

# GIECK RANCH MAIN STEM TRIBUTARY 1 & 2 FINAL DRAINAGE REPORT for DESIGN AND CONSTRUCTION

June 21, 2024

HR Green Project No: 201662.03

PCD File No. CDR228

**Prepared By:**

HR Green Development, LLC

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720-602-4999

✓ Provide TOC and report text

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## Appendix A

# Proposed Hydrology Calculations and Reference Materials





**NOAA Atlas 14, Volume 8, Version 2**  
**Location name: Peyton, Colorado, USA\***  
**Latitude: 38.9859°, Longitude: -104.5647°**  
**Elevation: 6982 ft\*\***  
 \* source: ESRI Maps  
 \*\* source: USGS



### POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF\\_tabular](#) | [PF\\_graphical](#) | [Maps & aerals](#)

### PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) <sup>1</sup>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.239 (0.189-0.303)	0.291 (0.231-0.370)	0.381 (0.301-0.486)	0.461 (0.361-0.589)	0.576 (0.440-0.768)	0.671 (0.499-0.904)	0.770 (0.554-1.06)	0.875 (0.604-1.24)	1.02 (0.678-1.48)	1.14 (0.733-1.67)
10-min	0.350 (0.277-0.444)	0.426 (0.338-0.542)	0.558 (0.441-0.711)	0.674 (0.529-0.863)	0.844 (0.644-1.12)	0.982 (0.731-1.32)	1.13 (0.811-1.56)	1.28 (0.884-1.81)	1.49 (0.992-2.17)	1.66 (1.07-2.44)
15-min	0.426 (0.338-0.541)	0.520 (0.412-0.660)	0.681 (0.537-0.867)	0.823 (0.645-1.05)	1.03 (0.785-1.37)	1.20 (0.891-1.62)	1.37 (0.988-1.90)	1.56 (1.08-2.21)	1.82 (1.21-2.65)	2.03 (1.31-2.98)
30-min	0.608 (0.482-0.771)	0.740 (0.586-0.940)	0.968 (0.764-1.23)	1.17 (0.916-1.49)	1.46 (1.11-1.94)	1.70 (1.26-2.28)	1.94 (1.40-2.68)	2.20 (1.52-3.12)	2.57 (1.71-3.73)	2.86 (1.84-4.19)
60-min	0.775 (0.615-0.984)	0.933 (0.739-1.18)	1.21 (0.956-1.54)	1.46 (1.15-1.87)	1.84 (1.41-2.47)	2.16 (1.61-2.92)	2.49 (1.80-3.45)	2.85 (1.97-4.05)	3.37 (2.24-4.90)	3.78 (2.44-5.54)
2-hr	0.943 (0.754-1.19)	1.12 (0.898-1.42)	1.46 (1.16-1.84)	1.76 (1.39-2.23)	2.22 (1.72-2.97)	2.62 (1.97-3.52)	3.04 (2.21-4.19)	3.50 (2.45-4.95)	4.16 (2.80-6.03)	4.70 (3.06-6.85)
3-hr	1.03 (0.829-1.29)	1.22 (0.978-1.53)	1.57 (1.25-1.97)	1.90 (1.51-2.40)	2.41 (1.88-3.22)	2.86 (2.17-3.84)	3.34 (2.45-4.60)	3.88 (2.73-5.48)	4.66 (3.15-6.74)	5.29 (3.46-7.69)
6-hr	1.20 (0.968-1.48)	1.40 (1.13-1.74)	1.78 (1.44-2.22)	2.16 (1.73-2.70)	2.76 (2.18-3.66)	3.28 (2.52-4.39)	3.86 (2.86-5.29)	4.51 (3.20-6.34)	5.46 (3.73-7.86)	6.24 (4.12-9.01)
12-hr	1.38 (1.13-1.70)	1.61 (1.31-1.98)	2.05 (1.66-2.53)	2.48 (2.00-3.07)	3.15 (2.51-4.15)	3.74 (2.89-4.96)	4.39 (3.28-5.96)	5.12 (3.66-7.13)	6.17 (4.25-8.82)	7.04 (4.69-10.1)
24-hr	1.60 (1.31-1.95)	1.87 (1.54-2.28)	2.38 (1.94-2.91)	2.85 (2.32-3.51)	3.60 (2.88-4.67)	4.24 (3.29-5.56)	4.94 (3.71-6.63)	5.71 (4.12-7.87)	6.82 (4.73-9.66)	7.73 (5.20-11.0)
2-day	1.85 (1.54-2.24)	2.18 (1.80-2.63)	2.76 (2.28-3.34)	3.29 (2.70-4.01)	4.11 (3.30-5.27)	4.80 (3.76-6.22)	5.54 (4.19-7.36)	6.35 (4.62-8.68)	7.50 (5.25-10.5)	8.44 (5.73-11.9)
3-day	2.03 (1.69-2.44)	2.39 (1.98-2.87)	3.02 (2.50-3.64)	3.60 (2.97-4.36)	4.47 (3.60-5.69)	5.20 (4.08-6.70)	5.98 (4.55-7.90)	6.83 (4.99-9.28)	8.03 (5.65-11.2)	9.00 (6.15-12.7)
4-day	2.18 (1.82-2.61)	2.56 (2.13-3.06)	3.22 (2.68-3.87)	3.82 (3.16-4.62)	4.73 (3.83-6.00)	5.49 (4.33-7.04)	6.30 (4.81-8.30)	7.18 (5.26-9.72)	8.43 (5.94-11.7)	9.43 (6.46-13.3)
7-day	2.58 (2.17-3.07)	2.98 (2.50-3.54)	3.68 (3.08-4.39)	4.32 (3.60-5.18)	5.29 (4.30-6.65)	6.09 (4.84-7.76)	6.96 (5.34-9.09)	7.89 (5.82-10.6)	9.21 (6.55-12.8)	10.3 (7.10-14.4)
10-day	2.93 (2.48-3.47)	3.36 (2.84-3.98)	4.13 (3.47-4.90)	4.81 (4.02-5.74)	5.83 (4.76-7.28)	6.68 (5.32-8.45)	7.58 (5.85-9.86)	8.55 (6.34-11.4)	9.92 (7.08-13.7)	11.0 (7.65-15.4)
20-day	3.91 (3.33-4.58)	4.51 (3.84-5.29)	5.52 (4.68-6.50)	6.39 (5.39-7.55)	7.63 (6.25-9.37)	8.62 (6.90-10.8)	9.64 (7.47-12.4)	10.7 (7.98-14.1)	12.2 (8.74-16.6)	13.3 (9.31-18.4)
30-day	4.70 (4.02-5.47)	5.44 (4.65-6.34)	6.65 (5.66-7.78)	7.66 (6.49-9.00)	9.06 (7.44-11.0)	10.1 (8.15-12.5)	11.2 (8.74-14.3)	12.3 (9.24-16.2)	13.8 (9.98-18.7)	15.0 (10.5-20.6)
45-day	5.67 (4.88-6.57)	6.55 (5.63-7.60)	7.97 (6.82-9.27)	9.12 (7.77-10.7)	10.7 (8.79-12.9)	11.9 (9.56-14.5)	13.0 (10.2-16.4)	14.2 (10.6-18.4)	15.6 (11.3-21.0)	16.7 (11.9-23.0)
60-day	6.48 (5.60-7.48)	7.46 (6.43-8.62)	9.01 (7.74-10.4)	10.3 (8.77-11.9)	11.9 (9.82-14.3)	13.1 (10.6-16.0)	14.3 (11.2-18.0)	15.5 (11.7-20.0)	16.9 (12.3-22.6)	18.0 (12.8-24.6)

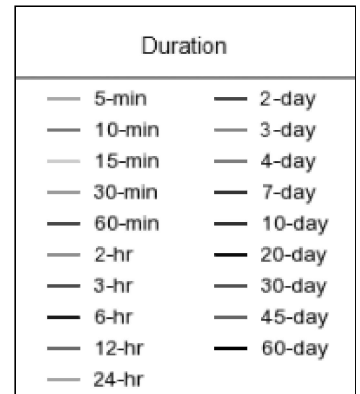
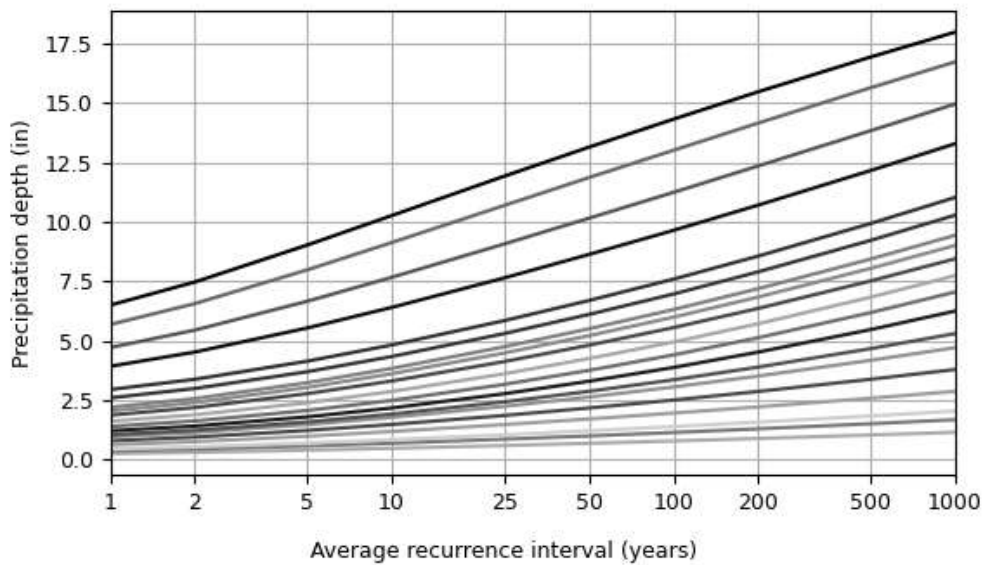
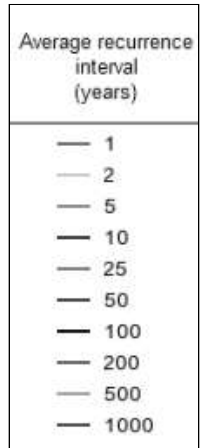
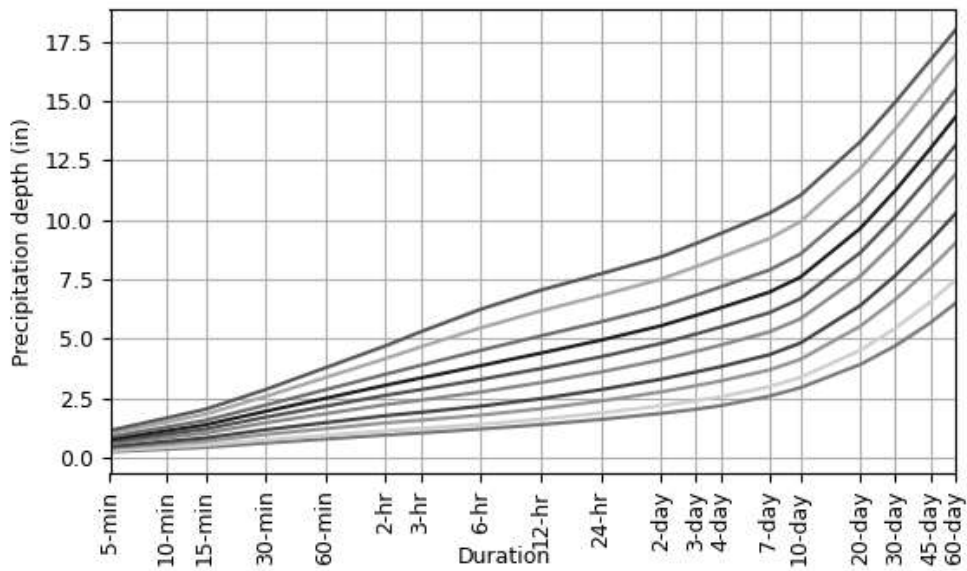
<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

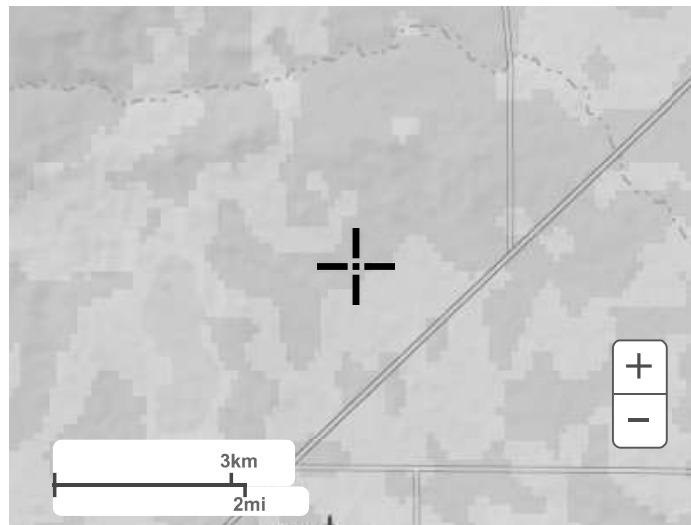
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### PF graphical

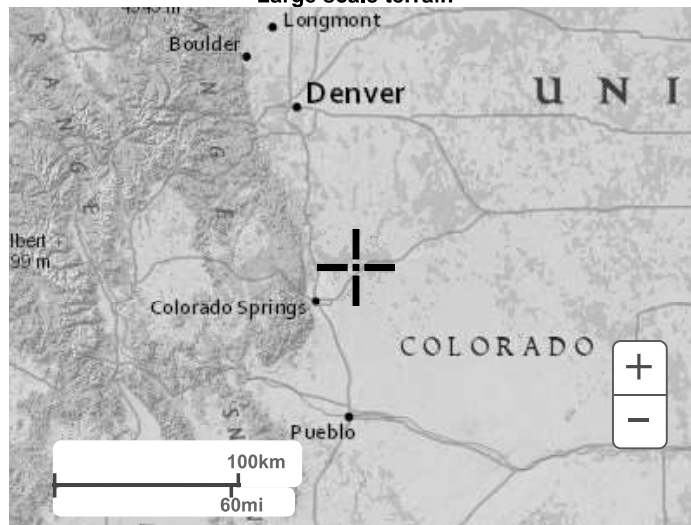
## PDS-based depth-duration-frequency (DDF) curves

Latitude: 38.9859°, Longitude: -104.5647°

[Back to Top](#)**Maps & aerials****Small scale terrain**



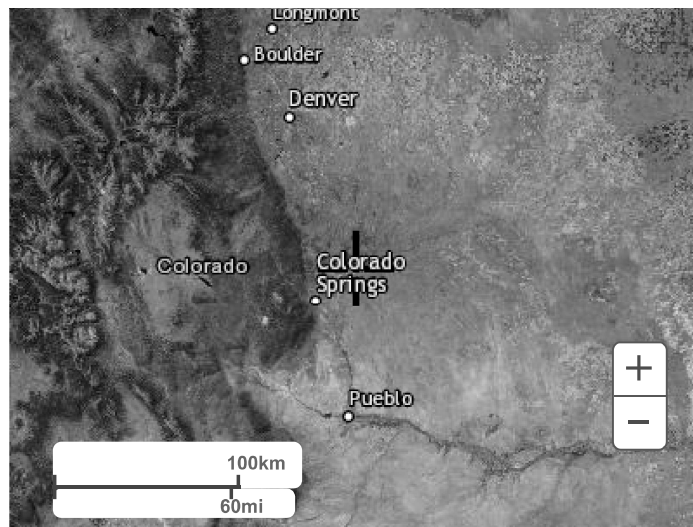
Large scale terrain



Large scale map



Large scale aerial



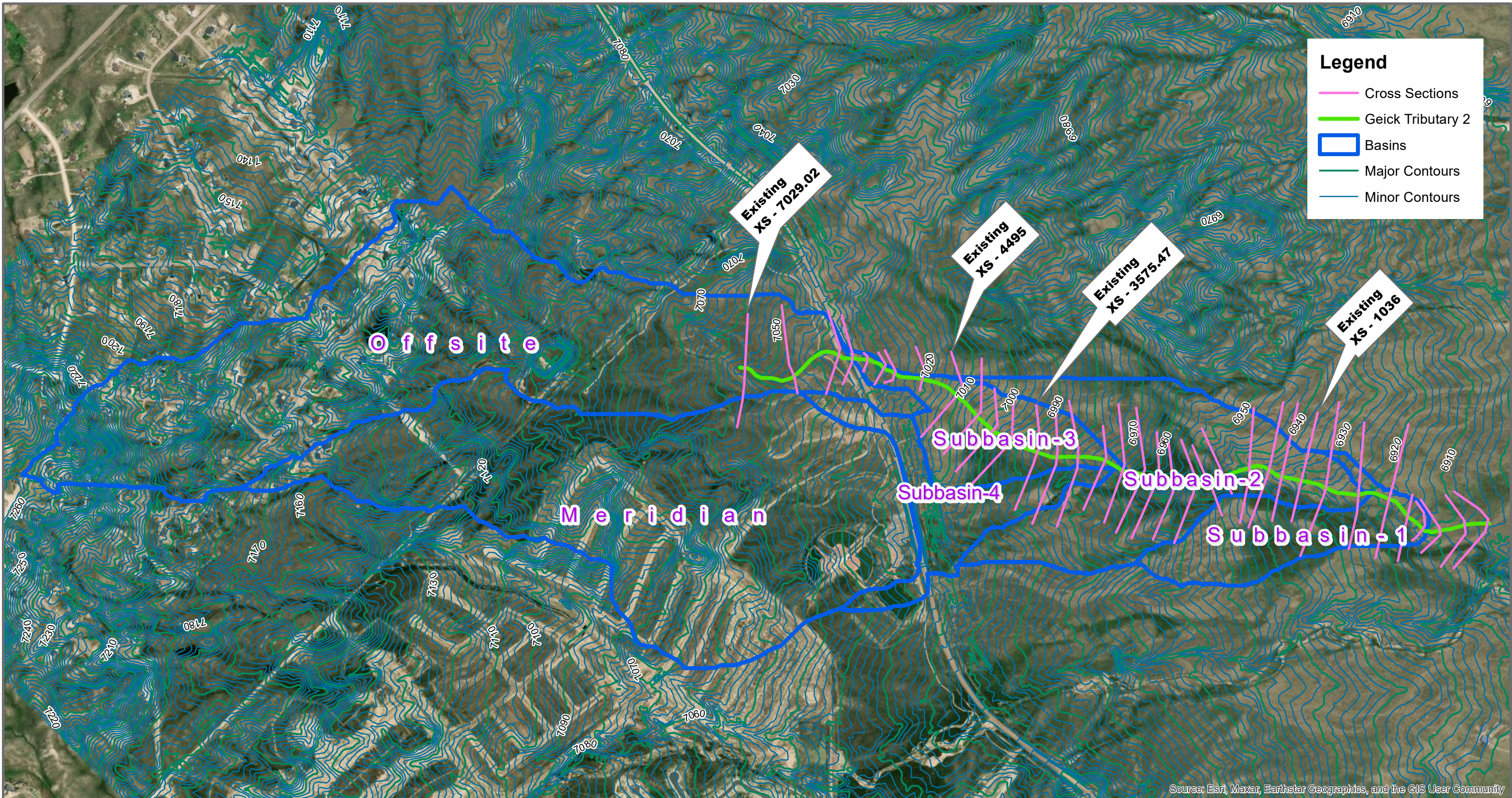
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[US Department of Commerce](#)  
[National Oceanic and Atmospheric Administration](#)  
[National Weather Service](#)  
[National Water Center](#)  
1325 East West Highway  
Silver Spring, MD 20910  
Questions?: [HDSC.Questions@noaa.gov](mailto:HDSC.Questions@noaa.gov)

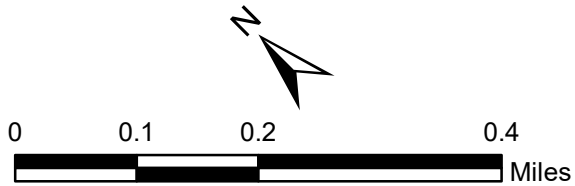
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## Grandview Tributary 2 Topographic Hydrologic Work Map

Datum = NAVD88





REVISION TO:  
MASTER DEVELOPMENT  
DRAINAGE PLAN  
MERIDIAN RANCH  
EL PASO COUNTY, COLORADO



July 2021

Prepared For:

**GTL DEVELOPMENT, INC.**  
**P.O. Box 80036**  
**San Diego, CA 92138**

Prepared By:  
Tech Contractors  
11886 Stapleton Drive  
Falcon, CO 80831  
719.495.7444

PCD Project No. SKP-21003

## CERTIFICATIONS

### Design Engineer's Statement:


The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Thomas A. Kerby, P.E.  
#31429



### Owner/Developer's Statement:

I, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

  
\_\_\_\_\_  
Raul Guzman, Vice President  
GTL Development, Inc.  
P.O. Box 80036  
San Diego, CA 92138

July 8, 2021

\_\_\_\_\_  
Date

### El Paso County:

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 & 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

\_\_\_\_\_  
Jennifer Irvine, P.E.  
County Engineer / ECM Administrator

**APPROVED**  
**Engineering Department**

07/15/2021 8:53:01 AM

*dsdnijkamp*

**EPC Planning & Community  
Development Department**

## **EXECUTIVE SUMMARY**

The purpose of the revision to the following Master Development Drainage Plan is to present updated conceptual drainage improvements for the remaining undeveloped portions of the Meridian Ranch Development based upon the proposed sketch plan amendment and to update data from within the development tributary to area of interest. Runoff quantities and proposed facilities have been calculated using the current City of Colorado Springs/El Paso County Drainage Criteria Manual (DCM) (1994 version) and portions of the City of Colorado Springs Drainage Criteria Manual, Volume 1 (DCM-1) ((2014 version). Concepts presented in this report will be refined and specific improvements addressed during the Final Plat process.

The revisions included within this report include the density increase as proposed with this sketch plan amendment. The previous revision to the MDDP (2017) included the removal of the 40-acre business park near the northwest corner of Stapleton Dr. and Eastonville Rd. and repurposing it to residential land use. The developed calculations reflect the density increase sought in this revision.

The hydrologic calculations within this report follow method outlined in Chapter 6 of the 2014 version of the City of Colorado Springs Drainage Criteria Manual (COSDCM) as adopted by the El Paso County Board of County Commissioners by Resolution 15-042. Chapter 6 addresses the hydrologic calculation methods and includes an updated hydrograph to be used with storm drainage runoff. The Board adopted by the same resolution, Section 3.2.1 of Chapter 13 of the COSDCM referencing Full Spectrum Detention; the concept “provides better control of the full range of runoff rates that pass through detention facilities than the convention multi-stage concept. This section of the COSDCM identifies the necessity to provide full spectrum detention but does not prescribe a methodology to reach such the detention requirements. This report includes hydrologic models from HEC-HMS for the historic and future conditions for the 2-yr, 5-yr, 10-yr, 50-yr, and 100-yr design storm frequencies. The future conditions include detention facilities sized and modeled such that *“frequent and infrequent inflows are released at rates approximating undeveloped conditions.”*

On November 16, 2000 the El Paso County Board of County Commissioners approved the rezoning of the Meridian Ranch project (PUD-00-010) from A-35 to PUD with several conditions. Condition number seven stated in part that “drainage plans shall release and/or retain at approximately eighty percent (80%) of historic rates.” The previous report (2017 MDDP) removed this condition and allow the project to release developed flow at historic rates as outlined in the current City of Colorado Springs/El Paso County Drainage Criteria Manual (DCM) (1994 version) and those portions of the City of Colorado Springs Drainage Criteria Manual, Volume 1 (DCM-1) ((2014 version) adopted by the El Paso County Board of County Commissioners by Resolution No. 15-042.

The original boundary limits of Meridian Ranch encompassed 2620 acre proposed development and is located approximately 12 miles northeast of the City of Colorado Springs, 2.5 miles north of the town of Falcon and immediately north of the Woodmen Hills development.

The Sketch Plan amendment includes all the remaining 197 acres of the undeveloped portion of Meridian Ranch. Of the undeveloped land it is proposed to have 110 acres of residential development, 49 acres of open space, drainage/detention facilities and park sites, and 38 acres of R.O.W.

The calculated developed flow rates greater than the historic discharge flow rates will be mitigated with the use of full spectrum detention facilities to be located within the project and along eastern boundary of the project. The Meridian Ranch Development will not adversely impact the downstream properties.



Subbasin	CN	L [mi]	L [ft]	Y	Y[%]	S	Tc [hr]	Tc [min]	Lag [hr]	Lag [min]
1	79.41	0.52	2727.6	0.023	2.31	2.59	0.79	47.52	0.4752	28.51
2	73.76	0.75	3954.4	0.022	2.21	3.56	1.29	77.24	0.7724	46.35
3	72.81	0.34	1782.5	0.023	2.34	3.73	0.68	40.76	0.4076	24.46
4	70.32	0.42	2238.8	0.027	2.66	4.22	0.82	49.10	0.491	29.46
Meridian	80.16	1.37	7254.6	0.024	2.37	2.48	1.67	100.17	1.0017	60.10
Offsite	78.64	1.76	9293.3	0.027	2.68	2.72	2.01	120.52	1.2052	72.31

## Time of Concentration (T<sub>c</sub>)

Time taken by a rainfall drop to travel from the farthest point in the watershed to the outlet.

$$T_c = \frac{\ell^{0.8} (S+1)^{0.7}}{1,140 Y^{0.5}} \quad \text{Lag} = 0.6 T_c$$

where:

L = lag, h

T<sub>c</sub> = time of concentration, h

ℓ = flow length, ft

Y = average watershed land slope, %

S = maximum potential retention, in

$$S = \frac{1000}{CN} - 10$$

(American Units; 0 < CN < 100)

**Project:** M G**Simulation Run:** 100-year**Simulation Start:** 1 January 2023, 01:00**Simulation End:** 2 January 2023, 01:00**HMS Version:** 4.11**Executed:** 26 March 2024, 16:21**Global Parameter Summary - Subbasin**

Location		
Element Name	Longitude Degrees	Latitude Degrees
Offsite	-104.57	39
Meridian	-104.57	38.99
Subbasin - 3	-104.56	38.99
Subbasin - 4	-104.57	38.99
Subbasin - 2	-104.56	38.99
Subbasin - 1	-104.56	38.98

Area (MI <sup>2</sup> )	
Element Name	Area (MI <sup>2</sup> )
Offsite	0.33
Meridian	0.3
Subbasin - 3	0.05
Subbasin - 4	0.04
Subbasin - 2	0.12
Subbasin - 1	0.05

Downstream	
Element Name	Downstream
Offsite	Reach - 3
Meridian	Reach - 4
Subbasin - 3	Reach - 2
Subbasin - 4	Reach - 2
Subbasin - 2	Reach - 1
Subbasin - 1	Sink - 1

Loss Rate: Scs			
Element Name	Percent Impervious Area	Curve Number	Initial Abstraction
Offsite	0	78.64	0
Meridian	0	80.16	0
Subbasin - 3	0	72.81	0
Subbasin - 4	0	70.32	0
Subbasin - 2	0	73.76	0
Subbasin - 1	0	79.41	0

Transform: Scs

Element Name	Lag	Unitgraph Type
Offsite	72.31	Standard
Meridian	60.1	Standard
Subbasin - 3	24.46	Standard
Subbasin - 4	29.46	Standard
Subbasin - 2	46.35	Standard
Subbasin - 1	28.51	Standard

Global Parameter Summary - Reach

Downstream

Element Name	Downstream
Reach - 3	Reach - 2
Reach - 4	Reach - 2
Reach - 2	Reach - 1
Reach - 1	Sink - 1

Route: Muskingum Cunge

Element Name	Method	Channel	Length (FT)	Energy Slope (FT/FT)	Mannings n	Bottom Width (FT)	Side Slope (FT/FT)	Initial Variable	Space - Time Method	Index Parameter Type	Index Celerity	Number of Sub
Reach - 3	Muskingum Cunge	Trapezoid	1865.37	0.03	0.04	38.76	4	Combined Inflow	Automatic DX and DT	Index Celerity	1.33	
Reach - 4	Muskingum Cunge	Trapezoid	1902.61	0.02	0.04	38.76	4	Combined Inflow	Automatic DX and DT	Index Celerity	1.33	
Reach - 2	Muskingum Cunge	Trapezoid	2337.51	0.02	0.04	38.76	4	Combined Inflow	Automatic DX and DT	Index Celerity	1.33	
Reach - 1	Muskingum Cunge	Trapezoid	849.59	0.01	0.04	38.76	4	Combined Inflow	Automatic DX and DT	Index Celerity	1.33	

Global Results Summary

Hydrologic Element	Drainage Area (MI <sup>2</sup> )	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Offsite	0.33	241.65	01Jan2023, 14:20	3.14
Reach - 3	0.33	241.33	01Jan2023, 14:25	3.12
Meridian	0.3	261.88	01Jan2023, 14:05	3.25
Reach - 4	0.3	261.88	01Jan2023, 14:10	3.24
Subbasin - 3	0.05	62.65	01Jan2023, 13:30	2.8
Subbasin - 4	0.04	47.38	01Jan2023, 13:35	2.65
Reach - 2	0.72	536.09	01Jan2023, 14:15	3.11
Subbasin - 2	0.12	103.28	01Jan2023, 13:50	2.84
Reach - 1	0.84	621.27	01Jan2023, 14:10	3.07
Subbasin - 1	0.05	67.11	01Jan2023, 13:35	3.22
Sink - 1	0.89	649.23	01Jan2023, 14:10	3.08

## Subbasin: Offsite

**Area (MI<sup>2</sup>)** : 0.33

**Latitude Degrees** : 39

**Longitude Degrees** : -104.57

**Downstream** : Reach - 3

### Loss Rate: SCS

Percent Impervious Area	0
Curve Number	78.64
Initial Abstraction	0

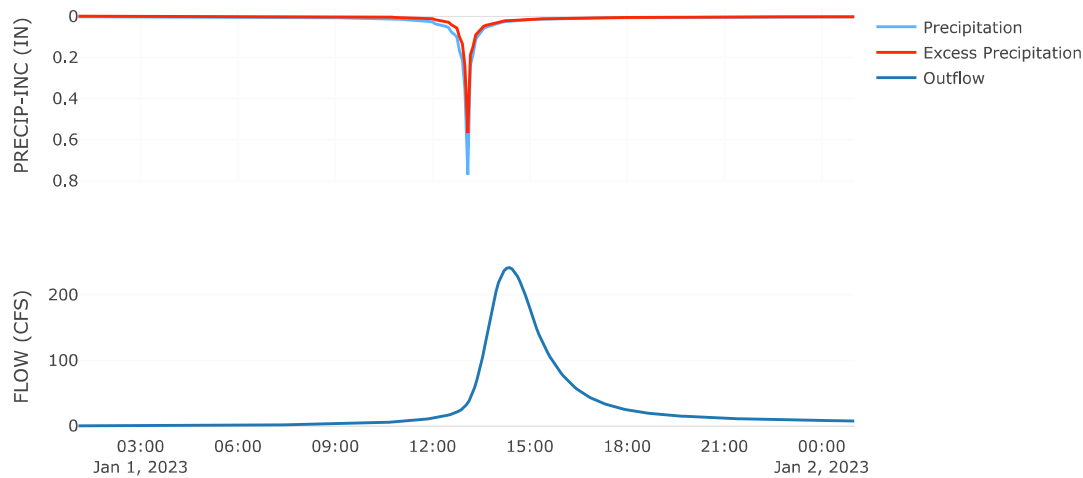
### Transform: SCS

Lag	72.31
Unitgraph Type	Standard

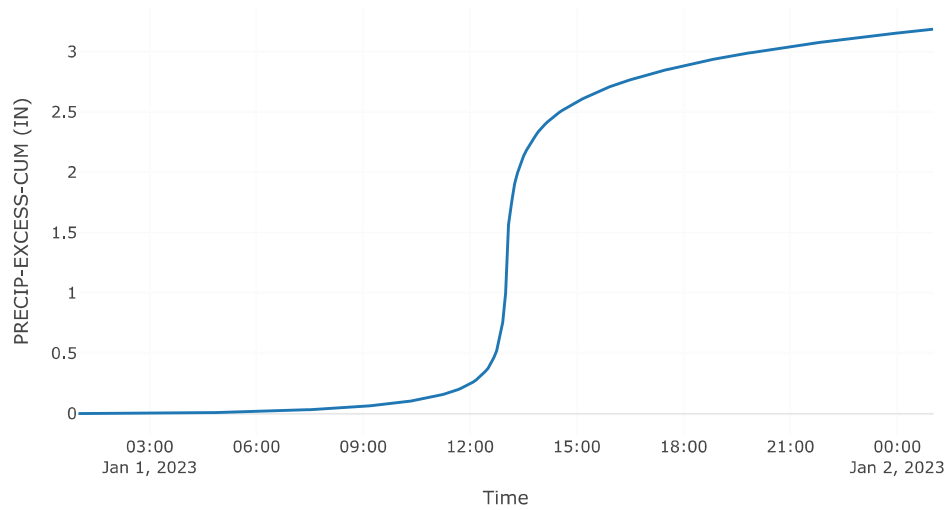
### Results: Offsite

Peak Discharge (CFS)	241.65
Time of Peak Discharge	01 Jan 2023, 14:20
Volume (IN)	3.14
Precipitation Volume (AC - FT)	86.48
Loss Volume (AC - FT)	30.69
Excess Volume (AC - FT)	55.8
Direct Runoff Volume (AC - FT)	54.89
Baseflow Volume (AC - FT)	0

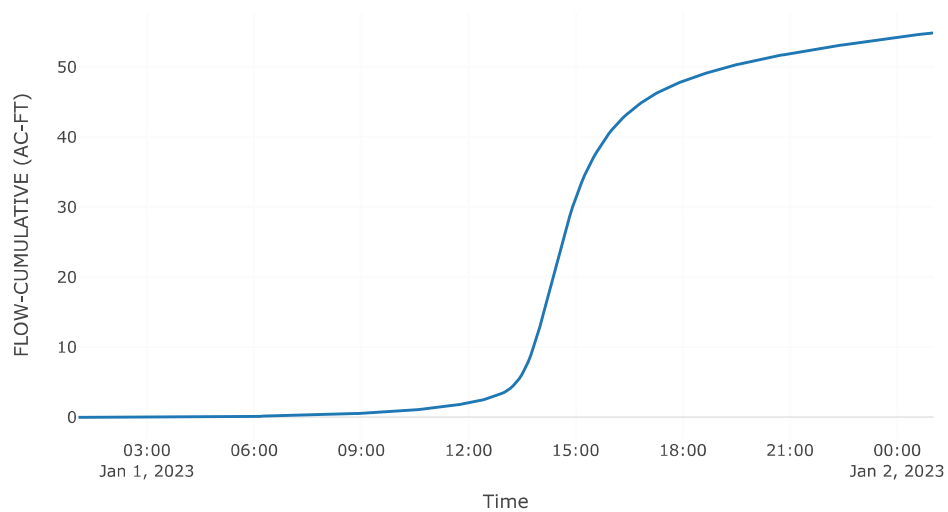
Precipitation and Outflow



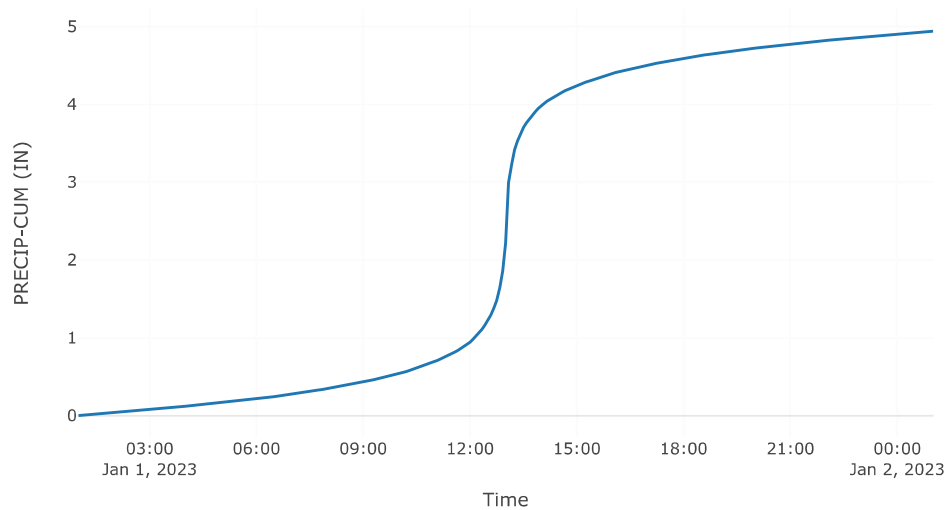
Cumulative Excess Precipitation

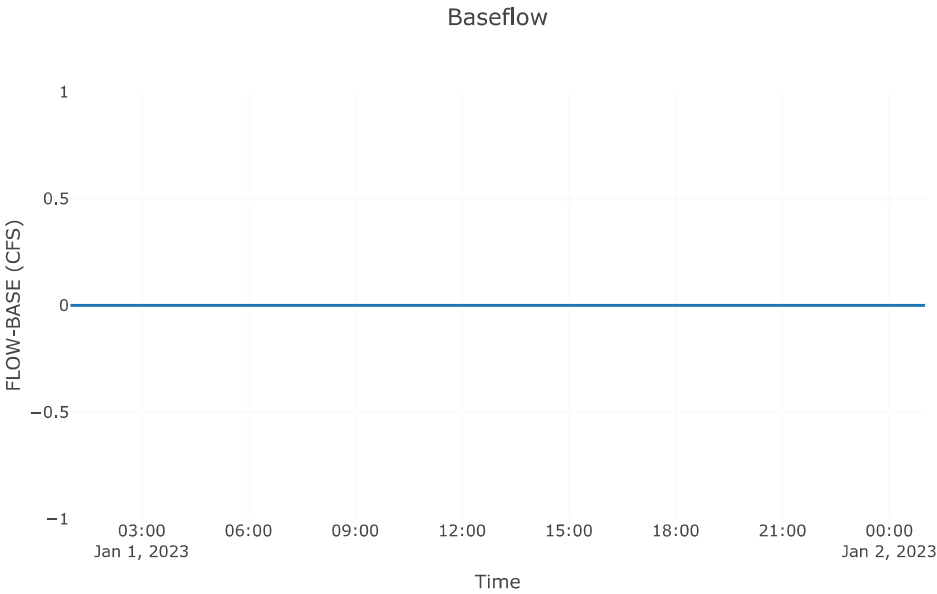
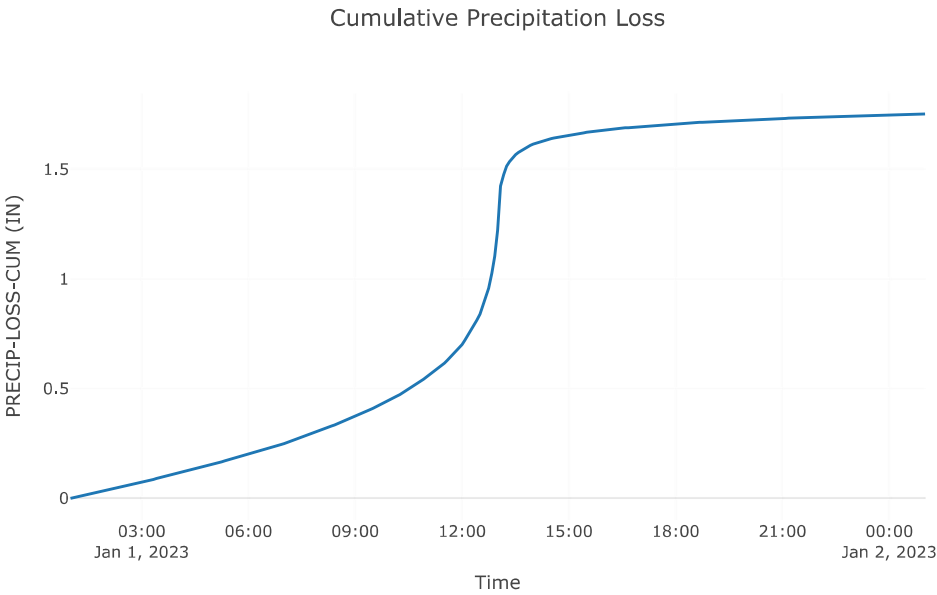


Cumulative Outflow

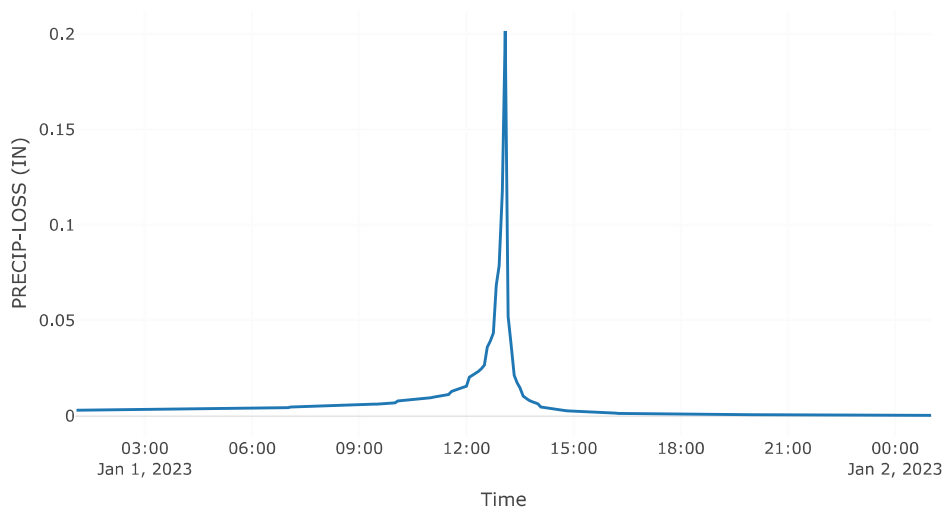


Cumulative Precipitation

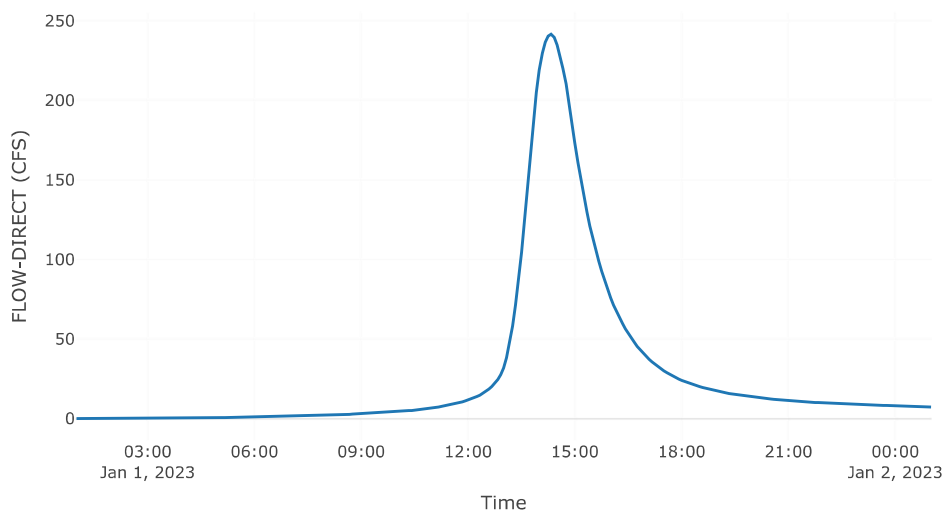




Precipitation Loss

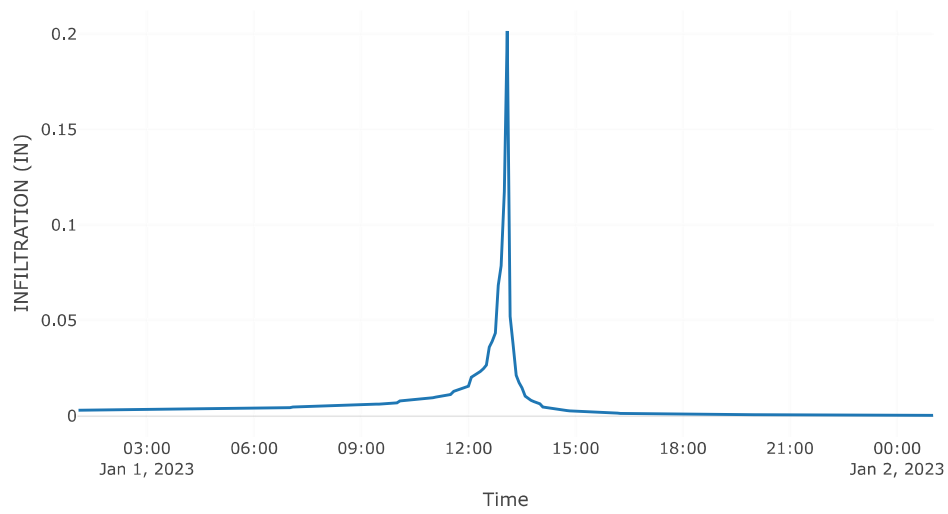


Direct Runoff





### Soil Infiltration



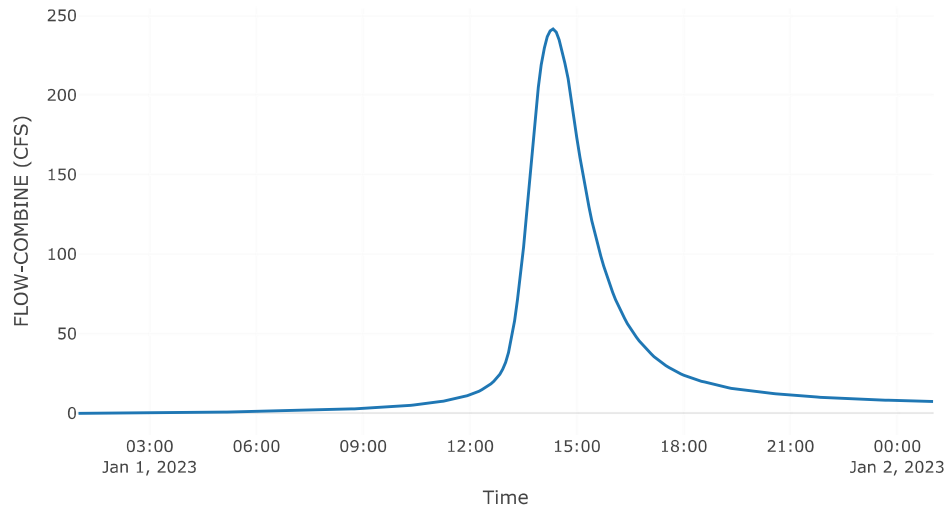
**Reach: Reach-3****Downstream** : Reach - 2**Route: Muskingum Cunge**

Method	Muskingum Cunge
Channel	Trapezoid
Length (FT)	1865.37
Energy Slope (FT/FT)	0.03
Mannings n	0.04
Bottom Width (FT)	38.76
Side Slope (FT/FT)	4
Initial Variable	Combined Inflow
Space - Time Method	Automatic DX and DT
Index Parameter Type	Index Celerity
Index Celerity	1.33
Number Subreaches	1
Maximum Depth Iterations	20
Maximum Route Step Iterations	30

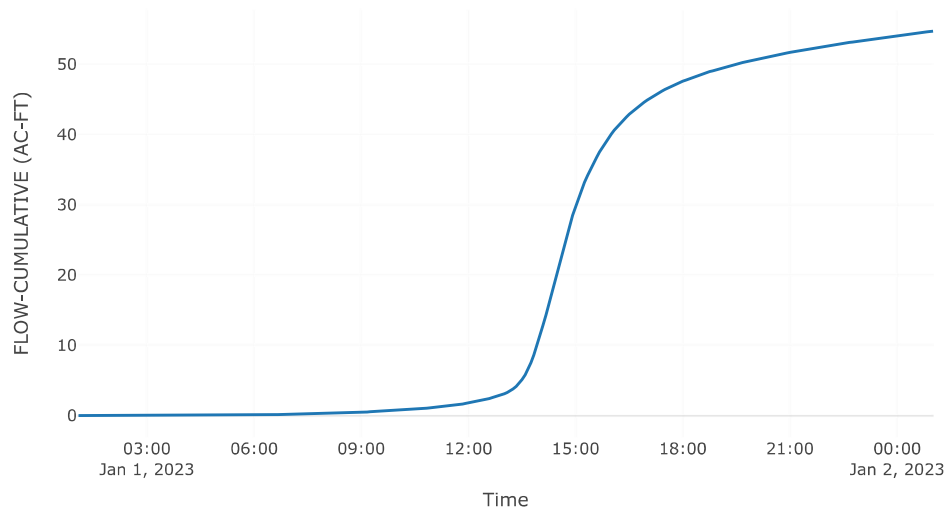
**Results: Reach-3**

Peak Discharge (CFS)	241.33
Time of Peak Discharge	01Jan2023, 14:25
Volume (IN)	3.12
Peak Inflow (CFS)	241.65
Inflow Volume (AC - FT)	54.89

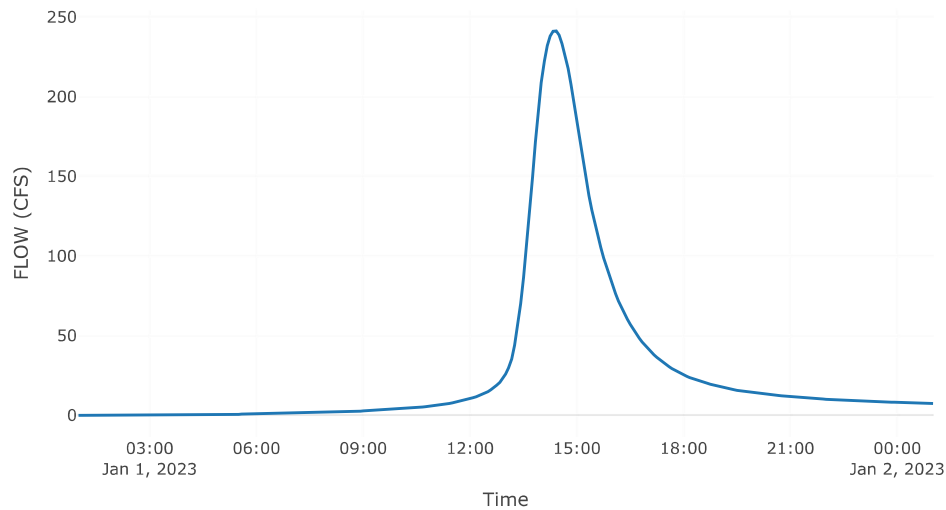
Combined Inflow



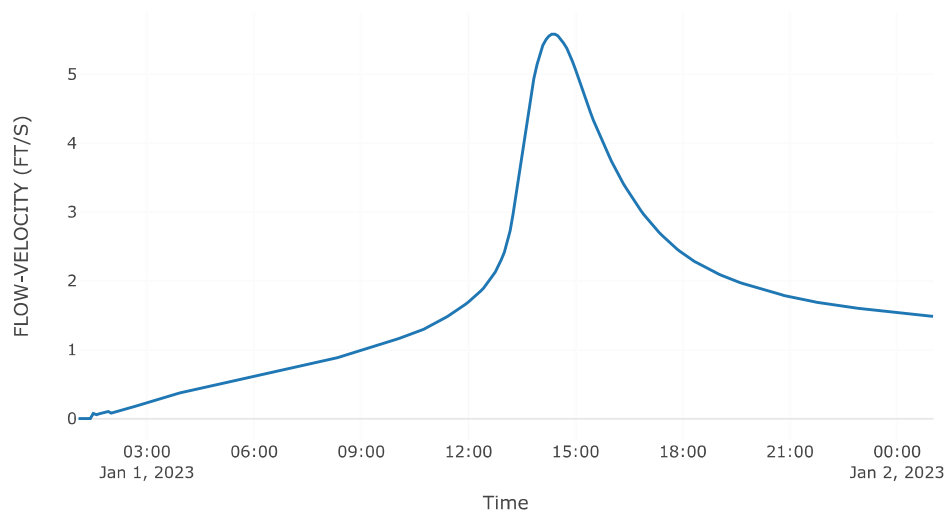
Cumulative Outflow



Outflow



Flow Velocity



## Subbasin: Meridian

**Area (MI<sup>2</sup>)** : 0.3

**Latitude Degrees** : 38.99

**Longitude Degrees** : -104.57

**Downstream** : Reach - 4

### Loss Rate: SCS

Percent Impervious Area	0
Curve Number	80.16
Initial Abstraction	0

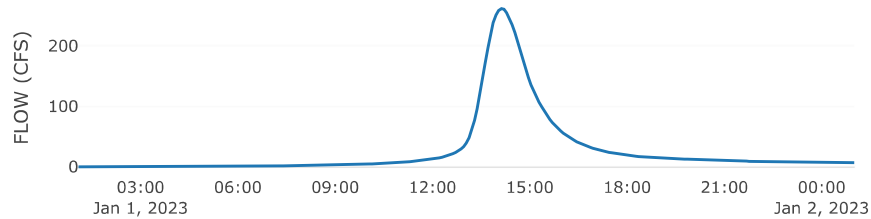
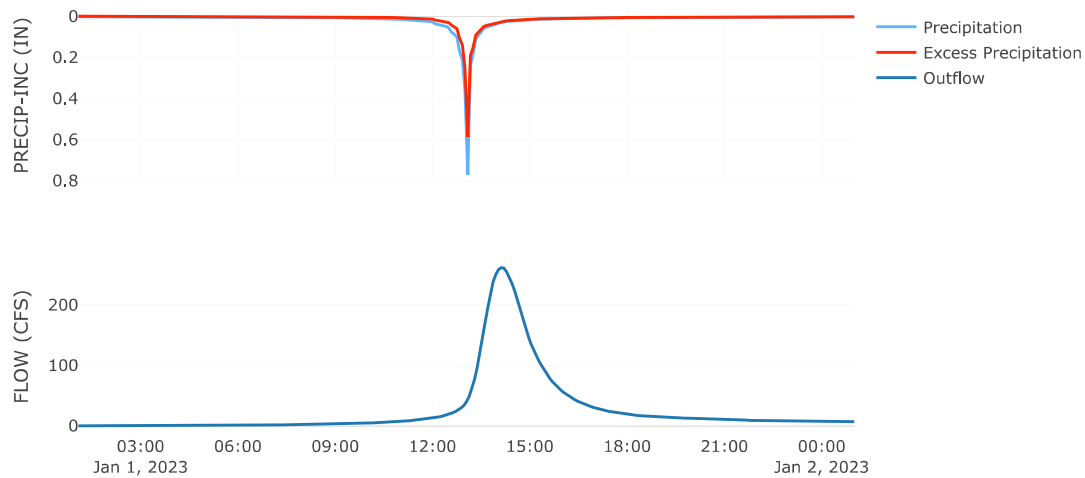
### Transform: SCS

Lag	60.1
Unitgraph Type	Standard

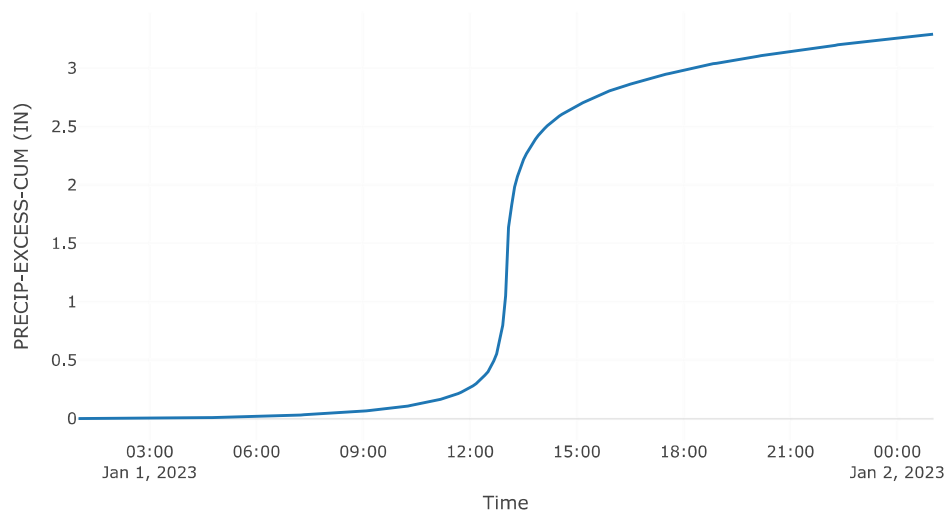
### Results: Meridian

Peak Discharge (CFS)	261.88
Time of Peak Discharge	01 Jan 2023, 14:05
Volume (IN)	3.25
Precipitation Volume (AC - FT)	79.77
Loss Volume (AC - FT)	26.63
Excess Volume (AC - FT)	53.14
Direct Runoff Volume (AC - FT)	52.44
Baseflow Volume (AC - FT)	0

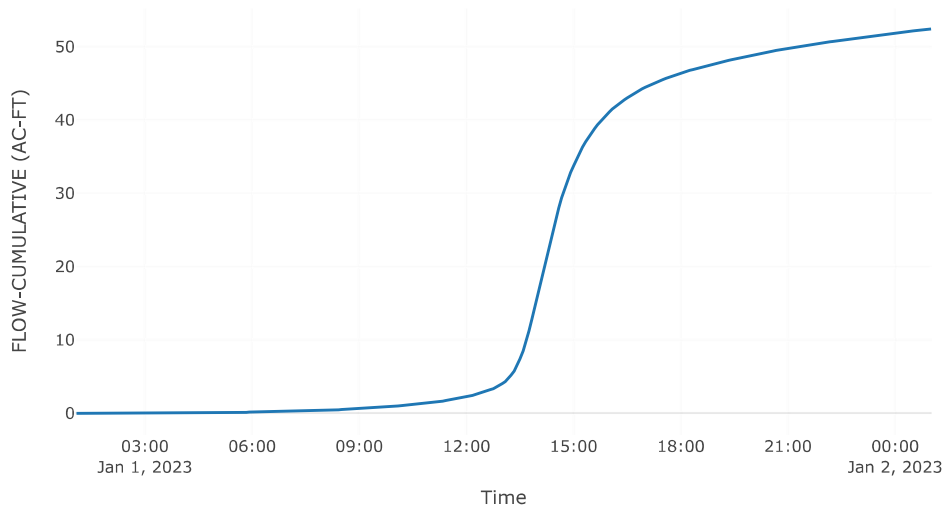
### Precipitation and Outflow



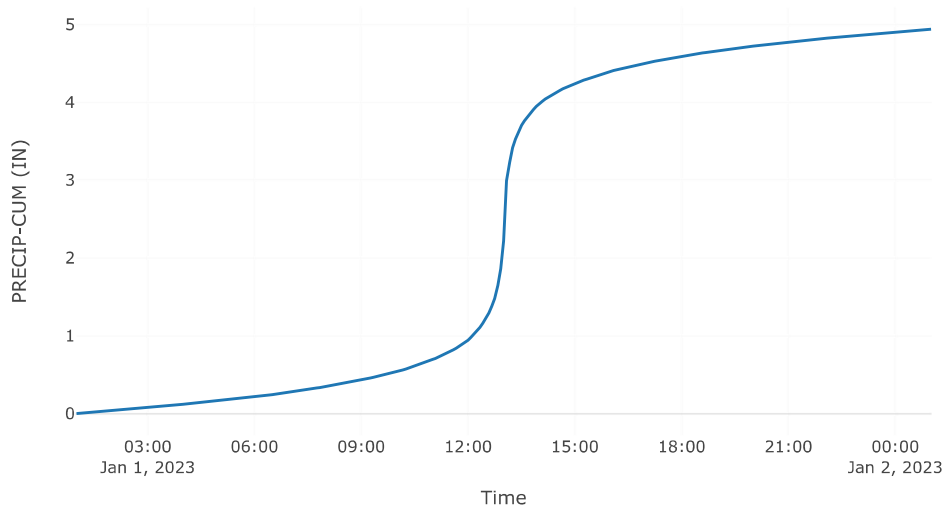
### Cumulative Excess Precipitation



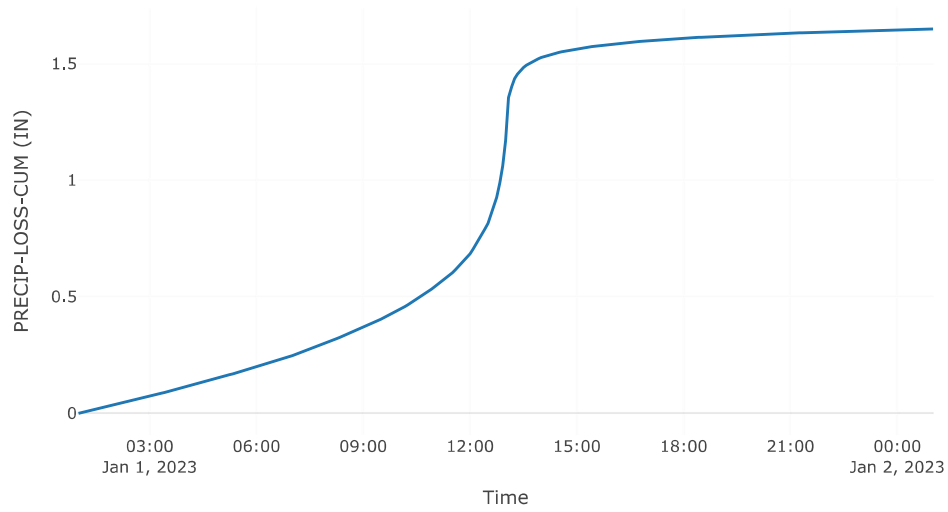
Cumulative Outflow



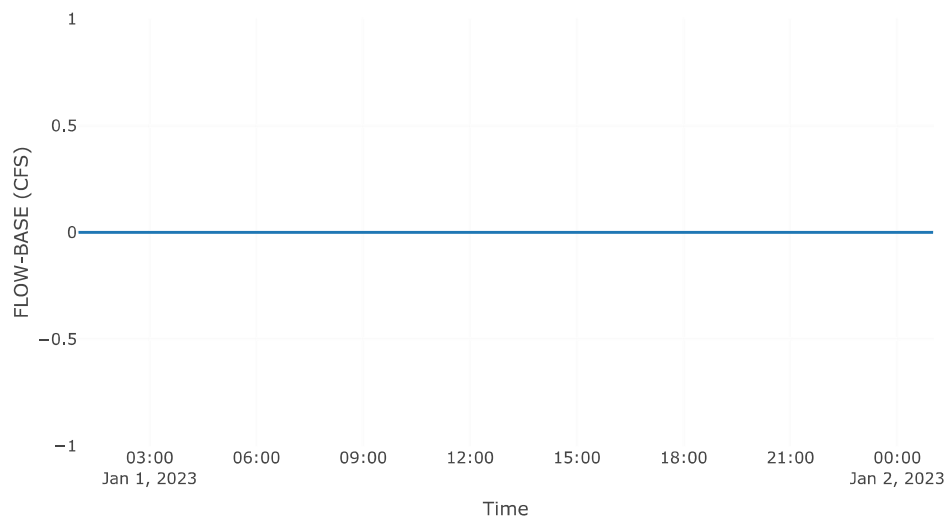
Cumulative Precipitation



Cumulative Precipitation Loss

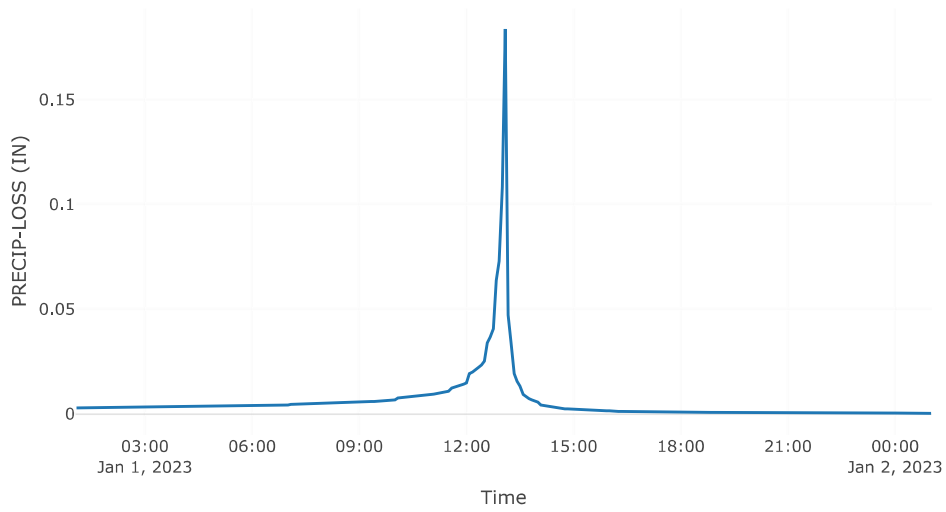


Baseflow

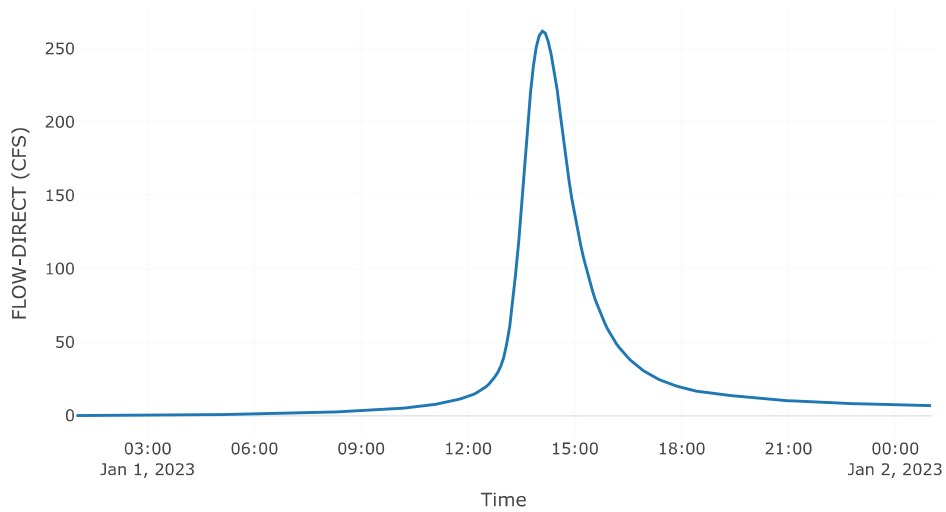


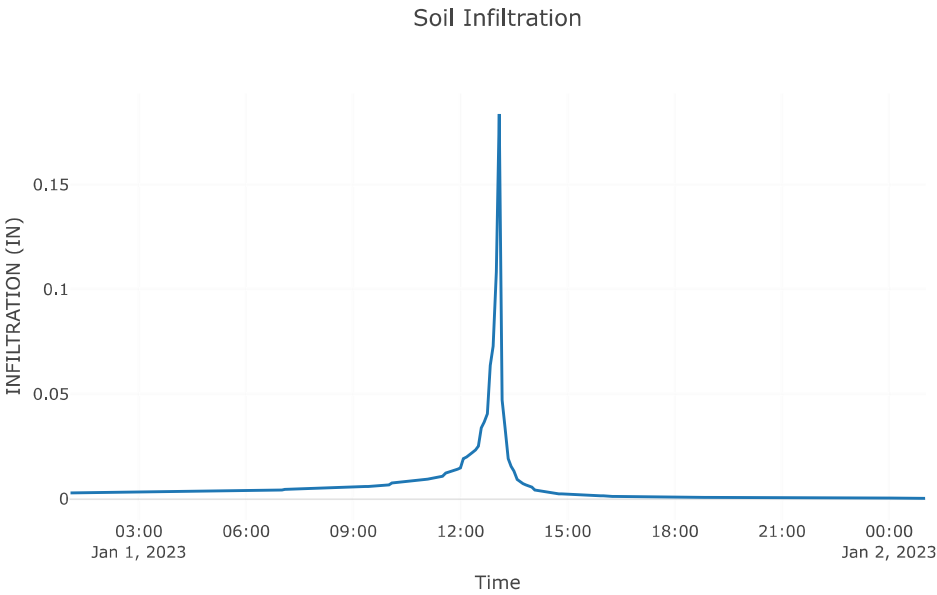


Precipitation Loss



Direct Runoff





## Reach: Reach-4

**Downstream** : Reach - 2

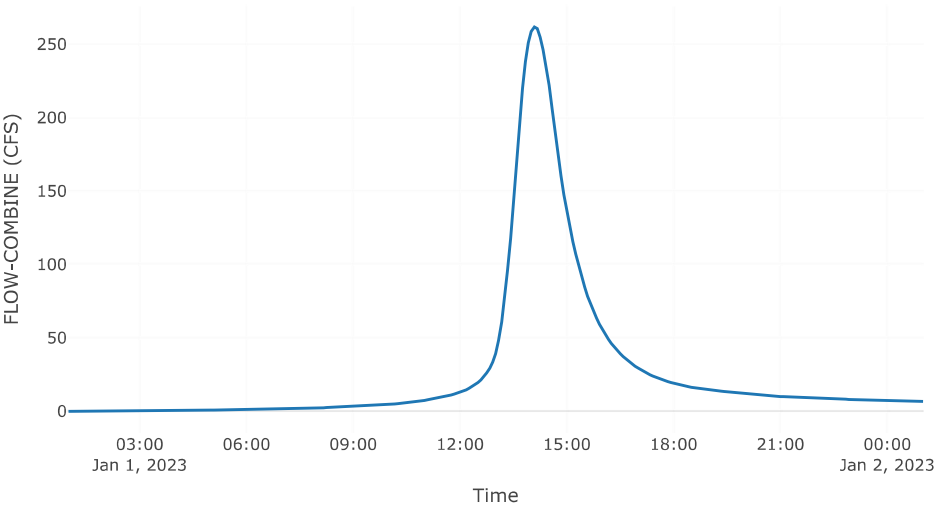
### Route: Muskingum Cunge

Method	Muskingum Cunge
Channel	Trapezoid
Length (FT)	1902.61
Energy Slope (FT/FT)	0.02
Mannings n	0.04
Bottom Width (FT)	38.76
Side Slope (FT/FT)	4
Initial Variable	Combined Inflow
Space - Time Method	Automatic DX and DT
Index Parameter Type	Index Celerity
Index Celerity	1.33
Number Subreaches	1
Maximum Depth Iterations	20
Maximum Route Step Iterations	30

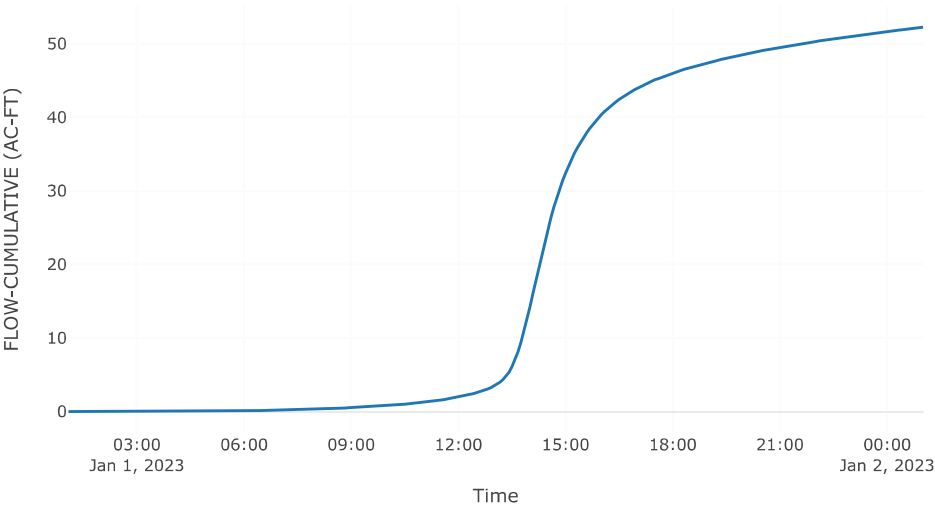
### Results: Reach-4

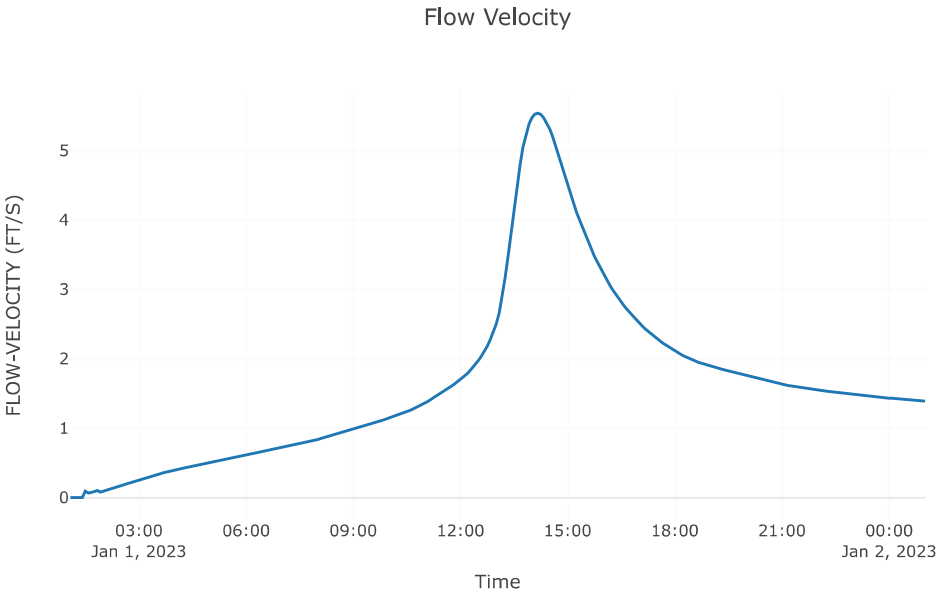
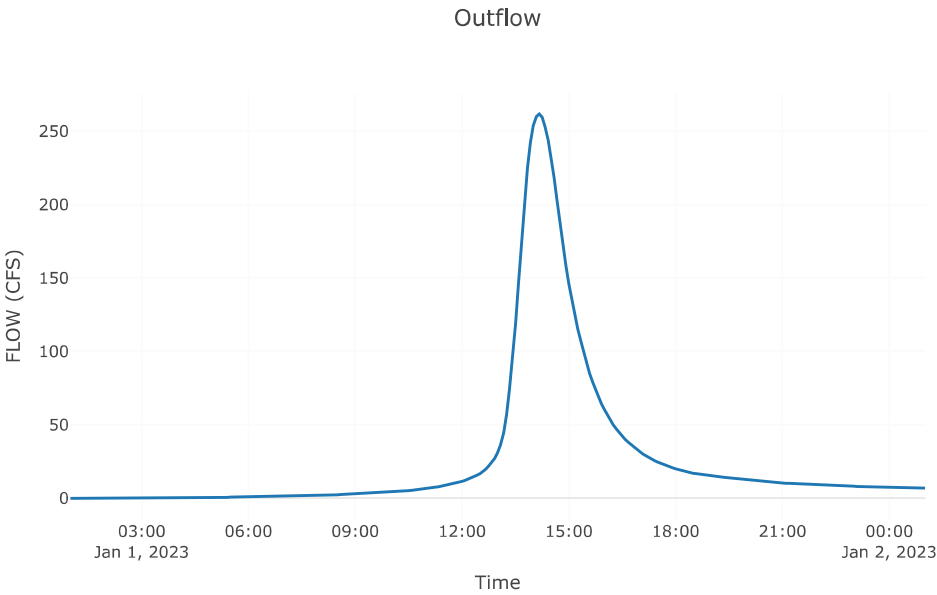
Peak Discharge (CFS)	261.88
Time of Peak Discharge	01 Jan 2023, 14:10
Volume (IN)	3.24
Peak Inflow (CFS)	261.88
Inflow Volume (AC - FT)	52.44

Combined Inflow



Cumulative Outflow





## Subbasin: Subbasin-3

**Area (MI<sup>2</sup>)** : 0.05

**Latitude Degrees** : 38.99

**Longitude Degrees** : -104.56

**Downstream** : Reach - 2

### Loss Rate: SCS

Percent Impervious Area	0
Curve Number	72.81
Initial Abstraction	0

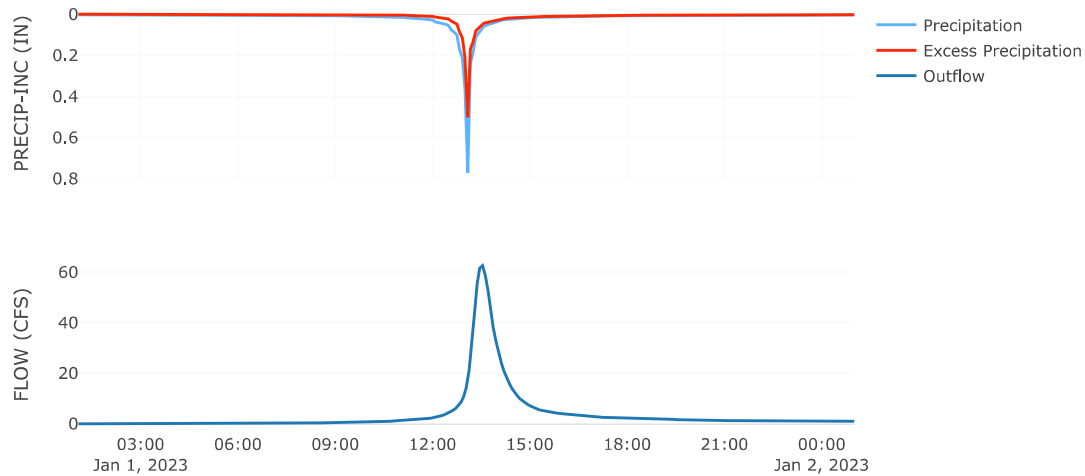
### Transform: SCS

Lag	24.46
Unitgraph Type	Standard

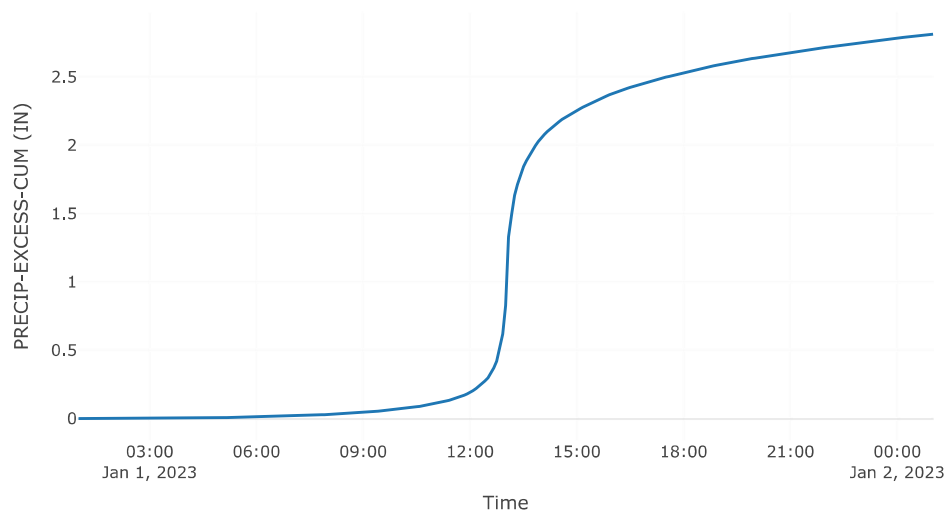
### Results: Subbasin-3

Peak Discharge (CFS)	62.65
Time of Peak Discharge	01 Jan 2023, 13:30
Volume (IN)	2.8
Precipitation Volume (AC - FT)	12.83
Loss Volume (AC - FT)	5.52
Excess Volume (AC - FT)	7.31
Direct Runoff Volume (AC - FT)	7.27
Baseflow Volume (AC - FT)	0

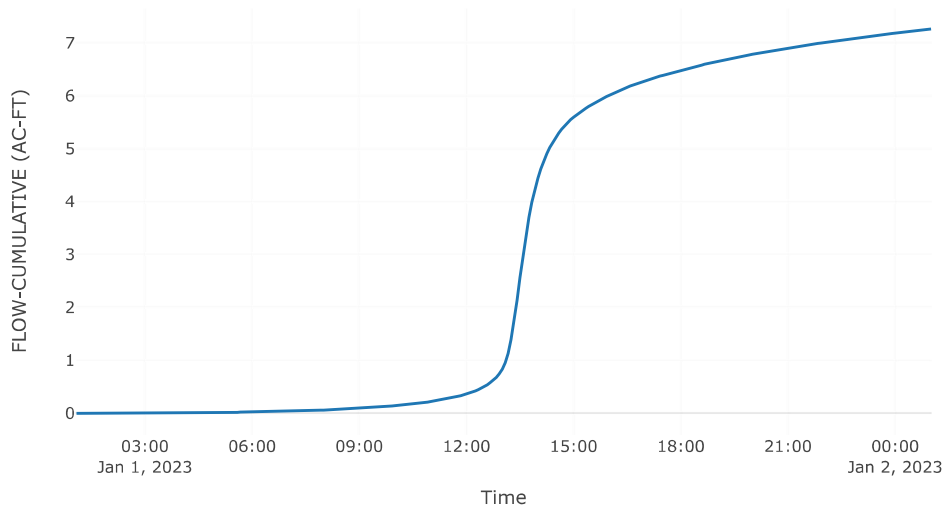
### Precipitation and Outflow



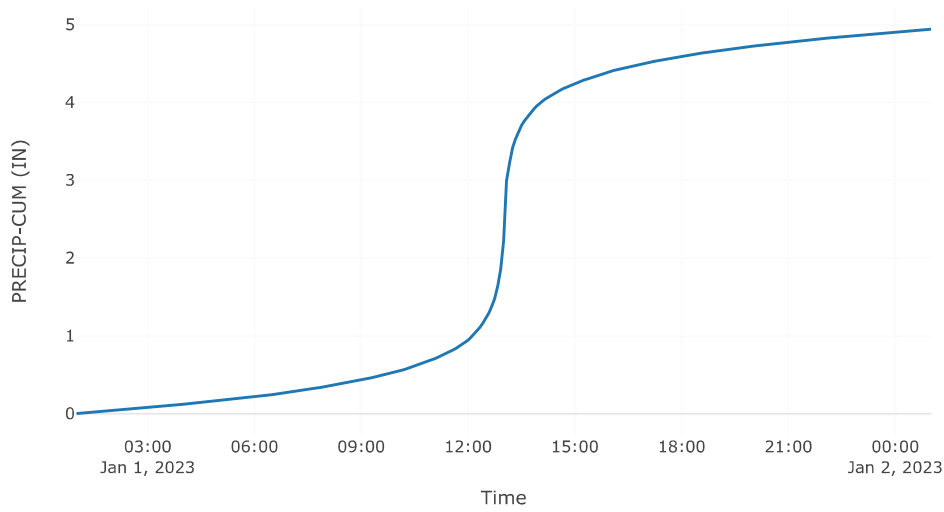
### Cumulative Excess Precipitation



Cumulative Outflow

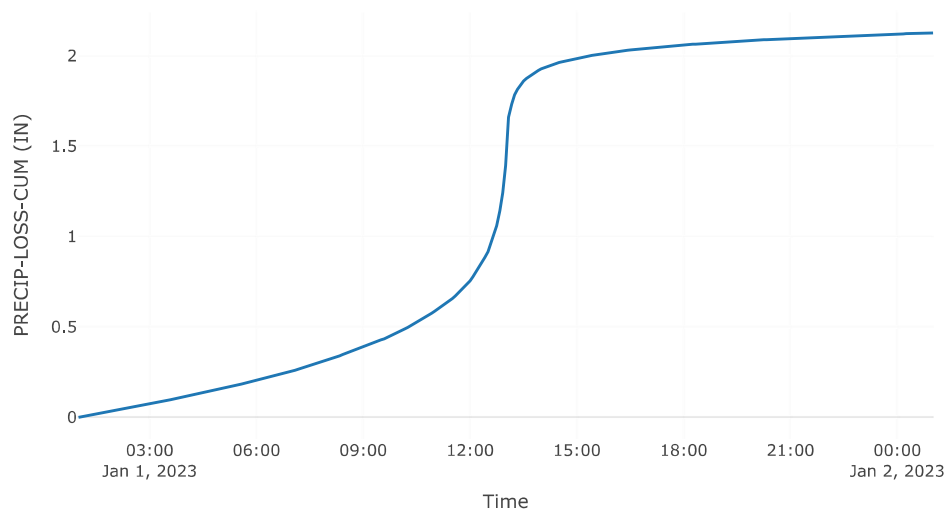


Cumulative Precipitation

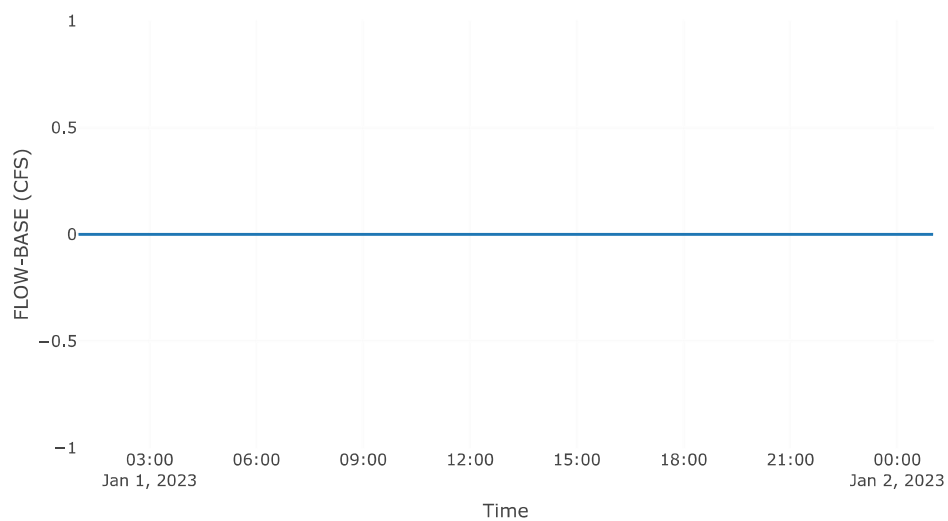




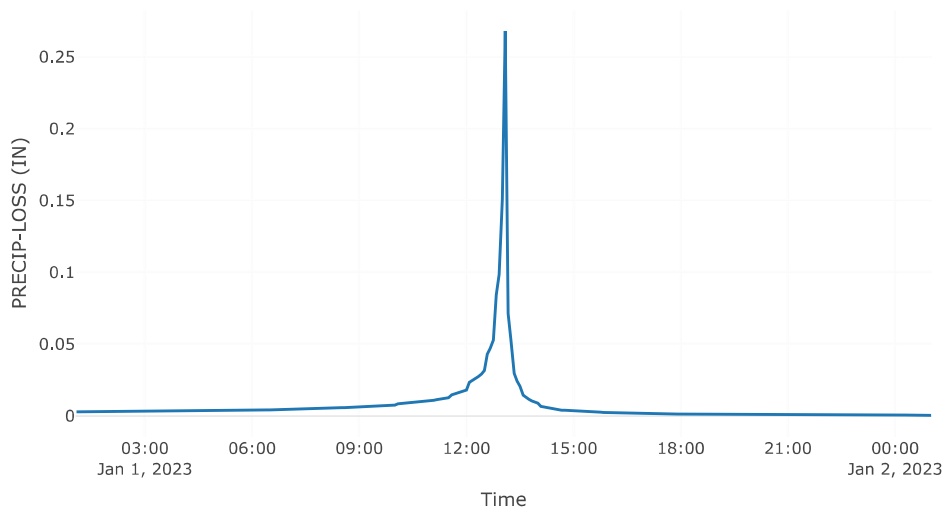
Cumulative Precipitation Loss



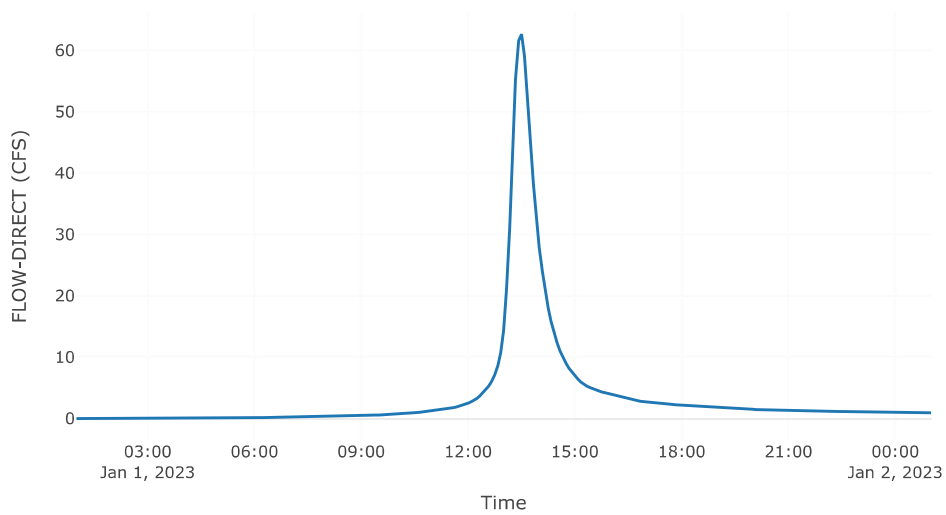
Baseflow



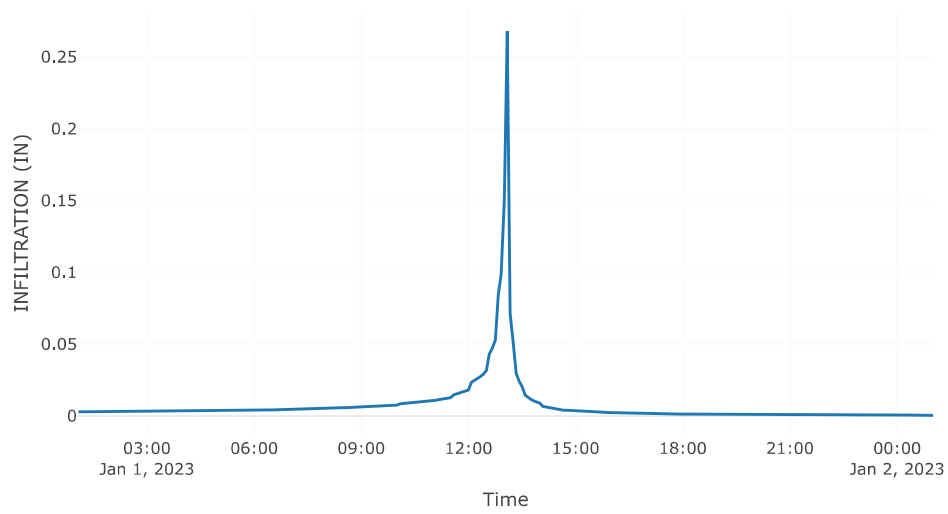
Precipitation Loss



Direct Runoff



### Soil Infiltration



## Subbasin: Subbasin-4

**Area (MI<sup>2</sup>)** : 0.04

**Latitude Degrees** : 38.99

**Longitude Degrees** : -104.57

**Downstream** : Reach - 2

### Loss Rate: SCS

Percent Impervious Area	0
Curve Number	70.32
Initial Abstraction	0

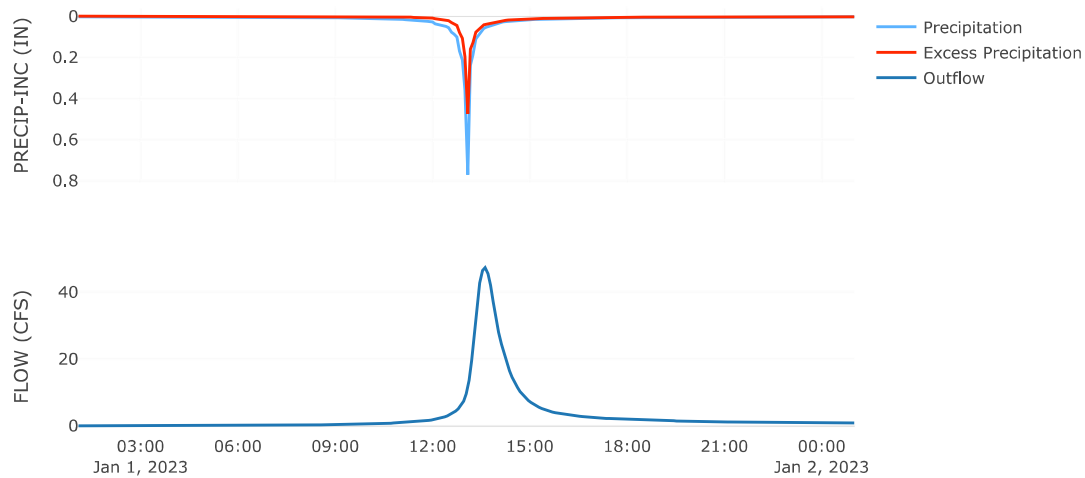
### Transform: SCS

Lag	29.46
Unitgraph Type	Standard

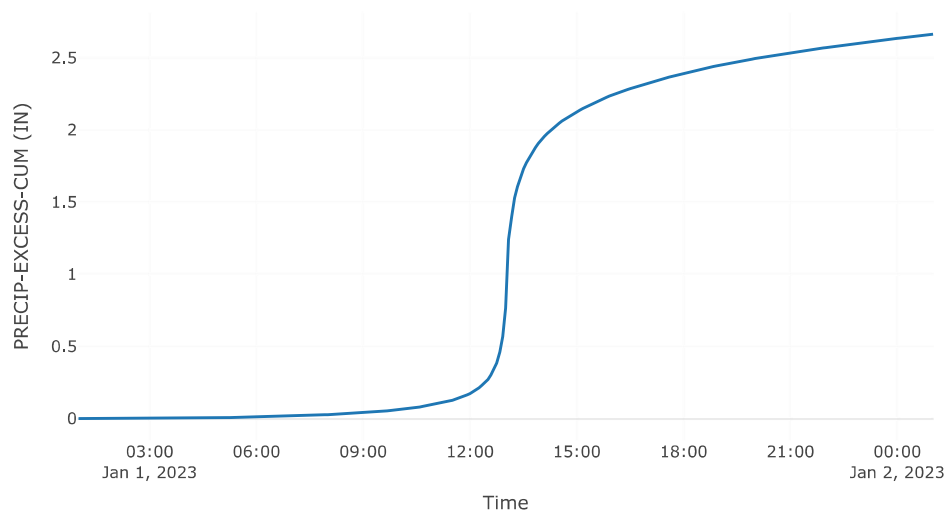
### Results: Subbasin-4

Peak Discharge (CFS)	47.38
Time of Peak Discharge	01 Jan 2023, 13:35
Volume (IN)	2.65
Precipitation Volume (AC - FT)	11.41
Loss Volume (AC - FT)	5.26
Excess Volume (AC - FT)	6.15
Direct Runoff Volume (AC - FT)	6.11
Baseflow Volume (AC - FT)	0

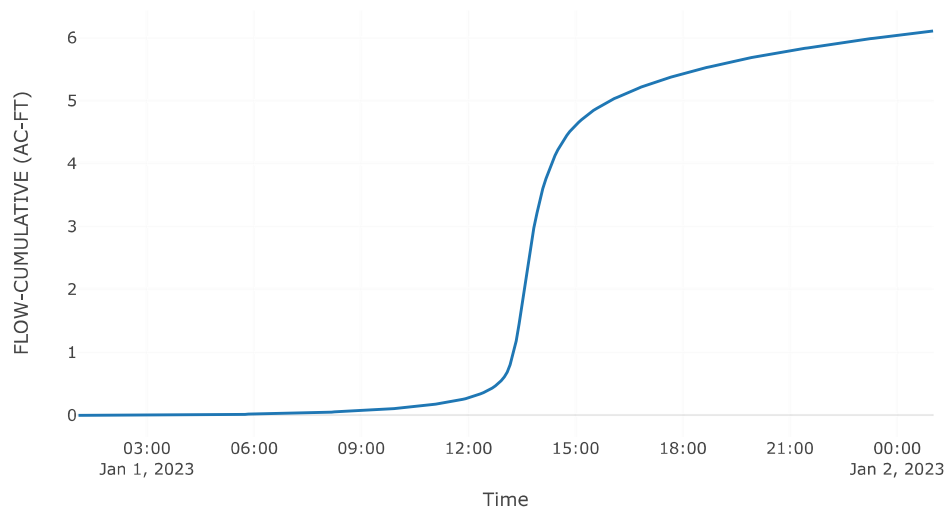
### Precipitation and Outflow



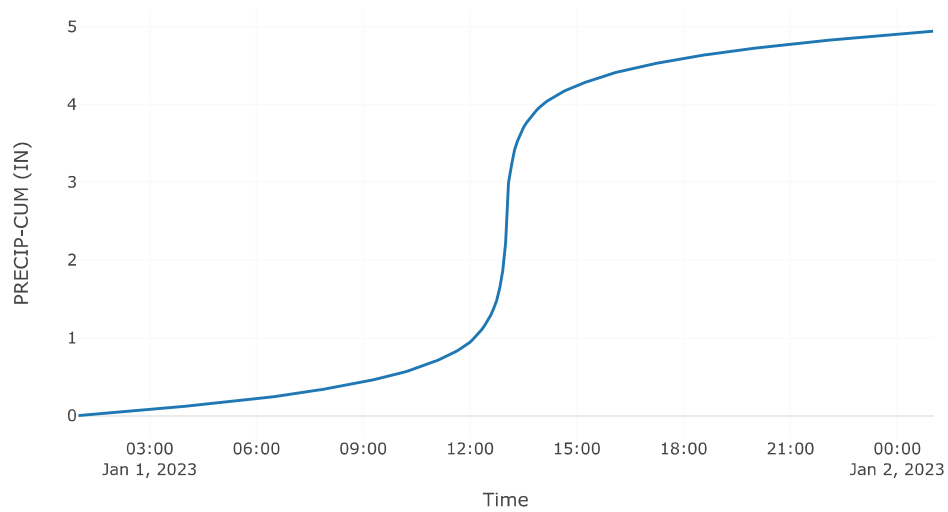
### Cumulative Excess Precipitation



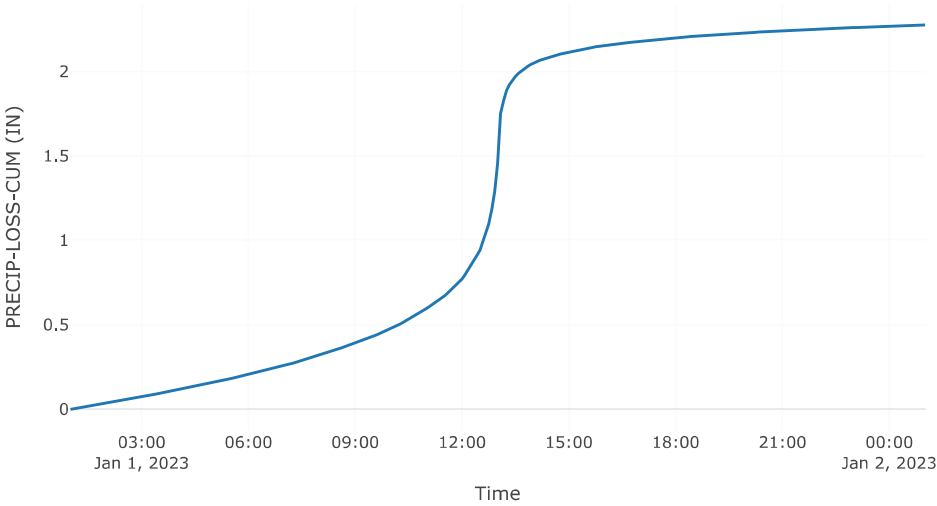
Cumulative Outflow



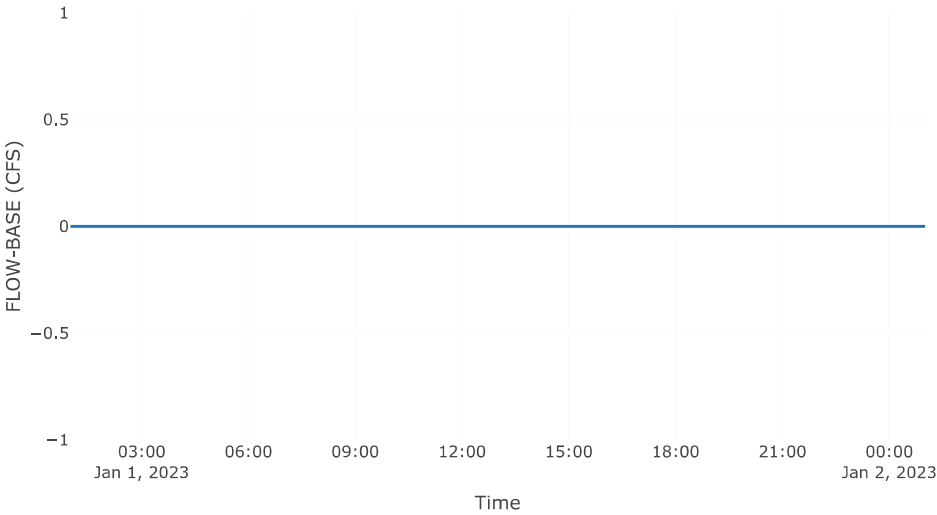
Cumulative Precipitation



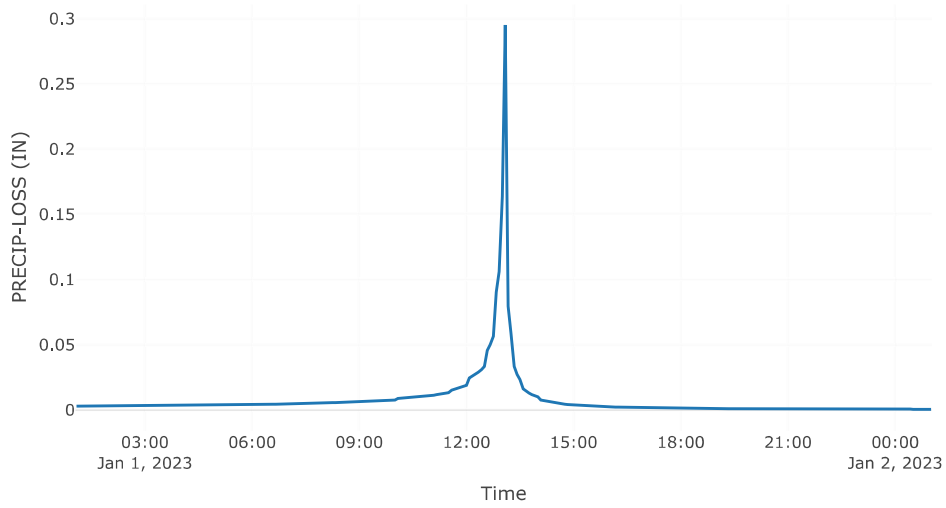
Cumulative Precipitation Loss



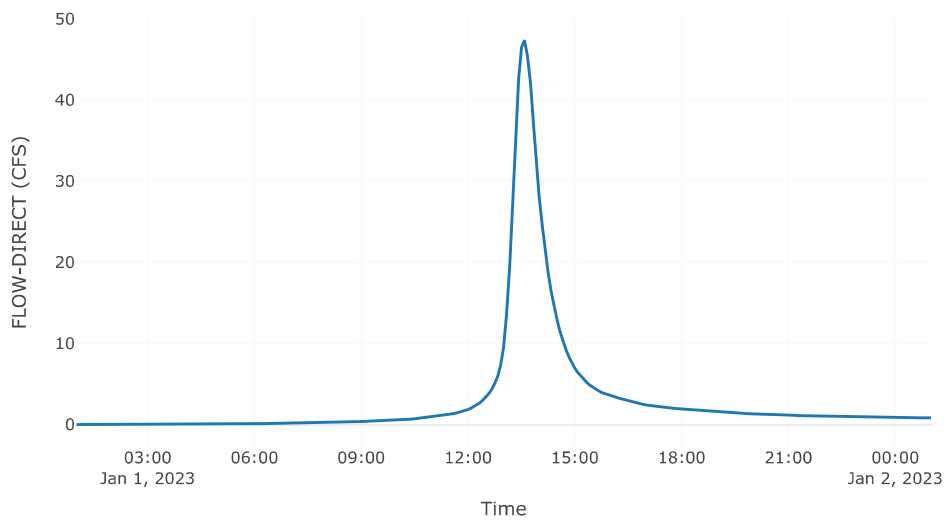
Baseflow



Precipitation Loss

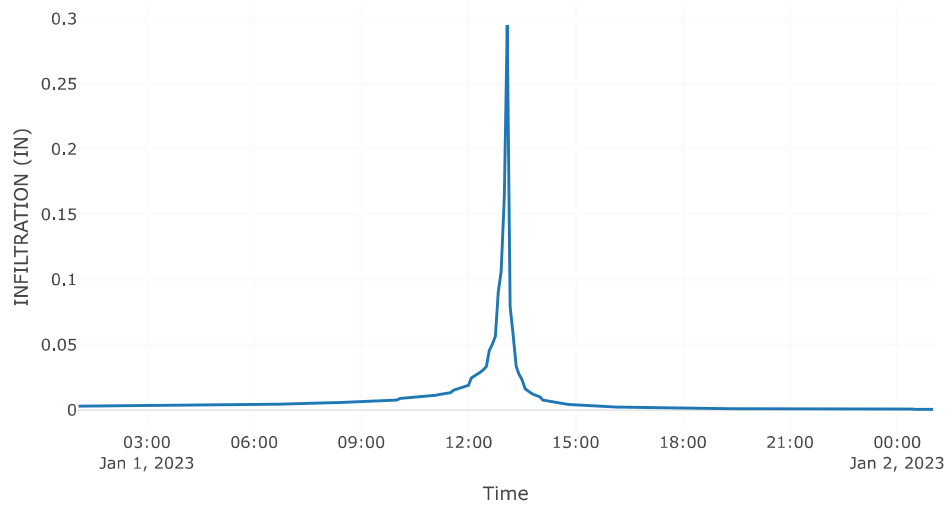


Direct Runoff





### Soil Infiltration



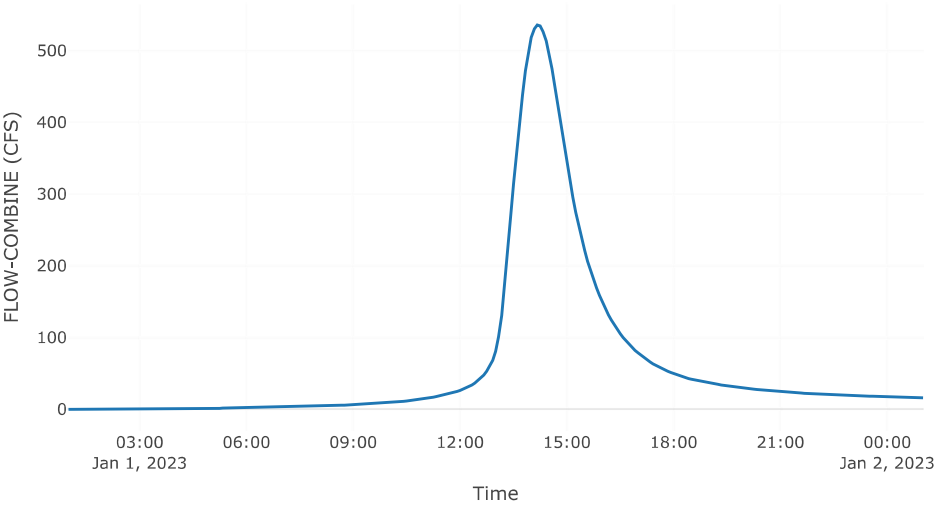
**Reach: Reach-2****Downstream** : Reach - 1**Route: Muskingum Cunge**

Method	Muskingum Cunge
Channel	Trapezoid
Length (FT)	2337.51
Energy Slope (FT/FT)	0.02
Mannings n	0.04
Bottom Width (FT)	38.76
Side Slope (FT/FT)	4
Initial Variable	Combined Inflow
Space - Time Method	Automatic DX and DT
Index Parameter Type	Index Celerity
Index Celerity	1.33
Number Subreaches	1
Maximum Depth Iterations	20
Maximum Route Step Iterations	30

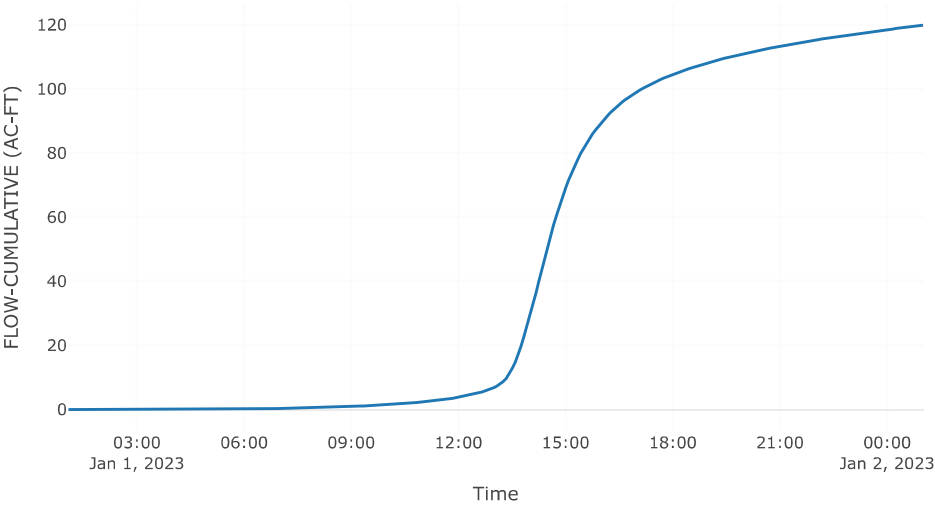
**Results: Reach-2**

Peak Discharge (CFS)	536.09
Time of Peak Discharge	01Jan2023, 14:15
Volume (IN)	3.11
Peak Inflow (CFS)	535.98
Inflow Volume (AC - FT)	120.33

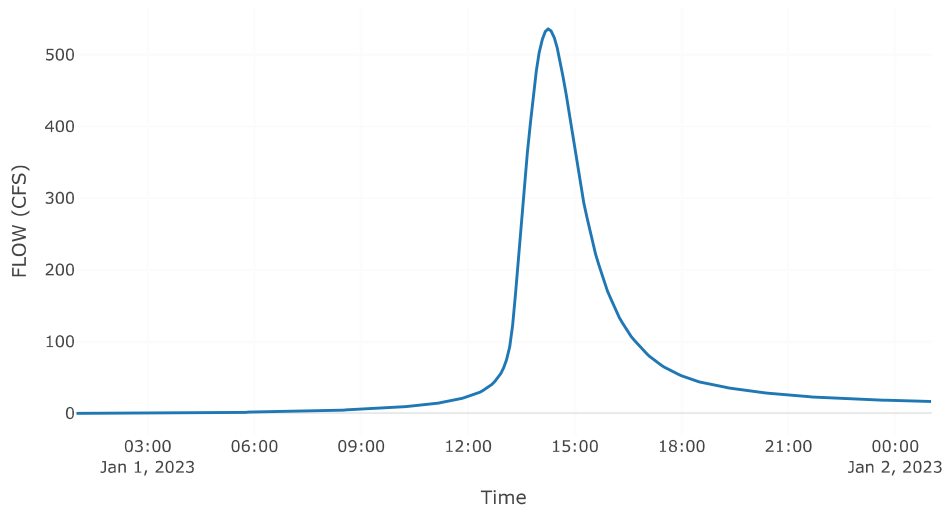
Combined Inflow



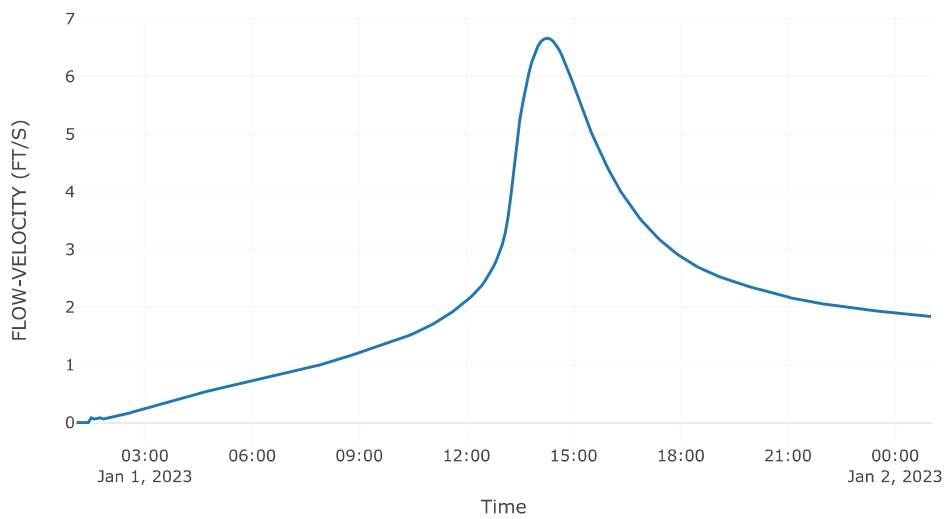
Cumulative Outflow



Outflow



Flow Velocity



## Subbasin: Subbasin-2

**Area (MI<sup>2</sup>)** : 0.12

**Latitude Degrees** : 38.99

**Longitude Degrees** : -104.56

**Downstream** : Reach - 1

### Loss Rate: SCS

Percent Impervious Area	0
Curve Number	73.76
Initial Abstraction	0

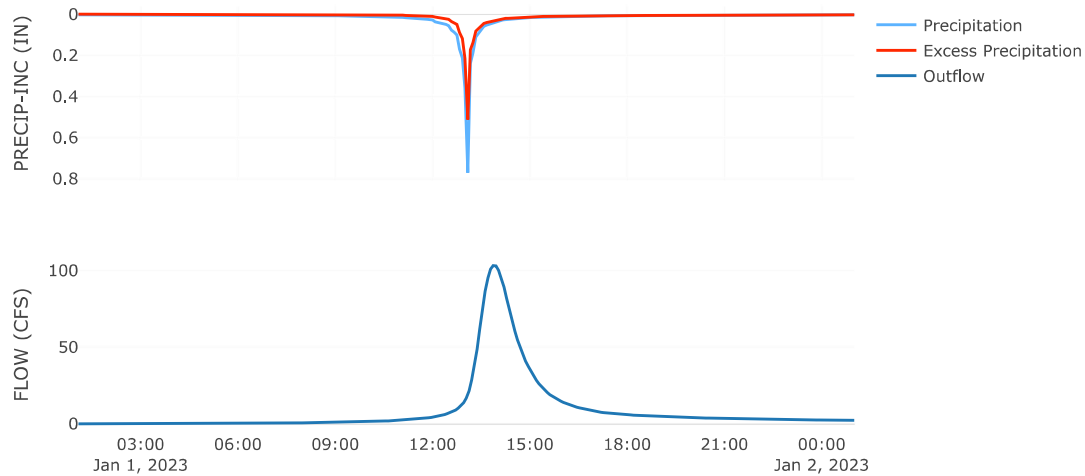
### Transform: SCS

Lag	46.35
Unitgraph Type	Standard

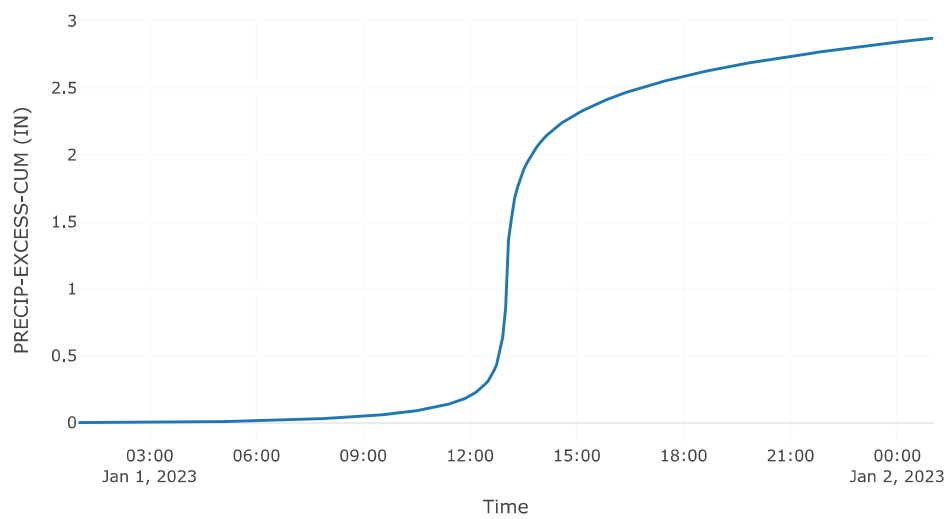
### Results: Subbasin-2

Peak Discharge (CFS)	103.28
Time of Peak Discharge	01 Jan 2023, 13:50
Volume (IN)	2.84
Precipitation Volume (AC - FT)	30.52
Loss Volume (AC - FT)	12.78
Excess Volume (AC - FT)	17.74
Direct Runoff Volume (AC - FT)	17.55
Baseflow Volume (AC - FT)	0

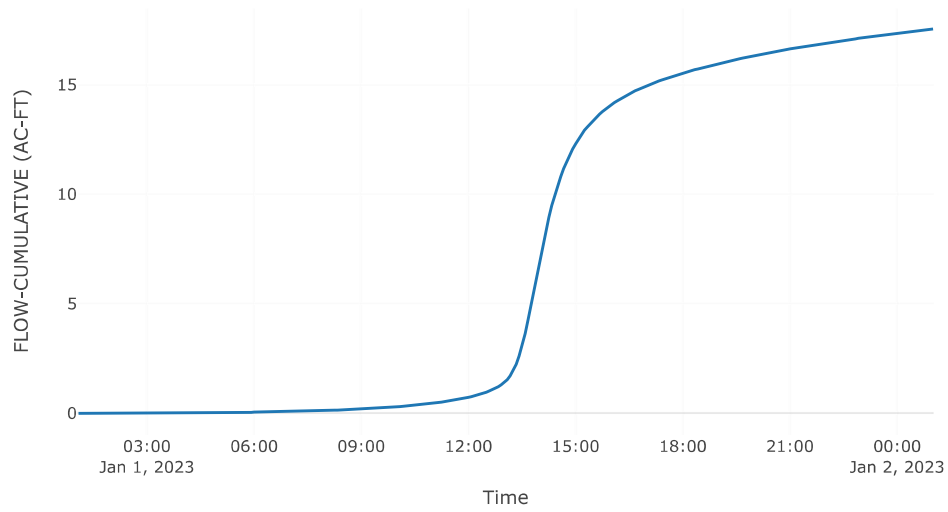
### Precipitation and Outflow



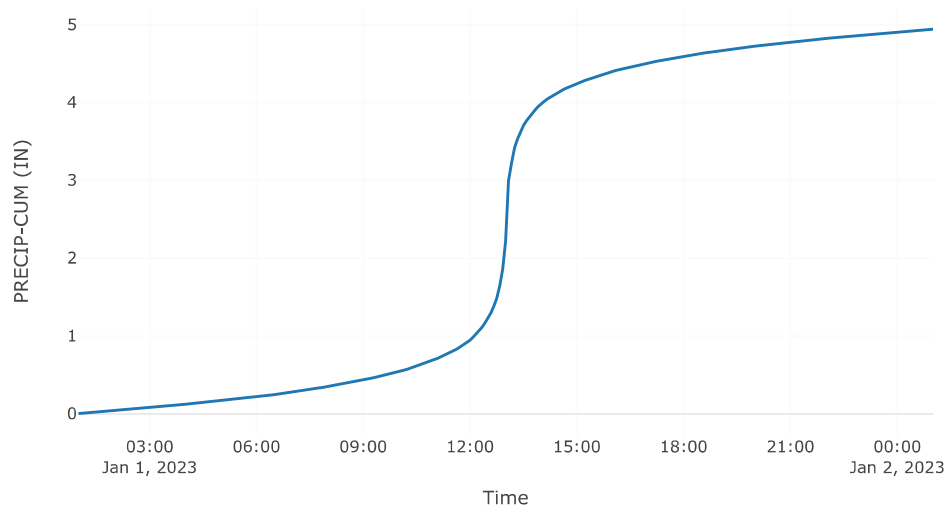
### Cumulative Excess Precipitation



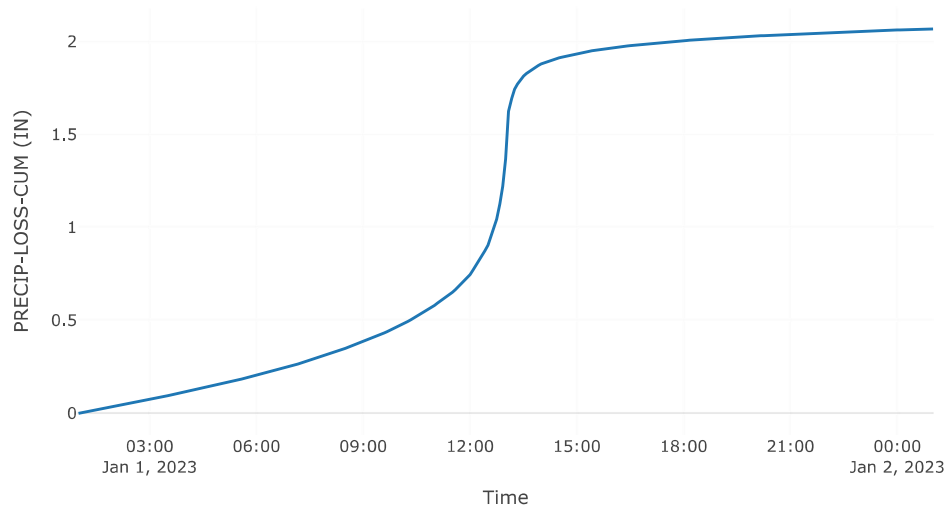
Cumulative Outflow



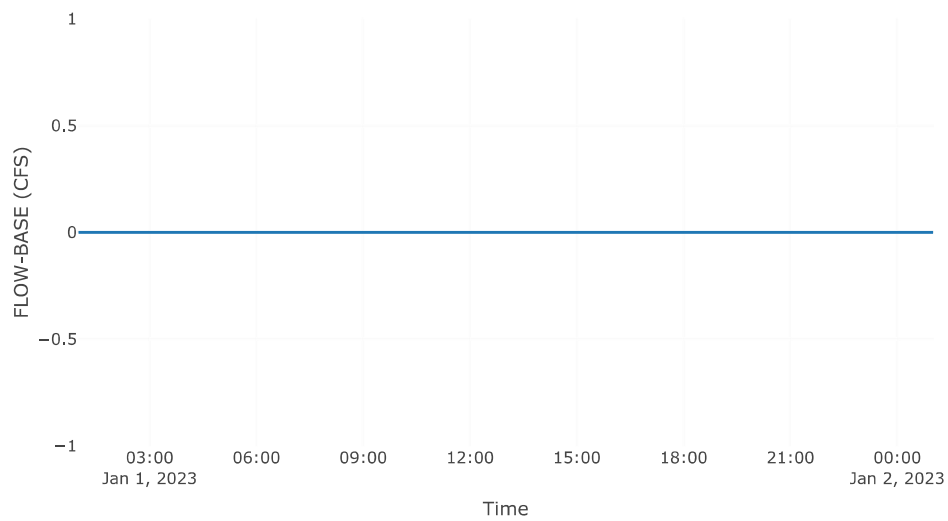
Cumulative Precipitation



Cumulative Precipitation Loss

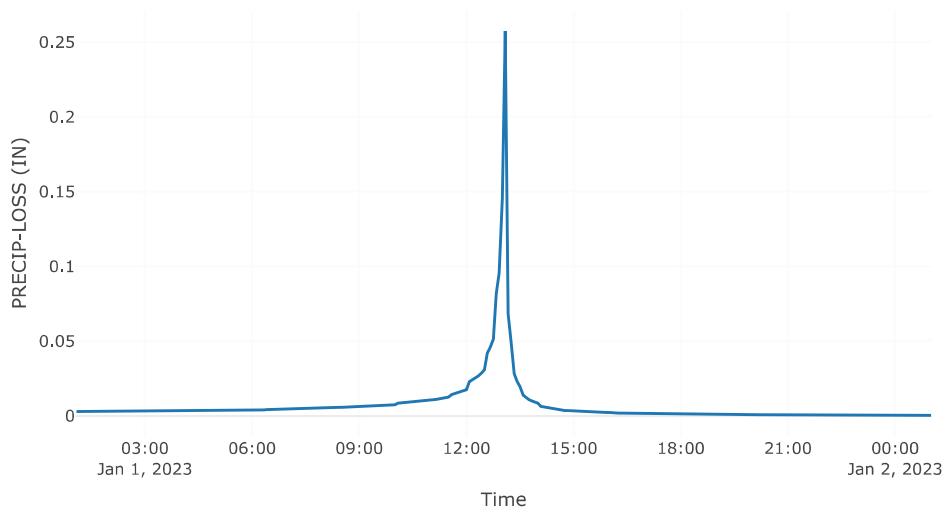


Baseflow

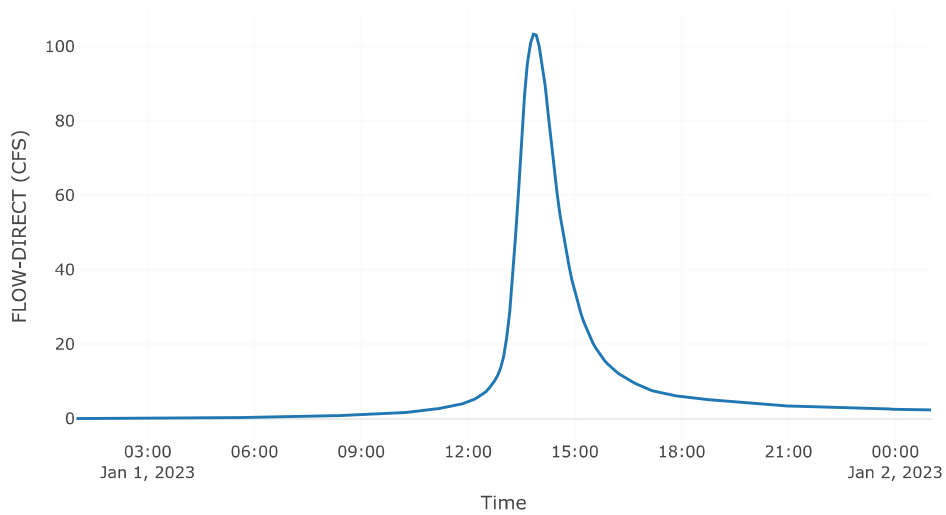




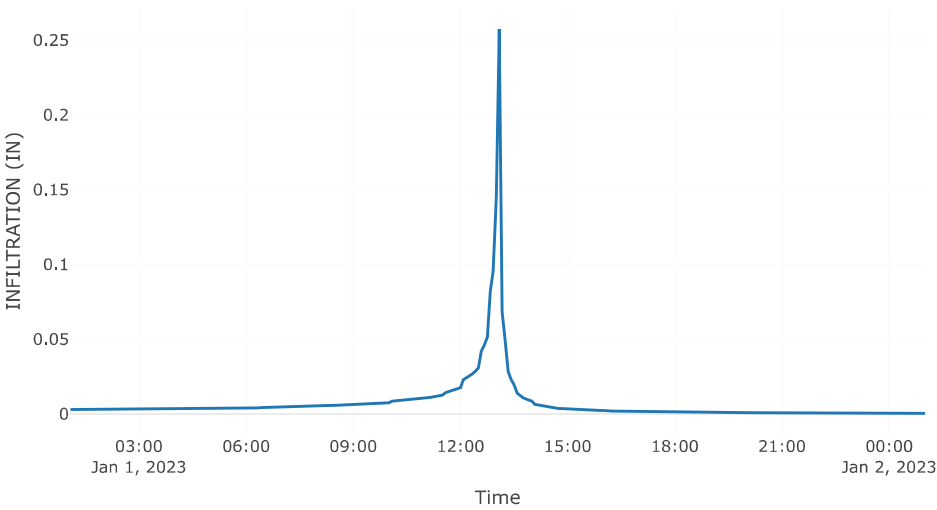
Precipitation Loss



Direct Runoff



Soil Infiltration



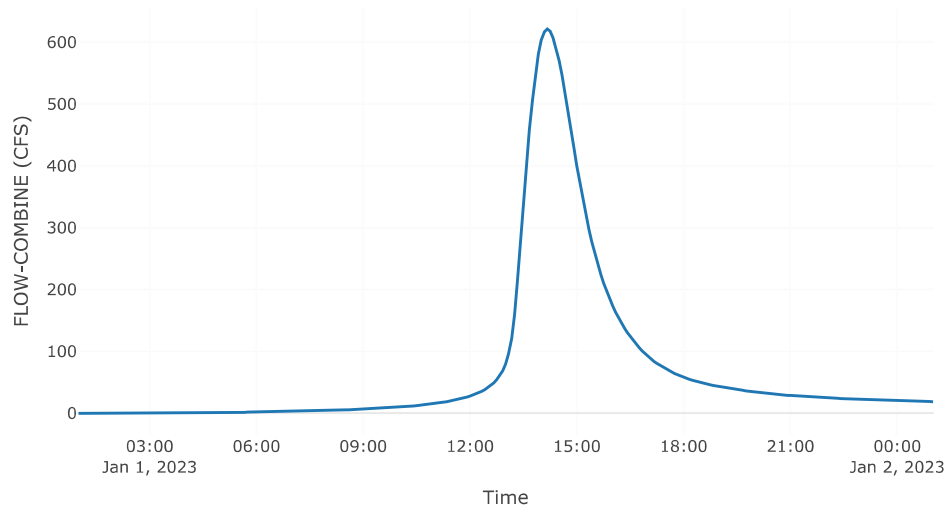
Reach: Reach-1

Downstream : Sink - 1

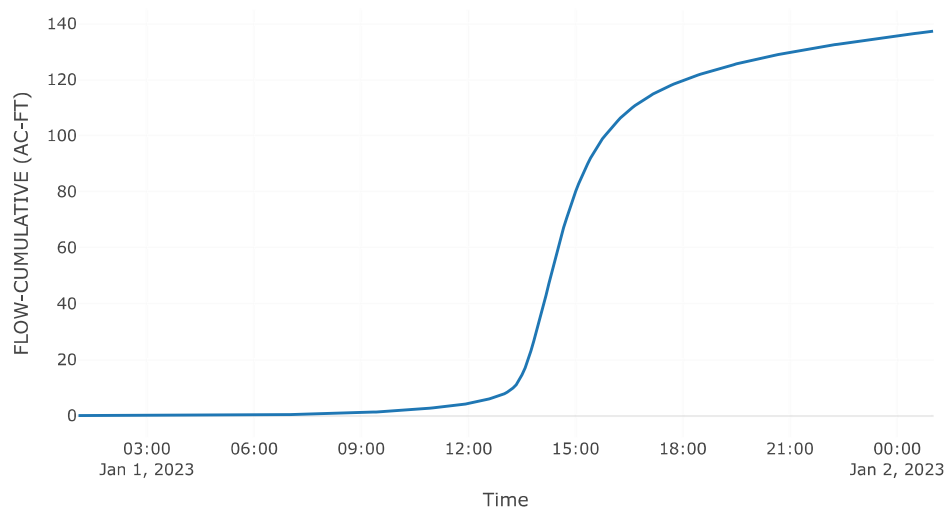
Route: Muskingum Cunge	
Method	Muskingum Cunge
Channel	Trapezoid
Length (FT)	849.59
Energy Slope (FT/FT)	0.01
Mannings n	0.04
Bottom Width (FT)	38.76
Side Slope (FT/FT)	4
Initial Variable	Combined Inflow
Space - Time Method	Automatic DX and DT
Index Parameter Type	Index Celerity
Index Celerity	1.33
Number Subreaches	1
Maximum Depth Iterations	20
Maximum Route Step Iterations	30

Results: Reach-1	
Peak Discharge (CFS)	621.27
Time of Peak Discharge	01Jan2023, 14:10
Volume (IN)	3.07
Peak Inflow (CFS)	621.77
Inflow Volume (AC - FT)	137.46

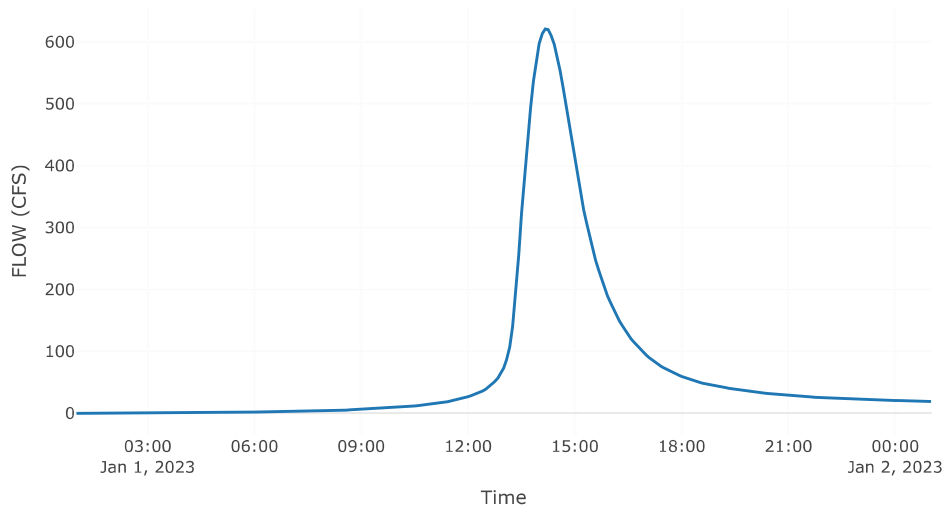
Combined Inflow



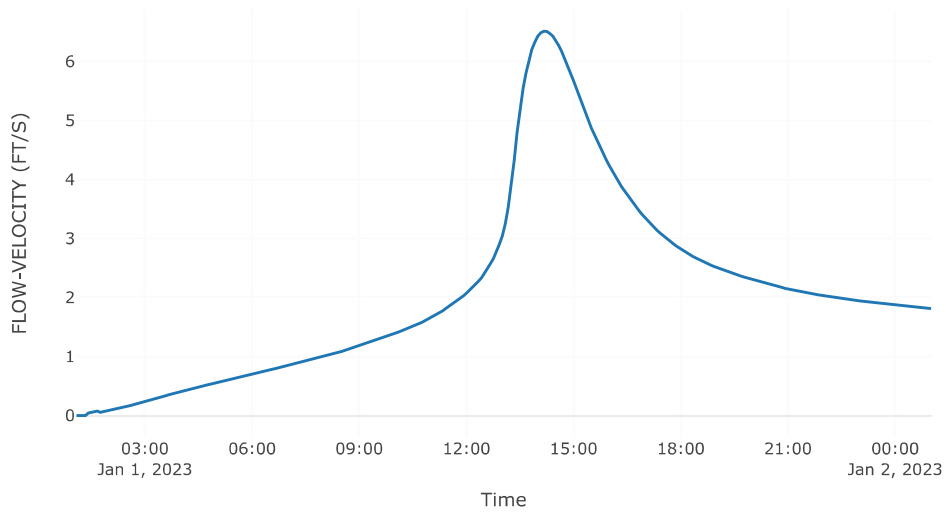
Cumulative Outflow



Outflow



Flow Velocity



**Subbasin: Subbasin-1****Area (MI<sup>2</sup>)** : 0.05**Latitude Degrees** : 38.98**Longitude Degrees** : -104.56**Downstream** : Sink - 1**Loss Rate: SCS**

Percent Impervious Area	0
Curve Number	79.41
Initial Abstraction	0

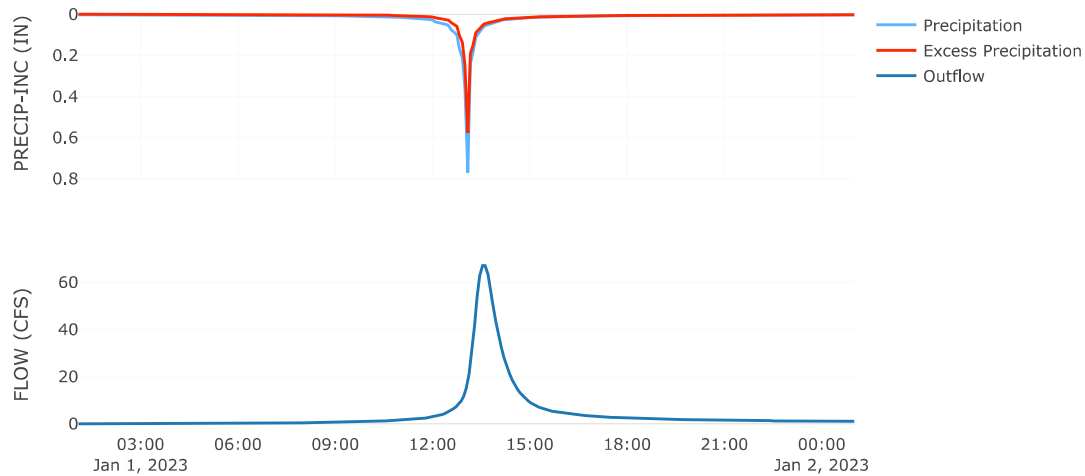
**Transform: SCS**

Lag	28.51
Unitgraph Type	Standard

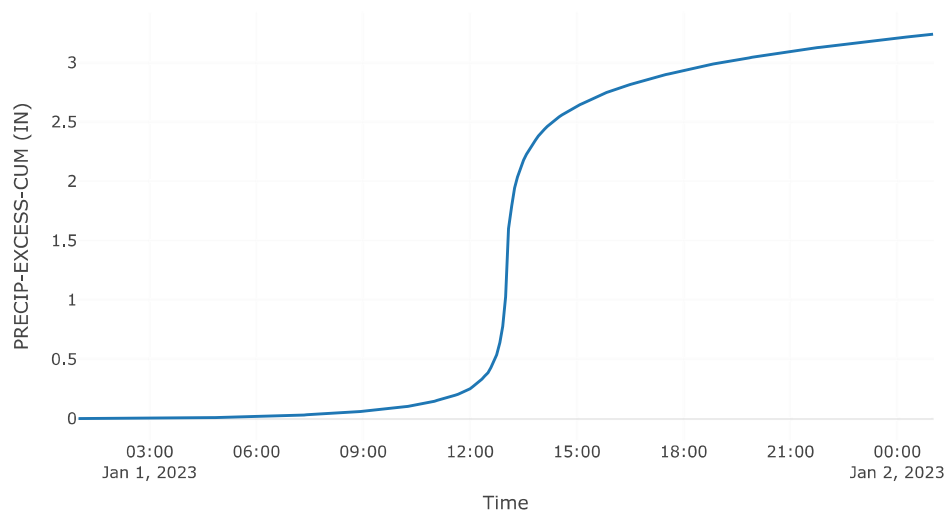
**Results: Subbasin-1**

Peak Discharge (CFS)	67.11
Time of Peak Discharge	01 Jan 2023, 13:35
Volume (IN)	3.22
Precipitation Volume (AC - FT)	13.01
Loss Volume (AC - FT)	4.48
Excess Volume (AC - FT)	8.53
Direct Runoff Volume (AC - FT)	8.48
Baseflow Volume (AC - FT)	0

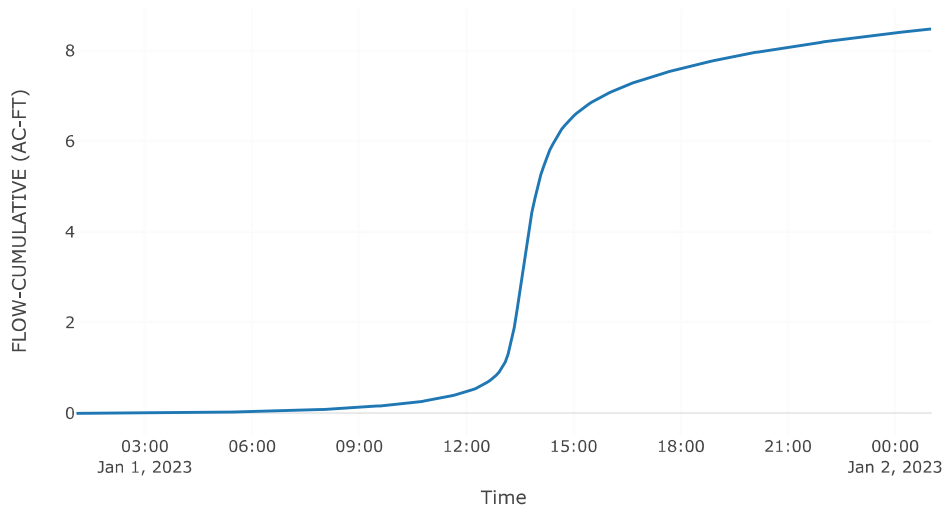
### Precipitation and Outflow



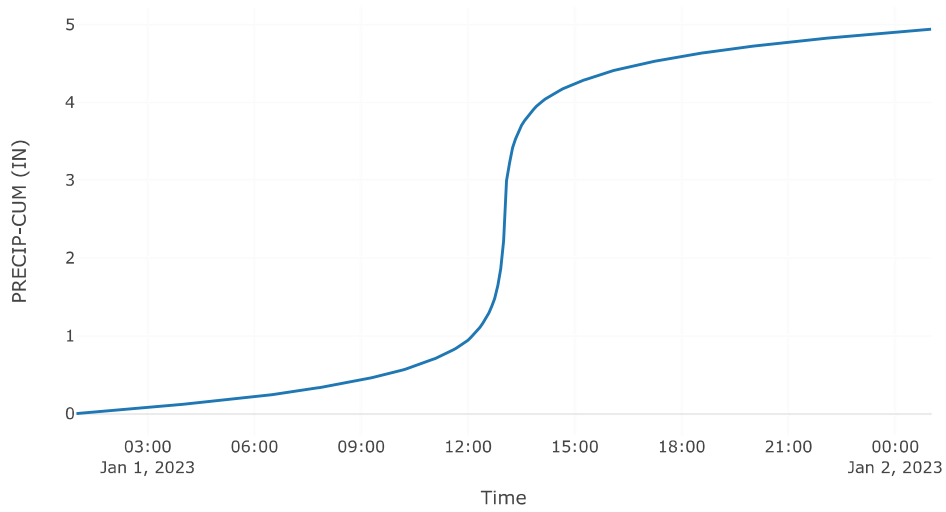
### Cumulative Excess Precipitation



Cumulative Outflow

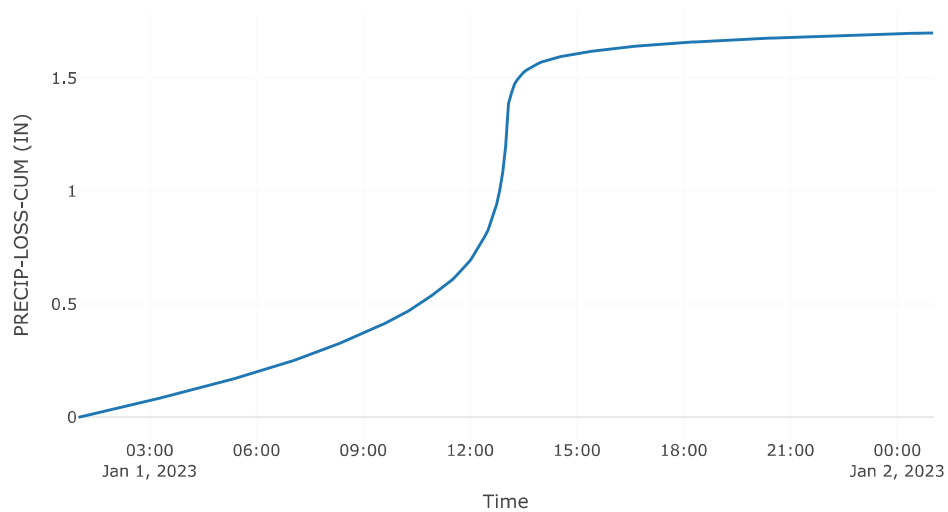


Cumulative Precipitation

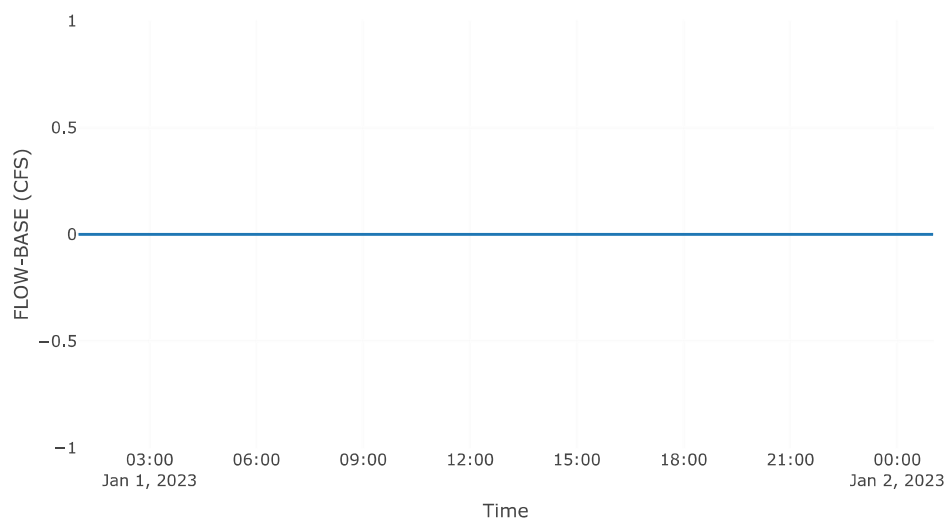




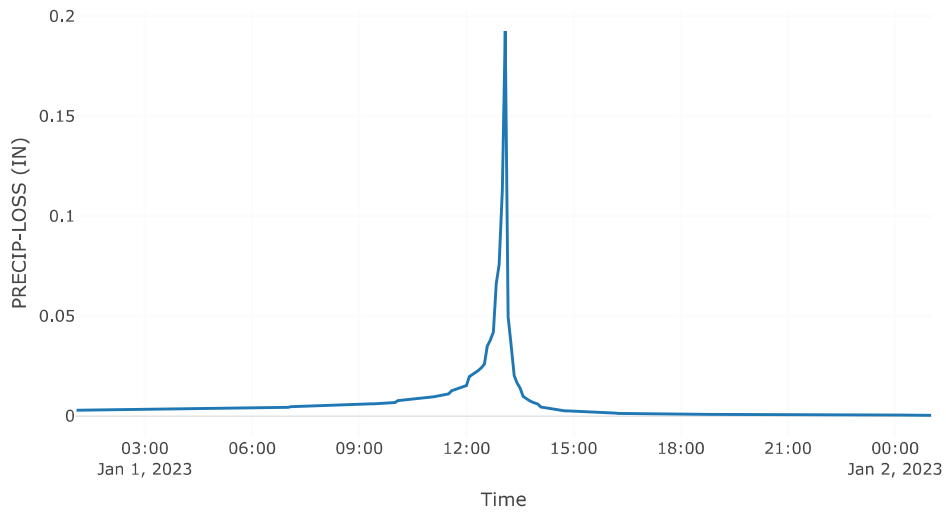
Cumulative Precipitation Loss



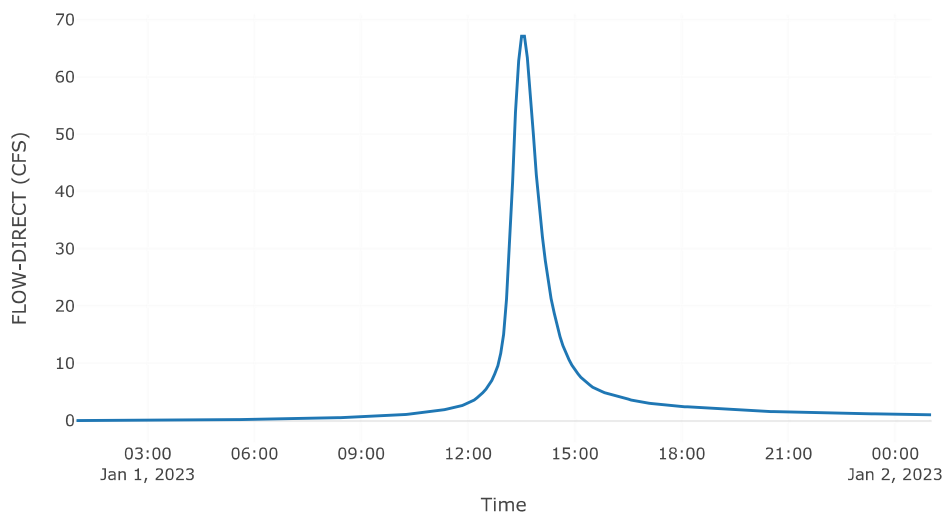
Baseflow

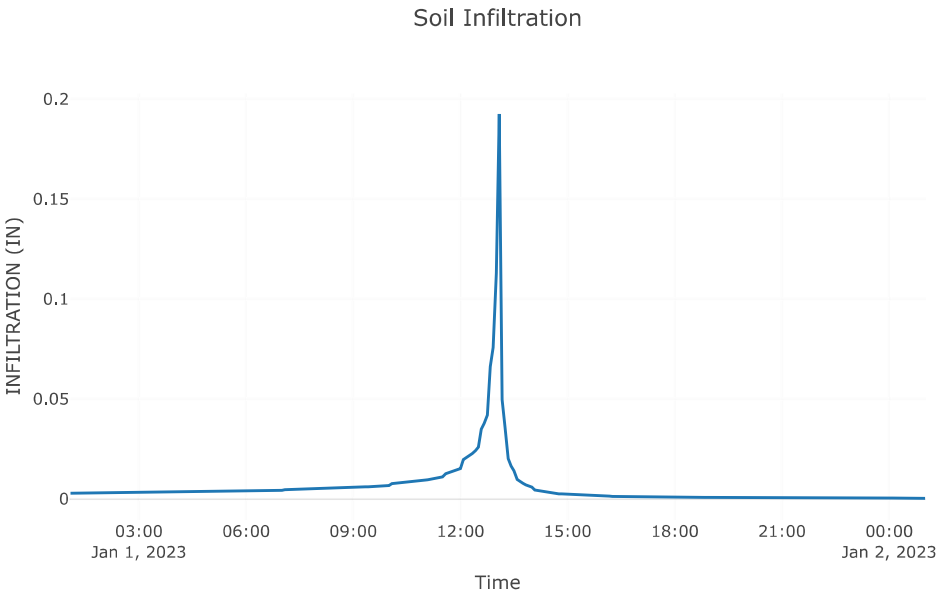


Precipitation Loss



Direct Runoff



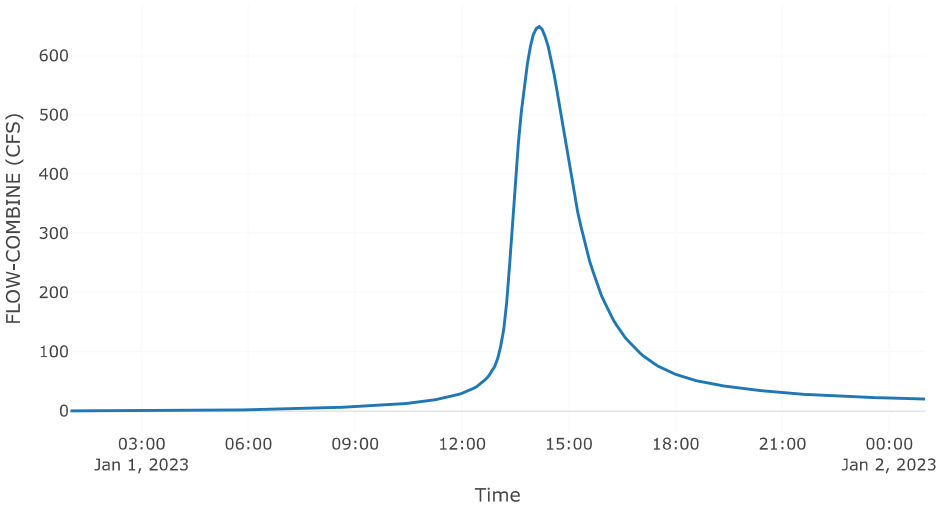


Sink: Sink-1

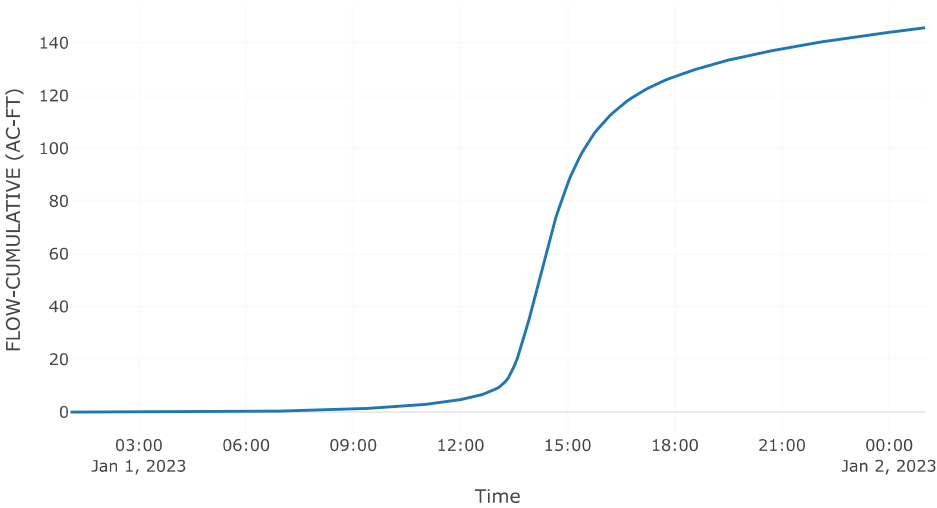
Results: Sink-1

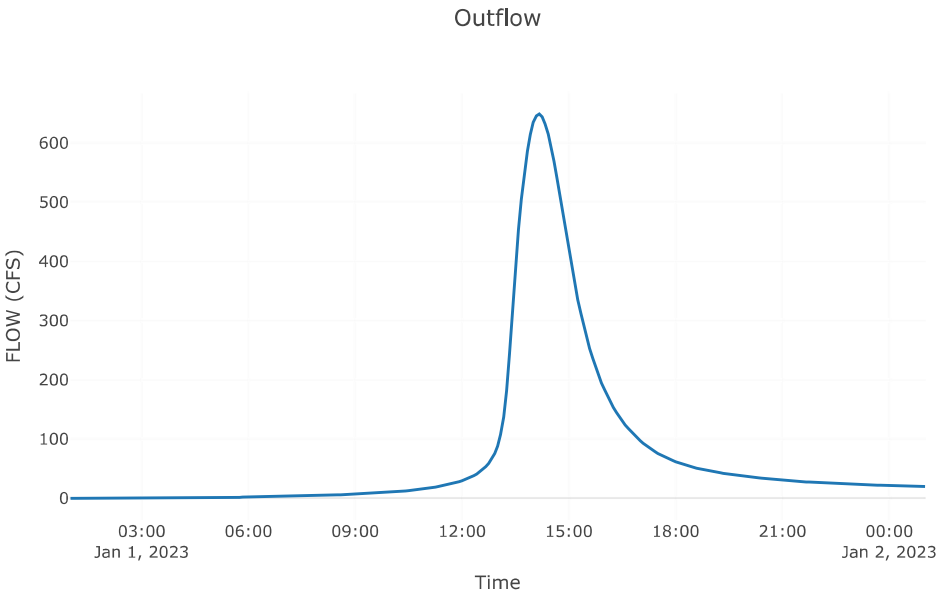
Peak Discharge (CFS)	649.23
Time of Peak Discharge	01Jan2023, 14:10
Volume (IN)	3.08

Combined Inflow



Cumulative Outflow









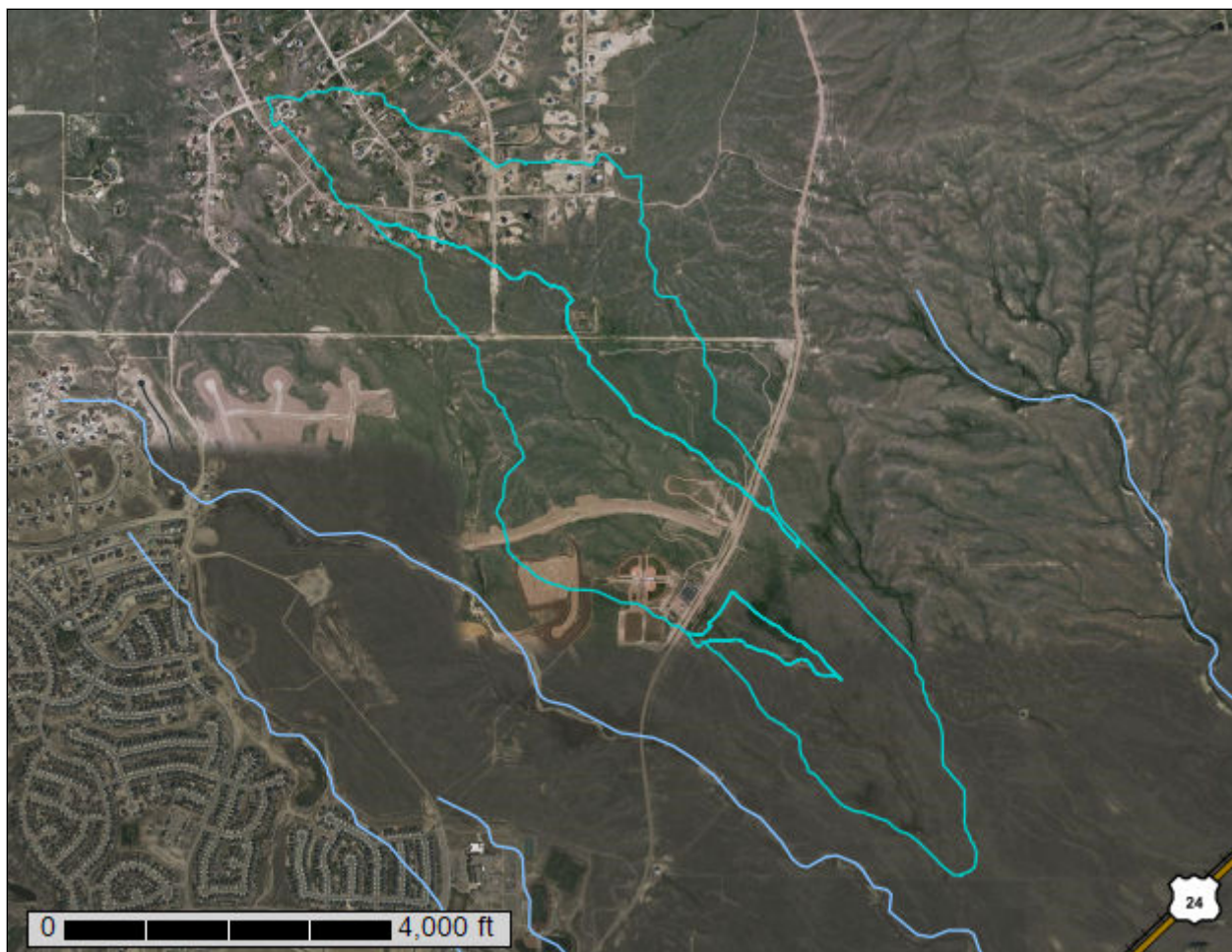
United States  
Department of  
Agriculture

**NRCS**

Natural  
Resources  
Conservation  
Service

A product of the National  
Cooperative Soil Survey,  
a joint effort of the United  
States Department of  
Agriculture and other  
Federal agencies, State  
agencies including the  
Agricultural Experiment  
Stations, and local  
participants

# Custom Soil Resource Report for **El Paso County Area, Colorado**



# Preface

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Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist ([http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2\\_053951](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951)).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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# Contents

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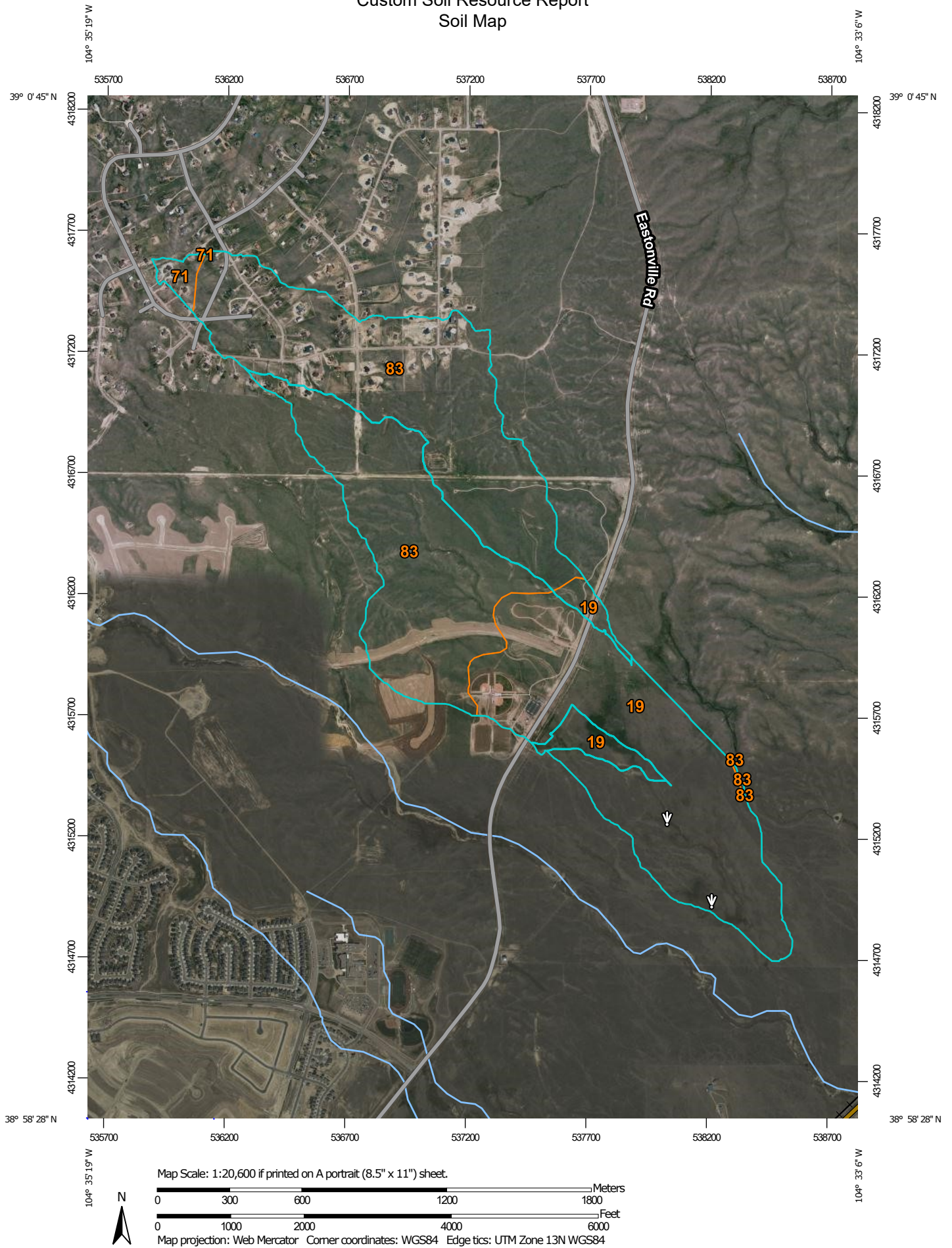
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# Soil Map

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The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

# Custom Soil Resource Report Soil Map




# Custom Soil Resource Report


## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

 Soil Map Unit Polygons


 Soil Map Unit Lines


 Soil Map Unit Points

### Special Point Features

 Blowout

 Borrow Pit


 Clay Spot


 Closed Depression

 Gravel Pit


 Gravelly Spot


 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water


 Perennial Water

 Rock Outcrop


 Saline Spot

 Sandy Spot

 Severely Eroded Spot


 Sinkhole


 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot


 Very Stony Spot

 Wet Spot

 Other


 Special Line Features

### Water Features

 Streams and Canals


### Transportation

 Rails


 Interstate Highways

 US Routes

 Major Roads

 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 21, Aug 24, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 11, 2018—Jun 12, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	211.4	38.0%
71	Pring coarse sandy loam, 3 to 8 percent slopes	6.5	1.2%
83	Stapleton sandy loam, 3 to 8 percent slopes	338.4	60.8%
<b>Totals for Area of Interest</b>		<b>556.3</b>	<b>100.0%</b>

## Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or

landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

## El Paso County Area, Colorado

### 19—Columbine gravelly sandy loam, 0 to 3 percent slopes

#### Map Unit Setting

*National map unit symbol:* 367p  
*Elevation:* 6,500 to 7,300 feet  
*Mean annual precipitation:* 14 to 16 inches  
*Mean annual air temperature:* 46 to 50 degrees F  
*Frost-free period:* 125 to 145 days  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Columbine and similar soils:* 97 percent  
*Minor components:* 3 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Columbine

##### Setting

*Landform:* Flood plains, fan terraces, fans  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Alluvium

##### Typical profile

*A - 0 to 14 inches:* gravelly sandy loam  
*C - 14 to 60 inches:* very gravelly loamy sand

##### Properties and qualities

*Slope:* 0 to 3 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Runoff class:* Very low  
*Capacity of the most limiting layer to transmit water (Ksat):* High to very high (5.95 to 19.98 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water supply, 0 to 60 inches:* Very low (about 2.5 inches)

##### Interpretive groups

*Land capability classification (irrigated):* 4e  
*Land capability classification (nonirrigated):* 6e  
*Hydrologic Soil Group:* A  
*Ecological site:* R049XY214CO - Gravelly Foothill  
*Hydric soil rating:* No

#### Minor Components

##### Fluvaquentic haplaquolls

*Percent of map unit:* 1 percent  
*Landform:* Swales  
*Hydric soil rating:* Yes



**Other soils**

*Percent of map unit:* 1 percent  
*Hydric soil rating:* No

**Pleasant**

*Percent of map unit:* 1 percent  
*Landform:* Depressions  
*Hydric soil rating:* Yes

**71—Pring coarse sandy loam, 3 to 8 percent slopes**

**Map Unit Setting**

*National map unit symbol:* 369k  
*Elevation:* 6,800 to 7,600 feet  
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Pring and similar soils:* 85 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Pring**

**Setting**

*Landform:* Hills  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Arkosic alluvium derived from sedimentary rock

**Typical profile**

*A - 0 to 14 inches:* coarse sandy loam  
*C - 14 to 60 inches:* gravelly sandy loam

**Properties and qualities**

*Slope:* 3 to 8 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* High (2.00 to 6.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water supply, 0 to 60 inches:* Low (about 6.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 3e  
*Hydrologic Soil Group:* B  
*Ecological site:* R048AY222CO - Loamy Park  
*Hydric soil rating:* No

## Minor Components

### Pleasant

*Percent of map unit:*  
*Landform:* Depressions  
*Hydric soil rating:* Yes

### Other soils

*Percent of map unit:*  
*Hydric soil rating:* No

## 83—Stapleton sandy loam, 3 to 8 percent slopes

### Map Unit Setting

*National map unit symbol:* 369z  
*Elevation:* 6,500 to 7,300 feet  
*Mean annual precipitation:* 14 to 16 inches  
*Mean annual air temperature:* 46 to 48 degrees F  
*Frost-free period:* 125 to 145 days  
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Stapleton and similar soils:* 97 percent  
*Minor components:* 3 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Stapleton

#### Setting

*Landform:* Hills  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy alluvium derived from arkose

#### Typical profile

*A - 0 to 11 inches:* sandy loam  
*Bw - 11 to 17 inches:* gravelly sandy loam  
*C - 17 to 60 inches:* gravelly loamy sand

#### Properties and qualities

*Slope:* 3 to 8 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* High (2.00 to 6.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None

## Custom Soil Resource Report

*Available water supply, 0 to 60 inches:* Low (about 4.7 inches)

### **Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 3e

*Hydrologic Soil Group:* B

*Ecological site:* R049XY214CO - Gravelly Foothill

*Hydric soil rating:* No

### **Minor Components**

#### **Fluvaquentic haplaquolls**

*Percent of map unit:* 1 percent

*Landform:* Swales

*Hydric soil rating:* Yes

#### **Other soils**

*Percent of map unit:* 1 percent

*Hydric soil rating:* No

#### **Pleasant**

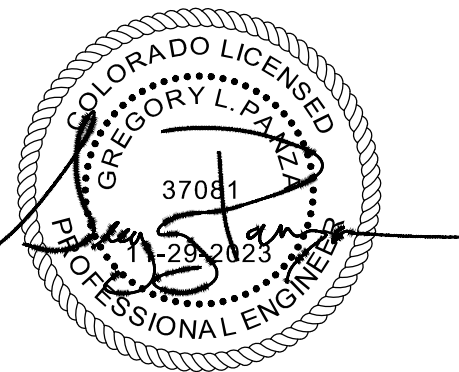
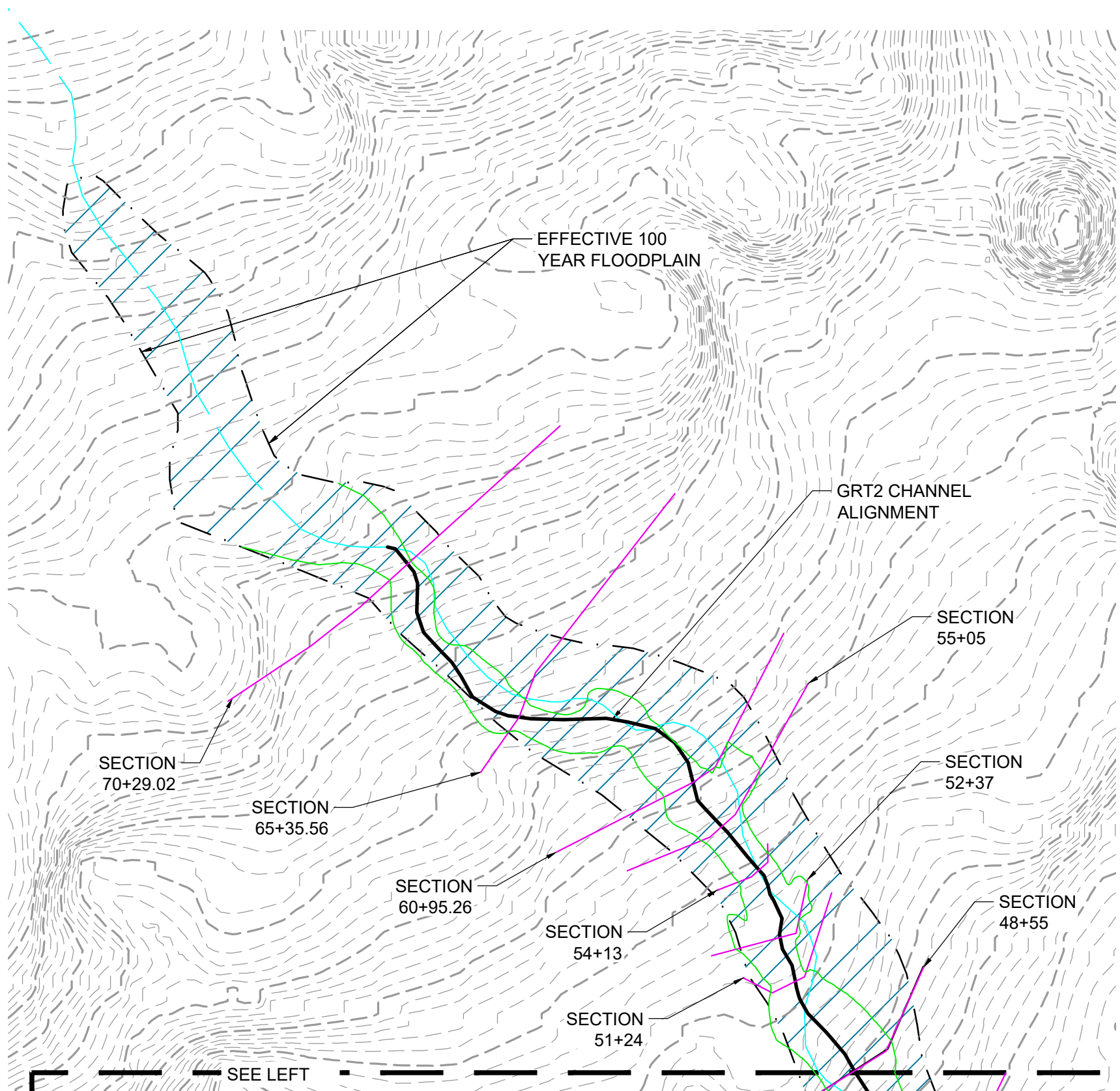
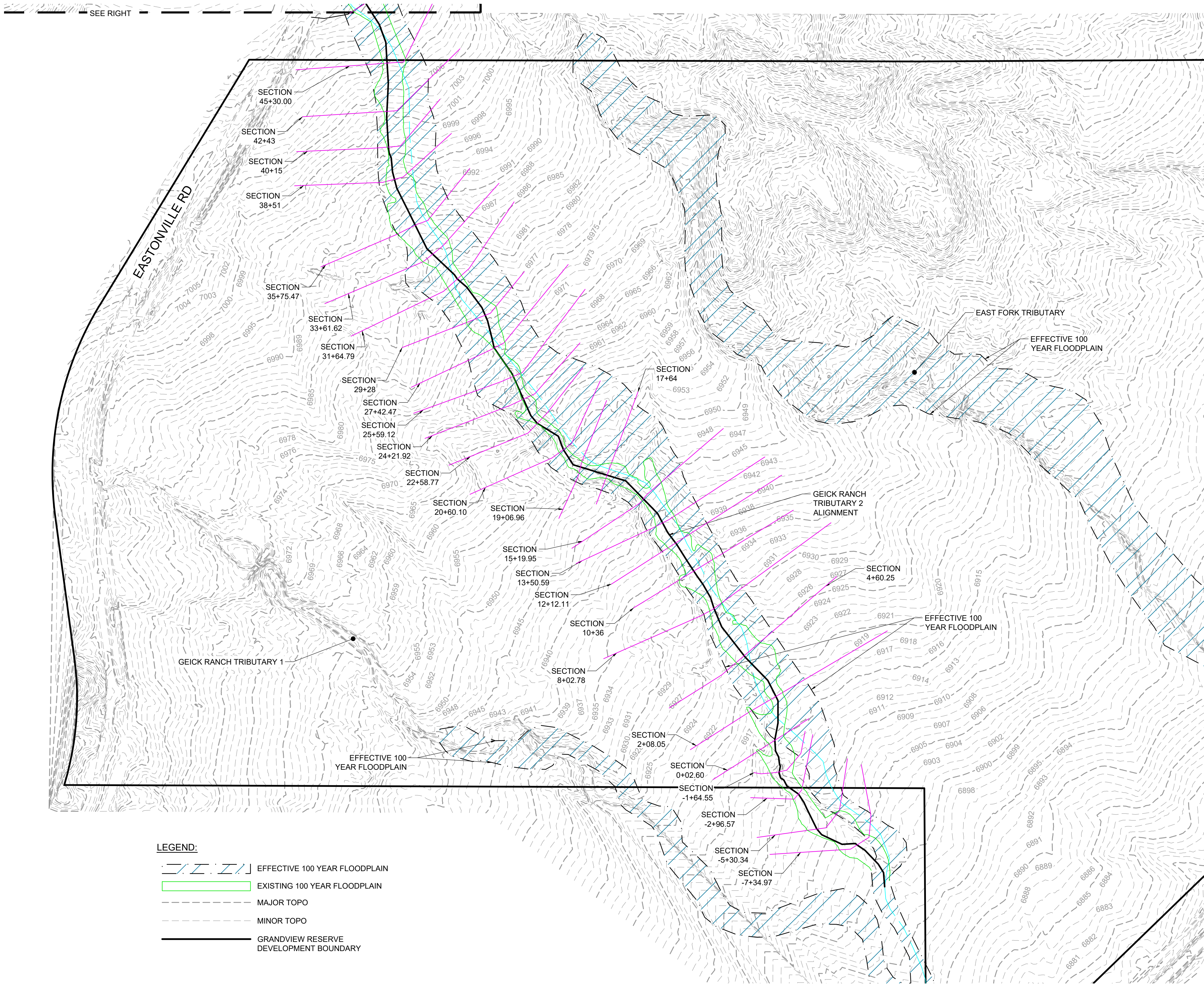
*Percent of map unit:* 1 percent

*Landform:* Depressions

*Hydric soil rating:* Yes

## Appendix B Topographic Map





NOTES:  
1. BASIS OF BEARINGS: THE EAST LINE OF SECTION 21, BEING MONUMENTED AT THE SOUTHEAST CORNER BY A 3-1/4" ALUMINUM SURVEYOR'S CAP STAMPED "PS INC PLS 30087 1996", BEING APPROPRIATELY MARKED, AND BEING MONUMENTED AT THE NORTHEAST CORNER BY A 3-1/4" ALUMINUM SURVEYOR'S CAP STAMPED "PS INC PLS 30087 1996", BEING APPROPRIATELY MARKED, BEING ASSUMED TO BEAR NORTH 00 DEGREES 52 MINUTES 26 SECONDS WEST, A DISTANCE OF 5290.17 FEET.

NAVD88 6866.33

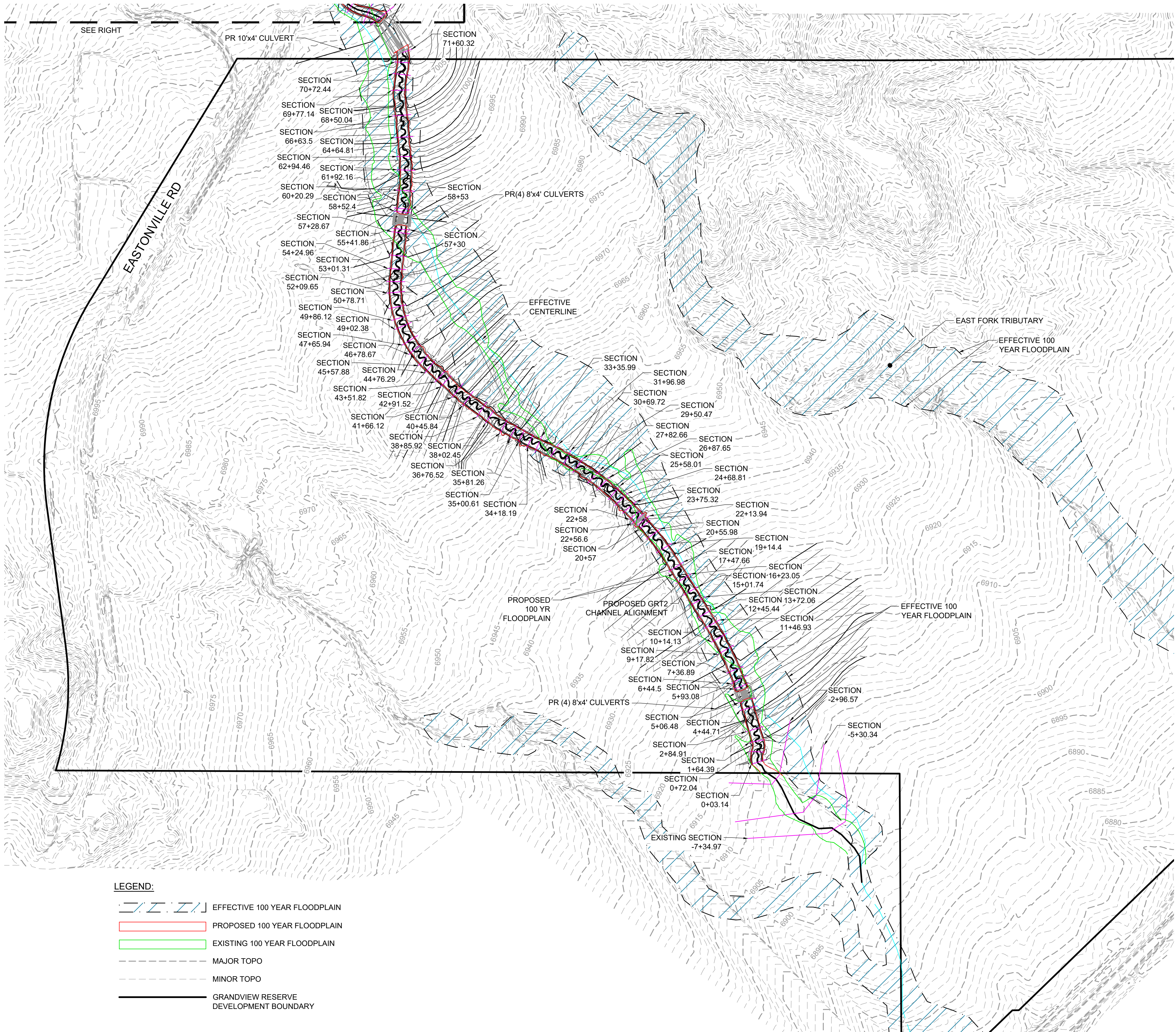


Job No.:	201662
Prepared By:	SJF
Date:	4/8/2024

EXISTING FLOODPLAIN EXHIBIT

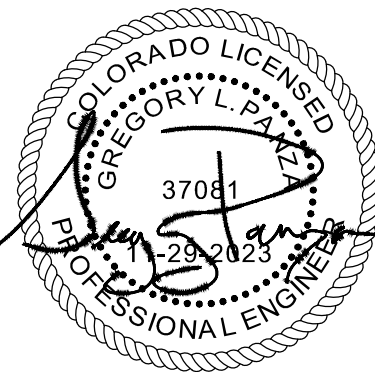
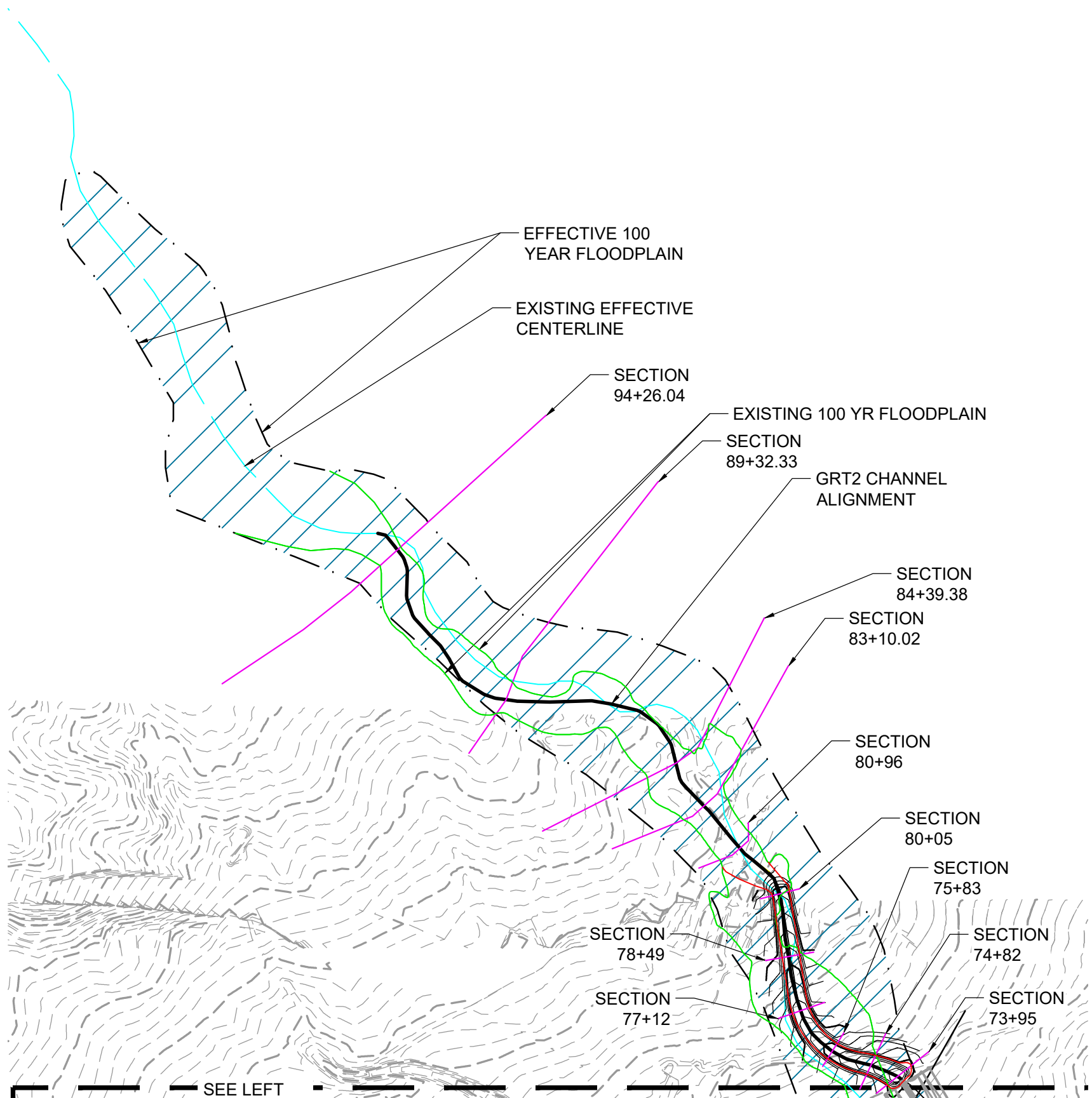
FIG.1





LEGEND:

- EFFECTIVE 100 YEAR FLOODPLAIN
- PROPOSED 100 YEAR FLOODPLAIN
- EXISTING 100 YEAR FLOODPLAIN
- MAJOR TOPO
- MINOR TOPO
- GRANDVIEW RESERVE DEVELOPMENT BOUNDARY



NOTES:

- BASIS OF BEARINGS: THE EAST LINE OF SECTION 21, BEING MONUMENTED AT THE SOUTHEAST CORNER BY A 3-1/4" ALUMINUM SURVEYOR'S CAP STAMPED "PS INC PLS 30087 1996", BEING APPROPRIATELY MARKED, AND BEING MONUMENTED AT THE NORTHEAST CORNER BY A 3-1/4" ALUMINUM SURVEYOR'S CAP STAMPED "PS INC PLS 30087 1996", BEING APPROPRIATELY MARKED, BEING ASSUMED TO BEAR NORTH 00 DEGREES 52 MINUTES 26 SECONDS WEST, A DISTANCE OF 5290.17 FEET.

NAVD88



Job No.:	201662
Prepared By:	SJF
Date:	4/8/2024

PROPOSED FLOODPLAIN EXHIBIT



to flooding, particularly from local drainage  
map repository should be consulted for  
d information.

as where **Base Flood Elevations (BFEs)**  
suraged to consult the Flood  
Elevations tables contained  
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http://www.ngs.noaa.gov/.

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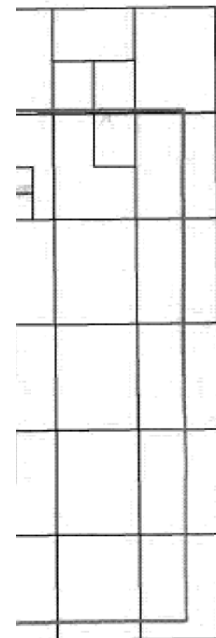
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overview map of the county  
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Map Information eXchange  
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and its website at

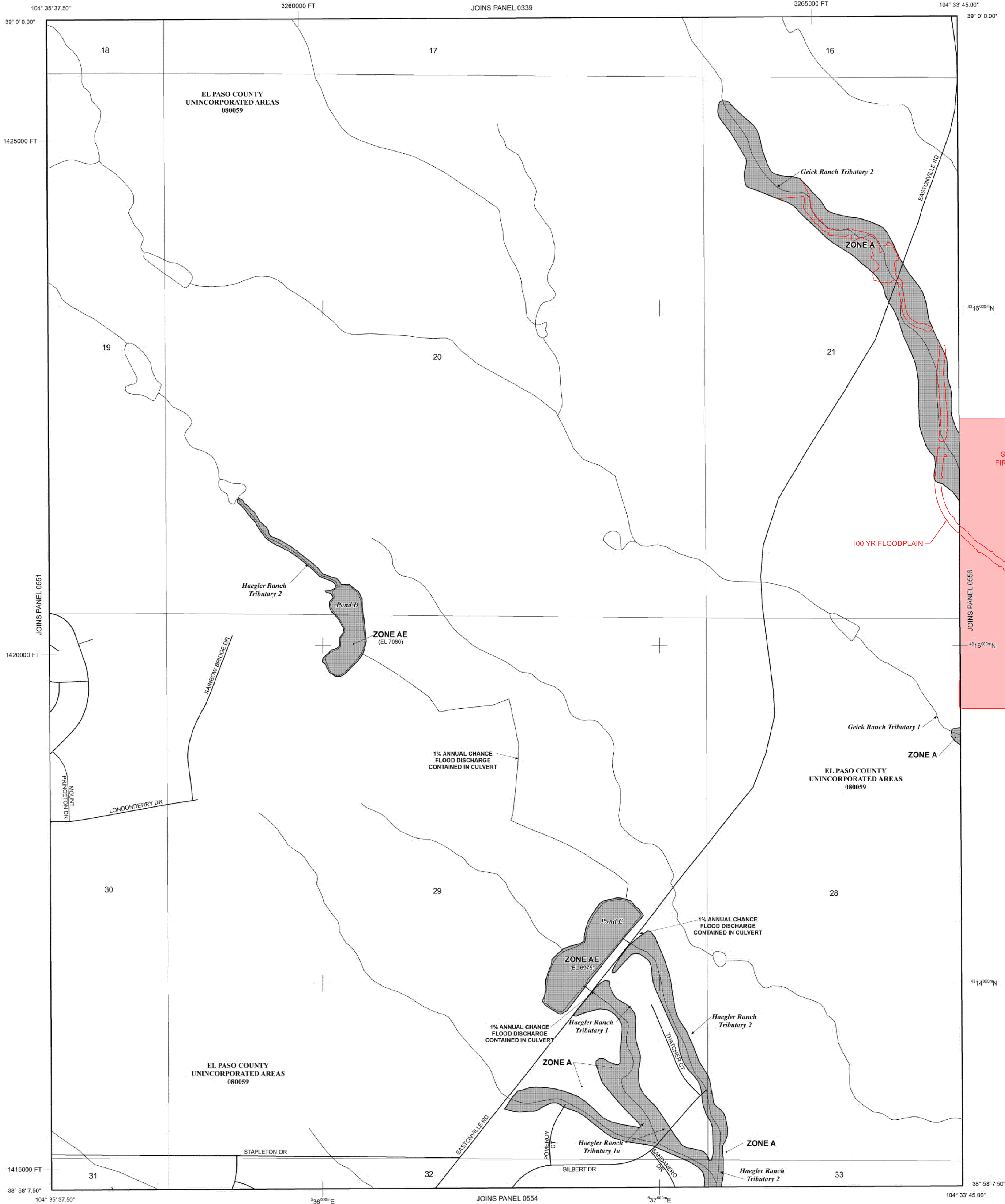
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let Table
Vertical Datum Offset (ft)
IOD INSURANCE STUDY RSION INFORMATION



was produced through a  
reen the State of Colorado  
Emergency Management

formation and resources are  
munities and the Colorado



## INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

## FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

## OTHER FLOOD AREAS

**ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

## OTHER AREAS

- ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D** Areas in which flood hazards are undetermined, but possible.

## COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

## OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- Base Flood Elevation line and value; elevation in feet\*
- Base Flood Elevation value where uniform within zone; elevation in feet\*

\* Referenced to the North American Vertical Datum of 1985 (NAVD 88)

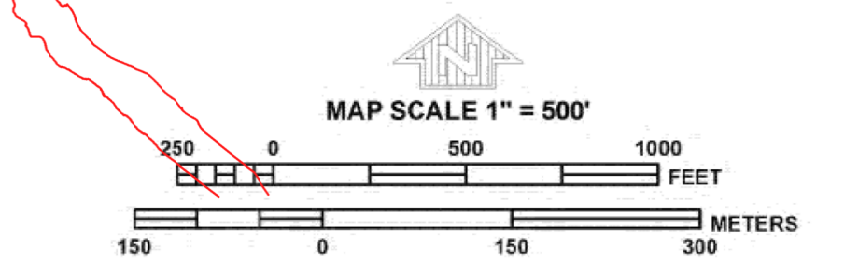
- Cross section line
- Transect line
- Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- River Mile

MAP REPOSITORIES  
Refer to Map Repositories list on Map Index  
EFFECTIVE DATE OF COUNTYWIDE  
FLOOD INSURANCE RATE MAP  
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL  
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



PANEL 0552G

## FIRM FLOOD INSURANCE RATE MAP EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 552 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0552	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  
08041C0552G

MAP REVISED  
DECEMBER 7, 2018



subject to flooding, particularly from local drainage community map repository should be consulted for flood hazard information.

in areas where **Base Flood Elevations (BFEs)** are encouraged to consult the Flood Hazard Insurance Study (FHIS) contained within this FIRM. Users are presented rounded whole-foot BFEs for rating purposes only and are not to be used for engineering or design purposes. Accordingly, BFEs should be utilized in conjunction with the Flood Insurance Study report.

apply only landward of 0.0' from the water's edge. Users of this FIRM should be aware that the Summary of Stillwater Levels for this jurisdiction. Elevations should be used for construction purposes higher than the elevations shown on the map.

is sections and interpolated hydraulic considerations with the Flood Insurance Study report. Floodway widths are shown in the Flood Insurance Study report.

are protected by **flood control structures** of the Flood Insurance Study for this jurisdiction.

was Universal Transverse Mercator (UTM) zones used in the result in slight positional differences. These differences do not affect the map's accuracy.

h American Vertical Datum (AVD) compared to structure and map. For information regarding datum of 1929 and the North Geodetic Survey website at <http://www.ngs.noaa.gov/>.

information for **bench marks** is available from the National Geodetic Survey website at <http://www.ngs.noaa.gov/>.

d in digital format by El Paso County Engineering, Inc. These maps are for informational purposes only.

channel configurations and cross-sections for this FIRM may differ from the previous FIRM. As a result, the Flood Insurance Study may reflect stream channel profile baselines depicted that match the flood profiles shown. As a result, the profile map channel representation may differ from the previous FIRM.

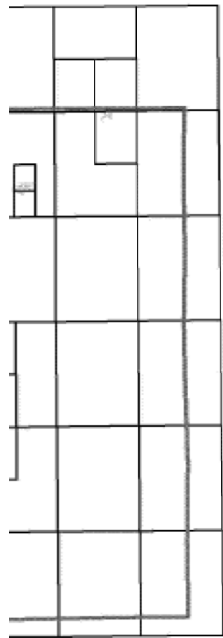
est data available at the time of the Flood Insurance Study or de-annexations may have occurred. Users should contact appropriate agencies for the most current information.

overview map of the county showing community addresses, and a Flood Insurance Study report for which each community is shown.

A Map Information Exchange (MIX) is available for users to download products associated with this Flood Insurance Study, a map of this map. The MIX may be found at <http://www.flood.gov/> and its website at <http://www.flood.gov/>.

concerning the National Flood Insurance Program (NFIP) or the Flood Insurance Study report.

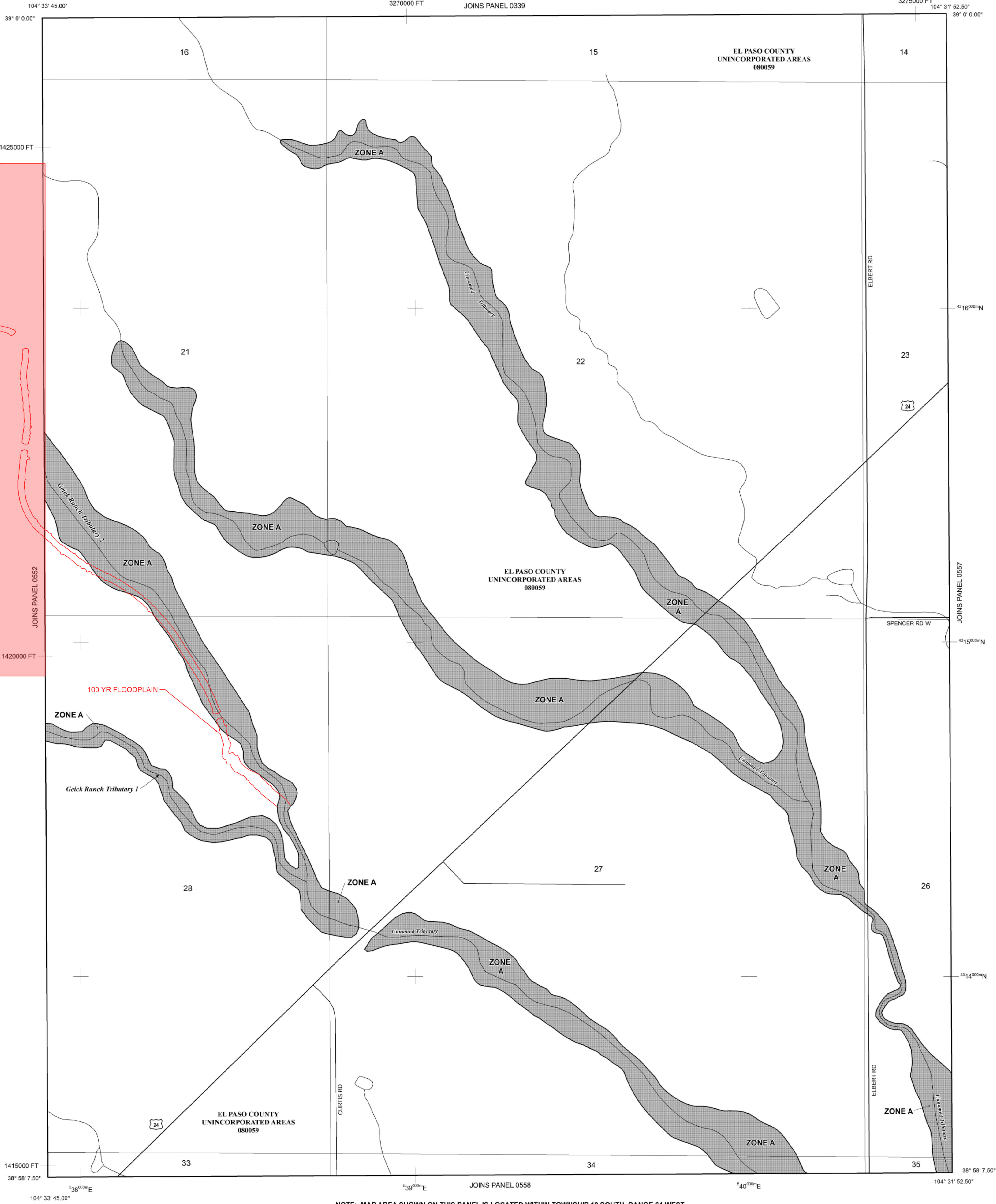
**Legend**  
Vertical Datum Offset (ft)  
FLOOD INSURANCE STUDY REVISION INFORMATION



was produced through a contract with the State of Colorado Department of Emergency Management.

Information and resources are available from the Colorado Department of Emergency Management.

SEE ANNOTATED FIRM 08041C0552G



**INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- ZONE A** No Base Flood Elevations determined.  
**ZONE AE** Base Flood Elevations determined.  
**ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.  
**ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.  
**ZONE AR** Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently de-certified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.  
**ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.  
**ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.  
**ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

**FLOODWAY AREAS IN ZONE AE**

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

**OTHER FLOOD AREAS**

**ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

**OTHER AREAS**

**ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.  
**ZONE D** Areas in which flood hazards are undetermined, but possible.

**COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**

**OTHERWISE PROTECTED AREAS (OPAs)**

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary  
Floodway boundary  
Zone D boundary  
CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 Base Flood Elevation line and value; elevation in feet\* (EL 513)  
Base Flood Elevation value where uniform within zone; elevation in feet\*

\* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A A Cross section line

23 23 Transect line

87° 07' 30.00" 32° 22' 30.00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

4275000mN 1000-meter Universal Transverse Mercator grid ticks, zone 13

6000000 FT 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection

DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

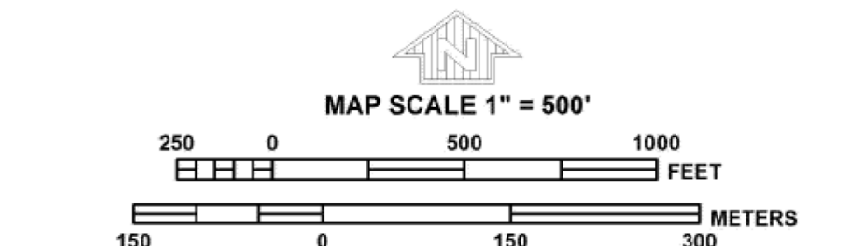
MAP REPOSITORIES Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP: MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL: DECEMBER 7, 2018 - to update corporate limits; to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



**NFIP**

**NATIONAL FLOOD INSURANCE PROGRAM**

**PANEL 0556G**

**FIRM**  
**FLOOD INSURANCE RATE MAP**  
**EL PASO COUNTY,**  
**COLORADO**  
**AND INCORPORATED AREAS**

**PANEL 556 OF 1300**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0556	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**  
**08041C0556G**

**MAP REVISED**  
**DECEMBER 7, 2018**

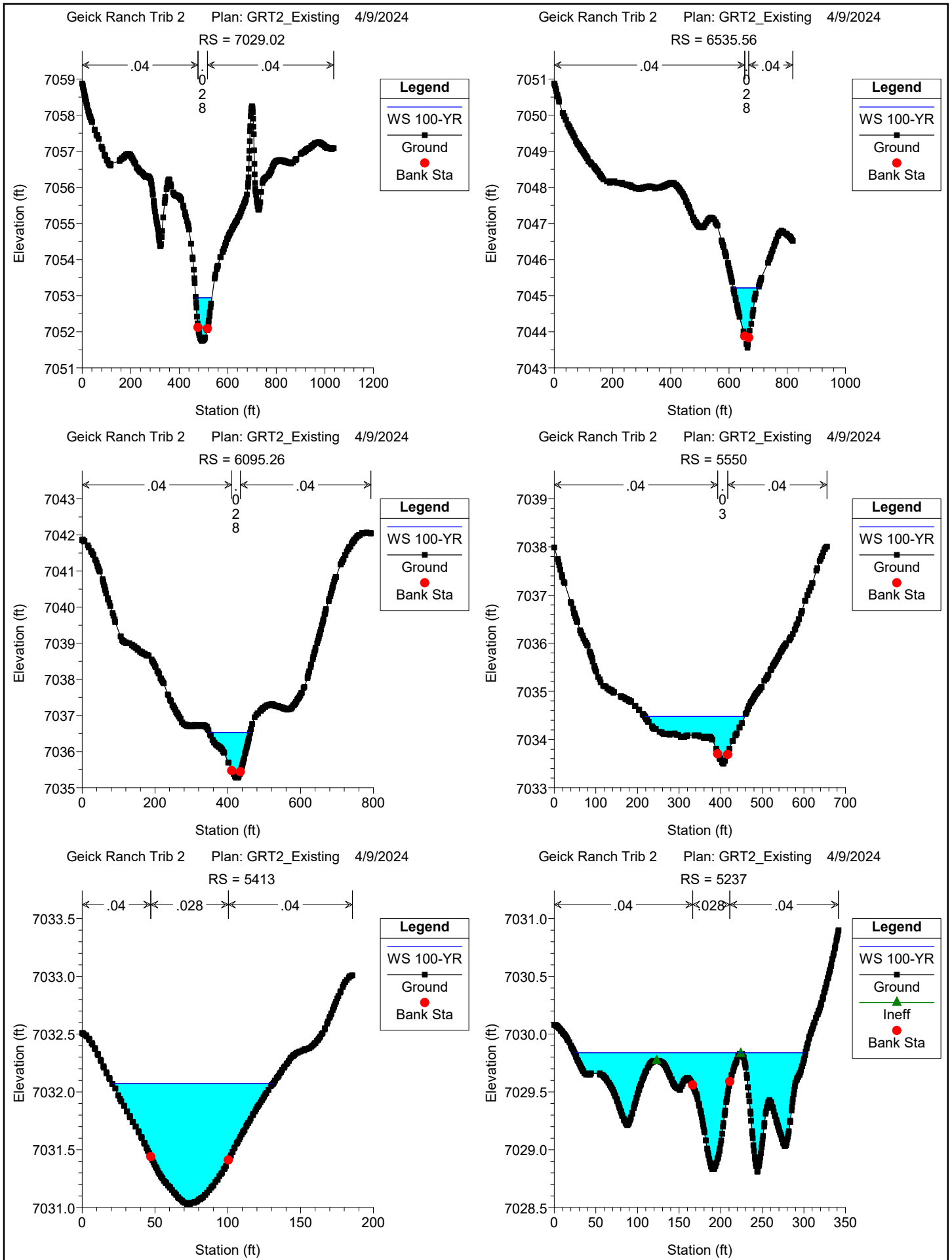


## Appendix C

### Existing Conditions Cross Sections

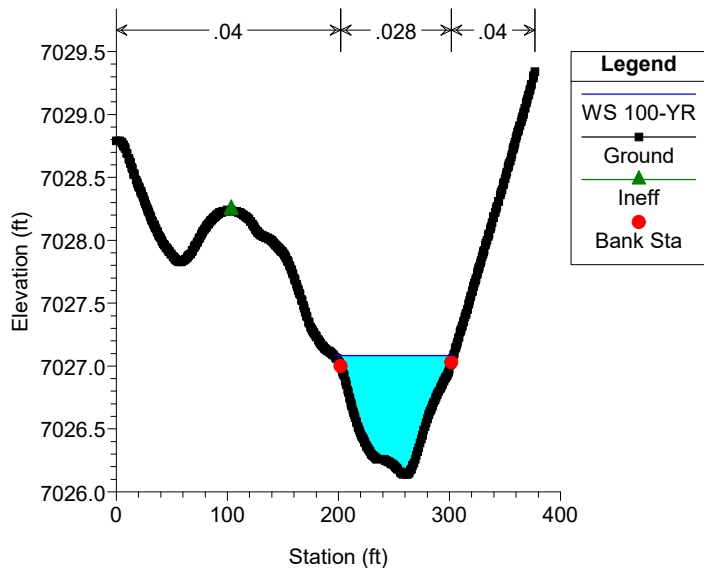
HEC-RAS Plan: Existing River: Geick Ranch Trib Reach: Existing Profile: 100-YR

Reach	River Sta	Profile	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 # Chl
Existing	7029.02	100-YR	262.00	7051.75	7052.94	7052.94	7053.39	0.010081	5.59	54.13	65.93	0.95
Existing	6535.56	100-YR	262.00	7043.56	7045.22	7045.22	7045.63	0.009209	6.69	67.67	86.30	0.96
Existing	6095.26	100-YR	262.00	7035.28	7036.53	7036.53	7036.87	0.009121	5.67	73.49	112.77	0.92
Existing	5550	100-YR	262.00	7033.50	7034.48	7034.48	7034.66	0.011136	4.83	100.58	240.04	0.90
Existing	5413	100-YR	262.00	7031.03	7032.07	7032.07	7032.40	0.009781	4.87	65.39	110.54	0.91
Existing	5237	100-YR	262.00	7028.83	7029.84	7029.84	7029.99	0.010073	4.05	106.13	277.65	0.88
Existing	5124	100-YR	262.00	7026.14	7027.08	7027.08	7027.37	0.012735	4.30	61.10	107.26	0.97
Existing	4855	100-YR	262.00	7020.15	7020.80	7020.80	7020.99	0.013829	3.79	79.67	201.93	0.97
Existing	4495	100-YR	536.00	7010.15	7011.28	7011.28	7011.65	0.011813	4.88	113.01	171.72	0.98
Existing	4243	100-YR	536.00	7002.09	7003.34	7003.34	7003.73	0.011797	5.05	108.79	154.34	0.98
Existing	4015	100-YR	536.00	6997.08	6998.32	6998.32	6998.71	0.011300	5.04	110.50	160.73	0.97
Existing	3851	100-YR	536.00	6991.46	6992.64	6992.64	6993.04	0.010640	5.23	112.82	153.86	0.95
Existing	3575.47	100-YR	621.00	6984.32	6985.50	6985.50	6985.87	0.010708	5.04	138.08	202.24	0.95
Existing	3361.62	100-YR	621.00	6980.90	6982.00	6982.00	6982.36	0.012054	4.84	130.18	188.10	0.98
Existing	3164.79	100-YR	621.00	6975.30	6976.37	6976.37	6976.72	0.010555	4.83	137.69	197.74	0.93
Existing	2928	100-YR	621.00	6971.11	6972.22	6972.22	6972.59	0.012484	4.85	130.01	193.19	0.99
Existing	2742.47	100-YR	621.00	6965.00	6966.54	6966.54	6967.04	0.009167	5.68	117.61	148.26	0.92
Existing	2559.12	100-YR	621.00	6957.93	6960.30	6960.30	6961.16	0.007891	7.60	90.71	61.39	0.93
Existing	2421.92	100-YR	621.00	6954.85	6956.79	6956.79	6957.49	0.009703	6.75	93.87	71.40	0.98
Existing	2258.77	100-YR	621.00	6950.91	6952.90	6952.90	6953.61	0.009437	6.81	94.14	72.89	0.97
Existing	2060.1	100-YR	621.00	6945.95	6948.30	6948.30	6949.04	0.009630	6.90	91.69	70.41	0.98
Existing	1906.96	100-YR	621.00	6942.93	6945.22	6945.22	6945.78	0.008074	6.22	115.74	111.50	0.90
Existing	1764	100-YR	621.00	6940.99	6942.96	6942.96	6943.59	0.009775	6.39	101.45	91.75	0.97
Existing	1519.95	100-YR	621.00	6936.99	6938.54	6938.54	6938.91	0.009685	6.04	151.56	180.35	0.95
Existing	1350.59	100-YR	621.00	6933.90	6935.32		6935.66	0.006056	4.77	143.76	147.12	0.75
Existing	1221	100-YR	621.00	6932.65	6934.13	6934.13	6934.57	0.011897	5.33	117.43	144.85	1.00
Existing	1036	100-YR	649.00	6929.64	6930.88	6930.88	6931.22	0.013098	4.65	140.56	218.13	1.00
Existing	802.78	100-YR	649.00	6925.60	6926.82	6926.82	6927.23	0.012292	5.16	126.25	158.15	1.00
Existing	460.25	100-YR	649.00	6921.40	6922.68	6922.68	6923.08	0.011297	5.13	130.31	177.43	0.97
Existing	208.05	100-YR	649.00	6917.96	6918.61	6918.61	6918.88	0.013643	4.21	159.36	399.93	0.99
Existing	2.6	100-YR	649.00	6912.97	6915.00	6915.00	6915.51	0.010275	6.22	133.19	213.29	0.98
Existing	-164.55	100-YR	649.00	6909.88	6911.20	6911.20	6911.73	0.010630	5.83	113.61	115.94	0.98
Existing	-296.57	100-YR	649.00	6907.23	6909.25	6909.25	6909.86	0.008634	6.48	113.17	106.09	0.93
Existing	-530.34	100-YR	649.00	6905.98	6907.20	6907.20	6907.55	0.009816	5.42	161.42	224.58	0.93
Existing	-734.97	100-YR	649.00	6902.27	6903.80	6903.80	6904.20	0.008556	5.95	158.64	195.26	0.91



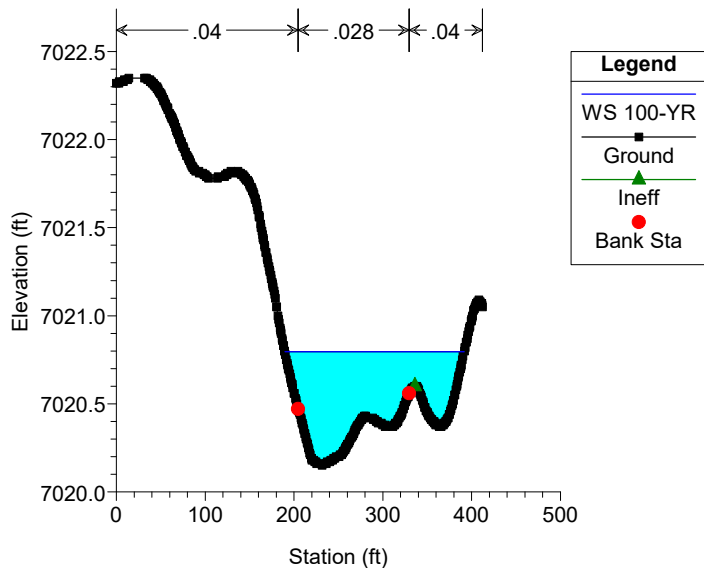
Geick Ranch Trib 2 Plan: GRT2\_Existing 4/9/2024

RS = 5124



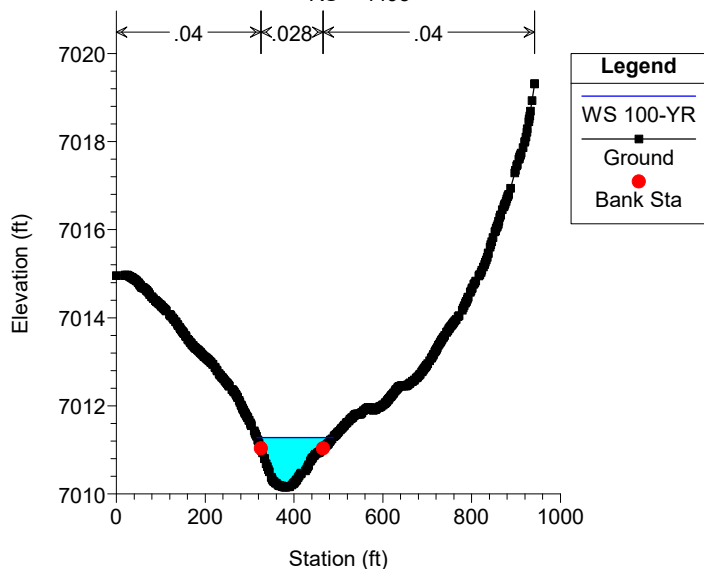
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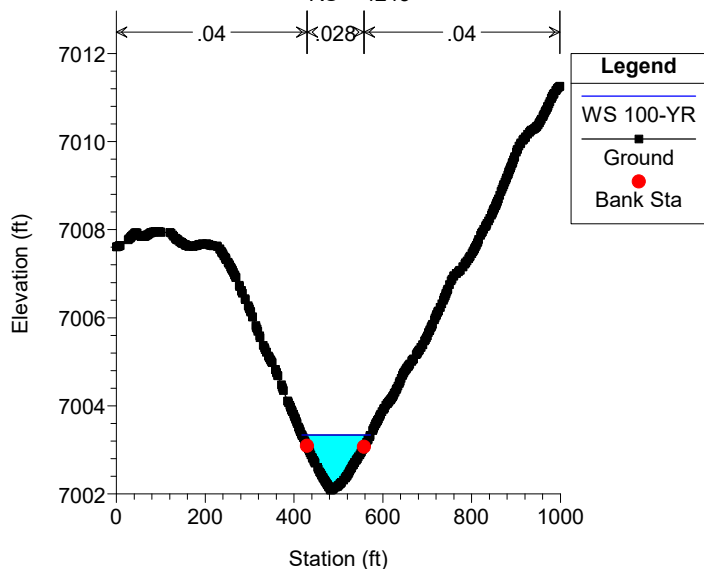
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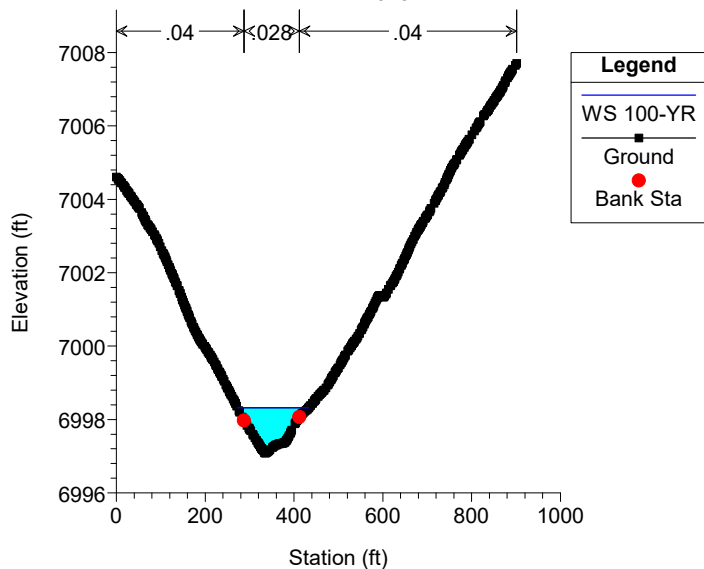
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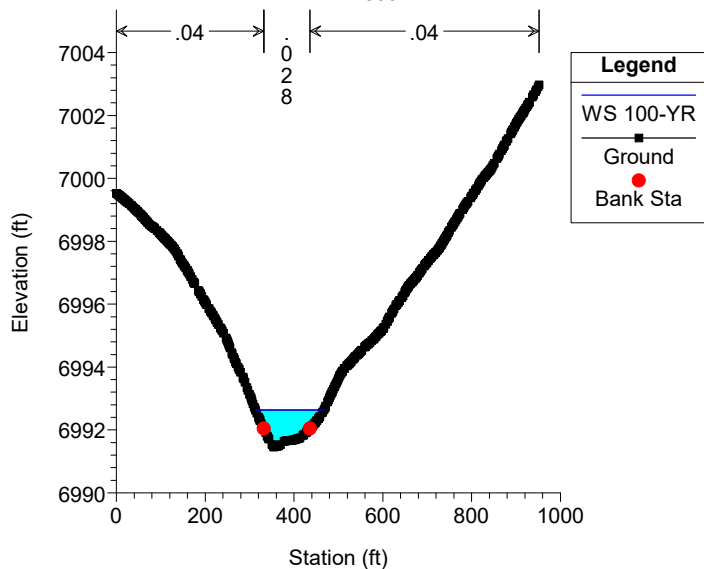
Geick Ranch Trib 2 Plan: GRT2\_Existing 4/9/2024

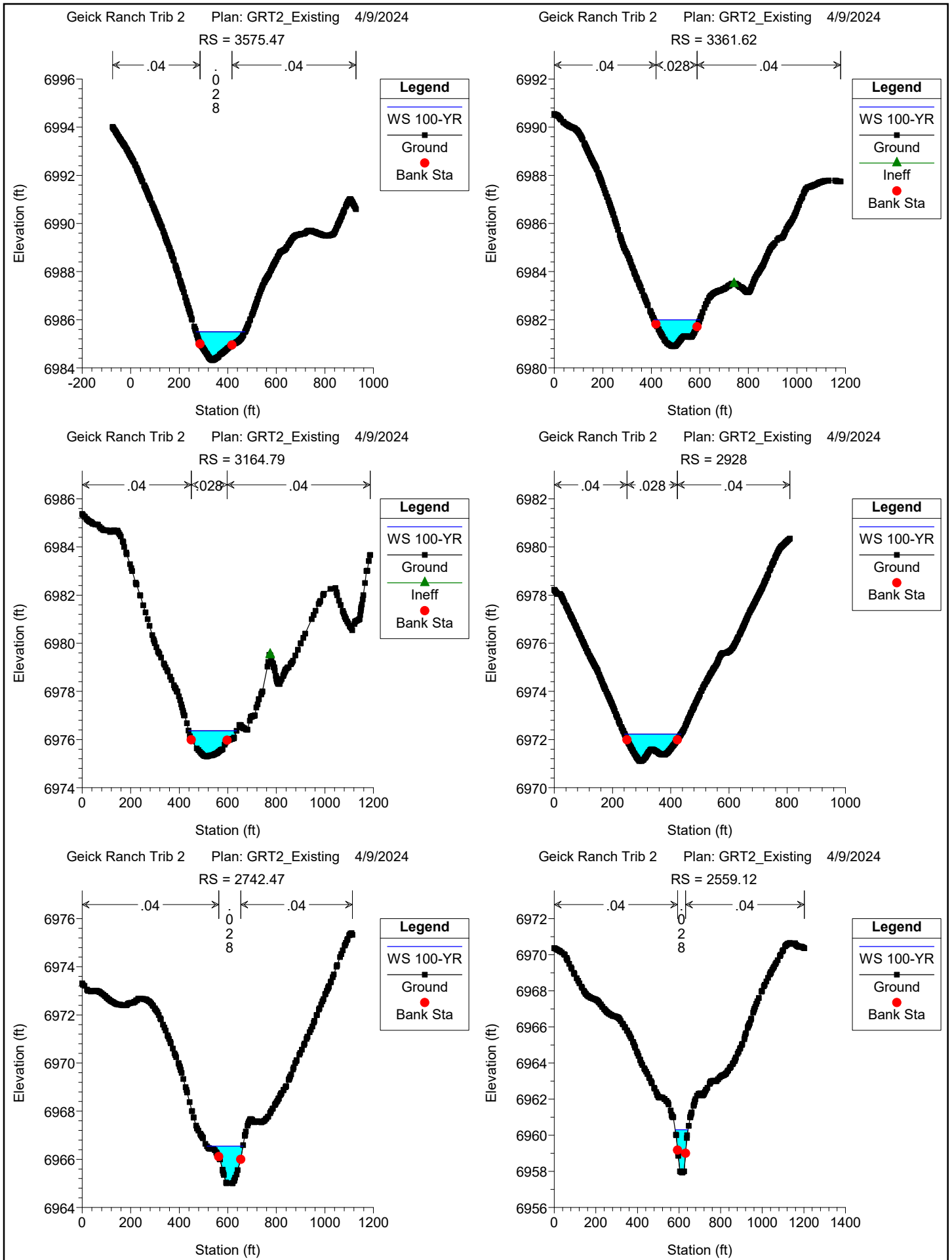
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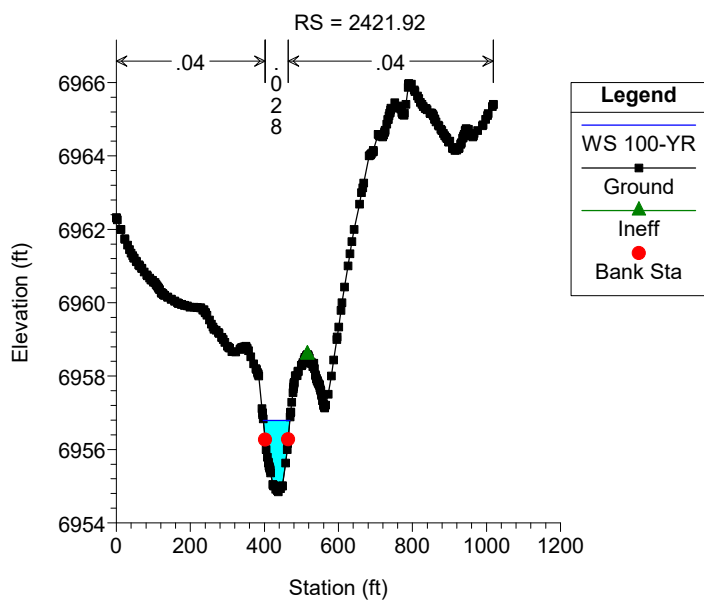
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RS = 3851

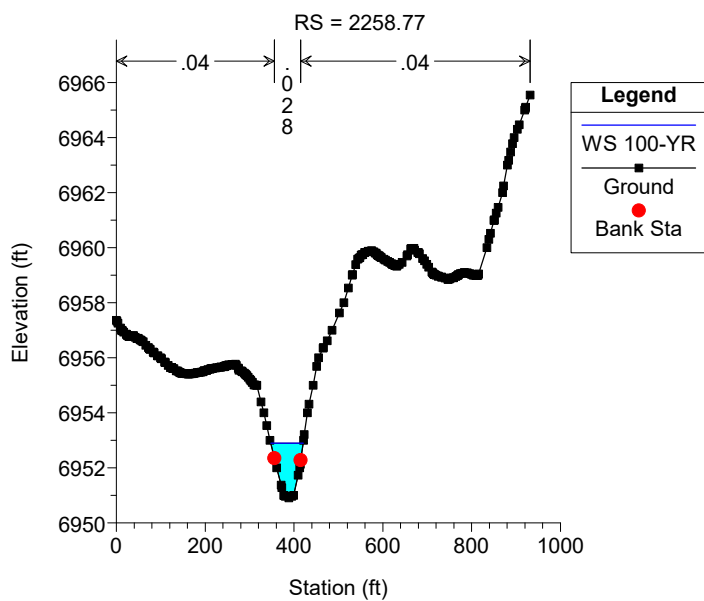




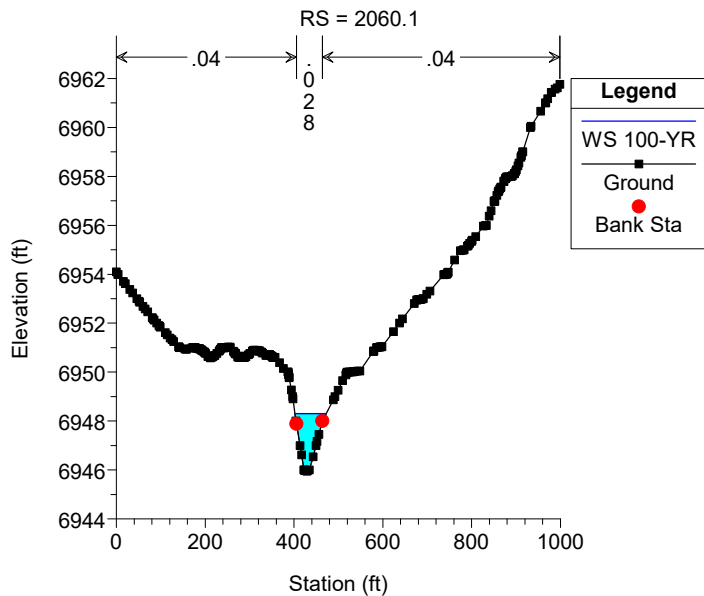
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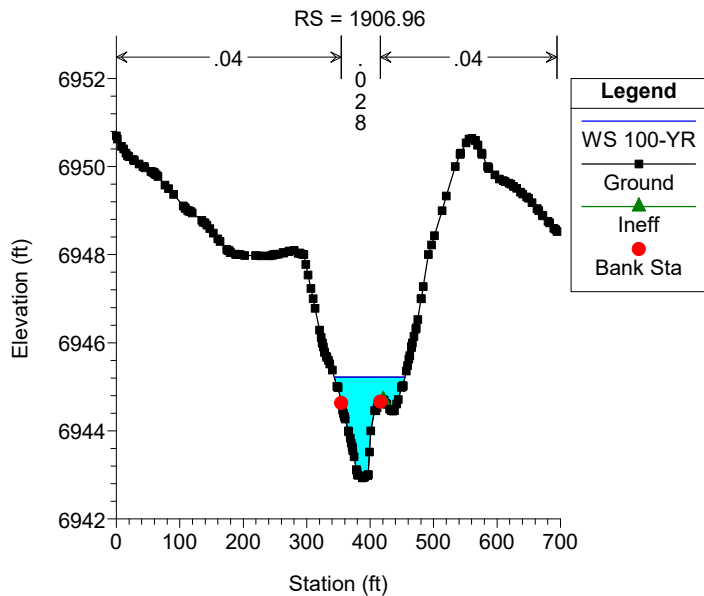
Geick Ranch Trib 2 Plan: GRT2\_Existing 4/9/2024



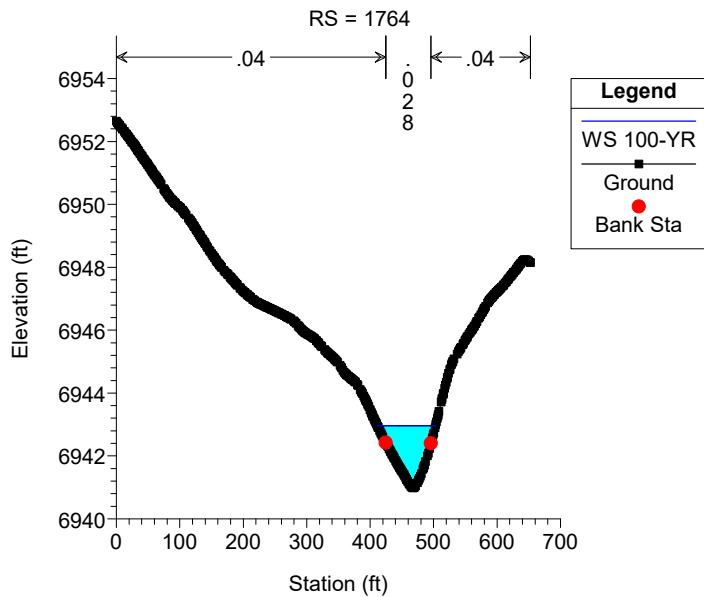
Geick Ranch Trib 2 Plan: GRT2\_Existing 4/9/2024



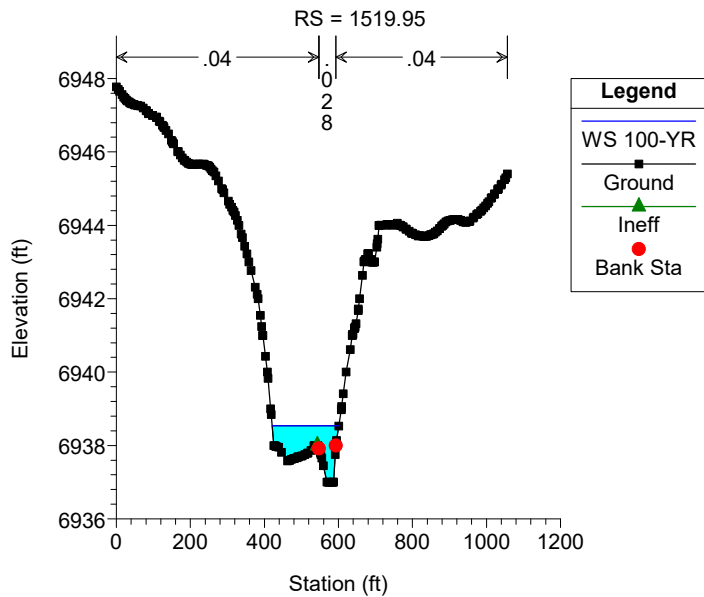
Geick Ranch Trib 2 Plan: GRT2\_Existing 4/9/2024

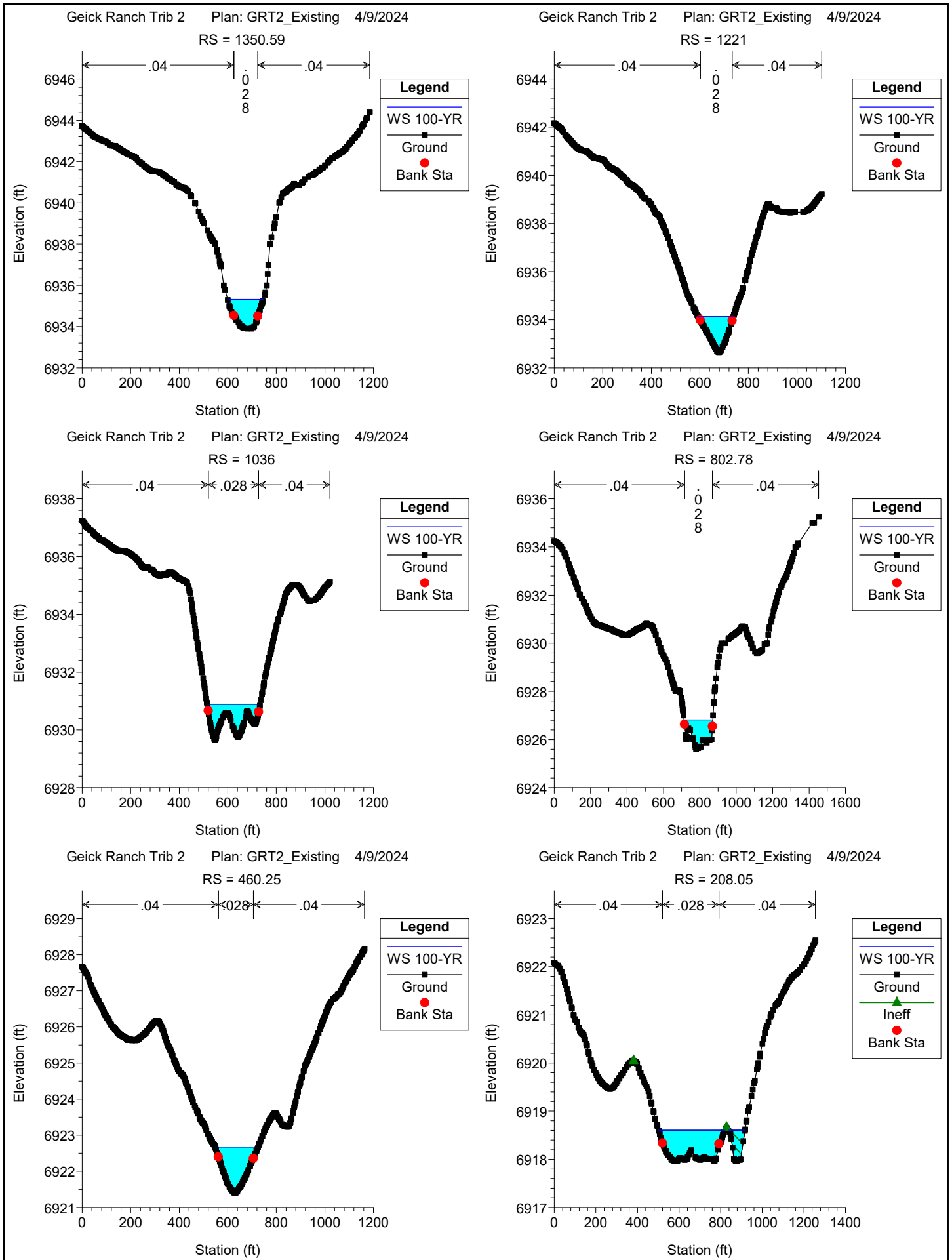


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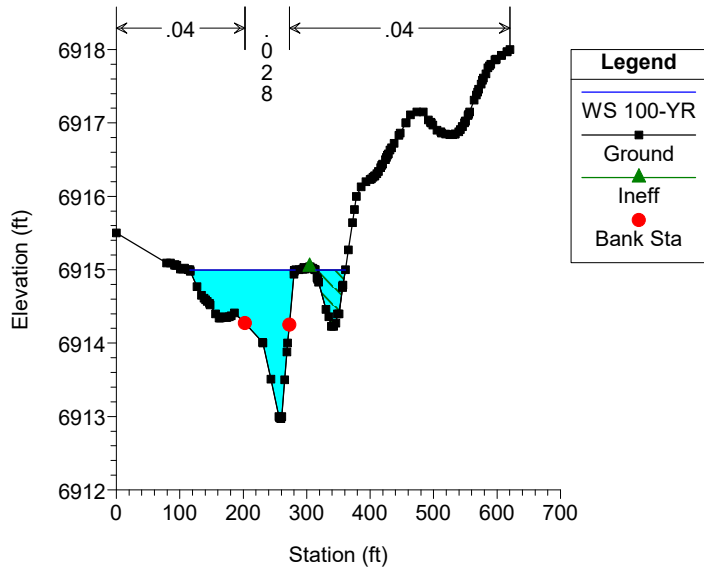
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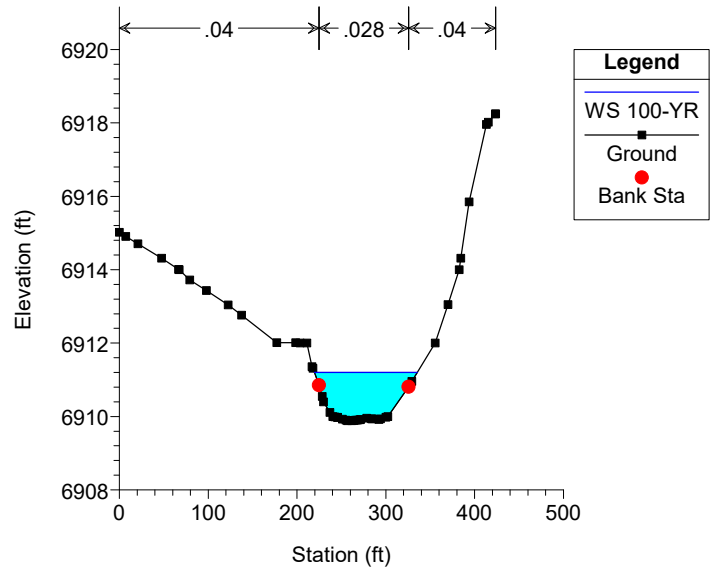
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RS = 2.6



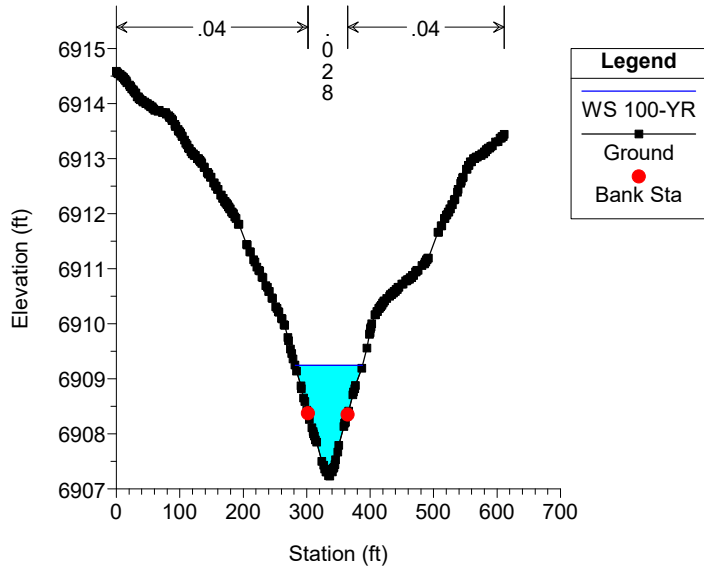
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RS = -164.55



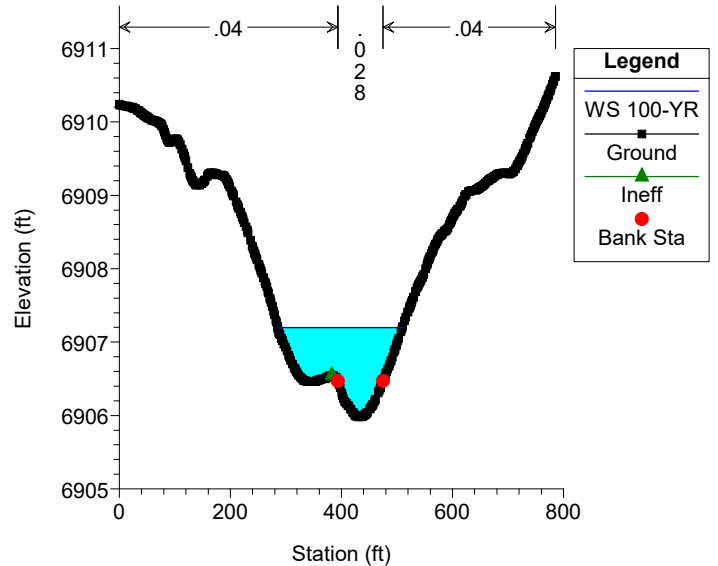
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RS = -296.57



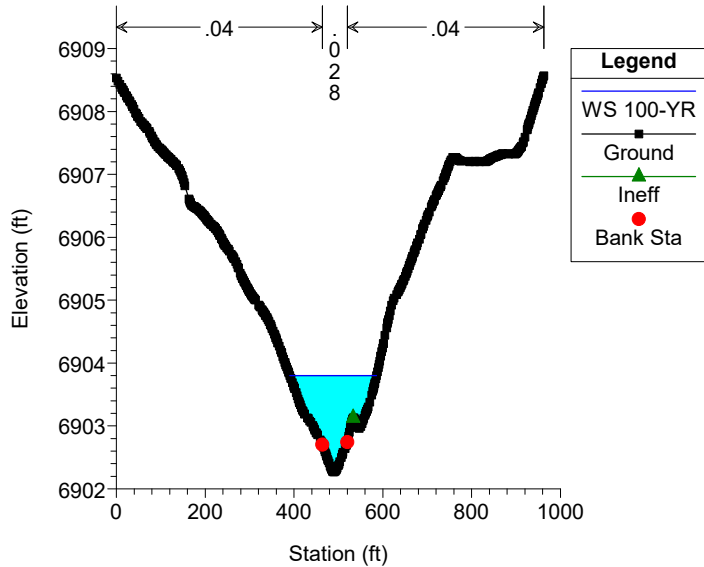
Geick Ranch Trib 2 Plan: GRT2\_Existing 4/9/2024

RS = -530.34



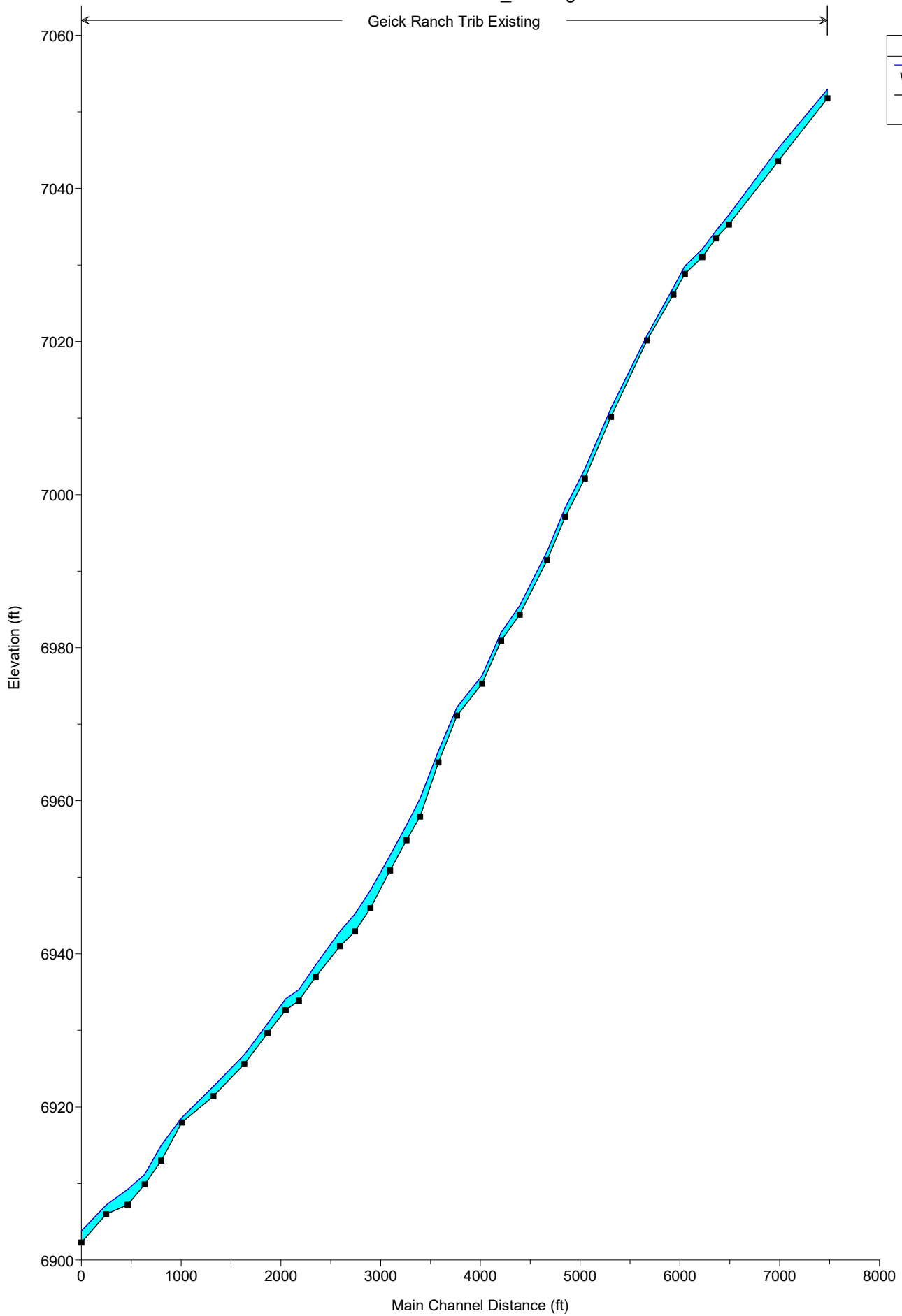
Geick Ranch Trib 2 Plan: GRT2\_Existing 4/9/2024

RS = -734.97





Geick Ranch Trib Existing



**Legend**

WS 100-YR

Ground

## Appendix D

### Proposed Conditions Cross Sections

Reach	River Sta	Profile	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 # Chl
Combined PR Chan	9426.04	PF# 1	262.00	7051.75	7052.93	7052.93	7053.38	0.011758	5.61	53.55	65.66	0.96
Combined PR Chan	8932.93	PF# 1	262.00	7043.56	7045.16	7045.16	7045.60	0.011814	6.88	62.59	81.30	1.01
Combined PR Chan	8439.38	PF# 1	262.00	7035.28	7036.53	7036.53	7036.85	0.009943	5.53	73.38	112.72	0.90
Combined PR Chan	8310.02	PF# 1	262.00	7033.50	7034.48	7034.48	7034.66	0.011063	4.82	100.81	240.12	0.90
Combined PR Chan	8096	PF# 1	262.00	7031.03	7032.06	7032.06	7032.40	0.010062	4.91	64.64	109.49	0.92
Combined PR Chan	8005	PF# 1	262.00	7024.27	7025.75	7025.75	7026.29	0.009830	5.98	45.91	42.50	0.96
Combined PR Chan	7849	PF# 1	262.00	7021.00	7022.19	7022.19	7022.74	0.010473	5.99	45.15	42.84	0.98
Combined PR Chan	7712	PF# 1	262.00	7017.86	7019.07	7019.07	7019.62	0.010396	6.02	45.44	43.01	0.98
Combined PR Chan	7583	PF# 1	262.00	7014.94	7016.15	7016.15	7016.70	0.010460	6.05	45.70	43.41	0.98
Combined PR Chan	7482	PF# 1	262.00	7012.11	7014.67		7014.81	0.001179	3.10	93.53	51.06	0.37
Combined PR Chan	7395	PF# 1	262.00	7011.00	7014.69	7012.14	7014.74	0.000185	1.72	161.63	75.13	0.16
Combined PR Chan	7290		Culvert									
Combined PR Chan	7160.32	PF# 1	536.00	7005.60	7008.77	7008.77	7010.03	0.010692	10.44	63.12	69.52	1.07
Combined PR Chan	7072.44	PF# 1	536.00	7004.86	7007.44	7007.16	7007.91	0.008036	7.78	105.98	62.56	0.88
Combined PR Chan	6977.14	PF# 1	536.00	7004.12	7006.78		7007.19	0.006646	7.22	113.68	64.67	0.81
Combined PR Chan	6850.04	PF# 1	536.00	7003.14	7005.29	7005.29	7005.95	0.014787	9.25	90.01	65.81	1.16
Combined PR Chan	6663.5	PF# 1	536.00	6999.28	7001.57	7001.57	7002.26	0.014092	9.47	88.62	61.65	1.15
Combined PR Chan	6464.81	PF# 1	536.00	6996.40	6998.65	6998.65	6999.34	0.014508	9.46	88.10	61.88	1.16
Combined PR Chan	6294.46	PF# 1	536.00	6993.77	6996.12	6996.12	6996.80	0.013444	9.38	89.28	60.64	1.12
Combined PR Chan	6192.16	PF# 1	536.00	6991.76	6993.96	6993.96	6994.64	0.014392	9.31	89.28	63.88	1.15
Combined PR Chan	6020.29	PF# 1	536.00	6988.02	6990.18	6990.18	6990.83	0.014818	9.27	90.30	66.49	1.16
Combined PR Chan	5853	PF# 1	536.00	6984.80	6987.49	6987.22	6987.95	0.007433	7.75	108.64	63.90	0.86
Combined PR Chan	5852.4	PF# 1	536.00	6984.59	6987.24	6987.05	6987.77	0.008777	8.27	101.86	63.57	0.93
Combined PR Chan	5800		Culvert									
Combined PR Chan	5730	PF# 1	536.00	6983.79	6986.56	6986.13	6987.03	0.006230	7.27	103.96	65.48	0.79
Combined PR Chan	5728.67	PF# 1	621.00	6983.48	6985.98	6985.98	6986.72	0.013073	9.70	98.62	63.82	1.12
Combined PR Chan	5541.86	PF# 1	621.00	6980.68	6983.47		6983.94	0.007272	7.81	122.08	65.77	0.85
Combined PR Chan	5424.96	PF# 1	621.00	6979.61	6982.01	6982.01	6982.76	0.014064	9.76	97.51	62.37	1.15
Combined PR Chan	5301.31	PF# 1	621.00	6977.39	6980.03	6979.80	6980.60	0.009445	8.56	111.25	63.75	0.96
Combined PR Chan	5209.65	PF# 1	621.00	6976.56	6979.27		6979.78	0.008121	8.09	117.04	64.40	0.90
Combined PR Chan	5078.71	PF# 1	621.00	6975.36	6978.03	6977.83	6978.62	0.009662	8.72	110.31	63.94	0.97
Combined PR Chan	4986.12	PF# 1	621.00	6974.51	6977.17	6976.94	6977.73	0.009324	8.53	111.76	64.13	0.96
Combined PR Chan	4902.38	PF# 1	621.00	6973.75	6976.41	6976.17	6976.96	0.009068	8.43	113.49	65.20	0.94
Combined PR Chan	4765.94	PF# 1	621.00	6972.50	6975.20	6974.93	6975.74	0.008801	8.39	113.82	63.92	0.93
Combined PR Chan	4678.67	PF# 1	621.00	6971.70	6974.04	6974.04	6974.76	0.014325	9.65	99.31	65.62	1.16
Combined PR Chan	4557.88	PF# 1	621.00	6969.52	6972.34		6972.79	0.006819	7.62	124.66	66.06	0.83
Combined PR Chan	4476.29	PF# 1	621.00	6968.79	6971.22	6971.22	6971.98	0.014198	9.91	97.51	62.86	1.16
Combined PR Chan	4351.82	PF# 1	621.00	6966.57	6968.89	6968.89	6969.63	0.014780	9.76	98.43	65.84	1.17
Combined PR Chan	4291.52	PF# 1	621.00	6964.93	6967.53	6967.53	6968.29	0.013124	9.97	98.66	61.74	1.13
Combined PR Chan	4166.12	PF# 1	621.00	6961.61	6964.38	6964.33	6965.14	0.011703	9.85	99.95	58.86	1.08
Combined PR Chan	4045.84	PF# 1	621.00	6960.53	6962.83	6962.83	6963.56	0.014681	9.68	98.93	66.29	1.17
Combined PR Chan	3885.92	PF# 1	621.00	6958.00	6960.50	6960.50	6961.25	0.013517	9.87	98.64	62.80	1.14
Combined PR Chan	3802.45	PF# 1	621.00	6956.15	6958.55	6958.55	6959.29	0.014357	9.83	98.58	64.87	1.16
Combined PR Chan	3676.52	PF# 1	621.00	6954.01	6956.29	6956.29	6957.01	0.014967	9.68	99.30	67.92	1.18
Combined PR Chan	3581.26	PF# 1	621.00	6952.06	6954.33	6954.33	6955.03	0.014785	9.58	99.90	68.17	1.17
Combined PR Chan	3500.61	PF# 1	621.00	6950.24	6952.58	6952.58	6953.34	0.014739	9.80	96.47	62.41	1.17
Combined PR Chan	3418.19	PF# 1	621.00	6948.40	6951.20		6951.62	0.006243	7.25	128.92	67.16	0.79
Combined PR Chan	3335.99	PF# 1	621.00	6947.66	6950.08	6950.08	6950.84	0.014314	9.87	97.01	62.49	1.16
Combined PR Chan	3196.98	PF# 1	621.00	6945.32	6947.96		6948.51	0.008957	8.34	113.46	64.26	0.94
Combined PR Chan	3069.72	PF# 1	621.00	6944.17	6946.98		6947.46	0.007261	7.86	121.62	65.76	0.85
Combined PR Chan	2950.47	PF# 1	621.00	6943.10	6945.51	6945.51	6946.26	0.014197	9.83	97.65	62.88	1.16
Combined PR Chan	2782.66	PF# 1	621.00	6940.49	6943.12	6942.91	6943.70	0.009780	8.67	110.46	64.30	0.98
Combined PR Chan	2687.65	PF# 1	621.00	6939.64	6942.32		6942.83	0.008263	8.09	117.25	65.57	0.90
Combined PR Chan	2558.01	PF# 1	621.00	6938.47	6941.23	6940.93	6941.76	0.008153	8.21	116.00	63.59	0.90
Combined PR Chan	2468.81	PF# 1	621.00	6937.67	6940.06	6940.06	6940.80	0.014226	9.79	98.59	64.52	1.16
Combined PR Chan	2375.32	PF# 1	621.00	6935.73	6938.45		6938.92	0.007421	7.75	122.12	66.71	0.86
Combined PR Chan	2258	PF# 1	621.00	6935.10	6937.93		6938.38	0.006469	7.57	126.08	66.07	0.81
Combined PR Chan	2256.6	PF# 1	621.00	6934.66	6937.74	6937.12	6938.11	0.005022	6.95	137.28	66.72	0.72
Combined PR Chan	2238		Culvert									
Combined PR Chan	2213.94	PF# 1	621.00	6934.28	6937.09		6937.53	0.006641	7.49	125.68	66.34	0.81
Combined PR Chan	2057	PF# 1	621.00	6933.91	6936.54	6936.34	6937.13	0.009755	8.75	109.42	62.96	0.98
Combined PR Chan	2055.98	PF# 1	621.00	6932.86	6935.60		6936.12	0.008152	8.16	116.80	64.54	0.90
Combined PR Chan	1914.4	PF# 1	621.00	6931.58	6934.29	6934.09	6934.88	0.009394	8.70	111.36	64.00	0.96
Combined PR Chan	1747.66	PF# 1	649.00	6930.08	6932.86		6933.40	0.008268	8.30	119.66	64.68	0.91
Combined PR Chan	1623.05	PF# 1	649.00	6928.96	6931.63	6931.45	6932.25	0.010138	8.94	112.16	64.58	1.00
Combined PR Chan	1501.74	PF# 1	649.00	6927.87	6930.69		6931.17	0.007304	7.89	125.53	66.14	0.85
Combined PR Chan	1372.06	PF# 1	649.00	6926.70	6929.42	6929.25	6930.05	0.010070	9.02	111.83	64.02	1.00
Combined PR Chan	1245.44	PF# 1	649.00	6925.56	6928.45	6928.06	6928.94	0.007174	7.96	125.90	66.03	0.85
Combined PR Chan	1146.93	PF# 1	649.00	6924.68	6927.18	6927.18	6927.95	0.013952	10.03	100.51	62.50	1.16
Combined PR Chan	1014.13	PF# 1	649.00	6922.39	6925.17		6925.64	0.007027	7.69	127.72	67.30	0.84
Combined PR Chan	917.82	PF# 1	649.00	6921.52	6924.23	6924.03	6924.84	0.009701	8.84	113.28	64.01	0.98
Combined PR Chan	736.89	PF# 1	649.00	6919.89	6922.72	6922.38	6923.24	0.007852	8.19	121.50	64.92	0.89
Combined PR Chan	644.5	PF# 1	649.00	6919.06	6921.48	6921.48	6922.26	0.014160	9.90	100.13	62.86	1.16
Combined PR Chan	593.08	PF# 1	649.00	6916.97	6920.99	6919.65	6921.21	0.002095	5.40	185.92	69.05	0.49
Combined PR Chan	550		Culvert									
Combined PR Chan	506.48	PF# 1	649.00	6916.72	6919.69	6919.69	6920.75	0.012365	10.64	83.59	66.84	1.12
Combined PR Chan	444.71	PF# 1	649.00	6916.17	6918.72	6918.72	6919.47	0.013025	9.80	102.18	63.04	1.12
Combined PR Chan	284.91	PF# 1	649.00	6912.10	6914.91	6914.58	6915.43	0.007927	8.19	121.51	65.49	0.89
Combined PR Chan	164.39	PF# 1	649.00	6911.01	6913.39	6913.39	6914.13	0.014800	9.94	103.01	69.10	1.18
Combined PR Chan	72.04	PF# 1	649.00	6909.09	6912.08		6912.53	0.006334	7.67	131.58	66.93	0.80

Highlighted values exceed Table 3 values.

HEC-RAS Plan: Proposed River: ChannelB Reach: Combined PR Chan Profile: PF# 1 (Continued)

Reach	River Sta	Profile	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 # Chl
Combined PR Chan	3.14	PF# 1	649.00	6908.47	6911.13	6911.13	6911.89	0.012901	10.06	103.05	63.35	1.12
Combined PR Chan	-296.57	PF# 1	649.00	6907.23	6909.25	6909.25	6909.86	0.008634	6.48	113.17	106.09	0.93
Combined PR Chan	-530.34	PF# 1	649.00	6905.98	6907.20	6907.20	6907.55	0.009816	5.42	161.42	224.58	0.93
Combined PR Chan	-734.97	PF# 1	649.00	6902.27	6903.80	6903.80	6904.20	0.008556	5.95	158.64	195.26	0.91

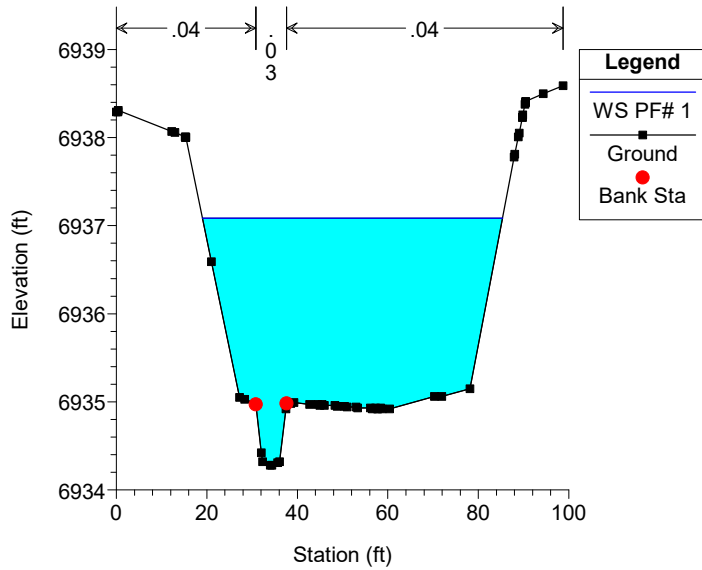
Also provide tables  
for 2-year and  
10-year flows

HEC-RAS Plan: PR\_No\_Detention River: Geick Ranch Trib Reach: Alignment - (2) Profile: 100-YR

Reach	River Sta	Profile	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 # Chl
Alignment - (2)	3712.84	100-YR	413.00	6993.54	6994.93	6994.93	6995.39	0.009732	5.98	87.19	94.92	0.95
Alignment - (2)	3618.51	100-YR	413.00	6989.96	6991.79	6991.79	6992.29	0.008631	7.10	92.42	90.50	0.95
Alignment - (2)	3424.5	100-YR	413.00	6985.91	6987.05	6987.05	6987.47	0.009395	5.41	88.79	118.95	0.92
Alignment - (2)	3214.73	100-YR	413.00	6979.87	6981.85	6981.85	6982.60	0.008004	7.29	67.40	49.24	0.93
Alignment - (2)	2882.47	100-YR	413.00	6973.22	6974.71	6974.71	6975.21	0.011454	5.71	72.33	71.59	1.00
Alignment - (2)	2772.34	100-YR	413.00	6972.00	6973.30		6973.47	0.003509	3.37	122.58	110.36	0.56
Alignment - (2)	2748.72	100-YR	413.00	6972.00	6972.90	6972.90	6973.31	0.012495	5.10	80.95	101.39	1.01
Alignment - (2)	2592.31	100-YR	413.00	6966.70	6968.62	6968.62	6969.36	0.009052	7.39	67.18	49.16	0.98
Alignment - (2)	2527.18	100-YR	413.00	6964.78	6966.67	6966.67	6967.38	0.008558	7.25	69.06	51.61	0.95
Alignment - (2)	2478.84	100-YR	413.00	6963.36	6965.76	6965.76	6966.53	0.007321	7.84	70.67	48.25	0.92
Alignment - (2)	2303.17	100-YR	413.00	6959.99	6962.39	6962.39	6963.16	0.007352	7.82	70.39	48.23	0.92
Alignment - (2)	2121.94	100-YR	413.00	6957.99	6960.42	6960.42	6961.34	0.007762	8.26	62.07	38.40	0.95
Alignment - (2)	1814.04	100-YR	413.00	6953.99	6956.08	6956.08	6956.87	0.007846	7.55	65.23	44.14	0.93
Alignment - (2)	1556.67	100-YR	466.95	6949.87	6952.01	6952.01	6952.92	0.009634	8.30	72.82	57.19	1.03
Alignment - (2)	1297.03	100-YR	466.95	6941.99	6945.48	6945.48	6946.63	0.006525	9.39	65.37	31.52	0.91
Alignment - (2)	1084.03	100-YR	466.95	6939.97	6943.08	6943.08	6943.48	0.003703	6.56	149.65	164.47	0.68
Alignment - (2)	642.96	100-YR	466.95	6930.00	6932.36	6932.36	6933.13	0.007703	7.51	75.56	51.90	0.92
Alignment - (2)	523.77	100-YR	466.95	6929.58	6931.11	6931.11	6931.71	0.009858	6.68	82.43	70.97	0.99
Alignment - (2)	290.78	100-YR	466.95	6924.69	6926.16	6926.16	6926.79	0.010058	6.60	78.84	67.36	0.99
Alignment - (2)	214.43	100-YR	466.95	6922.96	6924.89	6924.89	6925.66	0.008748	7.51	74.63	52.02	0.97
Alignment - (2)	148.72	100-YR	466.95	6920.98	6922.89	6922.89	6923.64	0.008774	7.45	75.04	51.92	0.97
Alignment - (2)	33.13	100-YR	466.95	6918.00	6920.58	6920.58	6921.35	0.007483	7.91	80.70	55.43	0.93

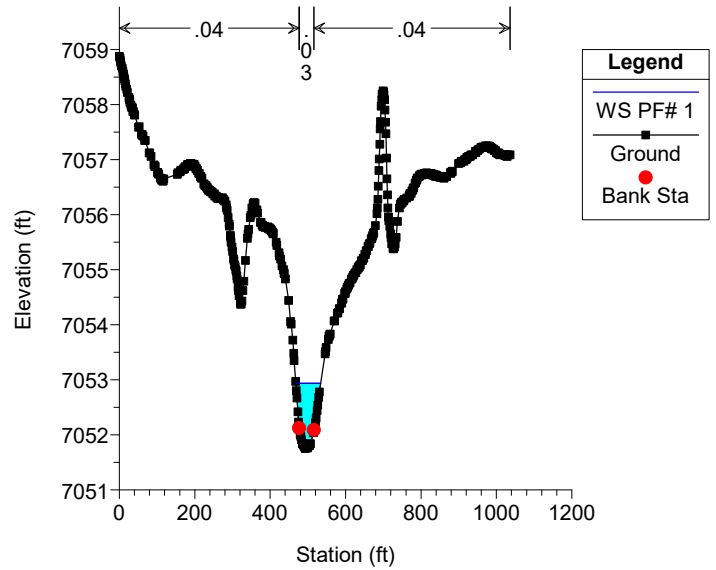
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 2213.94



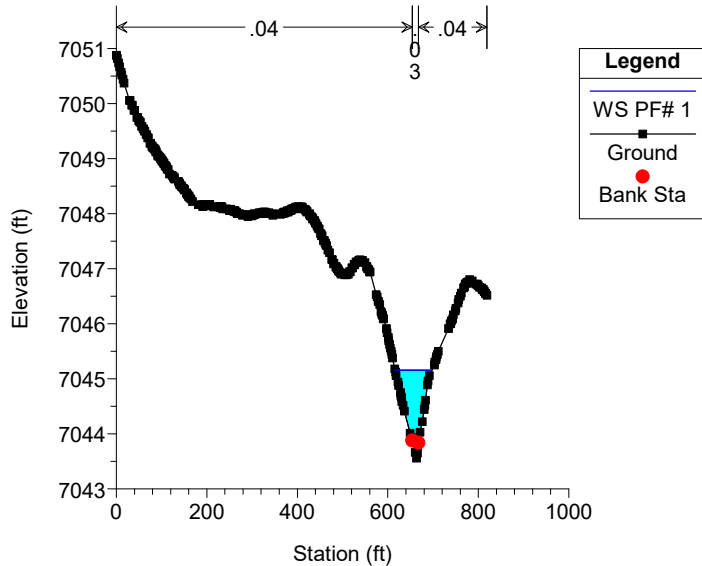
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RS = 9426.04



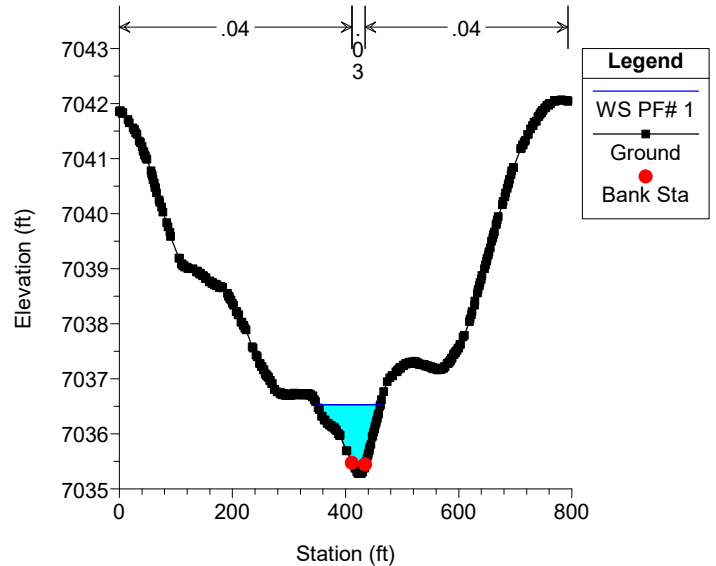
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 8932.93



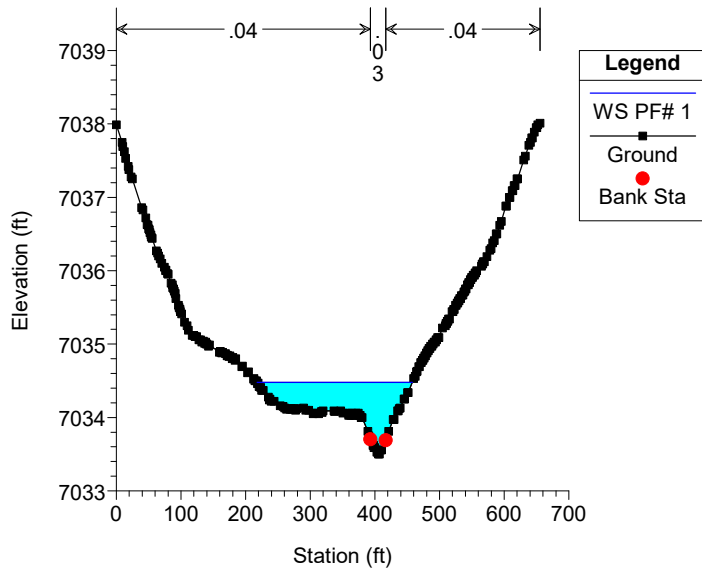
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 8439.38



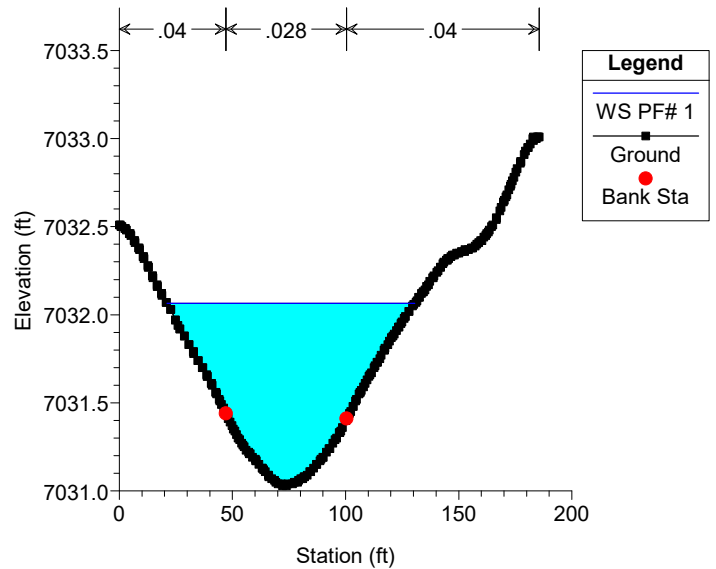
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 8310.02



Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

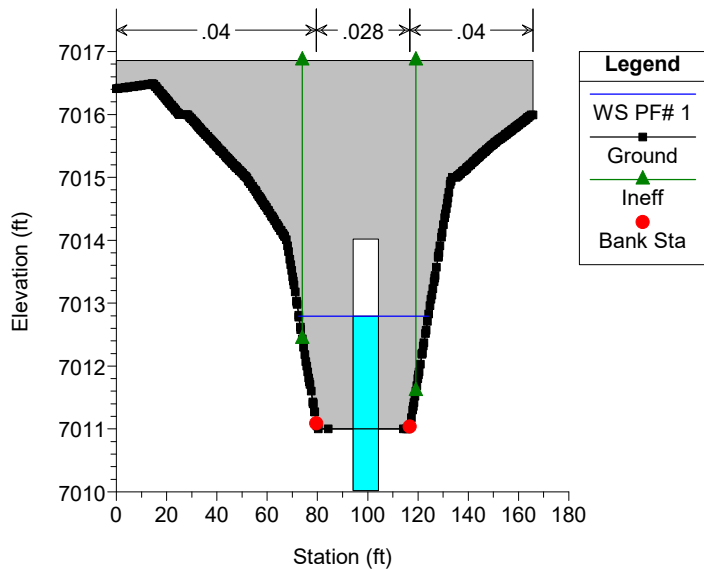
RS = 8096





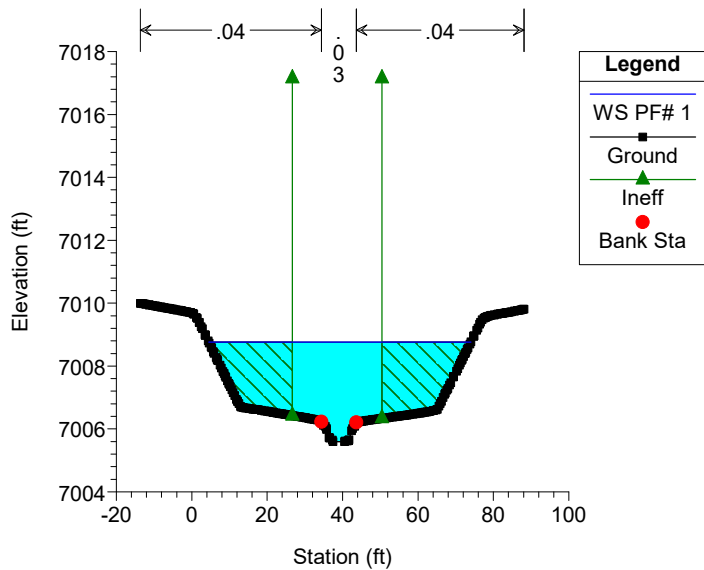
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 7290 Culv. Rex Road



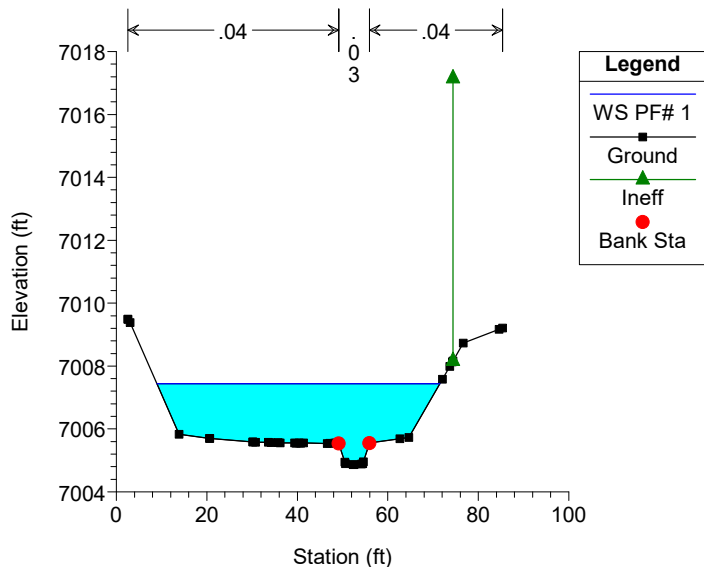
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 7160.32



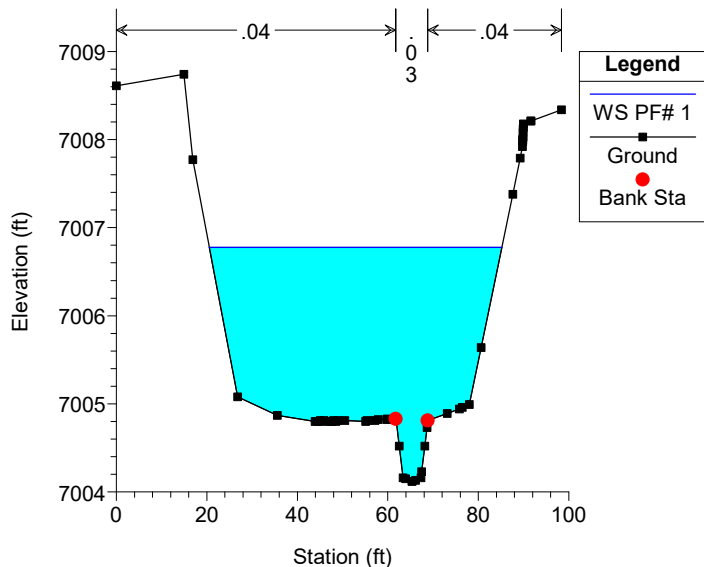
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 7072.44



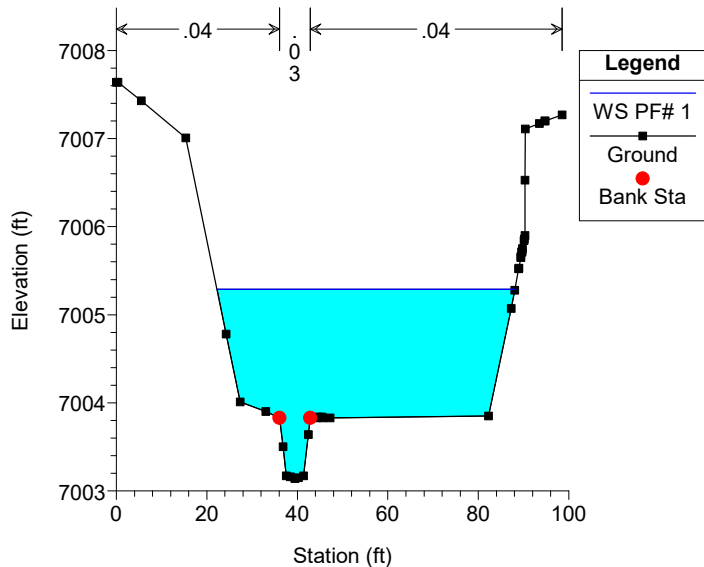
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 6977.14



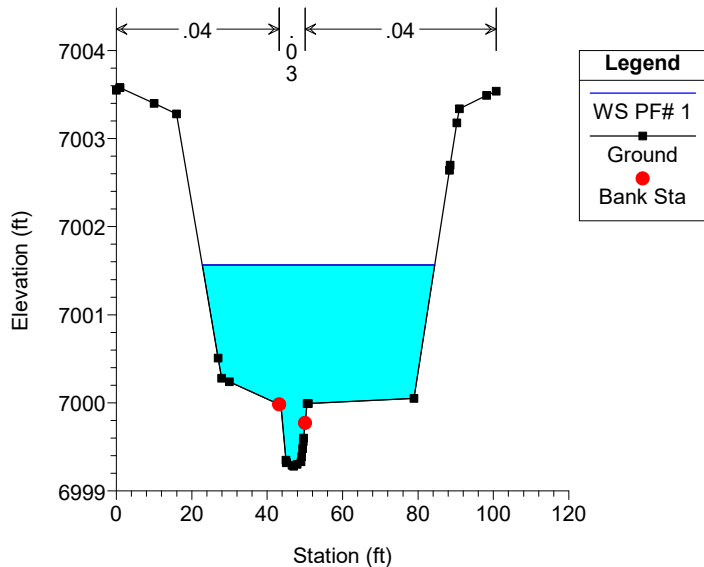
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 6850.04



Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

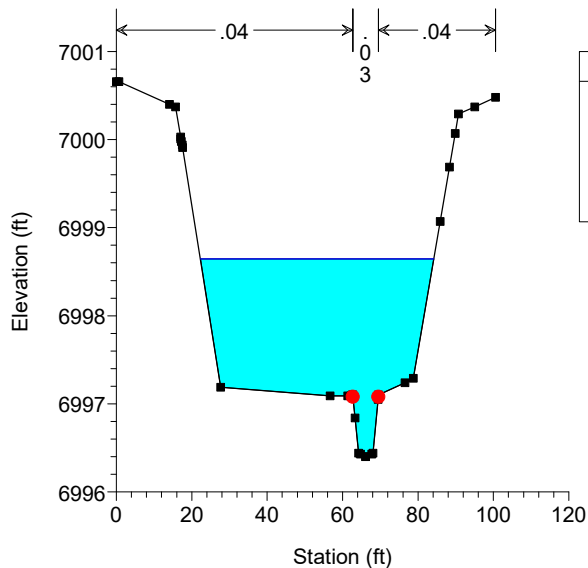
RS = 6663.5





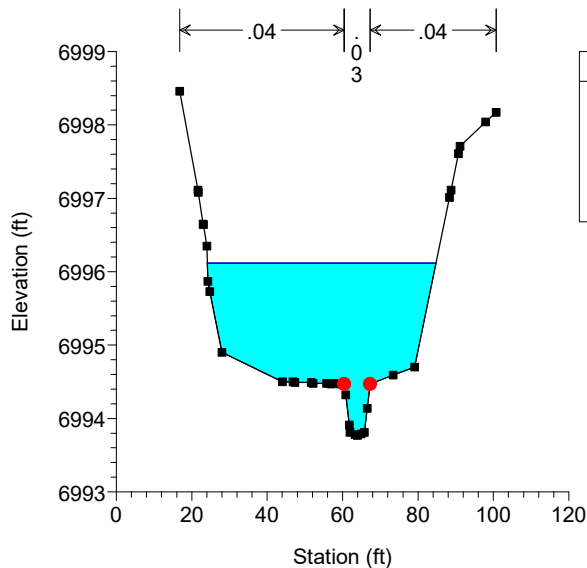
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 6464.81



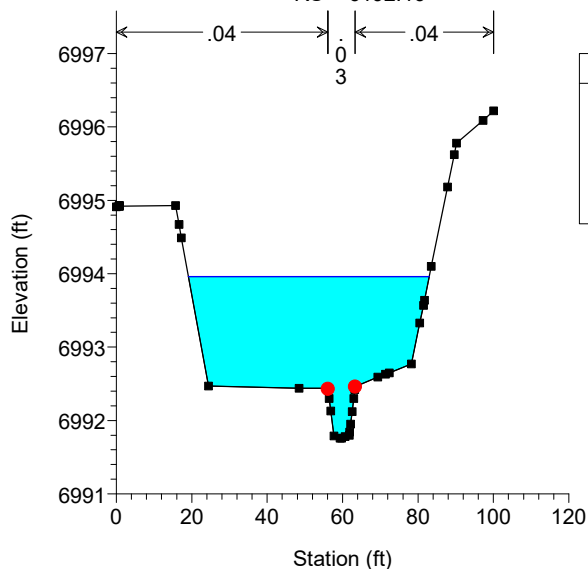
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 6294.46



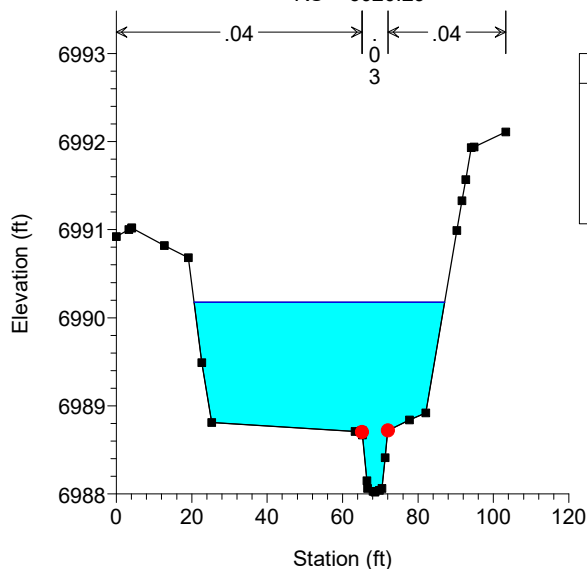
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 6192.16



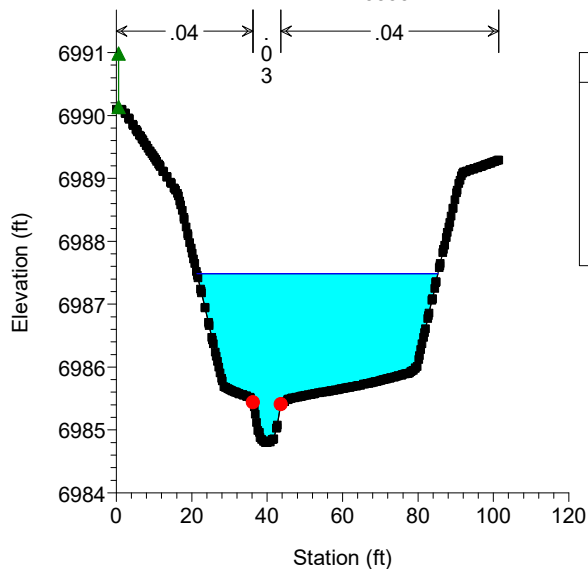
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 6020.29



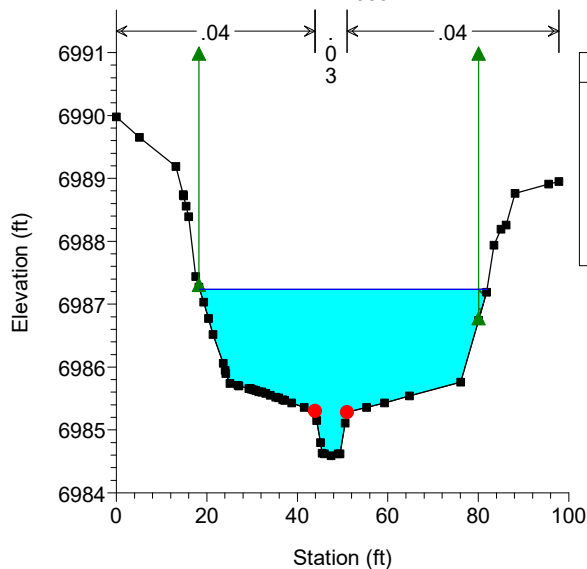
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 5853



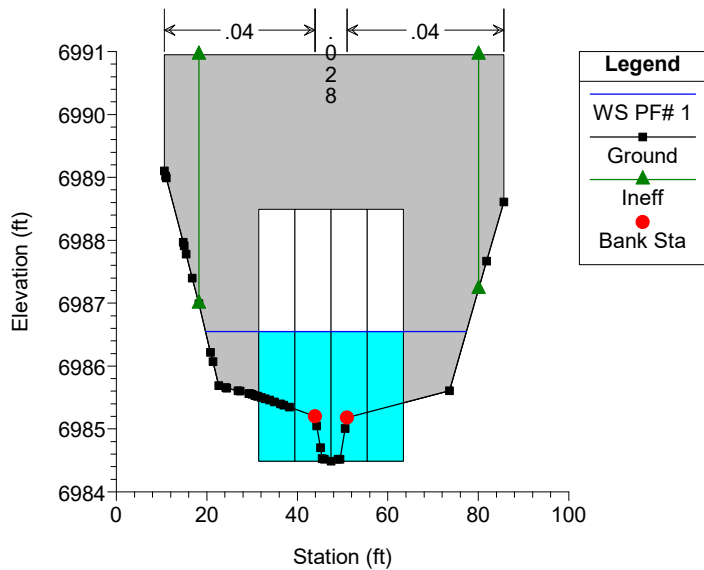
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 5852.4



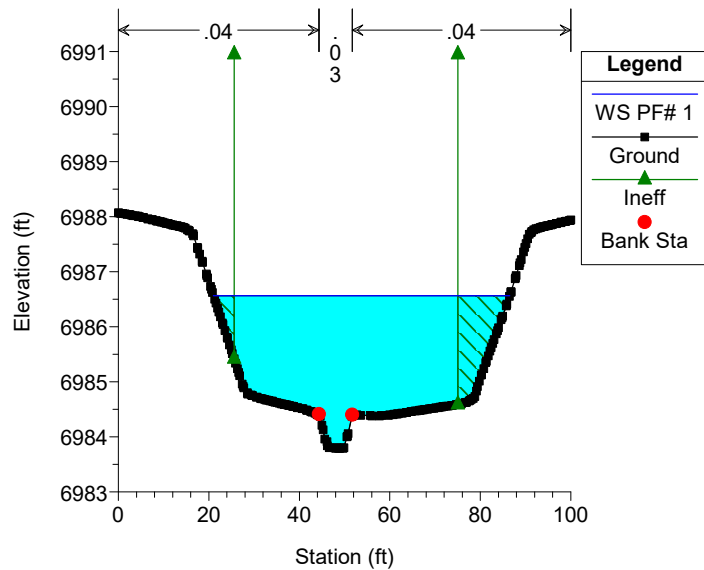
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 5800 Culv Dawlish Road



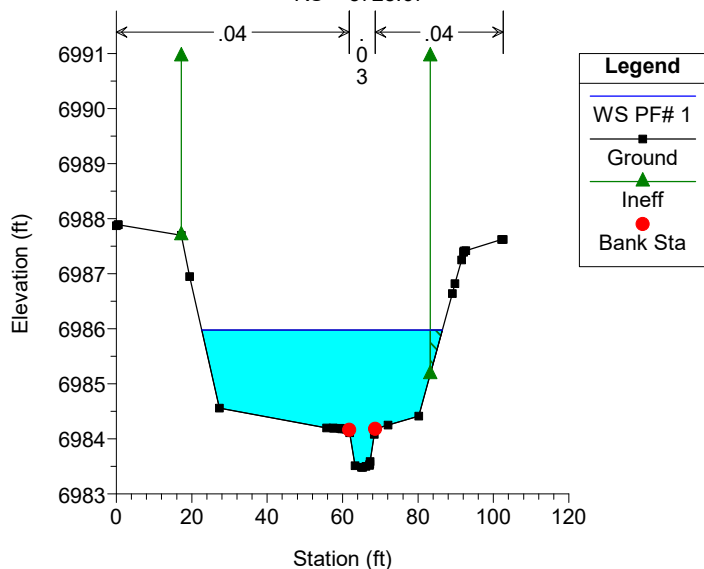
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 5730



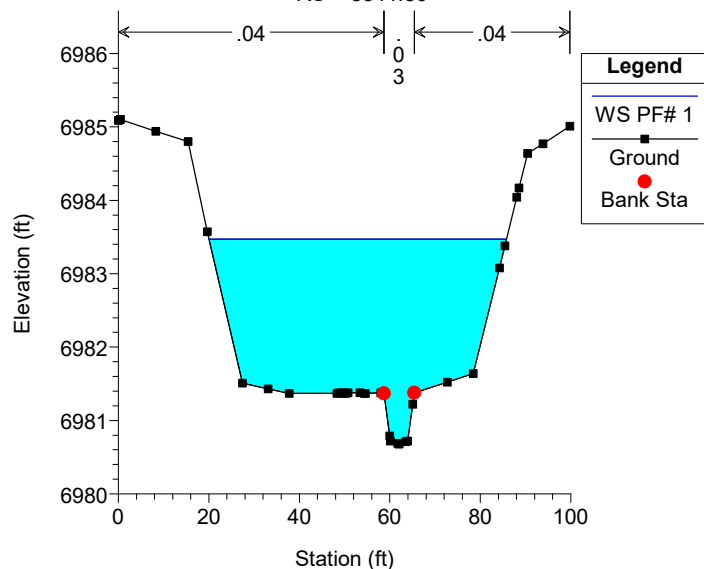
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 5728.67



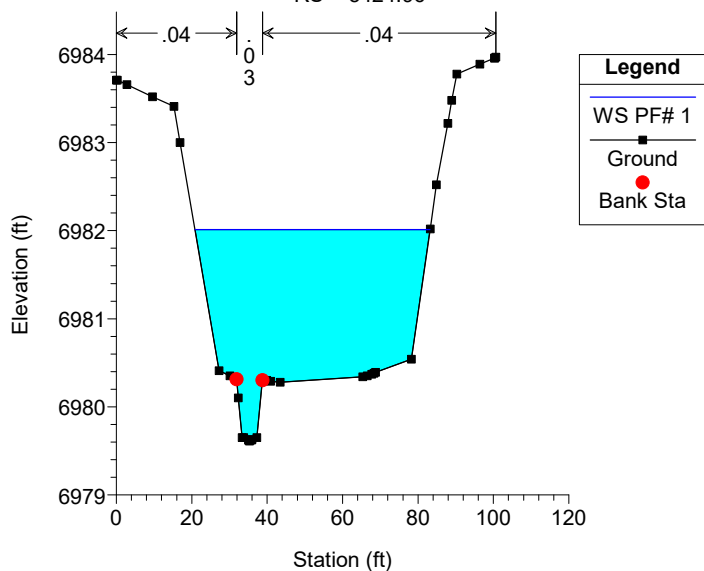
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 5541.86



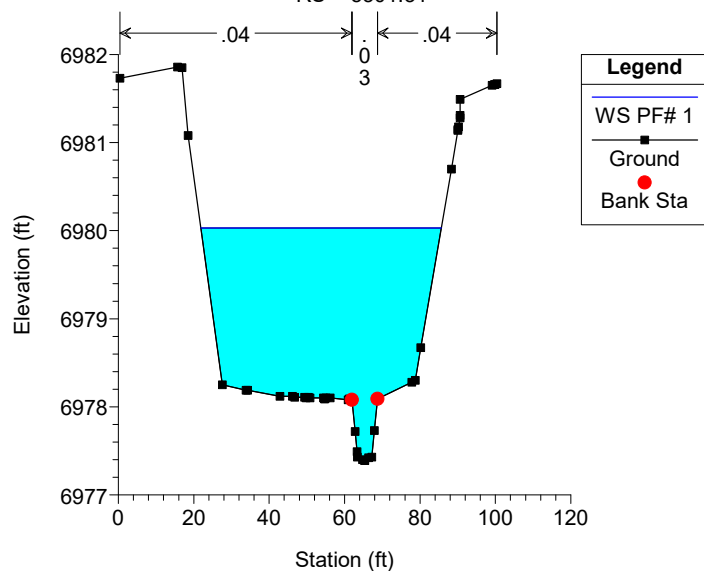
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 5424.96



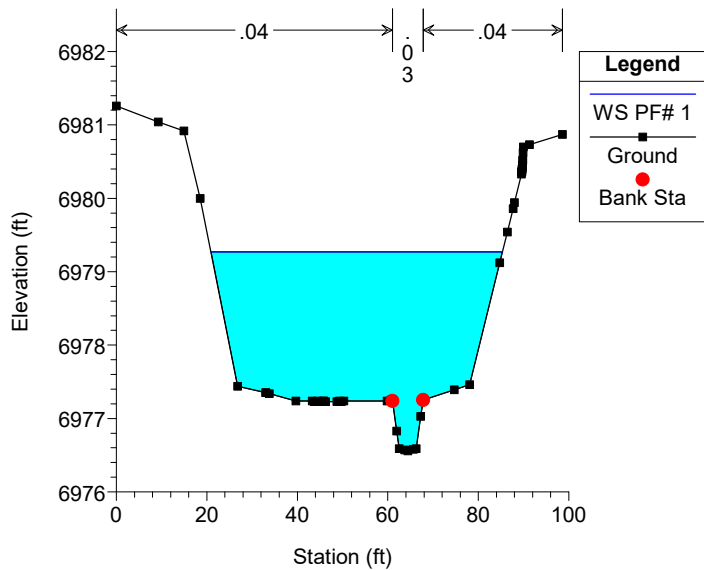
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

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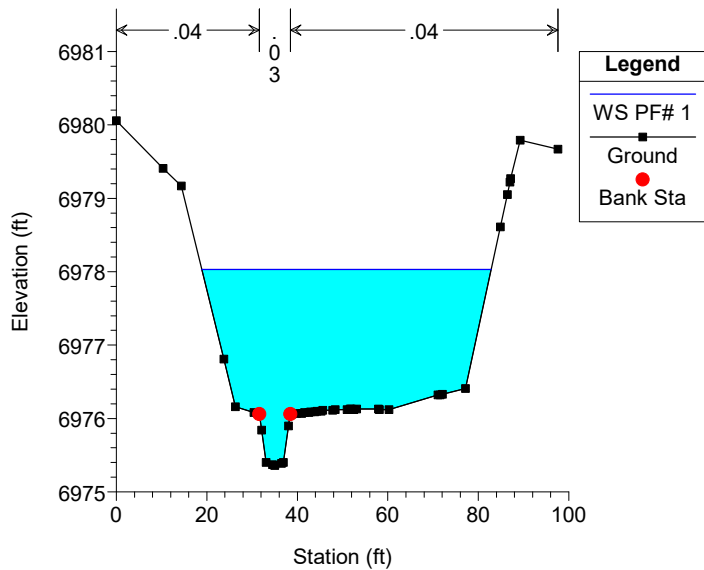
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 5209.65



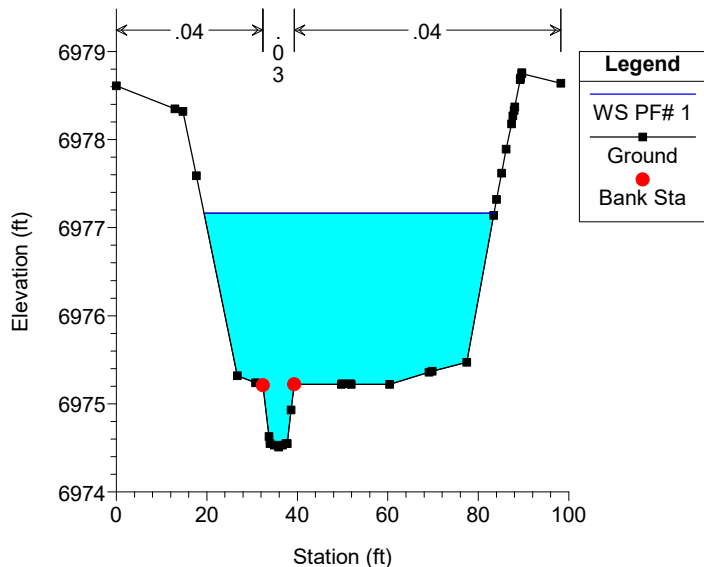
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 5078.71



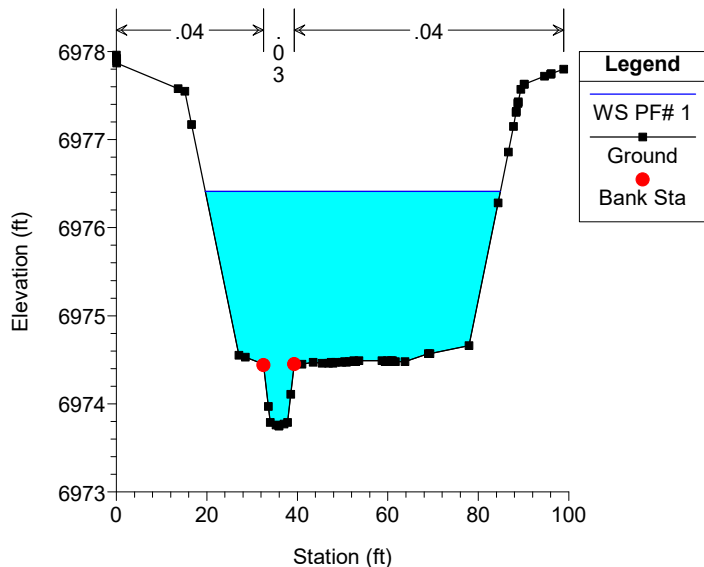
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 4986.12



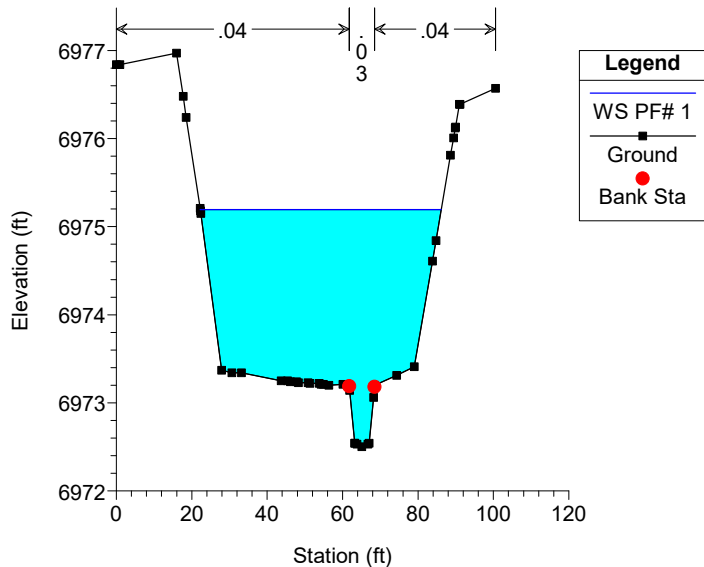
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 4902.38



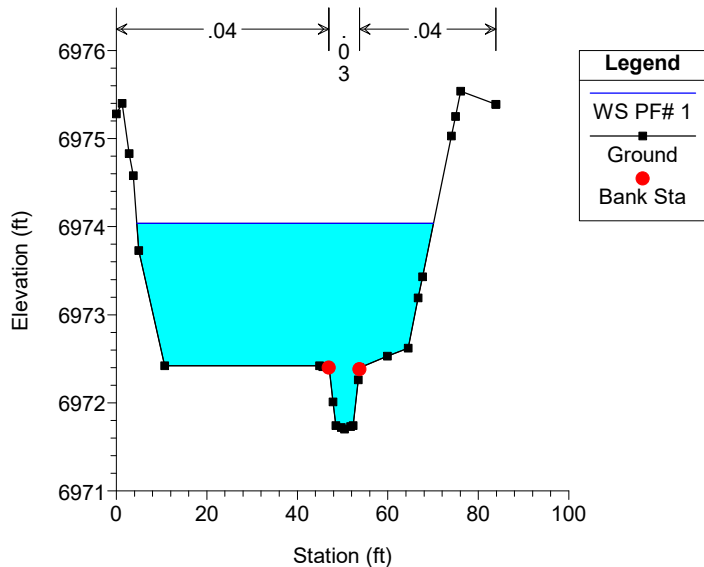
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 4765.94



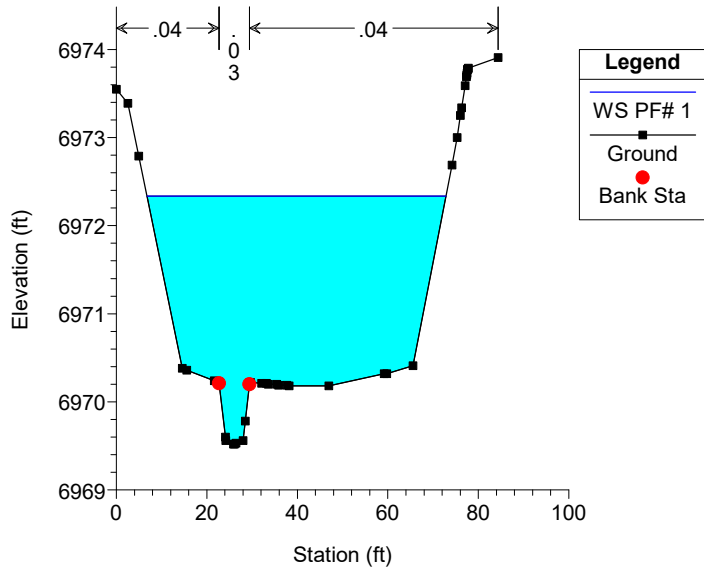
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 4678.67



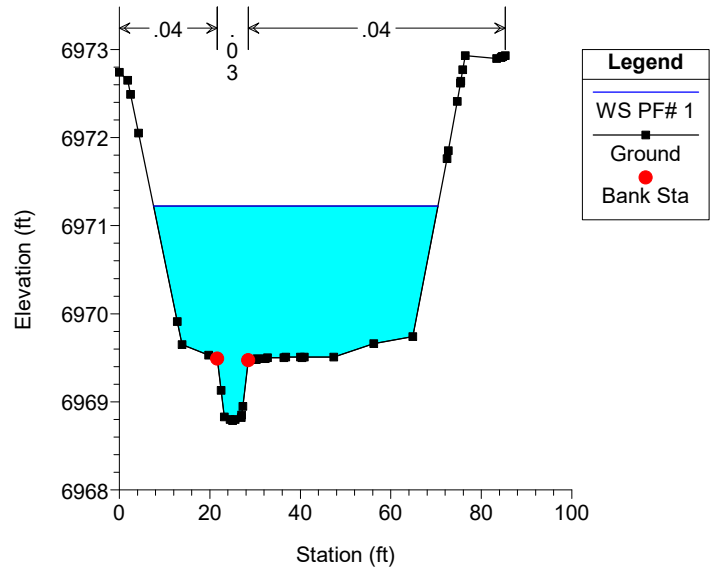
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 4557.88



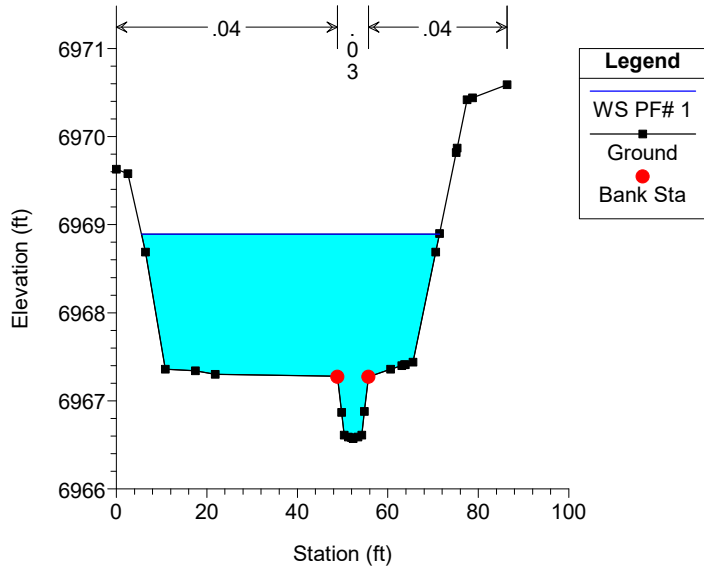
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 4476.29



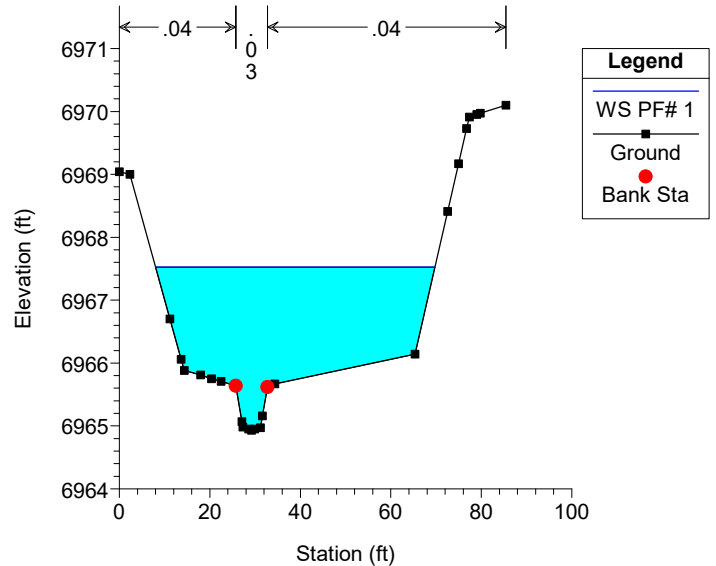
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 4351.82



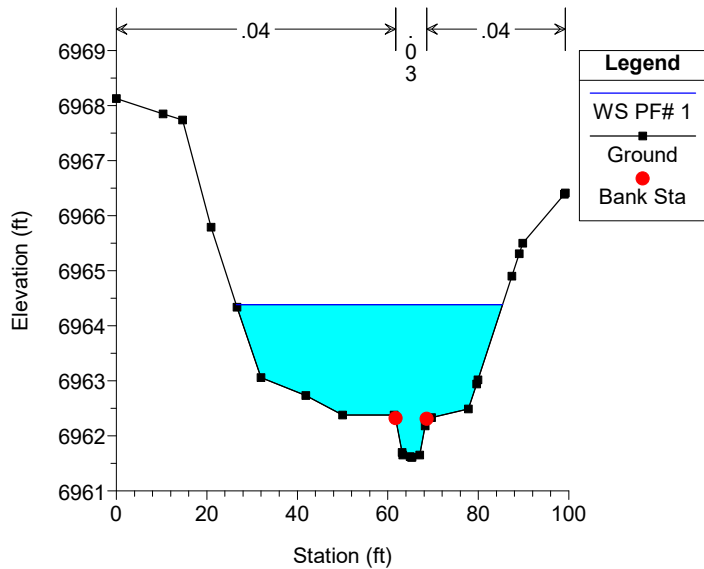
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 4291.52



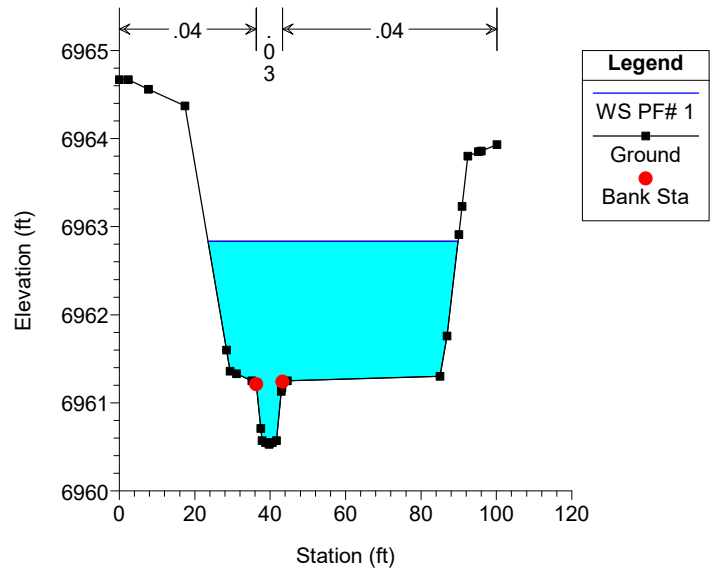
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 4166.12



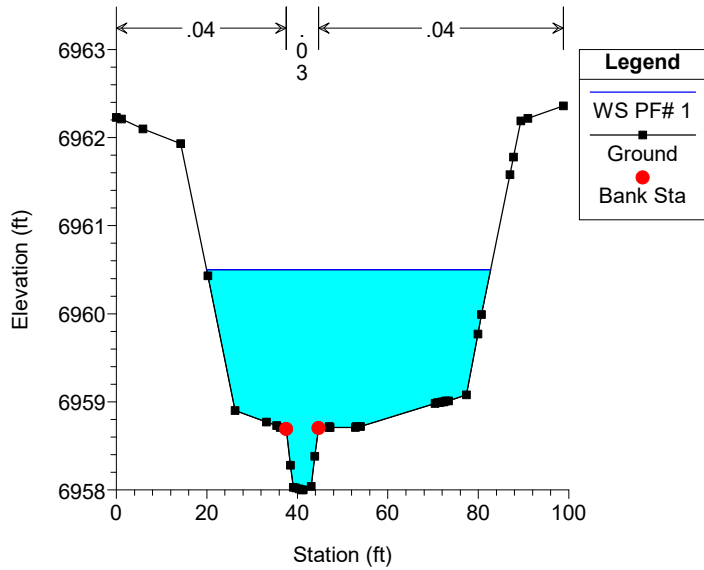
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 4045.84



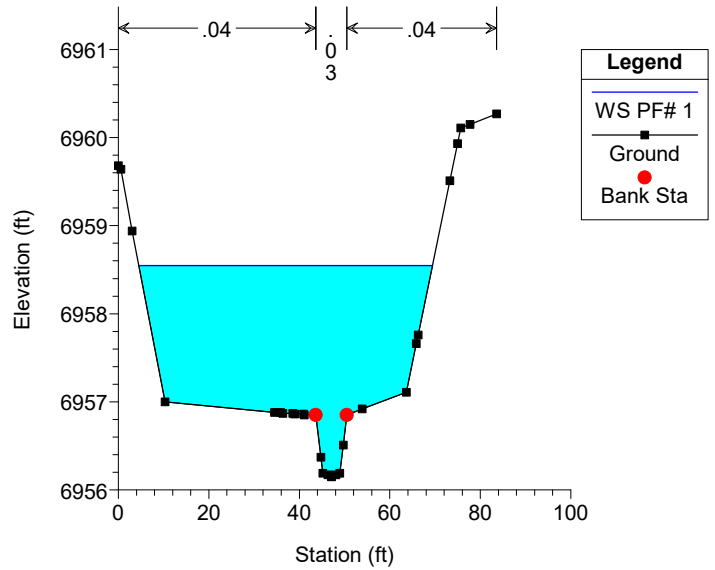
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 3885.92



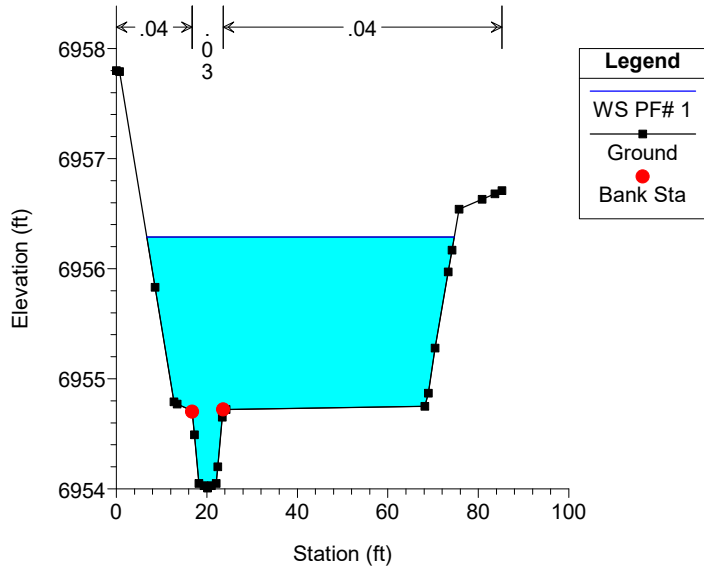
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 3802.45



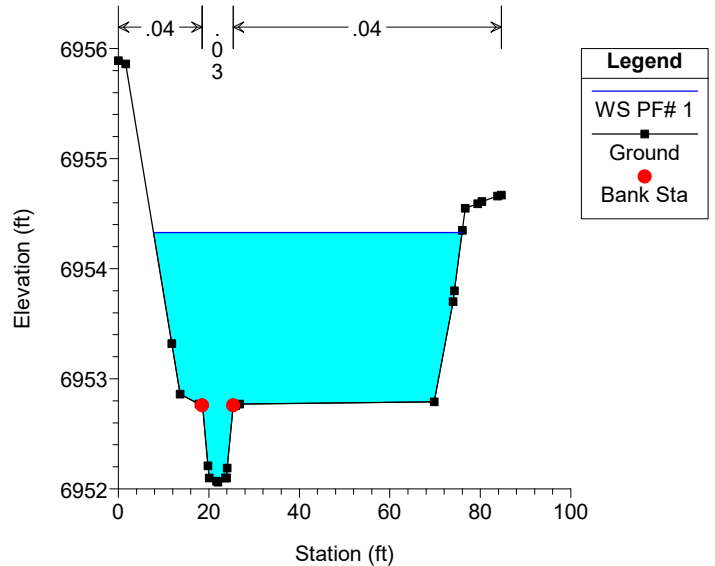
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 3676.52



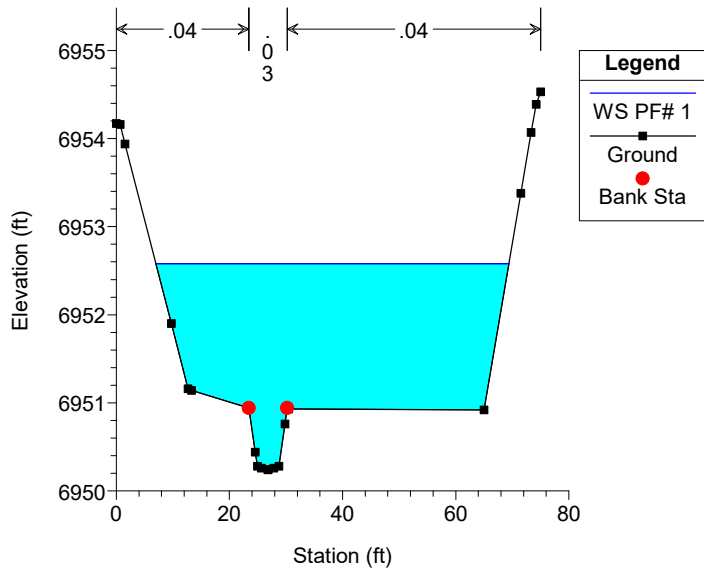
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 3581.26



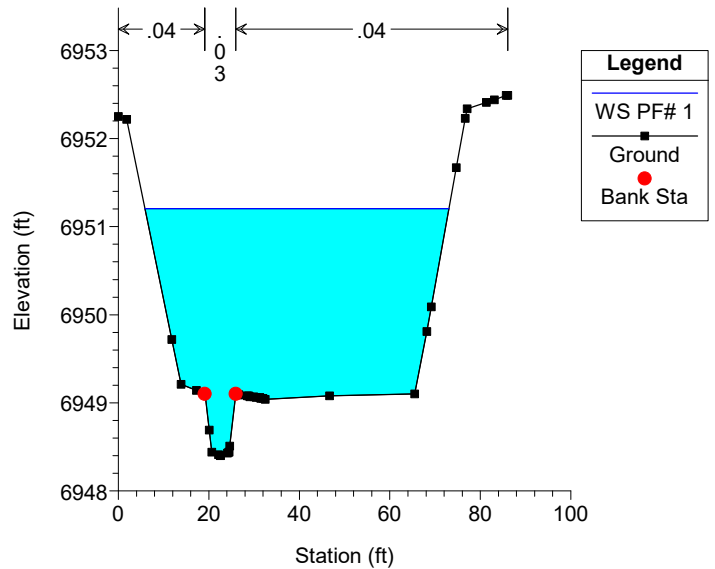
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 3500.61



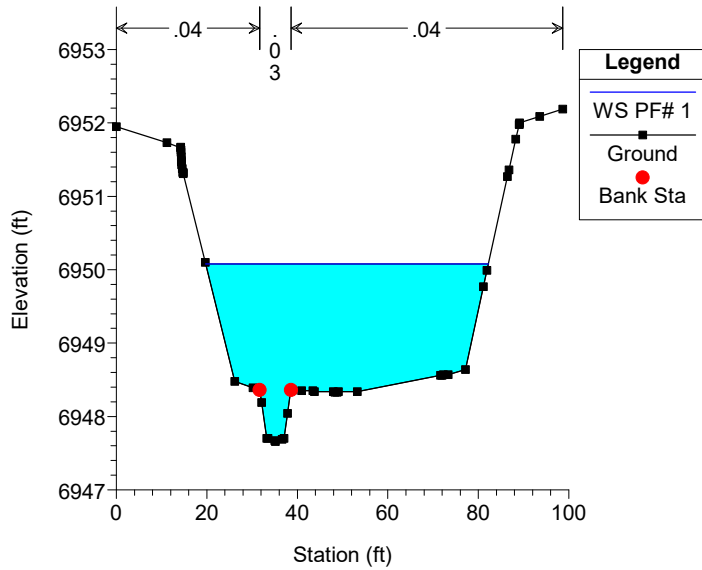
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 3418.19



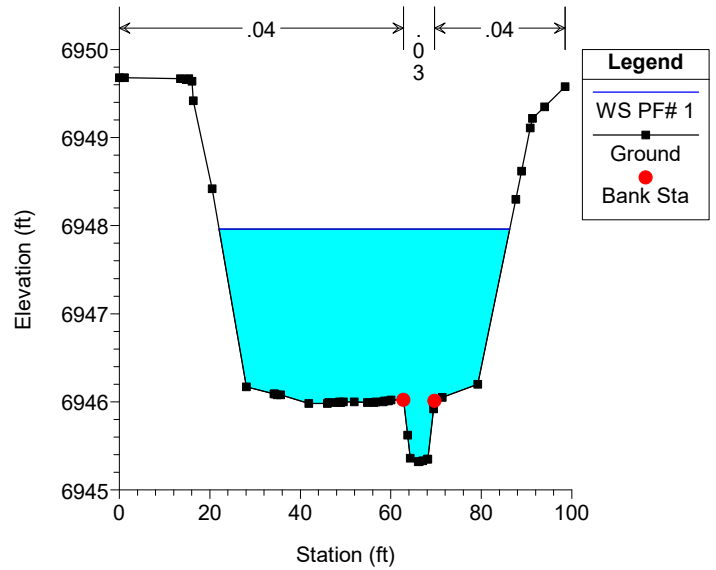
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 3335.99



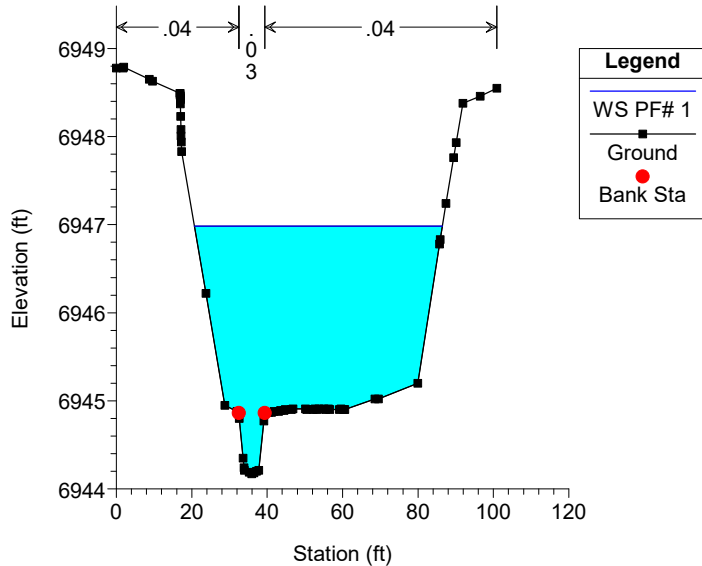
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 3196.98



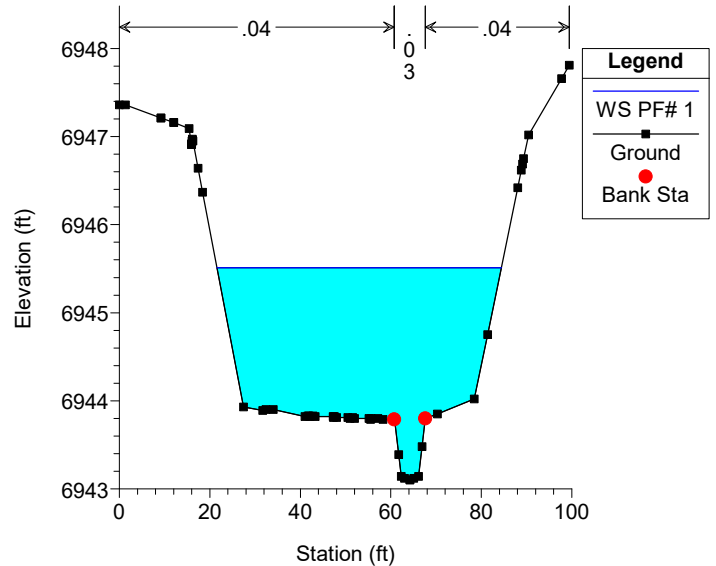
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 3069.72



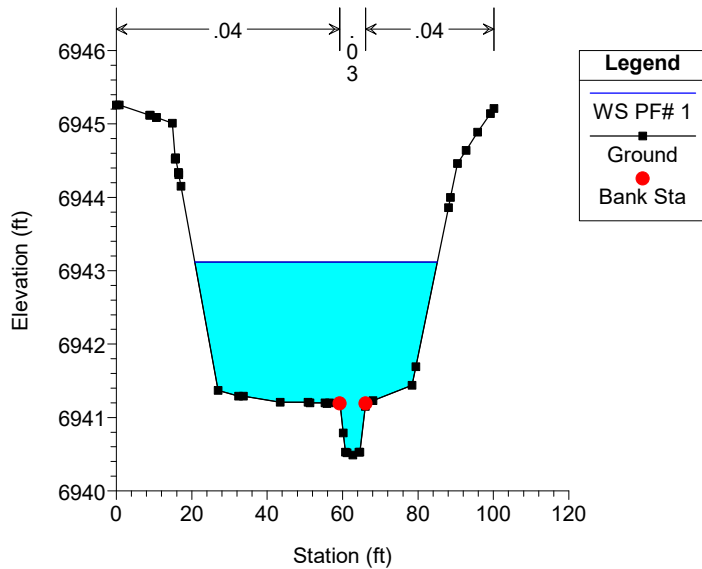
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 2950.47



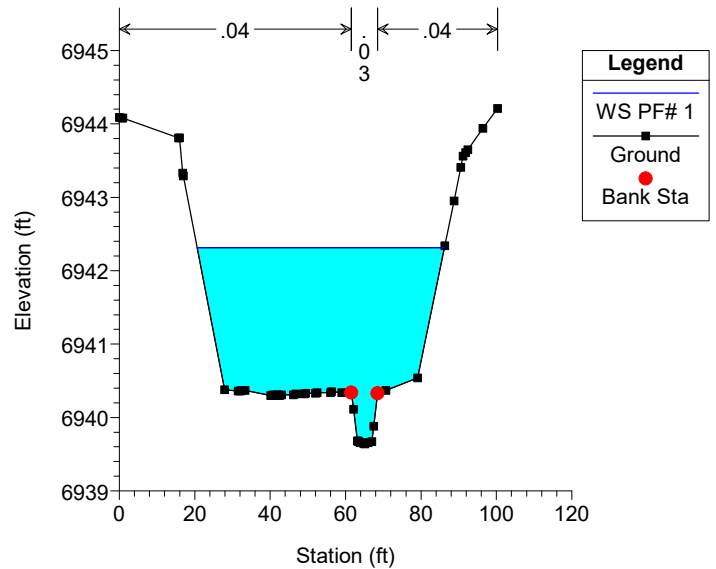
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

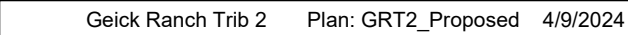
RS = 2782.66



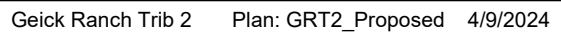
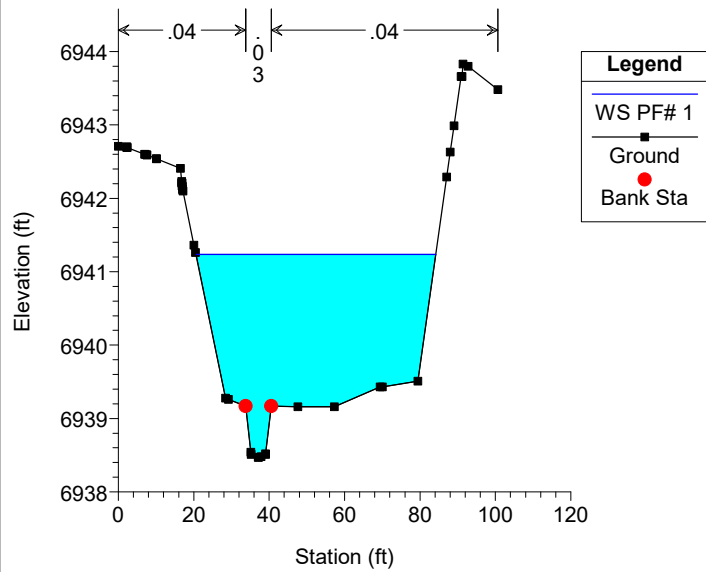
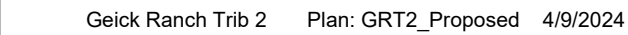
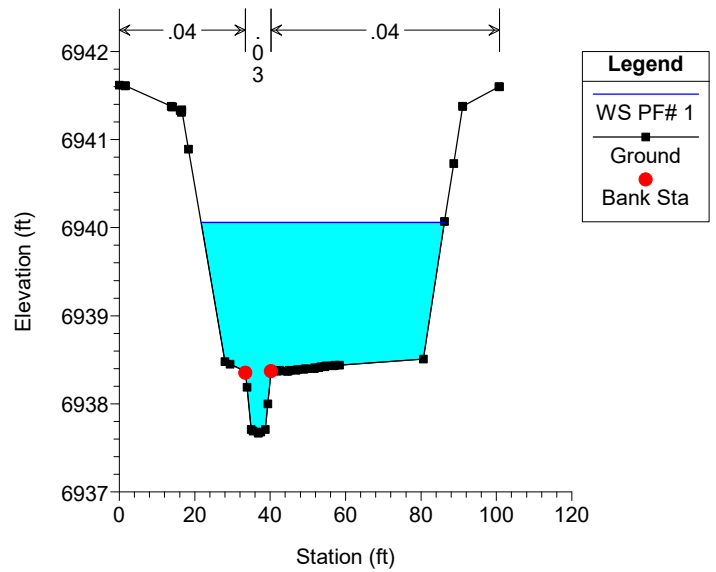
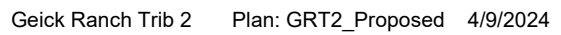
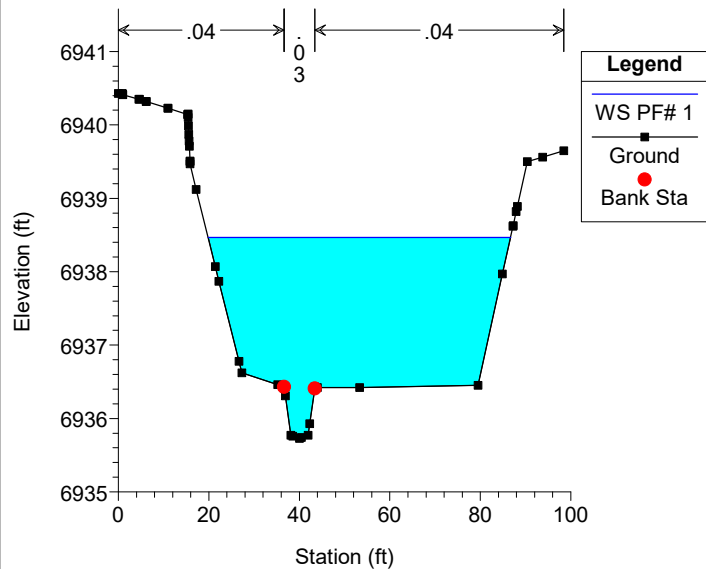
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 2687.65

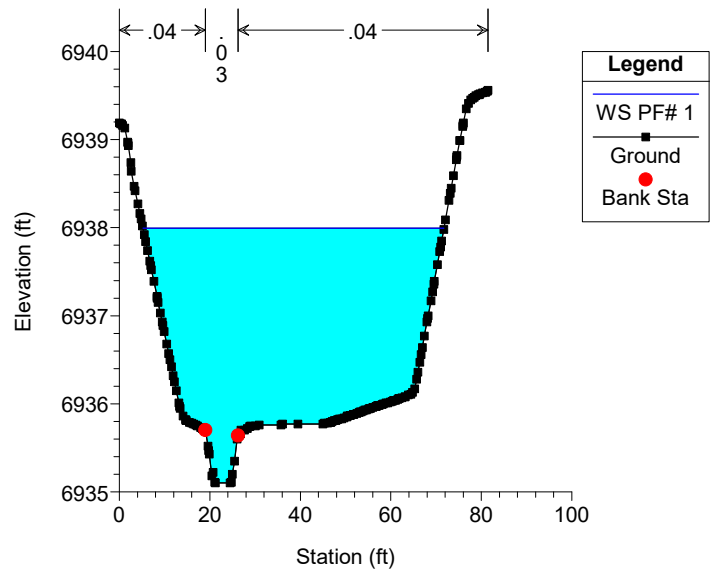
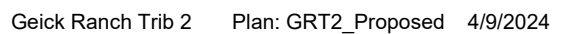
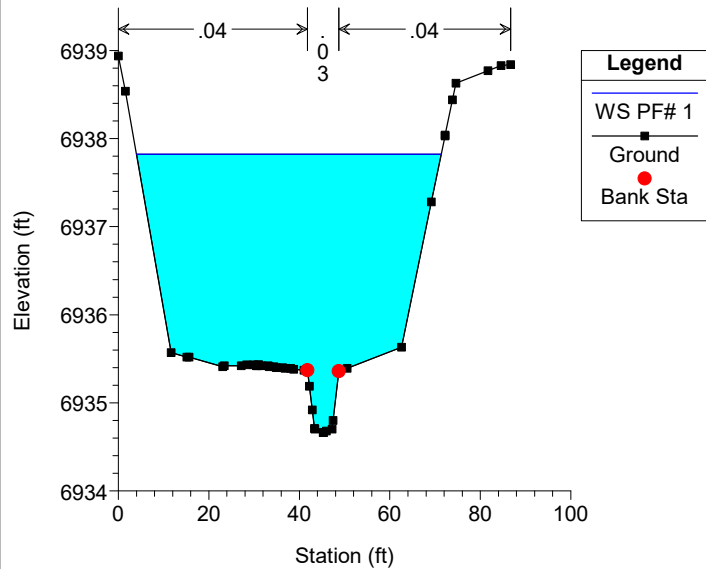




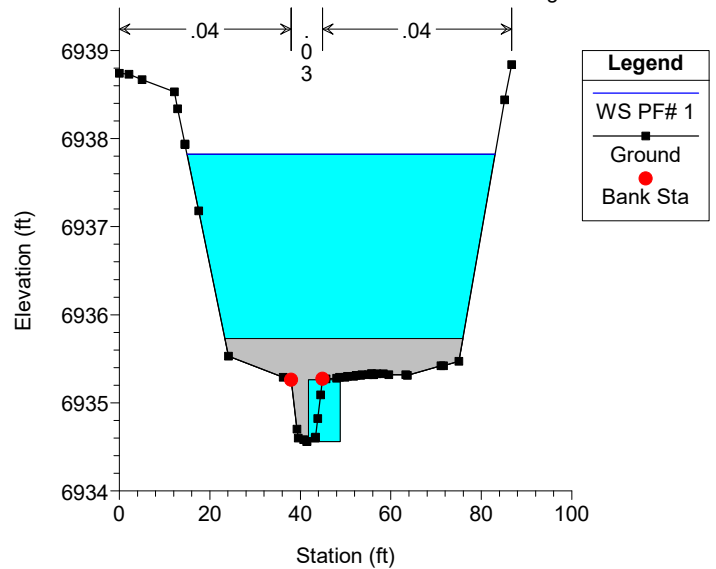
RS = 2558.01


$$RS = 2468.81$$

$$RS = 2375.32$$


RS = 2258

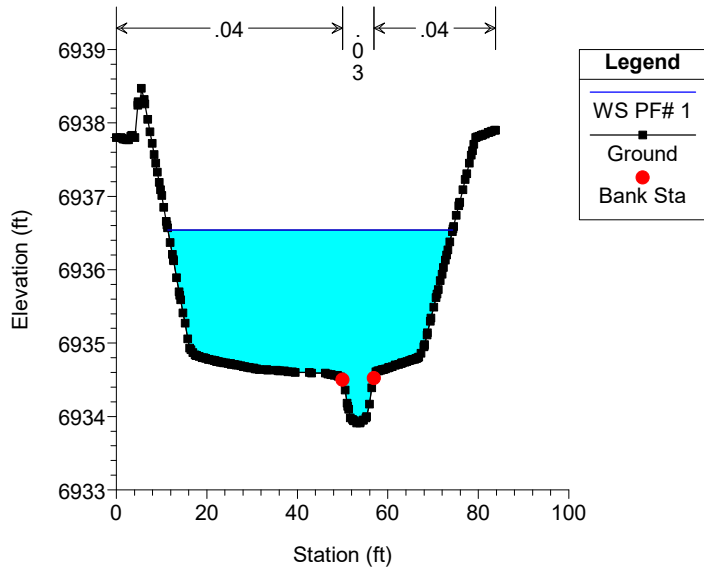

$$RS = 2256.6$$


RS = 2238 Culv Low Water Crossing



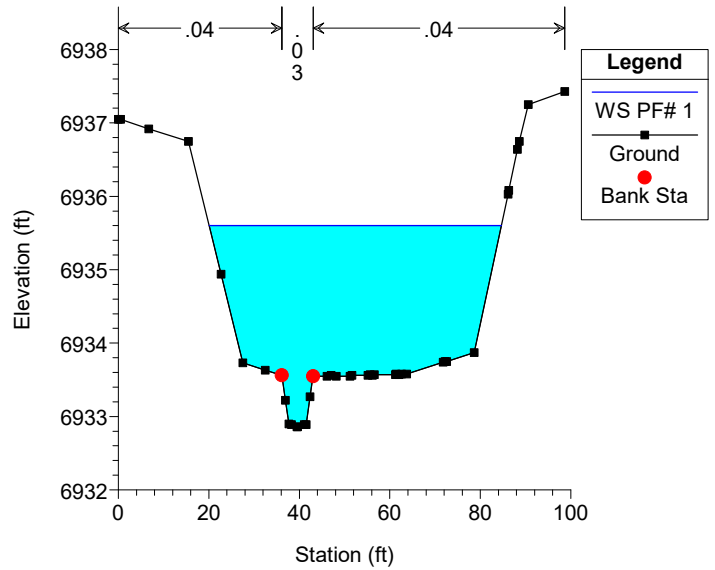
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 2057



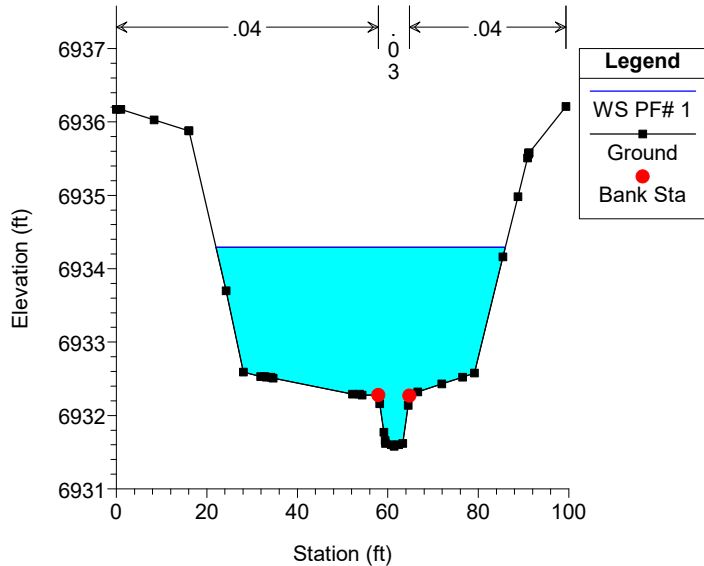
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 2055.98



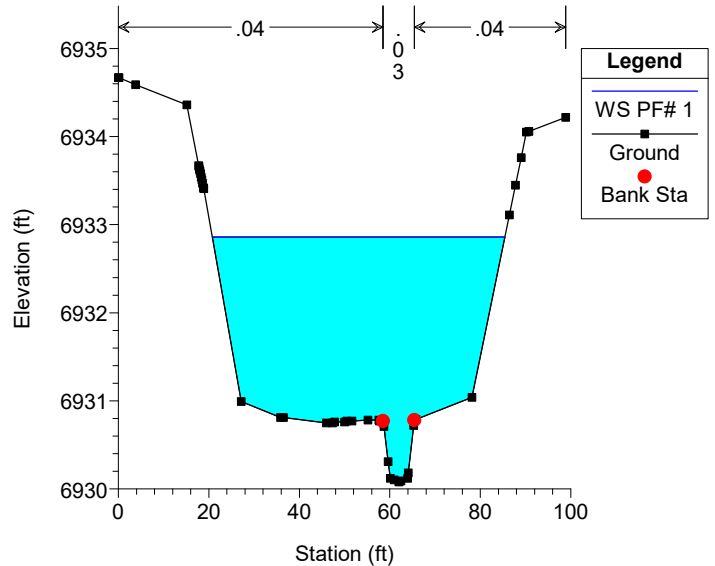
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 1914.4



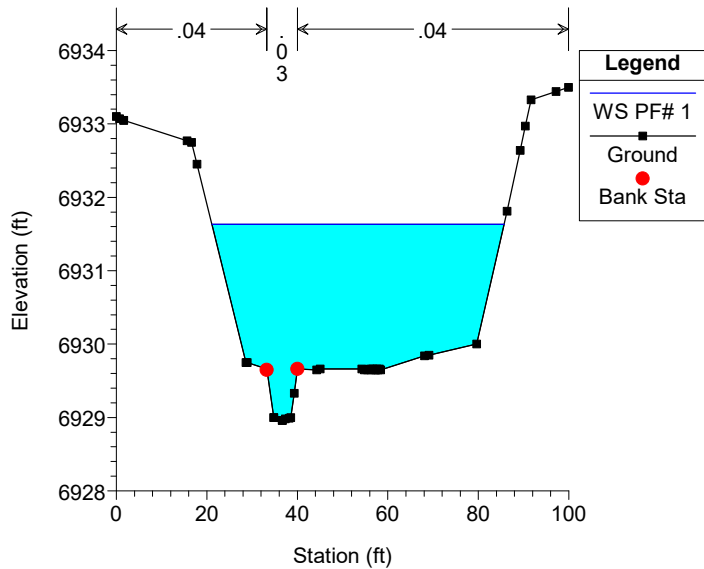
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 1747.66



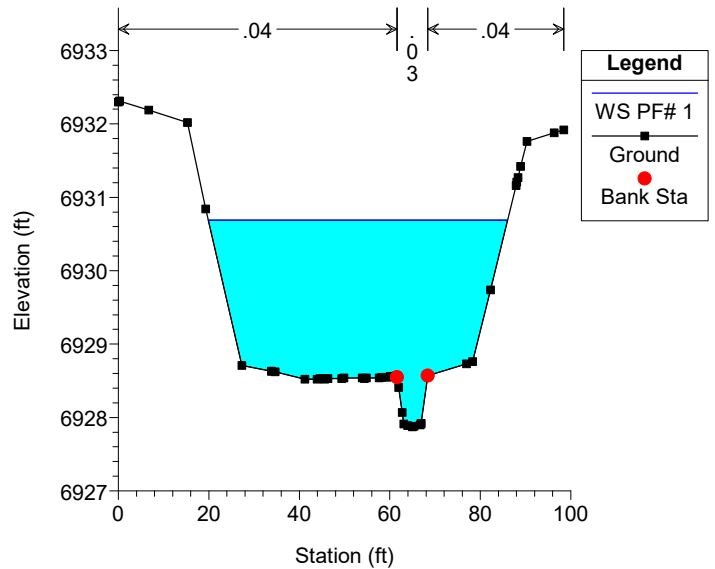
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 1623.05



Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

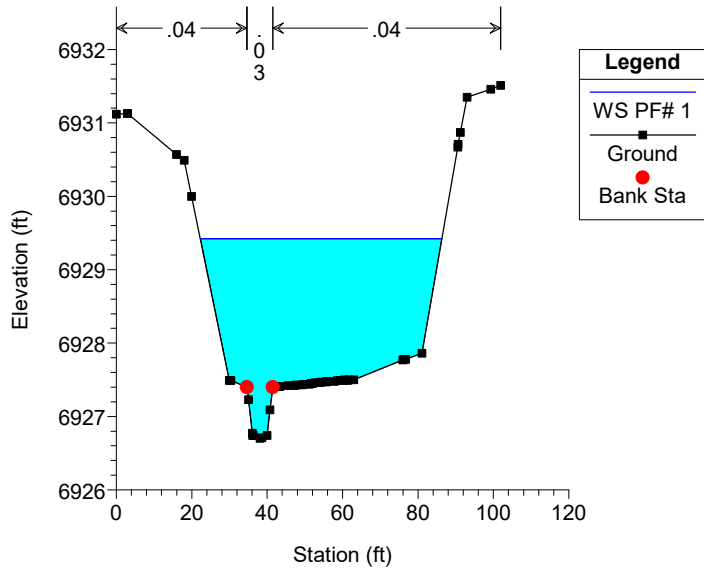
RS = 1501.74





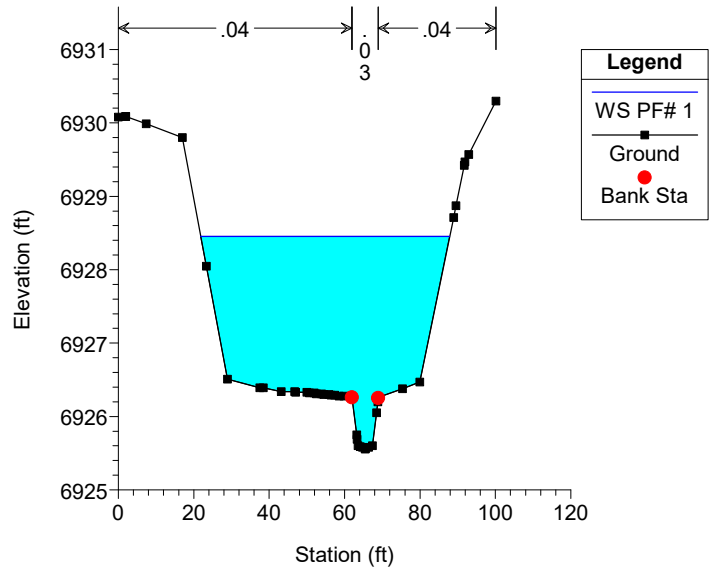
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 1372.06



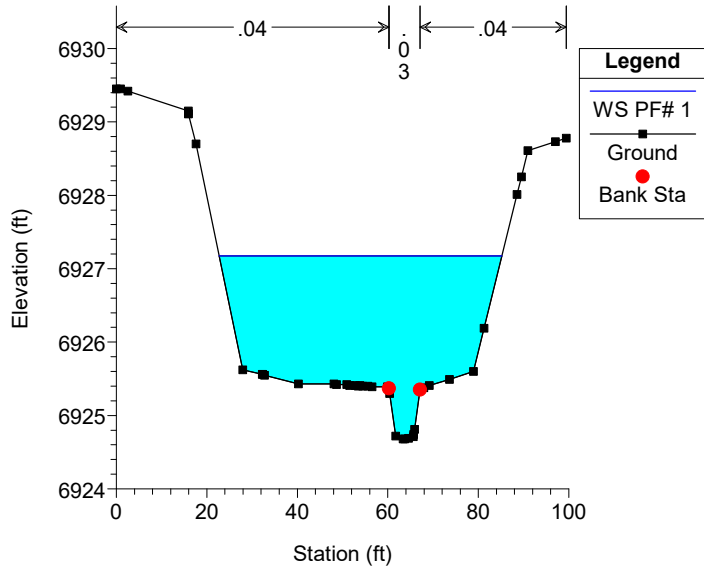
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 1245.44



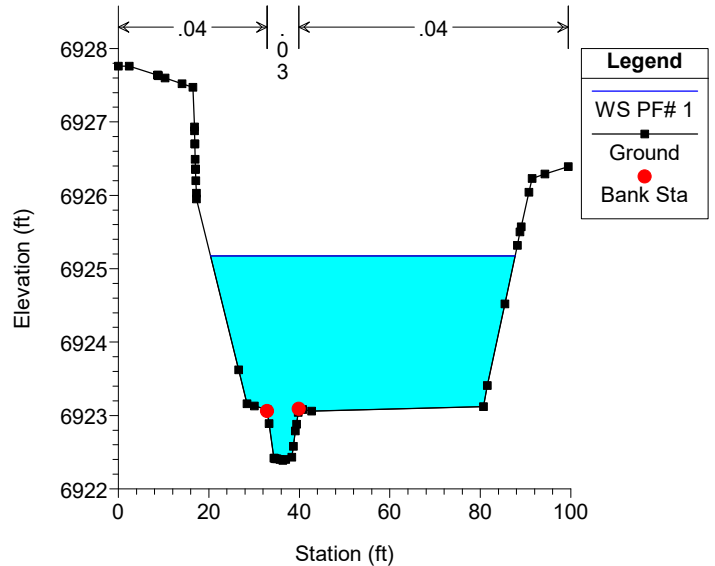
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 1146.93



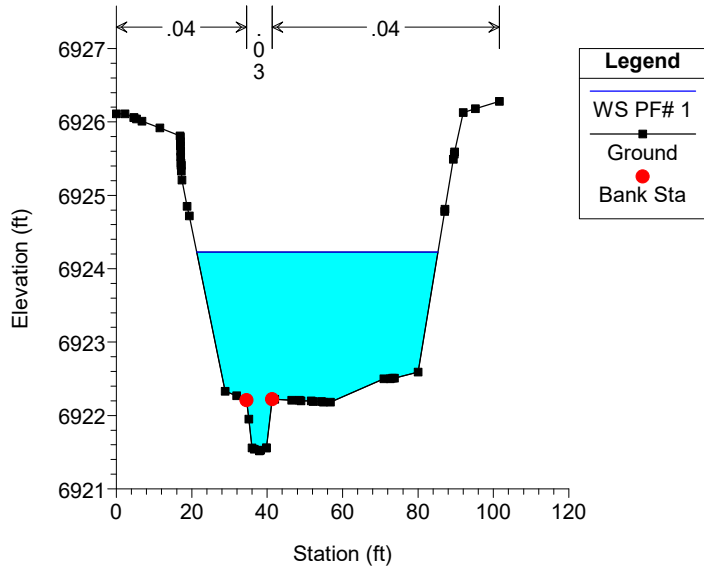
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 1014.13



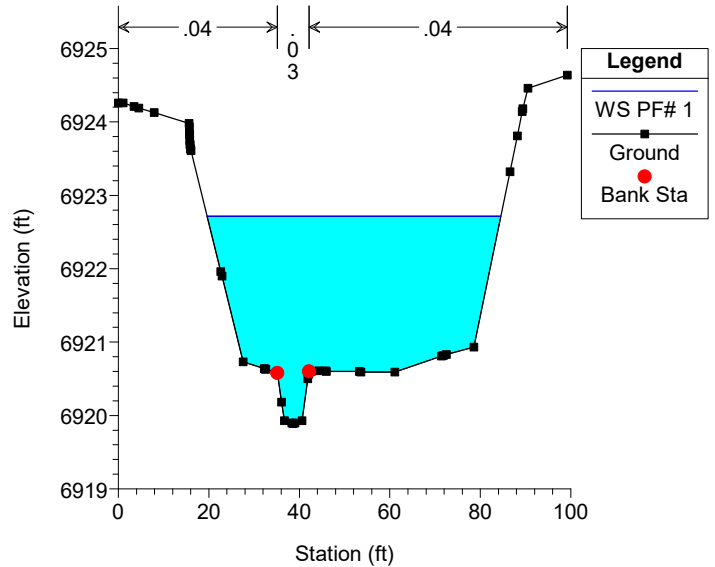
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 917.82



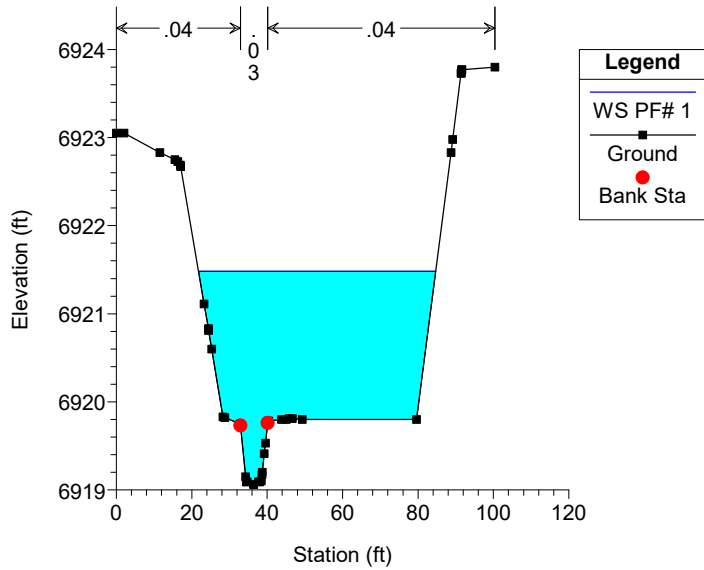
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 736.89



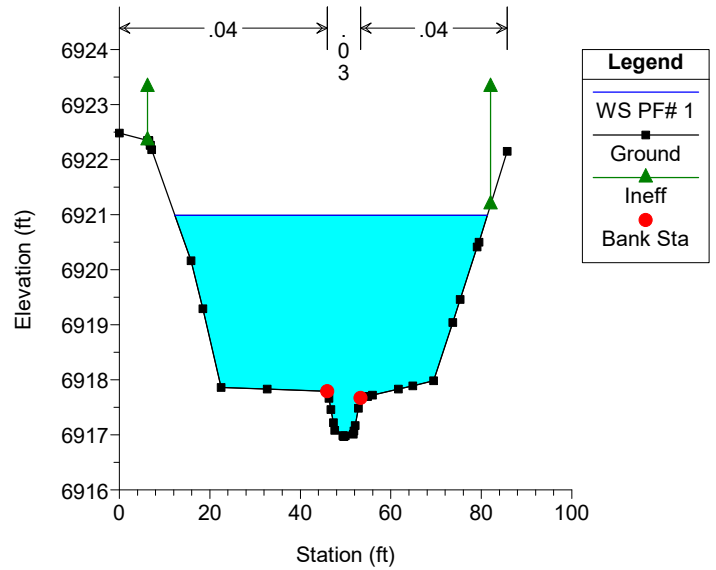
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 644.5



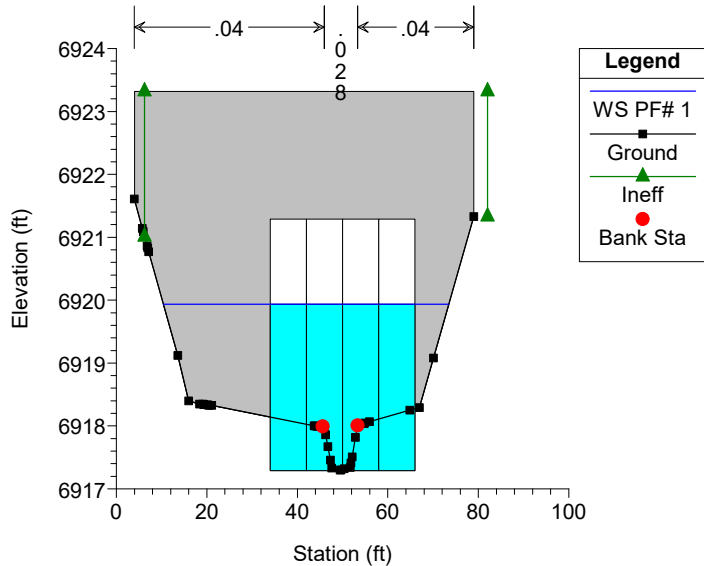
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 593.08



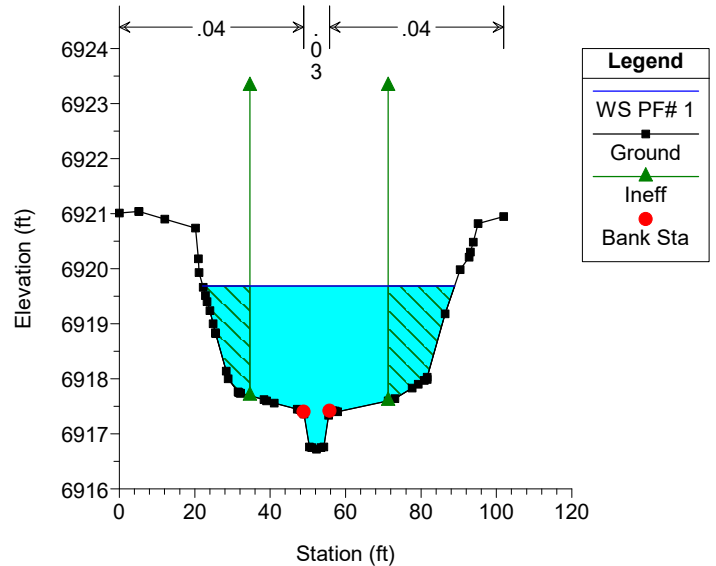
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 550 Culv. Road G



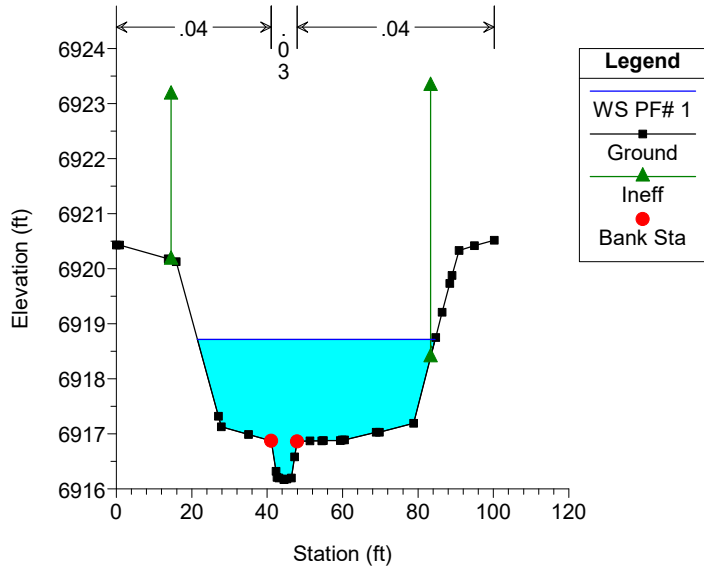
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 506.48



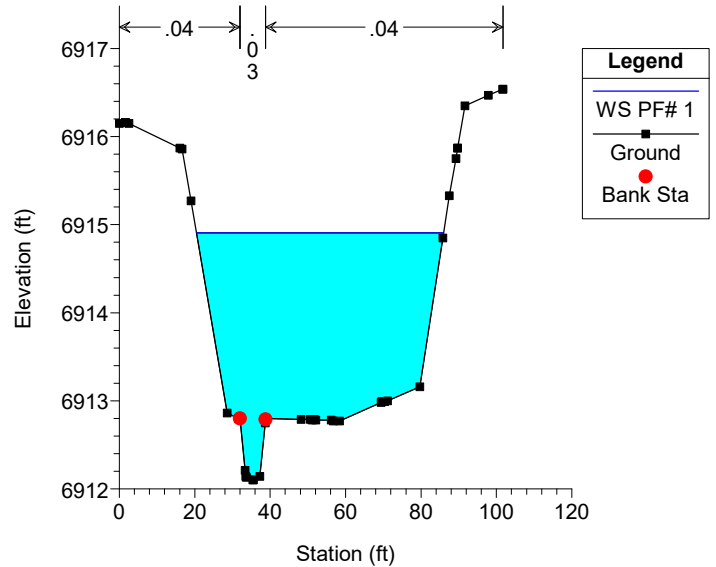
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 444.71



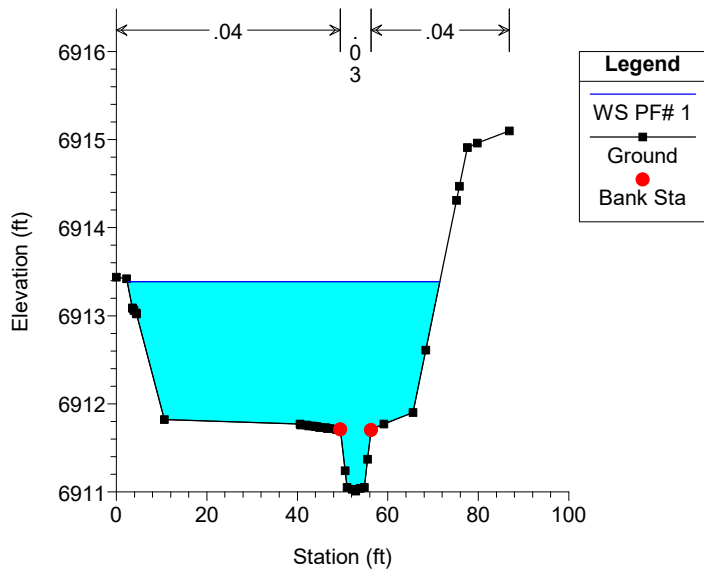
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 284.91



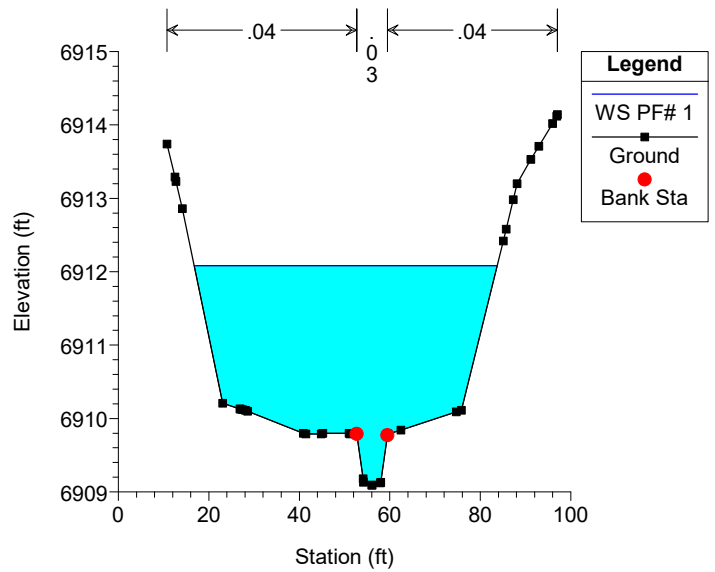
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 164.39



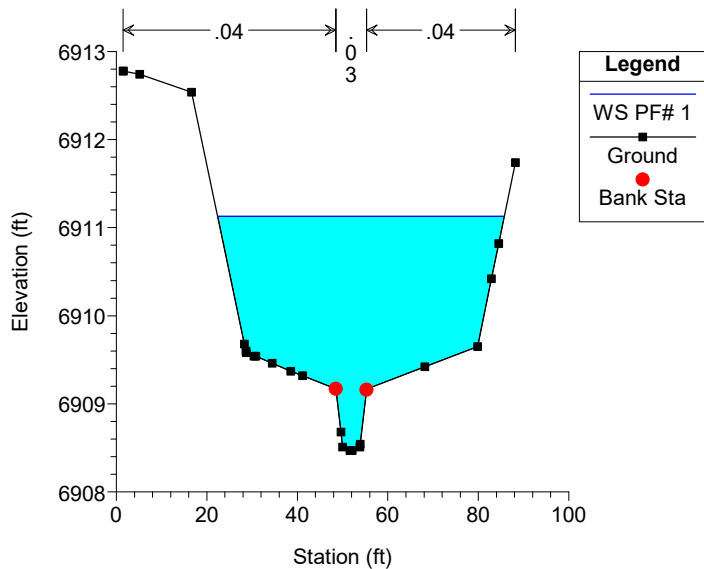
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 72.04



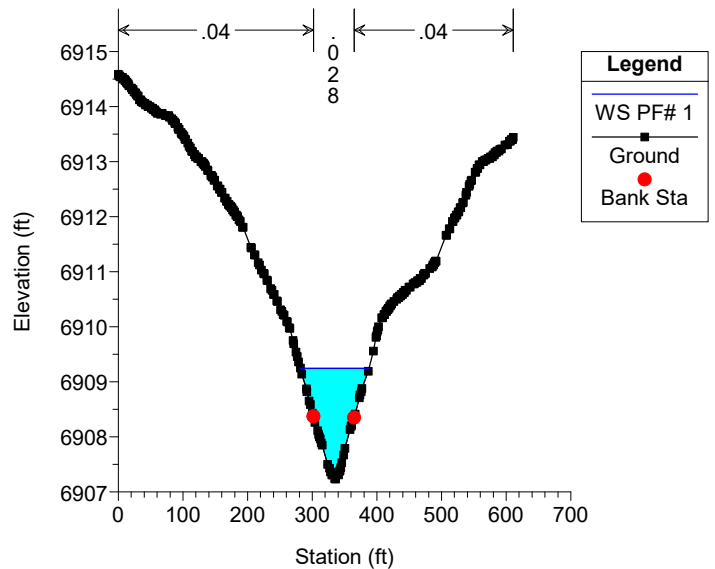
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = 3.14



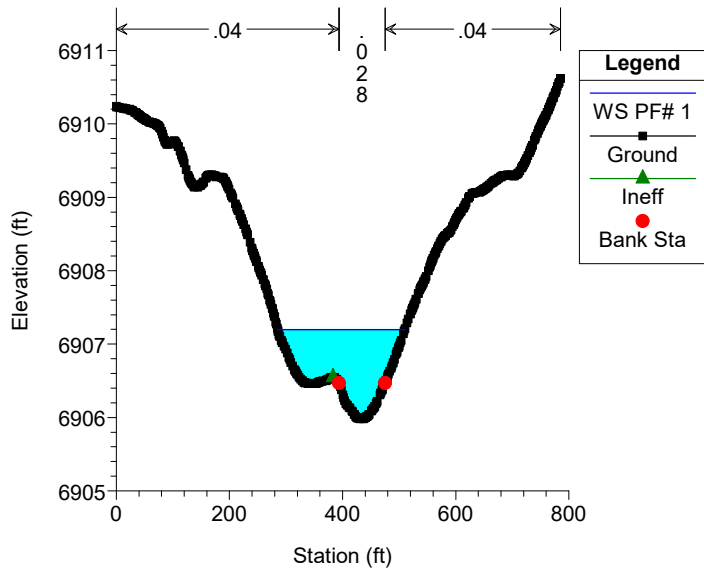
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = -296.57



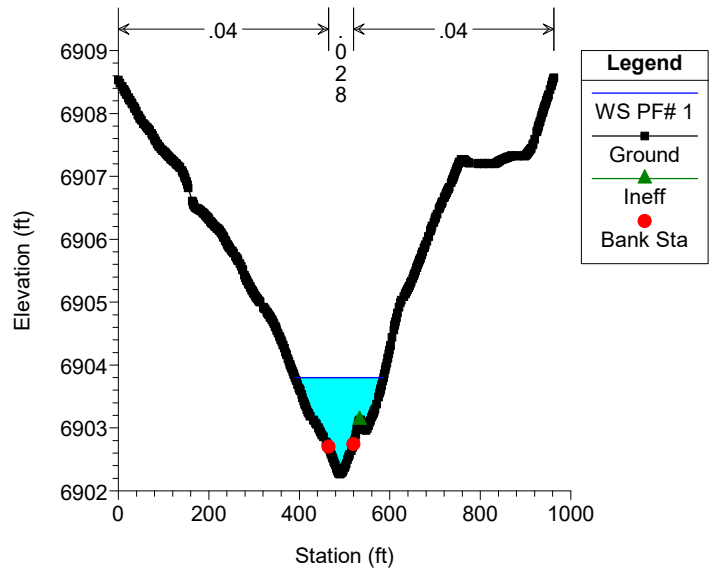
Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

RS = -530.34



Geick Ranch Trib 2 Plan: GRT2\_Proposed 4/9/2024

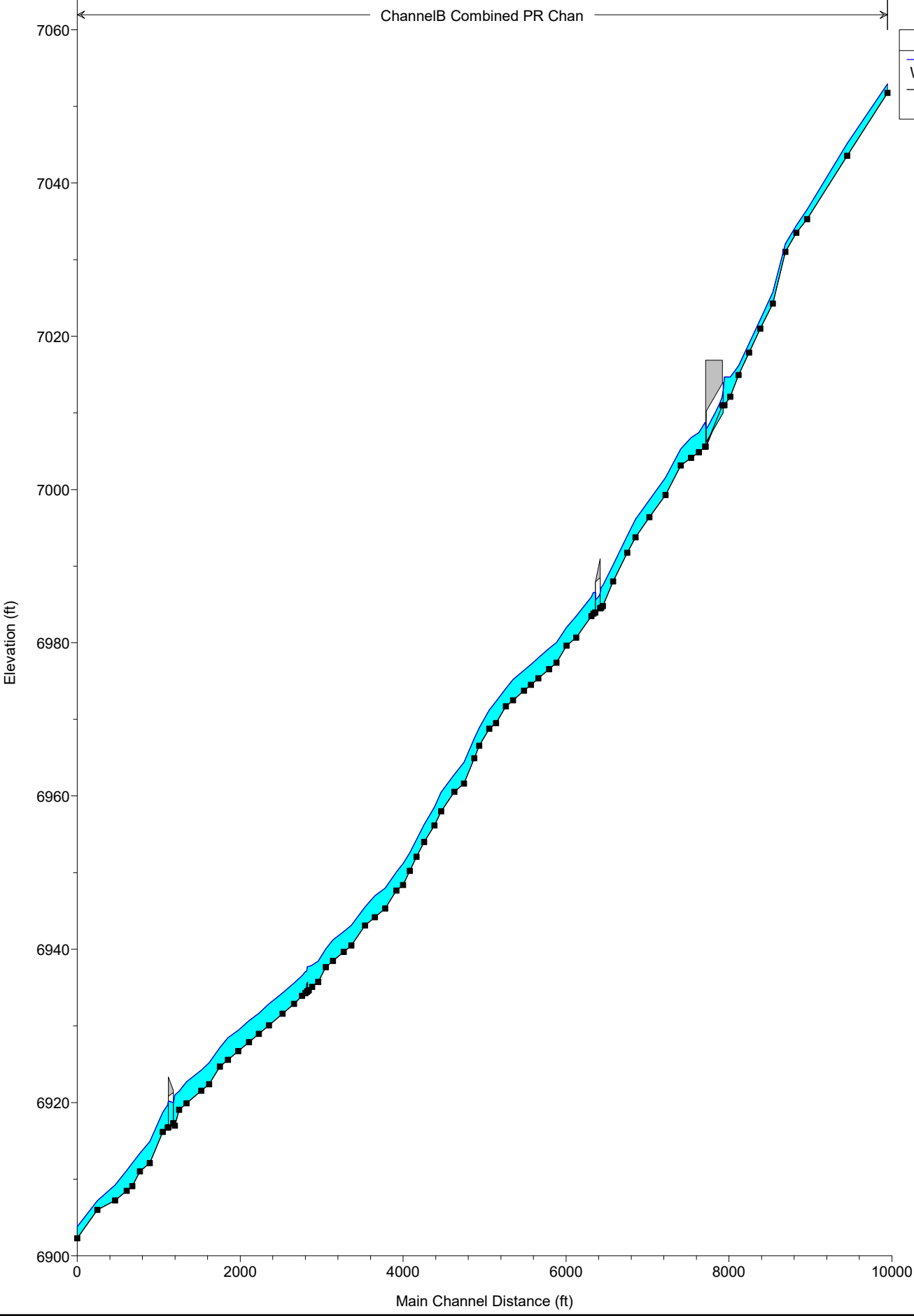
RS = -734.97



ChannelB Combined PR Chan

Legend

- WS PF# 1
- Ground



## Appendix E

### Hydraulic Calculations

Drainage B Riprap Bend Protection Upstream of Rex Road								
Model	River	Q Total	Max Chl Dpth	Vel Chnl	Froude # Chl	Invert Slope	Riprap	Rock Type
Station	Station	(cfs)	(ft)	(ft/s)			Req.	
7849	60+70.02	262	1.19	5.99	0.98	0.02	2.4	VL
7712	59+33.34	262	1.21	6.02	0.98	0.02	2.4	VL
7583	58+04.2	262	1.21	6.05	0.98	0.03	2.5	VL
7482	57+02.55	262	2.56	3.1	0.37	0.02	1.2	--
7395	56+30.5	262	3.69	1.72	0.16	0.02	0.7	--

Drainage A Riprap Protection								
River Sta	Profile	Q Total	Max Chl Dpth	Vel Chnl	Froude # Chl	Invert Slope	Riprap	Rock Type
		(cfs)	(ft)	(ft/s)			Req.	
2748.72	100-YR	413	0.9	5.1	1.01	0.0216	2.0	VL
2592.31	100-YR	413	1.92	7.39	0.98	0.0295	3.1	VL
2527.18	100-YR	413	1.89	7.25	0.95	0.0294	3.0	VL
2478.84	100-YR	413	2.4	7.84	0.92	0.0192	3.1	VL

## GRANDVIEW OUTLET PROTECTION RIPRAP CALCULATIONS

$$D_{50} = 0.023D \left( \frac{Q}{\alpha D^{2.5}} \right) \left( \frac{D}{TW} \right)^{1.2} \quad (D.1a)$$

$$D_{50} = 0.014D \left( \frac{Q}{\alpha B D^{1.5}} \right) \left( \frac{D}{TW} \right) \quad (D.1b)$$

where,

- $D_{50}$  = riprap size, m (ft)
- $Q$  = design discharge, m<sup>3</sup>/s (ft<sup>3</sup>/s)
- $D$  = culvert diameter (circular) or culvert rise (rectangular), m (ft)
- $B$  = culvert span (rectangular), m (ft)
- $TW$  = tailwater depth, m (ft)
- $\alpha$  = unit conversion constant, 1.811 (SI) and 1.0 (CU)

Unresolved: Provide design calculations for each culvert

Rex Rd Culvert	
Q (cfs) =	262
D (ft) =	4
B (ft) =	10
TW (ft) =	2.66
D50 (ft) =	0.276
<b>D50 Selected</b>	<b>6 in</b>
<b>Apron Length (L)</b>	<b>16 ft</b>

Dawlish Rd Culvert	
Q (cfs) =	536
D (ft) =	4
B (ft) =	32
TW (ft) =	2.1
D50 (ft) =	0.223
<b>D50 Selected</b>	<b>6 in</b>
<b>Apron Length (L)</b>	<b>16 ft</b>

Low Water Crossing	
Q (cfs) =	32.05
D (ft) =	0.7
B (ft) =	7
TW (ft) =	1.89
D50 (ft) =	0.028
<b>D50 Selected</b>	<b>6 in</b>
<b>Apron Length (L)</b>	<b>2.8 ft (Use 3 ft)</b>

Road G	
Q (cfs) =	649
D (ft) =	4
B (ft) =	32
TW (ft) =	2.28
D50 (ft) =	0.249
<b>D50 Selected</b>	<b>6 in</b>
<b>Apron Length (L)</b>	<b>16 ft</b>



## Riprap Bankful Channel Calculations

Model	River	Q Total	Max Chl Dpth	Vel Chnl	Froude # Chl	Invert Slope	Riprap	Rock Type
Station	Station	(cfs)	(ft)	(ft/s)			Req.	
8005	62+23	262	1.48	5.98	0.96	0.021	2.4	VL
7849	60+67	262	1.19	5.99	0.98	0.023	2.4	VL
7712	59+31	262	1.21	6.02	0.98	0.0226	2.4	VL
7583	58+03	262	1.21	6.05	0.98	0.0278	2.5	VL
7482	57+01	262	2.56	3.1	0.37	0.0154	1.2	VL
7395	56+29	262	3.69	1.72	0.16	0.023	0.7	VL
7160.32	53+87	536	3.17	10.44	1.07	0.0096	3.6	L
7072.44	53+31	536	2.58	7.78	0.88	0.0078	2.6	VL
6977.14	52+63	536	2.66	7.22	0.81	0.0077	2.4	VL
6850.04	51+76	536	2.15	9.25	1.16	0.0207	3.7	L
6663.5	50+34	536	2.29	9.47	1.15	0.0145	3.5	L
6464.81	49+13	536	2.25	9.46	1.16	0.0154	3.6	L
6294.46	48+06	536	2.35	9.38	1.12	0.0197	3.7	L
6192.16	47+29	536	2.2	9.31	1.15	0.0218	3.7	L
6020.29	46+16	536	2.16	9.27	1.16	0.0254	3.8	L
5853	45+16	536	2.69	7.75	0.86	0.0108	2.7	VL
5852.4	44+95	536	2.65	8.27	0.93	0.0083	2.8	VL
5730	44+00	536	2.77	7.27	0.79	0.0125	2.6	VL
5728.67	43+80	621	2.5	9.7	1.12	0.015	3.6	L
5541.86	42+51	621	2.79	7.81	0.85	0.0092	2.7	VL
5424.96	41+78	621	2.4	9.76	1.15	0.018	3.8	L
5301.31	41+07	621	2.64	8.56	0.96	0.0091	2.9	VL
5209.65	40+47	621	2.71	8.09	0.9	0.0092	2.8	VL
5078.71	39+66	621	2.67	8.72	0.97	0.0092	3.0	VL
4986.12	39+04	621	2.66	8.53	0.96	0.0091	2.9	VL
4902.38	38+56	621	2.66	8.43	0.94	0.0092	2.9	VL
4765.94	37+67	621	2.69	8.39	0.93	0.0092	2.9	VL
4678.67	37+10	621	2.34	9.65	1.16	0.018	3.7	L
4557.88	36+35	621	2.82	7.62	0.83	0.0089	2.6	VL
4476.29	35+83	621	2.43	9.91	1.16	0.0178	3.8	L
4351.82	35+05	621	2.32	9.76	1.17	0.0272	4.0	M
4291.52	34+63	621	2.6	9.97	1.13	0.0265	4.1	M
4166.12	33+82	621	2.77	9.85	1.08	0.009	3.4	L
4045.84	33+07	621	2.3	9.68	1.17	0.0158	3.7	L
3885.92	32+09	621	2.5	9.87	1.14	0.0222	4.0	M
3802.45	31+51	621	2.4	9.83	1.16	0.017	3.8	L
3676.52	30+57	621	2.28	9.68	1.18	0.0205	3.8	L
3581.26	29+94	621	2.27	9.58	1.17	0.0226	3.8	L
3500.61	29+44	621	2.34	9.8	1.17	0.0223	3.9	M
3418.19	298+89	621	2.8	7.25	0.79	0.009	2.5	VL
3335.99	28+39	621	2.42	9.87	1.16	0.0168	3.8	L

Highlighted values exceed Table 3 values.

3196.98	27+43	621	2.64	8.34	0.94	0.009	2.9	VL
3069.72	26+62	621	2.81	7.86	0.85	0.009	2.7	VL
2950.47	25+88	621	2.41	9.83	1.16	0.0156	3.7	L
2782.66	24+82	621	2.63	8.67	0.98	0.0089	3.0	VL
2687.65	24+17	621	2.68	8.09	0.9	0.009	2.8	VL
2558.01	23+38	621	2.76	8.21	0.9	0.009	2.8	VL
2468.81	22+84	621	2.39	9.79	1.16	0.0208	3.9	L
2375.32	22+21	621	2.74	7.69	0.85	0.0084	2.6	VL
2258	21+69	621	2.89	7.33	0.78	0.0111	2.6	VL
2256.6	21+42	621	3.16	6.67	0.68	0.0089	2.3	VL
2213.94	21+15	621	2.81	7.49	0.81	0.0089	2.6	VL
2057	20+87	621	2.63	8.75	0.98	0.0108	3.1	VL
2055.98	20+19	621	2.74	8.16	0.9	0.009	2.8	VL
1914.4	19+22	621	2.71	8.7	0.96	0.009	3.0	VL
1747.66	17+99	649	2.78	8.3	0.91	0.009	2.9	VL
1623.05	17+21	649	2.67	8.94	1	0.009	3.1	VL
1501.74	16+43	649	2.82	7.89	0.85	0.009	2.7	VL
1372.06	15+73	649	2.72	9.02	1	0.009	3.1	VL
1245.44	14+93	649	2.89	7.96	0.85	0.0089	2.7	VL
1146.93	14+23	649	2.49	10.03	1.16	0.0172	3.8	L
1014.13	13+38	649	2.78	7.69	0.84	0.009	2.6	VL
917.82	12+62	649	2.71	8.84	0.98	0.009	3.0	VL
736.89	11+39	649	2.82	8.19	0.89	0.009	2.8	VL
644.5	10+79	649	2.42	9.9	1.16	0.0406	4.4	M
593.08	10+41	649	4.02	5.4	0.49	0.0029	1.5	VL
506.48	9+55	649	2.97	10.64	1.12	0.0089	3.6	L
444.71	9+11	649	2.55	9.8	1.12	0.0255	4.0	M
284.91	7+91	649	2.81	8.19	0.89	0.009	2.8	VL
164.39	7+23	649	2.38	9.94	1.18	0.0208	3.9	M
72.04	6+60	649	2.99	7.67	0.8	0.009	2.6	VL
3.14	6+00	649	2.66	10.06	1.12	0.0086	3.4	L

\*Riprap sizing calculation based on El Paso Criteria Manual (Section 10.10.2)



North American Green  
 5401 St. Wendel-Cynthiana Rd.  
 Poseyville, Indiana 47633  
 Tel. 800.772.2040  
 >Fax 812.867.0247  
 www.nagreen.com  
 ECMDS v7.0

## CHANNEL ANALYSIS

> > > Grandview Drainage B

Name Grandview Drainage B  
 Discharge 500  
 Channel Slope 0.01  
 Channel Bottom Width 39  
 Left Side Slope 4  
 Right Side Slope 4  
 Low Flow Liner  
 Retardence Class E <2 in  
 Vegetation Type Bunch Type  
 Vegetation Density Poor < 50%  
 Soil Type Sandy Loam (GM)

### C125BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
C125BN Unvegetated	Straight	500 cfs	6.77 ft/s	1.62 ft	0.028	2.8 lbs/ft2	1.01 lbs/ft2	2.77	STABLE	D
Underlying Substrate	Straight	500 cfs	6.77 ft/s	1.62 ft	0.028	2.65 lbs/ft2	0.88 lbs/ft2	3.02	STABLE	D

### S150BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
S150BN Unvegetated	Straight	500 cfs	5.88 ft/s	1.84 ft	0.034	1.9 lbs/ft2	1.15 lbs/ft2	1.66	STABLE	D
Underlying Substrate	Straight	500 cfs	5.88 ft/s	1.84 ft	0.034	1.8 lbs/ft2	0.98 lbs/ft2	1.83	STABLE	D

### SC150BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
SC150BN Unvegetated	Straight	500 cfs	5.88 ft/s	1.84 ft	0.034	2 lbs/ft2	1.15 lbs/ft2	1.75	STABLE	D
Underlying Substrate	Straight	500 cfs	5.88 ft/s	1.84 ft	0.034	1.89 lbs/ft2	0.98 lbs/ft2	1.93	STABLE	D

### Unreinforced Vegetation

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
Unreinforced Vegetation	Straight	500 cfs	7.88 ft/s	1.42 ft	0.022	4 lbs/ft2	0.89 lbs/ft2	4.52	STABLE	--
Underlying Substrate	Straight	500 cfs	7.88 ft/s	1.42 ft	0.022	0.32 lbs/ft2	0.78 lbs/ft2	0.41	UNSTABLE	--

### S75BN

Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
S75BN Unvegetated	Straight	500 cfs	6.36 ft/s	1.71 ft	0.03	1.6 lbs/ft2	1.07 lbs/ft2	1.5	STABLE	D

Underlying Substrate	Straight	500 cfs	6.36 ft/s	1.71 ft	0.03	1.51 lbs/ft2	0.92 lbs/ft2	1.64	STABLE	D
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$$y_e = (A/2)^{1/2} \text{ or } (D^2/16)^{1/2}$$

The specific energy  $H_o = y_e + V_o^2/2g$  and the Froude number

$$F = V_o/(gy_e)^{1/2}.$$

River Sta	Vel Left	Vel Right	Area Left	Area Right	$y_e$ Left	$y_e$ Right	Fr Left	Fr Right
	(ft/s)	(ft/s)	(sq ft)	(sq ft)				
9426.04	2.31	2.35	3.86	7.81	1.39	1.98	0.35	0.29
8932.93	3.1	2.85	25.85	17.6	3.60	2.97	0.29	0.29
8439.38	2.3	2.52	30.38	15.1	3.90	2.75	0.21	0.27
8310.02	2	2.02	64.42	15.15	5.68	2.75	0.15	0.21
8096	1.7	1.7	8.02	9.28	2.00	2.15	0.21	0.20
8005	2.16	2.02	1.76	1.43	0.94	0.85	0.39	0.39
7849	1.76	1.96	0.86	1.18	0.66	0.77	0.38	0.39
7712	2	2.22	1.25	1.72	0.79	0.93	0.40	0.41
7583	2.29	2.33	1.89	1.98	0.97	0.99	0.41	0.41
7482	1.23	1.17	7.96	6.69	1.99	1.83	0.15	0.15
7395	1.02	1.12	29.22	27.92	3.82	3.74	0.09	0.10
7072.44	4.71	4.1	68.12	21.57	5.84	3.28	0.34	0.40
6977.14	4.39	3.84	72.42	23.69	6.02	3.44	0.32	0.36
6850.04	4.77	5.53	15.16	61.4	2.75	5.54	0.51	0.41
6663.5	5.05	5.55	25.25	48.9	3.55	4.94	0.47	0.44
6464.81	5.6	4.92	56.99	17.1	5.34	2.92	0.43	0.51
6294.46	5.47	5.01	52.31	22.09	5.11	3.32	0.43	0.48
6192.16	5.55	4.9	51.78	22.86	5.09	3.38	0.43	0.47
6020.29	5.5	4.82	60.01	16.77	5.48	2.90	0.41	0.50
5853	4.02	4.47	21.29	68.99	3.26	5.87	0.39	0.33
5852.4	4.46	4.79	37.28	47.67	4.32	4.88	0.38	0.38
5728.67	5.6	5.73	59.55	24.34	5.46	3.49	0.42	0.54
5541.86	4.78	4.27	72.11	32.22	6.00	4.01	0.34	0.38
5424.96	4.8	5.91	12.82	69.41	2.53	5.89	0.53	0.43
5301.31	5.22	4.56	70.13	24.28	5.92	3.48	0.38	0.43
5209.65	4.99	4.34	73.58	26.15	6.07	3.62	0.36	0.40
5078.71	4.39	5.22	17.11	76.18	2.92	6.17	0.45	0.37
4986.12	4.33	5.18	17.63	77.07	2.97	6.21	0.44	0.37
4902.38	4.25	5.1	17.26	79.28	2.94	6.30	0.44	0.36
4765.94	5.1	4.51	70.45	26.35	5.94	3.63	0.37	0.42
4678.67	5.84	5.1	64.31	20.3	5.67	3.19	0.43	0.50
4557.88	4.01	4.7	24.16	82.64	3.48	6.43	0.38	0.33
4476.29	5.13	5.86	17.87	64.23	2.99	5.67	0.52	0.43

$$y_e = (A/2)^{1/2} \text{ or } (D^2/16)^{1/2}$$

The specific energy  $H_o = y_e + V_o^2/2g$  and the Froude number

$$F = V_o/(gy_e)^{1/2}.$$

River Sta	Vel Left	Vel Right	Area Left	Area Right	y <sub>e</sub> Left	y <sub>e</sub> Right	Fr Left	Fr Right
	(ft/s)	(ft/s)	(sq ft)	(sq ft)				
4351.82	5.86	5.15	64.34	19.28	5.67	3.10	0.43	0.52
4291.52	5.36	5.61	25.29	56.43	3.56	5.31	0.50	0.43
4166.12	5.5	5.26	56.66	25.51	5.32	3.57	0.42	0.49
4045.84	4.96	5.84	15.04	69.19	2.74	5.88	0.53	0.42
3885.92	5.31	5.68	24.32	57.74	3.49	5.37	0.50	0.43
3802.45	5.81	5.29	58.66	24.74	5.42	3.52	0.44	0.50
3676.52	4.69	5.82	10.73	74.26	2.32	6.09	0.54	0.42
3581.26	4.73	5.8	11.74	73.84	2.42	6.08	0.54	0.41
3500.61	5.19	6.04	20.51	61.19	3.20	5.53	0.51	0.45
3418.19	3.65	4.58	18.71	92.15	3.06	6.79	0.37	0.31
3335.99	4.96	5.91	14.3	67.26	2.67	5.80	0.53	0.43
3196.98	5.14	4.45	72.47	23.95	6.02	3.46	0.37	0.42
3069.72	3.8	4.77	15.86	87.64	2.82	6.62	0.40	0.33
2950.47	5.89	5.23	60.48	21.83	5.50	3.30	0.44	0.51
2782.66	5.24	4.7	65.9	27.86	5.74	3.73	0.39	0.43
2687.65	4.97	4.35	73.63	26.27	6.07	3.62	0.36	0.40
2558.01	4.14	5	18.37	79.98	3.03	6.32	0.42	0.35
2468.81	4.9	5.83	13.93	69.63	2.64	5.90	0.53	0.42
2375.32	4.09	4.77	25.01	80.71	3.54	6.35	0.38	0.33
2258	3.69	4.45	20.78	89.56	3.22	6.69	0.36	0.30
2256.6	4.07	3.7	80.51	41.9	6.34	4.58	0.28	0.30
2213.94	3.63	4.67	15.83	91.93	2.81	6.78	0.38	0.32
2057	5.29	4.66	67.29	25.26	5.80	3.55	0.39	0.44
2055.98	4.32	4.96	23.75	75.31	3.45	6.14	0.41	0.35
1914.4	5.12	4.76	61.31	32.63	5.54	4.04	0.38	0.42
1747.66	5.09	4.53	70.23	31.41	5.93	3.96	0.37	0.40
1623.05	4.43	5.38	15.98	79.22	2.83	6.29	0.46	0.38
1501.74	4.88	4.23	80.07	27.48	6.33	3.71	0.34	0.39
1372.06	4.48	5.37	16.61	77.81	2.88	6.24	0.47	0.38
1245.44	4.8	4.32	76.19	30.92	6.17	3.93	0.34	0.38
1146.93	5.94	5.4	59.56	24.95	5.46	3.53	0.45	0.51
1014.13	3.81	4.8	17.31	92.19	2.94	6.79	0.39	0.32
917.82	4.48	5.33	18.23	77.75	3.02	6.23	0.45	0.38

$$y_e = (A/2)^{1/2} \text{ or } (D^2/16)^{1/2}$$

The specific energy  $H_o = y_e + V_o^2/2g$  and the Froude number

$$F = V_o/(gy_e)^{1/2}.$$

River Sta	Vel Left	Vel Right	Area Left	Area Right	$y_e$ Left	$y_e$ Right	Fr Left	Fr Right
	(ft/s)	(ft/s)	(sq ft)	(sq ft)				
736.89	4.29	4.98	23.49	79.39	3.43	6.30	0.41	0.35
644.5	4.89	5.99	13.18	70.67	2.57	5.94	0.54	0.43
593.08	3.21	3.08	88.93	69.07	6.67	5.88	0.22	0.22
444.71	5.32	5.89	27.8	58.4	3.73	5.40	0.49	0.45
284.91	3.94	5	15.25	88.3	2.76	6.64	0.42	0.34
164.39	5.81	5.22	68.98	19.11	5.87	3.09	0.42	0.52
72.04	4.58	4.28	69.76	42.66	5.91	4.62	0.33	0.35
3.14	5.54	5.58	39.6	46.55	4.45	4.82	0.46	0.45
-296.57	2	1.93	8.99	9.67	2.12	2.20	0.24	0.23
-530.34	2.56	1.92	63.22	13.07	5.62	2.56	0.19	0.21
-734.97	2.45	2.46	44.32	40.01	4.71	4.47	0.20	0.20

## Appendix F

### Financial Assurances Form



# 2024 Financial Assurance Estimate Form (with pre-plat construction)

Updated: 10/2023

PROJECT INFORMATION			
Grandview Reserve Gieck Basin Channel	6/21/2024	CDR-228	
Project Name	Date	PCD File No.	

Description	Quantity	Units	Unit Cost		Total	(with Pre-Plat Construction) % Complete	Remaining
SECTION 1 - GRADING AND EROSION CONTROL (Construction and Permanent BMPs)							
Earthwork							
less than 1,000; \$5,300 min		CY	\$ 8.00	=	\$ -		\$ -
1,000-5,000; \$8,000 min		CY	\$ 6.00	=	\$ -		\$ -
5,001-20,000; \$30,000 min		CY	\$ 5.00	=	\$ -		\$ -
20,001-50,000; \$100,000 min		CY	\$ 3.50	=	\$ -		\$ -
50,001-200,000; \$175,000 min	195223.	CY	\$ 2.50	=	\$ 488,057.50		\$ 488,057.50
greater than 200,000; \$500,000 min		CY	\$ 2.00	=	\$ -		\$ -
Permanent Erosion Control Blanket	40000.	SY	\$ 9.00	=	\$ 360,000.00		\$ 360,000.00
Permanent Seeding (inc. noxious weed mgmnt.) & Mulching	84.	AC	\$ 2,018.00	=	\$ 169,512.00		\$ 169,512.00
Permanent Pond/BMP (provide engineer's estimate)		EA		=	\$ -		\$ -
Concrete Washout Basin	1.	EA	\$ 1,172.00	=	\$ 1,172.00		\$ 1,172.00
Inlet Protection		EA	\$ 217.00	=	\$ -		\$ -
Rock Check Dam	2.	EA	\$ 651.00	=	\$ 1,302.00		\$ 1,302.00
Safety Fence		LF	\$ 3.00	=	\$ -		\$ -
Sediment Basin		EA	\$ 2,294.00	=	\$ -		\$ -
Sediment Trap		EA	\$ 538.00	=	\$ -		\$ -
Silt Fence	1168.	LF	\$ 3.00	=	\$ 3,504.00		\$ 3,504.00
Slope Drain		LF	\$ 43.00	=	\$ -		\$ -
Straw Bale		EA	\$ 33.00	=	\$ -		\$ -
Straw Wattle/Rock Sock		LF	\$ 8.00	=	\$ -		\$ -
Surface Roughening		AC	\$ 269.00	=	\$ -		\$ -
Temporary Erosion Control Blanket		SY	\$ 3.00	=	\$ -		\$ -
Temporary Seeding and Mulching		AC	\$ 1,793.00	=	\$ -		\$ -
Vehicle Tracking Control	1.	EA	\$ 3,085.00	=	\$ 3,085.00		\$ 3,085.00
Riprap Drop Structures	29.	EA	\$ 34,000.00	=	\$ 986,000.00		\$ 986,000.00
[insert items not listed but part of construction plans]				=	\$ -		\$ -
MAINTENANCE (35% of Construction BMPs)				=	\$ 347,861.85		\$ 347,861.85
Section 1 Subtotal				=	\$ 2,360,494.35		\$ 2,360,494.35
SECTION 2 - PUBLIC IMPROVEMENTS *							
ROADWAY IMPROVEMENTS							
Construction Traffic Control		LS		=	\$ -		\$ -
Aggregate Base Course (135 lbs/cf)		Tons	\$ 37.00	=	\$ -		\$ -
Aggregate Base Course (135 lbs/cf)		CY	\$ 66.00	=	\$ -		\$ -
Asphalt Pavement (3" thick)		SY	\$ 18.00	=	\$ -		\$ -
Asphalt Pavement (4" thick)		SY	\$ 25.00	=	\$ -		\$ -
Asphalt Pavement (6" thick)		SY	\$ 38.00	=	\$ -		\$ -
Asphalt Pavement (147 lbs/cf) _" thick		Tons	\$ 114.00	=	\$ -		\$ -
Raised Median, Paved		SF	\$ 11.00	=	\$ -		\$ -
Regulatory Sign/Advisory Sign		EA	\$ 392.00	=	\$ -		\$ -
Guide/Street Name Sign		EA		=	\$ -		\$ -
Epoxy Pavement Marking		SF	\$ 17.00	=	\$ -		\$ -
Thermoplastic Pavement Marking		SF	\$ 30.00	=	\$ -		\$ -
Barricade - Type 3		EA	\$ 259.00	=	\$ -		\$ -
Delineator - Type I		EA	\$ 31.00	=	\$ -		\$ -
Curb and Gutter, Type A (6" Vertical)		LF	\$ 38.00	=	\$ -		\$ -
Curb and Gutter, Type B (Median)		LF	\$ 38.00	=	\$ -		\$ -
Curb and Gutter, Type C (Ramp)		LF	\$ 38.00	=	\$ -		\$ -
4" Sidewalk (common areas only)		SY	\$ 62.00	=	\$ -		\$ -
5" Sidewalk		SY	\$ 77.00	=	\$ -		\$ -
6" Sidewalk		SY	\$ 94.00	=	\$ -		\$ -
8" Sidewalk		SY	\$ 125.00	=	\$ -		\$ -
Pedestrian Ramp		EA	\$ 1,496.00	=	\$ -		\$ -
Cross Pan, local (8" thick, 6' wide to include return)		LF	\$ 79.00	=	\$ -		\$ -
Cross Pan, collector (9" thick, 8' wide to include return)		LF	\$ 119.00	=	\$ -		\$ -
Curb Opening with Drainage Chase		EA	\$ 1,926.00	=	\$ -		\$ -
Guardrail Type 3 (W-Beam)		LF	\$ 65.00	=	\$ -		\$ -
Guardrail Type 7 (Concrete)		LF	\$ 94.00	=	\$ -		\$ -
Guardrail End Anchorage		EA	\$ 2,731.00	=	\$ -		\$ -
Guardrail Impact Attenuator		EA	\$ 4,902.00	=	\$ -		\$ -
Sound Barrier Fence (CMU block, 6' high)		LF	\$ 102.00	=	\$ -		\$ -
Sound Barrier Fence (panels, 6' high)		LF	\$ 104.00	=	\$ -		\$ -
Electrical Conduit, Size =		LF	\$ 22.00	=	\$ -		\$ -
Traffic Signal, (provide engineer's estimate)		EA		=	\$ -		\$ -

PROJECT INFORMATION				
Grandview Reserve Gieck Basin Channel	6/21/2024	CDR-228		
Project Name	Date	PCD File No.		

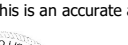
Description	Quantity	Units	Unit Cost		Total	(with Pre-Plat Construction)	
						% Complete	Remaining
				=	\$ -		\$ -
<i>[insert items not listed but part of construction plans]</i>				=	\$ -		\$ -
<b>STORM DRAIN IMPROVEMENTS</b>							
Concrete Box Culvert (M Standard), Size ( 8' x 4' )	54.	LF	\$ 3,025.00	=	\$ 163,350.00		\$ 163,350.00
Concrete Box Culvert (M Standard), Size ( 8' x 4' )	60.	LF	\$ 3,025.00	=	\$ 181,500.00		\$ 181,500.00
Concrete Box Culvert (M Standard), Size ( 10' x 4' )	206.	LF	\$ 3,760.00	=	\$ 774,560.00		\$ 774,560.00
Concrete Box Culvert (M Standard), Size ( 7' x 1' )	12.	LF	\$ 1,370.00	=	\$ 16,440.00		\$ 16,440.00
18" Reinforced Concrete Pipe		LF	\$ 82.00	=	\$ -		\$ -
24" Reinforced Concrete Pipe		LF	\$ 98.00	=	\$ -		\$ -
30" Reinforced Concrete Pipe		LF	\$ 123.00	=	\$ -		\$ -
36" Reinforced Concrete Pipe		LF	\$ 151.00	=	\$ -		\$ -
42" Reinforced Concrete Pipe		LF	\$ 201.00	=	\$ -		\$ -
48" Reinforced Concrete Pipe		LF	\$ 245.00	=	\$ -		\$ -
54" Reinforced Concrete Pipe		LF	\$ 320.00	=	\$ -		\$ -
60" Reinforced Concrete Pipe		LF	\$ 374.00	=	\$ -		\$ -
66" Reinforced Concrete Pipe		LF	\$ 433.00	=	\$ -		\$ -
72" Reinforced Concrete Pipe		LF	\$ 495.00	=	\$ -		\$ -
18" Corrugated Steel Pipe		LF	\$ 105.00	=	\$ -		\$ -
24" Corrugated Steel Pipe		LF	\$ 121.00	=	\$ -		\$ -
30" Corrugated Steel Pipe		LF	\$ 154.00	=	\$ -		\$ -
36" Corrugated Steel Pipe		LF	\$ 184.00	=	\$ -		\$ -
42" Corrugated Steel Pipe		LF	\$ 212.00	=	\$ -		\$ -
48" Corrugated Steel Pipe		LF	\$ 223.00	=	\$ -		\$ -
54" Corrugated Steel Pipe		LF	\$ 327.00	=	\$ -		\$ -
60" Corrugated Steel Pipe		LF	\$ 353.00	=	\$ -		\$ -
66" Corrugated Steel Pipe		LF	\$ 427.00	=	\$ -		\$ -
72" Corrugated Steel Pipe		LF	\$ 502.00	=	\$ -		\$ -
78" Corrugated Steel Pipe		LF	\$ 578.00	=	\$ -		\$ -
84" Corrugated Steel Pipe		LF	\$ 691.00	=	\$ -		\$ -
Flared End Section (FES) RCP Size = (unit cost = 6x pipe unit cost)		EA		=	\$ -		\$ -
Flared End Section (FES) CSP Size = (unit cost = 6x pipe unit cost)		EA		=	\$ -		\$ -
End Treatment- Headwall	53.	CY	\$ 1,798.00	=	\$ 95,294.00		\$ 95,294.00
End Treatment- Wingwall	23.	CY	\$ 1,084.00	=	\$ 24,932.00		\$ 24,932.00
End Treatment - Cutoff Wall	12.	CY	\$ 4,083.00	=	\$ 48,996.00		\$ 48,996.00
Curb Inlet (Type R) L=5', Depth < 5'		EA	\$ 7,212.00	=	\$ -		\$ -
Curb Inlet (Type R) L=5', 5' ≤ Depth < 10'		EA	\$ 9,377.00	=	\$ -		\$ -
Curb Inlet (Type R) L=5', 10' ≤ Depth < 15'		EA	\$ 10,859.00	=	\$ -		\$ -
Curb Inlet (Type R) L=10', Depth < 5'		EA	\$ 9,925.00	=	\$ -		\$ -
Curb Inlet (Type R) L=10', 5' ≤ Depth < 10'		EA	\$ 10,230.00	=	\$ -		\$ -
Curb Inlet (Type R) L=10', 10' ≤ Depth < 15'		EA	\$ 12,805.00	=	\$ -		\$ -
Curb Inlet (Type R) L=15', Depth < 5'		EA	\$ 12,907.00	=	\$ -		\$ -
Curb Inlet (Type R) L=15', 5' ≤ Depth < 10'		EA	\$ 13,835.00	=	\$ -		\$ -
Curb Inlet (Type R) L=15', 10' ≤ Depth < 15'		EA	\$ 15,130.00	=	\$ -		\$ -
Curb Inlet (Type R) L=20', Depth < 5'		EA	\$ 13,755.00	=	\$ -		\$ -
Curb Inlet (Type R) L=20', 5' ≤ Depth < 10'		EA	\$ 15,181.00	=	\$ -		\$ -
Grated Inlet (Type C), Depth < 5'		EA	\$ 6,037.00	=	\$ -		\$ -
Grated Inlet (Type D), Depth < 5'		EA	\$ 7,458.00	=	\$ -		\$ -
Storm Sewer Manhole, Box Base		EA	\$ 15,130.00	=	\$ -		\$ -
Storm Sewer Manhole, Slab Base		EA	\$ 8,322.00	=	\$ -		\$ -
Geotextile (Erosion Control)		SY	\$ 9.00	=	\$ -		\$ -
Rip Rap, d50 size from 6" to 24"		Tons	\$ 104.00	=	\$ -		\$ -
Rip Rap, Grouted		Tons	\$ 124.00	=	\$ -		\$ -
Drainage Channel Lining, Concrete		CY	\$ 741.00	=	\$ -		\$ -
Drainage Channel Lining, Rip Rap				=	\$ -		\$ -
Drainage Channel Lining, Grass				=	\$ -		\$ -
Drainage Channel Lining, Other Stabilization				=	\$ -		\$ -
<i>[insert items not listed but part of construction plans]</i>				=	\$ -		\$ -
Section 2 Subtotal					=	\$ 1,305,072.00	\$ 1,305,072.00

\* - Subject to defect warranty financial assurance. A minimum of 20% shall be retained until final acceptance (MAXIMUM OF 80% COMPLETE ALLOWED)

PROJECT INFORMATION								
Grandview Reserve Gieck Basin Channel			6/21/2024			CDR-228		
Project Name			Date			PCD File No.		
Description	Quantity	Units	Unit Cost		Total	(with Pre-Plat Construction)		
						% Complete	Remaining	
<b>SECTION 3 - COMMON DEVELOPMENT IMPROVEMENTS (Private or District and NOT Maintained by EPC)**</b>								
<b>ROADWAY IMPROVEMENTS</b>								
Maintenance Road - Aggregate Base Course (135 lbs/cf)	2671.	CY	\$ 65.00	=	\$ 173,615.00		\$	173,615.00
				=	\$ -		\$	-
				=	\$ -		\$	-
				=	\$ -		\$	-
				=	\$ -		\$	-
				=	\$ -		\$	-
<b>STORM DRAIN IMPROVEMENTS</b> (Exception: Permanent Pond/BMP shall be itemized under Section 1)								
Drainage Channel Lining, Rip Rap	1400.	CY	\$ 145.00	=	\$ 203,000.00		\$	203,000.00
Drainage Channel Lining, Grass	9.21	AC	\$ 98,900.00	=	\$ 910,869.00		\$	910,869.00
Drainage Channel Lining, Soil Rip Rap	900.	CY	\$ 209.00	=	\$ 188,100.00		\$	188,100.00
				=	\$ -		\$	-
				=	\$ -		\$	-
				=	\$ -		\$	-
<b>WATER SYSTEM IMPROVEMENTS</b>								
Water Main Pipe (PVC), Size 8"		LF	\$ 84.00	=	\$ -		\$	-
Water Main Pipe (Ductile Iron), Size 8"		LF	\$ 98.00	=	\$ -		\$	-
Gate Valves, 8"		EA	\$ 2,418.00	=	\$ -		\$	-
Fire Hydrant Assembly, w/ all valves		EA	\$ 8,584.00	=	\$ -		\$	-
Water Service Line Installation, inc. tap and valves		EA	\$ 1,723.00	=	\$ -		\$	-
Fire Cistern Installation, complete		EA		=	\$ -		\$	-
				=	\$ -		\$	-
[insert items not listed but part of construction plans]				=	\$ -		\$	-
<b>SANITARY SEWER IMPROVEMENTS</b>								
Sewer Main Pipe (PVC), Size 8"		LF	\$ 84.00	=	\$ -		\$	-
Sanitary Sewer Manhole, Depth < 15 feet		EA	\$ 5,708.00	=	\$ -		\$	-
Sanitary Service Line Installation, complete		EA	\$ 1,825.00	=	\$ -		\$	-
Sanitary Sewer Lift Station, complete		EA		=	\$ -		\$	-
				=	\$ -		\$	-
[insert items not listed but part of construction plans]				=	\$ -		\$	-
<b>LANDSCAPING IMPROVEMENTS</b> (For subdivision specific condition of approval, or PUD)								
		EA		=	\$ -		\$	-
		EA		=	\$ -		\$	-
		EA		=	\$ -		\$	-
		EA		=	\$ -		\$	-
		EA		=	\$ -		\$	-
<b>Section 3 Subtotal</b>				<b>=</b>	<b>\$ 1,475,584.00</b>		<b>\$</b>	<b>1,475,584.00</b>

\*\* - Section 3 is not subject to defect warranty requirements

PROJECT INFORMATION		
Grandview Reserve Gieck Basin Channel	6/21/2024	CDR-228
Project Name	Date	PCD File No.

<b>Approvals</b> I hereby certify that this is an accurate and <div style="text-align: center;">  </div>	
Engineer (P.E. Seal Required)	
Approved by Owner / Applicant	Date
Approved by El Paso County Engineer / ECM Administrator	Date

# V5\_FDR.pdf Markup Summary

Text Box (6)	
	<p><b>Subject:</b> Text Box <b>Page Label:</b> 1 <b>Author:</b> Jeff Rice - EPC Engineering Review <b>Date:</b> 7/31/2024 1:36:08 PM <b>Status:</b> <b>Color:</b>  <b>Layer:</b> <b>Space:</b></p> <p>Provide TOC and report text</p>
	<p><b>Subject:</b> Text Box <b>Page Label:</b> 114 <b>Author:</b> Jeff Rice - EPC Engineering Review <b>Date:</b> 7/31/2024 1:36:49 PM <b>Status:</b> <b>Color:</b>  <b>Layer:</b> <b>Space:</b></p> <p>Unresolved: Provide design calculations for each culvert</p>
	<p><b>Subject:</b> Text Box <b>Page Label:</b> 115 <b>Author:</b> Jeff Rice - EPC Engineering Review <b>Date:</b> 7/31/2024 1:42:48 PM <b>Status:</b> <b>Color:</b>  <b>Layer:</b> <b>Space:</b></p> <p>Highlighted values exceed Table 3 values.</p>
	<p><b>Subject:</b> Text Box <b>Page Label:</b> 93 <b>Author:</b> Jeff Rice - EPC Engineering Review <b>Date:</b> 7/31/2024 1:43:27 PM <b>Status:</b> <b>Color:</b>  <b>Layer:</b> <b>Space:</b></p> <p>Highlighted values exceed Table 3 values.</p>
	<p><b>Subject:</b> Text Box <b>Page Label:</b> 94 <b>Author:</b> Jeff Rice - EPC Engineering Review <b>Date:</b> 7/31/2024 1:46:54 PM <b>Status:</b> <b>Color:</b>  <b>Layer:</b> <b>Space:</b></p> <p>Also provide tables for 2-year and 10-year flows</p>
	<p><b>Subject:</b> Text Box <b>Page Label:</b> 1 <b>Author:</b> CDurham <b>Date:</b> 8/1/2024 12:22:31 PM <b>Status:</b> <b>Color:</b>  <b>Layer:</b> <b>Space:</b></p> <p>and signature page</p>


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011063	4.82	100.81
010062	4.91	64.64
009830	5.98	45.91
010473	5.99	45.15
010396	6.02	45.44
010460	6.05	45.70
001179	3.10	93.53
000185	1.77	161.63

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ITEM	QTY	UNIT	PRICE	TOTAL	TAXES
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93	1	1	1	1	1</

$t, t_0$	$u, u_0$	$u(t)/u_0$
7.22	0.81	0.0077
9.25	1.16	0.0207
9.47	1.15	0.0145
9.46	1.16	0.0154
9.38	1.12	0.0197
9.31	1.15	0.0218
9.27	1.16	0.0254
7.75	0.86	0.0108
8.27	0.92	0.0082


	Q21	2.88	3.33	3.86	0.0390	2.1	35	
	Q22	2.89	3.42	3.94	0.0390	2.9 <th>35</th>	35	
	Q23	2.89	3.30	3.83	0.0390	2.9 <th>35</th>	35	
	Q24	2.92	3.80	3.96	0.0390	3.7 <th>35</th>	35	
	Q25	2.92	3.47	3.97	0.0390	3.7 <th>35</th>	35	
	Q26	2.93	3.93	3.99	0.0378	3.9 <th>35</th>	35	
	Q27	2.93	3.76	3.97	0.0372	3.9 <th>35</th>	35	
	Q28	2.9	3.8	3.97	0.113	0.206	4.1 <th>35</th>	35
	Q29	2.77	3.85	3.98	0.039	3.6 <th>35</th>	35	
	Q30	2.9	3.88	3.98	0.039	3.6 <th>35</th>	35	
	Q31	2.9	3.9	3.97	0.0393	3.9 <th>35</th>	35	
	Q32	2.9	3.93	3.93	0.037	3.9 <th>35</th>	35	
	Q33	2.78	3.89	3.93	0.0399	3.8 <th>35</th>	35	
	Q34	2.77	3.94	3.97	0.0398	3.8 <th>35</th>	35	
	Q35	2.92	3.9	3.97	0.0393	3.9 <th>35</th>	35	
	Q36	2.9	3.92	3.97	0.039	3.9 <th>35</th>	35	
	Q37	2.92	3.97	3.93	0.0398	3.9 <th>35</th>	35	

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**Page Label:** 115  
**Author:** Jeff Rice - EPC Engineering Review  
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Fr	Froude # Chi
1.35	1.12
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1.58	0.93
1.26	0.91

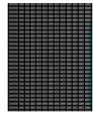
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(ft/s)	
10.06	
6.48	

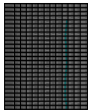
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10.06	
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