Farrar Dairy Stream and Wetland Restoration Site

EEP Project #92552 **DWQ 404 #08-0994**
Contract # D06002 **USACE Action ID #SAW-2006-40970**

Monitoring Year 05/Closeout

Project Type: Stream and Wetland Restoration

Submitted: February 2014

Table 1a. Project Setting and Classifications Farrar Dairy Stream and Wetland Restoration Site	
County	Harnett
General Location	Lillington
Basin	Cape Fear
Physiographic Region	Sandhills
USGS Hydro Unit	03030004110010
NCDWQ Sub-basin	03-06-14
Trout Water	No
Project Performers	
Source Agency	NCEEP
Provider	KCI Technologies
Designer	KCI Associates of NC
Monitoring Firm	KCI Associates of NC
Planting	Bruton Nurseries and Landscapes
Property Interest Holder	NCEEP

Table 1b. Project Activity and Reporting History		
Farrar Dairy Stream and Wetland Restoration Site		
Activity or Report	**Data Collection Complete**	**Completion or Delivery**
Restoration Plan	2007	May 2008
Final Design	2007	May 2008
Construction	N/A	March 2009
Planting	N/A	Jan 2009
Mitigation Plan / As-Built (Year 0 Monitoring - Baseline)	May 2009	June 2009
Monitoring Year 01	Dec 2009	Dec 2009
Additional log sills were installed along T1		Oct 2010
Regrading and stabilizing small areas of banks erosion and bed degradation on NPAC		Oct 2010
Monitoring Year 02	Dec 2010	Dec 2010
Monitoring Year 03	Oct 2011	Dec 2011
Supplemental Planting		April 2011
Invasive plant treatment		Aug 2011
Constructed riffles were installed at Stations 57+58, 58+47, 59+13, 59+84, and 60+50		May 2011
Bank grading and matting installation occurred at Stations 55+30, 56+80, 60+60, and 61+60		May 2011
Beaver Management USDA		2011
Monitoring Year 04	July-Aug 2012	Dec2012
Beaver Management USDA		2012
Supplemental Planting		March 2012
Invasive plant treatment		August 2012
Monitoring Year 05	July-Oct 2013	Dec 2013
Beaver Management USDA		2013

1.0 PROJECT SETTING AND BACKGROUND SUMMARY

The Farrar Dairy Stream and Wetland Restoration Site is a full-delivery project that was developed for the North Carolina Ecosystem Enhancement Program (EEP). The project restored, enhanced, and preserved 13,044 linear feet of the North Prong of Anderson Creek (NPAC) and its tributaries, and included 112.0 acres of Coastal Plain Small Stream Swamp wetland community.

The pre-restoration channel of NPAC had been moved and channelized to maximize the use of an agricultural field adjacent to Powell Farm Road. The other significant hydrologic alterations to the site included ditched wetlands and straightened tributaries. Due to the clearing of the riparian areas, the streams were experiencing significant bank erosion prior to restoration. In addition to the ditching that drained the historic wetlands, ponds were also built to attract migratory waterfowl.

Over the course of the project, following construction, supplemental planting and site maintenance has been conducted. In October 2010, additional log sills were installed along T1 to provide additional grade control as preventive maintenance. Regrading and stabilization on small areas of banks erosion and bed degradation was conducted on the upper end of NPAC. Stream and vegetation maintenance actions were completed in 2011. The stream maintenance addressed areas of bed degradation and bank erosion as discussed in the Monitoring Year 2 report. Constructed riffles were installed at Stations 57+58, 58+47, 59+13, 59+84, and 60+50 and bank grading and matting installation occurred at Stations 55+30, 56+80, 60+60, and 61+60. These maintenance areas have exhibited stability since installation. The bank repairs have not shown any signs of erosion, and the constructed riffles are holding grade and have washed-in with native sediment. The repeated establishment of beaver dams has caused some localized aggradation as sediment and debris has collected within the impounded stream. Where this has occurred the stream has remained stable and this trend has not proven detrimental to the stream. In 2011 and 2012, the vegetation maintenance included planting additional 5,900 and 8,500 bare-root trees, in various locations throughout the site that were found to have low densities of planted trees (See Appendix E Additional Data for the Supplemental Planting List). Invasive control was conducted with herbicide application targeting denseflower knotweed (*Polygonum densiflorum*), curly doc (*Rumex crispus*), and cockle burs (*Xanthium strumarium*). Throughout 2011-2013 numerous beaver dams were removed from the site. In June 2013 four additional wetland gauges were installed at the site and in August 2013, one additional wetland gauge was installed near the start of NPAC. These gauges will provide supplemental wetland hydrology data for the restored wetlands.

2.0 PROJECT GOALS AND OBJECTIVES

The goals and objectives of the restoration project are as follows:

Restoration Goals:

- Protect aquatic resources from excess nutrients, sediment, and other pollutants coming from the agricultural watershed.
- Reestablish a functional Coastal Plain Small Swamp Stream wetland complex that creates terrestrial and aquatic habitat and connects to the existing floodplain corridor along the NPAC.

Restoration Objectives:

- Restore 11,517 linear feet of stable stream channel with the appropriate pattern, profile, and dimension that can support a sand transport system.
- Connect the streams to functioning floodplains.

- Fill and plug ditches in the drained hydric soils to restore saturated hydrologic conditions to the upper soil horizons.
- Plant the NPAC, its tributaries, riparian corridors, floodplains and upland habitats with herbaceous cover as well as trees and shrubs to create and restore appropriate habitats within the landscape.
- Eliminate existing nutrient source associated with land application of animal waste in proximity to project streams.

3.0 SUCCESS CRITERIA

Table 2. Success Criteria
Farrar Dairy Stream and Wetland Restoration Site

Feature	Success Criteria
Stream	Minimal changes to the measured stream characteristics, demonstrating system stability. At least two bankfull events occurring in separate years over the course of the monitoring period.
Wetland	Continual wetland hydrology for 5% of the growing season (12.5 of 251 days) within a normal precipitation year.
Vegetation	Average of 260 stems/acre, as indicated by permanent vegetation plots after 5 years of monitoring.

Table 3a. Project Assets Farrar Dairy Stream and Wetland Restoration Site					
Project					
Project Segment	**Pre-Construction (linear feet/acreage)**	**Mitigation Approach**	**As-Built (linear feet/acreage)**	**Mitigation Ratio**	**Mitigation Units (SMU/WMU)**
NPAC	4,565	Restoration	6,746	1:1	6,714*
T1.1	864	Restoration	825	1:1	825
T1.2	995	Restoration	980	1:1	980
T1	818	Restoration	884	1:1	853*
T2A	977	Restoration	500	1:1	500
T2B		Restoration	522	1:1	522
T3	1,335	Restoration	1,167	1:1	1,167
T4.1	180	Enhancement II	180	2.5 : 1	72
T4.2	1,240	Preservation	1,240	5:1	248
TOTAL			**13,044**		**11,881**
* Easement exceptions for landowner ford crossings were excluded for these calculations.					
Project Wetlands					
Area 1	-	Preservation	45.93	5:1	9.18
Area 2	-	Enhancement	6.88	2:1	3.44
Area 3	-	Enhancement	2.57	2:1	1.29
Area 4	-	Enhancement	12.67	2:1	6.34
Area 5	-	Restoration	43.80	1:1	43.80
TOTAL			**111.85**		**64.05**

Table 3b. Mitigation Unit Totals Farrar Dairy Stream and Wetland Restoration Site			
Stream Mitigation Units (SMU)	**Riparian Wetland Units**	**Non-Riparian Units**	**Total Wetland (WMU)**
11,881	64.05		64.05

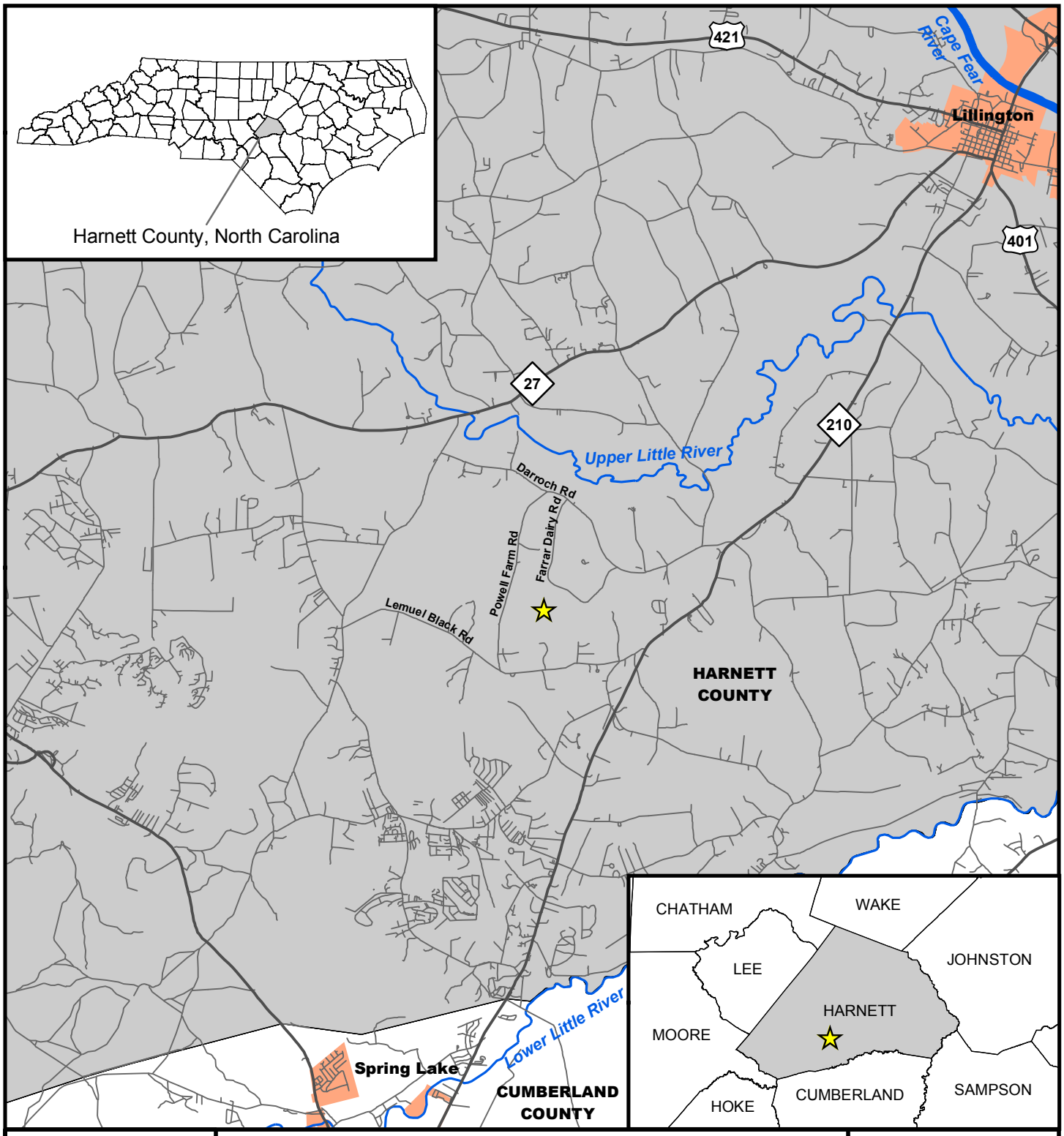


Figure 1. Vicinity Map

- Project Site Location
- Major Roads
- Other Roads
- Major Rivers
- Municipalities
- County Boundaries

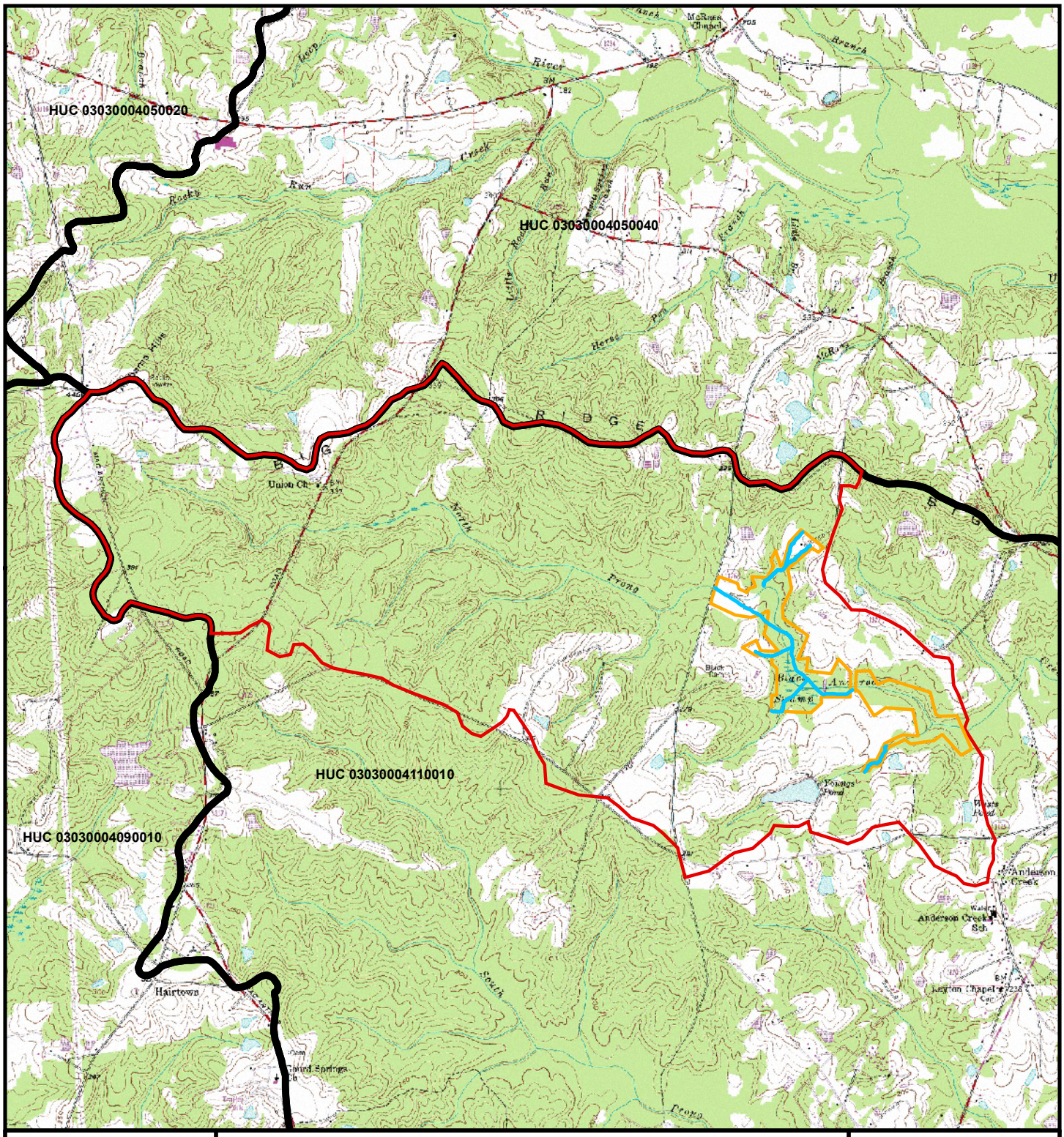
1:126,720
1 inch equals 2 miles

2 1 0 2 Miles

KCI TECHNOLOGIES

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.



KCI TECHNOLOGIES

Figure 2. Project Watershed

Project Watershed (Approx. 5.7 sq. miles)

Project Streams

14-digit HUC Boundaries

Project Easement Boundary

N
W E
S

1:42,000

1 inch equals 3,500 feet

3,500 1,750 0 3,500 Feet

Source: USGS Topographic Quadrangle Anderson Creek, 1981

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

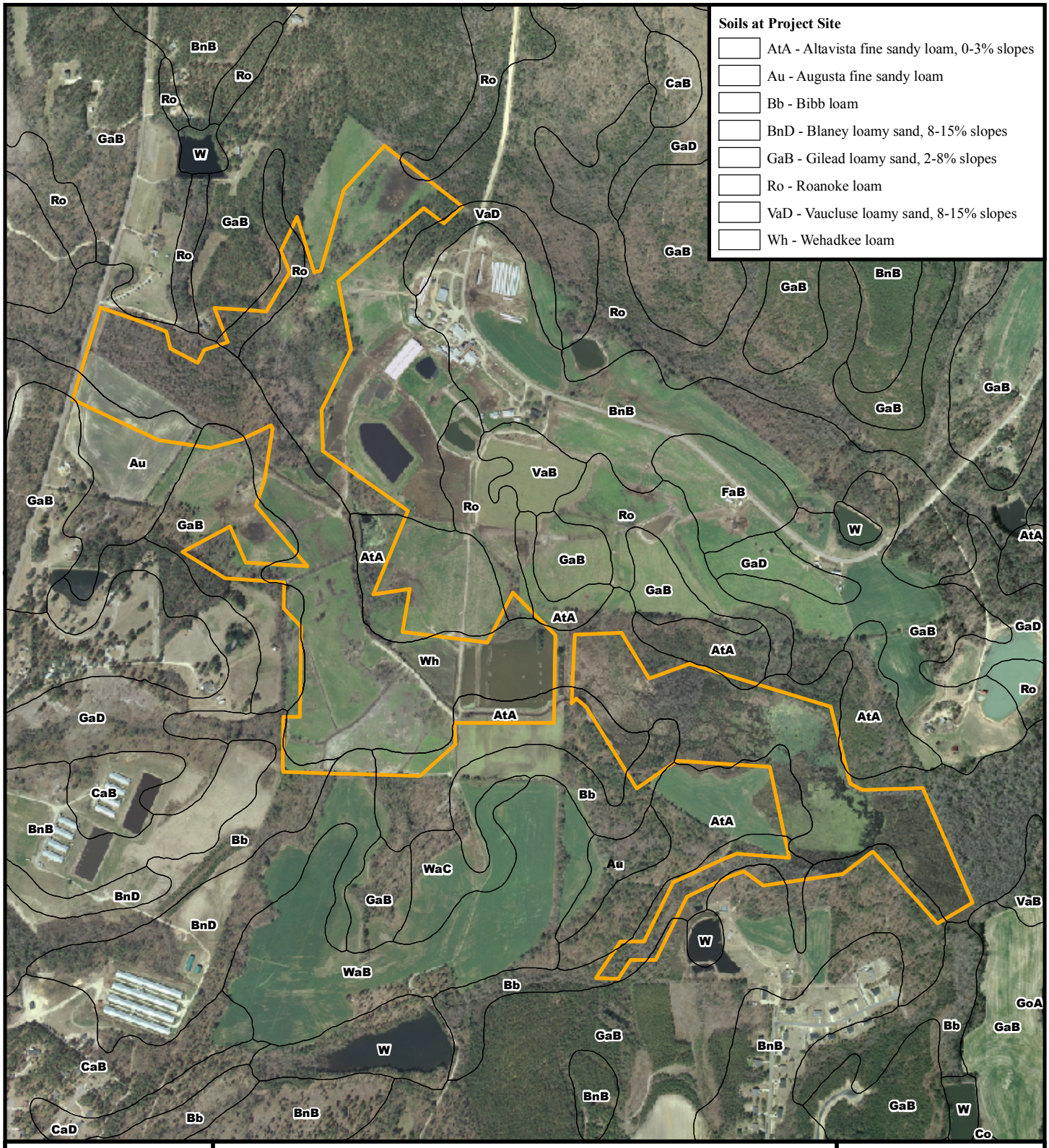


Figure 3. Project Site NRCS Soil Survey

Soils

Project Easement Boundary

1:12,000

1 inch equals 1,000 feet

1,000 500 0 1,000 Feet

Source: SSURGO Dataset from NRCS based on Soil Survey of Harnett County, North Carolina, USDA SCS 1994; 2005 Orthoimagery from Harnett County GIS/Land Records

KCI TECHNOLOGIES

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

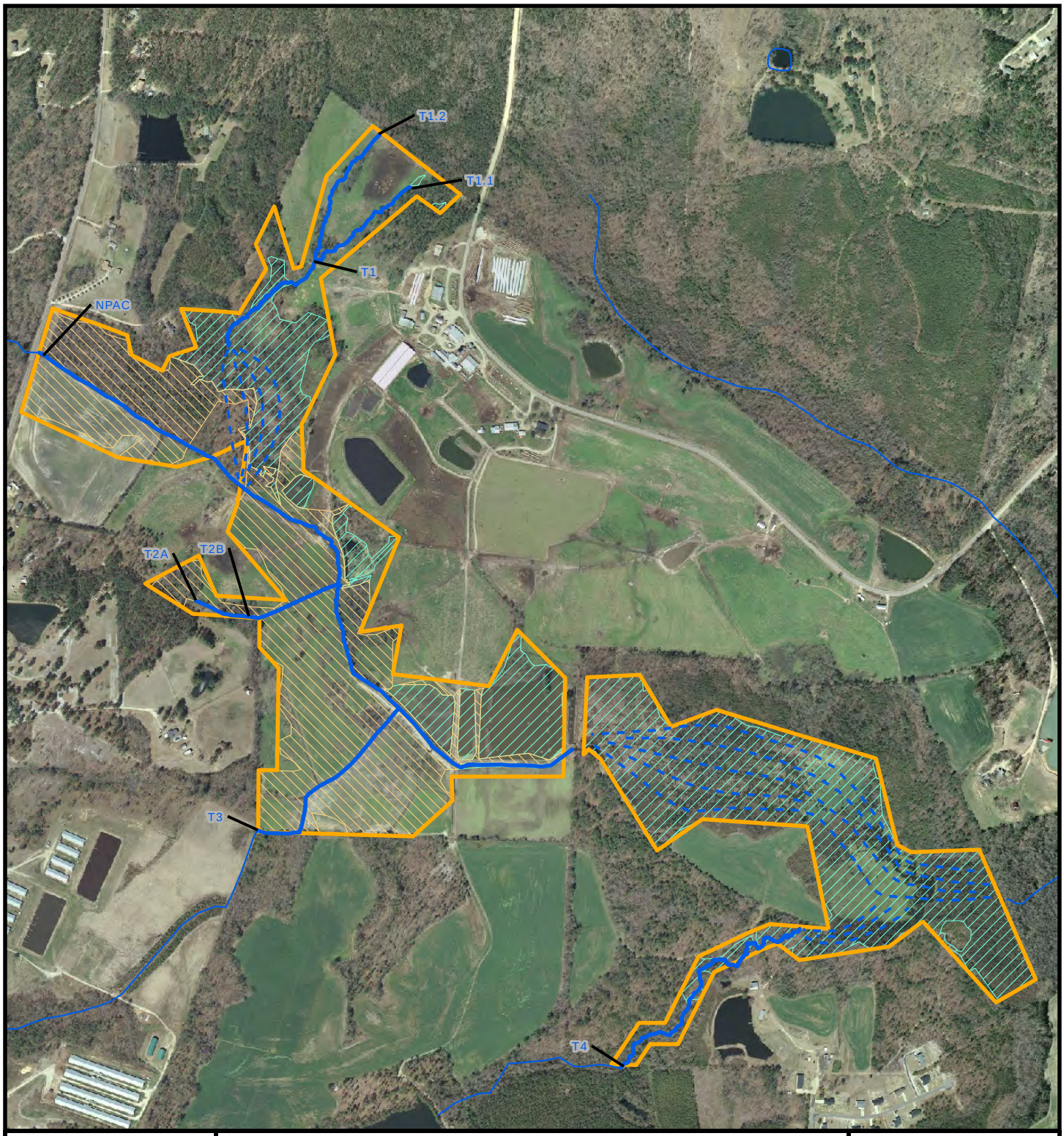


Figure 4. Hydric Soil Map

Project Streams
Diffuse Flow
Other Streams
Project Easement Boundary
Drained Hydric Soils
Existing Wetlands (Hydric)

1:10,800
1 inch = 900 feet

900 450 0 900 Feet

Source: Orthoimagery 2005, Harnett County GIS/Land Records

KCI TECHNOLOGIES

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

LEGEND

- RESTORATION
- ENHANCEMENT
- PRESERVATION
- CONSERVATION EASEMENT
- STREAM RESTORATION
- STREAM ENHANCEMENT II
- STREAM PRESERVATION
- PRE-EXISTING TRAILS
- REACH BREAKS

N

-300 -150 0 300 600

GRAPHIC SCALE

POWELL FARM ROAD

FARRAR DAIRY RD.

T1.1

T1.2

T1-1

WETLAND AREA 2 ENHANCEMENT

NPAC-1

WETLAND AREA 3 ENHANCEMENT

WETLAND AREA 4 ENHANCEMENT

WETLAND AREA 1 PRESERVATION

T2A

T2B

NPAC-2

NPAC-3

T3

WETLAND AREA 5 RESTORATION

T4.2

T4.1

NOTES:

NOTES:

REVISIONS

SYM.	DESCRIPTION	DATE

Ecosystem Enhancement Program

KCI TECHNOLOGIES
ENGINEERS • PLANNERS • SCIENTISTS
460 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: JAN 2014

SCALE: GRAPHIC

CURRENT CONDITION PLAN VIEW

FIGURE 5

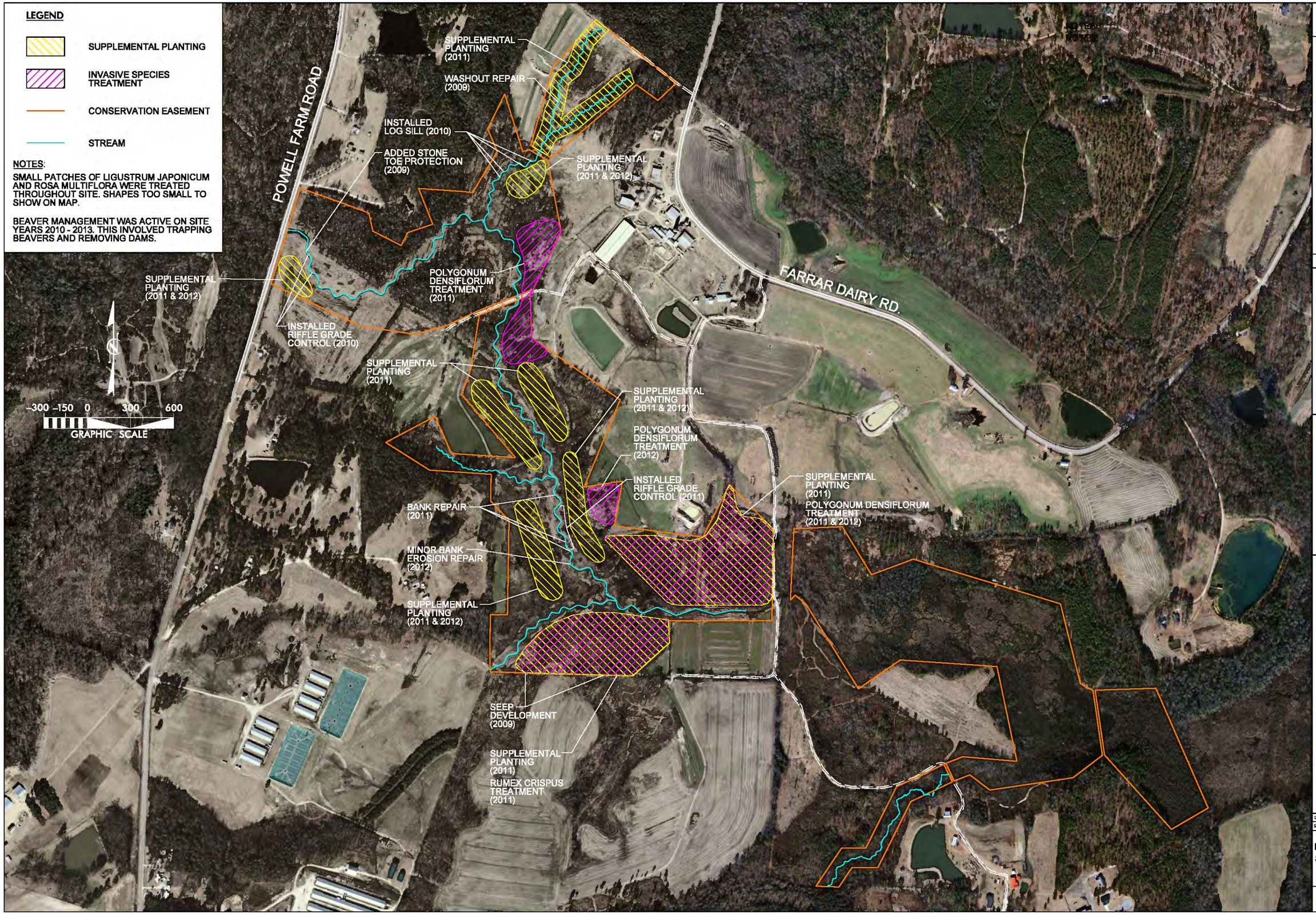
LEGEND

- SUPPLEMENTAL PLANTING
- INVASIVE SPECIES TREATMENT
- CONSERVATION EASEMENT
- STREAM

NOTES:

SMALL PATCHES OF LIGUSTRUM JAPONICUM AND ROSA MULTIFLORA WERE TREATED THROUGHOUT SITE. SHAPES TOO SMALL TO SHOW ON MAP.

BEAVER MANAGEMENT WAS ACTIVE ON SITE YEARS 2010 - 2013. THIS INVOLVED TRAPPING BEAVERS AND REMOVING DAMS.



REVISIONS

SYM.	DESCRIPTION	DATE

Ecosystem Enhancement

KCI TECHNOLOGIES
ENGINEERS • PLANNERS • SCIENTISTS
460 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: JAN 2014
SCALE: GRAPHIC

MAINTENANCE & SUPPLEMENTAL PLANTING

FIGURE 6

LEGEND

CONSERVATION EASEMENT

CROSS-SECTION (XS)

VEGETATION PLOT (VP)

GAUGE LOCATION

–300 –150 0 300 600

GRAPHIC SCALE

POWELL FARM ROAD

FARRAR DAIRY RD.

REFERENCE GAUGE

REVISIONS

DESCRIPTION	DATE
SYM.	

Ecosystem Enhancement Program

KCI TECHNOLOGIES

ENGINEERS • PLANNERS • SCIENTISTS

460 SIX FORKS ROAD

RALEIGH, NORTH CAROLINA 27609

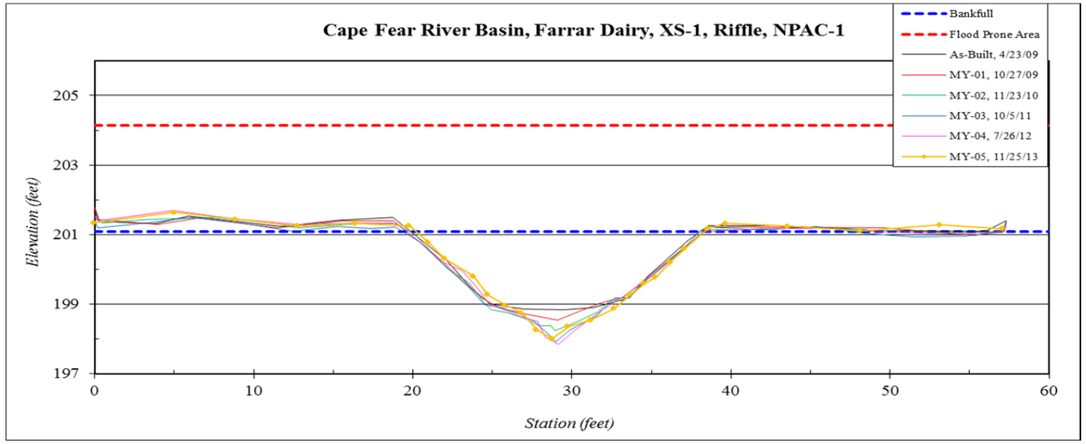
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

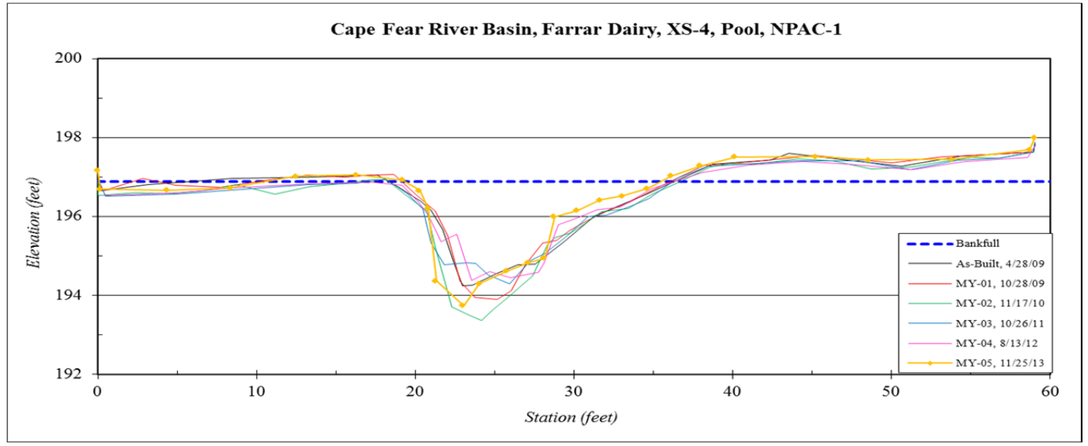
DATE: JAN 2014

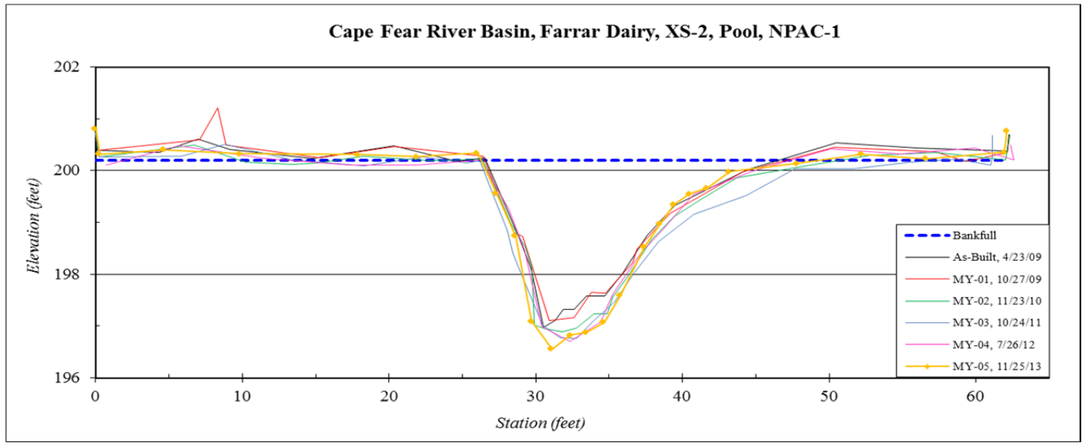
SCALE: GRAPHIC

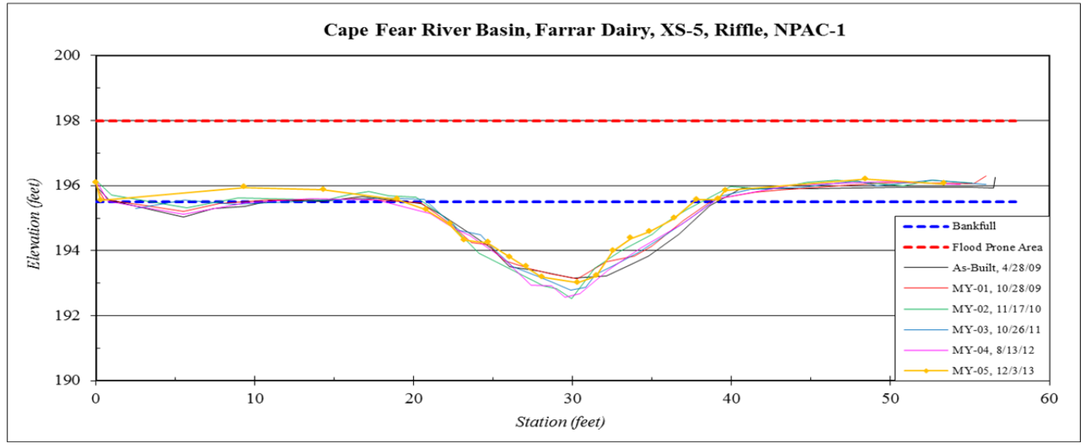
MONITORING FEATURES

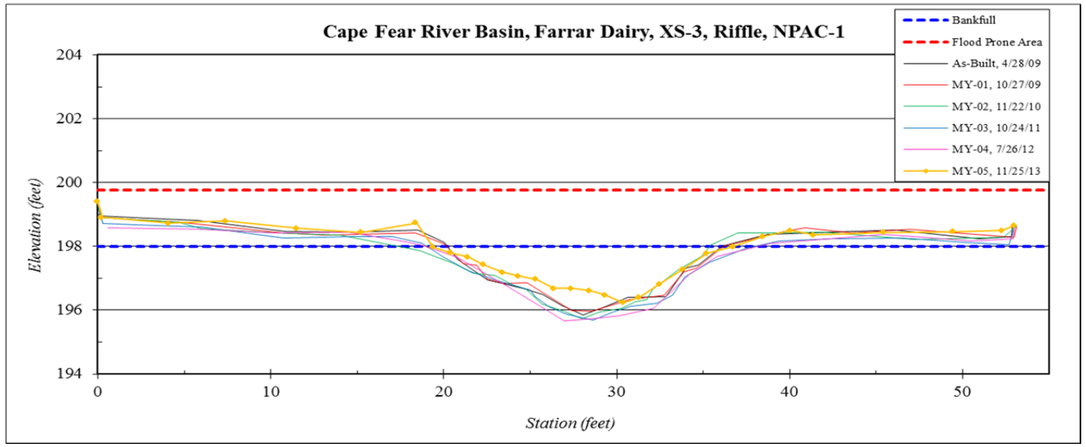
FIGURE 7

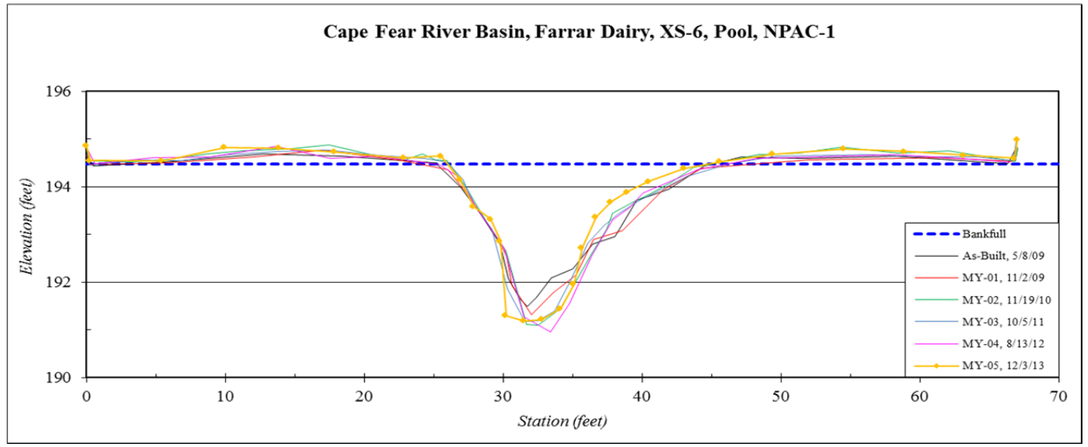

Cape Fear River Basin, Farrar Dairy, XS-1, Riffle, NPAC-1
Bankfull
Flood Prone Area
As-Built, 4/23/09
MY-01, 10/27/09
MY-02, 11/23/10
MY-03, 10/5/11
MY-04, 7/26/12
MY-05, 11/25/13
Elevation (feet)
Station (feet)

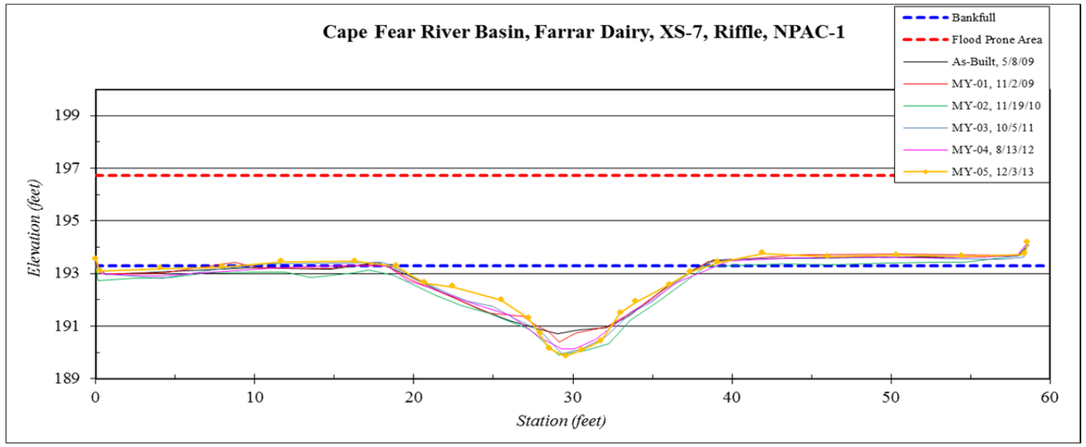

Cape Fear River Basin, Farrar Dairy, XS-4, Pool, NPAC-1
Bankfull
As-Built, 4/28/09
MY-01, 10/28/09
MY-02, 11/17/10
MY-03, 10/26/11
MY-04, 8/13/12
MY-05, 11/25/13
Elevation (feet)
Station (feet)

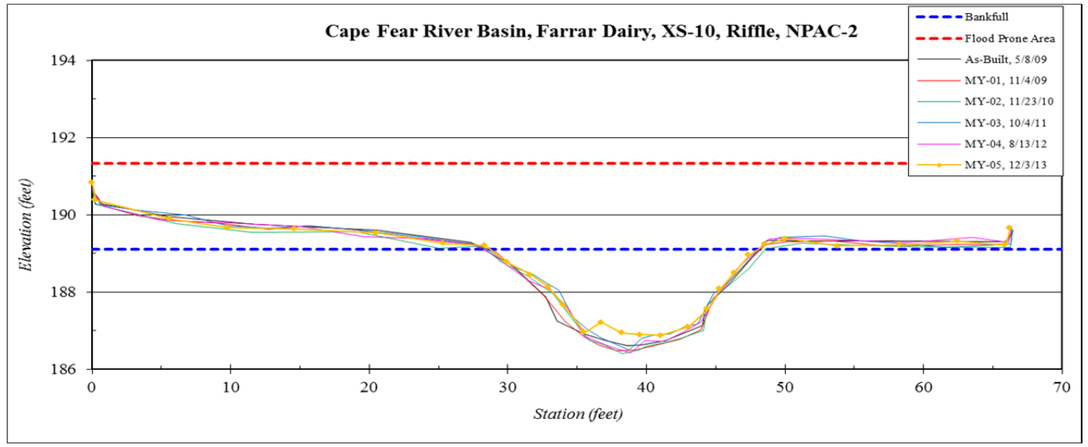

Cape Fear River Basin, Farrar Dairy, XS-2, Pool, NPAC-1
Bankfull
As-Built, 4/23/09
MY-01, 10/27/09
MY-02, 11/23/10
MY-03, 10/24/11
MY-04, 7/26/12
MY-05, 11/25/13
Elevation (feet)
Station (feet)

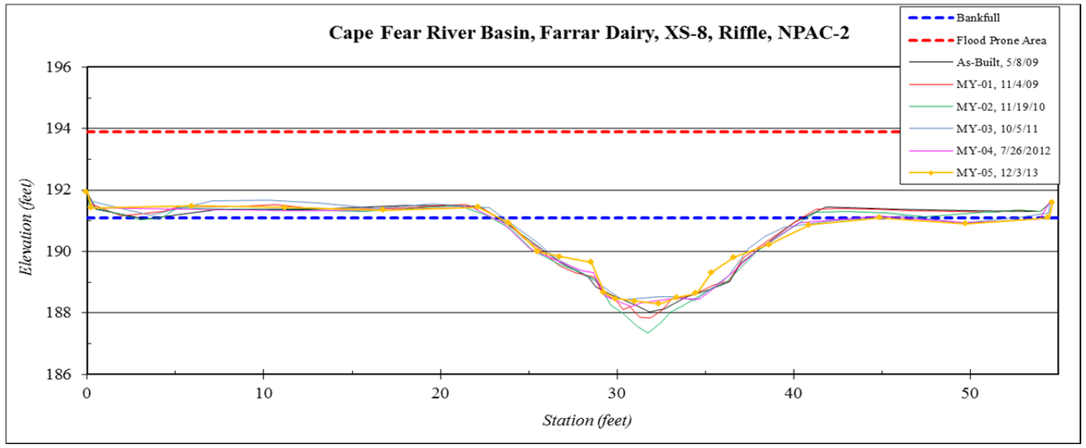

Cape Fear River Basin, Farrar Dairy, XS-5, Riffle, NPAC-1
Bankfull
Flood Prone Area
As-Built, 4/28/09
MY-01, 10/28/09
MY-02, 11/17/10
MY-03, 10/26/11
MY-04, 8/13/12
MY-05, 12/3/13
Elevation (feet)
Station (feet)

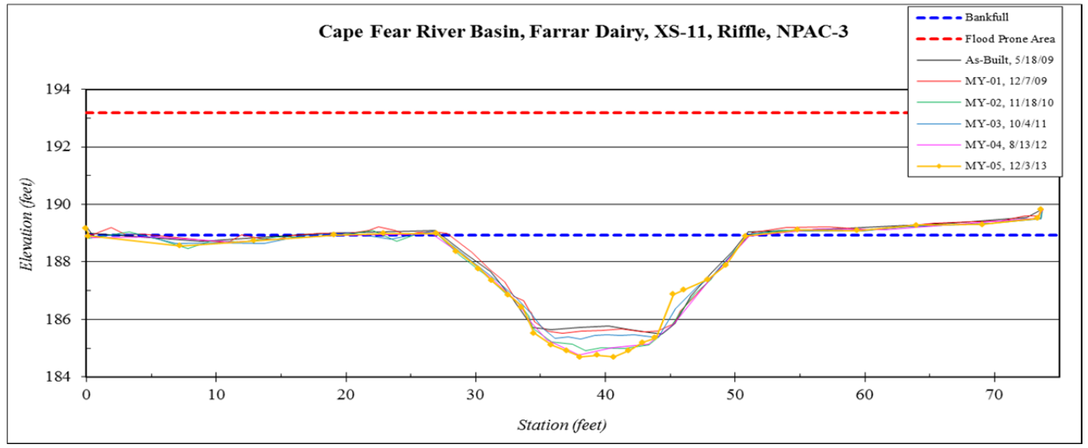

Cape Fear River Basin, Farrar Dairy, XS-3, Riffle, NPAC-1
Bankfull
Flood Prone Area
As-Built, 4/28/09
MY-01, 10/27/09
MY-02, 11/22/10
MY-03, 10/24/11
MY-04, 7/26/12
MY-05, 11/25/13
Elevation (feet)
Station (feet)

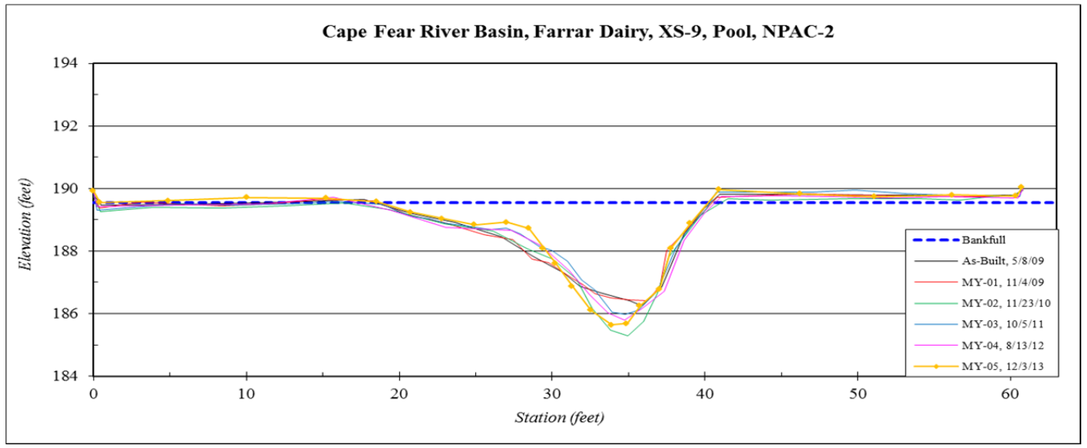

Cape Fear River Basin, Farrar Dairy, XS-6, Pool, NPAC-1
Bankfull
As-Built, 5/8/09
MY-01, 11/2/09
MY-02, 11/19/10
MY-03, 10/5/11
MY-04, 8/13/12
MY-05, 12/3/13
Elevation (feet)
Station (feet)

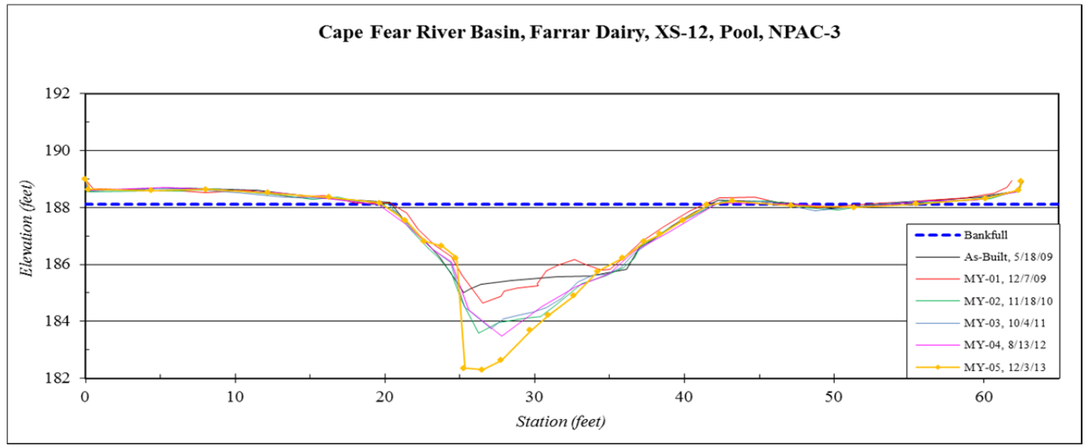

Cape Fear River Basin, Farrar Dairy, XS-7, Riffle, NPAC-1
Bankfull
Flood Prone Area
As-Built, 5/8/09
MY-01, 11/2/09
MY-02, 11/19/10
MY-03, 10/5/11
MY-04, 8/13/12
MY-05, 12/3/13
Elevation (feet)
Station (feet)

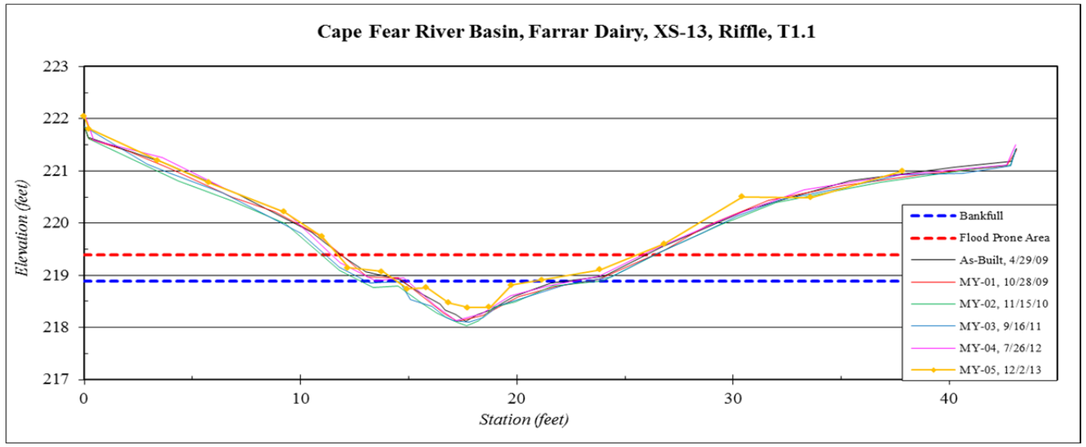

Cape Fear River Basin, Farrar Dairy, XS-10, Riffle, NPAC-2
Bankfull
Flood Prone Area
As-Built, 5/8/09
MY-01, 11/4/09
MY-02, 11/23/10
MY-03, 10/4/11
MY-04, 8/13/12
MY-05, 12/3/13
Elevation (feet)
Station (feet)

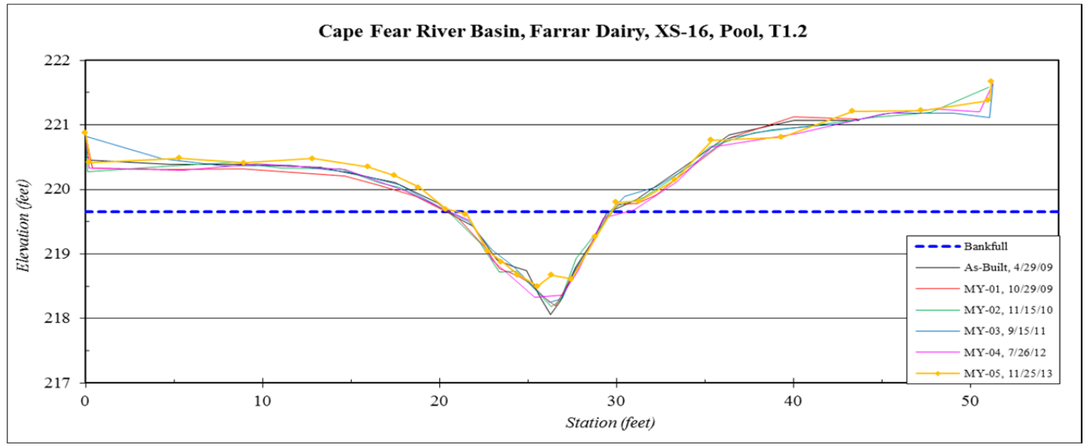

Cape Fear River Basin, Farrar Dairy, XS-8, Riffle, NPAC-2
Bankfull
Flood Prone Area
As-Built, 5/8/09
MY-01, 11/4/09
MY-02, 11/19/10
MY-03, 10/5/11
MY-04, 7/26/2012
MY-05, 12/3/13
Elevation (feet)
Station (feet)

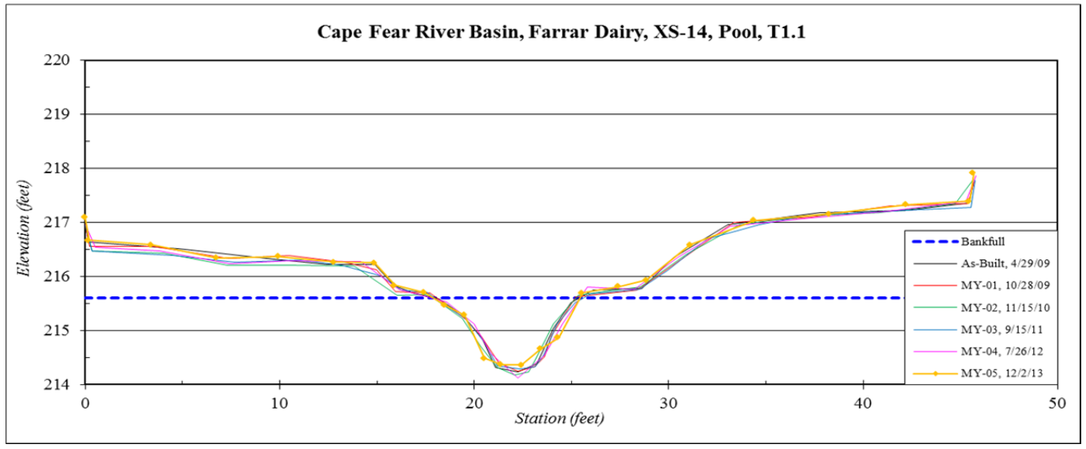

Cape Fear River Basin, Farrar Dairy, XS-11, Riffle, NPAC-3
Bankfull
Flood Prone Area
As-Built, 5/18/09
MY-01, 12/7/09
MY-02, 11/18/10
MY-03, 10/4/11
MY-04, 8/13/12
MY-05, 12/3/13
Elevation (feet)
Station (feet)

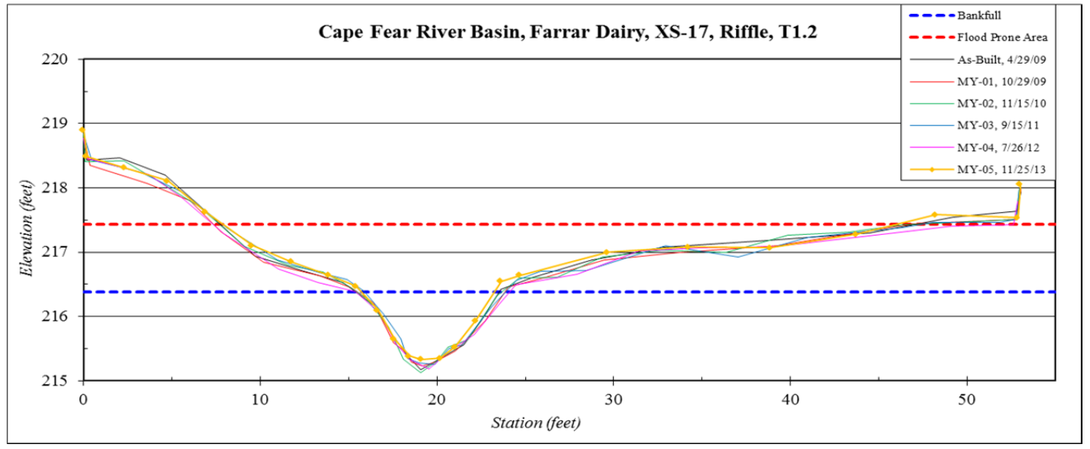

Cape Fear River Basin, Farrar Dairy, XS-9, Pool, NPAC-2
Bankfull
As-Built, 5/8/09
MY-01, 11/4/09
MY-02, 11/23/10
MY-03, 10/5/11
MY-04, 8/13/12
MY-05, 12/3/13
Elevation (feet)
Station (feet)

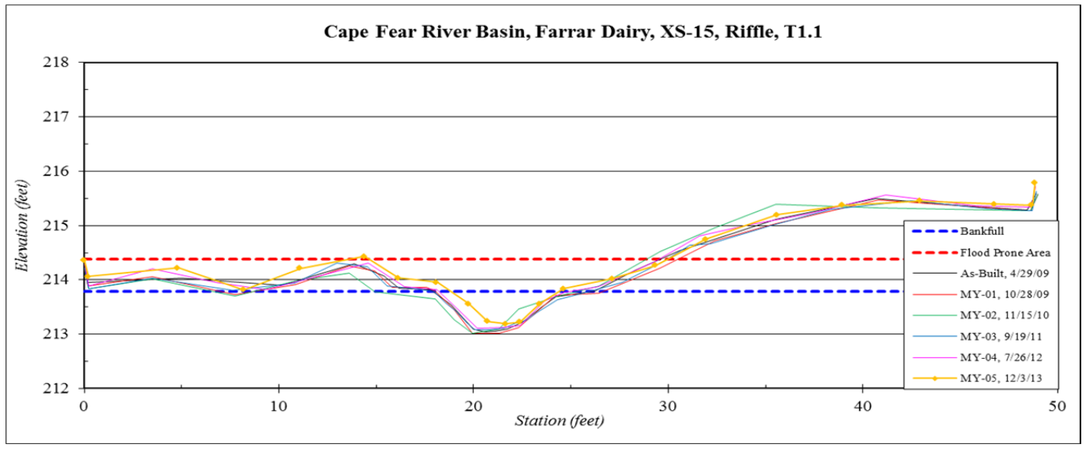

Cape Fear River Basin, Farrar Dairy, XS-12, Pool, NPAC-3
Bankfull
As-Built, 5/18/09
MY-01, 12/7/09
MY-02, 11/18/10
MY-03, 10/4/11
MY-04, 8/13/12
MY-05, 12/3/13
Elevation (feet)
Station (feet)

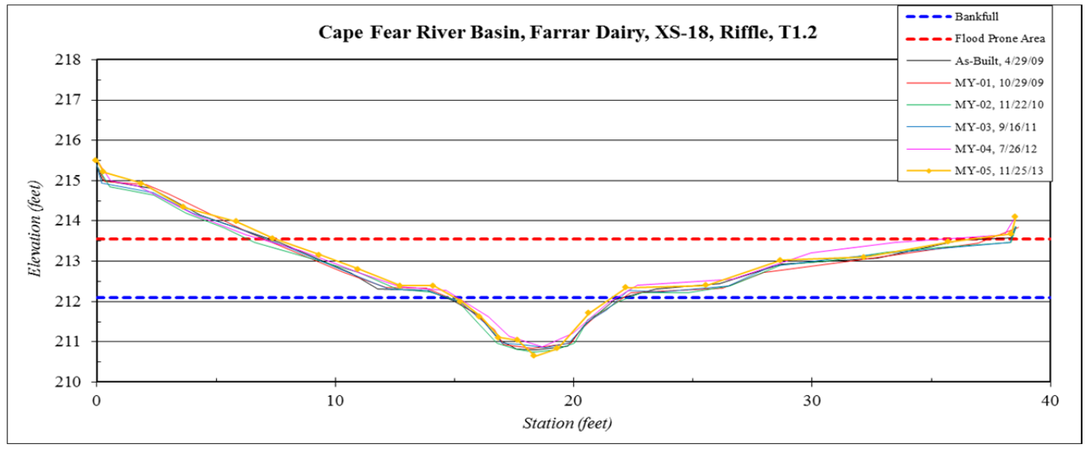

Cape Fear River Basin, Farrar Dairy, XS-13, Riffle, T1.1
Elevation (feet)
Station (feet)
Bankfull
Flood Prone Area
As-Built, 4/29/09
MY-01, 10/28/09
MY-02, 11/15/10
MY-03, 9/16/11
MY-04, 7/26/12
MY-05, 12/2/13

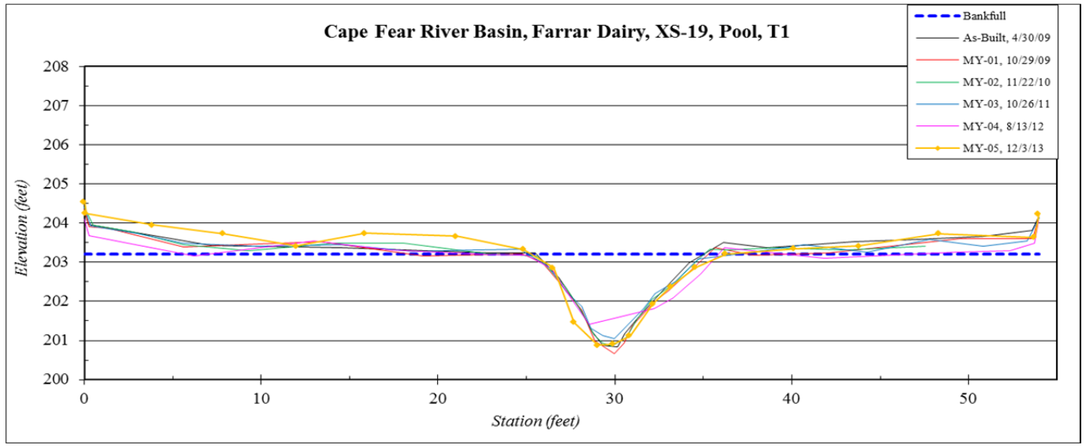

Cape Fear River Basin, Farrar Dairy, XS-16, Pool, T1.2
Elevation (feet)
Station (feet)
Bankfull
As-Built, 4/29/09
MY-01, 10/29/09
MY-02, 11/15/10
MY-03, 9/15/11
MY-04, 7/26/12
MY-05, 11/25/13

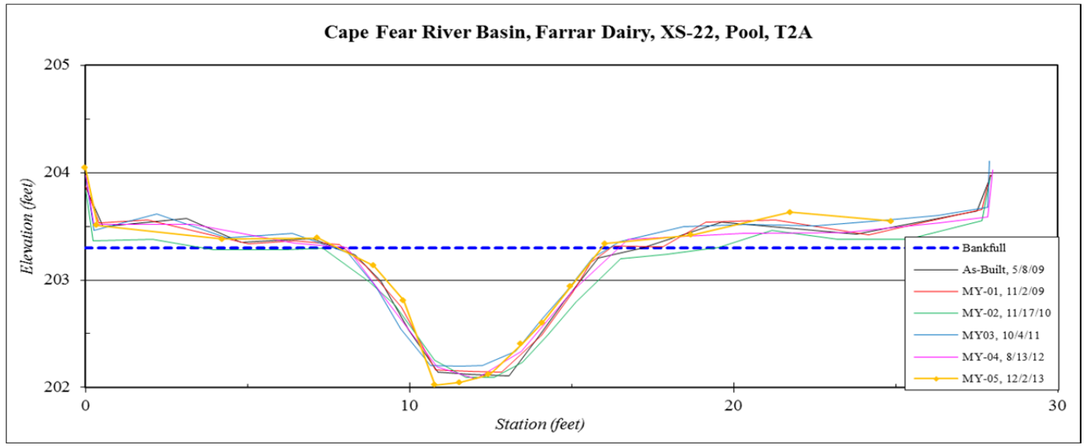

Cape Fear River Basin, Farrar Dairy, XS-14, Pool, T1.1
Elevation (feet)
Station (feet)
Bankfull
As-Built, 4/29/09
MY-01, 10/28/09
MY-02, 11/15/10
MY-03, 9/15/11
MY-04, 7/26/12
MY-05, 12/2/13

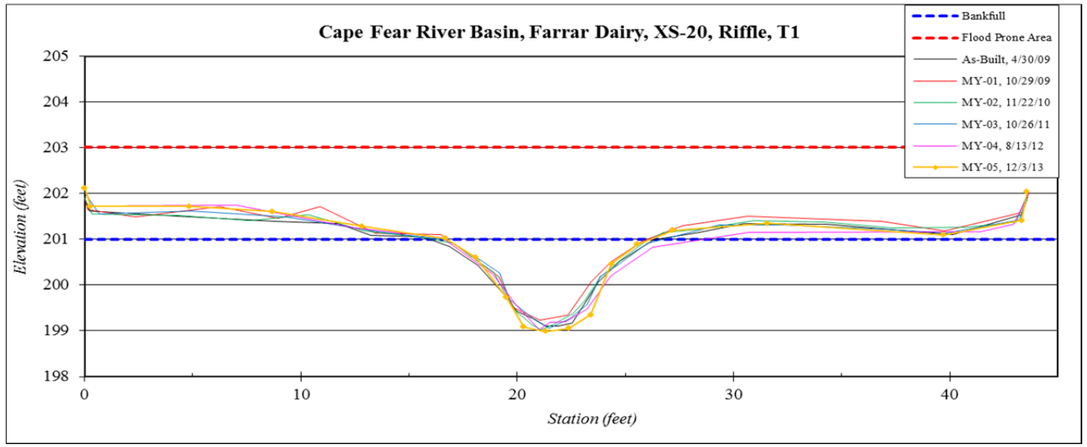

Cape Fear River Basin, Farrar Dairy, XS-17, Riffle, T1.2
Elevation (feet)
Station (feet)
Bankfull
Flood Prone Area
As-Built, 4/29/09
MY-01, 10/29/09
MY-02, 11/15/10
MY-03, 9/15/11
MY-04, 7/26/12
MY-05, 11/25/13

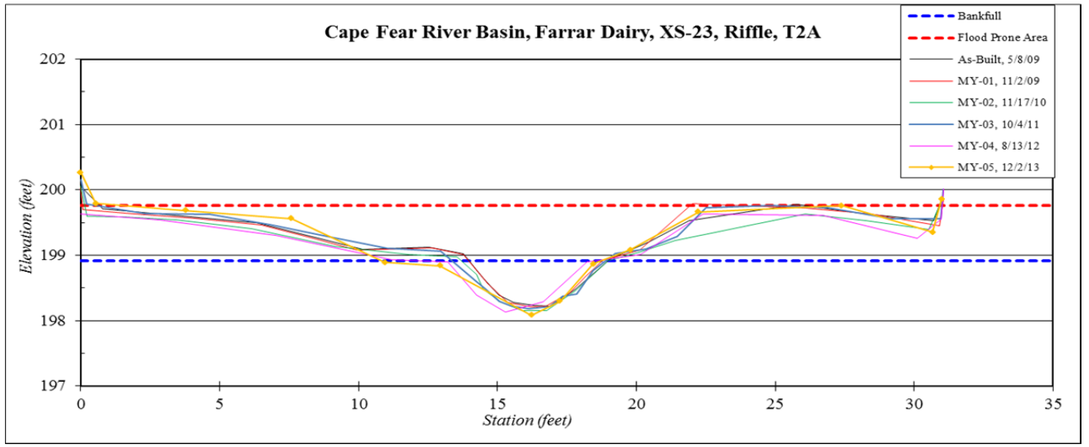

Cape Fear River Basin, Farrar Dairy, XS-15, Riffle, T1.1
Elevation (feet)
Station (feet)
Bankfull
Flood Prone Area
As-Built, 4/29/09
MY-01, 10/28/09
MY-02, 11/15/10
MY-03, 9/19/11
MY-04, 7/26/12
MY-05, 12/3/13

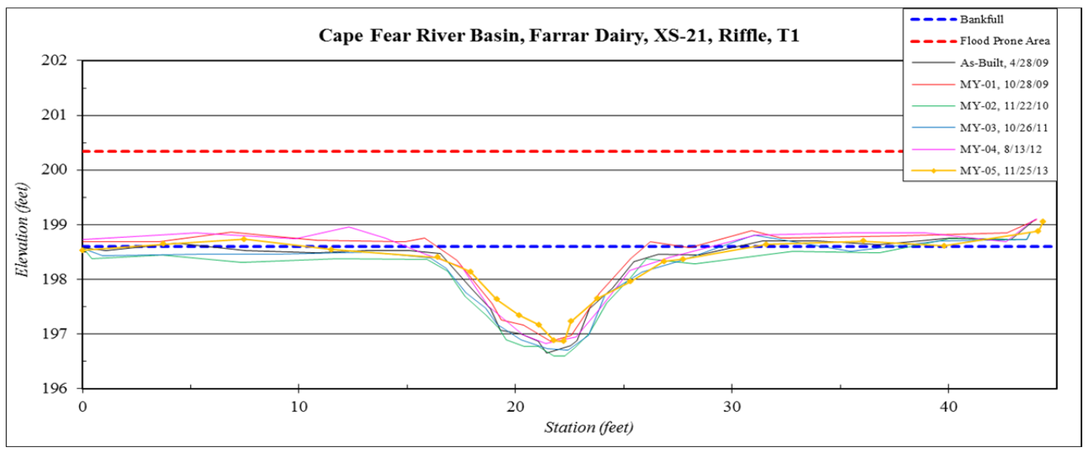

Cape Fear River Basin, Farrar Dairy, XS-18, Riffle, T1.2
Elevation (feet)
Station (feet)
Bankfull
Flood Prone Area
As-Built, 4/29/09
MY-01, 10/29/09
MY-02, 11/22/10
MY-03, 9/16/11
MY-04, 7/26/12
MY-05, 11/25/13

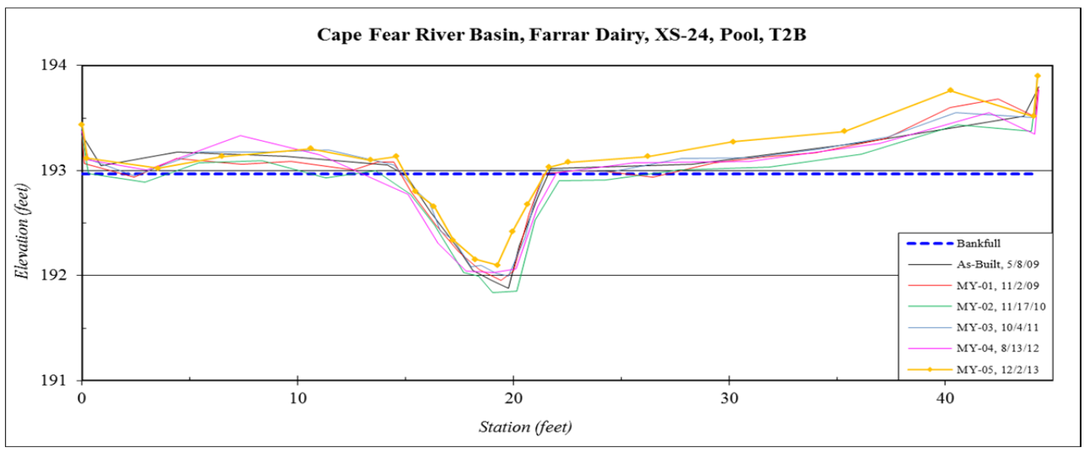

Cape Fear River Basin, Farrar Dairy, XS-19, Pool, T1
Bankfull
As-Built, 4/30/09
MY-01, 10/29/09
MY-02, 11/22/10
MY-03, 10/26/11
MY-04, 8/13/12
MY-05, 12/3/13
Elevation (feet)
Station (feet)

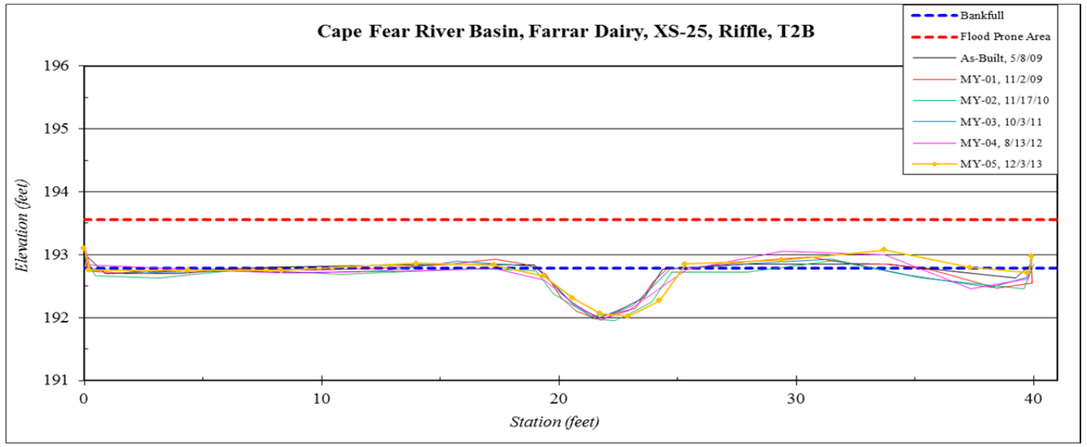

Cape Fear River Basin, Farrar Dairy, XS-22, Pool, T2A
Bankfull
As-Built, 5/8/09
MY-01, 11/2/09
MY-02, 11/17/10
MY03, 10/4/11
MY-04, 8/13/12
MY-05, 12/2/13
Elevation (feet)
Station (feet)

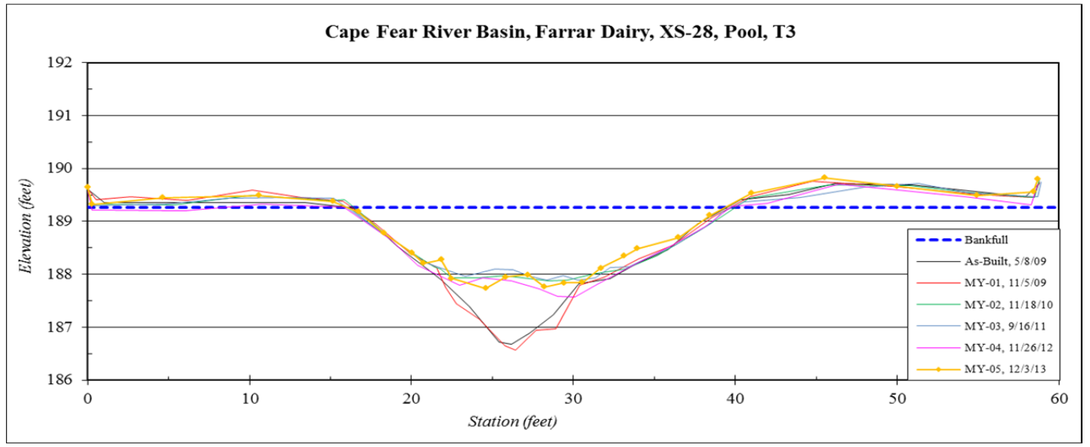

Cape Fear River Basin, Farrar Dairy, XS-20, Riffle, T1
Bankfull
Flood Prone Area
As-Built, 4/30/09
MY-01, 10/29/09
MY-02, 11/22/10
MY-03, 10/26/11
MY-04, 8/13/12
MY-05, 12/3/13
Elevation (feet)
Station (feet)

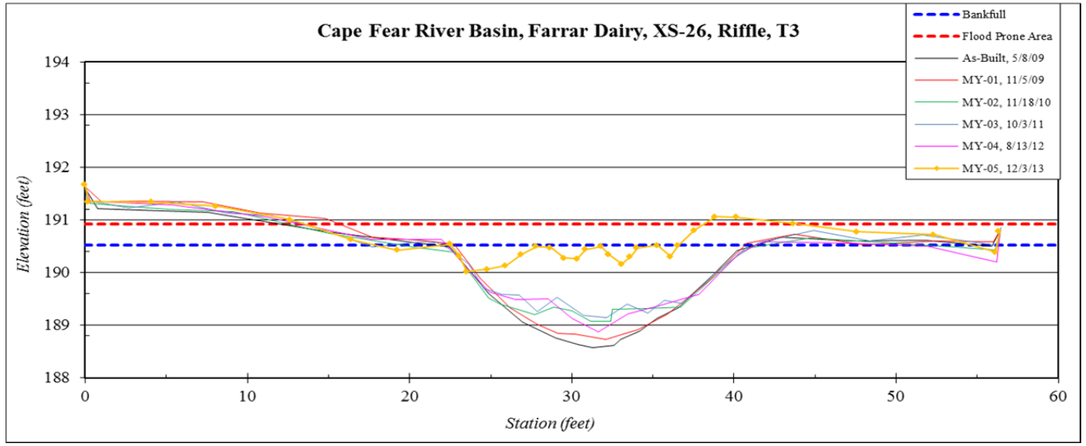

Cape Fear River Basin, Farrar Dairy, XS-23, Riffle, T2A
Bankfull
Flood Prone Area
As-Built, 5/8/09
MY-01, 11/2/09
MY-02, 11/17/10
MY-03, 10/4/11
MY-04, 8/13/12
MY-05, 12/2/13
Elevation (feet)
Station (feet)

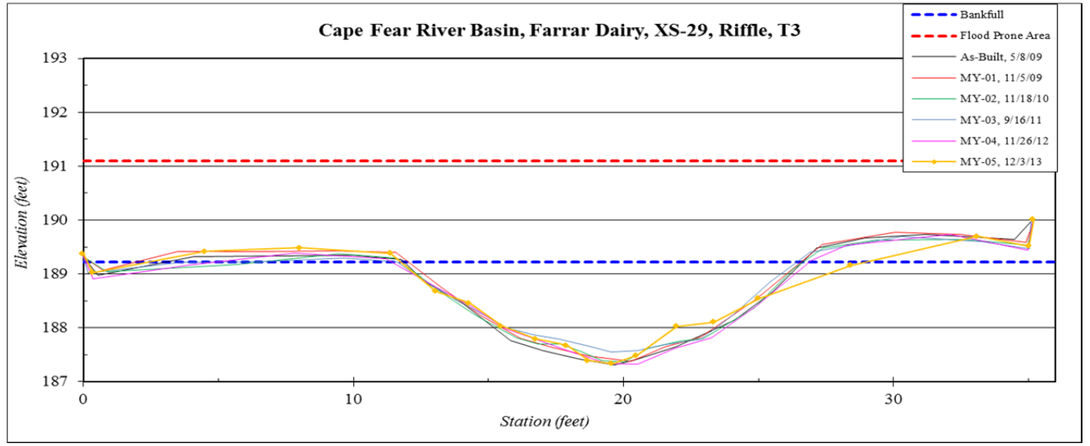

Cape Fear River Basin, Farrar Dairy, XS-21, Riffle, T1
Bankfull
Flood Prone Area
As-Built, 4/28/09
MY-01, 10/28/09
MY-02, 11/22/10
MY-03, 10/26/11
MY-04, 8/13/12
MY-05, 11/25/13
Elevation (feet)
Station (feet)

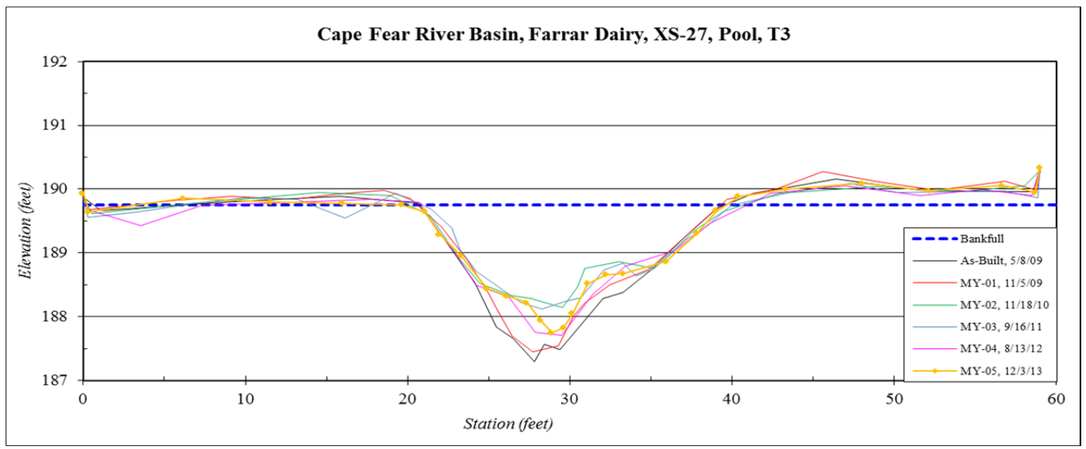

Cape Fear River Basin, Farrar Dairy, XS-24, Pool, T2B
Bankfull
As-Built, 5/8/09
MY-01, 11/2/09
MY-02, 11/17/10
MY-03, 10/4/11
MY-04, 8/13/12
MY-05, 12/2/13
Elevation (feet)
Station (feet)

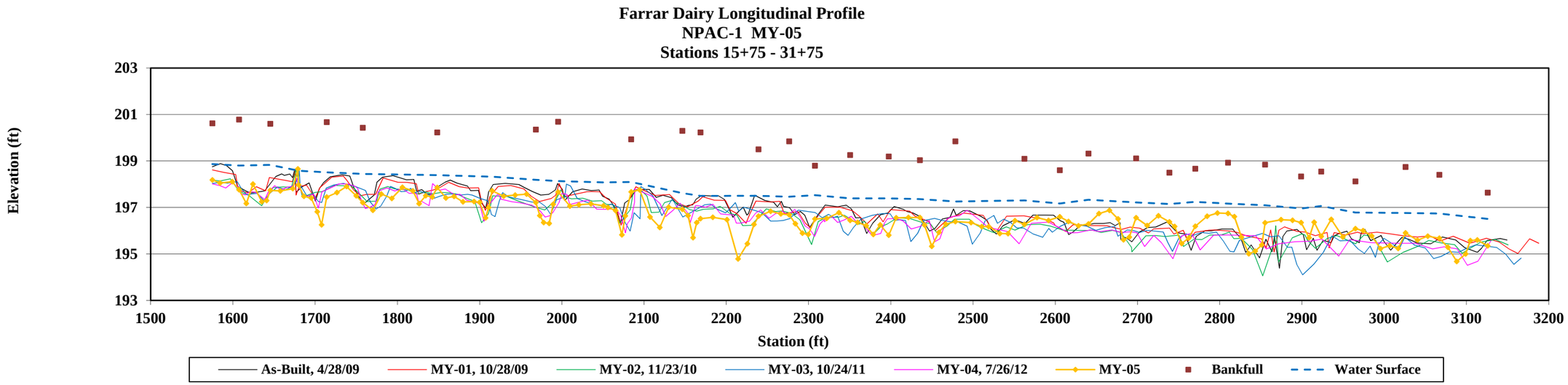

Cape Fear River Basin, Farrar Dairy, XS-25, Riffle, T2B
Elevation (feet)
Station (feet)
Bankfull
Flood Prone Area
As-Built, 5/8/09
MY-01, 11/2/09
MY-02, 11/17/10
MY-03, 10/3/11
MY-04, 8/13/12
MY-05, 12/3/13


Cape Fear River Basin, Farrar Dairy, XS-28, Pool, T3
Elevation (feet)
Station (feet)
Bankfull
As-Built, 5/8/09
MY-01, 11/5/09
MY-02, 11/18/10
MY-03, 9/16/11
MY-04, 11/26/12
MY-05, 12/3/13

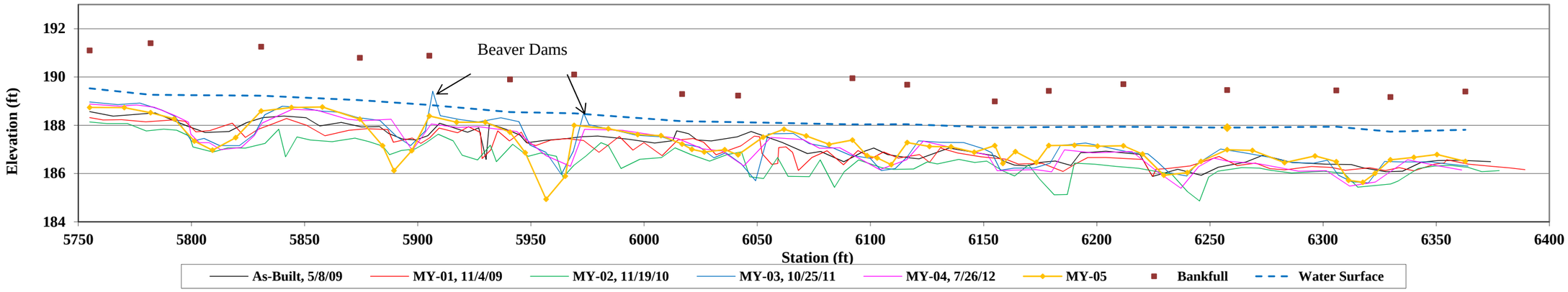

Cape Fear River Basin, Farrar Dairy, XS-26, Riffle, T3
Elevation (feet)
Station (feet)
Bankfull
Flood Prone Area
As-Built, 5/8/09
MY-01, 11/5/09
MY-02, 11/18/10
MY-03, 10/3/11
MY-04, 8/13/12
MY-05, 12/3/13


Cape Fear River Basin, Farrar Dairy, XS-29, Riffle, T3
Elevation (feet)
Station (feet)
Bankfull
Flood Prone Area
As-Built, 5/8/09
MY-01, 11/5/09
MY-02, 11/18/10
MY-03, 9/16/11
MY-04, 11/26/12
MY-05, 12/3/13

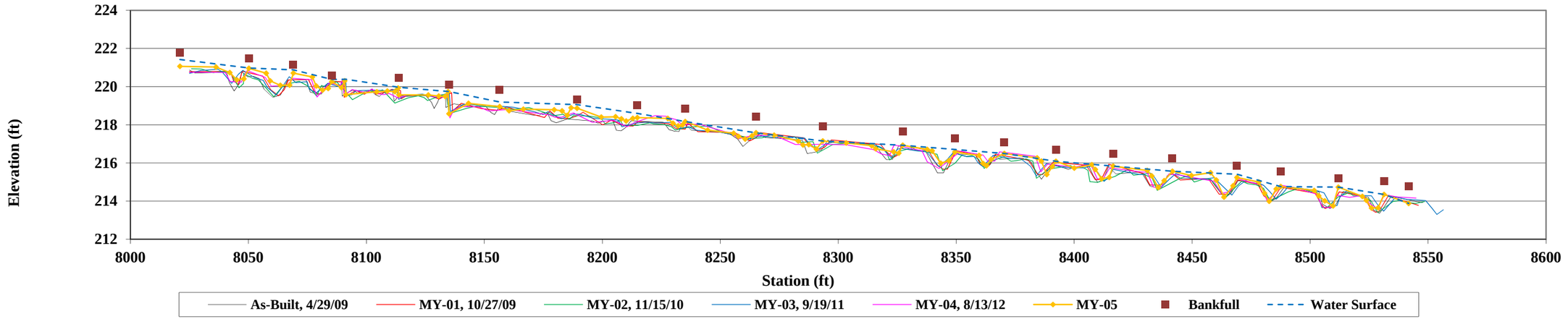

Cape Fear River Basin, Farrar Dairy, XS-27, Pool, T3
Elevation (feet)
Station (feet)
Bankfull
As-Built, 5/8/09
MY-01, 11/5/09
MY-02, 11/18/10
MY-03, 9/16/11
MY-04, 8/13/12
MY-05, 12/3/13



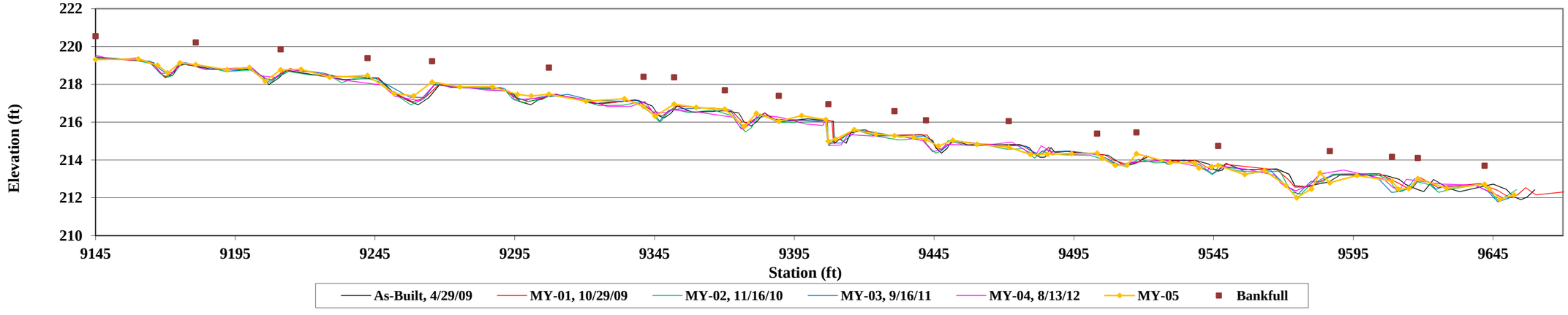
Farrar Dairy Longitudinal Profile



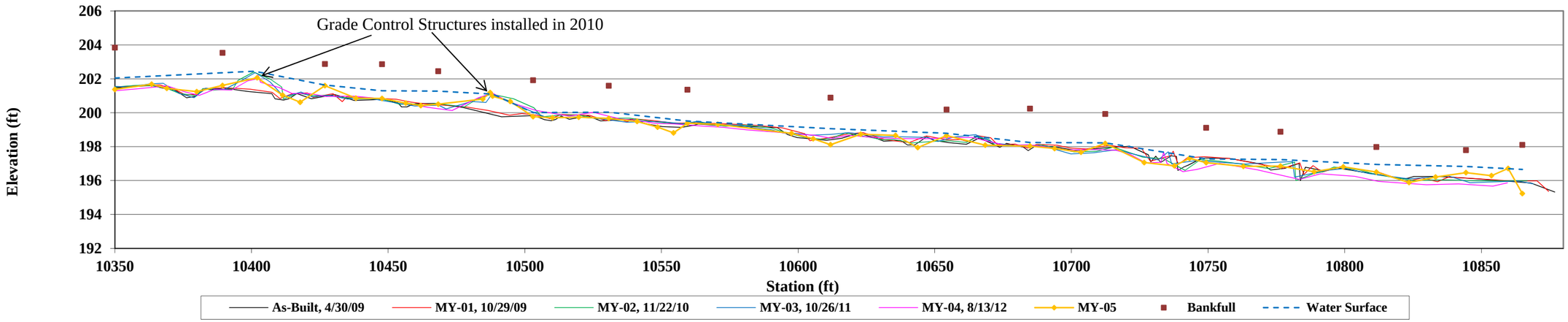
Farrar Dairy Longitudinal Profile
Tributary 1.1 MY-05
Stations 80+25 - 85+75



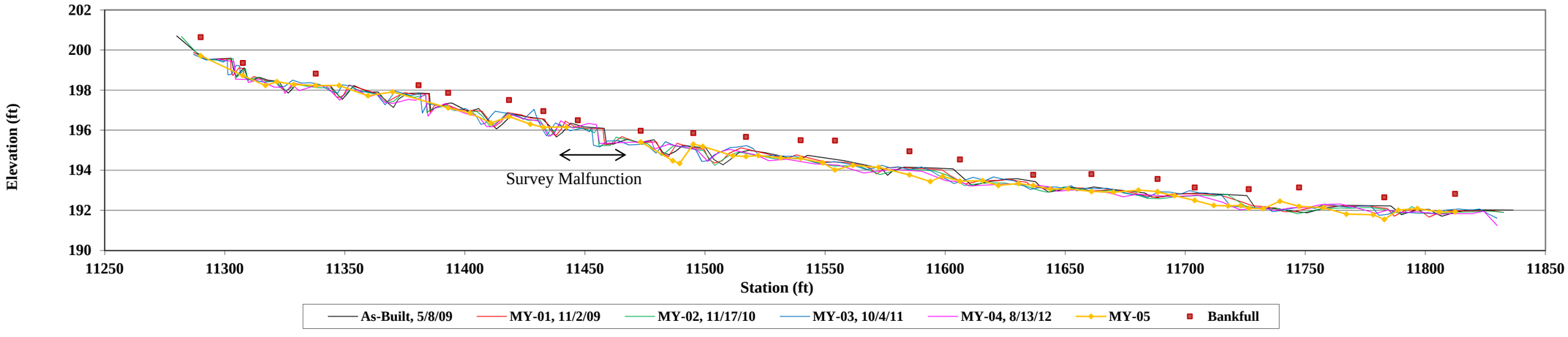
Farrar Dairy Longitudinal Profile
Tributary 1.2 MY-05
Stations 91+45 - 96+70



Farrar Dairy Longitudinal Profile
Tributary 1 MY-05
Stations 103+50 - 108+77



Farrar Dairy Longitudinal Profile
Tributary 2 MY-05
Stations 112+80 - 118+37



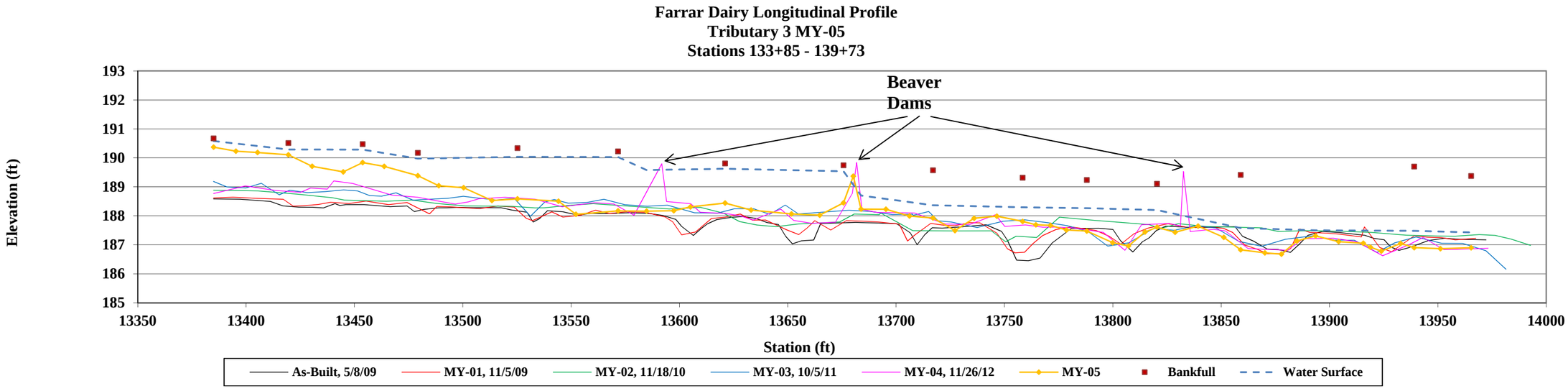

Farrar Dairy Longitudinal Profile
Tributary 3 MY-05
Stations 133+85 - 139+73
Beaver Dams
Elevation (ft)
193
192
191
190
189
188
187
186
185
13350
13400
13450
13500
13550
13600
13650
13700
13750
13800
13850
13900
13950
14000
Station (ft)
As-Built, 5/8/09
MY-01, 11/5/09
MY-02, 11/18/10
MY-03, 10/5/11
MY-04, 11/26/12
MY-05
Bankfull
Water Surface

Table 4a. Morphology and Hydraulic Monitoring Summary
Farrar Dairy Stream and Wetland Restoration Site

Parameter	Cross-Section 1 Riffle						Cross-Section 2 Pool						Cross-Section 3 Pool					
Reach	NPAC 1						NPAC 1						NPAC 1					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	19.6	20.0	18.5	19.2	18.5	18.1	20.9	23.9	24.8	22.3	21.1	23.1	19.6	16.0	16.0	18.9	19.2	17.4
Floodprone Width (ft)	>60	>60	>60	>60	>60	>60	-	-	-	-	-	-	>60	>60	>60	>60	>60	>60
Bankfull Cross-Sectional Area (ft^2)	31.0	31.7	31.6	32.4	31.0	30.2	29.2	28.8	32.9	31.1	31.6	32.9	26.6	19.9	19.9	23.4	24.0	15.7
Bankfull Mean Depth (ft)	1.6	1.6	1.7	1.7	1.7	1.7	1.4	1.2	1.3	1.4	1.5	1.4	1.4	1.2	1.2	1.3	1.2	1.2
Bankfull Max Depth (ft)	2.4	2.7	2.9	3.2	3.2	3.1	3.3	3.2	3.3	3.3	3.5	3.6	2.5	2.0	2.3	2.3	2.3	1.8
Width/Depth Ratio	12.4	12.6	10.8	11.4	11.1	10.8	-	-	-	-	-	-	14.4	12.9	12.9	15.3	15.4	15.4
Entrenchment Ratio	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	-	-	-	-	-	-	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0
Substrate																		
d50 (mm)	0.07	0.06	0.06	0.06	0.13	0.06	0.09	0.14	0.28	0.06	0.43	2.00	0.06	0.18	0.062	0.06	0.07	0.16
d84 (mm)	0.22	0.11	0.11	0.10	0.22	1.60	0.65	0.49	3.70	0.26	3.40	4.90	0.11	0.44	0.09	0.06	0.11	2.80

Table 4b. Morphology and Hydraulic Monitoring Summary continued
Farrar Dairy Stream and Wetland Restoration Site

Parameter	Cross-Section 4 Riffle						Cross-Section 5 Riffle						Cross-Section 6 Riffle					
Reach	NPAC 1						NPAC 1						NPAC 1					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	18.9	18.5	18.6	18.3	19.0	16.1	18.4	18.0	18.0	17.9	19.1	17.2	20.4	18.6	20.4	21.1	20.8	18.7
Floodprone Width (ft)	-	-	-	-	-	-	>60	>60	>60	>60	>60	>60	-	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	24.7	26.7	28.7	24.5	21.3	22.0	26.5	24.6	24.6	26.7	31.5	21.5	26.6	25.1	28.1	27.2	27.8	25.2
Bankfull Mean Depth (ft)	1.3	1.4	1.5	1.3	1.1	1.4	1.4	1.4	1.4	1.5	1.6	1.3	1.3	1.5	1.4	1.3	1.3	1.3
Bankfull Max Depth (ft)	2.8	3.2	3.0	2.7	2.5	3.1	2.3	2.3	2.9	2.7	2.9	2.5	3.0	3.1	3.5	3.3	3.5	3.3
Width/Depth Ratio	-	-	-	-	-	-	12.8	13.1	13.1	12.0	11.6	13.8	-	-	-	-	-	-
Entrenchment Ratio	-	-	-	-	-	-	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	-	-	-	-	-	-
Bank Height Ratio	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-
Substrate																		
d50 (mm)	0.54	0.11	0.10	0.11	0.11	0.11	0.09	0.09	0.21	0.20	0.09	0.09	0.12	0.07	0.073	0.06	0.13	0.08
d84 (mm)	0.82	0.40	0.34	0.36	0.33	0.33	0.37	0.38	0.38	0.37	0.23	0.23	0.29	0.26	0.14	0.06	0.27	0.21

Table 4c. Morphology and Hydraulic Monitoring Summary continued
Farrar Dairy Stream and Wetland Restoration Site

Parameter	Cross-Section 7 Riffle						Cross-Section 8 Riffle						Cross-Section 9 Riffle					
Reach	NPAC 1						NPAC 2						NPAC 2					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	20.7	20.0	20.9	20.3	20.6	19.9	19.5	18.9	19.2	21.2	20.7	21.6	22.9	22.2	24.7	23.3	23.2	21.4
Floodprone Width (ft)	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	-	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	32.2	30.7	33.6	33.5	32.5	29.9	35.9	35.0	36.0	28.0	29.9	28.0	36.0	34.3	36.7	31.9	34.6	32.5
Bankfull Mean Depth (ft)	1.6	1.5	1.6	1.7	1.6	1.5	1.8	1.9	1.9	1.3	1.4	1.3	1.6	1.5	1.5	1.4	1.5	1.5
Bankfull Max Depth (ft)	2.7	2.9	3.2	3.4	3.2	3.4	3.4	3.6	3.9	2.7	2.9	2.8	3.4	3.2	4.2	3.6	3.7	3.9
Width/Depth Ratio	13.3	13.0	13.0	12.3	13.1	13.7	10.6	10.2	10.2	16.1	14.3	16.7	-	-	-	-	-	-
Entrenchment Ratio	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	-	-	-	-	-	-
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-
Substrate																		
d50 (mm)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	57	35	27	0.11	0.29	0.17	1.20	0.19	0.22
d84 (mm)	0.10	0.10	0.06	0.06	0.06	0.06	0.07	0.10	0.09	110	69	53	0.66	0.69	0.23	1.80	0.44	0.45

* In 2011, a constructed riffle was installed at XS8 due to stream maintenance issues.

Table 4d. Morphology and Hydraulic Monitoring Summary continued
Farrar Dairy Stream and Wetland Restoration Site

Parameter	Cross-Section 10 Pool						Cross-Section 11 Riffle						Cross-Section 12 Riffle					
Reach	NPAC 2						NPAC 3						NPAC 3					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	22.6	21.0	20.2	19.7	19.3	19.3	24.2	21.6	23.9	23.9	24.3	20.8	22.3	21.0	22.8	22.7	22.6	23.4
Floodprone Width (ft)	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	-	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	35.8	34.0	31.3	28.0	29.9	26.9	55.8	53.1	59.8	54.9	60.4	56.7	42.0	38.0	50.9	49.0	49.9	55.2
Bankfull Mean Depth (ft)	1.6	1.6	1.5	1.4	1.6	1.4	2.3	2.2	2.5	2.3	2.5	2.7	1.9	1.8	2.2	2.2	2.2	2.4
Bankfull Max Depth (ft)	2.7	2.8	2.7	2.6	2.7	2.2	3.6	3.5	4.0	3.6	4.2	4.2	3.2	3.5	4.5	4.4	4.6	5.8
Width/Depth Ratio	14.3	13.0	13.0	13.9	12.4	12.4	10.5	8.7	9.6	10.4	9.8	7.6	-	-	-	-	-	-
Entrenchment Ratio	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	-	-	-	-	-	-
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-
Substrate																		
d50 (mm)	0.06	0.49	0.35	0.32	0.22	0.20	0.71	0.29	0.15	0.07	0.06	0.15	1.40	0.23	0.09	0.08	0.35	0.32
d84 (mm)	3.10	9.60	18.0	8.90	0.39	0.39	0.90	0.44	0.21	0.12	0.62	3.00	3.00	0.40	0.11	0.11	0.45	0.43

Table 4e. Morphology and Hydraulic Monitoring Summary continued
Farrar Dairy Stream and Wetland Restoration Site

Parameter	Cross-Section 13 Riffle						Cross-Section 14 Riffle						Cross-Section 15 Pool					
Reach	T1.1						T1.1						T1.1					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	6.9	8.0	7.2	7.4	7.7	6.5	7.1	6.9	7.3	7.6	7.6	7.5	5.9	5.8	6.5	6.0	6.5	5.6
Floodprone Width (ft)	16	16	16	16	16	16	-	-	-	-	-	-	29	30	30	30	30	30
Bankfull Cross-Sectional Area (ft^2)	2.4	2.8	2.8	2.8	2.7	1.7	5.1	5.2	5.5	5.4	5.4	5.5	2.3	2.5	2.2	2.1	2.8	2.0
Bankfull Mean Depth (ft)	0.3	0.4	0.4	0.4	0.4	0.3	0.7	0.7	0.8	0.7	0.7	0.7	0.4	0.4	0.3	0.4	0.4	0.4
Bankfull Max Depth (ft)	0.7	0.7	0.8	0.7	0.8	0.5	1.3	1.3	1.5	1.3	1.5	1.2	0.6	0.7	0.6	0.6	0.7	0.6
Width/Depth Ratio	19.8	22.9	18.5	19.6	21.9	24.9	-	-	-	-	-	-	15.1	13.2	13.2	17.1	15.2	15.7
Entrenchment Ratio	2.3	2.0	2.2	2.2	2.1	2.3	-	-	-	-	-	-	4.9	5.2	5.2	5.1	4.6	3.2
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-	1.0	1.0	1.1	1.1	1.0	1.0
Substrate																		
d50 (mm)	0.06	0.06	0.06	0.06	0.06	0.21	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	1.50
d84 (mm)	0.07	0.06	0.06	0.06	0.50	0.87	0.06	37.00	0.06	0.06	0.06	0.06	0.09	11.00	0.48	0.50	13.00	6.50

Table 4f. Morphology and Hydraulic Monitoring Summary continued
Farrar Dairy Stream and Wetland Restoration Site

Parameter	Cross-Section 16 Riffle						Cross-Section 17 Riffle						Cross-Section 18 Pool					
Reach	T1.2						T1.2						T1.2					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	8.9	9.2	9.3	9.0	8.8	8	8.3	8.5	8.5	8.2	8.7	7.5	6.9	6.9	7.0	6.9	6.7	6.6
Floodprone Width (ft)	-	-	-	-	-	-	46	46	46	46	46	46	26	26	26	26	26	26
Bankfull Cross-Sectional Area (ft^2)	6.4	6.8	6.8	6.4	6.4	5.6	5.7	5.8	5.7	5.4	5.7	4.9	5.2	5.1	5.6	5.1	4.6	5.1
Bankfull Mean Depth (ft)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.7	0.8	0.7	0.7	0.8
Bankfull Max Depth (ft)	1.6	1.4	1.5	1.4	1.3	1.2	1.2	1.2	1.3	1.1	1.2	1.0	1.2	1.2	1.3	1.2	1.2	1.5
Width/Depth Ratio	-	-	-	-	-	-	12.1	12.5	12.7	12.5	11.6	11.5	9.2	9.3	8.8	9.3	9.8	8.5
Entrenchment Ratio	-	-	-	-	-	-	5.5	5.4	5.4	5.6	5.7	5.2	3.8	3.8	3.7	3.8	3.5	4.7
Bank Height Ratio	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Substrate																		
d50 (mm)	0.31	0.12	0.30	0.31	0.13	0.10	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.25	0.28	0.26	0.79	0.30
d84 (mm)	0.48	0.35	0.42	0.43	2.00	0.23	0.08	44.00	0.42	0.37	1.40	0.69	0.10	0.65	0.42	0.41	3.40	1.30

Table 4e. Morphology and Hydraulic Monitoring Summary continued
Farrar Dairy Stream and Wetland Restoration Site

Parameter	Cross-Section 19 Riffle						Cross-Section 20 Riffle						Cross-Section 21 Pool					
Reach	T1						T1						T1					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	9.5	10.5	9.3	10.6	10.6	10.9	10.3	9.1	8.9	8.9	12.1	9.4	8.6	10.1	10.1	13.5	14.1	11.8
Floodprone Width (ft)	-	-	-	-	-	-	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
Bankfull Cross-Sectional Area (ft^2)	10.9	12.0	10.8	11.7	10.3	12.5	9.7	8.3	8.5	8.1	10.2	10.1	8.2	9.9	10.3	11.3	11.1	7.5
Bankfull Mean Depth (ft)	1.1	1.1	1.2	0.9	1.0	1.1	0.9	0.9	1.0	0.9	0.8	0.8	1.0	1.0	1.0	0.8	0.8	0.6
Bankfull Max Depth (ft)	2.4	2.5	2.3	2.1	1.8	2.3	1.9	1.8	1.9	1.8	2.0	2	1.7	1.8	1.8	1.6	1.8	1.7
Width/Depth Ratio	-	-	-	-	-	-	10.9	10.1	12.0	9.8	15.1	11.8	9.0	10.3	9.9	16.1	17.9	18.6
Entrenchment Ratio	-	-	-	-	-	-	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>30	>30	>30	>30	>30
Bank Height Ratio	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Substrate																		
d50 (mm)	0.06	0.06	0.33	0.33	0.26	0.36	0.062	0.06	0.06	0.06	0.16	1.20	0.53	0.06	0.3	0.06	0.062	0.52
d84 (mm)	0.12	0.06	0.44	0.44	0.44	1.20	0.10	0.06	0.33	0.06	2.40	5.40	2.0	7.3	0.44	0.21	1.10	1.10

Table 4f. Morphology and Hydraulic Monitoring Summary continued
Farrar Dairy Stream and Wetland Restoration Site

Parameter	Cross-Section 22 Riffle						Cross-Section 23 Riffle						Cross-Section 24 Pool					
Reach	T2						T2						T2					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	7.5	7.5	8.9	8.5	8.4	8.1	5.7	5.9	6.0	6.8	6.8	6.5	7.1	6.5	7.7	6.9	9.0	6.5
Floodprone Width (ft)	-	-	-	-	-	-	30	31	31	31	30	30	-	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	5.1	5.0	5.5	5.6	5.8	5.5	2.8	2.8	2.9	3.4	2.5	2.5	4.2	3.9	4.5	4.1	4.7	3.2
Bankfull Mean Depth (ft)	0.7	0.7	0.6	0.7	0.7	0.7	0.5	0.5	0.5	0.5	0.4	0.4	0.6	0.6	0.6	0.6	0.5	0.5
Bankfull Max Depth (ft)	1.1	1.1	1.1	1.1	1.2	1.3	0.8	0.8	0.8	0.9	0.8	0.8	1.1	1.0	1.1	1.0	0.9	0.9
Width/Depth Ratio	-	-	-	-	-	-	11.6	12.8	13.2	13.6	18.4	16.9	-	-	-	-	-	-
Entrenchment Ratio	-	-	-	-	-	-	5.3	5.2	4.0	4.4	4.4	4.2	-	-	-	-	-	-
Bank Height Ratio	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	-	-
Substrate																		
d50 (mm)	0.06	0.06	0.06	0.06	0.16	0.15	0.06	0.06	0.06	0.06	0.82	11	0.06	0.06	0.06	0.06	0.06	0.06
d84 (mm)	0.06	0.06	0.06	0.06	0.22	0.21	16	52	0.19	17.0	25.0	49	0.06	0.06	0.06	0.06	0.06	0.06

Table 4e. Morphology and Hydraulic Monitoring Summary continued
Farrar Dairy Stream and Wetland Restoration Site

Parameter	Cross-Section 25 Riffle						Cross-Section 26 Riffle						Cross-Section 27 Pool					
Reach	T2						T3						T3					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	5.2	5.6	6.7	5.9	8.4	6.4	18.4	17.6	17.6	17.9	17.9	8.3	19.2	18.9	21.2	19.1	20.1	19.9
Floodprone Width (ft)	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60	-	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	2.5	2.7	2.9	2.7	3.2	2.7	21.4	20.1	15.8	14.7	15.8	1.5	24.2	22.1	18.3	17.9	20.5	19.5
Bankfull Mean Depth (ft)	0.5	0.5	0.4	0.5	0.4	0.4	1.2	1.1	0.9	0.8	0.9	0.4	1.3	1.2	0.9	0.9	1.0	1.0
Bankfull Max Depth (ft)	0.8	0.8	0.8	0.8	1.0	0.8	1.9	1.8	1.3	1.3	1.5	0.2	2.5	2.3	1.6	1.6	2.0	2.0
Width/Depth Ratio	10.8	11.7	15.5	12.9	22.1	15.2	15.8	15.5	19.6	21.8	20.3	45.9	-	-	-	-	-	-
Entrenchment Ratio	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0	-	-	-	-	-	-
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.4	-	-	-	-	-	-
Substrate																		
d50 (mm)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.09	0.14	0.06	0.06	0.37	0.06	0.06	0.07	0.06	0.30	0.16
d84 (mm)	0.06	0.06	0.06	0.06	0.06	0.06	0.09	0.18	0.21	0.10	0.10	0.82	0.10	0.08	0.10	0.09	1.00	0.23

Table 4f. Morphology and Hydraulic Monitoring Summary continued
Farrar Dairy Stream and Wetland Restoration Site

Parameter	Cross-Section 28 Riffle						Cross-Section 29 Riffle					
Reach	T3						T3					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	23.3	23.3	23.5	23.8	23.8	23.2	14.9	15.4	15.3	14.8	15.5	17.2
Floodprone Width (ft)	-	-	-	-	-	-	>60	>60	>60	>60	>60	>60
Bankfull Cross-Sectional Area (ft^2)	29.1	29.4	22.5	21.9	24.7	21.6	18.4	19.4	18.2	15.9	17.6	16.8
Bankfull Mean Depth (ft)	1.2	1.3	1.0	0.9	1.0	0.5	1.2	1.3	1.2	1.1	1.1	1.1
Bankfull Max Depth (ft)	2.6	2.7	1.4	1.4	1.7	0.9	1.9	2.0	1.9	1.7	1.9	1.9
Width/Depth Ratio	-	-	-	-	-	-	12.1	12.2	12.9	13.8	13.7	17.6
Entrenchment Ratio	-	-	-	-	-	-	>3.0	>3.0	>3.0	>3.0	>3.0	>3.0
Bank Height Ratio	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0
Substrate						-						
d50 (mm)	0.06	0.06	0.08	0.07	0.07	0.09	0.06	0.06	0.06	0.06	0.06	2.3
d84 (mm)	0.06	0.06	0.11	0.10	0.10	0.15	0.06	0.06	0.46	0.08	0.19	5.7

Table 5. Wetland Hydrology Criteria Attainment Table
Farrar Dairy Stream and Wetland Restoration Site

Gauge	Success Criteria Achieved / Max Consecutive Days During Growing Season (Percentage)				
	Year 1 (2009)	**Year 2 (2010)**	**Year 3 (2011)**	**Year 4 (2012)**	**Year 5 (2013)**
Well 1	Yes/41 (16.3%)	Yes/33 (13.1%)	Yes/60 (23.9%)	Yes/59 (23.5%)	Yes/45 (17.9%)
Well 2	Yes/28 (11.2%)	Yes/10 (4.0%)	Yes/148 (59.0%)	Yes/41 (16.3%)	Yes/32 (12.7%)
Well 3	Yes/25 (10.0%)	Yes/28 (11.2%)	Yes/14 (5.6%)	Yes/20 (8.0%)	Yes/31 (12.4%)
Well 4	Yes/25 (10.0%)	No/8 (3.2%)	Yes/15 (6.0%)	Yes/19 (7.6%)	Yes/44 (17.3%)
Well 5	Yes/30 (12.0%)	Yes/33 (13.1%)	Yes/52 (20.7%)	Yes/100 (39.8%)	Yes/64 (25.5%)
Well 6	Yes/20 (8.8%)	Yes/39 (15.5%)	No/0 (0%)	No/0 (0%)	Yes/57 (22.5%)
Well 7	Yes/44 (17.5%)	Yes/39 (15.5%)	Yes/19 (7.6%)	Yes/16 (6.4%)	Yes/17 (6.8%)
Well 8 Installed 6-4-13					Yes/31 (12.4%)
Well 9 Installed 6-4-13					Yes/47 (18.7%)
Well 10 Installed 6-4-13					Yes/13 (5.0%)
Well 11 Installed 6-4-13					No/4 (1.4%)
Well 12 Installed 8-20-13					No/0 (4.3%)
Well Reference	Yes/111 (42.2%)	Yes/63 (25.1%)	Yes/251 (100.0%)	Yes/46 (18.3%)	Yes/105 (41.8%)

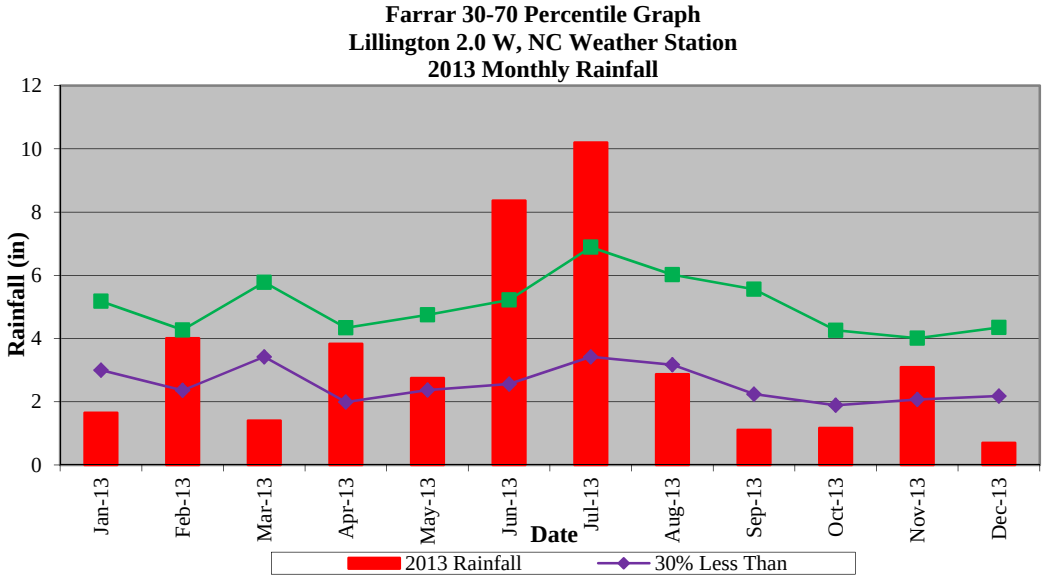


Table 6. Hydrological (Bankfull) Verifications Farrar Dairy Stream and Wetland Restoration Site				
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo Number**	**Rainfall Event**
3/5/2010	1/21/2010	automated stream gauge	N/A	1.84"
3/5/2010	2/6/2010	automated stream gauge	N/A	1.79"
3/21/2012	3/21/2012	N/A	N/A	2.10"
8/28/2012	8/28/2012	N/A	N/A	2.52"
8/20/2013	6/7/2013	automated stream gauge	N/A	1.83"
8/20/2013	6/8/2013	automated stream gauge	N/A	2.78"
8/20/2013	7/11/2013	automated stream gauge	N/A	2.33"
8/20/2013	7/12/2013	automated stream gauge	N/A	2.38"

Due to the frequent beaver activity throughout the site, many parts of the site have had extended periods of backwater. Combined with large precipitation events, there have been instances (at least two in 2012) where flows have gone out of the bankfull channel in 2012, but it is difficult to determine if these events are true bankfull events. From examining precipitation data in 2010 and the corresponding bankfull events, it is likely that the 2.10” rain event on March 21, 2012 and 2.52" rain event on August 28, 2012 produced bankfull events.

Table 7a. Riparian Buffer Vegetation History (stems/acre)
Farrar Dairy Stream and Wetland Restoration Site

Plot Number	MY-00	MY-01	MY-02		MY-03		MY-04		MY-05	
	Planted	Planted	Planted	Total	Planted	Total	Planted	Total	Planted	Total
1	880	840	840	840	720	1,578	648	2,065	728	2,064
2	720	560	520	1000	486	1,133	486	1,134	486	931
3	320	400*	440	5,720	243	2,226	202	3,117	202	7,608
4	840	400	520	3,960	445	1,983	405	2,024	324	2,590
5	760	640	680	2,240	567	890	567	1,457	526	1,295
6	560	440	440	480	445	445	445	972	769	1,255
7	840	720	680	840	688	1,174	688	1,296	688	1,255
8	560	560	560	560	526	607	526	688	647	1,052
9	600	600	600	600	567	647	324	324	324	567
10	520	520	480	560	486	567	486	931	486	931
11	680	360	240	440	202	1,214	202	1,012	202	1,740
12	520	240	320	320	324	364	324	445	324	445
13	720	480	480	600	486	1,295	486	1,660	486	1,942
14	520	480	480	680	486	769	445	1,498	445	2,630
15	560	520	520	520	526	607	526	850	647	850

*Uncounted stems from previous year added to total

Table 7b. Wetland Vegetation History (stems/acre)
Farrar Dairy Stream and Wetland Restoration Site

Plot Number	MY-00	MY-01	MY-02		MY-03		MY-04		MY-05	
	Planted	Planted	Planted	Total	Planted	Total	Planted	Total	Planted	Total
16	400	400	360	400	364	890	364	1,134	364	1,214
17	560	520	520	520	526	809	486	1,215	486	1,052
18	400	400	400	480	405	890	405	1,174	405	1,214
19	1,000	960	920	1,040	971	1,012	931	1,053	931	1,052
20	520	520	480	480	526	1,012	526	1,377	526	1,700
21	520	480	480	6,080	486	4,168	324	2,996	162	3,521
22	840	840	880	6,280	850	8,134	769	8,016	567	9,105
23	920	800	760	3,320	769	5,949	688	5,466	647	5,261
24	520	480	400	480	405	567	324	850	324	1,133
25	440	440	440	680	445	890	364	850	364	1,012
26	520	520	520	560	526	668	526	1,255	486	688
27	480	480	480	920	405	647	202	486	202	688
28	480	400	400	800	364	688	364	1,296	567	971
29	520	560	440	920	405	850	405	1,215	567	1,497
30	440	440	440	480	445	931	445	1,093	445	971
31	440	400	360	480	364	526	364	688	243	364
32	400	400	400	400	243	364	243	607	243	647
33	440	400	400	400	405	486	405	688	445	1,538
34	480	360	320	360	283	324	283	405	283	364
35	400	360	280	320	283	324	283	405	243	526
36	640	640	640	640	607	607	648	729	647	728
37	480	440	400	560	405	567	405	1,296	324	850
38	520	280	280	280	162	283	162	526	121	486
39	520	440	440	440	364	486	364	729	445	850
40	600	600	560	600	567	607	567	607	526	607
41	600	440	440	440	445	526	445	526	567	1,052
42	680	560	560	560	567	567	567	1255	607	2,307
43	480	400	400	400	405	688	324	607	283	607
44	560	400	480	480	445	445	405	972	647	931
45	480	320	120	160	81	81	81	648	405	769

4.0 EEP RECOMMENDATIONS AND CONCLUSIONS

The stream is functioning as designed and has not developed any significant problems. The monitored cross-sections and profiles indicate some changes over the course of monitoring, but the stream in these areas is not trending towards instability.

During the fifth year of monitoring wetland hydrology was achieved at ten of the twelve monitoring wells on the site. The two gauges (Gauges 11 and 12) that did not demonstrate wetland hydrology in 2013 were installed in June and August 2013, which is after the time period that most of the gauges meet the hydrology success criteria, in the early part of the growing season. The precipitation data show that 2013 was an average year for rainfall. The months of February, April, May, and November experienced average rainfall. Rainfall was less than average in January, March, May, August, September, October, and December, while June and July experienced above average rainfall.

With multiple bankfull events since construction, the stream has met the success criterion of at least two bankfull events occurring in separate years over the course of the monitoring period. The two stream gauges recorded four bankfull events for 2013.

The monitored vegetation plots within the stream buffer and wetland revealed that the planted vegetation is growing well with 486 and 436 stems/acre, respectively. The planted vegetation has been doing well, with some plots experiencing more mortality than others. This mortality can be attributed to normal losses after the initial planting as well as aggressive growth from the site's herbaceous vegetation. The site also has vigorous volunteers, which will increase the overall vegetation success of the site.

Overall the stream and the site's vegetation condition indicate that it is on a path to success. The EEP recommends that this site be closed out.

5.0 CONTINGENCIES

None

Pre-Construction Photos (2006)

Tributary 2

Post-Construction Photos MY-05

PP2 – MY05 – 12/11/13

PP3 – MY05 – 12/11/13

PP4 – MY05 – 12/11/13

PP20 – MY05 – 12/11/13

PP22 – MY05 – 12/11/13

PP8 – MY05 – 1/9/14

PP13 – MY05 – 1/9/14

PP18 – MY05 – 1/9/14

PP27 – MY05 – 1/9/14

PP30 – MY05 – 1/9/14

PP32 – MY05 – 1/9/14

Appendix A
Watershed Planning Summary

Appendix B
Land Ownership and Protection

Appendix C
NCDWQ 401/USACE Section 404

Michael F. Easley, Governor

William G. Ross Jr., Secretary
North Carolina Department of Environment and Natural Resources

Coleen H. Sullins, Director
Division of Water Quality

July 23, 2008

DWQ Project # 08-0994
Harnett County

Mr. Alex French
KCI Technologies, Inc.
4601 Six Forks Road, Suite 220
Raleigh, NC 27609

Subject Property: **Farrar Dairy**
North Prong of Anderson Creek [030614, 18-23-32, C]

Approval of 401 Water Quality Certification with Additional Conditions

Dear Mr. French:

You have our approval, in accordanee with the attached eonditions and those listed below, to place fill within or otherwise impact 28.65 acres of 404/wetland, 10,545 linear feet of perennial stream, and 0.62 acres of open water (pond) as described in your application dated June 20, 2008, and received by the Division of Water Quality (DWQ) on June 20, 2008, to conduct a wetland and stream restoration at the site. After reviewing your application, we have decided that the impacts are covered by General Water Quality Certification Number(s) 3689 (GC3689). The Certification(s) allows you to use Nationwide Permit(s) 27 (NW27) when issued by the US Army Corps of Engineers (USACE). In addition, you should obtain or otherwise comply with any other required federal, state or local permits before you go ahead with your project including (but not limited to) Erosion and Sediment Control, and Non-discharge regulations. **Also, this approval to proceed with your proposed impacts or to conduct impacts to waters as depicted in your application shall expire upon expiration of the 404 or CAMA Permit.**

This approval is for the purpose and design that you described in your application. If you change your project, you must notify us and you may be required to send us a new application. If the property is sold, the new owner must be given a copy of this Certification and approval letter and is thereby responsible for complying with all conditions. If total fills for this project (now or in the future) exceed one acre of wetland or 150 linear feet of stream, compensatory mitigation may be required as described in 15A NCAC 2H .0506 (h). **This approval requires you to follow the conditions listed in the attached certification and any additional conditions listed below.**

The Additional Conditions of the Certification are:

1. Impacts Approved

   The following impacts are hereby approved as long as all of the other specific and general conditions of this Certification (or Isolated Wetland Permit) are met. No other impacts are approved including incidental impacts:

Type of Impact	Amount Approved (Units)	Plan Location or Reference
404/Wetland	28.65 (acres)	PCN page 8 of 13
Stream - perennial	10,545 (linear feet)	PCN page 9 of 13
Open Water (pond)	0.62 (acres)	PCN page 9 of 13

2. No Waste, Spoil, Solids, or Fill of Any Kind

   No waste, spoil, solids, or fill of any kind shall occur in wetlands, waters, or riparian areas beyond the footprint of the impacts depicted in the Pre-Construction Notification. All construction activities, including the design, installation, operation, and maintenance of sediment and erosion control Best Management Practices, shall be performed so that no violations of state water quality standards, statutes, or rules occur.

3. Erosion and sediment control practices must be in full compliance with all specifications governing the proper design, installation and operation and maintenance of such Best Management Practices in order to protect surface waters standards:

   a. The erosion and sediment control measures for the project must be designed, installed, operated, and maintained in accordance with the most recent version of the *North Carolina Sediment and Erosion Control Planning and Design Manual.*
   b. The design, installation, operation, and maintenance of the sediment and erosion control measures must be such that they equal, or exceed, the requirements specified in the most recent version of the *North Carolina Sediment and Erosion Control Manual.* The devices shall be maintained on all construction sites, borrow sites, and waste pile (spoil) projects, including contractor-owned or leased borrow pits associated with the project.
   c. Sufficient materials required for stabilization and/or repair of erosion control measures and stormwater routing and treatment shall be on site at all times.

4. Sediment and Erosion Control Measures

   Sediment and erosion control measures shall not be placed in wetlands or waters to the maximum extent practicable. If placement of sediment and erosion control devices in wetlands and waters is unavoidable, they shall be removed and the natural grade restored within six months of the date that the Division of Land Resources has released the project;

5. Protective Fencing

   The outside buffer, wetland or water boundary and along the construction corridor within these boundaries approved under this authorization shall be clearly marked with orange warning fencing (or similar high visibility material) for the areas that have been approved to infringe within the buffer, wetland or water prior to any land disturbing activities;

6. Certificate of Completion

   Upon completion of all work approved within the 401 Water Quality Certification or applicable Buffer Rules, and any subsequent modifications, the applicant is required to return the attached certificate of completion to the 401 Oversight/Express Review Permitting Unit, North Carolina Division of Water Quality, 1650 Mail Service Center, Raleigh, NC, 27699-1650.

Violations of any condition herein set forth may result in revocation of this Certification and may result in criminal and/or civil penalties. The authorization to proceed with your proposed impacts or to conduct impacts to waters as depicted in your application and as authorized by this Certification shall expire upon expiration of the 404 or CAMA Permit.

If you do not accept any of the conditions of this Certification (associated with the approved wetland or stream impacts), you may ask for an adjudicatory hearing. You must act within 60 days of the date that

you receive this letter. To ask for a hearing, send a written petition, which conforms to Chapter 150B of the North Carolina General Statutes to the Office of Administrative Hearings, 6714 Mail Service Center, Raleigh, N.C. 27699-6714. This certification and its conditions are final and binding unless you ask for a hearing.

Any disputes over determinations regarding this Authorization Certificate (associated with the approved buffer impacts) shall be referred in writing to the Director for a decision. The Director's decision is subject to review as provided in Articles 3 and 4 of G.S. 150B.

This letter completes the review of the Division of Water Quality under Section 401 of the Clean Water Act. If you have any questions, please telephone Cyndi Karoly or Ian McMillan at 919-733-1786.

Sincerely,

Coleen H. Sullins

CHS/*ijm*

Enclosures: GC3689
Certificate of Completion

cc: USACE Wilmington Regulatory Field Office
Ken Averitte, DWQ Fayetteville Regional Office
DLR Fayetteville Regional Office
File Copy
Central Files

Filename: 080994FarrarDairy(Harnett)401

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action Id. **2006-40970** County: **Harnett** U.S.G.S. Quad: **Anderson Creek**

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Applicant/Property Owner: **Mr. Steve Stokes**
KCI Associates of NC
Address: **Landmark Building II, Suite 220**
4601 Six Forks Road
Raleigh, NC 27609

Phone Number: **919-783-9214**
Property description:

Size (acres)	**176**	Nearest Town	**Lillington**
Nearest Waterway	**North Prong Anderson Creek**	River Basin	**Cape Fear**
USGS HUC	**030300040513**	Coordinates	**N 35.29891 W -78.93111**

Location description: **The property is adjacent to North Prong Anderson Creek and is located south of Farrar Dairy Road, east of Powell Farm Road, north of Lemuel Black Road, west of NC Highway 210, southwest of Lillington, Harnett, North Carolina.**

Indicate Which of the Following Apply:

_ Based on preliminary information, there may be wetlands on the above described property. We strongly suggest you have this property inspected to determine the extent of Department of the Army (DA) jurisdiction. To be considered final, a jurisdictional determination must be verified by the Corps. This preliminary determination is not an appealable action under the Regulatory Program Administrative Appeal Process (Reference 33 CFR Part 331).

_ There are Navigable Waters of the United States within the above described property subject to the permit requirements of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

X **There are waters of the U.S. including wetlands on the above described property subject to the permit requirements of Section 404 of the Clean Water Act (CWA)(33 USC § 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.**

We strongly suggest you have the waters of the U.S. on your property delineated. Due to the size of your property and/or our present workload, the Corps may not be able to accomplish this wetland delineation in a timely manner. For a more timely delineation, you may wish to obtain a consultant. To be considered final, any delineation must be verified by the Corps.

_ The waters of the U.S. on your property have been delineated and the delineation has been verified by the Corps. We strongly suggest you have this delineation surveyed. Upon completion, this survey should be reviewed and verified by the Corps. Once verified, this survey will provide an accurate depiction of all areas subject to CWA jurisdiction on your property which, provided there is no change in the law or our published regulations, may be relied upon for a period not to exceed five years.

X The waters of the U.S. including wetlands have been delineated and surveyed and are accurately depicted on the plat signed by the Corps Regulatory Official identified below on August 20, 2007. Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ There are no waters of the U.S., to include wetlands, present on the above described property which are subject to the permit requirements of Section 404 of the Clean Water Act (33 USC 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

Action ID: SAW-2007-01723

_ The property is located in one of the 20 Coastal Counties subject to regulation under the Coastal Area Management Act (CAMA). You should contact the Division of Coastal Management in Wilmington, NC at (910) 796-7215 to determine their requirements.

Placement of dredged or fill material within waters of the US and/or wetlands without a Department of the Army permit may constitute a violation of Section 301 of the Clean Water Act (33 USC § 1311). If you have any questions regarding this determination and/or the Corps regulatory program, please contact **Ronnie Smith** at **(910) 251-4829**

Basis For Determination: **This site exhibits wetland criteria as described in the 1987 Corps Wetland Delineation Manual and is adjacent to North Prong Anderson Creek, a tributary of Anderson Creek, a tributary of the Little River, a tributary of the Cape Fear River, which is a navigable water of the U.S.**

Remarks: **This determination is based on information provided by KCI Associates of NC and a site visit conducted on September 27, 2006 by Ronnie Smith.**

Corps Regulatory Official: **Ronnie Smith**

Date: **August 20, 2007** Expiration Date: **August 20, 2012**

Corps Regulatory Official (Initial): **RDS**

FOR OFFICE USE ONLY:

- A plat or sketch of the property and the wetland data form must be attached to the file copy of this form.
- A copy of the "Notification Of Administrative Appeal Options And Process And Request For Appeal" form must be transmitted with the property owner/agent copy of this form.
- If the property contains isolated wetlands/waters, please indicate in "Remarks" section and attach the "Isolated Determination Information Sheet" to the file copy of this form.

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: **KCI Associates of NC**	File Number: **2006-40970**	Date: **August 27, 2007**

Attached is: signed plat		See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A
	PROFFERED PERMIT (Standard Permit or Letter of permission)	B
	PERMIT DENIAL	C
X	APPROVED JURISDICTIONAL DETERMINATION	D
	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/inet/functions/cw/cecwo/reg or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptauce of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:	If you only have questions regarding the appeal process you may also contact:
Ronnie Smith PO Box 1890 Wilmington, NC 28402	Mr. Mike Bell, Administrative Appeal Review Officer CESAD-ET-CO-R U.S. Army Corps of Engineers, South Atlantic Division 60 Forsyth Street, Room 9M15 Atlanta, Georgia 30303-8801

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

	Date:	Telephone number:
_____ Signature of appellant or agent.		

For appeals on Initial Proffered Permits and approved Jurisdictional Determinations send this form to:

District Engineer, Wilmington Regulatory Division, Attn: Ronnie Smith, Project Manager, Wilmington Regulatory Field Office, PO Box 1890, Wilmington, North Carolina 28403

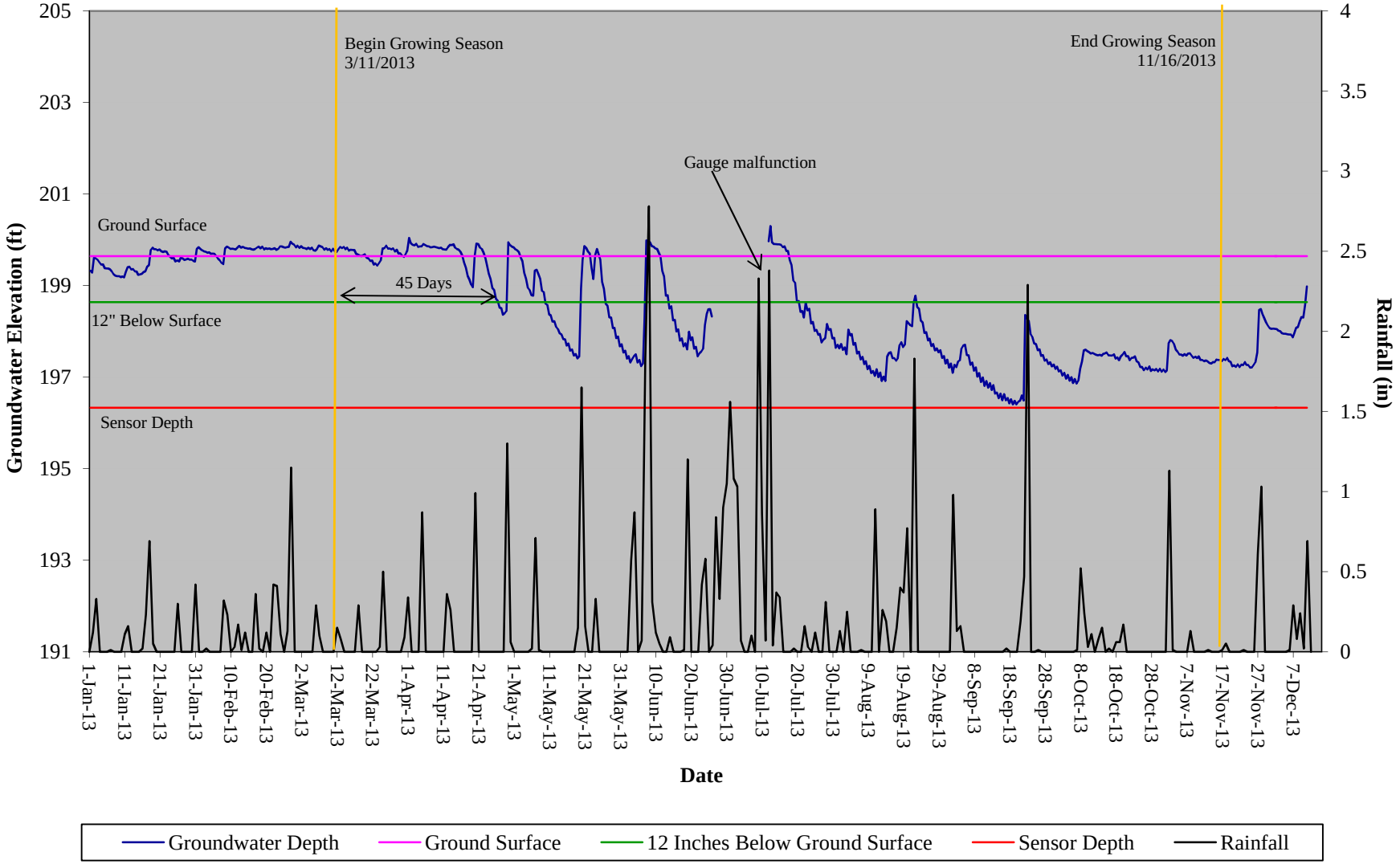
For Permit denials and Proffered Permits send this form to:

Division Engineer, Commander, U.S. Army Engineer Division, South Atlantic, Attn: Mr. Mike Bell, Administrative Appeal Officer, CESAD-ET-CO-R, 60 Forsyth Street, Room 9M15, Atlanta, Georgia 30303-8801

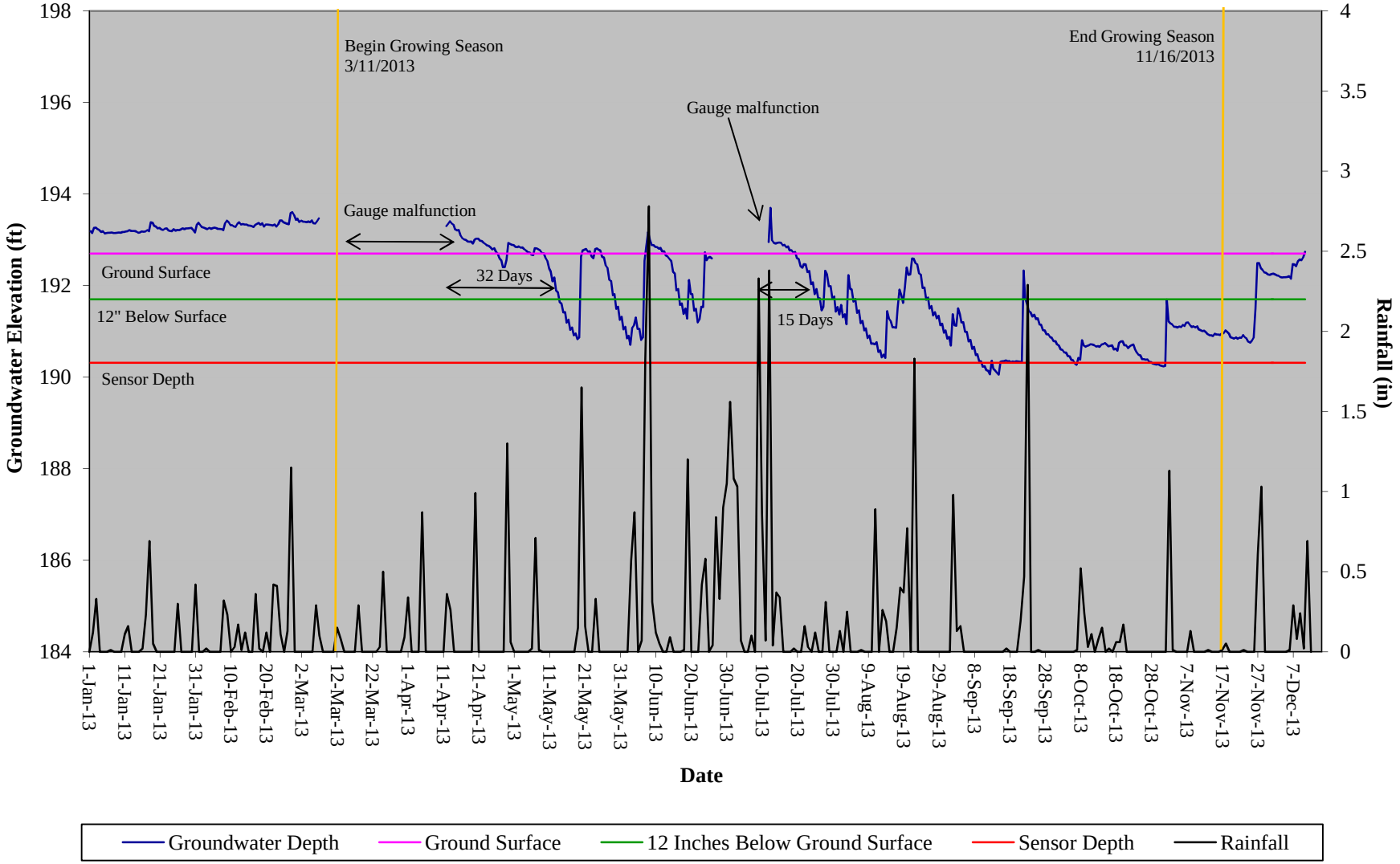
Appendix D
Debit Ledger

Appendix E
Wetland and Stream Hydrographs

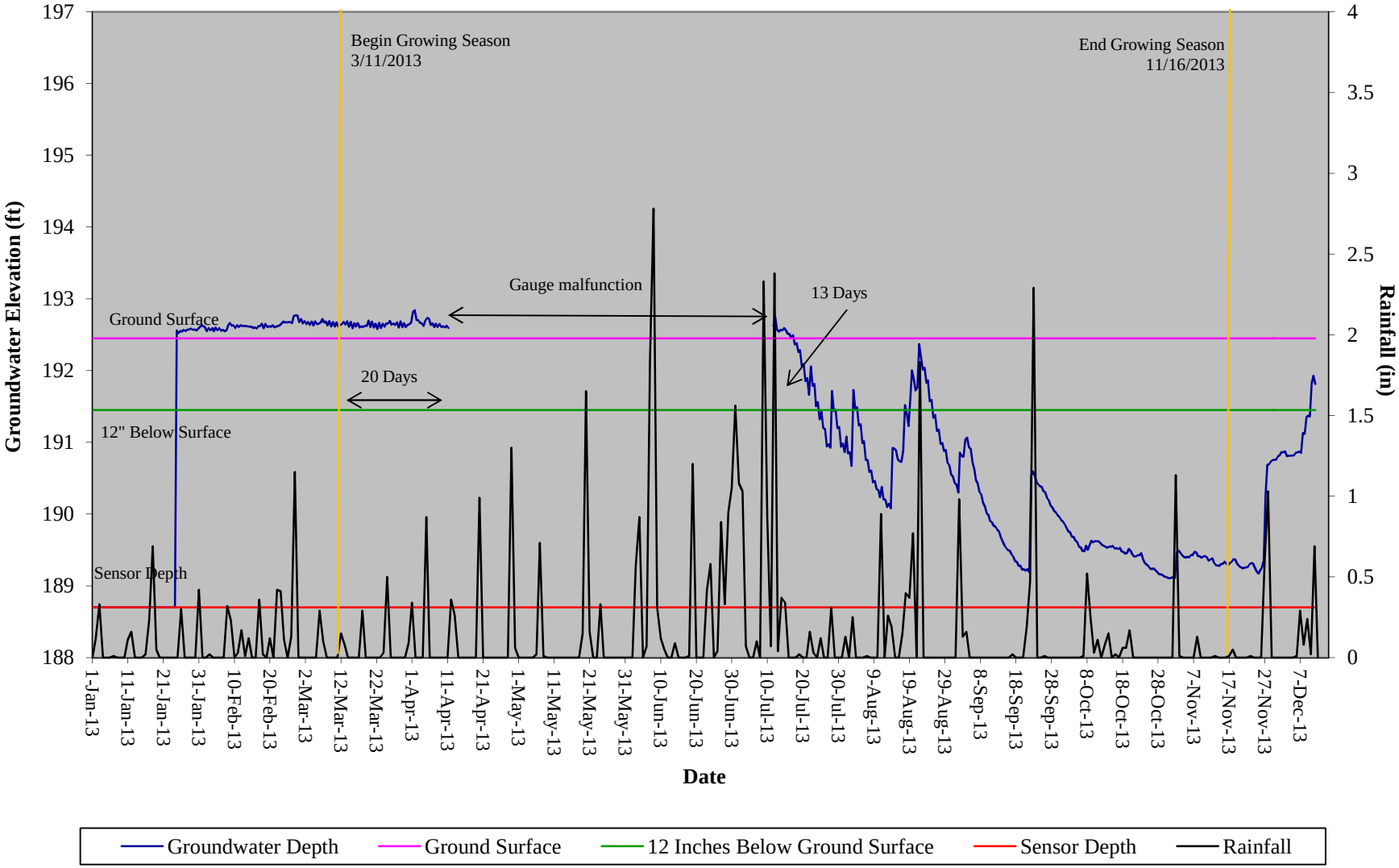
Farrar Dairy Restoration Site
Hydrograph
Wetland Gauge 1

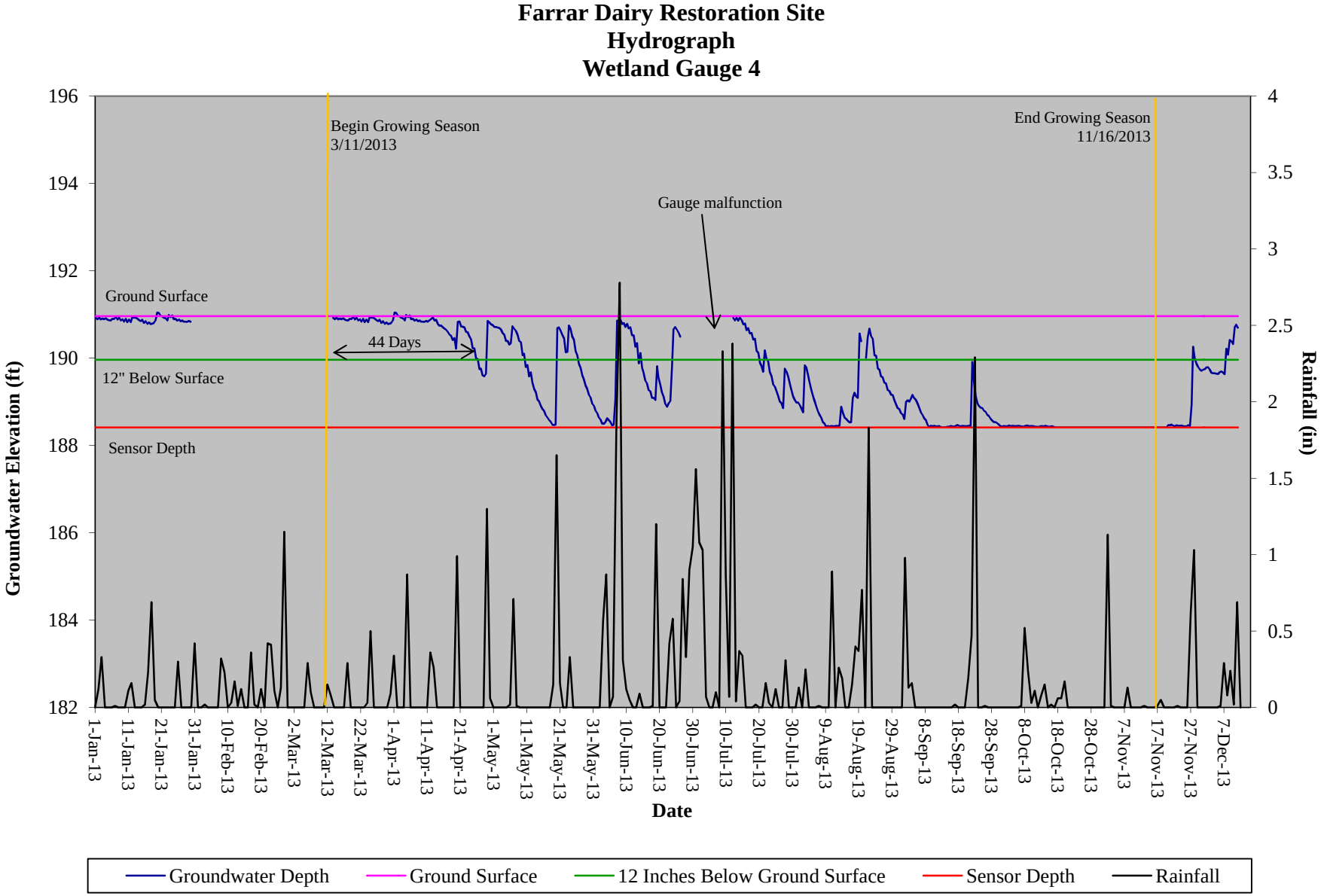


Farrar Dairy Restoration Site
Hydrograph
Wetland Gauge 2

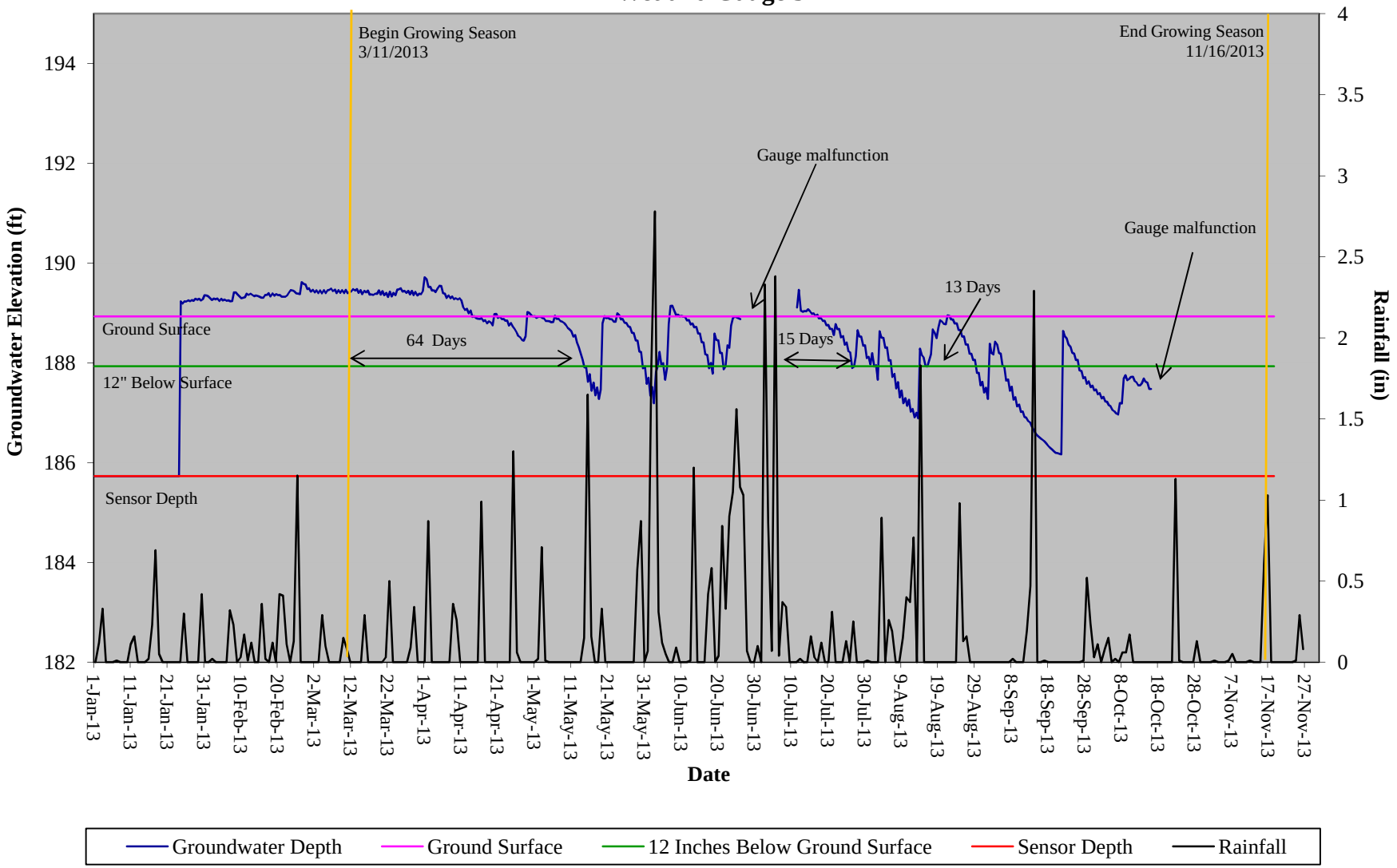


Farrar Dairy Restoration Site
Hydrograph
Wetland Gauge 3

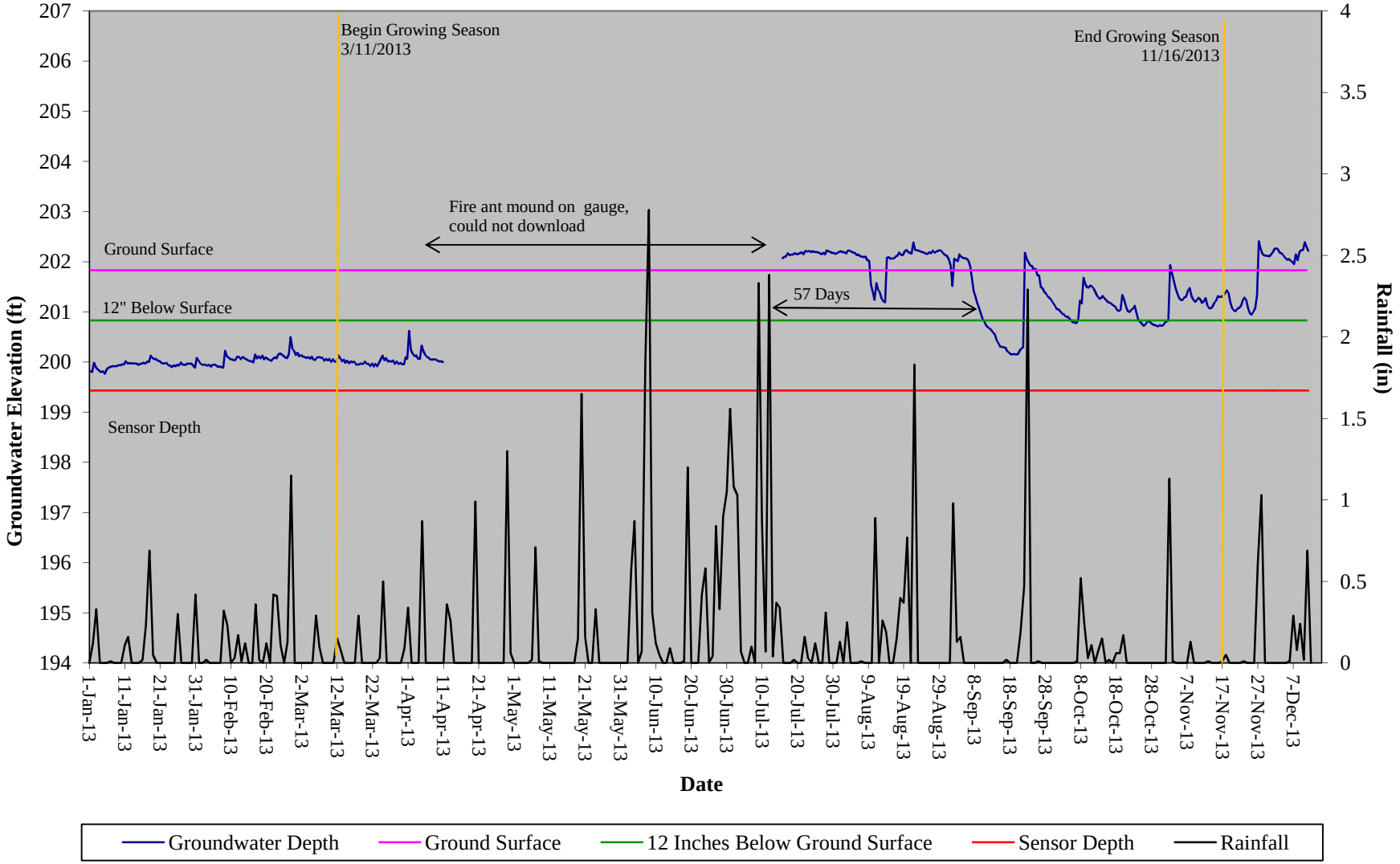


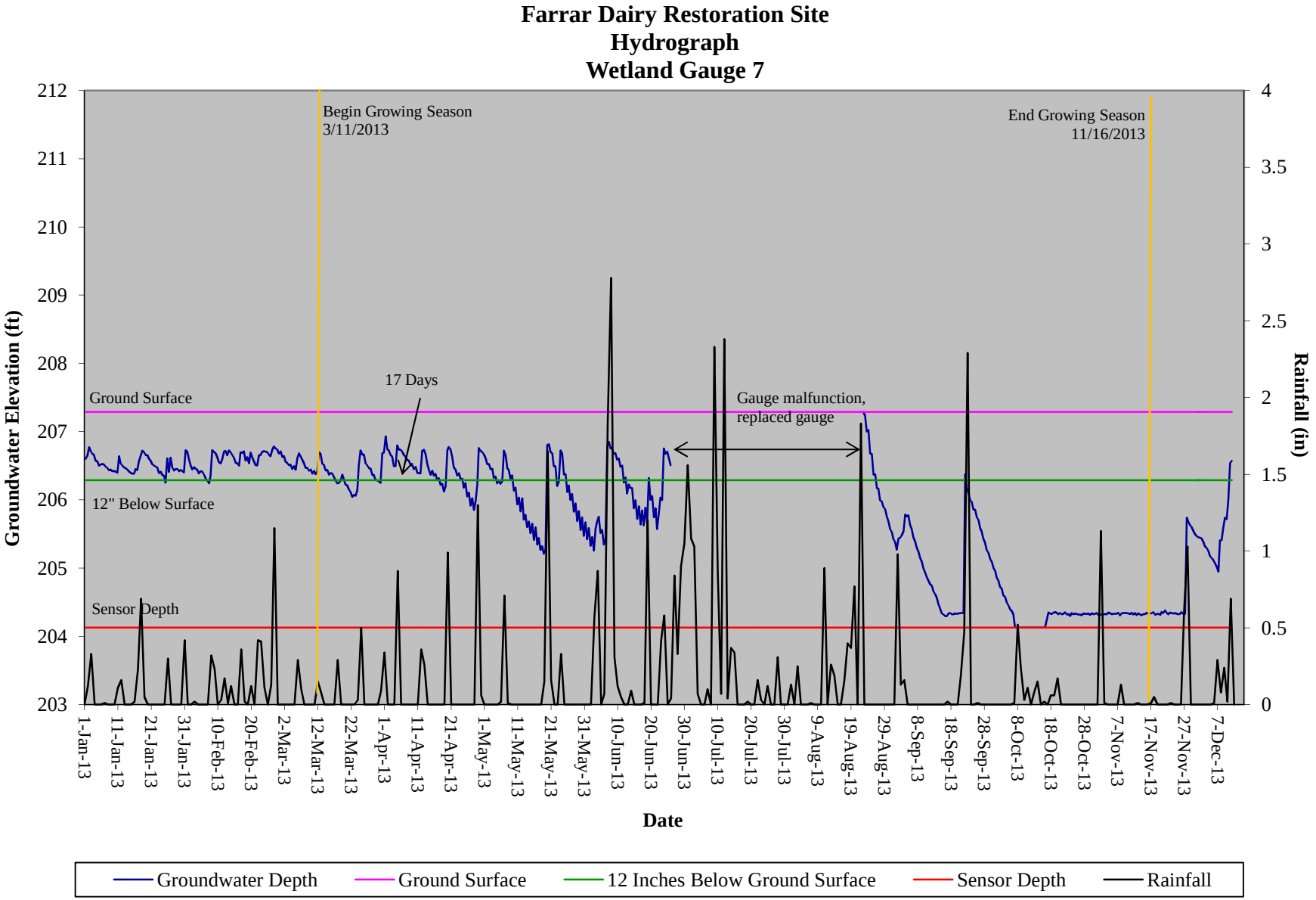

Farrar Dairy Restoration Site
Hydrograph
Wetland Gauge 4
Begin Growing Season
3/11/2013
End Growing Season
11/16/2013
Gauge malfunction
Ground Surface
44 Days
12" Below Surface
Sensor Depth
Groundwater Elevation (ft)
Rainfall (in)
Date
196
194
192
190
188
186
184
182
4
3.5
3
2.5
2
1.5
1
0.5
0
1-Jan-13
11-Jan-13
21-Jan-13
31-Jan-13
10-Feb-13
20-Feb-13
2-Mar-13
12-Mar-13
22-Mar-13
1-Apr-13
11-Apr-13
21-Apr-13
1-May-13
11-May-13
21-May-13
31-May-13
10-Jun-13
20-Jun-13
30-Jun-13
10-Jul-13
20-Jul-13
30-Jul-13
9-Aug-13
19-Aug-13
29-Aug-13
8-Sep-13
18-Sep-13
28-Sep-13
8-Oct-13
18-Oct-13
28-Oct-13
7-Nov-13
17-Nov-13
27-Nov-13
7-Dec-13
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth
Rainfall

Farrar Dairy Restoration Site
Hydrograph
Wetland Gauge 5

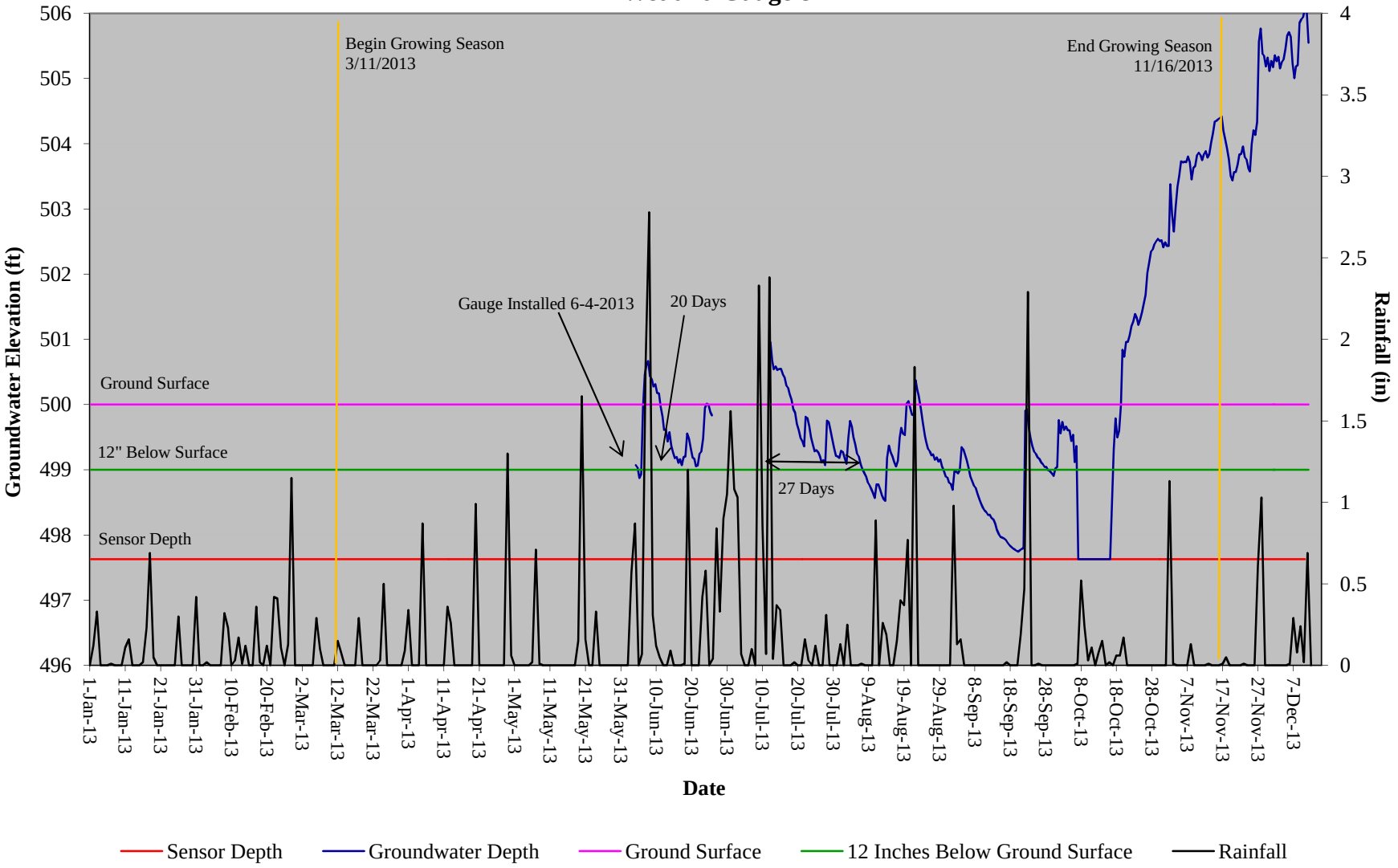


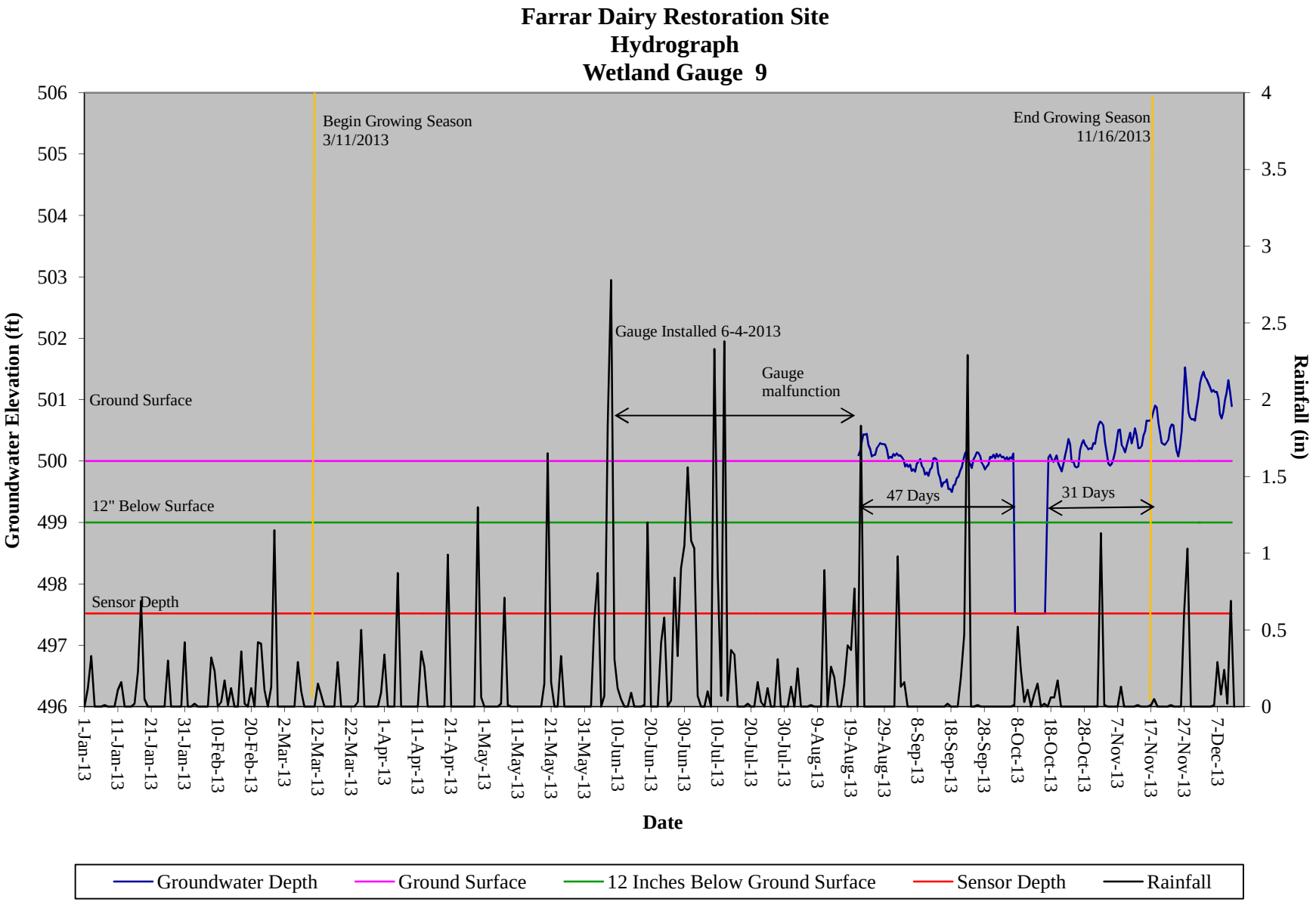
Farrar Dairy Restoration Site
Hydrograph
Wetland Gauge 6

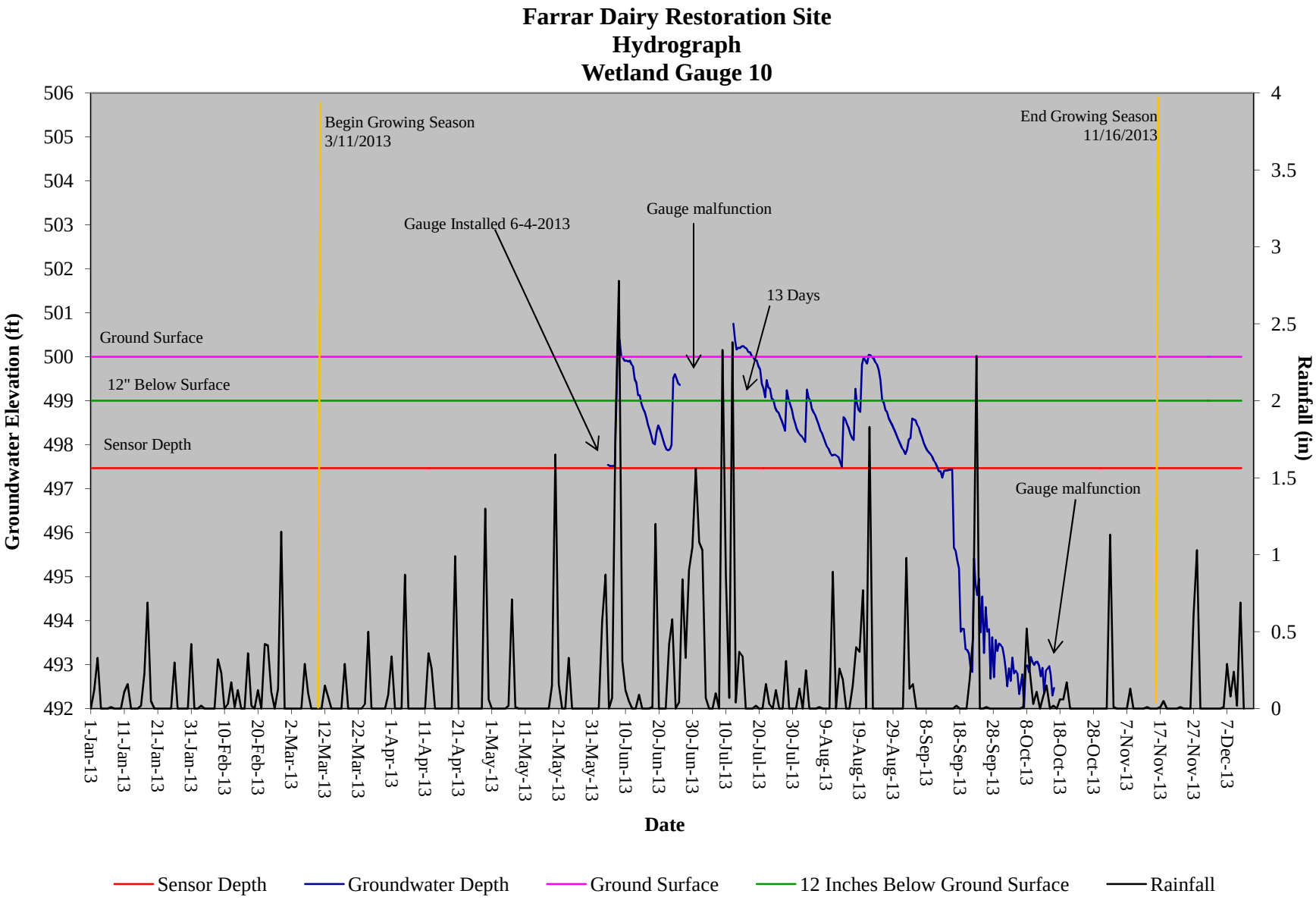



Farrar Dairy Restoration Site
Hydrograph
Wetland Gauge 7
Groundwater Elevation (ft)
Rainfall (in)
Begin Growing Season
3/11/2013
End Growing Season
11/16/2013
17 Days
Ground Surface
Gauge malfunction,
replaced gauge
12" Below Surface
Sensor Depth
Date
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth
Rainfall

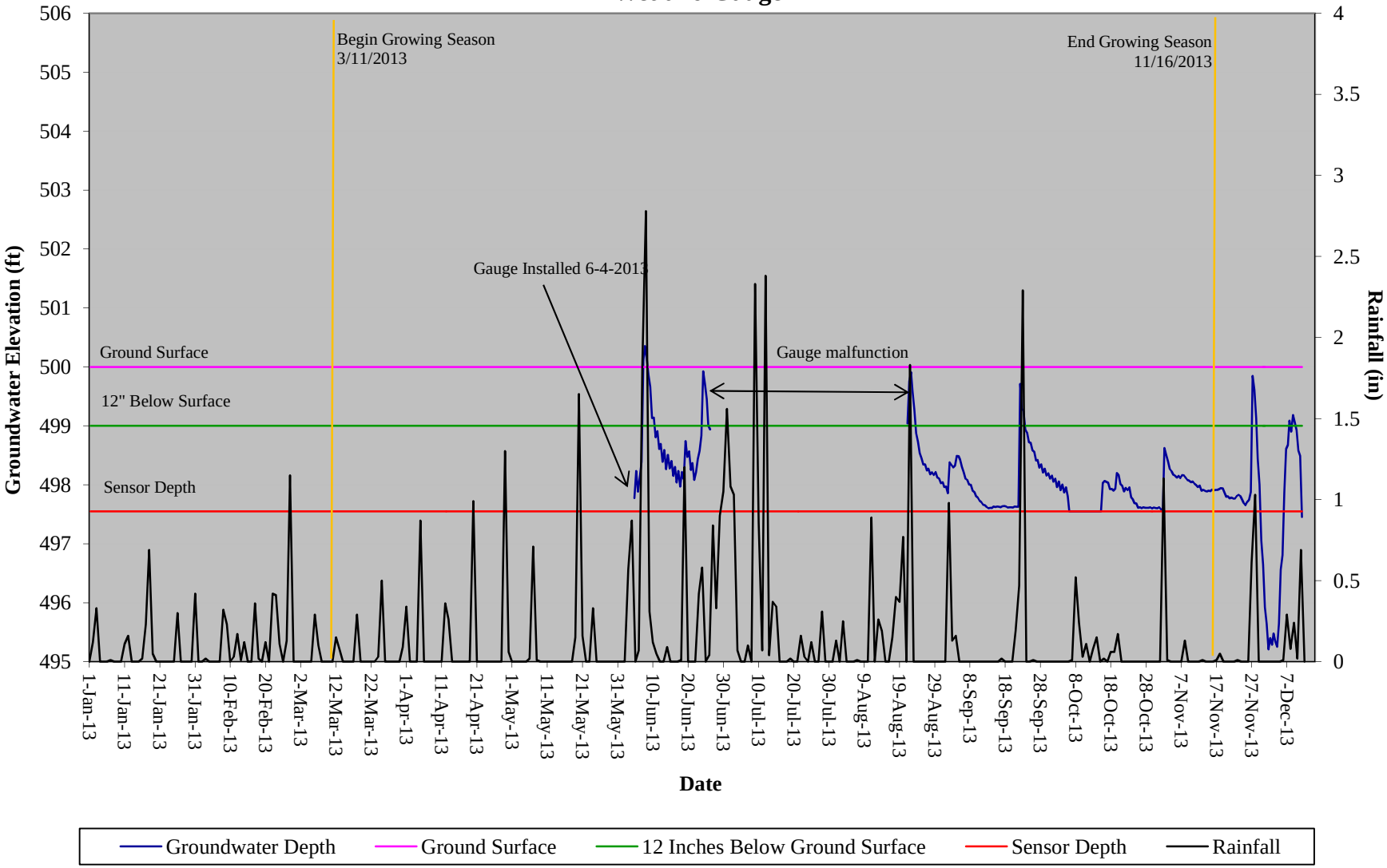
Farrar Dairy Restoration Site
Hydrograph
Wetland Gauge 8



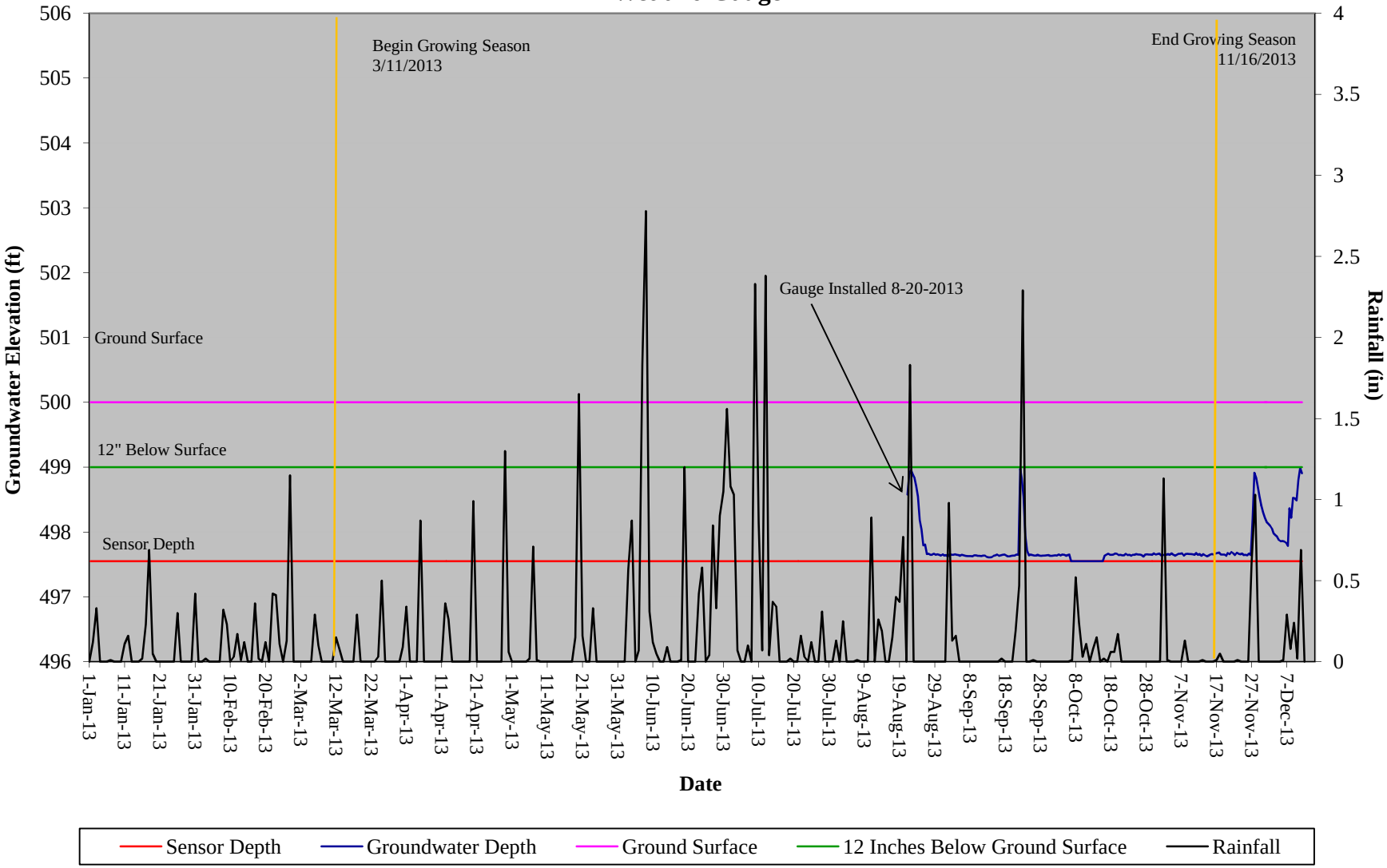

Farrar Dairy Restoration Site
Hydrograph
Wetland Gauge 9
Groundwater Elevation (ft)
Rainfall (in)
Date
Begin Growing Season
3/11/2013
End Growing Season
11/16/2013
Gauge Installed 6-4-2013
Gauge
malfunction
Ground Surface
12" Below Surface
Sensor Depth
47 Days
31 Days
506
505
504
503
502
501
500
499
498
497
496
4
3.5
3
2.5
2
1.5
1
0.5
0
1-Jan-13
11-Jan-13
21-Jan-13
31-Jan-13
10-Feb-13
20-Feb-13
2-Mar-13
12-Mar-13
22-Mar-13
1-Apr-13
11-Apr-13
21-Apr-13
1-May-13
11-May-13
21-May-13
31-May-13
10-Jun-13
20-Jun-13
30-Jun-13
10-Jul-13
20-Jul-13
30-Jul-13
9-Aug-13
19-Aug-13
29-Aug-13
8-Sep-13
18-Sep-13
28-Sep-13
8-Oct-13
18-Oct-13
28-Oct-13
7-Nov-13
17-Nov-13
27-Nov-13
7-Dec-13
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth
Rainfall


Farrar Dairy Restoration Site
Hydrograph
Wetland Gauge 10
Groundwater Elevation (ft)
Rainfall (in)
Date
Begin Growing Season
3/11/2013
End Growing Season
11/16/2013
Gauge Installed 6-4-2013
Gauge malfunction
13 Days
Gauge malfunction
Ground Surface
12" Below Surface
Sensor Depth
506
505
504
503
502
501
500
499
498
497
496
495
494
493
492
4
3.5
3
2.5
2
1.5
1
0.5
0
1-Jan-13
11-Jan-13
21-Jan-13
31-Jan-13
10-Feb-13
20-Feb-13
2-Mar-13
12-Mar-13
22-Mar-13
1-Apr-13
11-Apr-13
21-Apr-13
1-May-13
11-May-13
21-May-13
31-May-13
10-Jun-13
20-Jun-13
30-Jun-13
10-Jul-13
20-Jul-13
30-Jul-13
9-Aug-13
19-Aug-13
29-Aug-13
8-Sep-13
18-Sep-13
28-Sep-13
8-Oct-13
18-Oct-13
28-Oct-13
7-Nov-13
17-Nov-13
27-Nov-13
7-Dec-13
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Rainfall

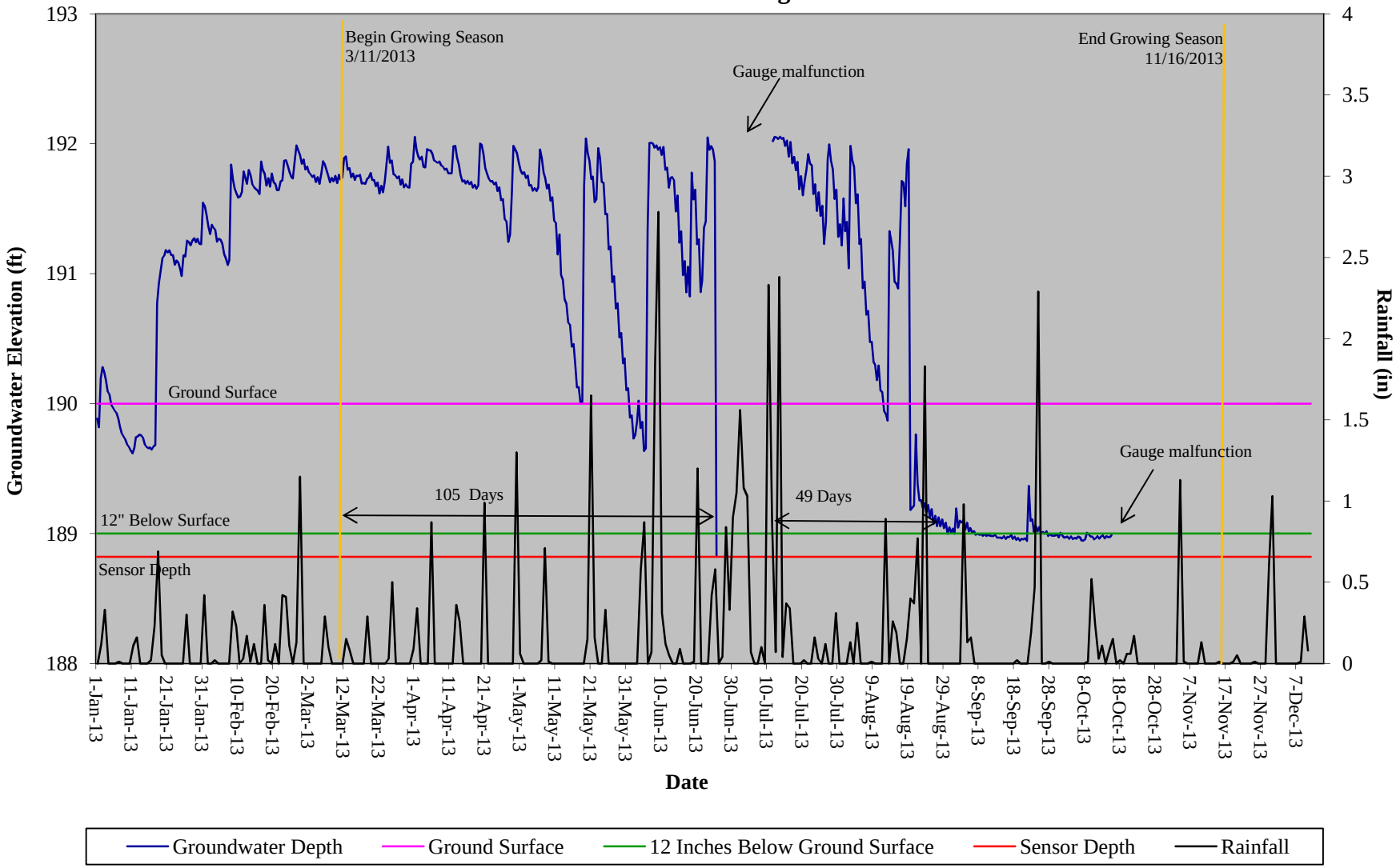
Farrar Dairy Restoration Site
Hydrograph
Wetland Gauge 11



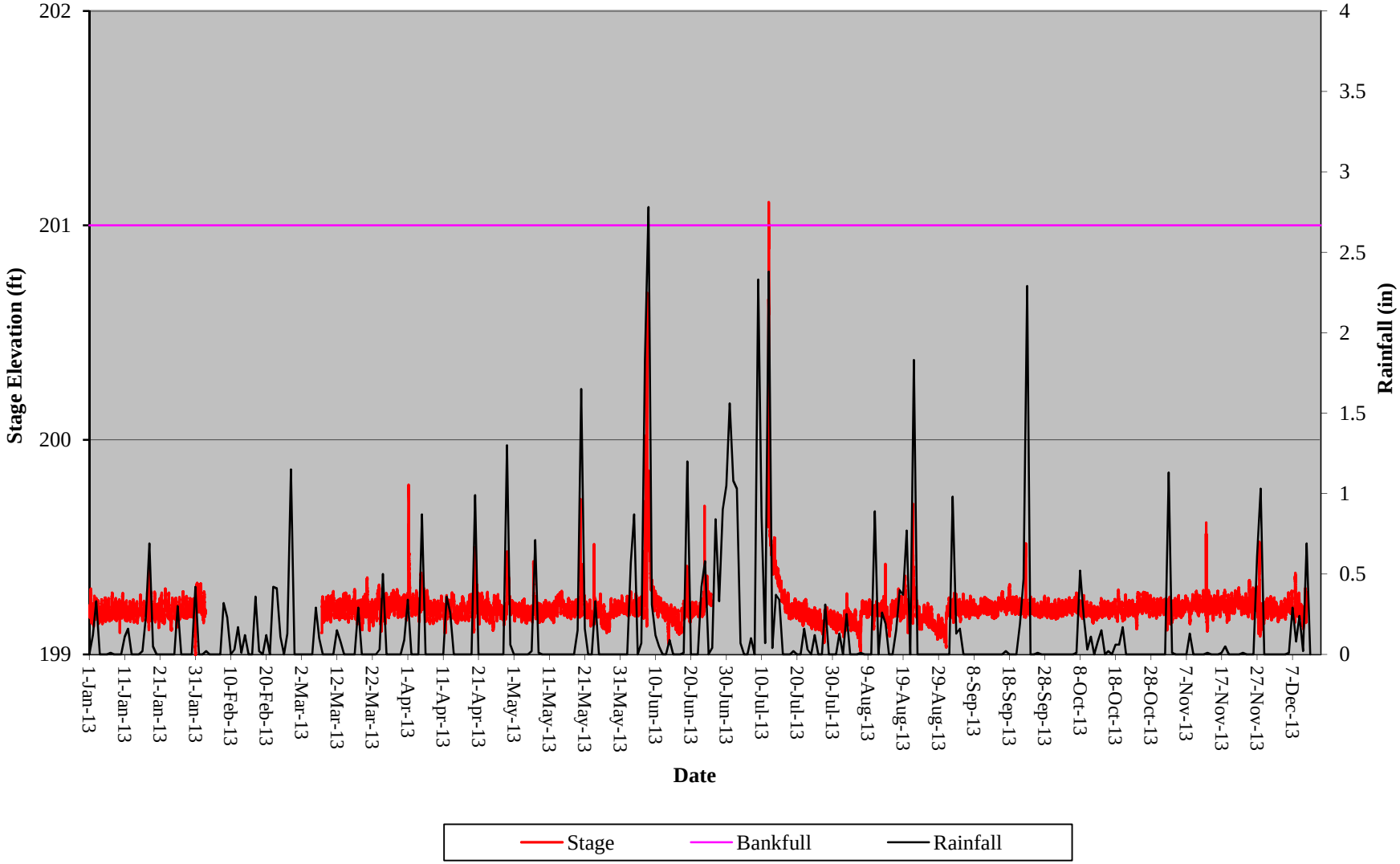
Farrar Dairy Restoration Site
Hydrograph
Wetland Gauge 12



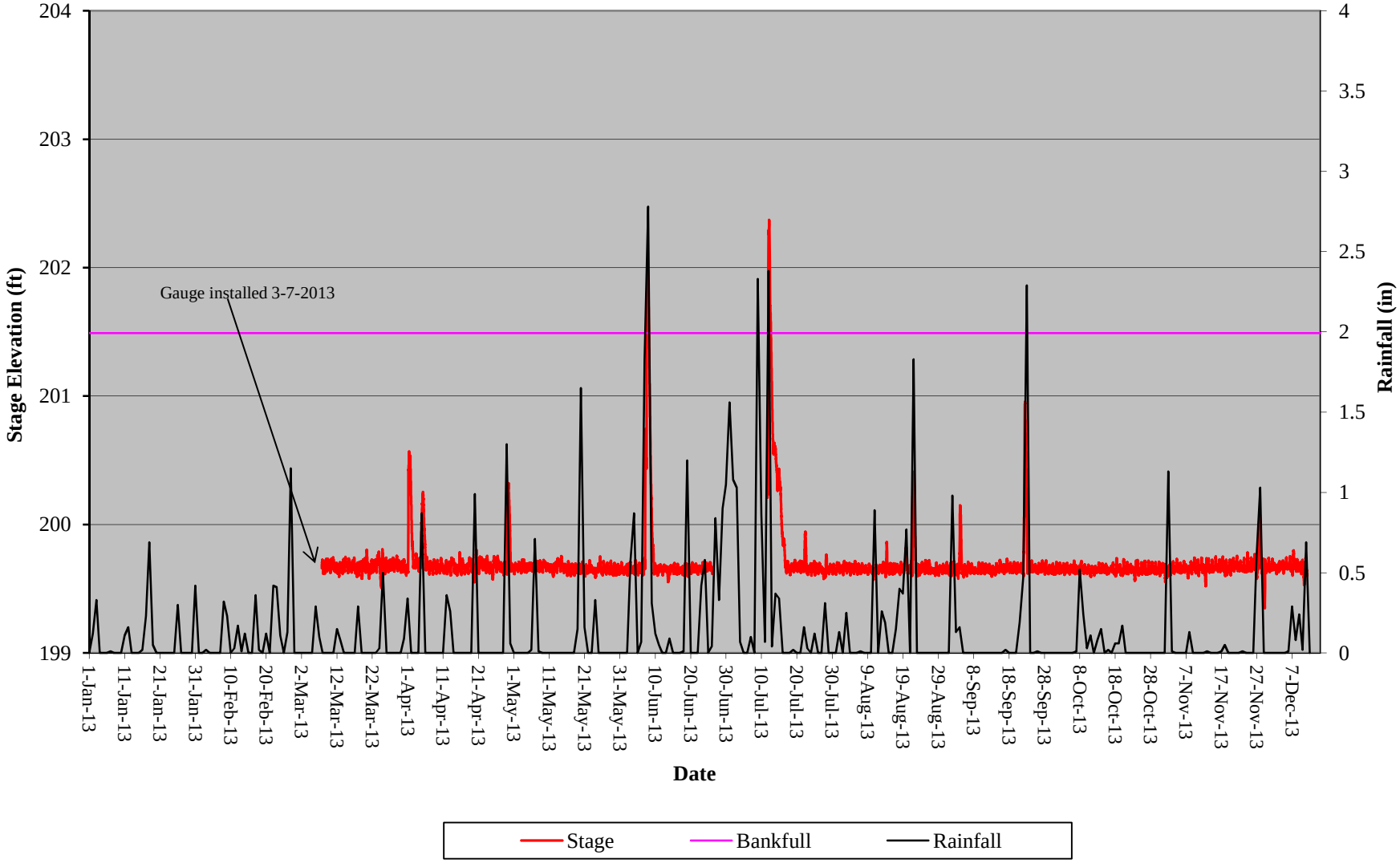
Farrar Dairy Restoration Site
Hydrograph
Reference Gauge



Farrar Dairy Restoration Site
Stage Hydrograph
Stream Gauge 1

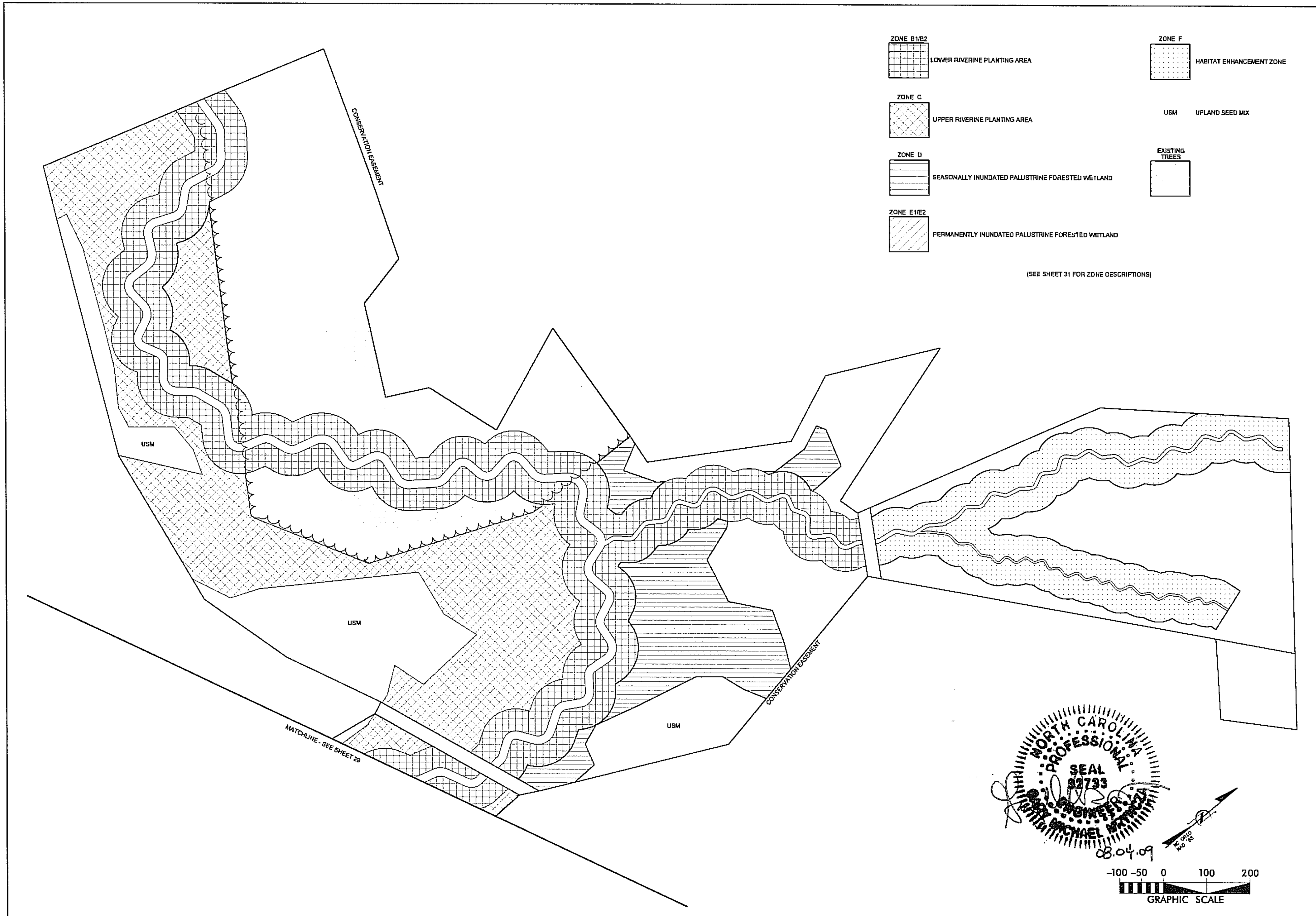


Farrar Dairy Restoration Site
Stage Hydrograph
Stream Gauge 2



Appendix F
Supplemental and As-Built Planting Lists

Table 8. Supplemental Planting List Farrar Dairy Stream and Wetland Restoration Site		
2011 Supplemental Planting		
Common Name	Scientific Name	Planted
Green Ash	*Fraxinus pennsylvanica*	2,000
Willow Oak	*Quercus phellos*	1,300
Swamp Chestnut Oak	*Quercus michauxii*	1,300
Cherrybark Oak	*Quercus pagoda*	1,300
TOTAL PLANTED		**5,900**
2012 Supplemental Planting		
Bald Cypress	*Taxodium distichum*	2,000
Water Oak	*Quercus nigra*	1,000
Sycamore	*Platanus occidentalis*	1,000
River Birch	*Betula nigra*	4,000
Silky Dogwood	*Cornus amomum*	500
TOTAL PLANTED		**8,500**



SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

REVISIONS

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: JUNE 2009
SCALE: 1"=100'

AS-BUILT PLANTING PLAN

SHEET 28 OF 31

ZONE B1/B2
LOWER RIVERINE PLANTING AREA

ZONE C
UPPER RIVERINE PLANTING AREA

ZONE D
SEASONALLY INUNDATED PALUSTRINE FORESTED WETLAND

ZONE E1/E2
PERMANENTLY INUNDATED PALUSTRINE FORESTED WETLAND

(SEE SHEET 31 FOR ZONE DESCRIPTIONS)

ZONE F
HABITAT ENHANCEMENT ZONE

USM UPLAND SEED MIX

EXISTING TREES

MATCHLINE - SEE SHEET 30

MATCHLINE - SEE SHEET 28

CONSERVATION EASEMENT

USM

USM

USM

USM

USM

USM

-100 -50 0 100 200
GRAPHIC SCALE

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER MICHAEL MATTINGLY
08.04.09

REVISIONS

A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009		
	DESCRIPTION	DATE	APPROVED	

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: JUNE 2009
SCALE: 1"=100'

AS-BUILT PLANTING PLAN

SHEET 29 OF 31

ZONE B1/B2
LOWER RIVERINE PLANTING AREA

ZONE C
UPPER RIVERINE PLANTING AREA

ZONE D
SEASONALLY INUNDATED PALUSTRINE FORESTED WETLAND

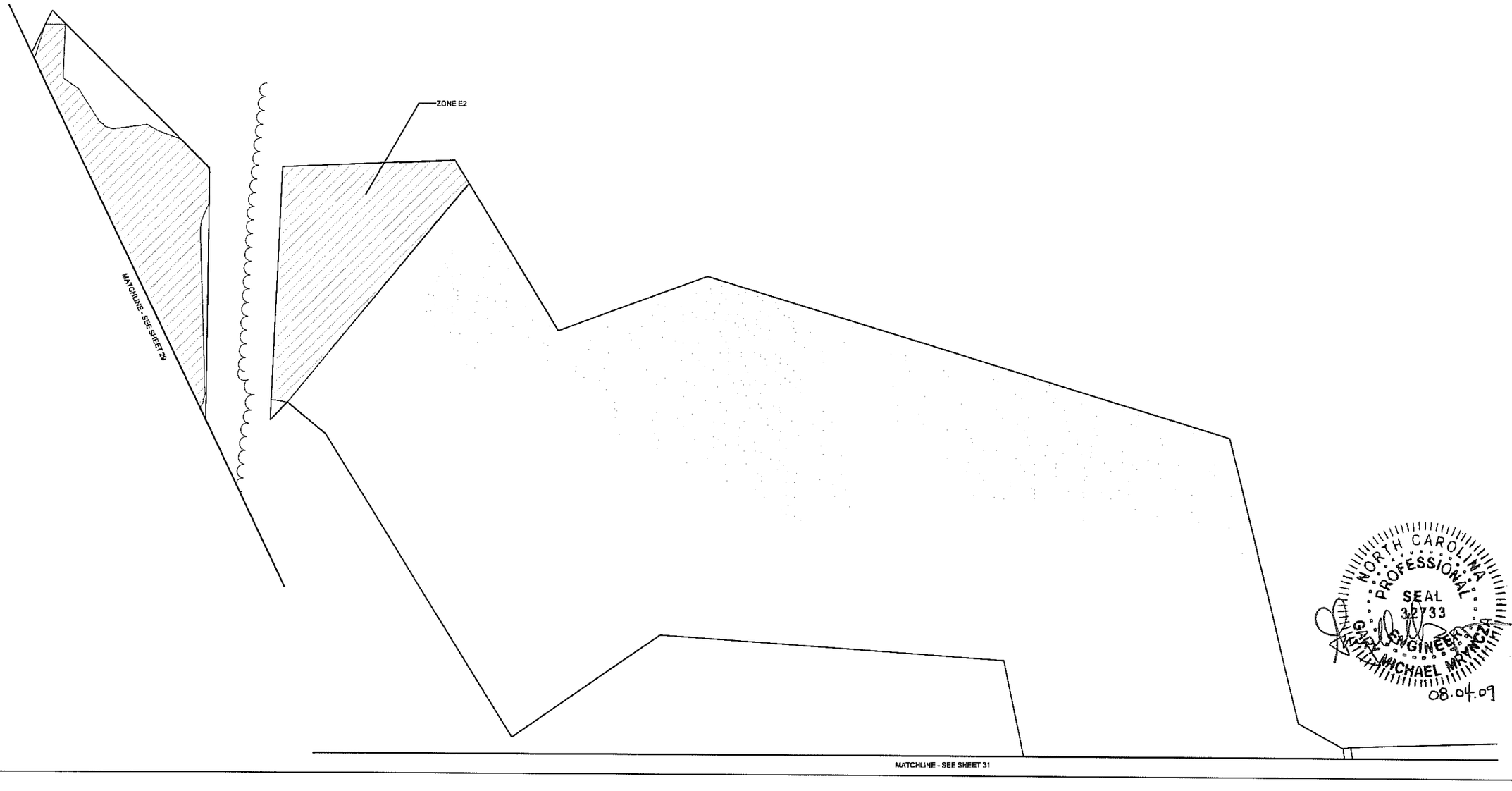
ZONE E1/E2
PERMANENTLY INUNDATED PALUSTRINE FORESTED WETLAND

ZONE F
HABITAT ENHANCEMENT ZONE

USM UPLAND SEED MIX

EXISTING TREES

(SEE SHEET 31 FOR ZONE DESCRIPTIONS)



N

-100 -50 0 100 200
GRAPHIC SCALE

REVISIONS				
NO.	DESCRIPTION	DATE	APPROVED	
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009		

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MCYNCH
08.04.09

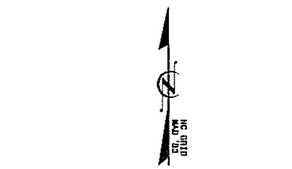
KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

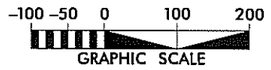
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

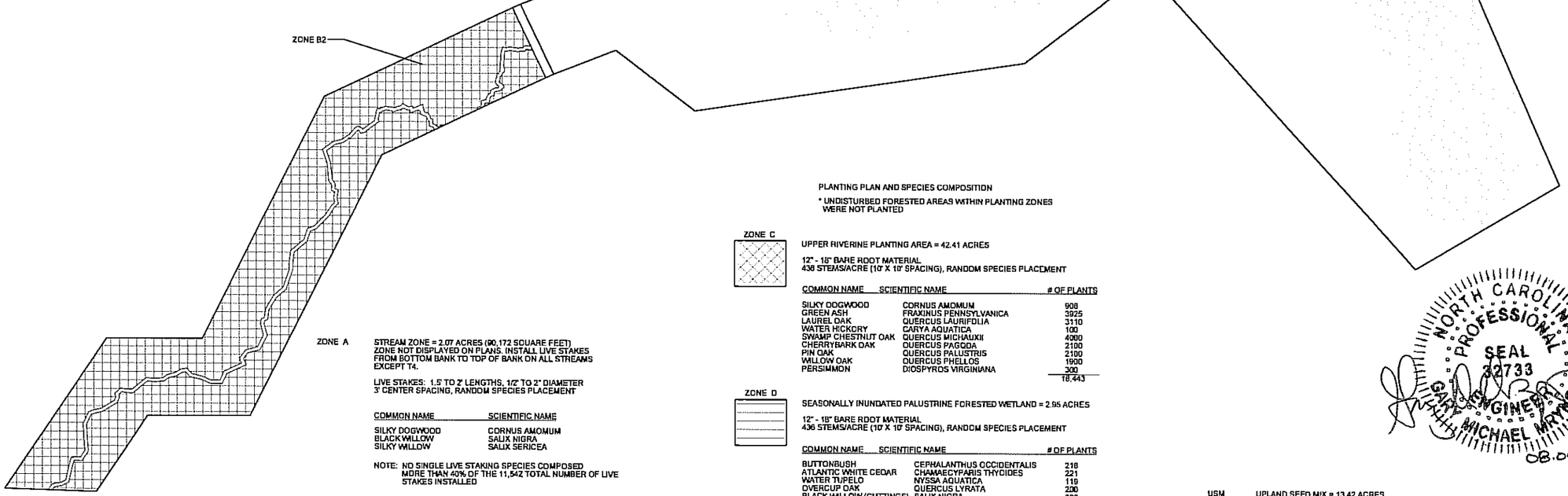
DATE: JUNE 2009
SCALE: 1"=100'

AS-BUILT PLANTING PLAN

MATCHLINE - SEE SHEET 30







PLANTING PLAN AND SPECIES COMPOSITION

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONES WERE NOT PLANTED

ZONE A

STREAM ZONE = 2.07 ACRES (90,172 SQUARE FEET)
ZONE NOT DISPLAYED ON PLANS. INSTALL LIVE STAKES FROM BOTTOM BANK TO TOP OF BANK ON ALL STREAMS EXCEPT T4.

LIVE STAKES: 1.5' TO 2' LENGTHS, 1/2" TO 2" DIAMETER
3' CENTER SPACING, RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME
SILKY DOGWOOD	CORNUS AMOMUM
BLACK WILLOW	SALIX NIGRA
SILKY WILLOW	SALIX SERICEA

NOTE: NO SINGLE LIVE STAKING SPECIES COMPOSED MORE THAN 40% OF THE 11,542 TOTAL NUMBER OF LIVE STAKES INSTALLED

ZONE B1/B2

B1 - STREAM RESTORATION
LOWER RIVERINE PLANTING AREA = 21.13 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
RIVER BIRCH	BETULA NIGRA	2200
SUGARBERRY	CELTIS LAEVIGATA	964
BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS	1040
SILKY DOGWOOD	CORNUS AMOMUM	1400
GREEN ASH	FRAXINUS PENNSYLVANICA	1900
WATER TUPELO	NYSSA AQUATICA	847
LAUREL OAK	QUERCUS LAURIFOLIA	950
		9241

B2 - STREAM ENHANCEMENT
LOWER RIVERINE PLANTING AREA = 3.67 ACRES

12" - 18" BARE ROOT MATERIAL
100 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
RIVER BIRCH	BETULA NIGRA	88
SUGARBERRY	CELTIS LAEVIGATA	30
BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS	42
SILKY DOGWOOD	CORNUS AMOMUM	92
GREEN ASH	FRAXINUS PENNSYLVANICA	75
WATER TUPELO	NYSSA AQUATICA	34
LAUREL OAK	QUERCUS LAURIFOLIA	40
		407

ZONE C

UPPER RIVERINE PLANTING AREA = 42.41 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
SILKY DOGWOOD	CORNUS AMOMUM	908
GREEN ASH	FRAXINUS PENNSYLVANICA	3925
LAUREL OAK	QUERCUS LAURIFOLIA	3110
WATER HICKORY	CARYA AQUATICA	100
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII	4000
CHERRYBARK OAK	QUERCUS PAGODA	2100
PIN OAK	QUERCUS PALUSTRIS	2100
WILLOW OAK	QUERCUS PHELLOS	1900
PERSIMMON	DIOSPYROS VIRGINIANA	300
		18,443

ZONE D

SEASONALLY INUNDATED PALUSTRINE FORESTED WETLAND = 2.95 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS	218
ATLANTIC WHITE CEDAR	CHAMAECYPARIS THYOIDES	221
WATER TUPELO	NYSSA AQUATICA	119
OVERCUP OAK	QUERCUS LYRATA	200
BLACK WILLOW (CUTTINGS)	SALIX NIGRA	308
BALD CYPRESS	TAXODIUM DISTICHUM	342
		1,408

ZONE E1/E2

E1 - WETLAND RESTORATION
PERMANENTLY INUNDATED PALUSTRINE FORESTED WETLAND = 8.43 ACRES
PLANT ALL OF ZONE E AS E1 UNLESS OTHERWISE INDICATED

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
ATLANTIC WHITE CEDAR	CHAMAECYPARIS THYOIDES	840
BLACK WILLOW (CUTTINGS)	SALIX NIGRA	1406
BALD CYPRESS	TAXODIUM DISTICHUM	1502
		3,808

E2 - WETLAND ENHANCEMENT
PERMANENTLY INUNDATED PALUSTRINE FORESTED WETLAND = 2.25 ACRES

12" - 18" BARE ROOT MATERIAL
100 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
ATLANTIC WHITE CEDAR	CHAMAECYPARIS THYOIDES	51
BLACK WILLOW (CUTTINGS)	SALIX NIGRA	68
BALD CYPRESS	TAXODIUM DISTICHUM	90
		233

ZONE F

HABITAT ENHANCEMENT ZONE = 4.03 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
SUGARBERRY	CELTIS LAEVIGATA	250
PERSIMMON	DIOSPYROS VIRGINIANA	300
YELLOW POPLAR	LIRIODENDRON TULIPIFERA	400
SYCAMORE	PLATANUS OCCIDENTALIS	300
WHITE OAK	QUERCUS ALBA	500
		1,750

USM UPLAND SEED MIX = 13.42 ACRES

SEED/ACRE	COMMON NAME	SCIENTIFIC NAME
5 LBS	BUCKWHEAT	FAGOPYRUM ESCULENTUM
5 LBS	SUNFLOWER	HELIANTHUS SPECIES
5 LBS	GRAIN SORGHUM	SORGHUM BICOLOR
5 LBS	BROWNTOP MILLET	UROCHLOA RAMOSA
20 LBS/ACRE		

WSM WETLAND SEED MIX = 71.34 ACRES

PLANTED IN ZONES B, C, D, AND E (ON ISLANDS ONLY FOR ZONE E)

SEED/ACRE	COMMON NAME	SCIENTIFIC NAME
1.25 LBS	ORCHARD GRASS	DACTYLIS GLOMERATA
1.25 LBS	BIG BLUESTEM	ANDROPOGON GERARDII
1.25 LBS	VIRGINIA WILD RYE	ELYMUS VIRGINICUS
1.25 LBS	RIVER OATS	CHASMANTHIUM LATIFOLIUM
1.25 LBS	PURPLE TOP	VERBENA BONARIENSIS
0.25 LBS	DEER TONGUE	PANICUM CLADESTINUM
0.25 LBS	SWITCH GRASS	PANICUM VIRGATUM
0.25 LBS	RYE GRAIN	SECALE CEREALE
25 LBS/ACRE		

EXISTING TREES

DO NOT PLANT IN FORESTED AREAS UNLESS OTHERWISE INDICATED.

REVISIONS				
NO.	DESCRIPTION	DATE	APPROVED	
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009		

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: JUNE 2009
SCALE: 1"=100'

AS-BUILT PLANTING PLAN

SHEET 31 OF 31

Appendix G
Approved Wetland JD Plat

"THIS CERTIFIES THAT THIS COPY OF THIS PLAT ACCURATELY DEPICTS THE BOUNDARY OF THE JURISDICTION OF SECTION 404 OF THE CLEAN WATER ACT AS DETERMINED BY THE UNDERSIGNED ON THIS DATE. UNLESS THERE IS A CHANGE IN THE LAW OR OR OUR PUBLISHED REGULATIONS, THIS DETERMINATION OF SECTION 404 JURISDICTION MAY BE RELIED UPON FOR A PERIOD NOT TO EXCEED FIVE YEARS FROM THIS DATE. THIS DETERMINATION WAS MADE UTILIZING THE 1987 CORPS OF ENGINEERS WETLANDS DELINEATION MANUAL."

NAME: RST

TITLE: Regulatory Specialist

DATE: 8/20/07

AID: 2006-40970

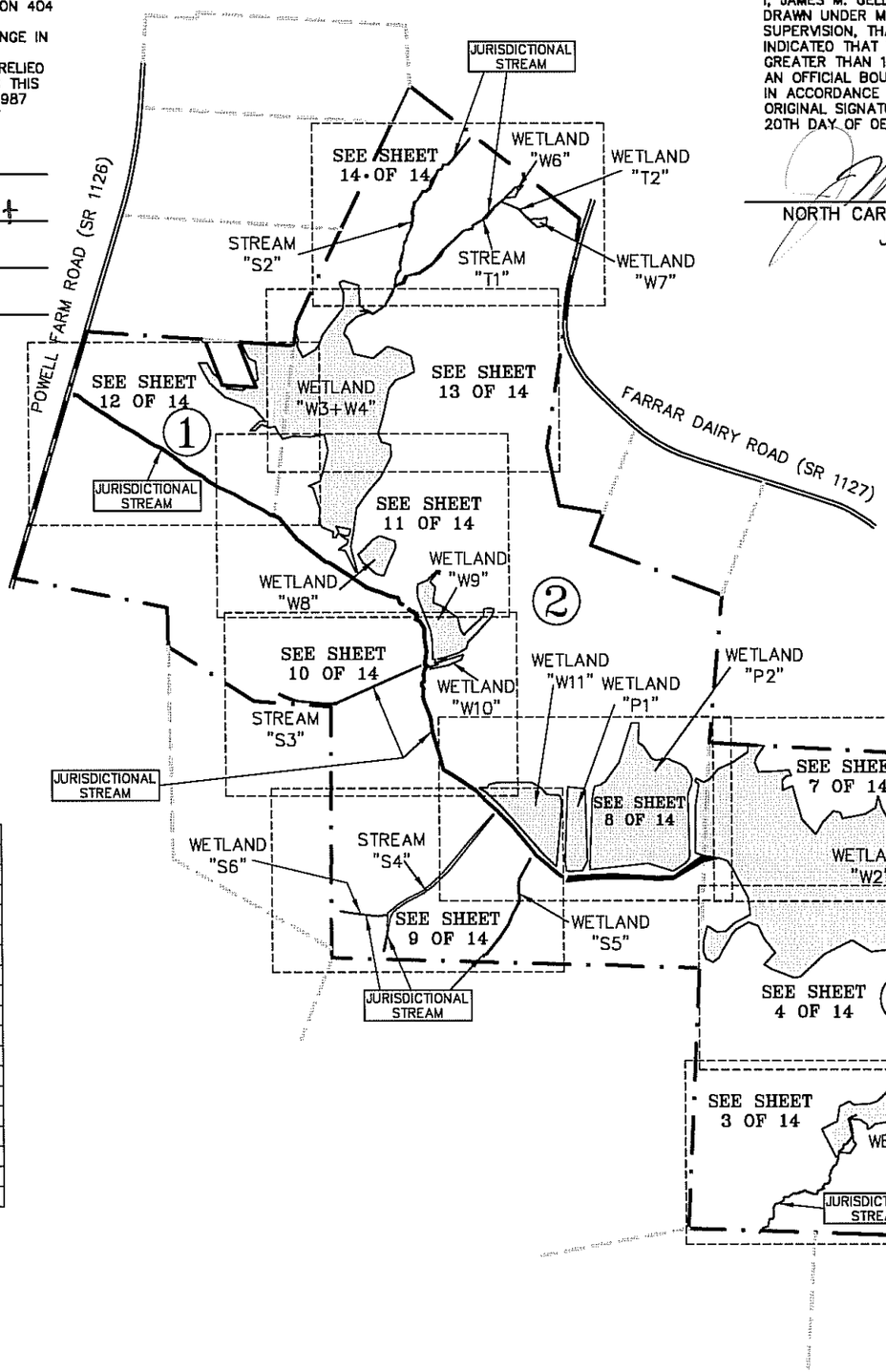
The above signature applies to sheets 1-14.

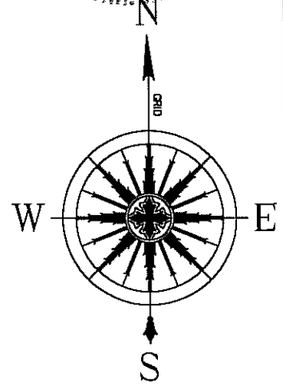
I, JAMES M. GELLENTHIN, HEREBY DECLARE THAT THIS MAP WAS DRAWN UNDER MY SUPERVISION FROM A SURVEY MADE UNDER MY SUPERVISION, THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED THAT THE RATIO OF PRECISION AS CALCULATED IS GREATER THAN 1:10,000; THAT THIS MAP DOES NOT REPRESENT AN OFFICIAL BOUNDARY SURVEY AND HAS NOT BEEN PREPARED IN ACCORDANCE WITH G.S. 47-3D AS AMENDED. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 20TH DAY OF DECEMBER, 2005.

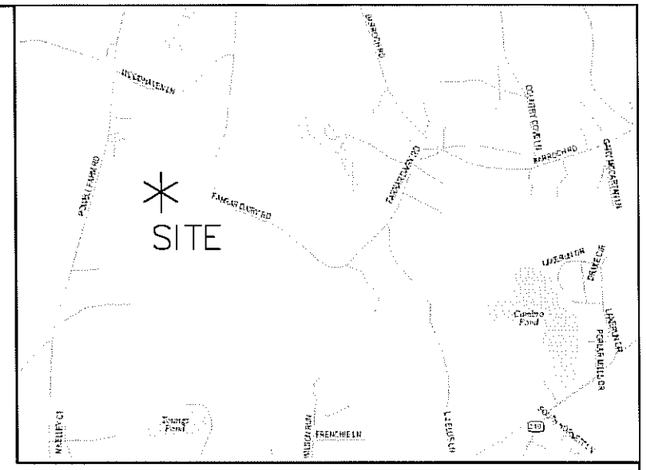
NORTH CAROLINA REGISTRATION NUMBER L-3860

JAMES M. GELLENTHIN

NORTH CAROLINA REGISTERED LAND SURVEYOR SEAL L-3860 JAMES M. GELLENTHIN







VICINITY MAP
(NOT TO SCALE)

GENERAL NOTES:

THE BASIS OF THE COORDINATES SHOWN HEREON IS THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983.

ALL WETLAND FLAGS AND DATA POINTS WERE LOCATED IN THE FIELD BY CONVENTIONAL SURVEY METHODS BETWEEN JULY AND OCTOBER 2006.

WETLAND AREA TABLE

WETLAND/STREAM	ACREAGE
W1	1.70 AC
W2	60.60 AC
W3+W4	13.15 AC
W6	0.06 AC
W7	0.07 AC
W8	0.10 AC
W9	1.56 AC
W10	0.62 AC
W11	2.28 AC
T1	0.15 AC
T2	0.02 AC
S2	0.21 AC
S3	0.16 AC
S4	0.32 AC
S5	0.04 AC
S6	0.13 AC
P1	1.11 AC
P2	7.09 AC

(1) SANDRA WOMACK PAIT
PIN 0516-86-5081
DB 794-970

(2) JAMES FARRAR
PIN 0516-94-3941, PIN 0516-96-8380,
PIN 0526-05-0461, PIN 0526-03-4936
DB 471-27, DB 1055-324,
DB 1088-933

(3) BRIGHAM & KATHLEEN WILSON
PIN 0526-22-5697
DB 903-983

LEGEND:

- WETLANDS
- STREAM
- SURVEY BOUNDARY LIMITS
- PROPERTY LINE

12065438

KCI ASSOCIATES OF NORTH CAROLINA

KCI ASSOCIATES OF N.C.
ENGINEERS, SURVEYORS AND PLANNERS
4601 SIX FORKS ROAD, SUITE 220
RALEIGH, NC 27609
PHONE (919) 783-9214 * FAX (919) 783-9266

WETLAND DELINEATION PLAT
FOR
FARRAR SITE
@ STATE ROADS 1126 AND 1127
ANDERSON CREEK TOWNSHIP
HARNETT COUNTY, NORTH CAROLINA

DATE:	SCALE:	SHEET:
OCT 31, 2006	1" = 800'	1 OF 14