**Project Conditions Hydraulic Evaluation of the Corte Madera Creek Levees**

Stetson Engineers Inc.
October 11, 2019

## 1. Introduction

The 10/7/2019 technical memorandum entitled "Existing Conditions Hydraulic Evaluation of the Corte Madera Creek Levees" documented Stetson's hydraulic evaluation of the Corte Madera levees under existing conditions. After examining the 100-year riverine and coastal flood inundation extents with consideration to sources of floodwater and future sea level rise (SLR), Stetson identified two potential alignments of flood barriers. Alignment #1 would fully utilize flood barriers to combat flooding while Alignment #2 would primarily use existing earthen channel levees that would be raised and tidal gates. The two alignments were documented and described in the 10/7/2019 technical memorandum.

Figure 1a shows the Alignment #2 flood barriers and tidal gates. A3GEO reviewed the flood barrier alignments in the field and selected the Alignment #2 flood barriers and tidal gates in the upper portion of the Corte Madera Creek earthen channel (the label-highlighted flood barriers in Figure 1b) as the recommended project for further hydraulic evaluation, as these flood barriers and tidal gates were considered most feasible in terms of constructability and cost (e.g., less private property impacts and required private property coordination, etc.). These flood barriers (with stationing) and tidal gates are also shown in Figure 2. The proposed flood barriers include:

- Existing levee – Hillview Gardens levee (length: 2,925 ft);
- Existing levee – Kentfield Gardens levee (length: 3,995 ft);
- College Ct flood barrier (length: 1,595 ft);
- Bon Air Road Complex flood barrier (length: 560 ft);
- South Eliseo flood barrier (length: 2,225 ft);
- Wolfe Grade flood barrier #1 (length: 460 ft);
- Wolfe Grade flood barrier #2 (length: 235 ft); and
- Wolfe Grade flood barrier #3 (length: 1,575 ft).

Three segments of the Wolfe Grade flood barrier were considered due to the two bridges between them. Floodwalls and wingwalls would be needed at the bridges to connect with the Wolfe Grade flood barriers.

In addition to the above proposed flood barriers and tidal gates, under the County direction, the project condition also considered the earthen channel dredging and the preferred Alternative J measures for the upstream concrete channel and Unit 4 under the U.S. Army Corps of Engineers' (USACE) Corte Madera Creek Flood Risk Management Project.

Figure 3 shows the dredging extent scenarios from the Stilling Basin down to the Larkspur Creek confluence (green + blue + yellow dashed lines; Phase 1 + 2 + 3). Laterally the dredged channel cross sections in the earthen channel followed the typical cross section shown in Figure 4, with the same width and same side slope (1V: 6H) as the USACE original design channel (but to varying depths along the reach). The simulated water surface elevation (WSE) profiles under

existing levee conditions are also shown in Figure 3. Under the County direction, the Phase 1 + 2 dredging scenario was considered in the project condition analysis. Figure 5a shows the water surface reduction benefit by the Phase 1 + 2 dredging. Figure 5b shows the zoom-in water surface reduction benefit.

The preferred Alternative J measures for the upstream concrete channel and Unit 4 under the U.S. Army Corps of Engineers' (USACE) Corte Madera Creek Flood Risk Management Project are shown in Figure 6, which were described in the Draft EIR for the USACE Corte Madera Creek Flood Risk Management Project that was released in October 2018.

This technical memorandum documents the results of hydraulic evaluation of the Corte Madera Creek levees/flood barriers under project conditions.

## 2. Model Simulations of Project Conditions

The levee assessment will seek to evaluate the adequacy of the heights and freeboards of the levees to contain the design flood events. Since the levees/flood barriers must contain both riverine floods and coastal floods, it follows that the assessment will need to analyze both *riverine* flood conditions and *coastal* flood conditions, independently, since simultaneous flooding from both sources is improbable. The model results for the two flood conditions will be overlaid to determine which flood condition "controls" and where.

Table 1a is a summary of formulated four scenarios for the 100-year riverine flood (Scenarios #1, #2, #3, and #4) and Table 1b is a summary of formulated four scenarios for the 100-year coastal flood (Scenarios #5, #6, #7, and #8). Coastal floods in the San Francisco Bay area are typically accompanied by storms, so some measure of riverine contribution should be accounted for. For the purpose of this levee evaluation, a 10-year storm event to accompany the 100-year coastal flood was assumed in the 100-year coastal flood analysis. The inclusion of a 10-year storm event with the 100-year coastal flood is considered a reasonable combination[1]; however, it is not required by FEMA for its 100-year coastal floodplain mapping.

The model simulations of project conditions used the updated HEC-RAS 1D/2D unsteady-flow hydraulic model that was prepared for the simulations of existing conditions. In the model simulations of project conditions, unlimited heights of the levees/flood barriers were assumed and, thus, there would be no overtopping.

The State of California Sea-Level Rise Guidance/2018 Update (California Natural Resources Agency 2017) provides a science-based methodology for state and local governments to analyze and assess the risks associated with sea level rise and incorporate sea level rise into their planning, permitting, and investment decisions. For the purpose of this study, the future sea level rise of 1.1 ft by 2050 under the "67% probability, high emissions" scenario (see Table 1 of the California Sea-Level Rise Guidance) was selected for the sea level rise modeling analysis.

[1] For example, the 1/27/1983 coastal flood event, which has the highest recorded peak tide observed at the San Francisco Bay tidal gage station (NOAA #9414290) over its 150-year period of record, was accompanied by a 5 - 10 year storm event.

Figure 7 compares the simulated inundation extents between the 100-year riverine flood and the 100-year coastal flood under the without dredging and without SLR conditions (Scenario #1 vs. Scenario #5).

Figure 8 compares the simulated inundation extents between the 100-year riverine flood and the 100-year coastal flood under the without dredging and with SLR conditions (Scenario #2 vs. Scenario #6).

Figure 9 compares the simulated inundation extents between the 100-year riverine flood and the 100-year coastal flood under the with dredging and without SLR conditions (Scenario #3 vs. Scenario #7).

Figure 10 compares the simulated inundation extents between the 100-year riverine flood and the 100-year coastal flood under the with dredging and with SLR conditions (Scenario #4 vs. Scenario #8).

Figure 11 compares the simulated 100-year riverine inundation extents between the without SLR and the with SLR conditions under the without dredging condition (Scenario #1 vs. Scenario #2).

Figure 12 compares the simulated 100-year coastal inundation extents between the without SLR and the with SLR under the without dredging condition (Scenario #5 vs. Scenario #6).

Figure 13 compares the simulated 100-year riverine inundation extents between the without dredging and the with dredging conditions under the without SLR condition (Scenario #1 vs. Scenario #3).

Figure 14 compares the simulated 100-year riverine inundation extents between the without dredging and the with dredging conditions under the with SLR condition (Scenario #2 vs. Scenario #4).

Figure 15 shows the simulated riverine 100-year WSE profiles for Scenarios #1 to #4 and Figure 16 shows the simulated coastal 100-year WSE profiles for Scenarios #5 to #8.

Figure 17 compares the simulated WSE profiles between the riverine 100-year flood and the coastal 100-year flood under the without dredge and without SLR conditions (Scenario #1 vs. Scenario#5).

Figure 18 compares the simulated WSE profiles between the riverine 100-year flood and the coastal 100-year flood under the without dredge and with SLR conditions (Scenario #2 vs. Scenario #6).

Figure 19 compares the simulated WSE profiles between the riverine 100-year flood and the coastal 100-year flood under the with dredge and without SLR conditions (Scenario #3 vs. Scenario #7).

Figure 20 compares the simulated WSE profiles between the riverine 100-year flood and the coastal 100-year flood under the with dredge and with SLR conditions (Scenario #4 vs. Scenario #8).

Findings

- The levees/flood barriers would be effective to protect the properties behind the levees/flood barriers from both the 100-year riverine and coastal floods, except the interior area behind the existing Hillview Gardens levee and the proposed Bon Air Rd Complex flood barrier (see Figures 7 – 10). Examination of the 100-year riverine flood WSE results in the Corte Madera Creek channel and the ground elevations in this interior area indicates that the flood water in this interior area could be drained into the Corte Madera Creek channel by the storm drain pipes. The 100-year coastal flood inundation in this area, which is the result from the assumed 10-year storm flow accompanying the 100-year coastal flood, would not be drained out due to too high tailwater elevations in the Corte Madera Creek channel. A pump station would be needed to drain the 10-year storm flow during a 100-year coastal flood.

- The flood WSE along the Corte Madera Creek earthen channel is dominated by the 100-year coastal flood (see Figures 17 – 20).

- With the levees/flood barriers in place, the benefit of dredging during a 100-year riverine flood would be insignificant in terms of reduction in flood inundation (see Figures 13 and 14).

- The benefit of dredging during a 100-year coastal flood would be minimal (see Figure 16).

## 3. Freeboard Assessment

Using the results of the hydraulic analysis for project conditions and the FEMA's applicable freeboard requirements, a freeboard assessment was conducted for the proposed levees/flood barriers. Per FEMA CFS65.10, the following requirements will be applicable:

*Riverine Flood*

- A minimum freeboard of three feet above the water-surface level of the base flood;
- An additional one foot above the minimum is required within 100 feet upstream and downstream of structures (such as bridges) riverward of the levee or wherever the flow is constricted;
- An additional one-half foot above the minimum at the upstream end of the levee is also required, tapering to not less than the minimum at the downstream end of the levee;

*Coastal Flood*

- For coastal levees, the freeboard must be established at one foot above the height of the 1-percent wave or maximum wave runup (whichever is greater) associated with the 100-year stillwater surge elevation at the site.

For the purpose of this analysis, a freeboard of 3 ft for riverine flood and a freeboard of 1 ft for coastal flood were used. This is reasonable because there are no structures/bridges except the high

Bon Air Bridge[2] and the large HWY 101 Bridge, and there would be little wave effect in the study reach due to its small wind fetch and far away location from the bay. Wave runup is normally considered for coastal shorelines, not for tide-affected stream reaches.

Refer to Figure 2 for levee/flood barrier stationing that was used for the freeboard assessment. The ground elevations for the levees/flood barriers used the 2010 LiDAR data except for the Wolfe Grade flood barrier #3, for which the Stetson field-surveyed flood threshold along the Wolfe Grade Creek (see Figure 29) was used.

Figures 21a, 21b, 21c, and 21d graphically present the freeboard assessment for the existing Hillview Gardens levee (Scenarios #1 vs. #5, #2 vs. #6, #3 vs. #7, and #4 vs. #8, respectively).

Figures 22a, 22b, 22c, and 22d graphically present the freeboard assessment for the existing Kentfield Gardens levee.

Figures 23a, 23b, 23c, and 23d graphically present the freeboard assessment for the proposed College Ct flood barrier.

Figures 24a, 24b, 24c, and 24d graphically present the freeboard assessment for the proposed Bon Air Rd Complex flood barrier.

Figures 25a, 25b, 25c, and 25d graphically present the freeboard assessment for the proposed South Eliseo flood barrier.

Figures 26a, 26b, 26c, and 26d graphically present the freeboard assessment for the proposed Wolfe Grade flood barrier #1.

Figures 27a, 27b, 27c, and 27d graphically present the freeboard assessment for the proposed Wolfe Grade flood barrier #2.

Figures 28a, 28b, 28c, and 28d graphically present the freeboard assessment for the proposed Wolfe Grade flood barrier #3. Note that the ground elevations along the Wolfe Grade flood barrier #3 used the Stetson field-surveyed flood threshold along the Wolfe Grade Creek (see Figure 29).

The freeboard assessment of the levees/flood barriers is summarized in Table 2a for the 100-year riverine flood and in Table 2b for the 100-year coastal flood.

[2] In this modeling, the old Bon Air Bridge was used and was not updated to the proposed new bridge with construction currently being underway by the City of Larkspur. Previous modeling for the new bridge design indicated that the new bridge and the old bridge would have almost the same hydraulics and little backwater effects during the 100-year riverine flood. In other words, using either the old Bon Air Bridge or the new bridge in the modeling would have almost the same WSE profiles for the levee evaluation.

## 4. Interior Drainage Analysis

As shown in Figures 7 – 10, the interior area behind the existing Hillview Gardens levee and the proposed Bon Air Rd Complex flood barrier would be flooded during the 100-year riverine and coastal floods, with the 100-year coastal flood having more/higher inundation. Examination of the 100-year riverine flood WSE results in the Corte Madera Creek channel and the ground elevations in this interior area indicates that the flood water in this interior area could be drained into the Corte Madera Creek channel by the storm drain pipes. The 100-year coastal flood inundation in this area, which is the result from the assumed 10-year storm flow (primarily from the King Mountain Creek) accompanying the 100-year coastal flood, would not be drained out due to too high tailwater elevations in the Corte Madera Creek channel. A pump station would be needed to drain the 10-year storm flow during a 100-year coastal flood[3]. The pump station being designed by the City of Larkspur for the Bon Air Road just south of the Hillview Subdivision would provide some relief for the flooding in this interior area during a 100-year coastal flood.

The 10-year storm flow has an estimated peak discharge of approximately 110 cfs. It is estimated that a pump station with a capacity of about 50,000 gpm would be needed. The pump intake could be located at the King Mountain Creek discharge marsh near the existing Hillview Gardens levee. The construction cost of the pump station is estimated to be approximately $4.5 million.

[3] Any interior stormwater runoff accompanying the 100-year coastal flood would be ponded behind the improved/raised Hillview Gardens levee due to too high tailwater elevations in the Corte Madera Creek channel. If there is no stormwater runoff during a 100-year coastal flood, there would be no flood inundation behind the improved/raised Hillview Gardens levee that is designed to prevent overtopping from the Corte Madera Creek channel.

**Table 1a 100-Year Riverine Modeling**

| Scenario | Channel Bed Condition | Creek Improvements | Upstream Inflow | Downstream Tidal Boundary Condition |
|---|---|---|---|---|
| **Scenario #1** | Existing Condition (2018) | • USACE's Alternative J<br>• Proposed Lower CMC Flood Barriers and Tidal Gates | Q100 | Current MHHW (5.9 ft NAVD88) |
| **Scenario #2** | | | | Future MHHW (7.0 ft NAVD88) with SLR (1.1 ft) by 2050 |
| **Scenario #3** | Phase 1 + 2 Dredging | | | Current MHHW (5.9 ft NAVD88) |
| **Scenario #4** | | | | Future MHHW (7.0 ft NAVD88) with SLR (1.1 ft) by 2050 |

**Table 1b 100-Year Coastal Modeling**

| Scenario | Channel Bed Condition | Creek Improvements | Upstream Inflow | Downstream Tidal Boundary Condition |
|---|---|---|---|---|
| **Scenario #5** | Existing Condition (2018) | • USACE's Alternative J<br>• Proposed Lower CMC Flood Barriers and Tidal Gates | Q10 | Current 100-Yr Tide (10 ft NAVD88) |
| **Scenario #6** | | | | Future 100-Yr Tide (11.1 ft NAVD88) with SLR (1.1 ft) by 2050 |
| **Scenario #7** | Phase 1 + 2 Dredging | | | Current 100-Yr Tide (10 ft NAVD88) |
| **Scenario #8** | | | | Future 100-Yr Tide (11.1 ft NAVD88) with SLR (1.1 ft) by 2050 |

1) Source of current 100-year tide: FEMA effective 2017 FIS.
2) Source of sea level rise (SLR): California Natural Resources Agency: *State of California Sea-Level Rise Guidance, 2018 Update*.

## Table 2a Levee/Flood Barrier Height and Freeboard Assessment – Riverine 100-Year Flood

| Levee/ Flood Barrier | Deficiency | Scenario #1 (Riverine 100-yr, no dredge, no SLR) | Scenario #2 (Riverine 100-yr, no dredge, with SLR) | Scenario #3 (Riverine 100-yr, with dredge, no SLR) | Scenario #4 (Riverine 100-yr, with dredge, with SLR) |
|---|---|---|---|---|---|
| **Existing Levee – Hillview Gardens Levee** | Height Deficiency | Small portion; up to 2 ft | Small portion; up to 2.5 ft | Small potion; up to 1.2 ft | Small portion; up to 1.8 ft |
| | Freeboard Deficiency | Most portion; up to 5 ft | Most portion; up to 5.5 ft | Most portion; up to 4.2 ft | Most portion; up to 4.8 ft |
| **Existing Levee – Kentfield Gardens Levee** | Height Deficiency | None | Small portion; up to 0.2 ft | None | Small portion; up to 0.4 ft |
| | Freeboard Deficiency | Most portion; up to 2.3 ft | Most portion; up to 3.2 ft | Most portion; up to 2.9 ft | Most portion; up to 3.4 ft |
| **College Ct Flood Barrier** | Height Deficiency | Entire reach; up to 4.5 ft | Entire reach; up to 4.7 ft | Entire reach; up to 4.0 ft | Entire reach; up to 4.2 ft |
| | Freeboard Deficiency | Entire reach; up to 7.5 ft | Entire reach; up to 7.7 ft | Entire reach; up to 7.0 ft | Entire reach; up to 7.2 ft |
| **Bon Air Rd Complex Flood Barrier** | Height Deficiency | None | Small portion; up to 0.3 ft | None | Most portion; up to 0.3 ft |
| | Freeboard Deficiency | Entire reach; up to 2.5 ft | Small portion; up to 3.3 ft | Entire reach; up to 2.5 ft | Small portion; up to 3.3 ft |
| **South Eliseo Flood Barrier** | Height Deficiency | Small portion; up to 0.2 ft | Half portion; up to 1.1 ft | Small portion; up to 0.2 ft | Half portion; up to 1.1 ft |
| | Freeboard Deficiency | Most portion; up to 3.2 ft | Most portion; up to 4.1 ft | Most portion; up to 3.2 ft | Most portion; up to 4.1 ft |
| **Wolfe Grade Flood Barrier #1** | Height Deficiency | Small portion; up to 0.6 ft | 1/3 portion; up to 1.0 ft | Small portion; up to 0.2 ft | Small portion; up to 0.7 ft |
| | Freeboard Deficiency | Entire reach; up to 3.6 ft | Entire reach; up to 4.0 ft | Entire reach; up to 3.2 ft | Entire reach; up to 3.7 ft |
| **Wolfe Grade Flood Barrier #2** | Height Deficiency | Most portion: up to 0.9 ft | Most portion: up to 1.3 ft | Most portion: up to 0.6 ft | Most portion: up to 1.0 ft |
| | Freeboard Deficiency | Entire reach: up to 3.9 ft | Entire reach: up to 4.3 ft | Entire reach: up to 3.6 ft | Entire reach: up to 4.0 ft |
| **Wolfe Grade Flood Barrier #3** | Height Deficiency | Small portion: up to 0.7 ft | Half portion: up to 1.2 ft | Small portion: up to 0.3 ft | Half portion: up to 0.8 ft |
| | Freeboard Deficiency | Entire reach: up to 3.7 ft | Entire reach: up to 4.2 ft | Entire reach: up to 3.3 ft | Entire reach: up to 3.8 ft |

Elevation datum: ft NAVD88; Required freeboard for riverine flood: 3 ft.

## Table 2b Levee/Flood Barrier Height and Freeboard Assessment – Coastal 100-Year Flood

| Levee/ Flood Barrier | Deficiency | Scenario #5 (Coastal 100-yr, no dredge, no SLR) | Scenario #6 (Coastal 100-yr, no dredge, with SLR) | Scenario #7 (Coastal 100-yr, with dredge, no SLR) | Scenario #8 (Coastal 100-yr, with dredge, with SLR) |
|---|---|---|---|---|---|
| **Existing Levee – Hillview Gardens Levee** | Height Deficiency | 1/3 portion; up to 3.5 ft | Most portion; up to 4.5 ft | Small potion; up to 3.2 ft | Most portion; up to 4.2 ft |
| | Freeboard Deficiency | Most portion; up to 4.5 ft | Entire reach; up to 5.5 ft | Most portion; up to 4.2 ft | Entire reach; up to 5.2 ft |
| **Existing Levee – Kentfield Gardens Levee** | Height Deficiency | 1/4 portion; up to 2 ft | Most portion; up to 3 ft | 1/4 portion; up to 2 ft | Most portion; up to 3 ft |
| | Freeboard Deficiency | Most portion; up to 3 ft | Entire reach; up to 4 ft | Most portion; up to 3 ft | Entire reach; up to 4 ft |
| **College Ct Flood Barrier** | Height Deficiency | Most portion; up to 4.8 ft | Entire reach; up to 5.8 ft | Most portion; up to 4.5 ft | Entire reach; up to 5.5 ft |
| | Freeboard Deficiency | Entire reach; up to 5.8 ft | Entire reach; up to 6.8 ft | Entire reach; up to 5.5 ft | Entire reach; up to 6.5 ft |
| **Bon Air Rd Complex Flood Barrier** | Height Deficiency | Most portion; up to 2 ft | Most portion; up to 3 ft | Most portion; up to 2 ft | Most portion; up to 3 ft |
| | Freeboard Deficiency | Most portion; up to 3 ft | Entire reach; up to 4 ft | Most portion; up to 3 ft | Entire reach; up to 4 ft |
| **South Eliseo Flood Barrier** | Height Deficiency | Most portion; up to 3.4 ft | Entire reach; up to 4.4 ft | Most portion; up to 3.4 ft | Entire reach; up to 4.4 ft |
| | Freeboard Deficiency | Entire reach; up to 4.4 ft | Entire reach; up to 5.4 ft | Entire reach; up to 4.4 ft | Entire reach; up to 5.4 ft |
| **Wolfe Grade Flood Barrier #1** | Height Deficiency | Most portion; up to 2.1 ft | Entire reach; up to 3.1 ft | Most portion; up to 1.9 ft | Entire reach; up to 2.9 ft |
| | Freeboard Deficiency | Entire reach; up to 3.1 ft | Entire reach; up to 4.1 ft | Entire reach; up to 2.9 ft | Entire reach; up to 3.9 ft |
| **Wolfe Grade Flood Barrier #2** | Height Deficiency | Entire reach; up to 2.6 ft | Entire reach; up to 3.5 ft | Entire reach; up to 2.3 ft | Entire reach; up to 3.3 ft |
| | Freeboard Deficiency | Entire reach; up to 3.6 ft | Entire reach; up to 4.5 ft | Entire reach; up to 3.3 ft | Entire reach; up to 4.3 ft |
| **Wolfe Grade Flood Barrier #3** | Height Deficiency | Most portion: up to 2.2 ft | Entire reach; up to 3.1 ft | Most portion: up to 2.1 ft | Entire reach; up to 3.1 ft |
| | Freeboard Deficiency | Entire reach: up to 3.2 ft | Entire reach; up to 4.1 ft | Entire reach: up to 3.1 ft | Entire reach; up to 4.1 ft |

Elevation datum: ft NAVD88. Required freeboard for coastal flood: 1 ft.

FIGURE 1a

Wolfe Grade Flood Barrier

(E) Kentfield Gardens Levee

South Eliseo Flood Barrier

College Ct Flood Barrier

(E) Hillview Gardens Levee

Bon Air Rd Complex Flood Barrier

Larkspur Plaza Flood Barrier

Riviera Cir Flood Barrier

Old Railway Flood Barrier

Primary Coastal Flood Barrier

Alternative Primary Coastal Flood Barrier

Larkspur

Corte Madera

Corte Madera Creek

Wolfe Grade Creek

McAllister Creek

King Mountain Creek

Larkspur Creek

Sir Francis Drake Blvd

S Hwy 101 Ramp

N Hwy 101 Ramp

NWP RR

Greenbrae Boardwalk

Boardwalk 1

Piper Park Trl

Bon Air Rd

Harvard Dr

Nellen Ave

Redwood Hwy

Industrial Way

Rich St

Tamal Plaza

Tamal Vista Blvd

Wornum Dr

Doherty Dr

Creekside Dr

Meadowsweet Dr

Tamalpais Dr

Manzanita Ave

Sausalito St

Grace Ct

Toyon Ct

Deer Run

Harbor Dr

Echo Ave

San Clemente Dr

Casa Buena Dr

N Hwy 101 Paradise Dr

Corte Madera Ave

Montecito Ave

Serra St

Pixley Ave

Willow Ave

Palm Ave

Baltimore Ave

Alexander Ave

Monona Dr

Seminole Ave

Lakeside Dr

Madera Blvd

Mohawk Ave

Walnut Ave

Hickory Ave

Blue Rock Ct

Mohave Ct

Ash Ave

Arrowhead Ln

Birch Ave

Heather Way

Liberty St

Diane Ln

Corte Madera Cr

College Ave

Terrace Ave

Ash Ave

Villa Ct

Oak Ave

Broadway

Fay Dr

Edna Ct

Vista Grande

Corte Anita

Tioga Ln

Nadina Way

Bretano Way

Almenar Dr

Los Cerros Dr

La Cuesta Dr

Corte de Sabla

Corte Cayuga

Eliseo Dr

Parkside Way

Via la Cumbre

Victoria Way

E Sir Francis Drake Blvd

Via Hidalgo

El Porta Dr

Bon Air Center

Barry Way

Del Monte

Via Casitas

Corte Ortega

S Eliseo Dr

Laderman Ln

Berens Dr

Hillcrest Ln

Estelle Ave

Fern Way

Ranchería Rd

Briar Rd

Fern Rd

Citron Ave

Skylark Dr

Murray Ave

Bond St

Hawthorne Ave

Locust Ave

Magnolia Ave

Rice Ln

Cane St

King St

Arch St

Hazel Ave

Walnut Ave

Onyx Ct

Onyx St

Madrone Ave

W Baltimore Ave

William Ave

Monte Vista Ave

Holcomb Ave

Elm Ave

Piedmont Rd

Ardmore Rd

Park Way

Wiltshire Ave

Lark Ct

Bahl Ln

Edison Ave

Riviera Cir

Lucky Dr

Fifer Ave

Doherty Dr

Diane Ln

Liberty St

Heather Way

Birch Ave

Arrowhead Ln

Mohave Ct

Ash Ave

Blue Rock Ct

Walnut Ave

Hickory Ave

Monona Dr

Seminole Ave

Lakeside Dr

Madera Blvd

Mohawk Ave

Alexander Ave

Baltimore Ave

Palm Ave

Willow Ave

Pixley Ave

Tamalpais Dr

Manzanita Ave

Sausalito St

Grace Ct

Toyon Ct

Deer Run

Meadowsweet Dr

S Hwy 101 Ramp

N Hwy 101 Paradise Dr

Casa Buena Dr

San Clemente Dr

Harbor Dr

Echo Ave

**Legend**

- Proposed Tidal Gate
- Potential Flood Barriers
- Existing Levee
- River
- LV Evaluation Model (Bed 2018); 100yr Flow + MHHW Tide (5.9 ft)
- LV Evaluation Model (Bed 2018); Tide Only (10ft)
- City Limit

0 500 1,000 Feet

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STETSON ENGINEERS INC.

**CORTE MADERA CREEK LEVEE EVALUATION**

Potential Flood Barriers Locations
Alignment #2

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FIGURE 1b

Wolfe Grade Flood Barrier
(E) Kentfield Gardens Levee
South Eliseo Flood Barrier
College Ct Flood Barrier
(E) Hillview Gardens Levee
Bon Air Rd Complex Flood Barrier
Larkspur Plaza Flood Barrier
Riviera Cir Flood Barrier
Old Railway Flood Barrier
Primary Coastal Flood Barrier
Alternative Primary Coastal Flood Barrier

Corte Madera Creek
Wolfe Grade Creek
McAllister Creek
King Mountain Creek
Larkspur Creek

Larkspur
Corte Madera

Terrace Ave
Ash Ave
Villa Ct
Oak Ave
Broadway
Fay Dr
Edna Ct
Vista Grande
Corte Anita
Tioga Ln
Nadina Way
Bretano Way
Almenar Dr
Los Cerros Dr
La Cuesta Dr
Corte de Sabla
Corte Cayuga
Eliseo Dr
Parkside Way
Via la Cumbre
Via Hidalgo
El Porta Dr
Sir Francis Drake Blvd
Bon Air Center
Barry Way
Del Monte
Via Casitas
Laderman Ln
S Eliseo Dr
S Hwy 101 Ramp
NWP RR
Redwood Hwy
Victoria Way
E Sir Francis Drake Blvd
N Hwy 101 Ramp
Greenbrae Boardwalk
Corte Madera Cr
College Ave
Harvard Dr
Bon Air Rd
Boardwalk Ln
Piper Park Trl
Riviera Cir
Lucky Dr
Fifer Ave
Nellen Ave
Rich St
Industrial Way
Redwood Hwy
Tamal Plaza
Tamal Vista Blvd
Wornum Dr
Doherty Dr
Diane Ln
Liberty St
Heather Way
Birch Ave
Arrowhead Ln
Mohave Ct
Blue Rock Ct
Ash Ave
Walnut Ave
Hickory Ave
Monona Dr
Lakeside Dr
Seminole Ave
Madera Blvd
Mohawk Ave
Meadowsweet Dr
Tamalpais Dr
Manzanita Ave
Sausalito St
Grace Ct
Toyon Ct
Deer Run
Harbor Dr
Echo Ave
San Clemente Dr
Casa Buena Dr
N Hwy 101
Paradise Dr
Black Log Rd
Briar Rd
Fern Rd
Fern Way
Ranchería Rd
Citron Ave
Skylark Dr
Murray Ave
Bond St
Hawthorne Ave
Locust Ave
Magnolia Ave
Rice Ln
Cane St
King St
Arch St
Hazel Ave
Onyx Ct
Onyx St
Walnut Ave
William Ave
Monte Vista Ave
Holcomb Ave
Elm Ave
Madrone Ave
W Baltimore Ave
Alexander Ave
Baltimore Ave
Palm Ave
Willow Ave
Pixley Ave
Park Way
Piedmont Rd
Ardmore Rd
Wilshire Ave
Lark Ct
Bahr Ln
Corte Madera Ave
Montecito Ave
Serra St
Edison Ave

## Legend

- Proposed Tidal Gate
- Potential Flood Barriers
- Existing Levee
- River
- LV Evaluation Model (Bed 2018); 100yr Flow + MHHW Tide (5.9 ft)
- LV Evaluation Model (Bed 2018); Tide Only (10ft)
- City Limit

0 500 1,000 Feet

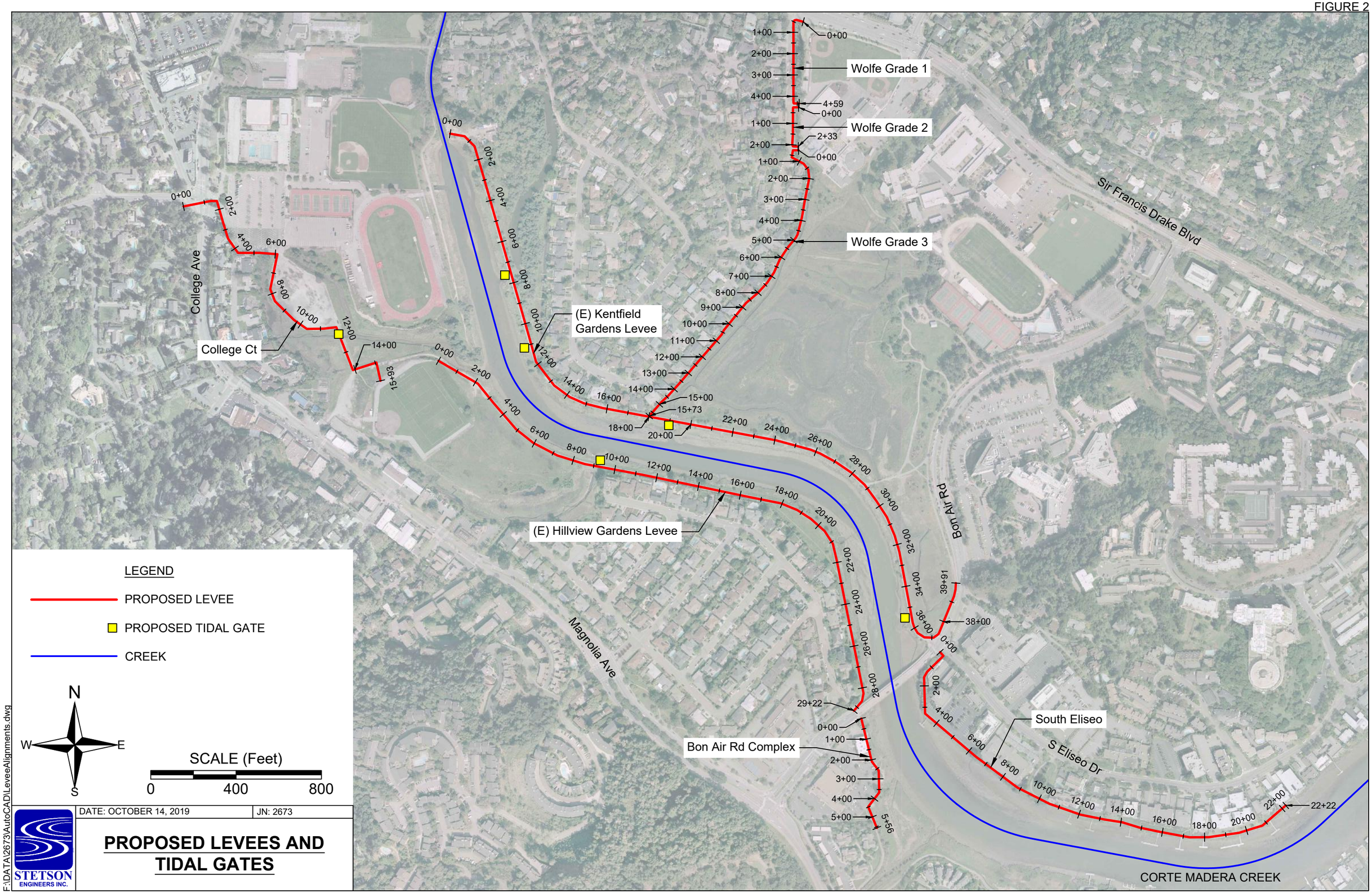
N

STETSON ENGINEERS INC.

**CORTE MADERA CREEK LEVEE EVALUATION**

Potential Flood Barriers Locations
Alignment #2

Document Path: C:\DATA\2673\GIS\FIGURE EDITS\Fig 1b Levee Alignment.mxd




STETSON ENGINEERS INC.

DATE: OCTOBER 14, 2019 | JN: 2673

# PROPOSED LEVEES AND TIDAL GATES

F:\DATA\2673\AutoCAD\LeveeAlignments.dwg

**Figure 3**

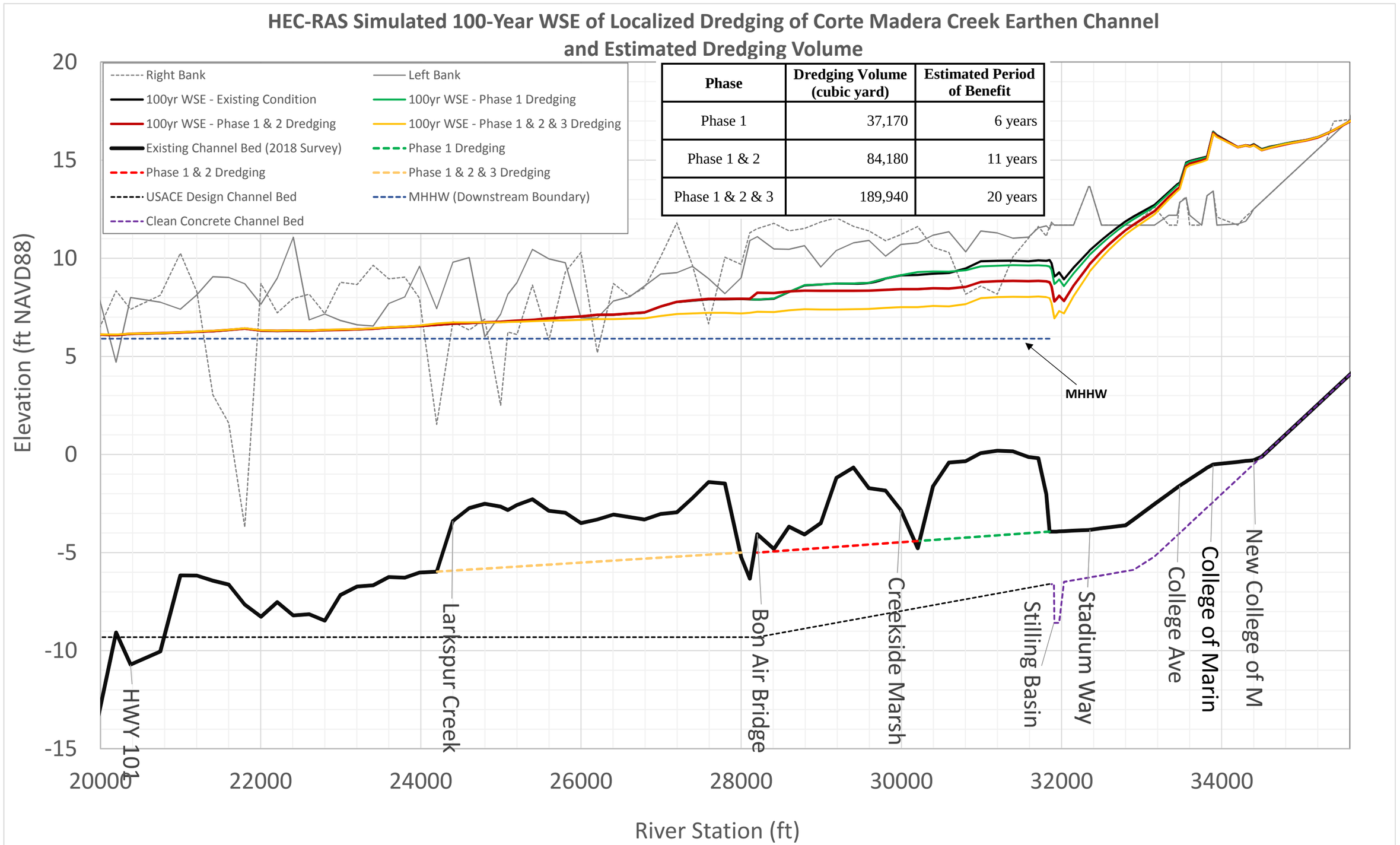
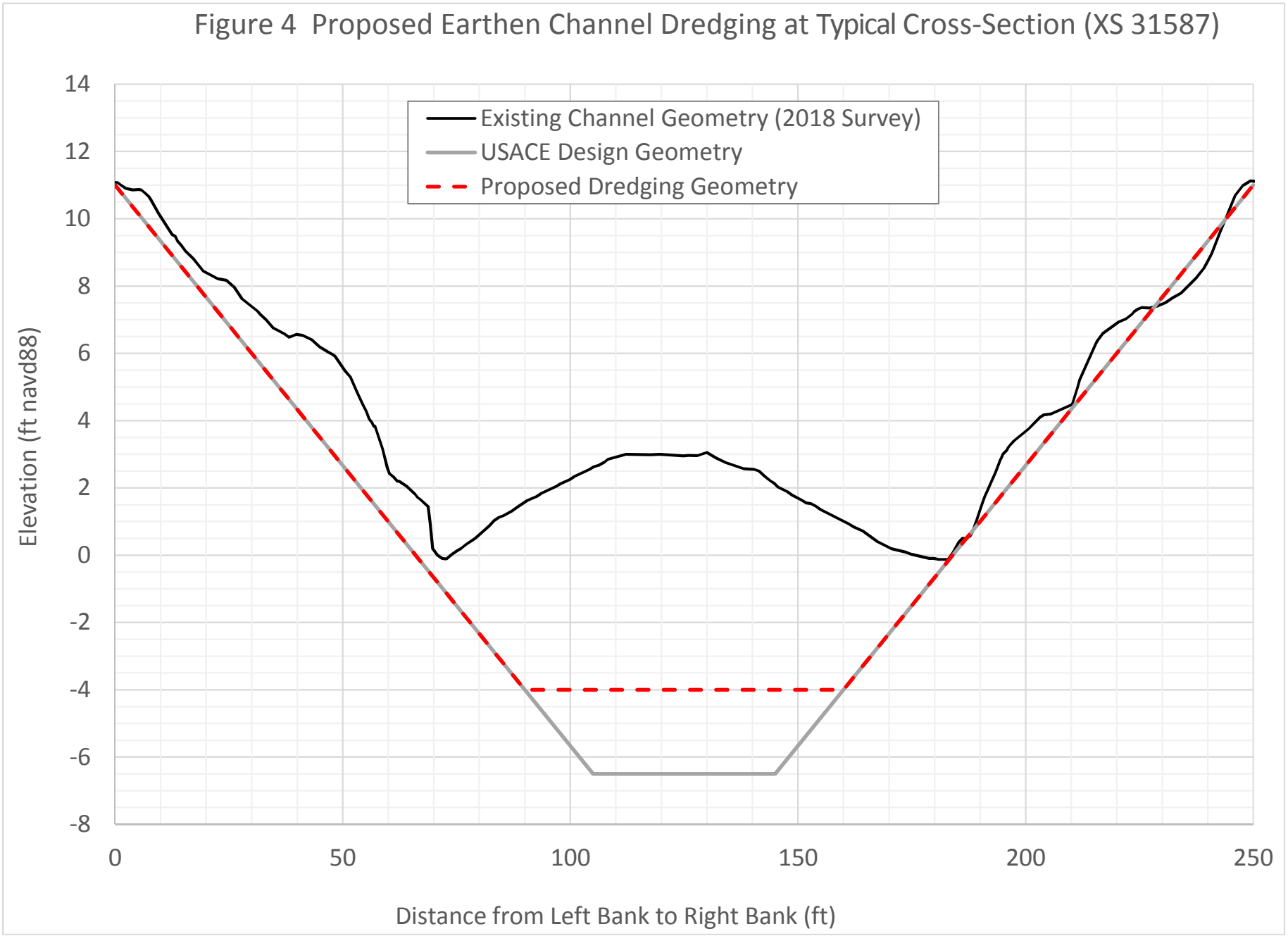
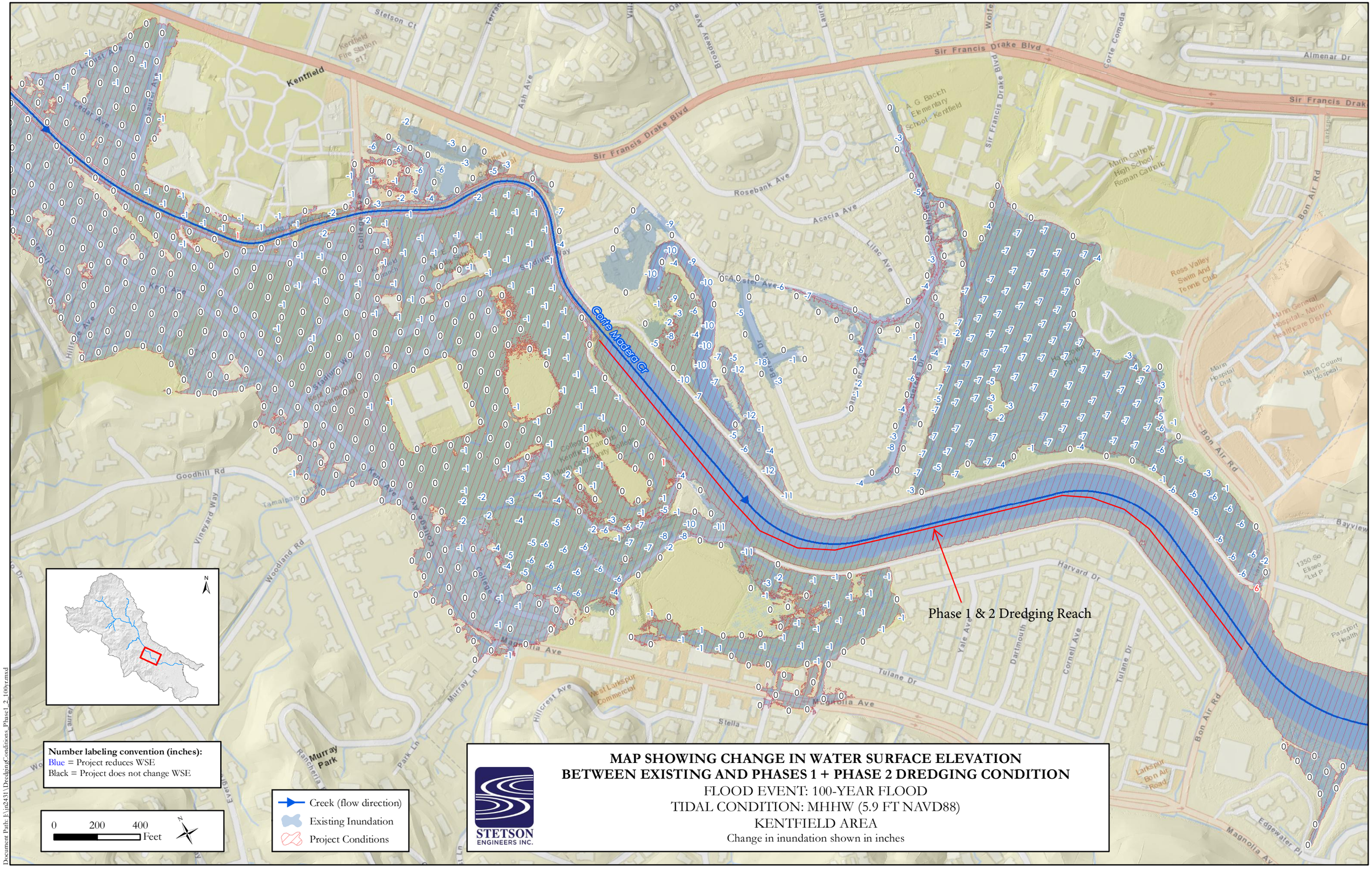

HEC-RAS Simulated 100-Year WSE of Localized Dredging of Corte Madera Creek Earthen Channel and Estimated Dredging Volume
Right Bank
Left Bank
100yr WSE - Existing Condition
100yr WSE - Phase 1 Dredging
100yr WSE - Phase 1 & 2 Dredging
100yr WSE - Phase 1 & 2 & 3 Dredging
Existing Channel Bed (2018 Survey)
Phase 1 Dredging
Phase 1 & 2 Dredging
Phase 1 & 2 & 3 Dredging
USACE Design Channel Bed
MHHW (Downstream Boundary)
Clean Concrete Channel Bed
Phase | Dredging Volume (cubic yard) | Estimated Period of Benefit
Phase 1 | 37,170 | 6 years
Phase 1 & 2 | 84,180 | 11 years
Phase 1 & 2 & 3 | 189,940 | 20 years
MHHW
HWY 101
Larkspur Creek
Bon Air Bridge
Creekside Marsh
Stilling Basin
Stadium Way
College Ave
College of Marin
New College of M
Elevation (ft NAVD88)
River Station (ft)
20
15
10
5
0
-5
-10
-15
20000
22000
24000
26000
28000
30000
32000
34000

Figure 4 Proposed Earthen Channel Dredging at Typical Cross-Section (XS 31587)




Kentfield
Sir Francis Drake Blvd
Corte Madera Cr
Phase 1 & 2 Dredging Reach
Goodhill Rd
Woodland Rd
Magnolia Ave
Rosebank Ave
Acacia Ave
Lilac Ave
Tulane Dr
Harvard Dr
Bon Air Rd
Almenar Dr
Ross Valley Swim And Tennis Club
Marin General Hospital - Marin Healthcare District
Marin Hospital Dist
Marin County Hospital
Marin Catholic High School - Roman Catholic
A. G. Bacich Elementary School - Kentfield
Kentfield Fire Station #1
Murray Park
Larkspur - Bon Air Road
Edgewater Pl
Bayview
Passport Health
Number labeling convention (inches):
Blue = Project reduces WSE
Black = Project does not change WSE
0 200 400 Feet
Creek (flow direction)
Existing Inundation
Project Conditions
STETSON ENGINEERS INC.
MAP SHOWING CHANGE IN WATER SURFACE ELEVATION
BETWEEN EXISTING AND PHASES 1 + PHASE 2 DREDGING CONDITION
FLOOD EVENT: 100-YEAR FLOOD
TIDAL CONDITION: MHHW (5.9 FT NAVD88)
KENTFIELD AREA
Change in inundation shown in inches
Document Path: I:\jn2431\DredgingConditions_Phase1_2_100yr.mxd

STETSON ENGINEERS INC.

# MAP SHOWING CHANGE IN WATER SURFACE ELEVATION BETWEEN EXISTING AND PHASES 1 + PHASE 2 DREDGING CONDITION

FLOOD EVENT: 100-YEAR FLOOD

TIDAL CONDITION: MHHW (5.9 FT NAVD88)

KENTFIELD AREA

Change in inundation shown in inches

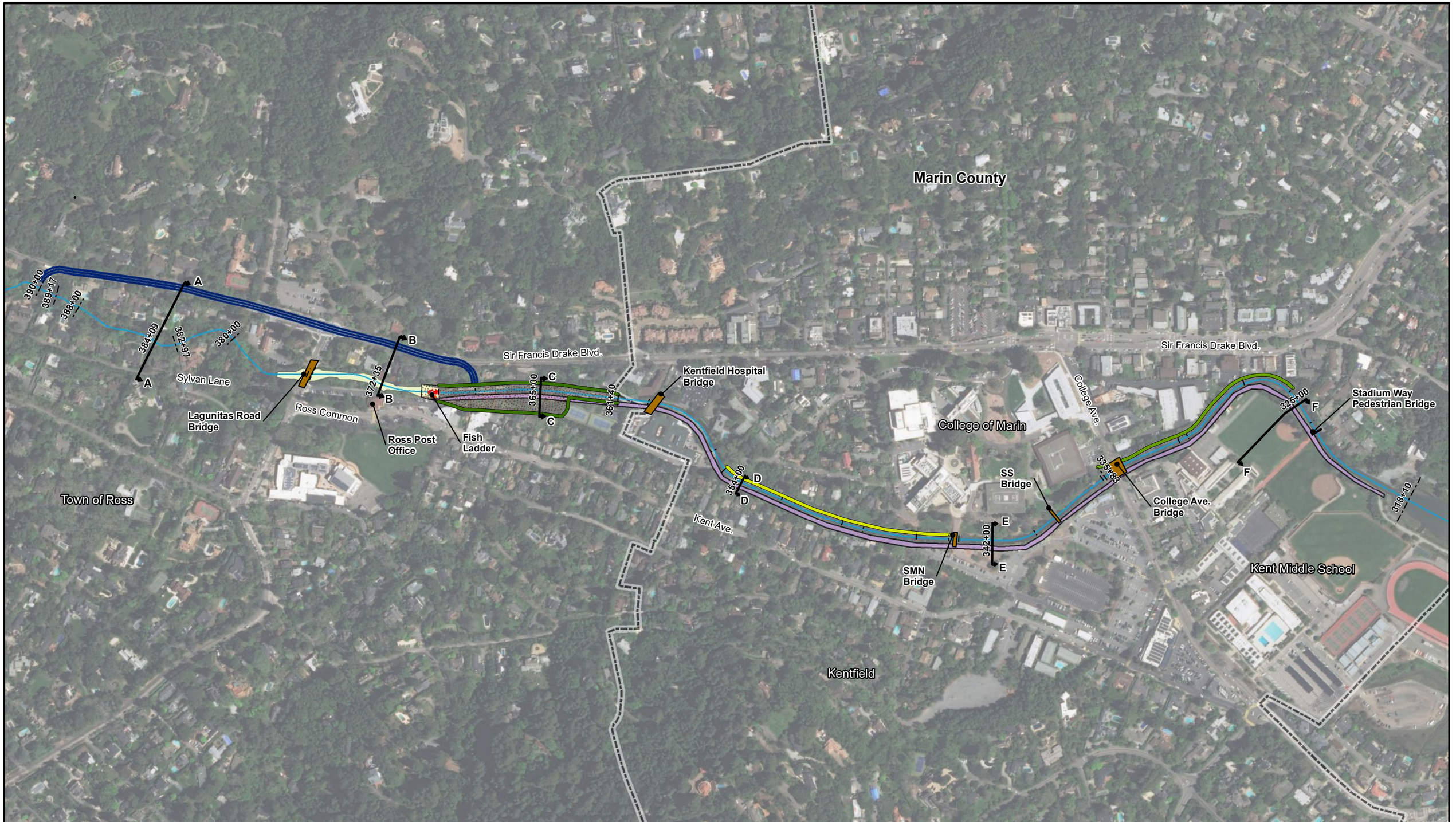
**Number labeling convention (inches):**
Blue = Project reduces WSE
Black = Project does not change WSE

Creek (flow direction)
Existing Inundation
Project Conditions

N

0 100 200 Feet

Document Path: J:\in2431\DredgingConditions_Phase1_2_100yr_zoom.mxd




**Alternative J**

- Underground Bypass
- Fish Ladder Removal
- Allen Park Riparian Corridor
- Fish Passage Transition Grading

**Maximum Top of Bank Floodwall Heights (feet)**

- 2
- 4
- 6

**Existing Features**

- Corte Madera Creek Centerline
- Bridges
- Existing Bike Lane

- Channel Stations
- Cross-Section Location

Date: 7/26/2018

0 200 400 800 Feet

*Document Path: S:\Corte Madera EIS-EIR\GIS 2017 Files\Corte_MaderaAlts_11_21_17\CM_Alternative F_Current_Overview.mxd*

**Alternative J**

**Figure 6 Overview**

**Corte Madera Creek FRM EIS/EIR**
**Ross, Marin County**

**Burleson Consulting, Inc.**

NOTE:

Project Condition:
(a) USACE Alt J;
(b) Proposed Levees;
(c) Proposed Tide Gates

Hydrologic Conditions:
(1) Riverine 100yr Flow + Coastal MHHW Tide
5.9 ft NAVD88
(2) Riverine 10yr Flow + Coastal 100yr Tide
10 ft NAVD88

Wolfe Grade Creek

King Mountain Creek

Ash Ave
Oak Ave
Broadway
Rosebank Ave
Rosebank Ln
McAllister Ave
Wolfe Grade
Manor Rd
Vista Grande
Corte Anita
Corte Comoda
Corte Elena
Corte Balboa
Tioga Ln
Nadina Way
Almenar Dr
Sir Francis Drake Blvd
Via Hidalgo
Corte Lenosa
Acacia Ave
Lilac Ave
Lancaster Ave
Berens Dr
Kent Ave
Stadium Way
Goodhill Rd
Woodland Rd
College Ave
College Ct
Murray Ln
Hillcrest Ave
Hillcrest Ln
Ranchería Rd
Frances Ave
Estelle Ave
Evergreen Dr
El Portal Dr
Bon Air Center
Via Casitas
Upper Via Casitas
Via Belardo
Via Holon
Laderman Ln
Corte Oriental
Bayview Rd
Corte Real
S Eliseo Dr
Yale Ave
Dartmouth Dr
Cornell Ave
Tulane Dr
Harvard Dr
Bon Air Rd
Edgewater Pl
Piper Park Trl
Riviera Cir
Boardwalk 1
Creek View Cir
Larkspur Plaza Dr
Magnolia Ave
Opal St
Cedar Ave
Doherty Dr

## Legend

- Proposed Levee
- Proposed Tidal Gate
- R32. Alt J + Levee + Gate, Riverine 100yr Flow + Coastal MHHW Tide (5.9 ft navd88)
- T36. Alt J + Levee + Gate, Riverine 10yr Flow + Coastal 100yr Tide (10 ft navd88)
- Creek

0 250 500 Feet

N

STETSON ENGINEERS INC.

**CORTE MADERA CREEK LEVEE EVALUATION**

Proposed Levee and Tide Gate
Riverine 100yr Flow vs. Coastal 100yr Tide
(without Dredging, without SLR)

Document Path: C:\DATA\2673\GIS\FIGURE EDITS\Fig 7 - Scenario Runs - No Dredge, No SLR - Riverian100yr vs Coastal100yr - 11x17.mxd

NOTE:

Project Condition:
(a) USACE Alt J;
(b) Proposed Levees;
(c) Proposed Tide Gates

Hydrologic Conditions:
(1) Riverine 100yr Flow + Coastal MHHW Tide
5.9 ft NAVD88 + Sea Level Rise 1.1 ft
(2) Riverine 10yr Flow + Coastal 100yr Tide
10 ft NAVD88 + Sea Level Rise 1.1 ft

**Legend**

- Proposed Levee
- Proposed Tidal Gate
- R33. Alt J + Levee + Gate, Riverine 100yr Flow + Coastal MHHW Tide + SLR (7.0 ft navd88)
- T37. Alt J + Levee + Gate, Riverine 10yr Flow + Coastal 100yr Tide + SLR (11.1 ft navd88)
- Creek

0 250 500 Feet

N

STETSON ENGINEERS INC.

**CORTE MADERA CREEK LEVEE EVALUATION**

Proposed Levee and Tide Gate
Riverine 100yr Flow vs. Coastal 100yr Tide
(without Dredging, with SLR)

Document Path: C:\DATA\2673\GIS\FIGURE EDITS\Fig 8 - Scenario Runs - No Dredge, with SLR - Riverian100yr vs Coastal100yr - 11x17.mxd

NOTE:

Project Condition:
(a) USACE Alt J;
(b) Proposed Levees;
(c) Proposed Tide Gates
(d) Proposed Phase 1 and Phase 2 Dredging

Hydrologic Conditions:
(1) Riverine 100yr Flow + Coastal MHHW Tide 5.9 ft NAVD88
(2) Riverine 10yr Flow + Coastal 100yr Tide 10 ft NAVD88

Wolfe Grade Creek
King Mountain Creek
Ash Ave
Oak Ave
Broadway
Rosebank Ave
Rosebank Ln
McAllister Ave
Wolfe Grade
Manor Rd
Vista Grande
Corte Anita
Corte Comoda
Corte Elena
Corte Balboa
Tioga Ln
Nadina Way
Almenar Dr
Sir Francis Drake Blvd
Via Hidalgo
Corte Lenosa
Acacia Ave
Lilac Ave
Lancaster Ave
Berens Dr
Kent Ave
Stadium Way
Goodhill Rd
Woodland Rd
College Ave
College Ct
Murray Ln
Hillcrest Ave
Hillcrest Ln
Ranchería Rd
Frances Ave
Estelle Ave
Evergreen Dr
Yale Ave
Dartmouth Dr
Cornell Ave
Tulane Dr
Harvard Dr
Bon Air Rd
Edgewater Pl
El Portal Dr
Bon Air Center
Via Casitas
Upper Via Casitas
Via Belardo
Laderman Ln
Corte Oriental
Via Holon
Bayview Rd
Corte Real
S Eliseo Dr
Piper Park Trl
Riviera Cir
Boardwalk 1
Creek View Cir
Larkspur Plaza Dr
Magnolia Ave
Opal St
Cedar Ave
Doherty Dr

## Legend

- Proposed Levee
- Proposed Tidal Gate
- R34. Alt J + Levee + Gate + Dredging, Riverine Q100yr Flow + Coastal MHHW Tide (5.9 ft navd88)
- T38. Alt J + Levee + Gate + Dredging, Riverine 10yr Flow +Coastal 100yr Tide (10 ft navd88)
- Creek

0 250 500 Feet

N

STETSON ENGINEERS INC.

**CORTE MADERA CREEK LEVEE EVALUATION**

Proposed Levee and Tide Gate
Riverine 100yr Flow vs. Coastal 100yr Tide
(with Dredging, without SLR)

Document Path: C:\DATA\2673\GIS\FIGURE EDITS\Fig 9 - Scenario Runs - with Dredge, No SLR - Riverian100yr vs Coastal100yr - 11x17.mxd

NOTE:

Project Condition:
(a) USACE Alt J;
(b) Proposed Levees;
(c) Proposed Tide Gates
(d) Proposed Phase 1 and Phase 2 Dredging

Hydrologic Conditions:
(1) Riverine 100yr Flow + Coastal MHHW Tide
5.9 ft NAVD88 + Sea Level Rise 1.1 ft
(2) Riverine 10yr Flow + Coastal 100yr Tide
10 ft NAVD88 + Sea Level Rise 1.1 ft

Wolfe Grade Creek
King Mountain Creek
Ash Ave
Oak Ave
Broadway
Rosebank Ave
Rosebank Ln
McAllister Ave
Wolfe Grade
Manor Rd
Vista Grande
Corte Anita
Corte Comoda
Corte Elena
Corte Balboa
Tioga Ln
Nadina Way
Almenar Dr
Sir Francis Drake Blvd
Via Hidalgo
Corte Lenosa
Acacia Ave
Lilac Ave
Lancaster Ave
Berens Dr
Kent Ave
Stadium Way
Goodhill Rd
Woodland Rd
College Ave
College Ct
Murray Ln
Hillcrest Ave
Hillcrest Ln
Frances Ave
Estelle Ave
Rancheria Rd
Evergreen Dr
Yale Ave
Dartmouth Dr
Cornell Ave
Tulane Dr
Harvard Dr
Bon Air Rd
Edgewater Pl
Creek View Cir
Larkspur Plaza Dr
Magnolia Ave
Opal St
Cedar Ave
Corte Oriental
Via Holon
Via Belardo
Via Casitas
Upper Via Casitas
Laderman Ln
El Portal Dr
Bon Air Center
Bayview Rd
Corte Real
S Eliseo Dr
Piper Park Trl
Riviera Cir
Boardwalk 1
Doherty Dr

## Legend

- Proposed Levee
- Proposed Tidal Gate
- R35. Alt J + Levee + Gate + Dredging, Riverine 100yr Flow + Coastal MHHW Tide + SLR (7.0 ft navd88)
- T39. Alt J + Levee + Gate + Dredging, Riverine 10yr Flow + Coastal 100yr Tide + SLR (11.1 ft navd88)
- Creek

0 250 500 Feet

N

STETSON ENGINEERS INC.

# CORTE MADERA CREEK LEVEE EVALUATION

Proposed Levee and Tide Gate
Riverine 100yr Flow vs. Coastal 100yr Tide
(with Dredging, with SLR)

Document Path: C:\DATA\2673\GIS\FIGURE EDITS\Fig 10 - Scenario Runs - with Dredge, with SLR - Riverian100yr vs Costal100yr - 11x17.mxd

NOTE:

Project Condition:
(a) USACE Alt J;
(b) Proposed Levees;
(c) Proposed Tide Gates

Hydrologic Conditions:
(1) Riverine 100yr Flow + Coastal MHHW Tide 5.9 ft NAVD88
(2) Riverine 100yr Flow + Coastal MHHW Tide 5.9 ft NAVD88 + Sea Level Rise 1.1 ft

Wolfe Grade Creek
King Mountain Creek
Ash Ave
Oak Ave
Broadway
Rosebank Ave
Rosebank Ln
McAllister Ave
Wolfe Grade
Manor Rd
Vista Grande
Corte Anita
Corte Comoda
Corte Elena
Corte Balboa
Tioga Ln
Nadina Way
Almenar Dr
Sir Francis Drake Blvd
Via Hidalgo
Corte Lenosa
Acacia Ave
Lilac Ave
Lancaster Ave
Berens Dr
Kent Ave
Stadium Way
Goodhill Rd
Woodland Rd
College Ave
College Ct
Murray Ln
Hillcrest Ave
Hillcrest Ln
Frances Ave
Estelle Ave
Rancheria Rd
Evergreen Dr
El Portal Dr
Bon Air Center
Via Casitas
Upper Via Casitas
Via Belardo
Laderman Ln
Corte Oriental
Via Hoton
Bayview Rd
Corte Real
S Eliseo Dr
Yale Ave
Dartmouth Dr
Cornell Ave
Tulane Dr
Harvard Dr
Bon Air Rd
Edgewater Pl
Creek View Cir
Larkspur Plaza Dr
Boardwalk-1
Piper Park Trl
Riviera Cir
Magnolia Ave
Opal St
Cedar Ave
Doherty Dr

## Legend

- Proposed Levee
- Proposed Tidal Gate
- R32. Alt J + Levee + Gate, Riverine 100yr Flow + Coastal MHHW Tide (5.9 ft navd88)
- R33. Alt J + Levee + Gate, Riverine 100yr Flow + Coastal MHHW Tide + SLR (7.0 ft navd88)
- Creek

0 250 500 Feet

N

STETSON ENGINEERS INC.

**CORTE MADERA CREEK LEVEE EVALUATION**

Proposed Levee and Tide Gate
without SLR vs. with SLR
(without Dredging, Riverine 100yr Flow)

Document Path: C:\DATA\2673\GIS\FIGURE EDITS\Fig 11 - Scenario Runs - No Dredge - Riverian 100yr - with SLR vs No SLR - 11x17.mxd

NOTE:

Project Condition:
(a) USACE Alt J;
(b) Proposed Levees;
(c) Proposed Tide Gates

Hydrologic Conditions:
(1) Riverine 10yr Flow + Coastal 100yr Tide
10 ft NAVD88
(2) Riverine 10yr Flow + Coastal 100yr Tide
10 ft NAVD88 + Sea Level Rise 1.1 ft

Document Path: C:\DATA\2673\GIS\FIGURE EDITS\Fig 12 - Scenario Runs - No Dredge - Coastal 100yr - with SLR vs No SLR - 11x17.mxd

## Legend

- Proposed Levee
- Proposed Tidal Gate
- T36. Alt J + Levee + Gate, Riverine 10yr Flow + Coastal 100yr Tide (10 ft navd88)
- T37. Alt J + Levee + Gate, Riverine 10yr Flow + Coastal 100yr Tide + SLR (11.1 ft navd88)
- Creek

0 250 500 Feet

N

STETSON ENGINEERS INC.

**CORTE MADERA CREEK LEVEE EVALUATION**

Proposed Levee and Tide Gate
without SLR vs with SLR
(without Dredging, Coastal 100yr Tide)

NOTE:

Project Conditions:
(a) USACE Alt J;
(b) Proposed Levees;
(c) Proposed Tide Gates
(d) Without Dredging vs Proposed Phase 1&2 Dredging

Hydrologic Condition:
(1) Riverine 100yr Flow + Coastal MHHW Tide 5.9 ft NAVD88

## Legend

- Proposed Levee
- Proposed Tidal Gate
- R32. Alt J + Levee + Gate, Riverine 100yr Flow + Coastal MHHW Tide (5.9 ft navd88)
- R34. Alt J + Levee + Gate + Dredging, Riverine Q100yr Flow + Coastal MHHW Tide (5.9 ft navd88)
- Creek

0 250 500 Feet

N

STETSON ENGINEERS INC.

**CORTE MADERA CREEK LEVEE EVALUATION**

Proposed Levee and Tide Gate
without Dredging vs with Dredging
(Riverine 100yr Flow, without SLR )

Document Path: C:\DATA\2673\GIS\FIGURE EDITS\Fig 13 - Scenario Runs - No SLR - Riverian 100yr - with Dredge vs No Dredge - 11x17.mxd

NOTE:

Project Conditions:
(a) USACE Alt J;
(b) Proposed Levees;
(c) Proposed Tide Gates
(d) Without Dredging vs Proposed Phase 1&2 Dredging

Hydrologic Condition:
(1) Riverine 100yr Flow + Coastal MHHW Tide 5.9 ft NAVD88 + Sea Level Rise 1.1 ft

## Legend

- Proposed Levee
- Proposed Tidal Gate
- R33. Alt J + Levee + Gate, Riverine 100yr Flow + Coastal MHHW Tide + SLR (7.0 ft navd88)
- R35. Alt J + Levee + Gate + Dredging, Riverine Q100yr Flow + Coastal MHHW Tide + SLR (7.0 ft navd88)
- Creek

0 250 500 Feet

N

STETSON ENGINEERS INC.

**CORTE MADERA CREEK LEVEE EVALUATION**

Proposed Levee and Tide Gate
without Dredging vs with Dredging
(Riverine 100yr Flow, with SLR )

Document Path: C:\DATA\2673\GIS\FIGURE EDITS\Fig 14 - Scenario Runs - with SLR - Riverian 100yr - with Dredge vs No Dredge - 11x17.mxd

**Figure 15 Riverine 100-Year WSE Profiles; Scenarios #1, #2, #3, and #4** (solid blue, dashed blue, solid red, dashed red respectively)

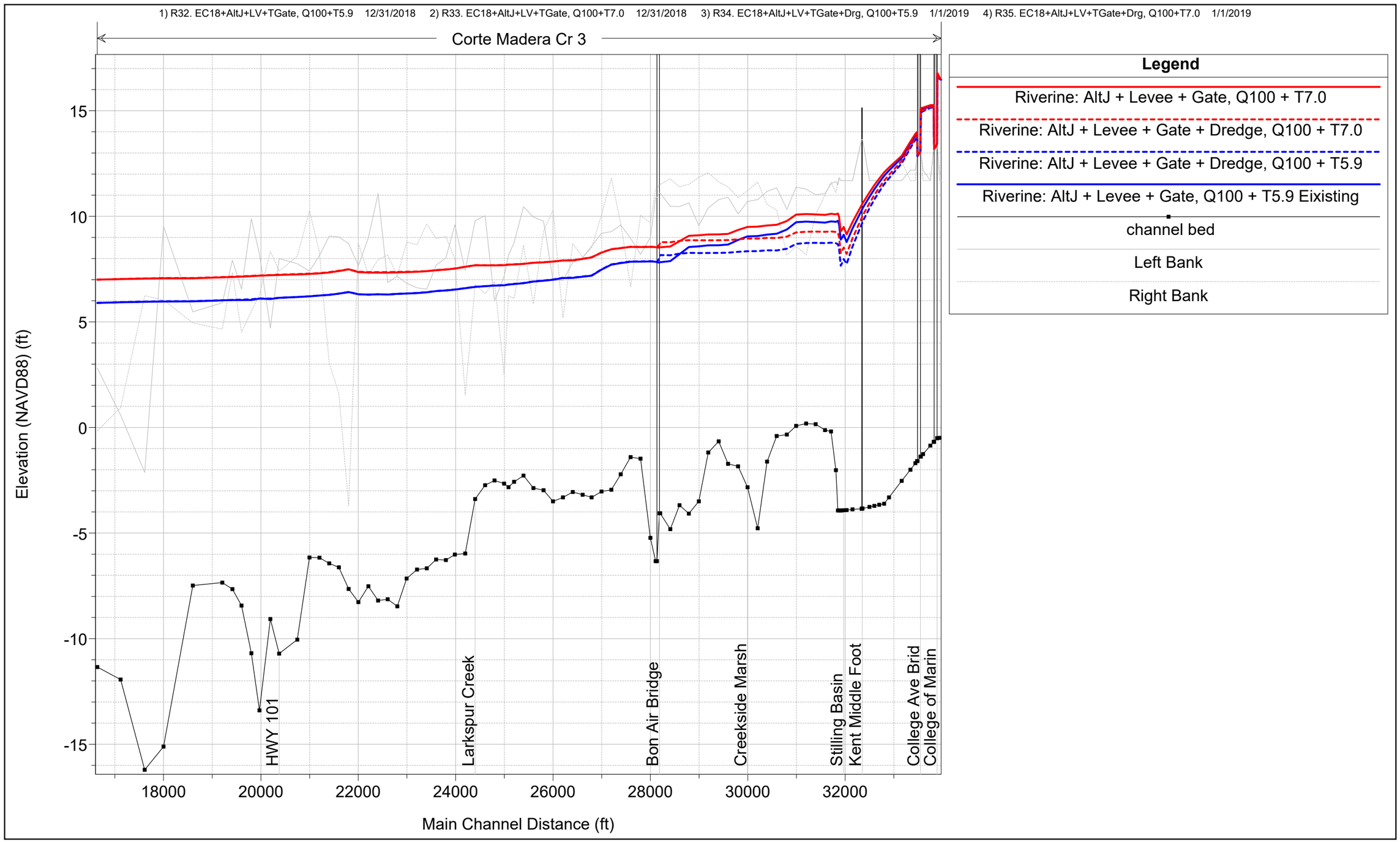


**Figure 16 Coastal 100-Year WSE Profiles; Scenarios #5, #6, #7, and #8** (solid blue, dashed blue, solid red, dashed red respectively)

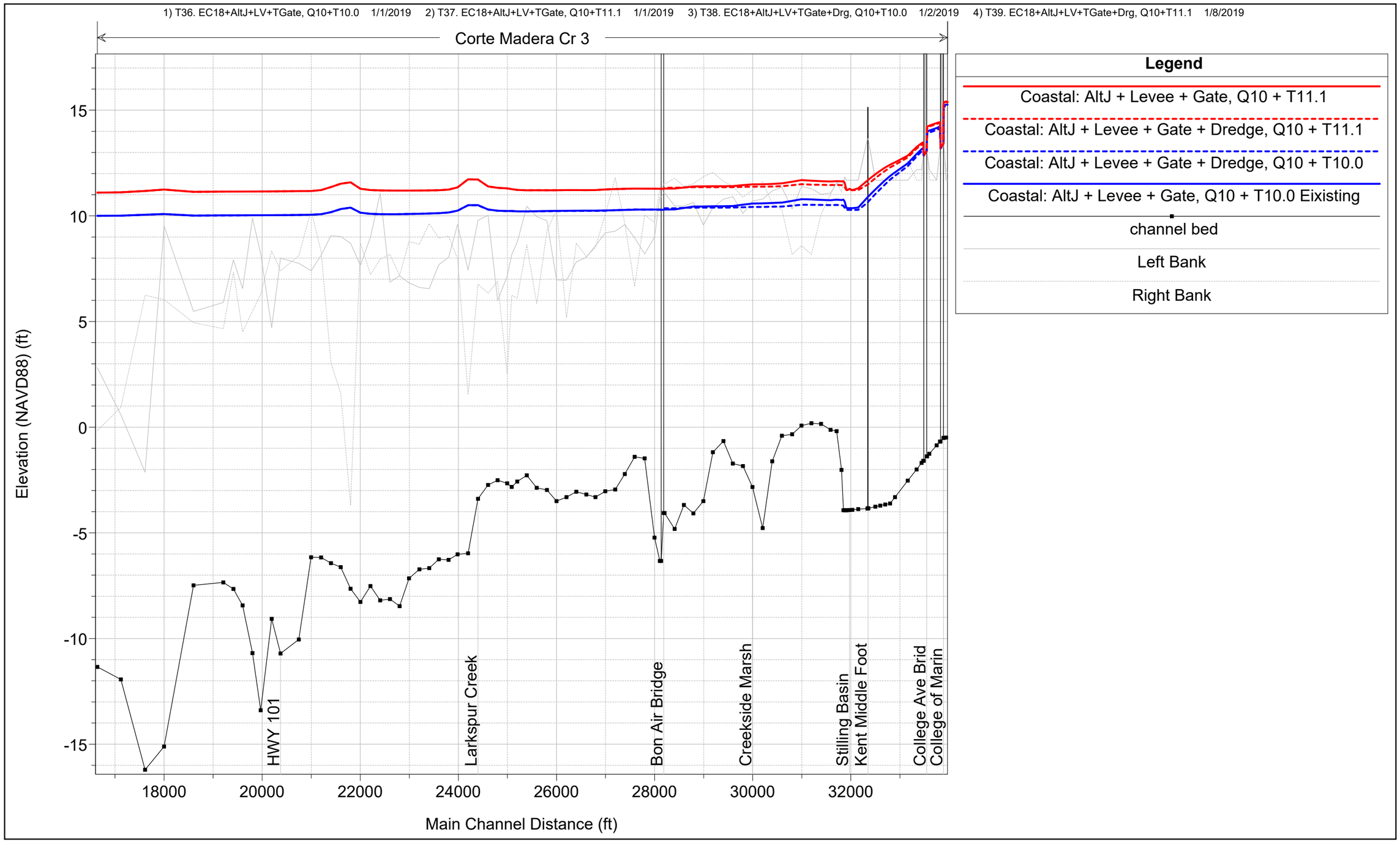


**Figure 17 Riverine and Coastal 100-Year WSE Profiles; (no dredge, no SLR); Scenarios #1 and #5**

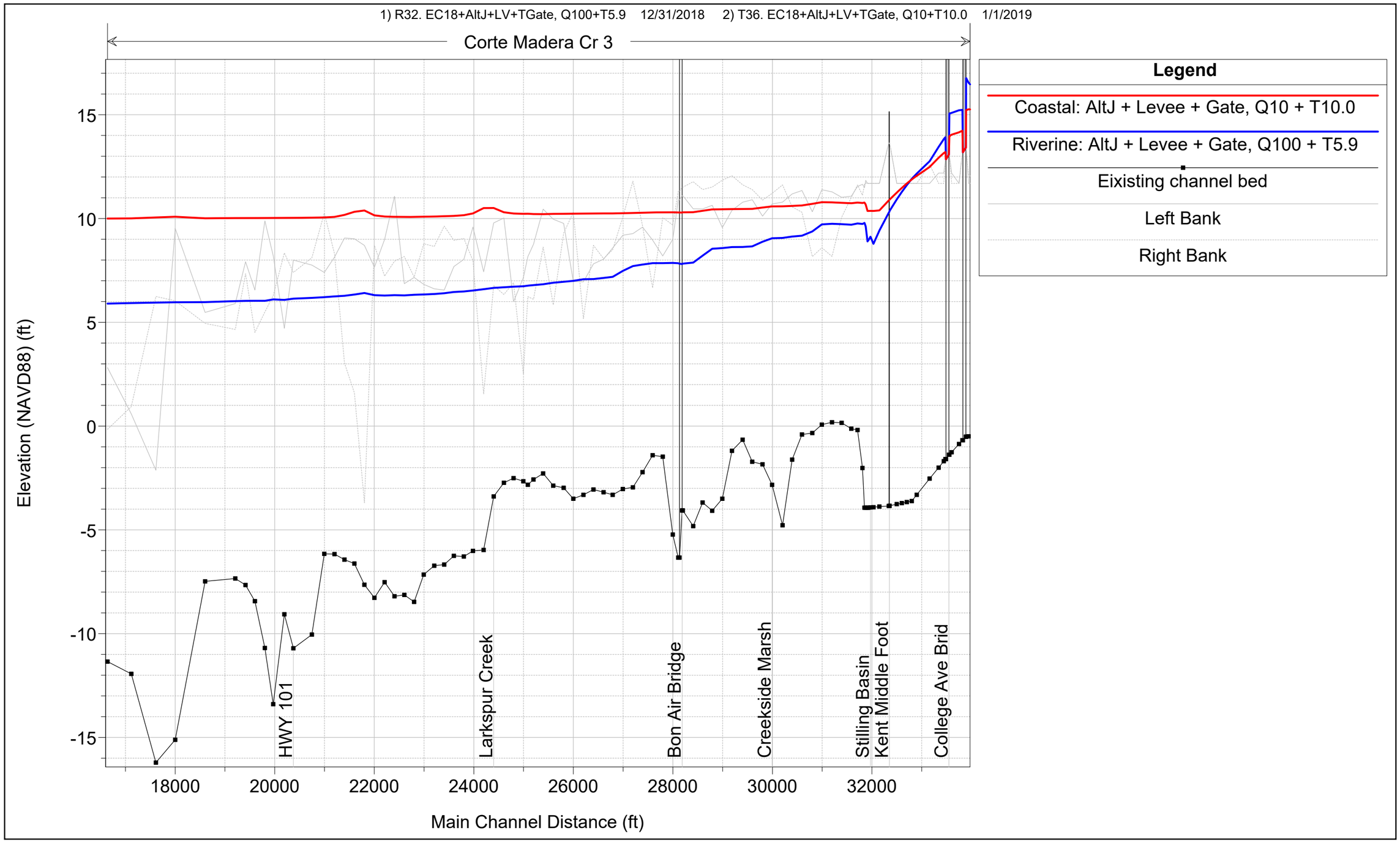


**Figure 18 Riverine and Coastal 100-Year WSE Profiles; (no dredge, with SLR); Scenarios #2 and #6**

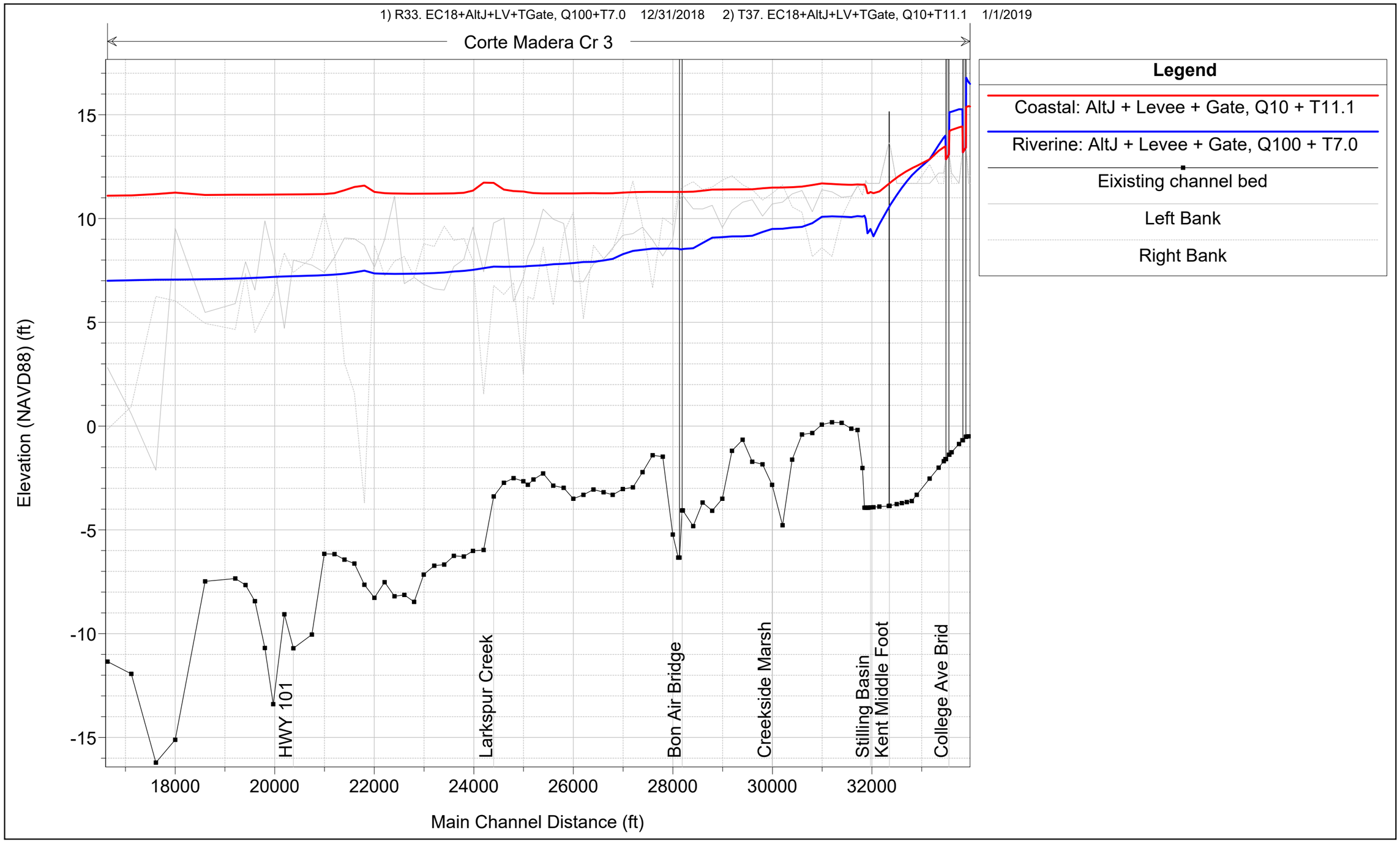


**Figure 19 Riverine and Coastal 100-Year WSE Profiles; (with dredge, no SLR); Scenarios #3 and #7**

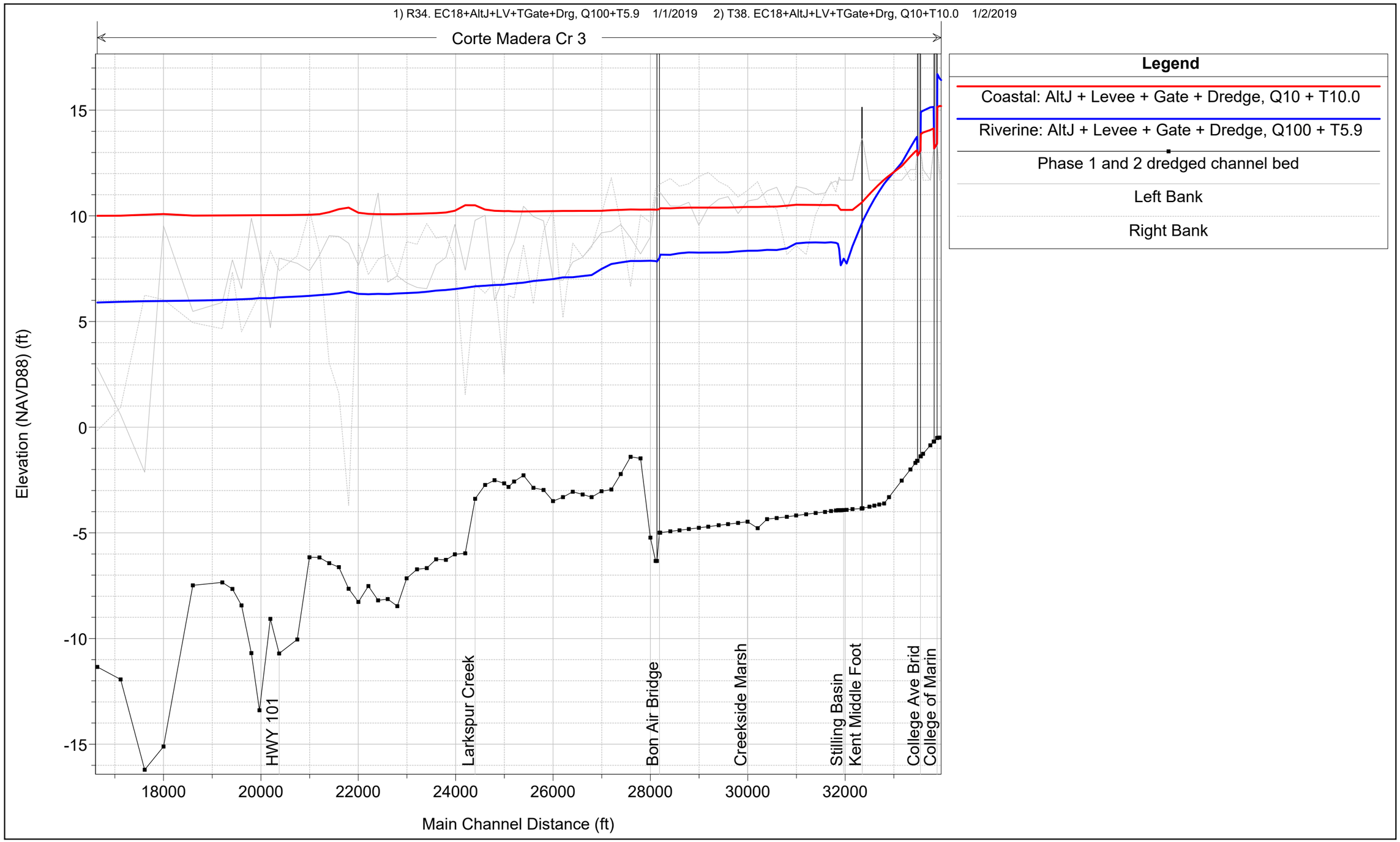


**Figure 20 Riverine and Coastal 100-Year WSE Profiles; (with dredge, with SLR); Scenarios #4 and #8**

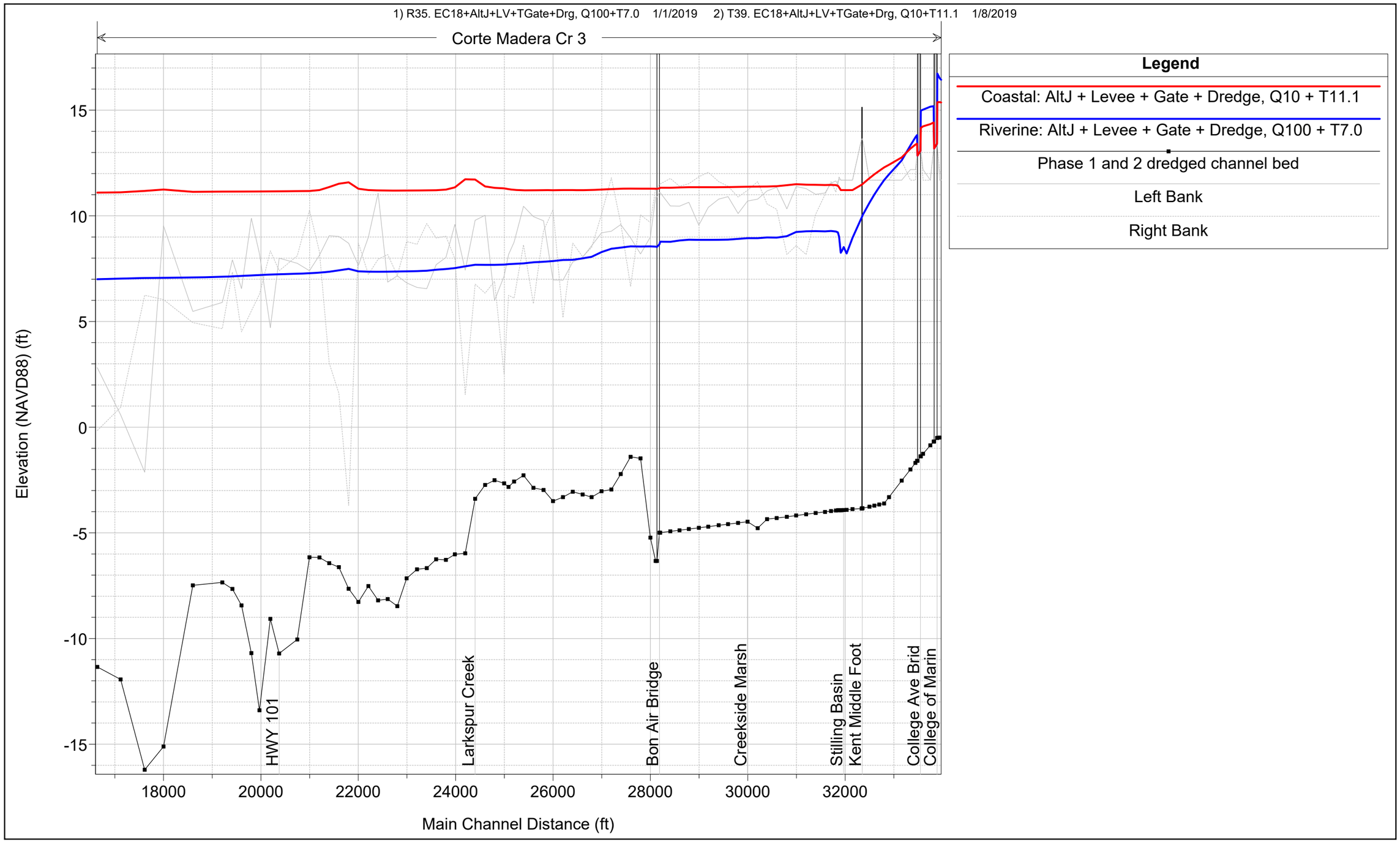


**Figure 21a**

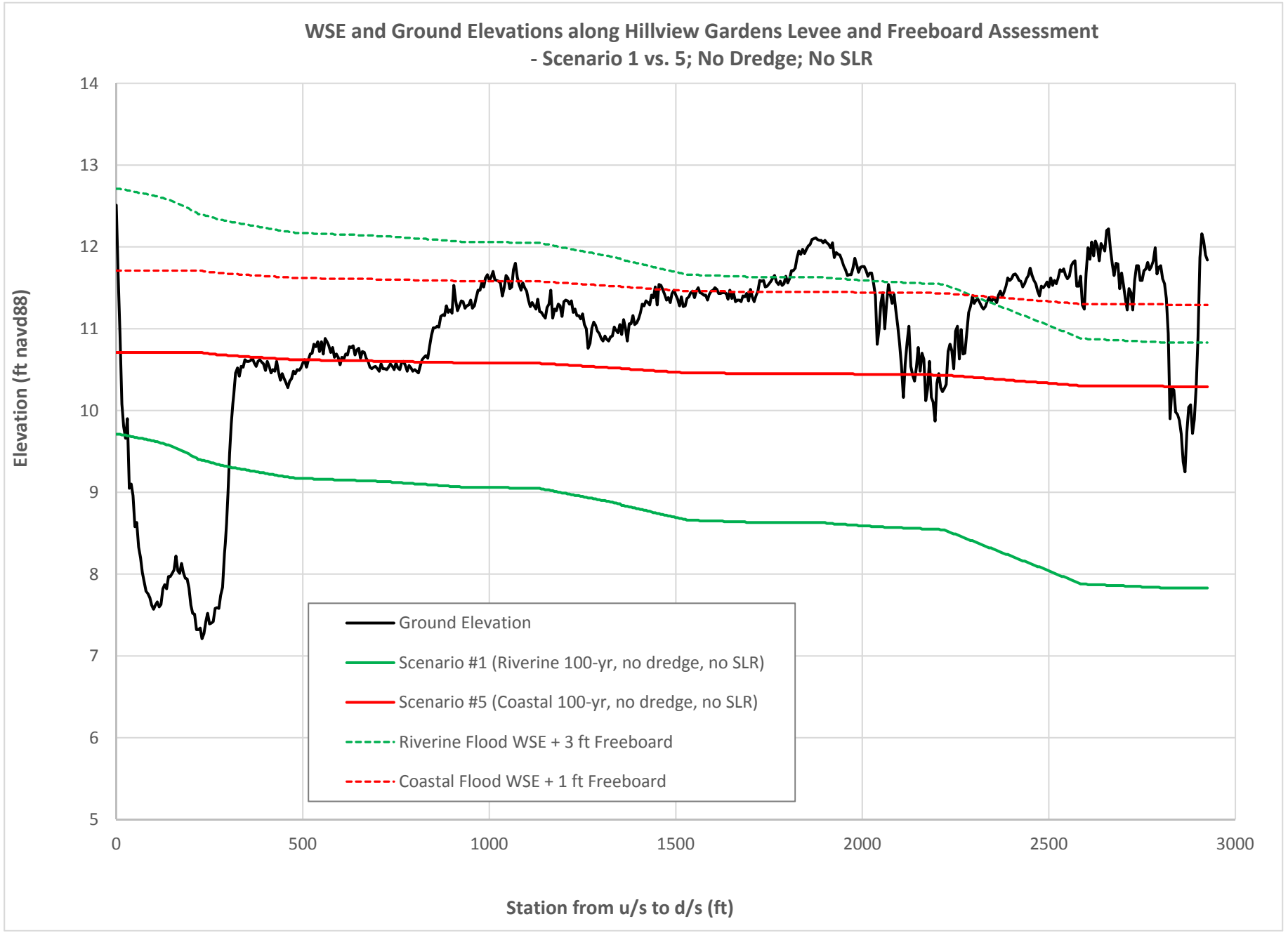

WSE and Ground Elevations along Hillview Gardens Levee and Freeboard Assessment
- Scenario 1 vs. 5; No Dredge; No SLR
Elevation (ft navd88)
14
13
12
11
10
9
8
7
6
5
0
500
1000
1500
2000
2500
3000
Station from u/s to d/s (ft)
Ground Elevation
Scenario #1 (Riverine 100-yr, no dredge, no SLR)
Scenario #5 (Coastal 100-yr, no dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 21b**

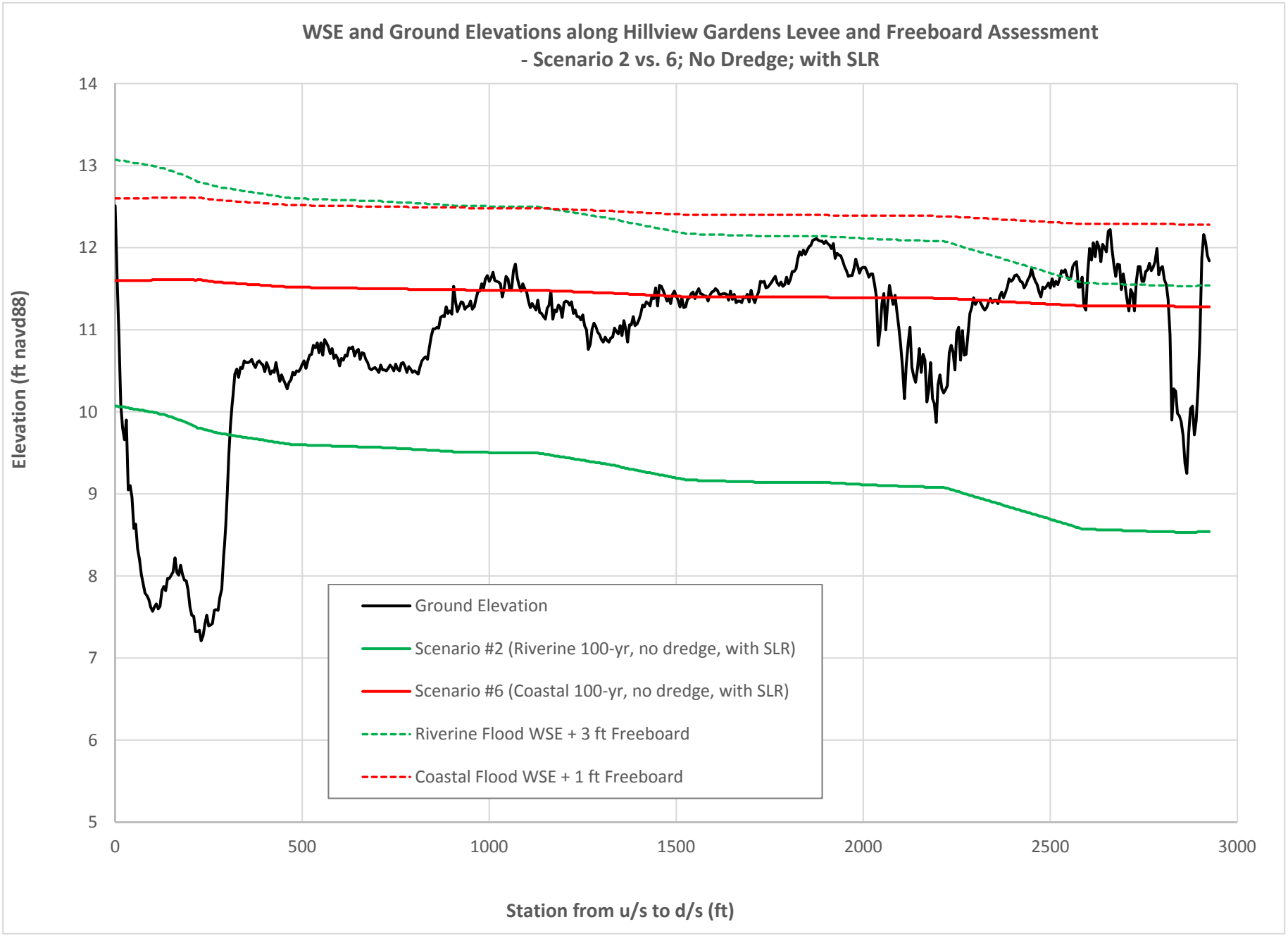

WSE and Ground Elevations along Hillview Gardens Levee and Freeboard Assessment
- Scenario 2 vs. 6; No Dredge; with SLR
Elevation (ft navd88)
14
13
12
11
10
9
8
7
6
5
0
500
1000
1500
2000
2500
3000
Station from u/s to d/s (ft)
Ground Elevation
Scenario #2 (Riverine 100-yr, no dredge, with SLR)
Scenario #6 (Coastal 100-yr, no dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 21c**

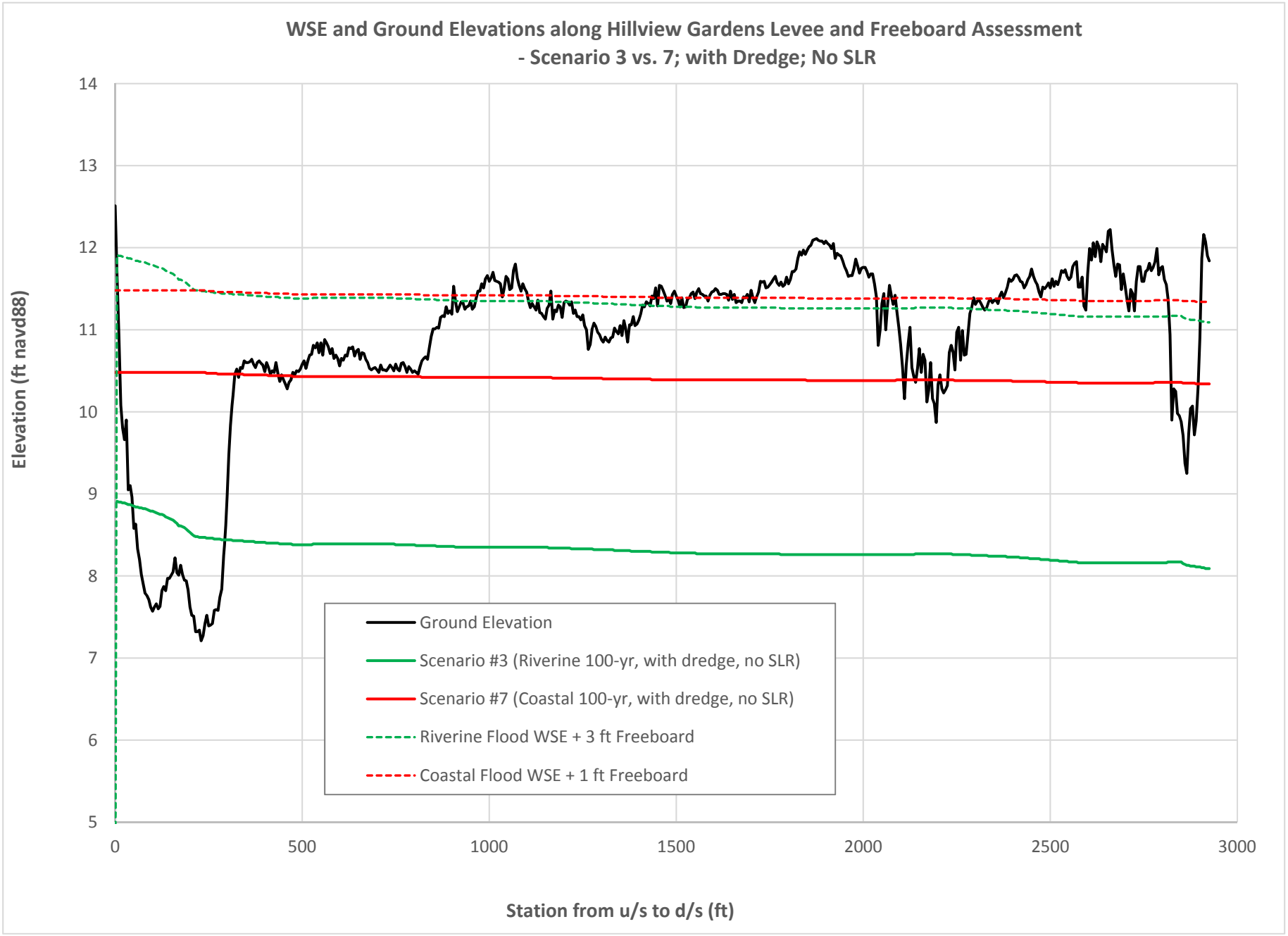

WSE and Ground Elevations along Hillview Gardens Levee and Freeboard Assessment
- Scenario 3 vs. 7; with Dredge; No SLR
Elevation (ft navd88)
14
13
12
11
10
9
8
7
6
5
0
500
1000
1500
2000
2500
3000
Station from u/s to d/s (ft)
Ground Elevation
Scenario #3 (Riverine 100-yr, with dredge, no SLR)
Scenario #7 (Coastal 100-yr, with dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 21d**

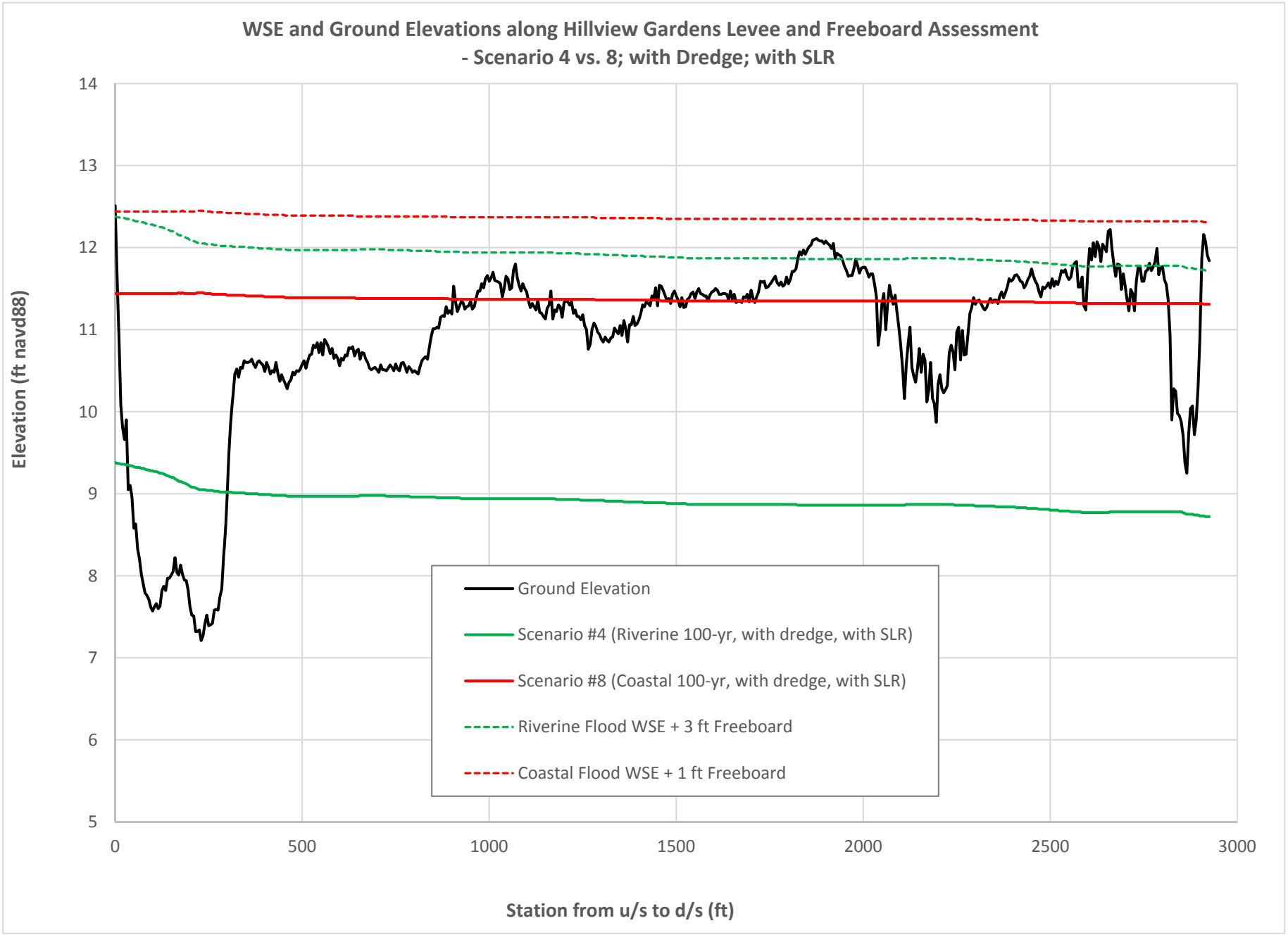

WSE and Ground Elevations along Hillview Gardens Levee and Freeboard Assessment
- Scenario 4 vs. 8; with Dredge; with SLR
Elevation (ft navd88)
14
13
12
11
10
9
8
7
6
5
0
500
1000
1500
2000
2500
3000
Station from u/s to d/s (ft)
Ground Elevation
Scenario #4 (Riverine 100-yr, with dredge, with SLR)
Scenario #8 (Coastal 100-yr, with dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 22a**

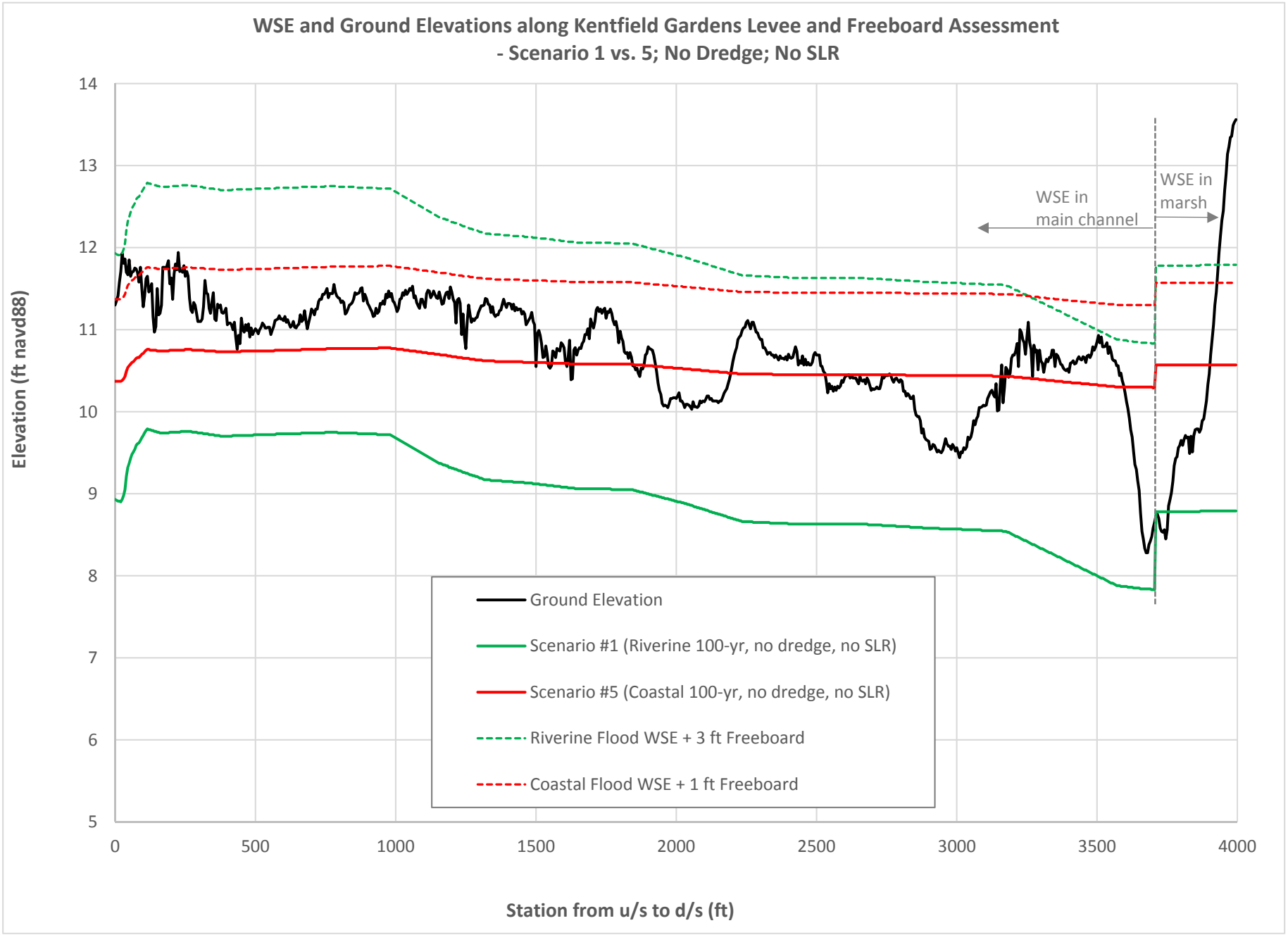

WSE and Ground Elevations along Kentfield Gardens Levee and Freeboard Assessment
- Scenario 1 vs. 5; No Dredge; No SLR
Elevation (ft navd88)
14
13
12
11
10
9
8
7
6
5
0
500
1000
1500
2000
2500
3000
3500
4000
Station from u/s to d/s (ft)
WSE in main channel
WSE in marsh
Ground Elevation
Scenario #1 (Riverine 100-yr, no dredge, no SLR)
Scenario #5 (Coastal 100-yr, no dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 22b**

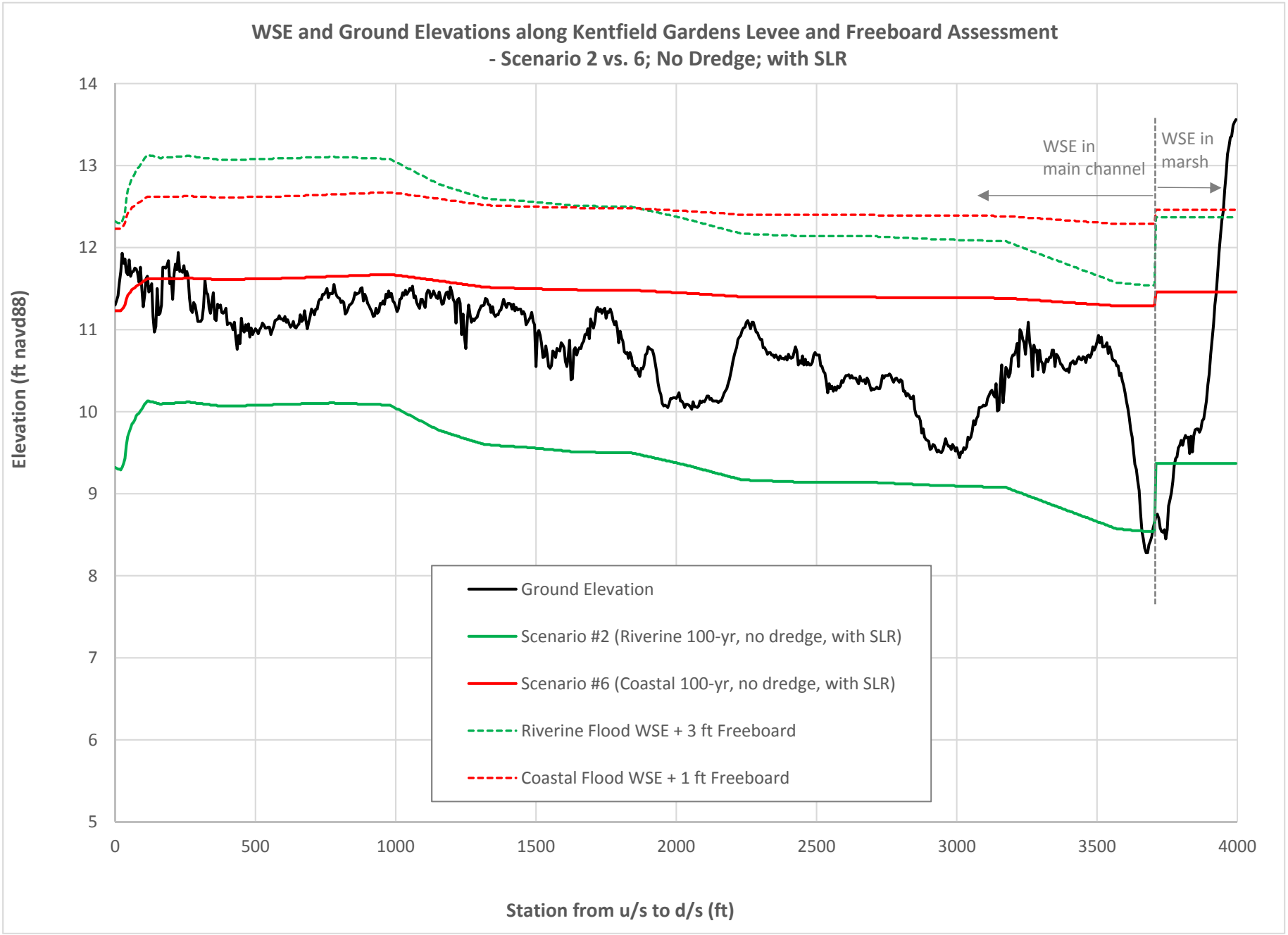

WSE and Ground Elevations along Kentfield Gardens Levee and Freeboard Assessment
- Scenario 2 vs. 6; No Dredge; with SLR
Elevation (ft navd88)
14
13
12
11
10
9
8
7
6
5
0
500
1000
1500
2000
2500
3000
3500
4000
Station from u/s to d/s (ft)
WSE in main channel
WSE in marsh
Ground Elevation
Scenario #2 (Riverine 100-yr, no dredge, with SLR)
Scenario #6 (Coastal 100-yr, no dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 22c**

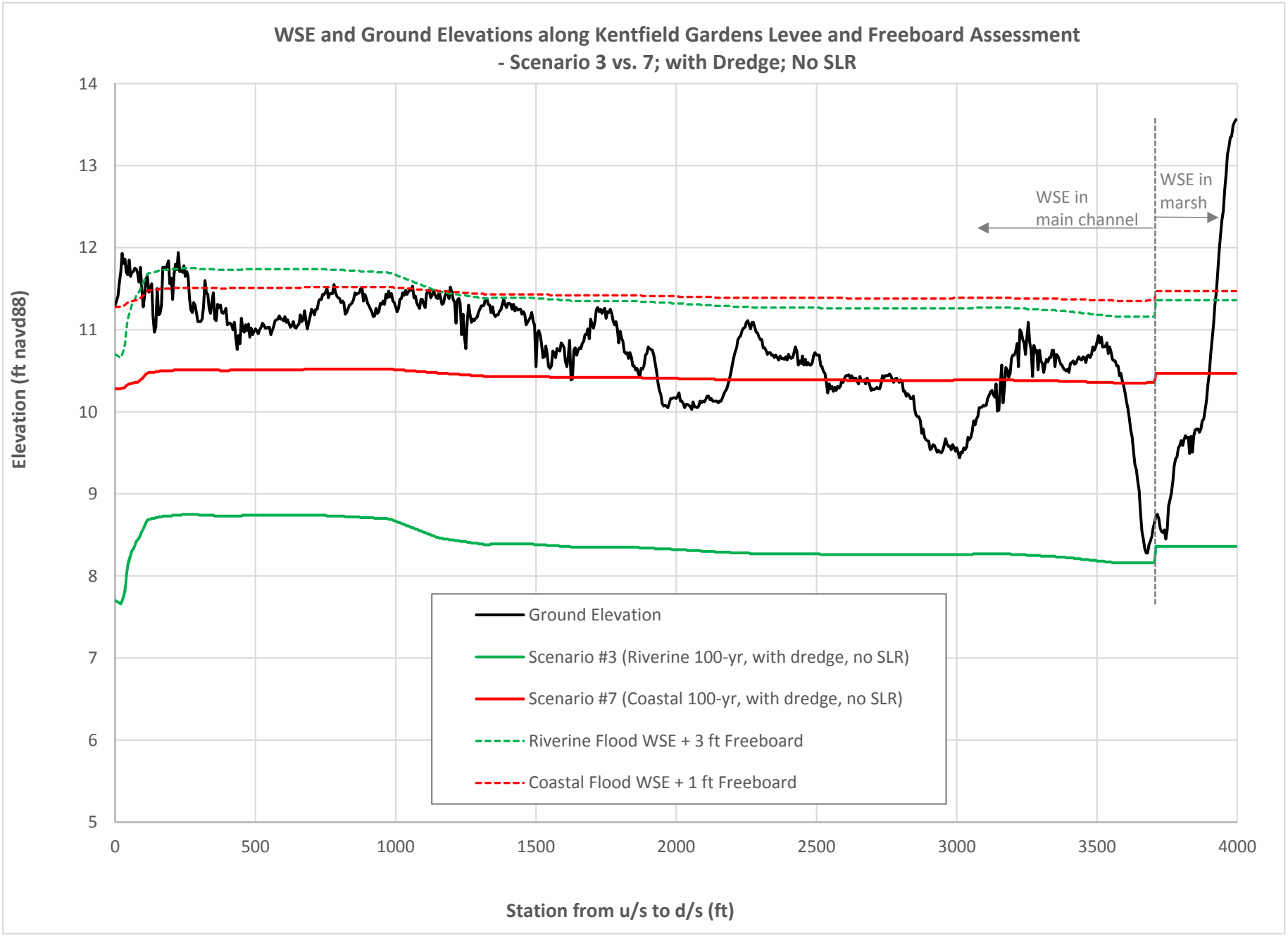

WSE and Ground Elevations along Kentfield Gardens Levee and Freeboard Assessment
- Scenario 3 vs. 7; with Dredge; No SLR
Elevation (ft navd88)
14
13
12
11
10
9
8
7
6
5
0
500
1000
1500
2000
2500
3000
3500
4000
Station from u/s to d/s (ft)
WSE in main channel
WSE in marsh
Ground Elevation
Scenario #3 (Riverine 100-yr, with dredge, no SLR)
Scenario #7 (Coastal 100-yr, with dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 22d**

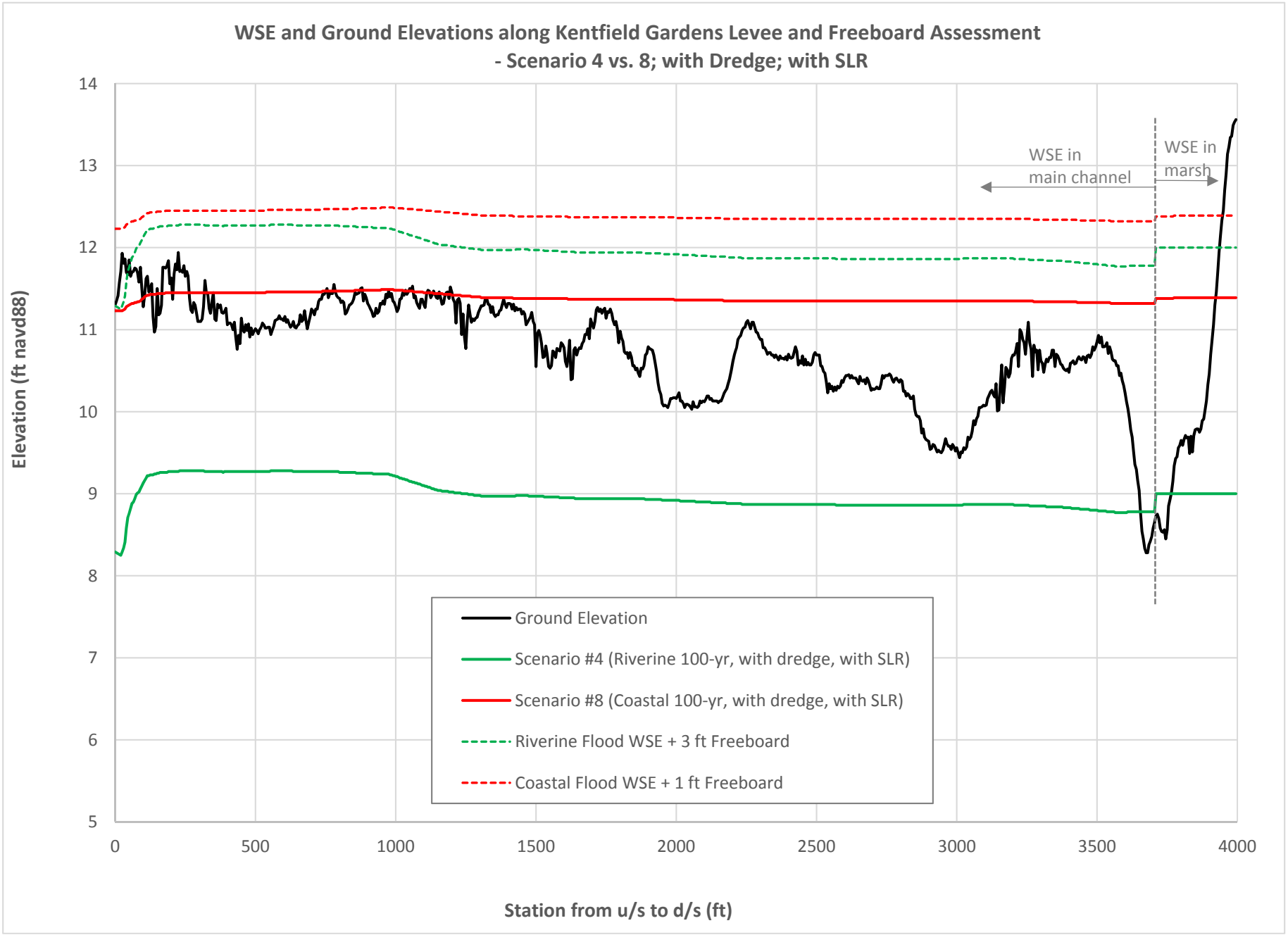

WSE and Ground Elevations along Kentfield Gardens Levee and Freeboard Assessment
- Scenario 4 vs. 8; with Dredge; with SLR
Elevation (ft navd88)
14
13
12
11
10
9
8
7
6
5
0
500
1000
1500
2000
2500
3000
3500
4000
Station from u/s to d/s (ft)
WSE in main channel
WSE in marsh
Ground Elevation
Scenario #4 (Riverine 100-yr, with dredge, with SLR)
Scenario #8 (Coastal 100-yr, with dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 23a**

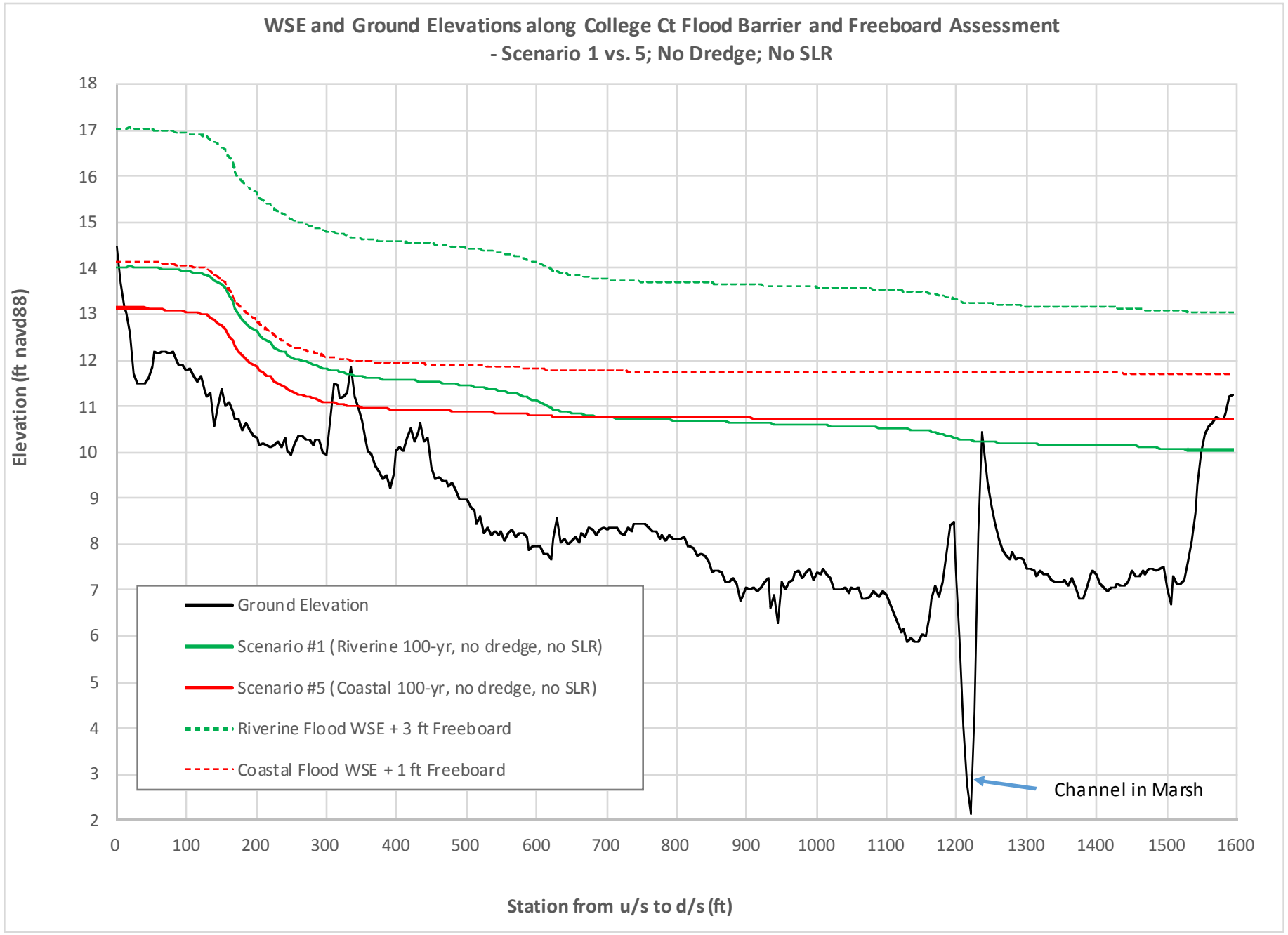

WSE and Ground Elevations along College Ct Flood Barrier and Freeboard Assessment
- Scenario 1 vs. 5; No Dredge; No SLR
Elevation (ft navd88)
Station from u/s to d/s (ft)
Ground Elevation
Scenario #1 (Riverine 100-yr, no dredge, no SLR)
Scenario #5 (Coastal 100-yr, no dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard
Channel in Marsh
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600

**Figure 23b**

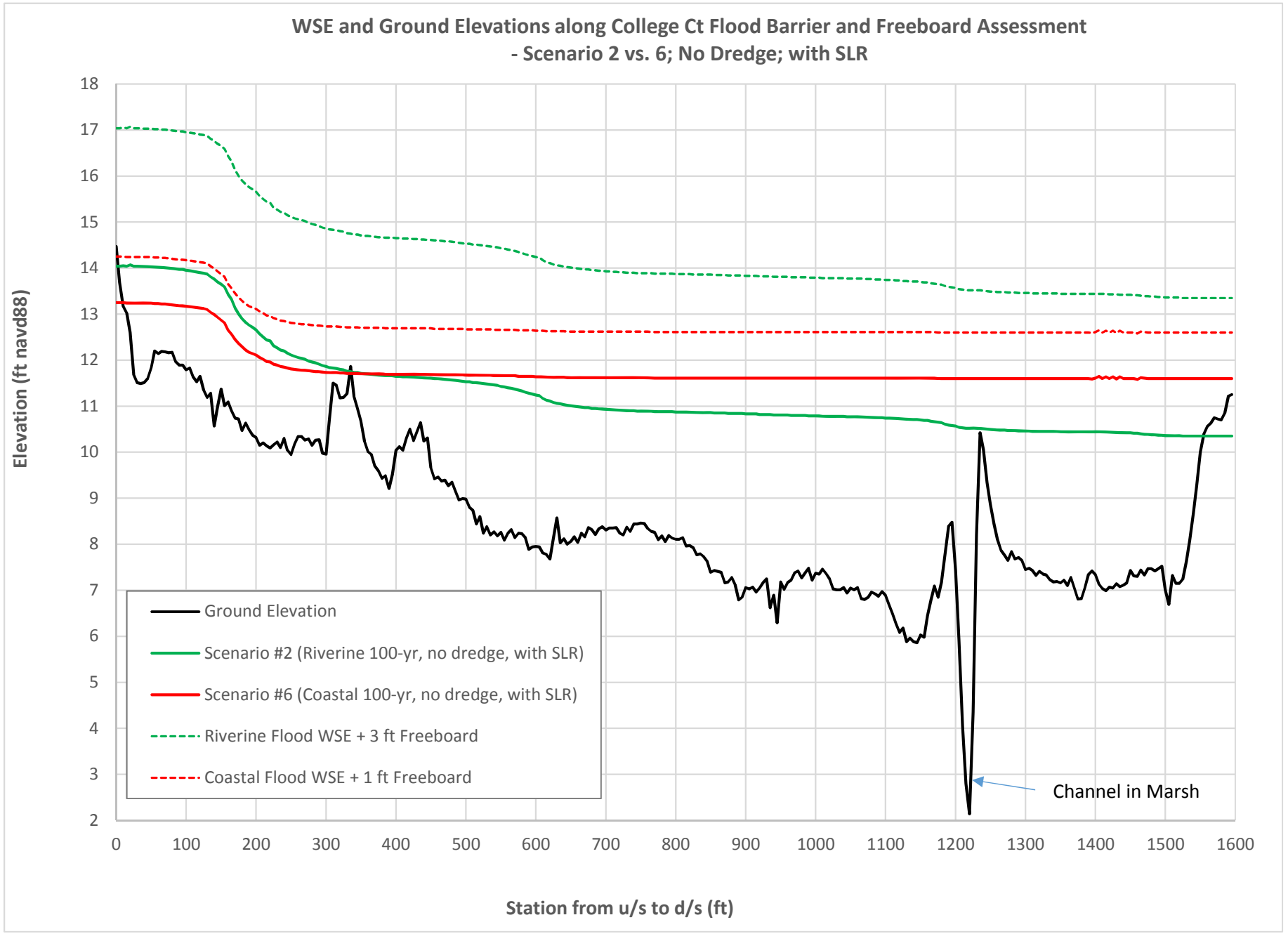

WSE and Ground Elevations along College Ct Flood Barrier and Freeboard Assessment
- Scenario 2 vs. 6; No Dredge; with SLR
Elevation (ft navd88)
Station from u/s to d/s (ft)
Ground Elevation
Scenario #2 (Riverine 100-yr, no dredge, with SLR)
Scenario #6 (Coastal 100-yr, no dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard
Channel in Marsh

**Figure 23c**

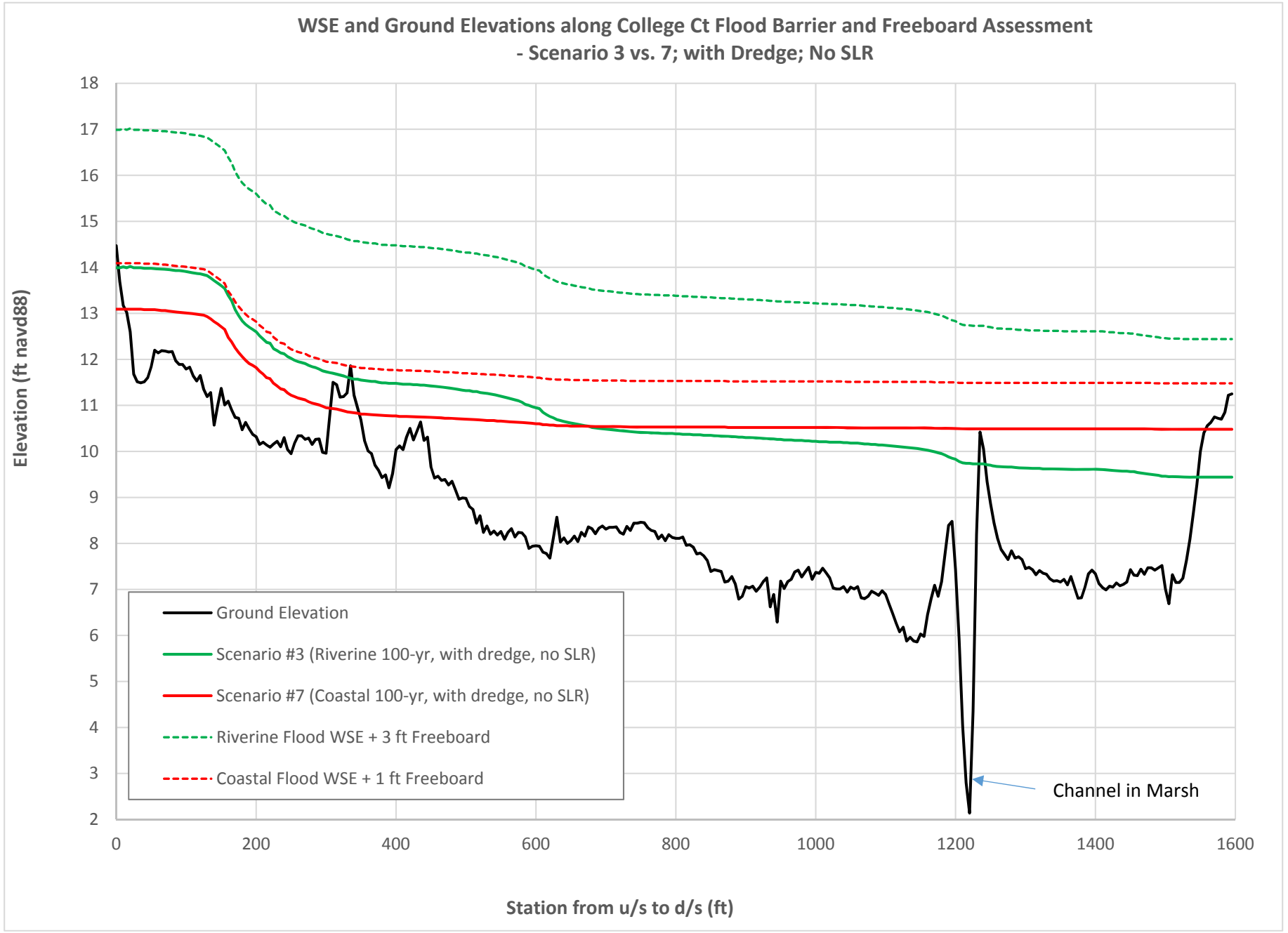

WSE and Ground Elevations along College Ct Flood Barrier and Freeboard Assessment
- Scenario 3 vs. 7; with Dredge; No SLR
Elevation (ft navd88)
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
0
200
400
600
800
1000
1200
1400
1600
Station from u/s to d/s (ft)
Ground Elevation
Scenario #3 (Riverine 100-yr, with dredge, no SLR)
Scenario #7 (Coastal 100-yr, with dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard
Channel in Marsh

**Figure 23d**

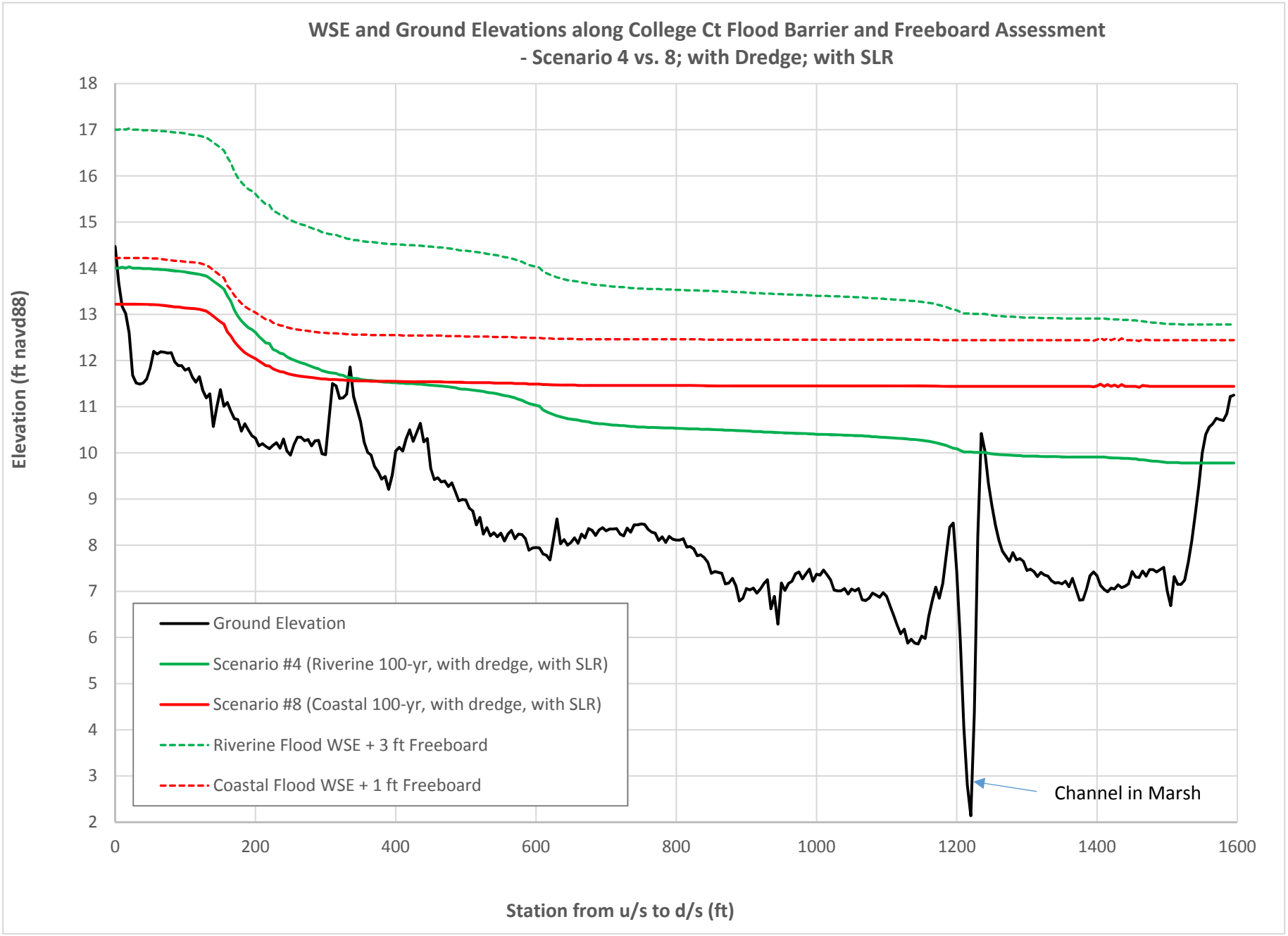

WSE and Ground Elevations along College Ct Flood Barrier and Freeboard Assessment
- Scenario 4 vs. 8; with Dredge; with SLR
Elevation (ft navd88)
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
0
200
400
600
800
1000
1200
1400
1600
Station from u/s to d/s (ft)
Ground Elevation
Scenario #4 (Riverine 100-yr, with dredge, with SLR)
Scenario #8 (Coastal 100-yr, with dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard
Channel in Marsh

**Figure 24a**

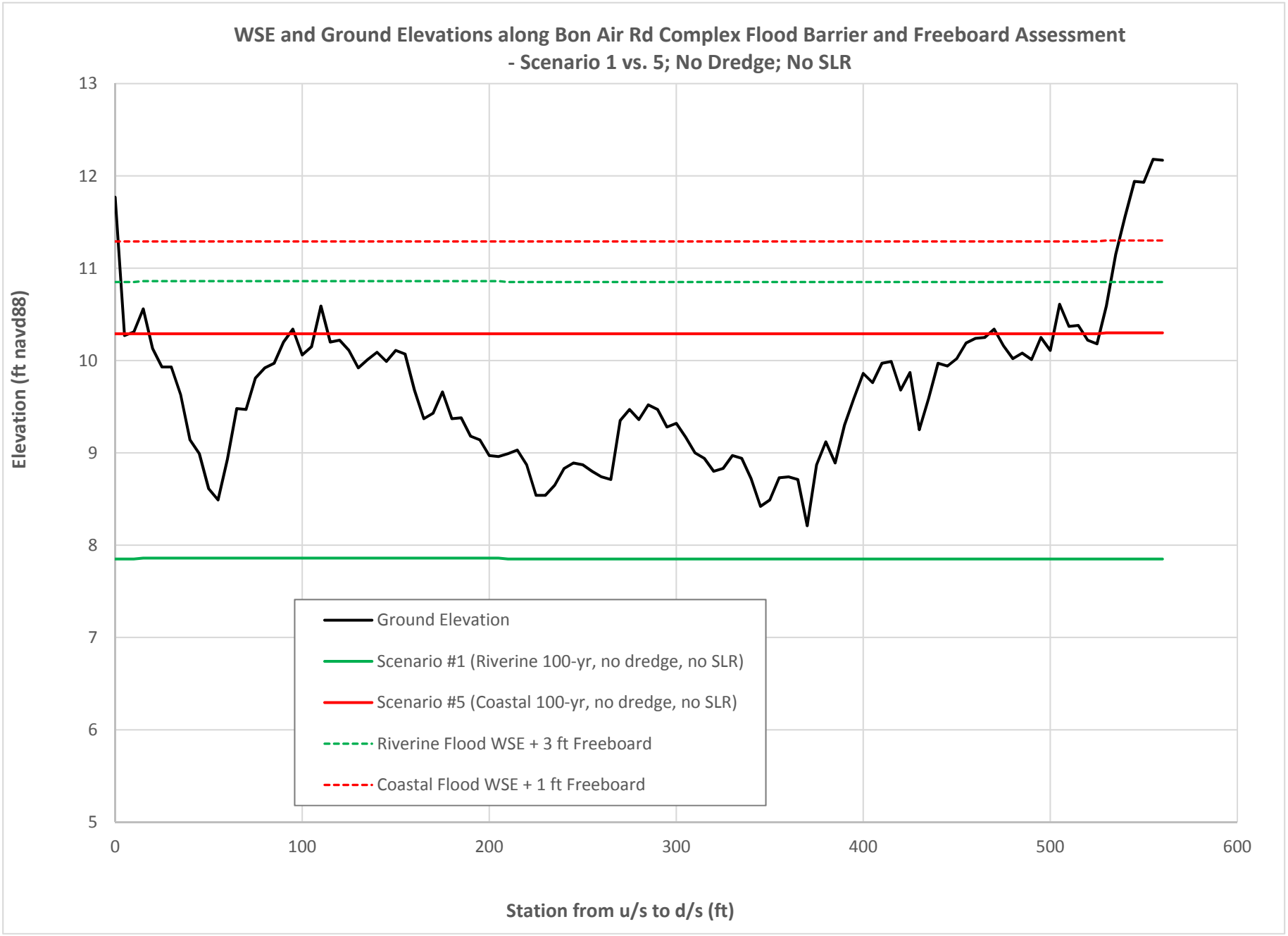

WSE and Ground Elevations along Bon Air Rd Complex Flood Barrier and Freeboard Assessment
- Scenario 1 vs. 5; No Dredge; No SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
0
100
200
300
400
500
600
Station from u/s to d/s (ft)
Ground Elevation
Scenario #1 (Riverine 100-yr, no dredge, no SLR)
Scenario #5 (Coastal 100-yr, no dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 24b**

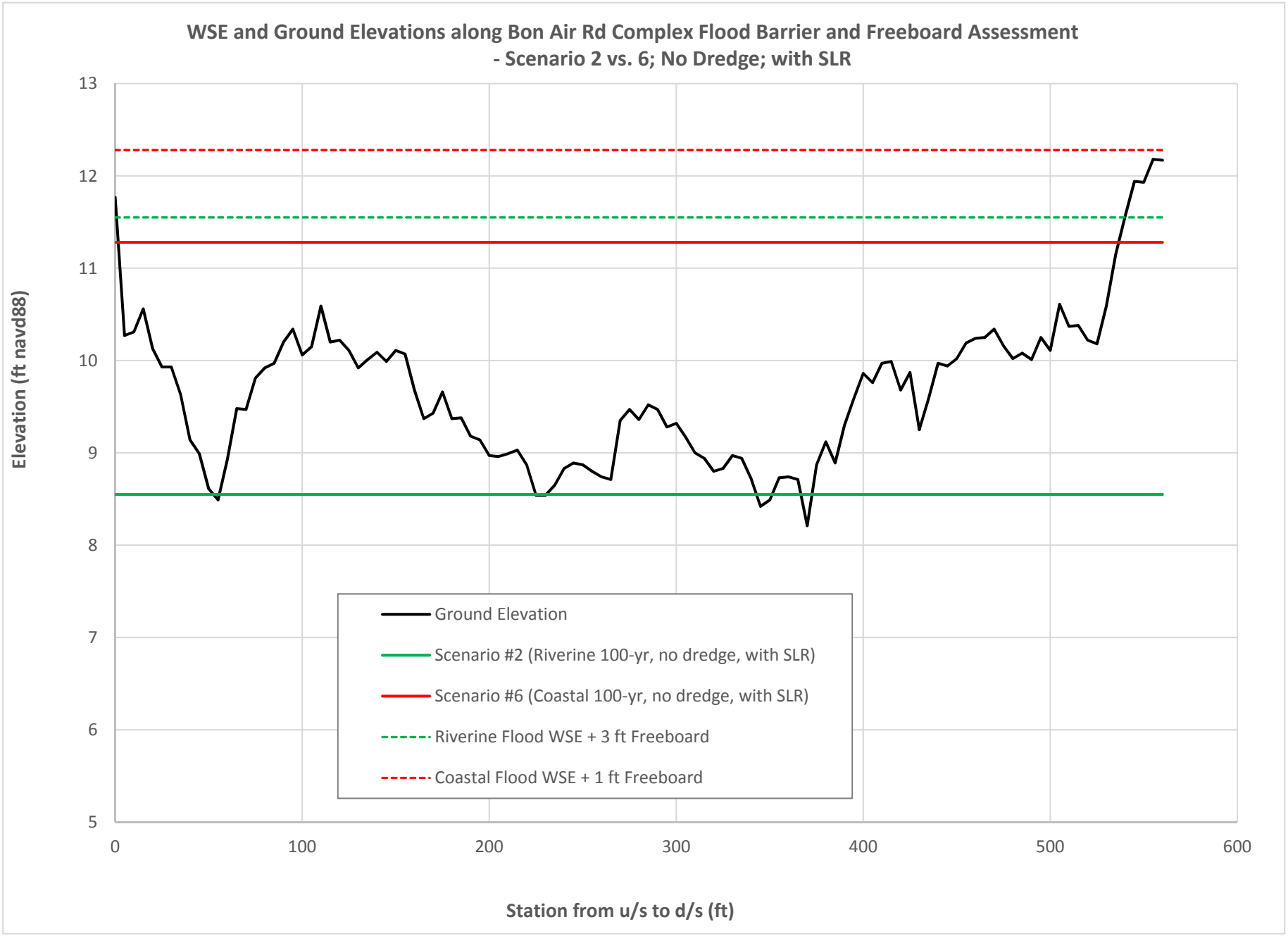

WSE and Ground Elevations along Bon Air Rd Complex Flood Barrier and Freeboard Assessment
- Scenario 2 vs. 6; No Dredge; with SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
0
100
200
300
400
500
600
Station from u/s to d/s (ft)
Ground Elevation
Scenario #2 (Riverine 100-yr, no dredge, with SLR)
Scenario #6 (Coastal 100-yr, no dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 24c**

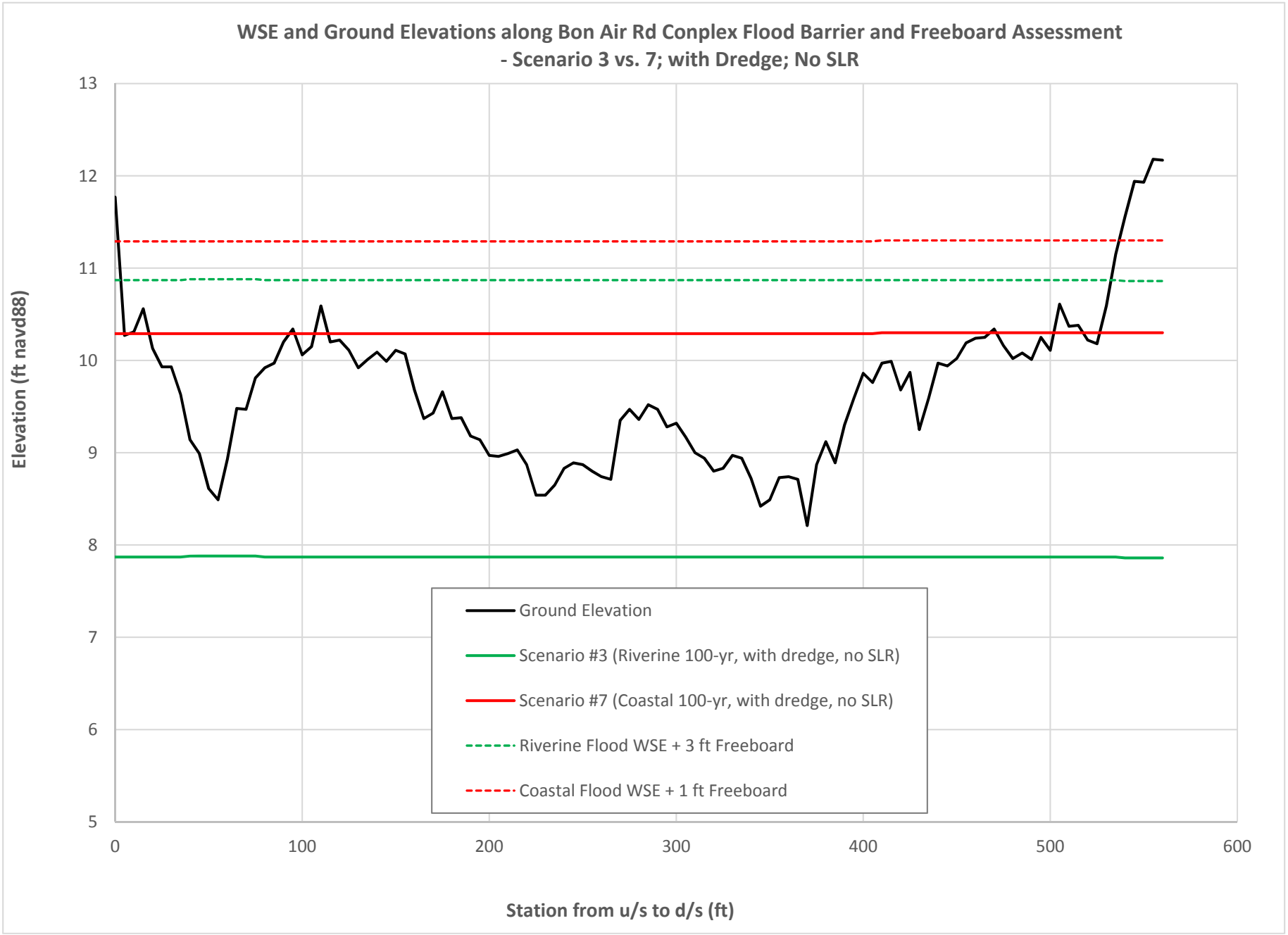

WSE and Ground Elevations along Bon Air Rd Conplex Flood Barrier and Freeboard Assessment
- Scenario 3 vs. 7; with Dredge; No SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
0
100
200
300
400
500
600
Station from u/s to d/s (ft)
Ground Elevation
Scenario #3 (Riverine 100-yr, with dredge, no SLR)
Scenario #7 (Coastal 100-yr, with dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 24d**

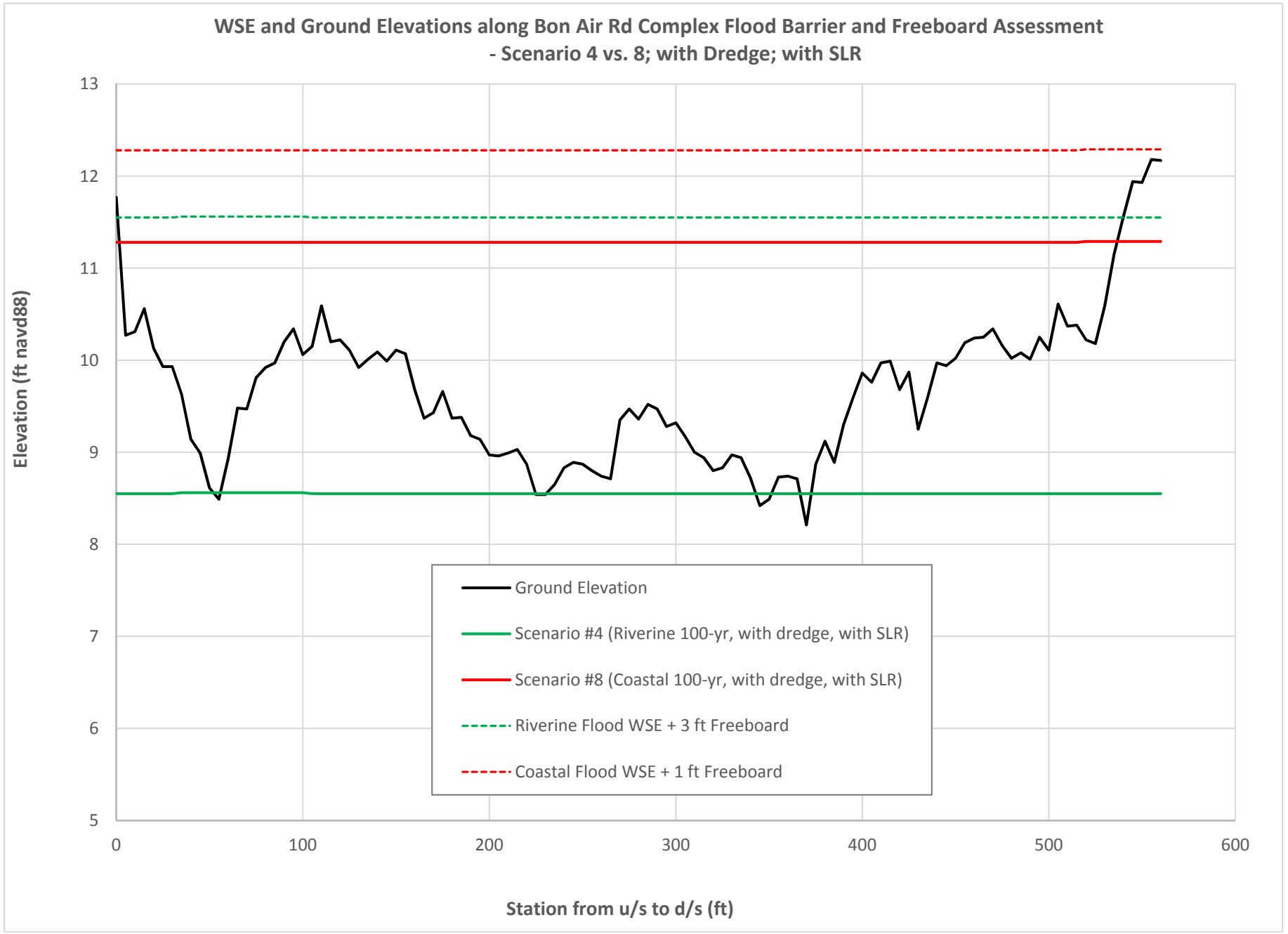

WSE and Ground Elevations along Bon Air Rd Complex Flood Barrier and Freeboard Assessment
- Scenario 4 vs. 8; with Dredge; with SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
0
100
200
300
400
500
600
Station from u/s to d/s (ft)
Ground Elevation
Scenario #4 (Riverine 100-yr, with dredge, with SLR)
Scenario #8 (Coastal 100-yr, with dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 25a**

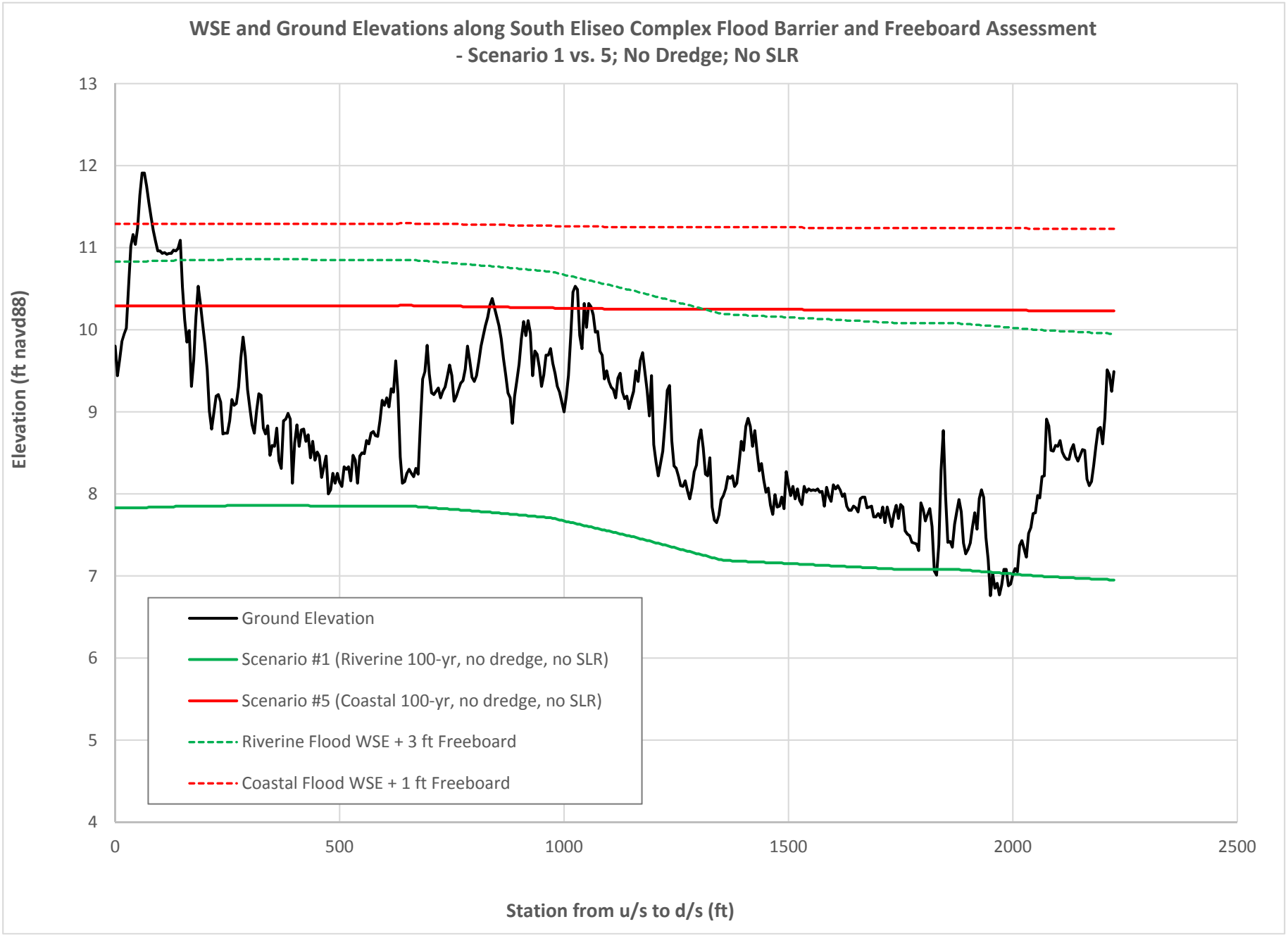

WSE and Ground Elevations along South Eliseo Complex Flood Barrier and Freeboard Assessment
- Scenario 1 vs. 5; No Dredge; No SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
500
1000
1500
2000
2500
Station from u/s to d/s (ft)
Ground Elevation
Scenario #1 (Riverine 100-yr, no dredge, no SLR)
Scenario #5 (Coastal 100-yr, no dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 25b**

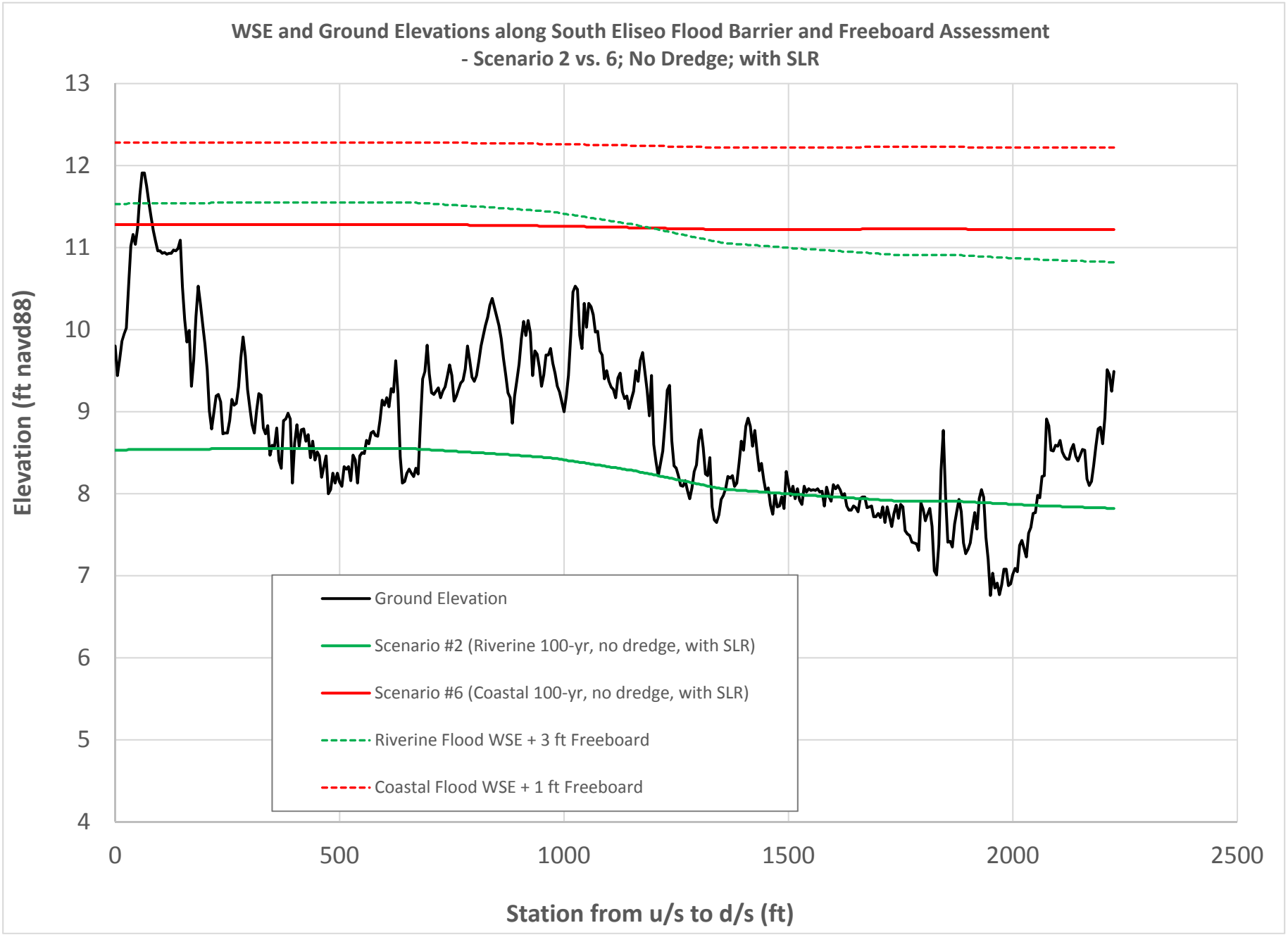

WSE and Ground Elevations along South Eliseo Flood Barrier and Freeboard Assessment
- Scenario 2 vs. 6; No Dredge; with SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
500
1000
1500
2000
2500
Station from u/s to d/s (ft)
Ground Elevation
Scenario #2 (Riverine 100-yr, no dredge, with SLR)
Scenario #6 (Coastal 100-yr, no dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 25c**

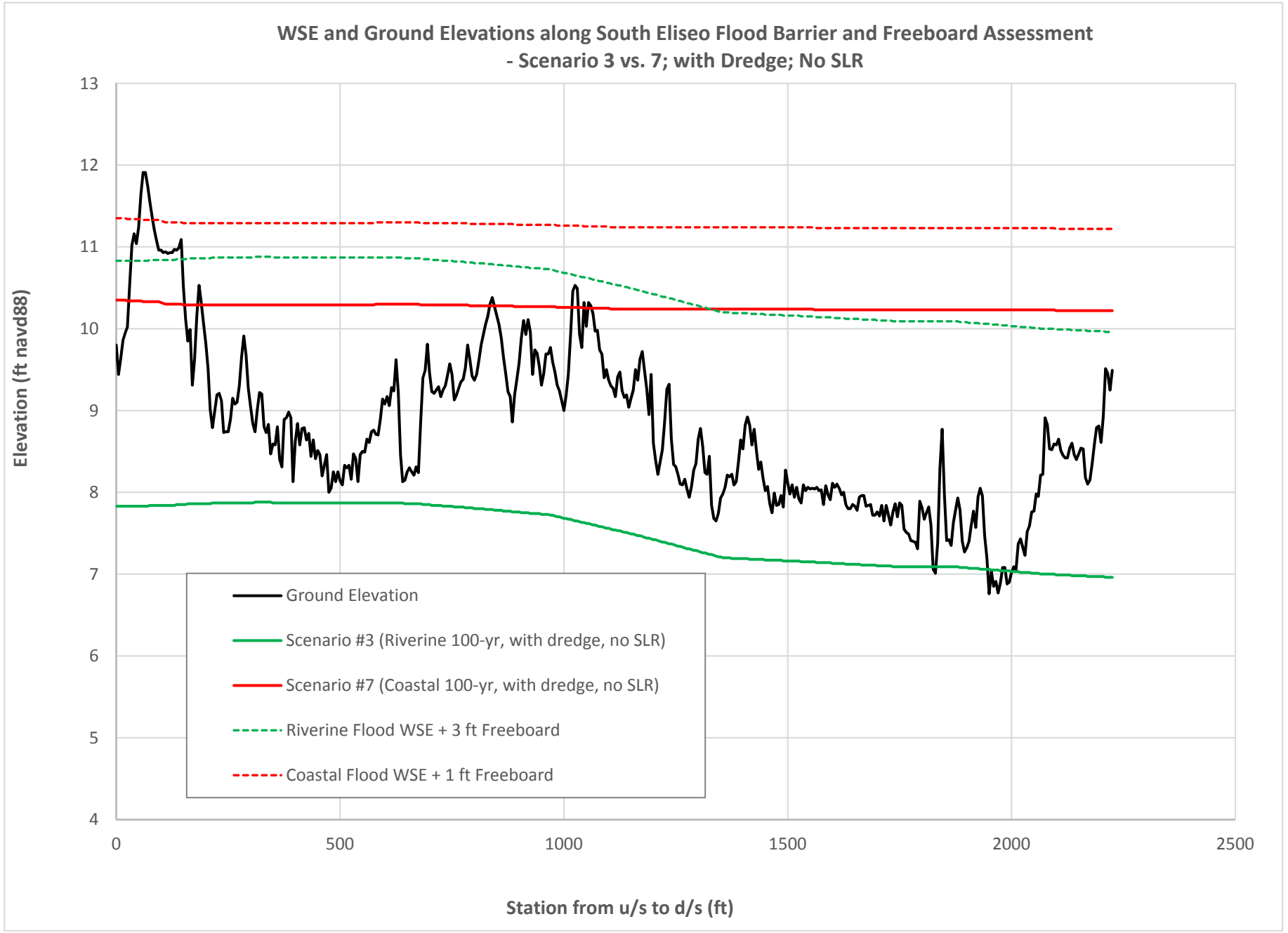

WSE and Ground Elevations along South Eliseo Flood Barrier and Freeboard Assessment
- Scenario 3 vs. 7; with Dredge; No SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
500
1000
1500
2000
2500
Station from u/s to d/s (ft)
Ground Elevation
Scenario #3 (Riverine 100-yr, with dredge, no SLR)
Scenario #7 (Coastal 100-yr, with dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 25d**

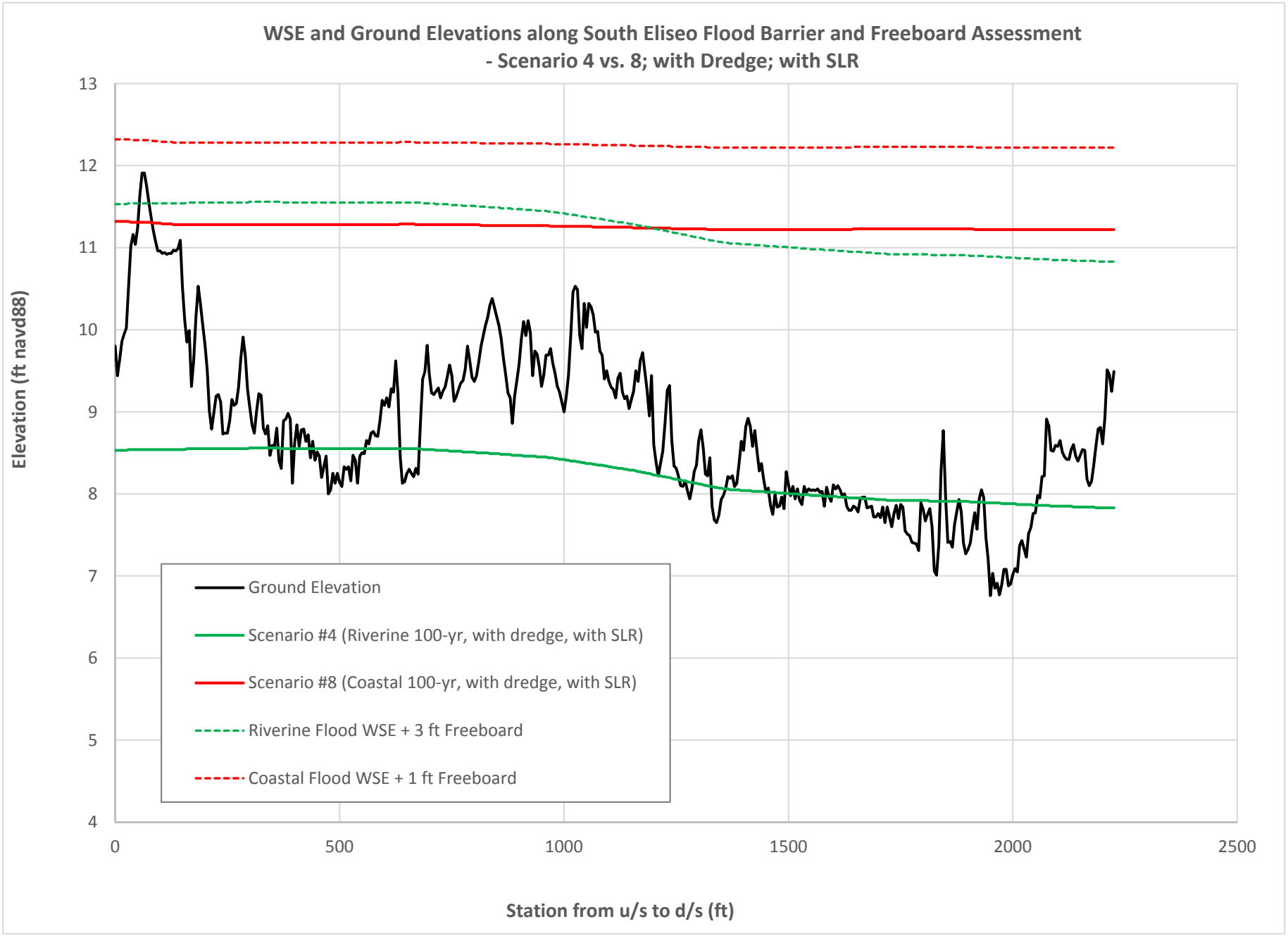

WSE and Ground Elevations along South Eliseo Flood Barrier and Freeboard Assessment
- Scenario 4 vs. 8; with Dredge; with SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
500
1000
1500
2000
2500
Station from u/s to d/s (ft)
Ground Elevation
Scenario #4 (Riverine 100-yr, with dredge, with SLR)
Scenario #8 (Coastal 100-yr, with dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 26a**

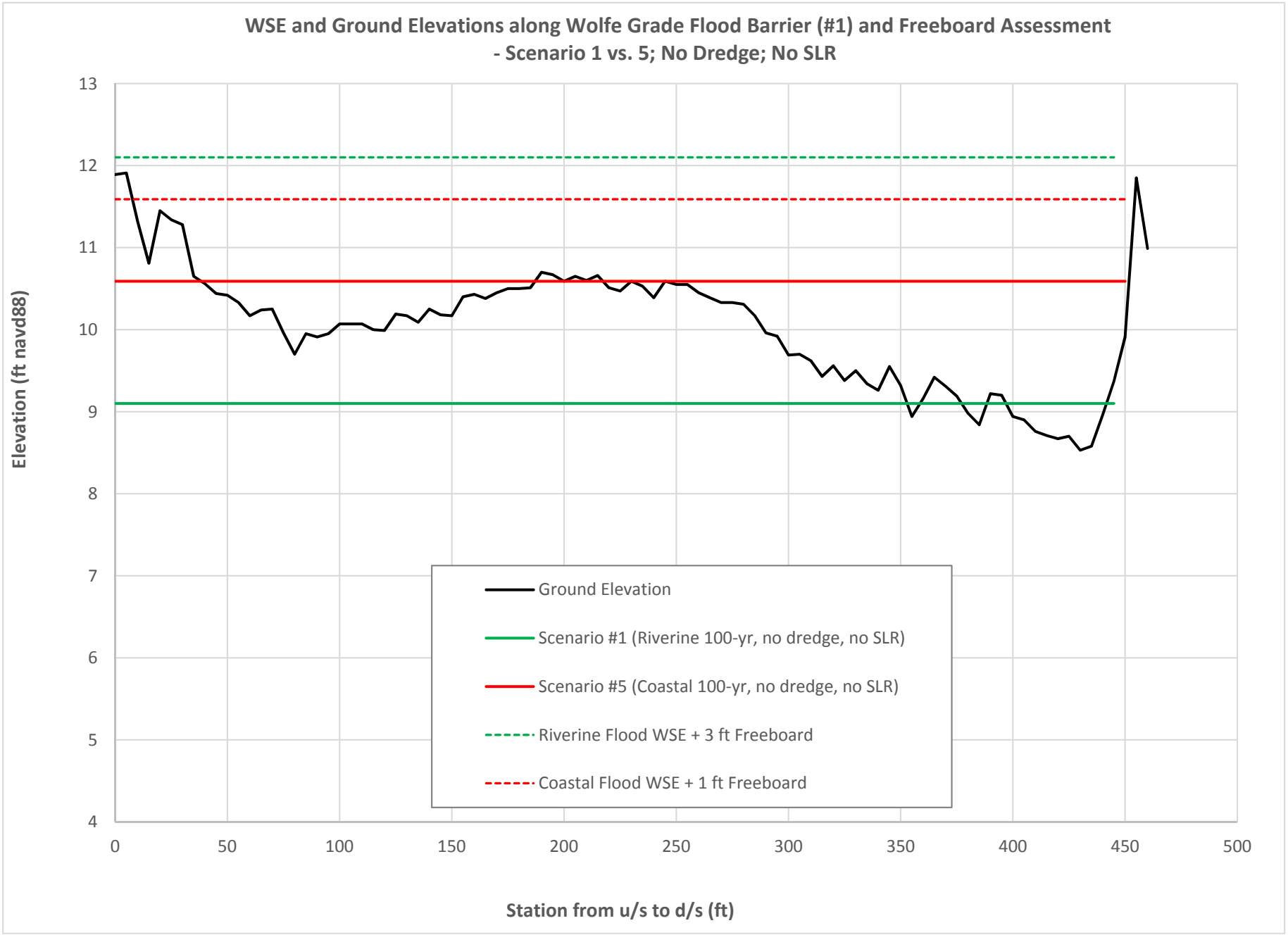

WSE and Ground Elevations along Wolfe Grade Flood Barrier (#1) and Freeboard Assessment
- Scenario 1 vs. 5; No Dredge; No SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
50
100
150
200
250
300
350
400
450
500
Station from u/s to d/s (ft)
Ground Elevation
Scenario #1 (Riverine 100-yr, no dredge, no SLR)
Scenario #5 (Coastal 100-yr, no dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 26b**

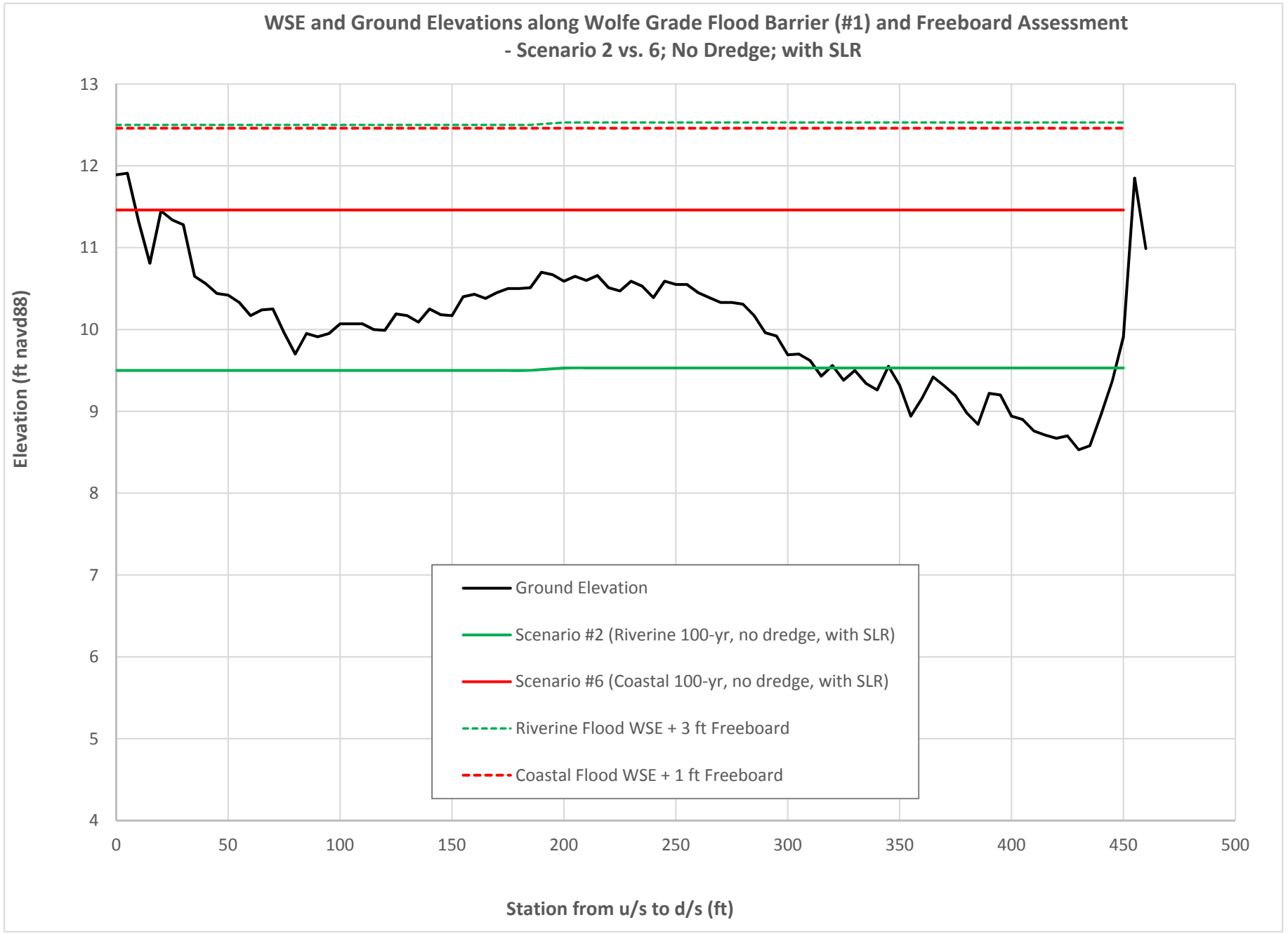

WSE and Ground Elevations along Wolfe Grade Flood Barrier (#1) and Freeboard Assessment
- Scenario 2 vs. 6; No Dredge; with SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
50
100
150
200
250
300
350
400
450
500
Station from u/s to d/s (ft)
Ground Elevation
Scenario #2 (Riverine 100-yr, no dredge, with SLR)
Scenario #6 (Coastal 100-yr, no dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 26c**

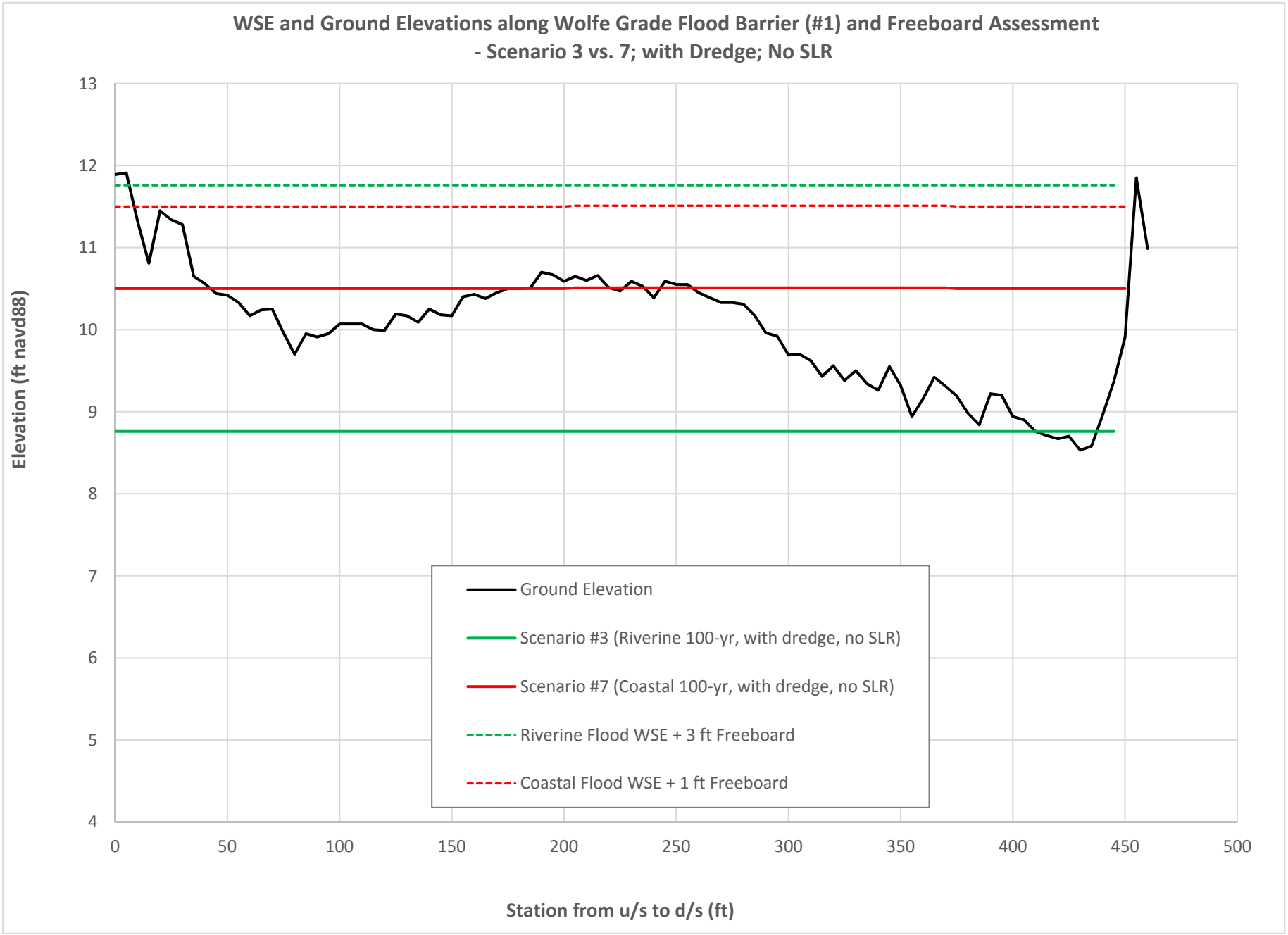

WSE and Ground Elevations along Wolfe Grade Flood Barrier (#1) and Freeboard Assessment
- Scenario 3 vs. 7; with Dredge; No SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
50
100
150
200
250
300
350
400
450
500
Station from u/s to d/s (ft)
Ground Elevation
Scenario #3 (Riverine 100-yr, with dredge, no SLR)
Scenario #7 (Coastal 100-yr, with dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 26d**

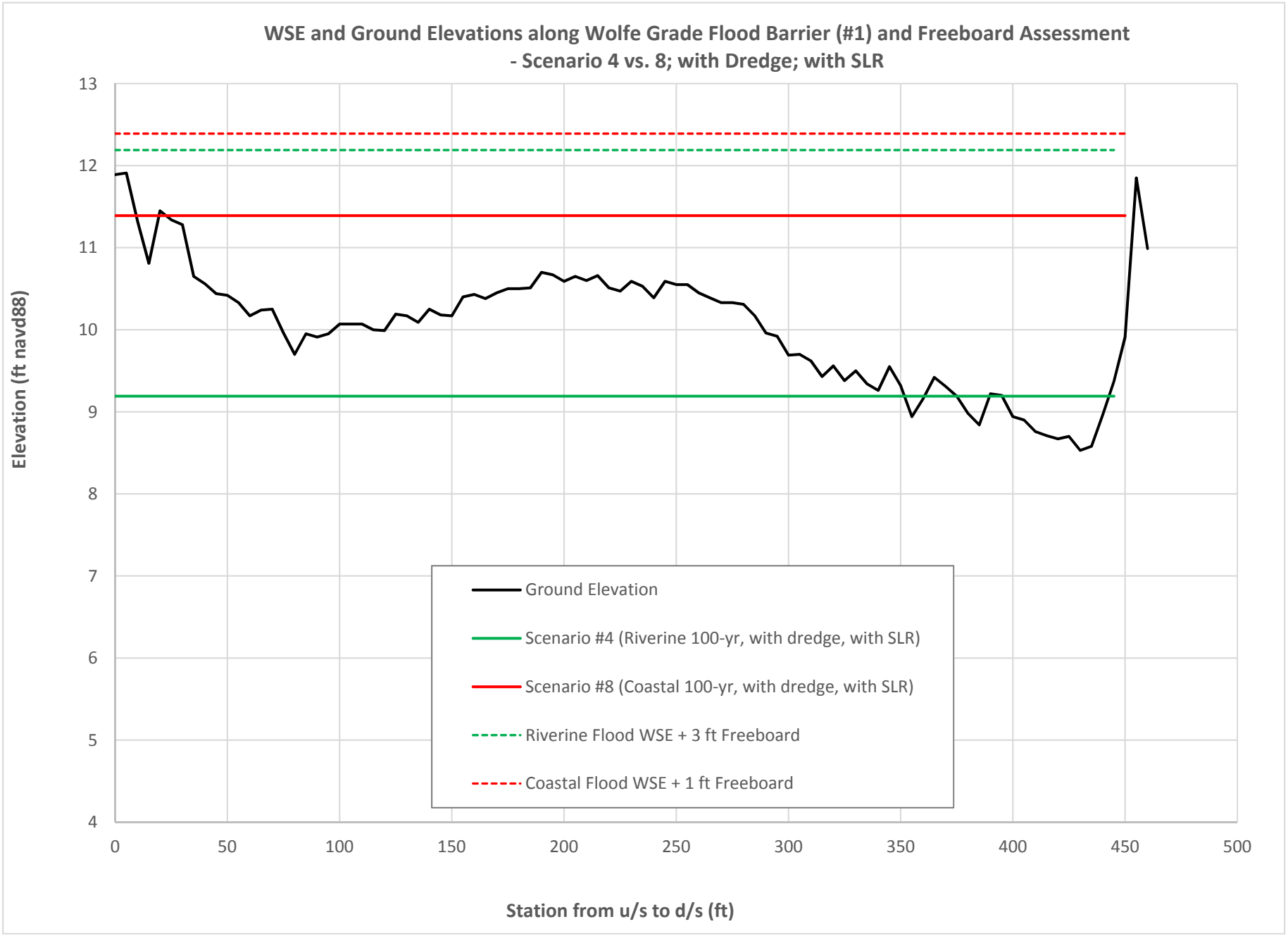

WSE and Ground Elevations along Wolfe Grade Flood Barrier (#1) and Freeboard Assessment
- Scenario 4 vs. 8; with Dredge; with SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
50
100
150
200
250
300
350
400
450
500
Station from u/s to d/s (ft)
Ground Elevation
Scenario #4 (Riverine 100-yr, with dredge, with SLR)
Scenario #8 (Coastal 100-yr, with dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 27a**

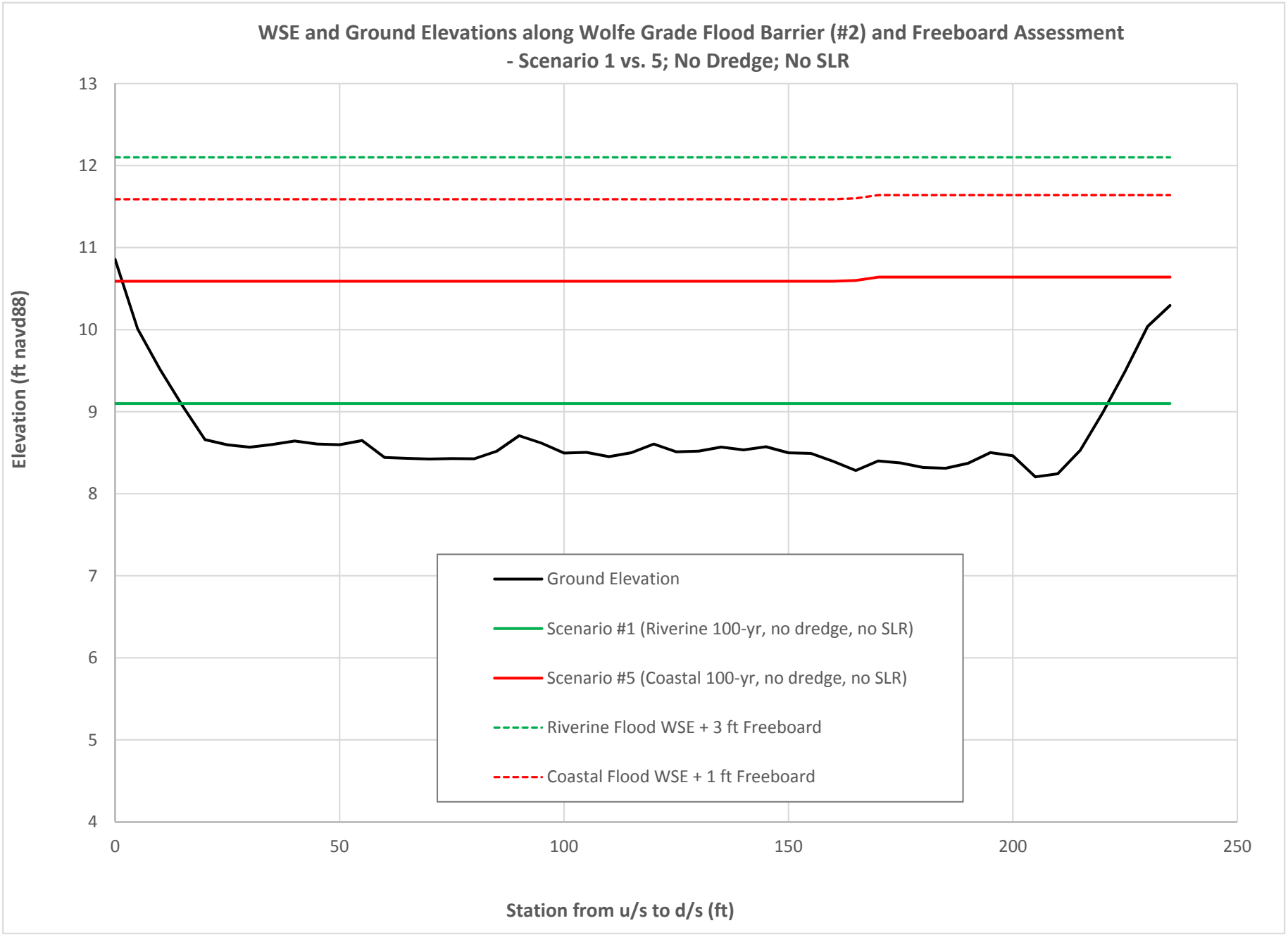

WSE and Ground Elevations along Wolfe Grade Flood Barrier (#2) and Freeboard Assessment
- Scenario 1 vs. 5; No Dredge; No SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
50
100
150
200
250
Station from u/s to d/s (ft)
Ground Elevation
Scenario #1 (Riverine 100-yr, no dredge, no SLR)
Scenario #5 (Coastal 100-yr, no dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 27b**

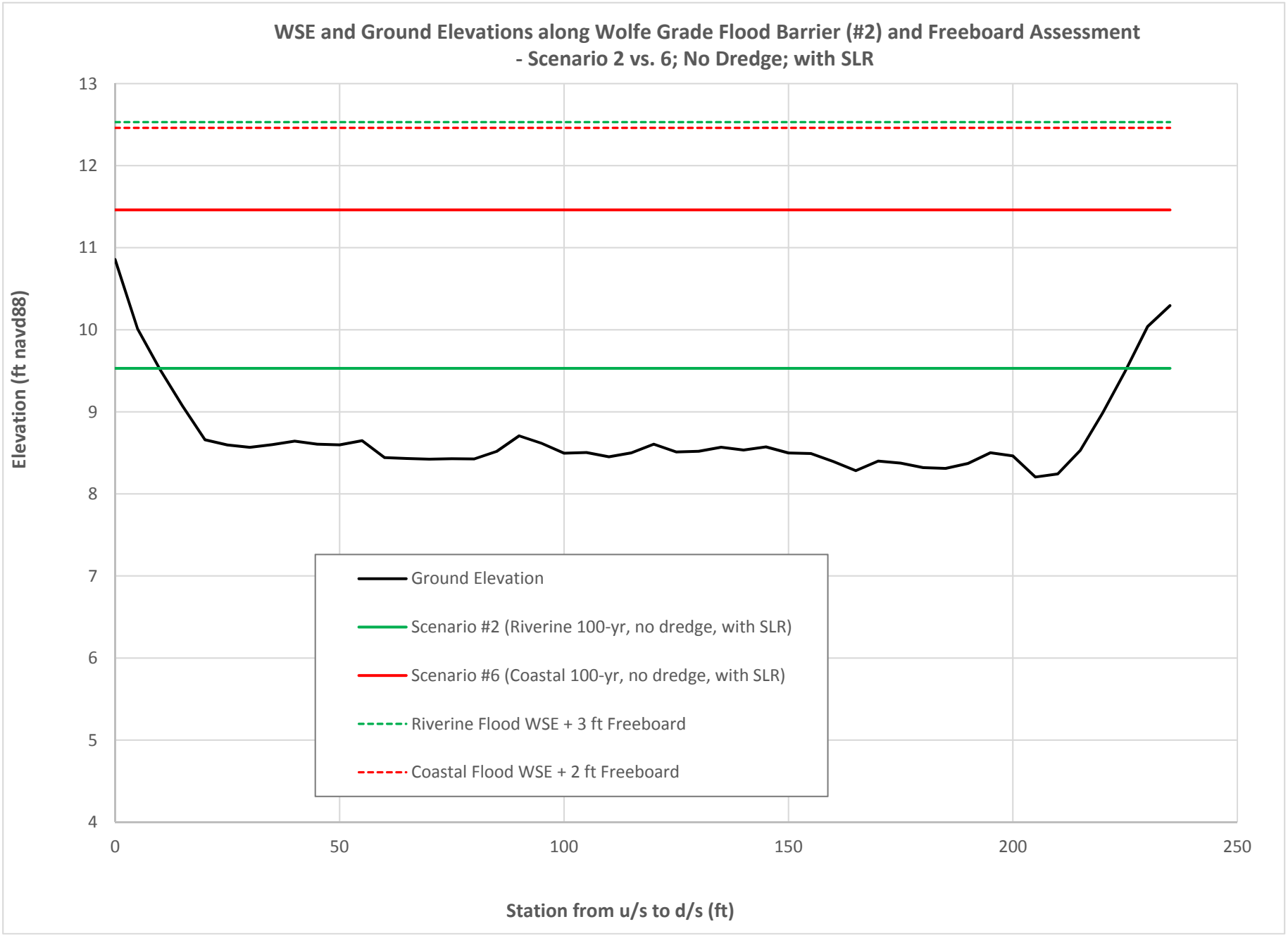

WSE and Ground Elevations along Wolfe Grade Flood Barrier (#2) and Freeboard Assessment
- Scenario 2 vs. 6; No Dredge; with SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
50
100
150
200
250
Station from u/s to d/s (ft)
Ground Elevation
Scenario #2 (Riverine 100-yr, no dredge, with SLR)
Scenario #6 (Coastal 100-yr, no dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 2 ft Freeboard

**Figure 27c**

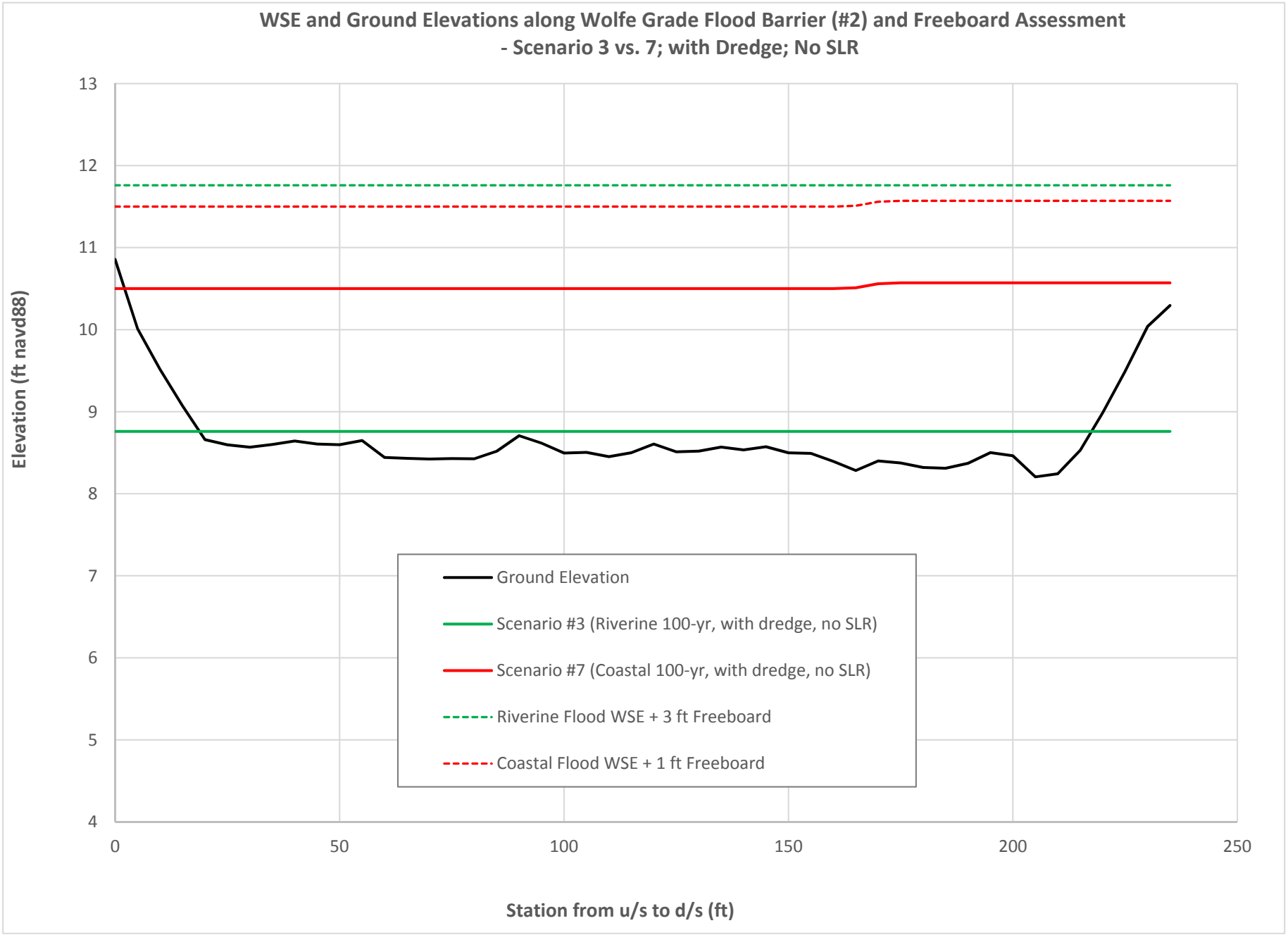

WSE and Ground Elevations along Wolfe Grade Flood Barrier (#2) and Freeboard Assessment
- Scenario 3 vs. 7; with Dredge; No SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
50
100
150
200
250
Station from u/s to d/s (ft)
Ground Elevation
Scenario #3 (Riverine 100-yr, with dredge, no SLR)
Scenario #7 (Coastal 100-yr, with dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 27d**

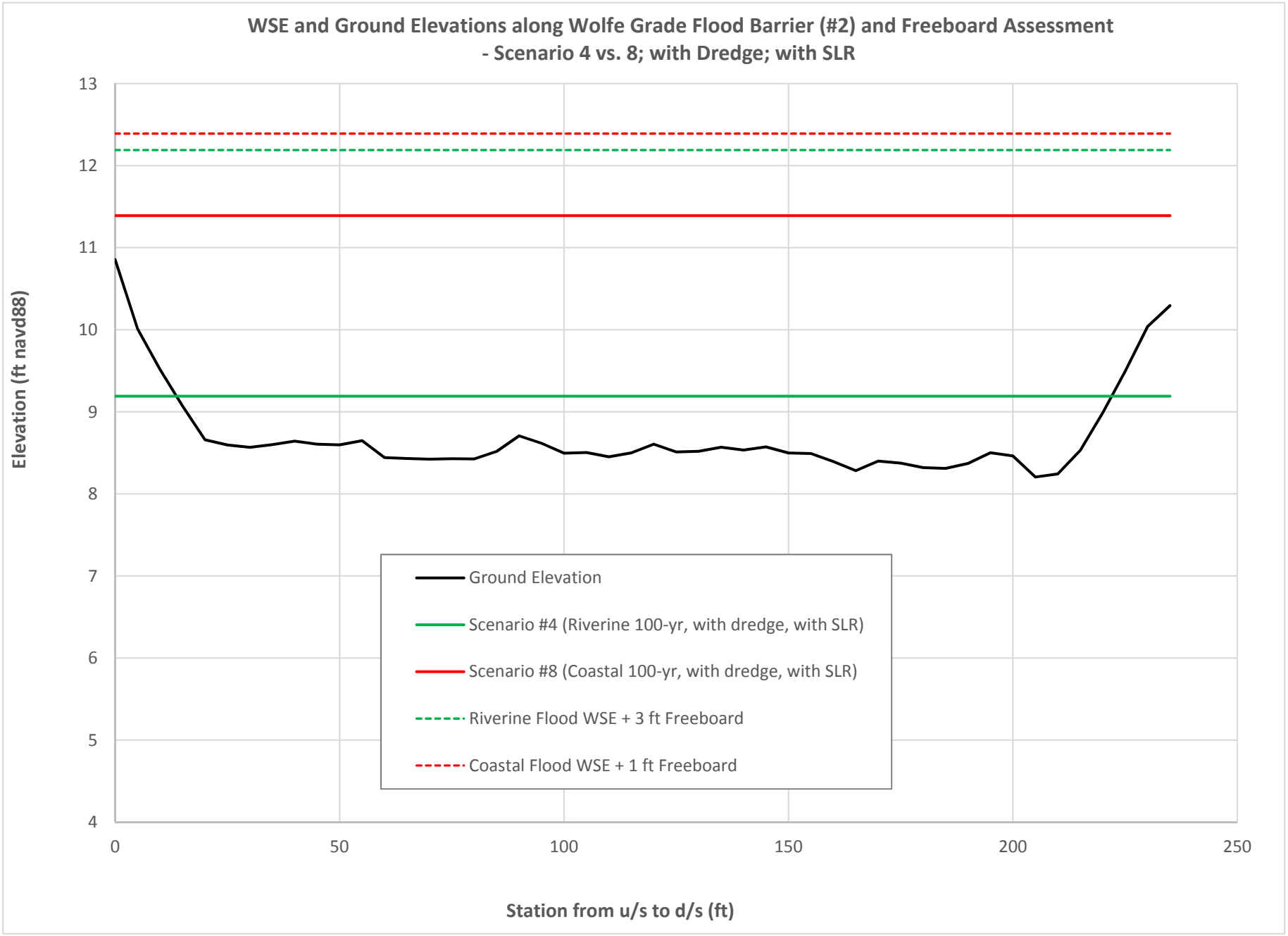

WSE and Ground Elevations along Wolfe Grade Flood Barrier (#2) and Freeboard Assessment
- Scenario 4 vs. 8; with Dredge; with SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
50
100
150
200
250
Station from u/s to d/s (ft)
Ground Elevation
Scenario #4 (Riverine 100-yr, with dredge, with SLR)
Scenario #8 (Coastal 100-yr, with dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 28a**

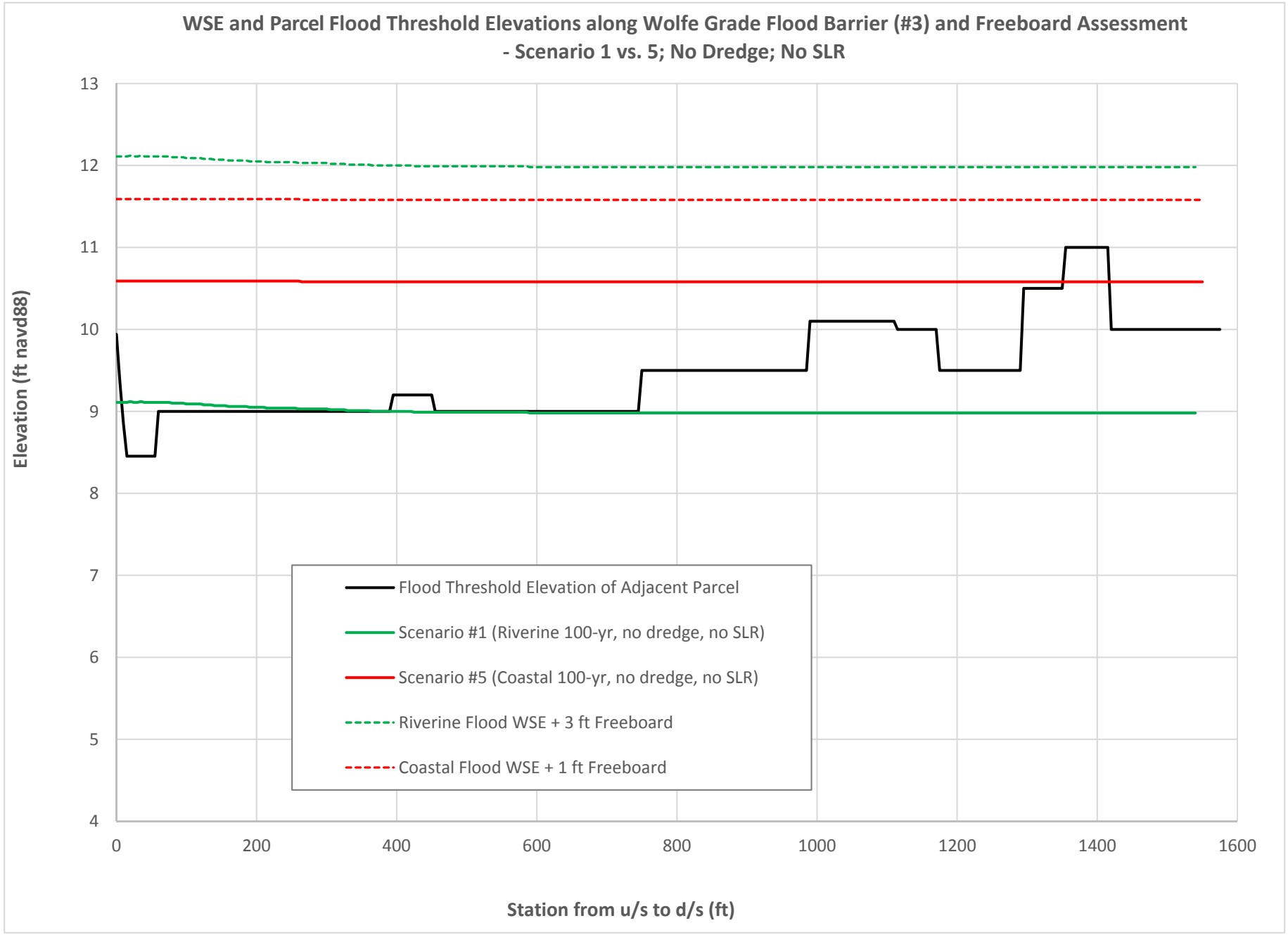

WSE and Parcel Flood Threshold Elevations along Wolfe Grade Flood Barrier (#3) and Freeboard Assessment
- Scenario 1 vs. 5; No Dredge; No SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
200
400
600
800
1000
1200
1400
1600
Station from u/s to d/s (ft)
Flood Threshold Elevation of Adjacent Parcel
Scenario #1 (Riverine 100-yr, no dredge, no SLR)
Scenario #5 (Coastal 100-yr, no dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 28b**

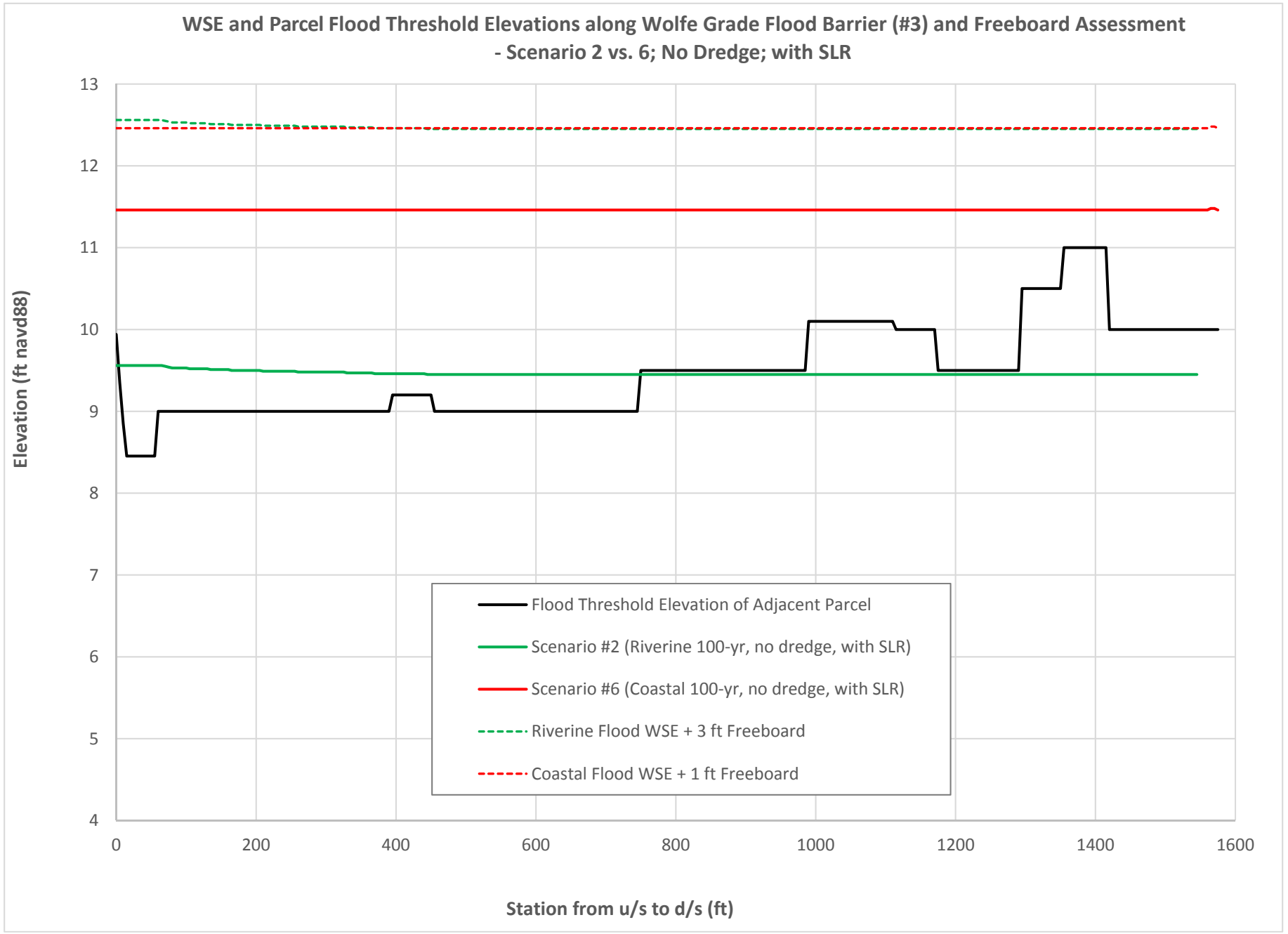

WSE and Parcel Flood Threshold Elevations along Wolfe Grade Flood Barrier (#3) and Freeboard Assessment
- Scenario 2 vs. 6; No Dredge; with SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
200
400
600
800
1000
1200
1400
1600
Station from u/s to d/s (ft)
Flood Threshold Elevation of Adjacent Parcel
Scenario #2 (Riverine 100-yr, no dredge, with SLR)
Scenario #6 (Coastal 100-yr, no dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 28c**

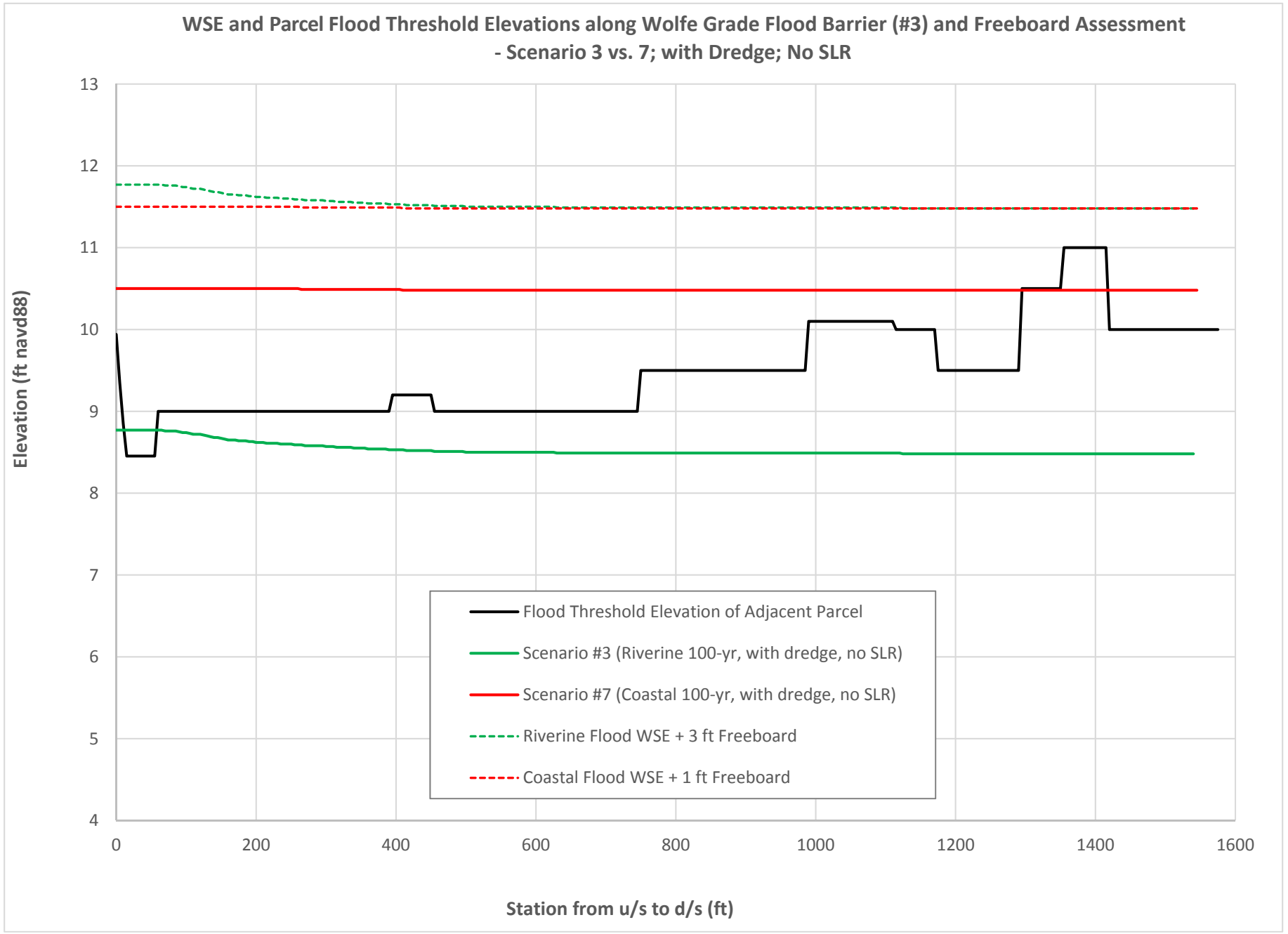
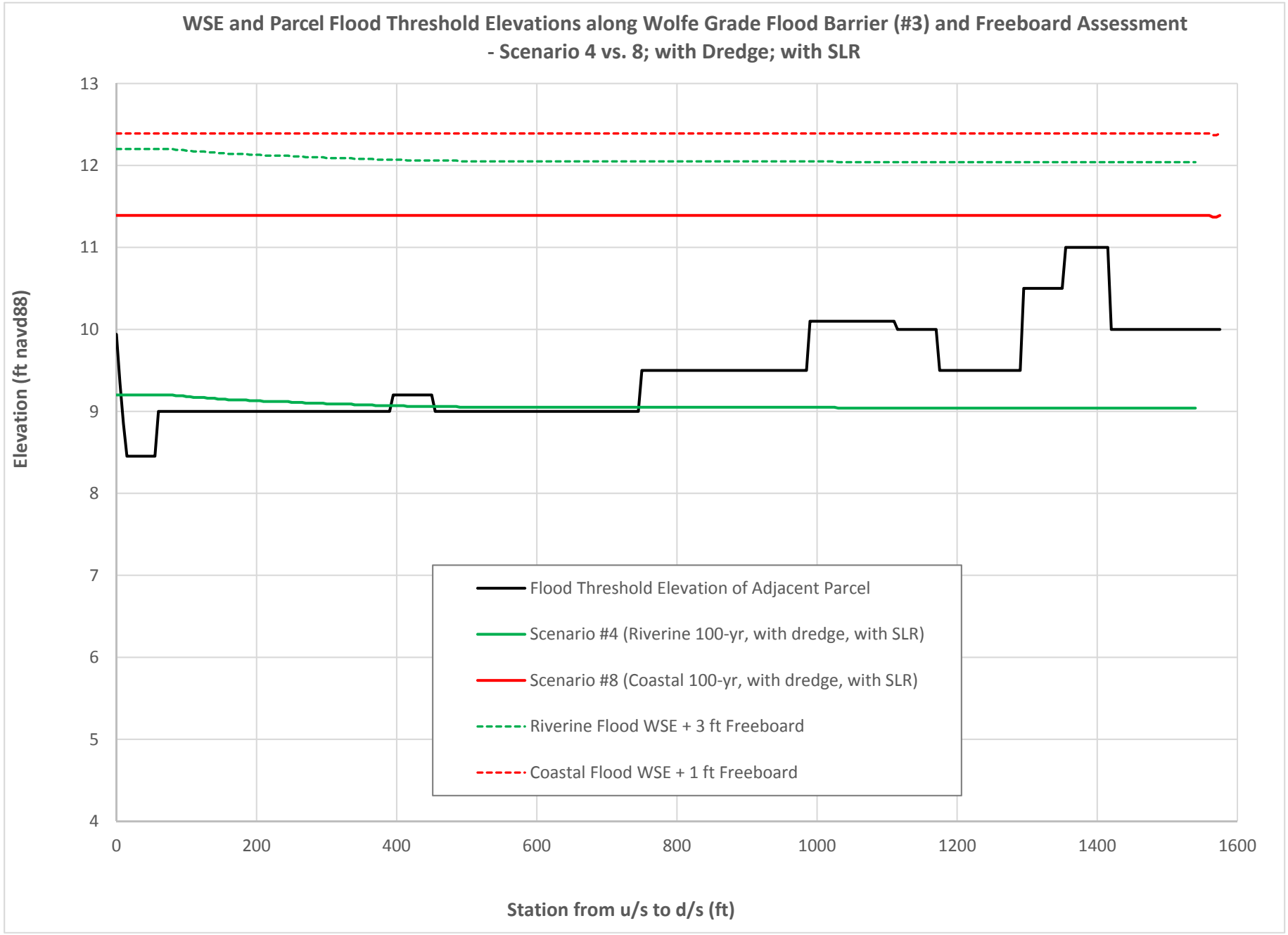
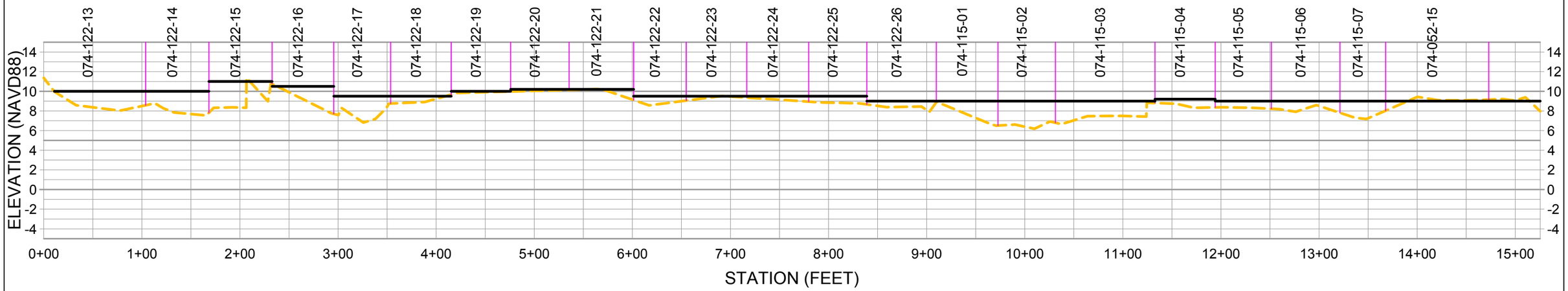
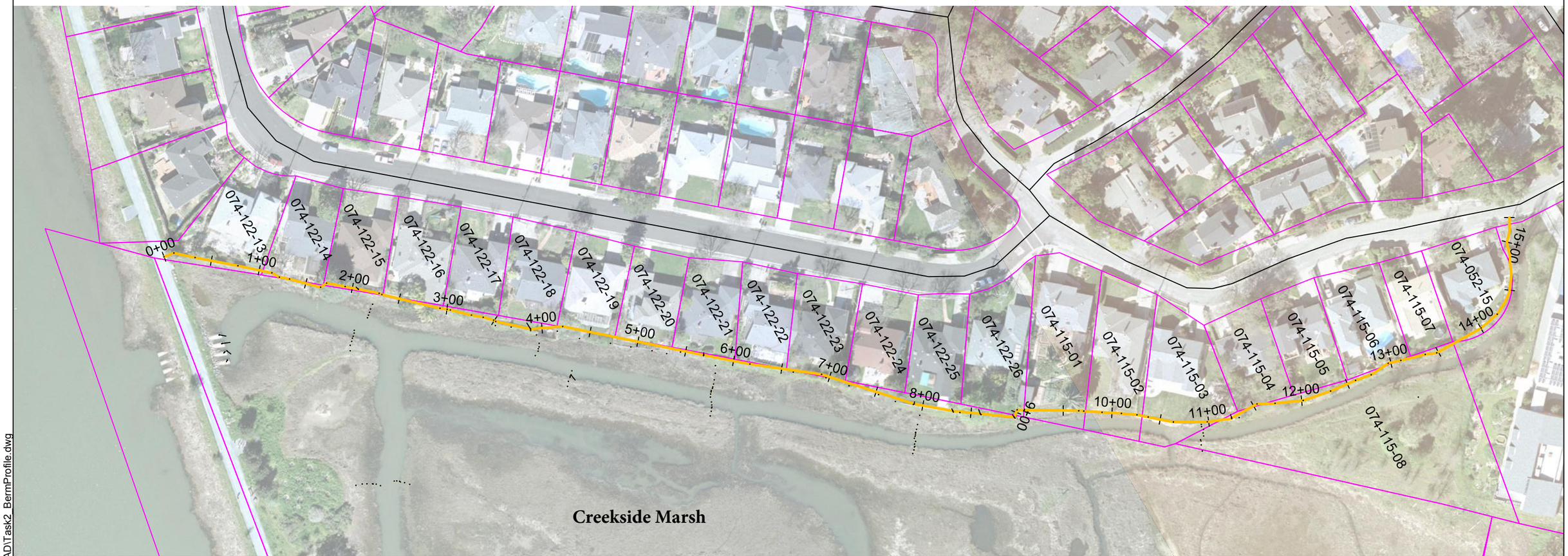

WSE and Parcel Flood Threshold Elevations along Wolfe Grade Flood Barrier (#3) and Freeboard Assessment
- Scenario 3 vs. 7; with Dredge; No SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
200
400
600
800
1000
1200
1400
1600
Station from u/s to d/s (ft)
Flood Threshold Elevation of Adjacent Parcel
Scenario #3 (Riverine 100-yr, with dredge, no SLR)
Scenario #7 (Coastal 100-yr, with dredge, no SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

**Figure 28d**


WSE and Parcel Flood Threshold Elevations along Wolfe Grade Flood Barrier (#3) and Freeboard Assessment
- Scenario 4 vs. 8; with Dredge; with SLR
Elevation (ft navd88)
13
12
11
10
9
8
7
6
5
4
0
200
400
600
800
1000
1200
1400
1600
Station from u/s to d/s (ft)
Flood Threshold Elevation of Adjacent Parcel
Scenario #4 (Riverine 100-yr, with dredge, with SLR)
Scenario #8 (Coastal 100-yr, with dredge, with SLR)
Riverine Flood WSE + 3 ft Freeboard
Coastal Flood WSE + 1 ft Freeboard

# BERM PROFILE




**LEGEND**

- PARCEL EXTENT
- GROUND SURFACE ALONG PROFILE LINE
- PARCEL FLOOD THRESHOLD
- PROFILE ALIGNMENT LINE

SCALE (Feet)
0 50 100

N W E S

STETSON ENGINEERS INC.

DATE: October 22, 2012 | JN: 2429

**CREEKSIDE MARSH NORTH-WEST BERM**
**PLAN VIEW AND PROFILE**

F:\DATA\2429\AutoCAD\Task2_BermProfile.dwg