

APPENDIX A

Site Characteristics for Selected USGS Gage Stations in the Coastal Plain Physiographic Province

This Appendix provides summaries of field data collected by the U.S. Fish and Wildlife Service (Service) at fourteen U.S. Geological Survey (USGS) gage station monitored stream sites in the Coastal Plain hydro-physiographic region of Maryland and Delaware. For each site, information and survey data is summarized on four pages. The first page for each site contains general information on the drainage basin, gage station, and the study reach. The Maryland State Highway Administration provided land use/land cover information using the software program *GIS Hydro* (Ragan 1991) and 1994 Landsat and Spot coverage information. Stream order and magnitude are based on Strahler (1964) and Shreve (1967), respectively. The reported discharge recurrence intervals are from the log-Pearson type III flood frequency distribution for the annual maximum series calculated by USGS according to the Bulletin 17B procedures. The second page provides information on the study reach including cross-section plots and particle size distributions in the riffle and reach. The third page presents photographic views of the surveyed cross-section in the study reach and the fourth page provides a geomorphic sketch map (not to scale) or scale plan form diagram of the study reach mapped using a total station survey instrument and generated with the graphic and survey reduction software *Terra Model*.

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**BEAVERDAM BRANCH AT HOUSTON, DE
USGS STATION NUMBER: 1484100**

Latitude:	30° 54' 20"	Gage Period of Record:	1958 – Present
Longitude:	75° 30' 49"	Mean Annual Discharge (cfs):	3.63
Map Coordinates:	MD&DE Gazet	Rosgen Stream Type:	E5
	Map 52/ C2	Survey Date:	Feb. 2001
Drainage Area (sq. mi.):	2.83		
Stream Order / Magnitude:	2/6		
Percent Imperviousness:	0.00		

Land Use (%): Residential: 00.05 Agricultural: 56.32 Forest: 36.58 Commercial: 0.00

Log-Pearson Flood Frequency Discharge (cfs): $Q_{1.005}$: 12.90 $Q_{1.5}$: 38.00 $Q_{2.0}$: 49.00
(Log-Pearson Period: 1958 – 1998)

General Study Reach Description: The study reach starts 89 feet downstream of the active gage station on the eastern shore in Kent County, Delaware. The stream is channelized with pool/run features, little lateral scour and appears vertically stable. The right bank and floodplain is maintained in a mowed condition with scattered mature red maple and sweet gum. The left bank and floodplain is densely forested wetland with American holly, black willow, and viburnum spp. There is little coarse woody debris and no depositional features in the channel.

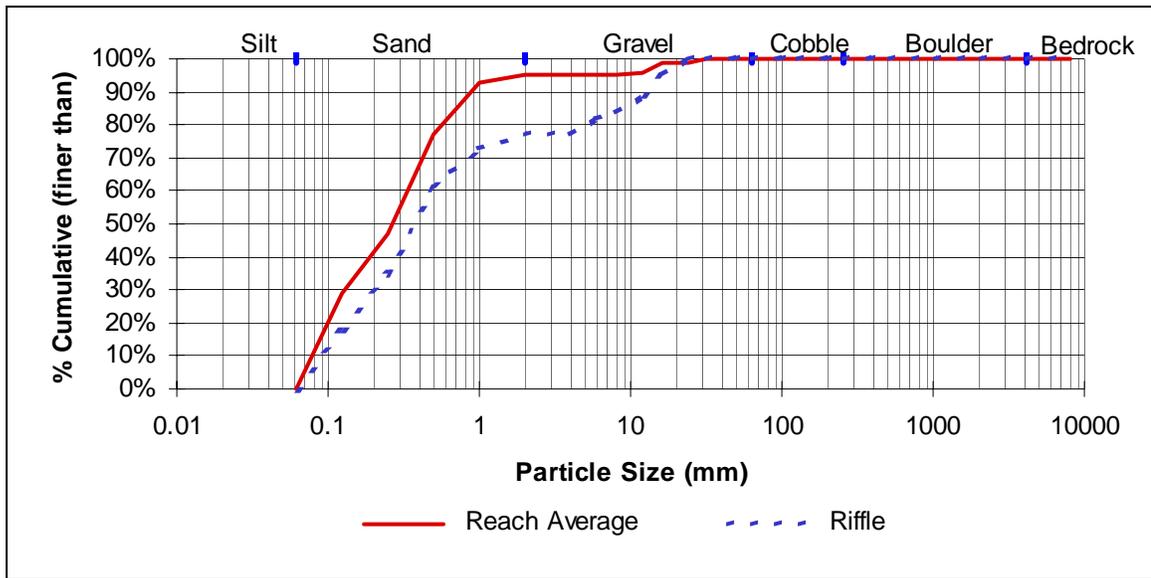
DISCHARGE BASED ON SURVEY OF GEOMORPHIC FEATURES

Bankfull Discharge (Q_{bkf} cfs):	34.95	$Q_{bkf} / Q_{1.5}$:	0.92
Bankfull Return Interval (R.I.):	1.35	$Q_{bkf} / Q_{2.0}$:	0.71
Gage Height (ft):	3.40		

STUDY REACH SURVEY INFORMATION

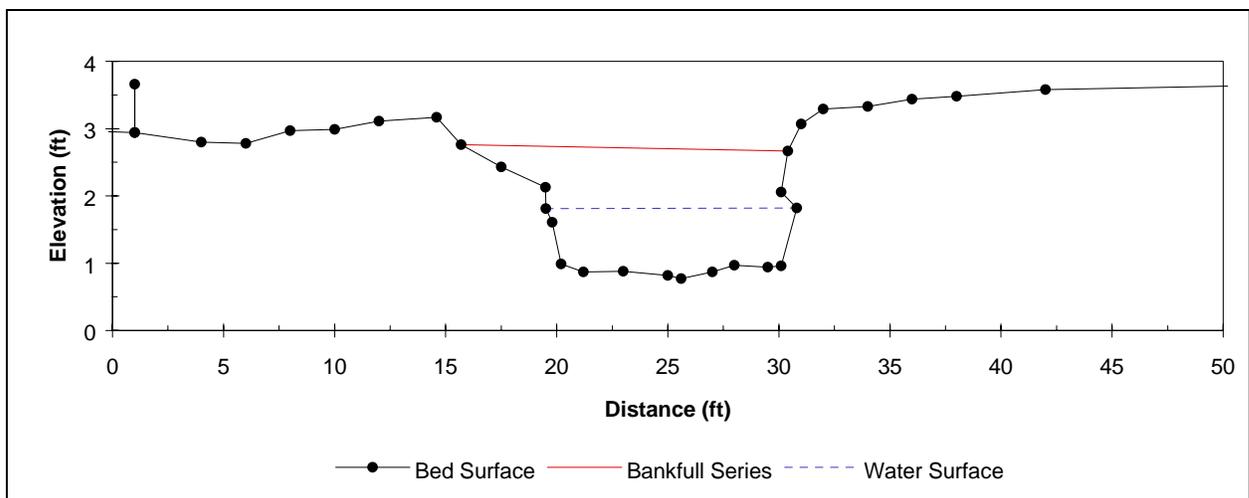
Average Water Surface Slope (ft/ft):	0.0007	Flood-prone Width (ft):	346.00
Manning's "n":	0.026	Entrenchment Ratio:	23.54
Mean Bankfull Velocity (ft/sec):	1.68	Width/Depth Ratio:	10.35
u/u^* :	10.50	Channel Sinuosity:	1.1
R/D_{84} :	44.74	Beltwidth (ft):	540
Froude Number:	0.27	Meander Width Ratio:	37

BEAVERDAM BRANCH AT HOUSTON, DE PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D ₁₆	0.09	0.12
D ₃₅	0.16	0.25
D ₅₀	0.27	0.37
D ₈₄	0.68	8.00
D ₉₅	8.00	16.00

STUDY REACH CROSS SECTION



Bankfull Width (ft):	14.70	Mean Bankfull Depth (ft):	1.42
Bankfull Cross-sectional Area (ft ²):	20.81	Maximum Bankfull Depth (ft):	1.93
Hydraulic Radius (ft):	1.17	Wetted Perimeter (ft):	17.72

Beaverdam Branch at Houston, Delaware

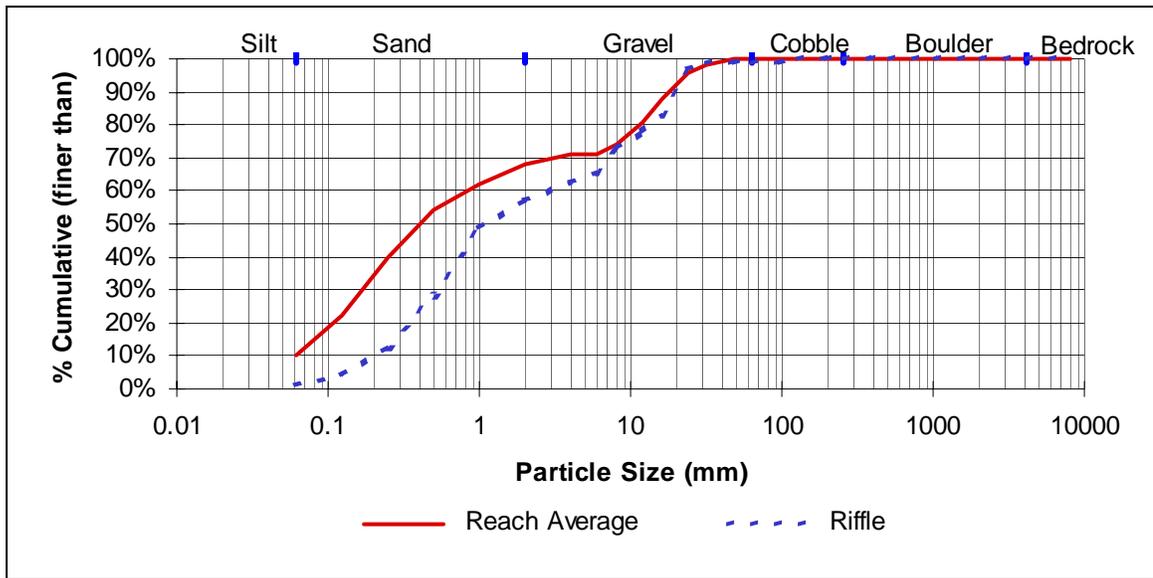


Upstream view of classification cross-section



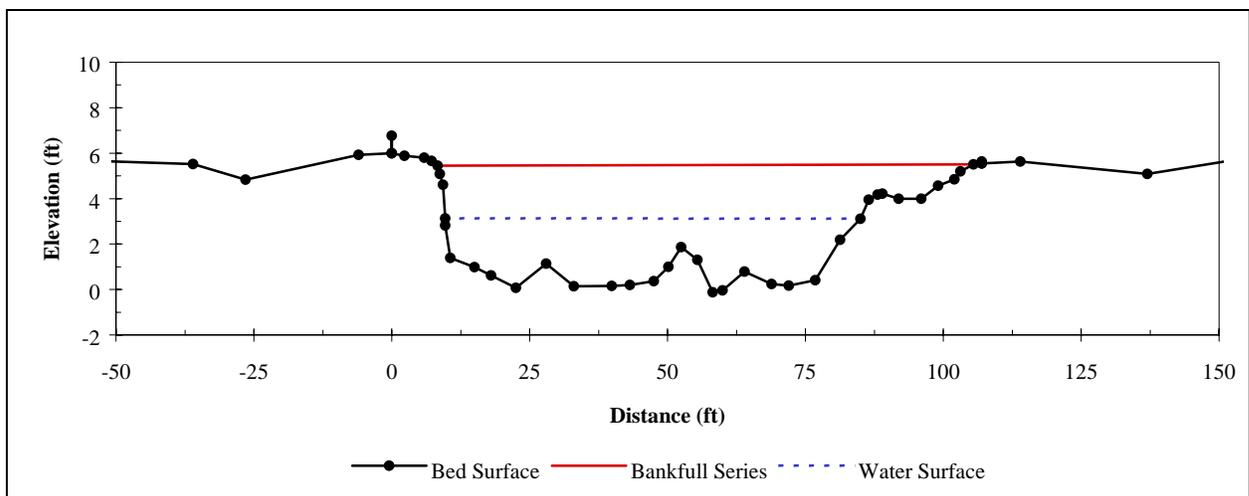
Left bank of classification cross-section

CHOPTANK RIVER NEAR GREENSBORO, MD PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D ₁₆	0.09	0.29
D ₃₅	0.21	0.62
D ₅₀	0.41	1.12
D ₈₄	13.57	16.53
D ₉₅	22.81	22.58

STUDY REACH CROSS SECTION



Bankfull Width (ft):	97.20	Mean Bankfull Depth (ft):	3.94
Bankfull Cross-sectional Area (ft ²):	383.11	Maximum Bankfull Depth (ft):	5.60
Hydraulic Radius (ft):	3.77	Wetted Perimeter (ft):	101.61

Choptank River near Greensboro, Maryland



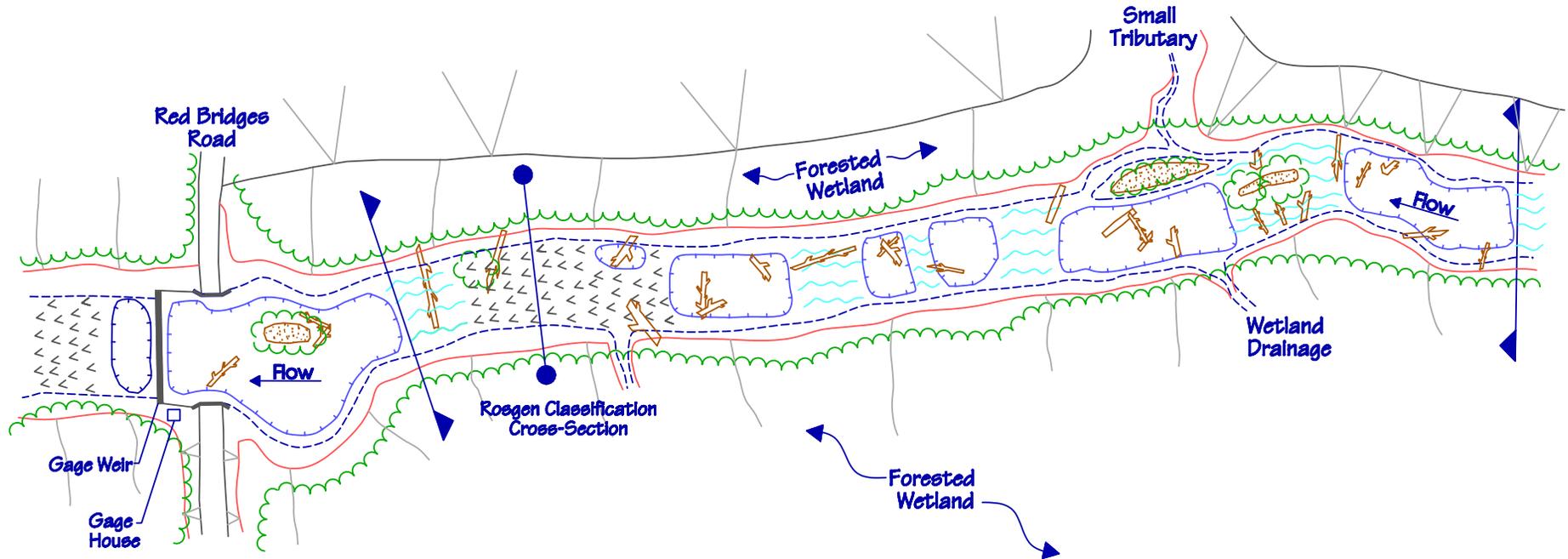
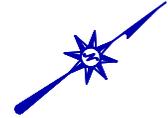
Downstream view of classification cross-section



Right bank of classification cross-section

CHOPTANK RIVER

near Greensboro, MD
U.S.G.S. Gage: 1491000



LEGEND	
Top of Bank :	
Edge of Water :	
Run:	
Pool:	
Riffle:	
Sand/Gravel :	
Fallen Trees :	
Study Reach End Point:	

NOT TO SCALE

Survey Dates: 6/29/01 & 7/11/01
Study Reach Length: 1851'

Classification Cross-Section

Monument Locations:

Left Monument:
38° 59' 53.10" N
75° 47' 09.10" W
Elevation: 20'

Right Monument:
38° 59' 53.00" N
75° 47' 10.20" W
Elevation: 20'

**FAULKNER BRANCH AT FEDERALSBURG, MD
USGS STATION NUMBER: 1489000**

Latitude:	38° 42' 45"	Gage Period of Record:	1950 – 1992
Longitude:	75° 47' 35"	Mean Annual Discharge (cfs):	9.10
ADC Map Coordinates:	MD&DE Gazet Map 43/B5	Rosgen Stream Type:	E5
Drainage Area (sq. mi.):	7.10	Survey Date:	Feb.& March 2001
Stream Order / Magnitude:	4/59		
Percent Imperviousness:	2.20		

Land Use (%): Residential: 5.36 Agricultural: 72.03 Forest: 21.49 Commercial: 0.77

Log-Pearson Flood Frequency Discharge (cfs): $Q_{1.005}$: 21.00 $Q_{1.5}$: 155.00 $Q_{2.0}$: 241.30
(Log-Pearson Period: 1950 – 1991)

General Study Reach Description: The study reach is 90 feet downstream of the discontinued gage station. The stream has pool/riffle/run features with little lateral scour and appears vertically stable. The floodplain is densely forested with red maple, sweet gum, tulip poplar, sycamore, loblolly pine, oak spp., and ironwood. The under story is moderately dense with elderberry, red maple, and sweet gum. There are numerous floodplain wetlands. The stream has point bar deposition and low to moderate amount of coarse woody debris.

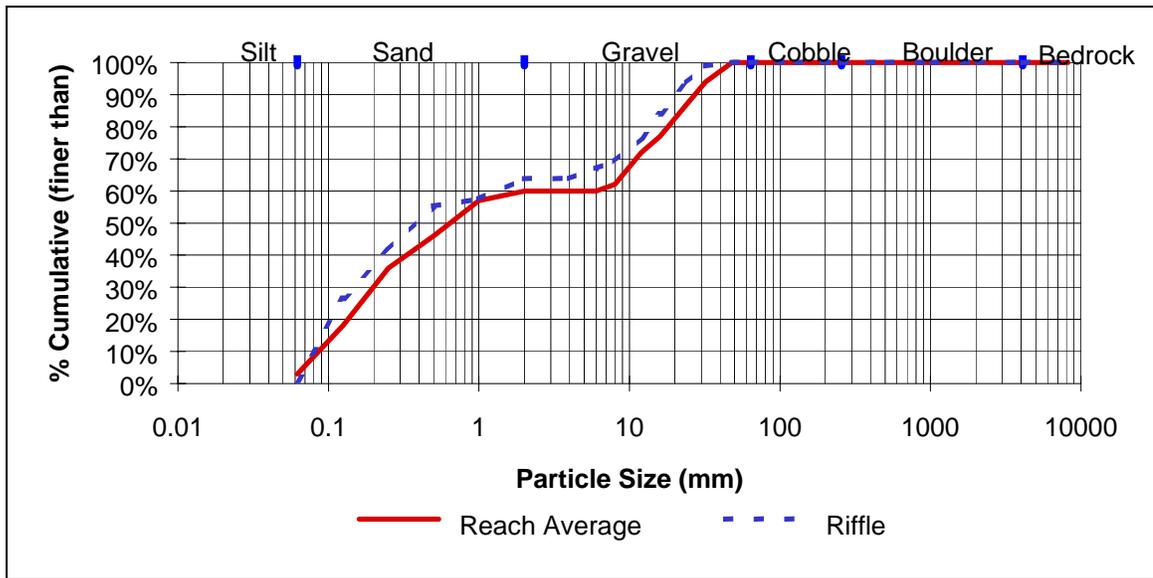
DISCHARGE BASED ON SURVEY OF GEOMORPHIC FEATURES

Bankfull Discharge (Q_{bkf} cfs):	85.94	$Q_{bkf} / Q_{1.5}$:	0.55
Bankfull Return Interval (R.I.):	1.17	$Q_{bkf} / Q_{2.0}$:	0.36
Gage Height (ft):	2.55		

STUDY REACH SURVEY INFORMATION

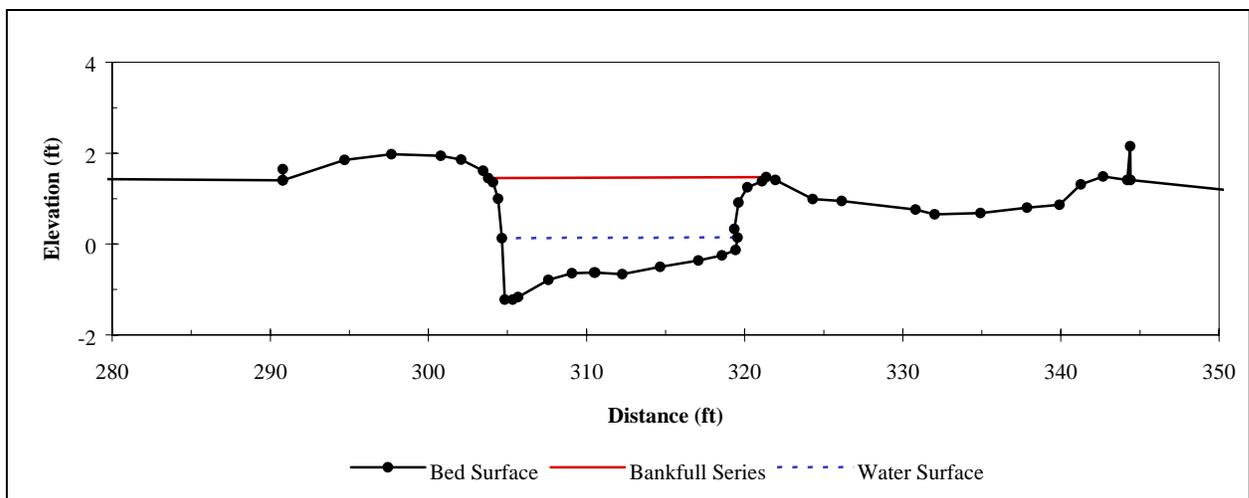
Average Water Surface Slope (ft/ft):	0.0023	Flood-prone Width (ft):	344.00
Manning's "n":	0.035	Entrenchment Ratio:	19.57
Mean Bankfull Velocity (ft/sec):	2.71	Width/Depth Ratio:	9.77
u/u^* :	7.97	Channel Sinuosity:	1.26
R/D_{84} :	29.04	Beltwidth (ft):	212
Froude Number:	0.39	Meander Width Ratio:	12

FAULKNER BRANCH AT FEDERALSBURG, MD PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D ₁₆	0.11	0.09
D ₃₅	0.24	0.18
D ₅₀	0.64	0.38
D ₈₄	21.25	15.97
D ₉₅	34.24	25.86

STUDY REACH CROSS SECTION



Bankfull Width (ft):	17.58	Mean Bankfull Depth (ft):	1.80
Bankfull Cross-sectional Area (ft ²):	31.68	Maximum Bankfull Depth (ft):	2.67
Hydraulic Radius (ft):	1.52	Wetted Perimeter (ft):	20.82

Faulkner Branch at Federalsburg, Maryland

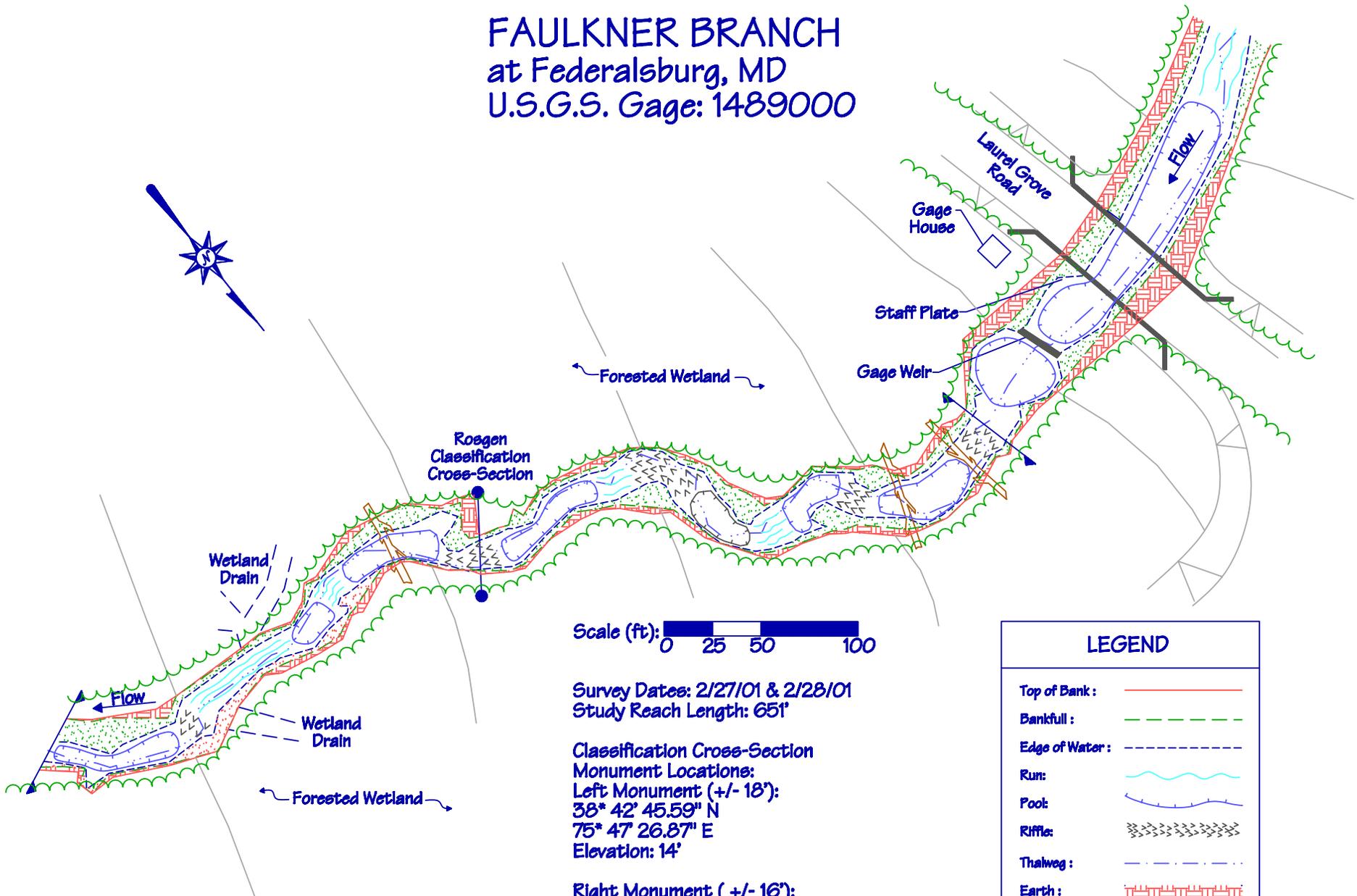


Upstream view of classification cross-section



Right bank of classification cross-section

FAULKNER BRANCH at Federalsburg, MD U.S.G.S. Gage: 1489000



Scale (ft): 0 25 50 100

Survey Dates: 2/27/01 & 2/28/01
Study Reach Length: 651'

Classification Cross-Section

Monument Locations:
Left Monument (+/- 18'):
38° 42' 45.59" N
75° 47' 26.87" E
Elevation: 14'

Right Monument (+/- 16'):
38° 42' 45.36" N
75° 47' 26.84" E
Elevation: 2'

LEGEND	
Top of Bank :	
Bankfull :	
Edge of Water :	
Run :	
Pool :	
Riffle :	
Thalweg :	
Earth :	
Sand/Gravel :	
Fallen Trees :	
Study Reach End Point:	

**GLEBE BRANCH AT VALLEY LEE, MD
USGS STATION NUMBER: 1661430**

Latitude:	38° 11' 40"	Gage Period of Record:	1968 – 1978
Longitude:	76° 31' 13"	Mean Annual Discharge (cfs):	N/A
ADC Map Coordinates:	MD&DE Gazet Map 30/D3	Rosgen Stream Type:	C4
Drainage Area (sq. mi.):	0.30	Survey Date:	July 2000 Feb. 2001
Stream Order / Magnitude:	1/1		
Percent Imperviousness:	7.00		

Land Use (%): Residential: 27.25 Agricultural: 35.80 Forest: 36.95 Commercial: N/A

Log-Pearson Flood Frequency Discharge (cfs): (Log-Pearson Period: 1969 – 1978)	Q _{1.005} : 8.10 (adjusted log- Pearson)	Q _{1.5} : 19.50 (adjusted log-Pearson)	Q _{2.0} : 35.00 (weighted log-Pearson)
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General Study Reach Description: The study reach is 47 feet upstream of the discontinued crest gage. The stream is a pool riffle channel with little lateral scour and appears vertically stable. The entire left bank floodplain is maintained as a mowed area. The right bank abuts a high terrace with a moderately dense tree canopy comprised of oak and tulip poplar spp. with a moderate to sparse under story.

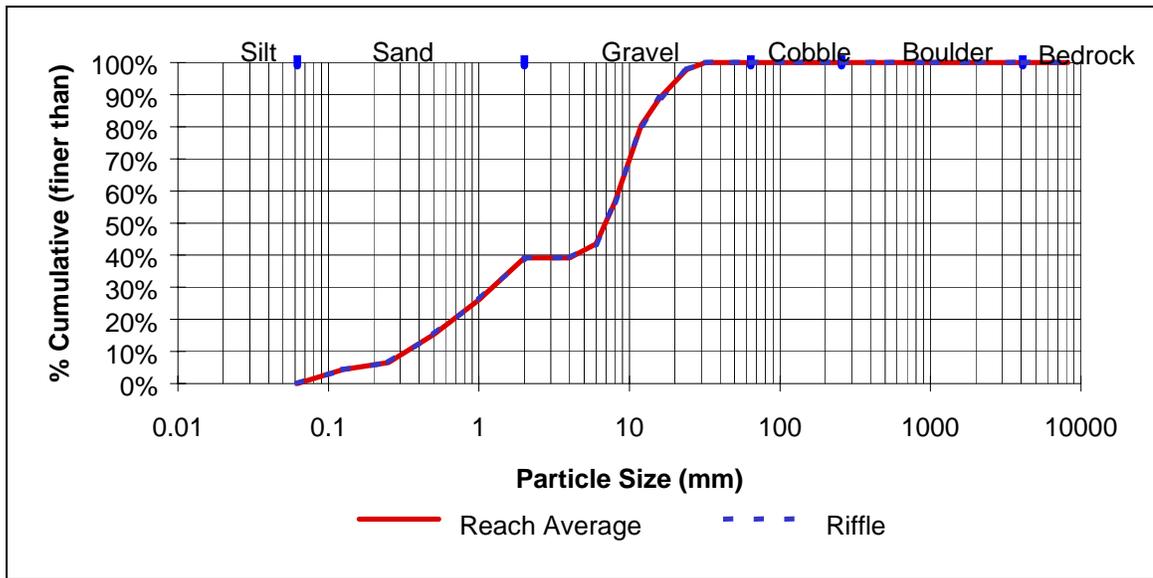
DISCHARGE BASED ON SURVEY OF GEOMORPHIC FEATURES

Bankfull Discharge (Q _{bkf} cfs):	11.91	Q _{bkf} / Q _{1.5} :	0.61
Bankfull Return Interval (R.I.):	1.11	Q _{bkf} / Q _{2.0} :	0.34
Gage Height (ft):	3.66		

STUDY REACH SURVEY INFORMATION

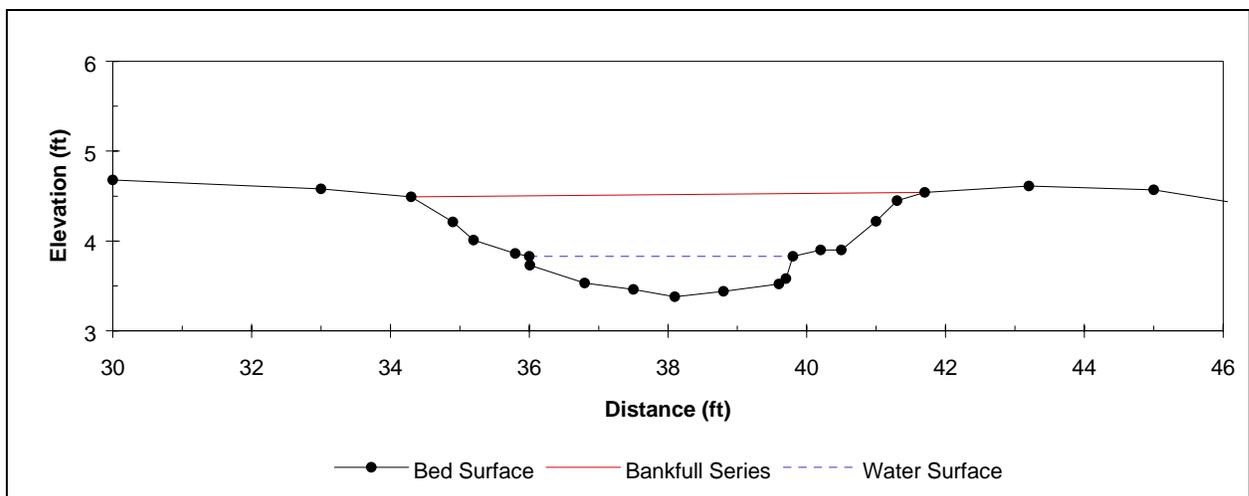
Average Water Surface Slope (ft/ft):	0.0100	Flood-prone Width (ft):	48.00
Manning's "n":	0.050	Entrenchment Ratio:	6.49
Mean Bankfull Velocity (ft/sec):	2.25	Width/Depth Ratio:	10.28
u/u*:	4.89	Channel Sinuosity:	1.11
R/D ₈₄ :	14.82	Beltwidth (ft):	155
Froude Number:	0.49	Meander Width Ratio:	21

GLEBE BRANCH AT VALLEY LEE, MD PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D ₁₆	0.53	0.53
D ₃₅	1.61	1.61
D ₅₀	6.93	6.93
D ₈₄	13.50	13.50
D ₉₅	21.04	21.04

STUDY REACH CROSS SECTION



Bankfull Width (ft):	7.40	Mean Bankfull Depth (ft):	0.72
Bankfull Cross-sectional Area (ft ²):	5.29	Maximum Bankfull Depth (ft):	1.14
Hydraulic Radius (ft):	0.66	Wetted Perimeter (ft):	8.06

Glebe Branch at Valley Lee, Maryland



Downstream view of classification cross-section



Left bank of classification cross-section

GRAVEL RUN AT BEULAH, MD
USGS STATION NUMBER:1492050

Latitude:	38° 40' 54"	Gage Period of Record:	1965 – 1976
Longitude:	75° 53' 53"	Mean Annual Discharge (cfs):	N/A
ADC Map Coordinates:	MD&DE Gazet	Rosgen Stream Type:	E5
	Map 43/B4	Survey Date:	March 2001
Drainage Area (sq. mi.):	8.40		
Stream Order / Magnitude:	3/25		
Percent Imperviousness:	2.00		

Land Use (%): Residential: 4.94 Agricultural: 74.96 Forest: 14.43 Commercial: 1.49

Log-Pearson Flood Frequency Discharge (cfs):	Q _{1.005} : 25.20	Q _{1.5} : 76.50	Q _{2.0} : 110.70
(Log-Pearson Period: 1966 – 1975)	(adjusted log-Pearson)	(adjusted log-Pearson)	(weighted log-Pearson)

General Study Reach Description: The study reach is inclusive of the gage reach at a discontinued crest gage. The stream has pool/run features with little lateral scour and appears vertically stable. The floodplain is predominately densely forested wetland with sweet gum, red maple, and loblolly pine. The under story is sparse with sweet gum, and red maple. The stream has frequent fallen trees in the channel and along the banks.

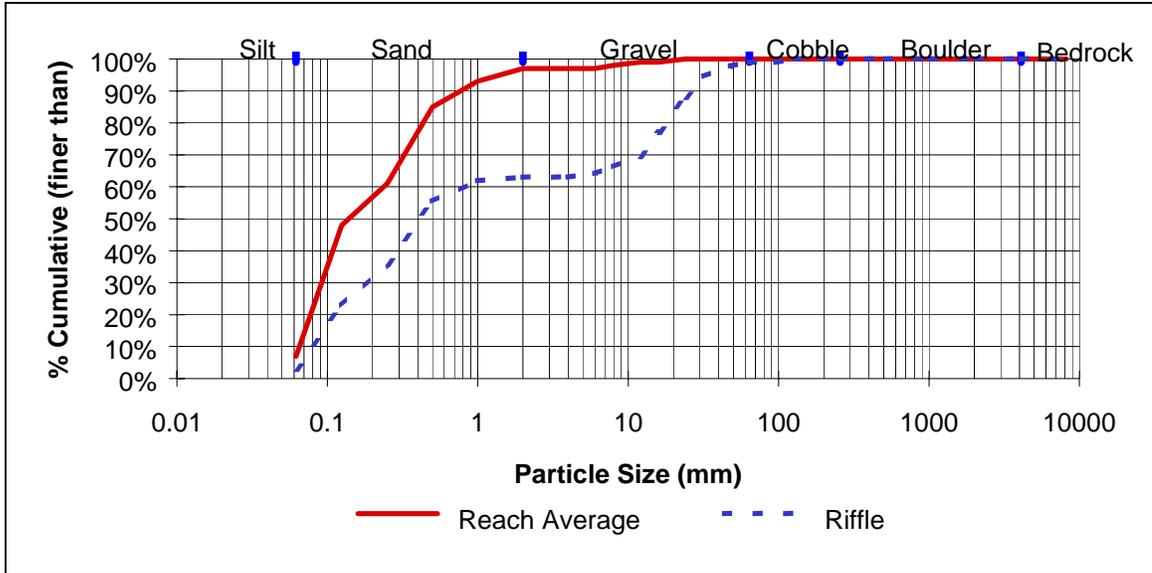
DISCHARGE BASED ON SURVEY OF GEOMORPHIC FEATURES

Bankfull Discharge (Q _{bkf} cfs):	64.72	Q _{bkf} / Q _{1.5} :	0.85
Bankfull Return Interval (R.I.):	1.37	Q _{bkf} / Q _{2.0} :	0.58
Gage Height (ft):	4.79		

STUDY REACH SURVEY INFORMATION

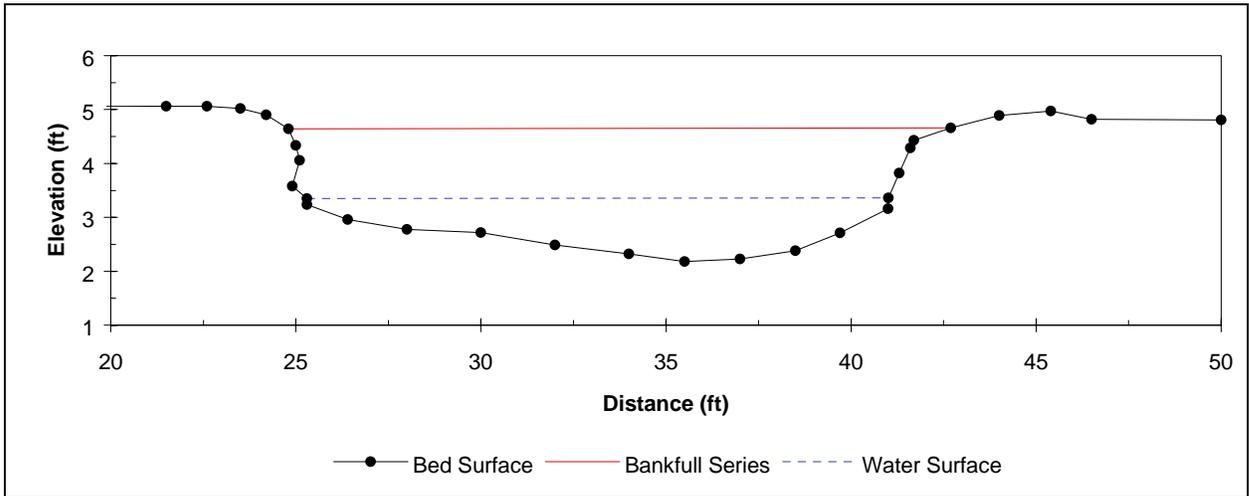
Average Water Surface Slope (ft/ft):	0.0014	Flood-prone Width (ft):	403.00
Manning's "n":	0.041	Entrenchment Ratio:	22.51
Mean Bankfull Velocity (ft/sec):	1.93	Width/Depth Ratio:	9.57
u/u*:	7.15	Channel Sinuosity:	1.13
R/D ₈₄ :	24.61	Beltwidth (ft):	396
Froude Number:	0.26	Meander Width Ratio:	22

GRAVEL RUN AT BEULAH, MD PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D_{16}	0.07	0.10
D_{35}	0.10	0.24
D_{50}	0.14	0.41
D_{84}	0.49	20.64
D_{95}	1.41	33.78

STUDY REACH CROSS SECTION



Bankfull Width (ft):	17.90	Mean Bankfull Depth (ft):	1.87
Bankfull Cross-sectional Area (ft ²):	33.56	Maximum Bankfull Depth (ft):	2.47
Hydraulic Radius (ft):	1.67	Wetted Perimeter (ft):	20.14

Gravel Run at Beulah, Maryland

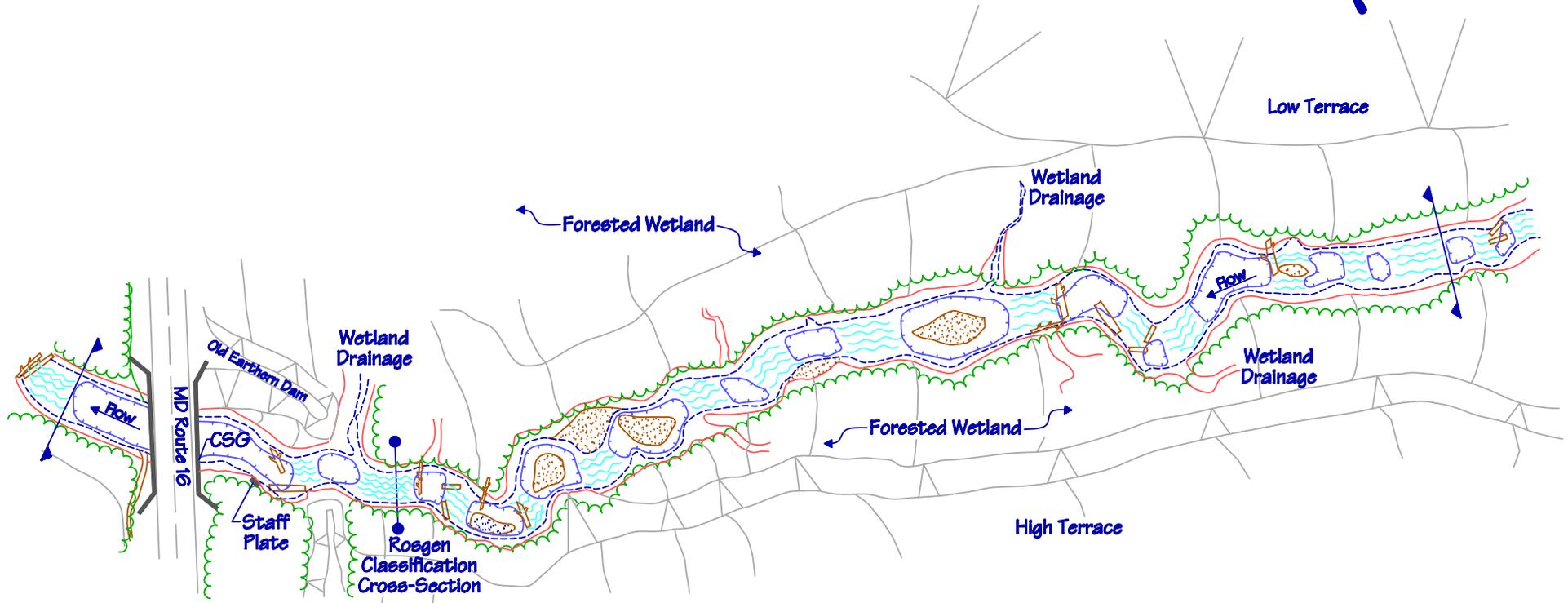


Upstream view of classification cross-section



Right bank of classification cross-section

GRAVEL RUN at Beulah, MD U.S.G.S. Gage: 01492050



LEGEND	
Top of Bank :	
Edge of Water :	
Run:	
Pool:	
Riffle:	
Sand/Gravel :	
Fallen Trees :	
Study Reach End Point:	

NOT TO SCALE

Survey Dates: 3/20/01 & 3/27/01
Study Reach Length: 1371'

Classification Cross-Section

Monument Locations:

Left Monument (+/- 17):

38° 40' 50.68" N

75° 53' 51.53" W

Elevation: 6'

Right Monument (+/- 16):

38° 40' 51.16" N

75° 53' 51.36" W

Elevation: 6'

MATTAWOMAN CREEK NEAR POMONKEY, MD
USGS STATION NUMBER: 1658000

Latitude:	38° 35' 45"	Gage Period of Record:	1949 – 1972
Longitude:	77° 03' 25"		2001 - Present
ADC Map Coordinates:	MD&DE Gazet Map 36/C3	Mean Annual Discharge (cfs):	54.2
Drainage Area (sq. mi.):	54.80	Rosgen Stream Type:	C4
Stream Order / Magnitude:	3/41	Survey Date:	June 2001
Percent Imperviousness:	10.00		

Land Use (%): Residential: 21.14 Agricultural: 15.87 Forest: 56.54 Commercial: 6.26

Log-Pearson Flood Frequency Discharge (cfs): $Q_{1.005}$: 168.30 $Q_{1.5}$: 850.00 $Q_{2.0}$: 1264.00
(Log-Pearson Period: 1950 – 1986)

General Study Reach Description: The study reach starts 67 feet downstream of the re-activated gage station. The stream is a pool/riffle/run channel with little lateral scour and appears vertically stable. There is numerous coarse woody debris in-stream with depositional features throughout. The floodplain is densely forested with some floodplain wetlands.

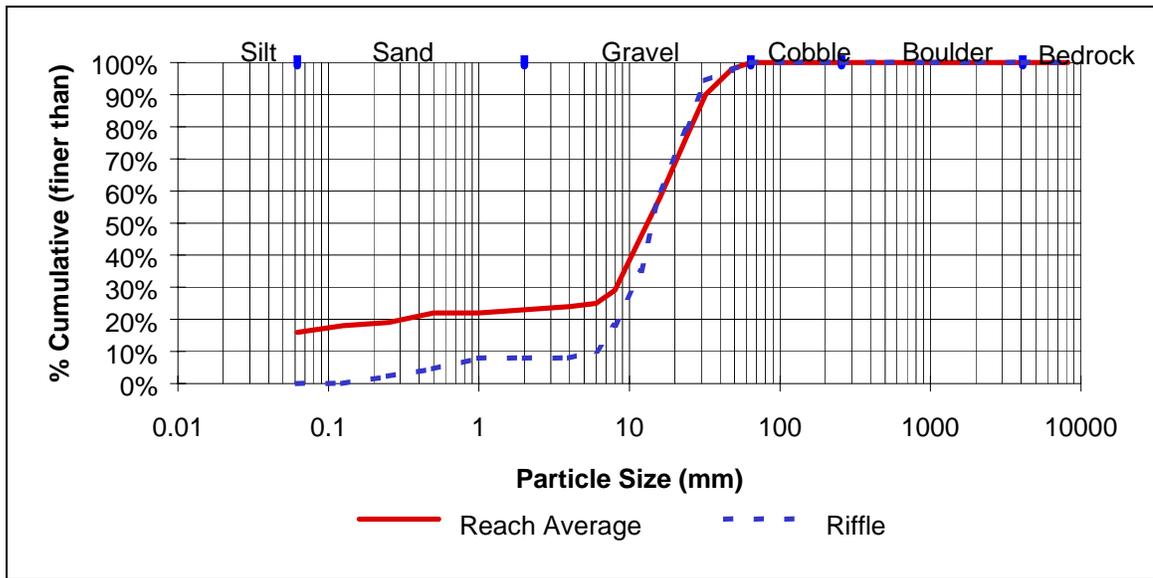
DISCHARGE BASED ON SURVEY OF GEOMORPHIC FEATURES

Bankfull Discharge (Q_{bkf} cfs):	540.00	$Q_{bkf} / Q_{1.5}$:	0.64
Bankfull Return Interval (R.I.):	1.20	$Q_{bkf} / Q_{2.0}$:	0.43
Gage Height (ft):	5.25		

STUDY REACH SURVEY INFORMATION

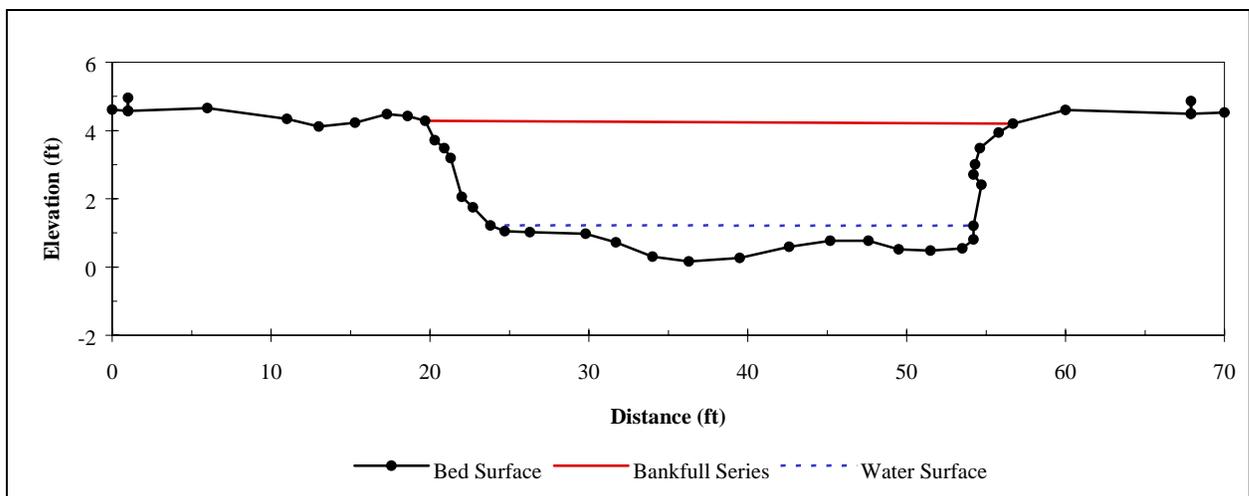
Average Water Surface Slope (ft/ft):	0.0014	Flood-prone Width (ft):	1350.00
Manning's "n":	0.025	Entrenchment Ratio:	36.49
Mean Bankfull Velocity (ft/sec):	4.54	Width/Depth Ratio:	11.49
u/u^* :	12.61	Channel Sinuosity:	1.40
R/D_{84} :	35.06	Beltwidth (ft):	1618
Froude Number:	0.47	Meander Width Ratio:	44

MATTAWOMAN CREEK NEAR POMONKEY, MD PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D ₁₆	0.06	7.39
D ₃₅	9.23	11.94
D ₅₀	13.21	14.22
D ₈₄	28.02	26.17
D ₉₅	41.23	34.70

STUDY REACH CROSS SECTION



Bankfull Width (ft):	37.00	Mean Bankfull Depth (ft):	3.22
Bankfull Cross-sectional Area (ft ²):	118.97	Maximum Bankfull Depth (ft):	4.08
Hydraulic Radius (ft):	2.89	Wetted Perimeter (ft):	41.22

Mattawoman Creek near Pomonkey, Maryland



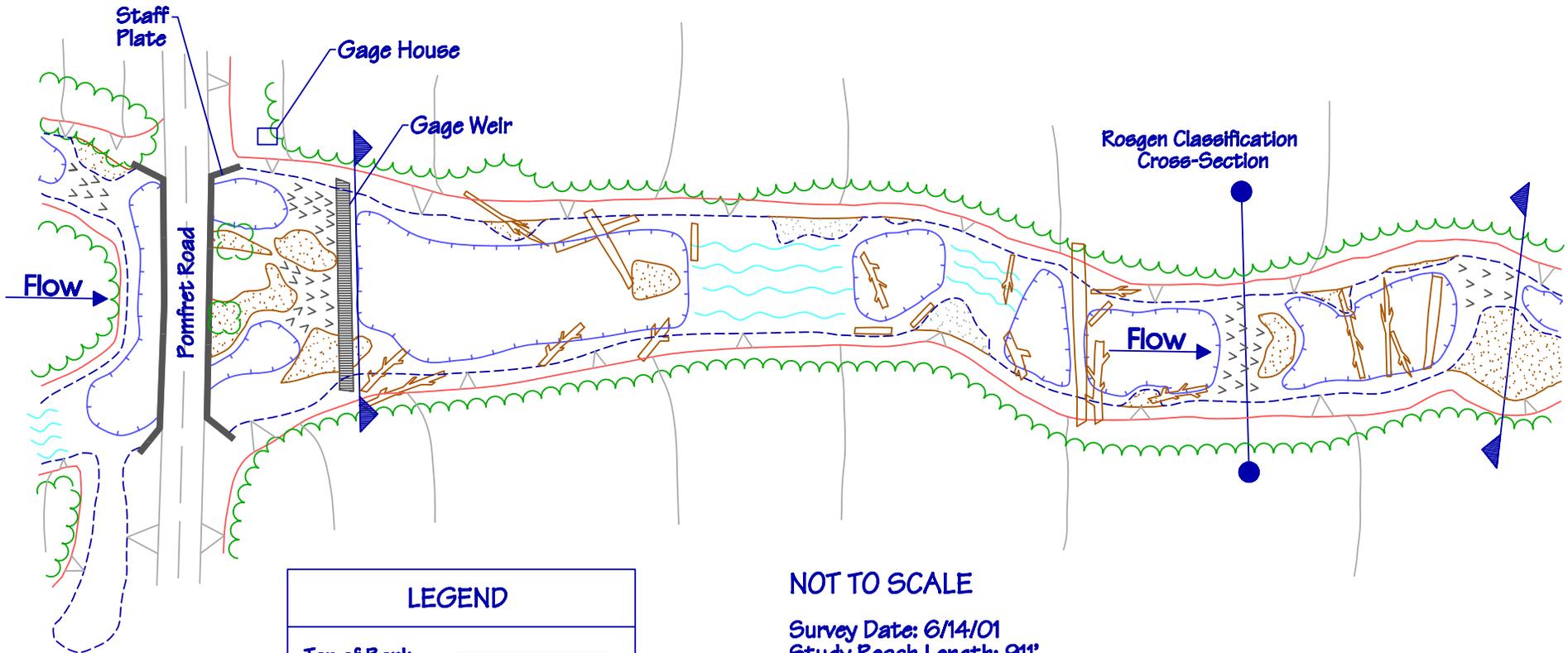
Downstream view of classification cross-section



Left bank of classification cross-section

MATTAWOMAN CREEK

near Pomonkey, MD
U.S.G.S. Gage: 0165800



LEGEND	
Top of Bank :	— (solid red line)
Edge of Water :	- - - (dashed blue line)
Run:	~ ~ ~ (wavy cyan line)
Pool:	— (solid blue line with vertical ticks)
Riffle:	^ ^ ^ (hatched pattern)
Sand/Gravel :	• • • (dotted pattern)
Fallen Trees :	✂ (brown tree symbols)
Study Reach End Point:	◄ (arrow pointing left)

NOT TO SCALE

Survey Date: 6/14/01
Study Reach Length: 911'

Classification Cross-Section
Monument Locations:
Left Monument (+/- 36):
38° 35' 40.39" N
77° 03' 25.95" W
Elevation: 45'

Right Monument (+/- 37):
38° 35' 40.46" N
77° 03' 26.19" W
Elevation: 45'

**MILL CREEK NEAR SKIPTON, MD
USGS STATION NUMBER: 1492550**

Latitude:	38° 55' 00"	Gage Period of Record:	1966 – 1976
Longitude:	76° 03' 42"	Mean Annual Discharge (cfs):	N/A
ADC Map Coordinates:	MD&DE Gazet Map 50/C2	Rosgen Stream Type:	C5
Drainage Area (sq. mi.):	4.60	Survey Date:	Feb. 2001
Stream Order / Magnitude:	2/5		
Percent Imperviousness:	0.10		

Land Use (%): Residential: 00.51 Agricultural: 91.11 Forest: 8.03 Commercial: 0.00

Log-Pearson Flood Frequency Discharge (cfs): (Log-Pearson Period: 1965 – 1976)	Q _{1.005} : 24.70 (adjusted L.P. for high outlier)	Q _{1.5} : 85.00 (adjusted L.P. for high outlier)	Q _{2.0} : 130.60 (Weighted regression equation)
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General Study Reach Description: The study reach starts 106 feet upstream of the discontinued crest gage. The floodplain is densely forested with red maple, sycamore, sweet gum, and oak spp. The under story has low to moderate density with red maple, elderberry, and dogwood spp. The stream has pool/run features with some point bar development and a low to moderate amount of coarse woody debris. Debris jams and fallen trees throughout the study reach cause local backwater. Wetland drainages discharge to channel throughout the study reach.

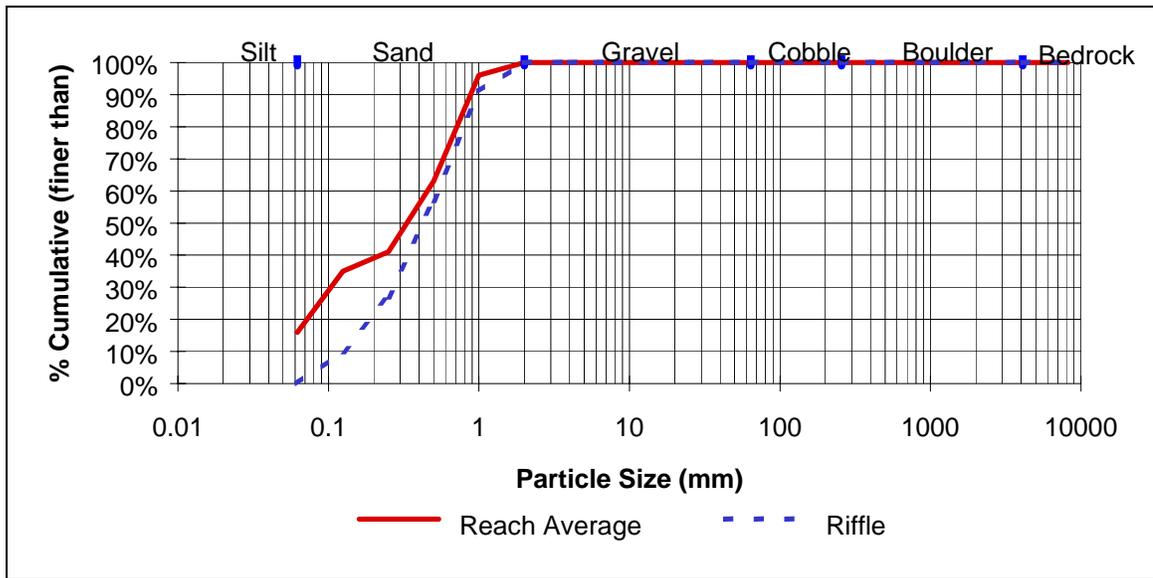
DISCHARGE BASED ON SURVEY OF GEOMORPHIC FEATURES

Bankfull Discharge (Q _{bkf} cfs):	39.10	Q _{bkf} / Q _{1.5} :	0.46
Bankfull Return Interval (R.I.):	1.06	Q _{bkf} / Q _{2.0} :	0.30
Gage Height (ft):	4.34		

STUDY REACH SURVEY INFORMATION

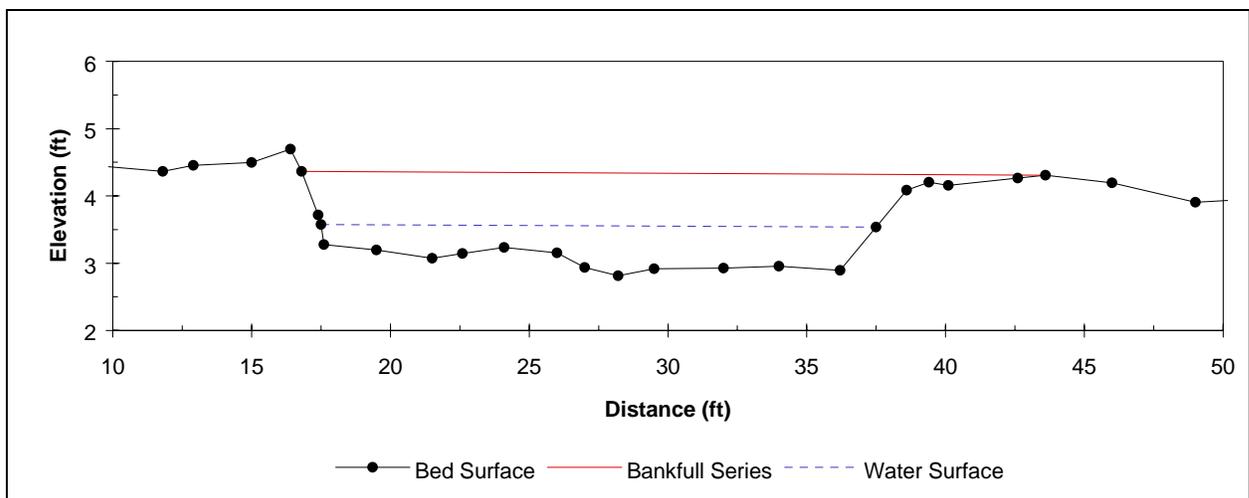
Average Water Surface Slope (ft/ft):	0.0013	Flood-prone Width (ft):	216.00
Manning's "n":	0.037	Entrenchment Ratio:	8.06
Mean Bankfull Velocity (ft/sec):	1.44	Width/Depth Ratio:	26.53
u/u*:	7.20	Channel Sinuosity:	1.15
R/D ₈₄ :	342.63	Beltwidth (ft):	230
Froude Number:	0.26	Meander Width Ratio:	9

MILL CREEK NEAR SKIPTON, MD PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D ₁₆	0.06	0.16
D ₃₅	0.13	0.30
D ₅₀	0.33	0.43
D ₈₄	0.78	0.87
D ₉₅	0.98	1.36

STUDY REACH CROSS SECTION



Bankfull Width (ft):	26.80	Mean Bankfull Depth (ft):	1.01
Bankfull Cross-sectional Area (ft ²):	27.10	Maximum Bankfull Depth (ft):	1.52
Hydraulic Radius (ft):	0.98	Wetted Perimeter (ft):	27.71

Mill Creek near Skipton, Maryland

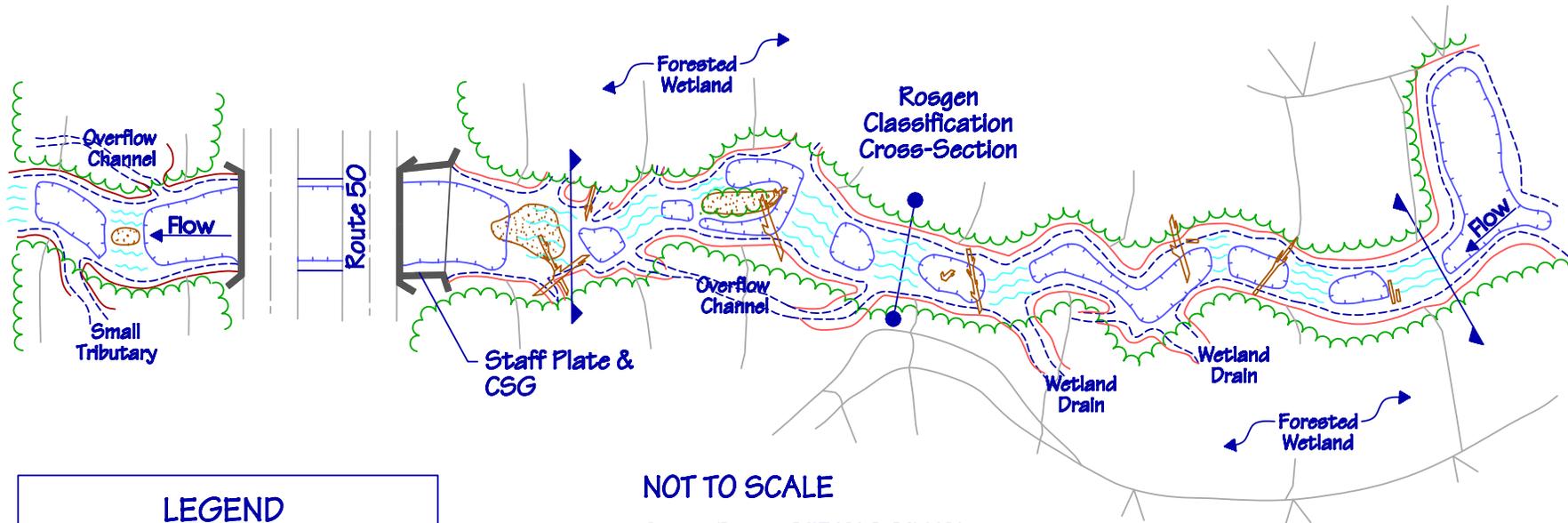


Upstream view of classification cross-section



Left bank of classification cross-section

MILL CREEK
 near Skipton, MD
 U.S.G.S. Gage: 1492550



LEGEND	
Top of Bank :	
Edge of Water :	
Run:	
Pool:	
Riffle:	
Sand/Gravel :	
Fallen Trees :	
Study Reach End Point:	

NOT TO SCALE

Survey Dates: 2/13/01 & 2/14/01
 Study Reach Length: 522'

Classification Cross-Section 1

Monument Locations:

Left Monument (+/- 23'):

38° 54' 58.77" N
 76° 03' 39.62" W
 Elevation: 36'

Right Monument (+/- 22'):

38° 54' 59.37" N
 76° 03' 39.91" W
 Elevation: 21'

**MURDERKILL RIVER NEAR FELTON, DE
USGS STATION NUMBER: 1484000**

Latitude:	38° 58' 33"	Gage Period of Record:	1931 – 1934
Longitude:	75° 34' 03"		1960 – 1985
ADC Map Coordinates:	MD&DE Gazet Map 52/B1		1997 – 1999
Drainage Area (sq. mi.):	13.6	Mean Annual Discharge (cfs):	18.3
Stream Order / Magnitude:	3/31	Rosgen Stream Type:	C5c
Percent Imperviousness:	0.54	Survey Date:	Feb. 2001

Land Use (%): Residential: 0.75 Agricultural: 60.29 Forest: 23.57 Commercial: 0.56

Log-Pearson Flood Frequency Discharge (cfs): $Q_{1.005}$: 44.20 $Q_{1.5}$: 210.00 $Q_{2.0}$: 299.60
(Log-Pearson Period: 1932–1933, 1960-1985,
1997-1998)

General Study Reach Description: The study reach starts 276 feet downstream of the discontinued gage station. The stream has pool/riffle features with little lateral scour and appears vertically stable. The floodplain is densely forested wetlands with sweet gum, red maple, loblolly pine, black cherry, American holly, river birch, and oak spp. The under story is low to moderately dense with sweet gum, spicebush, ironwood, and oak spp. The stream has point bar depositional features with coarse woody debris throughout the study reach.

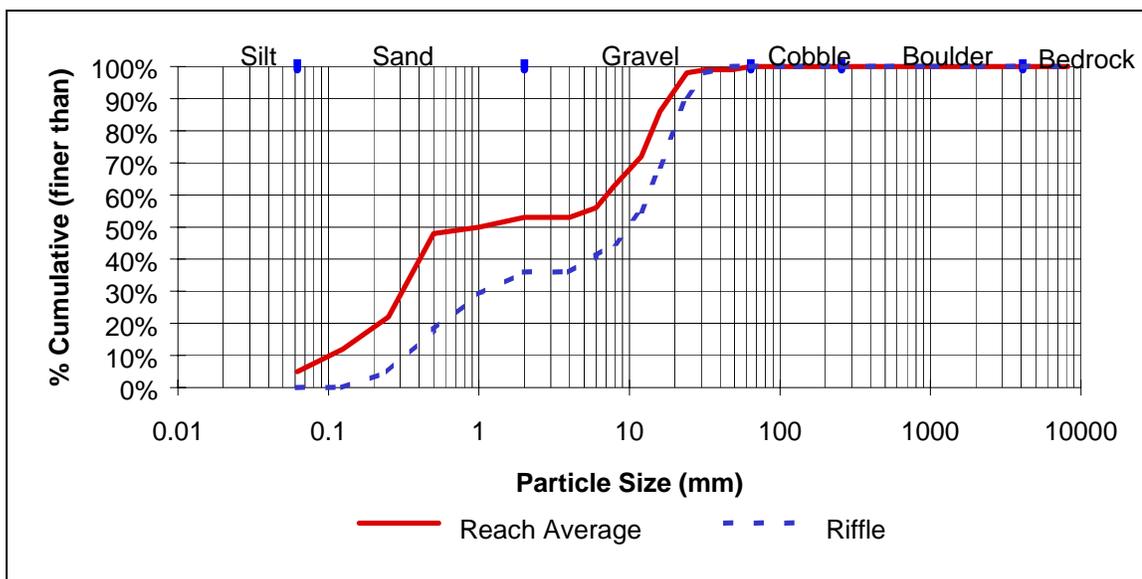
DISCHARGE BASED ON SURVEY OF GEOMORPHIC FEATURES

Bankfull Discharge (Q_{bkf} cfs):	100.00	$Q_{bkf} / Q_{1.5}$:	0.48
Bankfull Return Interval (R.I.):	1.09	$Q_{bkf} / Q_{2.0}$:	0.33
Gage Height (ft):	13.60		

STUDY REACH SURVEY INFORMATION

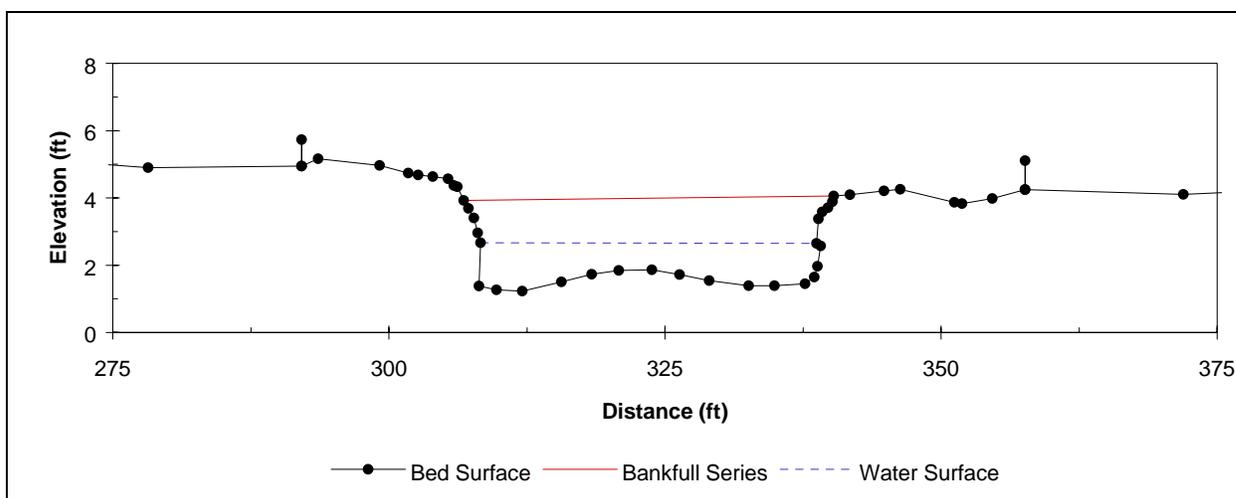
Average Water Surface Slope (ft/ft):	0.0004	Flood-prone Width (ft):	1000.00
Manning's "n":	0.037	Entrenchment Ratio:	29.85
Mean Bankfull Velocity (ft/sec):	1.31	Width/Depth Ratio:	14.63
u/u^* :	8.19	Channel Sinuosity:	1.31
R/D_{84} :	29.48	Beltwidth (ft):	236
Froude Number:	0.16	Meander Width Ratio:	7

MURDERKILL RIVER NEAR FELTON, DE PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D ₁₆	0.16	0.45
D ₃₅	0.35	1.81
D ₅₀	1.00	9.80
D ₈₄	15.36	21.10
D ₉₅	21.69	28.29

STUDY REACH CROSS SECTION



Bankfull Width (ft):	33.50	Mean Bankfull Depth (ft):	2.29
Bankfull Cross-sectional Area (ft ²):	76.57	Maximum Bankfull Depth (ft):	2.71
Hydraulic Radius (ft):	2.04	Wetted Perimeter (ft):	37.52

Murderkill River near Felton, Delaware



Downstream view of classification cross-section



Right bank of classification cross-section

**NANTICOKE RIVER NEAR BRIDGEVILLE, DE
USGS STATION NUMBER: 1487000**

Latitude:	38° 43' 42"	Gage Period of Record:	1943 - Present
Longitude:	75° 33' 44"	Mean Annual Discharge (cfs):	92.0
ADC Map Coordinates:	MD&DE Gazet Map 44/B1	Rosgen Stream Type:	C5c
Drainage Area (sq. mi.):	75.4	Survey Date:	July 2001
Stream Order / Magnitude:	4/117		
Percent Imperviousness:	1.22		

Land Use (%): Residential: 1.86 Agricultural: 56.11 Forest: 27.65 Commercial: 0.69

Log-Pearson Flood Frequency Discharge (cfs): $Q_{1.005}$: 157.40 $Q_{1.5}$: 445.00 $Q_{2.0}$: 584.00
(Log-Pearson Period: 1943 – 1998)

General Study Reach Description: The study reach starts 149 feet upstream and runs through the gage station. The stream has pool/run features, little lateral scour, and appears vertically stable. The entire upstream portion of the stream has been ditched while downstream of the gage the channel is natural, not ditched, with low swampy banks covered by dense brush. There are fallen trees along the banks and in the channel. The floodplain is forested wetland and densely vegetated with red maple, black cherry, and sycamore. The under story is moderately dense with elderberry, spicebush, and viburnum spp. The stream has some point bar deposition and a moderate amount of coarse woody debris.

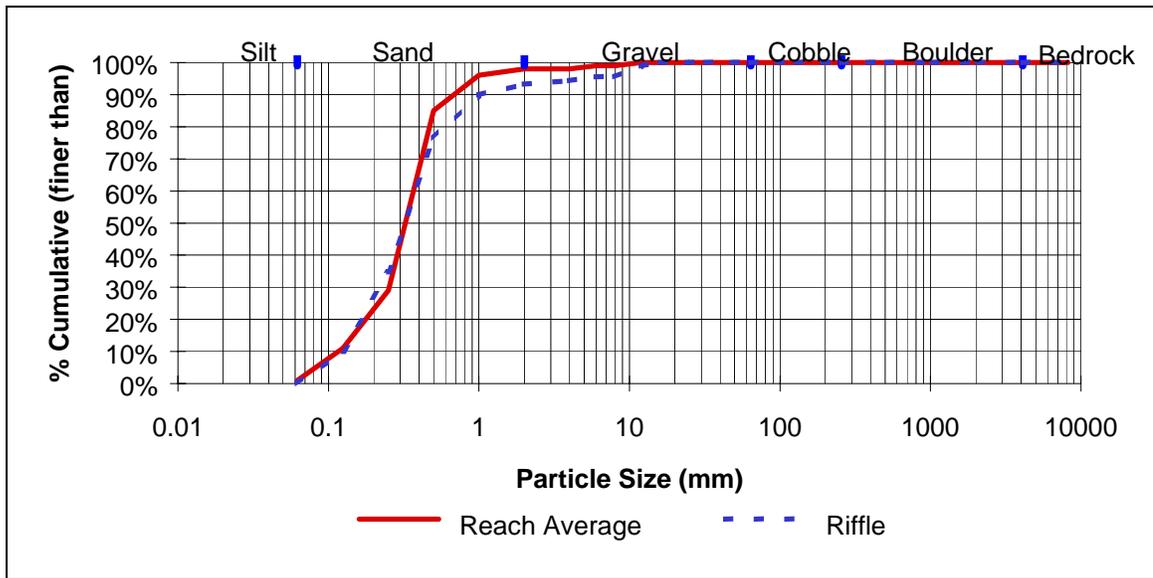
DISCHARGE BASED ON SURVEY OF GEOMORPHIC FEATURES

Bankfull Discharge ($Q_{b_{kf}}$ cfs):	340.70	$Q_{b_{kf}} / Q_{1.5}$:	0.77
Bankfull Return Interval (R.I.):	1.23	$Q_{b_{kf}} / Q_{2.0}$:	0.58
Gage Height (ft):	6.33		

STUDY REACH SURVEY INFORMATION

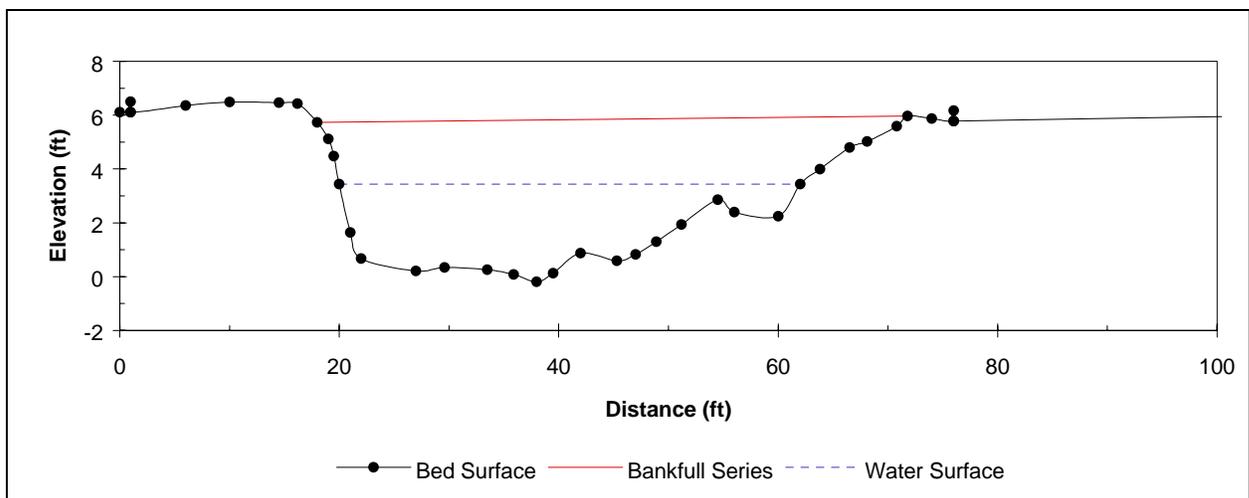
Average Water Surface Slope (ft/ft):	0.0004	Flood-prone Width (ft):	2600.00
Manning's "n":	0.038	Entrenchment Ratio:	48.33
Mean Bankfull Velocity (ft/sec):	1.60	Width/Depth Ratio:	13.59
u/u^* :	8.42	Channel Sinuosity:	1.18
R/D_{84} :	1521.28	Beltwidth (ft):	212
Froude Number:	0.15	Meander Width Ratio:	4

NANTICOKE RIVER NEAR BRIDGEVILLE, DE PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D ₁₆	0.15	0.15
D ₃₅	0.27	0.25
D ₅₀	0.32	0.32
D ₈₄	0.49	0.74
D ₉₅	0.94	5.00

STUDY REACH CROSS SECTION



Bankfull Width (ft):	53.80	Mean Bankfull Depth (ft):	3.96
Bankfull Cross-sectional Area (ft ²):	212.85	Maximum Bankfull Depth (ft):	6.02
Hydraulic Radius (ft):	3.69	Wetted Perimeter (ft):	57.63

Nanticoke River near Bridgeville, Delaware



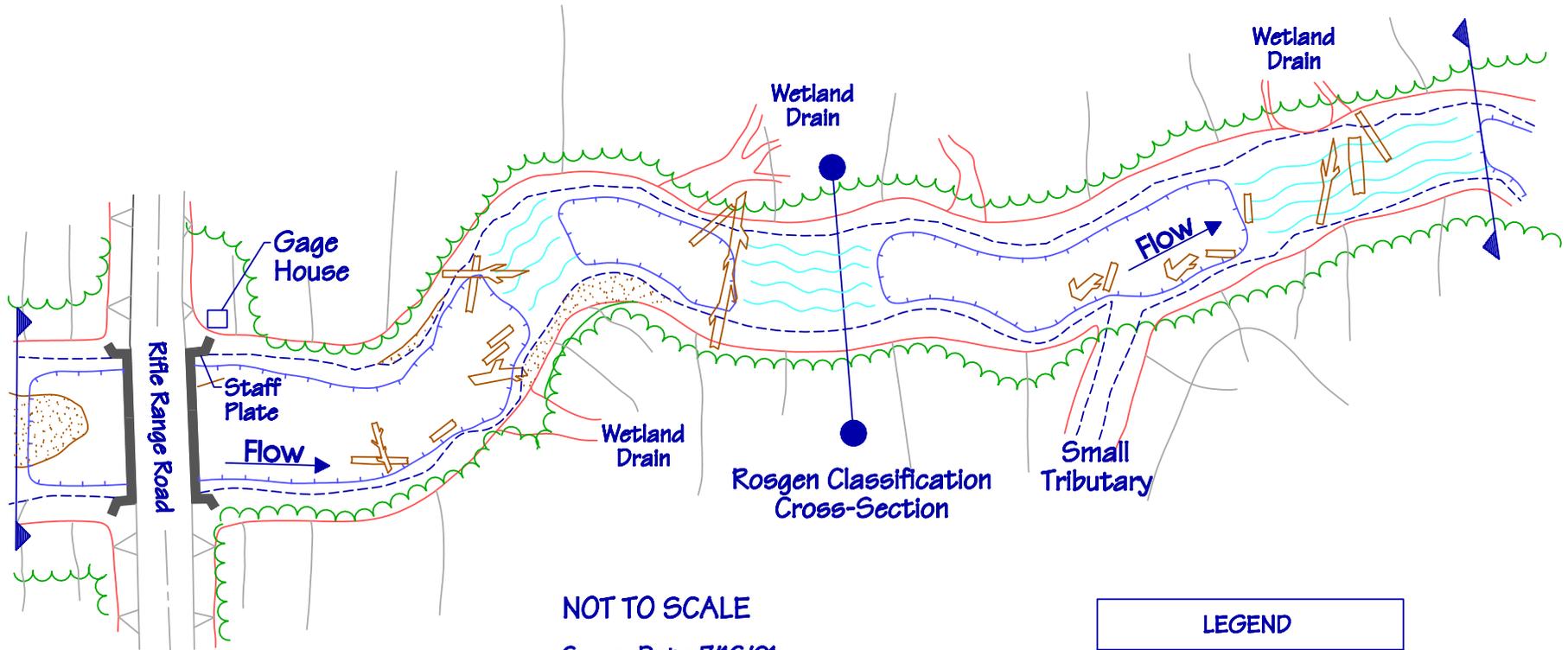
Upstream view of classification cross-section



Left bank of classification cross-section

NANTICOKE RIVER

near Bridgeville, DE
U.S.G.S. Gage: 01487000



NOT TO SCALE

Survey Date: 7/16/01
Study Reach Length: 1301'

Classification Cross-Section

Monument Locations:

Left Monument (+/- 23'):

38° 43' 39.49" N

75° 33' 38.46" W

Elevation: 42'

Right Monument (+/- 18'):

38° 43' 39.23" N

75° 33' 39.26" W

Elevation: 42'

LEGEND	
Top of Bank :	— (red solid line)
Edge of Water :	- - - (blue dashed line)
Run:	~ (cyan wavy line)
Pool:	- - - (blue dashed line)
Riffle:	~ (hatched pattern)
Sand/Gravel :	••••• (dotted pattern)
Fallen Trees :	↘ ↙ (orange arrows)
Study Reach End Point:	▶ (blue arrowhead)

**NASSAWANGO CREEK NEAR SNOW HILL, MD
USGS STATION NUMBER: 1485500**

Latitude:	38° 13' 44"	Gage Period of Record:	1949 - Present
Longitude:	75° 28' 19"	Mean Annual Discharge (cfs):	53.8
ADC Map Coordinates:	MD&DE Gazet Map 34/D2	Rosgen Stream Type:	E5
Drainage Area (sq. mi.):	44.9	Survey Date:	July 2001
Stream Order / Magnitude:	3/34		
Percent Imperviousness:	0.59		

Land Use (%): Residential: 0.68 Agricultural: 23.31 Forest: 56.06 Commercial: 3.80

Log-Pearson Flood Frequency Discharge (cfs): $Q_{1.005}$: 123.60 $Q_{1.5}$: 415.00 $Q_{2.0}$: 546.40
(Log-Pearson Period: 1950 – 1998)

General Study Reach Description: The study reach starts 167 feet downstream of the gage. The stream has pool/run features, little lateral scour and appears vertically stable. The floodplain is forested wetland with dense red maple, American Holly, bald cypress, river birch, ironwood, chestnut oak, beech and sweetgum. The under story has a low to moderate density. There are some point and side bar depositional features and a moderate amount of coarse woody debris in the channel.

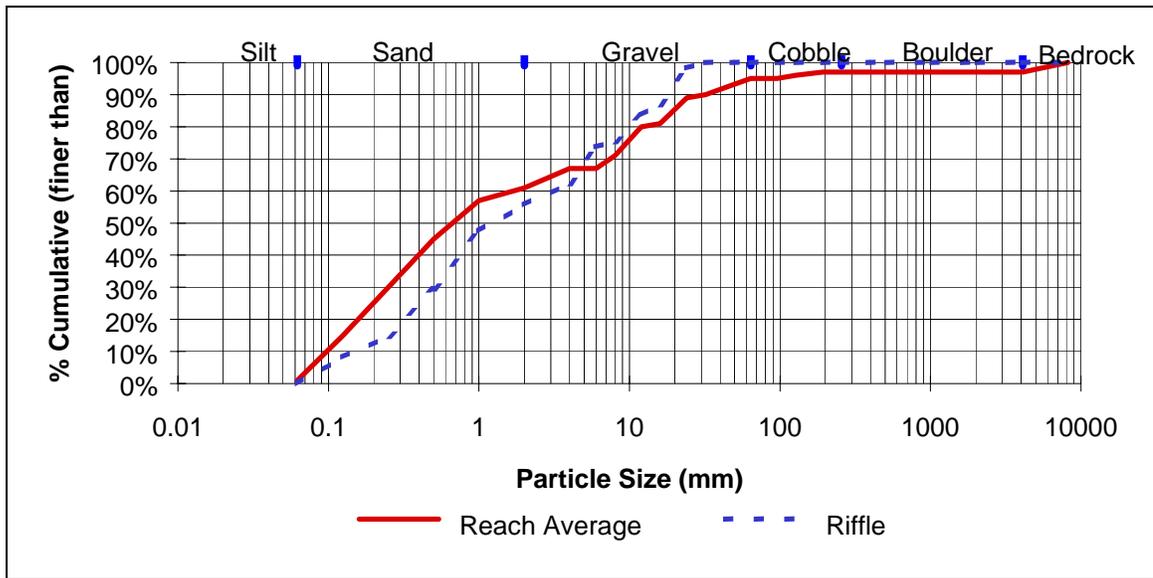
DISCHARGE BASED ON SURVEY OF GEOMORPHIC FEATURES

Bankfull Discharge (Q_{bkf} cfs):	221.60	$Q_{bkf} / Q_{1.5}$:	0.53
Bankfull Return Interval (R.I.):	1.07	$Q_{bkf} / Q_{2.0}$:	0.41
Gage Height (ft):	4.97		

STUDY REACH SURVEY INFORMATION

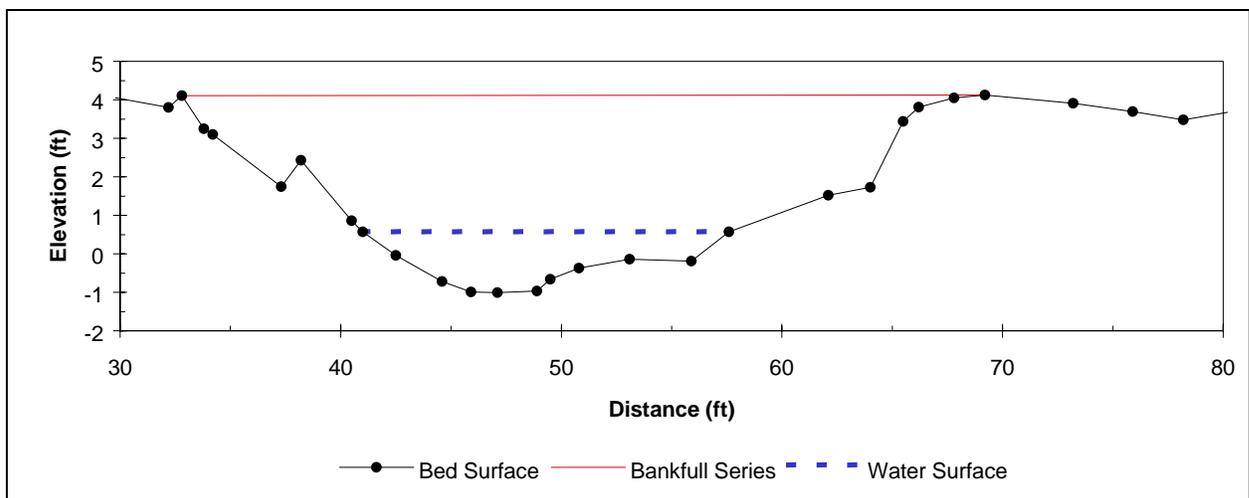
Average Water Surface Slope (ft/ft):	0.0003	Flood-prone Width (ft):	860.00
Manning's "n":	0.026	Entrenchment Ratio:	23.63
Mean Bankfull Velocity (ft/sec):	1.99	Width/Depth Ratio:	11.90
u/u^* :	11.71	Channel Sinuosity:	1.45
R/D_{84} :	69.51	Beltwidth (ft):	390
Froude Number:	0.21	Meander Width Ratio:	11

NASSAWANGO CREEK NEAR SNOW HILL, MD PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D ₁₆	0.13	0.27
D ₃₅	0.31	0.62
D ₅₀	0.67	1.23
D ₈₄	18.63	12.42
D ₉₅	96.00	21.31

STUDY REACH CROSS SECTION

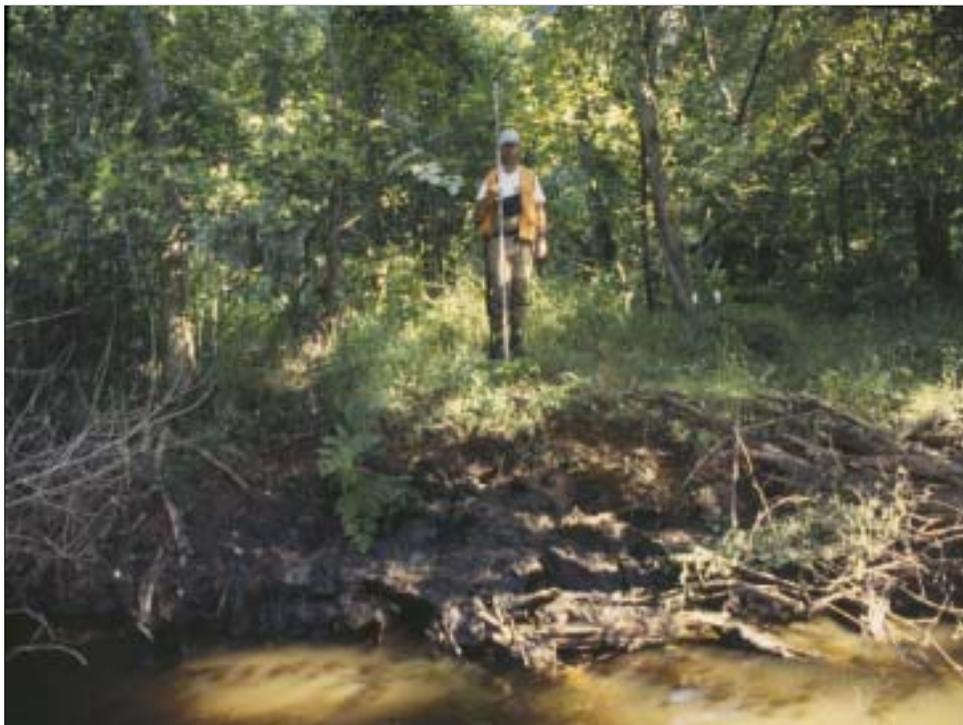


Bankfull Width (ft):	36.40	Mean Bankfull Depth (ft):	3.06
Bankfull Cross-sectional Area (ft ²):	111.48	Maximum Bankfull Depth (ft):	5.12
Hydraulic Radius (ft):	2.83	Wetted Perimeter (ft):	39.36

Nassawango Creek near Snow Hill, Maryland



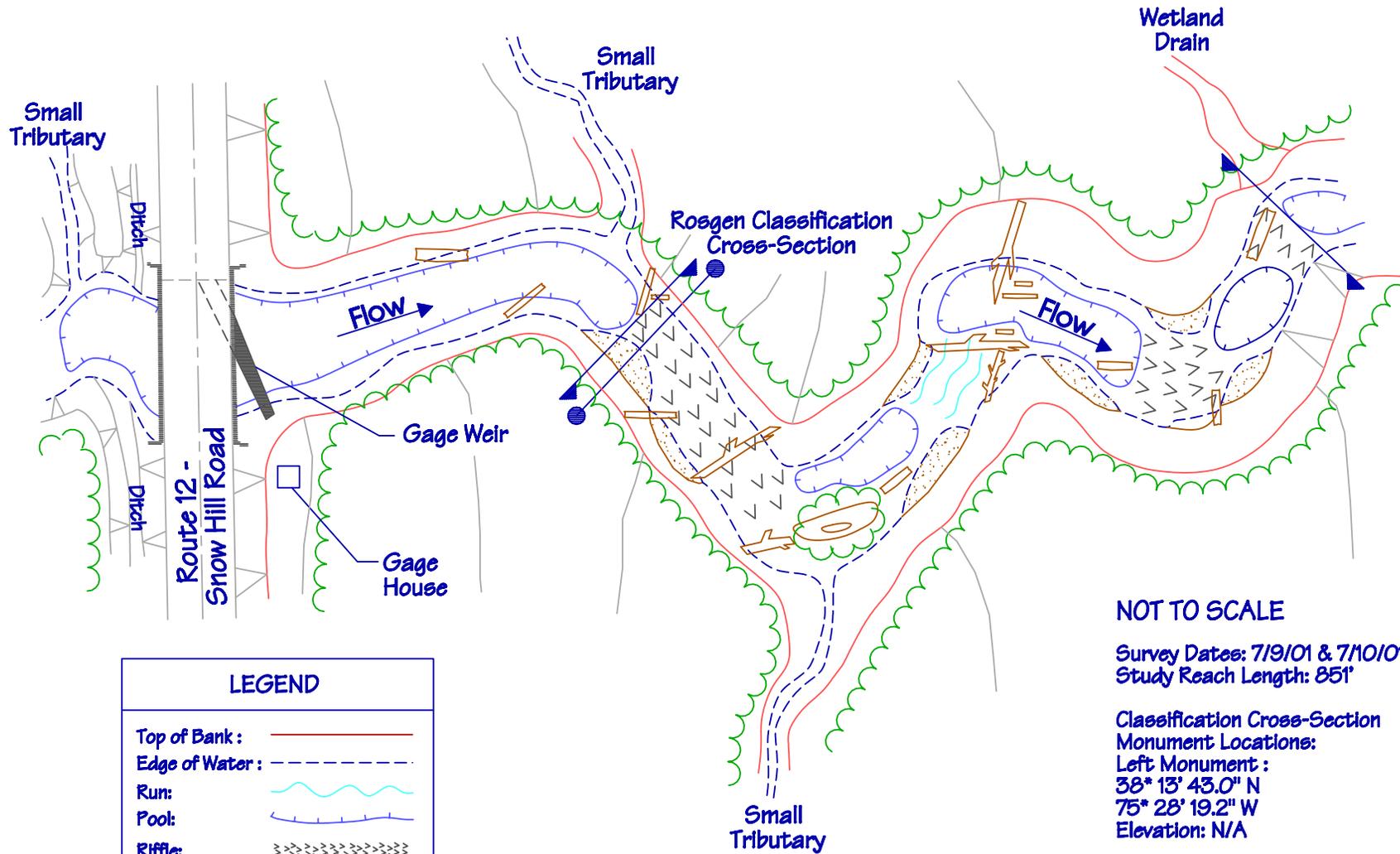
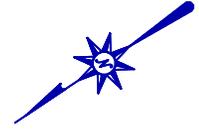
Upstream view of classification cross-section



Left bank of classification cross-section

NASSAWANGO CREEK

near Snow Hill, MD
U.S.G.S. Gage: 01485500



LEGEND	
Top of Bank :	
Edge of Water :	
Run:	
Pool:	
Riffle:	
Sand/Gravel :	
Fallen Trees :	
Study Reach End Point:	

NOT TO SCALE

Survey Dates: 7/9/01 & 7/10/01
Study Reach Length: 851'

Classification Cross-Section

Monument Locations:

Left Monument :

38° 13' 43.0" N

75° 28' 19.2" W

Elevation: N/A

Right Monument :

38° 13' 41.9" N

75° 28' 20.3" E

Elevation: N/A

**SALLIE HARRIS CREEK NEAR CARMICHAEL, MD
USGS STATION NUMBER: 1492500**

Latitude:	38° 57' 54"	Gage Period of Record:	1951 – 1956
Longitude:	76° 06' 32"		1957 – 1981
ADC Map Coordinates:	MD&DE Gazet Map 50/C1		2000 - Present
Drainage Area (sq. mi.):	8.09	Mean Annual Discharge (cfs):	8.48
Stream Order / Magnitude:	2/5	Rosgen Stream Type:	E5
Percent Imperviousness:	0.60	Survey Date:	Apr. 2001

Land Use (%): Residential: 2.08 Agricultural: 68.69 Forest: 29.03 Commercial: 0.01

Log-Pearson Flood Frequency Discharge (cfs): $Q_{1.005}$: 34.80 $Q_{1.5}$: 150.00 $Q_{2.0}$: 215.70
(Log-Pearson Period: 1952 – 1981)

General Study Reach Description: The study reach starts 228 feet upstream of the recently (2001) re-started gage station. The stream has pool/run features, little lateral scour, and appears vertically stable. The floodplain is densely forested wetland with red maple, tulip poplar, black walnut, and sycamore. The under story is sparse with paw paw, elderberry and multiflora rose. There are few depositional features and a moderate amount of coarse woody debris in the channel.

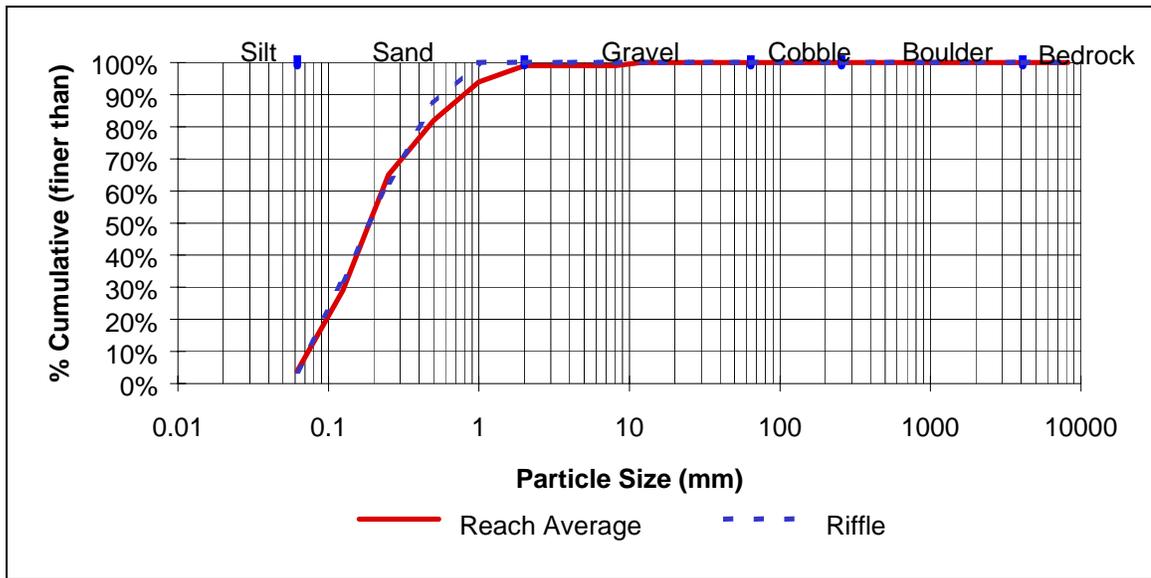
DISCHARGE BASED ON SURVEY OF GEOMORPHIC FEATURES

Bankfull Discharge (Q_{bkf} cfs):	78.01	$Q_{bkf} / Q_{1.5}$:	0.52
Bankfull Return Interval (R.I.):	1.11	$Q_{bkf} / Q_{2.0}$:	0.36
Gage Height (ft):	3.20		

STUDY REACH SURVEY INFORMATION

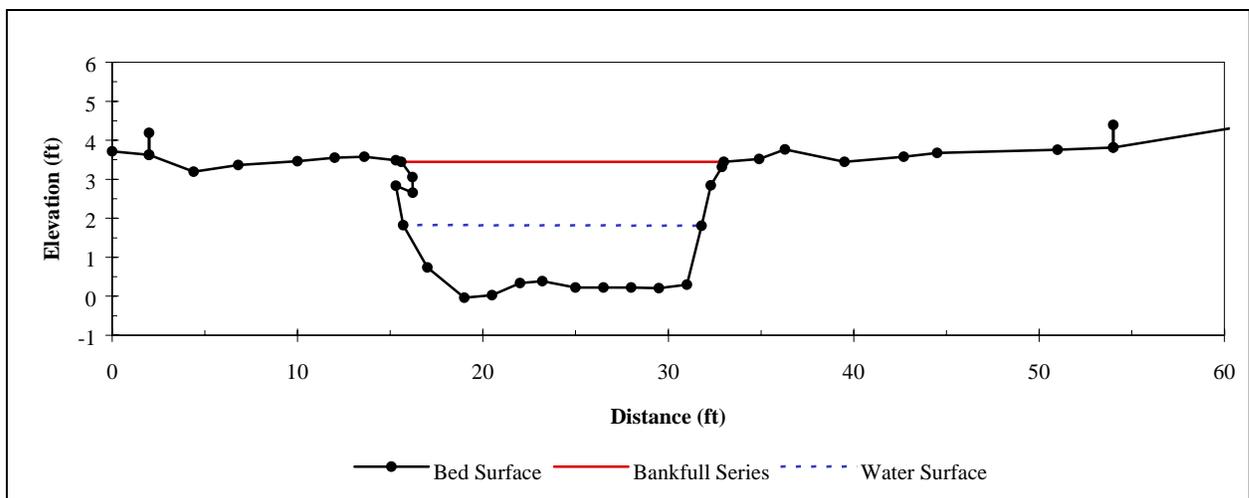
Average Water Surface Slope (ft/ft):	0.0002	Flood-prone Width (ft):	244.00
Manning's "n":	0.024	Entrenchment Ratio:	14.02
Mean Bankfull Velocity (ft/sec):	1.52	Width/Depth Ratio:	5.90
u/u^* :	12.67	Channel Sinuosity:	1.20
R/D_{84} :	1493.19	Beltwidth (ft):	517
Froude Number:	0.18	Meander Width Ratio:	30

SALLIE HARRIS CREEK NEAR CARMICHAEL, MD PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D ₁₆	0.09	0.08
D ₃₅	0.14	0.13
D ₅₀	0.19	0.19
D ₈₄	0.56	0.46
D ₉₅	1.15	0.76

STUDY REACH CROSS SECTION



Bankfull Width (ft):	17.40	Mean Bankfull Depth (ft):	2.95
Bankfull Cross-sectional Area (ft ²):	51.38	Maximum Bankfull Depth (ft):	3.48
Hydraulic Radius (ft):	2.25	Wetted Perimeter (ft):	22.80

Sallie Harris Creek near Carmichael, Maryland



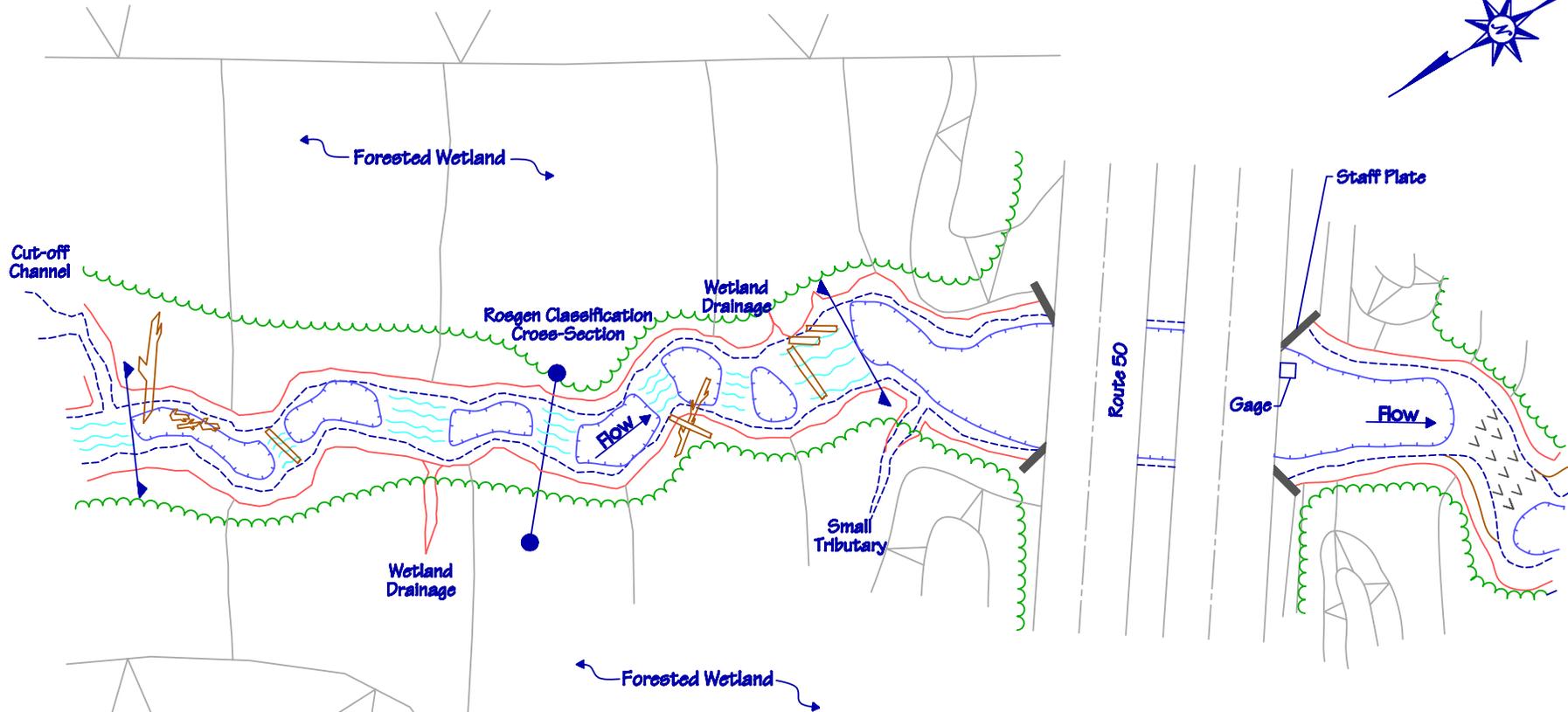
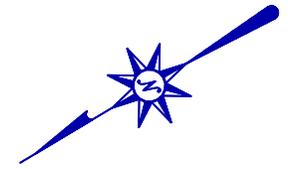
Downstream view of classification cross-section



Left bank of classification cross-section

SALLIE HARRIS CREEK

near Carmichael, MD
U.S.G.S. Gage: 1492500



LEGEND	
Top of Bank :	
Edge of Water :	
Run:	
Pool:	
Riffle:	
Sand/Gravel :	
Fallen Trees :	
Study Reach End Points:	

NOT TO SCALE

Survey Dates: 4/19/01 & 4/20/01
Study Reach Length: 423'

Classification Cross-Section
Monument Locations:
Left Monument (+/- 23'):
38° 57' 57.35" N
76° 06' 30.39" W
Elevation: 23'

Right Monument (+/- 24'):
38° 57' 57.74" N
76° 06' 30.50" W
Elevation: 24'

**ST. CLEMENTS CREEK NEAR CLEMENTS, MD
USGS STATION NUMBER: 1661050**

Latitude:	38° 20' 00"	Gage Period of Record:	1968 - Present
Longitude:	76° 43' 31"	Mean Annual Discharge (cfs):	19.60
ADC Map Coordinates:	MD&DE Gazet Map 30/C1	Rosgen Stream Type:	E5
Drainage Area (sq. mi.):	18.5	Survey Date:	Jan. 2001 Feb. 2001
Stream Order / Magnitude:	3/12		
Percent Imperviousness:	3.14		

Land Use (%): Residential: 10.80 Agricultural: 34.83 Forest: 53.65 Commercial: 1.70

Log-Pearson Flood Frequency Discharge (cfs): $Q_{1.005}$: 89.80 $Q_{1.5}$: 480.00 $Q_{2.0}$: 707.00
(Log-Pearson Period: 1969 – 1998)

General Study Reach Description: The study reach starts 200 feet upstream of the gage. The stream has pool/run features, little lateral scour and appears vertically stable. The stream appears channelized with remnant spoil piles along the banks. The floodplain vegetation is dense with a moderate amount of coarse woody debris in the channel.

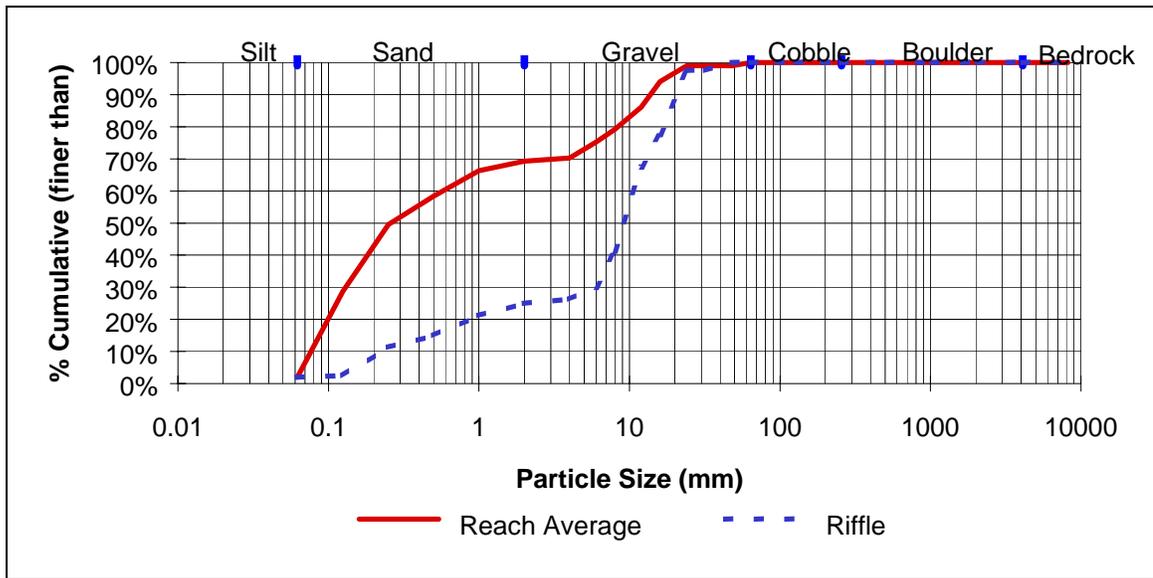
DISCHARGE BASED ON SURVEY OF GEOMORPHIC FEATURES

Bankfull Discharge (Q_{bkf} cfs):	273.40	$Q_{bkf} / Q_{1.5}$:	0.57
Bankfull Return Interval (R.I.):	1.19	$Q_{bkf} / Q_{2.0}$:	0.39
Gage Height (ft):	3.53		

STUDY REACH SURVEY INFORMATION

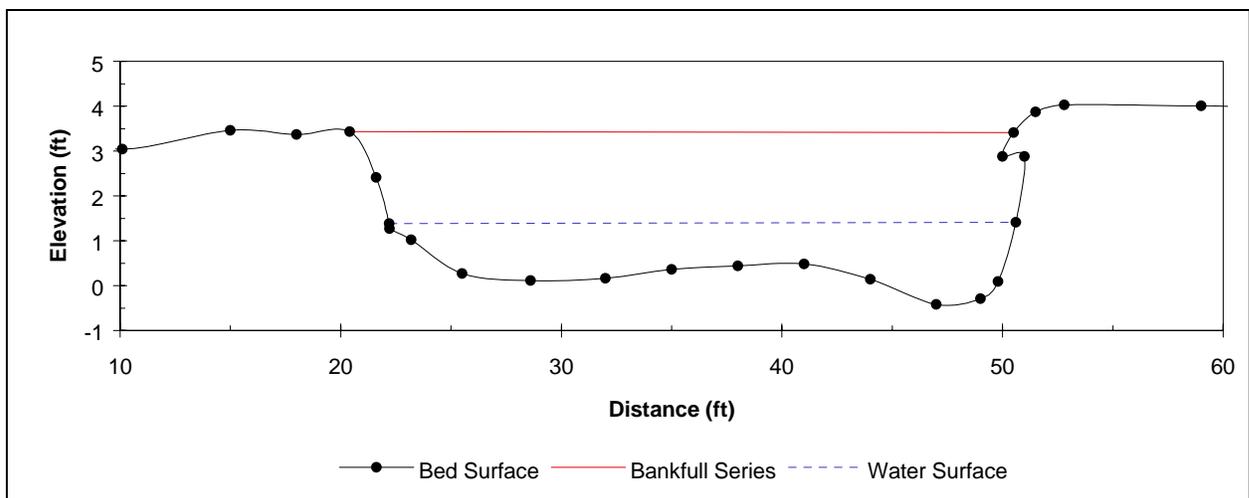
Average Water Surface Slope (ft/ft):	0.0010	Flood-prone Width (ft):	550.00
Manning's "n":	0.031	Entrenchment Ratio:	18.27
Mean Bankfull Velocity (ft/sec):	2.87	Width/Depth Ratio:	9.84
u/u^* :	9.90	Channel Sinuosity:	1.06
R/D_{84} :	46.79	Beltwidth (ft):	405
Froude Number:	0.32	Meander Width Ratio:	13

ST. CLEMENTS CREEK NEAR CLEMENTS, MD PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D_{16}	0.09	0.56
D_{35}	0.15	6.82
D_{50}	0.26	9.16
D_{84}	10.59	18.25
D_{95}	17.28	22.81

STUDY REACH CROSS SECTION



Bankfull Width (ft):	30.10	Mean Bankfull Depth (ft):	3.06
Bankfull Cross-sectional Area (ft ²):	91.98	Maximum Bankfull Depth (ft):	3.83
Hydraulic Radius (ft):	2.58	Wetted Perimeter (ft):	35.60

St. Clements Creek near Clements, Maryland



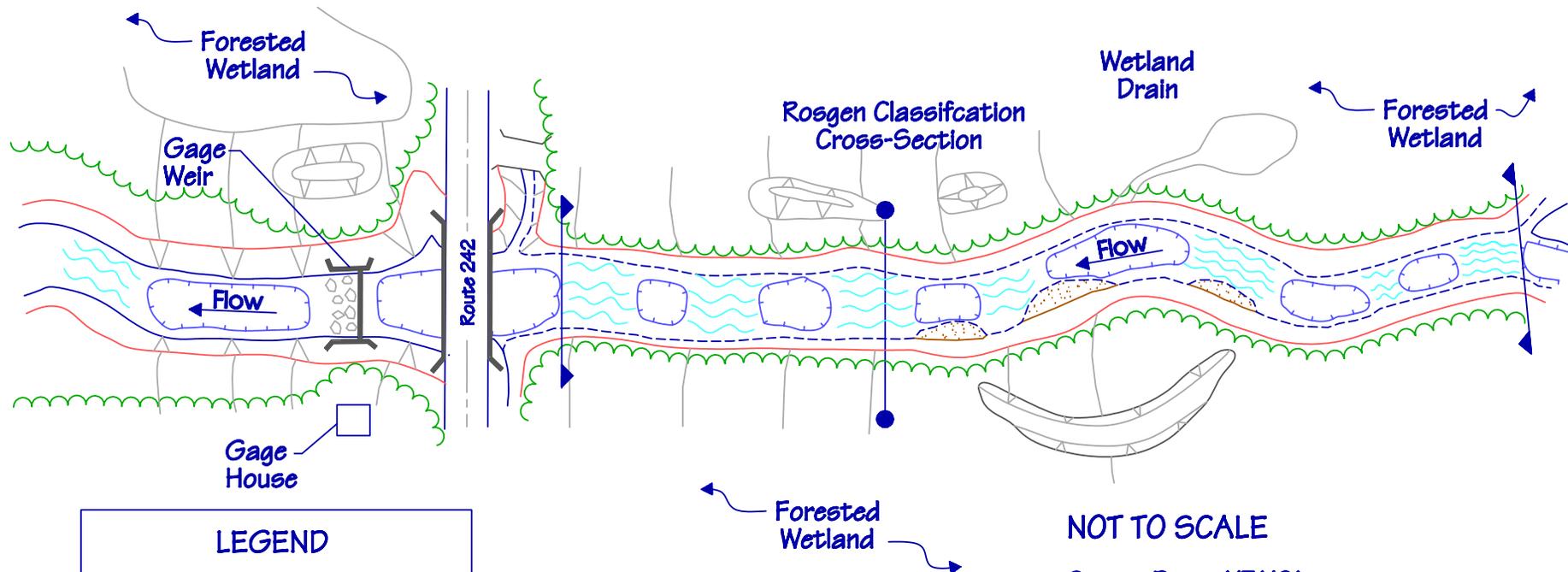
Downstream view of classification cross-section



Left bank of classification cross-section

ST CLEMENTS CREEK

near St Clements, MD
U.S.G.S. Gage: 01661050



LEGEND	
Top of Bank :	
Edge of Water :	
Run:	
Pool:	
Riffle:	
Sand/Gravel :	
Fallen Trees :	
Study Reach End Point:	

NOT TO SCALE

Survey Date: 1/31/01
Study Reach Length: 610'

Classification Cross-Section
Monument Locations:
Left Monument (+/- 14'):
38° 20' 03.41" N
76° 43' 30.60" W
Elevation: 61'

Right Monument (+/- 22'):
38° 20' 03.01" N
76° 43' 31.96" W
Elevation: 66'

**ST. MARY'S RIVER AT GREAT MILLS, MD
USGS STATION NUMBER: 1661500**

Latitude:	38° 14' 36"	Gage Period of Record:	1946 - Present
Longitude:	76° 30' 13"	Mean Annual Discharge (cfs):	24.9
ADC Map Coordinates:	MD&DE Gazet Map 30/D3	Rosgen Stream Type:	C4
Drainage Area (sq. mi.):	24.0	Survey Date:	Apr. 2001
Stream Order / Magnitude:	4/16		
Percent Imperviousness:	10.00		

Land Use (%): Residential: 16.25 Agricultural: 10.46 Forest: 65.73 Commercial: 6.00

Log-Pearson Flood Frequency Discharge (cfs): $Q_{1.005}$: 176.30 $Q_{1.5}$: 640.00 $Q_{2.0}$: 926.00
(Log-Pearson Period: 1947 – 2000)

General Study Reach Description: The gage and study reach are the same at an active gage station. The stream has pool/riffle features, little lateral scour, and appears vertically stable although there is evidence of past incision. The floodplain vegetation is dense with a moderate amount of coarse woody debris in the channel. The bed material is slightly bi-modal sand and gravel. The left bank is low in some places and subject to overflows. The bank vegetation has dense undergrowth.

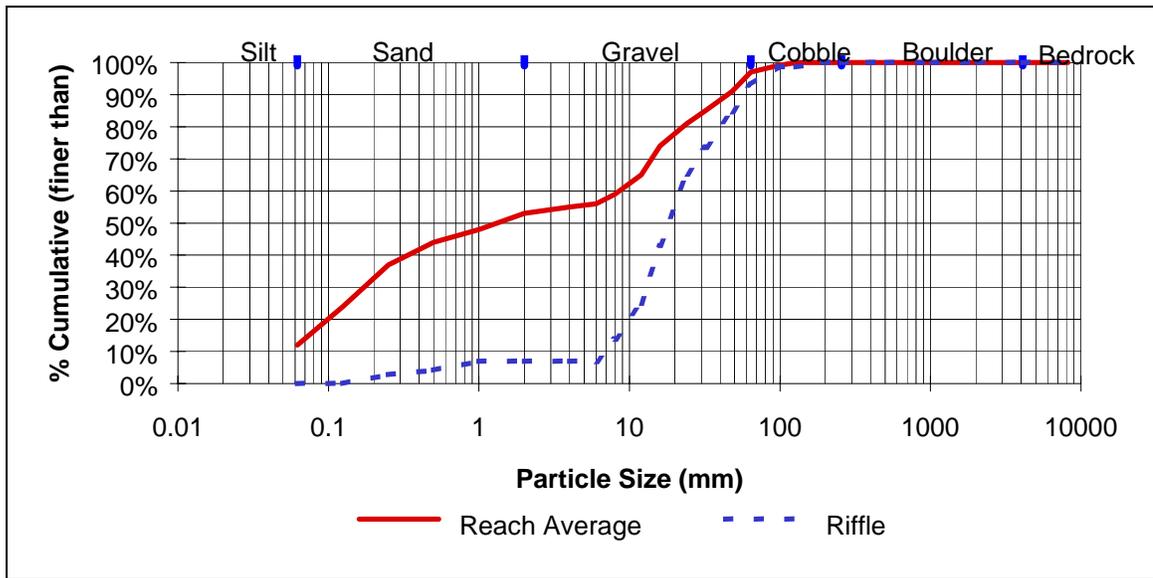
DISCHARGE BASED ON SURVEY OF GEOMORPHIC FEATURES

Bankfull Discharge (Q_{bkf} cfs):	464.90	$Q_{bkf} / Q_{1.5}$:	0.73
Bankfull Return Interval (R.I.):	1.24	$Q_{bkf} / Q_{2.0}$:	0.50
Gage Height (ft):	4.70		

STUDY REACH SURVEY INFORMATION

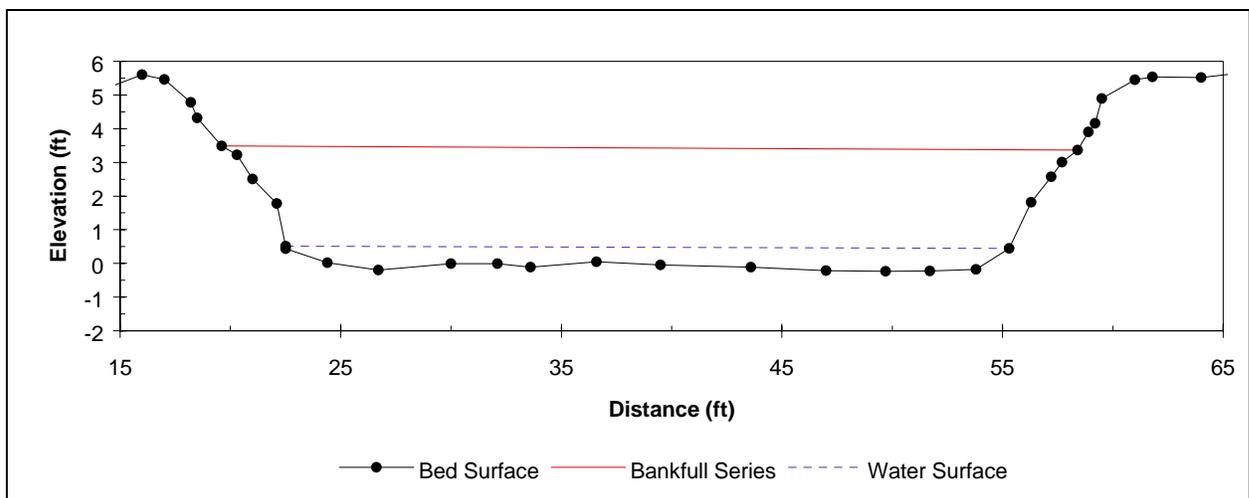
Average Water Surface Slope (ft/ft):	0.0014	Flood-prone Width (ft):	111.00
Manning's "n":	0.030	Entrenchment Ratio:	2.86
Mean Bankfull Velocity (ft/sec):	3.83	Width/Depth Ratio:	12.40
u/u^* :	10.64	Channel Sinuosity:	1.40
R/D_{84} :	18.95	Beltwidth (ft):	1160
Froude Number:	0.40	Meander Width Ratio:	30

ST. MARY'S RIVER AT GREAT MILLS, MD PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D ₁₆	0.16	8.64
D ₃₅	6.73	14.07
D ₅₀	13.11	18.16
D ₈₄	37.25	46.75
D ₉₅	64.00	73.76

STUDY REACH CROSS SECTION



Bankfull Width (ft):	38.80	Mean Bankfull Depth (ft):	3.13
Bankfull Cross-sectional Area (ft ²):	121.46	Maximum Bankfull Depth (ft):	3.66
Hydraulic Radius (ft):	2.91	Wetted Perimeter (ft):	41.79

St. Mary's River at Great Mills, Maryland

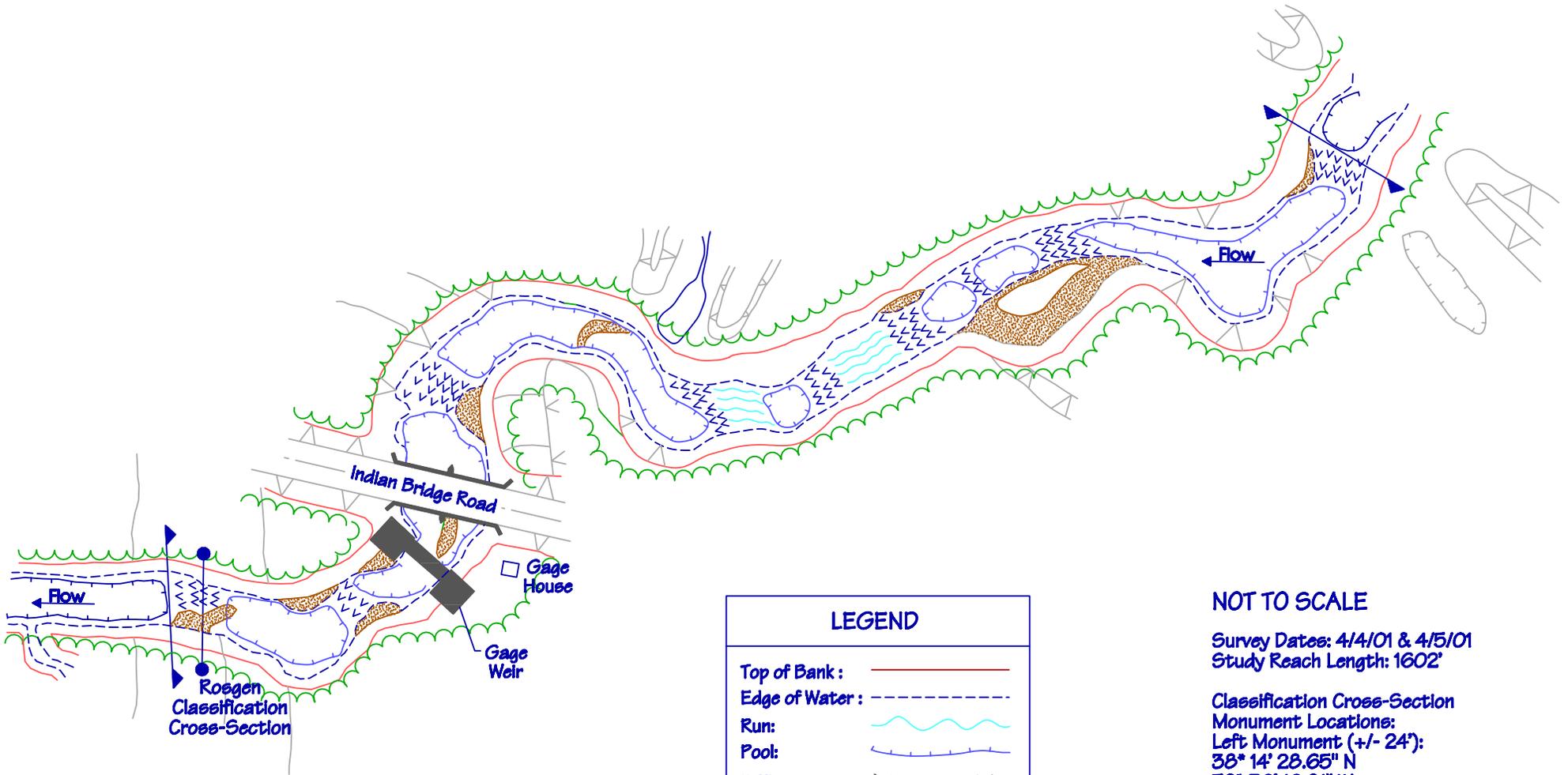


Upstream view of classification cross-section



Left bank of classification cross-section

ST. MARY'S RIVER at Great Mills, MD U.S.G.S. Gage: 1661500



LEGEND	
Top of Bank :	
Edge of Water :	
Run:	
Pool:	
Riffle:	
Sand/Gravel :	
Fallen Trees :	
Study Reach End Point:	

NOT TO SCALE

Survey Dates: 4/4/01 & 4/5/01
Study Reach Length: 1602'

Classification Cross-Section

Monument Locations:

Left Monument (+/- 24'):

38° 14' 28.65" N

76° 30' 10.81" W

Elevation: 42'

Right Monument (+/- 11'):

38° 14' 28.68" N

76° 30' 11.69" W

Elevation: 11'

WESTERN BRANCH AT UPPER MARLBORO, MD
USGS STATION NUMBER: 1594526

Latitude:	38° 48' 50"	Gage Period of Record:	1985 – 1989
Longitude:	76° 44' 50"		1992 - Present
ADC Map Coordinates:	MD&DE Gazet Map 48/D1	Mean Annual Discharge (cfs):	93.5
Drainage Area (sq. mi.):	89.7	Rosgen Stream Type:	C5c
Stream Order / Magnitude:	4/49	Survey Date:	June 2001
Percent Imperviousness:	17.50		

Land Use (%): Residential: 31.67 Agricultural: 22.80 Forest: 35.26 Commercial: 9.92

Log-Pearson Flood Frequency Discharge (cfs): $Q_{1.005}$: 484.10 $Q_{1.5}$: 1200.00 $Q_{2.0}$: 1566.00
(Log-Pearson Period: 1986 – 1989, 1993 - 1998)

General Study Reach Description: The gage reach and study reach are the same at an active gage station. The reach has long pools and poorly defined riffles. The floodplain near the gage is mowed grass. The remaining portion of the reach has a low density canopy consisting of American sycamore and black willow. The channel has low lateral scour and appears vertically stable. Well-defined benches, slope breaks, and levees are found on both sides of the channel. Rip-rap is located along the toe of some of the banks and along portions of the levees.

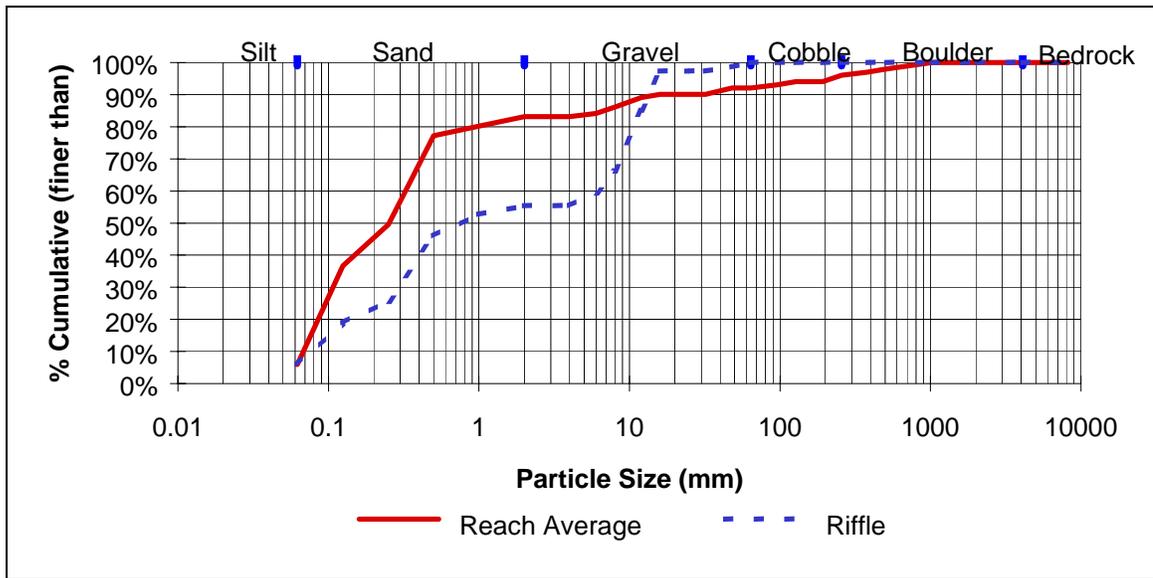
DISCHARGE BASED ON SURVEY OF GEOMORPHIC FEATURES

Bankfull Discharge (Q_{bkf} cfs):	673.20	$Q_{bkf} / Q_{1.5}$:	0.56
Bankfull Return Interval (R.I.):	1.04	$Q_{bkf} / Q_{2.0}$:	0.43
Gage Height (ft):	6.93		

STUDY REACH SURVEY INFORMATION

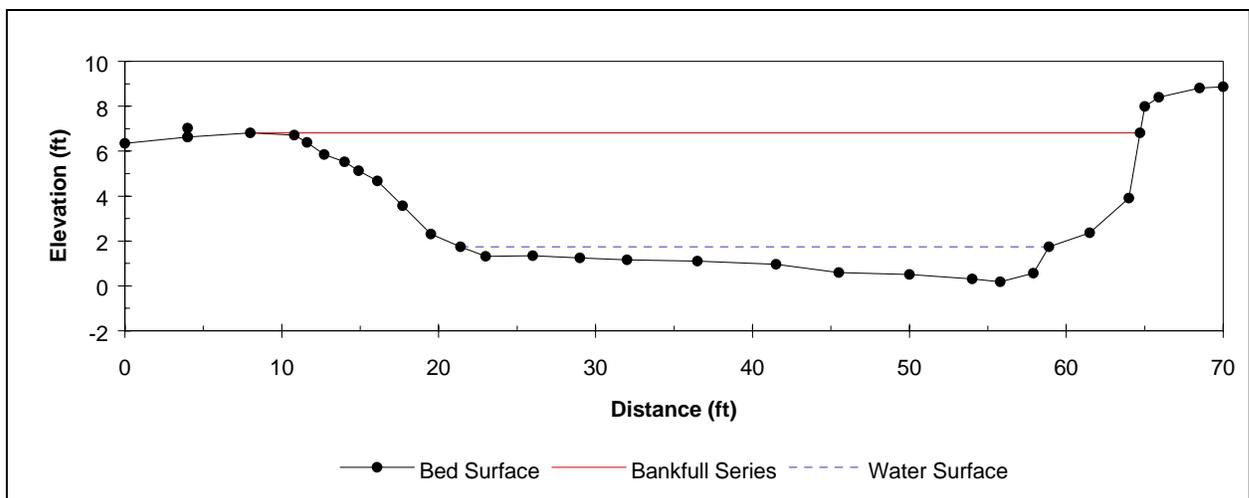
Average Water Surface Slope (ft/ft):	0.0002	Flood-prone Width (ft):	180.00
Manning's "n":	0.023	Entrenchment Ratio:	3.17
Mean Bankfull Velocity (ft/sec):	2.48	Width/Depth Ratio:	11.86
u/u^* :	14.59	Channel Sinuosity:	1.24
R/D_{84} :	114.89	Beltwidth (ft):	982
Froude Number:	0.21	Meander Width Ratio:	17

WESTERN BRANCH AT UPPER MARLBORO, MD PARTICLE SIZE DISTRIBUTION



Particle Size (m m)		
Finer Than	Reach	Riffle
D_{16}	0.08	0.10
D_{35}	0.12	0.34
D_{50}	0.25	0.76
D_{84}	5.62	11.71
D_{95}	220.11	15.15

STUDY REACH CROSS SECTION



Bankfull Width (ft):	56.70	Mean Bankfull Depth (ft):	4.78
Bankfull Cross-sectional Area (ft ²):	270.93	Maximum Bankfull Depth (ft):	6.63
Hydraulic Radius (ft):	4.41	Wetted Perimeter (ft):	61.38

Western Branch at Upper Marlboro, Maryland

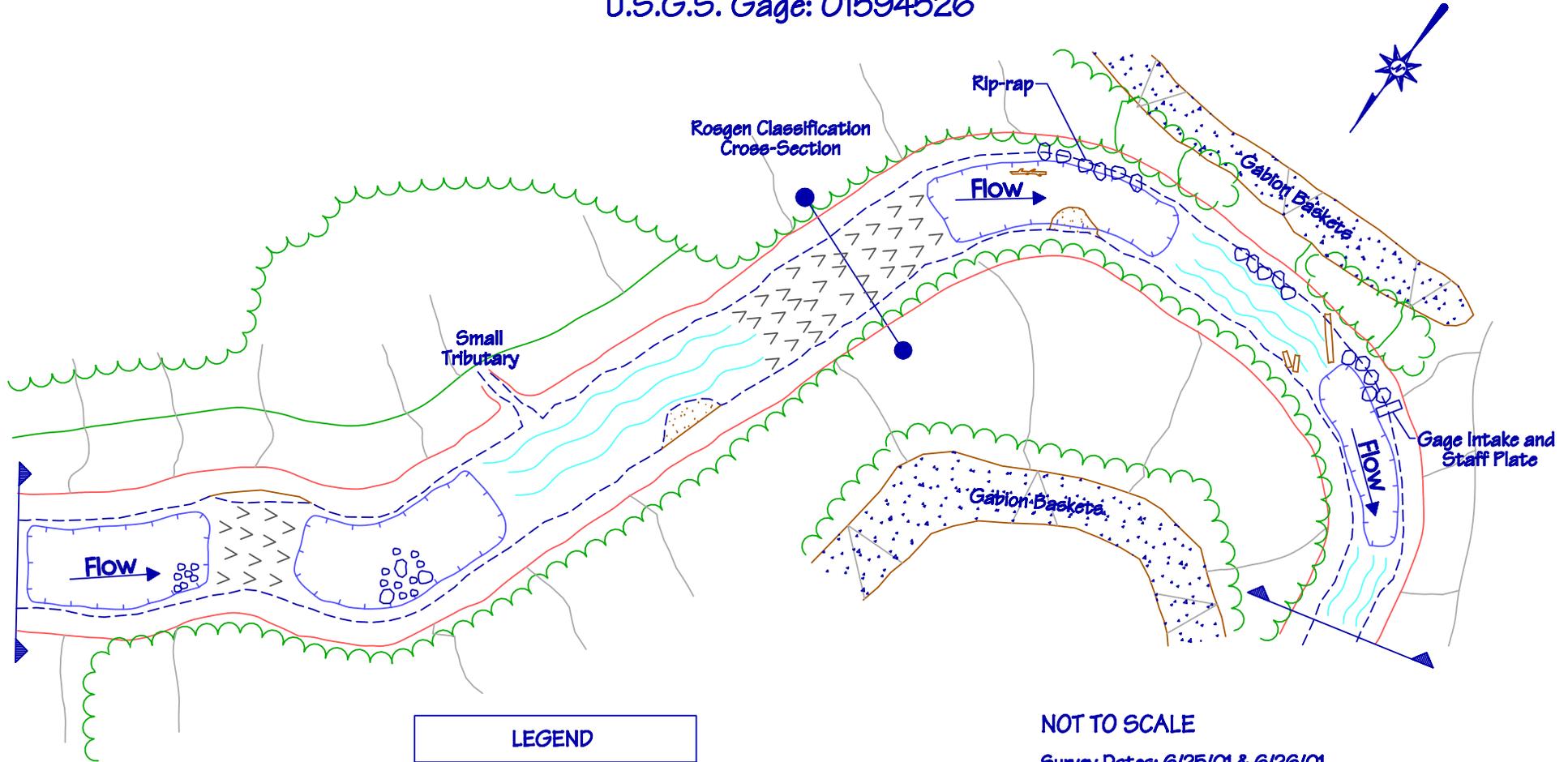


Upstream view of classification cross-section



Left bank of classification cross-section

WESTERN BRANCH
 at Upper Marlboro, MD
 U.S.G.S. Gage: 01594526



LEGEND	
Top of Bank :	— (solid red line)
Edge of Water :	- - - (dashed blue line)
Run:	~ (wavy cyan line)
Pool:	— (blue line with vertical dashes)
Riffle:	~ (hatched pattern)
Sand/Gravel :	••••• (stippled pattern)
Fallen Trees :	↘ ↙ (brown arrow symbols)
Study Reach End Points:	◀ ▶ (blue arrows)

NOT TO SCALE

Survey Dates: 6/25/01 & 6/26/01
 Study Reach Length: 2024'

Classification Cross-Section
 Monument Locations:

Left Monument (+/- 15'):
 38° 48' 54.91" N
 76° 44' 48.45" W
 Elevation: 27'

Right Monument (+/- 33'):
 38° 48' 54.73" N
 76° 44' 49.03" W
 Elevation: 39'