South Fork Hoppers Creek - Melton Farm Stream Restoration Project
Year 5 Monitoring Report

McDowell County, North Carolina

NCDMS Project Number – 92251

Project Info:	Monitoring Year: 5 of 5 Year of Data Collection: 2016 Year of Completed Construction: 2011 NCDMS Project Manager: Matthew Reid Submission Date: January 10, 2017
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FINAL

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Year 5 Monitoring Report

McDowell County, North Carolina

Report Prepared and Submitted by Michael Baker Engineering, Inc.

NC Professional Engineering License # F-1048

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Appendices

1.0 EXECUTIVE SUMMARY

The Hoppers Creek - Melton Farm Restoration Project (Project) was restored by Michael Baker Engineering, Inc. (Baker) through an on-call design and construction services contract with the North Carolina Division of Mitigation Services (NCDMS). This report documents and presents Year 5 monitoring data as required during the five-year monitoring period.

The specific goals for the Project were as follows:

- Create geomorphically stable conditions on the Project site,
- Improve and restore hydrologic connections between the streams and their floodplains,
- Improve water quality in the South Fork Hoppers Creek watershed,
- Protect the South Fork Hoppers Creek watershed from nearby rapid development,
- Restore wetlands along South Fork Hoppers Creek in the Project area, and
- Improve aquatic and terrestrial habitat along the Project corridor.

To accomplish these goals the following objectives were implemented:

- Stabilize eroding channel banks by implementing a combination of Priority I Restoration and Enhancement II approaches,
- Increase floodplain connectivity to restore historic floodplain wetlands,
- Incorporate bedform diversity with varied in-stream structures to provide a variety of aquatic habitats,
- Reestablish a riparian buffer with native vegetation to improve terrestrial habitat and eliminate excessive sedimentation from erosion,
- Restore and enhance existing floodplain wetlands, where feasible, and
- Eliminate livestock access to the channel to improve water quality and reduce erosion from hoof shear.

The Project site is located approximately 10 miles southeast of Marion in McDowell County, North Carolina, as shown in Figure 1 in Appendix A. The Project is situated in the Catawba River Basin, within the United States Geologic Survey (USGS) hydrologic unit 03050101040-020. Directions to the Project site can be found in Figure 1 of Appendix A.

South Fork Hoppers Creek lies within the Piedmont physiographic province. Its watershed is predominately forested, supporting some isolated rural residential housing, chicken farms, agricultural lands, nurseries, and several small rural residential developments. The land surrounding the Project site has been used historically for agriculture but was recently used as pasture land for livestock grazing. Some forest land is located in the upstream extents of UT1, UT2, and UT3.

South Fork Hoppers Creek and its tributaries had been impacted by livestock, were incised, and eroded. Channel incision along South Fork Hoppers Creek resulted in the lowering of the water table; thereby, dewatering floodplain wetlands. The Project involved the restoration or enhancement of 3,550 linear feet (LF) of stream along South Fork Hoppers Creek, and portions of UT1 and UT2 using Rosgen Priority I restoration and Level II enhancement approaches. An additional 1,071 LF of stream along portions of UT1 and UT3 was placed in preservation. The Project also included the restoration and enhancement of 1.56 acres of riparian wetland abutting South Fork Hoppers Creek and UT1 of which 1.23 acres comprised restoration and 0.33 acres comprised enhancement. The Priority I channel design approach entailed raising the elevation of the channel to establish greater connectivity to the floodplain and to restore the hydrologic relationship between South Fork

Hoppers Creek, its tributaries and riparian wetland areas in the Project area. Channel pattern was re-established to dissipate flow velocities in meander bends. In-stream habitat was created using riffle-pool sequences and the strategic placement of in-stream structures. Approximately 5.7 acres of associated riparian buffer were restored/enhanced throughout the Project area and a conservation easement consisting of 10.1 acres will protect and preserve all stream reaches, wetland areas, and riparian buffers in perpetuity.

Vegetation conditions for South Fork Hoppers Reaches 1 and 2, and UT1Reach B, and UT2 Reaches A and B were good and performing close to 100% for both the planted acreage and invasive/encroachment area categories. Treatment control applications for exotic invasive species were conducted in monitoring Years 2 and 4; however, three Vegetation Problem Areas (VPAs), consisting predominantly of *Lonicera japonica* (Japanese honeysuckle) and *Rosa multiflora* (multi-flora rose) and exceeding the mapping threshold continue to persist. A more detailed summary of the results for the vegetation condition assessment can be found in Appendix B which includes a technical memorandum, current condition plan view (CCPV) figures, supporting data tables, and photo logs. The contents of Appendix B were submitted to NCDMS in May 2016 and served as the interim visual site assessment report.

The average density of total planted stems per plot ranges from 324 – 890 stems per acre with a tract mean (not including volunteers) of 587 stems per acre; therefore the Site has met the Year 5 vegetative success criteria of 260 trees per acre. Volunteer species continue to thrive throughout the vegetation plots and include planted species, as well as, other native species such as: *Pinus virginiana* and *Rubus* sp. Vegetation stem counts are summarized in Tables 7 and 9 of Appendix C.

Tables 5a through 5d (Appendix B) indicate the Project site has remained geomorphically stable overall, with lateral/vertical stability and in-stream structure performance of 100% on UT1B, 83 – 100% on Reach 1, 95 – 100% on Reach 2, and 60 – 100% on UT2 A and B. The sub-categories receiving scores of less than 100% are namely due to small localized areas of bank scour and/or erosion around structures. Stream Problem Areas (SPAs) correlating with these areas of instability for the project reaches are documented and summarized in Table 5e of Appendix B. A more detailed summary of the results for the visual stream stability assessment can be found in the "Site Assessment Report – Monitoring Year 5" in Appendix B.

The six permanent cross-sections along the Project site show that there has been little adjustment to stream dimension overall within the Project site since construction. Cross-section 9 (X9) exhibits only a minor amount sedimentation in the riffle, which is most likely a result, as indicated from the sediment analysis, of an influx of sands from the upstream ford crossing. As indicated in Figure 3, cross-sectional measurements throughout the five year monitoring period have remained geomorphically similar to as-built conditions and do not indicate any stream bank or channel stability issues.

The longitudinal profiles show that bed features are stable. Pools are well maintained with only minor filling in the upstream sections of Reach 1 and UT1B, which is most likely due to the natural movement of sediment through the system in areas where the channel gradient is low and the floodplain remains inundated throughout much of the year. Grade control structures (constructed riffles, cross vanes and log sills) continue to help maintain the overall profile desired. As depicted in Figure 4, overall longitudinal profiles for Reach 1, 2, and UT1B have remained geomorphically stable throughout the post-construction five year monitoring period.

Visual observations and a review of pebble count data collected during Year 5 monitoring did not yield any signs that sediment transport functions have been hampered by the mitigation project. The pebble count data for South Fork Hoppers Creek and UT1B indicate that the stream is moving fines through the system and a mix of substrates make up the bed material. Pebble count data is provided in Figures 5a – 5c in Appendix D.

Two bankfull event were observed and documented during MY5. Overall the site has experienced at least seven documented bankfull events during the five year monitoring period. With at least two of the events occurring in separated monitoring years, the site has met its hydrologic success criteria. Information on bankfull events is provided in Table 12 of Appendix E.

Though groundwater data loggers for Wells 2 and 4 had to be replaced in August 2016, all four wetland areas met the success criteria for wetland hydrology during Monitoring Year 5. Groundwater conditions indicated saturated conditions existed throughout 100% of the growing season for Gauge 3 and for Gauges 2 and 4, after replacement, while Gauge 1 documented saturated conditions for 99.5% of the growing season. Based on ground water data collected during the five growing seasons following site construction (March 30, 2013 - November 2, 2016), the site has successfully met the success criteria for wetland hydrology of soil saturation within 12 inches of the soil surface for at least 9% of the growing season, or 19 consecutive days. See Appendix E for a depiction of plot of wetland gauge data as it relates to monthly precipitation for Monitoring Year 5 (Figure 7) and a summary of wetland gauge attainment for all five monitoring years (Table 13). See CCPV sheets (Figure 2) in Appendix B, for a depiction of wetland and corresponding gauge locations.

Summary information/data related to the occurrence of items such as beaver or encroachment, and statistics related to 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 Baseline Monitoring Report (formerly Mitigation Plan) and in the Mitigation Plan (formerly Restoration Plan) documents available on DMS's website. It should be noted that the Baseline Monitoring Report and Mitigation Plan for this Project site is included with the summary of constructed design approaches for the South Muddy Creek Restoration Project (DMS Project No. 737), a nearby project site that was designed and constructed in conjunction with the Hoppers Creek - Melton Farm Stream Restoration Project as part of the same DMS on-call design and construction services contract. All raw data supporting the tables and figures in the appendices is available from DMS upon request.

2.0 METHODOLOGY

The five-year monitoring plan for the Project site includes criteria to evaluate the success of the vegetation, stream, and wetland components of the project. The methodology and report template used to evaluate these three components adheres to the DMS monitoring guidance document dated November 7, 2011, which will continue to serve as the template for subsequent monitoring years. The specific locations of monitoring features, such as vegetation plots, permanent cross-sections, reference photo stations and wetland/crest gauges, are shown on the CCPV sheets found in Figure 2 of Appendix B.

The majority of Year 5 monitoring data was collected in May 2016 and October 2016. All visual site assessment data was collected on May 25, 2016. Vegetation monitoring plot and sediment data were collected between October 18th and 19th, 2016. All stream survey (channel dimension and profile) data were collected between September 27th and October 4th, 2016. Stream survey data was collected to a minimum of Class C Vertical and Class A Horizontal Accuracy using Leica TS06 Total Station and was geo-referenced to the NAD83 State Plane Coordinate System, FIPS3200 in US Survey Feet, which was derived from the South Fork Hoppers Creek As-built Survey.

2.1 Stream Assessment

Geomorphic monitoring of restored stream reaches was conducted for five years to evaluate the effectiveness of the restoration practices installed. Monitored stream parameters include channel dimension (cross-sections), profile (longitudinal survey), bed composition, bank and channel stability, bankfull flows, and reference sites documented by photographs. A crest gauge, as well as high flow marks, were used to document the occurrence of bankfull events. The methods used and any related success criteria are described below for each parameter. For monitoring stream success criteria, 6 permanent cross-sections, 1 crest gauge, and 39 photo identification points were installed.

2.1.1 Morphologic Parameters and Channel Stability

2.1.1.1 Dimension

Six permanent cross-sections were installed throughout the entire project area. Cross-sections selected for monitoring were located in representative riffle and pool facets and each cross-section was marked on both banks with permanent pins to establish the exact transect used. Each of the three restored Project reaches, Reaches 1 and 2 of South Fork Hoppers Creek and UT1B, contains one riffle and one pool cross-section. A common benchmark is being used for cross-sections and consistently referenced to facilitate comparison of year-to-year data. The cross-sectional surveys included points measured at major breaks in slope, including top of bank, bankfull, inner berm, edge of water, and thalweg, if the features are present. Riffle cross-sections were classified using the Rosgen Stream Classification System (Rosgen, 1994), and all monitored cross-sections should fall within the quantitative parameters defined for channels of the design stream type.

There should be little change in as-built cross-sections. If changes do take place, they will be evaluated to determine if they represent a movement toward a more unstable condition (e.g., down-cutting or erosion) or a movement toward increased stability (e.g., settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio). Cross-sectional data is presented in Figure 3 of Appendix D.

2.1.1.2 Longitudinal Profile

Longitudinal profiles were surveyed for the entire restored lengths of Reaches 1 and 2 of South Fork Hoppers Creek and UT1B, and are provided in Figure 4 of Appendix D. Longitudinal profiles were replicated annually during the five year monitoring period.

Measurements taken during longitudinal profiles include thalweg, water surface, and the top of low bank. All measurements were taken at the head of each feature (e.g., riffle, run, pool, glide) and the maximum pool depth. Elevations of grade control structures were also included in the longitudinal profiles surveyed. Surveys were tied to a permanent benchmark.

The pools should remain relatively deep with flat water surface slopes, and the riffles should remain steeper and shallower than the pools. Bed form observations should be consistent with those observed for channels of the design stream type as well as other design information.

2.1.1.3 Substrate and Sediment Transport

Bed load material analysis consists of a pebble count taken in the same constructed riffle during annual geomorphic surveys of the Project site. One sample was collected at the riffle cross-section corresponding with each of the three restored Project reaches for a total of three sediment samples (cross-sections X5, X7, X9). These samples, combined with evidence provided by changes in cross-section and profile data will reveal changes in sediment gradation that occur over time as the stream adjusts to upstream sediment loads. Significant changes in sediment gradation were evaluated with respect to stream stability and watershed changes. Bed material distribution data are located in Figure 5 of Appendix D.

2.1.2 Hydrology

2.1.2.1 Streams

The occurrence of bankfull events within the monitoring period were documented by the use of crest gauges and photographs. One crest gauge was installed on the floodplain at the bankfull elevation along the right top of bank at station 15+10. The bottom of the crest gauge coincides with the top of bank (bankfull) elevation. The crest gauges record the highest watermark between site visits, and are checked at each site visit to determine if a bankfull event has occurred. Photographs are used to document the occurrence of debris lines and sediment deposition on the floodplain during monitoring site visits.

Two bankfull flow events must be documented at the crest gauge within the 5-year monitoring period. The two bankfull events must occur in separate years; otherwise, the stream monitoring will continue until two bankfull events have been documented in separate years or until the monitoring period ends. If two bankfull events have not been documented at the end of 5 years the Interagency Review Team (IRT) will have to decide on an appropriate course of action.

2.1.3 Photographic Documentation of Site

Photographs were used to document restoration success visually. Reference stations were photographed during the as-built survey; this will be repeated for at least five years following construction. Reference photos were taken once a year, from a height of approximately five to six feet. Permanent markers ensure that the same locations (and view directions) are utilized during each monitoring period. Selected site photographs are shown in Appendix B.

2.1.3.1 Lateral Reference Photos

Reference photo transects were taken of the right and left banks at each permanent cross-section. A survey tape was captured in most photographs which represents the cross-section line located perpendicular to the channel flow. The water line was located in the lower edge of the frame in order to document bank and riparian conditions. Photographers will make an effort to consistently maintain the same area in each photo over time.

2.1.3.2 Structure Photos

Photographs of primary grade control structures (i.e. vanes and weirs), along the restored streams are included within the photographs taken at reference photo stations. Photographers have made every effort to consistently maintain the same area in each photo over time.

Lateral and structure photographs were used to evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, structure function, and stability, and effectiveness of erosion control measures subjectively. Lateral photos should not indicate excessive erosion or degradation of the banks. A series of photos over time should indicate successive maturation of riparian vegetation and consistent structure function.

2.1.4 Visual Stream Morphological Stability Assessment

The visual stream morphological stability assessment involves the qualitative evaluation of lateral and vertical channel stability, and the integrity and overall performance of in-stream structures throughout the Project reach as a whole. Habitat parameters, such as riffle embeddedness and pool depth maintenance, were also measured and scored. The entire project reach was walked, noting geomorphic conditions of the stream bed profile (riffle/pool facets), both stream banks, and engineered in-stream structures. Photos were taken at every stream photo reference station as discussed in the previous section, and in locations of potential SPAs which were documented in the field for subsequent mapping on the CCPV figures. A more detailed summary of the methodology and results for the visual stream stability assessment can be found in Appendix B which includes a technical memorandum, supporting data tables, and SPA photos.

2.2 Vegetation Assessment

Successful restoration of the vegetation on a mitigation site is dependent upon hydrologic restoration, active planting of preferred canopy species, and volunteer regeneration of the native plant community. In order to determine if the criteria are achieved, twelve vegetation monitoring quadrants were installed across the Project site, which included one wetland vegetation plot. The total number of quadrants was calculated using the CVS-NCEEP Entry Tool Database version 2.3.1 (CVS-NCEEP, 2012). The size of individual quadrants for tree species is 100-square meters. Level 1 CVS vegetation monitoring was conducted between spring, after leaf-out has occurred, and fall prior to leaf fall. At the end of the first growing season during baseline surveys, species composition, density, and survival were evaluated. Individual quadrant data provided during subsequent monitoring events will include diameter, height, density, and coverage quantities. Relative values were calculated, and importance values were determined. Individual seedlings were marked to ensure that they can be found in succeeding monitoring years. Mortality was determined from the difference between the previous year's living, planted seedlings and the current year's living, planted seedlings.

The interim measure of vegetative success for the site is the survival of at least 320, 3-year old, planted trees per acre at the end of Year 3 of the monitoring period. The final vegetative success criteria is the survival of 260, 5-year old, planted trees per acre at the end of Year 5 of the monitoring period.

Photographs were used to visually document vegetation success in sample plots. Reference photos of vegetation condition within plots were taken at least once per year. As part of the visual site assessment conducted on May 25, 2016, the vegetation condition of planted vegetation along stream banks, floodplains (wetlands), and terraces were qualitatively evaluated for performance. This assessment also included the documentation of invasive species and potential VPAs, which were recorded in the field for subsequent mapping on the CCPV figures. A more detailed summary of the methodology and results for the vegetation condition assessment can be found in Appendix B which includes a technical memorandum, supporting data tables, and photo logs.

2.3 Wetland Assessment

Four groundwater monitoring stations were installed in restored/enhanced wetland areas to document hydrologic conditions at the Project site. These four wetland gauges are depicted on the CCPV figures found

in Appendix B. Installation and monitoring of the groundwater stations have been conducted in accordance with the USACE standard methods outlined in WRP Technical Notes ERDC TN-WRAP-00-02 (July 2000). Precipitation data from a nearby U.S. Geological Survey rain gauge near Morganton, NC (USGS 354353081410545) was used for comparison to post-construction groundwater monitoring conducted during the Year 4 growing season. This data was obtained from the USGS "waterdata" website (USGS 2016).

Baker used DRAINMOD (Version 5.1) to develop hydrologic simulation models that represented conditions at a variety of locations across the Project site. DRAINMOD indicated wetland hydrology would occur for approximately 6-12% of the growing season. Based on these findings, it was determined that success criteria for wetland hydrology will be met when each wetland site is saturated within 12 inches of the soil surface for at least 9% of the growing season, or 19 consecutive days.

3.0 REFERENCES

Carolina Vegetation Survey (CVS) and NC Ecosystem Enhancement Program (NCEEP). 2012. CVS-NCEEP Data Entry Tool v. 2.3.1. University of North Carolina, Raleigh, NC.

Lee, M., Peet R., Roberts, S., Wentworth, T. 2007. CVS-NCEEP Protocol for Recording Vegetation, Version 4.1.

Rosgen, D. L. 1994. A Classification of Natural Rivers. Catena 22:169-199.

US Army Corps of Engineers, WRP, July 2000. Technical Notes ERDC TN-WRAP-00-02.

US Geological Survey, 2016. USGS 354353081410545. Morganton, NC. Retrieved: 2016-11-28. http://waterdata.usgs.gov/nc/nwis/uv/?site_no=354353081410545&PARAmeter_cd=00045

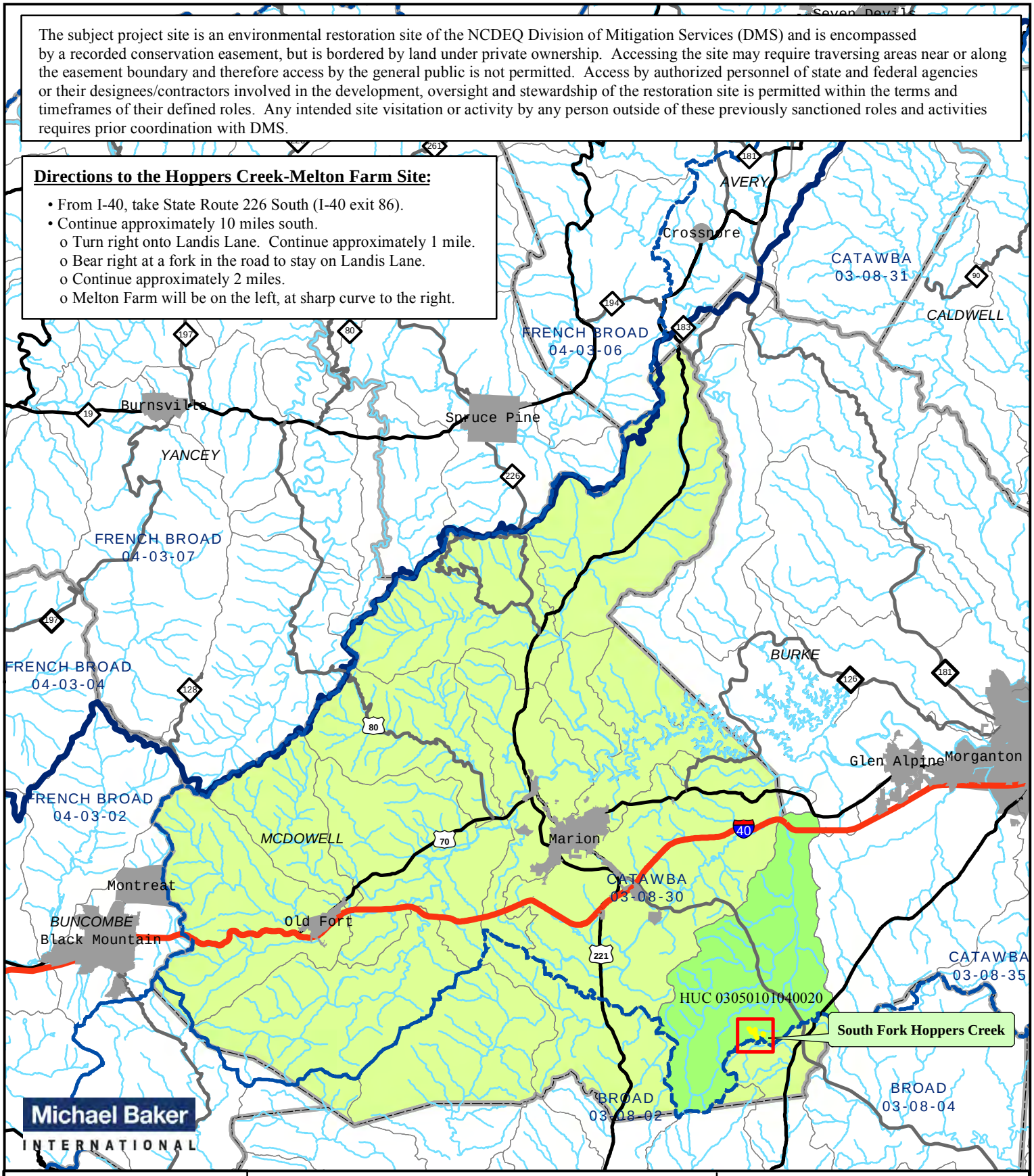
APPENDIX A

PROJECT VICINITY MAP AND BACKGROUND TABLES

The subject project site is an environmental restoration site of the NCDEQ Division of Mitigation Services (DMS) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activities requires prior coordination with DMS.

Directions to the Hoppers Creek-Melton Farm Site:

- From I-40, take State Route 226 South (I-40 exit 86).
- Continue approximately 10 miles south.
  - o Turn right onto Landis Lane. Continue approximately 1 mile.
  - o Bear right at a fork in the road to stay on Landis Lane.
  - o Continue approximately 2 miles.
  - o Melton Farm will be on the left, at sharp curve to the right.



Map Vicinity

McDowell County, NC

Figure 1. Vicinity Map

South Fork Hoppers Creek - Melton Farm

McDowell County, NC

NCDMS Project No.: 92251
2017

LEGEND:

- Project Boundary
- NC River Basins
- USGS Hydrologic Unit
- Counties

0 2.5 5 Miles

Table 1. Project Components
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

Project Segment or Reach ID	Existing Feet/Acres*	Mitigation Type	Approach	Linear Footage or Acreage*	Mitigation Ratio	Mitigation Units	Stationing	Comment
South Fork Hoppers Creek - Reach 1	1,350	R	P1	783	1:1	783	10+00 - 17+83	Installed in-stream structures to control grade, reduce bank erosion, and provide habitat. Priority I was implemented to reestablish stream pattern and relocate the channel onto the historic floodplain.
South Fork Hoppers Creek - Reach 2		R	P1	445	1:1	445	17+83 - 22+48**	Installed in-stream structures to control grade, reduce bank erosion, and provide habitat. Priority I was implemented to reestablish stream pattern and relocate the channel onto the historic floodplain.
UT1 - Reach A	782	P	-	722	5:1	144	-	Preservation. A 30 - 100 foot conservation easement was implemented to on right and left stream banks.
		EII	P4	60	2.5:1	24	7+86 - 8+46***	Regraded right bank to create a bankfull bench and implemented riparian plantings to improve stability and reduce erosion.
UT1 - Reach B	970	P	-	51	5:1	10	9+49 - 10+00***	Preservation. A 30 - 100 foot conservation easement was implemented to on right and left stream banks.
		R	P1	1,065	1:1	1065	10+00 - 20+85**	Installed in-stream structures to increase habitat diversity. Installed fencing to restrict cattle access. Priority I was implemented to restore dimension, pattern, and profile.
UT2 - Reach A	366	EII	P4	379	2.5:1	152	10+00 - 13+79	Regraded banks and implemented a step-pool channel where feasible. Implemented fencing to restrict hog access.
UT2 - Reach B	802	EII	P4	818	2.5:1	327	13+79 - 22+17**	Regraded banks and implemented riparian plantings to improve reach stability and reduce erosion.
UT3	298	P	-	298	5:1	60	-	Preservation. A 30 - 100 foot conservation easement was implemented to on right and left stream banks.
Ephermal drainage in left floodplain of South Fork Hoppers Creek	348	-	-	497	-		-	Stabilized ephemeral drainage from adjacent pasture by creating a flat bottom swale. Swale was matted and seeded. Not being sought for mitigation credit.
Ephermal drainage near the upstream extend of UT2	80	-	-	80	-		-	Stabilized ephemeral drainage with boulder sill structures and armored channel bed. Areas outside the channel were mulched and planted. Not being sought for mitigation credit.
Ephemeral drainage at Station 16+75 of UT2	15	-	-	15	-		-	Stabilized ephemeral drainage by regrading, rematting, and armoring with riprap. Not being sought for mitigation.
Wetland	0.33	E	-	0.33	2:1	.165	-	Regraded the wetland boundary to improve hydrologic imputs and maximize surface storage.
		R	-	1.23	1:1	1.23	-	Restored wetland hydrology to the original stream alignment.

* Existing reach breaks and design reach breaks varied based on initial geomorphic differences and design requirements.

** Stationing includes 20 ft. stream crossing, but is not reflected in the reach length

***During construction enhancement slated to occur between 9+49 and 10+00 of UT1B was shifted upstream into UT1A per conversations with DMS and CEC. The section slated for enhancement at the top of UT1B (9+49 to 10+00) became presevation upon the field change.

Component Summations

Restoration Level	Stream (LF)	Riparian Wetland (Ac)				Non-Ripar (Ac)	Upland (Ac)
		Riverine	Non-Riverine				
Restoration	2,293	1.23	-			-	-
Enhancement		0.33	-			-	-
Enhancement I	-						
Enhancement II	1,257						
Creation		-	-			-	-
Preservation	1,071	-	-			-	-
HQ Preservation	-	-	-			-	-
		1.56	0.00				
Totals	4,621	1.56					
Total Mitigation Units	3010 SMU	1.40 WMU					
= Non - Applicable							

Table 2. Project Activity and Reporting History South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251			
Elapsed Time Since Grading/Planting Complete: 5 Years 6 Months Number of Reporting Years: 5			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan Prepared	N/A	N/A	Jul-07
Restoration Plan Amended	N/A	N/A	Jan-08
Restoration Plan Approved	N/A	N/A	Aug-08
Final Design – (at least 90% complete)	N/A	N/A	Jun-09
Construction Begins	Jun-10	N/A	Jun-10
Temporary S&E mix applied to entire project area	N/A	N/A	N/A
Permanent seed mix applied to entire project area	Nov-10	N/A	Jan-11
Planting of live stakes	Mar-11	N/A	Mar-11
Planting of bare root trees	Mar-11	N/A	Mar-11
End of Construction	Mar-11	N/A	Jun-11
Survey of As-built conditions (Year 0 Monitoring-baseline)	Nov-10	N/A	Jun-11
Year 1 Monitoring	Dec-12	Sep-12	Nov-12
Invasive Treatment	NA	NA	Aug-13
Year 2 Monitoring	Dec-13	Sep-13	Dec-13
Year 3 Monitoring	Dec-14	Sep-14	Dec-14
Invasive Treatment	NA	NA	Sep-15
Year 4 Monitoring	Dec-15	Sep-15	Dec-15
Year 5 Monitoring	Dec-16	Nov-16	Jan-17

Table 3. Project Contacts Table South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251	
Designer	
Michael Baker Engineering, Inc.	9716-B Rea Road #56 Charlotte, NC 28277 Contact: Kristi Suggs, Tel. 704-665-2206
Construction Contractor	
Carolina Environmental Contracting, Inc.	150 Pine Ridge Road Mount Airy, NC 27030 Contact: Joanne Cheatham, Tel. 336-320-3849
Planting Contractor	
Carolina Environmental Contracting, Inc.	150 Pine Ridge Road Mount Airy, NC 27030 Contact: Joanne Cheatham, Tel. 336-320-3849
Seeding Contractor	
Carolina Environmental Contracting, Inc.	150 Pine Ridge Road Mount Airy, NC 27030 Contact: Joanne Cheatham, Tel. 336-320-3849
Seed Mix Sources	Green Resources, Tel. 336-855-6363
Nursery Stock Suppliers	Foggy Mountain Nursery, Tel. 336-384-5323
Profession Land Surveyor	
Turner Land Survey, PLLC.	3201 Glenridge Drive Raleigh, NC 27604 Contact:
Professional Land Surveyor	David Turner, Tel. 919-875-1378
As-Built Plan Set Production	Lissa Turner, Tel. 919-875-1378
Monitoring Performers	
Michael Baker Engineering, Inc.	9716-B Rea Road #56 Charlotte, NC 28277 Contact:
Stream Monitoring Point of Contact:	Kristi Suggs, Tel. 704-665-2206
Vegetation Monitoring Point of Contact:	Kristi Suggs, Tel. 704-665-2206
Wetland Monitoring Point of Contact:	Kristi Suggs, Tel. 704-665-2206

Table 4. Project Attribute Table
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

Project County	McDowell County, NC
Physiographic Region	Piedmont
Ecoregion	Inner Piedmon Belt
Project River Basin	Catawba
USGS HUC for Project and Reference sites	Project: 03050101040020; References: 03040103050 -090 (Spencer Creek), -080 (Barnes Creek); 03030002060 -070 (Morgan Creek); 03020201080 -020 (Sal's Branch)
NCDWQ Sub-basin for Project and Reference	Project: 03-08-30; References: 03-07-09 (Spencer Creek and Barnes Creek); 03-06-06 (Morgan Creek); 03-04-02 (Sal's Branch)
Within extent of EEP Watershed Plan ?	Muddy Creek Local Watershed Plan (LWP), 2003
WRC Class (Warm, Cool, Cold)	Warm
% of project easement fenced or demarcated	100%
Beaver activity observed during design phase ?	None

Restoration Component Attribute Table

	South Fork Hoppers - Reach 1	South Fork Hoppers - Reach 2	UT1 - Reach A (Preservation)	UT1 - Reach A (Enhancement 2)	UT1 - Reach B (Preservation)	UT1 - Reach B	UT2 - Reach A	UT2 - Reach B	UT3
Drainage area (sq. mi.)	0.48	0.52	0.06	0.06	0.08	0.08	0.04	0.07	0.02
Stream order	2nd	2nd	1st	1st	1st	1st	0	0	0
Restored length	783	445	722	60	51	1,065	379	818	298
Perennial or Intermittent	Perennial	Perennial	Perennial	Perennial	Perennial	Perennial	Perennial	Perennial	Intermittent
Watershed type (Rural, Urban, Developing etc.)	Rural	Rural	Rural	Rural	Rural	Rural	Rural	Rural	Rural
Watershed LULC Distribution (e.g.)									
Developed Low-Medium Intensity	-		-	-	-	-	-	-	-
Ag-Cultivated Crops	1.5		-	-	-	-	-	-	-
Ag-Pasture/Hay	15.3		-	-	-	-	-	-	-
Forested	60.8		-	-	-	-	-	-	-
Other (Open water, Grassland, Etc.)	22.4		-	-	-	-	-	-	-
Watershed impervious cover (%)	U	U	U	U	U	U	U	U	U
NCDWQ AU/Index number	03-08-30	03-08-30	03-08-30	03-08-30	03-08-30	03-08-30	03-08-30	03-08-30	03-08-30
NCDWQ classification	C	C	C	C	C	C	C	C	C
303d listed ?	No	No	No	No	No	No	No	No	No
Upstream of a 303d listed segment?	No	No	No	No	No	No	No	No	No
Reasons for 303d listing or stressor	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total acreage of easment	10.1								
Total planted arceage as part of the restoration	5.7								
Rosgen classification of pre-existing	G5c	C4/1	B	B	E5	E5	G5	G5c	B
Rosgen classification of As-built	C5	C5	B	B	C5	C5	G5/B5	G5c	B
Valley type	Alluvial	Alluvial	Alluvial	Alluvial	Alluvial	Alluvial	Alluvial	Alluvial	Alluvial
Valley slope	0.0115ft/ft	0.0115 ft/ft	-	-	0.023 ft/ft	0.023 ft/ft	0.034 ft/ft	0.023 ft/ft	-
Valley side slope range (e.g. 2-3%)	U	U	-	-	U	U	U	U	-
Valley toe slope range (e.g. 2-3%)	U	U	-	-	U	U	U	U	-
Cowardin classification									
Trout waters designation	No	No	No	No	No	No	No	No	No
Species of concern, endangered etc.? (Y?N)	No	No	No	No	No	No	No	No	No
Dominant soil series and characteristics									
Series	IoA	IoA	EwE	EwE	IoA	IoA	HeD	HeD / IoA	EwE
Depth	10	10	5	6	10	10	5, 8	5,8 / 10	5
Clay %	18	18	25,20	25,20	18	18	25	25 / 18	25,20
K	0.15	0.15	0.17, 0.10	0.17, 0.10	0.15	0.15	0.24, 0.17	0.24, 0.17 / 0.15	0.17, 0.10
T	5	5	3 / 5	3 / 5	5	5	5	5 / 5	3 / 5

APPENDIX B

VISUAL ASSESSMENT DATA

Site Assessment Report – Monitoring Year 5

Hoppers Creek-Melton Farm Stream Restoration Project
McDowell County, North Carolina
May 2016

Submitted To: NCDEQ – Division of Mitigation Services
1625 Mail Service Center
Raleigh, NC 27699
NCDEQ Contract ID No. 004518

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1 Introduction

1.1 Purpose

This report summarizes overall stream and vegetation conditions as part of an interim site assessment conducted in conjunction with the Year 5 monitoring services for the Hoppers Creek-Melton Farm Stream Restoration Project site located in McDowell County, NC. This site assessment will be included as part of a more comprehensive Annual Monitoring Report to be completed and submitted later this year (Fall 2016). The report describes project objectives, discusses the assessment methodology, summarizes assessment results, and documents potential stream and vegetation problem areas (SPAs and VPAs respectively).

1.2 Objectives

The objectives of the site assessment were to:

- Provide a general overview of stream morphological stability;
- Provide a general overview of vegetation conditions;
- Identify and document potential SPAs and VPAs.

1.3 Supporting Data

Supporting data and information are provided following the narrative portion of this report and include:

- Current condition plan view (CCPV) figures (Figure 2, sheets 1 through 3);
- Visual stream morphology stability assessment table (Tables 5a through 5d);
- SPA inventory table (Table 5e);
- Vegetation condition assessment table (Tables 6a and 6b);
- VPA inventory table (Table 6c);
- Stream station photos;
- SPA photos;
- VPA photos.

2 Methodology

The methodology used for assessing overall stream and vegetation conditions at the Hoppers Creek-Melton Farm Stream Restoration Project site adhered to the NCDEQ DMS monitoring guidance documents (dated November 7, 2011). The site assessment was comprised of two components, a visual stream morphology stability assessment and a vegetation condition assessment, both of which are described in more detail in the following sections of this report. The assessment was strictly qualitative. Vegetation monitoring plot counts were excluded from this assessment but will be conducted after July 2015. This data will be summarized in Appendix C and the CCPV figure of the Year 5 Annual Monitoring Report to be submitted in late November of this year.

The Hoppers Creek-Melton Farm Stream Restoration Project site was evaluated as four separate project reaches for the visual stream morphology stability assessment as they were for the Final Baseline Monitoring Document/As-Built Report: South Fork Hoppers Creek (SFHC) Reaches 1 and 2, UT1 Reach B, and UT2 (Reaches A and B). SFHC Reaches 1 and 2 are delineated by the confluence of UT1 Reach B where SFHC Reach 1 is located upstream of the confluence and SFHC Reach 2 is located downstream of the confluence. UT2 Reach A extends from the upstream limits located within the conservation easement boundary to the downstream limits of the constructed step-pool channel, and UT2 Reach B includes the remaining corridor located downstream of the step-pool channel until its confluence with SFHC Reach 1.

2.1 Visual Stream Morphology Stability Assessment

The visual stream morphology stability assessment involved the evaluation of lateral and vertical channel stability, and the integrity and overall performance of in-stream structures throughout each of the four project stream reaches. Habitat parameters, such as riffle embeddedness and pool depth maintenance, were also measured and scored. Each stream reach was walked, noting geomorphic conditions of the stream bed profile (riffle/pool facets), both stream banks, and engineered in-stream structures. Photos were taken at every existing stream photo point (from the as-built) and in locations of potential SPAs which were recorded in the field for subsequent mapping on the CCPV figures.

2.2 Vegetation Condition Assessment

The vegetation condition assessment involved the evaluation of vegetation within the 10.1 acre conservation easement and included assessing the performance of planted vegetation along stream banks, floodplains, and terraces as well as the documentation of invasive species. The assessment of planted vegetation was confined to the 5.7 acres of riparian buffer planting zones located within the easement boundary as part of the restoration design; whereas, invasive vegetation and encroachment areas of invasive species were evaluated for the entire 10.1 acre easement boundary. Photos were recorded in locations of potential VPAs throughout the easement, such as areas exhibiting sparse or slow growth/vigor, low stem density, and invasive areas of concern.

2.3 Post-processing of Field Data

The post-processing of field data consisted of the download and organization of photos into respective photo logs (stream and vegetation), creating the CCPV figures in GIS using the field-mapped SPAs and VPAs, populating the SPA and VPA tables, and finally scoring the performance of the four stream reaches and two vegetation tracts in terms of stream morphological stability and vegetation condition using assessment forms provided by NCDEQ DMS.

3 Summary of Results

3.1 Visual Stream Morphology Stability Assessment

Tables 5a through 5d summarize the performance of each of the four project stream reaches mentioned above for the Hoppers Creek-Melton Farm Stream Restoration Project in terms of lateral (stream bank) and vertical (channel bed) stability while evaluating the functionality and integrity of in-stream structures. Engineered in-stream structures evaluated for the assessment of this project reach consisted of constructed riffles, log sills (drops), cross vanes, log vanes, root wads, geo-lifts, and brush mattresses. Constructed riffles were justified for inclusion in the evaluation of structures since they are the predominant grade control structure used throughout the site; however, they were

only assessed for the 'overall integrity' and 'grade control' parameter categories in Tables 5a through 5d.

As Tables 5a through 5d indicate, the Hoppers Creek-Melton Farm Stream Restoration Project site was geomorphically stable overall and performing at or near 100 percent as the design intended for the majority of parameters evaluated within the lateral/vertical stability and in-stream structure performance categories. UT1 Reach B was functioning at the highest level geomorphically out of all the stream project reaches, performing at 100 percent for all morphological sub-categories. Individual results for the remaining reaches varied in performance for the three major morphological channel categories.

Both SFHC Reach 1 and Reach 2 performed at 100% for bedform condition and stability and at 96% for bank stability; however, they differed slightly relative to performance of engineered structures. SFHC Reach 1 received scores ranging from 91% to 100% for the performance of engineered structures, while SFHC Reach 2 received ranging from 95% to 100%. Performance rates of less than 100% on these reaches were due primarily due to erosional pockets forming around root wad and log sill bank tie-ins.

UT2 performed near 100% for the majority of the sub-category metrics. Pool performance for two out of the five step pools received more moderated ratings in the categories of condition and habitat. Though the results seem unfavorable, they are likely only the result of the natural processes of moving sediment loads from large storm events through the system and not a performance issue. This is especially likely since these results were not noted as occurring or trending in previous assessment years. SPAs correlating with these issues for these three project reaches were documented and summarized in Table 5e.

There were a total of thirteen SPAs documented, three of which were identified during the Year 1 visual assessment, one that was identified during the Year 2 assessment, three that were identified during the Year 4 assessment, and six that were identified during the Year 5 assessment. SPAs documented in previous years were included in this assessment since they have persisted to date. Any SPA's that have been documented in previous reports, but were not indicated as problems during the Year 5 assessment will not be described.

The first number in the SPA naming convention (in Table 5e) references the monitoring year in which the SPA was identified during the visual assessment. A brief description of the SPAs reported from this year and persisting from previous years is discussed below. The SPAs from previous years noted in this report have generally remained unchanged in condition and scale when observed during this assessment, but they still remain problem areas and should be monitored. All are included in the scoring of morphological performance categories in Tables 5a through 5d, and are also summarized in Table 5e, Figure 2 (CCPV), and the SPA photolog.

SPA1-2 is characterized by a localized area of bank scour along the right bank of Reach 1 of SFHC. This SPA is likely caused by the invert of the upstream log roller directing the channel flow toward the bank just downstream of sill tie-in. The bank slope in this area is vertical; however, it is well vegetated at the top of bank. The area may widen slightly, but should stabilize in time as the large woody vegetation becomes even more established in this area.

SPA1-5 consists of the piping of flow around a log sill structure in UT2 Reach A. The structure is vertically and laterally stable and should seal over time.

The heavily armored, ephemeral drainage located near the upstream extents of UT2 Reach A was inspected for overall structural integrity and stability even though the short reach is not being sought

for mitigation credit. Upon inspection, the channel bed of the downstream riffle cascade has eroded (SPA1-6) and a small localized area of erosion persists on the right upper bank. Coarse riprap material has been deposited downstream atop the lowest elevation boulder sill, exposing the underlying filter fabric as a result.

SPA2-1 and SPA5-3 are located just downstream of a log sill on SFHC Reach 1 at Station 16+25. These SPAs are characterized by erosion, undercut bank, and structure failure. The invert along the upstream log sill is directing velocity vectors into the bank which has caused erosion to occur around the back of the root wad and the invert/left bank tie-in of the downstream log sill; therefore, resulting in structure failure. The root wad has slumped into the channel and the log sill had separated from the bank and is under water. Native herbaceous and woody vegetation are present and providing some stability to the bank. This area will be assessed again during the Year 5 Monitoring period to document its state of stability.

SPA4-1 and SPA 5-5 are located on the left bank just downstream of a log sill on SFHC Reach 2 at Station 20+20. These SPAs are characterized by erosion, undercut bank, and structure failure. The invert along the upstream log sill is directing velocity vectors into the bank causing erosion to occur around the back of the root wad and around the downstream of log sill invert/left bank tie-in. The root wad and the sill's header log are still tied-in to the bank; however, it appears that the sill's header and footer have separated. Currently the header log is suspended across the channel above the surface water elevation. Native herbaceous and woody vegetation are present and aiding in the stability of the bank. This area will be assessed again during the Year 5 Monitoring period to document its state of stability.

SPA4-2 consists of both bank erosion and undercut bank and is located along the right bank downstream of a log sill on SFHC Reach 2 (Station 20+75). This SPA is likely caused by the invert of the log sill directing the channel flow into the right bank just downstream of sill's tie-in. The area of erosion is located immediately upstream of the root wad and may eventually compromise the integrity of the structure. However, the root wad is still providing some bank protection, at this time. Native herbaceous and woody vegetation are present and are providing some stability to the bank. This area will be assessed again during the Year 5 Monitoring period to document its state stability.

SPA4-3 is located on UT2 Reach A between Stations 12+36 to 12+53. In this area, the channel hugs the valley wall, and the outside meander bend experiences high levels of near bank stress during bankfull events which has led to a localized area of bank scour.

SPA5-1 and SPA5-2 are located on UT 2 Reach A just below the second and fourth log step, respectively. These SPAs consist of sediment filled pools. Because it is normal for an active channel to move sediment through the system and there are no other indicators of excessive aggradation within this area, it is likely that this is just part of the normal channel processes. These SPAs will be reassessed during the Year 5 monitoring period.

SPA 5-4 is located on Reach 1 of SFHC from Station 18+30 to 18+45. The SPA consists of a localized area of erosion on the left in between the rootwads along the apex of the meander bend. Both woody and herbaceous vegetation are still present and aiding the stability of the bank. This area is likely to heal over time.

SPA 5-6 is located on Reach 2 of SFHC at Station 20+45. The SPA consists of undercutting of the right bank between root wads immediately downstream of the compromised log sill associated with SPA5-5. This appears to be a localized area of erosion caused by high levels of near bank stresses

directed at the right bank and currently it is unclear whether or not this SPA is a result of the upstream problem area. This area will be further monitored during the Year 5 monitoring period.

Log sills associated with deep scour pools on UT1 Reach B between Stations 19+00 and 19+50 were inspected and assessed for vertical stability per DMS' request during the Year 2 assessment and reassessed during the Year 4 assessments. DMS' concern was that the depth of some of the scour pools on a channel with such a small dimension could potentially pose a threat and undermine the integrity of its upstream log step. During these assessments pool depth and pool to pool ratio were evaluated and compared to the design values.

The upstream log sill was the deepest of the three located within the assessment area and had a d_{pool} value and d_{pool}/d_{bkf} ratio of 2.8 feet and 5.2 respectively. These measurements are greater than design values and had slightly increased from the previous assessment; however, they still meet DMS' monitoring guidance criteria for the assessment. Additionally, this log sill structure was evaluated for stability. Because each sill is constructed with both a header and footer log, the footer log on this log sill was still buried below the elevation of the scour pool, affording protection from undermining and helping to hold the entire structure firmly in place. Therefore, since the channel bed is stable and it is normal for pool depths and pool to pool ratios to fluctuate over time in an active riparian systems. Observations of this area during the Year 5 assessment did not document any instability; therefore, no measurements were taken. These log sills/scour pools will also be assessed during the Year 5 monitoring period.

3.2 Vegetation Condition Assessment

Tables 6a and 6b summarize the vegetation conditions of the Hoppers Creek-Melton Farm Stream Restoration site. Table 6a references the vegetation assessment tract associated with SFHC Reaches 1 and 2, and UT1 Reach B; Table 6b references the vegetation assessment tract associated with UT2 (Reaches A and B). There were a total of three mapped VPAs. All of which consist of the presence of an invasive species population at least 1000 square feet in size. One of the three was identified during the Year 2, while the remaining two were identified during the Year 4 assessment. The presence of invasive species accounts for all three of the VPAs.

A DMS licensed contractor conducted exotic invasive plant control between June 20 and August 14, 2013. In September 2015, invasive species control treatments were conducted using a variety of treatment applications such as: cut-stump, foliar, hand pull, and hand digging methods. Invasive species that were treated throughout the conservation easement in September 2015 included Kudzu, multi-flora rose, privet, mimosa, autumn olive, trifoliate orange, tree of heaven, and Bradford pear.

As with the SPAs, the first number in the VPA naming convention references the monitoring year in which the VPA was identified during the visual assessment. A brief description of the VPAs reported from previous year's assessment that have persisted as well as Year 4 VPA's is discussed below. All VPAs are included in the scoring of easement acreage performance categories in Tables 6a and 6b, and are also summarized in Table 6c, Figure 2 (CCPV), and the VPA photolog.

VPA2-4 is located on UT1 Reach B within vegetation monitoring plot 22 on the right floodplain terrace. The area has received treatment applications in the past; however, though the overall populations of multi-flora rose and Japanese honeysuckle within this area have diminished, they continue to persist. The combined total acreage is 0.03 acres, or 0.3% of the planted area acreage for this assessment tract.

Two VPAs of invasive species also continue to persist after treatment along UT2 (VPA4-3 and VPA4-5). Both VPAs are located within the floodplain. VPA4-3 consists of both multi-flora rose

and Japanese honeysuckle, while VPA4-5 is comprised primarily of the latter. VPA4-3 encompasses the majority vegetation monitoring plot 14. The combined total acreage for these two VPAs is 0.06 acres, or 4.0% of the planted area acreage for this assessment tract.

Though there were no other VPAs which exceeded the mapping threshold, individual stems and/or localized populations of invasive species were observed throughout the assessment area. These species consisted primarily of multi-flora rose; however, Chinese privet and Japanese honeysuckle were also noted. Locations of these species were mainly limited to the fence line along the easement with a few sporadic populations within the planted easement areas.

CE CROSS SECTION

CONSERVATION EASMENT

TB ASBUILT TOP OF BANK

ASBUILT CHANNEL

X ASBUILT CENTERLINE

X - # FENCE

PHOTO ID POINT

VP VEGETATION PLOT

VEGETATION PROBLEM AREA (VPA)
INVASIVE SPECIES PRESENT

VEGETATION PROBLEM AREA (VPA)
BARE FLOOD PLAIN AREA

CREST GAUGE

WETLAND GAUGE

WETLAND ENHANCEMENT / RESTORATION

STREAM PROBLEM AREAS (SPA)
BANKS WITH EVIDENT SCOUR / EROSION

STREAM PROBLEM AREAS (SPA)
AGGRADATION

STREAM PROBLEM AREAS (SPA)
DEGRADATION

STREAM PROBLEM AREAS (SPA)
STRUCTURE PROBLEM

STREAM PROBLEM AREAS (SPA)
UNDERCUT BANKS

MATCHLINE SHEET 3

MATCHLINE SHEET 2

IMAGE SOURCE: NC OneMap, NC Center for Geographic Information and Analysis, NC 911 Board

40 0 40 80 Feet

SOUTH FORK HOPPERS CREEK
CURRENT CONDITION PLAN VIEW
YEAR 5 MONITORING
STA. 10+00 - 22+48

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SOUTH FORK HOPPERS CREEK -
MELTON FARM RESTORATION PROJECT
MCDOWELL COUNTY, NORTH CAROLINA

FIGURE 2

Prepared For:
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DMS Project No. 92251

Baker Project No. 128244

Date: 2017

DESIGNED: -----
DRAWN: KLS
APPROVED: JB

Monitoring Year: 5 of 5

Sheet: 1 of 3

CE CE CROSS SECTION

CONSERVATION EASMENT

TB TB ASBUILT TOP OF BANK

ASBUILT CHANNEL

X X ASBUILT CENTERLINE

X - # FENCE

PHOTO ID POINT

VP VEGETATION PLOT

FENCE DOWN DUE TO LOGGING

VEGETATION PROBLEM AREA (VPA)
INVASIVE SPECIES PRESENT

VEGETATION PROBLEM AREA (VPA)
BARE FLOOD PLAIN AREA

WETLAND ENHANCEMENT / RESTORATION

CREST GAUGE

WETLAND GAUGE

FALLEN TREE ON FENCE LINE

STREAM PROBLEM AREAS (SPA)
BANKS WITH EVIDENT SCOUR / EROSION

STREAM PROBLEM AREAS (SPA)
AGGRADATION

STREAM PROBLEM AREAS (SPA)
DEGRADATION

STREAM PROBLEM AREAS (SPA)
STRUCTURE PROBLEM

STREAM PROBLEM AREAS (SPA)
UNDERCUT BANKS

MATCHLINE SHEET 1

IMAGE SOURCE: NC OneMap, NC Center for Geographic Information and Analysis, NC 911 Board

UT1 - B
CURRENT CONDITION PLAN VIEW
YEAR 5 MONITORING
STA. 10+00 - 22+48

40 0 40 80 Feet

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SOUTH FORK HOPPERS CREEK - MELTON FARM RESTORATION PROJECT
MCDOWELL COUNTY, NORTH CAROLINA

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Sheet: 2 of 3

CE CE — CROSS SECTION

CONSERVATION EASMENT

TB TB — ASBUILT TOP OF BANK

ASBUILT CHANNEL

X X — ASBUILT CENTERLINE

X - # — FENCE

PHOTO ID POINT

VP — VEGETATION PLOT

VEGETATION PROBLEM AREA (VPA)
INVASIVE SPECIES PRESENT

VEGETATION PROBLEM AREA (VPA)
BARE FLOOD PLAIN AREA

WETLAND ENHANCEMENT / RESTORATION

CREST GAUGE

WETLAND GAUGE

FALLEN TREE ON FENCE LINE

STREAM PROBLEM AREAS (SPA)
BANKS WITH EVIDENT SCOUR / EROSION

STREAM PROBLEM AREAS (SPA)
AGGRADATION

STREAM PROBLEM AREAS (SPA)
DEGRADATION

STREAM PROBLEM AREAS (SPA)
STRUCTURE PROBLEM

STREAM PROBLEM AREAS (SPA)
UNDERCUT BANKS

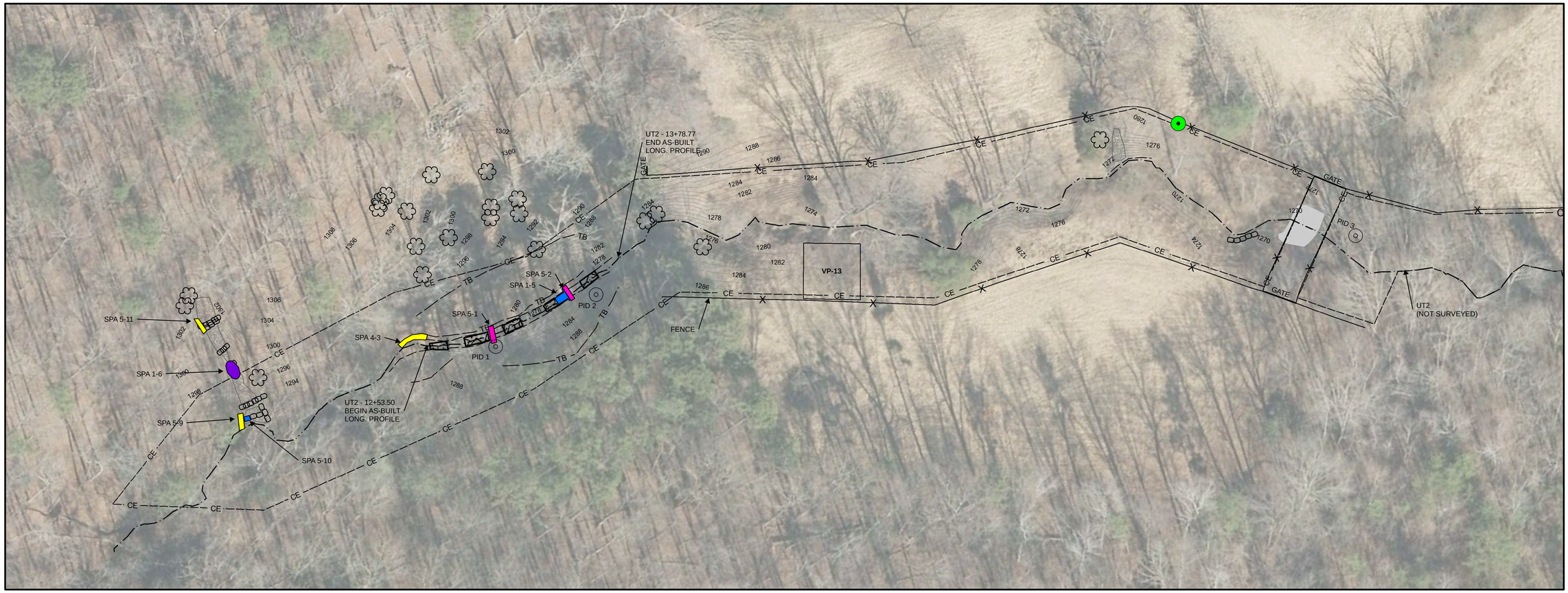

IMAGE SOURCE: NC OneMap, NC Center for Geographic Information and Analysis, NC 911 Board

30 0 30 60 Feet

UT2
CURRENT CONDITION PLAN VIEW
YEAR 5 MONITORING
STA. 12+54 - 13+79

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SOUTH FORK HOPPERS CREEK - FIGURE 2
MELTON FARM RESTORATION PROJECT
MCDOWELL COUNTY, NORTH CAROLINA

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Date: 2017

DESIGNED: -----
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APPROVED: JB

Monitoring Year: 5 of 5

Sheet: 3 of 3

Table 5a. Visual Stream Morphology Stability Assessment
Hoppers Creek-Melton Farm Stream Restoration Project: Project No. 92251

Reach ID	**South Fork Hoppers Creek Reach 1**
Assessed Length (LF)	**783**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Veg.	Footage with Stabilizing Woody Veg.	Adjusted % for Stabilizing Woody Veg.
1. Bed	1. Vertical Stability	1. Aggradation			0	0	100%			
		2. Degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate	6	6			100%			
	3. Meander Pool Condition	1. Depth	13	13			100%			
		2. Length	8	8			100%			
	4. Thalweg position	1. Thalweg centering at upstream of meander bend (Run)	8	8			100%			
		2. Thalweg centering at downstream of meander (Glide)	7	7			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			3	52	97%	0	0	97%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely			1	20	99%	0	0	99%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	4	72	95%	0	0	95%
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	20	24			83%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	10	11			91%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	9	9			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	13	13			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth	11	11			100%			

Table 5b. Visual Stream Morphology Stability Assessment
Hoppers Creek-Melton Farm Stream Restoration Project: Project No. 92251

Reach ID	**South Fork Hoppers Creek Reach 2**
Assessed Length (LF)	**445**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Veg.	Footage with Stabilizing Woody Veg.	Adjusted % for Stabilizing Woody Veg.
1. Bed	1. Vertical Stability	1. Aggradation			0	0	100%			
		2. Degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate	3	3			100%			
	3. Meander Pool Condition	1. Depth	10	10			100%			
		2. Length	3	3			100%			
	4. Thalweg position	1. Thalweg centering at upstream of meander bend (Run)	3	3			100%			
		2. Thalweg centering at downstream of meander (Glide)	4	4			100%			
2. Bank	1. Scoured/Eroding	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			3	39	96%	0	0	96%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	3	39	96%	0	0	96%
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	18	19			95%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	10	10			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	8	8			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	10	10			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth	14	14			100%			

Table 5c. Visual Stream Morphology Stability Assessment
Hoppers Creek-Melton Farm Stream Restoration Project: Project No. 92251

Reach ID UT1 Reach B

Assessed Length (LF) 1065

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Veg.	Footage with Stabilizing Woody Veg.	Adjusted % for Stabilizing Woody Veg.
1. Bed	1. Vertical Stability	1. Aggradation			0	0	100%			
		2. Degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate	12	12			100%			
	3. Meander Pool Condition	1. Depth	26	26			100%			
		2. Length	16	16			100%			
	4. Thalweg position	1. Thalweg centering at upstream of meander bend (Run)	16	16			100%			
		2. Thalweg centering at downstream of meander (Glide)	16	16			100%			
2. Bank	1. Scoured/Eroding	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			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	38	38			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	22	22			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	10	10			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	16	16			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth	10	10			100%			

Table 5d. Visual Stream Morphology Stability Assessment
Hoppers Creek-Melton Farm Stream Restoration Project: Project No. 92251

Reach ID	**UT2 (Reaches A and B)**
Assessed Length (LF)	**1197**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Veg.	Footage with Stabilizing Woody Veg.	Adjusted % for Stabilizing Woody Veg.
1. Bed	1. Vertical Stability	1. Aggradation			0	0	100%			
		2. Degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate	5	5			100%			
	3. Meander Pool Condition	1. Depth	3	5			60%			
		2. Length	N/A	N/A			N/A			
	4. Thalweg position	1. Thalweg centering at upstream of meander bend (Run)	5	5			100%			
		2. Thalweg centering at downstream of meander (Glide)	4	4			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			1	17	99%	1	15	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	1	17	99%	1	15	100%
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	10	10			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	5	5			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	4	5			80%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	5	5			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth	3	5			60%			

Table 5e. Stream Problem Areas Hoppers Creek-Melton Farm Stream Restoration Project: Project No. 92251			
South Fork Hoppers Creek (SFHC) Reach 1			
Feature Issue	**Station No.**	**Suspected Cause**	**Photo Number***
Bank Scour	14+35 to 14+57	Scour eroding the right bank immediately downstream of log sill invert/right bank tie-in. Appears to be a localized area of high near bank stress caused by flow (velocity vector) directed at the left bank by log sill orientation.	SPA1-2
Undercut Banks & Engineering structures - Rootwad & Log Sill Failure	16+12 to 16+32	Rootwad failure and undercut banks along the left bank immediately downstream of log sill invert/left bank tie-in. Appears to be caused by bank scour upstream and beneath the rootwad resulting from flow (velocity vector) directed at the left bank by log sill orientation which eventually undermined the rootwad and the log sill, to where each has separated from the left bank. The root was has slumped into the channel and the log sill had separated and is under water.	SPA2-1 & 5-3
Bank Scour & Engineering Structures - Rootwad and Log Sill Failure	18+30 to 18+45	Localized scour along the left bank behind root wads is causing the root wads to separate from the bank and has compromised the log sill tie-in.	SPA5-4 & 5-7
Bank Scour	18+60 to 18+75	Localized scour along the left bank diverting water behind bank toe and discharge downstream.	SPA5-8
SFHC Reach 2			
Feature Issue	**Station No.**	**Suspected Cause**	**Photo Number**
Undercut Banks & Engineering structures - Rootwad & Log Sill Failure	20+20 to 20+40	Rootwad failure and undercut banks along the left bank immediately downstream of log sill invert/left bank tie-in. Appears to be caused by bank scour upstream and beneath the rootwad resulting from flow (velocity vector) directed at the left bank by log sill orientation which eventually undermined the rootwad and the log sill. The root wad and the sill's header log are still tied-in to the bank; however, it appears that the sill's header and footer have separated. Currently the header log is suspended across the channel above the surface water elevation.	SPA4-1 & 5-5
Undercut Banks	20+45	Undercutting of right bank between root wads immediately downstream of compromised log sill. Appears to be a localized area of high near bank stress caused by flow (velocity vector) directed at the right bank.	SPA5-6
Undercut Bank & Engineering structures - Rootwad Failure	20+75	Rootwad failure along right bank due to undercutting along bank. Appears to be caused by high near bank stress caused by flood flow stream energy vectors being directed at bank.	SPA4-2

Table 5e cont. Stream Problem Areas Hoppers Creek-Melton Farm Stream Restoration Project: Project No. 92251			
South Fork Hoppers Creek (SFHC) Reach 1			
Feature Issue	**Station No.**	**Suspected Cause**	**Photo Number***
UT2 Reach A			
Feature Issue	**Station No.**	**Suspected Cause**	**Photo Number**
Bank Scour	12+36.50 to 12+53.50	Left bank scour on outside bend. Appears to be caused by high near bank stress during bankfull storm events.	SPA4-3
Engineered Structure/Aggradation	12+92	Step pool filling with sediment. Most likely to be from upstream sediment supply moving through the system.	SPA5-1
Piping	13+40	Flow piping within riffle cascade and around downstream log sill due to possible tear in filter fabric or lack of sealing from re-sorting of alluvial material and silt.	SPA1-5
Engineered Structure/Aggradation	13+42	Step pool filling with sediment. Most likely to be from upstream sediment supply moving through the system.	SPA5-2
Ephemeral Drainage (near upstream extents of UT2)**			
Feature Issue	**Station No.**	**Suspected Cause**	**Photo Number**
Bed Scour/Degradation	Riffle cascade downstream of second boulder sill	Scour of riffle cascade from large storm events over time has eroded the channel bed, depositing the coarse riffle substrate downstream, and exposed the underlying filter fabric.	SPA1-6
Bank Scour & Engineering Structures - Boulder Sill	Fourth boulder sill	Scour along right bank boulder tie-in which appears to be caused by high near bank stress during storm events. Erosion has led the boulder tie-in to dislodge from the bank and may lead to further structure failure.	SPA5-9 & SPA5-10
Bank Scour	First boulder sill	Scour along right bank boulder tie-in which appears to be caused by high near bank stress during storm events.	SPA5-11
*Note: The first digit in the Photo Number column references the monitoring year and the second digit references the problem area **Not being sought for mitigation			

Table 6a. Vegetation Condition Assessment
Hoppers Creek-Melton Farm Stream Restoration Project: Project No. 92251

Reach ID	**SFHC Reaches 1 and 2; UT1 Reach B**					
Planted Acreage	**4.3**					
Vegetation Category	**Definitions**	**Mapping Threshold**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreage**	**% of Planted Acreage**
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	NA	0	0.15	3.4%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	NA	0	0.00	0.0%
			Total	0	0.15	3.4%
3. 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	NA	0	0.00	0.0%
			Cumulative Total	0	0.15	3.4%
Easement Acreage	**8.6**					
Vegetation Category	**Definitions**	**Mapping Threshold**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreage**	**% of Easement Acreage**
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1000 SF	NA	1	0.03	0.3%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	NA	3	0.05	0.6%

Table 6b. Vegetation Condition Assessment
Hoppers Creek-Melton Farm Stream Restoration Project: Project No. 92251

Reach ID	**UT2 Reaches A and B**					
Planted Acreage	**1.4**					
Vegetation Category	**Definitions**	**Mapping Threshold**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreage**	**% of Planted Acreage**
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	NA	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	NA	0	0.00	0.0%
			Total	0	0	0.0%
3. 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	NA	0	0.00	0.0%
			Cumulative Total	0	0	0.0%
Easement Acreage	**1.5**					
Vegetation Category	**Definitions**	**Mapping Threshold**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreage**	**% of Easement Acreage**
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1000 SF	See Figure	2	0.06	4.0%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	See Figure	0	0.00	0.0%

Table 6c. Vegetation Problem Areas
Hoppers Creek-Melton Farm Stream Restoration Project: Project No. 92251

UT1 Reach B			
Feature Issue	**Station No.**	**Suspected Cause**	**Photo Number**
Invasive/Exotic Populations	See Plan View Figure	*Rosa multiflora* and *Lonicera japonica* : persisting after treatment	VPA2-4
UT2			
Feature Issue	**Station No.**	**Suspected Cause**	**Photo Number**
Invasive/Exotic Populations	See Plan View Figure	*Rosa multiflora* and *Lonicera japonica* : persisting after treatment.	VPA4-3
		Lonicera japonica: persisting after treatment.	VPA4-5
*Note: The first digit in the Photo Number column references the monitoring year and the second digit references the problem area or			

South Fork Hoppers Creek (SFHC)
Stream Station Photos

SOUTH FORK HOPPERS CREEK – Reach 1

PID 1– Constructed riffle (5/25/16)

PID 2 – Constructed riffle (5/25/16)

PID 3 – Log vane in constructed pool (5/25/16)

PID 4 – Constructed riffle (5/25/16)

PID 5 – Constructed riffle (5/25/16)

PID 6 – Log sills and root wad (5/25/16)

PID 7 – Constructed riffle (5/25/16)

PID 8 – Log sills & root wad (5/25/16)

PID 9 – Constructed riffle root wad (5/25/16)

PID 10 – Confluence of UT1 (5/25/16)

PID 11 – Constructed riffle root wad (5/25/16)

SOUTH FORK HOPPERS CREEK – Reach 2

PID 12 – Double drop cross vane below crossing (5/16/16)

PID 13 – Log sills & root wad (5/25/16)

PID 14 – Log sills & root wad (5/25/16)

PID 15 – Log Vane (5/25/16)

PID 16 – Log vane & matted bank (5/25/16)

UT1 – Reach B

P1D 1– Constructed riffle (5/25/16)

PID 2 – Constructed riffle (5/25/16)

PID 3 – Constructed riffle (5/25/16)

PID 4 – Constructed riffle (5/25/16)

PID 5 – Constructed riffle (5/25/16)

PID 6 – Log sills (5/25/16)

PID 7 – Constructed riffle (5/25/16)

PID 8 – Constructed riffle (5/25/16)

PID 9 – Ephemeral pool in right floodplain (5/25/16)

PID 10 – Log sills (5/25/16)

PID 11 – Constructed riffle (5/25/16)

PID 12 – Ephemeral pool in right floodplain (5/25/16)

PID 13 – Constructed riffle (5/25/16)

PID 14 – Log sill (5/25/16)

PID 15 – Constructed riffle below stream crossing (5/25/16)

PID 16 – Constructed riffle (5/25/16)

PID 17 – Log sills (5/25/16)

PID 18 – Constructed riffle (5/25/16)

PID 19 – Constructed riffle (5/25/16)

UT2

PID 1 – Constructed riffle & log sill (5/16/16)

PID 2 – Constructed riffles & log sills (5/25/16)

PID 3 – Stream crossing (5/25/16)

Hoppers Creek – Melton Farm
Stream Problem Area (SPA) Photos

SOUTH FORK HOPPERS CREEK – Reach 1

SPA1-2 –Right bank scour (5/16/16)

SPA2-1 – Bank scour along left bank has led to erosion around root wads and log sill causing structure failure (5/16/16)

SPA 5-3 – Log sill has slipped out of place and is under water due to bank scour of SPA2-1 (5/16/16)

SPA5-4 – Bank scour along left bank behind root wads (5/16/16)

SPA 5-7 – Bank scour from SPA5-4 has led to water to be diverted behind the bank toe and discharging downstream (10/19/16)

SOUTH FORK HOPPERS CREEK – Reach 2

SPA4-1 Undercutting bank along left bank has led to root wad failure

SPA4-2 – Root wad failure along right bank due to undercutting along bank

SPA5-5 – Log sill has been compromised due to bank scour on left bank from SPA 4-2 (5/16/16)

SPA5-6 – Undercut bank causing erosion around root wad (5/16/16)

UT1

Fence line down from logging activity located outside but adjacent to easement

UT2

SPA1-5 – Piping within riffle cascade around log sill

SPA4-3 – Small area of bank left bank erosion.

SPA5-1 –Pool below log sill is filling with sediment (5/16/16)

SPA5-2 – Pool below log sill is filling with sediment (5/16/16)

EPHEMERAL DRAINAGE

SPA1-6 – Ephemeral drainage channel bed erosion (5/16/16)

SPA5-9 & SPA5-10 – Scour and loss of structure integrity on boulder tie-in on fourth boulder sill of ephemeral drainage channel (10/19/16)

SPA5-11 – Scour around boulder tie-in on first boulder sill of ephemeral drainage channel (10/19/16)

South Fork Hoppers Creek (SFHC)
Vegetation Problem Area (VPA) Photos

UT2

VPA4-3 – Multi-flora rose and Japanese honeysuckle

VPA4-5 – Japanese honeysuckle in left floodplain

UT1B

VPA2-4 – Multi-flora rose and Japanese honeysuckle

APPENDIX C

VEGETATION PLOT DATA

Table 7. Vegetation Plot Criteria Attainment South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251			
Vegetation Plot ID	**Vegetation Survival Threshold Met?**	**Planted/Total Stem Count**	**Tract Mean**
13	Y	769/1578	587/867
14	Y	890/1457	
15	Y	445/769	
16	Y	324/405	
17	Y	607/607	
18	Y	526/526	
19	Y	445/445	
20	Y	567/567	
21	Y	890/890	
22	Y	526/809	
23	Y	607/1862	
WLP1	Y	445/486	
Note: *Planted/Total Stem Count reflects the changes in stem density based on the density of stems at the time of the As-Built Survey (Planted) and the current total density of planted stems including volunteers (Total).			

Table 8. CVS Vegetation Plot Metadata South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251	
Report Prepared By	Kristi Suggs
Date Prepared	11/25/2016 10:39
Database name	S.ForkHoppers_92251_MY2-5_cvs-eep-entrytool-v2.3.1_2016_rwm.mdb
Database location	C:\My Documents\Baker\CVS\S.ForkHoppers
Computer name	CHABLKSUGGS
File size	48009216
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes all planted stems and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY	
Project Code	92251
Project Name	South Fork Hoppers Creek
Description	This mitigation project consists of 4,621 LF of stream restoration and preservation efforts on South Fork Hoppers Creek at the Melton Farm.
River Basin	Catawba
Length(ft)	3550
Stream-to-edge width (ft)	120
Area (sq m)	40873.25
Required Plots (calculated)	11
Sampled Plots	12

Table 9. CVS Stem Count Total and Planted by Plot and Species (with Annual Means)
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

Tree Species	Common Name	Type	Current Data (MY5 2016)																						Annual Means											
			Plot 13		Plot 14		Plot 15		Plot 16		Plot 17		Plot 18		Plot 19		Plot 20		Plot 21		Plot 22		Plot 23		Plot WLP1		Current Mean		AB (2011)		MY1 (2012)		MY2 (2013)		MY3 (2014)		MY4 (2015)	
			P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T
Acer rubrum	Red Maple	Tree											3	3											4	4	3.5	3.5							2	3	4	4
Alnus serrulata	Hazel Alder	Tree					4	4	3	3			1	1									8	8	1	1	3.4	3.4				1	0	0	3	3	3	3
Betula nigra	River Birch	Tree			1	1			1	1	3	3	2	2	1	1	2	2	2	2	1	1	2	2			2	2	2	3	3	2	2	2	3	3	2	2
Carpinus caroliniana	American hornbeam	Tree																					1	1			1	1										
Celtis laevigata	Sugarberry	Tree	5	5															2	2							4	4	1	1	1	2	1	1	3	3	3	3
Cornus amomum	Silky Dogwood	Shrub																			1	1	1	1			1	1							1	1	1	1
Diospyros virginiana	Persimmon	Tree	7	7	18	18	1	1			1	1			1	1	3	3	4	4	1	1					5	5	1	1	1	4	1	1	4	4	5	5
Fraxinus pennsylvanica	Green Ash	Tree			1	1	1	1	2	2	7	7	1	1	3	3	2	2	4	4	3	3					3	3	2	3	3	3	2	3	3	3	3	3
Juglans nigra	Black Walnut	Tree			2	2											2	2									2	2	2	3	2	2	2	3	3	2	2	2
Liriodendron tulipfera	Tulip Poplar	Tree	7	7							1	1			2	2			1	1	4	4	1	1			3	3	3	3	3	3	3	3	3	3	3	3
Nyssa sylvatica	Blackgum	Tree					1	1			1	1	1	1							3	3					2	2	2	2	2	2	2	2	1	1	1	1
Platanus occidentalis	Sycamore	Tree					2	2	1	1	1	1	2	2	3	3	4	4	3	3			2	2	5	5	3	3	2	3	3	2	2	2	2	2	2	2
Quercus sp.	Oak	Tree																																	1	1	1	1
Quercus falcata	S. Red Oak	Tree									1	1															1	1	3	4	4	2	3	3	2	2	1	1
Quercus palustris	Pin Oak	Tree											2	2					6	6							4	4	3	4	4	2	3	3	2	2	2	2
Quercus phellos	Willow Oak	Tree															1	1							1	1	1	1	3	4	4	2	3	3	1	1	1	1
Quercus rubra	N. Red Oak	Tree																											2	4	4	2	2	2	1	1	1	1
Salix nigra	Black Willow	Tree					1	1					1	1	1	1											1	1							1	1	1	1
Salix sericea	Silky Willow	Tree					1	1	1	1																	1	1	1	1	1	1	0	0			1	1
Ulmus americana	American Elm	Tree																											2	2	2	1	1	1			1	1
Volunteers																																						
Acer rubrum	Red Maple	Tree								1												2		10				4			7		10		5		4
Alnus serrulata	Hazel Alder	Tree						5		1												3		10		1		4			2		0				4
Cornus amomum	Silky Dogwood	Shrub				1																						1						2			1
Betula nigra	River Birch	Tree				1																						1			1		0		1		1
Diospyros virginiana	Persimmon	Tree				1																	1					1			10		5		5		1
Fraxinus pennsylvanica	Green Ash	Tree																			1							1					0				1
Juglans nigra	Black Walnut	Tree																															0				
Liriodendron tulipfera	Tulip Poplar	Tree		20		9																	10				13			5		4		3.4		13
Platanus occidentalis	Sycamore	Tree						1																			1			1		2				1
Quercus rubra	N. Red Oak	Tree																												1		0		2		
Salix sericea	Silky Willow	Tree				2		2																			2									2
Salix nigra	Black Willow	Tree																			1						1			12		7				1
	Plot area (ares)		1		1		1		1		1		1		1		1		1		1		1		1											
	Species Count		3	3	4	7	7	7	5	5	7	7	8	8	6	6	6	6	7	7	6	11	6	7	4	4	6	7	7	7	7	8	6	7	6	6	6	7
P=Planted	Stems/Plot		19	39	22	36	11	19	8	10	15	15	13	13	11	11	14	14	22	22	13	20	15	46	11	12	15	21	19	19	19	29	13	21	13	17	15	22
T=Total	Stems Per Acre		769	1578	890	1457	445	769	324	405	607	607	526	526	445	445	567	567	890	890	526	809	607	1862	445	486	587	867	772	772	772	614	540	850	543	668	610	890
	Total Stems Per Acre (including		1578		1457		769		405		607		526		445		567		890		809		1862		486		867		772		1184		850		668		890	

Notes: CVS Level 1 Survey performed. In most cases, the volunteers observed were approximately 50 - 100 cm in height. The information presented is purely for providing information about the species of trees that may occupy the riparian area that were not planted.

South Fork Hoppers Creek – Melton Farm Restoration Project
Year 5 Monitoring – Vegetation Plot Photo Log

Veg Plot 13 - 10/19/2016

Veg Plot 14 – 10/19/2016

Veg Plot 15 – 10/19/2016

Veg Plot 16 – 10/19/2016

Veg Plot 17 – 10/19/2016

Veg Plot 18 – 10/19/2016

South Fork Hoppers Creek – Melton Farm Restoration Project
Year 5 Monitoring – Vegetation Plot Photo Log

Veg Plot 19 – 10/19/2016

Veg Plot 20 – 10/19/2016

Veg Plot 21 – 10/19/2016

Veg Plot 22 – 10/19/2016

Veg Plot 23 – 10/19/2016

Veg Plot WPL1 – 10/19/2016

APPENDIX D

STREAM SURVEY DATA

Figure 3. Cross-sections with Annual Overlays

South Fork Hoppers Creek - Reach 1

Permanent Cross Section X5

(Year 5 Monitoring - Oct 2016)

LEFT BANK

RIGHT BANK

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	14.6	12.93	1.13	1.67	11.47	1	4.9	1260.2	1260.24

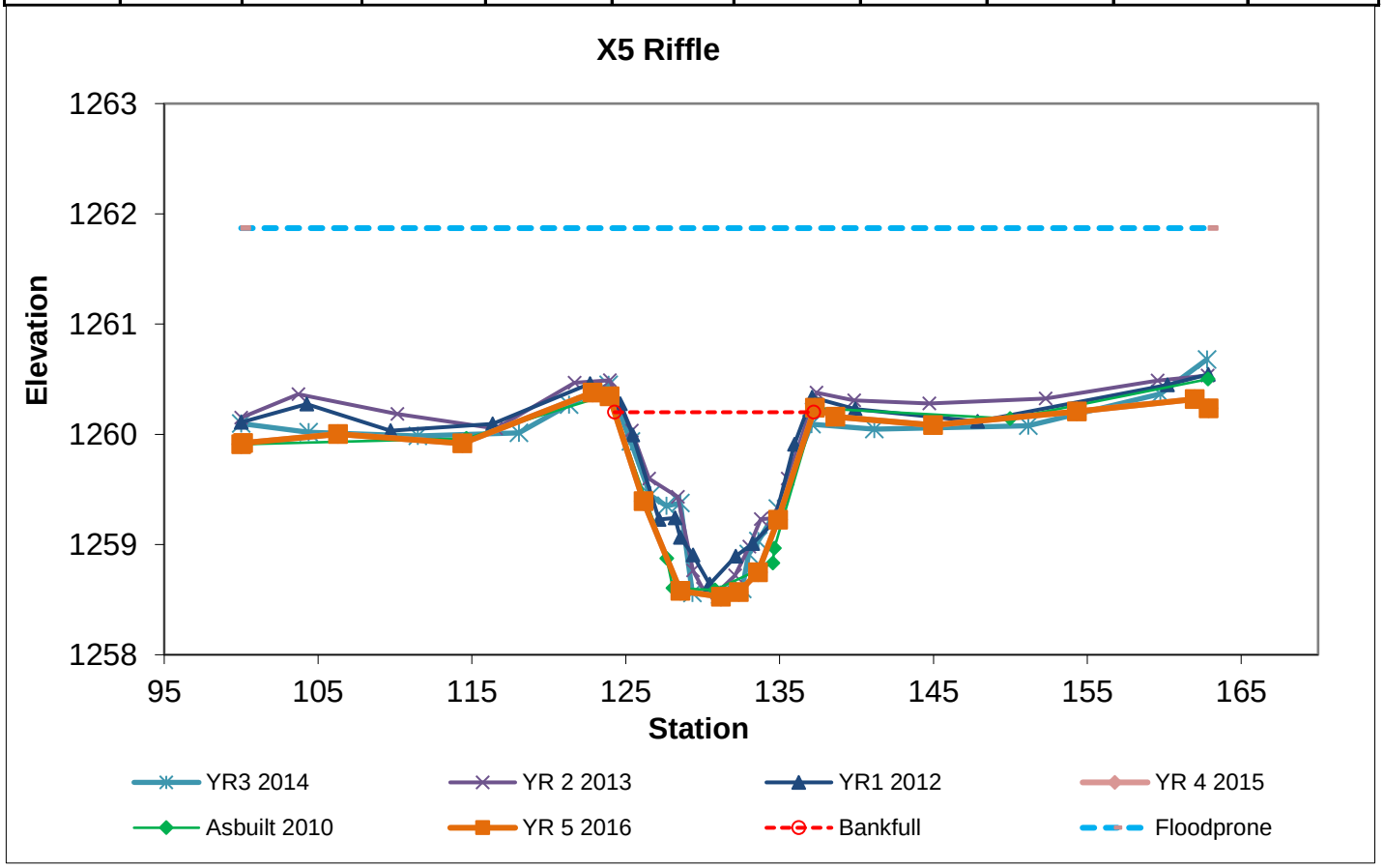


Figure 3 Cont. Cross-sections with Annual Overlays

South Fork Hoppers Creek - Reach 1

Permanent Cross Section X6

(Year 5 Monitoring - October 2016)

LEFT BANK

RIGHT BANK

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		14	11.39	1.23	2.93	9.26	1	6.6	1260.1	1260.2

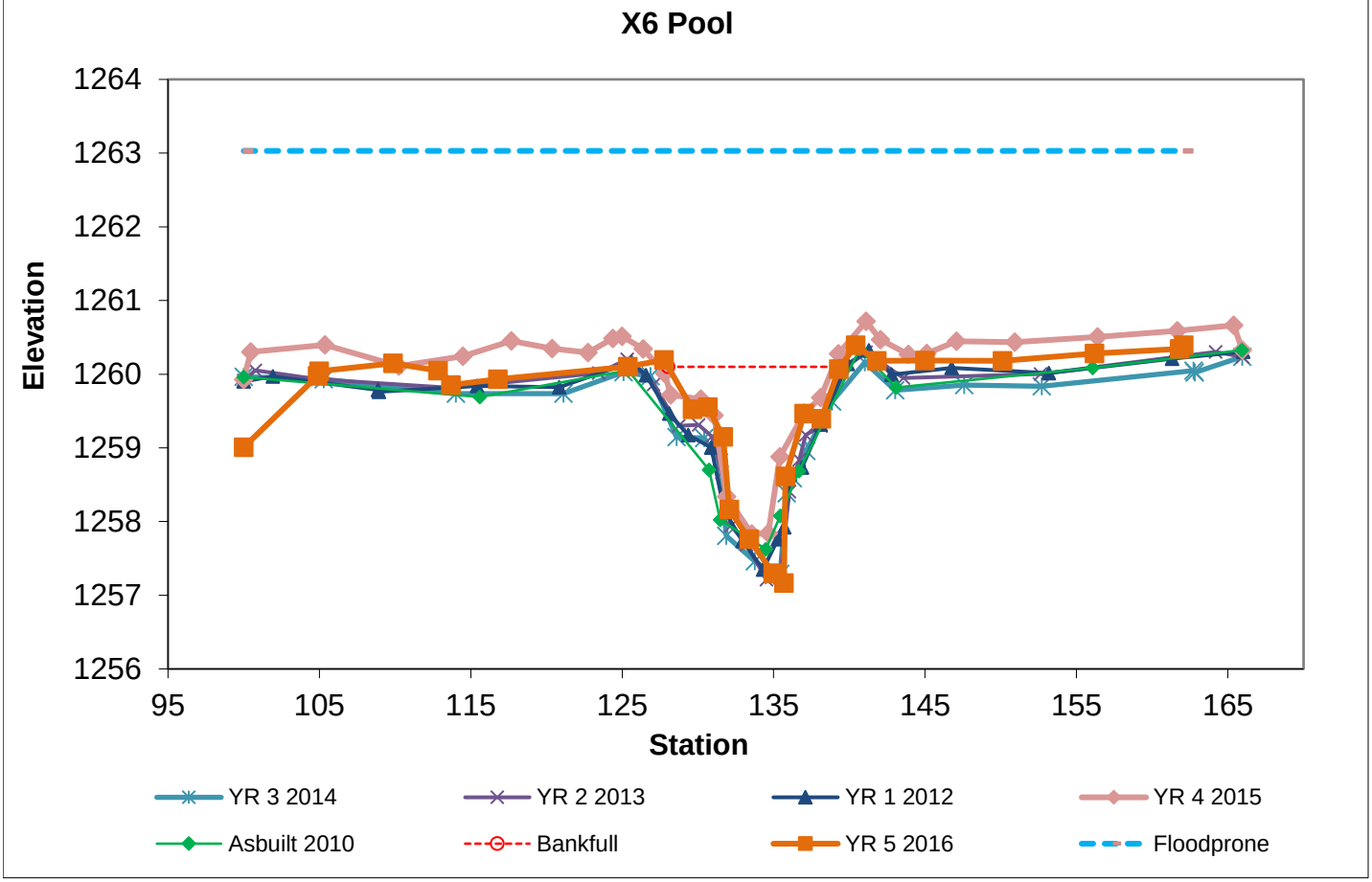


Figure 3 Cont. Cross-sections with Annual Overlays

South Fork Hoppers Creek - Reach 2
Permanent Cross Section X7

(Year 5 Monitoring - October 2016)

LEFT BANK

RIGHT BANK

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	15	13.73	1.09	1.85	12.58	1	4.6	1255.2	1255.24

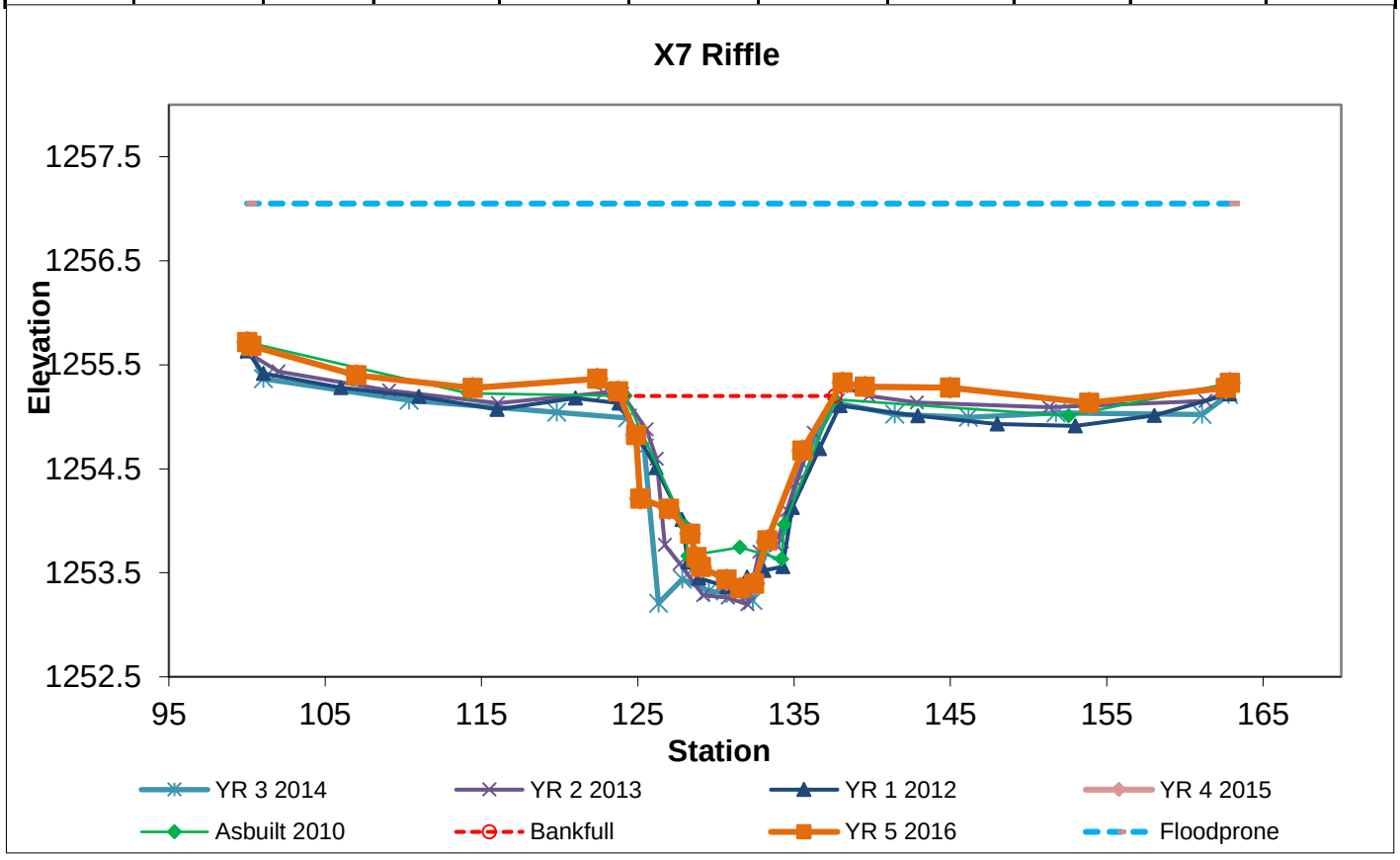


Figure 3 Cont. Cross-sections with Annual Overlays

South Fork Hoppers Creek - Reach 2

Permanent Cross Section X8

(Year 5 Monitoring - October 2016)

LEFT BANK **RIGHT BANK**

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		13.5	13.43	1	2.34	13.38	1	5.3	1252.96	1253.31

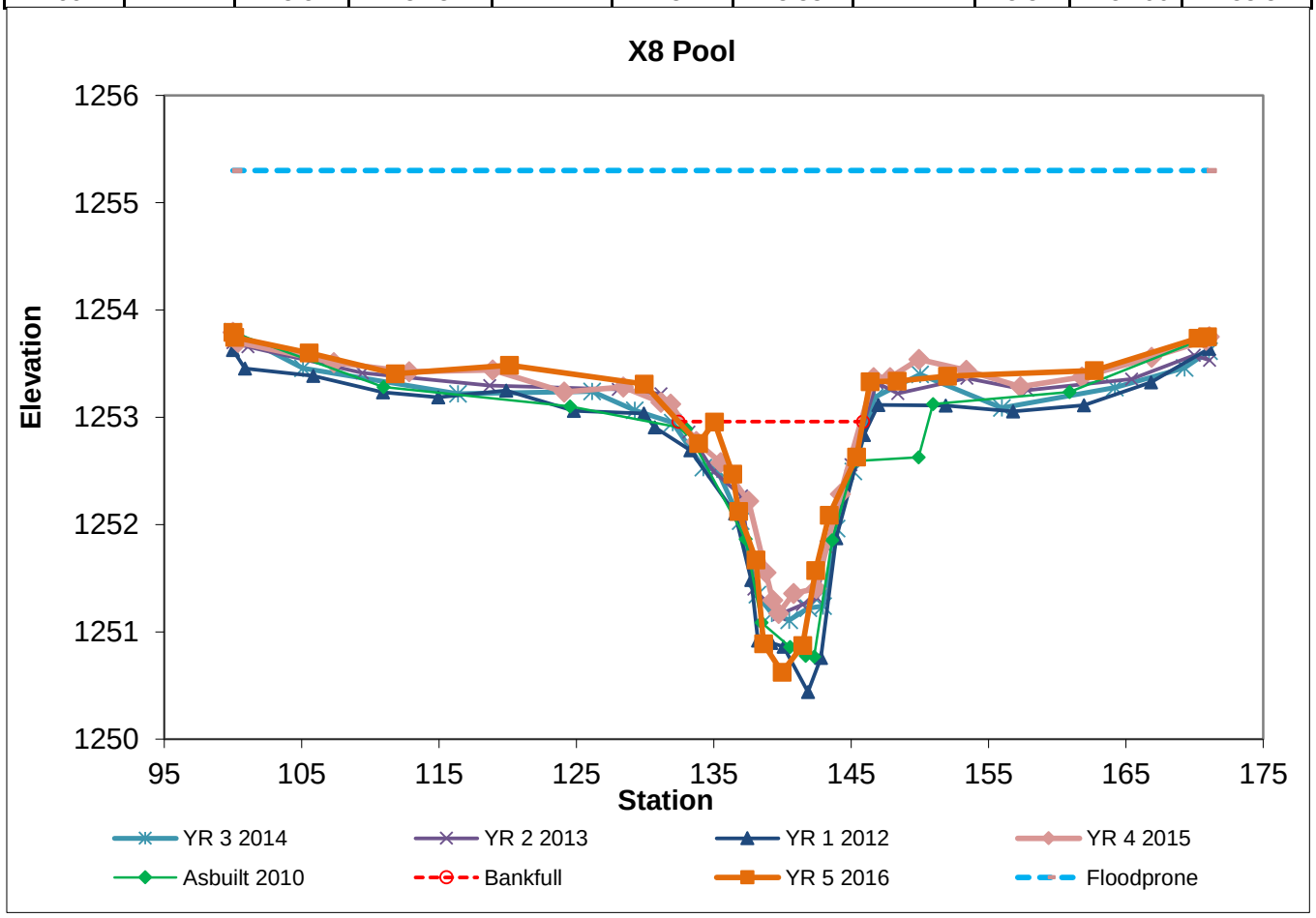


Figure 3 Cont. Cross-sections with Annual Overlays

UT1
Permanent Cross Section X9
(Year 5 Monitoring - October 2016)

LEFT BANK

RIGHT BANK

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	2.3	6.1	0.38	0.77	16.08	1	8.3	1258.8	1258.84

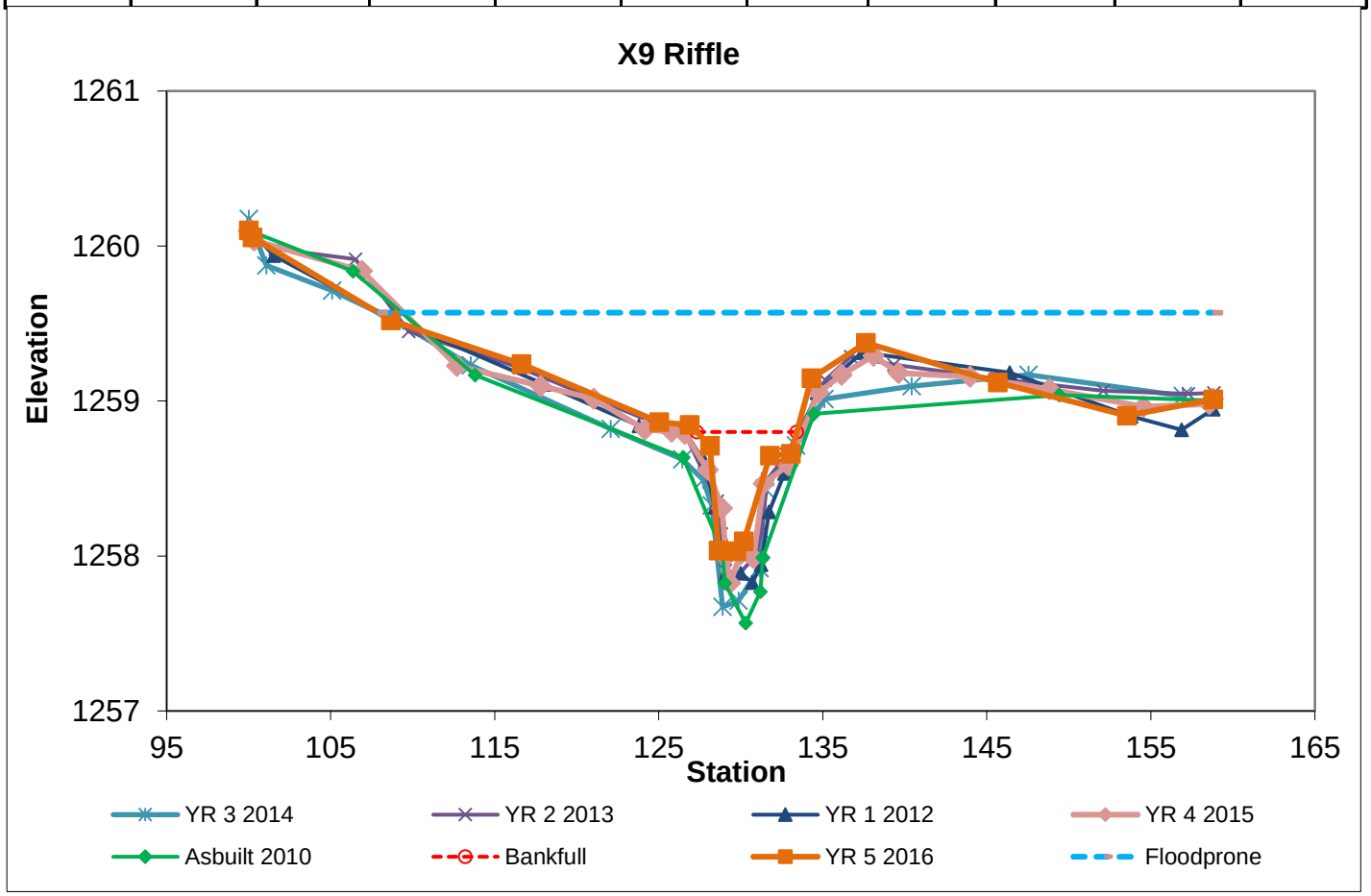


Figure 3 Cont. Cross-sections with Annual Overlays

UT1
Permanent Cross Section X10
(Year 5 Monitoring - October 2016)

LEFT BANK **RIGHT BANK**

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		6.2	12.7	0.48	1.66	26.23	1	4.9	1258.44	1258.62

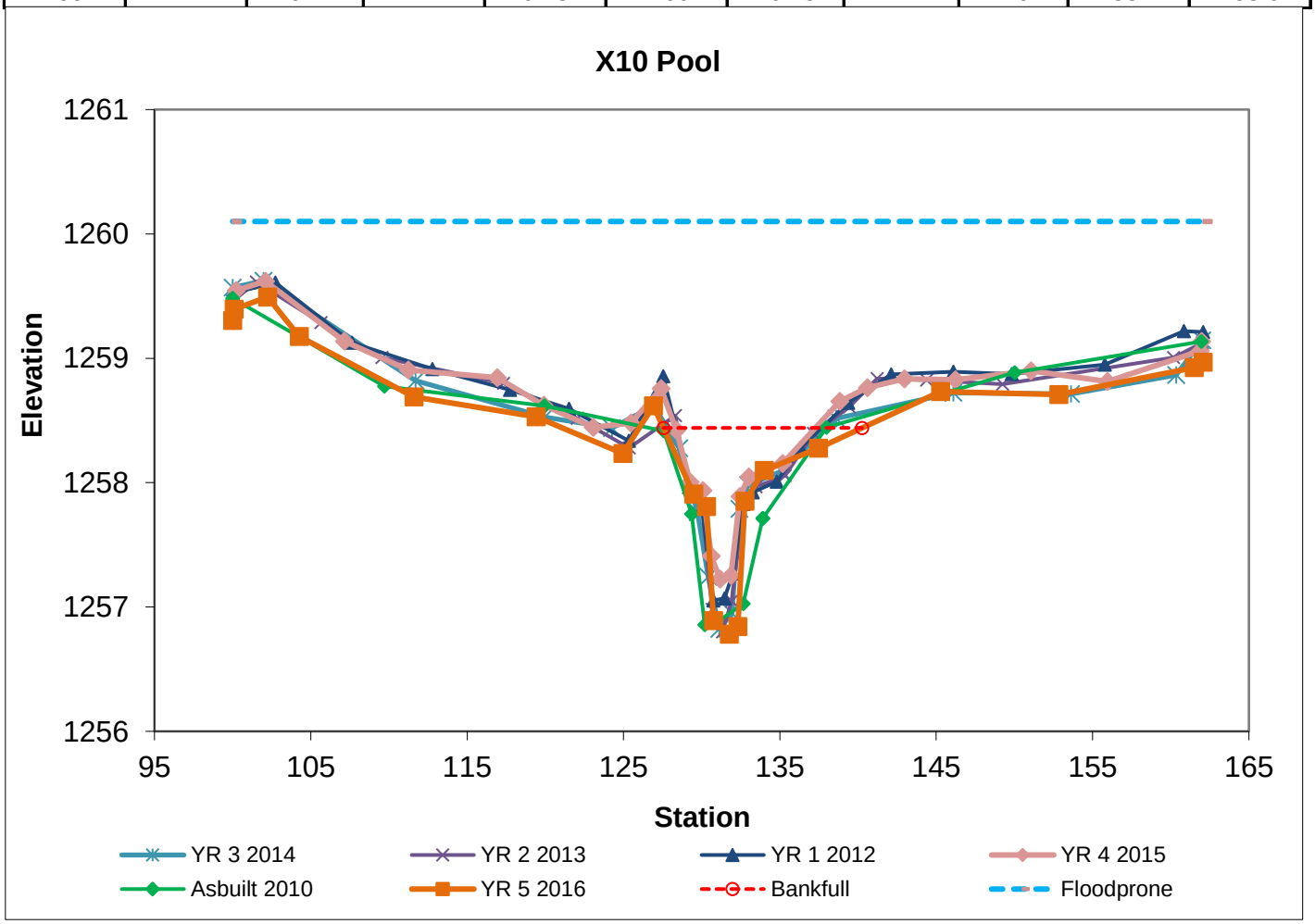


Figure 4. Longitudinal Profiles with Annual Overlays
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

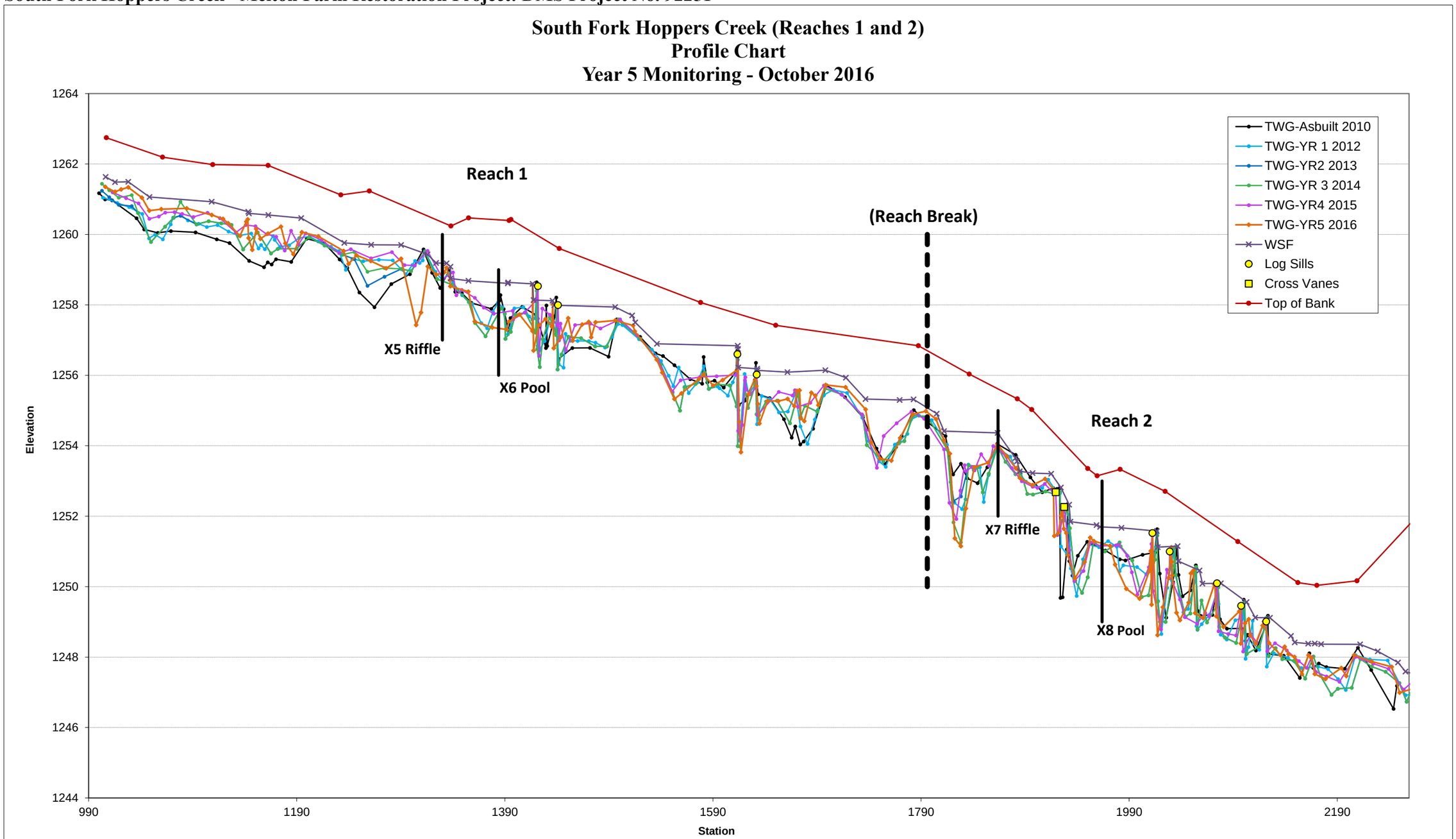


Figure 4 Cont. Longitudinal Profiles with Annual Overlays
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

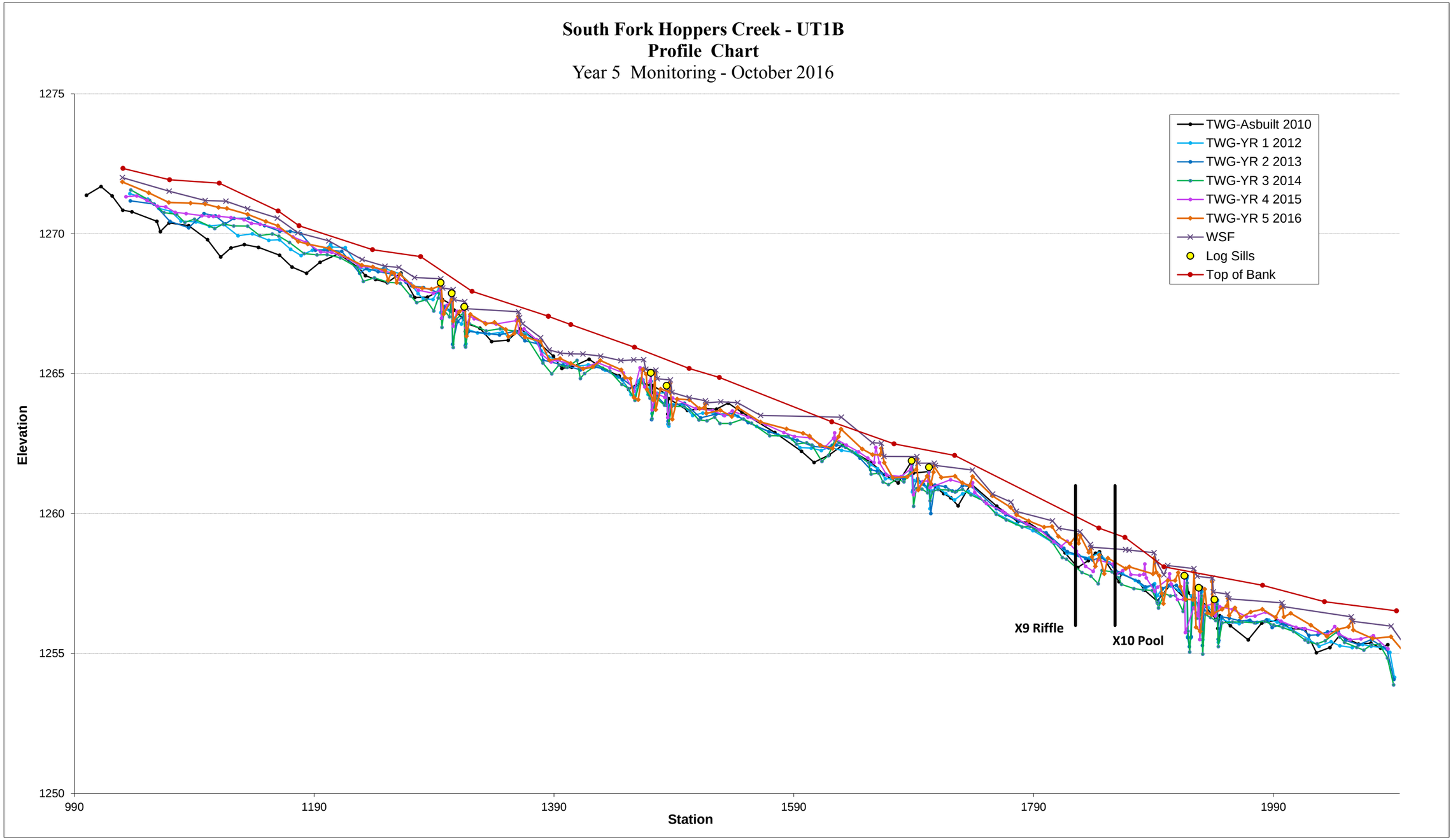
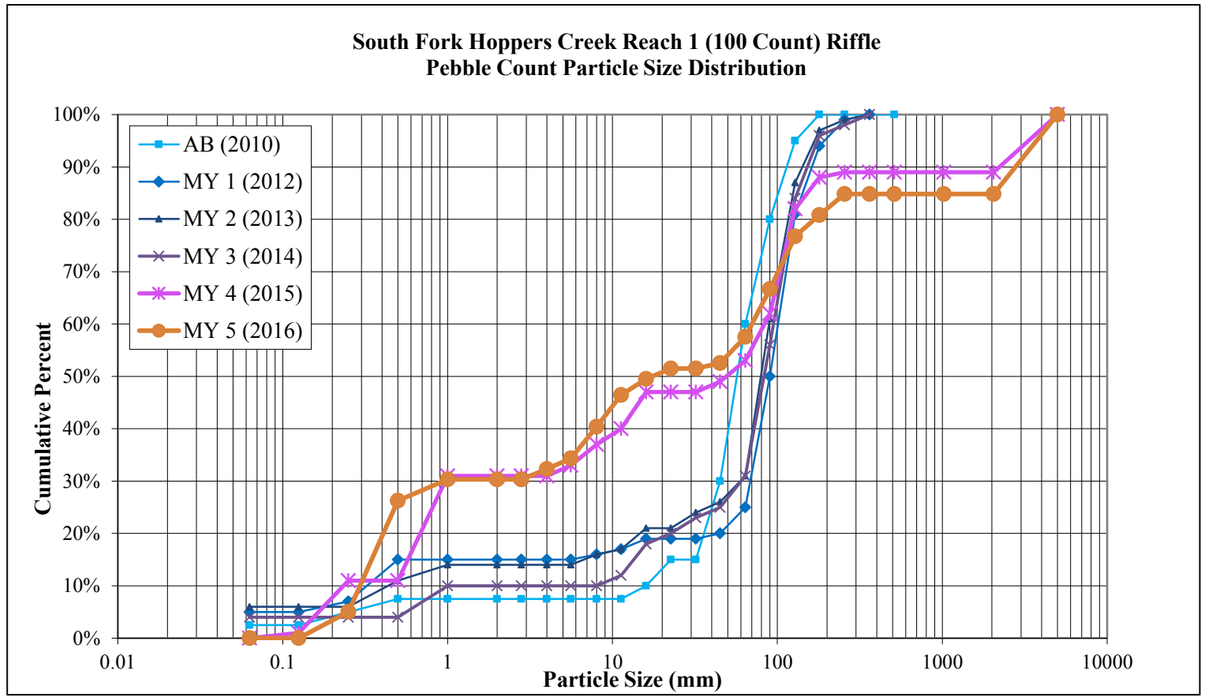


Figure 5a. Riffle Pebble Count Size Class Distribution with Annual Overlays
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

BAKER PROJECT NO.	128244
SITE OR PROJECT:	South Fork Hoppers Creek - Melton Farm Restoration Project
REACH/LOCATION:	Reach 1 - Cross-section 5 (Riffle)
DATE COLLECTED:	19-Oct-16
FIELD COLLECTION BY:	KS and RM
DATA ENTRY BY:	RM

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063			0%
SAND	Very Fine	.063 - .125			0%
	Fine	.125 - .25	5	5%	5%
	Medium	.25 - .50	21	21%	26%
	Coarse	.50 - 1.0	4	4%	30%
	Very Coarse	1.0 - 2.0			30%
GRAVEL	Very Fine	2.0 - 2.8			30%
	Very Fine	2.8 - 4.0	2	2%	32%
	Fine	4.0 - 5.6	2	2%	34%
	Fine	5.6 - 8.0	6	6%	40%
	Medium	8.0 - 11.0	6	6%	46%
	Medium	11.0 - 16.0	3	3%	49%
	Coarse	16.0 - 22.6	2	2%	52%
	Coarse	22.6 - 32			52%
	Very Coarse	32 - 45	1	1%	53%
	Very Coarse	45 - 64	5	5%	58%
COBBLE	Small	64 - 90	9	9%	67%
	Small	90 - 128	10	10%	77%
	Large	128 - 180	4	4%	81%
	Large	180 - 256	4	4%	85%
BOULDER	Small	256 - 362			85%
	Small	362 - 512			85%
	Medium	512 - 1024			85%
	Large-Very Large	1024 - 2048			85%
BEDROCK	Bedrock	> 2048	15	15%	100%
		Total	99	100%	100%

Cummulative	
Channel materials (mm)	
D_{16} =	0.4
D_{35} =	5.8
D_{50} =	17.4
D_{84} =	237.7
D_{95} =	3258.5
D_{100} =	> 2048



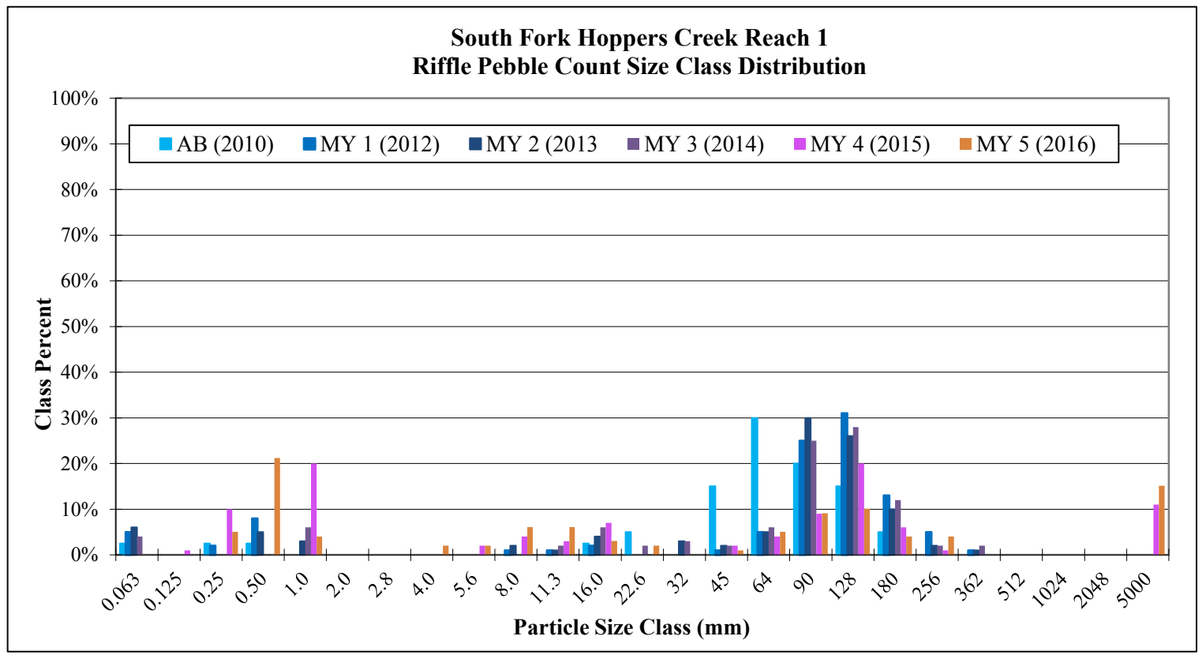
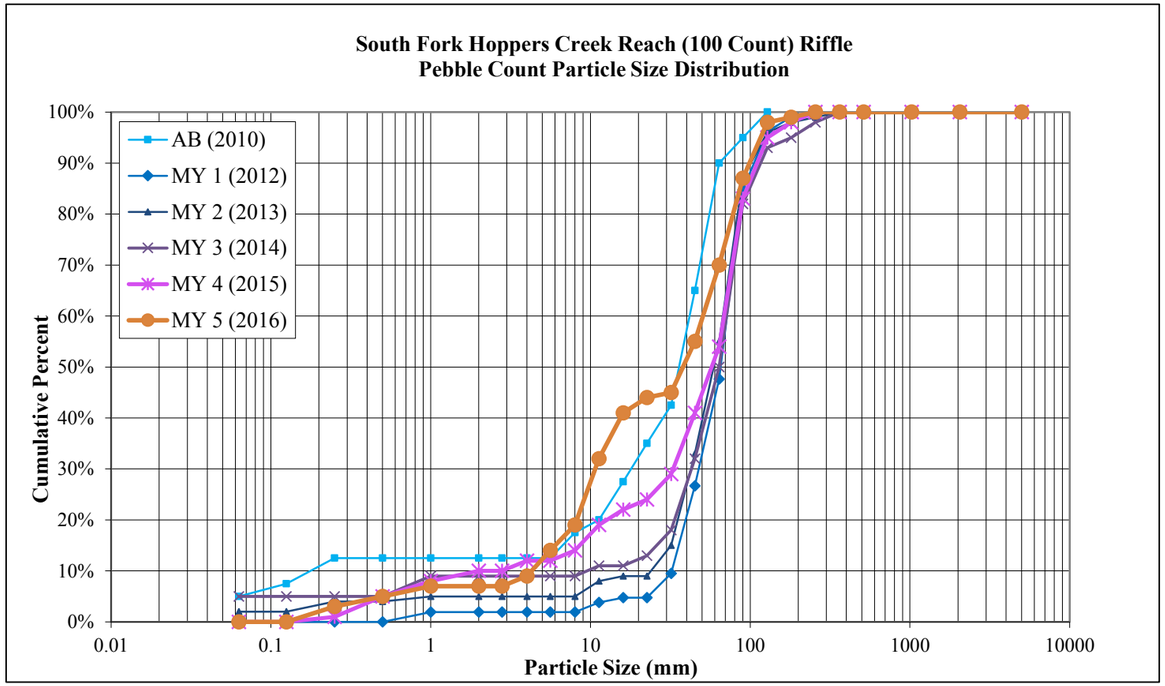


Figure 5b. Riffle Pebble Count Size Class Distribution with Annual Overlays
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

BAKER PROJECT NO.	128244
SITE OR PROJECT:	South Fork Hoppers Creek-Melton Farm Restoration Project
REACH/LOCATION:	Reach 2 - Cross-section 7 (Riffle)
DATE COLLECTED:	10/19/2016
FIELD COLLECTION BY:	KS and RM
DATA ENTRY BY:	RM

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063			0%
SAND	Very Fine	.063 - .125			0%
	Fine	.125 - .25	3	3%	3%
	Medium	.25 - .50	2	2%	5%
	Coarse	.50 - 1.0	2	2%	7%
	Very Coarse	1.0 - 2.0			7%
GRAVEL	Very Fine	2.0 - 2.8			7%
	Very Fine	2.8 - 4.0	2	2%	9%
	Fine	4.0 - 5.6	5	5%	14%
	Fine	5.6 - 8.0	5	5%	19%
	Medium	8.0 - 11.0	13	13%	32%
	Medium	11.0 - 16.0	9	9%	41%
	Coarse	16.0 - 22.6	3	3%	44%
	Coarse	22.6 - 32	1	1%	45%
	Very Coarse	32 - 45	10	10%	55%
	Very Coarse	45 - 64	15	15%	70%
COBBLE	Small	64 - 90	17	17%	87%
	Small	90 - 128	11	11%	98%
	Large	128 - 180	1	1%	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			100%
		Total	100	100%	100%

Cummulative	
Channel materials (mm)	
D_{16} =	6.46
D_{35} =	12.46
D_{50} =	37.95
D_{84} =	84.74
D_{95} =	116.28
D_{100} =	180 - 256



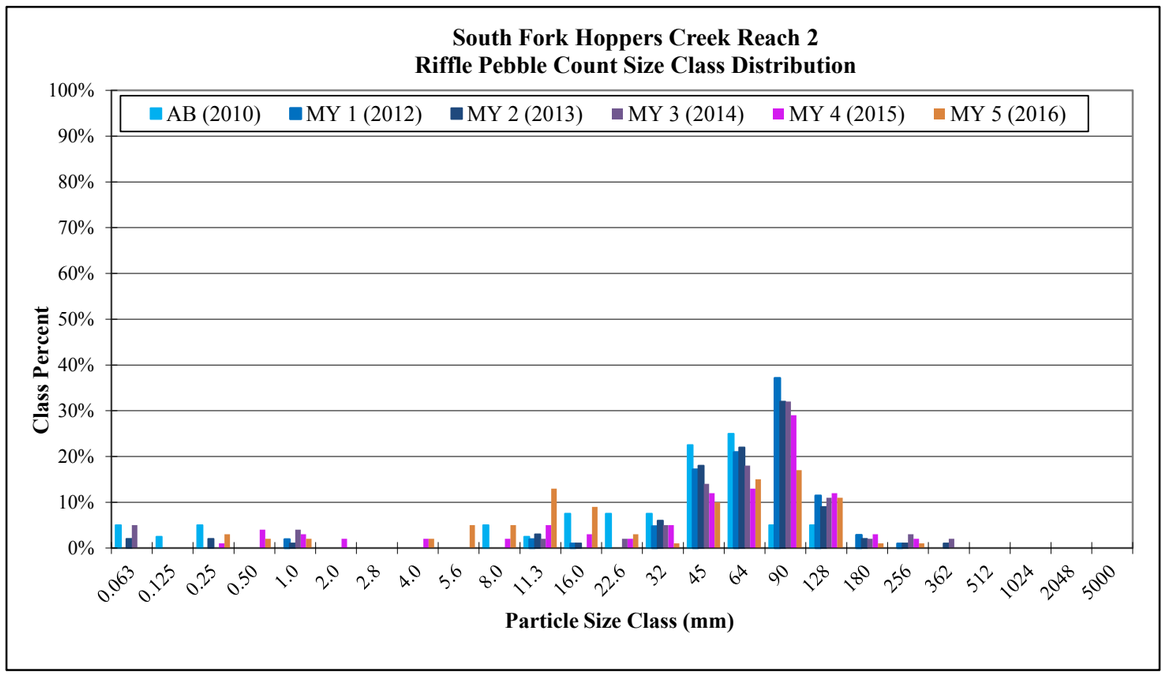
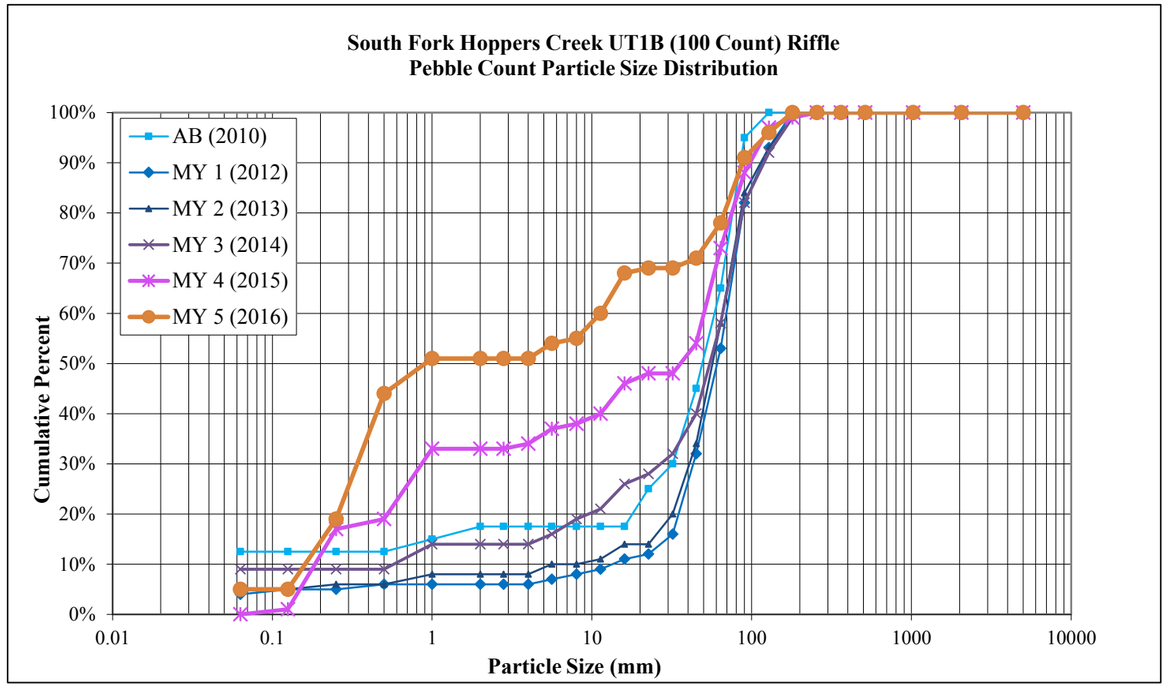


Figure 5c. Riffle Pebble Count Size Class Distribution with Annual Overlays
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

BAKER PROJECT NO.	128244
SITE OR PROJECT:	South Fork Hoppers Creek - Melton Farm Restoration Project
REACH/LOCATION:	UT1B - Cross-section 9 (Riffle)
DATE COLLECTED:	19-Oct-16
FIELD COLLECTION BY:	KS and RM
DATA ENTRY BY:	RM

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	5	5%	5%
SAND	Very Fine	.063 - .125			5%
	Fine	.125 - .25	14	14%	19%
	Medium	.25 - .50	25	25%	44%
	Coarse	.50 - 1.0	7	7%	51%
	Very Coarse	1.0 - 2.0			51%
GRAVEL	Very Fine	2.0 - 2.8			51%
	Very Fine	2.8 - 4.0			51%
	Fine	4.0 - 5.6	3	3%	54%
	Fine	5.6 - 8.0	1	1%	55%
	Medium	8.0 - 11.0	5	5%	60%
	Medium	11.0 - 16.0	8	8%	68%
	Coarse	16.0 - 22.6	1	1%	69%
	Coarse	22.6 - 32			69%
	Very Coarse	32 - 45	2	2%	71%
	Very Coarse	45 - 64	7	7%	78%
COBBLE	Small	64 - 90	13	13%	91%
	Small	90 - 128	5	5%	96%
	Large	128 - 180	4	4%	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			100%
		Total	100	100%	100%

Cummulative	
Channel materials (mm)	
D_{16} =	0.2
D_{35} =	0.4
D_{50} =	0.9
D_{84} =	74.9
D_{95} =	119.3
D_{100} =	128 - 180



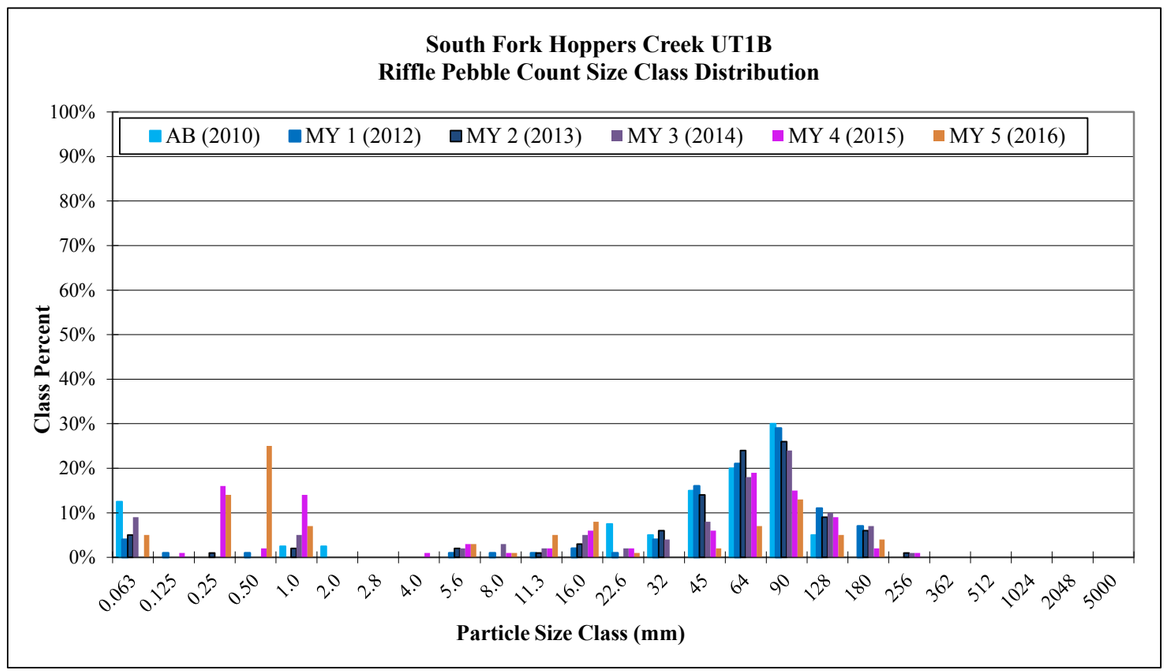


Table 10. Baseline Stream Summary
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

South Fork Hoppers Creek Reach 1 (783 LF)

Parameter	USGS Gauge		Regional Curve Interval (Harman et al, 1999)[1]			Pre-Existing Condition						Reference Reach(es) Data Sal's Branch						Reference Reach(es) Data Spencer Creek Downstream						Design						As-built					
	Jacob	Norwood	LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																																			
BF Width (ft)	61.3	32	5.0	20.0	8.7	7.4	10.5	-----	14.4	-----	3	-----	8.7	-----	-----	-----	1	-----	10.7	-----	-----	-----	1	-----	13.2	-----	-----	-----	1	-----	13.1	-----	-----	-----	1
Floodprone Width (ft)	96.3	-----	-----	-----	-----	16.8	26.2	-----	33.0	-----	3	-----	163.0	-----	-----	-----	1	-----	60.0	-----	-----	-----	1	-----	50+	-----	-----	-----	8	-----	62.9	-----	-----	-----	1
BF Mean Depth (ft)	4.7	3.1	0.7	2.0	1.2	1.0	1.2	-----	1.6	-----	3	-----	1.2	-----	-----	-----	1	-----	1.6	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.1	-----	-----	-----	1
BF Max Depth (ft)	5.8	-----	-----	-----	-----	1.7	1.9	-----	2.0	-----	3	-----	2.4	-----	-----	-----	1	-----	2.1	-----	-----	-----	1	-----	1.3	-----	-----	-----	1	-----	1.7	-----	-----	-----	1
BF Cross-sectional Area (ft²)	290.3	99	6.0	26.0	13.0	7.4	12.5	-----	15.6	-----	3	-----	10.4	-----	-----	-----	1	-----	17.8	-----	-----	-----	1	-----	13.8	-----	-----	-----	1	-----	15.0	-----	-----	-----	1
Width/Depth Ratio	13	10.3	-----	-----	-----	6.1	9.3	-----	14.4	-----	3	-----	7.3	-----	-----	-----	1	-----	5.7	-----	-----	-----	1	-----	13.2	-----	-----	-----	1	-----	11.5	-----	-----	-----	1
Entrenchment Ratio	1.6	-----	-----	-----	-----	2.0	2.6	-----	3.4	-----	3	-----	18.7	-----	-----	-----	1	-----	5.5	-----	-----	-----	1	-----	3.8+	-----	-----	-----	8	-----	4.8	-----	-----	-----	1
Bank Height Ratio	1.3	-----	-----	-----	-----	1.3	2.2	-----	2.6	-----	5+	-----	1.2	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1
d50 (mm)	-----	-----	-----	-----	-----	-----	0.7	-----	-----	-----	1	-----	9.5	-----	-----	-----	-----	-----	8.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																																			
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	10	-----	-----	16	-----	4	38.3	-----	-----	40.8	-----	2	54.0	-----	-----	78.0	-----	8	40.0	62.1	62.0	87.0	14.0	7
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	13.1	-----	-----	29.6	-----	4	10.9	-----	-----	14.6	-----	5	37.0	-----	-----	53.0	-----	8	34.0	39.9	39.0	47.0	5.4	7
Rc:Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	4.4	-----	-----	5.2	-----	3	1.3	-----	-----	1.4	-----	5	2.8	-----	-----	4.0	-----	8	2.6	3.0	3.0	3.6	0.4	7
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	38	-----	-----	45	-----	3	46	-----	-----	48	-----	2	130.0	-----	-----	177.0	-----	6	146.0	162.0	158.0	184.0	15.7	6
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.2	-----	-----	1.8	-----	4	3.4	-----	-----	3.6	-----	2	4.1	-----	-----	5.9	-----	8	3.1	4.7	4.7	6.6	1.1	7
Profile																																			
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	30.0	36.0	37.0	45.0	6.4	6
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	0.015	0.025	-----	0.035	-----	15	0.03	-----	-----	0.04	-----	4	-----	0.013	-----	-----	-----	2	0.013	-----	-----	0.0305	-----	6	0.01	0.02	0.02	0.03	0.01	6
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	27.0	66.0	-----	161.0	-----	14	35.5	-----	-----	47	-----	3	-----	71	-----	-----	-----	5	82.0	-----	-----	118.0	-----	7	74.0	103.0	100.0	129.0	18.0	7
Pool Max Depth (ft)	-----	-----	-----	-----	-----	2.1	2.2	-----	2.4	-----	3	-----	3.1	-----	-----	-----	1	-----	3.3	-----	-----	-----	1	-----	2.0	-----	-----	-----	9	-----	2.4	-----	-----	-----	1
Pool Volume (ft³)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																																			
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----				<0.2 / 0.38 / 0.69 /26 / 67						48 / N/A / 9.5/ 30 / N/A						<0.062 / 3 / 8.8 / 42 / 90						-----	-----	-----	-----	-----	-----				33 / 46 / 57 / 100 / 128		
Reach Shear Stress (competency) lb/f²	-----	-----	-----	-----	-----	0.5	-----	-----	0.76	-----	3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	200.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	100.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	27.9	-----	-----	48.8	-----	3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	22.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																																			
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	-----	-----	0.5	-----	-----	-----	-----	-----	0.2	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----	-----	0.52	-----	-----	-----	-----	-----	0.52	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	G5c	-----	-----	-----	-----	-----	E4	-----	-----	-----	-----	-----	E4	-----	-----	-----	-----	-----	C5	-----	-----	-----	-----	-----	E5/C5	-----	-----	-----	-----
BF Velocity (fps)[2]	3.9	2.6	-----	-----	-----	3.2	-----	-----	6.8	-----	3	-----	-----	-----	-----	-----	-----	-----	5.4	-----	-----	-----	-----	-----	3.6	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	1140	254	18.0	160.0	52.4	-----	50	-----	-----	-----	3	-----	-----	-----	-----	-----	-----	-----	97.0	-----	-----	-----	-----	-----	50.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length (ft)	-----	-----	-----	-----	-----	-----	1016.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	619.0	-----	-----	-----	-----
Channel length (ft)	850	-----	-----	-----	-----	-----	1016.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	783.0	-----	-----	-----	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.14	-----	-----	-----	-----	-----	1.19	-----	-----	-----	-----	-----	2.30	-----	-----	-----	-----	-----	1.20	-----	-----	-----	-----	-----	1.26	-----	-----	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	0.0101	-----	-----	-----	-----	-----	0.0109	-----	-----	-----	-----	-----	0.0047	-----	-----	-----	-----	-----	0.0077	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

1. The rural region curve by Harman, etal. 1999 was used for these parameters.

2. An insufficent amount of water surface data was collected along this reach which resulted in not being able to accurately calculate water surface and bankfull velocity.

Table 10. Baseline Stream Summary
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

South Fork Hoppers Creek Reach 2 (445 LF)

Parameter	USGS Gauge		Regional Curve Interval (Harman et al, 1999)[1]			Pre-Existing Condition						Reference Reach(es) Data Sal's Branch						Reference Reach(es) Data Spencer Creek Downstream						Design						As-built					
	Jacob	Norwood	LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension - Riffle																																			
BF Width (ft)	61.3	32	5.3	21.0	9.0	7.4	10.5	-----	14.4	-----	3	-----	8.7	-----	-----	-----	1	-----	10.7	-----	-----	-----	1	-----	14.2	-----	-----	-----	1	-----	13.3	-----	-----	-----	1
Floodprone Width (ft)	96.3	-----	-----	-----	-----	16.8	26.2	-----	33.0	-----	3	-----	163.0	-----	-----	-----	1	-----	60.0	-----	-----	-----	1	-----	50+	-----	-----	-----	2	-----	62.9	-----	-----	-----	1
BF Mean Depth (ft)	4.7	3.1	0.75	2	1.2	1.0	1.2	-----	1.6	-----	3	-----	1.2	-----	-----	-----	1	-----	1.6	-----	-----	-----	1	-----	0.9	-----	-----	-----	1	-----	1.0	-----	-----	-----	1
BF Max Depth (ft)	5.8	-----	-----	-----	-----	1.7	`	-----	2.0	-----	3	-----	2.4	-----	-----	-----	1	-----	2.1	-----	-----	-----	1	-----	1.2	-----	-----	-----	1	-----	1.5	-----	-----	-----	1
BF Cross-sectional Area (ft^2)	290.3	99	6.0	27.0	13.7	7.4	12.5	-----	15.6	-----	3	-----	10.4	-----	-----	-----	1	-----	17.8	-----	-----	-----	1	-----	12.7	-----	-----	-----	1	-----	13.5	-----	-----	-----	1
Width/Depth Ratio	13	10.3	-----	-----	-----	6.1	9.3	-----	14.4	-----	3	-----	7.3	-----	-----	-----	1	-----	5.7	-----	-----	-----	1	-----	15.8	-----	-----	-----	1	-----	13.1	-----	-----	-----	1
Entrenchment Ratio	1.6	-----	-----	-----	-----	2.0	2.6	-----	3.4	-----	3	-----	18.7	-----	-----	-----	1	-----	5.5	-----	-----	-----	1	-----	3.8+	-----	-----	-----	1	-----	4.7	-----	-----	-----	1
Bank Height Ratio	1.3	-----	-----	-----	-----	1.3	2.2	-----	2.6	-----	5+	-----	1.2	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1
d50 (mm)	-----	-----	-----	-----	-----	-----	0.7	-----	-----	-----	1	-----	9.5	-----	-----	-----	-----	-----	8.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																																			
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	10	-----	-----	16	-----	4	38.3	-----	-----	40.8	-----	2	62.0	-----	-----	62.0	-----	3	62.0	62.5	62.5	63.0	-----	2
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	13.1	-----	-----	29.6	-----	4	10.9	-----	-----	14.6	-----	5	45.0	-----	-----	87.0	-----	3	36.0	55.7	62.0	69.0	17..39	3
Rc:Bankfull Width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	4.4	-----	-----	5.2	-----	3	1.3	-----	-----	1.4	-----	5	3.2	-----	-----	6.1	-----	3	2.5	3.9	4.4	4.9	1.2	3
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	38	-----	-----	45	-----	3	46	-----	-----	48	-----	2	179.0	-----	-----	313.0	-----	2	178.0	246.5	246.5	315.0	-----	2
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.2	-----	-----	1.8	-----	4	3.4	-----	-----	3.6	-----	2	4.4	-----	-----	4.4	-----	3	4.4	4.4	4.4	4.4	-----	2
Profile																																			
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	31	37	37	43	6	3
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	0.015	0.025	-----	0.035	-----	15	0.03	-----	-----	0.04	-----	4	-----	0.013	-----	-----	-----	2	0.0275	-----	-----	0.0330	-----	3	0.024	0.029	0.028	0.032	0.004	3
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	27.0	66.0	-----	161.0	-----	14	35.5	-----	-----	47	-----	3	-----	71	-----	-----	-----	5	138.0	-----	-----	176.0	-----	2	92	155	155	218	-----	2
Pool Max Depth (ft)	-----	-----	-----	-----	-----	2.1	2.2	-----	2.4	-----	3	-----	3.1	-----	-----	-----	1	-----	3.3	-----	-----	-----	1	2.5	-----	-----	2.7	-----	3	-----	2.1	-----	-----	-----	2
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																																			
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----			<0.2 / 0.38 / 0.69 /26 / 67						48 / N/A / 9.5/ 30 / N/A						<0.062 / 3 / 8.8 / 42 / 90												7 / 22.6 / 36 / 60 / 90					
Reach Shear Stress (competency) lb/F	-----	-----	-----	-----	-----	0.5	-----	-----	0.76	-----	3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	200.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	175.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	27.9	-----	-----	48.8	-----	3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	44	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																																			
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	-----	-----	0.5	-----	-----	-----	-----	-----	0.2	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----	-----	0.52	-----	-----	-----	-----	-----	0.52	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	G5c	-----	-----	-----	-----	-----	E4	-----	-----	-----	-----	-----	E4	-----	-----	-----	-----	-----	C5	-----	-----	-----	-----	-----	C5	-----	-----	-----	-----
BF Velocity (fps)[2]	3.9	2.6	-----	-----	-----	3.2	-----	-----	6.8	-----	3	-----	-----	-----	-----	-----	-----	-----	5.4	-----	-----	-----	-----	-----	3.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	1140	254	19.0	175.0	55.5	-----	50	-----	-----	-----	3	-----	-----	-----	-----	-----	-----	-----	97.0	-----	-----	-----	-----	-----	50.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length (ft)	-----	-----	-----	-----	-----	-----	1016.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	405	-----	-----	-----	-----
Channel length (ft)	850	-----	-----	-----	-----	-----	1016.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	415	-----	-----	-----	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.14	-----	-----	-----	-----	-----	1.19	-----	-----	-----	-----	-----	2.30	-----	-----	-----	-----	-----	1.10	-----	-----	-----	-----	-----	1.02	-----	-----	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	0.0101	-----	-----	-----	-----	-----	0.0109	-----	-----	-----	-----	-----	0.0047	-----	-----	-----	-----	-----	0.0016	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Banfull Floodplain Area (Acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

1. The rural region curve by Harman, etal. 1999 was used for these parameters.

2. An insufficent amount of water surface data was collected along this reach which resulted in not being able to accurately calculate water surface and bankfull velocity.

Table 10. Baseline Stream Summary
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

					UT1B (1,065 LF)																									
Parameter	**USGS Gauge**	**Regional Curve Interval**			**Pre-Existing Condition**						**Reference Reach(es) Data Sal's Branch**						**Reference Reach(es) Data Spencer Creek Downstream**						**Design**						**As-built**					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension - Riffle																																	
BF Width (ft)	-----	-----	-----	-----	3.4	4.6	-----	5.7	-----	2.0	-----	8.7	-----	-----	-----	1	-----	10.7	-----	-----	-----	1	-----	7.0	-----	-----	-----	1	-----	7.0	-----	-----	-----	1
Floodprone Width (ft)	-----	-----	-----	-----	9.8	51.1	-----	92.5	-----	2.0	-----	163.0	-----	-----	-----	1	-----	60.0	-----	-----	-----	1	-----	30+	-----	-----	-----	16	-----	51.0	-----	-----	-----	1
BF Mean Depth (ft)	-----	-----	-----	-----	0.6	0.8	-----	1.0	-----	2.0	-----	1.2	-----	-----	-----	1	-----	1.6	-----	-----	-----	1	-----	0.5	-----	-----	-----	1	-----	0.5	-----	-----	-----	1
BF Max Depth (ft)	-----	-----	-----	-----	1.3	1.4	-----	1.6	-----	2.0	-----	2.4	-----	-----	-----	1	-----	2.1	-----	-----	-----	1	-----	0.8	-----	-----	-----	1	-----	1.1	-----	-----	-----	1
BF Cross-sectional Area (ft^2)	-----	-----	-----	-----	3.4	3.5	-----	3.5	-----	2.0	-----	10.4	-----	-----	-----	1	-----	17.8	-----	-----	-----	1	-----	3.6	-----	-----	-----	1	-----	3.7	-----	-----	-----	1
Width/Depth Ratio	-----	-----	-----	-----	3.4	6.5	-----	9.5	-----	2.0	-----	7.3	-----	-----	-----	1	-----	5.7	-----	-----	-----	1	-----	13.8	-----	-----	-----	1	-----	13.3	-----	-----	-----	1
Entrenchment Ratio	-----	-----	-----	-----	2.9	9.5	-----	16.2	-----	2.0	-----	18.7	-----	-----	-----	1	-----	5.5	-----	-----	-----	1	-----	4.3+	-----	-----	-----	1	-----	7.3	-----	-----	-----	1
Bank Height Ratio	-----	-----	-----	-----	1.1	2.0	-----	4.5	-----	5+	-----	1.2	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1
d50 (mm)	-----	-----	-----	-----	-----	0.46	-----	-----	-----	-----	-----	9.5	-----	-----	-----	-----	-----	8.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	10	-----	-----	16	-----	4	38.3	-----	-----	40.8	-----	2	32.0	-----	-----	59.0	-----	16	28.0	43.5	41.5	57.0	8.9	14
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	13.1	-----	-----	29.6	-----	4	10.9	-----	-----	14.6	-----	5	14.0	-----	-----	24.0	-----	16	12.0	19.4	19.0	27.0	4.0	15
Rc:Bankfull Width (ft/ft)	-----	-----	-----	-----			-----	-----	-----	-----	4.4	-----	-----	5.2	-----	3	1.3	-----	-----	1.4	-----	5	2.0	-----	-----	3.4	-----	16	1.7	2.8	2.7	3.9	0.6	15
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	38	-----	-----	45	-----	3	46	-----	-----	48	-----	2	58.0	-----	-----	134.0	-----	13	76.0	97.9	94.0	120.0	14.1	13
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.2	-----	-----	1.8	-----	4	3.4	-----	-----	3.6	-----	2	4.6	-----	-----	8.4	-----	16	4.0	6.2	5.9	8.1	1.3	14
Profile																																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	17.0	27.0	30.0	47.0	8.0	11
Riffle Slope (ft/ft)	-----	-----	-----	-----	0.033	0.127	-----	0.564	-----	19	0.03	-----	-----	0.04	-----	4	-----	0.013	-----	-----	-----	2	0.0198	-----	-----	0.0371	-----	12	0.010	0.030	0.020	0.040	0.009	11
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	14.0	52.0	-----	110.0	-----	9	35.5	-----	-----	47	-----	3	-----	71	-----	-----	-----	5	42.0	-----	-----	105.0	-----	15	49	63	69	106	20	14
Pool Max Depth (ft)	-----	-----	-----	-----	1.3	1.5	-----	1.6	-----	2	-----	3.1	-----	-----	-----	1	-----	3.3	-----	-----	-----	1	1.0	-----	-----	2.0	-----	16	-----	1.6	-----	-----	-----	1
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																																	
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----			0.17 / 0.33 / 0.46 / 22 / 56						48 / N/A / 9.5/ 30 / N/A						<0.062 / 3 / 8.8 / 42 / 90						-----	-----	-----	-----	-----	-----			1.25 / 35 / 49 / 80 / 90			
Reach Shear Stress (competency) lb/F	-----	-----	-----	-----	0.61	-----	-----	0.77	-----	2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max Part Size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	200.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	20.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	34.5	-----	-----	45.5	-----	2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	22.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																																	
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.1	-----	-----	-----	-----	-----	0.2	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----	-----	0.08	-----	-----	-----	-----	0.08	-----	-----	-----
Impervious cover estimate (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	E5	-----	-----	-----	-----	-----	E4	-----	-----	-----	-----	-----	E4	-----	-----	-----	-----	-----	C5	-----	-----	-----	-----	-----	C5	-----	-----	-----	-----
Bankfull Velocity (fps)[2]	-----	-----	-----	-----	4	-----	-----	4.1	-----	2	-----	-----	-----	-----	-----	-----	-----	5.4	-----	-----	-----	-----	-----	4.2	-----	-----	-----	1.0	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	-----	-----	-----	-----	14	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	97.0	-----	-----	-----	-----	-----	14.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length (ft)	-----	-----	-----	-----	-----	822	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	816.0	-----	-----	-----	-----
Channel length (ft)	-----	-----	-----	-----	-----	970	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1035	-----	-----	-----	-----
Sinuosity	-----	-----	-----	-----	-----	1.18	-----	-----	-----	-----	-----	1.19	-----	-----	-----	-----	-----	2.30	-----	-----	-----	-----	-----	1.60	-----	-----	-----	-----	-----	1.27	-----	-----	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	0.0193	-----	-----	-----	-----	-----	0.0109	-----	-----	-----	-----	-----	0.0047	-----	-----	-----	-----	-----	0.0144	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stablibity or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

1. The rural region curve by Harman, etal. 1999 was used for these parameters.
2. An insufficent amount of water surface data was collected along this reach which resulted in not being able to accurately calculate water surface and bankfull velocity.

Table 11a. Cross-section Morphology Data Table South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251												
South Fork Hoppers Creek Reach 1 (783 LF)												
	Cross-section 5 (Riffle)						Cross-section 6 (Pool)					
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation												
Record Elevation (Datum) Used (ft)	1260.2	1260.2	1260.2	1260.2	1260.2	1260.2	1260.1	1260.1	1260.1	1260.1	1260.1	1260.1
BF Width (ft)	13.1	12.1	12.3	12.2	13.2	12.9	14.6	13.5	13.4	13.4	11.2	11.4
BF Mean Depth (ft)	1.1	1.0	0.9	0.9	1.0	1.1	1.2	1.3	1.3	1.3	1.0	1.2
Width/Depth Ratio	11.5	12.5	13.1	13.5	13.1	11.5	11.8	10.7	10.7	10.7	11.2	9.3
BF Cross-sectional Area (ft²)	15.0	11.8	11.6	11.0	13.2	14.6	18.0	17.1	16.7	16.8	11.2	14.0
BF Max Depth (ft)	1.7	1.6	1.7	1.5	1.8	1.7	2.4	2.7	2.8	2.7	2.2	2.9
Width of Floodprone Area (ft)	62.9	62.9	62.8	62.8	62.8	62.9	65.9	66.0	66.0	65.9	66.0	62.1
Entrenchment Ratio	4.8	5.2	5.1	5.2	4.8	4.9	N/A	N/A	N/A	N/A	N/A	N/A
Bank Height Ratio	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0
Wetted Perimeter (ft)	15.4	14.1	14.2	14.0	15.2	15.2	17.1	16.0	15.9	15.9	13.2	13.9
Hydraulic Radius (ft)	1.0	0.8	0.8	0.8	0.9	1.0	1.1	1.1	1.1	1.1	0.8	1.0

South Fork Hoppers Creek Reach 2 (445 LF)												
	Cross-section 7 (Riffle)						Cross-section 8 (Pool)					
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation												
Record Elevation (Datum) Used (ft)	1255.17	1255.1*	1255.1	1255.1	1255.2	1255.2	1252.9	1252.9	1252.9	1252.9	1252.9	1253.0
BF Width (ft)	13.3	14.1	12.8	12.7	13.4	13.7	17.5	15.2	12.8	13.7	14.2	13.4
BF Mean Depth (ft)	1.0	1.1	1.2	1.2	1.2	1.1	0.9	1.1	1.0	1.0	1.0	1.0
Width/Depth Ratio	13.1	13.3	11.1	10.9	11.2	12.6	19.0	13.9	13.3	13.9	14.7	13.4
BF Cross-sectional Area (ft²)	13.5	14.8	14.8	14.8	16.0	15.0	16.0	16.6	12.3	13.6	13.7	13.5
BF Max Depth (ft)	1.5	1.7	1.9	1.8	1.9	1.9	2.1	2.5	1.7	1.8	2.0	2.3
Width of Floodprone Area (ft)	62.9	62.9	62.9	62.8	62.9	62.9	71.0	71.1	71.1	71.1	71.1	70.9
Entrenchment Ratio	4.7	4.5	4.9	4.9	4.7	4.6	N/A	N/A	N/A	N/A	N/A	N/A
Bank Height Ratio	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.2	1.2	1.0	1.0
Wetted Perimeter (ft)	15.4	16.2	15.1	15.0	15.8	15.9	19.3	17.4	14.7	15.7	16.1	15.4
Hydraulic Radius (ft)	0.9	0.9	1.0	1.0	1.0	0.9	0.8	1.0	0.8	0.9	0.9	0.9

* A lower bankfull elevation datum was used in calulating bankful dimension values for MY1 instead of using the baseline bankfull elevation datum which normalized the data between the two monitoring periods thereby reducing data anomalies and enabled a more accurate representation and comparison of dimension parameters.

** A higher bankfull elevation datum was used in calulating bankful dimension values for MY5 instead of using the baseline bankfull elevation datum which normalized the data between the monitoring periods thereby reducing data anomalies and enabled a more accurate representation and comparison of dimension parameters.

UT1B (1,065 LF)												
	Cross-section 9 (Riffle)						Cross-section 10 (Pool)					
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation												
Record Elevation (Datum) Used (ft)	1258.6	1258.6	1258.6	1258.6	1258.6	1258.8	1258.4	1258.4	1258.4	1258.4	1258.4	1258.44
BF Width (ft)	7.0	5.5	5.4	6.8	7.1	6.1	10.2	9.1	8.9	9.9	11.1	12.7
BF Mean Depth (ft)	0.5	0.5	0.4	0.4	0.4	0.4	0.8	0.6	0.6	0.6	0.6	0.5
Width/Depth Ratio	13.3	11.4	13.6	15.9	17.8	16.1	13.3	16.3	14.5	18.2	19.3	26.2
BF Cross-sectional Area (ft²)	3.7	2.6	2.2	2.9	2.8	2.3	7.9	5.1	5.5	5.4	6.4	6.2
BF Max Depth (ft)	1.1	0.8	0.8	1.0	1.0	0.8	1.6	1.4	1.6	1.6	1.4	1.7
Width of Floodprone Area (ft)	51.0	51.0	47.5	49.8	51.0	50.9	62.0	62.0	62.0	62.0	62.0	62.1
Entrenchment Ratio	7.3	8.8	8.8	7.3	7.2	8.3	N/A	N/A	N/A	N/A	N/A	N/A
Bank Height Ratio	1.0	1.2	1.2	1.0	1.0	1.0	1.0	1.3	1.1	1.1	1.0	1.0
Wetted Perimeter (ft)	8.1	6.4	6.2	7.7	7.9	6.9	11.8	10.2	10.1	11.0	12.3	13.7
Hydraulic Radius (ft)	0.5	0.4	0.4	0.4	0.4	0.3	0.7	0.5	0.5	0.5	0.5	0.5

Table 11b. Stream Reach Morphology
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

South Fork Hoppers Creek Reach 1 (783 LF)																																		
Parameter	**Monitoring Baseline (As-built)**						**MY-1**						**MY-2**						**MY-3**						**MY-4**						**MY-5**					
Dimension and Substrate - Riffle	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
BF Width (ft)	-----	13.1	-----	-----	-----	1	-----	12.1	-----	-----	-----	1	-----	12.3	-----	-----	-----	1	-----	12.2	-----	-----	-----	1	-----	13.2	-----	-----	-----	1	-----	12.9	-----	-----	-----	1
Floodprone Width (ft)	-----	62.9	-----	-----	-----	1	-----	62.9	-----	-----	-----	1	-----	62.8	-----	-----	-----	1	-----	62.8	-----	-----	-----	1	-----	62.8	-----	-----	-----	1	-----	62.9	-----	-----	-----	1
BF Mean Depth (ft)	-----	1.1	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	0.9	-----	-----	-----	1	-----	0.9	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.1	-----	-----	-----	1
BF Max Depth (ft)	-----	1.7	-----	-----	-----	1	-----	1.6	-----	-----	-----	1	-----	1.7	-----	-----	-----	1	-----	1.5	-----	-----	-----	1	-----	1.8	-----	-----	-----	1	-----	1.7	-----	-----	-----	1
BF Cross-sectional Area (ft²)	-----	15.0	-----	-----	-----	1	-----	11.8	-----	-----	-----	1	-----	11.6	-----	-----	-----	1	-----	11.0	-----	-----	-----	1	-----	13.2	-----	-----	-----	1	-----	14.6	-----	-----	-----	1
Width/Depth Ratio	-----	11.5	-----	-----	-----	1	-----	12.5	-----	-----	-----	1	-----	13.1	-----	-----	-----	1	-----	13.5	-----	-----	-----	1	-----	13.1	-----	-----	-----	1	-----	11.5	-----	-----	-----	1
Entrenchment Ratio	-----	4.8	-----	-----	-----	1	-----	5.2	-----	-----	-----	1	-----	5.1	-----	-----	-----	1	-----	5.2	-----	-----	-----	1	-----	4.8	-----	-----	-----	1	-----	4.9	-----	-----	-----	1
Bank Height Ratio	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.1	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1
d50 (mm)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	49.0	-----	-----	-----	1	-----	17.4	-----	-----	-----	1
Pattern																																				
Channel Beltwidth (ft)	40.0	62.1	62.0	87.0	14.0	7																														
Radius of Curvature (ft)	34.0	39.9	39.0	47.0	5.4	7																														
Rc:Bankfull width (ft/ft)	2.6	3.0	3.0	3.6	0.4	7																														
Meander Wavelength (ft)	146.0	162.0	158.0	184.0	15.7	6																														
Meander Width Ratio	3.1	4.7	4.7	6.6	1.1	7																														
Profile																																				
Riffle Length (ft)	30.0	36.0	37.0	45.0	6.4	6	31	41	37	60	11.34	5	36	42	42	49	4.94	5	34	43	43	51	5.96	5	27	44	36	70	18.3	6	20	35	39	41	9.0	5
Riffle Slope (ft/ft)	0.01	0.02	0.02	0.03	0.01	6	0.02	0.02	0.02	0.03	0.003	5	0.02	0.02	0.02	0.03	0.004	5	0.02	0.02	0.02	0.03	0.004	5	0.01	0.03	0.02	0.05	0.02	6	0.01	0.02	0.02	0.03	0.01	5
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	74.0	103.0	100.0	129.0	18.0	7	79.0	102	110	127	19.5	5	75	101	106	118	18.4	5	77	102	104	119	15.9	5	51	100	104	130	26.3	6	63	102	98	138	26.0	7
Substrate and Transport Parameters																																				
d16 / d35 / d50 / d84 / d95			33 / 46 / 57 / 100 / 128						8 / 73 / 89 / 138 / 192						8 / 67 / 79.4 / 122.9 / 168.1						14.1 / 67.6 / 82.9 / 128.0 / 175.0						0.8 / 6.9 / 49.0 / 160.0 / 3100 / 5000						0.4 / 5.8 / 17.4 / 237.7 / 3258.5 / >2048					
Reach Shear Stress (competency) lb/f²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																																				
Drainage Area (SM)	-----	-----	-----	0.52	-----	-----	-----	-----	-----	0.52	-----	-----	-----	-----	-----	0.52	-----	-----	-----	-----	-----	0.52	-----	-----	----	----	----	0.52	----	----	----	----	0.52	----	----
Rosgen Classification	-----	C4	-----	-----	-----	-----	-----	C3	-----	-----	-----	-----	-----	C3	-----	-----	-----	-----	-----	C3	-----	-----	-----	-----	----	C4	----	----	----	----	----	C4	----	----	----	----
BF Velocity (fps)1	-----	3.6	-----	-----	-----	-----	-----	3.6	-----	-----	-----	-----	-----	3.6	-----	-----	-----	-----	-----	3.6	-----	-----	-----	-----	----	3.6	----	----	----	----	----	3.6	----	----	----	----
BF Discharge (cfs)	-----	54.1	-----	-----	-----	-----	-----	42.5	-----	-----	-----	-----	-----	41.8	-----	-----	-----	-----	-----	39.6	-----	-----	-----	-----	----	47.5	----	----	----	----	----	52.6	----	----	----	----
Valley Length (ft)	-----	619.0	-----	-----	-----	-----	-----	619.0	-----	-----	-----	-----	-----	619.0	-----	-----	-----	-----	-----	619.0	-----	-----	-----	-----	----	619.0	----	----	----	----	----	619.0	----	----	----	----
Channel length (ft)	-----	783.0	-----	-----	-----	-----	-----	783.0	-----	-----	-----	-----	-----	783.0	-----	-----	-----	-----	-----	783.0	-----	-----	-----	-----	----	796.0	----	----	----	----	----	792.3	----	----	----	----
Sinuosity	-----	1.26	-----	-----	-----	-----	-----	1.26	-----	-----	-----	-----	-----	1.26	-----	-----	-----	-----	-----	1.26	-----	-----	-----	-----	----	1.29	----	----	----	----	----	1.28	----	----	----	----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.01	-----	-----	-----	-----	-----	0.01	-----	-----	-----	-----	----	0.01	----	----	----	----	----	0.01	----	----	----	----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----	----	----

Table 11b. Stream Reach Morphology
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

South Fork Hoppers Creek Reach 2 (445 LF)																																		
Parameter	**Monitoring Baseline (As-built)**						**MY-1**						**MY-2**						**MY-3**						**MY-4**						**MY-5**					
Dimension and Substrate - Riffle	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
BF Width (ft)	-----	13.3	-----	-----	-----	1	-----	14.0	-----	-----	-----	1	-----	12.8	-----	-----	-----	1	-----	12.7	-----	-----	-----	1	----	13.4	----	----	----	1	----	13.7	----	----	----	1
Floodprone Width (ft)	-----	62.9	-----	-----	-----	1	-----	62.9	-----	-----	-----	1	-----	62.9	-----	-----	-----	1	-----	62.8	-----	-----	-----	1	----	62.9	----	----	----	1	----	62.9	----	----	----	1
BF Mean Depth (ft)	-----	1.0	-----	-----	-----	1	-----	1.1	-----	-----	-----	1	-----	1.2	-----	-----	-----	1	-----	1.2	-----	-----	-----	1	----	1.2	----	----	----	1	----	1.1	----	----	----	1
BF Max Depth (ft)	-----	1.5	-----	-----	-----	1	-----	1.7	-----	-----	-----	1	-----	1.9	-----	-----	-----	1	-----	1.8	-----	-----	-----	1	----	1.9	----	----	----	1	----	1.9	----	----	----	1
BF Cross-sectional Area (ft^2)	-----	13.5	-----	-----	-----	1	-----	14.8	-----	-----	-----	1	-----	14.8	-----	-----	-----	1	-----	14.8	-----	-----	-----	1	----	16.0	----	----	----	1	----	15.0	----	----	----	1
Width/Depth Ratio	-----	13.1	-----	-----	-----	1	-----	13.3	-----	-----	-----	1	-----	11.1	-----	-----	-----	1	-----	10.9	-----	-----	-----	1	----	11.2	----	----	----	1	----	12.6	----	----	----	1
Entrenchment Ratio	-----	4.7	-----	-----	-----	1	-----	4.5	-----	-----	-----	1	-----	4.9	-----	-----	-----	1	-----	4.9	-----	-----	-----	1	----	4.7	----	----	----	1	----	4.6	----	----	----	1
Bank Height Ratio	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.1	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	----	1.0	----	----	----	1	----	1.0	----	----	----	1
d50 (mm)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	38.0	----	----	----	----
Pattern																																				
Channel Beltwidth (ft)	62.0	62.5	62.5	63.0	-----	2																														
Radius of Curvature (ft)	36.0	55.7	62.0	69.0	17..39	3																														
Rc:Bankfull Width (ft/ft)	2.5	3.9	4.4	4.9	1.2	3																														
Meander Wavelength (ft)	178.0	246.5	246.5	315.0	-----	2																														
Meander Width Ratio	4.4	4.4	4.4	4.4	-----	2																														
Profile																																				
Riffle Length (ft)	31.0	37.0	37.0	43.0	6	3	29.9	38	34	50	8.6	3	32	44	44	54	11.10	3	34	44	45	52	9.18	3	11	31	32	45	12.6	5	21	33	34	44	10.0	4
Riffle Slope (ft/ft)	0.02	0.03	0.03	0.03	0.00	3	0.02	0.02	0.03	0.03	0.01	3	0.02	0.03	0.03	0.03	0.01	3	0.02	0.03	0.03	0.03	0.00	3	0.02	0.03	0.03	0.05	0.01	5	0.02	0.03	0.03	0.05	0.02	4
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Spacing (ft)	92	155	155	218	-----	2	73.0	88	81	110	15.9	3	72	80	75	92	10.78	3	74	81	77	91	9.073	3	57	92	87	137	34.7	4	69	117	103	179	56.0	3
Substrate and Transport Parameters																																				
d16 / d35 / d50 / d84 / d95	7 / 22.6 / 36 / 60 / 90						36 / 51.8 / 65.4 / 89.4 / 123.4						32.6 / 46.5 / 59.1 / 87.2 / 123.1						28.8 / 48.7 /65.0 / 104.0 / 251.5						7.4 / 37.0 / 57.0 / 95.0 / 125.0						6.5 / 12.5 / 38.0 / 84.7 / 116.3 / 180 - 256					
Reach Shear Stress (competency) lb/f²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----	----	----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----	----	----
Additional Reach Parameters																																				
Drainage Area (SM)	-----	-----	-----	0.52	-----	-----	-----	-----	-----	0.52	-----	-----	-----	-----	-----	0.52	-----	-----	-----	-----	-----	0.52	-----	-----	----	----	----	0.52	----	----	----	----	----	0.52	----	----
Rosgen Classification	-----	C4	-----	-----	-----	-----	-----	C3	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C3	-----	-----	-----	-----	----	C4	----	----	----	----	----	C4	----	----	----	----
BF Velocity (fps)1	-----	3.9	-----	-----	-----	-----	-----	3.9	-----	-----	-----	-----	-----	3.9	-----	-----	-----	-----	-----	3.9	-----	-----	-----	-----	----	3.9	----	----	----	----	----	3.9	----	----	----	----
BF Discharge (cfs)	-----	52.767	-----	-----	-----	-----	-----	57.681	-----	-----	-----	-----	-----	57.72	-----	-----	-----	-----	-----	57.72	-----	-----	-----	-----	----	62.4	----	----	----	----	----	58.5	----	----	----	----
Valley Length (ft)	-----	405	-----	-----	-----	-----	-----	405	-----	-----	-----	-----	-----	405	-----	-----	-----	-----	-----	405	-----	-----	-----	-----	----	405	----	----	----	----	----	405	----	----	----	----
Channel length (ft)	-----	415	-----	-----	-----	-----	-----	415	-----	-----	-----	-----	-----	415	-----	-----	-----	-----	-----	415	-----	-----	-----	-----	----	453	----	----	----	----	----	454	----	----	----	----
Sinuosity	-----	1.02	-----	-----	-----	-----	-----	1.02	-----	-----	-----	-----	-----	1.02	-----	-----	-----	-----	-----	1.02	-----	-----	-----	-----	----	1.12	----	----	----	----	----	1.12	----	----	----	----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.02	-----	-----	-----	-----	-----	0.02	-----	-----	-----	-----	----	0.01	----	----	----	----	----	0.01	----	----	----	----
BF Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----	----	----

Table 11b. Stream Reach Morphology
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

UT1B (1,065 LF)																																		
Parameter	**Monitoring Baseline (As-built)**						**MY-1**						**MY-2**						**MY-3**						**MY-4**						**MY-5**					
Dimension and Substrate - Riffle	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
BF Width (ft)	-----	7.0	-----	-----	-----	1	-----	7.0	-----	-----	-----	1	-----	5.4	-----	-----	-----	1	-----	6.8	-----	-----	-----	1	----	7.1	----	----	----	1	----	6.1	----	----	----	1
Floodprone Width (ft)	-----	51.0	-----	-----	-----	1	-----	51.0	-----	-----	-----	1	-----	47.5	-----	-----	-----	1	-----	49.8	-----	-----	-----	1	----	51.0	----	----	----	1	----	50.9	----	----	----	1
BF Mean Depth (ft)	-----	0.5	-----	-----	-----	1	-----	0.5	-----	-----	-----	1	-----	0.4	-----	-----	-----	1	-----	0.4	-----	-----	-----	1	----	0.4	----	----	----	1	----	0.4	----	----	----	1
BF Max Depth (ft)	-----	1.1	-----	-----	-----	1	-----	1.1	-----	-----	-----	1	-----	0.8	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	----	1.0	----	----	----	1	----	0.8	----	----	----	1
BF Cross-sectional Area (ft^2)	-----	3.7	-----	-----	-----	1	-----	3.7	-----	-----	-----	1	-----	2.2	-----	-----	-----	1	-----	2.9	-----	-----	-----	1	----	2.8	----	----	----	1	----	2.3	----	----	----	1
Width/Depth Ratio	-----	13.3	-----	-----	-----	1	-----	13.3	-----	-----	-----	1	-----	13.6	-----	-----	-----	1	-----	15.9	-----	-----	-----	1	----	17.8	----	----	----	1	----	16.1	----	----	----	1
Entrenchment Ratio	-----	7.3	-----	-----	-----	1	-----	7.3	-----	-----	-----	1	-----	8.8	-----	-----	-----	1	-----	7.3	-----	-----	-----	1	----	7.2	----	----	----	1	----	8.3	----	----	----	1
Bank Height Ratio	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.2	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	----	1.0	----	----	----	1	----	1.0	----	----	----	1
d50 (mm)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	0.9	----	----	----	----
Pattern																																				
Channel Beltwidth (ft)	28.0	43.5	41.5	57.0	8.9	14																														
Radius of Curvature (ft)	12.0	19.4	19.0	27.0	4.0	15																														
Rc:Bankfull Width (ft/ft)	1.7	2.8	2.7	3.9	0.6	15																														
Meander Wavelength (ft)	76.0	97.9	94.0	120.0	14.1	13																														
Meander Width Ratio	4.0	6.2	5.9	8.1	1.3	14																														
Profile																																				
Riffle Length (ft)	17.0	27.0	30.0	47.0	8.0	11	17.0	33	42	53	12.2	7	16	38	43	52	14.34	5	15	39	46	51	14.88	5	9.0	33.0	26.0	68.0	21.9	12	12.9	30.0	29.9	60.0	14.0	10
Riffle Slope (ft/ft)	0.010	0.030	0.020	0.040	0.009	11	0.022	0.024	0.025	0.027	0.002	7	0.019	0.024	0.024	0.029	0.003	5	0.018	0.023	0.024	0.029	0.004	5	0.009	0.023	0.018	0.045	0.013	12	0.012	0.026	0.026	0.035	0.008	10
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Spacing (ft)	49.0	63.0	69.0	106.0	20.0	14.0	51.0	73	67	105	17.4	7	48	76	80	102	20.7	5	50	78	83	102	19.99	5	23	62	56	116	27	12	38	72	68	108	22	14
Substrate and Transport Parameters																																				
d16 / d35 / d50 / d84 / d95			1.25 / 35 / 49 / 80 / 90					32 / 47.3 / 60.9 / 96 / 141.1						25.4 / 45.7 / 56.9 / 90 / 143.4						5.6 / 36.4 / 55.7 / 96.7 / 148.1						0.2 / 4.7 / 36.0 / 73.0 / 125.0						0.2 / 0.4 / 0.9 / 74.9 / 119.3 / 128 - 180					
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----	----	----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----	----	----
Additional Reach Parameters																																				
Drainage Area (SM)	-----	-----	-----	0.08	-----	-----	-----	-----	-----	0.08	-----	-----	-----	-----	-----	0.08	-----	-----	-----	-----	-----	0.08	-----	-----	----	----	----	0.08	----	----	----	----	----	----	----	----
Rosgen Classification	-----	C4	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	----	C4	----	----	----	----	----	C5	----	----	----	----
Bankfull Velocity (fps)1	-----	4.2	-----	-----	-----	-----	-----	4.2	-----	-----	-----	-----	-----	4.2	-----	-----	-----	-----	-----	4.2	-----	-----	-----	-----	----	4.2	----	----	----	----	----	4.2	----	----	----	----
BF Discharge (cfs)	-----	15.6	-----	-----	-----	-----	-----	15.6	-----	-----	-----	-----	-----	9.2	-----	-----	-----	-----	-----	12.2	-----	-----	-----	-----	----	11.8	----	----	----	----	----	9.7	----	----	----	----
Valley Length (ft)	-----	816.0	-----	-----	-----	-----	-----	816.0	-----	-----	-----	-----	-----	816.0	-----	-----	-----	-----	-----	816.0	-----	-----	-----	-----	----	816.0	----	----	----	----	----	816.0	----	----	----	----
Channel length (ft)	-----	1035	-----	-----	-----	-----	-----	1035	-----	-----	-----	-----	-----	1035	-----	-----	-----	-----	-----	1035	-----	-----	-----	-----	----	1052	----	----	----	----	----	1070	----	----	----	----
Sinuosity	-----	1.27	-----	-----	-----	-----	-----	1.27	-----	-----	-----	-----	-----	1.27	-----	-----	-----	-----	-----	1.27	-----	-----	-----	-----	----	1.34	----	----	----	----	----	1.31	----	----	----	----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.02	-----	-----	-----	-----	-----	0.02	-----	-----	-----	-----	----	0.02	----	----	----	----	----	0.02	----	----	----	----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----	----	----

APPENDIX E

HYDROLOGIC DATA

Table 12. Verification of Bankfull Events South Fork Hoppers Creek Restoration Project: DMS Project No. 92251				
Location	Date of Data Collection	Date of Occurence of Bankfull Event	Method of Data Collection	Gage Height (feet)
South Fork Hoppers Creek (Station 15+10)	5/30/2012	Unknown	Crest Gauge	0.55
South Fork Hoppers Creek (Station 15+10)	8/1/2012	Unknown	Crest Gauge	0.10
South Fork Hoppers Creek (Station 15+10)	12/31/2012	Unknown	Crest Gauge	0.55
South Fork Hoppers Creek (Station 15+10)	5/1/2013	Unknown	Crest Gauge	0.10
South Fork Hoppers Creek (Station 15+10)	4/16/2014	Unknown	Crest Gauge	0.60
South Fork Hoppers Creek (Station 15+10)	5/6/2015	Unknown	Crest Gauge	0.25
South Fork Hoppers Creek (Station 15+10)	9/24/2015	Unknown	Crest Gauge	0.25
South Fork Hoppers Creek (Station 15+10)	11/16/2015	Unknown	Crest Gauge	0.20
South Fork Hoppers Creek (Station 15+10)	5/16/2016	Unknown	Crest Gauge	0.08
South Fork Hoppers Creek (Station 15+10)	10/19/2016	Unknown	Crest Gauge	0.15

Figure 6. Monthly Rainfall Data
South Fork Hoppers Creek-Melton Farm Restoration Project: DMS Project No. 99251

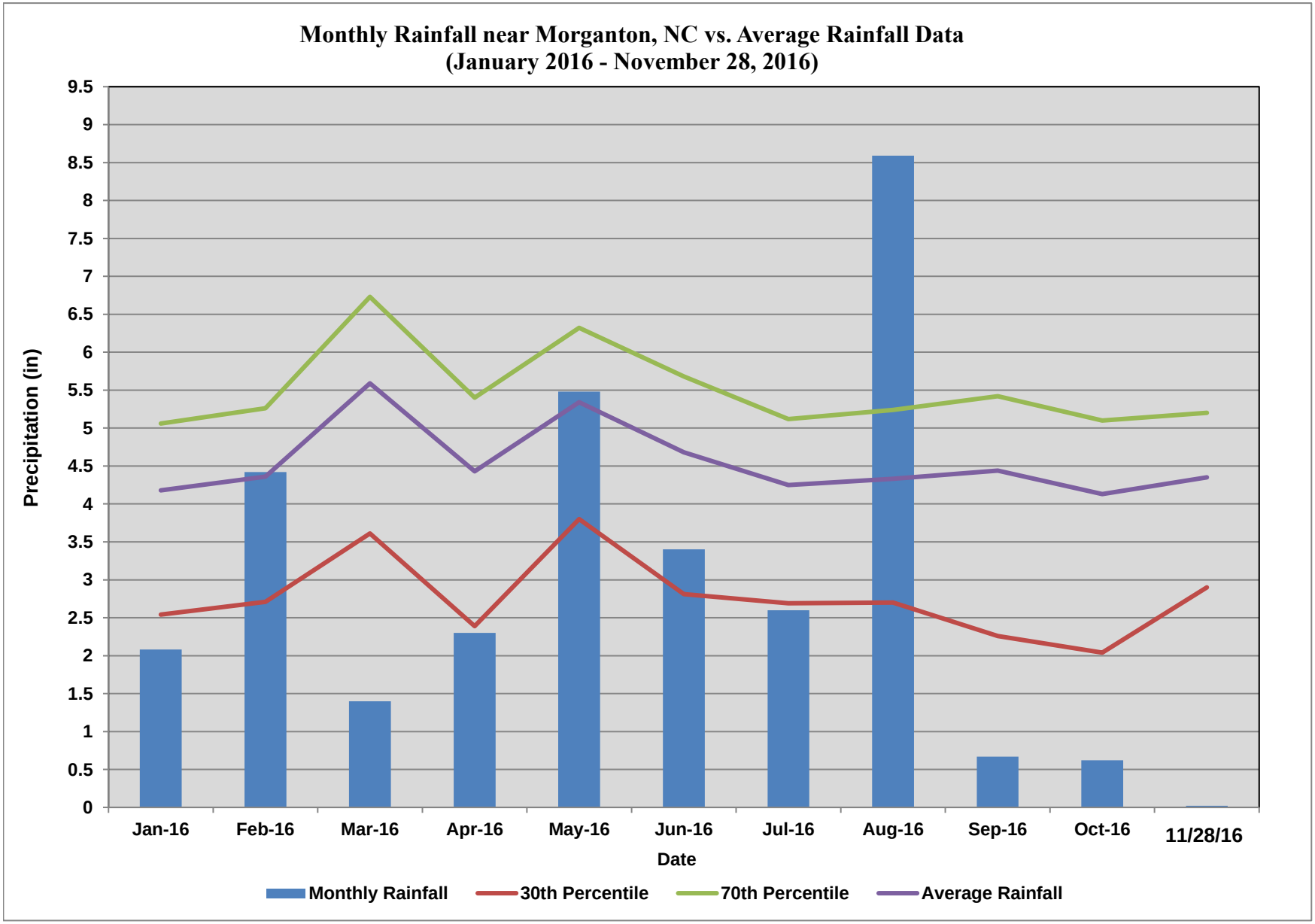


Figure 7. Precipitation and Water Level Plots
South Fork Hoppers Creek - Melton Farm Restoration Project: DMS Project No. 92251

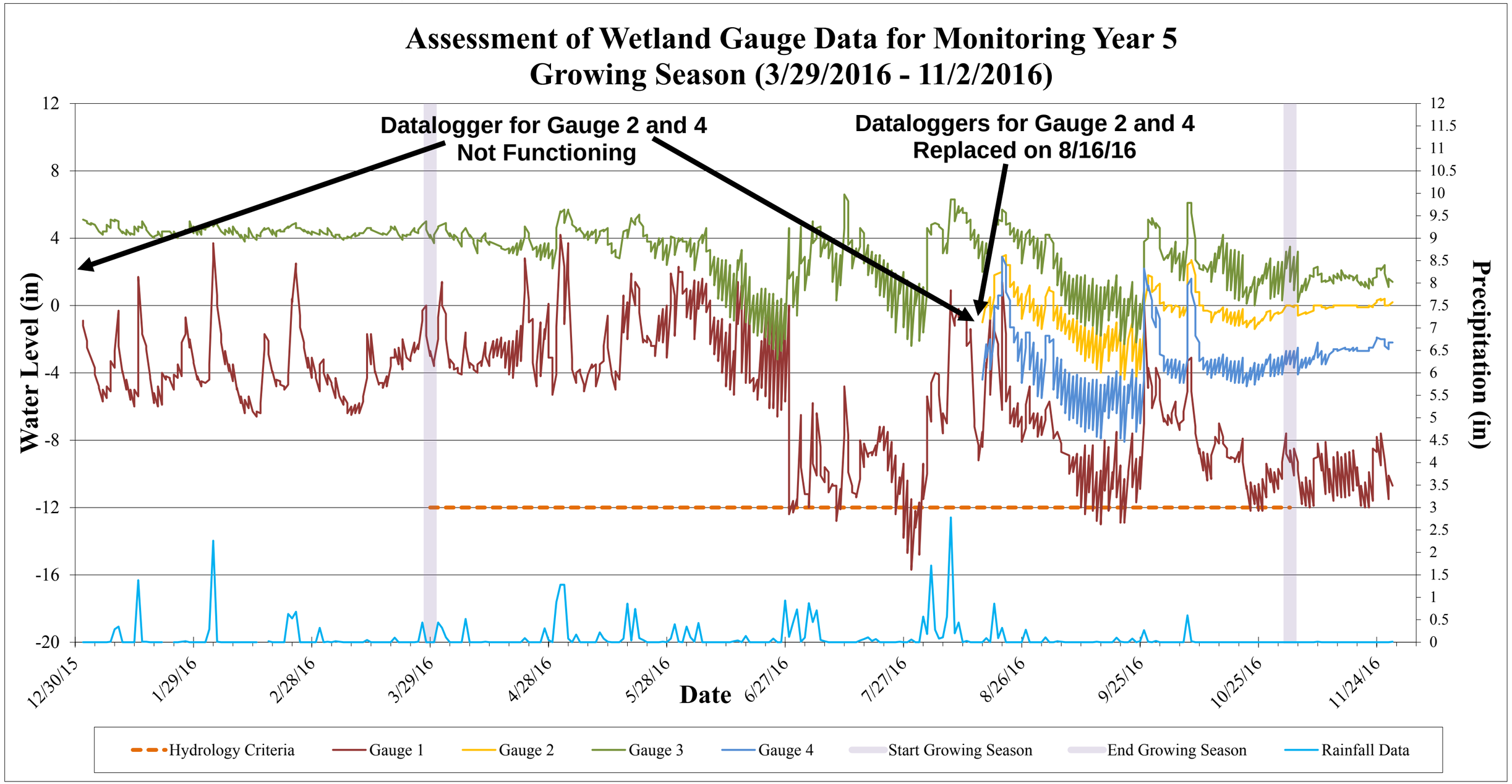


Table 13. Wetland Gauge Attainment Data South Fork Hoppers Creek Mitigation Plan: DMS Project No. 92251						
Summary of Groundwater Gauge Results for MY1-MY5						
Gauge	**Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)**					
	MY 1 (2011)	**MY2 (2012)**	**MY3 (2013)**	**MY4 (2014)**	**MY4 (2015)**	**MY5 (2016)**
Gauge 1	No/10 days (5%)	Yes/25 days (12%)	Yes/218 days (100%)	Yes/27 days (12%)*	Yes/176 days (81%)	Yes/95 days (44%)
Gauge 2	Yes/218 days (100%)	Yes/218 days (100%)	Yes/218 days (100%)	Yes/47 days (22%)*	Yes/218 days (100%)	Yes/79 days (36%)**
Gauge 3	Yes/188 days (86%)	Yes/218 days (100%)	Yes/218 days (100%)	Yes/218 days (100%)	Yes/218 days (100%)	Yes/218 days (100%)
Gauge 4	Yes/200 days (92%)	Yes/218 days (100%)	Yes/218 days (100%)	Yes/218 days (100%)	Yes/218 days (100%)	Yes/79 days (36%)**
*Gauge 1 and 2 were not working properly during much of the 2014 growing season.						
**Gauge 2 and 4 were not working properly during much of the 2016 growing season.						

South Fork Hoppers Creek (SFHC)
Bankfull Photo Documentation

South Fork Hoppers Creek – Bankfull Photolog

Crest Gauge Photo (5/16/16)

Crest Gauge Photo (10/19/16)