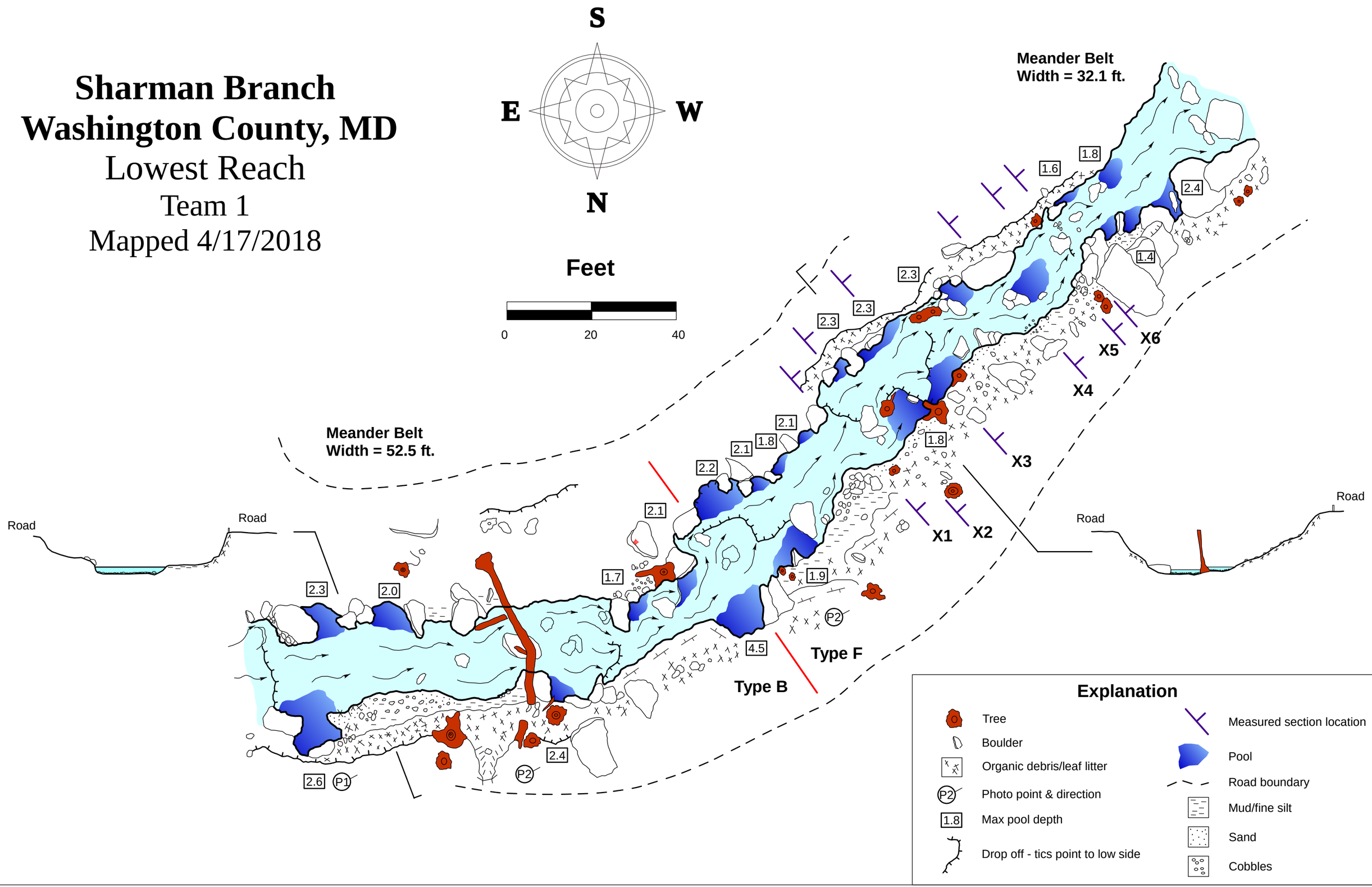
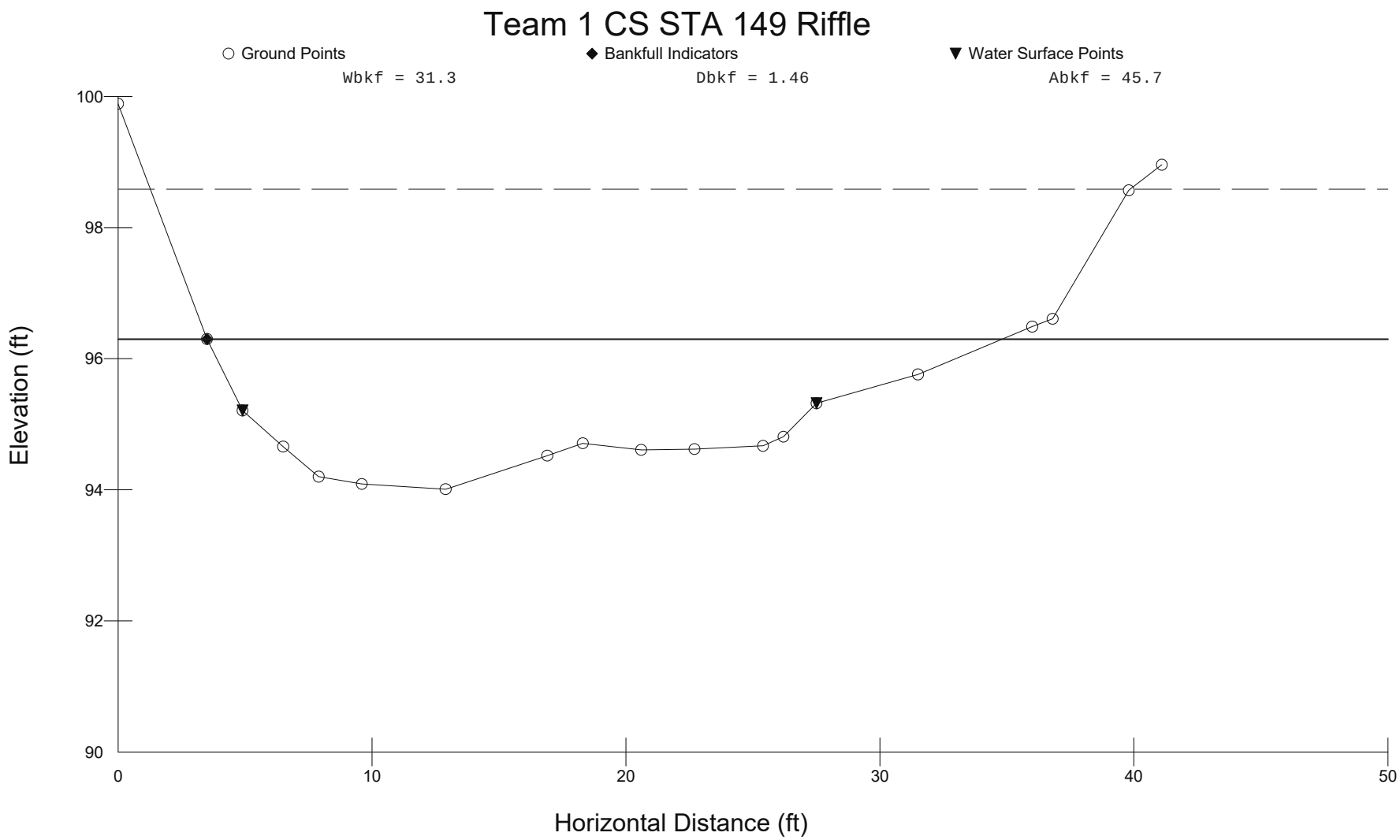
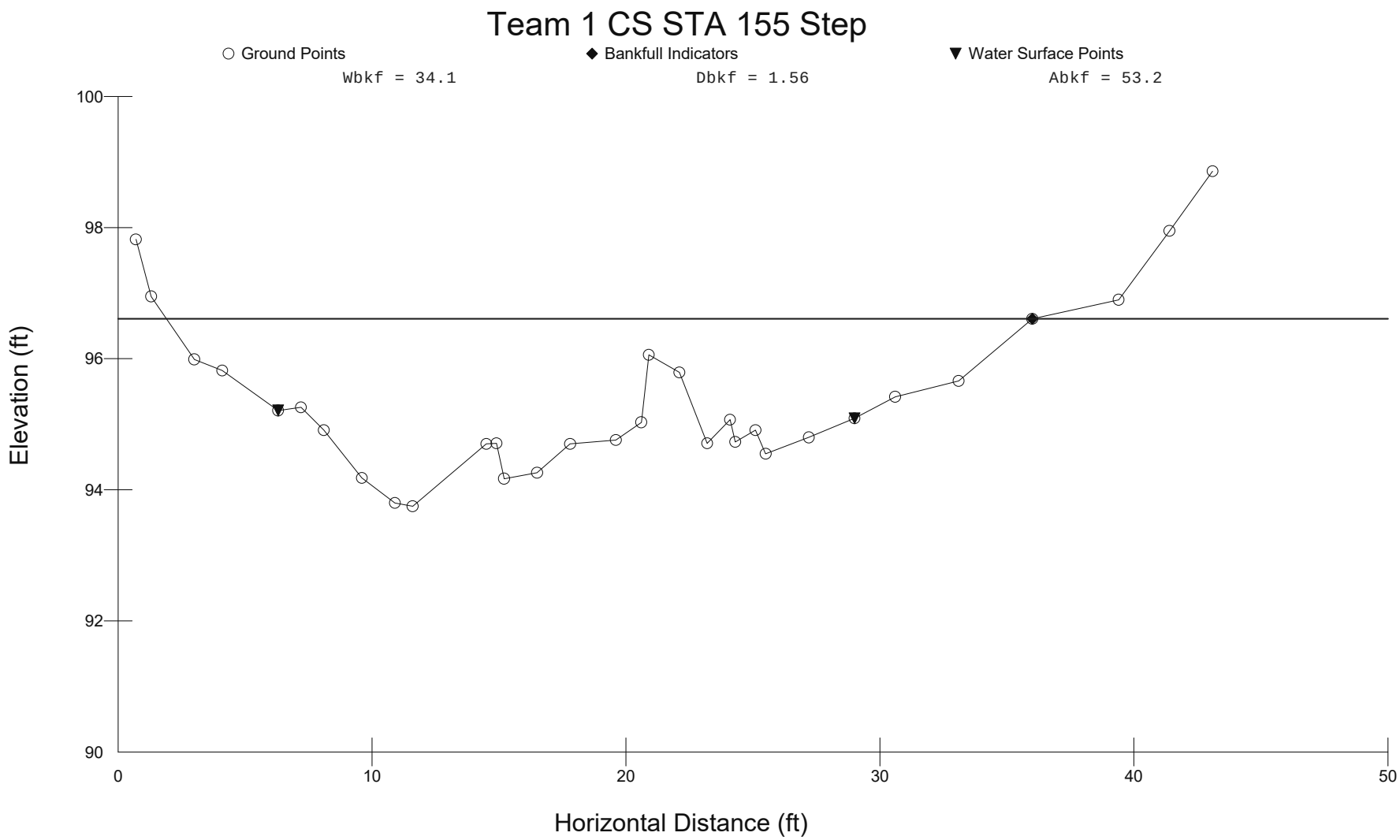
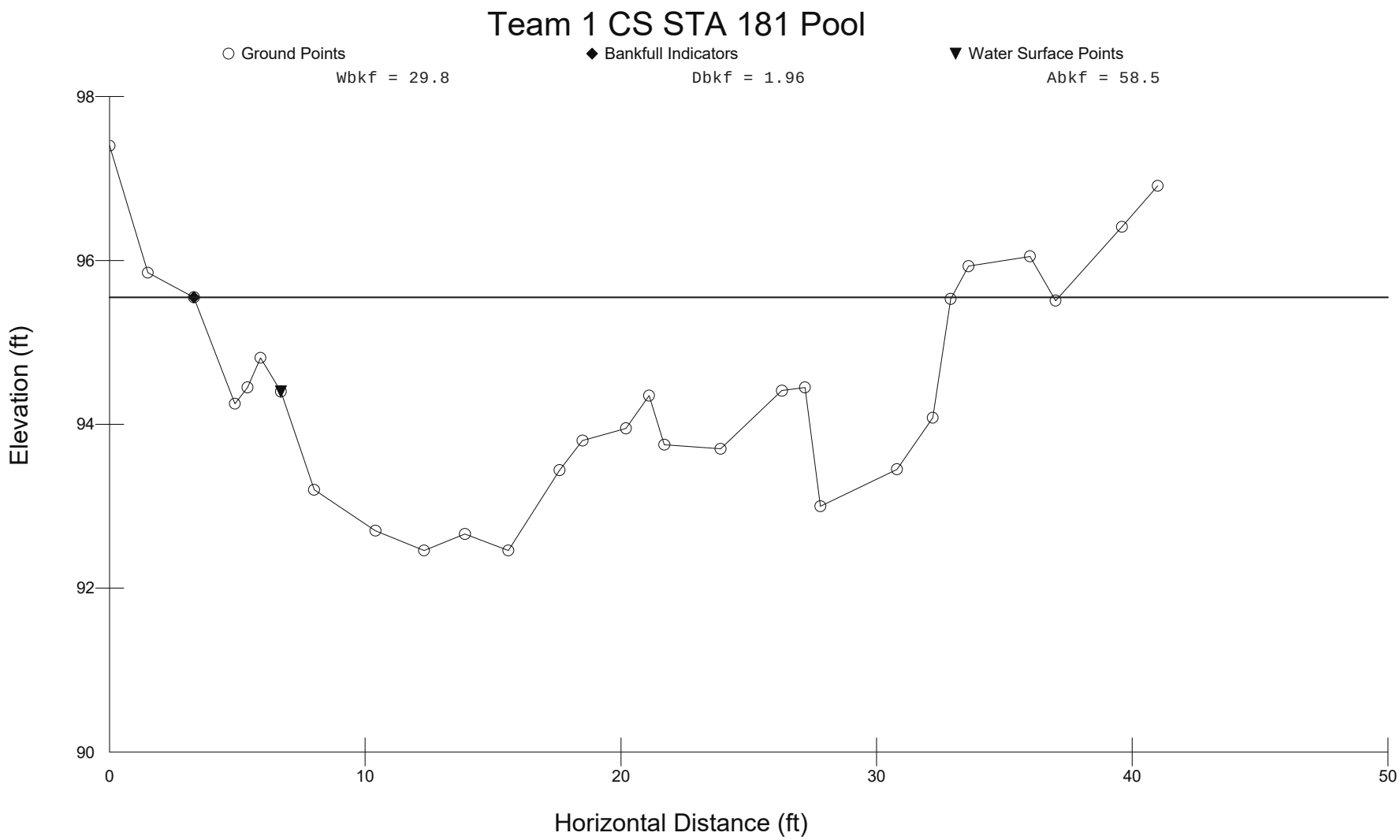
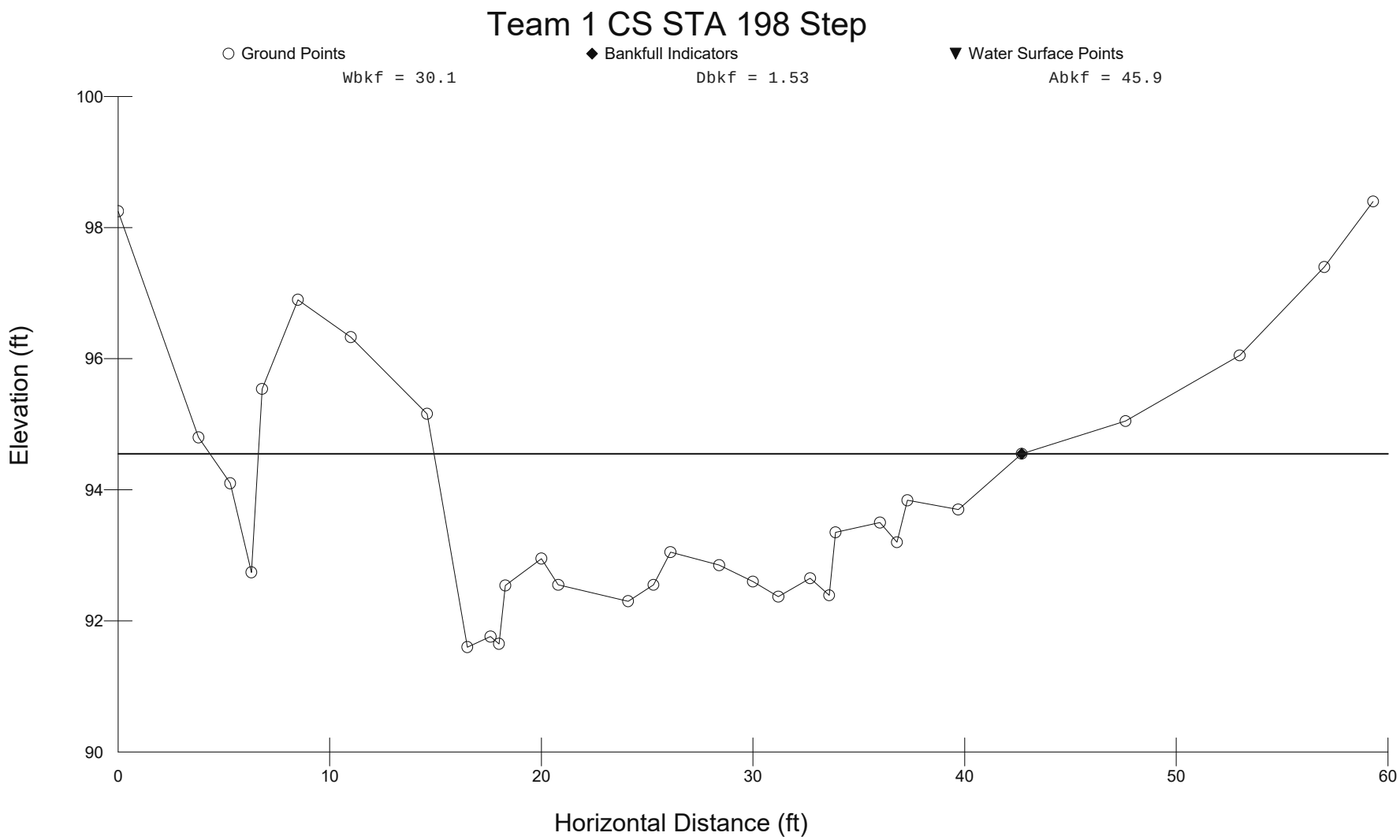
Sharman Branch
Washington County, MD
Lowest Reach
Team 1
Mapped 4/17/2018

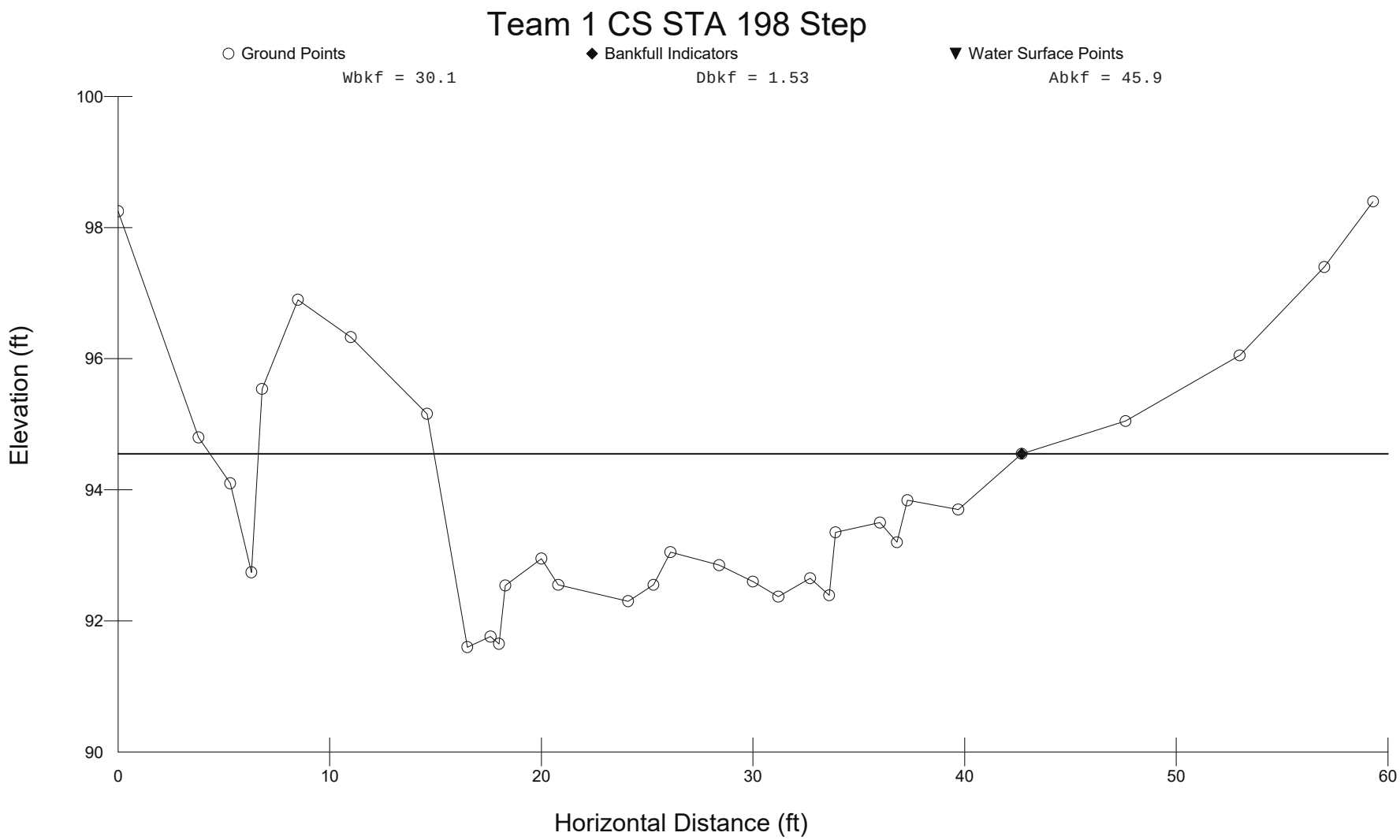


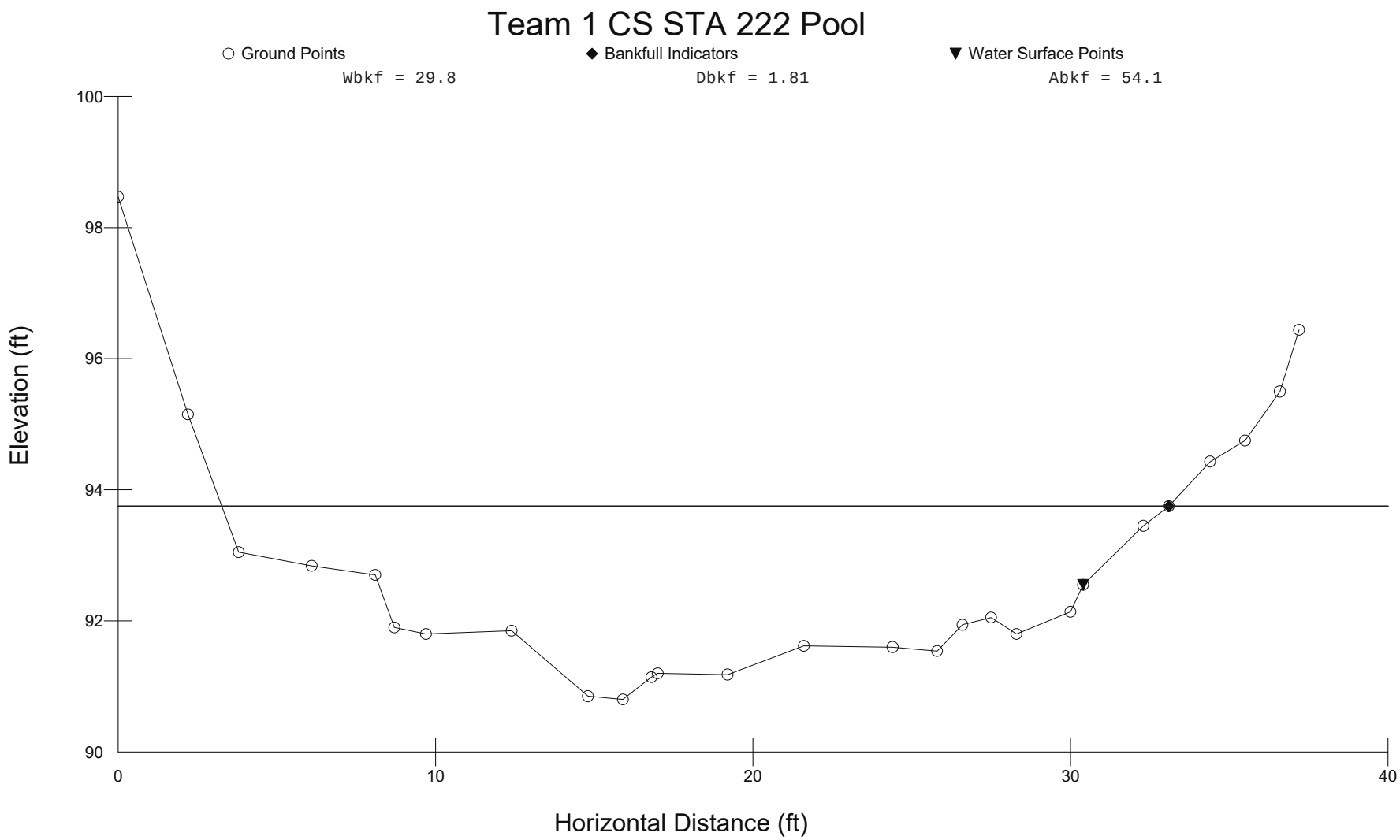

Team 1 CS STA 149 Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 31.3
Dbkf = 1.46
Abkf = 45.7
Elevation (ft)
100
98
96
94
92
90
0
10
20
30
40
50
Horizontal Distance (ft)

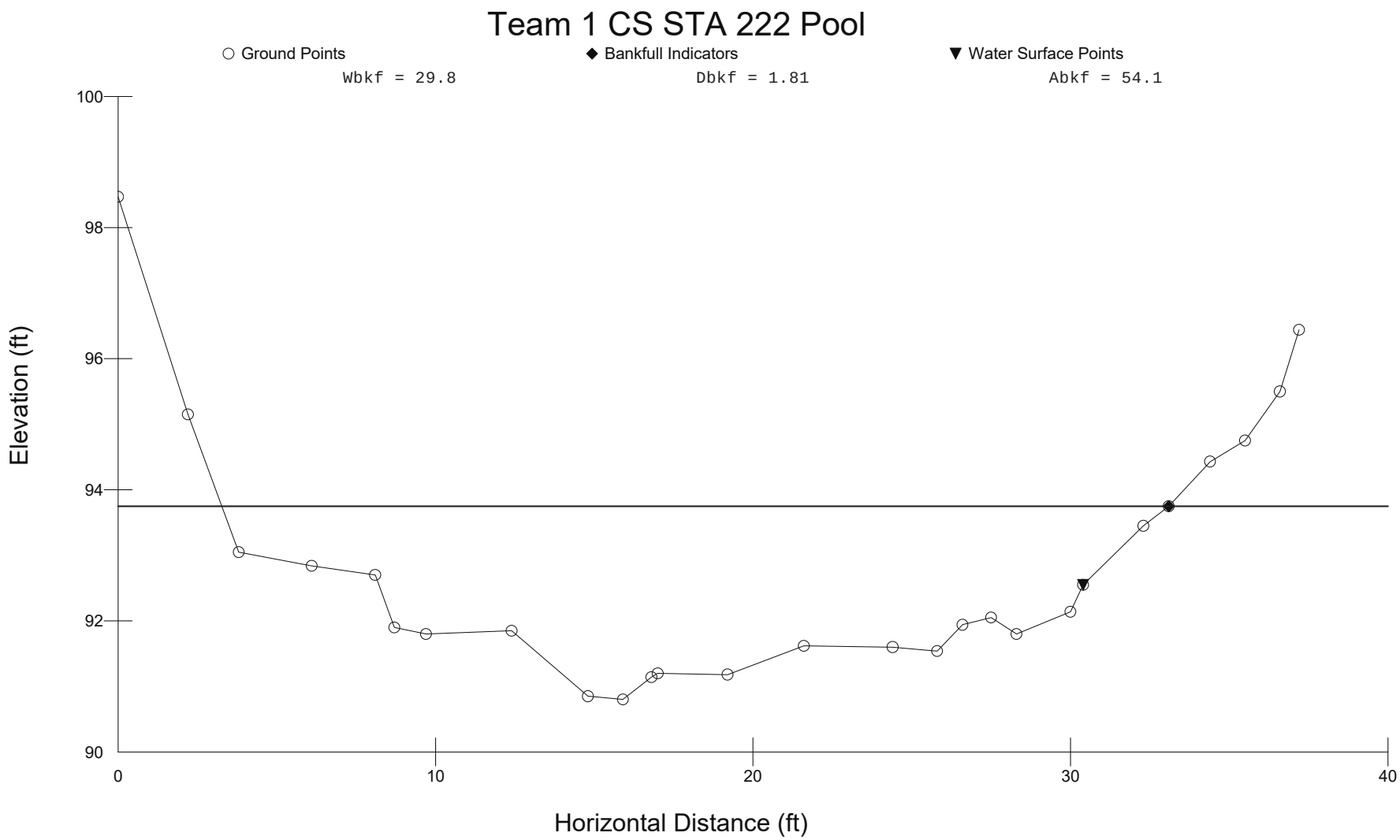

Team 1 CS STA 155 Step
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 34.1
Dbkf = 1.56
Abkf = 53.2
100
98
96
94
92
90
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

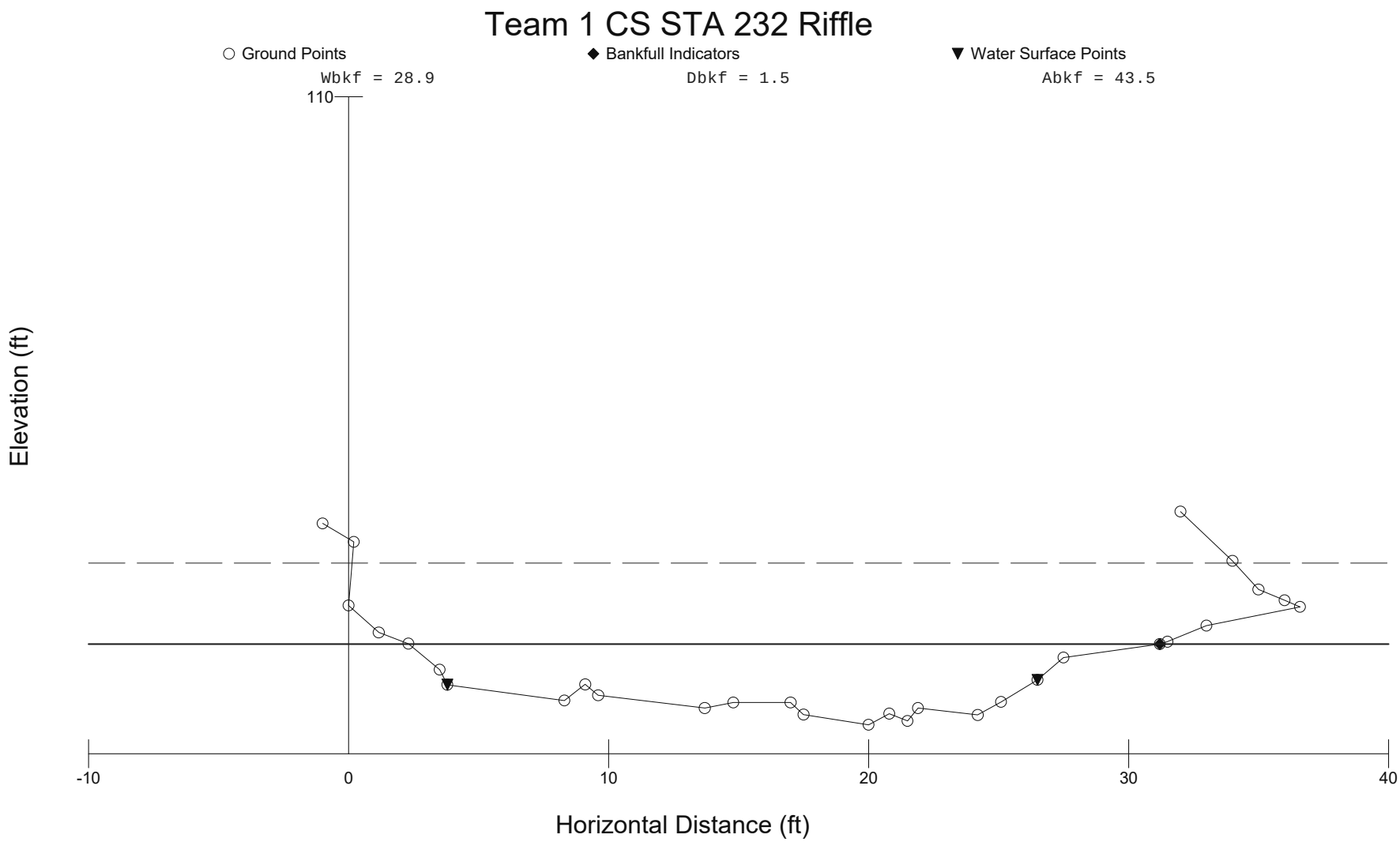

Team 1 CS STA 181 Pool
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 29.8
Dbkf = 1.96
Abkf = 58.5
98
96
94
92
90
Elevation (ft)
0
10
20
30
40
50
Horizontal Distance (ft)

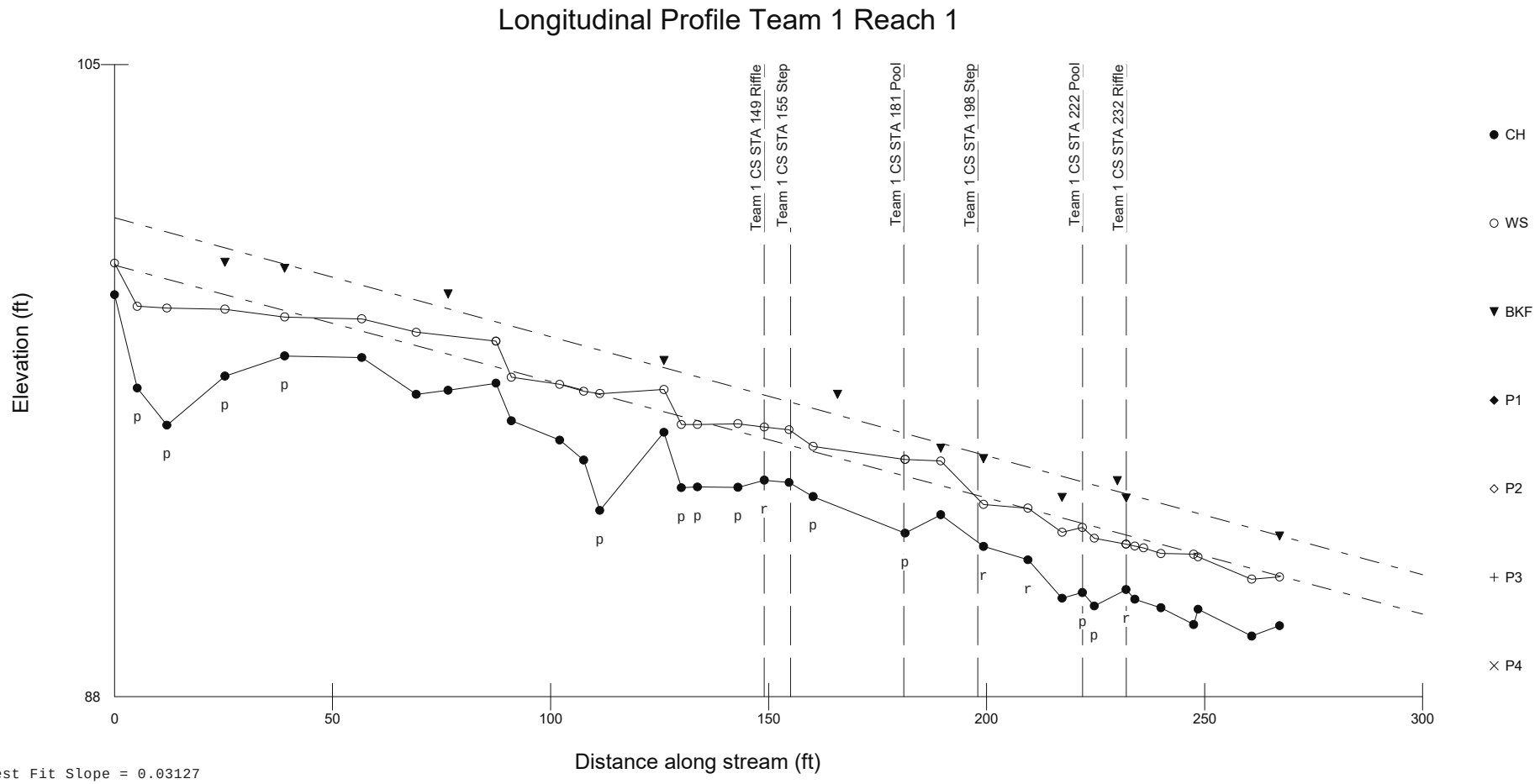

Team 1 CS STA 198 Step
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 30.1
Dbkf = 1.53
Abkf = 45.9
Elevation (ft)
100
98
96
94
92
90
0
10
20
30
40
50
60
Horizontal Distance (ft)


Team 1 CS STA 198 Step
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 30.1
Dbkf = 1.53
Abkf = 45.9
Elevation (ft)
100
98
96
94
92
90
0
10
20
30
40
50
60
Horizontal Distance (ft)

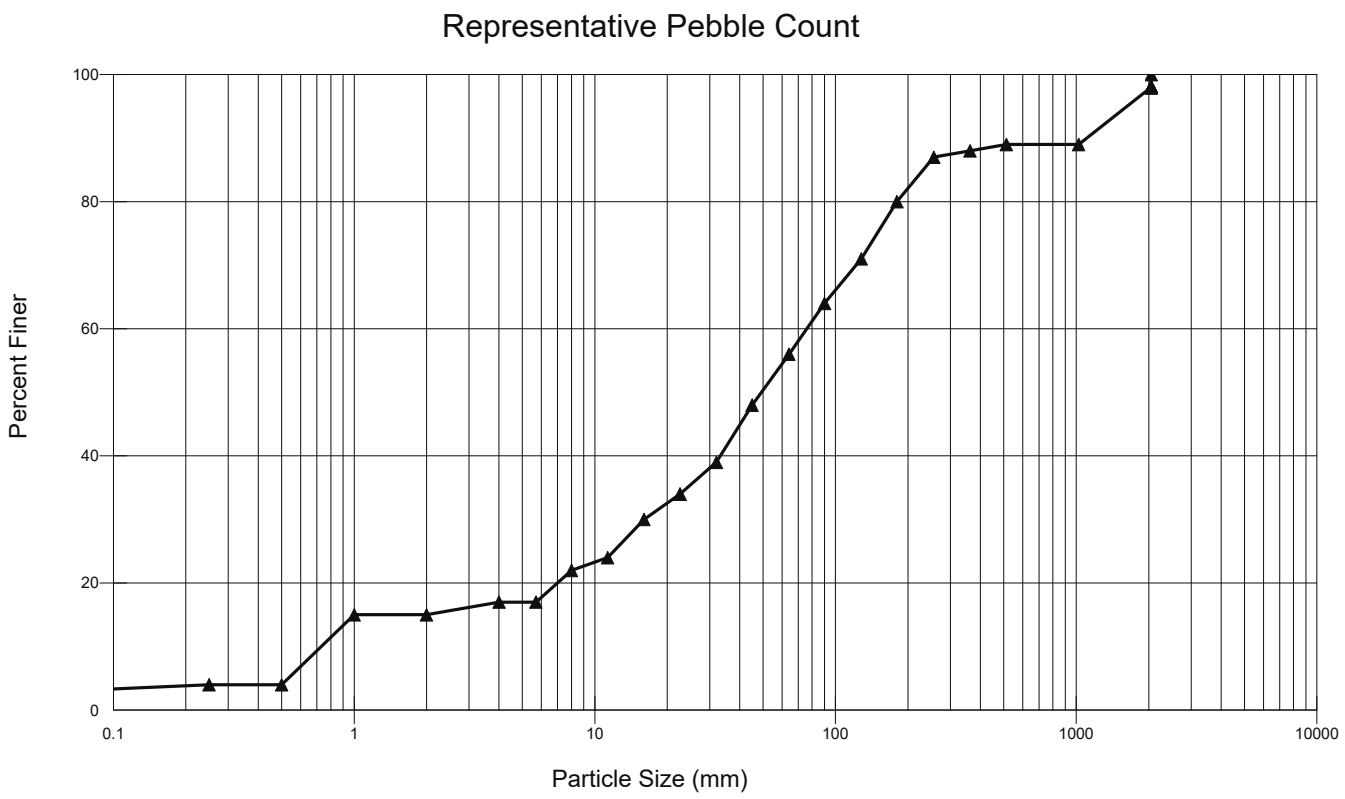

Team 1 CS STA 222 Pool
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 29.8
Dbkf = 1.81
Abkf = 54.1
Elevation (ft)
100
98
96
94
92
90
0
10
20
30
40
Horizontal Distance (ft)

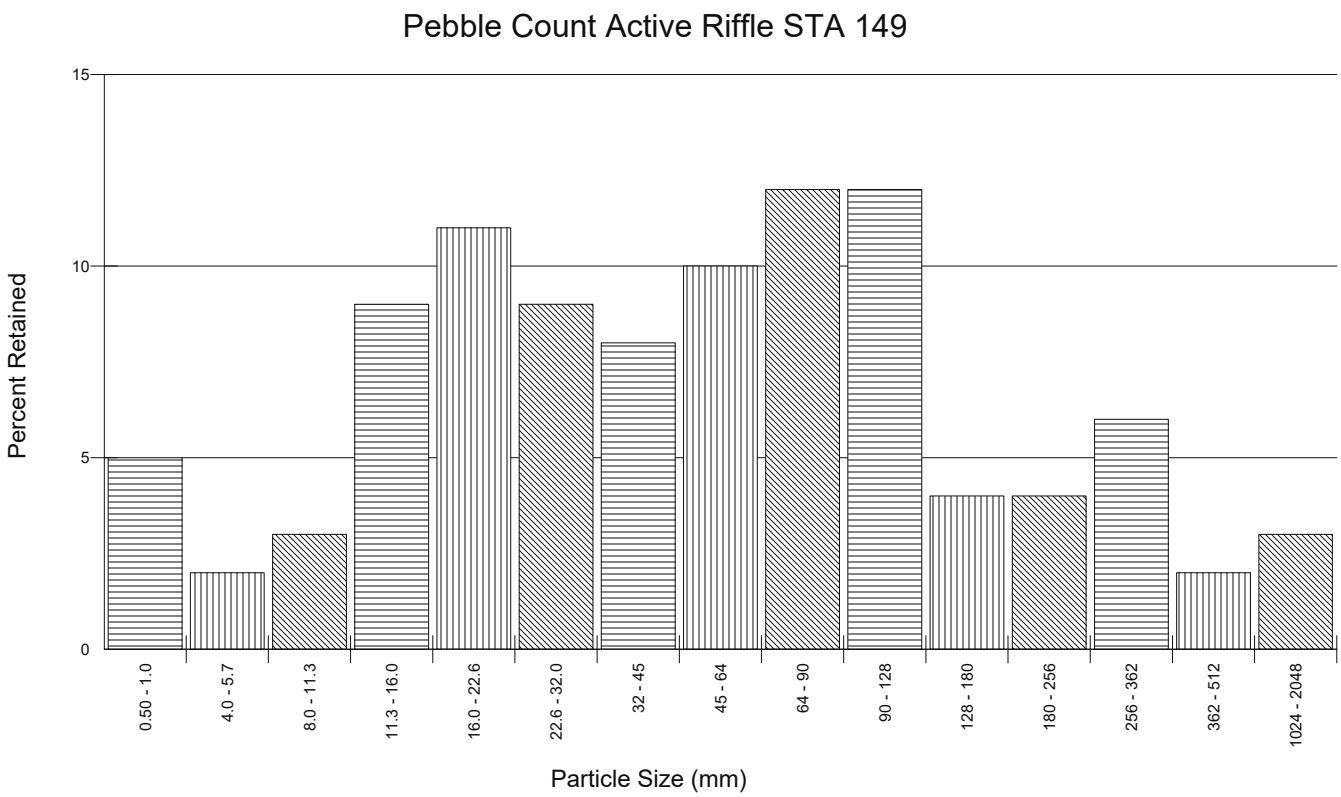

Team 1 CS STA 222 Pool
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 29.8
Dbkf = 1.81
Abkf = 54.1
Elevation (ft)
100
98
96
94
92
90
0
10
20
30
40
Horizontal Distance (ft)

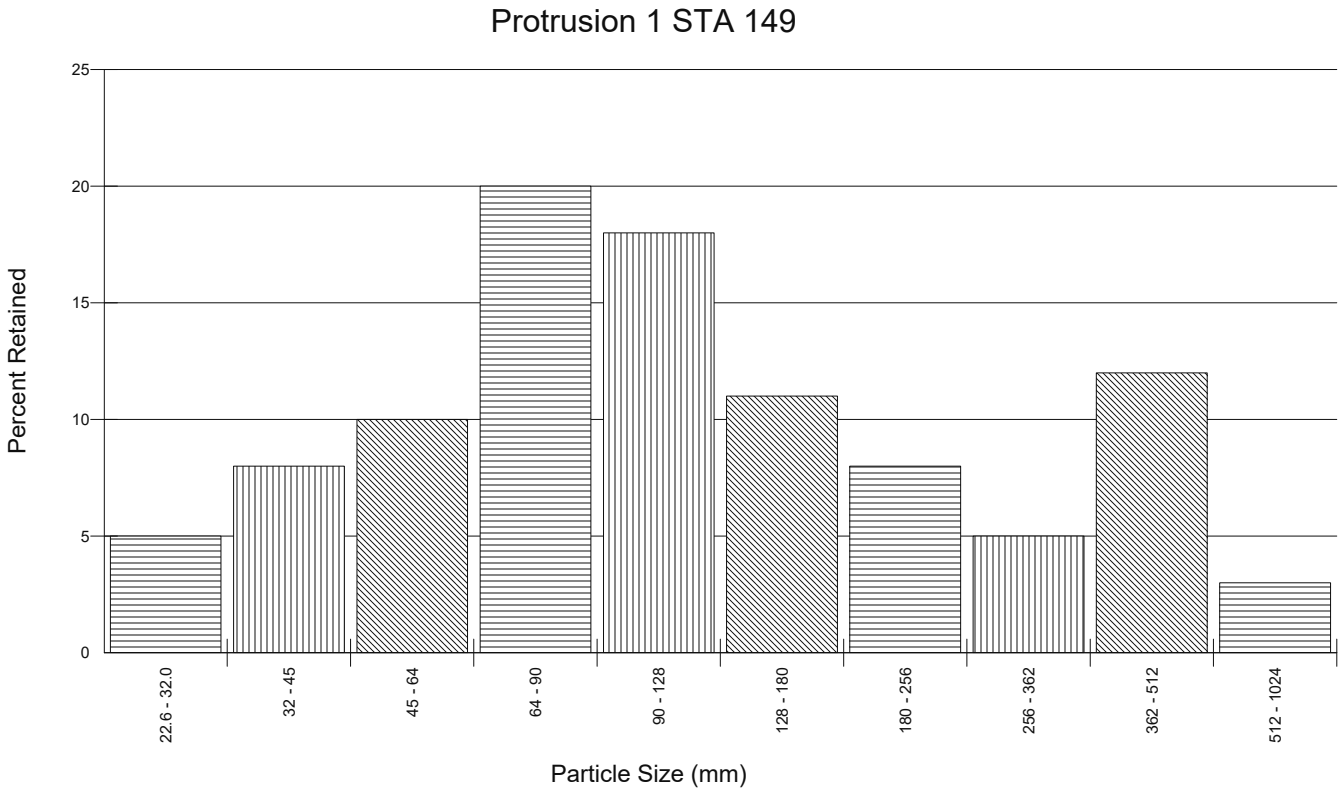

Team 1 CS STA 232 Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 28.9
Dbkf = 1.5
Abkf = 43.5
110
Elevation (ft)
-10
0
10
20
30
40
Horizontal Distance (ft)

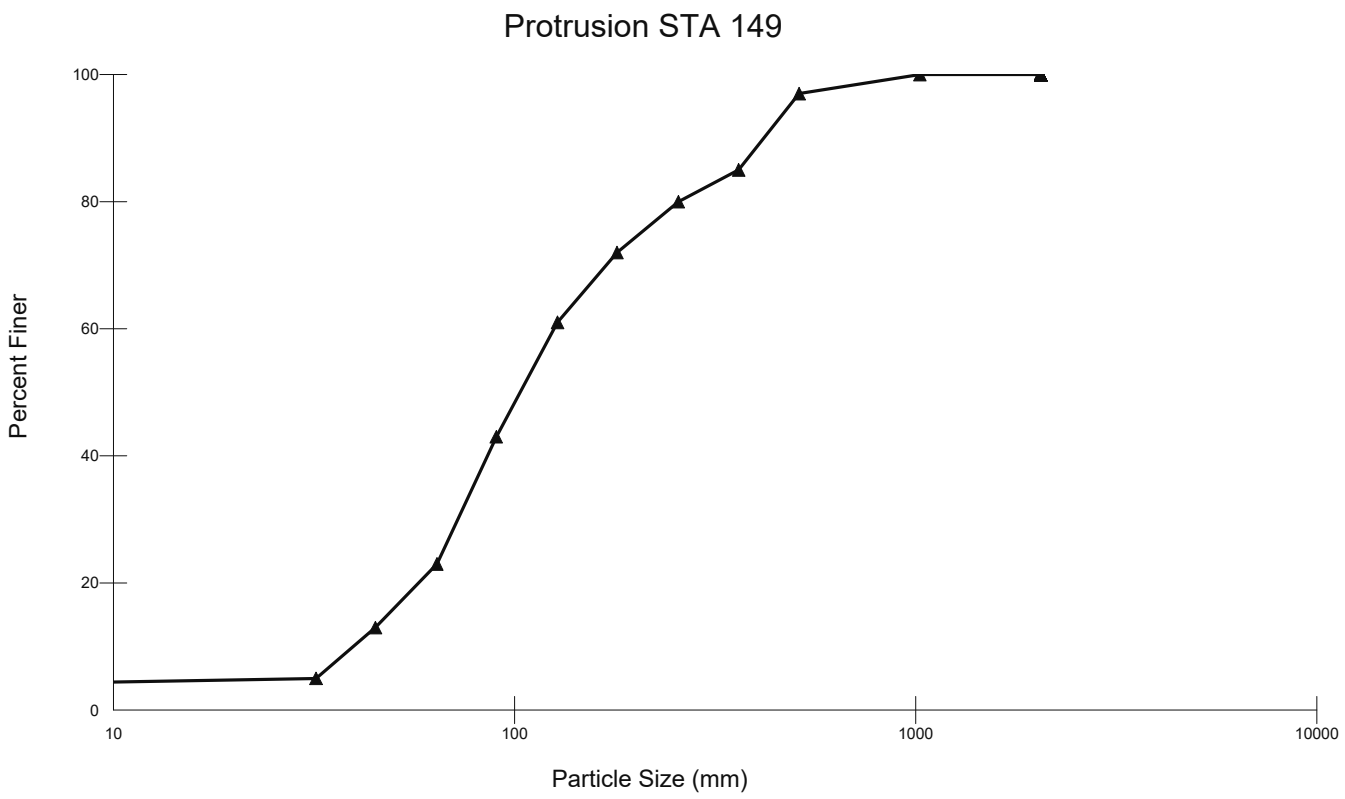


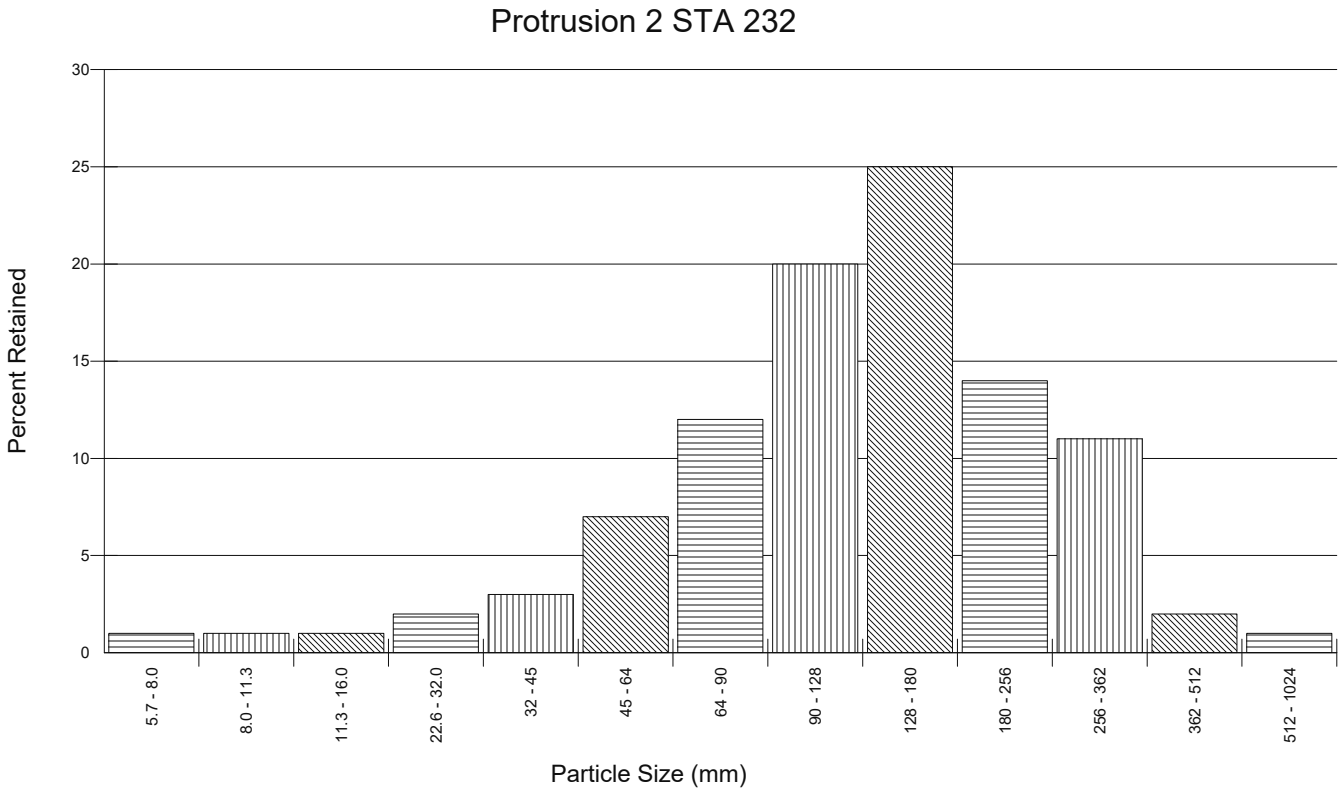
WS Best Fit Slope = 0.03127
BKF Best Fit Slope = 0.03200

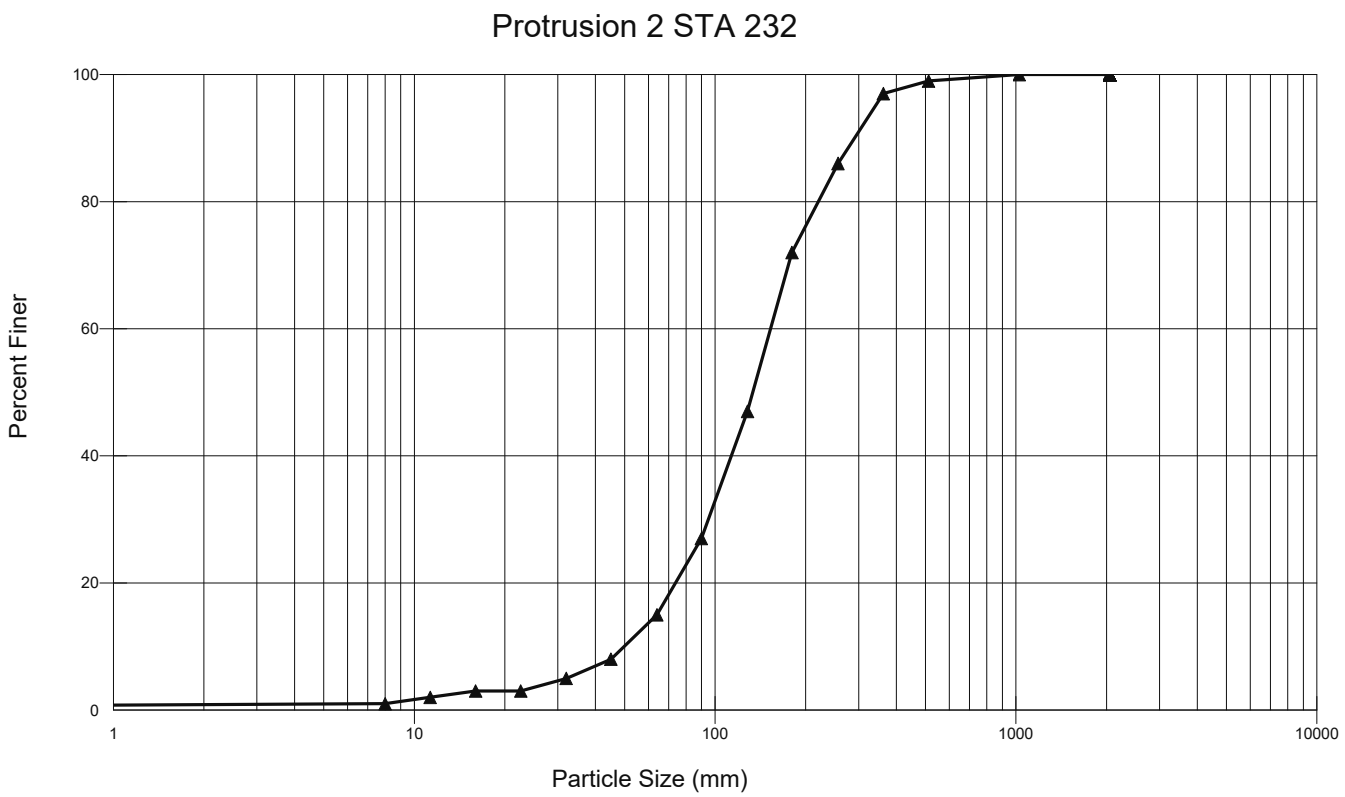

Representative Pebble Count
Percent Finer
100
80
60
40
20
0
0.1
1
10
100
1000
10000
Particle Size (mm)


Pebble Count Active Riffle STA 149
Percent Retained
15
10
5
0
0.50 - 1.0
4.0 - 5.7
8.0 - 11.3
11.3 - 16.0
16.0 - 22.6
22.6 - 32.0
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
1024 - 2048
Particle Size (mm)


Protrusion 1 STA 149
Percent Retained
25
20
15
10
5
0
22.6 - 32.0
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
Particle Size (mm)


Protrusion STA 149
Percent Finer
100
80
60
40
20
0
10
100
1000
10000
Particle Size (mm)


Protrusion 2 STA 232
Percent Retained
30
25
20
15
10
5
0
5.7 - 8.0
8.0 - 11.3
11.3 - 16.0
22.6 - 32.0
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
Particle Size (mm)


Protrusion 2 STA 232
Percent Finer
100
80
60
40
20
0
1
10
100
1000
10000
Particle Size (mm)

Worksheet 2-2. Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	Team 1			Location:	Reach - Reach 1
Date:	4/17/2018	Stream Type:	F4/2	Valley Type:	C-CO-US
Observers:	Team 1			HUC:	

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	45.72	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	1.46	d_{bkf} (ft)
Bankfull Riffle WIDTH	31.33	W_{bkf} (ft)	Wetted PERMIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	32.10	W_p (ft)
D_{84} at Riffle	167.00	Dia. (mm)	D_{84} (mm) / 304.8	0.55	D_{84} (ft)
Bankfull SLOPE	0.0319	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	1.42	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	2.59	R / D_{84}
Drainage Area	3.6	DA (mi^2)	Shear Velocity $u^* = (gRS)^{1/2}$	1.208	u^* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [\,2.83 + 5.66 * Log\{R / D_{84}\}\,]\,u^*$	6.27	ft / sec	286.49	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor / Relative Roughness (Figs. 2-18, 2-19) $u = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.05	6.73	ft / sec	307.47	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. 2-20) $u = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.05	6.73	ft / sec	307.47	cfs
2. Roughness Coefficient: c) Manning's *n* from Jarrett (USGS): $u = 1.49*R^{2/3}*S^{1/2}/n$ $n = 0.39*S^{0.38}*R^{-0.16}$ **Note:** This equation is applicable to **steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems**; i.e., for Stream Types A1, A2, A3, B1, B2, B3, C2 & E3 $n =$ 0.100	3.38	ft / sec	154.35	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) Darcy-Weisbach (Leopold, Wolman and Miller)	6.46	ft / sec	295.39	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) Chezy C	0.00	ft / sec	0.00	cfs
4. Continuity Equations: a) Regional Curves $u = Q / A$ Return Period for Bankfull Discharge Q = 0.0 year	2.50	ft / sec	113.00	cfs
4. Continuity Equations: b) USGS Gage Data $u = Q / A$	0.00	ft / sec	0.00	cfs

Protrusion Height Options for the D_{84} Term in the Relative Roughness Relation (R/D_{84}) – Estimation Method 1

Option 1.	For **sand-bed** channels: Measure 100 **"protrusion heights"** of sand dunes from the downstream side of feature to the top of feature. Substitute the D_{84} sand dune protrusion height in ft for the D_{84} term in method 1.
Option 2.	For **boulder-dominated** channels: Measure 100 **"protrusion heights"** of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the D_{84} boulder protrusion height in ft for the D_{84} term in method 1.
Option 3.	For **bedrock-dominated** channels: Measure 100 **"protrusion heights"** of rock separations, steps, joints or uplifted surfaces above channel bed elevation. Substitute the D_{84} bedrock protrusion height in ft for the D_{84} term in method 1.
Option 4.	For **log-influenced** channels: Measure **"protrusion heights"** proportionate to channel width of log diameters or the height of the log on upstream side if embedded. Substitute the D_{84} protrusion height in ft for the D_{84} term in method 1.

Copyright © 2008 Wildland Hydrology

Worksheet 2-3. Field form for Level II stream classification (Rosgen, 1996; Rosgen and Silvey, 2005).

Stream:	**Team 1, Reach - Reach 1**				
Basin:		Drainage Area:	**2304** acres	**3.6**	mi^2
Location:					
Twp.&Rge: ;		Sec.&Qtr.: ;			
Cross-Section Monuments (Lat./Long.):	**0 Lat / 0 Long**			Date:	**04/17/18**
Observers:	**Team 1**			Valley Type:	C-CO-U

Bankfull WIDTH (W_{bkf}) WIDTH of the stream channel at bankfull stage elevation, in a riffle section.	**31.33**	ft
Bankfull DEPTH (d_{bkf}) Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A / W_{bkf}$).	**1.46**	ft
Bankfull X-Section AREA (A_{bkf}) AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.	**45.72**	ft^2
Width/Depth Ratio (W_{bkf} / d_{bkf}) Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.	**21.46**	ft/ft
Maximum DEPTH (d_{mbkf}) Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section.	**2.29**	ft
WIDTH of Flood-Prone Area (W_{fpa}) Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section.	**38.6**	ft
Entrenchment Ratio (ER) The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH (W_{fpa} / W_{bkf}) (riffle section).	**1.23**	ft/ft
Channel Materials (Particle Size Index) D_{50} The D_{50} particle size index represents the mean diameter of channel materials, as sampled from the channel surface, between the bankfull stage and Thalweg elevations.	**50.7**	mm
Water Surface SLOPE (S) Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage.	**0.03193**	ft/ft
Channel SINUOSITY (k) Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope (VS / S).	**1.05**	

Stream Type **F 4/2b** (See **Figure 2-14**)

Copyright © 2006 Wildland Hydrology

Worksheet 2-4b. Morphological relations, including dimensionless ratios of river reach sites (Rosgen and Silvey, 2007; Rosgen, 2008).

Stream: **Team 1**		Location: **Reach - Reach 1**	
Observers: **Team 1**	Date: **04/17/18**	Valley Type: **C-CO-US**	Stream Type: **F 4b**

River Reach Summary Data.....2

Hydraulics

Streamflow: Estimated Mean Velocity at Bankfull Stage (u_{bkf})	0	ft/sec	Estimation Method		
Streamflow: Estimated Discharge at Bankfull Stage (Q_{bkf})	0	cfs	Drainage Area	3.6	mi^2

Channel Pattern

Geometry	Mean	Min	Max		Dimensionless Geometry Ratios	Mean	Min	Max
Linear Wavelength (λ)	0	0	0	ft	Linear Wavelength to Riffle Width (λ / W_{bkf})	0.000	0.000	0.000
Stream Meander Length (L_m)	0	0	0	ft	Stream Meander Length Ratio (L_m / W_{bkf})	0.000	0.000	0.000
Radius of Curvature (R_c)	0	0	0	ft	Radius of Curvature to Riffle Width (R_c / W_{bkf})	0.000	0.000	0.000
Belt Width (W_{blt})	42.3	32.1	52.5	ft	Meander Width Ratio (W_{blt} / W_{bkf})	1.405	1.066	1.744
Arc Length (L_a)	0	0	0	ft	Arc Length to Riffle Width (L_a / W_{bkf})	0.000	0.000	0.000
Riffle Length (L_r)	16.5	5.85	33	ft	Riffle Length to Riffle Width (L_r / W_{bkf})	0.547	0.194	1.097
Individual Pool Length (L_p)	27.6	16.8	34.7	ft	Individual Pool Length to Riffle Width (L_p / W_{bkf})	0.916	0.558	1.153
Pool to Pool Spacing (P_s)	42.5	27	57.2	ft	Pool to Pool Spacing to Riffle Width (P_s / W_{bkf})	1.413	0.896	1.899

Channel Profile

Valley Slope (S_{val})	0	ft/ft	Average Water Surface Slope (S)	0.03193	ft/ft	Sinuosity (S_{val} / S)	1.05
Stream Length (SL)	267.2	ft	Valley Length (VL)	254.5	ft	Sinuosity (SL / VL)	1.05

Low Bank Height (LBH)	start	0	ft	Max Depth (d_{max})	start	0	ft	Bank-Height Ratio (BHR) (LBH / d_{max}) start
	end	0	ft		end	0	ft	end

Facet Slopes	Mean	Min	Max		Dimensionless Facet Slope Ratios	Mean	Min	Max
Riffle Slope (S_{rif})	0.031	0.024	0.038	ft/ft	Riffle Slope to Average Water Surface Slope (S_{rif} / S)	0.976	0.759	1.193
Run Slope (S_{run})	0.000	0.000	0.000	ft/ft	Run Slope to Average Water Surface Slope (S_{run} / S)	0.000	0.000	0.000
Pool Slope (S_p)	0.017	0.004	0.046	ft/ft	Pool Slope to Average Water Surface Slope (S_p / S)	0.525	0.127	1.437
Glide Slope (S_g)	0.000	0.000	0.000	ft/ft	Glide Slope to Average Water Surface Slope (S_g / S)	0.000	0.000	0.000
Step Slope (S_s)	0.225	0.117	0.283	ft/ft	Step Slope to Average Water Surface Slope (S_s / S)	7.047	3.661	8.851

Max Depths[a]	Mean	Min	Max		Dimensionless Depth Ratios	Mean	Min	Max
Max Riffle Depth (d_{maxrif})	2.59	2.26	3.04	ft	Max Riffle Depth to Mean Riffle Depth (d_{maxrif} / d_{bkf})	1.75	1.527	2.05
Max Run Depth (d_{maxrun})	0	0	0	ft	Max Run Depth to Mean Riffle Depth (d_{maxrun} / d_{bkf})	0	0	0
Max Pool Depth (d_{maxp})	3.47	2.46	5.13	ft	Max Pool Depth to Mean Riffle Depth (d_{maxp} / d_{bkf})	2.345	1.662	3.47
Max Glide Depth (d_{maxg})	0	0	0	ft	Max Glide Depth to Mean Riffle Depth (d_{maxg} / d_{bkf})	0	0	0
Max Step Depth (d_{maxs})	0	0	0	ft	Max Step Depth to Mean Riffle Depth (d_{maxs} / d_{bkf})	0	0	0

Channel Materials

	Reach[b]	Riffle[c]	Bar		Reach[b]	Riffle[c]	Bar	Protrusion Height[d]	
% Silt/Clay		0		D_{16}		14.43		66.17	mm
% Sand		5		D_{35}		27.82		105.2	mm
% Gravel		52		D_{50}		50.7		134.24	mm
% Cobble		32		D_{84}		167		245.14	mm
% Boulder		11		D_{95}		362		342.73	mm
% Bedrock		0		D_{100}		2047.97		1023.95	mm

[a] Min, max & mean depths are measured from Thalweg to bankfull at mid-point of feature for riffles and runs, the deepest part of pools, & at the tail-out of glides.
[b] Composite sample of riffles and pools within the designated reach. [c] Active bed of a riffle. [d] Height of roughness feature above bed.

Copyright © 2009 Wildland Hydrology