

Bowman Consulting Group, Ltd.
13451 Sunrise Valley Drive
Suite 500
Herndon, Virginia 20171
Phone: (703) 464-1000
Fax: (703) 461-9720
www.bowmanconsulting.com

NORTHERN VIRGINIA
REGIONAL PARKS
5400 Ox Road
Fairfax Station
Virginia 22039



CONTEXT PLAN
BULL RUN REGIONAL PARK
CUB RUN CREEK
BRIDGE REPLACEMENT
SULLY DISTRICT FAIRFAX COUNTY, VIRGINIA

Designed By	Checked By
MT	MT
Date	August, 2023
PLAN STATUS	ALTERNATE BRIDGE
09/25/23	CONCEPT
Scale	1"=100'
NOVA Project Number	
Map Section	B-2
Sheet	2 of 12
NOVA File Number	
DATE	DESCRIPTION

Designed By	Checked By
MT	MT
Date	August, 2023
Scale	1"=20'
NOVA Project Number	
Map Section	13-2
Sheet	3 of 12
NOVA File Number	

BENCHMARKS

NUMBER	NORTHING	EASTING	ELEVATION	DESCRIPTION
#1	6974905	11777398	151.00	IRON ROD WITH CAP
#2	6974881	11777600	149.80	IRON ROD WITH CAP

LEGEND

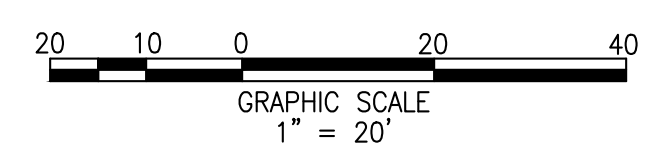
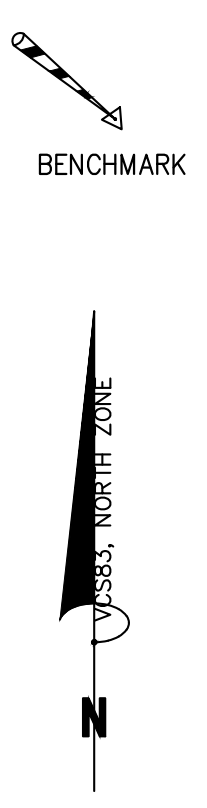
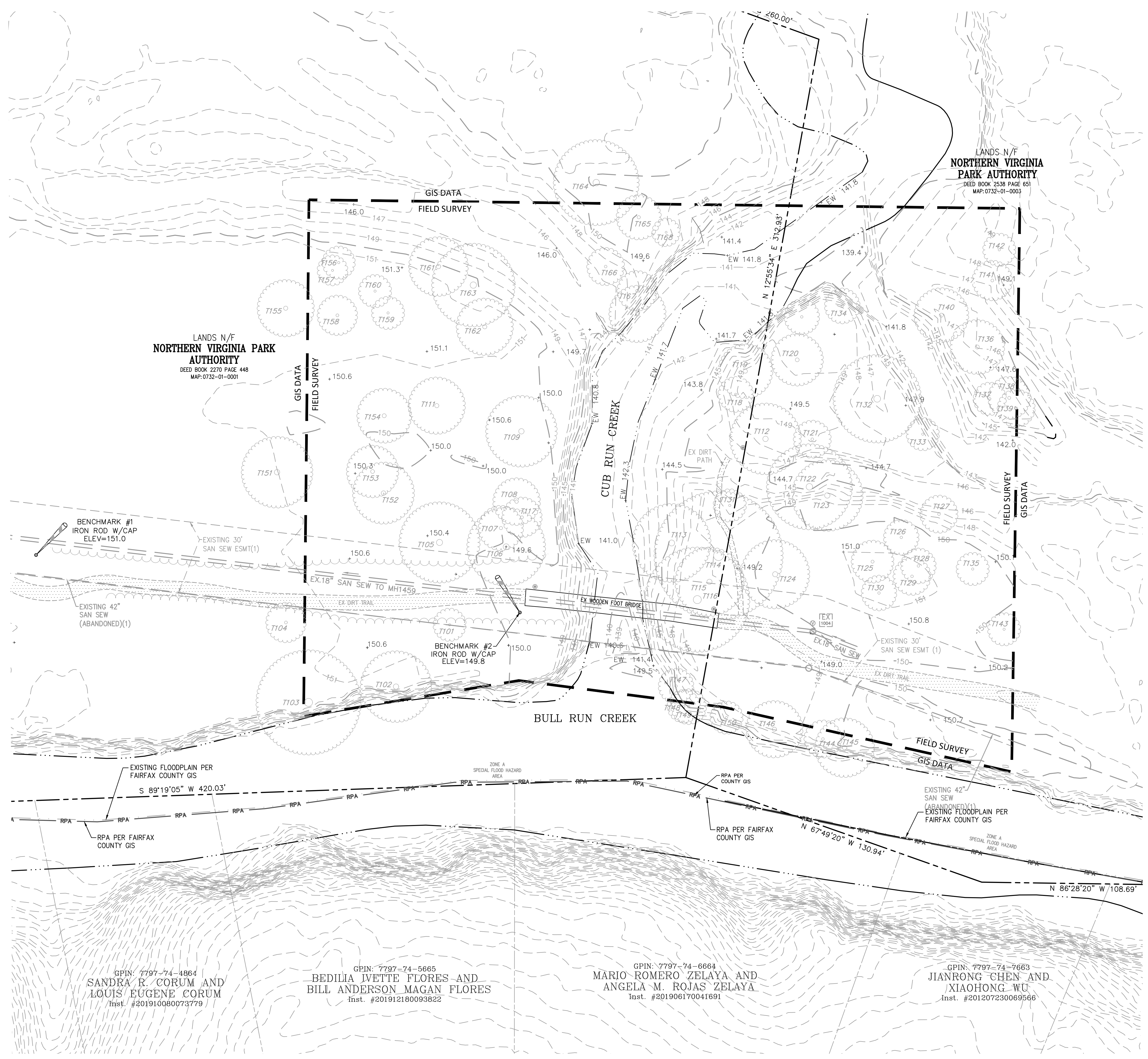
- SANITARY SEWER MANHOLE
- SANITARY SEWER MANHOLE ID NUMBER
- WOOD POST
- VENT PIPE
- EW 141.7
- EXISTING TREELINE
- EXISTING TREE/TREE NUMBER
- EXISTING CONTOUR
- EX. 18" SAN SEW
- LIMITS OF FIELD SURVEY/GIS TOPOGRAPHY DATA
- FLOODPLAIN LIMITS (PER FAIRFAX COUNTY GIS)
- APPROXIMATE STREAM EDGE
- RESOURCE PROTECTION AREA (RPA) LIMITS (PER FAIRFAX COUNTY GIS)
- EXISTING NATURAL SURFACE TRAIL

SANITARY SEWER TABLE

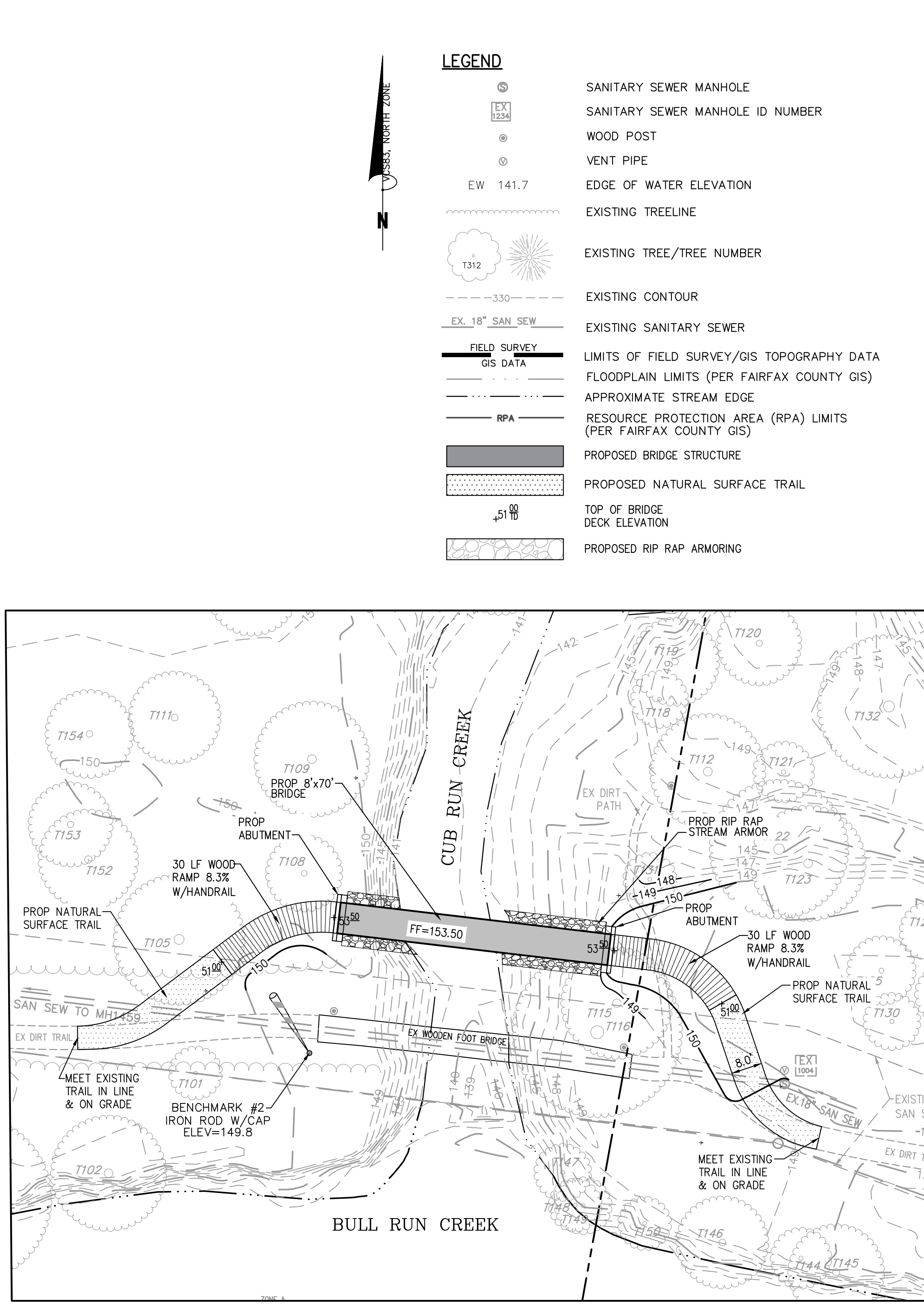
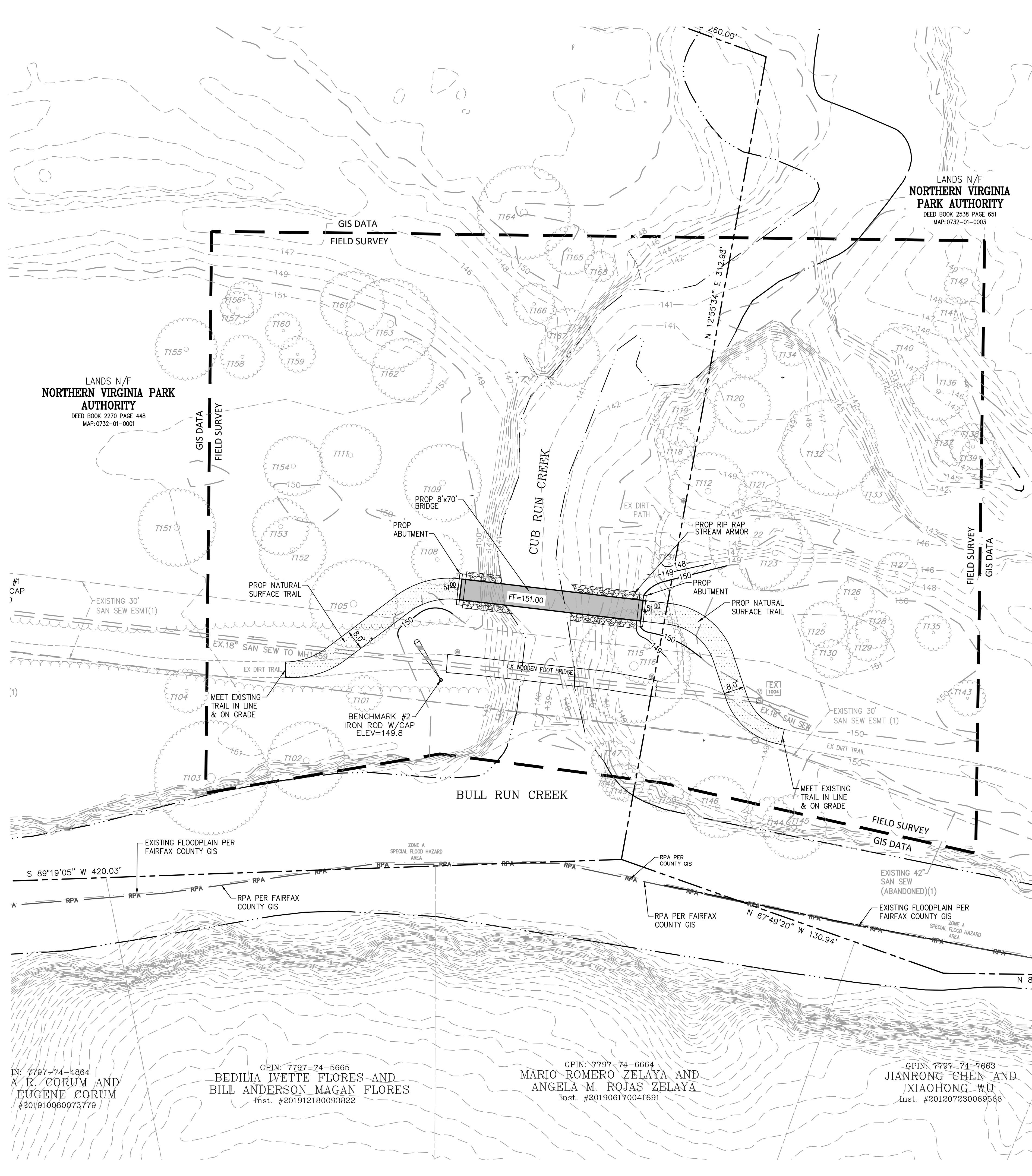
- RIM=204.59
- NO INVERT, MANHOLE BOLTED
- RIM=152.00
- NO INVERT, MANHOLE BOLTED

SOURCE NOTE:

- (1) DATA OBTAINED FROM PLANS PROVIDED BY U.O.S.A. TITLED "YORKSHIRE INTERCEPTOR UPGRADE" DATED OCTOBER 2021.



DATE	DESCRIPTION
09/25/23	ALTERNATE BRIDGE CONCEPT



LEGEND

	SANITARY SEWER MANHOLE
	SANITARY SEWER MANHOLE ID NUMBER
	WOOD POST
	VENT PIPE
	EDGE OF WATER ELEVATION
	EXISTING TREELINE
	EXISTING TREE/TREE NUMBER
	EXISTING CONTOUR
	EXISTING SANITARY SEWER
	LIMITS OF FIELD SURVEY/GIS TOPOGRAPHY DATA
	FLOODPLAIN LIMITS (PER FAIRFAX COUNTY GIS)
	APPROXIMATE STREAM EDGE
	RESOURCE PROTECTION AREA (RPA) LIMITS (PER FAIRFAX COUNTY GIS)
	PROPOSED BRIDGE STRUCTURE
	PROPOSED NATURAL SURFACE TRAIL
	TOP OF BRIDGE DECK ELEVATION
	PROPOSED RIP RAP ARMORING

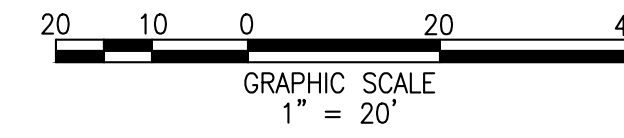
ALTERNATE BRIDGE LAYOUT

IN: 7797-74-4864
A. R. CORUM AND EUGENE CORUM
#201910080073779

GPIN: 7797-74-5665
BEDILIA IVETTE FLORES AND BILL ANDERSON MAGAN FLORES
Inst. #201912180093822

GPIN: 7797-74-6664
MARIO ROMERO ZELAYA AND ANGELA M. ROJAS ZELAYA
Inst. #201906170041691

GPIN: 7797-74-7663
JIANRONG CHEN AND XIAOHONG WU
Inst. #201207230069566



PLAN STATUS	DATE
ALTERNATE BRIDGE	August, 2023
CONCEPT	

Scale 1"=20'

NOVA Project Number

Map Section TB-2

Sheet 4 of 12

NOVA File Number

DATE	DESCRIPTION



Bowman Consulting Group, Ltd.
1345 Sunrise Valley Drive
Suite 500
Herndon, Virginia 20171
Phone: (703) 464-1000
Fax: (703) 461-9720
www.bowmanconsulting.com

NORTHERN VIRGINIA REGIONAL PARKS
5400 Ox Road
Fairfax Station
Virginia 22039

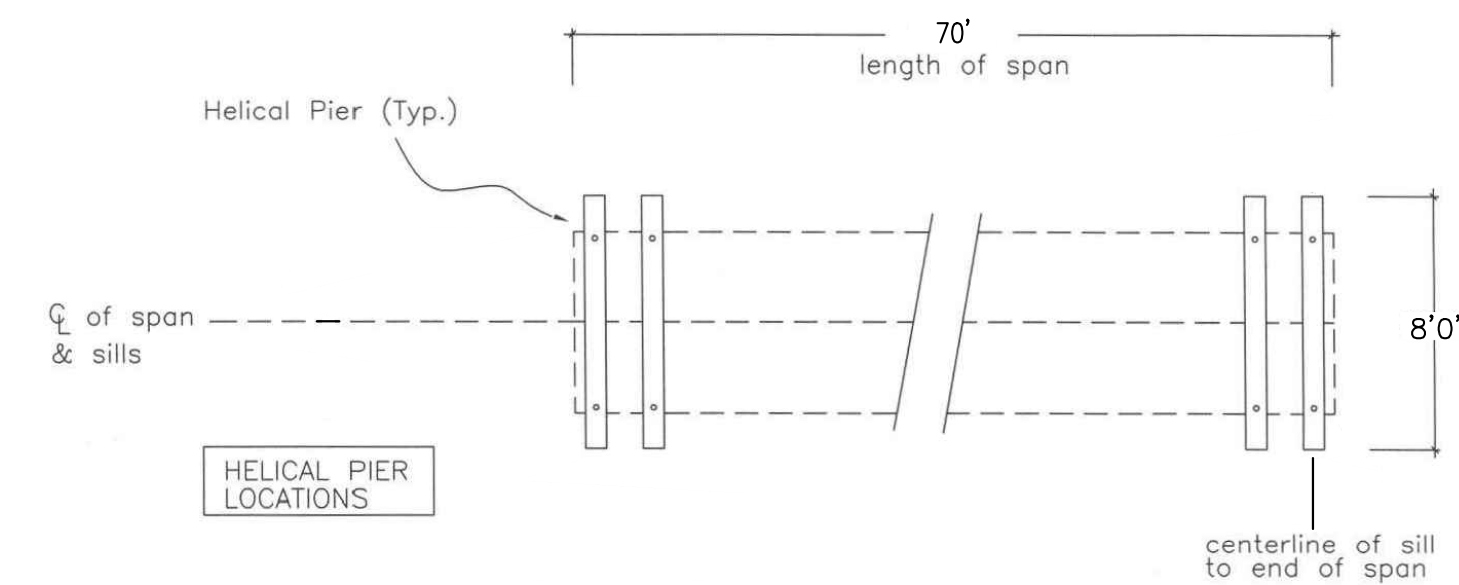


CONCEPT PLAN
BULL RUN REGIONAL PARK
CUB RUN CREEK
BRIDGE REPLACEMENT
SULLY DISTRICT FAIRFAX COUNTY, VIRGINIA

Designed By	Checked By
MT	MT

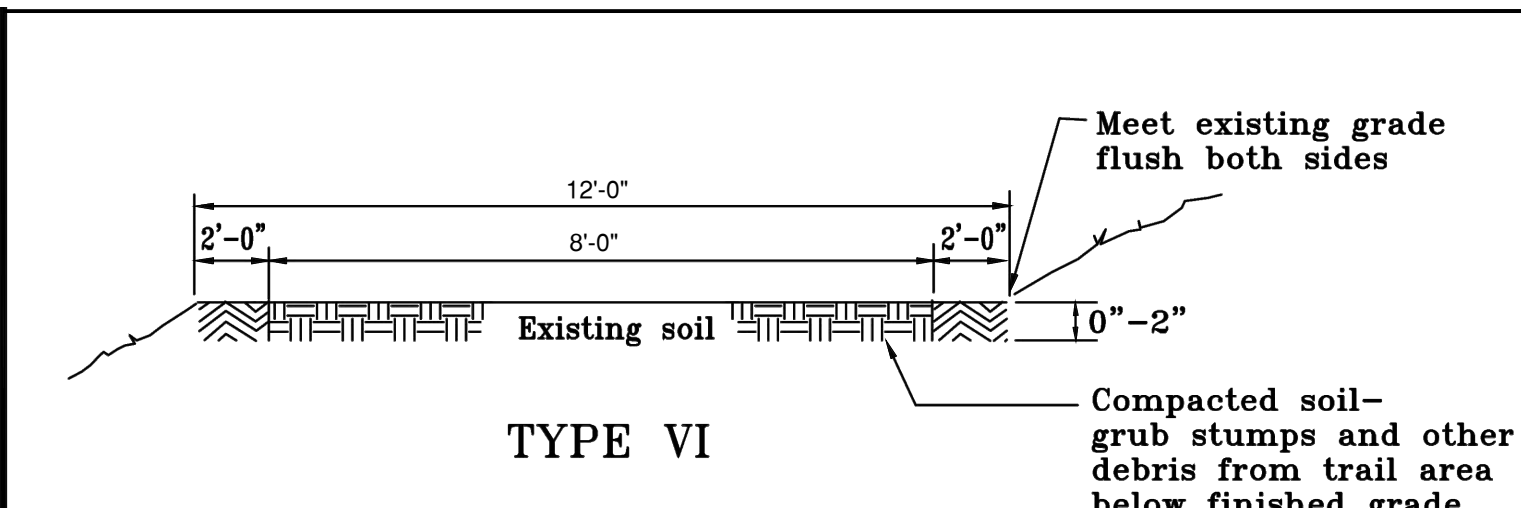
HELICAL PIER LAYOUT (ILLUSTRATIVE DESIGN)

Helical Pier layout for four 8'-0" x 8" x 8" P.T. wood sills
Sills must be square, aligned, and level



ILLUSTRATIVE-HELICAL PIER LAYOUT

PLAN VIEW NTS



TYPE VI

Suitable for equestrian use, hiking and all-terrain (mountain) bicycle use in low density areas. Construction of this selection is subject to the approval of the Director.

Alignment of this trail should be such that there is minimum ground disturbance during clearing.

Ref. Sec. 8-0202.1B, 8-0203.1B

Rev. 1-00, 2011 Reprint, 2018 Reprint, 10-20

TRAIL CROSS-SECTIONS

PLATE NO. STD. NO.

2-8

1 GRAVEL TRAIL

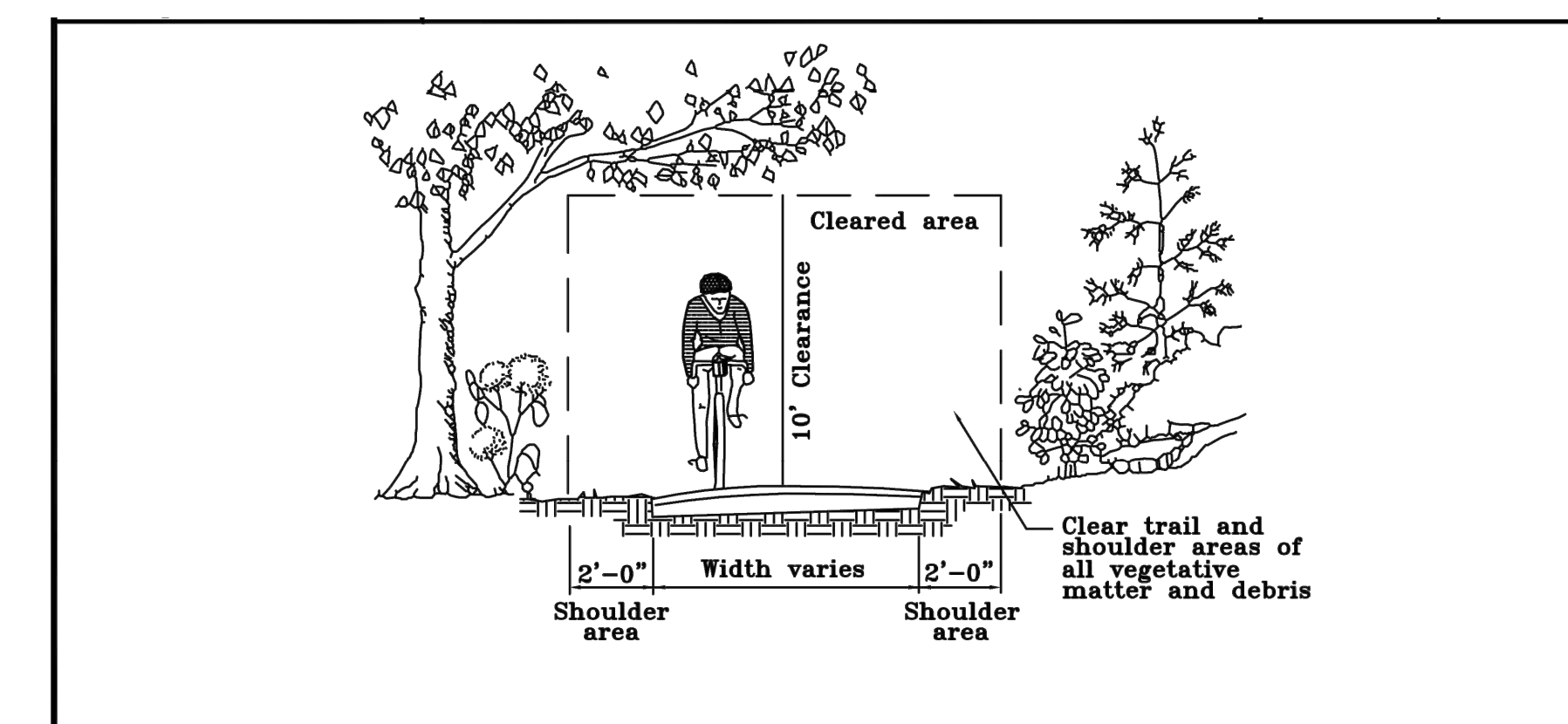
SECTION

NOT TO SCALE

2 TRAIL CLEARING

SECTION

NOT TO SCALE



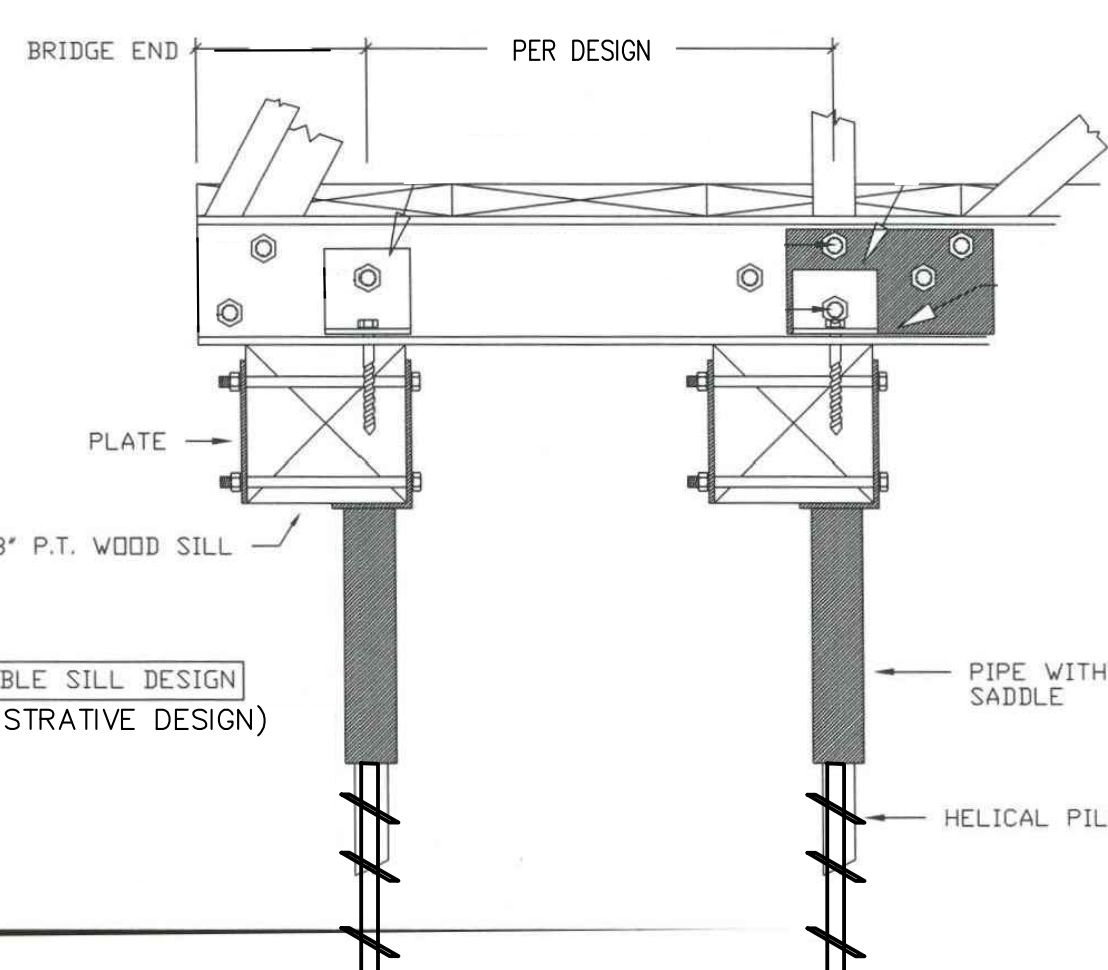
Ref. Sec. 8-0202.1B, 8-0202.3C, 8-0203.1B

Rev. 1-00, 2011 Reprint, 2018 Reprint

TRAIL CLEARING

PLATE NO. STD. NO.

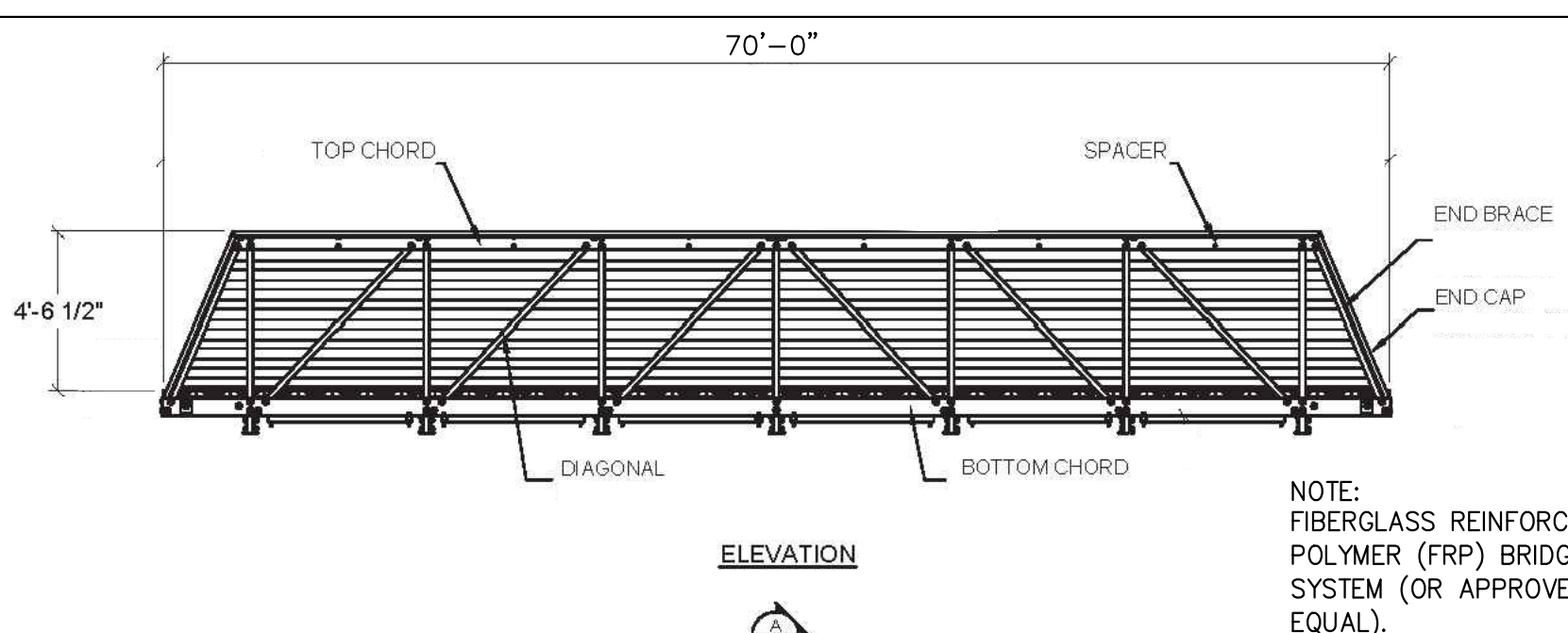
4-8



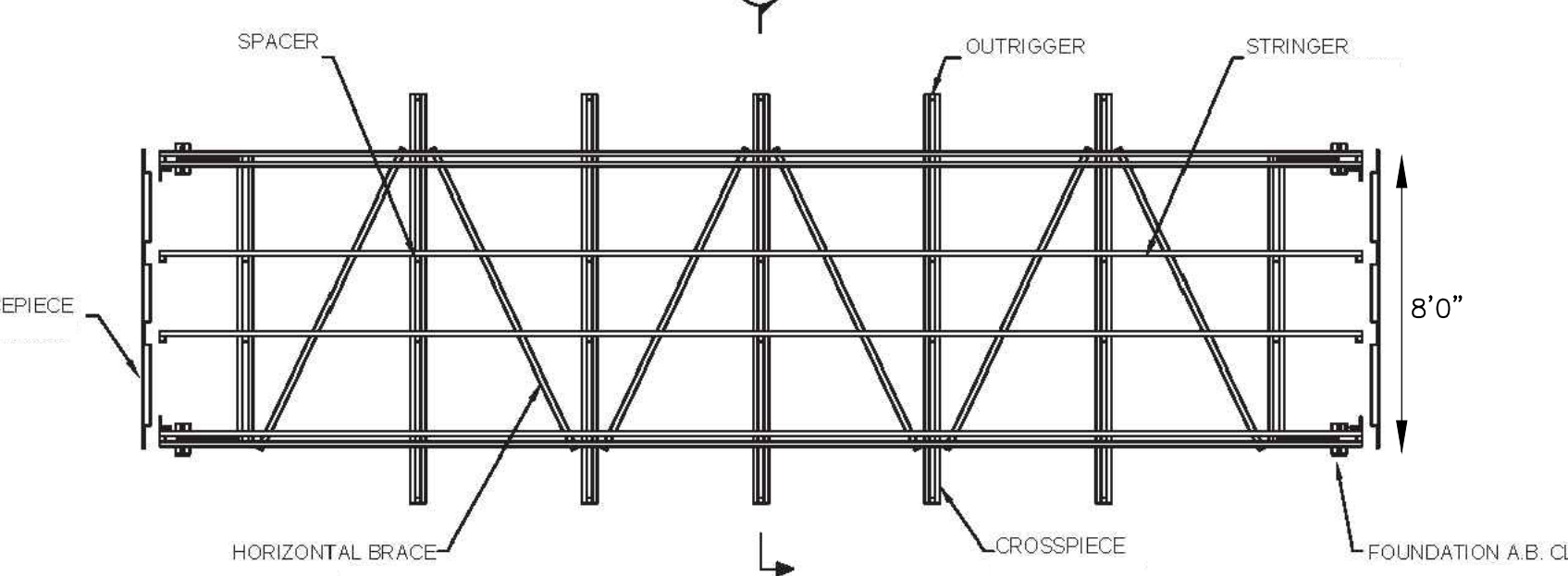
NOTE: HELICAL PIER ABUTMENT AND FOUNDATION SYSTEM IS SUBJECT TO CHANGE BASED ON GEOTECHNICAL INVESTIGATION AND SUBGRADE SOIL CONDITIONS.

ILLUSTRATIVE-HELICAL PIER SILL IMAGERY

SECTION VIEW NTS



NOTE: FIBERGLASS REINFORCED POLYMER (FRP) BRIDGE SYSTEM (OR APPROVED EQUAL).

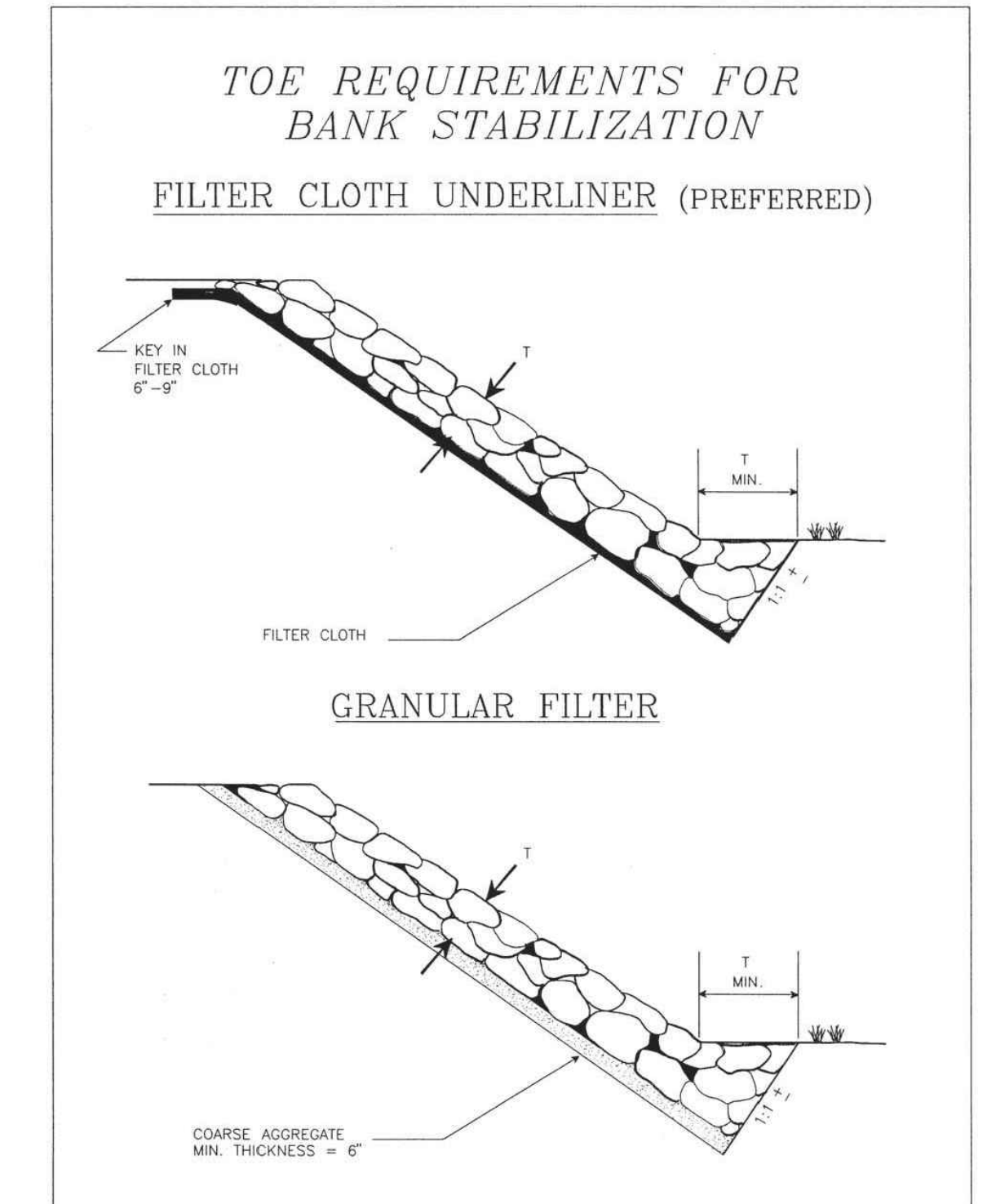


ILLUSTRATIVE-BRIDGE IMAGERY

(OR APPROVED EQUAL) NTS

BRIDGE IMAGERY: FOR ILLUSTRATION PURPOSES ONLY (NOT FOR PERMIT OR CONSTRUCTION)

1992 3.19



Source: Adapted from VDOT Drainage Manual

Plate 3.19-1

III - 173

3 STREAM BANK ARMOR

SECTION

NOT TO SCALE

Bowman

Bowman Consulting Group, Ltd.
1345 Sunrise Valley Drive
Suite 500
Herndon, Virginia 20171
Phone: (703) 464-1000
Fax: (703) 461-9720
www.bowmanconsulting.com

NORTHERN VIRGINIA
REGIONAL PARKS
5400 Ox Road
Farrax Station
Virginia 22039

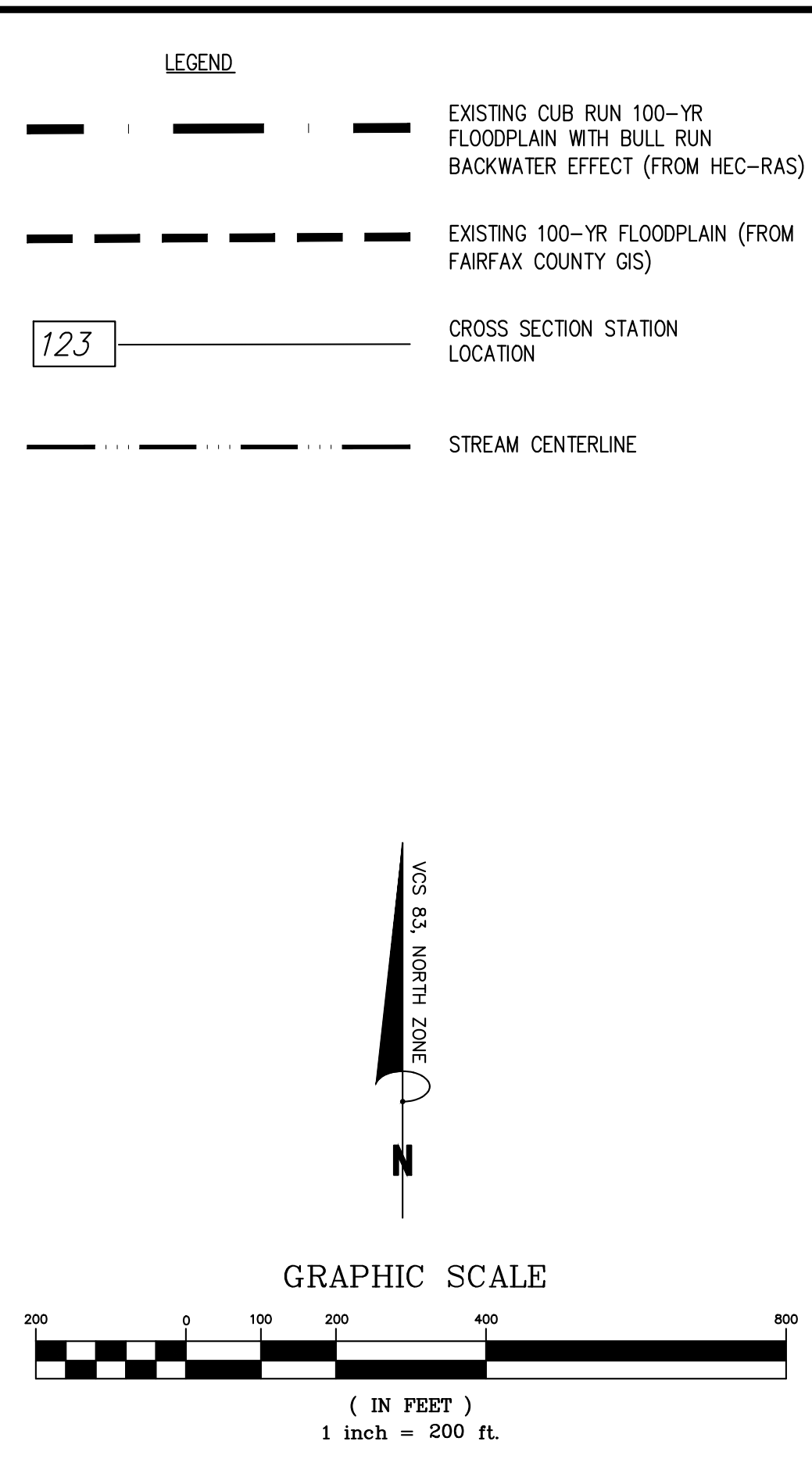
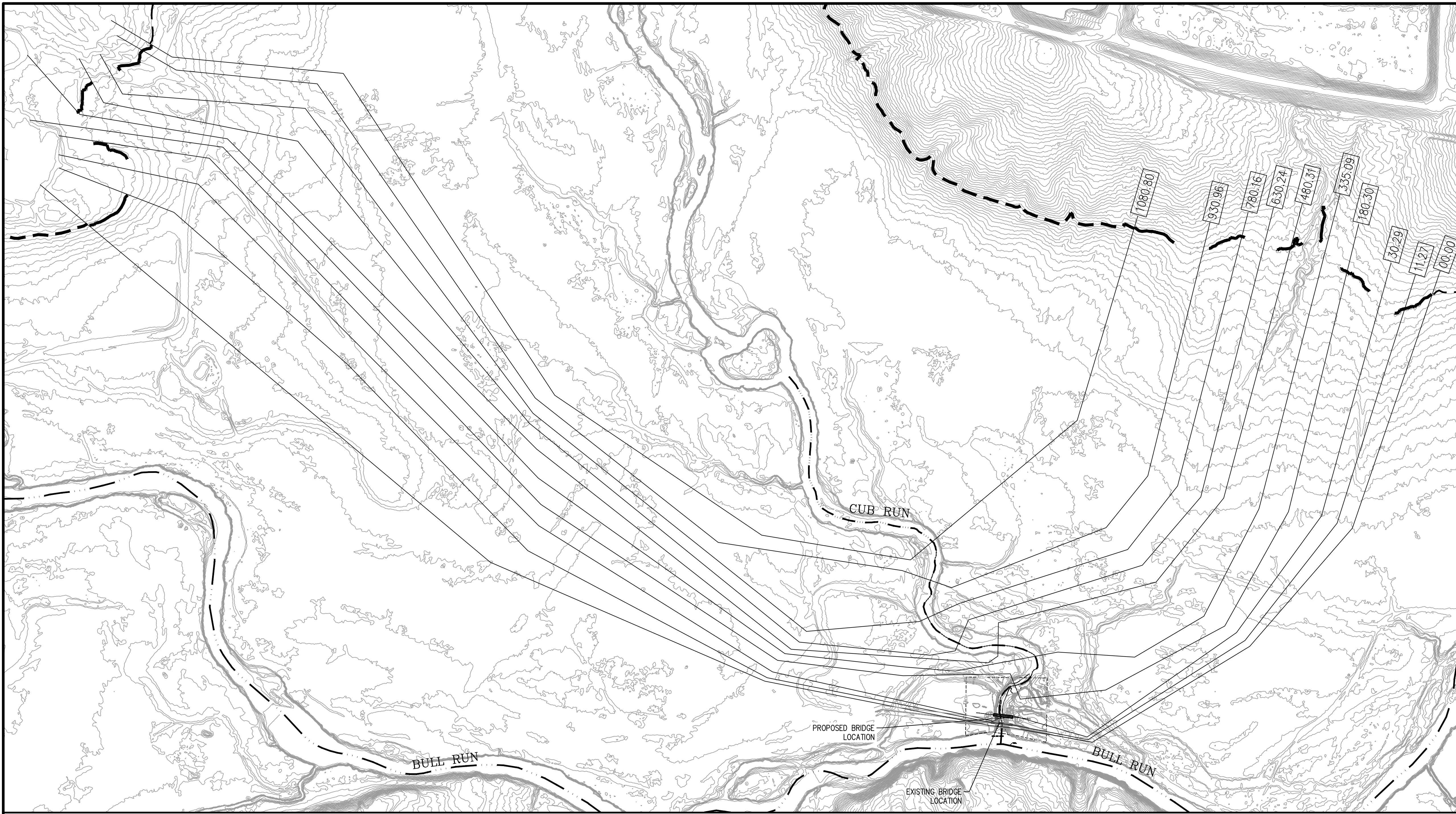
NOVA
PARKS

BULL RUN REGIONAL PARK
CUB RUN CREEK
BRIDGE REPLACEMENT
SULLY DISTRICT FAIRFAX COUNTY, VIRGINIA

SITE DETAILS

Designed By MT Checked By MT

PLAN STATUS	Date
09/25/23 ALTERNATE BRIDGE CONCEPT	August, 2023
	Scale 1"=20'
	NOVA Project Number
	Map Section B-2
	Sheet 5 of 12
	NOVA File Number
DATE	DESCRIPTION



Bowman

Bowman Consulting Group, Ltd.
13451 Sunrise Valley Drive
Suite 500
Herndon, Virginia 20171
Phone: (703) 464-1000
Fax: (703) 461-9720
www.bowmanconsulting.com

NORTHERN VIRGINIA
REGIONAL PARKS
5400 Ox Road
Farrax Station
Virginia 22659

**NOVA
PARKS**

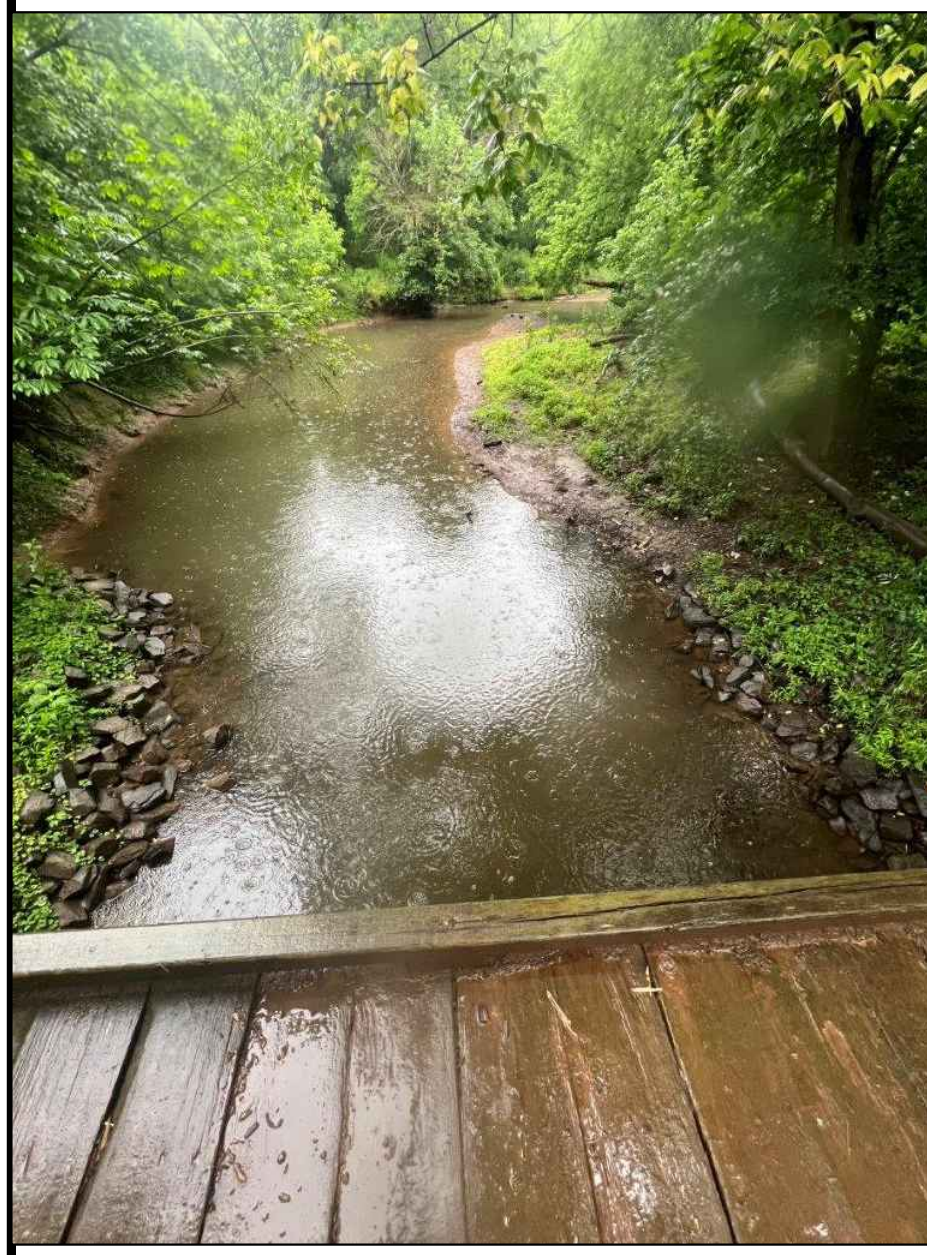
FLOOD PLAIN OVERALL

BULL RUN REGIONAL PARK
CUB RUN CREEK
BRIDGE REPLACEMENT

SULLY DISTRICT FAIRFAX COUNTY, VIRGINIA

CUB RUN STREAM SITE PHOTOS

CUB RUN STREAM - VIEW NORTH FROM EXISTING PED. BRIDGE

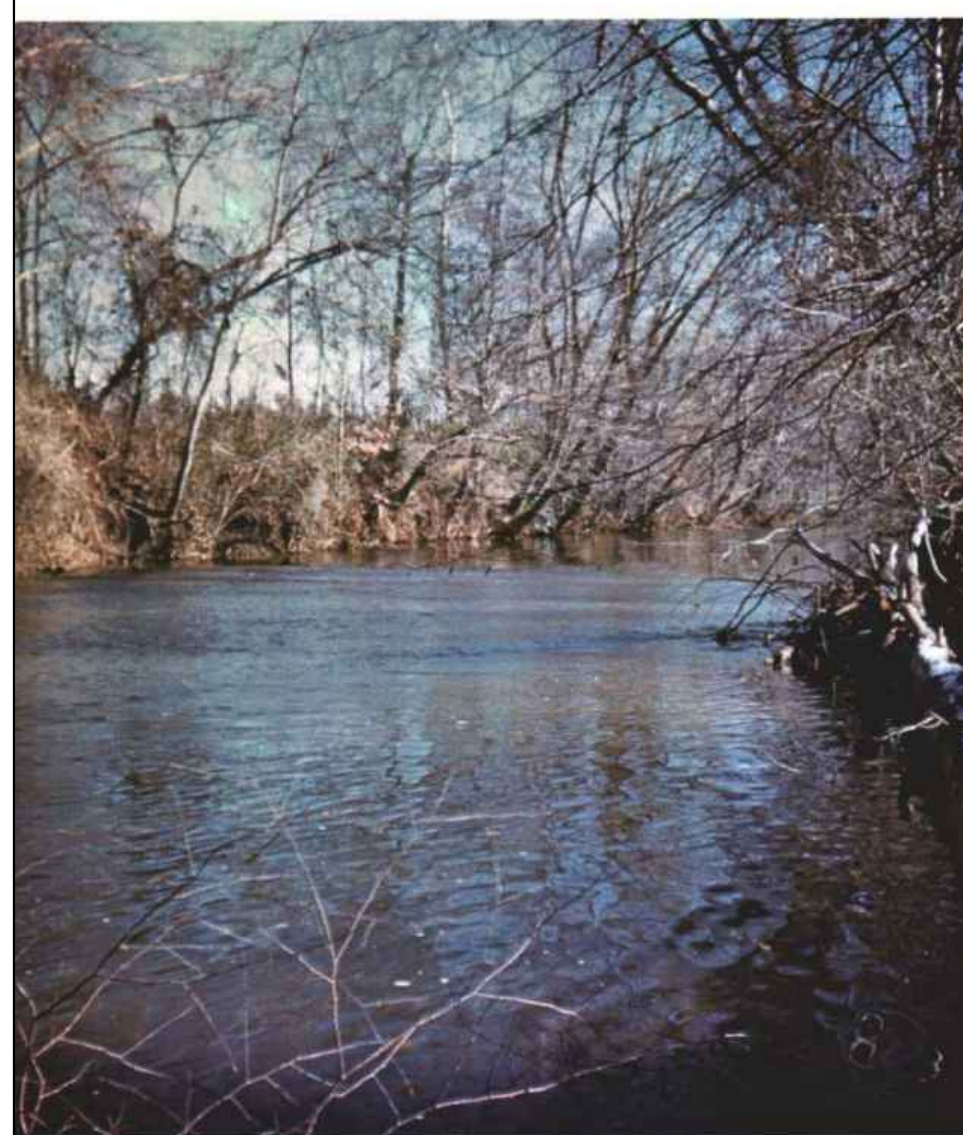


CUB RUN STREAM - VIEW UPSTREAM OF EXISTING PED. BRIDGE



EXAMPLE: USGS CHANNEL MANNING ROUGHNESS COEFFICIENT N=0.035

n = 0.041, 0.039, 0.035



No. 1167 downstream from right bank above section 9, Etowah River near Dawsonville, Ga.

EXAMPLE: USGS OVERBANK MANNING ROUGHNESS COEFFICIENT N=0.15



Computed roughness coefficient: Manning's n=0.15
Date of flood: December 7, 1971
Date of photograph: April 12, 1979
Depth of flow on flood plain: 4.1 ft
Description of flood plain: The vegetation of the flood plain is large and small trees, including oak, gum, and ironwood. The base is firm soil and has minor surface irregularities caused by rises and depressions. Obstructions are negligible (some exposed roots). Ground cover is negligible, and undergrowth is minimal. Veg₁=0.0067, and C₁=14.4. The selected values are n₁=0.025, n₂=0.003, n₃=0.002, and n₄=0.030.

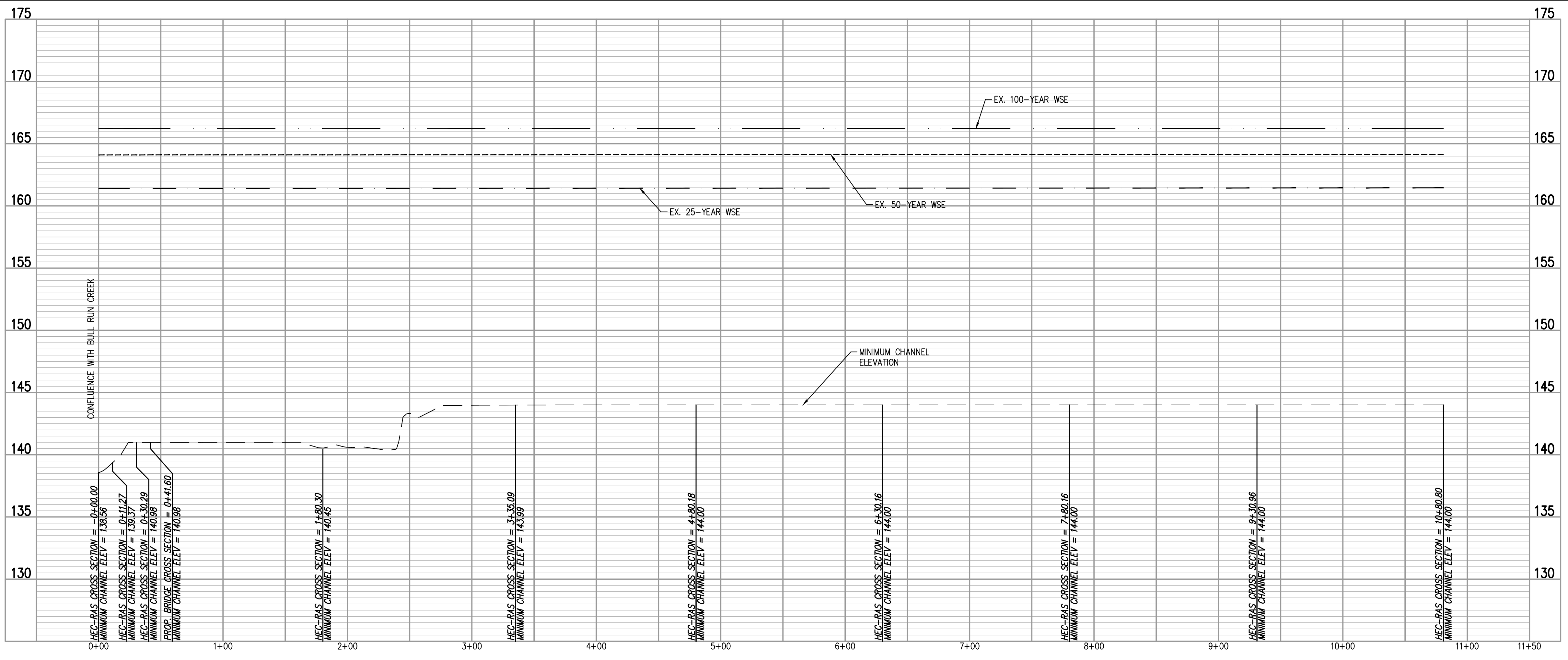
Figure 17. Tenmile Creek near Elizabeth, La. (Arcrement, Colson, and Ming, 1979; HA-606, cross section 3).

CUB RUN VELOCITY COMPARISON TABLE

STA	Cub Run 100-YR Velocity No Bull Run Backwater Effect (ft./sec.)	Cub Run 100-YR Velocity With Bull Run Backwater Effect (ft./sec.)
1080.80	6.56	1.73
930.96	7.15	1.77
780.16	7.56	1.71
630.16	8.35	1.73
480.18	7.96	1.68
335.09	8.14	1.65
180.30	8.34	1.63
30.29	11.11	1.62
11.27	11.26	1.58
0	14.46	1.60

PROP. BRIDGE LOCATION

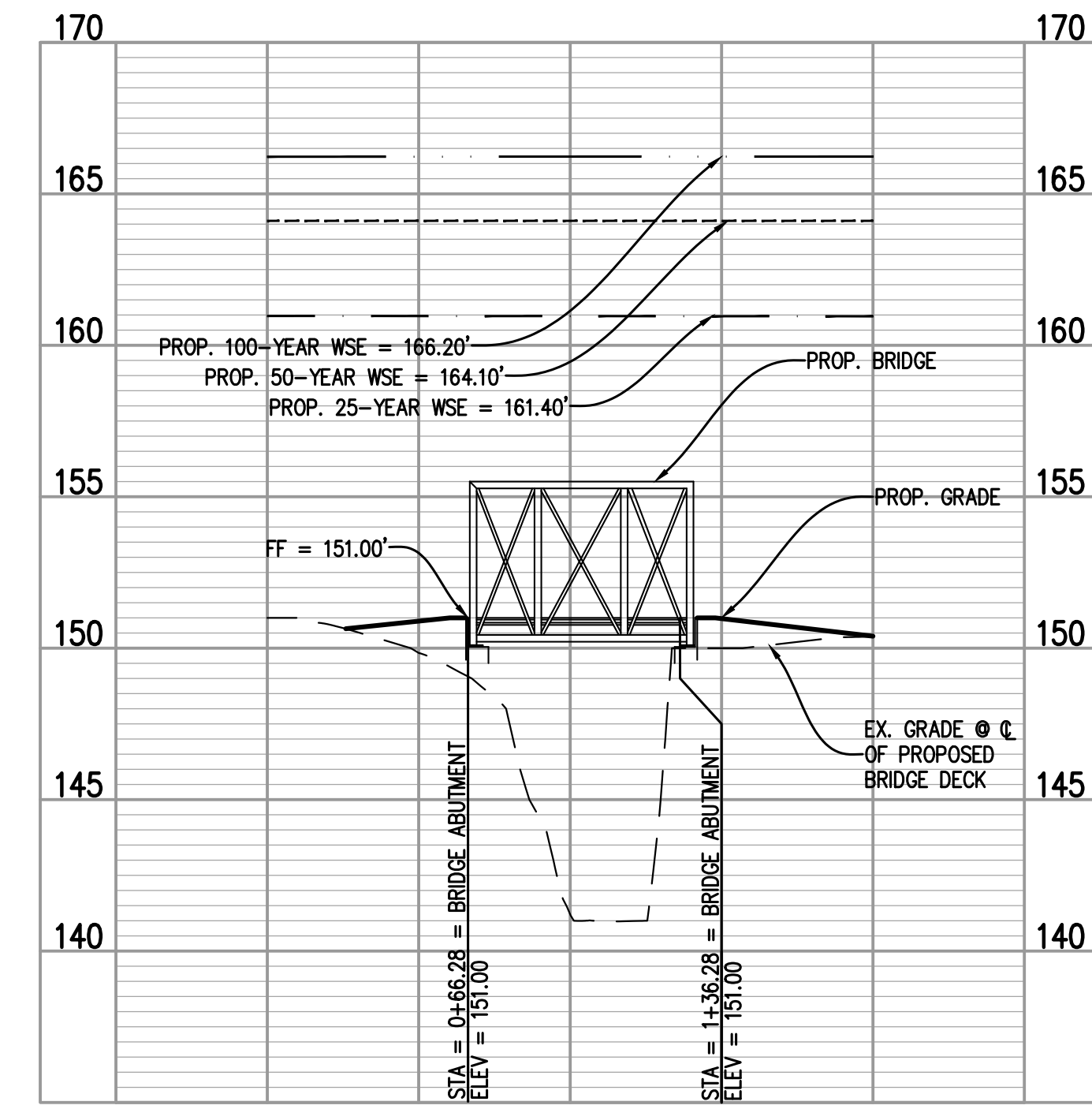
Designed By MT	Checked By MT
Date August, 2023	
PLAN STATUS 09/25/23 ALTERNATE BRIDGE CONCEPT	
Scale	
NOVA Project Number	
Map Section TB-2	
Sheet 6 of 12	
NOVA File Number	
DATE	DESCRIPTION



CUB RUN CREEK PROFILE (WITH BACKWATER EFFECT FROM BULL RUN)
 HORIZONTAL SCALE: 1"=50'
 VERTICAL SCALE: 1"=5'

CUB RUN BASIN
 Table 1: Water Surface Profile Data for Cub Run

Section Number	Base-Line Station (feet)	Imp. (%)	Discharge 25-year (cfs)	Discharge 50-year (cfs)	Discharge 100-year (cfs)	Elevation 25-year (feet)	Elevation 50-year (feet)	Elevation 100-year (feet)	Remarks
2	16+10	40	16,000	19,700	23,600	161.4	164.1	166.2	Confluence with Bull Run
3	25+04	40	16,000	19,700	23,600	161.5	164.2	166.2	
4	34+42	40	16,000	19,700	23,600	161.6	164.2	166.3	
5	41+20	40	16,000	19,700	23,600	161.7	164.3	166.4	
6	47+30	40	16,000	19,700	23,600	162.0	164.6	166.5	
7	53+19	40	16,000	19,700	23,600	162.3	164.8	166.7	
8	58+63	40	16,000	19,700	23,600	162.8	165.1	167.0	
9	64+33	40	16,000	19,700	23,600	163.1	165.3	167.2	
10	67+96	40	16,000	19,700	23,600	163.2	165.4	167.3	
11	71+17	40	16,000	19,700	23,600	163.3	165.5	167.3	
12	76+87	40	16,000	19,700	23,600	163.6	165.6	167.4	
13	80+84	40	16,000	19,700	23,600	163.7	165.7	167.5	
14	85+74	40	16,000	19,700	23,600	164.2	166.0	167.7	
15									Interstate 66
17	89+72	40	16,000	19,700	23,600	168.3	169.2	169.8	
18	94+30	40	16,000	19,700	23,600	168.6	169.6	170.3	
19	98+73	40	16,000	19,700	23,600	168.8	169.8	170.6	
20	104+54	40	16,000	19,700	23,600	169.0	170.1	170.8	
21	109+10	40	16,000	19,700	23,600	169.2	170.3	171.1	
22	113+52	40	16,000	19,700	23,600	169.5	170.6	171.3	
23	118+36	40	16,000	19,700	23,600	169.7	170.8	171.6	
24	122+36	40	16,000	19,700	23,600	169.9	171.1	171.8	
25	126+36	40	16,000	19,700	23,600	171.2	172.1	172.8	
26	130+09	40	16,000	19,700	23,600	170.6	171.9	172.8	
27									Compton Road (State Rte 658)



PROPOSED BRIDGE CROSS SECTION
 HORIZONTAL SCALE: 1"=50'
 VERTICAL SCALE: 1"=5'

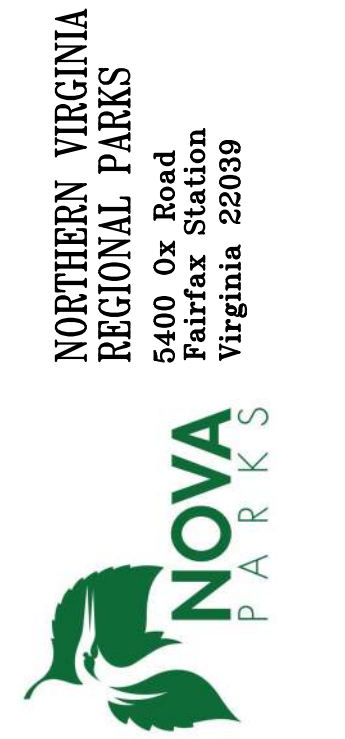
HYDRAULIC ANALYSIS NARRATIVE FOR CUB RUN WITH BACKWATER EFFECT FROM BULL RUN:
 THE STREAM PROFILE AND CROSS SECTIONS WERE DEVELOPED USING BOTH THE TOPOGRAPHIC SURVEY PERFORMED BY BOWMAN DATED JUNE 26, 2023 AND 2018 COUNTY GIS LIDAR CONTOURS - ALL REFERENCING NGVD29.

DISCHARGE:	DOWNSTREAM BOUNDARY CONDITION WSE AT STA. 16+10 OF THE 1978 FLOODPLAIN STUDY (STA. 0+00 OF THE BOWMAN STUDY)
$Q_{25yr} = 16,000$ CFS	161.40
$Q_{50yr} = 19,700$ CFS	164.10
$Q_{100yr} = 23,600$ CFS	166.20

HEC-RAS 6.0 WAS USED TO MODEL THE EXISTING AND PROPOSED CONDITIONS 25-YEAR, 50-YEAR, AND 100-YEAR FLOODPLAINS. THE USGS "ROUGHNESS CHARACTERISTICS OF NATURAL CHANNELS" DOCUMENT WAS USED TO SELECT A MANNING'S N VALUE OF 0.035 THE MAIN CHANNEL WHICH IS COMPRISED OF A SAND AND GRAVEL SUBSTRATE. THE USGS "GUIDE FOR SELECTING MANNING'S ROUGHNESS COEFFICIENTS FOR NATURAL CHANNELS AND FLOOD PLAINS" WAS USED TO SELECT THE OVERBANK MANNING'S N VALUE OF 0.15. SEE SHEET 6 FOR HEC-RAS CROSS SECTION LOCATIONS. SEE SHEETS 7 AND 8 FOR HEC-RAS OUTPUT WATER SURFACE ELEVATION PROFILES FOR THE 25-YEAR, 50-YEAR, AND 100-YEAR STORMS WITH AND WITHOUT BACKWATER EFFECT FROM CUB RUN. CROSS SECTION RESULTS FROM THE HEC-RAS MODEL FOR THE 100-YEAR STORM IN THE STUDY AREA ARE SUMMARIZED ON SHEETS 9 THROUGH 12.

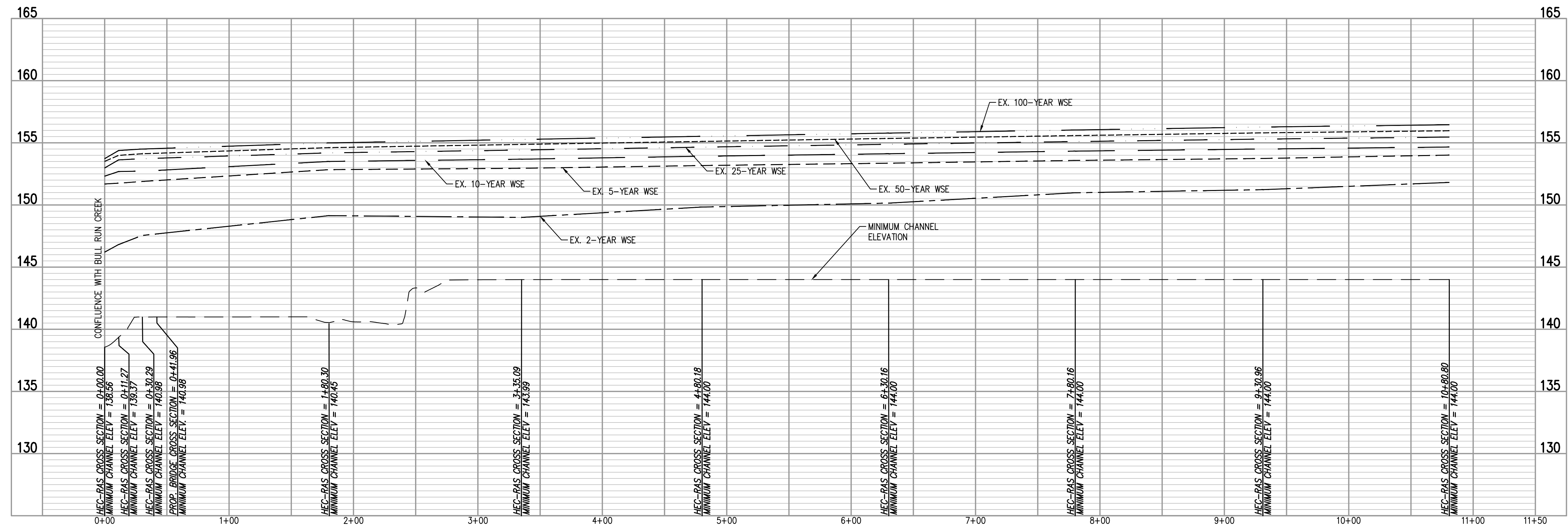


Bowman Consulting Group, Ltd.
 13451 Sunrise Valley Drive
 Suite 500
 Herndon, Virginia 20171
 Phone: (703) 464-1000
 Fax: (703) 461-9720
 www.bowmanconsulting.com

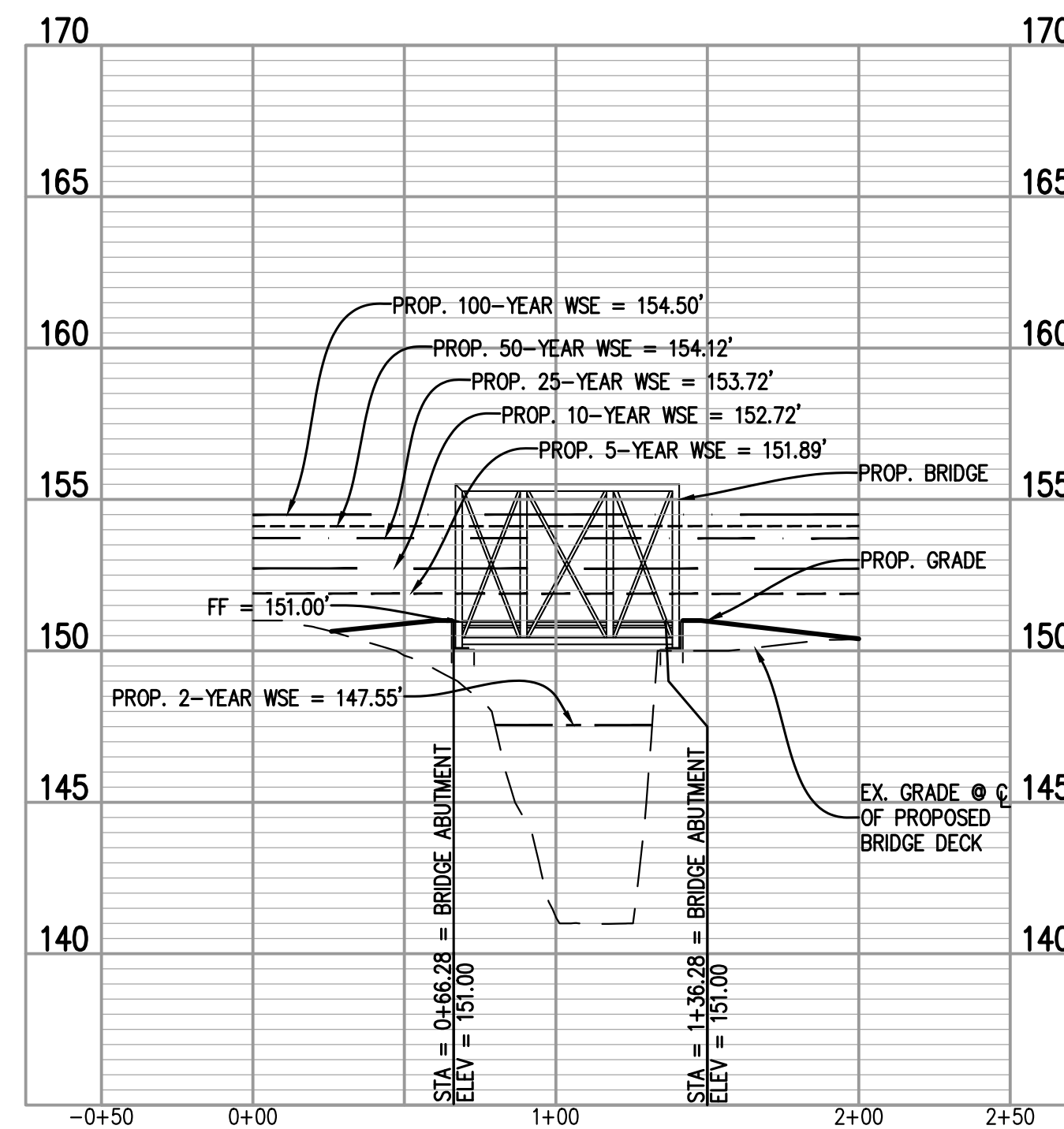


HYDRAULIC ANALYSIS - PROFILE (WITH BULL RUN BACKWATER EFFECT)
BULL RUN REGIONAL PARK
 CUB RUN CREEK
 BRIDGE REPLACEMENT
 SULLY DISTRICT FAIRFAX COUNTY, VIRGINIA

Designed By MT	Checked By MT
Date August, 2023	
PLAN STATUS 09/25/23 ALTERNATE BRIDGE CONCEPT	Scale
NOVA Project Number	
Map Section TB-2	
Sheet 7 of 12	
NOVA File Number	
DATE	DESCRIPTION



CUB RUN CREEK PROFILE (NO BACKWATER EFFECT FROM BULL RUN)
 HORIZONTAL SCALE: 1"=50'
 VERTICAL SCALE: 1"=5'



PROPOSED BRIDGE CROSS SECTION
 HORIZONTAL SCALE: 1"=50'
 VERTICAL SCALE: 1"=5'

HYDRAULIC ANALYSIS NARRATIVE FOR CUB RUN WITHOUT BACKWATER EFFECT FROM BULL RUN:
 THE STREAM PROFILE AND CROSS SECTIONS WERE DEVELOPED USING BOTH THE TOPOGRAPHIC SURVEY PERFORMED BY BOWMAN CONSULTING GROUP, LTD. DATED JUNE 26, 2023 AND 2018 COUNTY GIS LIDAR CONTOURS - ALL REFERENCING NGVD29.

A NORMAL WATER SURFACE ELEVATION OF 141.40', EQUIVALENT TO THE SURVEYED WATER SURFACE ELEVATION (WSE) AT THE CONFLUENCE OF CUB RUN AND BULL RUN, WAS USED AS THE DOWNSTREAM BOUNDARY CONDITION WHEN MODELING THE FLOODPLAIN OF CUB RUN WITH NO BACKWATER EFFECT FROM BULL RUN. THE DISCHARGES AND WATER SURFACE ELEVATIONS FOR THE 2, 5, 10, 25, 50 AND 100-YEAR STORMS ARE:

DISCHARGE:	DOWNSTREAM BOUNDARY CONDITION WSE AT STA. 0+00 OF THE BOWMAN STUDY:
$Q_{2YR} = 2,517.73$ CFS	146.21'
$Q_{5YR} = 7,408.87$ CFS	151.69'
$Q_{10YR} = 11,108.87$ CFS	152.32'
$Q_{25YR} = 16,000$ CFS	152.98'
$Q_{50YR} = 19,700$ CFS	153.51'
$Q_{100YR} = 23,600$ CFS	153.73'

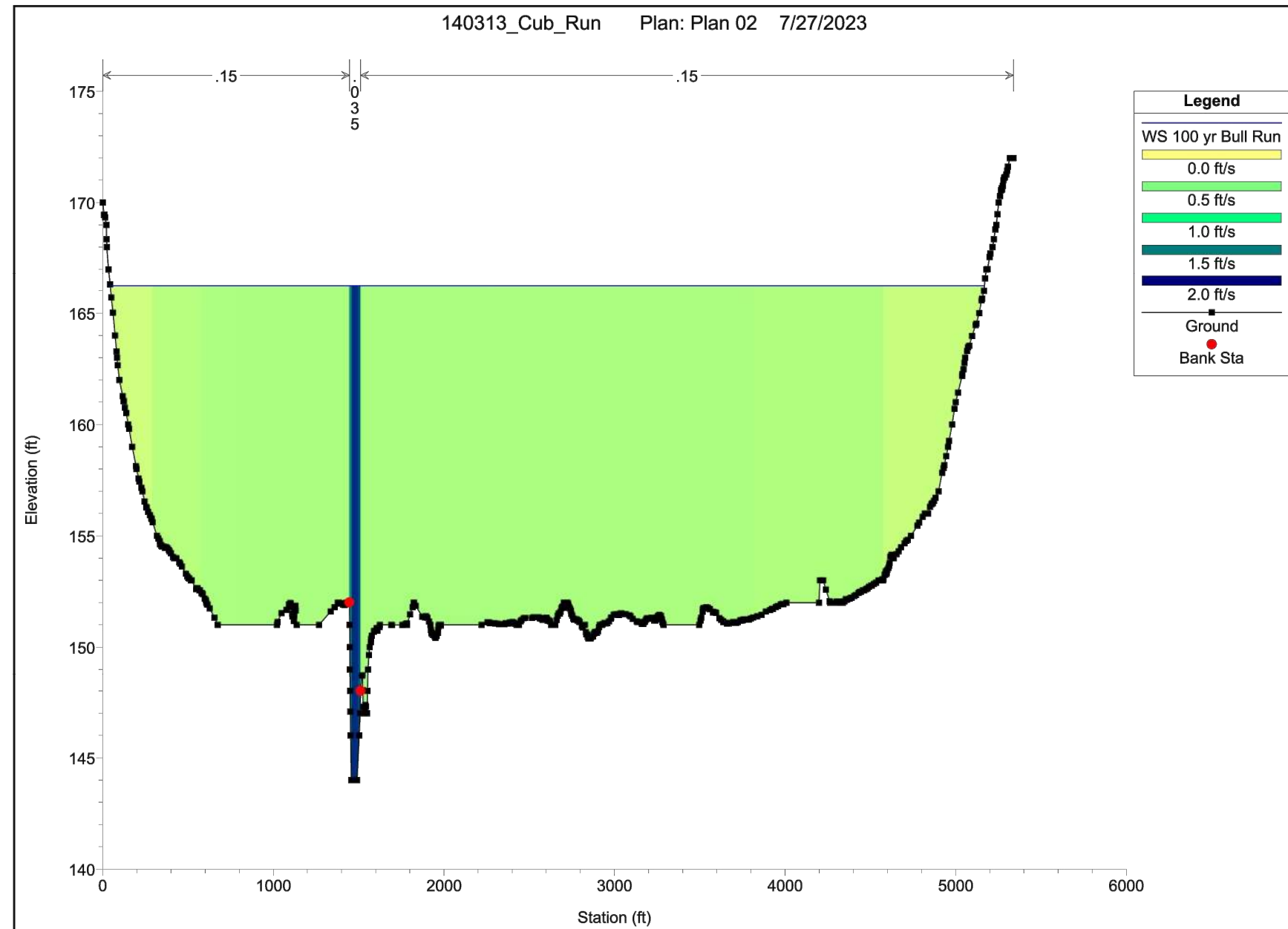
HEC-RAS 6.0 WAS USED TO MODEL THE EXISTING AND PROPOSED CONDITIONS 2-YEAR, 5-YEAR, 10-YEAR, 25-YEAR, 50-YEAR, AND 100-YEAR FLOODPLAINS. THE USGS "ROUGHNESS CHARACTERISTICS OF NATURAL CHANNELS" DOCUMENT WAS USED TO SELECT A MANNING'S N VALUE OF 0.035 THE MAIN CHANNEL WHICH IS COMPRISED OF A SAND AND GRAVEL SUBSTRATE. THE USGS "GUIDE FOR SELECTING MANNING'S ROUGHNESS COEFFICIENTS FOR NATURAL CHANNELS AND FLOOD PLAINS" WAS USED TO SELECT THE OVERBANK MANNING'S N VALUE OF 0.15. SEE SHEET 6 FOR HEC-RAS CROSS SECTION LOCATIONS. SEE SHEETS 7 AND 8 FOR HEC-RAS OUTPUT WATER SURFACE ELEVATION PROFILES FOR THE 2-YEAR, 5-YEAR, 10-YEAR, 25-YEAR, 50-YEAR, AND 100-YEAR STORMS WITH AND WITHOUT BACKWATER EFFECT FROM CUB RUN. CROSS SECTION RESULTS FROM THE HEC-RAS MODEL FOR THE 100-YEAR STORM IN THE STUDY AREA ARE SUMMARIZED ON SHEETS 9 THROUGH 12.

Designed By
 MT

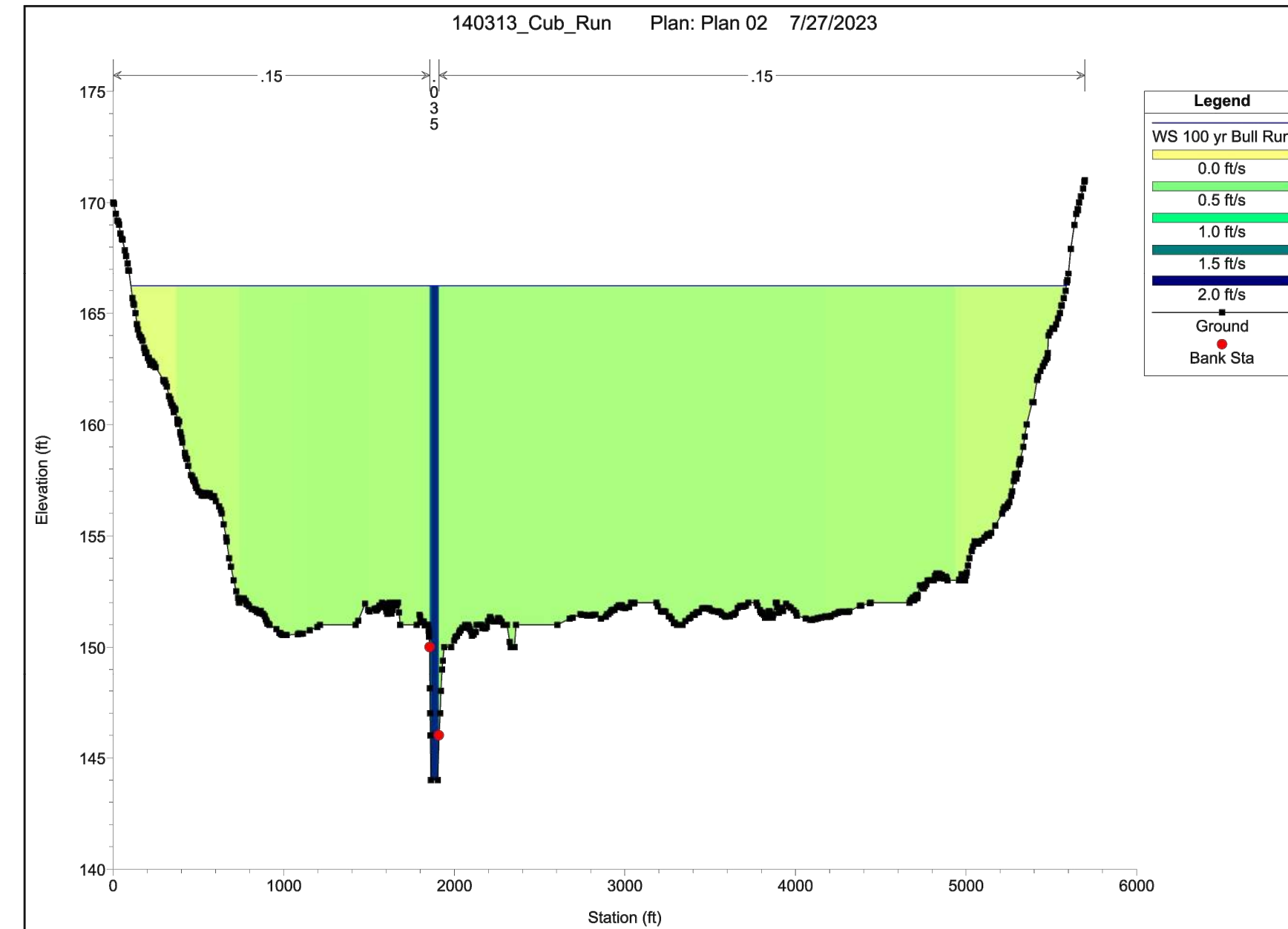
Checked By
 MT

PLAN STATUS	Date
09/25/23 ALTERNATE BRIDGE	August, 2023
CONCEPT	Scale
	NOVA Project Number
	Map Section TB-2
	Sheet 8 of 12
	NOVA File Number
DATE	DESCRIPTION

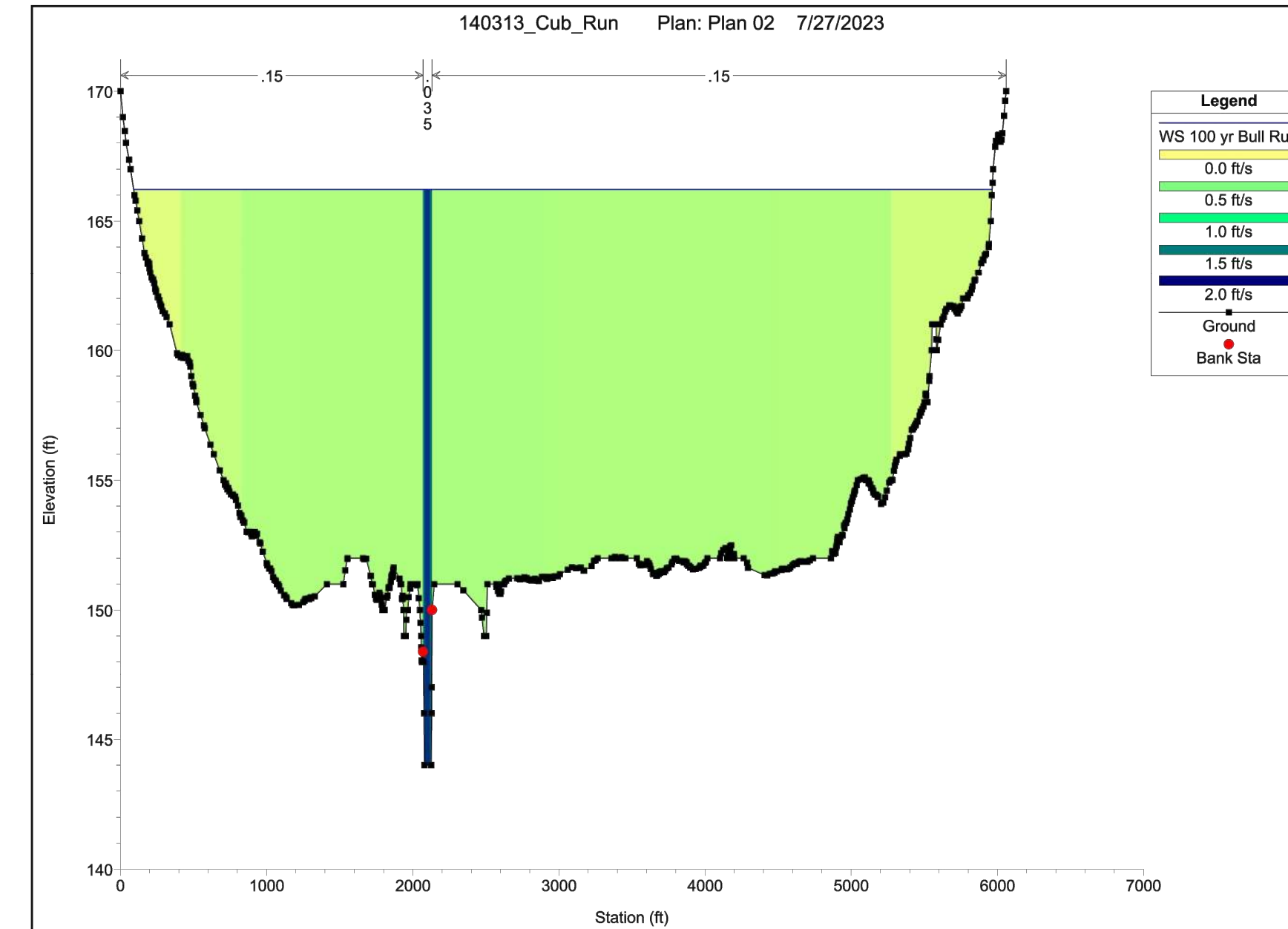
Plan: Plan 02 Cub Run Alignment - Cub RS: 1080.8 Profile: 100 yr Bull Run					
E.G. Elev (ft)	168.23	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	166.23	Reach Len. (ft)	149.84	149.84	149.84
Crit W.S. (ft)	154.03	Flow Area (sq ft)	18139.17	1382.00	50400.46
E.G. Slope (ft/ft)	0.000030	Area (sq ft)	18139.17	1382.00	50400.46
Q Total (cfs)	23600.00	Flow (cfs)	5441.11	2385.50	15773.40
Top Width (ft)	5125.38	Top Width (ft)	1402.72	65.45	3657.21
Vel Total (ft/s)	0.34	Avg. Vel. (ft/s)	0.30	1.73	0.31
Max Chl Dpth (ft)	22.23	Hydr. Depth (ft)	12.93	21.12	13.78
Conv. Total (cfs)	4282818.0	Conv. (cfs)	989732.6	433919.4	2869166.0
Length Wtd. (ft)	149.84	Wetted Per. (ft)	1403.21	68.71	3658.55
Min Ch El (ft)	144.00	Shear (lb/sq ft)	0.02	0.04	0.03
Alpha	3.40	Stream Power (lb/ft s)	0.01	0.07	0.01
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	616.58	32.79	1260.31
C & E Loss (ft)	0.00	Cum SA (acres)	49.32	1.49	98.11



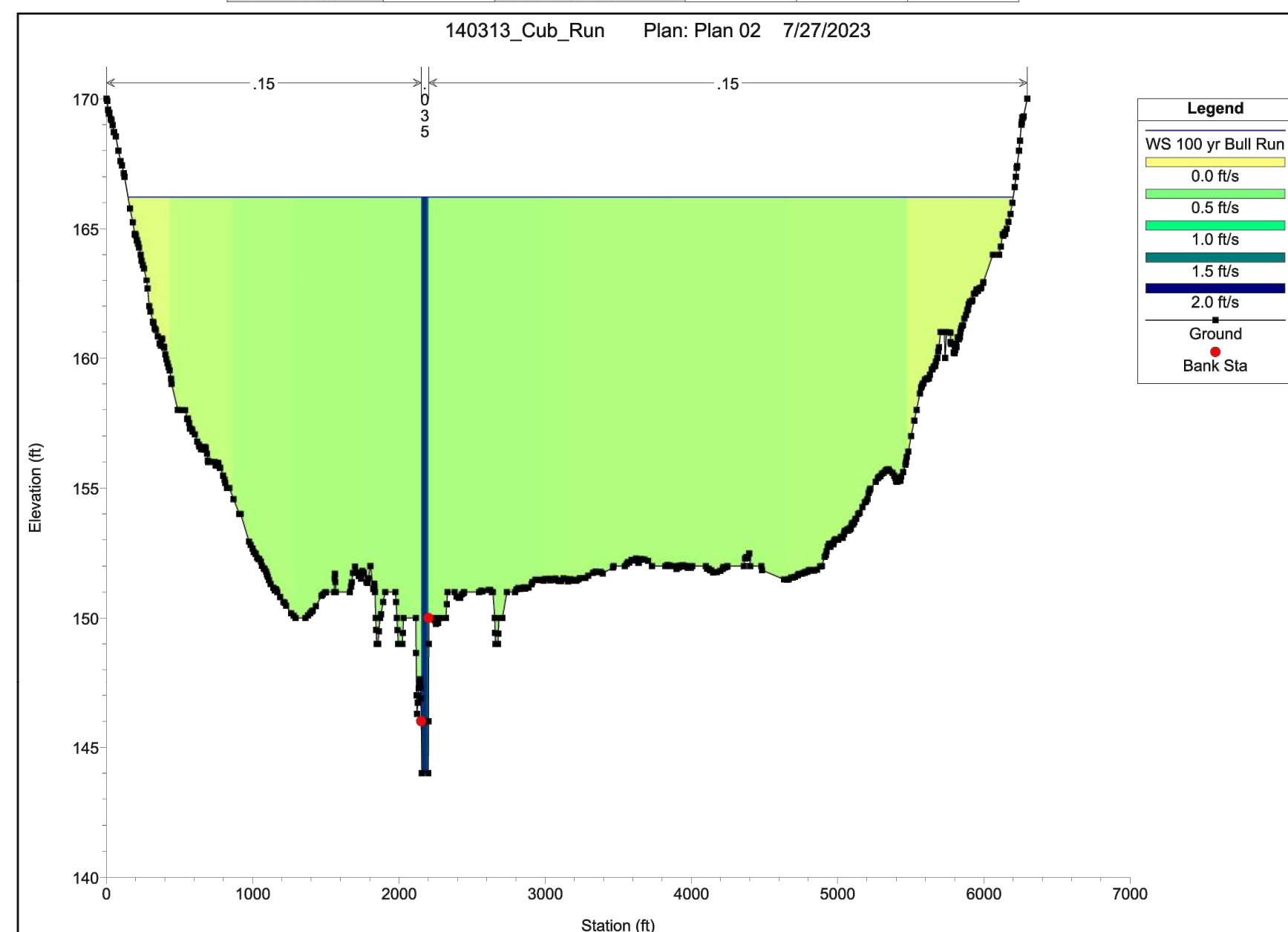
Plan: Plan 02 Cub Run Alignment - Cub RS: 930.96 Profile: 100 yr Bull Run					
E.G. Elev (ft)	166.23	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	166.22	Reach Len. (ft)	150.80	150.80	150.80
Crit W.S. (ft)	154.03	Flow Area (sq ft)	21247.76	1186.18	49689.29
E.G. Slope (ft/ft)	0.000030	Area (sq ft)	21247.76	1186.18	49689.29
Q Total (cfs)	23600.00	Flow (cfs)	6122.75	2096.61	15380.63
Top Width (ft)	5483.74	Top Width (ft)	1750.89	54.66	3678.19
Vel Total (ft/s)	0.33	Avg. Vel. (ft/s)	0.29	1.77	0.31
Max Chl Dpth (ft)	22.22	Hydr. Depth (ft)	12.14	21.70	13.51
Conv. Total (cfs)	4283421.0	Conv. (cfs)	1111285.0	380537.0	2791599.0
Length Wtd. (ft)	150.80	Wetted Per. (ft)	1751.46	57.11	3679.03
Min Ch El (ft)	144.00	Shear (lb/sq ft)	0.02	0.04	0.03
Alpha	3.38	Stream Power (lb/ft s)	0.01	0.07	0.01
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	548.83	28.38	1088.16
C & E Loss (ft)	0.00	Cum SA (acres)	43.90	1.28	85.49



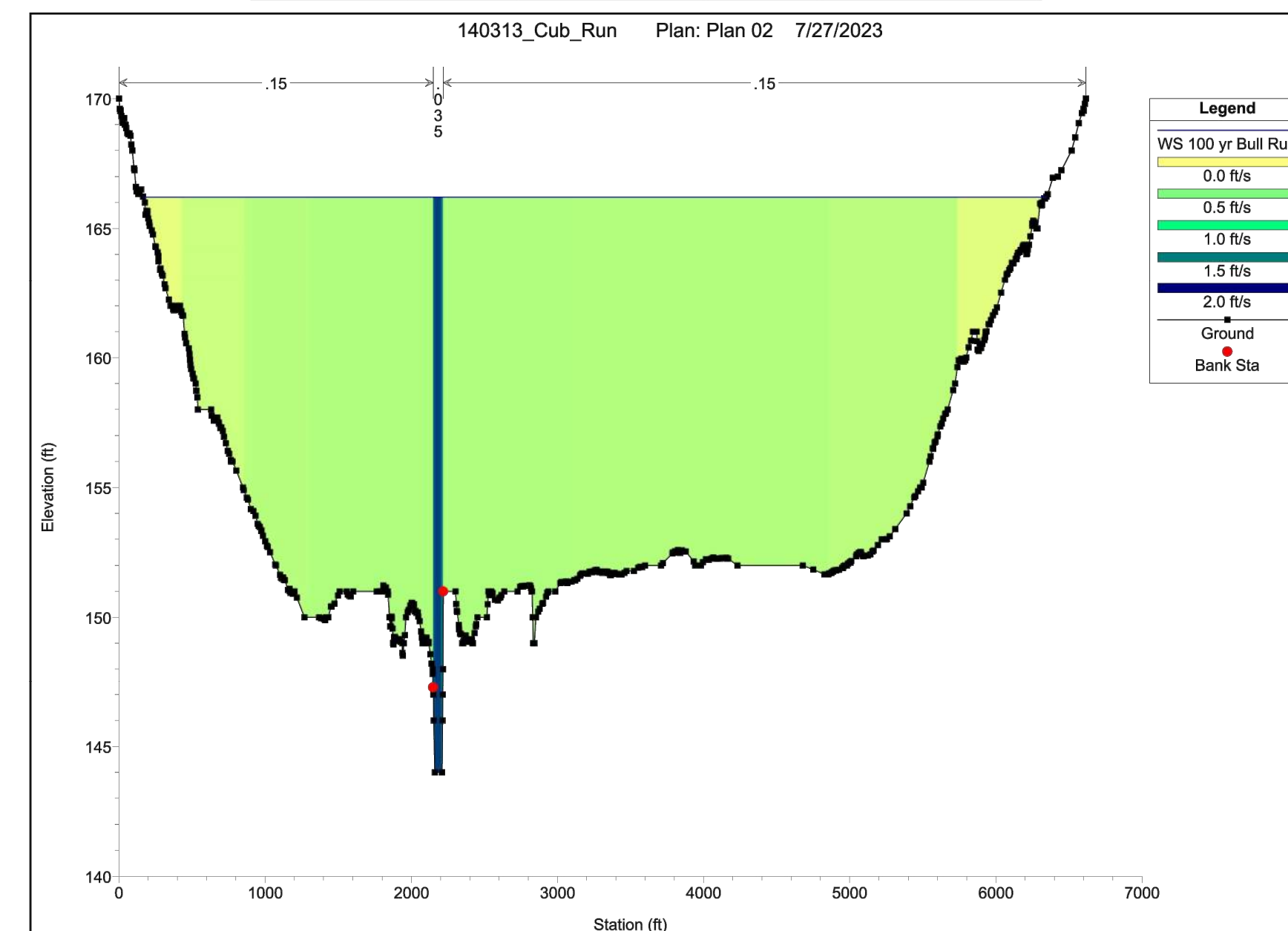
Plan: Plan 02 Cub Run Alignment - Cub RS: 780.16 Profile: 100 yr Bull Run					
E.G. Elev (ft)	166.23	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	166.22	Reach Len. (ft)	150.00	150.00	150.00
Crit W.S. (ft)	154.03	Flow Area (sq ft)	23970.23	1318.89	49435.79
E.G. Slope (ft/ft)	0.000029	Area (sq ft)	23970.23	1318.89	49435.79
Q Total (cfs)	23600.00	Flow (cfs)	6771.46	2255.78	14572.76
Top Width (ft)	5873.94	Top Width (ft)	1980.34	61.15	3832.45
Vel Total (ft/s)	0.32	Avg. Vel. (ft/s)	0.28	1.71	0.29
Max Chl Dpth (ft)	22.22	Hydr. Depth (ft)	12.10	21.57	12.90
Conv. Total (cfs)	4361243.0	Conv. (cfs)	1251355.0	416865.4	2693023.0
Length Wtd. (ft)	150.00	Wetted Per. (ft)	1981.37	64.93	3833.54
Min Ch El (ft)	144.00	Shear (lb/sq ft)	0.02	0.04	0.02
Alpha	3.57	Stream Power (lb/ft s)	0.01	0.06	0.01
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	470.56	24.04	916.58
C & E Loss (ft)	0.00	Cum SA (acres)	37.44	1.08	72.49



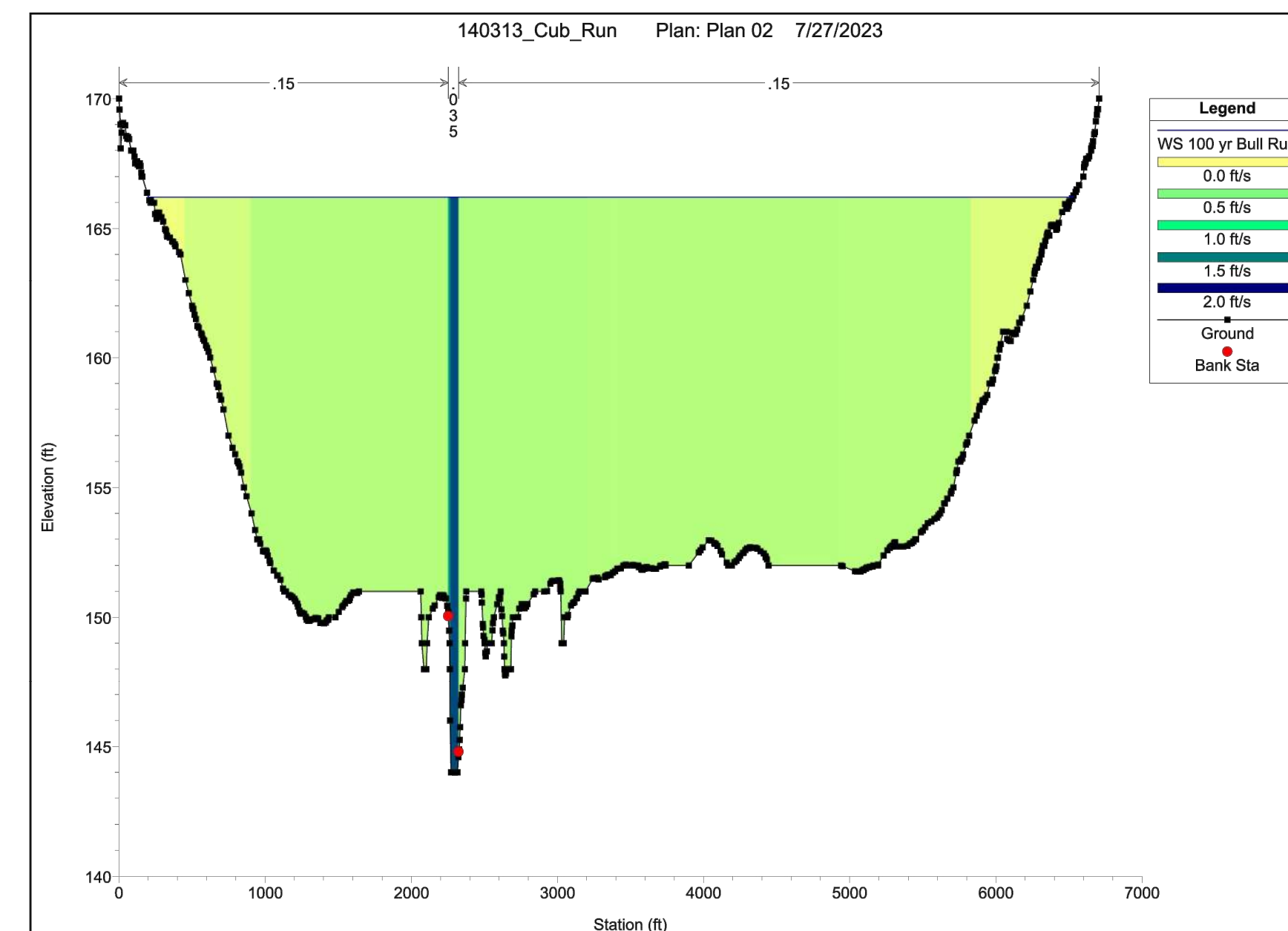
Plan: Plan 02 Cub Run Alignment - Cub RS: 630.16 Profile: 100 yr Bull Run					
E.G. Elev (ft)	166.22	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	166.22	Reach Len. (ft)	149.98	149.98	149.98
Crit W.S. (ft)	154.03	Flow Area (sq ft)	24732.14	1119.00	49900.65
E.G. Slope (ft/ft)	0.000030	Area (sq ft)	24732.14	1119.00	49900.65
Q Total (cfs)	23600.00	Flow (cfs)	7136.88	1938.03	14525.09
Top Width (ft)	6053.51	Top Width (ft)	2005.33	51.01	3997.17
Vel Total (ft/s)	0.31	Avg. Vel. (ft/s)	0.29	1.73	0.29
Max Chl Dpth (ft)	22.22	Hydr. Depth (ft)	12.33	21.94	12.48
Conv. Total (cfs)	4321629.0	Conv. (cfs)	1306904.0	354891.5	2659834.0
Length Wtd. (ft)	149.98	Wetted Per. (ft)	2007.45	54.81	3997.98
Min Ch El (ft)	144.00	Shear (lb/sq ft)	0.02	0.04	0.02
Alpha	3.33	Stream Power (lb/ft s)	0.01	0.07	0.01
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	386.71	19.84	745.55
C & E Loss (ft)	0.00	Cum SA (acres)	30.58	0.89	59.01



Plan: Plan 02 Cub Run Alignment - Cub RS: 480.18 Profile: 100 yr Bull Run					
E.G. Elev (ft)	166.22	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	166.21	Reach Len. (ft)	145.09	145.09	145.09
Crit W.S. (ft)	154.03	Flow Area (sq ft)	24175.12	1457.48	51595.13
E.G. Slope (ft/ft)	0.000028	Area (sq ft)	24175.12	1457.48	51595.13
Q Total (cfs)	23600.00	Flow (cfs)	6666.80	2445.07	14488.13
Top Width (ft)	6179.44	Top Width (ft)	1986.01	67.35	4126.09
Vel Total (ft/s)	0.31	Avg. Vel. (ft/s)	0.28	1.68	0.28
Max Chl Dpth (ft)	22.21	Hydr. Depth (ft)	12.17	21.64	12.50
Conv. Total (cfs)	4484789.0	Conv. (cfs)	1266915.0	464645.6	2753228.0
Length Wtd. (ft)	145.09	Wetted Per. (ft)	1986.81	70.83	4126.81
Min Ch El (ft)	144.00	Shear (lb/sq ft)	0.02	0.04	0.02
Alpha	3.87	Stream Power (lb/ft s)	0.01	0.06	0.01
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	302.51	15.41	570.82
C & E Loss (ft)	0.00	Cum SA (acres)	23.71	0.69	45.03



Plan: Plan 02 Cub Run Alignment - Cub RS: 335.09 Profile: 100 yr Bull Run					
E.G. Elev (ft)	166.21	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	166.21	Reach Len. (ft)	154.79	154.79	154.79
Crit W.S. (ft)	154.03	Flow Area (sq ft)	24492.06	1511.31	53060.45
E.G. Slope (ft/ft)	0.000026	Area (sq ft)	24492.06	1511.31	53060.45
Q Total (cfs)	23600.00	Flow (cfs)	6499.75	2486.74	14613.50
Top Width (ft)	6326.60	Top Width (ft)	2051.71	71.27	4203.62
Vel Total (ft/s)	0.30	Avg. Vel. (ft/s)	0.27	1.65	0.28
Max Chl Dpth (ft)	22.22	Hydr. Depth (ft)	11.94	21.21	12.62
Conv. Total (cfs)	4600325.0	Conv. (cfs)	1266990.0	484738.4	2848596.0
Length Wtd. (ft)	154.79	Wetted Per. (ft)	2052.39	72.78	4205.69
Min Ch El (ft)	143.99	Shear (lb/sq ft)	0.02	0.03	0.02
Alpha	3.95	Stream Power (lb/ft s)	0.01	0.06	0.01
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	221.46	10.48	396.53
C & E Loss (ft)	0.00	Cum SA (acres)	16.98	0.46	31.16



Bowman Consulting Group, Ltd.
1045 Sunrise Valley Drive
Suite 500
Hemlock, Virginia 20771
Phone: (703) 464-1000
Fax: (703) 461-9720
www.bowmanconsulting.com

NORTHERN VIRGINIA
REGIONAL PARKS
5400 Ox Road
Farrax Station
Virginia 22639

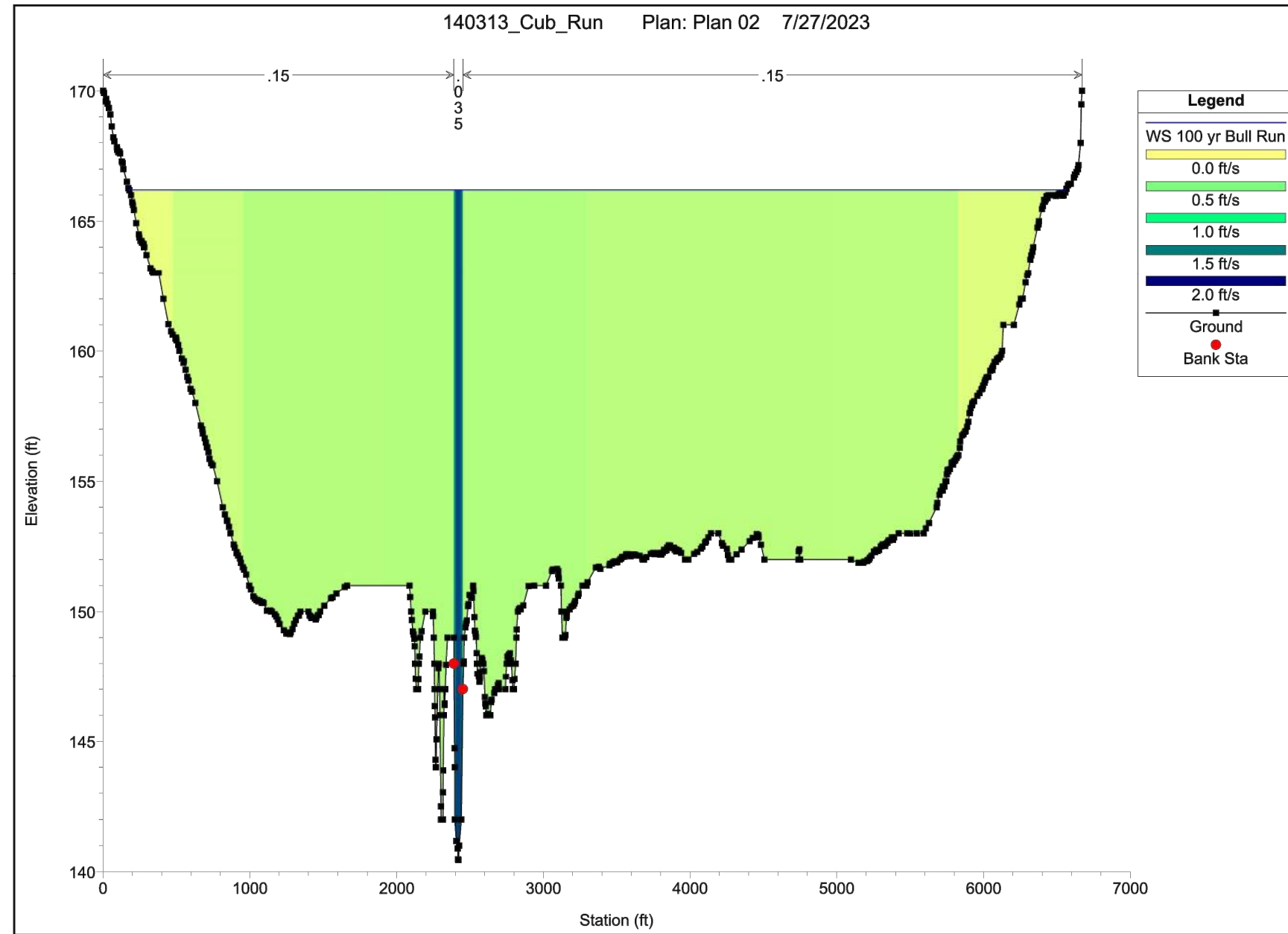


RAS 100 YEAR CROSS SECTIONS (WITH
BULL RUN BACKWATER EFFECT)
BULL RUN REGIONAL PARK
CUB RUN CREEK
BRIDGE REPLACEMENT
SULLY DISTRICT FAIRFAX COUNTY, VIRGINIA

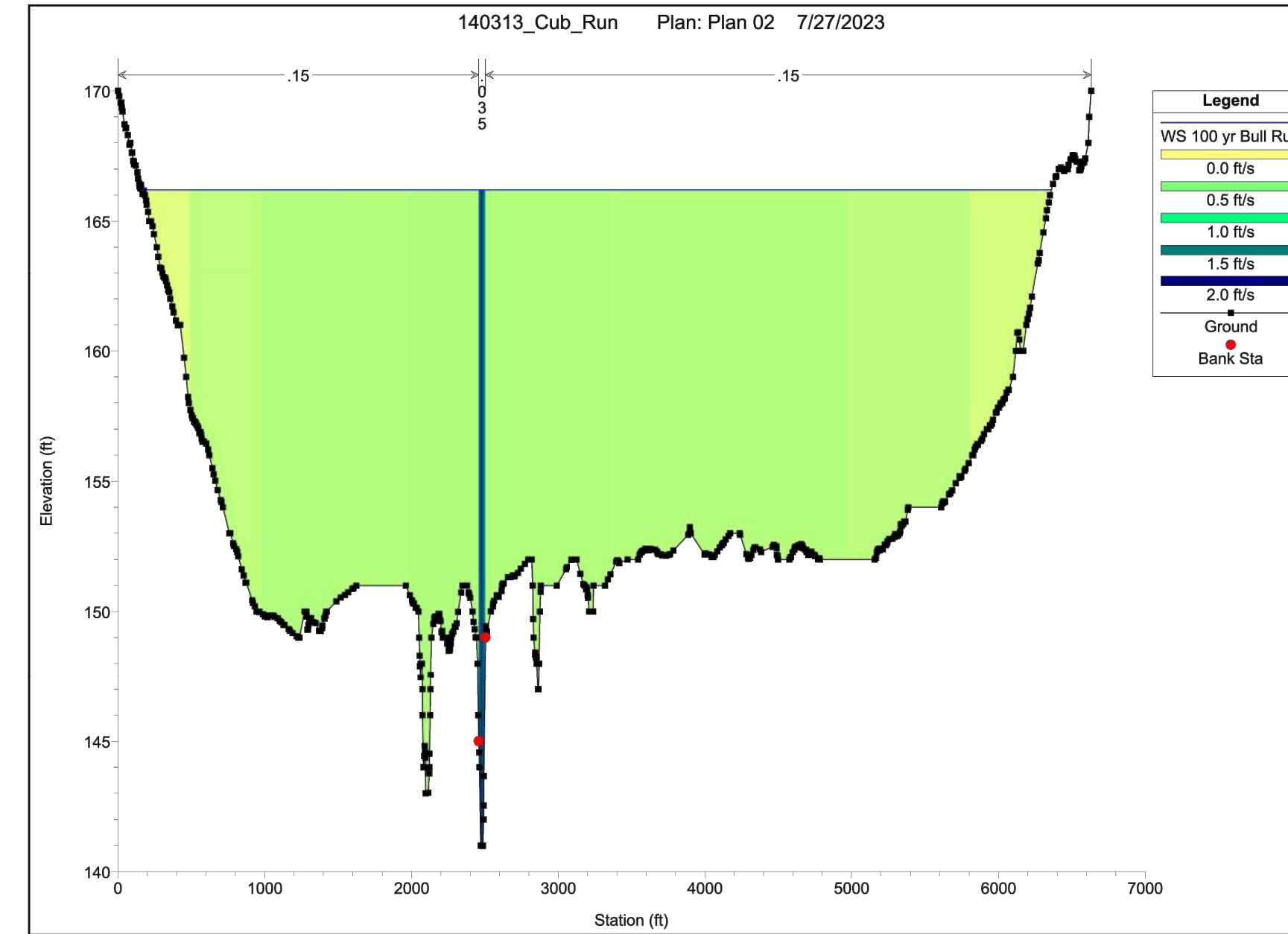
Designed By	Checked By
MT	MT
Date	August, 2023
Scale	
NOVA Project Number	
Map Section	B-2
Sheet	9 of 12
NOVA File Number	
DATE	DESCRIPTION
09/25/23	ALTERNATE BRIDGE CONCEPT

DATE	DESCRIPTION
09/25/23	PLAN STATUS
	ALTERNATE BRIDGE
	CONCEPT

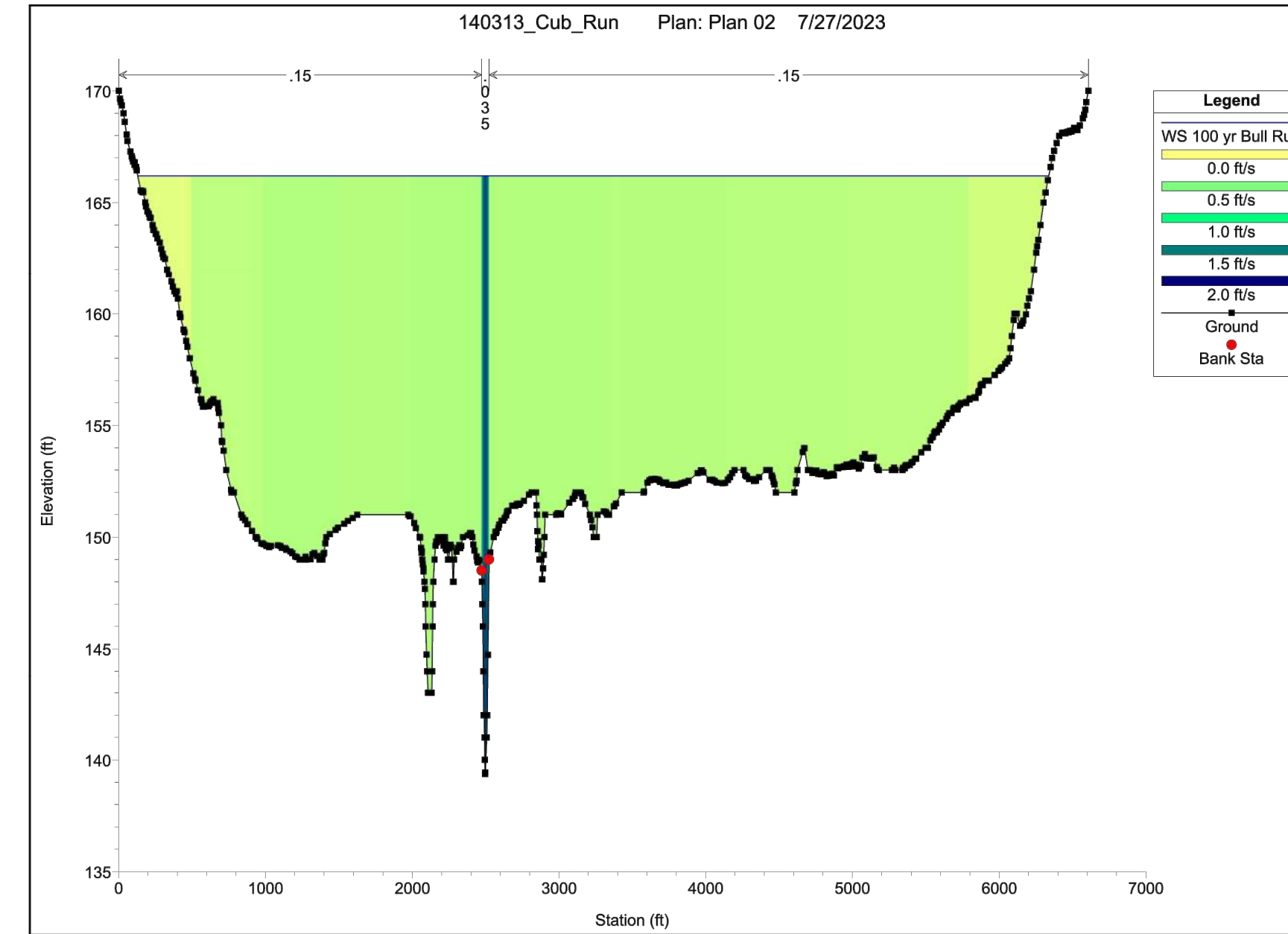
Plan: Plan 02 Cub Run Alignment - Cub RS: 180.3 Profile: 100 yr Bull Run					
E.G. Elev (ft)	166.21	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	166.20	Reach Len. (ft)	150.01	150.01	150.01
Crit W.S. (ft)		Flow Area (sq ft)	28949.31	1482.74	52280.71
E.G. Slope (ft/ft)	0.000023	Area (sq ft)	28949.31	1482.74	52280.71
Q Total (cfs)	23600.00	Flow (cfs)	7833.42	2414.05	13552.53
Top Width (ft)	6385.35	Top Width (ft)	2213.46	62.16	4109.73
Vel Total (ft/s)	0.29	Avg. Vel. (ft/s)	0.26	1.63	0.26
Max Chl Dpth (ft)	25.75	Hydr. Depth (ft)	13.08	23.85	12.72
Conv. Total (cfs)	4913153.0	Conv. (cfs)	1589159.0	502568.1	2821425.0
Length Wtd. (ft)	150.01	Wetted Per. (ft)	2219.22	65.73	4111.57
Min Ch El (ft)	140.45	Shear (lb/sq ft)	0.02	0.03	0.02
Alpha	4.08	Stream Power (lb/ft s)	0.00	0.05	0.00
Frictn Loss (ft)	0.00	Cum Volume (acre-ft)	126.51	5.14	209.36
C & E Loss (ft)	0.00	Cum SA (acres)	9.40	0.22	16.39



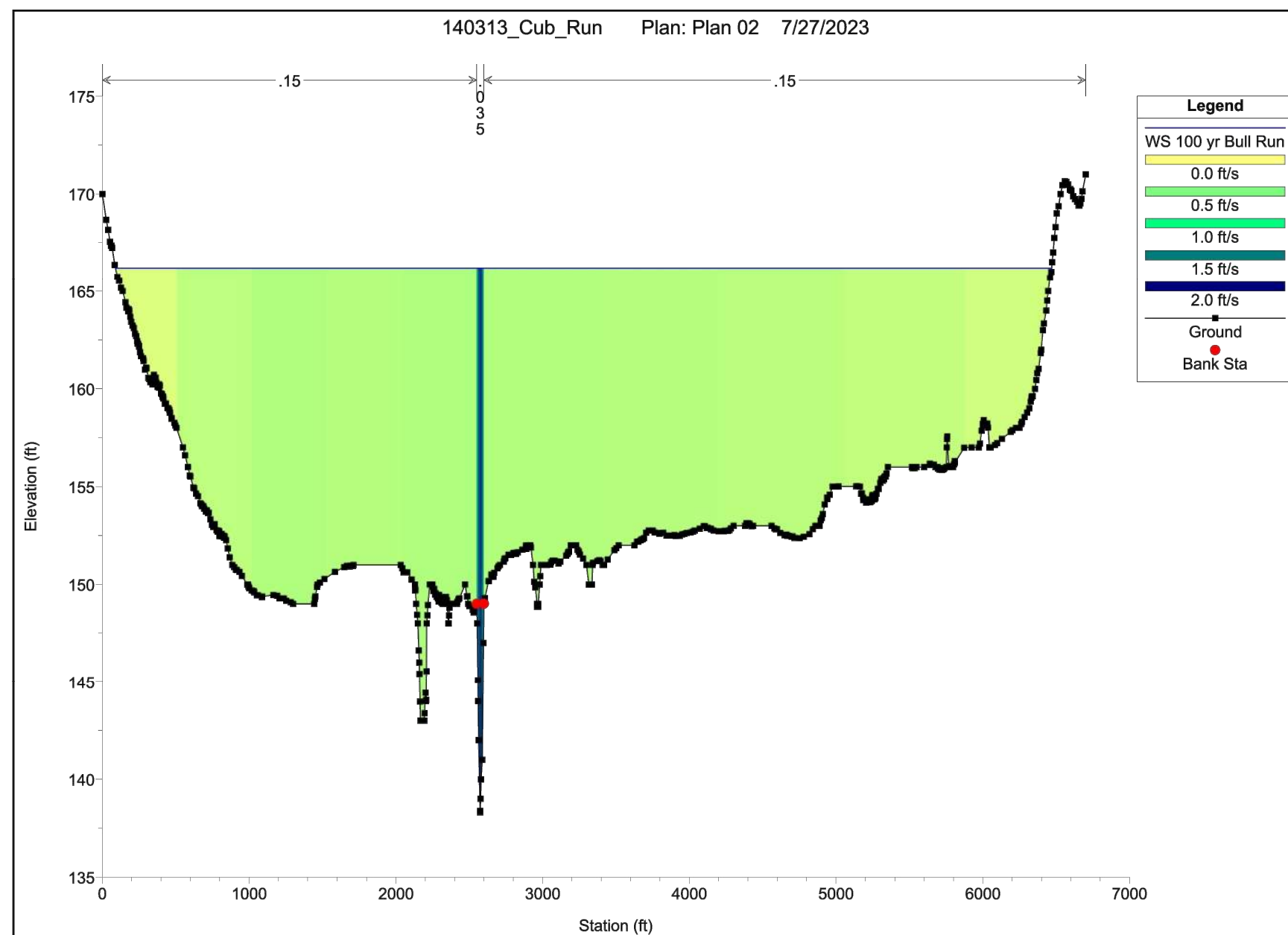
Plan: Plan 02 Cub Run Alignment - Cub RS: 30.29 Profile: 100 yr Bull Run					
E.G. Elev (ft)	166.20	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	166.20	Reach Len. (ft)	19.02	19.02	19.02
Crit W.S. (ft)		Flow Area (sq ft)	31493.00	1053.10	49665.54
E.G. Slope (ft/ft)	0.000024	Area (sq ft)	31493.00	1053.10	49665.54
Q Total (cfs)	23600.00	Flow (cfs)	8706.39	1708.30	13185.31
Top Width (ft)	6200.81	Top Width (ft)	2298.65	45.53	3856.63
Vel Total (ft/s)	0.29	Avg. Vel. (ft/s)	0.28	1.62	0.27
Max Chl Dpth (ft)	25.22	Hydr. Depth (ft)	13.70	23.13	12.88
Conv. Total (cfs)	4836824.0	Conv. (cfs)	1784376.0	350115.8	2702332.0
Length Wtd. (ft)	19.02	Wetted Per. (ft)	2302.30	48.06	3856.21
Min Ch El (ft)	140.98	Shear (lb/sq ft)	0.02	0.03	0.02
Alpha	3.13	Stream Power (lb/ft s)	0.01	0.05	0.01
Frictn Loss (ft)	0.00	Cum Volume (acre-ft)	22.44	0.78	33.82
C & E Loss (ft)	0.00	Cum SA (acres)	1.64	0.03	2.67



Plan: Plan 02 Cub Run Alignment - Cub RS: 11.27 Profile: 100 yr Bull Run					
E.G. Elev (ft)	166.20	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	166.20	Reach Len. (ft)	11.27	11.27	11.27
Crit W.S. (ft)		Flow Area (sq ft)	32155.88	1150.06	48464.48
E.G. Slope (ft/ft)	0.000024	Area (sq ft)	32155.88	1150.06	48464.48
Q Total (cfs)	23600.00	Flow (cfs)	8952.45	1822.57	12824.98
Top Width (ft)	6208.15	Top Width (ft)	2343.29	50.37	3814.50
Vel Total (ft/s)	0.29	Avg. Vel. (ft/s)	0.28	1.58	0.26
Max Chl Dpth (ft)	26.83	Hydr. Depth (ft)	13.72	22.83	12.71
Conv. Total (cfs)	4809354.0	Conv. (cfs)	1824386.0	371414.0	2613554.0
Length Wtd. (ft)	11.27	Wetted Per. (ft)	2346.02	54.82	3815.64
Min Ch El (ft)	139.37	Shear (lb/sq ft)	0.02	0.03	0.02
Alpha	3.14	Stream Power (lb/ft s)	0.01	0.05	0.01
Frictn Loss (ft)	0.00	Cum Volume (acre-ft)	8.54	0.30	12.40
C & E Loss (ft)	0.00	Cum SA (acres)	0.62	0.01	0.99



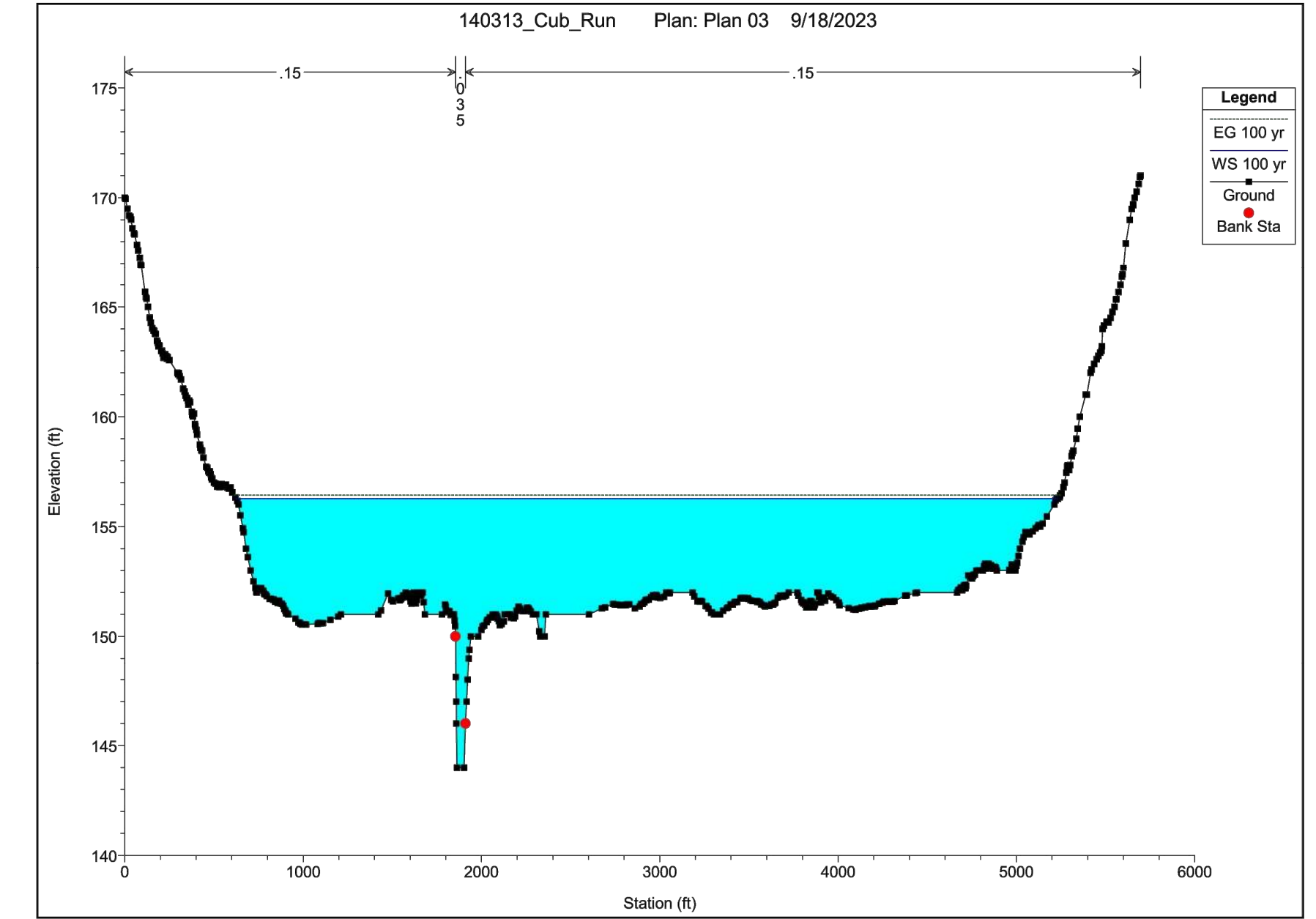
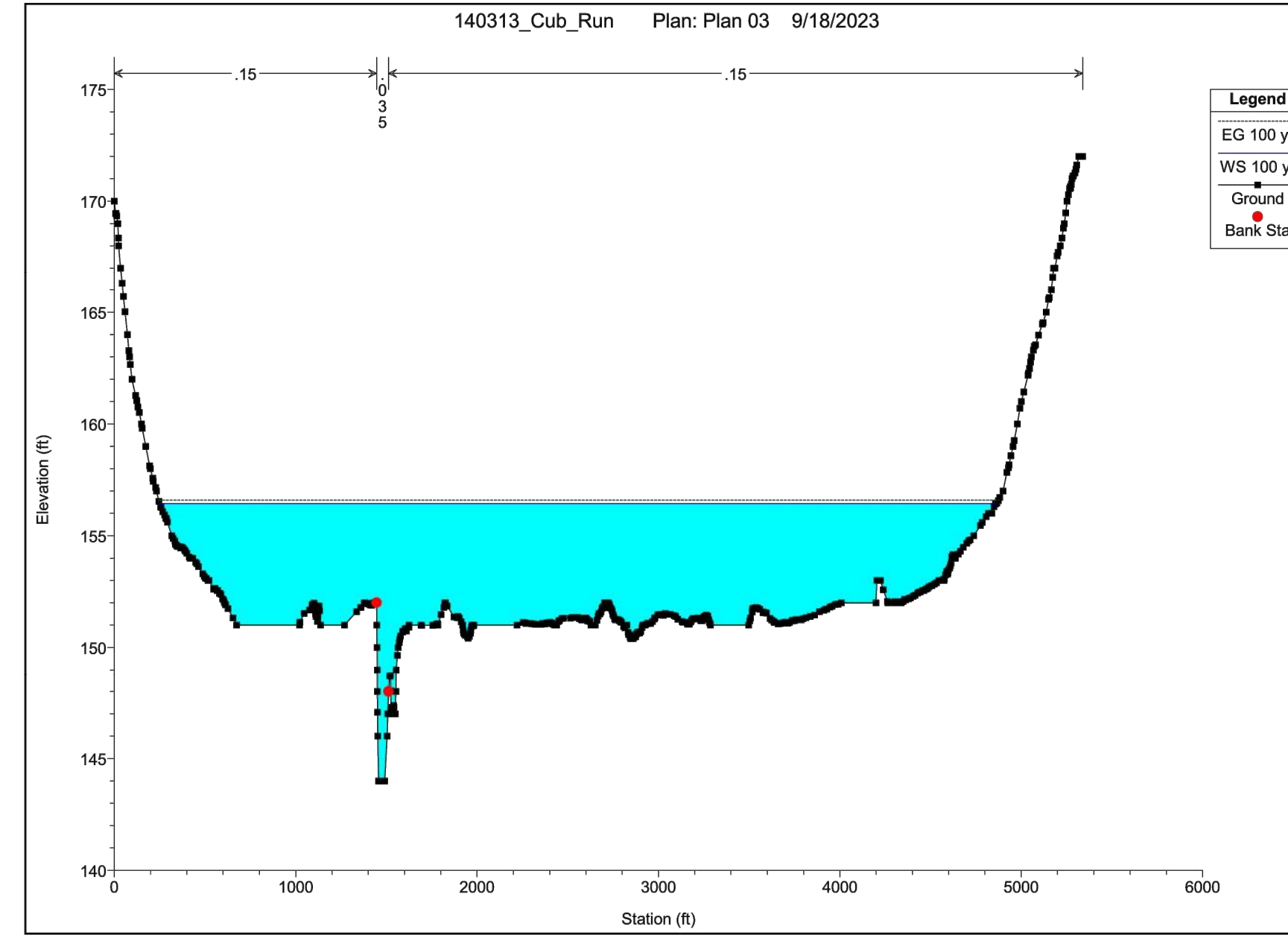
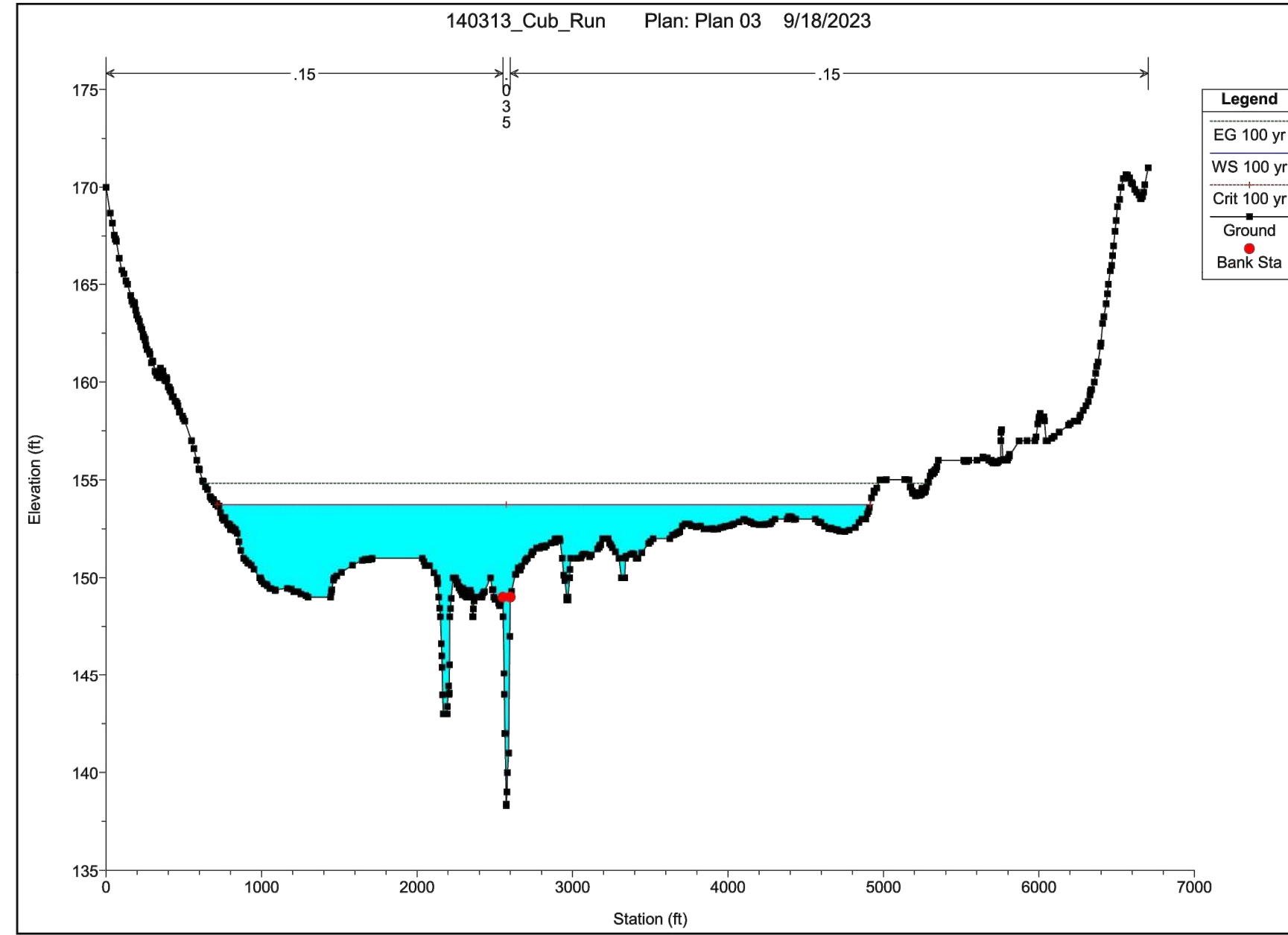
Plan: Plan 02 Cub Run Alignment - Cub RS: 0 Profile: 100 yr Bull Run					
E.G. Elev (ft)	166.20	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	166.20	Reach Len. (ft)			
Crit W.S. (ft)	153.73	Flow Area (sq ft)	33880.32	1140.75	47382.43
E.G. Slope (ft/ft)	0.000024	Area (sq ft)	33880.32	1140.75	47382.43
Q Total (cfs)	23600.00	Flow (cfs)	9489.66	1824.58	12265.76
Top Width (ft)	6380.70	Top Width (ft)	2462.13	48.38	3870.18
Vel Total (ft/s)	0.29	Avg. Vel. (ft/s)	0.28	1.60	0.26
Max Chl Dpth (ft)	27.89	Hydr. Depth (ft)	13.76	23.58	12.24
Conv. Total (cfs)	4788336.0	Conv. (cfs)	1825409.0	370199.9	2492727.0
Length Wtd. (ft)		Wetted Per. (ft)	2465.70	53.98	3871.57
Min Ch El (ft)	138.31	Shear (lb/sq ft)	0.02	0.03	0.02
Alpha	3.22	Stream Power (lb/ft s)	0.01	0.05	0.00
Frictn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			



Plan: Plan 03 Cub Run Alignment - Cub RS: 1080.8 Profile: 100 yr					
E.G. Elev (ft)	156.59	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.15	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	156.45	Reach Len. (ft)	149.84	149.84	149.84
Crit W.S. (ft)		Flow Area (sq ft)	5230.42	741.66	16083.39
E.G. Slope (ft/ft)	0.001002	Area (sq ft)	5230.42	741.66	16083.39
Q Total (cfs)	23600.00	Flow (cfs)	4382.29	4866.81	14350.89
Top Width (ft)	4610.79	Top Width (ft)	1196.94	65.45	3348.40
Vel Total (ft/s)	1.07	Avg. Vel. (ft/s)	0.84	6.56	0.89
Max Chl Dpth (ft)	12.45	Hydr. Depth (ft)	4.37	11.33	4.80
Conv. Total (cfs)	745716.8	Conv. (cfs)	138472.4	153782.4	453462.0
Length Wtd. (ft)	149.84	Wetted Per. (ft)	1197.16	68.71	3349.57
Min Ch El (ft)	144.00	Shear (lb/sq ft)	0.27	0.67	0.30
Alpha	8.29	Stream Power (lb/ft s)	0.23	4.43	0.27
Frctn Loss (ft)	0.16	Cum Volume (acre-ft)	158.22	16.95	305.19
C & E Loss (ft)	0.00	Cum SA (acres)	35.32	1.49	81.46

Plan: Plan 03 Cub Run Alignment - Cub RS: 930.96 Profile: 100 yr					
E.G. Elev (ft)	156.43	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.16	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	156.27	Reach Len. (ft)	150.80	150.80	150.80
Crit W.S. (ft)		Flow Area (sq ft)	5905.15	641.89	14856.09
E.G. Slope (ft/ft)	0.001126	Area (sq ft)	5905.15	641.89	14856.09
Q Total (cfs)	23600.00	Flow (cfs)	5585.07	4588.85	13426.07
Top Width (ft)	4600.36	Top Width (ft)	1230.13	54.66	3315.57
Vel Total (ft/s)	1.10	Avg. Vel. (ft/s)	0.95	7.15	0.90
Max Chl Dpth (ft)	12.27	Hydr. Depth (ft)	4.80	11.74	4.48
Conv. Total (cfs)	703268.8	Conv. (cfs)	166432.3	136745.9	400090.5
Length Wtd. (ft)	150.80	Wetted Per. (ft)	1230.49	57.11	3316.17
Min Ch El (ft)	144.00	Shear (lb/sq ft)	0.34	0.79	0.31
Alpha	8.73	Stream Power (lb/ft s)	0.32	5.65	0.28
Frctn Loss (ft)	0.16	Cum Volume (acre-ft)	139.06	14.57	251.97
C & E Loss (ft)	0.00	Cum SA (acres)	31.15	1.28	70.00

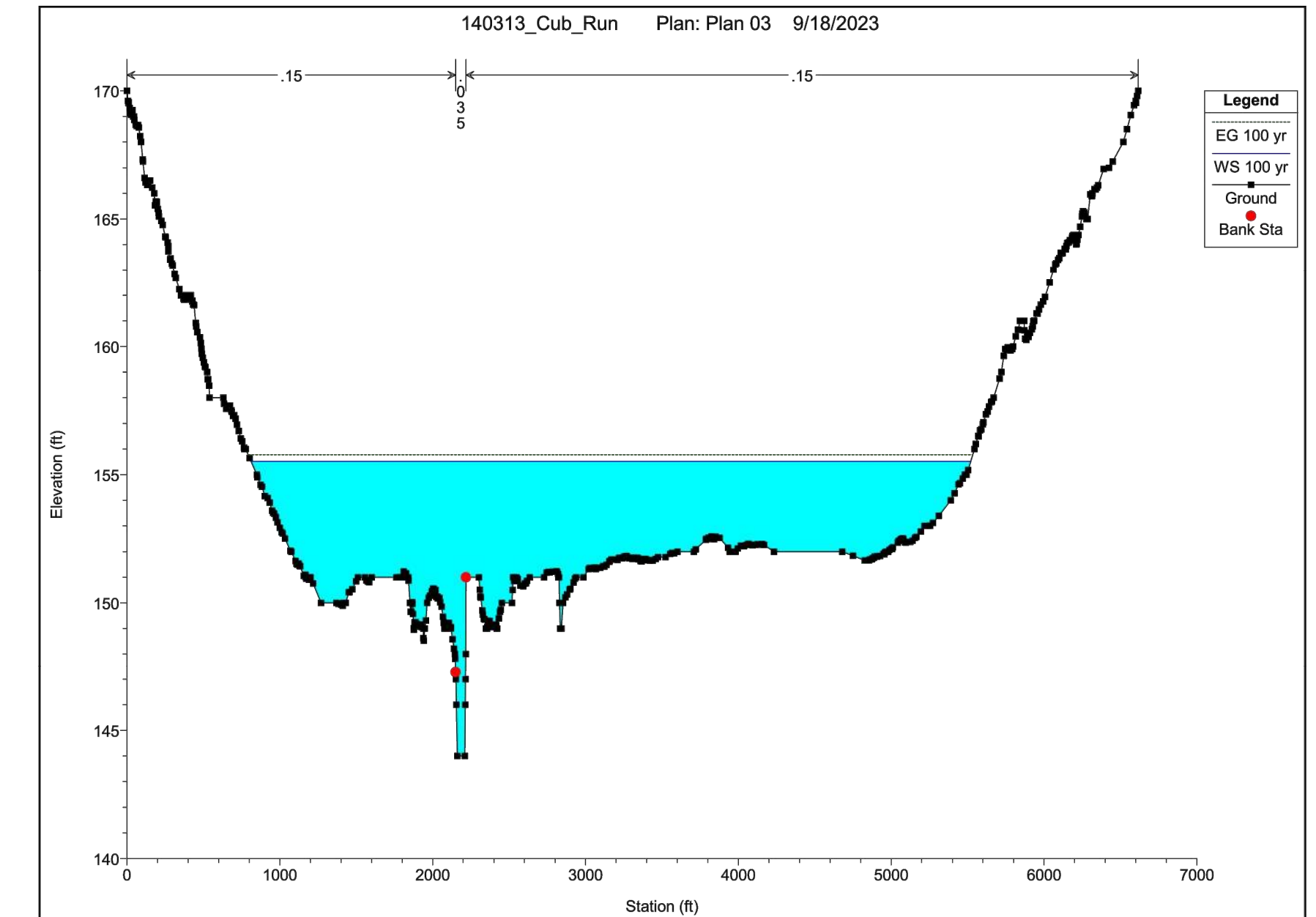
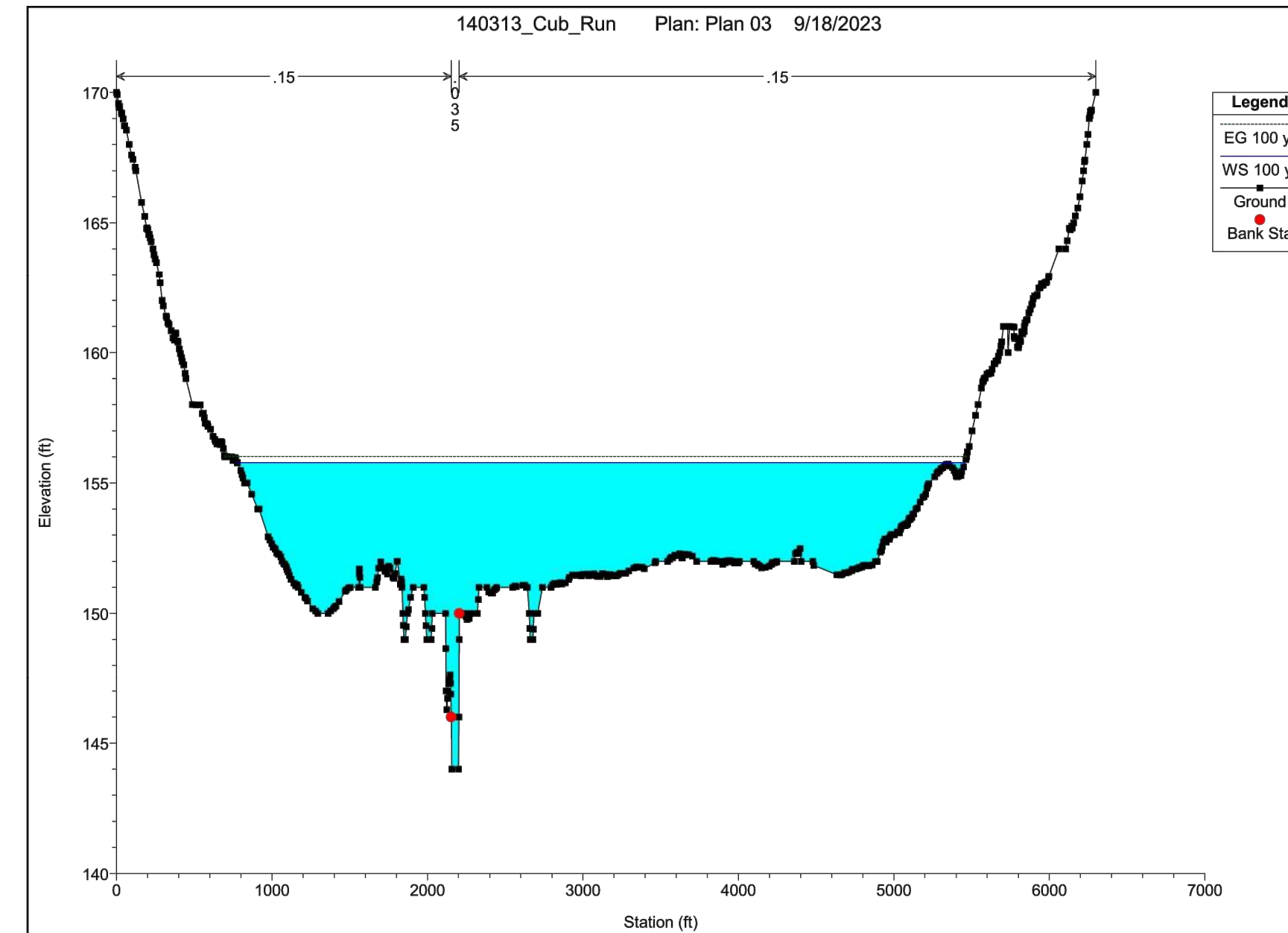
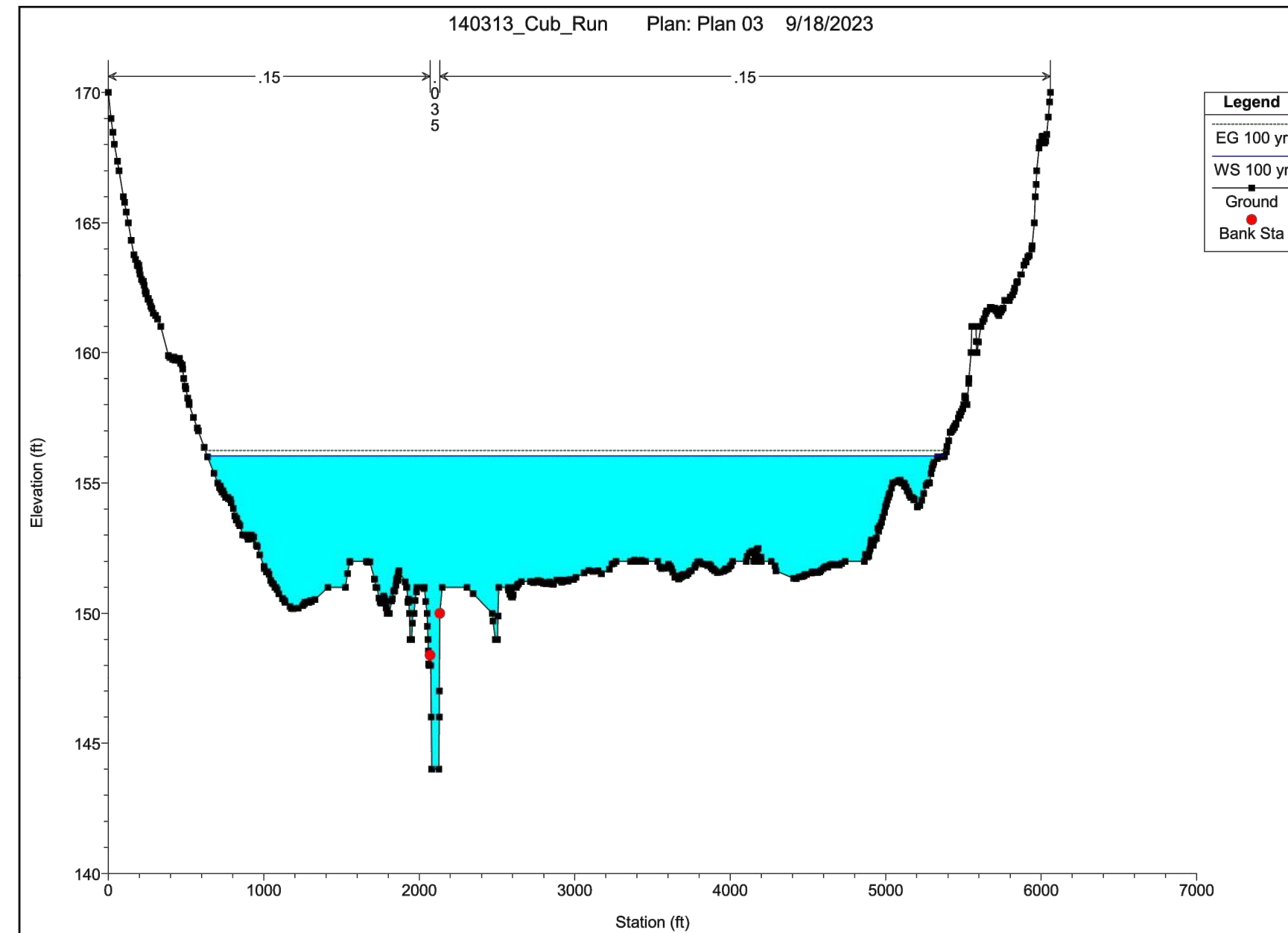
Plan: Plan 03 Cub Run Alignment - Cub RS: 780.16 Profile: 100 yr					
E.G. Elev (ft)	156.24	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	156.03	Reach Len. (ft)	150.00	150.00	150.00
Crit W.S. (ft)		Flow Area (sq ft)	6314.67	696.04	13196.92
E.G. Slope (ft/ft)	0.001341	Area (sq ft)	6314.67	696.04	13196.92
Q Total (cfs)	23600.00	Flow (cfs)	6149.00	5260.67	12190.33
Top Width (ft)	4742.86	Top Width (ft)	1434.72	61.15	3246.78
Vel Total (ft/s)	1.17	Avg. Vel. (ft/s)	0.97	7.56	0.92
Max Chl Dpth (ft)	12.03	Hydr. Depth (ft)	4.40	11.38	4.06
Conv. Total (cfs)	644523.3	Conv. (cfs)	167931.0	143670.6	332921.7
Length Wtd. (ft)	150.00	Wetted Per. (ft)	1435.61	64.93	3247.32
Min Ch El (ft)	144.00	Shear (lb/sq ft)	0.37	0.90	0.34
Alpha	9.84	Stream Power (lb/ft s)	0.36	6.78	0.31
Frctn Loss (ft)	0.22	Cum Volume (acre-ft)	117.91	12.26	203.41
C & E Loss (ft)	0.00	Cum SA (acres)	26.53	1.08	58.64



Plan: Plan 03 Cub Run Alignment - Cub RS: 630.16 Profile: 100 yr					
E.G. Elev (ft)	156.02	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.24	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	155.78	Reach Len. (ft)	149.98	149.98	149.98
Crit W.S. (ft)		Flow Area (sq ft)	6198.03	586.73	12280.84
E.G. Slope (ft/ft)	0.001638	Area (sq ft)	6198.03	586.73	12280.84
Q Total (cfs)	23600.00	Flow (cfs)	6764.43	4897.46	11938.11
Top Width (ft)	4682.02	Top Width (ft)	1378.24	51.01	3252.77
Vel Total (ft/s)	1.24	Avg. Vel. (ft/s)	1.09	8.35	0.97
Max Chl Dpth (ft)	11.78	Hydr. Depth (ft)	4.50	11.50	3.78
Conv. Total (cfs)	583061.4	Conv. (cfs)	167122.0	120996.6	294942.9
Length Wtd. (ft)	149.98	Wetted Per. (ft)	1380.19	54.81	3253.14
Min Ch El (ft)	144.00	Shear (lb/sq ft)	0.46	1.09	0.39
Alpha	9.97	Stream Power (lb/ft s)	0.50	9.14	0.38
Frctn Loss (ft)	0.24	Cum Volume (acre-ft)	96.37	10.05	159.55
C & E Loss (ft)	0.00	Cum SA (acres)	21.89	0.89	47.45

Plan: Plan 03 Cub Run Alignment - Cub RS: 480.18 Profile: 100 yr					
E.G. Elev (ft)	155.78	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	155.52	Reach Len. (ft)	145.09	145.09	145.09
Crit W.S. (ft)		Flow Area (sq ft)	5997.05	737.63	12224.81
E.G. Slope (ft/ft)	0.001545	Area (sq ft)	5997.05	737.63	12224.81
Q Total (cfs)	23600.00	Flow (cfs)	6341.31	5869.91	11388.78
Top Width (ft)	4709.44	Top Width (ft)	1338.47	67.35	3302.62
Vel Total (ft/s)	1.24	Avg. Vel. (ft/s)	1.06	7.96	0.93
Max Chl Dpth (ft)	11.52	Hydr. Depth (ft)	4.48	10.95	3.70
Conv. Total (cfs)	600425.0	Conv. (cfs)	161334.0	149340.6	289750.3
Length Wtd. (ft)	145.09	Wetted Per. (ft)	1340.02	70.83	3303.13
Min Ch El (ft)	144.00	Shear (lb/sq ft)	0.43	1.00	0.36
Alpha	10.63	Stream Power (lb/ft s)	0.46	7.99	0.33
Frctn Loss (ft)	0.23	Cum Volume (acre-ft)	75.37	7.77	117.36
C & E Loss (ft)	0.00	Cum SA (acres)	17.01	0.69	36.16

Plan: Plan 03 Cub Run Alignment - Cub RS: 335.09 Profile: 100 yr					
E.G. Elev (ft)	155.54	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.27	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	155.27	Reach Len. (ft)	154.79	154.79	154.79
Crit W.S. (ft)		Flow Area (sq ft)	6026.28	731.98	11881.80
E.G. Slope (ft/ft)	0.001694	Area (sq ft)	6026.28	731.98	11881.80
Q Total (cfs)	23600.00	Flow (cfs)	6476.72	5859.03	11164.25
Top Width (ft)	4872.67	Top Width (ft)	1407.41	71.27	3394.00
Vel Total (ft/s)	1.27	Avg. Vel. (ft/s)	1.07	8.14	0.94
Max Chl Dpth (ft)	11.28	Hydr. Depth (ft)	4.28	10.27	3.50
Conv. Total (cfs)	573437.8	Conv. (cfs)	157372.8	144793.8	271271.2
Length Wtd. (ft)	154.79	Wetted Per. (ft)	1407.94	72.78	3395.91
Min Ch El (ft)	143.99	Shear (lb/sq ft)	0.45	1.06	0.37
Alpha	10.90	Stream Power (lb/ft s)	0.49	8.66	0.35
Frctn Loss (ft)	0.24	Cum Volume (acre-ft)	55.35	5.32	77.21
C & E Loss (ft)	0.00	Cum SA (acres)	12.44	0.46	25.01



Bowman

Bowman Consulting Group, Ltd.
1245 Sunrise Valley Drive
Suite 500
Herndon, Virginia 20171
Phone: (703) 464-1000
Fax: (703) 461-9720
www.bowmanconsulting.com

NORTHERN VIRGINIA
REGIONAL PARKS

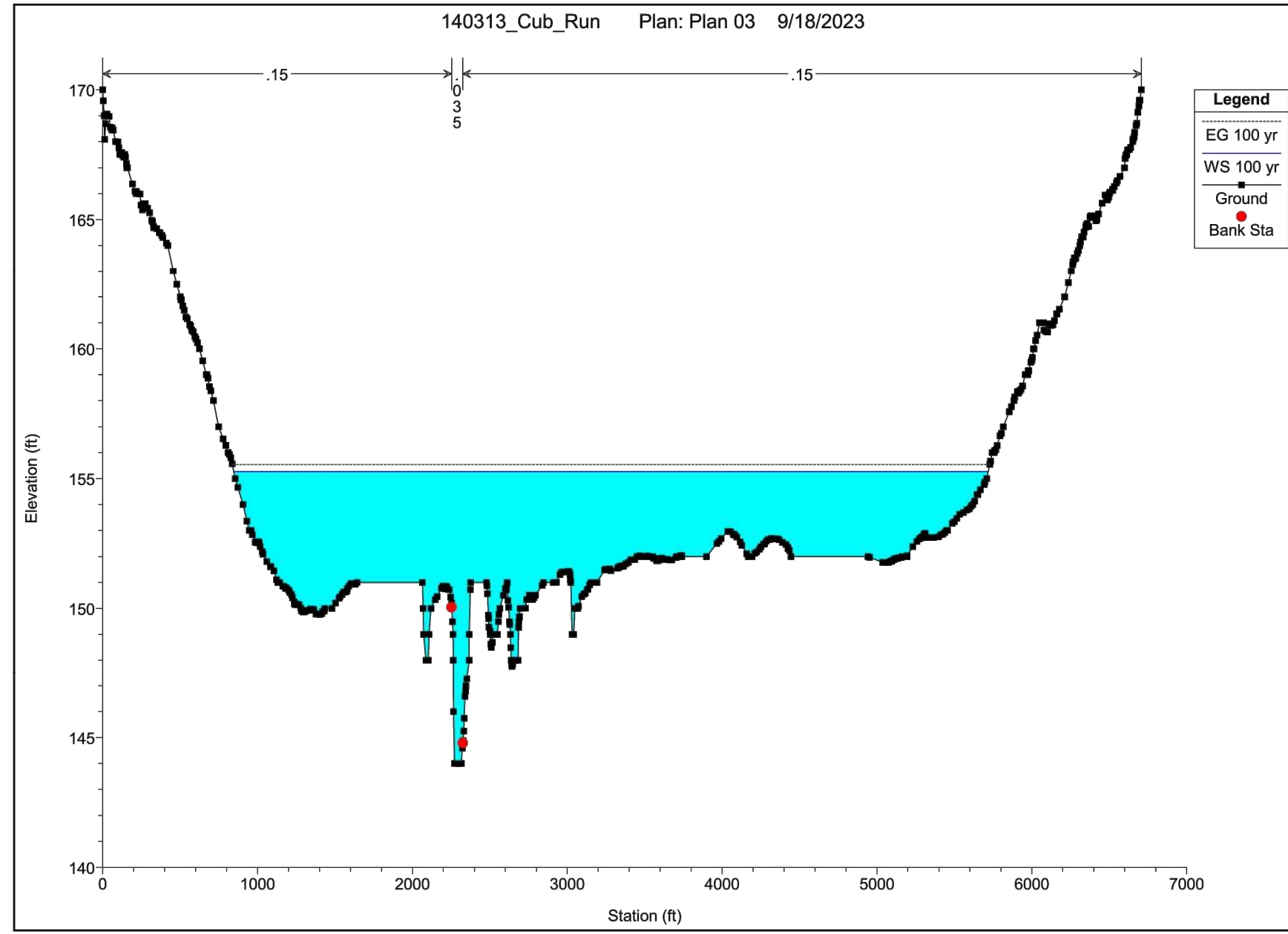
5400 Ox Road
Farrax Station
Virginia 22659

RAS 100 YEAR CROSS SECTIONS
(WITHOUT BULL RUN BACKWATER EFFECT)
BULL RUN REGIONAL PARK
CUB RUN CREEK
BRIDGE REPLACEMENT
SULLY DISTRICT FAIRFAX COUNTY, VIRGINIA

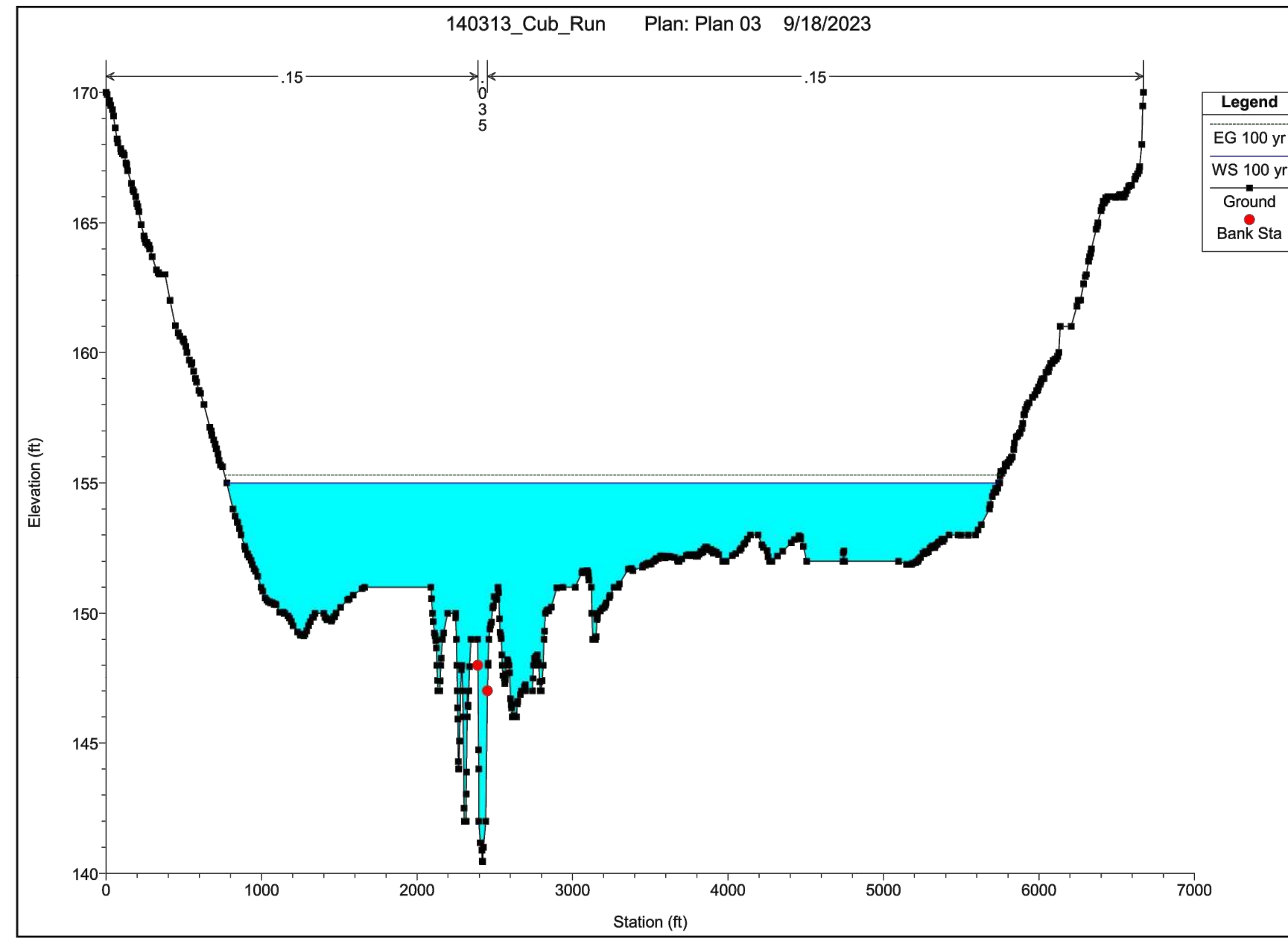
Designed By	Checked By
MT	MT
Date	August, 2023
Scale	
NOVA Project Number	
Map Section	B-2
Sheet	11 of 12
NOVA File Number	

DATE	DESCRIPTION
09/25/23	ALTERNATE BRIDGE CONCEPT

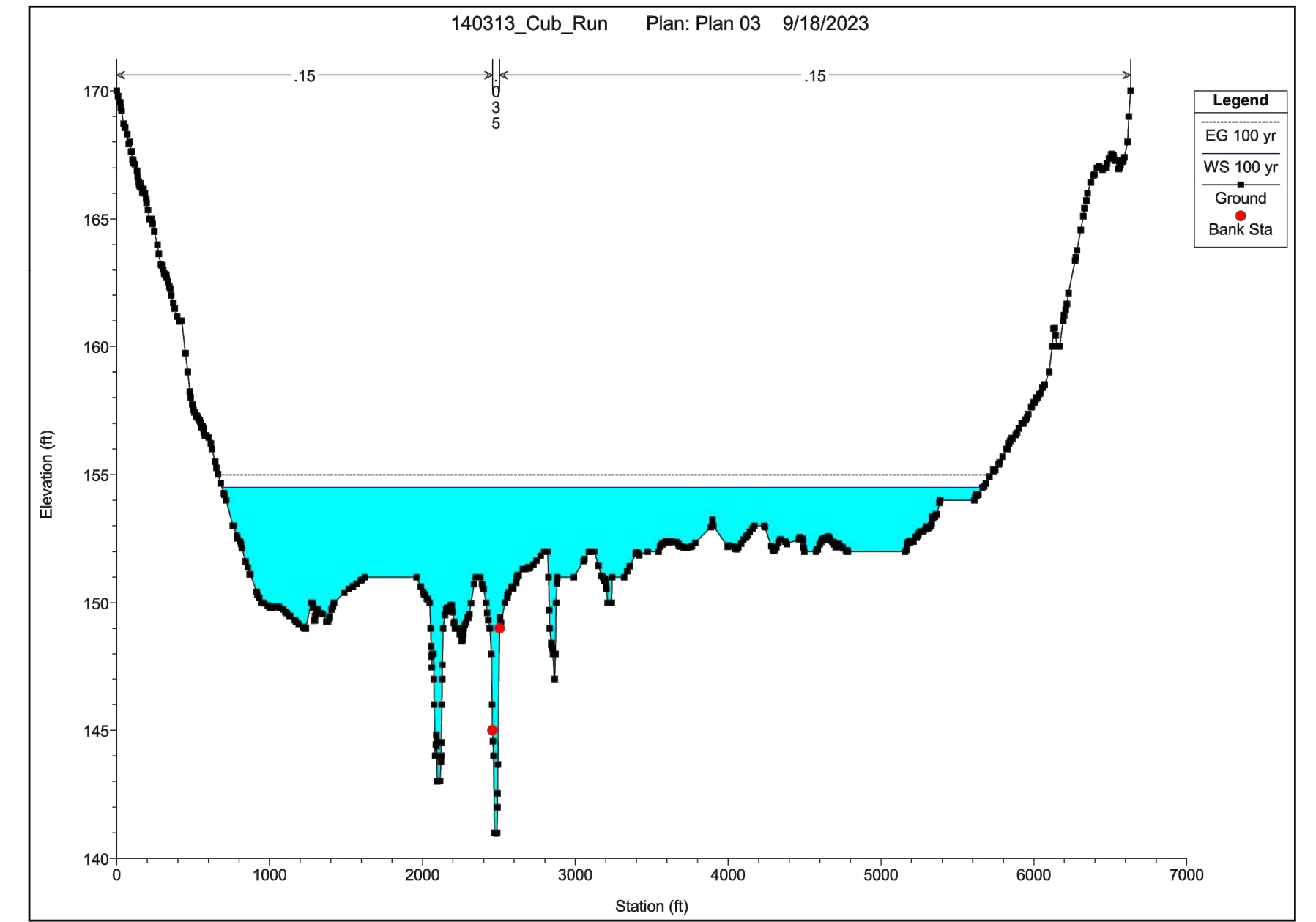
Plan: Plan 03 Cub Run Alignment - Cub RS: 180.3 Profile: 100 yr					
E.G. Elev (ft)	155.30	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.31	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	154.99	Reach Len. (ft)	150.01	150.01	150.01
Crit W.S. (ft)		Flow Area (sq ft)	7507.26	785.72	11087.81
E.G. Slope (ft/ft)	0.001412	Area (sq ft)	7507.26	785.72	11087.81
Q Total (cfs)	23600.00	Flow (cfs)	7767.61	652.75	9279.64
Top Width (ft)	4963.29	Top Width (ft)	1614.18	62.16	3286.95
Vel Total (ft/s)	1.22	Avg. Vel. (ft/s)	1.03	8.34	0.94
Max Chi Dpth (ft)	14.54	Hydr. Depth (ft)	4.65	12.64	3.37
Conv. Total (cfs)	628091.4	Conv. (cfs)	206727.5	174395.2	246968.7
Length Wtd. (ft)	150.01	Wetted Per. (ft)	1619.80	65.73	3288.58
Min Ch El (ft)	140.45	Shear (lb/sq ft)	0.41	1.05	0.30
Alpha	13.45	Stream Power (lb/ft s)	0.42	8.79	0.25
Frctn Loss (ft)	0.29	Cum Volume (acre-ft)	31.30	2.63	36.40
C & E Loss (ft)	0.02	Cum SA (acres)	7.07	0.22	13.14



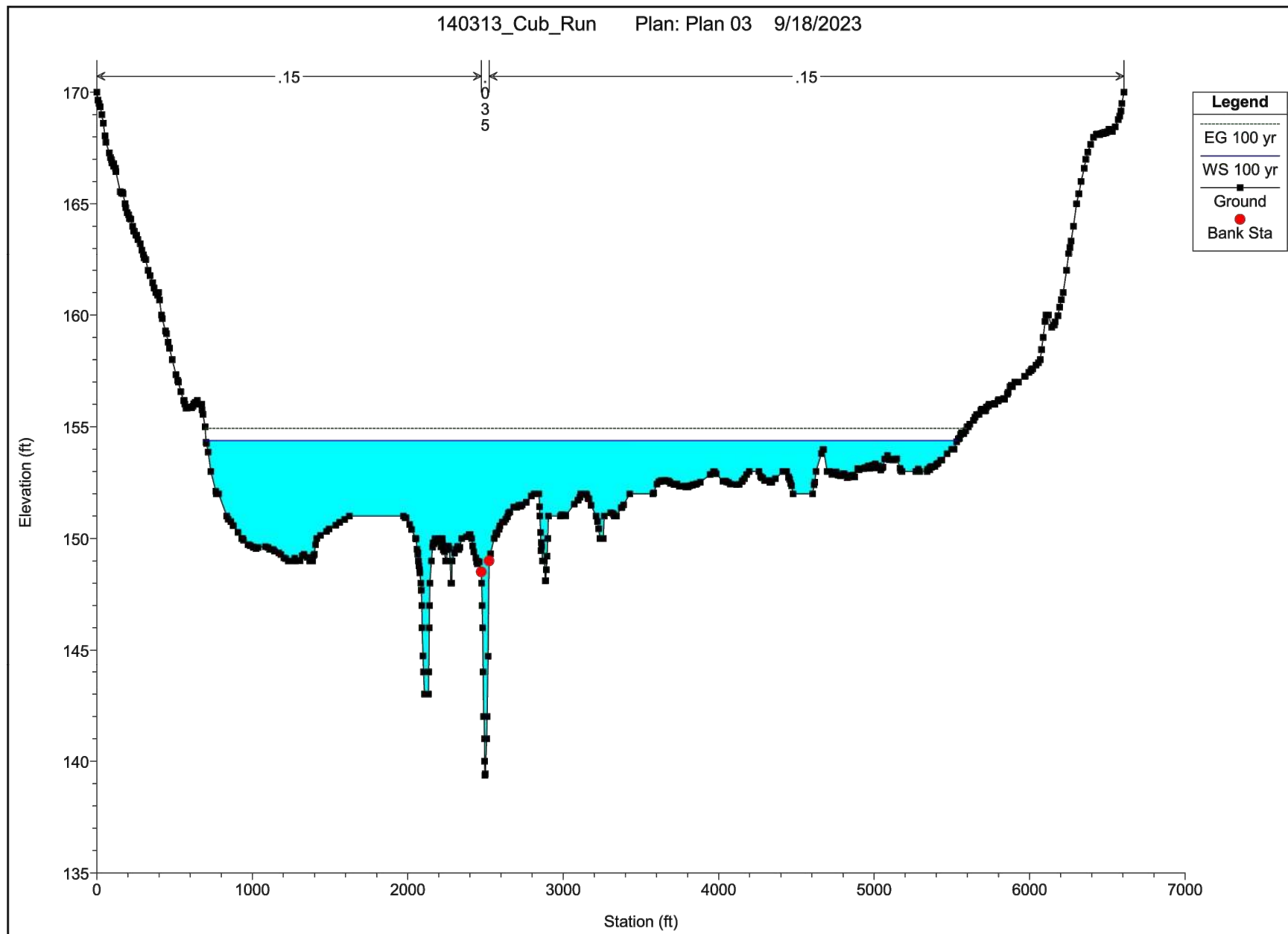
Plan: Plan 03 Cub Run Alignment - Cub RS: 30.29 Profile: 100 yr					
E.G. Elev (ft)	154.99	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.49	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	154.50	Reach Len. (ft)	19.02	19.02	19.02
Crit W.S. (ft)		Flow Area (sq ft)	7635.75	520.45	7532.55
E.G. Slope (ft/ft)	0.002859	Area (sq ft)	7635.75	520.45	7532.55
Q Total (cfs)	23600.00	Flow (cfs)	10700.29	5782.72	7117.00
Top Width (ft)	4976.23	Top Width (ft)	1770.73	45.53	3159.97
Vel Total (ft/s)	1.50	Avg. Vel. (ft/s)	1.40	11.11	0.94
Max Chi Dpth (ft)	13.52	Hydr. Depth (ft)	4.31	11.43	2.38
Conv. Total (cfs)	441409.1	Conv. (cfs)	200135.8	108158.6	133114.7
Length Wtd. (ft)	19.02	Wetted Per. (ft)	1774.18	48.06	3161.35
Min Ch El (ft)	140.98	Shear (lb/sq ft)	0.77	1.93	0.43
Alpha	13.88	Stream Power (lb/ft s)	1.08	21.47	0.40
Frctn Loss (ft)	0.06	Cum Volume (acre-ft)	5.23	0.38	4.34
C & E Loss (ft)	0.01	Cum SA (acres)	1.24	0.03	2.04



Plan: Plan 03 Cub Run Alignment - Cub RS: 11.27 Profile: 100 yr					
E.G. Elev (ft)	154.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.54	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	154.38	Reach Len. (ft)	11.27	11.27	11.27
Crit W.S. (ft)		Flow Area (sq ft)	7711.01	554.90	6321.78
E.G. Slope (ft/ft)	0.003213	Area (sq ft)	7711.01	554.90	6321.78
Q Total (cfs)	23600.00	Flow (cfs)	11533.39	6249.07	5817.54
Top Width (ft)	4833.94	Top Width (ft)	1771.23	50.37	3012.34
Vel Total (ft/s)	1.62	Avg. Vel. (ft/s)	1.50	11.26	0.92
Max Chi Dpth (ft)	15.01	Hydr. Depth (ft)	4.35	11.02	2.10
Conv. Total (cfs)	416342.4	Conv. (cfs)	203467.8	110243.8	102630.8
Length Wtd. (ft)	11.27	Wetted Per. (ft)	1773.74	54.82	3013.27
Min Ch El (ft)	139.37	Shear (lb/sq ft)	0.87	2.03	0.42
Alpha	13.33	Stream Power (lb/ft s)	1.30	22.87	0.39
Frctn Loss (ft)	0.05	Cum Volume (acre-ft)	1.88	0.14	1.32
C & E Loss (ft)	0.06	Cum SA (acres)	0.47	0.01	0.69



Plan: Plan 03 Cub Run Alignment - Cub RS: 0 Profile: 100 yr					
E.G. Elev (ft)	154.82	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.10	Wt. n-Val.	0.150	0.035	0.150
W.S. Elev (ft)	153.73	Reach Len. (ft)			
Crit W.S. (ft)	153.73	Flow Area (sq ft)	6816.61	537.34	3845.56
E.G. Slope (ft/ft)	0.005416	Area (sq ft)	6816.61	537.34	3845.56
Q Total (cfs)	23600.00	Flow (cfs)	11897.86	7769.15	3932.99
Top Width (ft)	4198.91	Top Width (ft)	1836.75	48.38	2313.77
Vel Total (ft/s)	2.11	Avg. Vel. (ft/s)	1.75	14.46	1.02
Max Chi Dpth (ft)	15.42	Hydr. Depth (ft)	3.71	11.11	1.66
Conv. Total (cfs)	320681.5	Conv. (cfs)	181670.5	105588.7	53442.3
Length Wtd. (ft)		Wetted Per. (ft)	1840.06	53.98	2314.34
Min Ch El (ft)	138.31	Shear (lb/sq ft)	1.25	3.37	0.56
Alpha	15.88	Stream Power (lb/ft s)	2.19	48.67	0.57
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			



Bowman Consulting Group, Ltd.
 1245 Sunrise Valley Drive
 Suite 500
 Herndon, Virginia 20171
 Phone: (703) 464-1000
 Fax: (703) 461-9720
 www.bowmanconsulting.com

NORTHERN VIRGINIA
 REGIONAL PARKS
 5400 Ox Road
 Fairfax Station
 Virginia 22039



RAS 100 YEAR CROSS SECTIONS (WITHOUT
 BULL RUN BACKWATER EFFECT)
BULL RUN REGIONAL PARK
 CUB RUN CREEK
 BRIDGE REPLACEMENT
 SULLY DISTRICT FAIRFAX COUNTY, VIRGINIA

Designed By	MT	Checked By	MT
Date	August, 2023		
Scale			
NOVA Project Number			
Map Section	B-2		
Sheet	12 of 12		
NOVA File Number			
DATE	DESCRIPTION		