Buffalo Creek Watershed
Phase II
Year 1 Monitoring Report
Greensboro, North Carolina

North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program

Prepared By:

BUCK ENGINEERING
8000 Regency Parkway
Suite 200
Cary, North Carolina 27511
Phone: 919.463.5488
Fax: 919.463.5490
www.buckengineering.com

January 2006

Buffalo Creeks Phase II
Benbow and Brown Bark Parks
Year 1 Monitoring Report
Greensboro, North Carolina

Prepared For:

NC Department of Environment and Natural Resources,
Ecosystem Enhancement Program

January 2006

Monitoring Report Prepared By Buck Engineering PC

William A. Harman, P.G.
Principal

Michael K. Rooney
Project Engineer

Table of Contents

1. Introduction

1.1. Summary

During the timeframe from January 2003 through final acceptance in May 2005 the North Carolina Ecosystem Enhancement Program (EEP) restored 16,126 feet of streams in two phases at four sites in the Buffalo and South Buffalo Creek Watersheds in Greensboro, North Carolina. This report addresses Year 1 monitoring in Phase II at Benbow Park and Brown Bark Park. Construction began at Benbow Park on April 23, 2004 and was completed, at Brown Bark Park, on August 26, 2004. Final walkthrough was conducted by NCEEP, State Construction Office, City of Greensboro Water Resources Department, and Buck Engineering on May 4, 2005 with both sites accepted as complete.

1.2. Year 1 Monitoring

Buck Engineering conducted the first of five years of monitoring from November 23 to December 2, 2005. This included cross section surveys done with a total station between permanent cross section pins (Tab 2). The longitudinal surveys were done with a total station (Tab 3). The photographs were taken with a digital camera which included the cross sections, structures, and vegetation plots (Tab 4). All photographs were taken from the photo points indicated on plan view and match the photo log in the original Buffalo Creek Watershed Phase II Mitigation Plan dated June 2005. The vegetation survival plots were counted for both bare-root plantings and live stakes (Tab 5). Finally, Buck Engineering checked both sites for maintenance concerns and impacts.

1.3. Year 1 Results

Overall the streams are functioning as designed. In most cases, changes in dimension represent an increase in stability. The pattern has remained constant, and there has been no change to sinuosity. The profile indicates bedform features are remaining within a stable range. The planting plan has not been as successful. Survival rates for bare roots and live stakes have been fair and are addressed in detail in section 2.5.

2. Success Criteria

Environmental components monitored in this project are those that allow an evaluation of channel stability and riparian survivability. Specifically, the success of channel modification, erosion control, seeding, and woody vegetation plantings were evaluated. The details for the first year follow.

2.1. Dimension

All 12 permanent cross section pins are still in place. Stakes were re-established as needed. The data in Tab 2 shows comparisons of the as-built cross sections to year 1 data.

2.1.1 Benbow Park Reach 1

The natural channel design for Reach 1 of Benbow Park was based on a combined Rosgen Priority 2 and 3 restoration approach. The incised Rosgen type "E5" channel was changed to a "B5c" and has remained so. There are three cross sections in this reach. Cross Sections 1 and 3 are stable riffles with very minor variations in dimension. The thalweg in the pool at Cross Section 2 has shifted to the left along with bank erosion that merits continued observation for possible repair.

2.1.2 Benbow Park Reach 2

The natural channel design for Reach 2 was based on a Rosgen Priority 1 approach. The existing straight channel was replaced with a new meandering channel at a higher elevation, which gives it access to its existing floodplain. There are three cross sections in this reach. Cross Sections 4 and 6 are stable riffles with minor variations in dimension. Cross Section 5 is a root wad pool that has increased in depth.

2.1.3 Brown Bark Reach

The natural channel design for the Brown Bark Park Reach was based on a combined Rosgen Priority 2 and 3 restoration approach. The existing Rosgen type "C5/E5" was changed to a "B5/C5" as part of the restoration work. There are six cross sections in this reach. Cross Sections 1, 3, 5, and 6 are stable riffles with minor changes in dimension. Cross Section 2 is a pool with root wads that has had an increase in depth of one foot where the root wads are. Cross section 4 is also a pool, without root wads, that has had minor changes to its dimension since construction.

2.2. Pattern and Profile

Buck Engineering completed longitudinal profiles using a total station. This included 4500 feet of channel in Benbow and Brown bark reaches. Measurements included the thalweg and water surface. The survey shows there is no change in sinuosity or pattern. The bedform diversity has improved and the riffle/pool sequence has remained fairly constant. The new thalweg shows some deeper pools and some with minor deposition.

2.3. Bed Material Analysis

We did not complete a bed material analysis since this is a sand/small gravel stream. We do not expect significant coarsening over time.

2.4. Photo Reference Sites

Photographs were taken at all permanent photo points. The photographs are in Tab 4. The photographs generally show the maturation of the sites. The vegetation is established on the banks. Woody vegetation survival rates are an issue. At Benbow 72% of the bare root plantings have survived. At Brown Bark this number is 54%. The survival rate for live stakes, at both sites, is a more robust 84%. Continued monitoring is recommended along with replanting, when needed. Banks are stable, with no unusual bank erosion.

2.5. Vegetation Survival Plots

Both Benbow and Brown Bark planting plans generally consisted of a 25-foot forested buffer except where limited, at Benbow, by sanitary sewer easements.

Benbow Park: Two vegetation survival plots (25'x100') were staked out. Plot one at ~ Station 15+00 (left bank) and at Plot two at ~ Station 27+50 (left bank). At Plot one, 84 of 100 live stakes (84%) and 36 of 43 (84%) bare root plantings were located. At plot two, 23 of 39 bare root plantings were located (59%).

Brown Bark Park: Two vegetation survival plots (25'x100') were staked out. Plot one at ~ Station 11+75 (left bank) and at Plot two at ~ Station 28+00 (left bank). At Plot one, 84 of 100 live stakes (84%) and 19 of 30 (63%) bare root plantings were located. At plot two, 24 of 49 bare root plantings were located (49%).

2.6. Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrate monitoring will be conducted by the NC Division of Water Quality.

3. Maintenance and Contingency Plans

3.1. Buffer Vegetation at Benbow and Brown Bark

The overall planted survival rates for Phase II are 63% for bare roots and 84% for live stakes. All vegetation was challenged by the lengthy drought conditions of the summer of 2005. Another mitigating factor in vegetative survival is the fact that the projects are located in active city parks. It should be noted that installation of the 4" x 4" buffer markers has made a tangible difference in bare root survival. At Phase I locations. Hillsdale Park and Gillespie Golf Course, reaches the bare root survival rate was 27%, with no buffer markers. Most of the damage to the bare roots was caused by the City of Greensboro Parks and Recreation Department mowers. At Phase II locations, Benbow Park and Brown Bark Park, the bare root survival rate was 63%, with buffer markers.

Benbow Park Cross Section Pin Locations

Cross Section	Northing	Easting	Elevation
XSEC 1 Left Pin	839329	1771034	736.6
XSEC 1 Right Pin	839300	1770970	740.0
XSEC 2 Left Pin	839179	1771098	734.0
XSEC 2 Right Pin	839159	1771038	738.9
XSEC 3 Left Pin	839072	1771135	733.5
XSEC 3 Right Pin	839054	1771085	737.8
XSEC 4 Left Pin	838399	1771303	728.3
XSEC 4 Right Pin	838427	1771250	729.4
XSEC 5 Left Pin	838316	1771422	732.1
XSEC 5 Right Pin	838290	177357	727.8
XSEC 6 Left Pin	838183	1771422	727.8
XSEC 6 Right Pin	838135	1771413	728.9

Benbow Park Reach 1

Cross Section Dimension Summary

XSEC	STA	Date	Feature	Str Type	Wfpa	Wbkf	Dbkf	W/D	Abkf	Dmax	ER	BHR
1	13+30	11/30/2004	Riffle	B5c	35	16.4	1.3	13.1	20.5	2.0	2.2	1.0
	13+30	11/31/2005	Riffle	B5c	35	15.4	1.1	14.1	16.7	1.8	2.1	1.0
	13+30	Y2	Riffle									
	13+30	Y3	Riffle									
	13+30	Y4	Riffle									
2	14+95	11/30/2004	Pool		49	16.9	2.4	7.2	39.7	3.7	2.9	1.0
	14+95	11/31/2005	Pool		49	18.7	2.5	7.4	47.4	3.8	2.6	1.0
	14+95	Y2	Pool									
	14+95	Y3	Pool									
	14+95	Y4	Pool									
3	16+10	11/30/2004	Riffle	B5c	38	20.3	1.2	15.1	20.3	1.7	2.2	1.0
	16+10	11/31/2005	Riffle	B5c	39	20.0	1.3	14.9	26.9	2.2	2.1	1.0
	16+10	Y2	Riffle									
	16+10	Y3	Riffle									
	16+10	Y4	Riffle									

Str Type = Rosgen Classification
Wfpa = Width Flood Prone Area (ft)
Wbkf = Bankfull Width (ft)

Dbkf = Bankfull Mean Depth (ft)
W/D = Bkf Width to Depth Ratio (ft/ft)
Abkf = Bkf Cross Section Area (sq ft)

Dmax = Bankfull Maximum Depth (ft)
ER = Entrenchment Ratio, Wfpa/Wbkf (ft/ft)
BHR = Bank Height Ratio, Dtob/Dmax (ft/ft)

Benbow Park Reach 2

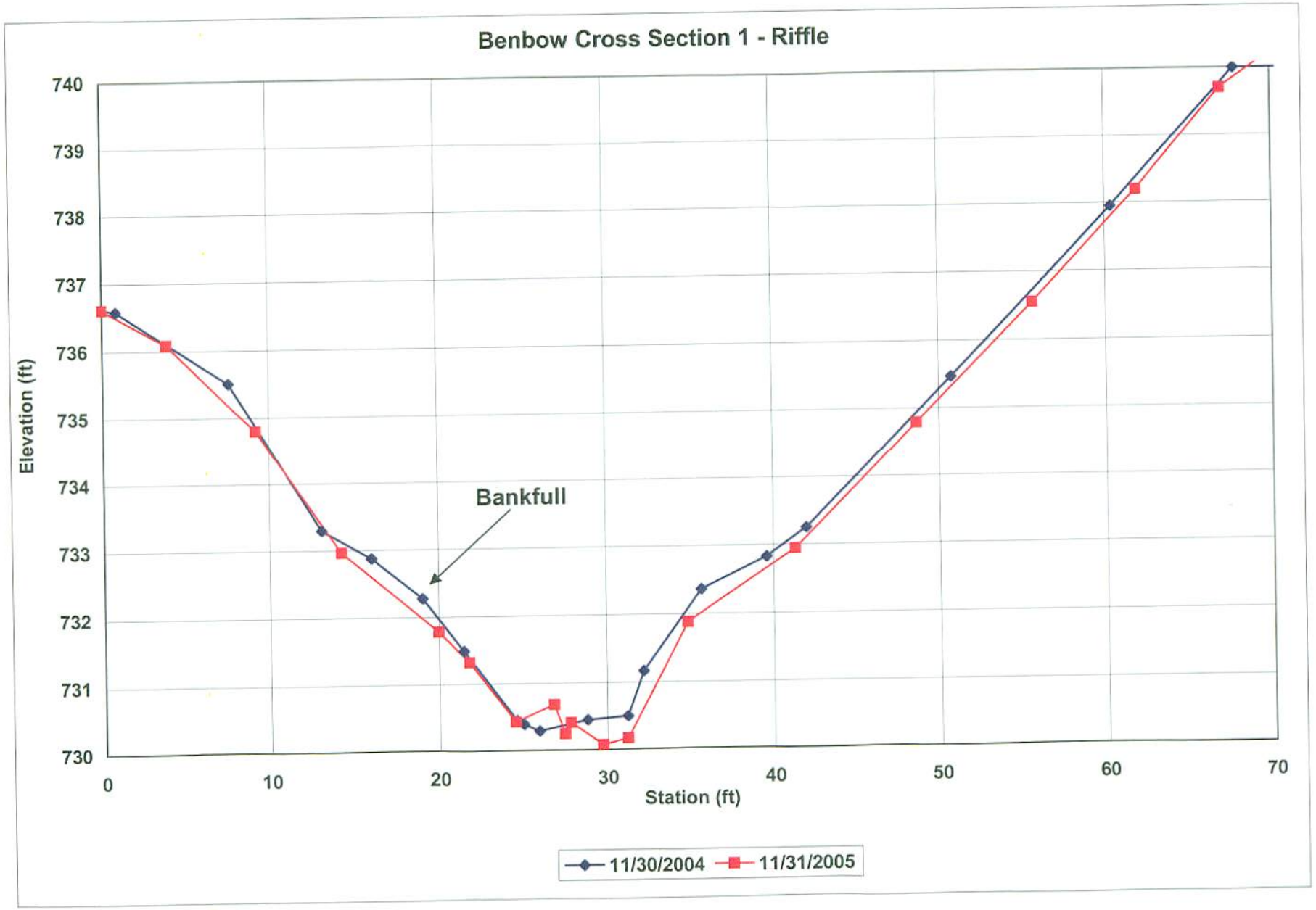
Cross Section Dimension Summary

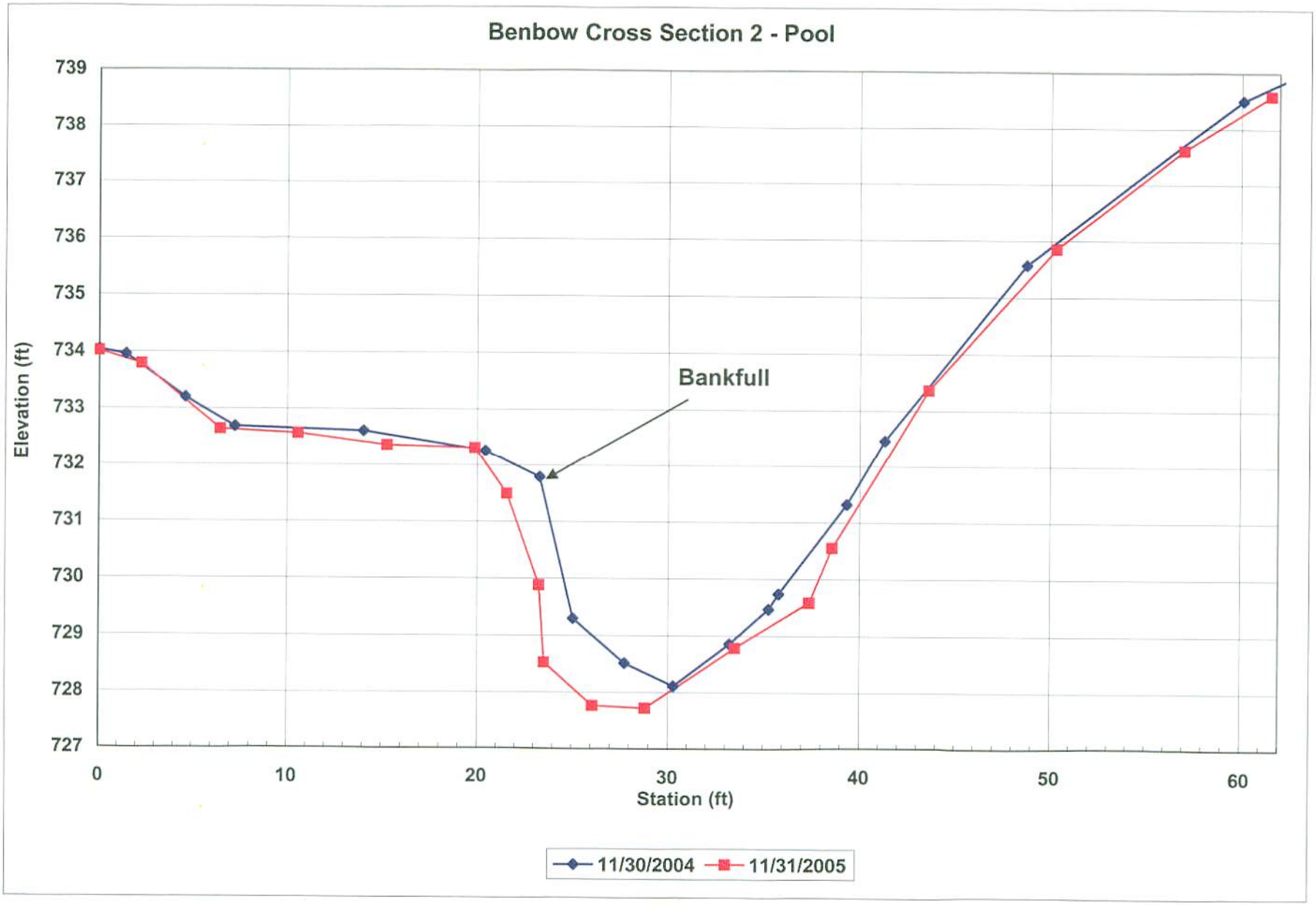
XSEC	STA	Date	Feature	Str Type	Wfpa	Wbkf	Dbkf	W/D	Abkf	Dmax	ER	BHR
4	23+36	11/30/2004	Riffle	E5	59	20.0	1.9	10.4	38.1	3.0	3.0	1.0
	23+36	11/31/2005	Riffle	E5	59	19.4	1.9	10.4	36.1	2.9	3.1	1.0
	23+36	Y2	Riffle									
	23+36	Y3	Riffle									
	23+36	Y4	Riffle									
5	25+10	11/30/2004	Pool		58	18.4	1.9	9.6	35.5	3.4	3.2	1.0
	25+10	11/31/2005	Pool		59	18.9	2.1	8.9	40.0	3.9	3.3	1.0
	25+10	Y2	Pool									
	25+10	Y3	Pool									
	25+10	Y4	Pool									
6	26+92	11/30/2004	Riffle	E5	49	18.5	1.8	10.3	33.2	2.7	2.7	1.0
	26+92	11/31/2005	Riffle	E5	49	18.0	1.9	9.3	35.0	3.3	2.7	1.0
	26+92	Y2	Riffle									
	26+92	Y3	Riffle									
	26+92	Y4	Riffle									

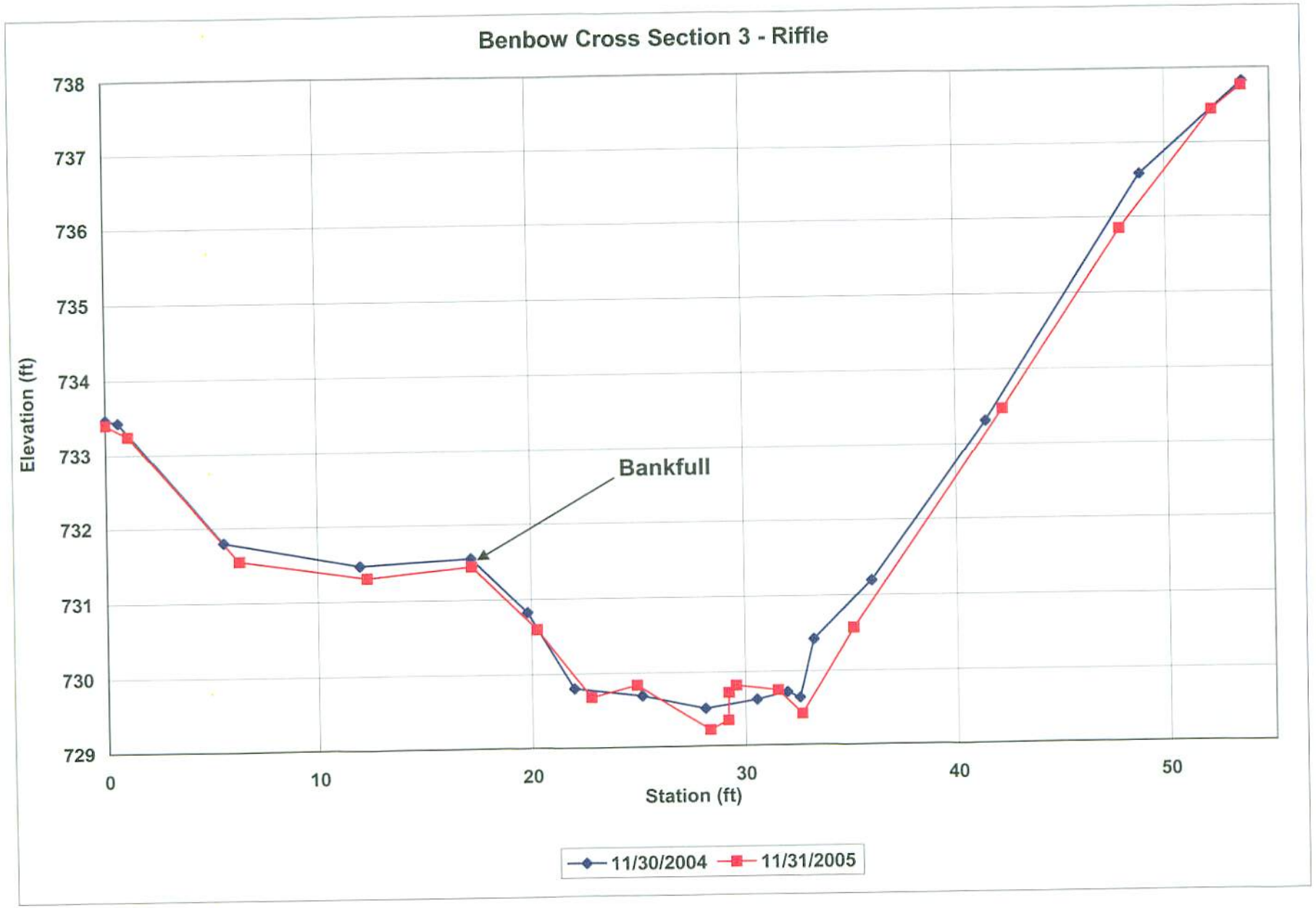
Str Type = Rosgen Classification
Wfpa = Width Flood Prone Area (ft)
Wbkf = Bankfull Width (ft)

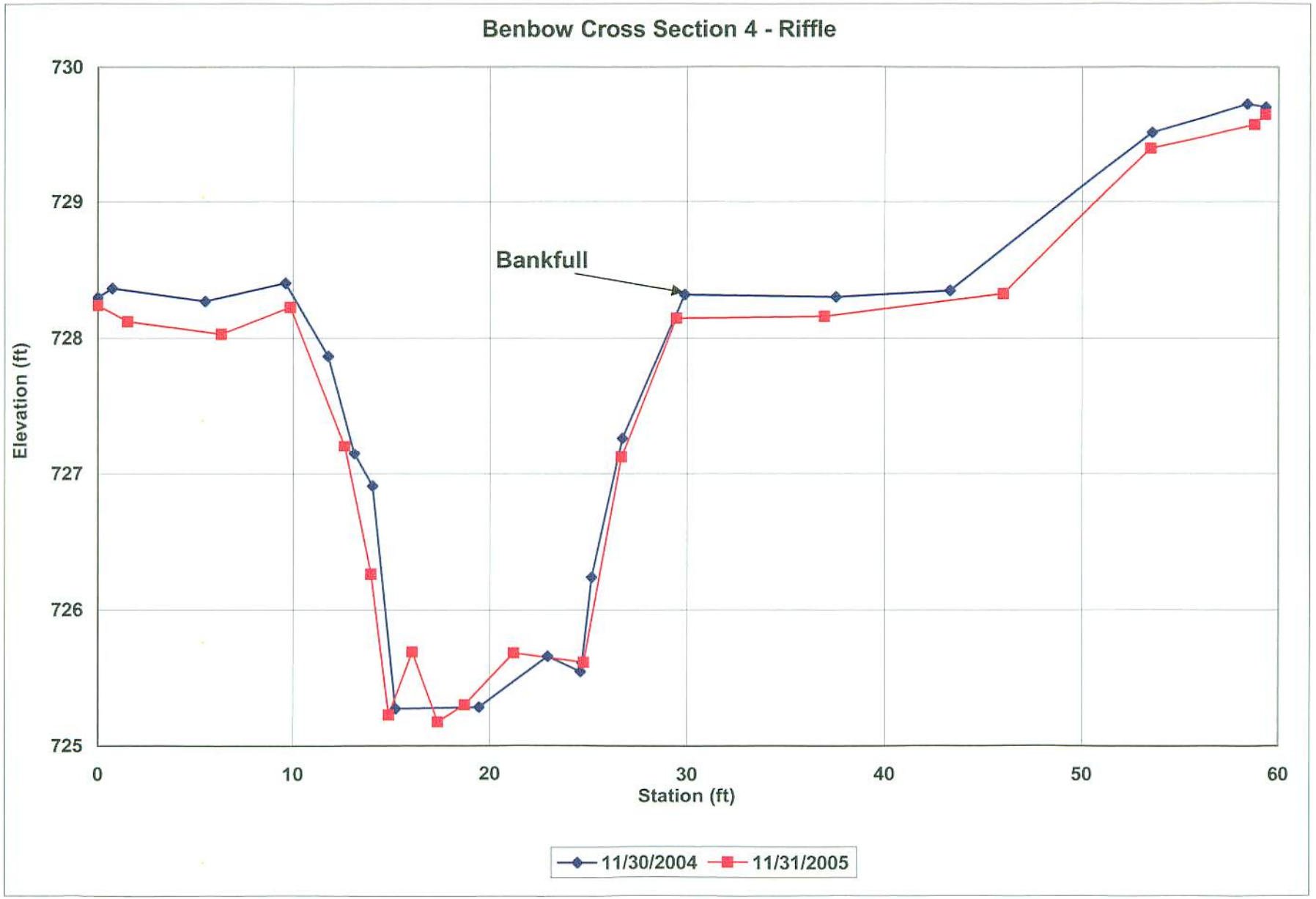
Dbkf = Bankfull Mean Depth (ft)
W/D = Bkf Width to Depth Ratio (ft/ft)
Abkf = Bkf Cross Section Area (sq ft)

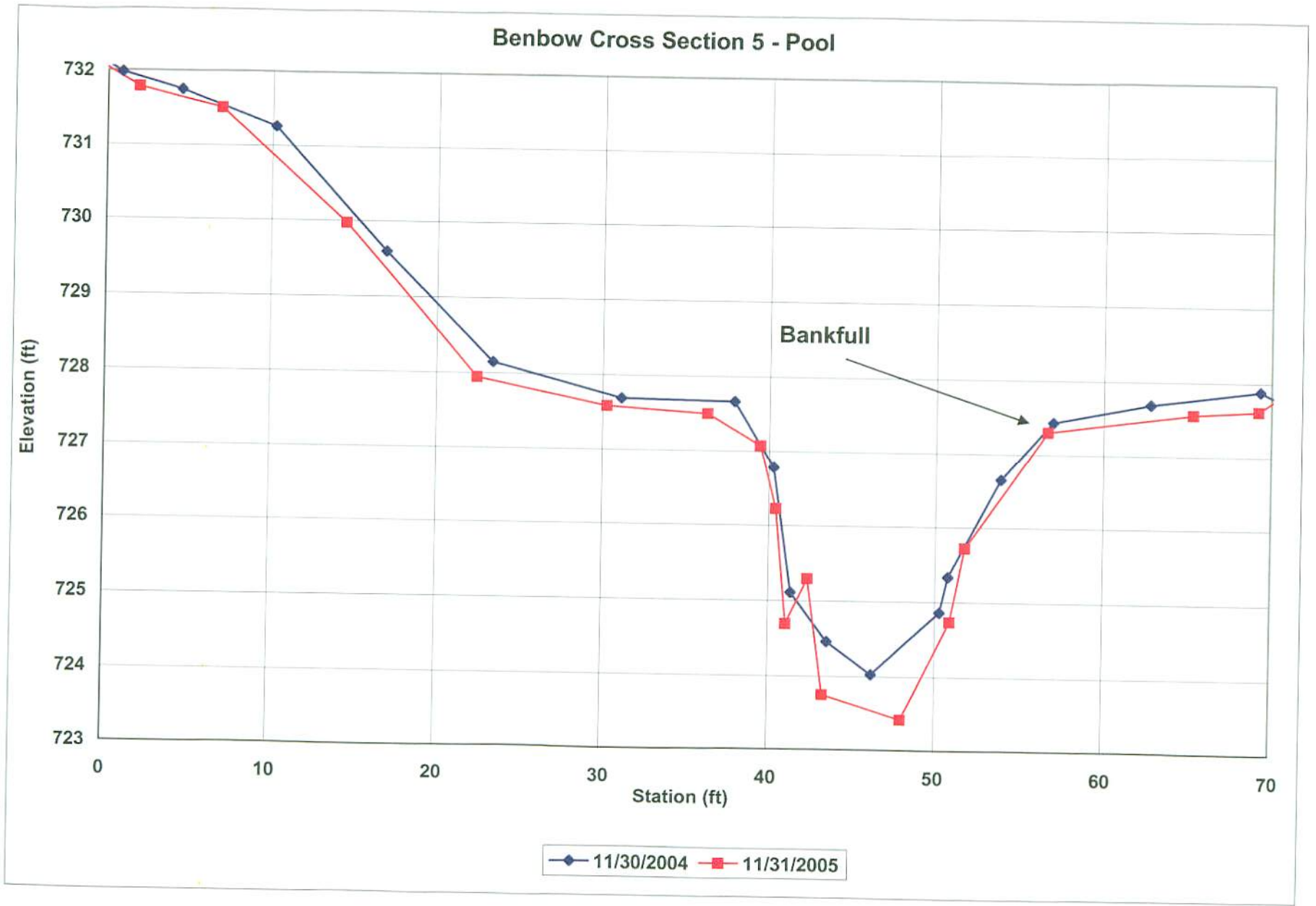
Dmax = Bankfull Maximum Depth (ft)
ER = Entrenchment Ratio, Wfpa/Wbkf (ft/ft)
BHR = Bank Height Ratio, Dtob/Dmax (ft/ft)

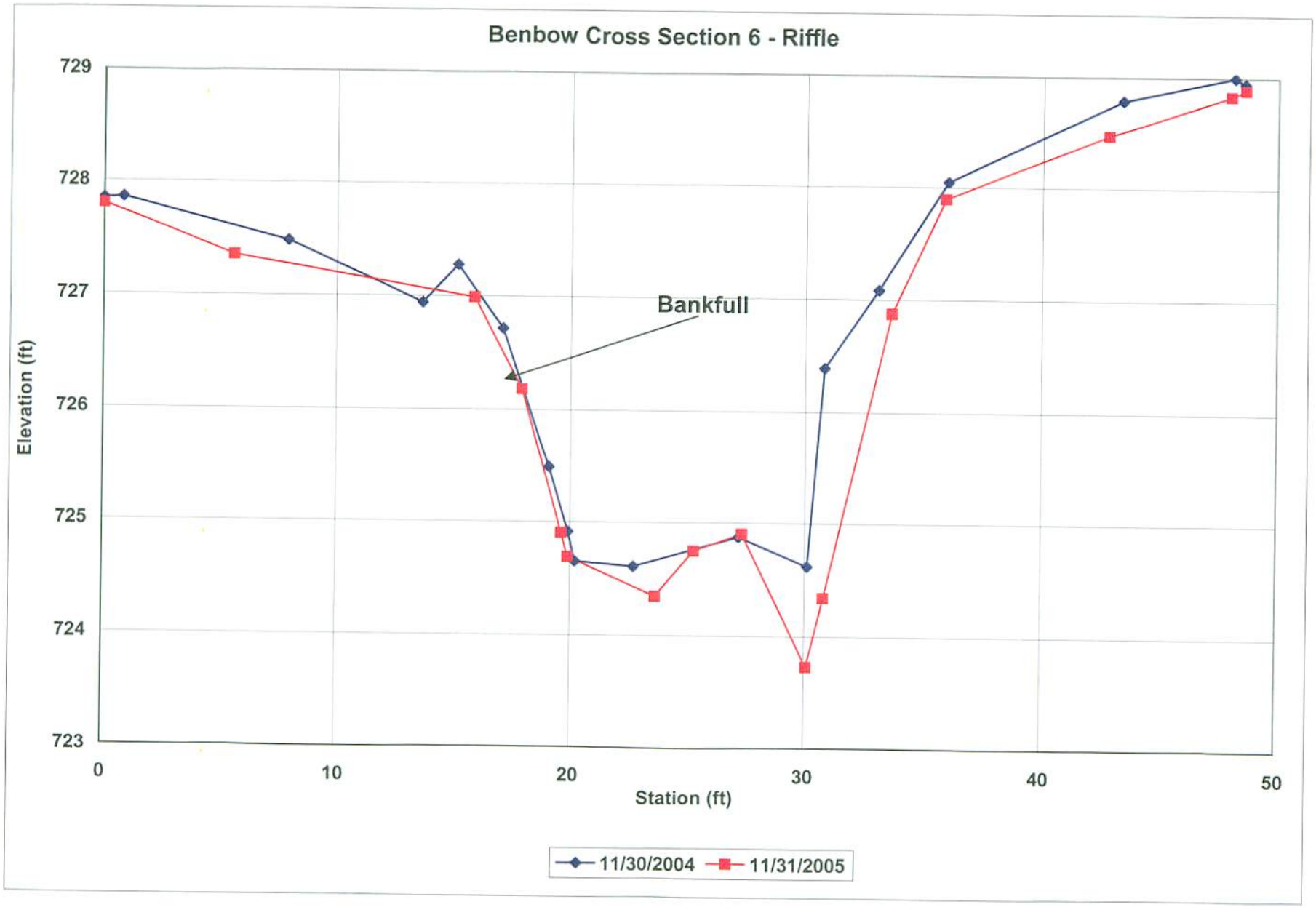

Benbow Cross Section 1 - Riffle
740
739
738
737
736
735
734
733
732
731
730
Elevation (ft)
Bankfull
0
10
20
30
40
50
60
70
Station (ft)
11/30/2004
11/31/2005


Benbow Cross Section 2 - Pool
739
738
737
736
735
734
733
732
731
730
729
728
727
Elevation (ft)
Bankfull
0
10
20
30
40
50
60
Station (ft)
11/30/2004
11/31/2005


Benbow Cross Section 3 - Riffle
738
737
736
735
734
733
732
731
730
729
Elevation (ft)
Bankfull
0
10
20
30
40
50
Station (ft)
11/30/2004
11/31/2005


Benbow Cross Section 4 - Riffle
730
729
728
727
726
725
Elevation (ft)
Bankfull
0
10
20
30
40
50
60
Station (ft)
11/30/2004
11/31/2005


Benbow Cross Section 5 - Pool
Elevation (ft)
732
731
730
729
728
727
726
725
724
723
0
10
20
30
40
50
60
70
Station (ft)
Bankfull
11/30/2004
11/31/2005


Benbow Cross Section 6 - Riffle
729
728
727
726
725
724
723
Elevation (ft)
Bankfull
0
10
20
30
40
50
Station (ft)
11/30/2004
11/31/2005

Brown Bark Park Cross Section Pin Locations

Cross Section	Northing	Easting	Elevation
XSEC 1 Left Pin	854763	1746572	868.5
XSEC 1 Right Pin	854702	1746563	867.0
XSEC 2 Left Pin	854696	1746998	861.9
XSEC 2 Right Pin	854642	1746983	860.6
XSEC 3 Left Pin	854718	1747297	860.0
XSEC 3 Right Pin	854669	1747308	858.9
XSEC 4 Left Pin	854818	1748118	849.1
XSEC 4 Right Pin	854749	1748138	849.2
XSEC 5 Left Pin	855252	1748451	843.8
XSEC 5 Right Pin	855164	1748506	845.9
XSEC 6 Left Pin	855304	1748486	844.1
XSEC 6 Right Pin	855264	1748556	843.2

Brown Bark Park

Cross Section Dimension Summary

XSEC	STA	Date	Feature	Str Type	Wfpa	Wbkf	Dbkf	W/D	Abkf	Dmax	ER	BHR
1	12+34	11/30/2004	Riffle	B5c	23	13.5	0.9	15.0	12.2	1.9	1.7	1.0
	12+34	12/1/2005	Riffle	B5c	23	14.9	0.9	17.2	13.0	2.0	1.6	1.0
	12+34	Y2	Riffle									
	12+34	Y3	Riffle									
	12+34	Y4	Riffle									
2	16+68	11/30/2004	Pool		36	15.0	0.8	18.0	12.5	1.9	2.4	1.0
	16+68	12/1/2005	Pool		36	15.9	0.9	17.0	14.9	2.8	3.3	1.0
	16+68	Y2	Pool									
	16+68	Y3	Pool									
	16+68	Y4	Pool									
3	20+25	11/30/2004	Riffle	C5c	48	19.3	1.2	16.1	23.2	3.3	2.5	1.0
	20+25	12/1/2005	Riffle	C5c	48	19.2	1.3	14.9	24.9	3.8	2.6	1.0
	20+25	Y2	Riffle									
	20+25	Y3	Riffle									
	20+25	Y4	Riffle									

Str Type = Rosgen Classification
Wfpa = Width Flood Prone Area (ft)
Wbkf = Bankfull Width (ft)

Dbkf = Bankfull Mean Depth (ft)
W/D = Bkf Width to Depth Ratio (ft/ft)
Abkf = Bkf Cross Section Area (sq ft)

Dmax = Bankfull Maximum Depth (ft)
ER = Entrenchment Ratio, Wfpa/Wbkf (ft/ft)
BHR = Bank Height Ratio, Dtob/Dmax (ft/ft)

Brown Bark Park

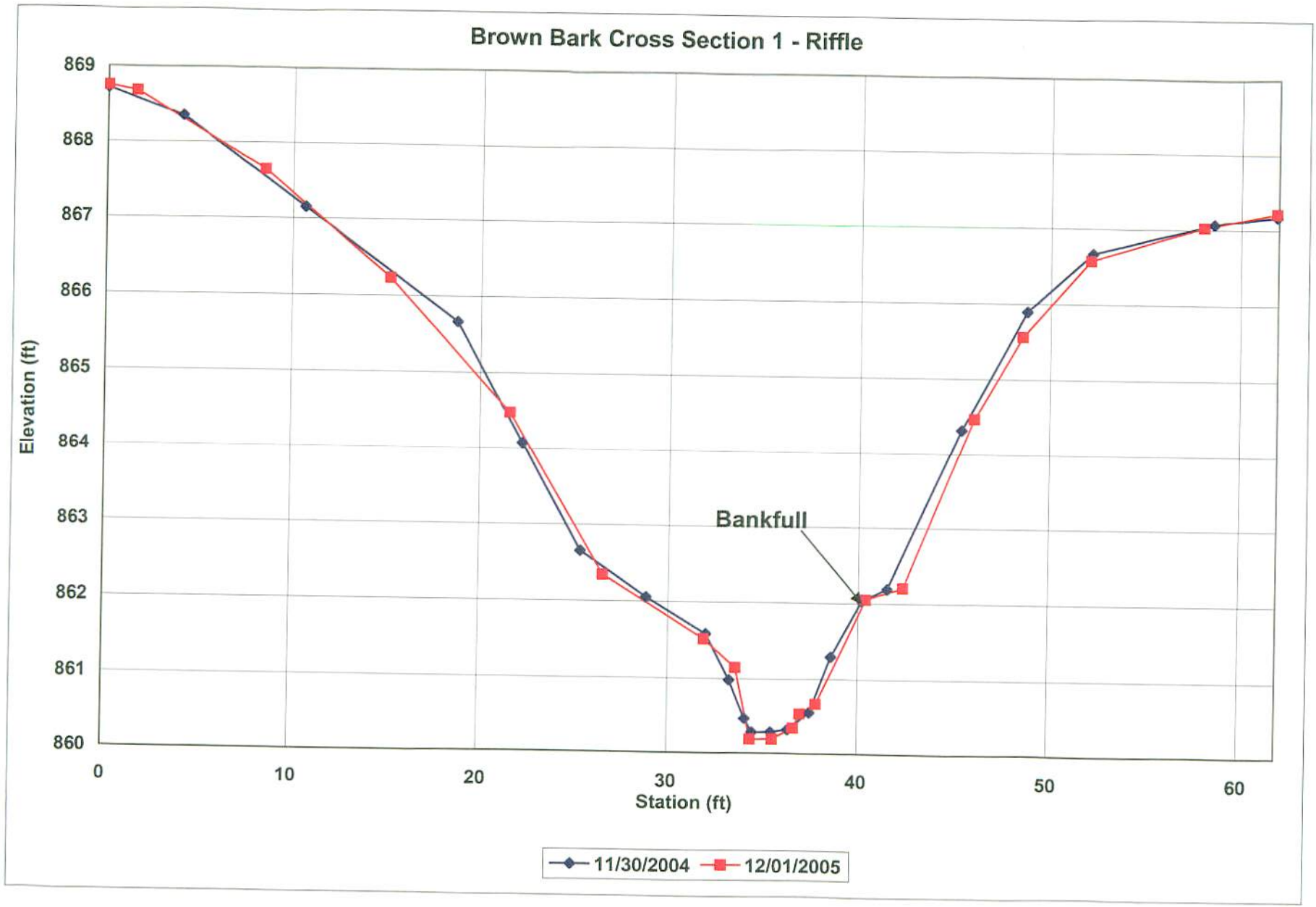
Cross Section Dimension Summary

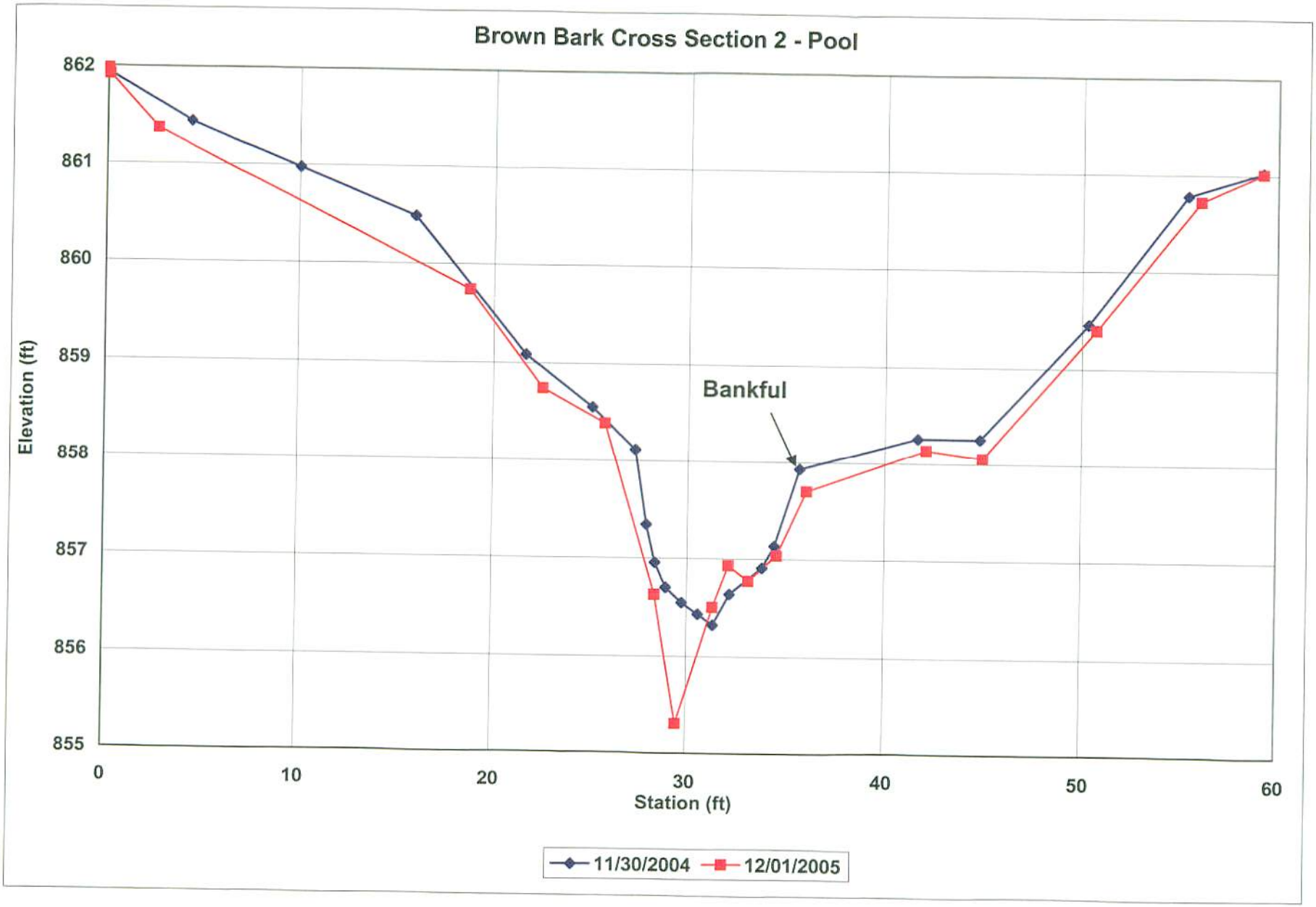
XSEC	STA	Date	Feature	Str Type	Wfpa	Wbkf	Dbkf	W/D	Abkf	Dmax	ER	BHR
4	29+31	11/30/2004	Pool		30	15.5	0.8	18.8	12.9	2.4	1.9	1.0
	29+31	12/1/2005	Pool		30	13.5	1.0	13.8	13.2	2.4	2.1	1.0
	29+31	Y2	Pool									
	29+31	Y3	Pool									
	29+31	Y4	Pool									
5	35+67	11/30/2004	Riffle	C5c	50	14.0	0.9	16.0	12.3	1.7	3.6	1.0
	35+67	12/1/2005	Riffle	C5c	50	15.7	18.0	19.6	12.5	1.6	3.3	1.0
	35+67	Y2	Riffle									
	35+67	Y3	Riffle									
	35+67	Y4	Riffle									
6	36+69	11/30/2004	Riffle	C5c	59	19.4	0.8	23.4	16.1	2.1	3.6	1.0
	36+69	12/1/2005	Riffle	C5c	59	19.7	0.7	28.7	13.6	1.8	2.6	1.0
	36+69	Y2	Riffle									
	36+69	Y3	Riffle									
	36+69	Y4	Riffle									

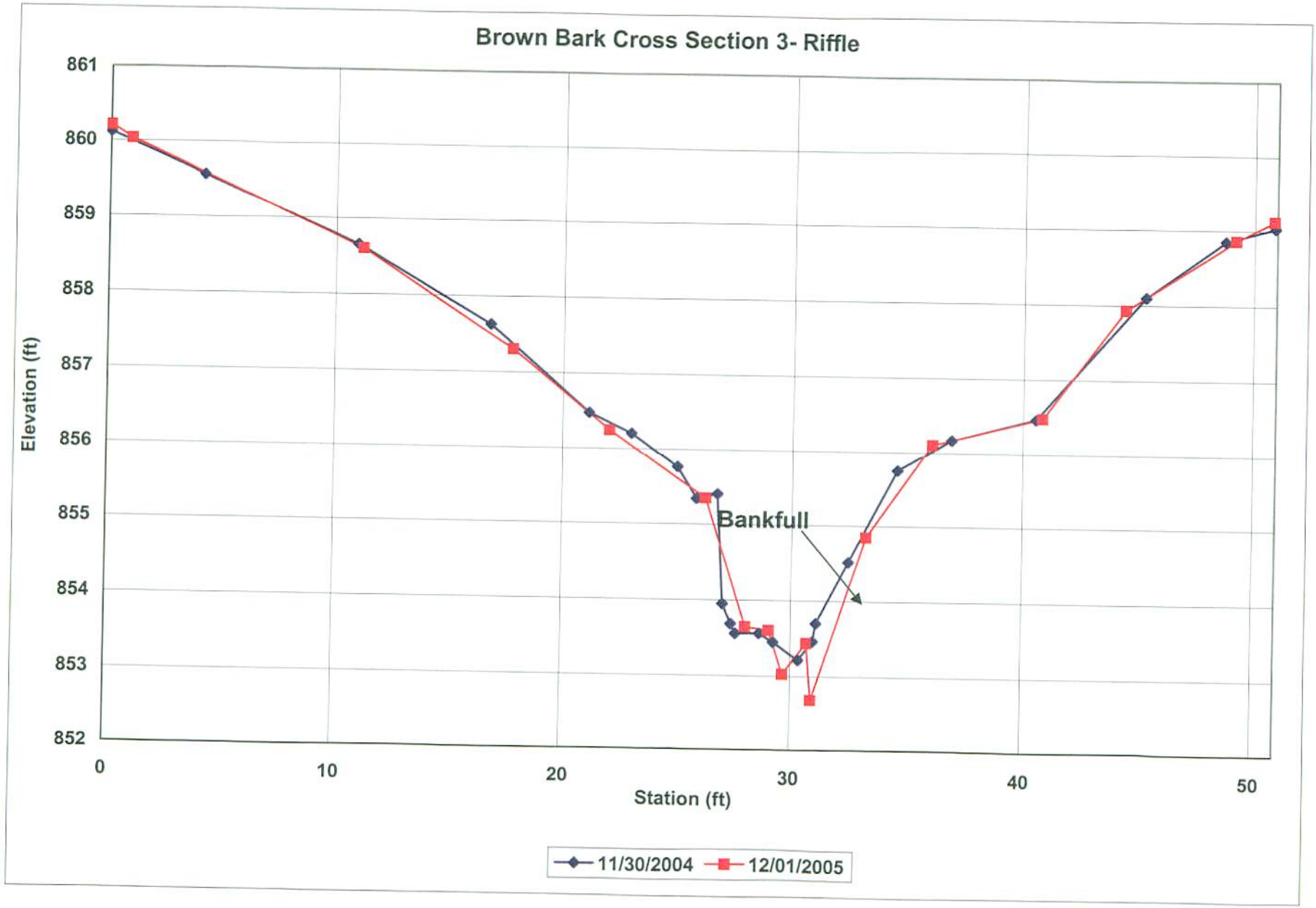
Str Type = Rosgen Classification
Wfpa = Width Flood Prone Area (ft)
Wbkf = Bankfull Width (ft)

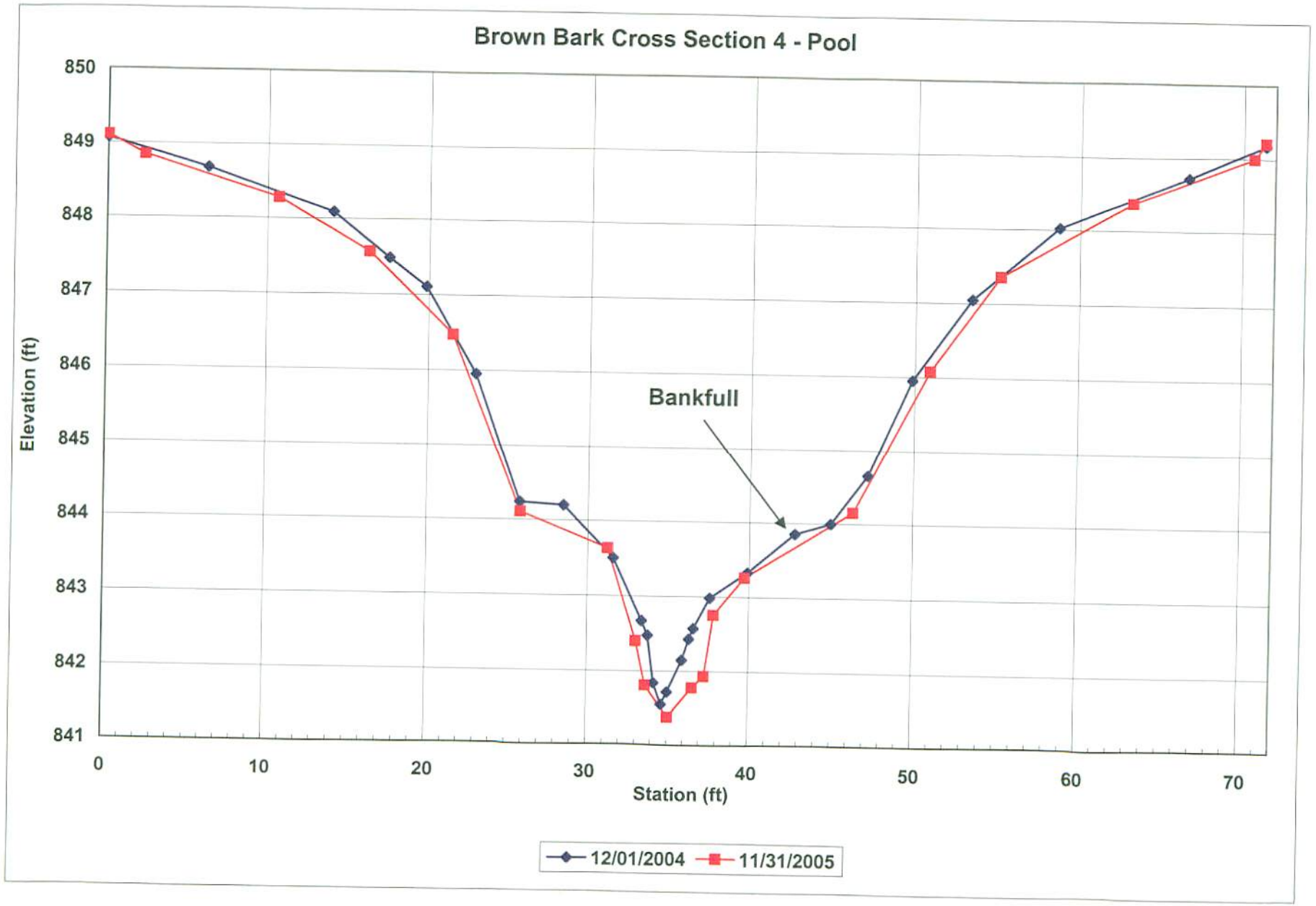
Dbkf = Bankfull Mean Depth (ft)
W/D = Bkf Width to Depth Ratio (ft/ft)
Abkf = Bkf Cross Section Area (sq ft)

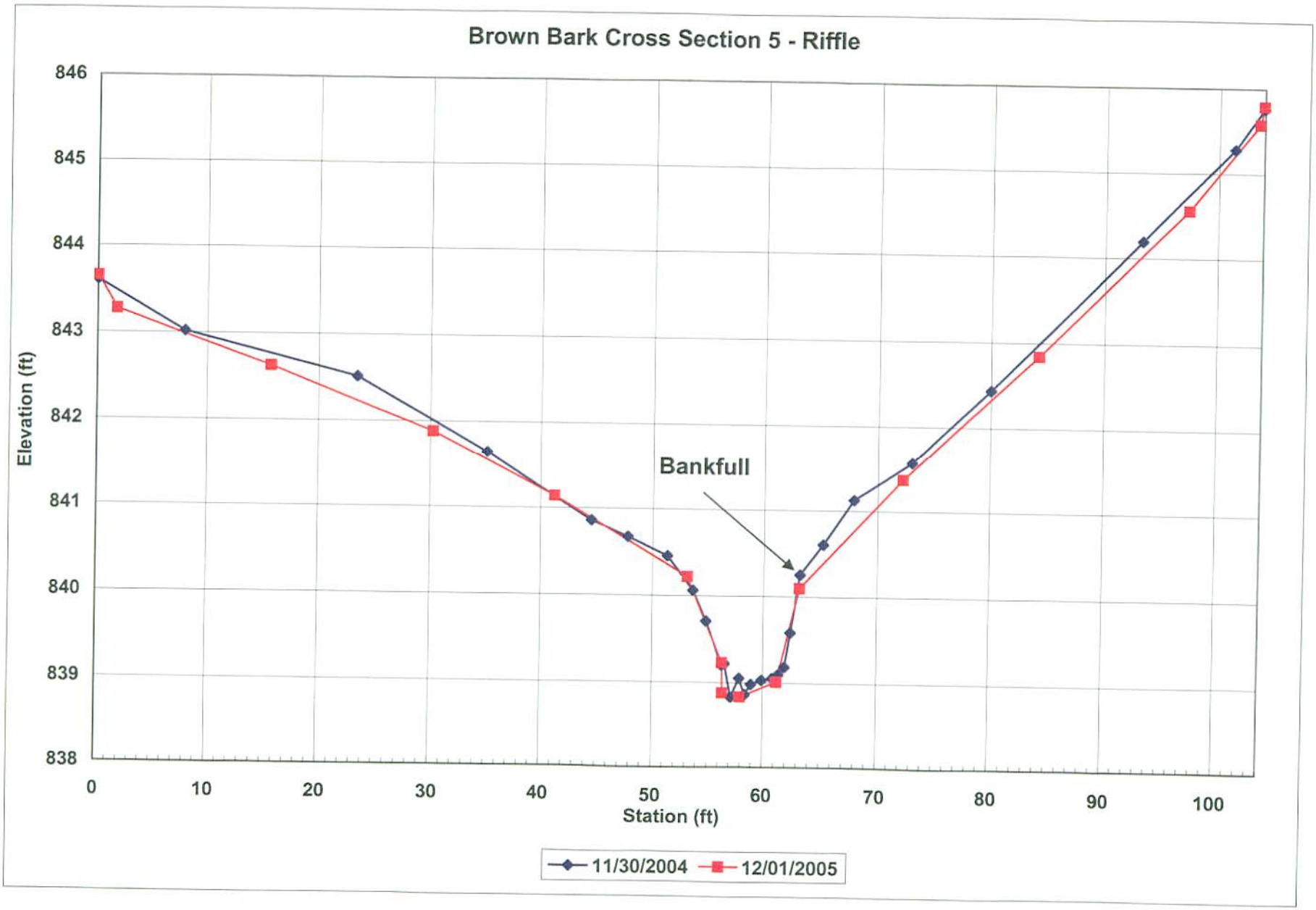
Dmax = Bankfull Maximum Depth (ft)
ER = Entrenchment Ratio, Wfpa/Wbkf (ft/ft)
BHR = Bank Height Ratio, Dtob/Dmax (ft/ft)

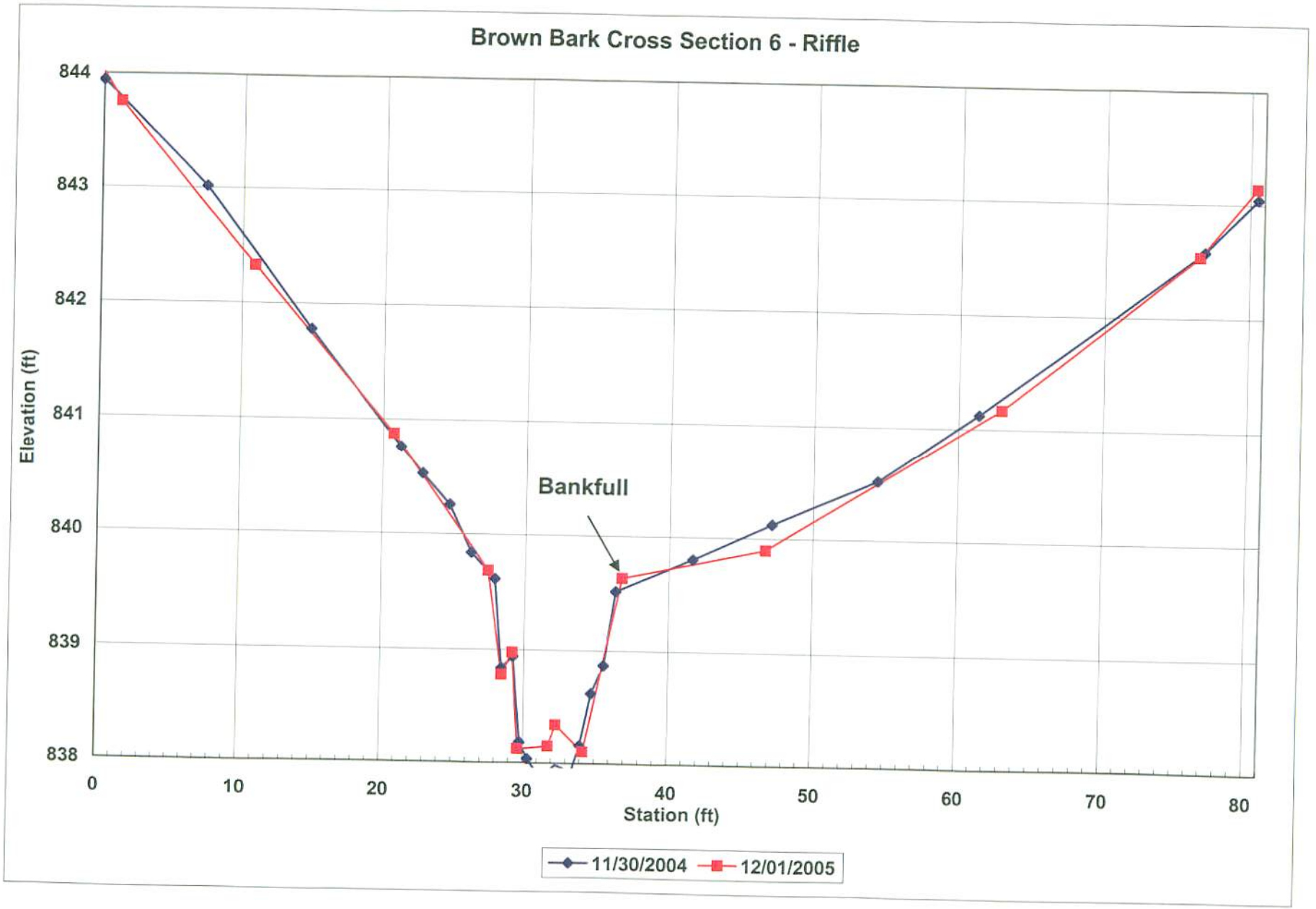

Brown Bark Cross Section 1 - Riffle
869
868
867
866
865
864
863
862
861
860
Elevation (ft)
0
10
20
30
40
50
60
Station (ft)
Bankfull
11/30/2004
12/01/2005

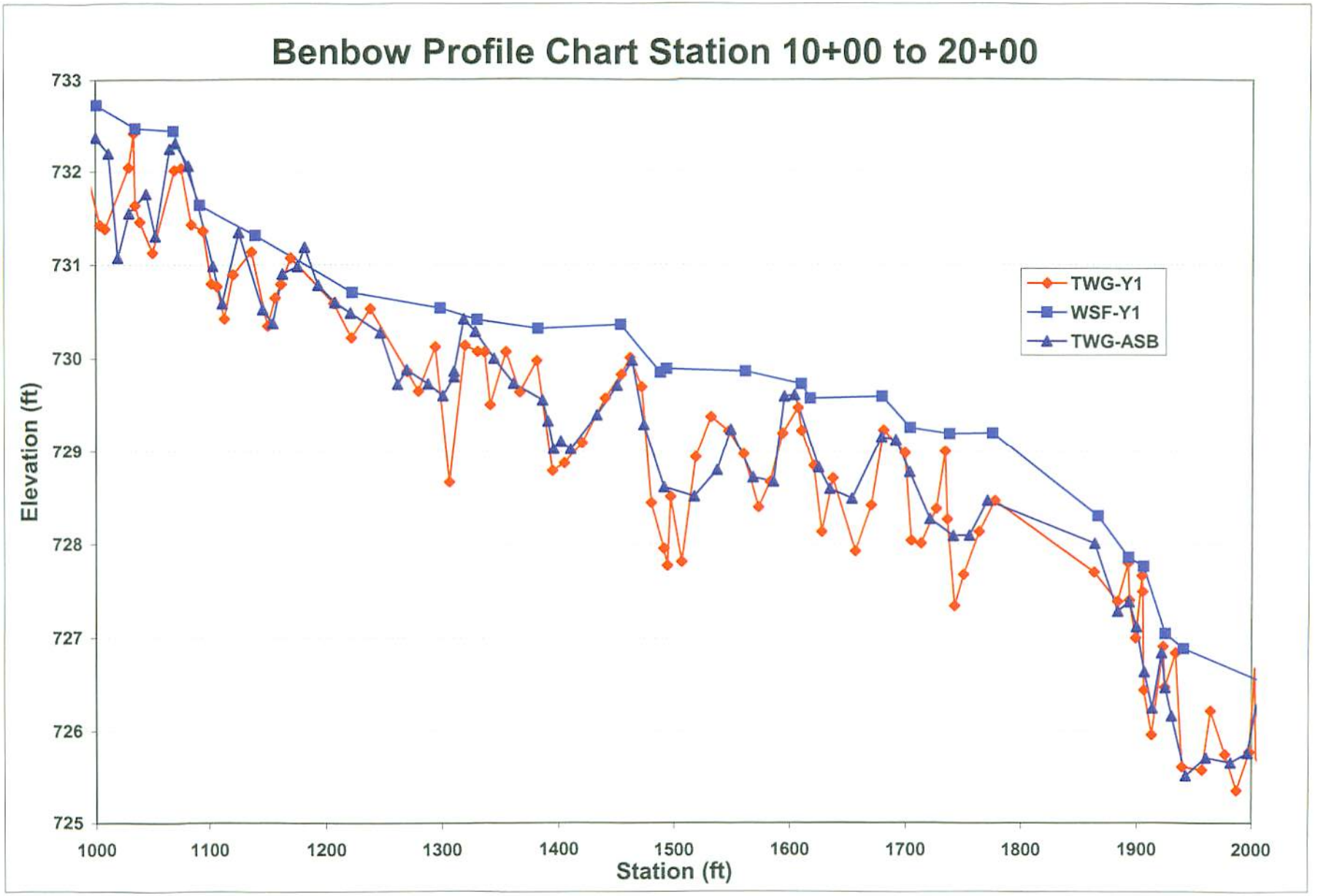

Brown Bark Cross Section 2 - Pool
862
861
860
859
858
857
856
855
Elevation (ft)
Bankful
0
10
20
30
40
50
60
Station (ft)
11/30/2004
12/01/2005

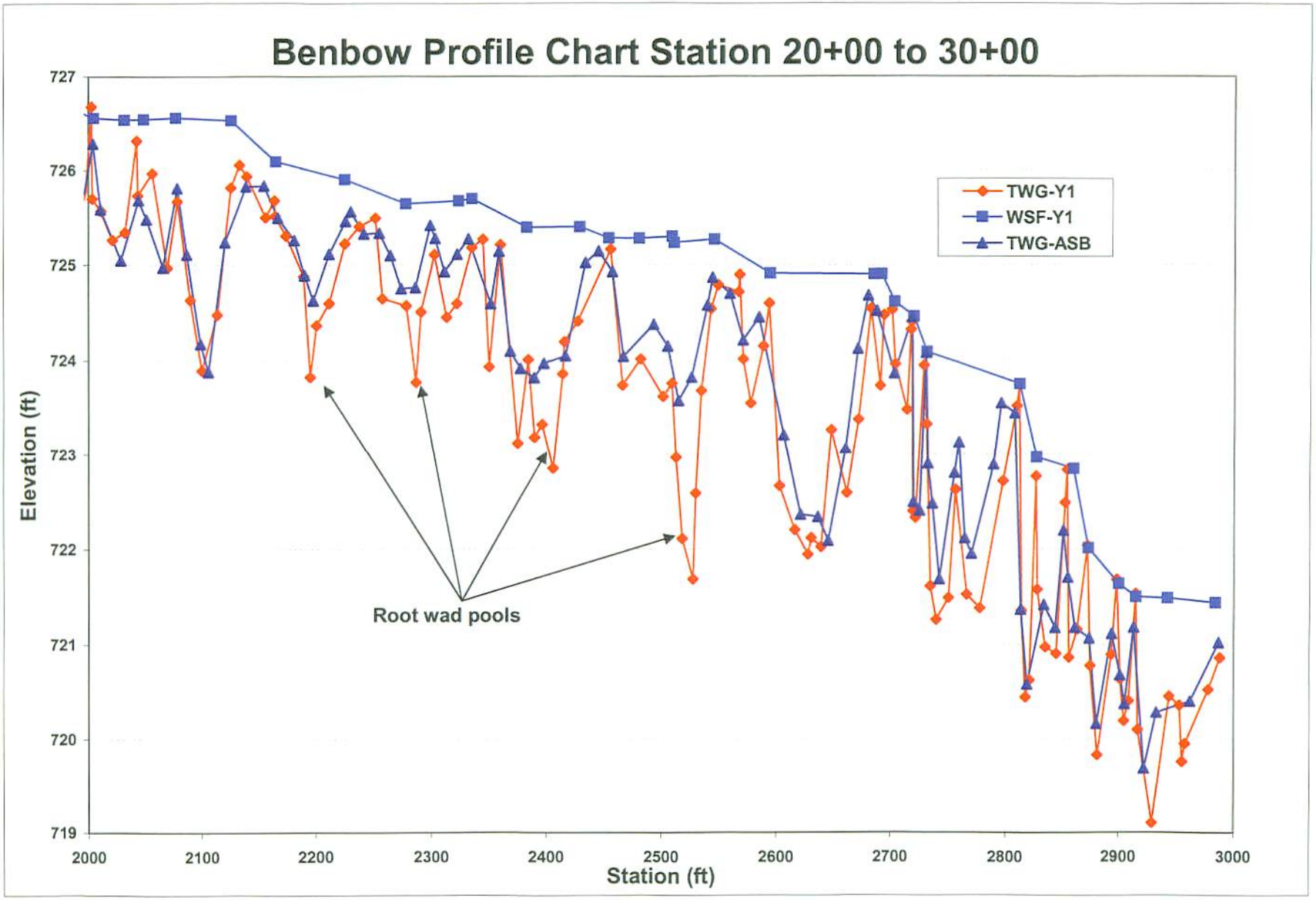

Brown Bark Cross Section 3- Riffle
861
860
859
858
857
856
855
854
853
852
Elevation (ft)
0
10
20
30
40
50
Station (ft)
Bankfull
11/30/2004
12/01/2005

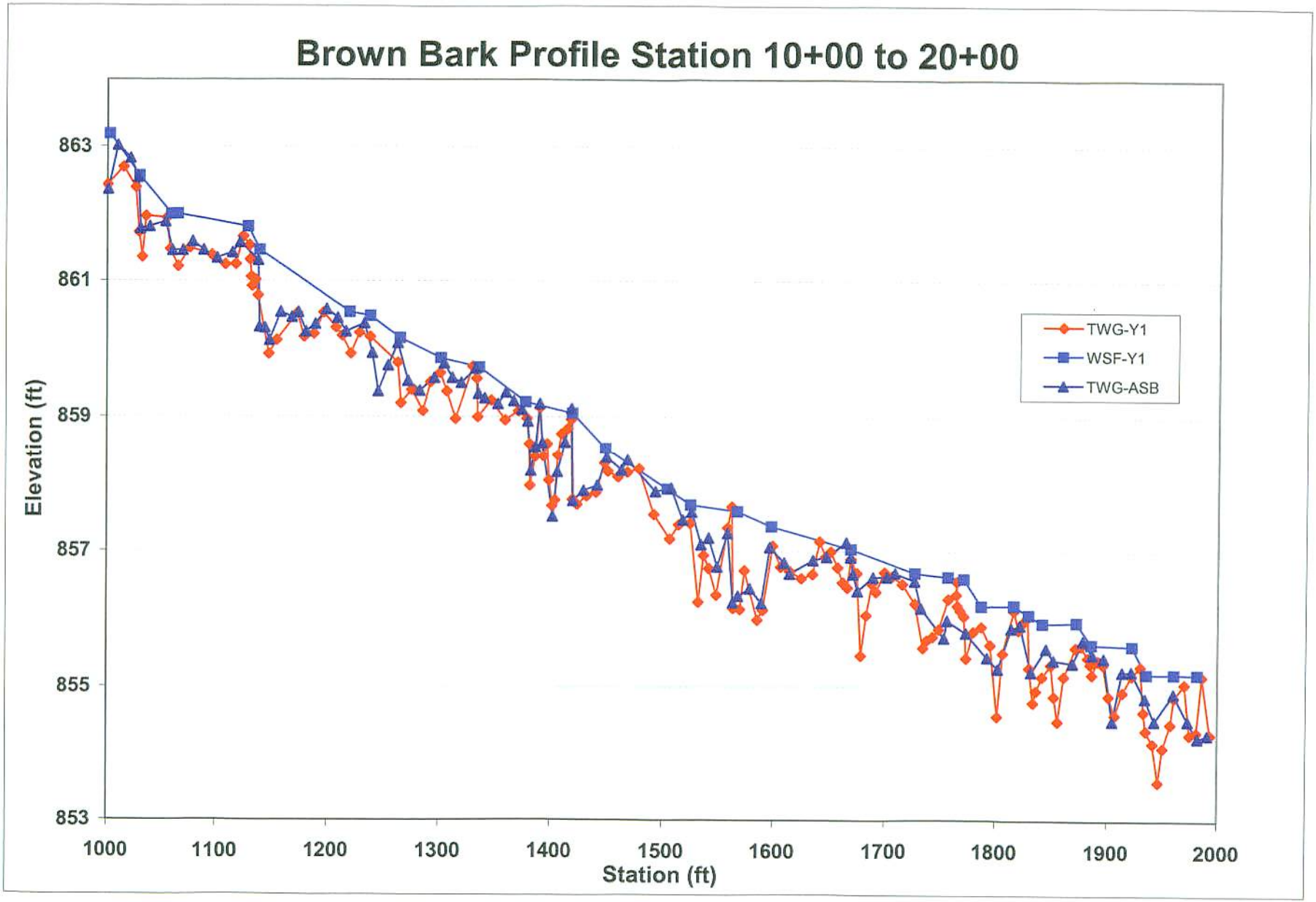

Brown Bark Cross Section 4 - Pool
850
849
848
847
846
845
844
843
842
841
Elevation (ft)
Bankfull
0
10
20
30
40
50
60
70
Station (ft)
12/01/2004
11/31/2005

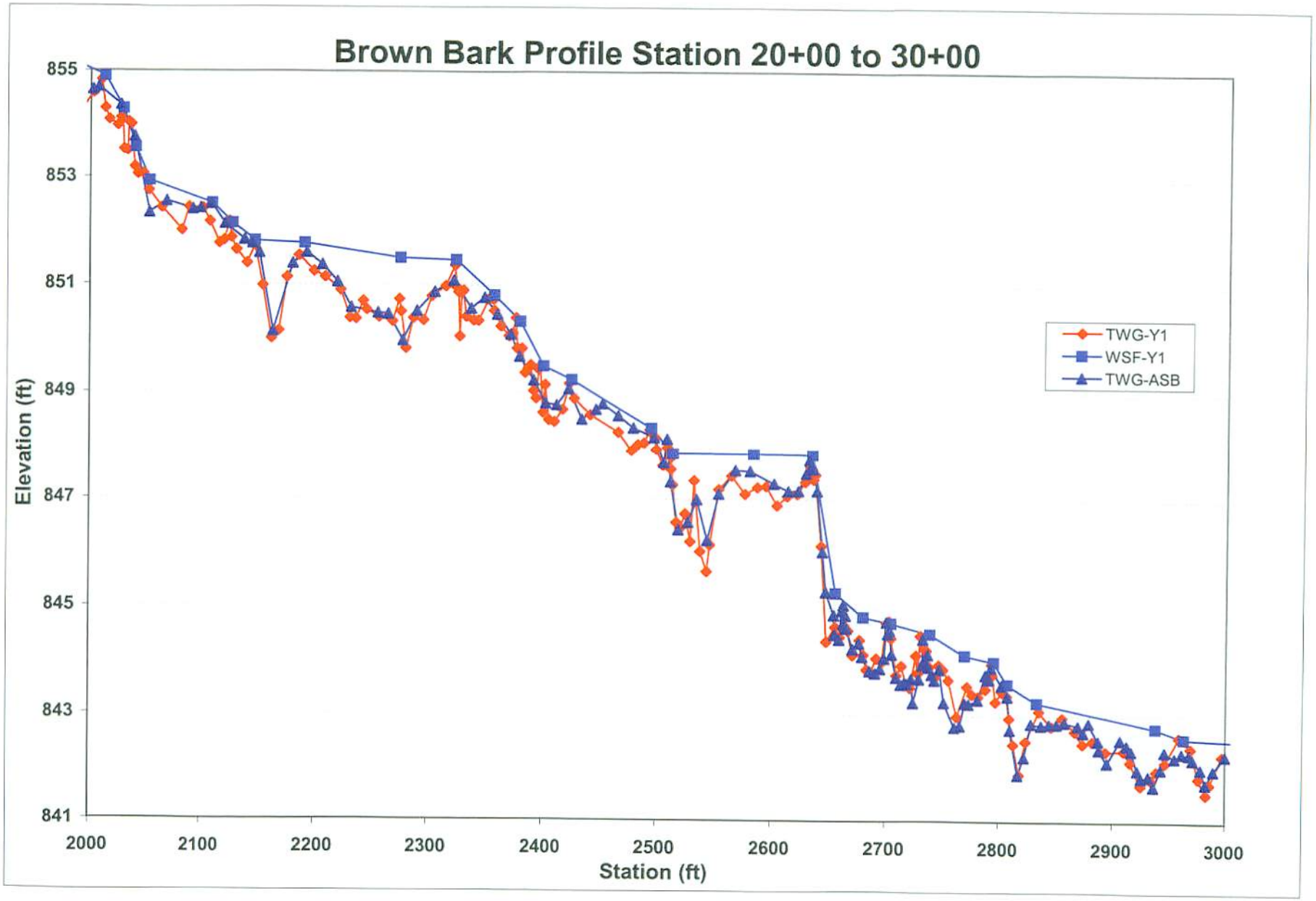

Brown Bark Cross Section 5 - Riffle
Elevation (ft)
846
845
844
843
842
841
840
839
838
0
10
20
30
40
50
60
70
80
90
100
Station (ft)
Bankfull
11/30/2004
12/01/2005

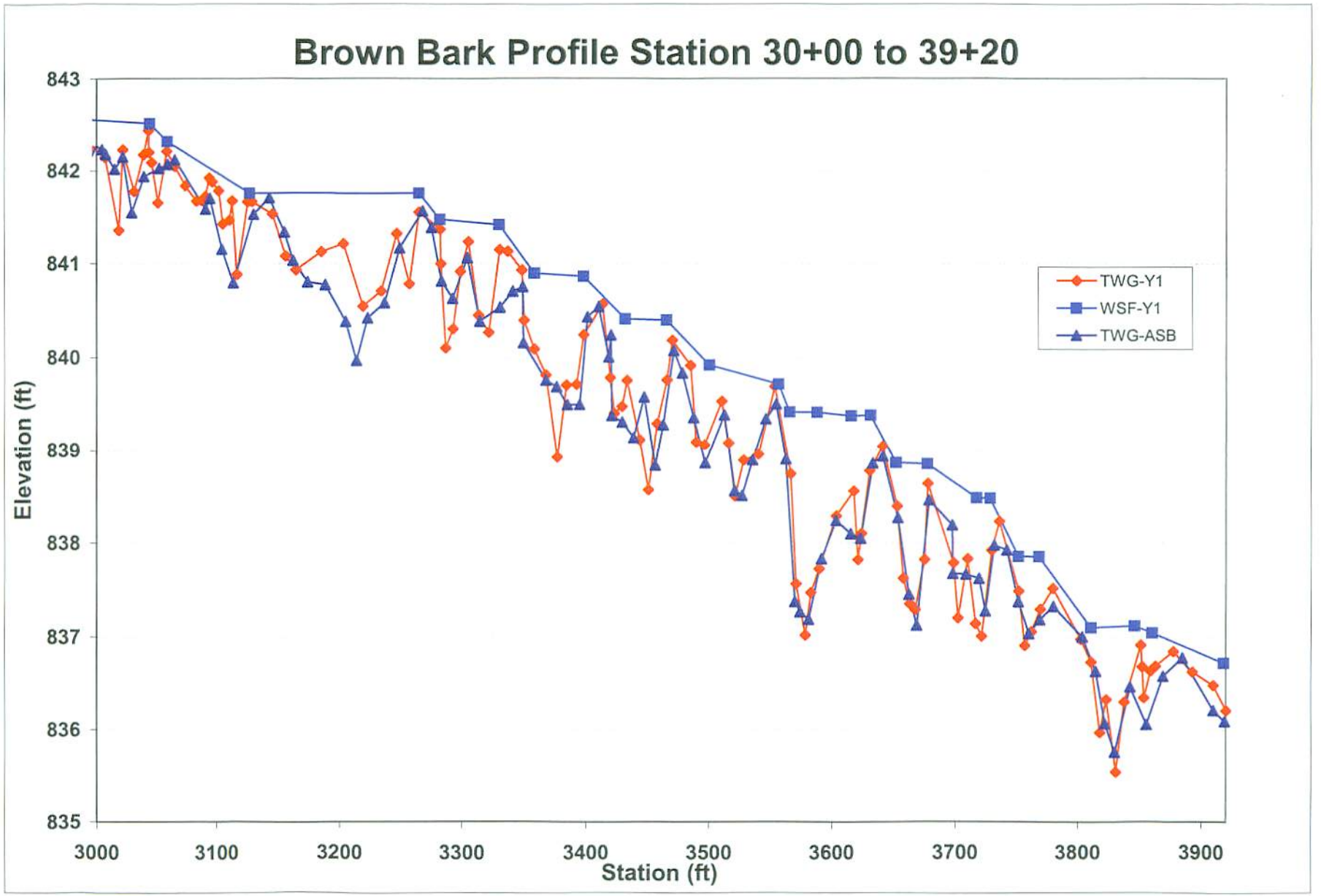

Brown Bark Cross Section 6 - Riffle
844
843
842
841
840
839
838
Elevation (ft)
0
10
20
30
40
50
60
70
80
Station (ft)
Bankfull
11/30/2004
12/01/2005


Benbow Profile Chart Station 10+00 to 20+00
733
732
731
730
729
728
727
726
725
Elevation (ft)
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
Station (ft)
TWG-Y1
WSF-Y1
TWG-ASB


Benbow Profile Chart Station 20+00 to 30+00
Elevation (ft)
727
726
725
724
723
722
721
720
719
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
Station (ft)
TWG-Y1
WSF-Y1
TWG-ASB
Root wad pools


Brown Bark Profile Station 10+00 to 20+00
Elevation (ft)
863
861
859
857
855
853
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
Station (ft)
TWG-Y1
WSF-Y1
TWG-ASB


Brown Bark Profile Station 20+00 to 30+00
855
853
851
849
847
845
843
841
Elevation (ft)
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
Station (ft)
TWG-Y1
WSF-Y1
TWG-ASB


Brown Bark Profile Station 30+00 to 39+20
Elevation (ft)
843
842
841
840
839
838
837
836
835
3000
3100
3200
3300
3400
3500
3600
3700
3800
3900
Station (ft)
TWG-Y1
WSF-Y1
TWG-ASB

Buffalo Creeks Watershed Phase II
Benbow Park
Photo Log

Reach 1

Photo Points 1-16

Reach 2

Photo Points 17-44

Notes:

1. Photo point locations are shown on the plan views. Descriptive locations and views follow on the next two pages.
2. All photos are oriented downstream (unless otherwise noted).
3. Photo locations include longitudinal photos and cross sections.

Buffalo Creeks Watershed Phase II
Benbow Park
Photo Point Locations

Photo Point	Location	View
Reach 1		
1	Top of Florida Avenue Culvert	Project Start
2	Thalweg (TW) at invert of Cross Vane #1	Cross Vane (CV) #1
3	TW Constructed Riffle (CR) #1	CR #1
4	TW at CV (CR) #2	CV #2
5	TW at Knick point and natural riffle	Natural riffle
6	TW at natural riffle	Natural riffle
7	TW at CV #3	Cross Section (CS) #1
8	TW at ~Station 13+50	Downstream
9	TW at CV #4	CV #4
10A	TW at CR #2	CR #2
10B	TW at CR #2 looking at Step Pool #2	Step Pool (SP) #2
11A	TW at tail of riffle (TOR) CR #2	Vegetation Plot #1
11B	TW at TOR of riffle CR #2	CS #2
12A	Looking left ~ Station 15+90	SP #3
12B	TW at CR #3	CS #3
13	Invert at Rock Vane #1	Rock vane #1
14	TW at CR #4	CR #4
15	TW at CV #4	CV #4
16	Top of South Benbow Street culvert, upstream side	Reach 1 End
Reach 2		
17	Top of South Benbow Street culvert downstream side	Reach 2 Start
18A	TW at Double Drop (DD) CV #1 upstream	Stabilized South Benbow Street culvert
18B	TW at DD CV #1	DD CV #1
19	TW at DD CV #2	DD CV #2
20	TW at Rock Vane (RV) #1	RV #1
21	TW at "J" Hook #1	J Hook #1
22	15' upstream from bridge	Pedestrian Bridge
23A	Pedestrian Bridge looking upstream	Reach 2 Start
23B	Pedestrian Bridge looking downstream	DD CV #3
24	TW at DD CV#3	DD CV #3
25	TW at RV #2	RV #2, Root Wad #1
26	TW at CR #1	CR #1
27	TW at RV #3	RV #3, Root Wad #2
28	Looking right at ~ Station 22+00	SP #2

Photo Point	Location	View
29	TW at CR #2	CR #2, Root Wad #3
30	TW at RV #4	RV #4
31A	TW at CR #3	Playground Equipment
31B	TW at CR #3	CR #3
32	TW at RV #4	RV #4
33	Looking right at ~ Station 24+00	SP #3
34	TW at CR #4	CS #5
35	TW at CR #5	CR #5
36A	Top of bank at RV #5	Vegetation Plot
36B	TW at RV #5	Aerial sewer, Root Wad #6
37	TW at CR #6	CR #6
38	TW at DD CV #4	DD CV #4
39	TW at RV #6	RV #6
40	TW at DD CV #5	DD CV #5
41	TW at DD CV #6	DD CV #6
42	TW at DD CV #7	DD CV #7
43	20' Downstream from CV#7	Culvert at Belcrest Road
44	Top of Belcrest Road culvert looking upstream	Reach 2 End

PP#1 Reach 1 (R1) Upstream View from Culvert at Florida Avenue

PP#2 R1 Cross Vane #1

PP#3 R1 Constructed Riffle #1

PP#4 R1 Cross Vane #2

PP#5 R1 Natural Riffle

PP#6 R1 Natural Riffle

PP# 7 R1 Cross Vane #3 and Cross Section #1

PP#8 R1 Downstream View

PP#9 R1 Cross Vane #4

PP#10A R1 Toe protection on left bank into Constructed Riffle #2

PP#10B R1 Step Pool #2

PP#11A R1 Bare-root and Live-stakes Plot #1

PP#11B R1 Cross Section #2 Pool

PP#12A R1 Step Pool #3

PP#12B R1 Constructed Riffle #3 and Cross Section #3

PP#13 R1 Rock Vane

PP#14 R1 Constructed Riffle #4

PP#15 R1 Cross Vane #4

PP#16 R1 Upstream View from South Benbow Road

PP#17 R2 Downstream View from South Benbow Road

PP#18A R2 upstream view of stabilized culvert from invert of Double Drop Cross Vane #1

PP#18B R2 Double Drop Cross vane #1

PP#19 R1 Double Drop Cross Vane #2

PP#20 R1 Rock Vane #1

PP#21 R1 J Hook #1

PP#22 R2 Newly Installed Pedestrian Bridge

PP#23A R2 Upstream View from Pedestrian Bridge

PP#23B R2 Downstream view from Pedestrian Bridge

PP#24 R2 Double Drop Cross Vane #3

PP#25 R2 Rock Vane #2, and Root Wad Cluster #1

PP#26 R2 Constructed Riffle #1

PP#27 R2 Rock Vane #3, Step pool #2, and Root Wad Cluster #2

PP#28 R2 Step Pool #2

PP#29 R2 Constructed Riffle #2 and Root Wad Cluster #3

PP#30 R2 Rock Vane #4 and Constructed Riffle #3

PP#31A R2 Relocated Playground with new equipment

PP#31B R2 Constructed Riffle #3, Rock Vane #4, and Cross Section #4

PP#32 R2 Rock Vane #4, Step Pool #3, and Root Wad Cluster #4

PP#33 R2 Step Pool #3

PP#34 R2 Constructed Riffle #4, Root Wad Cluster #5, and Cross Section #5

PP#35 R2 Constructed Riffle #5

PP#36A R2 Bare-root and Live-stakes Plot #2

PP#36B R2 Rock Vane #5, newly installed aerial sewer and Root Wad Cluster #6

PP#37 R2 Constructed Riffle #6, Cross Section #6

PP#38 R2 Double Drop Cross Vane #4

PP#39 R2 Rock Vane #6

PP#40 R2 Double Drop Cross Vane #5

PP#41 R2 Double Drop Cross Vane #6

PP#42 R2 Double Drop Cross Vane #7

PP#43 R2 Toe protection and rock weir into culvert at end of R2

PP#44 R2 Upstream view from Belcrest Road at end of R2

Buffalo Creek
Brown Bark Park
Photo Log

Reach 1

Photo Points 1-43

Notes:
1. Photo point locations are shown on the plan views. Descriptive locations and views follow on the next two pages.
2. All photos are oriented downstream (unless otherwise noted).
3. Photo locations include longitudinal photos and cross sections.

Buffalo Creek
Brown Bark Park
Photo Point Locations

Photo Point	Location	View
1	Top of Watauga Drive Culvert	Project Start
2	Thalweg (TW) at invert of Constructed (CR)Riffle #1	CR #1 & Vegetation Plot #1
3	TW at CR #1	Step Pool #1
4	TW at invert of Cross Vane (CV) #1	CV #1
5	TW at CR #2	CR#2 & XSEC #1
6	TW at invert of CV #2	CV #2
7	TW at Station 13+75	Meander Bend
8	TW at invert of CV #3	CV#3
9	TW at CR#3	CR#3
10	TW at CV #4	CV #4
11	TW at CV #5	CV#5, Root Wad Cluster #1 (RWC), & XSEC #2
12	TW at CV #6	CV #6
13	TW 15' upstream from CR #4	CR #4
14	TW 15' upstream from RWC #2	RWC #2
15	TW at CR #5	CR #5
16	TW 15' upstream from RWC #3	RWC #3
17	TW 15' upstream from CR #7	CR #7 & RWC #4
18	TW 15' upstream from CR #8	CR #8 and pedestrian bridge
19	TW 15' upstream from CR #9	CR #9 XSEC #3
20A	TW at Station 20+00	Natural Riffle
20B	Looking left at Station 20+00	Step Pool #2
21A	TW at Station 21+90	Downstream view
21B	Looking right at Station 21+90	Constructed Swale from RCP
22	TW at Station 22+80	Downstream View
23	TW at Station 24+00	Downstream View
24	TW at Station 25+50	Downstream View of Bedrock knick point
25	Right Bank at Top of Knick point at Station 26+00	RWC #4, transplants, & boulder/rip-rap toe protection
26	TW of Knick Point at Station 26+00	RWC #5 with toe protection
27	Top of RWC #5	RWC #6
28	TW at CR #10	CR #10 & Vegetation Plot #2
29A	TW at Station 28+50 looking right	Step Pool #6
29B	TW at Station 28+50 looking downstream	XSEC #4
30	TW at Station 29+60 downstream view	Natural Riffle

Photo Point	Location	View
31	TW at Station 30+50 looking right	Step Pool #7
32	TW 15' upstream from CR #11	CR #11 & RWC #7
33	TW 15' upstream from CR #12	CR #12 & RWC #8
34	TW 15' upstream from CR #13	CR #13 & RWC #9
35	TW 15' upstream from CR #14	CR #14, RWC #10, & XSEC #4
36	TW 15' upstream from CR #15	CR #15 & RWC #11
37	TW 15' upstream from CR #16	CR #16, RWC #12, & XSEC #5
38	TW 15' upstream from CR #17	CR #17 & RWC #13
39	TW 15' upstream from CR #18	CR #18, RWC #14, & XSEC #6
40	TW at Station 36+75	Run into RWC #15
41	TW at Station 37+55	RWC #16 & Reach end at West Minister Drive culvert
42	Top of West Minister Drive culvert	Upstream view from end of reach
43	Type of conservation easement marker used on-site	

PP1 Beginning of Reach

PP2 Riffle #1 Bare-root and Live-stakes Plot #1

PP3 Step Pool #1

PP4 Cross Vane #1

PP5 Riffle #2 and Cross Section #1

PP6 Cross Vane #2

PP7 Meander Bend

PP8 Cross Vane #3

PP9 Riffle #3

PP10 Cross Vane #4

PP11 Cross Vane #5, Root Wad Cluster #1 and Cross Section #2

PP12 Cross Vane #6

PP13 Riffle #4

PP14 Root Wad Cluster #2

P15 Riffle #5

PP16 Riffle #6 Root Wad Cluster #3

PP17 Riffle #7 and Root Wad Cluster #4

PP18 Riffle #8 and Pedestrian Footbridge

PP19 Riffle #9 & Cross Section 3

PP20A Natural Riffle

PP20B Swale into Step Pool #2

PP21A Downstream View

PP21B Swale from RCP on Right Bank

PP22 Run and Riffle

PP23 Run

PP24 Run into Bedrock Knick point with 3 ft drop. Step Pool #5 on Right Bank

PP 25 Knick point with 90 degree bend with Root Wad Cluster #4, Transplants, and toe protection

PP26 Root Wad Cluster #5 with toe protection

PP27 Root Wad Cluster #6

PP#28 Riffle #10, Cross Section #3 and Bare Root Plot #2

PP#29B Step Pool #6

PP#29A Downstream View Meander Bend with Transplant and Cross Section #4

PP#30 Riffle

PP#31 Swale into Step Pool #7

PP#32 Riffle #11 and Root Wad Cluster #7

PP#33 Riffle #12 and Root Wad Cluster #8

PP#34 Riffle #13 and Root Wad Cluster #9

PP#35 Riffle #14, Root Wad Cluster #10, and Cross Section #4

PP#36 Riffle #15 and Root Wad Cluster #11

PP#37 Riffle #16, Root Wad Cluster #12, and Cross Section #5

PP#38 Riffle #17 and Root Wad Cluster #13

PP#39 Riffle #18, Root Wad Cluster #14, and Cross Section #6

PP#40 Run into Root Wad Cluster #15

PP#41 Root Wad Cluster #16 into Culvert at Reach End

PP#42 Upstream view from end of project

Conservation Easement Marker

Buffalo Creek Watershed Phase II
Benbow Park
Vegetation Survival Plots

Bare-Root Plantings

Reach 1	Photo Point (#)	Planted (stems)	Year 1 (stems)	Year 2 (stems)	Year 3 (stems)	Year 4 (stems)	Year 5 (stems)
Plot #1	11A	43	36				
Plot #2	37	39	23				

Live Stakes

Reach 1	Photo Point (#)	Planted (stakes)	Year 1 (stakes)	Year 2 (stakes)	Year 3 (stakes)	Year 4 (stakes)	Year 5 (stakes)
Plot #1	11A	100	84				

Note: Live stakes counted from eastern end of plot down to step pool #3 at Station 15+90

Notes:

1. All plots are shown on the plan views. All plot corners are marked with a wooden stake and orange flagging tape.
2. Each counted stem or live stake is marked with pink flagging tape.
3. Photo point locations are shown on the plan views.
4. Bare root Plots are 25x100 feet.
4. Use successive columns for survivability from year to year.

Buffalo Creek Watershed Phase II
Brown Bark Park
Vegetation Survival Plots

Bare-Root Plantings

Reach 1	Photo Point (#)	Planted (stems)	Year 1 (stems)	Year 2 (stems)	Year 3 (stems)	Year 4 (stems)	Year 5 (stems)
Plot #1	2	30	19				
Plot #2	28	49	24				

Live Stakes

Reach 1	Photo Point (#)	Planted (stakes)	Year 1 (stakes)	Year 2 (stakes)	Year 3 (stakes)	Year 4 (stakes)	Year 5 (stakes)
Plot #1	2	100	84				

Note: Live stakes counted from eastern end of plot down to Station 12+50

Notes:

1. All plots are shown on the plan views. All plot corners are marked with a wooden stake and orange flagging tape.
2. Each counted stem or live stake is marked with pink flagging tape.
3. Photo point locations are shown on the plan views.
4. Bare root plots are 25x100 feet.
4. Use successive columns for survivability from year to year.