Technical Memorandum

Date:	Tuesday, October 14, 2025
Project:	Xcel Tline: Pathways Segment 5 Arapahoe County Build County Case No. ASI25-001/LE25-003 SEMSWA Case No. DPR25-00034
To:	Sue Liu. P.E., CFM Arapahoe County Public Works and Development Engineering Services Division
From:	HDR Engineering, Inc. Jose Velasquez, P.E., CFM Jose.Velasquez@hdrinc.com, (719-272-8889) 5555 Tech Center Dr #310, Colorado Springs, CO 80919 Public Service Company of Colorado (PSCo) Sascha Archie, Project Manager Sascha.archie@xcelenergy.com, (718) 869-4118 Chad Campbell, Environmental Services Group Manager Chad.campbell@xcelenergy.com, (202) 285-6590 3500 Blake Street, Denver Co 80205
Subject:	Technical Memorandum (TM) of Floodplain Delineation Study: Floodplain Development Permit Support

Introduction/Background

As part of the Power Pathway (PWAY) Segment 5 project, the Public Service Company of Colorado (PSCo), an Xcel Energy company, proposes to construct approximately 18 miles of new 345-kilovolt (kV) double-circuit overhead transmission line through Arapahoe County, extending from the Harvest Mile Substation to proposed Structure 593 near the Arapahoe–Elbert County boundary. From there, the transmission line will continue south through Elbert, El Paso, Lincoln, and Pueblo Counties. The new line would be comprised of a mix of monopole, tangent, and dead-end steel pole (tower) structures. The proposed transmission line alignment crosses FEMA Special Flood Hazard Area (SFHA) in multiple locations, including Murphy Creek, Senac Creek, Black Shack Creek, Coal Creek, and Box Elder Creek. Of the five SFHA that the Project intersects, Black Shack Creek, Box Elder Creek, and Coal Creek had a proposed tower located within the SFHA. Per the current Arapahoe County guidelines, drainageways unmapped by FEMA or Urban Drainage and Flood Control District (now known as Mile High Flood District) with contributing areas larger than 130-acres (unmapped streams or tributaries), must also be investigated in the same manner as a FEMA SFHA. An investigation of drainage areas crossing the proposed alignment found 11 locations that meet the 130-acre criteria. However, 8 of the 11 crossings had proposed tower locations significantly set back from the crossing watercourse or were elevated sufficiently enough to well outside of the 100-yr inundation area of the watercourse crossing. These additional 8 crossing locations do not have a hydraulic model analysis developed due to this reasoning.

The purpose of this project is to analyze the impact of the proposed structures on the Base Flood Elevation (BFE) of the FEMA SFHA or unmapped tributaries they are proposed to be within. It is necessary to comply with the Arapahoe Land Development code to obtain a Floodplain Development Permit (FDP) prior to the start of new construction in the SFHA.

For the purpose of documenting the potential impacts to the SFHA in Arapahoe County, Colorado the transmission line has been analyzed at six locations, each with at least one proposed transmission tower located in a SFHA or in close proximity to one of the 130-acre crossing watercourses.

These locations include:

- A crossing at Box Elder Creek that is within a Zone A SFHA of FEMA FIRM panel 08005C0245L, effective date September 28, 2018.
- A crossing at Black Shack Creek within a Zone A SFHA of FEMA FIRM panel 08005C0219L, effective date April 18, 2018.
- A crossing at Coal Creek with a Zone AO SFHA FEMA FIRM panel 08005C0219L, effective date April 18, 2018, and panel 08005C0240M, effective date September 28, 2018.
- A crossing at a Senac Creek Tributary, the outlet of a watershed with a drainage area greater than 130-acres just west of the intersection of East Quincy Avenue and South Powaton Road.
- A crossing at a tributary to the west of Black Shack Creek, the outlet of a watershed with a drainage area greater than 130-acres.
- A crossing to the east of Kiowa Creek, the outlet of a watershed with a drainage area greater than 130-acres just east of the intersection of County Road 194 and Rolling Vista Street.

Of the locations above a Floodplain Development Permit (FDP) will be submitted for the following:

- Box Elder Creek for poles 651 and 652
- Black Shack Creek pole 682
- Coal Creek pole 678
- Kiowa Creek Tributary pole 596

The proposed PWAY Segment 5 transmission line alignment overlaid over the Arapahoe County SFHA (including the unmapped streams) are shown in Figure 1 on the next page.

Within Arapahoe County, three of the SFHA being encroached upon are approximate Zone A and three are crossings with at least 130-acres of contributing watershed, neither of which provide BFE. Therefore, the water surface elevation must be determined using methods as described in FEMA guidance. For these crossings, detailed methodology using the step-backwater method to develop water surface elevations for the 1-percent-annual-exceedance probability (AEP) flood event, otherwise known as the 100-year storm, was utilized.

The SFHA being encroached upon at Coal Creek is a SFHA Zone AO. Zone AO is defined as an area with 1% or greater chance of flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These zones are developed from detailed FEMA studies with effective models. The effective model was not located by FEMA upon request; therefore, a duplicate hydraulic model was developed using the publicly data available in the FEMA database and FIS report.

Within Arapahoe County, there are multiple jurisdictional entitities present at the locations of the proposed crossings. The jurisdictional boundaries of the Southeast Metro Stormwater Authority (SEMSWA) and the City of Aurora can be seen in Figure 1. All areas on the figure outside of SEMSWA and the City of Aurora boundaries are within Arapahoe County Jurisdiction. The jurisidcition corresponding to each crossing can be found in Table 1.

Structure Locations
SFHA FLOODWAY
SFHA ZONE AE
SFHA ZONE A
SFHA ZONE AO
SFHA ZONE AH
SEGMENT 5 ALIGNMENT
SEMSWA Boundary
Aurora City Limits
County Boundaries

Denver
Aurora
Littleton
Castle Rock
70

Senac Creek Tributary
Black Shack Creek
Black Shack Creek Tributary
Coal Creek
Watkins Rd
E Quincy Ave
Box Elder Creek
Aurora Reservoir
State Highway 470
Kiowa Creek Tributary

700 690 687 685 683 679 677 674 672 669 668 667 663 661 660 657 654 655 653 651 649 647 644 643 638 637 636 635 634 633 632 631 630 629 628 627 626 625 623 624 622 621 620 619 618 617 616 615 614 613 612 611 610 609 608 607 606 605 604 603 602 601 596 595 594 593 592 591 590 589 588 587 586 585 584 583

HMIL-SUB
701
702
697 695 693 691

Arapahoe County
Douglas County
Douglas County
Elbert County
Arapahoe County
Elbert County

0 1 mi

VICINITY MAP
Figure 1

Hydrology

The hydrologic assessment for watercourse crossed by the PWAY Segment 5 alignment was performed to estimate the peak discharge for the 100-year flood event. A hydrologic assessment was also performed at unmapped stream locations along the proposed alignment outside of FEMA SFHA with a watershed greater than 130-acres. These locations were determined using USGS StreamStats delineation tool with a design point location at the proposed transmission line crossings.

Peak discharge rates for the 100-year flood event were determined using the USGS StreamStats web application and statistical analysis using published data. The calculations specific to Colorado are based on a study conducted by the USGS in cooperation with Colorado Department of Transportation to develop regression equations for peak streamflow of the 50-, 20-, 10-, 4-, 2, 1-, 0.5-, and 0.2-percent AEP at un-gaged locations in Colorado (USGS, 2016). The StreamStats website allows the user to delineate a watershed at a point along the watercourse and calculate the parameters using geographical information systems (GIS), which was performed for the flood sources at their representative site locations. For streams that had Arapahoe County Flood Insurance Study (FIS) hydrologic study data available, flows were projected from the FIS hydrologic locations (Eq. 1) using a ratio of drainage area at the FIS table flow location to the structure location within the FEMA SFHA in accordance with “Analysis of the Magnitude and Frequency of Floods in Colorado” (USGS, 2000).

$$Q_{T(u)} = Q_{T(g)} \left(\frac{A_u}{A_g} \right)^x \quad \text{Eq. 1}$$

In areas where FIS hydrologic data was either unavailable or outside of the allowable drainage area ratio threshold of +/- 50%, the StreamStats regression equation values were utilized instead. Published FIS hydrology is assumed to be the more accurate hydrologic data than regression equations and the basis for the approximate Zone A delineation. It is preferred to use or project these studied flows when the data is available to better match the calculated BFE with the effective delineation.

Table 1 below summarizes the 1 percent AEP (100-year flood) peak discharge determined using StreamStats, the FIS reports, or a FIS projection observed for each of the SFHA and 130-acre (0.2-mile) crossings in Arapahoe County. The peak discharge estimates are then used within the hydraulic analysis to determine the BFE at the various sites.

Table 1: 100-Year Peak Flow

Crossing Location	Crossing Type	Transmission Structure/ Tower Number	Hydrology Source	Drainage Area (sq. mi.)	100-Year Peak Discharge (cfs)	Jurisdiction
Black Shack Creek	SFHA	682	Regression Equation	7.74	1,500	SEMSWA
Box Elder Creek	SFHA	651 & 652	FIS Projected	148	10,600	Arapahoe County
Senac Creek Tributary	130-Acre	694	Regression Equation	0.33	180	SEMSWA
Black Shack Creek West Tributary	130-Acre	684	Regression Equation	0.29	170	SEMSWA
Coal Creek	SFHA	678	FIS, Coal Creek Effective FEMA XS AU	52.4	12,593	SEMSWA
Kiowa Creek Tributary	130-Acre	596	Regression Equation	3.27	1,300	Arapahoe County

Hydraulics

The BFE for the SFHA at Black Shack Creek, Box Elder Creek, and Coal Creek as well as unmapped streams, Senac Creek Tributary, Black Shack Creek West Tributary, and Kiowa Creek Tributary were calculated in the vicinity of the transmission line towers to compare the existing conditions to the potential impacts of the proposed improvements. It was decided that rather than approximate methods of determining the BFE a detailed method was utilized to provide a better estimate.

In order to provide a detailed analysis, a topographic data source was utilized to create ground surface cross sections perpendicular to the flow path of the effective SFHA. The 2020 LiDAR terrain mapping from the United States Geological Survey (USGS) for all portions of Arapahoe County was utilized for this purpose. The LiDAR data is published as 1 meter data and was converted to 3.28 ft cell size for the creation of a Digital Elevation Model (DEM) raster. The vertical datum used was NAVD88 and the horizontal projection was NAD 1983 (2011) State Plane Colorado Central FIPS 0501 (US Feet).

Hydraulic Model

To obtain the hydraulic parameters needed for the detailed method, a hydraulic model was created based on the 2020 LiDAR for the SFHA and 130-acre crossings. The hydraulic model utilized is a one-dimensional (1D) Hydraulic Engineering Center River Analysis System (HEC-RAS), Version 6.6 using steady state, sub-critical, and fixed bed conditions. An existing conditions model was developed to determine the BFE within the stream crossing locations and if the proposed structures are within the floodplain extents. For the project sites, separate proposed hydraulic models were developed to determine the change in BFE of the locations where the proposed structures were within the modeled existing SFHA. Hydraulic model cross sections were used to represent the channel and floodplain at each of the structure locations relative to the site are shown in Appendix A. In general, the flow paths from the SFHA are perpendicular to the proposed alignment. Cross sections placed along the alignment of the proposed structures were used to analyze the existing versus proposed conditions represented by the addition of blocked obstructions with widths equal to the foundation diameter of the proposed tower structures. Ineffective flow areas were also utilized to remove floodplain flow that becomes disconnected, blocked, or shallow and attenuated. The model extents, stream length, and downstream normal slope boundary conditions can be found in Table 2 below.

Upon request, FEMA was not able to provide supporting data for the effective study at Coal Creek, including the HEC-RAS model and accompanying hydrologic data. An existing condition hydraulic model was created using data available in the Arapahoe County FIS Study and the FEMA Floodplain Mapping database. Table 3 illustrates the differences in BFE between the Coal Creek effective model and the existing Coal Creek model created for this analysis.

Table 2: HEC-RAS Model Parameters

Stream Name	US Extents	DS Extents	Stream Length (ft)	DS Boundary Condition (ft/ft)
Black Shack Creek	1,903 ft US of E. Quincy Ave.	1,472 ft DS of E Quincy Ave	3,359	0.008
Box Elder Creek	2,885 ft US of E. Quincy Ave.	3,091 ft DS of E Quincy Ave.	5,967	0.004
Senac Creek Tributary	1,000 ft US of E Quincy Ave	336 ft DS of E Quincy Ave	1,383	0.02
Black Shack Creek West Tributary	1,726 ft US of E Quincy Ave	524 ft DS of E Quincy Ave	2,360	0.001
Coal Creek	375 ft US of E Quincy Ave	2,100 ft DS of E Quincy Ave	2.506	0.004
Kiowa Creek Tributary	471 ft US of Antelope Dr	185 ft DS of Antelope Dr	680	0.007

Table 3: Coal Creek BFE Comparison Table

Model Cross Section	FEMA Cross Section	Model BFE	FEMA BFE	Difference
2582	-	5763.72	-	-
2327	AT	5763.45	5763.6	-0.15
2221	-	5762.02	-	-
2140	-	5758.84	-	-
2000	-	5757.23	-	-
1670	AS	5754.47	5754.8	-0.33
1336	-	5752.85	-	-
868	AR	5751.49	5752.1	-0.61
478	-	5749.51	-	-
76	-	5747.45	-	-

Surface roughness in each of the models, except the Coal Creek model, represented as Manning's "n" values, was assigned spatially based on aerial imagery and engineering judgement. As the land use is predominantly irrigated agricultural area the main channel value of 0.04 and overbank value 0.042 were applied in the model. In models where a significant amount of flow was flowing along a roadway a manning's value of 0.011 was applied on the roadway section in the model.

Surface roughness for the Coal Creek was initially estimated based upon aerial imagery and engineering judgement, 0.042 for the overbank and 0.04 for the channel. However, the initial existing BFE results at the FEMA lettered cross sections using these values were consistently 1 to 2 feet lower than the effective BFE's. Manning's roughness values were then raised in the model to 0.055 for the overbank and 0.05 for the channel in order to raise the model BFE to better match the effective data. These adjusted values are shown in Table 3.

A survey site visit was conducted to collect data on the dimensions for the bridges on Black Shack Creek and Box Elder Creek as well as the culverts on Senac Creek Tributary and Black Shack Creek West Tributary. Field notes from that site visit can be seen in Appendix B. The

survey data was used to supplement the terrain elevations to simulate the bridge openings in the hydraulic models.

Both of the E Quincy Ave. roadway culverts at Senac Creek Tributary and Black Shack Creek West Tributary are projecting from fill and use entrance loss coefficient of 0.9 found in the HEC-RAS Hydraulic Reference Manual. The E Quincy Ave. bridges at Box Elder Creek, Black Shack Creek, and Coal Creek were modeled using low-flow computations as the flood stage never reached the low chord of the bridges to induce pressure flow. The bridges have triangle nose piers with 60-degree angles. The low-flow computations equations chosen were standard-step energy, momentum, and Yarnell equations with the highest energy answer used for computation. The momentum equation uses a Drag Coefficient (C_D) value of 1.39 and Yarnell Equation uses a Yarnell K Coefficient (K) value of 1.0 as advised in the HEC-RAS Hydraulic Reference Manual. Ineffective flow areas were placed at the expansion and contraction angles upstream and downstream of both the bridges and culverts. The contraction coefficients were increased from 0.1 to 0.3 and the expansion coefficients were increased from 0.3 to 0.5 at the two upstream and one downstream cross section bounding the bridges.

The model extents for each crossing as well as the existing and proposed (if needed) 100-yr floodplain extents can be found in Appendix A.

SFHA Crossing Results

Using HEC-RAS, the existing 1 percent AEP (100-year flood) flood profile was determined for each of the locations of the SFHA crossings studied. The figures below show the flood profile and base flood elevation (BFE) for each crossings existing conditions. The base flood elevation is noted on the profiles at the cross sections that would include the transmission towers in the proposed improvement model if a proposed conditions model was necessary.

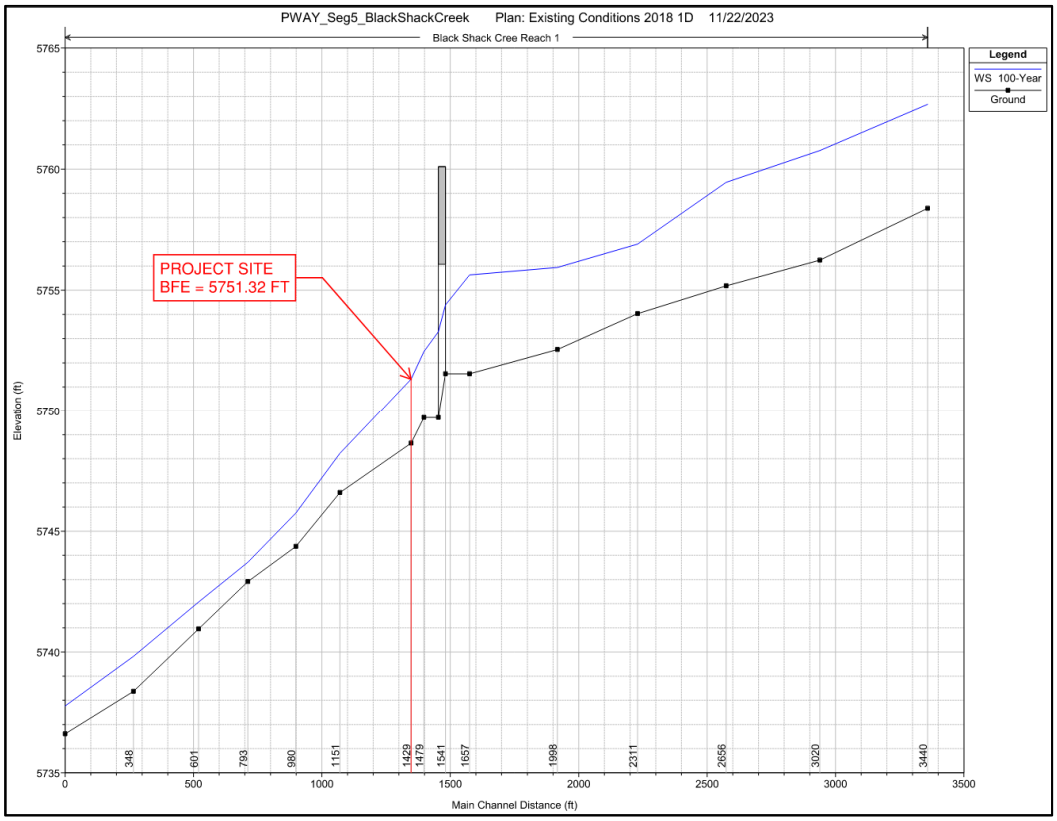


Figure 2. Black Shack Creek HEC-RAS Model Flood Profile

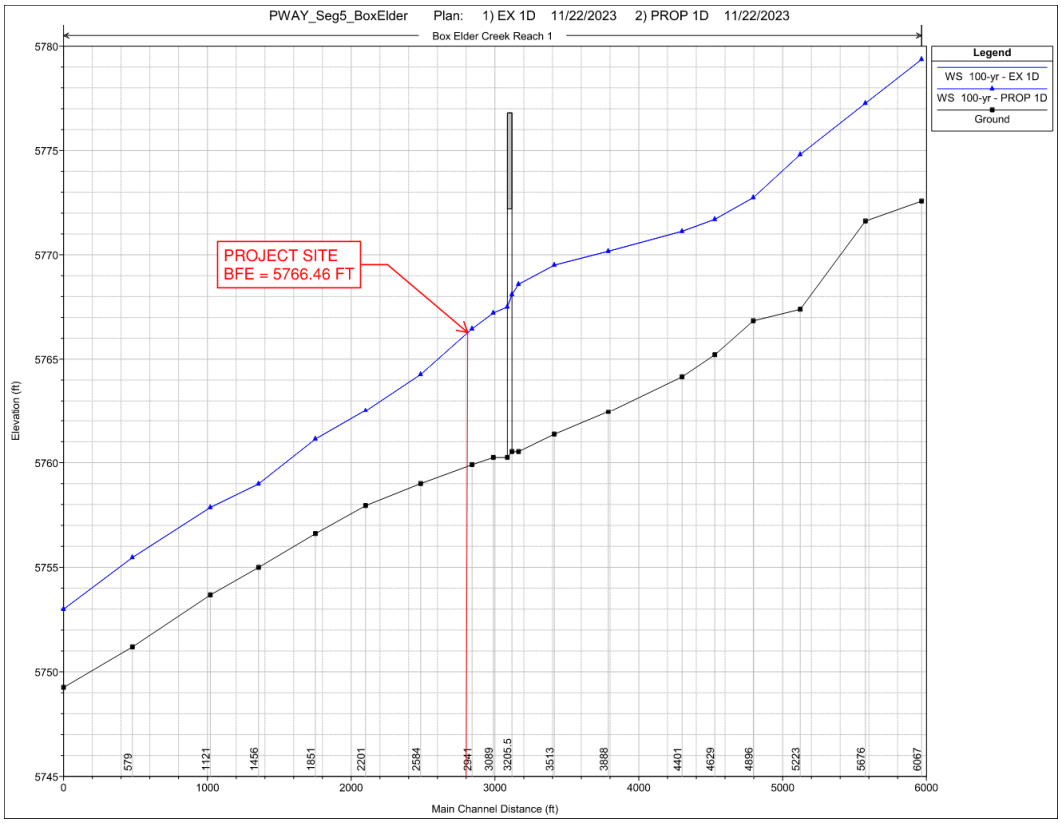


Figure 3. Box Elder Creek HEC-RAS Model Flood Profile

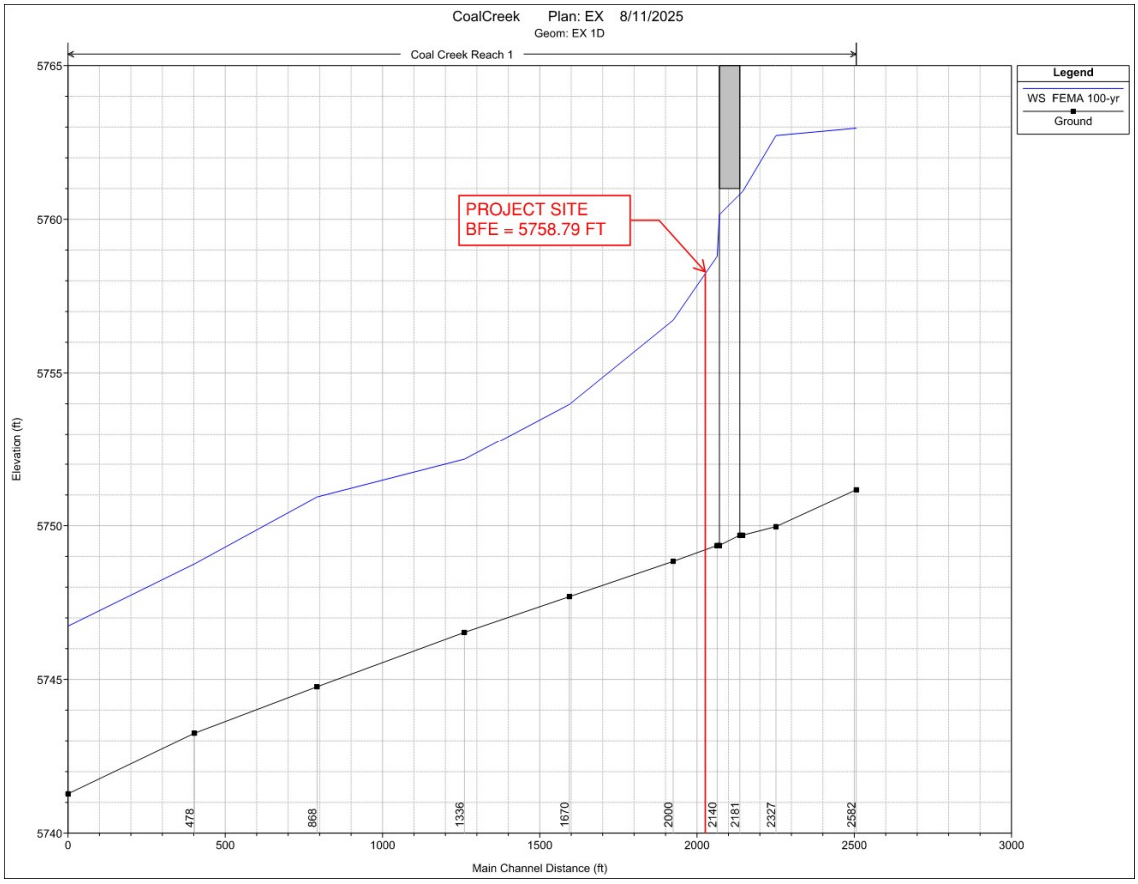


Figure 4. Coal Creek HEC-RAS Model Flood Profile

The floodplain mapping results seen in the figures, in general, show a reduction in the existing floodplain extents compared to the effective Zone A mapping extents at the crossings that encroach on a SFHA Zone A (See Appendix A).

No proposed structures are within the modeled effective extents of the Black Shack Creek existing 100-yr floodplain (see Appendix A) and for this reason, a proposed condition model was not developed for this site.

A proposed structure (structure number 651) is within the modeled effective extents of the Box Elder Creek existing 100-yr floodplain (See Appendix A), and for this reason, a proposed condition model was developed for this site. A comparison of the existing and proposed conditions for Box Elder Creek shows no change in BFE due to the incorporation of the proposed transmission tower structure. See Appendix A for proposed condition cross section results and a BFE comparison for the sites cross sections.

The model results at Coal Creek show that the proposed tower, located in a Zone AO, is within an ineffective flow area downstream of the bridge at E Quincy Ave. Model results verified that the SFHA Zone AO shown in the FEMA Effective Map is a shallow flooding zone graphically placed to transition overbank flooding near the roadway embankment back to the main channel

downstream of the sharp bend to the east. As the proposed tower location is within the ineffective (low to no velocity) flow area downstream of the bridge structure and is also located in shallow flooding zone (Zone AO), the proposed tower will not affect the BFE and a proposed model was not developed for this single transmission tower (structure number 678).

130-Acre Crossing Results

Using HEC-RAS, the existing 1 percent AEP (100-year flood) flood profile was determined for each of the locations of the 130-acre crossings studied. The figures following show the flood profile and base flood elevation (BFE) for each crossings existing conditions. The base flood elevation is noted on the profiles at the cross sections where the transmission towers would be located in the proposed improvement model when a proposed conditions model was necessary.

No proposed structures are within the modeled effective extents of the Black Shack Creek West Tributary or the Senac Creek Tributary existing 100-yr floodplain (See Appendix A), and for this reason, a proposed condition model was not developed for either of these sites.

A proposed structure (structure number 596) is within the modeled effective extents of the Kiowa Creek Tributary existing 100-yr floodplain (See Appendix A), and for this reason, a proposed condition model was developed for this site. A comparison of the existing and proposed conditions for Kiowa Creek Tributary shows no change in BFE due to the incorporation of the proposed transmission tower structure. See Appendix A for proposed condition cross section results and a BFE comparison for the sites cross sections.

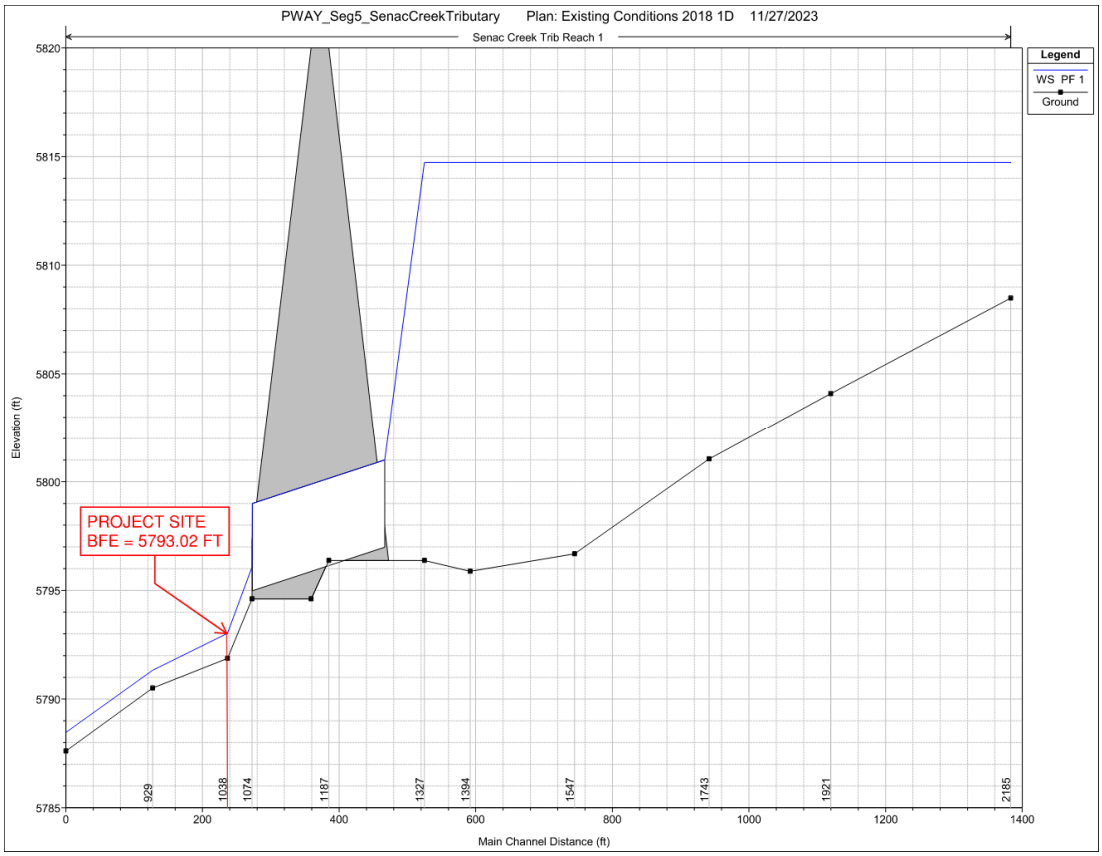


Figure 5. Senac Creek Tributary HEC-RAS Model Flood Profile

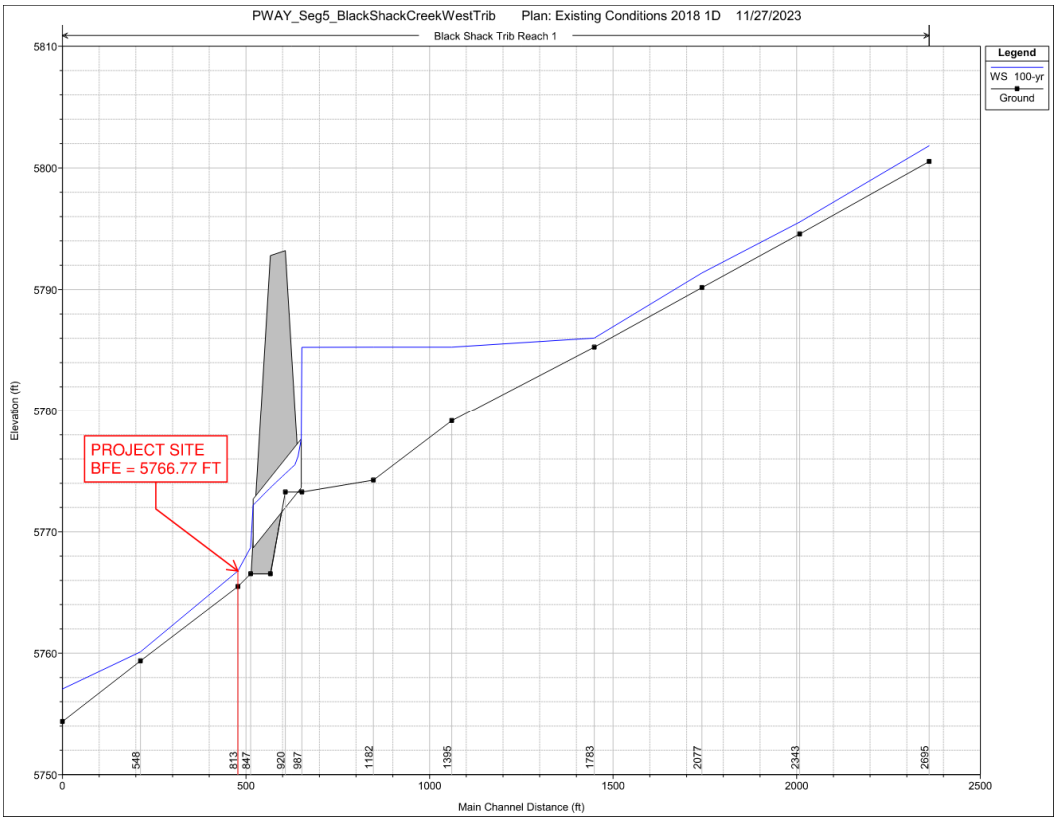


Figure 6. Black Shack Creek West Tributary HEC-RAS Model Flood Profile

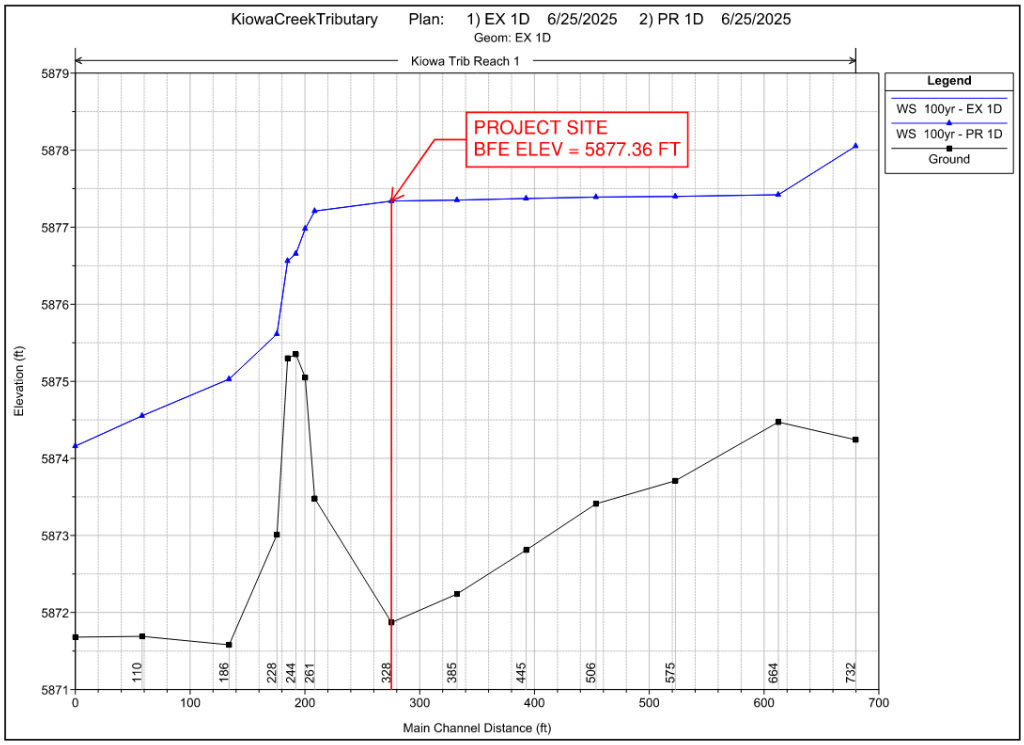


Figure 7. Kiowa Creek Tributary HEC-RAS Model Flood Profile

Compliance with Code

The hydrologic and hydraulic analysis has been performed within the standards stated in the jurisdictional code associated with each crossing: Chapter 5 of the Arapahoe County Stormwater Management Manual for crossings within SEMSWA jurisdiction and in accordance with Arapahoe County Land Development Code for all other crossings within Arapahoe County. Compliance with the Code has been met by providing the documents required, including a Floodplain Development Permit, and following review processes.

Limitations

The conclusions and recommendations in this TM are based on conditions at the time of study. Any modifications to the site, man-made or natural, could alter the analysis findings, and recommendations contained herein and could invalidate the analysis, findings, and recommendations. Site conditions, completion of upstream or downstream projects, upstream or downstream land use changes, climate changes, vegetation changes, maintenance practice changes, or other factors may change over time. Additional analysis or updates may be required in the future as a result of these changes.

References

Arapahoe County Stormwater Management Manual – adopted January 30, 2007, revised July 1, 2019.

FEMA, Flood Insurance Study, Arapahoe County Colorado and Incorporated Areas, EFFECTIVE APRIL 11, 2024.

USGS, Paleoflood Investigations to Improve Peak-Streamflow Regional-Regression Equations for Natural Streamflow in Eastern Colorado, Scientific Investigations Report 2016-5099, 2015

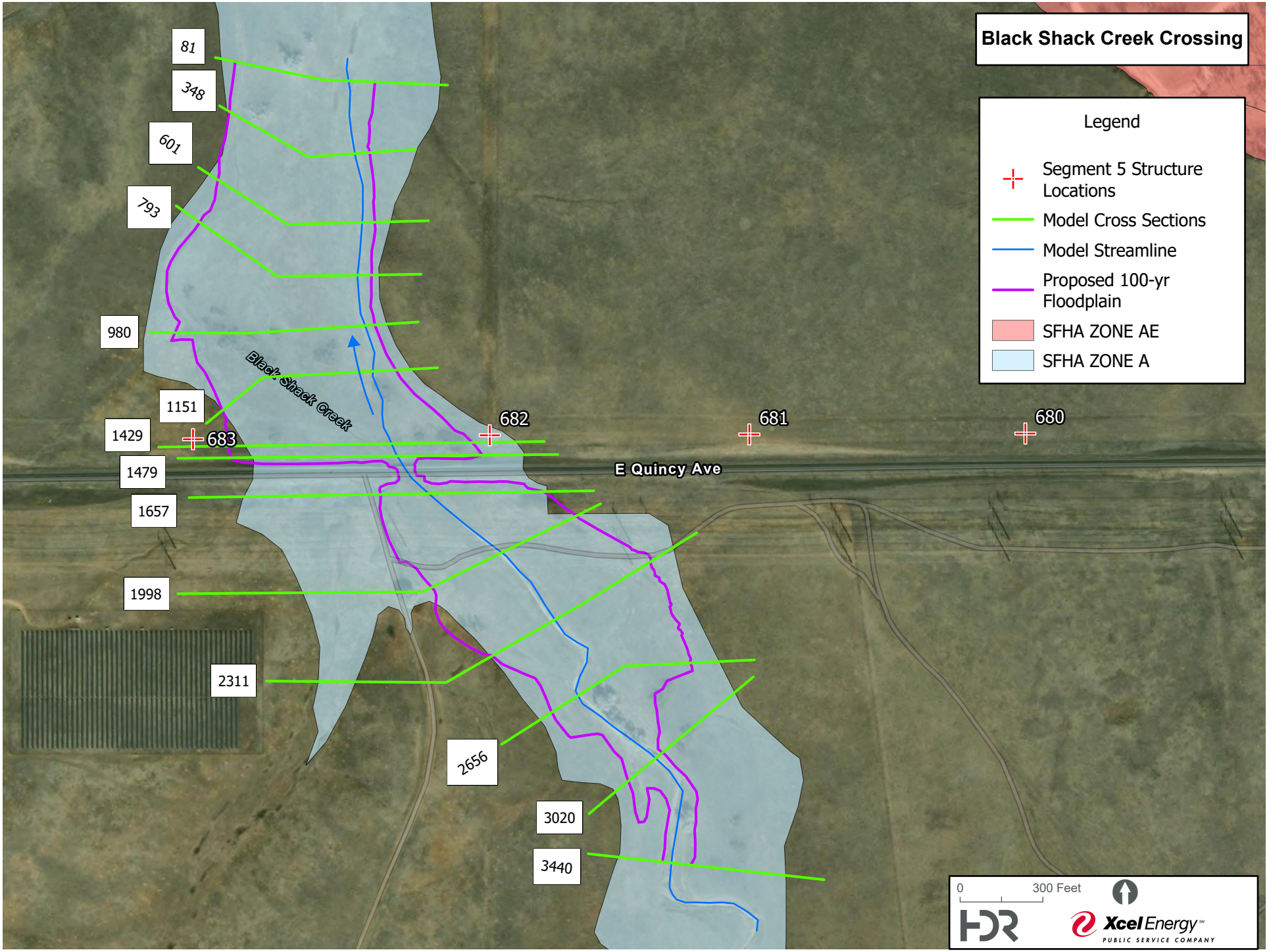
Vaill, J. & Babbitt, Bruce & Groat, Charles. U.S Geological Survey. (2000). Analysis of the Magnitude and Frequency of Floods in Colorado.

Appendix A

RAS Results

SFHA Crossing

Black Shack Creek



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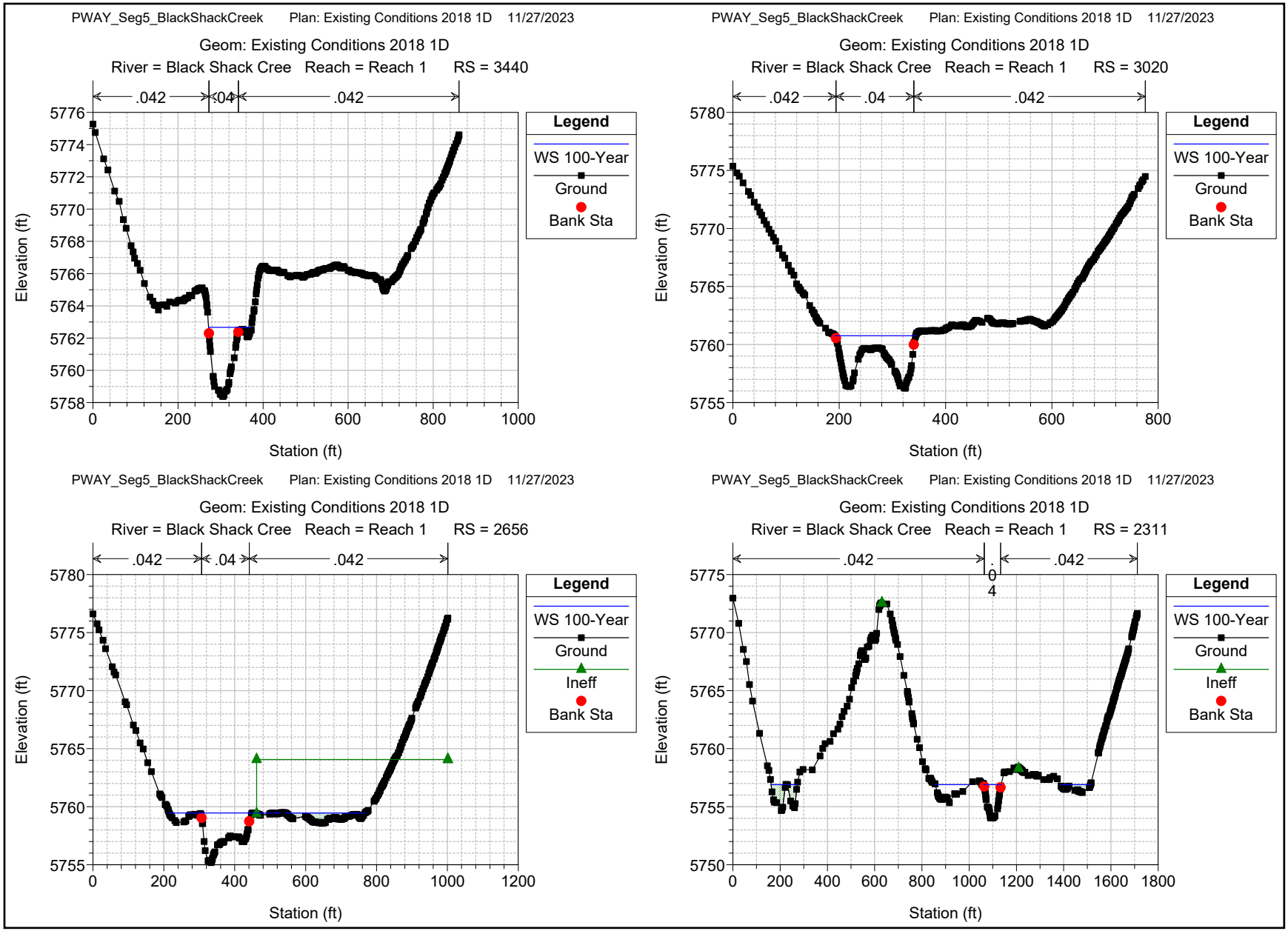
HEC-RAS Plan: EX 1D River: Black Shack Cree Reach: Reach 1 Profile: 100-Year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	3440	100-Year	1460.00	5758.38	5762.67	5762.07	5763.45	0.008768	7.10	213.00	100.75	0.73
Reach 1	3020	100-Year	1460.00	5756.24	5760.76		5761.02	0.003671	4.06	360.30	152.22	0.46
Reach 1	2656	100-Year	1460.00	5755.18	5759.46	5758.40	5759.71	0.003533	4.11	385.48	531.27	0.45
Reach 1	2311	100-Year	1460.00	5754.03	5756.90	5756.90	5757.52	0.015224	7.19	259.57	451.32	0.90
Reach 1	1998	100-Year	1460.00	5752.55	5755.94		5756.01	0.001219	2.26	700.07	991.89	0.26
Reach 1	1657	100-Year	1460.00	5751.55	5755.63	5753.64	5755.69	0.000660	2.11	767.65	1131.67	0.21
Reach 1	1541		Bridge									
Reach 1	1479	100-Year	1460.00	5749.71	5752.47	5752.47	5753.12	0.016174	7.05	242.28	908.25	0.92
Reach 1	1429	100-Year	1460.00	5748.64	5751.32	5751.20	5751.70	0.014564	4.37	303.62	888.83	0.78
Reach 1	1151	100-Year	1460.00	5746.60	5748.23	5748.03	5748.39	0.009141	4.03	479.35	650.09	0.65
Reach 1	980	100-Year	1460.00	5744.37	5745.75	5745.75	5746.06	0.022964	5.76	349.02	554.57	1.00
Reach 1	793	100-Year	1460.00	5742.91	5743.72		5743.81	0.005740	2.07	590.41	686.06	0.46
Reach 1	601	100-Year	1460.00	5740.95	5742.07		5742.24	0.012526	3.52	449.26	616.67	0.70
Reach 1	348	100-Year	1460.00	5738.37	5739.82		5739.95	0.006785	3.21	516.11	554.03	0.55
Reach 1	81	100-Year	1460.00	5736.61	5737.76	5737.45	5737.91	0.007995	3.42	477.25	520.83	0.59


PWAY_Seg5_BlackShackCreek Plan: Existing Conditions 2018 1D 11/27/2023
Geom: Existing Conditions 2018 1D
River = Black Shack Cree Reach = Reach 1 RS = 3440
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Bank Sta
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Geom: Existing Conditions 2018 1D
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Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Bank Sta
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Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
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Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
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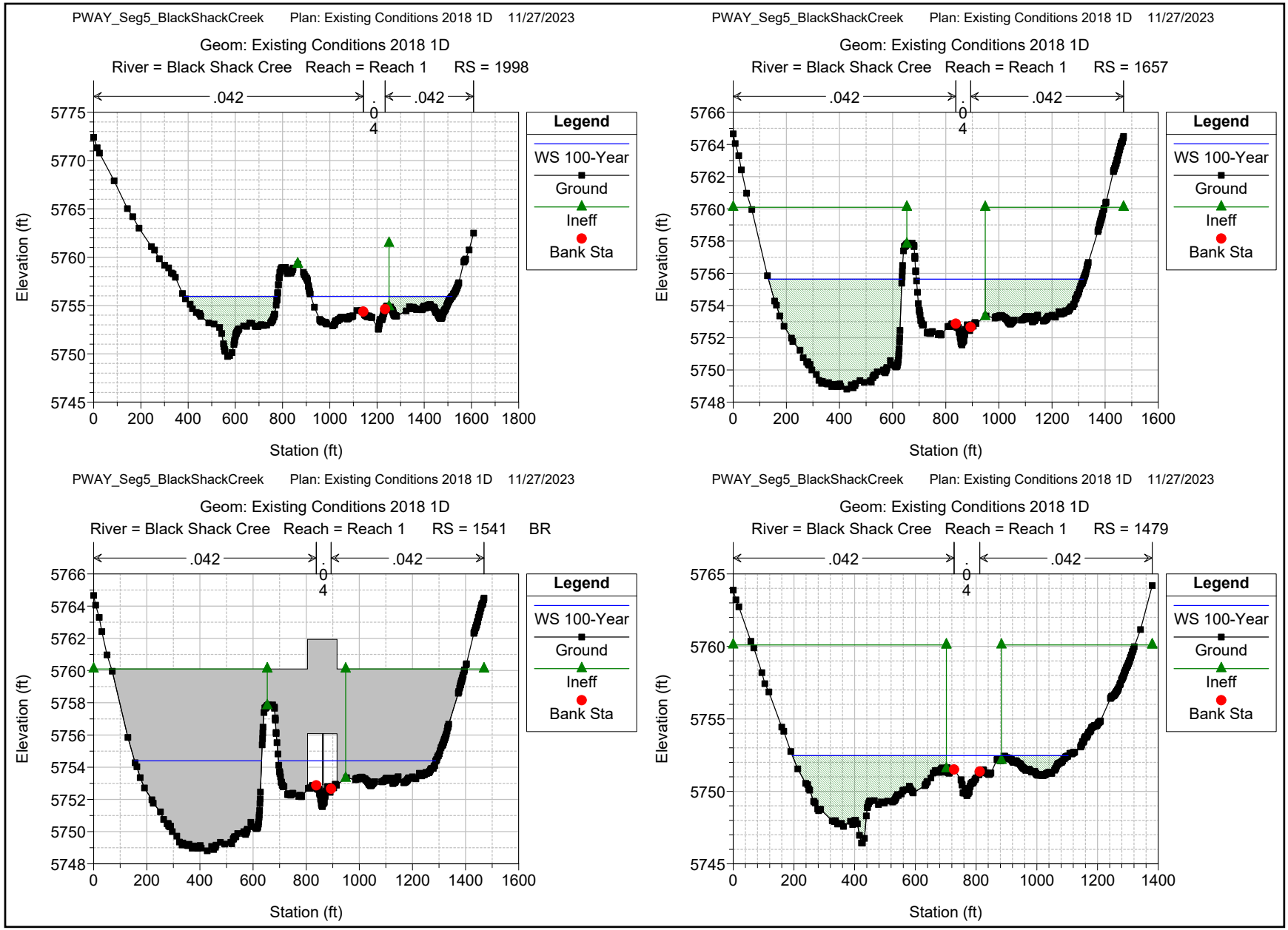
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Elevation (ft)
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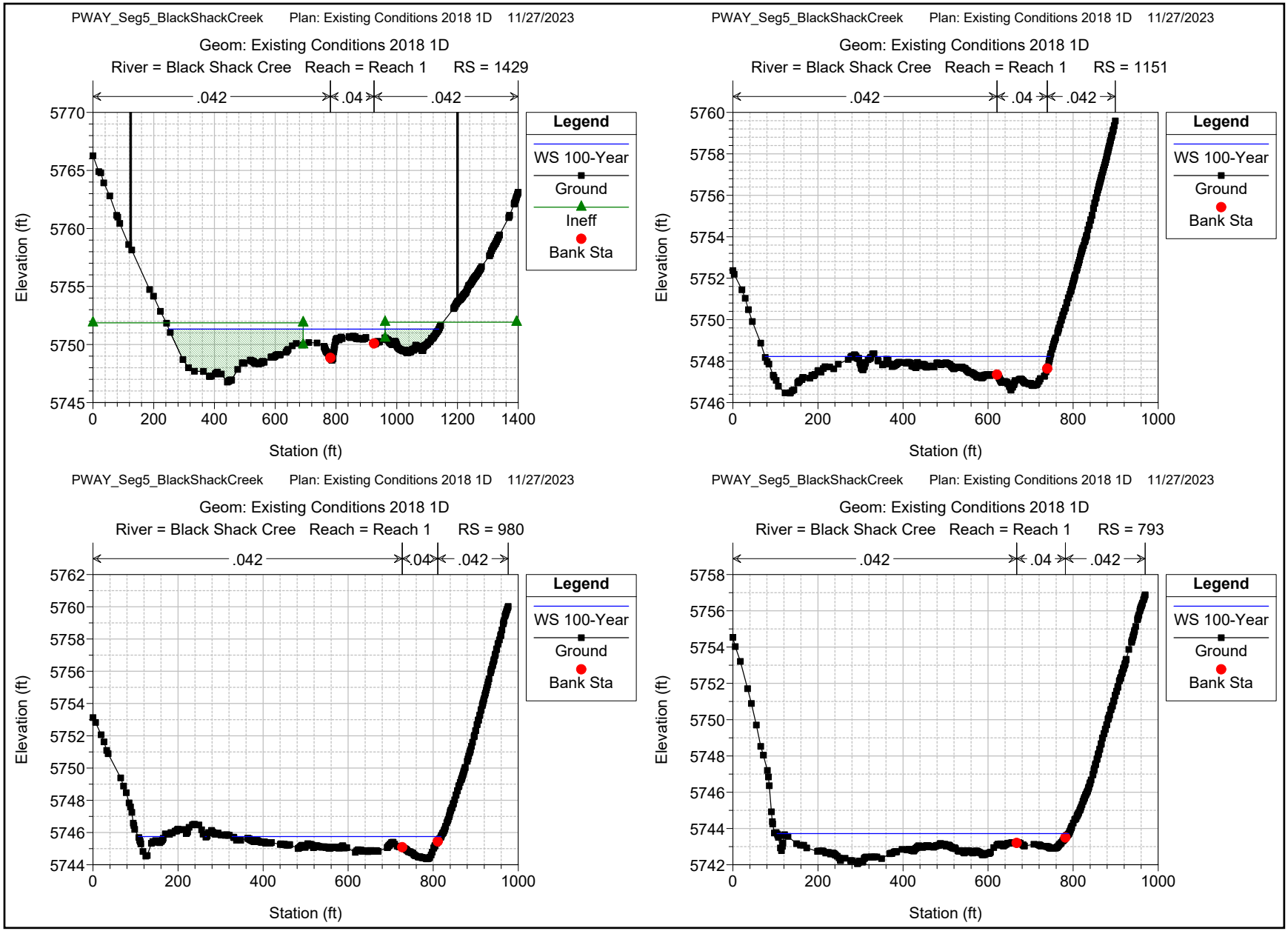
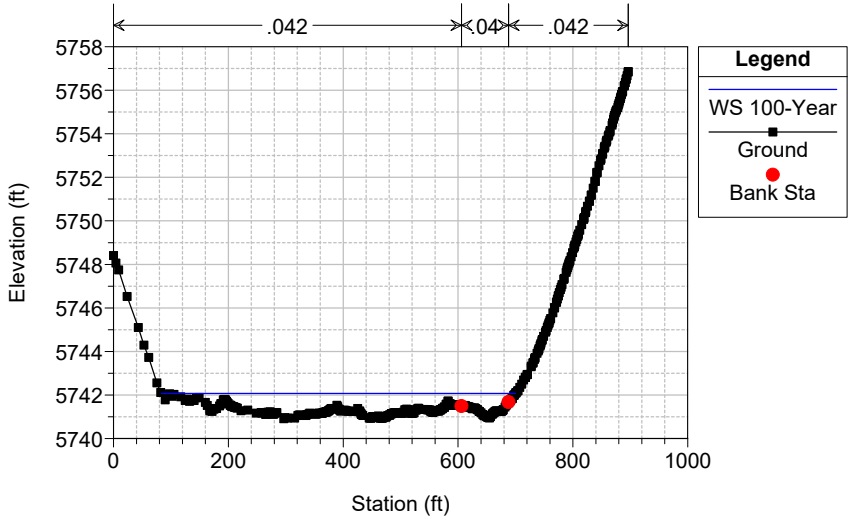
PWAY_Seg5_BlackShackCreek Plan: Existing Conditions 2018 1D 11/27/2023
Geom: Existing Conditions 2018 1D
River = Black Shack Cree Reach = Reach 1 RS = 1657
.042
.042
Legend
WS 100-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_BlackShackCreek Plan: Existing Conditions 2018 1D 11/27/2023
Geom: Existing Conditions 2018 1D
River = Black Shack Cree Reach = Reach 1 RS = 1541 BR
.042
.042
Legend
WS 100-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_BlackShackCreek Plan: Existing Conditions 2018 1D 11/27/2023
Geom: Existing Conditions 2018 1D
River = Black Shack Cree Reach = Reach 1 RS = 1479
.042
.042
Legend
WS 100-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


PWAY_Seg5_BlackShackCreek Plan: Existing Conditions 2018 1D 11/27/2023
Geom: Existing Conditions 2018 1D
River = Black Shack Cree Reach = Reach 1 RS = 1429
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Ineff
Bank Sta
PWAY_Seg5_BlackShackCreek Plan: Existing Conditions 2018 1D 11/27/2023
Geom: Existing Conditions 2018 1D
River = Black Shack Cree Reach = Reach 1 RS = 1151
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Bank Sta
PWAY_Seg5_BlackShackCreek Plan: Existing Conditions 2018 1D 11/27/2023
Geom: Existing Conditions 2018 1D
River = Black Shack Cree Reach = Reach 1 RS = 980
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Bank Sta
PWAY_Seg5_BlackShackCreek Plan: Existing Conditions 2018 1D 11/27/2023
Geom: Existing Conditions 2018 1D
River = Black Shack Cree Reach = Reach 1 RS = 793
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Bank Sta

PWAY_Seg5_BlackShackCreek Plan: Existing Conditions 2018 1D 11/27/2023

Geom: Existing Conditions 2018 1D

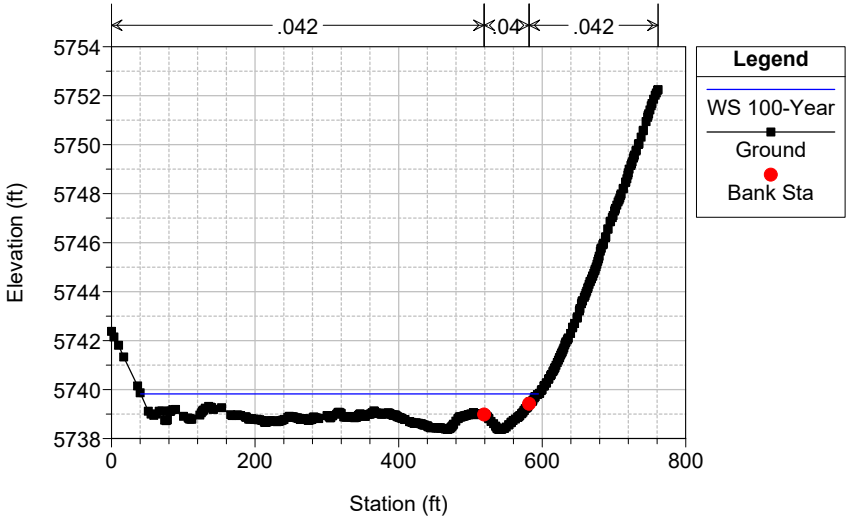
River = Black Shack Cree Reach = Reach 1 RS = 601



PWAY_Seg5_BlackShackCreek Plan: Existing Conditions 2018 1D 11/27/2023

Geom: Existing Conditions 2018 1D

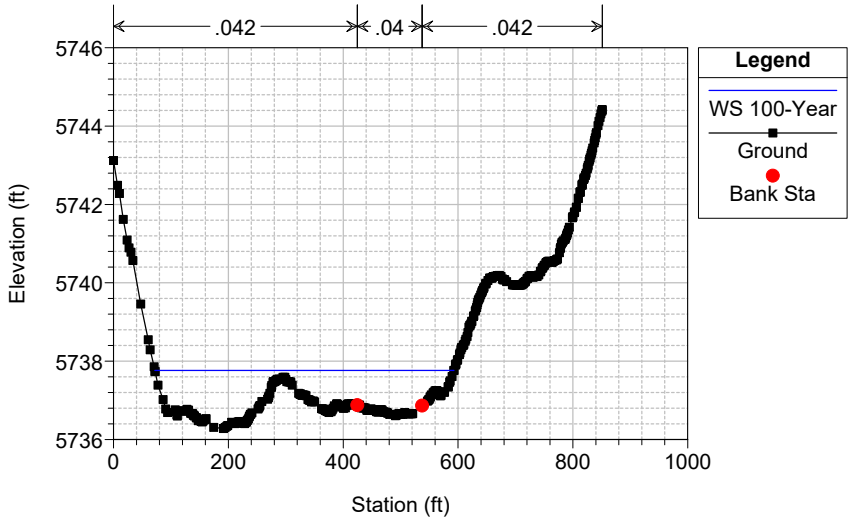
River = Black Shack Cree Reach = Reach 1 RS = 348



PWAY_Seg5_BlackShackCreek Plan: Existing Conditions 2018 1D 11/27/2023

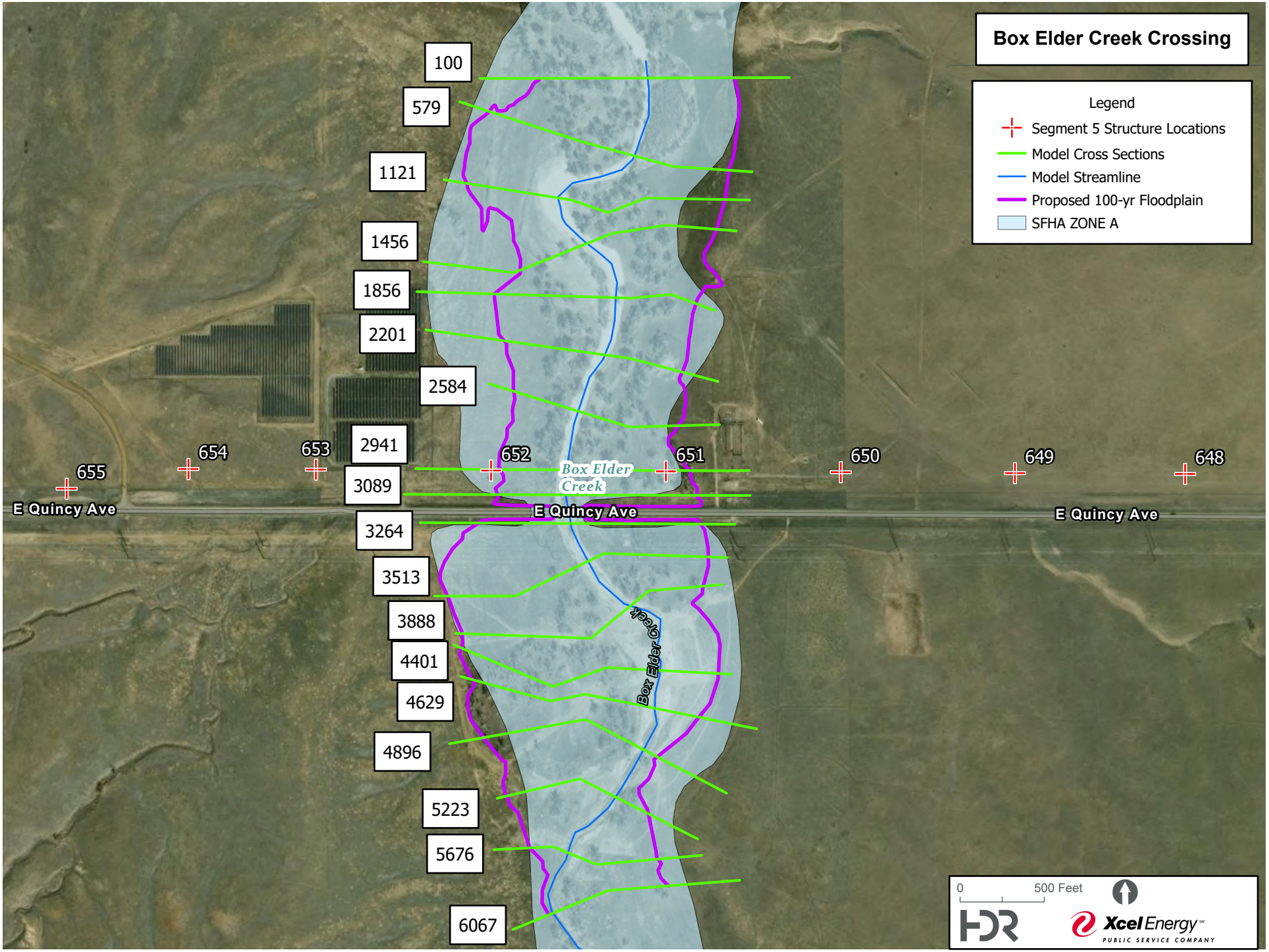
Geom: Existing Conditions 2018 1D

River = Black Shack Cree Reach = Reach 1 RS = 81



SFHA Crossing

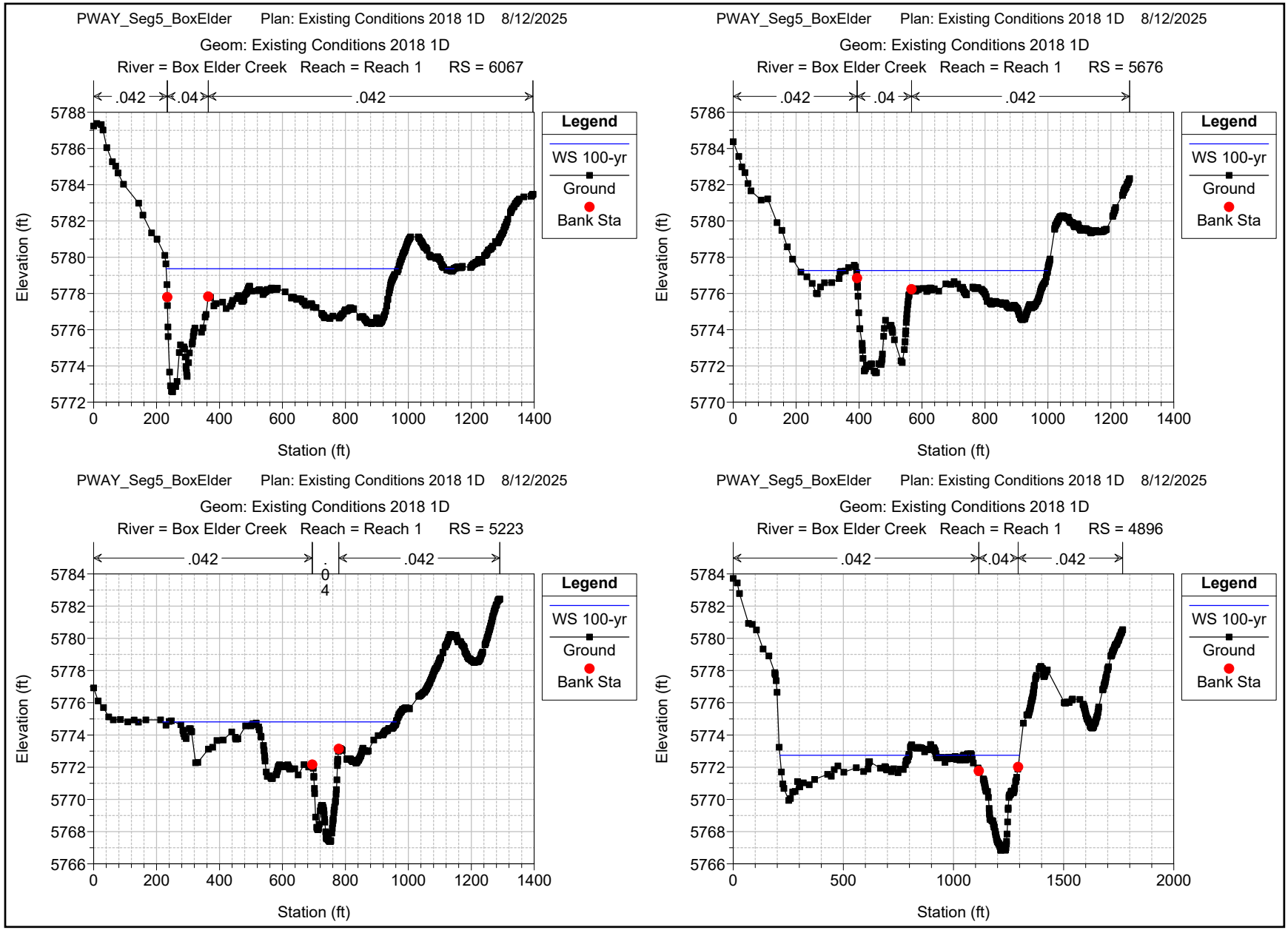
Box Elder Creek

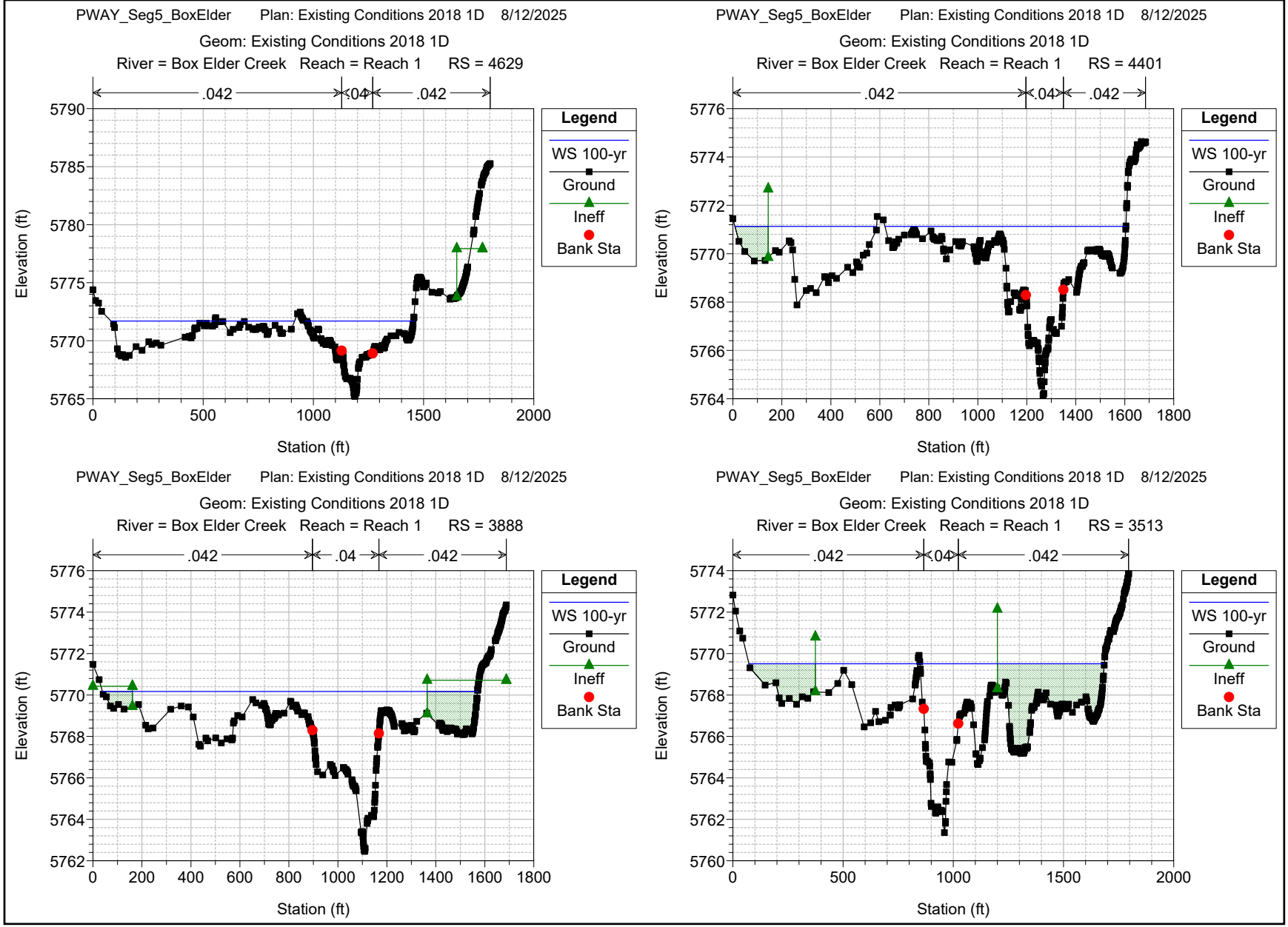


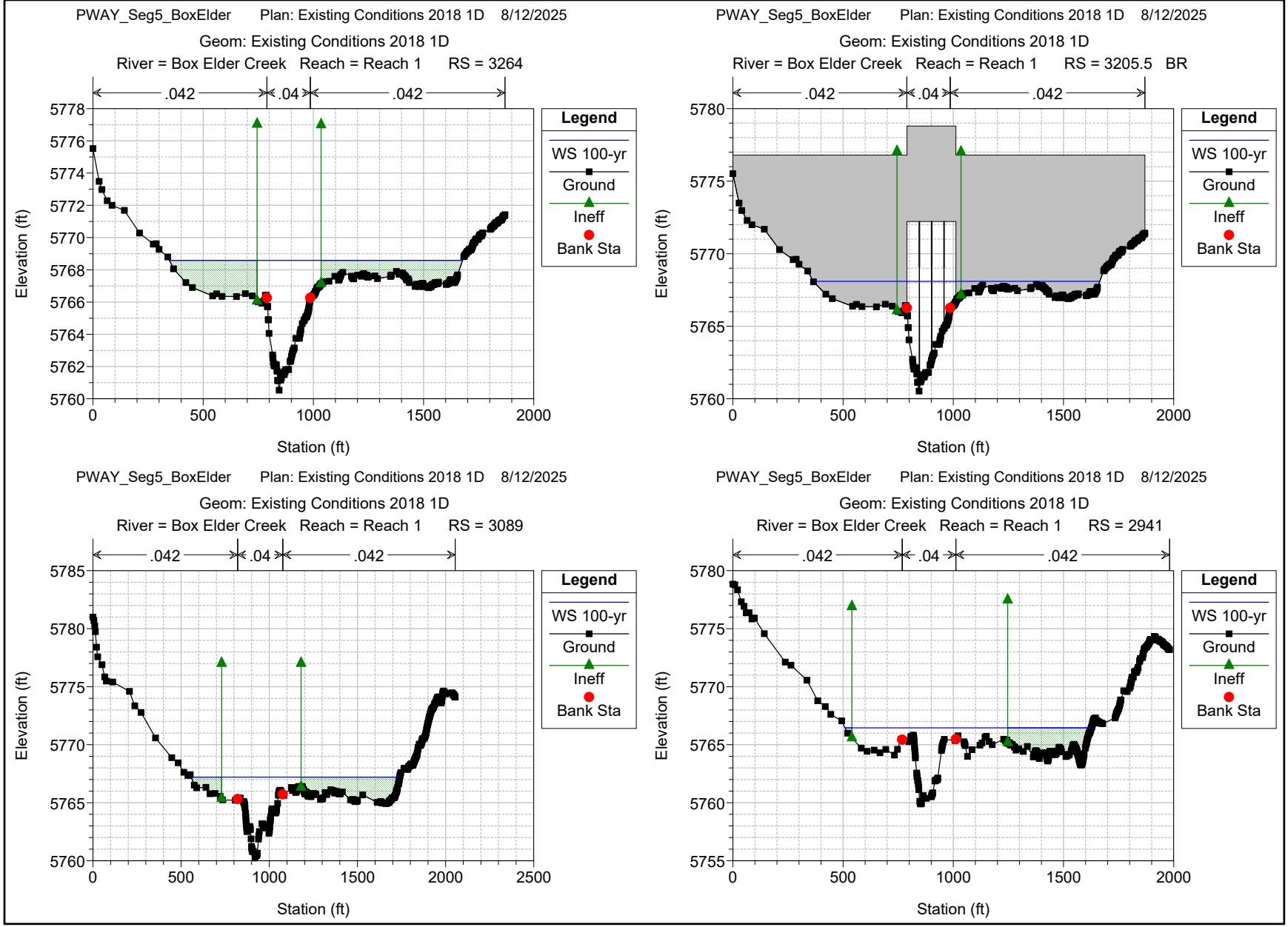
X:\PROJECTS\XCEL\10347285 - XCELPWAY SEGMENT 5\7.2_WORK_IN_PROGRESS\MAP DOCS\ARAPAHOE_COUNTY\DRAFT\ARAPAHOECOUNTY\APRX\XCEL_PWAY_SEGMENT5_ARAPAHOECOUNTY.APRX DATE: 8/12/2025

HEC-RAS River: Box Elder Creek Reach: Reach 1 Profile: 100-yr

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	6067	100-yr	EX 1D	7210.00	5772.57	5779.36		5779.71	0.003618	5.95	1733.62	766.13	0.50
Reach 1	6067	100-yr	PROP 1D	7210.00	5772.57	5779.36		5779.71	0.003618	5.95	1733.62	766.13	0.50
Reach 1	5676	100-yr	EX 1D	7210.00	5771.62	5777.26		5777.89	0.006020	7.26	1369.42	754.00	0.64
Reach 1	5676	100-yr	PROP 1D	7210.00	5771.62	5777.26		5777.89	0.006020	7.26	1369.42	754.00	0.64
Reach 1	5223	100-yr	EX 1D	7210.00	5767.39	5774.81	5774.34	5775.44	0.004903	8.12	1468.62	728.16	0.60
Reach 1	5223	100-yr	PROP 1D	7210.00	5767.39	5774.81	5774.34	5775.44	0.004903	8.12	1468.62	728.16	0.60
Reach 1	4896	100-yr	EX 1D	7210.00	5766.84	5772.74	5772.73	5773.39	0.008252	7.64	1348.85	948.49	0.73
Reach 1	4896	100-yr	PROP 1D	7210.00	5766.84	5772.74	5772.73	5773.39	0.008252	7.64	1348.85	948.49	0.73
Reach 1	4629	100-yr	EX 1D	7210.00	5765.21	5771.70	5771.00	5771.96	0.003283	5.44	2122.98	1303.86	0.47
Reach 1	4629	100-yr	PROP 1D	7210.00	5765.21	5771.70	5771.00	5771.96	0.003283	5.44	2122.98	1303.86	0.47
Reach 1	4401	100-yr	EX 1D	7210.00	5764.15	5771.13	5770.12	5771.35	0.002142	4.86	2476.84	1562.25	0.39
Reach 1	4401	100-yr	PROP 1D	7210.00	5764.15	5771.13	5770.12	5771.35	0.002142	4.86	2476.84	1562.25	0.39
Reach 1	3888	100-yr	EX 1D	7210.00	5762.45	5770.17	5768.72	5770.37	0.001679	4.13	2459.07	1531.73	0.34
Reach 1	3888	100-yr	PROP 1D	7210.00	5762.45	5770.17	5768.72	5770.37	0.001679	4.13	2459.07	1531.73	0.34
Reach 1	3513	100-yr	EX 1D	7210.00	5761.36	5769.51	5768.06	5769.75	0.001619	4.73	2199.43	1601.33	0.35
Reach 1	3513	100-yr	PROP 1D	7210.00	5761.36	5769.51	5768.06	5769.75	0.001619	4.73	2199.43	1601.33	0.35
Reach 1	3264	100-yr	EX 1D	7210.00	5760.53	5768.59	5766.78	5769.13	0.002844	6.11	1276.30	1329.77	0.46
Reach 1	3264	100-yr	PROP 1D	7210.00	5760.53	5768.59	5766.78	5769.13	0.002844	6.11	1276.30	1329.77	0.46
Reach 1	3205.5			Bridge									
Reach 1	3089	100-yr	EX 1D	7210.00	5760.24	5767.21	5766.48	5767.79	0.005179	6.43	1256.72	1182.43	0.59
Reach 1	3089	100-yr	PROP 1D	7210.00	5760.24	5767.21	5766.48	5767.79	0.005179	6.43	1256.72	1182.43	0.59
Reach 1	2941	100-yr	EX 1D	7210.00	5759.90	5766.46	5766.02	5766.89	0.005966	6.03	1472.02	1117.48	0.61
Reach 1	2941	100-yr	PROP 1D	7210.00	5759.90	5766.46	5766.02	5766.89	0.005966	6.03	1472.02	1110.48	0.61
Reach 1	2584	100-yr	EX 1D	7210.00	5759.00	5764.27	5763.92	5764.67	0.006455	6.36	1579.66	988.15	0.63
Reach 1	2584	100-yr	PROP 1D	7210.00	5759.00	5764.27	5763.92	5764.67	0.006455	6.36	1579.66	988.15	0.63
Reach 1	2201	100-yr	EX 1D	7210.00	5757.94	5762.51		5762.73	0.003886	4.02	1982.39	1010.41	0.47
Reach 1	2201	100-yr	PROP 1D	7210.00	5757.94	5762.51		5762.73	0.003886	4.02	1982.39	1010.41	0.47
Reach 1	1851	100-yr	EX 1D	7210.00	5756.60	5761.13		5761.39	0.003811	5.10	2012.58	1150.23	0.49
Reach 1	1851	100-yr	PROP 1D	7210.00	5756.60	5761.13		5761.39	0.003811	5.10	2012.58	1150.23	0.49
Reach 1	1456	100-yr	EX 1D	7210.00	5754.99	5758.98		5759.29	0.007861	5.51	1716.46	1201.48	0.66
Reach 1	1456	100-yr	PROP 1D	7210.00	5754.99	5758.98		5759.29	0.007861	5.51	1716.46	1201.48	0.66
Reach 1	1121	100-yr	EX 1D	7210.00	5753.67	5757.86	5756.63	5758.02	0.002105	3.57	2496.79	1548.25	0.36
Reach 1	1121	100-yr	PROP 1D	7210.00	5753.67	5757.86	5756.63	5758.02	0.002105	3.57	2496.79	1548.25	0.36
Reach 1	579	100-yr	EX 1D	7210.00	5751.19	5755.46	5755.36	5755.97	0.008259	6.85	1540.49	1303.26	0.71
Reach 1	579	100-yr	PROP 1D	7210.00	5751.19	5755.46	5755.36	5755.97	0.008259	6.85	1540.49	1303.26	0.71
Reach 1	100	100-yr	EX 1D	7210.00	5749.25	5752.99	5752.23	5753.23	0.004005	4.51	1986.00	1094.48	0.49
Reach 1	100	100-yr	PROP 1D	7210.00	5749.25	5752.99	5752.23	5753.23	0.004005	4.51	1986.00	1094.48	0.49


PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 6067
.042
.04
.042
Legend
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 5676
.042
.04
.042
Legend
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 5223
.042
.04
.042
Legend
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 4896
.042
.04
.042
Legend
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)


PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 4629
.042
.04
.042
Legend
WS 100-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 4401
.042
.04
.042
Legend
WS 100-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 3888
.042
.04
.042
Legend
WS 100-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 3513
.042
.04
.042
Legend
WS 100-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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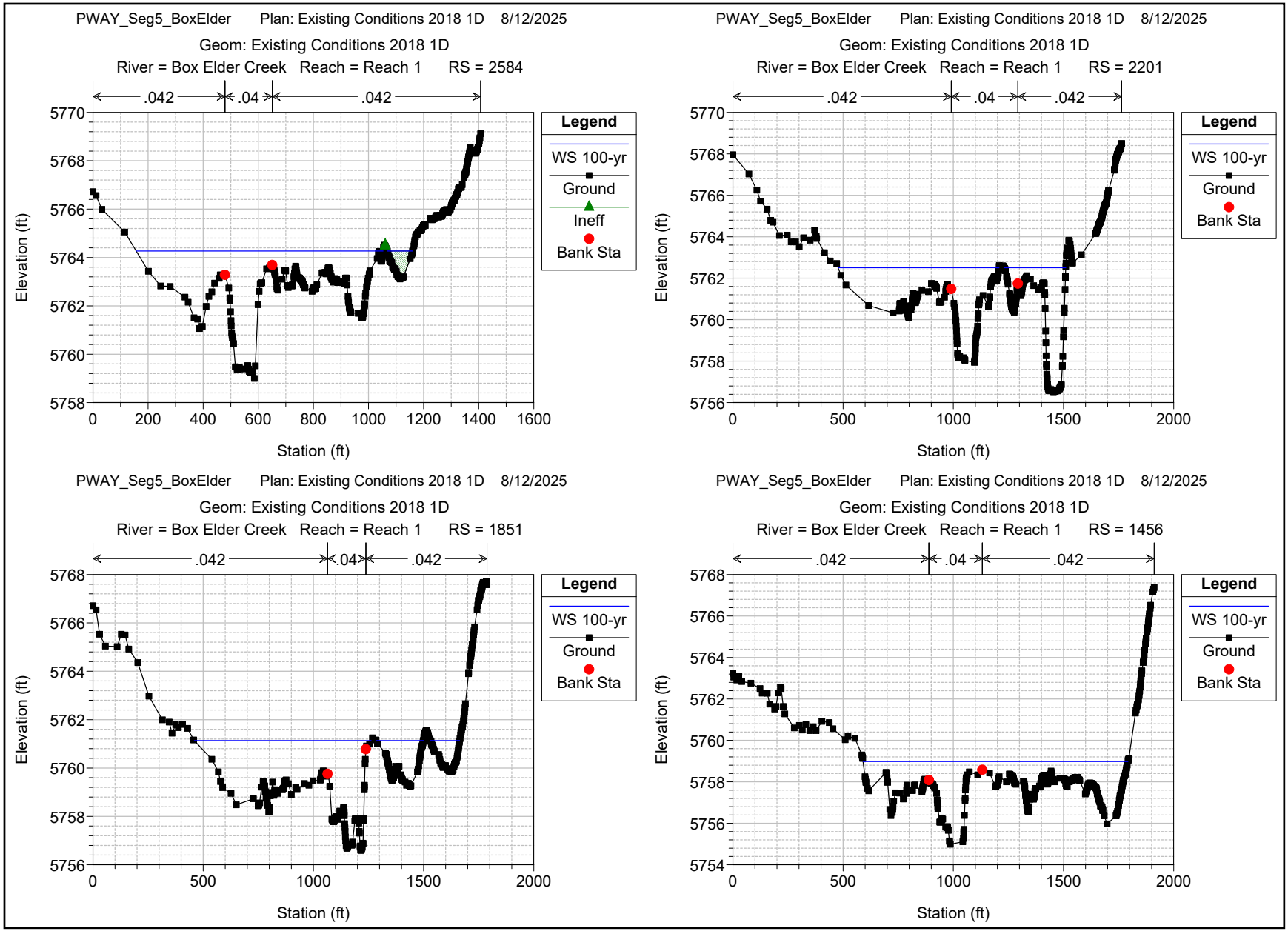
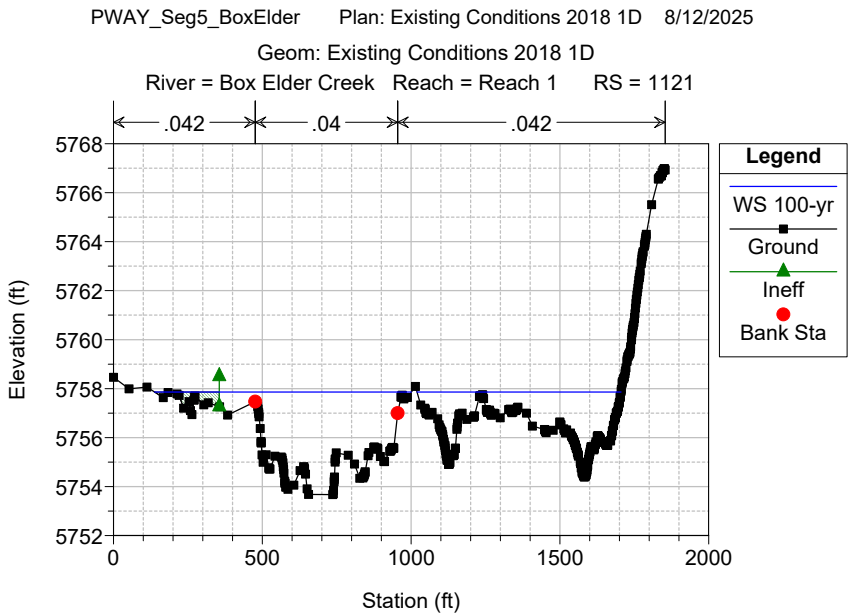
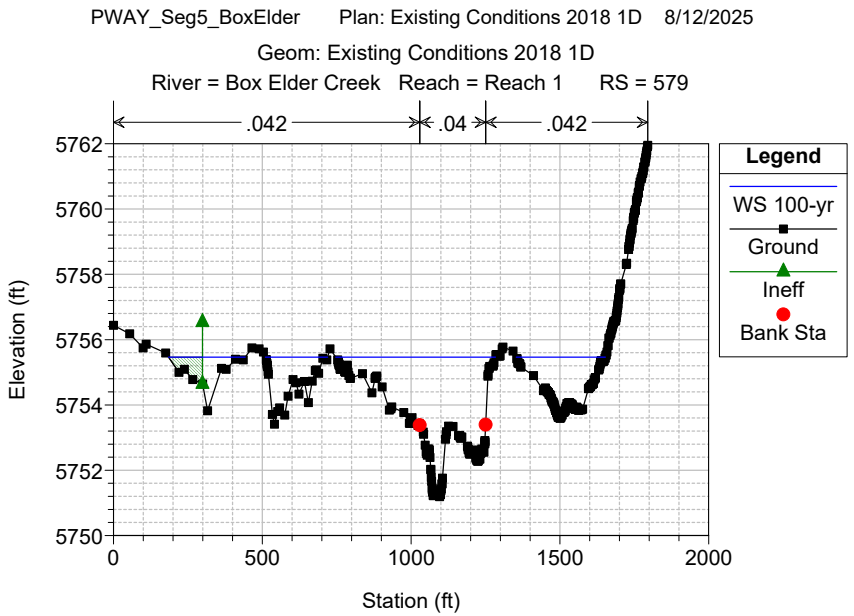
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 3264
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr
Ground
Ineff
Bank Sta
PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 3205.5 BR
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr
Ground
Ineff
Bank Sta
PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 3089
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr
Ground
Ineff
Bank Sta
PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 2941
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr
Ground
Ineff
Bank Sta


PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 2584
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr
Ground
Ineff
Bank Sta
PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 2201
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr
Ground
Bank Sta
PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 1851
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr
Ground
Bank Sta
PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 1456
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr
Ground
Bank Sta


PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 1121
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr
Ground
Ineff
Bank Sta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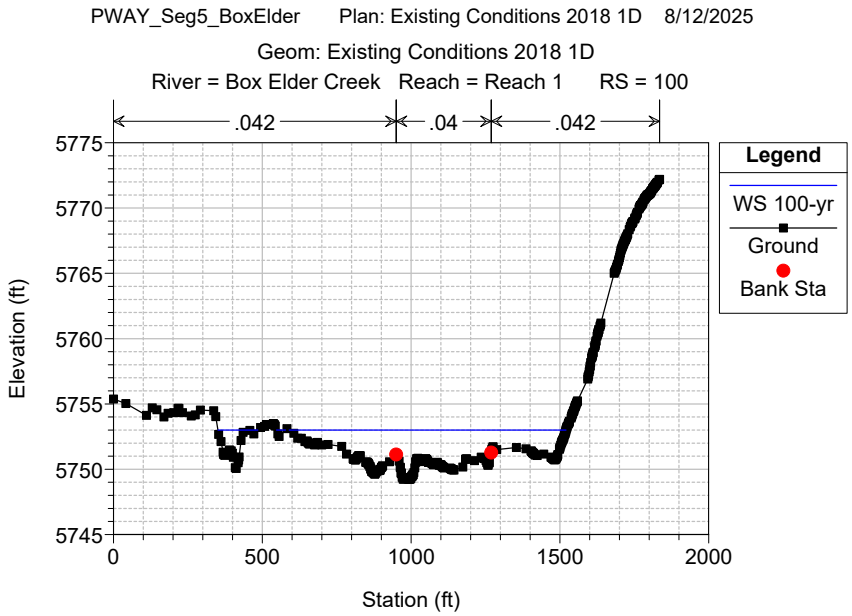
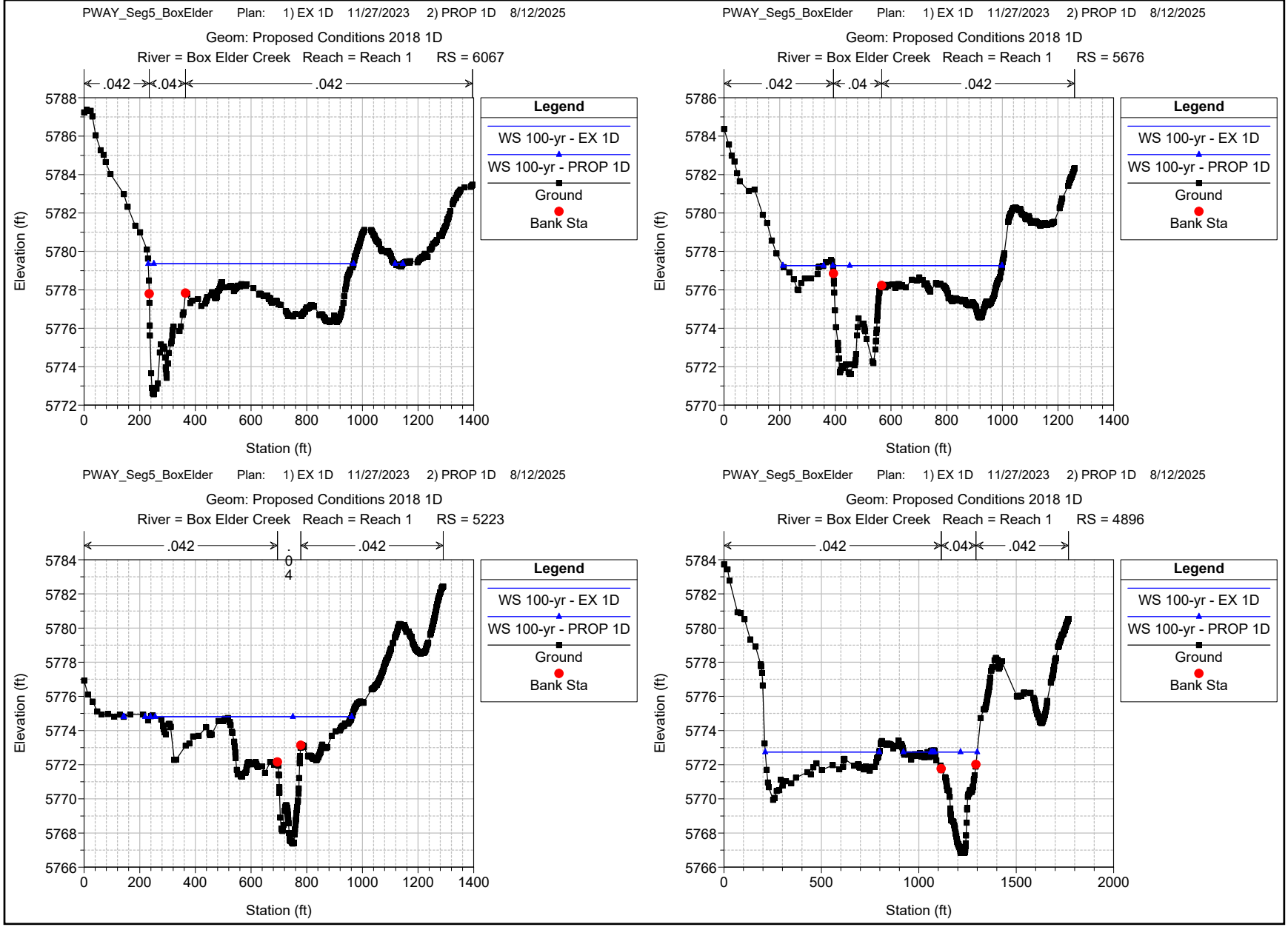
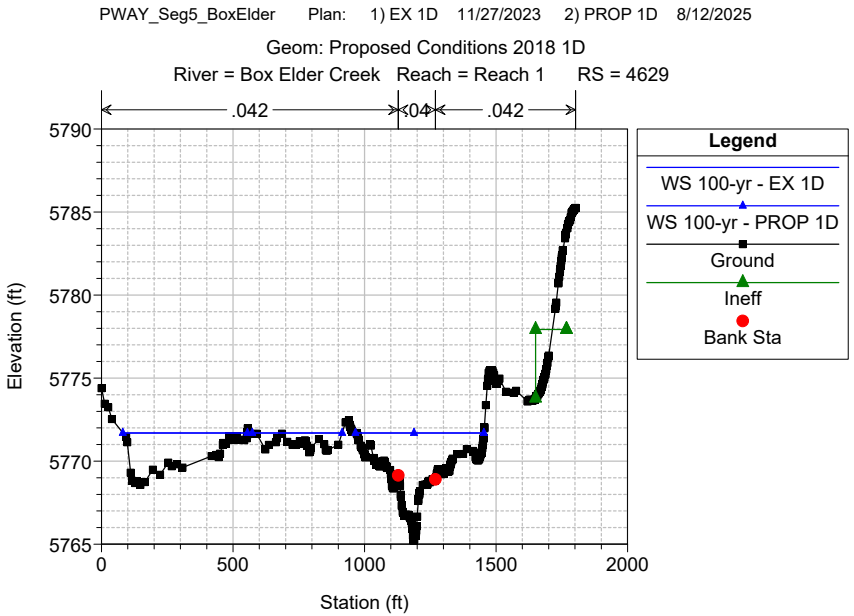
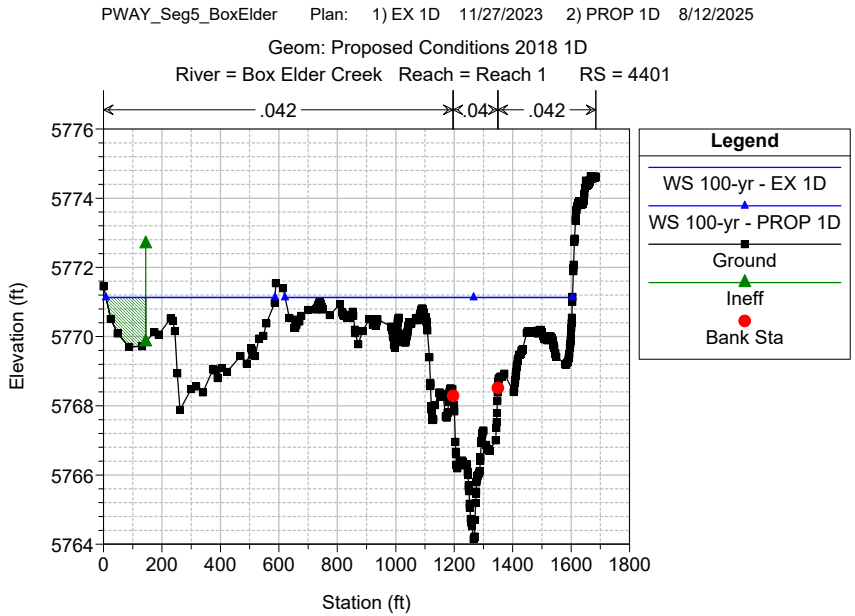
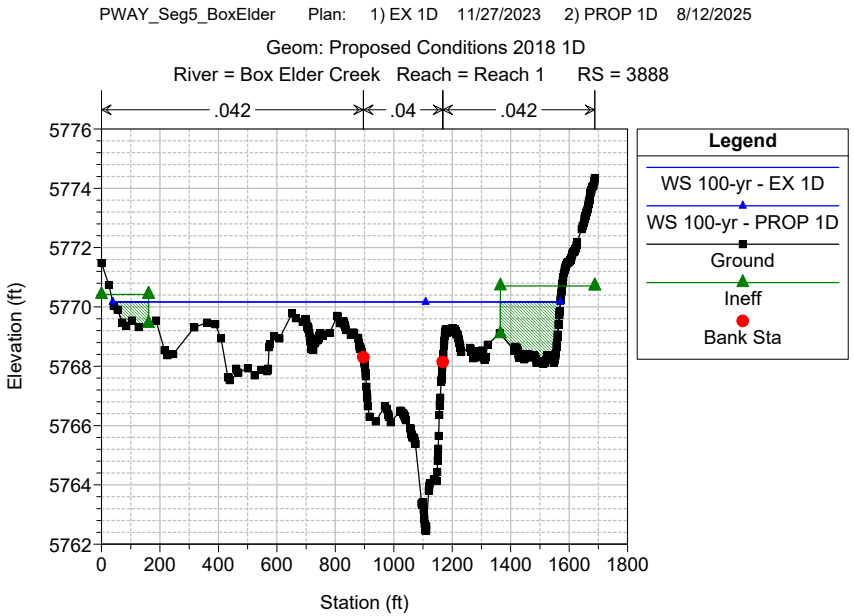
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 579
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr
Ground
Ineff
Bank Sta


PWAY_Seg5_BoxElder Plan: Existing Conditions 2018 1D 8/12/2025
Geom: Existing Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 100
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr
Ground
Bank Sta


PWAY_Seg5_BoxElder Plan: 1) EX 1D 11/27/2023 2) PROP 1D 8/12/2025
Geom: Proposed Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 6067
.042
.04
.042
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_BoxElder Plan: 1) EX 1D 11/27/2023 2) PROP 1D 8/12/2025
Geom: Proposed Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 5676
.042
.04
.042
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_BoxElder Plan: 1) EX 1D 11/27/2023 2) PROP 1D 8/12/2025
Geom: Proposed Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 5223
.042
.04
.042
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_BoxElder Plan: 1) EX 1D 11/27/2023 2) PROP 1D 8/12/2025
Geom: Proposed Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 4896
.042
.04
.042
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Bank Sta
Elevation (ft)
Station (ft)


PWAY_Seg5_BoxElder Plan: 1) EX 1D 11/27/2023 2) PROP 1D 8/12/2025
Geom: Proposed Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 4629
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Ineff
Bank Sta


PWAY_Seg5_BoxElder Plan: 1) EX 1D 11/27/2023 2) PROP 1D 8/12/2025
Geom: Proposed Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 4401
.042
.04
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Ineff
Bank Sta


PWAY_Seg5_BoxElder Plan: 1) EX 1D 11/27/2023 2) PROP 1D 8/12/2025
Geom: Proposed Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 3888
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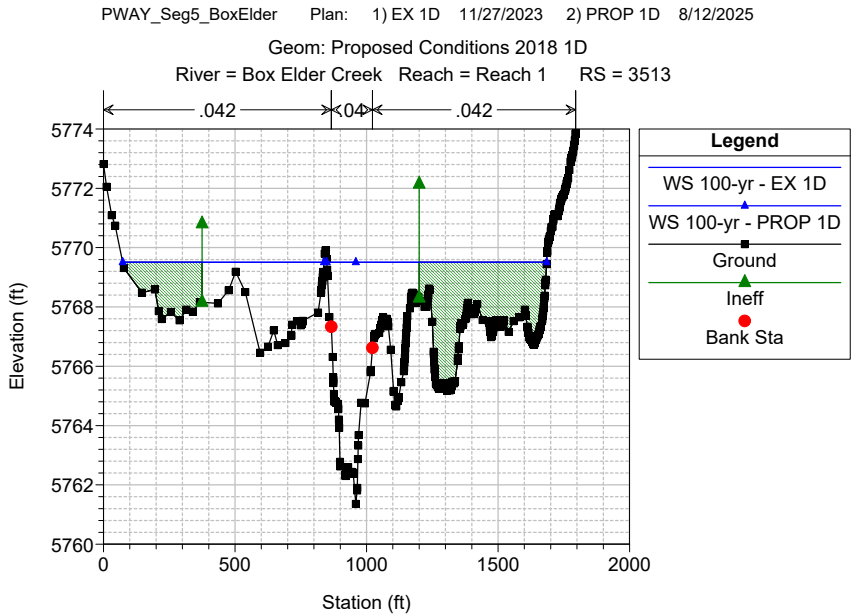
Elevation (ft)
Station (ft)
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Ineff
Bank Sta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Geom: Proposed Conditions 2018 1D
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Elevation (ft)
Station (ft)
Legend
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WS 100-yr - PROP 1D
Ground
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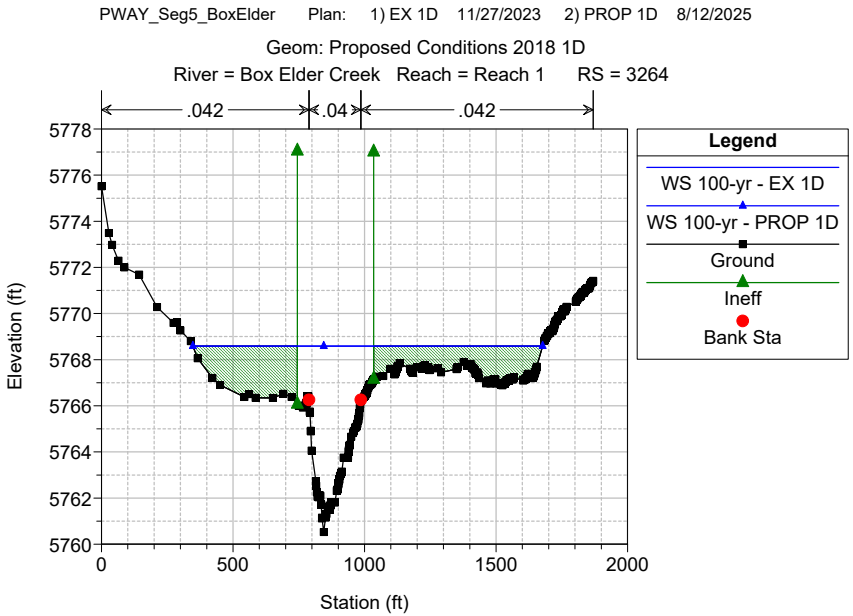
Bank Sta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Station (ft)
Legend
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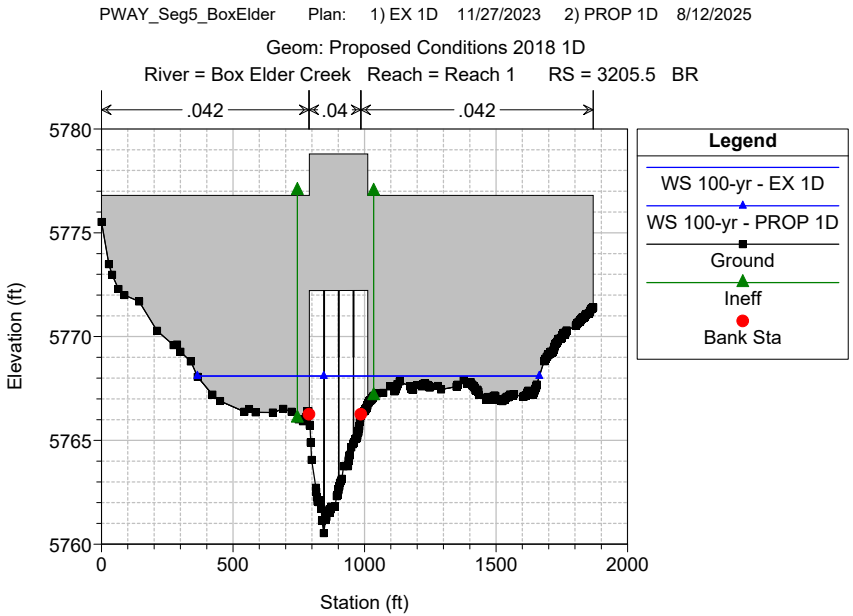
WS 100-yr - PROP 1D
Ground
Ineff
Bank Sta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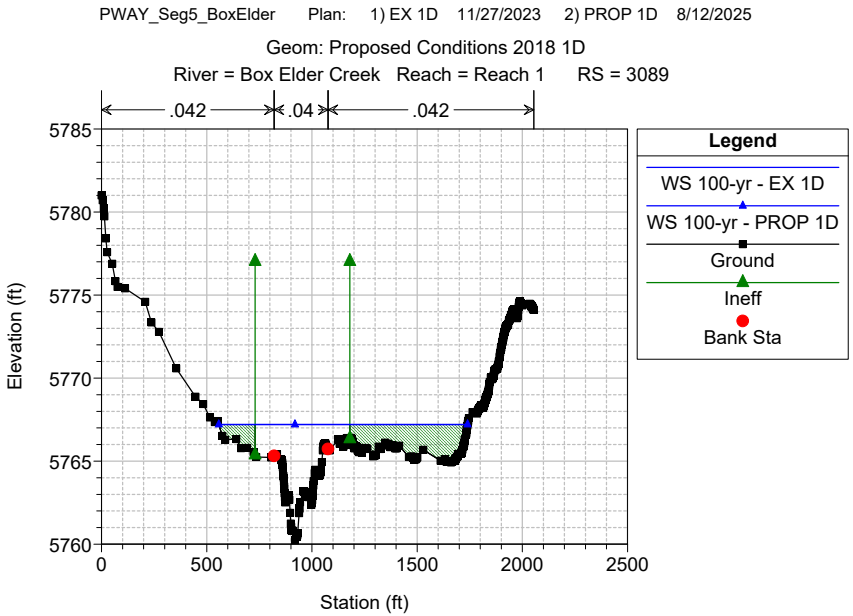
Station (ft)
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Ineff
Bank Sta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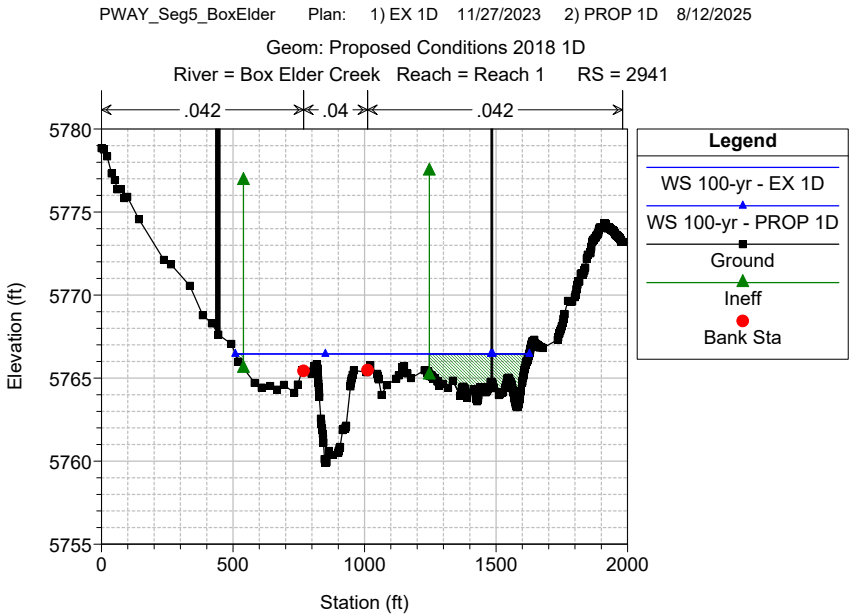
Elevation (ft)
Station (ft)
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Ineff
Bank Sta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Station (ft)
Legend
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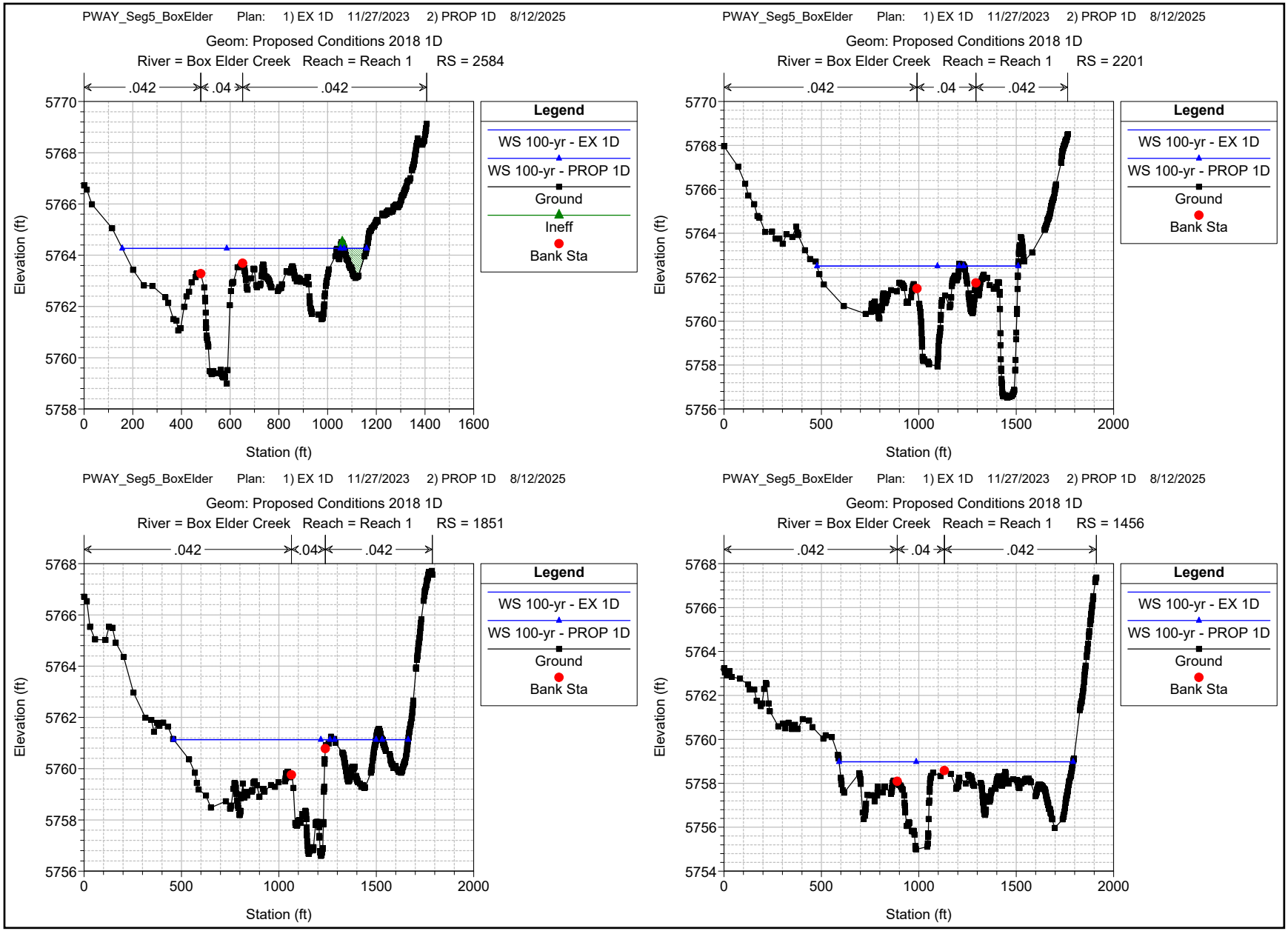
WS 100-yr - PROP 1D
Ground
Ineff
Bank Sta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Geom: Proposed Conditions 2018 1D
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Elevation (ft)
Station (ft)
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Ineff
Bank Sta
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Geom: Proposed Conditions 2018 1D
River = Box Elder Creek Reach = Reach 1 RS = 2201
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.04
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Elevation (ft)
Station (ft)
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Bank Sta
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Geom: Proposed Conditions 2018 1D
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Elevation (ft)
Station (ft)
Legend
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WS 100-yr - PROP 1D
Ground
Bank Sta
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Geom: Proposed Conditions 2018 1D
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Station (ft)
Legend
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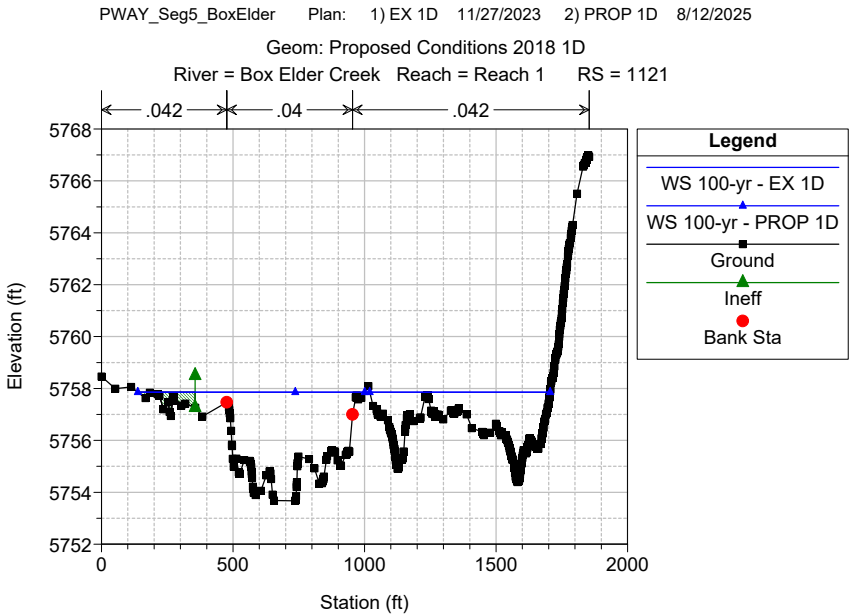
WS 100-yr - PROP 1D
Ground
Bank Sta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Geom: Proposed Conditions 2018 1D
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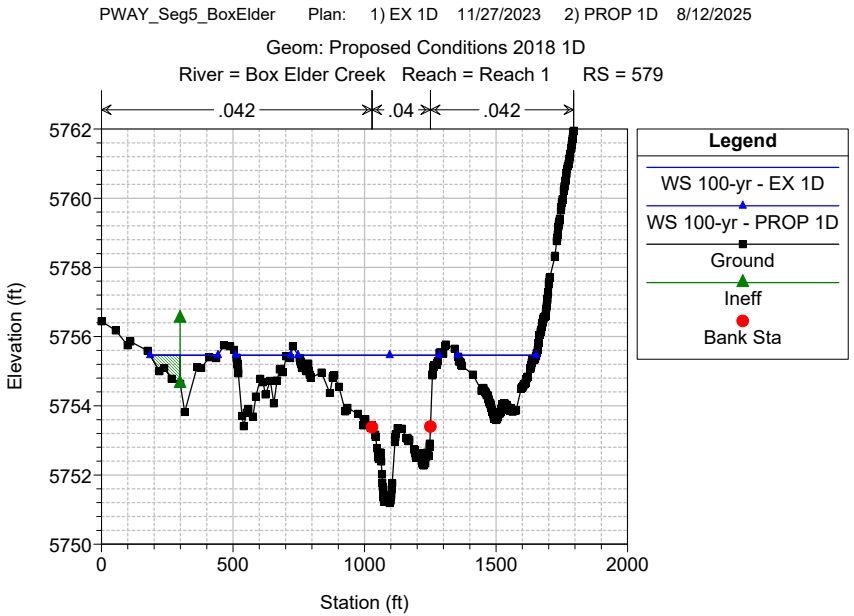
Elevation (ft)
Station (ft)
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Ineff
Bank Sta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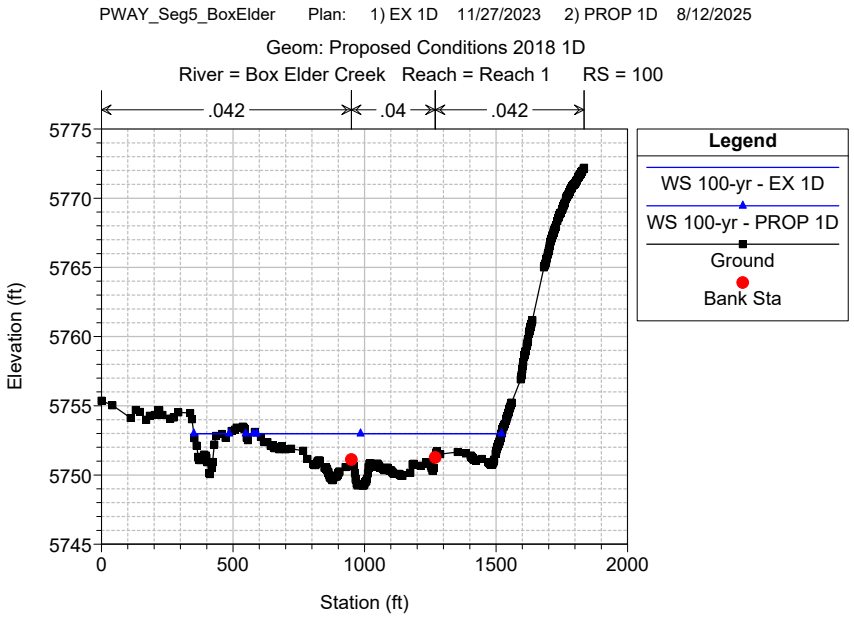
Station (ft)
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Ineff
Bank Sta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Geom: Proposed Conditions 2018 1D
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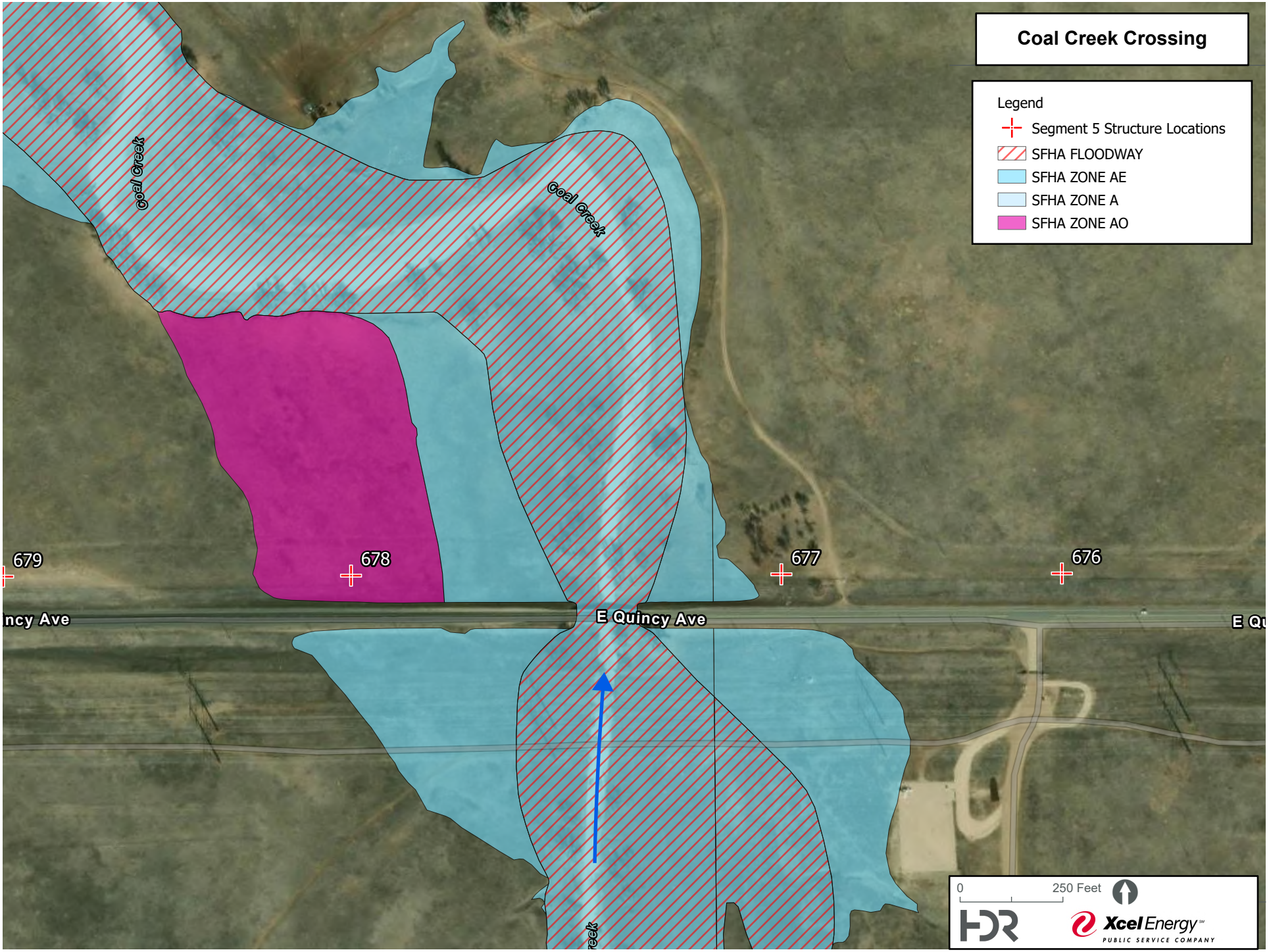
.042
Elevation (ft)
Station (ft)
Legend
WS 100-yr - EX 1D
WS 100-yr - PROP 1D
Ground
Bank Sta

SFHA Crossing

Coal Creek

FIS Reference Material



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c) Hydrology

For Dutch Creek, Coon Creek, Three Lakes Tributary and Coal Creek study, Peak discharges for the 0.2-, 1-, 2, and 10-percent-annual-chance of occurrence events were analyzed using the Colorado Urban Hydrograph Procedure (CUHP 2005), version 1.3.3, to generate hydrographs for each subwatershed. Hydrographs for the subwatersheds were routed using the Environmental Protection Agency Stormwater Management Model (EPA SWMM), version 5.0, to determine peak discharge rates at selected design points. The EPA SWMM results were then compared to watersheds of similar size and imperviousness.

d) Hydraulic

For Dutch Creek, Coon Creek and Three Lakes Tributary study, the U.S. Army Corps of Engineer's step backwater program HEC-RAS, Version 3.1.3, was used for the floodplain analysis of the drainage ways. Cross sections used by the HEC-RAS model were developed from the digital elevation model (DEM) developed from the breakline survey file provided by Urban Drainage under separate survey contract. Bridges and culverts were individually surveyed or measured in the field.

For Coal Creek Study, the U.S. Army Corps of Engineer's step backwater program HEC-RAS, Version 4.1.0, was used for the floodplain analysis of the drainage ways. Cross sections used by the HEC-RAS model were developed electronically by cutting the triangulated irregular network (TIN) developed from the USGS topographic 2-foot contour mapping provided by UDFCD. Bridges and culverts were individually surveyed or measured in the field. The average spacing of cross sections is 372 feet, with the maximum spacing at 702 feet.

A steady flow analysis was utilized to determine the flood profiles for the 0.2-, 1-, 2, and 10-percent-annual-chance storm events. Flow change locations were established at critical design points where there are significant changes in hydrology as determined by the EPA SWMM model. Between flow change locations, steady flow is maintained for defined channel segments along the reach.

e) Manning

For Dutch Creek, Coon Creek and Three Lakes Tributary study, estimates of channel and overbank roughness were made from aerial photographs and field observations. Manning's 'n' values ranged from 0.03 to 0.045 in the channel and from 0.03 to 0.08 in the overbank areas. Blocked obstructions and ineffective flow were utilized to account for large structures and flow conveyance paths.

For Coal Creek Study, estimates of channel and overbank roughness for existing conditions were made from aerial photographs and field observation, and through experience for future fully developed conditions. Manning's n values in the hydraulic model ranged from 0.035 to 0.075 in the channel section, and from 0.02 to 0.08 in the overbank areas.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
AC	34,766	687	3,098	4.8	5,658.3	5,658.3	5,658.7	0.4
AD	36,166	405	1,789	8.1	5,663.0	5,663.0	5,663.3	0.3
AE	37,251	363	2,047	7.0	5,670.4	5,670.4	5,670.4	0.0
AF	37,709	293	1,555	9.3	5,671.7	5,671.7	5,672.0	0.3
AG	38,865	375	1,977	7.3	5,676.3	5,676.3	5,676.6	0.3
AH	40,291	336	2,095	6.9	5,689.1	5,689.1	5,689.1	0.0
AI	41,665	440	2,065	7.0	5,693.9	5,693.9	5,694.4	0.5
AJ	42,756	535	2,371	6.1	5,700.4	5,700.4	5,700.4	0.0
AK	44,195	581	2,452	5.9	5,708.4	5,708.4	5,708.4	0.0
AL	45,657	621	2,432	5.2	5,713.1	5,713.1	5,713.1	0.0
AM	47,917	500	1,673	7.6	5,725.7	5,725.7	5,725.8	0.1
AN	48,879	430	1,727	7.3	5,729.6	5,729.6	5,729.8	0.2
AO	49,841	449	2,141	5.9	5,735.7	5,735.7	5,736.0	0.3
AP	50,671	634	2,376	5.3	5,740.5	5,740.5	5,740.5	0.0
AQ	51,582	520	1,969	6.4	5,742.4	5,742.4	5,742.6	0.2
AR	53,194	461	2,249	5.6	5,752.1	5,752.1	5,752.2	0.1
AS	53,975	476	1,775	7.1	5,754.8	5,754.8	5,755.2	0.4
AT	54,632	418	3,781	3.3	5,763.6	5,763.6	5,763.6	0.0
AU	55,802	461	1,657	7.6	5,764.8	5,764.8	5,764.8	0.0
AV	57,691	581	1,857	6.7	5,774.1	5,774.1	5,774.1	0.0
AW	58,630	295	2,113	5.9	5,780.5	5,780.5	5,780.9	0.4

[1] FEET UPSTREAM CONFLUENCE WITH SAND CREEK

TABLE 5

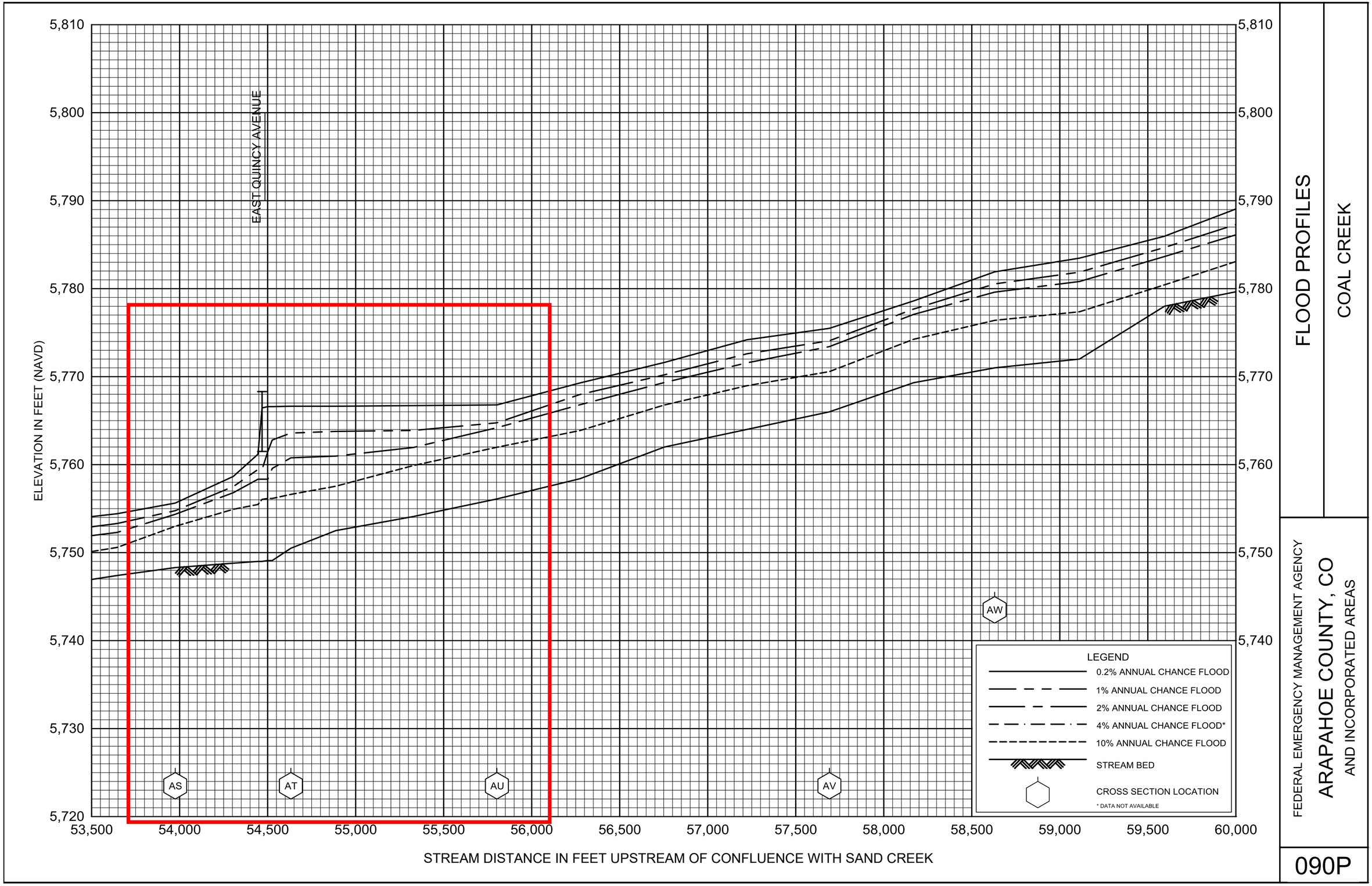
FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

COAL CREEK



FLOOD PROFILES

COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ARAPAHOE COUNTY, CO

AND INCORPORATED AREAS

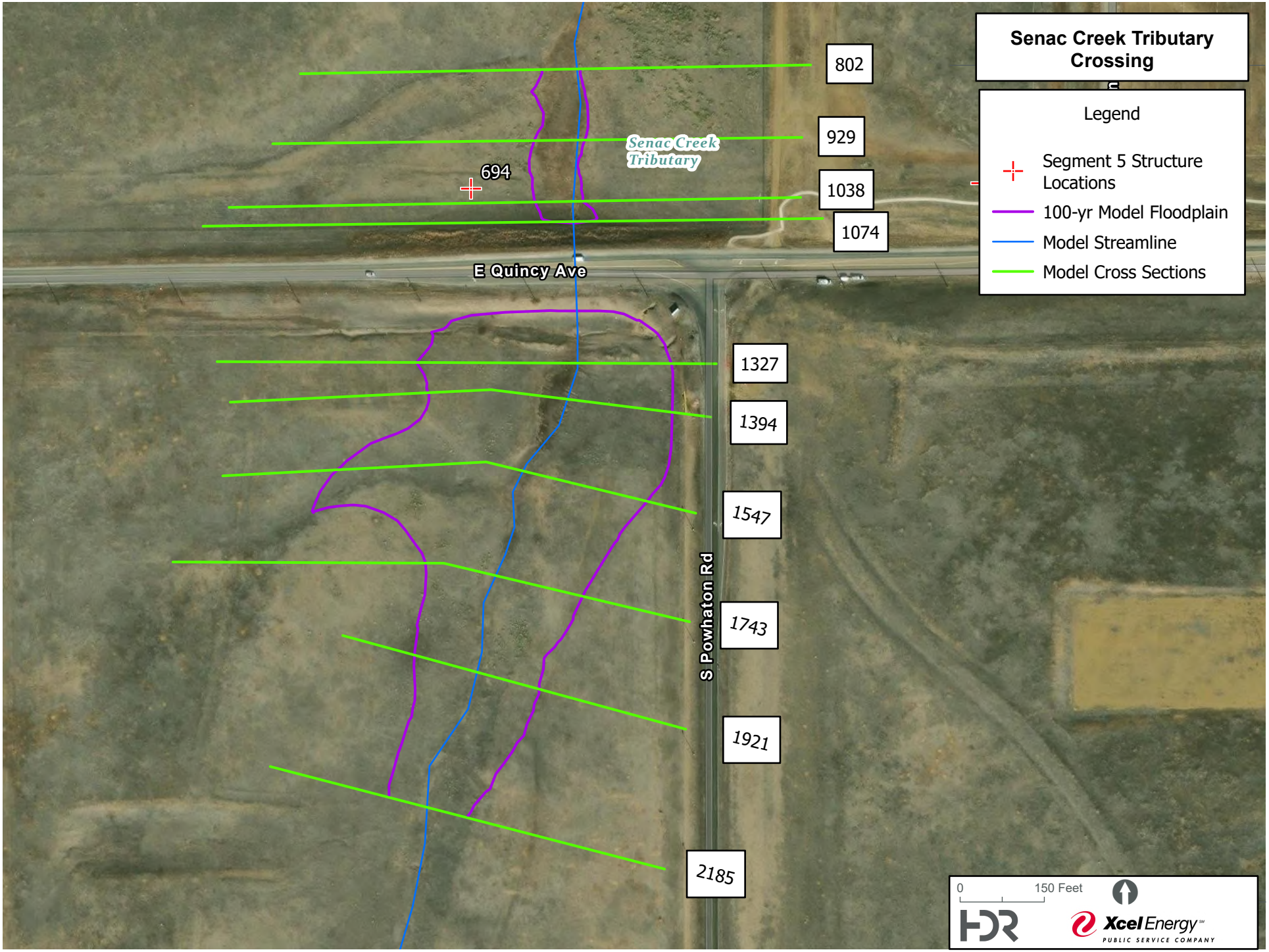
090P

Flooding Source/Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Cherry Creek Below Cherry Creek State Park					
Approximately 645 feet downstream of South Monaco Parkway	--[1]	2,892	4,725	6,000	--[1]
At Colorado Boulevard	--[1]	2,892	5,661	7,320	--[1]
Cherry Creek					
At Downstream Limit of Study	340	10,300	31,000	51,000	150,000
At Upstream Limit of Study	169	3,300	9,300	13,300	63,000
Cherry Creek (Right Overbank Split Flow)					
At Arapahoe Road	--[1]	1	2,090	7,077	62,211
Cherry Creek Spillway Drain					
At Confluence with West Toll Gate Creek	2.0	1,038	2,190	2,780	4,110
At Upstream Limit of Study	1.0	482	776	855	2,292
Coal Creek					
At East Yale Avenue	--[1]	4,972	11,489	14,982	21,714
At Mutchie Creek Confluence	--[1]	4,698	11,003	14,425	20,928
Approximately 2,700 ft Upstream of E. Quincy	--[1]	3,095	9,177	12,656	19,154
At Llama Drow	--[1]	2,505	8,614	11,919	17,916
County Line Road	--[1]	2,495	8,035	10,991	16,351
Coon Creek					
At County Boundary	--[1]	1,215	2,333	2,958	3,982
Cottonwood Creek					
At Peoria Street	--[1]	2,630	3,880	4,690	6,220
Downstream of Peakview Avenue	--[1]	2,340	3,410	3,910	4,760
At Easter Avenue	--[1]	2,070	3,040	3,500	4,220
Downstream of Airport Tributary	--[1]	1,960	3,430	4,200	5,470
Coyote Run					
Approximately 1700 feet upstream of Confluence with Box Elder Creek	--[1]	1,920	6,111	8,703	15,349
At I-70	--[1]	1,546	4,190	5,804	6,533
Approximately 7.7 miles upstream of I-70	--[1]	46	109	141	169

[1]Data Not Available

130-Acre Crossing

Senac Creek Tributary



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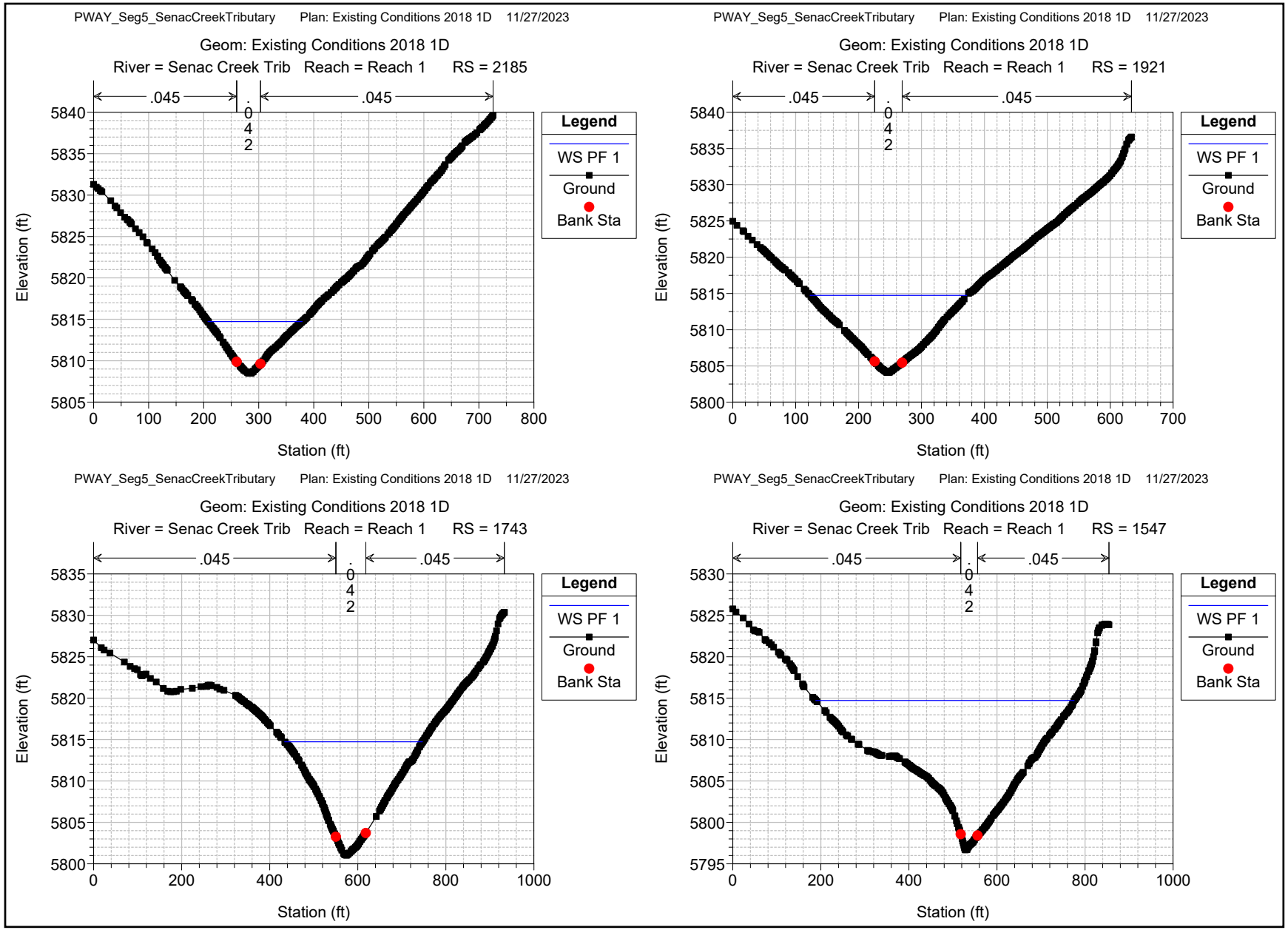
HEC-RAS Plan: EX_1D River: Senac Creek Trib Reach: Reach 1 Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	2185	PF 1	176.00	5808.49	5814.73		5814.73	0.000015	0.43	554.45	171.14	0.03
Reach 1	1921	PF 1	176.00	5804.09	5814.73		5814.73	0.000001	0.18	1413.07	249.13	0.01
Reach 1	1743	PF 1	176.00	5801.05	5814.73		5814.73	0.000000	0.12	2139.07	313.10	0.01
Reach 1	1547	PF 1	176.00	5796.68	5814.73		5814.73	0.000000	0.06	4767.14	586.79	0.00
Reach 1	1394	PF 1	176.00	5795.88	5814.73		5814.73	0.000000	0.05	4891.35	459.43	0.00
Reach 1	1327	PF 1	176.00	5796.37	5814.73	5797.25	5814.73	0.000000	0.05	5026.52	476.38	0.00
Reach 1	1187		Culvert									
Reach 1	1074	PF 1	176.00	5794.61	5796.08	5796.08	5796.43	0.027021	4.98	38.92	63.41	0.99
Reach 1	1038	PF 1	176.00	5791.87	5793.02	5792.80	5793.16	0.009605	3.13	60.34	84.01	0.60
Reach 1	929	PF 1	176.00	5790.51	5791.32	5791.29	5791.55	0.025222	4.03	47.50	90.18	0.91
Reach 1	802	PF 1	176.00	5787.61	5788.47	5788.39	5788.71	0.020021	4.21	45.93	68.26	0.84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Geom: Existing Conditions 2018 1D
River = Senac Creek Trib Reach = Reach 1 RS = 2185
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Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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Geom: Existing Conditions 2018 1D
River = Senac Creek Trib Reach = Reach 1 RS = 1921
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Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_SenacCreekTributary Plan: Existing Conditions 2018 1D 11/27/2023
Geom: Existing Conditions 2018 1D
River = Senac Creek Trib Reach = Reach 1 RS = 1743
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Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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Geom: Existing Conditions 2018 1D
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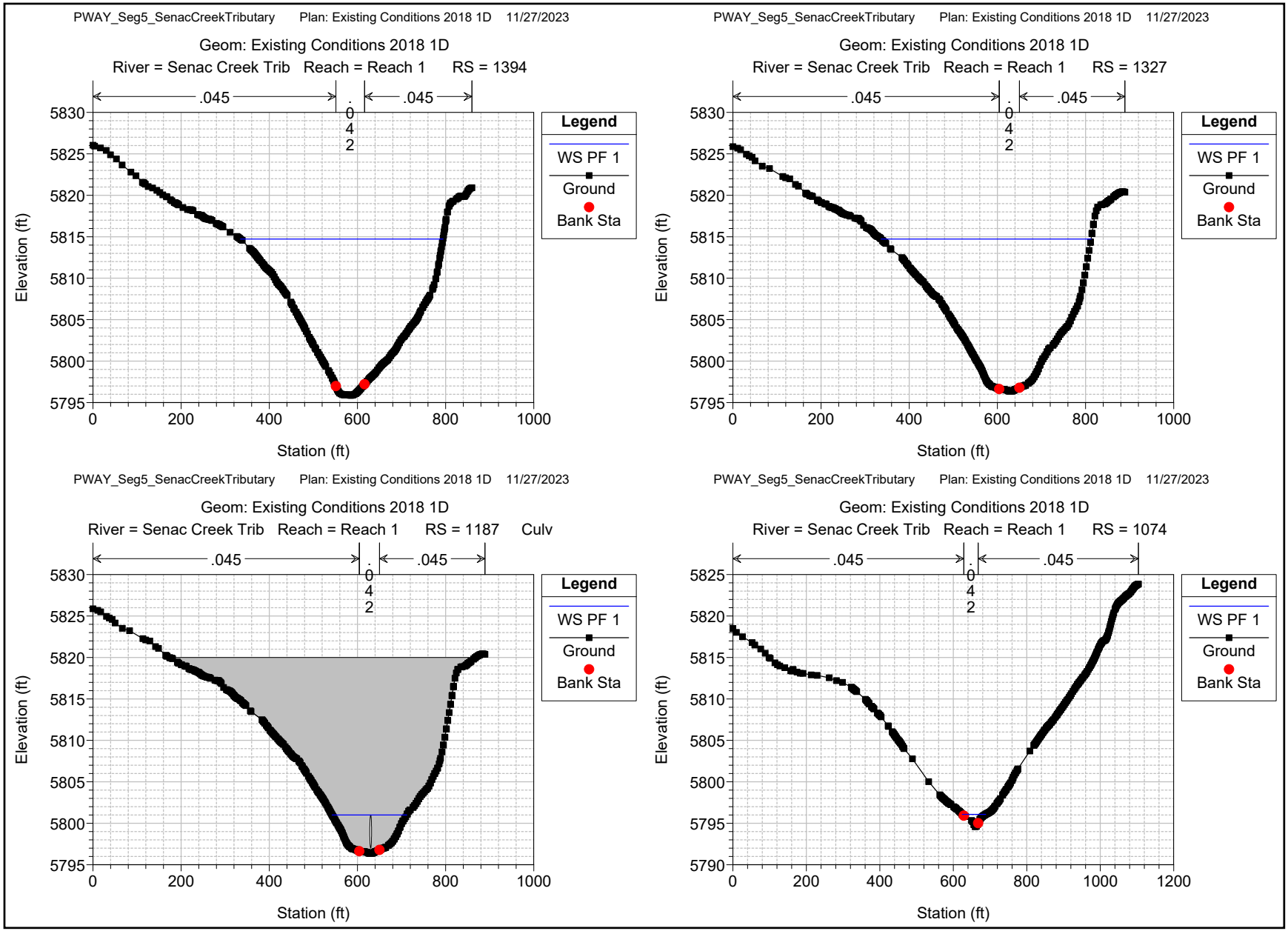
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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Geom: Existing Conditions 2018 1D
River = Senac Creek Trib Reach = Reach 1 RS = 1327
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Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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Geom: Existing Conditions 2018 1D
River = Senac Creek Trib Reach = Reach 1 RS = 1187 Culv
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Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_SenacCreekTributary Plan: Existing Conditions 2018 1D 11/27/2023
Geom: Existing Conditions 2018 1D
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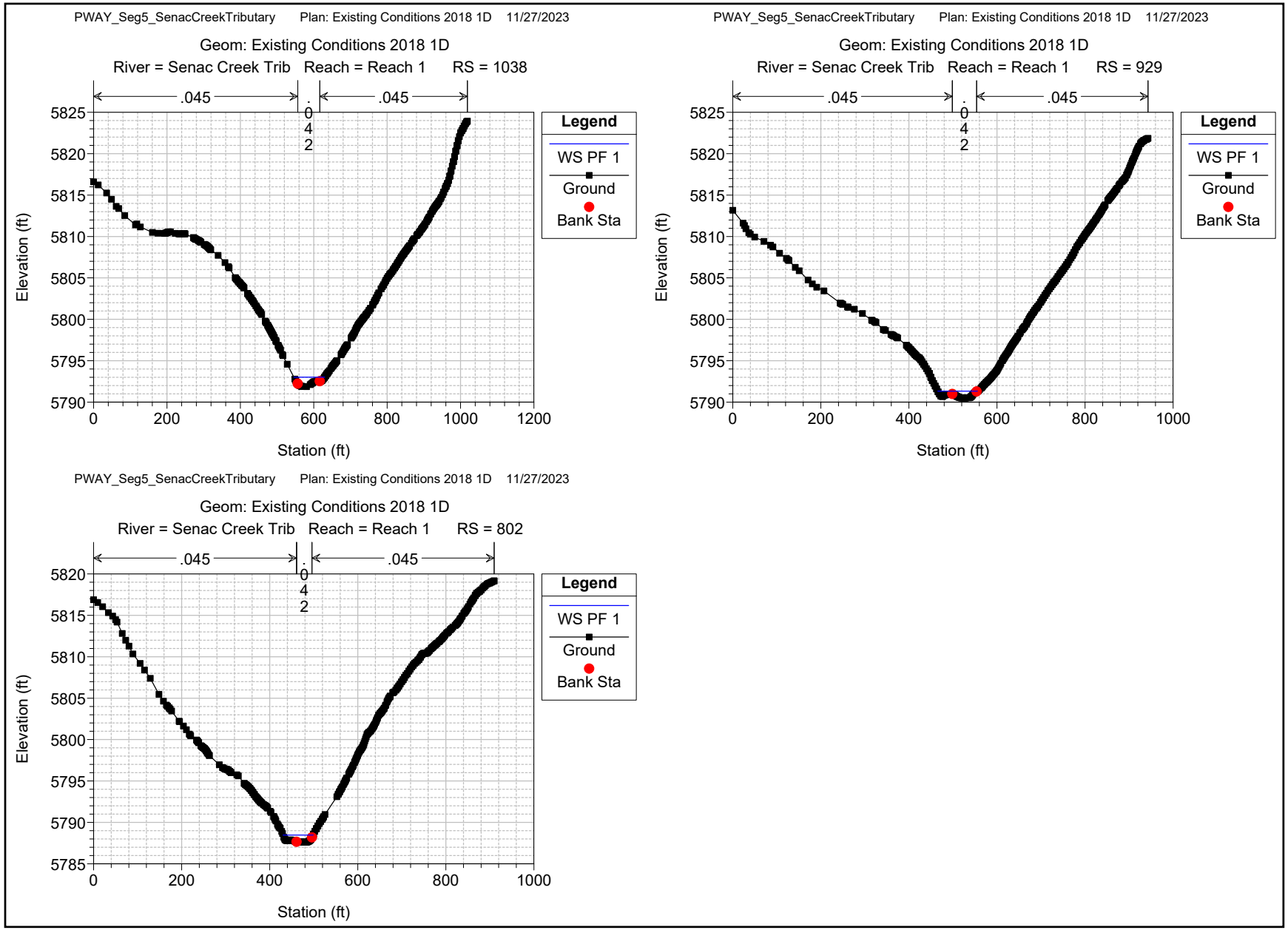
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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River = Senac Creek Trib Reach = Reach 1 RS = 1038
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Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_SenacCreekTributary Plan: Existing Conditions 2018 1D 11/27/2023
Geom: Existing Conditions 2018 1D
River = Senac Creek Trib Reach = Reach 1 RS = 929
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.045
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_SenacCreekTributary Plan: Existing Conditions 2018 1D 11/27/2023
Geom: Existing Conditions 2018 1D
River = Senac Creek Trib Reach = Reach 1 RS = 802
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.042
.045
Legend
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

StreamStats Report

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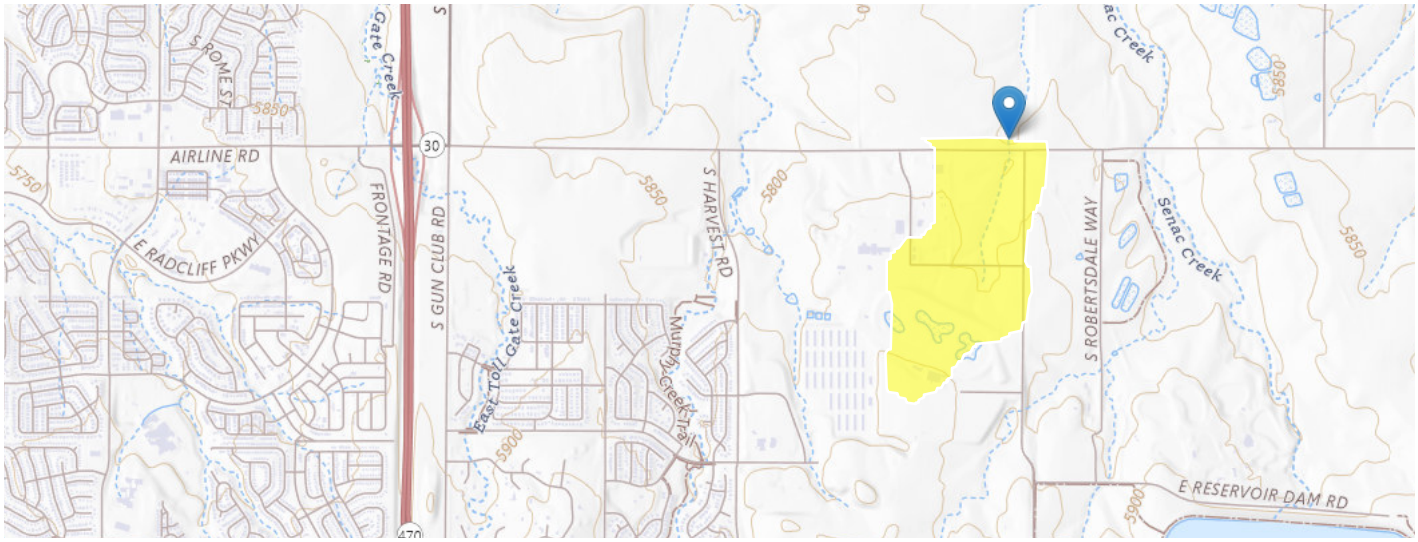


Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.33	square miles
I6H100Y	6-hour precipitation that is expected to occur on average once in 100 years	3	inches
OUTLETELEV	Elevation of the stream outlet in feet above NAVD88	5791	feet
STATSCLAY	Percentage of clay soils from STATSGO	25.03	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Foothills Region Peak Flow 2016 5099]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.33	square miles	0.6	2850
I6H100Y	6 Hour 100 Year Precipitation	3	inches	2.38	4.89
OUTLETELEV	Elevation of Gage	5791	feet	4290	8270
STATSCLAY	STATSGO Percentage of Clay Soils	25.03	percent	9.87	37.5

Peak-Flow Statistics Disclaimers [Foothills Region Peak Flow 2016 5099]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Peak-Flow Statistics Flow Report [Foothills Region Peak Flow 2016 5099]

Statistic	Value	Unit
50-percent AEP flood	11.2	ft^3/s
20-percent AEP flood	33.1	ft^3/s

Statistic	Value	Unit
10-percent AEP flood	56	ft^3/s
4-percent AEP flood	94.5	ft^3/s
2-percent AEP flood	131	ft^3/s
1-percent AEP flood	176	ft^3/s
0.5-percent AEP flood	228	ft^3/s
0.2-percent AEP flood	311	ft^3/s

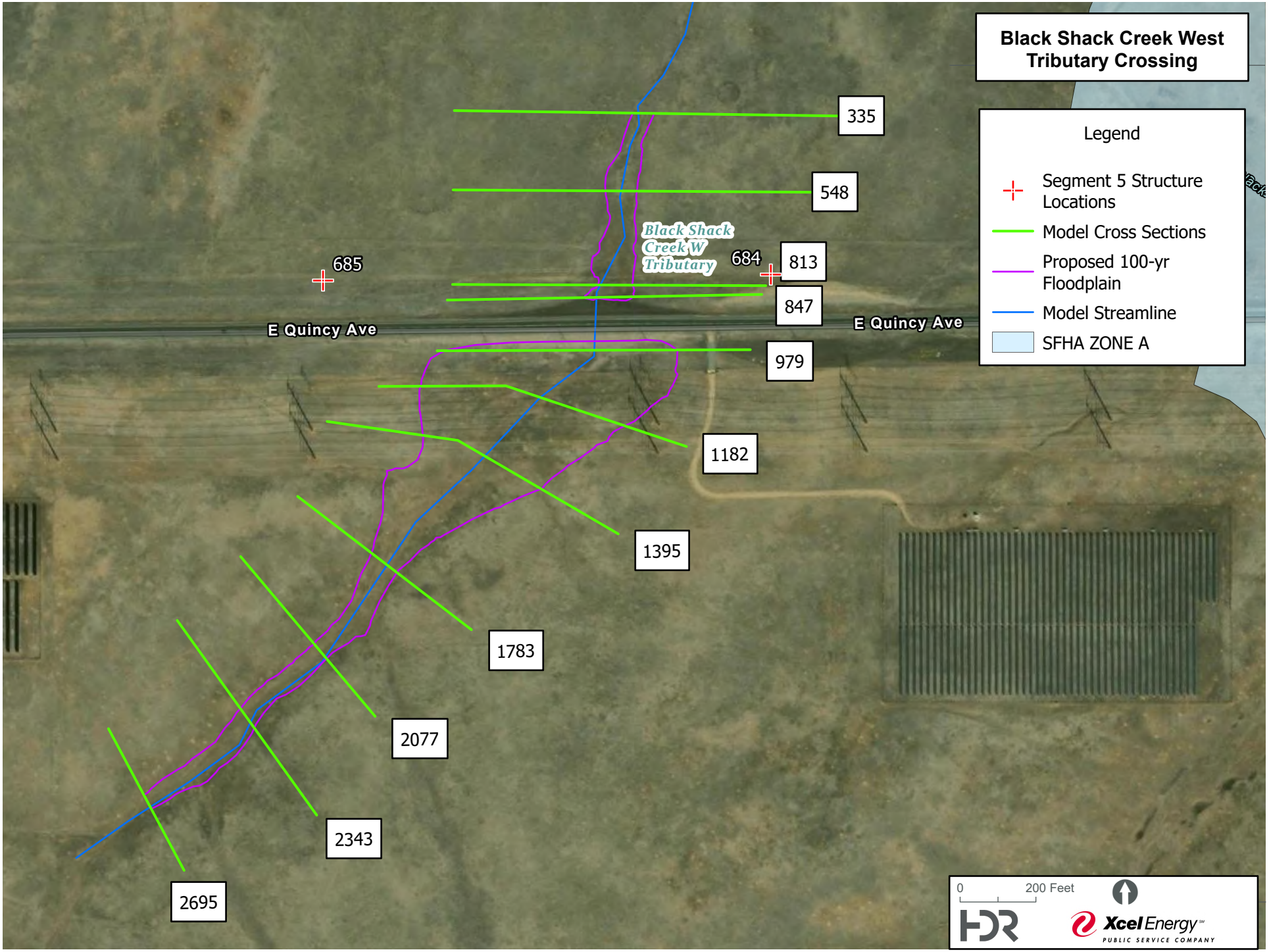
Peak-Flow Statistics Citations

Kohn, M.S., Stevens, M.R., Harden, T.M., Godaire, J.E., Klinger, R.E., and Mommandi, A.,2016, Paleoflood investigations to improve peak-streamflow regional-regression equations for natural streamflow in eastern Colorado, 2015: U.S. Geological Survey Scientific Investigations Report 2016–5099, 58 p. (http://dx.doi.org/10.3133/sir20165099)

Application Version: 4.29.3
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

130-Acre Crossing

Black Shack Creek Tributary



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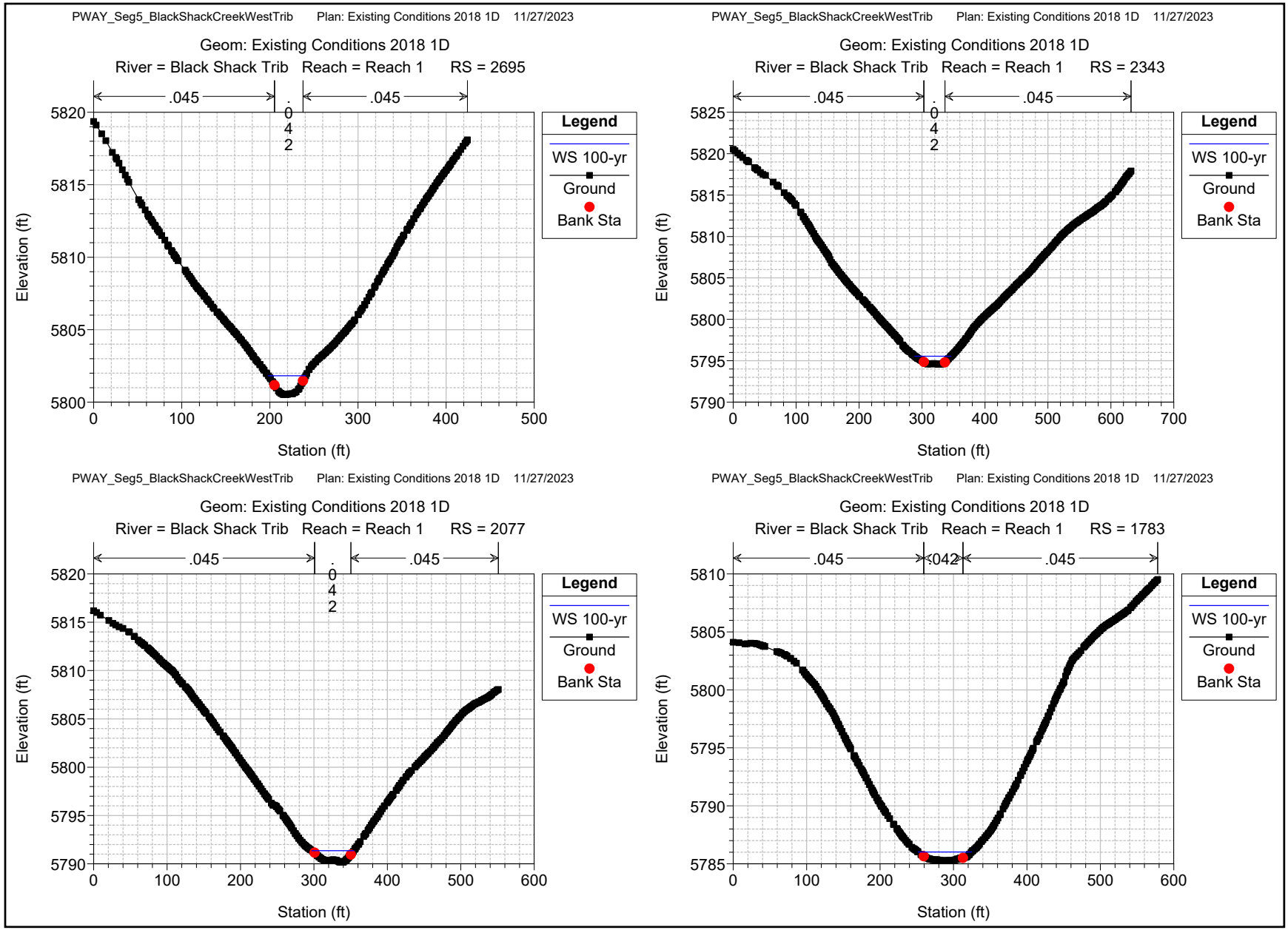
HEC-RAS Plan: EX_1D River: Black Shack Trib Reach: Reach 1 Profile: 100-yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	2695	100-yr	165.00	5800.52	5801.83	5801.69	5802.15	0.015341	4.60	37.58	42.54	0.78
Reach 1	2343	100-yr	165.00	5794.57	5795.55	5795.52	5795.87	0.021020	4.78	38.83	57.44	0.89
Reach 1	2077	100-yr	165.00	5790.16	5791.36	5791.16	5791.57	0.012582	3.69	45.58	57.26	0.69
Reach 1	1783	100-yr	165.00	5785.27	5786.02	5786.02	5786.31	0.027513	4.39	39.96	72.72	0.96
Reach 1	1395	100-yr	165.00	5779.16	5785.27	5779.73	5785.27	0.000002	0.16	1251.56	307.47	0.01
Reach 1	1182	100-yr	165.00	5774.26	5785.27	5775.39	5785.27	0.000000	0.09	2404.80	517.36	0.00
Reach 1	987	100-yr	165.00	5773.27	5785.26	5774.93	5785.27	0.000011	0.60	287.53	576.88	0.03
Reach 1	920		Culvert									
Reach 1	847	100-yr	165.00	5766.54	5768.71	5768.71	5769.45	0.019782	7.01	24.83	108.19	0.94
Reach 1	813	100-yr	165.00	5765.48	5766.77	5766.69	5767.02	0.021305	4.07	40.58	92.71	0.86
Reach 1	548	100-yr	165.00	5759.36	5760.11	5760.11	5760.37	0.030077	4.48	42.19	82.39	1.00
Reach 1	335	100-yr	165.00	5754.37	5757.05	5755.67	5757.10	0.001001	1.82	96.65	55.29	0.22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Bank Sta
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Ground
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Geom: Existing Conditions 2018 1D
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Station (ft)
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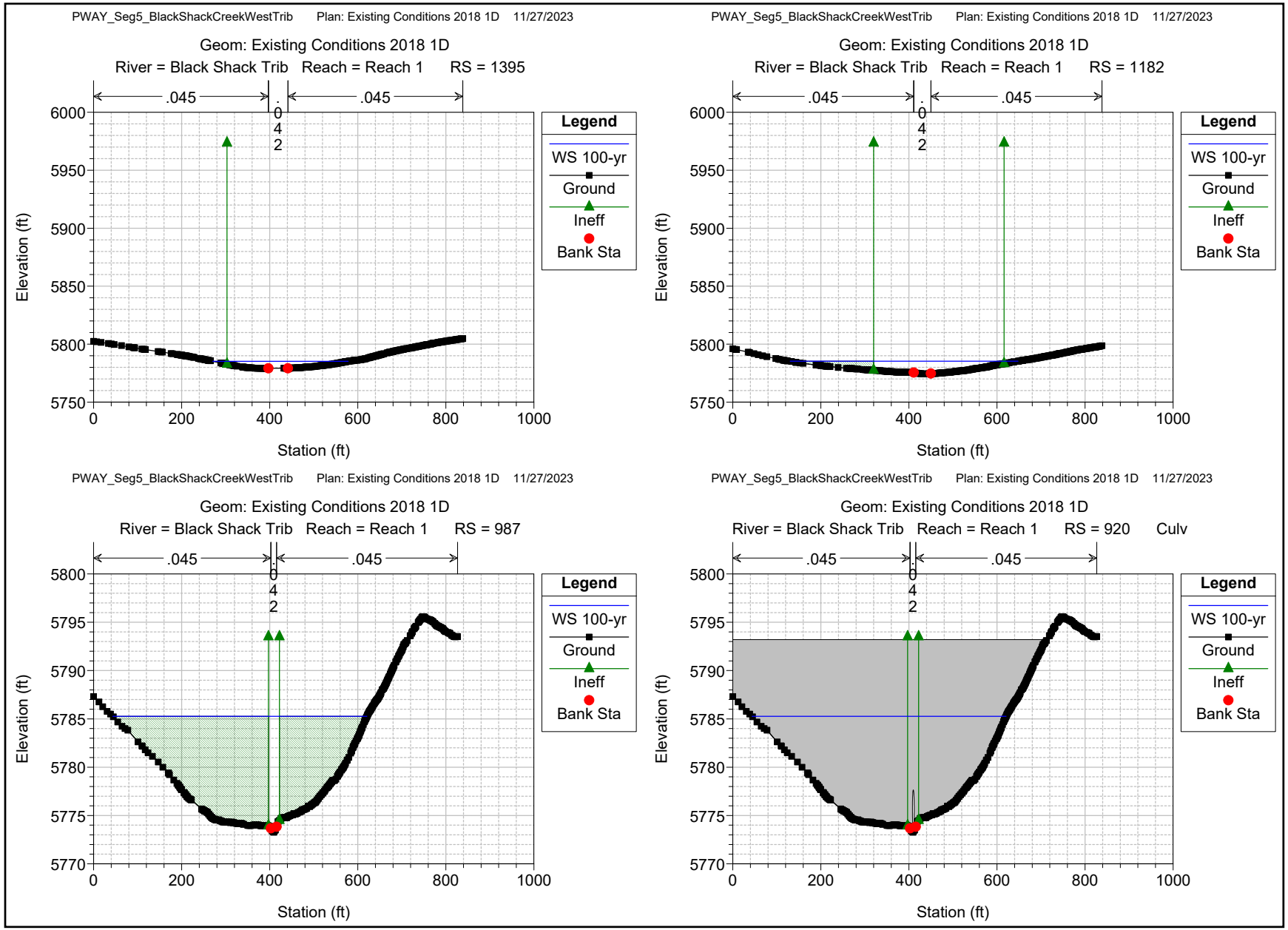
Station (ft)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Geom: Existing Conditions 2018 1D
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Ground
Ineff
Bank Sta
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Station (ft)
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Geom: Existing Conditions 2018 1D
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WS 100-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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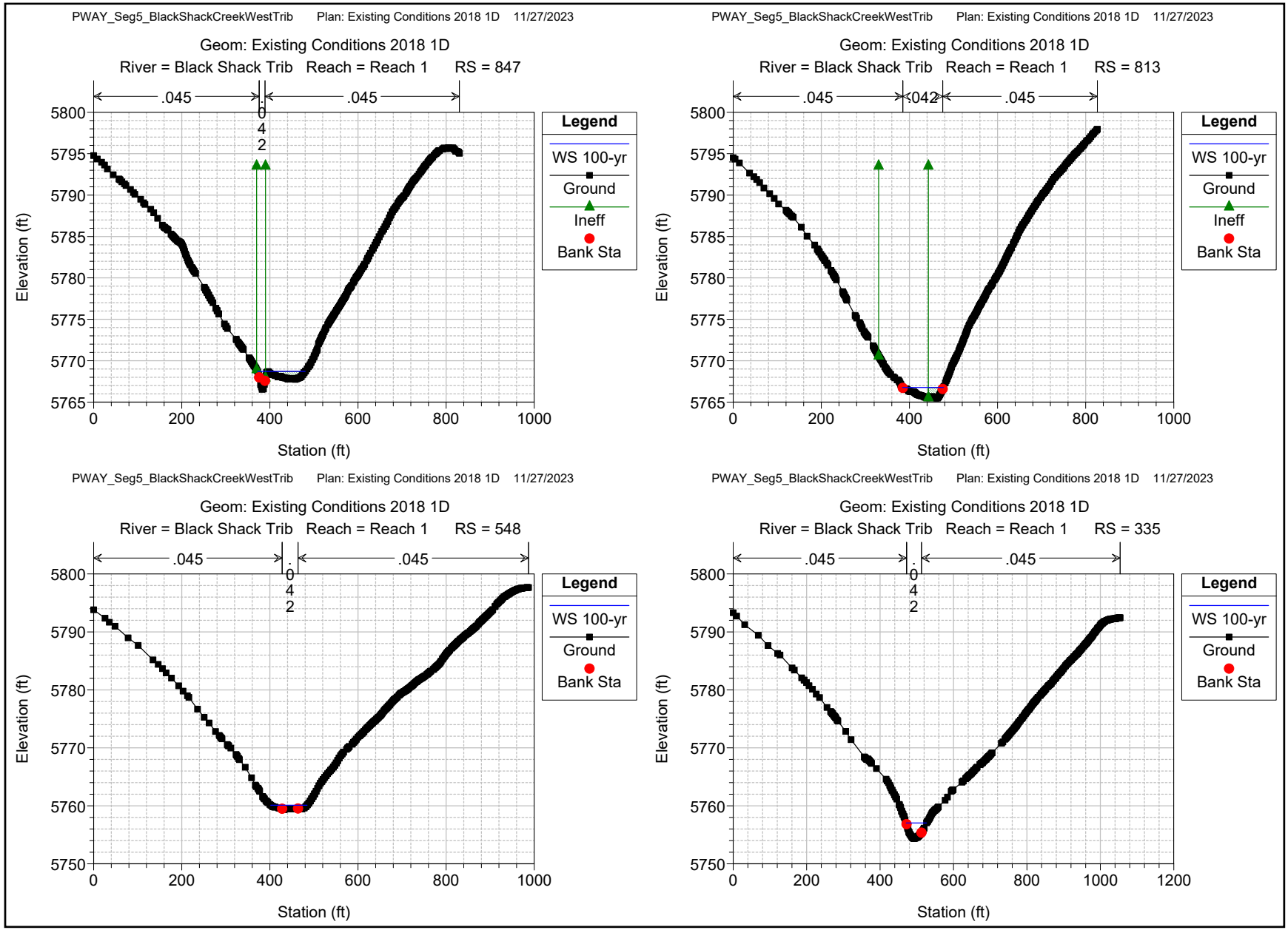
Station (ft)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Legend
WS 100-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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Geom: Existing Conditions 2018 1D
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Legend
WS 100-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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Geom: Existing Conditions 2018 1D
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Legend
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
PWAY_Seg5_BlackShackCreekWestTrib Plan: Existing Conditions 2018 1D 11/27/2023
Geom: Existing Conditions 2018 1D
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Legend
WS 100-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

StreamStats Report

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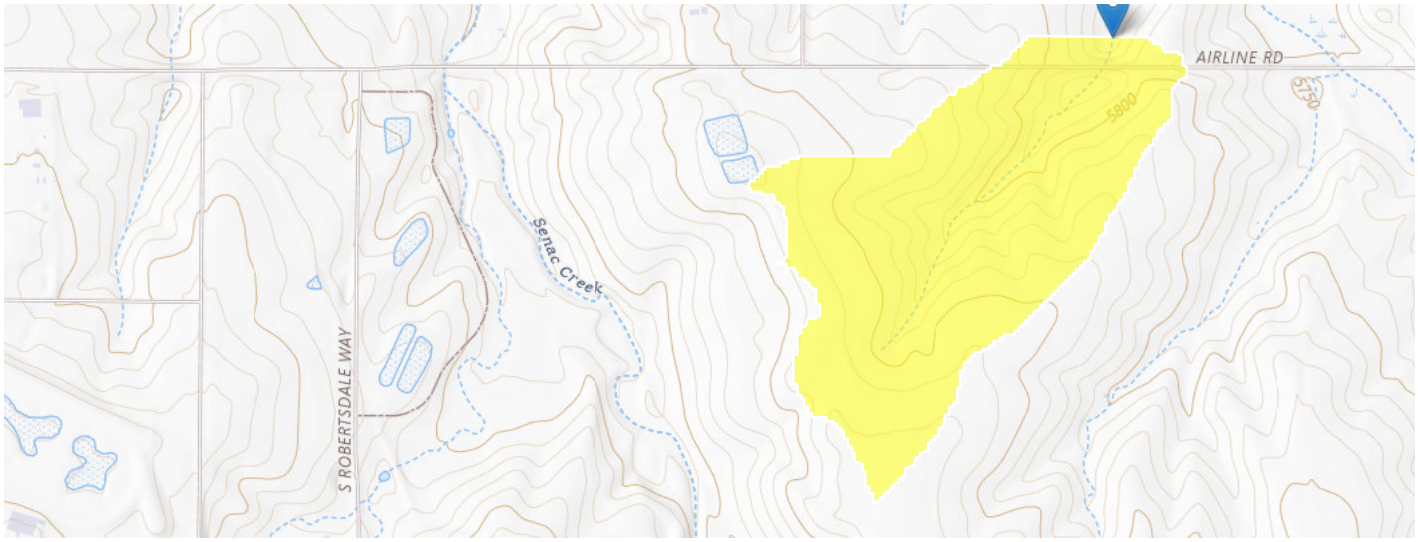


Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.29	square miles
I6H100Y	6-hour precipitation that is expected to occur on average once in 100 years	3	inches
OUTLETELEV	Elevation of the stream outlet in feet above NAVD88	5767	feet
STATSCLAY	Percentage of clay soils from STATSGO	25	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Foothills Region Peak Flow 2016 5099]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.29	square miles	0.6	2850
I6H100Y	6 Hour 100 Year Precipitation	3	inches	2.38	4.89
OUTLETELEV	Elevation of Gage	5767	feet	4290	8270
STATSCLAY	STATSGO Percentage of Clay Soils	25	percent	9.87	37.5

Peak-Flow Statistics Disclaimers [Foothills Region Peak Flow 2016 5099]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Peak-Flow Statistics Flow Report [Foothills Region Peak Flow 2016 5099]

Statistic	Value	Unit
50-percent AEP flood	10.5	ft^3/s
20-percent AEP flood	31	ft^3/s

Statistic	Value	Unit
10-percent AEP flood	52.6	ft^3/s
4-percent AEP flood	88.9	ft^3/s
2-percent AEP flood	123	ft^3/s
1-percent AEP flood	165	ft^3/s
0.5-percent AEP flood	214	ft^3/s
0.2-percent AEP flood	293	ft^3/s

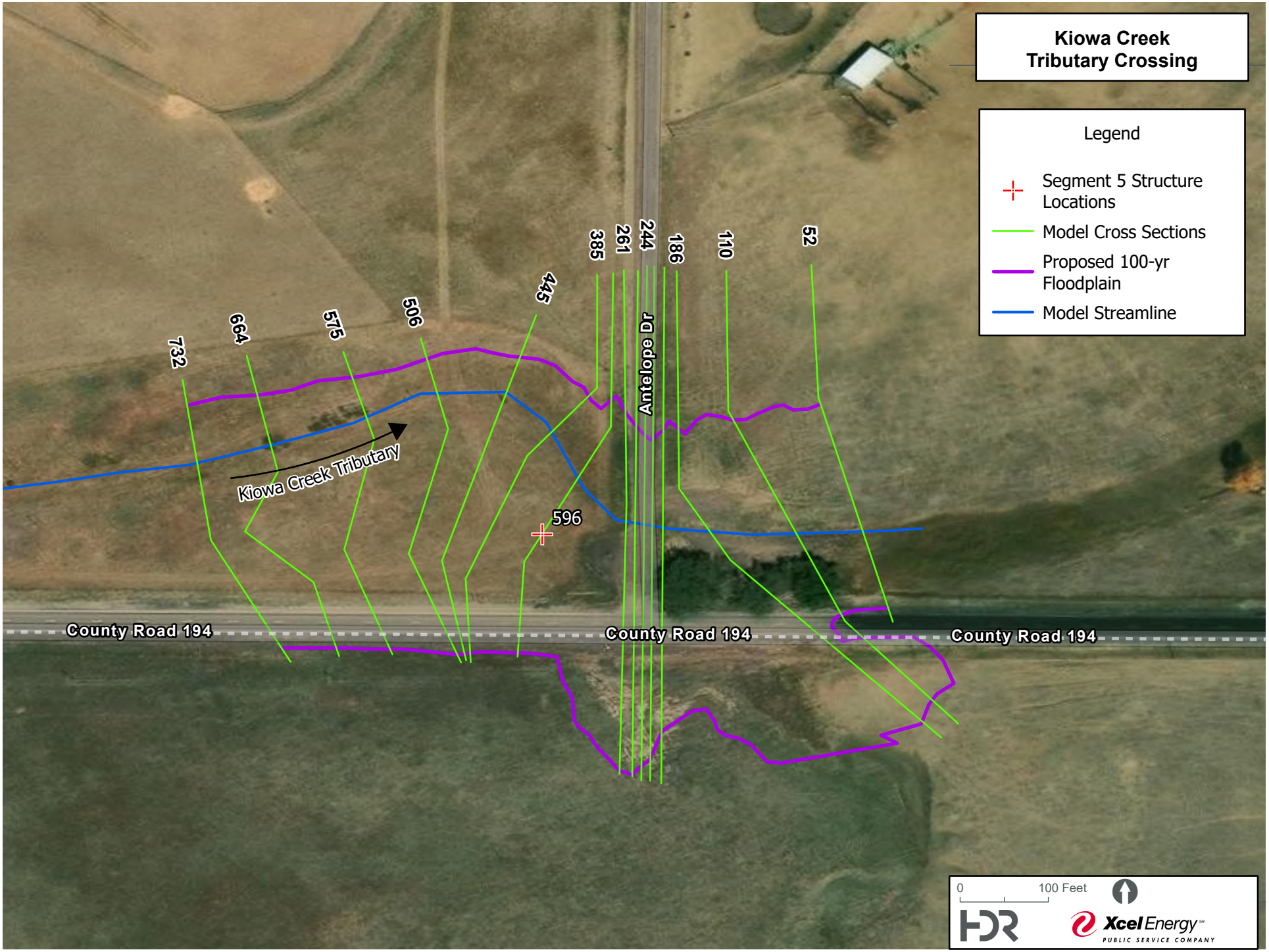
Peak-Flow Statistics Citations

Kohn, M.S., Stevens, M.R., Harden, T.M., Godaire, J.E., Klinger, R.E., and Mommandi, A.,2016, Paleoflood investigations to improve peak-streamflow regional-regression equations for natural streamflow in eastern Colorado, 2015: U.S. Geological Survey Scientific Investigations Report 2016–5099, 58 p. (http://dx.doi.org/10.3133/sir20165099)

Application Version: 4.29.3
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

130-Acre Crossing

Kiowa Creek Tributary



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HEC-RAS River: Kiowa Trib Reach: Reach 1 Profile: 100yr

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	732	100yr	EX 1D	1300.00	5874.24	5878.05	5878.05	5878.60	0.008258	6.63	238.98	235.80	0.68
Reach 1	732	100yr	PR 1D	1300.00	5874.24	5878.05	5878.05	5878.60	0.008258	6.63	238.98	235.80	0.68
Reach 1	664	100yr	EX 1D	1300.00	5874.47	5877.48	5877.38	5877.93	0.009172	6.32	274.58	273.54	0.70
Reach 1	664	100yr	PR 1D	1300.00	5874.47	5877.48	5877.38	5877.93	0.009172	6.32	274.58	273.54	0.70
Reach 1	575	100yr	EX 1D	1300.00	5873.71	5877.42	5876.37	5877.53	0.001647	3.17	523.20	310.30	0.31
Reach 1	575	100yr	PR 1D	1300.00	5873.71	5877.42	5876.37	5877.53	0.001647	3.17	523.20	310.30	0.31
Reach 1	506	100yr	EX 1D	1300.00	5873.41	5877.41	5875.67	5877.45	0.000511	1.90	784.32	348.94	0.17
Reach 1	506	100yr	PR 1D	1300.00	5873.41	5877.41	5875.67	5877.45	0.000511	1.90	784.32	348.94	0.17
Reach 1	445	100yr	EX 1D	1300.00	5872.81	5877.39	5875.36	5877.43	0.000359	1.71	877.53	347.98	0.15
Reach 1	445	100yr	PR 1D	1300.00	5872.81	5877.39	5875.36	5877.43	0.000359	1.71	877.53	347.98	0.15
Reach 1	385	100yr	EX 1D	1300.00	5872.24	5877.37	5875.01	5877.40	0.000321	1.74	865.15	319.49	0.14
Reach 1	385	100yr	PR 1D	1300.00	5872.24	5877.37	5875.01	5877.40	0.000321	1.74	865.15	319.49	0.14
Reach 1	328	100yr	EX 1D	1300.00	5871.87	5877.36	5874.50	5877.39	0.000230	1.54	917.36	303.01	0.12
Reach 1	328	100yr	PR 1D	1300.00	5871.87	5877.36	5874.50	5877.39	0.000230	1.54	917.36	303.01	0.12
Reach 1	261	100yr	EX 1D	1300.00	5873.48	5877.22	5876.08	5877.35	0.001356	2.67	502.65	413.44	0.26
Reach 1	261	100yr	PR 1D	1300.00	5873.48	5877.22	5876.08	5877.35	0.001356	2.67	502.65	413.44	0.26
Reach 1	252	100yr	EX 1D	1300.00	5875.05	5876.99	5876.61	5877.31	0.003359	2.87	336.01	397.63	0.37
Reach 1	252	100yr	PR 1D	1300.00	5875.05	5876.99	5876.61	5877.31	0.003359	2.87	336.01	397.63	0.37
Reach 1	244	100yr	EX 1D	1300.00	5875.35	5876.66	5876.66	5877.25	0.006799	3.15	247.71	368.63	0.50
Reach 1	244	100yr	PR 1D	1300.00	5875.35	5876.66	5876.66	5877.25	0.006799	3.15	247.71	368.63	0.50
Reach 1	237	100yr	EX 1D	1300.00	5875.30	5876.58	5876.58	5877.18	0.006446	3.02	243.20	361.43	0.49
Reach 1	237	100yr	PR 1D	1300.00	5875.30	5876.58	5876.58	5877.18	0.006446	3.02	243.20	361.43	0.49
Reach 1	228	100yr	EX 1D	1300.00	5873.01	5875.60	5875.60	5876.15	0.012265	6.17	243.32	341.17	0.75
Reach 1	228	100yr	PR 1D	1300.00	5873.01	5875.60	5875.60	5876.15	0.012265	6.17	243.32	341.17	0.75
Reach 1	186	100yr	EX 1D	1300.00	5871.58	5875.10	5874.95	5875.44	0.007039	5.46	316.65	411.16	0.58
Reach 1	186	100yr	PR 1D	1300.00	5871.58	5875.10	5874.95	5875.44	0.007039	5.46	316.65	411.16	0.58
Reach 1	110	100yr	EX 1D	1300.00	5871.69	5874.63	5874.16	5874.87	0.007203	4.94	346.29	339.27	0.57
Reach 1	110	100yr	PR 1D	1300.00	5871.69	5874.63	5874.16	5874.87	0.007203	4.94	346.29	339.27	0.57
Reach 1	52	100yr	EX 1D	1300.00	5871.68	5874.23	5873.70	5874.45	0.006999	4.64	357.43	243.95	0.55
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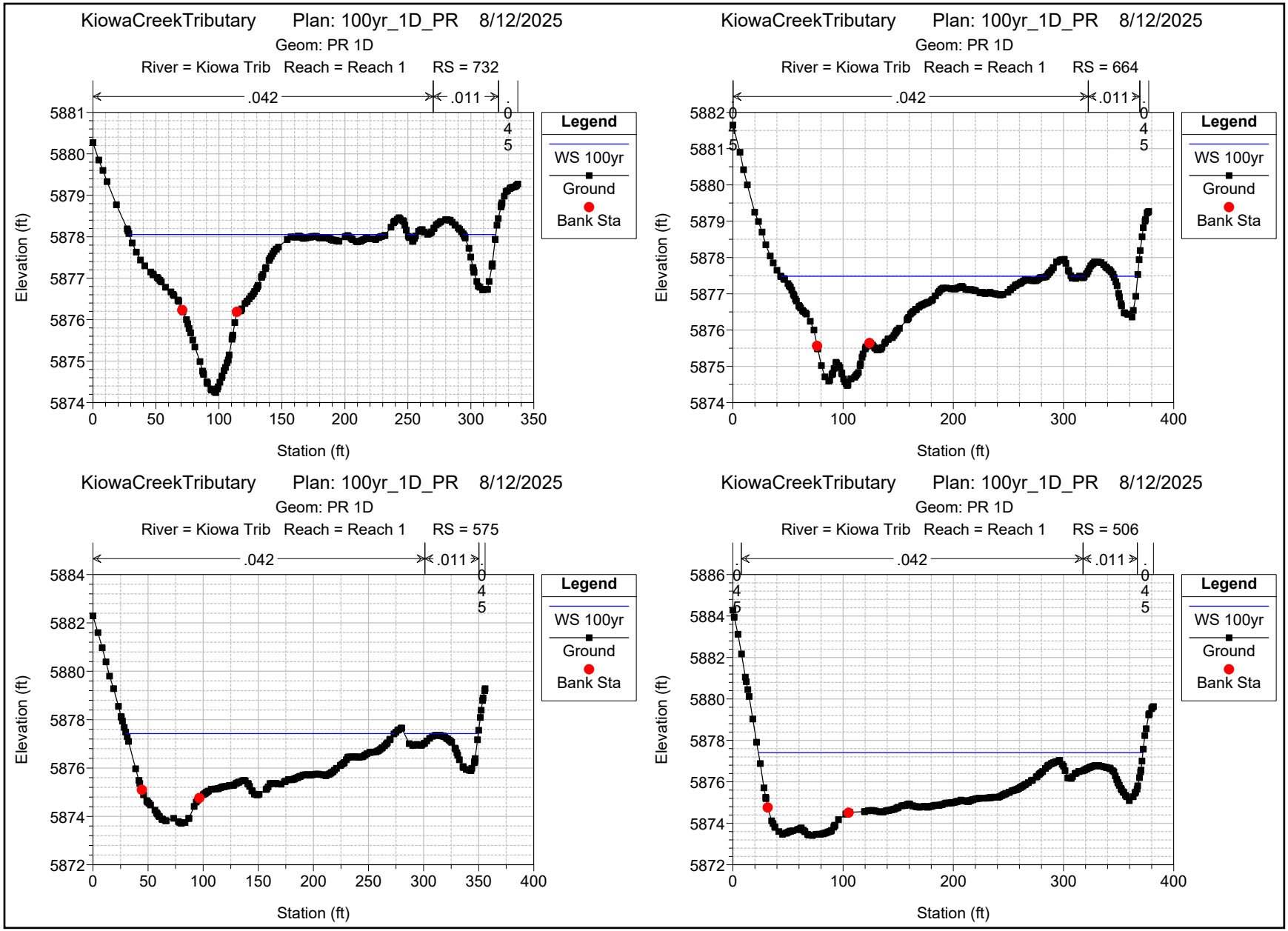
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Station (ft)
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Bank Sta
Elevation (ft)
Station (ft)
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Ground
Bank Sta
Elevation (ft)
Station (ft)
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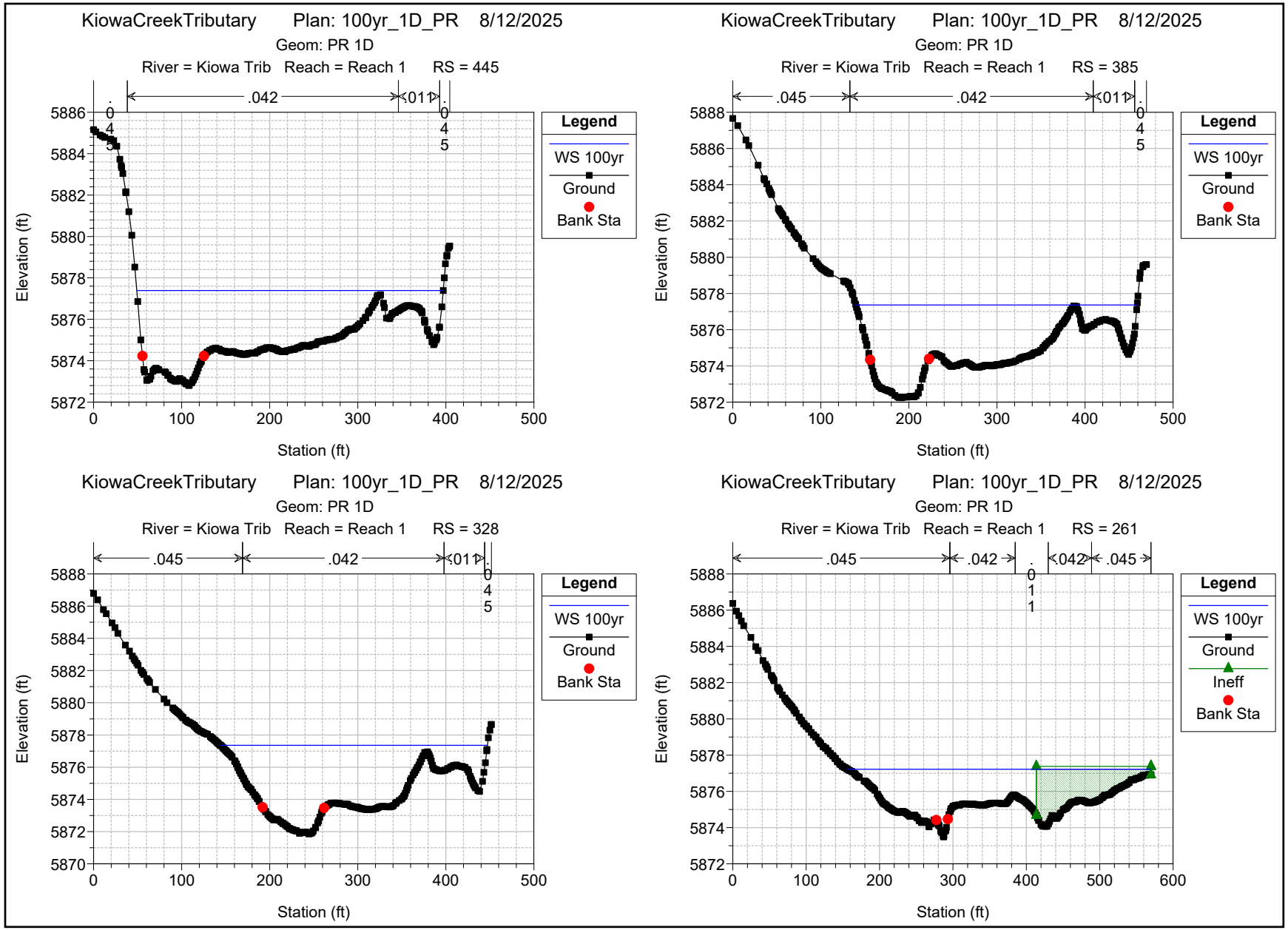
Station (ft)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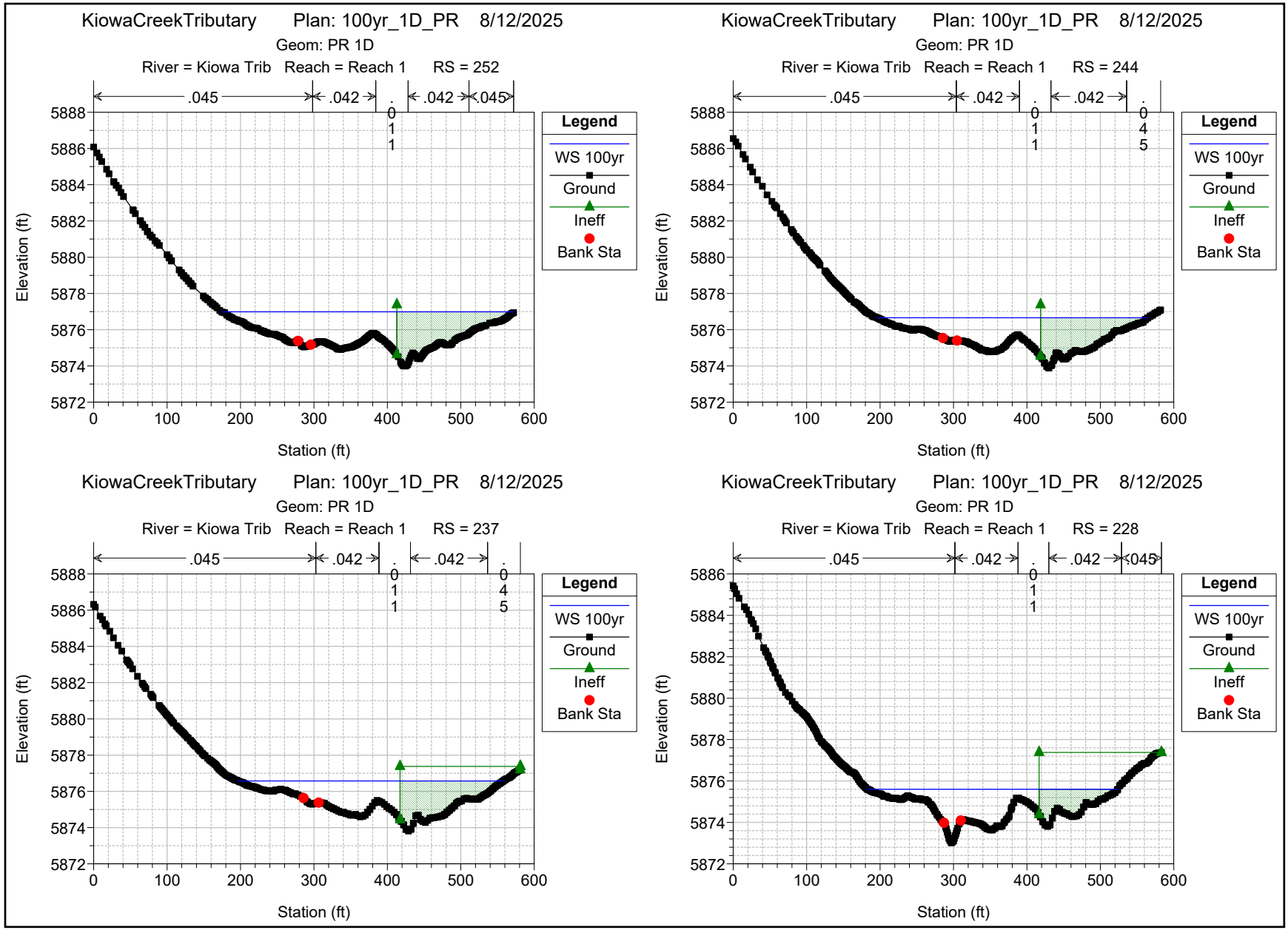
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Bank Sta
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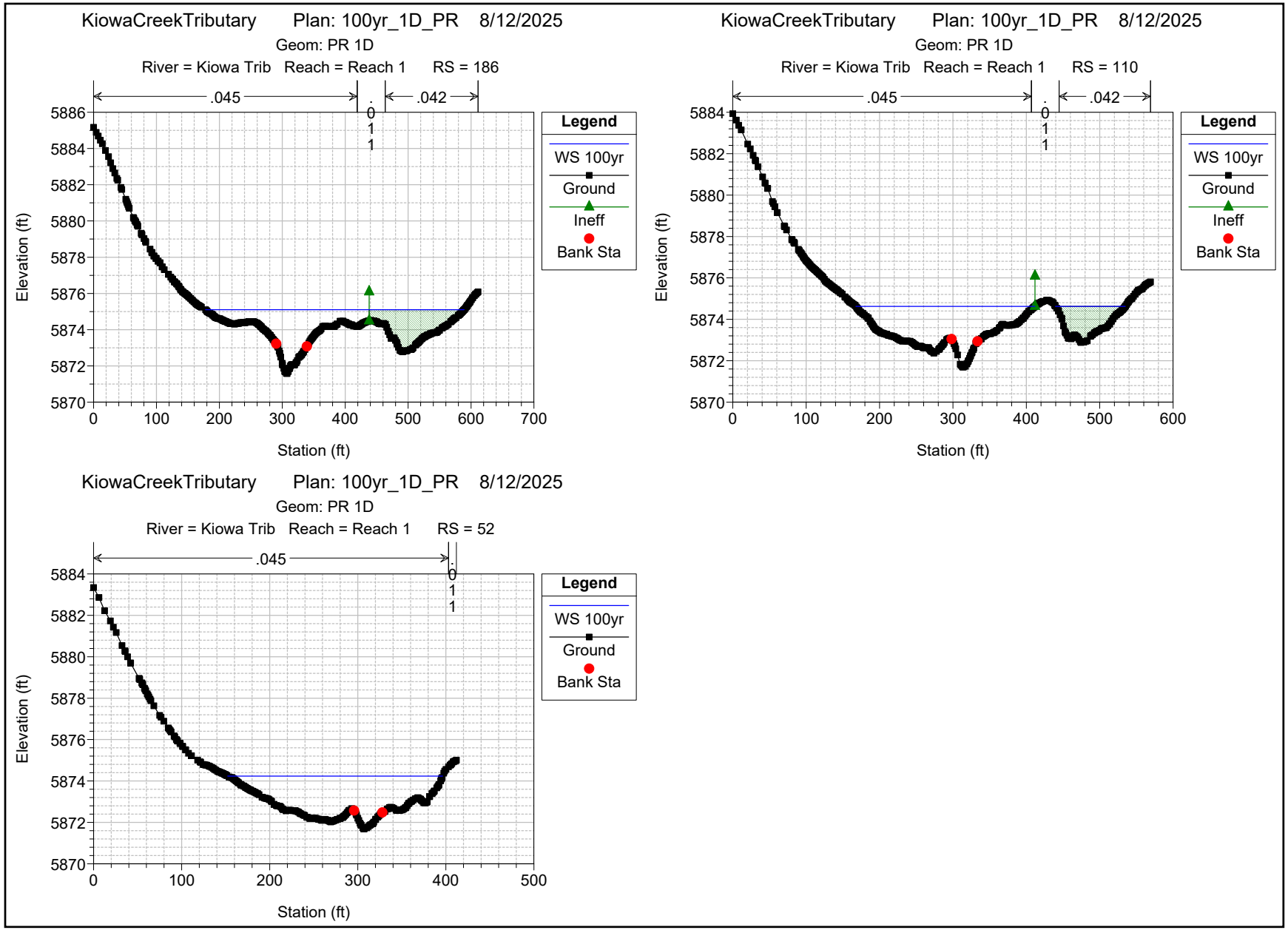
Station (ft)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Geom: PR 1D
River = Kiowa Trib Reach = Reach 1 RS = 186
.045
.042
0
1
1
Legend
WS 100yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
KiowaCreekTributary Plan: 100yr_1D_PR 8/12/2025
Geom: PR 1D
River = Kiowa Trib Reach = Reach 1 RS = 110
.045
.042
0
1
1
Legend
WS 100yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
KiowaCreekTributary Plan: 100yr_1D_PR 8/12/2025
Geom: PR 1D
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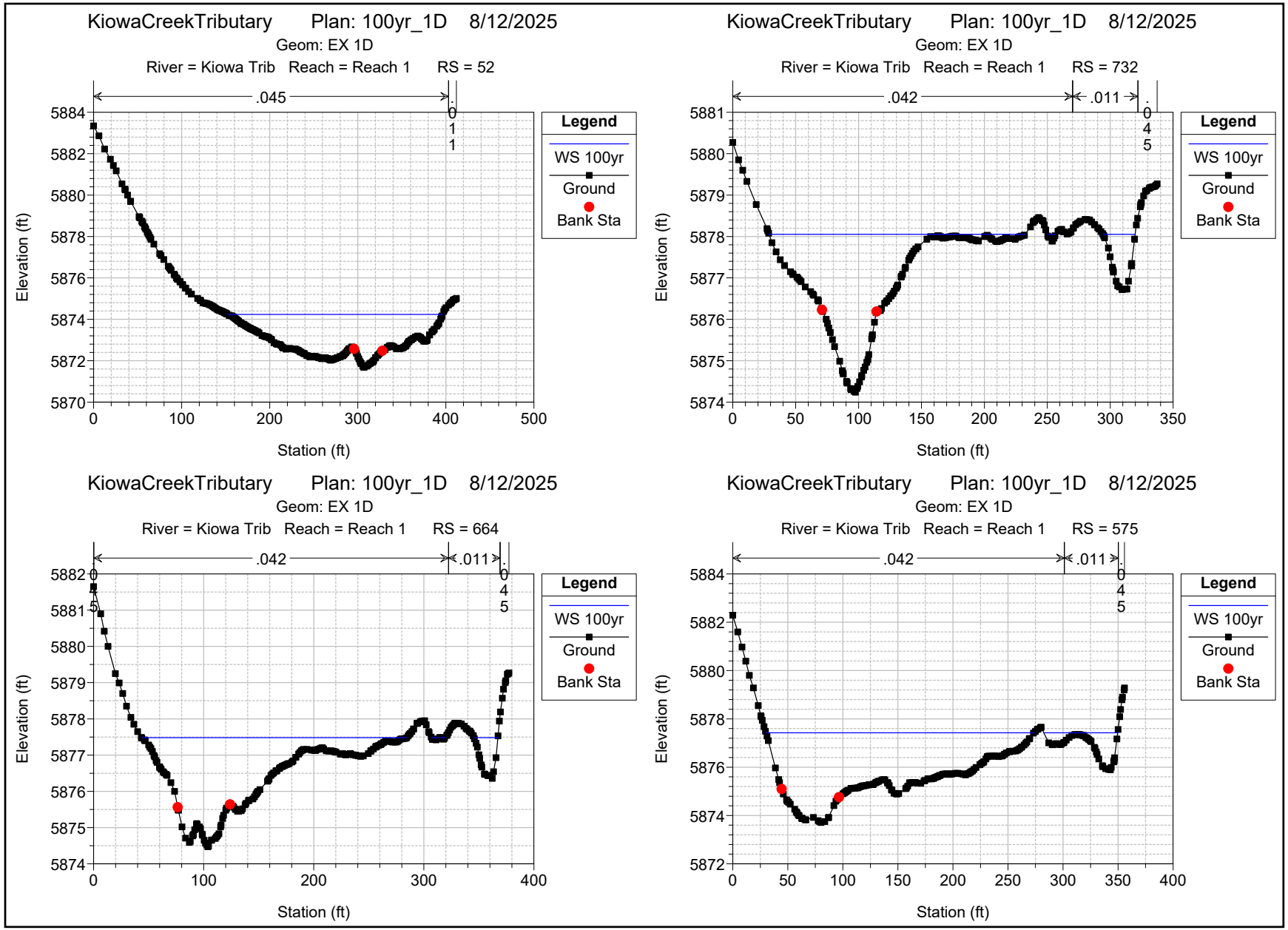
Legend
WS 100yr
Ground
Bank Sta
Elevation (ft)
Station (ft)


KiowaCreekTributary Plan: 100yr_1D 8/12/2025
Geom: EX 1D
River = Kiowa Trib Reach = Reach 1 RS = 52
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.011
Legend
WS 100yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
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Geom: EX 1D
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.042
.011
.045
Legend
WS 100yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
KiowaCreekTributary Plan: 100yr_1D 8/12/2025
Geom: EX 1D
River = Kiowa Trib Reach = Reach 1 RS = 664
.042
.011
.045
Legend
WS 100yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
KiowaCreekTributary Plan: 100yr_1D 8/12/2025
Geom: EX 1D
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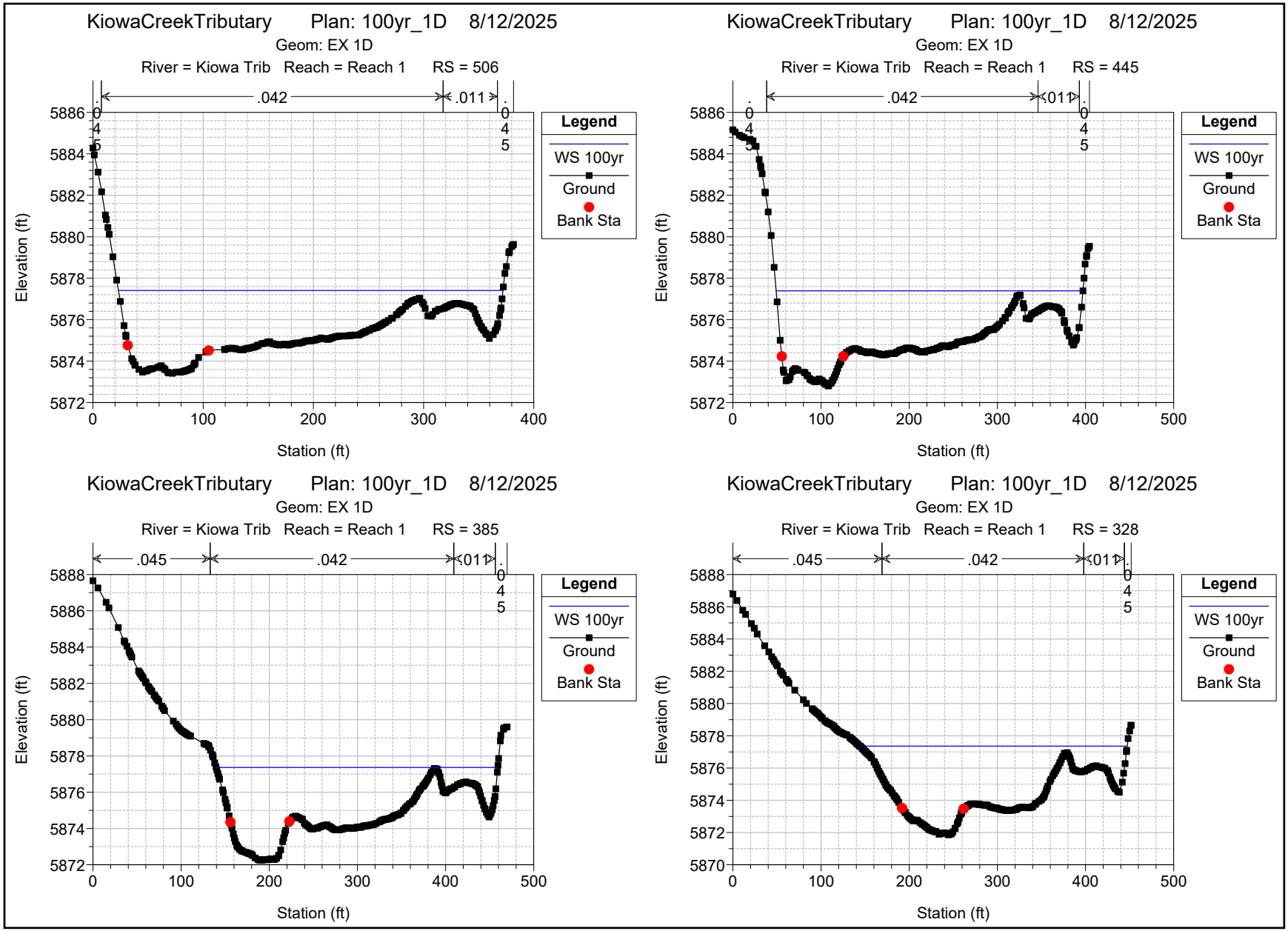
.042
.011
.045
Legend
WS 100yr
Ground
Bank Sta
Elevation (ft)
Station (ft)


KiowaCreekTributary Plan: 100yr_1D 8/12/2025
Geom: EX 1D
River = Kiowa Trib Reach = Reach 1 RS = 506
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.045
Legend
WS 100yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
KiowaCreekTributary Plan: 100yr_1D 8/12/2025
Geom: EX 1D
River = Kiowa Trib Reach = Reach 1 RS = 445
.042
.011
.045
Legend
WS 100yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
KiowaCreekTributary Plan: 100yr_1D 8/12/2025
Geom: EX 1D
River = Kiowa Trib Reach = Reach 1 RS = 385
.045
.042
.011
.045
Legend
WS 100yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
KiowaCreekTributary Plan: 100yr_1D 8/12/2025
Geom: EX 1D
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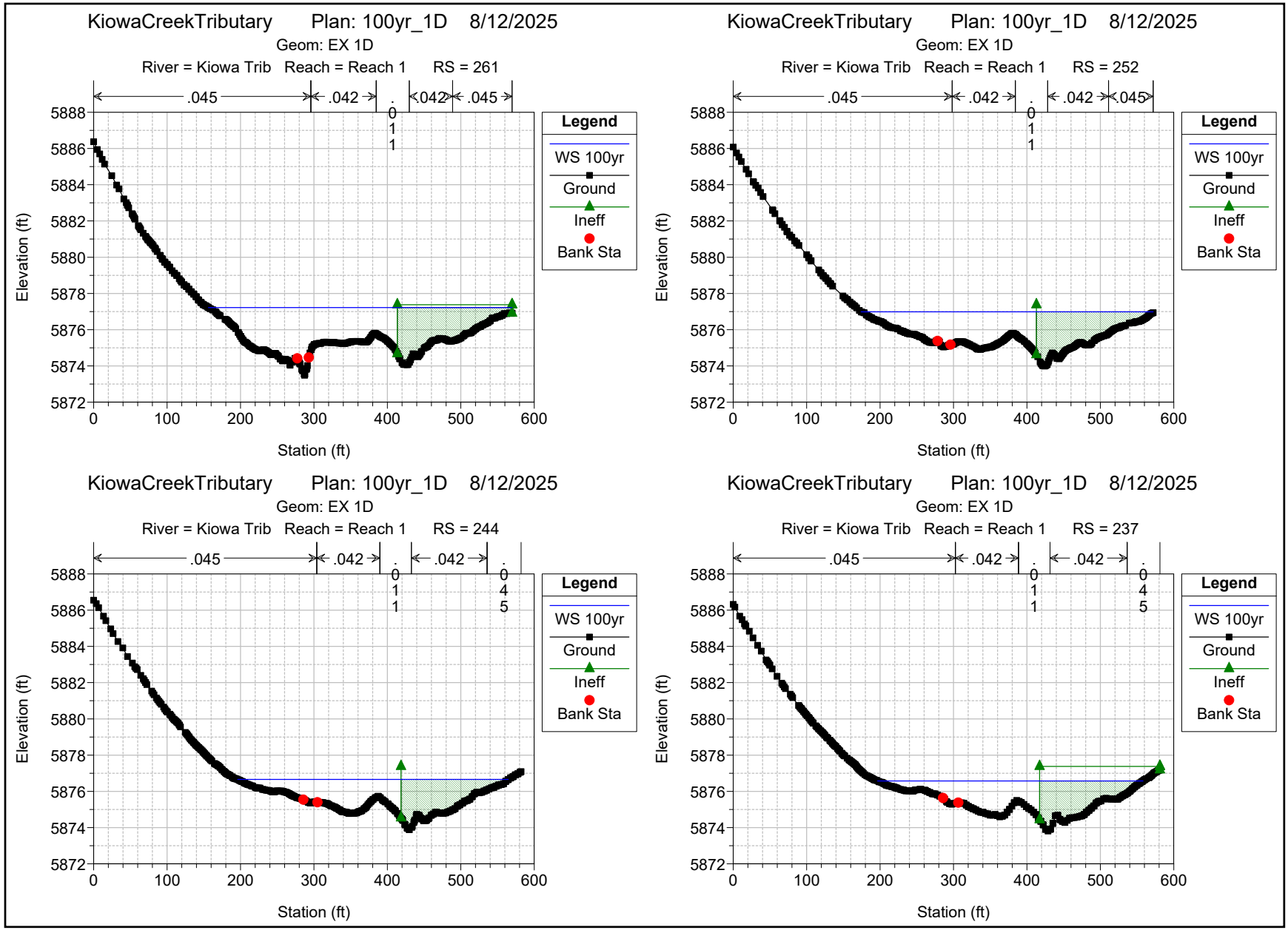
.042
.011
.045
Legend
WS 100yr
Ground
Bank Sta
Elevation (ft)
Station (ft)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Geom: EX 1D
River = Kiowa Trib Reach = Reach 1 RS = 261
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.042
.045
0.011
Legend
WS 100yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
KiowaCreekTributary Plan: 100yr_1D 8/12/2025
Geom: EX 1D
River = Kiowa Trib Reach = Reach 1 RS = 252
.045
.042
.042
.045
0.011
Legend
WS 100yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
KiowaCreekTributary Plan: 100yr_1D 8/12/2025
Geom: EX 1D
River = Kiowa Trib Reach = Reach 1 RS = 244
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.042
.042
0.011
0.045
Legend
WS 100yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
KiowaCreekTributary Plan: 100yr_1D 8/12/2025
Geom: EX 1D
River = Kiowa Trib Reach = Reach 1 RS = 237
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0.011
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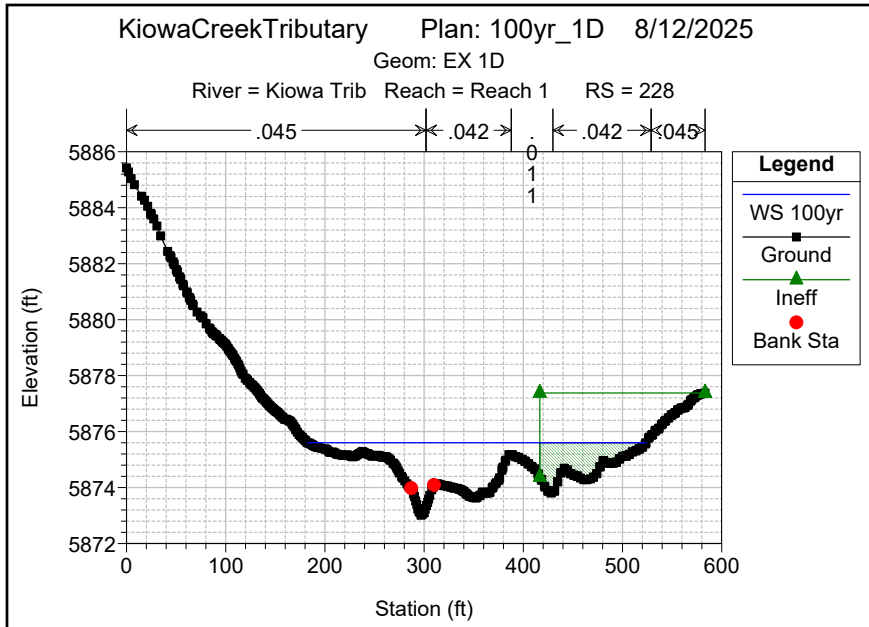
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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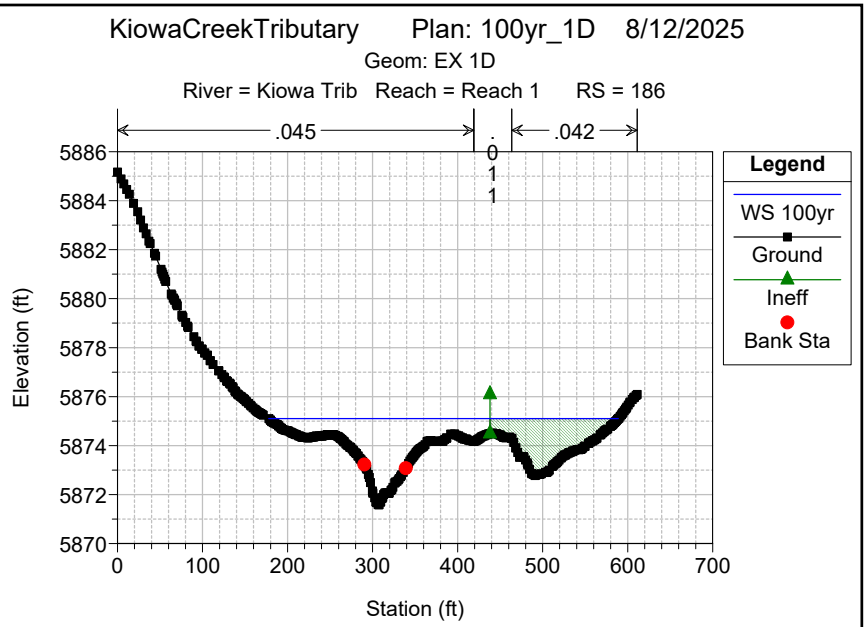
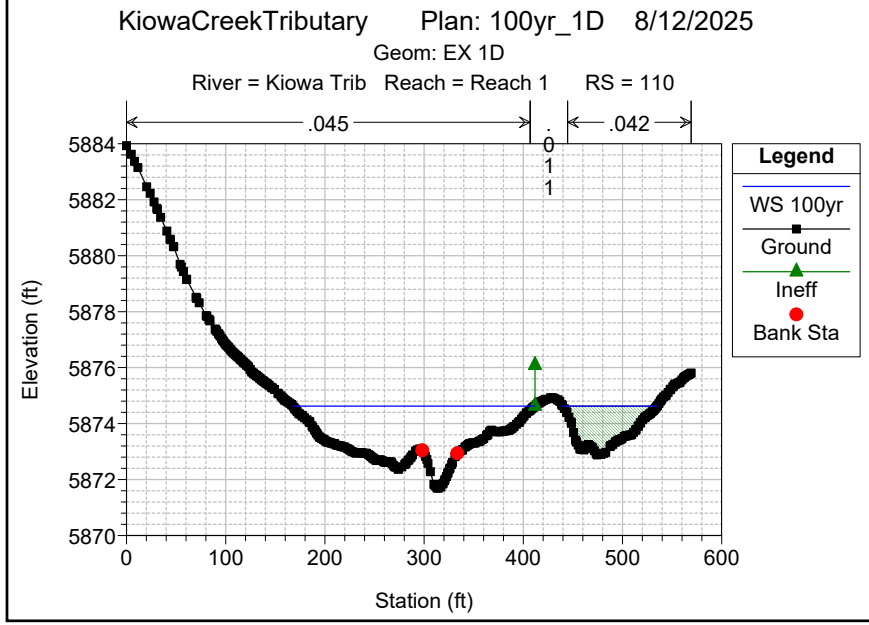
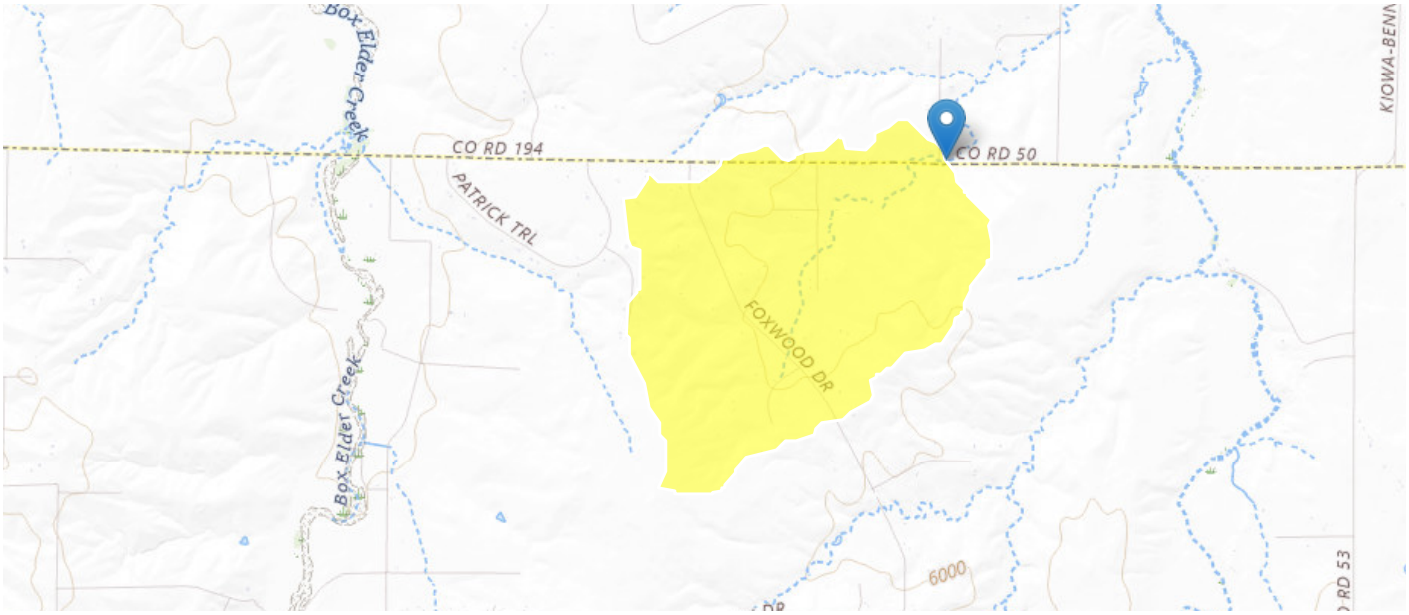
Geom: EX 1D
River = Kiowa Trib Reach = Reach 1 RS = 228
.045
.042
.042
.045
0.01
1
1
Legend
WS 100yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
5886
5884
5882
5880
5878
5876
5874
5872
0
100
200
300
400
500
600


KiowaCreekTributary Plan: 100yr_1D 8/12/2025
Geom: EX 1D
River = Kiowa Trib Reach = Reach 1 RS = 186
.045
.042
0.01
1
1
Legend
WS 100yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
5886
5884
5882
5880
5878
5876
5874
5872
5870
0
100
200
300
400
500
600
700


KiowaCreekTributary Plan: 100yr_1D 8/12/2025
Geom: EX 1D
River = Kiowa Trib Reach = Reach 1 RS = 110
.045
.042
0.01
1
1
Legend
WS 100yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
5884
5882
5880
5878
5876
5874
5872
5870
0
100
200
300
400
500
600

StreamStats Report

Region ID: CO
Workspace ID: CO20250618213111910000
Clicked Point (Latitude, Longitude): 39.56421, -104.46883
NHD Stream GNIS Name of Click Point: Stream name not found
Time: 2025-06-18 15:31:38 -0600



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	5	percent
CSL1085LFP	Change in elevation divided by length between points 10 and 85 percent of distance along the longest flow path to the basin divide, LFP from 2D grid	61.5	feet per mi
DRNAREA	Area that drains to a point on a stream	3.27	square miles
EL7500	Percent of area above 7500 ft	0	percent
ELEV	Mean Basin Elevation	6012	feet
ELEVMAX	Maximum basin elevation	6190	feet
I24H100Y	Maximum 24-hour precipitation that occurs on average once in 100 years	4.79	inches
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	1.93	inches
I6H100Y	6-hour precipitation that is expected to occur on average once in 100 years	3.73	inches
I6H2Y	Maximum 6-hour precipitation that occurs on average once in 2 years	1.33	inches
LAT_OUT	Latitude of Basin Outlet	39.564207	degrees
LC11BARE	Percentage of barren from NLCD 2011 class 31	0	percent
LC11CRPHAY	Percentage of cultivated crops and hay, classes 81 and 82, from NLCD 2011	0	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	1.6	percent

Parameter Code	Parameter Description	Value	Unit
LC11FOREST	Percentage of forest from NLCD 2011 classes 41-43	0	percent
LC11GRASS	Percent of area covered by grassland/herbaceous using 2011 NLCD	96.6	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	1.6	percent
LC11SHRUB	Percent of area covered by shrubland using 2011 NLCD	1.8	percent
LC11SNOIC	Percent snow and ice from NLCD 2011 class 12	0	percent
LC11WATER	Percent of open water, class 11, from NLCD 2011	0	percent
LC11WETLND	Percentage of wetlands, classes 90 and 95, from NLCD 2011	0	percent
LFPLENGTH	Length of longest flow path	3.93	miles
LONG_OUT	Longitude of Basin Outlet	-104.46886	degrees
MINBELEV	Minimum basin elevation	5870	feet
OUTLETELEV	Elevation of the stream outlet in feet above NAVD88	5871	feet
PRECIP	Mean Annual Precipitation	18.35	inches
RCN	Runoff-curve number as defined by NRCS (http://policy.nrcs.usda.gov/OpenNonWebContent.aspx?content=17758.wba)	65.95	dimensionless
RUNCO_CO	Soil runoff coefficient as defined by Verdin and Gross (2017)	0.22	dimensionless
SSURGOA	Percentage of area of Hydrologic Soil Type A from SSURGO	0	percent
SSURGOB	Percentage of area of Hydrologic Soil Type B from SSURGO	42.3	percent
SSURGOC	Percentage of area of Hydrologic Soil Type C from SSURGO	55.3	percent
SSURGOD	Percentage of area of Hydrologic Soil Type D from SSURGO	2.47	percent
STATSCLAY	Percentage of clay soils from STATSGO	26.18	percent
STORNHD	Percent storage (wetlands and waterbodies) determined from 1:24K NHD	0.1	percent
TOC	Time of concentration in hours	3.98	hours

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Foothills Region Peak Flow 2016 5099]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	3.27	square miles	0.6	2850
I6H100Y	6 Hour 100 Year Precipitation	3.73	inches	2.38	4.89
OUTLETELEV	Elevation of Gage	5871	feet	4290	8270
STATSCLAY	STATSGO Percentage of Clay Soils	26.18	percent	9.87	37.5

Peak-Flow Statistics Flow Report [Foothills Region Peak Flow 2016 5099]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct, RMSE: Root Mean Squared Error, PseudoR^2: Pseudo R Squared (other -- see report)

Statistic	Value	Unit	ASEp
50-percent AEP flood	64	ft^3/s	117
20-percent AEP flood	202	ft^3/s	87
10-percent AEP flood	358	ft^3/s	80

Statistic	Value	Unit	ASEp
4-percent AEP flood	642	ft^3/s	80
2-percent AEP flood	927	ft^3/s	83
1-percent AEP flood	1300	ft^3/s	88
0.5-percent AEP flood	1750	ft^3/s	94
0.2-percent AEP flood	2490	ft^3/s	104

Peak-Flow Statistics Citations

Kohn, M.S., Stevens, M.R., Harden, T.M., Godaire, J.E., Klinger, R.E., and Mommandi, A.,2016, Paleoflood investigations to improve peak-streamflow regional-regression equations for natural streamflow in eastern Colorado, 2015: U.S. Geological Survey Scientific Investigations Report 2016–5099, 58 p. (http://dx.doi.org/10.3133/sir20165099)

NHD Features of Delineated Basin

NHD Streams Intersecting Basin Delineation Boundary

This functionality attempts to find the stream name at the delineation point. The name of the nearest intersecting National Hydrography Dataset (NHD) stream is selected by default to appear in the report above. NHD streams do not correspond to the StreamStats stream grid and may not be accurate. If you would like a different stream to appear in the above section, please make a selection below.

No NHD streams intersect the delineated basin.

Watershed Boundary Dataset (WBD) HUC 8 Intersecting Basin Delineation Boundary

This functionality attempts to find the intersecting HUC 8 of the delineated watershed. HUC boundaries do not correspond to the StreamStats data and may not be accurate.

HUC 8	Name
10190010	Kiowa
10190003	Middle South Platte-Cherry Creek

NHD Hydrologic Features Citations

U.S. Geological Survey, 2022, USGS TNM - National Hydrography Dataset, accessed July 21, 2022 at URL https://hydro.nationalmap.gov/arcgis/rest/services/nhd/MapServer/6. (https://hydro.nationalmap.gov/arcgis/rest/services/nhd/MapServer/6) U.S. Geological Survey, 2022, USGS TNM - National Hydrography Dataset, accessed July 21, 2022 at URL https://hydro.nationalmap.gov/arcgis/rest/services/wbd/MapServer/4. (https://hydro.nationalmap.gov/arcgis/rest/services/wbd/MapServer/4)

Application Version: 4.29.1
StreamStats Services Version: 1.2.22

NSS Services Version: 2.2.1

Appendix B

Field Notes from Structures Site Visit

Project:	PWAY SEG 5	Computed:	Date:
Subject:	BLACK SHACK CREEK	Checked:	Date:
Task:		Page:	of:
Job #:		No:	

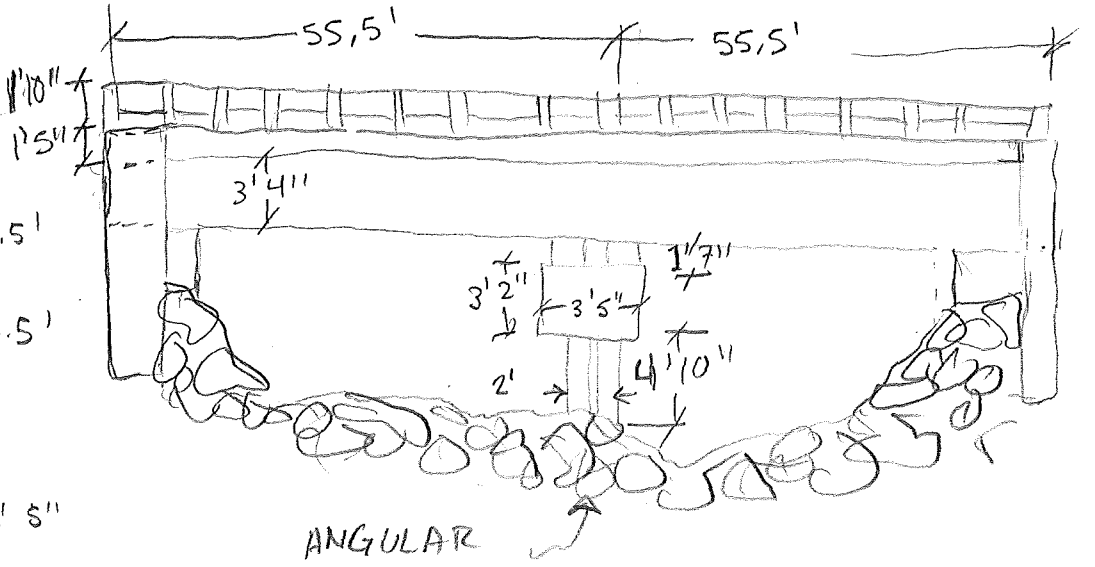
OF SPANS: 2

OF PIERS: 1

SPAN 1 LENGTH: 55.5'

SPAN 2 LENGTH: 55.5'

PIER WIDTH: 2'



PIER CAP WIDTH: 3' 5"

PIER CAP HEIGHT: 3' 2"

PIER HEIGHT: 4' 10"

GUARD RAIL HEIGHT: 1' 10"

DECK THICKNESS: 1' 5" + 3' 4" = 4' 9"

WINGWALL TYPE: 30%

WINGWALL LENGTH: 8' 10"

SKEW: 0%

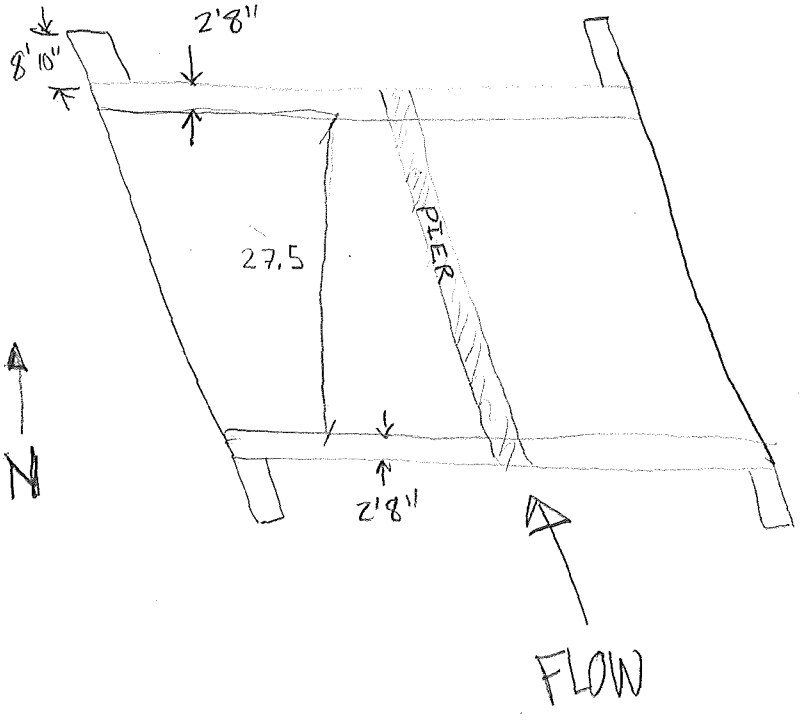
BRIDGE WIDTH: 27.5'

CURB HEIGHT: 11"

PIER SHAPE: TRIANGLE NOSE

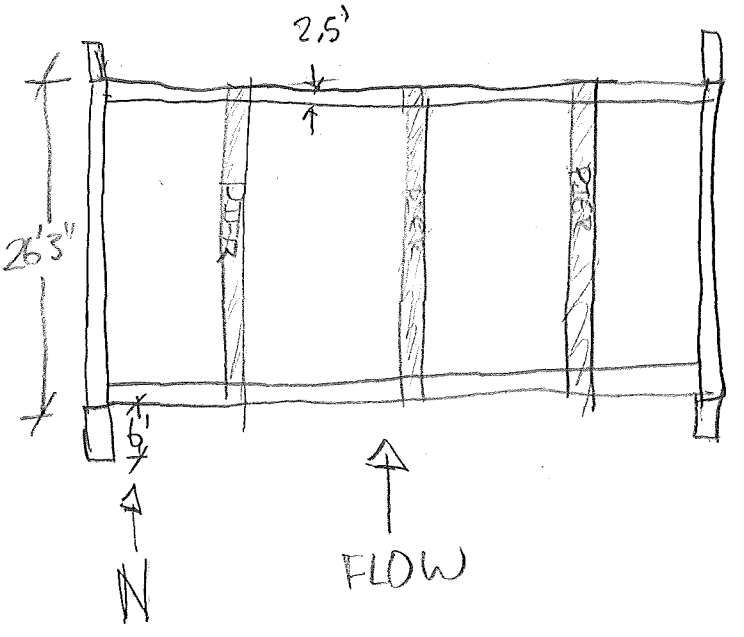
SPACERS: 1' 7"

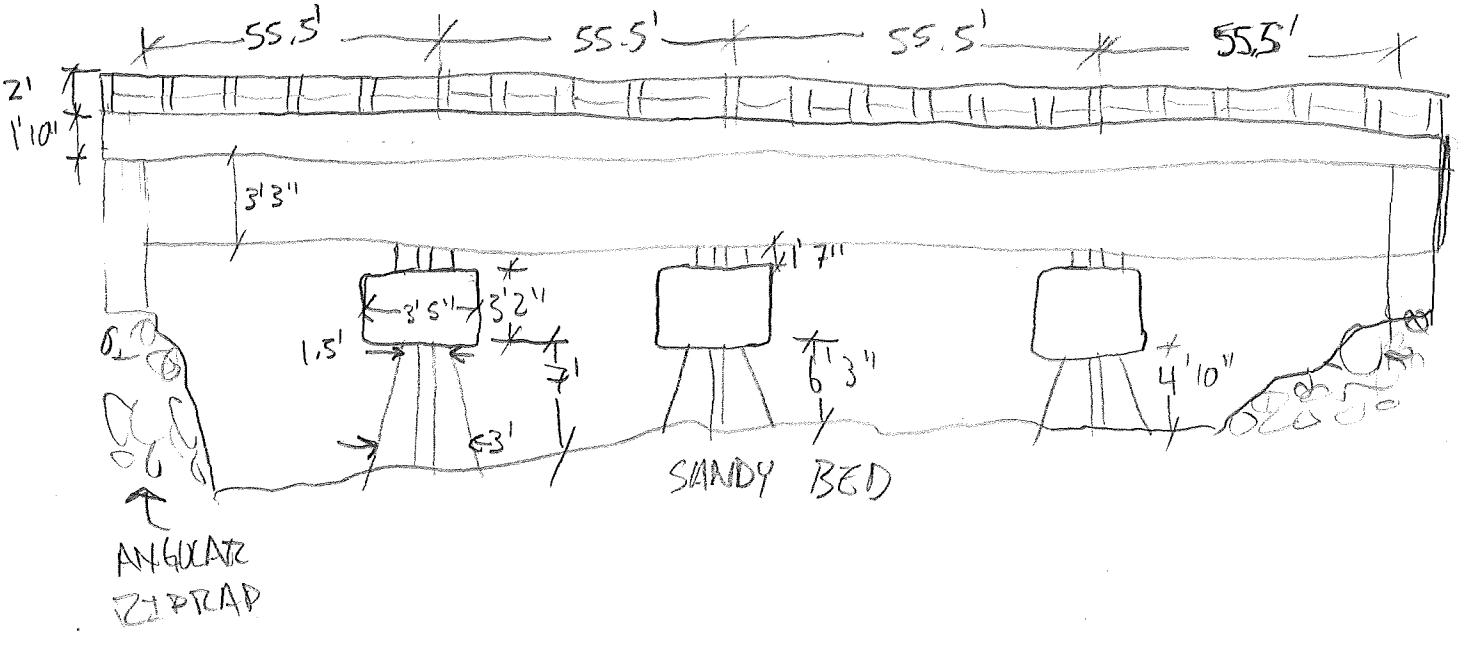
CURB WIDTH: 2' 8"



Project: PWAY SEG 5		Computed:	Date:
Subject: BOX ELDER CREEK		Checked:	Date:
Task:		Page:	of:
Job #:		No:	

OF SPANS: 4
OF PIERS: 3
SPAN 1 LENGTH: 55.5'
SPAN 2 LENGTH: 55.5
SPAN 3 LENGTH 55.5
SPAN 4 LENGTH 55.5
PIER CAP HEIGHT 3' 2"
PIER CAP WIDTH 3' 5"
PIER WIDTH Top 1'6" Bottom 3'
PIER HEIGHT 7' 6' 3" 4' 10"
GUARD RAIL HEIGHT: 2'
CURB HEIGHT: 0.5'
CURB WIDTH: 2.5'
WINGWALL TYPE: STRAIGHT
WINGWALL LENGTH: 6'
BRIDGE WIDTH: 26' 3"
PIER SHAPE: TRIANGLE NOSE
DECK THICKNESS: 1' 10" + 3' 3"
SPACERS 1' 7"





Project: PWAY SEG 5		Computed:	Date:
Subject: BLACK SHACK CREEK TRIB		Checked:	Date:
Task:		Page:	of:
Job #:		No:	

HEADWALL: PROJECTING

PIPE MATERIAL: CMP

BARREL TYPE: CIRCULAR

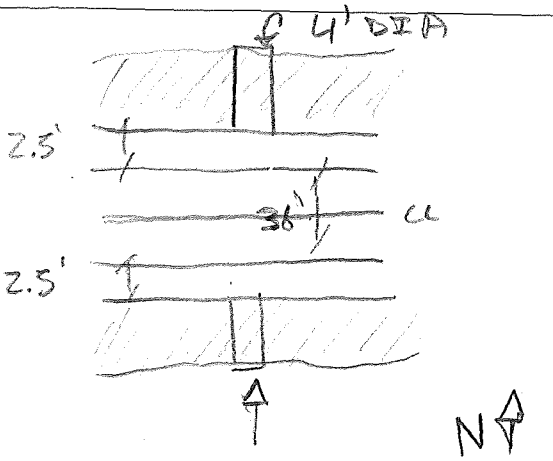
OF BARRELS: 1

DIAMETER: 4

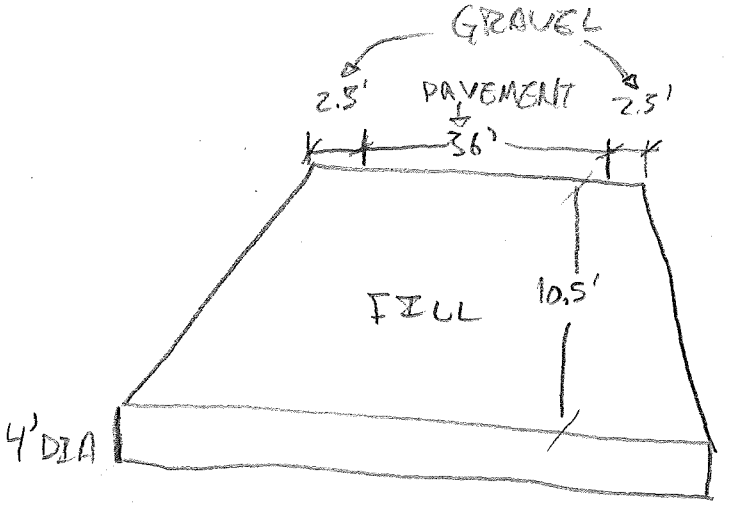
PIPE LENGTH:

PIPE COVER: 10.5 FT

DESCRIPTION: 18" GRASS STAND IN UPSTREAM WATERSHED, LIGHT DEBRIS, ~3.5' SCOUR HOLE AT DS END OF PIPE.



PLAN



Project: PWAY SEGMENT 5		Computed:	Date:
Subject: SENAL CREEK TRIB		Checked:	Date:
Task: CULVERT		Page:	of:
Job #:		No:	

HEADWALL TYPE: PROJECTING

PIPE MATERIAL: CMP

BARREL TYPE: CIRCULAR

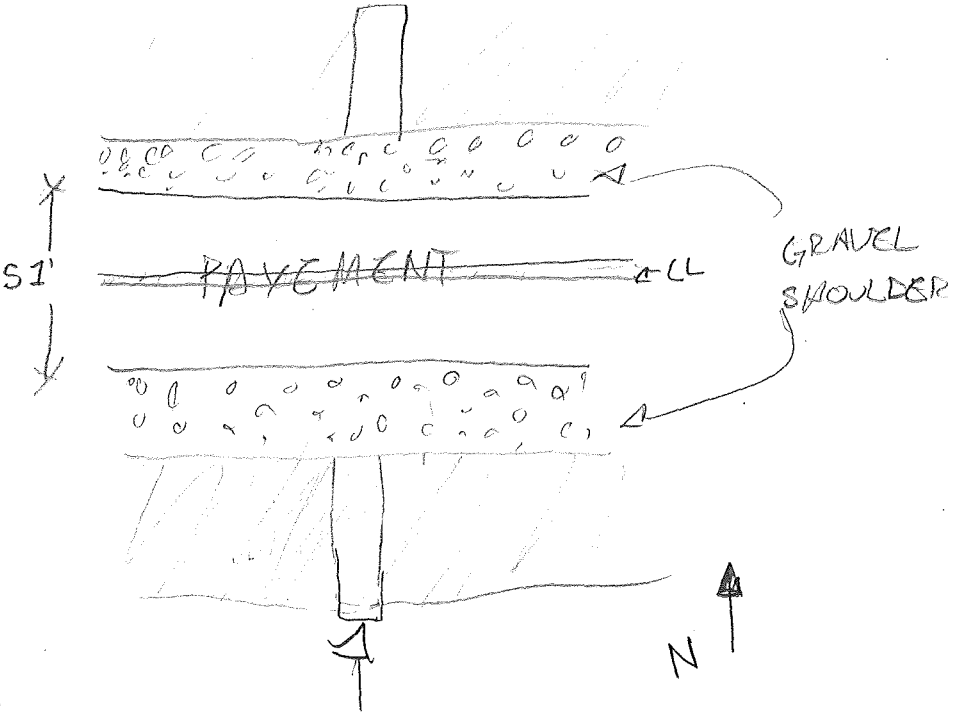
OF BARRELS: 1

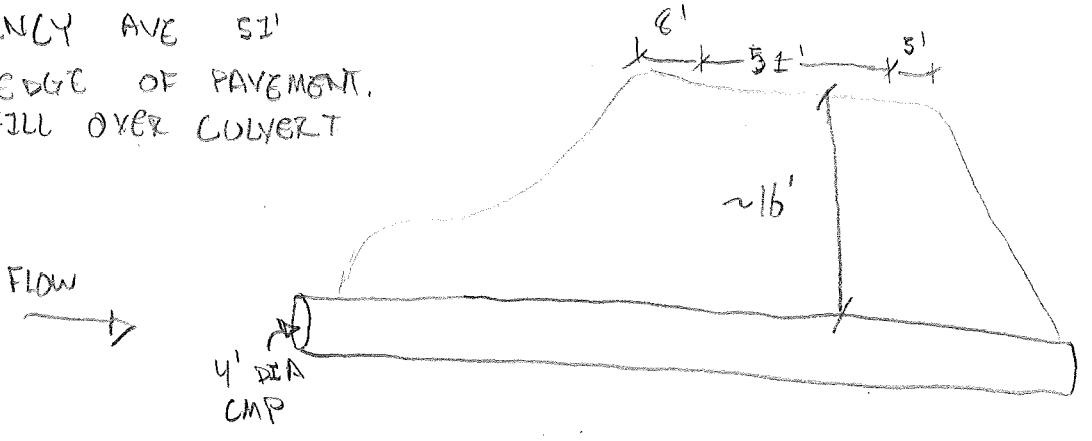
DIAMETER: 4 FT

PIPE LENGTH:

COVER DEPTH: 12 FT

DESCRIPTION:
NO OBSTRUCTION, ~18" GRASS
IN UPSTREAM BASIN, 2' CONC
CULVERT AT RIGHT BANK
UNDER POWHATON RD.
E QUINCY AVE 51'
FROM EDGE OF PAVEMENT.
~12' FILL OVER CULVERT





PROFILE