

LITTLE TROUBLESOME CREEK MITIGATION SITE  
*Rockingham County, NC*  
*NCDENR Contract 003267*  
*NCEEP Project Number 94640*

**Monitoring Year 2 Annual Report**  
**FINAL**

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# LITTLE TROUBLESOME CREEK MITIGATION SITE

## Monitoring Year 2 Annual Report

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## 1.0 Executive Summary

The Little Troublesome Creek Mitigation Site is a full-delivery stream and wetland restoration project for the North Carolina Ecosystem Enhancement Program (NCEEP) in Rockingham County, NC. The stream area, hereafter referred to as the Stream Site, is located on the southeastern side of Reidsville along Irvin and Little Troublesome Creeks. The wetland area, hereafter referred to as the Wetland Site, is located approximately four (4) miles southeast of the Stream Site and is also adjacent to Little Troublesome Creek. The Stream Site is located south of Turner Road, east of the intersection of Turner Road and Way Street in the City of Reidsville, North Carolina. The Wetland Site is located approximately 3,000 feet southwest of the intersection of NC Highway 150 and Mizpah Church Road, south of the City of Reidsville. Little Troublesome Creek is located within the Haw River watershed (North Carolina Division of Water Quality (NCDWQ) Subbasin 03-06-01) of the Cape Fear River Basin (Hydrologic Unit 03030002010030).

The Stream Site is located in a mature bottomland hardwood forest within a 34.5-acre tract owned by Wildlands Little Troublesome Creek Holdings, LLC. A conservation easement has been recorded on 33 acres of the tract (Deed Book 1411, Page Number 2458). Project streams reaches consist of Irvin Creek reach 1 and 2, Little Troublesome Creek, and UT1 as shown in Figure 2a. The wetland portion of the Little Troublesome Creek project is located within a tract of land owned by Jerry Apple. A conservation easement has been recorded on the 19-acre project area within the Apple tract (Deed Book 1412, Page Number 1685). Project wetland areas consist of one (1) wetland (RW1) as shown in Figure 2b.

Little Troublesome Creek (NCDWQ Index No. 16-7), which is the main creek on the project site, has been classified as Class C; NSW waters. Class C waters are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture, and other uses. The Nutrient Sensitive Waters (NSW) classification is a supplemental classification for waters that are subject to excessive growth of microscopic or macroscopic vegetation and therefore need nutrient management. Directions and a map of the Site are provided in Figure 1.

### 1.1 Project Goals and Objectives

Prior to construction activities, the most significant watershed stressors identified during the technical assessment were stream bank erosion and instability. Other stressors included declining aquatic habitat, loss of forest, degraded riparian buffers, loss of wetlands, lack of urban stormwater detention, and water quality problems related to increased sediment and nutrient loadings. As a result of the aforementioned stressors, the Stream Site and Wetland Site had poor water quality due to sediment pollution and poor habitat due to lack of riparian and wetland vegetation. In particular, the Stream Site lacked stable streambank vegetation despite being surrounded by mature vegetation. The Stream Site also lacked in-stream bed diversity and exhibited unstable geomorphic conditions. Table 4 in Appendix 1 and Tables 10a, 10b, and 10c in Appendix 4 present the pre-restoration conditions in detail.

The primary objectives of the project were to stabilize highly eroding stream banks, reconnect streams to their historic floodplain, improve wetland hydrology and function, reduce nutrient levels, sediment input, and water temperature, increase dissolved oxygen concentrations, create appropriate in-stream and terrestrial habitat, and decrease channel velocities. These objectives were achieved by restoring 4,988 linear feet (LF) of perennial stream channel, and restoring, enhancing, and creating 18.0 acres of riparian wetland. The Stream Site and Wetland Site riparian areas were also planted to stabilize streambanks, improve habitat, and protect water quality.

The following primary project goals (measured) were established in the project Mitigation Plan (2011) to address the effects from watershed and project site stressors:



- Stabilize stream dimensions;
- Stabilize stream pattern and profile;
- Establish proper substrate distribution throughout stream;
- Establish wetland hydrology for restored wetlands; and
- Restore native vegetation throughout wetlands and buffer zones.

The following secondary project goals (unmeasured) were established in the project Mitigation Plan (2011) to address the effects from watershed and project site stressors:

- Decrease nutrient and urban runoff pollutant levels;
- Decrease sediment input;
- Decrease water temperature and increase dissolved oxygen levels;
- Create appropriate in-stream habitat;
- Create appropriate terrestrial habitat; and
- Decrease channel velocities.

The following project objectives were established to meet these primary and secondary goals:

- Riffle cross-sections of the restoration and enhancement reaches were constructed to remain stable and will show little change in bankfull area, maximum depth ratio, and width-to-depth ratio over time.
- The project was constructed so that the bedform features of the restoration reaches will remain stable overtime. This includes riffles that will remain steeper and shallower than the pools and pools that are deep with flat water surface slopes. The relative percentage of riffles and pools will not change significantly over time. Banks will be constructed so that bank height ratios will remain very near to 1.0 for nearly all of the restoration reaches.
- Stream substrate will remain coarse in the riffles and finer in the pools.
- A free groundwater surface will be present within 12 inches of the ground surface in the restored wetland areas for 7 percent of the growing season measured on consecutive days under typical precipitation conditions.
- Native vegetation appropriate for the wetland and riparian buffer zones were planted throughout both the Wetland and Stream Sites. The planted trees will become well established and survival criteria will be met.
- Off-site nutrient input will be absorbed on-site by filtering flood flows through restored floodplain areas and wetlands, where flood flows can disperse through native vegetation and be captured in vernal pools. Increased surface water residency time will provide contact treatment time and groundwater recharge potential.
- Sediment input from eroding stream banks was reduced by installing bioengineering and in-stream structures while creating a stable channel form using geomorphic design principles. Sediment from off-site sources will be captured by deposition on restored floodplain areas where native vegetation will slow overland flow velocities.
- Restored riffle/step-pool sequences where distinct points of re-aeration can occur will allow for oxygen levels to be maintained in the perennial reaches. Creation of deep pool zones will lower temperature, helping to maintain dissolved oxygen concentrations. Establishment and maintenance of riparian buffers will create long-term shading of the channel flow to minimize thermal heating.
- A channel form that includes riffle/pool sequences and gravel and cobble zones of macroinvertebrate habitat for fish was created. Large woody debris, rock structures, root



wads, and native stream bank vegetation were introduced to substantially increase habitat value.

- Adjacent buffer areas were restored by removing invasive vegetation and planting native vegetation. These areas will be allowed to receive more regular and inundating flows. Riparian wetland areas were restored and enhanced to provide wetland habitat.
- By allowing for more overbank flooding and by increasing channel roughness, local channel velocities can be reduced. This will allow for less bank shear stress, formation of refuge zones during large storm events and zonal sorting of depositional material.

## 1.2 *Monitoring Year 2 Data Assessment*

The final restoration plan was submitted and accepted by NCEP in June 2011. Construction activities were completed by Fluvial Solutions in May 2012. The baseline monitoring and as-built survey (MY-0) were completed between April and May 2012. Annual monitoring will be conducted on the Stream Site for a total of five (5) years. Annual monitoring will be conducted on the Wetland Site for a total of seven (7) years. The close-out for both the Stream Site and Wetland Site is anticipated to commence in 2019.

Annual monitoring and quarterly site visits were conducted during monitoring year 2 (MY-2) to assess the condition of the project. The stream and wetland mitigation success criteria for the Site follow the approved success criteria presented in the Little Troublesome Mitigation Plan (2011).

### 1.2.1 *Vegetative Assessment*

Vegetation assessments were conducted following the Carolina Vegetation Survey (CVS) Level 2 Protocol for Recording Vegetation (Lee et al, 2008). A total of 35 vegetation plots were established during the baseline monitoring within the project easement areas (22 at the Wetland Site; 13 at the Stream Site) using standard 10 meter by 10 meter vegetation monitoring plots. Due to the narrow planted corridor along UT1, vegetation plots were not established. Instead, a visual assessment of the planted corridor is used to evaluate vegetation growth success. The final vegetative success criteria will be the survival of 260 planted stems per acre in the riparian corridor of the Stream Site at the end of MY-5, and 200 planted stems per acre within the Wetland Site at the end of year seven monitoring (MY-7). The interim measure of vegetative success for the Stream and Wetland Sites will be the survival of at least 320 planted stems per acre at the end of the third monitoring year (MY-3).

The MY-2 vegetation survey on the Wetland Site resulted in an average stem density of 532 stems per acre, which is greater than the interim requirement of 320 stems/acre and approximately 24% less than the baseline (MY-0) density recorded (701 stems/acre). There was an average of 13 stems per plot compared to 17 stems per plot during MY-0 for the Wetland Site. The average stem density on the Stream Site was 781 stems/acre, which is also greater than the interim requirement, but approximately 18% less than the baseline density recorded (953 stems/acre). There was an average of 19 stems per plot compared to 24 stems per plot in MY-0 for the Stream Site.

A total of 33 plots are on track to meet the interim success criteria of 320 stems per acre required for MY-3. Vegetation plots 16 and 17 within the Wetland Site resulted in fewer surviving stems than required to reach the interim success criteria, however the plots currently exceed the final vegetative success criteria of 200 stems per acre density for the Wetland Site in MY-7. Invasive species have been identified onsite at the Stream Site, including Kudzu, Murdannia, Japanese Stilt Grass, Multiflora Rose, Air Potato, and Morning Glory. However, the presence of these species does not appear to be affecting the survivability of planted stems. Please refer to Appendix 3 for vegetation summary tables and raw data tables and Appendix 2 for vegetation plot photographs and the vegetation condition assessment table.



### *Maintenance Plan*

The need for supplemental plantings will be evaluated in Winter 2013/2014. Wildlands will re-evaluate the low stem density areas from the MY-2 vegetation survey during the winter 2013 and determine where and if supplemental planting is needed on the Site. Maintenance of invasive vegetation areas will be assessed in Winter 2013/2014 and will be selectively treated with herbicide in the Spring 2014. Follow up treatments will be conducted annually as necessary to control their spread and dominance.

#### 1.2.2 Stream Assessment

Morphological surveys for the MY-2 were conducted in June 2013. All streams within the Site met the success criteria for MY-2. Please refer to Appendix 2 for the visual assessment table, current condition plan view (CCPV), and photographs and Appendix 4 for morphological data and plots.

Riffle cross-sections surveyed along the restoration reaches have met success criteria for MY-2. The cross-sections appear stable and show little to no change in the bankfull area, maximum depth ratio, or width-to-depth ratio. All surveyed riffle cross-sections fell within the parameters defined for channels of the appropriate Rosgen stream type. The surveyed longitudinal profile data for the stream restoration reaches illustrates that the bedform features are maintaining lateral and vertical stability. The riffles are remaining steeper and shallower than the pools, while the pools are remaining deeper than riffles and maintaining flat water surface slopes. The longitudinal profiles show that the bank height ratios remain very near to 1.0 for all of the restoration reaches. Deposition within pools was documented in the longitudinal profile along UT1. The deposition is not affecting channel stability but will be monitored. In-stream structures, such as root wads used to enhance channel habitat and stability on the outside bank of meander bends are providing stability and habitat as designed. Pattern data will only be completed in MY-5 if there are indicators from the profile or cross-sections that significant geomorphic adjustments have occurred. No changes were observed that indicated a change in the radius of curvature or channel belt width; therefore, pattern data is not included in the MY-2 report.

Substrate materials in the restoration reaches indicate a progression toward and the maintenance of coarser materials in the riffle features and smaller particles in the pool features.

#### 1.2.3 Hydrology Assessment

At the end of the MY-5 period, two (2) or more bankfull events must occur in separate years within the restoration reach. Bankfull events were recorded on Irvin Creek, Little Troublesome Creek, and UT1 by crest gage or onsite observations (wrack lines) during the MY-2 data collection. Please refer to Appendix 5 to review the hydrologic data.

#### 1.2.4 Wetland Assessment

Groundwater monitoring gages were established throughout the wetland restoration, enhancement, and creation areas on the Wetland Site. The gages were installed at appropriate locations so that the data collected will provide an indication of groundwater levels throughout the wetland project area. A total of eight (8) groundwater gages were installed. According to local WETS station in Eden, NC, the growing season in Rockingham County runs from March 25<sup>th</sup> to November 6<sup>th</sup> (226 days). Wildlands installed two (2) soil temperature loggers, one (1) within each wetland, to collect additional growing season data. These probes can be used to better define the growing season using the threshold soil temperature of 41 degrees or higher measured at a depth of 12 inches (USACE, 2010). The probes indicate a longer growing season than that defined for



Rockingham County by the WETS station data. A barotroll logger and a rain gage were also installed onsite. All monitoring gages were downloaded on a quarterly basis and will be maintained on an as needed basis. The onsite rain gage appeared to be malfunctioning during part the growing season, therefore daily and monthly rainfall totals beginning on May 24 are reported from a nearby weather monitoring station (REID) at Upper Piedmont Research Station, Reidsville NC, part of the ECONet/CRONOS database maintained by the State Climate Office of North Carolina. Monitoring gage locations are depicted on the CCPV maps in Appendix 2.

The success criteria for wetland hydrology is to have a free groundwater surface within 12 inches of the ground surface for 7 percent of the growing season, which is measured on consecutive days under typical precipitation conditions. An onsite rainfall gage recorded 16.61 inches of precipitation from January through May 2013. This is lower than the historic precipitation average of 20.02 inches from January through May collected at nearby weather station Reidsville 2 NW, NC7202 between 1971 and 2000 (USDA 2002). In addition, a nearby active weather station (REID) recorded 38.45 inches from January through October of 2013, which is more than the historic precipitation average of 31.34 inches collected at Reidsville 2 NW NC7202 (SCONC 2013, USDA 2002). All of the groundwater monitoring gages met the annual wetland hydrology success criteria. Please refer to Appendix 5 for wetland hydrology data and plots.

### *1.3 Monitoring Year 2 Summary*

Overall, all streams within the Site are stable and functioning as designed. Of the 35 vegetation plots, 33 met the success criteria required for MY-2 as seen in the CCPV. There has been at least two (2) bankfull events recorded along each restored project reach since construction commenced, therefore, the MY5 hydrology attainment requirement has been met for the Site. Currently, all groundwater gages are meeting success criteria for wetland hydrology.

Summary information/data related to the performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Mitigation Plan documents available on NCEEP's website. All raw data supporting the tables and figures in the appendices is available from NCEEP upon request.

## **2.0 Methodology**

Geomorphic data was collected followed the standards outlined in *The Stream Channel Reference Site: An Illustrated Guide to Field Techniques* (Harrelson et al., 1994) and in *Stream Restoration: A Natural Channel Design Handbook* (Doll et al., 2003). Longitudinal and cross-sectional data were collected using a total station and were georeferenced. Reach wide pebble counts were conducted along each restored reach for channel classification. Cross-section substrate analyses conducted in each surveyed riffle followed the 100 count wetted perimeter methodology. Subpavement samples were collected at each surveyed riffle cross-section and processed in an outsourced lab. All CCPV mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using *Pathfinder* and *ArcView*. Crest gages were installed in surveyed riffle cross-sections and monitored quarterly. Hydrology attainment installation and monitoring methods are in accordance with the United States Army Corps of Engineers guidelines (2003). Vegetation monitoring protocols followed the Carolina Vegetation Survey-NCEEP Level 2 Protocol (Lee et al., 2008).



### 3.0 References

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## **APPENDIX 1. General Tables and Figures**







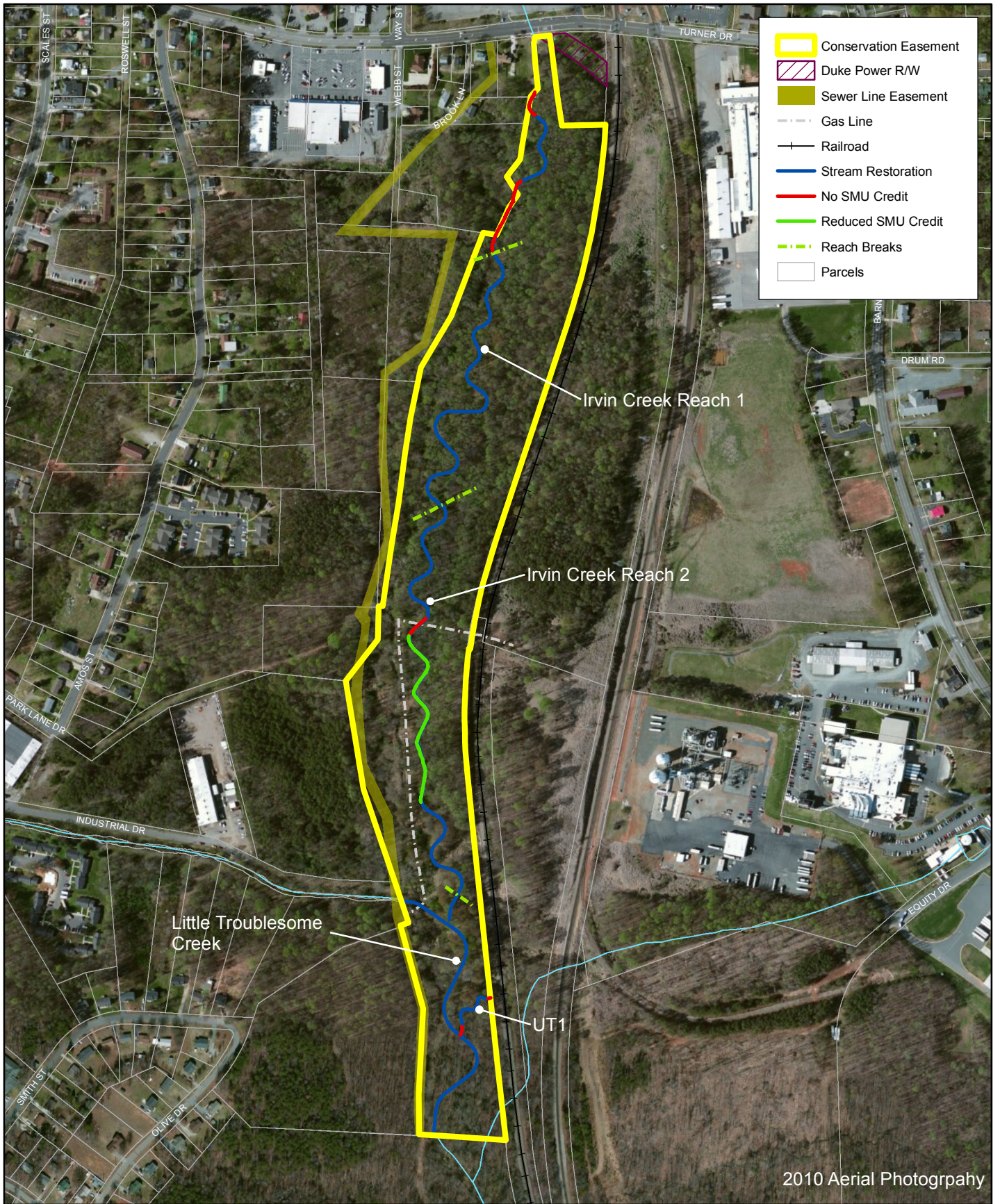
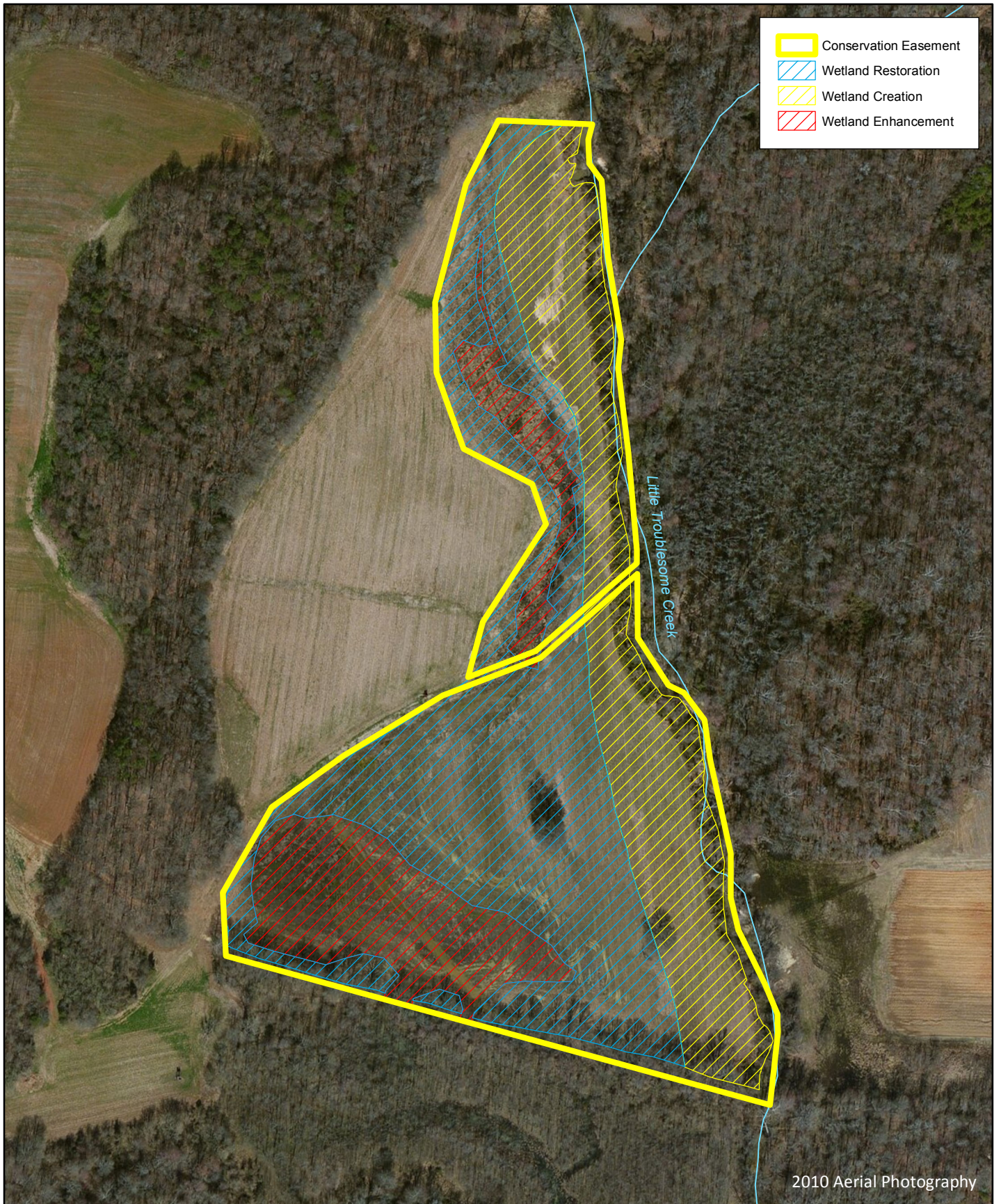


Figure 2a Project Component/Asset Map  
 Little Troublesome Creek Mitigation Site  
 Stream Site  
 NCEEP Project Number 94640  
 Monitoring Year 2  
 Rockingham County, NC

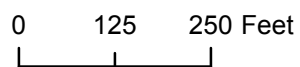






- Conservation Easement
- Wetland Restoration
- Wetland Creation
- Wetland Enhancement

Figure 2b Project Component/Asset Map  
 Little Troublesome Creek Mitigation Site  
 Wetland Site  
 NCEEP Project Number 94640  
 Monitoring Year 2  
 Rockingham County, NC





**Table 1. Project Components and Mitigation Credits**  
**Little Troublesome Creek Mitigation Site (NCEP Project No. 94640)**  
**Monitoring Year 2**

Mitigation Credits									
	Stream		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	5,052	N/A	10.3	2.8	N/A	N/A	N/A	N/A	N/A
Project Components									
Reach ID	As-Built Stationing/ Location	Existing Footage (LF)	Approach	Restoration or Restoration Equivalent	Restoration Footage (LF) / Acreage (Ac)*	Mitigation Ratio			
Irvin Creek - Reach 1	102+10 to 123+05	1,640	Priority 1	Restoration	1,793	1:1			
Irvin Creek - Reach 2	123+05 to 142+37	1,505	Priority 1	Restoration	1,882	1:1			
Little Troublesome Creek	200+00 to 211+71	1,080	Priority 1	Restoration	1,080	1:1			
UT1	400+00 to 402+33	184	Priority 1/2	Restoration	233	1:1			
RW1	N/A	N/A	Restoration	Restoration	8.7	1:1			
RW1	N/A	N/A	Creation	Restoration Equivalent	4.9	3:1			
RW1	N/A	3.7	Enhancement	Restoration Equivalent	3.7	1.3:1**			
Component Summation									
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)		Buffer (square feet)	Upland (acres)		
Restoration	4,988	8.7	-	-	-	-	-		
Enhancement		2.8	-	-	-	-	-		
Enhancement I	-								
Enhancement II	-								
Creation		1.9	-	-	-				
Preservation	-	-	-	-	-		-		
High Quality Preservation	-	-	-	-	-		-		
BMP Elements									
Elements	Location	Purpose/Function		Notes					
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

BR = Bioretention Cell; S F= Sand Filter; SW = Stormwater Wetland; WDP = Wet Detention Pond; DDP = Dry Detention Pond; FS = Filter Strip; S = Grassed Swale; LS = Level Spreader; NI = Natural Infiltration Area; FB = Forested Buffer

\* Note that lengths do not match stationing because channel sections that do not generate credit have been removed from length calculations.

\*\*The higher enhancement ratio was agreed to with Todd Tugwell, with the USACE, during a March 9, 2011 meeting for the several reasons. The higher ratio is warranted because of the low quality of the existing wetland enhancement zone. Currently the enhancement zone, like the restoration and creation zones, is being used for farming. The hydrology of the site has been altered by a drainage ditch and a berm along Little Troublesome Creek. There is no vegetation on the site except for some areas of grasses and cultivated crops. Enhancement activities performed on the site will include improving the hydrology of the enhancement zone (as well as the creation and restoration zones) and restoring the native vegetation. Therefore the functional uplift of the enhancement portion of the project will be nearly the same as that of the restoration zone and, thus, a high ratio for enhancement is appropriate.

Table 2. Project Activity and Reporting History  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Monitoring Year 2

Activity or Report	Date Collection Complete	Completion or Scheduled Delivery
Mitigation Plan	June 2011	June 2011
Final Design - Construction Plans	August 2011	August 2011
Construction	April 2012	May 2012
Temporary S&E mix applied to entire project area <sup>1</sup>	April 2012	May 2012
Permanent seed mix applied to reach/segments	April 2012	May 2012
Bare root plantings for reach/segments	April 2012	May 2012
Baseline Monitoring Document (Year 0 Monitoring - baseline)	April/May 2012	June 2012
Year 1 Monitoring	September/October 2012	December 2012
Year 2 Monitoring	June/October 2013	December 2013
Year 3 Monitoring	2014	December 2014
Year 4 Monitoring	2015	December 2015
Year 5 Monitoring	2016	December 2016
Year 6 Monitoring <sup>2</sup>	2017	December 2017
Year 7 Monitoring <sup>2</sup>	2018	December 2018

<sup>1</sup>Seed and mulch is added as each section of construction is completed.

<sup>2</sup>Monitoring Year 6 and 7 include monitoring the Wetland Site only.

Table 3. Project Contact Table  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Monitoring Year 2

<b>Designer</b>	<b>Wildlands Engineering, Inc.</b> 5605 Chapel Hill Road, Suite 122 Raleigh, NC 27604 919.851.9986
Jeff Keaton, PE	
<b>Construction Contractor</b>	<b>Fluvial Solutions</b> PO Box 28749 Raleigh, NC 28749
Peter Jelenevsky	
<b>Planting Contractor - Stream Site</b>	<b>Fluvial Solutions</b> PO Box 28749 Raleigh, NC 28749
Peter Jelenevsky	
<b>Planting Contractor - Wetland Site</b>	<b>Bruton Natural Systems, Inc.</b> PO Box 1197 Freemont, NC 27830 919.242.6555
Charlie Bruton	
<b>Seeding Contractor - Stream and Wetland Site</b>	<b>Fluvial Solutions</b> PO Box 28749 Raleigh, NC 28749
Peter Jelenevsky	
<b>Seed Mix Sources</b>	<b>Mellow Marsh Farm</b>
<b>Nursery Stock Suppliers</b>	<b>Arborgen Dykes and Son Nursery NC Forestry Service, Claridge Nursery</b>
<b>Monitoring Performers</b>	<b>Wildlands Engineering, Inc.</b> Kirsten Y. Gimbert 704.332.7754, ext. 110
Stream, Vegetation, and Wetland Monitoring, POC	

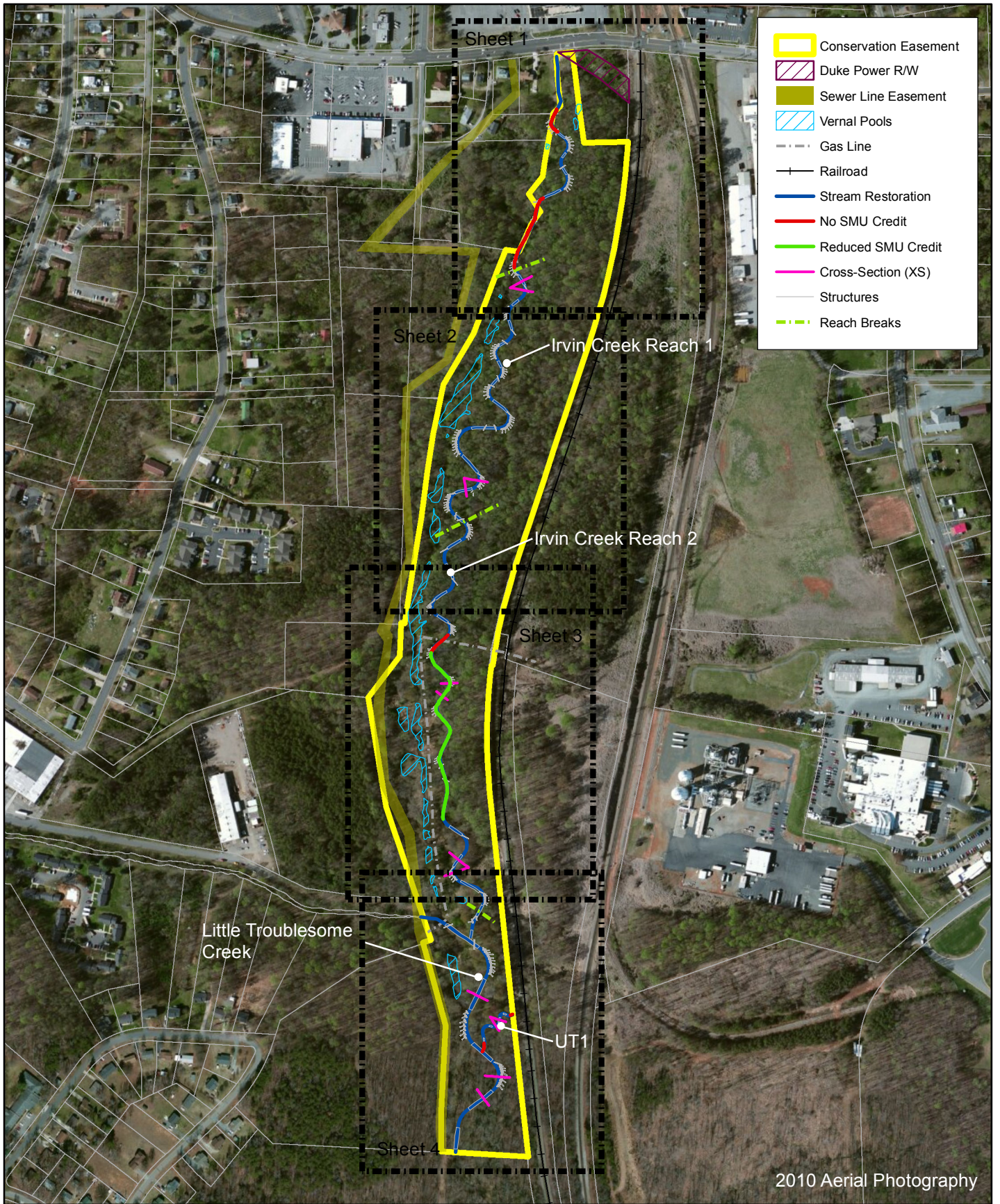
Table 4. Project Baseline Information and Attributes  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Monitoring Year 2

Project Information					
Project Name	Little Troublesome Creek Mitigation Site				
County	Rockingham				
Project Area (acres)	Stream Site: 33 acres, Wetland Site: 19 acres				
Project Coordinates (latitude and longitude)	36° 20' 96"N, 79° 39' 31"W				
Project Watershed Summary Information					
Physiographic Province	Inner Piedmont Belt of the Piedmont				
River Basin	Cape Fear				
USGS Hydrologic Unit 8-digit	03030002				
USGS Hydrologic Unit 14-digit	03030002010030				
DWQ Sub-basin	03-06-01				
Project Drainage Area (acres)	3,254				
Project Drainage Area Percentage of Impervious Area	17%				
CGIA Land Use Classification	55% Forest Land, 17% Cultivated Land, 28% Developed				
Reach Summary Information					
Parameters	Irvin Creek Reach 1	Irvin Creek Reach 2	Little Troublesome Creek	UT1	RW1
Length of reach (linear feet) - Post-Restoration	2,095	1,932	1,171	233	N/A
Drainage area (acres)	525	584	3,245	62	N/A
NCDWQ stream identification score	45	45	45.5	26.5	N/A
NCDWQ Water Quality Classification	C	C	C; NSW	C	C; NSW
Morphological Description (stream type)	Perennial	Perennial	Perennial	Intermittent	N/A
Evolutionary trend (Simon's Model) - Pre- Restoration	Stage IV	Stage IV	Stage IV	Stage IV	N/A
Underlying mapped soils	CsA	CsA	CsA	CsA	CsA / HcA
Drainage class	Somewhat Poorly-Drained	Somewhat Poorly-Drained	Somewhat Poorly-Drained	Somewhat Poorly-Drained	Somewhat Poorly-Drained / Poorly Drained
Soil Hydric status	No	No	No	No	No / Yes
Slope	0-2%	0-2%	0-2%	0-2%	0-2%
FEMA classification	Zone AE				
Native vegetation community	Bottom-land forest				
Percent composition of exotic invasive vegetation - Post-Restoration	0%				
Regulatory Considerations					
Regulation	Applicable?	Resolved?	Supporting Documentation		
Waters of the United States - Section 404	X	X	Little Troublesome Creek Mitigation Plan; USACE Nationwide Permit No.27 and DWQ 401 Water Quality Certification No. 3689		
Waters of the United States - Section 401	X	X			
Division of Land Quality (Dam Safety)	N/A	N/A	N/A		
Endangered Species Act	X	X	Little Troublesome Creek Mitigation Plan; studies found "no effect" (letter from USFWS)		
Historic Preservation Act	X	X	Little Troublesome Creek Mitigation Plan; No historic resources were found to be impacted		
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	N/A	N/A	N/A		
FEMA Floodplain Compliance	X	X	Approved CLOMR		
Essential Fisheries Habitat	N/A	N/A	N/A		

\*LF provided included portions of the stream that will be monitoring and have been reconstructed, but for which mitigation credit will not be claimed. Please refer to Table 1 for the credit summary lengths.

## APPENDIX 2. Visual Assessment Data





- Conservation Easement
- Duke Power R/W
- Sewer Line Easement
- Vernal Pools
- Gas Line
- Railroad
- Stream Restoration
- No SMU Credit
- Reduced SMU Credit
- Cross-Section (XS)
- Structures
- Reach Breaks

Figure 3.0 Integrated Current Condition Plan View (Key)

Little Troublesome Creek Mitigation Site  
 Stream Site  
 NCEEP Project Number 94640  
 Monitoring Year 2

Rockingham County, NC





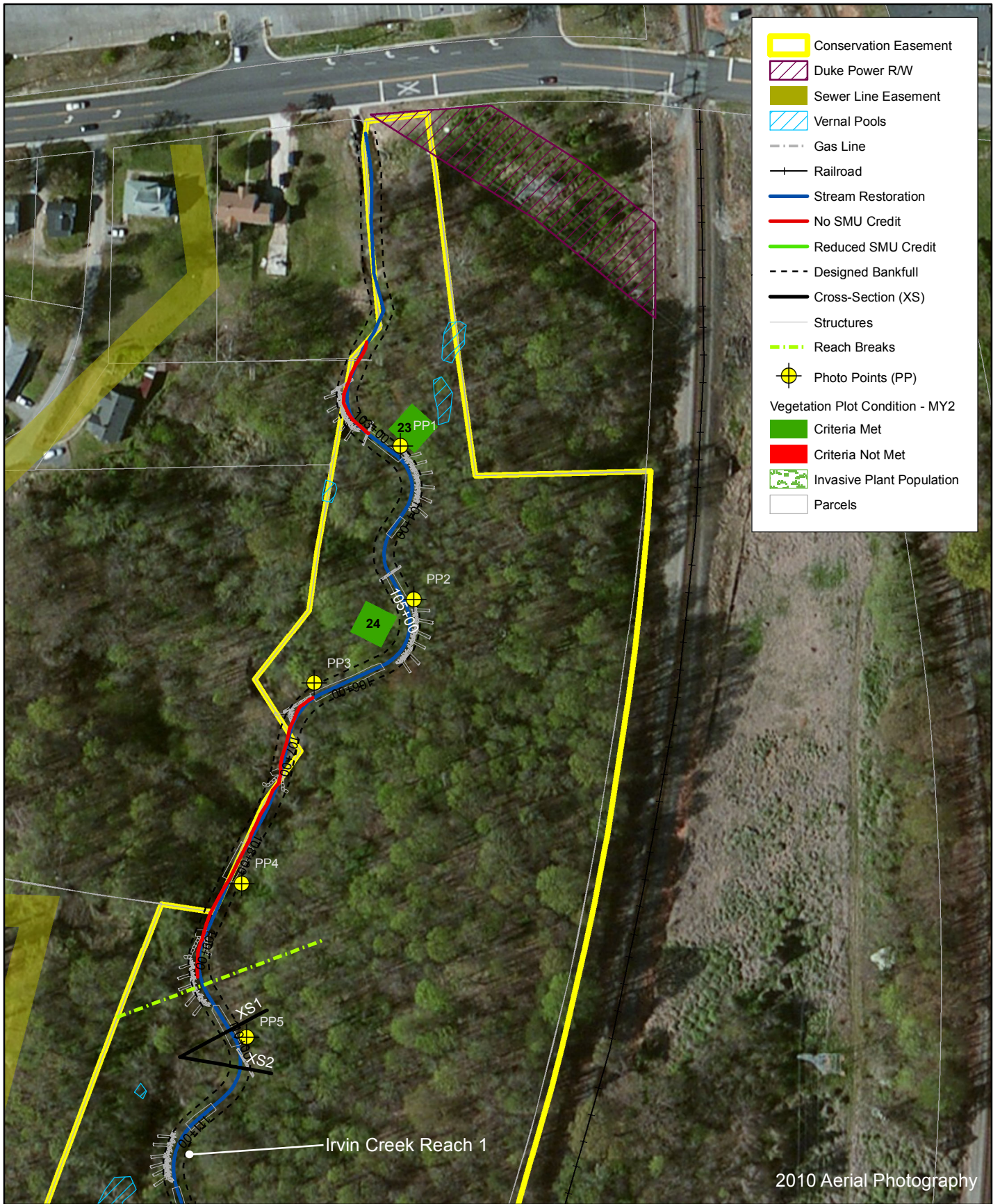
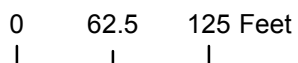


Figure 3.1 Integrated Current Condition Plan View  
(Sheet 1 of 4)

Little Troublesome Creek Mitigation Site  
Stream Site  
NCEEP Project Number 94640  
Monitoring Year 2

Rockingham County, NC





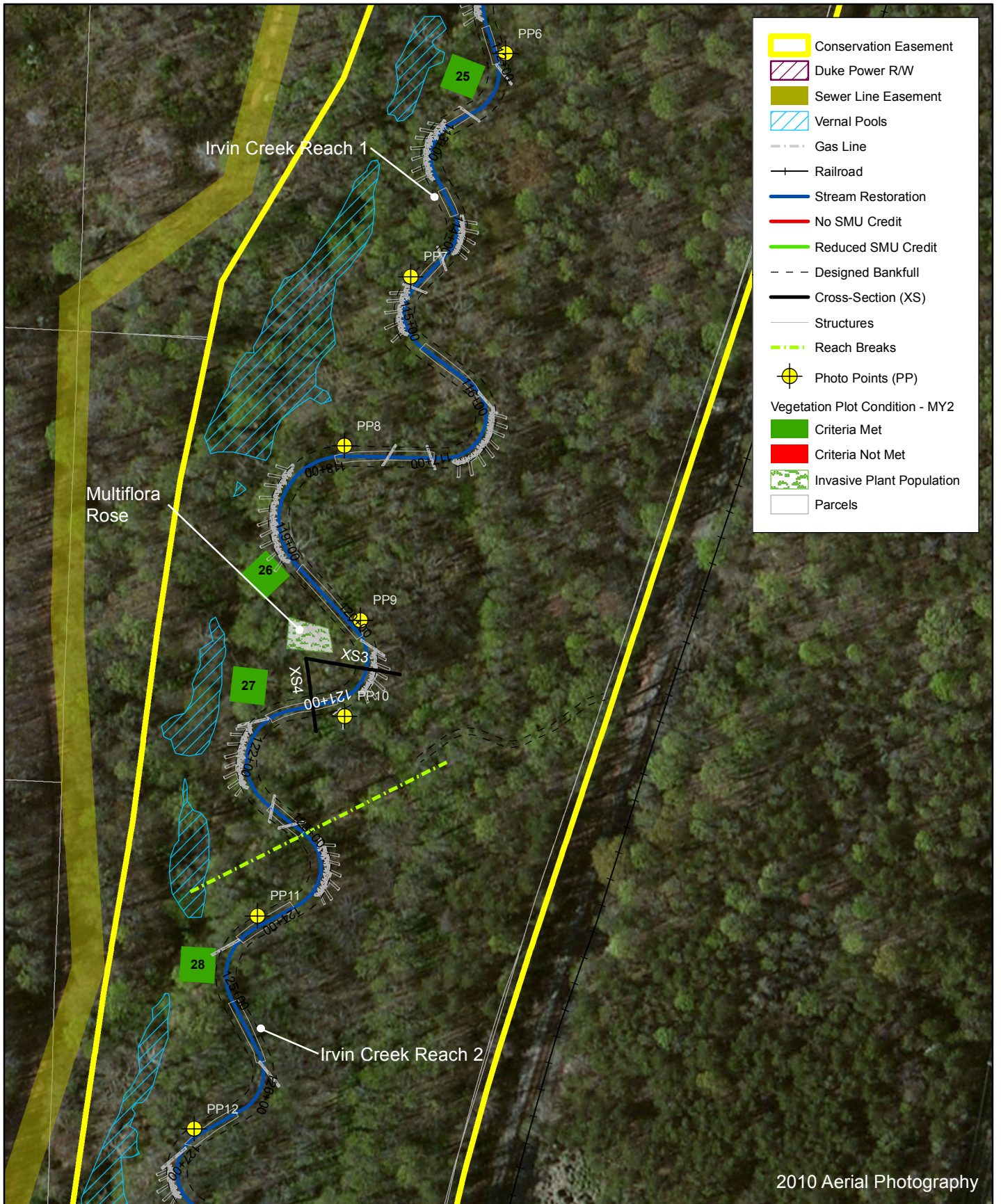


Figure 3.2 Integrated Current Condition Plan View  
(Sheet 2 of 4)

Little Troublesome Creek Mitigation Site  
Stream Site  
NCEEP Project Number 94640  
Monitoring Year 2

Rockingham County, NC





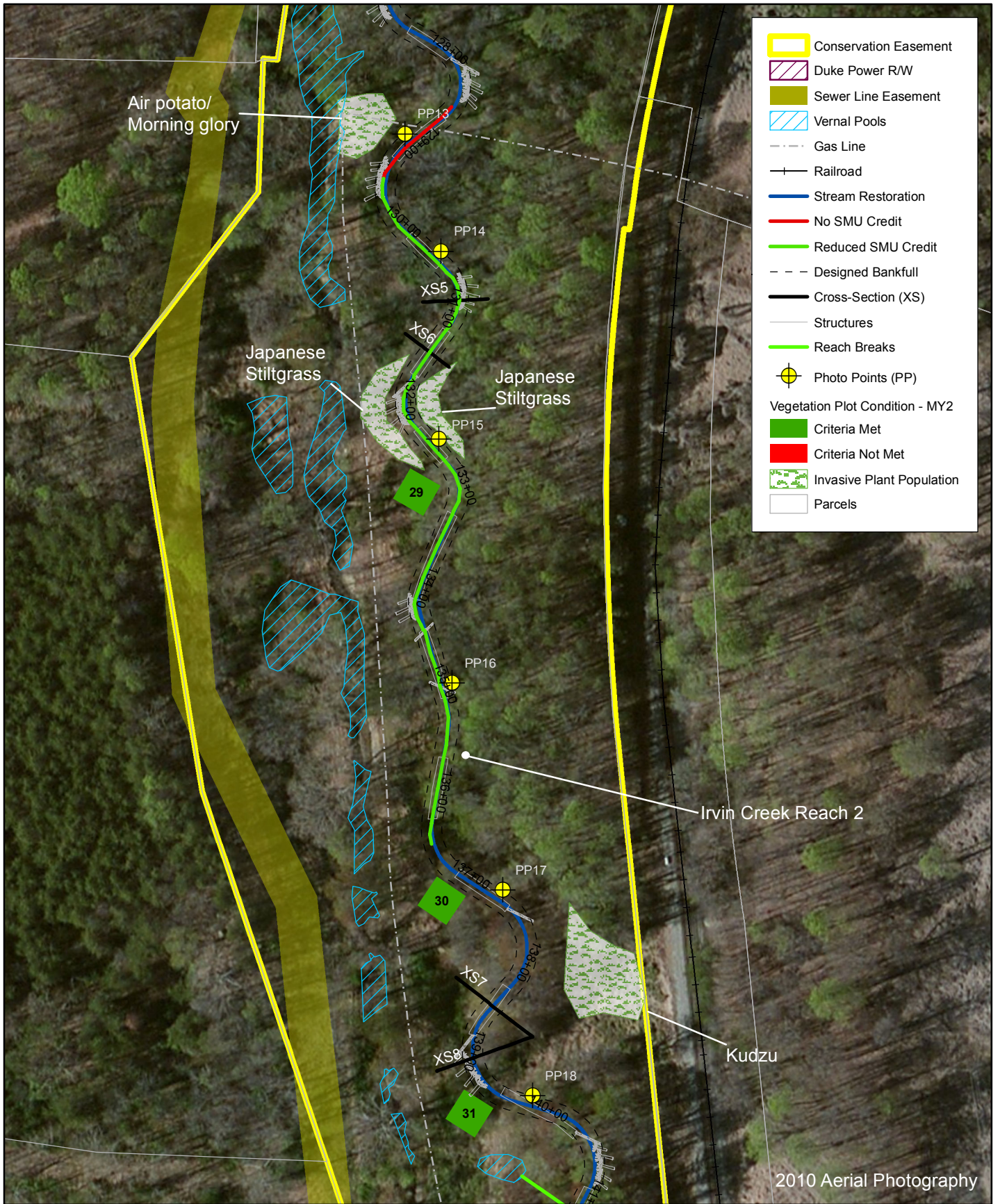
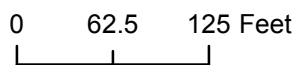


Figure 3.3 Integrated Current Condition Plan View  
(Sheet 3 of 4)

Little Troublesome Creek Mitigation Site  
Stream Site  
NCEEP Project Number 94640  
Monitoring Year 2

Rockingham County, NC





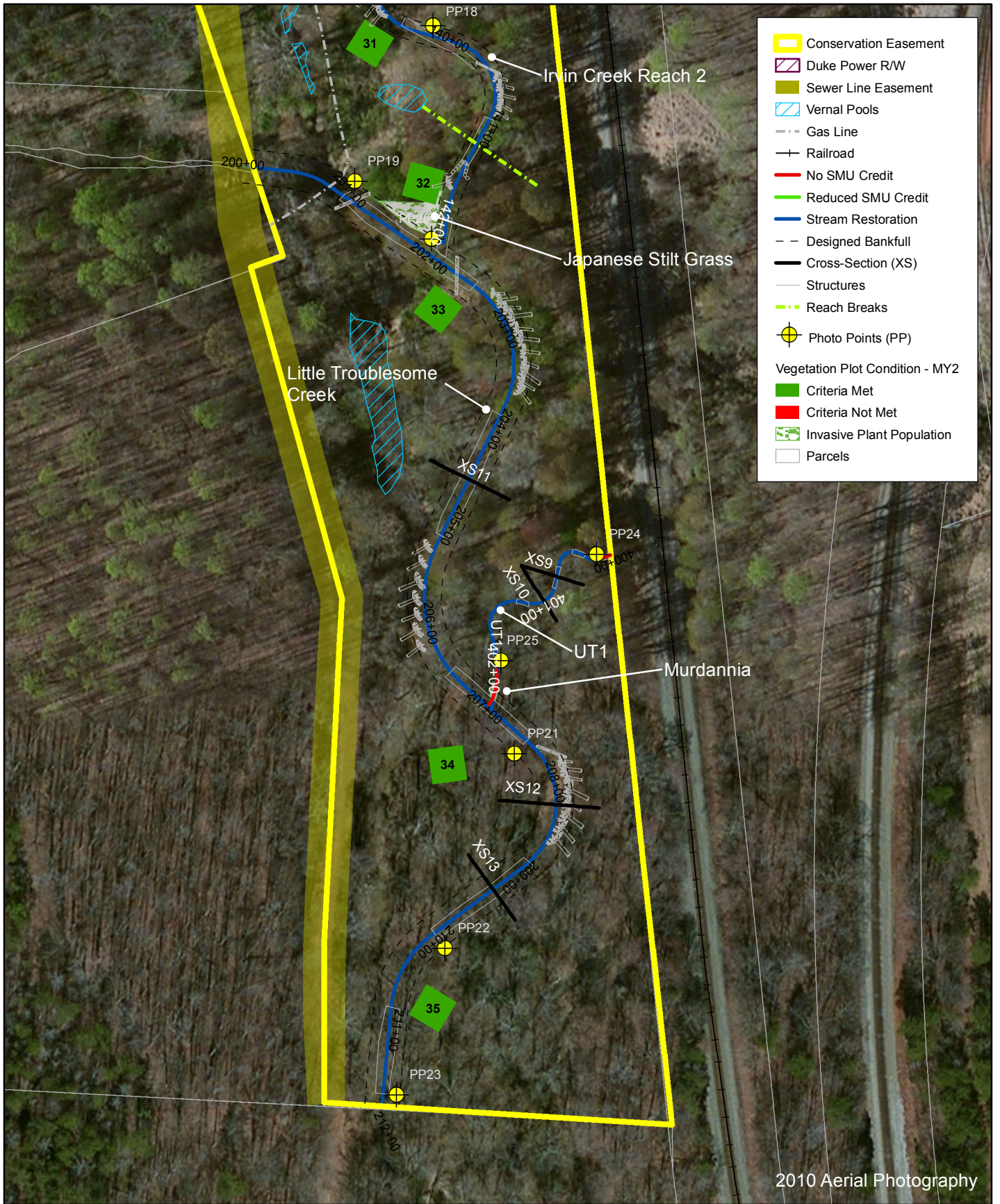
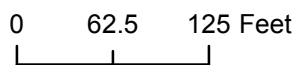


Figure 3.4 Integrated Current Condition Plan View  
(Sheet 4 of 4)

Little Troublesome Creek Mitigation Site  
Stream Site  
NCEEP Project Number 94640  
Monitoring Year 2

Rockingham County, NC





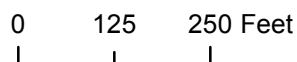
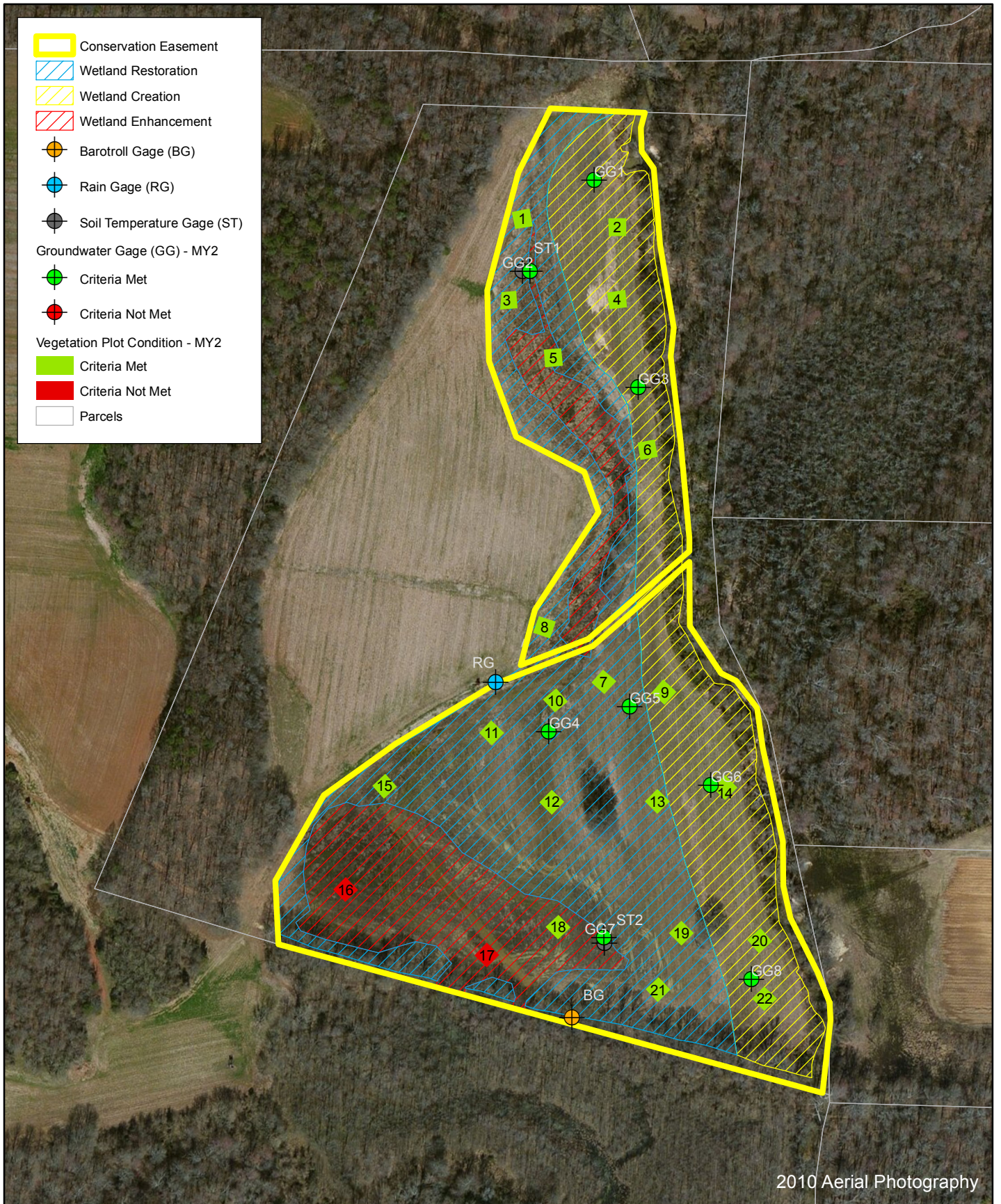


Figure 3.5 Integrated Current Condition Plan View  
 Little Troublesome Creek Mitigation Site  
 Wetland Site  
 NCEEP Project Number 94640  
 Monitoring Year 2



Table 5a. Visual Stream Morphology Stability Assessment Table  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Irvin Creek Reach 1 (1,793 LF)  
 Monitoring Year 2

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
<b>1. Bed</b>	<b>1. Vertical Stability (Riffle and Run units)</b>	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	<b>2. Riffle Condition</b>	Texture/Substrate	16	16			100%			
	<b>3. Meander Pool Condition</b>	Depth Sufficient	16	16			100%			
		Length Appropriate	16	16			100%			
	<b>4. Thalweg Position</b>	Thalweg centering at upstream of meander bend (Run)	16	16			100%			
Thalweg centering at downstream of meander bend (Glide)		16	16	100%						
<b>2. Bank</b>	<b>1. Scoured/Eroded</b>	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	<b>2. Undercut</b>	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	0	0	100%
	<b>3. Mass Wasting</b>	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
<b>Totals</b>					0	0	100%	0	0	100%
<b>3. Engineered Structures</b>	<b>1. Overall Integrity</b>	Structures physically intact with no dilodged boulders or logs.	36	36			100%			
	<b>2. Grade Control</b>	Grade control structures exhibiting maintenance of grade across the sill	24	24			100%			
	<b>2a. Piping</b>	Structures lacking any substantial flow underneath sills or arms.	24	24			100%			
	<b>3. Bank Protection</b>	Bank erosion within the structures extent of influence does not exceed 15%.	31	31			100%			
	<b>4. Habitat</b>	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	12	12			100%			

Table 5b. Visual Stream Morphology Stability Assessment Table  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Irvin Creek Reach 2 (1,882 LF)  
 Monitoring Year 2

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
<b>1. Bed</b>	<b>1. Vertical Stability (Riffle and Run units)</b>	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	<b>2. Riffle Condition</b>	Texture/Substrate	16	16			100%			
	<b>3. Meander Pool Condition</b>	Depth Sufficient	15	15			100%			
		Length Appropriate	15	15			100%			
	<b>4. Thalweg Position</b>	Thalweg centering at upstream of meander bend (Run)	15	15			100%			
Thalweg centering at downstream of meander bend (Glide)		15	15	100%						
<b>Totals</b>										
<b>2. Bank</b>	<b>1. Scoured/Eroded</b>	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	<b>2. Undercut</b>	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	0	0	100%
	<b>3. Mass Wasting</b>	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
<b>Totals</b>										
<b>3. Engineered Structures</b>	<b>1. Overall Integrity</b>	Structures physically intact with no dilodged boulders or logs.	35	35			100%			
	<b>2. Grade Control</b>	Grade control structures exhibiting maintenance of grade across the sill	19	19			100%			
	<b>2a. Piping</b>	Structures lacking any substantial flow underneath sills or arms.	9	9			100%			
	<b>3. Bank Protection</b>	Bank erosion within the structures extent of influence does not exceed 15%.	19	19			100%			
	<b>4. Habitat</b>	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	19	19			100%			

Table 5c. Visual Stream Morphology Stability Assessment Table  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 UT1 (233 LF)  
 Monitoring Year 2

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	6	6		100%				
	3. Meander Pool Condition	Depth Sufficient	4	4		100%				
		Length Appropriate	4	4		100%				
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	4	4		100%				
Thalweg centering at downstream of meander bend (Glide)		4	4	100%						
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
<b>Totals</b>					0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dilodged boulders or logs.	6	6			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	6	6			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	0	0			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	0	0			100%			

Table 5d. Visual Stream Morphology Stability Assessment Table  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Little Troublesome Creek (1,080 LF)  
 Monitoring Year 2

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
<b>1. Bed</b>	<b>1. Vertical Stability (Riffle and Run units)</b>	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	<b>2. Riffle Condition</b>	Texture/Substrate	5	5			100%			
	<b>3. Meander Pool Condition</b>	Depth Sufficient	4	4			100%			
		Length Appropriate	4	4			100%			
	<b>4. Thalweg Position</b>	Thalweg centering at upstream of meander bend (Run)	4	4			100%			
		Thalweg centering at downstream of meander bend (Glide)	4	4			100%			
<b>2. Bank</b>	<b>1. Scoured/Eroded</b>	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	<b>2. Undercut</b>	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	0	0	100%
	<b>3. Mass Wasting</b>	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
<b>Totals</b>					0	0	100%	0	0	100%
<b>3. Engineered Structures</b>	<b>1. Overall Integrity</b>	Structures physically intact with no dilodged boulders or logs.	9	9			100%			
	<b>2. Grade Control</b>	Grade control structures exhibiting maintenance of grade across the sill	6	6			100%			
	<b>2a. Piping</b>	Structures lacking any substantial flow underneath sills or arms.	1	1			100%			
	<b>3. Bank Protection</b>	Bank erosion within the structures extent of influence does not exceed 15%.	4	4			100%			
	<b>4. Habitat</b>	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	4	4			100%			



Table 6. Vegetation Condition Assessment Table  
 Little Troublesome Creek Mitigation Site (EEP Project No. 94640)  
 Monitoring Year 2

Planted Acreage **33.7**

Vegetation Category	Definitions	Mapping Threshold (acres)	Number of Polygons	Combined Acreage	% of Planted Acreage*
Bare Areas	Very limited cover of both woody and herbaceous material	0.1	0	0	0.00%
Low Stem Density Areas^	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1	2	0.04	0.1%
<b>Total</b>			<b>2</b>	<b>0.04</b>	<b>0.1%</b>
Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	0	0	0%
<b>Cumulative Total</b>			<b>2</b>	<b>0.0</b>	<b>0%</b>

Easement Acreage **52**

Vegetation Category	Definitions	Mapping Threshold (SF)	Number of Polygons	Combined Acreage	% of Planted Acreage
Invasive Areas of Concern	Areas of points (if too small to render as polygons at map scale).	1000	5	0.31	1%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	0	0	0%

## Stream Photographs





Photo Point 1 – looking upstream (5/29/2013)



Photo Point 1 – looking downstream (5/29/2013)



Photo Point 2 – looking upstream (5/29/2013)



Photo Point 2 – looking downstream (5/29/2013)



Photo Point 3 – looking upstream (5/29/2013)

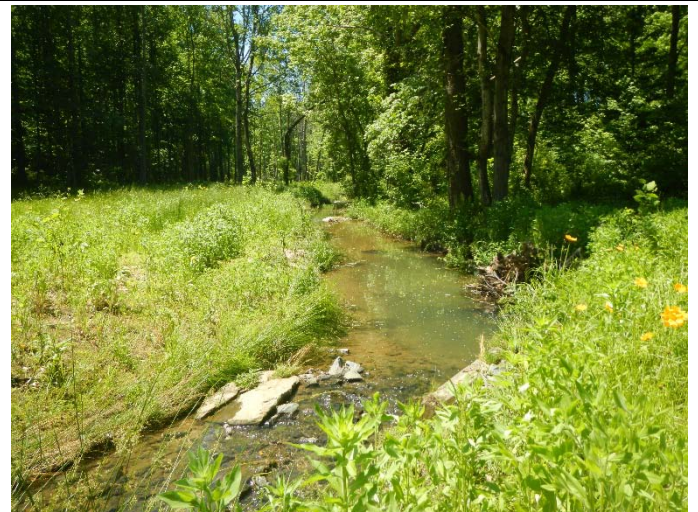


Photo Point 3 – looking downstream (5/29/2013)







Photo Point 4 – looking upstream (5/29/2013)



Photo Point 4 – looking downstream (5/29/2013)



Photo Point 5 – looking upstream (5/29/2013)



Photo Point 5 – looking downstream (5/29/2013)



Photo Point 6 – looking upstream (5/29/2013)



Photo Point 6 – looking downstream (5/29/2013)







Photo Point 7 – looking upstream (5/29/2013)



Photo Point 7 – looking downstream (5/29/2013)



Photo Point 8 – looking upstream (5/29/2013)



Photo Point 8 – looking downstream (5/29/2013)

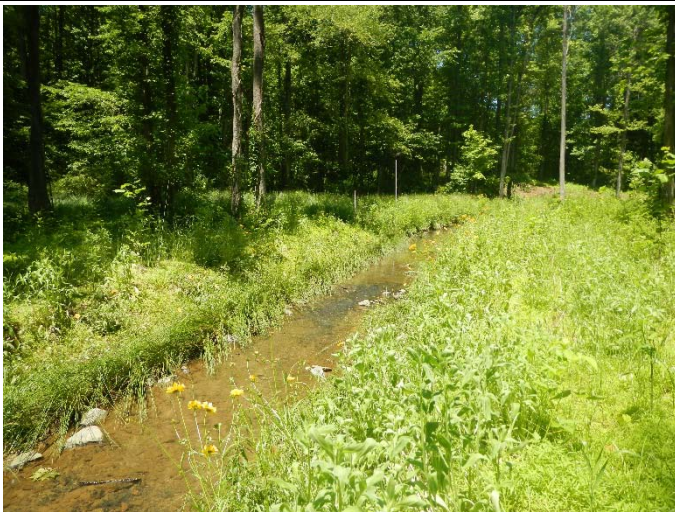


Photo Point 9 – looking upstream (5/29/2013)



Photo Point 9 – looking downstream (5/29/2013)







Photo Point 10 – looking upstream (5/29/2013)



Photo Point 10 – looking downstream (5/29/2013)

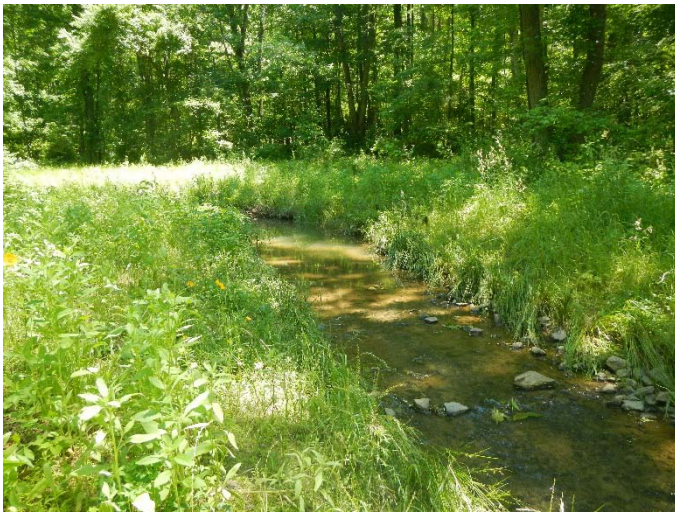


Photo Point 11 – looking upstream (5/29/2013)



Photo Point 11 – looking downstream (5/29/2013)



Photo Point 12 – looking upstream (5/29/2013)



Photo Point 12 – looking downstream (5/29/2013)







Photo Point 13 – looking upstream (5/29/2013)

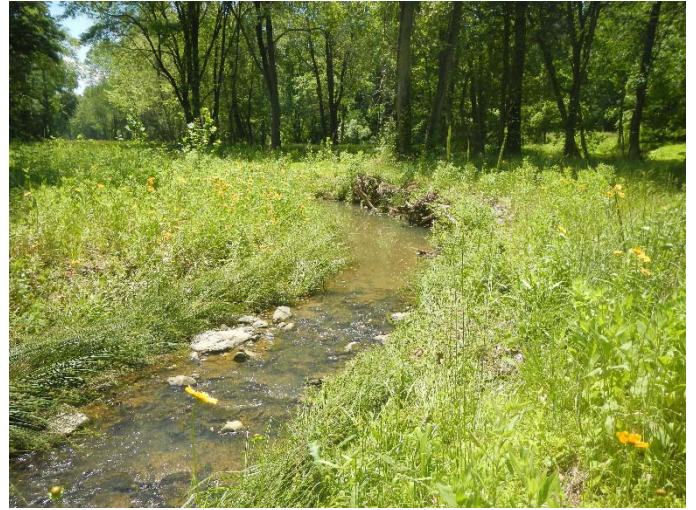


Photo Point 13 – looking downstream (5/29/2013)



Photo Point 14 – looking upstream (5/29/2013)



Photo Point 14 – looking downstream (5/29/2013)

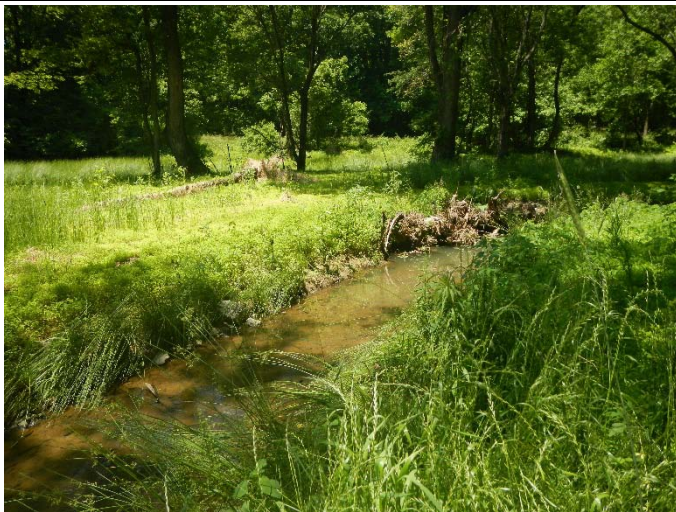


Photo Point 15 – looking upstream (5/29/2013)



Photo Point 15 – looking downstream (5/29/2013)







Photo Point 16 – looking upstream (5/29/2013)



Photo Point 16 – looking downstream (5/29/2013)



Photo Point 17 – looking upstream (5/29/2013)



Photo Point 17 – looking downstream (5/29/2013)



Photo Point 18 – looking upstream (5/29/2013)



Photo Point 18 – looking downstream (5/29/2013)







Photo Point 19 – looking upstream (5/29/2013)



Photo Point 19 – looking downstream (5/29/2013)



Photo Point 20 – looking upstream - Irvin (5/29/2013)



Photo Point 20 – looking upstream – LTC (5/29/2013)



Photo Point 20 – looking downstream - LTC (5/29/2013)







Photo Point 21 – looking upstream (5/29/2013)



Photo Point 21 – looking downstream (5/29/2013)



Photo Point 22 – looking upstream (5/29/2013)



Photo Point 22 – looking downstream (5/29/2013)



Photo Point 23 – looking upstream (5/29/2013)

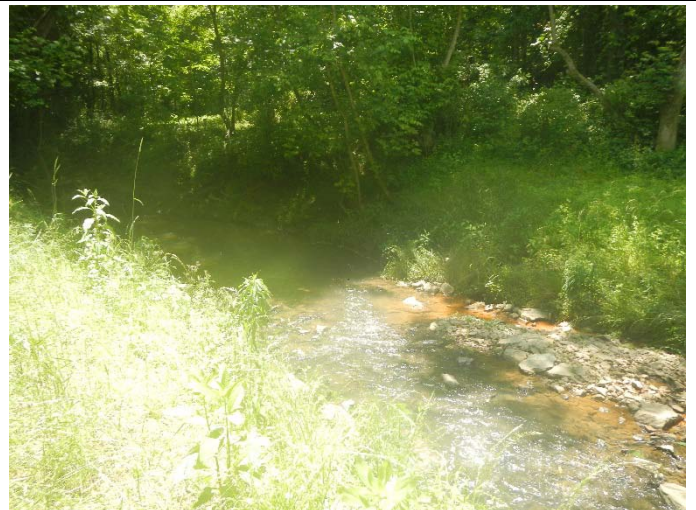


Photo Point 23 – looking downstream (5/29/2013)







Photo Point 24 – looking upstream (5/29/2013)



Photo Point 24 – looking downstream (5/29/2013)



Photo Point 25 – looking upstream (5/29/2013)



Photo Point 25 – looking downstream (5/29/2013)



## Wetland Site Vegetation Photographs





Vegetation Plot 1 (06/25/2013)



Vegetation Plot 2 (06/25/2013)



Vegetation Plot 3 (06/26/2013)



Vegetation Plot 4 (06/25/2013)



Vegetation Plot 5 (06/26/2013)



Vegetation Plot 6 (06/25/2013)







Vegetation Plot 7 (06/25/2013)



Vegetation Plot 8 (06/25/2013)



Vegetation Plot 9 (06/25/2013)



Vegetation Plot 10 (06/25/2013)



Vegetation Plot 11 (06/26/2013)



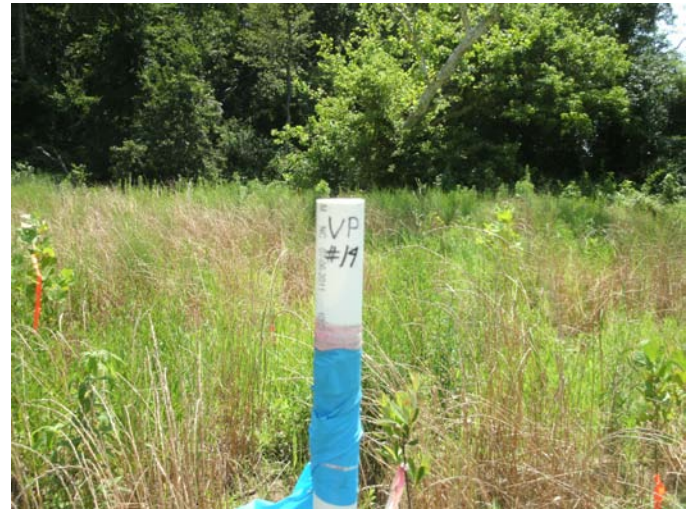
Vegetation Plot 12 (06/24/2013)







Vegetation Plot 13 (06/24/2013)



Vegetation Plot 14 (06/24/2013)



Vegetation Plot 15 (06/26/2013)



Vegetation Plot 16 (06/24/2013)



Vegetation Plot 17 (06/24/2013)



Vegetation Plot 18 (06/24/2013)







Vegetation Plot 19 (06/24/2013)



Vegetation Plot 20 (06/24/2013)



Vegetation Plot 21 (06/24/2013)



Vegetation Plot 22 (06/24/2013)





## Stream Site Vegetation Photographs





Vegetation Plot 23 (6/27/2013)



Vegetation Plot 24 (6/27/2013)



Vegetation Plot 25 (6/27/2013)



Vegetation Plot 26 (6/27/2013)



Vegetation Plot 27 (6/27/2013)



Vegetation Plot 28 (6/27/2013)







Vegetation Plot 29 (6/27/2013)



Vegetation Plot 30 (6/27/2013)



Vegetation Plot 31 (6/27/2013)



Vegetation Plot 32 (6/27/2013)



Vegetation Plot 33 (6/27/2013)



Vegetation Plot 34 (6/27/2013)







Vegetation Plot 35 (6/27/2013)





## APPENDIX 3. Vegetation Plot Data



Table 7. Vegetation Plot Criteria Attainment  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Monitoring Year 2

Plot	MY2 Success Criteria Met (Y/N)	Tract Mean
1	Y	94%
2	Y	
3	Y	
4	Y	
5	Y	
6	Y	
7	Y	
8	Y	
9	Y	
10	Y	
11	Y	
12	Y	
13	Y	
14	Y	
15	Y	
16	N	
17	N	
18	Y	
19	Y	
20	Y	
21	Y	
22	Y	
23	Y	
24	Y	
25	Y	
26	Y	
27	Y	
28	Y	
29	Y	
30	Y	
31	Y	
32	Y	
33	Y	
34	Y	
35	Y	



Table 8a. CVS Vegetation Tables - Metadata  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Wetland Site  
 Monitoring Year 2

<b>Report Prepared By</b>	Alea Tuttle
<b>Date Prepared</b>	7/17/2013 10:36
<b>database name</b>	CVS Data Table Output- Wetland Site MY2
<b>database location</b>	\\WILDNCSVR\Projects\ActiveProjects\005-02124 Little Troublesome Creek FDP\Monitoring\Monitoring Year 2\Vegetation Assessment
<b>DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----</b>	
<b>Metadata</b>	<i>This worksheet, which is a summary of the project and the project data.</i>
<b>Plots</b>	<i>List of plots surveyed.</i>
<b>Vigor</b>	<i>Frequency distribution of vigor classes.</i>
<b>Vigor by Spp</b>	<i>Frequency distribution of vigor classes listed by species.</i>
<b>Damage</b>	<i>List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.</i>
<b>Damage by Spp</b>	<i>Damage values tallied by type for each species.</i>
<b>Damage by Plot</b>	<i>Damage values tallied by type for each plot.</i>
<b>Stem Count by Plot and Spp</b>	<i>Unknown</i>
<b>PROJECT SUMMARY-----</b>	
<b>Project Code</b>	94640
<b>project Name</b>	Little Troublesome Creek-Cotton Rd Site
<b>Description</b>	Wetland Mitigation Site
<b>length (ft)</b>	n/a
<b>stream-to-edge width (ft)</b>	n/a
<b>area (sq m)</b>	72843.42
<b>Required Plots (calculated)</b>	16
<b>Sampled Plots</b>	22

Table 8b. CVS Vegetation Tables - Metadata  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Stream Site  
 Monitoring Year 2

<b>Report Prepared By</b>	Alea Tuttle
<b>Date Prepared</b>	10/2/2013 0:00
<b>database name</b>	CVS Data Table Output- Stream Site MY2
<b>database location</b>	\\WILDNC SVR\Projects\ActiveProjects\005-02124 Little Troublesome Creek FDP\Monitoring\Monitoring Year 1\Vegetation Assessment
<b>DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----</b>	
<b>Metadata</b>	<i>This worksheet, which is a summary of the project and the project data.</i>
<b>Plots</b>	<i>List of plots surveyed.</i>
<b>Vigor</b>	<i>Frequency distribution of vigor classes.</i>
<b>Vigor by Spp</b>	<i>Frequency distribution of vigor classes listed by species.</i>
<b>Damage</b>	<i>List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.</i>
<b>Damage by Spp</b>	<i>Damage values tallied by type for each species.</i>
<b>Damage by Plot</b>	<i>Damage values tallied by type for each plot.</i>
<b>Stem Count by Plot and Spp</b>	<i>Unknown</i>
<b>PROJECT SUMMARY-----</b>	
<b>Project Code</b>	94640
<b>project Name</b>	Little Troublesome Mitigation Site
<b>Description</b>	Stream Mitigation Site
<b>length (ft)</b>	n/a
<b>stream-to-edge width (ft)</b>	n/a
<b>area (sq m)</b>	50990.39
<b>Required Plots (calculated)</b>	13
<b>Sampled Plots</b>	13



Table 9. Planted and Total Stem Counts  
 Little Troublesome Creek (EEP Project No. 94640)  
 Wetland Site  
 Monitoring Year 2

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2013)														
			94640-WEI-0001			94640-WEI-0002			94640-WEI-0003			94640-WEI-0004			94640-WEI-0005		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Alnus serrulata</i>	hazel alder	Shrub	2	2	2	1	1	1	2	2	2	2	2	2	1	1	1
<i>Betula nigra</i>	river birch	Tree	1	1	1	1	1	1	3	3	3	3	3	3			
<i>Cornus amomum</i>	silky dogwood	Shrub										4	4	4			
<i>Fraxinus americana</i>	white ash	Tree															
<i>Fraxinus pennsylvanica</i>	green ash	Tree				3	3	3	6	6	6	1	1	1	10	10	10
<i>Nyssa sylvatica</i>	blackgum	Tree							2	2	2	3	3	3	5	5	5
<i>Platanus occidentalis</i>	American sycamore	Tree	7	7	7	2	2	2	5	5	5				3	3	3
<i>Quercus michauxii</i>	swamp chestnut oak	Tree	2	2	2	3	3	3				1	1	1	1	1	1
<i>Quercus phellos</i>	willow oak	Tree	1	1	1				1	1	1	4	4	4			
Unknown		Shrub/Tree															
<b>Stem count</b>			13	13	13	10	10	10	19	19	19	18	18	18	20	20	20
<b>size (ACRES)</b>			0.02			0.02			0.02			0.02			0.02		
<b>Species count</b>			5	5	5	5	5	5	6	6	6	7	7	7	5	5	5
<b>Stems per ACRE</b>			526	526	526	405	405	405	769	769	769	728	728	728	809	809	809

**Color for Density**

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes

T: Total Stems

Table 9. Planted and Total Stem Counts  
 Little Troublesome Creek (EEP Project No. 94640)  
 Wetland Site  
 Monitoring Year 2

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2013)														
			94640-WEI-0006			94640-WEI-0007			94640-WEI-0008			94640-WEI-0009			94640-WEI-0010		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Alnus serrulata</i>	hazel alder	Shrub															
<i>Betula nigra</i>	river birch	Tree	3	3	3	3	3	3	2	2	2	6	6	6	2	2	2
<i>Cornus amomum</i>	silky dogwood	Shrub	5	5	5				2	2	2				2	2	2
<i>Fraxinus americana</i>	white ash	Tree															
<i>Fraxinus pennsylvanica</i>	green ash	Tree	2	2	2	8	8	8				1	1	1	2	2	2
<i>Nyssa sylvatica</i>	blackgum	Tree							3	3	3	4	4	4			
<i>Platanus occidentalis</i>	American sycamore	Tree	1	1	1	3	3	3	5	5	5				4	4	4
<i>Quercus michauxii</i>	swamp chestnut oak	Tree													4	4	4
<i>Quercus phellos</i>	willow oak	Tree	1	1	1	1	1	1				5	5	5	1	1	1
Unknown		Shrub/Tree															
<b>Stem count</b>			12	12	12	15	15	15	13	13	13	16	16	16	15	15	15
<b>size (ACRES)</b>			0.02			0.02			0.02			0.02			0.02		
<b>Species count</b>			5	5	5	4	4	4	5	5	5	4	4	4	6	6	6
<b>Stems per ACRE</b>			486	486	486	607	607	607	526	526	526	647	647	647	607	607	607

**Color for Density**

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes

T: Total Stems



Table 9. Planted and Total Stem Counts  
 Little Troublesome Creek (EEP Project No. 94640)  
 Wetland Site  
 Monitoring Year 2

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2013)														
			94640-WEI-0011			94640-WEI-0012			94640-WEI-0013			94640-WEI-0014			94640-WEI-0015		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Alnus serrulata</i>	hazel alder	Shrub	1	1	1	1	1	1				2	2	2			
<i>Betula nigra</i>	river birch	Tree	5	5	5	1	1	1	2	2	2	3	3	3	2	2	2
<i>Cornus amomum</i>	silky dogwood	Shrub				2	2	2				1	1	1			
<i>Fraxinus americana</i>	white ash	Tree															
<i>Fraxinus pennsylvanica</i>	green ash	Tree	5	5	5	1	1	1	5	5	5	2	2	2	2	2	2
<i>Nyssa sylvatica</i>	blackgum	Tree				1	1	1	2	2	2						
<i>Platanus occidentalis</i>	American sycamore	Tree	3	3	3	1	1	1				6	6	6	4	4	4
<i>Quercus michauxii</i>	swamp chestnut oak	Tree				5	5	5	1	1	1						
<i>Quercus phellos</i>	willow oak	Tree							4	4	4	3	3	3			
Unknown		Shrub/Tree															
<b>Stem count</b>			14	14	14	12	12	12	14	14	14	17	17	17	8	8	8
<b>size (ACRES)</b>			0.02			0.02			0.02			0.02			0.02		
<b>Species count</b>			4	4	4	7	7	7	5	5	5	6	6	6	3	3	3
<b>Stems per ACRE</b>			567	567	567	486	486	486	567	567	567	688	688	688	324	324	324

**Color for Density**

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes

T: Total Stems

Table 9. Planted and Total Stem Counts  
 Little Troublesome Creek (EEP Project No. 94640)  
 Wetland Site  
 Monitoring Year 2

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2013)														
			94640-WEI-0016			94640-WEI-0017			94640-WEI-0018			94640-WEI-0019			94640-WEI-0020		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Alnus serrulata</i>	hazel alder	Shrub															
<i>Betula nigra</i>	river birch	Tree	2	2	2	1	1	1	1	1	1				2	2	2
<i>Cornus amomum</i>	silky dogwood	Shrub	1	1	1				1	1	1	1	1	1			
<i>Fraxinus americana</i>	white ash	Tree															
<i>Fraxinus pennsylvanica</i>	green ash	Tree	1	1	1	2	2	2	3	3	3	1	1	1	5	5	5
<i>Nyssa sylvatica</i>	blackgum	Tree										1	1	1			
<i>Platanus occidentalis</i>	American sycamore	Tree	1	1	1				5	5	5	1	1	1	3	3	3
<i>Quercus michauxii</i>	swamp chestnut oak	Tree				2	2	2									
<i>Quercus phellos</i>	willow oak	Tree				1	1	1				5	5	5	2	2	2
Unknown		Shrub/Tree															
<b>Stem count</b>			5	5	5	6	6	6	10	10	10	9	9	9	12	12	12
<b>size (ACRES)</b>			0.02			0.02			0.02			0.02			0.02		
<b>Species count</b>			4	4	4	4	4	4	4	4	4	5	5	5	4	4	4
<b>Stems per ACRE</b>			202	202	202	243	243	243	405	405	405	364	364	364	486	486	486

**Color for Density**

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes

T: Total Stems



Table 9. Planted and Total Stem Counts  
 Little Troublesome Creek (EEP Project No. 94640)  
 Wetland Site  
 Monitoring Year 2

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2013)						Annual Summary								
			94640-WEI-0021			94640-WEI-0022			MY2 (2013)			MY1 (2012)			MY0 (2012)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Alnus serrulata</i>	hazel alder	Shrub	4	4	4	3	3	3	20	20	20	31	31	31	62	62	62
<i>Betula nigra</i>	river birch	Tree							43	43	43	55	55	55	75	75	75
<i>Cornus amomum</i>	silky dogwood	Shrub				1	1	1	20	20	20	30	30	30	38	38	38
<i>Fraxinus americana</i>	white ash	Tree										1	1	1			
<i>Fraxinus pennsylvanica</i>	green ash	Tree	2	2	2	2	2	2	64	64	64	68	68	68	71	71	71
<i>Nyssa sylvatica</i>	blackgum	Tree	3	3	3	1	1	1	25	25	25	27	27	27	17	17	17
<i>Platanus occidentalis</i>	American sycamore	Tree	5	5	5	8	8	8	67	67	67	75	75	75	82	82	82
<i>Quercus michauxii</i>	swamp chestnut oak	Tree	1	1	1				20	20	20	24	24	24	18	18	18
<i>Quercus phellos</i>	willow oak	Tree	1	1	1				30	30	30	35	35	35	11	11	11
Unknown		Shrub/Tree													7	7	7
<b>Stem count</b>			16	16	16	15	15	15	289	289	289	346	346	346	381	381	381
<b>size (ACRES)</b>			0.02			0.02			0.54			0.54			0.54		
<b>Species count</b>			6	6	6	5	5	5	8	8	8	9	9	9	9	9	9
<b>Stems per ACRE</b>			647	647	647	607	607	607	532	532	532	636	636	636	701	701	701

**Color for Density**

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes

T: Total Stems

Table 9. Planted and Total Stem Counts- Stream  
 Little Troublesome Creek (EEP Project No. 94640)  
 Stream Site  
 Monitoring Year 2

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2013)											
			94640-WEI-0023			94640-WEI-0024			94640-WEI-0025			94640-WEI-0026		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree	2	2	2	1	1	1	2	2	2	2	2	2
Carpinus caroliniana	American hornbeam	Tree	2	2	2	10	10	10	3	3	3	2	2	2
Cornus amomum	silky dogwood	Shrub				2	2	2						
Fraxinus pennsylvanica	green ash	Tree	1	1	1	2	2	2	12	12	12	6	6	6
Liriodendron tulipifera	tuliptree	Tree	5	5	5	2	2	2						
Platanus occidentalis	American sycamore	Tree	5	5	5	2	2	2	2	2	2	5	5	5
Quercus phellos	willow oak	Tree				4	4	4						
Quercus rubra	northern red oak	Tree				3	3	3						
Unknown														
Stem count			15	15	15	26	26	26	19	19	19	15	15	15
	<b>size (ACRES)</b>		0.025			0.025			0.025			0.025		
	<b>Species count</b>		5			8			4			4		
	<b>Stems per ACRE</b>		607	607	607	1052	1052	1052	769	769	769	607	607	607

**Color for Density**

- Exceeds requirements by 10%
- Exceeds requirements, but by less than 10%
- Fails to meet requirements, by less than 10%
- Fails to meet requirements by more than 10%
- Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes

T: Total Stems



Table 9. Planted and Total Stem Counts- Stream  
 Little Troublesome Creek (EEP Project No. 94640)  
 Stream Site  
 Monitoring Year 2

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2013)											
			94640-WEI-0027			94640-WEI-0028			94640-WEI-0029			94640-WEI-0030		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree										1	1	1
Carpinus caroliniana	American hornbeam	Tree	2	2	2	3	3	3	3	3	3	7	7	7
Cornus amomum	silky dogwood	Shrub												
Fraxinus pennsylvanica	green ash	Tree	7	7	7	4	4	4	6	6	6	2	2	2
Liriodendron tulipifera	tuliptree	Tree										4	4	4
Platanus occidentalis	American sycamore	Tree	12	12	12	11	11	11	10	10	10	2	2	2
Quercus phellos	willow oak	Tree												
Quercus rubra	northern red oak	Tree												
Unknown														
Stem count			21	21	21	18	18	18	19	19	19	16	16	16
	<b>size (ACRES)</b>		0.025			0.025			0.025			0.025		
	<b>Species count</b>		3			3			3			5		
	<b>Stems per ACRE</b>		850	850	850	728	728	728	769	769	769	647	647	647

**Color for Density**

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- Fails to meet requirements, by less than 10%
- Fails to meet requirements by more than 10%
- Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes

T: Total Stems

Table 9. Planted and Total Stem Counts- Stream  
 Little Troublesome Creek (EEP Project No. 94640)  
 Stream Site  
 Monitoring Year 2

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2013)											
			94640-WEI-0031			94640-WEI-0032			94640-WEI-0033			94640-WEI-0034		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree	9	9	9	7	7	7	6	6	6	1	1	1
Carpinus caroliniana	American hornbeam	Tree							2	2	2	8	8	8
Cornus amomum	silky dogwood	Shrub										2	2	2
Fraxinus pennsylvanica	green ash	Tree	7	7	7	3	3	3				3	3	3
Liriodendron tulipifera	tuliptree	Tree	4	4	4	1	1	1				5	5	5
Platanus occidentalis	American sycamore	Tree	2	2	2	10	10	10	1	1	1			
Quercus phellos	willow oak	Tree							1	1	1	7	7	7
Quercus rubra	northern red oak	Tree	2	2	2	1	1	1						
Unknown														
Stem count			24	24	24	22	22	22	10	10	10	26	26	26
	size (ACRES)		0.025			0.025			0.025			0.025		
	Species count		5			5			4			6		
	Stems per ACRE		971	971	971	890	890	890	405	405	405	1052	1052	1052

**Color for Density**

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- Fails to meet requirements, by less than 10%
- Fails to meet requirements by more than 10%
- Volunteer species included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes

T: Total Stems



Table 9. Planted and Total Stem Counts- Stream  
 Little Troublesome Creek (EEP Project No. 94640)  
 Stream Site  
 Monitoring Year 2

Scientific Name	Common Name	Species Type	(MY2 2013)			Annual Summary								
			94640-WEI-0035			MY2 (2013)			MY1 (2012)			MY0 (2012)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree	2	2	2	33	33	33	36	36	36	36	36	36
Carpinus caroliniana	American hornbeam	Tree	2	2	2	44	44	44	50	50	50	56	56	56
Cornus amomum	silky dogwood	Shrub	1	1	1	5	5	5	6	6	6	8	8	8
Fraxinus pennsylvanica	green ash	Tree	2	2	2	55	55	55	63	63	63	67	67	67
Liriodendron tulipifera	tuliptree	Tree				21	21	21	31	31	31	37	37	37
Platanus occidentalis	American sycamore	Tree	3	3	3	65	65	65	67	67	67	68	68	68
Quercus phellos	willow oak	Tree	5	5	5	17	17	17	20	20	20	22	22	22
Quercus rubra	northern red oak	Tree	5	5	5	11	11	11	13	13	13	11	11	11
Unknown												1	1	1
Stem count			20	20	20	251	251	251	286	286	286	306	306	306
	size (ACRES)		0.025			0.321			0.321			0.321		
	Species count		7			8			8			9		
	Stems per ACRE		809	809	809	781	781	781	890	890	890	953	953	953

**Color for Density**

- Exceeds requirements by 10%
- Exceeds requirements, but by less than 10%
- Fails to meet requirements, by less than 10%
- Fails to meet requirements by more than 10%
- Volunteer species included in total

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P-all: Number of planted stems including live stakes

T: Total Stems

## **APPENDIX 4. Morphological Summary Data and Plots**



Table 10a. Baseline Stream Data Summary  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Irvin Creek Reaches 1 and 2  
 Monitoring Year 2

Parameter	Gage	Pre-Restoration Condition				Reference Reach Data								Design <sup>1</sup>				As-Built/Baseline				
		Irvin Creek Reach 1		Irvin Creek Reach 2		Collins Creek		UT to Belews Creed		UT to Rocky Creek		Spencer Creek		Irvin Creek Reach 1		Irvin Creek Reach 2		Irvin Creek Reach 1		Irvin Creek Reach 2		
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
<b>Dimension and Substrate - Riffle</b>																						
Bankfull Width (ft)	n/a	17.7	15.2	17.2	11.9	20.1	14.4	12.2	8.7	19.0	19.0	18.6	19.7	18.1	20.9							
Floodprone Width (ft)		21.0	18.0	21.0	60.0		200.0	72.0	229.0	80+	200+	200+	200+	200+	200+							
Bankfull Mean Depth		1.5	1.9	2.0	1.6	2.7	2.0	1.3	1.2	1.6	1.6	1.6	1.7	1.6	1.6							
Bankfull Max Depth		1.8	2.4	2.6	3.3	4.2	2.7	1.8	1.9	2.2	2.2	2.4	2.6	2.4	2.4							
Bankfull Cross-sectional Area (ft <sup>2</sup> )		27.3	30.6	32.8	32.9		27.4	16.3	10.6	29.7	29.7	29.3	33.7	29.0	32.7							
Width/Depth Ratio		11.5	8.0	8.6	4.4	12.1	7.6	9.1	7.3	12.0	12.0	11.5	11.8	11.3	13.3							
Entrenchment Ratio		1.2	1.2	1.2	2.0	3.0	34.7	6.0	26.3	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+							
Bank Height Ratio		1.9	3.3	2.3	2.5	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0							
d50 (mm)		32.8	24.2												22.6	18.6						
<b>Profile</b>																						
Riffle Length (ft)	n/a														18	92	17	73				
Riffle Slope (ft/ft)		0.001	0.025	0.0019	0.017	0.003	0.008	-	0.0606	0.0892	0.01	0.067	0.006	0.008	0.007	0.015	0.0039	0.0215	0.0021	0.028		
Pool Length (ft)																32	141	46	85			
Pool Max Depth (ft)		2.09	3.65	2.27	3.33	2.4		4.6	2.2		2.5		2.8	4.0	2.9	4.0	3.7	4.2	3.6	4.0		
Pool Spacing (ft) <sup>^</sup>		39	60	27	76	32	80	75	26	81	13	47	76	133	77	135	57	236	91	142		
Pool Volume (ft <sup>3</sup> )																						
<b>Pattern</b>																						
Channel Beltwidth (ft)	n/a	39	81	46	94	-	31	32	-	24	52	57	152	58	154	52	151	49	86			
Radius of Curvature (ft)		57	114	100	251	-	16	27	-	5	22	38	57	38	58	38	59	38	62			
Rc:Bankfull Width (ft/ft)		3.2	6.4	6.6	14.6	-	2.2	4.1	-	1.5	2.8	2	3	2	3	2.0	3.1	2	3			
Meander Wave Length (ft)		86	175	175	348	-	71	101	-	54	196	152	228	154	231	150	235	166	229			
Meander Width Ratio		2.2	4.6	3	5.5	-	2.15	2.22	-	2.8	6	3	8	3	8	2.7	7.9	3	5			
<b>Substrate, Bed and Transport Parameters</b>																						
Ri%/Ru%/P%/G%/S%	n/a																					
SC%/Sa%/G%/C%/B%/Be% d16/d35/d50/d84/d95/d100		0.1/0.6/15/56/98/>2048	0.1/0.3/5/25/31/45		N/A		N/A		N/A		N/A				SC/SC/23/49/64/128		SC/SC/19/49/79/180					
Reach Shear Stress (Competency) lb/ft <sup>2</sup>		0.88	0.42										0.38	0.43	0.38	0.41	0.40					
Max part size (mm) mobilized at bankfull																						
Stream Power (Capacity) W/m <sup>2</sup>																						
<b>Additional Reach Parameters</b>																						
Drainage Area (SM)	n/a	0.67	0.82	0.82	0.91	1.68		3.40		1.1		0.5		0.82		0.91		0.82		0.91		
Watershed Impervious Cover Estimate (%)		17	17		-		-		-		-		17		17		17		17			
Rosgen Classification		G4c	G4c		E4		E5		E4b		E4/C4		C4		C4		C		C			
Bankfull Velocity (fps)		3.3	3.00		3.30								3.0		3.3		2.7		3.1		3.1	
Bankfull Discharge (cfs)		90	100		115		150		125		85		N/A		90		100		90		100	
Q-NFF regression		110	126																			
Q-USGS extrapolation		-	-																			
Q-Mannings		122	99		102		-		-		-		-		-		-		-			
Valley Length (ft)		1490.9	1505.0		-		-		-		-		-		-		-		-			
Channel Thalweg Length (ft)		1640.0	1505.0		-		-		-		-		2057*		1919*		2095*		1932*			
Sinuosity (ft)		1.1	1.0		-		1.2		1.1		1.05		1.3		1.2		1.3		1.2			
Water Surface Slope (ft/ft)		-	-		0.003		0.007		0.0235		0.0132		-		-		N/A <sup>1</sup>		N/A <sup>1</sup>			
Bankfull Slope (ft/ft)		0.0107	0.0043		-		-		-		-		0.0045		0.0049		0.0045		0.0047			

(-): Data was not provided

N/A: Not Applicable

<sup>1</sup>Design parameters were expanded during the final design phase.

\*LF provided included portions of the stream that will be monitored and have been reconstructed, but for which mitigation credit will not be claimed. Please refer to Table 1 in Appendix 1 for the credit summary lengths.

<sup>^</sup>Pool to pool spacing calculations were measured using the most downstream pool in the meander for the as-built compared to the design pool to pool spacing, which included pools and plunge pools in the min and max values.

Table 10b. Baseline Stream Data Summary  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Little Troublesome Creek and UT1  
 Monitoring Year 2

Parameter	Gage	Pre-Restoration Condition <sup>1</sup>				Reference Reach Data		Design <sup>1</sup>				As-Built/Baseline						
		UT1		Little Troublesome Creek		Min	Max	UT1 <sup>2</sup>		Little Troublesome Creek		UT1 <sup>2</sup>		Little Troublesome Creek				
		Min	Max	Min	Max			Min	Max	Min	Max	Min	Max					
<b>Dimension and Substrate - Riffle</b>																		
Bankfull Width (ft)	n/a	5.2		28.7		refer to table 5a	7.8		32.3		10.9		32.6		41.0			
Floodprone Width (ft)		8.0		93.0			100+		285+		36.7		200+					
Bankfull Mean Depth		1.2		2.6			0.6		2.7		0.5		2.2		2.7			
Bankfull Max Depth		1.9		3.3			0.9		3.8		1		4.1		4.17			
Bankfull Cross-sectional Area (ft <sup>2</sup> )		6.4		73.6			5.0		86.6		5.1		77.4		87.1			
Width/Depth Ratio		4.3		11.2			12.0		12.0		23		12.2		15.47			
Entrenchment Ratio		1.5		3.2			2.2+		2.2+		2.2+		2.2+		2.2+			
Bank Height Ratio		1.2	2.5	1.6	2.8		1.0		1.0		1.0		1.0		1.0			
d50 (mm)		0.8		9.7							0.4		20.7					
<b>Profile</b>																		
Riffle Length (ft)	n/a					refer to table 5a	-		-		11		26		79		142	
Riffle Slope (ft/ft) <sup>1</sup>		0.0072	0.05	0.0007	0.0110		0.0185	0.0369	0.0066	0.0088	0.0231	0.0600	0.0063	0.0126				
Pool Length (ft)							-		-		18		48		88		159	
Pool Max Depth (ft)		2.24	3.31	3.19	5.25		1.2	1.6	4.8	6.7	1.2		5.9					
Pool Spacing (ft) <sup>^</sup>		29	42	46	127		24	43	129	226	35	59	206	267				
Pool Volume (ft <sup>3</sup> )																		
<b>Pattern</b>																		
Channel Beltwidth (ft)	n/a	-		119		refer to table 5a	27	62	113	258	27	62	113	258				
Radius of Curvature (ft)		-		103	313		16	23	65	97	16	23	65	97				
Rc:Bankfull Width (ft/ft)		-		3.6	10.9		2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0				
Meander Wave Length (ft)		-		179	315		62	94	258	388	62	94	258	388				
Meander Width Ratio		-		4.1			3.5	8.0	3.5	8.0	3.5	8.0	3.5	8.0				
<b>Substrate, Bed and Transport Parameters</b>																		
Ri%/Ru%/P%/G%/S%	n/a					refer to table 5a												
SC%/Sa%/G%/C%/B%/Be%																		
d16/d35/d50/d84/d95/d100		SC/SC/SC/4/13/>2048		0.2/0.5/1/22/30/>2048							SC/SC/0.4/44/64/128		SC/C/21/62/110/180					
Reach Shear Stress (Competency) lb/ft <sup>2</sup>		0.96		0.41			N/A <sup>3</sup>		N/A <sup>3</sup>		0.34		0.38		0.53			
Max part size (mm) mobilized at bankfull																		
Stream Power (Capacity) W/m <sup>2</sup>																		
<b>Additional Reach Parameters</b>																		
Drainage Area (SM)	n/a	0.1		4.95	5.07	refer to table 5a	0.1	5.07	0.1	5.07	0.1	5.07						
Watershed Impervious Cover Estimate (%)		17		17			17	17	17	17	17	17	17					
Rosgen Classification		G5		C5			C5	C5	C5	C5	C5	C5	C5					
Bankfull Velocity (fps)		4.4		5.0			2.7	4.3	2.7	4.3	2.7	4.3	2.7	4.3	4.2	4.8		
Bankfull Discharge (cfs)		14		370			14	370	14	370	14	370	14	370				
Q-NFF regression		-		422														
Q-USGS extrapolation		-		-														
Q-Mannings		-		237														
Valley Length (ft)		184		982														
Channel Thalweg Length (ft)		184		1080			240	1158*	233	1171*	233	1171*	233	1171*				
Sinuosity (ft)		1.0		1.1			1.3	1.3	1.2	1.3	1.2	1.3	1.2	1.3				
Water Surface Slope (ft/ft)		-		-							N/A <sup>1</sup>		N/A <sup>1</sup>					
Bankfull Slope (ft/ft)		0.0183		0.0033			0.0123	0.0044	0.0126	0.0038	0.0126	0.0038	0.0126	0.0038				

(-): Data was not provided

N/A: Not Applicable

<sup>1</sup>Design parameters were expanded during the final design phase.

<sup>2</sup>Restoration approach was adjusted from a priority 1 to a priority 2 during the final design phase.

<sup>3</sup>The critical shear stress analysis was not performed on the sand bed channels.

\*LF provided included portions of the stream that will be monitored and have been reconstructed, but for which mitigation credit will not be claimed. Please refer to Table 1 in Appendix 1 for the credit summary lengths.

<sup>^</sup>Pool to pool spacing calculations were measured using the most downstream pool in the meander for the as-built compared to the design pool to pool spacing, which included pools and plunge pools in the min and max values.



Table 11 Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Irvin Creek Reaches 1 and 2, Little Troublesome Creek, UT1  
 Monitoring Year 2

Irvin Creek Reach 1																									
Cross-Section 1 (Riffle)							Cross-Section 2 (Pool)					Cross-Section 3 (Pool)					Cross-Section 4 (Riffle)								
Dimension and Substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	
<i>based on fixed bankfull elevation</i>																									
Bankfull Width (ft)	18.6	17.7	17.5				19.9	18.0	18.3				31.1	31.1	34.5				19.7	20.2	25.5				
Floodprone Width (ft)	200+	200+	200+				N/A	N/A	N/A				N/A	N/A	N/A				200+	200+	200+				
Bankfull Mean Depth (ft)	1.6	1.5	1.5				1.9	2.2	2.4				1.9	1.9	1.6				1.7	1.7	1.3				
Bankfull Max Depth (ft)	2.4	2.5	2.4				3.7	4.0	3.9				4.2	4.2	4.5				2.6	2.7	2.6				
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	29.3	27.2	26.0				36.8	38.6	43.1				57.6	57.6	56.5				33.7	34.4	33.0				
Bankfull Width/Depth Ratio	11.8	11.6	11.8				10.7	8.4	7.8				16.8	16.8	21.1				11.5	11.9	19.8				
Bankfull Entrenchment Ratio	2.2+	2.2+	2.2+				N/A	N/A	N/A				N/A	N/A	N/A				2.2+	2.2+	2.2+				
Bankfull 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				
Irvin Creek Reach 2																									
Cross-Section 5 (Pool)							Cross-Section 6 (Riffle)					Cross-Section 7 (Riffle)					Cross-Section 8 (Pool)								
Dimension and Substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	
<i>based on fixed bankfull elevation</i>																									
Bankfull Width (ft)	35.3	35.6	36.9				18.1	18.6	18.0				20.9	20.9	32.3				29.2	32.0	35.7				
Floodprone Width (ft)	N/A	N/A	N/A				200+	200+	200+				200+	200+	200+				N/A	N/A	N/A				
Bankfull Mean Depth (ft)	1.4	1.3	1.3				1.6	1.5	1.7				1.6	1.4	1.1				1.7	1.6	1.5				
Bankfull Max Depth (ft)	4.0	4.1	4.2				2.4	2.5	2.6				2.4	2.4	2.7				3.6	3.6	3.9				
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	47.9	46.0	49.2				29.0	27.8	30.7				32.7	28.7	35.1				50.1	50.0	54.8				
Bankfull Width/Depth Ratio	26.0	27.5	27.6				11.3	12.4	10.6				13.3	15.2	29.7				17.0	20.5	23.3				
Bankfull Entrenchment Ratio	N/A	N/A	N/A				2.2+	2.2+	2.2+				2.2+	2.2+	2.2+				N/A	N/A	N/A				
Bankfull Bank Height Ratio	1.0	1.0	1.1				1.0	1.0	0.8				1.0	1.0	0.9				1.0	1.0	0.9				
UT1												Little Troublesome Creek													
Cross-Section 9 (Riffle)						Cross-Section 10 (Pool)						Cross-Section 11 (Riffle)					Cross-Section 12 (Pool)								
Dimension and Substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	
<i>based on fixed bankfull elevation</i>																									
Bankfull Width (ft)	10.9	8.0	8.3				9.3	9.6	8.9				32.6	33.0	31.9				41.0	42.2	42.1				
Floodprone Width (ft)	36.7	35.7	34.3				N/A	N/A	N/A				200+	200+	200+				N/A	N/A	N/A				
Bankfull Mean Depth (ft)	0.5	0.5	0.5				0.7	0.6	0.5				2.7	2.6	2.6				3.1	3.1	3.2				
Bankfull Max Depth (ft)	1.0	1.0	1.0				1.2	1.2	1.1				4.1	4.0	3.9				5.9	6.5	7.4				
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	5.1	4.1	3.7				6.4	5.6	4.0				87.1	84.6	82.8				125.3	128.8	133.4				
Bankfull Width/Depth Ratio	23.0	15.5	18.5				13.5	16.6	19.7				12.2	12.9	12.3				13.4	13.8	13.3				
Bankfull Entrenchment Ratio	2.2+	2.2+	2.2+				N/A	N/A	N/A				2.2+	2.2+	2.2+				N/A	N/A	N/A				
Bankfull 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				
Little Troublesome Creek																									
Cross-Section 13 (Riffle)																									
Dimension and Substrate	Base	MY1	MY2	MY3	MY4	MY5																			
<i>based on fixed bankfull elevation</i>																									
Bankfull Width (ft)	34.6	35.7	33.7																						
Floodprone Width (ft)	200+	200+	200+																						
Bankfull Mean Depth (ft)	2.2	2.1	2.2																						
Bankfull Max Depth (ft)	4.2	3.9	3.9																						
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	77.4	74.8	74.4																						
Bankfull Width/Depth Ratio	15.5	17.1	15.3																						
Bankfull Entrenchment Ratio	2.2+	2.2+	2.2+																						
Bankfull Bank Height Ratio	1.0	1.0	1.0																						

Table 12a. Monitoring Data - Stream Reach Data Summary  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Irvin Creek Reach 1  
 Monitoring Year 2

Parameter	As-Built/Baseline		MY-1			MY-2			MY-3			MY-4			MY-5			
	Min	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	
<b>Dimension and Substrate - Riffle</b>																		
Bankfull Width (ft)	18.6	19.7	17.7	19.0	20.2	17.5	21.5	25.5										
Floodprone Width (ft)	200+	200+	200+	200+	200+	200+	200+	200+										
Bankfull Mean Depth	1.6	1.7	1.5	1.6	1.7	1.3	1.4	1.5										
Bankfull Max Depth	2.4	2.6	2.5	2.6	2.7	2.4	2.5	2.6										
Bankfull Cross-sectional Area (ft <sup>2</sup> )	29.3	33.7	27.2	30.8	34.4	26.0	29.5	33.0										
Width/Depth Ratio	11.5	11.8	11.6	11.7	11.9	11.8	15.8	19.8										
Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+										
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0										
D50 (mm)			35.0	-	44.2	23.7	-	41.1										
<b>Profile</b>																		
Riffle Length (ft)	18	92	11	41	79	33	47	98										
Riffle Slope (ft/ft)	0.0039	0.0215	0.0008	0.0075	0.0174	0.0038	0.0060	0.0117										
Pool Length (ft)	32	141	33	63	153	42	64	141										
Pool Max Depth (ft)	3.7	4.2	3.5	4.2	6.3	3.9	4.6	5.9										
Pool Spacing (ft)	57	236	63	105	227	86	120	203										
Pool Volume (ft <sup>3</sup> )																		
<b>Pattern</b>																		
Channel Beltwidth (ft)	52	151																
Radius of Curvature (ft)	38	59																
Rc:Bankfull Width (ft/ft)	2.0	3.1																
Meander Wave Length (ft)	150	235																
Meander Width Ratio	2.7	7.9																
<b>Additional Reach Parameters</b>																		
Rosgen Classification	C		C			C												
Channel Thalweg Length (ft)	2095		2095			2095												
Sinuosity (ft)	1.3		1.3			1.3												
Water Surface Slope (ft/ft)	N/A		0.0044			0.0039												
Bankfull Slope (ft/ft)	0.0045		0.0048			0.0043												
Ri%/Ru%/P%/G%/S%																		
SC%/Sa%/G%/C%/B%/Be%																		
d16/d35/d50/d84/d95/d100	SC/SC/23/49/64/128		0.2/0.7/10/38/58/362			0.1/0.5/2/47/80/128												
% of Reach with Eroding Banks			0%			0%												

(-): Data was not provided  
 N/A: Not Applicable



Table 12b. Monitoring Data - Stream Reach Data Summary  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Irvin Creek Reach 2  
 Monitoring Year 2

Parameter	As-Built/Baseline		MY-1			MY-2			MY-3			MY-4			MY-5		
	Min	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
<b>Dimension and Substrate - Riffle</b>																	
Bankfull Width (ft)	18.1	20.9	18.6	19.8	20.9	18.0	25.1	32.3									
Floodprone Width (ft)	200+	200+	200+	200+	200+	200+	200+	200+									
Bankfull Mean Depth	1.6	1.6	1.4	1.5	1.5	1.1	1.4	1.7									
Bankfull Max Depth	2.4	2.4	2.4	2.5	2.5	2.6	2.6	2.7									
Bankfull Cross-sectional Area (ft <sup>2</sup> )	29.0	32.7	27.8	28.3	28.7	30.7	32.9	35.1									
Width/Depth Ratio	11.3	13.3	12.4	13.8	15.2	10.6	20.1	29.7									
Entrenchment Ratio	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+	2.2+									
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	0.8	0.8	0.9									
D50 (mm)			18.6	-	39.8	20.7	-	42.7									
<b>Profile</b>																	
Riffle Length (ft)	17	73	21	59	72	28.6	58.9	72.4									
Riffle Slope (ft/ft)	0.0021	0.0280	0.0026	0.0087	0.0149	0.0016	0.0078	0.0169									
Pool Length (ft)	46	85	52	64	89	42	66	109									
Pool Max Depth (ft)	3.6	4.0	3.1	3.8	6.0	3.5	4.0	5.1									
Pool Spacing (ft)	91	142	89	123	139	88	126	140									
Pool Volume (ft <sup>3</sup> )																	
<b>Pattern</b>																	
Channel Beltwidth (ft)	49	86															
Radius of Curvature (ft)	38	62															
Rc:Bankfull Width (ft/ft)	2	3															
Meander Wave Length (ft)	166	229															
Meander Width Ratio	3	5															
<b>Additional Reach Parameters</b>																	
Rosgen Classification	C		C			C											
Channel Thalweg Length (ft)	1932		1932			1932											
Sinuosity (ft)	1.2		1.2			1.2											
Water Surface Slope (ft/ft)	N/A		0.0045			0.0048											
Bankfull Slope (ft/ft)	0.0047		0.0049			0.0046											
Ri%/Ru%/P%/G%/S%																	
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100	SC/SC/19/48/79/180		0.1/0.4/6/66/104/512			5/13/21/51/80/256											
% of Reach with Eroding Banks			0%			0%											

(-): Data was not provided  
 N/A: Not Applicable

Table 12c. Monitoring Data - Stream Reach Data Summary  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 UT1  
 Monitoring Year 2

Parameter	As-Built/Baseline		MY-1			MY-2			MY-3			MY-4			MY-5		
	Min	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
<b>Dimension and Substrate - Riffle</b>																	
Bankfull Width (ft)	10.9		8.0			8.3											
Floodprone Width (ft)	36.7		35.7			34.3											
Bankfull Mean Depth	0.5		0.5			0.5											
Bankfull Max Depth	1.0		1.0			1.0											
Bankfull Cross-sectional Area (ft <sup>2</sup> )	5.1		4.1			3.7											
Width/Depth Ratio	23.0		15.5			18.5											
Entrenchment Ratio	2.2+		2.2+			2.2+											
Bank Height Ratio	1.0		1.0			1.0											
D50 (mm)			13.3			42.4											
<b>Profile</b>																	
Riffle Length (ft)	11	26	14	20	31	9	17	28									
Riffle Slope (ft/ft)	0.0231	0.0600	0.0089	0.0217	0.0448	0.0225	0.0274	0.0446									
Pool Length (ft)	18	48	15	23	36	20	28	43									
Pool Max Depth (ft)	1.2		1.2	1.3	1.4	1.05	1.19	1.44									
Pool Spacing (ft)	35	59	43	52	62	47	58	60									
Pool Volume (ft <sup>3</sup> )																	
<b>Pattern</b>																	
Channel Beltwidth (ft)	27	62															
Radius of Curvature (ft)	16	23															
Rc:Bankfull Width (ft/ft)	2.0	3.0															
Meander Wave Length (ft)	62	94															
Meander Width Ratio	3.5	8.0															
<b>Additional Reach Parameters</b>																	
Rosgen Classification	C5		C5			C5											
Channel Thalweg Length (ft)	233		233			233											
Sinuosity (ft)	1.2		1.2			1.2											
Water Surface Slope (ft/ft)	N/A		0.0120			0.0136											
Bankfull Slope (ft/ft)	0.0126		0.0121			0.0108											
Ri%/Ru%/P%/G%/S%																	
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100	SC/SC/0.4/44/64/128		SC/0.1/0.5/501/90/128			SC/0.4/0.9/43/76/180											
% of Reach with Eroding Banks			0%			0%											

(-): Data was not provided  
 N/A: Not Applicable

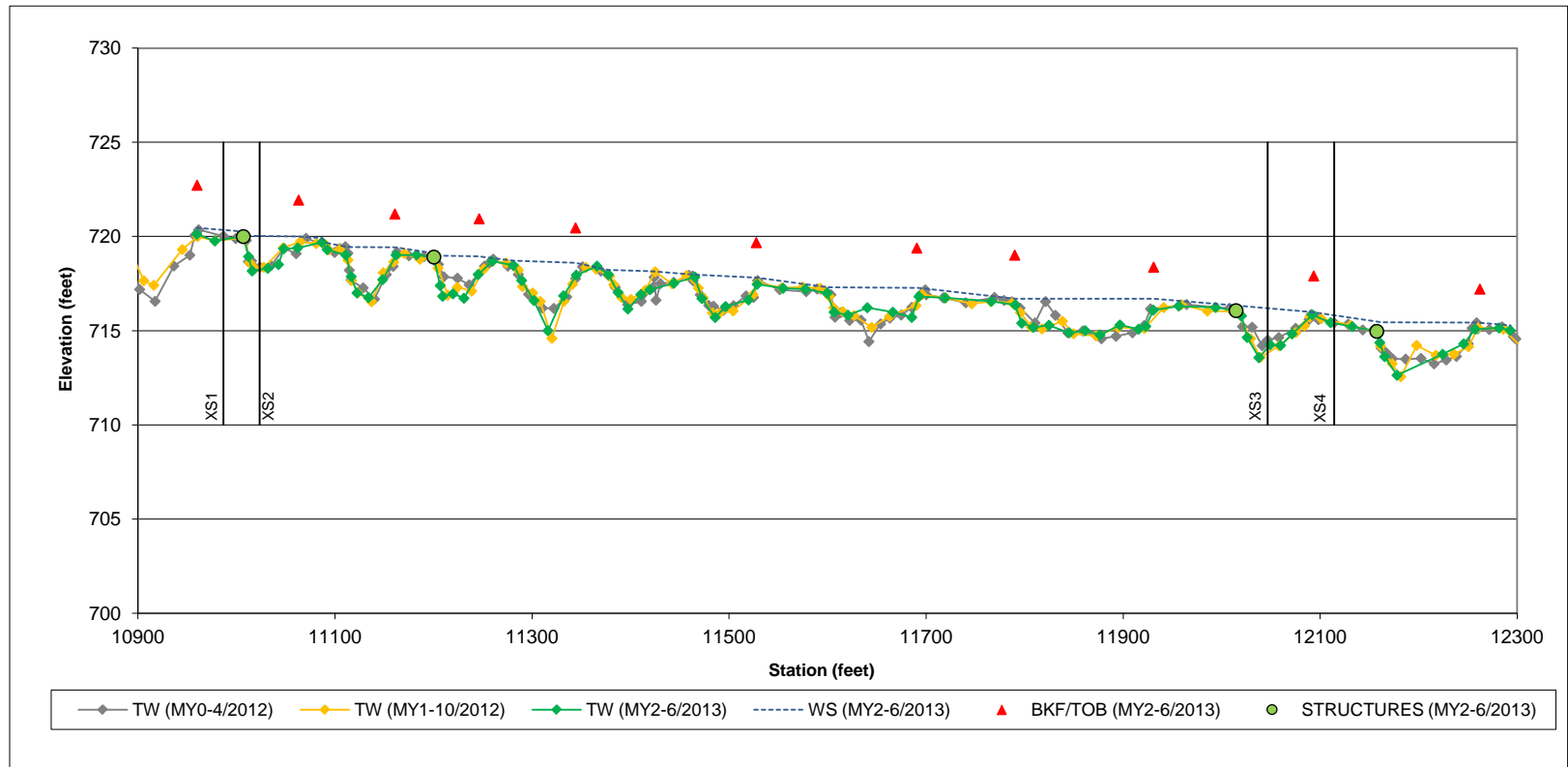


Table 12d. Monitoring Data - Stream Reach Data Summary  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Little Troublesome Creek  
 Monitoring Year 2

Parameter	As-Built/Baseline		MY-1			MY-2			MY-3			MY-4			MY-5		
	Min	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
<b>Dimension and Substrate - Riffle</b>																	
Bankfull Width (ft)	32.6	48.8	33.0	34.4	35.7	31.9	32.8	33.7									
Floodprone Width (ft)	200+		200+	200+	200+	200+	200+	200+									
Bankfull Mean Depth	1.6	2.7	2.1	2.4	2.6	2.2	2.4	2.6									
Bankfull Max Depth	4.1	4.2	3.9	4.0	4.0	3.9	3.9	3.9									
Bankfull Cross-sectional Area (ft <sup>2</sup> )	79.6	87.1	74.8	79.7	84.6	74.4	78.6	82.8									
Width/Depth Ratio	12.2	30	12.9	15.0	17.1	12.3	13.8	15.3									
Entrenchment Ratio	2.2+		0.0	-	2.2+	2.2+	2.2+	2.2+									
Bank Height Ratio	1.0		1.0	1.0	1.0	1.0	1.0	1.0									
d50 (mm)			32.7	-	39.7	41.8	-	47.3									
<b>Profile</b>																	
Riffle Length (ft)	79	142	74	107	147	77	100	141									
Riffle Slope (ft/ft)	0.0063	0.0126	0.0061	0.0071	0.0178	0.0056	0.0080	0.0127									
Pool Length (ft)	88	159	88	121	168	83	127	162									
Pool Max Depth (ft)	5.9		6.0	6.3	7.7	6.0	6.7	7.9									
Pool Spacing (ft)	206	267	194	219	297	208	242	289									
Pool Volume (ft <sup>3</sup> )																	
<b>Pattern</b>																	
Channel Beltwidth (ft)	113	258															
Radius of Curvature (ft)	65	97															
Rc:Bankfull Width (ft/ft)	2.0	3.0															
Meander Wave Length (ft)	258	388															
Meander Width Ratio	3.5	8.0															
<b>Additional Reach Parameters</b>																	
Rosgen Classification	C4		C4			C4											
Channel Thalweg Length (ft)	1171		1171			1171											
Sinuosity (ft)	1.3		1.3			1.3											
Water Surface Slope (ft/ft)	N/A		0.0039			0.0038											
Bankfull Slope (ft/ft)	0.0038		0.0039			0.0037											
Ri%/Sa%/G%/C%/B%/Be%																	
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100	SC/SC/21/62/110/180		SC/0.3/8/74/165/512			0.1/0.3/0.7/60/130/362											
% of Reach with Eroding Banks			0%			0%											

(-): Data was not provided  
 N/A: Not Applicable

Longitudinal Profile Plots  
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
Irvin Creek Reach 1  
Monitoring Year 2





Cross-Section Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Irvin Creek Reach 1, Cross-Section 1 (Riffle)  
 Monitoring Year 2

River Basin	Cape Fear
Watershed HUC	3030002
XS ID	1
Drainage Area	0.8 sq.mi
Date	6/27/2013
Field Crew	Wildlands Engineering

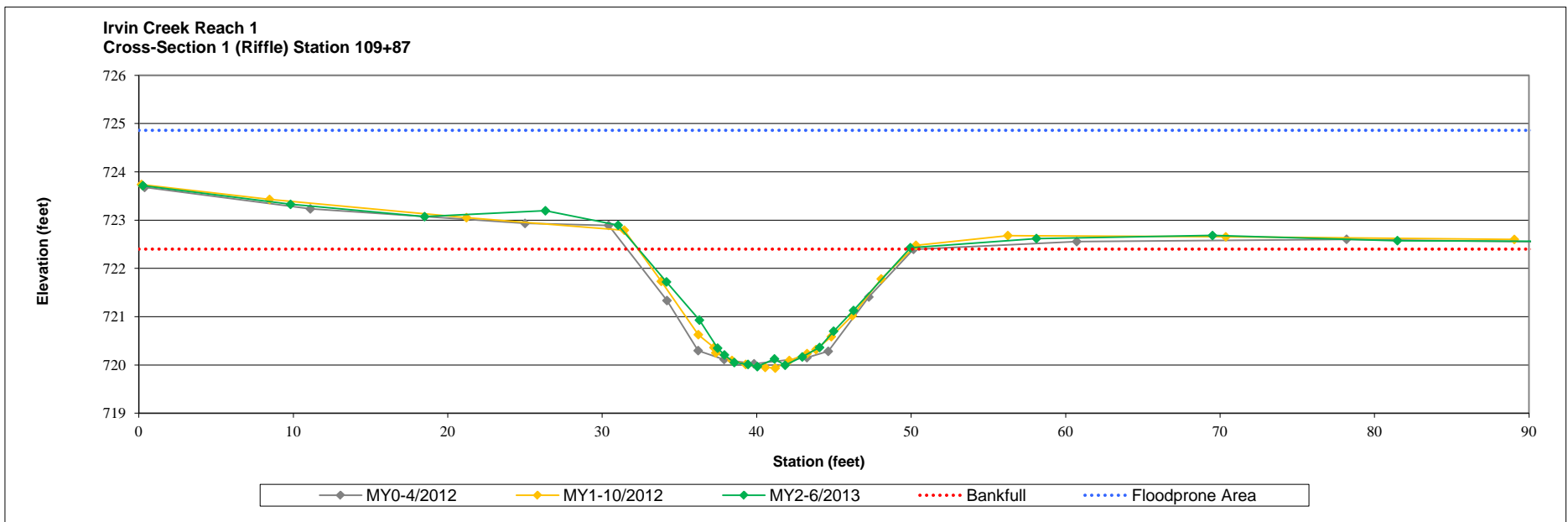
Summary Data	
Bankfull Elevation (ft)	722.4
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	26.0
Bankfull Width (ft)	17.5
Flood Prone Area Elevation (ft)	724.83
Flood Prone Width (ft)	200+
Max Depth at Bankfull (ft)	2.4
Mean Depth at Bankfull (ft)	1.5
W/D Ratio	11.79
Entrenchment Ratio	2.2+
Bank Height Ratio	1.0
Stream Type	E



Cross-Section 1: View Upstream



Cross-Section 1: View Downstream



Cross-Section Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Irvin Creek Reach 1, Cross-Section 2 (Pool)  
 Monitoring Year 2

River Basin	Cape Fear
Watershed HUC	3030002
XS ID	2
Drainage Area	0.8 sq.mi
Date	6/27/2013
Field Crew	Wildlands Engineering

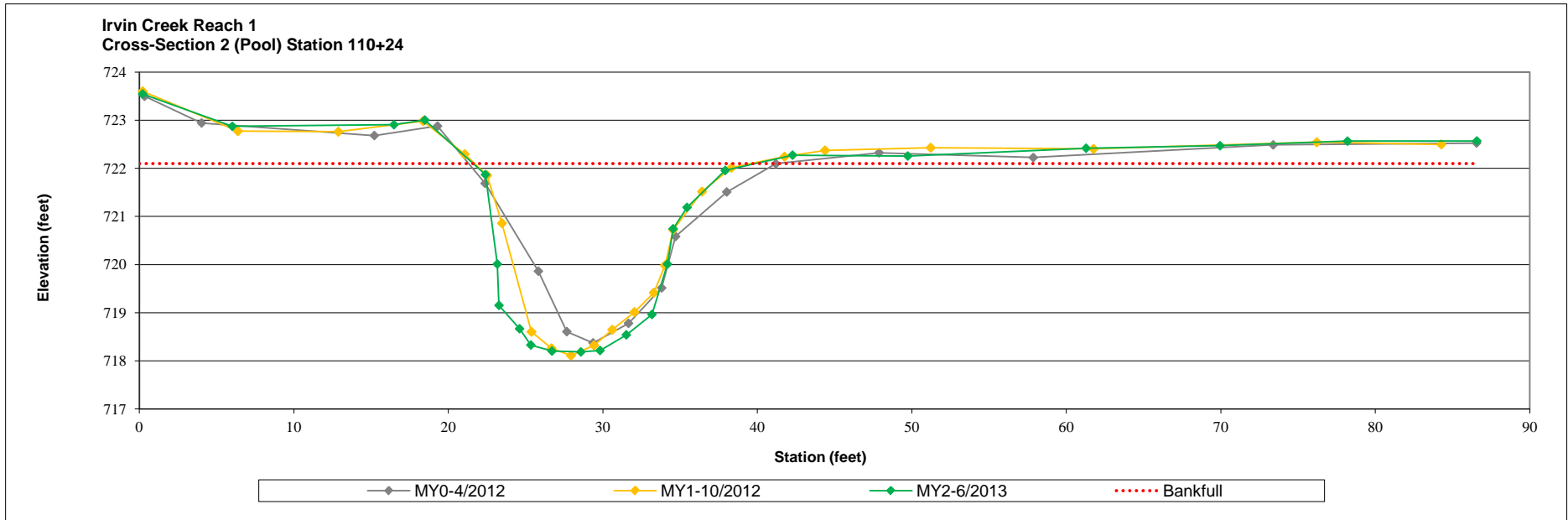
Summary Data	
Bankfull Elevation (ft)	722.1
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	43.13
Bankfull Width (ft)	18.29
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	3.91
Mean Depth at Bankfull (ft)	2.36
W/D Ratio	7.76
Entrenchment Ratio	N/A
Bank Height Ratio	1.0
Stream Type	N/A



Cross-Section 2: View Upstream



Cross-Section 2: View Downstream





Cross-Section Plots

Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)

Irvin Creek Reach 1, Cross-Section 3 (Pool)

Monitoring Year 2

River Basin	Cape Fear
Watershed HUC	3030002
XS ID	3
Drainage Area	0.8 sq.mi
Date	6/27/2013
Field Crew	Wildlands Engineering

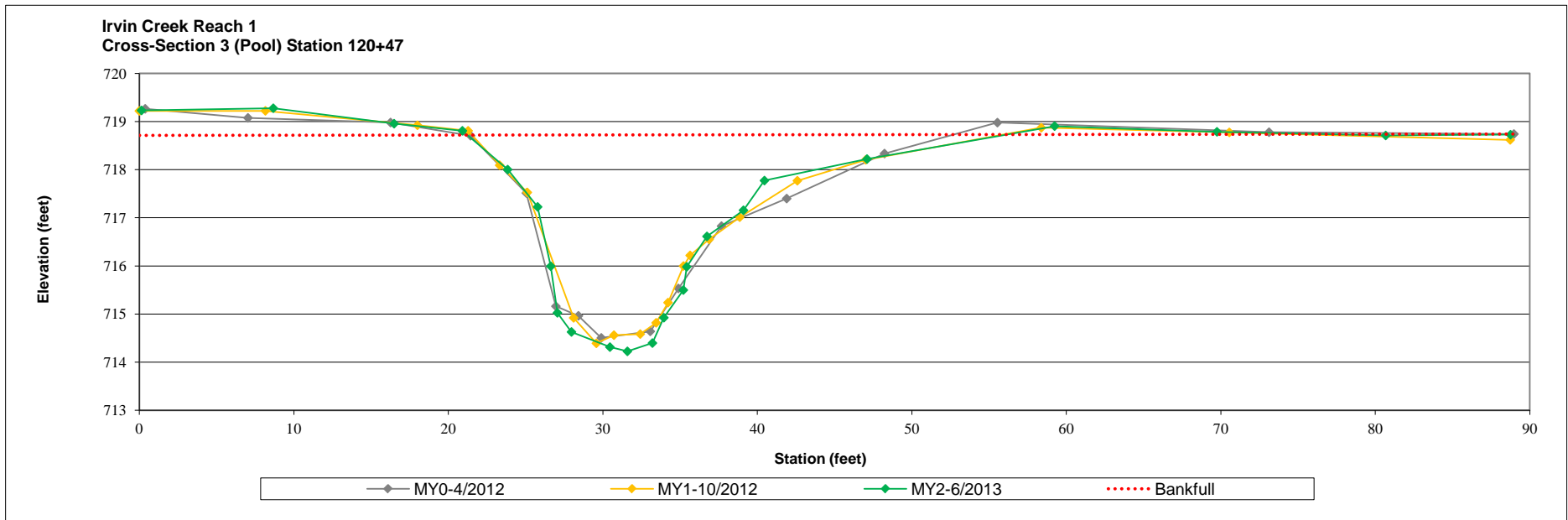
Summary Data	
Bankfull Elevation (ft)	718.7
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	56.5
Bankfull Width (ft)	34.5
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	4.5
Mean Depth at Bankfull (ft)	1.6
W/D Ratio	21.1
Entrenchment Ratio	N/A
Bank Height Ratio	1.0
Stream Type	N/A



Cross-Section 3: View Upstream



Cross-Section 3: View Downstream



Cross-Section Plots

Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)

Irvin Creek Reach 1, Cross-Section 4 (Riffle)

Monitoring Year 2

<b>River Basin</b>	Cape Fear
<b>Watershed HUC</b>	3030002
<b>XS ID</b>	4
<b>Drainage Area</b>	0.8 sq.mi
<b>Date</b>	6/27/2013
<b>Field Crew</b>	Wildlands Engineering

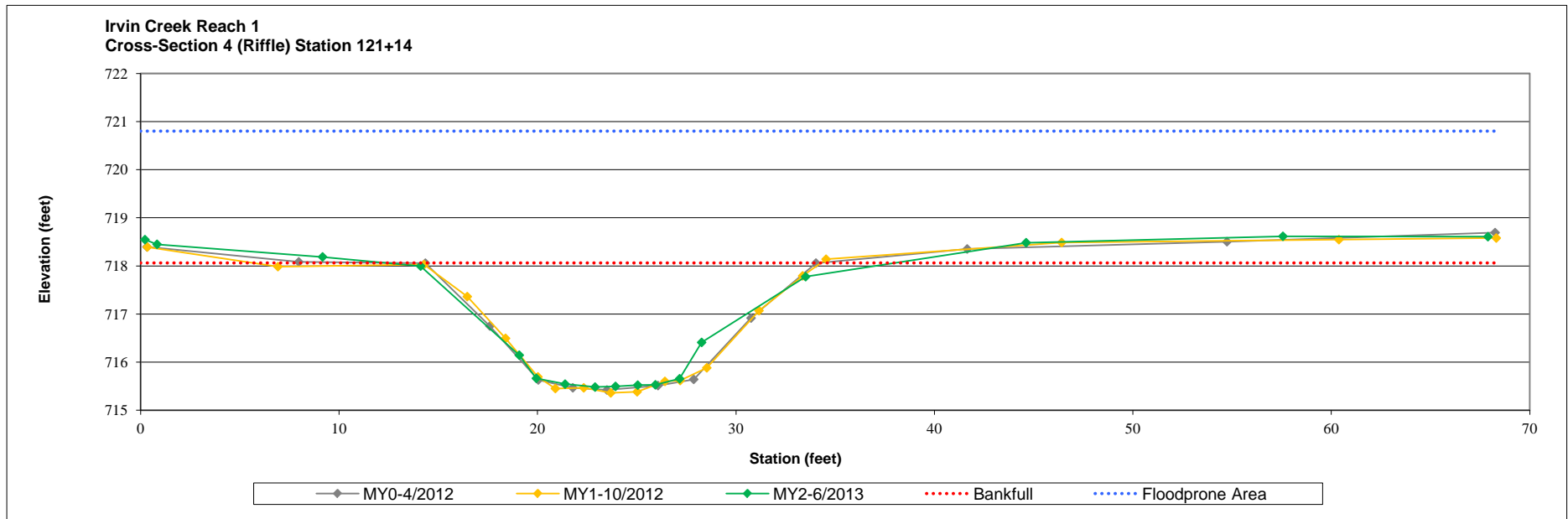
Summary Data	
<b>Bankfull Elevation (ft)</b>	718.1
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	33.0
<b>Bankfull Width (ft)</b>	25.5
<b>Flood Prone Area Elevation (ft)</b>	720.6
<b>Flood Prone Width (ft)</b>	200+
<b>Max Depth at Bankfull (ft)</b>	2.6
<b>Mean Depth at Bankfull (ft)</b>	1.3
<b>W/D Ratio</b>	19.8
<b>Entrenchment Ratio</b>	2.2+
<b>Bank Height Ratio</b>	1.0
<b>Stream Type</b>	C



Cross-Section 4: View Upstream



Cross-Section 4: View Downstream

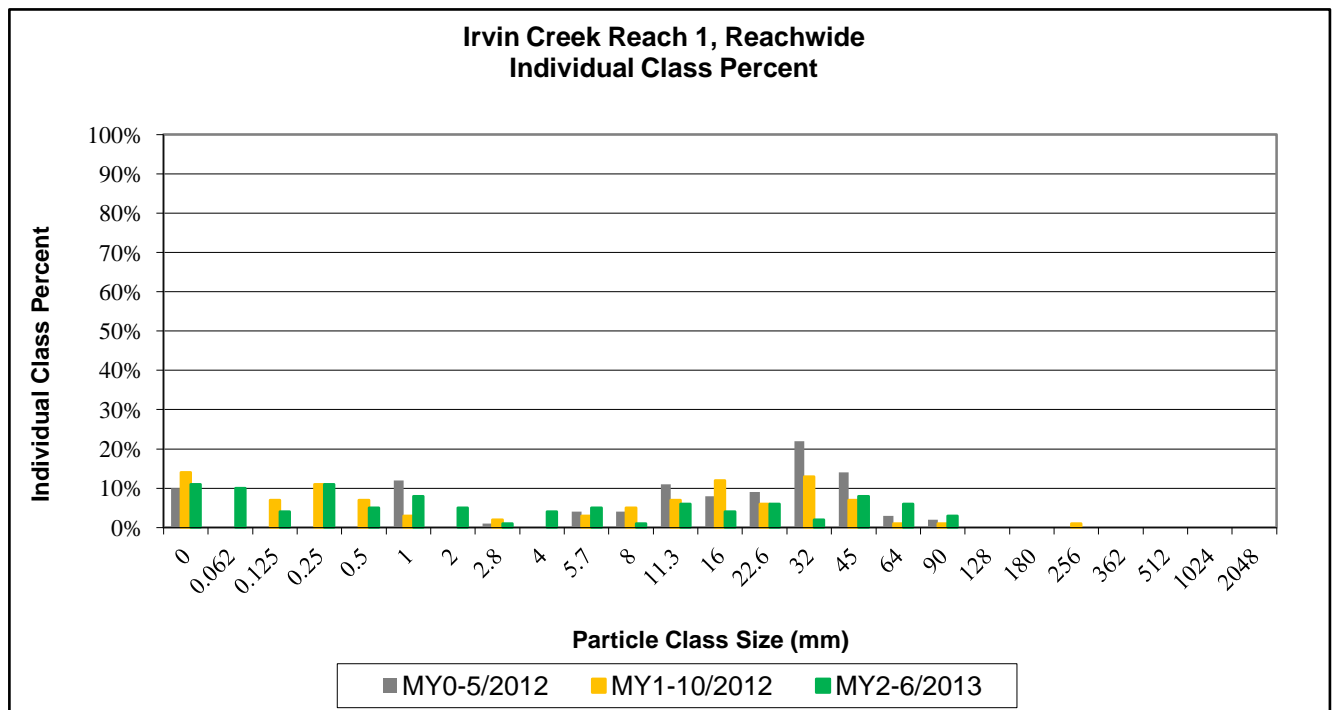
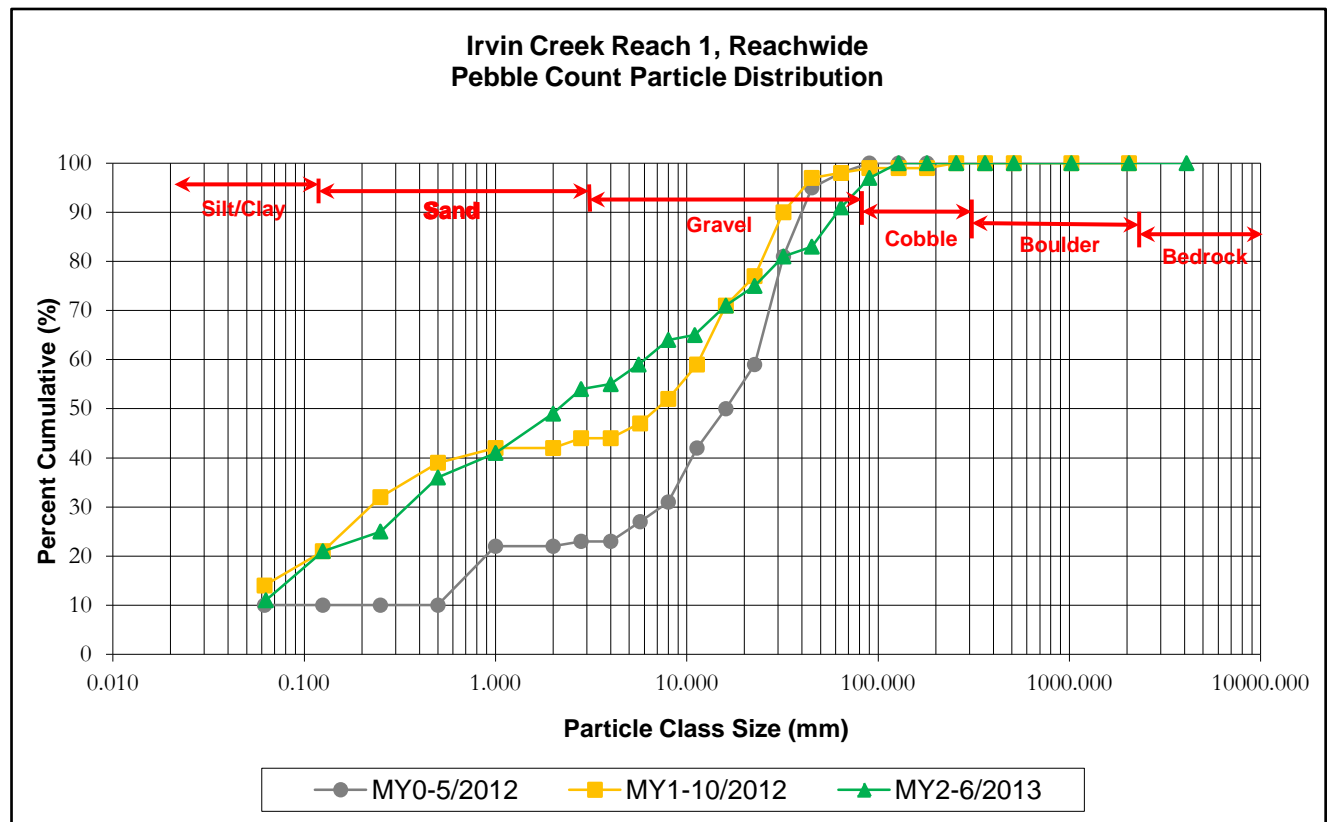




Reachwide and Cross-Section Substrate Plots  
 Little Troublesome Creek Mitigation Site (NCEP Project No. 94640)  
 Irvin Creek Reach 1, Reachwide  
 Monitoring Year 2

Particle Class		Diameter (mm)		Particle Count			Irvin Creek Reach 1 Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY		0.000	0.062	2	9	11	11	11
SAND	Very fine	0.062	0.125	4	6	10	10	21
	Fine	0.125	0.250	3	1	4	4	25
	Medium	0.250	0.500	2	9	11	11	36
	Coarse	0.5	1.0		5	5	5	41
	Very Coarse	1.0	2.0	1	7	8	8	49
GRAVEL	Very Fine	2.0	2.8		5	5	5	54
	Very Fine	2.8	4.0	1		1	1	55
	Fine	4.0	5.7		4	4	4	59
	Fine	5.7	8.0	2	3	5	5	64
	Medium	8.0	11.3	1		1	1	65
	Medium	11.3	16.0	5	1	6	6	71
	Coarse	16.0	22.6	4		4	4	75
	Coarse	22.6	32	6		6	6	81
	Very Coarse	32	45	2		2	2	83
	Very Coarse	45	64	8		8	8	91
COBBLE	Small	64	90	6		6	6	97
	Small	90	128	3		3	3	100
	Large	128	180					100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
BEDROCK	Large/Very Large	1024	2048					100
	Bedrock	2048	>2048					100
<b>Total</b>				<b>50</b>	<b>50</b>	<b>100</b>	<b>100</b>	<b>100</b>

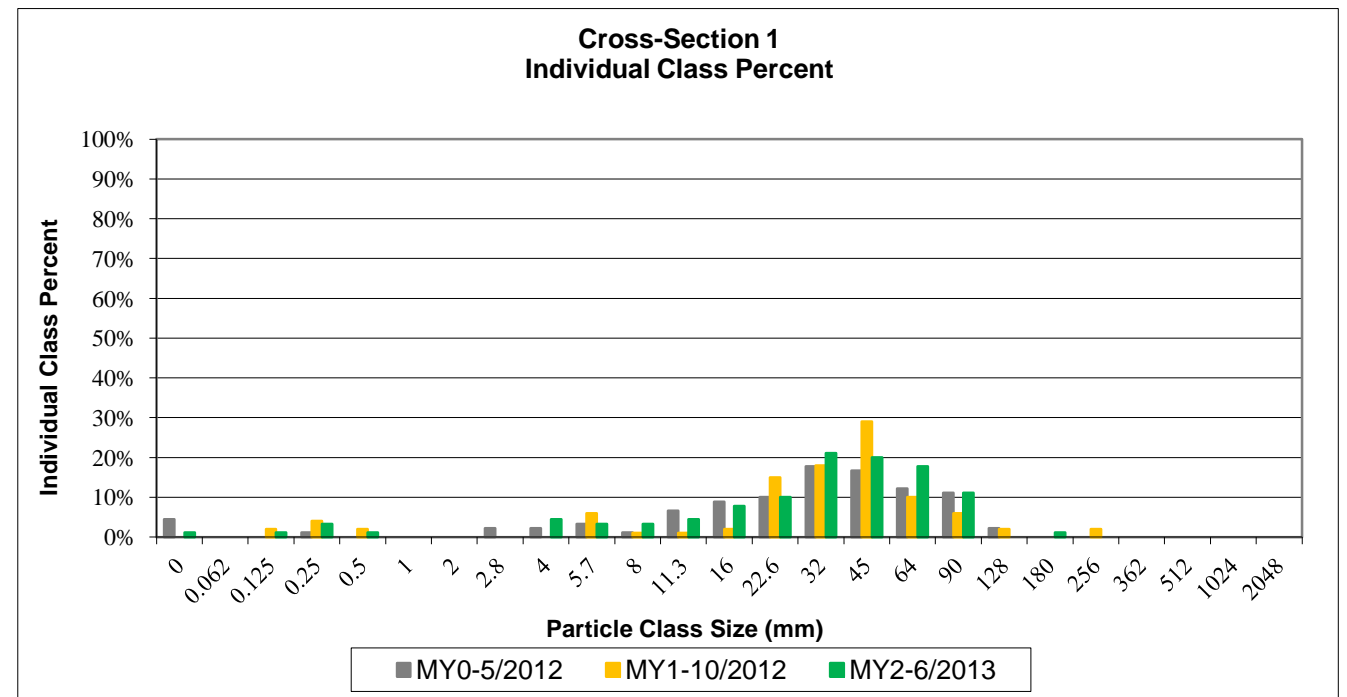
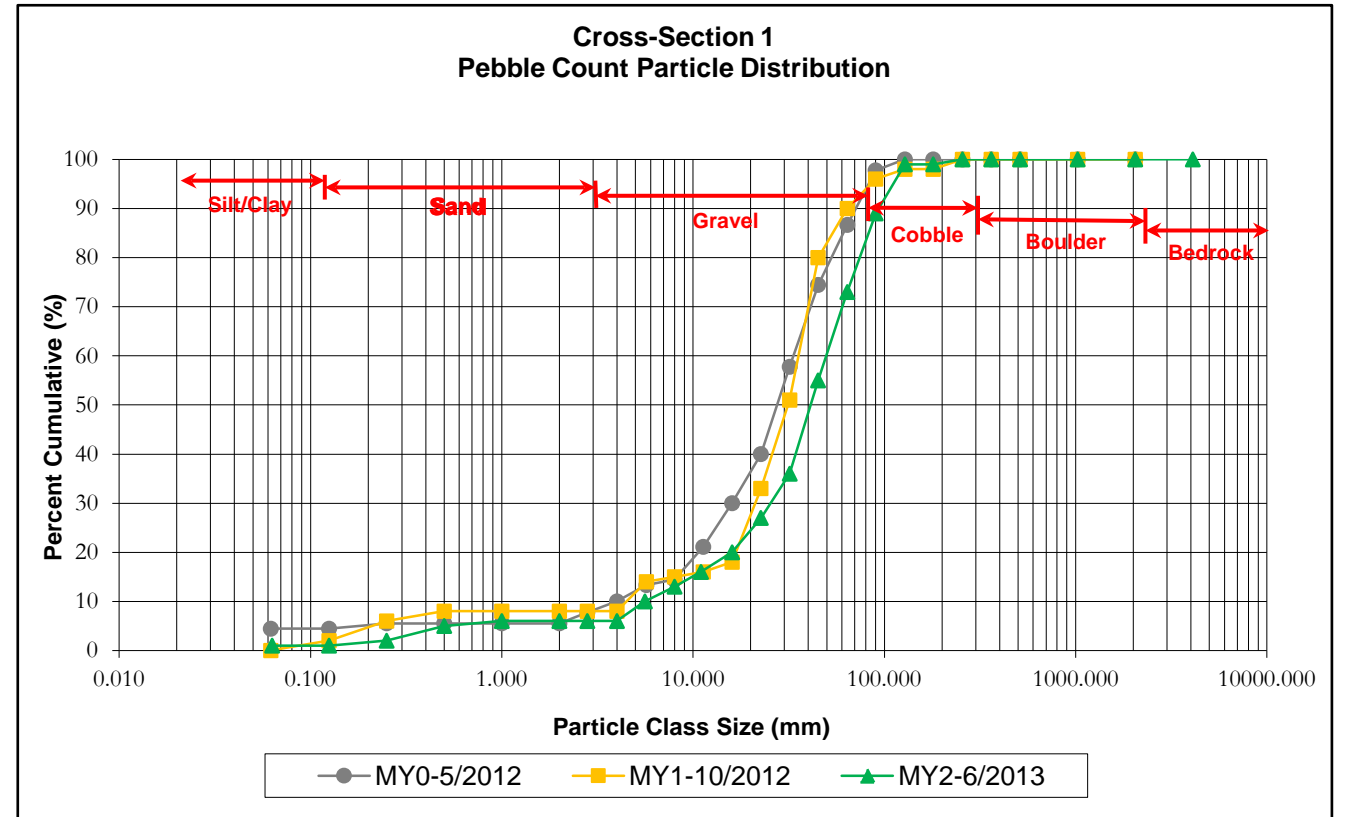
Reachwide Channel materials (mm)	
D <sub>16</sub> =	0.1
D <sub>35</sub> =	0.5
D <sub>50</sub> =	2.1
D <sub>84</sub> =	47.0
D <sub>95</sub> =	80.3
D <sub>100</sub> =	128.0



Reachwide and Cross-Section Substrate Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Irvin Creek Reach 1, Cross-Section 1 (Riffle)  
 Monitoring Year 2

Particle Class		Diameter (mm)		Particle Count	Cross-Section 1 Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY		0.000	0.062	1	1	1
SAND	Very fine	0.062	0.125			1
	Fine	0.125	0.250	1	1	2
	Medium	0.250	0.500	3	3	5
	Coarse	0.5	1.0	1	1	6
	Very Coarse	1.0	2.0			6
FINE GRAVEL	Very Fine	2.0	2.8			6
	Very Fine	2.8	4.0			6
	Fine	4.0	5.7	4	4	10
	Fine	5.7	8.0	3	3	13
	Medium	8.0	11.3	3	3	16
	Medium	11.3	16.0	4	4	20
	Coarse	16.0	22.6	7	7	27
	Coarse	22.6	32	9	9	36
	Very Coarse	32	45	19	19	55
	Very Coarse	45	64	18	18	73
COBBLE	Small	64	90	16	16	89
	Small	90	128	10	10	99
	Large	128	180			99
	Large	180	256	1	1	100
Boulder	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
<b>Total</b>				<b>100</b>	<b>100</b>	<b>100</b>

Cross-Section 1 Channel materials (mm)	
D <sub>16</sub> =	11.0
D <sub>35</sub> =	30.8
D <sub>50</sub> =	41.1
D <sub>84</sub> =	80.9
D <sub>95</sub> =	111.2
D <sub>100</sub> =	256.0

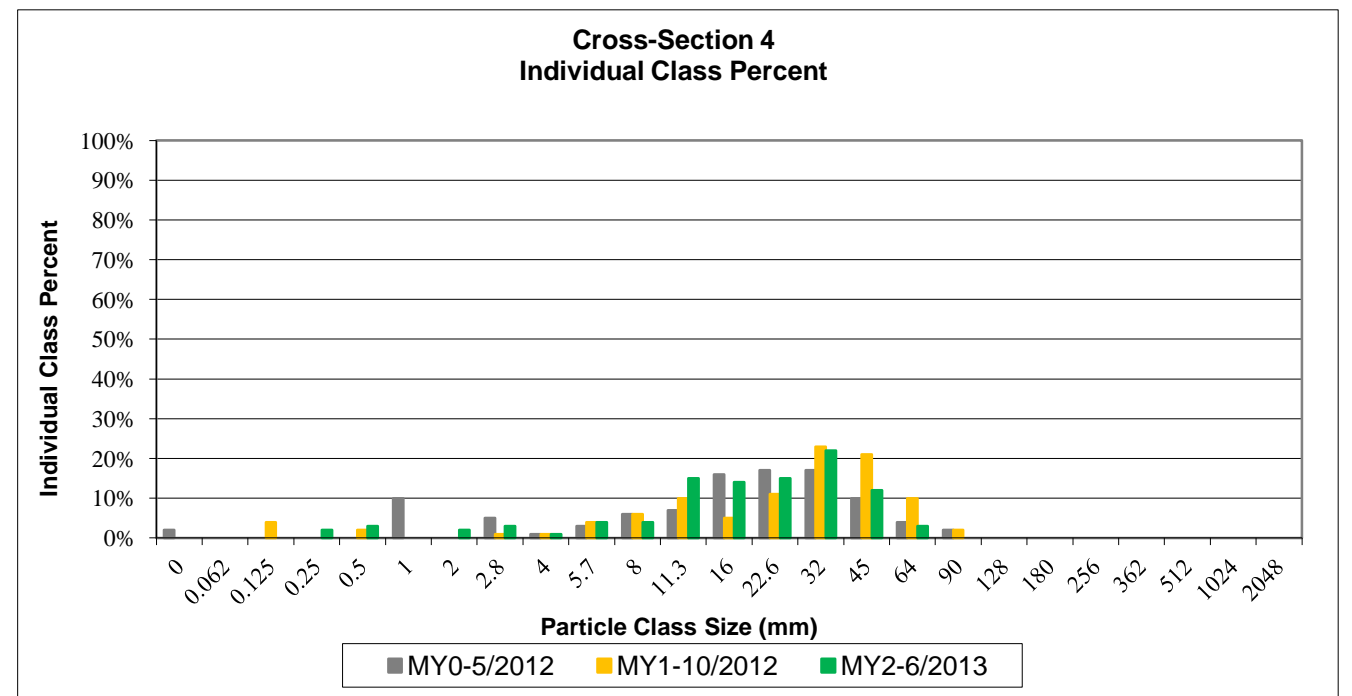
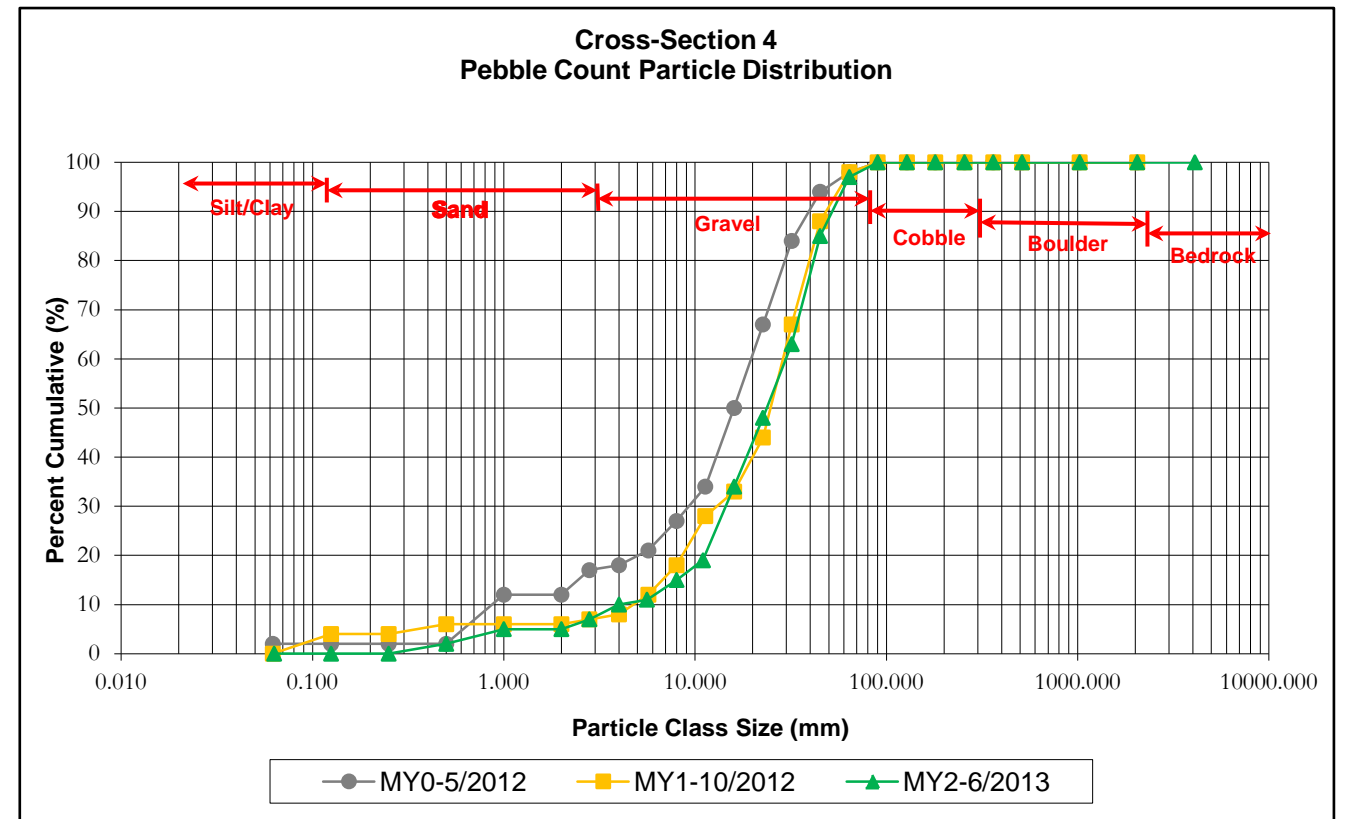




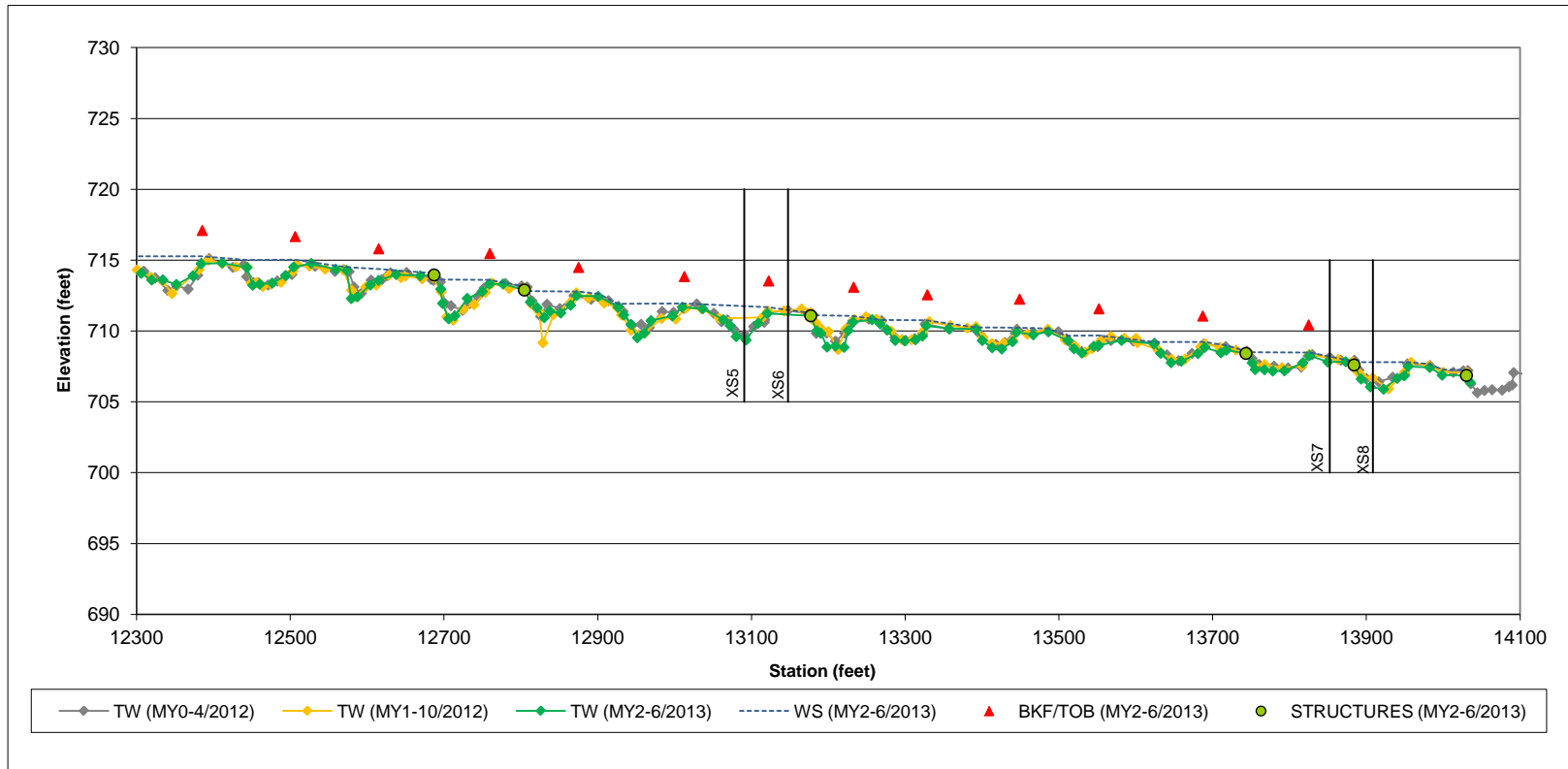
Reachwide and Cross-Section Substrate Plots  
 Little Troublesome Creek Mitigation Site (NCEP Project No. 94640)  
 Irvin Creek Reach 1, Cross-Section 4 (Riffle)  
 Monitoring Year 2

Particle Class		Diameter (mm)		Particle Count	Cross-Section 4 Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY		0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.250	0.500	2	2	2
	Coarse	0.5	1.0	3	3	5
	Very Coarse	1.0	2.0			5
GRAVEL	Very Fine	2.0	2.8	2	2	7
	Very Fine	2.8	4.0	3	3	10
	Fine	4.0	5.7	1	1	11
	Fine	5.7	8.0	4	4	15
	Medium	8.0	11.3	4	4	19
	Medium	11.3	16.0	15	15	34
	Coarse	16.0	22.6	14	14	48
	Coarse	22.6	32	15	15	63
	Very Coarse	32	45	22	22	85
	Very Coarse	45	64	12	12	97
BOULDER	Small	64	90	3	3	100
	Small	90	128			100
	Large	128	180			100
	Large	180	256			100
BEDROCK	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK		2048	>2048			100
<b>Total</b>				<b>100</b>	<b>100</b>	<b>100</b>

Cross-Section 4 Channel materials (mm)	
D <sub>16</sub> =	8.7
D <sub>35</sub> =	16.4
D <sub>50</sub> =	23.7
D <sub>84</sub> =	44.3
D <sub>95</sub> =	60.4
D <sub>100</sub> =	90.0



Longitudinal Profile Plots  
Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
Irvin Creek Reach 2  
Monitoring Year 2





Cross-Section Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Irvin Creek Reach 2, Cross-Section 5 (Pool)  
 Monitoring Year 2

<b>River Basin</b>	Cape Fear
<b>Watershed HUC</b>	3030002
<b>XS ID</b>	5
<b>Drainage Area</b>	0.9 sq.mi
<b>Date</b>	6/27/2013
<b>Field Crew</b>	Wildlands Engineering

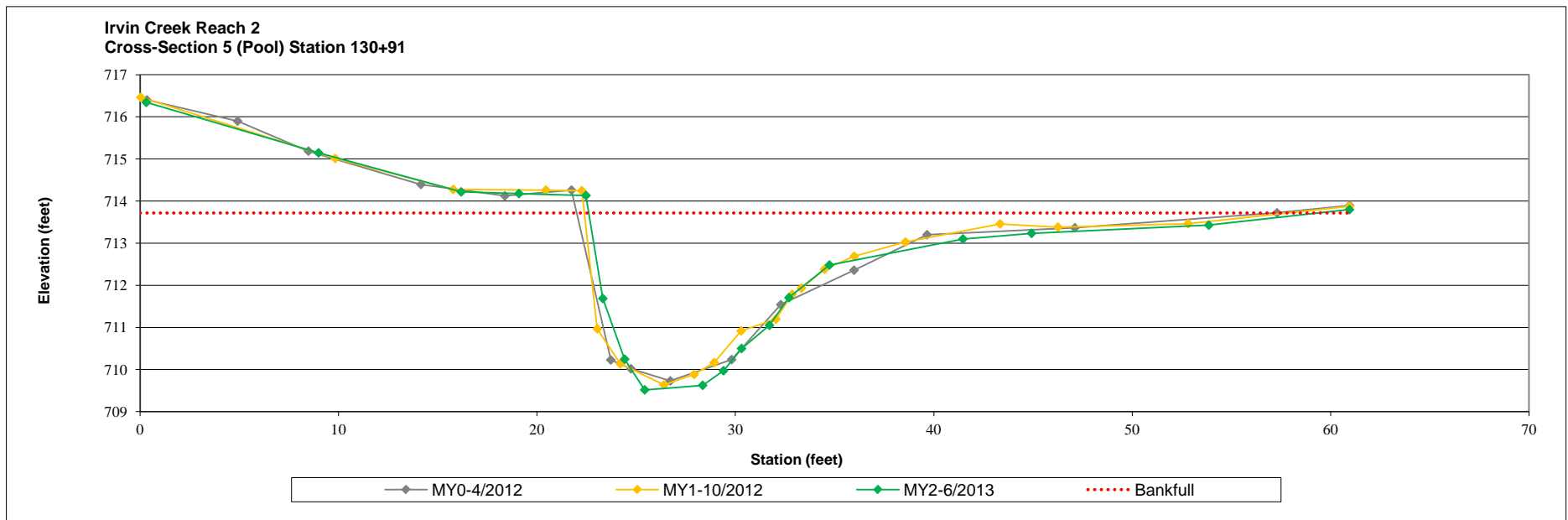
Summary Data	
<b>Bankfull Elevation (ft)</b>	713.7
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	49.2
<b>Bankfull Width (ft)</b>	36.9
<b>Flood Prone Area Elevation (ft)</b>	N/A
<b>Flood Prone Width (ft)</b>	N/A
<b>Max Depth at Bankfull (ft)</b>	4.2
<b>Mean Depth at Bankfull (ft)</b>	1.3
<b>W/D Ratio</b>	27.6
<b>Entrenchment Ratio</b>	N/A
<b>Bank Height Ratio</b>	1.1
<b>Stream Type</b>	N/A



Cross-Section 5: View Upstream



Cross-Section 5: View Downstream



Cross-Section Plots  
 Little Troublesome Creek Mitigation Site (NCEP Project No. 94640)  
 Irvin Creek Reach 2, Cross-Section 6 (Riffle)  
 Monitoring Year 2

<b>River Basin</b>	Cape Fear
<b>Watershed HUC</b>	3030002
<b>XS ID</b>	6
<b>Drainage Area</b>	0.9 sq.mi
<b>Date</b>	6/27/2013
<b>Field Crew</b>	Wildlands Engineering

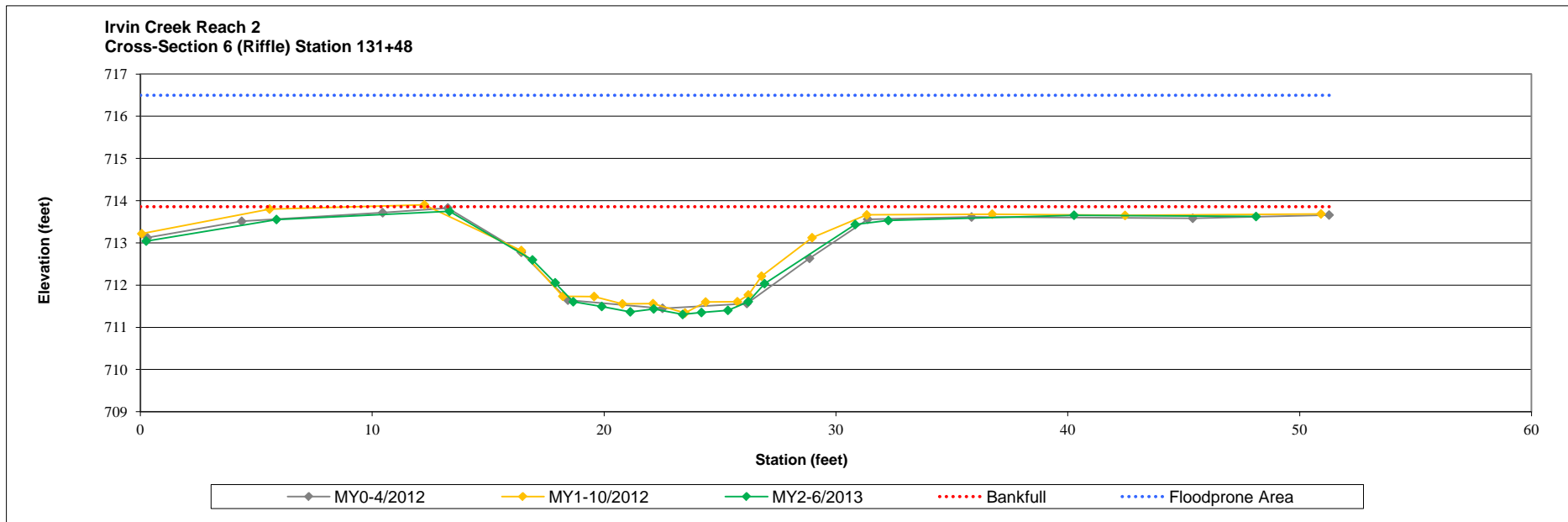
Summary Data	
<b>Bankfull Elevation (ft)</b>	713.9
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	30.7
<b>Bankfull Width (ft)</b>	18.0
<b>Flood Prone Area Elevation (ft)</b>	716.5
<b>Flood Prone Width (ft)</b>	200+
<b>Max Depth at Bankfull (ft)</b>	2.6
<b>Mean Depth at Bankfull (ft)</b>	1.7
<b>W/D Ratio</b>	10.6
<b>Entrenchment Ratio</b>	2.2+
<b>Bank Height Ratio</b>	0.8
<b>Stream Type</b>	E



Cross-Section 6: View Upstream



Cross-Section 6: View Downstream





Cross-Section Plots  
 Little Troublesome Creek Mitigation Site (NCEP Project No. 94640)  
 Irvin Creek Reach 2, Cross-Section 7 (Riffle)  
 Monitoring Year 2

<b>River Basin</b>	Cape Fear
<b>Watershed HUC</b>	3030002
<b>XS ID</b>	7
<b>Drainage Area</b>	0.9 sq.mi
<b>Date</b>	6/27/2013
<b>Field Crew</b>	Wildlands Engineering

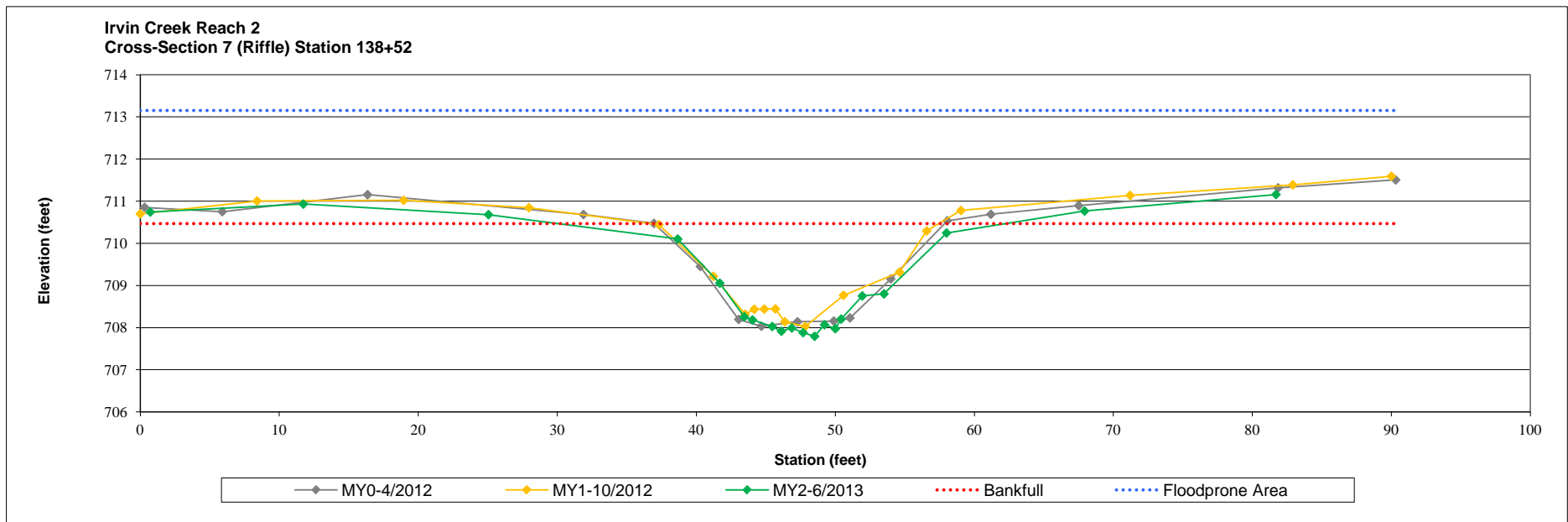
Summary Data	
<b>Bankfull Elevation (ft)</b>	710.5
<b>Bankfull Cross-Sectional Area (ft<sup>2</sup>)</b>	35.1
<b>Bankfull Width (ft)</b>	32.3
<b>Flood Prone Area Elevation (ft)</b>	713.2
<b>Flood Prone Width (ft)</b>	200+
<b>Max Depth at Bankfull (ft)</b>	2.7
<b>Mean Depth at Bankfull (ft)</b>	1.1
<b>W/D Ratio</b>	29.7
<b>Entrenchment Ratio</b>	2.2+
<b>Bank Height Ratio</b>	0.9
<b>Stream Type</b>	C



Cross-Section 7: View Upstream



Cross-Section 7: View Downstream



Cross-Section Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Irvin Creek Reach 2, Cross-Section 8 (Pool)  
 Monitoring Year 2

River Basin	Cape Fear
Watershed HUC	3030002
XS ID	8
Drainage Area	0.9 sq.mi
Date	6/27/2013
Field Crew	Wildlands Engineering

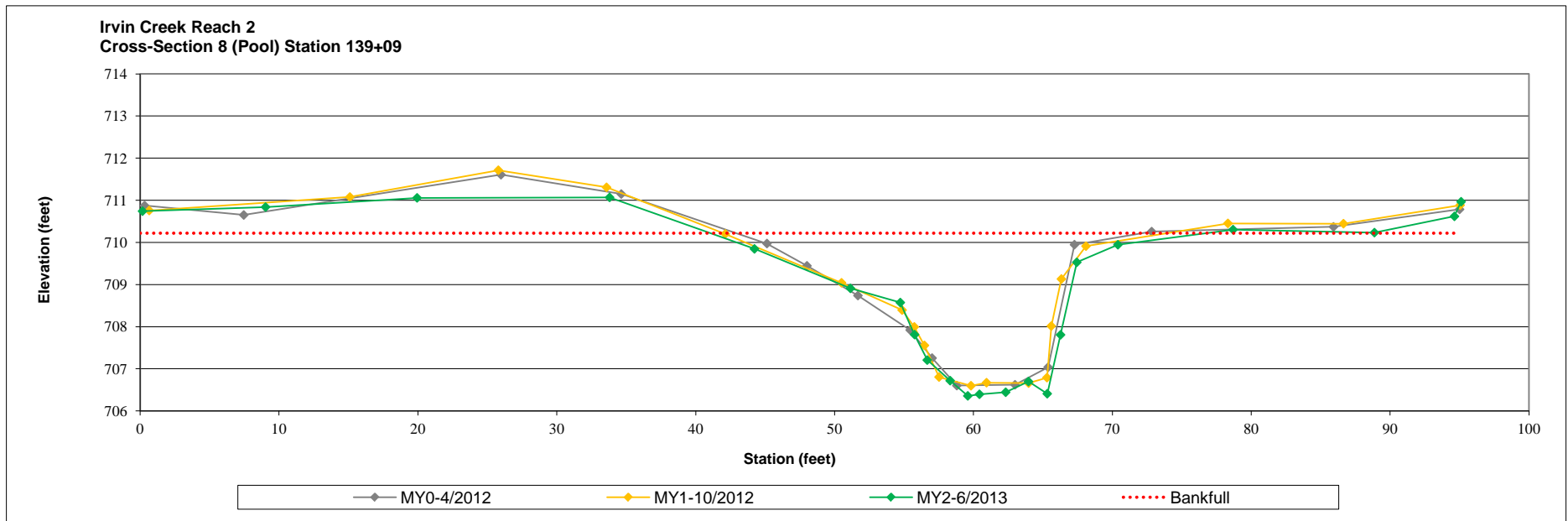
Summary Data	
Bankfull Elevation (ft)	710.2
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	54.8
Bankfull Width (ft)	35.7
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	3.9
Mean Depth at Bankfull (ft)	1.5
W/D Ratio	23.3
Entrenchment Ratio	N/A
Bank Height Ratio	0.9
Stream Type	N/A



Cross-Section 8: View Upstream



Cross-Section 8: View Downstream

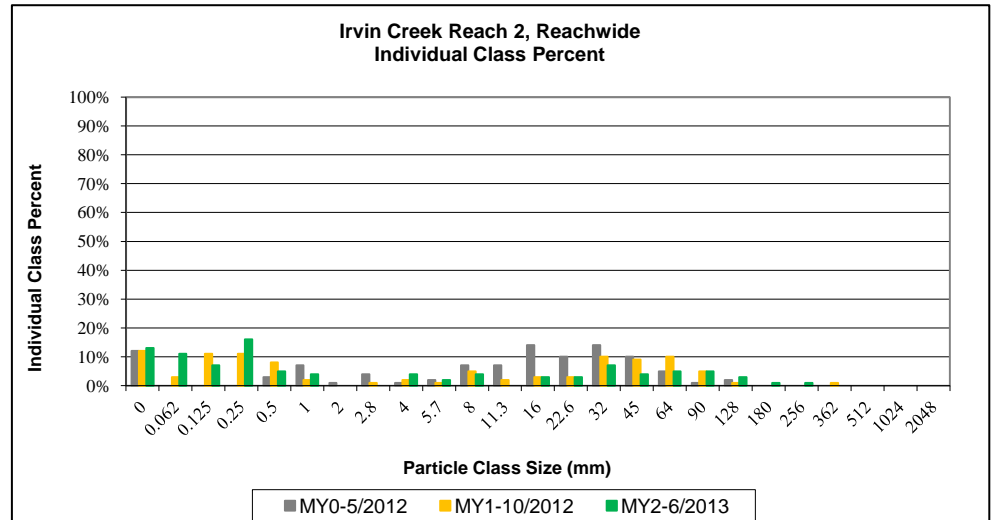
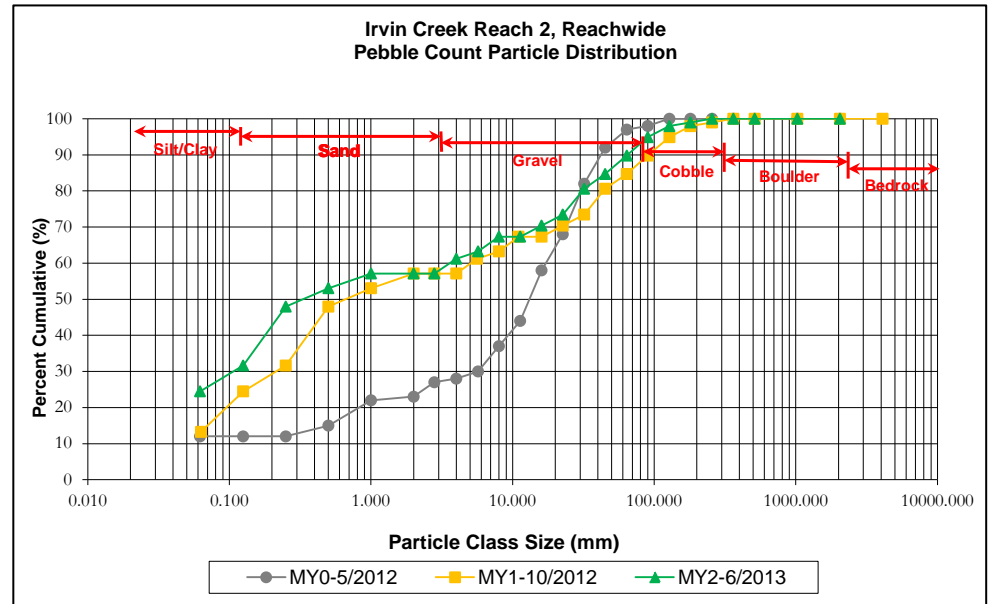




Reachwide and Cross-Section Substrate Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Irvin Creek Reach 2, Reachwide  
 Monitoring Year 2

Particle Class		Diameter (mm)		Particle Count			Irvin Creek Reach 2 Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
<i>SILT/CLAY</i>		Silt/Clay	0.000	0.062		13	13	13
<i>SA AND</i>	Very fine	0.062	0.125	5	6	11	11	24
	Fine	0.125	0.250	4	3	7	7	32
	Medium	0.250	0.500	5	11	16	16	48
	Coarse	0.5	1.0		5	5	5	53
	Very Coarse	1.0	2.0	2	2	4	4	57
<i>GRAVEL</i>	Very Fine	2.0	2.8					57
	Very Fine	2.8	4.0					57
	Fine	4.0	5.7		4	4	4	61
	Fine	5.7	8.0		2	2	2	63
	Medium	8.0	11.3	2	2	4	4	67
	Medium	11.3	16.0					67
	Coarse	16.0	22.6	3		3	3	70
	Coarse	22.6	32	3		3	3	73
	Very Coarse	32	45	7		7	7	81
	Very Coarse	45	64	4		4	4	85
<i>COBBLE</i>	Small	64	90	5		5	5	90
	Small	90	128	5		5	5	95
	Large	128	180	3		3	3	98
	Large	180	256	1		1	1	99
<i>BOULDER</i>	Small	256	362	1		1	1	100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
<i>BEDROCK</i>	Bedrock	2048	>2048					100
<b>Total</b>				<b>50</b>	<b>48</b>	<b>98</b>	<b>100</b>	<b>100</b>

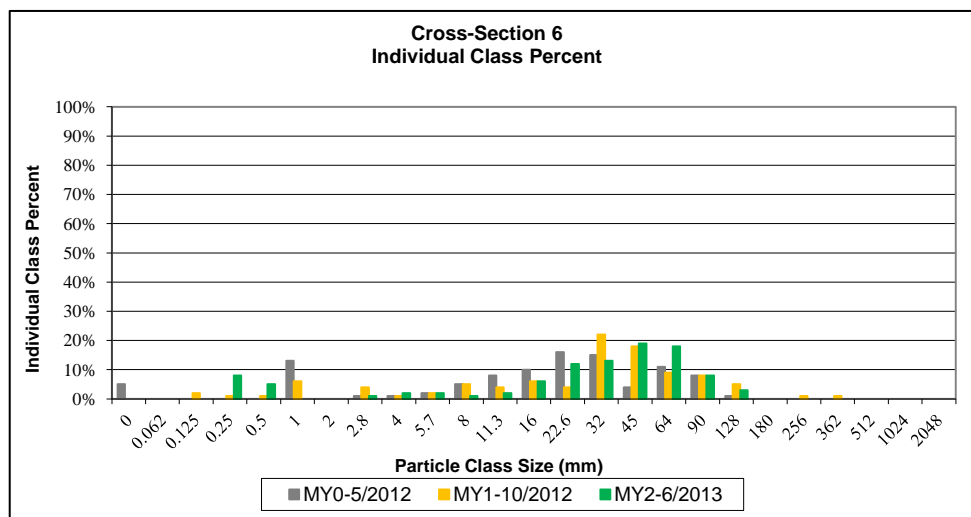
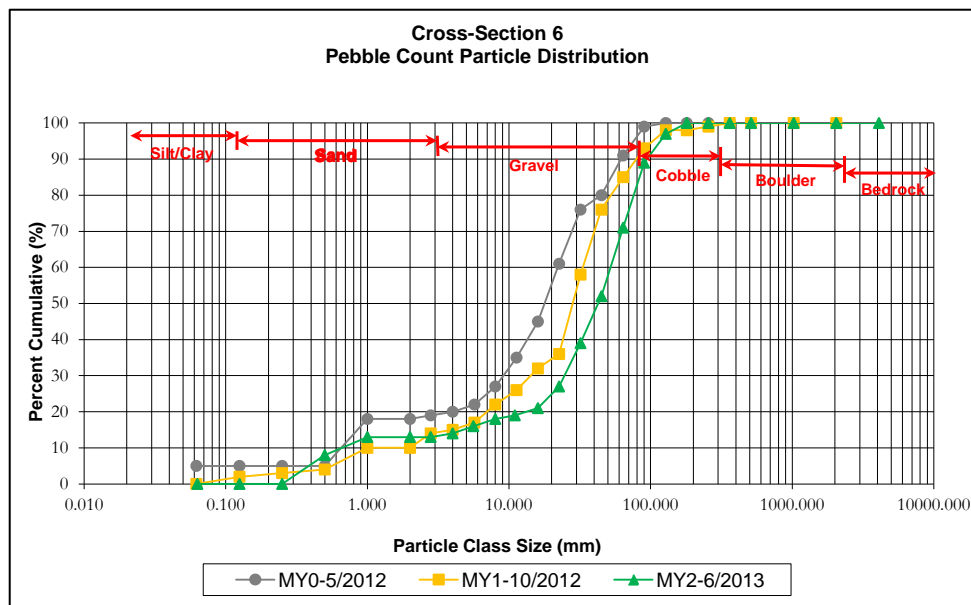
Reachwide Channel materials (mm)	
D <sub>16</sub> =	0.1
D <sub>35</sub> =	0.3
D <sub>50</sub> =	0.7
D <sub>84</sub> =	60.3
D <sub>95</sub> =	129.5
D <sub>100</sub> =	362.0



Reachwide and Cross-Section Substrate Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Irvin Creek Reach 2, Cross-Section 6 (Riffle)  
 Monitoring Year 2

Particle Class		Diameter (mm)		Particle Count	Cross-Section 6 Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY		0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.250	0.500	8	8	8
	Coarse	0.5	1.0	5	5	13
	Very Coarse	1.0	2.0			13
GRAVEL	Very Fine	2.0	2.8			13
	Very Fine	2.8	4.0	1	1	14
	Fine	4.0	5.7	2	2	16
	Fine	5.7	8.0	2	2	18
	Medium	8.0	11.3	1	1	19
	Medium	11.3	16.0	2	2	21
	Coarse	16.0	22.6	6	6	27
	Coarse	22.6	32	12	12	39
	Very Coarse	32	45	13	13	52
	Very Coarse	45	64	19	19	71
COBBLE	Small	64	90	18	18	89
	Small	90	128	8	8	97
	Large	128	180	3	3	100
	Large	180	256			100
Boulder	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK		2048	>2048			100
<b>Total</b>				<b>100</b>	<b>100</b>	<b>100</b>

Cross-Section 6 Channel materials (mm)	
D <sub>16</sub> =	5.6
D <sub>35</sub> =	28.5
D <sub>50</sub> =	42.7
D <sub>84</sub> =	81.9
D <sub>95</sub> =	117.2
D <sub>100</sub> =	180.0

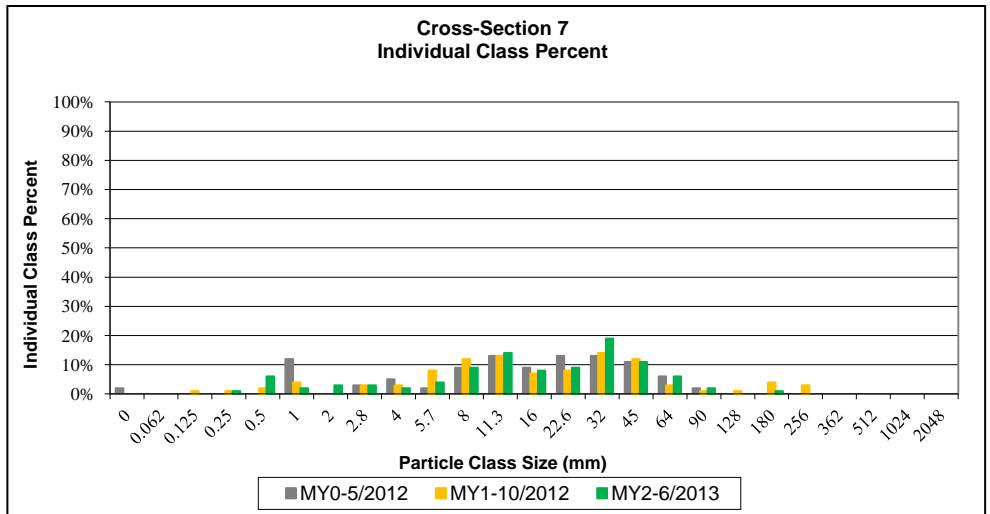
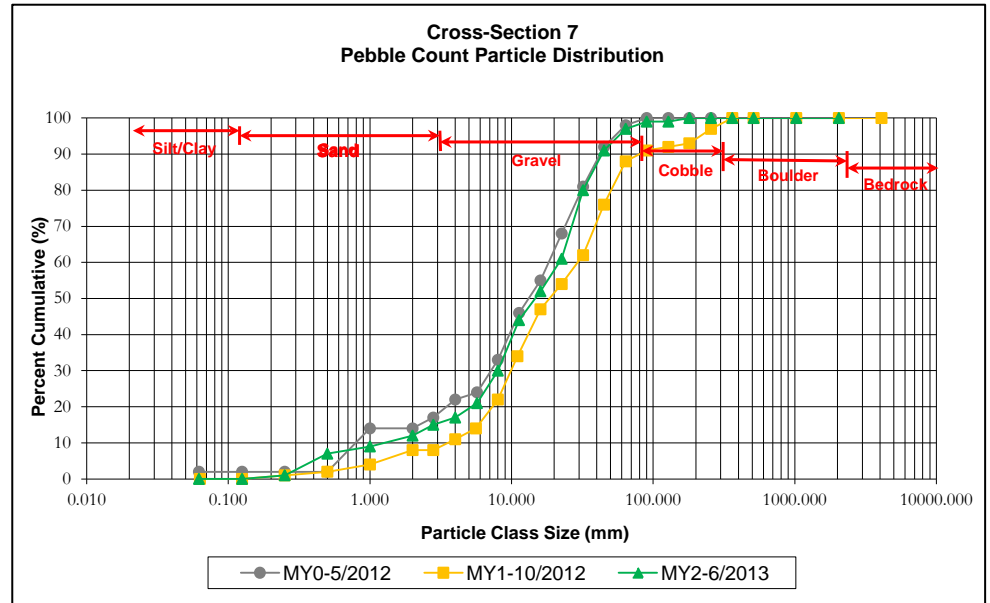




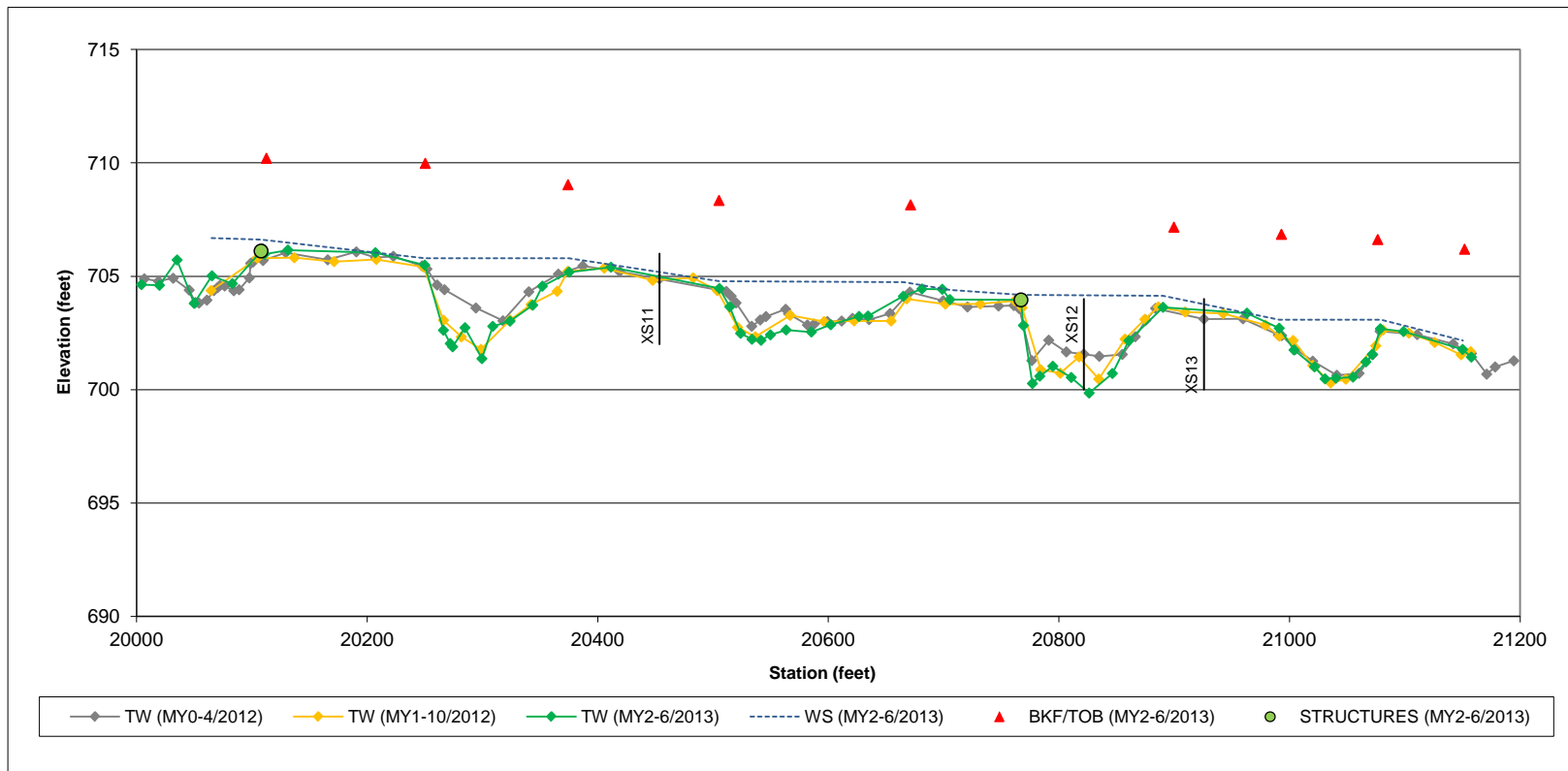
Reachwide and Cross-Section Substrate Plots  
 Little Troublesome Creek Mitigation Site (NCEP Project No. 94640)  
 Irvin Creek Reach 2, Cross-Section 7 (Riffle)  
 Monitoring Year 2

Particle Class		Diameter (mm)		Particle Count	Cross-Section 7 Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
	Very fine	0.062	0.125			0
SAND	Fine	0.125	0.250			0
	Medium	0.250	0.500	1	1	1
	Coarse	0.5	1.0	6	6	7
	Very Coarse	1.0	2.0	2	2	9
	Very Fine	2.0	2.8	3	3	12
GRAVEL	Very Fine	2.8	4.0	3	3	15
	Fine	4.0	5.7	2	2	17
	Fine	5.7	8.0	4	4	21
	Medium	8.0	11.3	9	9	30
	Medium	11.3	16.0	14	14	44
	Coarse	16.0	22.6	8	8	52
	Coarse	22.6	32	9	9	61
	Very Coarse	32	45	19	19	80
	Very Coarse	45	64	11	11	91
COBBLE	Small	64	90	6	6	97
	Small	90	128	2	2	99
	Large	128	180			99
	Large	180	256	1	1	100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
<b>Total</b>				<b>100</b>	<b>100</b>	<b>100</b>

Cross-Section 7 Channel materials (mm)	
D <sub>16</sub> =	4.7
D <sub>35</sub> =	12.6
D <sub>50</sub> =	20.7
D <sub>84</sub> =	51.1
D <sub>95</sub> =	80.3
D <sub>100</sub> =	256.0



Longitudinal Profile Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Little Troublesome Creek  
 Monitoring Year 2



Cross-Section Plots

Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)

Little Troublesome Creek, Cross-Section 11 (Riffle)

Monitoring Year 2

River Basin	Cape Fear
Watershed HUC	3030002
XS ID	11
Drainage Area	5.1 sq.mi
Date	6/27/2013
Field Crew	Wildlands Engineering

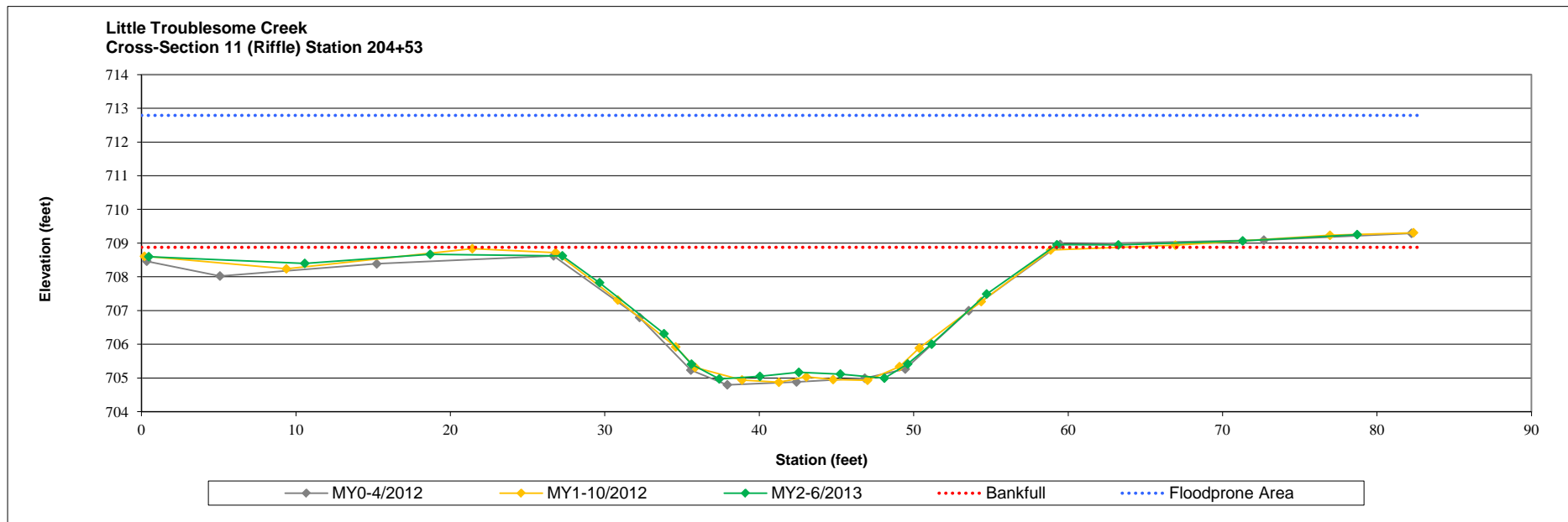
Summary Data	
Bankfull Elevation (ft)	708.9
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	82.8
Bankfull Width (ft)	31.9
Flood Prone Area Elevation (ft)	712.8
Flood Prone Width (ft)	200+
Max Depth at Bankfull (ft)	3.9
Mean Depth at Bankfull (ft)	2.6
W/D Ratio	12.3
Entrenchment Ratio	2.2+
Bank Height Ratio	1.0
Stream Type	C



Cross-Section 11: View Upstream



Cross-Section 11: View Downstream





Cross-Section Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Little Troublesome Creek, Cross-Section 12 (Pool)  
 Monitoring Year 2

River Basin	Cape Fear
Watershed HUC	3030002
XS ID	12
Drainage Area	5.1sq.mi
Date	6/27/2013
Field Crew	Wildlands Engineering

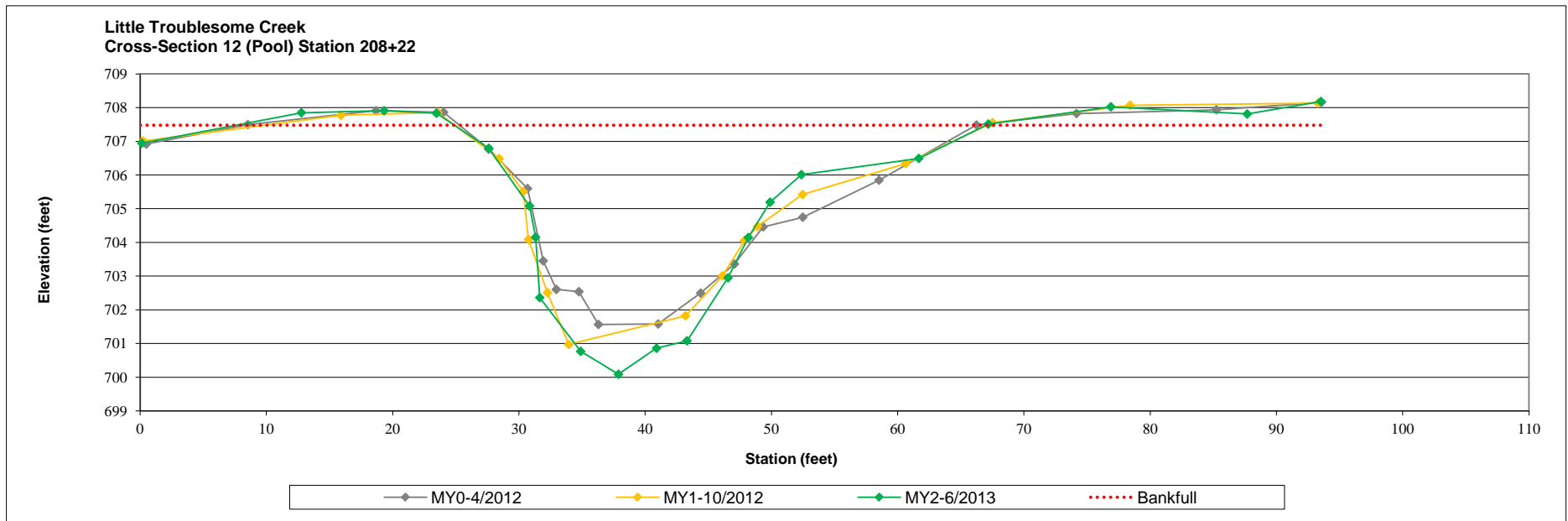
Summary Data	
Bankfull Elevation (ft)	707.5
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	133.4
Bankfull Width (ft)	42.1
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	7.4
Mean Depth at Bankfull (ft)	3.2
W/D Ratio	13.3
Entrenchment Ratio	N/A
Bank Height Ratio	1.0
Stream Type	N/A



Cross-Section 12: View Upstream



Cross-Section 12: View Downstream



Cross-Section Plots

Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)

Little Troublesome Creek, Cross-Section 13 (Riffle)

Monitoring Year 2

River Basin	Cape Fear
Watershed HUC	3030002
XS ID	13
Drainage Area	5.1 sq.mi
Date	6/27/2013
Field Crew	Wildlands Engineering

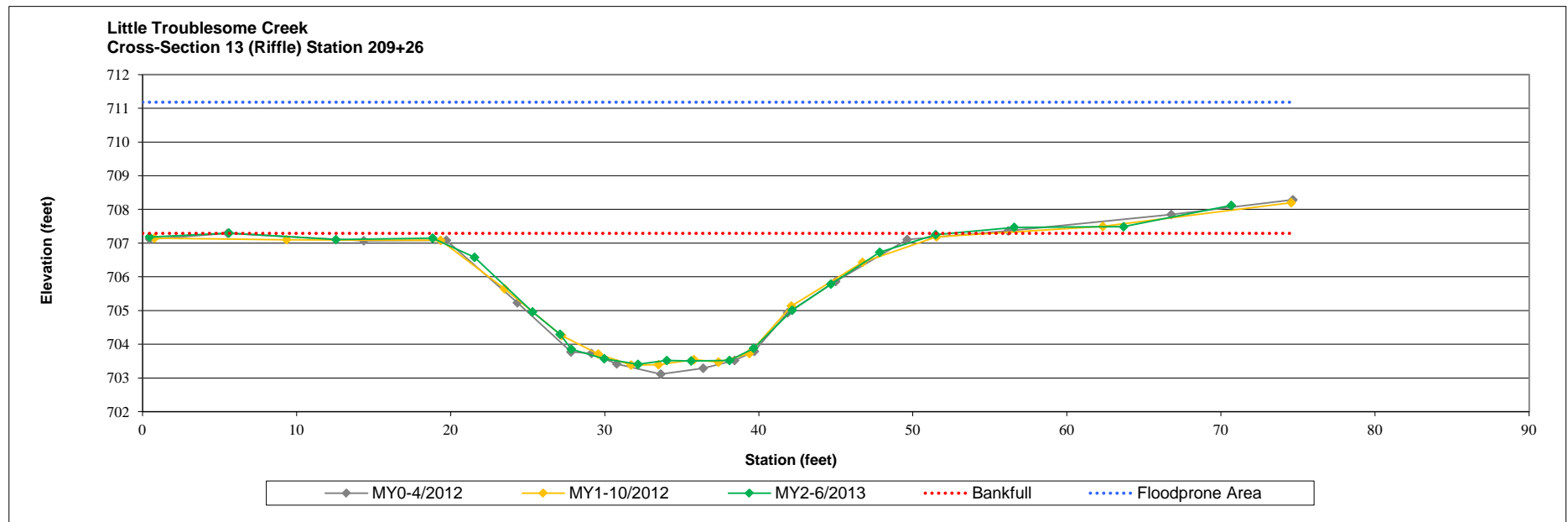
Summary Data	
Bankfull Elevation (ft)	707.3
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	74.4
Bankfull Width (ft)	33.7
Flood Prone Area Elevation (ft)	711.2
Flood Prone Width (ft)	200+
Max Depth at Bankfull (ft)	3.9
Mean Depth at Bankfull (ft)	2.2
W/D Ratio	15.3
Entrenchment Ratio	2.2+
Bank Height Ratio	1.0
Stream Type	C



Cross-Section 13: View Upstream



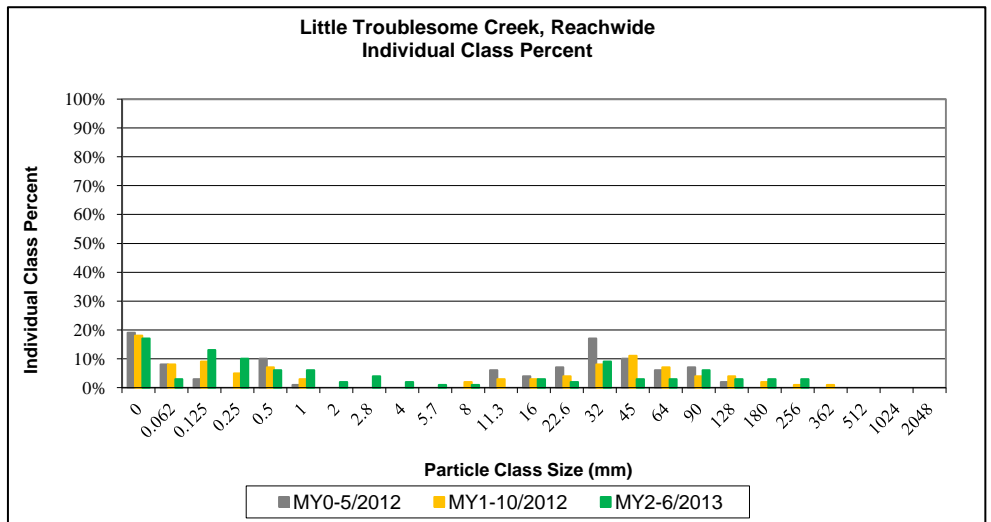
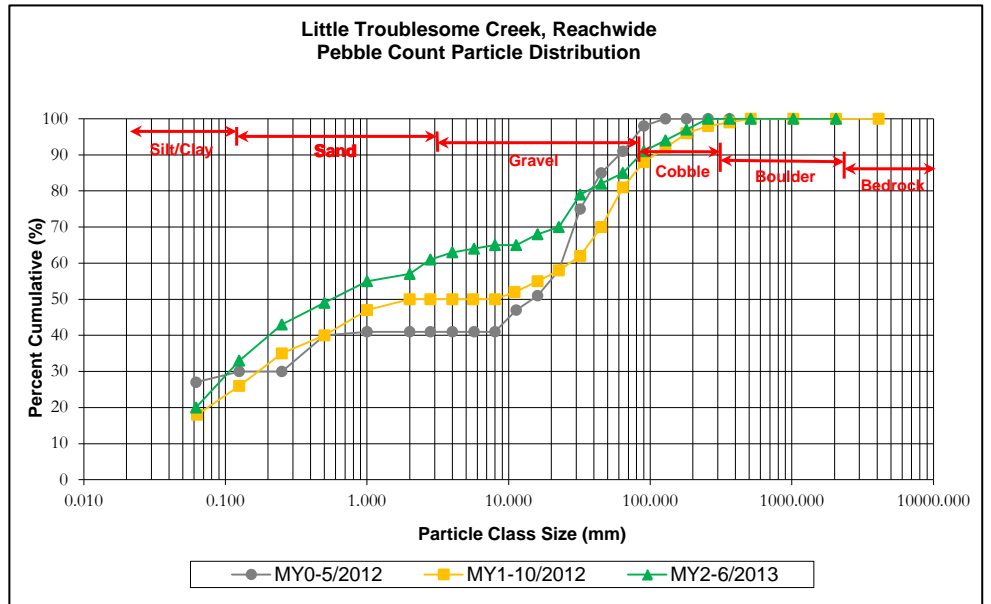
Cross-Section 13: View Downstream



Reachwide and Cross-Section Substrate Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Little Troublesome Creek, Reachwide  
 Monitoring Year 2

Particle Class	Diameter (mm)		Particle Count			Little Troublesome Creek Summary		
	min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative	
<b>SILT/CLAY</b>	Silt/Clay	0.000	0.062	2	15	17	10	10
<b>SAND</b>	Very fine	0.062	0.125		3	3	2	12
	Fine	0.125	0.250	1	12	13	8	20
	Medium	0.250	0.500	2	4	6	4	24
	Coarse	0.5	1.0	1	2	3	2	26
	Very Coarse	1.0	2.0	1	5	6	4	30
<b>GRAVEL</b>	Very Fine	2.0	2.8	2		2	1	31
	Very Fine	2.8	4.0	4	8	12	7	38
	Fine	4.0	5.7	2		2	1	40
	Fine	5.7	8.0		1	1	1	40
	Medium	8.0	11.3	1		1	1	41
	Medium	11.3	16.0					41
	Coarse	16.0	22.6	3	6	9	6	46
	Coarse	22.6	32	2	4	6	4	50
	Very Coarse	32	45	8	16	24	15	65
	Very Coarse	45	64	3	6	9	6	70
<b>BOULDER</b>	Small	64	90	3	6	9	6	76
	Small	90	128	6	12	18	11	87
	Large	128	180	3		3	2	89
	Large	180	256	3	6	9	6	94
<b>BEDROCK</b>	Small	256	362	3	6	9	6	100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
<b>BEDROCK</b>	Bedrock	2048	>2048					100
<b>Total</b>			<b>50</b>	<b>112</b>	<b>162</b>	<b>100</b>	<b>100</b>	

Reachwide Channel materials (mm)	
D <sub>16</sub> =	Silt/Clay
D <sub>35</sub> =	3.4
D <sub>50</sub> =	32.0
D <sub>84</sub> =	116.3
D <sub>95</sub> =	265.0
D <sub>100</sub> =	362.0

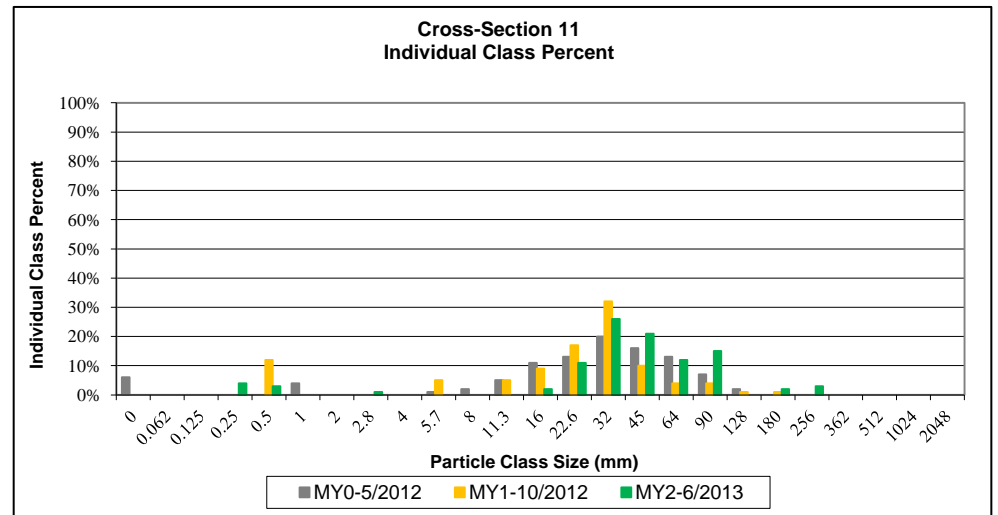
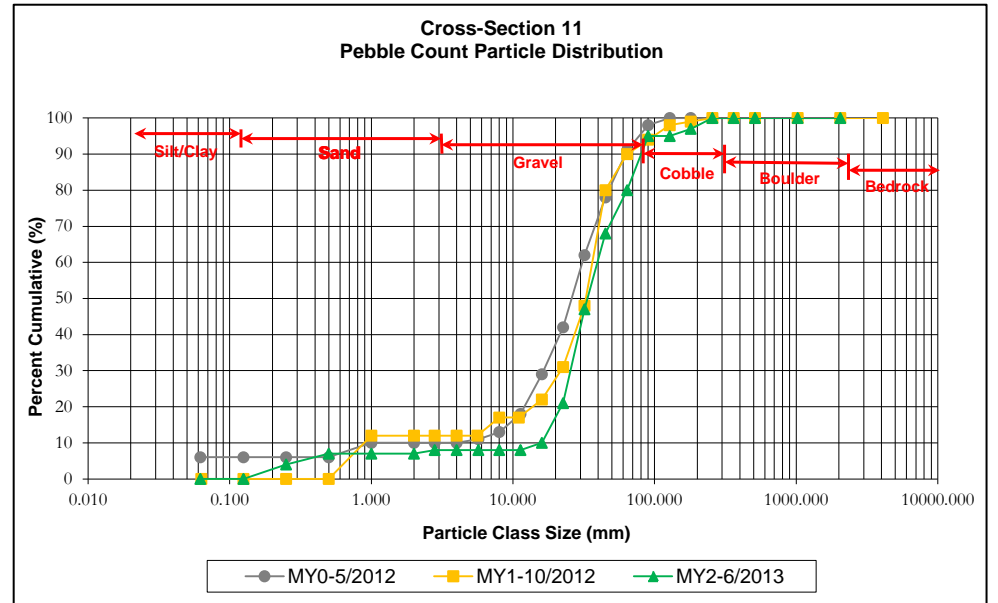




Reachwide and Cross-Section Substrate Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Little Troublesome Creek , Cross-Section 11 (Riffle)  
 Monitoring Year 2

Particle Class		Diameter (mm)		Particle Count	Cross-Section 11 Summary	
		min	max		Class Percentage	Percent Cumulative
<i>SILT/CLAY</i>		Silt/Clay	0.000 0.062			0
<i>SAND</i>	Very fine	0.062 0.125				0
	Fine	0.125 0.250				0
	Medium	0.250 0.500	4	4	4	4
	Coarse	0.5 1.0	3	3	7	7
	Very Coarse	1.0 2.0				7
<i>GRAVEL</i>	Very Fine	2.0 2.8				7
	Very Fine	2.8 4.0	1	1	8	8
	Fine	4.0 5.7				8
	Fine	5.7 8.0				8
	Medium	8.0 11.3				8
	Medium	11.3 16.0				8
	Coarse	16.0 22.6	2	2	10	10
	Coarse	22.6 32	11	11	21	21
	Very Coarse	32 45	26	26	47	47
	Very Coarse	45 64	21	21	68	68
<i>BOULDER</i>	Small	64 90	12	12	80	80
	Small	90 128	15	15	95	95
	Large	128 180				95
	Large	180 256	2	2	97	97
<i>COBBLE</i>	Small	256 362	3	3	100	100
	Small	362 512				100
	Medium	512 1024				100
	Large/Very Large	1024 2048				100
<i>BEDROCK</i>	Bedrock	2048 >2048				100
<b>Total</b>				<b>100</b>	<b>100</b>	<b>100</b>

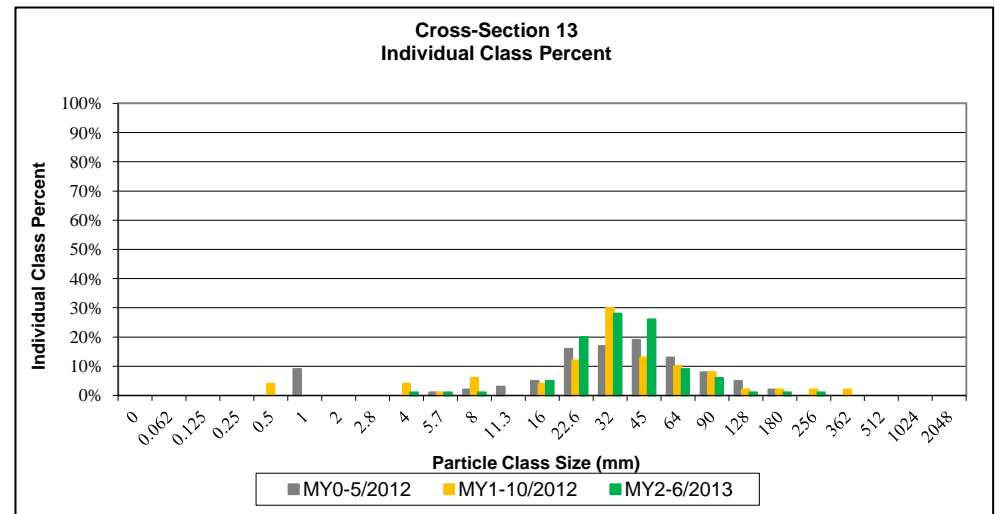
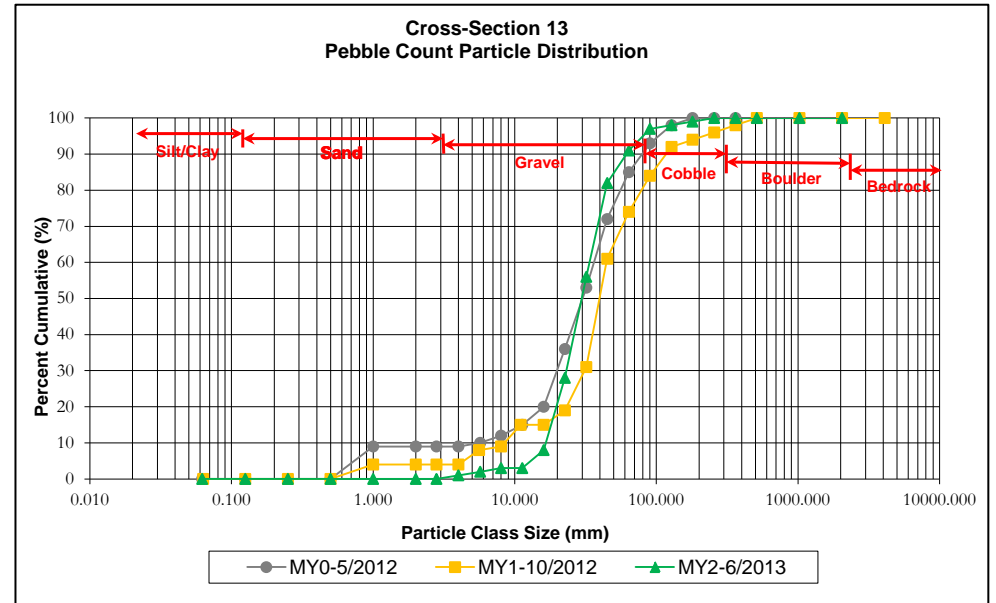
Cross-Section 11 Channel materials (mm)	
D <sub>16</sub> =	27.3
D <sub>35</sub> =	38.4
D <sub>50</sub> =	47.3
D <sub>84</sub> =	98.9
D <sub>95</sub> =	180.0
D <sub>100</sub> =	362.0



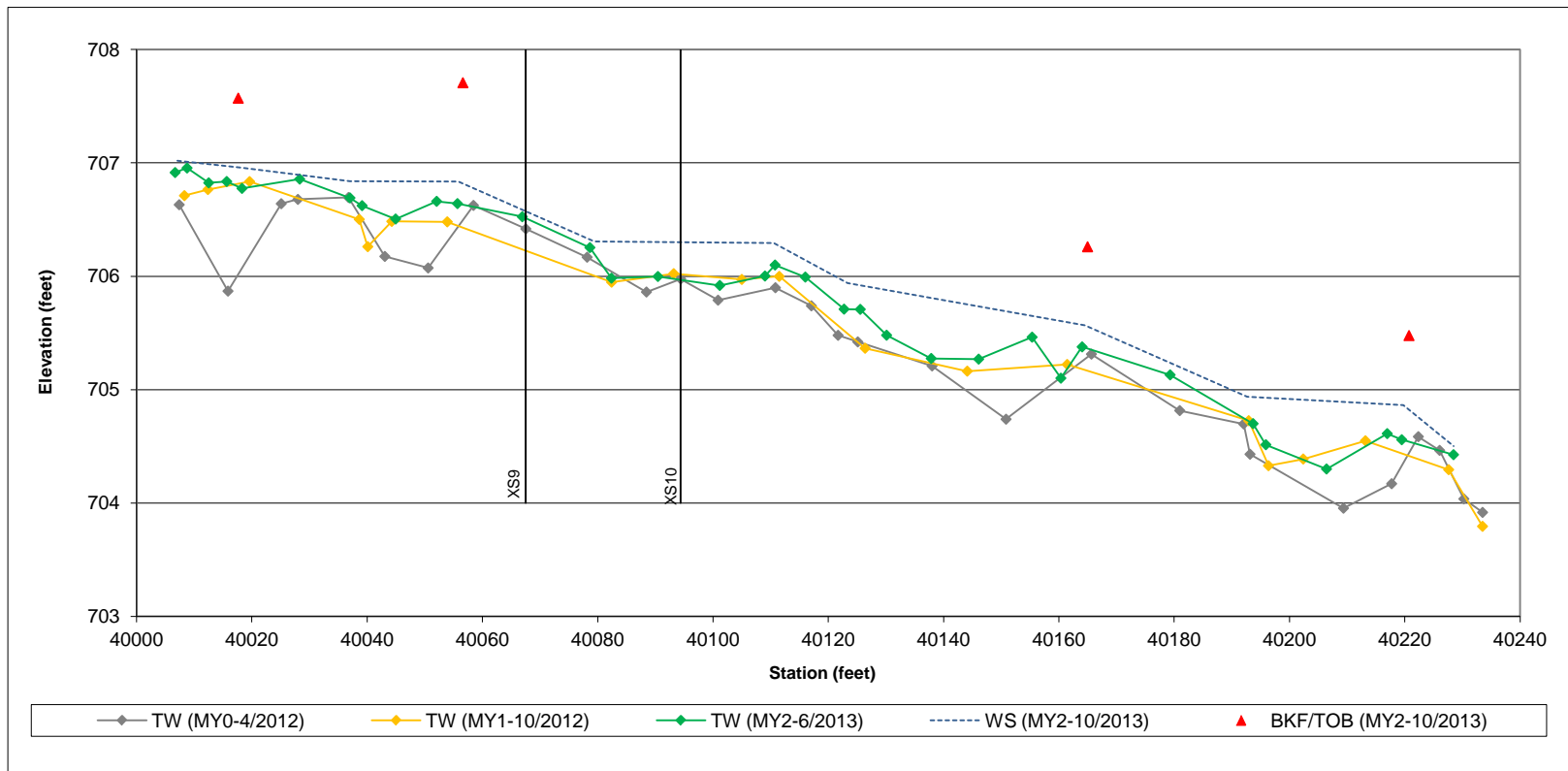
Reachwide and Cross-Section Substrate Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Little Troublesome Creek , Cross-Section 13 (Riffle)  
 Monitoring Year 2

Particle Class		Diameter (mm)		Particle Count	Cross-Section 13 Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.250	0.500			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0			0
GRAVEL	Very Fine	2.0	2.8			0
	Very Fine	2.8	4.0			0
	Fine	4.0	5.7	1	1	1
	Fine	5.7	8.0	1	1	2
	Medium	8.0	11.3	1	1	3
	Medium	11.3	16.0			3
	Coarse	16.0	22.6	5	5	8
	Coarse	22.6	32	20	20	28
	Very Coarse	32	45	28	28	56
COBBLES	Very Coarse	45	64	26	26	82
	Small	64	90	9	9	91
	Small	90	128	6	6	97
	Large	128	180	1	1	98
	Large	180	256	1	1	99
Boulders	Small	256	362	1	1	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
<b>Total</b>				<b>100</b>	<b>100</b>	<b>100</b>

Cross-Section 13 Channel materials (mm)	
D <sub>16</sub> =	26.0
D <sub>35</sub> =	34.8
D <sub>50</sub> =	41.8
D <sub>84</sub> =	69.0
D <sub>95</sub> =	113.8
D <sub>100</sub> =	362.0



Longitudinal Profile Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 UT1  
 Monitoring Year 2





Cross-Section Plots

Little Troublesome Creek Mitigation Site (NCEP Project No. 94640)

UT1, Cross-Section 9 (Riffle)

Monitoring Year 2

River Basin	Cape Fear
Watershed HUC	3030002
XS ID	9
Drainage Area	0.1 sq.mi
Date	6/27/2013
Field Crew	Wildlands Engineering

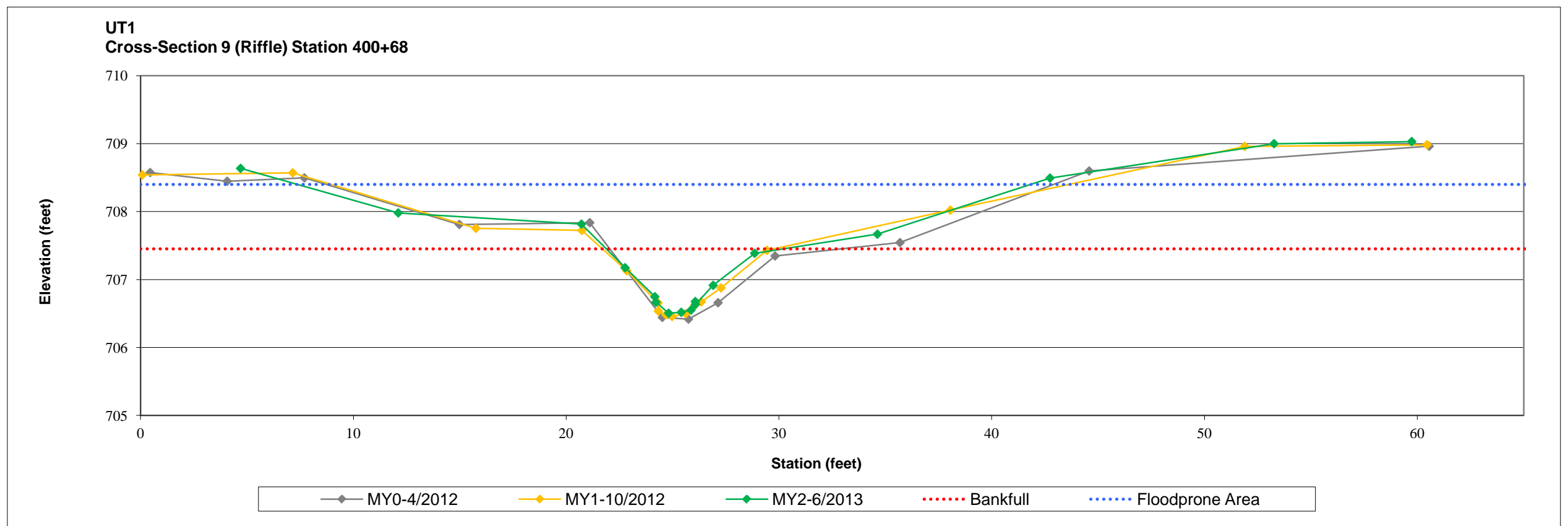
Summary Data	
Bankfull Elevation (ft)	707.5
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	3.7
Bankfull Width (ft)	8.3
Flood Prone Area Elevation (ft)	708.4
Flood Prone Width (ft)	34.3
Max Depth at Bankfull (ft)	1.0
Mean Depth at Bankfull (ft)	0.5
W/D Ratio	18.5
Entrenchment Ratio	2.2+
Bank Height Ratio	1.0
Stream Type	C



Cross-Section 9: View Upstream



Cross-Section 9: View Downstream



Cross-Section Plots

Little Troublesome Creek Mitigation Site (NCEP Project No. 94640)

UT1, Cross-Section 10 (Pool)

Monitoring Year 2

River Basin	Cape Fear
Watershed HUC	3030002
XS ID	10
Drainage Area	0.1 sq.mi
Date	6/27/2013
Field Crew	Wildlands Engineering

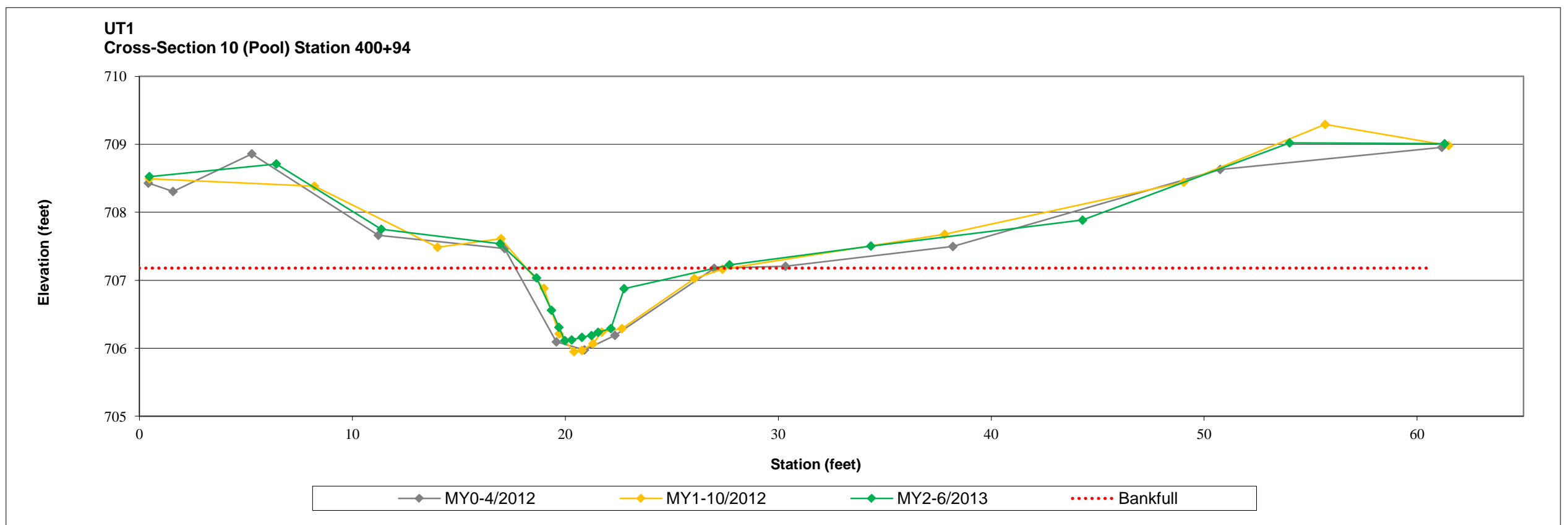
Summary Data	
Bankfull Elevation (ft)	707.2
Bankfull Cross-Sectional Area (ft <sup>2</sup> )	4.0
Bankfull Width (ft)	8.9
Flood Prone Area Elevation (ft)	N/A
Flood Prone Width (ft)	N/A
Max Depth at Bankfull (ft)	1.1
Mean Depth at Bankfull (ft)	0.5
W/D Ratio	19.7
Entrenchment Ratio	N/A
Bank Height Ratio	1.0
Stream Type	N/A



Cross-Section 10: View Upstream



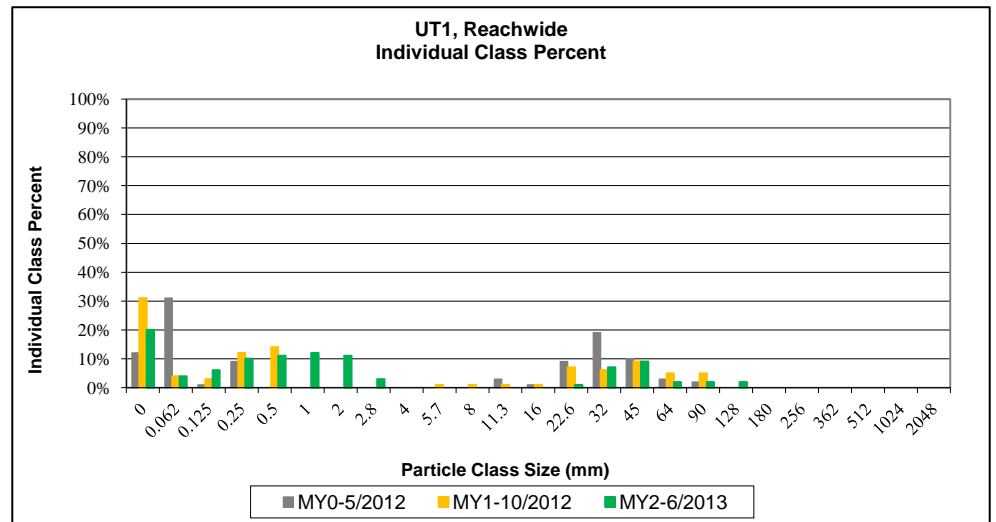
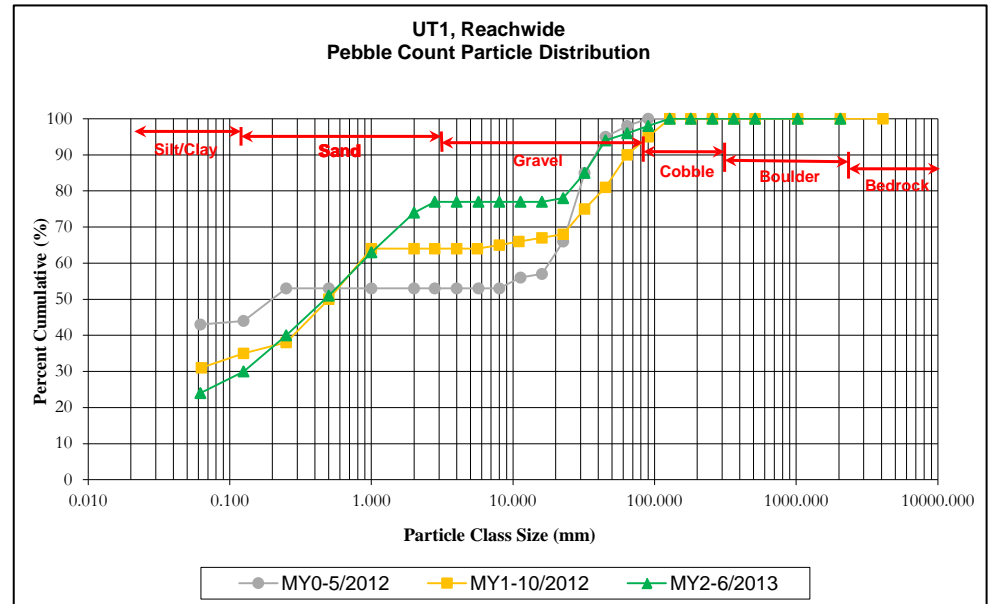
Cross-Section 10: View Downstream



Reachwide and Cross-Section Pebble Count Plots  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 UT1, Reachwide  
 Monitoring Year 2

Particle Class		Diameter (mm)		Particle Count			UT1 Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
<b>SILT/CLAY</b>		Silt/Clay	0.000	0.062	5	15	20	20
<b>SAND</b>	Very fine	0.062	0.125		4	4	4	24
	Fine	0.125	0.250	1	5	6	6	30
	Medium	0.250	0.500	4	6	10	10	40
	Coarse	0.5	1.0	4	7	11	11	51
	Very Coarse	1.0	2.0	5	7	12	12	63
<b>GRAVEL</b>	Very Fine	2.0	2.8	7	4	11	11	74
	Very Fine	2.8	4.0	1	2	3	3	77
	Fine	4.0	5.7					77
	Fine	5.7	8.0					77
	Medium	8.0	11.3					77
	Medium	11.3	16.0					77
	Coarse	16.0	22.6					77
	Coarse	22.6	32	1		1	1	78
	Very Coarse	32	45	7		7	7	85
	Very Coarse	45	64	9		9	9	94
<b>COBBLE</b>	Small	64	90	2		2	2	96
	Small	90	128	2		2	2	98
	Large	128	180	2		2	2	100
	Large	180	256					100
<b>BOULDER</b>	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
<b>BEDROCK</b>	Bedrock	2048	>2048					100
<b>Total</b>				<b>50</b>	<b>50</b>	<b>100</b>	<b>100</b>	<b>100</b>

Reachwide Channel materials (mm)	
D <sub>16</sub> =	Silt/ Clay
D <sub>35</sub> =	0.4
D <sub>50</sub> =	0.9
D <sub>84</sub> =	42.9
D <sub>95</sub> =	75.9
D <sub>100</sub> =	180.0

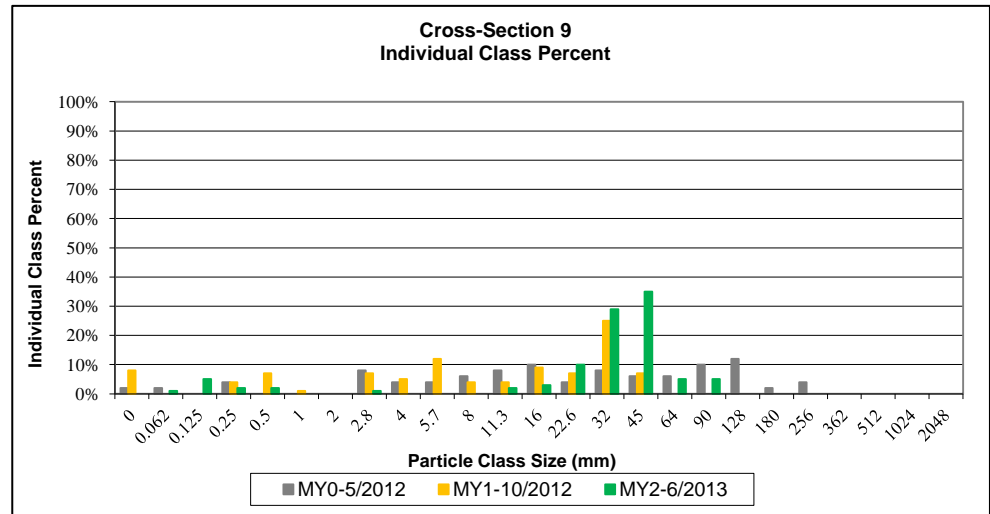
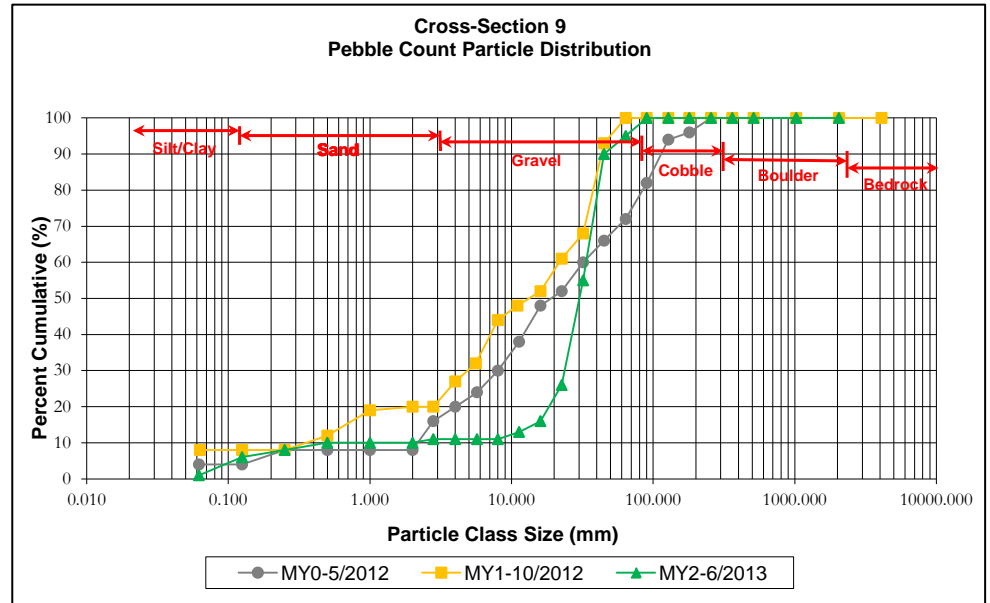




Reachwide and Cross-Section Substrate Plots  
 Little Troublesome Creek Mitigation Site (NCEP Project No. 94640)  
 UT1, Cross-Section 9 (Riffle)  
 Monitoring Year 2

Particle Class		Diameter (mm)		Particle Count	Cross-Section 9 Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY		0.000	0.062			0
SAND	Very fine	0.062	0.125	1	1	1
	Fine	0.125	0.250	5	5	6
	Medium	0.250	0.500	2	2	8
	Coarse	0.5	1.0	2	2	10
	Very Coarse	1.0	2.0			10
GRAVEL	Very Fine	2.0	2.8			10
	Very Fine	2.8	4.0	1	1	11
	Fine	4.0	5.7			11
	Fine	5.7	8.0			11
	Medium	8.0	11.3			11
	Medium	11.3	16.0	2	2	13
	Coarse	16.0	22.6	3	3	16
	Coarse	22.6	32	10	10	26
	Very Coarse	32	45	29	29	55
	Very Coarse	45	64	35	35	90
COBBLES	Small	64	90	5	5	95
	Small	90	128	5	5	100
	Large	128	180			100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
<b>Total</b>				<b>100</b>	<b>100</b>	<b>100</b>

Cross-Section 9 Channel materials (mm)	
D <sub>16</sub> =	22.6
D <sub>35</sub> =	35.6
D <sub>50</sub> =	42.4
D <sub>84</sub> =	60.2
D <sub>95</sub> =	90.0
D <sub>100</sub> =	128.0



## **APPENDIX 5. Hydrology Summary Data and Plots**

Table 13. Verification of Bankfull Events  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Monitoring Year 2

Reach	Date of Data Collection	Date of Occurrence	Method
Irvin Creek	11/7/2013	U	Crest Gage
Little Troublesome Creek	11/7/2013	U	Crest Gage
UT1	11/7/2013	U	Crest Gage

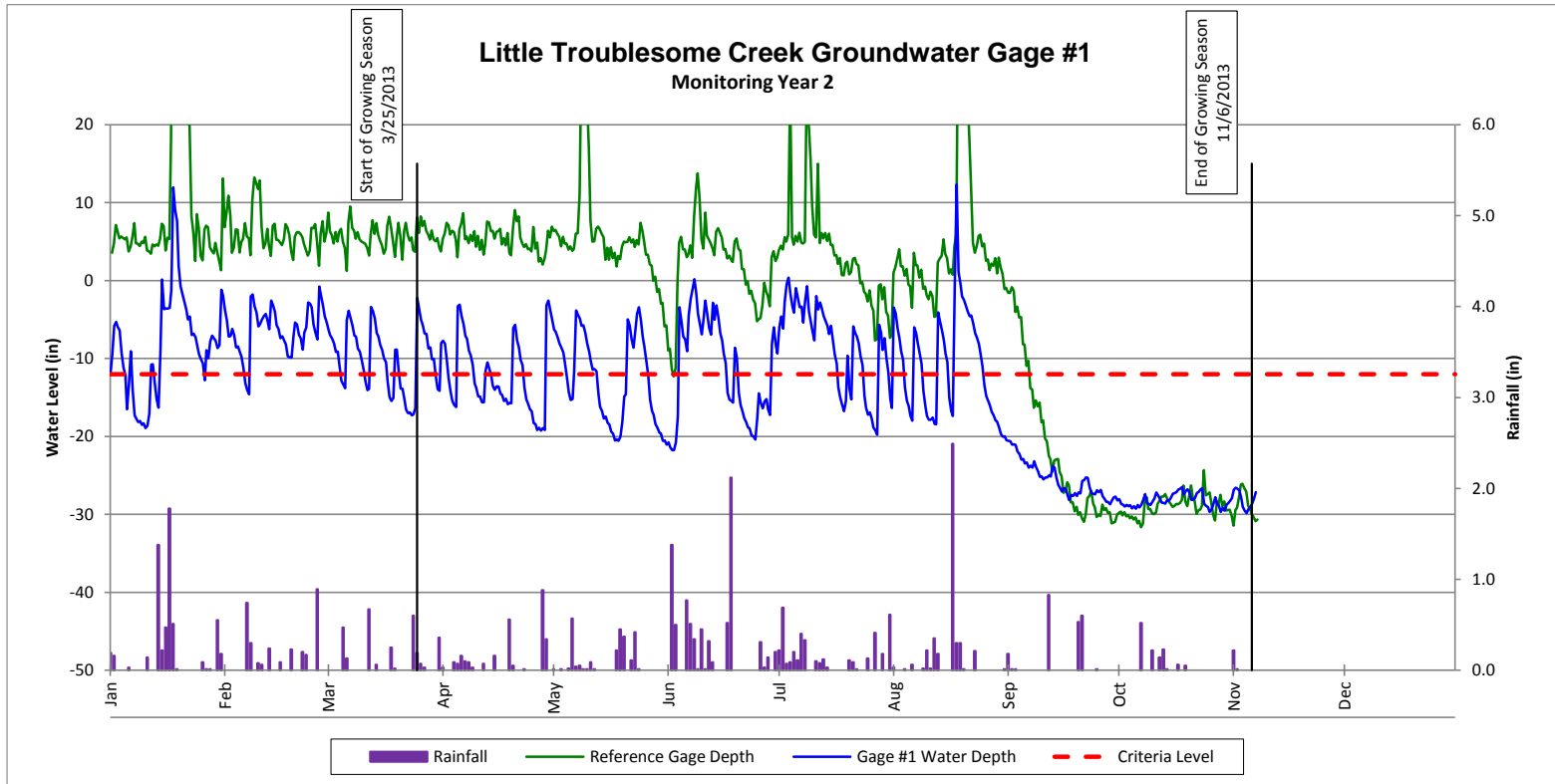
u: unknown

Table 14. Wetland Gage Attainment Summary  
 Little Troublesome Creek Mitigation Site (NCEEP Project No. 94640)  
 Monitoring Year 2

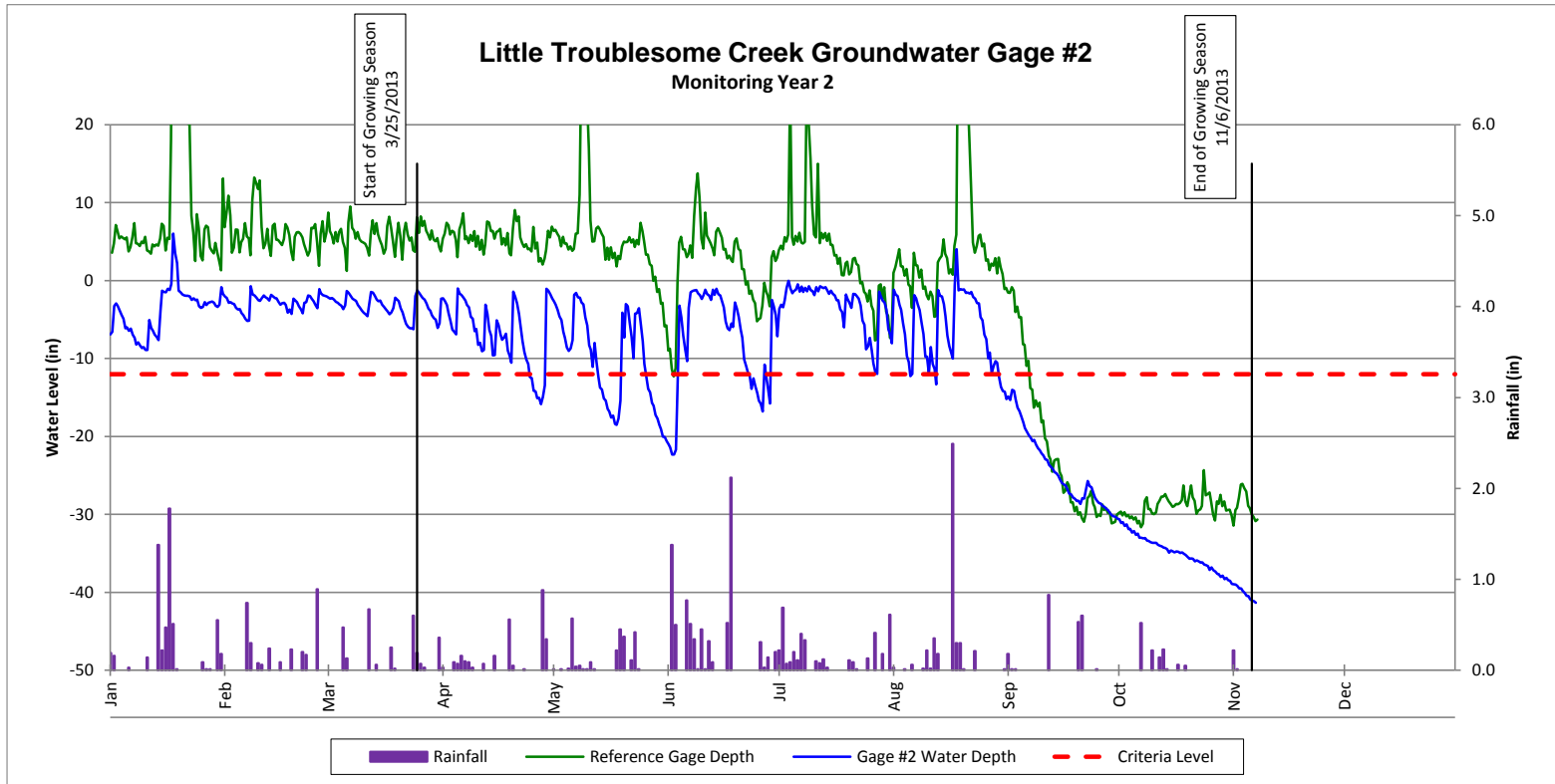
Summary of Groundwater Gage Results for Years 1 through 7							
Gage	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)						
	Year 1 (2012)	Year 2 (2013)	Year 3 (2014)	Year 4 (2015)	Year 5 (2016)	Year 6 (2017)	Year 7 (2018)
1	No/5.5 Days (2.4%)	Yes/18.0 Days (8.0%)					
2	Yes/26/5 Days (11.7%)	Yes/61.5 Days (27.2%)					
3	Yes/87.5 Days (38.7%)	Yes/195.5 Days (86.5%)					
4	Yes/65.5 Days (29%)	Yes/165.5 Days (73.2%)					
5	Yes/60.5 Days (26.8%)	Yes/24.0 Days (10.6%)					
6	No/6.0 Days (2.7%)	Yes/17.5 Days (7.7%)					
7	Yes/83.0 Days (36.7%)	Yes/70.0 Days (31.0%)					
8	No/11.5 Days (5.1%)	Yes/31.5 Days (13.9%)					



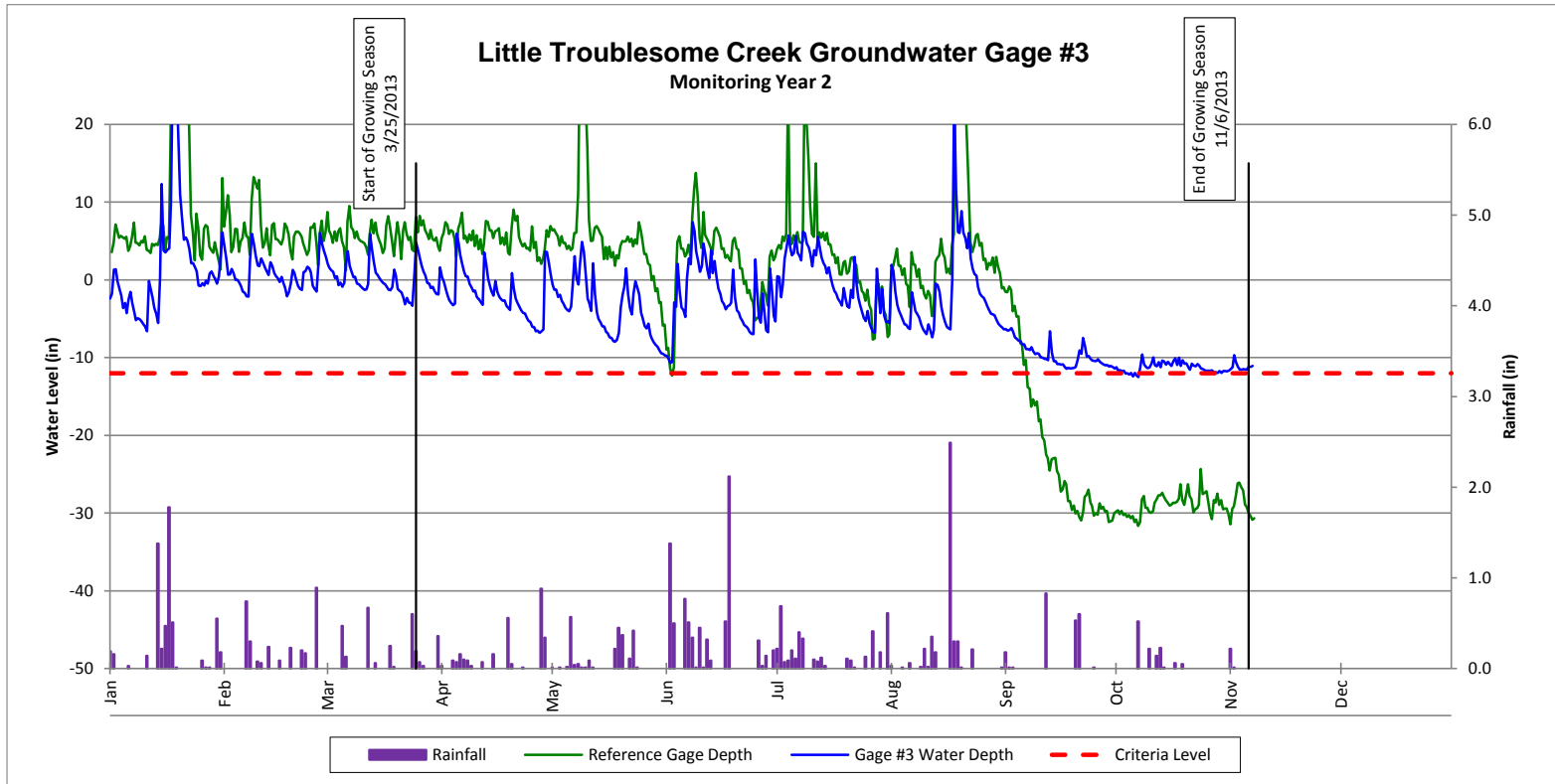
**Groundwater Gage Plots**  
**Little Troublesome Creek Wetland (EEP Project No. 94640)**  
**Wetland RW1**  
**Monitoring Year 2**



**Groundwater Gage Plots**  
**Little Troublesome Creek Wetland (EEP Project No. 94640)**  
**Wetland RW1**  
**Monitoring Year 2**

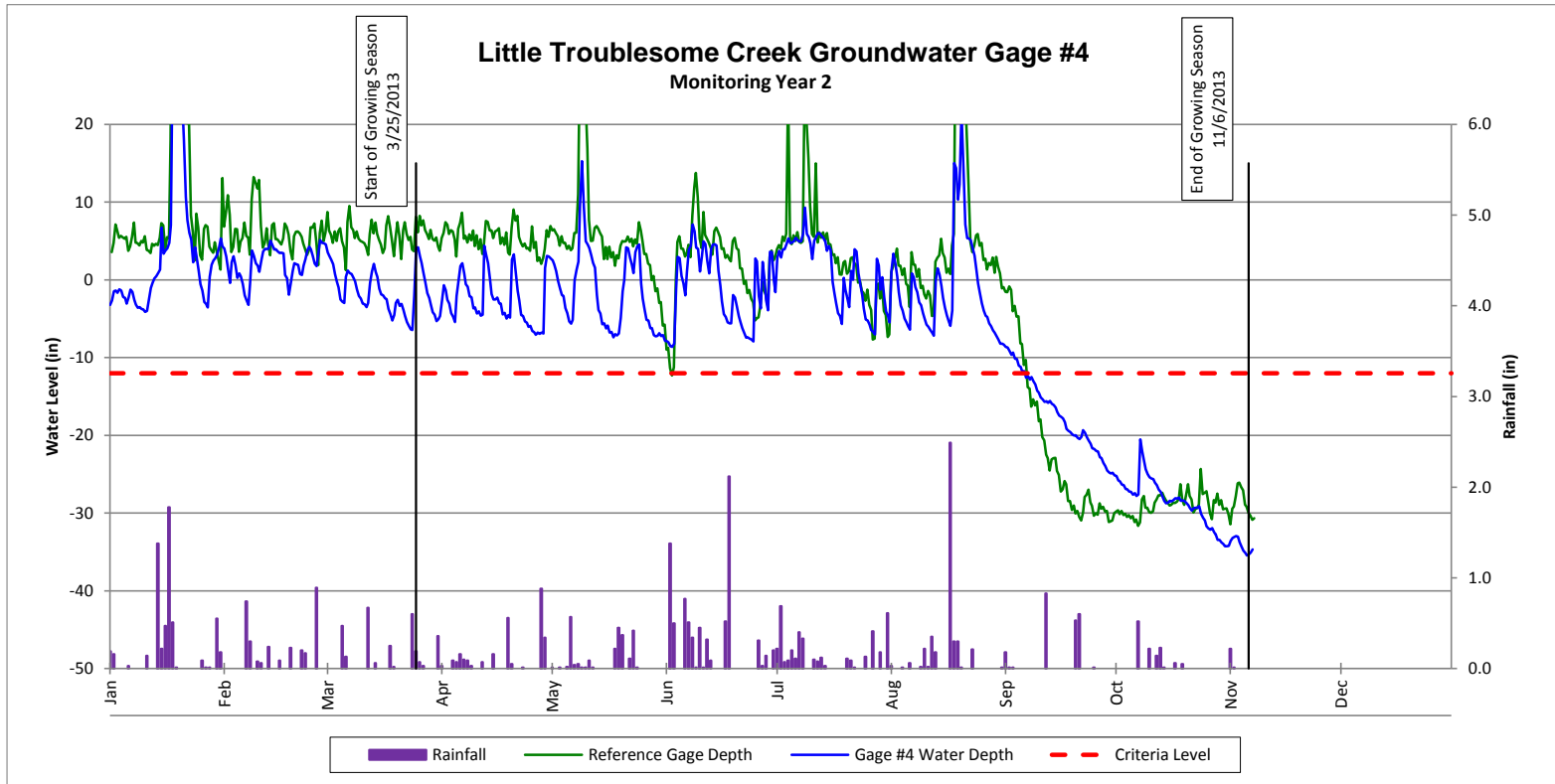


**Groundwater Gage Plots**  
**Little Troublesome Creek Wetland (EEP Project No. 94640)**  
**Wetland RW1**  
**Monitoring Year 2**

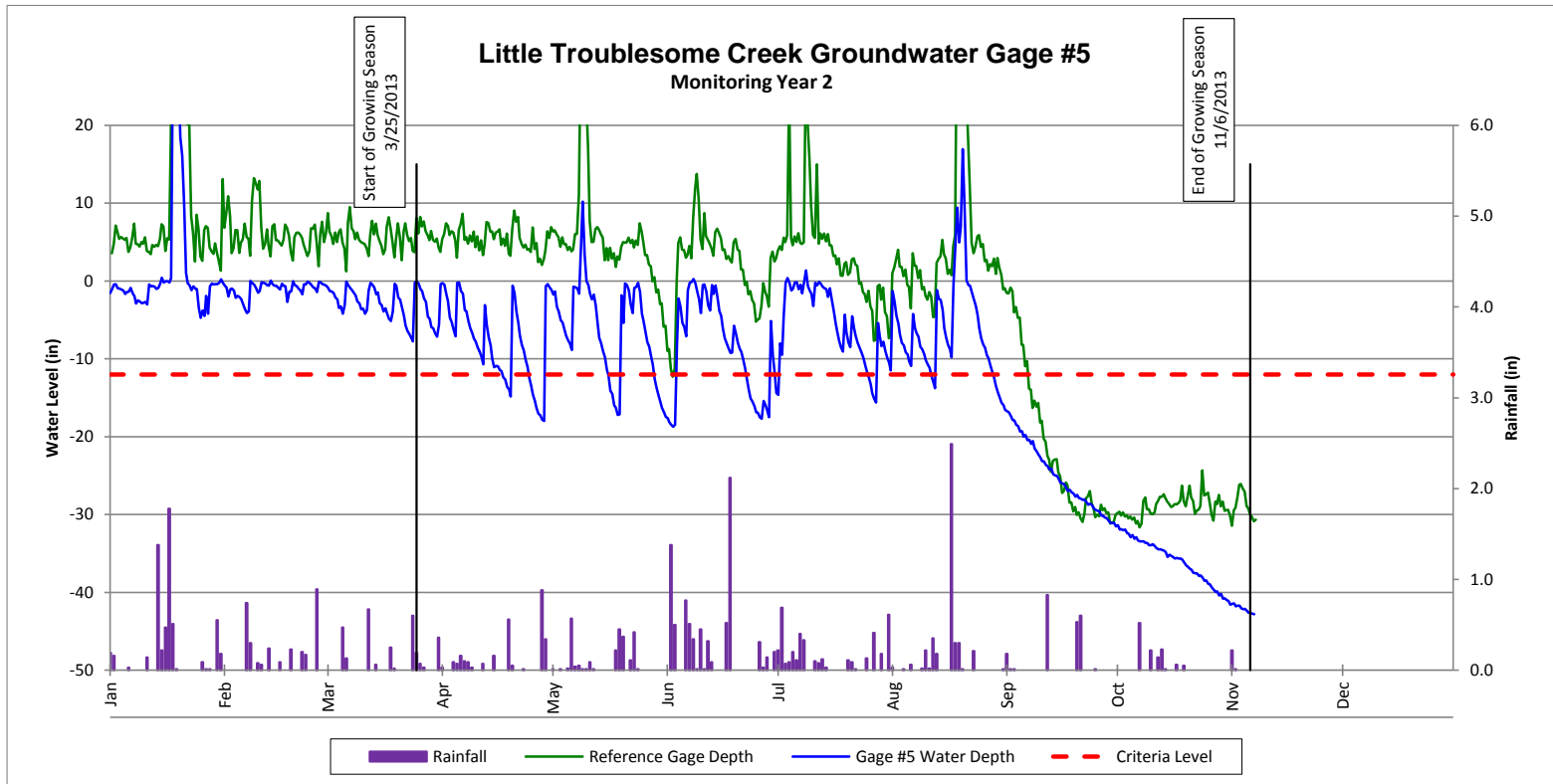




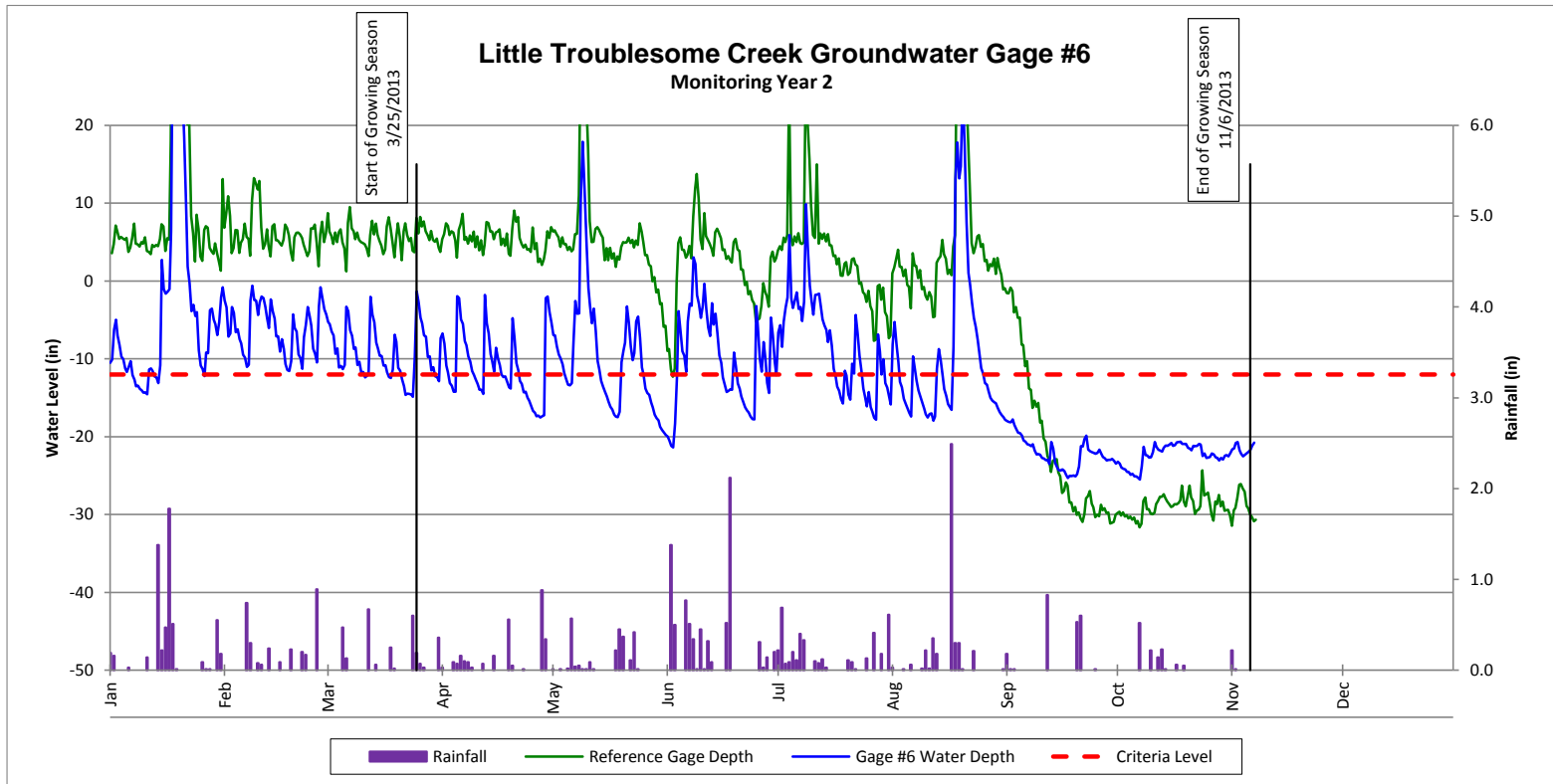
**Groundwater Gage Plots**  
**Little Troublesome Creek Wetland (EEP Project No. 94640)**  
**Wetland RW1**  
**Monitoring Year 2**



**Groundwater Gage Plots**  
**Little Troublesome Creek Wetland (EEP Project No. 94640)**  
**Wetland RW1**  
**Monitoring Year 2**

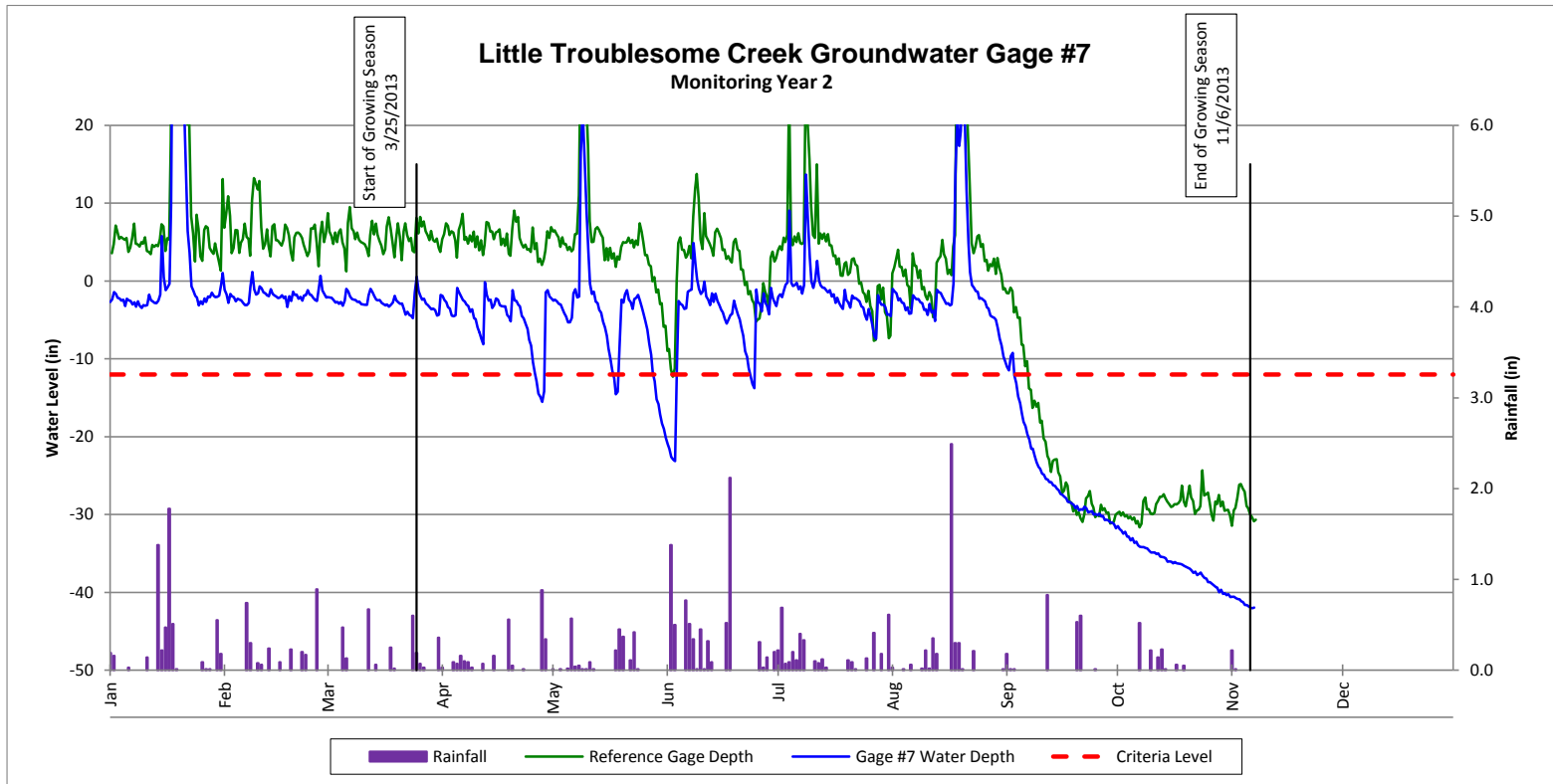


**Groundwater Gage Plots**  
**Little Troublesome Creek Wetland (EEP Project No. 94640)**  
**Wetland RW1**  
**Monitoring Year 2**

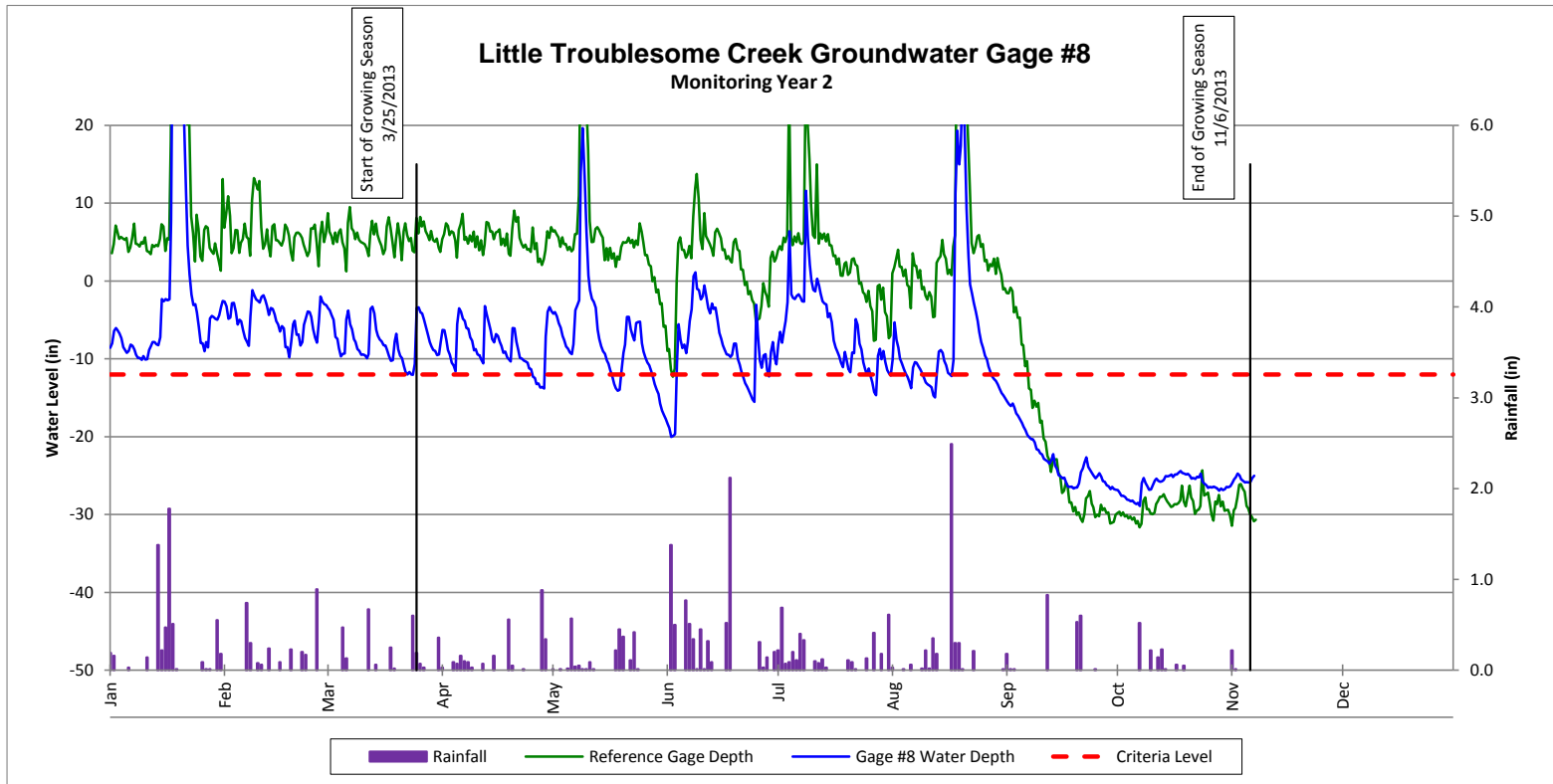




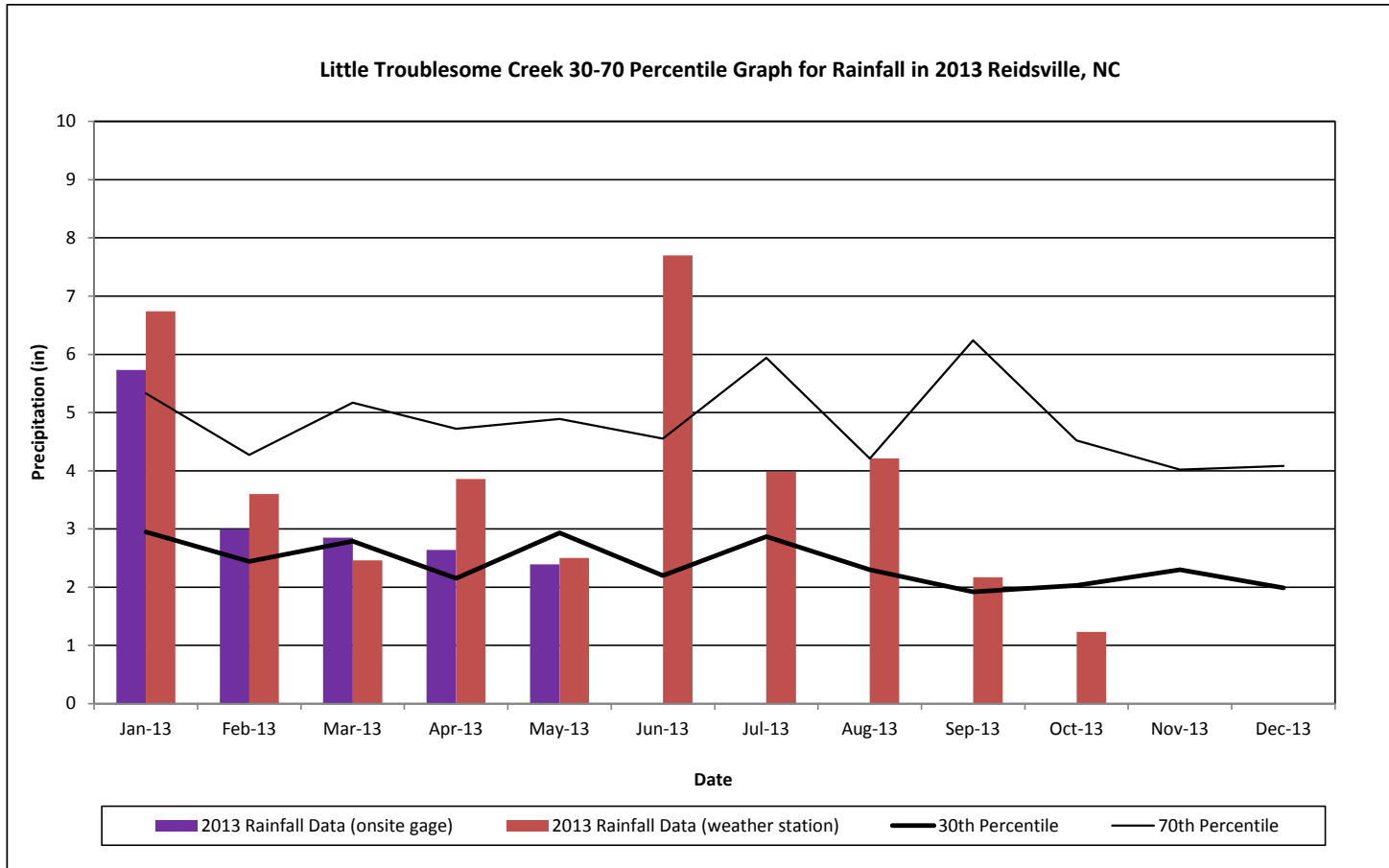
**Groundwater Gage Plots**  
**Little Troublesome Creek Wetland (EEP Project No. 94640)**  
**Wetland RW1**  
**Monitoring Year 2**



**Groundwater Gage Plots**  
**Little Troublesome Creek Wetland (EEP Project No. 94640)**  
**Wetland RW1**  
**Monitoring Year 2**



Monthly Rainfall Data  
 Little Troublesome Creek Mitigation Site (NCEP Project No. 94640)  
 Monitoring Year 2



<sup>1</sup> 2013 monthly rainfall collected by onsite rainfall gage, and the ECONet weather station "REID" at Upper Piedmont Research Station, Reidsville, NC (NCSCO, 2013)

<sup>2</sup> 30th and 70th percentile rainfall data collected from weather station NC7202, in Reidsville, NC (USDA, 2002).