# Hydraulics Report

## Sespe Creek Overflow Channel Railroad Bridge Hydraulic Analysis at Fillmore, CA

Prepared for RailPros

October 24, 2023

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**GHD**

943 Reserve Drive,

Roseville, California 95678, United States

**T** +1 916 782 8688 | **F** +1 916 782 8689 | **E** info-northamerica@ghd.com | **ghd.com**

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# 1. Introduction

## 1.1 General Introduction

The Ventura County Transportation Commission (VCTC) is planning to reconstruct a portion of the existing railroad bridge over the Sespe Creek Overflow Channel in Fillmore, California. During high flows on January 10, 2023, the west end of the bridge was damaged, including washing out 2 bents and severe damage to the abutment, resulting in the loss of three bridge deck spans, as shown in Figure 1. The repair includes replacing the two washed out bents and one of the remaining bents with two new concrete bents, as well as replacing the existing west abutment with a new concrete abutment, resulting in two new bridge deck spans.

The design is currently at the 90% design level and this report and associated analysis is based on the information included in those design drawings.

***Figure 1*** ***Damaged Portion of Railroad Bridge (looking upstream)***

## 1.2 Purpose of this Report

The purpose of this report is to present the methods and outcomes of a hydraulic analysis of Sespe Creek that was conducted to assist in the design of the repair of the damaged railroad bridge in Fillmore, California. The key objectives of the analysis are:

- Provide a hydraulic assessment to estimate the water surface profile, flow depth, and flow velocity in Sespe Creek in the vicinity of the Project for the pre-project and post-project conditions
- Provide an evaluation of bridge scour for the proposed improvements in the post-project conditions

## 1.3 Scope and Limitations

This report has been prepared by GHD for *RailPros* and may only be used and relied on by *RailPros* for the purpose agreed between GHD and *RailPros* as set out in Section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than *RailPros* arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions, and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer Section 1.4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

**Accessibility of documents**

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

## 1.4 Assumptions

It is assumed that the data provided for using in this study, including the hydraulic, topographic survey, and drawings represent the creek, hydraulic structures, and flows to a level of accuracy that is appropriate for this study.

# 2. Background

## 2.1 Study Area Description

The study area includes Sespe Creek in the vicinity of the railroad bridge. The land adjacent to the creek along the left bank (looking downstream) is developed with mostly single-family residences and the land adjacent to the creek along the right bank (looking downstream) consists of mostly agricultural land use. Sespe Creek flows from north to south within this reach and consists of a natural channel with a levee along the left bank (looking downstream). Approximately 2,500 feet upstream of the rail bridge, the creek splits into two channels, with the main channel to the west and the Sespe Creek Overflow Channel to the east. As a result, there are two rail bridges over Sespe Creek at this location, one over the main channel to the west and the other over the overflow channel to the east. The bridge over the overflow channel is the focus of this study.

## 2.2 Vertical Datum

The Project references the North American Vertical Datum of 1988 (NAVD88) in units of feet and all elevations presented herein are based on that datum.

## 2.3 Existing Conditions

The existing Sespe Creek Overflow Channel bridge was constructed in 1969 as a fifteen-span bridge and is approximately 450 feet long and 17 feet wide. The bridge superstructure consists of concrete box girders with ballast curbs and sidewalks that have a combined deck thickness of approximately 4 feet and 1 inch. Prior to the damage, the superstructure was supported on 14 bents (constructed of concrete bent caps with steel piles and concrete infill walls) and two abutments, as shown in Figure 2. The bridge deck slopes at approximately 1% from the west to the east from approximately elevation 451.0 feet to 447.0 feet. Adjacent to the railroad bridge and approximately 45 feet downstream is the Old Telegraph Road bridge.

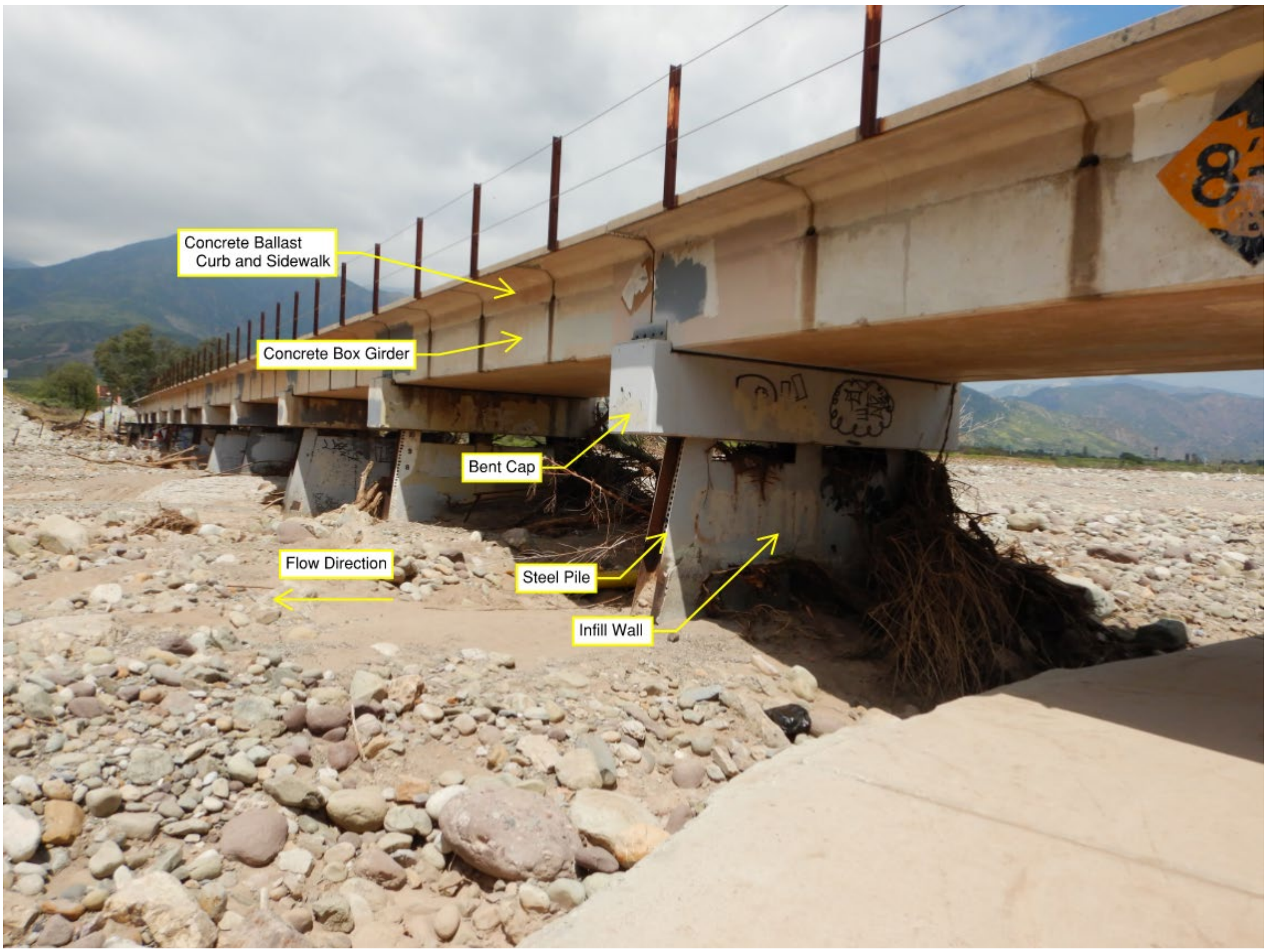



***Figure 2*** ***Downstream Side of Railroad bridge (East Side of Bridge)***

## 2.4 Proposed Improvements

The proposed improvements at the bridge include replacing the two washed out bents and one of the remaining bents with two new concrete bents, as well as replacing the existing west abutment with a new concrete abutment, resulting in two new bridge deck spans of 48 feet and 10 inches each and an overall bridge length that is approximately 6 feet and 9 inches longer than the existing bridge. The proposed bridge is 19 feet wide, so approximately 2 feet wider than the existing bridge. The proposed bridge superstructure is a concrete box girder with ballast curbs and sidewalks, like the existing bridge, however, the proposed bridge soffit will extend approximately 12 inches below the existing bridge soffit due to the increased thickness of the structure.

The two proposed bents consist of a 4-foot-thick bent cap on two 4-foot-diameter columns with a concrete infill wall between the columns. The two columns will each be supported by a 6-foot-diameter CIDH concrete pile. The proposed concrete abutment will be supported by a concrete pile cap and four 6-foot-diameter piles.

# 3. Hydraulic Design Standards and Criteria

## 3.1 Overview

This section summarizes the design standards and criteria that were considered for the hydraulic analysis, which include requirements from the Federal Emergency Management Association (FEMA) and the Southern California Regional Rail Authority (SCRRA).

## 3.2 FEMA

Sespe Creek at the project location is located within a FEMA Special Flood Hazard Area (SFHA) Zone A, as shown on Flood Insurance Rate Map (FIRM) panel numbers 06111C0641E and 06111C0643E, last revised on January 20, 2010 (Attachment 1). Zone A represents areas which are subject to inundation by the 1-percent-annual flood (100-yr flood), also known as the Base Flood. Detailed hydraulic analyses have not been conducted for these areas, and consequently Base Flood Elevations (BFEs) have not been determined. The areas of inundation in Zone A are generally determined using approximate methods.

The planned bridge repairs are proposed within a FEMA SFHA, and as such are subject to FEMA requirements which are intended to reduce flood loss and to protect resources. Typically, encroachments into a SFHA outside of a regulated floodway (which does not exist at the Project site), should not cause an increase in the BFE by more than one foot.

## 3.3 SCRRA

SCRRA criteria for the hydraulic design of bridges is specified in the SCRRA Design Criteria Manual (SCRRA, 2021) and includes the following for bridges conveying cross-track flood flows:

- the opening will be sized so that the water surface for a 50-year event will rise no higher than the lowest low chord of the bridge
- the opening will be sized so that the energy grade line for a 100-year event will not rise above the adjacent subgrade elevation (defined as 2.81 feet below top of rail elevation)

The existing (pre-disaster) condition of the bridge did not meet these criteria. A bridge design repair to meet these criteria would require the bridge and adjacent tracks to be raised substantially, thus a relocation of the railroad tracks would likely be more practical. Regardless, either of these efforts require design that exceeds the limitations of the rehabilitation which is to repair the bridge to its pre-disaster design, capacity, and function. As such, the proposed design will not meet the SCRRA criteria presented above.

# 4. Hydrologic Assessment

FEMA is currently in the process of updating the Flood Insurance Study (FIS) for Ventura County and the preliminary FIS (FEMA, 2022) that was developed as part of that effort includes the 50 and 100-year peak discharges for Sespe Creek that were used for this study and are shown in Table 1. These flows are at the confluence with the Santa Clara River and are based on a drainage area of 263 square miles. They were estimated by FEMA using the Hydrologic Simulation Program-FORTRAN (HSPF) model as described in the preliminary FIS (FEMA, 2022).

The peak discharge in the FIS is for the entire Sespe Creek, which includes the main channel and the overflow channel where the railroad bridge is located. As discussed in more detail in Section 5.2.3, the hydraulic model had to be truncated for the scour analysis to include only the Sespe Creek Overflow Channel, so the 100-year peak discharge within that section of the channel had to be estimated as part of this study. This was accomplished by using the data from the Preliminary FEMA Model described in Section 5.1. The model provides the flow through each of the two railroad bridges, which are shown in Table 1, and the flow at the bridge in the Sespe Creek Overflow Channel was used in the truncated hydraulic model for the scour analysis.

***Table 1 Peak Discharge Rates***

| Annual Chance Exceedance | Sespe Creek (Entire Channel) | Sespe Creek Overflow Channel | Sespe Creek Main Channel |
|---|---|---|---|
| 2% (50-year) | 102,604 cfs | N/A | N/A |
| 1% (100-year) | 135,789 cfs | 96,955 cfs | 38,834 cfs |

# 5. Hydraulic Assessment

## 5.1 Hydraulic Modeling Overview

Hydraulic modeling of Sespe Creek was conducted as part of this study to assess the effect of the proposed bridge repairs on the water surface profile, flow depth, and flow velocity in the channel. The modeling was performed using the USACE Hydrologic Engineering Center River Analysis System (HEC-RAS) version 6.3 software. The base model for this study was provided by Ventura County and is the model developed by FEMA as part of the recent FIS and FIRM updates that are currently preliminary FEMA products, referred to herein as the Preliminary FEMA Model. Although the model is preliminary is status, it is considered the best available model for this study area as it was recently developed and there are no previous FEMA models for this location. The model is a one-dimensional (1D) steady-flow model of Sespe Creek and extends from the confluence with the Santa Clara River to approximately 6 miles upstream.

## 5.2 Hydraulic Model Setup

### 5.2.1 Pre-Project Conditions

The Preliminary FEMA Model was assumed to represent the pre-project conditions, which, for purposes of this study, refers to the railroad bridge and channel prior to the damage that occurred in January of 2023. Accordingly, no updates were made to the model for the pre-project conditions.

### 5.2.2 Post-Project Conditions

The post-project conditions geometry within the HEC-RAS model was developed by modifying the railroad bridge at the Sespe Creek Overflow Channel to reflect the proposed bridge repairs based on the 30% design, including the new bents, new bridge deck, new abutment, and rock slope protection at the abutment. In addition, the topography at the bridge crossing was updated based on the topography obtained for the design of the bridge repair.

## 5.3 Results

The following four scenarios were evaluated with the hydraulic model to assess the effect of the proposed bridge repairs on the water surface elevation in the channel:

1. Pre-project Conditions with 50-year peak discharge
2. Pre-project Conditions with 100-year peak discharge
3. Post-project Conditions with 50-year peak discharge
4. Post-project Conditions with 100-year peak discharge

Detailed model output for the entire model domains for the scenarios evaluated is included in Attachment 3. A comparison of the pre-project and post-project water surface elevations for both flow scenarios within the vicinity of the railroad bridge is shown in Table 2 and Table 3 and the water surface profiles are shown in Figure 3. For both flow rates, the modeling is showing minor decreases in water surface elevation for the post-project condition extending approximately 1,500 ft upstream of the bridge. The decreases in water surface elevation are less than 0.3 feet and 0.1 feet for the 50-year and 100-year peak discharges, respectively. The decreases are likely due to the removal of one bent and changes in topography at the bridge. In all other locations, there is no change in water surface elevation (WSE). The decreases in water surface elevations are in accordance with the FEMA requirements discussed in Section 3.

*Table 2 Water Surface Elevation Summary for 50-Year Peak Discharge*

| Channel Station | Pre-Project Water Surface Elev. (ft) | Post-Project Water Surface Elev. (ft) | Change in Water Surface Elev. (ft) |
|---|---|---|---|
| 15728 | 469.67 | 469.67 | 0.00 |
| 15144 | 462.80 | 462.80 | 0.00 |
| 14340 | 456.56 | 456.56 | 0.00 |
| 13782 | 452.15 | 451.97 | -0.18 |
| 13104 | 451.79 | 451.59 | -0.20 |
| 12892 | 451.62 | 451.39 | -0.23 |
| 12852 | Railroad Bridge | | |
| 12827 | 448.45 | 448.45 | 0.00 |
| 12807 | 448.44 | 448.44 | 0.00 |
| 12780 | Old Telegraph Road Bridge | | |
| 12712 | 442.80 | 442.80 | 0.00 |
| 12238 | 437.85 | 437.85 | 0.00 |
| 11854 | 434.18 | 434.18 | 0.00 |
| 10652 | 427.37 | 427.37 | 0.00 |
| 10111 | 422.25 | 422.25 | 0.00 |

*Table 3 Water Surface Elevation Summary for 100-Year Peak Discharge*

| Channel Station | Pre-Project Water Surface Elev. (ft) | Post-Project Water Surface Elev. (ft) | Change in Water Surface Elev. (ft) |
|---|---|---|---|
| 15728 | 471.46 | 471.46 | 0.00 |
| 15144 | 464.53 | 464.53 | 0.00 |
| 14340 | 457.85 | 457.85 | 0.00 |
| 13782 | 455.46 | 455.41 | -0.05 |
| 13104 | 455.23 | 455.18 | -0.05 |
| 12892 | 455.13 | 455.07 | -0.06 |
| 12852 | Railroad Bridge | | |
| 12827 | 452.18 | 452.18 | 0.00 |
| 12807 | 451.45 | 451.45 | 0.00 |
| 12780 | Old Telegraph Road Bridge | | |
| 12712 | 444.76 | 444.76 | 0.00 |
| 12238 | 439.53 | 439.53 | 0.00 |
| 11854 | 435.65 | 435.65 | 0.00 |
| 10652 | 428.75 | 428.75 | 0.00 |
| 10111 | 423.40 | 423.40 | 0.00 |

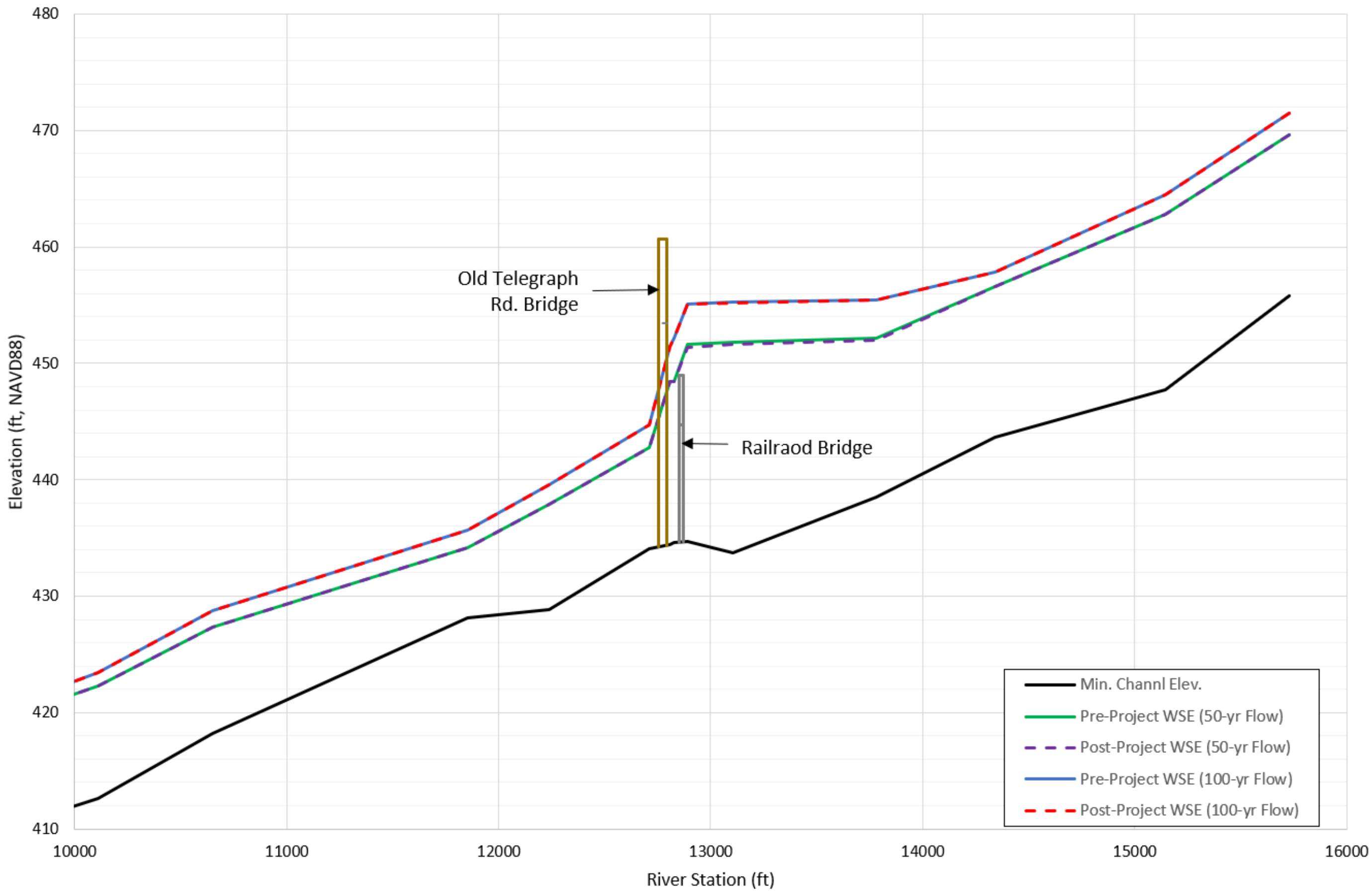



***Figure 3 Water Surface Profiles for Sespe Creek in Project Vicinity***

# 6. Bridge Scour Analysis

Scour analyses were conducted as part of this study to evaluate bridge scour for the post-project conditions. The scour analysis included four primary components: long-term degradation of the riverbed, contraction scour at the bridge, local scour at the proposed piers, and local scour at the proposed abutment. The sum of these components represents the total scour at the bridge.

## 6.1 Basis of Scour Analysis

The bridge scour analysis was conducted for the post-project condition based on the methods presented in the Federal Highway Administration (FHWA) Hydraulic Engineering Circular No. 18 *Evaluating Scour at Bridges* (FHWA, 2012), commonly referred to as HEC-18. The methods that are presented in HEC-18 are applicable to railroad structures, per the SCRRA Design Criteria Manual (SCRRA, 2021).

As discussed previously in this report, Sespe Creek is divided into two channels at the railroad crossing, the main channel and the overflow channel, and there are bridges at each channel. The Preliminary FEMA Model discussed in Section 5 represents the two bridges by using the Multiple Opening Bridge option, which allows the model to split flow between multiple openings within a crossing. While the Multiple Opening option is appropriate for predicting the hydraulic grade line through a structure, it prevents the use of the bridge scour tool within HEC-RAS. To use the bridge scour tool within HEC-RAS, GHD truncated the Preliminary FEMA model into a single channel with a single bridge over the Sespe Creek Overflow Channel only. The model truncation included the following process:

- created a new river reach for the Sespe Creek Overflow Channel from the split of Sespe Creek and extending downstream of the crossing (approximately 5,000 linear feet in total length)
- cross-section geometry and physical representation from the post-project conditions model were copied over to the new river reach (including bank stations, roughness coefficients, reach lengths, etc.)
- cross-section geometries were truncated at the right bank of the overflow channel to isolate it from the Sespe Creek main channel
- the railroad bridge and Old Telegraph Road bridge geometries were added to the model and truncated to the overflow channel, including overbank areas
- the upstream boundary condition was set to estimated 100-year peak discharge for the Sespe Creek Overflow Channel
- the downstream boundary condition was set to a water surface elevation from the post-project conditions model output for the 100-year peak discharge
- the resulting model output was compared to the post-project conditions model to ensure acceptable agreement between the two models.

The scour analysis was performed using the results of the truncated hydraulic model discussed above and the 100-yr peak discharge for the Sespe Creek Overflow Channel discussed in Section 4.

## 6.2 Geotechnical Data

The project geotechnical engineering consultant, Diaz Yourman & Associates, provided a particle size analysis from a soil sample taken from a boring at the project site which is included in Attachment 5. The soil sample was from a depth of 0 to 5 feet and had a median grain size diameter of approximately 5.1 mm, which was used for the scour analysis for this study.

## 6.3 Long-Term Bed Elevation Change

Long-term bed elevation change, as it relates to scour, is due to degradation of the channel bed as it tends toward an equilibrium slope. Historical channel elevation data at the project site could inform the potential for long-term degradation in the area, however, historical channel elevation data, including record drawings for the bridge were not available for this study. The only data provided for this study that relates to long-term bed elevation change were two bridge inspection reports, one from 11/30/2022 (Koppers Railroad Structures Inc., 2022) and one after the damage from 5/8/2023 (Wilson & Company, 2023). Both reports noted local scour at some of the bents and west abutment, neither indicated elevation change across the entire channel.

Most of the 263-square mile watershed for Sespe Creek is undeveloped so it is expected that the sediment supply and runoff from the watershed have historically remained consistent. Based on this, it was assumed that the lower reach of Sespe Creek was in equilibrium with respect to long-term bed elevation change and that estimating an equilibrium slope for the channel would provide an indication whether localized long-term bed elevation change may be expected. Using this approach, a channel profile was developed that extended from the Hwy. 126 bridge upstream through the Sespe Creek Overflow Channel and a “best-fit” equilibrium slope was drawn on the channel profile. This profile is included in Attachment 4. This approach indicated the potential for the channel to degrade at the railroad bridge by approximately 4 feet, so this is what was assumed for the long-term degradation at the bridge.

## 6.4 Clear-Water versus Live-Bed Scour

Clear-water scour and live-bed scour are two methods by which contraction and pier scour occur. Clear-water scour occurs where there is no transport of bed material from upstream of the bridge while live-bed scour occurs where there is transport of bed material from upstream. The type of scour which occurs is dependent on the bed material grain size, upstream average velocity, and upstream average depth of flow. The critical velocity, $V_C$, necessary for transport of the bed material median diameter, $D_{50}$, is used as an indicator for clear-water or live-bed scour conditions. Clear-water scour is assumed to occur when the average velocity, V, upstream of the bridge is less than or equal to $V_C$ for the $D_{50}$ of the bed material. Live-bed scour is assumed to occur if V is greater than $V_C$. The critical velocity was calculated using equation 6.1 from HEC-18:

$$V_C = K_u y^{1/6} D^{1/3}$$

Where:

$$V_C = Critical\ velocity\ above\ which\ bed\ material\ of\ size\ D\ and\ smaller\ will\ be\ transported\ \left(\frac{ft}{s}\right)$$
$$y = Average\ depth\ of\ flow\ upstream\ of\ the\ bridge\ (ft)$$
$$D = Particle\ size\ for\ V_C\ (ft)$$
$$D_{50} = Particle\ size\ in\ a\ mixture\ of\ which\ 50\ percent\ are\ smaller\ (ft)$$
$$K_u = 11.17\ English\ units$$

The critical velocity was calculated for the bed material ($D_{50}$=5.1 mm) at the bridge, and it was found that the channel velocity exceeded the critical velocity for particles of that size, so live-bed scour was used for the scour analysis. The calculation is included in Attachment 4.

## 6.5 Contraction Scour

Contraction scour occurs when the flow area of a stream is reduced due by either a bridge structure or a natural contraction of the channel. The reduction of flow area causes a corresponding increase in average velocity of the flow, resulting in increased erosion. The scour will reach maximum depth once the flow area is increased to the point at which there is no net sediment loss from the area.

Contraction scour calculations were performed as part of this study using the Hydraulic Design Function in the HEC-RAS model used for the hydraulic analysis. The Hydraulic Design Function uses the equation presented below to calculate live-bed contraction scour. The output from the calculations is included in Attachment 4 and the calculated scour depths are shown in Table 4.

Live-bed contraction scour was calculated using equation 6.2 from HEC-18, which is a modified version of Laursen's equation:

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{6/7} \left(\frac{W_1}{W_2}\right)^{k_1}$$

Where:

$$y_s = y_2 - y_0 = Average\ contraction\ scour\ depth$$
$$y_1 = Average\ depth\ in\ the\ upstream\ main\ channel\ (ft)$$
$$y_2 = Average\ depth\ in\ the\ contracted\ section\ (ft)$$
$$y_0 = Existing\ depth\ in\ the\ contracted\ section\ before\ scour\ (ft)$$
$$Q_1 = Flow\ in\ the\ upstream\ channel\ transporting\ sediment\ (ft^3/s)$$
$$Q_2 = Flow\ in\ the\ contracted\ channel\ (ft^3/s)$$
$$W_1 = Bottom\ width\ of\ the\ upstream\ main\ channel\ that\ is\ transporting\ bed\ material\ (ft)$$
$$W_2 = Bottom\ width\ of\ main\ channel\ in\ contracted\ section\ less\ pier\ widths\ (ft)$$
$$k_1 = Mode\ of\ bed\ material\ transport\ exponent$$

*Table 4 Contraction Scour Depths*

| Location | Scour Depth (ft) |
|---|---|
| Left Overbank (looking downstream) | N/A |
| Channel | 4.6 |
| Right Overbank (looking downstream) | 2.1 |

## 6.6 Pier Scour

Local scour at bridge piers occurs due to the formation of vortices at the base of the piers which causes the flow to accelerate in that area, resulting in increased sediment transport. The magnitude of pier scour is dependent on the flow velocity, flow depth, pier width, size and gradation of bed material, pier shape, and other factors. Pier scour increases with increased flow velocity, flow depth, and pier width.

Maximum pier scour depth can be predicted using the HEC-18 Pier Scour Equation, which is based on the Colorado State University (CSU) equation, for both clear-water and live-bed scour. The equation is based on the Colorado State University equation and was calculated as follows:

$$\frac{y_s}{y_1} = 2\, K_1 K_2 K_3 \left(\frac{a}{y_1}\right)^{0.65} Fr_1^{0.43}$$

Where:

$$y_s = Scour\ depth\ (ft)$$
$$y_1 = Flow\ depth\ depth\ directly\ upstream\ of\ the\ pier\ (ft)$$
$$K_1 = Correlation\ factor\ of\ pier\ nose\ shape$$
$$K_2 = Correlation\ factor\ of\ angle\ of\ attack\ of\ flow$$
$$K_3 = Correlation\ factor\ for\ bed\ condition$$
$$a = Pier\ width\ (ft)$$
$$Fr_1 = Froude\ Number\ directly\ upstream\ of\ the\ pier = V_1/(gy_1)^{1/2}$$
$$V_1 = Mean\ velocity\ of\ flow\ directly\ upstream\ of\ the\ pier\ (ft/s)$$
$$g = Acceleration\ due\ to\ gravity = 32.2\ (ft/s^2)$$

A Rule of Thumb for maximum scour depth for round nose piers aligned with flow is given in HEC-18 as:

$$y_s \leq 2.4a\ for\ Fr \leq 0.8$$

$$y_s \leq 3.0a\ for\ Fr > 0.8$$

Pier scour calculations were performed as part of this study for the two proposed bents using the Hydraulic Design Function in the HEC-RAS model used for the hydraulic analysis. The Hydraulic Design Function uses the equation presented above to calculate pier scour. The calculations were performed using a 5-foot diameter pier to represent an average of the 4-foot diameter of the columns and the 6-foot-diameter piles that would be exposed due to long term-degradation and contraction scour in the channel. The output from the calculations is included in Attachment 4.

The pier scour calculations performed in HEC-RAS do not account for debris loading on the piers which can increase scour at the piers. After the January 10, 2023 flow event that damaged the bridge, significant debris was observed on the upstream side of the bridge piers. To account for debris accumulation on the piers when considering scour, pier scour calculations were also performed as part of this study outside of HEC-RAS. Those calculations used the same method from HEC-18 described above but use an effective pier width that is calculated based on an assumed debris accumulation of 12 feet wide and 6 feet high. Those calculations were used as the basis for the design and are included in Attachment 4 and the calculated scour depths are shown in Table 5.

*Table 5* *Pier Scour Depths*

| Support Location | Scour Depth (ft) |
|---|---|
| Pier 2 | 15.8 |
| Pier 3 | 15.8 |

## 6.7 Abutment Scour

Abutment scour occurs when the abutment and roadway embankment obstruct flow and cause contraction and turbulence of the flow at the abutment. Abutment scour was calculated using Equation 8.1 from HEC-18, which is known as the Froelich equation:

$$\frac{y_s}{y_a} = 2.27\,K_1 K_2 \left(\frac{L'}{y_a}\right)^{0.43} Fr^{0.61} + 1$$

Where:

$$\begin{aligned}
y_s &= Scour\ depth\ (ft)\\
K_1 &= Coefficient\ for\ abutment\ shape\\
K_2 &= Coefficient\ for\ angle\ of\ embankment\ to\ flow\\
L' &= Length\ of\ active\ flow\ obstructed\ by\ the\ embankment\ (ft)\\
A_e &= Flow\ area\ of\ the\ approach\ cross\ section\ obstructed\ by\ the\ embankment\ (ft^2)\\
Fr &= Froude\ Number\ directly\ upstream\ of\ the\ pier = V_e/(gy_a)^{1/2}\\
V_e &= Q_e/A_e\ (ft/s)\\
Q_e &= Fow\ obstructed\ by\ the\ abutment\ and\ approach\ embankment\ (ft^3/s)\\
y_a &= Average\ depth\ of\ flow\ on\ the\ floodplain\ (A_e/L)\ (ft)\\
L &= Length\ of\ embankment\ projected\ normal\ to\ the\ flow\ (ft)\\
g &= Acceleration\ due\ to\ gravity = 32.2\ (ft/s^2)
\end{aligned}$$

Abutment scour calculations were performed as part of this study for the proposed abutment using the Hydraulic Design Function in the HEC-RAS models used for the hydraulic analyses. The Hydraulic Design Function uses the equation presented above to calculate abutment scour and the output from the calculations is included in Attachment 4 and the calculated scour depths are shown in Table 6.

*Table 6* *Abutment Scour Depth*

| Support Location | Scour Depth (ft) |
|---|---|
| Abutment 1 | 23.5 |

## 6.8 Total Scour

Total scour was calculated as part of this study as the sum of the estimated long-term degradation, contraction, abutment, and pier scour. The results are shown in Table 7.

*Table 7 Total Estimated Scour Depths*

| Support Location | Long-Term Scour Depth (ft) | | Local Scour Depth (ft) | | Total Scour Depth (ft) |
|---|---|---|---|---|---|
| | Long-Term Degradation | Contraction | Pier | Abutment | |
| Abutment 1 | 4.0 | 4.6 | N/A | 23.5 | 32.1 |
| Pier 2 | 4.0 | 4.6 | 15.8 | N/A | 24.4 |
| Pier 3 | 4.0 | 4.6 | 15.8 | N/A | 24.4 |

*Table 8 Total Estimated Scour Elevation*

| Support Location | Approx. Existing Ground Elev. at Upstream Side of Pier or Face of Abutment (ft) | Total Scour Depth (ft) | Total Scour Elev. (ft) |
|---|---|---|---|
| Abutment 1 | 444.0 | 32.1 | 411.9 |
| Pier 2 | 430.7 | 24.4 | 406.3 |
| Pier 3 | 431.0 | 24.4 | 406.6 |

# 7. Scour Countermeasures

The scour analysis presented in Section 6 assumes that no scour countermeasures are in place. At a minimum, scour countermeasures should be installed at the railroad embankment to protect the embankment from scouring and/or breaching behind the abutment. In addition, scour countermeasures could be installed at the bents and abutment to protect against local (pier and abutment) scour. If used, these scour countermeasures should be designed in accordance with allowable methods, such as those presented in FHWA HEC No. 23 (FHWA, 2009). If scour countermeasures are incorporated into the design to protect against local scour, the design of the bridge and scour countermeasures should take into account the long-term and contraction scour of the channel.

Evaluation of the scour potential at the Old Telegraph Road bridge immediately downstream of the railroad bridge was outside of the scope of this study. Based on photographs provided, it appears that scour has damaged the grouted rock slope protection (RSP) at the western abutment of that bridge. The design of the railroad bridge and any associated scour countermeasures should be coordinated with any planned repairs at the Old Telegraph Road bridge.

# 8. References


FEMA. (2022). *Flood Insurance Study for Ventra County, California (Revised Preliminary: August 19, 2022).*

FHWA. (2009). *Bridge Scour and Sream Instability Countermeasures: Experience, Selection, and Design Guidance - Third Edition.*

FHWA. (2012). *Hydraulic Engineering Circular No. 18 Evaluating Scour at Bridges, Fifth Edition.*

Koppers Railroad Structures Inc. (2022). *Inspection Summary (Milepost 423.44).*

SCRRA. (2021, January). SCRRA Design Criteria Manual.

Wilson & Company. (2023). *Bridge Inspetion Report (Milepost 423.44).*

# Attachments

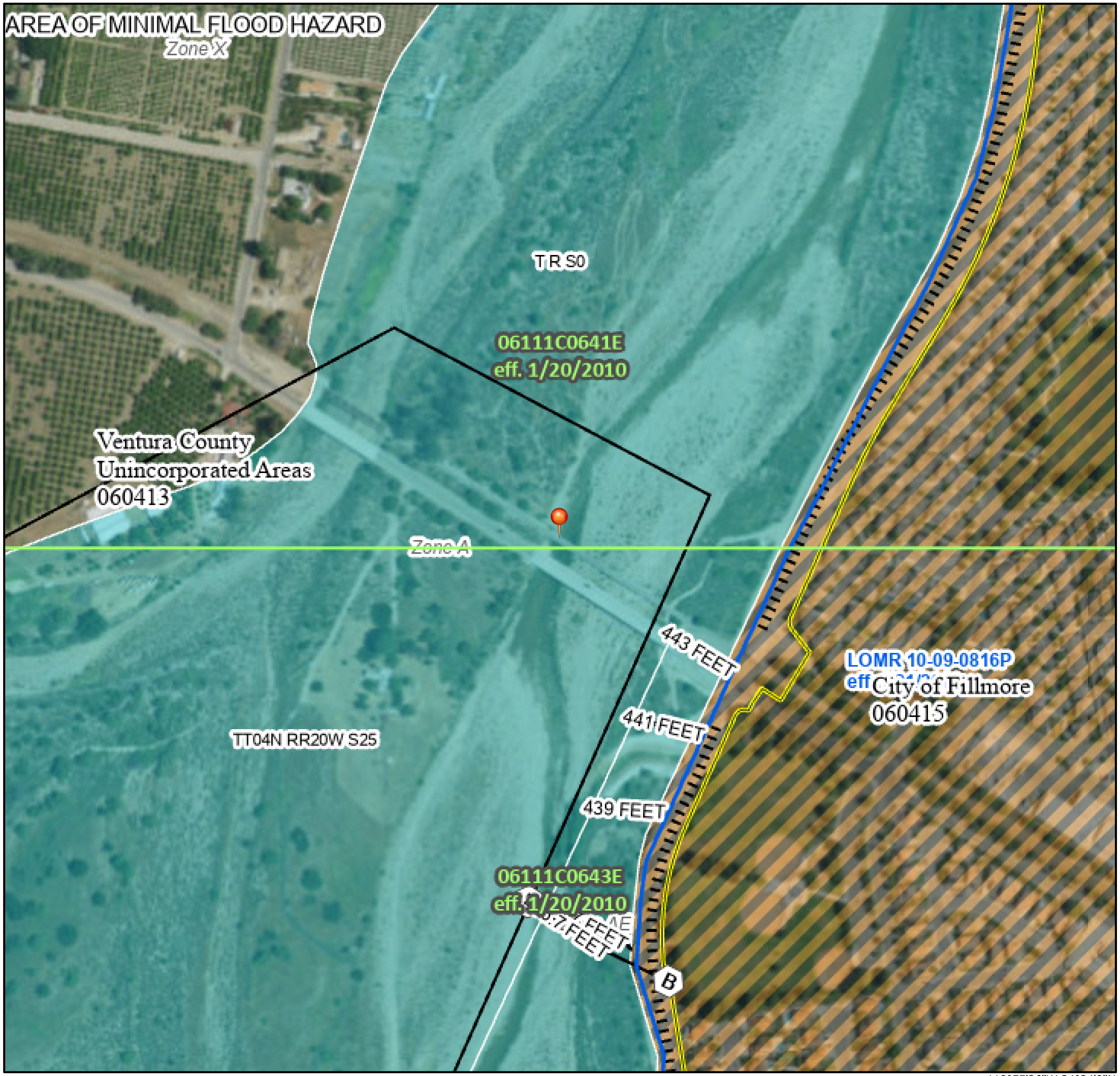
# Attachment 1

## FEMA FIRMette

# National Flood Hazard Layer FIRMette

FEMA

118°56'14"W 34°24'38"N




0 250 500 1,000 1,500 2,000 Feet

1:6,000

118°55'36"W 34°24'8"N

*Basemap Imagery Source: USGS National Map 2023*

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

**SPECIAL FLOOD HAZARD AREAS**

- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**

- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

**OTHER AREAS**

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

**GENERAL STRUCTURES**

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

**OTHER FEATURES**

- B 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

**MAP PANELS**

- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

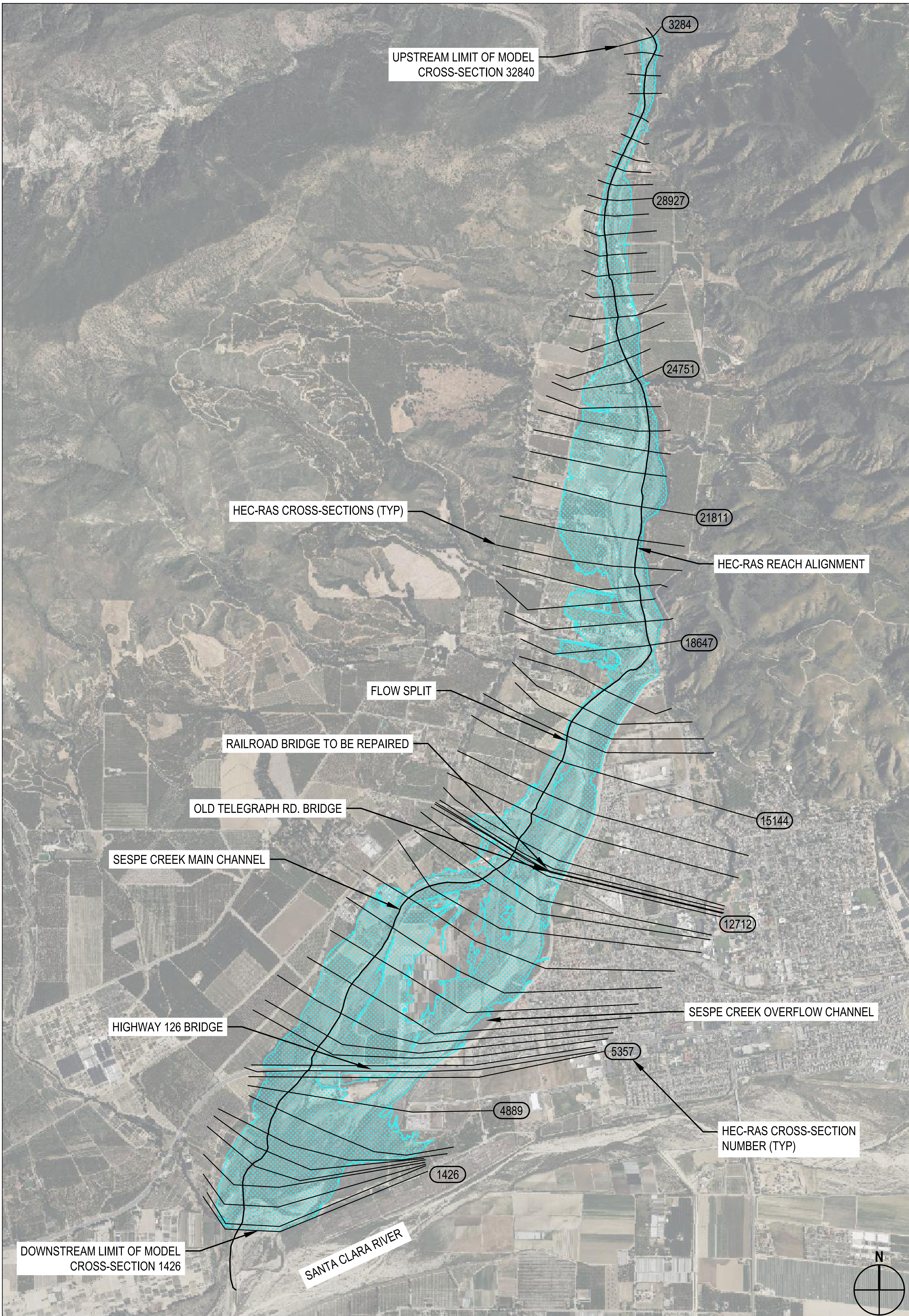
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/18/2023 at 7:52 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

# Attachment 2

## Hydraulic Workmap




APPROXIMATE LIMIT OF
100-YEAR FLOOD INUNDATION

0 2,000' 4,000'

GHD

RAILPROS
SESPE CREEK OVERFLOW CHANNEL
RAILROAD BRIDGE

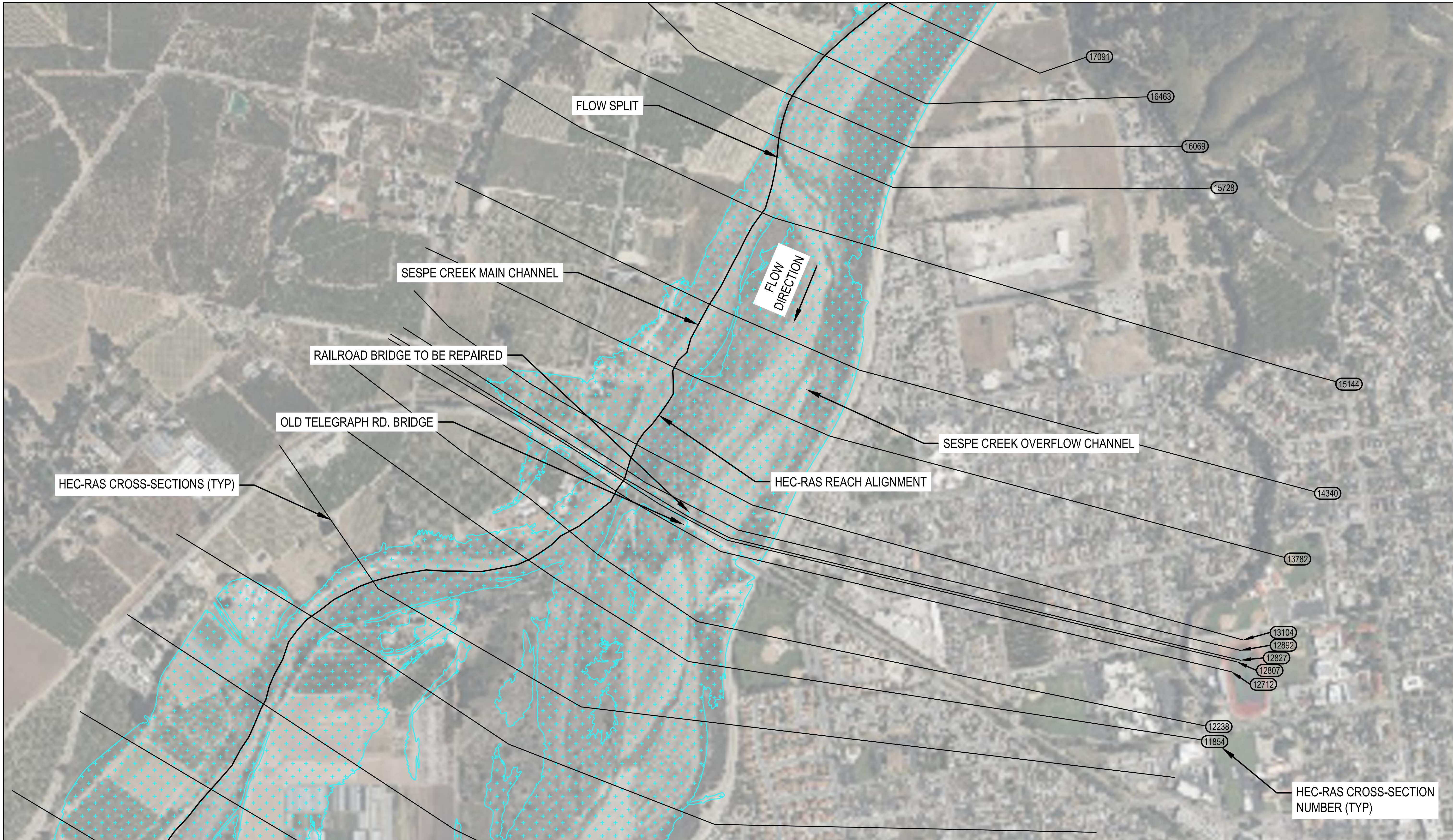
**HYDRAULIC WORKMAP**
**OVERVIEW**

Project No. **12611830**
Date **10/13/23**

**ATTACHMENT 2-A**

Filename: \\ghdnet\ghd\US\Roseville\Projects\561\12611830\Digital_Design\ACAD\Figures\12611830-FIG-HYDRAULIC WORKMAP.dwg
Plot Date: 17 October 2023 9:17 AM

Data Source




APPROXIMATE LIMIT OF 100-YEAR FLOOD INUNDATION

N

0 700' 1,400'

GHD

RAILPROS
SESPE CREEK OVERFLOW RAILROAD BRIDGE

HYDRAULIC WORKMAP
PROJECT AREA

Project No. **12611830**
Date **10/13/23**

**ATTACHMENT 2B**

Filename: \\ghdnet\ghd\US\Roseville\Projects\561\12611830\Digital_Design\ACAD\Figures\12611830-FIG-HYDRAULIC WORKMAP.dwg
Plot Date: 17 October 2023 9:17 AM

Data Source

# Attachment 3

## Hydraulic Model Results

# Hydraulic Model Output

## Pre-project Conditions with 50-year Peak Discharge

HEC-RAS Plan: Multi River: SespeCreek Reach: Reach1 Profile: 50Yr

| 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) | |
| Reach1 | 32840 | 50Yr | 102000.00 | 613.47 | 636.50 | 636.50 | 643.64 | 0.007742 | 21.44 | 4780.33 | 350.78 | 0.99 |
| Reach1 | 32411 | 50Yr | 102000.00 | 609.99 | 630.57 | 630.57 | 637.58 | 0.007584 | 21.26 | 4838.79 | 362.36 | 0.99 |
| Reach1 | 31894 | 50Yr | 102000.00 | 597.39 | 624.46 | 624.46 | 632.96 | 0.007102 | 23.46 | 4439.68 | 283.87 | 0.99 |
| Reach1 | 31482 | 50Yr | 102000.00 | 595.13 | 620.92 | 620.92 | 628.49 | 0.007631 | 22.07 | 4630.70 | 313.03 | 1.00 |
| Reach1 | 30924 | 50Yr | 102000.00 | 590.05 | 614.60 | 613.67 | 622.38 | 0.006251 | 22.39 | 4582.33 | 265.17 | 0.92 |
| Reach1 | 30411 | 50Yr | 102000.00 | 584.48 | 609.84 | 609.84 | 618.87 | 0.006990 | 24.15 | 4281.21 | 249.81 | 0.99 |
| Reach1 | 29986 | 50Yr | 102000.00 | 580.62 | 604.55 | 604.55 | 613.11 | 0.007419 | 23.48 | 4358.91 | 263.80 | 1.00 |
| Reach1 | 29672 | 50Yr | 102000.00 | 579.41 | 600.95 | 600.95 | 608.89 | 0.007988 | 22.61 | 4516.91 | 290.72 | 1.00 |
| Reach1 | 29284 | 50Yr | 102000.00 | 575.87 | 597.91 | 597.91 | 604.80 | 0.006384 | 21.16 | 5084.58 | 450.74 | 0.93 |
| Reach1 | 28927 | 50Yr | 102000.00 | 574.82 | 595.73 | 595.73 | 601.67 | 0.005352 | 20.15 | 6006.02 | 593.44 | 0.85 |
| Reach1 | 28571 | 50Yr | 102000.00 | 573.87 | 591.53 | 591.53 | 597.48 | 0.005854 | 19.91 | 5634.34 | 604.69 | 0.89 |
| Reach1 | 28122 | 50Yr | 102000.00 | 567.66 | 587.62 | 587.62 | 594.24 | 0.006327 | 21.05 | 5168.36 | 411.41 | 0.93 |
| Reach1 | 27668 | 50Yr | 102000.00 | 562.66 | 584.29 | 584.29 | 591.10 | 0.007020 | 21.04 | 4990.71 | 420.10 | 0.97 |
| Reach1 | 27222 | 50Yr | 102000.00 | 561.98 | 581.38 | | 585.06 | 0.005730 | 15.49 | 6809.87 | 631.93 | 0.74 |
| Reach1 | 26715 | 50Yr | 102604.00 | 556.60 | 578.14 | | 581.03 | 0.010160 | 13.63 | 7560.96 | 506.44 | 0.61 |
| Reach1 | 26242 | 50Yr | 102604.00 | 554.12 | 570.11 | 570.11 | 575.83 | 0.010644 | 19.17 | 5354.84 | 476.48 | 1.00 |
| Reach1 | 25713 | 50Yr | 102604.00 | 546.47 | 564.33 | 564.33 | 569.14 | 0.007984 | 17.67 | 6025.20 | 698.38 | 0.97 |
| Reach1 | 25258 | 50Yr | 102604.00 | 544.62 | 561.98 | 560.95 | 565.43 | 0.006169 | 14.92 | 6924.36 | 765.23 | 0.85 |
| Reach1 | 24751 | 50Yr | 102604.00 | 541.72 | 558.67 | 558.02 | 561.97 | 0.007391 | 14.60 | 7234.60 | 1224.52 | 0.88 |
| Reach1 | 24081 | 50Yr | 102604.00 | 536.87 | 552.36 | 552.36 | 556.38 | 0.009222 | 16.09 | 6376.04 | 805.38 | 1.01 |
| Reach1 | 23531 | 50Yr | 102604.00 | 531.05 | 546.82 | 546.82 | 550.59 | 0.006874 | 15.63 | 7000.15 | 1460.74 | 0.92 |
| Reach1 | 23080 | 50Yr | 102604.00 | 527.22 | 543.89 | 543.89 | 546.55 | 0.006218 | 14.21 | 9807.25 | 1934.20 | 0.84 |
| Reach1 | 22567 | 50Yr | 102604.00 | 520.15 | 535.86 | 535.86 | 538.28 | 0.005957 | 13.70 | 9455.00 | 2033.58 | 0.75 |
| Reach1 | 21811 | 50Yr | 102604.00 | 511.42 | 525.86 | 525.86 | 529.23 | 0.008057 | 15.12 | 7462.23 | 1247.09 | 0.94 |
| Reach1 | 21055 | 50Yr | 102604.00 | 501.73 | 517.64 | 517.64 | 521.09 | 0.008089 | 14.93 | 7158.14 | 1456.78 | 0.94 |
| Reach1 | 20433 | 50Yr | 102604.00 | 497.18 | 511.17 | 511.17 | 514.76 | 0.008463 | 15.28 | 6873.12 | 1011.94 | 0.97 |
| Reach1 | 19991 | 50Yr | 102604.00 | 489.17 | 505.89 | 505.89 | 509.94 | 0.011713 | 16.15 | 6353.25 | 792.90 | 1.01 |
| Reach1 | 19675 | 50Yr | 102604.00 | 485.77 | 501.97 | 501.42 | 505.59 | 0.008152 | 15.26 | 6726.58 | 786.06 | 0.92 |
| Reach1 | 19191 | 50Yr | 102604.00 | 482.46 | 499.53 | | 502.37 | 0.004816 | 13.52 | 7629.70 | 727.12 | 0.71 |
| Reach1 | 18647 | 50Yr | 102604.00 | 478.75 | 494.33 | 494.33 | 498.78 | 0.008586 | 16.92 | 6077.58 | 1318.82 | 1.00 |
| Reach1 | 17091 | 50Yr | 102604.00 | 467.11 | 482.74 | 482.74 | 487.37 | 0.005720 | 17.71 | 6461.67 | 738.78 | 0.86 |
| Reach1 | 16463 | 50Yr | 102604.00 | 463.81 | 477.19 | 477.19 | 480.83 | 0.011882 | 15.30 | 6705.55 | 920.83 | 1.00 |
| Reach1 | 16069 | 50Yr | 102604.00 | 460.12 | 472.92 | 472.87 | 476.46 | 0.008664 | 15.14 | 6856.27 | 980.80 | 0.97 |
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| Reach1 | 15144 | 50Yr | 102604.00 | 447.74 | 462.80 | 462.80 | 466.64 | 0.007607 | 15.72 | 6526.92 | 847.31 | 1.00 |
| Reach1 | 14340 | 50Yr | 102604.00 | 443.62 | 456.56 | 456.56 | 459.53 | 0.008122 | 14.12 | 7959.79 | 1376.90 | 0.95 |
| Reach1 | 13782 | 50Yr | 102604.00 | 438.49 | 452.15 | 450.51 | 453.91 | 0.005208 | 10.70 | 9723.88 | 1405.45 | 0.71 |
| Reach1 | 13104 | 50Yr | 102604.00 | 433.71 | 451.79 | 444.84 | 452.39 | 0.000848 | 6.31 | 17001.11 | 1712.84 | 0.31 |
| Reach1 | 12892 | 50Yr | 102604.00 | 434.72 | 451.62 | 445.12 | 452.20 | 0.000743 | 6.67 | 16758.66 | 1622.19 | 0.31 |
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| Reach1 | 12827 | 50Yr | 102604.00 | 434.59 | 448.45 | 444.15 | 450.02 | 0.001934 | 9.52 | 10217.87 | 1497.92 | 0.49 |
| Reach1 | 12807 | 50Yr | 102604.00 | 434.42 | 448.44 | 444.07 | 449.95 | 0.001880 | 9.56 | 10547.23 | 1157.32 | 0.48 |
| Reach1 | 12780 | | Mult Open | | | | | | | | | |
| Reach1 | 12712 | 50Yr | 102604.00 | 434.07 | 442.80 | 442.80 | 446.92 | 0.008639 | 14.42 | 6342.99 | 3808.91 | 0.96 |
| Reach1 | 12238 | 50Yr | 102604.00 | 428.86 | 437.85 | 437.85 | 441.08 | 0.005768 | 10.38 | 7363.93 | 3016.71 | 0.76 |
| Reach1 | 11854 | 50Yr | 102604.00 | 428.14 | 434.18 | 434.18 | 436.82 | 0.005845 | 10.07 | 8197.13 | 3236.58 | 0.76 |
| Reach1 | 10652 | 50Yr | 102604.00 | 418.20 | 427.37 | 427.37 | 429.87 | 0.007163 | 13.08 | 8119.27 | 1657.86 | 0.87 |
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| Reach1 | 5357 | 50Yr | 102604.00 | 383.52 | 394.34 | 394.15 | 396.85 | 0.006711 | 14.01 | 8486.65 | 2858.30 | 0.86 |
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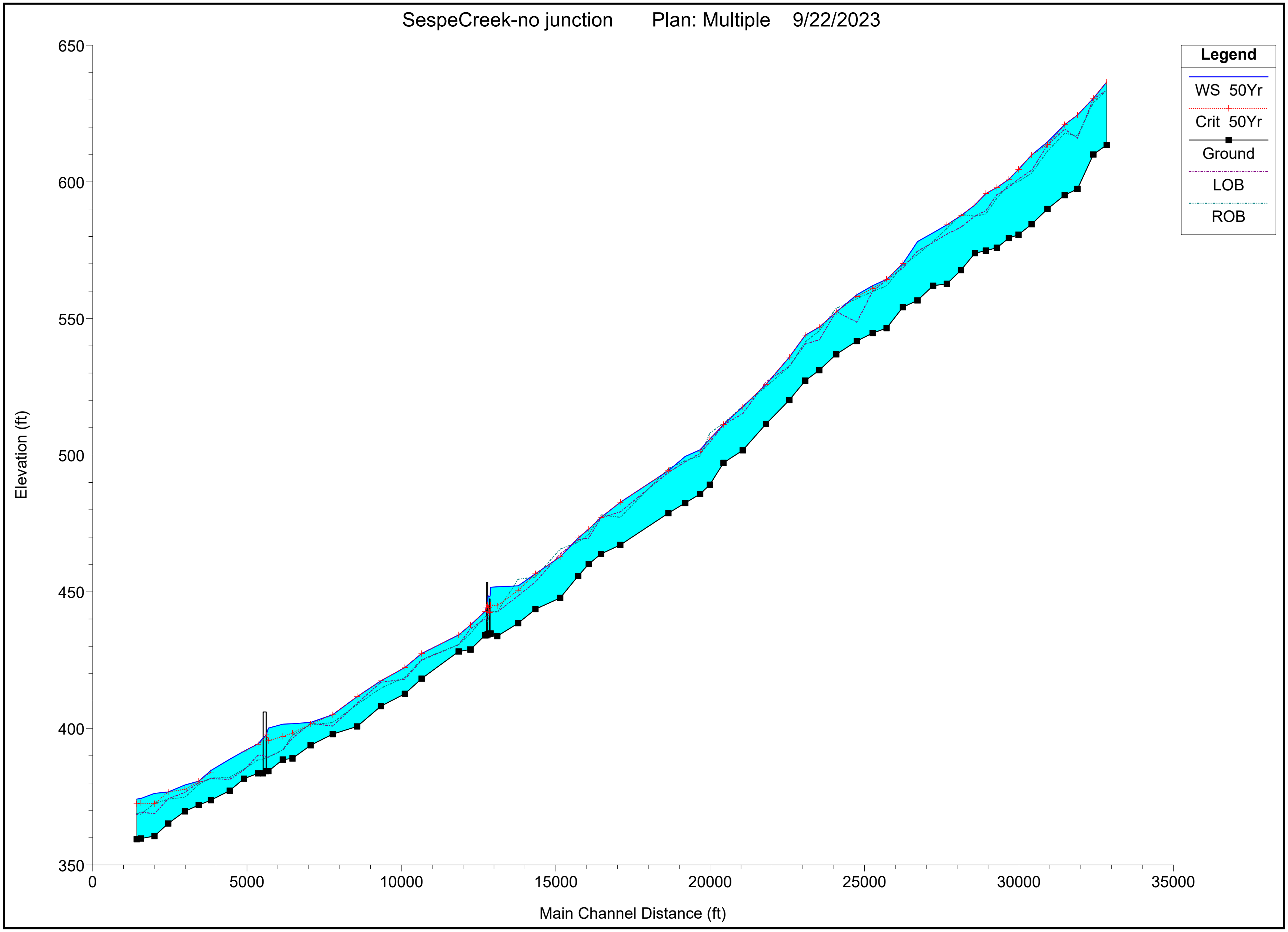
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ROB
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450
400
350
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10000
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20000
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30000
35000
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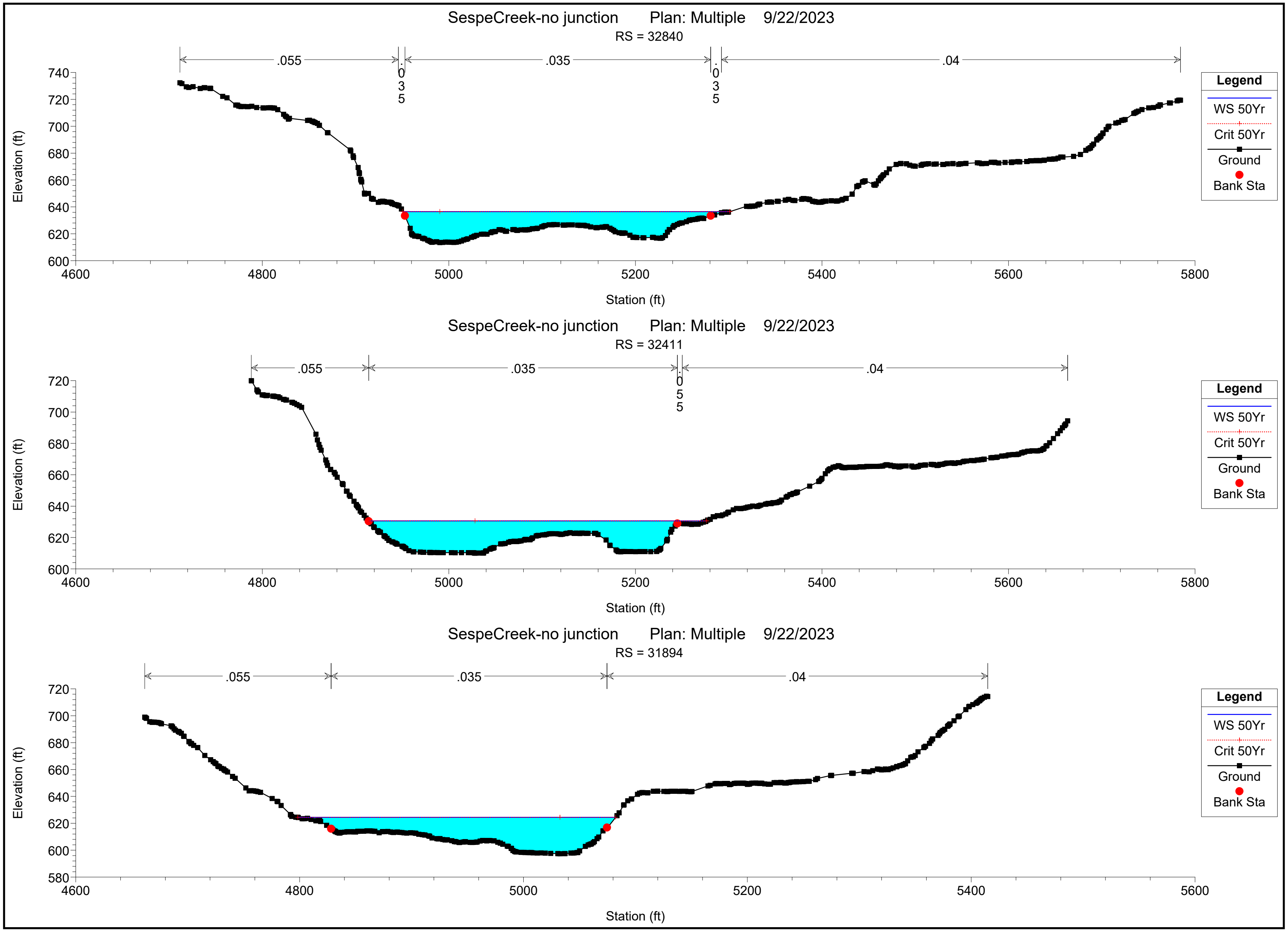
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Station (ft)
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.035
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Legend
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Crit 50Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
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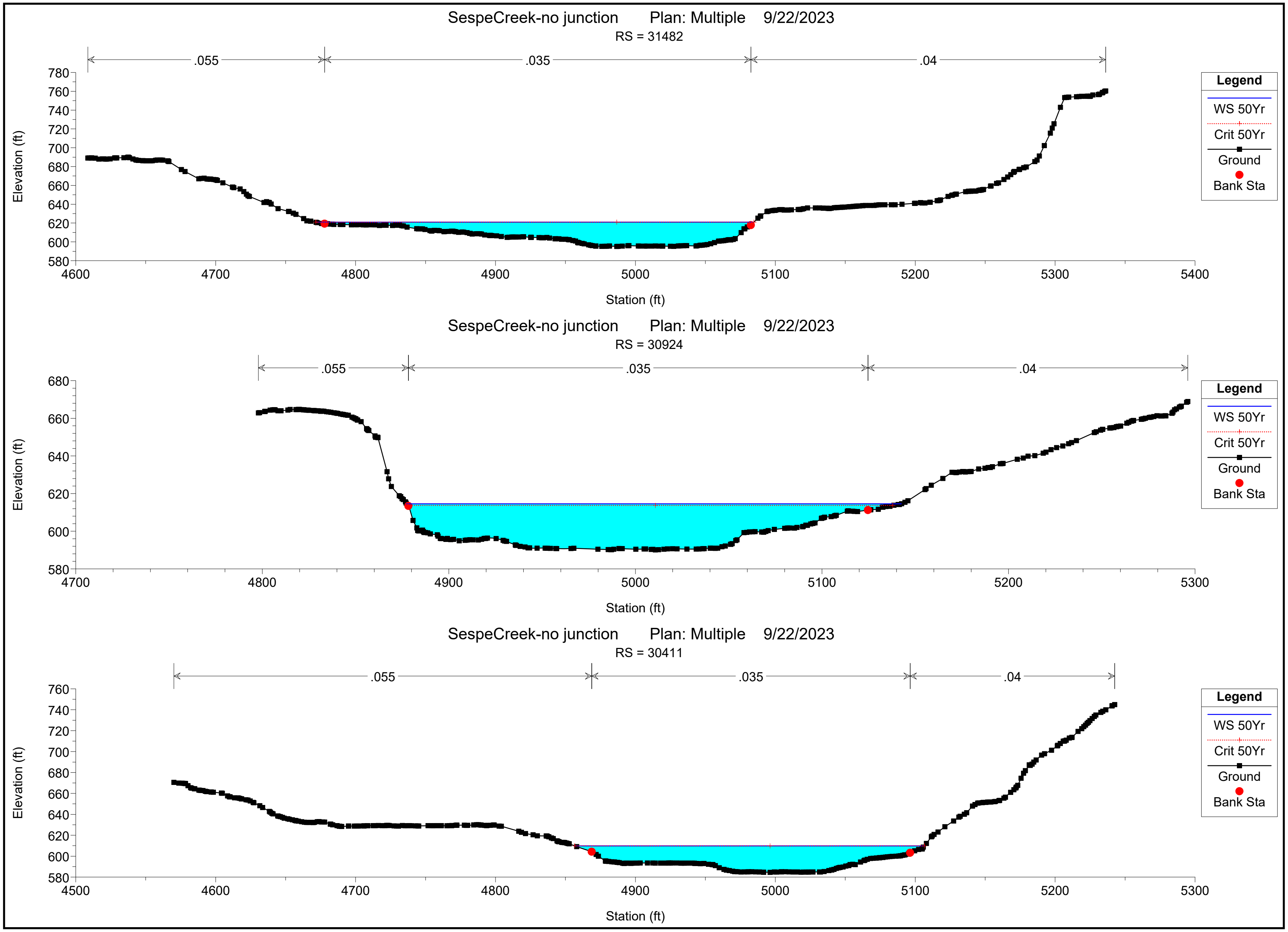
Ground
Bank Sta
Elevation (ft)
Station (ft)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Station (ft)
Legend
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Ground
Bank Sta
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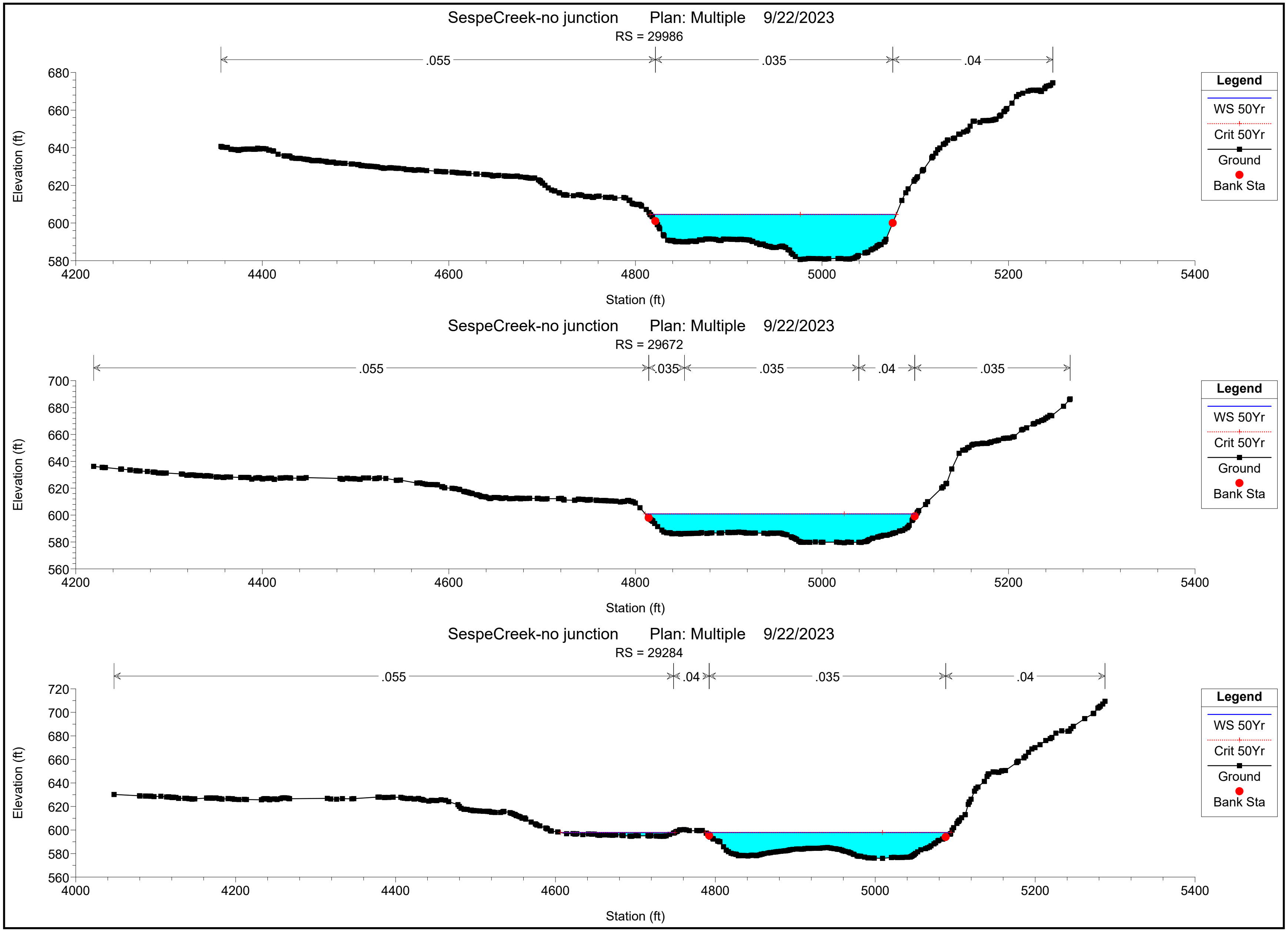
Bank Sta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Ground
Bank Sta
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Station (ft)
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Bank Sta
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Crit 50Yr
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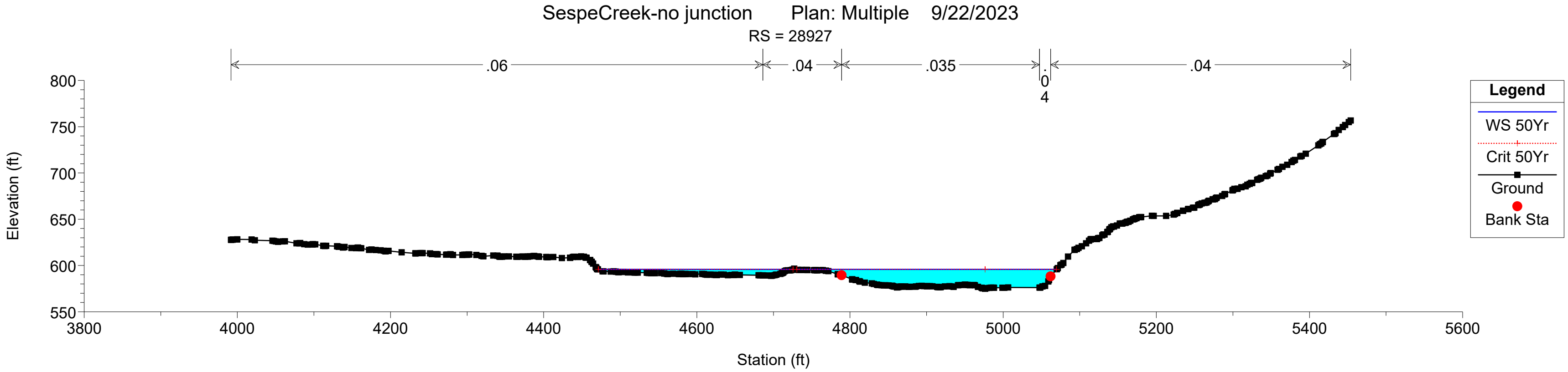
Bank Sta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Elevation (ft)
Station (ft)
Legend
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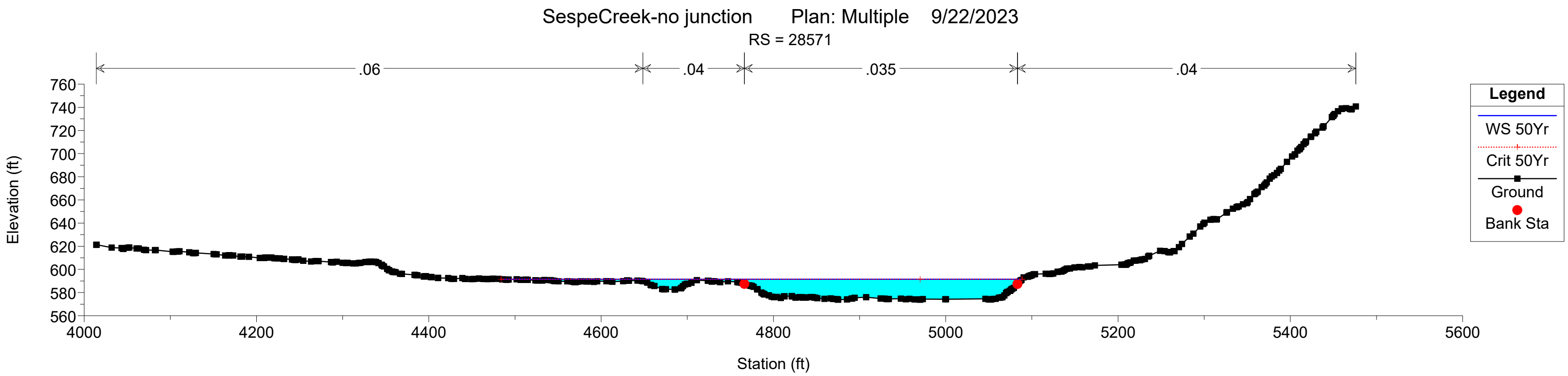
Crit 50Yr
Ground
Bank Sta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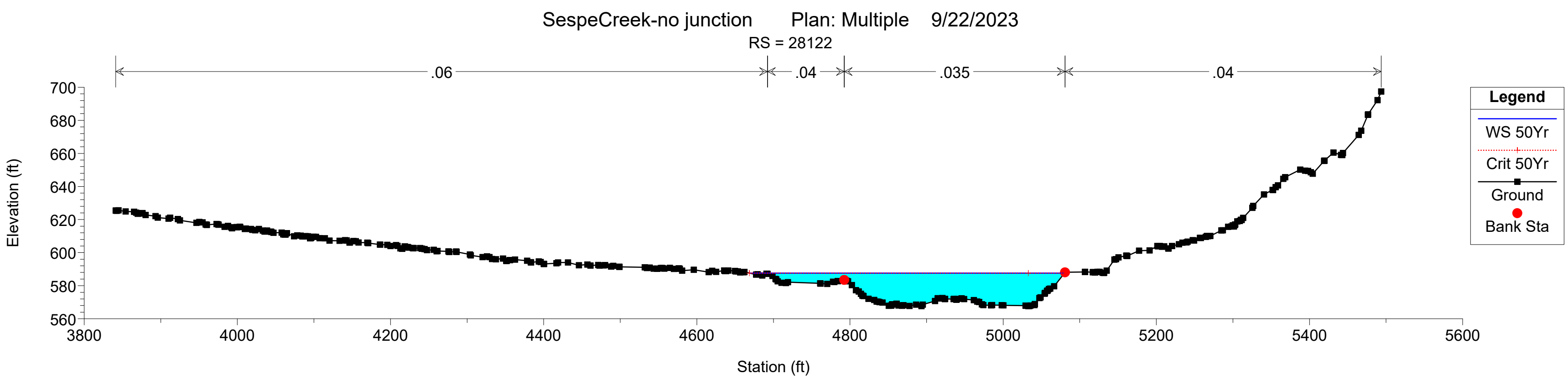
Bank Sta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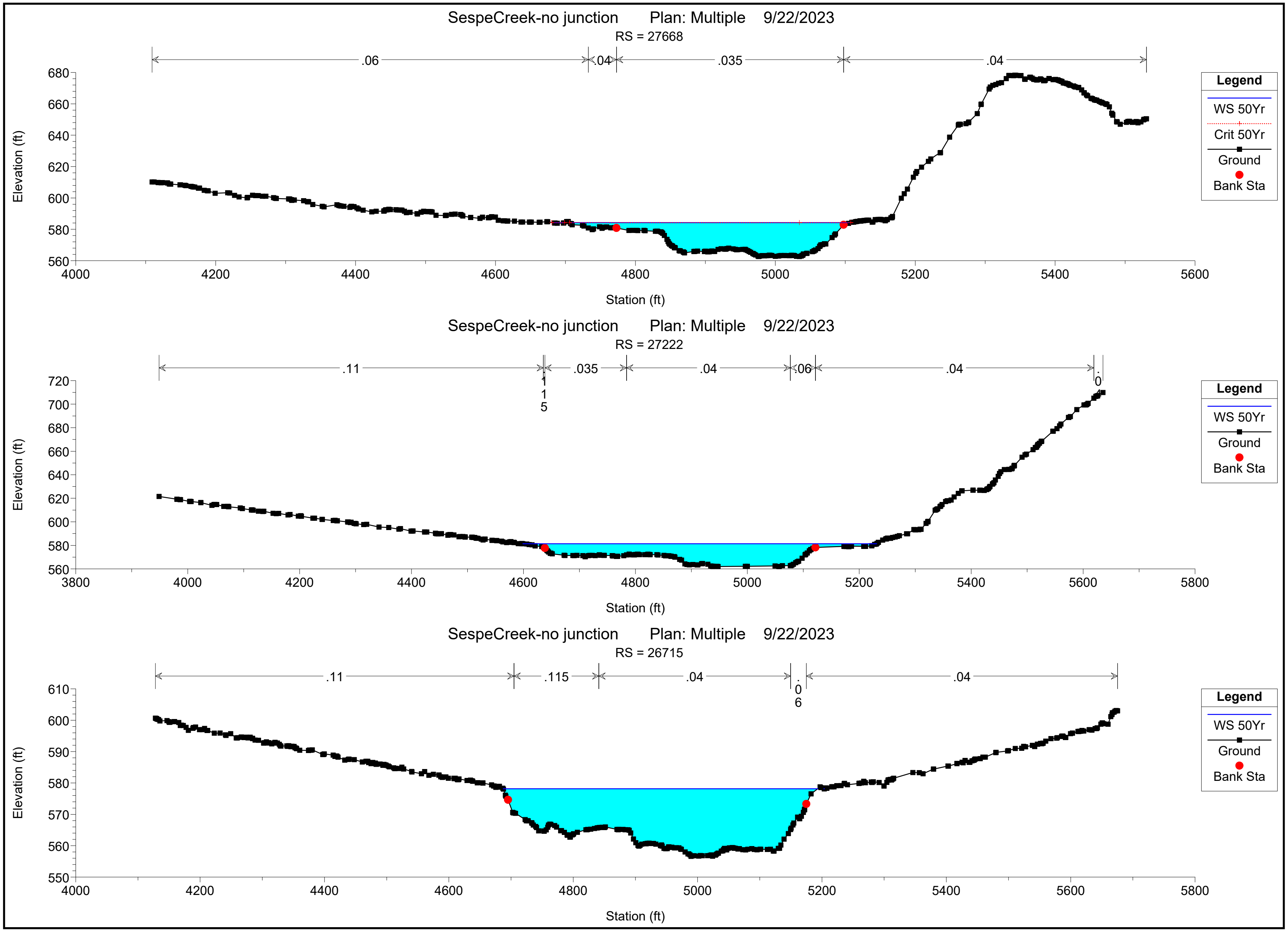
Bank Sta



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Bank Sta
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Elevation (ft)
Station (ft)
Legend
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Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
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Elevation (ft)
Station (ft)
Legend
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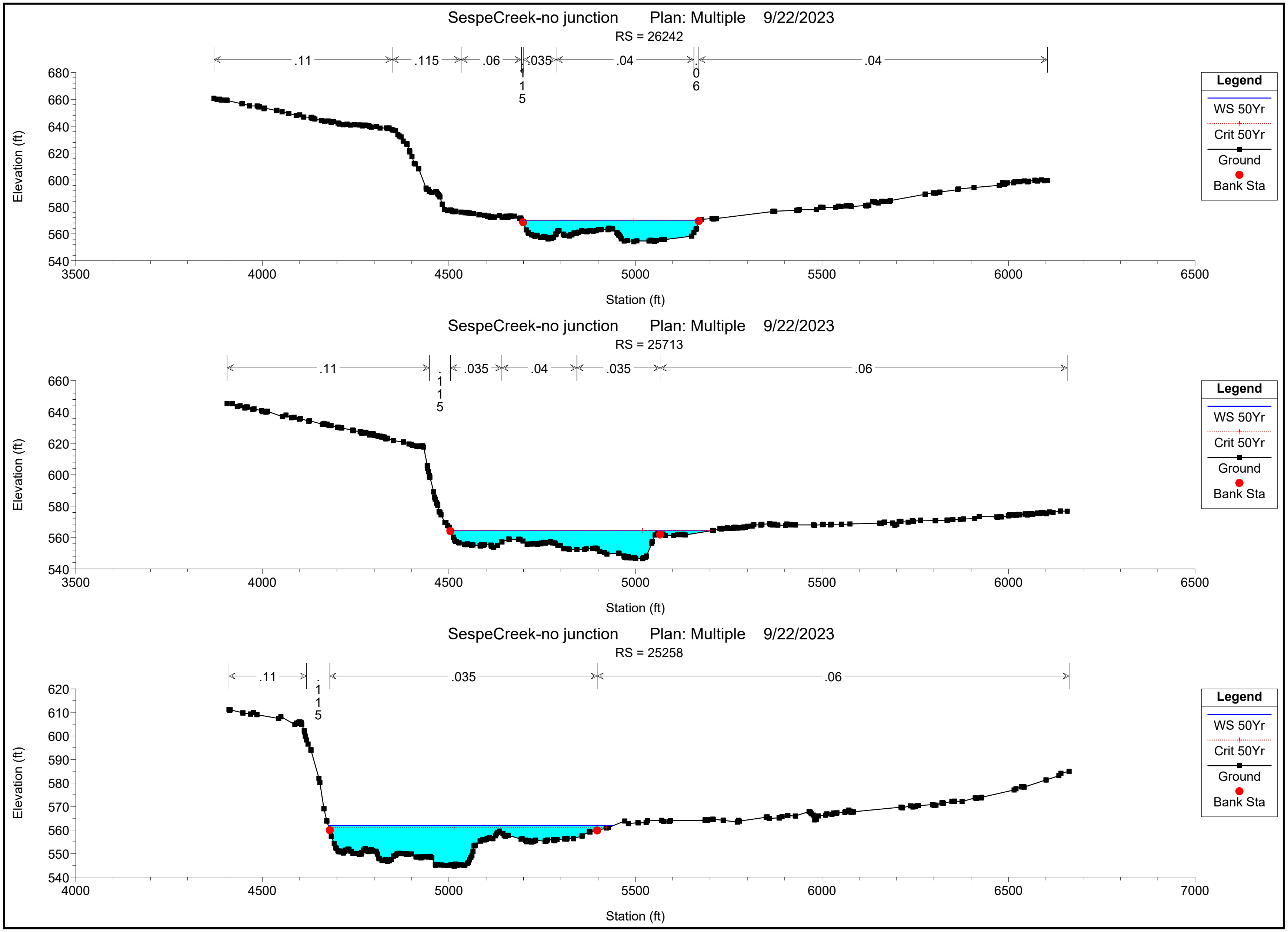
Ground
Bank Sta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Crit 50Yr
Ground
Bank Sta
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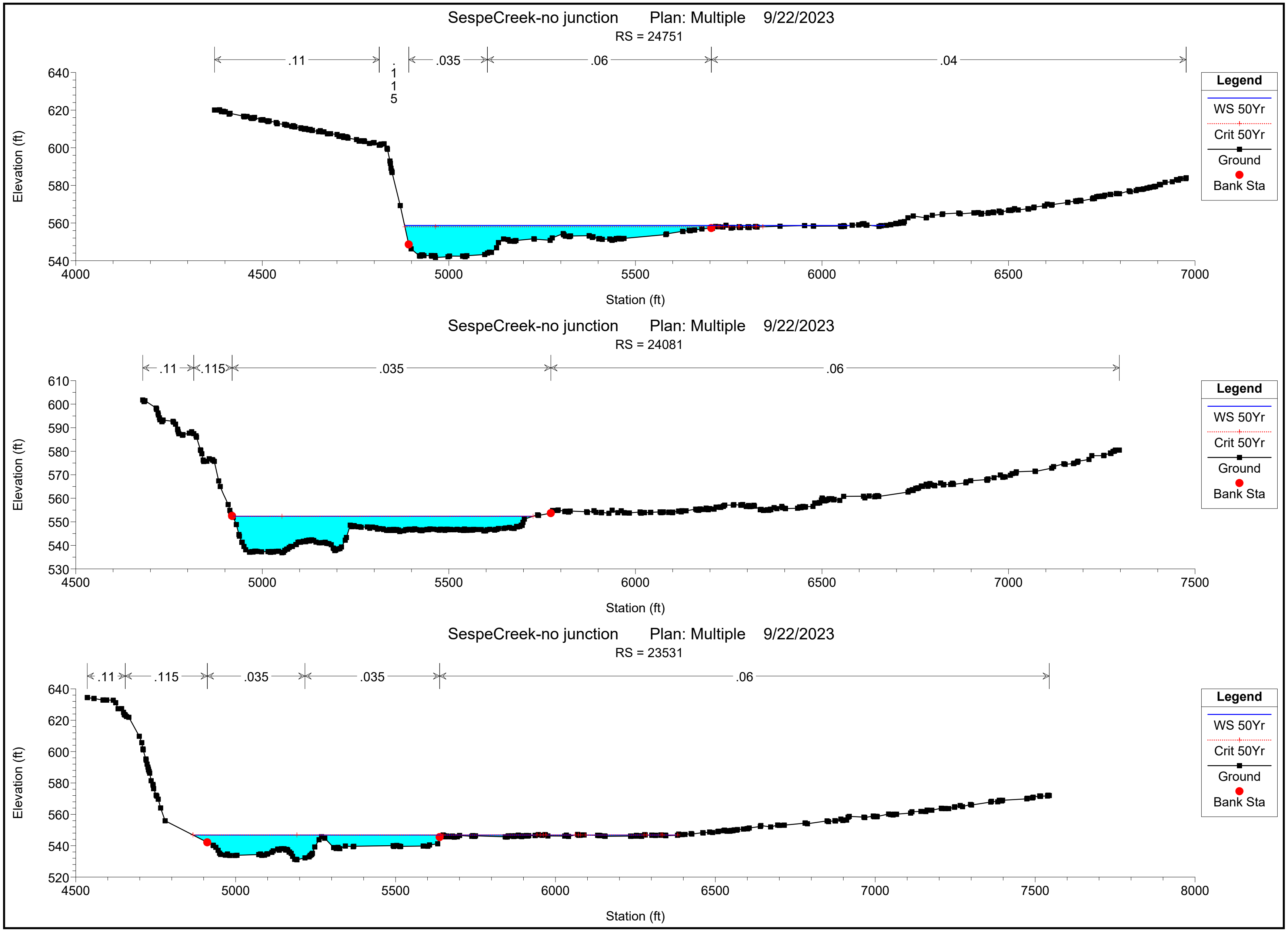
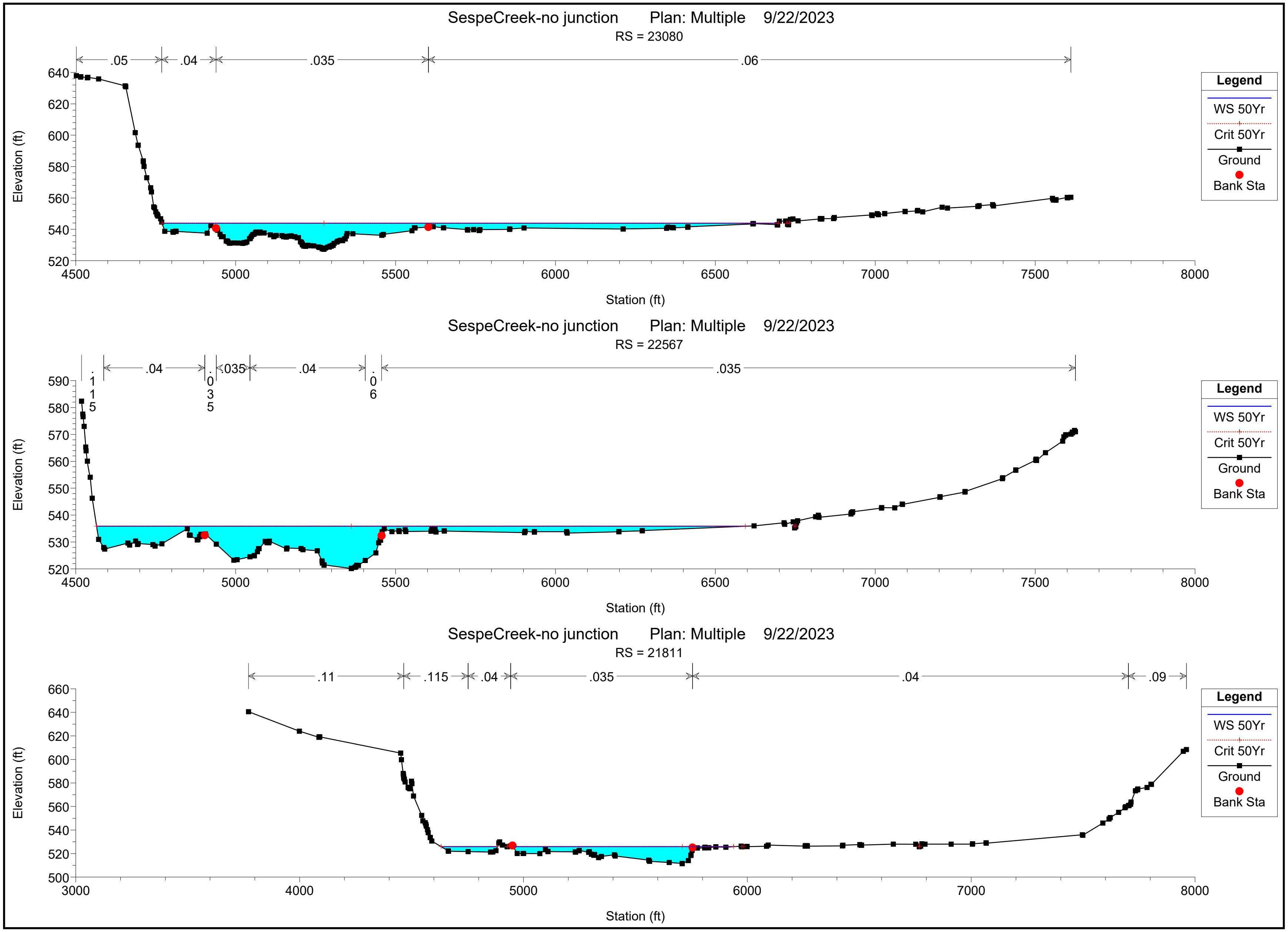
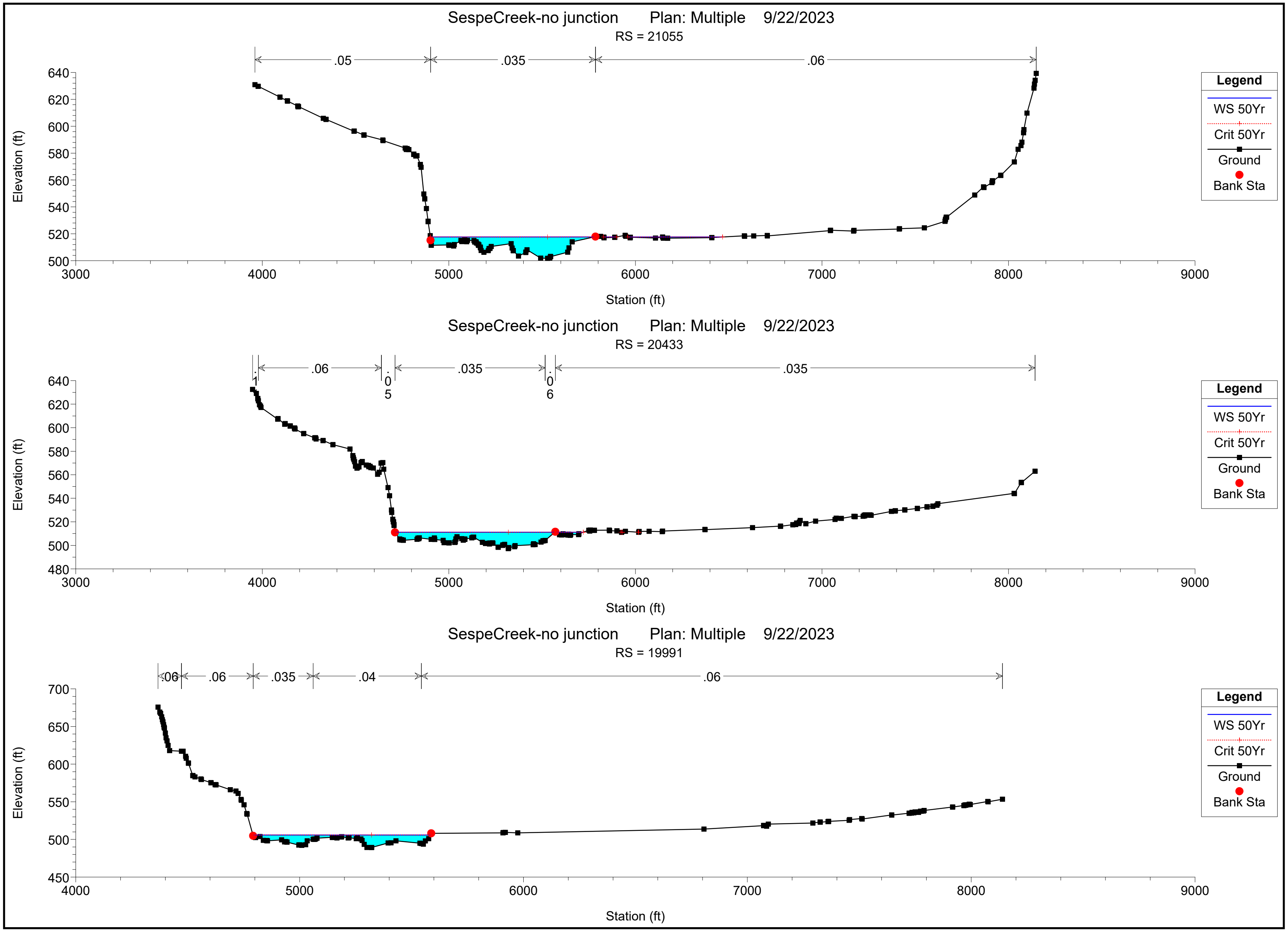
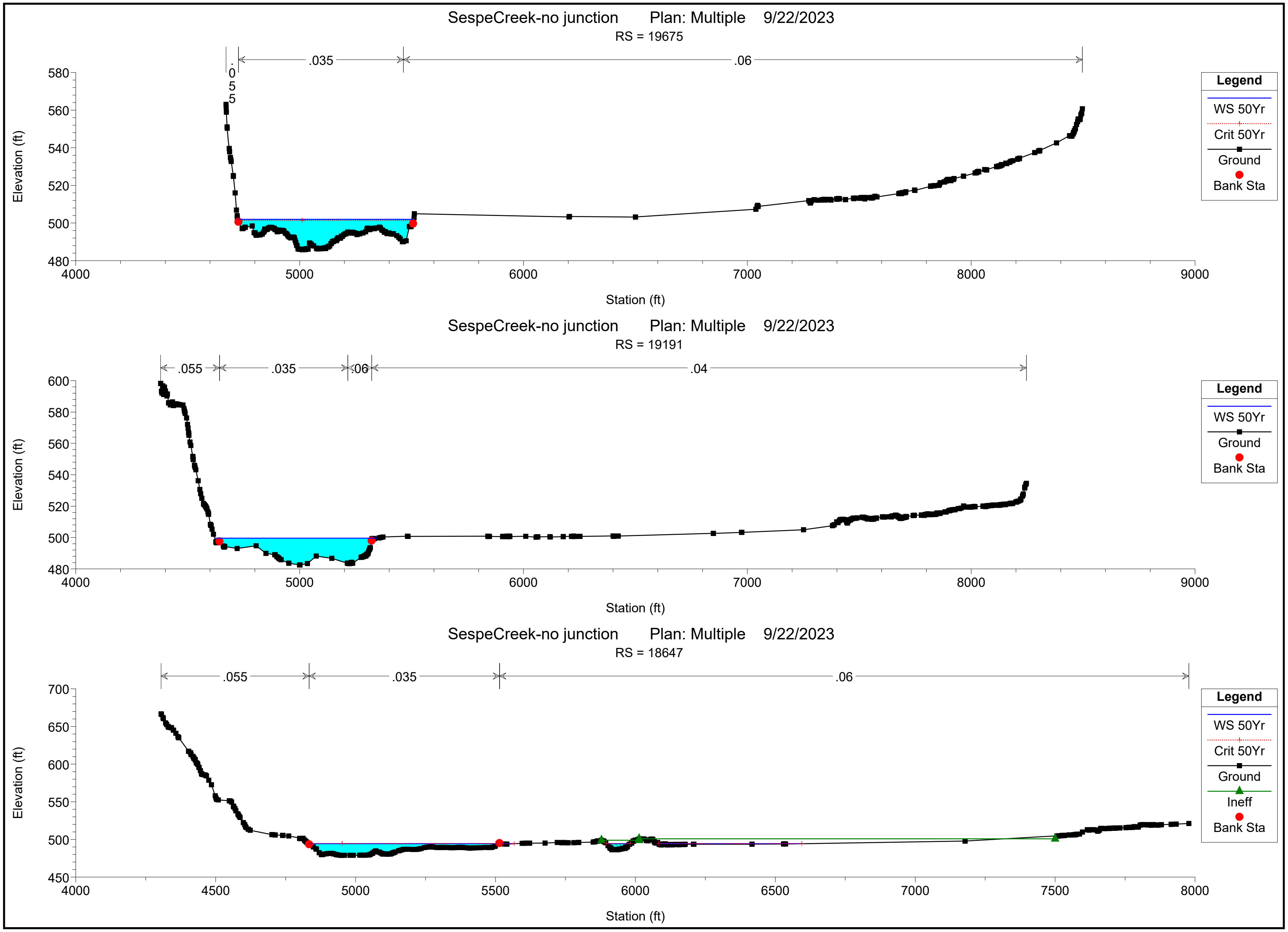
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta

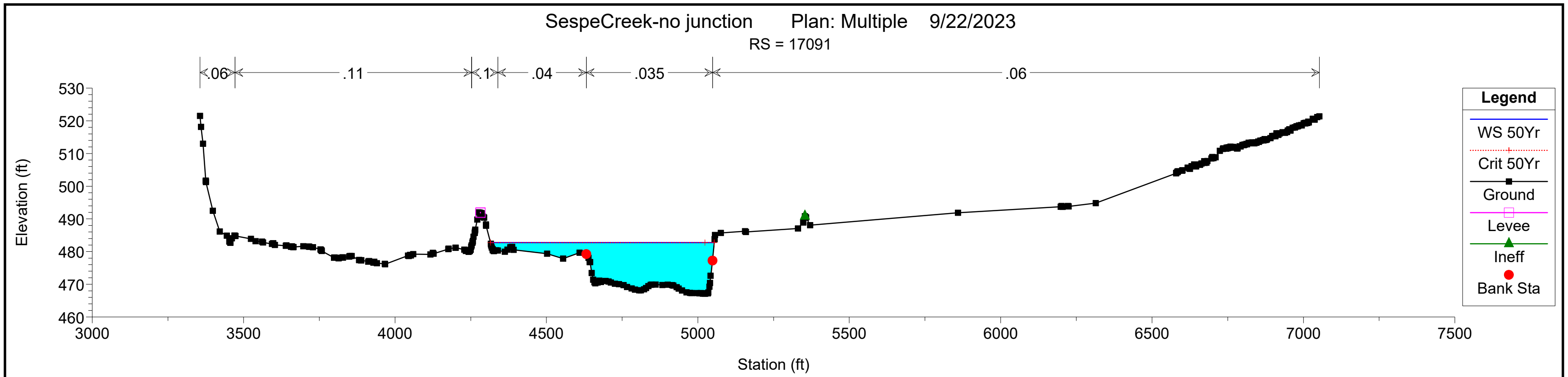

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 24751
.11
.115
.035
.06
.04
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 24081
.11
.115
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 23531
.11
.115
.035
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta

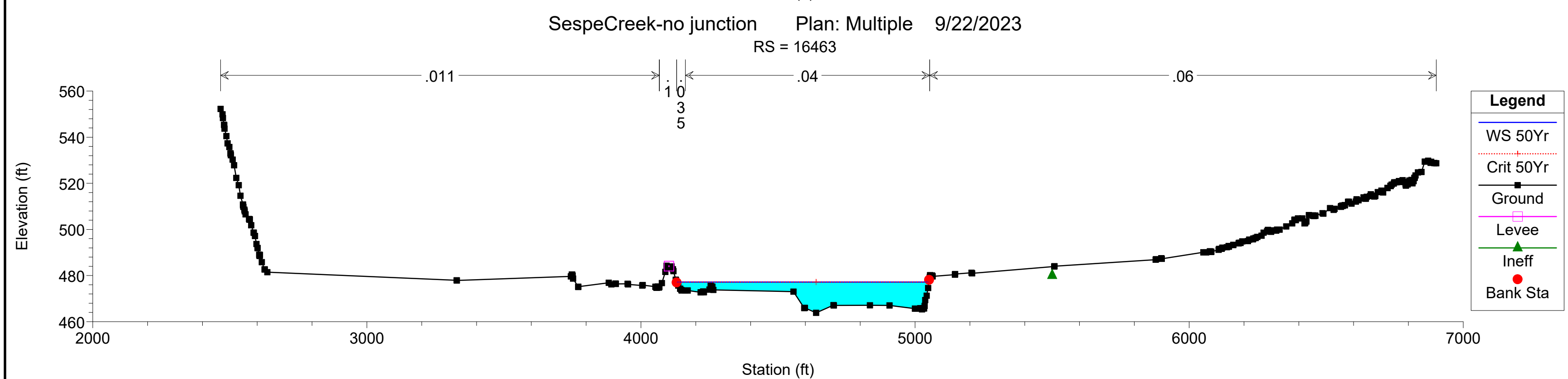

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 23080
.05
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 22567
.115
.04
.035
.035
.04
.06
.035
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 21811
.11
.115
.04
.035
.04
.09

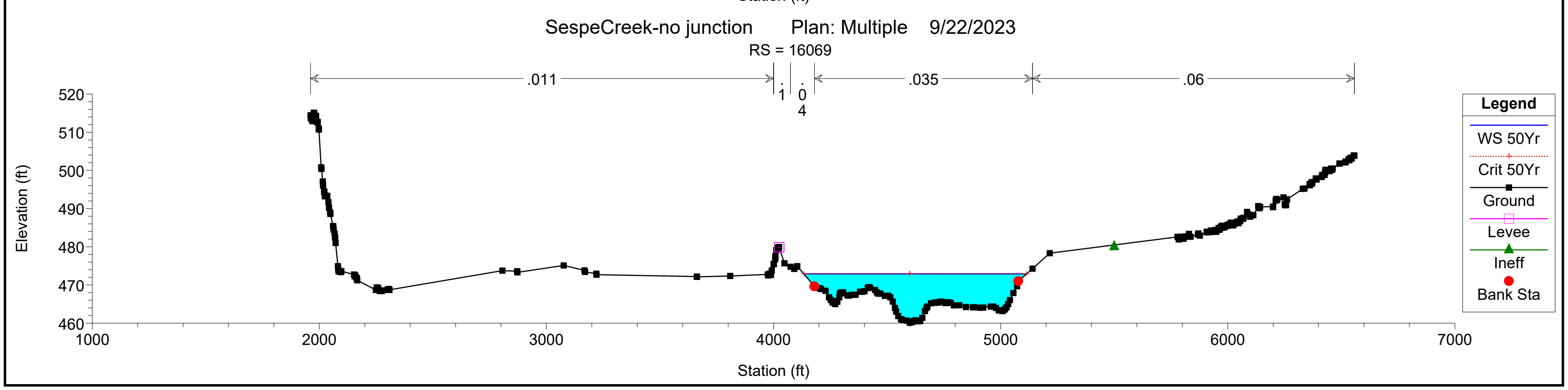

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 21055
.05
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 20433
.06
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 19991
.06
.06
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta

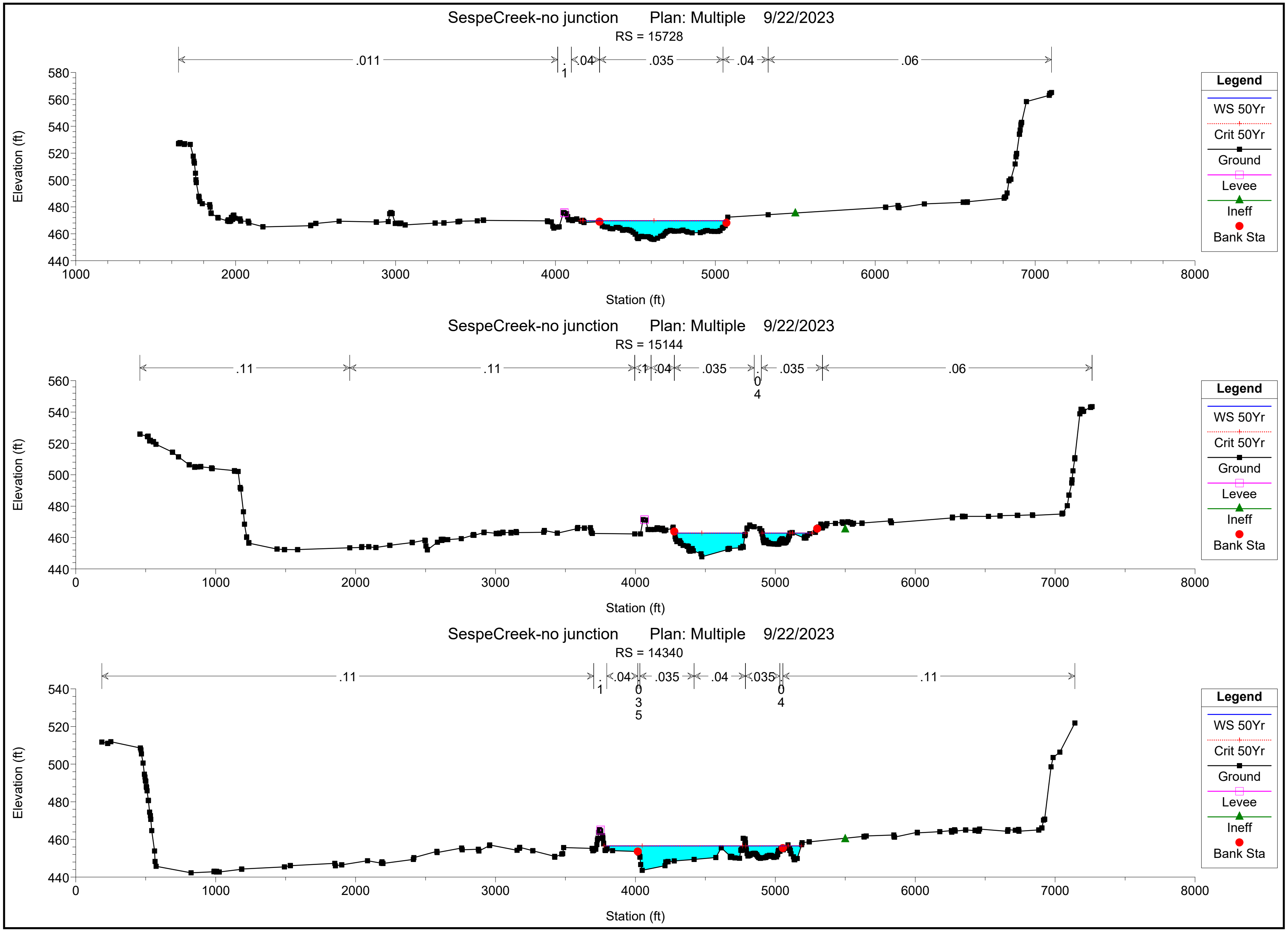


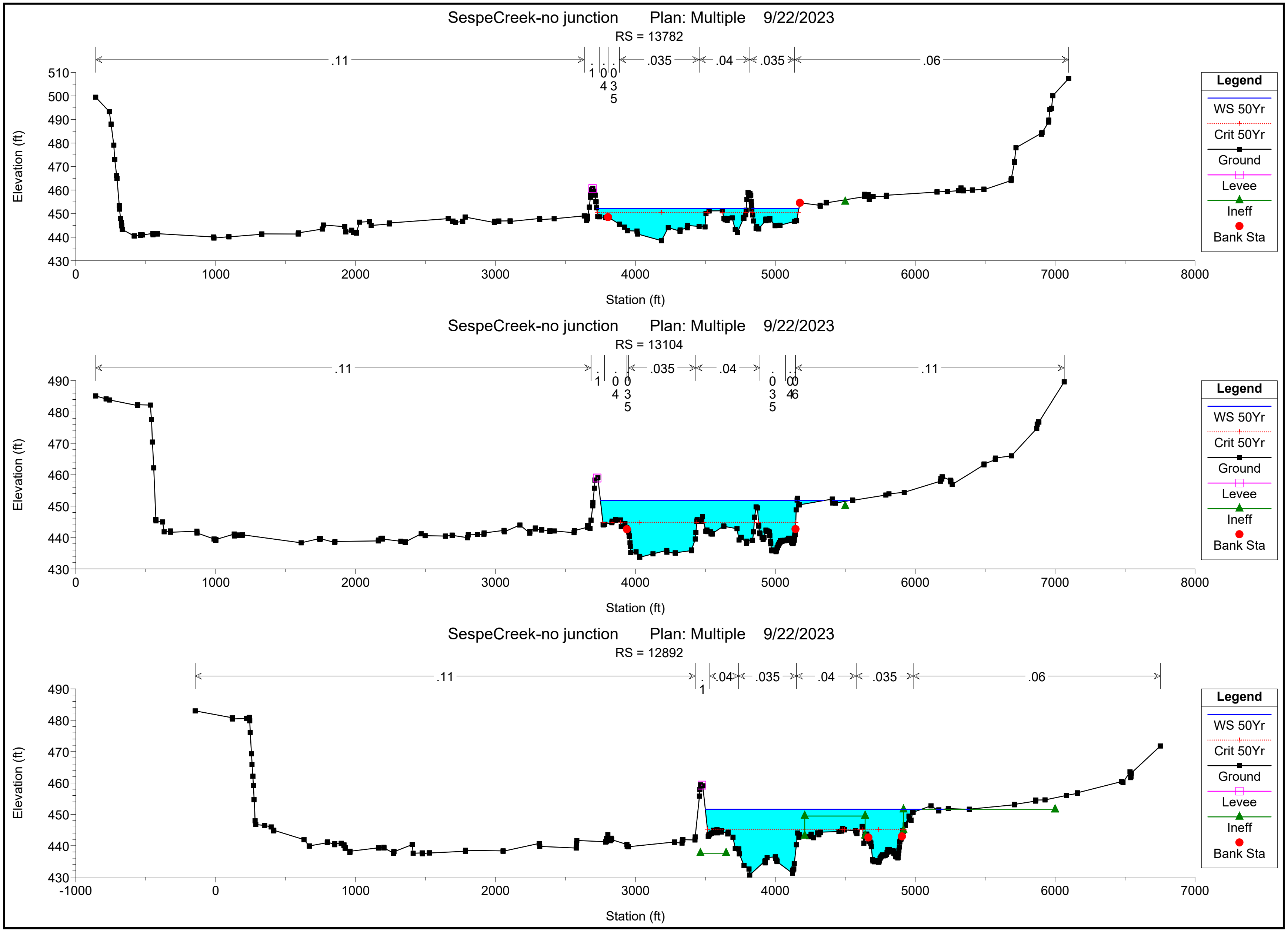
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 19675
.055
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 19191
.055
.035
.06
.04
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 18647
.055
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta


SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 17091
.06
.11
.1
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta

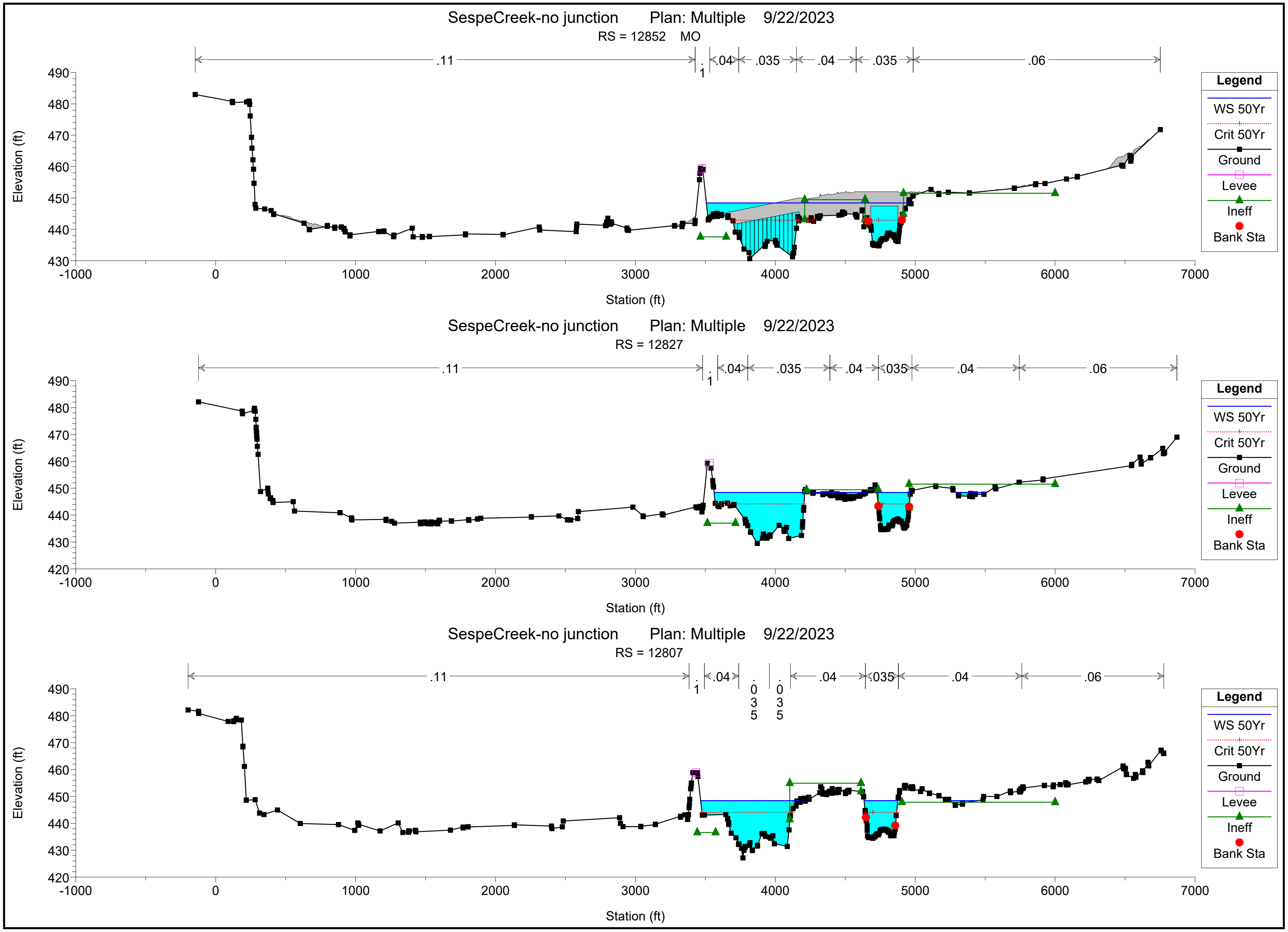

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 16463
.011
.1
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta

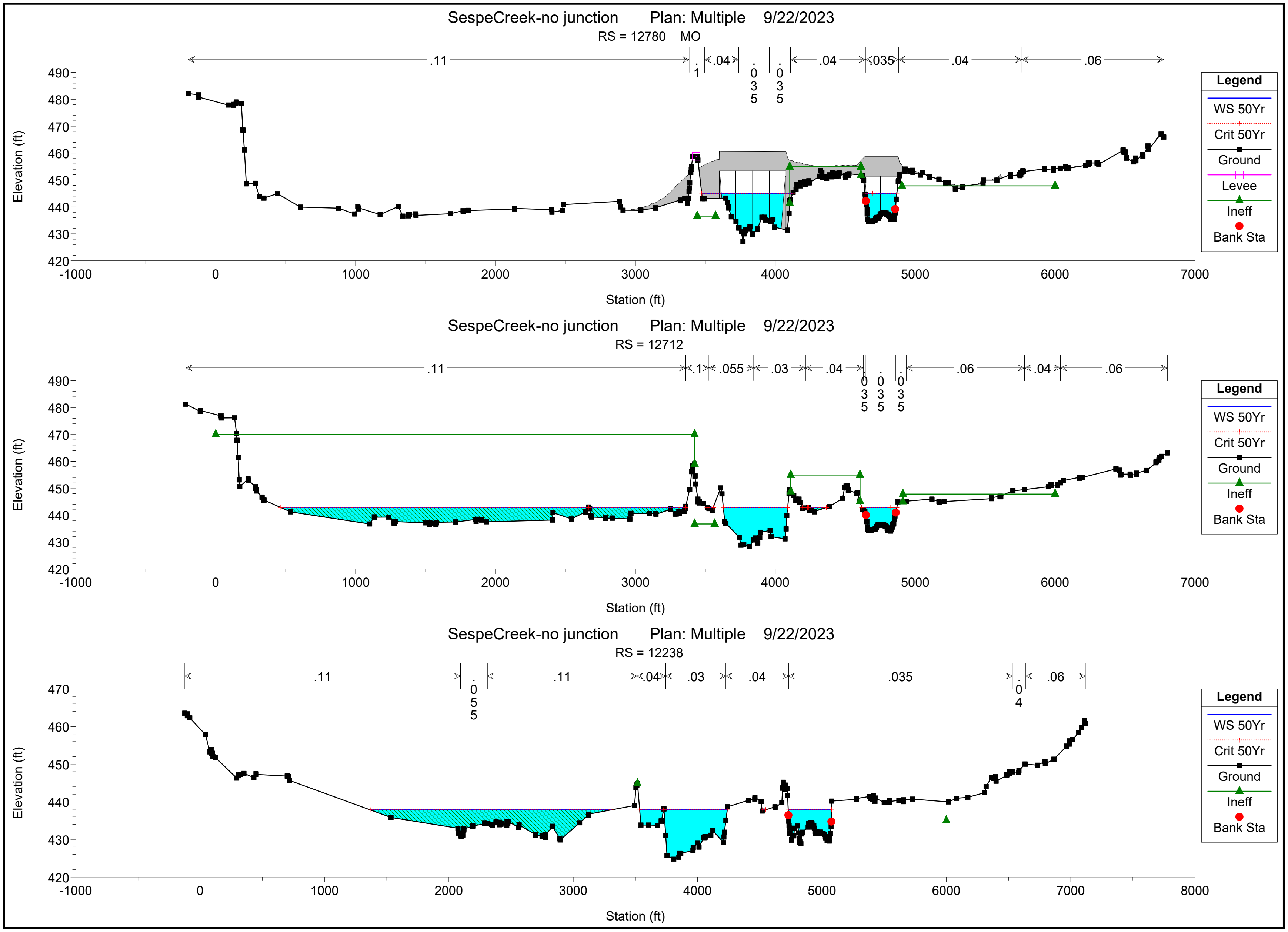

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 16069
.011
.1
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta

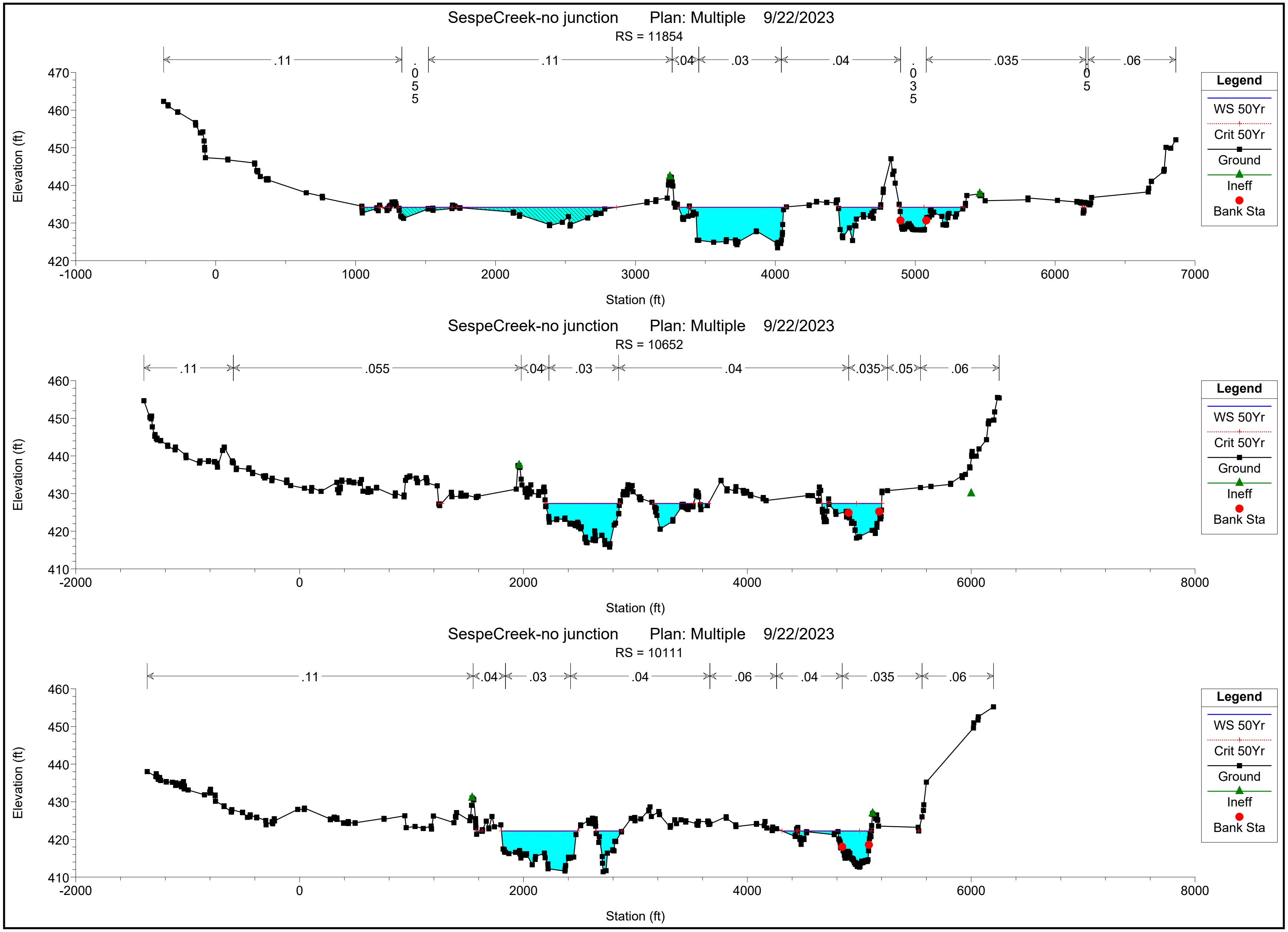

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 15728
.011
.04
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 15144
.11
.11
.04
.035
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 14340
.11
.04
.035
.04
.035
.11
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta

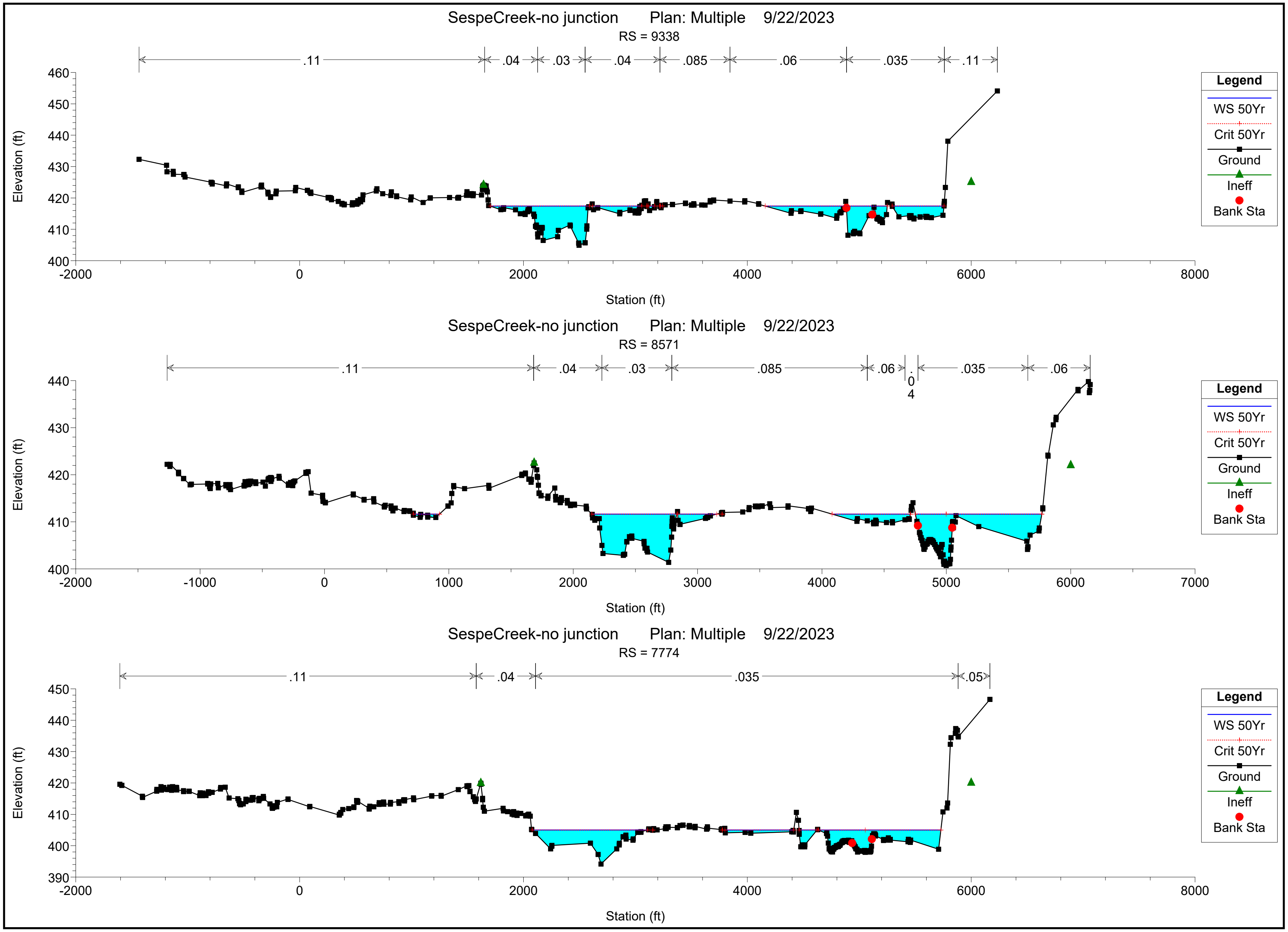


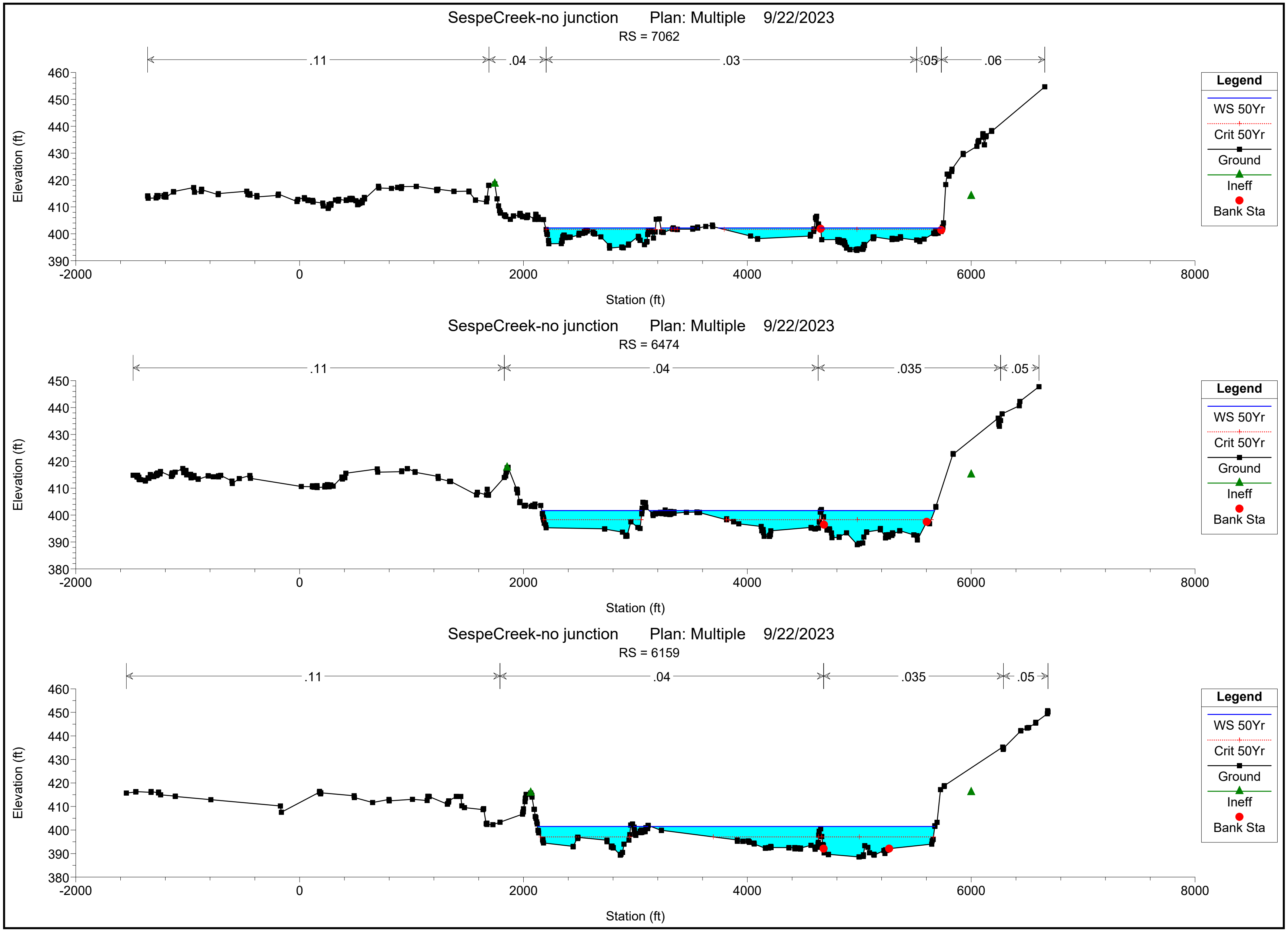
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 13782
.11
.035
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 13104
.11
.035
.04
.11
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12892
.11
.04
.035
.04
.035
.06

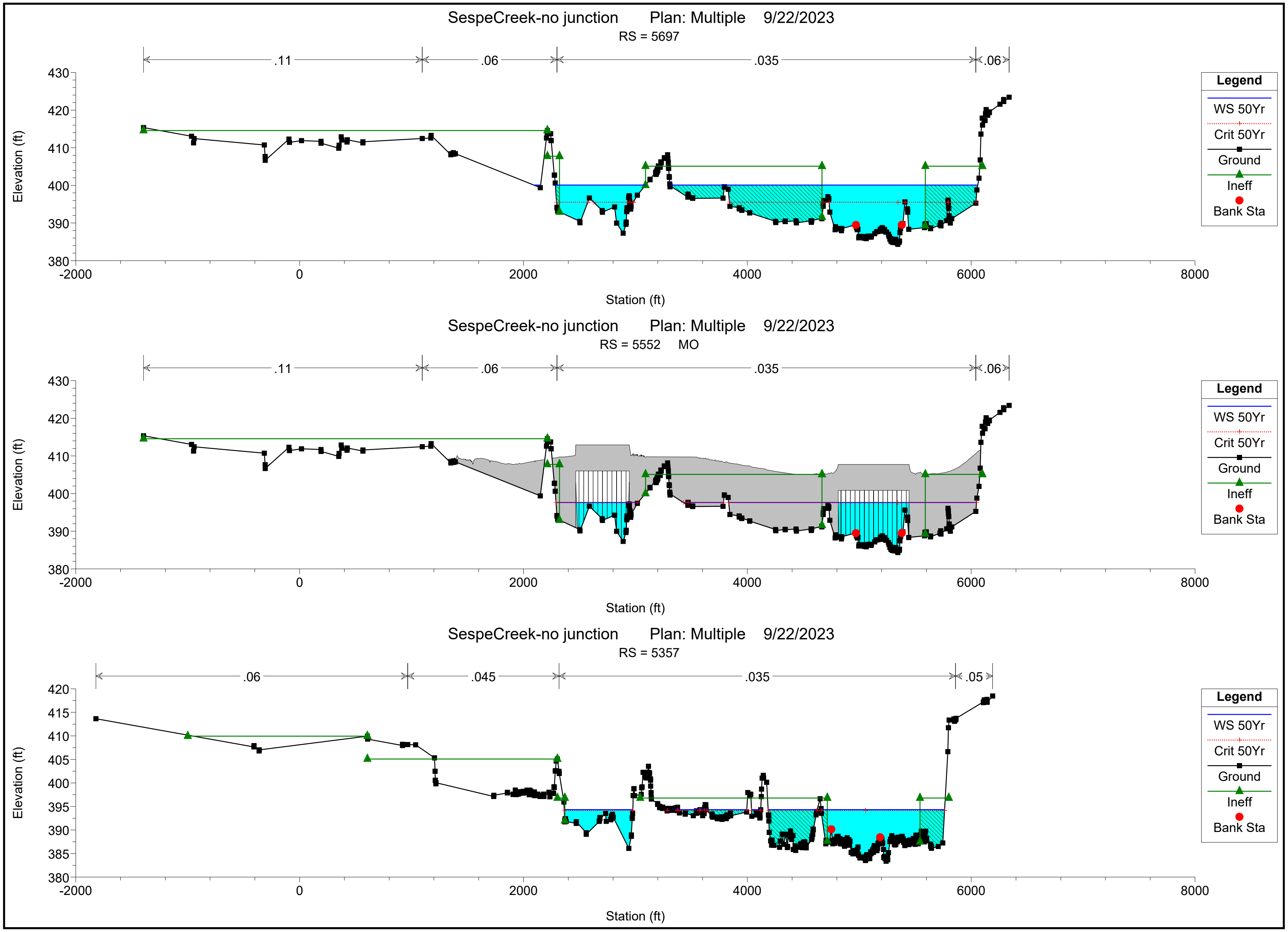

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12852 MO
.11
.1
.04
.035
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12827
.11
.1
.04
.035
.04
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12807
.11
.1
.04
.035
.035
.04
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta

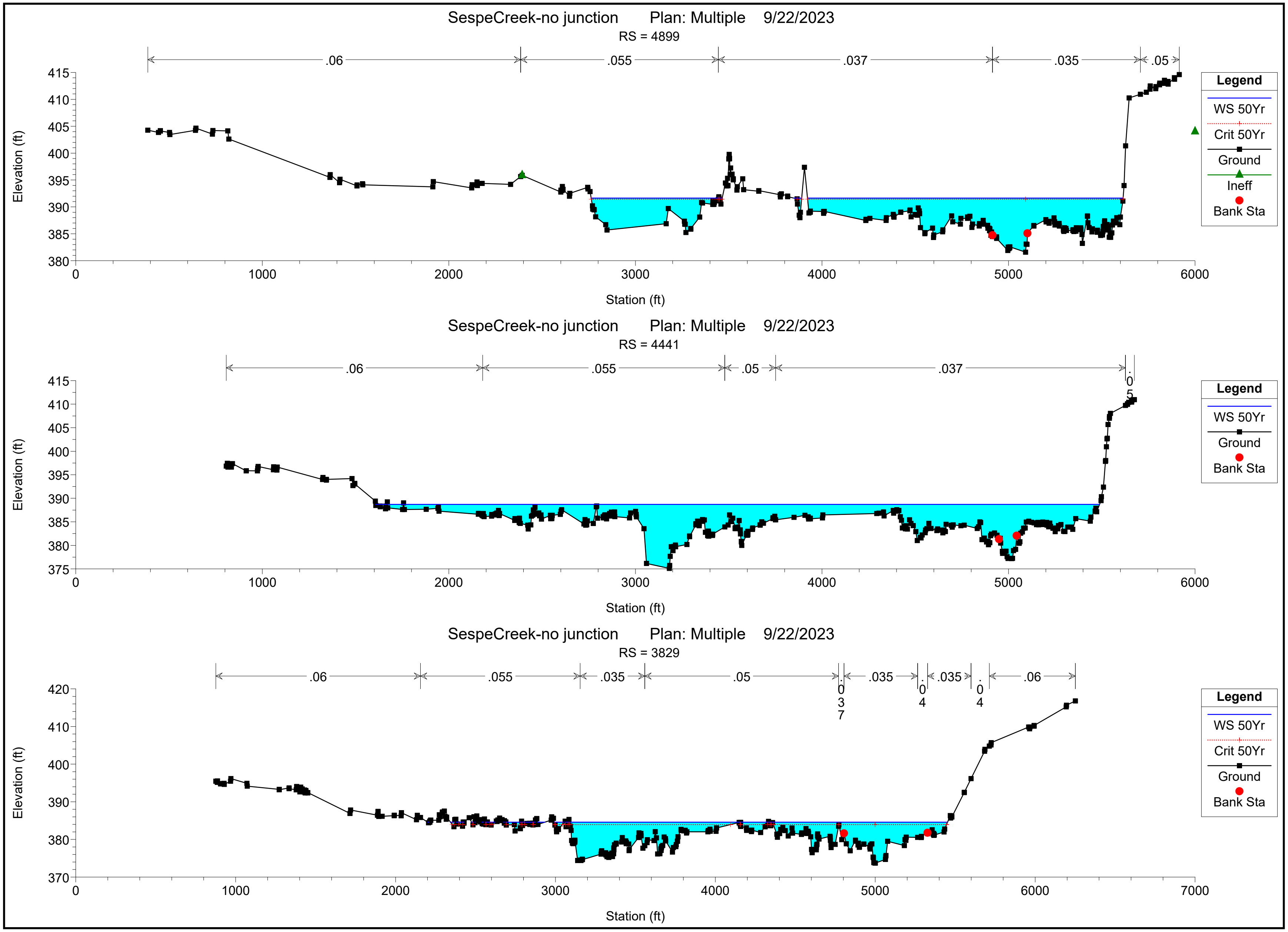

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12780 MO
.11
.1
.04
.035
.035
.04
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12712
.11
.1
.055
.03
.04
.035
.035
.035
.06
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12238
.11
.055
.11
.04
.03
.04
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta

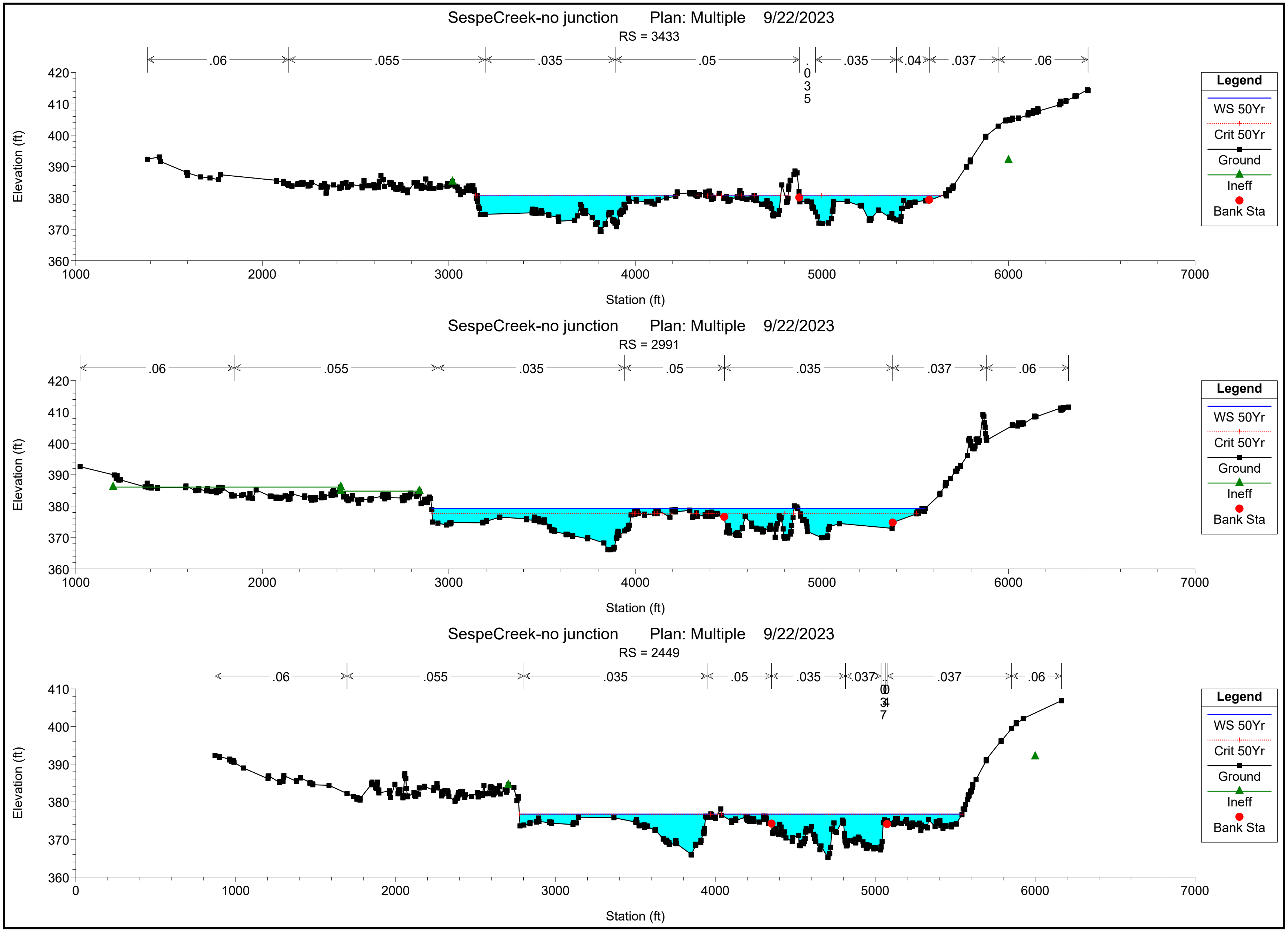

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 11854
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 10652
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 10111

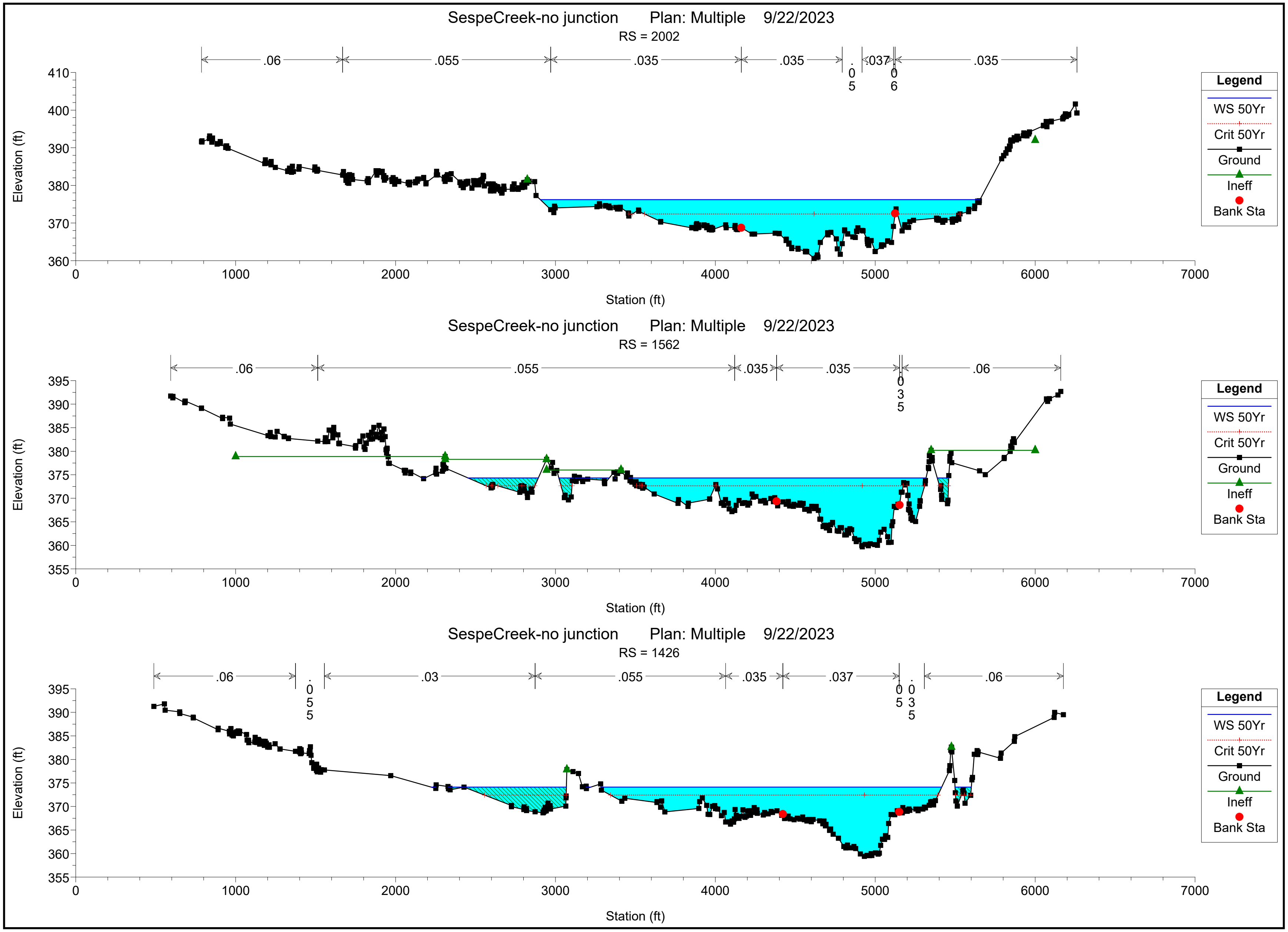

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 9338
.11
.04
.03
.04
.085
.06
.035
.11
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 8571
.11
.04
.03
.085
.06
0
4
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 7774
.11
.04
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta


SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 7062
.11
.04
.03
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 6474
.11
.04
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 6159
.11
.04
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta


SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 5697
.11
.06
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 5552 MO
.11
.06
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 5357
.06
.045
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta


SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 4899
.06
.055
.037
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 4441
.06
.055
.05
.037
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 3829
.06
.055
.035
.05
.035
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta


SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 3433
.06 .055 .035 .05 .035 .035 .04 .037 .06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 2991
.06 .055 .035 .05 .035 .037 .06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 2449
.06 .055 .035 .05 .035 .037 .047 .037 .06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta

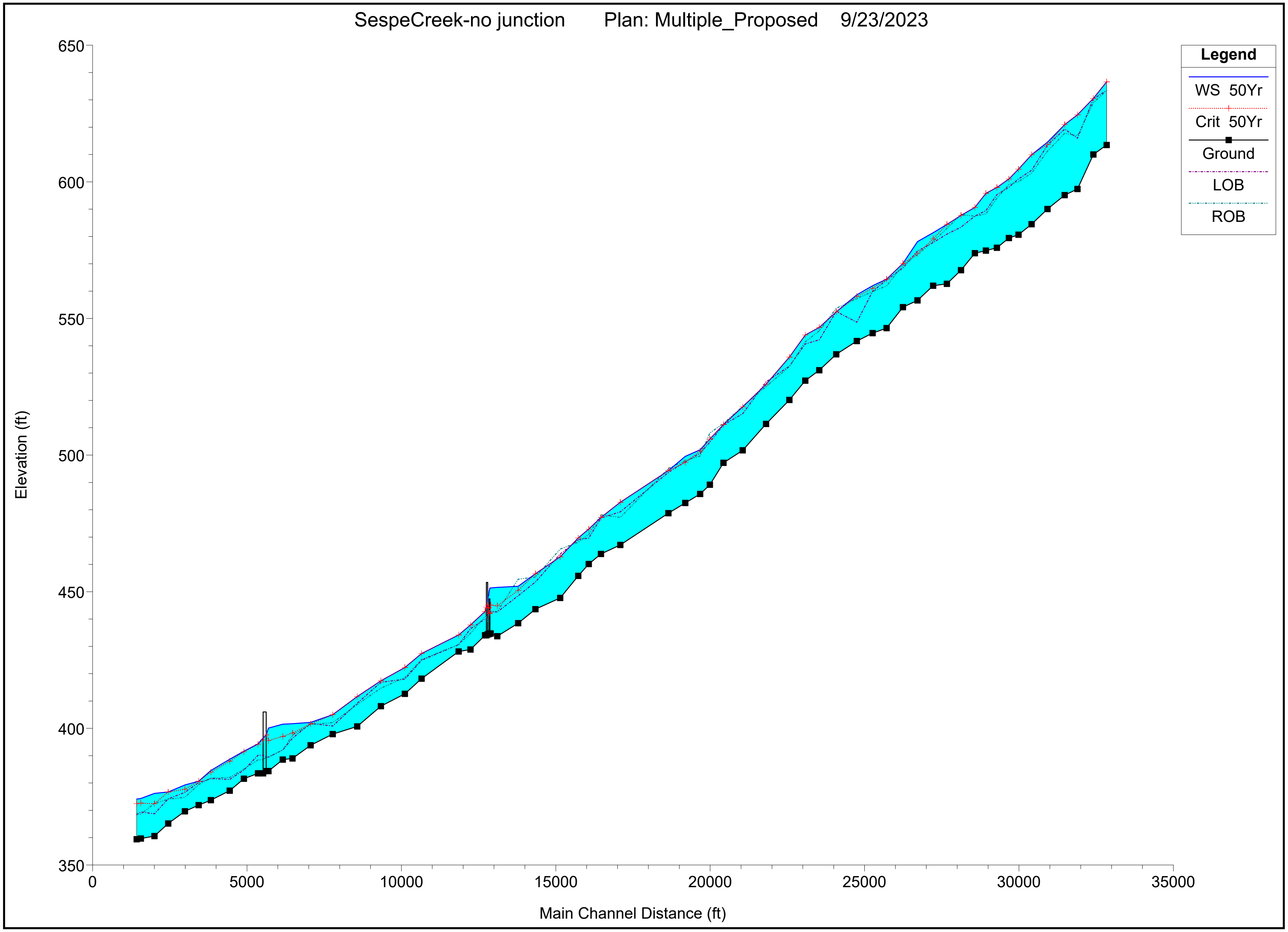

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 2002
.06
.055
.035
.035
.037
.035
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 1562
.06
.055
.035
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 1426
.06
.03
.055
.035
.037
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta

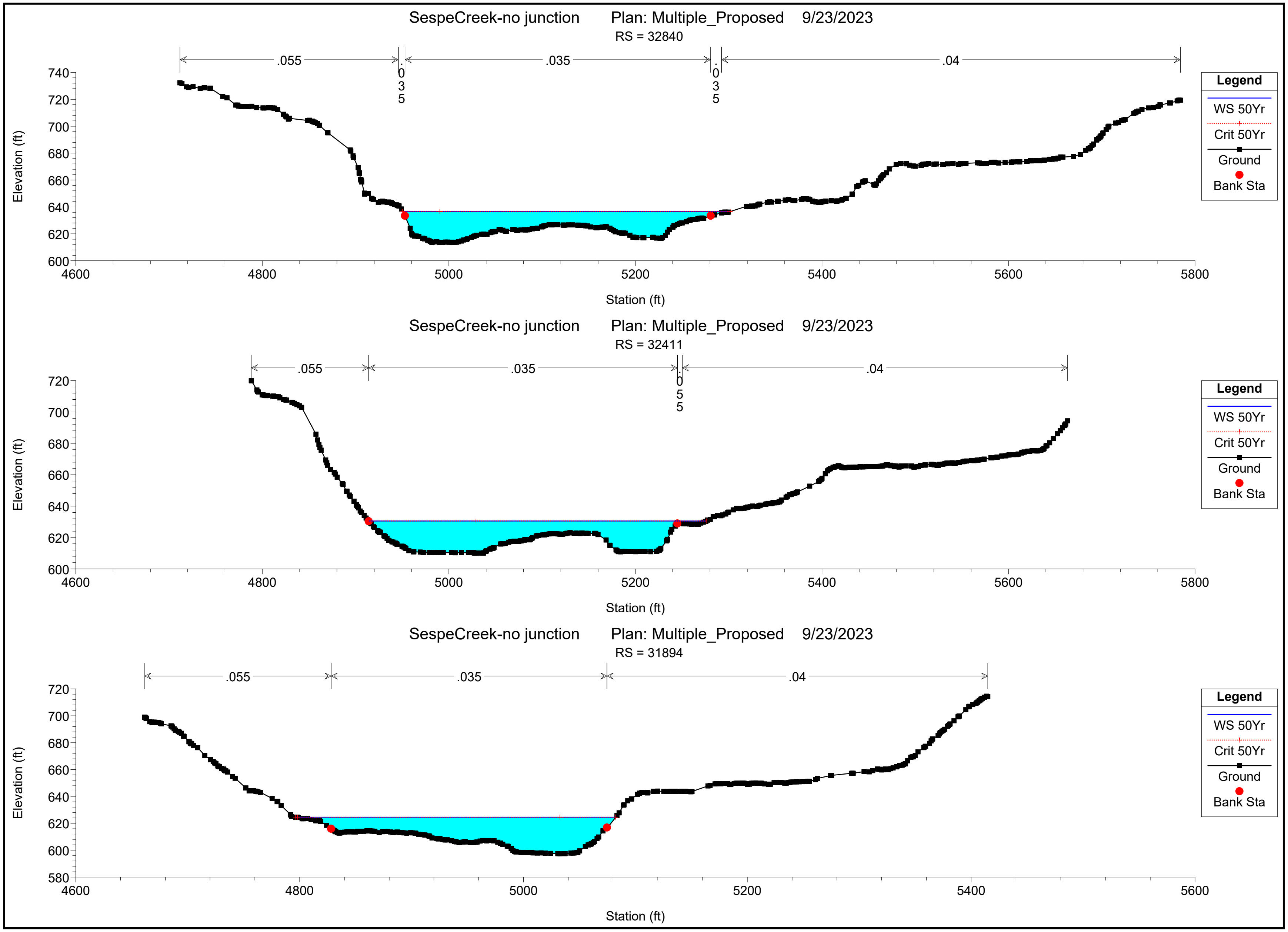
# Hydraulic Model Output

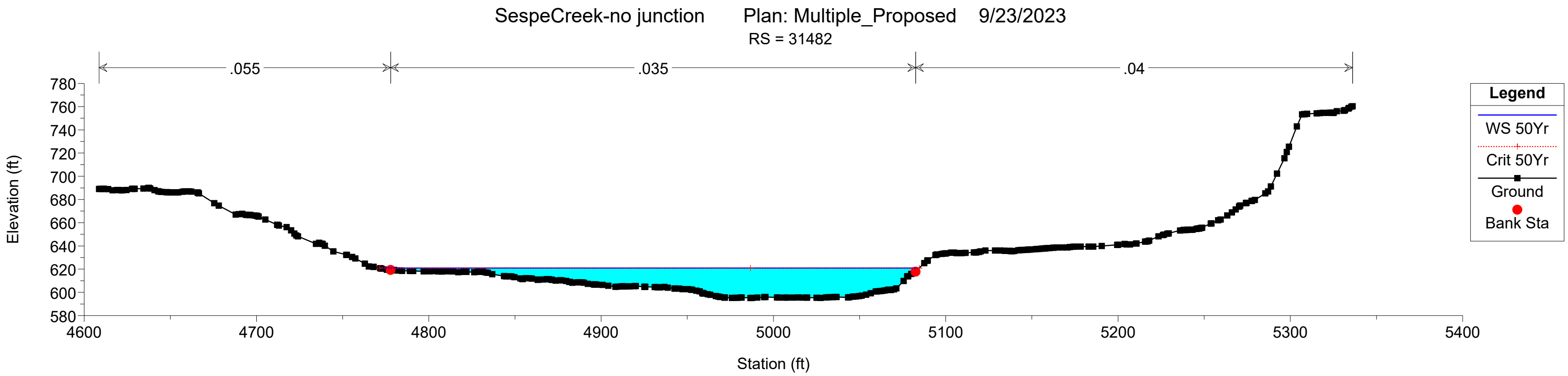
## Post-project Conditions with 50-year Peak Discharge

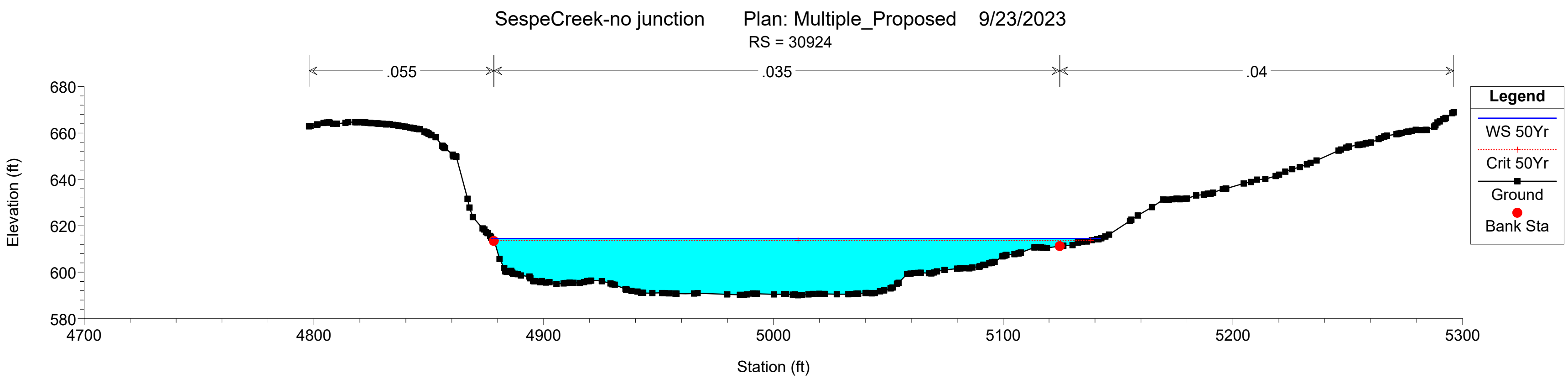
HEC-RAS Plan: Multi_Proposed River: SespeCreek Reach: Reach1 Profile: 50Yr

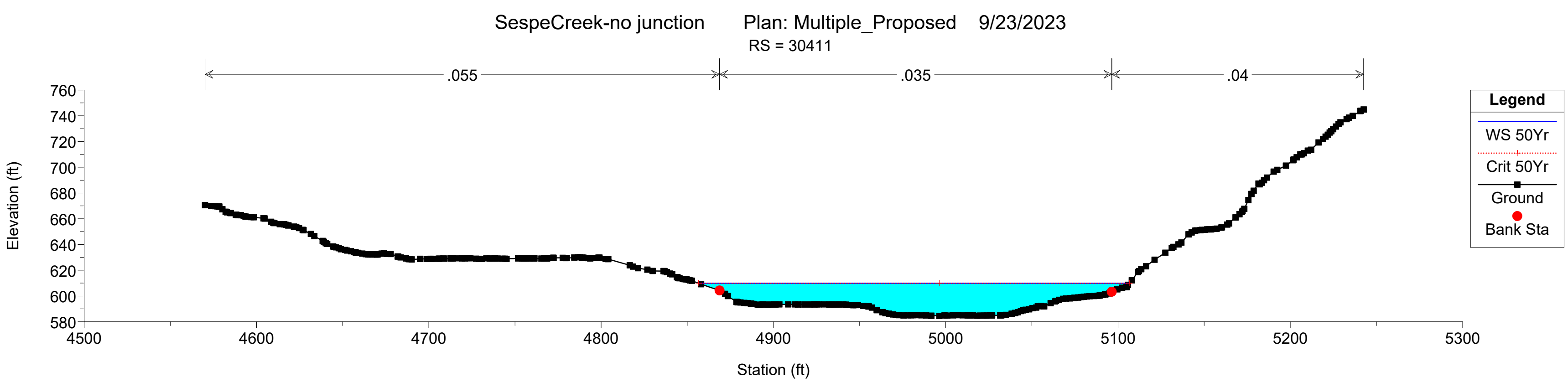
| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach1 | 32840 | 50Yr | 102000.00 | 613.47 | 636.58 | 636.58 | 643.64 | 0.007612 | 21.34 | 4805.95 | 351.16 | 0.99 |
| Reach1 | 32411 | 50Yr | 102000.00 | 609.99 | 630.54 | 630.54 | 637.58 | 0.007647 | 21.31 | 4826.10 | 362.22 | 0.99 |
| Reach1 | 31894 | 50Yr | 102000.00 | 597.39 | 624.55 | 624.55 | 632.96 | 0.006971 | 23.32 | 4467.10 | 285.66 | 0.98 |
| Reach1 | 31482 | 50Yr | 102000.00 | 595.13 | 620.93 | 620.93 | 628.49 | 0.007612 | 22.05 | 4634.27 | 313.08 | 1.00 |
| Reach1 | 30924 | 50Yr | 102000.00 | 590.05 | 614.51 | 613.71 | 622.37 | 0.006357 | 22.50 | 4558.02 | 264.85 | 0.93 |
| Reach1 | 30411 | 50Yr | 102000.00 | 584.48 | 609.92 | 609.92 | 618.86 | 0.006885 | 24.04 | 4301.98 | 250.02 | 0.98 |
| Reach1 | 29986 | 50Yr | 102000.00 | 580.62 | 604.64 | 604.64 | 613.11 | 0.007281 | 23.35 | 4384.32 | 264.12 | 0.99 |
| Reach1 | 29672 | 50Yr | 102000.00 | 579.41 | 601.01 | 601.01 | 608.89 | 0.007891 | 22.53 | 4533.74 | 290.84 | 1.00 |
| Reach1 | 29284 | 50Yr | 102000.00 | 575.87 | 597.94 | 597.94 | 604.80 | 0.006345 | 21.12 | 5097.10 | 451.07 | 0.93 |
| Reach1 | 28927 | 50Yr | 102000.00 | 574.82 | 595.80 | 595.80 | 601.67 | 0.005278 | 20.06 | 6042.26 | 594.03 | 0.85 |
| Reach1 | 28571 | 50Yr | 102000.00 | 573.87 | 590.66 | 590.66 | 597.47 | 0.007202 | 21.25 | 5126.54 | 554.66 | 0.98 |
| Reach1 | 28122 | 50Yr | 102000.00 | 567.66 | 587.69 | 587.69 | 594.24 | 0.006231 | 20.94 | 5197.12 | 412.35 | 0.92 |
| Reach1 | 27668 | 50Yr | 102000.00 | 562.66 | 584.42 | 584.42 | 591.10 | 0.006806 | 20.84 | 5046.36 | 423.40 | 0.95 |
| Reach1 | 27222 | 50Yr | 102000.00 | 561.98 | 581.37 | 579.14 | 585.06 | 0.005738 | 15.49 | 6806.51 | 631.88 | 0.74 |
| Reach1 | 26715 | 50Yr | 102604.00 | 556.60 | 578.13 | 573.73 | 581.02 | 0.010194 | 13.64 | 7553.05 | 505.99 | 0.61 |
| Reach1 | 26242 | 50Yr | 102604.00 | 554.12 | 570.13 | 570.13 | 575.83 | 0.010578 | 19.14 | 5365.02 | 476.65 | 1.00 |
| Reach1 | 25713 | 50Yr | 102604.00 | 546.47 | 564.37 | 564.37 | 569.14 | 0.007874 | 17.59 | 6055.36 | 699.52 | 0.97 |
| Reach1 | 25258 | 50Yr | 102604.00 | 544.62 | 561.98 | 561.04 | 565.43 | 0.006159 | 14.92 | 6927.77 | 765.31 | 0.85 |
| Reach1 | 24751 | 50Yr | 102604.00 | 541.72 | 558.63 | 558.04 | 561.96 | 0.007504 | 14.68 | 7175.39 | 1214.56 | 0.88 |
| Reach1 | 24081 | 50Yr | 102604.00 | 536.87 | 552.40 | 552.40 | 556.38 | 0.009073 | 16.01 | 6410.58 | 806.39 | 1.00 |
| Reach1 | 23531 | 50Yr | 102604.00 | 531.05 | 546.73 | 546.73 | 550.59 | 0.007128 | 15.82 | 6864.20 | 1398.92 | 0.94 |
| Reach1 | 23080 | 50Yr | 102604.00 | 527.22 | 543.92 | 543.92 | 546.55 | 0.006135 | 14.14 | 9860.49 | 1934.43 | 0.84 |
| Reach1 | 22567 | 50Yr | 102604.00 | 520.15 | 535.86 | 535.86 | 538.28 | 0.005954 | 13.69 | 9456.61 | 2033.74 | 0.75 |
| Reach1 | 21811 | 50Yr | 102604.00 | 511.42 | 525.88 | 525.88 | 529.23 | 0.007984 | 15.07 | 7487.77 | 1250.97 | 0.94 |
| Reach1 | 21055 | 50Yr | 102604.00 | 501.73 | 517.67 | 517.67 | 521.09 | 0.008008 | 14.88 | 7194.86 | 1463.32 | 0.94 |
| Reach1 | 20433 | 50Yr | 102604.00 | 497.18 | 511.20 | 511.20 | 514.76 | 0.008345 | 15.21 | 6905.57 | 1017.21 | 0.96 |
| Reach1 | 19991 | 50Yr | 102604.00 | 489.17 | 505.91 | 505.91 | 509.94 | 0.011611 | 16.11 | 6370.28 | 792.96 | 1.00 |
| Reach1 | 19675 | 50Yr | 102604.00 | 485.77 | 501.97 | 501.48 | 505.59 | 0.008152 | 15.26 | 6726.58 | 786.06 | 0.92 |
| Reach1 | 19191 | 50Yr | 102604.00 | 482.46 | 499.53 | 497.30 | 502.37 | 0.004816 | 13.52 | 7629.70 | 727.12 | 0.71 |
| Reach1 | 18647 | 50Yr | 102604.00 | 478.75 | 494.33 | 494.33 | 498.78 | 0.008586 | 16.92 | 6077.58 | 1318.82 | 1.00 |
| Reach1 | 17091 | 50Yr | 102604.00 | 467.11 | 482.74 | 482.74 | 487.37 | 0.005720 | 17.71 | 6461.67 | 738.78 | 0.86 |
| Reach1 | 16463 | 50Yr | 102604.00 | 463.81 | 477.19 | 477.19 | 480.83 | 0.011882 | 15.30 | 6705.55 | 920.83 | 1.00 |
| Reach1 | 16069 | 50Yr | 102604.00 | 460.12 | 472.92 | 472.87 | 476.46 | 0.008664 | 15.14 | 6856.27 | 980.80 | 0.97 |
| Reach1 | 15728 | 50Yr | 102604.00 | 455.80 | 469.67 | 469.67 | 473.53 | 0.008348 | 15.78 | 6584.26 | 911.62 | 0.97 |
| Reach1 | 15144 | 50Yr | 102604.00 | 447.74 | 462.80 | 462.80 | 466.64 | 0.007607 | 15.72 | 6526.92 | 847.31 | 1.00 |
| Reach1 | 14340 | 50Yr | 102604.00 | 443.62 | 456.56 | 456.56 | 459.53 | 0.008122 | 14.12 | 7959.79 | 1376.90 | 0.95 |
| Reach1 | 13782 | 50Yr | 102604.00 | 438.49 | 451.97 | 450.51 | 453.83 | 0.005650 | 10.97 | 9480.59 | 1404.11 | 0.73 |
| Reach1 | 13104 | 50Yr | 102604.00 | 433.71 | 451.59 | 444.84 | 452.21 | 0.000895 | 6.42 | 16666.61 | 1660.24 | 0.32 |
| Reach1 | 12892 | 50Yr | 102604.00 | 434.72 | 451.39 | 445.12 | 452.02 | 0.000797 | 6.83 | 16159.55 | 1542.18 | 0.32 |
| Reach1 | 12852 | | Mult Open | | | | | | | | | |
| Reach1 | 12827 | 50Yr | 102604.00 | 434.59 | 448.45 | 444.15 | 450.02 | 0.001934 | 9.52 | 10217.87 | 1497.92 | 0.49 |
| Reach1 | 12807 | 50Yr | 102604.00 | 434.42 | 448.44 | 444.07 | 449.95 | 0.001880 | 9.56 | 10547.23 | 1157.32 | 0.48 |
| Reach1 | 12780 | | Mult Open | | | | | | | | | |
| Reach1 | 12712 | 50Yr | 102604.00 | 434.07 | 442.80 | 442.80 | 446.92 | 0.008639 | 14.42 | 6342.99 | 3808.91 | 0.96 |
| Reach1 | 12238 | 50Yr | 102604.00 | 428.86 | 437.85 | 437.85 | 441.08 | 0.005768 | 10.38 | 7363.93 | 3016.71 | 0.76 |
| Reach1 | 11854 | 50Yr | 102604.00 | 428.14 | 434.18 | 434.18 | 436.82 | 0.005845 | 10.07 | 8197.13 | 3236.58 | 0.76 |
| Reach1 | 10652 | 50Yr | 102604.00 | 418.20 | 427.37 | 427.37 | 429.87 | 0.007163 | 13.08 | 8119.27 | 1657.86 | 0.87 |
| Reach1 | 10111 | 50Yr | 102604.00 | 412.64 | 422.25 | 422.25 | 424.64 | 0.006065 | 12.63 | 8295.56 | 1743.66 | 0.81 |
| Reach1 | 9338 | 50Yr | 102604.00 | 408.13 | 417.40 | 417.40 | 419.04 | 0.005342 | 10.99 | 10318.84 | 2940.90 | 0.75 |
| Reach1 | 8571 | 50Yr | 102604.00 | 400.71 | 411.65 | 411.65 | 413.40 | 0.005235 | 11.32 | 10213.88 | 2853.94 | 0.75 |
| Reach1 | 7774 | 50Yr | 102604.00 | 397.88 | 404.99 | 404.99 | 406.71 | 0.009050 | 13.66 | 9951.39 | 2901.84 | 0.96 |
| Reach1 | 7062 | 50Yr | 102604.00 | 393.83 | 402.18 | 401.63 | 403.39 | 0.005100 | 9.45 | 11689.83 | 3232.46 | 0.78 |
| Reach1 | 6474 | 50Yr | 102604.00 | 388.98 | 401.70 | 398.28 | 402.16 | 0.001295 | 6.50 | 20405.12 | 3438.08 | 0.39 |
| Reach1 | 6159 | 50Yr | 102604.00 | 388.55 | 401.52 | 397.09 | 401.84 | 0.000698 | 5.76 | 24941.21 | 3492.51 | 0.30 |
| Reach1 | 5697 | 50Yr | 102604.00 | 384.34 | 400.09 | 395.51 | 400.83 | 0.001151 | 8.07 | 15557.92 | 3619.39 | 0.39 |
| Reach1 | 5552 | | Mult Open | | | | | | | | | |
| Reach1 | 5357 | 50Yr | 102604.00 | 383.52 | 394.34 | 394.15 | 396.85 | 0.006711 | 14.01 | 8486.65 | 2858.30 | 0.86 |
| Reach1 | 4899 | 50Yr | 102604.00 | 381.58 | 391.64 | 391.45 | 393.36 | 0.006817 | 14.99 | 11199.36 | 2433.98 | 0.89 |
| Reach1 | 4441 | 50Yr | 102604.00 | 377.19 | 388.70 | 388.02 | 389.64 | 0.005708 | 13.99 | 15171.22 | 3872.39 | 0.78 |
| Reach1 | 3829 | 50Yr | 102604.00 | 373.71 | 384.57 | 383.97 | 386.04 | 0.006941 | 11.79 | 11056.22 | 2832.15 | 0.84 |
| Reach1 | 3433 | 50Yr | 102604.00 | 371.89 | 380.66 | 380.66 | 382.71 | 0.009249 | 10.81 | 8989.49 | 2182.83 | 0.93 |
| Reach1 | 2991 | 50Yr | 102604.00 | 369.65 | 379.29 | 377.74 | 380.25 | 0.003523 | 8.34 | 13190.33 | 2628.60 | 0.60 |
| Reach1 | 2449 | 50Yr | 102604.00 | 365.18 | 376.73 | 376.73 | 378.49 | 0.007478 | 12.43 | 10529.02 | 2743.64 | 0.86 |
| Reach1 | 2002 | 50Yr | 102604.00 | 360.59 | 376.21 | 372.42 | 376.78 | 0.001252 | 6.73 | 18357.01 | 2749.30 | 0.36 |
| Reach1 | 1562 | 50Yr | 102604.00 | 359.68 | 374.33 | 372.65 | 375.82 | 0.003195 | 10.82 | 12153.81 | 2691.97 | 0.61 |
| Reach1 | 1426 | 50Yr | 102604.00 | 359.40 | 374.12 | 372.43 | 375.33 | 0.002999 | 10.02 | 13100.40 | 3028.28 | 0.57 |

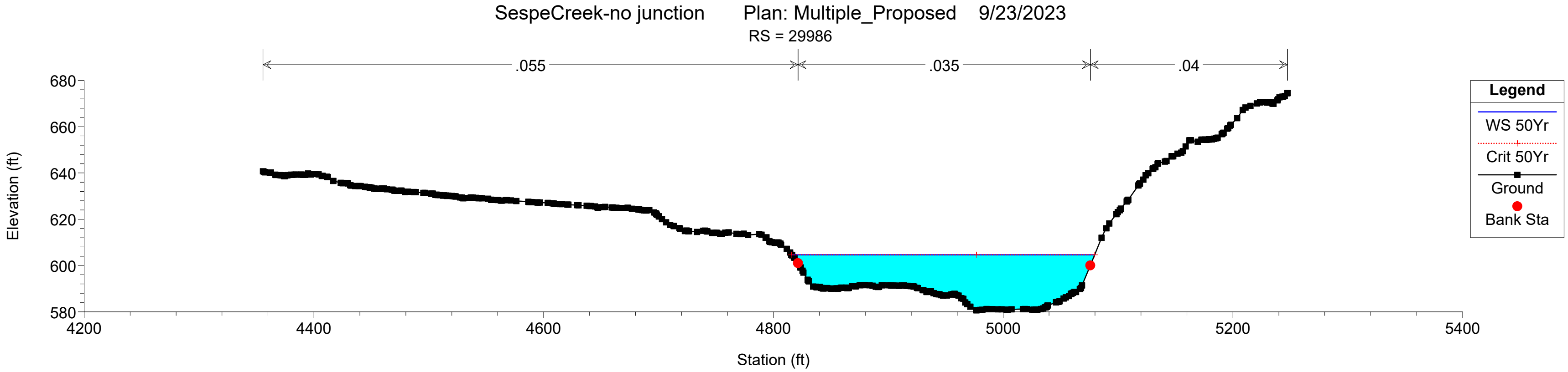

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
Legend
WS 50Yr
Crit 50Yr
Ground
LOB
ROB
Elevation (ft)
Main Channel Distance (ft)
650
600
550
500
450
400
350
0
5000
10000
15000
20000
25000
30000
35000

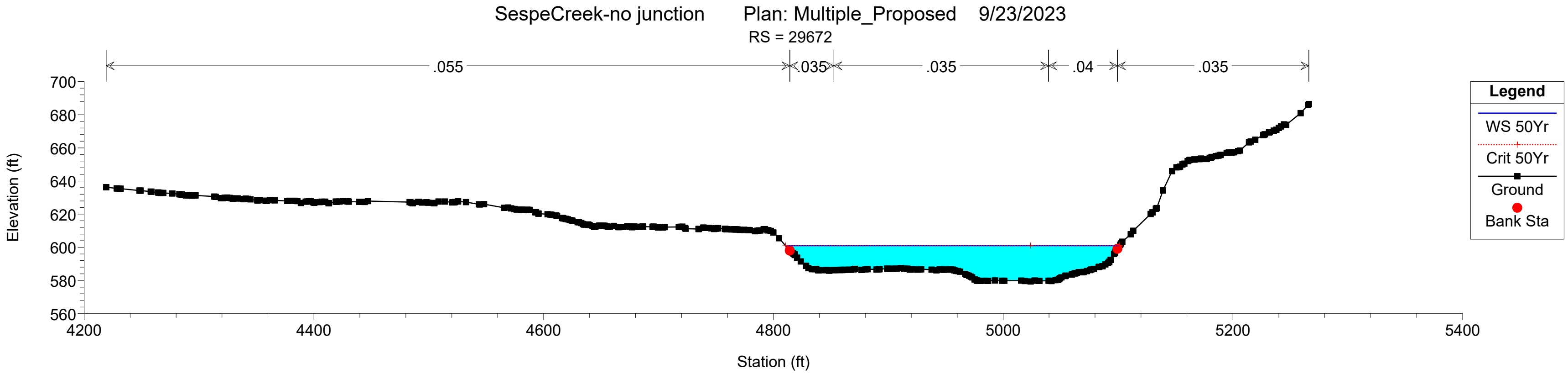

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 32840
.055
.035
.04
0 3 5
0 3 5
Elevation (ft)
740
720
700
680
660
640
620
600
4600
4800
5000
5200
5400
5600
5800
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 32411
.055
.035
.04
0 5 5
Elevation (ft)
720
700
680
660
640
620
600
4600
4800
5000
5200
5400
5600
5800
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 31894
.055
.035
.04
Elevation (ft)
720
700
680
660
640
620
600
580
4600
4800
5000
5200
5400
5600
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta

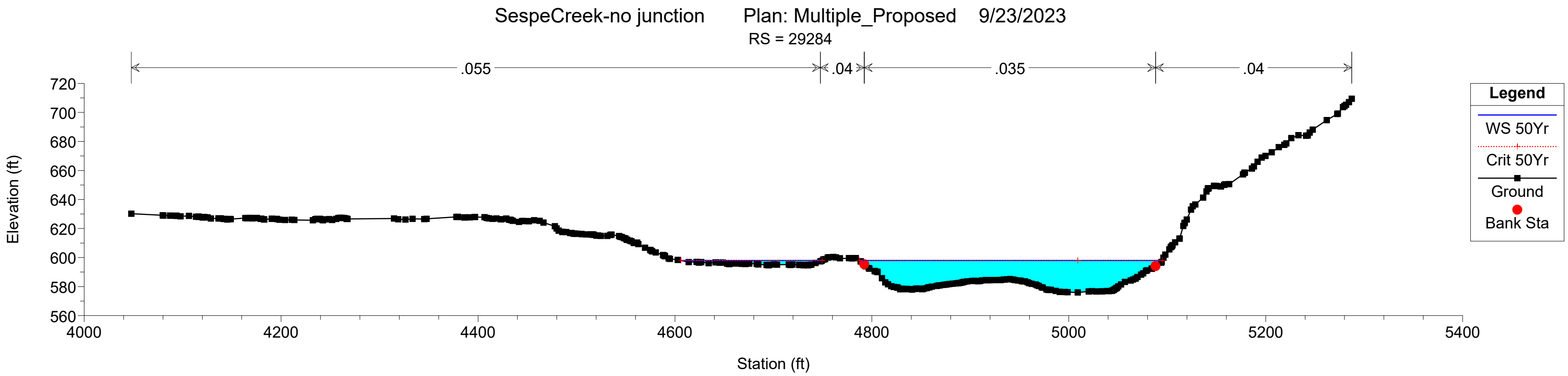

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 31482
.055
.035
.04
Elevation (ft)
780
760
740
720
700
680
660
640
620
600
580
4600
4700
4800
4900
5000
5100
5200
5300
5400
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta

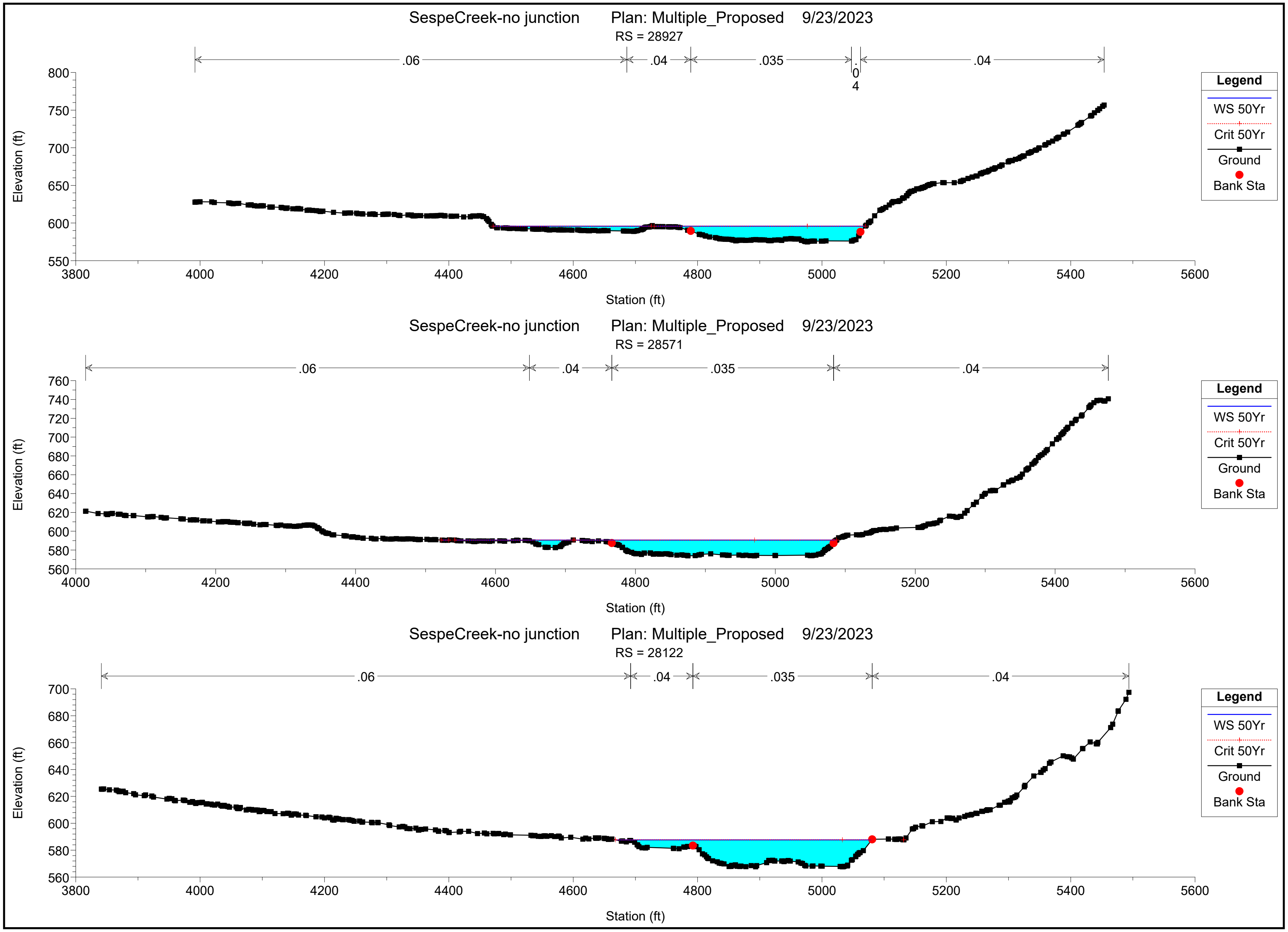

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 30924
.055
.035
.04
Elevation (ft)
680
660
640
620
600
580
4700
4800
4900
5000
5100
5200
5300
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta

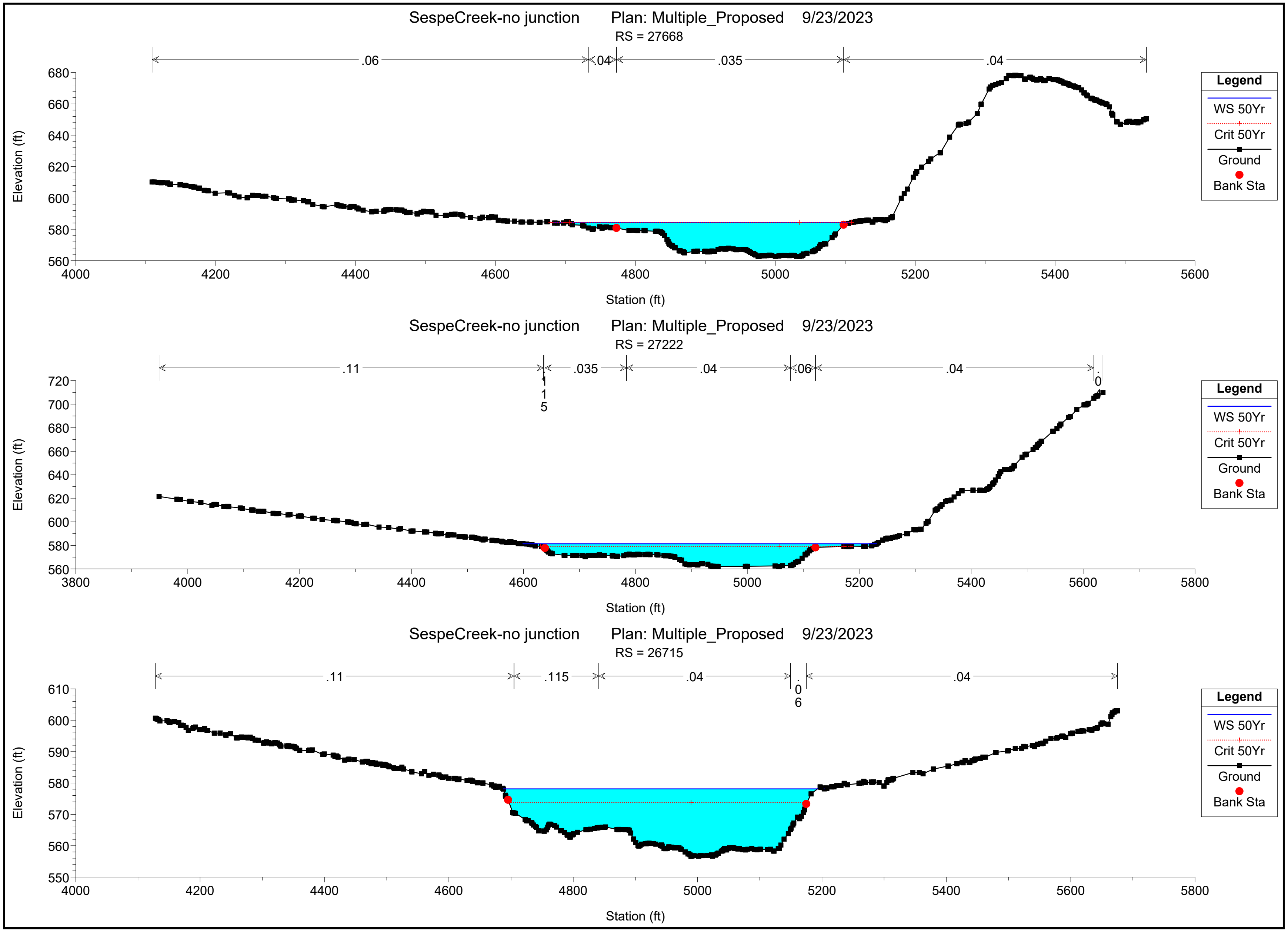

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 30411
.055
.035
.04
Elevation (ft)
760
740
720
700
680
660
640
620
600
580
4500
4600
4700
4800
4900
5000
5100
5200
5300
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta

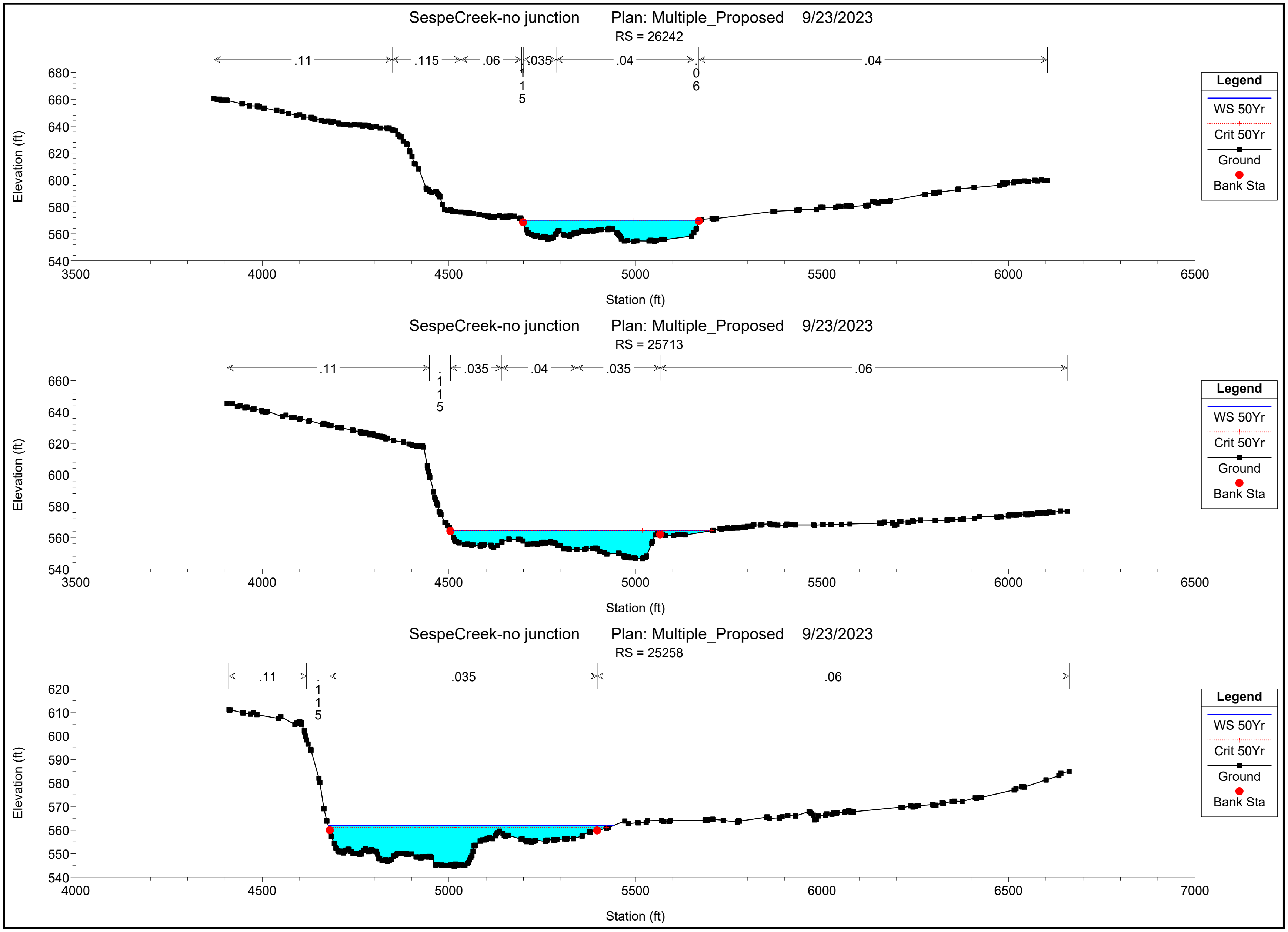

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 29986
.055
.035
.04
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

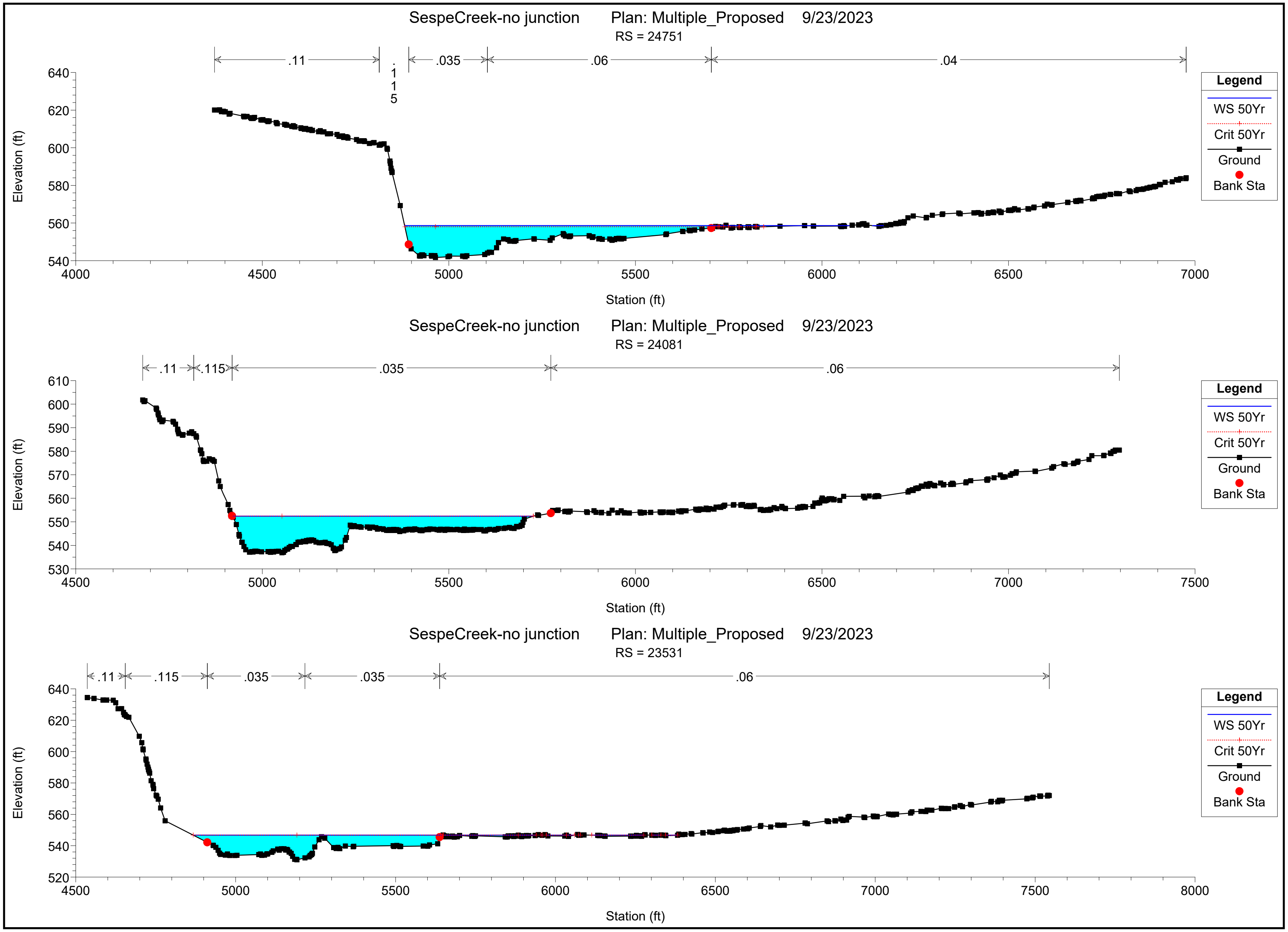

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 29672
.055
.035
.035
.04
.035
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

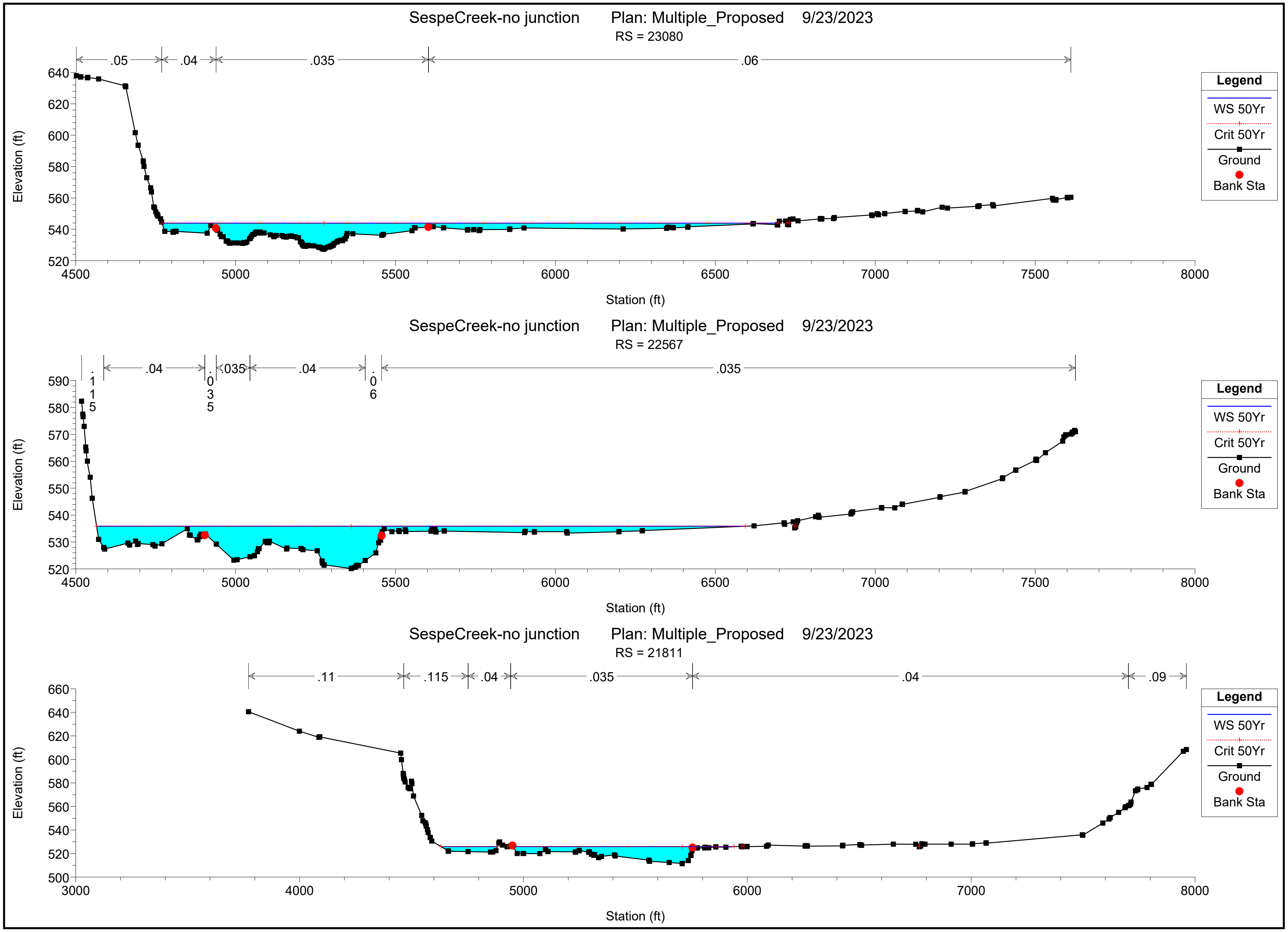

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 29284
.055
.04
.035
.04
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

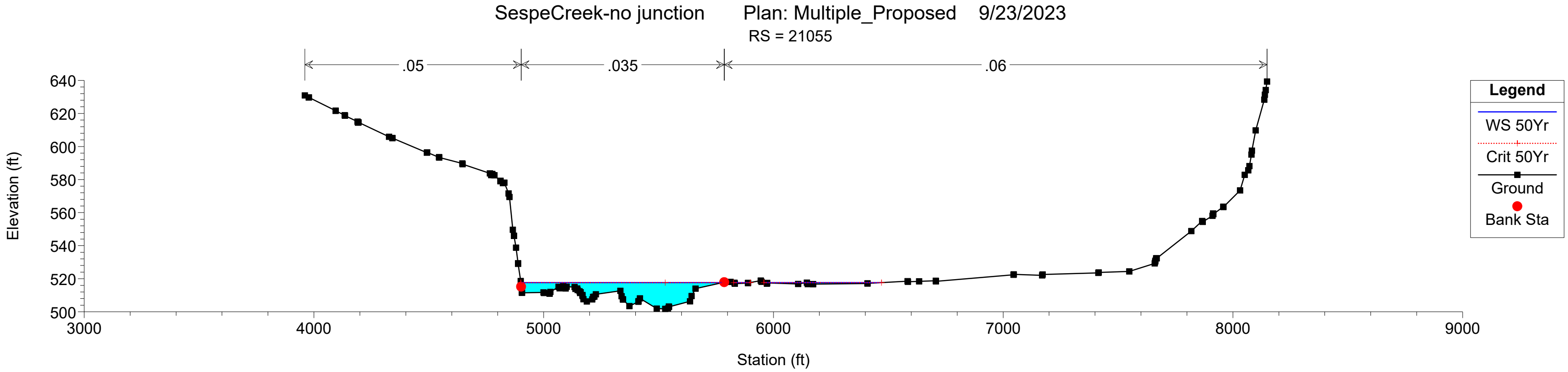

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 28927
.06
.04
.035
.04
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 28571
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 28122

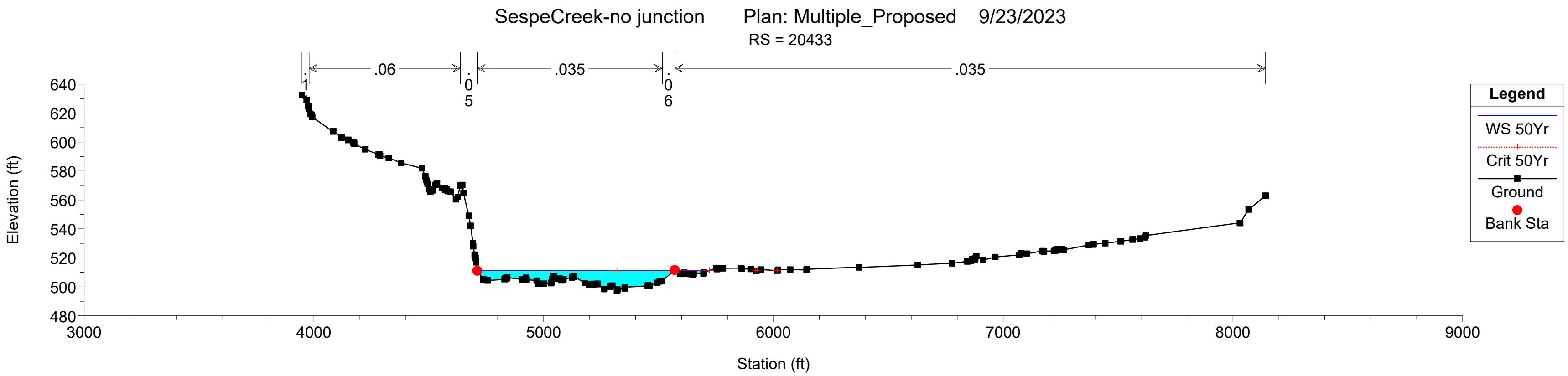

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 27668
.06
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 27222
.11
.115
.035
.04
.06
.04
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 26715
.11
.115
.04
.06
.04
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta

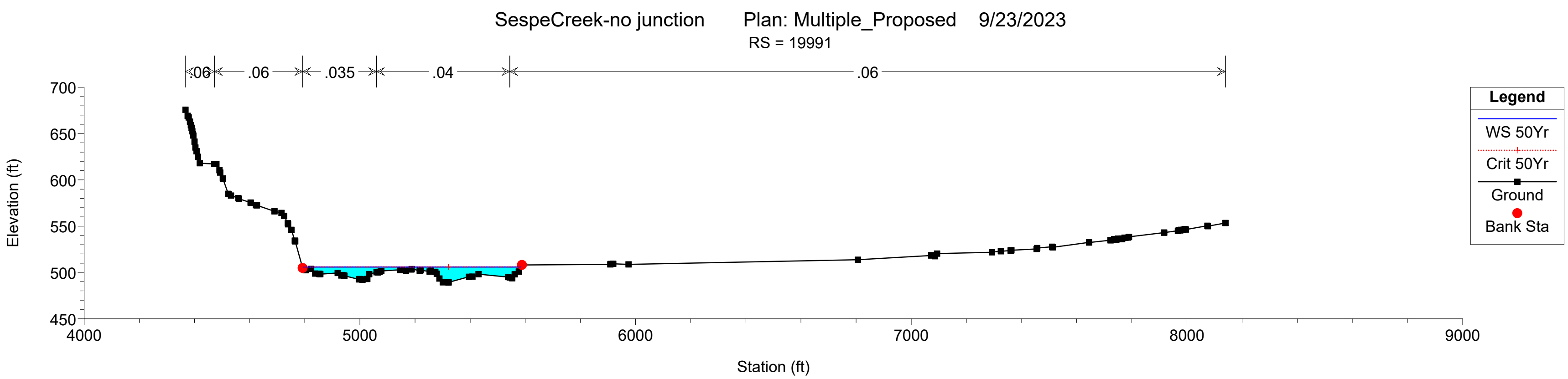

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 26242
.11
.115
.06
.035
.04
.04
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 25713
.11
.035
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 25258
.11
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta

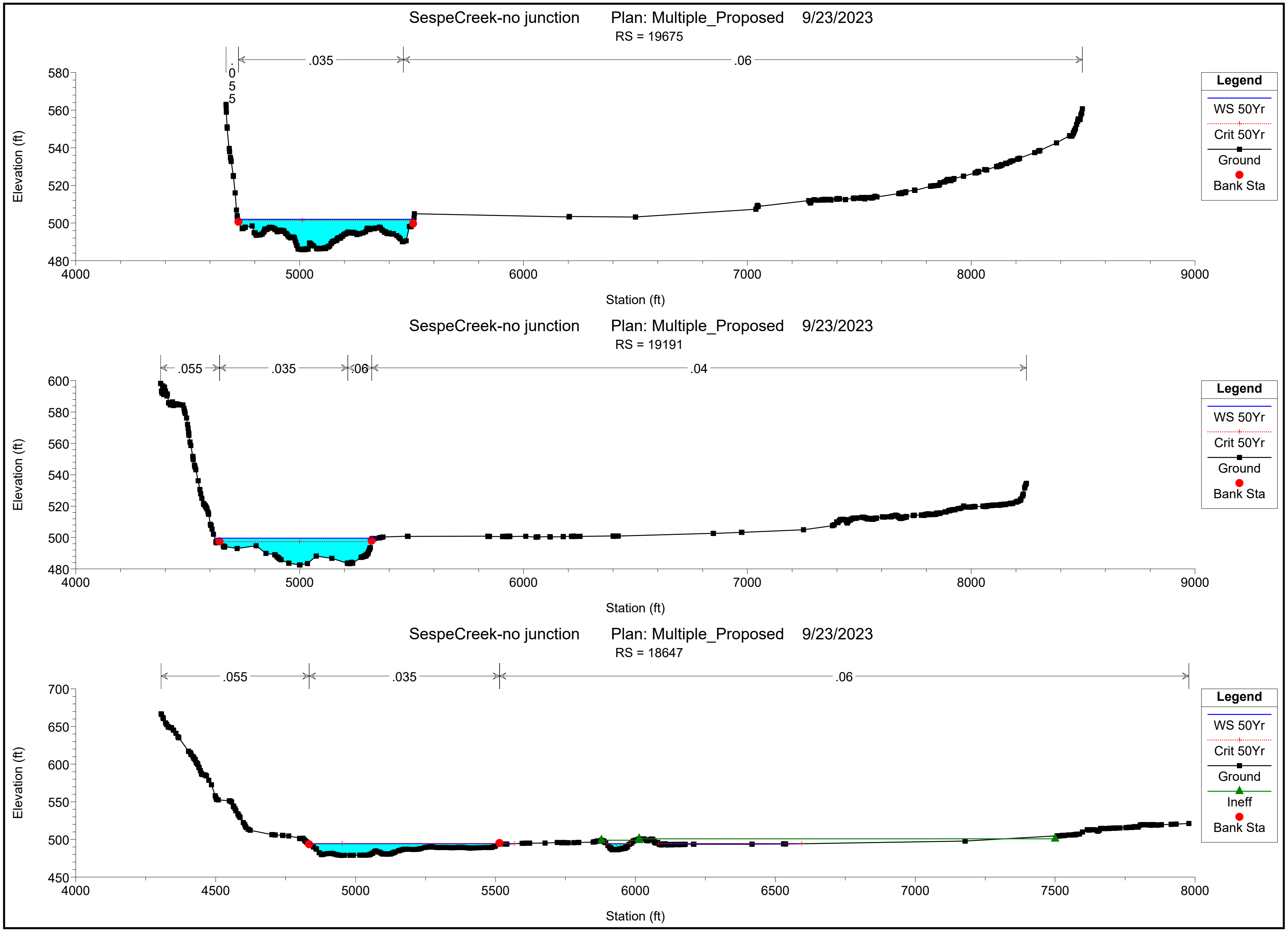

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 24751
.11
1
1
5
.035
.06
.04
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 24081
.11
.115
.035
.06
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 23531
.11
.115
.035
.035
.06
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 23080
.05
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 22567
.115
.04
.035
.035
.04
.06
.035
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 21811
.11
.115
.04
.035
.04
.09
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta

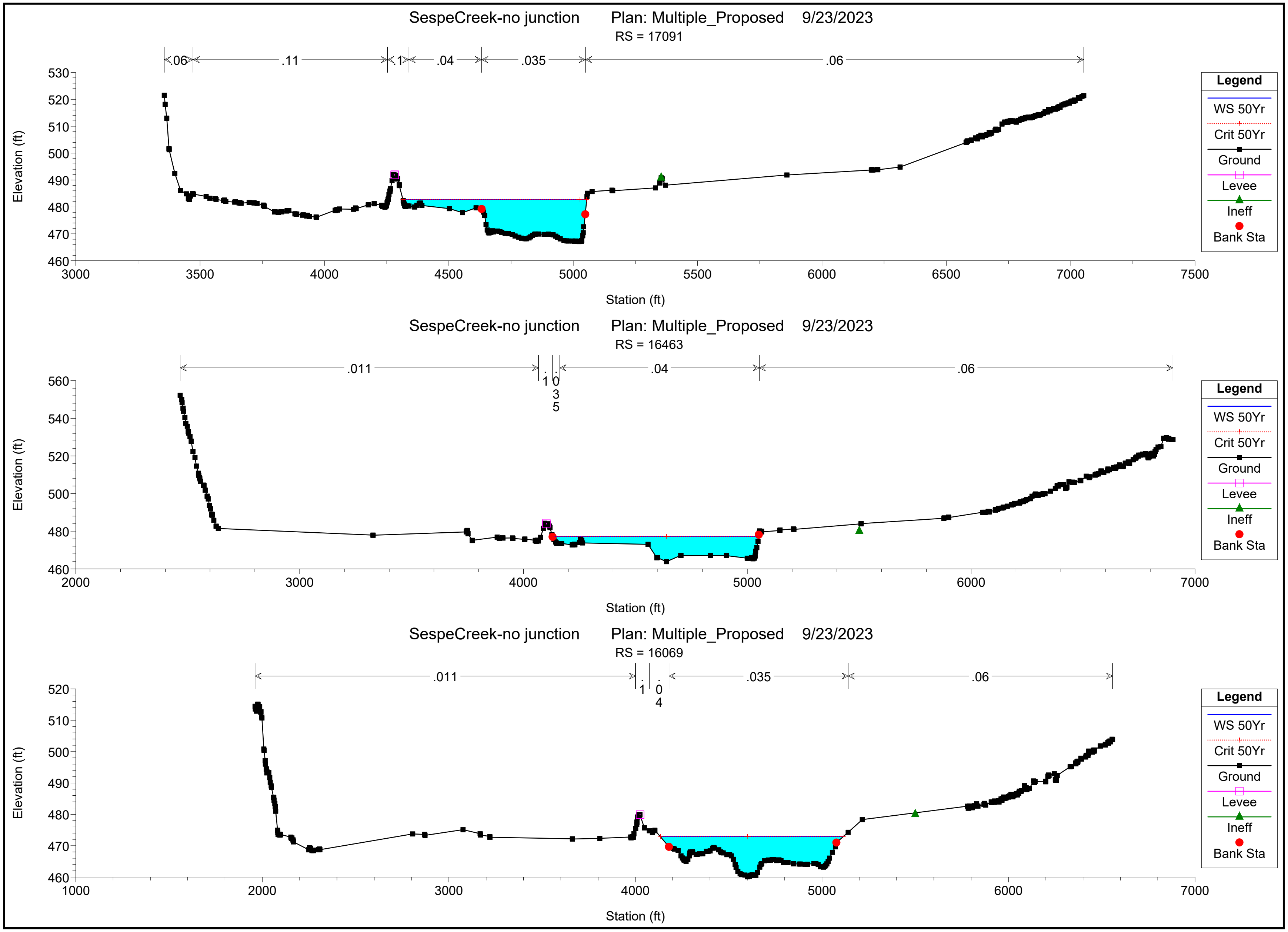

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 21055
.05
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 20433
.06
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 19991
.06
.06
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta

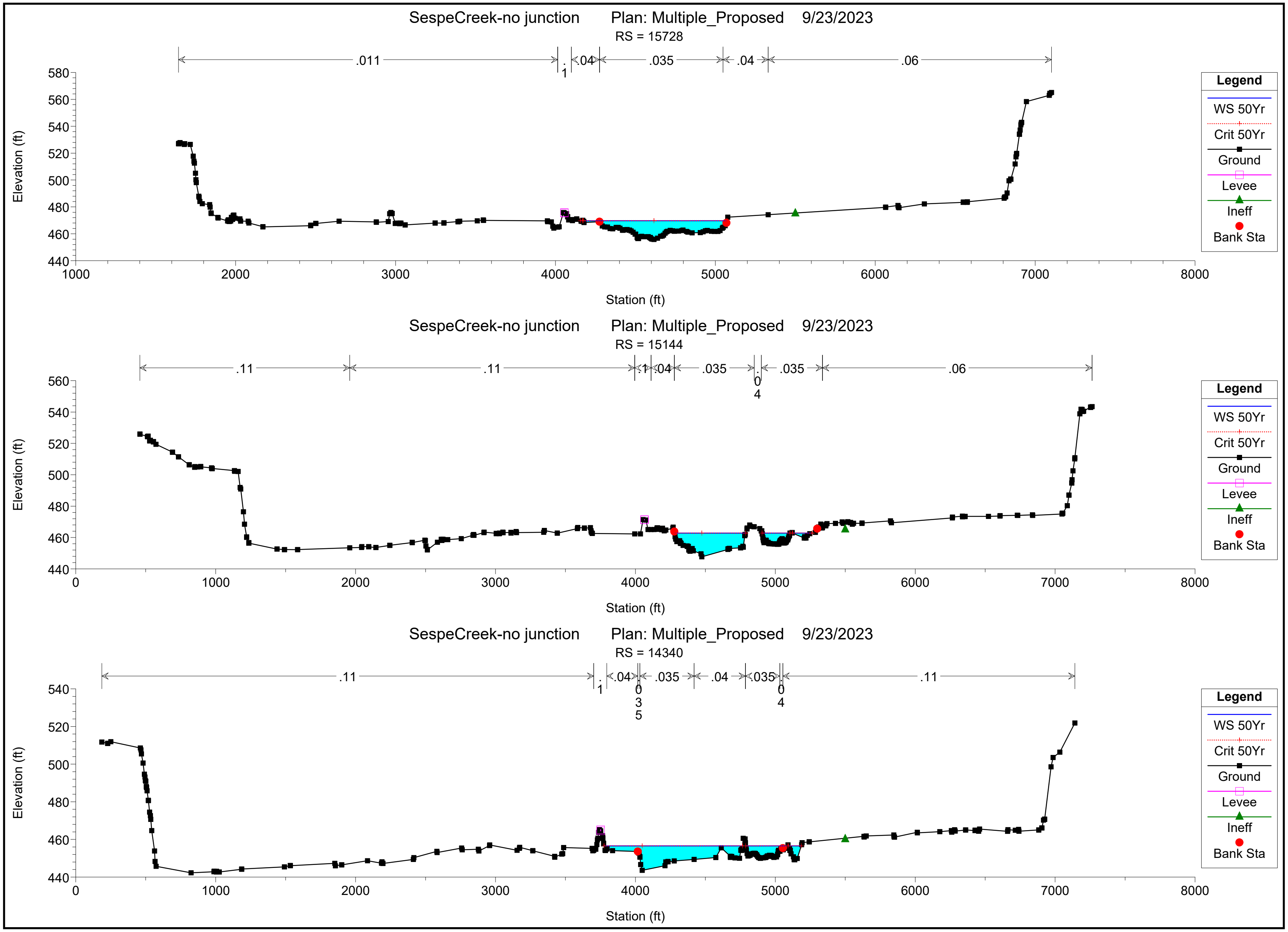


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 19675
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 19191
.055
.035
.06
.04
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 18647
.055
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta

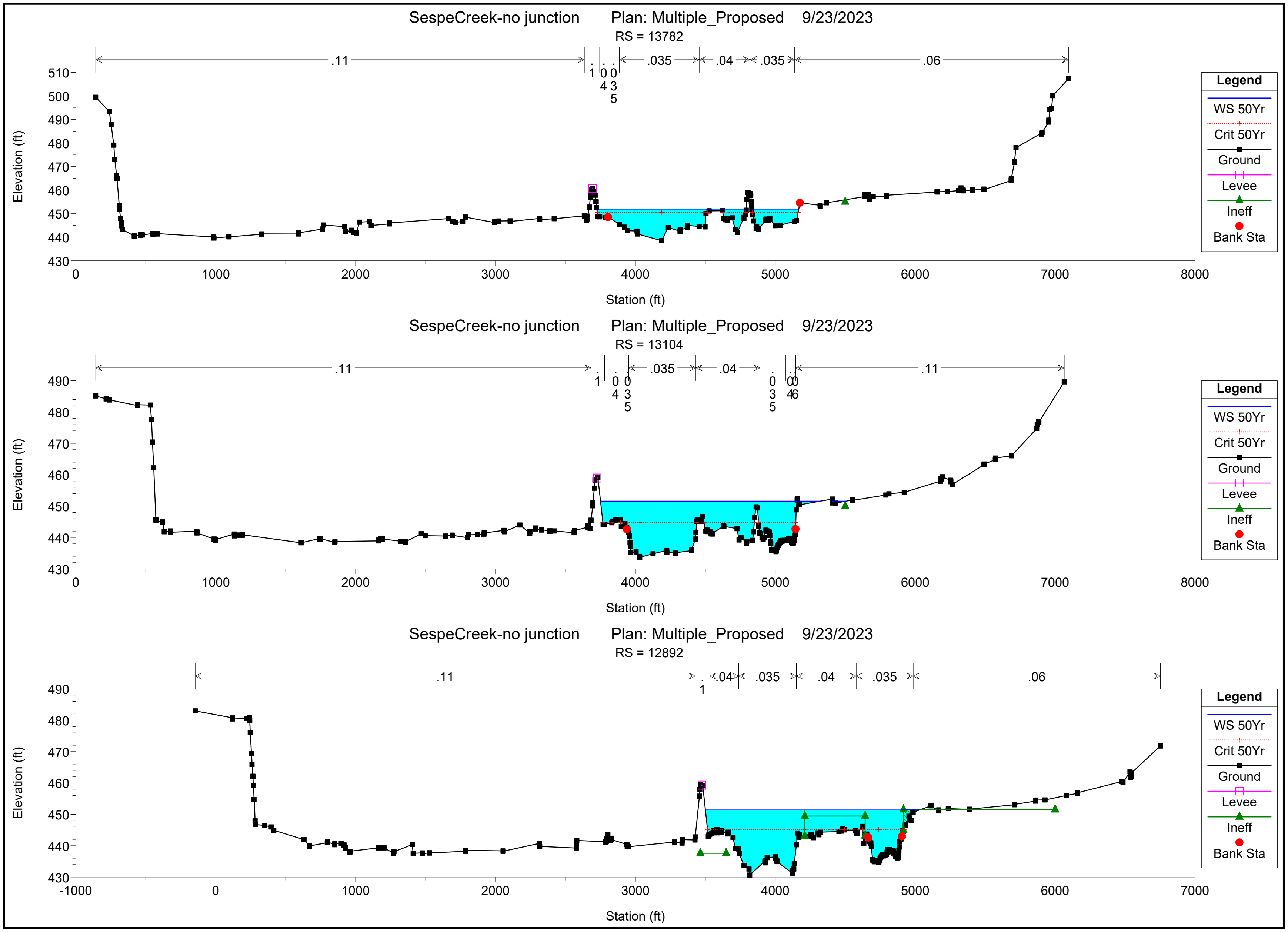



SPBL-2025-01
SESPE CREEK OVERFLOW RAILROAD BRIDGE REPAIR

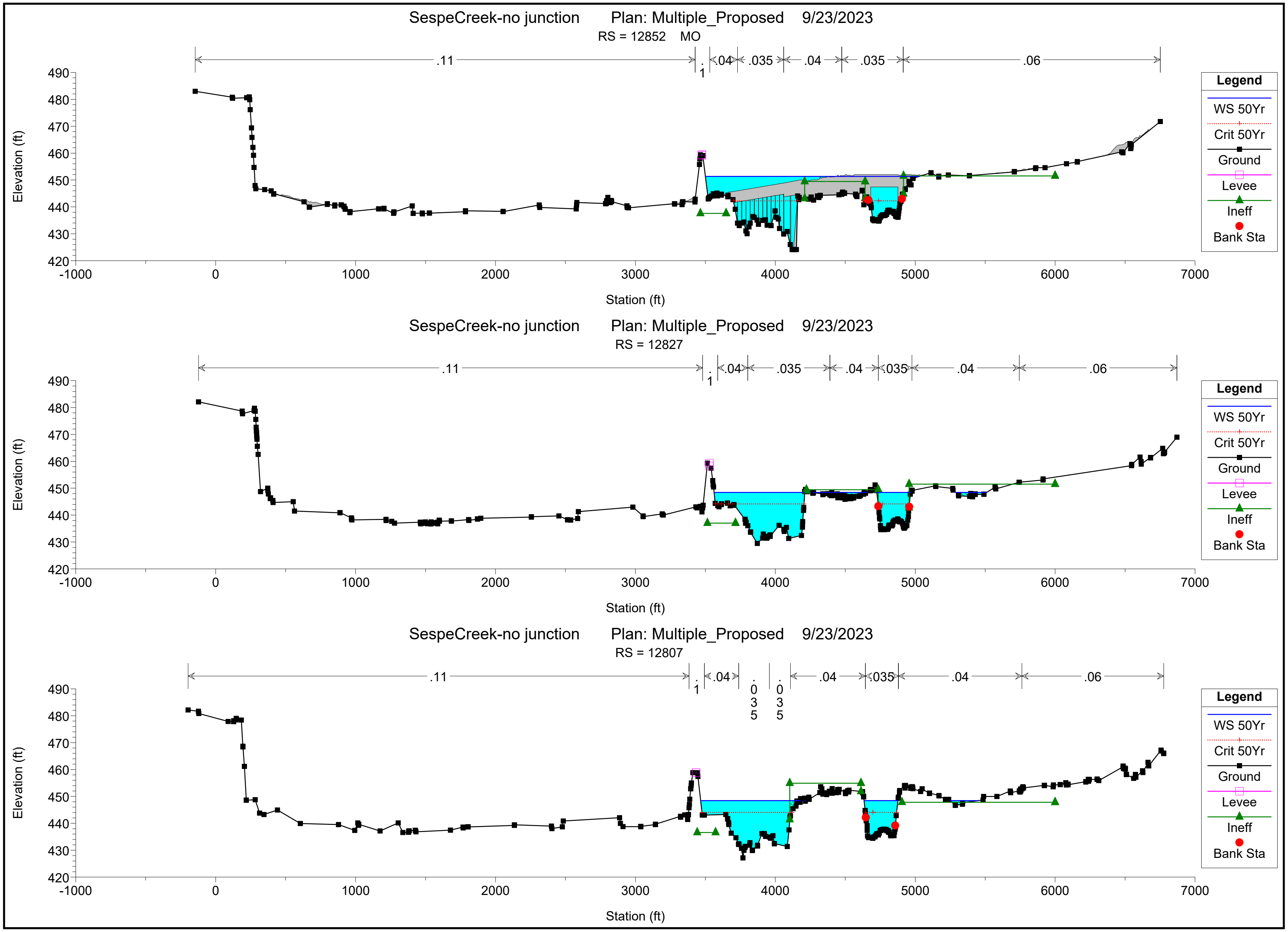
DATE ISSUED: 04/04/2025

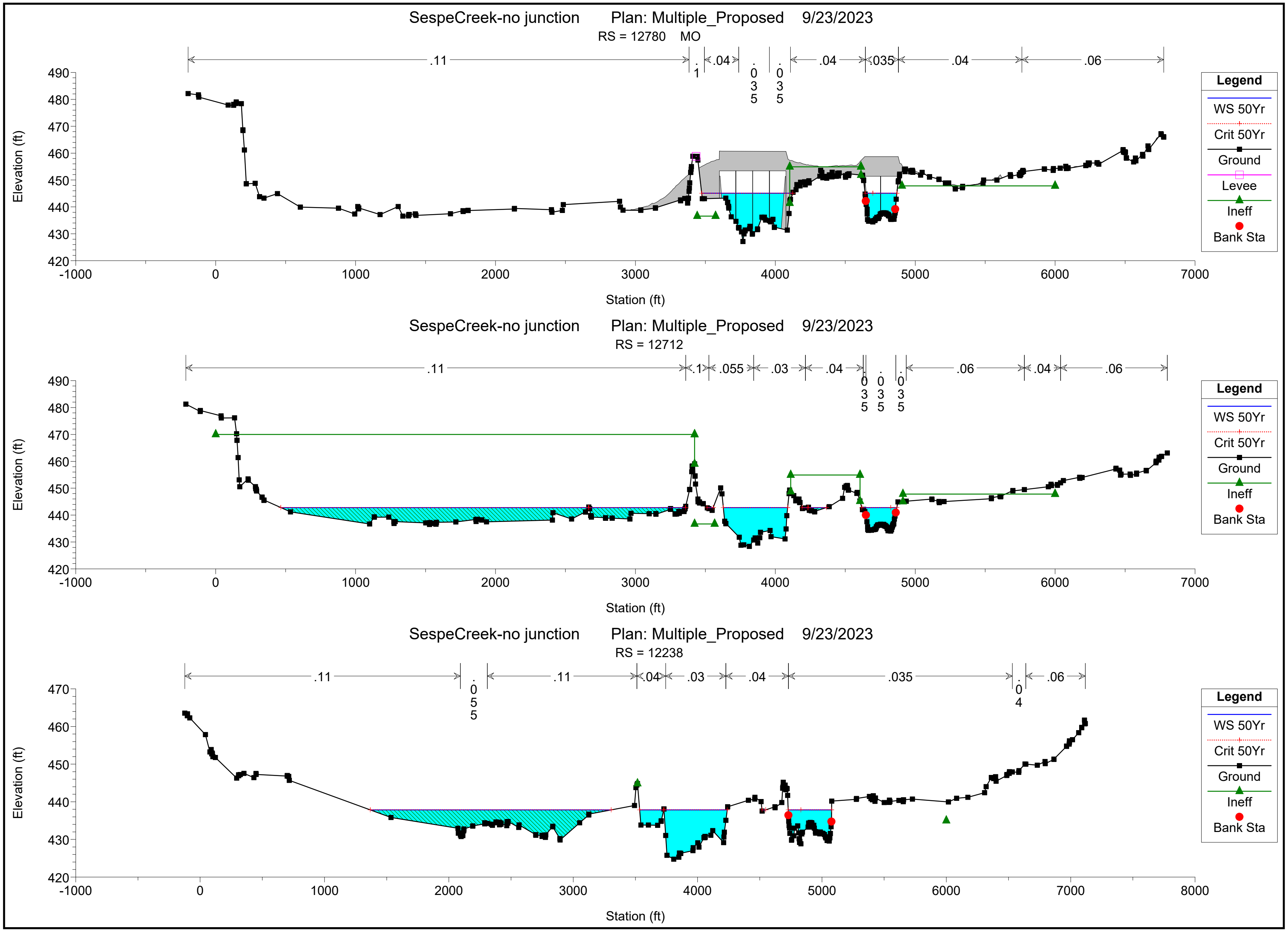


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 15728
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 15144
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 14340



SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 13782
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 13104
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12892
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12852 MO
.11
.04
.035
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12827
.11
.04
.035
.04
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12807
.11
.04
.04
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12780 MO
.11
.1
.04
.035
.035
.04
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12712
.11
.1
.055
.03
.04
.035
.035
.035
.06
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12238
.11
.055
.11
.04
.03
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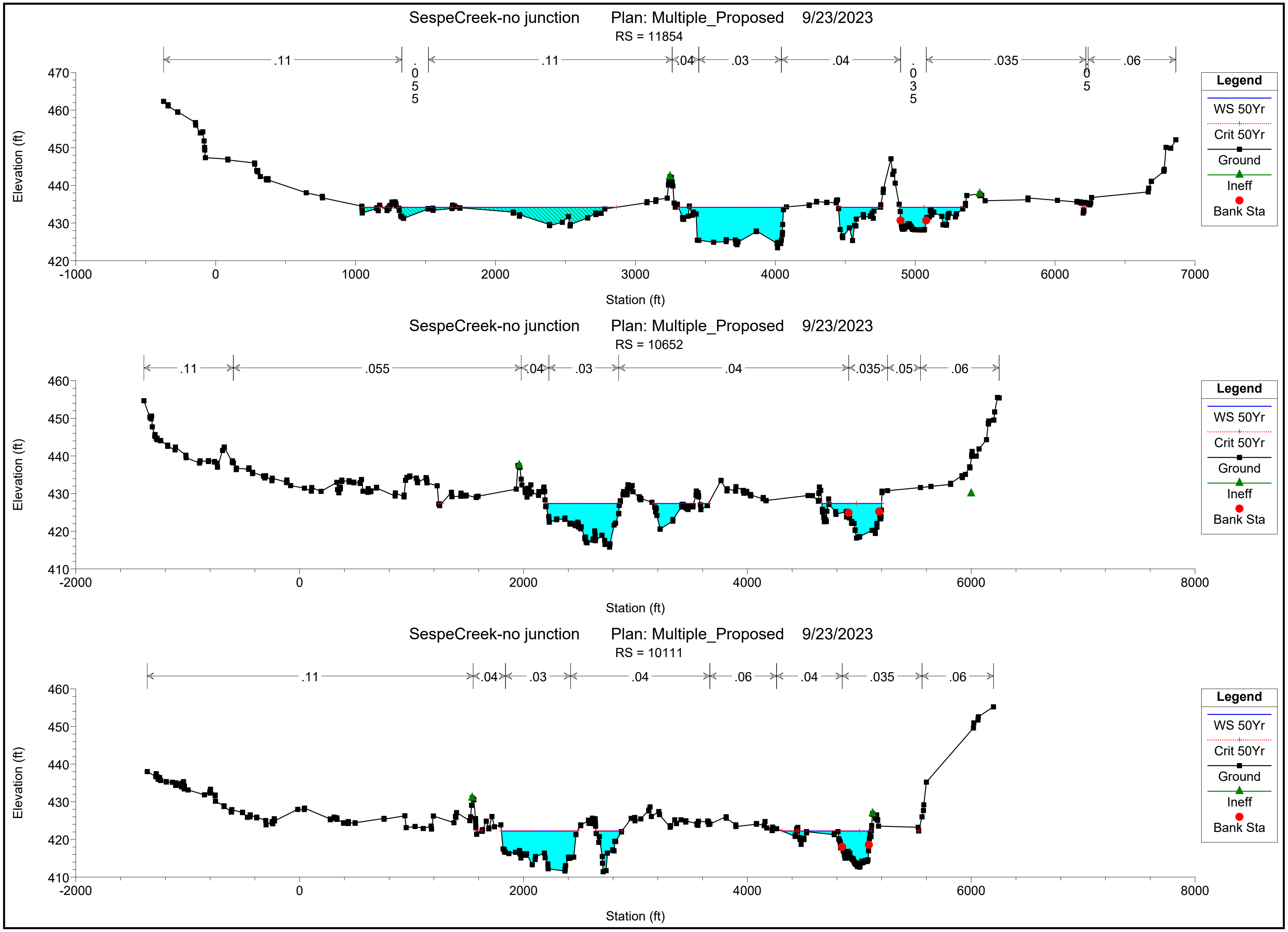
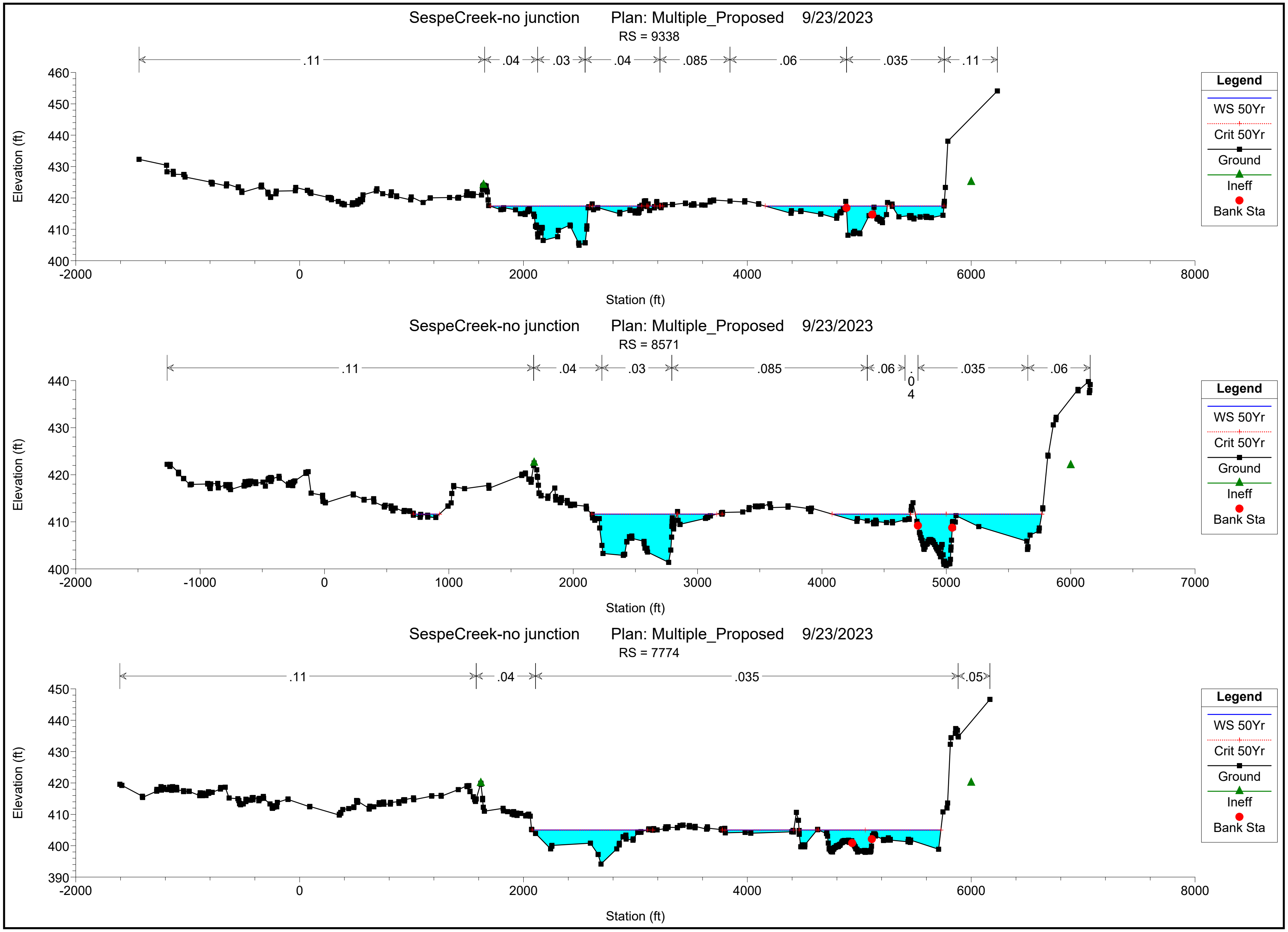
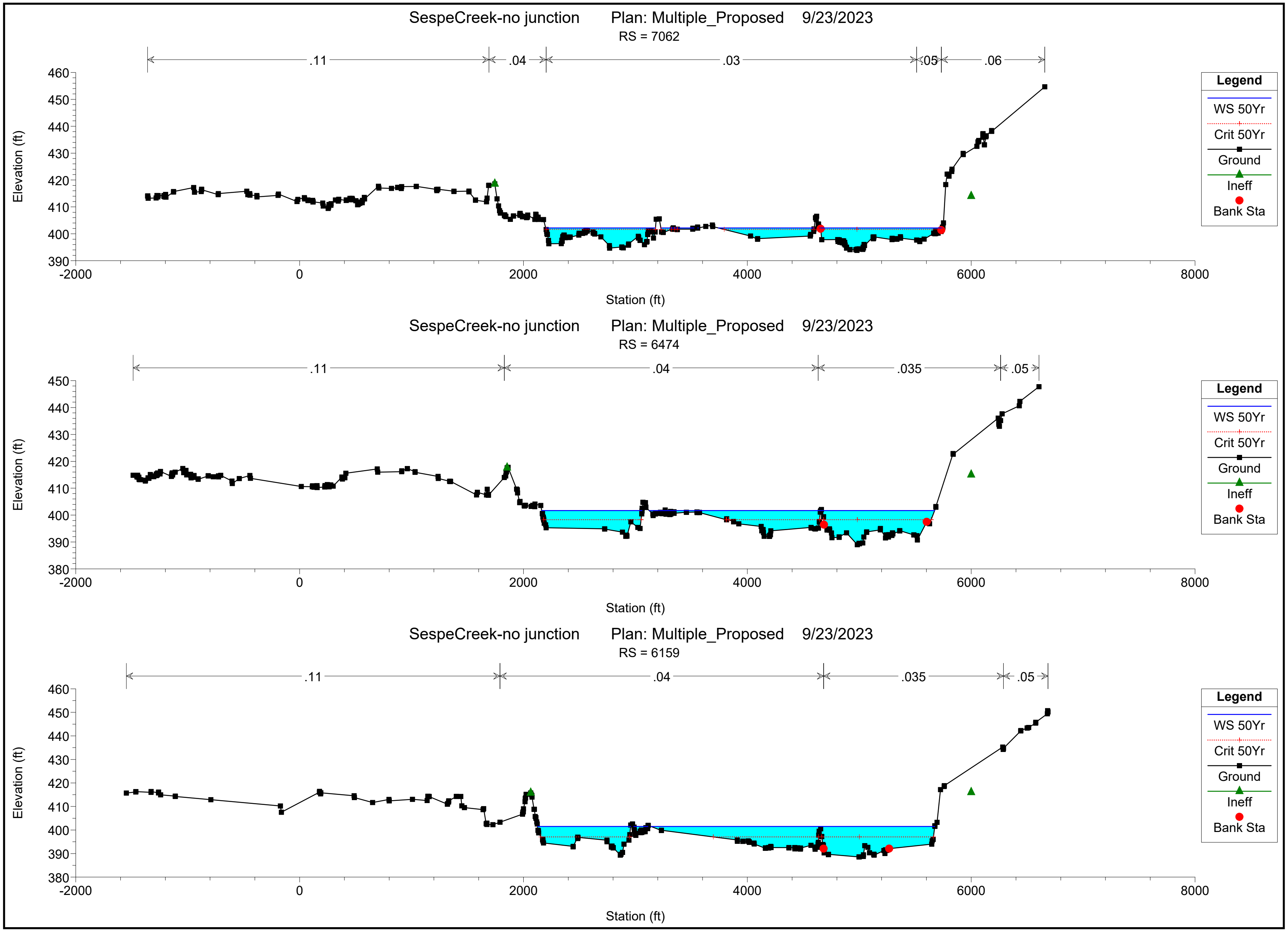
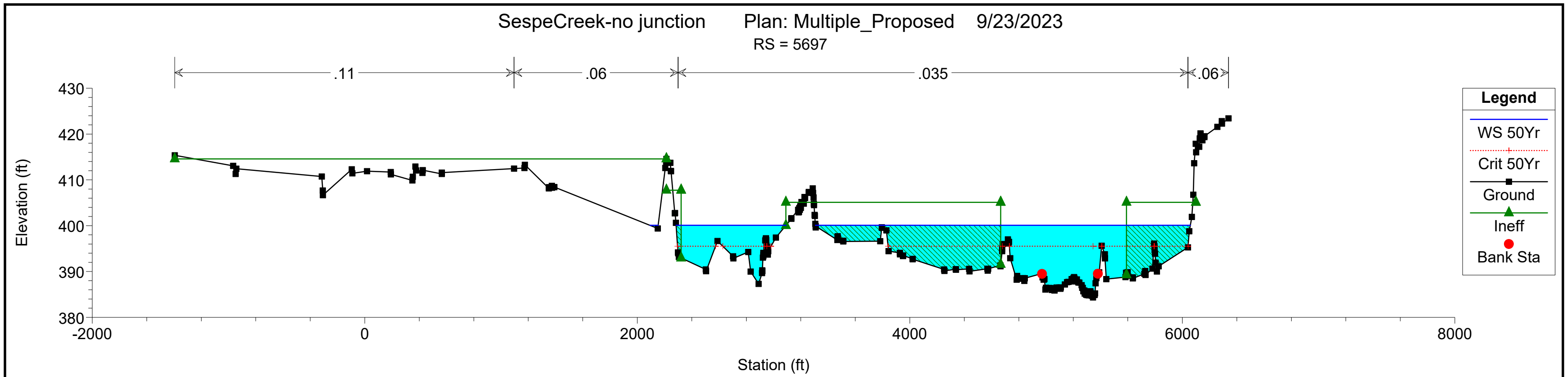
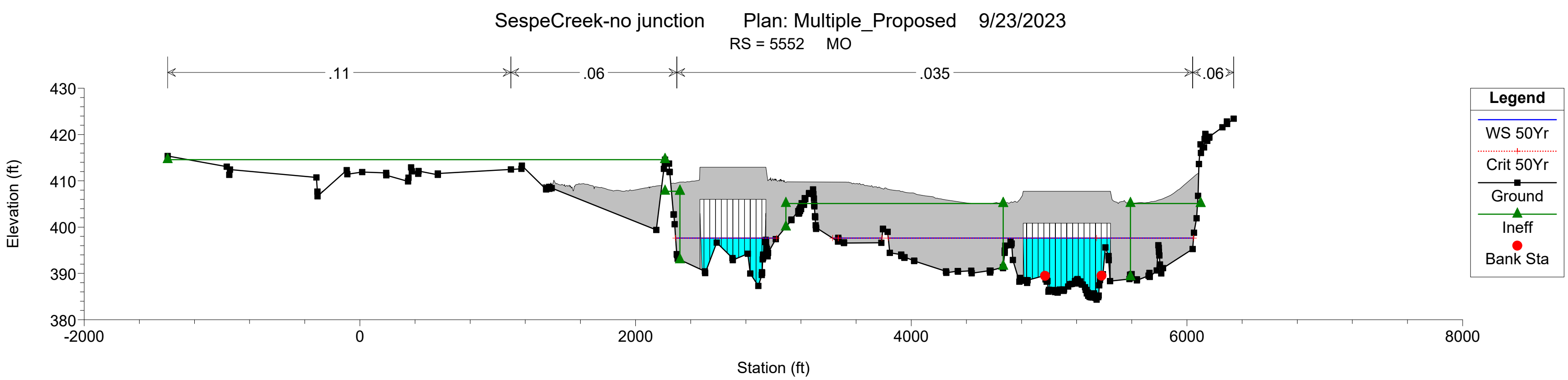
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta

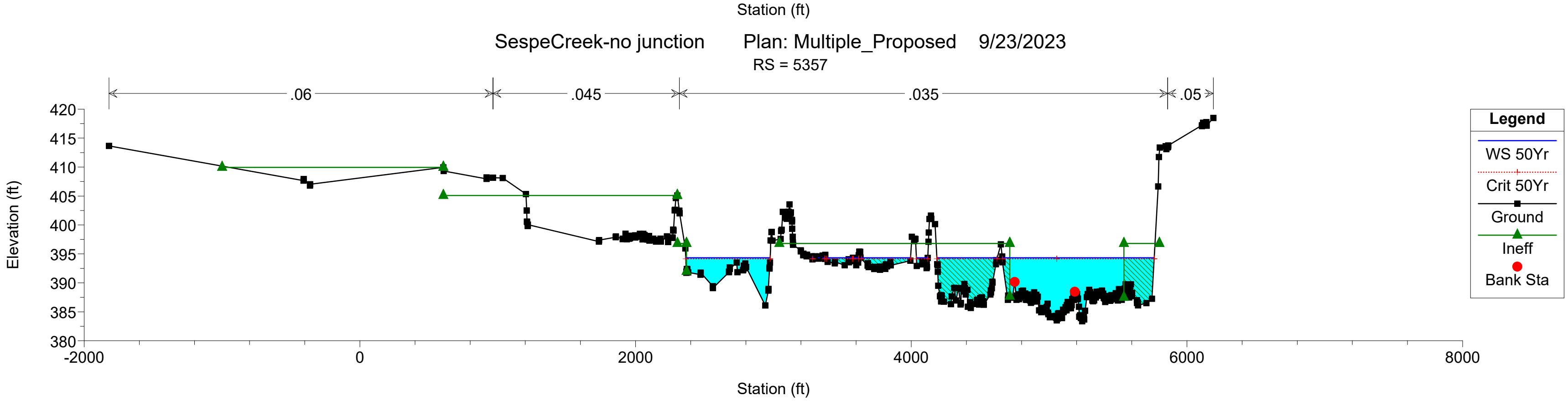

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 11854
.11
.055
.11
.04
.03
.04
.035
.035
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 10652
.11
.055
.04
.03
.04
.035
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 10111
.11
.04
.03
.04
.06
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta

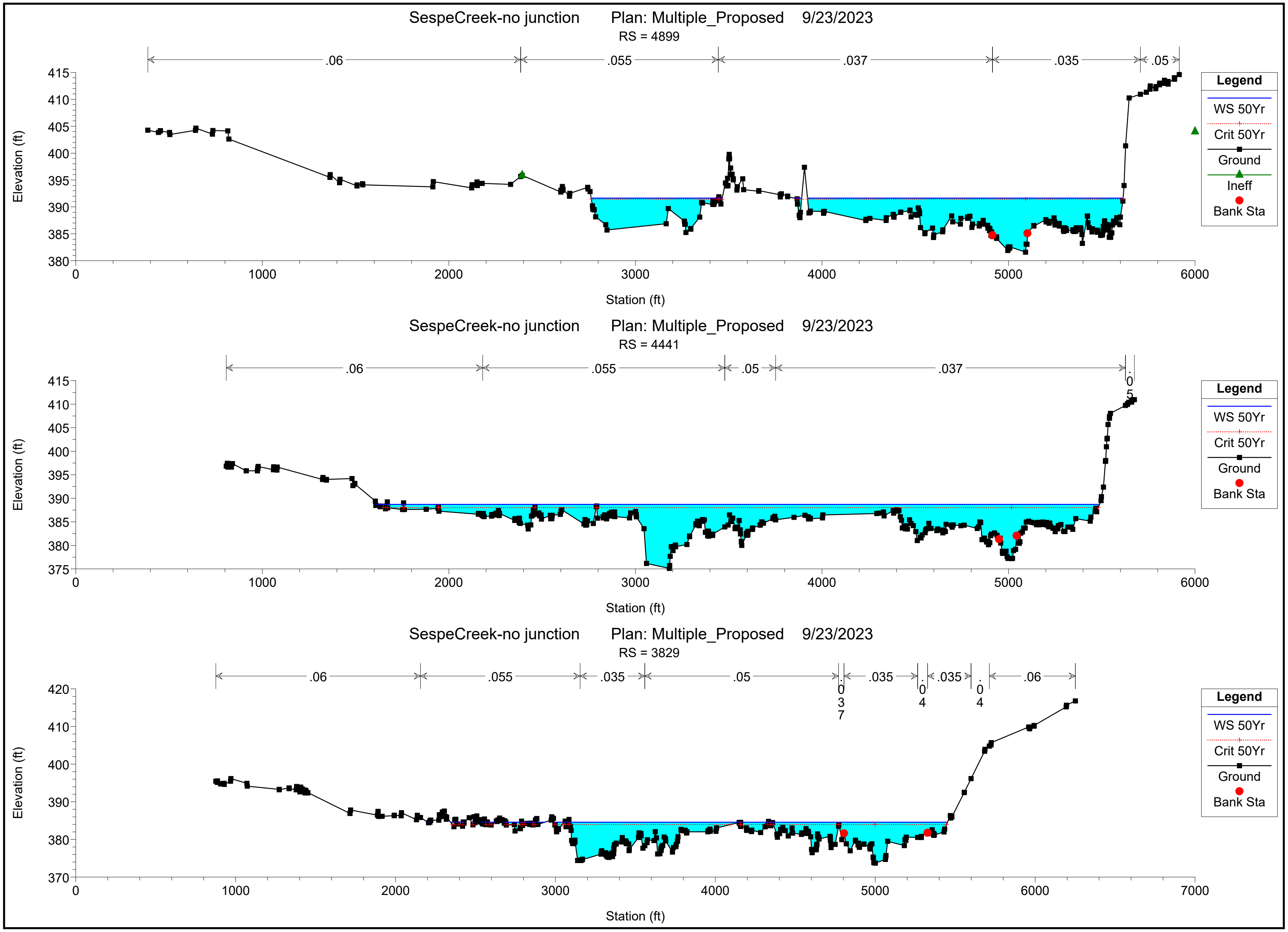

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 9338
.11
.04
.03
.04
.085
.06
.035
.11
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 8571
.11
.04
.03
.085
.06
0
4
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 7774
.11
.04
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 7062
.11
.04
.03
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 6474
.11
.04
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 6159
.11
.04
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta

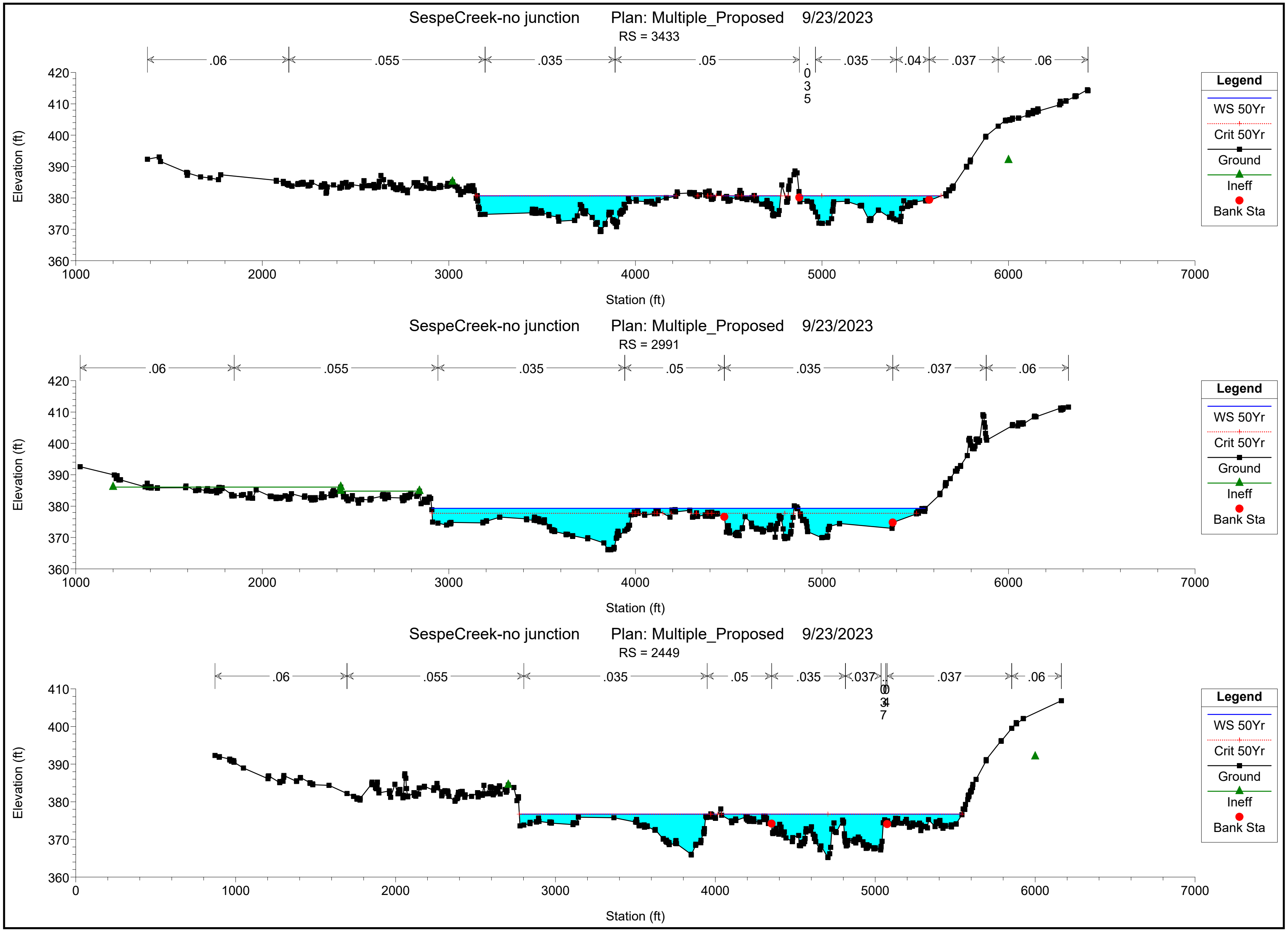

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 5697
.11
.06
.035
.06
Elevation (ft)
430
420
410
400
390
380
-2000
0
2000
4000
6000
8000
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta

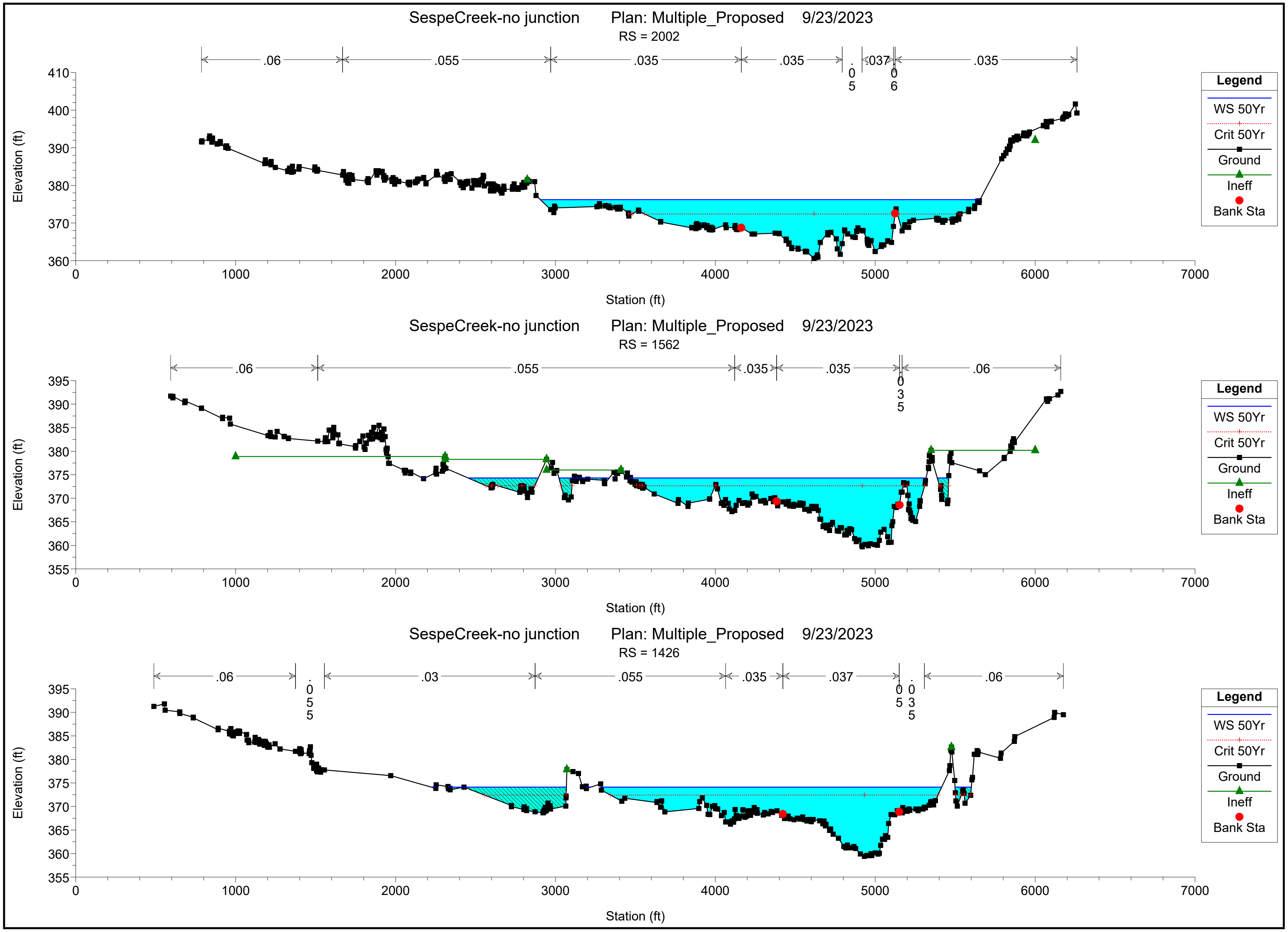

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 5552 MO
.11
.06
.035
.06
Elevation (ft)
430
420
410
400
390
380
-2000
0
2000
4000
6000
8000
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 5357
.06
.045
.035
.05
Elevation (ft)
420
415
410
405
400
395
390
385
380
-2000
0
2000
4000
6000
8000
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta



SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 4899
.06
.055
.037
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 4441
.06
.055
.05
.037
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 3829
.06
.055
.035
.05
.035
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 3433
.06
.055
.035
.05
.035
.04
.037
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 2991
.06
.055
.035
.05
.035
.037
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 2449
.06
.055
.035
.05
.035
.037
.037
.06
Elevation (ft)
Station (ft)
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta



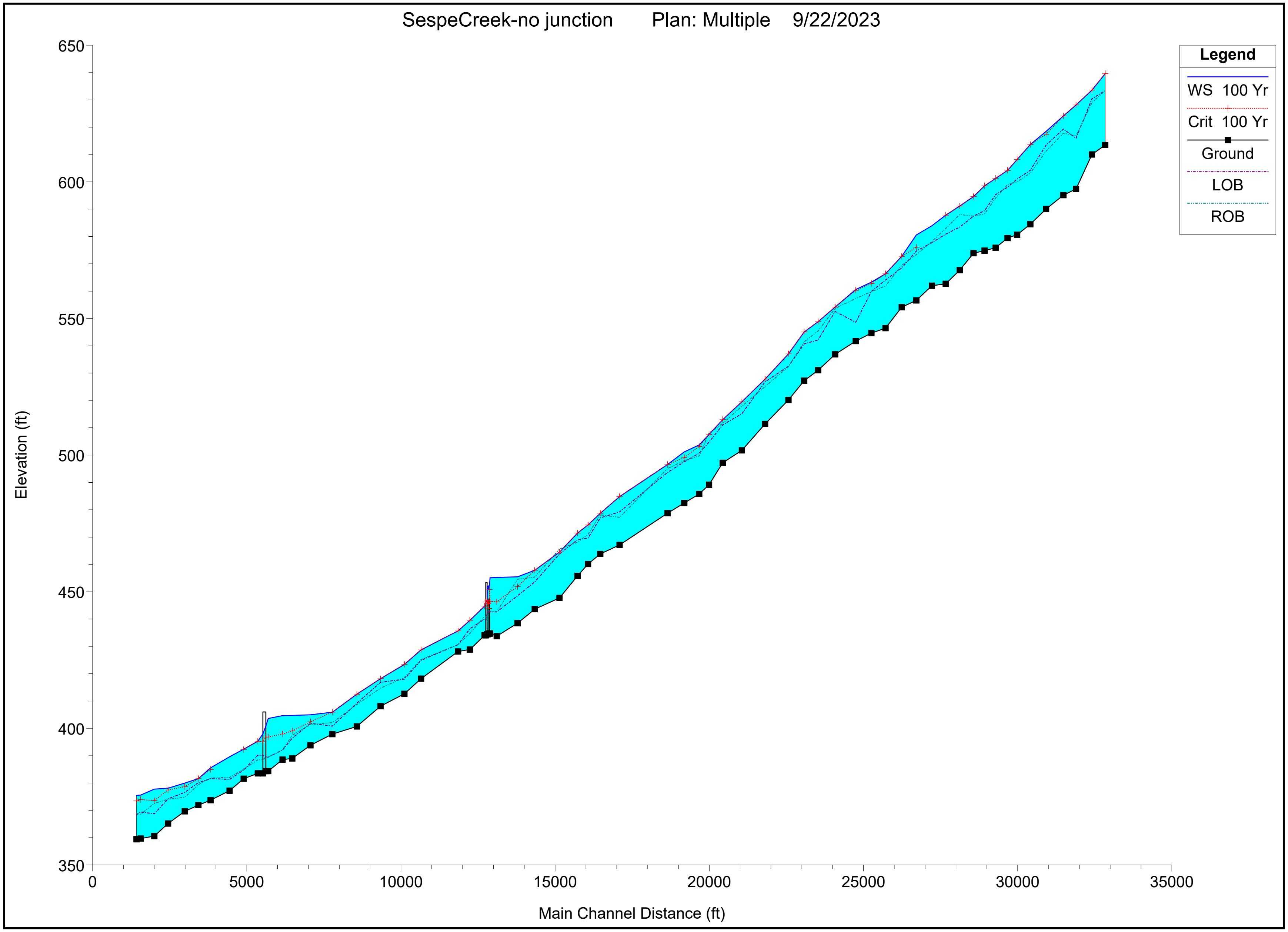
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 2002
.06
.055
.035
.035
.037
.035
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 1562
.06
.055
.035
.035
.06
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 1426
.06
.03
.055
.035
.037
.06
Legend
WS 50Yr
Crit 50Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

# Hydraulic Model Output

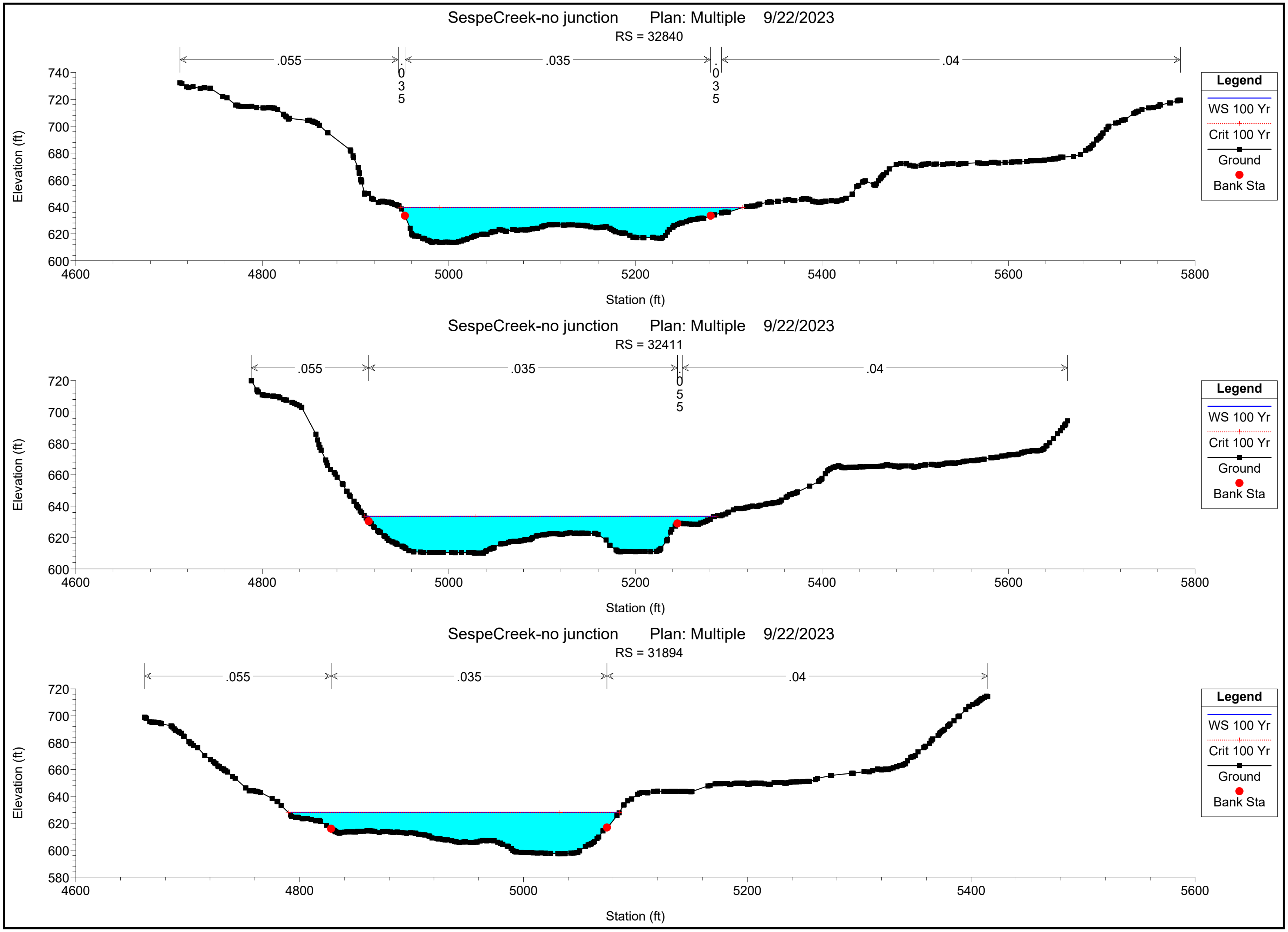
## Pre-project Conditions with 100-year Peak Discharge

HEC-RAS Plan: Multi River: SespeCreek Reach: Reach1 Profile: 100 Yr

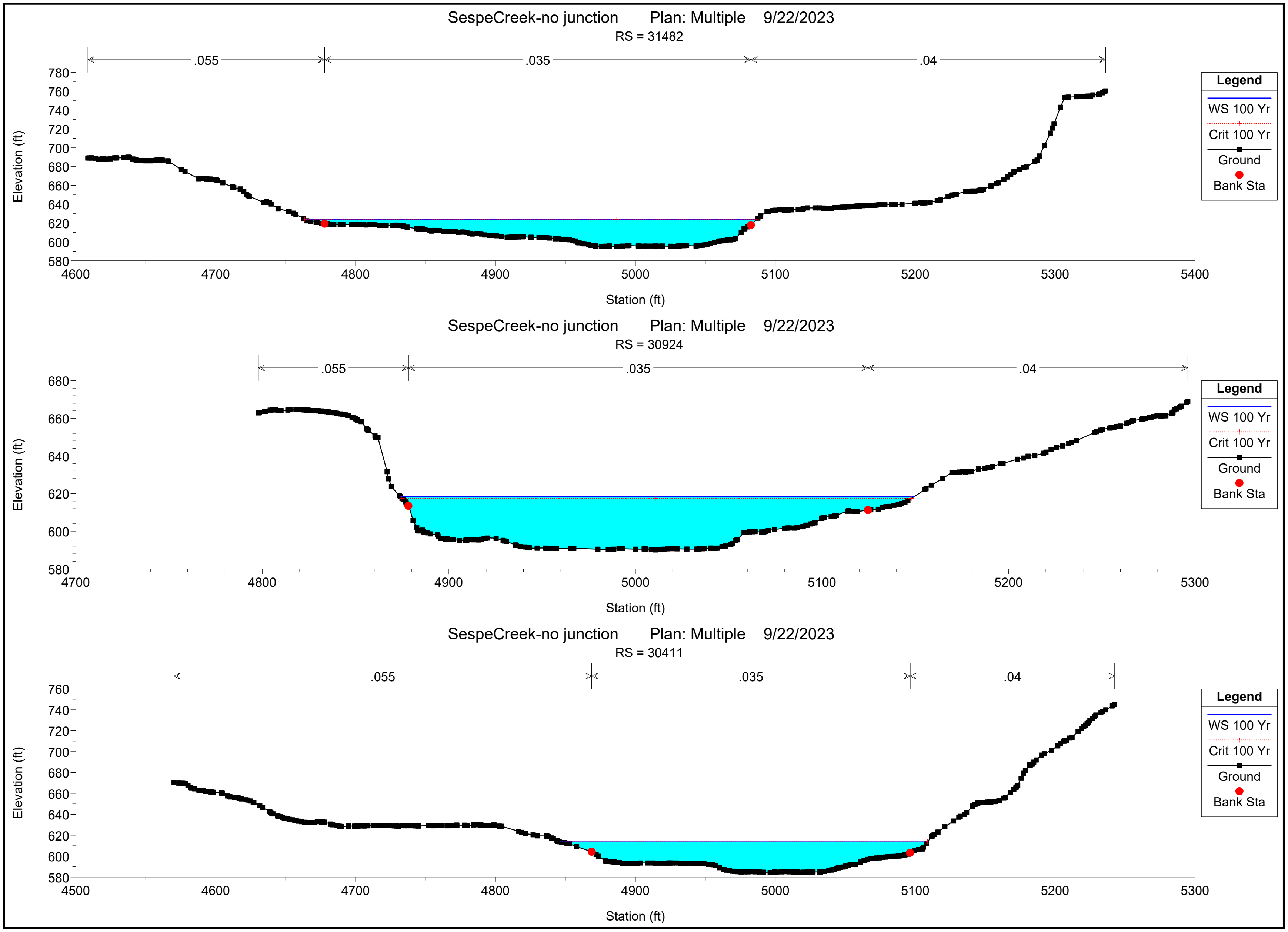
| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach1 | 32840 | 100 Yr | 135000.00 | 613.47 | 639.60 | 639.60 | 647.95 | 0.007023 | 23.24 | 5892.99 | 367.31 | 0.98 |
| Reach1 | 32411 | 100 Yr | 135000.00 | 609.99 | 633.58 | 633.58 | 641.84 | 0.006990 | 23.15 | 5948.00 | 376.51 | 0.98 |
| Reach1 | 31894 | 100 Yr | 135000.00 | 597.39 | 628.14 | 628.14 | 638.06 | 0.006475 | 25.43 | 5515.27 | 295.85 | 0.97 |
| Reach1 | 31482 | 100 Yr | 135000.00 | 595.13 | 624.09 | 624.09 | 633.12 | 0.007077 | 24.12 | 5643.18 | 323.24 | 0.99 |
| Reach1 | 30924 | 100 Yr | 135000.00 | 590.05 | 618.48 | 617.39 | 627.64 | 0.005735 | 24.36 | 5632.61 | 275.50 | 0.91 |
| Reach1 | 30411 | 100 Yr | 135000.00 | 584.48 | 613.64 | 613.64 | 624.36 | 0.006493 | 26.37 | 5252.95 | 262.78 | 0.98 |
| Reach1 | 29986 | 100 Yr | 135000.00 | 580.62 | 608.18 | 608.18 | 618.32 | 0.006809 | 25.58 | 5331.90 | 273.70 | 0.99 |
| Reach1 | 29672 | 100 Yr | 135000.00 | 579.41 | 604.21 | 604.21 | 613.75 | 0.007474 | 24.79 | 5476.91 | 298.51 | 1.00 |
| Reach1 | 29284 | 100 Yr | 135000.00 | 575.87 | 601.25 | 601.25 | 608.83 | 0.005621 | 22.51 | 6694.60 | 508.01 | 0.90 |
| Reach1 | 28927 | 100 Yr | 135000.00 | 574.82 | 598.55 | 598.55 | 605.16 | 0.005101 | 21.75 | 7699.31 | 605.04 | 0.85 |
| Reach1 | 28571 | 100 Yr | 135000.00 | 573.87 | 594.62 | 594.62 | 600.81 | 0.005020 | 20.81 | 7726.98 | 709.80 | 0.85 |
| Reach1 | 28122 | 100 Yr | 135000.00 | 567.66 | 591.14 | 591.14 | 598.01 | 0.005251 | 21.84 | 7020.48 | 606.13 | 0.87 |
| Reach1 | 27668 | 100 Yr | 135000.00 | 562.66 | 587.80 | 587.80 | 594.91 | 0.005678 | 21.81 | 6851.65 | 599.68 | 0.90 |
| Reach1 | 27222 | 100 Yr | 135000.00 | 561.98 | 583.92 | | 588.23 | 0.005409 | 16.89 | 8488.00 | 686.54 | 0.74 |
| Reach1 | 26715 | 100 Yr | 135789.00 | 556.60 | 580.55 | 576.06 | 584.27 | 0.010899 | 15.53 | 8952.27 | 666.99 | 0.64 |
| Reach1 | 26242 | 100 Yr | 135789.00 | 554.12 | 572.76 | 572.76 | 579.27 | 0.009200 | 20.50 | 6743.74 | 604.11 | 0.96 |
| Reach1 | 25713 | 100 Yr | 135789.00 | 546.47 | 566.36 | 566.36 | 572.04 | 0.007645 | 19.29 | 7504.66 | 778.31 | 0.97 |
| Reach1 | 25258 | 100 Yr | 135789.00 | 544.62 | 563.29 | 562.79 | 567.94 | 0.007001 | 17.33 | 7965.77 | 842.58 | 0.93 |
| Reach1 | 24751 | 100 Yr | 135789.00 | 541.72 | 560.58 | 560.29 | 564.03 | 0.007058 | 15.21 | 9721.26 | 1340.93 | 0.83 |
| Reach1 | 24081 | 100 Yr | 135789.00 | 536.87 | 554.19 | 554.19 | 558.77 | 0.008504 | 17.16 | 7959.97 | 1048.49 | 0.99 |
| Reach1 | 23531 | 100 Yr | 135789.00 | 531.05 | 548.85 | 548.85 | 552.69 | 0.005705 | 16.12 | 10201.13 | 1657.08 | 0.86 |
| Reach1 | 23080 | 100 Yr | 135789.00 | 527.22 | 545.06 | 545.06 | 548.13 | 0.006382 | 15.63 | 12064.08 | 1943.92 | 0.87 |
| Reach1 | 22567 | 100 Yr | 135789.00 | 520.15 | 537.05 | 537.05 | 539.66 | 0.005912 | 14.64 | 11955.17 | 2168.19 | 0.76 |
| Reach1 | 21811 | 100 Yr | 135789.00 | 511.42 | 527.81 | 527.81 | 531.10 | 0.006152 | 15.26 | 10740.14 | 2012.05 | 0.86 |
| Reach1 | 21055 | 100 Yr | 135789.00 | 501.73 | 519.50 | 519.50 | 523.01 | 0.006488 | 15.34 | 10365.70 | 1902.53 | 0.87 |
| Reach1 | 20433 | 100 Yr | 135789.00 | 497.18 | 512.96 | 512.96 | 516.81 | 0.007146 | 16.01 | 9098.66 | 1560.39 | 0.92 |
| Reach1 | 19991 | 100 Yr | 135789.00 | 489.17 | 507.56 | 507.56 | 512.42 | 0.010999 | 17.68 | 7685.34 | 797.26 | 1.00 |
| Reach1 | 19675 | 100 Yr | 135789.00 | 485.77 | 503.75 | 503.15 | 508.08 | 0.007608 | 16.71 | 8319.55 | 1354.88 | 0.91 |
| Reach1 | 19191 | 100 Yr | 135789.00 | 482.46 | 501.16 | 499.08 | 504.85 | 0.005246 | 15.48 | 9352.43 | 1863.79 | 0.76 |
| Reach1 | 18647 | 100 Yr | 135789.00 | 478.75 | 496.59 | 496.59 | 501.44 | 0.007057 | 17.73 | 8047.23 | 2030.49 | 0.94 |
| Reach1 | 17091 | 100 Yr | 135789.00 | 467.11 | 484.80 | 484.80 | 490.16 | 0.005629 | 19.37 | 7994.23 | 746.91 | 0.88 |
| Reach1 | 16463 | 100 Yr | 135789.00 | 463.81 | 478.69 | 478.69 | 483.07 | 0.011188 | 16.78 | 8097.44 | 926.53 | 1.00 |
| Reach1 | 16069 | 100 Yr | 135789.00 | 460.12 | 474.46 | 474.46 | 478.65 | 0.008028 | 16.50 | 8409.97 | 1044.93 | 0.97 |
| Reach1 | 15728 | 100 Yr | 135789.00 | 455.80 | 471.46 | 471.46 | 475.85 | 0.007419 | 16.93 | 8303.47 | 996.60 | 0.95 |
| Reach1 | 15144 | 100 Yr | 135789.00 | 447.74 | 464.53 | 464.53 | 468.93 | 0.007400 | 16.83 | 8069.03 | 921.34 | 1.00 |
| Reach1 | 14340 | 100 Yr | 135789.00 | 443.62 | 457.85 | 457.85 | 461.34 | 0.008017 | 15.41 | 9746.85 | 1397.75 | 0.96 |
| Reach1 | 13782 | 100 Yr | 135789.00 | 438.49 | 455.46 | 451.88 | 456.85 | 0.002546 | 9.54 | 14727.21 | 1705.52 | 0.52 |
| Reach1 | 13104 | 100 Yr | 135789.00 | 433.71 | 455.23 | 446.30 | 455.85 | 0.000640 | 6.43 | 23984.45 | 2241.28 | 0.28 |
| Reach1 | 12892 | 100 Yr | 135789.00 | 434.72 | 455.13 | 446.53 | 455.68 | 0.000554 | 6.68 | 24481.68 | 2492.97 | 0.28 |
| Reach1 | 12852 | | Mult Open | | | | | | | | | |
| Reach1 | 12827 | 100 Yr | 135789.00 | 434.59 | 452.18 | 445.85 | 453.21 | 0.001363 | 9.59 | 17935.02 | 2188.22 | 0.43 |
| Reach1 | 12807 | 100 Yr | 135789.00 | 434.42 | 451.45 | 445.63 | 453.02 | 0.001565 | 10.12 | 14362.07 | 1757.99 | 0.46 |
| Reach1 | 12780 | | Mult Open | | | | | | | | | |
| Reach1 | 12712 | 100 Yr | 135789.00 | 434.07 | 444.76 | 444.76 | 449.38 | 0.008045 | 16.38 | 7900.25 | 4105.56 | 0.96 |
| Reach1 | 12238 | 100 Yr | 135789.00 | 428.86 | 439.53 | 439.53 | 442.94 | 0.005230 | 11.70 | 9354.04 | 3566.10 | 0.75 |
| Reach1 | 11854 | 100 Yr | 135789.00 | 428.14 | 435.65 | 435.65 | 438.30 | 0.005202 | 11.12 | 10723.75 | 4215.56 | 0.74 |
| Reach1 | 10652 | 100 Yr | 135789.00 | 418.20 | 428.75 | 428.75 | 431.34 | 0.006349 | 13.89 | 10552.38 | 2127.34 | 0.85 |
| Reach1 | 10111 | 100 Yr | 135789.00 | 412.64 | 423.40 | 423.40 | 426.05 | 0.006155 | 13.99 | 10451.52 | 2416.62 | 0.84 |
| Reach1 | 9338 | 100 Yr | 135789.00 | 408.13 | 418.18 | 418.18 | 420.00 | 0.006029 | 12.56 | 12802.12 | 3580.92 | 0.81 |
| Reach1 | 8571 | 100 Yr | 135789.00 | 400.71 | 412.49 | 412.49 | 414.42 | 0.005828 | 12.86 | 12620.14 | 3425.89 | 0.80 |
| Reach1 | 7774 | 100 Yr | 135789.00 | 397.88 | 405.90 | 405.90 | 407.73 | 0.008441 | 14.44 | 12848.54 | 3459.86 | 0.95 |
| Reach1 | 7062 | 100 Yr | 135789.00 | 393.83 | 404.94 | 402.41 | 405.58 | 0.001500 | 6.86 | 21231.45 | 3519.69 | 0.45 |
| Reach1 | 6474 | 100 Yr | 135789.00 | 388.98 | 404.75 | 399.07 | 405.09 | 0.000667 | 5.69 | 31230.95 | 3718.31 | 0.29 |
| Reach1 | 6159 | 100 Yr | 135789.00 | 388.55 | 404.66 | 397.93 | 404.91 | 0.000399 | 5.10 | 36112.25 | 3793.73 | 0.23 |
| Reach1 | 5697 | 100 Yr | 135789.00 | 384.34 | 403.60 | 396.84 | 404.25 | 0.000717 | 7.44 | 21492.52 | 4063.38 | 0.32 |
| Reach1 | 5552 | | Mult Open | | | | | | | | | |
| Reach1 | 5357 | 100 Yr | 135789.00 | 383.52 | 395.27 | 395.27 | 398.50 | 0.007452 | 15.87 | 9828.97 | 3046.74 | 0.93 |
| Reach1 | 4899 | 100 Yr | 135789.00 | 381.58 | 392.38 | 392.25 | 394.51 | 0.007571 | 16.66 | 13024.01 | 2548.76 | 0.95 |
| Reach1 | 4441 | 100 Yr | 135789.00 | 377.19 | 389.61 | | 390.62 | 0.005300 | 14.28 | 18701.65 | 3896.67 | 0.76 |
| Reach1 | 3829 | 100 Yr | 135789.00 | 373.71 | 385.56 | 384.96 | 387.19 | 0.006764 | 12.81 | 14065.11 | 3222.58 | 0.85 |
| Reach1 | 3433 | 100 Yr | 135789.00 | 371.89 | 381.63 | 381.63 | 383.93 | 0.009006 | 12.06 | 11214.11 | 2438.82 | 0.94 |
| Reach1 | 2991 | 100 Yr | 135789.00 | 369.65 | 379.96 | 378.63 | 381.27 | 0.004264 | 9.76 | 14966.40 | 2652.79 | 0.67 |
| Reach1 | 2449 | 100 Yr | 135789.00 | 365.18 | 378.10 | 377.47 | 379.69 | 0.005304 | 11.89 | 14325.28 | 2787.94 | 0.74 |
| Reach1 | 2002 | 100 Yr | 135789.00 | 360.59 | 377.76 | 373.55 | 378.38 | 0.001171 | 7.12 | 22637.04 | 2796.48 | 0.36 |
| Reach1 | 1562 | 100 Yr | 135789.00 | 359.68 | 375.59 | 373.93 | 377.41 | 0.003392 | 12.10 | 14532.19 | 3182.15 | 0.65 |
| Reach1 | 1426 | 100 Yr | 135789.00 | 359.40 | 375.47 | 373.45 | 376.87 | 0.003000 | 10.92 | 16134.57 | 3370.00 | 0.58 |

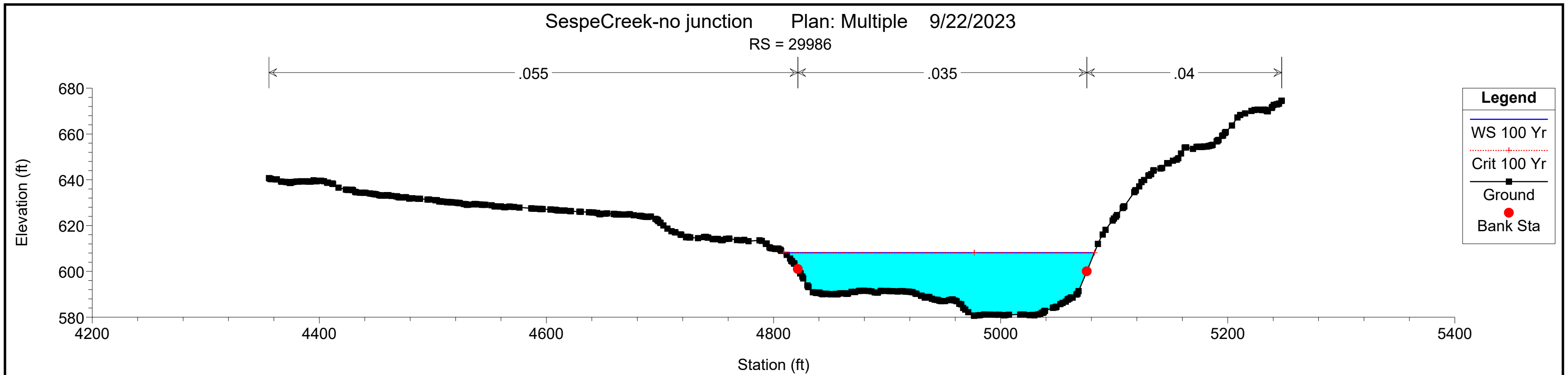


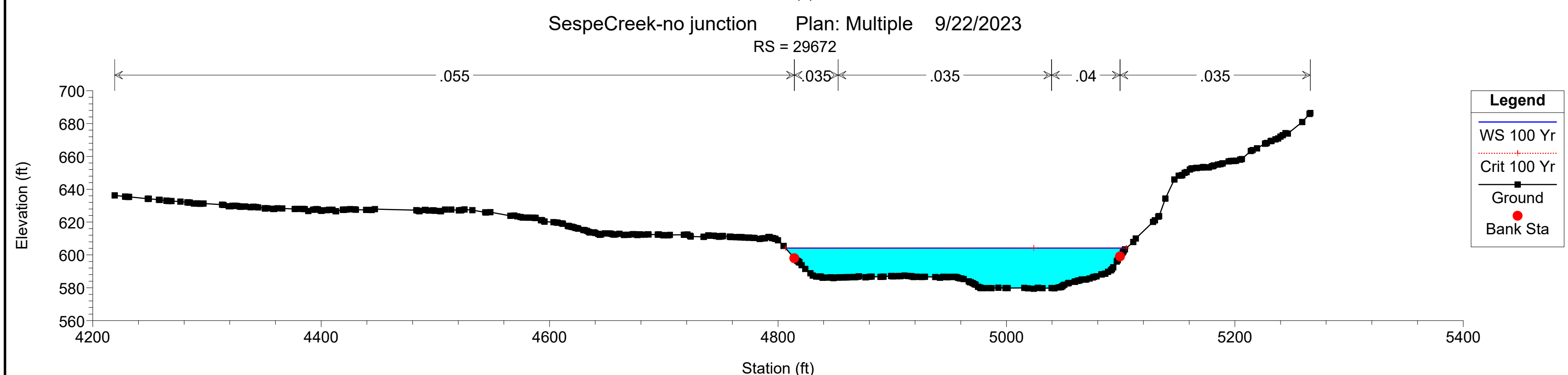
SespeCreek-no junction Plan: Multiple 9/22/2023
Legend
WS 100 Yr
Crit 100 Yr
Ground
LOB
ROB
Elevation (ft)
Main Channel Distance (ft)
650
600
550
500
450
400
350
0
5000
10000
15000
20000
25000
30000
35000

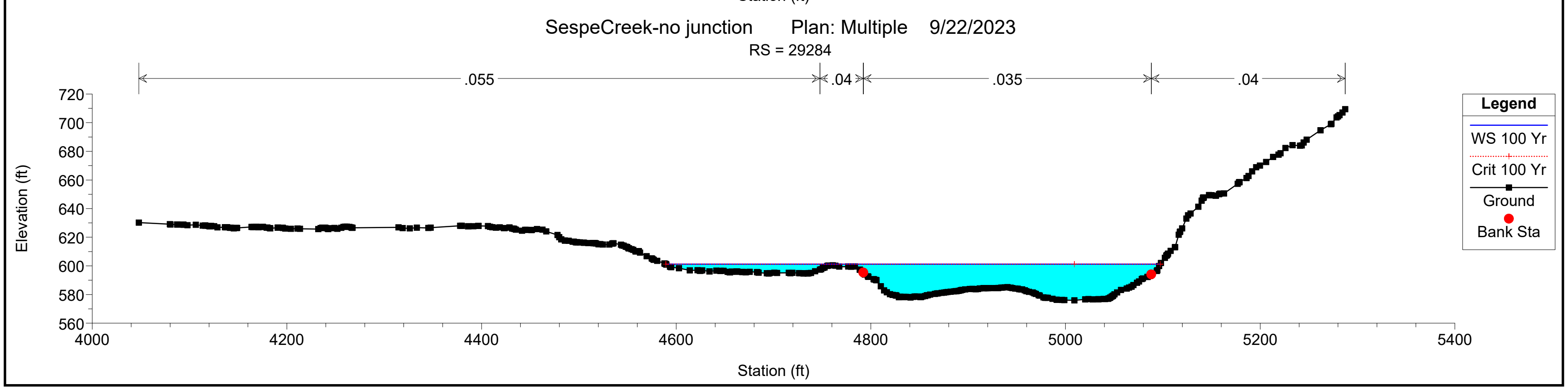


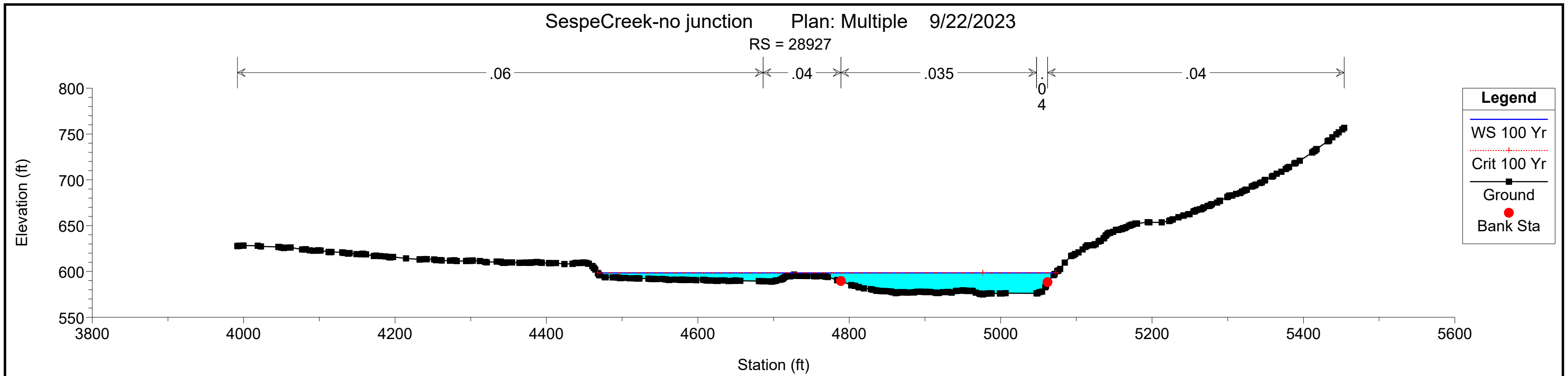
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 32840
.055
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 32411
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 31894

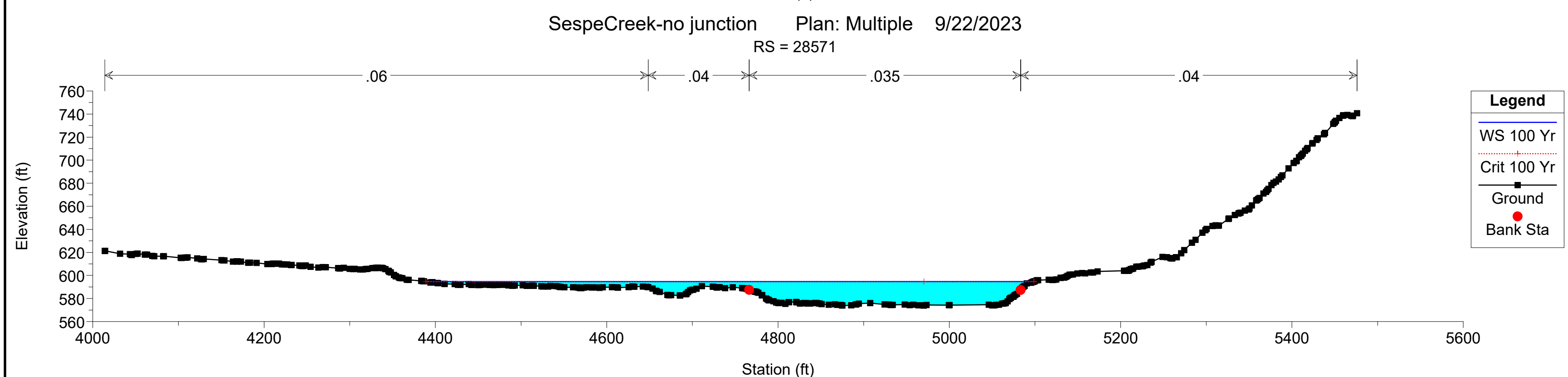

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 31482
.055
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 30924
.055
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 30411
.055
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

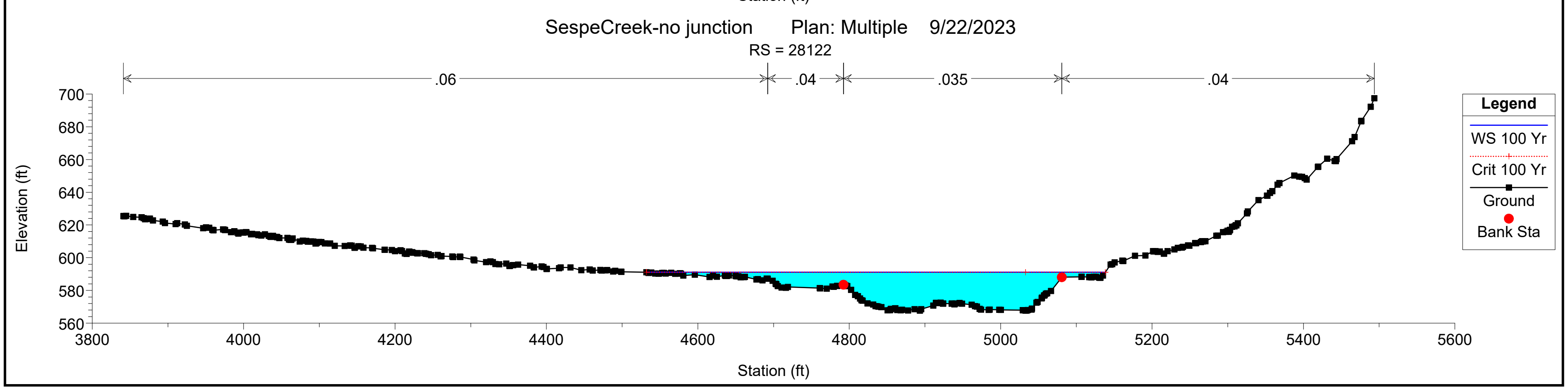

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 29986
.055
.035
.04
Elevation (ft)
680
660
640
620
600
580
4200
4400
4600
4800
5000
5200
5400
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

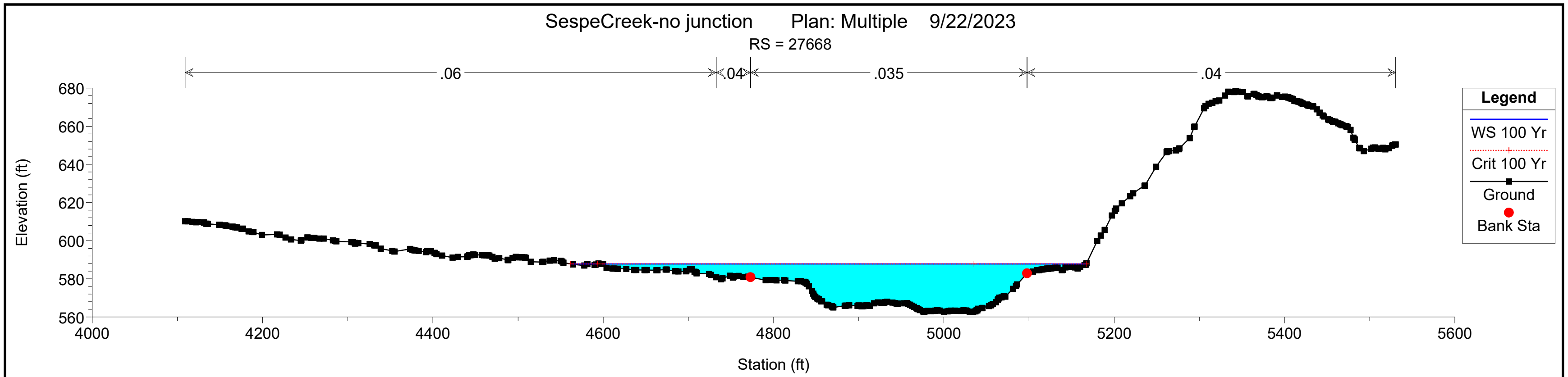

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 29672
.055
.035
.035
.04
.035
Elevation (ft)
700
680
660
640
620
600
580
560
4200
4400
4600
4800
5000
5200
5400
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

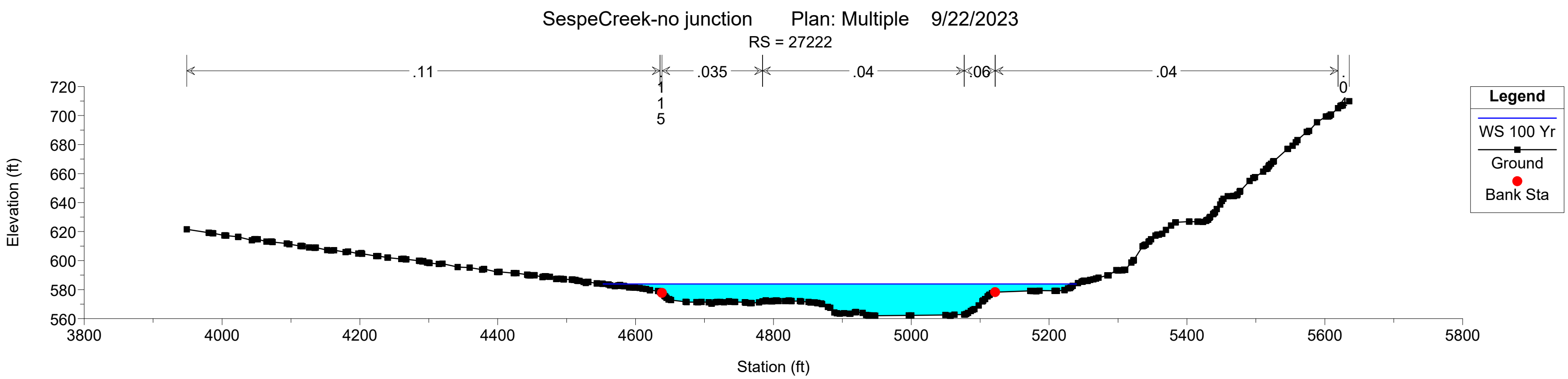

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 29284
.055
.04
.035
.04
Elevation (ft)
720
700
680
660
640
620
600
580
560
4000
4200
4400
4600
4800
5000
5200
5400
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

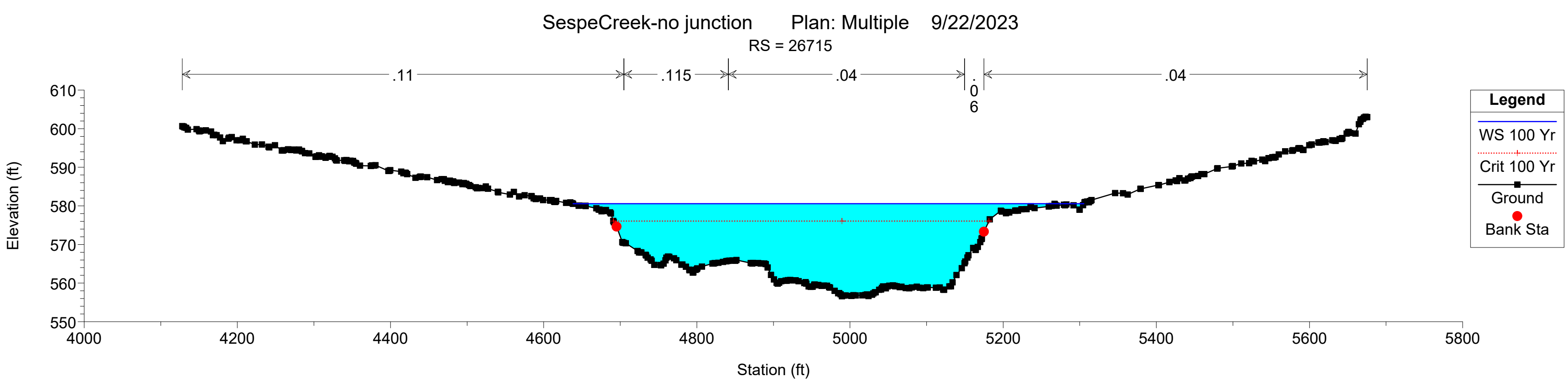

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 28927
.06
.04
.035
.04
0
4
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

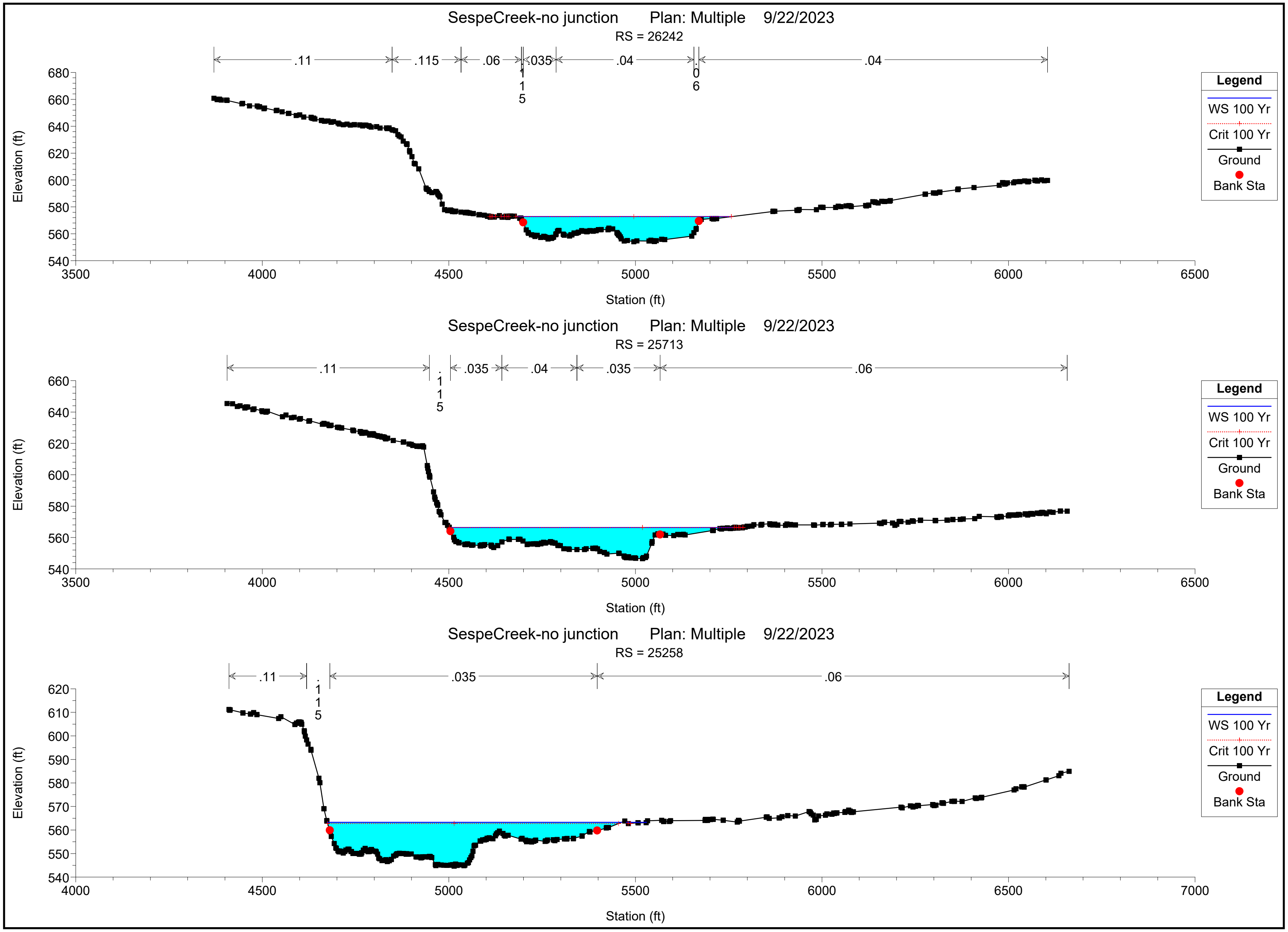

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 28571
.06
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

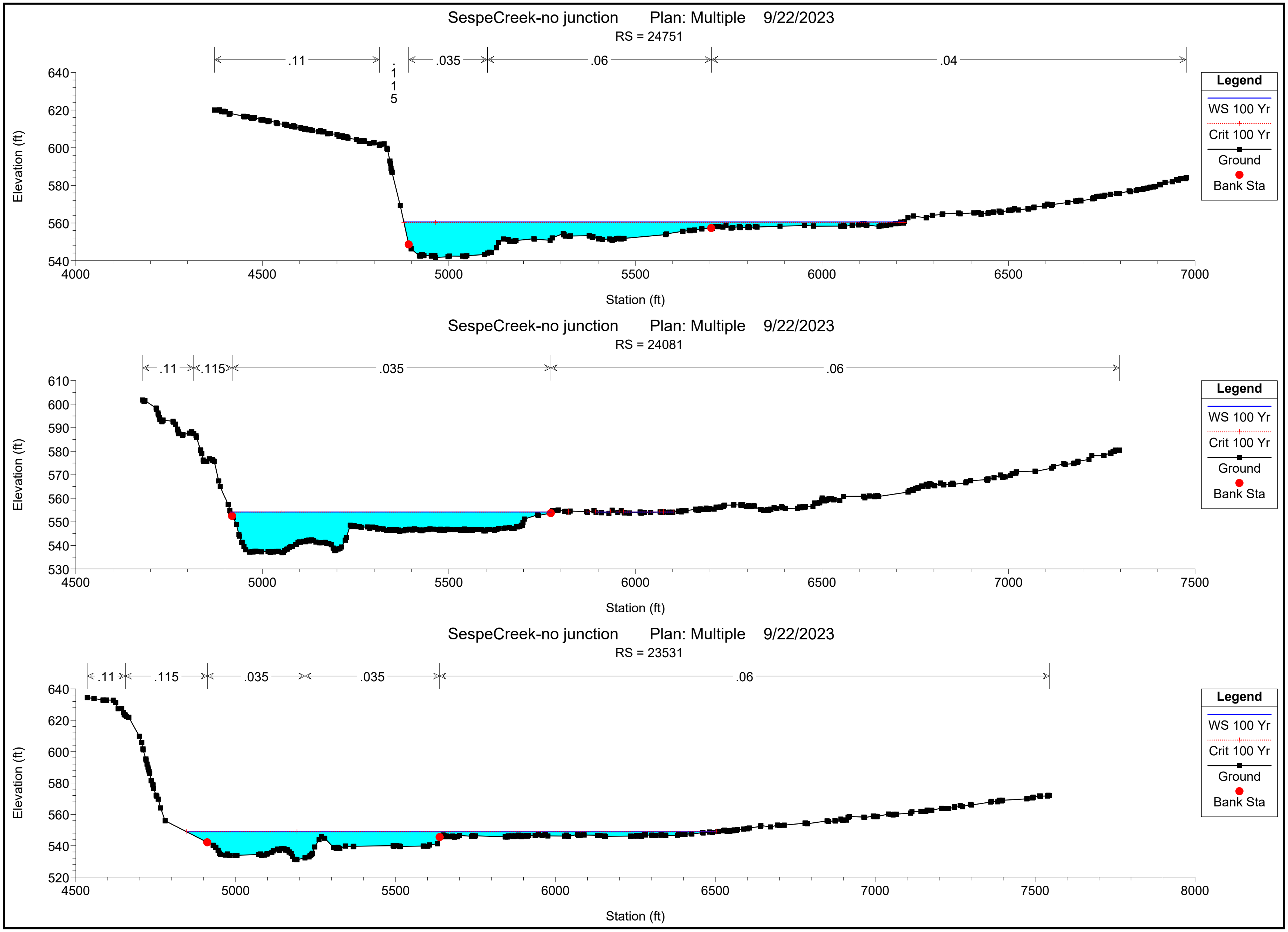

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 28122
.06
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

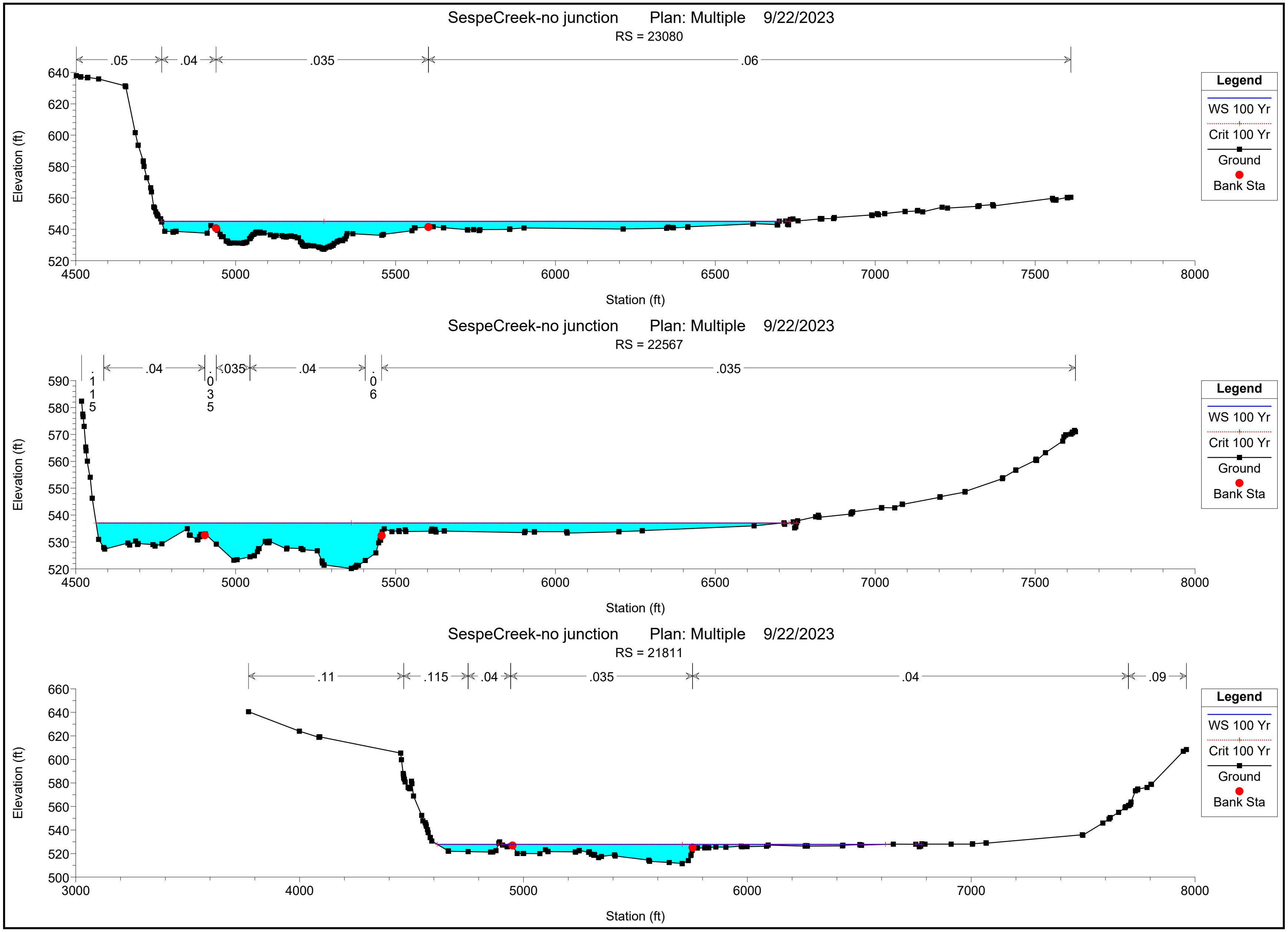

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 27668
.06
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta


SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 27222
.11
.035
.04
.06
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Ground
Bank Sta

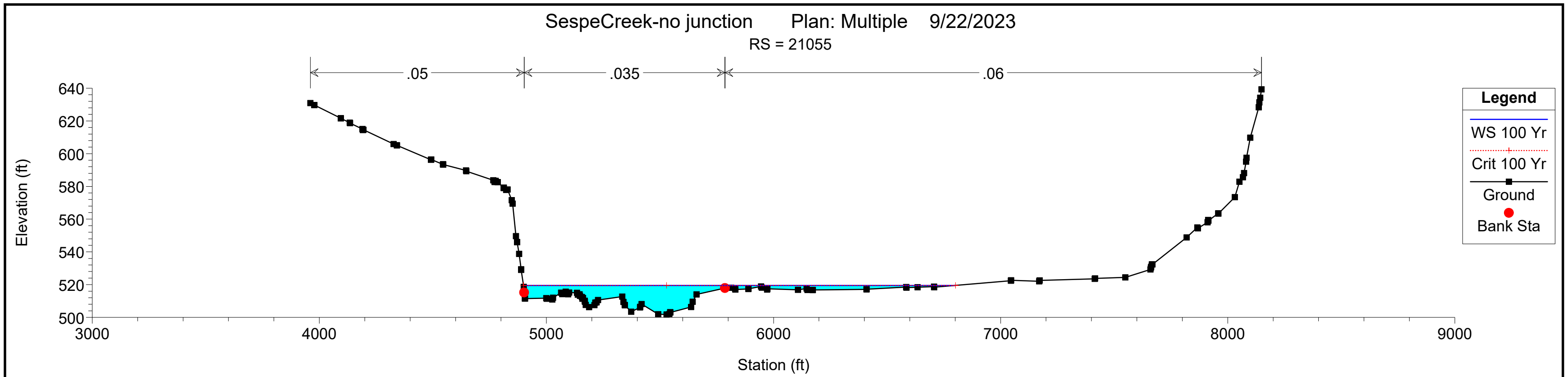

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 26715
.11
.115
.04
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

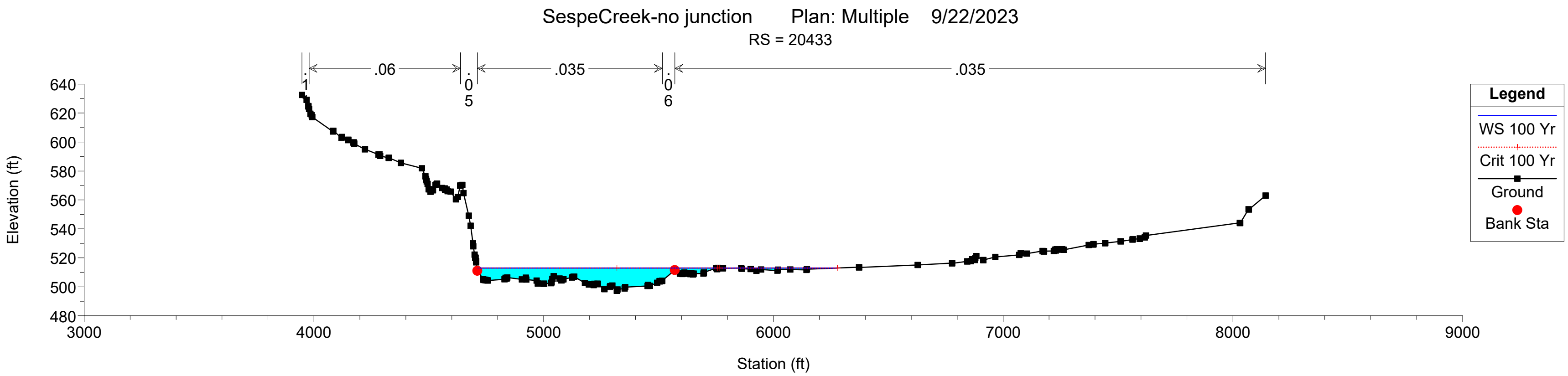

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 26242
.11
.115
.06
.035
.04
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 25713
.11
.035
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 25258
.11
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

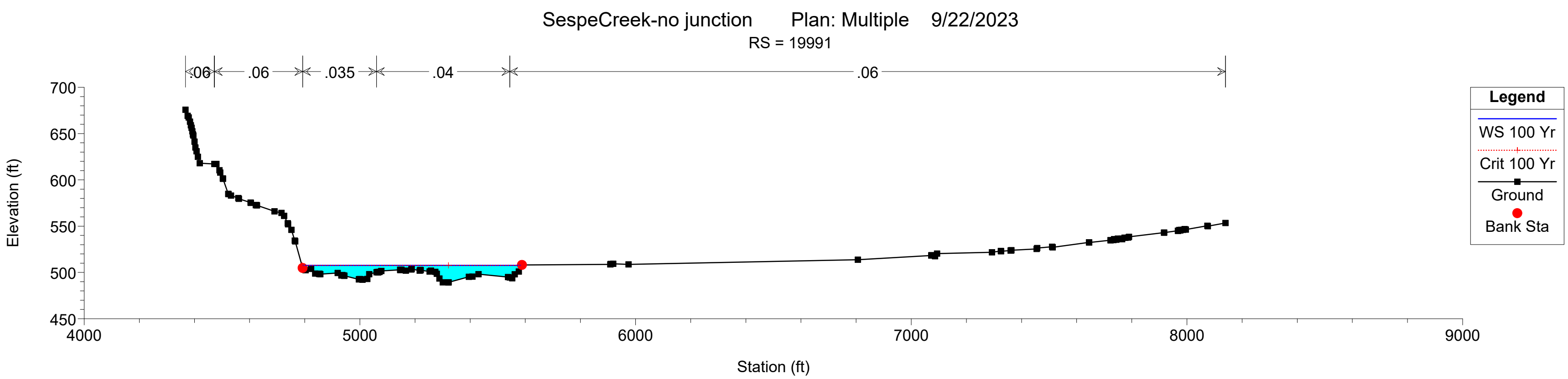

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 24751
.11
1
1
5
.035
.06
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 24081
.11
.115
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 23531
.11
.115
.035
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

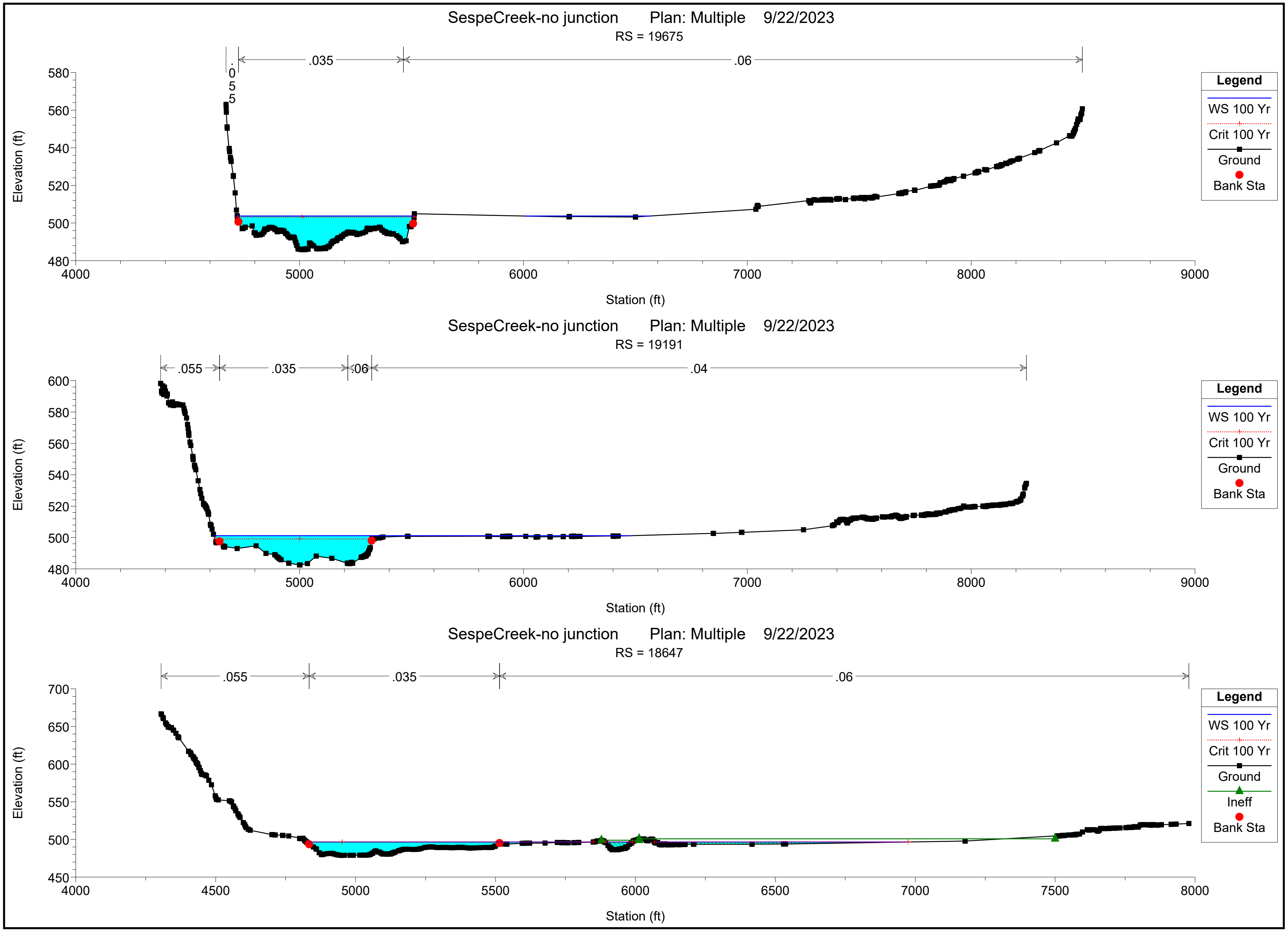


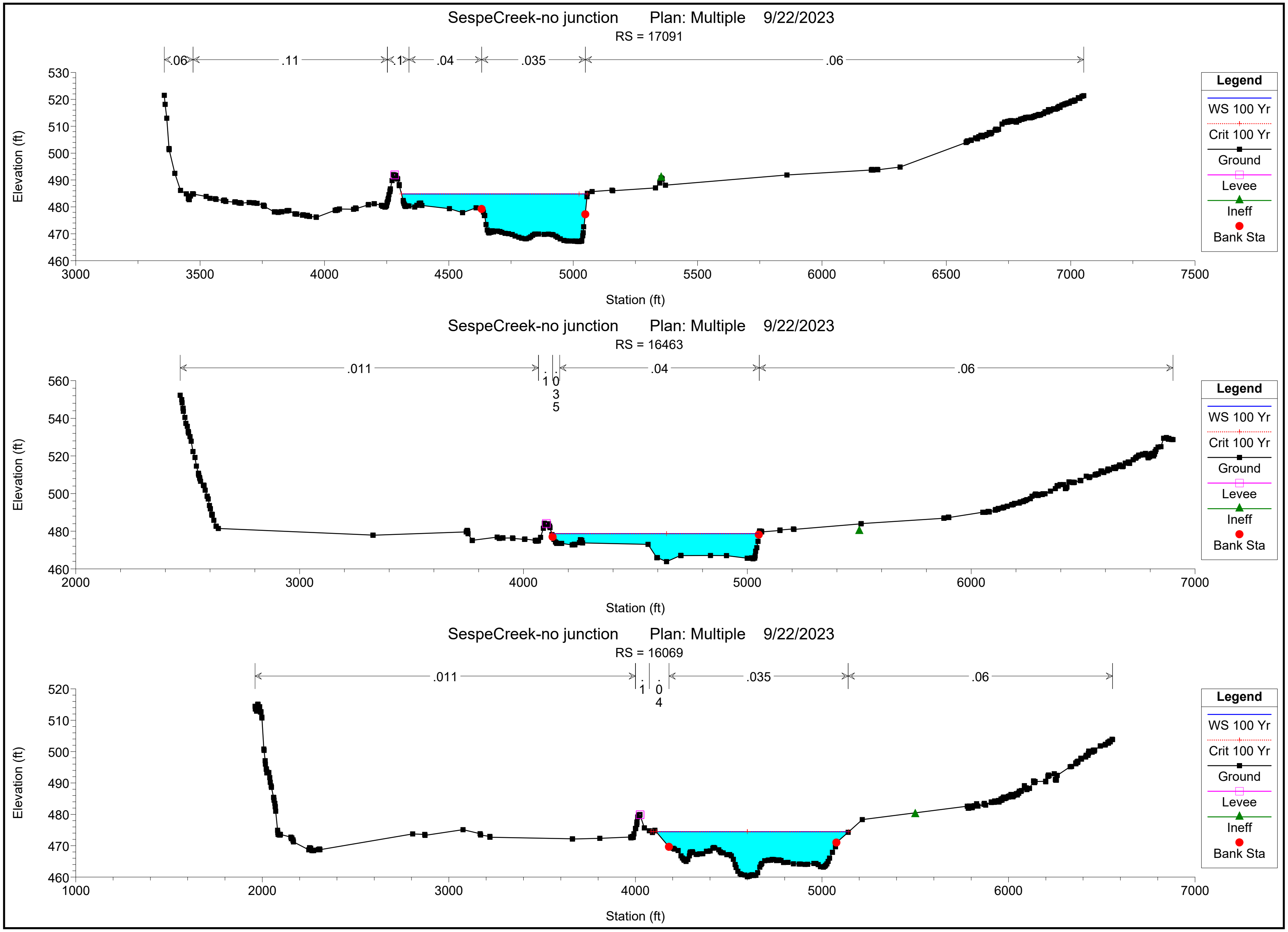
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 23080
.05
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 22567
.115
.04
.035
.035
.04
.06
.035
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 21811
.11
.115
.04
.035
.04
.09
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

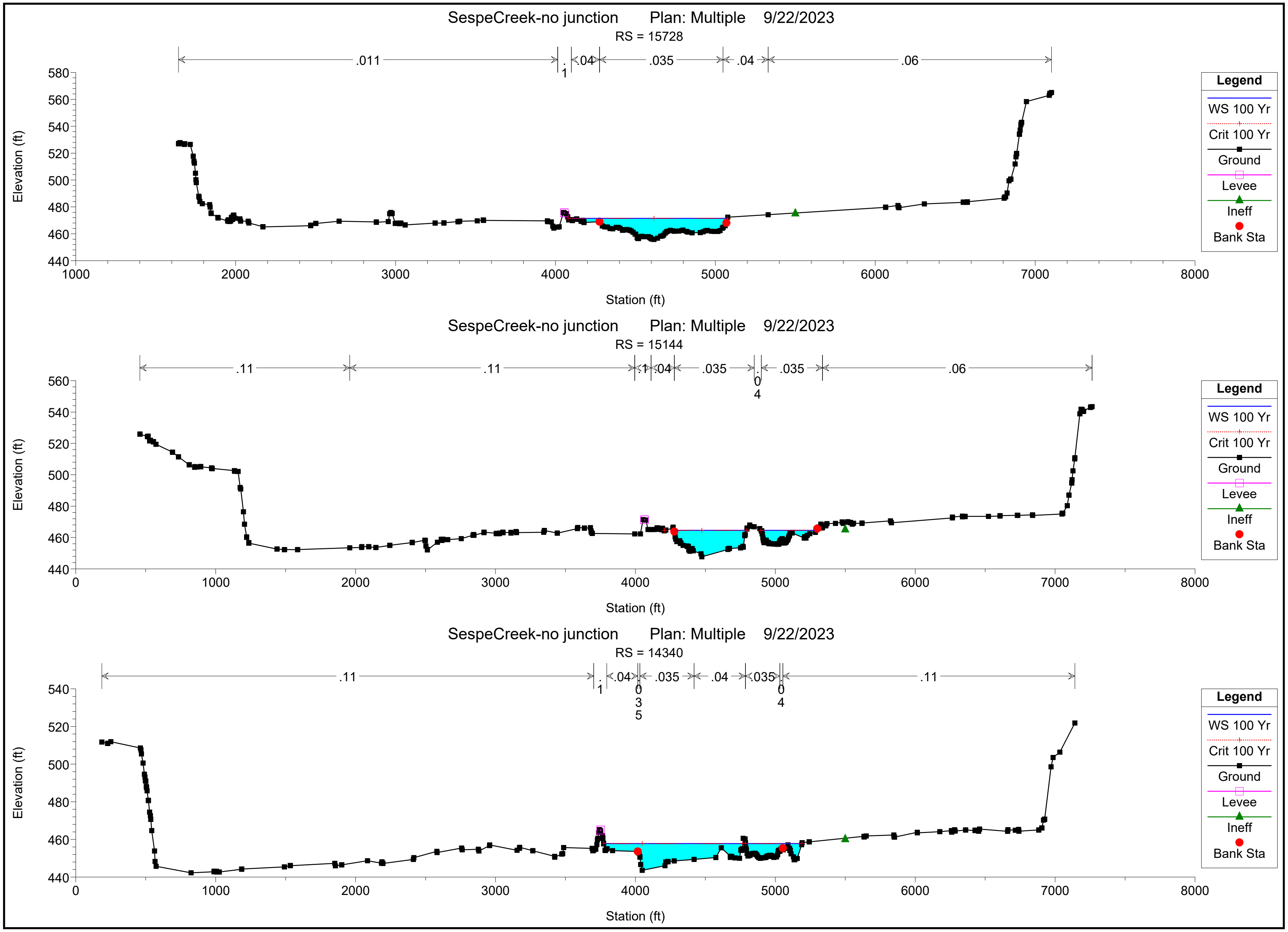

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 21055
.05
.035
.06
640
620
600
580
560
540
520
500
Elevation (ft)
3000
4000
5000
6000
7000
8000
9000
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta


SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 20433
.1
.06
.05
.035
.06
.035
640
620
600
580
560
540
520
500
480
Elevation (ft)
3000
4000
5000
6000
7000
8000
9000
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

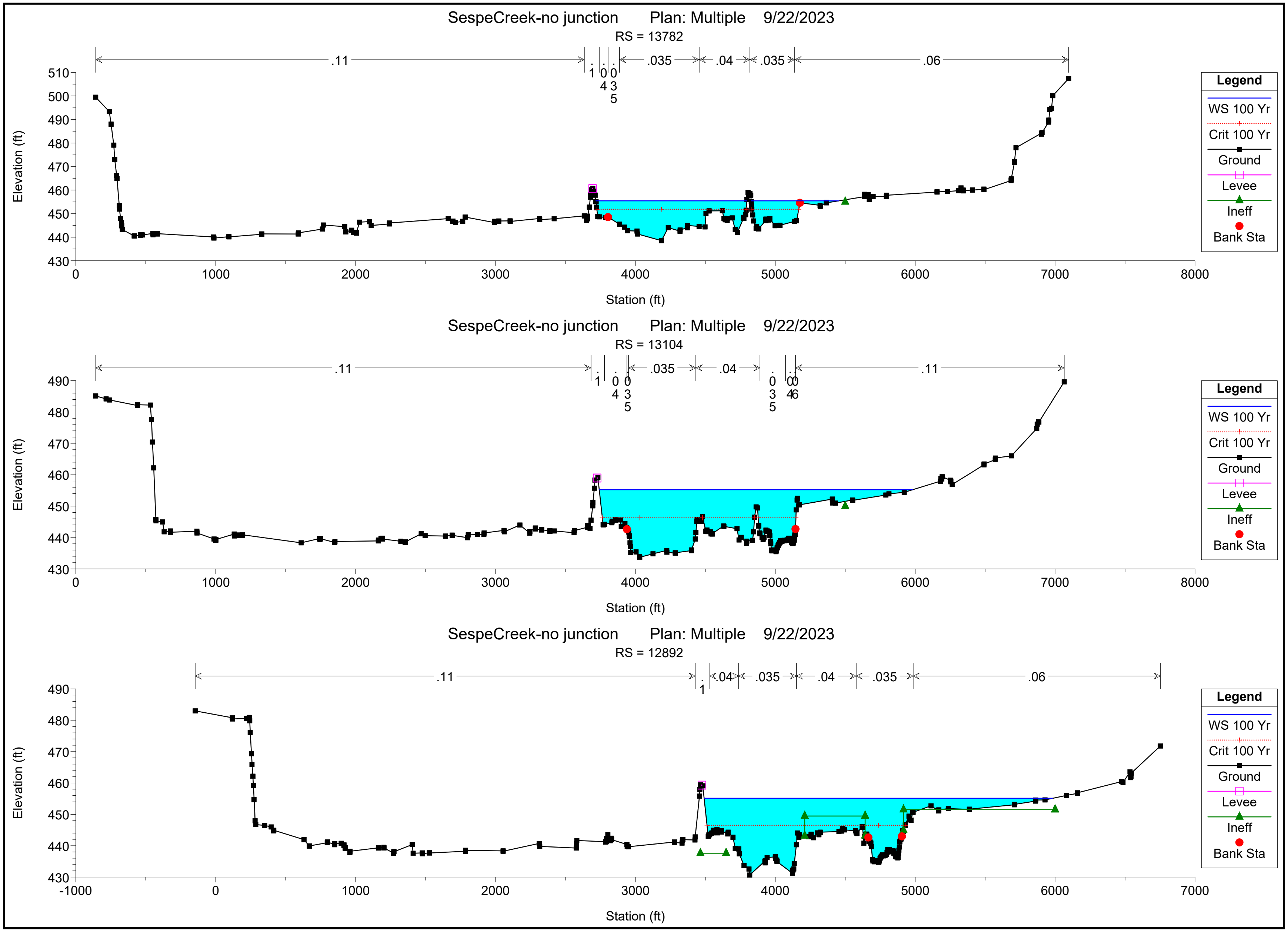

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 19991
.06
.06
.035
.04
.06
700
650
600
550
500
450
Elevation (ft)
4000
5000
6000
7000
8000
9000
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

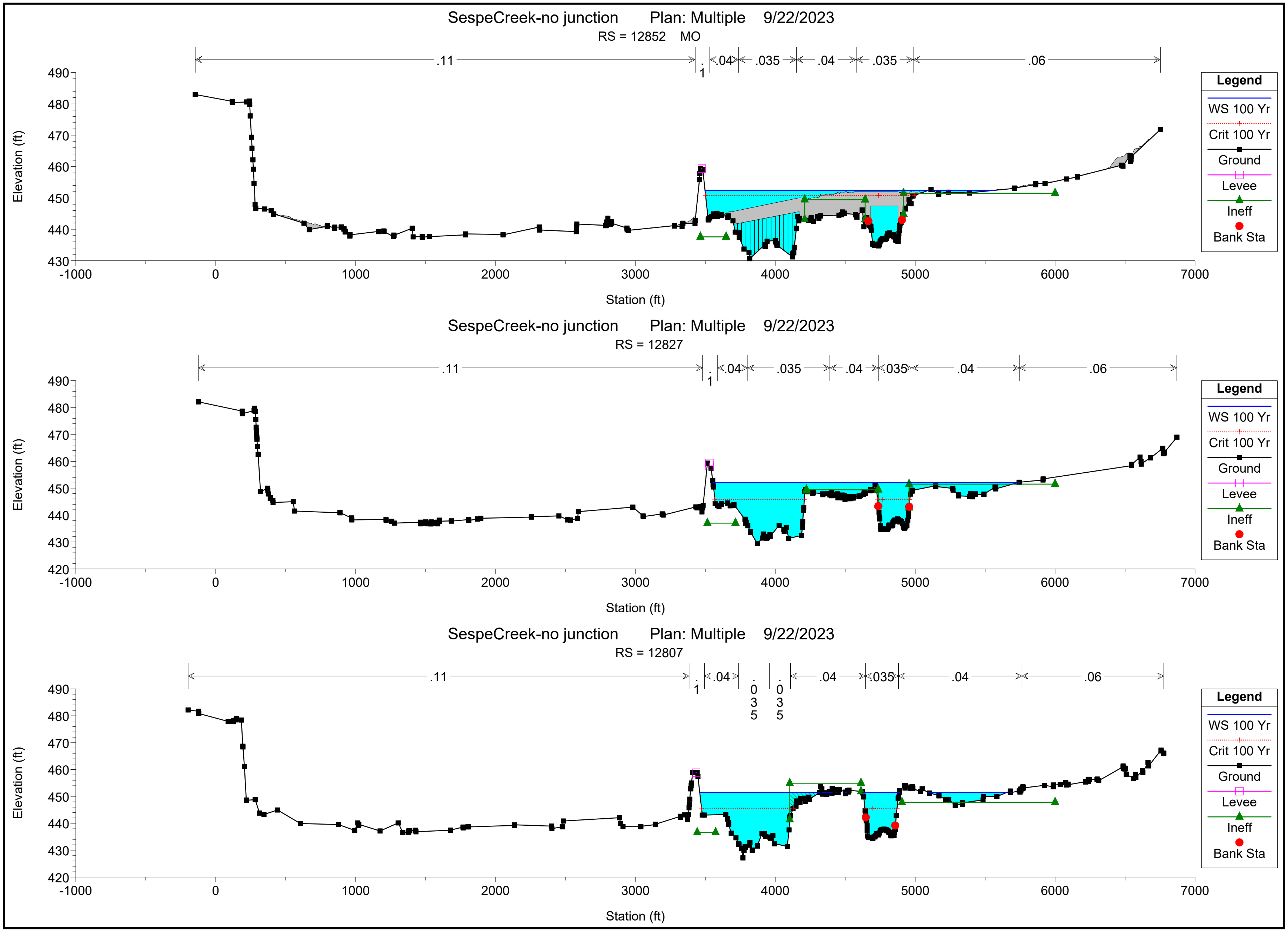

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 19675
.055
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 19191
.055
.035
.06
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 18647
.055
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta

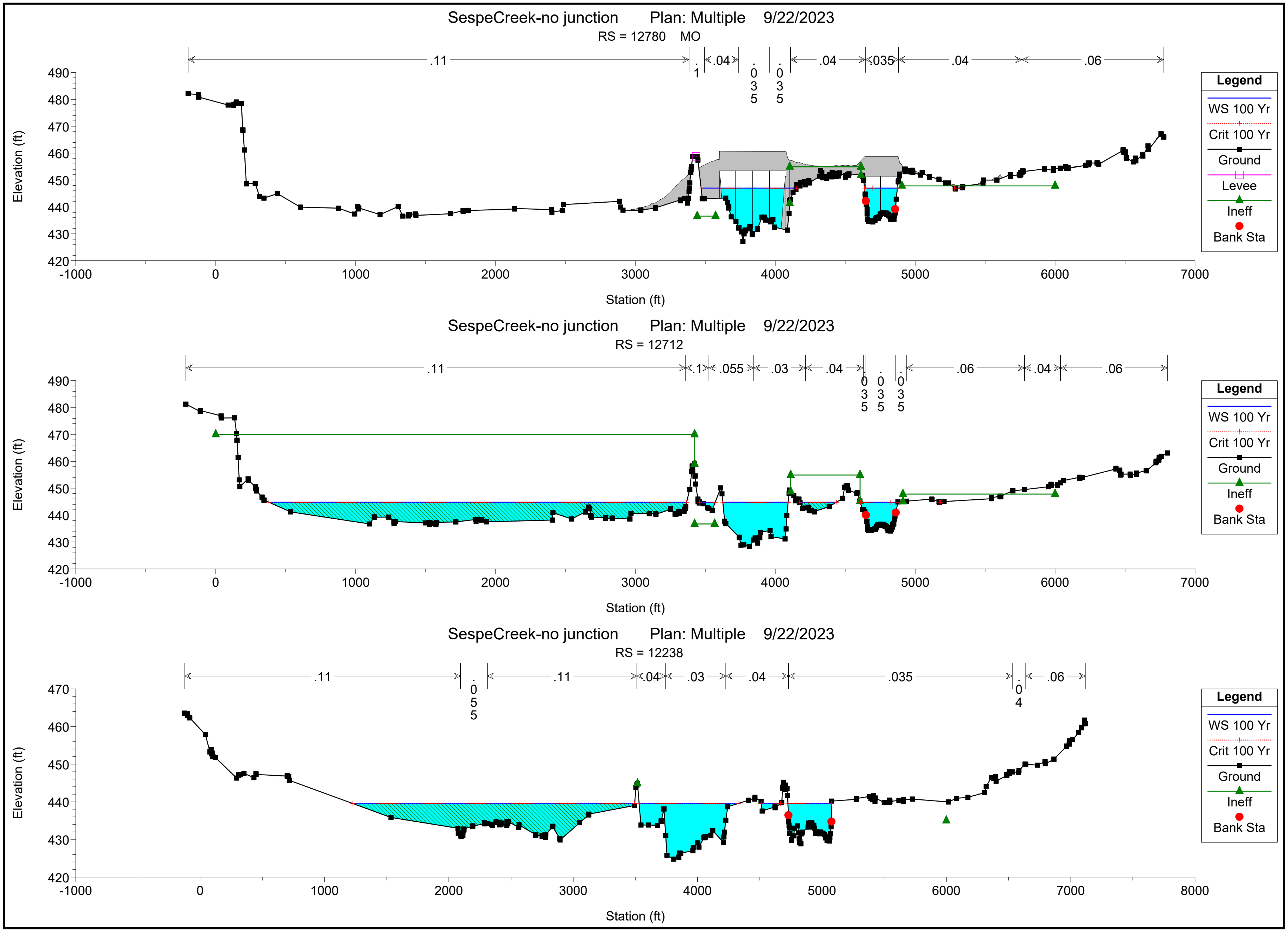

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 17091
.06
.11
.1
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 16463
.011
.1
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 16069
.011
.1
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta

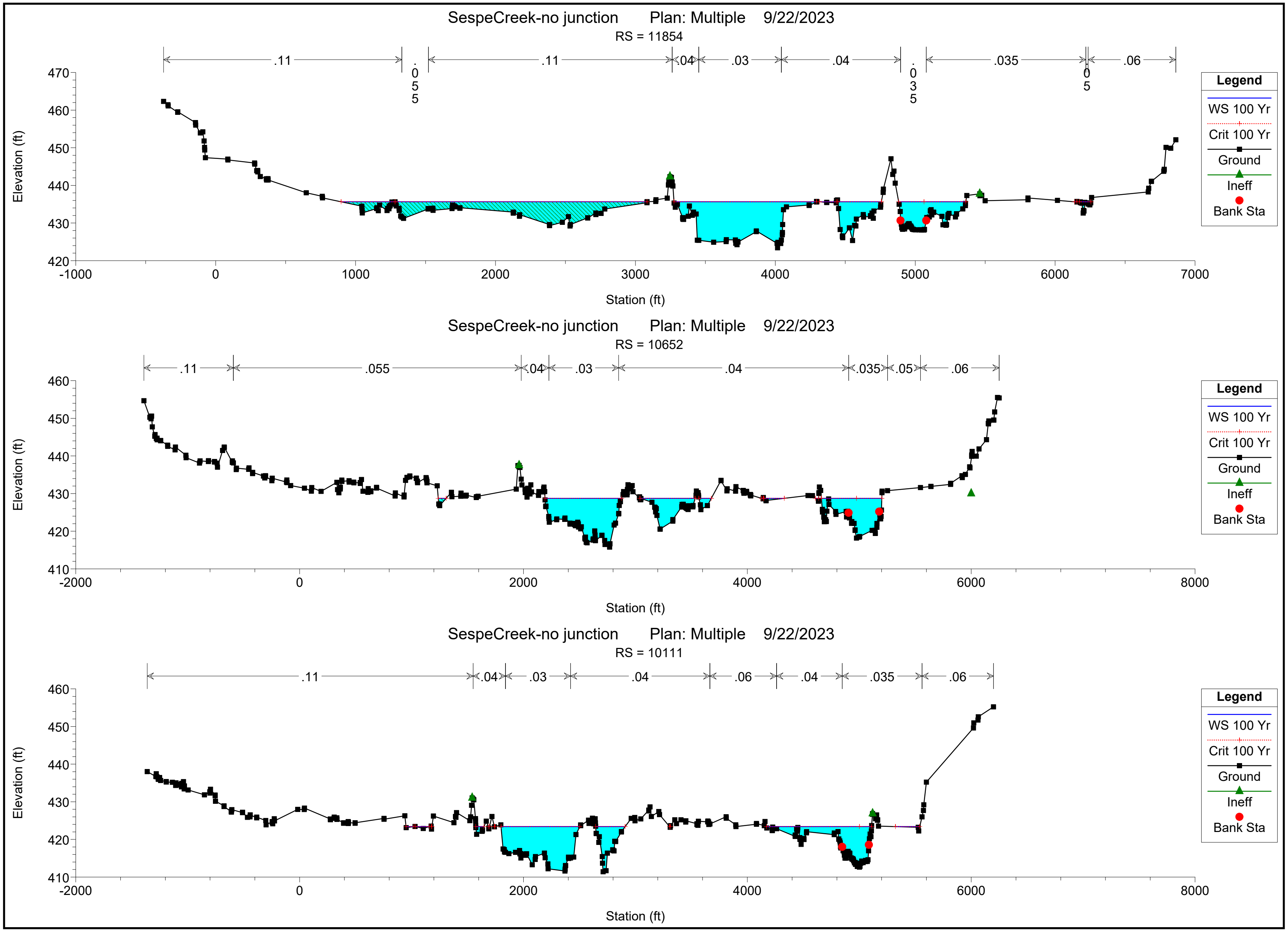


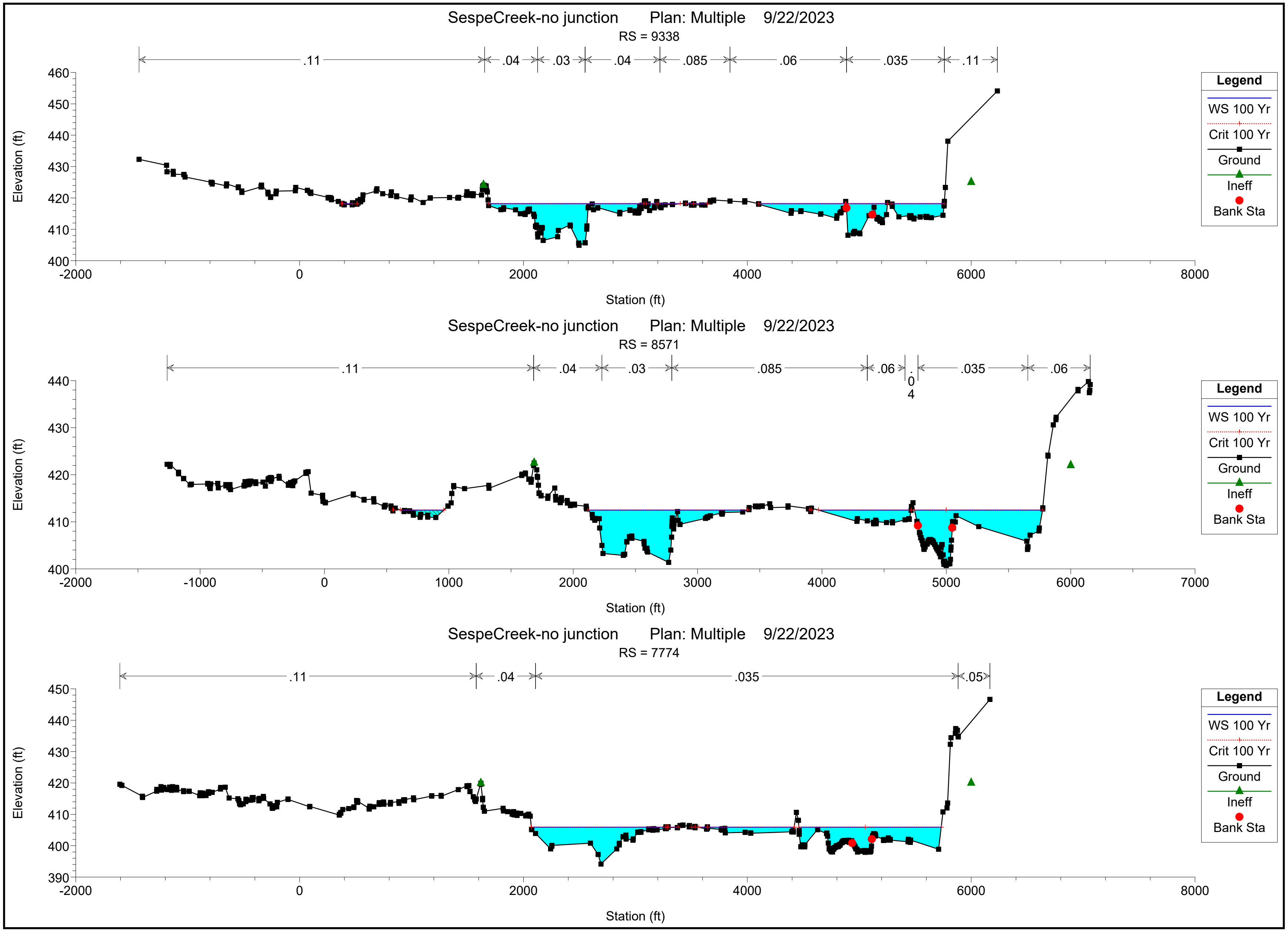
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 15728
.011
.04
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 15144
.11
.11
.04
.035
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 14340
.11
.04
.035
.04
.035
.11
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta


SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 13782
.11
.035
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 13104
.11
.035
.04
.11
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12892
.11
.04
.035
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta

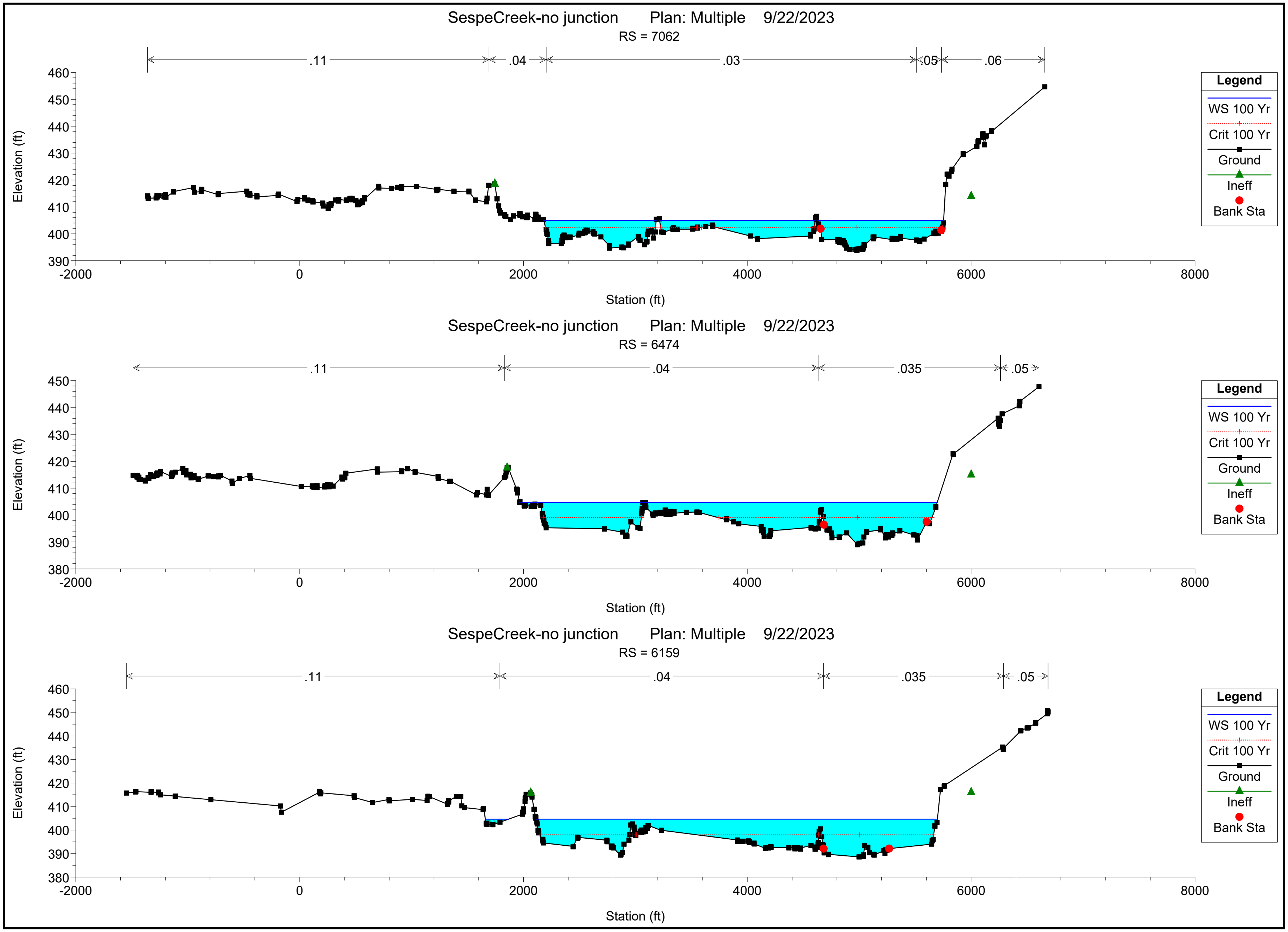

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12852 MO
.11
.1
.04
.035
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12827
.11
.1
.04
.035
.04
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12807
.11
.1
.04
.035
.035
.04
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta

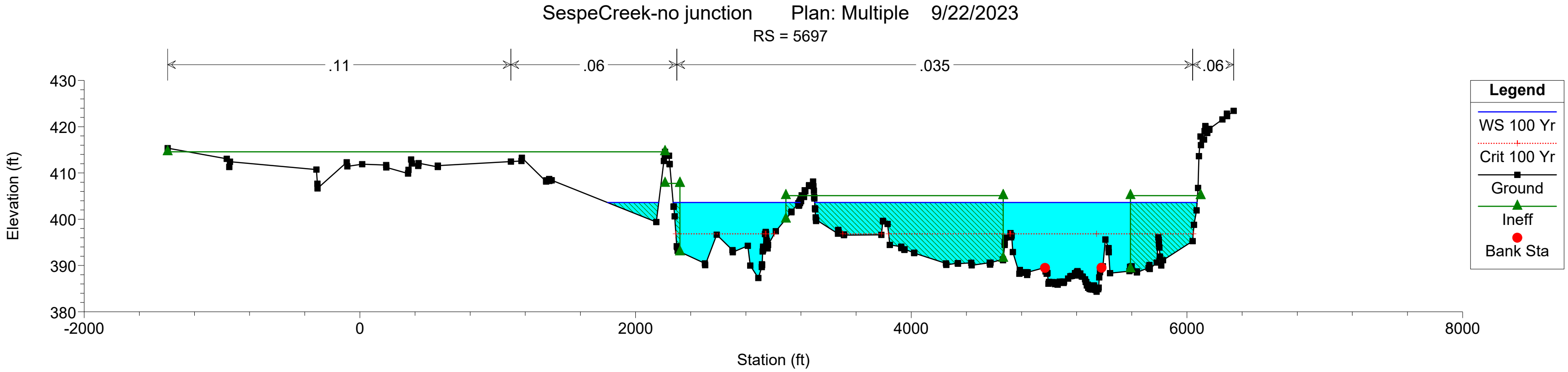

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12780 MO
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
Station (ft)
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12712
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 12238
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 11854
.11
.055
.11
.04
.03
.04
.035
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 10652
.11
.055
.04
.03
.04
.035
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 10111
.11
.04
.03
.04
.06
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta

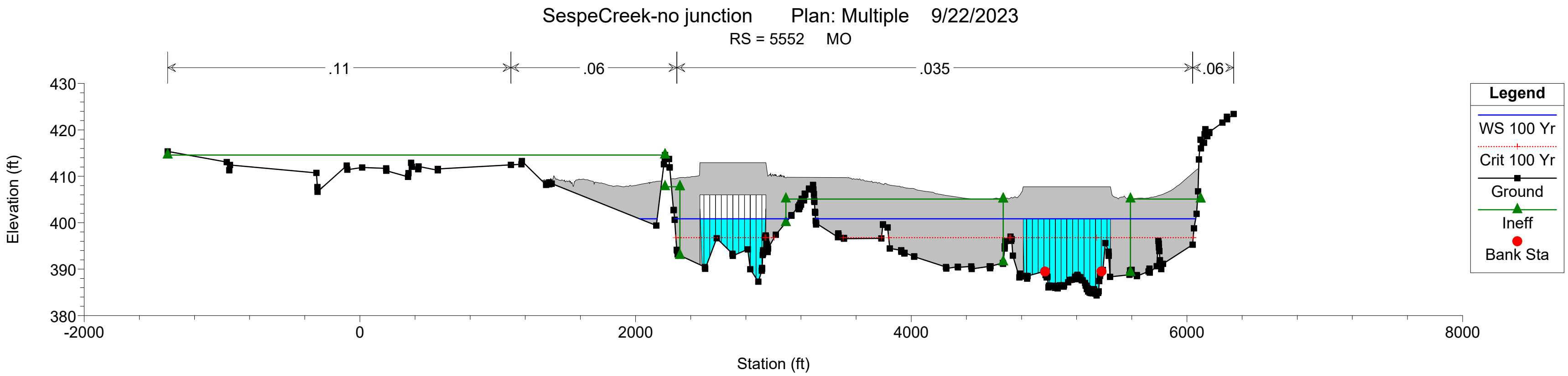


SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 9338
.11 .04 .03 .04 .085 .06 .035 .11
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 8571
.11 .04 .03 .085 .06 0 4 .035 .06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 7774
.11 .04 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta

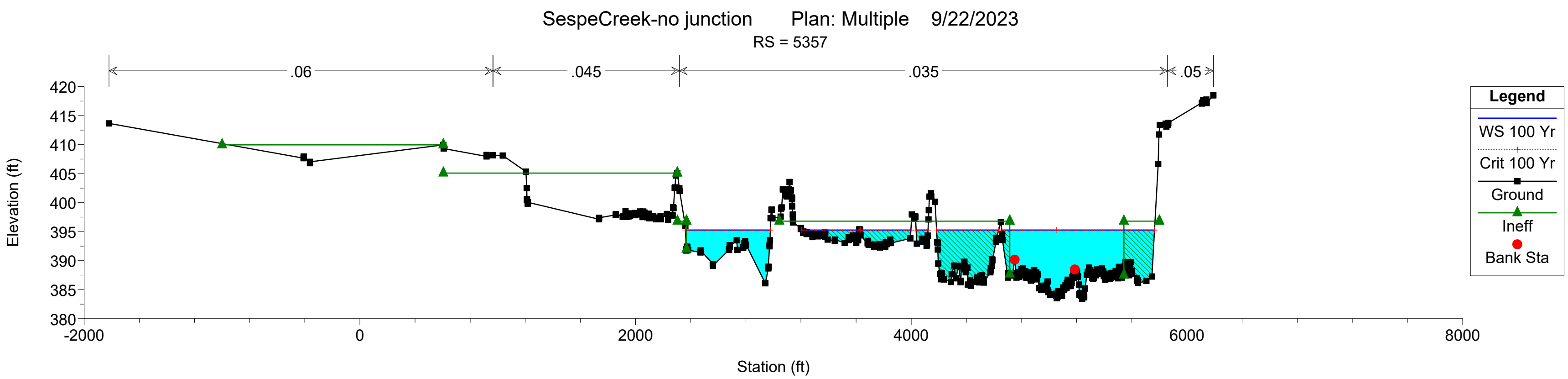

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 7062
.11
.04
.03
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 6474
.11
.04
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 6159
.11
.04
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta



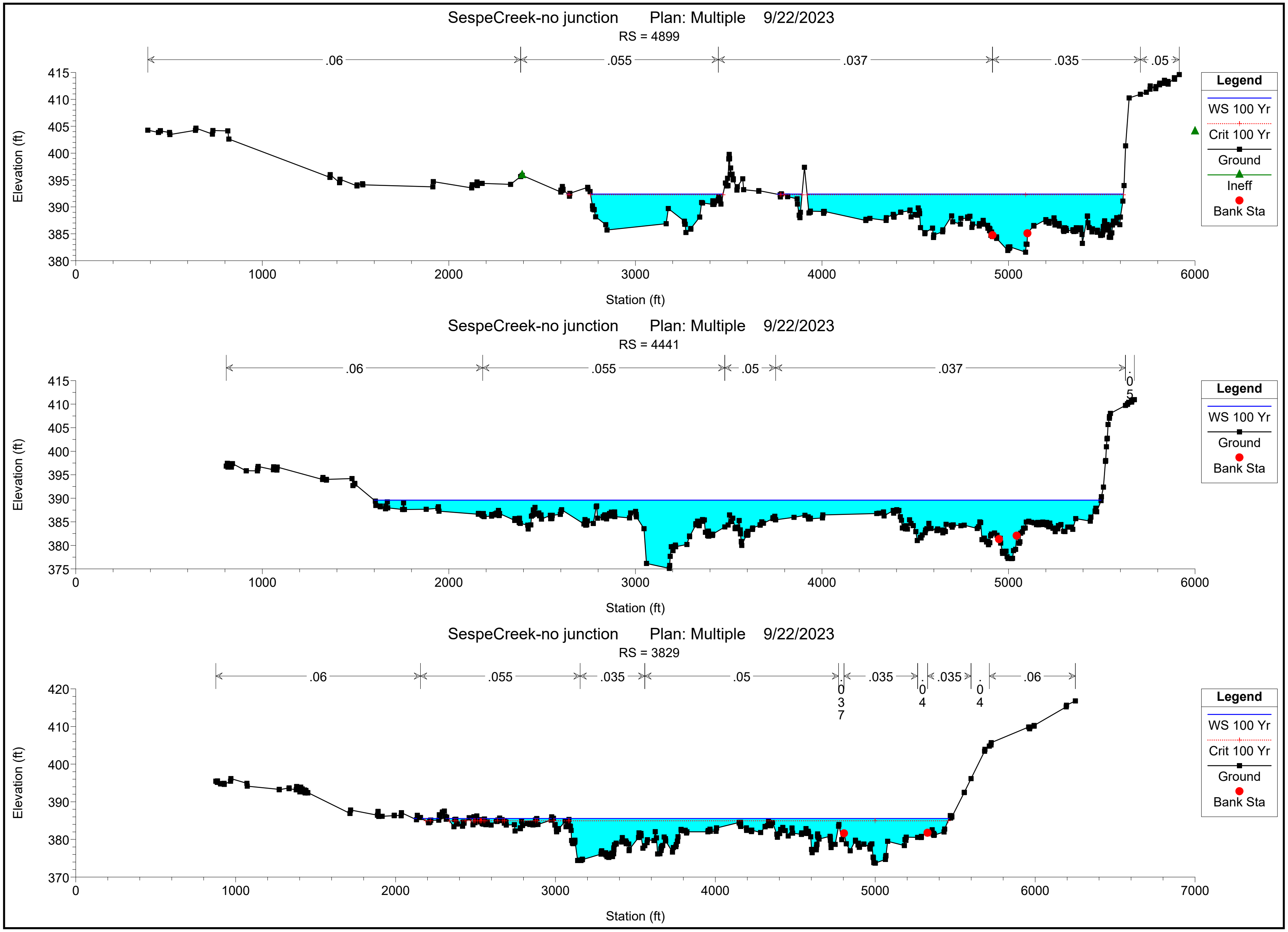
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 5697
.11
.06
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta

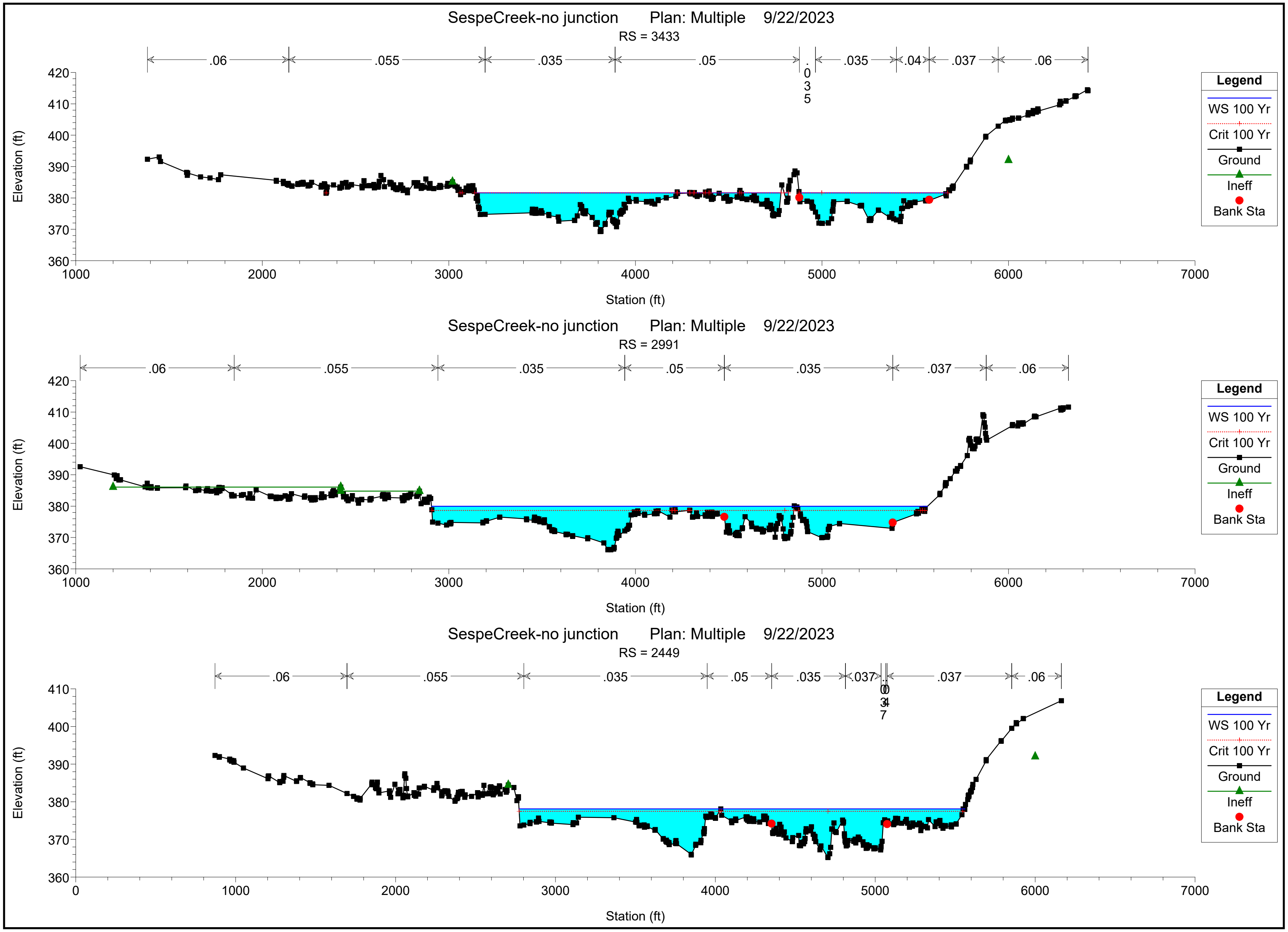
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 5552 MO
.11
.06
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta

SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 5357
.06
.045
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta



SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 4899
.06
.055
.037
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 4441
.06
.055
.05
.037
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 3829
.06
.055
.035
.05
.035
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta


SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 3433
.06 .055 .035 .05 .035 .035 .04 .037 .06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 2991
.06 .055 .035 .05 .035 .037 .06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 2449
.06 .055 .035 .05 .035 .037 .037 .06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta

# Hydraulic Model Output

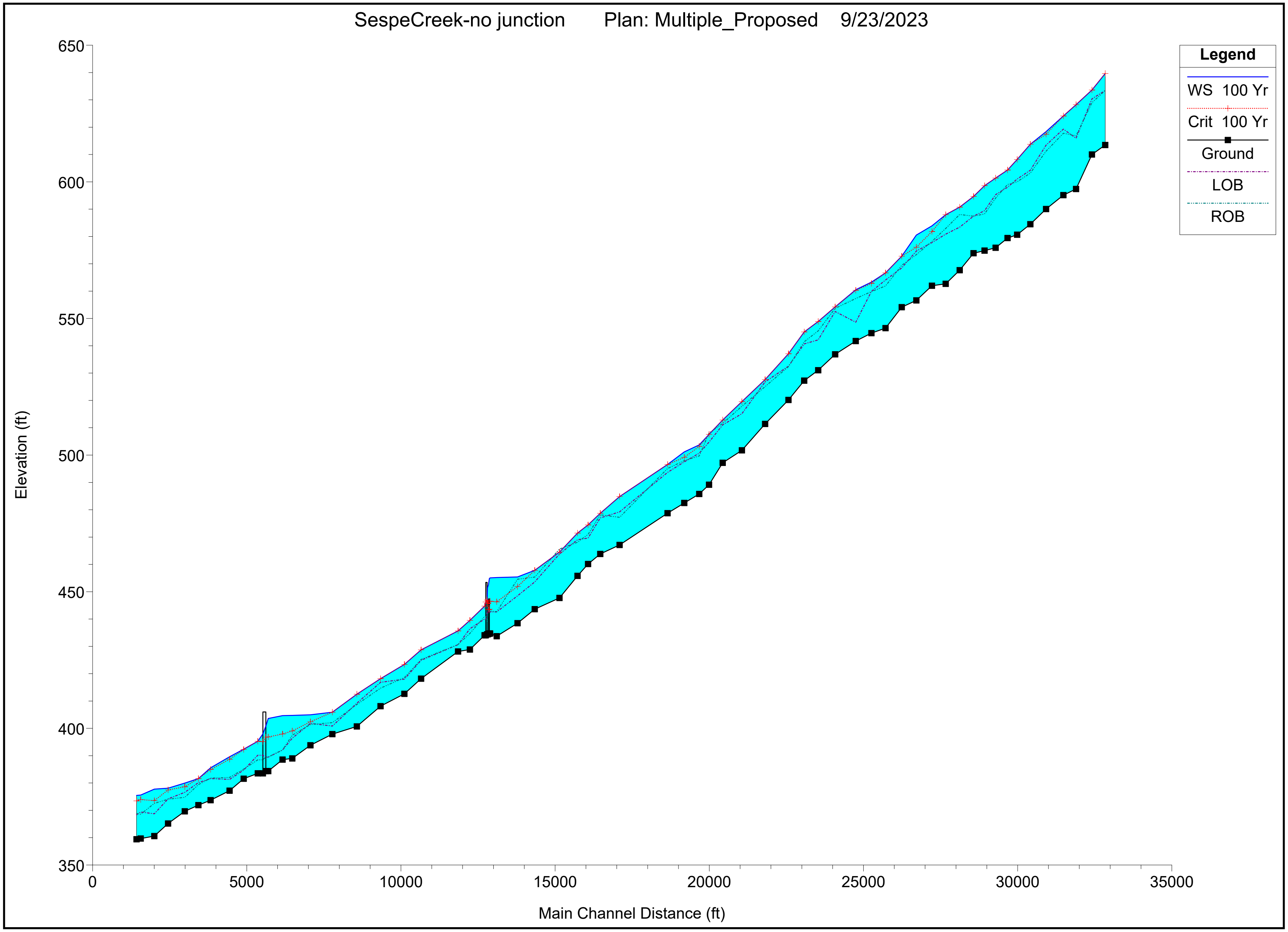
## Post-project Conditions with 100-year Peak Discharge

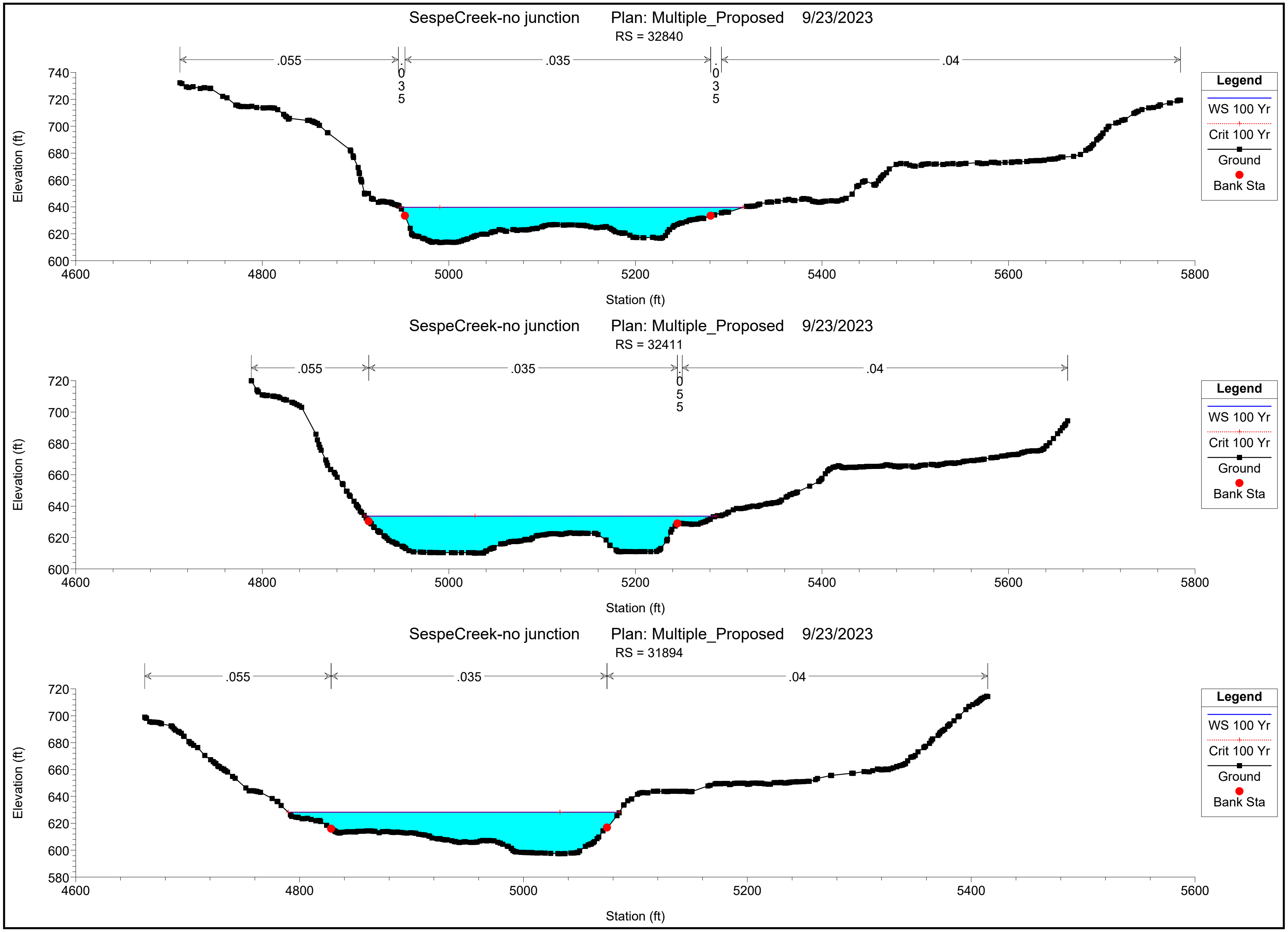
HEC-RAS Plan: Multi_Proposed River: SespeCreek Reach: Reach1 Profile: 100 Yr

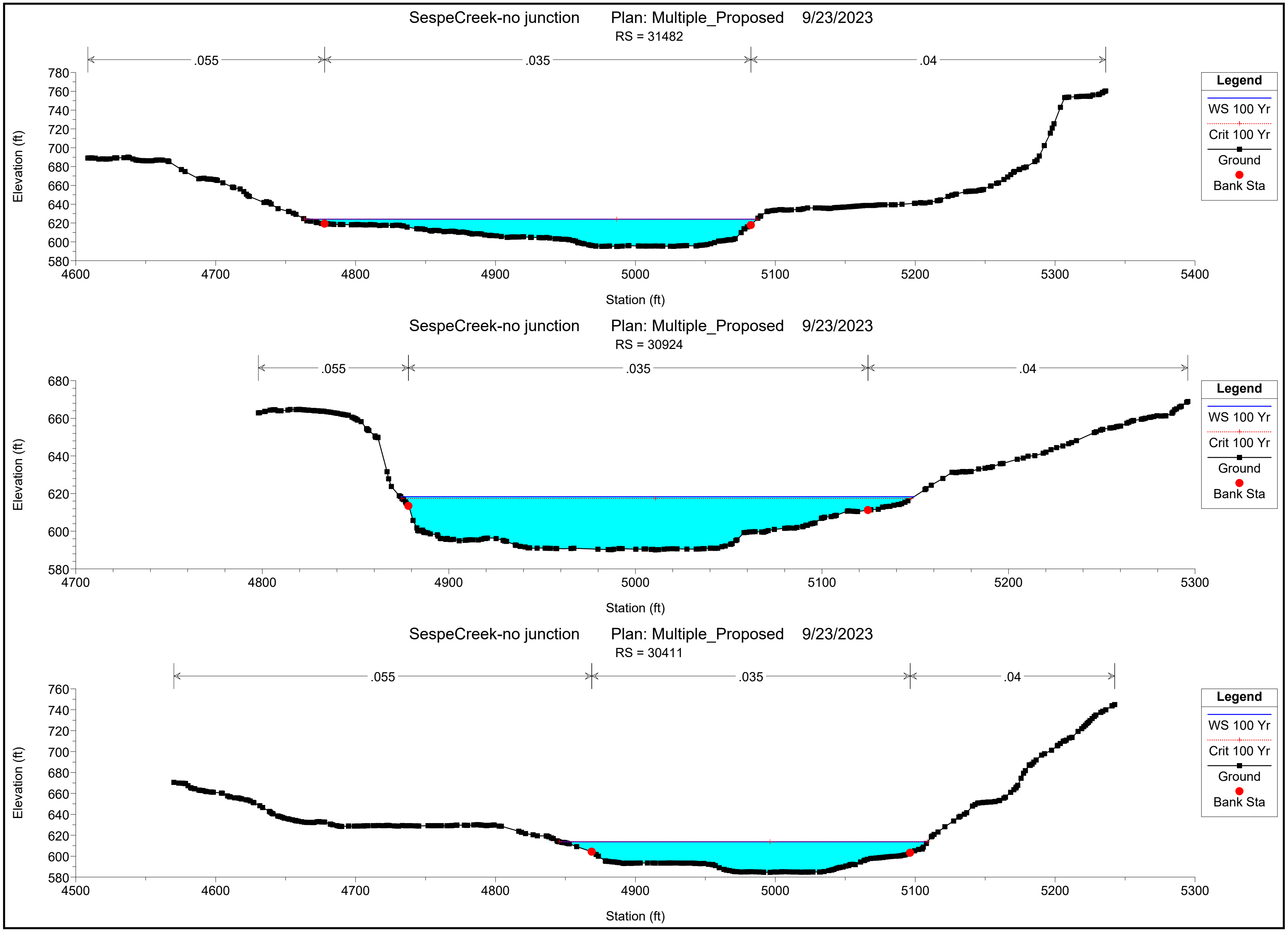
| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach1 | 32840 | 100 Yr | 135000.00 | 613.47 | 639.65 | 639.65 | 647.95 | 0.006964 | 23.18 | 5909.03 | 367.56 | 0.97 |
| Reach1 | 32411 | 100 Yr | 135000.00 | 609.99 | 633.60 | 633.60 | 641.84 | 0.006953 | 23.11 | 5958.27 | 376.66 | 0.97 |
| Reach1 | 31894 | 100 Yr | 135000.00 | 597.39 | 628.21 | 628.21 | 638.06 | 0.006406 | 25.35 | 5534.89 | 295.98 | 0.97 |
| Reach1 | 31482 | 100 Yr | 135000.00 | 595.13 | 624.11 | 624.11 | 633.12 | 0.007062 | 24.10 | 5647.00 | 323.26 | 0.99 |
| Reach1 | 30924 | 100 Yr | 135000.00 | 590.05 | 618.36 | 617.43 | 627.62 | 0.005840 | 24.49 | 5599.96 | 275.18 | 0.92 |
| Reach1 | 30411 | 100 Yr | 135000.00 | 584.48 | 613.75 | 613.75 | 624.36 | 0.006390 | 26.24 | 5280.75 | 263.15 | 0.98 |
| Reach1 | 29986 | 100 Yr | 135000.00 | 580.62 | 608.20 | 608.20 | 618.32 | 0.006784 | 25.55 | 5338.08 | 273.78 | 0.99 |
| Reach1 | 29672 | 100 Yr | 135000.00 | 579.41 | 604.31 | 604.31 | 613.75 | 0.007340 | 24.65 | 5507.76 | 298.81 | 0.99 |
| Reach1 | 29284 | 100 Yr | 135000.00 | 575.87 | 601.35 | 601.35 | 608.83 | 0.005512 | 22.37 | 6746.18 | 508.38 | 0.89 |
| Reach1 | 28927 | 100 Yr | 135000.00 | 574.82 | 598.60 | 598.60 | 605.16 | 0.005050 | 21.67 | 7729.37 | 605.13 | 0.85 |
| Reach1 | 28571 | 100 Yr | 135000.00 | 573.87 | 594.63 | 594.63 | 600.81 | 0.005010 | 20.80 | 7733.26 | 709.89 | 0.85 |
| Reach1 | 28122 | 100 Yr | 135000.00 | 567.66 | 590.74 | 590.74 | 598.02 | 0.005692 | 22.43 | 6777.49 | 598.90 | 0.90 |
| Reach1 | 27668 | 100 Yr | 135000.00 | 562.66 | 587.98 | 587.98 | 594.91 | 0.005469 | 21.54 | 6962.48 | 607.07 | 0.88 |
| Reach1 | 27222 | 100 Yr | 135000.00 | 561.98 | 583.91 | 581.82 | 588.23 | 0.005418 | 16.90 | 8482.73 | 686.31 | 0.75 |
| Reach1 | 26715 | 100 Yr | 135789.00 | 556.60 | 580.53 | 576.09 | 584.26 | 0.010952 | 15.55 | 8936.03 | 666.77 | 0.65 |
| Reach1 | 26242 | 100 Yr | 135789.00 | 554.12 | 572.79 | 572.79 | 579.27 | 0.009130 | 20.45 | 6762.78 | 607.33 | 0.96 |
| Reach1 | 25713 | 100 Yr | 135789.00 | 546.47 | 566.65 | 566.65 | 572.05 | 0.007080 | 18.83 | 7730.09 | 792.17 | 0.94 |
| Reach1 | 25258 | 100 Yr | 135789.00 | 544.62 | 563.31 | 562.81 | 567.95 | 0.006973 | 17.30 | 7976.94 | 842.99 | 0.92 |
| Reach1 | 24751 | 100 Yr | 135789.00 | 541.72 | 560.52 | 560.31 | 564.03 | 0.007189 | 15.32 | 9642.70 | 1340.71 | 0.83 |
| Reach1 | 24081 | 100 Yr | 135789.00 | 536.87 | 554.24 | 554.24 | 558.77 | 0.008353 | 17.07 | 8012.00 | 1059.62 | 0.99 |
| Reach1 | 23531 | 100 Yr | 135789.00 | 531.05 | 548.88 | 548.88 | 552.69 | 0.005650 | 16.07 | 10247.47 | 1658.23 | 0.85 |
| Reach1 | 23080 | 100 Yr | 135789.00 | 527.22 | 545.08 | 545.08 | 548.13 | 0.006330 | 15.59 | 12100.51 | 1944.07 | 0.87 |
| Reach1 | 22567 | 100 Yr | 135789.00 | 520.15 | 537.07 | 537.07 | 539.66 | 0.005866 | 14.60 | 11991.98 | 2170.20 | 0.76 |
| Reach1 | 21811 | 100 Yr | 135789.00 | 511.42 | 527.61 | 527.61 | 531.10 | 0.006672 | 15.67 | 10339.10 | 1963.72 | 0.89 |
| Reach1 | 21055 | 100 Yr | 135789.00 | 501.73 | 519.55 | 519.55 | 523.01 | 0.006356 | 15.24 | 10462.89 | 1906.94 | 0.87 |
| Reach1 | 20433 | 100 Yr | 135789.00 | 497.18 | 512.84 | 512.84 | 516.81 | 0.007479 | 16.24 | 8915.61 | 1480.60 | 0.94 |
| Reach1 | 19991 | 100 Yr | 135789.00 | 489.17 | 507.60 | 507.60 | 512.42 | 0.010874 | 17.61 | 7712.32 | 797.35 | 1.00 |
| Reach1 | 19675 | 100 Yr | 135789.00 | 485.77 | 503.75 | 503.16 | 508.08 | 0.007608 | 16.71 | 8319.55 | 1354.88 | 0.91 |
| Reach1 | 19191 | 100 Yr | 135789.00 | 482.46 | 501.16 | 499.17 | 504.85 | 0.005246 | 15.48 | 9352.43 | 1863.79 | 0.76 |
| Reach1 | 18647 | 100 Yr | 135789.00 | 478.75 | 496.59 | 496.59 | 501.44 | 0.007057 | 17.73 | 8047.23 | 2030.49 | 0.94 |
| Reach1 | 17091 | 100 Yr | 135789.00 | 467.11 | 484.80 | 484.80 | 490.16 | 0.005629 | 19.37 | 7994.23 | 746.91 | 0.88 |
| Reach1 | 16463 | 100 Yr | 135789.00 | 463.81 | 478.69 | 478.69 | 483.07 | 0.011188 | 16.78 | 8097.44 | 926.53 | 1.00 |
| Reach1 | 16069 | 100 Yr | 135789.00 | 460.12 | 474.46 | 474.46 | 478.65 | 0.008028 | 16.50 | 8409.97 | 1044.93 | 0.97 |
| Reach1 | 15728 | 100 Yr | 135789.00 | 455.80 | 471.46 | 471.46 | 475.85 | 0.007419 | 16.93 | 8303.47 | 996.60 | 0.95 |
| Reach1 | 15144 | 100 Yr | 135789.00 | 447.74 | 464.53 | 464.53 | 468.93 | 0.007400 | 16.83 | 8069.03 | 921.34 | 1.00 |
| Reach1 | 14340 | 100 Yr | 135789.00 | 443.62 | 457.85 | 457.85 | 461.34 | 0.008017 | 15.41 | 9746.85 | 1397.75 | 0.96 |
| Reach1 | 13782 | 100 Yr | 135789.00 | 438.49 | 455.41 | 451.88 | 456.81 | 0.002591 | 9.59 | 14636.02 | 1699.75 | 0.53 |
| Reach1 | 13104 | 100 Yr | 135789.00 | 433.71 | 455.18 | 446.30 | 455.79 | 0.000648 | 6.45 | 23855.71 | 2236.97 | 0.28 |

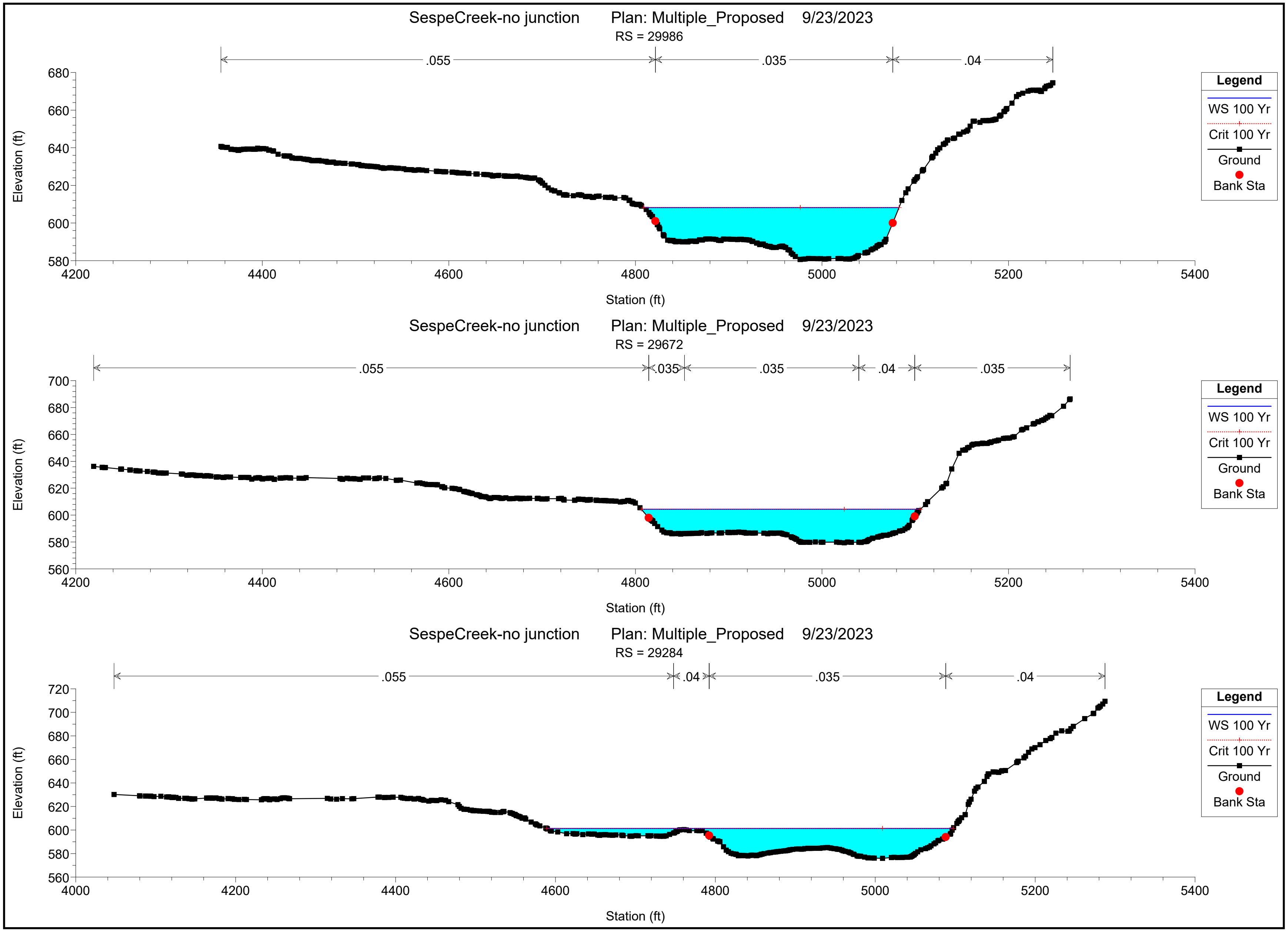
HEC-RAS Plan: Multi_Proposed River: SespeCreek Reach: Reach1 Profile: 100 Yr (Continued)

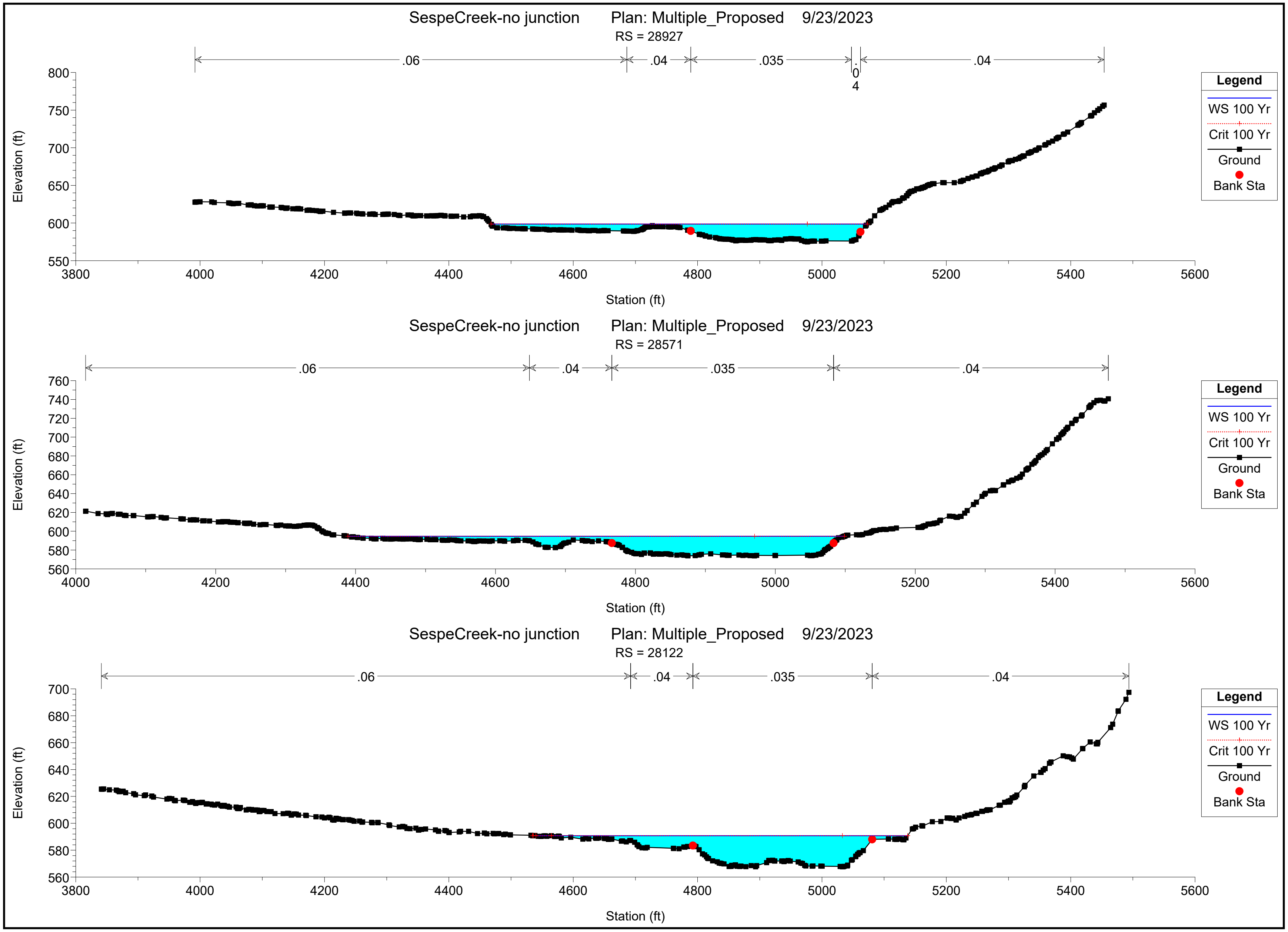
| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Reach1 | 12892 | 100 Yr | 135789.00 | 434.72 | 455.07 | 446.53 | 455.63 | 0.000562 | 6.71 | 24333.59 | 2486.61 | 0.28 |
| Reach1 | 12852 | | Mult Open | | | | | | | | | |
| Reach1 | 12827 | 100 Yr | 135789.00 | 434.59 | 452.18 | 445.85 | 453.21 | 0.001363 | 9.59 | 17935.02 | 2188.22 | 0.43 |
| Reach1 | 12807 | 100 Yr | 135789.00 | 434.42 | 451.45 | 445.63 | 453.02 | 0.001565 | 10.12 | 14362.07 | 1757.99 | 0.46 |
| Reach1 | 12780 | | Mult Open | | | | | | | | | |
| Reach1 | 12712 | 100 Yr | 135789.00 | 434.07 | 444.76 | 444.76 | 449.38 | 0.008045 | 16.38 | 7900.25 | 4105.56 | 0.96 |
| Reach1 | 12238 | 100 Yr | 135789.00 | 428.86 | 439.53 | 439.53 | 442.94 | 0.005230 | 11.70 | 9354.04 | 3566.10 | 0.75 |
| Reach1 | 11854 | 100 Yr | 135789.00 | 428.14 | 435.65 | 435.65 | 438.30 | 0.005202 | 11.12 | 10723.75 | 4215.56 | 0.74 |
| Reach1 | 10652 | 100 Yr | 135789.00 | 418.20 | 428.75 | 428.75 | 431.34 | 0.006349 | 13.89 | 10552.38 | 2127.34 | 0.85 |
| Reach1 | 10111 | 100 Yr | 135789.00 | 412.64 | 423.40 | 423.40 | 426.05 | 0.006155 | 13.99 | 10451.52 | 2416.62 | 0.84 |
| Reach1 | 9338 | 100 Yr | 135789.00 | 408.13 | 418.18 | 418.18 | 420.00 | 0.006029 | 12.56 | 12802.12 | 3580.92 | 0.81 |
| Reach1 | 8571 | 100 Yr | 135789.00 | 400.71 | 412.49 | 412.49 | 414.42 | 0.005828 | 12.86 | 12620.14 | 3425.89 | 0.80 |
| Reach1 | 7774 | 100 Yr | 135789.00 | 397.88 | 405.90 | 405.90 | 407.73 | 0.008441 | 14.44 | 12848.54 | 3459.86 | 0.95 |
| Reach1 | 7062 | 100 Yr | 135789.00 | 393.83 | 404.94 | 402.41 | 405.58 | 0.001500 | 6.86 | 21231.45 | 3519.69 | 0.45 |
| Reach1 | 6474 | 100 Yr | 135789.00 | 388.98 | 404.75 | 399.07 | 405.09 | 0.000667 | 5.69 | 31230.95 | 3718.31 | 0.29 |
| Reach1 | 6159 | 100 Yr | 135789.00 | 388.55 | 404.66 | 397.93 | 404.91 | 0.000399 | 5.10 | 36112.25 | 3793.73 | 0.23 |
| Reach1 | 5697 | 100 Yr | 135789.00 | 384.34 | 403.60 | 396.84 | 404.25 | 0.000717 | 7.44 | 21492.52 | 4063.38 | 0.32 |
| Reach1 | 5552 | | Mult Open | | | | | | | | | |
| Reach1 | 5357 | 100 Yr | 135789.00 | 383.52 | 395.27 | 395.27 | 398.50 | 0.007452 | 15.87 | 9828.97 | 3046.74 | 0.93 |
| Reach1 | 4899 | 100 Yr | 135789.00 | 381.58 | 392.38 | 392.25 | 394.51 | 0.007571 | 16.66 | 13024.01 | 2548.76 | 0.95 |
| Reach1 | 4441 | 100 Yr | 135789.00 | 377.19 | 389.61 | 388.70 | 390.62 | 0.005300 | 14.28 | 18701.65 | 3896.67 | 0.76 |
| Reach1 | 3829 | 100 Yr | 135789.00 | 373.71 | 385.56 | 384.98 | 387.19 | 0.006764 | 12.81 | 14065.11 | 3222.58 | 0.85 |
| Reach1 | 3433 | 100 Yr | 135789.00 | 371.89 | 381.63 | 381.63 | 383.93 | 0.009006 | 12.06 | 11214.11 | 2438.82 | 0.94 |
| Reach1 | 2991 | 100 Yr | 135789.00 | 369.65 | 379.96 | 378.63 | 381.27 | 0.004264 | 9.76 | 14966.40 | 2652.79 | 0.67 |
| Reach1 | 2449 | 100 Yr | 135789.00 | 365.18 | 378.10 | 377.47 | 379.69 | 0.005304 | 11.89 | 14325.28 | 2787.94 | 0.74 |
| Reach1 | 2002 | 100 Yr | 135789.00 | 360.59 | 377.76 | 373.55 | 378.38 | 0.001171 | 7.12 | 22637.04 | 2796.48 | 0.36 |
| Reach1 | 1562 | 100 Yr | 135789.00 | 359.68 | 375.59 | 373.93 | 377.41 | 0.003392 | 12.10 | 14532.19 | 3182.15 | 0.65 |
| Reach1 | 1426 | 100 Yr | 135789.00 | 359.40 | 375.47 | 373.45 | 376.87 | 0.003000 | 10.92 | 16134.57 | 3370.00 | 0.58 |

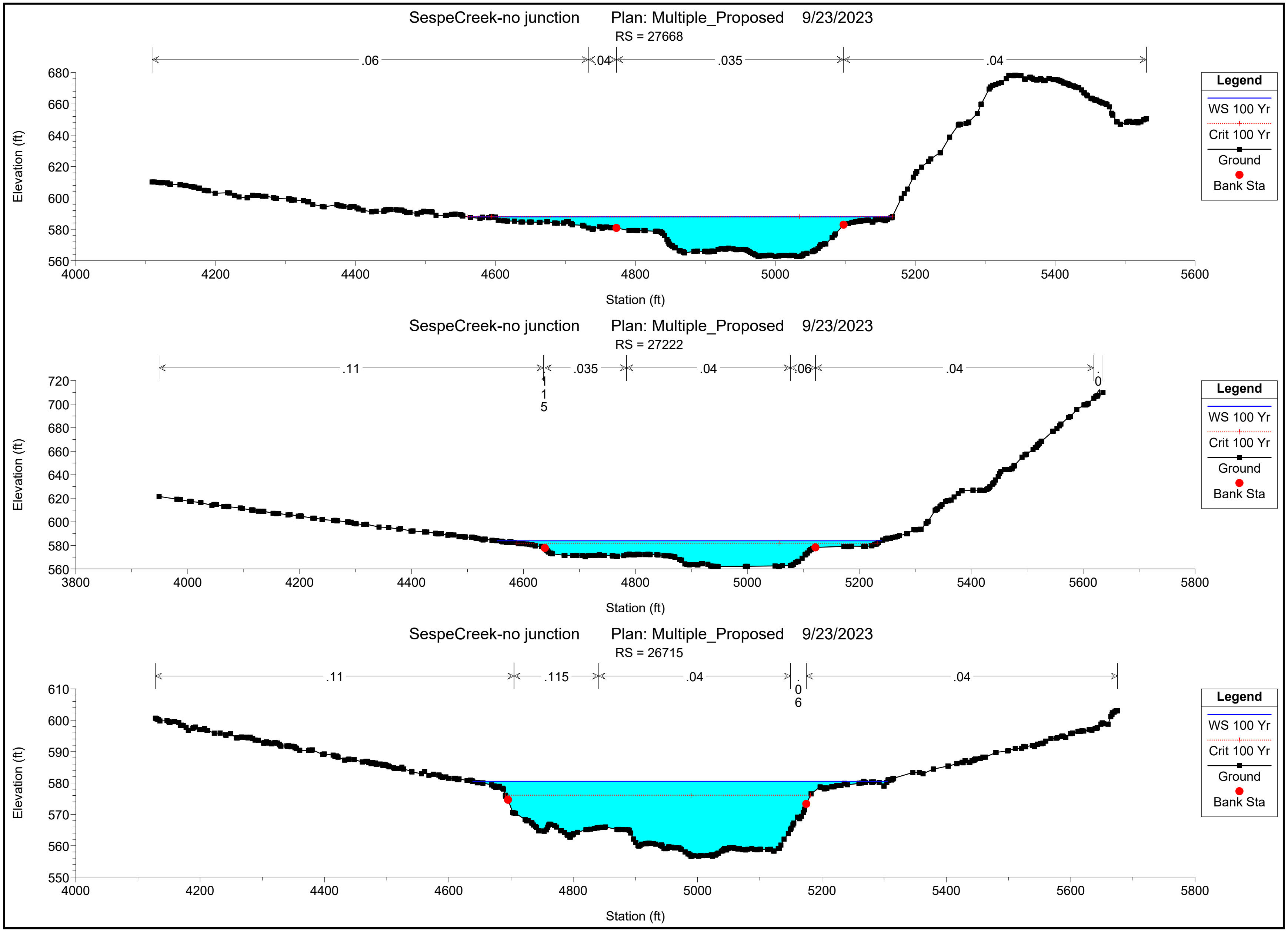

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
Legend
WS 100 Yr
Crit 100 Yr
Ground
LOB
ROB
Elevation (ft)
Main Channel Distance (ft)
650
600
550
500
450
400
350
0
5000
10000
15000
20000
25000
30000
35000

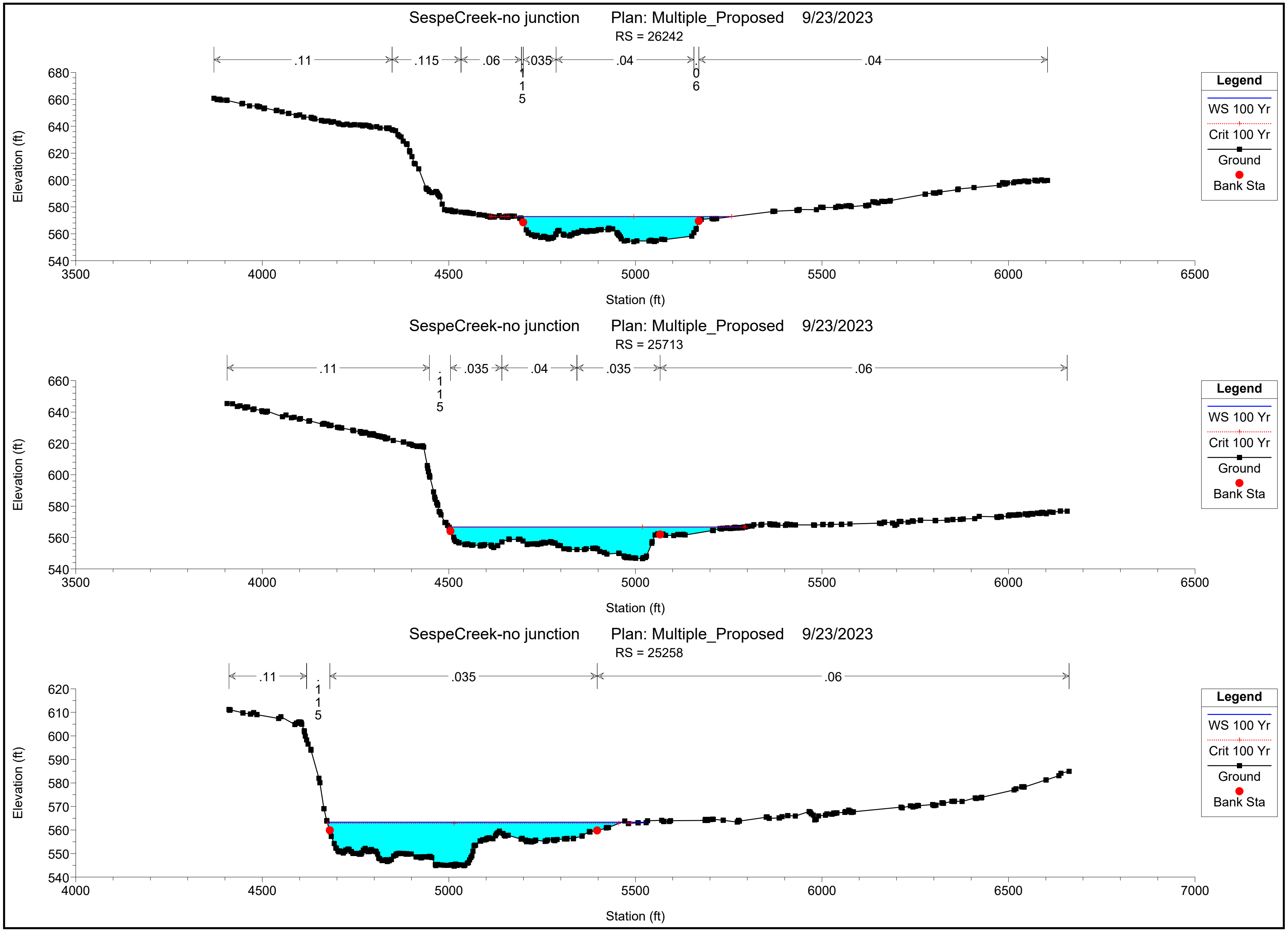

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 32840
.055
.035
.04
0
3
5
Elevation (ft)
740
720
700
680
660
640
620
600
4600
4800
5000
5200
5400
5600
5800
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 32411
.055
.035
.04
0
5
5
Elevation (ft)
720
700
680
660
640
620
600
4600
4800
5000
5200
5400
5600
5800
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 31894
.055
.035
.04
Elevation (ft)
720
700
680
660
640
620
600
580
4600
4800
5000
5200
5400
5600
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

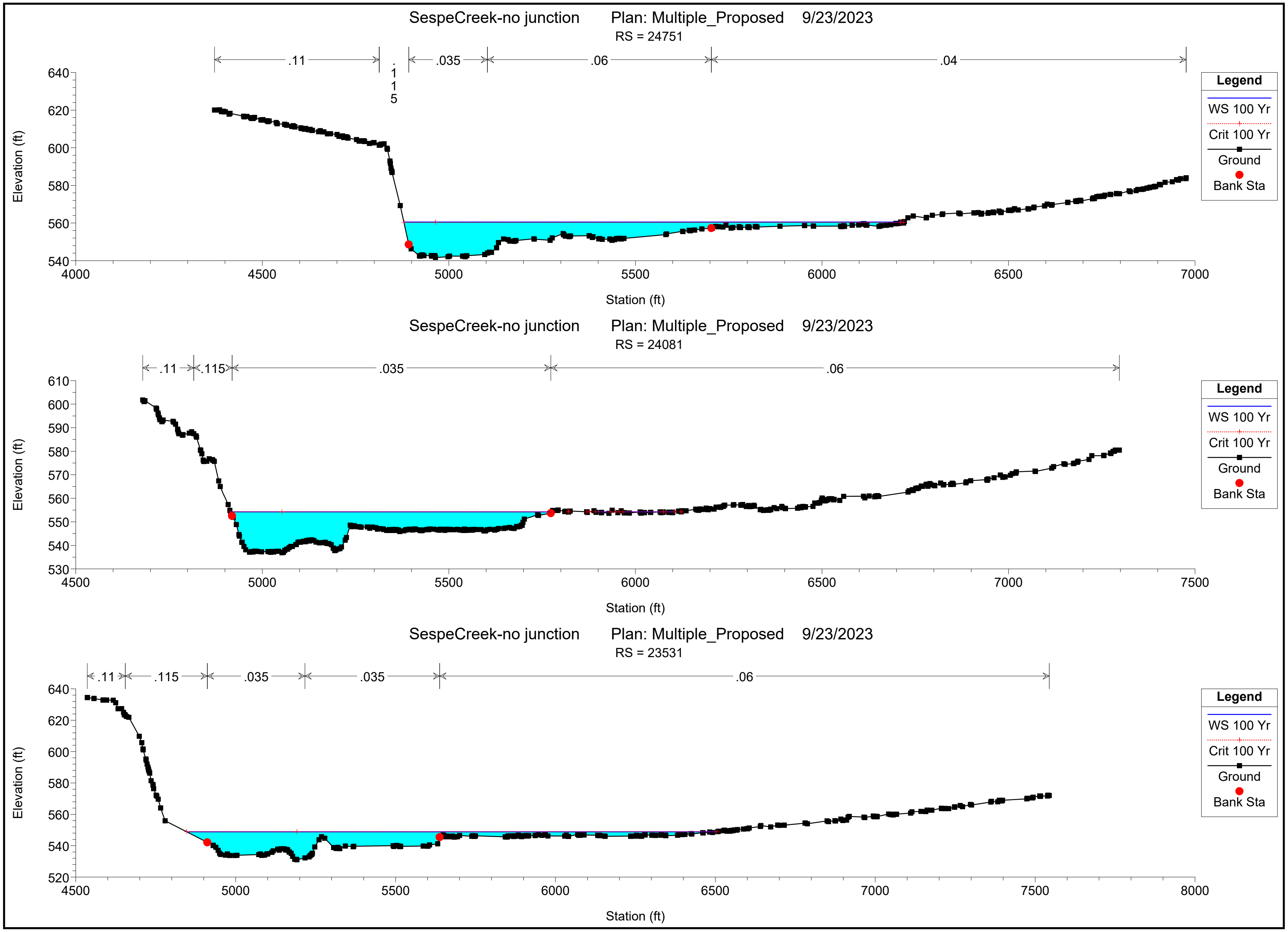

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 31482
.055
.035
.04
780
760
740
720
700
680
660
640
620
600
580
Elevation (ft)
4600
4700
4800
4900
5000
5100
5200
5300
5400
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 30924
.055
.035
.04
680
660
640
620
600
580
Elevation (ft)
4700
4800
4900
5000
5100
5200
5300
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 30411
.055
.035
.04
760
740
720
700
680
660
640
620
600
580
Elevation (ft)
4500
4600
4700
4800
4900
5000
5100
5200
5300
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

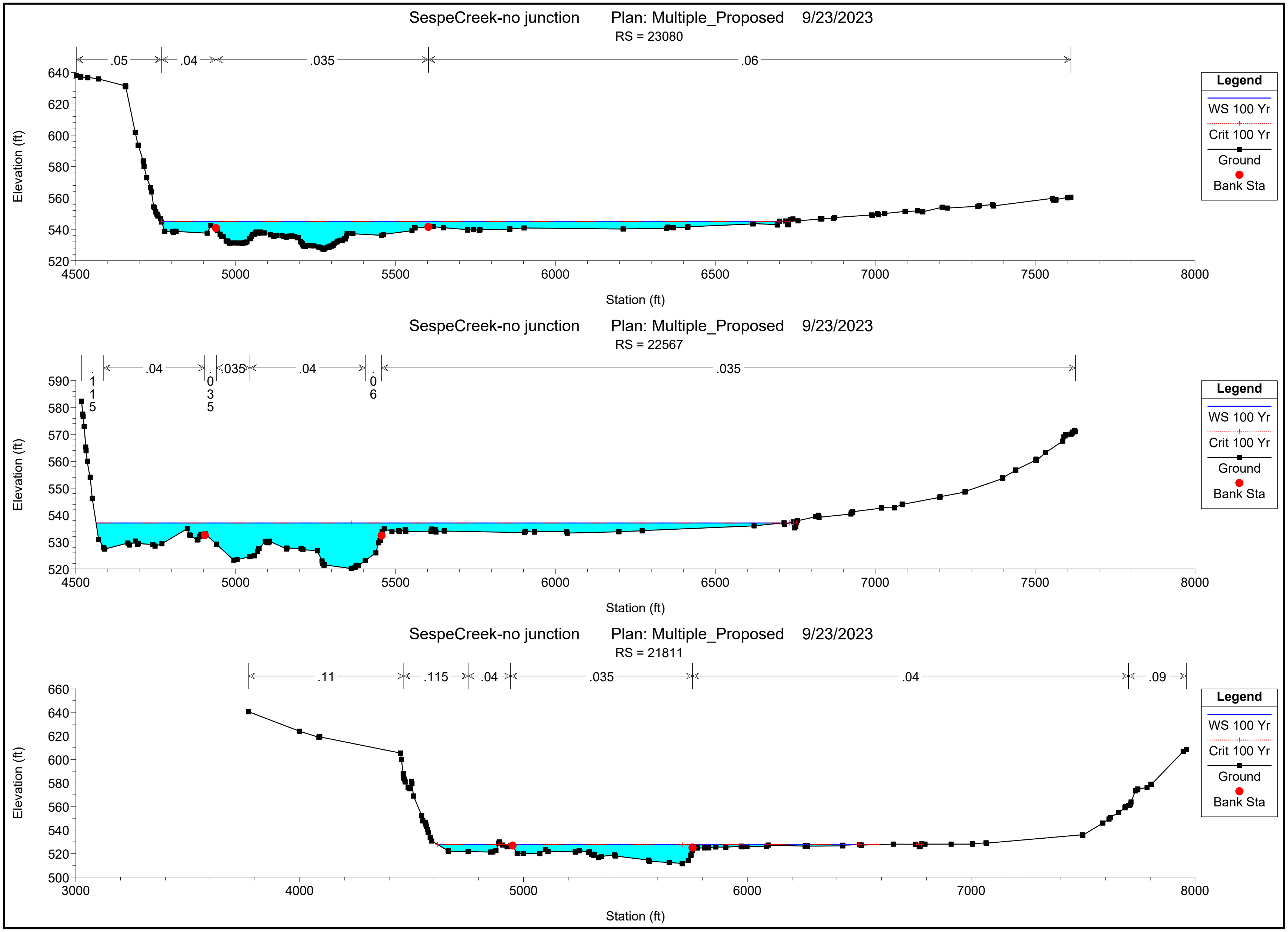

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 29986
.055
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 29672
.055
.035
.035
.04
.035
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 29284
.055
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

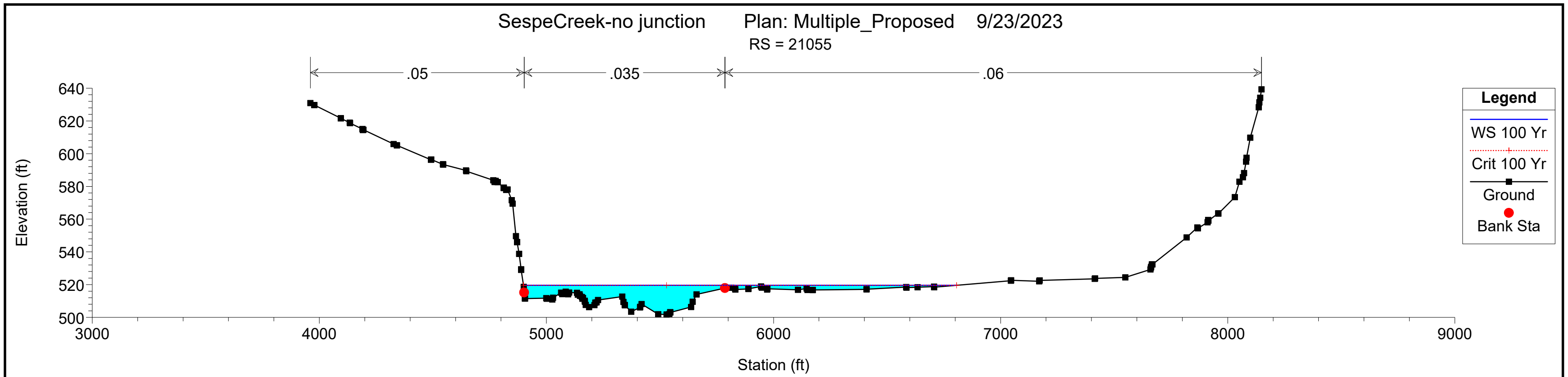

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 28927
.06
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 28571
.06
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 28122
.06
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

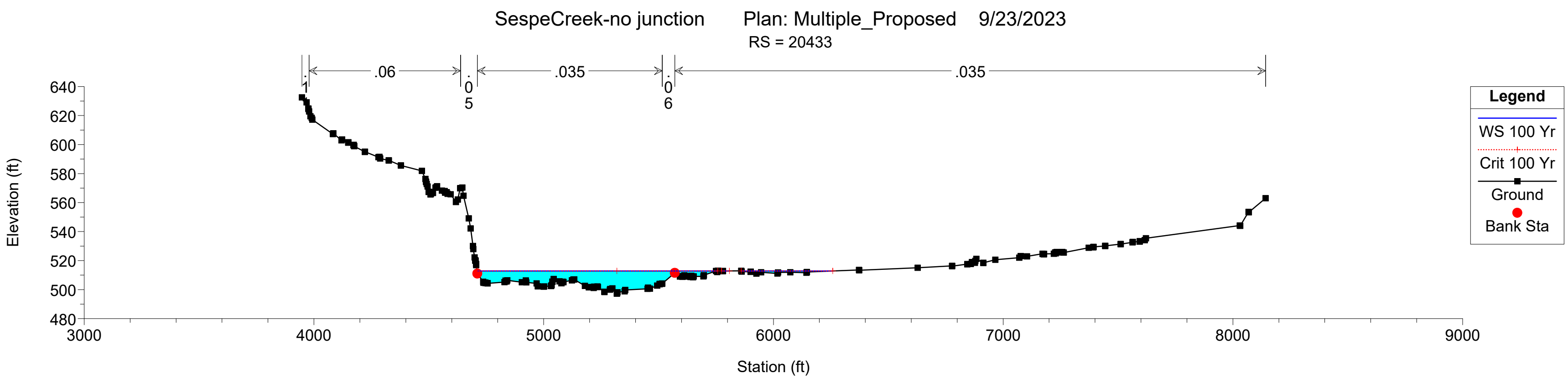

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 27668
.06
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 27222
.11
.115
.035
.04
.06
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 26715
.11
.115
.04
.06
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

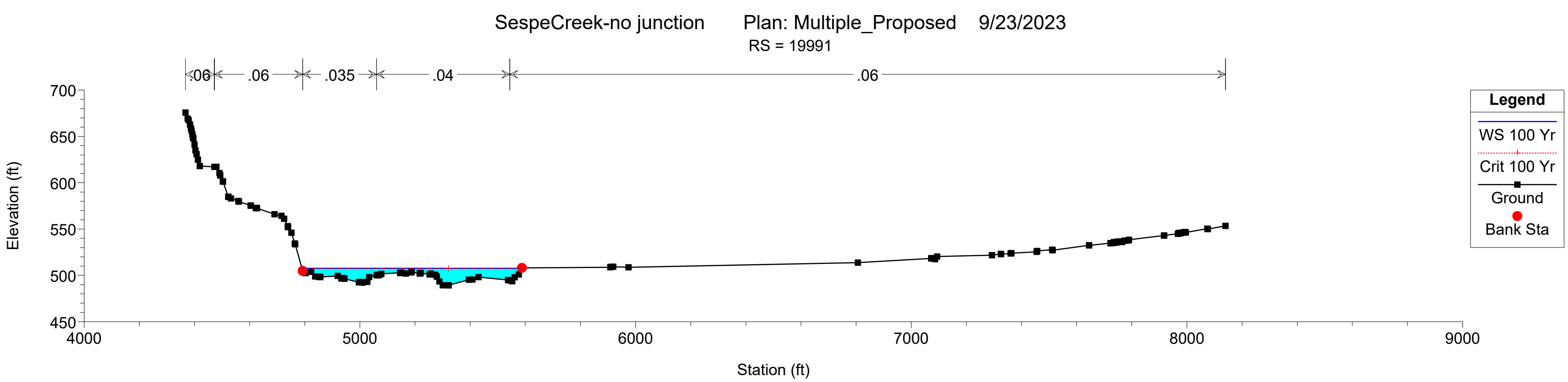

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 26242
.11
.115
.06
.035
.04
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 25713
.11
.035
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 25258
.11
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

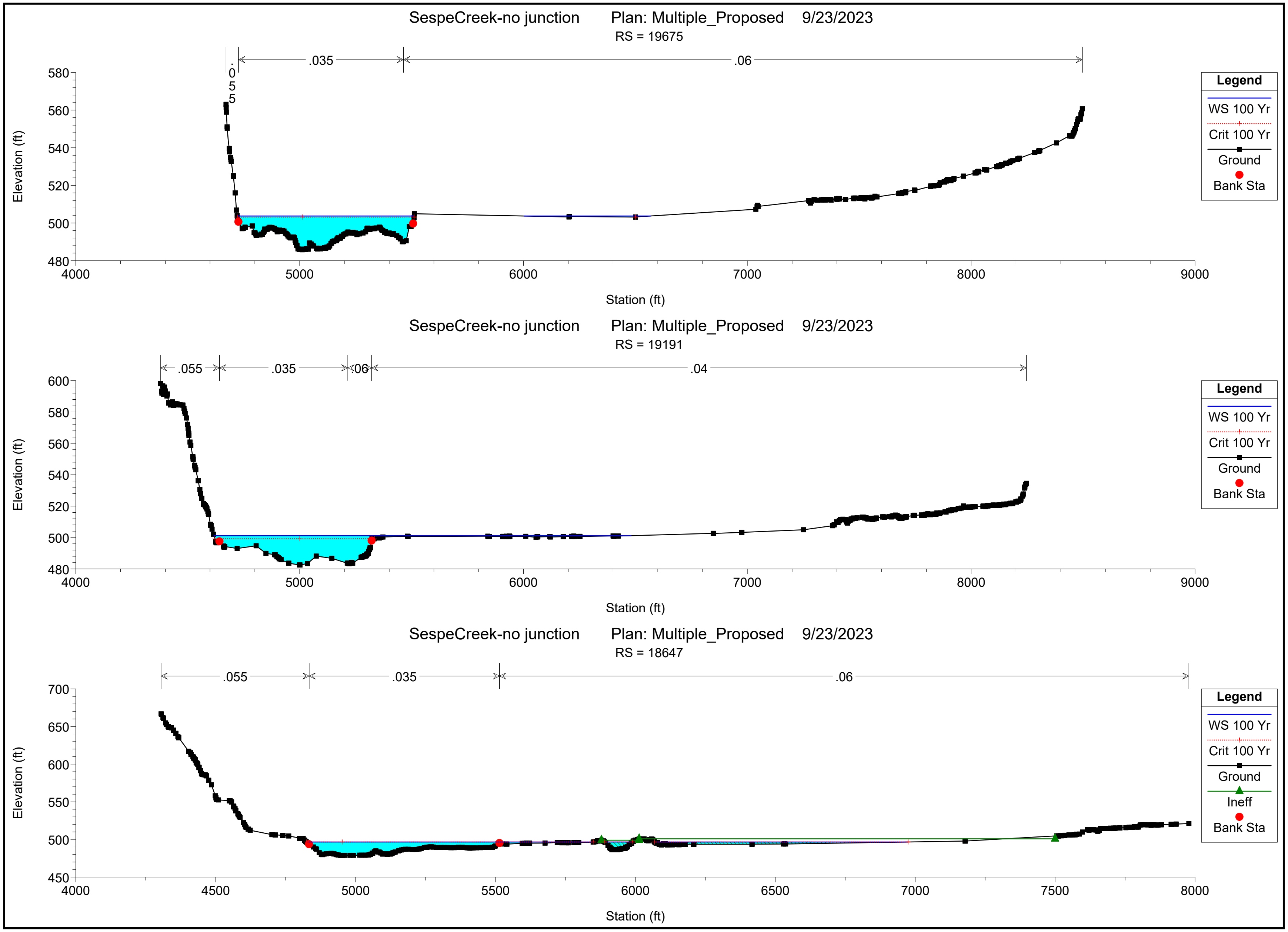

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 24751
.11
.115
.035
.06
.04
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 24081
.11
.115
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 23531
.11
.115
.035
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 23080
.05
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 22567
.115
.04
.035
.035
.04
.06
.035
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 21811
.11
.115
.04
.035
.04
.09
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta

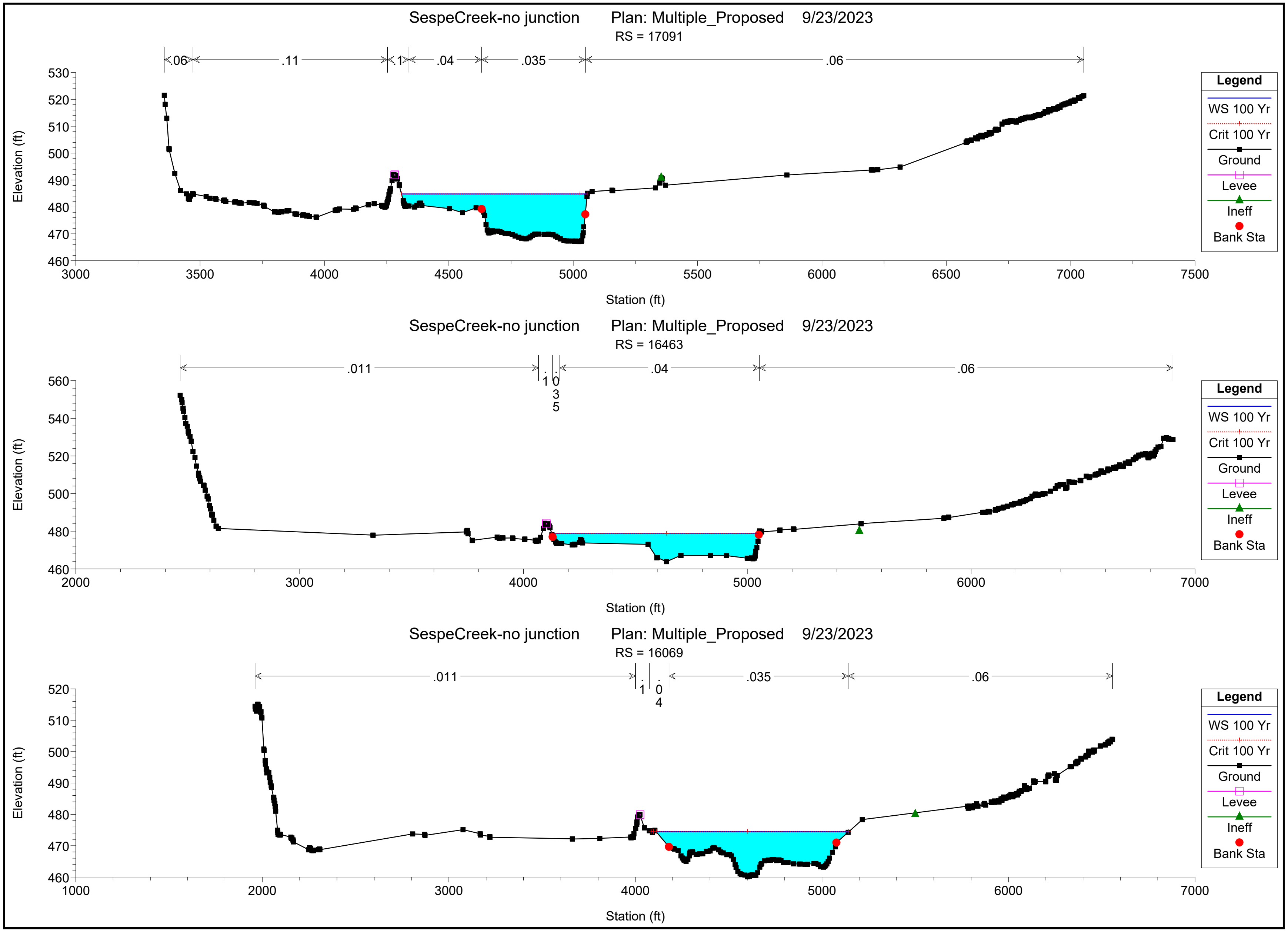

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 21055
.05
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 20433
.06
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 19991
.06
.06
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta



SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 19675
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 19191
.055
.035
.06
.04
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 18647
.055
.035
.06
Ineff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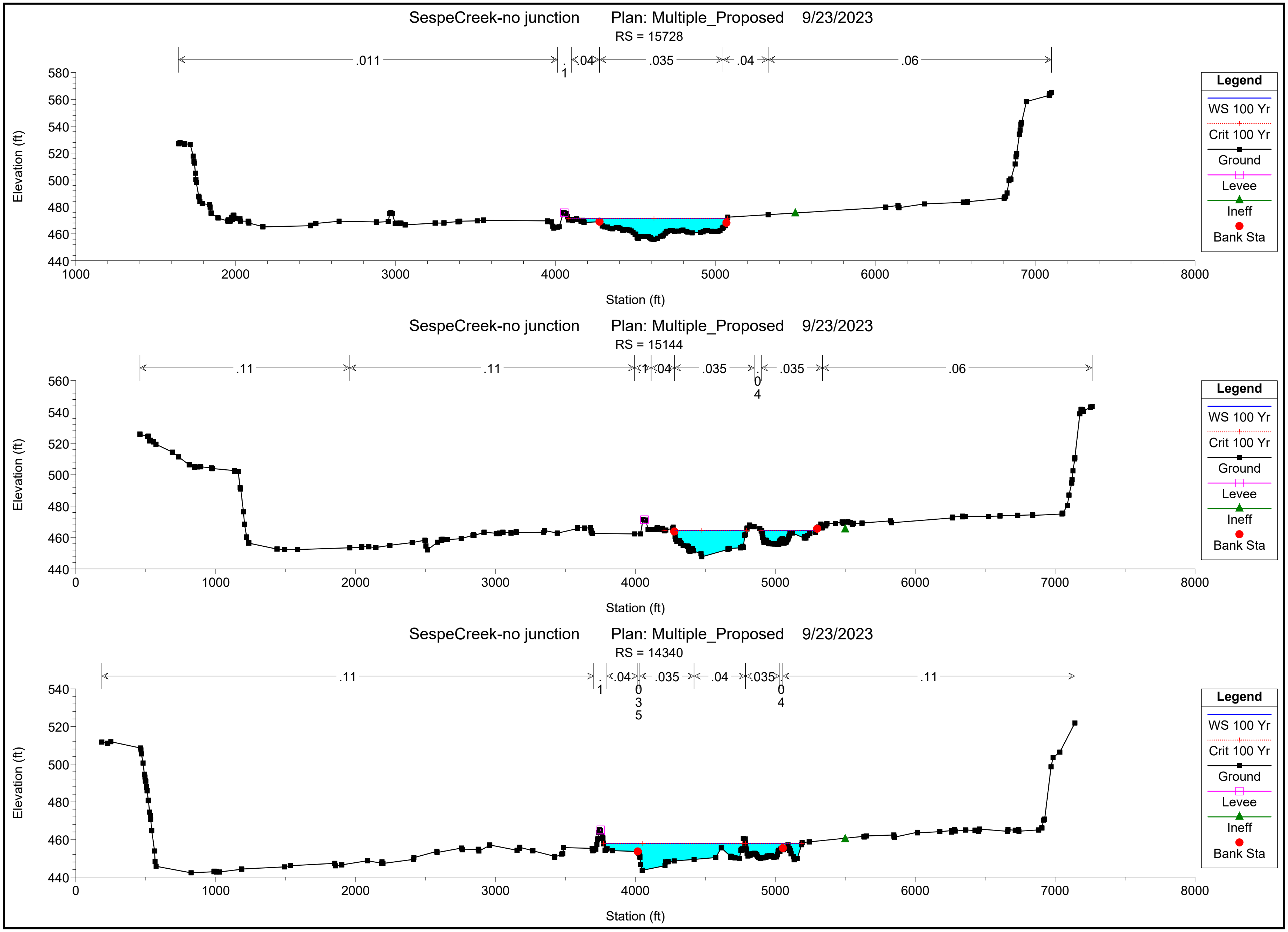
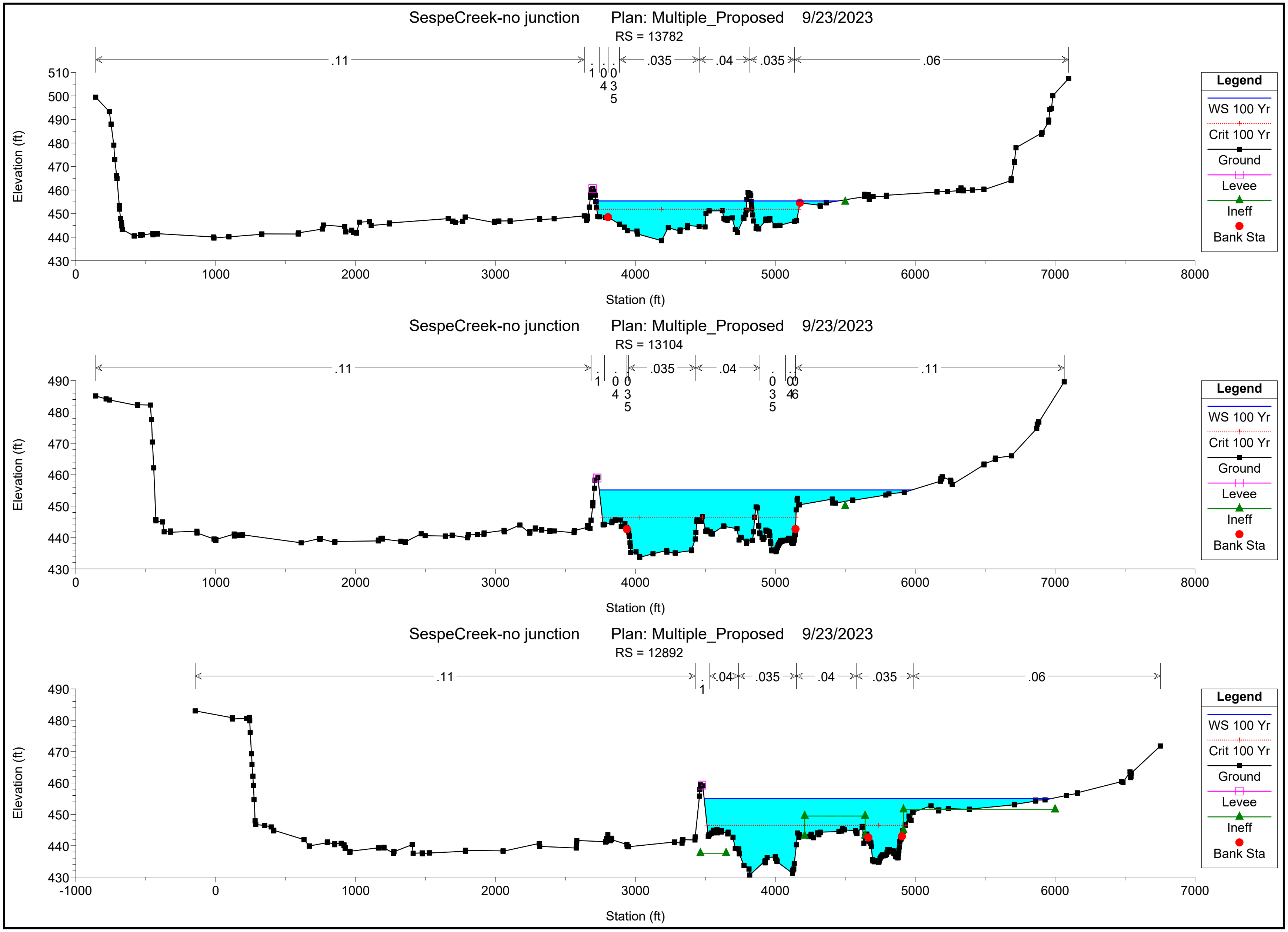
RS = 17091
.06
.11
.1
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 16463
.011
.1
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 16069
.011
.1
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 15728
.011
.04
.035
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 15144
.11
.11
.04
.035
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 14340
.11
.04
.035
.04
.035
.11
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta



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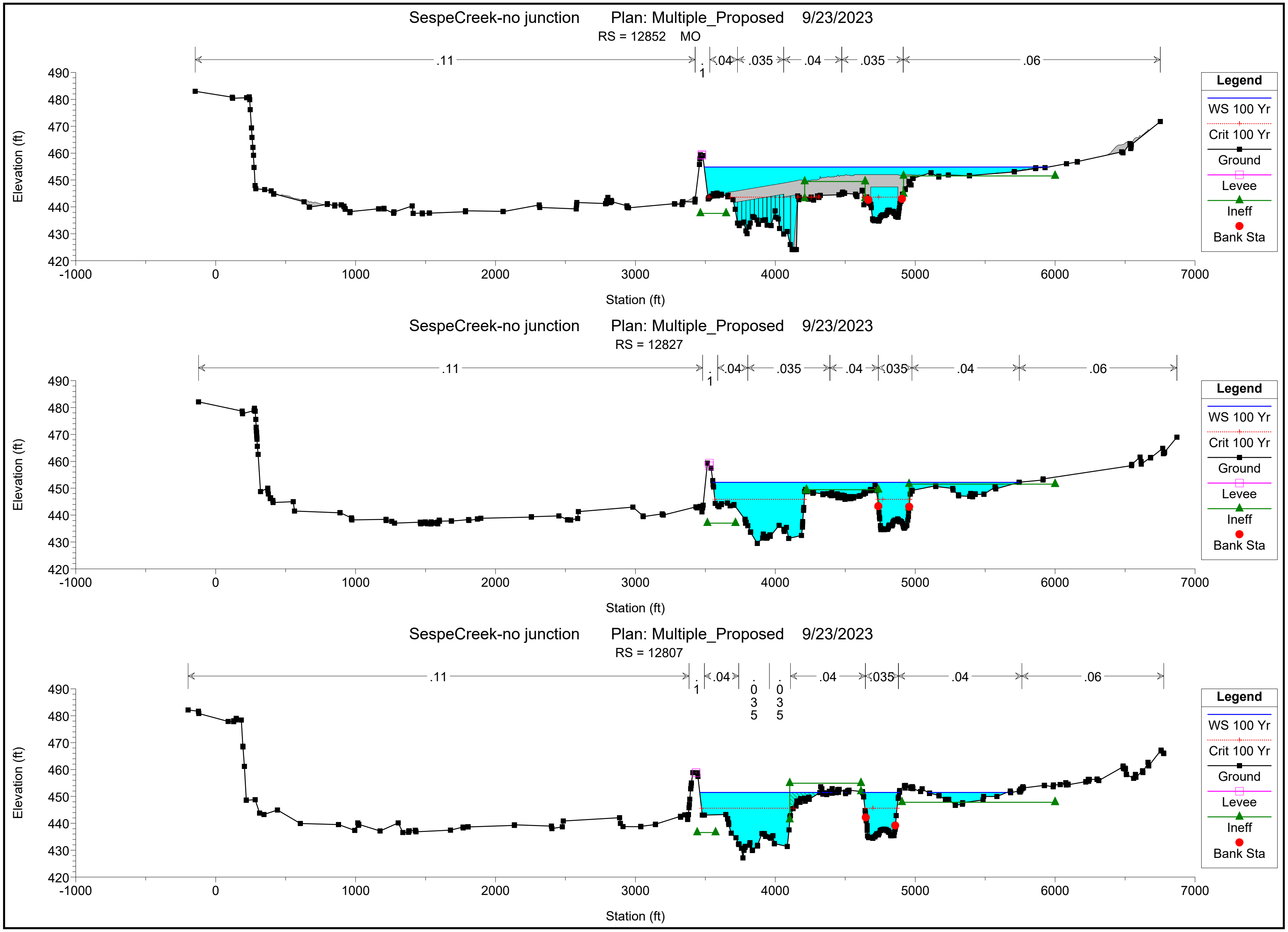
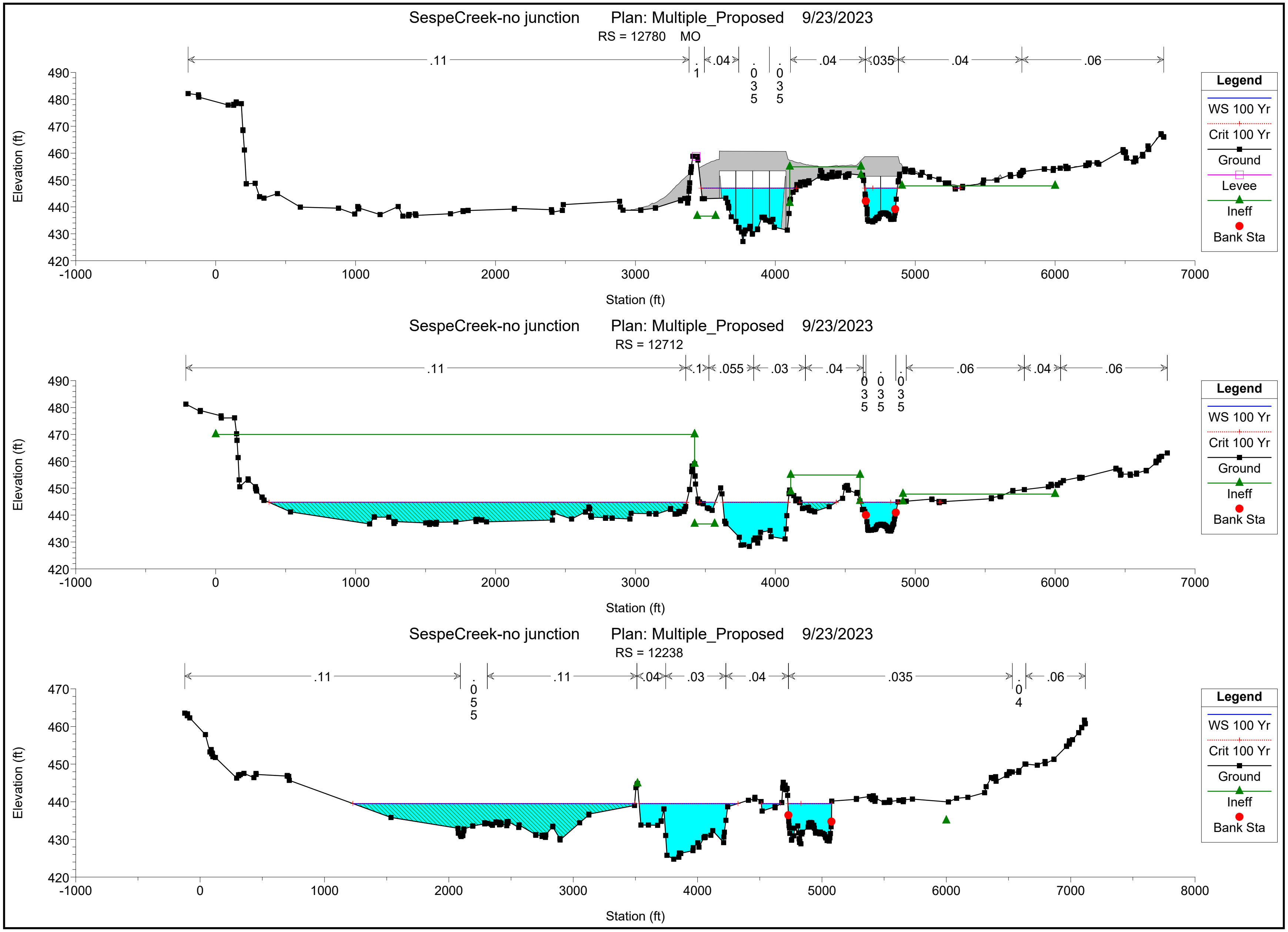
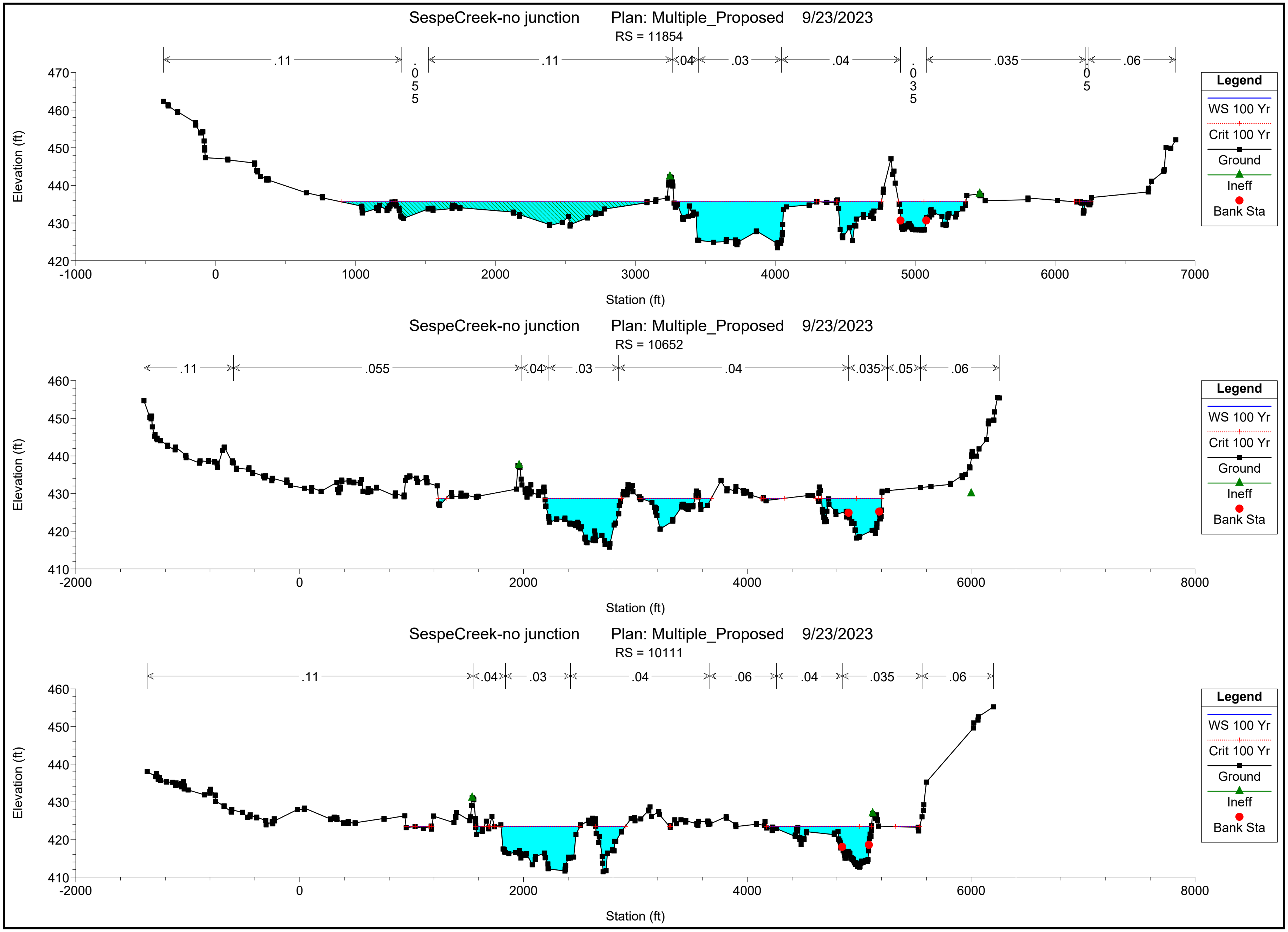
.11
.035
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 13104
.11
.035
.04
.11
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12892
.11
.04
.035
.04
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12852 MO
.11
.04
.035
.04
.035
.06
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
Station (ft)
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12827
.11
.04
.035
.04
.035
.04
.06
Elevation (ft)
Station (ft)
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12807
.11
.04
.04
.035
.04
.06
Elevation (ft)
Station (ft)



SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12780 MO
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Levee
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12712
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 12238
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta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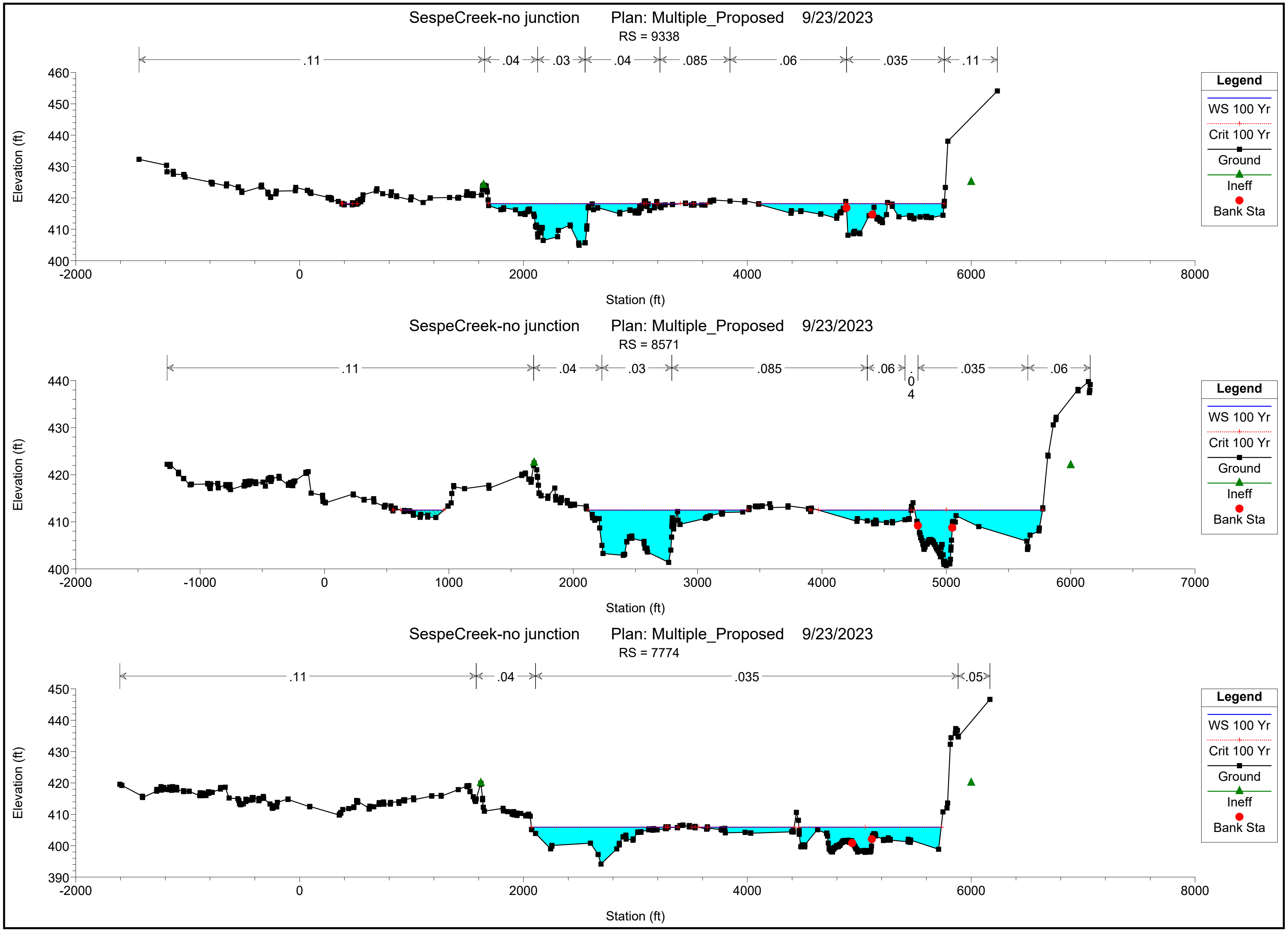
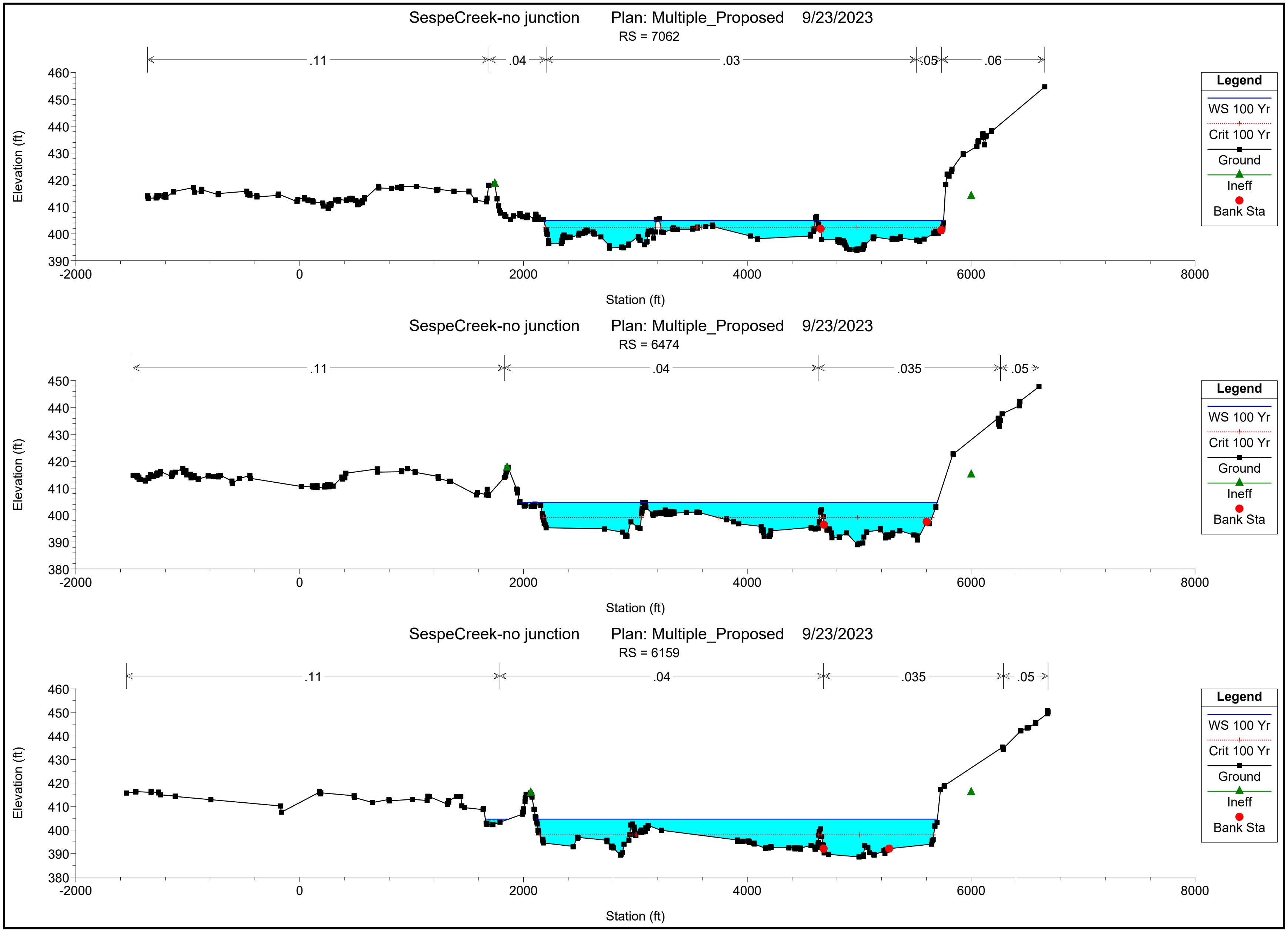
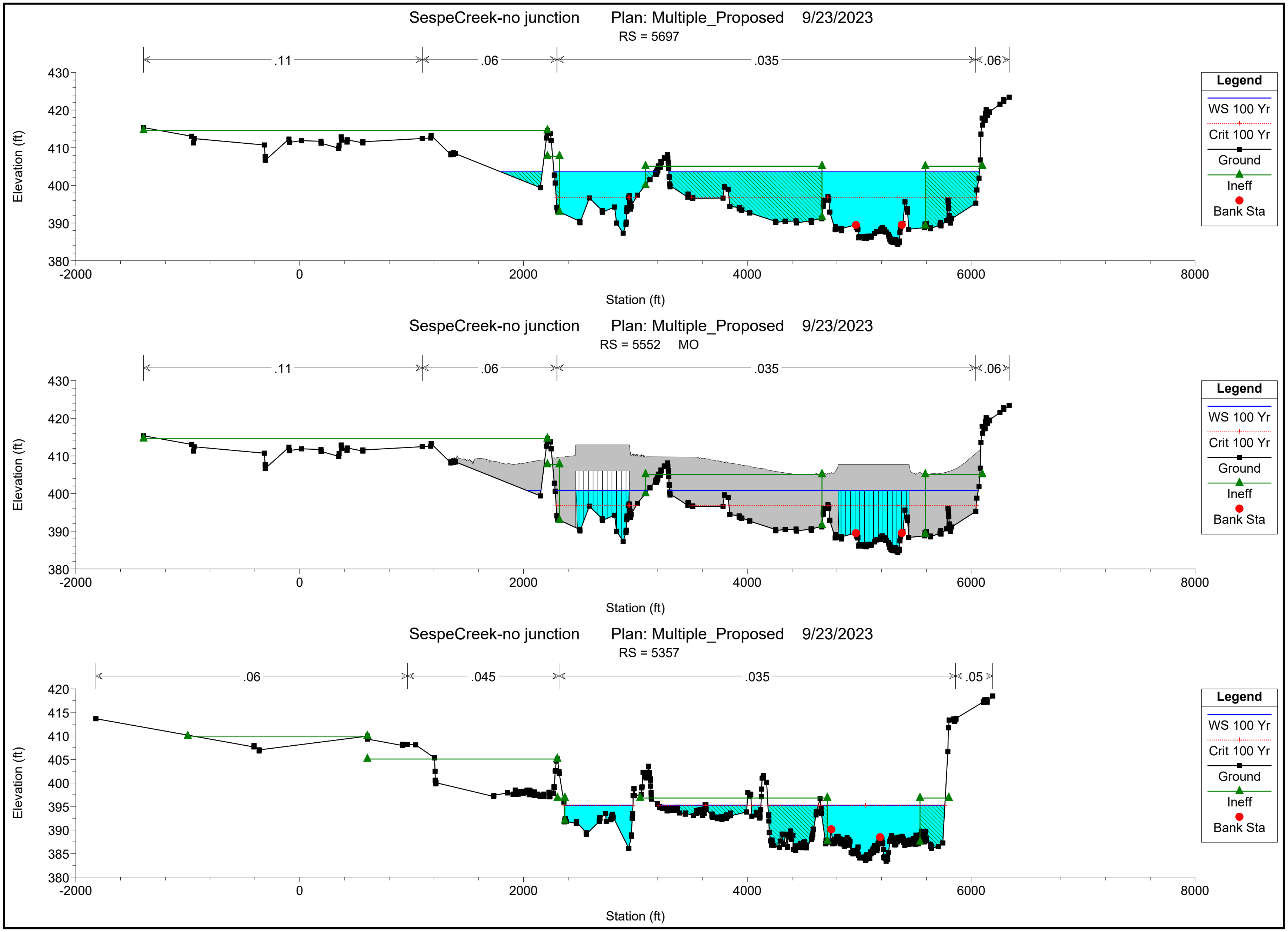
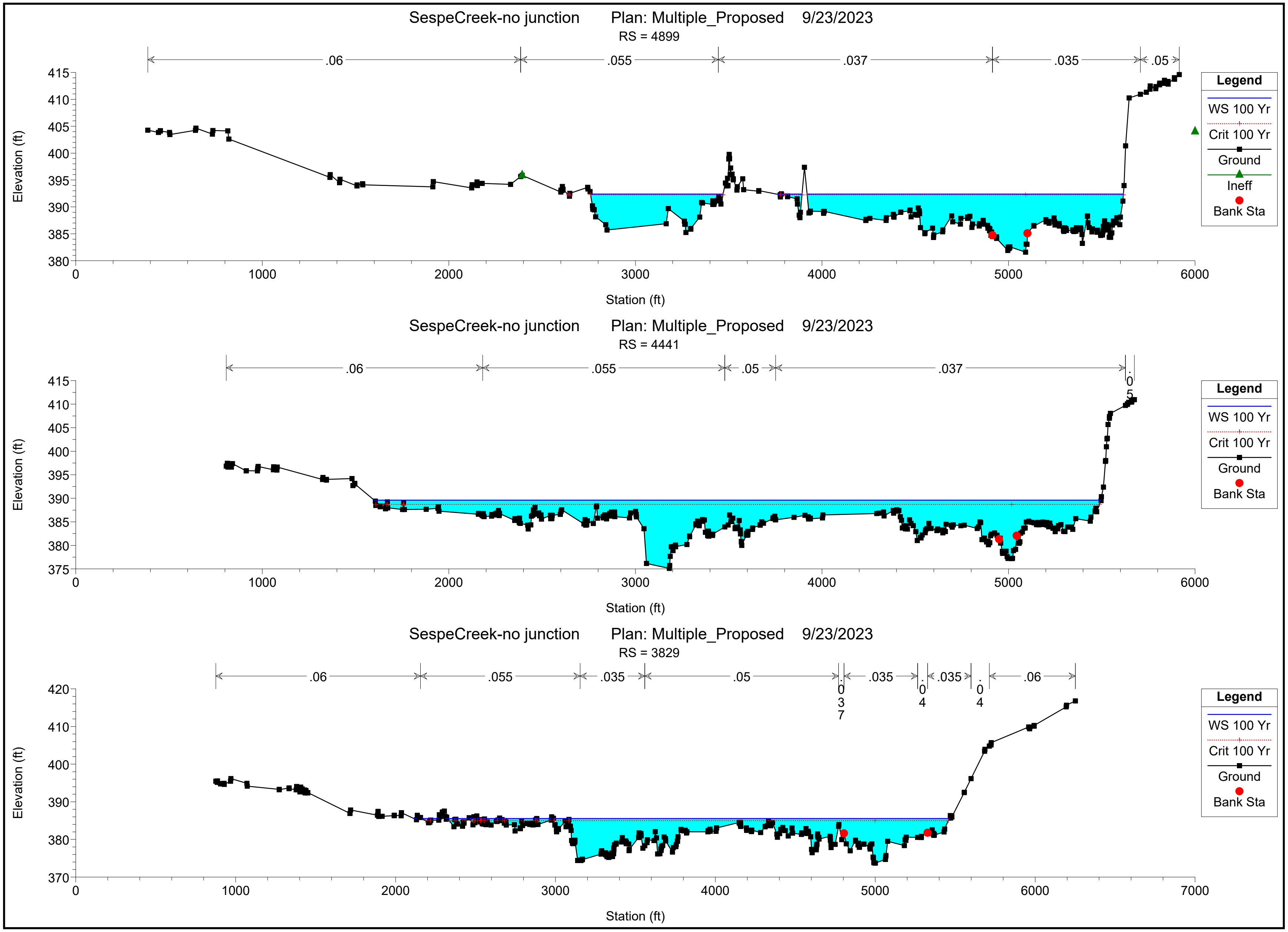
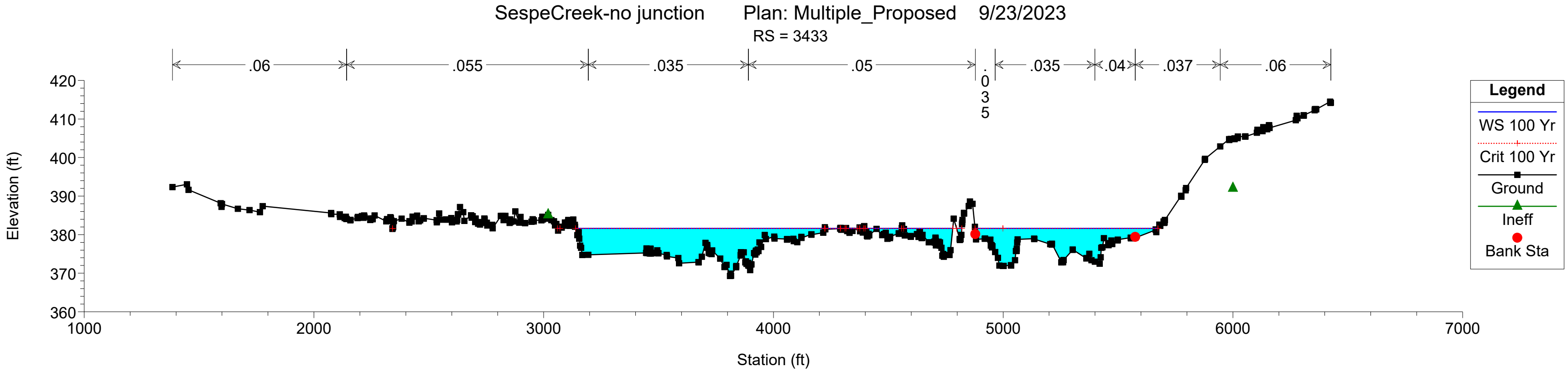
RS = 11854
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 10652
Elevation (ft)
Station (ft)
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 10111
Elevation (ft)
Station (ft)

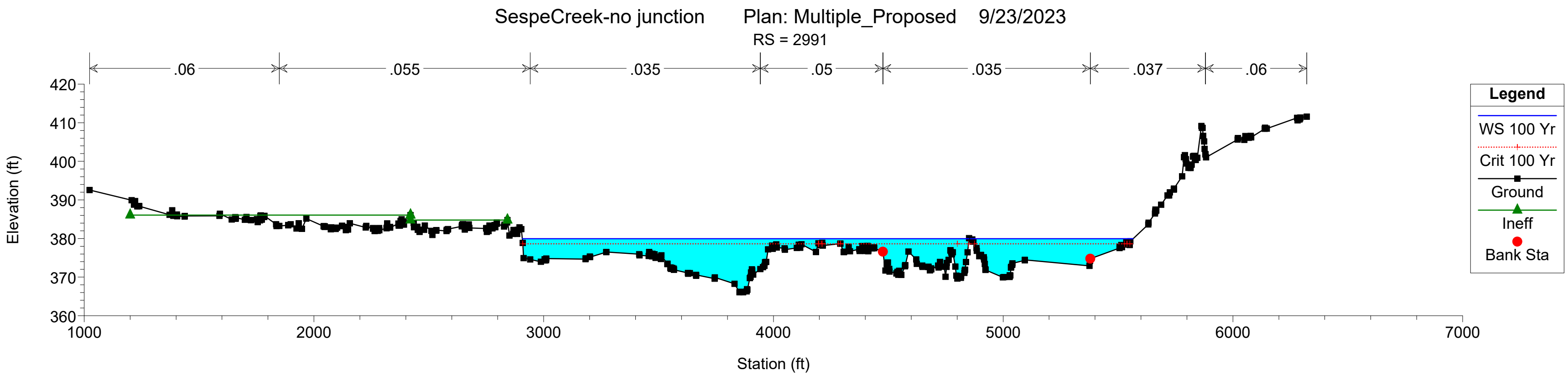

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 9338
.11 .04 .03 .04 .085 .06 .035 .11
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 8571
.11 .04 .03 .085 .06 0 4 .035 .06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 7774
.11 .04 .035 .05
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta

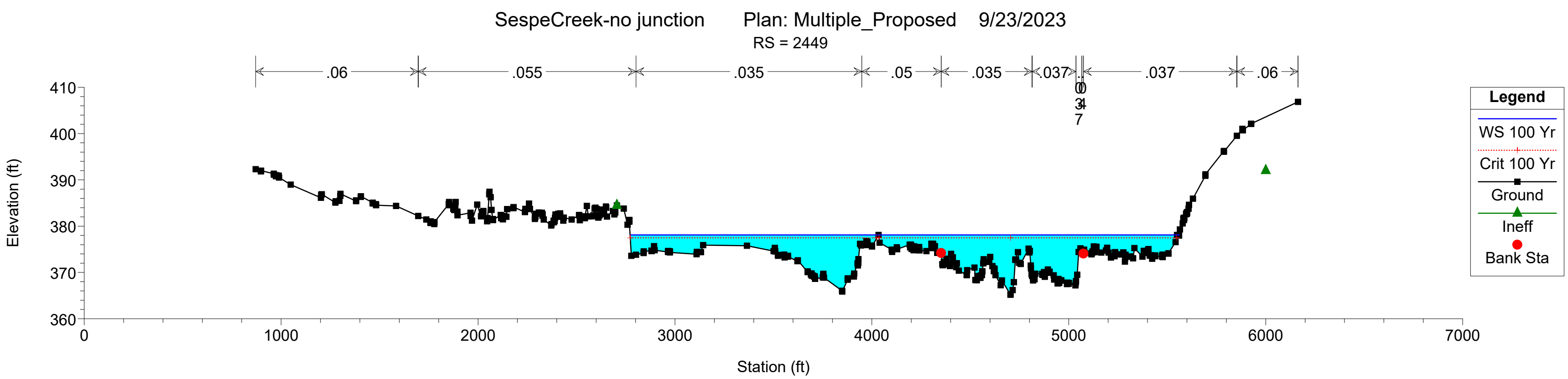

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 7062
.11
.04
.03
.05
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 6474
.11
.04
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 6159
.11
.04
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta

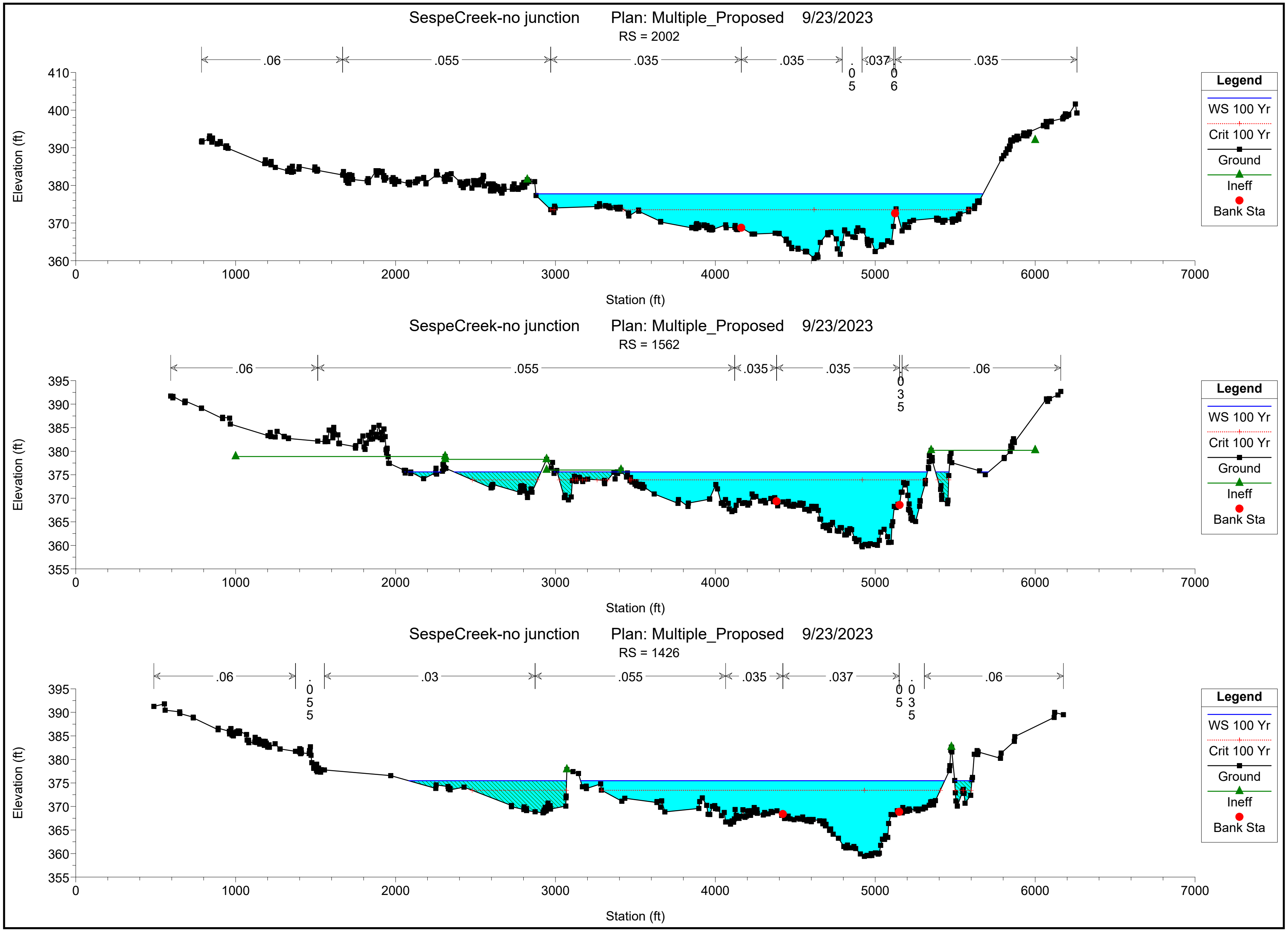

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 5697
.11
.06
.035
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 5552 MO
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 5357
.06
.045
.035
.05


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 4899
.06 .055 .037 .035 .05
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 4441
.06 .055 .05 .037
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 3829
.06 .055 .035 .05 .035 .035 .06
Legend
WS 100 Yr
Crit 100 Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

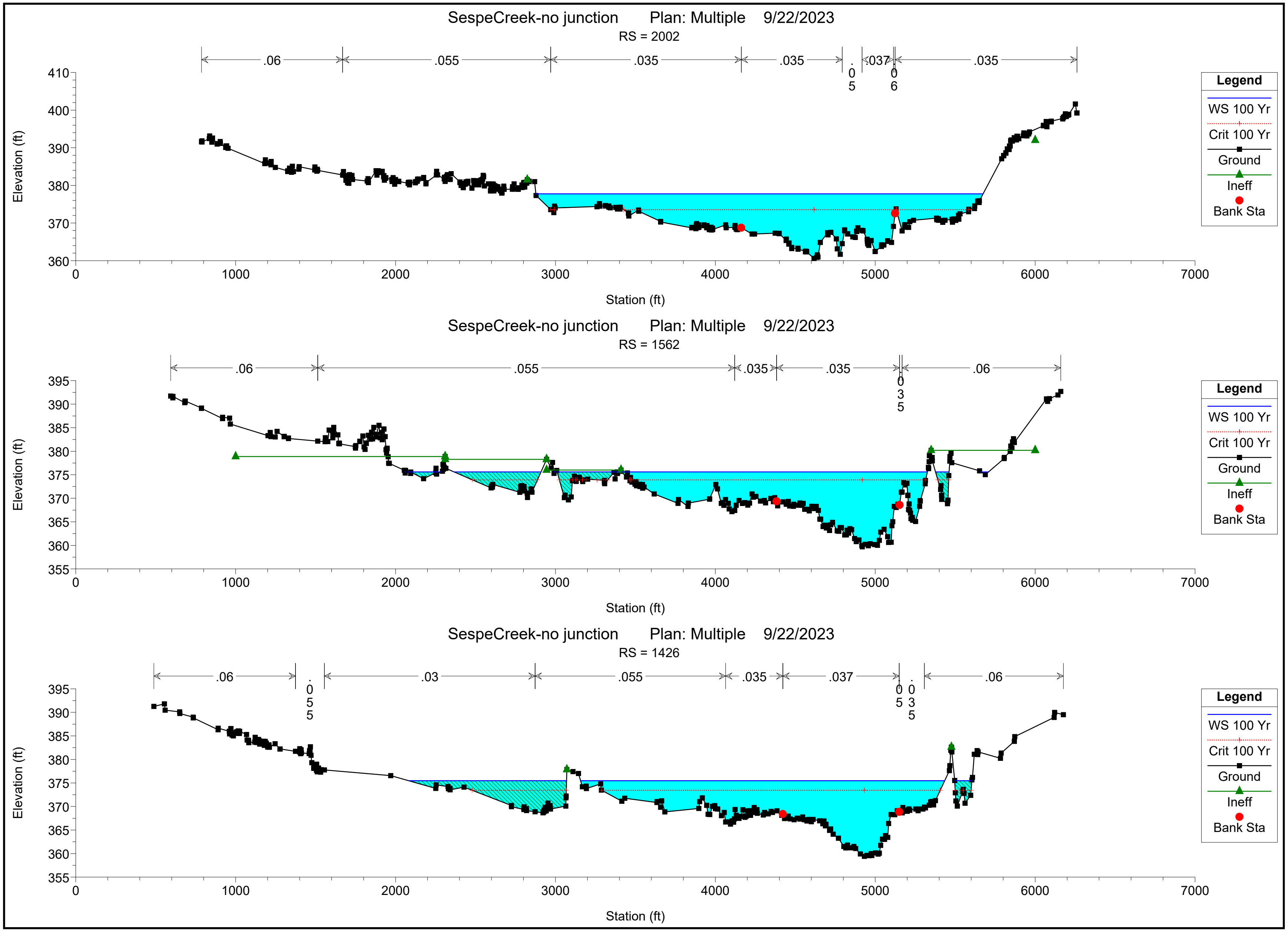

SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 3433
.06
.055
.035
.05
.035
.035
.04
.037
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 2991
.06
.055
.035
.05
.035
.037
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta


SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 2449
.06
.055
.035
.05
.035
.037
.037
.06
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta



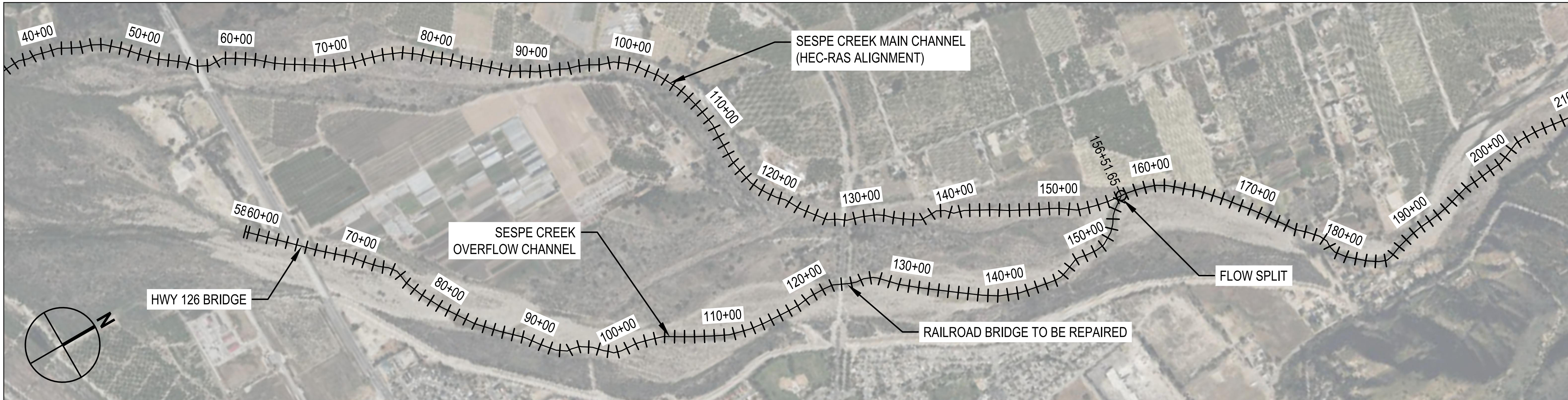
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 2002
.06
.055
.035
.035
.037
.035
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 1562
.06
.055
.035
.035
.06
SespeCreek-no junction Plan: Multiple_Proposed 9/23/2023
RS = 1426
.06
.03
.055
.035
.037
.06



SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 2002
.06
.055
.035
.035
.037
Elevation (ft)
Station (ft)
Legend
WS 100 Yr
Crit 100 Yr
Ground
Ineff
Bank Sta
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 1562
.06
.055
.035
.035
.06
SespeCreek-no junction Plan: Multiple 9/22/2023
RS = 1426
.06
.03
.055
.035
.037
.06

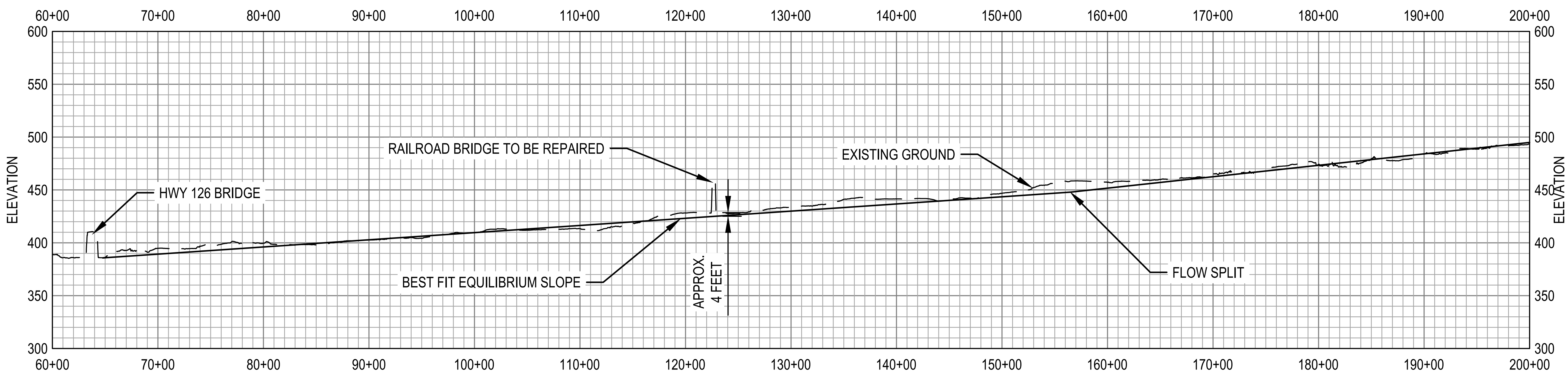
# Attachment 4

## Bridge Scour Calculations




1 **PLAN VIEW**

1" = 1,000'




2 **PROFILE VIEW**

H: 1" = 1,000'; V: 1" = 100'

NOTE: THE EXISTING GROUND PROFILE WAS DEVELOPED USING A SURFACE CREATED FROM THE 2018 USGS LIDAR: SOUTHERN CA WILDFIRES DATA SET.

0 1,000' 2,000'

GHD

RAILPROS
SESPE CREEK OVERFLOW RAILROAD BRIDGE

CHANNEL PROFILE FOR
LONG-TERM DEGRADATION ESTIMATION

Project No. 12611830
Date 10/16/23

**ATTACHMENT 4A**

Filename: \\ghdnet\ghd\US\Roseville\Projects\561\12611830\Digital_Design\ACAD\Figures\12611830-FIG-CHANNEL PROFILE.dwg
Plot Date: 16 October 2023 1:56 PM

Data Source

## Live-Bed vs Clear-Water Scour Determination

**Project Name:** Sespe Creek Bridge
**Project No.:** 12611830
**Updated:** 9/25/2023
**Calc By:** STS

The following calculations are based on the methods presented in FHWA HEC No. 18, Fifth Edition for calculating critical velocity.

To determine if the flow upstream of the bridge is transporting bed material, calculate the critical velocity for beginning of motion $V_c$ of the $D_{50}$ size of the bed material being considered for movement and compare it with the mean velocity V of the flow in the main channel or overbank area upstream of the bridge opening. If the critical velocity of the bed material is larger than the mean velocity ($V_c > V$), then clear-water contraction scour will exist. If the critical velocity is less than the mean velocity ($V_c < V$), then live-bed contraction scour will exist. To calculate the critical velocity use the equation derived in the Appendix C. This equation is:

$$V_c = K_u\, y^{1/6}\, D^{1/3} \qquad (6.1)$$

where:

- $V_c$ = Critical velocity above which bed material of size D and smaller will be transported, ft/s (m/s)
- y = Average depth of flow upstream of the bridge, ft (m)
- D = Particle size for $V_c$, ft (m)
- $D_{50}$ = Particle size in a mixture of which 50 percent are smaller, ft (m)
- $K_u$ = 6.19 SI units
- $K_u$ = 11.17 English units

**Critical Velocity Calculation**

Input Parameters

Ku: 11.17
$D_{50}$: 0.0167 ft (5.1 mm)

| Flow Scenario | Flow* (cfs) | Avg. Flow Depth*, y (ft) | Critical Velocity, $V_c$ (ft/s) | Channel Velocity*, V (ft/s) | Contraction Scour Type |
|---|---|---|---|---|---|
| 100-yr Sespe Creek Overflow | 88,957 | 16.25 | 4.55 | 8.81 | Live-Bed |

*Channel Flow, Velocity and Avg. Flow Depth are from HEC-RAS output.

# HEC-RAS Hydraulic Design Function Scour Calculations

**Contraction Scour**

| | Left | Channel | Right |
|---|---|---|---|
| Input Data | | | |
| Average Depth (ft): | 8.16 | 16.25 | 11.09 |
| Approach Velocity (ft/s): | 4.27 | 8.81 | 5.23 |
| Br Average Depth (ft): | 8.44 | 15.04 | 0.99 |
| BR Opening Flow (cfs): | | 93840.61 | 3171.73 |
| BR Top WD (ft): | 167.73 | 497.10 | 422.78 |
| Grain Size D50 (mm): | 5.10 | 5.10 | 5.10 |
| Approach Flow (cfs): | 3954.72 | 88957.41 | 4043.09 |
| Approach Top WD (ft): | 113.59 | 620.90 | 69.70 |
| K1 Coefficient: | 0.590 | 0.640 | 0.590 |
| Results | | | |
| Scour Depth Ys (ft): | | 4.57 | 2.12 |
| Critical Velocity (ft/s): | 8.79 | 4.56 | 4.28 |
| Equation: | | Live | Live |

**Pier: #2 (CL = 4109)**

| | |
|---|---|
| Input Data | |
| Pier Shape: | Round nose |
| Pier Width (ft): | 5.00 |
| Grain Size D50 (mm): | 5.10000 |
| Depth Upstream (ft): | 24.52 |
| Velocity Upstream (ft/s): | 9.24 |
| K1 Nose Shape: | 1.00 |
| Pier Angle: | 0.00 |
| Pier Length (ft): | 19.50 |
| K2 Angle Coef: | 1.00 |
| K3 Bed Cond Coef: | 1.10 |
| Grain Size D90 (mm): | |
| K4 Armouring Coef: | 1.00 |
| Results | |
| Scour Depth Ys (ft): | 11.89 (without debris) |
| Froude #: | 0.33 |
| Equation: | CSU equation |

**Pier: #3 (CL = 4060)**

| | |
|---|---|
| Input Data | |
| Pier Shape: | Round nose |
| Pier Width (ft): | 5.00 |
| Grain Size D50 (mm): | 5.10000 |
| Depth Upstream (ft): | 24.52 |
| Velocity Upstream (ft/s): | 9.24 |
| K1 Nose Shape: | 1.00 |
| Pier Angle: | 0.00 |
| Pier Length (ft): | 19.50 |
| K2 Angle Coef: | 1.00 |
| K3 Bed Cond Coef: | 1.10 |
| Grain Size D90 (mm): | |
| K4 Armouring Coef: | 1.00 |
| Results | |
| Scour Depth Ys (ft): | 11.89 (without debris) |
| Froude #: | 0.33 |
| Equation: | CSU equation |

**Abutment #1 Scour**

Input Data

| | |
|---|---|
| Station at Toe (ft): | 4158.00 |
| Toe Sta at appr (ft): | 4477.90 |
| Abutment Length (ft): | 52.95 |
| Depth at Toe (ft): | 13.00 |
| K1 Shape Coef: | 0.82 - Vert. with wing walls |
| Degree of Skew (degrees): | 90.00 |
| K2 Skew Coef: | 1.00 |
| Projected Length L' (ft): | 52.95 |
| Avg Depth Obstructed Ya (ft): | 7.00 |
| Flow Obstructed Qe (cfs): | 4217.99 |
| Area Obstructed Ae (sq ft): | 795.29 |

Results

| | |
|---|---|
| Scour Depth Ys (ft): | 23.49 |
| Qe/Ae = Ve: | 5.30 |
| Froude #: | 0.35 |
| Equation: | Froehlich |

## Pier Scour - Effective Pier Width with Debris

**Project Name:** Sespe Creek Bridge
**Project No.:** 12611830
**Updated:** 10/17/2023
**Calc By:** STS

The following calculations are based on the methods presented in FHWA HEC No. 18, Fifth Edition for calculating the effective pier width with debris.

Equation 7.32 (HEC-18 Equation):

$$a^*_d = \frac{K_1(HW) + (y - K_1H)a}{y} \qquad (7.32)$$

where:

| | | |
|---|---|---|
| $a^*_d$ | = | Effective width of pier when debris is present, ft (m) |
| a | = | Width of pier perpendicular to flow, ft (m) |
| $K_1$ | = | 0.79 for rectangular debris, 0.21 for triangular debris |
| H | = | Height (thickness) of the debris, ft (m) |
| W | = | Width of debris perpendicular to the flow direction, ft (m) |
| y | = | Depth of approach flow, ft (m) |

| | | |
|---|---|---|
| a: | 5.00 | ft |
| $K_1$: | 0.79 | |
| H: | 6.00 | ft (assumed from 5/8/23 Bridge Inspection Report) |
| W: | 12.00 | ft (assumed from 5/8/23 Bridge Inspection Report) |
| y: | 12.22 | ft (from HEC-RAS model) |
| $a^*_d$: | 7.72 | ft |

## Pier Scour - Pier 2

**Project Name:** Sespe Creek Bridge
**Project No.:** 12611830
**Updated:** 10/17/2023
**Calc By:** STS

The following calculations are based on the methods presented in FHWA HEC No. 18, Fifth Edition for calculating pier scour.

Location: Pier 2

Equation 7.1 (HEC-18 Equation):

$$\frac{y_s}{y_1} = 2.0\ K_1\ K_2\ K_3 \left(\frac{a}{y_1}\right)^{0.65} Fr_1^{0.43}$$

As a Rule of Thumb, the maximum scour depth for round nose piers aligned with the flow is:

$y_s \leq 2.4$ times the pier width (a) for $Fr \leq 0.8$ (7.2)
$y_s \leq 3.0$ times the pier width (a) for $Fr > 0.8$

where:

$y_s$ = Scour depth, ft (m)
$y_1$ = Flow depth directly upstream of the pier, ft (m)
$K_1$ = Correction factor for pier nose shape from Figure 7.3 and Table 7.1
$K_2$ = Correction factor for angle of attack of flow from Table 7.2 or Equation 7.4
$K_3$ = Correction factor for bed condition from Table 7.3
a = Pier width, ft (m)
L = Length of pier, ft (m)
$Fr_1$ = Froude Number directly upstream of the pier = $V_1/(gy_1)^{1/2}$
$V_1$ = Mean velocity of flow directly upstream of the pier, ft/s (m/s)
g = Acceleration of gravity (32.2 ft/s$^2$) (9.81 m/s$^2$)

Shape: Round Nose
$y_1$: 24.52 ft
$K_1$: 1.0
$K_2$: 1.0
$K_3$: 1.1
a: 7.72 ft (using effective pier width with debris accumulation)
L: 19.5 ft
$Fr_1$: 0.33
$V_1$: 9.2 ft/s
g: 32.2 ft/s$^2$
θ: 0 degrees

**Scour Depth $y_s$: 15.8 ft**

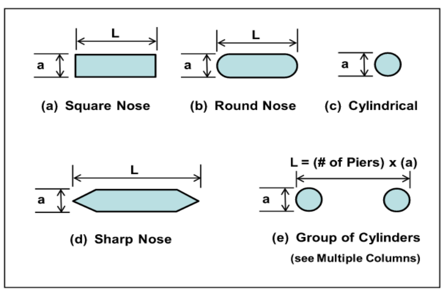



Figure 7.3. Common pier shapes.

Equation 7.4:

$$K_2 = (\cos\theta + \frac{L}{a}\sin\theta)^{0.65}$$

If L/a is larger than 12, use L/a = 12 as a maximum in Equation 7.4 and Table 7.2. Table 7.2 illustrates the magnitude of the effect of the angle of attack on local pier scour.

Table 7.1. Correction Factor, $K_1$, for Pier Nose Shape.

| Shape of Pier Nose | $K_1$ |
|---|---|
| (a) Square nose | 1.1 |
| (b) Round nose | 1.0 |
| (c) Circular cylinder | 1.0 |
| (d) Group of cylinders | 1.0 |
| (e) Sharp nose | 0.9 |

Table 7.2. Correction Factor, $K_2$, for Angle of Attack, 2, of the Flow.

| Angle | L/a=4 | L/a=8 | L/a=12 |
|---|---|---|---|
| 0 | 1.0 | 1.0 | 1.0 |
| 15 | 1.5 | 2.0 | 2.5 |
| 30 | 2.0 | 2.75 | 3.5 |
| 45 | 2.3 | 3.3 | 4.3 |
| 90 | 2.5 | 3.9 | 5.0 |

Angle = skew angle of flow
L = length of pier

Table 7.3. Increase in Equilibrium Pier Scour Depths, $K_3$, for Bed Condition.

| Bed Condition | Dune Height ft | $K_3$ |
|---|---|---|
| Clear-Water Scour | N/A | 1.1 |
| Plane bed and Antidune flow | N/A | 1.1 |
| Small Dunes | $10 > H \geq 2$ | 1.1 |
| Medium Dunes | $30 > H \geq 10$ | 1.2 to 1.1 |
| Large Dunes | $H \geq 30$ | 1.3 |

## Pier Scour - Pier 3

**Project Name:** Sespe Creek Bridge
**Project No.:** 12611830
**Updated:** 10/17/2023
**Calc By:** STS

The following calculations are based on the methods presented in FHWA HEC No. 18, Fifth Edition for calculating pier scour.

Location: Pier 3

Equation 7.1 (HEC-18 Equation):

$$\frac{y_s}{y_1} = 2.0\ K_1\ K_2\ K_3 \left(\frac{a}{y_1}\right)^{0.65} Fr_1^{0.43}$$

As a Rule of Thumb, the maximum scour depth for round nose piers aligned with the flow is:

$y_s \leq 2.4$ times the pier width (a) for $Fr \leq 0.8$ (7.2)
$y_s \leq 3.0$ times the pier width (a) for $Fr > 0.8$

where:

- $y_s$ = Scour depth, ft (m)
- $y_1$ = Flow depth directly upstream of the pier, ft (m)
- $K_1$ = Correction factor for pier nose shape from Figure 7.3 and Table 7.1
- $K_2$ = Correction factor for angle of attack of flow from Table 7.2 or Equation 7.4
- $K_3$ = Correction factor for bed condition from Table 7.3
- a = Pier width, ft (m)
- L = Length of pier, ft (m)
- $Fr_1$ = Froude Number directly upstream of the pier = $V_1/(gy_1)^{1/2}$
- $V_1$ = Mean velocity of flow directly upstream of the pier, ft/s (m/s)
- g = Acceleration of gravity (32.2 ft/s$^2$) (9.81 m/s$^2$)

Shape: Round Nose
$y_1$: 24.52 ft
$K_1$: 1.0
$K_2$: 1.0
$K_3$: 1.1
a: 7.72 ft (using effective pier width with debris accumulation)
L: 19.5 ft
$Fr_1$: 0.33
$V_1$: 9.2 ft/s
g: 32.2 ft/s$^2$
θ: 0 degrees

**Scour Depth $y_s$: 15.8 ft**

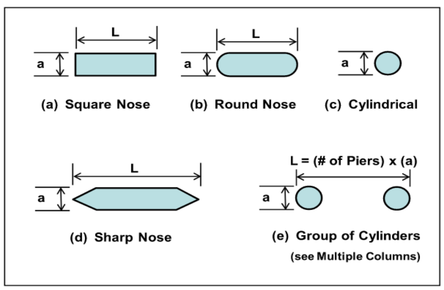



Figure 7.3. Common pier shapes.

Equation 7.4:

$$K_2 = \left(\cos\theta + \frac{L}{a}\sin\theta\right)^{0.65}$$

If L/a is larger than 12, use L/a = 12 as a maximum in Equation 7.4 and Table 7.2. Table 7.2 illustrates the magnitude of the effect of the angle of attack on local pier scour.

Table 7.1. Correction Factor, $K_1$, for Pier Nose Shape.

| Shape of Pier Nose | $K_1$ |
|---|---|
| (a) Square nose | 1.1 |
| (b) Round nose | 1.0 |
| (c) Circular cylinder | 1.0 |
| (d) Group of cylinders | 1.0 |
| (e) Sharp nose | 0.9 |

Table 7.2. Correction Factor, $K_2$, for Angle of Attack, 2, of the Flow.

| Angle | L/a=4 | L/a=8 | L/a=12 |
|---|---|---|---|
| 0 | 1.0 | 1.0 | 1.0 |
| 15 | 1.5 | 2.0 | 2.5 |
| 30 | 2.0 | 2.75 | 3.5 |
| 45 | 2.3 | 3.3 | 4.3 |
| 90 | 2.5 | 3.9 | 5.0 |

Angle = skew angle of flow
L = length of pier

Table 7.3. Increase in Equilibrium Pier Scour Depths, $K_3$, for Bed Condition.

| Bed Condition | Dune Height ft | $K_3$ |
|---|---|---|
| Clear-Water Scour | N/A | 1.1 |
| Plane bed and Antidune flow | N/A | 1.1 |
| Small Dunes | $10 > H \geq 2$ | 1.1 |
| Medium Dunes | $30 > H \geq 10$ | 1.2 to 1.1 |
| Large Dunes | $H \geq 30$ | 1.3 |

# Attachment 5

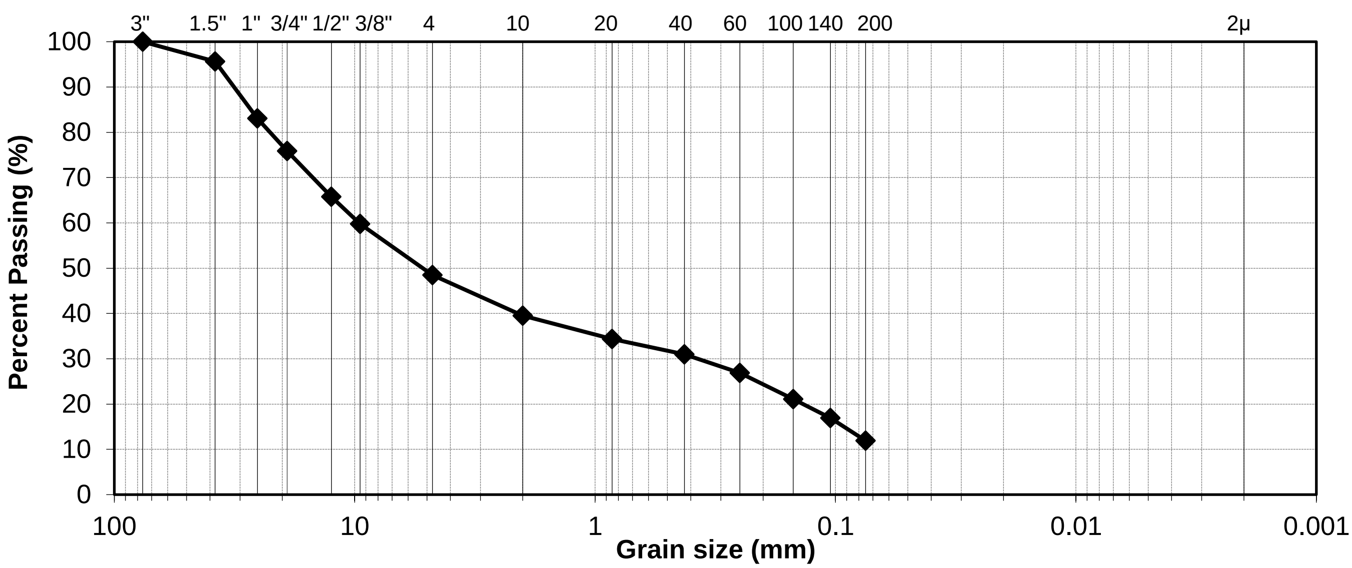
## Geotechnical Data

# PARTICLE-SIZE ANALYSIS OF SOILS
## ASTM D6913

| | | | |
|---|---|---|---|
| *Client:* | Diaz Yourman | *HAI Project No.:* | DYAL-23-008-2 |
| *Project Name:* | VCTC Sespe Creek Bridge | *Tested by:* | GA |
| *Project No.:* | 2023-010 | *Checked by:* | KL |
| *Boring No.:* | DYB23-01 | *Date:* | 08/01/23 |
| *Sample No.:* | 0 | | |
| *Depth (ft):* | 0-5 | | |
| *Sample Description:* | Light Brown, Poorly Graded Gravel with Silt and Sand (GP-GM) | | |

**Dry Weight (g)** **16097.7**

| Sieve Size | Aperture | Weight Retained | % Retained | **(Accumulative) % Passing** | **Project Specification** |
|---|---|---|---|---|---|
| | mm | g | % | **%** | **%** |
| 3" | 76.2 | 0.00 | 0.0 | **100.0** | **-** |
| 1.5" | 38.1 | 700.01 | 4.3 | **95.7** | **-** |
| 1" | 25.4 | 2018.62 | 12.5 | **83.1** | **-** |
| 3/4 " | 19.1 | 1166.06 | 7.2 | **75.9** | **-** |
| 1/2 " | 12.5 | 1619.76 | 10.1 | **65.8** | **-** |
| 3/8 " | 9.5 | 972.52 | 6.0 | **59.8** | **-** |
| # 4 | 4.75 | 1817.43 | 11.3 | **48.5** | **-** |
| **Dry Weight (g)** | **680.2** | | | | |
| # 10 | 2.00 | 125.72 | 18.5 | **39.5** | **-** |
| # 20 | 0.85 | 71.79 | 10.6 | **34.4** | **-** |
| # 40 | 0.425 | 48.28 | 7.1 | **31.0** | **-** |
| # 60 | 0.250 | 57.25 | 8.4 | **26.9** | **-** |
| # 100 | 0.150 | 81.18 | 11.9 | **21.1** | **-** |
| # 140 | 0.105 | 58.54 | 8.6 | **16.9** | **-** |
| # 200 | 0.075 | 70.41 | 10.4 | **11.9** | **-** |
| **Pan** | | 167.06 | 24.6 | **0.0** | **-** |



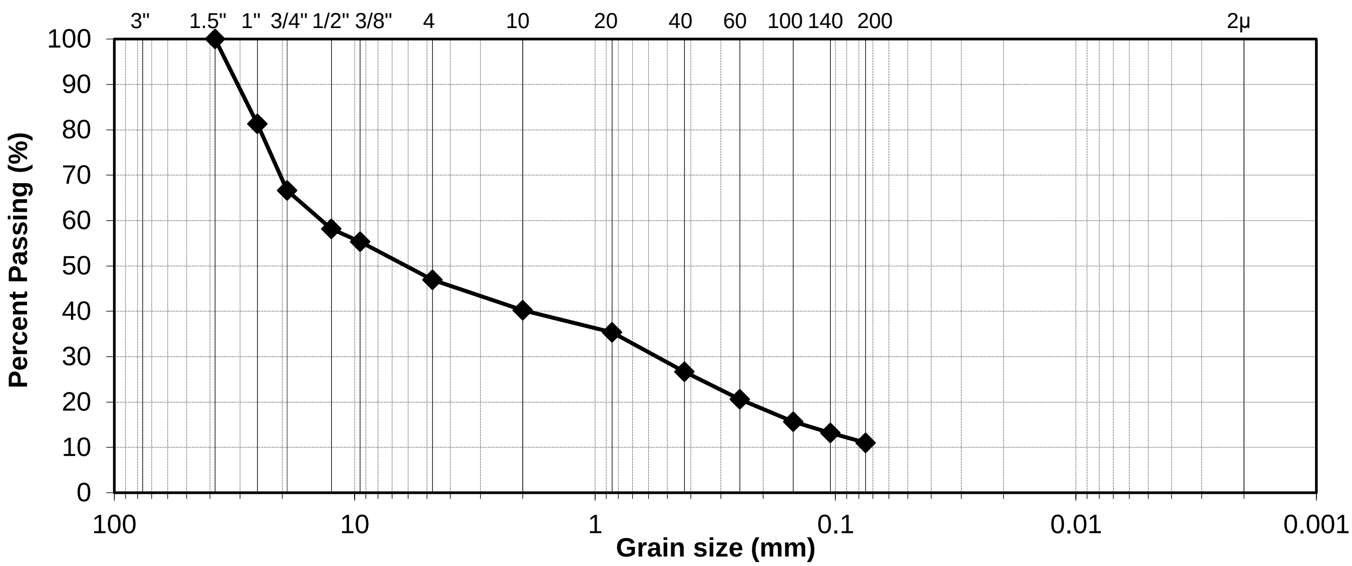

| Particle-Size Analysis | | | | | |
|---|---|---|---|---|---|
| | $D_{10}$ | 0.07 | % Gravel | % Sand | % Fines |
| | $D_{30}$ | 0.38 | 51.5 | 36.6 | 11.9 |
| | $D_{60}$ | 9.62 | Sample Description / USCS Classification | | |
| | $C_u$ | 137.38 | Light Brown, Poorly Graded Gravel with Silt and Sand (GP-GM) | | |
| | $C_c$ | 0.22 | | | |

# PARTICLE-SIZE ANALYSIS OF SOILS
## ASTM D6913

| | | | |
|---|---|---|---|
| *Client:* | Diaz Yourman | *HAI Project No.:* | DYAL-23-008-2 |
| *Project Name:* | VCTC Sespe Creek Bridge | *Tested by:* | GA |
| *Project No.:* | 2023-010 | *Checked by:* | KL |
| *Boring No.:* | DYB23-01 | *Date:* | 08/01/23 |
| *Sample No.:* | 2 | | |
| *Depth (ft):* | 10 | | |
| *Sample Description:* | Olive Brown, Poorly Graded Gravel with Silt and Sand (GP-GM) | | |

**Dry Weight (g)** **824.4**

| Sieve Size | Aperture | Weight Retained | % Retained | **% Passing** | **Project Specification** |
|---|---|---|---|---|---|
| | mm | g | % | **%** | **%** |
| 3" | 76.2 | 0.00 | 0.0 | **100.0** | - |
| 1.5" | 38.1 | 0.00 | 0.0 | **100.0** | - |
| 1" | 25.4 | 154.16 | 18.7 | **81.3** | - |
| 3/4 " | 19.1 | 121.21 | 14.7 | **66.6** | - |
| 1/2 " | 12.5 | 69.63 | 8.4 | **58.2** | - |
| 3/8 " | 9.5 | 23.15 | 2.8 | **55.3** | - |
| # 4 | 4.75 | 69.19 | 8.4 | **47.0** | - |
| # 10 | 2.00 | 55.27 | 6.7 | **40.2** | - |
| # 20 | 0.85 | 40.54 | 4.9 | **35.3** | - |
| # 40 | 0.425 | 71.48 | 8.7 | **26.7** | - |
| # 60 | 0.250 | 49.80 | 6.0 | **20.6** | - |
| # 100 | 0.150 | 40.92 | 5.0 | **15.7** | - |
| # 140 | 0.105 | 20.46 | 2.5 | **13.2** | - |
| # 200 | 0.075 | 17.70 | 2.1 | **11.0** | - |
| **Pan** | | 90.91 | 11.0 | **0.0** | - |




| | | | | | |
|---|---|---|---|---|---|
| Particle-Size Analysis | $D_{10}$ | 0.07 | % Gravel | % Sand | % Fines |
| | $D_{30}$ | 0.59 | 53.0 | 35.9 | 11.0 |
| | $D_{60}$ | 13.94 | Sample Description / USCS Classification | | |
| | $C_u$ | 199.20 | Olive Brown, Poorly Graded Gravel with Silt and Sand (GP-GM) | | |
| | $C_c$ | 0.36 | | | |

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