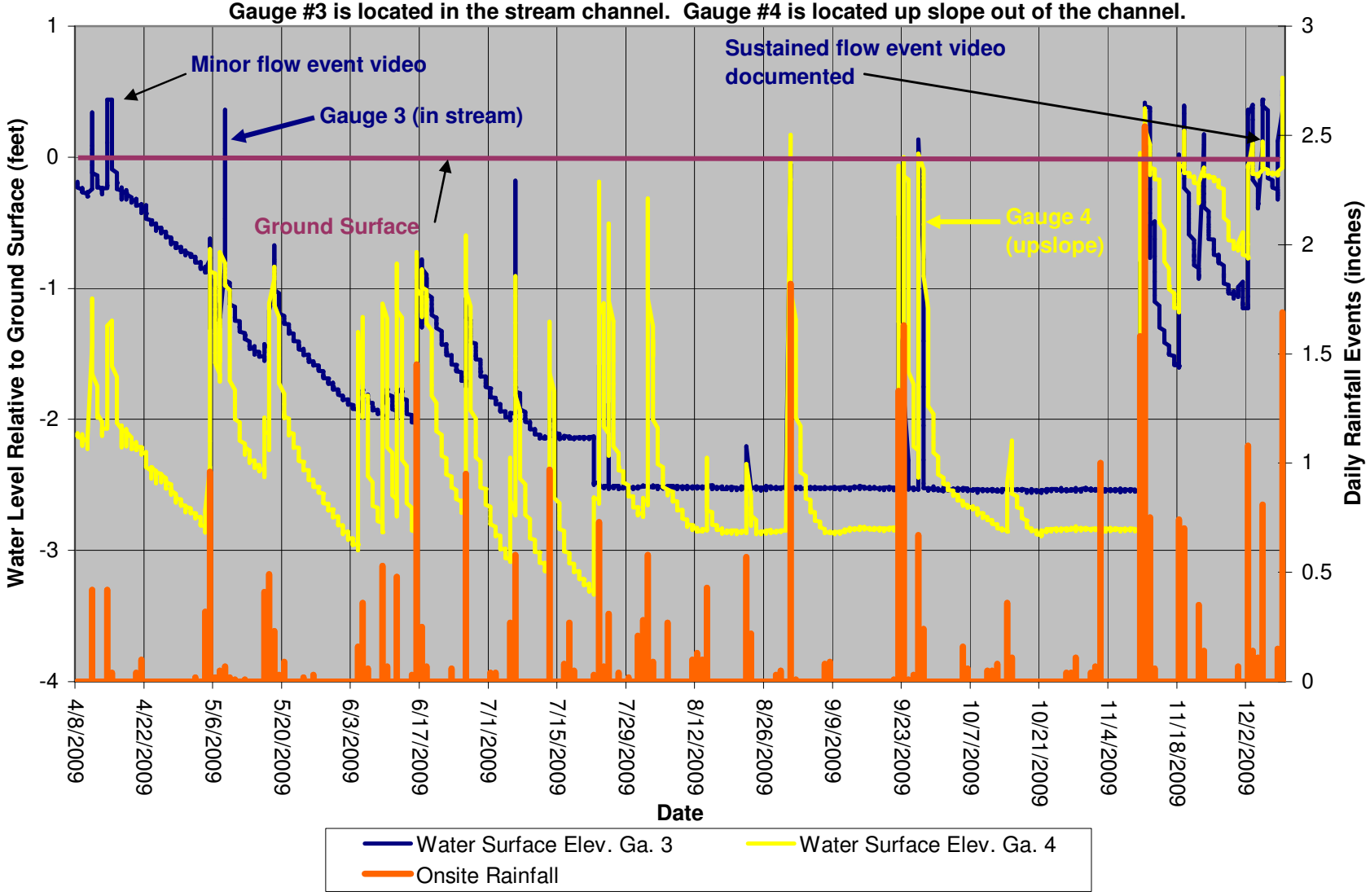


Figure F3.
Goodman Monitoring Gauges #5 and #6
Gauge #5 is located in the stream channel. Gauge #6 is located up slope out of the channel.

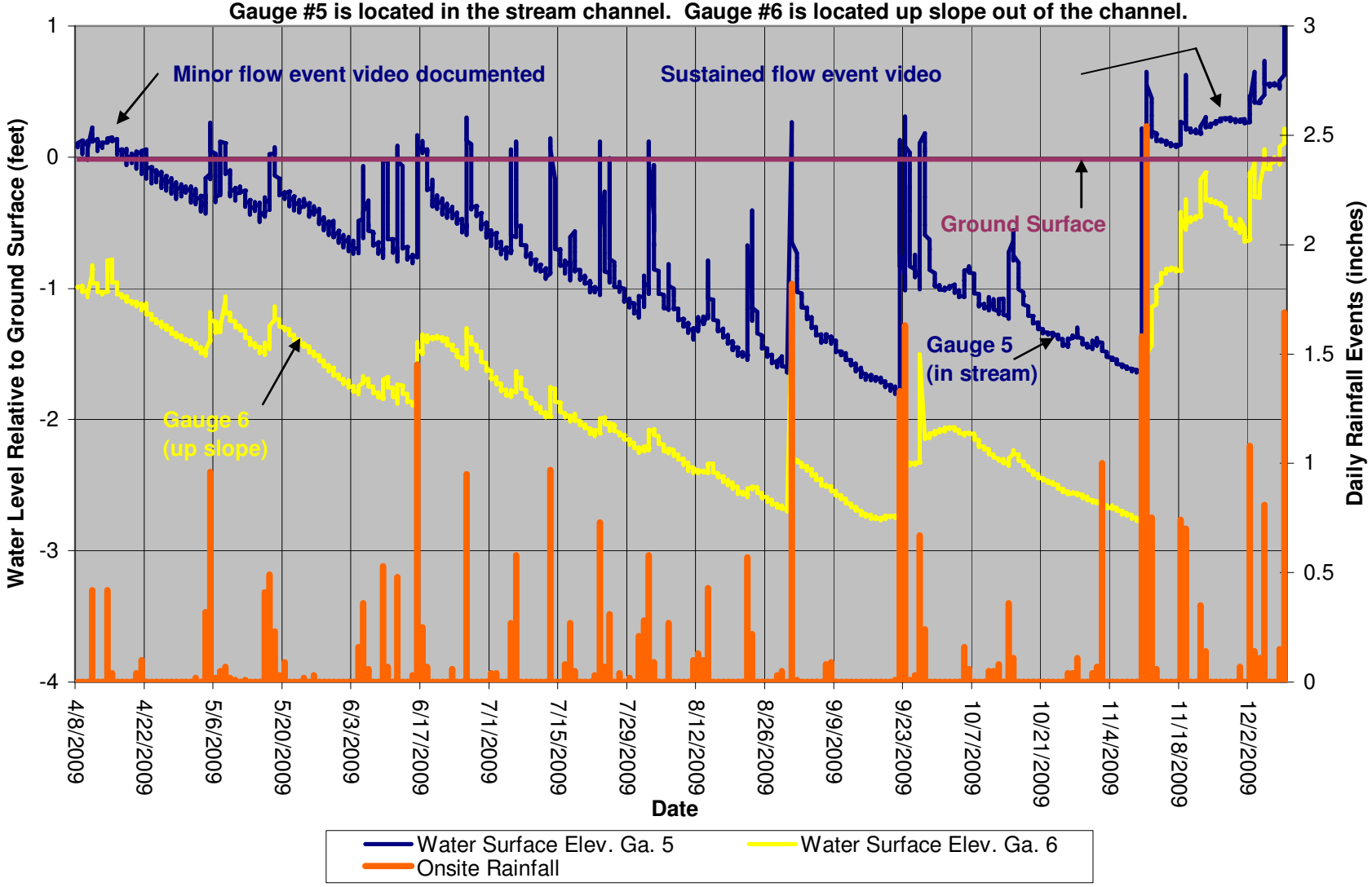


Figure F4.
Goodman Monitoring Gauges #7 and #8
Gauge #7 is located upslope out of the channel. Gauge #8 is located just out of the stream channel.

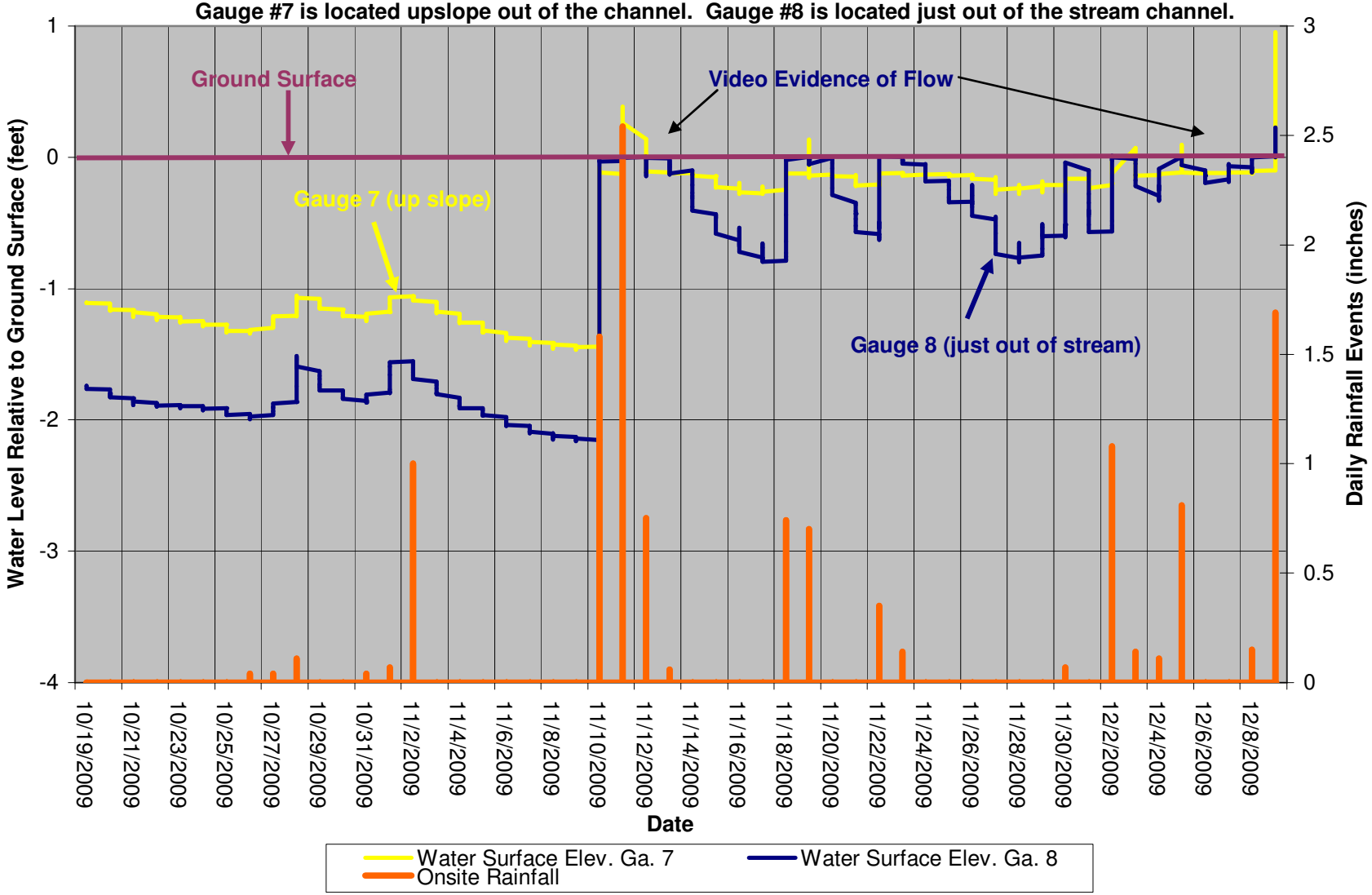
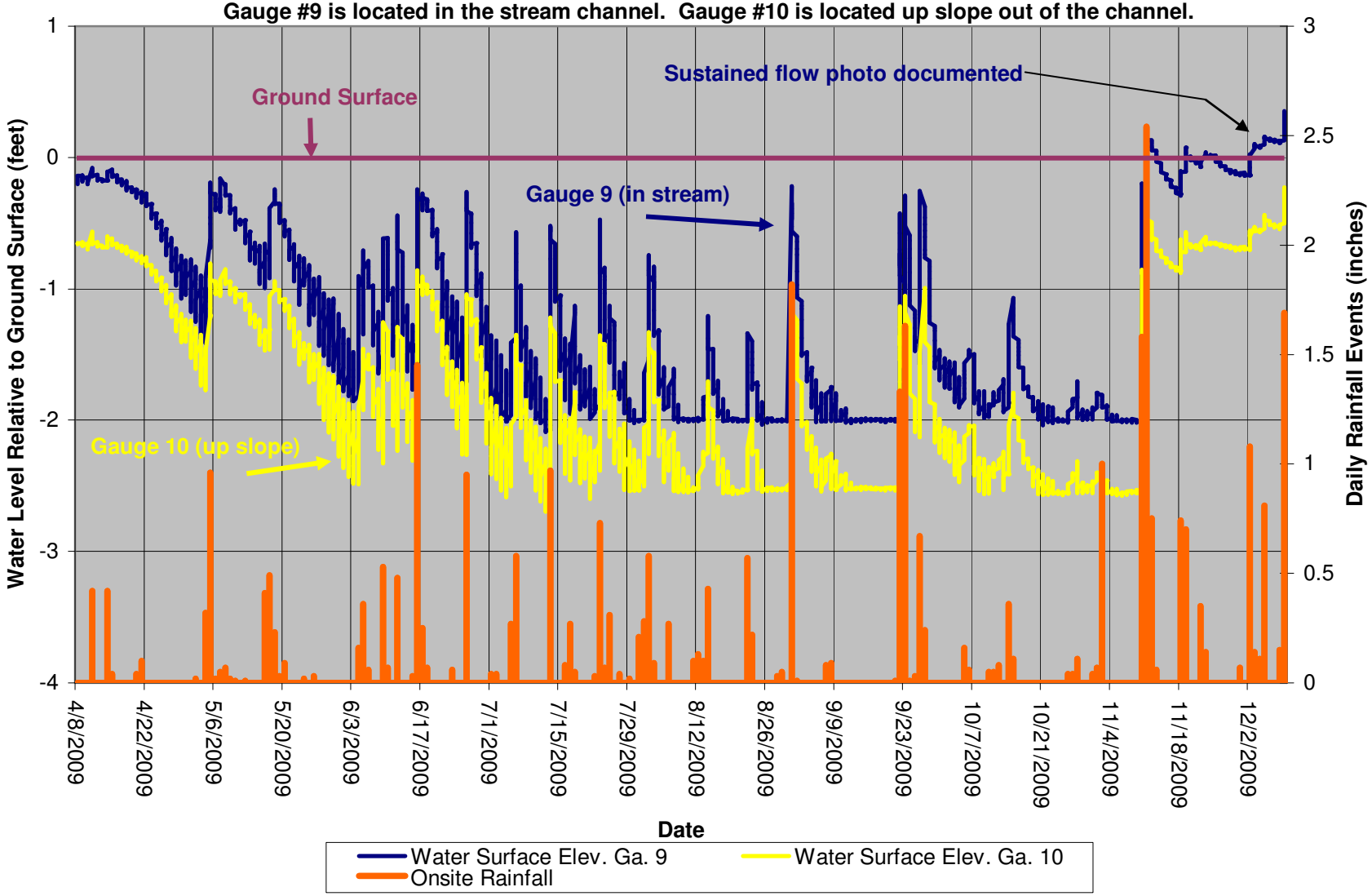


Figure F5.
Goodman Monitoring Gauges #9 and #10
Gauge #9 is located in the stream channel. Gauge #10 is located up slope out of the channel.



2.1 Monitoring Plan View

Figure 4 in Appendix D provides an overview of the watershed success of the southern branch 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. Given the data and video evidence captured in 2009, this potentially weaker part of the project was entirely successful.

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

Vegetation Plot	Vegetation Success Met	Stems per Acre	Vegetation Mean
1	Y	454	100% Success, Average for the Site is 74% survival
2	Y	454	
3	Y	330	
4	Y	330	
5	Y	577	
6	Y	536	

3.0 Project Success Discussion

After the first year of monitoring during a dry summer, substantial rainfall in November successfully recharged groundwater levels and swamp runs. It has quickly become evident that when the reference area has water flowing through it, the Goodman project will as well. In fact, flow through the project was noted when the reference area had none – again probably due to droughty conditions. 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 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 the summer after heavy rainfall. Channel and bank development are more pronounced at the end of the first year of monitoring than they were after construction. There are small areas of shelf formation, scouring, minor sediment deposits and lateral channel formation that are all indicators of successful stream development.

III. Methodology Section

Year 1 monitoring for the Goodman 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. Vegetation Metadata

Report Prepared By	Ashby Brown
Date Prepared	10/8/2009 15:22
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	6

Table 2. Vigor by Species

	Species	4	3	2	1	0	Missing	Unknown
	Cephalanthus occidentalis	1	4	4				
	Itea virginica		1					
	Liquidambar styraciflua	4						
	Nyssa biflora			1				
	Quercus bicolor	1	3	3				
	Quercus phellos	2	10	4				
	Taxodium distichum	5	8					
	Myrica cerifera	7	1	3				
TOT:	**8**	**20**	**27**	**15**				

Table 3. Damage by Species

	Species	All Damage Categories	(no damage)
	Cephalanthus occidentalis	7	7
	Fraxinus pennsylvanica	8	8
	Itea virginica	5	5
	Myrica	2	2
	Nyssa biflora	5	5
	Quercus bicolor	1	1
	Quercus phellos	8	8
	Taxodium distichum	21	21
	Unknown	8	8
TOT:	**9**	**65**	**65**

Table 4. Damage by Plot

	plot	All Damage Categories	(no damage)
	000616-AB-0001	11	11
	000616-AB-0002	11	11
	000616-AB-0003	8	8
	000616-AB-0004	8	8
	000616-AB-0005	14	14
	000616-AB-0006	13	13
TOT:	**6**	**65**	**65**

Table 5. Stem Count by Plot and Species

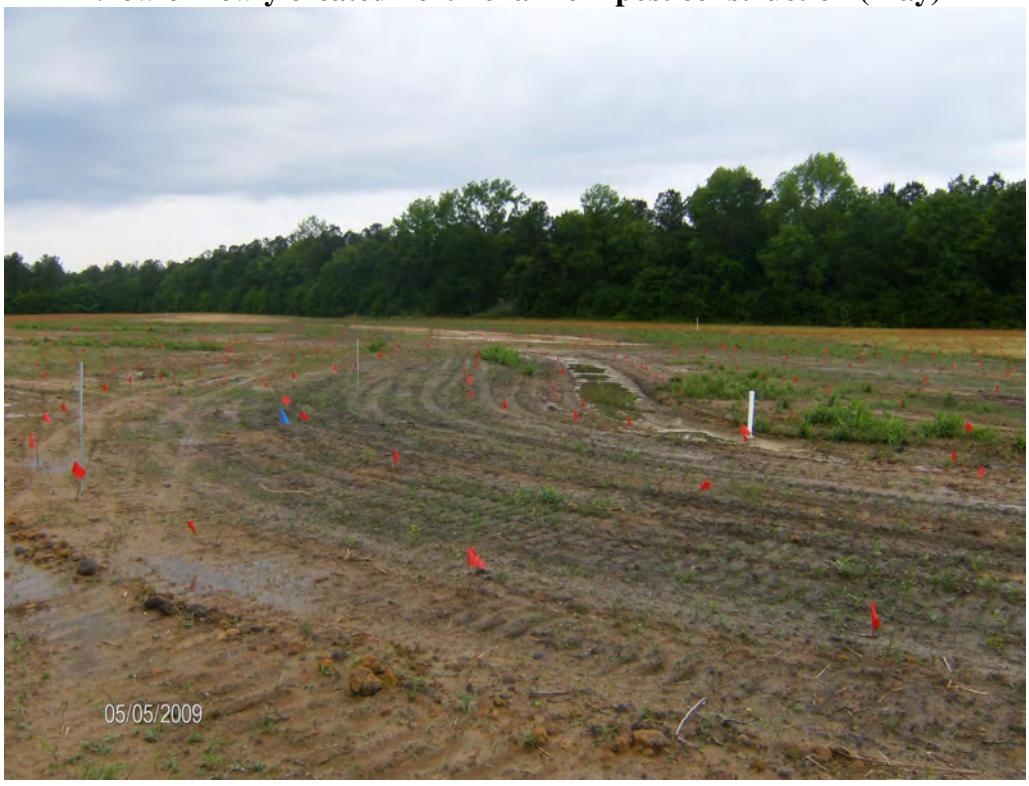
					Plot D000616-AB-					
	Species	**Total Planted Stems**	**# plots**	**avg# stems**	**1**	**2**	**3**	**4**	**5**	**6**
	Cephalanthus occidentalis	7	4	1.75	1	3		2	1	
	Fraxinus pennsylvanica	8	2	4					7	1
	Itea virginica	5	2	2.5		2		3		
	Myrica	2	1	2	2					
	Nyssa biflora	5	1	5		5				
	Quercus bicolor	1	1	1				1		
	Quercus phellos	8	4	2	4	1		1		2
	Taxodium distichum	21	4	5.25	3		7		3	8
	Unknown	8	5	1.6	1		1	1	3	2
TOT:	**9**	**65**	**9**		**11**	**11**	**8**	**8**	**14**	**13**
	Average Stems per Acre				**454**	**454**	**330**	**330**	**577**	**536**

Table 6. Vegetation Problem Areas

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

Looking downstream on the southern branch - post construction (May)

View of newly created north channel - post construction (May)



Channel below confluence of two branches shows high water mark (June)

Channel establishment and scouring – southern branch (June)

Evidence of bank establishment (June)

Trees along original ditch course were protected during construction and are doing well

Scoured channel at outlet end of project (September)

Lateral channel development (December)

Photo shows three lateral channels beginning to develop (December)

Deep, fast moving water at upper end of northern branch (December)

Completely flooded and flowing channel upper end of northern branch (December)

Water flow in reference area (December)

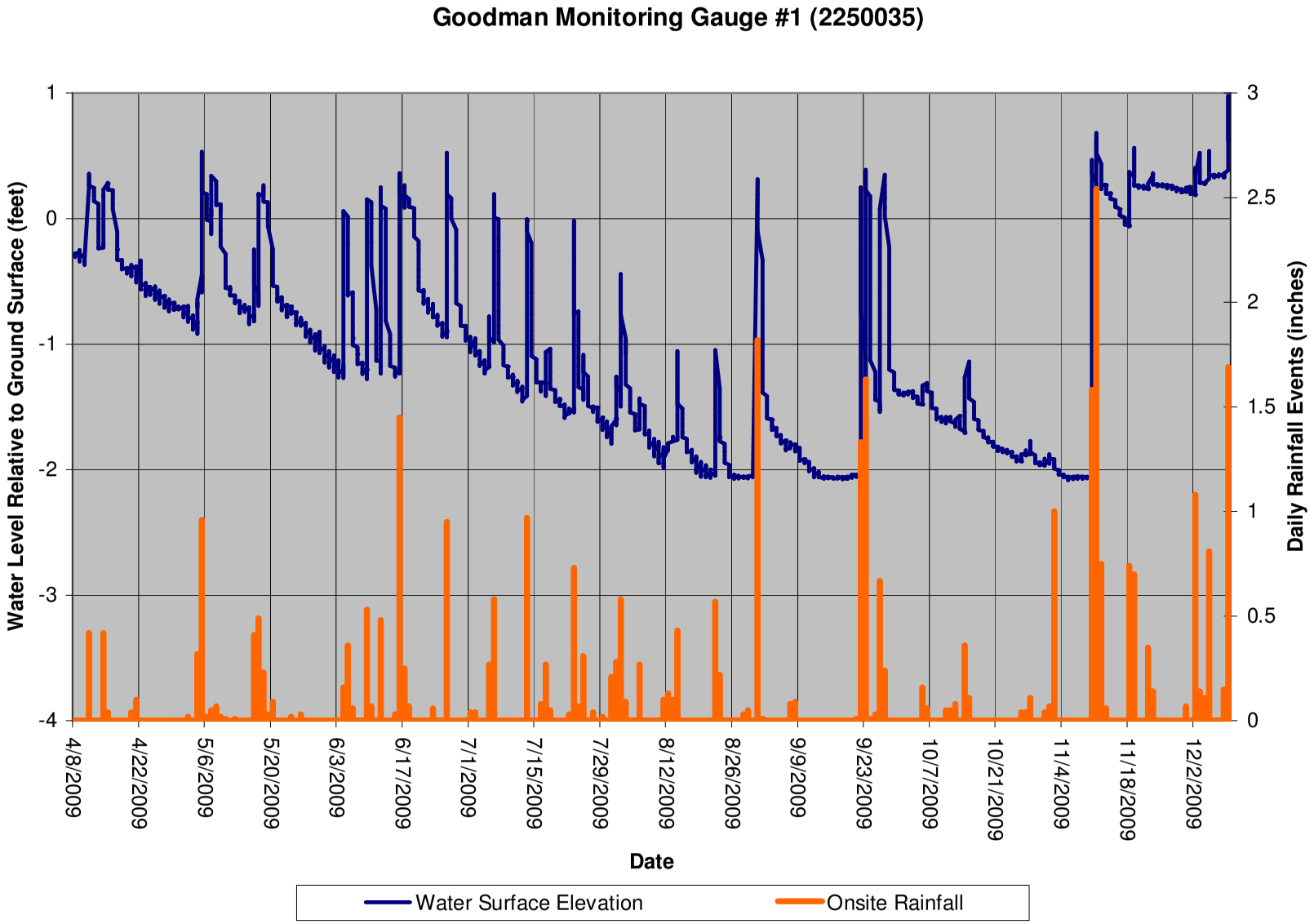
Appendix B

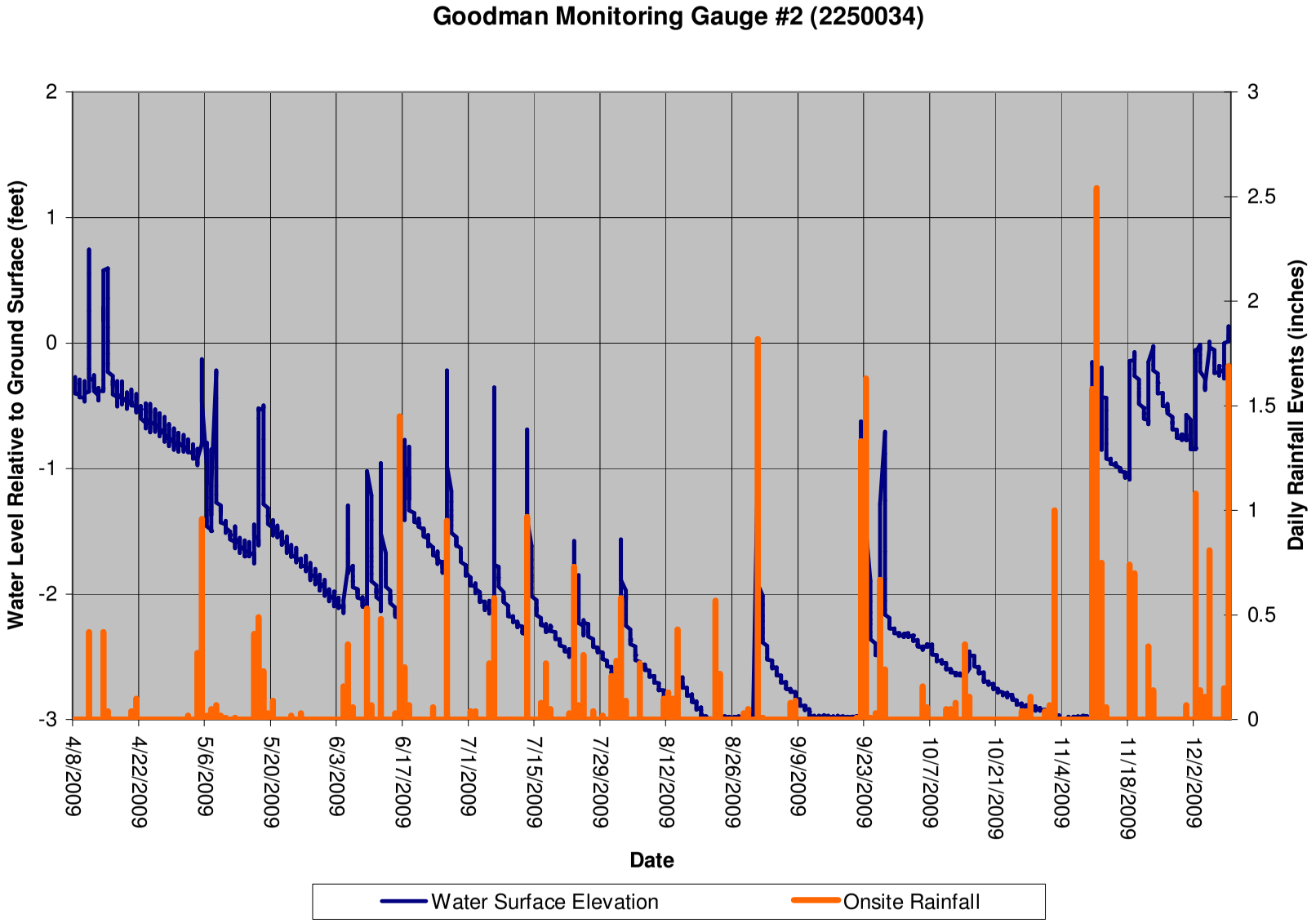
Geomorphologic Raw Data

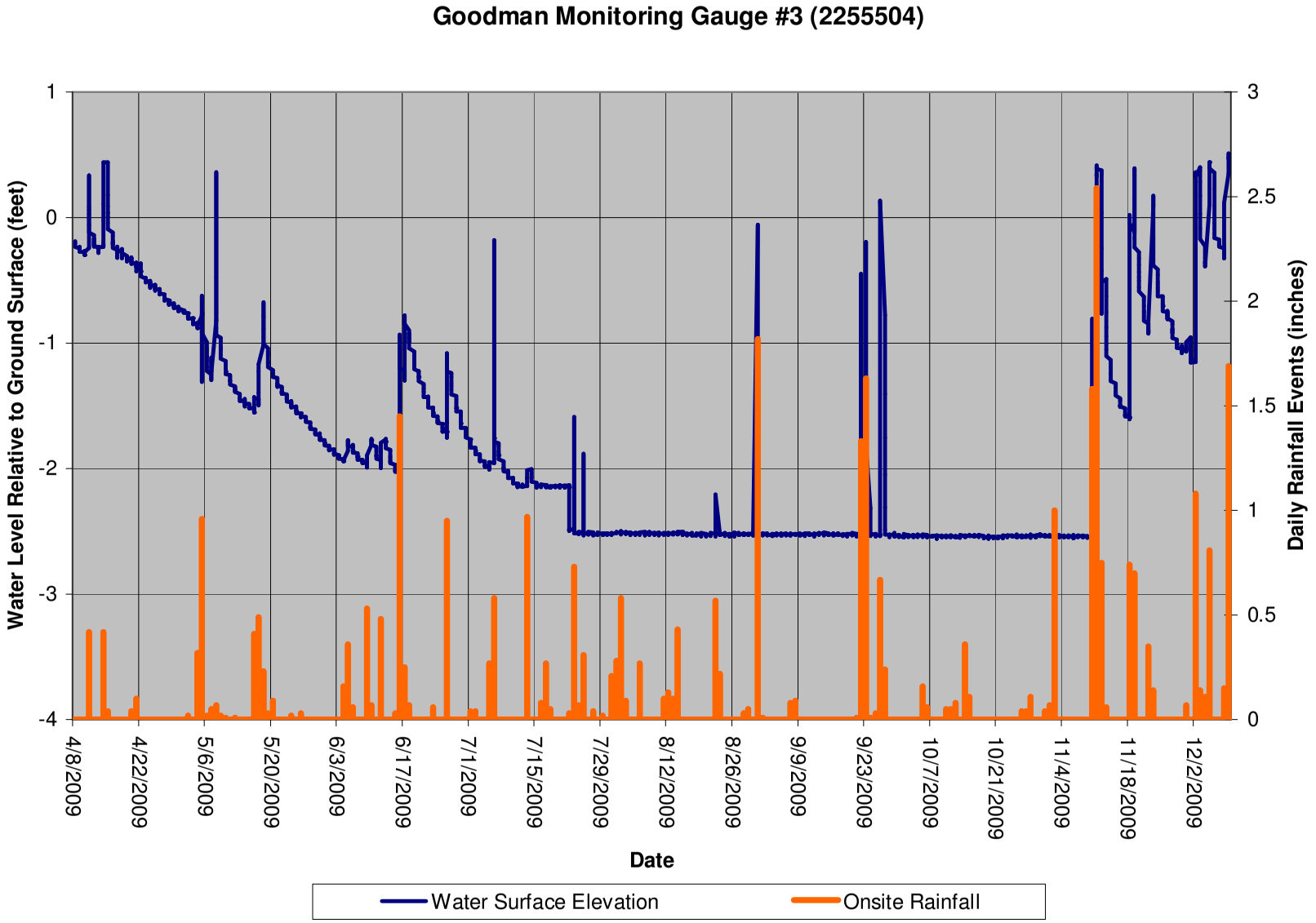
Not used in this report

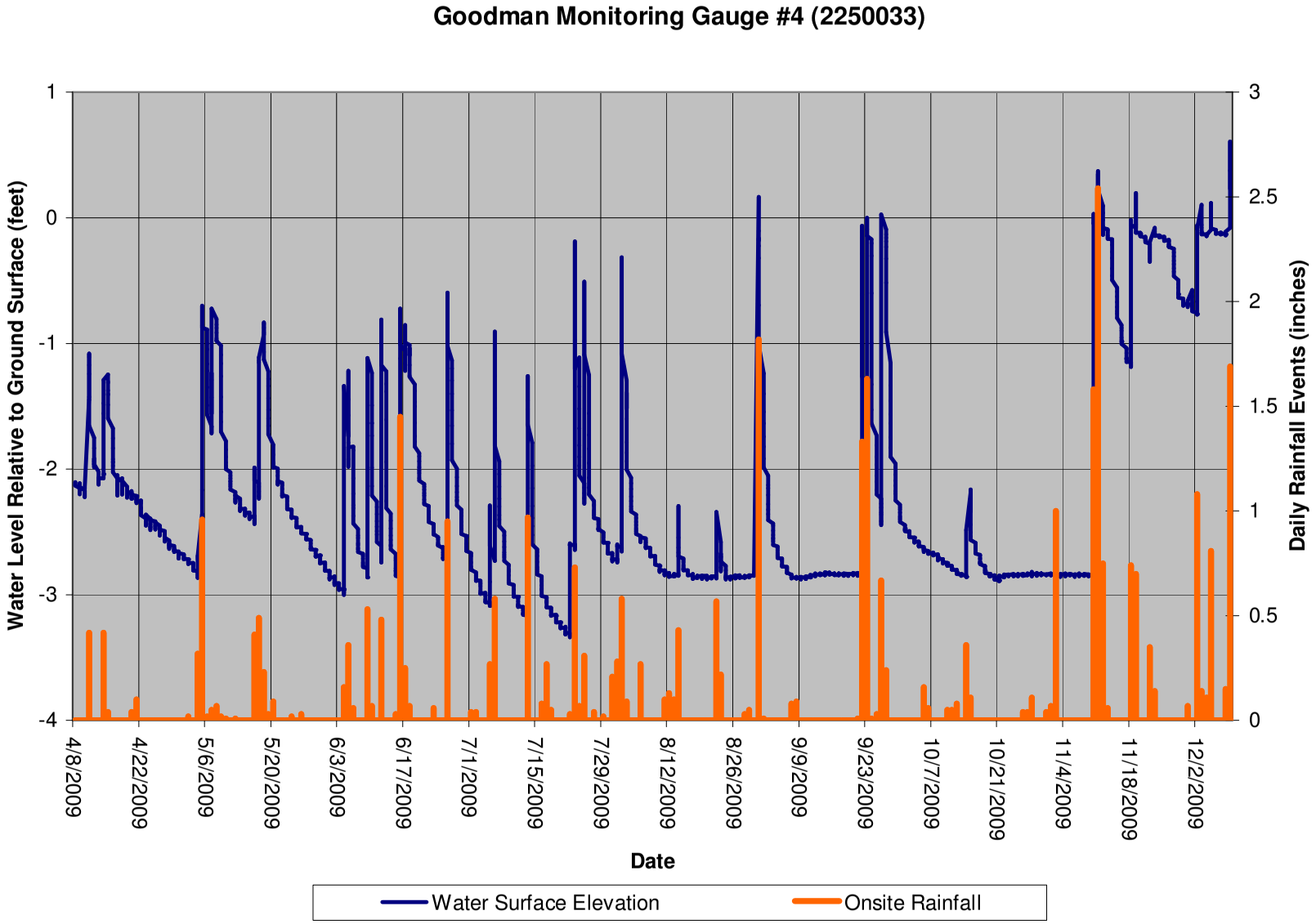
Appendix C

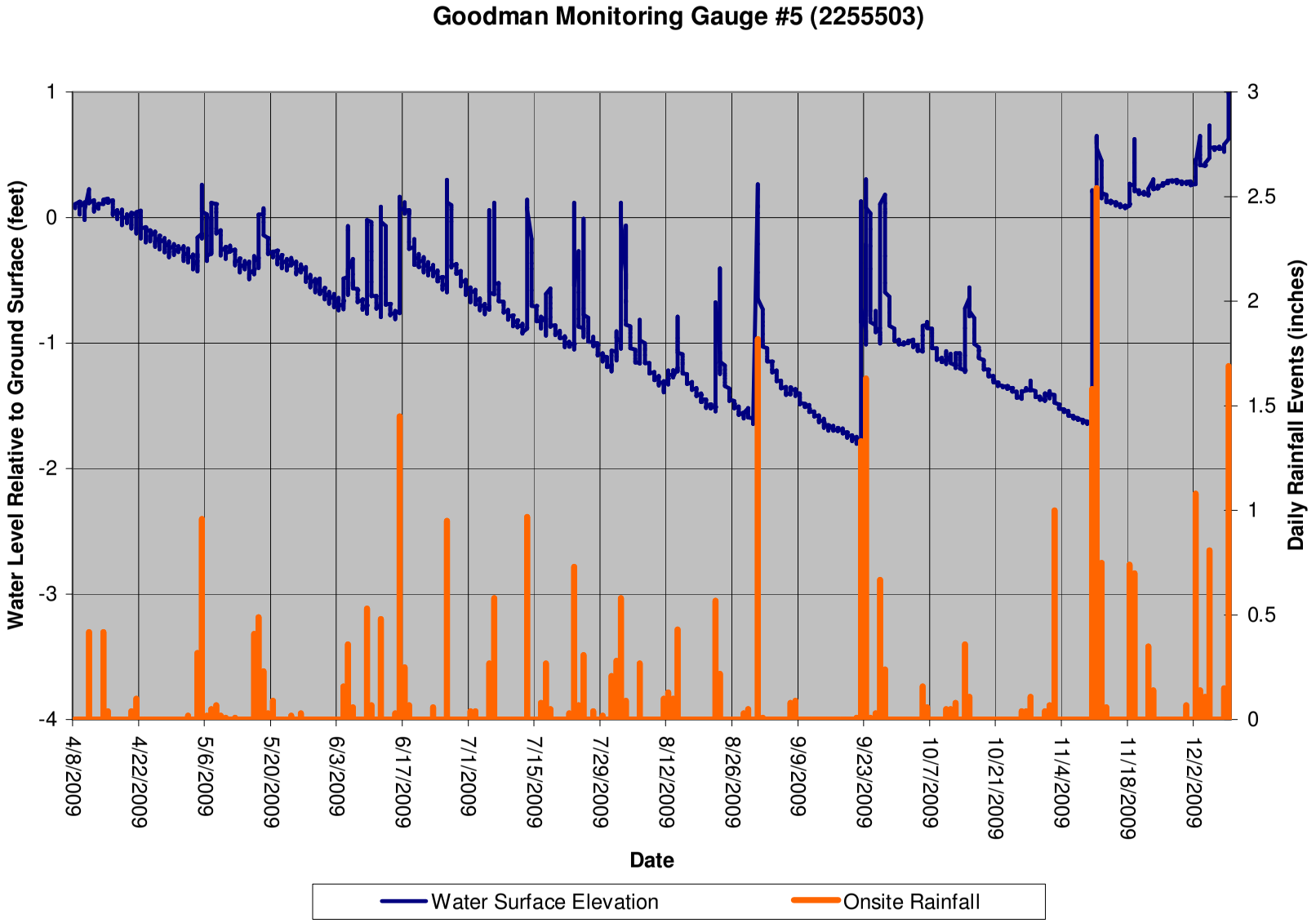
Hydrologic Data Tables

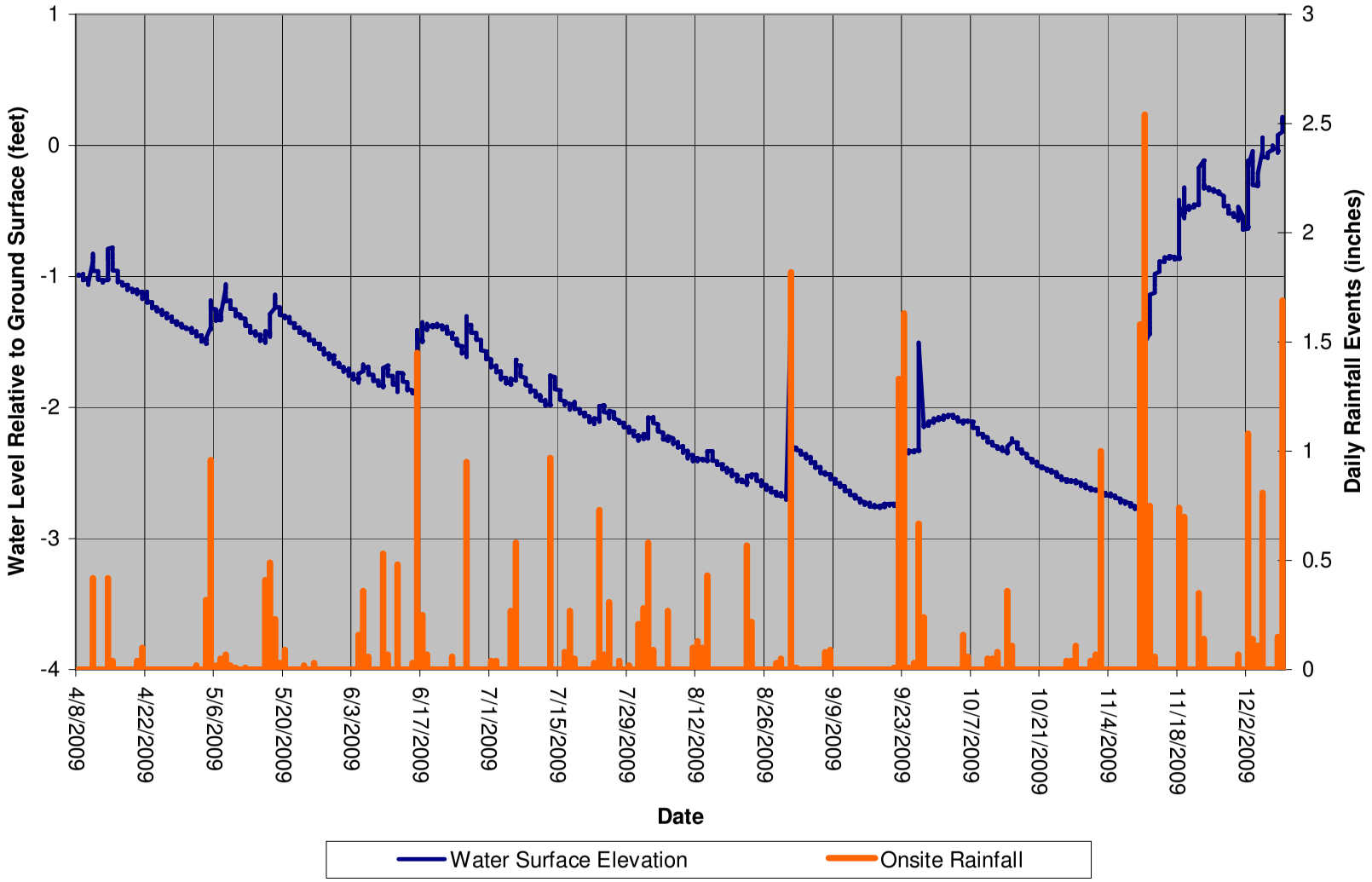

Goodman Monitoring Gauge #1 (2250035)
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
-4
3
2.5
2
1.5
1
0.5
0
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Date
Water Surface Elevation
Onsite Rainfall

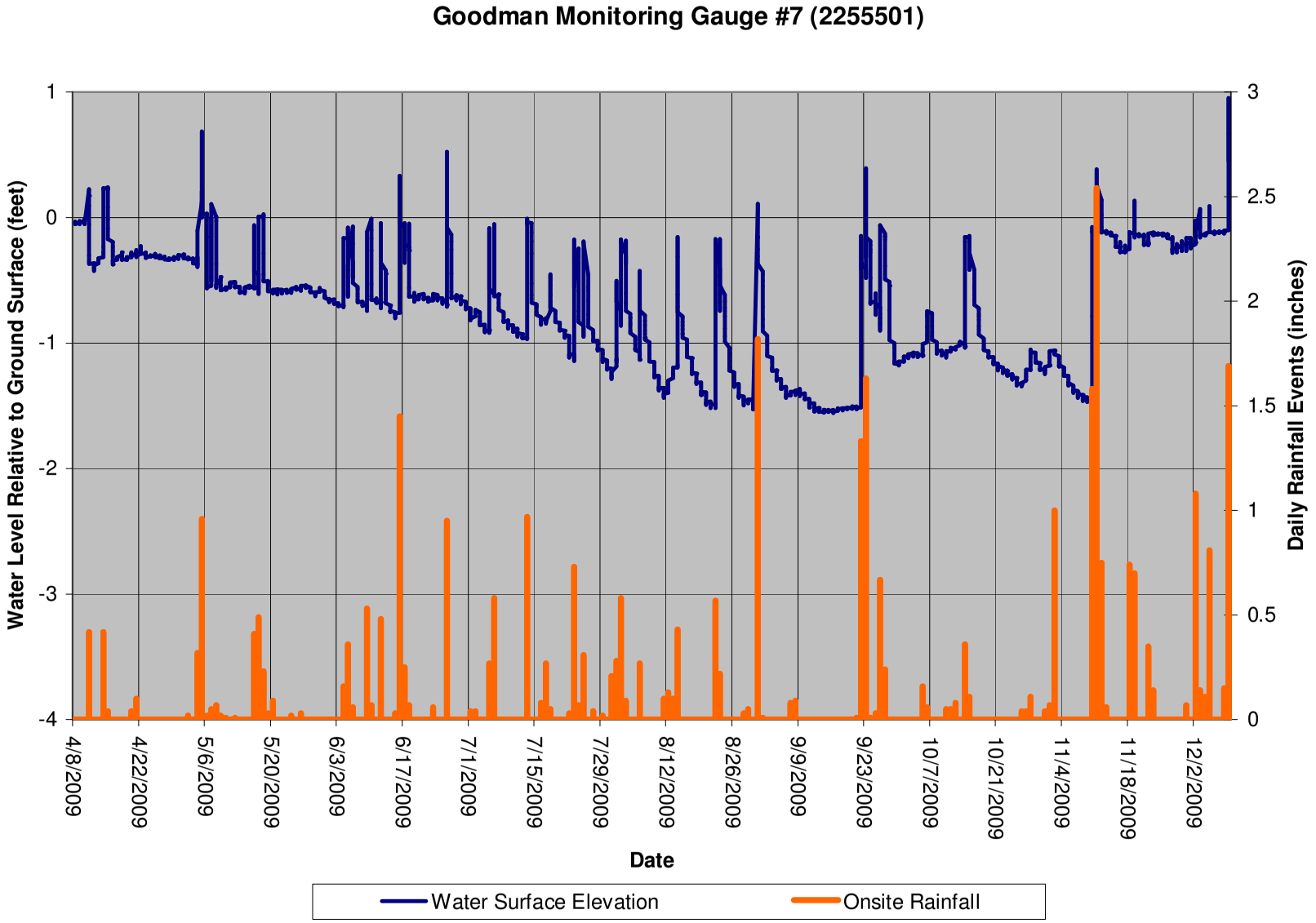

Goodman Monitoring Gauge #2 (2250034)
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
2
1
0
-1
-2
-3
3
2.5
2
1.5
1
0.5
0
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Date
Water Surface Elevation
Onsite Rainfall

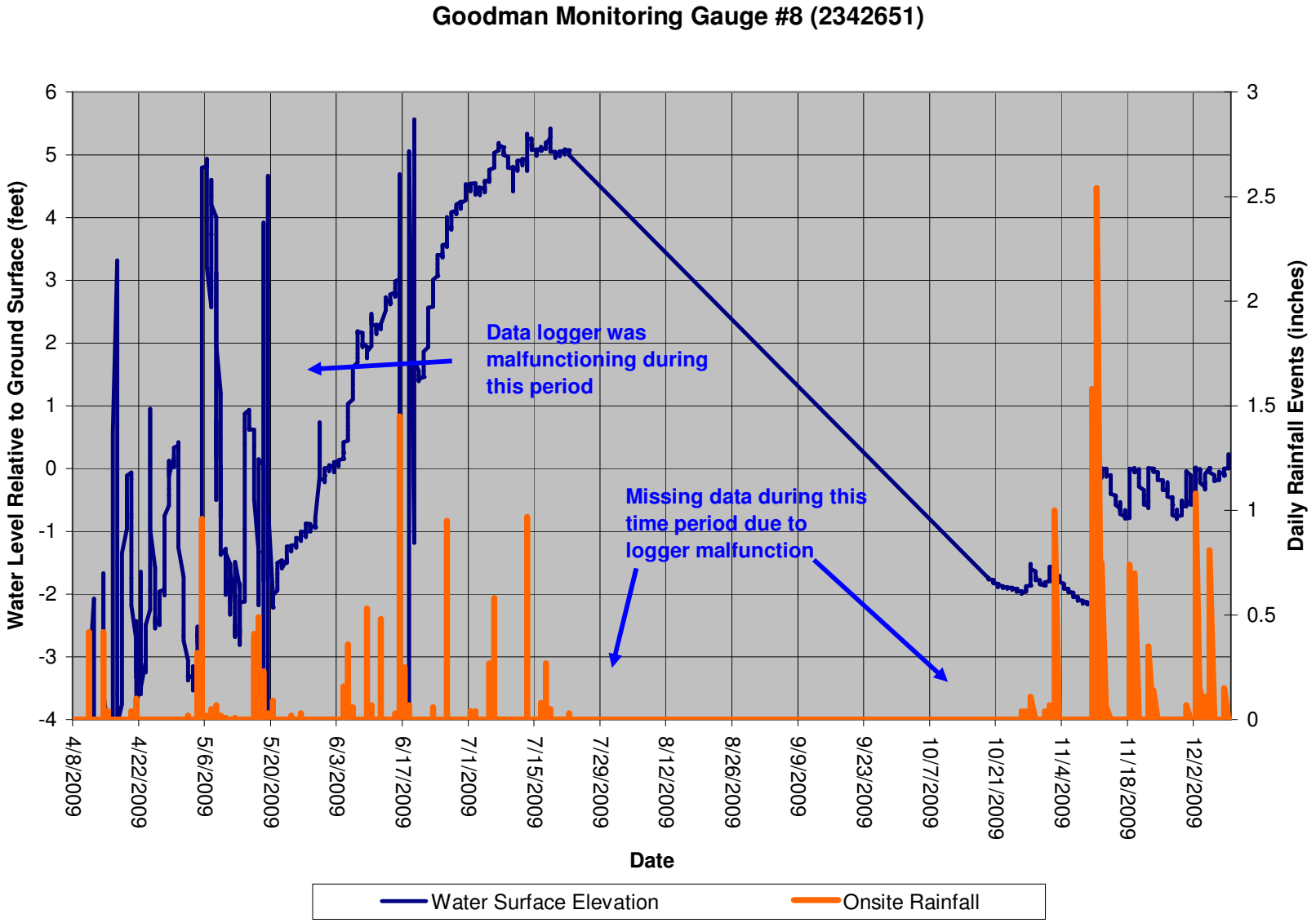

Goodman Monitoring Gauge #3 (2255504)
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
-4
3
2.5
2
1.5
1
0.5
0
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Date
Water Surface Elevation
Onsite Rainfall

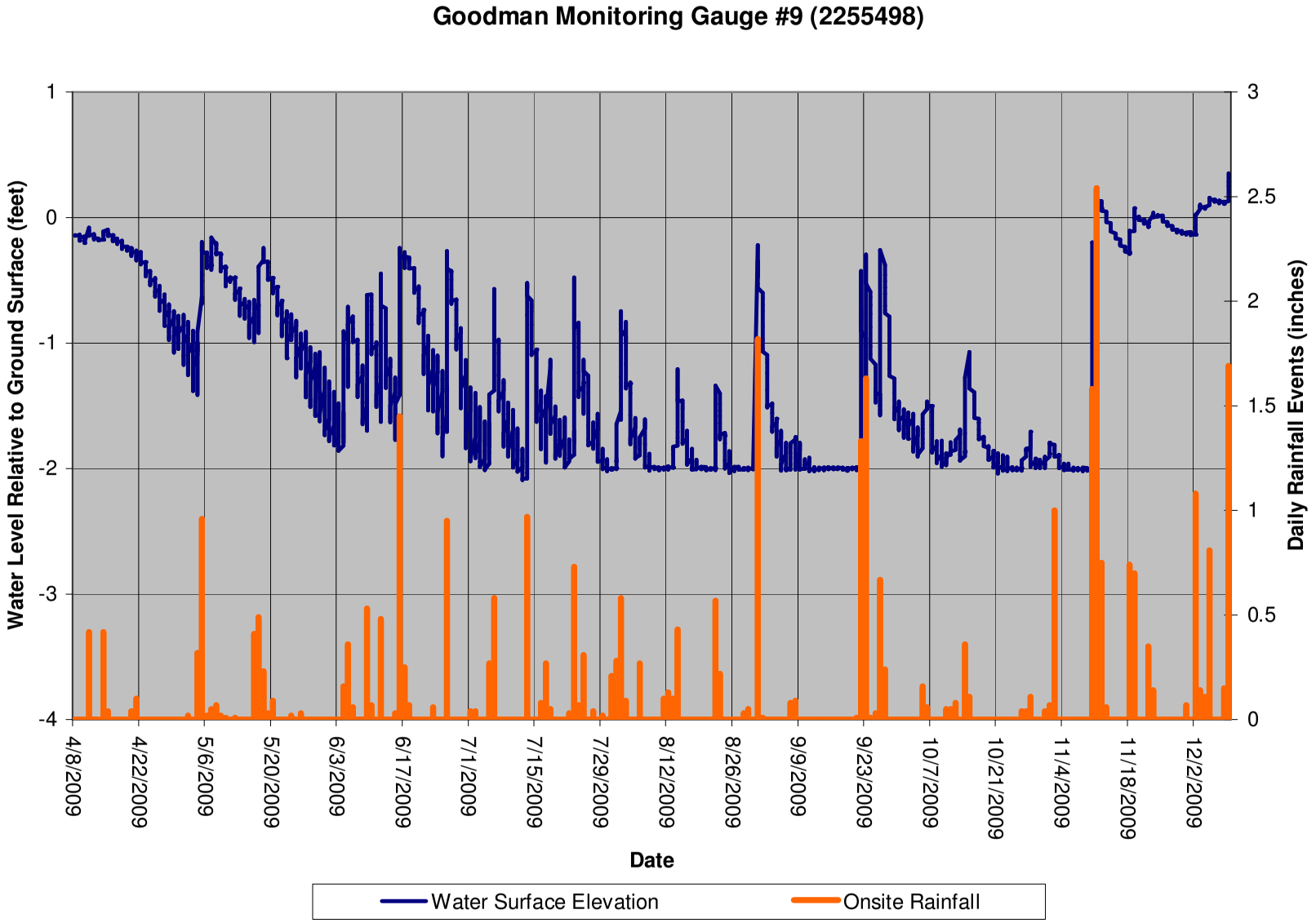

Goodman Monitoring Gauge #4 (2250033)
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
-4
3
2.5
2
1.5
1
0.5
0
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Date
Water Surface Elevation
Onsite Rainfall


Goodman Monitoring Gauge #5 (2255503)
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
-4
3
2.5
2
1.5
1
0.5
0
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
Onsite Rainfall


Goodman Monitoring Gauge #6 (2255502)
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
-4
3
2.5
2
1.5
1
0.5
0
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
Onsite Rainfall


Goodman Monitoring Gauge #7 (2255501)
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
-4
3
2.5
2
1.5
1
0.5
0
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
Onsite Rainfall


Goodman Monitoring Gauge #8 (2342651)
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Data logger was malfunctioning during this period
Missing data during this time period due to logger malfunction
Date
Water Surface Elevation
Onsite Rainfall


Goodman Monitoring Gauge #9 (2255498)
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
-4
3
2.5
2
1.5
1
0.5
0
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
Onsite Rainfall

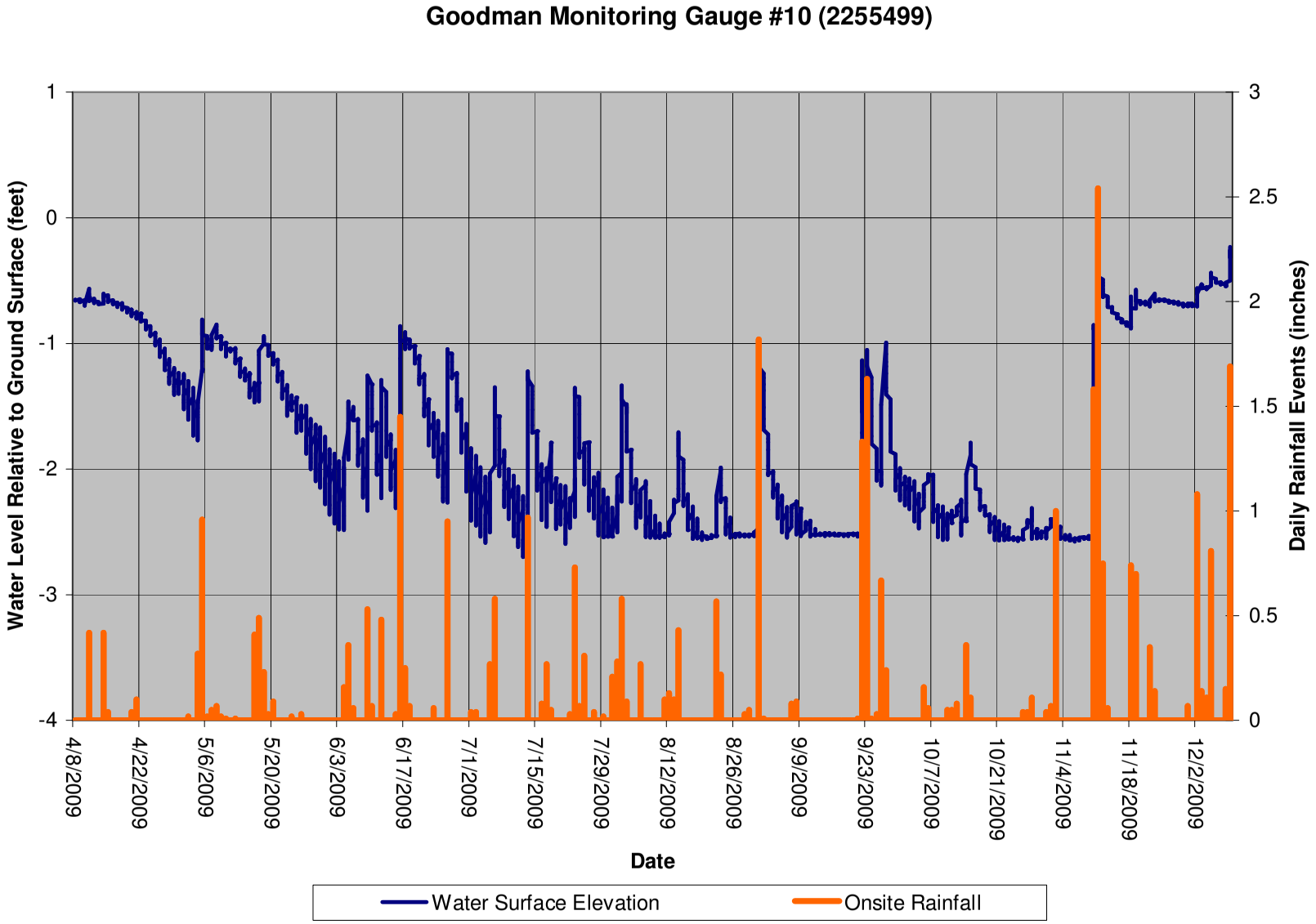
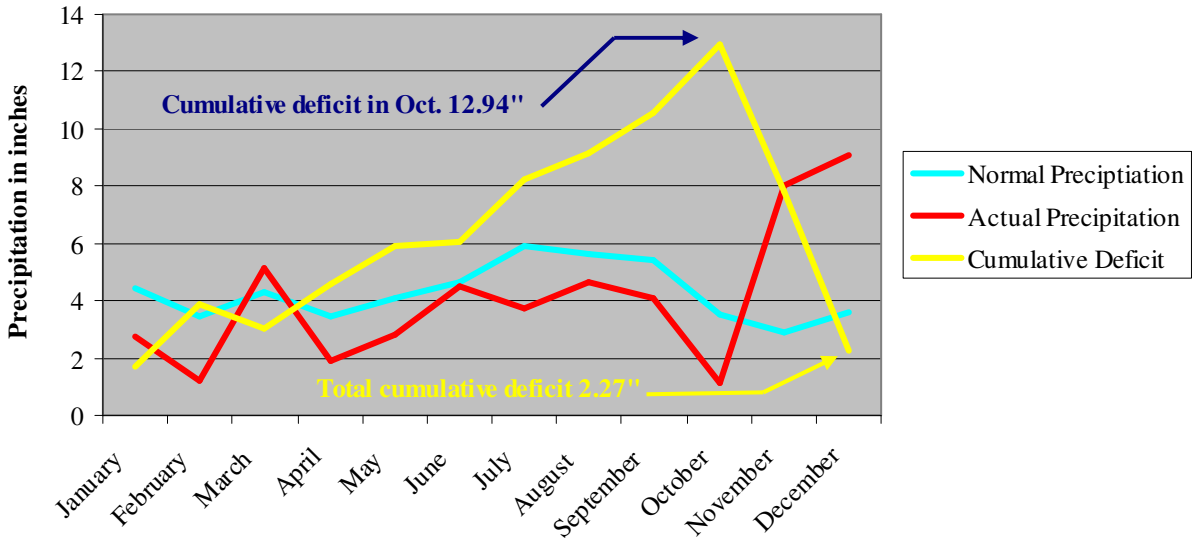

Goodman Monitoring Gauge #10 (2255499)
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
-4
3
2.5
2
1.5
1
0.5
0
4/8/2009
4/22/2009
5/6/2009
5/20/2009
6/3/2009
6/17/2009
7/1/2009
7/15/2009
7/29/2009
8/12/2009
8/26/2009
9/9/2009
9/23/2009
10/7/2009
10/21/2009
11/4/2009
11/18/2009
12/2/2009
Date
Water Surface Elevation
Onsite Rainfall

Figure P-1
2009 Reference Precipitation
Actual precip. data for Jan, Feb, Mar and Dec are from WETS Sation 7 mi. NE of Kinston



Accumulated rainfall deficit through October 2009 was 12.94 inches. Total for the year was reduced to 2.27 inches due to heavy rainfall in November and December.

Appendix D

Concentrated Drainage Areas

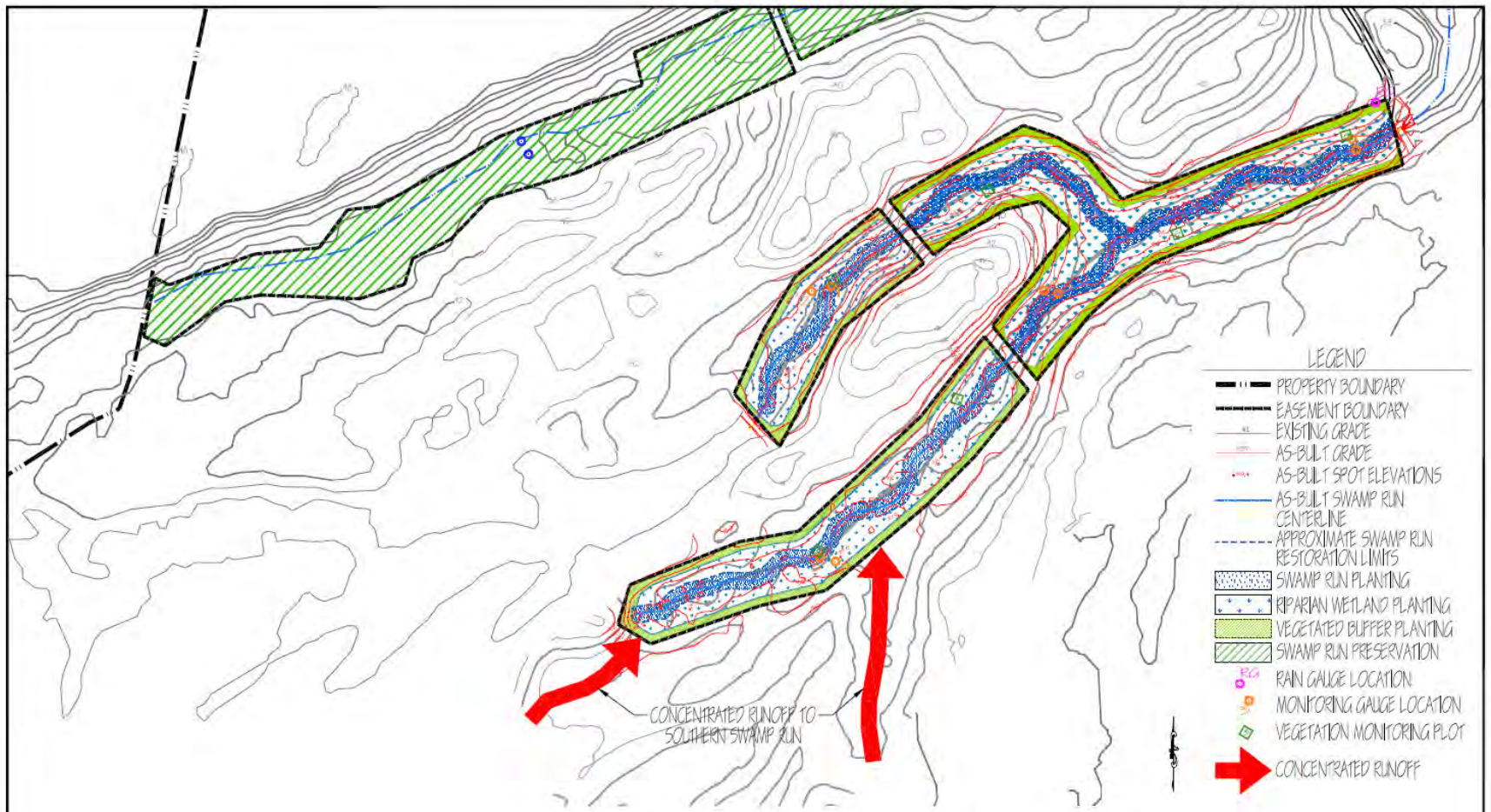


FIGURE 4: CONCENTRATED DRAINAGE AREAS
SCALE: 1" = 500'

FIGURE 3

PREPARED BY:
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WETLAND RESTORATION,
STREAM RESTORATION,
& WILDLIFE HABITAT CREATION
6586 PINEY WOODS ROAD FAIRFIELD, NC 27826
(252) 333-0296 FAX (252) 5268963

Ecosystem Enhancement Program

GOODMAN PROPERTY
STREAM MITIGATION UNITS: 4,966 SMU'S
LENOIR COUNTY, NORTH CAROLINA
EEP CONTRACT #: 000816

FEBRUARY 2010

NO.	DATE	REVISIONS	INITIALS