Jacob's Landing
Stream Restoration Monitoring Report
DMS Project # 95024
DMS Contract # 003984
Monitoring Year 04

Submitted to:

NCDEQ-DMS, 1652 Mail Service Center, Raleigh, NC 27699-1652

Construction Completed: January 2014
Data Collection: 2017
Submitted: January 2018

KCI ASSOCIATES OF NORTH CAROLINA, PA

ENGINEERS • SCIENTISTS • SURVEYORS • CONSTRUCTION MANAGERS
4505 Falls of Neuse Road Suite 400 Raleigh, NC 27609 (919) 783-9214 (919) 783-9266 Fax

MEMORANDUM

Date: January 22, 2018

To: Matthew Reid, DMS Project Manager

From: Adam Spiller, Project Manager
KCI Associates of North Carolina, PA

Subject: Jacob's Landing Stream Restoration Site
MY-04 Monitoring Report Comments
Yadkin River Basin CU 03040105
Rowan County, North Carolina
NCDMS Project # 95024
Contract # 003984

Please find below our responses in italics to the MY-04 Monitoring Report comments from NCDMS received on January 19, 2018, for the Jacob's Landing Stream Restoration Site.

General

- Executive summary discusses aggradation on T1. According to the profile and Table 5, there appears to be approximately 550' of aggradation at the upstream section of T1. Please be aware that if a stream fills in and is not functioning as designed, the IRT may deny credit for this section. DMS recommends requesting site visit with IRT to discuss and develop an adaptive management plan if necessary.
  - *KCI will request a site visit with the IRT.*

- All four of the failing vegetation plots are on Reach T2. Does KCI plan to replant portions of this reach?
  - *KCI is currently planning a supplemental planting at the site to address areas of low stem density/majority sweetgum areas before the beginning of the next growing season. Three of the 4 failing plots have a significant number of high quality volunteers and it is not believed that overall the site is lacking in woody vegetation.*

- The IRT has expressed concern over BHR having a measurement of 1 throughout the monitoring period. Please update the calculations to reflect changes observed in the overlays and explain in detail as a table footnote how the calculations were made. Be prepared to defend the method used for credit release and justify through context whether or not any changes observed in a cross section represent an issue.
  - *Bank height ratios have been updated throughout the report for all monitoring years. None of the cross sections have experienced a significant change in BHR since construction.*

- Since this project is post instrument and follows the credit release schedule, please be prepared to discuss the two above issues during the credit release meeting in April. The IRT will likely have questions and may request a site visit.
  - ➢ *KCI is prepared to discuss these issues with the IRT.*

- As KCI has done in the past, please include a response letter that includes how/where the comments were addressed in the report. Please insert this letter directly behind the cover page in the final deliverables. The IRT has requested that we include this letter with the final deliverables. The response letter will need to be included with all future monitoring deliverables.
  - ➢ *This letter has been added to the report.*

Please contact me if you have any questions or would like clarification concerning these responses.

Sincerely,

Adam Spiller
Project Manager

Design and Monitoring Firm

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Suite 400
Raleigh, NC 27609
Phone: (919) 278-2514
Fax: (919) 783-9266

Project Manager: Tim Morris
Email: tim.morris@kci.com
Project No: 20110675

Table of Contents

1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

The Jacob's Landing Stream Restoration Site is a full-delivery project that was developed for the North Carolina Division of Mitigation Services (DMS). Construction was completed in November 2013. The site includes the restoration of 4,484 linear feet of restoration and 109 linear feet of enhancement on four tributaries to Irish Buffalo Creek in the Yadkin-Pee Dee River Basin. The project is located west of China Grove and north of Kannapolis off of Saw Road in Rowan County (Figure 1, Appendix A). This project will expand aquatic and terrestrial habitat in the Rocky River Watershed (03040105). The project is within the 03040105020040 Irish Buffalo Creek Local Watershed Unit (14-digit HUC) (NCDENR, EEP 2009). In DMS' most recent publication of excluded and Targeted Local Watersheds/Hydrologic Units, the 03040105020040 14-digit HUC has been identified as a Targeted Local Watershed. The project is located in the Piedmont Physiographic Province and the project streams initiate as headwater systems out of moderately-sloped, forested hills before reaching the floodplain of Irish Buffalo Creek. The site's 0.72-square mile watershed is mostly pasture and mixed hardwoods with small pockets of rural residential development. Prior to construction the site was actively used for timber and cattle production for over five generations.

The project goals and objectives are listed below.

Project Goals

- Restore a diverse riparian corridor that connects forested stream systems upstream and downstream of the project.
- Reduce the sediment supply entering Irish Buffalo Creek.

Project Objectives

- Restore stable channel planforms to streams that have been straightened and modified.
- Reshape and stabilize eroding stream banks.
- Plant the site with native trees to help reestablish a diverse riparian corridor.
- Install exclusion fencing and alternative watering options to keep livestock out of the project streams.

During the Proposal Stage of the project, Reach T2-A was identified as Enhancement Level 1 at a 1.5:1 credit ratio. During the assessment and design stage for this reach, a more aggressive restoration approach was determined to be need, and the because of this the decision was made to completely change the stream type from a G-type channel to a C/B type channel. This required a restoration level approach during construction and because of this KCI requested a reallocation of credit type from the IRT from 1.5:1 to 1:1. After several meetings and discussions with the IRT, this reallocation of credit type was agreed to and resulted in an increase of 155 credits from the credits listed in the mitigation plan. See Appendix F for more information on this change.

Vegetation success is based on the criteria established in the USACE Stream Mitigation Guidelines (2003). This document states that vegetation monitoring results should have the following planted stem density minimums in the corresponding monitoring years: 320 stems/acre through Year Three, 288 stems/acre in Year Four, and 260 stems/acre in Year Five. The fourth-year vegetation monitoring was based on the Level 2 CVS-EEP vegetation monitoring protocol. The site's average density for this monitoring period is 402 planted stems/acre, with none of the plots having live stakes planted in them. Nine of the thirteen plots had greater than 288 planted stems/acre. There are four monitoring plots that have calculated planted stem densities less than 288 stems/acre; (Plots 1, 3, 4, and 6). Additionally, three small areas of low stem density were identified within the easement. These areas collectively make up 0.23 acres or less than 2% of the total easement. This is not seen as problematic given the high potential for desirable volunteers to become established in the plots and across the site. Like natural vegetative communities, some areas will have slightly higher densities than others, but the data from the

vegetation monitoring plots reveal that the site has an adequate average stem density. To ensure continued vegetative success, some parts of the site received supplemental planting in early 2015. Including volunteers, the monitoring plots averaged 931 total stems/acre. Although the overall vegetation assessment found the site to be on track to meeting the vegetative success criterion, KCI is evaluating the need for a supplemental planting to create more uniform vegetative cover across the site..

Fourth-year monitoring found the Jacob's Landing Site to be stable, with only minor changes from the as-built conditions. Two small areas of bank erosion that were reported on T1 during MY02 were repaired with soil lifts in the beginning of 2016 and these have shown no signs of instability since. The monitoring components were installed in February/March 2014. Two automatic recording gauges have been installed along T1 and T2. Both stream gauges recorded several bankfull events during 2017. The monitoring plan for each tributary is as follows: T1 has a 1,500 foot longitudinal profile, 3 riffle cross-sections, and 1 pool cross-section; T2 has a 1,500 foot longitudinal profile, 5 riffle cross-sections and 2 pool cross-sections; T1A and T2A are being monitored visually since they are short reaches and small channels. Pebble counts were conducted at all eleven cross-sections. Ten permanent photo reference points have been established with a total of twenty-two photos to be taken annually. The fourth year of monitoring found the site to be functioning and T2 shows little change from the baseline conditions. The two areas of deposition mentioned in last year's report have since washed out and are more closely aligned with the baseline condition. This is representative of the natural cycle of sediment transport within the restored system, which receives a high volume of sediment input upstream of the restored reach. Similarly, although there are several areas of aggradation still present on T1, much of the aggradation reported last year has washed out and the remaining instances are confined to the upper quarter of the reach. As with T2, this is not seen as an indicator of instability in the reach, but will be monitored to ensure it does not become a problem for the site.

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 and in the Mitigation Plan documents available on the DMS' website. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

2.0 METHODOLOGY

The survey data were collected with a total station instrument between June 31 and July 2 for T1, and between November 16 and December 11 for T2.

Some of the cross-sections have shown minor settling in the floodplain. The bankfull elevations at these cross-sections have not been changed to reflect this. For calculating cross-sectional morphologic data the cross-section width has been limited to a width that appropriately reflects the top of bank location so as not to inaccurately skew data. Based on feedback from the IRT and DMS, the bank height ratios for the monitored cross-sections have been updated. Bank height ratios are now being calculated by comparing the as-built max depth of the channel to the new low bank height.

The CVS-EEP protocol, Level 2 (http://cvs.bio.unc.edu/methods.htm) was used to collect vegetation data from the site. The vegetation monitoring was completed on August 14, 2017.

3.0 REFERENCES

Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation, Version 4.2 (http://cvs.bio.unc.edu/methods.htm)

NCDENR, Ecosystem Enhancement Program. 2009. Lower Yadkin Pee-Dee River Basin Priorities 2009. Raleigh, NC. http://www.nceep.net/services/restplans/Yadkin_Pee_Dee_RBRP_2009_Final.pdf

USACE. 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

Appendix A

Project Vicinity Map and Background Tables

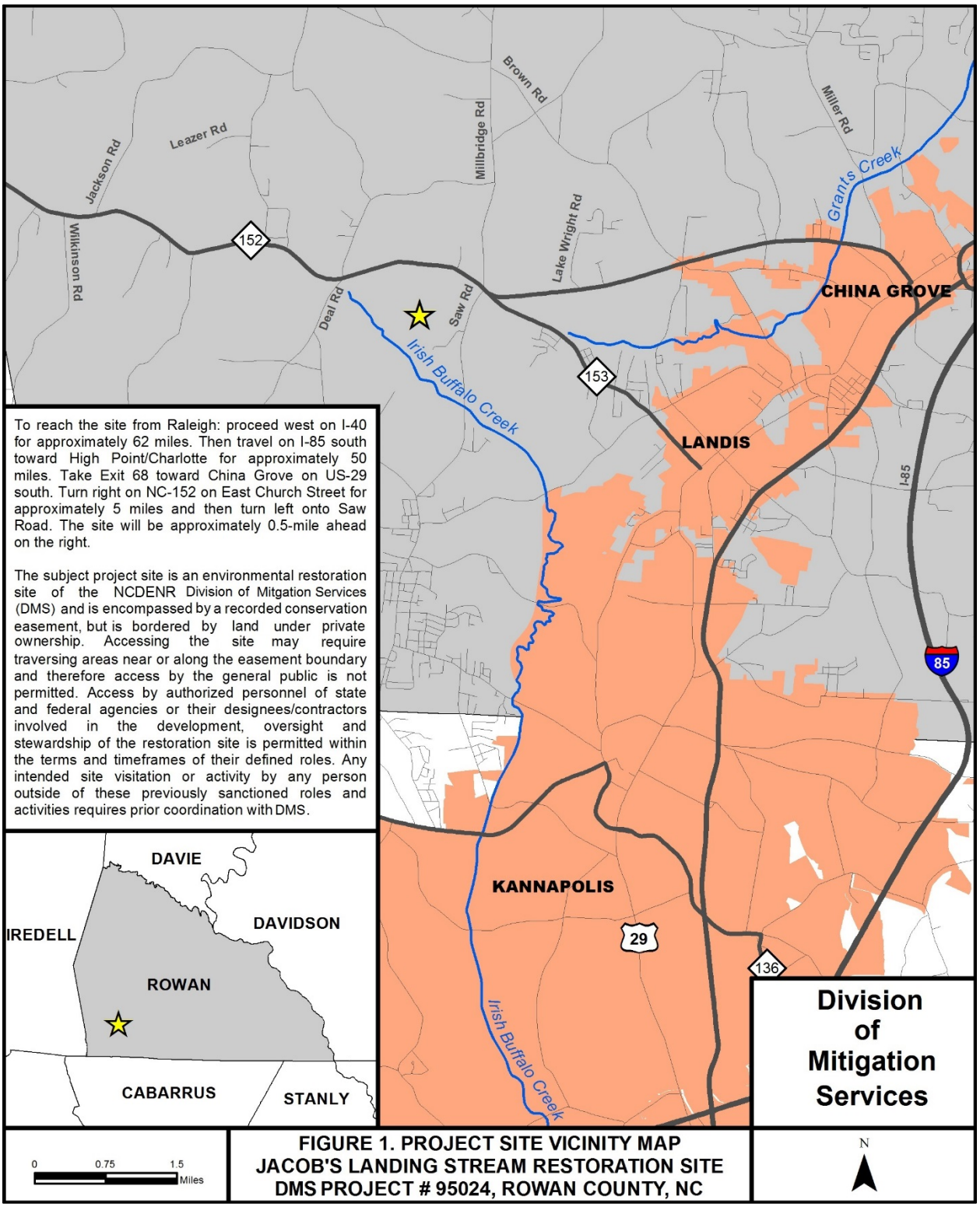


FIGURE 1. PROJECT SITE VICINITY MAP
JACOB'S LANDING STREAM RESTORATION SITE
DMS PROJECT # 95024, ROWAN COUNTY, NC

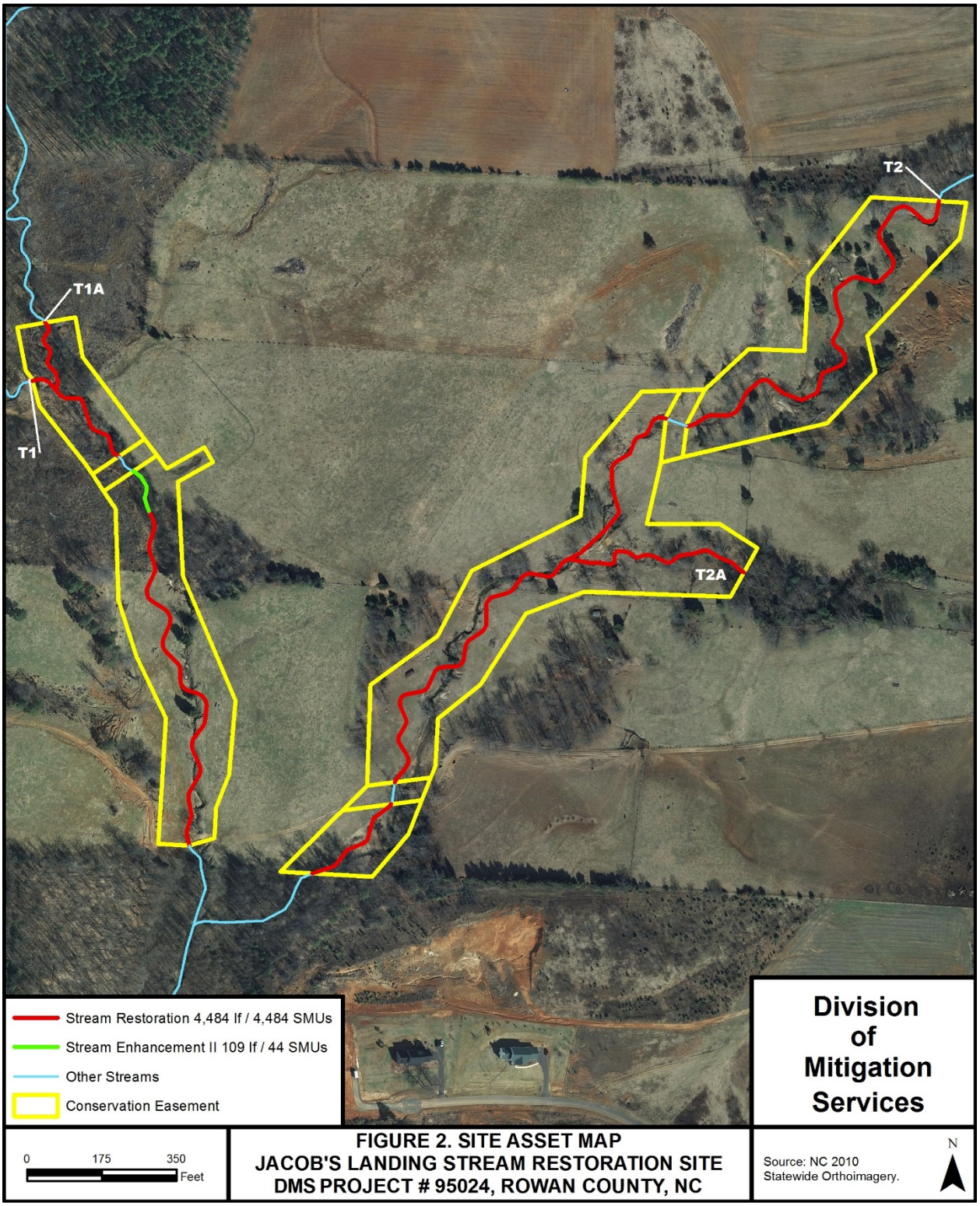

T1A
T1
T2
T2A
Stream Restoration 4,484 lf / 4,484 SMUs
Stream Enhancement II 109 lf / 44 SMUs
Other Streams
Conservation Easement
Division of Mitigation Services
0 175 350 Feet
FIGURE 2. SITE ASSET MAP
JACOB'S LANDING STREAM RESTORATION SITE
DMS PROJECT # 95024, ROWAN COUNTY, NC
Source: NC 2010 Statewide Orthoimagery.
N

Table 1. Project Components and Mitigation Credits
Jacob's Landing Stream Restoration Site, DMS Project # 95024

Mitigation Credits

	Stream		Riparian Wetland	Non-riparian Wetland	Buffer	Nitrogen Nutrient Offset
Type	R	EII				
Length	4,484	109				
Credits	4,484	44				
TOTAL CREDITS	4,528					

Project Components

Project Component -or- Reach ID	Design Stationing/ Location	Existing Footage	Approach (PI, PII etc.)	Restoration -or- Restoration Equivalent	Restoration Footage	Mitigation Ratio
T1	10+00 – 13+03	326	P2	Restoration	303	1:1
T1	13+52 – 14+61	158	-	Enhancement II	109*	1:2.5
T1	14+61 – 23+54	846	P2	Restoration	893	1:1
T1A	40+00 – 41+78	294	P2	Restoration	178	1:1
T2	50+00 – 77+45	2,935	P2	Restoration	2,645*	1:1
T2A	100+00 – 104+65	465	P2	Restoration	465	1:1

Component Summation

Restoration Level	Stream (linear feet)	Mitigation Units (SMU)
Total Restoration	4,484	4,484
Total Enhancement II	109	44
TOTAL SMU		**4,528**

*Mitigation units have been calculated to exclude the easement exceptions and water utility easements.

Though not formal BMPs, several small water quality detention structures were installed throughout the project to improve water quality from the surrounding drainage area.

Table 2. Project Activity & Reporting History Jacob's Landing Stream Restoration Site, DMS Project # 95024		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Mitigation Plan		Sept 12
Final Design - Construction Plans		Dec 12
Construction		Nov 13
Planting		Jan 14
Baseline Monitoring/Report	March 14	April 14
Vegetation Monitoring	Feb. 20, 2014	
Photo Points	March 11, 2014	
Stream Survey	Feb. 25, 2014	
Year 1 Monitoring	Oct 14	Nov 14
Vegetation Monitoring	Oct. 1, 2014	
Photo Points	Oct. 29, 2014	
Stream Survey	Oct. 29, 2014	
Supplemental Planting		March 15
Year 2 Monitoring	August 15	Dec 15
Vegetation Monitoring	July 28, 2015	
Photo Points	Dec. 17, 2015	
Stream Survey	Aug. 11, 2015	
Bank erosion repair		Jan 16
Year 3 Monitoring	Dec 16	Dec 16
Vegetation Monitoring	Aug. 31, 2016	
Photo Points	Nov. 15, 2016	
Stream Survey	June 10, 2016 (T1), Dec. 8, 2016 (T2)	
Year 4 Monitoring	Dec 17	Dec 17
Vegetation Monitoring	Aug. 14, 2017	
Photo Points	Nov. 17, 2017	
Stream Survey	June 2, 2017 (T1), Dec. 11 2017 (T2)	

Table 3. Project Contacts **Jacob's Landing Stream Restoration Site, DMS Project # 95024**	
Design Firm	KCI Associates of North Carolina 4505 Falls of Neuse Road Suite 400 Raleigh, NC 27609 Contact: Mr. Tim Morris Phone: (919) 278-2512 Fax: (919) 783-9266
Construction Contractor	Wright Contracting, LLC 160 Walker Road Lawndale, NC 28090 Contact: Mr. Stephen James Phone: (704) 692-4633
Planting Contractor	Forestree Management Co. 1280 Maudis Road Bailey, NC 27807 Contact: Mr. Tony Cortez Phone: (252) 243-2513
Monitoring Performers	
MY-00 - MY-04	KCI Associates of North Carolina 4505 Falls of Neuse Road Suite 400 Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266

Table 4. Project Information **Jacob's Landing Stream Restoration Site, DMS Project # 95024**				
Project Name	Jacob's Landing Stream Restoration Site			
County	Rowan County			
Project Area (acres)	13.9 acres			
Project Coordinates (lat. and long.)	35.552956 N, 80.653116 W			
Project Watershed Summary Information				
Physiographic Province	Piedmont			
River Basin	Yadkin-Pee Dee			
USGS Hydrologic Unit 8-digit	03040105	USGS Hydrologic Unit 14-digit	03040105020040	
DWQ Sub-basin	13-17-09			
Project Drainage Area	459 acres/0.72 square miles			
Project Drainage Area Percentage of Impervious Area	2.3% / 6 acres			
CGIA Land Use Classification	4.8% Cultivated, 60.1% Managed Herbaceous Cover, and 35.1% Mixed Upland Hardwoods.			
Reach Summary Information (Post-Restoration)				
Parameters	**T1**	**T1A**	**T2**	**T2A**
Length of reach (linear feet)	1,305	178	2,645	465
Valley classification	VIII	VIII	VIII	VIII
Drainage area (acres)	258.6 acres	136.9 acres	200.6 acres	35.7 acres
NCDWQ Water Quality Classification	Class C, WSIII	Class C, WSIII	Class C, WSIII	Class C, WSIII
Morphological Description (stream type)	C4	B4c/C4	C4	B4c/C4
Evolutionary trend	Stage II (Constructed)	Stage II (Constructed)	Stage II (Constructed)	Stage II (Constructed)
Mapped Soil Series	Chewacla loam	Chewacla loam	Pacolet sandy loam and Chewacla loam	Pacolet sandy loam
Drainage class	Poorly drained	Well drained	Poor to Well drained	Well drained
Soil Hydric status	Non hydric	Non hydric	Non hydric	Non hydric
Slope	0-2%	0-2%	0-2%	0-2%
FEMA classification	N/A	N/A	N/A	N/A
Native vegetation community	Piedmont Alluvial Forest	Piedmont Alluvial Forest	Piedmont Alluvial Forest	Mesic Mixed Hardwood Forest
Percent composition of exotic invasive vegetation	0%	0%	0%	0%
Regulatory Considerations				
Regulation	**Applicable?**	**Resolved?**		**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes, received 404 permit.		N/A
Waters of the United States – Section 401	Yes	Yes, received 401 permit.		N/A
Endangered Species Act	No	N/A		N/A
Historic Preservation Act	No	N/A		N/A
Coastal Zone Management Act* (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A		N/A
FEMA Floodplain Compliance	Yes	Floodplain development permit obtained through Rowan County		N/A
Essential Fisheries Habitat	No	N/A		N/A

Appendix B

Visual Assessment Data

LEGEND

- CONSERVATION EASEMENT
- STREAM BED AGGRADATION
- CROSS-SECTION (XS)
- VEG PLOT ACHIEVING DENSITY CRITERION
- VEG PLOT BELOW DENSITY CRITERION
- 931 / 402 — VEG PLOT TOTAL / PLANTED STEM DENSITY
- PHOTO POINT (PP)
- GAUGE LOCATION
- 2016 REPAIRS
- LOW STEM DENSITY AREAS

IMAGE SOURCE: NC 2014 STATEWIDE ORTHOIMAGERY

NC GRID NAD '83

-80' -40' 0' 80' 160'

GRAPHIC SCALE

PP10
VP7
2226 / 607
XS11
(GAUGE 2)
50 FEET EASEMENT EXCEPTION
END PROFILE T2
VP8
931 / 445
WATER QUALITY STRUCTURE
50 FEET EASEMENT EXCEPTION
VP12
769 / 445
VP13
1376 / 526
XS3
PP2
XS2
PP3
VP10
607 / 445
XS1
VP11
1255 / 445
XS4
(GAUGE 1)
PP4
END PROFILE T1
VP9
1255 / 445
PP1
BEGIN REACH T1A
BEGIN PROFILE T1
BEGIN REACH T1

REVISIONS		
SYM.	DESCRIPTION	DATE

NCDEQ DIVISION OF MITIGATION SERVICES

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4505 FALLS OF NEUSE ROAD
RALEIGH, NORTH CAROLINA 27609

JACOB'S LANDING
STREAM MITIGATION PROJECT
MONITORING YEAR 4
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA
REACH T1

DATE: DEC 2017
SCALE: GRAPHIC

CURRENT CONDITION PLAN VIEW

LEGEND

- CONSERVATION EASEMENT
- STREAM BED AGGRADATION
- CROSS-SECTION (XS)
- VEG PLOT ACHIEVING DENSITY CRITERION
- VEG PLOT BELOW DENSITY CRITERION
- 931 / 402 — VEG PLOT TOTAL / PLANTED STEM DENSITY
- PHOTO POINT (PP)
- GAUGE LOCATION
- 2016 REPAIRS
- LOW STEM DENSITY AREAS

IMAGE SOURCE: NC 2014 STATEWIDE ORTHOIMAGERY

NC GRID NAD 83

-80' -40' 0' 80' 160'

GRAPHIC SCALE

WATER QUALITY STRUCTURE

BEGIN PROFILE T2

VP1 647 / 283

PP5

VP2 526 / 405

XS6

BEGIN REACH T2

XS5

WATER QUALITY STRUCTURE

VP3 364 / 273

PP6

XS7

50 FEET EASEMENT EXCEPTION

PP7

VP4 1133 / 243

XS8

BEGIN REACH T2A

VP5 567 / 405

PP8

PP9

XS9

VP6 445 / 202

XS10

VP7 2226 / 607

PP10

XS11 (GAUGE 2)

END PROFILE T2

50 FEET EASEMENT EXCEPTION

VP8 931 / 405

END PROFILE T1

VP13 1376 / 526

PP4

XS4 (GAUGE 1)

VP12 769 / 445

PP3

XS3

XS2

WATER QUALITY STRUCTURE

VP11 1255 / 567

PP2

NO.	DESCRIPTION	DATE
	REVISIONS	

NCDEQ DIVISION OF MITIGATION SERVICES

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4505 FALLS OF NEUSE ROAD
RALEIGH, NORTH CAROLINA 27609

JACOB'S LANDING STREAM MITIGATION PROJECT MONITORING YEAR 4

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACH T2

DATE: DEC 2017

SCALE: GRAPHIC

CURRENT CONDITION PLAN VIEW

SHEET 2 OF 2

Table 5. Visual Stream Morphology Stability Assessment
Jacob's Landing Stream Restoration Site, DMS Project # 95024
Assessed Length 2,389 Reach - T1

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			1	550	77%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	21	21			100%
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	16	16			100%
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	16	16			100%
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	11	11			100%
		2. Thalweg centering at downstream of meander (Glide)	10	10			100%
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%
				Totals	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	6	6			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	6	6			100%
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	6	6			N/A
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	6	6			100%
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	0	0			N/A

Table 5. Visual Stream Morphology Stability Assessment
Jacob's Landing Stream Restoration Site, DMS Project # 95024

Assessed Length 2,084 **Reach - T2**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	23	23			100%
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	26	26			100%
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	26	26			100%
	4.**Thalweg Position**[+]	1. Thalweg centering at upstream of meander bend (Run)					N/A
		2. Thalweg centering at downstream of meander (Glide)					N/A
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%
Totals					0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	15	15			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	15	15			100%
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	1	1			100%
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	6	6			100%
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	0	0			N/A

[+]Due to this reach's small size and the scale of the pattern, the exact position of the thalweg in relation to the meanders and morphological features is inconsistent and not practical to evaluate

Table 6. Vegetation Condition Assessment
Jacob's Landing Stream Restoration Site, DMS Project # 95024

Planted Acreage 12.83 **Easement Acreage 13.9**

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 acre	Pattern and Color	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 acre	Pattern and Color	3	0.23	1.8%
			Total	3	0.23	1.8%
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 acre	Pattern and Color	0	0.00	0.0%
			Cumulative Total	3	0.23	1.8%
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1,000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	0.0%

Stream Station Photos

Photo Point 1u: MY-00 – 3/11/14

Photo Point 1u: MY-04 – 11/17/17

Photo Point 1d: MY-00 – 3/11/14

Photo Point 1d: MY-04 – 11/17/17

Photo Point 1 Tributary: MY-00 – 3/11/14

Photo Point 1 Tributary: MY-04 – 11/17/17

Photo Point 2u: MY-00 – 3/11/14

Photo Point 2u: MY-04 – 11/17/17

Photo Point 2d: MY-00 – 3/11/14

Photo Point 2d: MY-04 – 11/17/17

Photo Point 3u: MY-00 – 3/11/14

Photo Point 3u: MY-04 – 11/17/17

Photo Point 3d: MY-00 – 3/11/14

Photo Point 3d: MY-04 – 11/17/17

Photo Point 4u: MY-00 – 3/11/14

Photo Point 4u: MY-04 – 11/17/17

Photo Point 4d: MY-00 – 3/11/14

Photo Point 4d: MY-04 – 11/17/17

Photo Point 5u: MY-00 – 3/11/14

Photo Point 5u: MY-04 – 11/17/17

Photo Point 5d: MY-00 – 3/11/14

Photo Point 5d: MY-04 – 11/17/17

Photo Point 6u: MY-00 – 3/11/14

Photo Point 6u: MY-04 – 11/17/17

Photo Point 6d: MY-00 – 3/11/14

Photo Point 6d: MY-04 – 11/17/17

Photo Point 7u: MY-00 – 3/11/14

Photo Point 7u: MY-04 – 11/17/17

Photo Point 7d: MY-00 – 3/11/14

Photo Point 7d: MY-04 – 11/17/17

Photo Point 8u: MY-00 – 3/11/14

Photo Point 8u: MY-04 – 11/17/17

Photo Point 8d: MY-00 – 3/11/14

Photo Point 8d: MY-04 – 11/17/17

Photo Point 9u: MY-00 – 3/11/14

Photo Point 9u: MY-04 – 11/17/17

Photo Point 9d: MY-00 – 3/11/14

Photo Point 9d: MY-04 – 11/17/17

Photo Point 9 Tributary: MY-00 – 3/11/14

Photo Point 9 Tributary: MY-04 – 11/17/17

Photo Point 10u: MY-00 – 3/11/14

Photo Point 10u: MY-04 – 11/17/17

Photo Point 10d: MY-00 – 3/11/14

Photo Point 10d: MY-04 – 11/17/17

Vegetation Monitoring Plot Photos

Plot 1 Photo: 8/14/17 – MY04

Plot 2 Photo: 8/14/17 – MY04

Plot 3 Photo: 8/14/17 – MY04

Plot 4 Photo: 8/14/17 – MY04

Plot 5 Photo: 8/14/17 – MY04

Plot 6 Photo: 8/14/17 – MY04

Plot 7 Photo: 8/14/17 – MY04

Plot 8 Photo: 8/14/17 – MY04

Plot 9 Photo: 8/14/17 – MY04

Plot 10 Photo: 8/14/17 – MY04

Plot 11 Photo: 8/14/17 – MY04

Plot 12 Photo: 8/14/17 – MY04

Plot 13 Photo: 8/14/17 – MY04

Appendix C

Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment Jacob's Landing Stream Restoration Site, DMS Project # 95024			
Vegetation Plot ID	**Vegetation Survival Threshold Met?**	**Monitoring Year 04 Planted Stem Density (stems/acre)**	**Monitoring Year 04 Total Stem Density (stems/acre)**
1	No	283	647
2	Yes	405	526
3	No	243	364
4	No	243	1,133
5	Yes	405	567
6	No	202	445
7	Yes	607	2,226
8	Yes	405	931
9	Yes	445	1,255
10	Yes	445	607
11	Yes	567	1,255
12	Yes	445	769
13	Yes	526	1,376

Table 8. CVS Vegetation Plot Metadata Jacob's Landing Stream Restoration Site, DMS Project # 95024	
Report Prepared By	Ben Grunwald
Date Prepared	8/15/2017 14:00
database name	KCI-2017-L.mdb
database location	M:\2011\20110675-Jacobs Landing\Monitoring\Vegetaton CVS Database
computer name	12-3ZV4FP1
file size	62001152
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 live stakes, 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.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	95024
project Name	Jacob's Landing
Description	Stream Restoration Site
River Basin	Yadkin-Pee Dee
length(ft)	4593
area (sq m)	0.72
Required Plots (calculated)	13
Sampled Plots	13

Table 9. CVS Stem Count Total and Planted by Plot and Species

DMS Project Code 95024, Project Name: Jacob's Landing			Current Plot Data (MY4 2017)																						
			95024-01-0001			95024-01-0002			95024-01-0003			95024-01-0004			95024-01-0005			95024-01-0006			95024-01-0007			95024-01-0008		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree																							
Acer nigrum	black maple	Tree																							1
Acer rubrum	red maple	Tree																							
Baccharis	baccharis	Shrub																							
Baccharis halimifolia	eastern baccharis	Shrub																							
Betula nigra	river birch	Tree	1	1	1	8	8	8	2	2	2	4	4	4				1	1	1	10	10	10	2	2	2
Callicarpa americana	American beautyberi	Shrub																							
Diospyros virginiana	common persimmon	Tree			1			1									1			1						
Fraxinus pennsylvanica	green ash	Tree	1	1	1													1	1	1						
Juglans nigra	black walnut	Tree												4						1			1			1
Juniperus virginiana	eastern redcedar	Tree						2						1									6			
Liquidambar styraciflua	sweetgum	Tree			8						3			15			3			4			30			9
Liriodendron tulipifera	tuliptree	Tree										1	1	1									1			1
Nyssa biflora	swamp tupelo	Tree																1	1	1						
Pinus taeda	loblolly pine	Tree																								1
Platanus occidentalis	American sycamore	Tree	4	4	4				3	3	3	1	1	1				2	2	2	2	2	2			
Quercus	oak	Tree																								
Quercus alba	white oak	Tree				2	2	2						2												
Quercus michauxii	swamp chestnut oak	Tree	1	1	1																					
Quercus palustris	pin oak	Tree													7	7	7									
Quercus phellos	willow oak	Tree							1	1	1										2	2	2	8	8	8
Quercus rubra	northern red oak	Tree													3	3	3				1	1	1			
Salix nigra	black willow	Tree																					2			
Sambucus canadensis	Common Elderberry	Shrub																								
Ulmus americana	American elm	Tree																								
Unknown		Shrub or Tree																								
		Stem count	7	7	16	10	10	13	6	6	9	6	6	28	10	10	14	5	5	11	15	15	55	10	10	23
		size (ares)	1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	4	4	6	2	2	4	3	3	4	3	3	7	2	2	4	4	4	7	4	4	9	2	2	7
		Stems per ACRE	283	283	647	405	405	526	243	243	364	243	243	1133	405	405	567	202	202	445	607	607	2226	405	405	931

Table 9. CVS Stem Count Total and Planted by Plot and Species

DMS Project Code 95024, Project Name: Jacob's Landing			Current Plot Data (MY4 2017)														Annual Means													
			95024-01-0009			95024-01-0010			95024-01-0011			95024-01-0012			95024-01-0013			MY4 (2017)			MY3 (2016)			MY2 (2015)			MY1 (2014)			MY0 (2014)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree																					6			6			3			
Acer nigrum	black maple	Tree												1			2			4												
Acer rubrum	red maple	Tree			1															1												
Baccharis	baccharis	Shrub																					1									
Baccharis halimifolia	eastern baccharis	Shrub			1															1						2						
Betula nigra	river birch	Tree				3	3	3	7	7	7	1	1	1	1	1	1	40	40	40	41	41	42	43	43	45	44	44	44	44	44	44
Callicarpa americana	American beautyberry	Shrub				3	3	3	3	3	3				1	1	1	7	7	7	9	9	9	9	9	9	11	11	12			
Diospyros virginiana	common persimmon	Tree																		4			3			1			1			
Fraxinus pennsylvanica	green ash	Tree	4	4	4				3	3	3				2	2	2	11	11	11	9	9	11	9	9	9	1	1	1			
Juglans nigra	black walnut	Tree																		7			1			3						
Juniperus virginiana	eastern redcedar	Tree			1									1						11			2			4						
Liquidambar styraciflua	sweetgum	Tree			14			4			14			6			16			126			206			171			272			
Liriodendron tulipifera	tuliptree	Tree															3	1	1	6	1	1	9	3	3	10	11	11	17			
Nyssa biflora	swamp tupelo	Tree																1	1	1	1	1	1									
Pinus taeda	loblolly pine	Tree																		1			1									
Platanus occidentalis	American sycamore	Tree			3						3							12	12	18	12	12	17	16	16	19	21	21	32	3	3	3
Quercus	oak	Tree																					1							11	11	11
Quercus alba	white oak	Tree																2	2	4	2	2	2	4	4	4	3	3	4	1	1	1
Quercus michauxii	swamp chestnut oak	Tree																1	1	1												
Quercus palustris	pin oak	Tree																7	7	7	7	7	7	5	5	5	5	5	5			
Quercus phellos	willow oak	Tree	7	7	7	5	5	5				9	9	9	9	9	9	41	41	41	43	43	43	46	46	46	41	41	41	54	54	54
Quercus rubra	northern red oak	Tree							1	1	1							5	5	5	5	5	5	6	6	6	5	5	5			
Salix nigra	black willow	Tree																		2			3									
Sambucus canadensis	Common Elderberry	Shrub										1	1	1				1	1	1	2	2	2	2	2	3	1	1	1			
Ulmus americana	American elm	Tree																					1									
Unknown		Shrub or Tree																						1	1	1	6	6	6	133	133	133
	Stem count		11	11	31	11	11	15	14	14	31	11	11	19	13	13	34	129	129	299	132	132	373	144	144	344	149	149	444	246	246	246
	size (ares)		1			1			1			1			1			13			13			13			13			13		
	size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.32			0.32			0.32			0.32			0.32		
	Species count		2	2	7	3	3	4	4	4	6	3	3	6	4	4	7	12	12	21	11	11	21	11	11	17	11	11	14	6	6	6
	Stems per ACRE		445	445	1255	445	445	607	567	567	1255	445	445	769	526	526	1376	402	402	931	411	411	1161	448	448	1071	464	464	1382	766	766	766

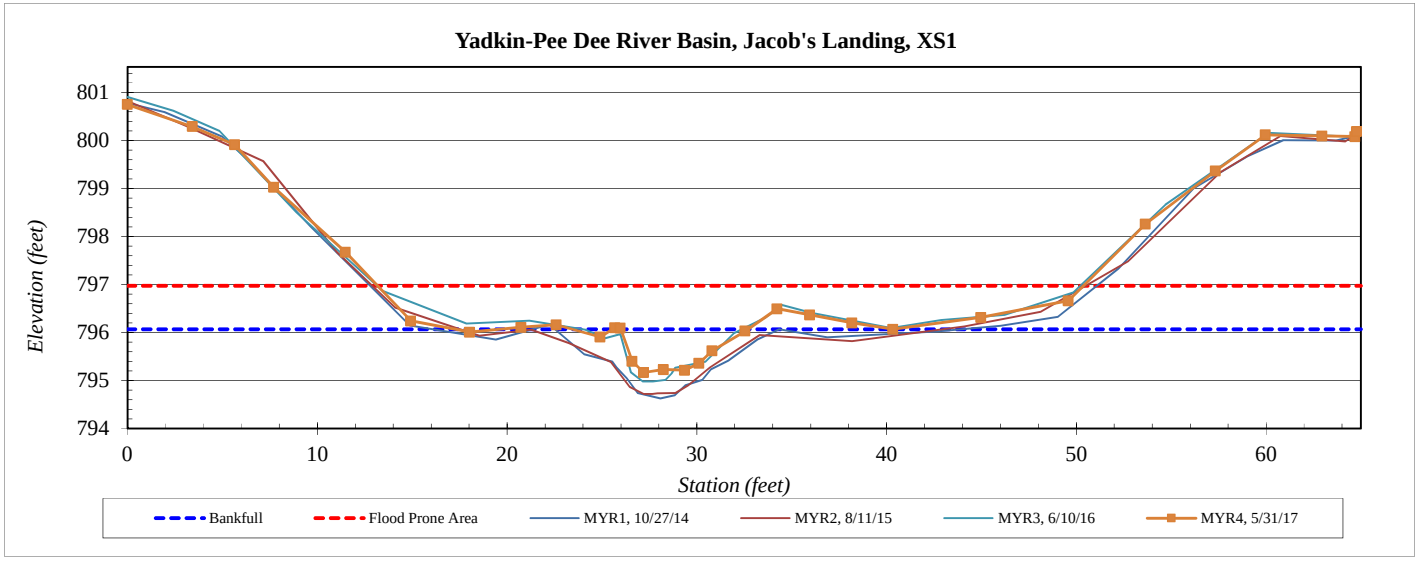
Appendix D

Stream Survey Data

River Basin:	Yadkin-Pee Dee
Site:	Jacob's Landing
XS ID	XS1
Drainage Area (sq mi):	0.37
Date:	5/31/2017
Field Crew:	T. Seelinger, B. Grunwald

Station	Elevation
0.00	800.51
3.42	800.05
5.65	799.67
7.71	798.79
11.49	797.44
14.94	796.00
18.04	795.77
20.75	795.87
22.60	795.92
24.91	795.67
25.68	795.86
25.97	795.85
26.60	795.16
27.20	794.93
28.25	794.99
29.37	794.97
30.12	795.12
30.80	795.38
32.55	795.79
34.24	796.25
35.95	796.13
38.18	795.96
40.34	795.83
44.97	796.08
49.58	796.42
53.65	798.02
57.34	799.13
59.97	799.88
62.95	799.85
64.68	799.84
64.77	799.94

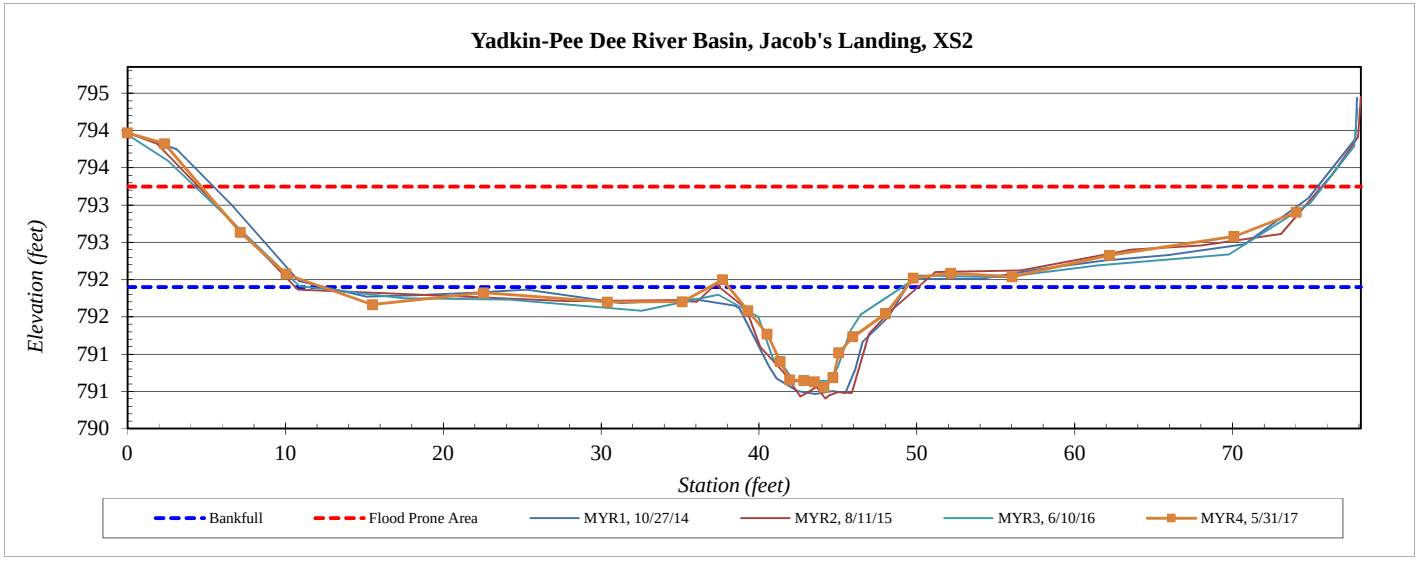
SUMMARY DATA	
Bankfull Elevation:	795.83
Bankfull Cross-Sectional Area:	4.0
Bankfull Width:	6.7
Flood Prone Area Elevation:	796.7
Flood Prone Width:	37.2
Max Depth at Bankfull:	0.9
Mean Depth at Bankfull:	0.6
W / D Ratio:	11.5
Entrenchment Ratio:	5.5
Bank Height Ratio:	0.7



River Basin:	Yadkin-Pee Dee
Site:	Jacob's Landing
XS ID	XS2
Drainage Area (sq mi):	0.37
Date:	5/31/2017
Field Crew:	T. Seelinger, B. Grunwald

Station	Elevation
0.00	794.46
2.36	794.31
7.15	793.12
10.06	792.56
15.52	792.15
22.56	792.31
30.41	792.19
35.15	792.19
37.70	792.49
39.31	792.07
40.53	791.76
41.37	791.39
41.96	791.14
42.86	791.14
43.52	791.12
44.13	791.05
44.70	791.17
45.06	791.51
45.95	791.72
48.02	792.03
49.78	792.51
52.16	792.57
56.05	792.53
62.20	792.82
70.10	793.07
74.05	793.39

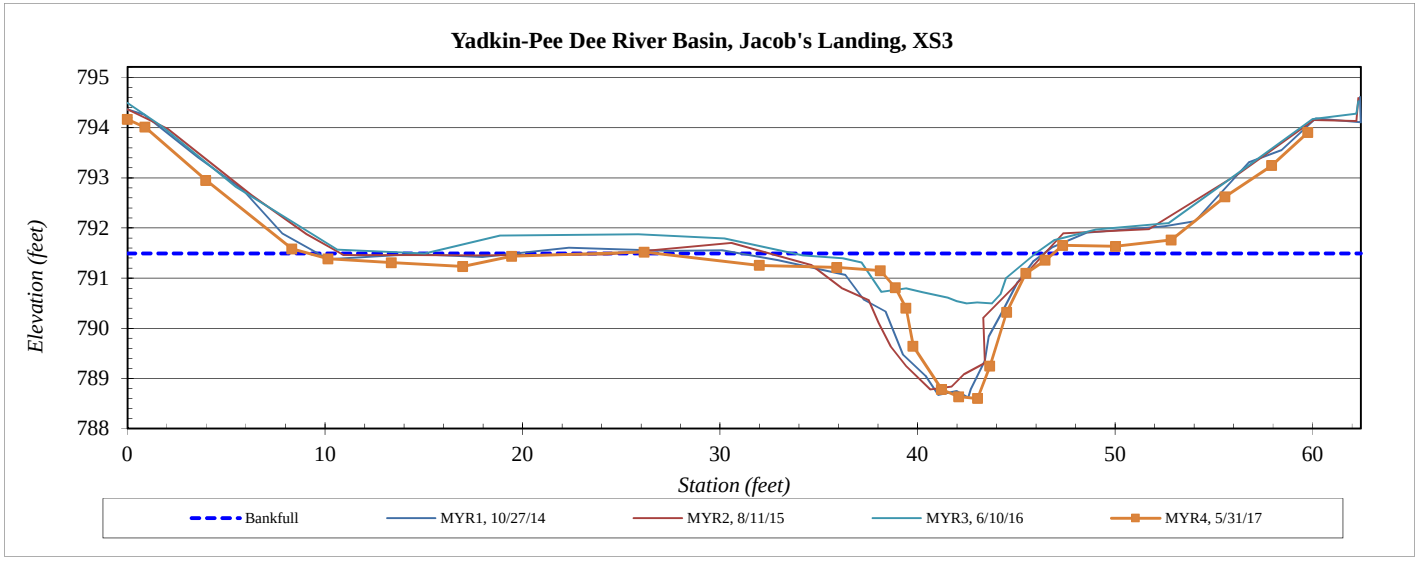
SUMMARY DATA	
Bankfull Elevation:	792.39
Bankfull Cross-Sectional Area:	8.0
Bankfull Width:	11.3
Flood Prone Area Elevation:	793.7
Flood Prone Width:	69.7
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.7
W / D Ratio:	15.9
Entrenchment Ratio:	6.2
Bank Height Ratio:	0.9



River Basin:	Yadkin-Pee Dee
Site:	Jacob's Landing
XS ID	XS3
Drainage Area (sq mi):	0.37
Date:	5/31/2017
Field Crew:	T. Seelinger, B. Grunwald

Station	Elevation
0.00	793.92
0.90	793.76
3.98	792.70
8.33	791.34
10.17	791.14
13.37	791.06
16.99	790.99
19.46	791.19
26.17	791.27
32.00	791.01
35.92	790.97
38.13	790.90
38.88	790.56
39.42	790.15
39.79	789.40
41.22	788.54
42.09	788.39
43.04	788.36
43.67	789.00
44.52	790.07
45.49	790.85
46.47	791.11
47.36	791.41
50.03	791.39
52.86	791.52
55.58	792.38
57.94	793.00
59.77	793.66

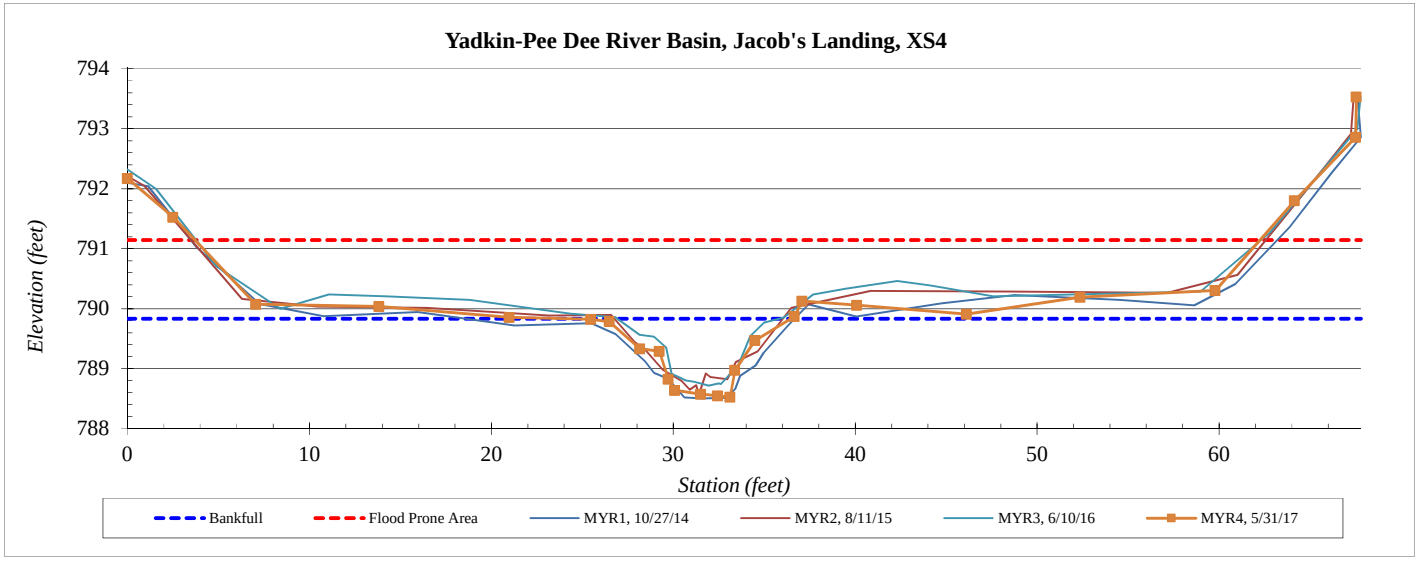
SUMMARY DATA	
Bankfull Elevation:	791.25
Bankfull Cross-Sectional Area:	14.0
Bankfull Width:	8.8
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.9
Mean Depth at Bankfull:	1.6
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-



River Basin:	Yadkin-Pee Dee
Site:	Jacob's Landing
XS ID	XS4
Drainage Area (sq mi):	0.37
Date:	5/31/2017
Field Crew:	T. Seelinger, B. Grunwald

Station	Elevation
0.00	792.25
2.51	791.60
7.06	790.15
13.83	790.11
20.99	789.93
25.48	789.90
26.49	789.86
28.16	789.41
29.23	789.36
29.73	788.90
30.07	788.71
31.51	788.65
32.44	788.62
33.12	788.60
33.40	789.05
34.50	789.55
36.66	789.94
37.08	790.20
40.10	790.13
46.12	789.98
52.37	790.26
59.79	790.38
64.15	791.88
67.50	792.93
67.55	793.60

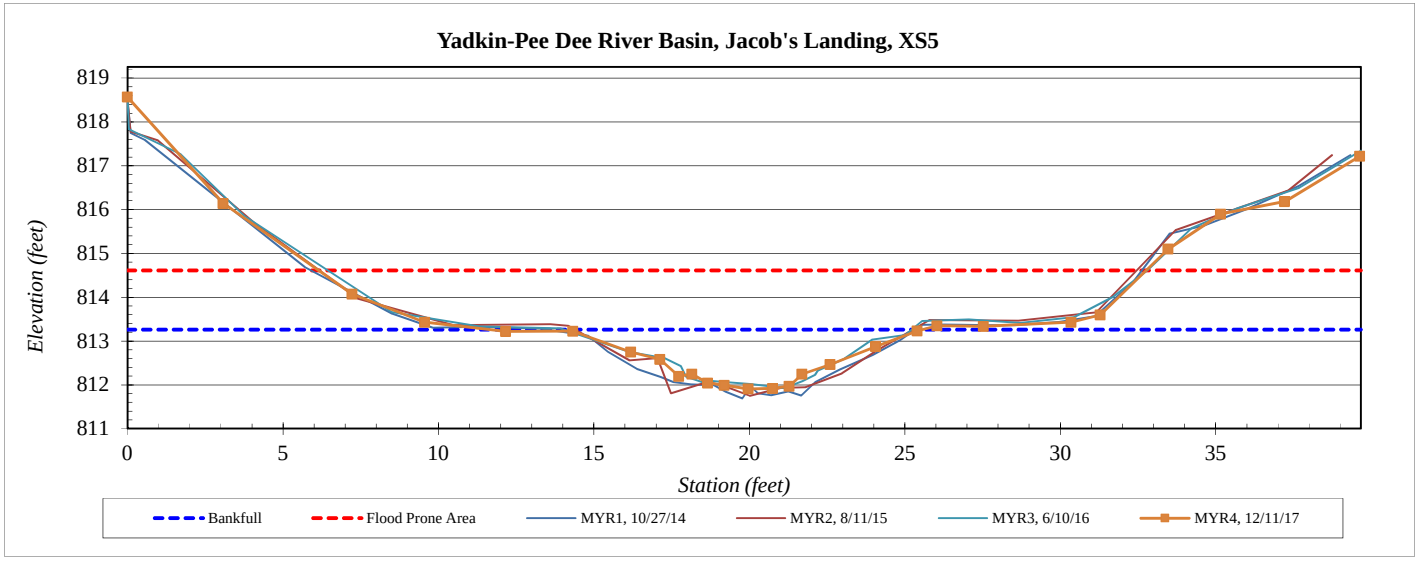
SUMMARY DATA	
Bankfull Elevation:	789.91
Bankfull Cross-Sectional Area:	7.0
Bankfull Width:	10.0
Flood Prone Area Elevation:	791.2
Flood Prone Width:	58.5
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.7
W / D Ratio:	14.3
Entrenchment Ratio:	5.9
Bank Height Ratio:	1.1



River Basin:	Yadkin-Pee Dee
Site:	Jacob's Landing
XS ID	XS5
Drainage Area (sq mi):	0.37
Date:	12/11/2017
Field Crew:	T. Seelinger, J. Sullivan

Station	Elevation
0.00	818.64
9.56	813.50
12.17	813.29
14.32	813.29
16.19	812.82
17.73	812.26
18.15	812.31
18.67	812.11
19.19	812.06
19.97	811.98
20.75	811.99
21.28	812.04
22.60	812.54
24.07	812.95
25.40	813.30
26.04	813.42
27.53	813.40
30.35	813.50
31.29	813.67
33.47	815.17
35.16	815.97
37.21	816.25
39.64	817.29

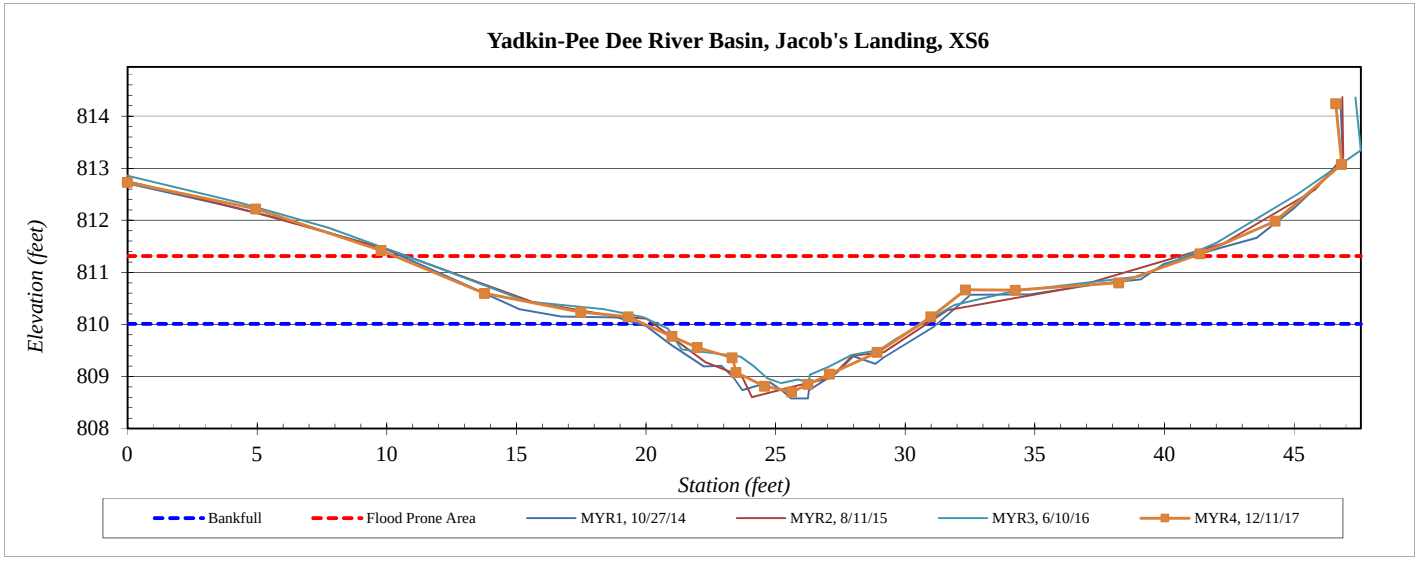
SUMMARY DATA	
Bankfull Elevation:	813.33
Bankfull Cross-Sectional Area:	8.5
Bankfull Width:	11.2
Flood Prone Area Elevation:	814.7
Flood Prone Width:	26.6
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	0.8
W / D Ratio:	14.9
Entrenchment Ratio:	2.4
Bank Height Ratio:	1.1



River Basin:	Yadkin-Pee Dee
Site:	Jacob's Landing
XS ID	XS6
Drainage Area (sq mi):	0.37
Date:	12/11/2017
Field Crew:	T. Seelinger, J. Sullivan

Station	Elevation
0.00	812.24
4.95	811.73
9.79	810.93
13.78	810.11
17.50	809.74
19.33	809.66
21.01	809.28
21.99	809.07
23.33	808.87
23.48	808.59
24.58	808.32
25.63	808.21
26.25	808.36
27.08	808.56
28.92	808.98
31.00	809.66
32.33	810.18
34.25	810.17
38.24	810.31
41.38	810.87
46.84	812.58
46.61	813.75

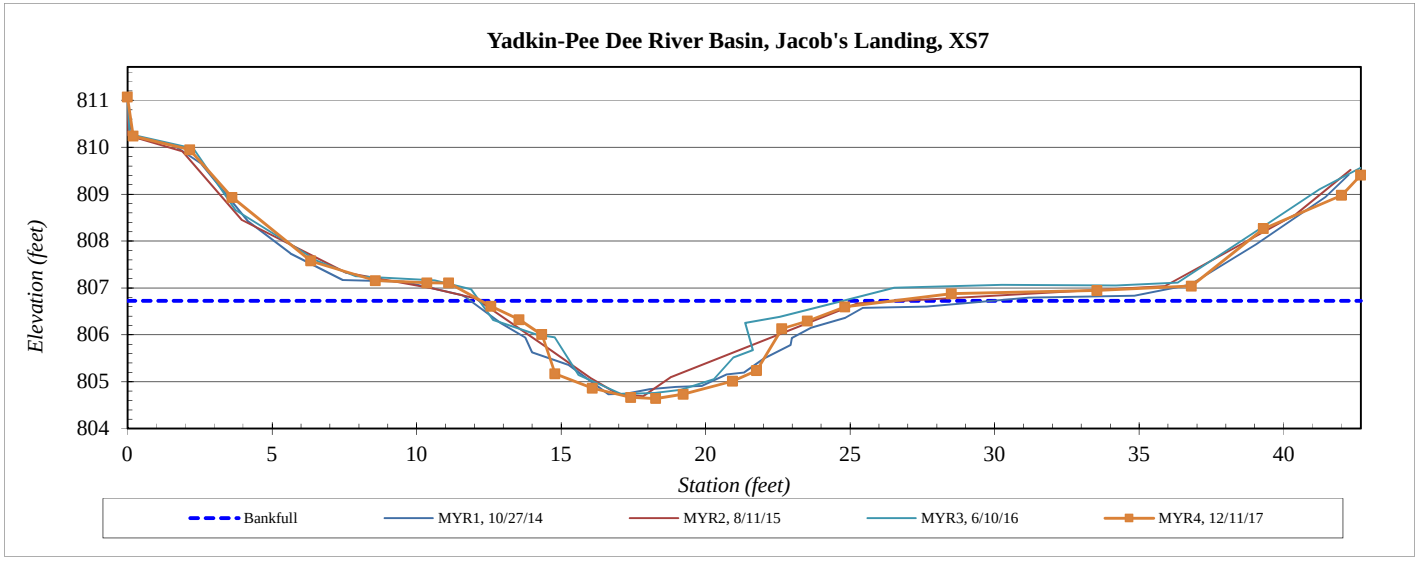
SUMMARY DATA	
Bankfull Elevation:	809.52
Bankfull Cross-Sectional Area:	7.3
Bankfull Width:	10.6
Flood Prone Area Elevation:	810.8
Flood Prone Width:	30.8
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.7
W / D Ratio:	15.5
Entrenchment Ratio:	2.9
Bank Height Ratio:	1.0



River Basin:	Yadkin-Pee Dee
Site:	Jacob's Landing
XS ID	XS7
Drainage Area (sq mi):	0.37
Date:	12/11/2017
Field Crew:	T. Seelinger, J. Sullivan

Station	Elevation
0.00	810.73
0.20	809.90
2.16	809.61
3.62	808.59
6.35	807.24
8.58	806.82
10.36	806.77
11.12	806.77
12.58	806.27
13.56	805.99
14.34	805.67
14.79	804.83
16.09	804.53
17.42	804.33
18.28	804.31
19.24	804.40
20.94	804.68
21.77	804.90
22.65	805.80
23.53	805.96
24.82	806.26
28.51	806.54
33.54	806.61
36.81	806.70
39.30	807.93
42.01	808.64
42.67	809.07

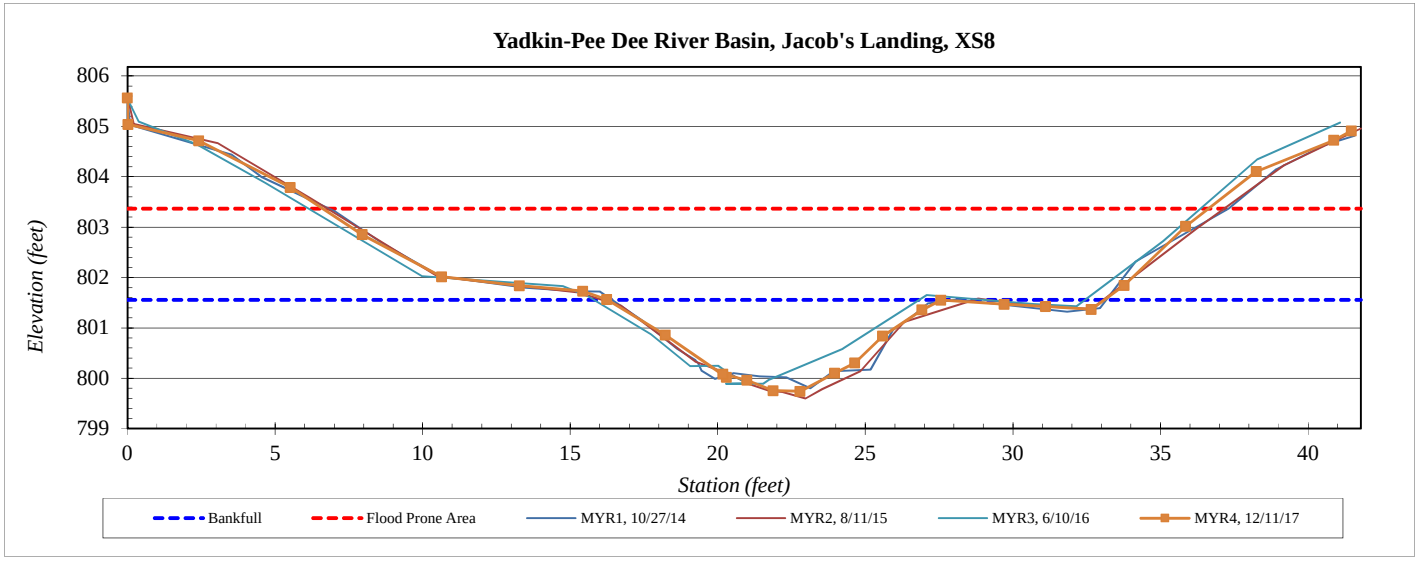
SUMMARY DATA	
Bankfull Elevation:	806.39
Bankfull Cross-Sectional Area:	16.0
Bankfull Width:	12.6
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	1.3
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-



River Basin:	Yadkin-Pee Dee
Site:	Jacob's Landing
XS ID	XS8
Drainage Area (sq mi):	0.37
Date:	12/11/2017
Field Crew:	T. Seelinger, J. Sullivan

Station	Elevation
0.00	805.39
0.02	804.86
2.42	804.54
5.53	803.61
7.97	802.67
10.65	801.84
13.28	801.66
15.44	801.55
16.24	801.39
18.23	800.68
20.30	799.84
20.18	799.91
21.00	799.79
21.88	799.58
22.79	799.57
23.96	799.93
24.65	800.13
25.59	800.67
26.92	801.19
27.56	801.38
29.71	801.30
31.11	801.25
32.66	801.19
33.77	801.67
35.86	802.84
38.25	803.93
40.88	804.55
41.47	804.73

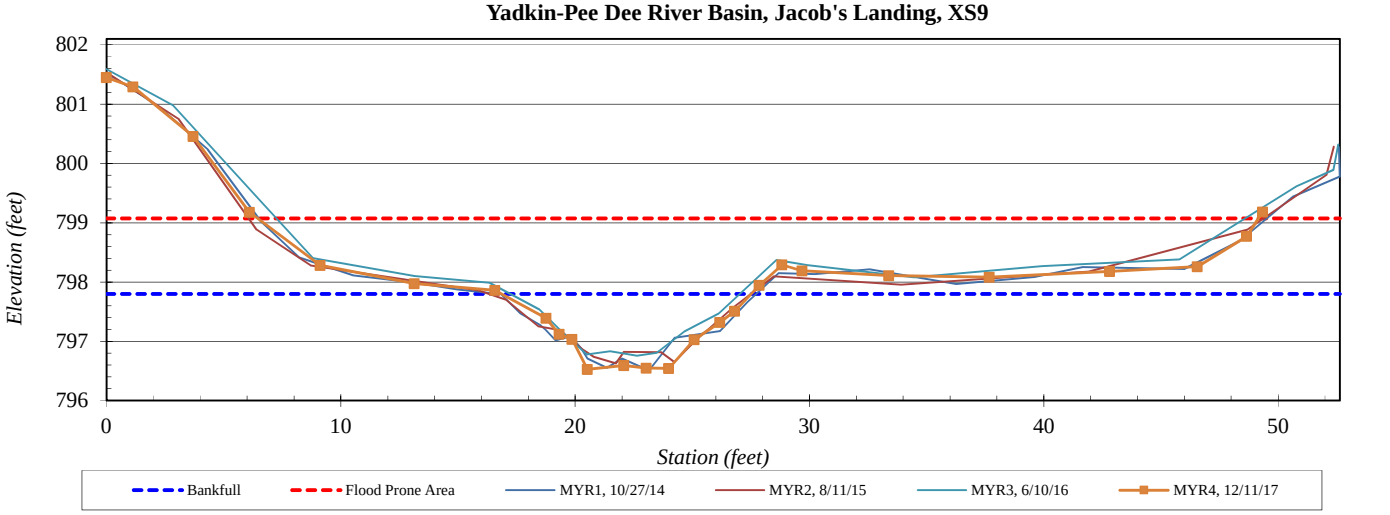
SUMMARY DATA	
Bankfull Elevation:	801.38
Bankfull Cross-Sectional Area:	11.6
Bankfull Width:	11.3
Flood Prone Area Elevation:	803.2
Flood Prone Width:	30.0
Max Depth at Bankfull:	1.8
Mean Depth at Bankfull:	1.0
W / D Ratio:	11.0
Entrenchment Ratio:	2.7
Bank Height Ratio:	1.4



River Basin:	Yadkin-Pee Dee
Site:	Jacob's Landing
XS ID	XS9
Drainage Area (sq mi):	0.37
Date:	12/11/2017
Field Crew:	T. Seelinger, J. Sullivan

Station	Elevation
0.00	801.41
1.14	801.25
3.70	800.41
6.11	799.14
9.12	798.24
13.14	797.93
16.58	797.82
18.77	797.35
19.33	797.08
19.88	796.99
20.53	796.49
22.08	796.55
23.04	796.51
23.99	796.50
25.08	796.99
26.18	797.28
26.81	797.47
27.86	797.91
28.83	798.25
29.69	798.15
33.40	798.07
37.68	798.04
42.82	798.14
46.55	798.22
48.66	798.73
49.34	799.14

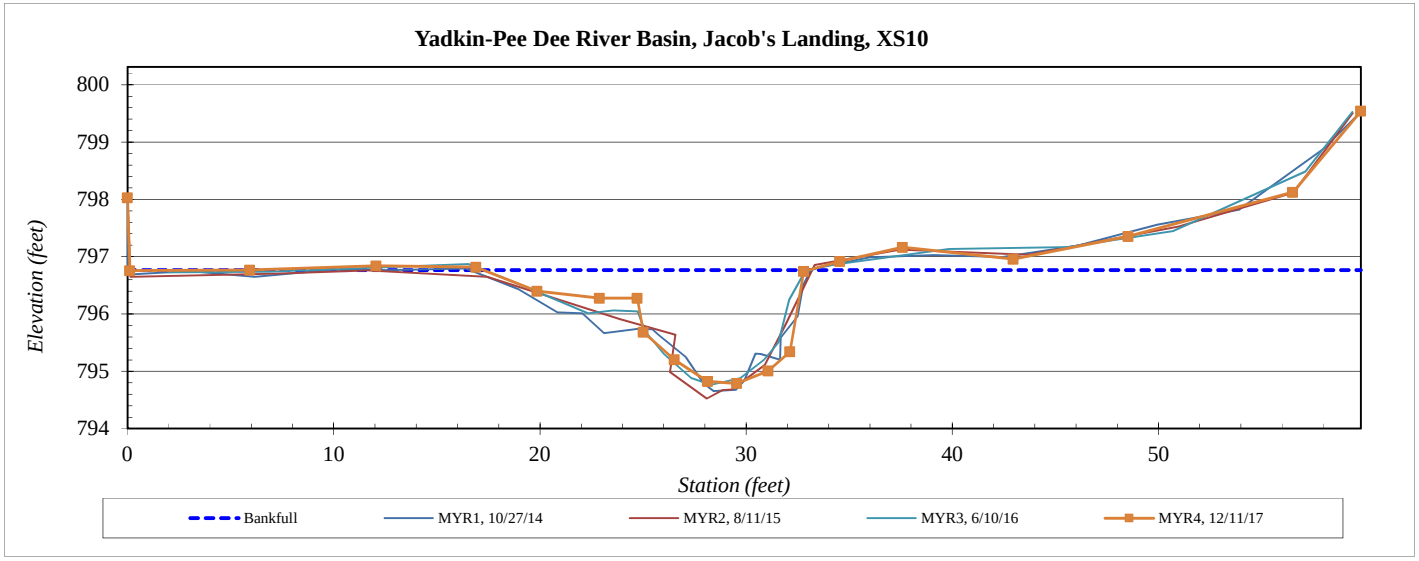
SUMMARY DATA	
Bankfull Elevation:	797.76
Bankfull Cross-Sectional Area:	8.2
Bankfull Width:	10.7
Flood Prone Area Elevation:	799.0
Flood Prone Width:	42.7
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.8
W / D Ratio:	13.8
Entrenchment Ratio:	4.0
Bank Height Ratio:	1.1



River Basin:	Yadkin-Pee Dee
Site:	Jacob's Landing
XS ID	XS10
Drainage Area (sq mi):	0.37
Date:	12/11/2017
Field Crew:	T. Seelinger, J. Sullivan

Station	Elevation
0.00	797.71
0.12	796.44
5.93	796.45
12.06	796.52
16.90	796.50
19.86	796.08
22.90	795.96
24.72	795.96
25.01	795.37
26.52	794.89
28.14	794.51
29.55	794.47
31.07	794.69
32.13	795.03
32.79	796.43
34.54	796.60
37.58	796.84
42.96	796.64
48.53	797.04
56.50	797.81
59.81	799.22

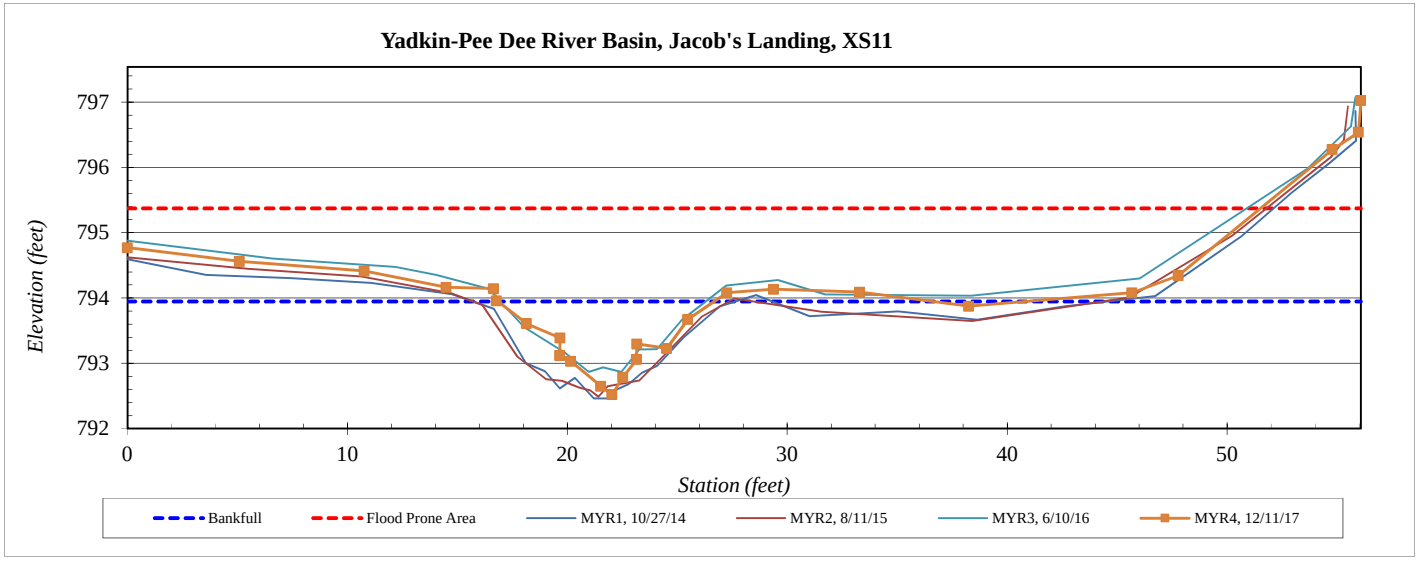
SUMMARY DATA	
Bankfull Elevation:	796.45
Bankfull Cross-Sectional Area:	17.2
Bankfull Width:	16.6
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	1.0
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-



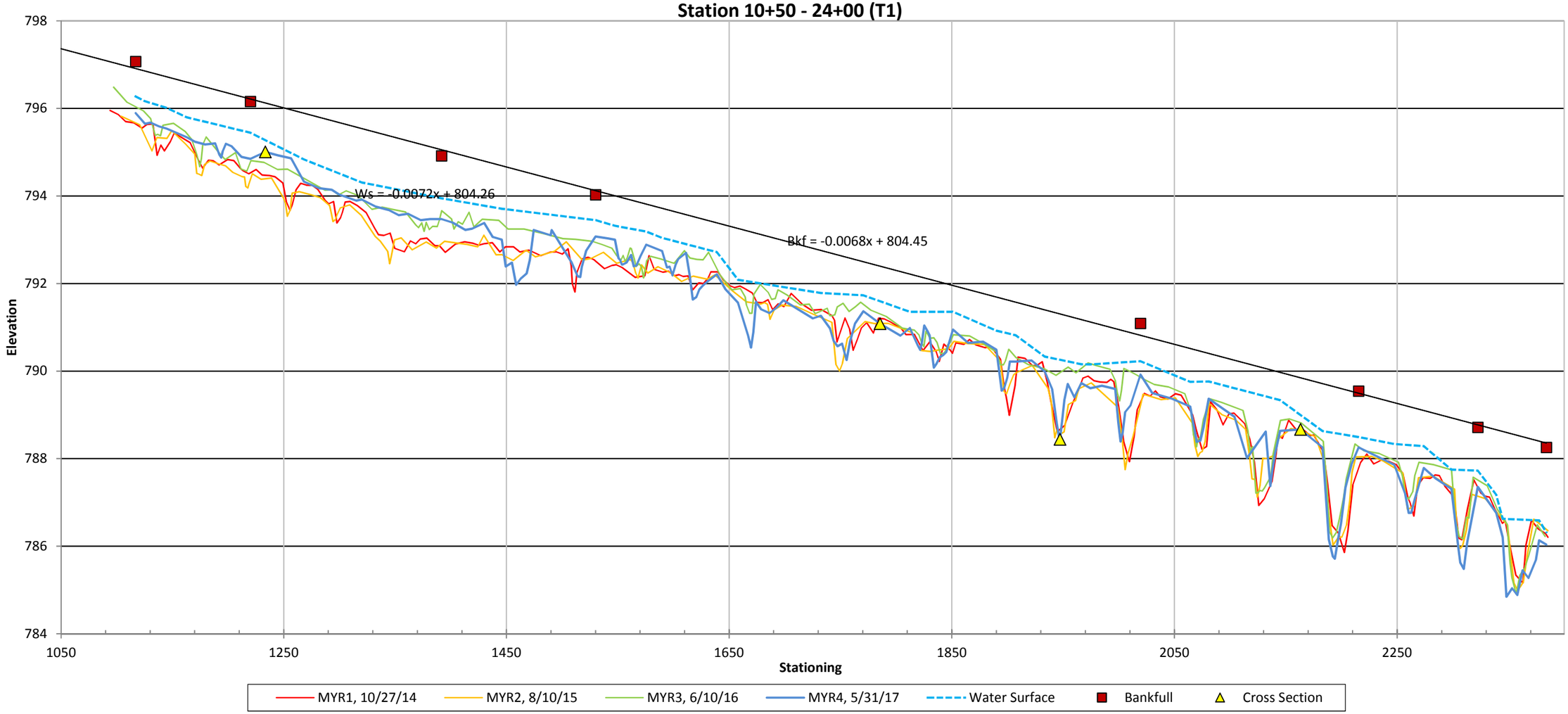
River Basin:	Yadkin-Pee Dee
Site:	Jacob's Landing
XS ID	XS11
Drainage Area (sq mi):	0.37
Date:	12/11/2017
Field Crew:	T. Seelinger, J. Sullivan

Station	Elevation
0.00	794.30
5.10	794.09
10.77	793.95
14.49	793.70
16.65	793.68
16.79	793.49
18.15	793.14
19.68	792.92
19.66	792.65
20.16	792.57
21.53	792.18
22.04	792.05
22.53	792.32
23.16	792.59
23.16	792.83
24.52	792.76
25.48	793.21
27.26	793.61
29.38	793.67
33.29	793.62
38.25	793.41
45.67	793.61
47.78	793.88
54.79	795.81
55.97	796.07
56.08	796.56

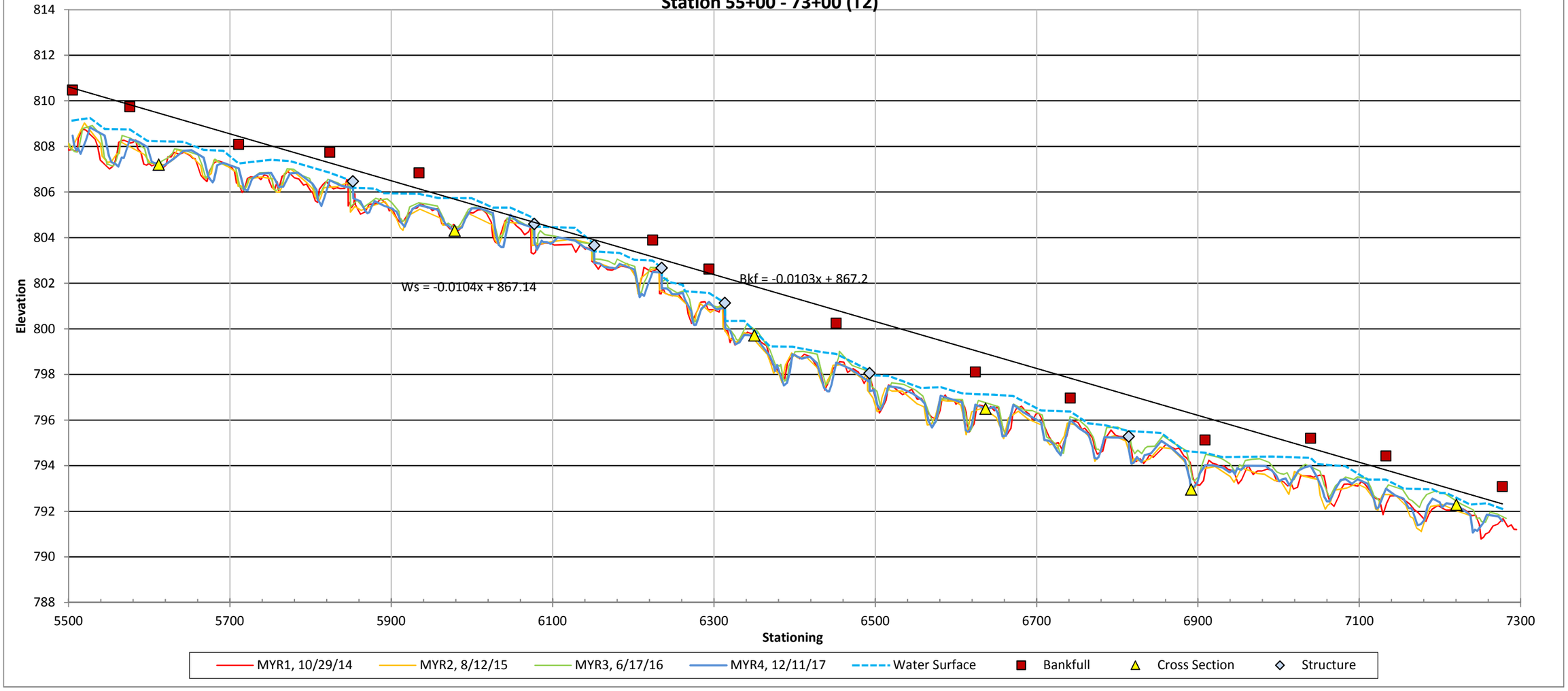
SUMMARY DATA	
Bankfull Elevation:	793.48
Bankfull Cross-Sectional Area:	6.4
Bankfull Width:	9.8
Flood Prone Area Elevation:	794.9
Flood Prone Width:	51.5
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	0.6
W / D Ratio:	15.2
Entrenchment Ratio:	5.2
Bank Height Ratio:	1.0



Longitudinal Profile
Jacob's Landing
DMS Project Number - 95024
Station 10+50 - 24+00 (T1)

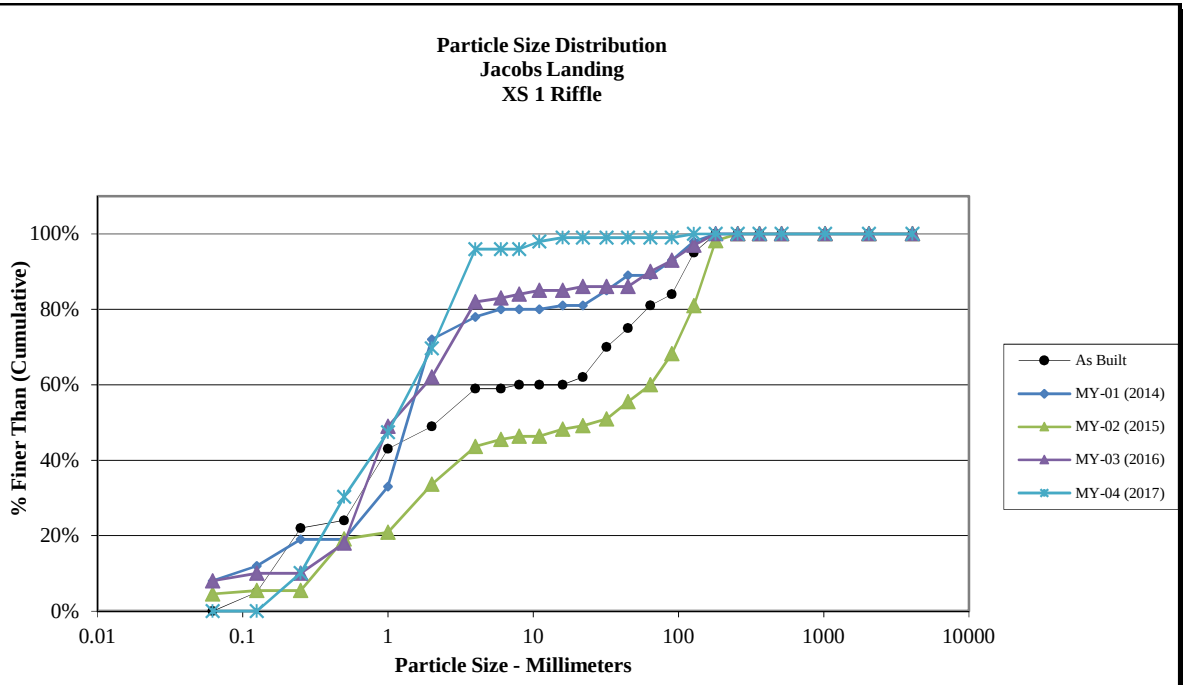


Longitudinal Profile
Jacob's Landing
DMS Project Number - 95024
Station 55+00 - 73+00 (T2)



Cross-Section 1 Riffle - MY-04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	10
Medium	.25 - .50	N	20
Coarse	.50 - 1	D	17
Very Coarse	1 - 2	S	22
Very Fine	2 - 4		26
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	2
Medium	11.3 - 16	V	1
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	1
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	99

Note:



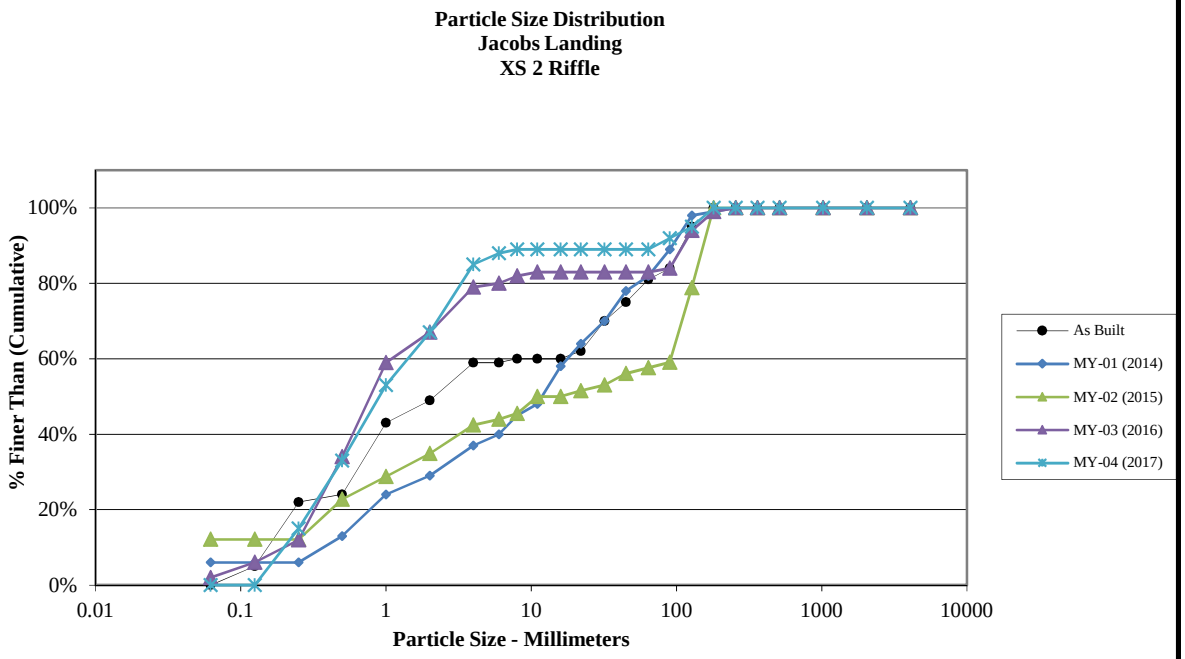
Size (mm)	
D16	0.31
D35	0.6
D50	1.1
D65	1.7
D84	2.9
D95	3.9

Size Distribution	
mean	0.9
dispersion	3.1
skewness	-0.07

Type	
silt/clay	0%
sand	70%
gravel	29%
cobble	1%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 2 Riffle - MY-04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	15
Medium	.25 - .50	N	18
Coarse	.50 - 1	D	20
Very Coarse	1 - 2	S	14
Very Fine	2 - 4		18
Fine	4 - 5.7	G	3
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	3
Small	90 - 128	O	3
Large	128 - 180	B	5
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



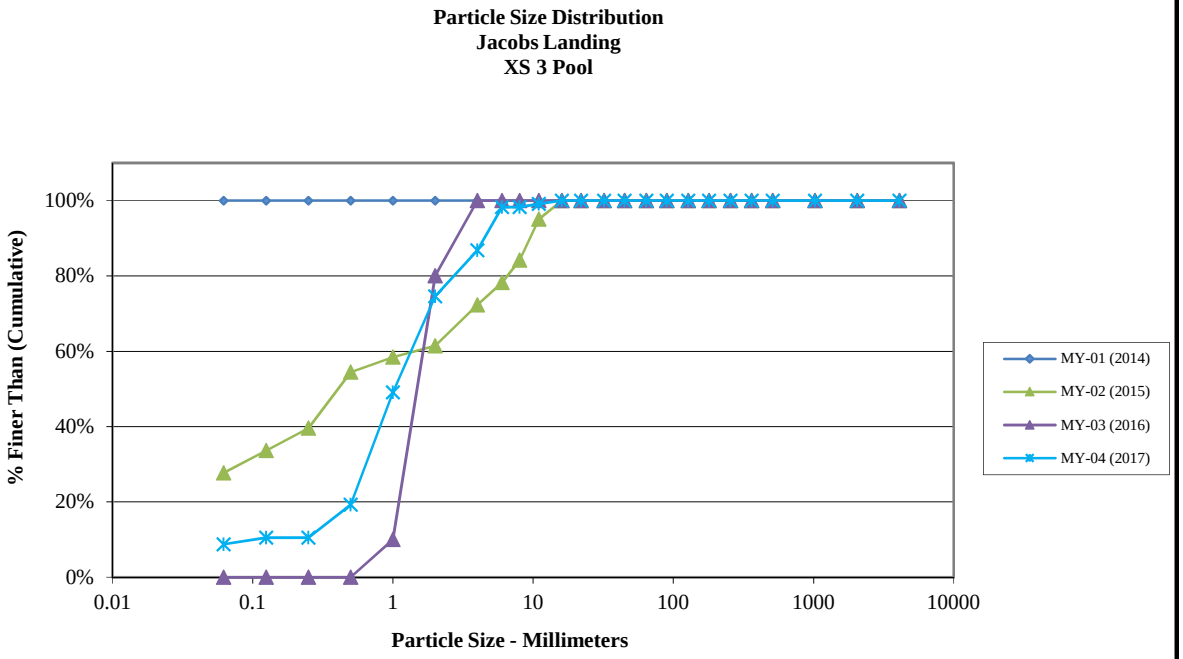
Size (mm)	
D16	0.26
D35	0.54
D50	0.9
D65	1.8
D84	3.8
D95	130

Size Distribution	
mean	1.0
dispersion	3.8
skewness	0.04

Type	
silt/clay	0%
sand	67%
gravel	22%
cobble	11%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 3 Pool - MY-04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	10
Very Fine	.062 - .125	S	2
Fine	.125 - .25	A	
Medium	.25 - .50	N	10
Coarse	.50 - 1	D	34
Very Coarse	1 - 2	S	29
Very Fine	2 - 4		14
Fine	4 - 5.7	G	13
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	1
Medium	11.3 - 16	V	1
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	114

Note:



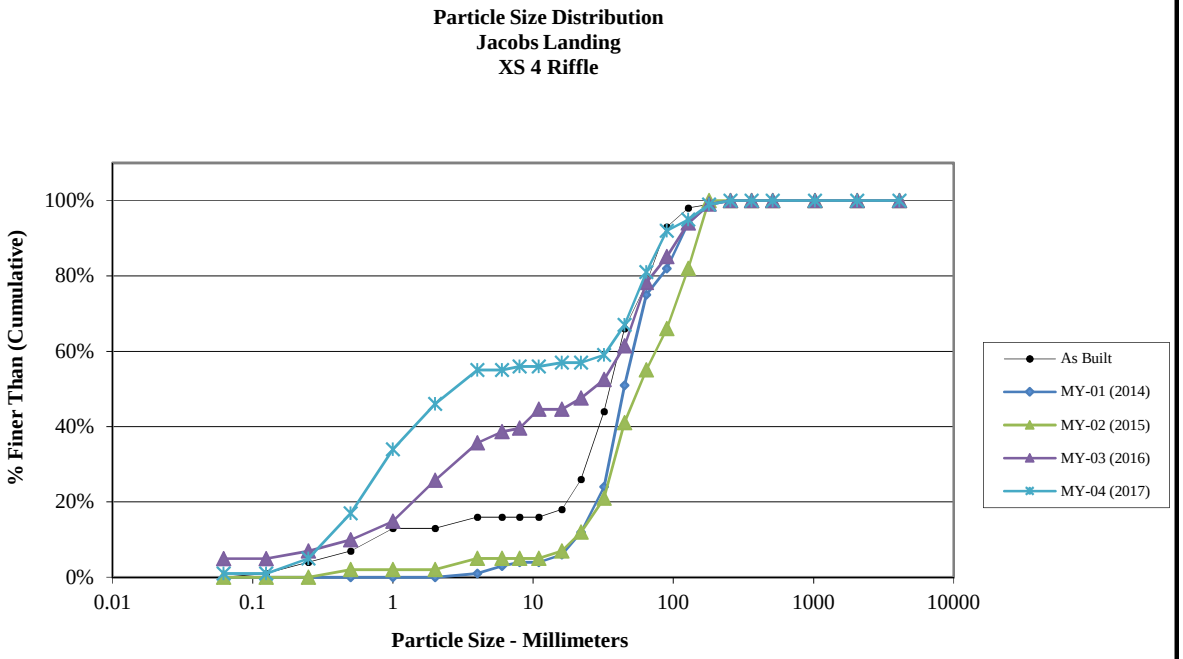
Size (mm)	
D16	0.39
D35	0.72
D50	1
D65	1.5
D84	3.4
D95	5.3

Size Distribution	
mean	1.2
dispersion	3.0
skewness	0.06

Type	
silt/clay	9%
sand	66%
gravel	25%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 4 Riffle - MY-04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	1
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	4
Medium	.25 - .50	N	12
Coarse	.50 - 1	D	17
Very Coarse	1 - 2	S	12
Very Fine	2 - 4		9
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	1
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	2
Very Coarse	32 - 45	S	8
Very Coarse	45 - 64		14
Small	64 - 90	C	11
Small	90 - 128	O	3
Large	128 - 180	B	4
Large	180 - 256	L	1
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



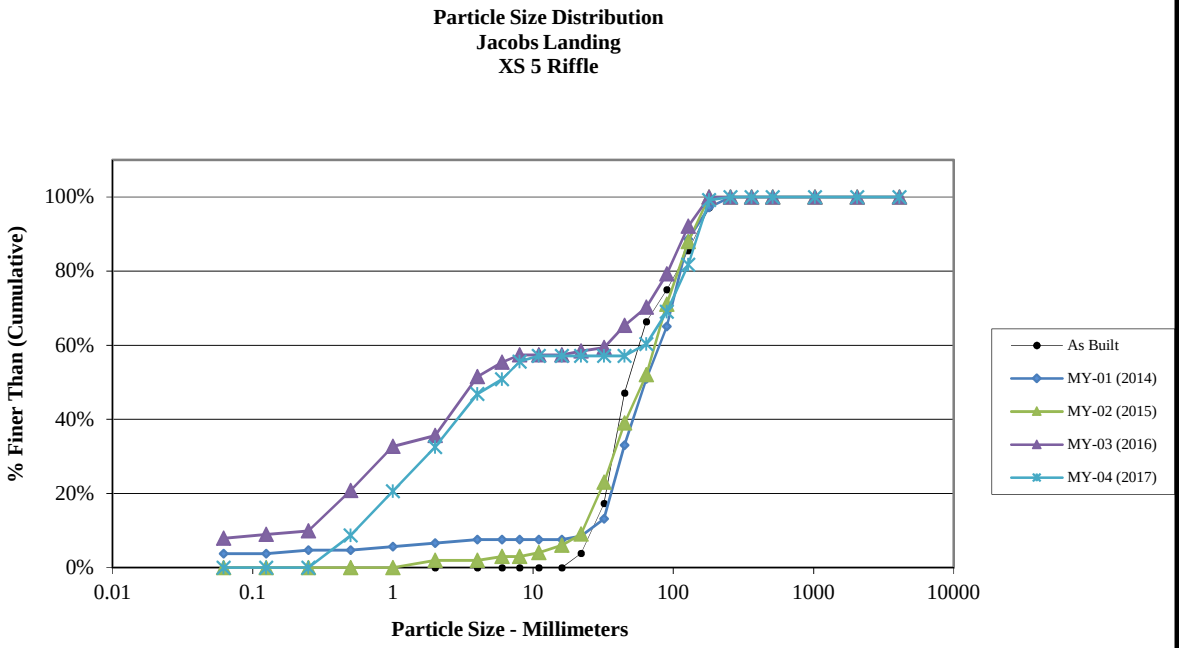
Size (mm)	
D16	0.47
D35	1.1
D50	2.7
D65	41
D84	70
D95	130

Size Distribution	
mean	5.7
dispersion	15.8
skewness	0.22

Type	
silt/clay	1%
sand	45%
gravel	35%
cobble	19%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 5 Riffle - MY-04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	11
Coarse	.50 - 1	D	15
Very Coarse	1 - 2	S	15
Very Fine	2 - 4		18
Fine	4 - 5.7	G	5
Fine	5.7 - 8	R	6
Medium	8 - 11.3	A	2
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		4
Small	64 - 90	C	11
Small	90 - 128	O	16
Large	128 - 180	B	22
Large	180 - 256	L	1
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	126

Note:



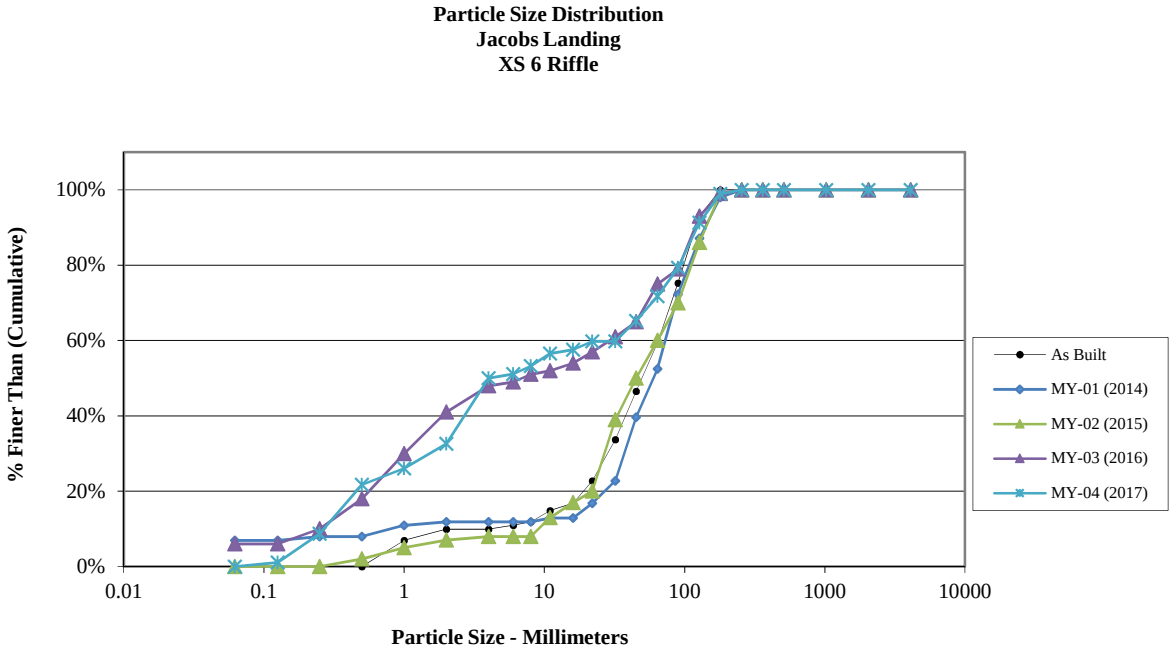
Size (mm)	
D16	0.76
D35	2.3
D50	5.5
D65	77
D84	130
D95	170

Size Distribution	
mean	9.9
dispersion	15.4
skewness	0.17

Type	
silt/clay	0%
sand	33%
gravel	28%
cobble	40%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 6 Riffle -MY-04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	1
Very Fine	.062 - .125	S	7
Fine	.125 - .25	A	12
Medium	.25 - .50	N	4
Coarse	.50 - 1	D	6
Very Coarse	1 - 2	S	16
Very Fine	2 - 4		1
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	1
Medium	11.3 - 16	V	2
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	5
Very Coarse	32 - 45	S	6
Very Coarse	45 - 64		7
Small	64 - 90	C	11
Small	90 - 128	O	7
Large	128 - 180	B	1
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	92

Note:



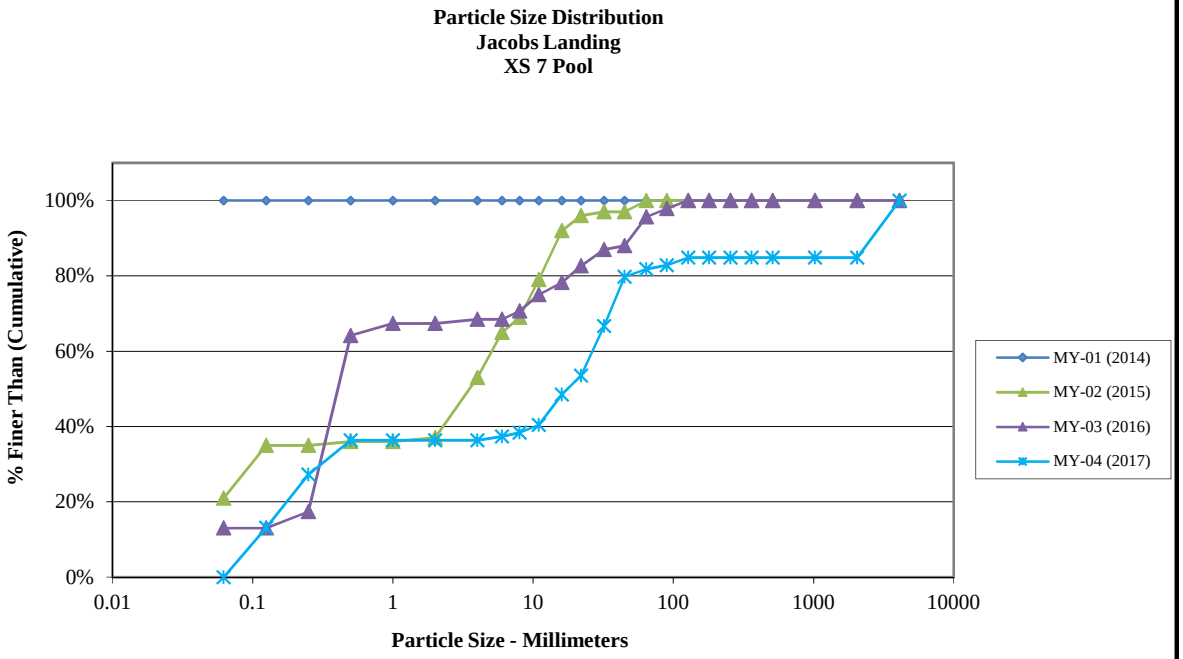
Size (mm)	
D16	0.18
D35	1.1
D50	2
D65	32
D84	73
D95	110

Size Distribution	
mean	3.6
dispersion	23.8
skewness	0.16

Type	
silt/clay	1%
sand	49%
gravel	29%
cobble	21%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 7 Pool -MY-04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	13
Fine	.125 - .25	A	14
Medium	.25 - .50	N	9
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	2
Medium	11.3 - 16	V	8
Coarse	16 - 22.6	E	5
Coarse	22.6 - 32	L	13
Very Coarse	32 - 45	S	13
Very Coarse	45 - 64		2
Small	64 - 90	C	1
Small	90 - 128	O	2
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	15
		Total	99

Note: Lots of saprolite, recorded as bedrock



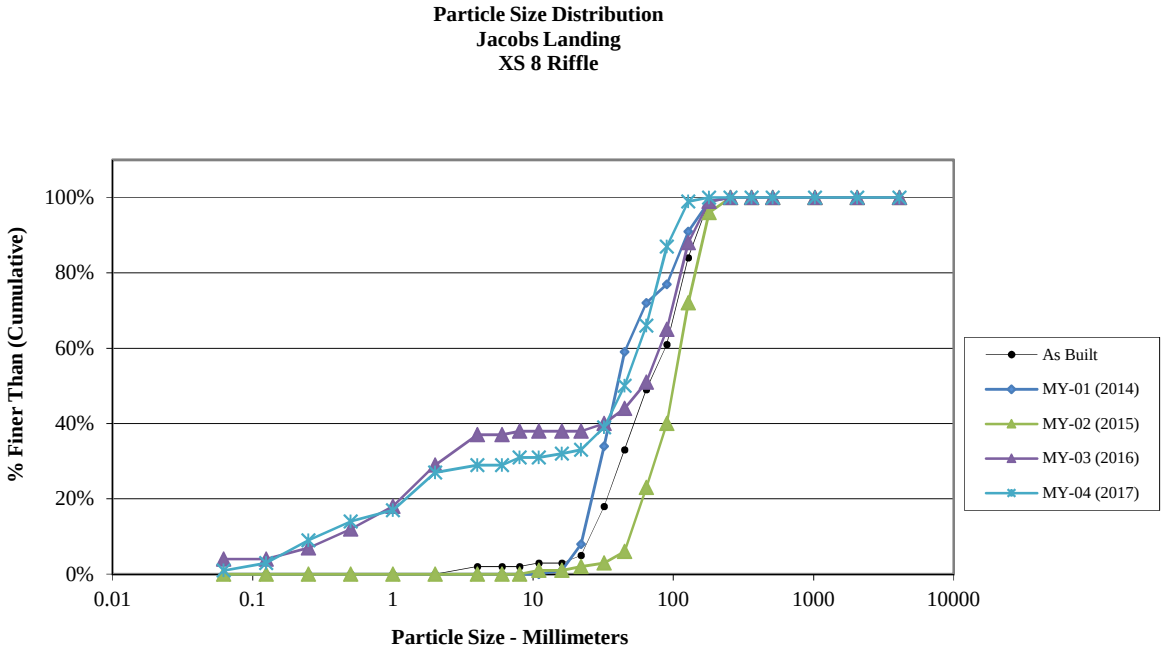
Size (mm)	
D16	0.14
D35	0.45
D50	18
D65	31
D84	110
D95	3300

Size Distribution	
mean	3.9
dispersion	67.3
skewness	-0.39

Type	
silt/clay	0%
sand	36%
gravel	45%
cobble	3%
boulder	0%
bedrock	15%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 8 Riffle -MY-04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	1
Very Fine	.062 - .125	S	2
Fine	.125 - .25	A	6
Medium	.25 - .50	N	5
Coarse	.50 - 1	D	3
Very Coarse	1 - 2	S	10
Very Fine	2 - 4		2
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	1
Coarse	16 - 22.6	E	1
Coarse	22.6 - 32	L	6
Very Coarse	32 - 45	S	11
Very Coarse	45 - 64		16
Small	64 - 90	C	21
Small	90 - 128	O	12
Large	128 - 180	B	1
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



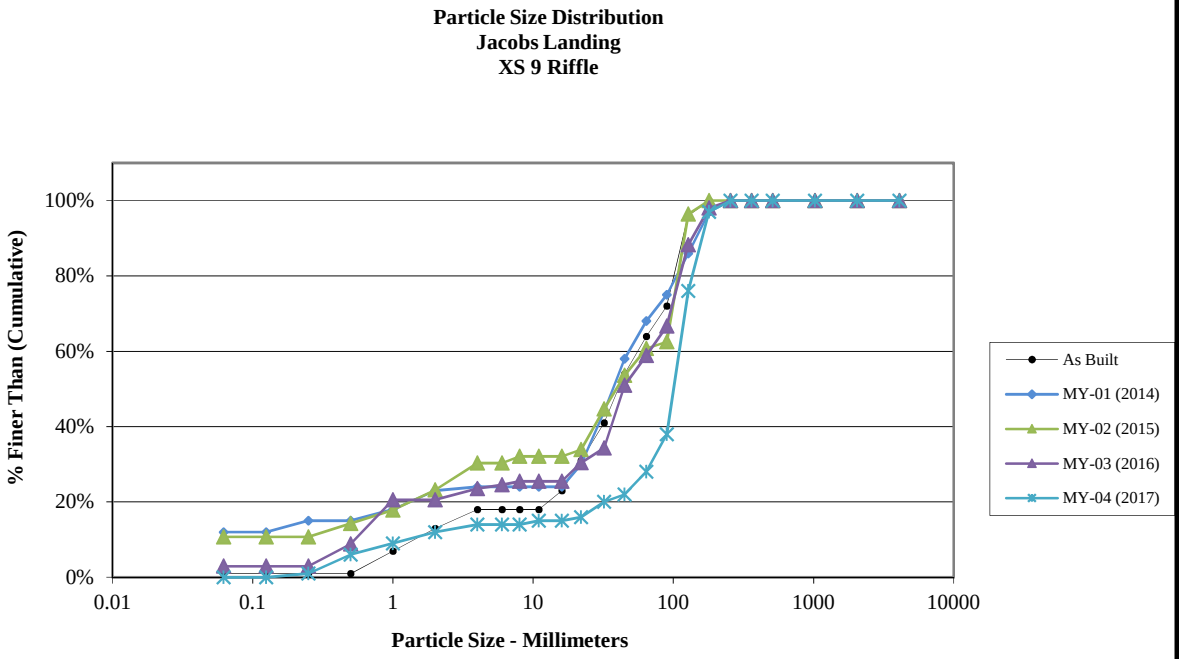
Size (mm)	
D16	0.79
D35	25
D50	45
D65	63
D84	86
D95	110

Size Distribution	
mean	8.2
dispersion	29.4
skewness	-0.52

Type	
silt/clay	1%
sand	26%
gravel	39%
cobble	34%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 9 Riffle - MY-04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	1
Medium	.25 - .50	N	5
Coarse	.50 - 1	D	3
Very Coarse	1 - 2	S	3
Very Fine	2 - 4		2
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	1
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	1
Coarse	22.6 - 32	L	4
Very Coarse	32 - 45	S	2
Very Coarse	45 - 64		6
Small	64 - 90	C	10
Small	90 - 128	O	38
Large	128 - 180	B	21
Large	180 - 256	L	3
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



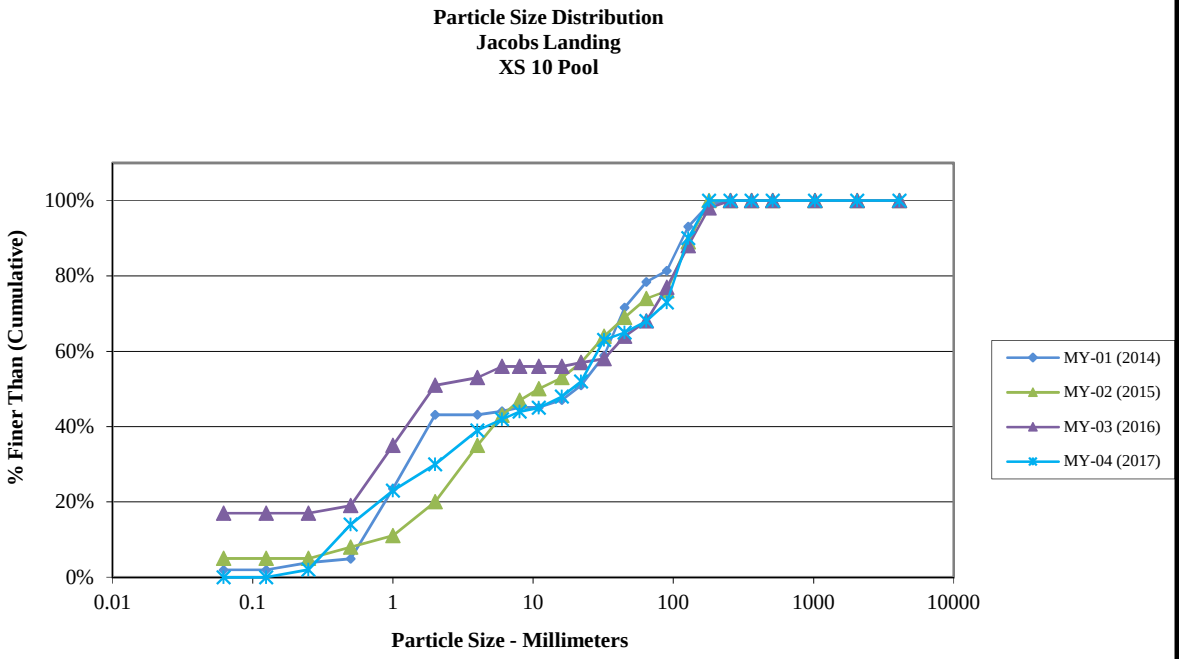
Size (mm)	
D16	22
D35	81
D50	100
D65	120
D84	150
D95	170

Size Distribution	
mean	57.4
dispersion	3.0
skewness	-0.26

Type	
silt/clay	0%
sand	12%
gravel	16%
cobble	72%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 10 Pool - MY-04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	2
Medium	.25 - .50	N	12
Coarse	.50 - 1	D	9
Very Coarse	1 - 2	S	7
Very Fine	2 - 4		9
Fine	4 - 5.7	G	3
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	1
Medium	11.3 - 16	V	3
Coarse	16 - 22.6	E	4
Coarse	22.6 - 32	L	11
Very Coarse	32 - 45	S	2
Very Coarse	45 - 64		3
Small	64 - 90	C	5
Small	90 - 128	O	17
Large	128 - 180	B	10
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



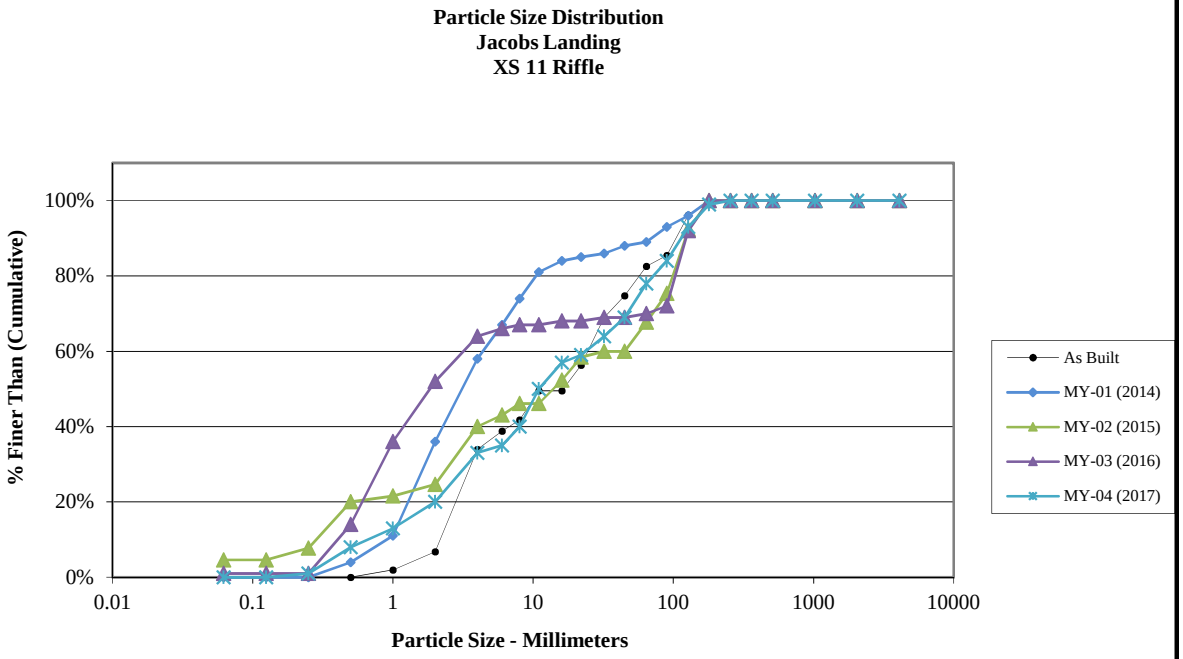
Size (mm)	
D16	0.58
D35	2.9
D50	19
D65	45
D84	110
D95	150

Size Distribution	
mean	8.0
dispersion	19.3
skewness	-0.25

Type	
silt/clay	0%
sand	30%
gravel	38%
cobble	32%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 11 Riffle - MY-04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	1
Medium	.25 - .50	N	7
Coarse	.50 - 1	D	5
Very Coarse	1 - 2	S	7
Very Fine	2 - 4		13
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	5
Medium	8 - 11.3	A	10
Medium	11.3 - 16	V	7
Coarse	16 - 22.6	E	2
Coarse	22.6 - 32	L	5
Very Coarse	32 - 45	S	5
Very Coarse	45 - 64		9
Small	64 - 90	C	6
Small	90 - 128	O	9
Large	128 - 180	B	6
Large	180 - 256	L	1
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



Size (mm)	
D16	1.3
D35	6
D50	11
D65	34
D84	90
D95	140

Size Distribution	
mean	10.8
dispersion	8.3
skewness	-0.01

Type	
silt/clay	0%
sand	20%
gravel	58%
cobble	22%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Table 10a. T1 Baseline Stream Data Summary
Jacob's Landing Stream Restoration Site, DMS Project # 95024

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design		As-built			
Dimension - Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Max	n
Bankfull Width (ft)	6.5			9.1	4	6.9				1	11.5	12.2	10.1	11.0	12.1	3
Floodprone Width (ft)	1			26	4	23				1	25	70	40	56	71	3
Bankfull Mean Depth (ft)	0.9			1.8	4	1.1				1	1.0	1.0	0.8	0.8	0.8	3
Bankfull Max Depth (ft)	1.1			2.8	4	1.6				1	1.5	1.6	1.2	1.3	1.4	3
Bankfull Cross-Sectional Area (ft^2)	8.6			12.1	4	7.4				1	11.2	12.6	7.9	8.8	10.0	3
Width/Depth Ratio	3.7			9.6	4	6.4				1	12.0	12.0	12.9	13.8	14.6	3
Entrenchment Ratio	1.5			3.3	4	3.4				1	2.2	4.9	3.7	5.1	5.9	3
Bank Height Ratio	1.6			2.2	4	1.0				1	1.0	1.0	1.0	1.0	1.0	3
Pattern																
Channel Beltwidth (ft)	13			26	2	14	26		38	2	25	50	25	38	50	
Radius of Curvature (ft)	6			30	2	12	19		25	2	20	45	20	33	45	
Rc:Bankfull width (ft/ft)	0.7			4.6	2	1.7	2.7		3.6	2	2.0	4.0	2.0	3.0	4.0	
Meander Wavelength (ft)	75			110	2	43	73		102	2	65	125	65	95	125	
Meander Width Ratio	1.4			4.0	2	2	3.8		5.5	2	1.9	3.5	1.9	3.0	3.5	
Profile																
Riffle Length (ft)													11	22	32	21
Riffle Slope (ft/ft)	0.007			0.043	2	0.011			0.025	2	0.007	0.012	0.001	0.013	0.026	21
Pool Length (ft)						16			23		12	30	6	18	38	23
Pool Spacing (ft)						28			57		20	75	30	56	79	23
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 24% / 76% / 0% / 0% / 0%												0% / 25% / 52% / 23% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)	1 / 5 / 7 / 10 / 17 / 25												5 / 15 / 22 / 38 / 94 / 143			
Additional Reach Parameters																
Channel length (ft)	1,330										1,305		1,305			
Drainage Area (SM)	0.40					0.16					0.40		0.40			
Rosgen Classification	G4					E4					C4		C4			
Sinuosity	1.07-1.15					1.18					1.09-1.12		1.09-1.12			
Water Surface Slope (ft/ft)	0.009-0.014					0.0070					0.007-0.010		0.007			

Table 10b. T1A Baseline Stream Data Summary																
Jacob's Landing Stream Restoration Site, DMS Project # 95024																
Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design		As-built			
Dimension - Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Max	n
Bankfull Width (ft)	7.7				1	6.9				1	8.5					
Floodprone Width (ft)	15				1	23				1	19					
Bankfull Mean Depth (ft)	0.8				1	1.1				1	0.7					
Bankfull Max Depth (ft)	1.2				1	1.6				1	1.2					
Bankfull Cross-Sectional Area (ft^2)	6.4				1	7.4				1	6.2					
Width/Depth Ratio	9.3				1	6.4				1	12.0					
Entrenchment Ratio	1.9				1	3.4				1	2.2					
Bank Height Ratio	2.2				1	1.0				1	1.0					
Pattern																
Channel Beltwidth (ft)	20			75	1	14	26		38	2	19	24				
Radius of Curvature (ft)	8			24	1	12	19		25	2	10	25				
Rc:Bankfull width (ft/ft)	1			3.1	1	1.7	2.7		3.6	2	1.2	2.9				
Meander Wavelength (ft)	25			50	1	43	73		102	2	50	55				
Meander Width Ratio	2.6			9.7	1	2	3.8		5.5	2	2.2	2.8				
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.013			0.019	1	0.011			0.025	2	0.010	0.012				
Pool Length (ft)						16			23		7	14				
Pool Spacing (ft)						28			57		22	34				
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%																
d16 / d35 / d50 / d84 / d95 (mm)																
Additional Reach Parameters																
Channel length (ft)	294										178		178			
Drainage Area (SM)	0.21					0.40					0.21		0.21			
Rosgen Classification	E4					B4c					B4c/C4		B4c/C4			
Sinuosity	2.10					1.20					1.11					
Water Surface Slope (ft/ft)	0.023					0.013					0.017					

Table 10c. T2 Baseline Stream Summary																
Jacob's Landing Stream Restoration Site, DMS Project # 95024																
Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design		As-built			
Dimension - Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Max	n
Bankfull Width (ft)	8.8			12.3	4	6.9				1	10.4	11.6	10.4	10.9	12.0	5
Floodprone Width (ft)	17			20	4	23				1	23	50	27	32	42	5
Bankfull Mean Depth (ft)	1.0			1.0	4	1.1				1	0.9	1.0	0.8	0.8	0.9	5
Bankfull Max Depth (ft)	1.3			1.8	4	1.6				1	1.4	1.5	1.2	1.3	1.4	5
Bankfull Cross-Sectional Area (ft^2)	9.2			11.7	4	7.4				1	9.1	11.1	8.8	9.2	9.7	5
Width/Depth Ratio	8.4			12.9	4	6.4				1	12.0	12.0	11.8	12.9	15.2	5
Entrenchment Ratio	1.4			2.3	4	3.4				1	2.2	4.3	2.6	3.2	4.2	5
Bank Height Ratio	1.5			4.7	4	1.0				1	1.0	1.0	1.0	1.0	1.0	5
Pattern																
Channel Beltwidth (ft)	10			60	2	14	26		38	2	25	50	25	38	50	
Radius of Curvature (ft)	8			35	2	12	19		25	2	20	45	20	33	45	
Rc:Bankfull width (ft/ft)	0.9			3.9	2	1.7	2.7		3.6	2	2.0	4.0	2.0	3.0	4.0	
Meander Wavelength (ft)	65			130	2	43	73		102	2	60	130	60	95	130	
Meander Width Ratio	1.1			6.8	2	2	3.8		5.5	2	2.2	4.8	2.2	4.0	4.8	
Profile																
Riffle Length (ft)													14	22	36	33
Riffle Slope (ft/ft)	0.003			0.011	2	0.011			0.025	2	0.006	0.017	0.004	0.016	0.041	33
Pool Length (ft)						16			23	2	8	35	7	18	35	31
Pool Spacing (ft)						28			57	2	30	95	42	59	107	31
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	6% / 25% / 68% / 1% / 0% / 0%												0% / 6% / 58% / 32% / 3% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)	1 / 2 / 3 / 6 / 12 / 24												16 / 30 / 44 / 65 / 109 / 144			
Additional Reach Parameters																
Channel length (ft)	2,935										2,641		2,641			
Drainage Area (SM)	0.31					0.16					0.31		0.31			
Rosgen Classification	E4, F4					E4					C4		C4			
Sinuosity	1.09-1.45					1.18					1.16-1.31		1.16-1.31			
Water Surface Slope (ft/ft)	0.007-0.010					0.0007					0.009-0.0100		0.009			

Table 10d. T2A Baseline Stream Data Summary																
Jacob's Landing Stream Restoration Site, DMS Project # 95024																
Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design		As-built			
Dimension - Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Max	n
Bankfull Width (ft)	6.6				1	6.9				1	6.5					
Floodprone Width (ft)	11				1	23				1	14					
Bankfull Mean Depth (ft)	0.5				1	1.1				1	0.5					
Bankfull Max Depth (ft)	1.1				1	1.6				1	0.9					
Bankfull Cross-Sectional Area (ft^2)	3.4				1	7.4				1	3.5					
Width/Depth Ratio	12.8				1	6.4				1	12.0					
Entrenchment Ratio	1.7				1	3.4				1	2.2					
Bank Height Ratio	6.3				1	1.0				1	1.0					
Pattern																
Channel Beltwidth (ft)	8			15	1	14	26		38	2	8	15				
Radius of Curvature (ft)	10			12	1	12	19		25	2	10	25				
Rc:Bankfull width (ft/ft)	1.5			1.8	1	1.7	2.7		3.6	2	1.5	3.8				
Meander Wavelength (ft)	50			63	1	43	73		102	2	50	63				
Meander Width Ratio	1.2			2.3	1	2	3.8		5.5	2	1.2	2.3				
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.010			0.017	1	0.011			0.025	2	0.010	0.012				
Pool Length (ft)						16			23	2	4	15				
Pool Spacing (ft)						28			57	2	22	42				
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%																
d16 / d35 / d50 / d84 / d95 (mm)																
Additional Reach Parameters																
Channel length (ft)	465										465		465			
Drainage Area (SM)	0.06					0.40					0.06		0.06			
Rosgen Classification	G4					B4c					B4c/C4		B4c/C4			
Sinuosity	1.16					1.20					1.13					
Water Surface Slope (ft/ft)	0.019					0.013					0.014					

Table 11. Cross-Section Morphology Data Tables
Jacob's Landing Stream Restoration Site, DMS Project # 95024

Dimension and Substrate	Cross-Section 1 (T1-Riffle) Station 12+29							Cross-Section 2 (T1-Riffle) Station 17+79							Cross-Section 3 (T1-Pool) Station 19+25							Cross-Section 4 (T1-Riffle) Station 21+36							Cross-Section 5 (T2-Riffle) Station 52+53						
Based on fixed baseline elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	10.8	11.8	12.1	8.4	6.7			12.1	24.1	12.8	11.7	11.3			15.5	15.3	13.9	12.3	8.8			10.1	11.9	9.2	8.9	10.0			10.4	11.7	10.8	11.2	11.2		
Floodprone Width (ft)	40.0	41.2	40.7	38.0	37.2			71.0	70.6	72.4	70.8	69.7			-	-	-	-	-			58.0	59.8	58.8	57.3	58.5			27.0	27.4	26.8	26.3	26.6		
Bankfull Mean Depth (ft)	0.8	0.8	0.7	0.6	0.6			0.8	0.5	0.8	0.7	0.7			1.2	1.1	1.2	0.5	1.6			0.8	0.7	0.7	0.6	0.7			0.9	0.9	0.9	0.7	0.8		
Bankfull Max Depth (ft)	1.3	1.4	1.4	1.1	0.9			1.4	1.4	1.5	1.3	1.3			2.8	2.9	2.7	1.0	2.9			1.2	1.3	1.3	1.1	1.3			1.3	1.6	1.5	1.3	1.4		
Bankfull Cross-Sectional Area (ft^2)	8.5	9.0	8.7	4.7	4.0			10.0	12.5	10.3	7.7	8.0			18.1	17.2	17.3	6.5	14.0			7.9	8.6	6.3	5.1	7.0			9.0	10.5	10.0	8.1	8.5		
Bankfull Width/Depth Ratio	13.7	15.5	16.8	15.0	11.5			14.6	46.5	15.9	17.8	15.9			-	-	-	-	-			12.9	16.7	13.4	15.5	14.3			12.0	13.0	11.8	15.5	14.9		
Bankfull Entrenchment Ratio	3.7	3.5	3.4	4.5	5.5			5.9	2.9	5.7	6.1	6.2			-	-	-	-	-			5.7	5.0	6.4	6.4	5.9			2.6	2.3	2.5	2.3	2.4		
Bankfull Bank Height Ratio	1.0	1.1	1.0	0.8	0.7			1.0	1.0	1.0	0.9	0.9			-	-	-	-	-			1.0	1.1	1.0	0.9	1.1			1.0	1.2	1.2	1.1	1.1		
d50 (mm)	2.1	1.4	27	1.1	1.1			28	12	11	0.8	0.9			-	-	-	-	-			35	44	56	27	2.7			47	63	61	3.7	5.5		

	Cross-Section 6 (T2-Riffle) Station 56+18							Cross-Section 7 (T2-Pool) Station 60+09							Cross-Section 8 (T2-Riffle) Station 63+84							Cross-Section 9 (T2-Riffle) Station 66+63							Cross-Section 10 (T2-Pool) Station 68+61						
Based on fixed baseline elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	10.6	12.5	10.5	10.2	10.6			13.3	13.5	14.3	12.6	12.6			10.7	11.4	12.5	11.0	11.3			10.8	11.8	11.1	9.8	10.7			12.5	16.5	21.2	20.7	16.6		
Floodprone Width (ft)	29.0	31.9	31.0	28.4	30.8			-	-	-	-	-			30.0	30.0	31.1	29.5	30.0			42.0	43.1	42.7	39.9	42.7			-	-	-	-	-		
Bankfull Mean Depth (ft)	0.8	0.7	0.8	0.6	0.7			1.0	1.2	1.0	1.1	1.3			0.9	1.0	1.0	0.9	1.0			0.9	0.7	0.7	0.6	0.8			1.2	1.0	0.8	1.3	1.0		
Bankfull Max Depth (ft)	1.3	1.4	1.4	1.1	1.3			1.9	2.0	2.0	2.0	2.1			1.3	1.8	2.0	1.7	1.8			1.2	1.3	1.2	1.0	1.3			1.8	2.1	2.2	2.0	2.1		
Bankfull Cross-Sectional Area (ft^2)	8.8	8.8	7.9	6.4	7.3			13.8	16.5	13.9	13.5	16.0			9.7	11.8	12.8	10.4	11.6			9.2	8.0	7.6	6.3	8.2			14.5	17.2	17.1	17.2	17.2		
Bankfull Width/Depth Ratio	12.8	18.6	13.8	16.3	15.5			-	-	-	-	-			11.8	11.0	12.2	11.6	11.0			12.7	17.8	16.2	15.2	13.8			-	-	-	-	-		
Bankfull Entrenchment Ratio	2.7	2.5	3.0	2.8	2.9			-	-	-	-	-			2.8	2.6	2.5	2.7	2.7			3.9	3.6	3.9	4.1	4.0			-	-	-	-	-		
Bankfull Bank Height Ratio	1.0	1.1	1.1	0.9	1.0			-	-	-	-	-			1.0	1.3	1.5	1.3	1.4			1.0	1.1	1.0	0.9	1.1			-	-	-	-	-		
d50 (mm)	49	60	45	6.9	2.0			-	-	-	-	-			66	40	100	61	45			41	37	29	44	100			-	-	-	-	-		

	Cross-Section 11 (T2-Riffle) Station 72+48						
Based on fixed baseline elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	12.0	11.7	11.5	10.8	9.8		
Floodprone Width (ft)	>50	>50	>50	>50	>50		
Bankfull Mean Depth (ft)	0.8	0.8	0.8	0.7	0.6		
Bankfull Max Depth (ft)	1.4	1.5	1.5	1.3	1.4		
Bankfull Cross-Sectional Area (ft^2)	9.5	9.6	9.7	8.0	6.4		
Bankfull Width/Depth Ratio	15.2	14.3	13.7	14.6	15.2		
Bankfull Entrenchment Ratio	4.2	4.5	4.5	4.7	5.2		
Bankfull Bank Height Ratio	1.0	1.0	1.0	0.9	1.0		
d50 (mm)	16	3.1	14	1.8	11		

Table 11b. Stream Reach Morphology Data Tables
Jacob's Landing Stream Restoration Site, DMS Project # 95024
Reach: T1 (2,389 ft.)

Parameter	MY01 (2014)						MY02 (2015)						MY03 (2016)						MY04 (2017)						MY05 (2018)					
Dimension	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
Bankfull Width (ft)	11.8	15.9	11.9	24.1	7.0	3	9.2	11.3	12.1	12.8	1.9	3	8.4	9.7	8.9	11.7	1.8	3	6.7	9.3	10.0	11.3	2.3	3						
Floodprone Width (ft)	41.2	57.2	59.8	70.6	14.9	3	40.7	57.3	58.8	72.4	15.9	3	38	55	57	71	16.5	3	37.2	55.1	58.5	69.7	16.5	3						
Bankfull Mean Depth (ft)	0.5	0.7	0.7	0.8	0.1	3	0.7	0.7	0.7	0.8	0.1	3	0.6	0.6	0.6	0.7	0.1	3	0.6	0.7	0.7	0.7	0.1	3						
Bankfull Max Depth (ft)	1.3	1.4	1.4	1.4	0.1	3	1.3	1.4	1.4	1.5	0.1	3	1.1	1.2	1.1	1.3	0.1	3	0.9	1.2	1.3	1.3	0.2	3						
Bankfull Cross-Sectional Area (ft^2)	8.6	10.0	9.0	12.5	2.1	3	6.3	8.4	8.7	10.3	2.0	3	4.7	5.8	5.1	7.7	1.6	3	4.0	6.3	7.0	8.0	2.1	3						
Width/Depth Ratio	15.5	26.2	16.7	46.5	17.6	3	13.4	15.4	15.9	16.8	1.7	3	15.0	16.1	15.5	17.8	1.5	3	11.5	13.9	14.3	15.9	2.2	3						
Entrenchment Ratio	2.9	3.8	3.5	5.0	1.1	3	3.4	5.1	5.7	6.4	1.6	3	4.5	5.7	6.1	6.4	1.0	3	5.5	5.9	5.9	6.2	0.3	3						
Bank Height Ratio	1.0	1.1	1.1	1.1	0.06	3	1.0	1.0	1.0	1.0	0.00	3	0.8	0.9	0.9	0.9	0.06	3	0.7	0.9	0.9	1.1	0.20	3						
Pattern																														
Channel Beltwidth (ft)	25.0	38.0		50.0																										
Radius of Curvature (ft)	20.0	33.0		45.0																										
Rad. of Curv. : Bankfull Width (ft/ft)	2.0	3.0		4.0																										
Meander Wavelength (ft)	65.0	95.0		125.0																										
Meander Width Ratio	1.9	3.0		3.5																										
Profile																														
Riffle Length (ft)	3.0	34.0	32.0	85.0	16.1	21.0	10.9	31.1	31.9	44.6	10.1	21	4.3	27.5	28.9	66.5	14.6	22	6.5	26.4	25.3	52.0	13.6	18						
Riffle Slope (ft/ft)	0.01	0.02	0.01	0.05	0.01	20	0.006	0.01	0.01	0.03	0.007	21	0.0002	0.01	0.01	0.04	0.009	22	0.001	0.02	0.01	0.04	0.01	18						
Pool Length (ft)	4.0	13.0	10.0	27.0	7.4	14.0	4.0	9.7	8.7	21.5	4.4	17	5.3	11.3	11.0	22.8	5.1	18	5.8	13.5	10.5	31.0	8.1	18						
Pool Max Depth (ft)	2.9	2.9		2.9		1	2.7	2.7		2.7		1	1.0	1.0		1.0		1	2.9	2.9		2.9		1						
Pool Spacing (ft)	41.0	83.0	62.0	233.0	60.4	13.0	36.9	74.5	56.2	231.1	51.6	16	16.1	71.6	67.6	196.6	45.7	17.0	14.4	67.8	60.0	253.8	50.5	17						
Additional Reach Parameters																														
Channel Thalweg Length (ft)	1,305						1,305						1,305						1,305											
Sinuosity	1.09-1.12						1.09-1.12						1.09-1.12						1.09-1.12											
Water Surface Slope (ft/ft)	0.0068						0.0066						0.0070						0.0072											
Bankfull Slope (ft/ft)	0.0068						0.0064						0.0067						0.0068											
Rosgen Classification	C4						C4						C4						C4											
SC% / Sa% / G% / C% / B% / Be%	29%/22%/36%/14%/0%/0%						11%/22%/35%/32%/0%/0%						4%/55%/29%/12%/0%/0%						2%/62%/28%/8%/0%/0%											
d16/d35/d50 / d84 / d95	7/10/14/49/88						7/11/24/104/128						1/2/8/14/46/98						0.36/0.74/1.4/11.5/20/67											
% of Reach with Eroding Banks	0%						1%						0%						0%											

Table 11c. Stream Reach Morphology Data Tables
Jacob's Landing Stream Restoration Site, DMS Project # 95024
Reach: T2 (2,084 ft.)

Parameter	MY01 (2014)						MY02 (2015)						MY03 (2016)						MY04 (2017)						MY05 (2018)					
Dimension	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
Bankfull Width (ft)	11.4	11.8	11.7	12.5	0.4	5	10.5	11.3	11.1	12.5	0.8	5	9.8	10.6	10.8	11.2	0.6	5	9.8	10.7	10.7	11.3	0.6	5						
Floodprone Width (ft)	27.4	36.9	31.9	52.3	10.5	5	26.8	36.7	31.1	51.9	10.4	5	26.3	35.1	29.5	51.2	10.4	5	26.6	36.3	30.8	51.5	10.4	5						
Bankfull Mean Depth (ft)	0.7	0.8	0.8	1.0	0.2	5	0.7	0.8	0.8	1.0	0.1	5	0.6	0.7	0.7	0.9	0.1	5	0.6	0.8	0.8	1.0	0.15	5						
Bankfull Max Depth (ft)	1.3	1.5	1.5	1.8	0.2	5	1.2	1.5	1.5	2.0	0.3	5	1.0	1.3	1.3	1.7	0.2	5	1.3	1.4	1.4	1.8	0.2	5						
Bankfull Cross-Sectional Area (ft^2)	8.0	9.7	9.6	11.8	1.5	5	7.6	9.6	9.7	12.8	2.1	5	6.3	7.8	8.0	10.4	1.7	5	6.4	8.4	8.2	11.6	2.0	5						
Width/Depth Ratio	11.0	15.0	14.3	18.6	3.2	5	11.8	13.5	13.7	16.2	1.7	5	11.6	14.6	14.6	16.3	1.8	5	11.0	14.1	14.9	15.5	1.9	5						
Entrenchment Ratio	2.3	3.1	2.6	4.5	0.9	5	2.5	3.3	3.0	4.5	0.9	5	2.3	3.3	3.3	4.7	1.0	5	2.4	3.4	2.9	5.2	1.2	5						
Bank Height Ratio	1.0	1.1	1.1	1.3	0.1	5	1.0	1.2	1.1	1.5	0.2	5	0.9	1.0	0.9	1.3	0.2	5	1.0	1.1	1.1	1.4	0.2	5						
Pattern																														
Channel Beltwidth (ft)	25.0	38.0		50.0																										
Radius of Curvature (ft)	20.0	33.0		45.0																										
Rad. of Curv. : Bankfull Width (ft/ft)	2.0	3.0		4.0																										
Meander Wavelength (ft)	60.0	95.0		130.0																										
Meander Width Ratio	2.2	4.0		4.8																										
Profile																														
Riffle Length (ft)	5.0	14.0	17.0	24.0	5.9	15	7.8	32.4	30.4	61.6	11.5	27	6.2	23.1	21.6	46.8	8.9	32	8.1	24.4	23.6	40.5	7.3	31						
Riffle Slope (ft/ft)	0.007	0.02	0.02	0.05	0.01	14	0.001	0.02	0.02	0.03	0.006	27	0.002	0.02	0.02	0.04	0.007	32	0.000	0.02	0.02	0.04	0.01	31						
Pool Length (ft)	4.1	15.8	14.7	26.9	6.5	29	5	13	12	28	6	25	3.5	13.3	11.8	29.5	5.8	30	7.6	15.6	13.1	27.4	6.0	31						
Pool Max Depth (ft)	2.0	2.1		2.1		2	2.0	2.1		2.2		2	2.0	2.0		2.0		2	2.0	2.1		2.1		2						
Pool Spacing (ft)	31.8	61.8	54.4	160.9	29.0	28	42.7	69.5	59.9	173.7	34.2	24	41.9	60.1	55.9	127.6	18.5	29	33.8	57.9	56.0	128.2	17.2	30						
Additional Reach Parameters																														
Channel Thalweg Length (ft)	2,641						2641						2641						2,641											
Sinuosity	1.16-1.31						1.16-1.31						1.16-1.31						1.16-1.31											
Water Surface Slope (ft/ft)	0.0106						0.0107						0.0104						0.0104											
Bankfull Slope (ft/ft)	0.0109						0.0106						0.0100						0.0103											
Rosgen Classification	C4						C4						C4						C4											
SC% / Sa% / G% / C% / B% / Be%	29%/22%/36%/14%/0%/0%						6%/10%/46%/38%/0%/0%						7%/35%/27%/30%/0%/0%						0/%29%/36%/32%/0%/2%											
d16 / d35 / d50 / d84 / d95	12/21/32/46/83/127						14/26/38/105/134						0.4/6/17/45/98/140						3.7/17/29/57/107/593											
% of Reach with Eroding Banks	0%						0%						0%						0%											

Appendix E

Hydrologic Data

Table 12. Verification of Bankfull Events Jacob's Landing Stream Restoration Site, DMS Project # 95024			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo Number**
4/19/2015	4/19/2015	On-site automatic gauge	N/A
10/3/2015	10/3/2015	On-site automatic gauge	N/A
11/9/2015	11/9/2015	On-site automatic gauge	N/A
Unkown	12/17/2015	Wrack lines and flattened vegetation observed at bankfull	1 - 2
12/23/2015	12/23/2015	On-site automatic gauge	N/A
12/30/2015	12/30/2015	On-site automatic gauge	N/A
2/23/2016	2/23/2016	On-site automatic gauge (T1 only)	N/A
5/16/2016	5/16/2016	On-site automatic gauge (T1 only)	N/A
5/25/2016	5/25/2016	On-site automatic gauge (T1 only)	N/A
6/14/2016	6/14/2016	On-site automatic gauge (T1 only)	N/A
10/8/2016	10/8/2016	On-site automatic gauge (T1 only)	N/A
6/5/2017	6/5/2017	On-site automatic gauge	N/A
6/13/2017	6/13/2017	On-site automatic gauge	N/A
6/19/2017	6/19/2017	On-site automatic gauge (T1 only)	N/A
6/20/2017	6/20/2017	On-site automatic gauge (T1 only)	N/A
9/1/2017	6/20/2017	On-site automatic gauge (T1 only)	N/A

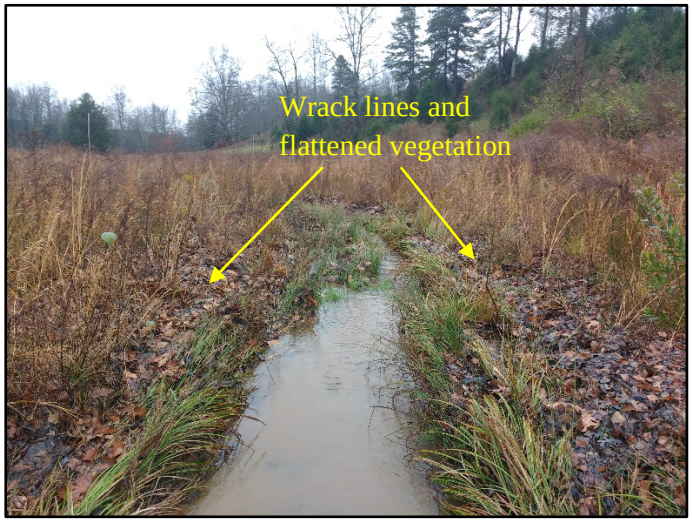


Photo 1. Bankfull indicators T1, 12/17/2015

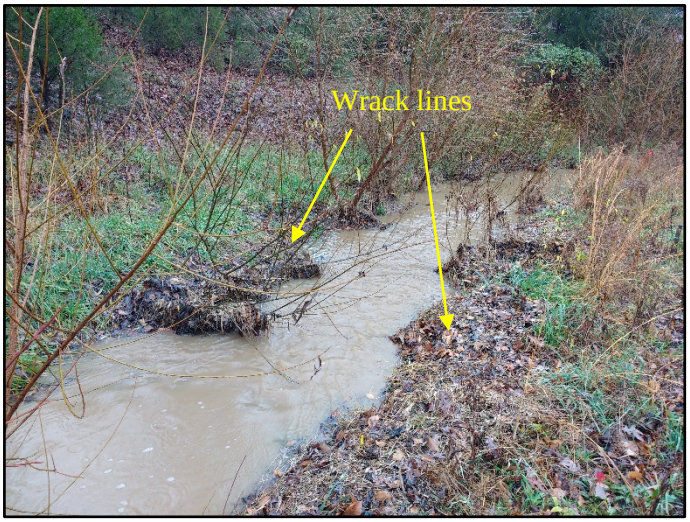
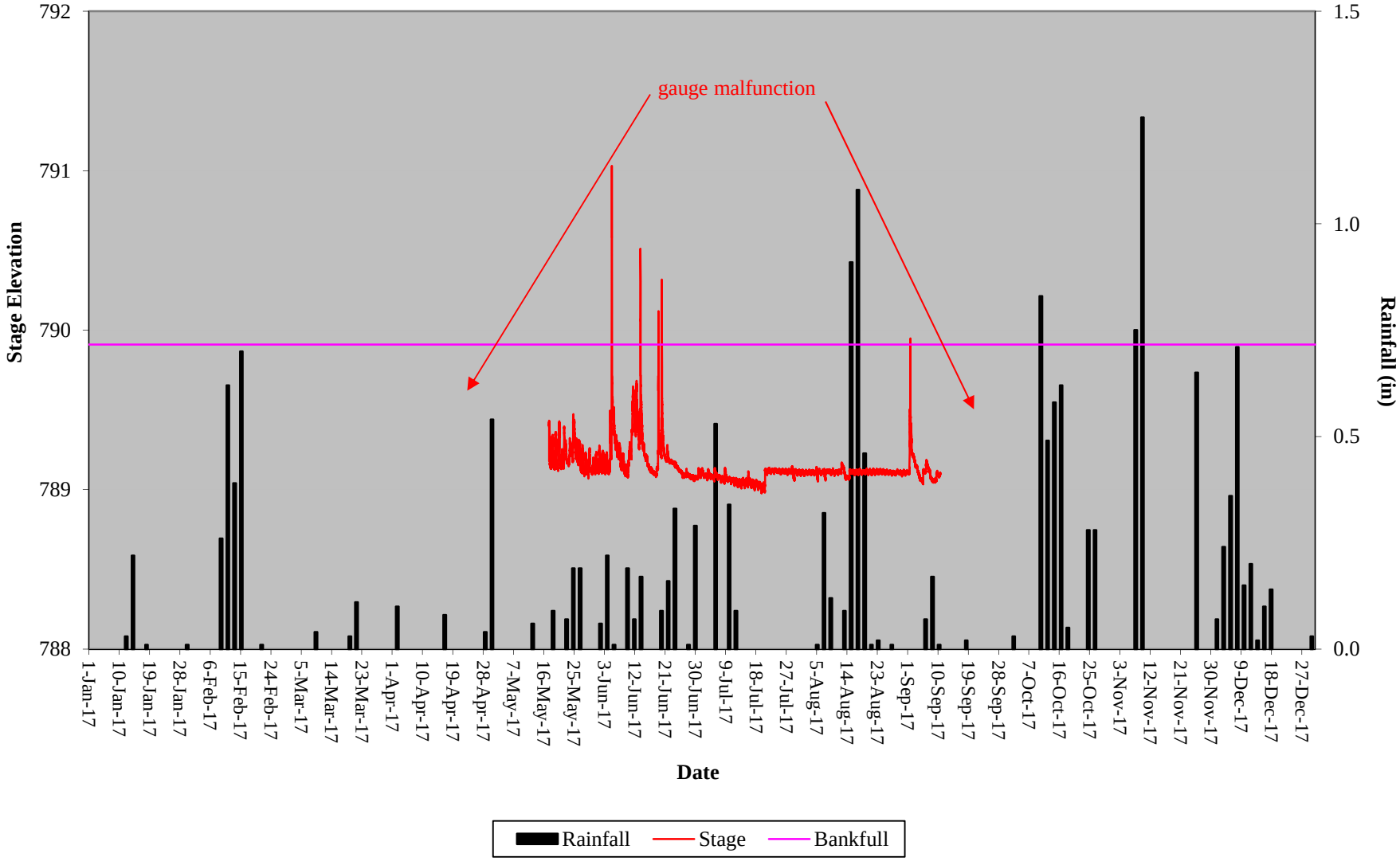
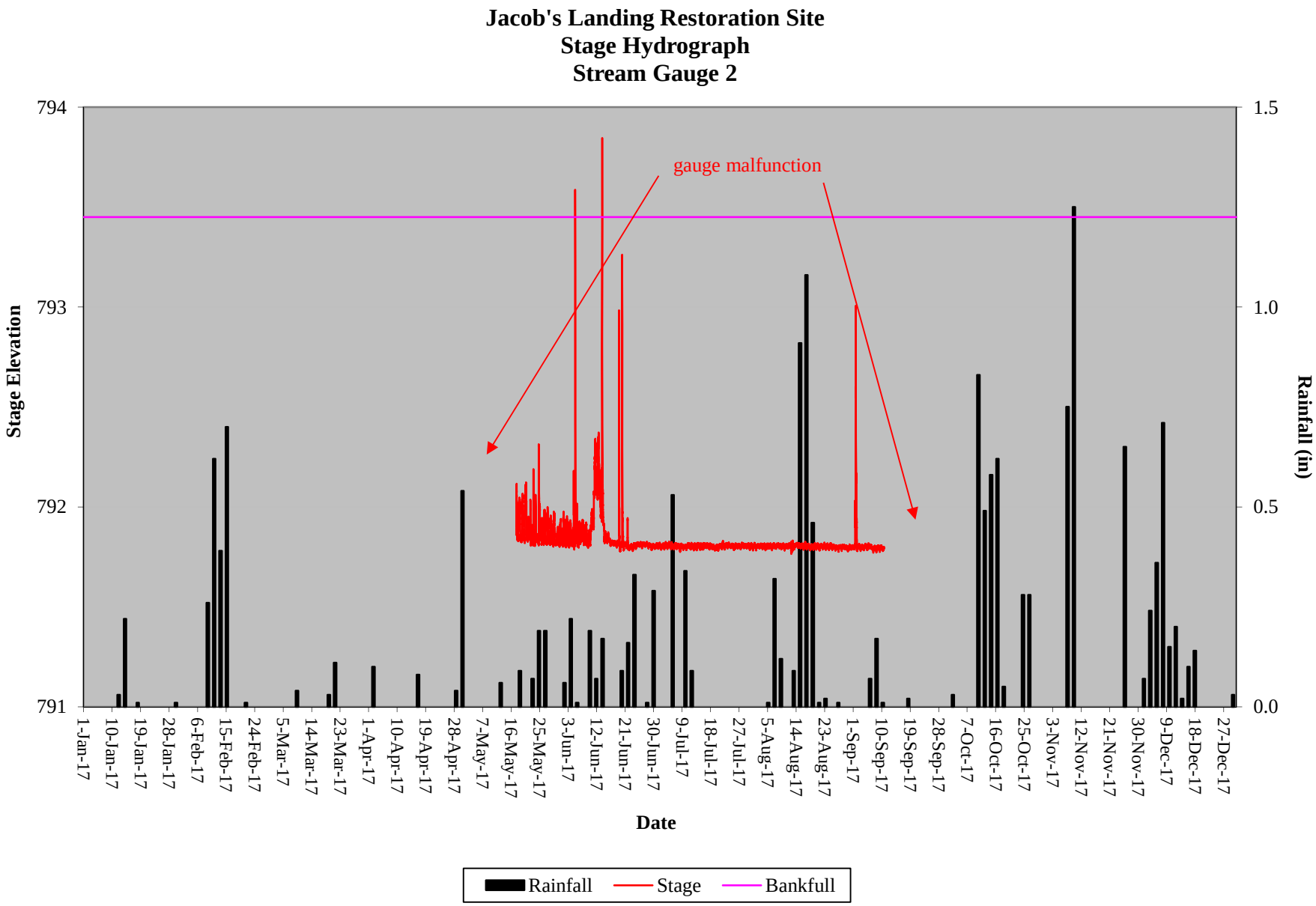


Photo 2. Bankfull indicators T2, 12/17/2015

Jacob's Landing Restoration Site
Stage Hydrograph
Stream Gauge 1




Jacob's Landing Restoration Site
Stage Hydrograph
Stream Gauge 2
gauge malfunction
Stage Elevation
Rainfall (in)
Date
794
793
792
791
1.5
1.0
0.5
0.0
1-Jan-17
10-Jan-17
19-Jan-17
28-Jan-17
6-Feb-17
15-Feb-17
24-Feb-17
5-Mar-17
14-Mar-17
23-Mar-17
1-Apr-17
10-Apr-17
19-Apr-17
28-Apr-17
7-May-17
16-May-17
25-May-17
3-Jun-17
12-Jun-17
21-Jun-17
30-Jun-17
9-Jul-17
18-Jul-17
27-Jul-17
5-Aug-17
14-Aug-17
23-Aug-17
1-Sep-17
10-Sep-17
19-Sep-17
28-Sep-17
7-Oct-17
16-Oct-17
25-Oct-17
3-Nov-17
12-Nov-17
21-Nov-17
30-Nov-17
9-Dec-17
18-Dec-17
27-Dec-17
Rainfall
Stage
Bankfull

Appendix F

Additional Information

KCI ASSOCIATES OF NORTH CAROLINA, PA

ENGINEERS • SCIENTISTS • SURVEYORS • CONSTRUCTION MANAGERS

Landmark Center II, Suite 220 4601 Six Forks Road Raleigh, NC 27609 (919) 783-9214 (919) 783-9266 Fax

May 22, 2014

Mr. Todd Tugwell
Regulatory Division
Wilmington District
U.S. Army Corps of Engineers
11405 Falls of Neuse Road
Wake Forest, NC 27587

And:

Mr. Tim Baumgartner
Deputy Director
NC DENR
Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699

Subject: Jacob's Landing (95024) Stream Restoration Project
Request for Mitigation Plan Amendment

Dear Mr. Tugwell and Mr. McDonald,

This letter is in response to the discussions at an Interagency Review Team (IRT) meeting attended by KCI on May 13, 2014. During this meeting KCI presented a request to modify the allocation of stream mitigation credits on the Jacob's Landing stream restoration project. Citing procedural reasons, the IRT requested that KCI submit a formal request to reallocate credits. This letter will serve as that request.

Request

KCI requests the following changes to the credit table provided in the *Jacob's Landing Stream Restoration Site - Final Mitigation Plan* dated September 2012 (requested changes shown in red).

Reach	Mitigation Type	Priority Approach	Existing Linear Footage	Designed Linear Footage	Mitigation Units
T1-1	Restoration	P2	326	303	303
T1-2	Enhancement II	-	158	109*	44
T1-3	Restoration	P2	846	893	893
T1A	Restoration	P2	294	178	178
T2-1	Restoration	P2	1,800	1,581*	1,581
T2-2	Restoration	P2	1,135	1,060*	1,060
T2A	Restoration	P2	465	465	465
Total Stream Enhancement I			0	0	0
Total Stream Enhancement II			158	109	44
Total Stream Restoration			4,866	4,015	4,480
Total Mitigation Units					4,524

Justification

The 465 linear feet of stream channel associated with reach T2-A was identified during the Proposal Stage (including an IRT site walk) as Enhancement Level 1 at a 1.5:1 ratio. As a matter of practice, KCI attempts to be consistent with the credit-types requested in the Proposal during the assessment and the design stages of the project. During the assessment and design stage for Reach T2-A, a more aggressive restoration approach was determined to be needed. This was primary due to the confinement of the valley, the difficulty of access, the absence of a functional floodplain and the poor condition of the valley walls leading down to the stream. These reasons and others resulted in ultimate decision to completely change the stream type from a G-type channel to a C/B-type channel. This approach was in fact a restoration approach, although it never was properly identified as such in the Mitigation Plan. The approach included the following restoration initiatives:

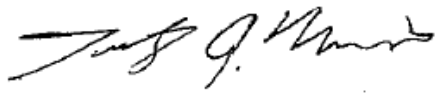
1. Channel type changed from a G4 channel to a C4/B4 channel by installing a typical riffle cross section with a 3.6' bankfull bench and a 0.9' bank height.
2. Adjusted thalweg and centerline (planform) slightly throughout the reach to allow for the incorporation of the bankfull bench. Bench location and width varied from cross section depending on condition of valley and the ability to accommodate the full bankfull width given the valley condition.
3. Installed significant number of structures (5 step pools, 8 riffle grade controls, 8 riffle enhancements) to stabilize the profile and create in-stream habitat.
4. Added bedform diversity and stabilized the planform.
5. Stabilized the valley walls and contributing drainage features.

All of the items mentioned above support the reallocation of credit type to restoration (or enhancement at a higher ratio). KCI requests that the IRT support the correction of the 1.5:1 Enhancement I ratio

proposed for Reach 2A in the Final Mitigation Plan to 1:1 ratio. KCI can provide amended copies of the Mitigation Plan, if desired.

We hope you find this information appropriate in order to move forward with your decision. If you have further questions or comments, feel free to contact me at 919-278-2511 or tim.morris@kci.com .

Sincerely,



Timothy J. Morris
Senior Environmental Scientist

cc: Joe Pfeiffer, KCI (email)
Adam Spiller (email)
Tim Baumgartner, EEP (email)

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

REPLY TO
ATTENTION OF:

September 2, 2014

Regulatory Division

Re: Request for Modification to the Jacob's Ladder and Jacob's Landing Mitigation Sites (USACE AIDs 2012-01007 and 2012-01006)

Mr. Tim Baumgartner
North Carolina Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Dear Mr. Baumgartner:

Please reference the North Carolina Interagency Review Team (IRT) meeting of May 13, 2014, during which we discussed the Jacob's Ladder and Jacob's Landing stream mitigation projects. The discussion dealt with a request by NCEEP to the U.S. Army Corps of Engineers, Wilmington District (District) to modify a reach within each project resulting in a change in the mitigation approach and associated credit.

During the IRT meeting, we asked that a written request be submitted to provide information on the specifics of each project modification so that the IRT could review the requests and provide comment back to us. Two letters dated May 22, 2014, were prepared by the project provider (KCI, Inc.) and distributed to the IRT. The following responses were received from the IRT agency members:

1. Travis Wilson, North Carolina Wildlife Resources Commission, 5/29/2014:
   A switch from enhancement to restoration should have been addressed earlier during design. As I understood it during the presentation most of the design elements outlined in the modification request were incorporated under the enhancement level and only slight changes occurred during construction, and I don't want to establish a practice where the IRT is constantly reviewing requests from providers on a credit hunt to cover contractual deficiencies. However, with that said, I agree the improvements on the two subject reaches are consistent with a restoration approach, and if successful it will provide a restoration level of uplift. WRC does not object to the modification request.

2. Eric Kulz, North Carolina Division of Water Resources, 5/29/2014:
   The approaches described in the mitigation plans for the referenced reaches were fairly non-quantitative and appeared to represent an Enhancement I approach, which was approved by the IRT. The activities conducted appeared consistent with the descriptions of mitigation measures proposed in the approved mitigation plans. Again, the mitigation plans were not quantitative in nature, and E1 spans a wide variety of mitigation treatments.

During the analysis phase of these projects, if the provider and EEP felt the initial assessment and proposal were incorrect/inappropriate, consultation with the IRT and re-review of the project stream conditions and mitigation approaches should have been requested and approval of revisions sought (note process taken with the Pancho bank site).

Minor adjustments often occur during construction and are expected, and are described in the as-built report. Linear footage/acreage of mitigation and associated credits are then normally finalized. However, in this case changing the name of the mitigation approach and associated credit after construction does not appear warranted as the activities conducted appear to be fairly consistent with what was described in the approved mitigation plans.

In addition to the responses above, we conducted a review of the information submitted and other information available regarding the two projects, including the mitigation plans for the projects. In the May 22nd request letters for the two projects, the explanation for the additional credit request was based on the fact that a more aggressive restoration approach was determined to be needed during the assessment and design stages of the two projects. The new approach for the streams on both projects was similar, in that it included such activities as adjusting the thalweg and centerline of the streams, installing a significant number of structures, incorporating bankfull benches, and adding bedform diversity.

In the case of both Jacob's Ladder and Jacob's Landing, the IRT reviewed the projects in the field in August, 2011, and agreed to the mitigation approach described in the respective mitigation plans, which were finalized in September, 2012. As noted by Mr. Kulz' comments, the work that was done and is now the basis for the request for additional credit appears to be fairly consistent with what was proposed in the mitigation plan. In the case of Jacob's Ladder, the mitigation plan states that for Tributary T2-1 "Enhancement will include shaping the banks, creating a bankfull bench, creating a more stable and heterogeneous stream bed, and replanting the riparian buffer to achieve a mix of native tree species." For Jacob's Landing, the mitigation plan states that for Tributary T2A "This reach will be enhanced by shaping the banks to creating a bankfull bench, and installing grade control structures to gradually drop the bed elevation down. The reach will be stabilized by replanting the riparian buffer to achieve a mix of native tree species." Despite this fact, if the amount of functional uplift resulting from the work is sufficient to be credited at a 1:1 ratio, we do not want to penalize these projects for failing to identify an appropriate credit ratio up front in the mitigation plan.

Another concern that arises from these requests is the way in which the changes to mitigation plan and credit yield were handled. As stated in the documentation submitted to the IRT, the need for a more aggressive approach was identified during the assessment and design stages of the mitigation process. This implies that the need to modify the approaches and associated credit structure for these tributaries was known well before construction yet not brought to the IRT's attention until the as-built stage of the project. Any modification to a project that results in a change to the mitigation approach substantial enough to warrant a different credit amount must be approved by the District prior to implementing that modification. In this case, the IRT was not notified of the change until the as-built stage of the project.

Lastly, the information submitted in support of the requested change is not consistent. The final credit amounts presented during the IRT meeting do not match the credit amounts listed in the supporting information that was submitted after the meeting. Specifically, Jacob's Landing was shown

to have 4,528 credits (SMUs) in the presentation and 4,524 credits in the supporting letter dated May 22, 2014. Similarly, Jacob's Ladder was shown to have 5,231 credits in the presentation and 5,203 credits in the supporting letter. In order to fully resolve this issue, please explain the discrepancy and identify the correct amount of credit to be generated by the two projects.

To conclude, it is our intention to make sure that the amount of credit generated by mitigation projects, as expressed by the mitigation ratio, is supported by the level of uplift resulting from the work. In the case of these two projects, we agree that the uplift provided by the mitigation activities conducted in the two reaches in question may be credited at a 1:1 ratio. However, for future projects, changes such as this that result in a modification to the amount of credit must be approved in advance so that the District and IRT has the opportunity to comment and agree with the proposed approach. For all NCEEP projects that were instituted after the approval of the Instrument on July 28, 2010, such modifications should be approved in accordance with the streamlined review process outlined in Section 332.8(g)(2) of the Federal Mitigation Rule, unless the district engineer determines those changes are of a significant nature and must be processed through the normal procedures. In cases where such modifications are time-sensitive (e.g., construction is on-going), we will endeavor to expedite the review and approval to the extent allowable under the Rule.

Thank you for working with us to address these issues. Please contact me if you have any questions about this letter, or if there is any additional information you need. I can be contacted at telephone (919) 846-2564.

Sincerely,

Todd Tugwell
Special Projects Manager

Enclosures

Electronic Copies Furnished:
Mr. Tim Morris, KCI, Inc.
NCIRT Distribution List