Freedom Park (Little Sugar Creek) Monitoring Report Year 5 of 5 (2009)

Mecklenburg County, North Carolina

USGS HUC: 03050103

Project ID No. 141

Prepared for:

NCDENR-Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

Submitted November 2009
Revised April 2010

Executive Summary

The Freedom Park Stream Restoration project falls within USGS hydrologic unit **03050103**. The project stream lies within an urban setting of the City of Charlotte that is comprised of predominantly residential and commercial uses. Prior to restoration work, the project stream (Little Sugar Creek) had been destabilized through historic channelization and dredging. Also, prior to restoration work, the channel consisted of a concrete lining.

HDR Engineering designed the restoration plans and restoration was completed in 2003. Baker Engineering prepared maintenance plans and Fluvial Solutions completed the maintenance construction in early 2008. Kimley-Horn and Associates (KHA) performed stream and riparian monitoring during 2009 for this Year 5 Monitoring Report. During the late growing season, KHA assessed six (6) vegetation quads. The Ecosystem Enhancement Program (EEP) replanted these quads during winter/spring of 2008-2009. Combined stem count density equaled approximately 493 stems per acre for planted stems; exceeding year 5 success criteria. Overall, the floodplain vegetation is performing well. Stream bank vegetation has had difficulty becoming established in some sections.

A stream assessment including a visual assessment and geomorphic survey indicated that the project reaches were performing mostly within established success criteria ranges. A few isolated sections showed bank erosion, but the length and occurrence of erosion does not appear to be expanding from previous years. Most of the project reach continues to be stable. The geomorphic measurements are within the range of the design parameters.

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Prepared For: Ecosystem Enhancement Program	**Project**	Freedom Park (Little Sugar Creek) Stream Restoration Monitoring Year 5 – 2009 Mecklenburg County, North Carolina	
	Date	**Project Number**	**Figure**
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Kimley-Horn and Associates, Inc.

Title	Current Conditions Plan View Upper (2007 Aerial)		
Prepared For: Ecosystem Enhancement Program	**Project**	Freedom Park (Little Sugar Creek) Stream Restoration Monitoring Year 5 – 2009 Mecklenburg County, North Carolina	
	Date	**Project Number**	**Figure**
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Kimley-Horn and Associates, Inc.

Title	Current Conditions Plan View Middle (2007 Aerial)		
Prepared For: Ecosystem Enhancement Program	**Project**	Freedom Park (Little Sugar Creek) Stream Restoration Monitoring Year 5 – 2009 Mecklenburg County, North Carolina	
	Date	**Project Number**	**Figure**
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Kimley-Horn and Associates, Inc.

Title	Current Conditions Plan View Lower (2007 Aerial)		
Prepared For: Ecosystem Enhancement Program	**Project**	Freedom Park (Little Sugar Creek) Stream Restoration Monitoring Year 5 – 2009 Mecklenburg County, North Carolina	
	Date	**Project Number**	**Figure**
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PROJECT TABLES

Table I. Project Restoration Components Little Sugar Creek Stream Restoration Site (EEP Project #141)											
Project Segment or Reach ID	**Existing Feet / Acres**	**Type**	**Approach**	**Footage or Acreage**		**Mitigation Ratio**	**Mitigation Units**	**Stationing**			**Comment**
Main	4,200	R	P2 / P3	4,450	lf	1:1	4,450	0+00.0	-	44+50.0	

Table II. Project Activity and Reporting History Little Sugar Creek Stream Restoration Site (EEP Project #141)				
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**	**Comments**
Restoration Plan			Oct-02	
Final Design – 90%				
Construction	2003		Sept-03	
Temporary S&E mix applied to entire project area	2003		Sept-03	
Permanent seed mix applied	2003		Sept-03	
Containerized and B&B plantings for reach/segments 1&2	2004		June-04	
Mitigation Plan / As-built (Year 0 Monitoring –	2004		Spring 04	Performed by NCSU
Year 1 monitoring	2005	Oct-05	Nov-05	Performed by SEC, PA
Year 2 Monitoring	2006	Oct-06	Jan-07	Performed by KHA, Inc.
Year 3 Monitoring	2007	Nov-07	Feb-08	Performed by KHA, Inc.
Repair	2008		Winter-08	Plans prepared Baker Engineer, Construction performed by Fluvial Solutions
Year 4 Monitoring	2008	Oct-08	May-09	Performed by KHA, Inc.
Year 5 Monitoring	2009	Sept-09	November-09	Performed by KHA, Inc.

Table III. Project Contact Table Little Sugar Creek Stream Restoration Site (EEP Project #141)		
Designer	128 South Tryon St., Suite 1400	
HDR Engineering, Inc. of the Carolinas	Charlotte, NC 28202	
Primary Designer POC		
Construction Contractor	5100 North I-85, Suite 7	
SEI Environmental	Charlotte, NC 28206	
Primary Contractor POC		
Planting Contractor		
Planting contractor POC		
Seeding Contractor		
Planting contractor POC		
Seed Mix Sources		
Nursery Stock Suppliers		
Monitoring Performers	PO Box 33068	
Kimley-Horn and Associates	Raleigh, NC 27636	
Stream Monitoring POC	Daren Pait	(919) 678-4155
Vegetation Monitoring POC	Daren Pait	(919) 678-4155

Table IV. Project Background Table Little Sugar Creek Stream Restoration Site (EEP Project #141)	
Project County	Mecklenburg
Drainage Area	13.6 square miles
Drainage impervious cover estimate (%)	75%
Stream Order	3
Physiographic Region	Piedmont
Ecoregion	Charlotte Belt
Rosgen Classification of As-built	C4
Cowardin Classification	N/A
Dominant soil types	Cecil, Monacan
Reference site ID	N/A
USGS HUC for Project and Reference	03050103
NCDWQ Sub-basin for Project and Reference	03-08-34
NCDWQ classification for Project and Reference	C
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	No
% of project easement fenced	0%

Table V. Verification of Bankfull Events Little Sugar Creek Stream Restoration Site (EEP Project #141)			
Date of Data	**Date of Occurrence**	**Method**	**Photo #**
10/1/2006	Before 10/1/2006	Photographed On-Site	BE1
11/3/2008	Before 11/03/2008	Photographed On-Site	PS4
4/28/2010	5/5/2009	USGS Stream Gauge	
4/28/2010	8/16/2009	USGS Stream Gauge	

Table VI. Categorical Stream Feature Visual Stability Assessment Little Sugar Creek Stream Restoration Site (EEP Project #141)						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles	--	100%	100%	100%	100%	100%
B. Pools	--	95%	98%	98%	89%	89%
C. Thalweg	--	100%	100%	100%	100%	100%
D. Meanders	--	85%	72%	72%	70%	70%
E. Bed General	--	94%	100%	100%	100%	100%
F. Bank Condition	--	92%	82%	95%	97%	92%
G. Vanes / J Hooks etc.	--	100%	80%	80%	100%	95%
H. Wads and Boulders	--	100%	35%	35%	68%	97%

Table VII. Baseline Morphology and Hydraulic Summary

Little Sugar Creek Stream Restoration Site (EEP Project #141)

Parameter		USGS Gage Data			Regional Curve			Pre-Existing Condition			Project Reference Stream			Design			As-built		
	Units	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Dimension																			
BF Width	ft	*	*	*	36	56	*	*	*	64	37	49	*	51	57	*	45.3	68.4	52.3
Floodprone Width	ft	*	*	*	*	*	*	*	*	300	72	150	*	*	*	300	60.2	85.9	75.7
BF Cross Sectional Area	ft^2	*	*	*	122	319	*	*	*	302	119	314	*	335	343	*	197.3	239.2	219.7
BF Mean Depth	ft	*	*	*	3.5	5.7	*	*	*	5.1	2.8	6.4	*	6	6.5	*	3.5	4.6	4.3
BF Max Depth	ft	*	*	*	*	*	*	*	*	9	5.2	11.1	*	8	8	*	4.8	6.9	5.5
Width/Depth Ratio		*	*	*	*	*	*	*	*	12.5	7.6	13.2	*	7.8	9.5	*	9.8	19.5	12.3
Entrenchment Ratio		*	*	*	*	*	*	*	*	5	1.9	2.2	*	*	*	5	1.3	1.6	1.3
Bank Height Ratio																	1.5	2.2	1.9
Wetted Perimeter	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	48.5	70.8	59.3
Hydraulic radius	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	3.4	4.3	3.7
Pattern																			
Channel Beltwidth	ft	*	*	*	*	*	*	0	125	*	92	100	*	200	467	*	105	236	153
Radius of Curvature	ft	*	*	*	*	*	*	*	*	*	64	210	*	160	220	*	72	232	147.5
Meander Wavelength	ft	*	*	*	*	*	*	433	532	*	362	552	*	*	*	395	403	840	531
Meander Width ratio		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1.9	4.3	3
Profile																			
Riffle length	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	15	207	66
Riffle slope	ft/ft	*	*	*	*	*	*	*	*	*	0.007	0.07	*	0.01	0.014	*	0.0027	0.0175	0.0115
Pool length	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	76	252	132
Pool spacing	ft	*	*	*	*	*	*	*	*	*	98	104	*	*	*	141	171	587	294
Substrate[1]																			
d50	mm	*	*	*	*	*	*	*	*	4.8	1.1	1.9	*	*	*	4.8	0.2	1.1	*
d84	mm	*	*	*	*	*	*	*	*	6.4	2.6	3	*	*	*	6.4	0.2	4.7	*
Additional Reach Parameters																			
Valley Length	ft		*			*			*			*			*			*	
Channel Length	ft		*			*			*			*			*			*	
Sinuosity			*			*			1.04		1.1	1.4			1.11			*	
Water Surface Slope	ft/ft		*			*			0.003		0.003	0.008		0.0026	0.0029			0.0025	
BF slope	ft/ft		*			*			*			*			*			*	
Rosgen Classification			*			*			C3-C5			*			*			*	
*Habitat Index			*			*			*			*			*			*	
*Macrobenthos			*			*			*			*			*			*	

[1]Substrate collected at each cross section

Table VIII. Morphology and Hydraulic Monitoring Summary
Little Sugar Creek Stream Restoration Site (EEP Project #141)

Parameter		Cross Section 1						Cross Section 2						Cross Section 3					
		Riffle						Pool						Riffle					
Dimension	Units	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5
BF Width	ft	46.3	47.6	47.6	48.9	48.58	51.46	66.5	71.4	64.8	74.6	72.93	46.44	45.3	46.1	46.3	46.9	41.36	36.32
Floodprone Width	ft	67	71.3	69.5	101.6	82.64	89.69	106	109.6	110.3	106	113.95	110.3	60.2	61.3	58.3	62.9	100.32	76.05
BF Cross Sectional Area	ft	197.3	205.7	214.7	223	229.52	291.25	235.9	253.5	236	235.6	262.77	224.19	208.2	213	213	215	174.95	146.12
BF Mean Depth	ft	4.3	4.3	4.5	4.6	4.72	5.66	3.6	3.5	3.6	3.2	3.6	4.83	4.6	4.6	4.6	4.6	4.23	4.02
BF Max Depth	ft	5.5	5.6	5.8	5.9	6.27	7.44	6.5	7.1	7	6.8	7.29	7.5	6.7	6.3	6.5	6.6	6.85	5.85
Width/Depth Ratio		10.9	11	10.6	10.7	10.3	9.1	18.7	20.1	17.8	23.3	20.3	9.6	9.8	10	10	10.2	9.8	9
Entrenchment Ratio		1.5	1.5	1.5	1.5	1.7	1.7	1.6	1.5	1.7	1.4	1.6	2.4	1.3	1.3	1.3	1.3	2.4	2.1
Bank Height Ratio		1.9	1.9	1.8	1.8	1.7	1.5	1.9	1.8	1.8	1.8	1.5	1.6	1.5	1.6	1.3	1.5	1.4	1.6
Wetted Perimeter	ft	50.1	50.5	50.9	52.4	51.83	55.76	68.8	74.3	68.5	77.6	76.56	51.67	48.5	49.2	49.5	49.8	44.93	39.82
Hydraulic radius	ft	*	4.1	4.2	4.3	4.43	5.22	3.4	3.4	3.5	3	3.43	4.34	4.3	4.3	4.3	4.3	3.89	3.67
Substrate																			
d50	mm	1.1	*	15.8	26.1	16	40.27	0.31	*	1.54	0.6	0.5	15.69	0.19	*	1.71	2.9	9.7	18.06
d84	mm	2.8	*	93.8	107.5	63	62.64	2.3	*	36.61	1.7	54.5	54.5	4.7	*	47.47	7.6	128	64.99

Parameter		Cross Section 4						Cross Section 5						Cross Section 6					
		Pool						Riffle						Pool					
Dimension	Units	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5
BF Width	ft	68.7	63.7	56.44	61.2	50.46	61.47	52.3	53.9	56	53	58.69	42.46	79.5	85.2	79.5	85.1	76.88	91.69
Floodprone Width	ft	100.7	104.8	88.4	99.8	72.6	90.3	81.3	81.06	92.6	86.9	97.33	56.26	140.4	145	131.2	144	145.15	148.53
BF Cross Sectional Area	ft	223.6	219.9	204.8	188.4	188.4	220	222.2	236.6	223.9	228.3	220.95	114.98	273.7	284.6	284.3	286.3	256.91	269.62
BF Mean Depth	ft	3.3	3.5	3.6	3.1	3.73	3.58	4.3	4.4	4	4.3	3.76	2.71	3.4	3.3	3.6	3.4	3.34	2.94
BF Max Depth	ft	6.6	6.8	6.5	6.6	5.69	6.86	6.9	7.2	7.4	7.8	7.73	5.19	7.8	8.2	7.7	8.3	7.84	7.78
Width/Depth Ratio		21.1	18.5	15.6	19.7	13.5	17.2	12.3	12.3	14	12.3	15.6	15.7	23.1	25.5	22.2	25	23	31.2
Entrenchment Ratio		1.5	1.7	1.6	1.6	1.4	1.5	1.6	1.5	1.7	1.6	1.7	1.3	1.8	1.7	1.7	1.7	1.9	1.6
Bank Height Ratio		2.0	2.0	1.8	2	1.9	1.8	1.7	1.6	1.4	1.6	1.7	3.1	2.1	2.0	1.9	1.9	1.9	1.8
Wetted Perimeter	ft	72.8	67.9	59.9	66.4	54.49	65.63	59.3	58.1	60.1	57	62.38	45.58	83.2	88.1	82.3	88.6	81.01	95.36
Hydraulic radius	ft	3.1	3.2	3.4	2.8	3.46	3.35	3.8	4.1	3.7	4	3.54	2.52	3.3	3.2	3.5	3.2	3.17	2.83
Substrate																			
d50	mm	0.24	*	4.52	1.2	11.3	32	0.52	*	11.15	59.3	11.3	1.8	0.06	*	0.79	0.8	0.1	1
d84	mm	1.4	*	29.99	26.9	128	74.05	2	*	151.9	291.3	230	135.6	0.2	*	1.56	1.8	171	199

Parameter		Cross Section 7						Cross Section 8						Cross Section 9					
		Riffle						Riffle						Pool					
Dimension	Units	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5
BF Width	ft	68.4	66.5	70	69.3	60.15	59.27	59.5	59.7	60.75	61	57.14	56.87	59.8	59.9	66.5	62.4	65.01	64.21
Floodprone Width	ft	85.9	84	91.1	85	91.93	80.2	75.7	76.6	82.1	78.6	74.81	73.65	96.4	96.5	95.3	105	105.3	105.28
BF Cross Sectional Area	ft	239.2	214.1	213.8	233.7	264.71	167.6	219.7	219.9	221.3	219.7	181.27	176.52	235.3	250.5	247.6	244.4	277.27	280.65
BF Mean Depth	ft	3.5	3.2	3.1	3.4	4.4	2.83	3.7	3.7	3.6	3.6	3.17	3.1	3.9	4.2	3.7	3.9	4.26	4.37
BF Max Depth	ft	5.02	5.02	4.3	4.4	5.4	3.65	4.8	5	4.9	4.8	4.23	4.01	9.6	9.5	9	9.5	8.36	8.53
Width/Depth Ratio		19.5	20.6	22.9	20.4	13.7	20.9	16.1	16.2	16.7	16.9	18	18.3	15.2	14.3	17.8	16	15.3	14.7
Entrenchment Ratio		1.3	1.3	1.3	1.2	1.5	1.4	1.3	1.3	1.4	1.3	1.3	1.3	1.6	1.6	1.4	1.7	1.6	1.6
Bank Height Ratio		2.1	2.1	2.3	2.4	1.8	2.8	2.2	2.2	1.5	2	2.6	2.7	1.7	1.7	1.7	1.7	1.6	1.6
Wetted Perimeter	ft	70.8	68.2	71.5	70.7	63.39	60.74	61.3	61.4	62.3	63.1	59.19	58.38	66.6	67.3	70.2	69	71.28	71.35
Hydraulic radius	ft	3.4	3.1	3	3.3	4.18	2.76	3.6	3.6	3.6	3.5	3.06	3.02	3.5	3.7	3.5	3.5	3.89	3.93
Substrate																			
d50	mm	0.53	*	17.65	66.2	30.7	43.52	0.18	*	42.64	36.2	19.3	26.13	0.85	*	1.24	1.9	7.2	31.53
d84	mm	1.5	*	55.41	135.1	73.8	45.28	1.3	*	205.33	175.8	59.4	86.29	1.5	*	15.81	16.9	41.7	49.75

Parameter		AB (2004)			MY-01 (2005)			MY-02 (2006)			MY-03 (2007)			MY-04 (2008)			MY-05 (2009)		
Pattern		Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth	ft	105	236	153	103	304	184	118	225	150	118	225	150	118	225	150	118	225	150
Radius of Curvature	ft	72	232	148	126	195	159	90	392	154	90	392	154	90	392	154	90	392	154
Meander Wavelength	ft	403	840	531	523	837	634	411	852	501	411	852	501	411	852	501	411	852	501
Meander Width ratio		1.9	4.3	2.8	1.9	5.5	3.3	2.1	4.1	2.7	2.1	4.1	2.7	2.1	4.1	2.7	2.1	4.1	2.7
Profile											*	*	*	*	*	*	*	*	*
Riffle length	ft	15	207	66	*	*	*	26	192	54	9.9	114.9	49.6	39	83.9	64.8	31.44	131.18	78.0
Riffle slope	ft/ft	0.0027	0.0175	0.0115	0.0021	0.0026	0.0023	0.0010	0.0240	0.0080	0.0000	0.0265	0.0083	0.0011	0.0238	0.0117	0.0033	0.0133	0.0275
Pool length	ft	76	252	132	83	413	168	34	296	126	64.9	403	168.3	34.3	377.2	163.6	50.6	105.63	82.1
Pool spacing	ft	171	587	294	133	651	372	131	600	250	146	434	266	213	658	466	206	632	454
Additional Parameters											*	*	*						
Valley Length	ft	*	*	*	*	*	39.26	*	*	39.26	*	*	39.26	*	*	39.26	*	*	39.26
Channel Length	ft	*	*	*	*	*	4437	*	*	4437	*	*	4437	*	*	4437	*	*	4437
Sinuosity		*	*	*	*	*	1.13	*	*	1.13	*	*	1.13	*	*	1.13	*	*	1.13
Water Surface Slope	ft/ft	*	*	*	*	*	0.00234	0.0006	0.0095	0.0021	0.0003	0.0065	0.0029	0.0015	0.0101	0.0028	0.0014	0.0018	0.0015
BF slope	ft/ft	*	*	*	*	*	0.00234	*	*	0.0015	0.0022	0.0039	0.0031	0.0016	0.005	0.002	0.0016	0.005	0.0058
Rosgen Classification		*	*	*	*	*	B5	*	*	B5	*	*	B5	*	*	B5	*	*	B5
Habitat Index*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Macrobenthos*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

APPENDIX A
VEGETATION MONITORING DATA

Table I. Vegetative Metadata

Little Sugar Creek Stream Restoration Site (EEP Project #141)

Report Prepared By	Joshua Allen
Date Prepared	November 2009
database name	KHA-2008-A-FreedomPark141-VMD-v210_a20081124.mdb
database location	K:\RAL_Environmental\011795 Freedom Park Monitoring FPARK\MY 2008

DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------

Metadata	This worksheet, which is a summary of the project and the project data.
Plots	List of plots surveyed.
Vigor	Frequency distribution of vigor classes.
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.
Stem Count by Plot and Spp	Count of living stems of each species for each plot; dead and missing stems are excluded.

PROJECT SUMMARY----------

Project Code	141
project Name	Freedom Park
Description	Riparian Buffer Restoration
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	24

Table II. Vegetation Vigor by Species

Little Sugar Creek Stream Restoration Site (EEP Project #141)

	Species	4	3	2	1	0	Missing
	Alnus serrulata	2	2				
	Betula nigra	49	7	2			6
	Celtis laevigata						
	Cornus amomum	11	12	5			
	Elaeagnus angustifolia						
	Fraxinus pennsylvanica	29	17	4			14
	Lagerstroemia indica						
	Liquidambar styraciflua						
	Pinus taeda						
	Quercus falcata	10	2				
	Quercus michauxii	6	6				8
	Quercus phellos	8	3	1			
	Robinia pseudoacacia						
	Salix nigra	28	11				1
	Sambucus canadensis	5	15	2		1	1
	Morus rubra	12	4				
	Juniperus virginiana						
	Cercis canadensis						
	Liriodendron tulipifera		1			3	
	Platanus occidentalis	15		1			
	Populus deltoides	15	5	1			5
	Acer negundo	1		1			2
	Acer rubrum	8	2				6
	Unknown	6	15	2		1	
TOT:	**24**	**205**	**102**	**19**		**5**	**43**

Table III. Vegetation Damage by Species

Little Sugar Creek Stream Restoration Site (EEP Project #141)

	Species	All Damage Categories	(no damage)	Diseased	Human Trampled	Insects	Removal	Unknown	Vine Strangulation	(other damage)
	Acer negundo	12	11				1			
	Acer rubrum	18	15				3			
	Alnus serrulata	6	5							1
	Betula nigra	79	68				4		7	
	Celtis laevigata	1	1							
	Cercis canadensis	1	1							
	Cornus amomum	32	28							4
	Elaeagnus angustifolia	1	1							
	Fraxinus pennsylvanica	71	61				7		3	
	Juniperus virginiana	1	1							
	Lagerstroemia indica	1	1							
	Liquidambar styraciflua	10	10							
	Liriodendron tulipifera	5	3	1				1		
	Morus rubra	23	23							
	Pinus taeda	1	1							
	Platanus occidentalis	20	20							
	Populus deltoides	32	28						4	
	Quercus falcata	13	12						1	
	Quercus michauxii	21	17				4			
	Quercus phellos	12	10		1				1	
	Robinia pseudoacacia	1	1							
	Salix nigra	41	40				1			
	Sambucus canadensis	30	28					2		
	Unknown	30	27			1		1	1	
TOT:	**24**	**462**	**413**	**1**	**1**	**1**	**20**	**4**	**17**	5

Table IV. Vegetation Damage by Plot

Little Sugar Creek Stream Restoration Site (EEP Project #141)

	plot	All Damage Categories	(no damage)	Diseased	Human Trampled	Insects	Removal	Unknown	Vine Strangulation	(other damage)
	141-01-0001	18	18							
	141-01-0001-year:1	16	13		1				2	
	141-01-0001-year:2	12	2				10			
	141-01-0001-year:3	12	12							
	141-01-0002	31	20						8	3
	141-01-0002-year:1	31	29							2
	141-01-0002-year:2	28	28							
	141-01-0002-year:3	23	23							
	141-01-0003	26	26							
	141-01-0003-year:1	25	22					3		
	141-01-0003-year:2	23	23							
	141-01-0003-year:3	18	18							
	141-01-0004	19	19							
	141-01-0004-year:1	17	16					1		
	141-01-0004-year:2	16	16							
	141-01-0004-year:3	12	11	1						
	141-01-0005	20	17			1			2	
	141-01-0005-year:1	21	16						5	
	141-01-0005-year:2	18	18							
	141-01-0005-year:3	15	15							
	141-01-0006	18	18							
	141-01-0006-year:1	19	19							
	141-01-0006-year:2	12	2				10			
	141-01-0006-year:3	12	12							
TOT:	**24**	**462**	**413**	**1**	**1**	**1**	**20**	**4**	**17**	**5**

Table V. Stem Count by Plot and Species
Little Sugar Creek Stream Restoration Site (EEP Project #141)

	Species	Total Stems	# plots	avg# stems	plot 141-01-0001	plot 141-01-0001-year:1	plot 141-01-0001-year:2	plot 141-01-0001-year:3	plot 141-01-0002	plot 141-01-0002-year:1	plot 141-01-0002-year:2	plot 141-01-0002-year:3	plot 141-01-0003	plot 141-01-0003-year:1	plot 141-01-0003-year:2	plot 141-01-0003-year:3	plot 141-01-0004	plot 141-01-0004-year:1	plot 141-01-0004-year:2	plot 141-01-0004-year:3	plot 141-01-0005	plot 141-01-0005-year:1	plot 141-01-0005-year:2	plot 141-01-0005-year:3	plot 141-01-0006	plot 141-01-0006-year:1	plot 141-01-0006-year:2	plot 141-01-0006-year:3
	Acer negundo	2	2	1																				1	1			
	Acer rubrum	10	4	2.5																				4	4	1	1	
	Alnus serrulata	4	4	1					1	1	1	1																
	Betula nigra	58	15	3.87	4	4		3	4	3	4	4	6	6	6	6					2	2	2	2				
	Cornus amomum	28	4	7					7	7	7	7																
	Fraxinus pennsylvanica	50	12	4.17	3	3											7	7	7	7	2	2	2	2	4	4		
	Liriodendron tulipifera	1	1	1													1											
	Morus rubra	16	8	2									1	1	1	1					3	3	3	3				
	Platanus occidentalis	16	16	1	1	1	1	1					1	1	1	1					1	1	1	1	1	1	1	1
	Populus deltoides	21	7	3					6	4	4	4									1	1	1					
	Quercus falcata	12	8	1.5													2	2	2	2	1	1	1	1				
	Quercus michauxii	12	8	1.5	2	2							1	1	1	1									2	2		
	Quercus phellos	12	12	1	1	1	1	1									1	1	1	1	1	1	1	1				
	Salix nigra	39	11	3.55	1	1		1	7	7	7	7	2	2	2	2												
	Sambucus canadensis	22	4	5.5									6	4	6	6												
	Unknown	23	11	2.09									1		1	1	1	1	1	1	4	4	4	4				
TOT:	**16**	**326**	**16**		**12**	**12**	**2**	**6**	**25**	**22**	**23**	**23**	**18**	**15**	**18**	**18**	**12**	**11**	**11**	**11**	**15**	**15**	**15**	**14**	**12**	**12**	**2**	**2**

Table VI. Vegetative Problem Areas Little Sugar Creek Stream Restoration Site (EEP Project #141)			
Feature/Issue	**Station # / Range**	**Probable Cause**	**Photo #**
2009			
Bare Bank	--	--	
Bare Bench	--	--	
Bare Floodplain	--	--	
Invasive/Exotic Populations	--	--	
2008			
Bare Bank	520 - 700 (Right Bank)	Excessive bank stresses during yearly flooding events	VP1
	520 - 700 (Left Bank)	Excessive bank stresses during yearly flooding events	
	1,690 - 1,750 (Left Bank)	Excessive bank stresses during yearly flooding events	VP2
	2,030 - 2,110 (Left Bank)	Excessive bank stresses during yearly flooding events	
	2,220 - 2,330 (Right Bank)	Excessive bank stresses during yearly flooding events	
	2,220 - 2,330 (Left Bank)	Excessive bank stresses during yearly flooding events or invasive treatment	
Bare Bench	--	--	
Bare Flood Plain	1,070 - 1,250 (Right Floodplain)	Cleared for staging area for channel maintenance	VP3
	4,000 - 4,250 (Right Floodplain)	Cleared for staging area for channel maintenance	
Invasive/Exotic Populations	--	--	
2007			
Bare Bank	100 - 350 (Right Bank)	Excessive bank stresses during yearly flooding events	
	400 - 700 (Right Bank)	Excessive bank stresses during yearly flooding events	
	750 - 775 (Right Bank)	Excessive bank stresses during yearly flooding events	
	800 - 850 (Right Bank)	Excessive bank stresses during yearly flooding events	
	930 - 950 (Right Bank)	Excessive bank stresses during yearly flooding events	
	1,690 - 1,750 (Left Bank)	Excessive bank stresses during yearly flooding events or invasive treatment	
	2,070 - 2,130 (Right Bank)	Excessive bank stresses during yearly flooding events or invasive treatment	
	2,250 - 2,600 (Left Bank)	Excessive bank stresses during yearly flooding events	
	2,280 - 2,335 (Right Bank)	Excessive bank stresses during yearly flooding events or invasive treatment	
	2,600 - 2,700 (Left Bank)	Excessive bank stresses during yearly flooding events or invasive treatment	
	3,010 - 3,070 (Left Bank)	Excessive bank stresses during yearly flooding events or invasive treatment	
	3,120 - 3,190 (Right Bank)	Excessive bank stresses during yearly flooding events or invasive treatment	
Bare Bench	--	--	
Bare Flood Plain	1,250 - 1,580 (Left Floodplain)	Cleared area exhibiting sucessional growth including invasives from local sources	
	2,065 - 2,200 (Left Bank)	Excessive bank stresses during yearly flooding events or invasive treatment	
Invasive/Exotic Populations	1,250 - 1,580 (Left Floodplain)	Cleared area exhibiting sucessional growth including invasives from local sources	
2006			
Bare Bank	410 - 1,140 (Both Banks)	Excessive bank stresses during yearly flooding events	
	1,690 - 1,750 (Left Bank)		
	2,065 - 2,350 (Both Banks)		
Bare Bench	--	--	
Bare Flood Plain	1,250 - 1,580 (Left Floodplain)	Cleared area exhibiting sucessional growth	
Invasive/Exotic Populations	35 - 1,030 (Both Banks)	Local source colonization after bank scour	
	1,240 - 1,860 (Left Bank)		
	1,250 - 1,580 (Left Floodplain)	Cleared area exhibiting sucessional growth including invasives from local sources	
	1,950 - 2,190 (Left Bank)		
	2,210 - 2,380 (Right Bank)		
	2,680 - 3,065 (Left Bank)		
	2,690 - 3,555 (Right Bank)		
	3,555 - 3,790 (Left Bank)		
2005			
Bare Bank	2,100 - 2,175	Overbank flow / Compacted soils	
	2,560 - 2,735	Overbank flow / Compacted soils	
2004			
General	2,500 - 2,800	Left bank has poor herbaceous success	
	3,100 - 3,200	Left bank has poor herbaceous success	
	3,400 - 3,500	Right bank has poor herbaceous success	
	3,700 - 4,479	Both banks have poor herbaceous success	
	Throughout	Poor hardwood tree and live stake establishment	

Table VII. Planted and Total Stem Counts
Little Sugar Creek Stream Restoration Site (EEP Project #141)

Scientific Name	Common Name	Species Type	Current Plot Data (MY5 2009)																		Annual Means								
			141-01-0001			141-01-0002			141-01-0003			141-01-0004			141-01-0005			141-01-0006			MY4 (2008)			MY3 (2007)			MY2 (2006)		
			Pw/oL	P-all	T	Pw/oL	P-all	T	Pw/oL	P-all	T	Pw/oL	P-all	T	Pw/oL	P-all	T	Pw/oL	P-all	T	Pw/oL	P-all	T	Pw/oL	P-all	T	Pw/oL	P-all	T
Acer negundo	boxelder	Tree																							1	22		1	27
Acer rubrum	red maple	Tree																	1	1		1	1		4	5		4	5
Alnus serrulata	hazel alder	Shrub Tree				1	1	1													1	1	1	1	1	1	1	1	4
Betula nigra	river birch	Tree					4	6	6	6	7			2	2	2	2				8	12	17	8	15	166	8	16	140
Celtis laevigata	sugarberry	Shrub Tree																											1
Cercis canadensis	eastern redbud	Shrub Tree																											2
Cornus amomum	silky dogwood	Shrub				7	7	9													7	7	9	7	7	23	7	7	10
Elaeagnus angustifolia	Russian olive	Shrub																											1
Fraxinus pennsylvanica	green ash	Tree											7	36		2	5					9	41		16	130		16	122
Juniperus virginiana	eastern redcedar	Tree									1												1						
Lagerstroemia indica	crapemyrtle	Shrub Tree																								1			
Liquidambar styraciflua	sweetgum	Tree									10			2									12			49			22
Liriodendron tulipifera	tuliptree	Tree												1									1					1	1
Morus rubra	red mulberry	Tree							1	1	1					3	4				1	4	5	1	4	14	1	4	11
Pinus taeda	loblolly pine	Tree																								1			
Platanus occidentalis	American sycamore	Tree		1	1			1	1	1	2					1	1		1	1	1	4	6	1	4	6	1	4	5
Populus deltoides	eastern cottonwood	Tree					4	4								1	3					5	7		5	16		7	31
Quercus falcata	southern red oak	Tree											2	2		1	1					3	3		3	4		3	3
Quercus michauxii	swamp chestnut oak	Tree								1	1											1	1		5	5		5	6
Quercus phellos	willow oak	Tree		1	1								1	1		1	1					3	3		3	3		3	3
Robinia pseudoacacia	black locust	Tree																											2
Salix nigra	black willow	Tree				7	7	7	2	2	2										9	9	9	9	10	25	9	10	10
Sambucus canadensis	Common Elderberry	Shrub Tree							6	6	9										6	6	9	4	4	8	6	6	11
Unknown		unknown							1	1	1		1	1		4	4				1	6	6		5	9	1	6	11
		Stem count	0	2	2	15	23	28	17	18	34	0	11	45	2	15	21	0	2	2	34	71	132	31	87	488	34	94	428
		size (ares)		1			1			1			1			1			1			6			6			6	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02			0.15			0.15			0.15	
		Species count	0	2	2	3	5	6	6	7	9	0	4	7	1	8	8	0	2	2	8	14	17	7	15	18	8	16	21
		Stems per ACRE	0	80.9	80.9	607	931	1133	688	728	1376	0	445	1821	80.9	607	850	0	80.9	80.9	229	479	890	209	587	3291	229	634	2887

VQ1: Vegetation Quad 1
Taken: 2005

VQ1: Vegetation Quad 1
Taken: 10/19/2006

VQ1: Vegetation Quad 1
Taken: 10/16/2007

VQ1: Vegetation Quad 1
Taken: 11/03/2008

VQ1: Vegetation Quad 1
Taken: 2009

VQ2: Vegetation Quad 2
Taken: 2005

VQ2: Vegetation Quad 2
Taken: 10/19/2006

VQ2: Vegetation Quad 2
Taken: 10/16/2007

VQ2: Vegetation Quad 2
Taken: 11/03/2008

VQ2: Vegetation Quad 2
Taken: 2009

VQ3: Vegetation Quad 3
Taken: 2005

VQ3: Vegetation Quad 3
Taken: 10/19/2006

VQ3: Vegetation Quad 3
Taken: 10/16/2007

VQ3: Vegetation Quad 3
Taken: 11/03/2008

VQ3: Vegetation Quad 3
Taken: 2009

VQ4: Vegetation Quad 4
Taken: 2005

VQ4: Vegetation Quad 4
Taken: 10/19/2006

VQ4: Vegetation Quad 4
Taken: 10/16/2007

VQ4: Vegetation Quad 4
Taken: 11/03/2008

VQ4: Vegetation Quad 4
Taken: 2009

VQ5: Vegetation Quad 5
Taken: 10/19/2006

VQ5: Vegetation Quad 5
Taken: 10/16/2007

VQ5: Vegetation Quad 5
Taken: 11/03/2008

VQ5: Vegetation Quad 5
Taken: 2009

VQ6: Vegetation Quad 6
Taken: 10/19/2006

VQ6: Vegetation Quad 6
Taken: 10/16/2007

VQ6: Vegetation Quad 6
Taken: 11/03/2008

VQ6: Vegetation Quad 6
Taken: 2009

APPENDIX B
STREAM MONITORING DATA

Table B1. Stream Problem Areas
Little Sugar Creek Stream Restoration Site (EEP Project #141)

Feature Issue	Reach	Station numbers	Description	Suspected Cause	Photo number
2009					
Aggradation/Bar Formation					
Bank scour		1,700-1900	Minimal Bank Scour (Right Bank)	Excessive shear stresses	
		1.750-1800	Minimal Bank Scour (Left Bank)	Excessive shear stresses	
		2,800 - 2,950	Bank Scour (Toe of Right Bank)	Excessive shear stresses	
		3,780-3,830	Bank Scour (Right Bank)	Excessive shear stresses	
		4,100-4,175	Bank Slump (Right Bank)	Excessive shear stresses	
Engineered structures – back or arm scour Etc.		2,020 - 2,060	Stressed rip-rap clusters (both sides of channel)	Excessive shear stresses	
		3,950 - 4,140	Scour behind root wads	Excessive shear stresses	
2008					
Aggradation/Bar Formation					
Bank scour		1,410 - 1,600	Bank Scour (Both Banks)	Excessive shear stresses	
		1,710 - 1,900	Bank Scour and Slump (Right Bank)	Excessive shear stresses	SP1
		2,770 - 2,890	Bank Scour (Both Banks)	Excessive shear stresses	
		3,100 - 3,300	Bank Scour (Right Bank)	Excessive shear stresses	
		4,110 - 4,170	Bank Scour (Right Bank)	Excessive shear stresses	SP2
Engineered structures – back or arm scour Etc.		2,020 - 2,060	Stressed rip-rap clusters (both sides of channel)	Excessive shear stresses	
		3,950 - 4,140	Scour behind root wads	Excessive shear stresses	
2007					
Aggradation/Bar Formation					
Bank scour		315 - 320	Bank Scour (Left Bank)	Stormwater Drain	
		1,300 - 1,360	Bank Scour (Left Bank)	Excessive shear stresses	
		2,015 - 2,060	Bank Scour (Right Bank)	Excessive shear stresses	
		2,040 - 2,140	Bank Scour (Left Bank)	Excessive shear stresses	
		2,630 - 2,700	Bank Scour (Left Bank)	Excessive shear stresses	
		2,625 - 2,740	Scour behind toe protect (Right Bank)	Excessive shear stresses	
		4,030 - 4,070	Scour (Left Bank) - Possibly displaced root wads	Excessive shear stresses	
Engineered structures – back or arm scour Etc.		1,260	Missing header rock	Excessive shear stresses	
		2,020 - 2,060	Scour behind coir log. Stressed rip-rap clusters (both sides of channel)	Excessive shear stresses	
		2,660	Arm boulder collapse	Excessive shear stresses	
		3,950 - 4,140	Scour behind root wads	Excessive shear stresses	
2006					
Aggradation/Bar Formation					
Bank scour		945 - 1,140	Bank Scour (Both Banks)	Excessive shear stresses	
		315 - 320	Bank Scour (Left Bank)	Stormwater Drain	
		1,260 - 1,330	Bank Scour (Left Bank)	Excessive shear stresses	
		1,310 - 1,390	Bank Scour (Right Bank)	Excessive shear stresses	
		1,395 - 1,500	Bank Scour (Left Bank)	Excessive shear stresses	
		1,570 - 1,620	Bank Scour (Right Bank)	Excessive shear stresses	
		1,940 - 2,015	Bank Scour (Right Bank)	Excessive shear stresses	
		2,040 - 2,140	Bank Scour (Left Bank)	Excessive shear stresses	
		2,190 - 2,700	Bank Scour (Left Bank)	Excessive shear stresses	
		2,625 - 2,740	Scour behind toe protect (Right Bank)	Excessive shear stresses	
		3,270 - 3,340	Bank Scour (Left Bank)	Excessive shear stresses	
		3450	Scour behind toe protection (Right Bank)	Excessive shear stresses	
		4,030 - 4,070	Scour (Left Bank) - Possibly displaced root wads	Excessive shear stresses	
Engineered structures – back or arm scour Etc.		1,260	Missing header rock	Excessive shear stresses	
		1,960	Missing structure	Excessive shear stresses	
		2,660	Arm boulder collapse	Excessive shear stresses	
		3,950 - 4,140	Scour behind root wads	Excessive shear stresses	
2005					
Bank Scour		1,047 - 1,117		Excessive bank shear stress	
		1,339 - 1,394		Resultant from floodplain drainage	
		2,066 - 2,182		Excessive bank shear stress	

Table B2. Visual Morphological Stability Assessment

Little Sugar Creek Stream Restoration Site (EEP Project #141)

Feature Category		Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state			% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1	Present?	15	15		NA		100%	100%
	2	Armor stable (e.g. no displacement)?	15	15		NA		100%	
	3	Facet grade appears stable?	15	15		NA		100%	
	4	Minimal evidence of embedding/fining?	15	15		NA		100%	
	5	Length appropriate?	15	15		NA		100%	
B. Pools	1	Present? (e.g not subject to severe aggrad. or migrat.?)	15	15		NA		100%	89%
	2	Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	13	15		NA		87%	
	3	Length appropriate?	12	15		NA		80%	
C. Thalweg	1	Upstream of meander bend (run/inflection) centering?	12	12		NA		100%	100%
	2	Downstream of meander (glide/inflection) centering?	12	12		NA		100%	
D. Meanders	1	Outer bend in state of limited/controlled erosion?	9	11		NA		82%	89%
	2	Of those eroding, # w/concomitant point bar formation?	0	2		NA		0%	
	3	Apparent Rc within spec?	11	11		NA		100%	
	4	Sufficient floodplain access and relief?	11	11		NA		100%	
E. Bed General	1	General channel bed aggradation areas (bar formation)	--	--	0	/	0	100%	100%
	2	Channel bed degradation – areas of increasing down-cutting or head cutting?	--	--	0	/	0	100%	
F. Bank	2	Actively eroding, wasting, or slumping bank	--	--	5	/	525	94%	94%
G. Vanes	1	Free of back or arm scour?	17	19		NA		89%	95%
	2	Height appropriate?	19	19		NA		100%	
	3	Angle and geometry appear appropriate?	19	19		NA		100%	
	4	Free of piping or other structural failures?	17	19		NA		89%	
H. Wads/ Boulders	1	Free of scour?	29	31		NA		94%	97%
	2	Footing stable?	31	31		NA		100%	

Assessment length is 4,450 linear feet

Permanent Photo PS01
Taken: 2004

Permanent Photo PS01
Taken: 2005

Permanent Photo PS01
Taken: 11/14/2006

Permanent Photo PS01
Taken: 11/20/2007

Permanent Photo PS01
Taken On: 11/03/2008

Permanent Photo PS01
Taken On: 2009

Permanent Photo PS02
Taken: 2004

Permanent Photo PS02
Taken: 2005

Permanent Photo PS02
Taken On: 11/14/2006

Permanent Photo PS02
Taken: 11/20/2007

Permanent Photo PS02
Taken: 11/03/2008

Permanent Photo PS02
Taken: 2009

Permanent Photo PS03
Taken: 2004

Permanent Photo PS03
Taken: 2005

Permanent Photo PS03
Taken On: 11/14/2006

Permanent Photo PS03
Taken: 11/20/2007

Permanent Photo PS03
Taken: 11/03/2008

Permanent Photo PS03
Taken: 2009

Permanent Photo PS04
Taken: 2004

Permanent Photo PS04
Taken: 2005

Permanent Photo PS04
Taken On: 11/14/2006

Permanent Photo PS04
Taken: 11/20/2007

Permanent Photo PS04
Taken: 10/13/2008

Permanent Photo PS04
Taken: 2009

Permanent Photo PS05
Taken: 2004

Permanent Photo PS05
Taken: 2005

Permanent Photo PS05
Taken On: 11/14/2006

Permanent Photo PS05
Taken: 11/20/2007

Permanent Photo PS05
Taken: 10/13/2008

Permanent Photo PS05
Taken: 2009

Permanent Photo PS06
Taken: 2004

Permanent Photo PS06
Taken: 2005

Permanent Photo PS06
Taken On: 11/14/2006

Permanent Photo PS06
Taken: 11/20/2007

Permanent Photo PS06
Taken: 10/13/2008

Permanent Photo PS06
Taken: 2009

Permanent Photo PS07
Taken: 2004

Permanent Photo PS07
Taken: 2005

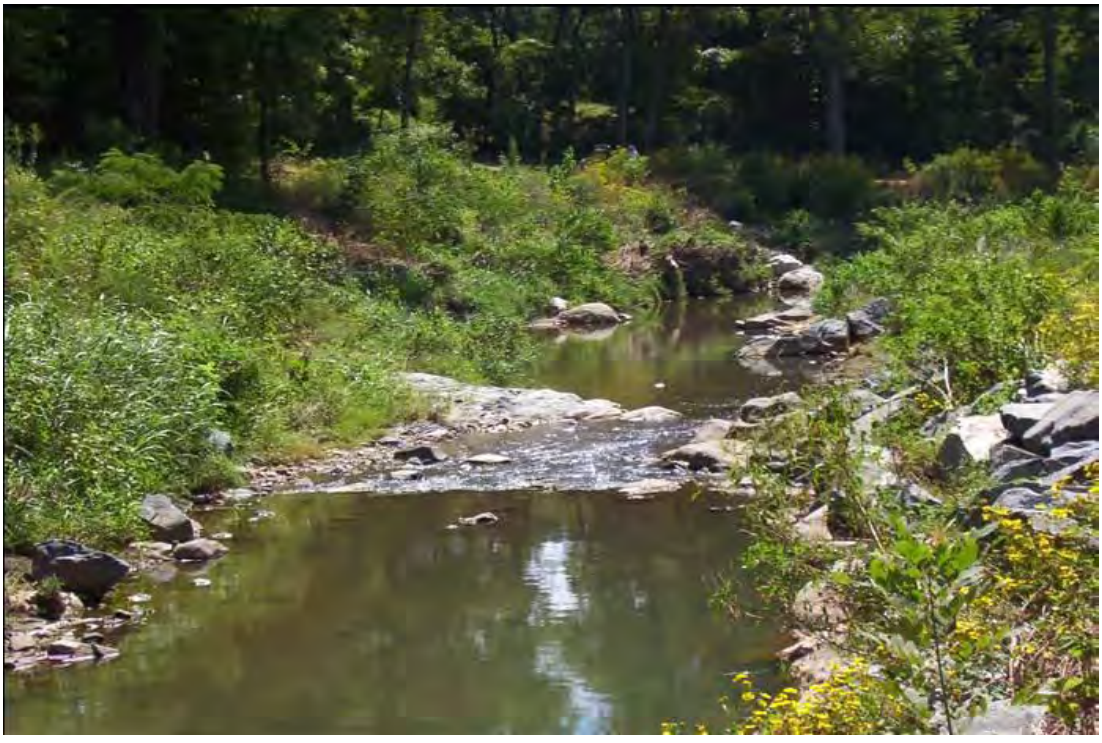
Permanent Photo PS07
Taken On: 11/14/2006

Permanent Photo PS07
Taken: 11/20/2007

Permanent Photo PS07
Taken: 10/13/2008

Permanent Photo PS07
Taken: 2009

Permanent Photo PS08
Taken: 2004



Permanent Photo PS08
Taken: 2005

Permanent Photo PS08
Taken On: 11/14/2006

Permanent Photo PS08
Taken: 11/20/2007

Permanent Photo PS08
Taken: 11/03/2008

Permanent Photo PS08
Taken: 2009

Permanent Photo PS09
Taken: 2004

Permanent Photo PS09
Taken: 2005

Permanent Photo PS09
Taken On: 11/14/2006

Permanent Photo PS09
Taken: 11/20/2007

Permanent Photo PS09
Taken: 10/13/2008

Permanent Photo PS09
Taken: 2009

Permanent Photo PS10
Taken: 2004

Permanent Photo PS10
Taken: 2005

Permanent Photo PS10
Taken On: 11/14/2006

Permanent Photo PS10
Taken: 11/20/2007

Permanent Photo PS10
Taken: 10/13/2008

Permanent Photo PS10
Taken: 2009

Permanent Photo PS11
Taken: 2004

Permanent Photo PS11
Taken: 2005

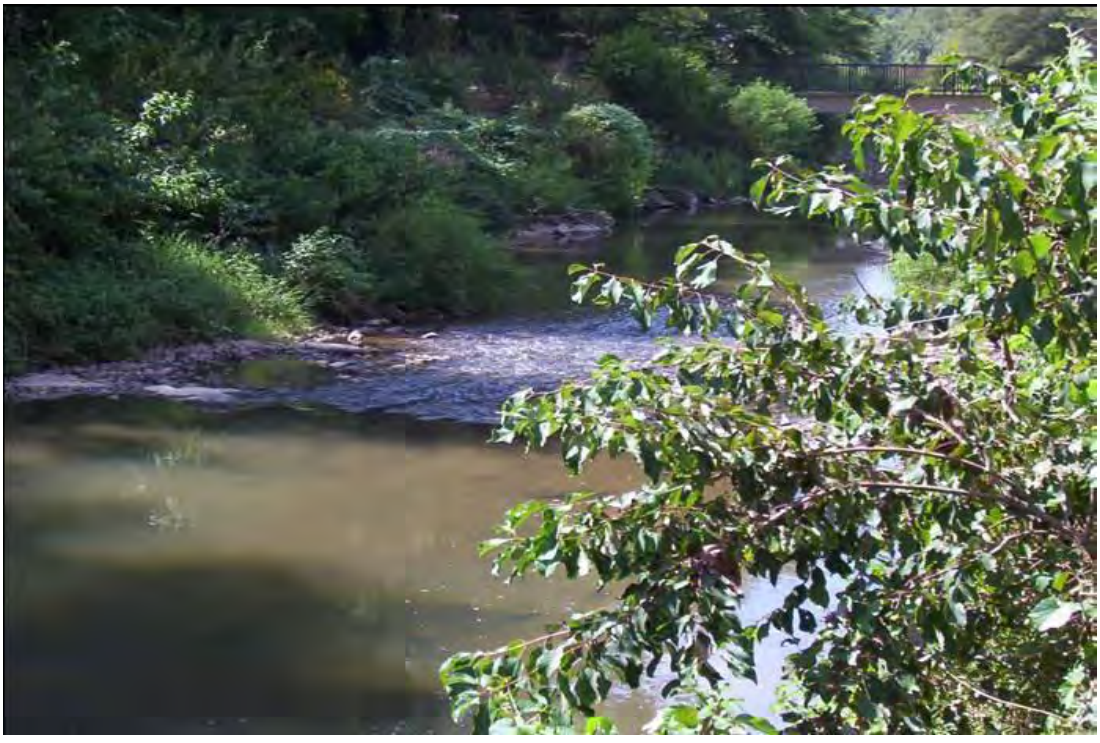
Permanent Photo PS11
Taken On: 11/14/2006

Permanent Photo PS11
Taken: 11/20/2007

Permanent Photo PS11
Taken: 10/13/2008

Permanent Photo PS11
Taken: 2009

Permanent Photo PS12
Taken: 2004



Permanent Photo PS12
Taken: 2005

Permanent Photo PS12
Taken On: 11/14/2006

Permanent Photo PS12
Taken: 11/20/2007

Permanent Photo PS12
Taken: 10/13/2008

Permanent Photo PS12
Taken: 2009

Permanent Photo PS13
Taken: 2004

Permanent Photo PS13
Taken: 2005

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Permanent Photo PS13
Taken On: 11/14/2006

Permanent Photo PS13
Taken: 11/20/2007

Permanent Photo PS13
Taken: 11/03/2008

Permanent Photo PS13
Taken: 2009

Permanent Photo PS14
Taken: 2004

Permanent Photo PS14
Taken: 2005

Permanent Photo PS14
Taken On: 11/14/2006

Permanent Photo PS14
Taken: 11/20/2007

Permanent Photo PS14
Taken: 10/13/2008

Permanent Photo PS14
Taken: 2009

Permanent Photo PS15
Taken: 2004

Permanent Photo PS15
Taken: 2005

Permanent Photo PS15
Taken On: 11/14/2006

Permanent Photo PS15
Taken: 11/20/2007

Permanent Photo PS15
Taken: 10/13/2008

Permanent Photo PS15
Taken: 2009

Permanent Photo PS16
Taken: 2004

Permanent Photo PS16
Taken: 2005

Permanent Photo PS16
Taken On: 11/14/2006

Permanent Photo PS16
Taken: 11/20/2007

Permanent Photo PS16
Taken: 10/13/2008

Permanent Photo PS16
Taken: 2009

Permanent Photo PS17
Taken: 2004

Permanent Photo PS17
Taken: 2005

Permanent Photo PS17
Taken On: 11/14/2006

Permanent Photo PS17
Taken: 11/20/2007

Permanent Photo PS17
Taken: 10/13/2008

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Permanent Photo PS18
Taken: 2004

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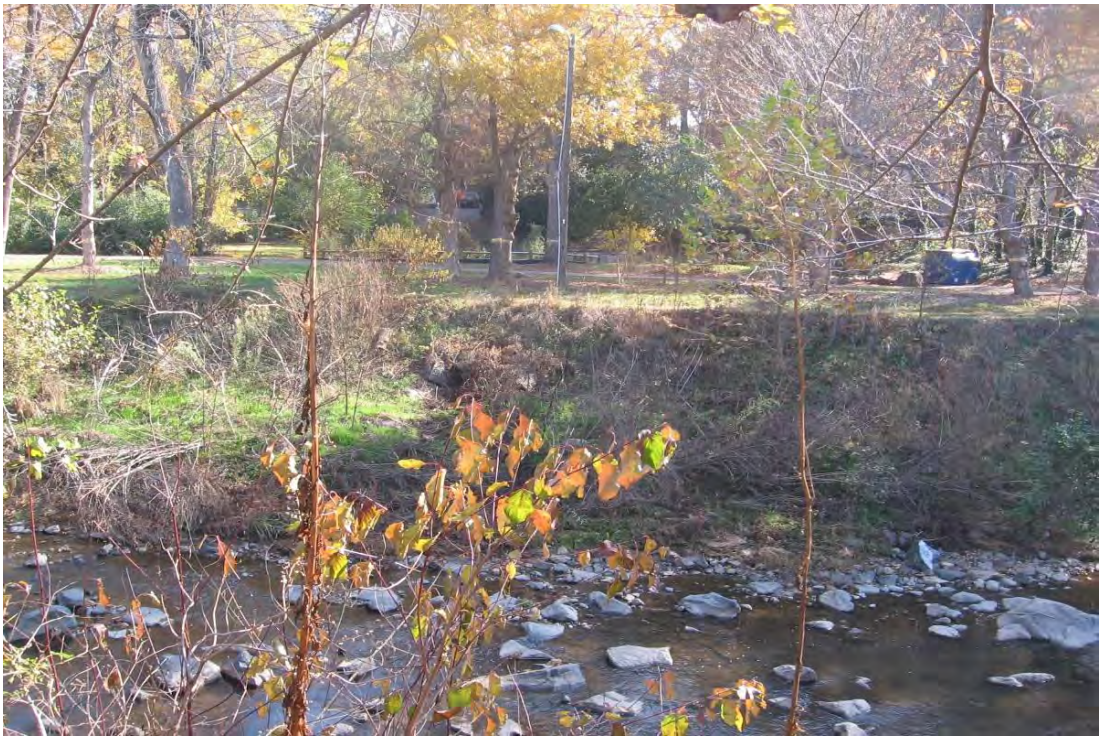
Taken: 2005

Permanent Photo PS18
Taken On: 11/14/2006



Permanent Photo PS18
Taken: 11/20/2007

Permanent Photo PS18
Taken: 11/03/2008

Permanent Photo PS18
Taken: 2009

Permanent Photo PS19
Taken: 2004

Permanent Photo PS19
Taken: 2005

Permanent Photo PS19
Taken On: 11/14/2006

Permanent Photo PS19
Taken: 11/20/2007

Permanent Photo PS19
Taken: 10/13/2008

Permanent Photo PS19
Taken: 2009

Permanent Photo PS20
Taken: 2004

Permanent Photo PS20
Taken: 2005

Permanent Photo PS20
Taken On: 11/14/2006

Permanent Photo PS20
Taken: 11/20/2007

Permanent Photo PS20
Taken: 10/13/2008

Permanent Photo PS20
Taken: 2009

Permanent Photo PS21
Taken: 2004

Permanent Photo PS21
Taken: 2005

Permanent Photo PS21
Taken On: 11/14/2006

Permanent Photo PS21
Taken: 11/20/2007

Permanent Photo PS21
Taken: 10/13/2008

Permanent Photo PS21
Taken: 2009

Permanent Photo PS22
Taken: 2004

Permanent Photo PS22
Taken: 2005

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Taken On: 11/14/2006

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Permanent Photo PS22
Taken: 10/13/2008

Permanent Photo PS22
Taken: 2009

Permanent Photo PS23
Taken: 2004

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Taken: 2005

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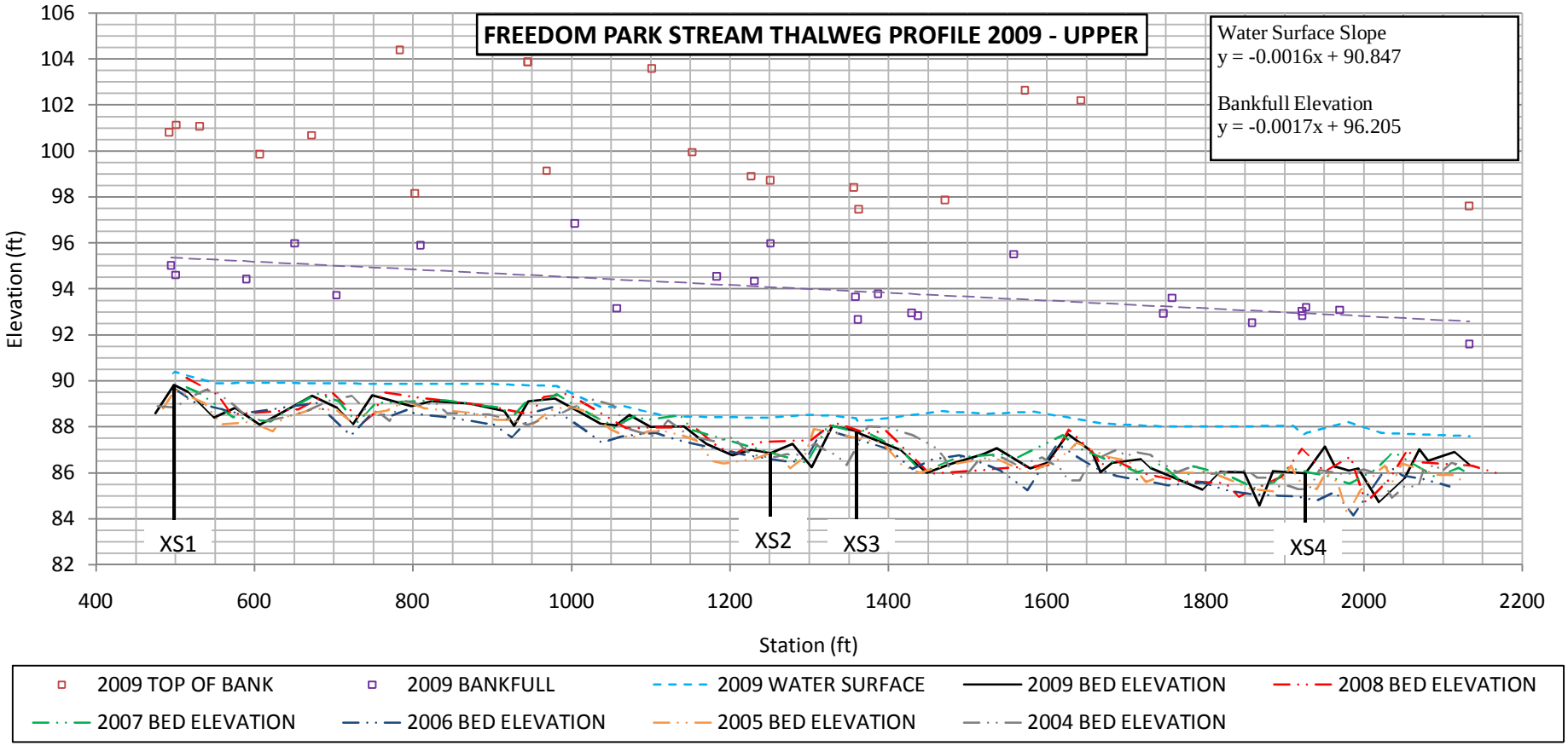
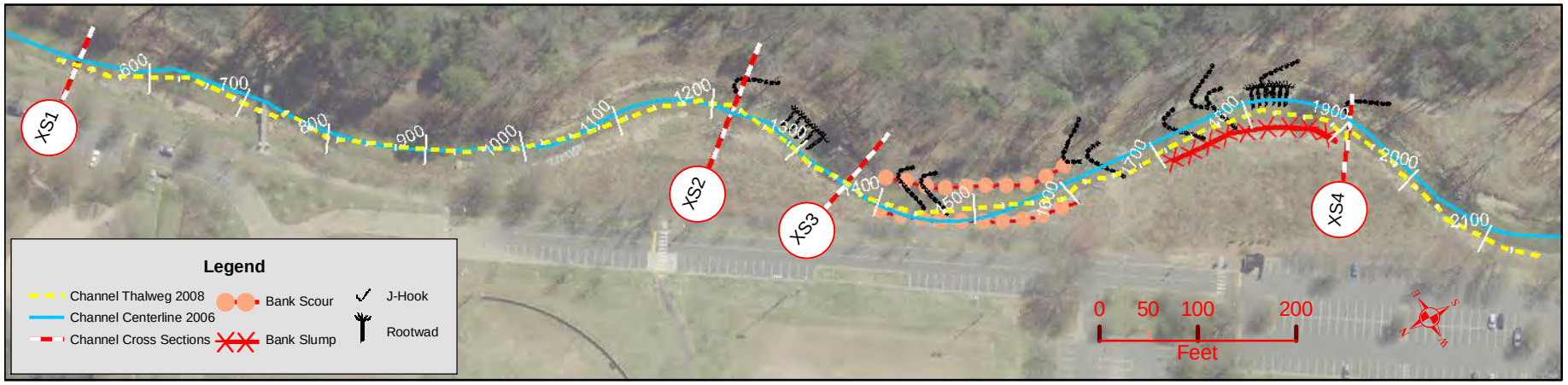
Taken: 10/13/2008

Permanent Photo PS23
Taken: 2009





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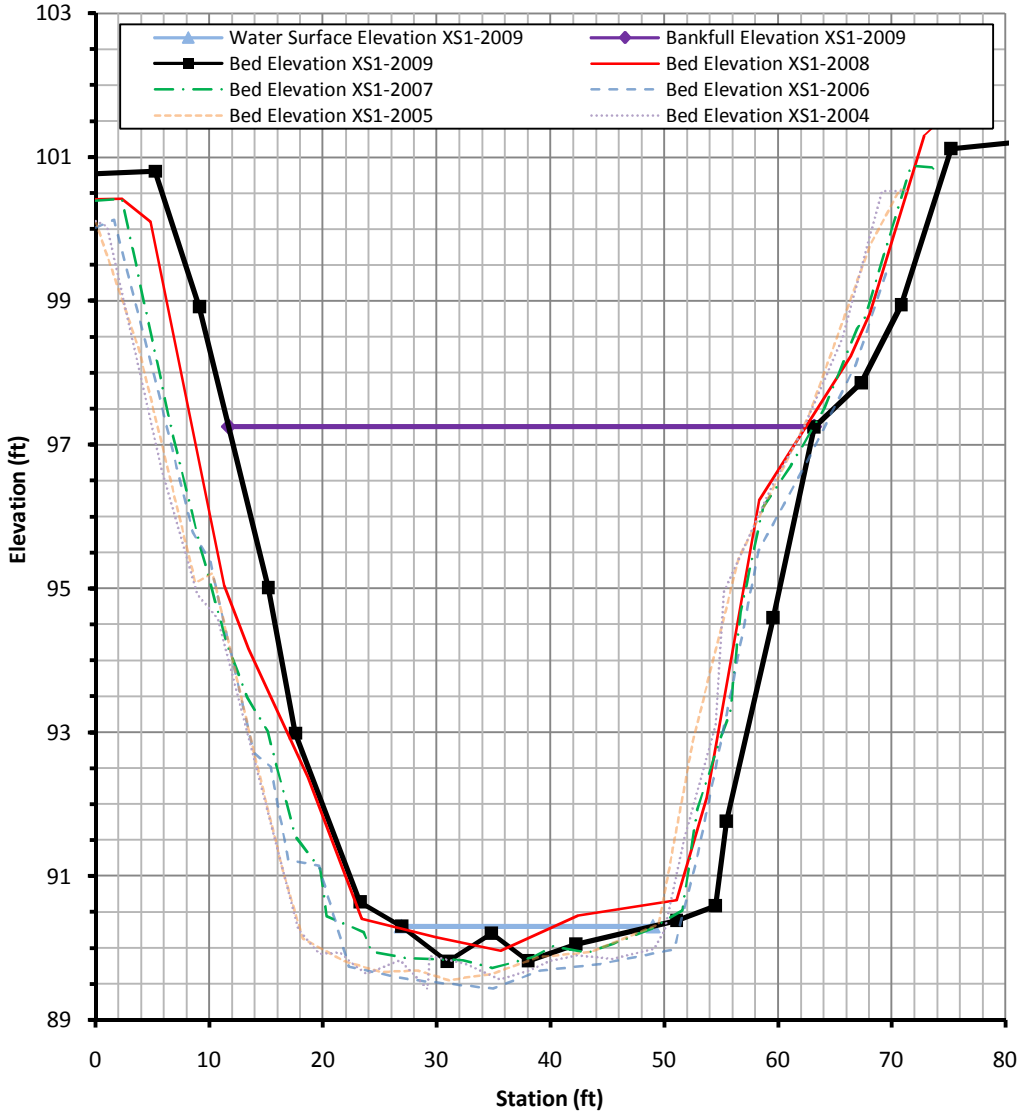
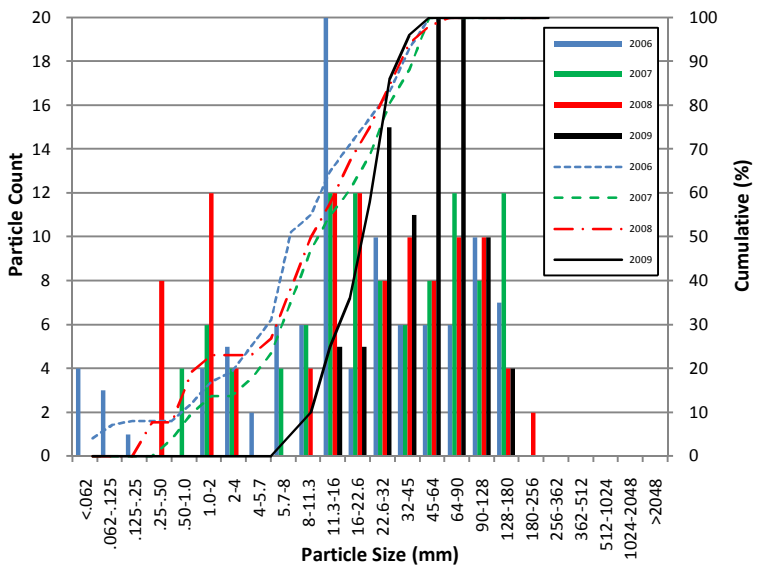
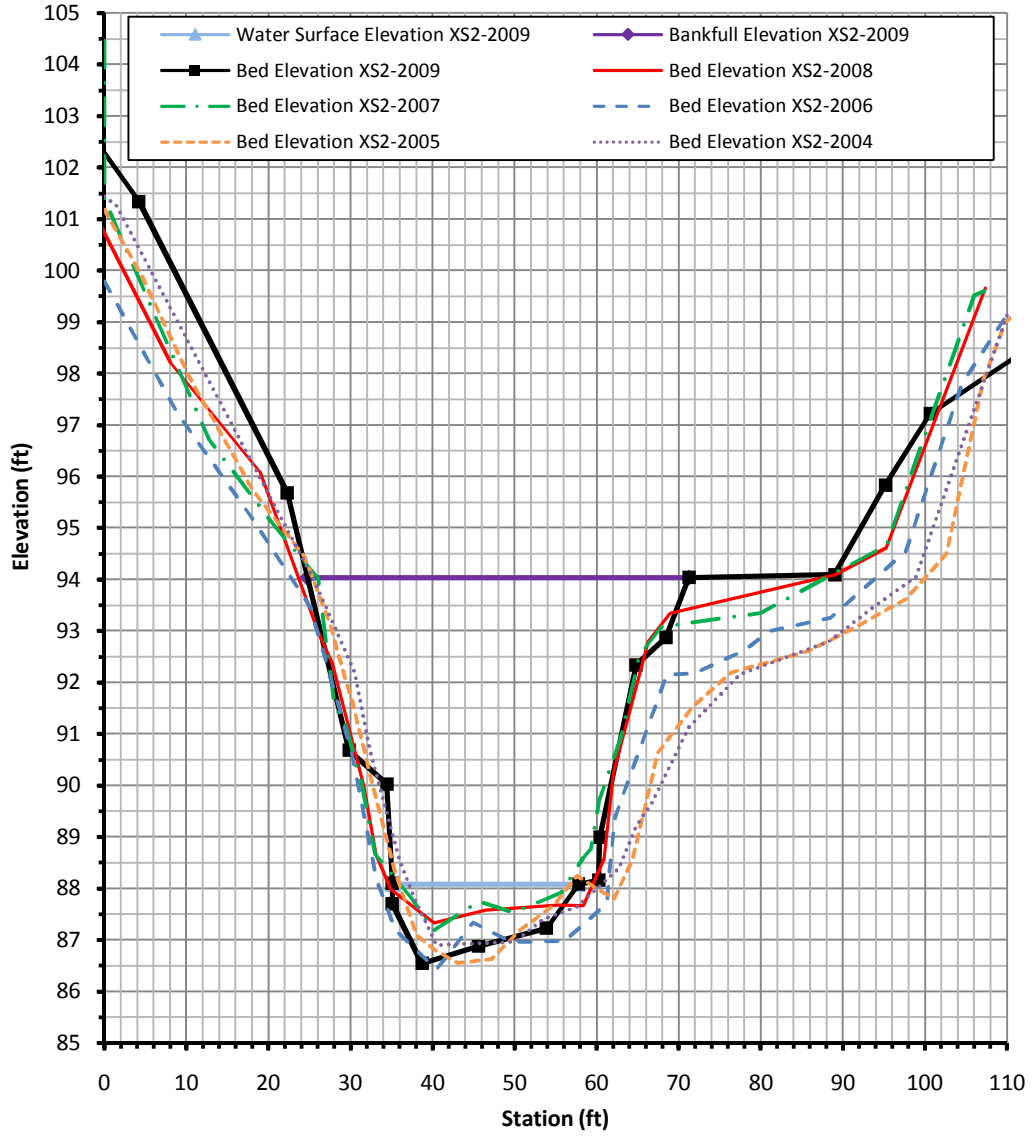
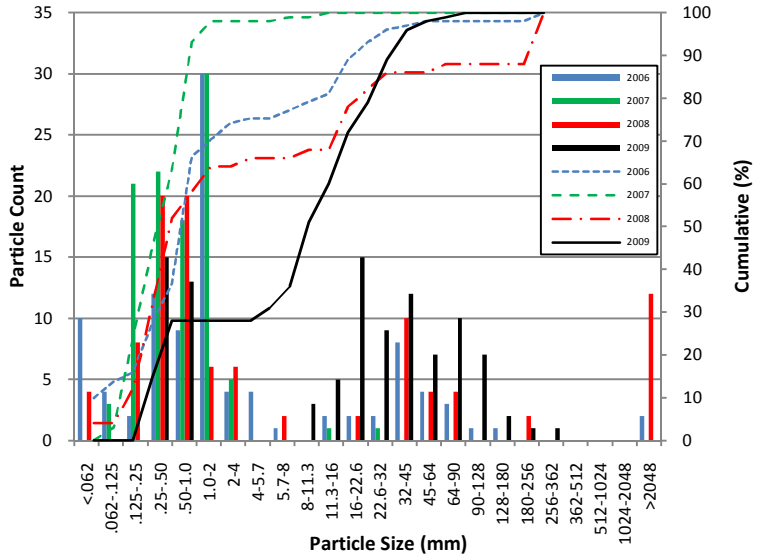




ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS1		DS	RIFFLE	54.0	33.9	6.3
XS1	2004	AB	RIFFLE	46.3	197.3	4.3
XS1	2005	MY1	RIFFLE	47.6	205.7	4.3
XS1	2006	MY2	RIFFLE	47.6	214.7	4.5
XS1	2007	MY3	RIFFLE	48.9	223.0	4.6
XS1	2008	MY4	RIFFLE	48.6	229.5	4.7
XS1	2009	MY5	RIFFLE	51.5	291.3	5.7

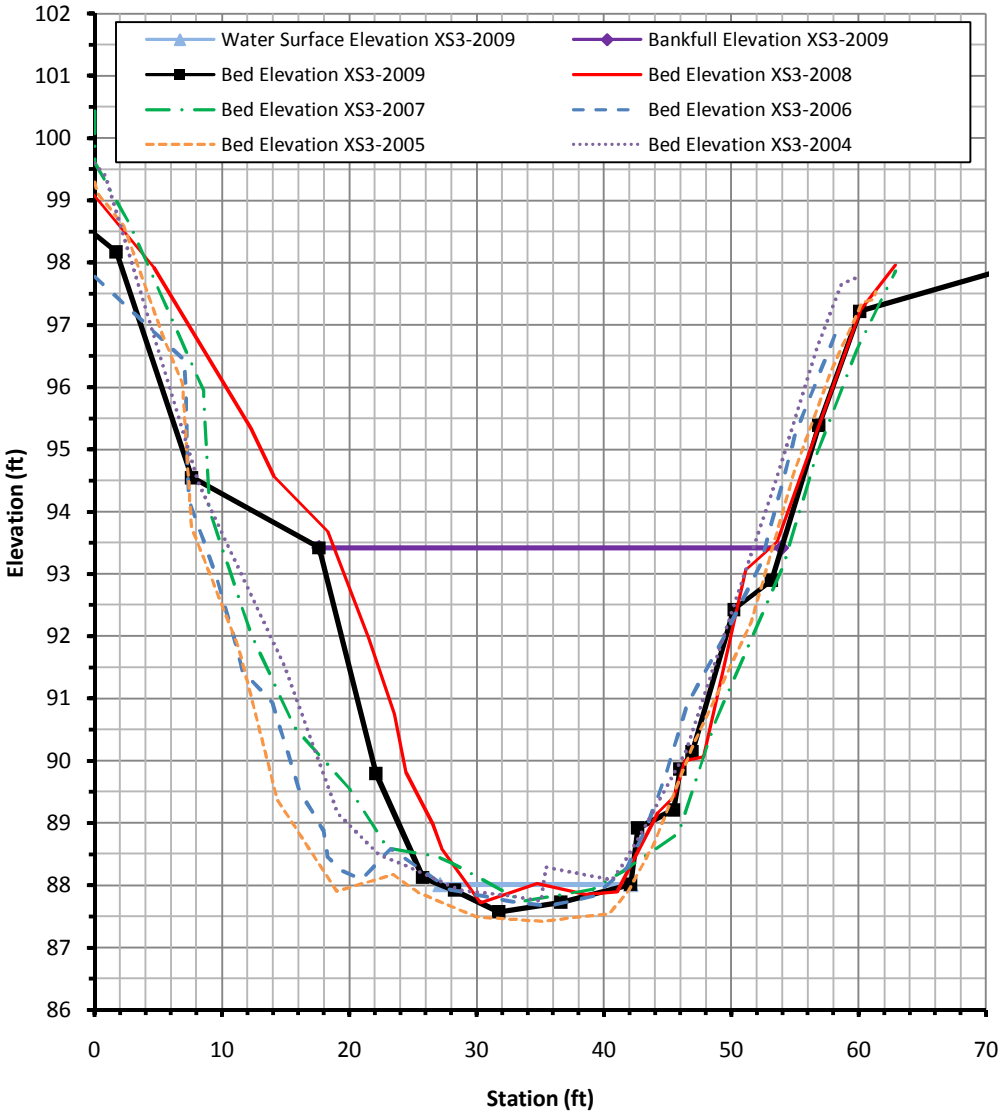
ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS1	2006	MY2	11.14	66.60
XS1	2007	MY3	18.84	75.96
XS1	2008	MY4	16.00	62.78
XS1	2009	MY5	40.27	62.64

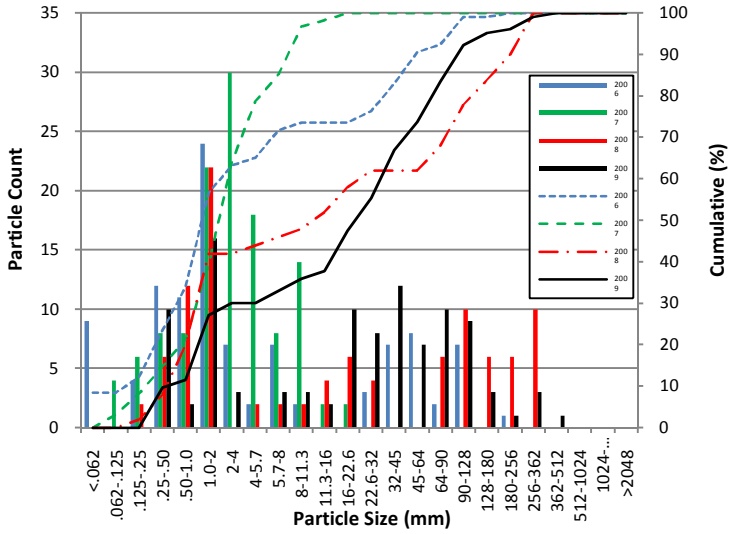




ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS2		DS	POOL	54.0	339.0	6.3
XS2	2004	AB	POOL	66.5	235.9	3.6
XS2	2005	MY1	POOL	71.4	253.5	3.5
XS2	2006	MY2	POOL	64.8	236.0	3.6
XS2	2007	MY3	POOL	74.6	235.6	3.2
XS2	2008	MY4	POOL	72.9	262.8	3.6
XS2	2009	MY5	POOL	46.4	224.2	4.8

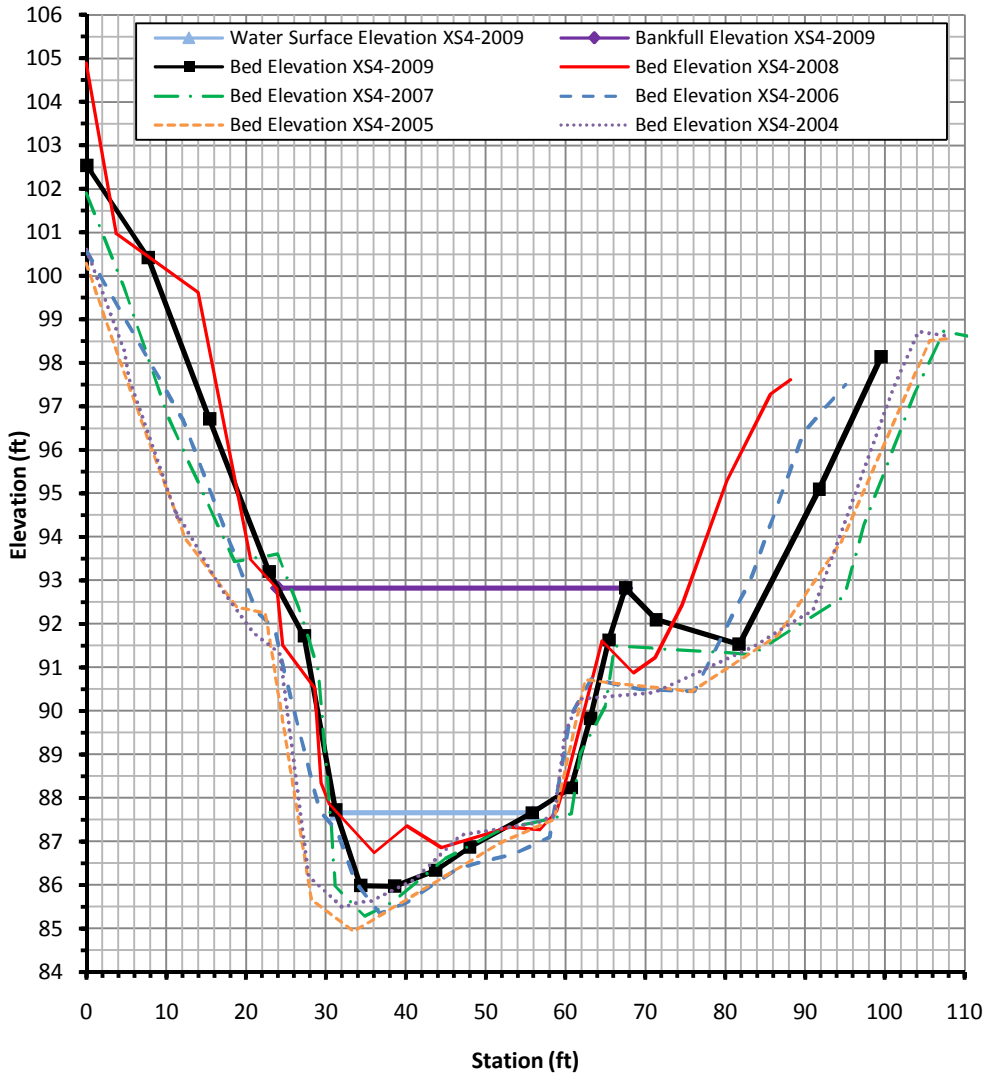
ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS2	2006	MY2	0.73	25.94
XS2	2007	MY2	0.31	0.85
XS2	2008	MY4	0.48	54.50
XS2	2009	MY5	15.69	54.50

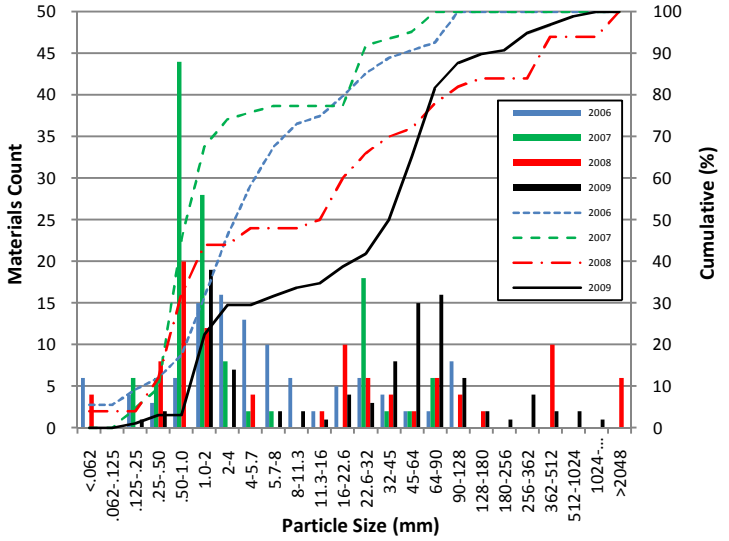




ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS3		DS	RIFFLE	54.0	339.0	6.3
XS3	2004	AB	RIFFLE	45.3	208.2	4.6
XS3	2005	MY1	RIFFLE	46.1	213.0	4.6
XS3	2006	MY2	RIFFLE	46.3	213.0	4.6
XS3	2007	MY3	RIFFLE	46.9	215.0	4.6
XS3	2008	MY4	RIFFLE	41.36	175.0	4.2
XS3	2009	MY5	RIFFLE	36.3	146.1	4.0

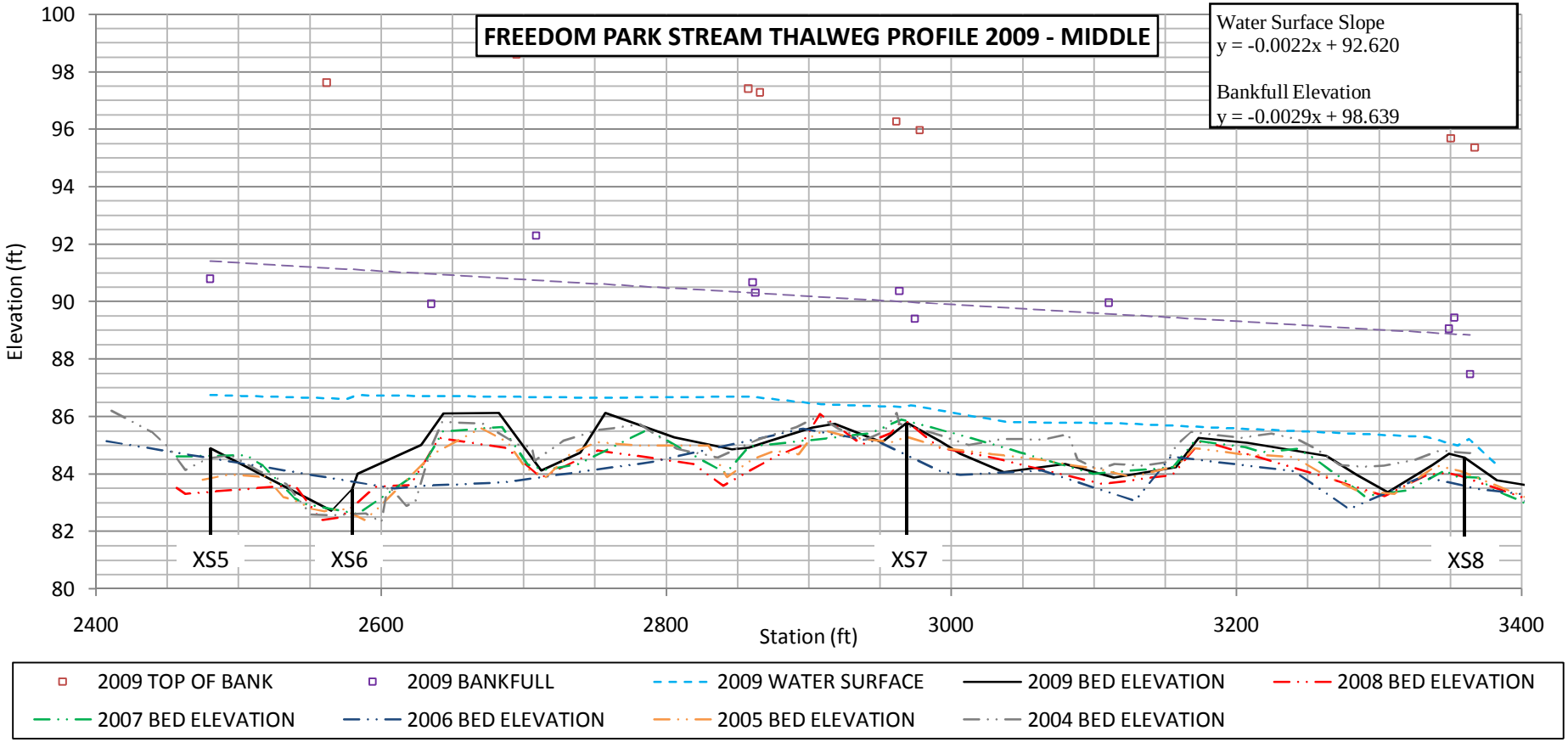
ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS3	2006	MY2	0.85	33.69
XS3	2007	MY3	1.43	5.38
XS3	2008	MY4	9.65	128.00
XS3	2009	MY5	18.06	64.99

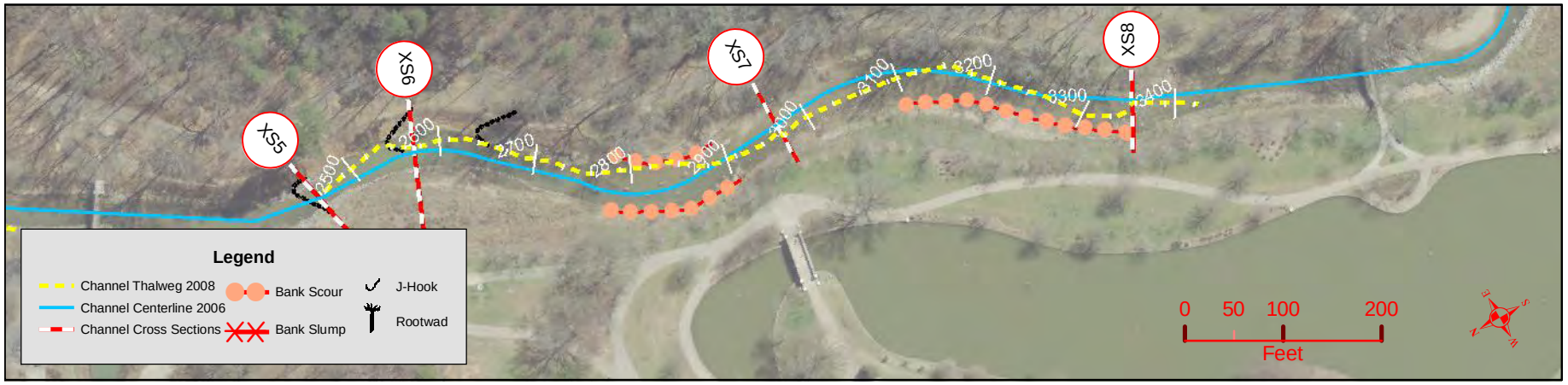




ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS4		DS	RIFFLE	54.0	339.0	6.3
XS4	2004	AB	RIFFLE	68.7	223.6	3.3
XS4	2005	MY1	RIFFLE	63.7	219.9	3.5
XS4	2006	MY2	RIFFLE	56.4	204.8	3.6
XS4	2007	MY3	RIFFLE	61.2	188.4	3.1
XS4	2008	MY4	RIFFLE	50.5	188.4	3.7
XS4	2009	MY5	RIFFLE	61.5	220.0	3.6

ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS4	2006	MY2	2.62	21.19
XS4	2007	MY3	0.61	18.99
XS4	2008	MY4	11.30	128.00
XS4	2009	MY5	32.00	74.05





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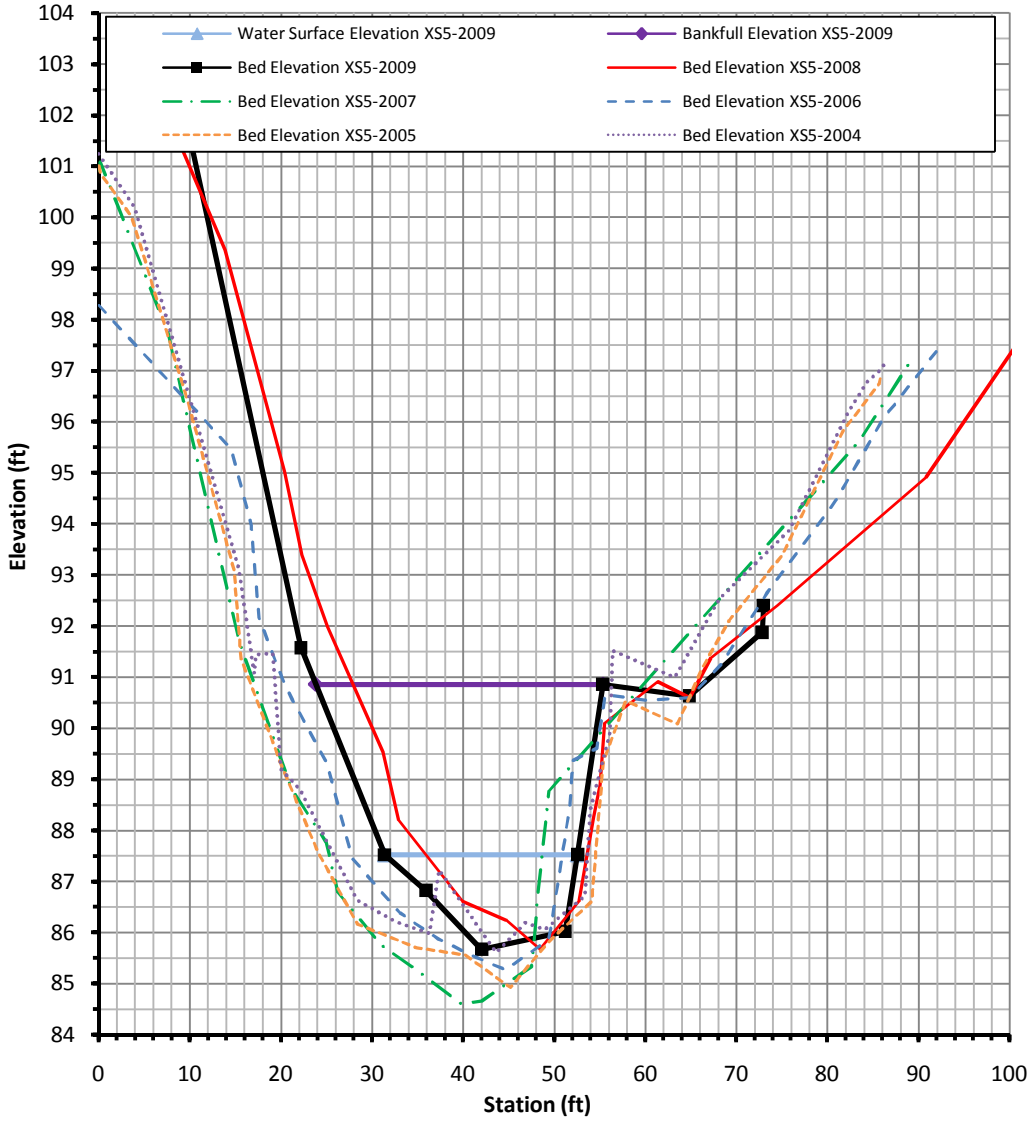
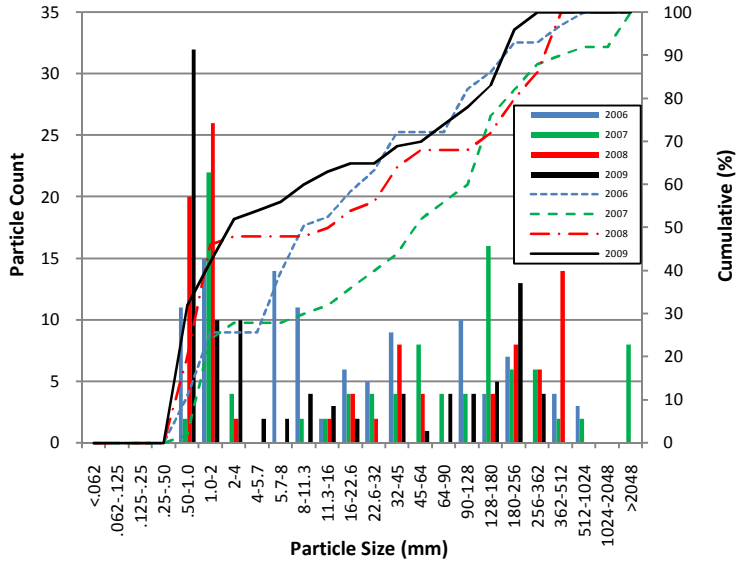
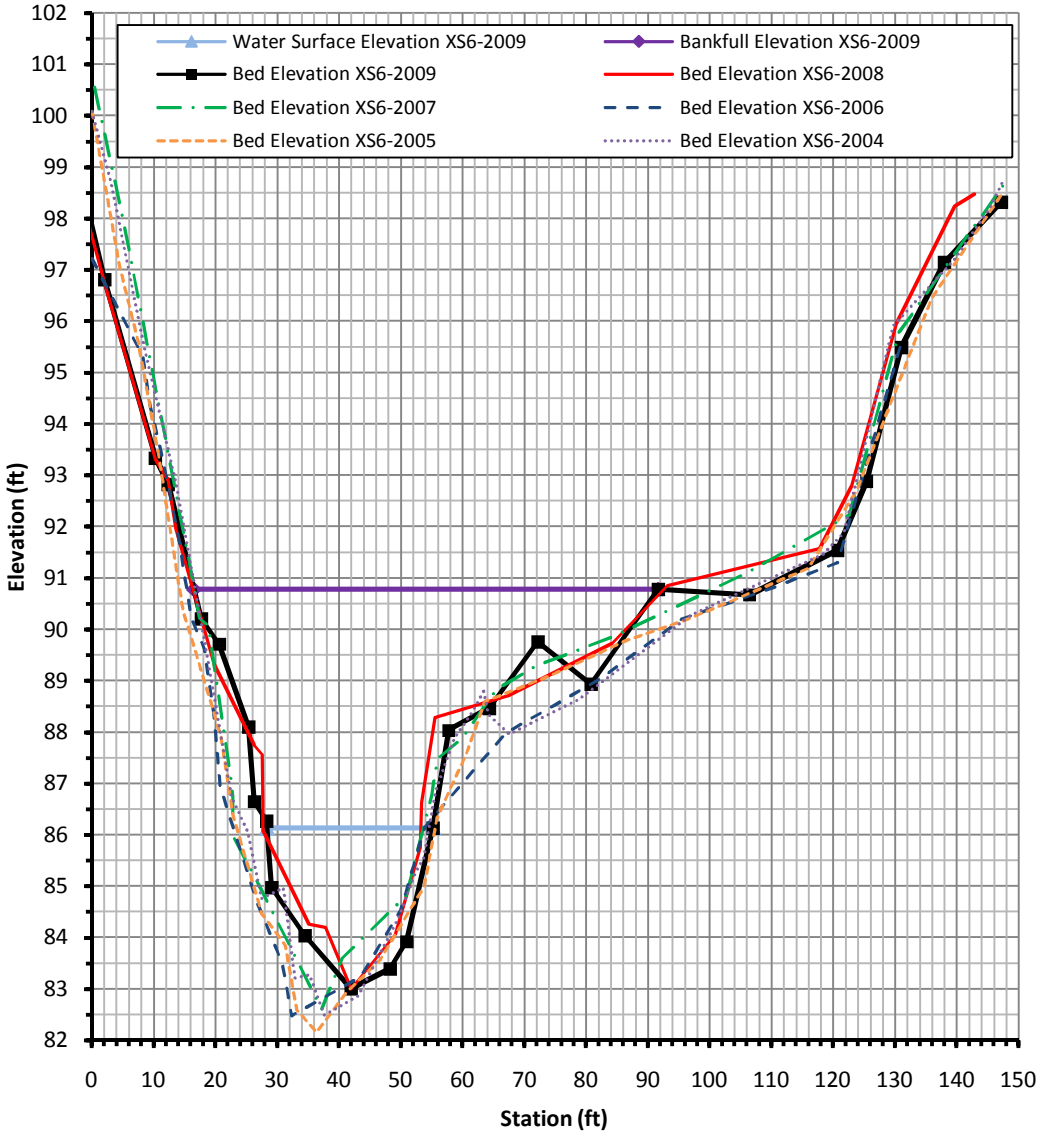
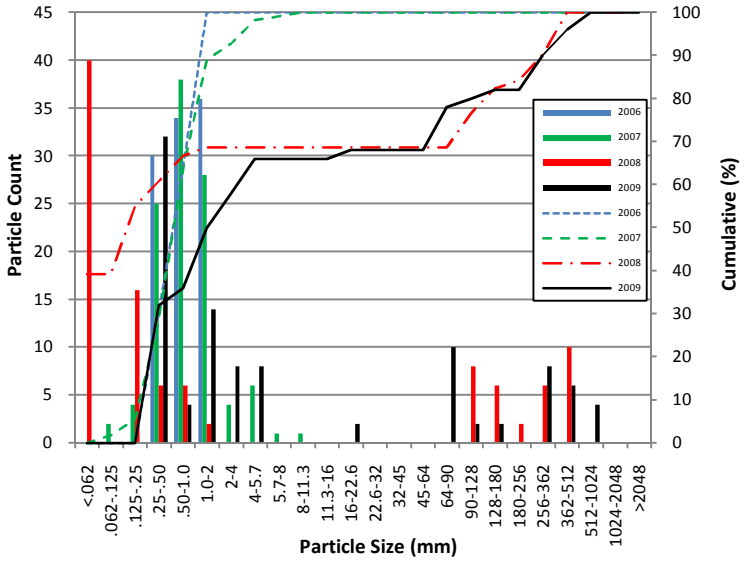




ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS5		DS	RIFFLE	54.0	339.0	6.3
XS5	2004	AB	RIFFLE	52.3	222.2	4.3
XS5	2005	MY1	RIFFLE	53.9	236.6	4.4
XS5	2006	MY2	RIFFLE	56.0	223.9	4.0
XS5	2007	MY3	RIFFLE	53.0	228.3	4.3
XS5	2008	MY4	RIFFLE	58.7	221.0	3.8
XS5	2009	MY5	RIFFLE	42.5	115.0	2.7

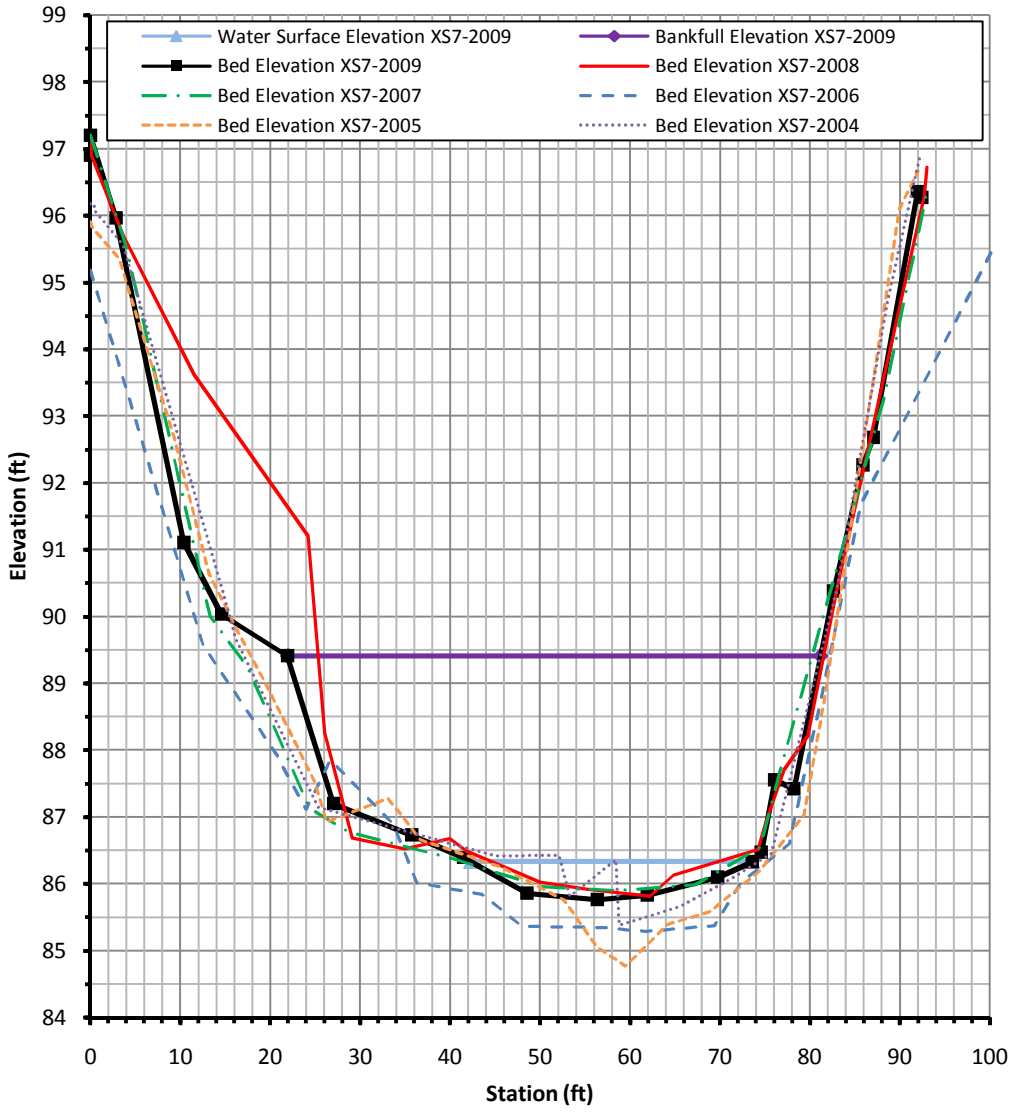
ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS5	2006	MY2	7.90	107.48
XS5	2007	MY3	41.75	205.33
XS5	2008	MY4	11.30	230.67
XS5	2009	MY5	1.80	135.60

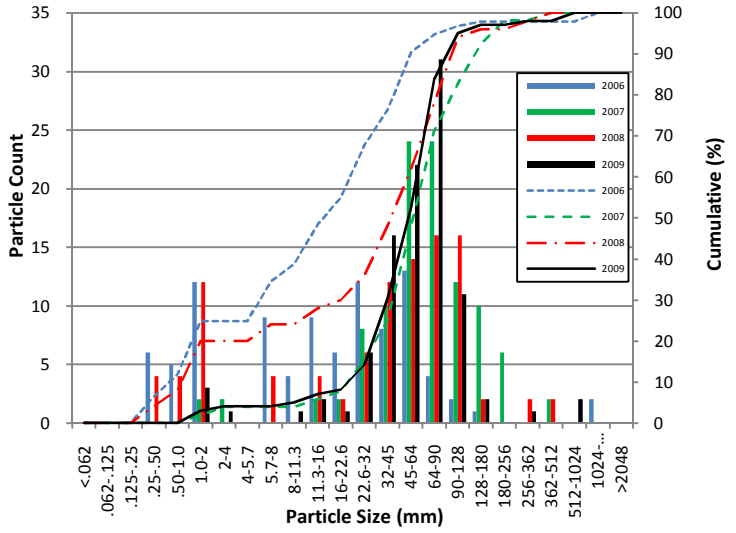




ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS6		DS	POOL	54.0	339.0	6.3
XS6	2004	AB	POOL	79.5	273.7	3.4
XS6	2005	MY1	POOL	85.2	284.6	3.3
XS6	2006	MY2	POOL	79.5	284.3	3.6
XS6	2007	MY3	POOL	85.1	286.3	3.4
XS6	2008	MY4	POOL	76.9	256.9	3.3
XS6	2009	MY5	POOL	91.7	269.6	2.9

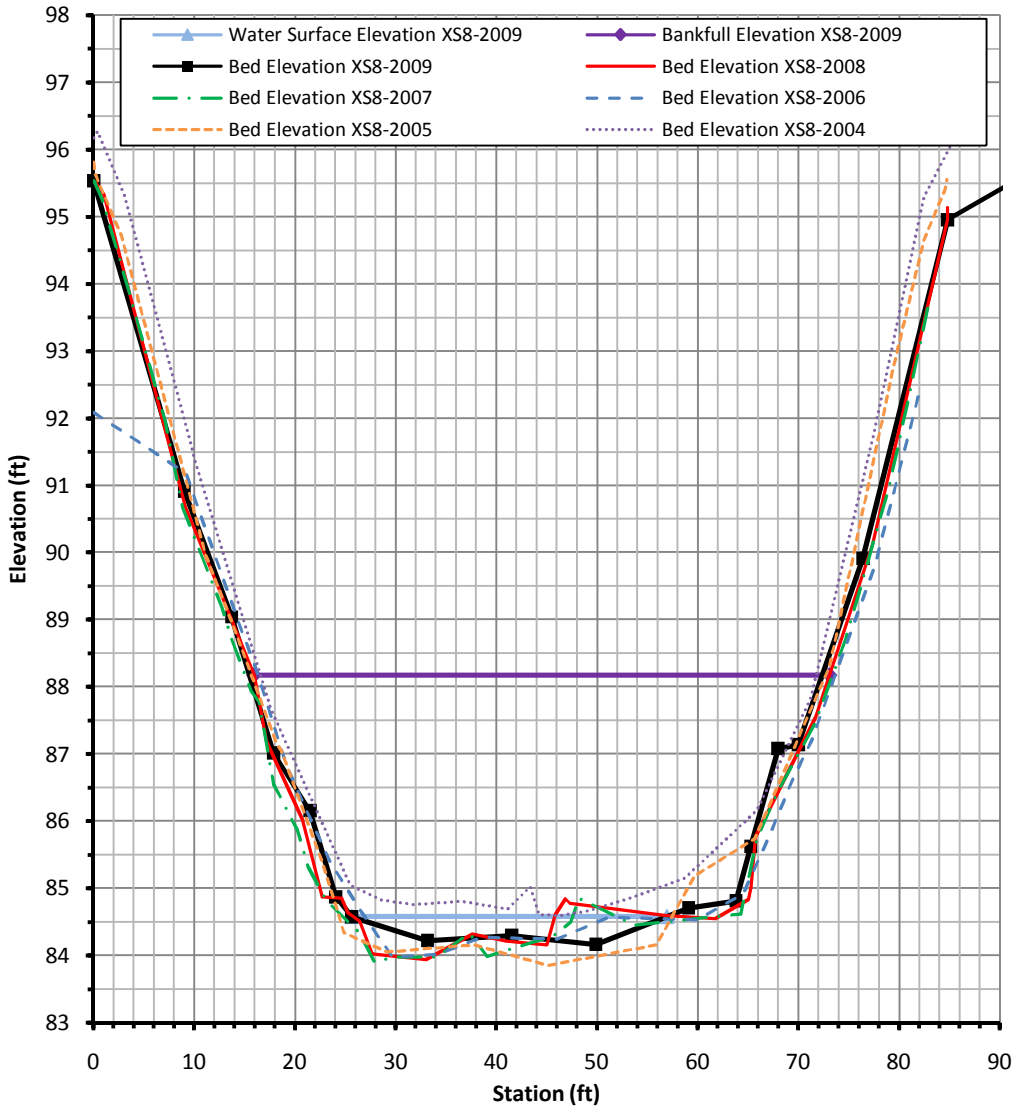
ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS6	2006	MY2	0.40	0.78
XS6	2007	MY3	0.40	0.90
XS6	2008	MY4	0.11	171.68
XS6	2009	MY5	1.00	199.00

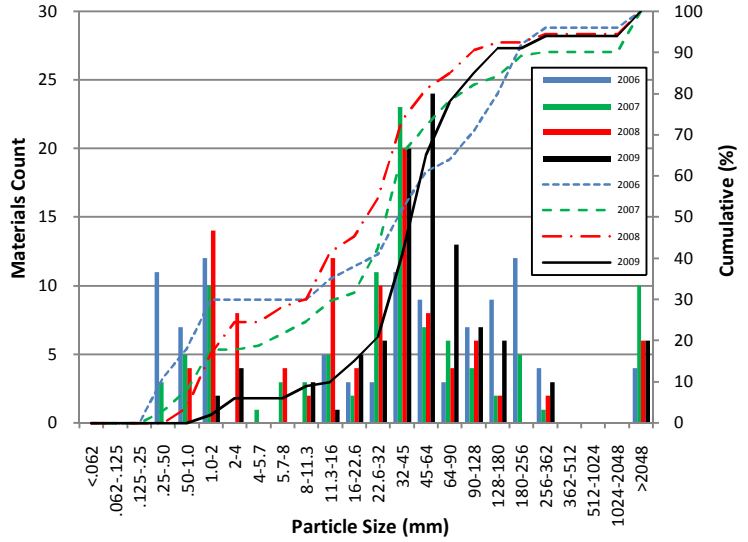




ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS7		DS	RIFFLE	54.0	339.0	6.3
XS7	2004	AB	RIFFLE	68.4	239.2	3.5
XS7	2005	MY1	RIFFLE	66.5	214.1	3.2
XS7	2006	MY2	RIFFLE	70.0	213.8	3.1
XS7	2007	MY3	RIFFLE	69.3	233.7	3.4
XS7	2008	MY4	RIFFLE	60.2	264.7	4.4
XS7	2009	MY5	RIFFLE	59.3	157.6	2.8

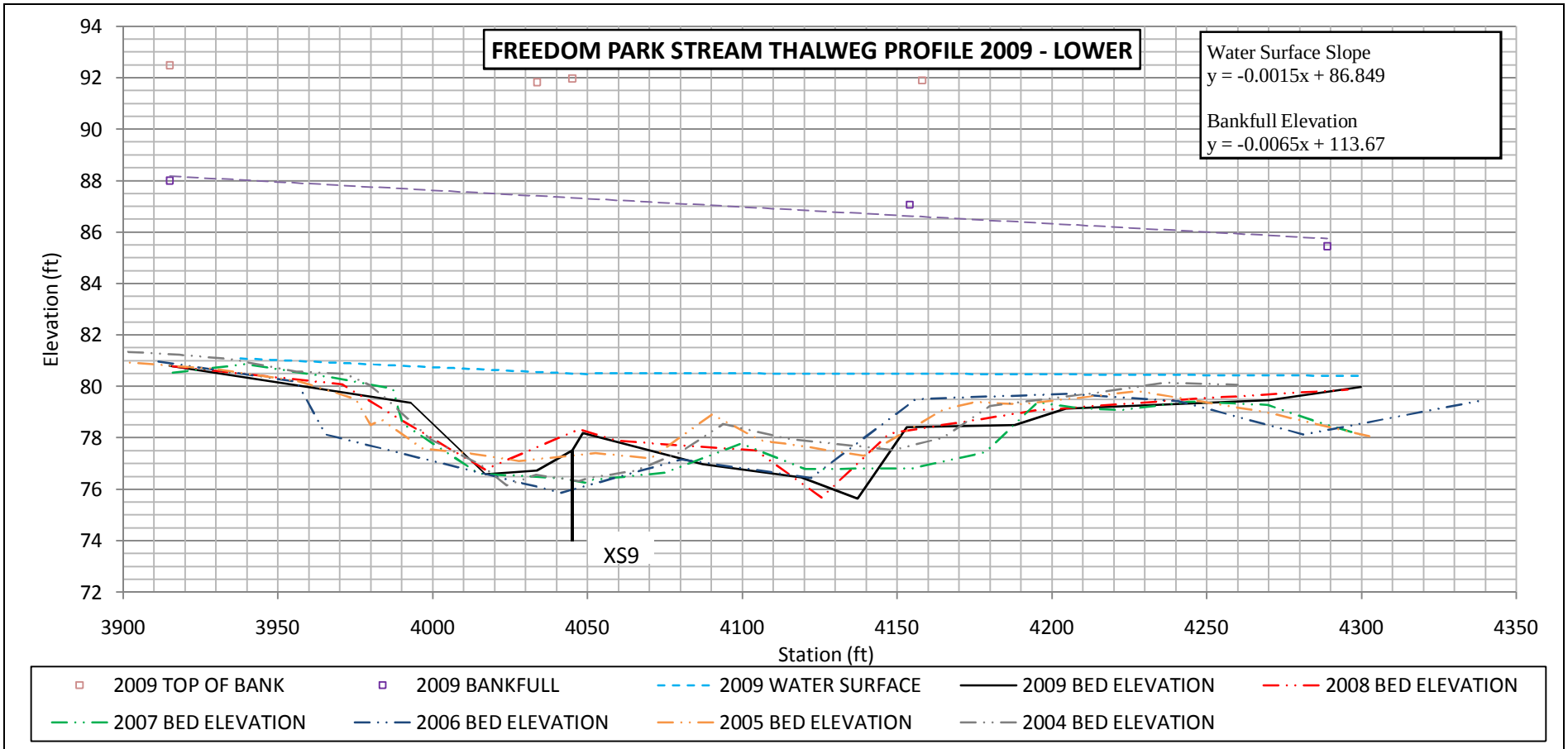
ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS7	2006	MY2	12.48	39.12
XS7	2007	MY3	46.58	95.17
XS7	2008	MY4	30.66	73.75
XS7	2009	MY5	43.52	45.28

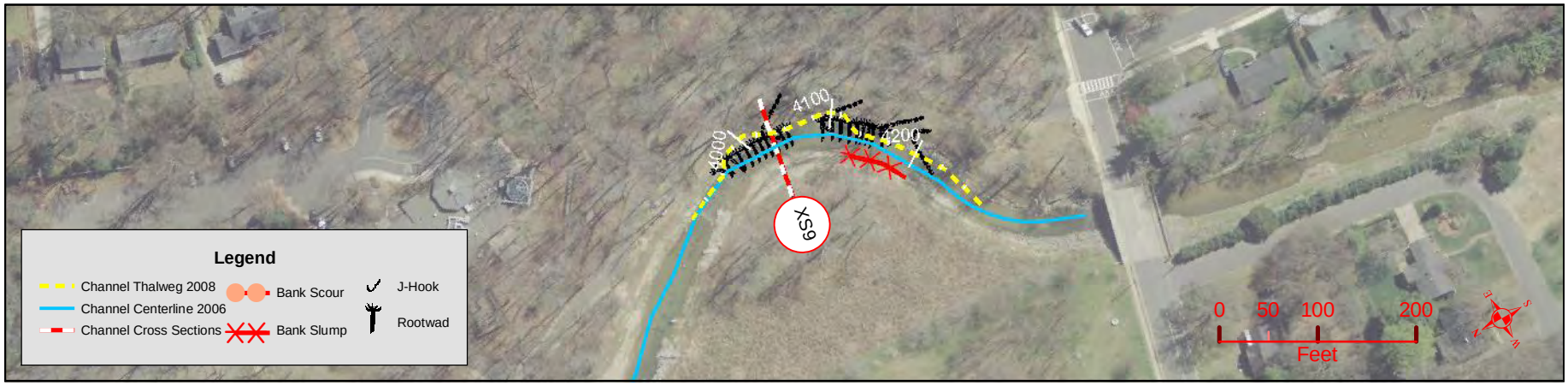




ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS8		DS	RIFFLE	54.0	339.0	6.3
XS8	2004	AB	RIFFLE	59.5	219.7	3.7
XS8	2005	MY1	RIFFLE	59.7	219.9	3.7
XS8	2006	MY2	RIFFLE	60.8	221.3	3.6
XS8	2007	MY3	RIFFLE	61.0	219.7	3.6
XS8	2008	MY4	RIFFLE	57.1	181.3	3.2
XS8	2009	MY5	RIFFLE	56.9	176.5	3.1

ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS8	2006	MY2	30.29	145.33
XS8	2007	MY3	25.67	124.96
XS8	2008	MY4	19.30	59.44
XS8	2009	MY5	26.13	86.29





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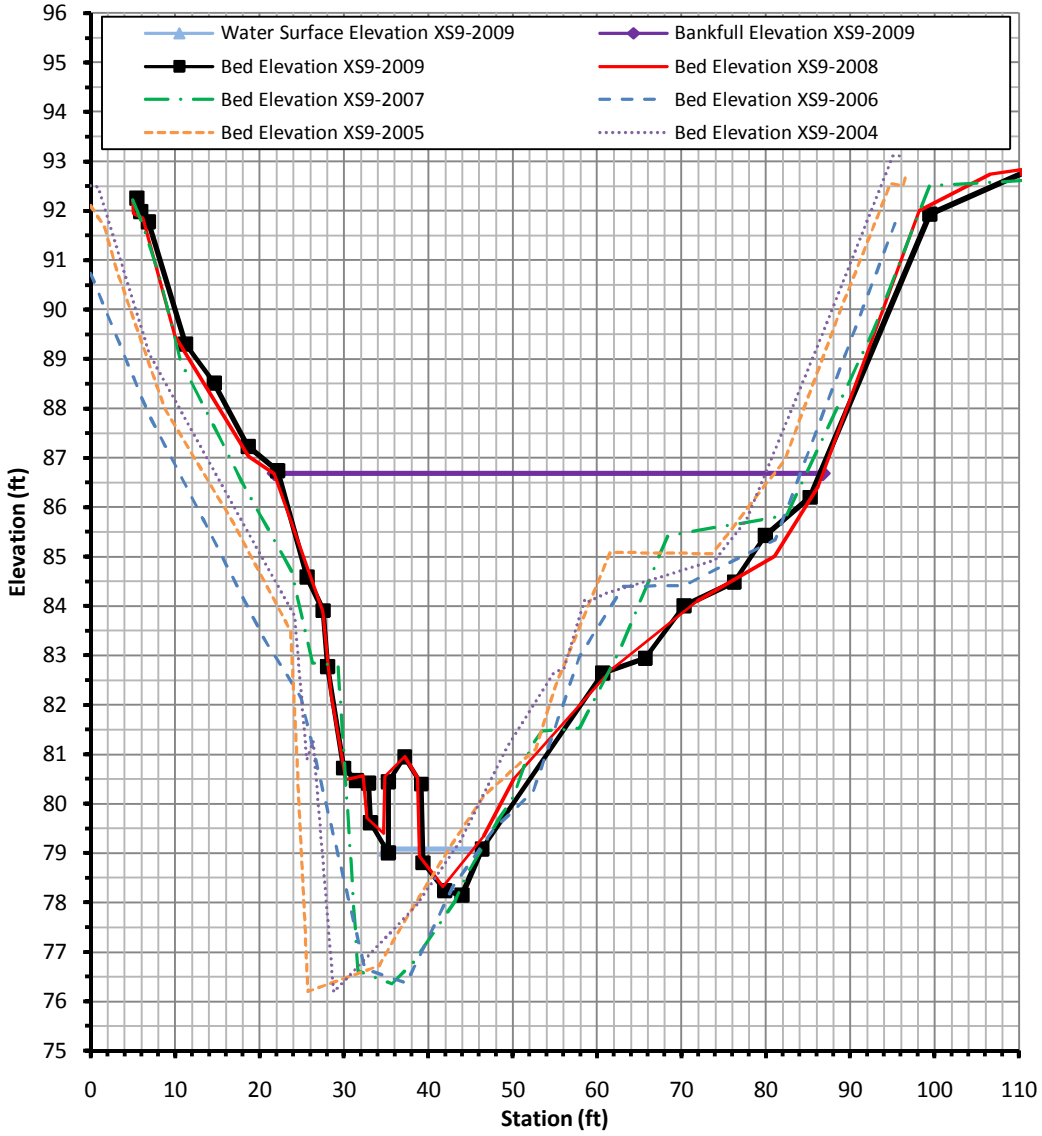

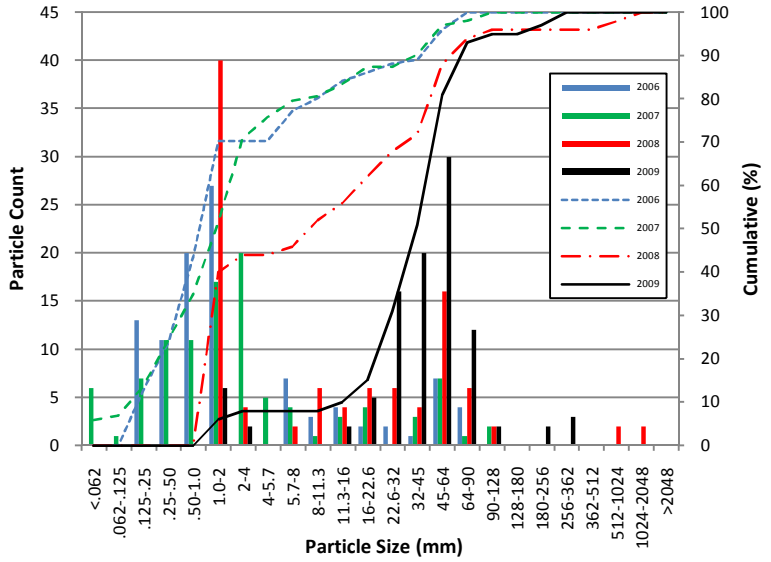

ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS9		DS	POOL	54.0	339.0	6.3
XS9	2004	AB	POOL	59.8	235.3	3.9
XS9	2005	MY1	POOL	59.9	250.5	4.2
XS9	2006	MY2	POOL	66.5	247.6	3.7
XS9	2007	MY3	POOL	62.4	244.4	3.9
XS9	2008	MY4	POOL	65.0	277.3	4.3
XS9	2009	MY5	POOL	64.2	280.7	4.4

ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS9	2006	MY2	0.62	11.17
XS9	2007	MY3	0.54	11.91
XS9	2008	MY4	7.23	41.75
XS9	2009	MY5	31.53	49.75