

Creekwood Condominium Project

Hydraulic Assessment

SEPTEMBER 2023

Prepared For:

Steven J Lafranchi and Associates, Inc.
140 Second Street, Suite 312
Petaluma, CA 92110



Prepared By:

WEST Consultants, Inc.
11440 W. Bernardo Court
Suite 360
San Diego, CA 92127



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APPENDICES

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1. Introduction

1.1. Scope of Work

WEST Consultants, Inc. (WEST) was retained by Steven J Lafranchi and Associates, Inc. (SJLA) to perform hydraulic analyses for the proposed Creekwood Condominium Project along Adobe Creek in Petaluma, CA (referred to hereafter as the 'Project'). The development is a residential community that is located west of Adobe Creek and is adjacent to Casa Grande Road and Ely Blvd South to the east and north, respectively.

The hydraulic analyses presented within this report compares proposed grading scenarios to the existing conditions to determine the Project flooding impacts within and adjacent to Adobe Creek. The following sections present the methodology, assumptions, and results of these analyses.

1.2. Acknowledgements

Mr. Justin W. Griffiths, P.E., was the WEST project manager, directed the analyses, and conducted quality control. Mr. Christian Hebert was the lead project engineer performing the hydrologic and hydraulic modeling and report writing activities. Mr. Steven Lafranchi of SJLA was the owner's representative for this project.

2. Background

2.1. Site Location

The Project is located in Petaluma, California, immediately west of Adobe Creek, east of Casa Grande Road, and south of Ely Blvd South (see Figure 1). Abutting its southern boundary is the newly constructed Casa Grande development.

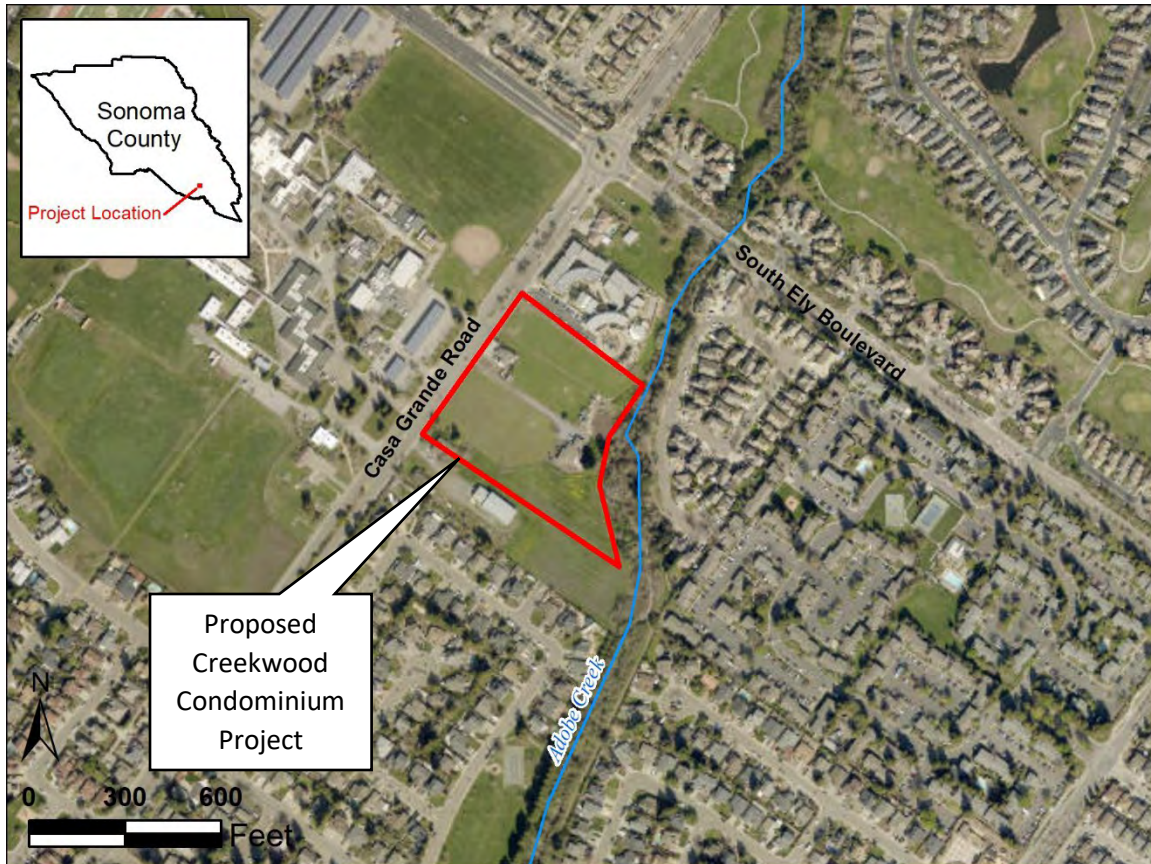


Figure 1. Vicinity Map

2.2. Existing Conditions Model

The city-wide hydraulic model developed by WEST (WEST, 2022) represents the existing conditions for this study (referred to as the “Existing Conditions model”); it establishes the baseline hydraulic results (e.g., water surface elevations and floodplain extents) to which the Project impacts will be compared. Pertinent hydrologic and hydraulic information adjacent to the Project location are summarized as follows:

- The peak 100-year flow rate in Adobe Creek is approximately 1,400 cubic feet per second (cfs).
- The maximum 100-year water surface elevation (WSEL) in Adobe Creek is approximately 47.2 feet (NAVD88) just upstream of the Project.

- The maximum 100-year WSEL in Adobe Creek is approximately 46.7 feet just downstream of the Project.
- The Manning's n value in the Adobe Creek channel adjacent to the Project is 0.056.
- The 100-year depth on the Project site is generally less than 0.5 feet with a maximum depth of two (2) feet (see Figure 2).

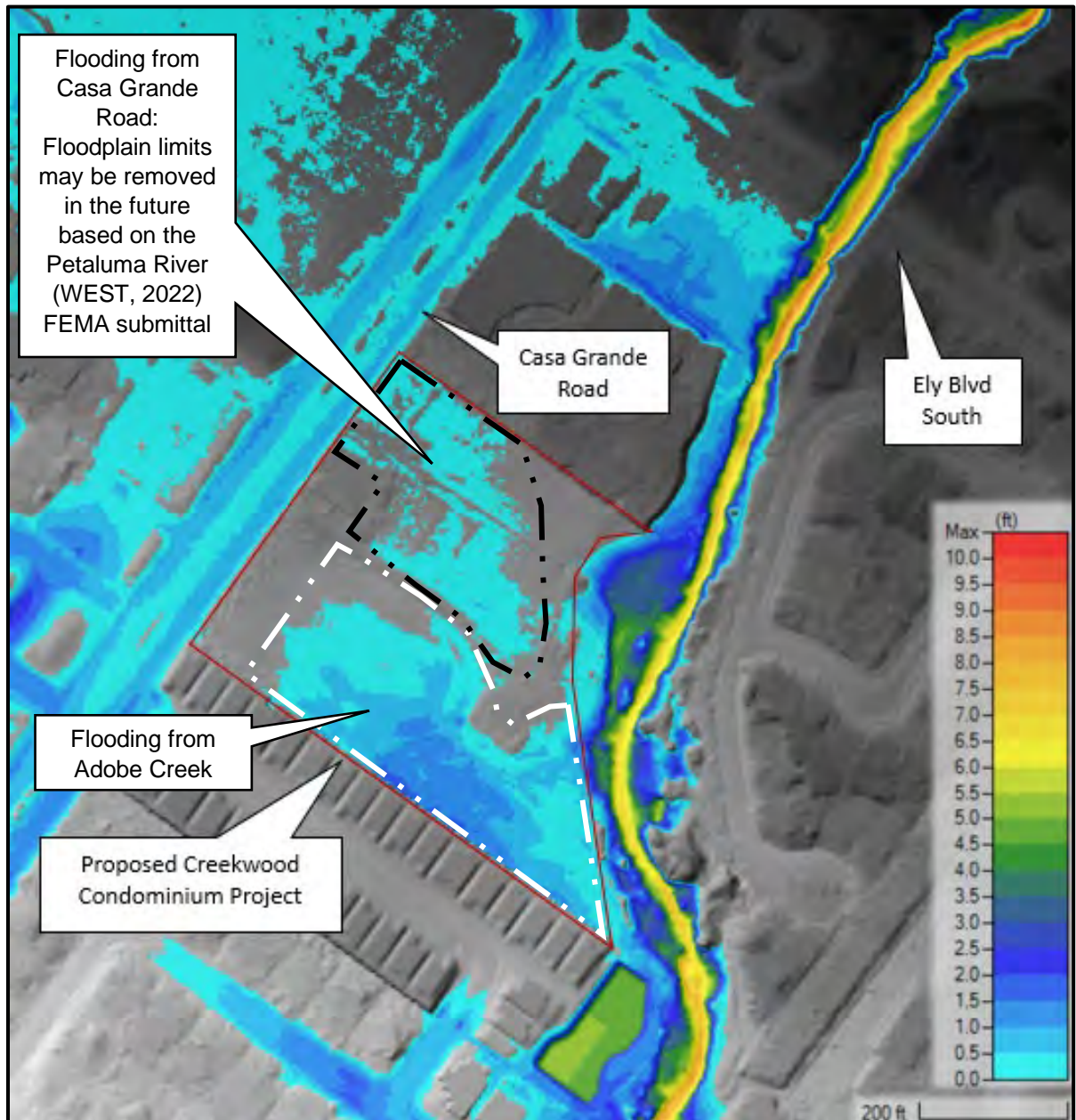


Figure 2. Existing Conditions 100-Year Flood Depth

3. Proposed Development Hydraulic Models

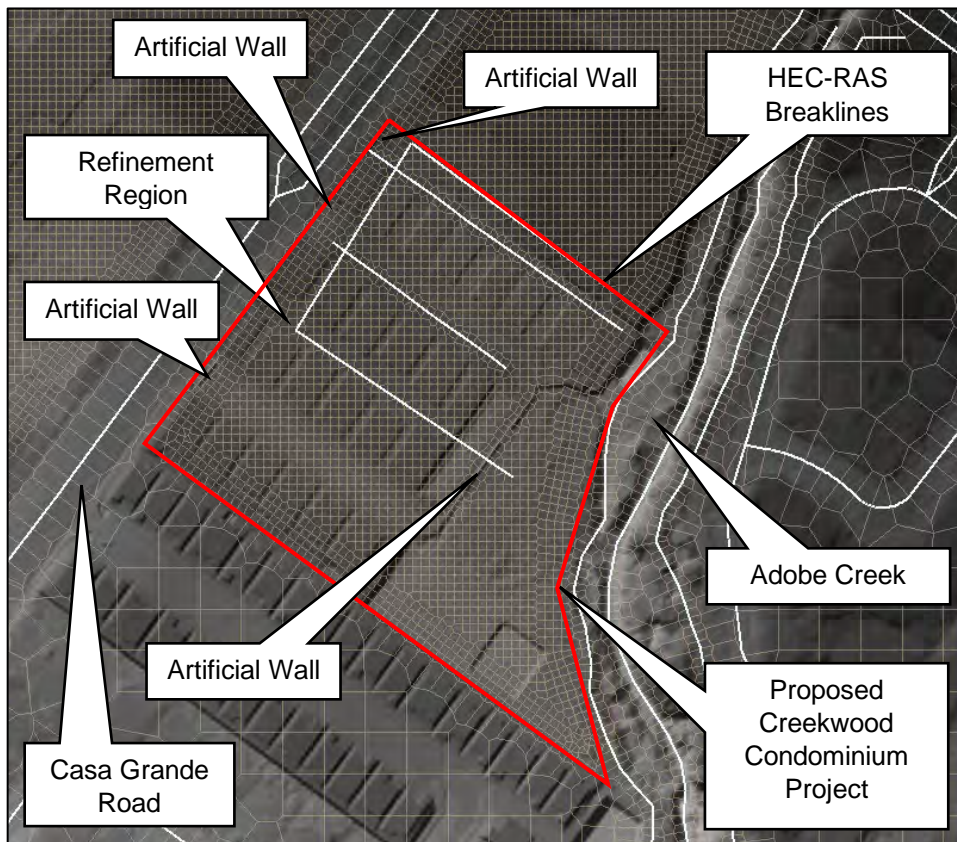
The United States Army Corps of Engineers (USACE) HEC-RAS two-dimensional (2D) model (version 6.3.1) was used to perform the hydraulic calculations, which is consistent with the software implemented in the Existing Conditions model. Two scenarios were analyzed to evaluate the potential 100-year flooding impacts of the Project: (1) Condominium and local roadway grading, referred to as the “Development Without Bridge” (see Section 3.1) and (2) Condominium and local roadway grading, with a pedestrian bridge across Adobe Creek near the southern side of the Project, referred to as the “Development With Bridge” (see Section 3.2).

3.1. Development Without Bridge

3.1.1. Model Development

To create the Development Without Bridge model, the Existing Conditions model was modified in the following manner:

- The proposed grading *.tif elevation raster provided by SJLA was incorporated into the existing conditions digital elevation model (DEM) to create a composite terrain surface (see Figure 3).



- Refinement regions were created in the vicinity of the Project site with ten (10)-foot cell definition.
- HEC-RAS breaklines were added to better align cell faces to the proposed grading features.
- Walls (artificial) were placed at three (3) locations to prevent onsite flooding from Casa Grande Road and Adobe Creek.

Figure 3. Development Without Bridge Model Mesh

Creek. Ultimately the site grading will be updated to reflect this condition (i.e., the ‘walls’ will not be present) such that onsite inundation does not occur.

3.1.2. Results

The proposed structure pads and local roadways within the Project site are not inundated by the 100-year storm event (see Figure 4). The Project grading also encroaches upon the Adobe Creek floodplain such that the right bank (looking downstream) inundation limits decrease. The left bank (looking downstream) floodplain is approximately coincident with the existing conditions floodplain (in Figure 4, the white line indicates the existing condition 100-year floodplain boundary).

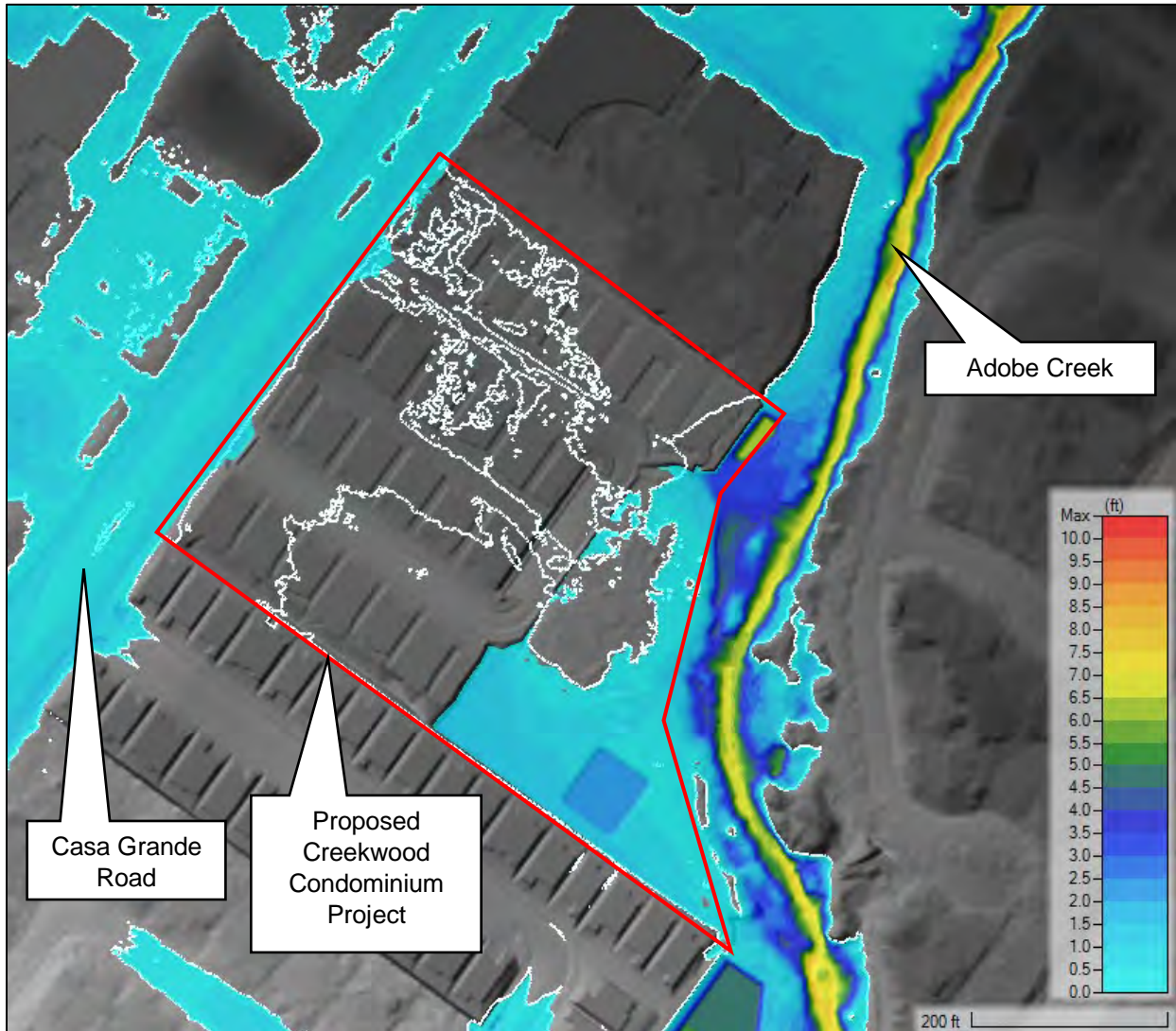


Figure 4. Development Without Bridge 100-Year Inundation

3.2. Development With Bridge Model

3.2.1. Model Development

The Development With Bridge model was created by adding the bridge geometry and approach grading to the Development Without Bridge model (see Figure 5). This additional data consisted of:

- Approach walkway and transition grading provided by SJLA.
- Preliminary pedestrian bridge structure information: Single-span, approximately eighty-five (85) feet long (abutment to abutment), and eight (8) feet wide (in the direction of flow). The preliminary bridge design plan is included in Appendix A.

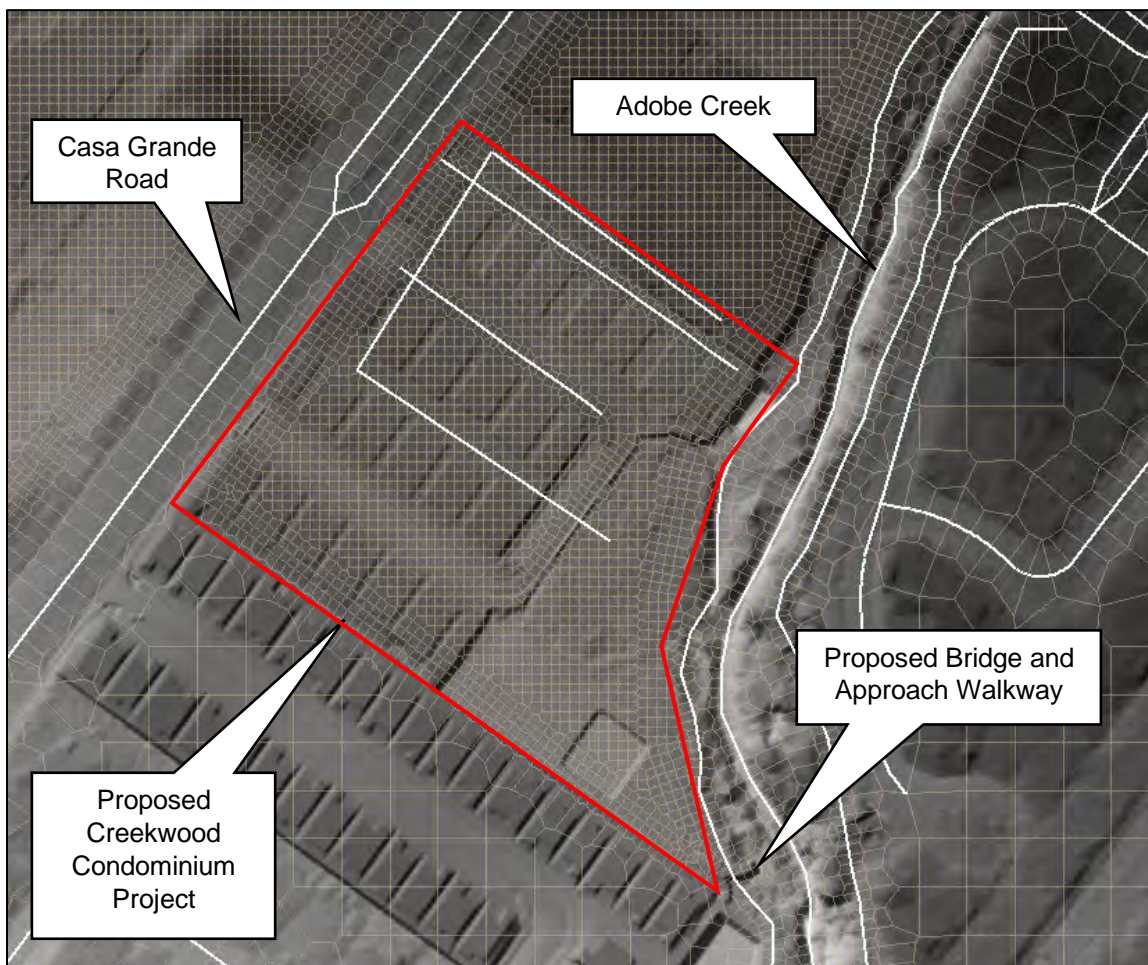


Figure 5. Development With Bridge Model Mesh

3.2.2. Results

The Project area is inundated in the same manner as the Development Without Bridge scenario. The addition of the pedestrian bridge causes a small increase and decrease in the 100-year Adobe Creek WSEL upstream and downstream of the bridge, respectively. Similar to the Development Without Bridge conditions, the left bank (looking downstream) floodplain is approximately coincident with the existing conditions floodplain (In Figure 6, the white line indicates the existing conditions 100-year floodplain boundary).

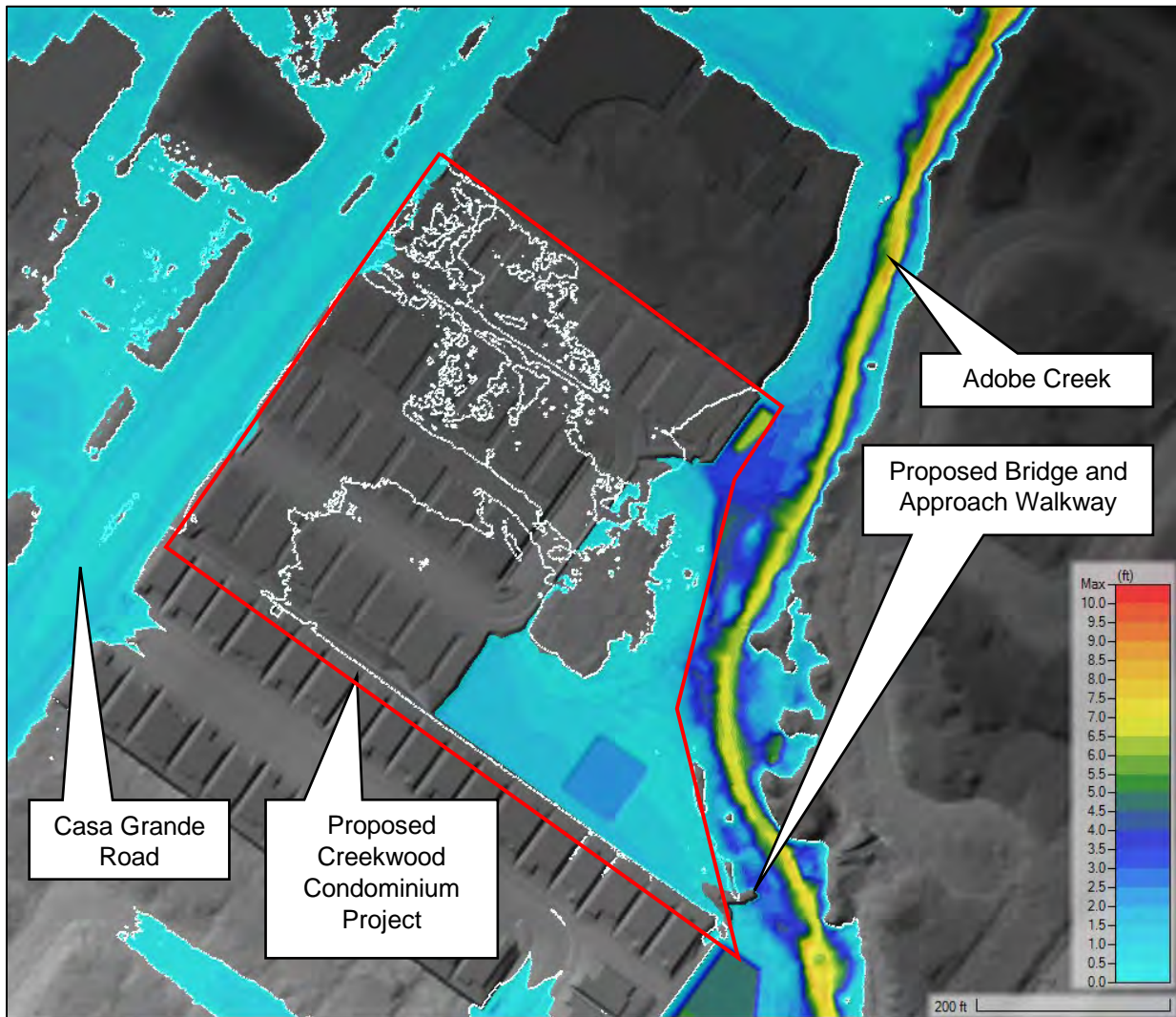


Figure 6. Development With Bridge 100-Year Inundation

4. Comparative Analysis

In this section, comparison analyses were performed to help quantify the Project impacts. These comparisons are discussed in further detail below:

Development Without Bridge and Existing Conditions

The 100-year flood depth differences (Development Without Bridge minus Existing Conditions) are shown below in Figure 7, where the positive values (pink) represent increases, the negative values (blue) represent decreases, and the white line indicates the existing conditions 100-year floodplain.

In Adobe Creek adjacent to the development, WSEL differences are approximately +/- 0.5 feet. The downstream comparison limits were terminated at WSEL differences of approximately +/- 0.1 feet to allow for an appropriate illustrative scale. Note that small WSEL differences may extend further downstream or upstream in Adobe Creek.

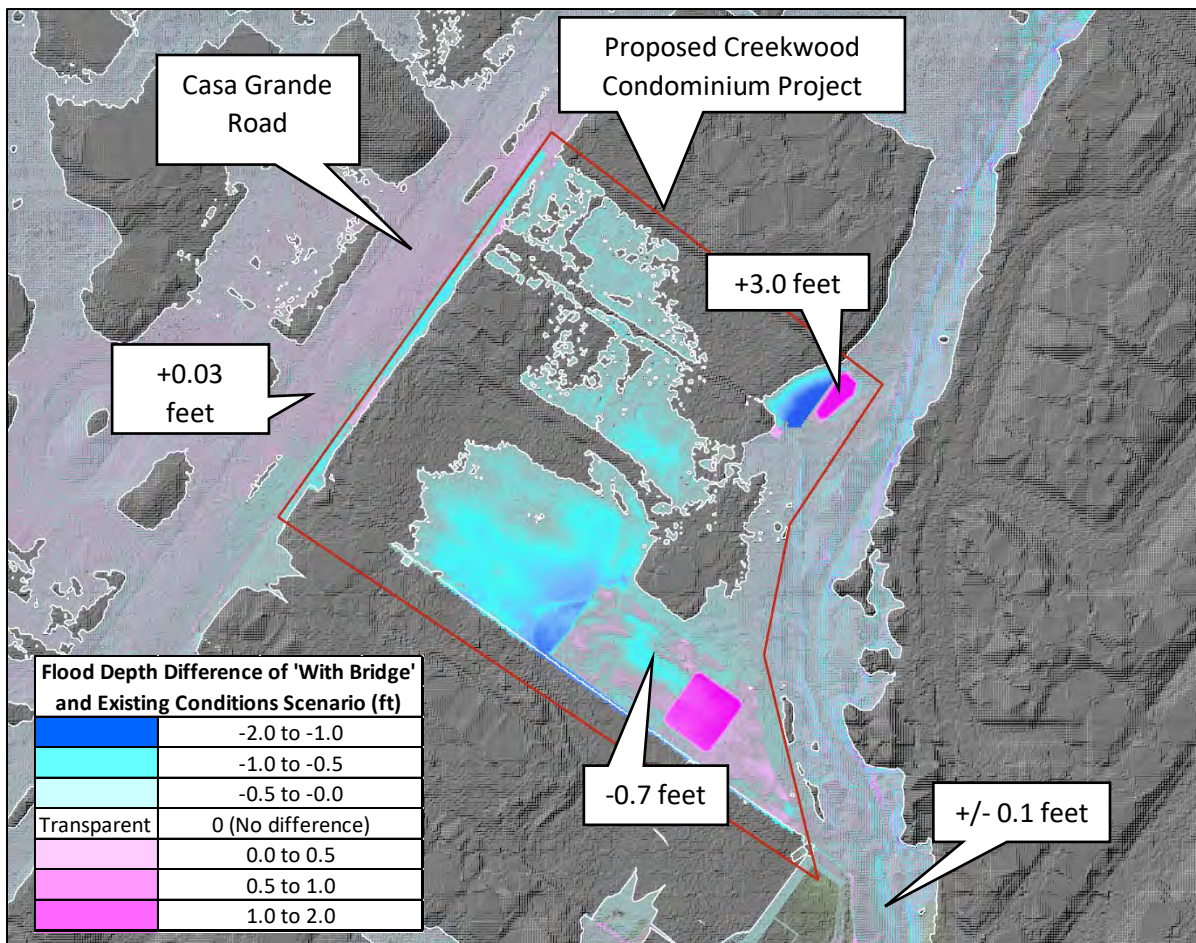


Figure 7. Development Without Bridge and Existing Conditions Scenario Flood Depth Difference

Development With Bridge and Existing Conditions

The 100-year flood depth differences (Development With Bridge minus Existing Conditions) are shown in Figure 8, where the positive values (pink) represent increases, the negative values (blue) represent decreases, and the white line indicates the existing conditions 100-year floodplain. In general, the differences are similar to the Development Without Bridge scenario. However, upstream and downstream of the pedestrian bridge, there are local WSEL changes of up to approximately +0.3 feet and -0.3 feet, respectively. This is due to the bridge abutments constricting flow; creating a modest increase in WSELs upstream, and the subsequent attenuation of the flow hydrograph results in a reduction in WSELs immediately downstream of the bridge.

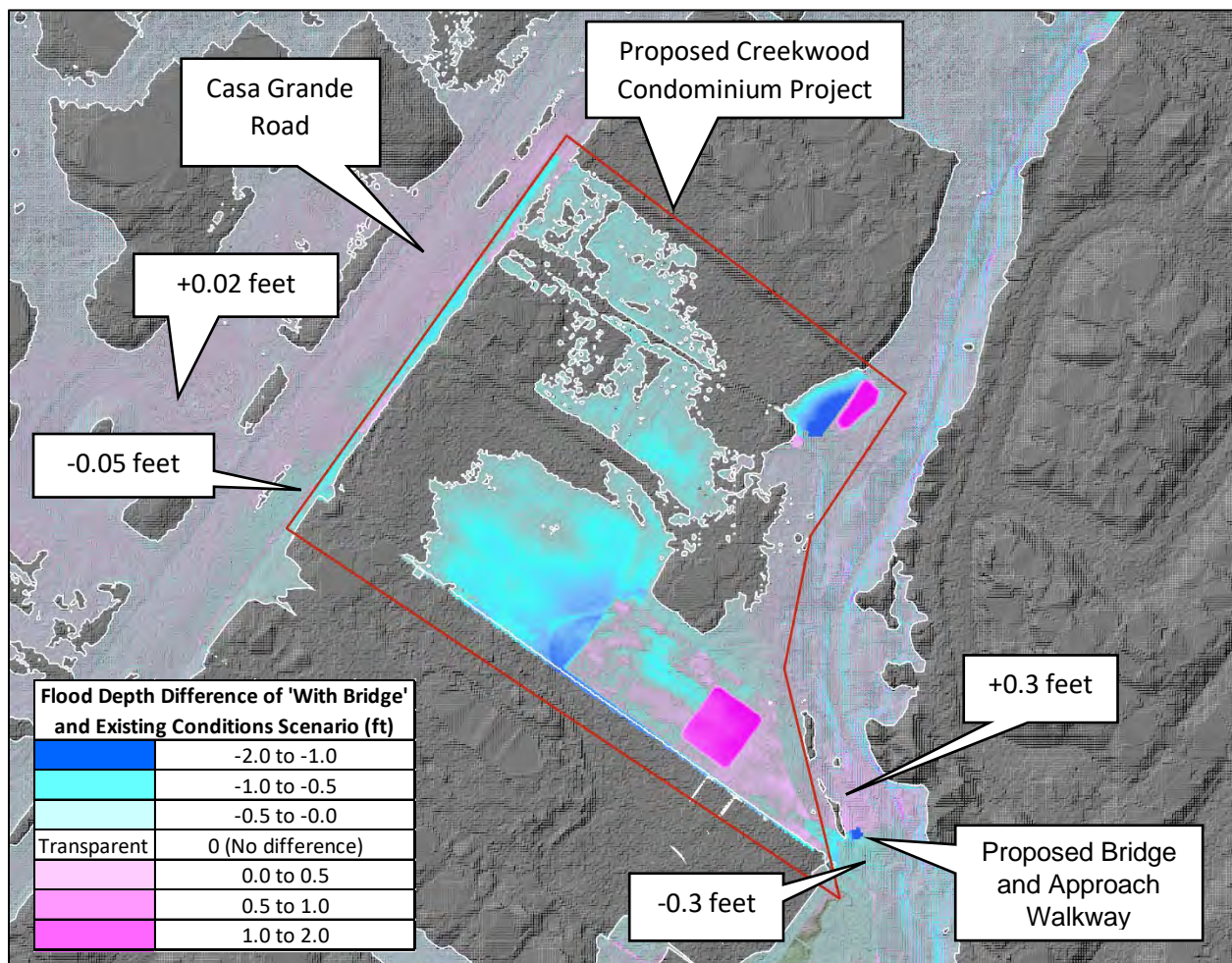


Figure 8. Development With Bridge and Existing Conditions Scenario Flood Depth Difference

Development With Bridge and Development Without Bridge

The flood depth differences (Development With Bridge minus Development Without Bridge) are shown in Figure 9. The positive values (pink) represent increases, the negative values (blue) represent decreases, and the white line indicates the existing conditions 100-year floodplain. As previously discussed, the most notable WSEL differences in Adobe Creek are in the vicinity the pedestrian bridge (e.g., approximately +/- 0.3 feet).

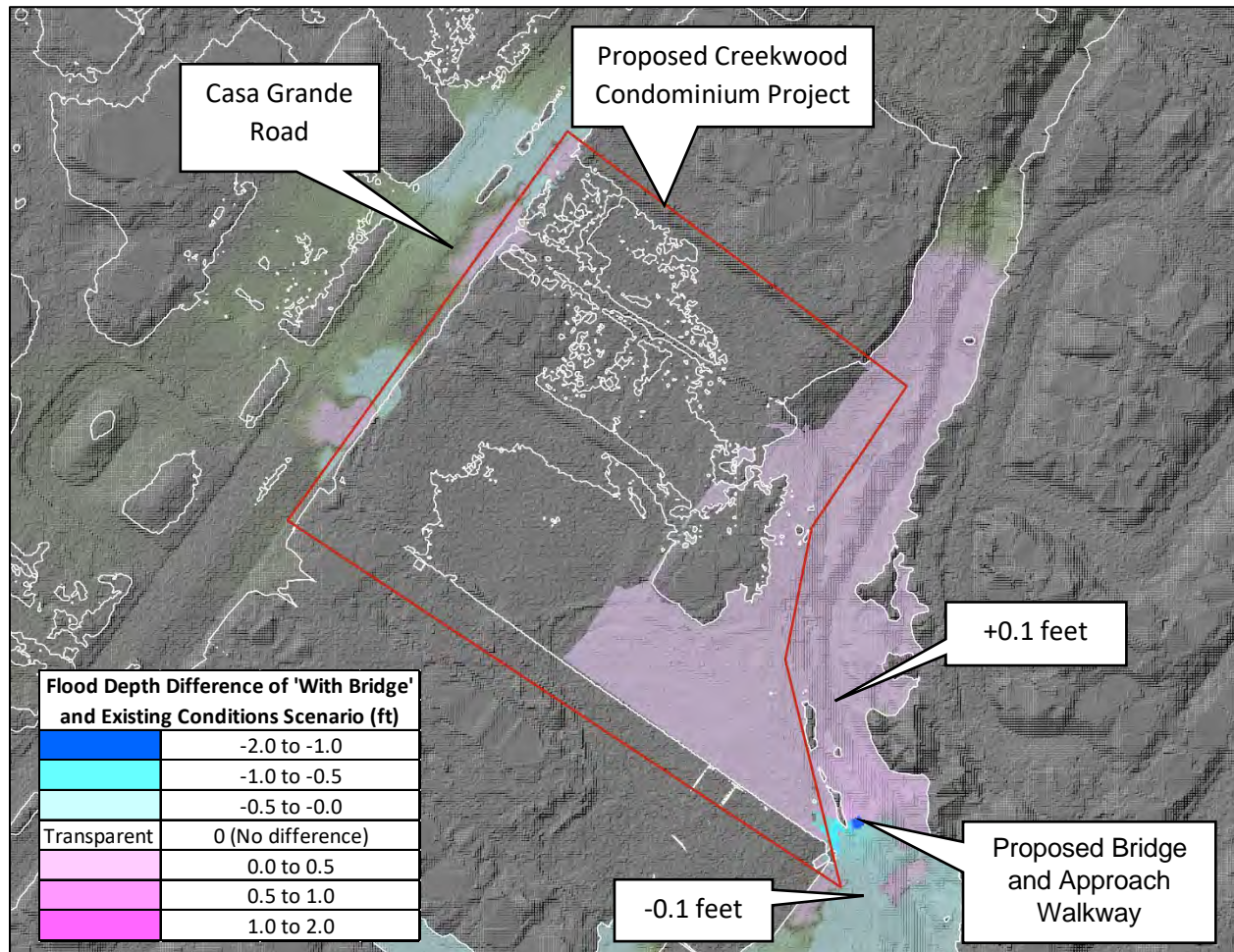


Figure 9. Development Scenario Flood Depth Difference

5. Summary and Conclusions

This assessment evaluates the effects of the proposed Creekwood Condominium Project on the existing conditions 100-year Adobe Creek floodplain. Two specific development scenarios were considered: (1) Development Without Bridge - Condominium and local roadway grading, and (2) Development With Bridge - Condominium and local roadway grading with a pedestrian bridge across Adobe Creek. In general, the results indicate:

- Both development scenarios increase the 100-year WSELs less than 0.5 feet and 0.1 feet in Adobe Creek and along/adjacent to Casa Grande Road, respectively.
- The pedestrian bridge addition across Adobe Creek creates localized 100-year WSEL increases and decreases of +0.3 feet and -0.3 feet, respectively.
- The impacts to the existing conditions Adobe Creek 100-year left bank (looking downstream) floodplain boundary appear minimal, which is consistent with the small changes to the WSELs. Note that a detailed evaluation of floodplain changes on adjacent properties was not performed as part of this assessment.

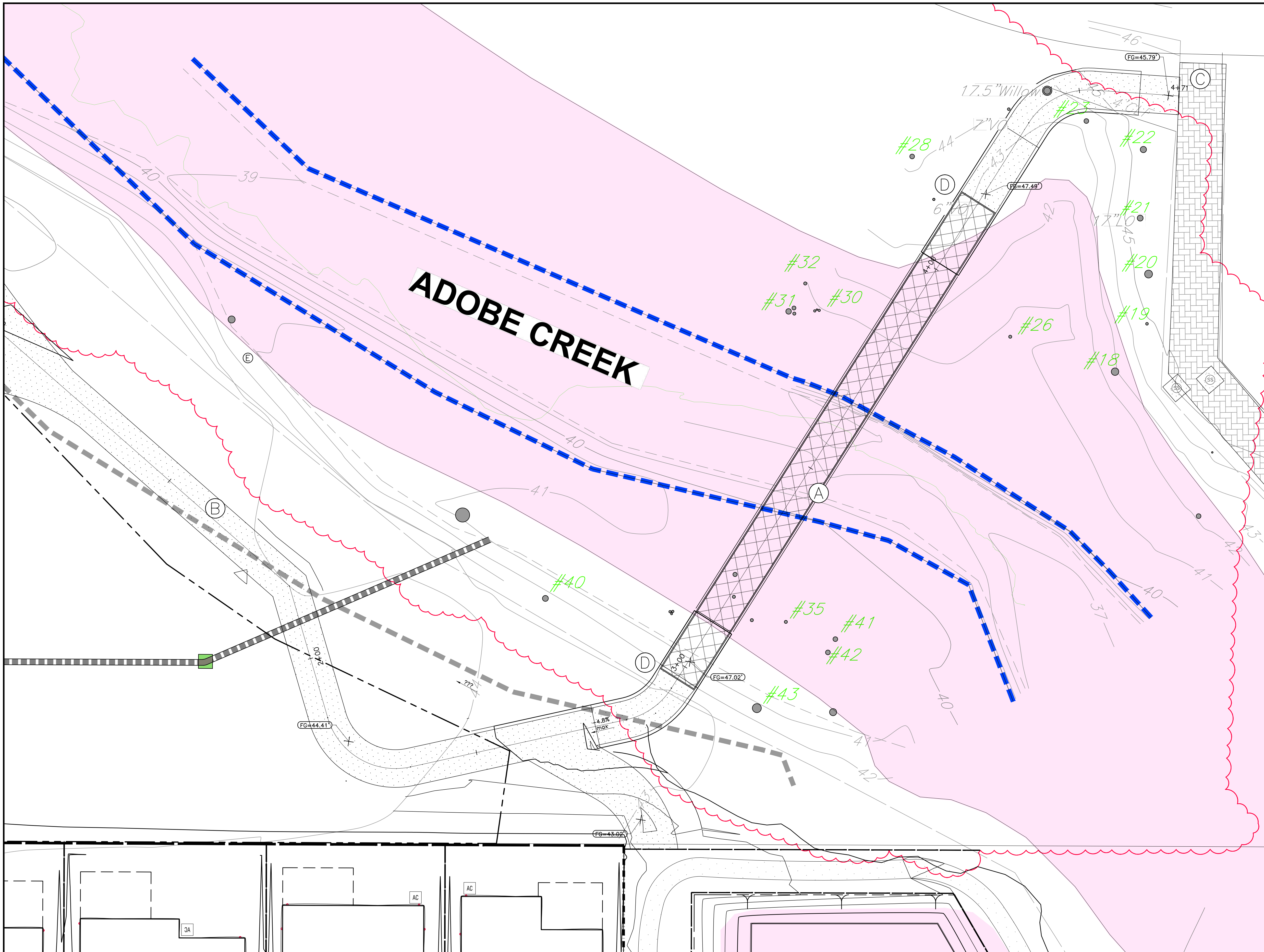
6. References

United States Army Corps of Engineers (2023). HEC-RAS 2D User's Manual.

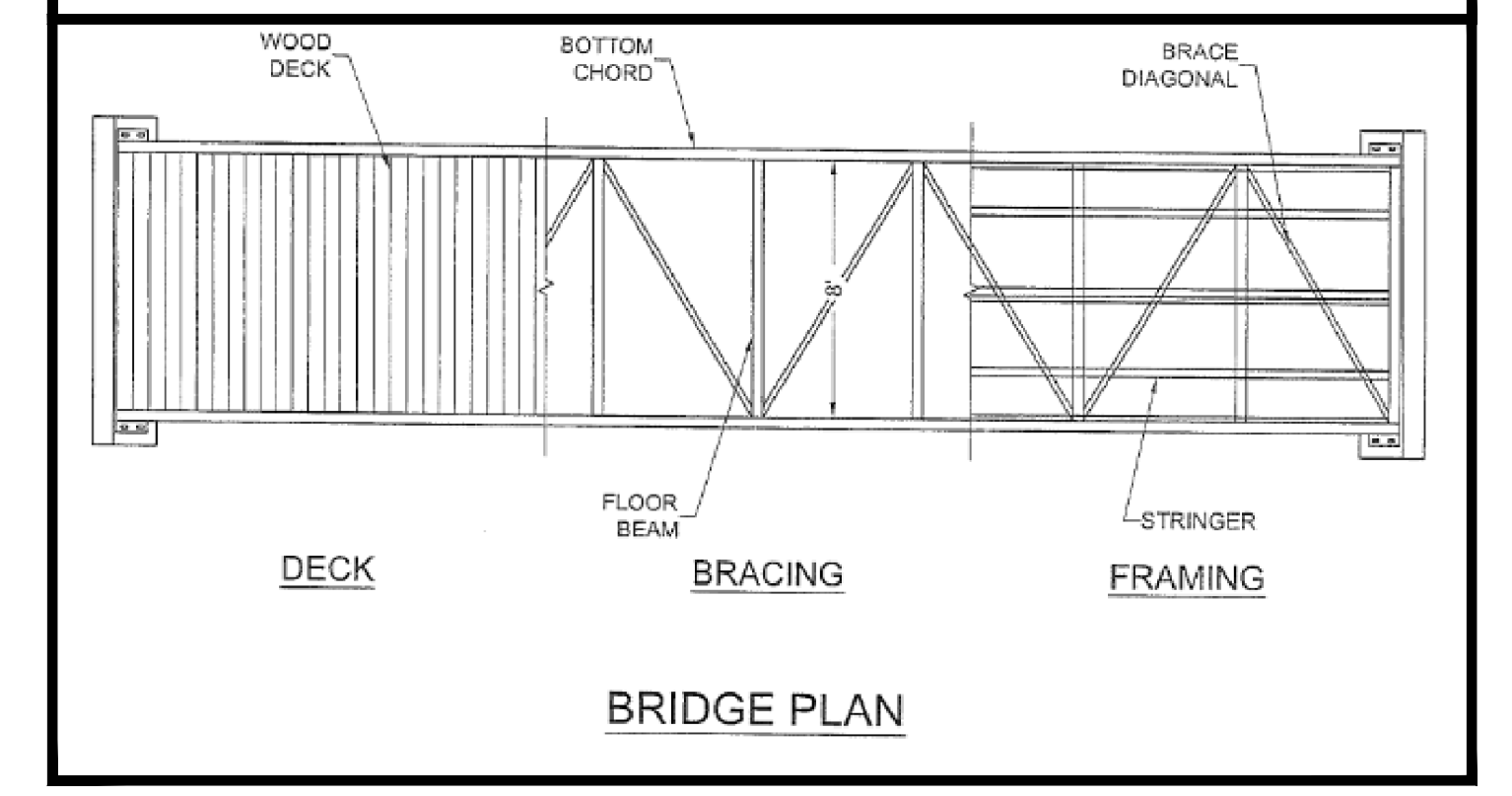
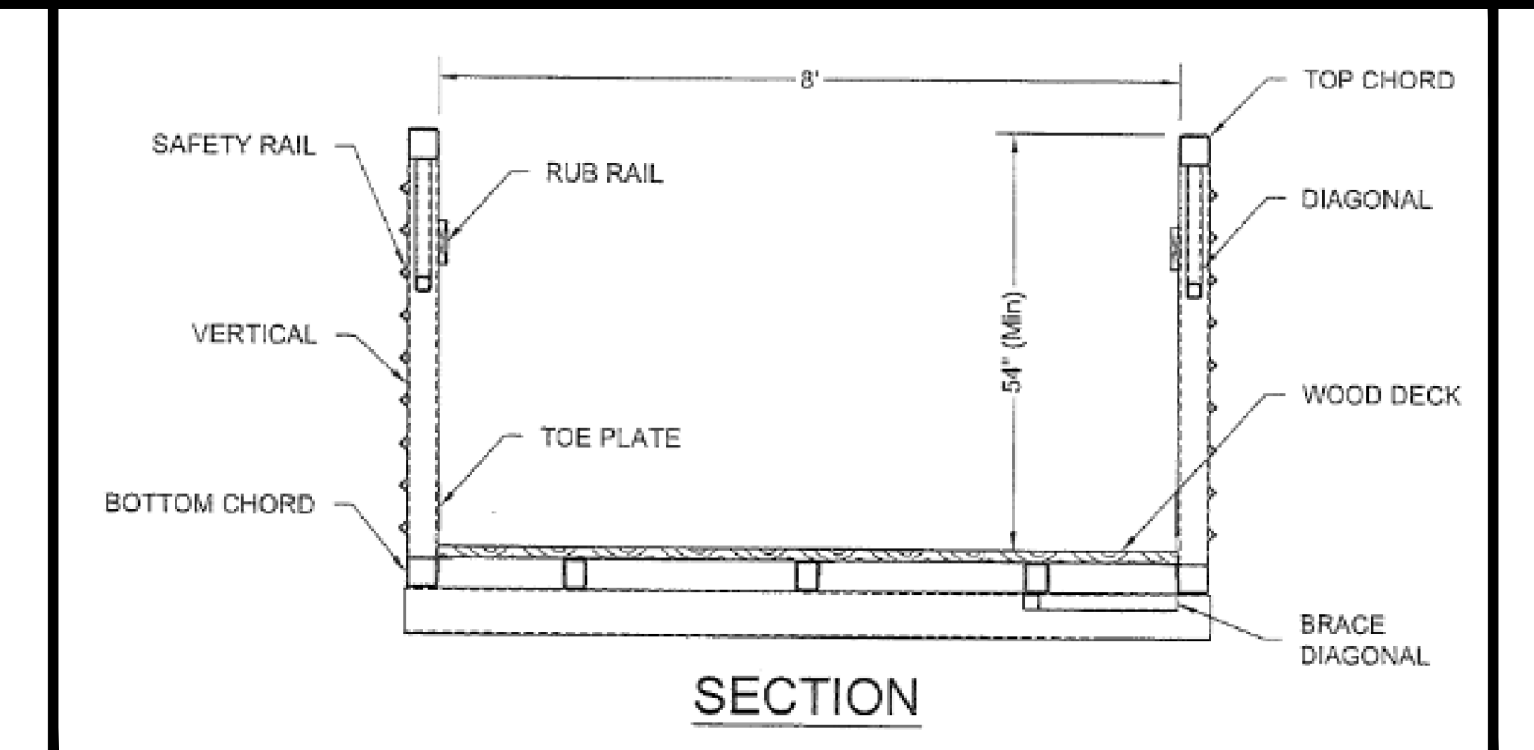
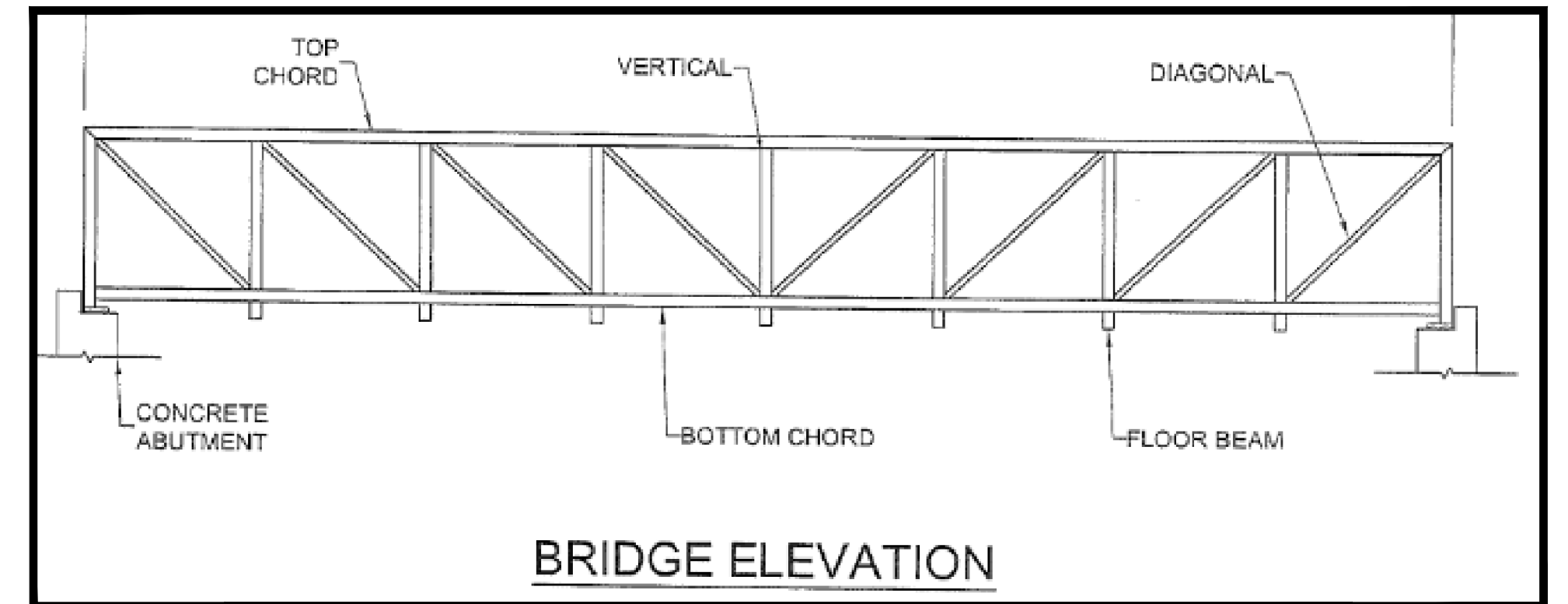
United States Army Corps of Engineers (2023). HEC-RAS Hydraulic Reference Manual.

WEST Consultants, Inc. (2022). Petaluma River Watershed HEC-RAS 2D Modeling.

Appendix A
Preliminary Bridge Plans



- KEYNOTES**
- (A) 90FT PREFABRICATED TRUSS BRIDGE, TENTATIVELY MANUFACTURED BY CONTECH, SEE DETAIL EXCERPTS THIS LAYOUT.
 - (B) 10FT WIDE MULTI-USE TRAIL FROM PROJECT SITE
 - (C) EXISTING TRAIL ALONG ADOBE CREEK, TRAIL HEAD AT SPYGLASS LANE SHOWN HERE. INTENT IS FOR EASTERLY LIMITS TO TIE INTO EXISTING TRAIL NETWORK.
 - (D) VERTICAL GRADE CONTROL FOR BRIDGE APPROACH & ABUTMENTS HAVE BEEN CONSIDERED FOR THE INITIAL EARTHWORK AND HYDROLOGICAL MODELING. FINAL STRUCTURE CONFIGURATION TO BE UPDATED PER FINAL SELECTION OF SUPERSTRUCTURE & GEOTECHNICAL RECOMMENDATIONS FOR BRIDGE SUPPORTS
- LEGEND**
- EXISTING: CONTOUR, TOE/TOP OF SLOPE, EXTERIOR PROPERTY LINE, CANOPY (SEE ARBORIST REPORT DATED 11/09/2021 FOR TREE INFORMATION)
 - PROPOSED: TREE TO BE REMOVED, BASIN AREA (FLOODWATER DETENTION), 50FT SETBACK FROM TOP OF BANK, APPROXIMATE TOP OF BANK FOR ADOBE CREEK, APPROXIMATE OHW PER AES BIOLOGICAL SURVEY, RIPARIAN CORRIDOR (SEE EXISTING CONDITIONS EXHIBIT FOR INFORMATION), MITIGATED FLOOD PLAN PER WEST CONSULTANT'S REPORT, REPORT DEVELOPMENT ONGOING, SEE NOTE 1



PRELIMINARY TRUSS BRIDGE CONFIGURATION AND SECTIONS - 90FT SPAN
SCALE: NOT TO SCALE

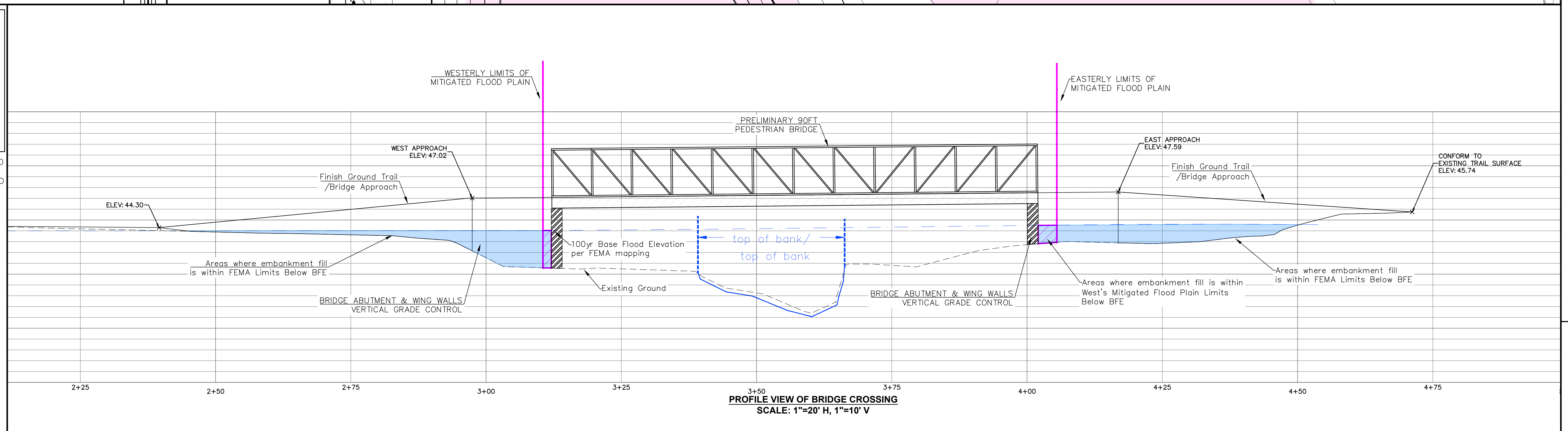
***EARTHWORK QUANTITIES - ABUTMENT FILL SLOPES**

CUT=	0 CY
* FILL=	90 CY
NET FILL =	
* THIS IS THE GROSS FILL REQUIRED TO CONSTRUCT BRIDGE EMBANKMENT WITH VERTICAL GRADE CONTROL AT ABUTMENT & WING WALLS.	
FILL below FEMA FIRM BFE	78 CY
FILL within MITIGATED FLOOD PLAN	12 CY

*EARTHWORK QUANTITIES ARE BASED ON IN SITE VOLUME AND SECTION OF FINISHED DESIGN PRIOR TO APPLICATION OF SHRINK/SWELL FACTORS. THEY VOLUMES CONSIDERED FOR THE BRIDGE EMBANKMENTS ARE SUBJECT TO REVISION AS NEEDED FOR FINAL DESIGN OF BRIDGE SUPERSTRUCTURE AND ABUTMENT DETAILS.

NOTES
1. THE MITIGATED FLOOD PLAN PRESENTED HEREIN IS BASED ON HYDROLOGICAL MODELING AND ANALYSIS COMPLETED BY WEST CONSULTANT DATED MARCH 3, 2022. CLOMR PENDING.

- NOTES**
1. SEE LAYOUT C-2 FOR SITE CONTEXT & ADJACENT LAND USES
 2. SEE LAYOUT C-3 FOR THE EXISTING CONDITIONS
 3. SEE LAYOUT C-4 FOR THE DEMOLITION & PRESERVATION
 4. SEE LAYOUT C-5 FOR SITE DENSITY & LAND USE
 5. SEE LAYOUT C-6 FOR SITE COVERAGE DATA
 6. SEE LAYOUT C-7 FOR THE VESTING TENTATIVE MAP
 7. SEE LAYOUT C-8 FOR THE PRELIMINARY CONDOMINIUM PLAN
 8. SEE LAYOUT C-9 FOR THE PARKING PLAN
 9. SEE LAYOUT C-11 FOR SITE DEVELOPMENT PLAN
 10. SEE LAYOUT C-12 FOR PRELIMINARY GRADING DESIGN
 11. SEE LAYOUT C-14 FOR PRELIMINARY UTILITY INFORMATION
 12. SEE LAYOUT C-15 FOR PRELIMINARY POST CONSTRUCTION STORM WATER CONTROL
 13. SEE LAYOUT C-16 FOR THE MAINTENANCE EXHIBIT
 14. SEE LAYOUT C-17 FOR THE FIRE APPARATUS ROUTING



REVISIONS BY

PRELIMINARY BRIDGE CROSSING PLAN & PROFILE
CREEKWOOD CONDOMINIUM PROJECT
270 & 280 CASA GRANDE ROAD APN 017-040-051 & -016
PETALUMA CALIFORNIA

STEVEN J. LAFRANCHI & ASSOCIATES, INC.
CIVIL ENGINEERS - LAND SURVEYORS
LAND PLANNERS - LANDSCAPE ARCHITECTS
PETALUMA THEATRE SQUARE
PETALUMA, CALIFORNIA 94952
(707) 762-3122 FAX (707) 762-3239



DATE: 2022.04.11
SCALE: 1"=30"
DESIGN: SJL, NOF
DRAWING: ORR, HSM, JTG, NOF
CHECK: SJL
JOB: CREEKWOOD
JOB No: 192119



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