

**Kings Creek
Stream Restoration
NCEEP Project Number: 208
Monitoring Project Number: D09082S
Monitoring Year 4
2012 Final Report**

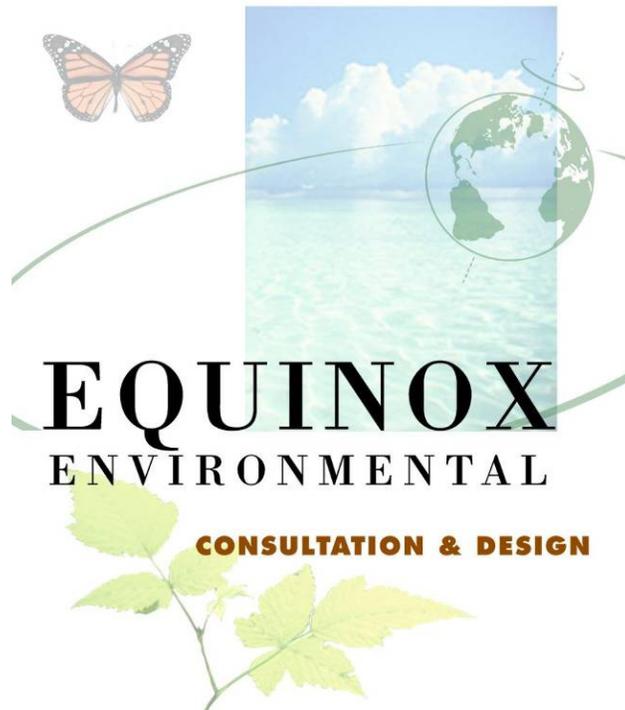


**Submitted to
North Carolina Ecosystem Enhancement Program
North Carolina Department of Environment and Natural Resources
November 2012**



**1619 Mail Service Center
Raleigh, NC 27699**

Monitoring Firm



**37 Haywood Street, Suite 100
Asheville, North Carolina 28801
Phone: 828-253-6856**

**Project Contact: Kevin Mitchell
Email: Kevin@equinoxenvironmental.com**

Kings Creek Stream Restoration 2012 Monitoring Report (MY 4)

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1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

The goals and objectives stated in the Kings Creek Mitigation Report (NCEEP 2006) are as follows:

- Restore 2,119 linear feet of channel dimension, pattern, and profile to the extent possible;
- Improve floodplain functionality by matching floodplain elevation with bankfull stage, thereby increasing watershed attenuation and reducing peak flows;
- Establish native floodplain vegetation, which will allow treatment of diffuse storm flow and nutrient uptake while establishing part of a wildlife corridor in the watershed;
- Remove invasive exotic vegetation species from the stream corridor;
- Improve the natural aesthetics of the stream corridor; and
- Improve the water quality in the Kings Creek watershed by reducing bank erosion, increasing nutrient storage and uptake, and increasing dissolved oxygen of the system.

The monitoring year four (MY4) vegetation plot data indicate that the project is on track to meet the final established criterion for planted stem density, which is a minimum survival of 260 planted stems per acre at the end of the year five monitoring period. Average stem density for planted stems in MY4 is approximately 594 stems per acre. Additionally, when planted and natural stems are combined, the average stem density is 2,037 stems per acre, which is well above the minimum established criterion. Of the 45 planted stems recorded within the monitoring plots, almost all (90%) had vigor codes of good or excellent. The site includes a diverse assemblage of 14 planted species of native trees and shrubs. Planted species range from 5 to 6 per plot with 8 to 9 species observed when volunteers are included. Problems with vegetation consist of areas of low stem densities adjacent to the stream reach as well as approximately 16 currently isolated patches of high threat invasive plant species that span the project area. A supplemental live stake planting occurred on March 16, 2011 in those areas noted with low stem densities and eroding banks. Dominant invasive non-native plants include multiflora rose (*Rosa multiflora*), Japanese honeysuckle (*Lonicera japonica*), privet (*Ligustrum sp.*), and kudzu (*Pueraria montana var. lobata*). Invasive plants on site are scheduled to be treated during 2013 and 2014.

Stream longitudinal profiles have remained relatively stable among monitoring years. The primary stream issue observed during MY4 was bank erosion resulting from thalweg migration and low woody stem densities. In particular, thalweg migration has continued at station 2+00 (83 feet) and 5+25 (38 feet) causing further bank erosion. These two areas of concern have continued to actively erode between monitoring years. All other morphological metrics indicated performance percentages averaging between 88 and 100%. One beaver dam was noted at the lower end of the reach during separate monitoring visits. EEP was informed and a beaver removal request form was submitted to the Animal and Plant Health Inspections Service's (APHIS) on both occasions. APHIS removed the beaver dam and two beavers from the lower reach of Kings Creek on October 29, 2012. Based on the presence of wrack lines and crest gauge monitoring two bankfull events were documented in MY4.

Summary information/data related to the occurrence of items such as beaver or easement 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 mitigation and restoration plan documents available on EEP's website. All raw data supporting tables and figures in the appendices is available from EEP upon request.

2.0 Methodology

The stream monitoring methodologies utilized in 2012 replicate those employed during previous monitoring years and are based on standard guidance and procedures documents (Rosgen 1996 and USACE 2003). Vegetation monitoring data were collected following the standard CVS-EEP Protocol for Recording Vegetation, Level II (Lee et al. 2008).

3.0 References

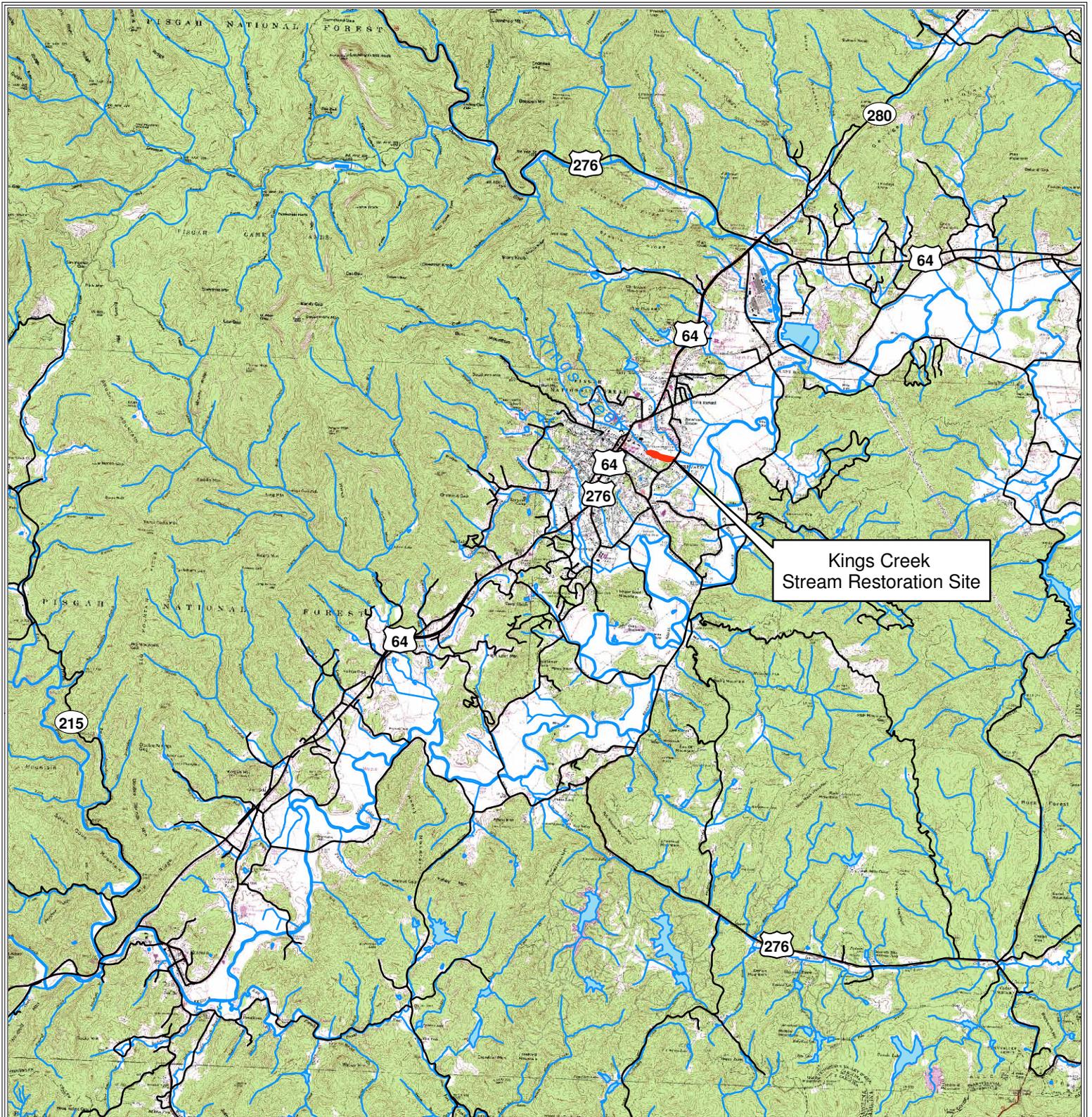
Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation. Version 4.2. The University of North Carolina at Chapel Hill, Department of Biology.

NCEEP (North Carolina Ecosystem Enhancement Program). 2006. Mitigation Report Kings Creek Restoration Project. Raleigh.

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology Books, Pagosa Springs, Colorado.

USACE (U.S. Army Corps of Engineers). 2003. Stream Mitigation Guidelines. USACOE, USEPA, NCWRC, NCDENR-DWQ. Wilmington District.

Appendix A
Project Vicinity Map and Background Tables



Kings Creek
Stream Restoration Site



Figure 1 - Vicinity Map

Kings Creek
Stream Restoration Site
Project No. 208

Transylvania County, North Carolina

Directions: From Raleigh, proceed west on I-40 W to Asheville. Take the Sweeten Creek Rd/US-25 A exit (Exit 51). Proceed south on US-25-Alt to NC-280 S in Fletcher. Continue on NC-280 S towards Brevard. NC-280 S becomes US-276 S/US-64 in Brevard. After passing Brevard College turn left on E French Broad St and continue to Park Ave. Turn left on Park Ave for approximately 1/4 mile and project site is on the left.



0 0.5 1 2 3 Miles

7.5 Minute Series Brevard
Quadrangle

Table 1a. Project Components Kings Creek / Project No. 208										
Project Component or Reach ID	Existing Feet	Restoration Level	Approach	Footage	Credible Footage	Stationing	Mitigation Ratio	* Anticipated Mitigation Units	BMP Elements	Comment
Reach I	824	R	P2	990	840	1+00 - 10+90	1 : 1	840	N/A	Excavated new off-line bankfull channel and constructed floodplain at lower elevation.
Reach II	191	EI	-	191	0	10+90 - 12+81	2.5 : 1	0	N/A	Excavated floodplain on left bank and stabilized left bank slopes. No work on right bank.
Reach III	800	R	P2	936	791	12+81 - 22+17	1 : 1	791	N/A	Excavated new off-line bankfull channel and constructed floodplain at lower elevation.

*The anticipated mitigation units are based on the expected yields due to the lack of a full 30-foot riparian buffer on portions of the stream
 - Information unavailable

Table 1b. Component Summations Kings Creek / Project No. 208							
Restoration Level	Stream (lf)	Riparian Wetland (Ac)		Non-Ripar (Ac)	Upland (Ac)	Buffer (Ac)	BMP
		Riverine	Non-Riverine				
Restoration	1,928						
Enhancement							
Enhancement I							
Enhancement II	191						
Creation							
Preservation							
HQ Preservation							
		0	0				
Totals	2,119	0.0	0.0	0.0	0.0	0.0	BMP Count
*Anticipated SMU Totals	1,631	0.0	0.0	0.0	0.0	0.0	0

=Non-Applicable

*The anticipated mitigation units are based on the expected yields due to the lack of a full 30-foot riparian buffer on portions of the stream

Table 2. Project Activity and Reporting History Kings Creek / Project No. 208 Elapsed Time Since Grading Complete: 6 Years Elapsed Time Since Planting Complete: 6 Years Number of Reporting Years: 4		
Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan	-	-
Final Design - Construction Plans	-	Sep-04
Construction	N/A	2006
Live Stakes and Bare Root Trees Planted	N/A	2006
Mitigation Plan / As-built (Year 0 Monitoring - Baseline)	Nov-05/Dec-05	May-06
Year 1 Monitoring	2008	2008
Year 2 Monitoring	Nov-10	Nov-10
Supplemental Live Stake Planting Effort	Mar-11	Mar-11
Year 3 Monitoring	Nov-11	Nov-11
Beaver and Beaver Dam Removal	Oct-12	Oct-12
Year 4 Monitoring	Nov-12	Dec-12
Year 5 Monitoring		

- Information unavailable

N/A - Item does not apply

Table 3. Project Contacts Kings Creek / Project No. 208	
Designer	Buck Engineering / Michael Baker Corp. 797 Haywood Road, Suite 201 Asheville, North Carolina 28806
Primary Project Design POC	Andrew Bick (828) 350-1408
Construction Contractor	L-J, Inc. 220 Stoneridge Drive, Suite 405 Columbia, SC 29210
Construction Contractor POC	Richard Goodwin (803) 929-1181
Survey Contractor	Joel Johnson Land Surveying
Survey Contractor POC	Joel Johnson (828) 586-6488
Planting Contractor	Unknown
Planting Contractor POC	Unknown
Seeding Contractor	Unknown
Planting Contractor POC	Unknown
Seed Mix Sources	Unknown
Nursery Stock Suppliers	Unknown
Monitoring Performers (Y0) - 2006	Buck Engineering / Michael Baker Corp. 797 Haywood Road, Suite 201 Asheville, North Carolina 28806
Stream Monitoring POC	Unknown
Vegetation Monitoring POC	Unknown
Monitoring Performers (Y1) - 2008	North Carolina Wildlife Resources Commission 171 Southern Cross Road Weaverville, North Carolina 28787
Stream Monitoring POC	Jeff Ferguson (828) 231-3517
Vegetation Monitoring POC	Jeff Ferguson (828) 231-3517
Monitoring Performers (Y2) - 2010	Equinox Environmental Consultation & Design, Inc. 37 Haywood Street, Suite 100 Asheville, North Carolina 28801
Stream Monitoring POC	Steve Melton (828) 253-6856
Vegetation Monitoring POC	Sarah Marcinko (828) 253-6856
Monitoring Performers (Y3) - 2011	Equinox Environmental Consultation & Design, Inc. 37 Haywood Street, Suite 100 Asheville, North Carolina 28801
Stream Monitoring POC	Win Taylor (828) 253-6856
Vegetation Monitoring POC	Kevin Mitchell (828) 253-6856
Monitoring Performers (Y4) - 2012	Equinox Environmental Consultation & Design, Inc. 37 Haywood Street, Suite 100 Asheville, North Carolina 28801
Stream Monitoring POC	Kevin Mitchell (828) 253-6856
Vegetation Monitoring POC	Kevin Mitchell (828) 253-6856
Monitoring Performers (Y5) - 2013	
Stream Monitoring POC	
Vegetation Monitoring POC	

Unknown - Information was unknown at time of report submittal

Table 4. Project Attributes Kings Creek / Project No. 208	
Project County	Transylvania
Physiographic Region	Blue Ridge
Ecoregion	Broad Basins
Project River Basin	French Broad
USGS HUC for Project (14 digit)	06010105010050
NCDWQ Sub-Basin for Project	04-03-01
Within Extent of EEP Watershed Plan	No
WRC Class (Warm, Cool, Cold)	Cool
% of Project Easement Fenced or Demarcated	100%
Beaver Activity Observed During Design Phase	Unknown
Restoration Component Attributes	
	Kings Creek
Drainage Area (sq.mi.)	4.2
Stream Order	Second
Restored Length (feet)	2,119
Perennial or Intermittent	Perennial
Watershed Type	Urban
Watershed LULC Distribution	-
Watershed Impervious Cover	-
NCDWQ AU / Index Number	6-30
NCDWQ Classification	C / Tr
303d Listed	No
Upstream of 303d Listed Segment	No
Reasons for 303d Listing or Stressor	N/A
Total Acreage of Easement	6.11
Total Vegetated Acreage within Easement	5.66
Total Planted Acreage as Part of Restoration	5.56
Rosgen Classification of Pre-Existing	-
Rosgen Classification of As-Built	C4
Valley Type	-
Valley Slope	-
Valley Side Slope Range	-
Valley Toe Slope Range	-
Cowardin Classification	N/A
Trout Waters Designation	Yes
Species of Concern, Endangered, Etc.	-
Dominant Soil Series and Characteristics	
Series	-
Depth	-
Clay%	-
K	-
T	-

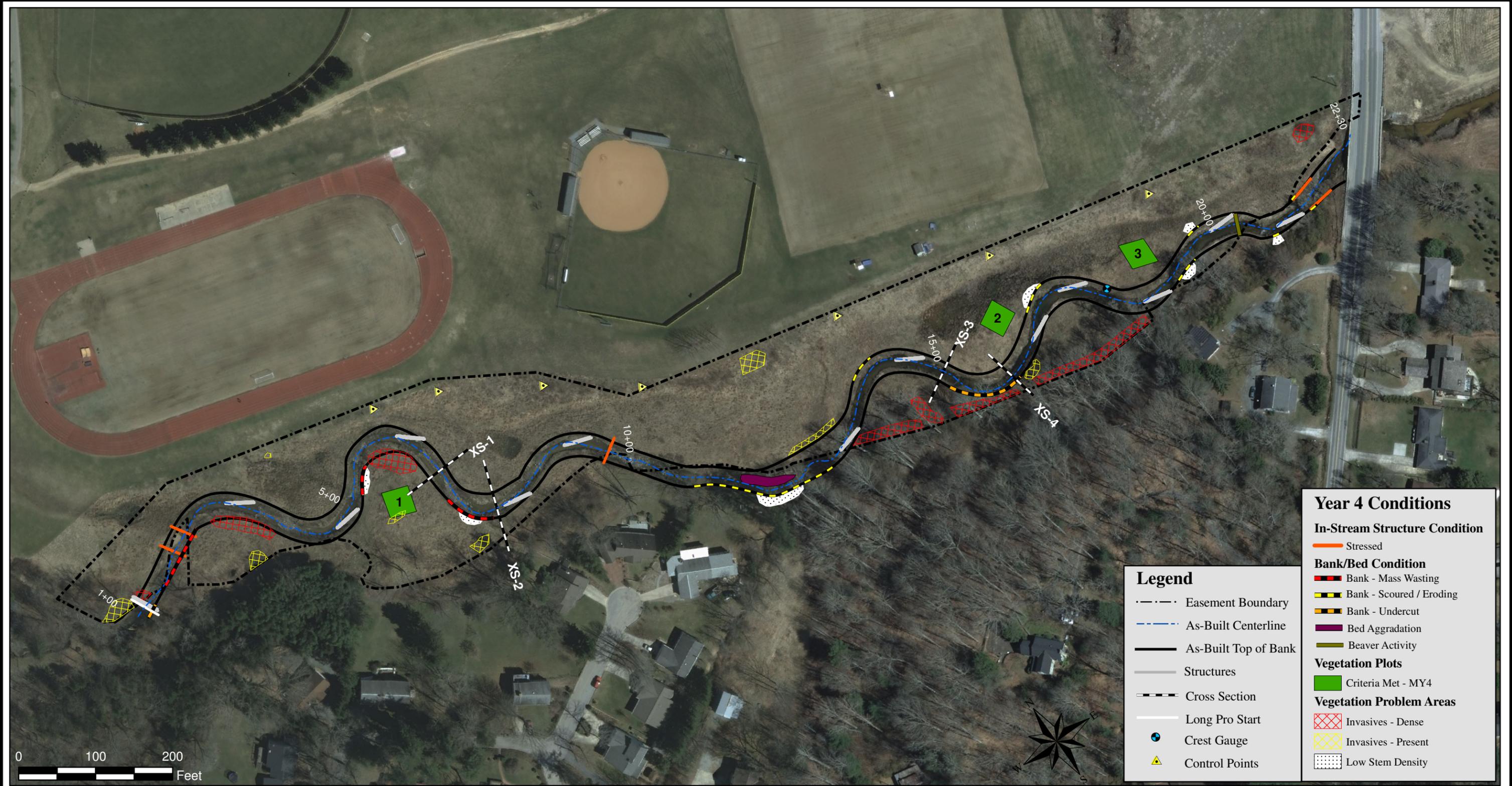
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N/A - Item does not apply

Appendix B

Visual Assessment Data

Figure 2. Integrated Current Condition Plan View Final



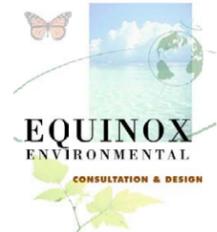
Prepared for	Project: Kings Creek Year 4 Monitoring Transylvania County, North Carolina	Notes: 1) Base Map Data Provided by NCEEP 2) 2010 Aerial Photo	Prepared by
	Sheet 1 of 1		
	Date November 2012	Project Number NCEEP # 208	

Table 5. Visual Stream Morphology Stability Assessment Kings Creek / Project No. 208 Assessed Length 2,119 feet												
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	74	96%					
		2. <u>Degradation</u> - Evidence of downcutting.			0	0	100%					
	2. Riffle Condition	1. <u>Texture/Substrate</u> - Riffle maintains coarser substrate.	13	13			100%					
		3. Meander Pool Condition	1. <u>Depth</u> Sufficient (Max Pool Depth : Mean Bankfull Depth \geq 1.6).	12			12				100%	
	2. <u>Length</u> appropriate ($>30\%$ of centerline distance between tail of upstream riffle and head of downstream riffle).		12	12			100%					
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run).	7	12			58%					
		2. Thalweg centering at downstream of meander bend (Glide).	10	11			91%					
2. Bank	1. <u>Scoured / Eroding</u>	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.					7	314	93%	7	113	95%
	2. <u>Undercut</u>	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.					2	119	97%	2	28	98%
	3. <u>Mass Wasting</u>	Bank slumping, calving, or collapse.			3	235	94%	2	155	98%		
Totals					12	668	84%	11	296	91%		
3. Engineered Structures	1. <u>Overall Integrity</u>	Structures physically intact with no dislodged boulders or logs.	14	16			88%					
	2. <u>Grade Control</u>	Grade control structures exhibiting maintenance of grade across the sill.	21	24			88%					
	2a. <u>Piping</u>	Structures lacking any substantial flow underneath sills or arms.	24	24			100%					
	3. <u>Bank Protection</u>	Bank erosion within the structures extent of influence does <u>NOT</u> exceed 15%.	29	30			97%					
	4. <u>Habitat</u>	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth Ratio \geq 1.6. Rootwads/logs providing some cover at base-flow.	12	12			100%					

Table 6. Vegetation Condition Assessment Kings Creek / Project No. 208 Planted Acreage 5.56					
Vegetation Category	Definitions	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	N/A	0	0.00	0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	Stipple Black Dots White Background	7	0.05	1%
Totals			7	0.05	1%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	N/A	0	0.00	0%
Cumulative Totals			7	0.05	1%
Easement Acreage 6.11					
Vegetation Category	Definitions	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	Cross Hatch (Red - Dense/Yellow - Present)	16	0.25	4%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	N/A	0	0.00	0%

Appendix C

Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment Kings Creek / Project No. 208		
Vegetation Plot ID	Vegetation Survival Threshold Met?	Tract Mean
1	Yes	100%
2	Yes	
3	Yes	



Vegetation Monitoring Plot 1
Monitoring Year 4 – June 26, 2012



Vegetation Monitoring Plot 2
Monitoring Year 4 – June 26, 2012



Vegetation Monitoring Plot 3
Monitoring Year 4 – June 26, 2012

Table 8. CVS Vegetation Plot Metadata Kings Creek / Project No. 208	
Report Prepared By	Owen Carson
Date Prepared	7/24/2012 14:16
Database Name	Equinox-2012-A-KingsCreek-MY4.mdb
Database Location	Z:\ES\NRI&M\EEP Monitoring\Kings Creek\KC-MY4-2012\Data\Veg
Computer Name	D16TNK71
File Size	47652864
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	208
project Name	Kings Creek
Description	On the campus of Brevard College
River Basin	French Broad
Length(ft)	
Stream-to-Edge Width (ft)	
Area (sq m)	
Required Plots (calculated)	
Sampled Plots	3

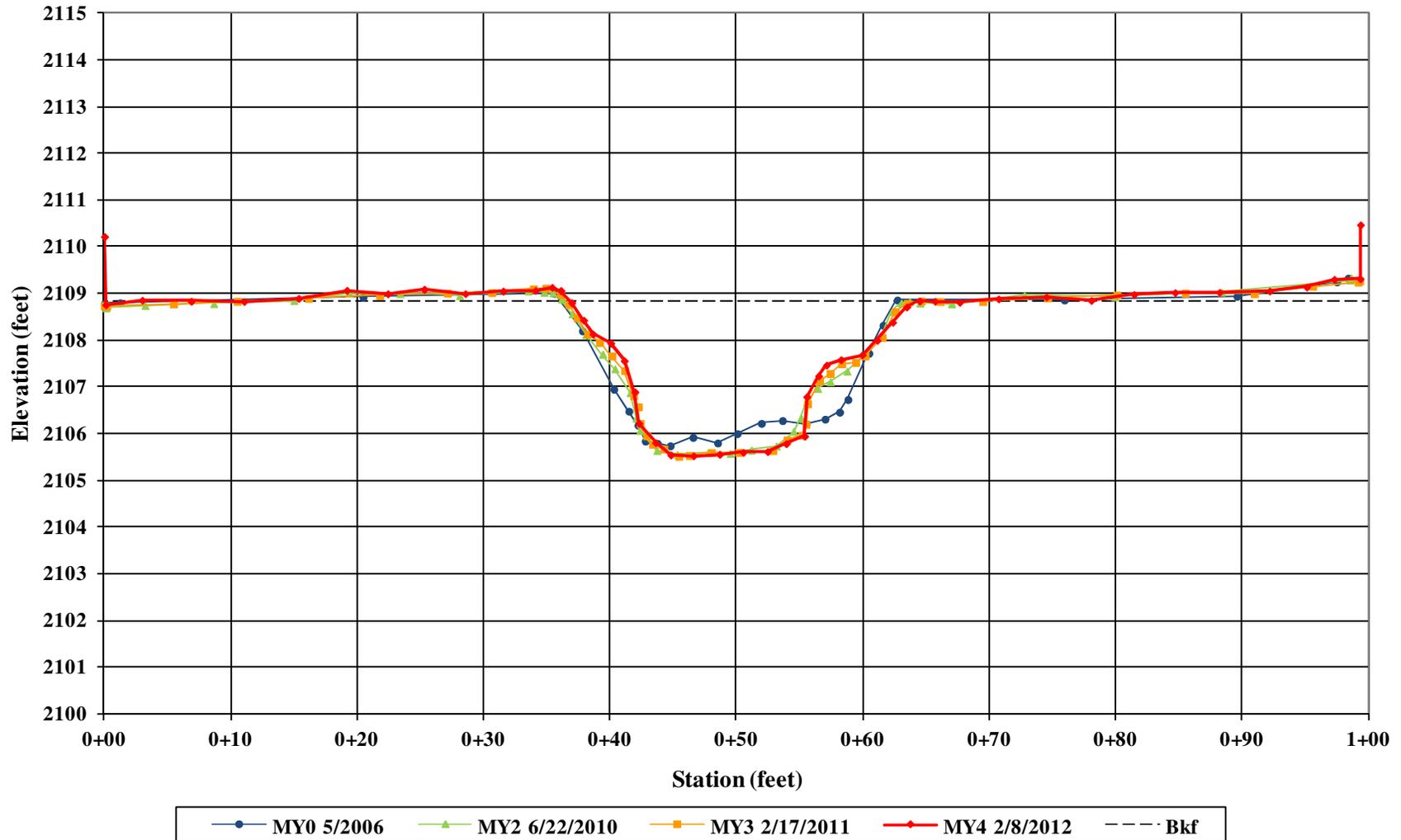
Table 9. Planted and Total Stem Counts (Species by Plot with Annual Means)																				
Kings Creek / Project No. 208																				
Scientific Name	Common Name	Species Type	Current Plot Data (MY4 2012)									Annual Means								
			E208-01-0001			E208-01-0002			E208-01-0003			MY4 (2012)			MY3 (2011)			MY2 (2010)		
			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 rubrum var. rubrum	Red maple	Tree			7			4			37			48			116			113
Alnus serrulata	Hazel alder	Shrub	6	6	9	1	1	5	1	1	2	8	8	16	8	8	13	10	10	10
Aronia arbutifolia	Red chokeberry	Shrub							2	2	2	2	2	2	2	2	3	2	2	2
Betula nigra	River birch	Tree	2	2	2	3	3	3	3	3	3	8	8	8	7	7	7	8	8	8
Cornus amomum	Silky dogwood	Shrub	3	3	19			2				3	3	21	3	3	8	3	3	5
Corylus americana	American hazelnut	Shrub							1	1	1	1	1	1	1	1	1	1	1	1
Fraxinus pennsylvanica	Green ash	Tree				1	1	1				1	1	1	1	1	1	1	1	1
Hamamelis virginiana var. virginiana	American witchhazel	Tree	4	4	4	2	2	2	1	1	1	7	7	7	7	7	7	5	5	5
Juglans nigra	Black walnut	Tree																		2
Liquidambar styraciflua	Sweetgum	Tree			7									7						2
Liriodendron tulipifera var. tulipifera	Tulip-tree, Yellow Poplar, Whitewood	Tree						3			3			6						12
Nyssa sylvatica	Blackgum	Tree	2	2	2							2	2	2	2	2	2	2	2	2
Pinus strobus	Eastern white pine	Tree																		1
Platanus occidentalis var. occidentalis	Sycamore, Plane-tree	Tree	5	5	19	3	3	3	4	4	6	12	12	28	16	16	27	15	15	39
Prunus serotina var. serotina	Black cherry	Tree			2									2						1
Quercus phellos	Willow oak	Tree																		1
Salix nigra	Black willow	Tree															4			3
Sambucus canadensis	Common elderberry	Shrub					1	2					1	2		1	1		1	1
Stem count			22	22	71	10	11	25	12	12	55	44	45	151	47	48	204	47	48	209
Size (ares)			1			1			1			3			3			3		
Size (ACRES)			0.02			0.02			0.02			0.07			0.07			0.07		
Species count			6	6	9	5	6	9	6	6	8	9	10	14	9	10	14	9	10	18
Stems per ACRE			890	890	2,873	405	445	1,012	486	486	2,226	594	607	2,037	634	647	2,752	634	647	2,819

Exceeds requirements by 10%

Appendix D

Stream Survey Data

**Kings Creek / Project No. 208
Cross-Section 1 - Riffle
Station 6+84**





Cross-Section 1 – Riffle
Left Bank Descending
Monitoring Year 4 – February 8, 2012



Cross-Section 1 – Riffle
Right Bank Descending
Monitoring Year 4 – February 8, 2012

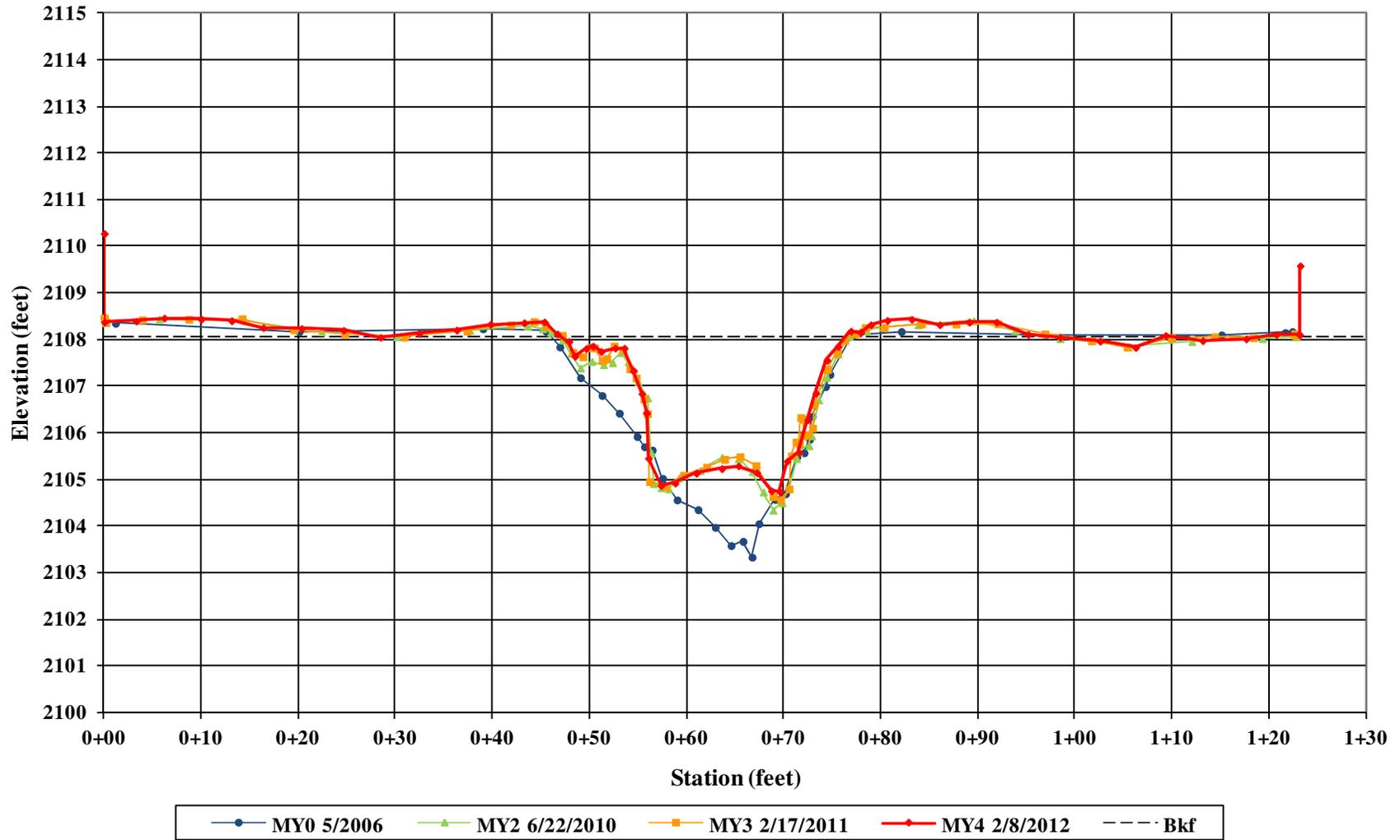


Cross-Section 1 – Riffle
Downstream
Monitoring Year 4 – February 8, 2012



Cross-Section 1 – Riffle
Upstream
Monitoring Year 4 – February 8, 2012

**Kings Creek / Project No. 208
Cross-Section 2 - Pool
Station 7+85**





Cross-Section 2 – Pool
Left Bank Descending
Monitoring Year 4 – February 8, 2012



Cross-Section 2 – Pool
Right Bank Descending
Monitoring Year 4 – February 8, 2012

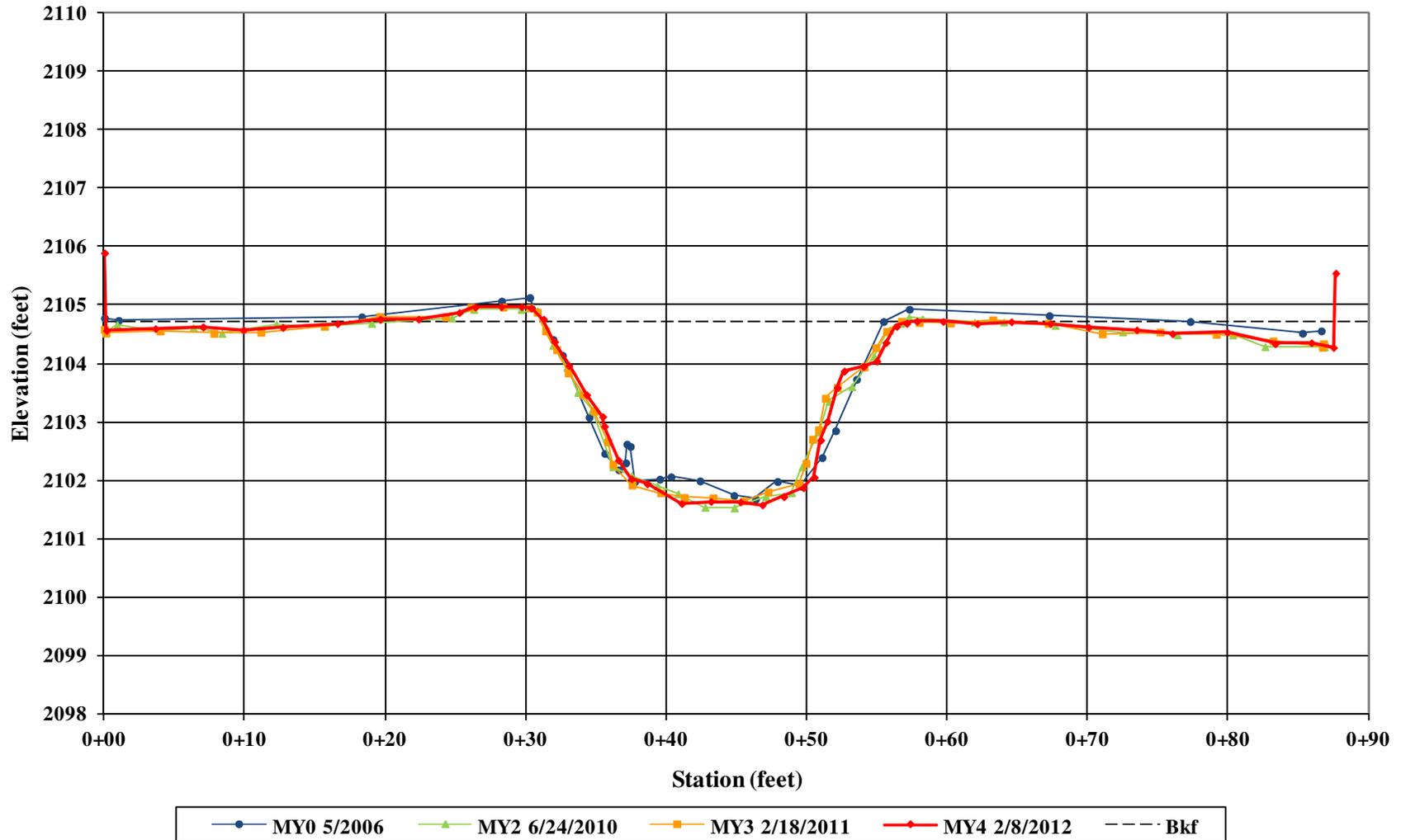


Cross-Section 2 – Pool
Downstream
Monitoring Year 4 – February 8, 2012



Cross-Section 2 – Pool
Upstream
Monitoring Year 4 – February 8, 2012

Kings Creek / Project No. 208
Cross-Section 3 - Riffle
Station 15+13





Cross-Section 3 – Riffle
Left Bank Descending
Monitoring Year 4 – February 8, 2012



Cross-Section 3 – Riffle
Right Bank Descending
Monitoring Year 4 – February 8, 2012

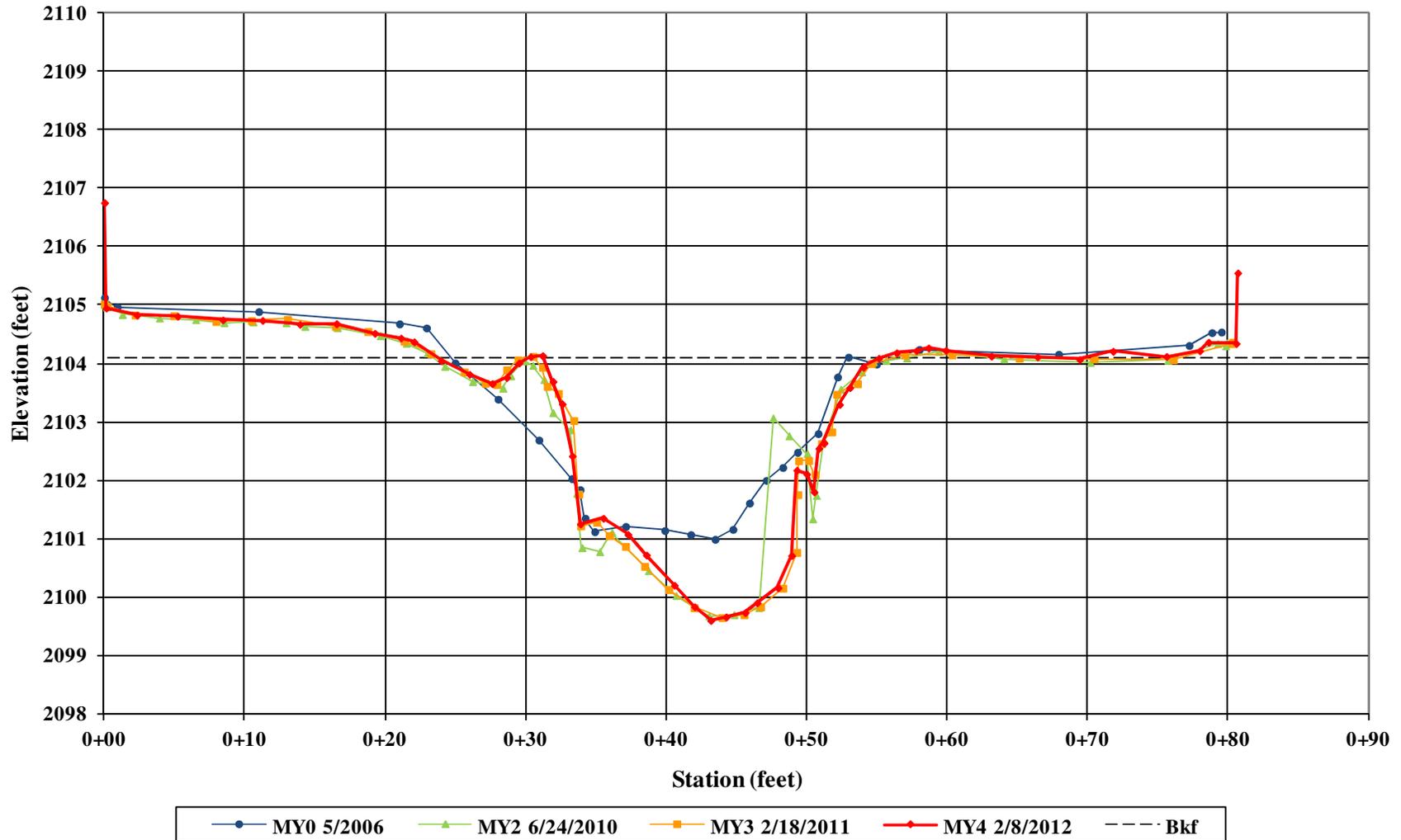


Cross-Section 3 – Riffle
Downstream
Monitoring Year 4 – February 8, 2012



Cross-Section 3 – Riffle
Upstream
Monitoring Year 4 – February 8, 2012

**Kings Creek / Project No. 208
Cross-Section 4 - Pool
Station 16+17**





Cross-Section 4 – Pool
Left Bank Descending
Monitoring Year 4 – February 8, 2012



Cross-Section 4 – Pool
Right Bank Descending
Monitoring Year 4 – February 8, 2012

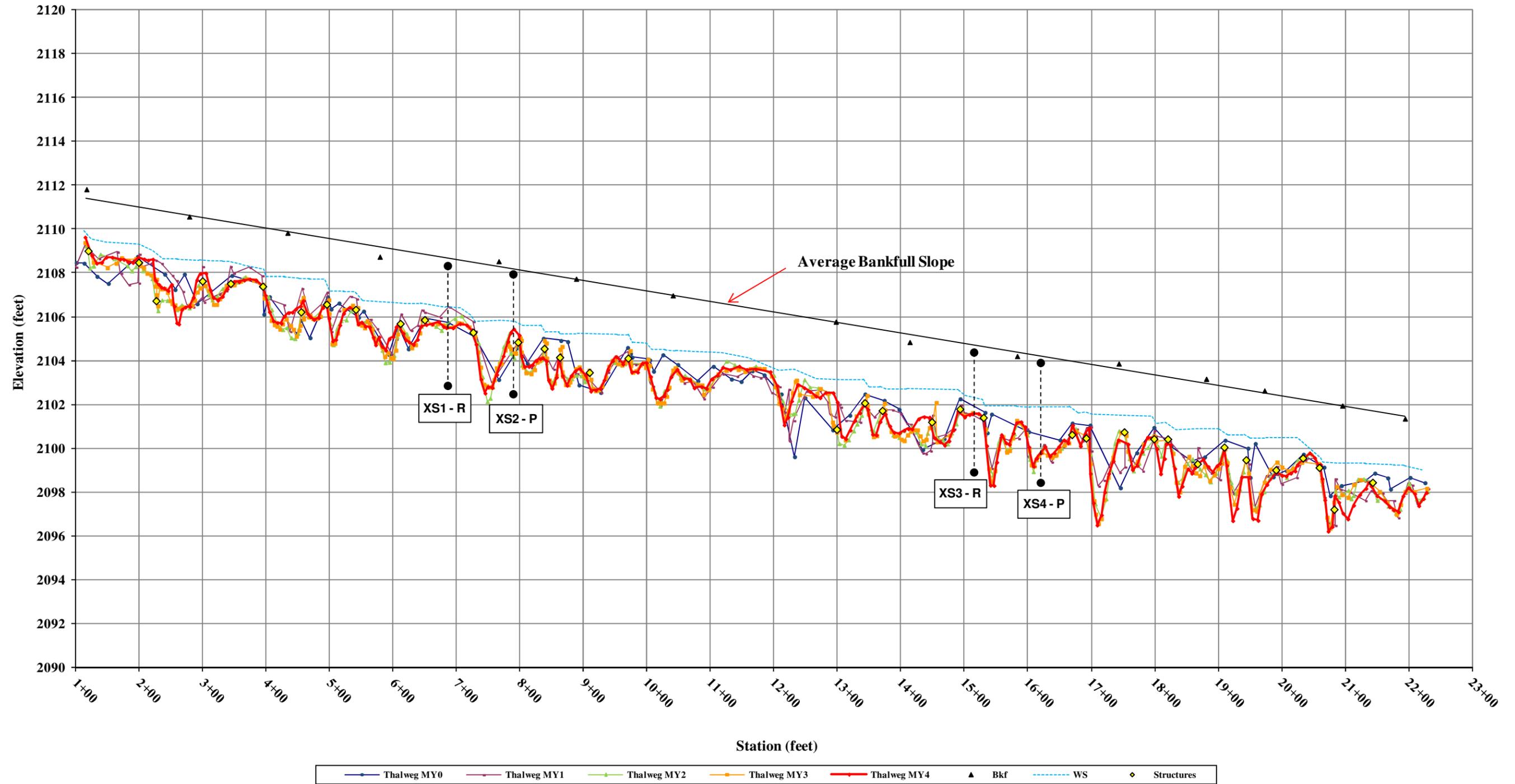


Cross-Section 4 – Pool
Downstream
Monitoring Year 4 – February 8, 2012



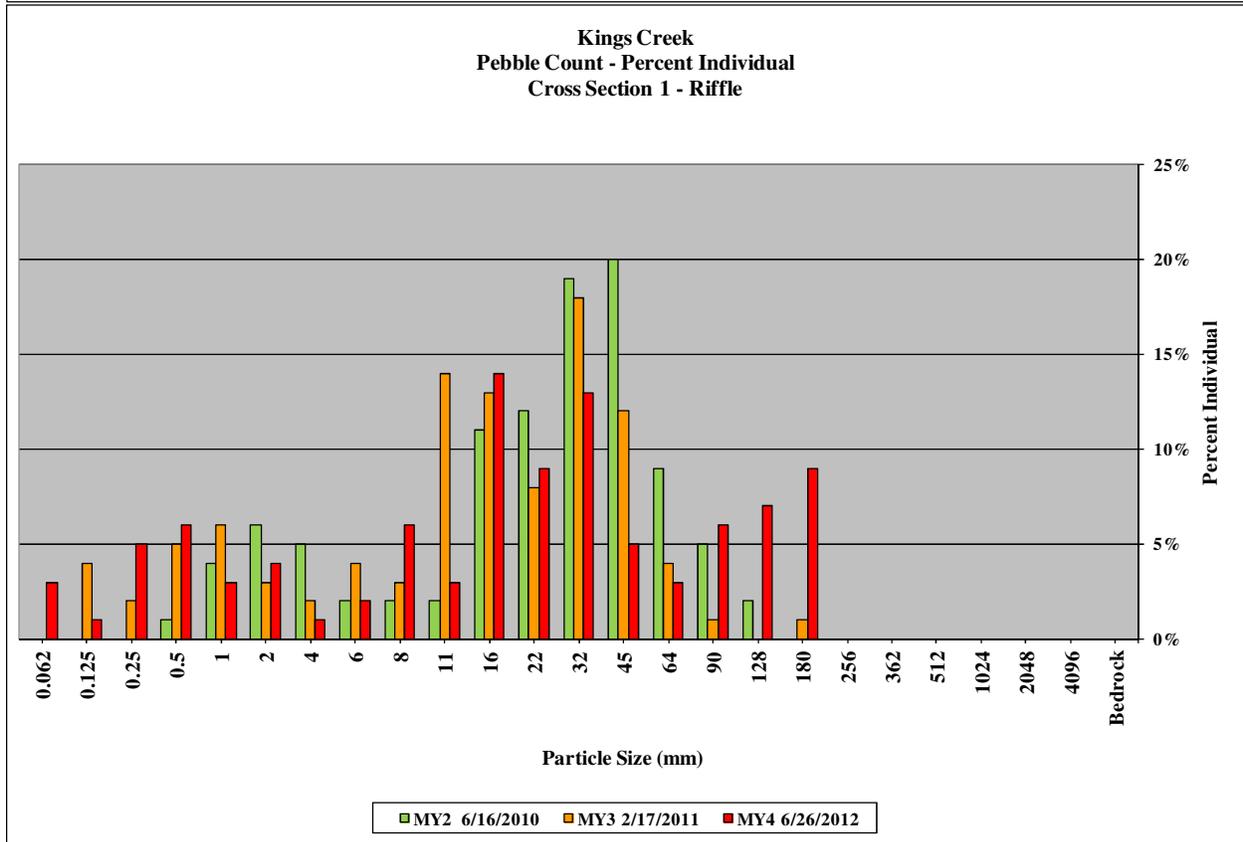
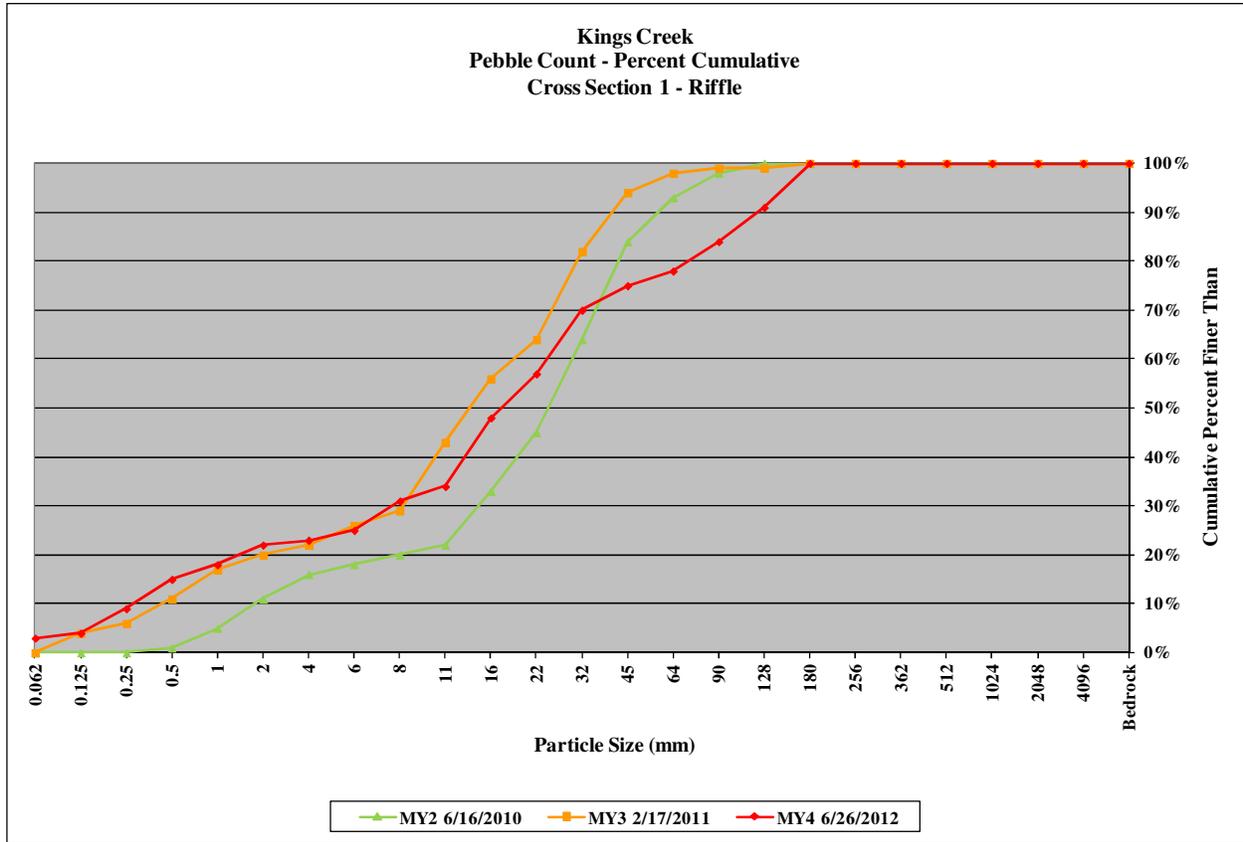
Cross-Section 4 – Pool
Upstream
Monitoring Year 4 – February 8, 2012

**Kings Creek
Longitudinal Profile
Stationing 1+14 - 22+28**



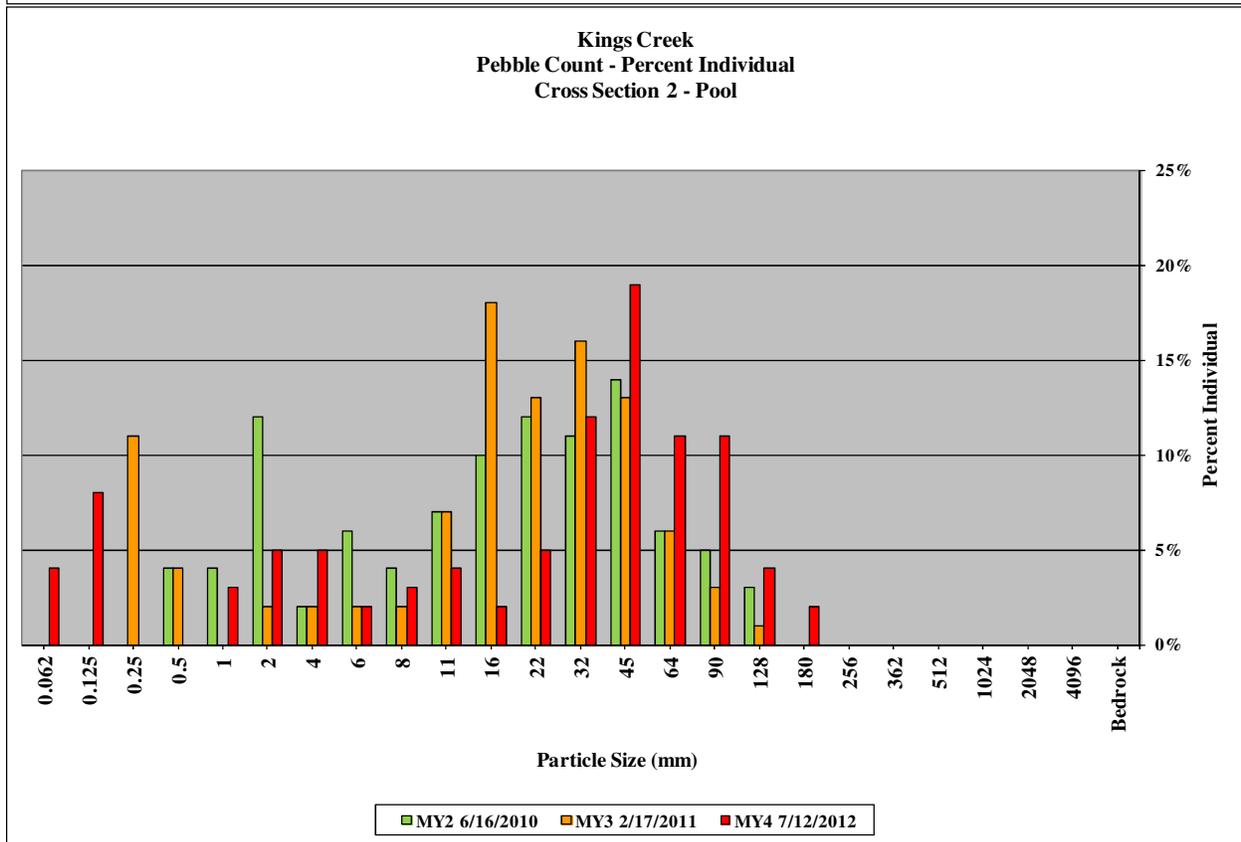
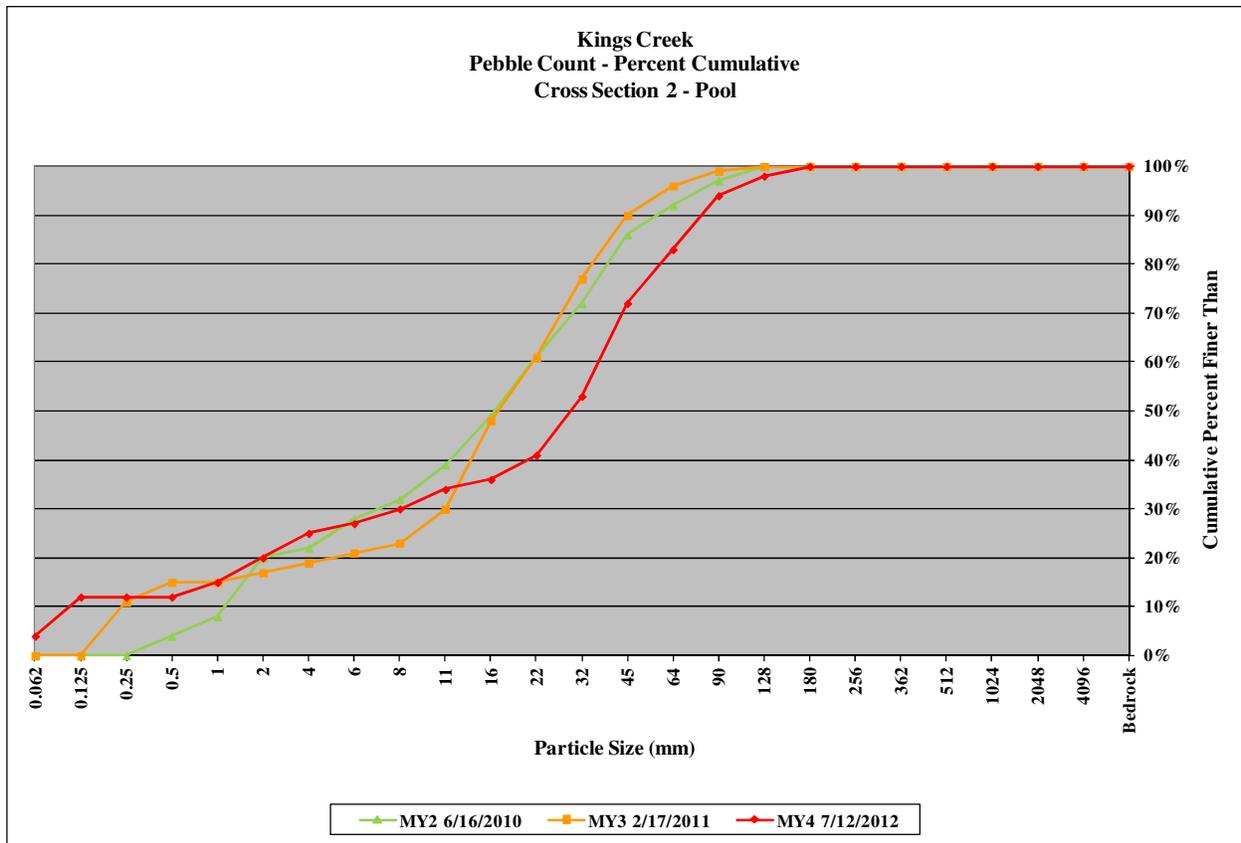
Kings Creek / Project No. 208					
Cross Section 1 - Pebble Count Summary					
Riffle					
			Monitoring Year 4		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	3	3%	3%
Sand	very fine sand	0.125	1	1%	4%
	fine sand	0.25	5	5%	9%
	medium sand	0.50	6	6%	15%
	coarse sand	1.00	3	3%	18%
	very coarse sand	2.00	4	4%	22%
Gravel	very fine gravel	4.0	1	1%	23%
	fine gravel	5.7	2	2%	25%
	fine gravel	8.0	6	6%	31%
	medium gravel	11.3	3	3%	34%
	medium gravel	16.0	14	14%	48%
	coarse gravel	22.3	9	9%	57%
	coarse gravel	32	13	13%	70%
	very coarse gravel	45	5	5%	75%
	very coarse gravel	64	3	3%	78%
Cobble	small cobble	90	6	6%	84%
	medium cobble	128	7	7%	91%
	large cobble	180	9	9%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
	very large boulder	4096	0	0%	100%
Bedrock	bedrock	>4096	0	0%	100%
TOTALS			100	100%	100%

Summary Data	
D50	17
D84	90
D95	150



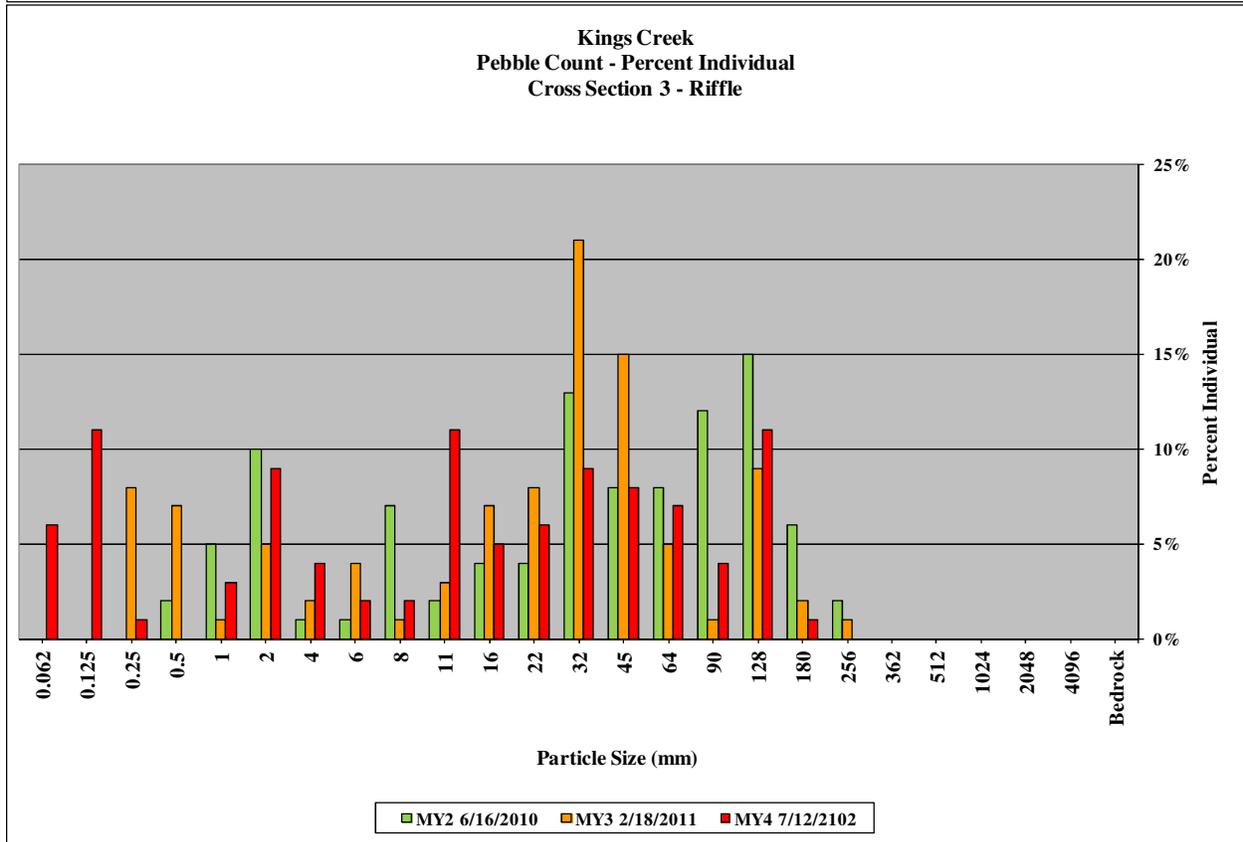
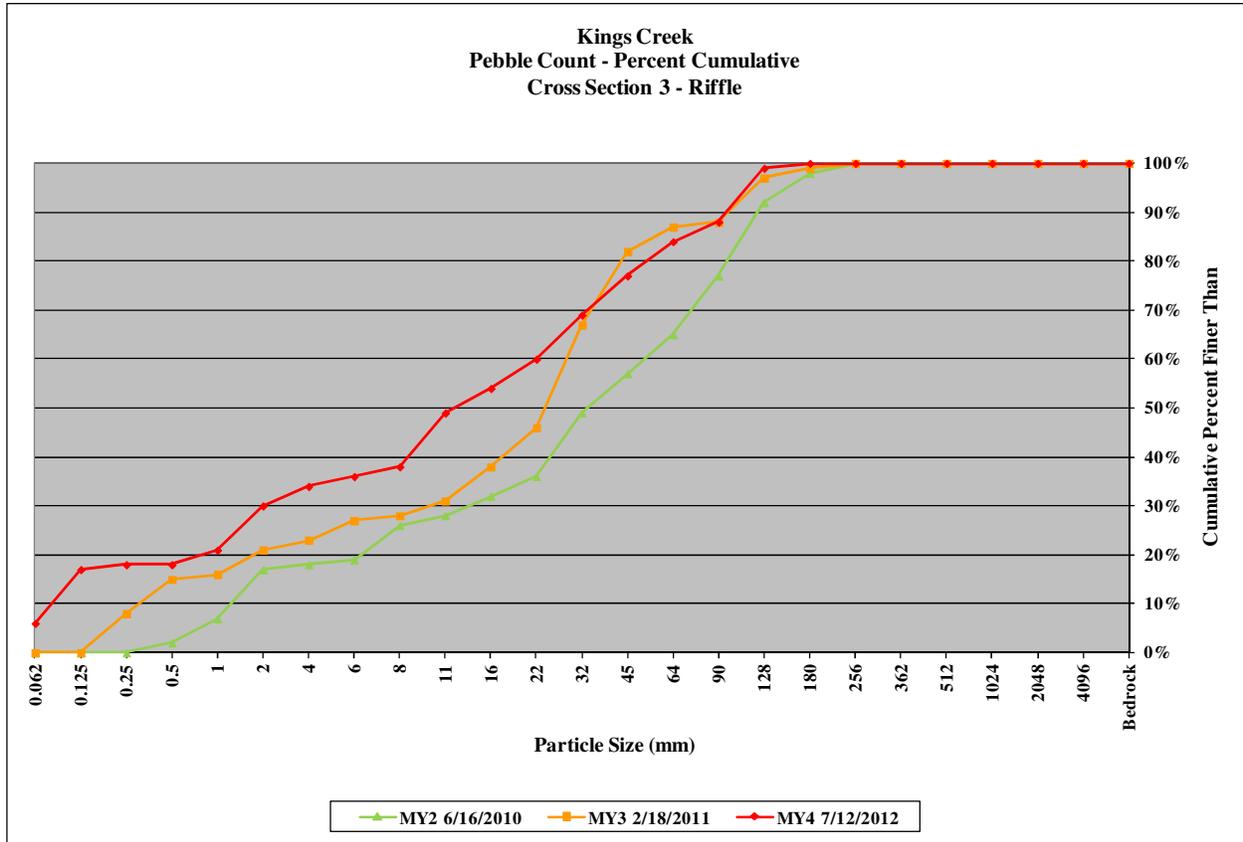
Kings Creek / Project No. 208					
Cross Section 2 - Pebble Count Summary					
Pool					
			Monitoring Year 4		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	4	4%	4%
Sand	very fine sand	0.125	8	8%	12%
	fine sand	0.25	0	0%	12%
	medium sand	0.50	0	0%	12%
	coarse sand	1.00	3	3%	15%
	very coarse sand	2.00	5	5%	20%
Gravel	very fine gravel	4.0	5	5%	25%
	fine gravel	5.7	2	2%	27%
	fine gravel	8.0	3	3%	30%
	medium gravel	11.3	4	4%	34%
	medium gravel	16.0	2	2%	36%
	coarse gravel	22.3	5	5%	41%
	coarse gravel	32	12	12%	53%
	very coarse gravel	45	19	19%	72%
	very coarse gravel	64	11	11%	83%
Cobble	small cobble	90	11	11%	94%
	medium cobble	128	4	4%	98%
	large cobble	180	2	2%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
	very large boulder	4096	0	0%	100%
Bedrock	bedrock	>4096	0	0%	100%
TOTALS			100	100%	100%

Summary Data	
D50	29
D84	66
D95	98



Kings Creek / Project No. 208					
Cross Section 3 - Pebble Count Summary					
Riffle					
			Monitoring Year 4		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	6	6%	6%
Sand	very fine sand	0.125	11	11%	17%
	fine sand	0.25	1	1%	18%
	medium sand	0.50	0	0%	18%
	coarse sand	1.00	3	3%	21%
	very coarse sand	2.00	9	9%	30%
Gravel	very fine gravel	4.0	4	4%	34%
	fine gravel	5.7	2	2%	36%
	fine gravel	8.0	2	2%	38%
	medium gravel	11.3	11	11%	49%
	medium gravel	16.0	5	5%	54%
	coarse gravel	22.3	6	6%	60%
	coarse gravel	32	9	9%	69%
	very coarse gravel	45	8	8%	77%
	very coarse gravel	64	7	7%	84%
Cobble	small cobble	90	4	4%	88%
	medium cobble	128	11	11%	99%
	large cobble	180	1	1%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
	very large boulder	4096	0	0%	100%
Bedrock	bedrock	>4096	0	0%	100%
TOTALS			100	100%	100%

Summary Data	
D50	12
D84	64
D95	110



Kings Creek / Project No. 208					
Cross Section 4 - Pebble Count Summary					
Pool					
			Monitoring Year 4		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	6	6%	6%
Sand	very fine sand	0.125	17	17%	23%
	fine sand	0.25	2	2%	25%
	medium sand	0.50	15	15%	40%
	coarse sand	1.00	0	0%	40%
	very coarse sand	2.00	12	12%	52%
Gravel	very fine gravel	4.0	2	2%	54%
	fine gravel	5.7	1	1%	55%
	fine gravel	8.0	4	4%	59%
	medium gravel	11.3	4	4%	63%
	medium gravel	16.0	4	4%	67%
	coarse gravel	22.3	7	7%	74%
	coarse gravel	32	13	13%	87%
	very coarse gravel	45	9	9%	96%
	very coarse gravel	64	2	2%	98%
Cobble	small cobble	90	2	2%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
	very large boulder	4096	0	0%	100%
Bedrock	bedrock	>4096	0	0%	100%
TOTALS			100	100%	100%

Summary Data	
D50	1.8
D84	29
D95	43

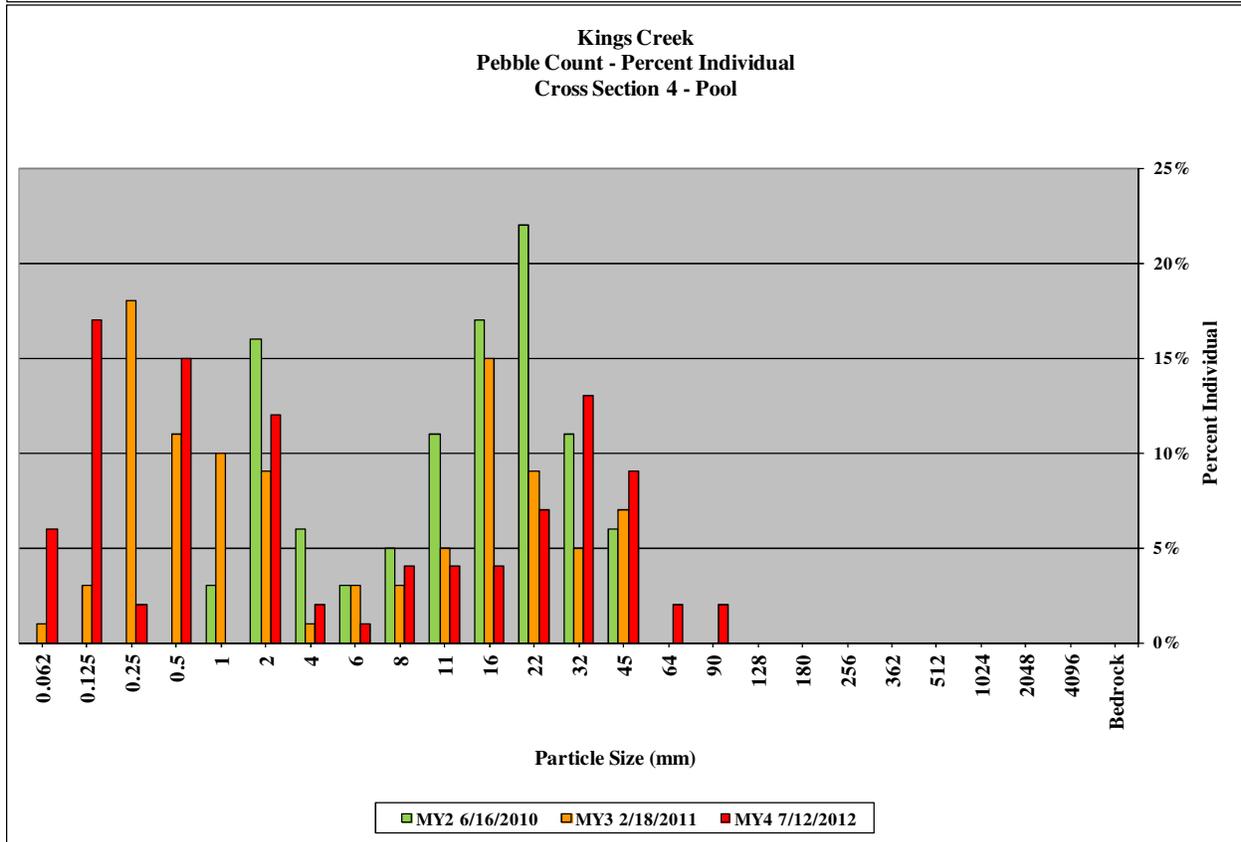
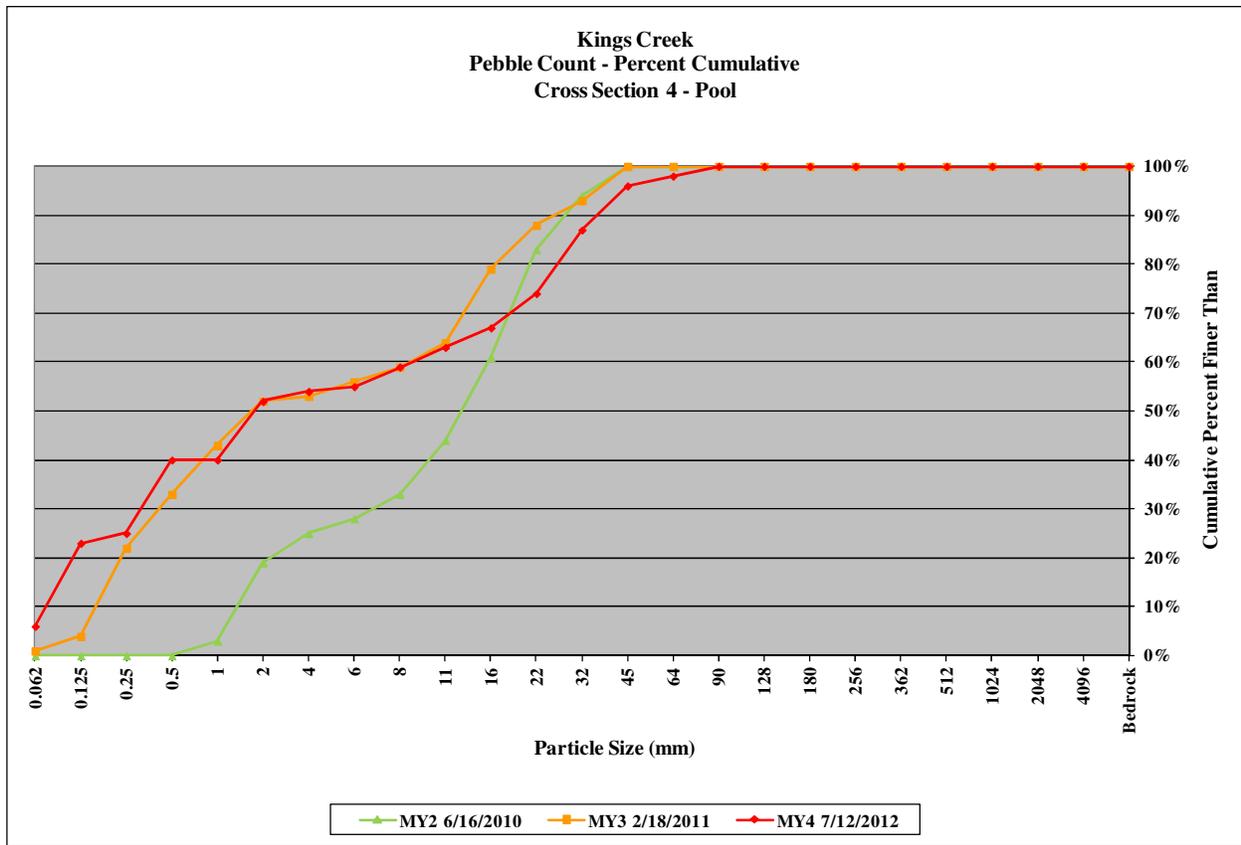


Table 10a. Baseline Stream Data Summary Kings Creek / Project No. 208																									
Parameter	Gauge	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data					Design			Monitoring Baseline						
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Med	Max	Min	Mean	Med	Max	SD	n
Dimension & Substrate - Riffle																									
Bankfull Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.2	25.5	25.5	26.7	N/A	2
Floodprone Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	>150	>150	>150	>150	N/A	2
Bankfull Mean Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.1	2.2	2.2	2.2	N/A	2
Bankfull Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.0	3.1	3.1	3.1	N/A	2
Bankfull Cross-Sectional Area (ft ²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51.9	55.2	55.2	58.5	N/A	2
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.3	11.8	11.8	12.2	N/A	2
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	>3.60	>3.65	>3.65	>3.70	N/A	2
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	1.0	1.0	1.0	N/A	2
Profile																									
Riffle Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29.3	46.0	44.4	68.2	13.2	10
Riffle Slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0026	0.0069	0.0059	0.0153	0.0039	10
Pool Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28.1	52.4	58.6	69.8	15.6	11
Pool Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.4	2.2	2.3	3.4	0.5	11
Pool Spacing (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98.5	150.6	143.2	220.9	40.9	8
Pattern																									
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	61.0	110.8	107.5	173.0	35.2	12
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41.0	62.0	56.0	139.0	26.7	11
Rc: Bankfull Width (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	231.0	276.8	240.0	414.0	77.6	5
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.0	4.2	4.2	4.4	N/A	2
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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C4
Bankfull Velocity (fps)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bankfull Discharge (cfs)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Valley Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel Thalweg Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,135
Sinuosity (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.28
Water Surface Slope (Channel) (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0049
Bankfull Slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0044
Bankfull Floodplain Area (acres)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
% of Reach with Eroding Banks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel Stability or Habitat Metric	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biological or Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- Information unavailable
N/A - Information does not apply

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions) Kings Creek / Project No. 208 - Reaches: I & III																											
Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design					Monitoring Baseline											
Ri% / Ru% / P% / G% / S%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33%	10%	41%	16%	0%	-	-
SC% / SA% / G% / C% / B% / Be%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d16 / d35 / d50 / d84 / d95 / di ^p / di ⁹⁵ (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Entrenchment Class	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Incision Class	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<1.5 / 1.5 - 1.99 / 2 - 4.9 / 5.0 - 9.9 / >10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<1.2 / 1.2 - 1.49 / 1.5 - 1.99 / >2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Ri = Riffle / Ru = Run / P = Pool / G = Glide / S = Step
 SC = Silt-Clay / SA = Sand / G = Gravel / C = Cobble / B = Boulder / Be = Bedrock
 di^p = max pave / di⁹⁵ = max sub pave
 - Information unavailable

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters - Cross-Sections) Kings Creek / Project No. 208												
Dimension	Cross-Section 1 Riffle						Cross-Section 2 Pool					
	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Record elevation (datum) used	-	-	2108.9	2108.9	2108.9		-	-	2108.1	2108.1	2108.1	
Bankfull Width (ft)	26.7	-	26.8	26.8	27.5		31.1	-	30.3	29.8	29.6	
Floodprone Width (ft)	>150	-	>150	>150	>150		>150	-	>150	>150	>150	
Bankfull Mean Depth (ft)	2.2	-	2.2	2.1	2.0		2.5	-	1.9	1.9	1.9	
Bankfull Max Depth (ft)	3.1	-	3.3	3.3	3.3		4.7	-	3.7	3.5	3.4	
Bankfull Cross-Sectional Area (ft ²)	58.5	-	58.0	57.3	56.1		76.6	-	58.5	55.6	55.0	
Bankfull Width/Depth Ratio	12.2	-	12.4	12.5	13.5		12.7	-	15.7	16.0	15.9	
Bankfull Entrenchment Ratio	>3.7	-	>5.6	>5.6	>5.4		>3.9	-	>4.9	>5.0	>5.1	
Bankfull Bank Height Ratio	1.0	-	1.0	1.0	1.0		1.0	-	1.1	1.1	1.1	
Cross-Sectional Area Between End Pins (ft ²)	-	-	59.6	58.4	56.6		-	-	61.6	57.4	57.1	
d50 (mm)	-	-	24	13	17		-	-	16	17	29	
Dimension	Cross-Section 3 Riffle						Cross-Section 4 Pool					
	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Record elevation (datum) used	-	-	2104.7	2104.7	2104.7		-	-	2104.1	2104.1	2104.1	
Bankfull Width (ft)	24.2	-	25.7	25.6	25.8		28.3	-	25.8	25.9	24.1	
Floodprone Width (ft)	>150	-	>150	>150	>150		>150	-	>150	>150	>150	
Bankfull Mean Depth (ft)	2.1	-	2.1	2.0	2.1		2.0	-	2.5	2.6	2.7	
Bankfull Max Depth (ft)	3.0	-	3.2	3.1	3.1		3.1	-	4.4	4.5	4.5	
Bankfull Cross-Sectional Area (ft ²)	51.9	-	53.1	52.0	53.0		55.5	-	63.1	67.4	65.9	
Bankfull Width/Depth Ratio	11.3	-	12.4	12.6	12.5		14.4	-	10.5	9.9	8.8	
Bankfull Entrenchment Ratio	>3.6	-	>5.8	>5.9	>5.8		>3.2	-	>5.8	>5.8	>6.2	
Bankfull Bank Height Ratio	1.0	-	1.0	1.0	1.0		1.0	-	1.0	1.0	1.0	
Cross-Sectional Area Between End Pins (ft ²)	-	-	60.2	59.3	59.4		-	-	66.1	69.3	67.6	
d50 (mm)	-	-	33	24	12		-	-	13	2	2	

- Information unavailable

Table 11b. Monitoring Data - Stream Reach Data Summary																																				
Kings Creek / Project No. 208 - Reach I & III																																				
Parameter	Baseline					MY - 1					MY - 2					MY - 3					MY - 4					MY - 5										
	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n						
Dimension & Substrate - Riffle																																				
Bankfull Width (ft)	24.2	25.5	25.5	26.7	N/A	2	-	-	-	-	-	-	25.7	26.3	26.3	26.8	N/A	2	25.6	26.2	26.2	26.8	N/A	2	25.8	26.7	26.7	27.5	N/A	2						
Floodprone Width (ft)	>150	>150	>150	>150	N/A	2	-	-	-	-	-	-	>150	>150	>150	>150	N/A	2	>150	>150	>150	>150	N/A	2	>150	>150	>150	>150	N/A	2						
Bankfull Mean Depth (ft)	2.1	2.2	2.2	2.2	N/A	2	-	-	-	-	-	-	2.1	2.2	2.2	2.2	N/A	2	2.0	2.1	2.1	2.1	N/A	2	2.0	2.1	2.1	2.1	N/A	2						
Bankfull Max Depth (ft)	3.0	3.1	3.1	3.1	N/A	2	-	-	-	-	-	-	3.2	3.3	3.3	3.3	N/A	2	3.1	3.2	3.2	3.3	N/A	2	3.1	3.2	3.2	3.3	N/A	2						
Bankfull Cross-Sectional Area (ft ²)	51.9	55.2	55.2	58.5	N/A	2	-	-	-	-	-	-	53.1	55.6	55.6	58.0	N/A	2	52.0	54.7	54.7	57.3	N/A	2	53.0	54.6	54.6	56.1	N/A	2						
Width/Depth Ratio	11.3	11.8	11.8	12.2	N/A	2	-	-	-	-	-	-	12.4	12.4	12.4	12.4	N/A	2	12.5	12.6	12.6	12.6	N/A	2	12.5	13.0	13.0	13.5	N/A	2						
Entrenchment Ratio	>3.6	>3.7	>3.7	>3.7	N/A	2	-	-	-	-	-	-	>5.6	>5.7	>5.7	>5.8	N/A	2	>5.6	>5.8	>5.8	>5.9	N/A	2	>5.4	>5.6	>5.6	>5.8	N/A	2						
Bank Height Ratio	1.0	1.0	1.0	1.0	N/A	2	-	-	-	-	-	-	1.0	1.0	1.0	1.0	N/A	2	1.0	1.0	1.0	1.0	N/A	2	1.0	1.0	1.0	1.0	N/A	2						
Profile																																				
Riffle Length (ft)	29.3	46.0	44.4	68.2	13.2	10	9.5	34.7	33.3	58.8	16.6	10	10.8	25.7	25.6	63.0	15.5	10	11.9	33.4	30.5	60.9	15.6	9	13.5	35.2	31.2	58.2	14.3	9						
Riffle Slope (ft/ft)	0.003	0.007	0.006	0.015	0.004	10	0.005	0.013	0.010	0.027	0.008	10	0.003	0.017	0.020	0.025	0.009	10	0.004	0.013	0.012	0.029	0.007	9	0.004	0.013	0.012	0.027	0.008	9						
Pool Length (ft)	28.1	52.4	58.6	69.8	15.6	11	12.9	35.7	32.2	87.9	18.9	22	14.4	41.4	38.1	99.8	21.7	22	14.7	38.3	33.9	100.7	21.4	21	15.1	38.2	37.4	96.7	21.1	21						
Pool Max Depth (ft)	3.1	3.9	3.9	4.7	N/A	2	-	-	-	-	-	-	3.7	4.1	4.1	4.4	N/A	2	3.5	4.0	4.0	4.5	N/A	2	4.0	5.1	5.0	7.2	0.8	21						
Pool Spacing (ft)	98.5	150.6	143.2	220.9	40.9	8	22.9	94.6	101.2	170.5	40.9	21	32.0	79.8	71.1	214.1	41.4	21	30.5	88.6	93.3	183.3	38.3	19	38.2	89.7	84.8	161.5	35.4	19						
Pattern																																				
Channel Belt Width (ft)	61.0	110.8	107.5	173.0	35.2	12																														
Radius of Curvature (ft)	41.0	62.0	56.0	139.0	26.7	11																														
Rc: Bankfull Width (ft/ft)	-	-	-	-	-	-																														
Meander Wavelength (ft)	231.0	276.8	240.0	414.0	77.6	5																														
Meander Width Ratio	4.0	4.2	4.2	4.4	N/A	2																														
Additional Reach Parameters																																				
Rosgen Classification	C4												C4																							
Channel Thalweg Length (ft)	2,119												2,135																							
Simosity (ft)	1.25												1.28																							
Water Surface Slope (Channel) (ft/ft)	0.0049												0.0048																							
Bankfull Slope (ft/ft)	0.0044												0.0052																							
Ri% / Ru% / P% / G% / S%*	33%	10%	41%	16%	0%		22%	11%	51%	16%	0%		16%	6%	57%	21%	0%		17%	9%	45%	28%	0%		17%	12%	44%	26%	0%							
SC% / SA% / G% / C% / B% / Be%													0%	17%	71%	13%	0%	0%	0%	27%	68%	5%	0%	0%	4.8%	26.3%	58.8%	10.3%	0.0%	0.0%						
d16 / d35 / d50 / d84 / d95 (mm)													N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A						
% of Reach with Eroding Banks	0%												11%																							
Channel Stability or Habitat Metric	N/A												N/A																							
Biological or Other	N/A												N/A																							

- Information unavailable
 N/A - Information does not apply.
 Ri = Riffle / Ru = Run / P = Pool / G = Glide / S = Step
 SC = Silt-Clay / SA = Sand / G = Gravel / C = Cobble / B = Boulder / Be = Bedrock
 *Percentages based on riffle and pool pebble counts

Appendix E

Hydrologic Data

Table 12. Verification of Bankfull Events Kings Creek / Project No. 208			
Date of Data Collection	Date of Occurrence	Method	Photo # (if available)
6/15/2010	Unknown	Crest gauge & wrack lines	
11/9/2010	Unknown	Crest gauge & wrack lines	
1/20/2011	Unknown	Crest gauge & wrack lines	
10/26/2011	9/6/2011	Crest gauge & wrack lines	
1/18/2012	11/29/2011	Crest gauge & wrack lines	
10/15/2012	9/19/2012	Crest gauge & wrack lines	