



February 7, 2018

John Matta, P.E.
Waterworks Engineers
7500 N. Dobson Road, Suite 200
Scottsdale, AZ 85256

Re: East Sedona Water Storage Tank Floodplain Analysis

Mr. Matta:

Lyon Engineering has completed a floodplain analysis on the East Sedona Water Storage Tank project, which is located on the west side of Highway 179, near the intersection of Mallard Drive in East Sedona. Two scenarios (existing and proposed conditions) were analyzed and mapped. It was determined that the proposed grading does not encroach nor affect the 100-year or 50-year floodplains through the Unnamed Wash. The existing and proposed floodplain limits are identical, as no channel geometry or other conditions are proposed to change within the 100-year or 50-year floodplain limits. Attached is the floodplain exhibit for the project.

The project is located in Zone X on the effective Flood Insurance Rate Map (FIRM), Map 04005C7659G, dated September 3, 2010. Zone X is defined by FEMA as an area outside the 500-year floodplain, indicating that the project is not in a major floodplain. Attached is the effective FIRM indicating the project location.

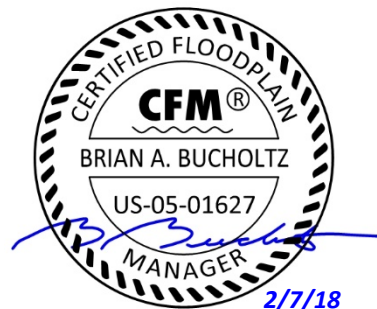
The floodplain analysis was completed in HEC-RAS floodplain modeling software. Topography for the project (1' contours) was provided by Waterworks Engineers in January 2018. Cross-sections were placed relatively close together (60-80 feet apart) to determine the most accurate floodplain limits. Both the 100-year (240 cfs) and the 50-year (190 cfs) flows were obtained from the Highway 179 ADOT plans at the upstream box culvert.

There were no ineffective flow areas, no obstructions, and no culverts/bridges necessary to input throughout the reach. All topography and calculations are completed on vertical datum NAVD 1988. Manning's roughness values for the modeling ranged from 0.040 in the main channel to 0.050 in locations with more vegetation. The models were run in a subcritical flow regime, resulting in the highest and most conservative water surface elevations (WSEs). The required downstream boundary conditions were input as known WSEs, obtained from the attached CulvertMaster and FlowMaster calculation worksheets for the existing driveway crossing at the downstream boundary. It is also verified in CulvertMaster that the upstream (Highway 179) box culvert outlet depths are similar to the calculated flow depths at the most upstream cross-section.

Attached are the existing and proposed HEC-RAS profile and cross-section results. As stated above, it was determined that the proposed grading does not encroach nor affect the 100-year OR 50-year floodplains through the Unnamed Wash. See the attached comparison tables on the following page.

Respectfully Submitted,

Brian A. Bucholtz, P.E., CFM
Floodplain Manager
Project Engineer
brianbucholtz@lyonengineering.com





100-Year Floodplain Results

Cross-Section	Existing WSE	Proposed WSE	Difference (ft)
1000.00	4167.72	4167.72	0.00
1081.47	4167.72	4167.72	0.00
1155.75	4169.03	4169.03	0.00
1229.31	4170.81	4170.81	0.00
1308.24	4173.86	4173.86	0.00
1366.36	4176.75	4176.75	0.00
1440.65	4180.75	4180.75	0.00

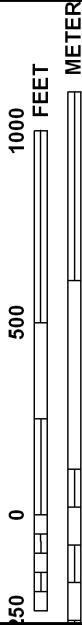
50-Year Floodplain Results

Cross-Section	Existing WSE	Proposed WSE	Difference (ft)
1000.00	4167.17	4167.17	0.00
1081.47	4167.17	4167.17	0.00
1155.75	4168.83	4168.83	0.00
1229.31	4170.62	4170.62	0.00
1308.24	4173.66	4173.66	0.00
1366.36	4176.56	4176.56	0.00
1440.65	4180.56	4180.56	0.00

Effective FIRM



MAP SCALE 1" = 500'



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 7659G

FIRM
FLOOD INSURANCE RATE MAP
COCONINO COUNTY,
ARIZONA
AND INCORPORATED AREAS

PANEL 7659 OF 8475
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COCONINO COUNTY	040019	7659	G
SEDONA, CITY OF	040130	7659	G

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.



MAP NUMBER
04005C7659G

EFFECTIVE DATE
SEPTEMBER 3, 2010

Federal Emergency Management Agency

1395000 FT

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps, check the FEMA Flood Map Store at www.msc.fema.gov

**CulvertMaster and FlowMaster
Calculation Worksheets**

Culvert Calculator Report

Driveway Culverts - 100-Year

Solve For: Discharge

Culvert Summary			
Allowable HW Elevation	4,167.72 ft	Headwater Depth/Height	2.44
Computed Headwater Elev:	4,167.72 ft	Discharge	118.15 cfs
Inlet Control HW Elev.	4,167.72 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	4,166.38 ft	Control Type	Inlet Control

Grades			
Upstream Invert	4,161.00 ft	Downstream Invert	4,160.00 ft
Length	25.00 ft	Constructed Slope	4.00 %

Hydraulic Profile			
Profile	S2	Depth, Downstream	2.35 ft
Slope Type	Steep	Normal Depth	2.34 ft
Flow Regime	Supercritical	Critical Depth	2.48 ft
Velocity Downstream	10.93 ft/s	Critical Slope	3.74 %

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.75 ft
Section Size	33 inch	Rise	2.75 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	4,166.38 ft	Upstream Velocity Head	1.71 ft
Ke	0.70	Entrance Loss	1.20 ft

Inlet Control Properties			
Inlet Control HW Elev.	4,167.72 ft	Flow Control	Submerged
Inlet Type	Mitered to slope	Area Full	11.9 ft ²
K	0.02100	HDS 5 Chart	2
M	1.33000	HDS 5 Scale	2
C	0.04630	Equation Form	1
Y	0.75000		

Culvert Calculator Report

Driveway Culverts - 50-Year

Solve For: Discharge

Culvert Summary			
Allowable HW Elevation	4,167.17 ft	Headwater Depth/Height	2.24
Computed Headwater Elev:	4,167.17 ft	Discharge	110.83 cfs
Inlet Control HW Elev.	4,167.17 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	4,166.07 ft	Control Type	Inlet Control
Grades			
Upstream Invert	4,161.00 ft	Downstream Invert	4,160.00 ft
Length	25.00 ft	Constructed Slope	4.00 %
Hydraulic Profile			
Profile	S2	Depth, Downstream	2.20 ft
Slope Type	Steep	Normal Depth	2.18 ft
Flow Regime	Supercritical	Critical Depth	2.42 ft
Velocity Downstream	10.87 ft/s	Critical Slope	3.36 %
Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.75 ft
Section Size	33 inch	Rise	2.75 ft
Number Sections	2		
Outlet Control Properties			
Outlet Control HW Elev.	4,166.07 ft	Upstream Velocity Head	1.55 ft
Ke	0.70	Entrance Loss	1.09 ft
Inlet Control Properties			
Inlet Control HW Elev.	4,167.17 ft	Flow Control	Submerged
Inlet Type	Mitered to slope	Area Full	11.9 ft ²
K	0.02100	HDS 5 Chart	2
M	1.33000	HDS 5 Scale	2
C	0.04630	Equation Form	1
Y	0.75000		

Worksheet for Driveway Weir - 50-Year

Project Description

Solve For Discharge

Input Data

Headwater Elevation		4167.17	ft
Crest Elevation		4165.50	ft
Tailwater Elevation		4164.00	ft
Crest Surface Type	Paved		
Crest Breadth		1.50	ft
Crest Length		12.00	ft

Results

Discharge		79.95	ft ³ /s
Headwater Height Above Crest		1.67	ft
Tailwater Height Above Crest		-1.50	ft
Weir Coefficient		3.09	US
Submergence Factor		1.00	
Adjusted Weir Coefficient		3.09	US
Flow Area		20.04	ft ²
Velocity		3.99	ft/s
Wetted Perimeter		15.34	ft
Top Width		12.00	ft

Culvert Calculator Report

Highway 179 Box - 100-Year

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	4,193.00 ft	Headwater Depth/Height	0.41
Computed Headwater Elev:	4,184.45 ft	Discharge	240.00 cfs
Inlet Control HW Elev.	4,184.06 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	4,184.45 ft	Control Type	Entrance Control

Grades			
Upstream Invert	4,180.40 ft	Downstream Invert	4,178.40 ft
Length	85.00 ft	Constructed Slope	2.35 %

Hydraulic Profile			
Profile	S2	Depth, Downstream	1.37 ft
Slope Type	Steep	Normal Depth	1.16 ft
Flow Regime	Supercritical	Critical Depth	2.32 ft
Velocity Downstream	14.56 ft/s	Critical Slope	0.29 %

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	12.00 ft
Section Size	12 x 10 ft	Rise	10.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	4,184.45 ft	Upstream Velocity Head	1.16 ft
Ke	0.50	Entrance Loss	0.58 ft

Inlet Control Properties			
Inlet Control HW Elev.	4,184.06 ft	Flow Control	N/A
Inlet Type	45° non-offset wingwall flares	Area Full	120.0 ft²
K	0.49700	HDS 5 Chart	12
M	0.66700	HDS 5 Scale	1
C	0.03390	Equation Form	2
Y	0.80300		

Culvert Calculator Report

Highway 179 Box - 50-Year

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	4,193.00 ft	Headwater Depth/Height	0.35
Computed Headwater Elev.	4,183.87 ft	Discharge	190.00 cfs
Inlet Control HW Elev.	4,183.53 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	4,183.87 ft	Control Type	Entrance Control

Grades			
Upstream Invert	4,180.40 ft	Downstream Invert	4,178.40 ft
Length	85.00 ft	Constructed Slope	2.35 %

Hydraulic Profile			
Profile	S2	Depth, Downstream	1.15 ft
Slope Type	Steep	Normal Depth	1.00 ft
Flow Regime	Supercritical	Critical Depth	1.98 ft
Velocity Downstream	13.77 ft/s	Critical Slope	0.29 %

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	12.00 ft
Section Size	12 x 10 ft	Rise	10.00 ft
Number Sections	1		

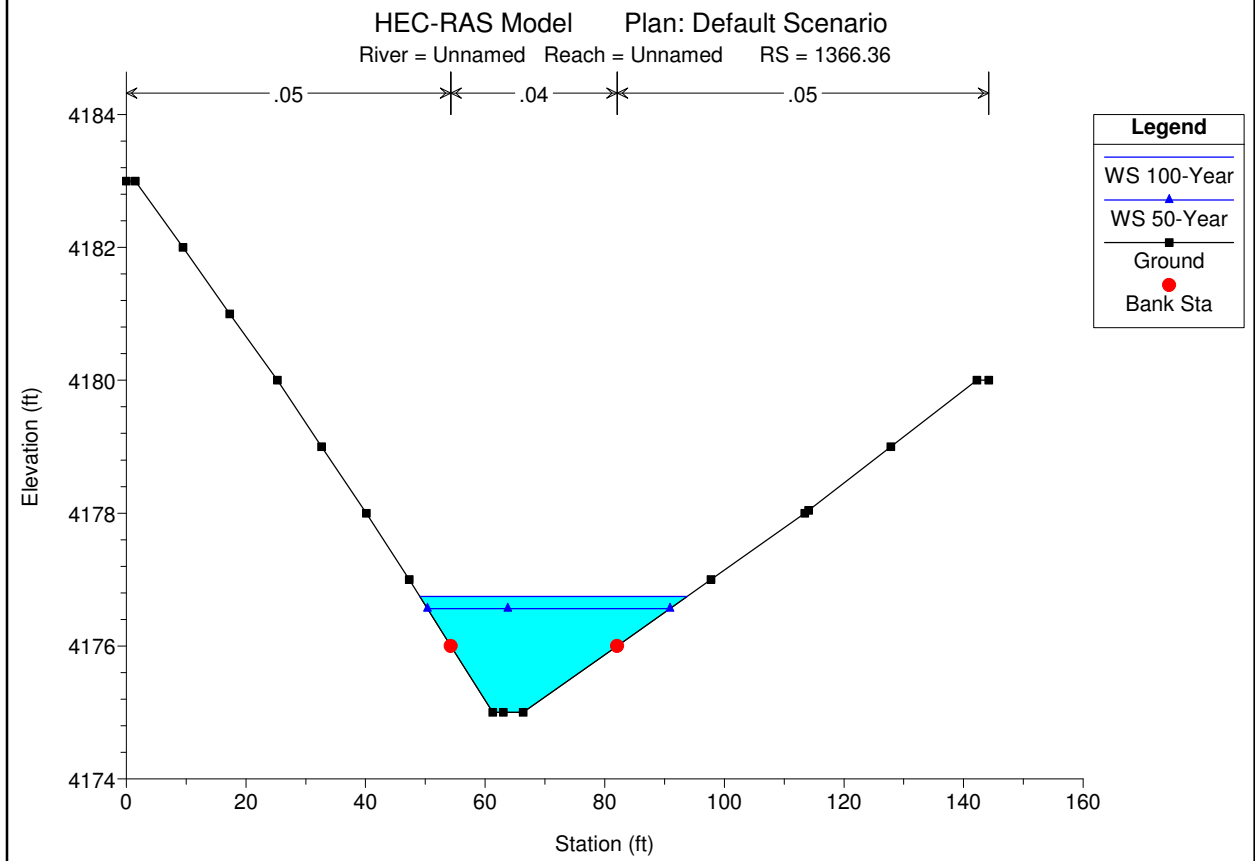
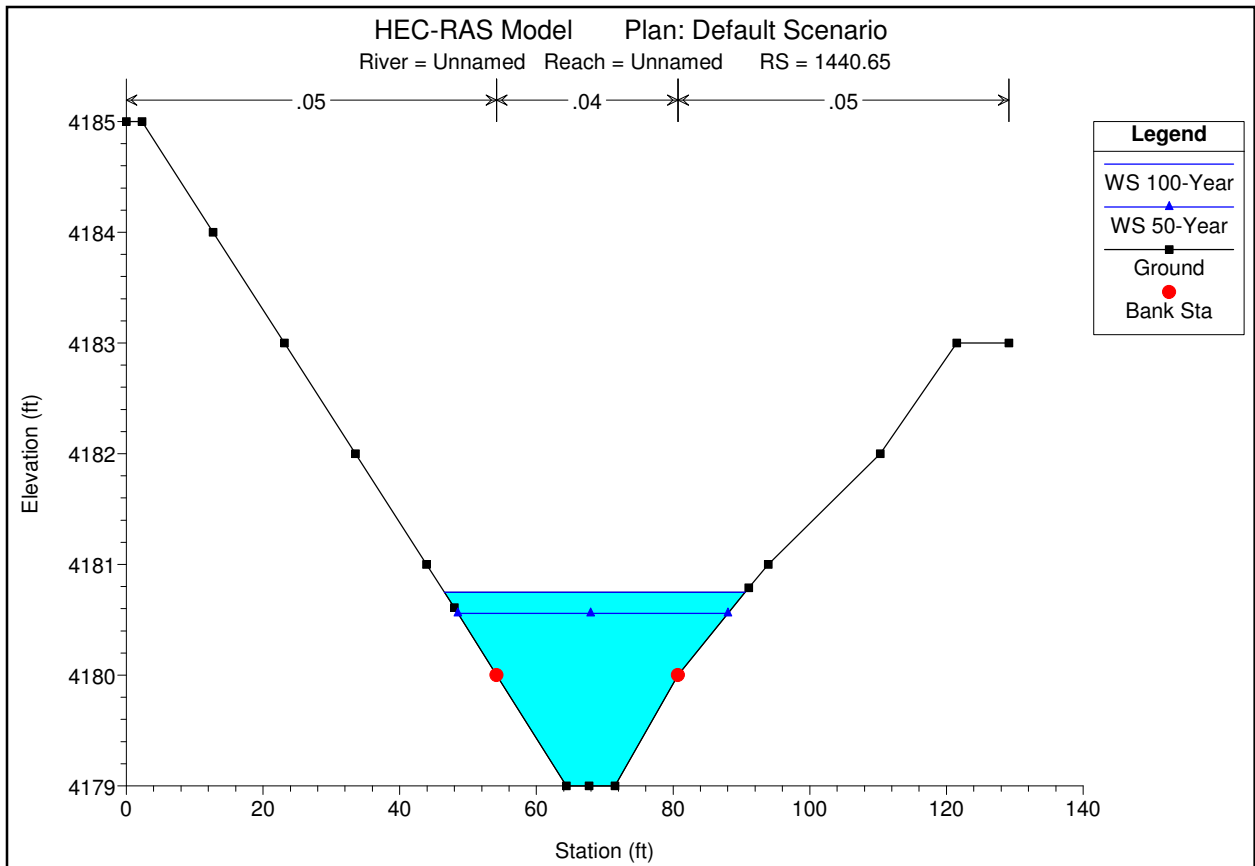
Outlet Control Properties			
Outlet Control HW Elev.	4,183.87 ft	Upstream Velocity Head	0.99 ft
Ke	0.50	Entrance Loss	0.50 ft

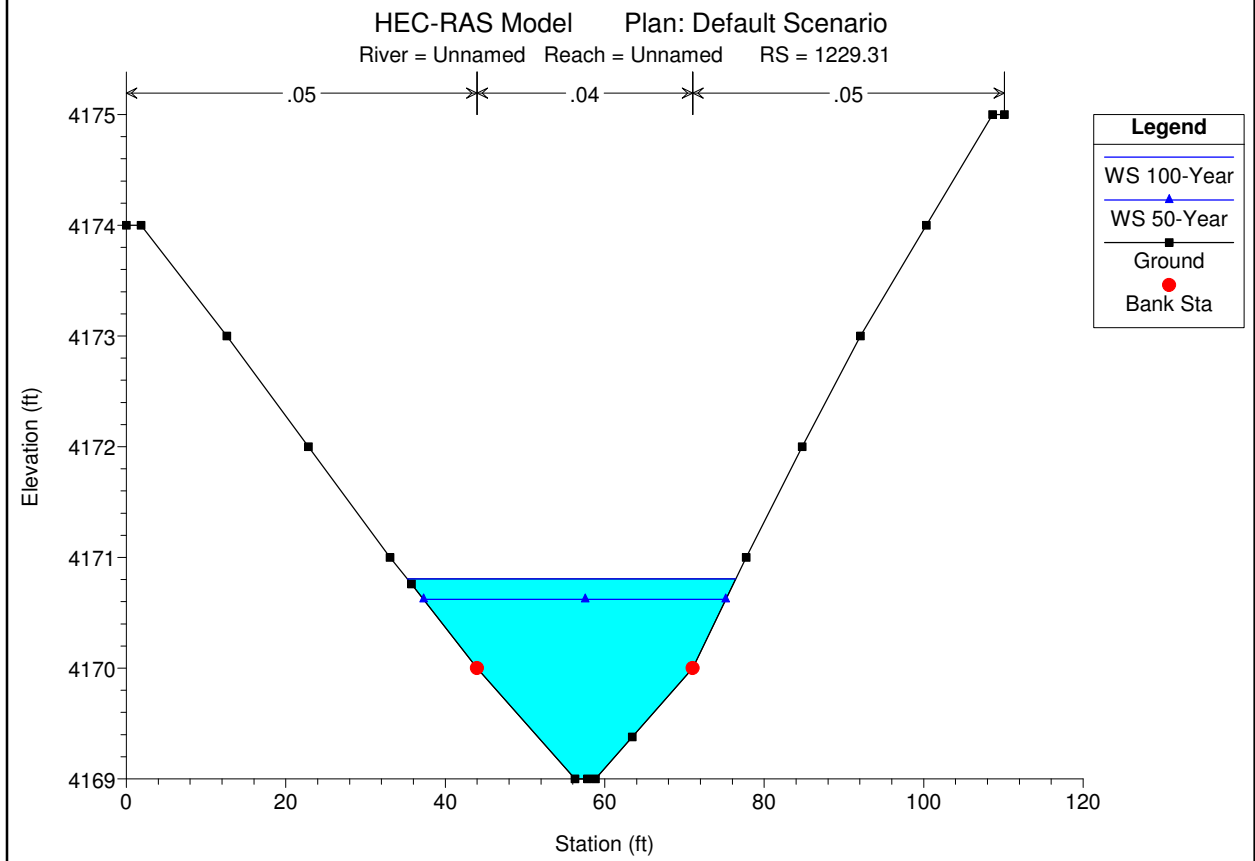
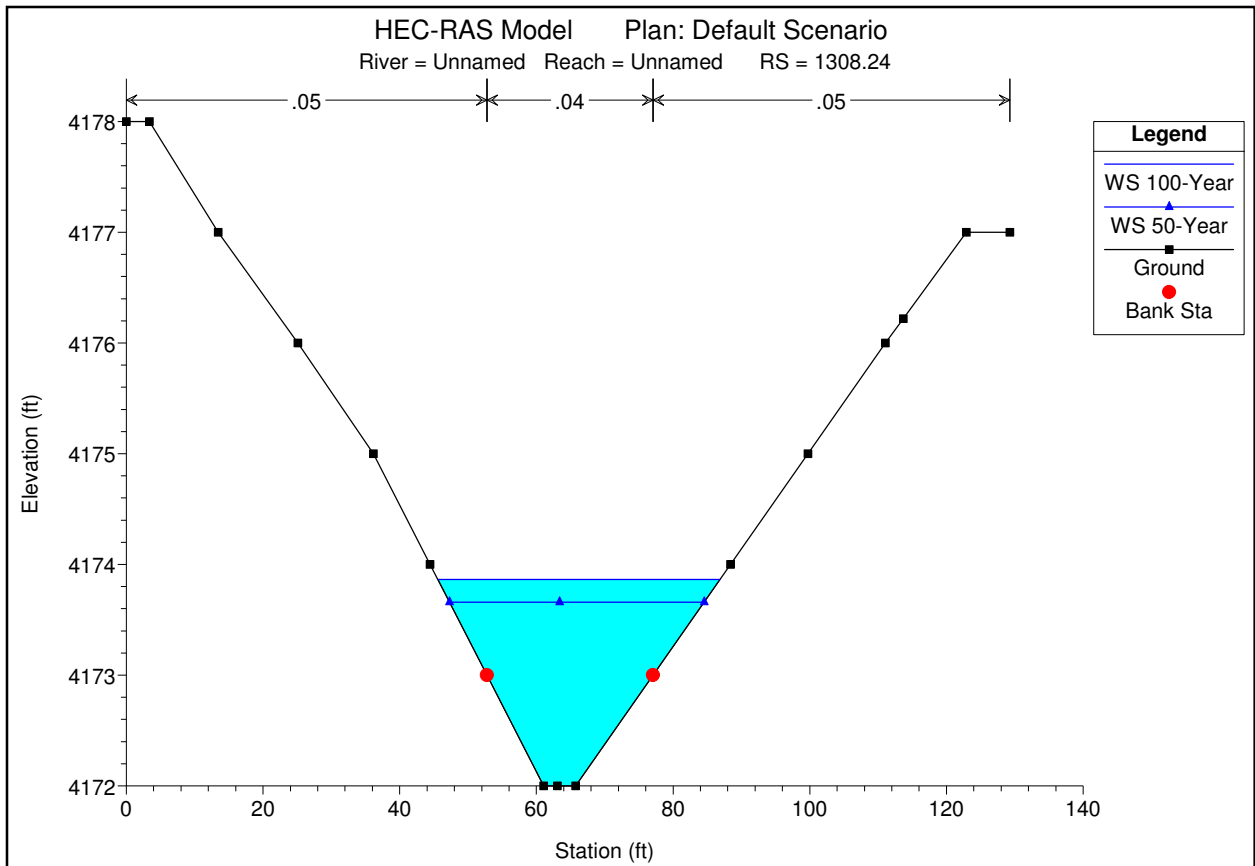
Inlet Control Properties			
Inlet Control HW Elev.	4,183.53 ft	Flow Control	N/A
Inlet Type 45° non-offset wingwall flares		Area Full	120.0 ft²
K	0.49700	HDS 5 Chart	12
M	0.66700	HDS 5 Scale	1
C	0.03390	Equation Form	2
Y	0.80300		

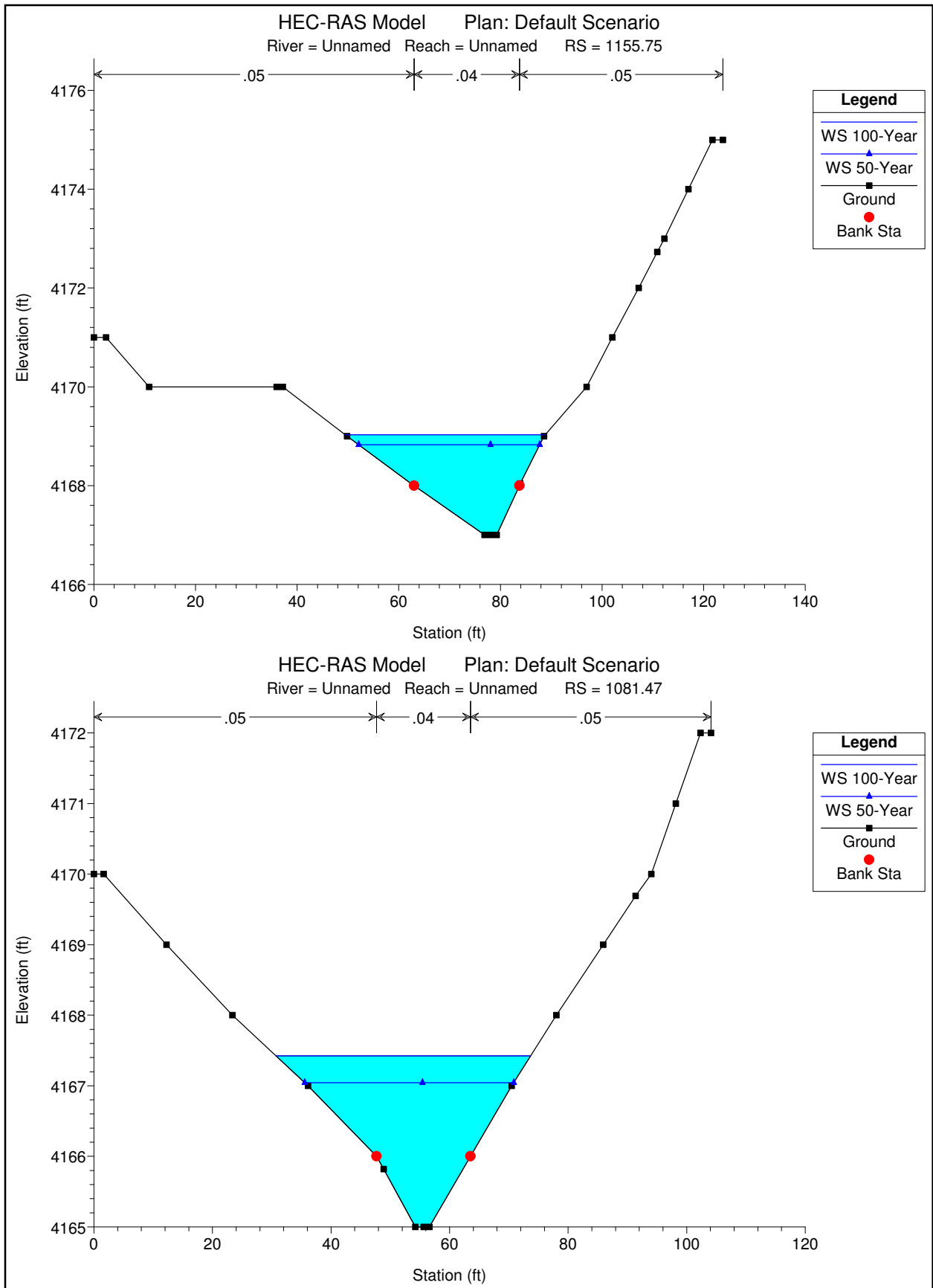
**Existing HEC-RAS
Profile and Cross-Section Results**

HEC-RAS Plan: Default Scenario River: Unnamed Reach: Unnamed

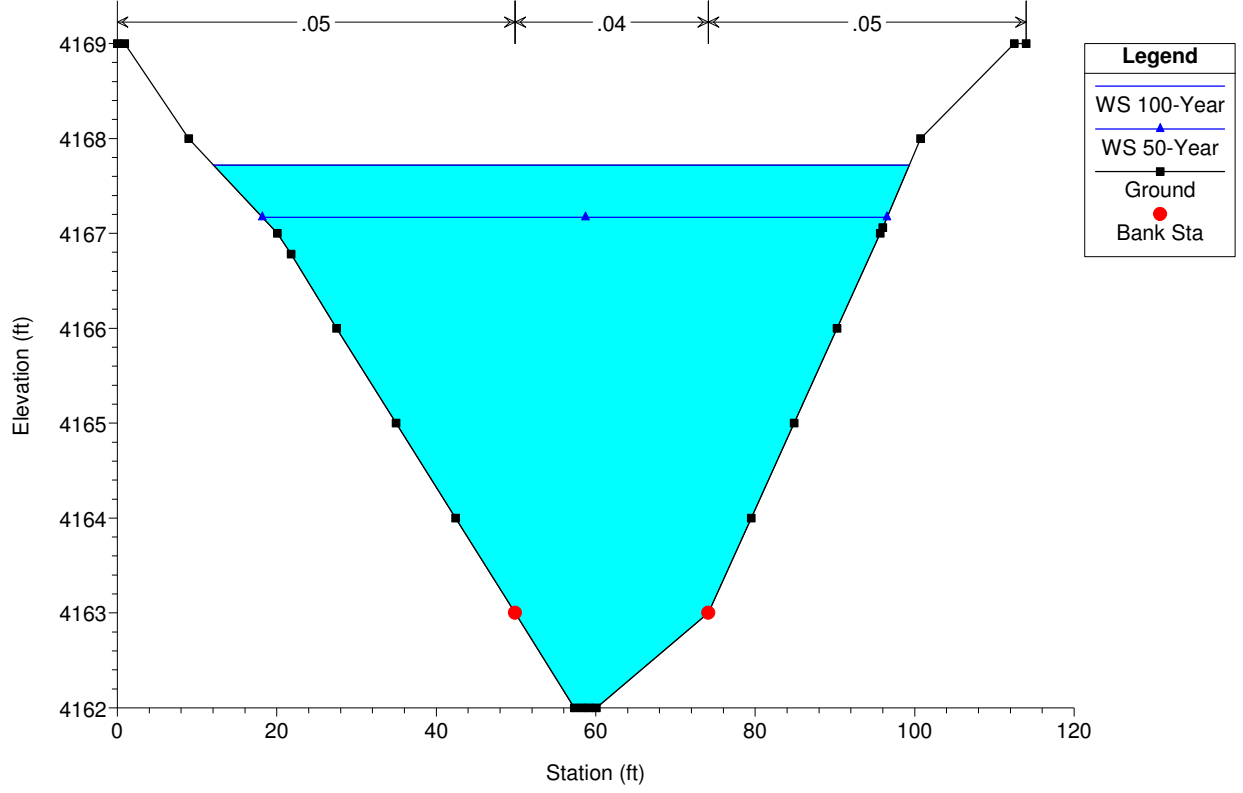
Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chi
Unnamed	1000.00	240.00	4162.00	4167.72	4163.90	4167.74	0.000122	1.24	271.89	87.27	0.10
Unnamed	1000.00	190.00	4162.00	4167.17	4163.69	4167.19	0.000121	1.15	226.32	78.35	0.09
Unnamed	1081.47	240.00	4165.00	4167.43	4167.27	4167.91	0.010906	6.12	50.64	42.99	0.76
Unnamed	1081.47	190.00	4165.00	4167.05	4167.05	4167.62	0.016042	6.44	35.77	35.26	0.89
Unnamed	1155.75	240.00	4167.00	4169.03	4169.03	4169.64	0.016994	6.56	42.56	39.45	0.92
Unnamed	1155.75	190.00	4167.00	4168.83	4168.83	4169.38	0.017936	6.15	34.87	35.66	0.92
Unnamed	1229.31	240.00	4169.00	4170.81	4170.81	4171.38	0.018677	6.20	42.36	41.20	0.94
Unnamed	1229.31	190.00	4169.00	4170.62	4170.62	4171.13	0.019963	5.81	34.96	37.91	0.95
Unnamed	1308.24	240.00	4172.00	4173.86	4173.86	4174.44	0.017434	6.29	42.85	41.29	0.92
Unnamed	1308.24	190.00	4172.00	4173.66	4173.66	4174.19	0.019032	5.95	34.81	37.28	0.94
Unnamed	1366.36	240.00	4175.00	4176.75	4176.75	4177.30	0.018353	6.10	43.52	44.72	0.93
Unnamed	1366.36	190.00	4175.00	4176.56	4176.56	4177.06	0.019684	5.72	35.67	40.54	0.94
Unnamed	1440.65	240.00	4179.00	4180.75	4180.75	4181.31	0.018057	6.18	43.18	43.96	0.93
Unnamed	1440.65	190.00	4179.00	4180.56	4180.56	4181.07	0.019384	5.80	35.27	39.53	0.94







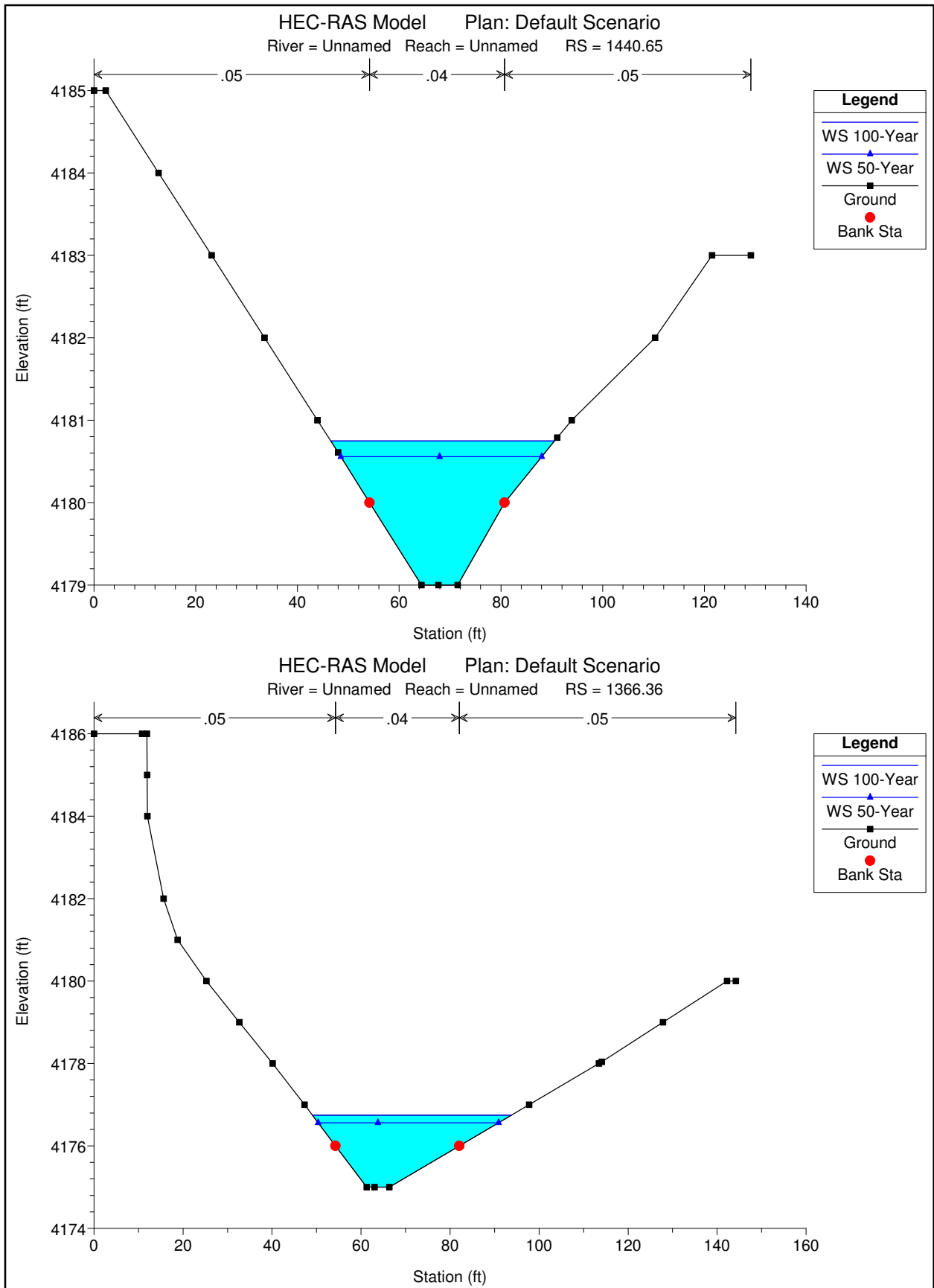
HEC-RAS Model Plan: Default Scenario
River = Unnamed Reach = Unnamed RS = 1000.00

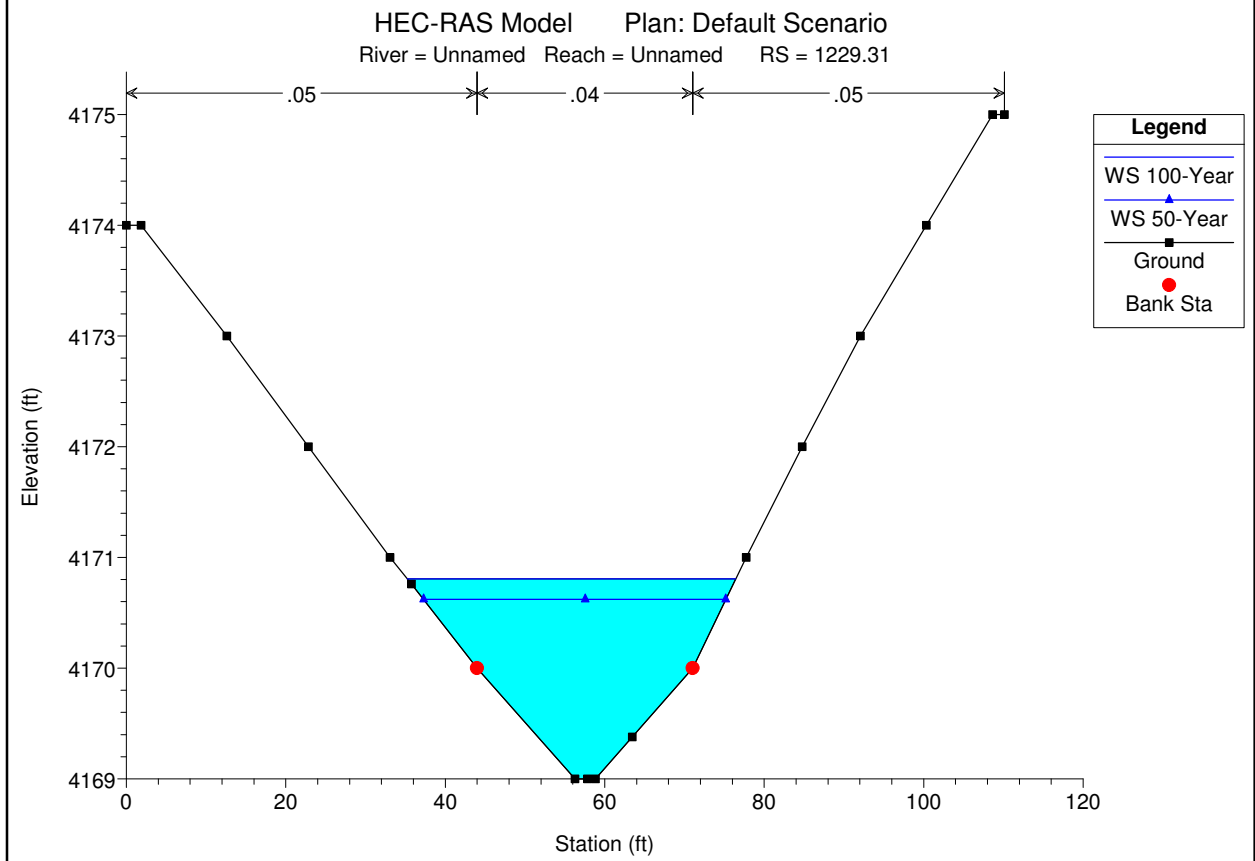
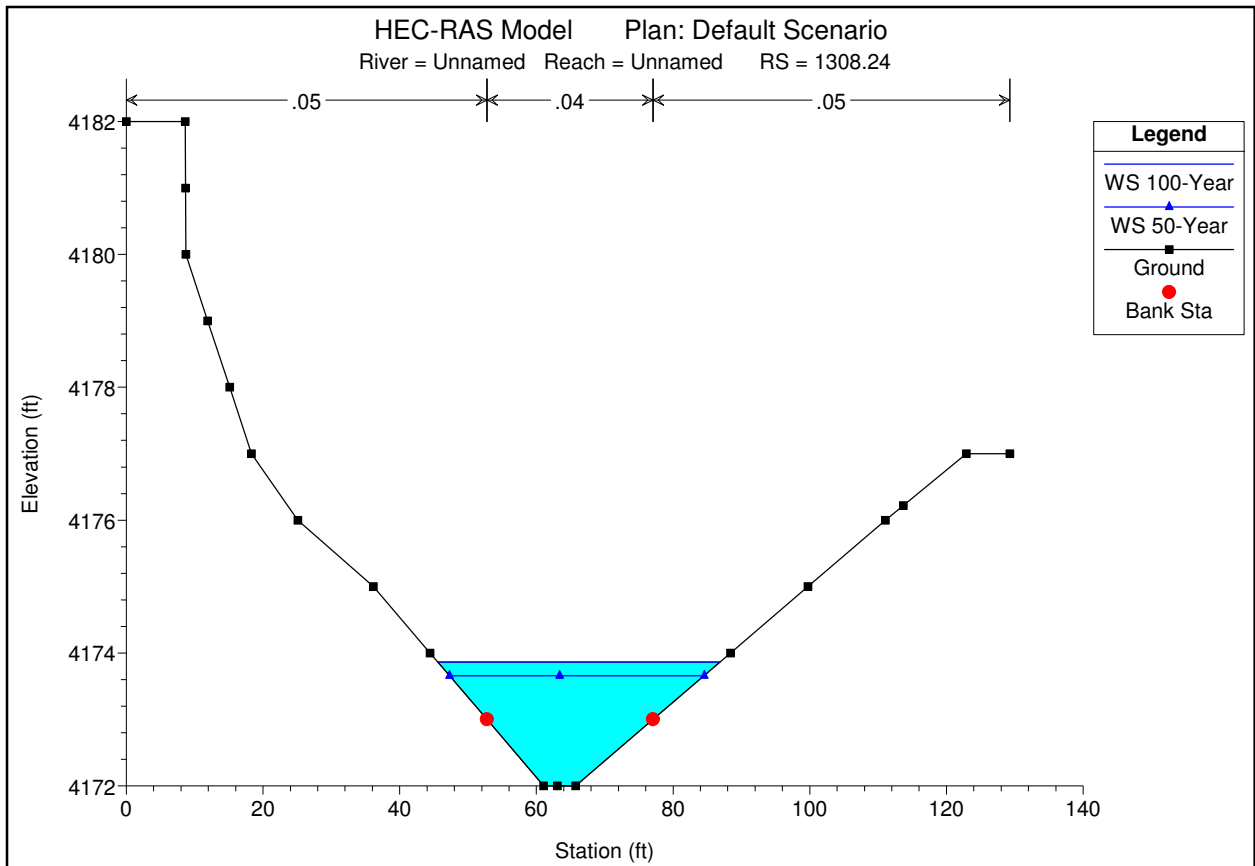


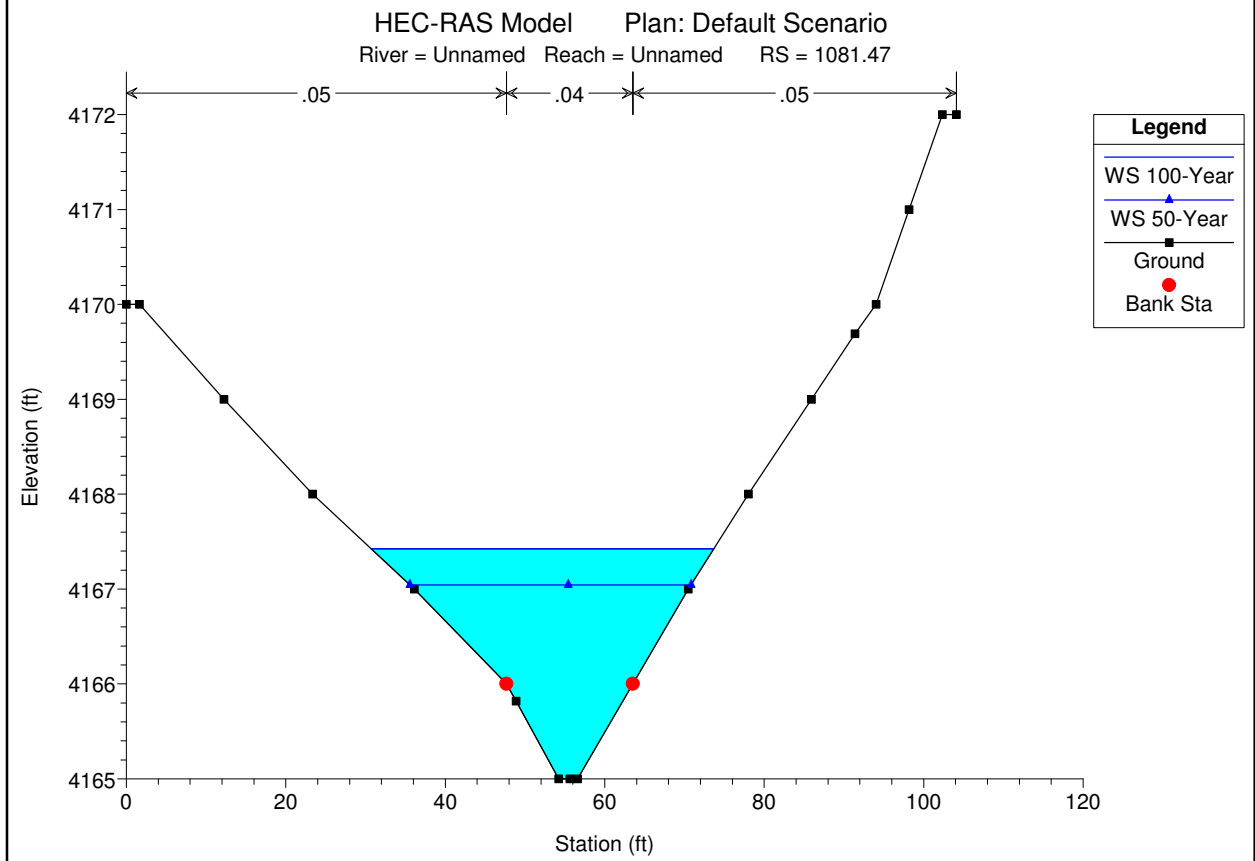
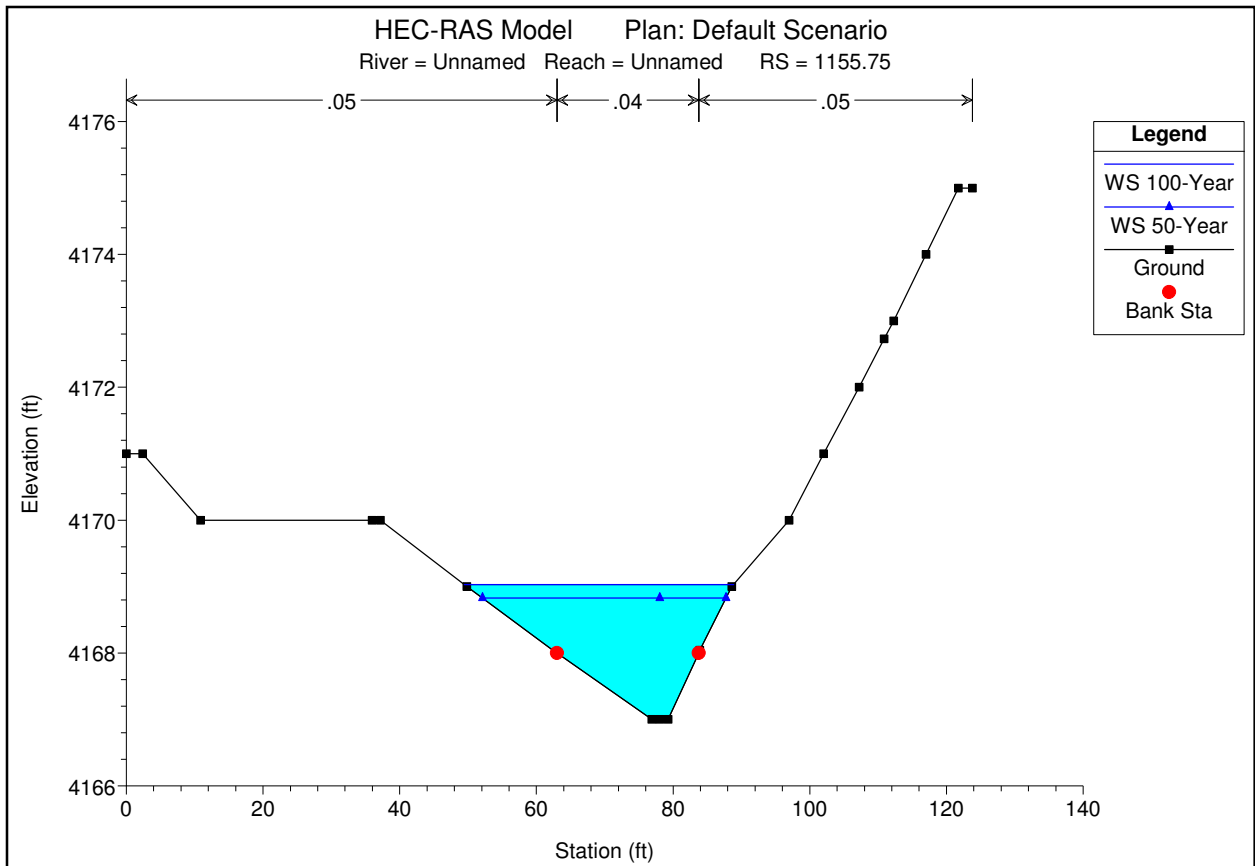
**Proposed HEC-RAS
Profile and Cross-Section Results**

HEC-RAS Plan: Default Scenario River: Unnamed Reach: Unnamed

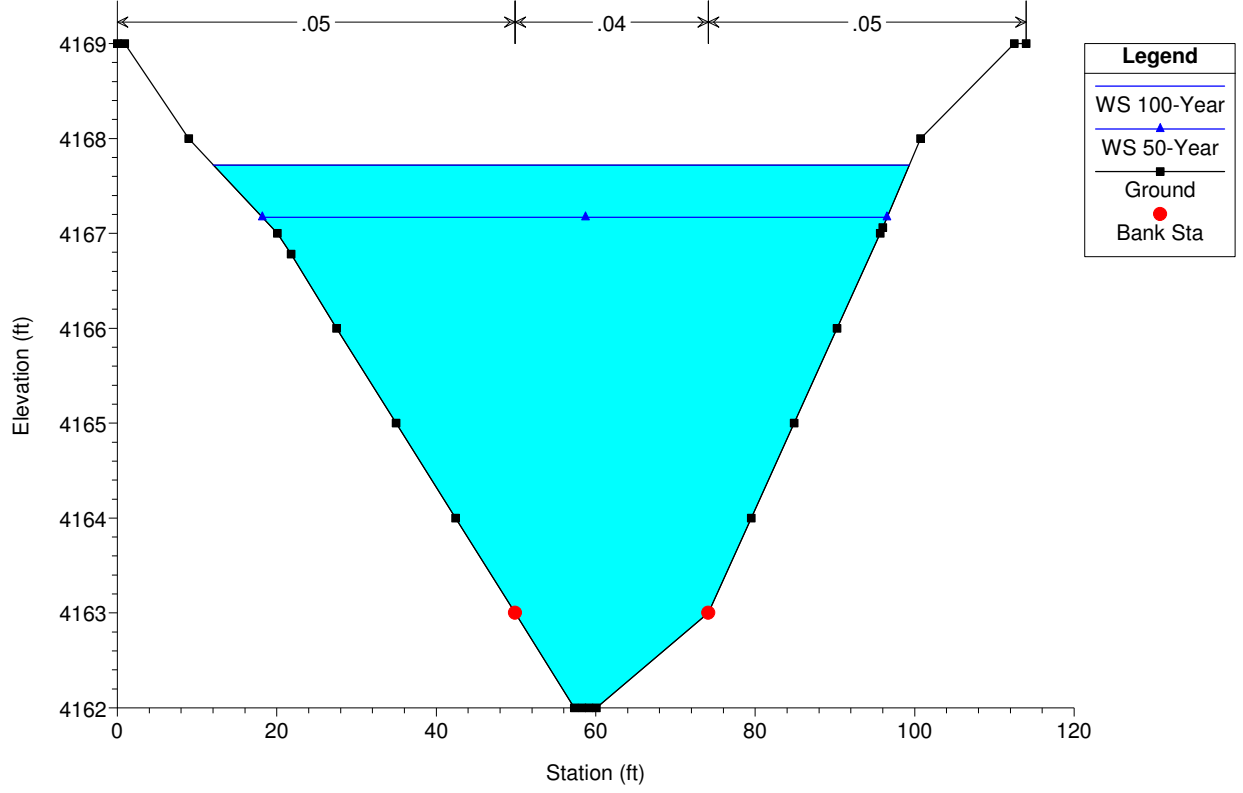
Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chi
Unnamed	1000.00	240.00	4162.00	4167.72	4163.90	4167.74	0.000122	1.24	271.89	87.27	0.10
Unnamed	1000.00	190.00	4162.00	4167.17	4163.69	4167.19	0.000121	1.15	226.32	78.35	0.09
Unnamed	1081.47	240.00	4165.00	4167.43	4167.27	4167.91	0.010906	6.12	50.64	42.99	0.76
Unnamed	1081.47	190.00	4165.00	4167.05	4167.05	4167.62	0.016042	6.44	35.77	35.26	0.89
Unnamed	1155.75	240.00	4167.00	4169.03	4169.03	4169.64	0.016994	6.56	42.56	39.45	0.92
Unnamed	1155.75	190.00	4167.00	4168.83	4168.83	4169.38	0.017936	6.15	34.87	35.66	0.92
Unnamed	1229.31	240.00	4169.00	4170.81	4170.81	4171.38	0.018677	6.20	42.36	41.20	0.94
Unnamed	1229.31	190.00	4169.00	4170.62	4170.62	4171.13	0.019963	5.81	34.96	37.91	0.95
Unnamed	1308.24	240.00	4172.00	4173.86	4173.86	4174.44	0.017434	6.29	42.85	41.29	0.92
Unnamed	1308.24	190.00	4172.00	4173.66	4173.66	4174.19	0.019032	5.95	34.81	37.28	0.94
Unnamed	1366.36	240.00	4175.00	4176.75	4176.75	4177.30	0.018353	6.10	43.52	44.72	0.93
Unnamed	1366.36	190.00	4175.00	4176.56	4176.56	4177.06	0.019684	5.72	35.67	40.54	0.94
Unnamed	1440.65	240.00	4179.00	4180.75	4180.75	4181.31	0.018057	6.18	43.18	43.96	0.93
Unnamed	1440.65	190.00	4179.00	4180.56	4180.56	4181.07	0.019384	5.80	35.27	39.53	0.94

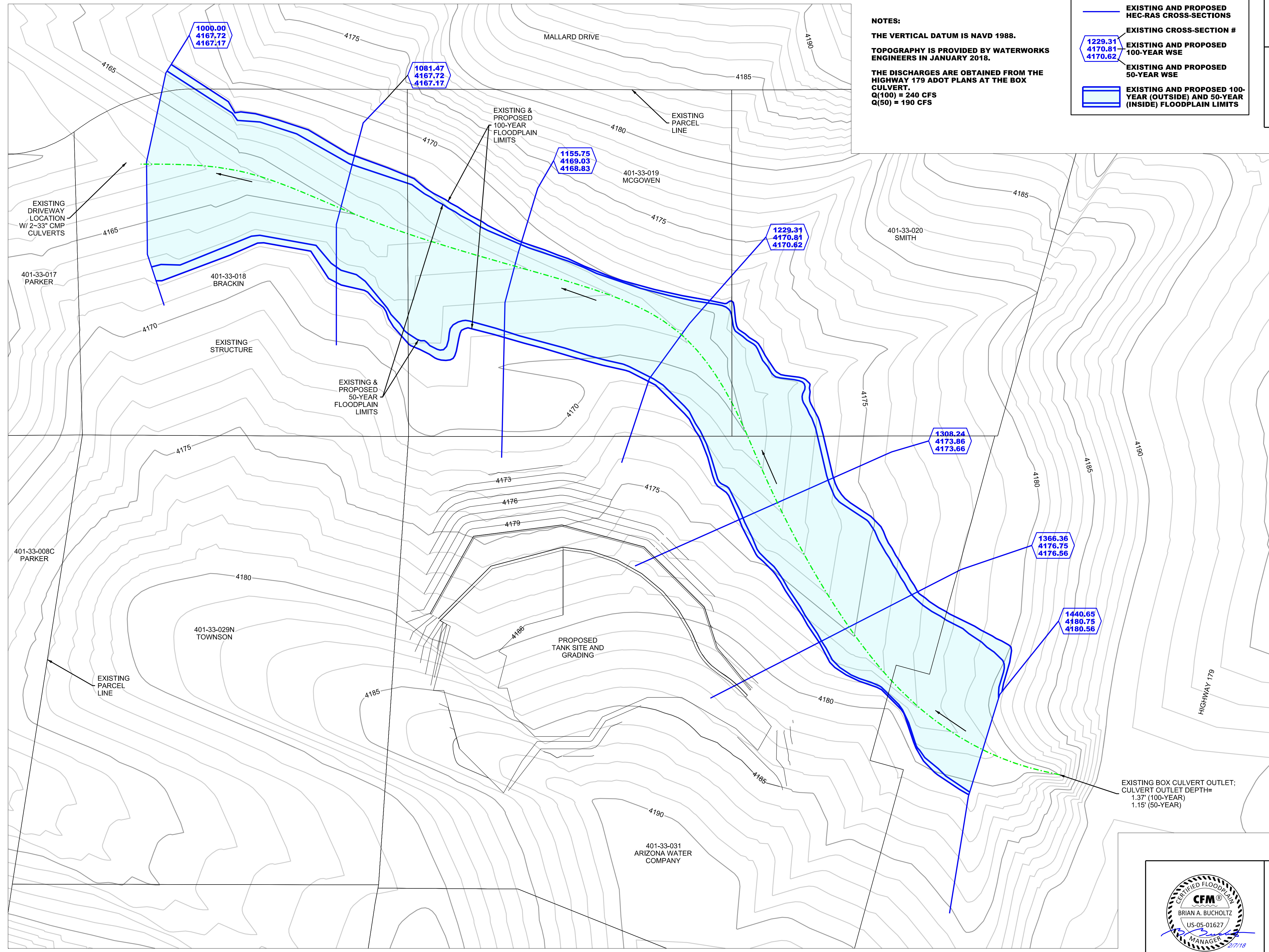






HEC-RAS Model Plan: Default Scenario
River = Unnamed Reach = Unnamed RS = 1000.00





NOTES:
 THE VERTICAL DATUM IS NAVD 1988.
 TOPOGRAPHY IS PROVIDED BY WATERWORKS ENGINEERS IN JANUARY 2018.
 THE DISCHARGES ARE OBTAINED FROM THE HIGHWAY 179 ADOT PLANS AT THE BOX CULVERT.
 Q(100) = 240 CFS
 Q(50) = 190 CFS

LEGEND

- EXISTING AND PROPOSED HEC-RAS CROSS-SECTIONS
- EXISTING AND PROPOSED 100-YEAR WSE
- EXISTING AND PROPOSED 50-YEAR WSE
- EXISTING AND PROPOSED 100-YEAR (OUTSIDE) AND 50-YEAR (INSIDE) FLOODPLAIN LIMITS

VERIFY SCALE
 BAR IS ONE INCH ON ORIGINAL DRAWING.
 IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DRAWING SCALE
 1 Inch = 20 Feet
 (This scale is valid for 22"x34" sheets only)

DESIGN	BAB	DATE	
DRAWN	BAB	NO.	
CHECKED	SAL	DATE	
APPROVED	BAB	NO.	
REVISION	BY	DATE	
<p>LYON ENGINEERING Civil Engineers - Land Surveyors 1650 W. Main Street, Suite 101, Prescott, AZ 86301 Phone: (928) 775-1750, Fax: (928) 775-9205</p>			
<p>EAST SEDONA WATER STORAGE TANK SITE</p>			
<p>EXISTING AND PROPOSED FLOODPLAIN EXHIBIT</p>			
<p>CIVIL</p>			
<p>DATE FEBRUARY 2018</p>			
<p>LYON PROJECT # 869-05</p>			
<p>DRAWING NUMBER FP.01</p>			
<p>SHEET 1 OF 1</p>			
<p>SCALE: 1:20</p>			

CERTIFIED FLOODPLAIN
 CFM
 BRIAN A. BUCHOLTZ
 US-05-01627
 MANAGER 2/7/18

BRIAN A. BUCHOLTZ, P.E.
 47997
 BRIAN A. BUCHOLTZ
 2/7/18
 AZ 201204 U.S.A.
 EXPIRES 6/30/2020