

**Kings Creek
Stream Restoration
NCEEP Project Number: 208
Monitoring Year 3
2011 Final Report**

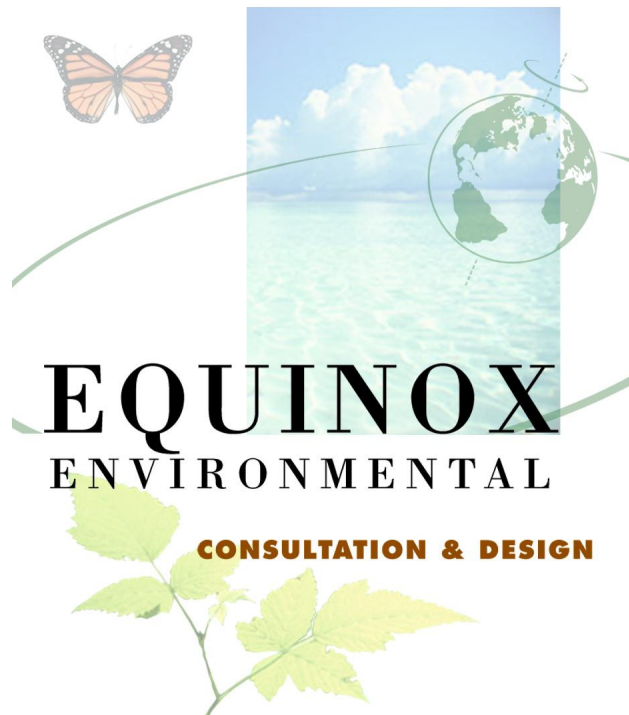


**Submitted to
North Carolina Ecosystem Enhancement Program
North Carolina Department of Environment and Natural Resources
November 2011**



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Raleigh, NC 27699**

Monitoring Firm



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Kings Creek Stream Restoration 2011 Monitoring Report (MY 3)

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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 three (MY3) vegetation plot data indicate that the project meets the established criterion for planted stem density, which is a minimum survival of 320 planted stems per acre at the end of the year three monitoring period. Average stem density for planted stems in MY3 is approximately 634 stems per acre. Additionally, when planted and natural stems are combined, the average stem density is 2,752 stems per acre, which is well above the minimum established criterion. Of the 48 planted stems recorded within the monitoring plots, almost all (98%) had vigor codes of good or excellent. Problems with vegetation consist of areas of low stem densities adjacent to the stream reach as well as approximately fifteen currently isolated patches of high threat invasive plant species that span the project extent. A supplemental live stake planting occurred on March 16, 2011 in those areas noted with low stem densities and eroding banks.

Stream longitudinal profiles have remained relatively stable among monitoring years. The primary stream issue observed during MY3 was bank erosion resulting from thalweg migration and low woody stem densities. All other morphological metrics indicated performance percentages averaging between 88 and 100%. Based on the presence of wrack lines and crest gauge monitoring two bankfull events were documented in MY3.

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the 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 2011 were intended to 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

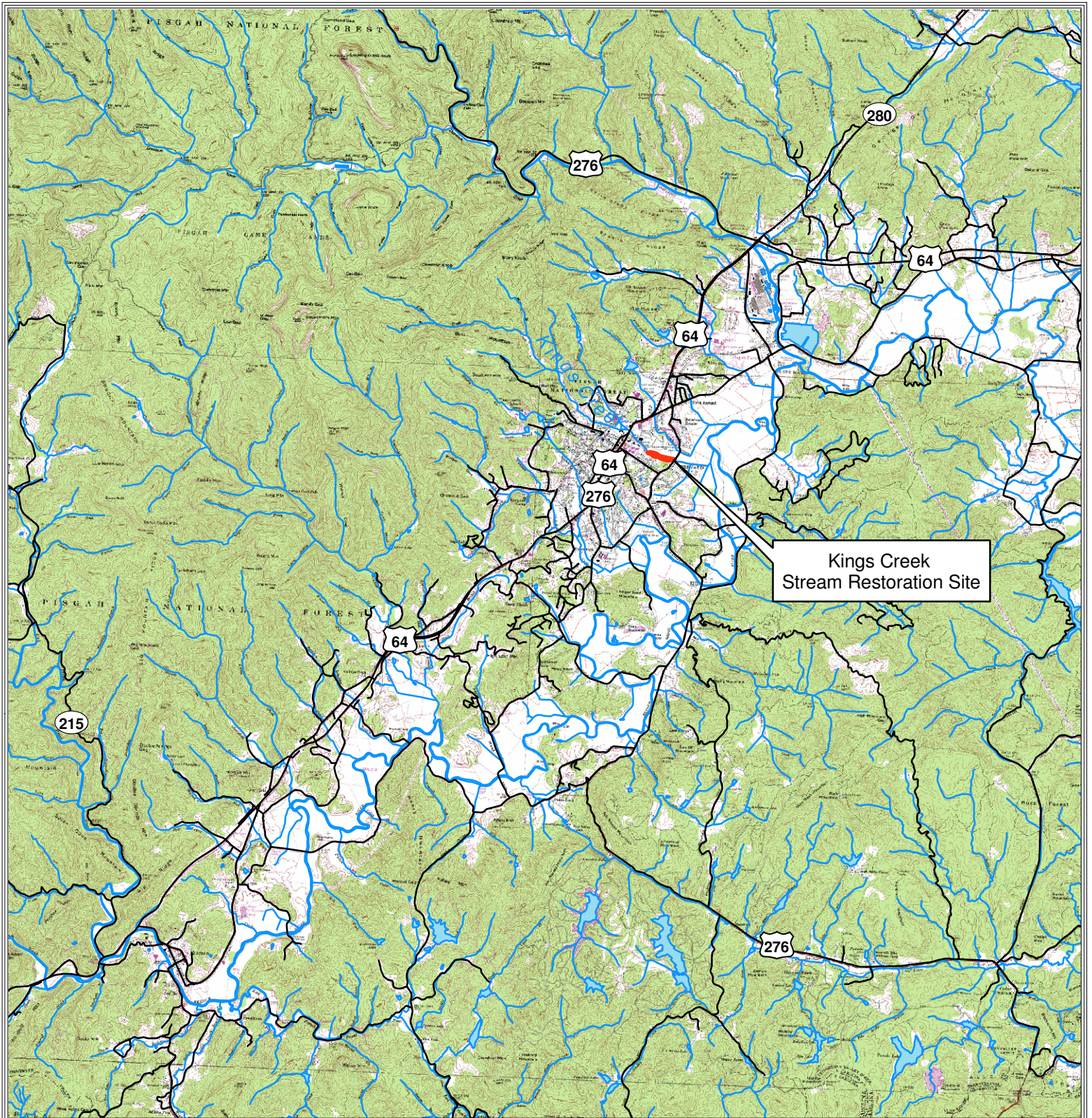
Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation. Version 4.2.

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

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

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

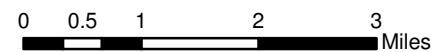


Figure 1 - Vicinity Map

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.



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	1,926						
Enhancement							
Enhancement I							
Enhancement II	191						
Creation							
Preservation							
HQ Preservation							
		0	0				
Totals	2,117	0.0		0.0	0.0	0.0	BMP Count
*Anticipated SMU Totals	1,631	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: 5 Years Elapsed Time Since Planting Complete: 5 Years Number of Reporting Years: 3		
Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan	-	-
Final Design - Construction Plans	-	9/24/2004
Construction	N/A	2006
Live Stakes and Bare Root Trees Planted	N/A	2006
Mitigation Plan / As-built (Year 0 Monitoring - Baseline)	-	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
Year 4 Monitoring		
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	
Stream Monitoring POC	
Vegetation Monitoring POC	
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	0%
Beaver Activity Observed During Design Phase	U
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	-

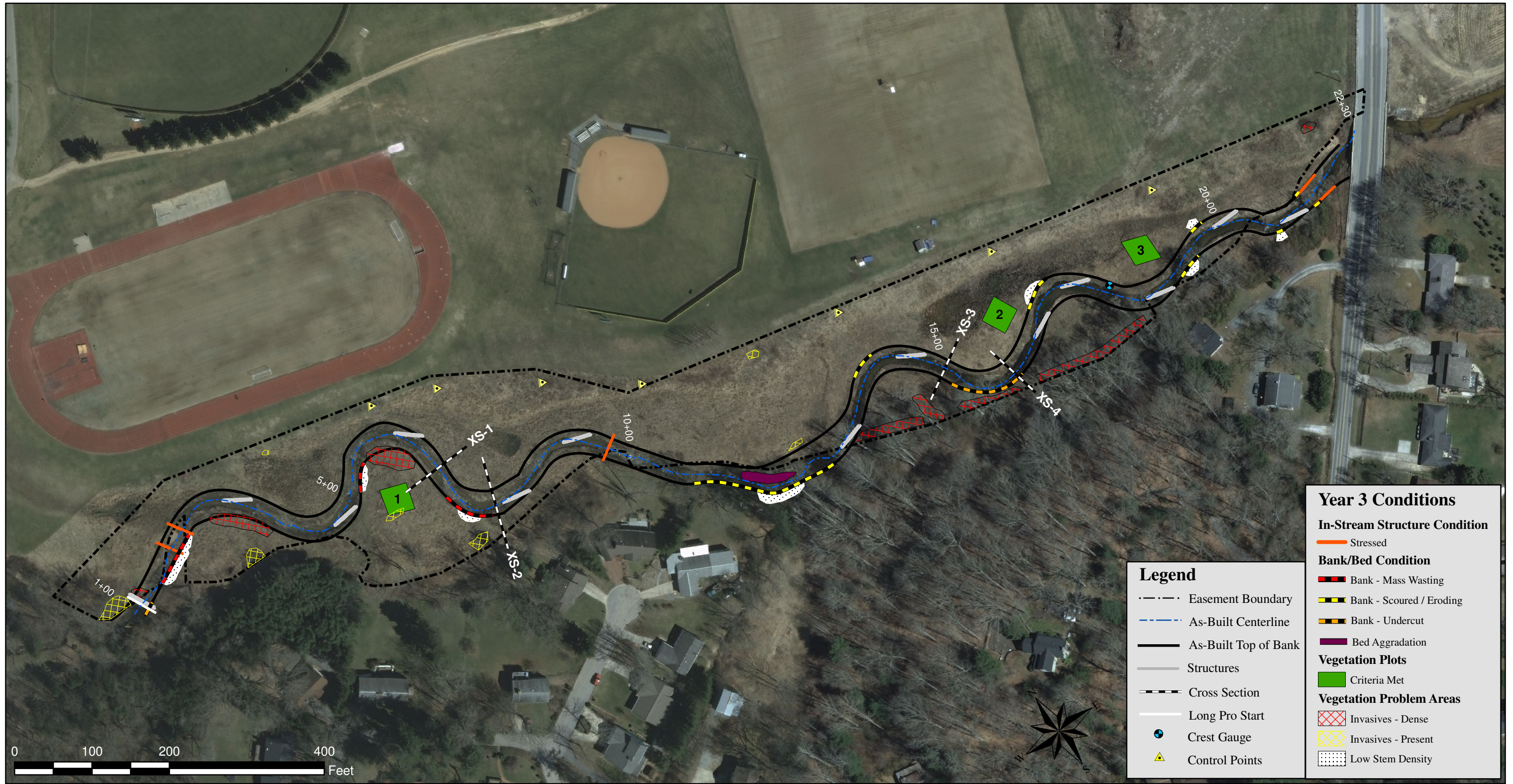
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N/A - Item does not apply

Appendix B

Visual Assessment Data

Figure 2. Integrated Current Condition Plan View





Prepared for	Project: Kings Creek	Notes: 1) Base Map Data Provided by NCEEP	Prepared by
	Year 3 Monitoring Transylvania County, North Carolina	2) 2010 Aerial Photo	
Sheet 1 of 1	Project Number	Date	November 2011
Date	NCEEP # 208	November 2011	

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					
	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. Scoured / Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			8	360	92%	8	113	94%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			2	119	97%	2	28	98%
	3. Mass Wasting	Bank slumping, calving, or collapse.			3	177	96%	3	50	97%
Totals					13	656	85%	13	191	89%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	14	16			88%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	21	24			88%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	24	24			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does NOT exceed 15%.	29	30			97%			
	4. Habitat	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	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	8	0.06	1%
Totals			8	0.06	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	0%
Cumulative Totals			8	0.06	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)	15	0.27	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 3 – June 23, 2011



Vegetation Monitoring Plot 2
Monitoring Year 3 – June 23, 2011



Vegetation Monitoring Plot 3
Monitoring Year 3 – June 23, 2011

Table 8. CVS Vegetation Plot Metadata Kings Creek / Project No. 208	
Report Prepared By	Owen Carson
Date Prepared	6/27/2011 15:55
Database Name	Equinox-2011-A-KingsCreek-MY3.mdb
Database Location	Z:\ES\NRI&M\EEP Monitoring\Kings Creek\KC-MY3-2011\Data\Veg
Computer Name	D16TNK71
File Size	36433920
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

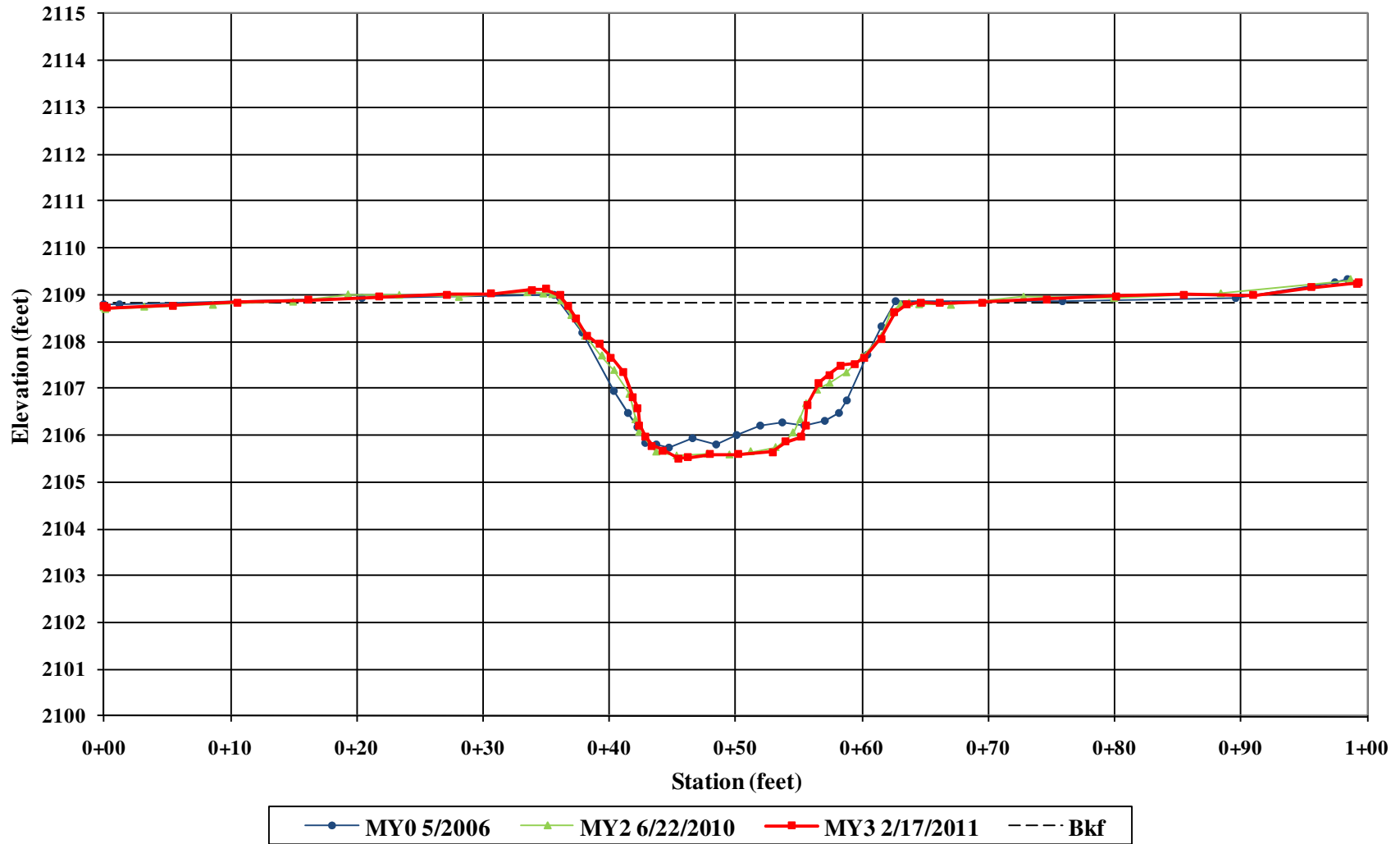
Table 9. Planted and Total Stem Counts (Species by Plot with Annual Means)																		
Kings Creek / Project No. 208																		
Scientific Name	Common Name	Species Type	Current Plot Data (MY3 2011)									Annual Means						
			E208-01-0001			E208-01-0002			E208-01-0003			MY3 (2011)			MY2 (2010)			
			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			13			7			96			116			113	
Alnus serrulata	Hazel alder	Shrub Tree	6	6	6	1	1	6	1	1	1	8	8	13	10	10	10	
Aronia arbutifolia	Red chokeberry	Shrub							2	2	3	2	2	3	2	2	2	
Betula nigra	River birch	Tree	2	2	2	3	3	3	2	2	2	7	7	7	8	8	8	
Cornus amomum	Silky dogwood	Shrub	3	3	8							3	3	8	3	3	5	
Corylus americana	American hazelnut	Shrub							1	1	1	1	1	1	1	1	1	
Fraxinus pennsylvanica	Green ash	Tree			1	1	1					1	1	1	1	1	1	
Hamamelis virginiana var. virginiana	American witchhazel	Shrub	4	4	4	2	2	2	1	1	1	7	7	7	5	5	5	
Juglans nigra	Black walnut	Tree															2	
Liquidambar styraciflua	Sweetgum	Tree			1									1			2	
Liriodendron tulipifera var. tulipifera	Tulip-tree, Yellow poplar, Whitewood	Tree			6			4			3			13			12	
Nyssa sylvatica	Blackgum	Tree	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	7	3	3	3	8	8	17	16	16	27	15	15	39	
Prunus serotina var. serotina	Black cherry	Shrub Tree															1	
Quercus phellos	Willow oak	Tree															1	
Salix nigra	Black willow	Tree			1						3			4			3	
Sambucus canadensis	Common elderberry	Shrub Tree					1	1					1	1		1	1	
Stem count			22	22	50	10	11	27	15	15	127	47	48	204	47	48	209	
size (ares)			1			1			1			3			3			
size (ACRES)			0.02			0.02			0.02			0.07			0.07			
Species count			6	6	10	5	6	8	6	6	9	9	10	14	9	10	18	
Stems per ACRE			890.31	890.31	2023.4	404.69	445.15	1092.7	607.03	607.03	5139.5	634.01	647.5	2751.9	634.01	647.5	2819.3	

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
(Looking at Left Bank Descending)
Monitoring Year 3 – February 17, 2011



Cross-Section 1 – Riffle
(Looking at Right Bank Descending)
Monitoring Year 3 – February 17, 2011

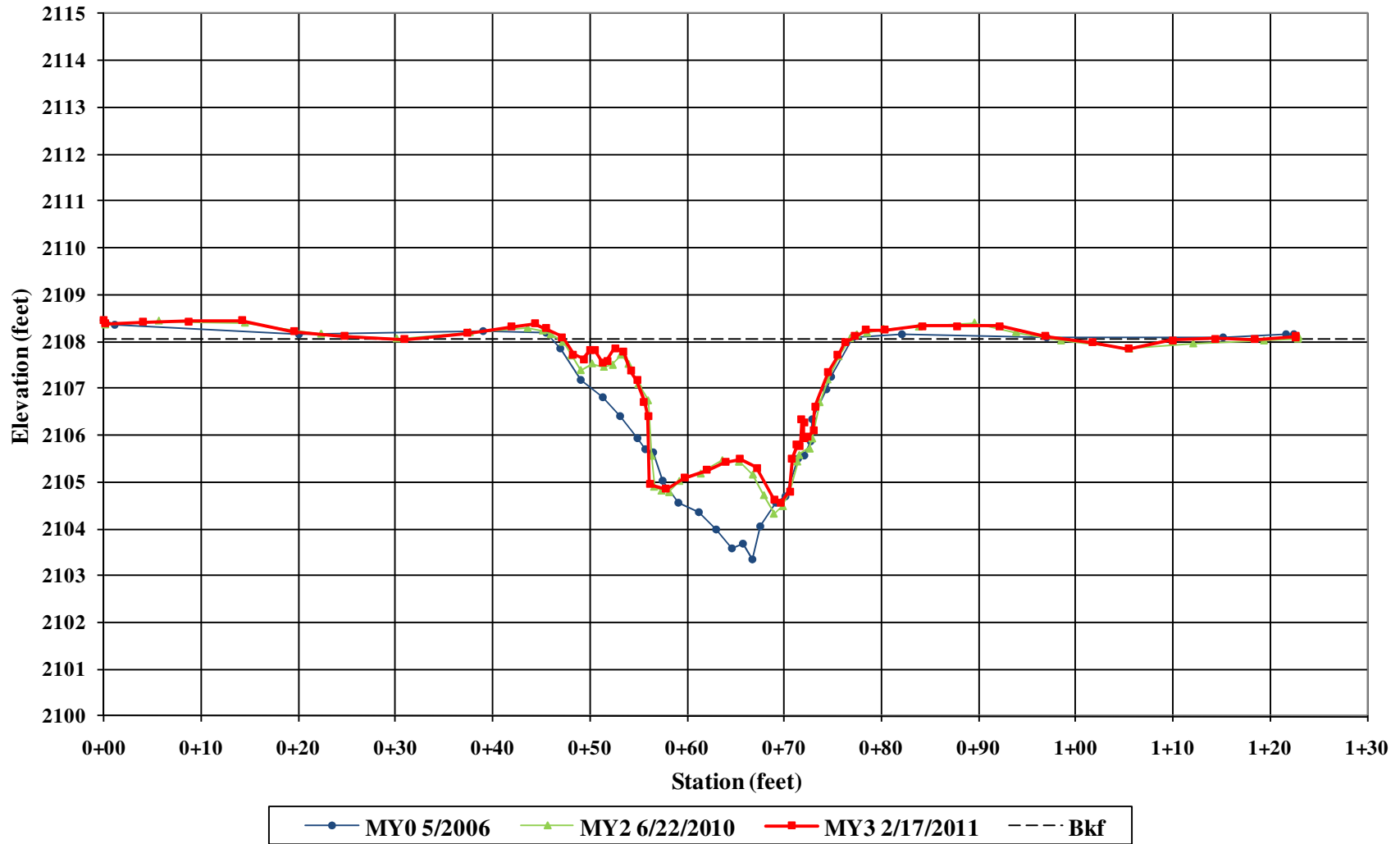


Cross-Section 1 – Riffle
(Looking Downstream)
Monitoring Year 3 – February 17, 2011



Cross-Section 1 – Riffle
(Looking Upstream)
Monitoring Year 3 – February 17, 2011

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





Cross-Section 2 – Pool
(Looking at Left Bank Descending)
Monitoring Year 3 – February 17, 2011



Cross-Section 2 – Pool
(Looking at Right Bank Descending)
Monitoring Year 3 – February 17, 2011

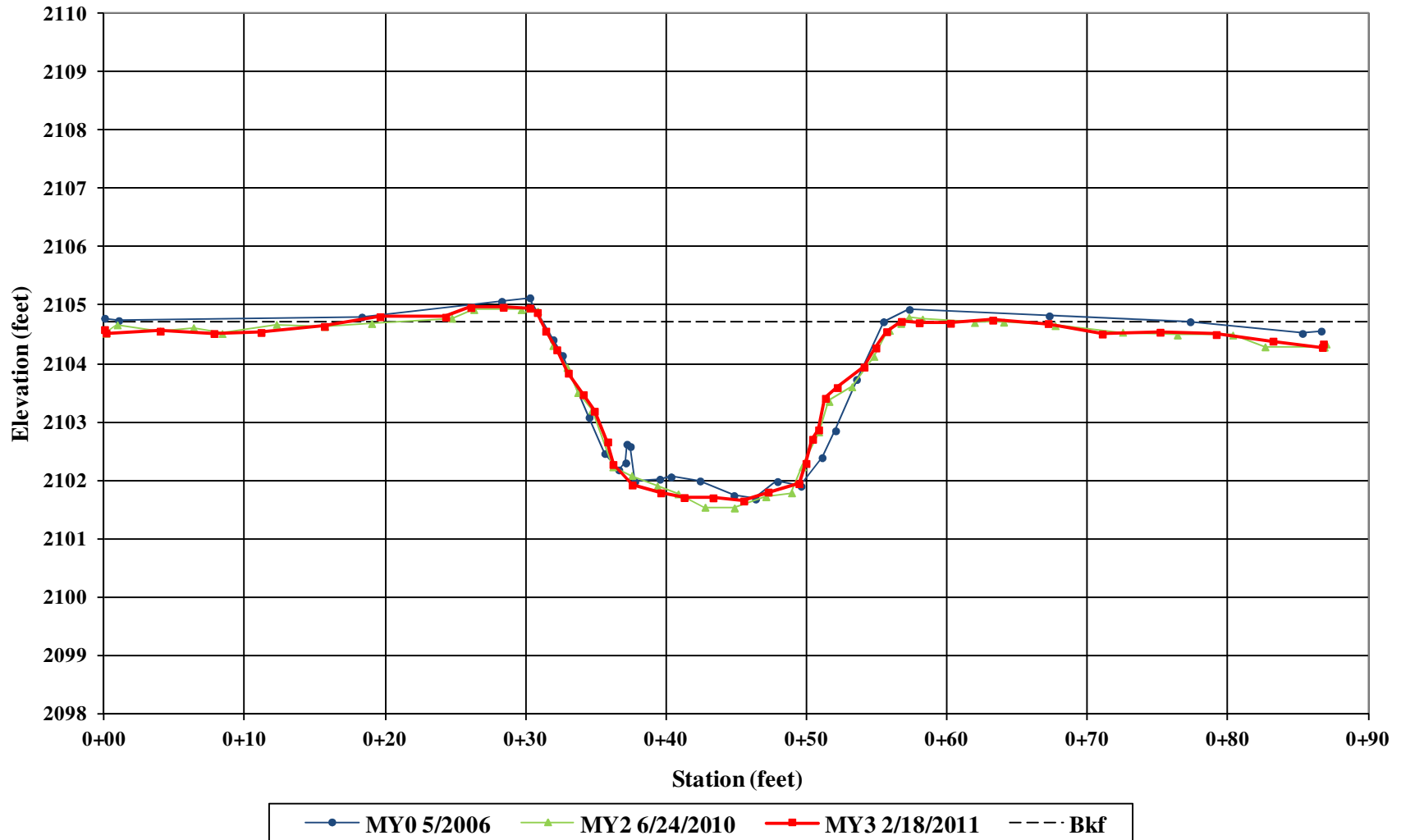


Cross-Section 2 – Pool
(Looking Downstream)
Monitoring Year 3 – February 17, 2011



Cross-Section 2 – Pool
(Looking Upstream)
Monitoring Year 3 – February 17, 2011

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





Cross-Section 3 – Riffle
(Looking at Left Bank Descending)
Monitoring Year 3 – February 18, 2011



Cross-Section 3 – Riffle
(Looking at Right Bank Descending)
Monitoring Year 3 – February 18, 2011

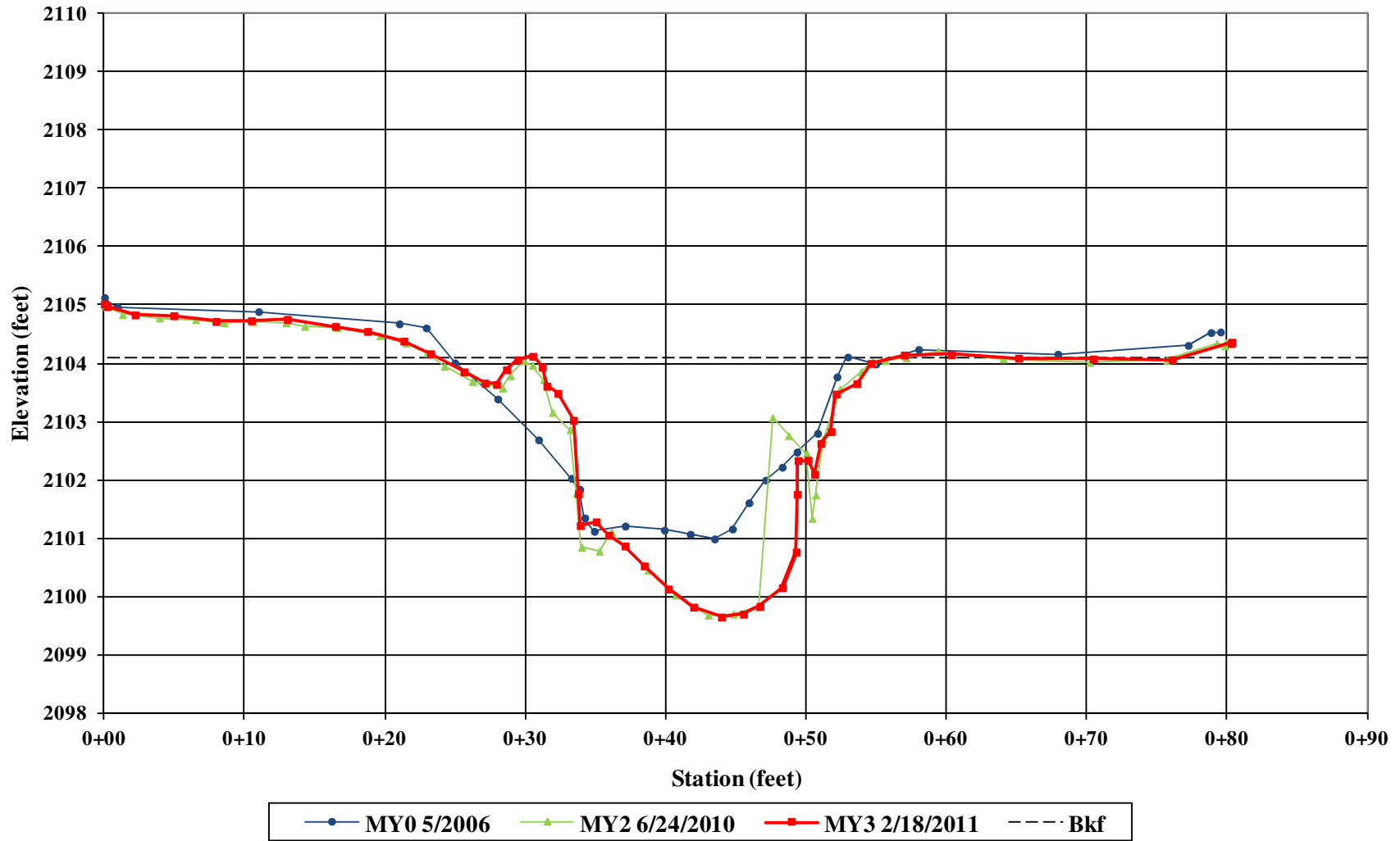


Cross-Section 3 – Riffle
(Looking Downstream)
Monitoring Year 3 – February 18, 2011



Cross-Section 3 – Riffle
(Looking Upstream)
Monitoring Year 3 – February 18, 2011

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





Cross-Section 4 – Pool
(Looking at Left Bank Descending)
Monitoring Year 3 – February 18, 2011



Cross-Section 4 – Pool
(Looking at Right Bank Descending)
Monitoring Year 3 – February 18, 2011

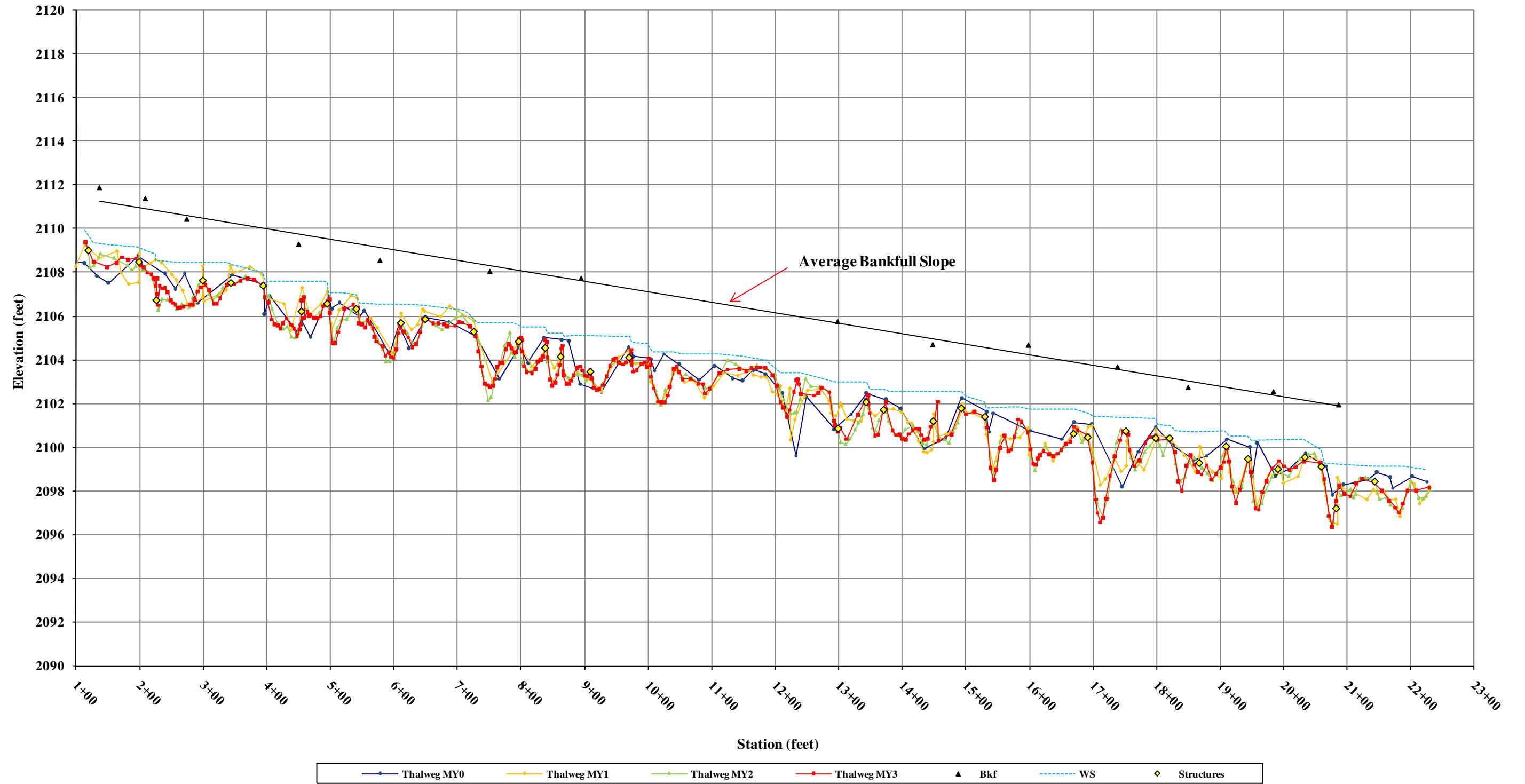


Cross-Section 4 – Pool
(Looking Downstream)
Monitoring Year 3 – February 18, 2011



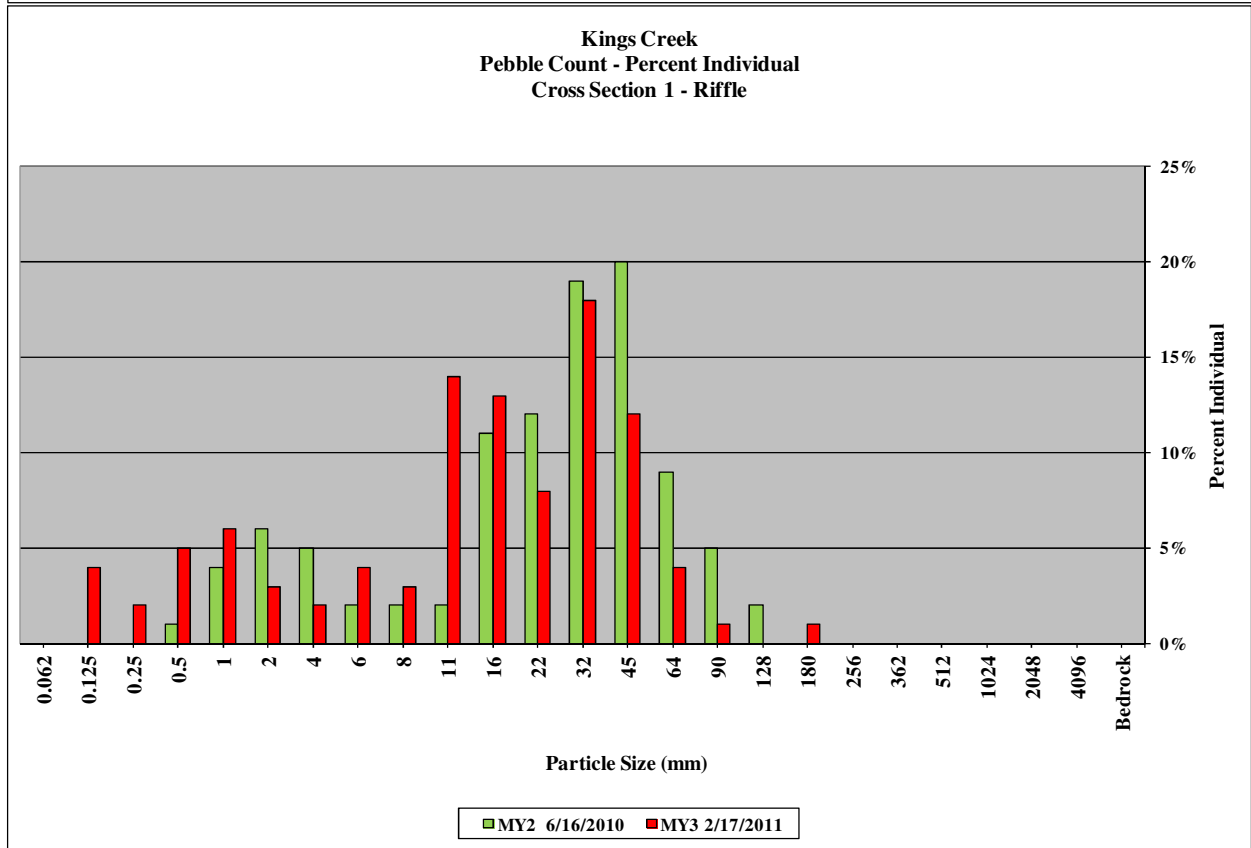
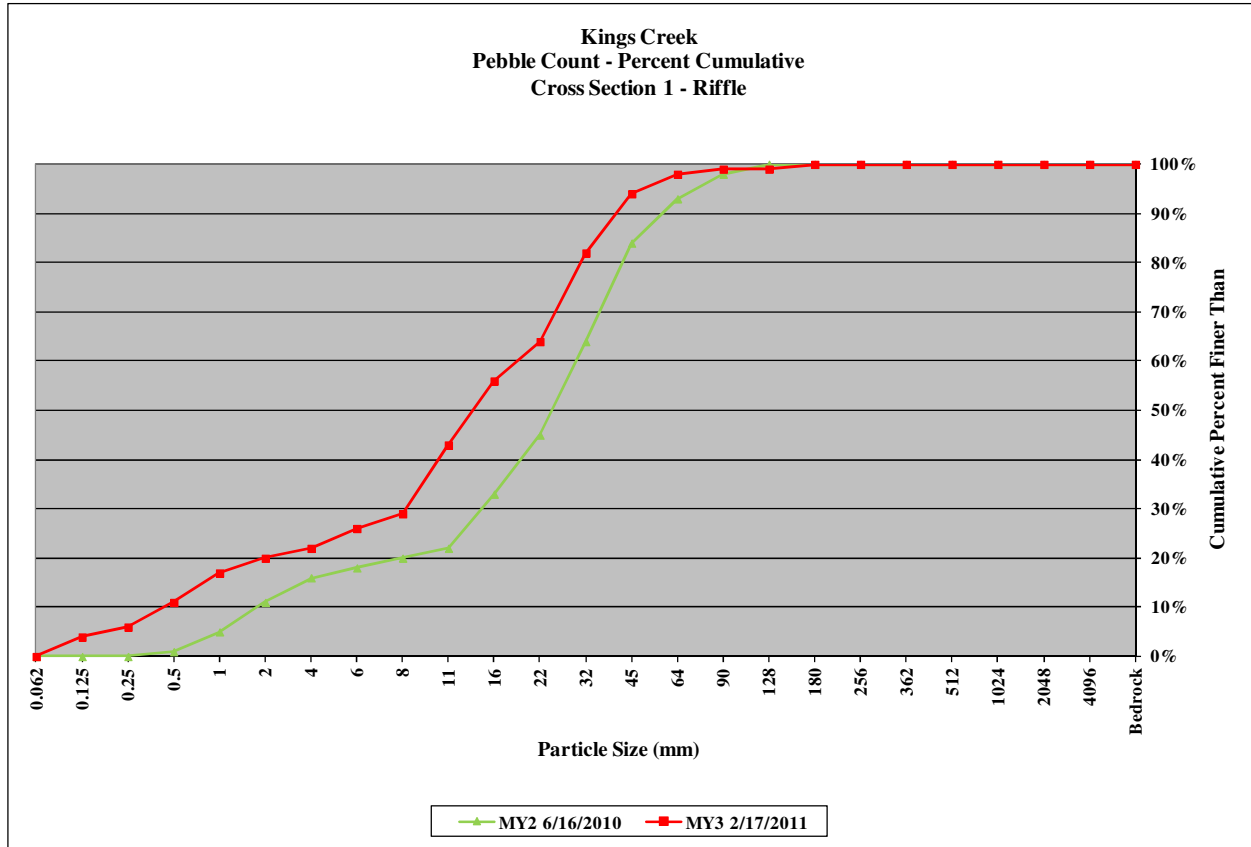
Cross-Section 4 – Pool
(Looking Upstream)
Monitoring Year 3 – February 18, 2011

Kings Creek Longitudinal Profile



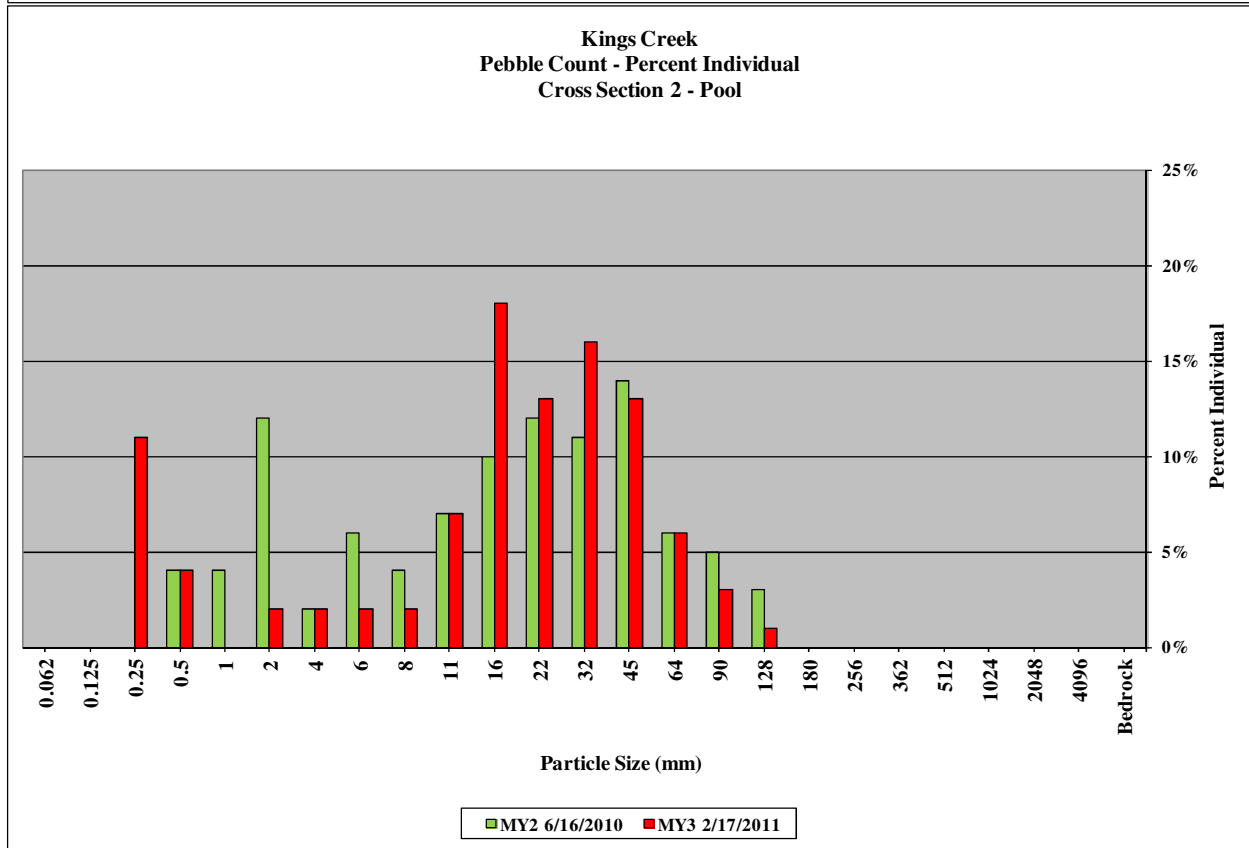
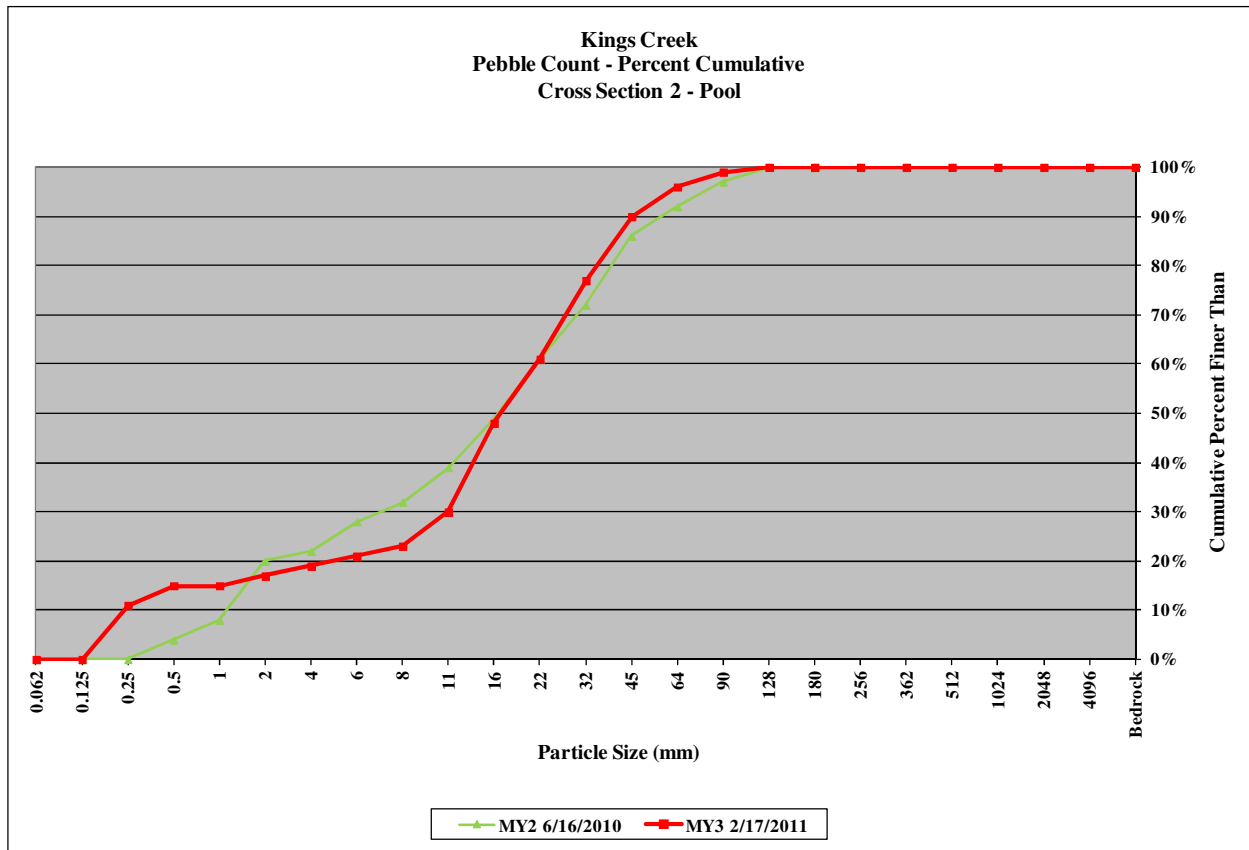
Kings Creek / Project No. 208					
Cross-Section 1 - Pebble Count Summary					
Riffle					
			2011		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	4	4%	4%
	fine sand	0.25	2	2%	6%
	medium sand	0.50	5	5%	11%
	coarse sand	1.00	6	6%	17%
	very coarse sand	2.00	3	3%	20%
Gravel	very fine gravel	4.0	2	2%	22%
	fine gravel	5.7	4	4%	26%
	fine gravel	8.0	3	3%	29%
	medium gravel	11.3	14	14%	43%
	medium gravel	16.0	13	13%	56%
	coarse gravel	22.3	8	8%	64%
	coarse gravel	32	18	18%	82%
	very coarse gravel	45	12	12%	94%
	very coarse gravel	64	4	4%	98%
Cobble	small cobble	90	1	1%	99%
	medium cobble	128	0	0%	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	13
D84	34
D95	49



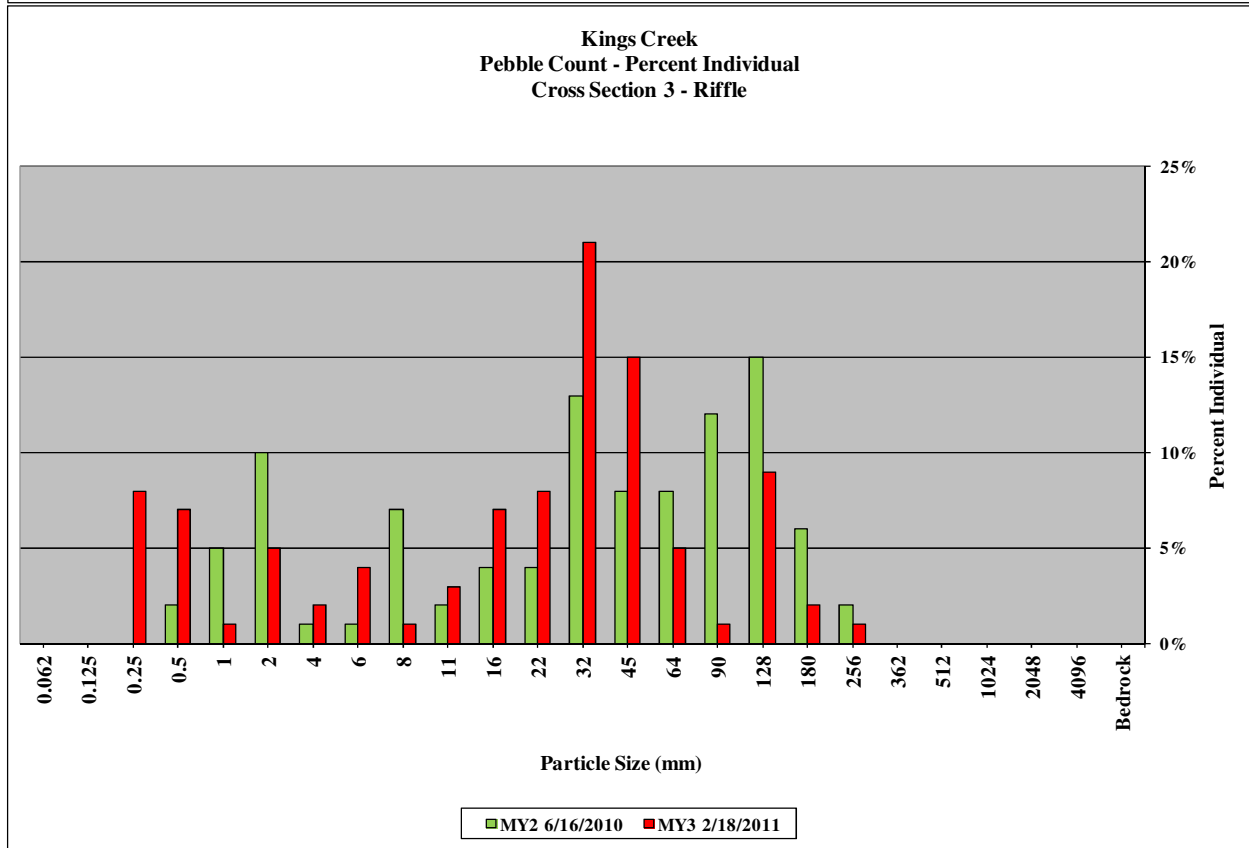
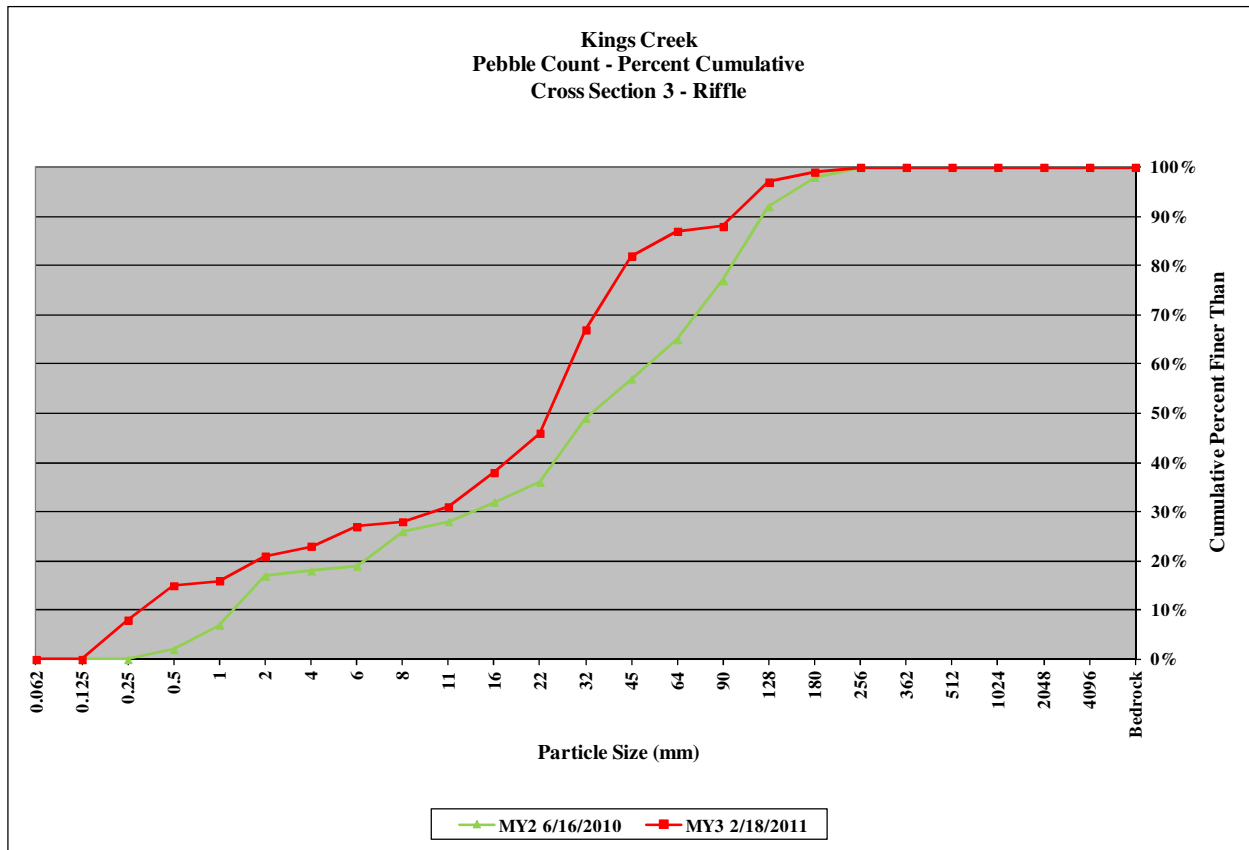
Kings Creek / Project No. 208					
Cross-Section 2 - Pebble Count Summary					
Pool					
			2011		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.25	11	11%	11%
	medium sand	0.50	4	4%	15%
	coarse sand	1.00	0	0%	15%
	very coarse sand	2.00	2	2%	17%
Gravel	very fine gravel	4.0	2	2%	19%
	fine gravel	5.7	2	2%	21%
	fine gravel	8.0	2	2%	23%
	medium gravel	11.3	7	7%	30%
	medium gravel	16.0	18	18%	48%
	coarse gravel	22.3	13	13%	61%
	coarse gravel	32	16	16%	77%
	very coarse gravel	45	13	13%	90%
	very coarse gravel	64	6	6%	96%
Cobble	small cobble	90	3	3%	99%
	medium cobble	128	1	1%	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	17
D84	38
D95	60



Kings Creek / Project No. 208					
Cross-Section 3 - Pebble Count Summary					
Riffle					
			2011		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.25	8	8%	8%
	medium sand	0.50	7	7%	15%
	coarse sand	1.00	1	1%	16%
	very coarse sand	2.00	5	5%	21%
Gravel	very fine gravel	4.0	2	2%	23%
	fine gravel	5.7	4	4%	27%
	fine gravel	8.0	1	1%	28%
	medium gravel	11.3	3	3%	31%
	medium gravel	16.0	7	7%	38%
	coarse gravel	22.3	8	8%	46%
	coarse gravel	32	21	21%	67%
	very coarse gravel	45	15	15%	82%
	very coarse gravel	64	5	5%	87%
Cobble	small cobble	90	1	1%	88%
	medium cobble	128	9	9%	97%
	large cobble	180	2	2%	99%
	very large cobble	256	1	1%	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	24
D84	52
D95	120



Kings Creek / Project No. 208					
Cross-Section 4 -Pebble Count Summary					
Pool					
			2011		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	1	1%	1%
Sand	very fine sand	0.125	3	3%	4%
	fine sand	0.25	18	18%	22%
	medium sand	0.50	11	11%	33%
	coarse sand	1.00	10	10%	43%
	very coarse sand	2.00	9	9%	52%
Gravel	very fine gravel	4.0	1	1%	53%
	fine gravel	5.7	3	3%	56%
	fine gravel	8.0	3	3%	59%
	medium gravel	11.3	5	5%	64%
	medium gravel	16.0	15	15%	79%
	coarse gravel	22.3	9	9%	88%
	coarse gravel	32	5	5%	93%
	very coarse gravel	45	7	7%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	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	1.7
D84	19
D95	35

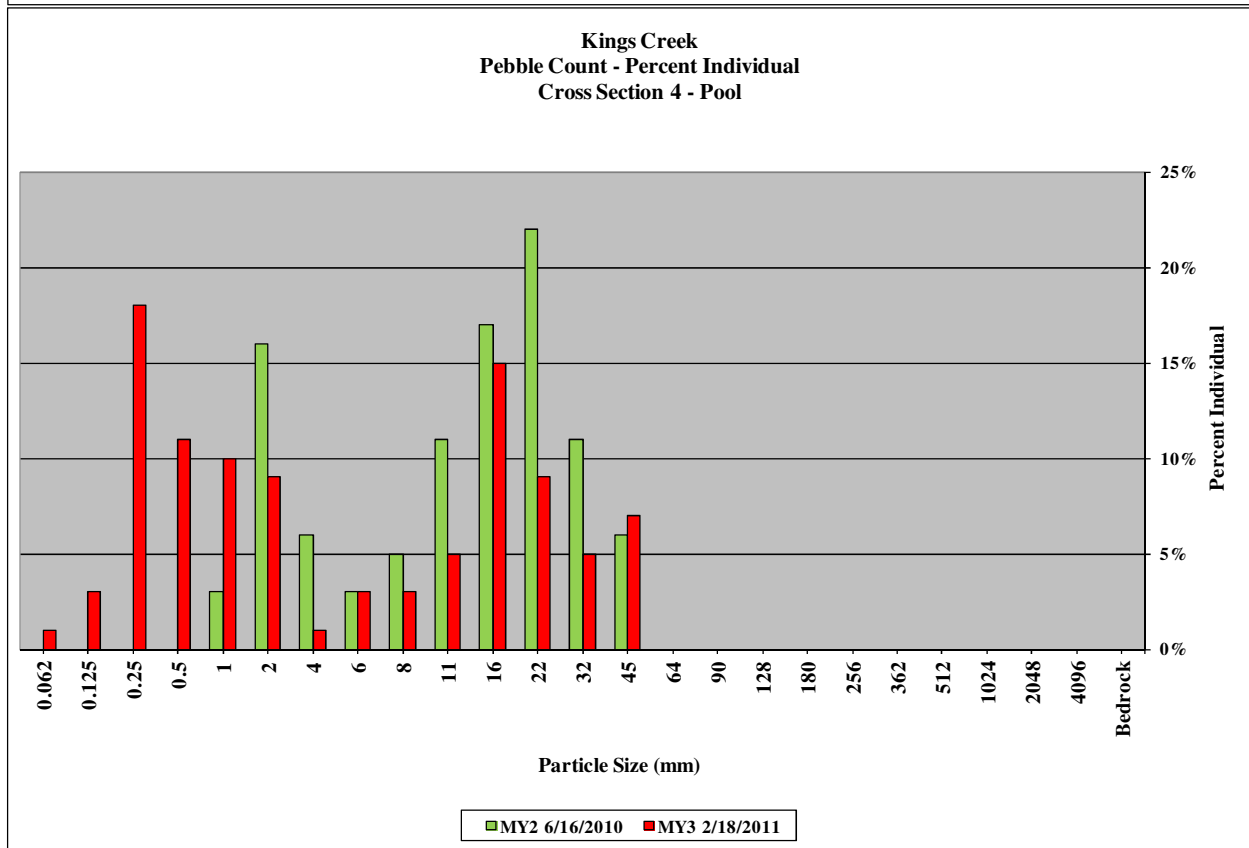
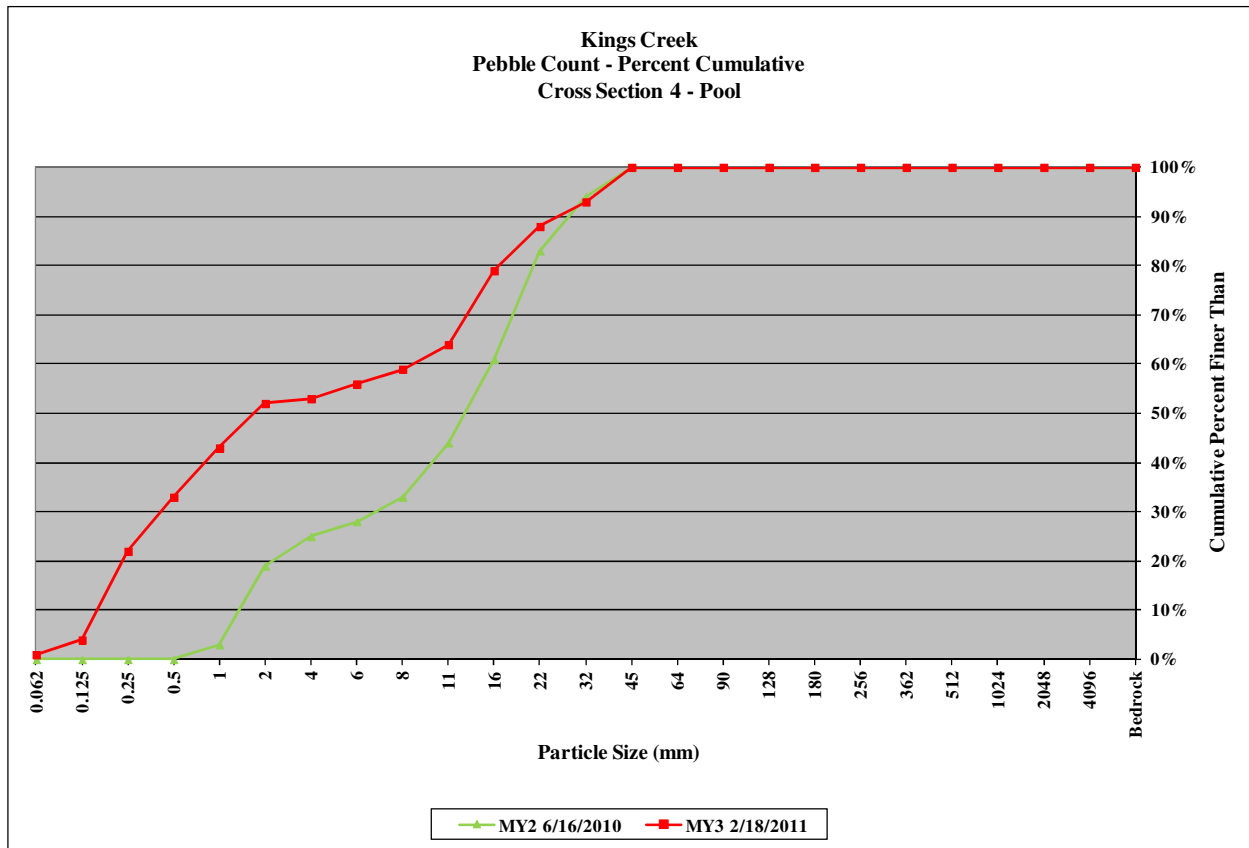


Table 10a. Baseline Stream Data Summary Kings Creek / Project No. 208																																	
Parameter	Gauge	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data					Design			Monitoring Baseline														
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Med	Max	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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<1.5 / 1.5 - 1.99 / 2 - 4.9 / 5.0 - 9.9 / >10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Incision Class	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<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			-	-	2108.1	2108.1		
Bankfull Width (ft)	26.7	-	26.8	26.8			31.1	-	30.3	29.8		
Floodprone Width (ft)	>150	-	>150	>150			>150	-	>150	>150		
Bankfull Mean Depth (ft)	2.2	-	2.2	2.1			2.5	-	1.9	1.9		
Bankfull Max Depth (ft)	3.1	-	3.3	3.3			4.7	-	3.7	3.5		
Bankfull Cross-Sectional Area (ft ²)	58.5	-	58.0	57.3			76.6	-	58.5	55.6		
Bankfull Width/Depth Ratio	12.2	-	12.4	12.5			12.7	-	15.7	16.0		
Bankfull Entrenchment Ratio	>3.7	-	>5.6	>5.6			>3.9	-	>4.9	>5.0		
Bankfull Bank Height Ratio	1.0	-	1.0	1.0			1.0	-	1.1	1.1		
Cross-Sectional Area Between End Pins (ft ²)	-	-	59.6	58.4			-	-	61.6	57.4		
d50 (mm)	-	-	24	13			-	-	16	17		
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			-	-	2104.1	2104.1		
Bankfull Width (ft)	24.2	-	25.7	25.6			28.3	-	25.8	25.9		
Floodprone Width (ft)	>150	-	>150	>150			>150	-	>150	>150		
Bankfull Mean Depth (ft)	2.1	-	2.1	2.0			2.0	-	2.5	2.6		
Bankfull Max Depth (ft)	3.0	-	3.2	3.1			3.1	-	4.4	4.5		
Bankfull Cross-Sectional Area (ft ²)	51.9	-	53.1	52.0			55.5	-	63.1	67.4		
Bankfull Width/Depth Ratio	11.3	-	12.4	12.6			14.4	-	10.5	9.9		
Bankfull Entrenchment Ratio	>3.6	-	>5.8	>5.9			>3.2	-	>5.8	>5.8		
Bankfull Bank Height Ratio	1.0	-	1.0	1.0			1.0	-	1.0	1.0		
Cross-Sectional Area Between End Pins (ft ²)	-	-	60.2	59.3			-	-	66.1	69.3		
d50 (mm)	-	-	33	24			-	-	13	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	Min	Mean	Med	Max	SD	n												
Dimension & Substrate - Riffle																																																
Bankfull Width (ft)	24.2	25.5	25.5	26.7	N/A	2	-	-	-	-	-	2	25.7	26.3	26.3	26.8	N/A	2	25.6	26.2	26.2	26.8	N/A	2	25.6	26.2	26.2	26.8	N/A	2	25.6	26.2	26.2	26.8	N/A	2	25.6	26.2	26.2	26.8	N/A	2						
Floodprone Width (ft)	>150	>150	>150	>150	N/A	2	-	-	-	-	-	2	>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	>150	>150	>150	>150	N/A	2						
Bankfull Mean Depth (ft)	2.1	2.2	2.2	2.2	N/A	2	-	-	-	-	-	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	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	-	-	-	-	-	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	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	-	-	-	-	-	2	53.1	55.6	55.6	58.0	N/A	2	52.0	54.7	54.7	57.3	N/A	2	52.0	54.7	54.7	57.3	N/A	2	52.0	54.7	54.7	57.3	N/A	2	52.0	54.7	54.7	57.3	N/A	2	52.0	54.7	54.7	57.3	N/A	2
Width/Depth Ratio	11.3	11.8	11.8	12.2	N/A	2	-	-	-	-	-	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	12.6	12.6	12.6	N/A	2	12.5	12.6	12.6	12.6	N/A	2	12.5	12.6	12.6	12.6	N/A	2						
Entrenchment Ratio	>3.6	>3.7	>3.7	>3.7	N/A	2	-	-	-	-	-	2	>5.6	>5.7	>5.7	>5.8	N/A	2	>5.6	>5.8	>5.8	>5.9	N/A	2	>5.6	>5.8	>5.8	>5.9	N/A	2	>5.6	>5.8	>5.8	>5.9	N/A	2	>5.6	>5.8	>5.8	>5.9	N/A	2						
Bank Height Ratio	1.0	1.0	1.0	1.0	N/A	2	-	-	-	-	-	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	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																								
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																								
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																								
Pool Max Depth (ft)	3.1	3.9	3.9	4.7	N/A	2	-	-	-	-	-	2	3.7	4.1	4.1	4.4	N/A	2	3.5	4.0	4.0	4.5	N/A	2	3.5	4.0	4.0	4.5	N/A	2	3.5	4.0	4.0	4.5	N/A	2	3.5	4.0	4.0	4.5	N/A	2						
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																								
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																																																
Rosen Classification	C4						-						C4						C4						C4						C4						C4						C4					
Channel Thalweg Length (ft)	2,119						2,189						2,135						2,138						2,138						2,138						2,138						2,138					
Sinuosity (ft)	1.25						1.29						1.28						1.28						1.28						1.28						1.28						1.28					
Water Surface Slope (Channel) (ft/ft)	0.0049						0.0050						0.0048						0.0048						0.0048						0.0048						0.0048						0.0048					
Bankfull Slope (ft/ft)	0.0044						0.0051						0.0052						0.0049						0.0049						0.0049						0.0049						0.0049					
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%	9%	45%	28%	0%		17%	9%	45%	28%	0%		17%	9%	45%	28%	0%							
SC% / SA% / G% / C% / B% / Be%													0%	17%	71%	13%	0%		0%	27%	68%	5%	0%		0%	27%	68%	5%	0%		0%	27%	68%	5%	0%		0%	27%	68%	5%	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	N/A	N/A		N/A	N/A	N/A	N/A	N/A							
% of Reach with Eroding Banks	0%						11%						15%						15%						15%						15%																	
Channel Stability or Habitat Metric	N/A						N/A						N/A						N/A						N/A						N/A																	
Biological or Other	N/A						N/A						N/A						N/A						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	