

FINAL
ANNUAL MONITORING REPORT
YEAR 4 (2012)
McCain Stream Restoration Site
RANDOLPH COUNTY, NORTH CAROLINA
(EEP Project No. 443, Contract No. 004807)
Construction Completed March 2009



Submitted to:
North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
Raleigh, North Carolina



December 2012

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Prepared by:
Axiom Environmental, Inc.
218 Snow Avenue
Raleigh, North Carolina 27603



December 2012

Table of Contents

1.0 EXECUTIVE SUMMARY	1
2.0 METHODOLOGY	3
2.1 Vegetation Assessment	3
2.2 Stream Assessment	3
3.0 REFERENCES	3

Appendices

APPENDIX A. PROJECT VICINITY MAP AND BACKGROUND TABLES

- Figure 1. Site Location Map
- Table 1. Project Components and Mitigation Credits
- Table 2. Project Activity and Reporting History
- Table 3. Project Contacts Table
- Table 4. Project Attributes Table

APPENDIX B. VISUAL ASSESSMENT DATA

- Figures 2 and 2A-2B. Monitoring Plan View
- Tables 5A-5B. Visual Stream Morphology Stability Assessment Tables
- Table 6. Vegetation Condition Assessment Table
- Fixed-Station Photos
- Vegetation Monitoring Plot Photos

APPENDIX C. VEGETATION PLOT DATA

- Table 7. Vegetation Plot Criteria Attainment
- Table 8. CVS Vegetation Plot Metadata
- Table 9. Total and Planted Stems by Plot and Species

APPENDIX D. STREAM SURVEY DATA

- Cross-section Plots
- Longitudinal Profile Plot
- Substrate Plots
- Table 10a. Baseline Stream Data Summary
- Table 10b. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
- Table 11a. Monitoring Data – Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
- Table 11b. Monitoring Data – Stream Reach Data Summary

APPENDIX E. HYDROLOGY DATA

- Table 12. Verification of Bankfull Events

1.0 EXECUTIVE SUMMARY

The North Carolina Ecosystem Enhancement Program (NCEEP) has completed stream restoration at the McCain Stream Restoration Site (hereafter referred to as the “Site”) to assist in fulfilling stream mitigation goals in the area. Site activities consisted of restoration of 2470 linear feet of stream; however, 53 linear feet of channel is located within a power line utility right-of-way and has therefore been excluded from credit assets, resulting in 2417 stream mitigation units. This report (compiled based on NCEEP’s *Procedural Guidance and Content Requirements for EEP Monitoring Reports* Version 1.4 dated 11/7/11) summarizes data for year 4 (2012) monitoring.

The Site is located one mile southeast of the intersection of Lake Lucas Road (SR 1518) and Spero Road (SR 1504) in Sophia, Randolph County, North Carolina. The project reach is located within United States Geological Society (USGS) Hydrologic Unit 03040103050050 (Yadkin River Basin), in a non-targeted portion of the NC Division of Water Quality (NCDWQ) Sub-basin 03-07-09.

The drainage area contributing to the most downstream extent of the project reach is 0.88 square miles. The contributing drainage area consists of: forest (67%), agriculture (16%), rangeland (12%), and urban (4%) land use / land cover.

Project Goals:

- Restore stable stream channel morphology that is capable of moving flows and sediment provided by its watershed.
- Restore riparian buffer habitat and functions.
- Improve water quality to the receiving watershed by reducing bank erosion and bed degradation.
- Improve aquatic habitat.

Project Objectives:

- Build an appropriate C4 channel with stable channel dimensions.
- Plant a functional Bottomland Hardwood Forest community to create an effective riparian buffer.
- Exclude livestock from the riparian areas.

Prior to construction, the Site was characterized by an active farm with a portion of the property dedicated to pasture and livestock grazing. Primary land uses on the property include rangeland, agriculture (small grain), and hardwood forest. Site streams were characterized by entrenched, narrow, deep, step-pool channels with low to moderate sinuosity. Project construction was completed in March 2009. The project restored 2417 linear feet of stream using Priority 2 restoration by constructing a new meandering channel within and excavated floodplain bench. Site activities provide 2417 Stream Mitigation Units. The Site will be protected by a permanent conservation easement held by the State of North Carolina.

Seven vegetation monitoring plots were monitored on October 10, 2012 for monitoring year 4 (2012). Vegetation success criteria dictate an average density of 320 stems per acre must be surviving in the first three monitoring years. Subsequently, 288 stems per acre must be surviving in year 4 and 260 stems per acre in year 5. Stem counts will be based on an average of the evaluated vegetation plots. Based on the number of stems counted, average densities were measured at 358 stems per acre surviving in year 4 (2012). The dominant species identified at the Site were planted stems of river birch (*Betula nigra*), greb ash (*Fraxinus pennsylvanica*), American sycamore (*Platanus occidentalis*), and willow oak (*Quercus phellos*). Four of the seven individual plots met success criteria based on planted stems alone. Plots 1, 2, and 7 were below success criteria based on planted stems alone; however, when including

naturally recruited stems of river birch (*Betula nigra*) and dogwood (*Cornus amomum*) plots 2 and 7 were well-above 288 stems per acre.

The dominant herbaceous vegetation throughout the Site is mainly comprised of planted grasses such as fescue and Japanese stiltgrass (*Microstegium vimineum*). Although fescue occurs throughout the Site, the northernmost end of the Site is characterized by dense fescue resulting in planted stem mortality (depicted on Figures 2A-2B, Appendix B). Additional vegetation problem areas include two small Japanese stiltgrass populations on stream banks located at stations 17+50 and 22+10. On the right bank of the southernmost end of the Site, a small population of Chinese privet (*Ligustrum sinense*) has established; however, the area is small enough to not be problematic. Chinese privet will be assessed during future Site monitoring. For additional information relating to vegetation, see Appendix C.

Success criteria for stream restoration will be assessed using measurements of stream dimension, pattern, and profile; site photographs; visual assessments; and vegetation sampling. Stream success criteria are based on significant changes in channel morphology between baseline measurements and the present monitoring year.

Stream problem areas include areas of minor bank erosion/scour in the upstream 300 linear feet of the Site (Reach 1). Stream problem areas do not appear to be worsening and no immediate maintenance actions are recommended at this time. Many areas considered problems during previous monitoring years have recovered and vegetation has established; therefore, these areas are no longer considered problems. Stream problem areas are depicted on Figures 2A-2B (Appendix B) and include the following.

Map Label*	Station	Notes
PA-1	10+00	Undercut banks at easement boundary
PA-2	11+25	Minor erosion and undercut bank on outer/left bank; vegetation is establishing
PA-3	12+90	Some erosion on outer/right bank; vegetation is establishing
PA-4	13+50	Minor scouring in riffle; vegetation is establishing
PA-5	25+00	Erosion on outer/right bank
PA-6	26+50	Minor erosion on outer/left bank; vegetation is establishing

*Map labels on Figures 2A-2B, Appendix B

Success criteria for stream restoration will include documentation of two bankfull channel events during the monitoring period. In the event that less than two bankfull events occur during the first five years, monitoring will continue until the second event is documented. In addition, bankfull events must occur during separate monitoring years. A crest gauge is located within the Site to assist with documentation of bankfull events (Figures 2-2A, Appendix B). No bankfull events were documented during the year 4 (2012) monitoring season. A total of two bankfull events have been documented to occur during the four year monitoring period; in addition, bankfull events occurred in separate monitoring years (2009 and 2010).

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 tables and figures within this report's appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report (formerly Mitigation Plan) and in the Mitigation Plan (formerly the Restoration Plan) documents available on NCEEP's website. All raw data supporting the tables and figures in the appendices is available from NCEEP upon request.

2.0 METHODOLOGY

2.1 Vegetation Assessment

Seven vegetation plots were established and marked after construction with four foot metal U-bar post demarking the corners with a ten foot, three-quarter inch PVC at the origin. The plots are 10 meters square or 5-meters by 20-meters and are located randomly within the Site. These plots were surveyed on October 10th for the year 4 (2012) monitoring season using the *CVS-EEP Protocol for Recording Vegetation, Version 4.2* (Lee et al. 2008) (<http://cvs.bio.unc.edu/methods.htm>); results are included in Appendix C. The taxonomic standard for vegetation used for this document was *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas* (Weakley 2007).

2.2 Stream Assessment

Annual stream monitoring was conducted for 2550-linear feet of channel. Six permanent cross-sections, four riffle and two pool, were established and will be used to evaluate stream dimension; locations are depicted on Figure 2 (Appendix B). Cross-sections are permanently monumented with 4-foot metal garden posts at each end point. Cross-sections were surveyed to provide a detailed measurement of the stream and banks including points on the adjacent floodplain, top of bank, bankfull, breaks in slope, edge of water, and thalweg. Data will be used to calculate width-depth ratios, entrenchment ratios, and bank height ratios for each cross-section. Photographs were taken and pebble counts were conducted at each permanent cross-section location annually. Thirteen permanent photo points were established throughout the restoration reach; locations are depicted on Figure 2 (Appendix B) and are included in Appendix B. In addition, visual stream morphology stability assessments were completed in each of the monitoring reaches to assess the channel bed, banks, and in-stream structures.

3.0 REFERENCES

- Lee, Michael T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. *CVS-EEP Protocol for Recording Vegetation, Version 4.2*. (online). Available: <http://cvs.bio.unc.edu/methods.htm>.
- Weakley, Alan S. 2007. *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas* (online). Available: <http://www.herbarium.unc.edu/WeakleysFlora.pdf> [February 1, 2008]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

APPENDIX A

PROJECT VICINITY MAP AND BACKGROUND TABLES

Figure 1. Site Location Map

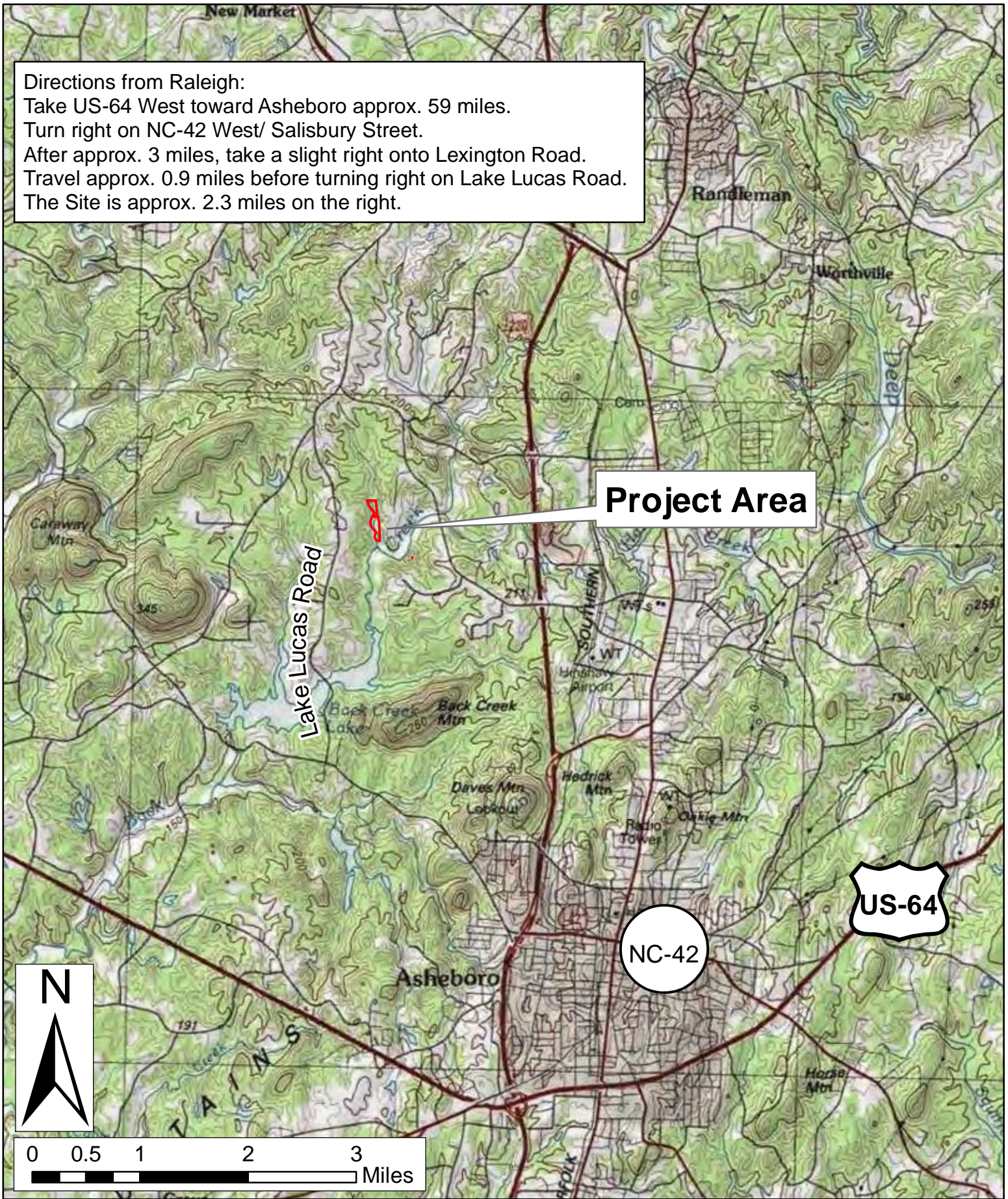
Table 1. Project Components and Mitigation Credits

Table 2. Project Activity and Reporting History

Table 3. Project Contacts Table

Table 4. Project Attributes Table

Directions from Raleigh:
 Take US-64 West toward Asheboro approx. 59 miles.
 Turn right on NC-42 West/ Salisbury Street.
 After approx. 3 miles, take a slight right onto Lexington Road.
 Travel approx. 0.9 miles before turning right on Lake Lucas Road.
 The Site is approx. 2.3 miles on the right.




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SITE LOCATION MAP
 McCAIN STREAM RESTORATION
 EEP PROJECT NUMBER 443
 Randolph County, North Carolina

Dwn. by: KRJ
Date: Oct. 2012
Project: 12-004.14

FIGURE
1

**Table 1. Project Components and Mitigation Credits
McCain Stream Restoration Site (EEP Project Number 443)**

Mitigation Credits							
Type	Stream			Riparian Wetland			Buffer
	Restoration	Restoration Equivalent		Restoration	Restoration Equivalent		
Totals	2417		--		--	--	--
Projects Components							
Project Component/ Reach ID	Station Range	Existing Linear Footage/ Acreage	Priority Approach	Restoration/ Restoration Equivalent	Restoration Linear Footage/ Acreage	Mitigation Ratio	Comment
Reach 1	10+00– 12+86	490	P2	Restoration	286	1:1	Priority 2 stream restoration.
Reach 2	12+87- 34+70	1955	P2	Restoration	2131*	1:1	Priority 2 stream restoration.
Component Summation							
Restoration Level				Stream (linear footage)		Riparian Wetland (acres)	Buffer (square footage)
Restoration				2417		--	--
Totals				2417		--	--
Mitigation Units				2417 SMUs		--	--

*Site activities restored 2183 linear feet of Reach 2; however, 53 linear feet of this reach are located within a power line utility right-of-way have been excluded from credit asset calculations.

**Table 2. Project Activity and Reporting History
McCain Stream Restoration Site (EEP Project Number 443)**

Elapsed Time Since Grading Complete: 3 years 9 months

Elapsed Time Since Planting Complete: 3 years 9 months

Number of Reporting Years: 4

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan	2003/2004	June 2005
Final Design – Construction Plans		May 2006
Construction		March 2009
Temporary S&E mix applied to entire project area		March 2009
Permanent seed mix applied to entire project area		March 2009
Mitigation Plan / As-built (Year 0 Monitoring – baseline)	May 2009	July 2009
Year 1 Monitoring (2009)	October 2009	December 2009
Year 2 Monitoring (2010)	November 2010	November 2010
Year 3 Monitoring (2011)	August 2011	November 2011
Year 4 Monitoring (2012)	October 2012	November 2012

**Table 3. Project Contacts Table
McCain Stream Restoration Site (EEP Project Number 443)**

Designer	KCI Associates of NC Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Adam Spiller (919) 783-9214
Construction, Planting, and Seeding Contractor	Carolina Environmental Contracting, Inc. PO Box 1905 Mount Airy, NC 27030 Stephen James (336) 320-3849
Survey Contractor	Unknown
Seed Mix Source	Unknown
Baseline Data Collection and Years 1-3 Monitoring Performers	Ward Consulting Engineers, P.C. 8368 Six Forks Road Suite 104 Raleigh, NC 27615-5083 Becky Ward 919-870-0526
Years 4-5 Monitoring Performers	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693

**Table 4. Project Attributes Table
McCain Stream Restoration Site (EEP Project Number 443)**

Project Information		
Project Name	McCain Stream Restoration Site	
Project County	Randolph County, North Carolina	
Project Area	13.34 acres	
Project Coordinates (NAD83/WGS84)	734162.6573, 1746572.2892	
Project Watershed Summary Information		
Physiographic Region	Piedmont	
Ecoregion	Carolina Slate Belt	
Project River Basin	Yadkin	
USGS 8-digit HUC	03040103	
USGS 14-digit HUC	03040103050050	
NCDWQ Subbasin	03-07-09	
Project Drainage Area	0.88 square miles	
Project Drainage Area Impervious Surface	2%	
Watershed Type	Rural	
Reach Summary Information		
Parameters	Reach 1	Reach 2
Restored/Enhanced Length	286 linear feet	2184 linear feet
Drainage Area	0.88 sq. mi.	0.88 sq. mi.
NCDWQ Index Number	13-2-3-3-(0.3) (UT to Back Creek)	
NCDWQ Classification	C	
Valley Type/Morphological Description	V/B4c	V/C4
Dominant Soil Series	Dogue Sandy Loam	
Drainage Class	Moderately Well Drained	
Soil Hydric Status	Nonhydric	
Slope	0.0066	
FEMA Classification	Zone C	
Native Vegetation Community	Bottomland Hardwood Forest	
Percent Composition of Exotic Invasives	>5	
Regulatory Considerations		
Regulation	Applicable	
Waters of the U.S. –Sections 404 and 401	Yes-Received Appropriate Permits	
Endangered Species Act	No	
Historic Preservation Act	No	
CZMA/CAMA	No	
FEMA Floodplain Compliance	Unknown	
Essential Fisheries Habitat	No	

APPENDIX B

VISUAL ASSESSMENT DATA

Figures 2 and 2A-2B. Monitoring Plan View

Tables 5A-5B. Visual Stream Morphology Stability Assessment Tables

Table 6. Vegetation Condition Assessment Table

Fixed-Station Photos

Vegetation Monitoring Plot Photos



Fig. 2A



Fig. 2B

Legend

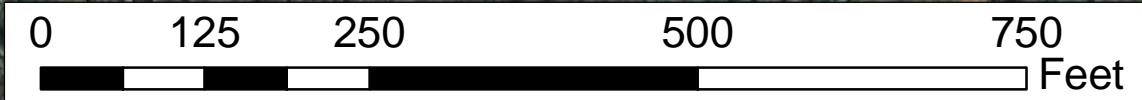
- Easement Boundary
- Stream
- In-Stream Structures
- Cross Sections
- CVS Monitoring Plots
- Photo Points

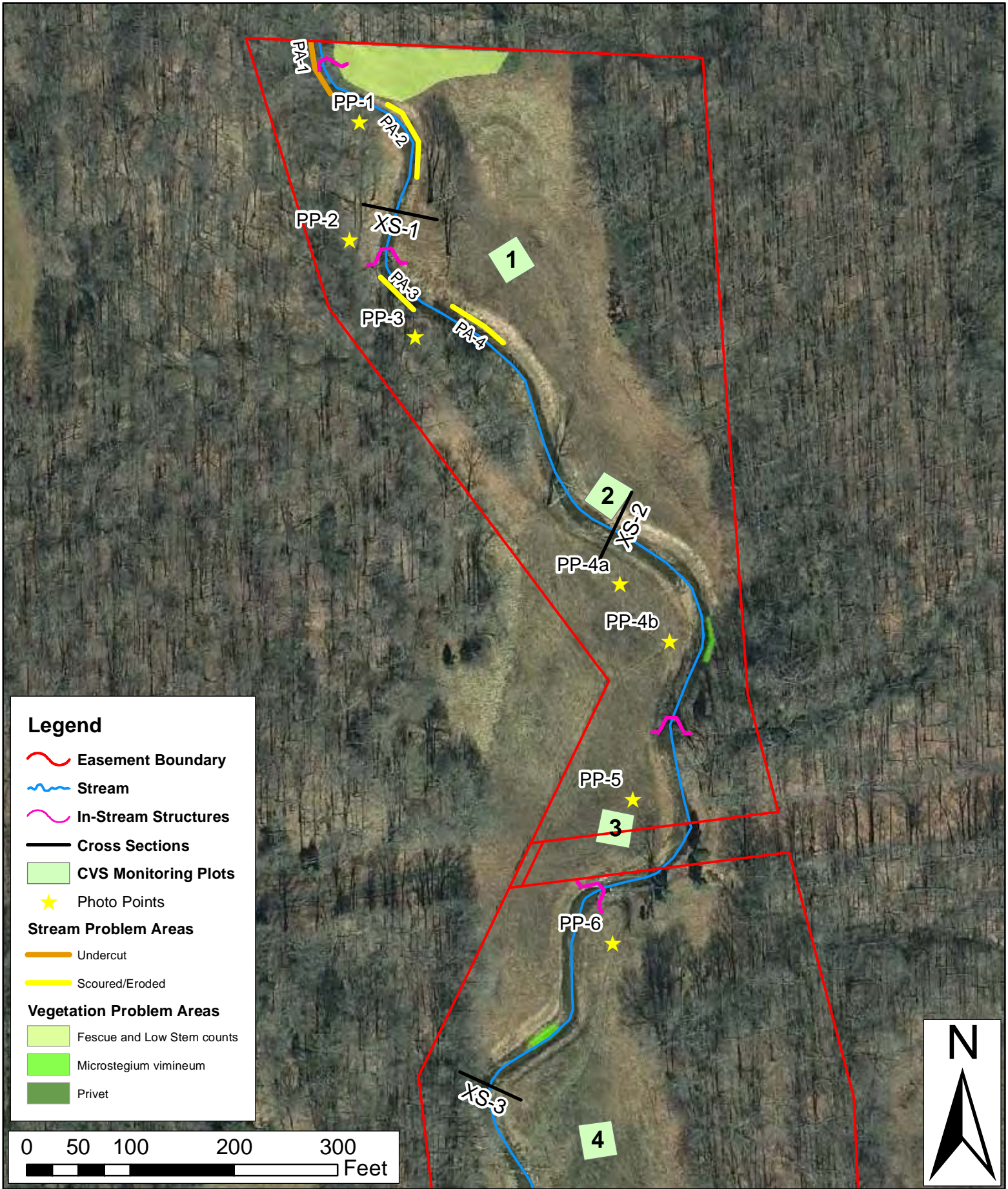
Stream Problem Areas

- Undercut
- Scoured/Eroded

Vegetation Problem Areas

- Fescue and Low Stem counts
- Microstegium vimineum
- Privet





Legend

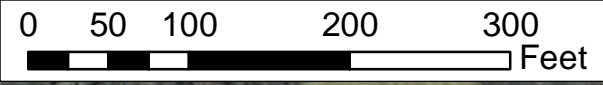
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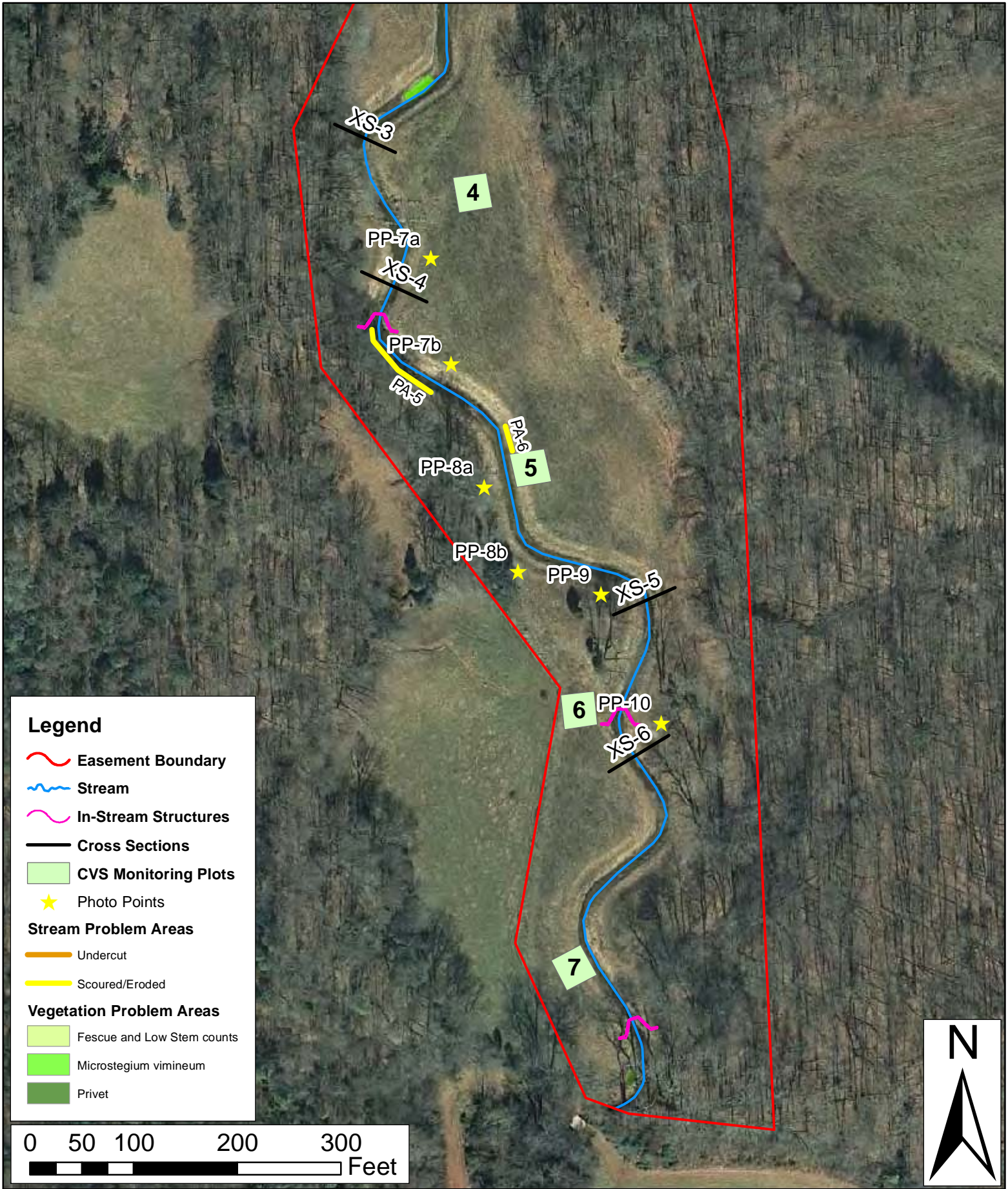
MONITORING PLAN VIEW
 McCAIN STREAM RESTORATION
 EEP PROJECT NUMBER 443
 Randolph County, North Carolina

Dwn. by:
 KRJ

Date:
 Oct. 2012

Project:
 12-004.14

FIGURE
2A



Legend

- Easement Boundary
- Stream
- In-Stream Structures
- Cross Sections
- CVS Monitoring Plots
- Photo Points

Stream Problem Areas

- Undercut
- Scoured/Eroded

Vegetation Problem Areas

- Fescue and Low Stem counts
- Microstegium vimineum
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MONITORING PLAN VIEW
 McCAIN STREAM RESTORATION
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 Randolph County, North Carolina

Dwn. by:
 KRJ

Date:
 Oct. 2012

Project:
 12-004.14

FIGURE
2B

Table 5A
 Reach ID
 Assessed Length

Visual Stream Morphology Stability Assessment
 Reach 1
 286

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	1. <u>Aggradation</u> - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)					100%			
		2. <u>Degradation</u> - Evidence of downcutting			1	30	90%			
	2. Riffle Condition	1. <u>Texture/Substrate</u> - Riffle maintains coarser substrate	2	2			100%			
	3. Meander Pool Condition	1. <u>Depth</u> Sufficient (Max Pool Depth : Mean Bankfull Depth \geq 1.6)	3	3			100%			
		2. <u>Length</u> appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	3	3			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	3	3			100%			
		2. Thalweg centering at downstream of meander (Glide)	2	2			100%			
Totals										
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion					100%			100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			1	50	91%			91%
	3. Mass Wasting	Bank slumping, calving, or collapse					100%			100%
Totals										
					1	50	91%	0	0	91%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	2	2			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	2	2			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	2	2			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in EEP monitoring guidance document)	2	2			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio \geq 1.6 Rootwads/logs providing some cover at base-flow.	2	2			100%			

Table 5B
 Reach ID
 Assessed Length

Visual Stream Morphology Stability Assessment
 Reach 2
 2184

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	1. <u>Aggradation</u> - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			1	30	99%			
		2. <u>Degradation</u> - Evidence of downcutting			1	125	94%			
	2. Riffle Condition	1. <u>Texture/Substrate</u> - Riffle maintains coarser substrate	16	17			94%			
	3. Meander Pool Condition	1. <u>Depth</u> Sufficient (Max Pool Depth : Mean Bankfull Depth \geq 1.6)	16	18			89%			
		2. <u>Length</u> appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	18	18			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	13	17			76%			
2. Thalweg centering at downstream of meander (Glide)		16	17			94%				
Totals										
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion					100%			100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.					100%			100%
	3. Mass Wasting	Bank slumping, calving, or collapse					100%			100%
Totals										
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	8	8			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	8	8			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	8	8			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in EEP monitoring guidance document)	5	6			83%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio \geq 1.6 Rootwads/logs providing some cover at base-flow.	6	6			100%			

McCain Property

Table 6 **Vegetation Condition Assessment**

Planted Acreage¹ **7.98**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage	
1. Bare Areas	Very limited cover of planted woody and herbaceous material on stream banks	0.1 acres	Solid Green	0	0.14	1.7%	
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on visual observations and MY3 stem count criteria.	0.1 acres	Solid Green	1	0.14	1.8%	
				Total	1	0.28	3.5%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	N/A	0	0.28	0.0%	
				Cumulative Total	1	0.56	7.0%

Easement Acreage² **13.34**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern ⁴	Microstegium, tall fescue, multiflora rose, Chinese privet, Chinese lespedeza	1000 SF	Green	3	0.02	0.1%
5. Easement Encroachment Areas ³	Microstegium encroachment	none	Green	3	0.02	0.1%

¹ = Enter the planted acreage within the easement. This number is calculated as the easement acreage minus any existing mature tree stands that were not subject to supplemental planting of the understory, the channel acreage, crossings or any other elements not directly planted as part of the project effort.

² = The acreage within the easement boundaries.

³ = Encroachment may occur within or outside of planted areas and will therefore be calculated against the overall easement acreage. In the event a polygon is cataloged into items 1, 2 or 3 in the table and is the result of encroachment, the associated acreage should be tallied in the relevant item (i.e., item 1,2 or 3) as well as a parallel tally in item 5.

⁴ = Invasives may occur in or out of planted areas, but still within the easement and will therefore be calculated against the overall easement acreage. Invasives of concern/interest are listed below. The list of high concern species are those with the potential to directly outcompete native, young, woody stems in the short-term (e.g. monitoring period or shortly thereafter) or affect the community structure for existing, more established tree/shrub stands over timeframes that are slightly longer (e.g. 1-2 decades). The low/moderate concern group are those species that generally do not have this capacity over the timeframes discussed and therefore are not expected to be mapped with regularity, but can be mapped, if in the judgement of the observer their coverage, density or distribution is suppressing the viability, density, or growth of planted woody stems. Decisions as to whether remediation will be needed are based on the integration of risk factors by EEP such as species present, their coverage, distribution relative to native biomass, and the practicality of treatment. For example, even modest amounts of Kudzu or Japanese Knotweed early in the projects history will warrant control, but potentially large coverages of Microstegium in the herb layer will not likely trigger control because of the limited capacities to impact tree/shrub layers within the timeframes discussed and the potential impacts of treating extensive amounts of ground cover. Those species with the "watch list" designator in gray shade are of interest as well, but have yet to be observed across the state with any frequency. Those in *red italics* are of particular interest given their extreme risk/threat level for mapping as points where isolated specimens are found, particularly early in a projects monitoring history. However, areas of discreet, dense patches will of course be mapped as polygons. The symbology scheme below was one that was found to be helpful for symbolizing invasives polygons, particularly for situations where the condition for an area is somewhere between isolated specimens and dense, discreet patches. In any case, the point or polygon/area feature can be symbolized to describe things like high or low concern and species can be listed as a map inset, in legend items if the number of species are limited or in the narrative section of the executive summary.

**McCain
Fixed-Station Photographs
Taken October 2012**



**McCain Stream
Fixed-Station Photographs
Taken October 2012
(continued)**



McCain Stream
Vegetation Monitoring Plot Photographs
Taken October 2012



APPENDIX C

VEGETATION PLOT DATA

Table 7. Vegetation Plot Criteria Attainment

Table 8. CVS Vegetation Plot Metadata

Table 9. Total and Planted Stems by Plot and Species

**Table 7. Vegetation Plot Criteria Attainment
McCain Creek Restoration Site (EEP Project Number 443)**

Vegetation Plot ID	Vegetation Survival Threshold Met?	Tract Mean
1	No*	57%
2	No*	
3	Yes	
4	Yes	
5	Yes	
6	Yes	
7	No*	

*Based on planted stems alone, these plots don't meet success criteria; however, when including naturally recruited stems of river birch (*Betula nigra*) and dogwood (*Cornus amomum*) these plots 2 and 7 were well-above 288 stems per acre.

Table 8. CVS Vegetation Plot Metadata

McCain Creek (EEP Project # 443)

Report Prepared By	Corri Faquin
Date Prepared	10/12/2012 11:10
database name	Axiom-EEP-2012-A.mdb
database location	C:\Documents and Settings\pperkinson\Desktop
computer name	PHILLIP-LT
file size	57331712
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	443
project Name	McCain
Description	Stream restoration site located in the Yadkin River Basin
River Basin	Yadkin-Pee Dee
length(ft)	2450
stream-to-edge width (ft)	50
area (sq m)	22758.94
Required Plots (calculated)	7
Sampled Plots	7

APPENDIX D
STREAM SURVEY DATA

Cross-section Plots

Longitudinal Profile Plot

Substrate Plots

Tables 10a-b. Baseline Stream Data Summary

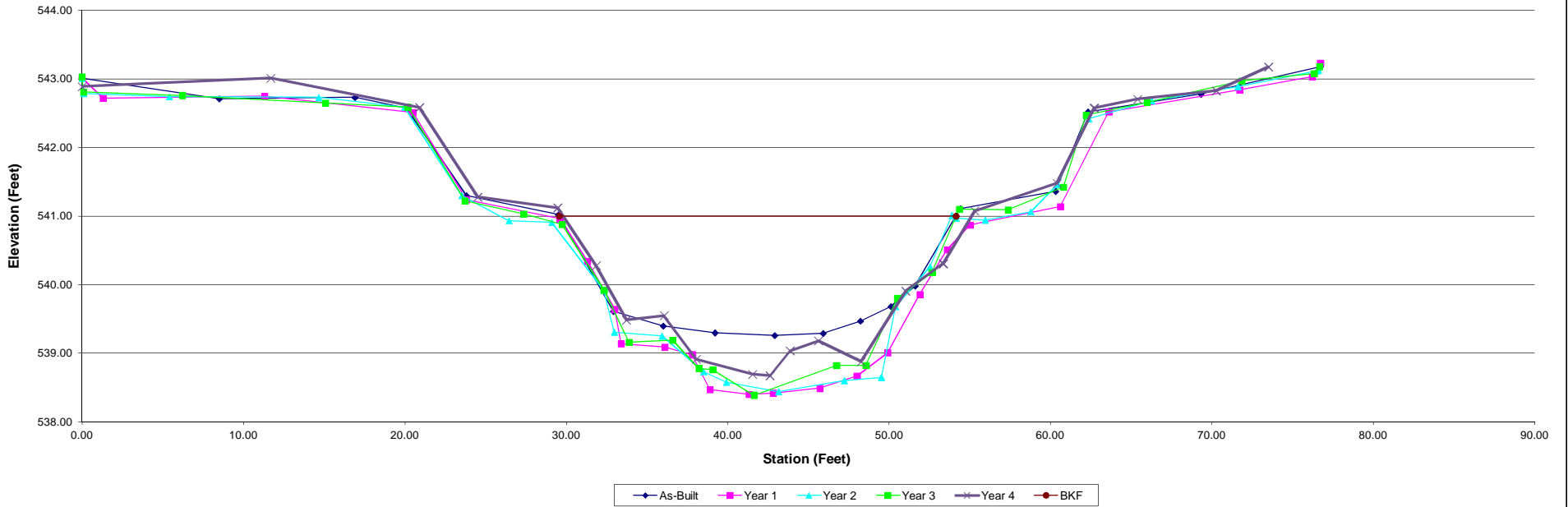
Tables 11a-b. Monitoring Data

Project:	McCain Property	Summary (bankfull)						
Cross Section:	Cross Section 2	MY0	MY1	MY2	MY3	MY4	MY5	
Feature:	Riffle Reach 2	A (BKF)	33.7	42.7	44.4	43.3	38.3	
Station:	16+25.07	W (BKF)	24.6	25.2	28.0	26.3	25.3	
Date:	10/22/12	Max d	1.8	2.5	2.6	2.6	2.3	
Crew:	PP, KJ	Mean d	1.4	1.7	1.6	1.6	11.5	
		W/D	18.0	14.9	17.6	16.0	16.7	

MY00-2009			MY01-2009			MY02-2010			MY03-2011			MY04-2012		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
8.50	543.01	LPIN	1.30	543.02	LPIN	0.10	542.79	LPIN	0.09	542.81	LPIN	11.68	542.89	LPIN
16.90	542.73		11.30	542.75		5.41	542.74		6.21	542.76		20.91	542.58	
20.10	542.57		20.50	542.51		14.66	542.73		15.09	542.65		24.51	541.28	
23.80	541.30		23.80	541.24		19.98	542.59		20.18	542.59		29.46	541.12	
29.50	541.02	TOBL BKFL	29.60	540.96	TOBL BKFL	23.53	541.30		23.71	541.22		31.85	540.28	TOBL BKFL
32.90	539.61		31.30	540.34		26.44	540.93		27.35	541.03		33.72	539.49	
36.00	539.40		33.00	539.64		29.09	540.91	TOBL BKFL	29.74	540.88	TOBL BKFL	36.05	539.55	
39.20	539.30		33.40	539.14		32.32	539.92		32.33	539.92		38.05	538.91	
42.90	539.26	TW	36.10	539.09		32.96	539.31		33.87	539.16	TOE L	41.53	538.69	
45.90	539.29		37.80	538.98		35.92	539.25		36.59	539.19		42.61	538.67	
48.20	539.47		38.90	538.47		38.49	538.73	TOE L	38.21	538.78		43.86	539.04	TW
50.10	539.68		41.30	538.40	TW	39.90	538.58		39.07	538.76		45.61	539.18	
51.60	539.98	TOBR BKFF	42.80	538.42		43.14	538.44	TW	41.63	538.39	TW	48.25	538.88	
54.40	541.11		45.70	538.49		47.21	538.60		46.73	538.82		51.02	539.91	
60.30	541.36		48.00	538.67		49.50	538.65	TOE R	48.55	538.82	TOE R	53.34	540.31	
62.30	542.52		49.90	539.01		50.39	539.68		50.50	539.80		55.28	541.08	TOBR BKFF
69.30	542.78		51.90	539.86		52.52	540.26		52.65	540.18		60.39	541.48	
76.70	543.18	RPIN	53.60	540.51		53.87	541.01		54.33	541.10	TOBR BKFF	62.69	542.58	
			55.00	540.87	TOBR BKFF	54.13	540.97	TOBR BKFF	57.37	541.09		65.37	542.70	
			60.60	541.14		55.94	540.94		60.79	541.42		70.25	542.83	
			63.60	542.52		58.75	541.06		62.20	542.47		73.48	543.17	RPIN
			71.70	542.84		60.44	541.46		65.96	542.66				
			76.20	543.03		62.34	542.42		71.83	542.97				
			76.70	543.23	RPIN	66.25	542.68		76.31	543.08				
						71.59	542.89		76.64	543.18	RPIN			
						76.49	543.12							
						76.58	543.13	RPIN						



Cross Section 2

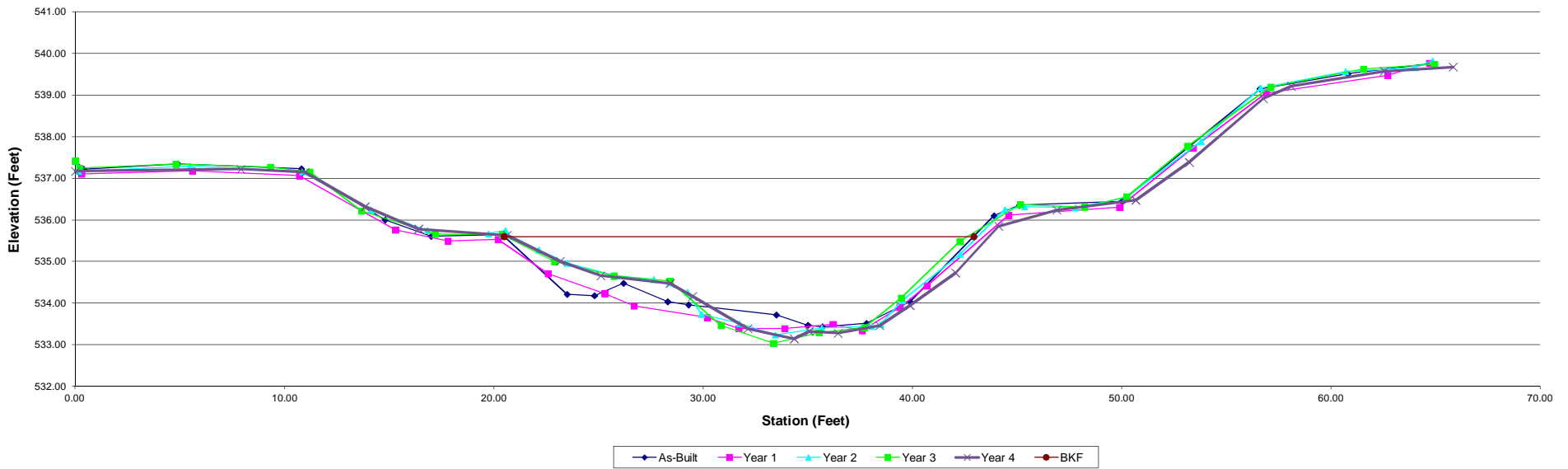


Project:	McCain Property	Summary (bankfull)						
Cross Section:	Cross Section 3	MY0	MY1	MY2	MY3	MY4	MY5	
Feature:	Pool Reach 2	A (BKF)	33.6	34.1	30.8	30.7	32.5	
Station:	23+45.75	W (BKF)	22.6	23.0	22.3	22.1	22.9	
Date:	10/22/12	Max d	2.2	2.2	2.4	2.6	2.5	
Crew:	PP, KJ	Mean d	1.5	1.5	1.4	1.4	1.4	
		W/D	-	-	-	-	-	



MY00-2009			MY01-2009			MY02-2010			MY03-2011			MY04-2012		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
	537.42	LPIN		537.41	LPIN		537.42	LPIN		537.42	LPIN		537.17	LPIN
0.40	537.22		0.30	537.10		0.16	537.17		0.21	537.24		7.91	537.22	
4.90	537.35		5.60	537.18		5.47	537.30		4.81	537.34		10.98	537.14	
10.80	537.23		10.70	537.06		10.85	537.15		9.33	537.27		13.84	536.32	
14.80	536.00		15.30	535.76	TOBL BKFL	14.13	536.24		11.21	537.15		16.41	535.78	
17.00	535.61		17.80	535.49		16.82	535.75		13.68	536.22		20.63	535.63	TOBL BKFL
20.40	535.64	TOBL BKFL	20.20	535.53		19.75	535.67		17.21	535.66		23.16	535.01	
23.50	534.21		22.60	534.71		20.55	535.75		20.39	535.65	TOBL BKFL	25.11	534.66	
24.80	534.18		25.30	534.23		20.59	535.67	TOBL BKFL	22.90	535.00		28.42	534.48	
26.20	534.48		26.70	533.93		22.15	535.28		25.74	534.65		29.48	534.16	
28.30	534.03		30.20	533.65		23.51	534.96		28.41	534.53		32.14	533.38	
29.30	533.96		31.70	533.39		25.84	534.66		30.85	533.46	TOE L	34.34	533.14	TW
33.50	533.72		33.90	533.39		27.64	534.57		33.36	533.03	TW	35.07	533.32	
35.00	533.47		36.20	533.49		29.25	534.26		35.53	533.29		36.44	533.28	
35.70	533.43	TW	37.60	533.34	TW	29.91	533.73	TOE L	37.70	533.41	TOE R	38.43	533.46	
37.80	533.51		39.40	533.90		31.73	533.51		39.46	534.12		39.88	533.94	
39.90	534.03		40.70	534.41		33.44	533.24	TW	42.27	535.48		42.06	534.73	
43.90	536.10	TOBR BKFF	44.60	536.11	TOBR BKFF	35.66	533.40		45.16	536.37	TOBR BKFF	44.12	535.84	
45.10	536.35		49.90	536.30		38.05	533.44		48.22	536.31		46.90	536.24	
50.00	536.45		53.40	537.72		38.48	533.49	TOE R	50.24	536.56		50.68	536.47	FOBR BKFR
56.60	539.15		56.90	539.05		39.52	534.06		53.15	537.77		53.23	537.38	
60.80	539.51		62.70	539.47		42.28	535.18		57.12	539.19		56.76	538.91	
64.70	539.76	RPIN	64.70	539.77	RPIN	44.41	536.24	TOBR BKFF	61.55	539.63		58.11	539.21	
						45.35	536.32		64.93	539.74		62.53	539.57	
						47.78	536.29		64.94	539.74	RPIN	65.83	539.67	RPIN
						50.18	536.53							
						53.78	537.89							
						56.63	539.17							
						60.69	539.57							
						64.01	539.66							
						64.85	539.83	RPIN						

Cross Section 3



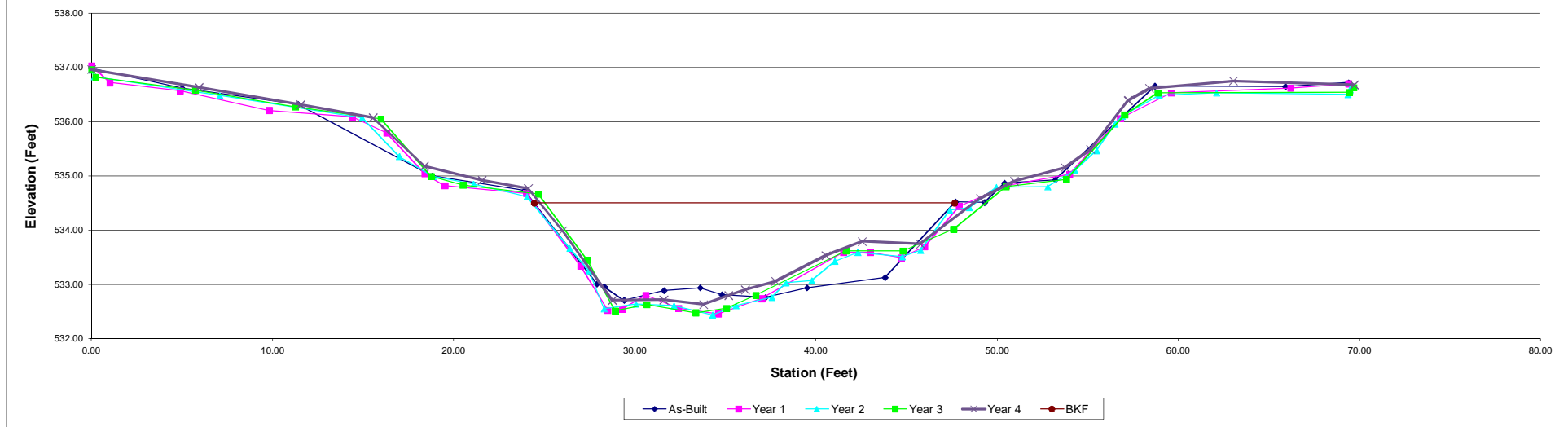
Project: McCain Property
 Cross Section: Cross Section 4
 Feature: Riffle Reach 2
 Station: 25+05.32
 Date: 10/22/12
 Crew: PP, KJ

Summary (bankfull)						
A (BKF)	MY0	MY1	MY2	MY3	MY4	MY5
W (BKF)	30.5	29.7	31.3	30.3	27.6	
Max d	23.3	23.4	24.4	24.3	23.9	
Mean d	1.8	2.0	2.1	2.0	1.9	
W/D	1.3	1.3	1.3	1.2	1.2	
	17.4	18.4	19.1	19.5	20.8	

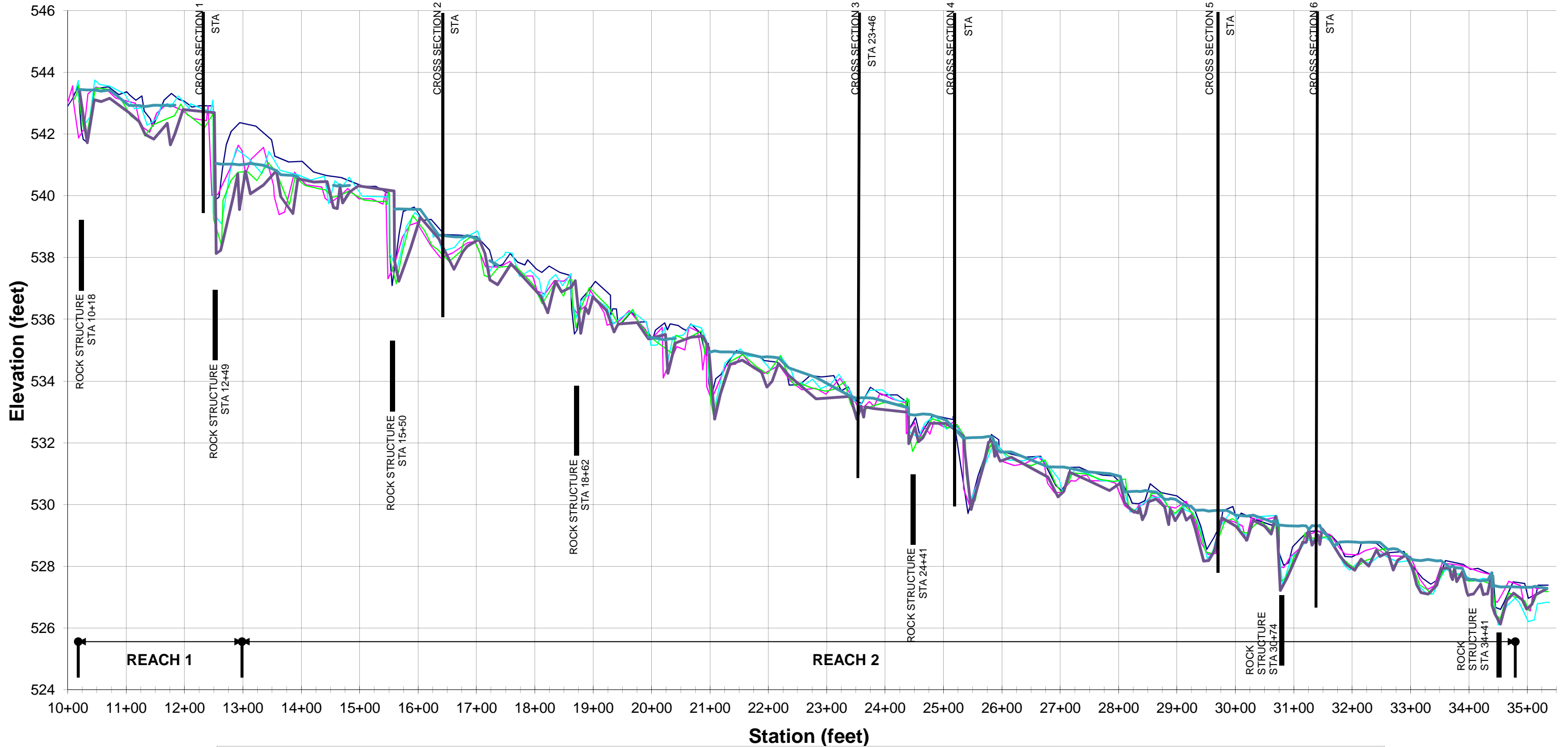
MY00-2009			MY01-2009			MY02-2010			MY03-2011			MY04-2012		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
	536.98	LPIN		537.03	LPIN		536.96	LPIN		536.96	LPIN		536.96	LPIN
5.00	536.62		1.00	536.72		0.14	536.83		0.23	536.82		5.93	536.63	
11.40	536.32		4.90	536.57		7.07	536.48		5.72	536.58		11.54	536.32	
18.80	535.00		9.80	536.21		14.93	536.07		11.25	536.27		15.54	536.08	
23.90	534.73	TOBL BKFL	14.40	536.09		16.99	535.36		15.98	536.05		18.37	535.18	
27.90	533.01		16.30	535.79		18.84	534.99		18.75	534.99		21.55	534.92	
28.30	532.96		18.40	535.04		21.09	534.85		20.51	534.83		24.11	534.77	TOBL BKFL
29.40	532.71	TW	19.50	534.82		24.04	534.62	TOBL BKFL	24.67	534.67	TOBL BKFL	26.00	533.99	
31.60	532.89		24.00	534.68	TOBL BKFL	26.40	533.67		27.38	533.45		28.74	532.71	
33.60	532.94		27.00	533.34		27.45	533.25		28.91	532.51		31.59	532.72	
34.80	532.81		28.50	532.52		28.30	532.55	TOE L	30.66	532.63		33.78	532.63	TW
37.20	532.76		29.30	532.54		30.05	532.64		33.36	532.48	TW	35.17	532.80	
39.50	532.94		30.60	532.80		32.15	532.61		35.06	532.56		36.08	532.90	
43.80	533.13		32.40	532.56		34.29	532.44	TW	36.68	532.80	TOE R	37.76	533.06	
47.70	534.52		34.60	532.46	TW	35.57	532.61		41.65	533.62		40.54	533.54	
49.30	534.51	TOBR BKFF	37.00	532.74		37.56	532.76	TOE R	44.80	533.62		42.54	533.79	
50.40	534.87		41.50	533.59		38.34	533.03		47.59	534.02		45.76	533.75	
53.20	534.93		43.00	533.59		39.76	533.07		50.48	534.80	TOBR BKFF	49.07	534.59	
58.70	536.66		44.70	533.49		41.03	533.43		53.81	534.94		50.93	534.90	TOBR BKFR
65.90	536.65		46.00	533.70		42.30	533.59		57.03	536.13		53.73	535.16	
69.40	536.72	RPIN	47.90	534.44	TOBR BKFF	44.75	533.51		58.87	536.53		55.15	535.49	
			50.50	534.82		45.77	533.63		69.44	536.54		57.23	536.39	
			54.00	535.03		47.37	534.37		69.69	536.63	RPIN	58.41	536.62	
			56.80	536.06		48.46	534.42					63.04	536.75	
			59.60	536.53		49.95	534.79	TOBR BKFR				69.71	536.68	RPIN
			66.20	536.62		52.78	534.80							
			69.40	536.70	RPIN	54.29	535.10							
						55.49	535.47							
						56.50	535.96							
						56.90	536.10							
						58.93	536.48							
						62.10	536.53							
						69.35	536.50							
						69.47	536.59	RPIN						



Cross Section 4

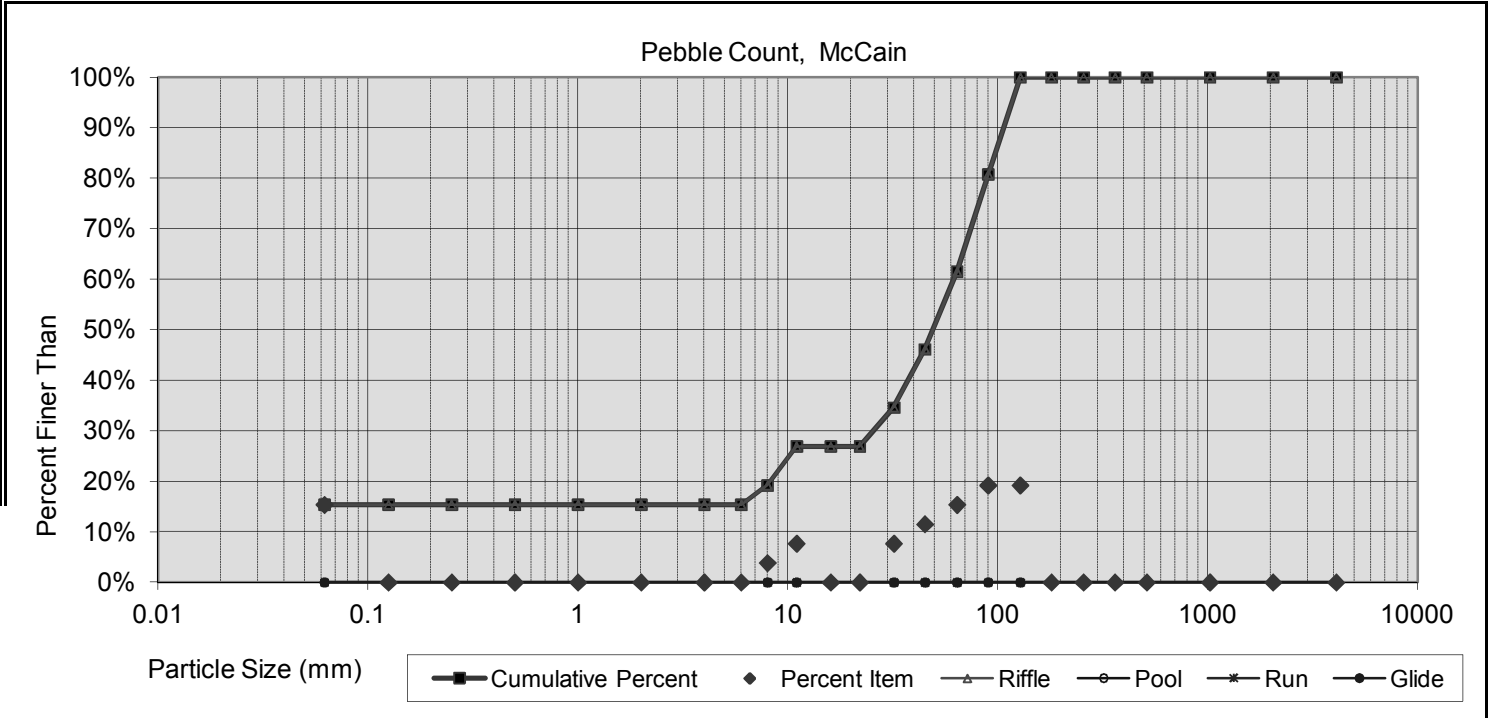


**McCain Property
MY-04 Longitudinal Profile
Main Channel: Station 10+00-35+50**



Pebble Count,	
McCain	

Note:	Cross Section 1

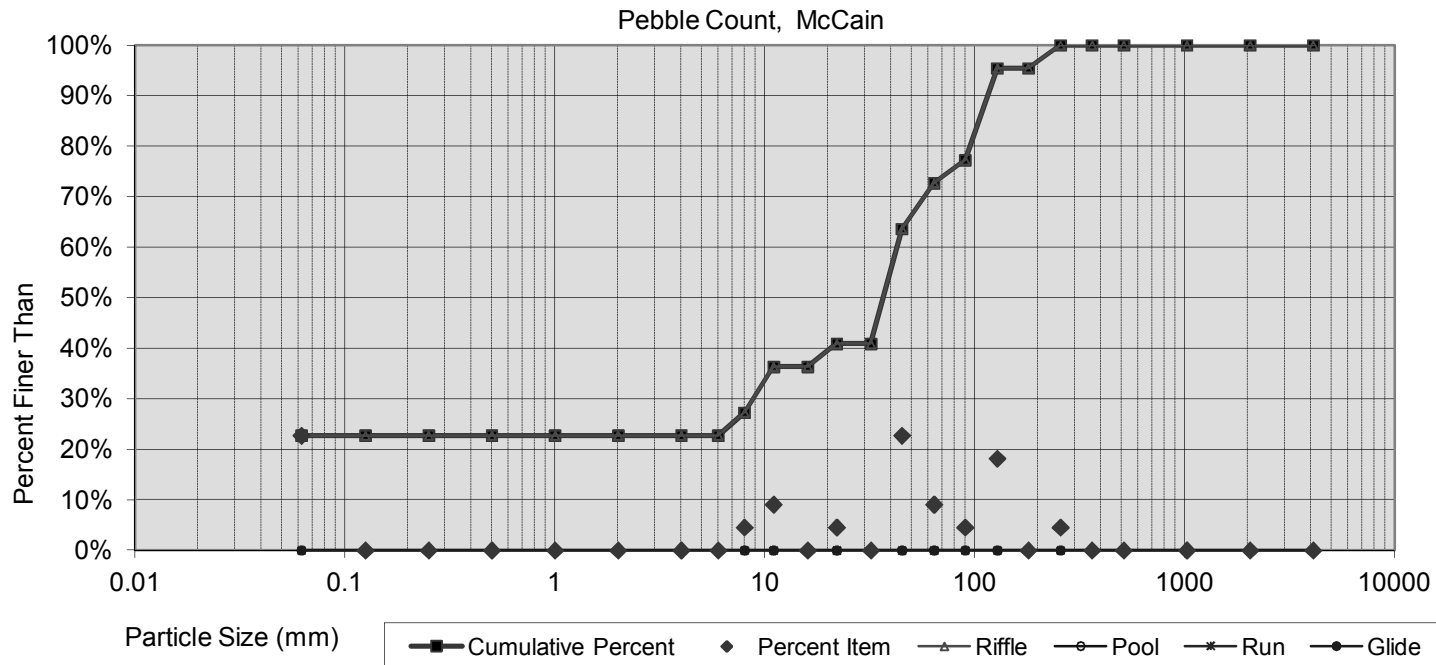


Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
6.283	32.37	49.1	95	117	15%	0%	46%	38%	0%	0%

Pebble Count,

McCain

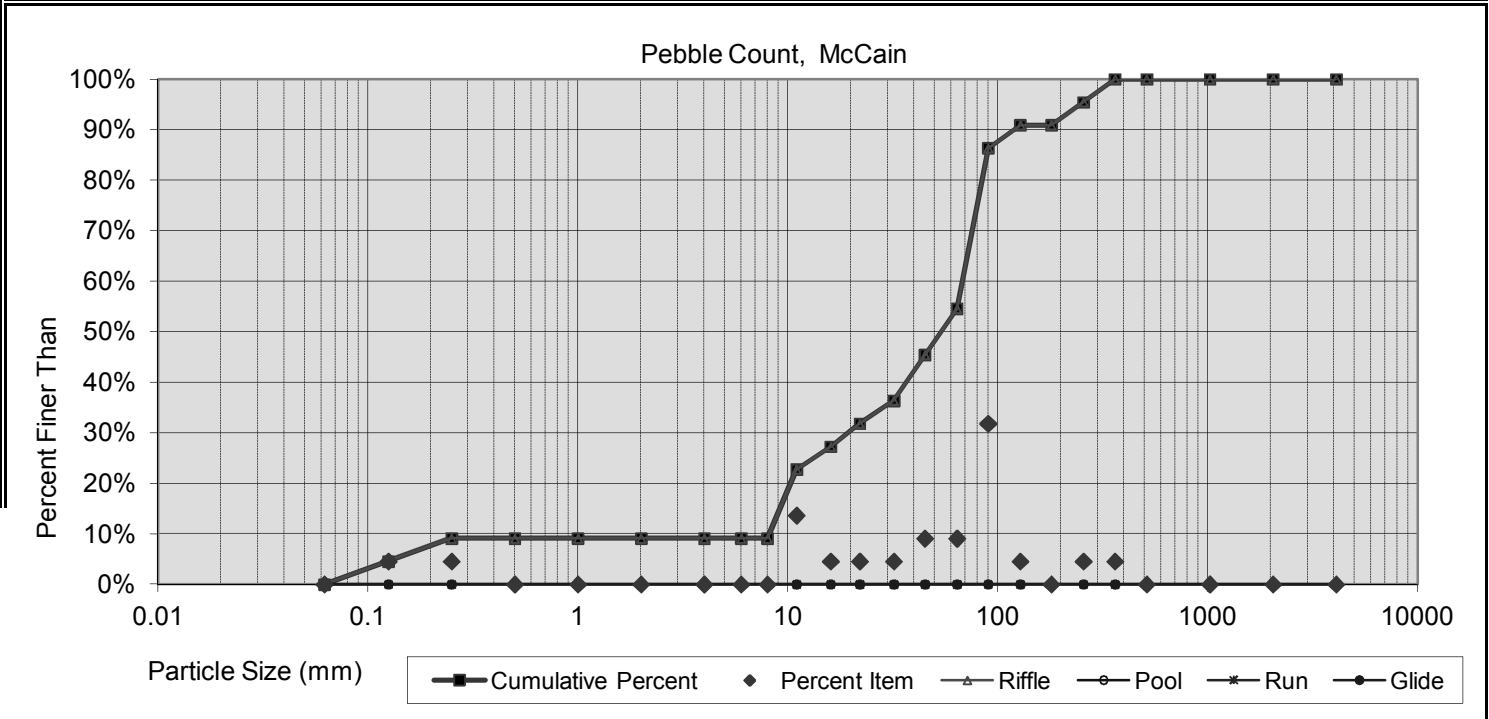
Note: **Cross Section 2**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
#N/A	10.49	36.7	103	127	20%	0%	44%	24%	0%	12%

	Pebble Count,
	McCain

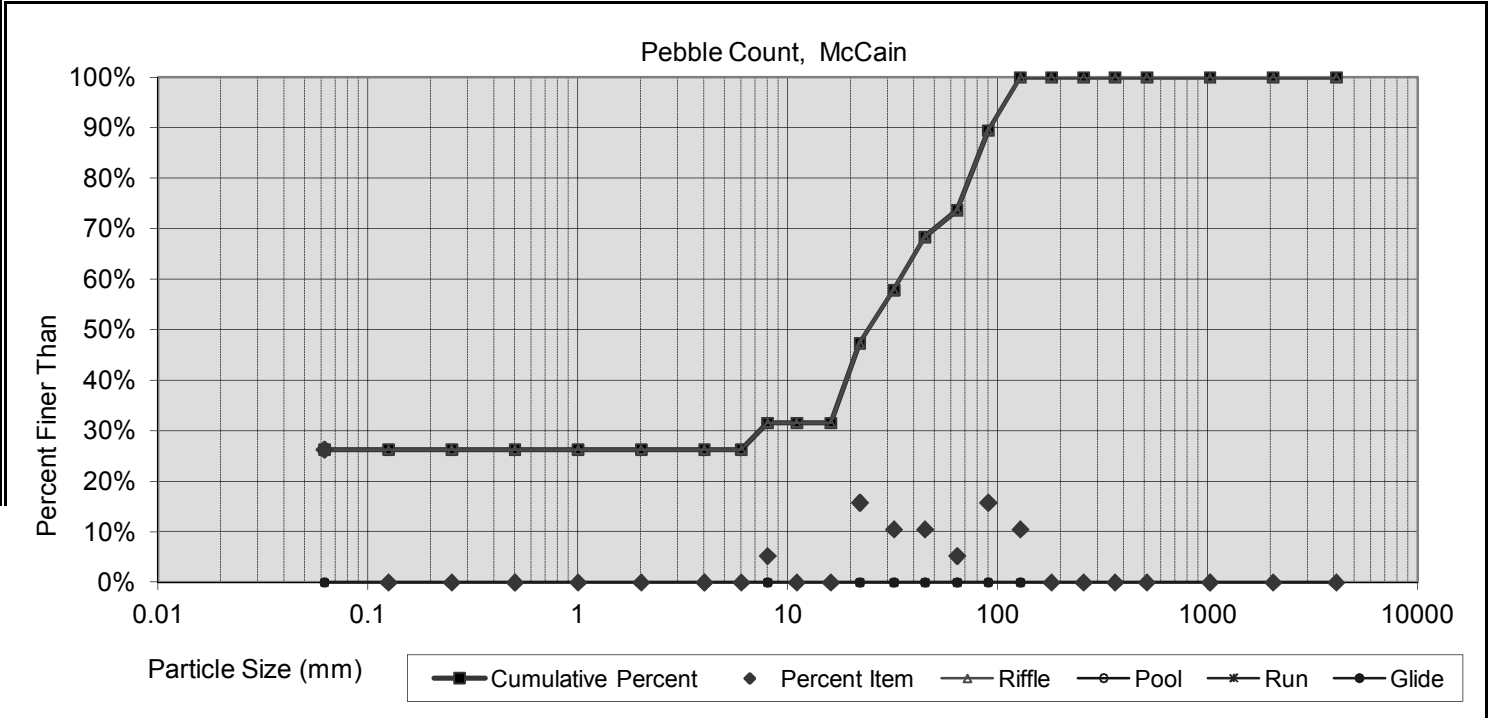
Note:	Cross Section 4



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
9.401	28.60	53.7	88	247	0%	8%	40%	36%	4%	12%

	Pebble Count,
	McCain

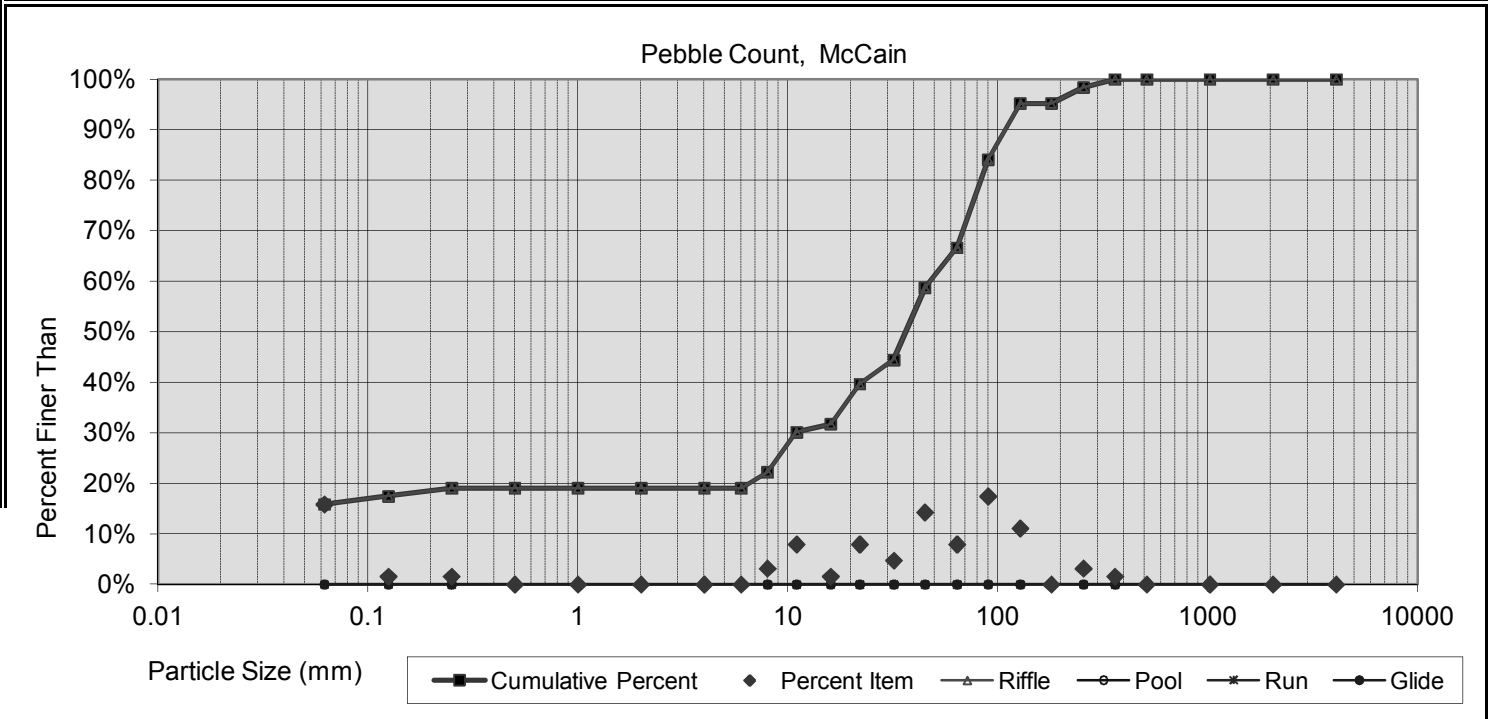
Note:	Cross Section 6



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
#N/A	17.14	24.2	80	108	20%	0%	36%	20%	0%	24%

	Pebble Count,
	McCain

Note:	Reach 2 Total



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.066	18.23	36.5	90	127	13%	3%	40%	27%	1%	16%

Table 10a. Baseline Stream Data Summary
McCain Stream Restoration Site/Project No. 443 - Reach: 1 (286 feet)

Parameter	Gauge ²	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline						
		LL	UL	Eq.	Min	Mean	Med	Max	SD ⁵	n	Min	Mean	Med	Max	SD ⁵	n	Min	Med	Max	Min	Mean	Med	Max	SD ⁵	n	
Dimension and Substrate - Riffle Only																										
Bankfull Width (ft)					14.6	18.7	25.9	29.3		4	10.4			27.1				18			16.9					
Floodprone Width (ft)					34	95	125	125		3	150			200							35					
Bankfull Mean Depth (ft)					1.1	1.4	1.4	1.7		4	0.8			1.5				1.4			1.1					
¹ Bankfull Max Depth (ft)					1.7	2.7	2.8	3.5		4	1.4			2				2			1.5					
Bankfull Cross Sectional Area (ft ²)					21.3	25.6	25.9	29.3		4	12.5			22.3				24.6			18.6					
Width/Depth Ratio					8.3	14	15	17.6		4	11.6			18.5				13.2			15.4					
Entrenchment Ratio					1.8	5.6	6.4	8.5		3	7.4			14.4							2.1					
¹ Bank Height Ratio					1	1.2	1.1	1.7		4	1			1				1			1					
Profile																										
Riffle Length (ft)											9			108				58			54	63	63	72	12	2
Riffle Slope (ft/ft)											0.01			0.076				0.007			0.005	0.006	0.006	0.007	0.002	2
Pool Length (ft)											28			108				38			16	21	22	25	4	3
Pool Max depth (ft)											1.8			3.1				3								
Pool Spacing (ft)											38			181				95			107	113	113	119	8	2
Pattern																										
Channel Beltwidth (ft)											75			135							78					
Radius of Curvature (ft)											14.5			26.8			30	35	35	38	38	40				2
Rc:Bankfull width (ft/ft)											1			1.6			1.7	1.9	2.1	2.2	2.2	2.4				
Meander Wavelength (ft)											70			148				190			204					1
Meander Width Ratio											3.6			13						4.6						
Transport parameters																										
Reach Shear Stress (competency) lb/ft ²																										
Max part size (mm) mobilized at bankfull																										
Stream Power (transport capacity) W/m ²																										
Additional Reach Parameters																										
Rosgen Classification					B4c/E4/C4-5						B4c/C3/C4						B4c			B4c						
Bankfull Velocity (fps)																		3.9								
Bankfull Discharge (cfs)																										
Valley length (ft)																										
Channel Thalweg length (ft)																										
Sinuosity (ft)																										
Water Surface Slope (Channel) (ft/ft)																										
BF slope (ft/ft)																										
³ Bankfull Floodplain Area (acres)																										
⁴ % of Reach with Eroding Banks																										
Channel Stability or Habitat Metric																										
Biological or Other																										

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing survey data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 10a. Baseline Stream Data Summary
McCain Stream Restoration Site/Project No. 443 - Reach: 2 (2184 feet)

Parameter	Gauge ²	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline						
		LL	UL	Eq.	Min	Mean	Med	Max	SD ⁵	n	Min	Mean	Med	Max	SD ⁵	n	Min	Med	Max	Min	Mean	Med	Max	SD ⁵	n	
Dimension and Substrate - Riffle Only																										
Bankfull Width (ft)					14.6	18.7	25.9	29.3		4	10.4			27.1			18	20	24	20.6	22.8	23.3	24.6	0.9	3	
Floodprone Width (ft)					34	95	125	125		3	150			200						47	54	51	63	6.2	3	
Bankfull Mean Depth (ft)					1.1	1.4	1.4	1.7		4	0.8			1.5			1	1.3	1.4	1.3	1.4	1.4	1.5	0.1	3	
¹ Bankfull Max Depth (ft)					1.7	2.7	2.8	3.5		4	1.4			2			1.3	1.7	2	1.8	1.9	1.8	2.1	0.2	3	
Bankfull Cross Sectional Area (ft ²)					21.3	25.6	25.9	29.3		4	12.5			22.3			25	25.5	26	30.8	31.89	31.2	33.7	1.3	3	
Width/Depth Ratio					8.3	14	15	17.6		4	11.6			18.5			12.7	15.6	23	13.8	16.4	17.4	18	0.8	3	
Entrenchment Ratio					1.8	5.6	6.4	8.5		3	7.4			14.4						2	2.3	2.5	2.5	0.1	3	
¹ Bank Height Ratio					1	1.2	1.1	1.7		4	1			1						1	1	1	1	0	3	
Profile																										
Riffle Length (ft)											9			108			59	67	88	20	68	76	97	23	13	
Riffle Slope (ft/ft)											0.01			0.076			0.008	0.008	0.01	0.003	0.009	0.008	0.019	0.004	13	
Pool Length (ft)											28			108			47	52	59	12	22	23	33	6	13	
Pool Max depth (ft)											1.8			3.1			2.3	2.8	3.3	2.2	2.5		2.8		2	
Pool Spacing (ft)											38			181			106	118	147	56	117	123	150	25	12	
Pattern																										
Channel Beltwidth (ft)											75			135						20	66	62	97	24	10	
Radius of Curvature (ft)											14.5			26.8			35		60	35	49	43	80	14	12	
Rc:Bankfull width (ft/ft)											1			1.6			1.8		3.1	1.5	2.2	2.2	3.3			
Meander Wavelength (ft)											70			148			212	236	294	158	221	229	261	36	10	
Meander Width Ratio											3.6			13						1.9	3.1	2.7	4.8			
Transport parameters																										
Reach Shear Stress (competency) lb/ft ²																										
Max part size (mm) mobilized at bankfull																										
Stream Power (transport capacity) W/m ²																										
Additional Reach Parameters																										
Rosgen Classification					B4c/E4/C4-5						B4c/C3/C4						B4c			B4c						
Bankfull Velocity (fps)																				3.9						
Bankfull Discharge (cfs)																										
Valley length (ft)																										
Channel Thalweg length (ft)																										
Sinuosity (ft)																										
Water Surface Slope (Channel) (ft/ft)																										
BF slope (ft/ft)																										
³ Bankfull Floodplain Area (acres)																										
⁴ % of Reach with Eroding Banks																										
Channel Stability or Habitat Metric																										
Biological or Other																										

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing survey data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

**Table 10b. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
McCain Stream Restoration Site/Project No. 443 - Entire Stream (2470 lf)**

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design					As-built/Baseline				
¹ Ri% / Ru% / P% / G% / S%											56%		40%							
¹ SC% / Sa% / G% / C% / B% / Be%																				
¹ d16 / d35 / d50 / d84 / d95 / di ^p / di ^{sp} (mm)																				
² Entrenchment Class <1.5/ 1.5-1.99/ 2.0-4.9/ 5.0-9.9/ >10																				
³ Incision Class <1.2/ 1.2-1.49/ 1.5-1.99/ >2.0																				

Shaded cells indicate that these will typically not be filled in.

1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates

3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosely built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design survey), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construction distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable section of the reach. This means that the distributions for these parameters should include data from both the cross-section surveys and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)

McCain Stream Restoration Site/Project No. 443

	Cross Section 1 (Reach 1-Riffle)							Cross Section 2 (Reach 2-Riffle)							Cross Section 3 (Reach 2-Pool)						
Based on fixed baseline bankfull elevation¹	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	544.4	544.3	544.4	544.4	544.4			541	540.9	541	541	541			535.6	535.5	535.6	535.6	535.6		
Bankfull Width (ft)	16.9	17.2	18.11	16.22	16.7			24.6	25.2	27.87	26.32	25.3			22.6	23	22.25	22.08	22.9		
Floodprone Width (ft)	35	37	35	35	46			63	>75	63	63	63			-	-	-	-	-		
Bankfull Mean Depth (ft)	1.1	1.2	1.033	1.096	1.1			1.4	1.7	1.584	1.645	1.5			1.5	1.5	1.384	1.388	1.4		
Bankfull Max Depth (ft)	1.5	1.6	1.6	1.7	1.6			18	2.5	2.55	2.61	2.3			2.2	2.2	2.36	2.57	2.5		
Bankfull Cross Sectional Area (ft ²)	18.6	20.8	18.71	17.77	18.1			33.7	42.7	44.14	43.3	38.3			33.6	34.1	30.8	30.65	32.5		
Bankfull Width/Depth Ratio	15.4	14.2	17.52	14.79	15.5			18	14.9	17.59	16	16.7			-	-	-	-	-		
Bankfull Entrenchment Ratio	2.1	2.2	1.933	2.158	2.7			2.5	>3.0	2.261	2.394	2.5			-	-	-	-	-		
Bankfull Bank Height Ratio	1	1	1.1	1.188	1.3			1	1	0.969	0.954	1			-	-	-	-	-		
Cross Sectional Area between end pins (ft ²)	174.2	182	184.8	184.2	----			119	137	137.4	136.9	----			97	87	90	167.3	----		
d50 (mm)	21	18	13.5	32.9	49.1			19	17	24.2	32	36.7			8.1	1.7	31	43.1	----		
	Cross Section 4 (Reach 2-Riffle)							Cross Section 5 (Reach 2-Pool)							Cross Section 6 (Reach 2-Riffle)						
Based on fixed baseline bankfull elevation¹	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	534.5	534.4	534.5	534.5	534.5			531.3	531.2	531.3	531.3	531.3			531.3	531	531.3	531.3	531.3		
Bankfull Width (ft)	23.3	23.4	23.99	24.32	23.9			18.1	14.3	16.46	13.96	14.4			20.6	18.4	20.79	20.6	21.4		
Floodprone Width (ft)	47	52	47	47	47			-	-	-	-	-			51	50.5	51	51	51		
Bankfull Mean Depth (ft)	1.3	1.3	1.234	1.246	1.2			1.2	1.2	1.282	1.339	1.3			1.5	1.4	1.339	1.363	1.4		
Bankfull Max Depth (ft)	1.8	2	1.99	2.02	1.9			2.8	2.5	2.88	2.77	2.8			2.1	2	2.18	2.3	2.4		
Bankfull Cross Sectional Area (ft ²)	31.2	29.7	29.61	30.29	27.6			22.2	17.8	21.1	18.69	18.8			30.8	25.2	27.84	28.08	29.6		
Bankfull Width/Depth Ratio	17.4	18.4	19.44	19.53	20.8			-	-	-	-	-			13.8	13.4	15.52	15.11	15.5		
Bankfull Entrenchment Ratio	2	2.2	1.959	1.932	2			-	-	-	-	-			2.5	2.7	2.453	2.476	2.4		
Bankfull Bank Height Ratio	1	1	1.095	1.084	1.05			-	-	-	-	-			1	1	1.069	1.026	1		
Cross Sectional Area between end pins (ft ²)	103	120	132.3	124.2	----			146	148	158.3	155.8	----			133	159	157.1	159.2	----		
d50 (mm)	17	14	24	29	53.7			0.6	3	9.3	16.9	----			11	4.6	16.8	26	24.2		

1 = Widths and depths for monitoring resurvey will be based on the baseline bankfull datum regardless of dimensional/depositional development. Input the elevation used as the datum, which should be consistent and based on the baseline datum established. If the performer has inherited the project and cannot acquire the datum used for prior years this must be discussed with EEP. If this cannot be resolved in time for a given years report submission a footnote in this should be included that states: "It is uncertain if the monitoring datum has been consistent over the monitoring history, which may influence calculated values. Additional data from a prior performer is being acquired to provide confirmation. Values will be recalculated in a future submission based on a consistent datum if determined to be necessary."

**Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
McCain Stream Restoration Site/Project No. 443 - Reach: 1 (286 feet)**

Parameter	Baseline																								MY-1						MY-2						MY-3						MY-4						MY-5					
	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n																		
Dimension and Substrate - Riffle only																																																						
Bankfull Width (ft)	16.9						17.2						17.03						16.22						16.7																													
Floodprone Width (ft)	35						37						35						35						46																													
Bankfull Mean Depth (ft)	1.1						1.2						0.92						1.096						1.1																													
¹ Bankfull Max Depth (ft)	1.5						1.6						1.42						1.7						1.6																													
Bankfull Cross Sectional Area (ft ²)	18.6						20.8						15.67						17.77						18.1																													
Width/Depth Ratio	15.4						14.2						18.5						14.79						15.5																													
Entrenchment Ratio	2.1						2.2						2.056						2.158						2.7																													
¹ Bank Height Ratio	1						1						1.239						1.188						1.3																													
Profile																																																						
Riffle Length (ft)	54.0	63.0	63.0	72.0	12.0	2		67.0					50.46	54.87	54.87	59.27	6.23	2	43.86	49.61	49.61	55.36		2	7	42	32	123	29																									
Riffle Slope (ft/ft)	0.005	0.006	0.006	0.007	0.002	2		0.007					0.002	0.005	0.005	0.009	0.005	2	0.005	0.007	0.007	0.008		2	0.000	0.010	0.008	0.049	0.010																									
Pool Length (ft)	16.0	21.0	22.0	25.0	4.0	3	25.0		30.0	31.0			93.02	96.96	96.96	100.9	5.57	2	28.85	63.2	58.56	102.2	36.88	3	7	25	22	66	15																									
Pool Max depth (ft)													3.72	4.82	4.82	5.91	1.55	2	3.31	4.35	3.39	6.35	1.733	3	2.5	2.6	2.8																											
Pool Spacing (ft)	107.0	113.0	113.0	119.0	8.0	2	112.0		125.0	194.0			127.1					1	104.5	117.9	117.9	131.4		2	7	58	69	66	29																									
Pattern																																																						
Channel Beltwidth (ft)		78																																																				
Radius of Curvature (ft)	35	38	38	40		2																																																
Rc:Bankfull width (ft/ft)	2.1	2.2	2.2	2.4																																																		
Meander Wavelength (ft)		204																																																				
Meander Width Ratio		4.6																																																				
Additional Reach Parameters																																																						
Rosgen Classification	B4c						C4						B4c						B4c						B4c																													
Channel Thalweg length (ft)	286						286						286						286						286																													
Sinuosity (ft)	1.3						1.3						1.3						1.3						1.3																													
Water Surface Slope (Channel) (ft/ft)	0.0068						0.65						0.0074						0.008						0.0078																													
BF slope (ft/ft)	0.0065												0.0039						0.0037						---																													
² Ri% / Ru% / P% / G% / S%													38%	10%	47%	10%			34.69	5.619	45.81	8.255			43	13	27	17																										
³ SC% / Sa% / G% / C% / B% / Be%													4%	19%	65%	11%	0%	1%	0%	9%	68%	22%	1%	0%	15	0	46	38	0	0																								
³ d16 / d35 / d50 / d84 / d95 /													0.2	14.2	21.1	58.2	90		7	18.4	32.9	82.2	162.7		6.3	32.4	49.1	95	117																									
² % of Reach with Eroding Banks							1%						21%						9%						10%																													
Channel Stability or Habitat Metric																																																						
Biological or Other																																																						

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Shaded cells indicate that these will typically not be filled in.
 1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile.
 2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
 3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
 4 = Of value/needed only if the n exceeds 3

**Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
McCain Stream Restoration Site/Project No. 443 - Reach: 2 (2184 feet)**

Parameter	Baseline						MY-1						MY-2						MY-3						MY-4						MY-5					
	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)	20.6	22.8	23.3	24.6	0.9	3	18.4	22.33	23.4	25.2	3.523	3	20.79	23.08	23.99	24.44	1.992	3	20.6	23.75	24.32	26.32	2.904	3	21.4	23.5	23.9	25.3	2							
Floodprone Width (ft)	47	54	51	63	6.2	3	51	55.33	52	63	6.658	3	47	53.67	51	63	8.327	3	47	53.67	51	63	8.327	3	47	53.7	51	63	8.3							
Bankfull Mean Depth (ft)	1.3	1.4	1.4	1.5	0.1	3	1.3	1.467	1.4	1.7	0.208	3	1.281	1.425	1.339	1.655	0.201	3	1.246	1.418	1.363	1.645	0.205	3	1.2	1.4	1.4	1.5	0.2							
¹ Bankfull Max Depth (ft)	1.8	1.9	1.8	2.1	0.2	3	2	2.167	2	2.5	0.289	3	2.06	2.197	2.18	2.35	0.146	3	2.02	2.31	2.3	2.61	0.295	3	1.9	2.2	2.3	2.4	0.3							
Bankfull Cross Sectional Area (ft ²)	30.8	31.89	31.2	33.7	1.3	3	25.2	32.53	29.7	42.7	9.088	3	27.84	32.95	31.3	39.71	6.102	3	28.08	33.89	30.29	43.3	8.222	3	27.6	31.8	29.6	38.3	5.7							
Width/Depth Ratio	13.8	16.4	17.4	18	0.8	3	13.4	15.57	14.9	18.4	2.566	3	14.5	16.37	15.52	19.09	2.41	3	15.11	16.88	16	19.53	2.335	3	15.3	17.4	16.9	19.9	2.4							
Entrenchment Ratio	2	2.3	2.5	2.5	0.1	3	2.2	2.467	2.5	2.7	0.252	3	1.923	2.334	2.453	2.626	0.366	3	1.932	2.267	2.394	2.476	0.293	3	2	2.3	2.4	2.5	0.3							
¹ Bank Height Ratio	1	1	1	1	0	3	1	1	1	1	0	3	1.051	1.059	1.058	1.069	0.009	3	0.954	1.021	1.026	1.084	0.065	3	1	1	1	1.1	0							
Profile																																				
Riffle Length (ft)	20.0	68.0	76.0	97.0	23.0	13	16.0		37.6	86.8			13.0	65.8	69.2	112.0	29.3	17	15.63	74.41	69.7	196	37.61	17	7	42	32	123	29							
Riffle Slope (ft/ft)	0.003	0.009	0.008	0.019	0.004	13	0.001		0.012	0.027			0.002	0.011	0.007	0.059	0.013	17	0.000	0.005	0.006	0.011	0.003	16	0.000	0.010	0.008	0.049	0.010							
Pool Length (ft)	12.0	22.0	23.0	33.0	6.0	13	12.0		29.2	44.3			29.4	57.0	50.1	160.4	30.6	19	26.74	48.29	45.31	78.75	14.47	18	7	25	22	66	15							
Pool Max depth (ft)	2.2	2.5		2.8		2							1.8	3.1	2.8	5.9	0.9	19	2.15	3.372	3.405	4.43	0.655	18	2.5		2.6	2.8								
Pool Spacing (ft)	56.0	117.0	123.0	150.0	25.0	12	52.0		144.0	317.0			76.9	121.5	116.5	183.7	30.7	18	48.5	124.9	121	241.2	43.89	17	7	58	59	66	29							
Pattern																																				
Channel Beltwidth (ft)	20	66	62	97	24	10																														
Radius of Curvature (ft)	35	49	43	80	14	12																														
Rc:Bankfull width (ft/ft)	1.5	2.2	2.2	3.3																																
Meander Wavelength (ft)	158	221	229	261	36	10																														
Meander Width Ratio	1.9	3.1	2.7	4.8																																
Additional Reach Parameters																																				
Rosgen Classification			C4						C4						C4						C4						C4									
Channel Thalweg length (ft)			2182						2182						2182						2182						2228									
Sinuosity (ft)			1.18						1.18						1.18						1.18						1.18									
Water Surface Slope (Channel) (ft/ft)			0.0068						0.0067						0.0066						0.0066						0.0064									
BF slope (ft/ft)			0.0065						0.0067						0.0068						0.0063						---									
² Ri% / Ru% / P% / G% / S%													54%	2%	32%	16%			61%	2%	33%	5%			52%	13%	21%	14%								
³ SC% / Sa% / G% / C% / B% / Be%													11%	10%	71%	7%	0%	1%	5%	7%	71%	15%	1%	1%	13	3	40	27	1	16						
³ d16 / d35 / d50 / d84 / d95 /													1.6	6.22	14.06	41.34	97.76		5	15.68	29	74.88	163.6		0.1	18.2	36.5	90	127							
² % of Reach with Eroding Banks									0%						1%						0%						0%									
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Shaded cells indicate that these will typically not be filled in.
 1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile.
 2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
 3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
 4 = Of value/needed only if the n exceeds 3

APPENDIX E
HYDROLOGY DATA

Table 12. Verification of Bankfull Events

Table 12. Verification of Bankfull Events

McCain Site Stream Restoration-Project No. 443			
Date of Data Collection	Date of Occurrence	Method	Photo #
17-Nov-09	13-Nov-09	Site Visit to evaluate indicators of stage after storm events	N/A
30-Sep-10	30-Sep-10	NWS COOP Station and site visit for confirmation	Photo 14 MY-02 Report

Photo 14. Evidence of overbank including wrack on top of banks.

