Big Warrior Creek Stream Restoration
2007 Final Monitoring Report
Monitoring Year Three

Ecosystem Enhancement Program Project Number 00412

Submitted to:
NCDENR-Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Prepared by:
URS Corporation – North Carolina
1600 Perimeter Park Drive, Suite 400
Morrisville, NC 27560

Project Designed by:
CDM
5400 Glenwood Ave, Suite 300
Raleigh, NC 27612

Submitted: February 26, 2007

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1.0 EXECUTIVE SUMMARY/PROJECT ABSTRACT

The Big Warrior Creek Stream Restoration Site is located in Wilkes County, North Carolina, approximately 10 miles southwest of Wilkesboro. Big Warrior Creek drains a watershed area of approximately 7.4 square miles, beginning on the Wilkes and Alexander County line. Two major tributaries (Mountain Creek and Unnamed Tributary) flow into the main channel of Big Warrior Creek within the project reach. Sections of these two tributaries were also restored. The project restoration segments that are on the downstream property are completely fenced to exclude cattle from the creek and riparian areas.

Per the 2005 Mitigation Plan and As-Built report (CDM 2005), the objectives of the Big Warrior Creek Stream Restoration Project include the following: reduce bank erosion, exclude cattle from the stream and riparian zone, improve water quality, establish a floodplain at a lower elevation, enhance in-stream habitat, improve functional and aesthetic value of the riparian corridor, and preserve existing beneficial channel, floodplain features, and riparian vegetation.

URS did not receive a Restoration Plan for the site. URS assumes from site visits and survey work that Big Warrior Creek originally had failing banks, unstable plan form and cross sectional geometry, little or no riparian buffer, cattle access to the creek, and several unstable creek crossings.

The Priority II restoration involved converting the impaired channels into stable channels that meander for a total of 11,035 linear feet. Rock cross-vanes, single arm vanes, staked log toe protection, and root wads were incorporated for aquatic habitat enhancement and bed and bank stability. A riparian buffer on either side of the stream was planted using native vegetation. The cattle were fenced from the riparian area along the Unnamed Tributary, Mountain Creek, and most of Big Warrior Creek. The upstream-most portion of Big Warrior Creek is not fenced, but cattle are not present on the surrounding property. In addition, two stabilized creek crossings and two culverts were installed to allow vehicular access to different parts of the farm while limiting impacts.

The 2007 monitoring indicated that the Big Warrior Creek restoration is functioning well and even improving in some areas. The majority of the bed features appear stable, with well-developed pools in the meander bends and long riffles in the straight reaches. However, there are areas of aggradation, evidenced by grass-vegetated mid-channel bars. Some of the rock structures are failing or causing bank erosion and should be repaired. Several rootwads and log bank protectors have experienced scour behind the device. Some bank erosion continues to be present along Big Warrior Creek. A beaver dam and sign of beaver activity were observed on Big Warrior Creek during 2007 monitoring between stations 20+00 and 25+00 and 40+00 and 50+00. A small beaver dam is present at station 22+40. Measures should be taken to remove the beaver from the site. Vegetation is growing in from the sides of the channel in many areas, indicating that the system may eventually transition from a C channel to a narrower E. Mountain Creek is showing stabilization trends as the cross sections re-classified this year into an E type channel.

The planted woody vegetation is doing fair along all three reaches. The streamside and floodplain zones are generally in better health than upland areas. Streamside survival appears to be the most successful. The banks of the Unnamed Tributary are covered with a dense mat of American hogpeanut (*Amphicarpaeae bracteata*) and arrowleaf tear thumb (*Polygonum sagittata*). This may become a problem in that the herbaceous species seem to be choking much of the planted vegetation along the streambanks. Tear thumb and Hogpeanut are also evident along the mainstem and Mountain Creek; however, the presence of kudzu (*Pueraria montana* var. *lobata*) and Chinese privet (*Ligustrum sinense*) pose a more serious problem to the survival of vegetation along those reaches. Taxonomy follows 'Flora of the Carolinas, Virginia, Georgia, and surrounding areas' (Weakley 2007). Kudzu is a serious problem along the upstream reach of Big Warrior. Maintenance to control the presence and spread of kudzu is recommended. There are also several large areas of bare ground where the soil appears compacted and not conducive to natural colonization. Soil amendments and reseeding are recommended in these areas.

Fish, snails, and several aquatic insects were observed in all three reaches, and evidence of wildlife use was observed again in 2007. All of the fencing and gates along the reaches are intact and functioning properly. However, the gates at the cattle crossings are not closed, allowing cattle to cross and/or congregate in the channel at their free will. It is recommended that these gates remain closed except when cattle are being herded. The unfenced, upstream edge of the project reach (Big Warrior Creek) has a very minimal buffer on the left floodplain. The landowner along the left bank has continued to mow the adjacent field to within five feet of the edge of the water.

2.0 PROJECT BACKGROUND

2.1 PROJECT OBJECTIVES

According to the 2005 Mitigation Plan prepared by CDM and Biohabitats, the overarching goal of the project was to establish a stable planform, cross-section, and profile pattern to Big Warrior Creek and it's tributaries, with the premise that geomorphic and habitat function will follow appropriate channel form. Specific project objectives included the following:

1. Reduce bank erosion.
2. Exclude cattle from the stream and riparian zone.
3. Improve water quality.
4. Establish a floodplain at a lower elevation.
5. Enhance in-stream habitat.
6. Improve functional and aesthetic value of the riparian corridor.
7. Preserve existing beneficial channel, floodplain features, and riparian vegetation.

2.2 PROJECT STRUCTURE, MITIGATION TYPE, AND APPROACH

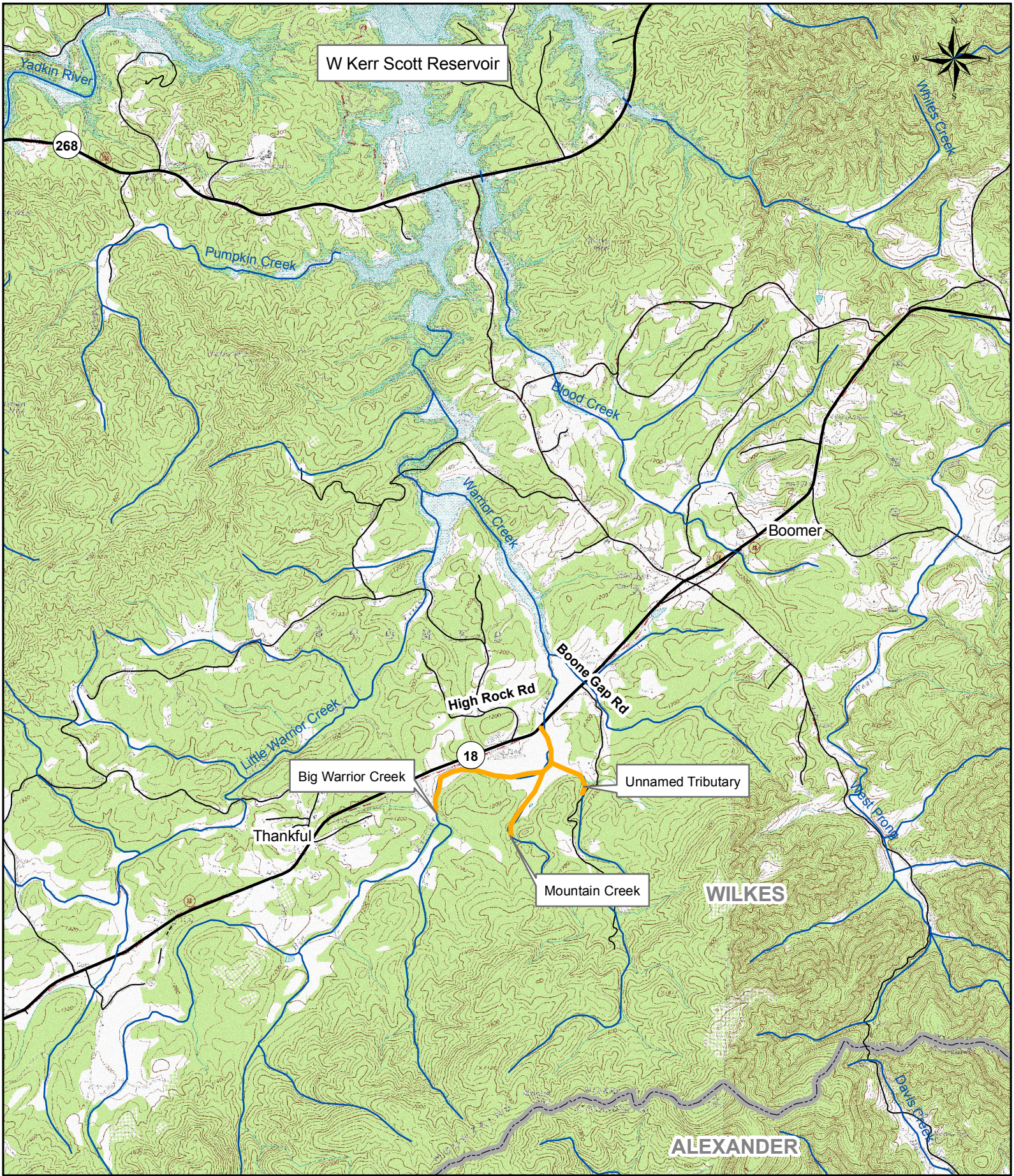
URS did not receive a Restoration Plan for the site. URS assumes from site visits and survey work that Big Warrior Creek originally had failing banks, unstable plan form and cross sectional geometry, little or no riparian buffer, cattle access to the creek, and several unstable creek crossings.

The Priority II restoration involved converting the impaired channels into stable channels that meander for a restored total of 11,035 feet as measured along the thalweg. Rock cross-vanes, single arm vanes, staked log toe protection, and root wads were incorporated for aquatic habitat enhancement and bed and bank stability. A riparian buffer was planted using native vegetation. Cattle were fenced from the riparian area. In addition, two stabilized creek crossings and two culverts were installed to allow vehicular access to different parts of the farm while limiting impacts.

2.3 LOCATION AND SETTING

The Big Warrior Creek Stream Restoration Site is located in Wilkes County, North Carolina, approximately 10 miles southwest of Wilkesboro (Figure 1). The project site is on the south side of North Carolina Highway 18, across from the intersection of northern end of the High Rock Road loop, which is about 4.5 miles east of the Caldwell County line. Big Warrior Creek drains a watershed area of approximately 7.4 square miles, beginning at the Wilkes and Alexander County line. Big Warrior Creek and its tributaries originate in the Brushy Mountains near the boundary between Wilkes County and Alexander County. Downstream of the project area, Big Warrior Creek ultimately flows into the W. Kerr Scott Reservoir, an impoundment of the Yadkin River. Two major tributaries (Mountain Creek and Unnamed Tributary) flow into the main channel of Big Warrior Creek within the project area. Sections of these two tributaries were also restored. The project restoration segments that are on the downstream property are completely fenced to exclude cattle from the creek and riparian areas.

To travel to the site from the Raleigh area, take I-40 West to US-421 North towards Wilkesboro. Take NC-16 South/NC-18 towards Wilkesboro/Lenoir/Taylorsville. Follow NC-18 to the site. It is approximately halfway between the towns of Boomer and Thankful.



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Fax: 919-461-1415

URS

Prepared For:
NC Ecosystem Enhancement Program

Ecosystem Enhancement PROGRAM

Project:
Big Warrior Creek
Stream Restoration
Wilkes County, NC

Monitoring Year:
3 (2007)

Project Number:
00412

Date:
November 2007

Legend
Project Reach

Figure 1
Project Vicinity

0 0.5 1 Miles

2.4 PROJECT HISTORY AND BACKGROUND

The Big Warrior Stream Restoration project was designed by CDM and construction was completed in November 2004. The Mitigation and As-built Plan were completed in March 2005. The estimated restoration length was 11,035 linear feet. This length includes 7,185 feet of Big Warrior Creek, 2,415 feet of Mountain Creek, and 1,435 feet of an Unnamed Tributary.

EcoLogic conducted the Year 1 monitoring in 2005. At that time, Ecologic was provided with an As-built site map. Other documentation such as project history, contacts, goals, and the As-built report were not provided. The measured restoration amount is 10,698 linear feet, as measured by EcoLogic (7,013 on Big Warrior, 2,373 on Mountain Creek, and 1,312 on Unnamed Tributary). Since EcoLogic did not have complete project data at the time of the Year 1 monitoring, much of their quantitative data differs from that presented in the As-built Plan (EcoLogic 2006).

At the time URS was given the contract, URS had only Ecologic's Year One Monitoring Report. Therefore, Year 2 (2006) and 3 (2007) surveys, cross-sections, photo stations, and vegetation plots follow those of Ecologic.

Table I. Project Mitigation Structure and Objectives Table
Big Warrior Creek
EEP Project Number 00412

Project Segment or Reach ID	Existing Feet	Mitigation Type	Approach	Linear Footage	Stationing	Comment
Big Warrior Creek	450	EII	PIII	450	0+00 to 4+50	
Big Warrior Creek	6,735	R	PII	6,735	4+50 to 70+00	
Mountain Creek	2,415	R	PII	2,352	0+00 to 25+00	
Unnamed Tributary	1,435	R	PII	1,409	0+00 to 15+00	

R= Restoration P1= Priority I EI= Enhancement I PII= Priority II
EII= Enhancement II PIII= Priority III S= Stabilization SS= Stream Bank Stabilization

Table II. Project Activity and Reporting History Big Warrior Creek EEP Project Number 00412			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	Unknown	Unknown	Unknown
Final Design – 90%	Unknown	Unknown	Unknown
Construction	Unknown	NA	November 2004
Permanent seed mix applied	Unknown	Unknown	Unknown
Live stakes and woody plants	Unknown	Unknown	Unknown
Final Walk Through	Unknown	Unknown	Unknown
Mitigation Plan/As-Built Report	Unknown	Unknown	March 2005
Year 1 Monitoring	October 2005	Unknown	April 2006
Year 2 Monitoring	Fall 2006	September 2006	December 2006
Year 3 Monitoring	Fall 2007	September 2007	November 2007
Year 4 Monitoring	Fall 2008	--	--
Year 5 Monitoring	Fall 2009	--	--
Year + Monitoring	Not scheduled	--	--

Table III. Project Contact Table Big Warrior Creek EEP Project Number 00412	
Designer Primary project design POC	Camp Dresser & McKee (CDM) 5400 Glenwood Ave, Suite 300 Raleigh, NC 27612 Kelly Boone 919-787-5620
Designer – Subcontractor Subcontractor POC	Biohabitats 15 W. Aylesbury Road Timonium, MD 21093 Ellen McClure 410-337-3659
Construction Contractor Construction contractor POC	Shamrock Environmental PO Box 14987 Greensboro, NC 27415 Bill Wright 336-375-1989
Planting Contractor Planting contractor POC	Seal Brothers Contracting 131 W Cleve Street Mt. Airy, NC 27030 Brian Seal 336-710-3560
Seeding Contractor Seeding contractor POC	Seal Brothers Contracting 131 W Cleve Street Mt. Airy, NC 27030 Brian Seal 336-710-3560
Seed Mix Sources	Unavailable

Nursery Stock Suppliers	Unavailable
2004 Monitoring Performers	Biohabitats 15 W. Aylesbury Road Timonium, MD 21093 Ellen McClure 410-337-3659
2005 Monitoring Performers	EcoLogic Associates, P.C. 4321-A South Elm-Eugene St. Greensboro, NC 27406 336-355-1108
2006 Monitoring Performers	URS Corporation – North Carolina 1600 Perimeter Park Drive, Suite 400 Morrisville, NC 27560 919-461-1100
Monitoring POC – Kathleen McKeithan	919-461-1597
2007 Monitoring Performers	URS Corporation – North Carolina 1600 Perimeter Park Drive, Suite 400 Morrisville, NC 27560 919-461-1100
Monitoring POC – Kathleen McKeithan	919-461-1597

Table IV. Project Background Table
Big Warrior Creek
EEP Project Number 00412

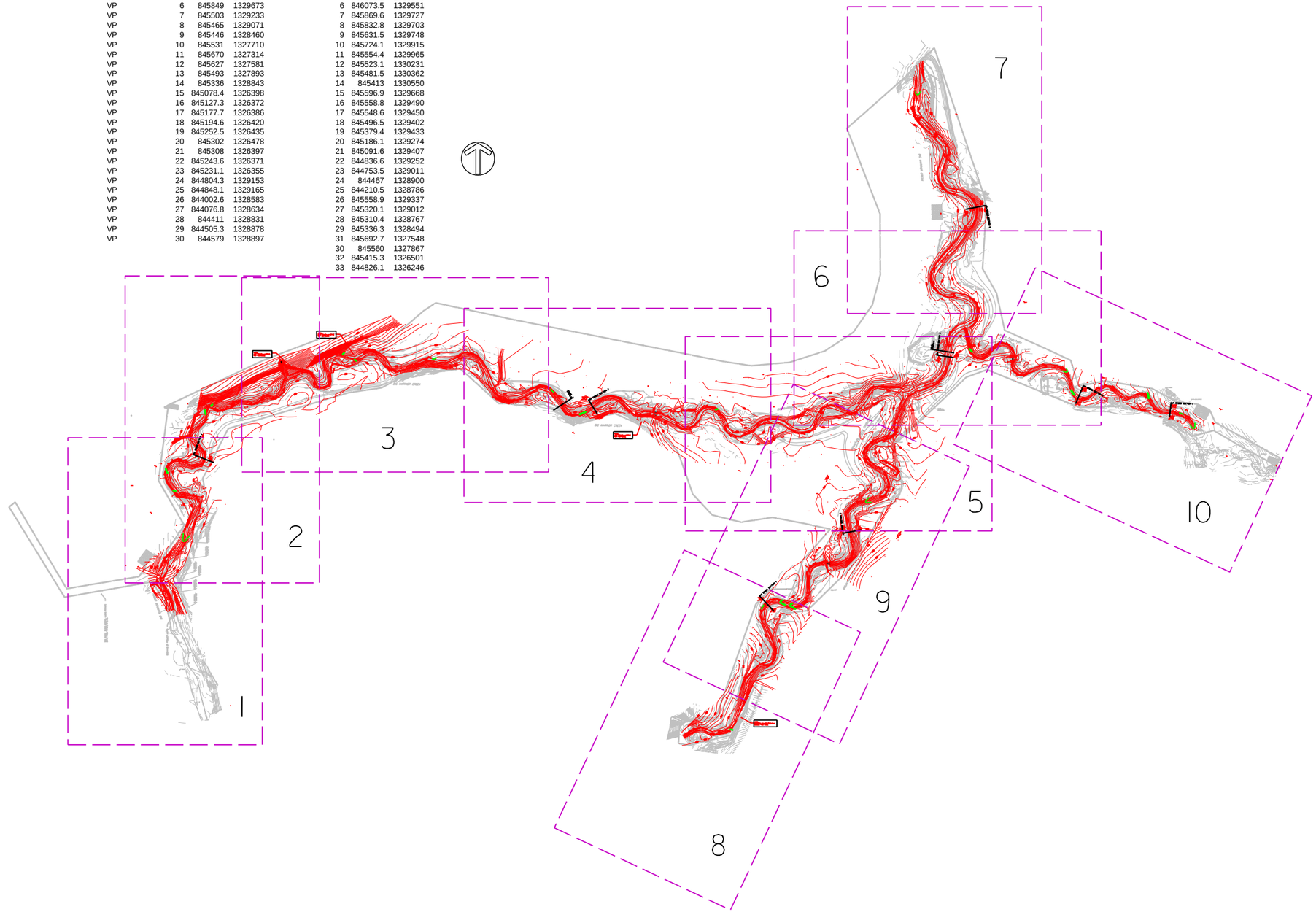
Project County	Wilkes County
Drainage Area Big Warrior Creek Mountain Creek Unnamed Tributary	7.4 square miles 1.77 square miles 0.5 square miles
Drainage impervious cover estimate (%)	Estimated at <5%
Stream Order	3rd for Big Warrior Creek
	2nd for Mountain Creek and Unnamed Tributary
Physiographic Region	Piedmont/Foothills
Ecoregion	Northern Inner Piedmont (45e)
Rosgen Classification of As-Built	C
Dominant soil types	Toccoa sandy loam, Douge fine sandy loam
Reference site ID	Unknown
USGS HUC for Project	03040101
NCDWQ Sub-basin for Project	YAD01
NCDWQ classification for Project	Class C, Index no. 12-29-2-(1)
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	NA
% of project easement fenced	75% - no cattle in upper reach

2.5 MONITORING PLAN VIEW

See Figure 2 for Monitoring Plan View.

Veg	Plots ID	Northing	Easting
VP	1	846695	1329477
VP	2	846596	1329584
VP	3	846351	1329638
VP	4	846273	1329696
VP	5	845893	1329659
VP	6	845849	1329673
VP	7	845503	1329233
VP	8	845465	1329071
VP	9	845446	1328460
VP	10	845531	1327710
VP	11	845670	1327314
VP	12	845627	1327581
VP	13	845493	1327893
VP	14	845336	1328843
VP	15	845078.4	1326398
VP	16	845127.3	1326372
VP	17	845177.7	1326386
VP	18	845194.6	1326420
VP	19	845252.5	1326435
VP	20	845302	1326478
VP	21	845308	1326397
VP	22	845243.6	1326371
VP	23	845231.1	1326355
VP	24	844804.3	1329153
VP	25	844848.1	1329165
VP	26	844002.6	1328583
VP	27	844076.8	1328634
VP	28	844411	1328831
VP	29	844505.3	1328878
VP	30	844579	1328897

Photo ID	Points Northing	Easting
1	846912.8	1329523
2	846712.5	1329464
3	846569.1	1329649
4	846372	1329627
5	846292.2	1329779
6	846073.5	1329551
7	845869.6	1329727
8	845832.8	1329703
9	845631.5	1329748
10	845724.1	1329915
11	845554.4	1329965
12	845523.1	1330231
13	845481.5	1330362
14	845413	1330550
15	845596.9	1329668
16	845558.8	1329490
17	845548.6	1329450
18	845496.5	1329402
19	845379.4	1329433
20	845186.1	1329274
21	845091.6	1329407
22	844836.6	1329252
23	844753.5	1329011
24	844467	1328900
25	844210.5	1328786
26	845558.9	1329337
27	845320.1	1329012
28	845310.4	1328767
29	845336.3	1328494
31	845692.7	1327548
30	845560	1327867
32	845415.3	1326501
33	844826.1	1326246



240 120 0 240 480
1" = 480'

REVISIONS

NO.	DATE

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Morrisville, North Carolina 27560
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PROJECT: BIG WARRIOR CREEK STREAM RESTORATION 2006 MONITORING REPORT

TITLE: KEY MAP

CLIENT: NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Ecosystem Enhancement Program

FIGURE 2

DATE: NOV 2007

TECHNICIAN: EHJ

CHECKED BY: KM

MONITORING YEAR 3

EEP PROJECT NO. 00412

SHEET NO. 0

SEE SHEET 3 FOR ACCESS ALONG PRIVATE DRIVE FROM STATE RTE. 18.

BIG WARRIOR CREEK

BEGINNING OF PROJECT LIMITS

33

N 844,548.8
E 1,326,270.6

N 844,639.0
E 1,326,248.5

N 844,688.1
E 1,326,196.6

N 844,662.7
E 1,326,209.0

N 844,777.5
E 1,326,241.6

N 844,864.5
E 1,326,312.6

MATCH LINE SEE SHEET 2

COLOR LEGEND FOR STRUCTURES:

- SYMBOLS GRAY IN COLOR REPRESENT STRUCTURES AS PROPOSED
- SYMBOLS RED IN COLOR REPRESENT STRUCTURES AS BUILT AND SURVEYED
- SYMBOLS GREEN IN COLOR REPRESENT STRUCTURES BUILT, BUT NOT SURVEY LOCATED

LEGEND FOR DRAWING

- SURVEY CONTROL POINT
- × 273.1 EXISTING SPOT ELEVATION
- EXISTING STREAM EDGE LIMITS
- 30" SYCAMORE EXISTING TREE
- 352 EXISTING CONTOUR
- EXISTING FENCE
- EXISTING THALWEG
- EXISTING WETLAND
- 1109 PROPOSED CONTOUR
- ROCK CROSS VANE
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- BRUSH PILE
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- CONTRACTORS STAGING AREA
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- SF SILT FENCE
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- VP 15 VEG PLOT

40 30 0 40 80
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PROJECT: BIG WARRIOR CREEK STREAM RESTORATION 2006 MONITORING REPORT

TITLE: MONITORING PLAN VIEW

CLIENT: NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Ecosystem Enhancement Program

FIGURE 2

DATE: NOV 2007

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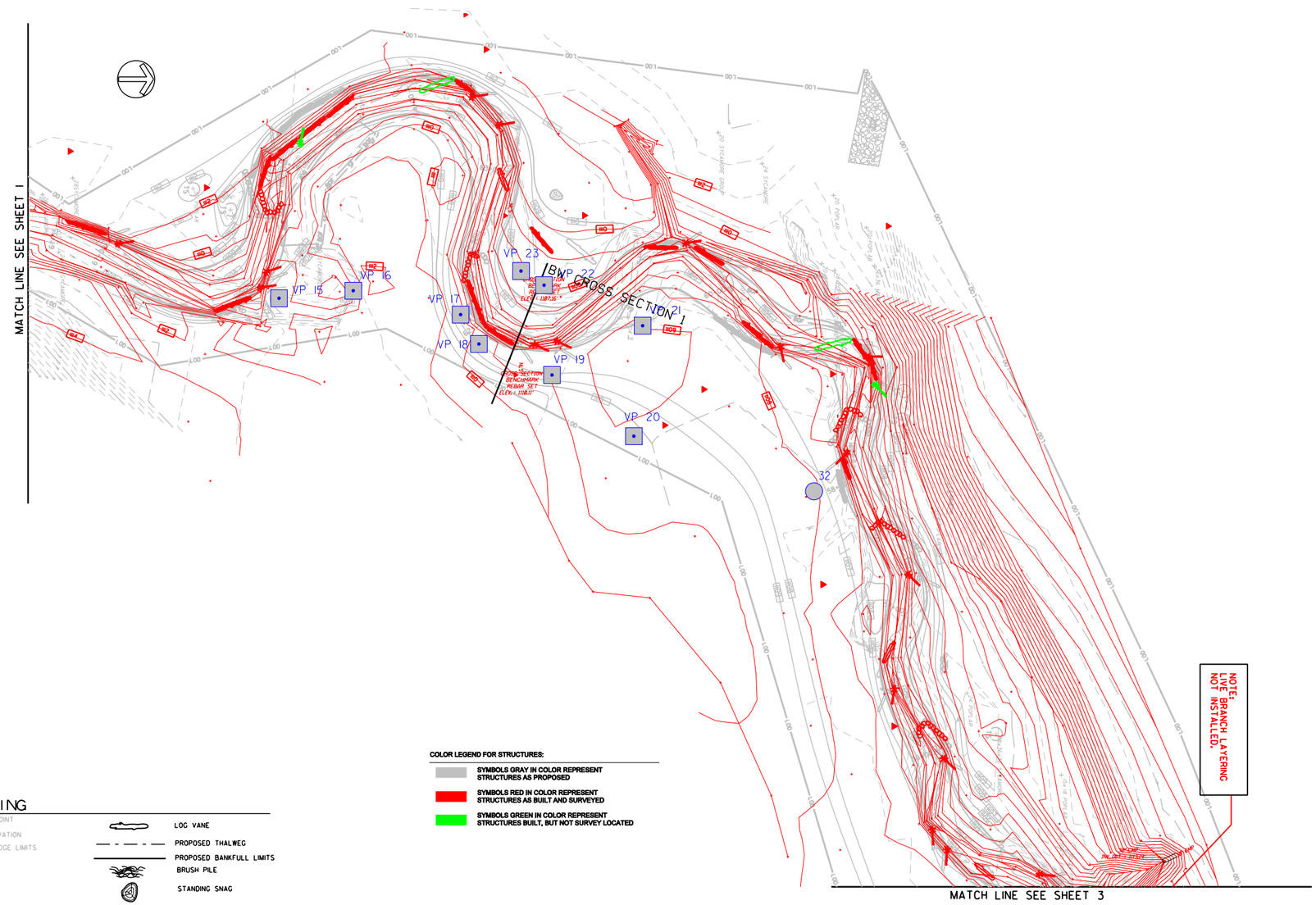
MONITORING YEAR 3

EEP PROJECT NO. 00412

SHEET NO. 1



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CLIENT: NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Ecosystem Enhancement Program

FIGURE 2

DATE: NOV 2007

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MONITORING YEAR 3

EEP PROJECT NO. 00412

SHEET NO. 2

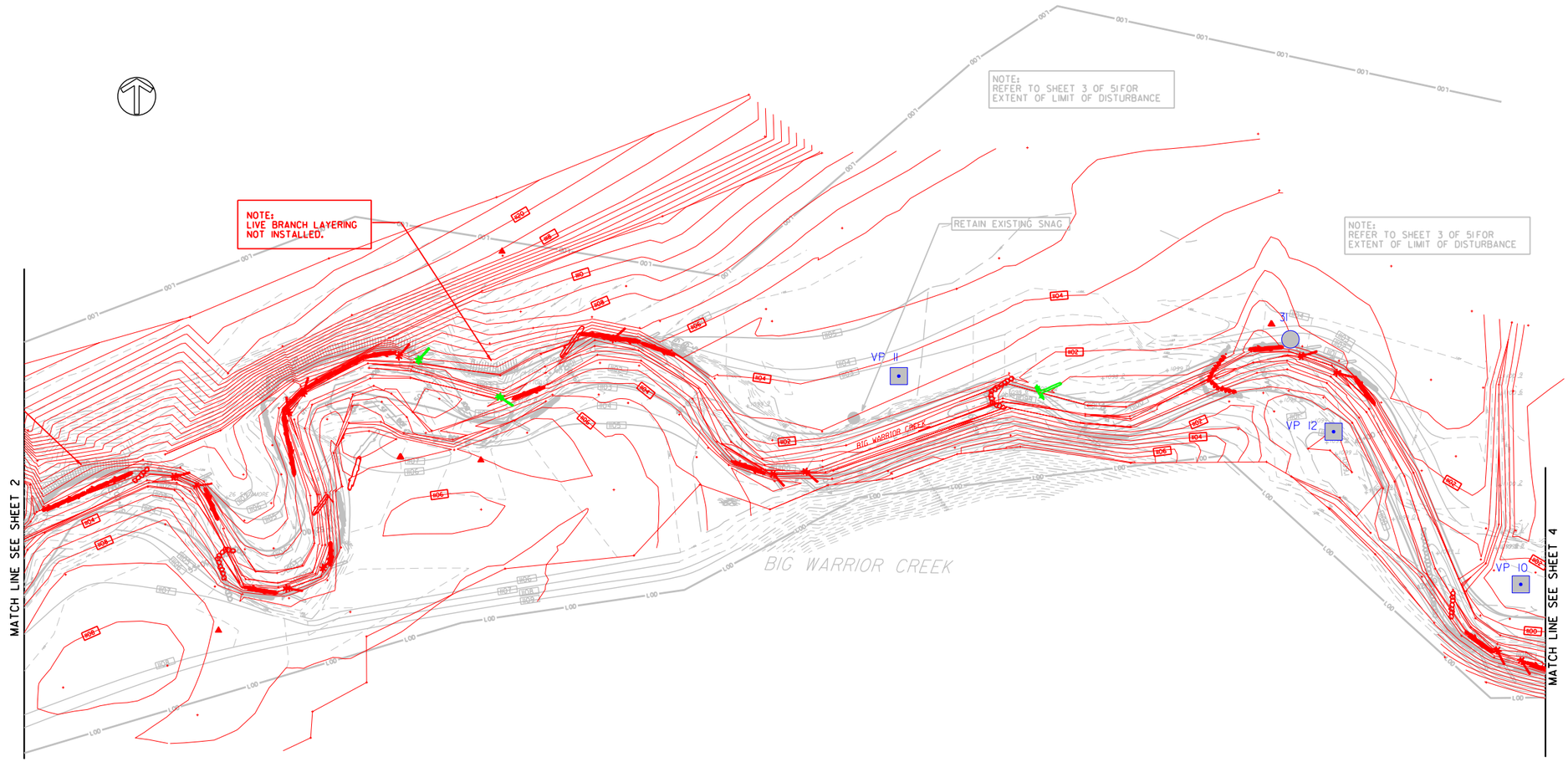

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FIGURE 2

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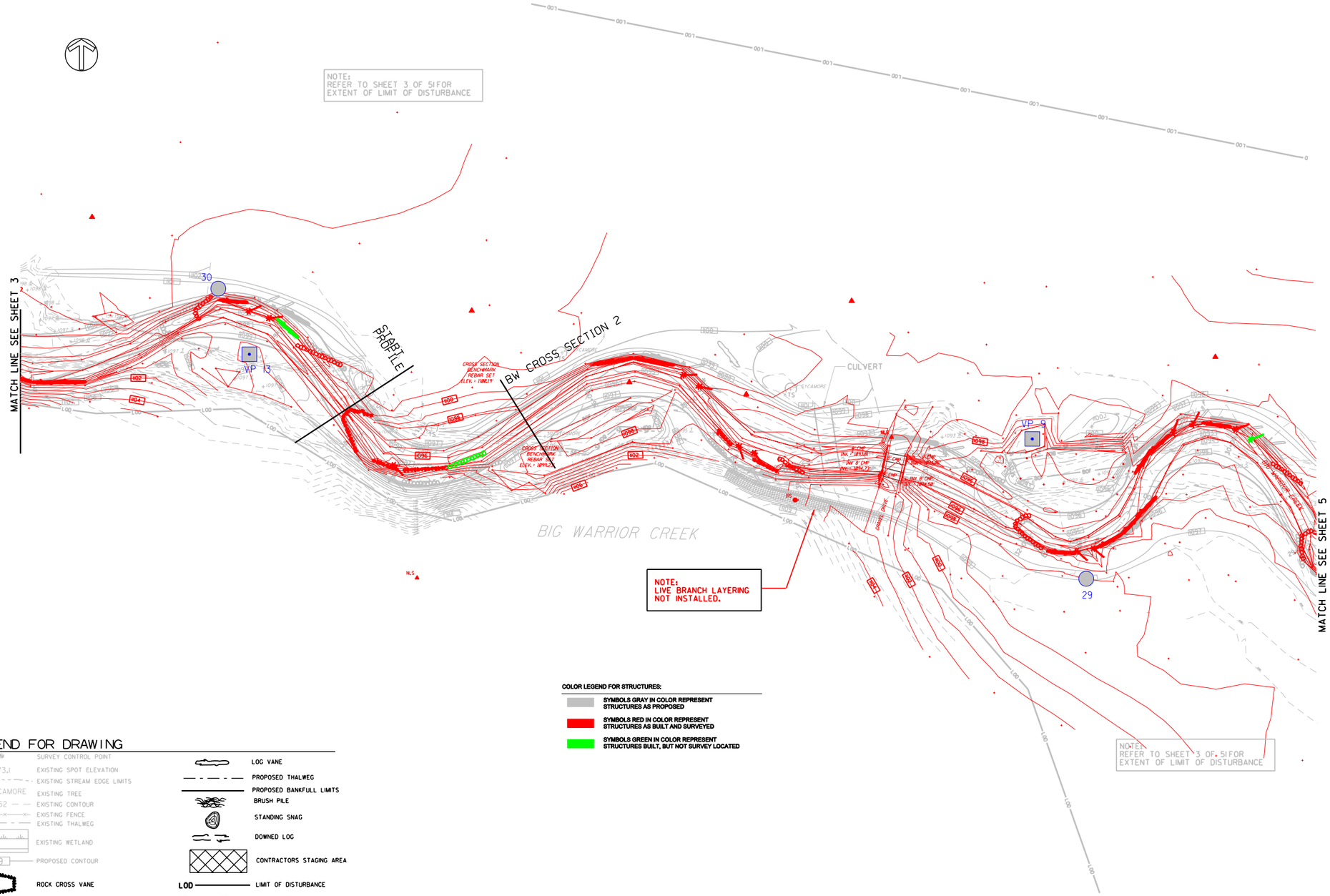

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FIGURE 2

DATE: NOV 2007

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MONITORING YEAR 3

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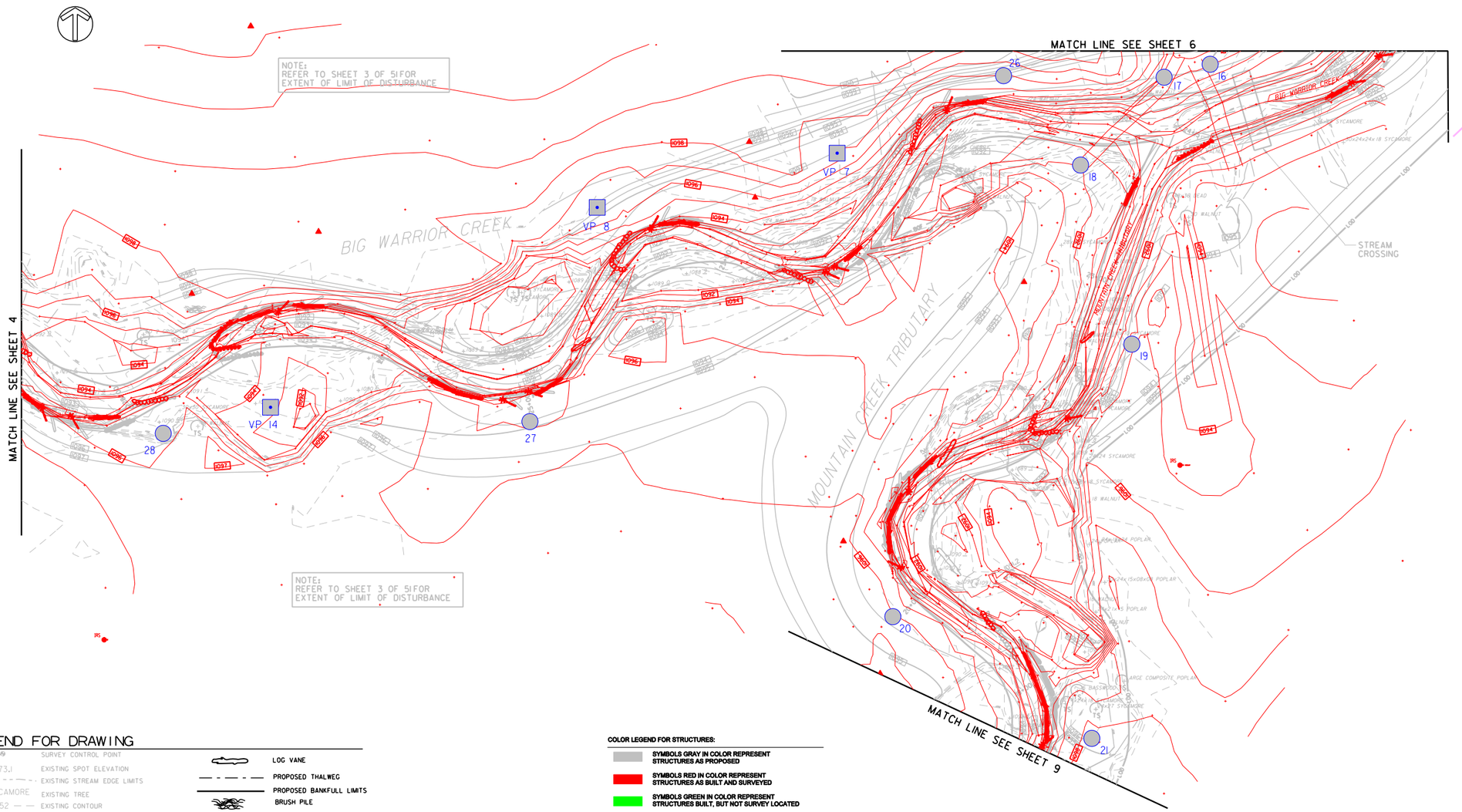
SHEET NO. 4



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- DOWNED LOG
- CONTRACTORS STAGING AREA
- LOD — LIMIT OF DISTURBANCE
- SF — SF — SILT FENCE
- BOF — BLAZE ORANGE FENCE
- TS — TREE SAVE
- EXISTING SNAG TO REMAIN
- LIVE BRANCH LAYERING
- 32 — PHOTO PLOT
- VP 15 — VEG PLOT

COLOR LEGEND FOR STRUCTURES:

- SYMBOLS GRAY IN COLOR REPRESENT STRUCTURES AS PROPOSED
- SYMBOLS RED IN COLOR REPRESENT STRUCTURES AS BUILT AND SURVEYED
- SYMBOLS GREEN IN COLOR REPRESENT STRUCTURES BUILT, BUT NOT SURVEY LOCATED

40 30 0 40 80
1" = 80'

REVISIONS

NO.	DATE

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URS
URS Corporation – North Carolina
1600 Perimeter Park Drive
Morrisville, North Carolina 27560
TELEPHONE (919) 461-1100 FAX (919) 461-1415

PROJECT: BIG WARRIOR CREEK STREAM RESTORATION 2006 MONITORING REPORT

TITLE: MONITORING PLAN VIEW

CLIENT: NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Ecosystem Enhancement Program

FIGURE 2

DATE: NOV 2007

TECHNICIAN: EHJ

CHECKED BY: KM

MONITORING YEAR 3

EEP PROJECT NO. 00412

SHEET NO. 5

MATCH LINE SEE SHEET 7

NOTE:
REFER TO SHEET 3 OF 5IFOR
EXTENT OF LIMIT OF DISTURBANCE

BIG WARRIOR CREEK

LOWER TRIBUTARY

CULVERT

VP 5

VP 6

7

8

9

10

11

12

13

15

BW CROSS SECTION 3

END PROFILE

MATCH LINE SEE SHEET 9

MATCH LINE SEE SHEET 10

LEGEND FOR DRAWING

- SURVEY CONTROL POINT
- × 273.1 EXISTING SPOT ELEVATION
- EXISTING STREAM EDGE LIMITS
- ×30" SYCAMORE EXISTING TREE
- 352 EXISTING CONTOUR
- EXISTING FENCE
- EXISTING THALWEG
- EXISTING WETLAND
- 1109 PROPOSED CONTOUR
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FIGURE 2

DATE: NOV 2007

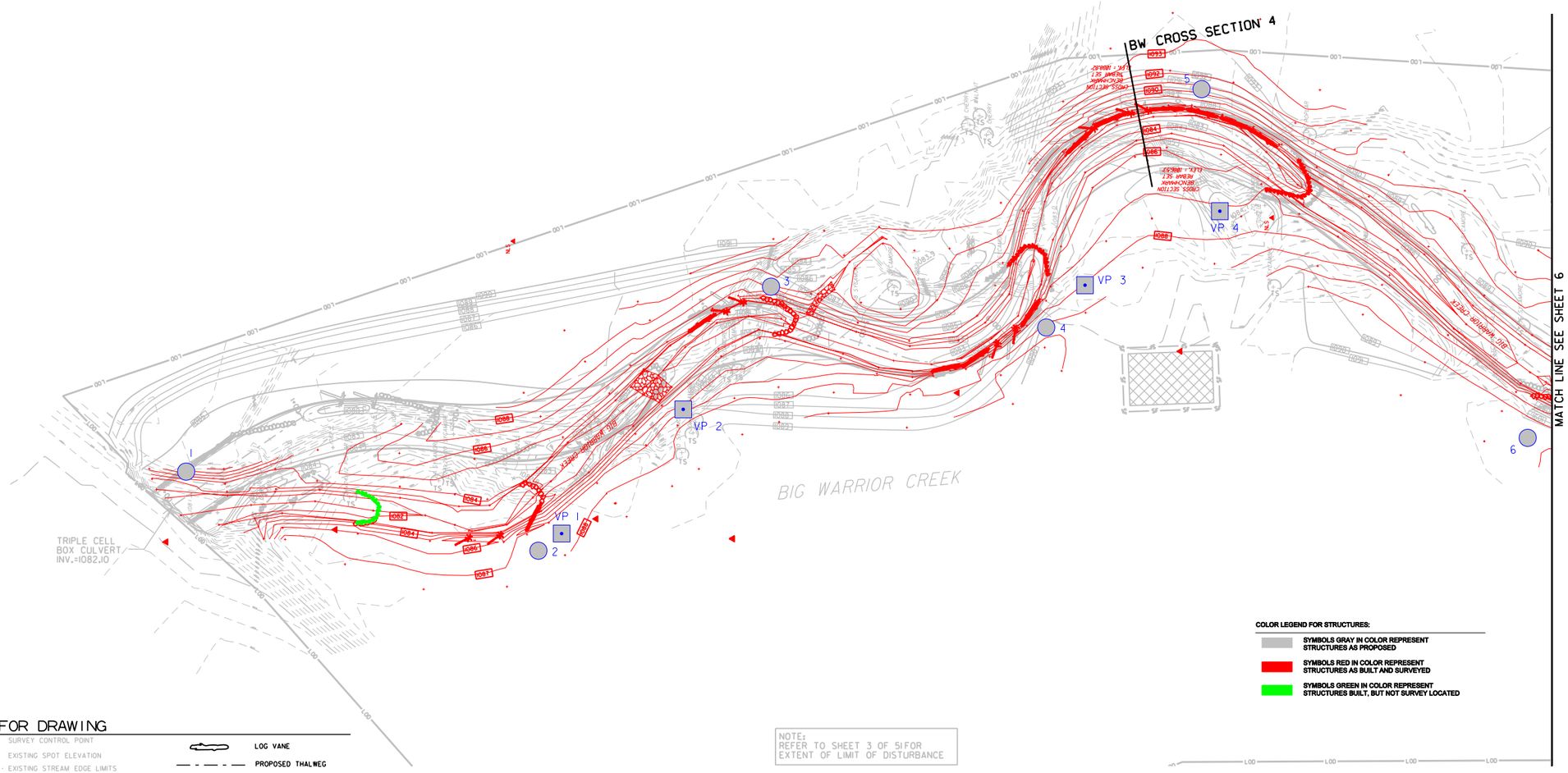
TECHNICIAN: EHJ

CHECKED BY: KM

MONITORING YEAR 3

EEP PROJECT NO. 00412

SHEET NO. 6



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NOTE:
REFER TO SHEET 3 OF 5 FOR
EXTENT OF LIMIT OF DISTURBANCE

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FIGURE 2

DATE: NOV 2007

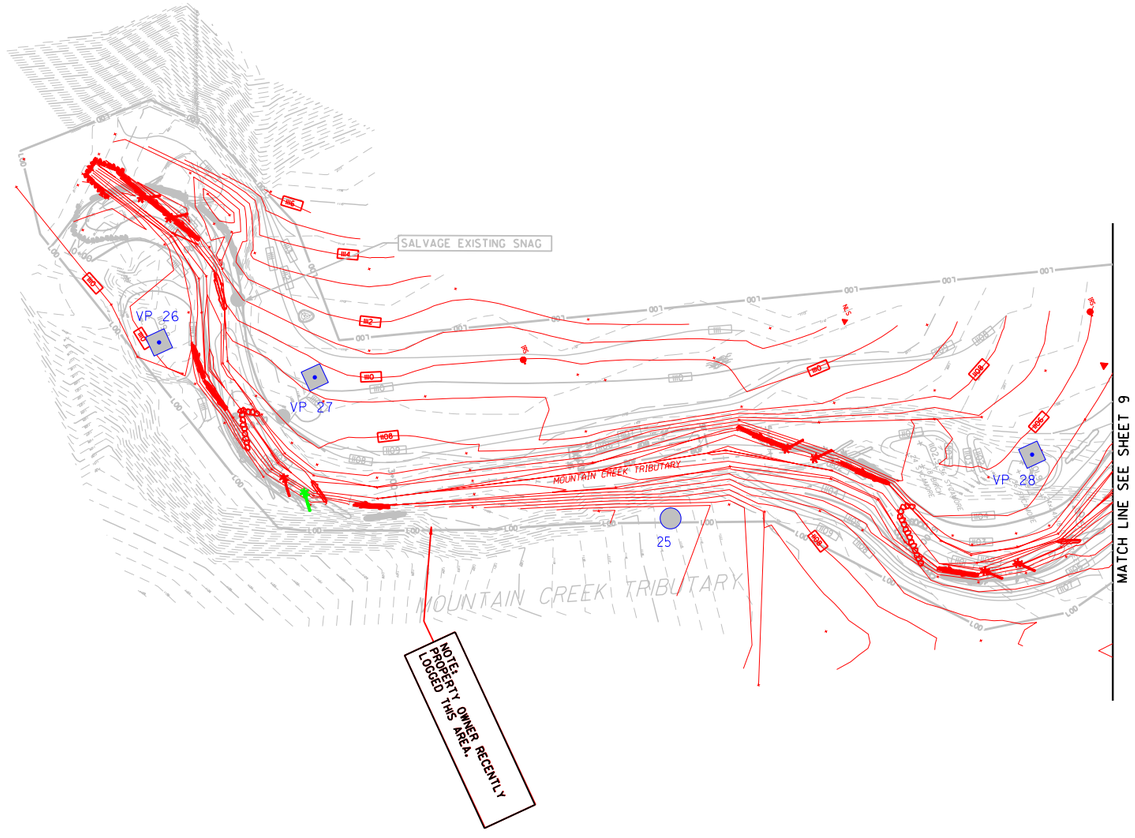
TECHNICIAN: EHJ

CHECKED BY: KM

MONITORING YEAR 3

EEP PROJECT NO. 00412

SHEET NO. 7



LEGEND FOR DRAWING

- SURVEY CONTROL POINT
- × 273.1 — EXISTING SPOT ELEVATION
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- ×30' SYCAMORE — EXISTING TREE
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FIGURE 2

DATE: NOV 2007

TECHNICIAN: EHJ

CHECKED BY: KM

MONITORING YEAR 3

EEP PROJECT NO. 00412

SHEET NO. 8

NOTE:
REFER TO SHEET 3 OF 51FOR
EXTENT OF LIMIT OF DISTURBANCE

MC CROSS SECTION 1

MC CROSS SECTION 2

MATCH LINE SEE SHEET 8

MATCH LINE SEE SHEET 5

VP 29
VP 30
VP 25
VP 24
23
24
22

MOUNTAIN CREEK TRIBUTARY

CULVERT

BENCH MARK
REBAR SET
ELEV.= 1099.34'

BENCH MARK
REBAR SET IN 18"OAK
ELEV.= 1111.82'

LEGEND FOR DRAWING

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FIGURE 2

DATE: NOV 2007

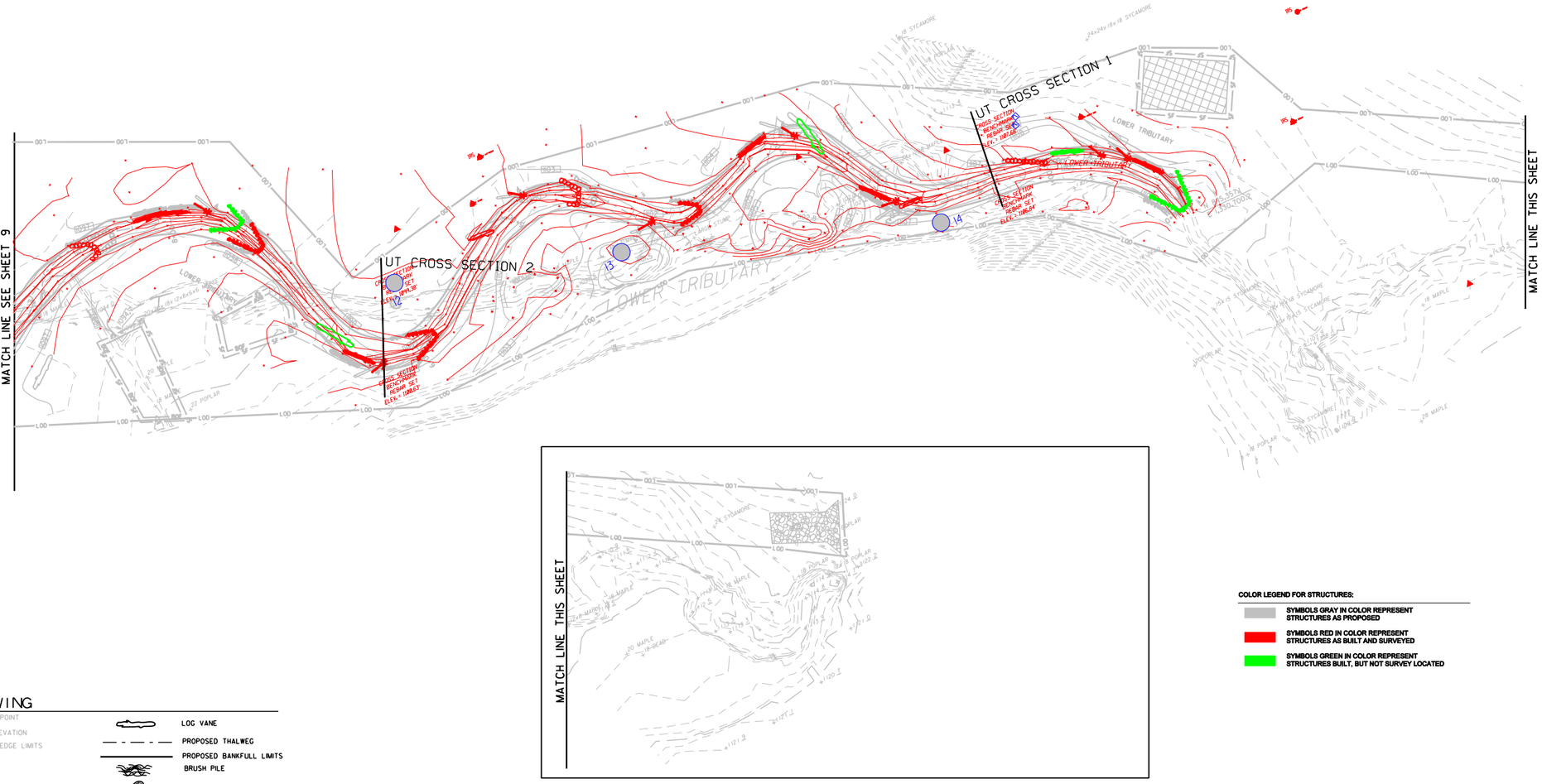
TECHNICIAN: EHJ

CHECKED BY: KM

MONITORING YEAR 3

EEP PROJECT NO. 00412

SHEET NO. 9



LEGEND FOR DRAWING

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FIGURE 2

DATE: NOV 2007

TECHNICIAN: EHJ

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MONITORING YEAR 3

EEP PROJECT NO. 00412

SHEET NO. 10

3.0 PROJECT CONDITION AND MONITORING RESULTS

3.1 VEGETATION ASSESSMENT

Vegetation monitoring plot stem counts and photos are located in Appendices A-I and A-IV.

3.1.1 Vegetative Problem Areas

The number of vegetative problem areas has decreased between 2006 and 2007, from 16 to 15, respectively. Of the 15 problem areas observed in 2007, six are areas of high concern. URS recommends that these areas receive repair or treatment. The other nine areas should be monitored further to see if they improve or worsen. The areas of high concern are related to invasive species and bare, eroding soil. Vegetative Problem Areas are listed in Tables A6a and A6b in Appendix A-I.

The presence and abundance of kudzu along Big Warrior Creek appears to have increased dramatically since 2006. Four notable areas are shown as problem areas. However, small patches of kudzu were observed along the majority of Big Warrior Creek. Because of the highly aggressive growth habit of kudzu, it is expected to continue expanding across the site and endangering the planted vegetation if it is not treated. American hogpeanut is also growing very aggressively along the Unnamed Tributary and portions of the other reaches. While this vine is a native species, it is a vigorous climber and may threaten the survivability of planted stems. Small Chinese privet were observed along the mainstem of Big Warrior Creek during the 2006 and 2007 monitoring periods. While these individuals do not pose an immediate threat, their presence should be noted and monitored.

Other problem areas include bare banks and floodplains along the mainstem and Mountain Creek. These problems are likely resulting from poor site soils or soils that were compacted during construction. URS recommends soil amendments and reseeding in these areas. No problem areas were documented along the Unnamed Tributary.

Vegetative Problem Area Photos are located in Appendix A-II.

3.1.2 Vegetative Problem Areas Plan View

See Figure 3 in Appendix A-III for the Vegetative Problem Areas Plan View.

3.2 STREAM ASSESSMENT

3.2.1 Procedural Items

3.2.1.1 Morphometric Criteria

Dimension and profile were sampled per the 2003 Stream Mitigation Guidelines (USACE 2003) as follows:

Dimension: Eight permanent cross sections were surveyed. Two are located on Mountain Creek (one riffle and one pool), two on the Unnamed Tributary (one riffle and one pool), and four on Big Warrior Creek (two riffles and two pools). The survey includes points measured at all breaks in slope, including top of bank, bankfull, and thalweg.

Profile: A total of 6,804 linear feet of longitudinal profile was surveyed, broken into three segments as follows: 2,361 linear feet on Mountain Creek, 1,423 linear feet on the Unnamed Tributary, and 3,020 linear feet on Big Warrior Creek. Survey points include the top of bank, the beginning of each stream feature such as riffle or pool and the maximum pool depth.

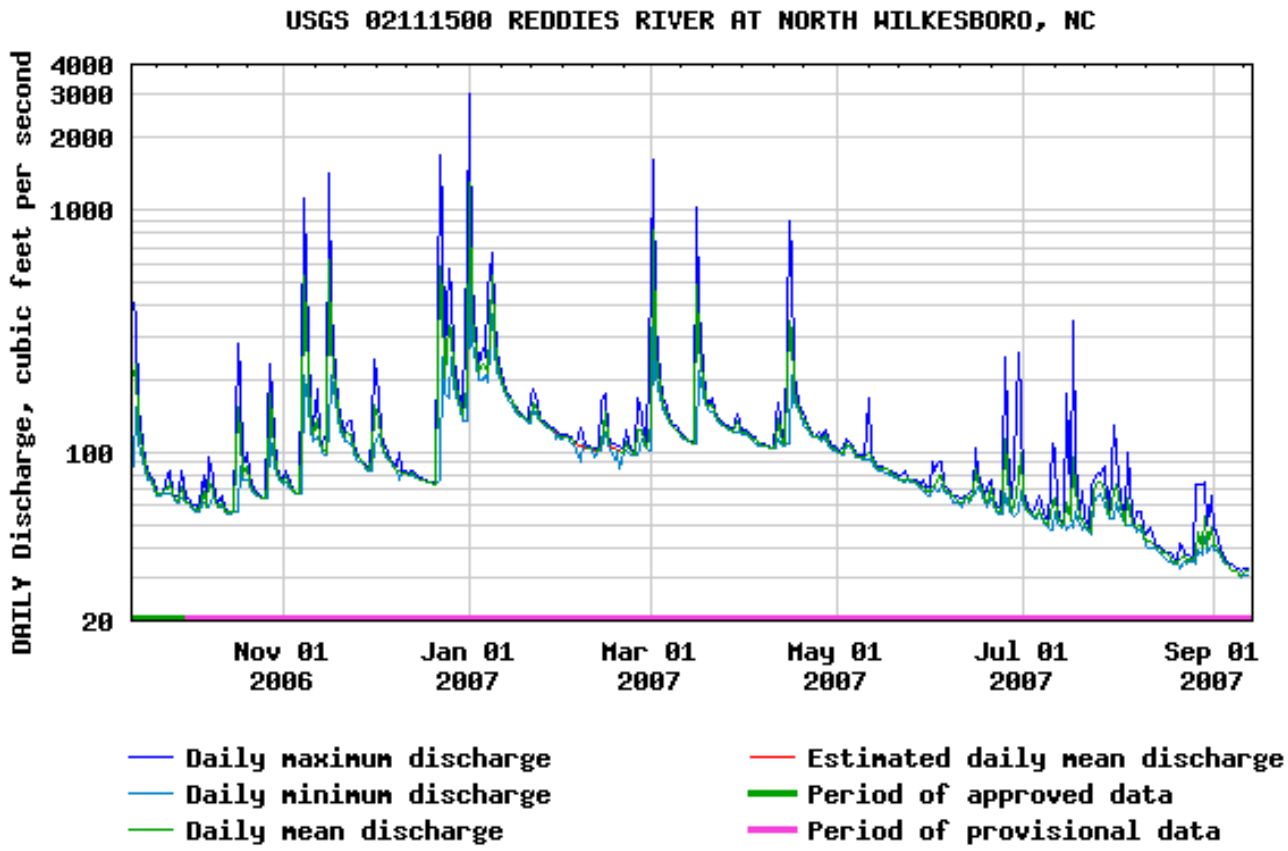
3.2.1.2 Hydrologic Criteria

No crest gages are installed at this site to document bankfull events. Therefore, potential occurrence was extrapolated based on USGS stream gage discharge data for the Reddies River at North Wilkesboro, NC (USGS 2007). The USGS gage plot is shown below. The gage is located about 10 miles from the project site in the same watershed and has a drainage area of 89 square miles. An estimate of the number of bankfull events from in 2007 was made by comparing the stream discharges from the USGS data in cubic feet per second (cfs) against the bankfull discharge estimated from the drainage area on the Rural Piedmont Regional Curve. According to the regional curve, a bankfull event occurs on a stream with an 89-square mile drainage area when the discharge is about 2,250 cfs. This discharge was exceeded on January 1 of 2007, indicating that the Reddies River has had one bankfull event between September 12, 2006 and September 12, 2007. Big Warrior Creek is in close proximity to the Reddies River, and it is likely that the project site also experienced a bankfull event in January 2007.

Table V. Verification of Bankfull Events
Big Warrior Creek
EEP Project Number 00412

Date of Data Collection	Date of Occurrence	Method
10/19/2006	Late June 2006	Proximal USGS Gage Resource
9/13/2007	January 1, 2007	Proximal USGS Gage Resource

Figure 4. USGS Stream Gage Discharge Data



3.2.2 Stream Problem Areas

There were a total of 37 stream problem areas identified for the project, 25 on the mainstem, 10 on Mountain Creek, and two on the Unnamed Tributary. Thirteen problem areas were classified as areas of high concern, and URS recommends repair or maintenance on these areas. The remaining 24 should be watched closely to see if they improve or worsen.

The stream problem areas consisted primarily of bank erosion, structure failure, and bed aggradation. The structure at the beginning of Mountain Creek, MCPA1 continues to be a problem area. Water is piping behind and around the structure, and it is constructed at a large elevation drop. If this structure fails, it is likely to induce a headcut that will work up the unrestored section of Mountain Creek. Many of the rootwads were causing scour on the downstream side. A common problem was also observed with many of the J-hook vanes, as shown in photos BWPA3 and BWPA10. These structures were often constructed with three rocks placed high above the invert of the bed, which caused an obstruction of flow, and the water to be diverted into the banks. This problem was further exacerbated by the fact that the rocks trap debris and create a larger obstruction.

A beaver dam and sign of beaver activity were observed on Big Warrior Creek during 2007 monitoring between stations 20+00 and 25+00 and 40+00 and 50+00. A small beaver dam is present at station 22+40. Measures should be taken to remove the beaver.

The Problem Areas Plan View is located in Appendix B-I, Problem Area data tables are located in Appendix B-II, and Problem Area Photos are located in Appendix B-III.

3.2.3 Fixed Photo Station Photos

Stream Photo Station photos are located in Appendix B-IV.

3.2.4 Stability Assessment

Table VI. Categorical Stream Feature Visual Stability Assessment (% Functioning)
Big Warrior Creek
EEP Project Number 00412

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffle	100	N/A	100	100		
B. Pool	100	N/A	100	100		
C. Thalweg	100	N/A	96	96		
D. Meanders	100	N/A	98	98		
E. Bed General	100	N/A	93	93		
F. Bank Condition	100	N/A	96	98		
G. Vanes / J Hooks	100	N/A	72	75		
H. Wads and Boulders	100	N/A	70	73		

3.2.5 Quantitative Measures Summary Tables (Morphology and Hydrology)

Neither EcoLogic nor URS received the Restoration Plan for the Big Warrior Stream Restoration Site, and the 2005 Mitigation Plan contained little pre-restoration data. Therefore, populating the Baseline Morphology and Hydraulic Summary Table was not possible. The table has been condensed to show the Regional Curve Interval data for each reach. Baseline data were unavailable for the rest of the table.

Table VII. Baseline Morphology and Hydraulic Summary Big Warrior Creek EEP Project Number 00412									
Parameter	**Big Warrior Creek Regional Curve Interval**			**Mountain Creek Regional Curve Interval**			**Unnamed Tributary Regional Curve Interval**		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
BF Width (ft)	17	52	30	17	60	30	6	28	14
Floodprone Width (ft)									
BF Cross Sectional Area (ft^2)	45	170	80	9	30	18	5.5	20	11
BF Mean Depth (ft)	1.9	4.0	3.0	1.1	3.0	1.9	0.8	2.0	1.5
BF Max Depth (ft)									
Width/Depth Ratio									
Entrenchment Ratio									
Wetted Perimeter (ft)									
Hydraulic radius (ft)									
Pattern									
Channel Beltwidth (ft)									
Radius of Curvature (ft)									
Meander Wavelength (ft)									
Meander Width Ratio									
Profile									
Riffle Length (ft)									
Riffle Slope (ft/ft)									
Pool Length (ft)									
Pool Spacing (ft)									
Substrate									
d50 (mm)									
d84 (mm)									
Additional Reach Parameters									
Valley Length (ft)									
Channel Length (ft)									
Sinuosity									
Water Surface Slope (ft/ft)									
BF Slope (ft/ft)									
Rosgen Classification									

Table VIIIa. Morphology and Hydraulic Monitoring Summary – Big Warrior Creek Big Warrior Creek EEP Project Number 00412																				
Parameter	**Cross Section 1 Pool**					**Cross Section 2 Riffle**					**Cross Section 3 Riffle***					**Cross Section 4 Pool**				
Dimension	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
BF Width (ft)	35.3	13.9	14.5			23	23.8	26.7			24.2	27.5	22.6			22.6	25.9	19.1		
Floodprone Width (ft)	99	>65	>65			41.4	>55	>55			31.6	>60	>60			40.5	>60	>60		
BF Cross Sectional Area (ft^2)	48.3	12.4	15.2			33.3	34.4	47			30	39.3	31.8			36.2	36.8	36.4		
BF Mean Depth	1.4	0.9	1.0			1.5	1.4	1.8			1.2	1.4	1.4			1.6	1.4	1.9		
BF Max Depth	3.2	1.6	2.1			2.5	2.5	2.8			1.8	2.1	1.8			3.1	3.1	2.9		
Width/Depth Ratio	25.8	15.5	13.9			15.9	16.5	15.2			19.6	19.2	16.1			14.1	18.2	10.1		
Entrenchment Ratio	2.8	>4.7	>4.5			1.8	>2.3	>2.1			1.3	>2.2	>2.7			1.8	>2.3	>3.1		
Bank Height Ratio	N/A	1.0	1.0			N/A	1.0	1.0			N/A	1.0	1.0			N/A	1.0	1.0		
Wetted Perimeter (ft)	36.5	15.2	15.8			24.7	26.0	28.2			24.8	28.6	23.6			23.9	27.3	20.4		
Hydraulic radius (ft)	1.3	0.8	1.0			1.4	1.3	1.7			1.2	1.4	1.4			1.5	1.3	1.8		
Substrate**																				
d50 (mm)	0.45	2.8	0.9			11.8	26	6			0.83	36	1.2			0.84	0.93	0.46		
d84 (mm)	1.5	25	16			39.4	82	36			1.91	110	10			8.83	12	1.5		

*Cross section 3 is transitioning to a glide.

** The d50 and d84 for MY2 are not comparable to the MY1 and MY3 data because different methods were used for the pebble count.

Table VIIIb. Morphology and Hydraulic Monitoring Summary – Big Warrior Creek Big Warrior Creek EEP Project Number 00412																		
Parameter	**MY1 (2005)**			**MY2 (2006)**			**MY3 (2007)**			**MY4 (2008)**			**MY5 (2009)**			**MY+**		
Pattern	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Channel Beltwidth (ft)	--	--	--	--	--	--	40	120	80									
Radius of Curvature (ft)	--	--	--	28	76	52	40	160	80									
Meander Wavelength (ft)	--	--	--	--	--	--	140	320	240									
Meander Width Ratio	--	--	--	--	--	--	1.5	4.5	3.0									
Profile																		
Riffle Length (ft)	34	166	54	11	185	49	12	187	43.5									
Riffle Slope (ft/ft)	0.004	0.017	0.008	0.005	0. 026	0.010	0.004	0.072	0.019									
Pool Length (ft)	13	200	70.5	12	259	77	6	152.4	44.5									
Pool Spacing (ft)	37.9	397	119	16	453	132	24	350.4	94.2									
Additional Reach Parameters																		
Valley Length (ft)	--	--	--	--	5200	--	--	5200	--									
Channel Length (ft)	--	7021	--	--	7185	--	--	7185	--									
Sinuosity	--	--	--	--	1.38	--	--	1.33	--									
Water Surface Slope (ft/ft)	--	0.0041	--	--	0.0032	--	--	0.0038	--									
BF Slope (ft/ft)	--	0.0041	--	--	0.0034	--	--	0.0041	--									
Rosgen Classification	--	C/B/F	--	--	C4	--	--	C4	--									

Table VIIIc. Morphology and Hydraulic Monitoring Summary – Mountain Creek Big Warrior Creek 00412										
Parameter	**Cross Section 1 Pool**					**Cross Section 2 Riffle**				
Dimension	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
BF Width (ft)	26.7	18.8	18.2			13.1	15.8	15.4		
Floodprone Width (ft)	56	>45	>45			45.8	>45	>45		
BF Cross Sectional Area (ft^2)	45.2	28.9	28.1			17.6	24.2	24.1		
BF Mean Depth	1.7	1.5	1.5			1.3	1.5	1.6		
BF Max Depth	3.4	2.8	2.5			1.9	2.3	2.5		
Width/Depth Ratio	15.9	12.2	11.8			9.76	10.3	9.9		
Entrenchment Ratio	2.1	>2.4	>2.5			3.5	>2.8	>2.9		
Bank Height Ratio	N/A	1.0	1.0			N/A	1.0	1.0		
Wetted Perimeter (ft)	28.4	20.0	19.5			14.1	17.0	16.5		
Hydraulic radius (ft)	1.6	1.4	1.4			1.3	1.4	1.5		
Substrate*										
d50 (mm)	2.36	0.41	2			6.85	23	1.8		
d84 (mm)	10.5	17	20			16.4	69	28		

* The d50 and d84 for MY2 are not comparable to the MY1 and MY3 data because different methods were used for the pebble count.

Table VIIId. Morphology and Hydraulic Monitoring Summary – Mountain Creek Big Warrior Creek EEP Project Number 00412																		
Parameter	**MY1 (2005)**			**MY2 (2006)**			**MY3 (2007)**			**MY4 (2008)**			**MY5 (2009)**			**MY+**		
Pattern	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Channel Beltwidth (ft)	84	180	147.5	--	--	--	50	160	80									
Radius of Curvature (ft)	40	70	50	--	--	--	70	140	100									
Meander Wavelength (ft)	140	300	200	--	--	--	240	360	280									
Meander Width Ratio	5.2	11.2	7.5	--	--	--	3.2	10.4	5.2									
Profile																		
Riffle Length (ft)	9.3	16.7	47	6	167	37	6.5	228	41.9									
Riffle Slope (ft/ft)	0.009	0.055	0.027	0.0034	0.063	0.023	0	0.052	0.020									
Pool Length (ft)	12	85	38	8	136	38	4	66.4	31.9									
Pool Spacing (ft)	22	208	75	16	187	84	15.4	351.5	87.5									
Additional Reach Parameters																		
Valley Length (ft)	--	1820	--	--	--	1820	--	--	1820									
Channel Length (ft)	--	2373	--	--	--	2352	--	--	2361									
Sinuosity	--	1.3	--	--	--	1.3	--	--	1.3									
Water Surface Slope (ft/ft)	--	0.009	--	--	--	0.008	--	--	0.009									
BF Slope (ft/ft)	--	0.009	--	--	--	0.008	--	--	0.009									
Rosgen Classification	--	B	--	--	--	C4	--	--	E4									

Table VIIIe. Morphology and Hydraulic Monitoring Summary – Unnamed Tributary Big Warrior Creek EEP Project Number 00412										
Parameter	**Cross Section 1 Riffle****					**Cross Section 2 Pool****				
Dimension	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
BF Width (ft)	10.6	10.9	10.9			8.12	17.8	13.1		
Floodprone Width (ft)	15.5	>25	>25			26.7	>40	>40		
BF Cross Sectional Area (ft^2)	6.1	7.9	7.6			3.9	8.7	4.8		
BF Mean Depth	0.6	0.7	0.7			0.5	0.5	0.4		
BF Max Depth	1	1.2	1.3			1	1.1	1.0		
Width/Depth Ratio	18.3	14.9	15.5			16.8	36.1	36.1		
Entrenchment Ratio	1.5	>2.3	>2.3			3.3	>2.3	>3.1		
Bank Height Ratio	N/A	1.0	1.0			N/A	1.0	1.0		
Wetted Perimeter (ft)	10.8	11.2	11.4			8.6	18.0	13.6		
Hydraulic radius (ft)	0.56	0.7	0.7			0.5	0.5	0.3		
Substrate										
d50 (mm)	1.56	4	0.76			0.46	0.13	0.42		
d84 (mm)	13.6	48	15			0.83	0.42	15		

* The d50 and d84 for MY2 are not comparable to the MY1 and MY3 data because different methods were used for the pebble counts.

** Cross sections have transitioned into runs.

Table VIIIf. Morphology and Hydraulic Monitoring Summary – Unnamed Tributary Big Warrior Creek EEP Project Number 00412																		
Parameter	**MY1 (2005)**			**MY2 (2006)**			**MY3 (2007)**			**MY4 (2008)**			**MY5 (2009)**			**MY+**		
Pattern	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Channel Beltwidth (ft)	100	200	165	--	--	--	50	120	80									
Radius of Curvature (ft)	50	115	60	--	--	--	50	120	80									
Meander Wavelength (ft)	250	345	285	--	--	--	160	260	220									
Meander Width Ratio	23.6	32.5	26.8	--	--	--	4.6	11.0	7.3									
Profile																		
Riffle Length (ft)	9.6	60.2	32.5	5	54	31	6	99.1	35.4									
Riffle Slope (ft/ft)	0.002	0.065	0.035	0.006	0.043	0.024	0.001	0.054	0.029									
Pool Length (ft)	13.2	60.2	34	8	78	37	2	31.5	15									
Pool Spacing (ft)	15.7	200	64.4	20	137	61	7	146	59									
Additional Reach Parameters																		
Valley Length (ft)	--	1000	--	--	--	1000	--	--	1000									
Channel Length (ft)	--	1309	--	--	--	1409	--	--	1423									
Sinuosity	--	--	--	--	--	1.4	--	--	1.4									
Water Surface Slope (ft/ft)	--	0.01	--	--	--	0.014	--	--	0.013									
BF Slope (ft/ft)	--	0.01	--	--	--	0.0135	--	--	0.014									
Rosgen Classification	--	B	--	--	--	C4	--	--	C4									

4.0 METHODOLOGY SECTION

All monitoring methodologies follow the most current templates and guidelines provided by EEP (EEP 2006). Photographs were taken at high resolution using an Olympus Stylus 4.0 megapixel digital camera. GPS location information was collected using a Trimble Geo XT handheld mapping grade GPS unit. GPS locations were collected in 2006 (Year 2) on both banks of each cross section and on all four corners of each vegetation plot. Stream and vegetation problem areas were noted in the field on As-Built Plan Sheets. Permanent photo station photographs were taken from locations marked in the Year One Monitoring Report, prepared by EcoLogic Associates.

4.1 STREAM METHODOLOGY

The methods used to generate the data in this report are standard fluvial geomorphology techniques as described in *Applied River Morphology* (Rosgen 1996) and related publications from US Forest Service and the interagency Stream Mitigation Guidelines (USACE 2003). URS' field morphology survey was conducted using a Topcon PL-H3C Rotating Laser and the data were analyzed and displayed using the Reference Reach Spreadsheet, Version 4.2L (Mecklenburg 2006). Modified Wolman pebble counts were conducted in the vicinity of each cross section. Photographs were taken at each cross section. A photo was taken from the left bank towards the right bank, and from the right bank towards the left bank.

4.2 VEGETATION METHODOLOGY

Seven vegetation plots were established by CDM in 2004. These seven plots were evaluated for the As-built survey. These plots consisted of 1/10-acre circular plots with the center points marked with rebar. For the Year 1 survey in 2005, EcoLogic did not have As-built project data. EcoLogic established 30 10-meter by 10-meter vegetation plots, per EEP's current protocol at that time.

According to the 2006, Version 4.0 CVS-EEP Protocol for Recording Vegetation (Lee *et al* 2006), the Big Warrior Creek Stream Restoration Project requires the monitoring of 16 vegetation plots. The new CVS-EEP Protocol for Recording Vegetation was used to inventory 16 (1, 2, 4, 6, 7, 8, 9, 11, 13, 15, 19, 25, 26, 28, 29, and 30) of the 30 vegetation plots established by EcoLogic.

Vegetation monitoring methods followed the 2006, Version 4.0 CVS-EEP Protocol for Recording Vegetation. Vegetation plot photographs were collected at the southwest corner of each vegetation plot. Vegetation monitoring plots were re-marked in the field by replacing all old flagging with new flagging. Each vegetation plot was marked by Ecologic in 2005 with a four-foot PVC pipe at the upstream, outside corner. The remaining three corners were marked with steel conduit. URS placed orange flagging at the southwest corner of each vegetation plot and blue flagging at the remaining corners. The orientation of the plot was marked on the CVS-EEP data sheet if the PVC was not in the southwest corner (the origin of the plot). Planted stems were flagged in white. Volunteer/natural regeneration stems were inventoried, but not flagged. Monitoring taxonomy follows 'Manual of the Vascular Flora of the Carolinas' (Radford *et. al* 1968). Stem height was measured with a folding one-meter rule. Diameter at breast height and decimeter height were measured with calipers. The X,Y coordinates relative to the southwest corner (origin) of each stem in the plot were recorded, as was the bearing of the x axis from the southwest corner. The results of the stem counts are located in Appendix A-I. Photographs of the monitoring plots are located in Appendix A-IV.

5.0 REFERENCES

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USGS. 2007. Reddies River at North Wilkesboro, NC streamflow gage. USGS Real-Time Water Data. Gage 02111500. http://waterdata.usgs.gov.

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APPENDIX A

VEGETATION RAW DATA

Table A1. Vegetation Metadata

Report Prepared By	Susan Shelingoski
Date Prepared	9/28/2007 9:11
database name	CVS_EEP_EntryTool_v220NEW.mdb
database location	P:\Jobs3\31825348_Monitoring\Veg
computer name	RDUXPL129

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

Metadata	This worksheet, which is a summary of the project and the project data.
Proj, planted	Each project is listed with its PLANTED stems, for each year. This excludes live stakes and lists stems per acre.
Proj, total stems	Each project is listed with its TOTAL stems, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems. Listed in stems per acre.
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.
ALL Stems by Plot and spp	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	412
project Name	Big Warrior Creek
Description	Stream Restoration
River Basin	
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	0

Table A2. Vegetation Vigor by Species

	Species	4	3	2	1	0	Missing
	Alnus serrulata	2	9			1	
	Betula nigra	3	4			3	
	Cephalanthus occidentalis						1
	Cornus amomum	2	12	2			1
	Fraxinus pennsylvanica		1	2		2	1
	Juglans nigra	1	7	6	1	2	4
	Nyssa sylvatica						1
	Salix nigra	2	5				
	Cercis canadensis	1		1			1
	Lindera benzoin			1			
	Liriodendron tulipifera	5	9	1		2	4
	Platanus occidentalis	6	9	4			1
	Physocarpus opulifolius		8	4			
TOT:	**13**	**22**	**64**	**21**	**1**	**10**	**14**

Table A3. Vegetation Damage by Species

	Species	All Damage Categories	(no damage)	Diseased	Insects	Vine Strangulation
	Alnus serrulata	12	5		7	
	Betula nigra	10	10			
	Cephalanthus occidentalis	1	1			
	Cercis canadensis	3	3			
	Cornus amomum	17	16		1	
	Fraxinus pennsylvanica	6	6			
	Juglans nigra	21	21			
	Lindera benzoin	1	1			
	Liriodendron tulipifera	21	15	3	3	
	Nyssa sylvatica	1	1			
	Physocarpus opulifolius	12	10			2
	Platanus occidentalis	20	12		8	
	Salix nigra	7	6		1	
TOT:	**13**	**132**	**107**	**3**	**20**	**2**

Table A4. Vegetation Damage by Plot

	plot	All Damage Categories	(no damage)	Diseased	Insects	Vine Strangulation
	412-01-0001-year:3	16	13		3	
	412-01-0002-year:3	10	7		3	
	412-01-0004-year:3	4	3			1
	412-01-0006-year:3	6	5		1	
	412-01-0007-year:3	16	16			
	412-01-0008-year:3	1			1	
	412-01-0009-year:3	9	8		1	
	412-01-0011-year:3	15	14	1		
	412-01-0013-year:3	9	9			
	412-01-0015-year:3	3	3			
	412-01-0019-year:3	5			5	
	412-01-0025-year:3	8	6		2	
	412-01-0026-year:3	9	6		3	
	412-01-0028-year:3	8	7			1
	412-01-0029-year:3	2	1		1	
	412-01-0030-year:3	11	9	2		
TOT:	**16**	**132**	**107**	**3**	**20**	**2**

Table A5. Stem Count by Plot and Species

	Species	Total Planted Stems	# plots	avg# stems	plot 412-01-0001-year:3	plot 412-01-0002-year:3	plot 412-01-0004-year:3	plot 412-01-0006-year:3	plot 412-01-0007-year:3	plot 412-01-0008-year:3	plot 412-01-0009-year:3	plot 412-01-0011-year:3	plot 412-01-0013-year:3	plot 412-01-0015-year:3	plot 412-01-0019-year:3	plot 412-01-0025-year:3	plot 412-01-0026-year:3	plot 412-01-0028-year:3	plot 412-01-0029-year:3	plot 412-01-0030-year:3
	Alnus serrulata	11	6	1.83		1					2	1	1	1	5					
	Betula nigra	7	4	1.75									1			3		2		1
	Cercis canadensis	2	2	1		1		1												
	Cornus amomum	16	7	2.29	2	1		1	8		1	2				1				
	Fraxinus pennsylvanica	3	2	1.5				1												2
	Juglans nigra	15	6	2.5	5		1		2		5			1		1				
	Lindera benzoin	1	1	1					1											
	Liriodendron tulipifera	15	4	3.75	6	3						3								3
	Physocarpus opulifolius	12	4	3	3		2						5					2		
	Platanus occidentalis	19	7	2.71		2		1		1		6				2	6		1	
	Salix nigra	7	5	1.4			1						2			1	2		1	
TOT:	**11**	**108**	**11**		**16**	**8**	**4**	**4**	**11**	**1**	**8**	**12**	**9**	**2**	**5**	**8**	**8**	**4**	**2**	**6**

Table A6a. Vegetative Problem Areas – Big Warrior Creek Big Warrior Creek EEP Project Number 00412				
Feature #	**Feature/Issue**	**Station #/Range**	**Probable Cause**	**Photo #**
BWVPA2	Invasive/exotic plant	12+00 to 20+10	Invasive/exotic plant	BWVPA2
BWVPA4	Invasive/exotic plant	33+00 to 35+00	Invasive/exotic plant	BWVPA4
BWVPA5	Bare bank	43+15	Bank erosion	BWVPA5
BWVPA6	Invasive/exotic plant	43+15	Invasive/exotic plant	BWVPA6
BWVPA7	Bare floodplain, gully erosion	49+00 to 50+00	Poor soil	BWVPA7
BWVPA8	Invasive/exotic plant	63+50	Invasive/exotic plant	BWVPA8
BWNVPA1	Bare bank	21+00 to 22+00	Bank erosion	BWNVPA1

Table A6b. Vegetative Problem Areas – Mountain Creek Big Warrior Creek EEP Project Number 00412				
Feature #	**Feature/Issue**	**Station #/Range**	**Probable Cause**	**Photo #**
MCVPA1	Bare bank	5+00	Bank erosion	MCVPA1
MCVPA2	Bare bank	6+20	Bank erosion	MCVPA2
MCVPA3	Bare bank	13+60	Bank erosion	MCVPA3
MCVPA4	Bare bank	15+00	Bank erosion	MCVPA4
MCVPA5	Bare floodplain	17+00 to 17+60	Overflow	MCVPA5
MCVPA6	Bare bank	17+00	Bank erosion	MCVPA6
MCVPA7	Bare bank	17+60	Bank erosion	MCVPA7
MCVPA8	Bare bank	19+00	Bank erosion	MCVPA8

BIG WARRIOR CREEK (9/12/07)


BWVPA2


BWVPA4


BWVPA5


BWVPA6


BWVPA7


BWVPA8

BWNVPA1

MOUNTAIN CREEK (9/11/07)

MCVPA1

MCVPA2

MCVPA3

MCVPA4

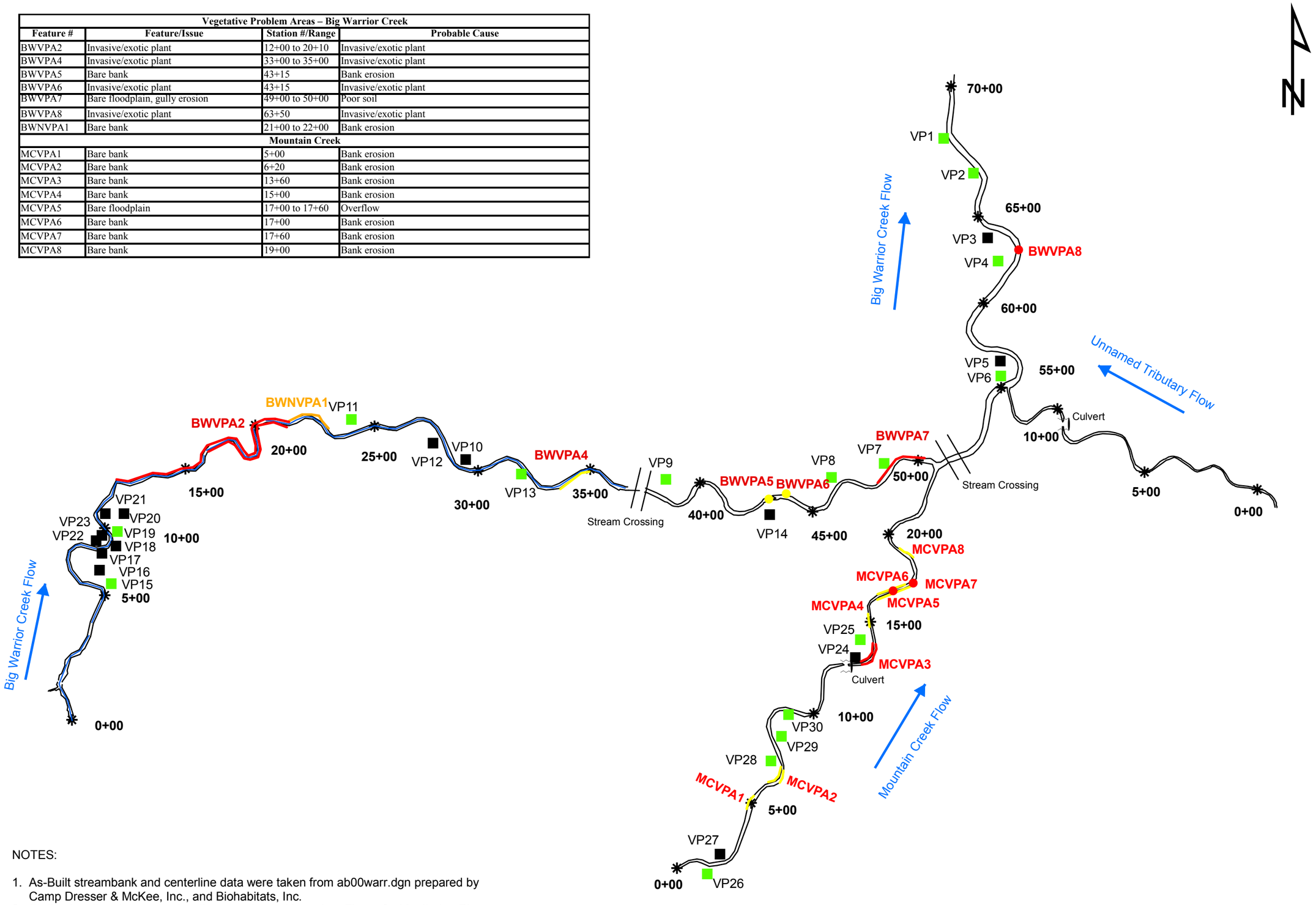

MCVPA5


MCVPA6


MCVPA7


MCVPA8

Vegetative Problem Areas – Big Warrior Creek			
Feature #	**Feature/Issue**	**Station #/Range**	**Probable Cause**
BWVPA2	Invasive/exotic plant	12+00 to 20+10	Invasive/exotic plant
BWVPA4	Invasive/exotic plant	33+00 to 35+00	Invasive/exotic plant
BWVPA5	Bare bank	43+15	Bank erosion
BWVPA6	Invasive/exotic plant	43+15	Invasive/exotic plant
BWVPA7	Bare floodplain, gully erosion	49+00 to 50+00	Poor soil
BWVPA8	Invasive/exotic plant	63+50	Invasive/exotic plant
BWNVPA1	Bare bank	21+00 to 22+00	Bank erosion
Mountain Creek			
MCVPA1	Bare bank	5+00	Bank erosion
MCVPA2	Bare bank	6+20	Bank erosion
MCVPA3	Bare bank	13+60	Bank erosion
MCVPA4	Bare bank	15+00	Bank erosion
MCVPA5	Bare floodplain	17+00 to 17+60	Overflow
MCVPA6	Bare bank	17+00	Bank erosion
MCVPA7	Bare bank	17+60	Bank erosion
MCVPA8	Bare bank	19+00	Bank erosion



NOTES:

1. As-Built streambank and centerline data were taken from ab00warr.dgn prepared by Camp Dresser & McKee, Inc., and Biohabitats, Inc.
2. Station location data were visually approximated based on Figure 3: Monitoring Plan View, Big Warrior Creek 2005 Monitoring Report, prepared by Ecologic Associates, P.C., dated April 2006.

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Prepared For:
NC Ecosystem Enhancement Program

Project:
Big Warrior Creek Stream Restoration
Wilkes County, NC

Monitoring Year:
3 (2007)

Project Number:
00412

Date:
November 2007

Legend
- 2006 Problem Area Concern
- 2006 Problem Area High Concern
- 2006 Problem Area Concern
- 2006 Problem Area High Concern
- 2007 Problem Area Concern

Vegetation Plots
- Inventoried
- Not Inventoried
- As-Built Centerline
- As-Built Streambank
- Stations

Vegetative Problem Areas Plan View


VP1 (9/11/07)


VP2 (9/11/07)


VP4 (9/11/07)


VP6 (9/11/07)


VP7 (9/10/07)


VP8 (9/10/07)


VP9 (9/10/07)


VP11 (9/12/07)


VP13 (9/12/07)


VP15 (9/12/07)


VP19 (9/12/07)


VP25 (9/11/07)


VP26 (9/11/07)


VP28 (9/11/07)

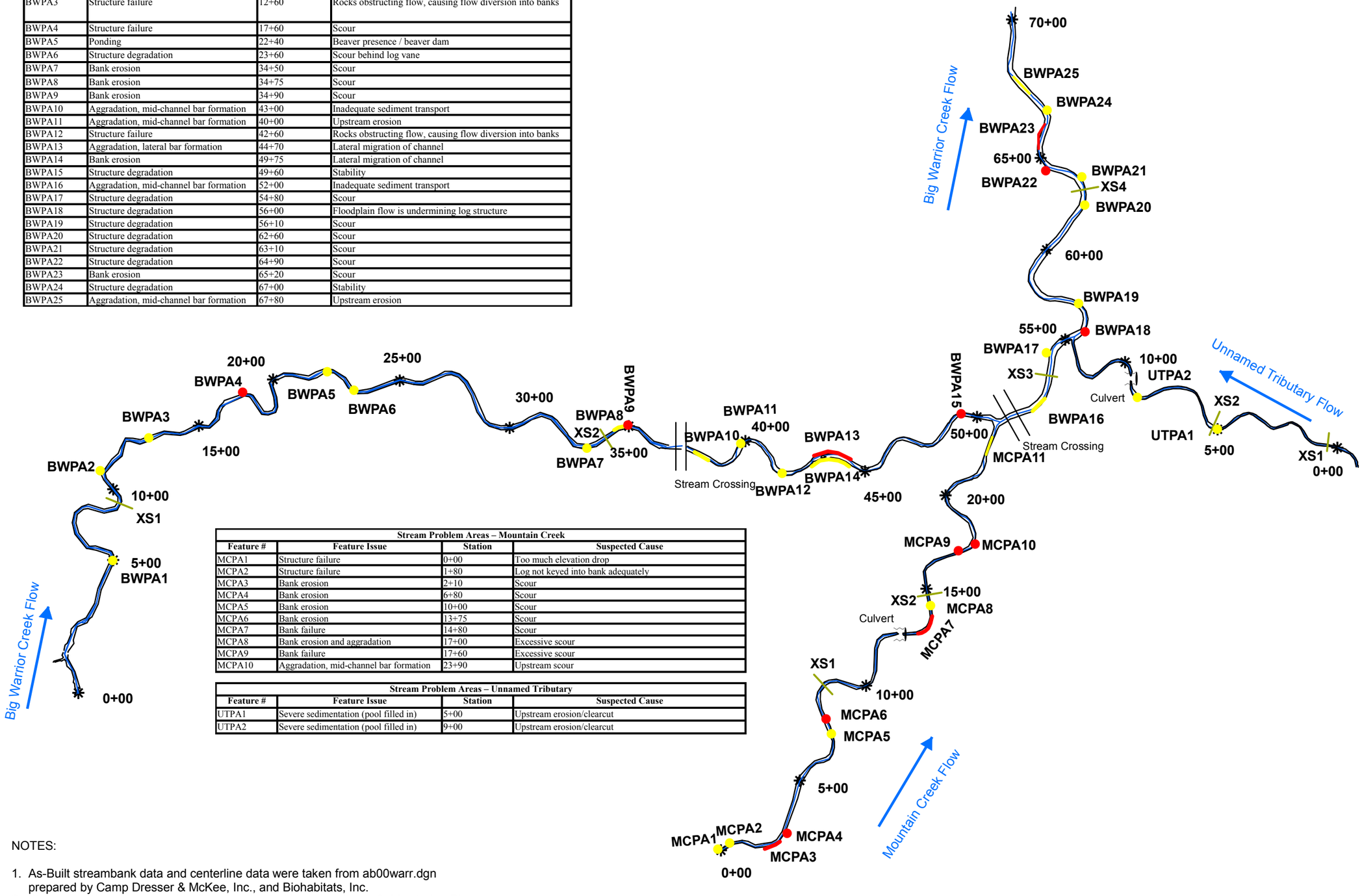

VP29 (9/11/07)


VP30 (9/11/07)

APPENDIX B

GEOMORPHIC RAW DATA

Stream Problem Areas – Big Warrior Creek			
Feature #	**Feature Issue**	**Station**	**Suspected Cause**
BWPA1	Structure degradation	5+00	Bank scour behind rootwad
BWPA2	Structure failure	11+00	Scour
BWPA3	Structure failure	12+60	Rocks obstructing flow, causing flow diversion into banks
BWPA4	Structure failure	17+60	Scour
BWPA5	Ponding	22+40	Beaver presence / beaver dam
BWPA6	Structure degradation	23+60	Scour behind log vane
BWPA7	Bank erosion	34+50	Scour
BWPA8	Bank erosion	34+75	Scour
BWPA9	Bank erosion	34+90	Scour
BWPA10	Aggradation, mid-channel bar formation	43+00	Inadequate sediment transport
BWPA11	Aggradation, mid-channel bar formation	40+00	Upstream erosion
BWPA12	Structure failure	42+60	Rocks obstructing flow, causing flow diversion into banks
BWPA13	Aggradation, lateral bar formation	44+70	Lateral migration of channel
BWPA14	Bank erosion	49+75	Lateral migration of channel
BWPA15	Structure degradation	49+60	Stability
BWPA16	Aggradation, mid-channel bar formation	52+00	Inadequate sediment transport
BWPA17	Structure degradation	54+80	Scour
BWPA18	Structure degradation	56+00	Floodplain flow is undermining log structure
BWPA19	Structure degradation	56+10	Scour
BWPA20	Structure degradation	62+60	Scour
BWPA21	Structure degradation	63+10	Scour
BWPA22	Structure degradation	64+90	Scour
BWPA23	Bank erosion	65+20	Scour
BWPA24	Structure degradation	67+00	Stability
BWPA25	Aggradation, mid-channel bar formation	67+80	Upstream erosion



Stream Problem Areas – Mountain Creek			
Feature #	**Feature Issue**	**Station**	**Suspected Cause**
MCPA1	Structure failure	0+00	Too much elevation drop
MCPA2	Structure failure	1+80	Log not keyed into bank adequately
MCPA3	Bank erosion	2+10	Scour
MCPA4	Bank erosion	6+80	Scour
MCPA5	Bank erosion	10+00	Scour
MCPA6	Bank erosion	13+75	Scour
MCPA7	Bank failure	14+80	Scour
MCPA8	Bank erosion and aggradation	17+00	Excessive scour
MCPA9	Bank failure	17+60	Excessive scour
MCPA10	Aggradation, mid-channel bar formation	23+90	Upstream scour

Stream Problem Areas – Unnamed Tributary			
Feature #	**Feature Issue**	**Station**	**Suspected Cause**
UTPA1	Severe sedimentation (pool filled in)	5+00	Upstream erosion/clearcut
UTPA2	Severe sedimentation (pool filled in)	9+00	Upstream erosion/clearcut

NOTES:

1. As-Built streambank data and centerline data were taken from ab00warr.dgn prepared by Camp Dresser & McKee, Inc., and Biohabitats, Inc.
2. Station location data were visually approximated based on figure 3: Monitoring Plan View, Big Warrior Creek 2005 Monitoring Report, prepared by Ecologic Associates, P.C., dated April 2006.

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Enhancement Program

Project:
Big Warrior Creek
Stream Restoration
Wilkes County, NC

Monitoring Year:
3 (2007)

Project Number:
00412

Date:
February 2008

Legend
- Problem Area Concern
- Problem Area High Concern
- Problem Area Concern
- Problem Area High Concern
- Cross Section
- As-Built Centerline
- As-Built Streambank
- Stations

Stream Current Condition Plan View

Table B1a. Stream Problem Areas – Big Warrior Creek
Big Warrior Creek
EEP Project Number 00412

Feature #	Feature Issue	Station	Suspected Cause	Photo #
BWPA1	Structure degradation	5+00	Bank scour behind rootwad	BWPA1
BWPA2	Structure failure	11+00	Scour	BWPA2
BWPA3	Structure failure	12+60	Rocks obstructing flow, causing flow diversion into banks	BWPA3
BWPA4	Structure failure	17+60	Scour	BWPA4
BWPA5	Ponding	22+40	Beaver presence / beaver dam	BWPA5
BWPA6	Structure degradation	23+60	Scour behind log vane	BWPA6
BWPA7	Bank erosion	34+50	Scour	BWPA7
BWPA8	Bank erosion	34+75	Scour	BWPA8
BWPA9	Bank erosion	34+90	Scour	BWPA9
BWPA10	Aggradation, mid-channel bar formation	43+00	Inadequate sediment transport	BWPA10
BWPA11	Aggradation, mid-channel bar formation	40+00	Upstream erosion	BWPA11
BWPA12	Structure failure	42+60	Rocks obstructing flow, causing flow diversion into banks	BWPA12
BWPA13	Aggradation, lateral bar formation	44+70	Lateral migration of channel	BWPA13
BWPA14	Bank erosion	49+75	Lateral migration of channel	BWPA14
BWPA15	Structure degradation	49+60	Stability	BWPA15
BWPA16	Aggradation, mid-channel bar formation	52+00	Inadequate sediment transport	BWPA16
BWPA17	Structure degradation	54+80	Scour	BWPA17
BWPA18	Structure degradation	56+00	Floodplain flow is undermining log structure	BWPA18
BWPA19	Structure degradation	56+10	Scour	BWPA19
BWPA20	Structure degradation	62+60	Scour	BWPA20
BWPA21	Structure degradation	63+10	Scour	BWPA21
BWPA22	Structure degradation	64+90	Scour	BWPA22
BWPA23	Bank erosion	65+20	Scour	BWPA23
BWPA24	Structure degradation	67+00	Stability	BWPA24
BWPA25	Aggradation, mid-channel bar formation	67+80	Upstream erosion	BWPA25

Table B1b. Stream Problem Areas – Mountain Creek
Big Warrior Creek
EEP Project Number 00412

Feature #	Feature Issue	Station	Suspected Cause	Photo #
MCPA1	Structure failure	0+00	Too much elevation drop	MCPA1
MCPA2	Structure failure	1+80	Log not keyed into bank adequately	MCPA2
MCPA3	Bank erosion	2+10	Scour	MCPA3
MCPA4	Bank erosion	6+80	Scour	MCPA4
MCPA5	Bank erosion	10+00	Scour	MCPA5
MCPA6	Bank erosion	13+75	Scour	MCPA6
MCPA7	Bank failure	14+80	Scour	MCPA7
MCPA8	Bank erosion and aggradation	17+00	Excessive scour	MCPA8
MCPA9	Bank failure	17+60	Excessive scour	MCPA9
MCPA10	Aggradation, mid-channel bar formation	23+90	Upstream scour	MCPA10

Table B1c. Stream Problem Areas – Unnamed Tributary
Big Warrior Creek
EEP Project Number 00412

Feature #	Feature Issue	Station	Suspected Cause	Photo #
UTPA1	Severe sedimentation (pool filled in)	5+00	Upstream erosion/clearcut	UTPA1
UTPA2	Severe sedimentation (pool filled in)	9+00	Upstream erosion/clearcut	UTPA2

BIG WARRIOR (9/12/07)


BWPA1 facing right bank


BWPA2 facing left bank


BWPA3 facing upstream


BWPA4 facing left bank


BWPA5 facing downstream


BWPA6 facing right bank


BWPA7 facing right bank


BWPA8 facing left bank


BWPA9 facing left bank


BWPA10 facing downstream


BWPA11 facing upstream


BWPA12 facing upstream


BWPA13 facing downstream


BWPA14 facing right bank


BWPA15 looking down at left bank


BWPA16 facing upstream


BWPA17 facing left bank


BWPA18 facing right bank


BWPA19 facing right bank


BWPA20 facing right bank


BWPA21 facing right bank


BWPA22 facing left bank


BWPA23 facing left bank


BWPA24 facing downstream

BWPA25 facing downstream

MOUNTAIN CREEK (9/11/07)

MCPA1 facing downstream at right bank

MCPA2 facing left bank

MCPA3 facing upstream

MCPA4 facing right bank


MCNPA5 facing right bank


MCPA6 facing right bank


MCPA7 facing right bank


MCPA8 facing downstream


MCPA9 facing downstream


MCPA10 facing right bank

UNNAMED TRIBUTARY (9/10/07)

UTPA1 facing upstream

UTPA2 facing upstream


PS1 – Big Warrior Creek (9/12/07)


PS2 – Big Warrior Creek (9/12/07)


PS3 – Big Warrior Creek (9/12/07)


PS4 – Big Warrior Creek (9/12/07)


PS5 – Big Warrior Creek (9/12/07)


PS6 – Big Warrior Creek (9/11/07)


PS7 – Big Warrior Creek (9/10/07)


PS8 - Big Warrior Creek (9/10/07)


PS9 – Unnamed Tributary (9/10/07)


PS10 – Unnamed Tributary (9/10/07)


PS11 – Unnamed Tributary (9/10/07)


PS12 – Unnamed Tributary (9/10/07)


PS13 – Unnamed Tributary (9/10/07)


PS14 – Unnamed Tributary (9/10/07)


PS15 – Big Warrior Creek (9/10/07)


PS16 – Big Warrior Creek (9/11/07)


PS17 – Big Warrior Creek (9/11/07)


PS18 – Mountain Creek (9/11/07)


PS19 – Mountain Creek (9/11/07)


PS20 – Mountain Creek (9/11/07)


PS21 – Mountain Creek (9/11/07)


PS22 – Mountain Creek (9/11/07)


PS23 – Mountain Creek (9/11/07)


PS24 – Mountain Creek (9/11/07)


PS25 – Mountain Creek (9/11/07)


PS26 – Big Warrior Creek (9/10/07)


PS27 – Big Warrior Creek (9/10/07)


PS28 – Big Warrior Creek (9/10/07)


PS29 – Big Warrior Creek (9/10/07)


PS30 – Big Warrior Creek (9/12/07)


PS31 – Big Warrior Creek (9/12/07)


PS32 – Big Warrior Creek (9/12/07)


PS33 – Big Warrior Creek (9/12/07)

Table B2. Visual Morphological Stability Assessment
Big Warrior Creek
EEP Project Number 00412

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?	41	41	NA	100	
	2. Armor stable (no displacement)?	41	41	NA	100	
	3. Facet grade appears stable?	41	41	NA	100	
	4. Minimal evidence of embedding/fining?	41	41	NA	100	
	5. Length appropriate?	41	41	NA	100	
						100
B. Pools	1. Present (not subject to severe aggrad. or migration)?	56	56	NA	100	
	2. Sufficiently deep (max pool D:mean Bkf >1.6)	56	56	NA	100	
	3. Length appropriate?	56	56	NA	100	
						100
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	54	56	NA	96	
	2. Downstream of meander (glide/inflection) centering?	54	56	NA	96	
						96
D. Meanders	1. Outer bend in state of limited/controlled erosion?	52	56	NA	93	
	2. Of those eroding, # w/concomitant point bar formation?	0	NA	NA	NA	
	3. Apparent Rc within spec?	56	56	NA	100	
	4. Sufficient floodplain access and relief?	56	56	NA	100	
						98
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	15/150 LF	85	
	2. Channel bed degradation–areas of increasing downcutting/headcutting?	NA	NA	0	100	
						93
F. Bank	1. Actively eroding, wasting, or slumping bank	NA	NA	250/11035	98	
						98
F. Vanes	1. Free of back or arm scour?	67	89	NA	75	
	2. Height appropriate?	67	89	NA	75	
	3. Angle and geometry appear appropriate?	67	89	NA	75	
	4. Free of piping or other structural failures?	67	89	NA	75	
						75
G. Wads/ Boulders	1. Free of scour?	52	71	NA	73	
	2. Footing stable?	52	71	NA	73	73

BIG WARRIOR (9/12/07)


XS1 facing left bank


XS1 facing right bank


XS2 facing left bank

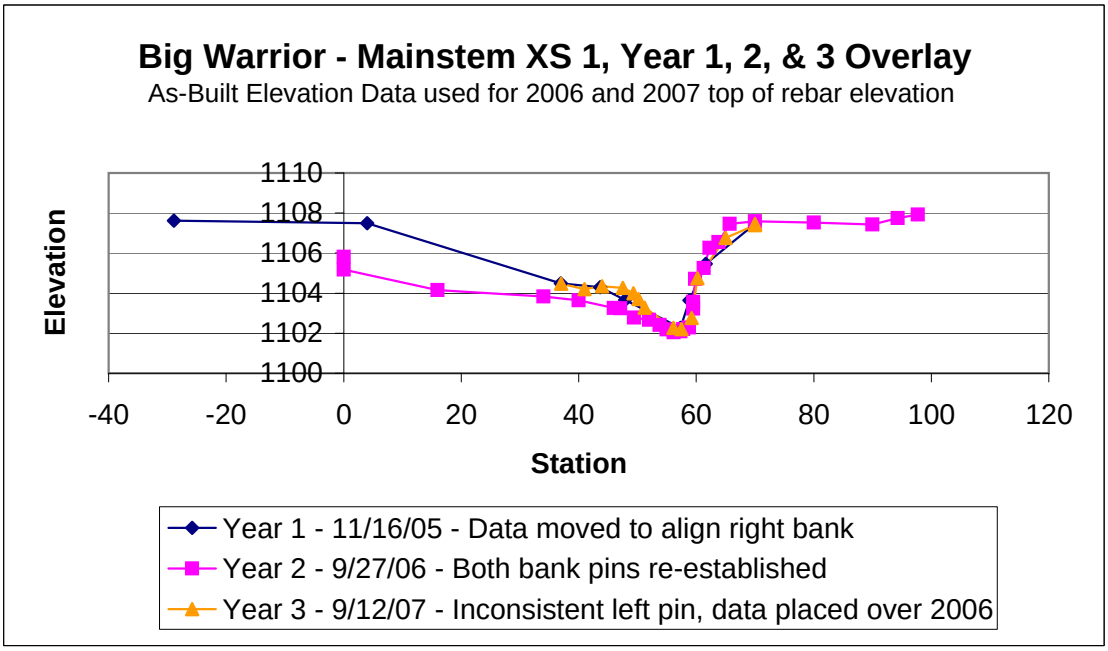

XS2 facing right bank

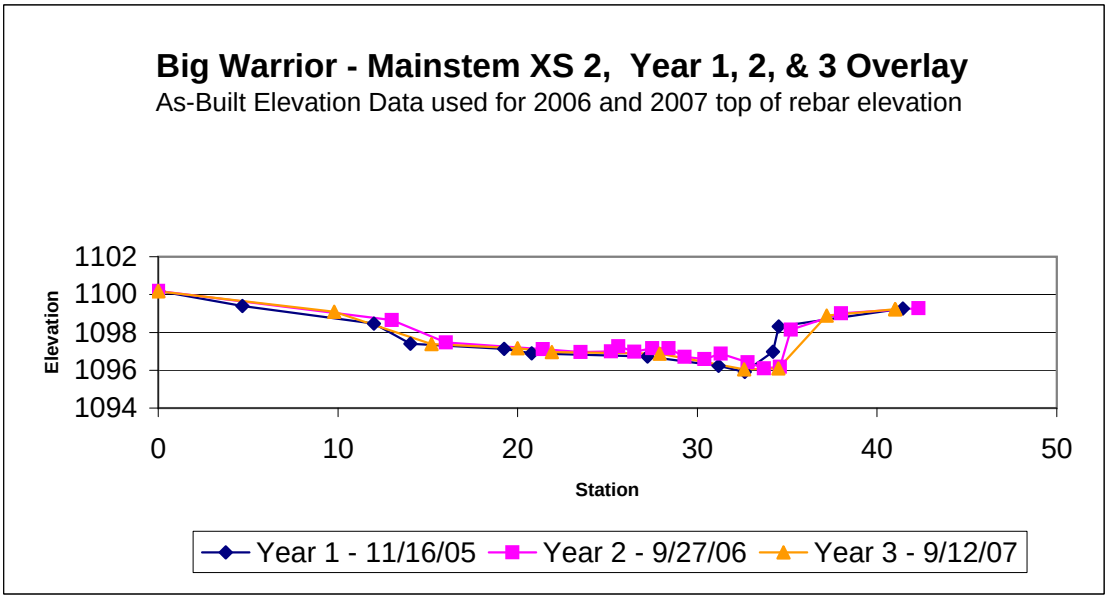

XS3 facing left bank

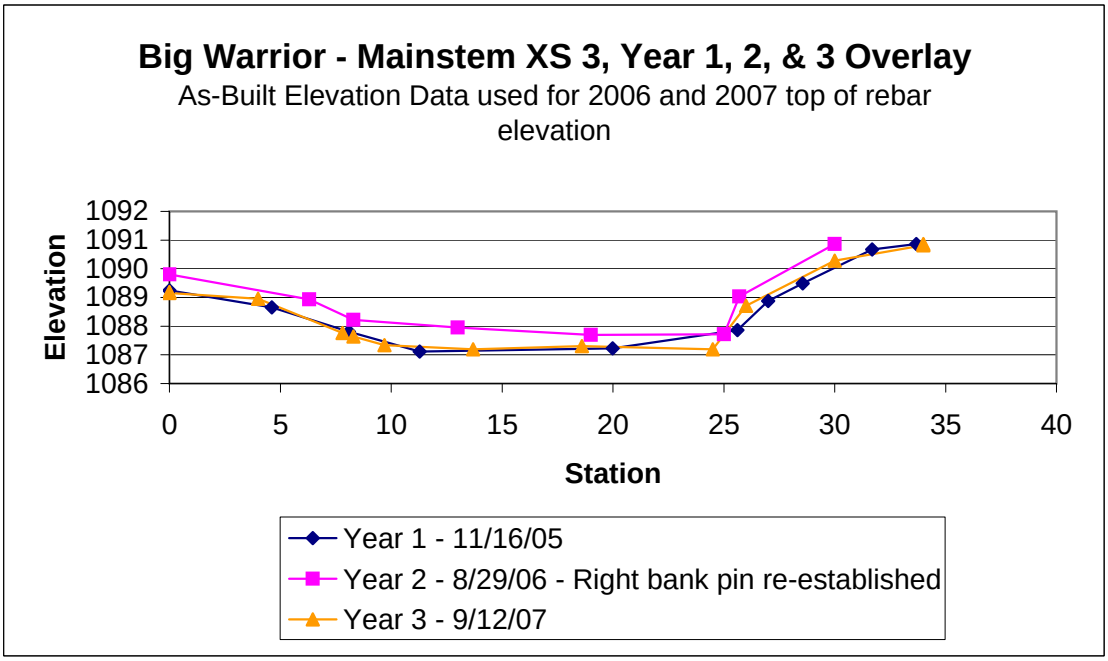

XS3 facing right bank

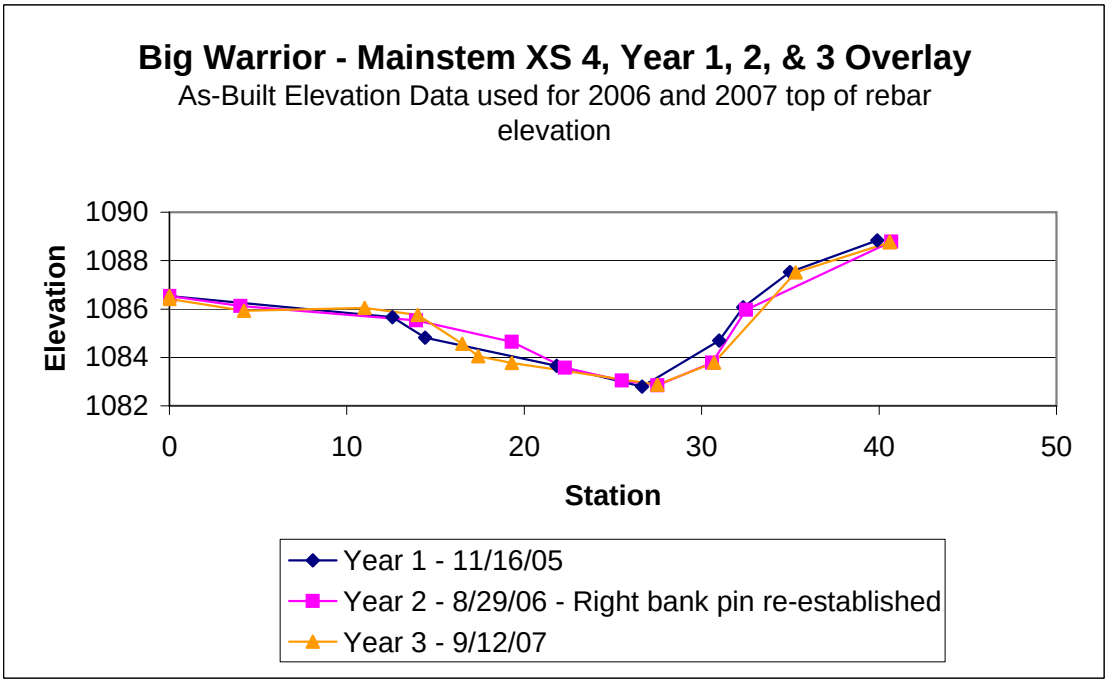

XS4 facing left bank


XS4 facing right bank


Big Warrior - Mainstem XS 1, Year 1, 2, & 3 Overlay
As-Built Elevation Data used for 2006 and 2007 top of rebar elevation
Elevation
1110
1108
1106
1104
1102
1100
-40
-20
0
20
40
60
80
100
120
Station
Year 1 - 11/16/05 - Data moved to align right bank
Year 2 - 9/27/06 - Both bank pins re-established
Year 3 - 9/12/07 - Inconsistent left pin, data placed over 2006


Big Warrior - Mainstem XS 2, Year 1, 2, & 3 Overlay
As-Built Elevation Data used for 2006 and 2007 top of rebar elevation
Elevation
1102
1100
1098
1096
1094
0
10
20
30
40
50
Station
Year 1 - 11/16/05
Year 2 - 9/27/06
Year 3 - 9/12/07


Big Warrior - Mainstem XS 3, Year 1, 2, & 3 Overlay
As-Built Elevation Data used for 2006 and 2007 top of rebar elevation
Elevation
1092
1091
1090
1089
1088
1087
1086
0
5
10
15
20
25
30
35
40
Station
Year 1 - 11/16/05
Year 2 - 8/29/06 - Right bank pin re-established
Year 3 - 9/12/07


Big Warrior - Mainstem XS 4, Year 1, 2, & 3 Overlay
As-Built Elevation Data used for 2006 and 2007 top of rebar elevation
Elevation
1090
1088
1086
1084
1082
0
10
20
30
40
50
Station
Year 1 - 11/16/05
Year 2 - 8/29/06 - Right bank pin re-established
Year 3 - 9/12/07

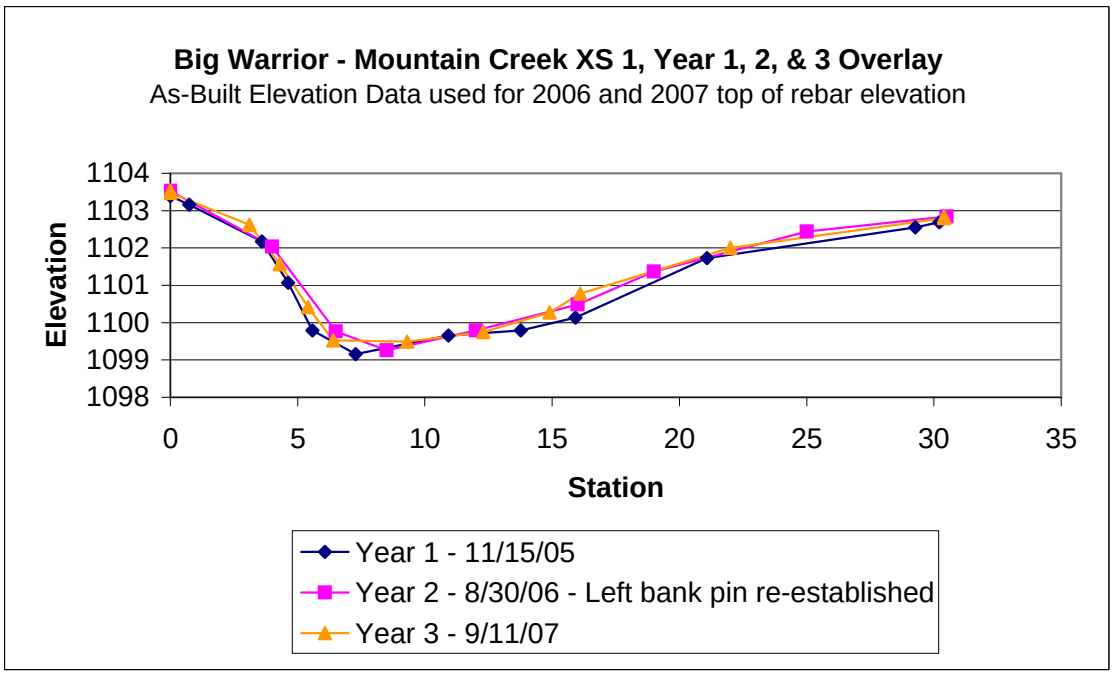
MOUNTAIN CREEK (9/11/07)

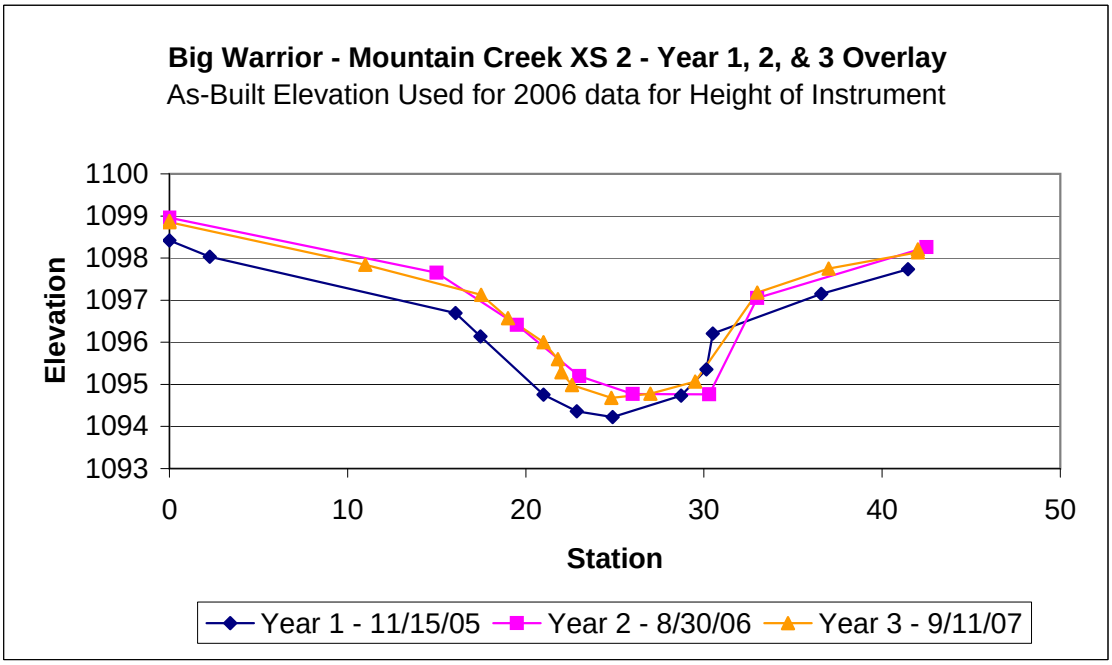

XS1 facing left bank


XS1 facing right bank


XS2 facing left bank


XS2 facing right bank


Big Warrior - Mountain Creek XS 1, Year 1, 2, & 3 Overlay
As-Built Elevation Data used for 2006 and 2007 top of rebar elevation
Elevation
1104
1103
1102
1101
1100
1099
1098
0
5
10
15
20
25
30
35
Station
Year 1 - 11/15/05
Year 2 - 8/30/06 - Left bank pin re-established
Year 3 - 9/11/07


Big Warrior - Mountain Creek XS 2 - Year 1, 2, & 3 Overlay
As-Built Elevation Used for 2006 data for Height of Instrument
Elevation
1100
1099
1098
1097
1096
1095
1094
1093
0
10
20
30
40
50
Station
Year 1 - 11/15/05
Year 2 - 8/30/06
Year 3 - 9/11/07

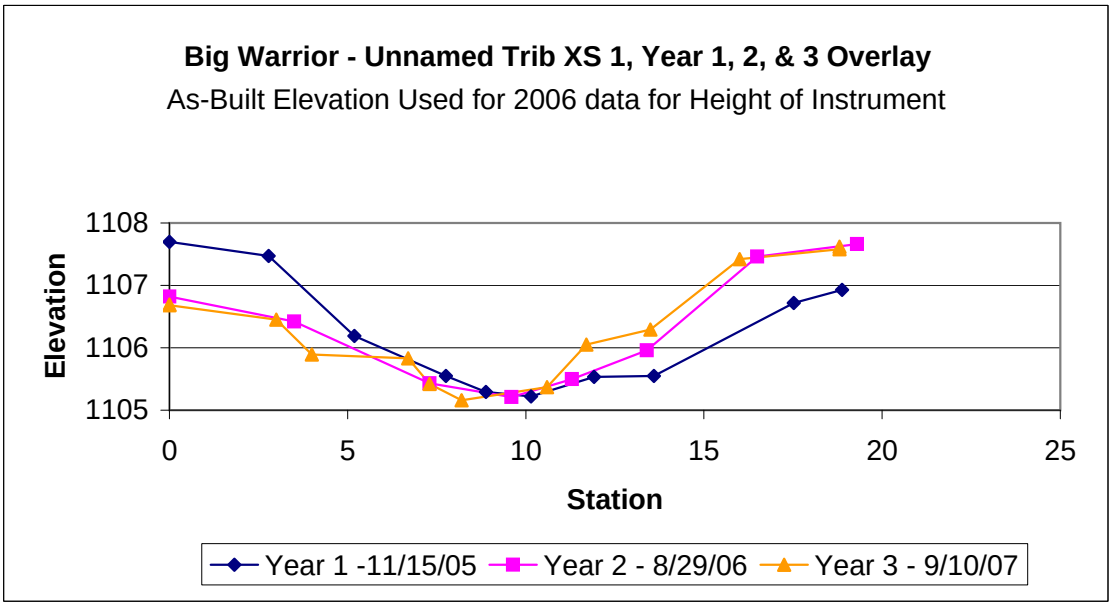
UNNAMED TRIBUTARY (9/10/07)

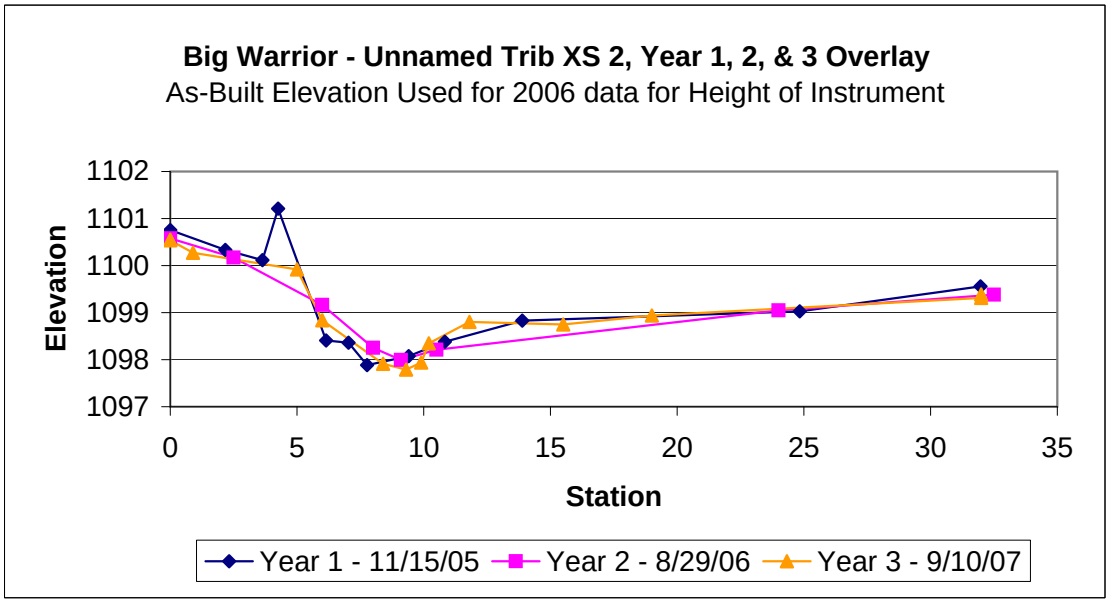

XS1 facing left bank


XS1 facing right bank


XS2 facing left bank

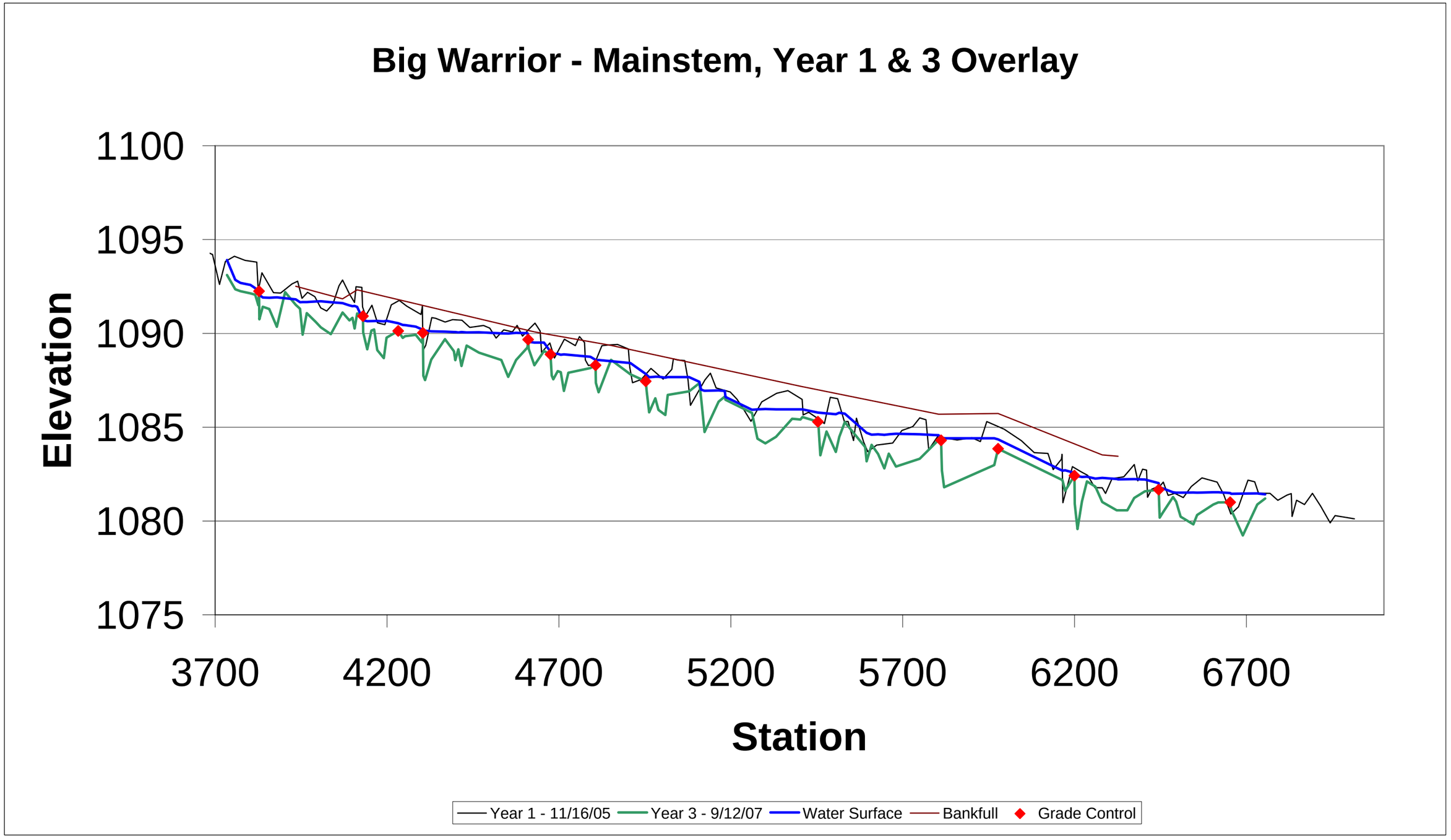

XS2 facing right bank


Big Warrior - Unnamed Trib XS 1, Year 1, 2, & 3 Overlay
As-Built Elevation Used for 2006 data for Height of Instrument
Elevation
1108
1107
1106
1105
0
5
10
15
20
25
Station
Year 1 -11/15/05
Year 2 - 8/29/06
Year 3 - 9/10/07


Big Warrior - Unnamed Trib XS 2, Year 1, 2, & 3 Overlay
As-Built Elevation Used for 2006 data for Height of Instrument
Elevation
1102
1101
1100
1099
1098
1097
0
5
10
15
20
25
30
35
Station
Year 1 - 11/15/05
Year 2 - 8/29/06
Year 3 - 9/10/07

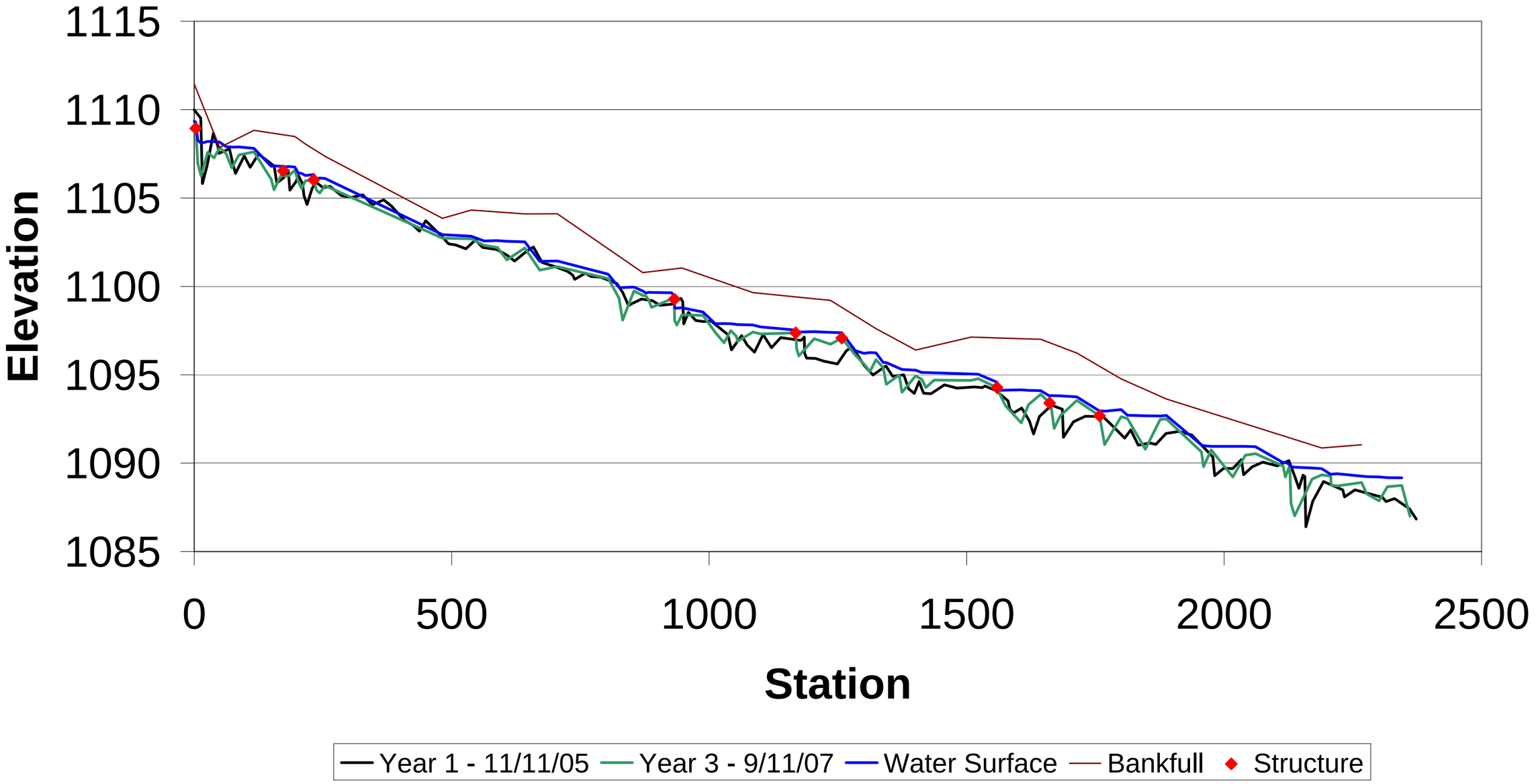
BIG WARRIOR

Big Warrior - Mainstem, Year 1 & 3 Overlay

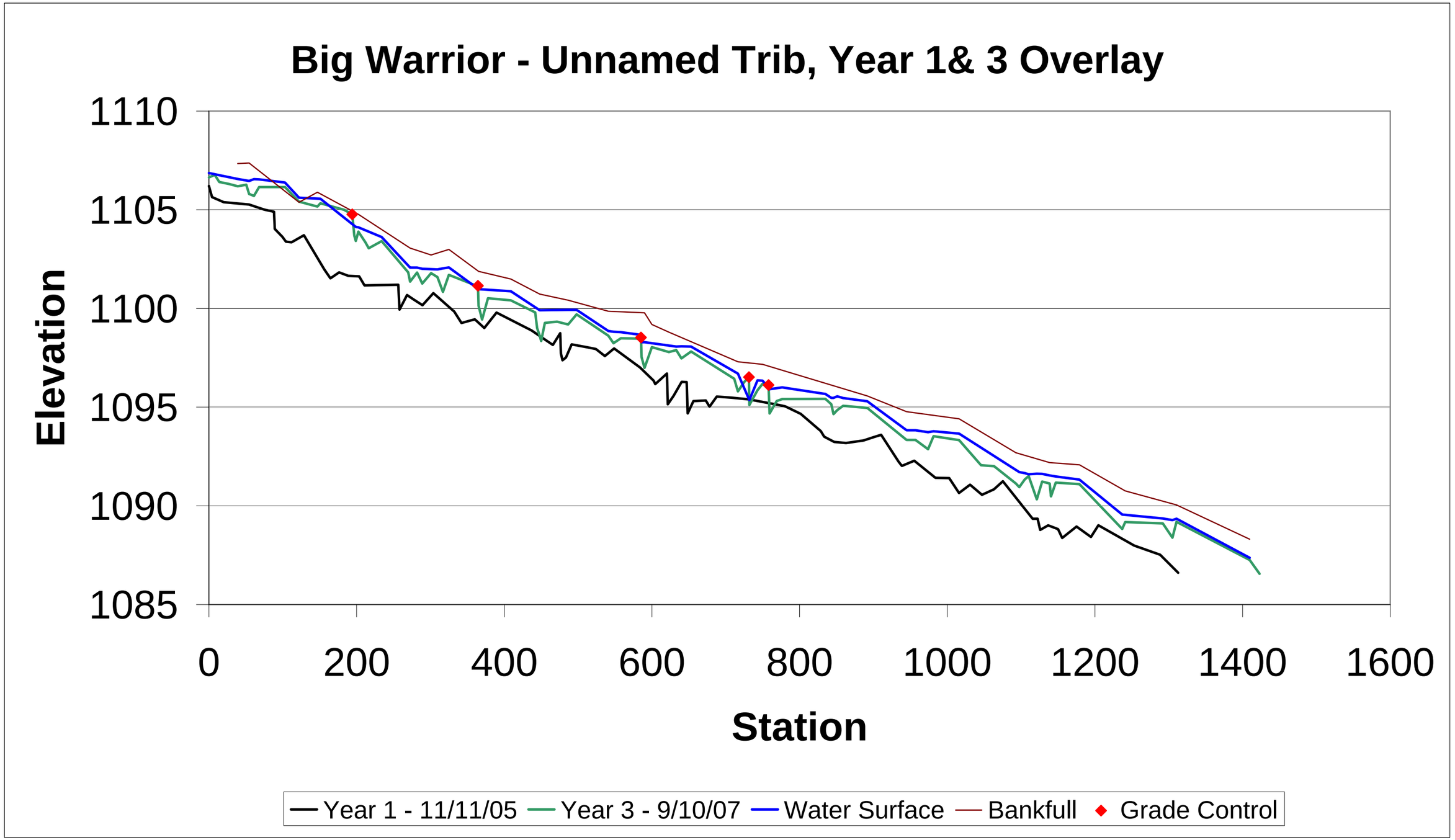


MOUNTAIN CREEK

Big Warrior - Mountain Creek, Year 1 & 3 Overlay



UNNAMED TRIBUTARY

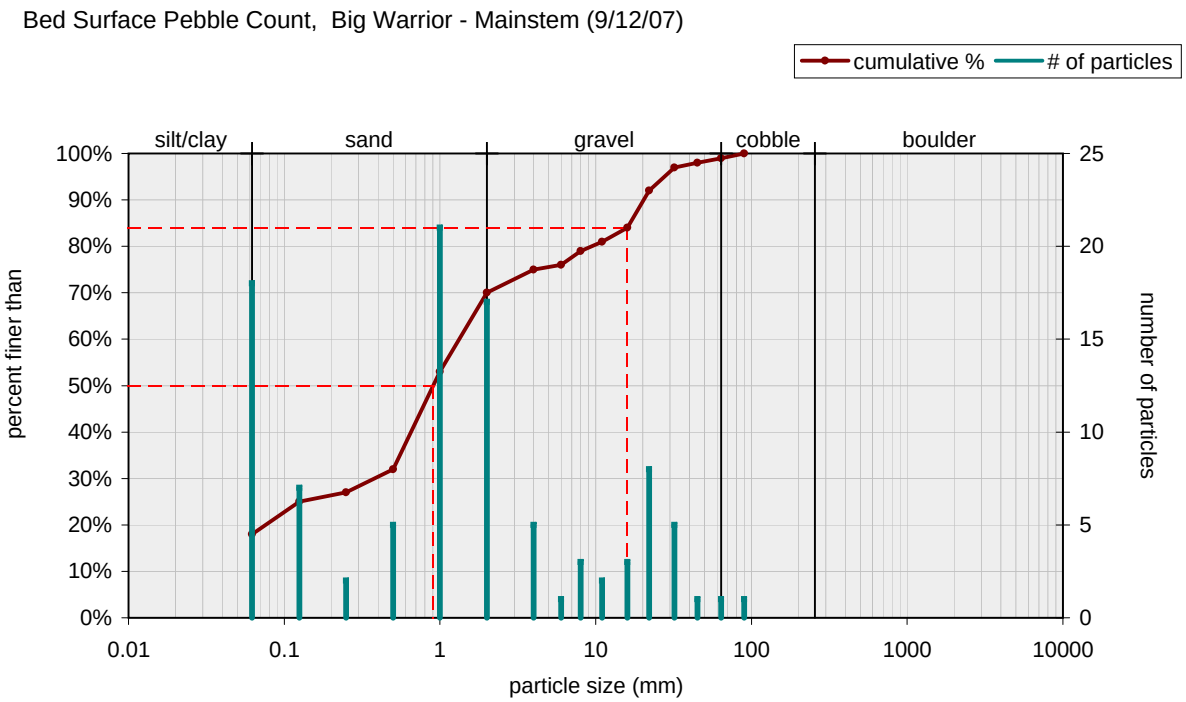

Big Warrior - Unnamed Trib, Year 1& 3 Overlay
Elevation
1110
1105
1100
1095
1090
1085
0
200
400
600
800
1000
1200
1400
1600
Station
Year 1 - 11/11/05
Year 3 - 9/10/07
Water Surface
Bankfull
Grade Control

BIG WARRIOR

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**18**
very fine sand	0.062 - 0.125	**7**
fine sand	0.125 - 0.25	**2**
medium sand	0.25 - 0.5	**5**
coarse sand	0.5 - 1	**21**
very coarse sand	1 - 2	**17**
very fine gravel	2 - 4	**5**
fine gravel	4 - 6	**1**
fine gravel	6 - 8	**3**
medium gravel	8 - 11	**2**
medium gravel	11 - 16	**3**
coarse gravel	16 - 22	**8**
coarse gravel	22 - 32	**5**
very coarse gravel	32 - 45	**1**
very coarse gravel	45 - 64	**1**
small cobble	64 - 90	**1**
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note:



Size (mm)	
D16	0.062
D35	0.55
D50	0.91
D65	1.6
D84	16
D95	28

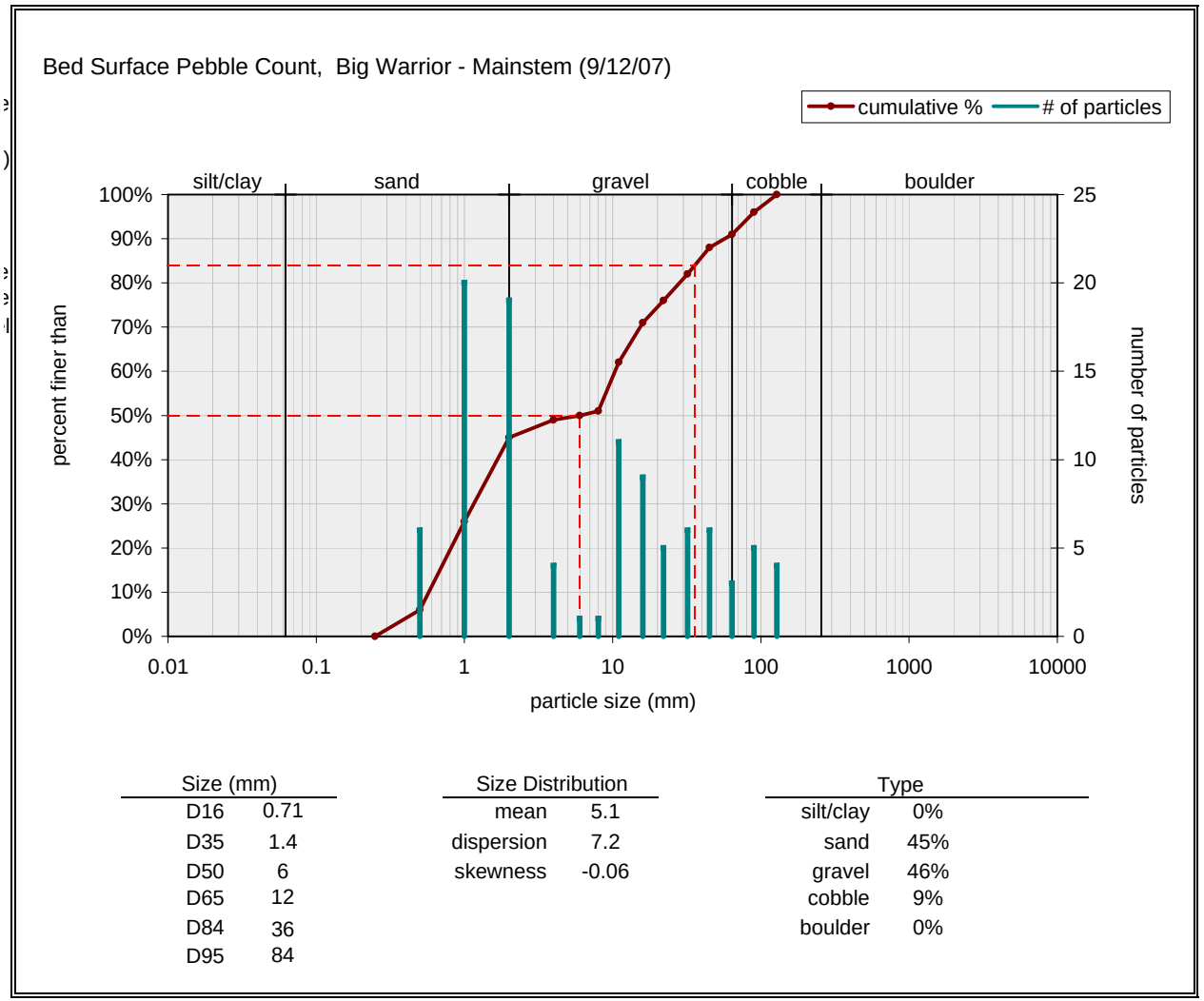
Size Distribution	
mean	1.0
dispersion	16.1
skewness	0.03

Type	
silt/clay	18%
sand	52%
gravel	29%
cobble	1%
boulder	0%

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	
medium sand	0.25 - 0.5	**6**
coarse sand	0.5 - 1	**20**
very coarse sand	1 - 2	**19**
very fine gravel	2 - 4	**4**
fine gravel	4 - 6	**1**
fine gravel	6 - 8	**1**
medium gravel	8 - 11	**11**
medium gravel	11 - 16	**9**
coarse gravel	16 - 22	**5**
coarse gravel	22 - 32	**6**
very coarse gravel	32 - 45	**6**
very coarse gravel	45 - 64	**3**
small cobble	64 - 90	**5**
medium cobble	90 - 128	**4**
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note:



Size (mm)	
D16	0.71
D35	1.4
D50	6
D65	12
D84	36
D95	84

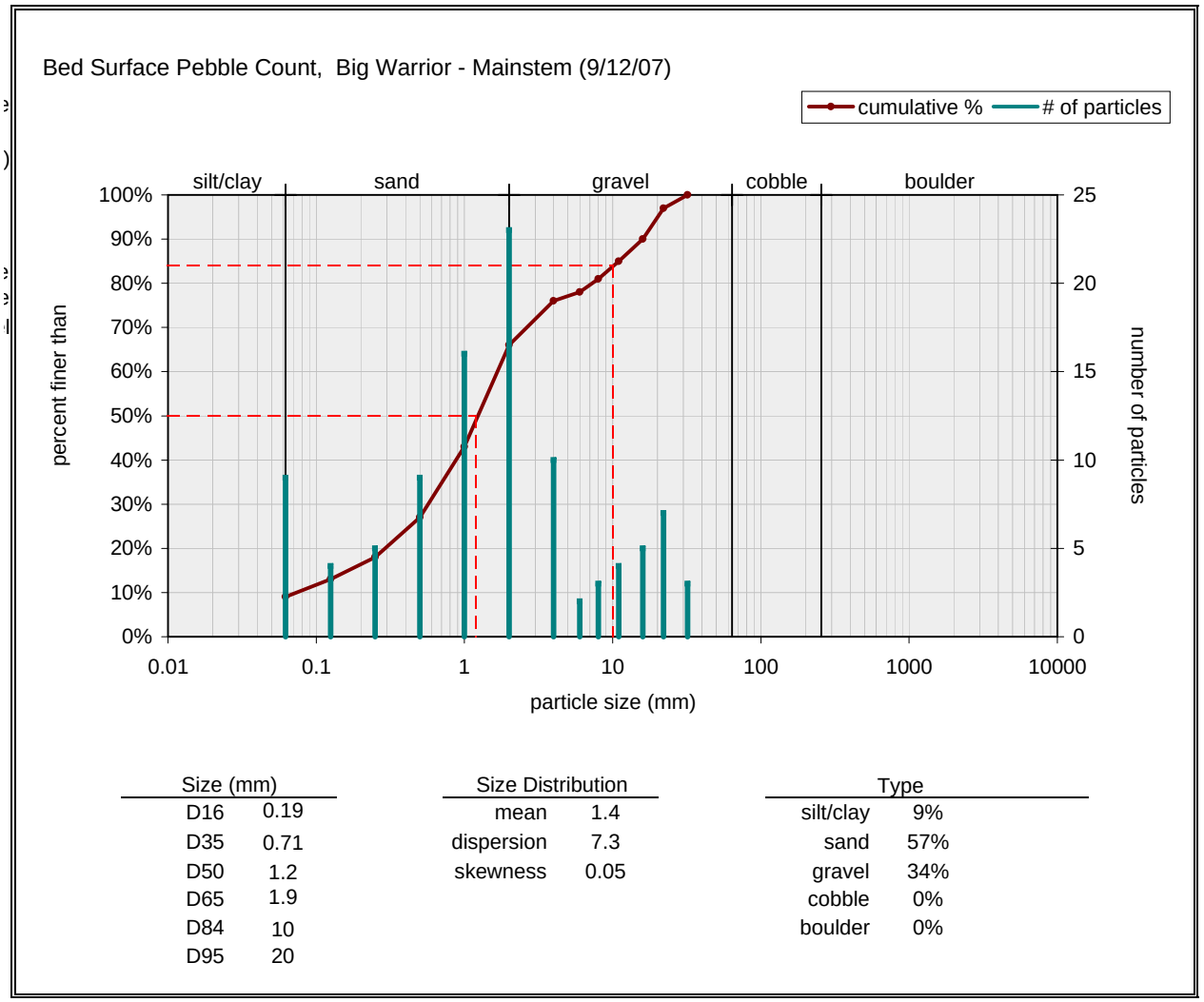
Size Distribution	
mean	5.1
dispersion	7.2
skewness	-0.06

Type	
silt/clay	0%
sand	45%
gravel	46%
cobble	9%
boulder	0%

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**9**
very fine sand	0.062 - 0.125	**4**
fine sand	0.125 - 0.25	**5**
medium sand	0.25 - 0.5	**9**
coarse sand	0.5 - 1	**16**
very coarse sand	1 - 2	**23**
very fine gravel	2 - 4	**10**
fine gravel	4 - 6	**2**
fine gravel	6 - 8	**3**
medium gravel	8 - 11	**4**
medium gravel	11 - 16	**5**
coarse gravel	16 - 22	**7**
coarse gravel	22 - 32	**3**
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
total count:		100

Note:



Size (mm)	
D16	0.19
D35	0.71
D50	1.2
D65	1.9
D84	10
D95	20

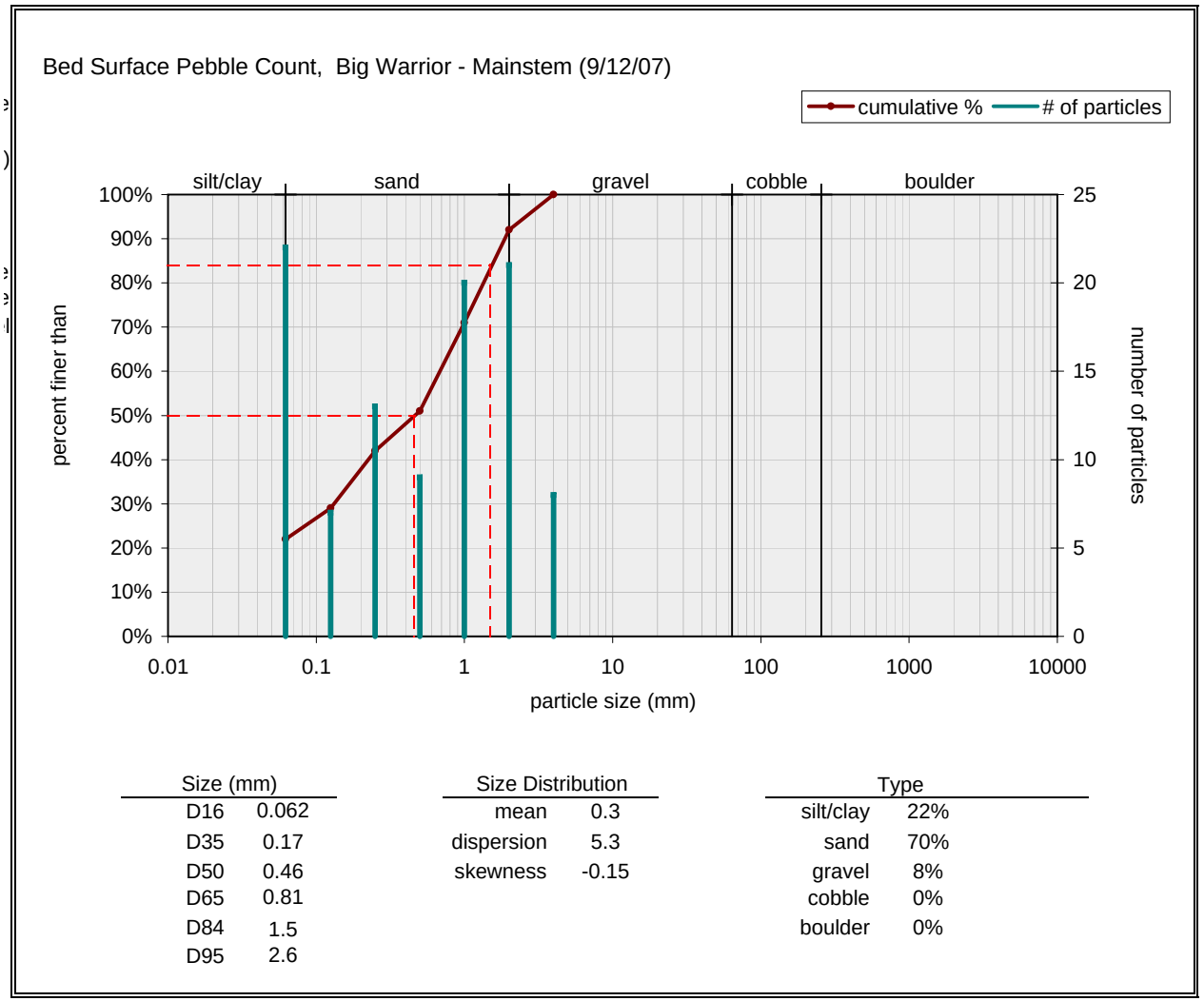
Size Distribution	
mean	1.4
dispersion	7.3
skewness	0.05

Type	
silt/clay	9%
sand	57%
gravel	34%
cobble	0%
boulder	0%

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**22**
very fine sand	0.062 - 0.125	**7**
fine sand	0.125 - 0.25	**13**
medium sand	0.25 - 0.5	**9**
coarse sand	0.5 - 1	**20**
very coarse sand	1 - 2	**21**
very fine gravel	2 - 4	**8**
fine gravel	4 - 6	
fine gravel	6 - 8	
medium gravel	8 - 11	
medium gravel	11 - 16	
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note:



Size (mm)	
D16	0.062
D35	0.17
D50	0.46
D65	0.81
D84	1.5
D95	2.6

Size Distribution	
mean	0.3
dispersion	5.3
skewness	-0.15

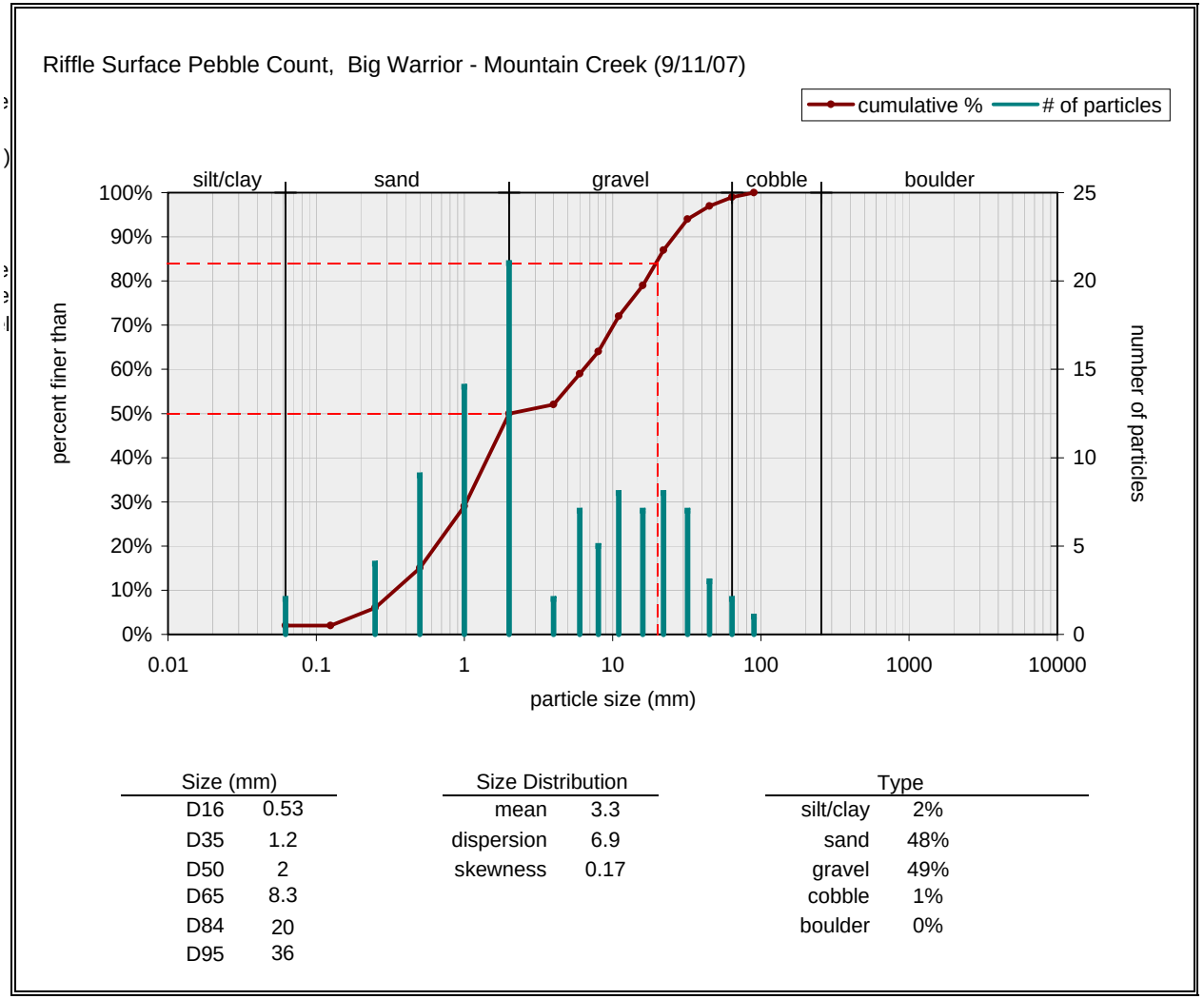
Type	
silt/clay	22%
sand	70%
gravel	8%
cobble	0%
boulder	0%

MOUNTAIN CREEK

Riffle Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**2**
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	**4**
medium sand	0.25 - 0.5	**9**
coarse sand	0.5 - 1	**14**
very coarse sand	1 - 2	**21**
very fine gravel	2 - 4	**2**
fine gravel	4 - 6	**7**
fine gravel	6 - 8	**5**
medium gravel	8 - 11	**8**
medium gravel	11 - 16	**7**
coarse gravel	16 - 22	**8**
coarse gravel	22 - 32	**7**
very coarse gravel	32 - 45	**3**
very coarse gravel	45 - 64	**2**
small cobble	64 - 90	**1**
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note:



Size (mm)	
D16	0.53
D35	1.2
D50	2
D65	8.3
D84	20
D95	36

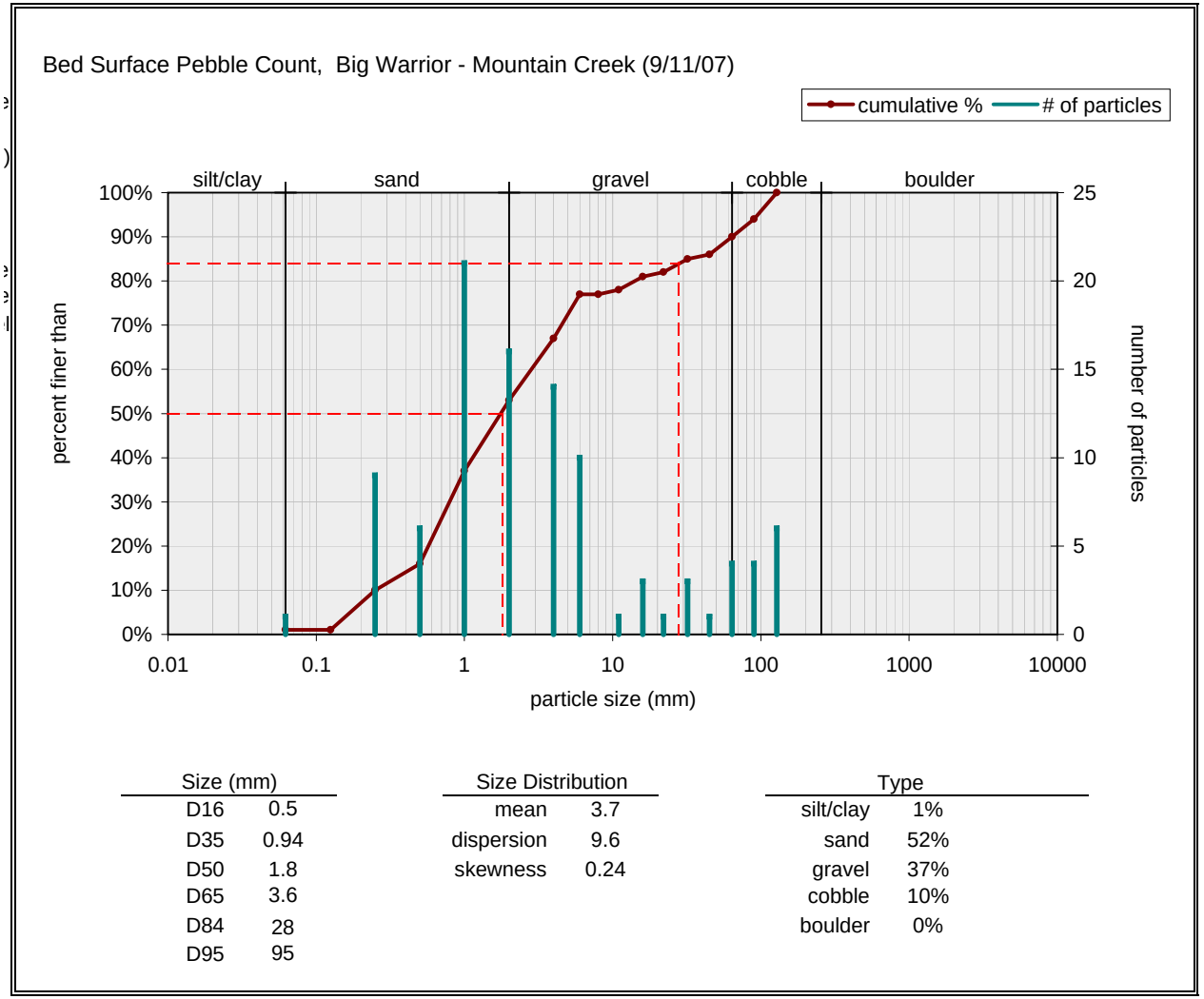
Size Distribution	
mean	3.3
dispersion	6.9
skewness	0.17

Type	
silt/clay	2%
sand	48%
gravel	49%
cobble	1%
boulder	0%

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**1**
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	**9**
medium sand	0.25 - 0.5	**6**
coarse sand	0.5 - 1	**21**
very coarse sand	1 - 2	**16**
very fine gravel	2 - 4	**14**
fine gravel	4 - 6	**10**
fine gravel	6 - 8	
medium gravel	8 - 11	**1**
medium gravel	11 - 16	**3**
coarse gravel	16 - 22	**1**
coarse gravel	22 - 32	**3**
very coarse gravel	32 - 45	**1**
very coarse gravel	45 - 64	**4**
small cobble	64 - 90	**4**
medium cobble	90 - 128	**6**
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
total count:		100

Note:



Size (mm)	
D16	0.5
D35	0.94
D50	1.8
D65	3.6
D84	28
D95	95

Size Distribution	
mean	3.7
dispersion	9.6
skewness	0.24

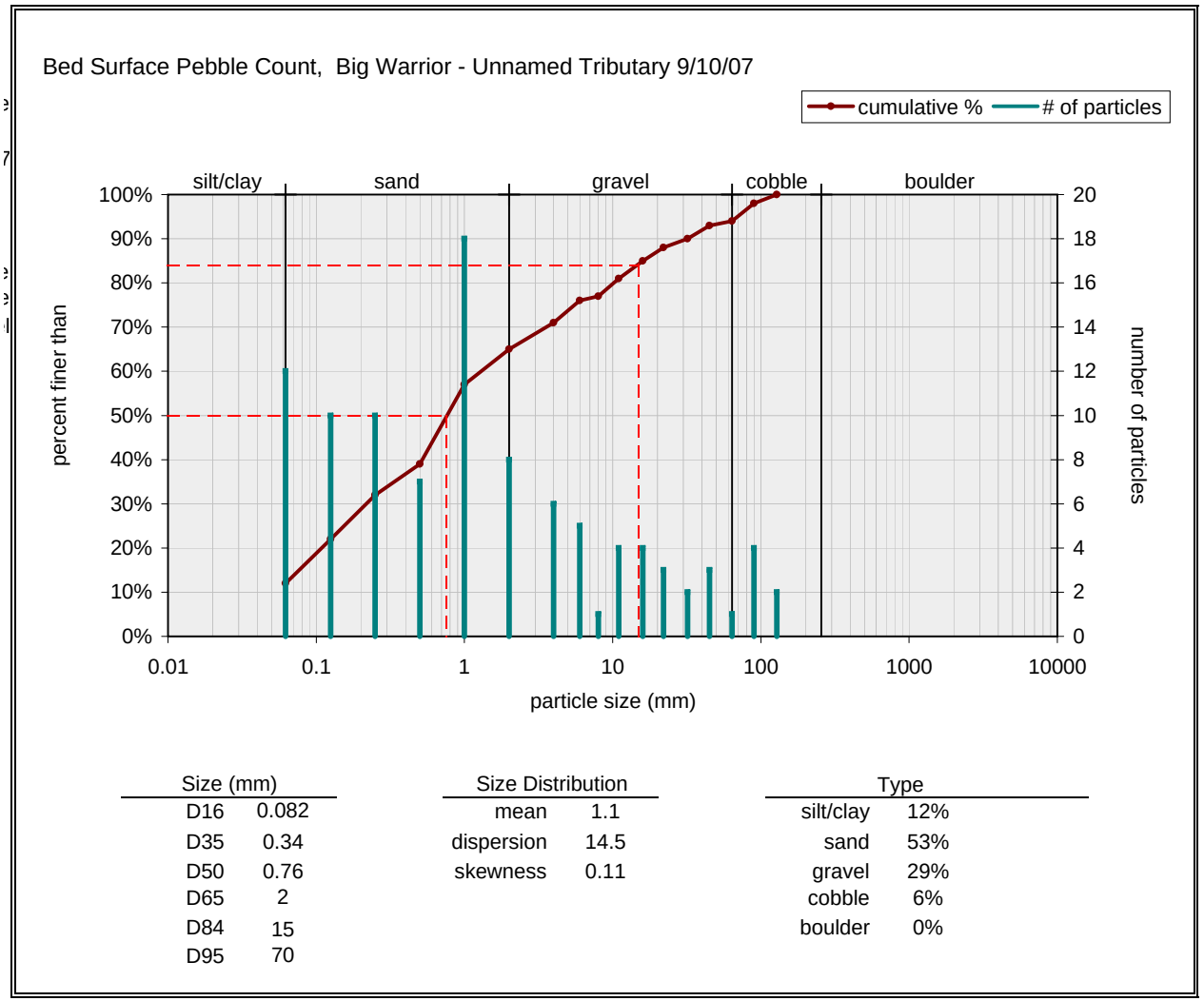
Type	
silt/clay	1%
sand	52%
gravel	37%
cobble	10%
boulder	0%

UNNAMED TRIBUTARY

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**12**
very fine sand	0.062 - 0.125	**10**
fine sand	0.125 - 0.25	**10**
medium sand	0.25 - 0.5	**7**
coarse sand	0.5 - 1	**18**
very coarse sand	1 - 2	**8**
very fine gravel	2 - 4	**6**
fine gravel	4 - 6	**5**
fine gravel	6 - 8	**1**
medium gravel	8 - 11	**4**
medium gravel	11 - 16	**4**
coarse gravel	16 - 22	**3**
coarse gravel	22 - 32	**2**
very coarse gravel	32 - 45	**3**
very coarse gravel	45 - 64	**1**
small cobble	64 - 90	**4**
medium cobble	90 - 128	**2**
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note:



Size (mm)	
D16	0.082
D35	0.34
D50	0.76
D65	2
D84	15
D95	70

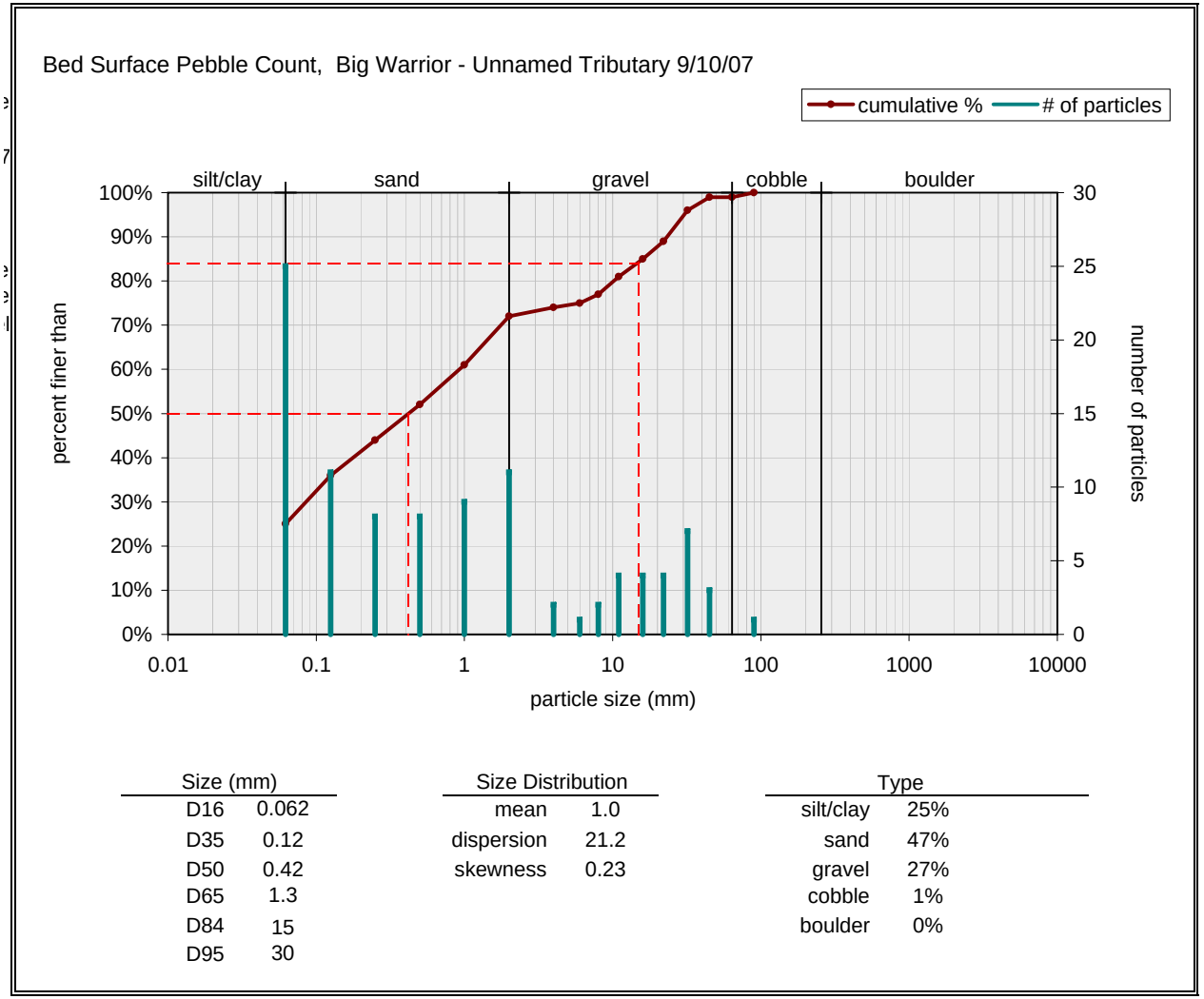
Size Distribution	
mean	1.1
dispersion	14.5
skewness	0.11

Type	
silt/clay	12%
sand	53%
gravel	29%
cobble	6%
boulder	0%

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**25**
very fine sand	0.062 - 0.125	**11**
fine sand	0.125 - 0.25	**8**
medium sand	0.25 - 0.5	**8**
coarse sand	0.5 - 1	**9**
very coarse sand	1 - 2	**11**
very fine gravel	2 - 4	**2**
fine gravel	4 - 6	**1**
fine gravel	6 - 8	**2**
medium gravel	8 - 11	**4**
medium gravel	11 - 16	**4**
coarse gravel	16 - 22	**4**
coarse gravel	22 - 32	**7**
very coarse gravel	32 - 45	**3**
very coarse gravel	45 - 64	
small cobble	64 - 90	**1**
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note:



Size (mm)	
D16	0.062
D35	0.12
D50	0.42
D65	1.3
D84	15
D95	30

Size Distribution	
mean	1.0
dispersion	21.2
skewness	0.23

Type	
silt/clay	25%
sand	47%
gravel	27%
cobble	1%
boulder	0%