Request for FEMA Conditional Letter of Map Revision
(CLOMR Case No.: R5514739020939)

Proposed Removal of Building Bridge #2
on San Anselmo Creek

Town of San Anselmo, Marin County, California

Prepared by

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July 22, 2025

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Town of San Anselmo, Marin County, California

This report has been prepared under the supervision of the following Registered Civil Engineer. The Registered Civil Engineer attests to the technical information contained herein and the engineering data upon which recommendations, conclusions, and decisions are based.

REGISTERED PROFESSIONAL ENGINEER
JAMES F. REILLY
C 37084
Expires 06/30/26
CIVIL
STATE OF CALIFORNIA

James Reilly ______ 7/21/2025 ______

James Reilly, P.E. Date

Registered Civil Engineer

Principal, Stetson Engineers Inc.

San Rafael, CA

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1.0 Narrative

1.1 Project Description

This request for CLOMR covers the removal of the Building Bridge #2 ("BB2") as proposed by the Marin County Flood Control and Water Conservation District, Flood Zone 9 ("District"). BB2 spans over San Anselmo Creek and obstructs flood flow during large floods and, in doing so, it contributes to flooding in downtown San Anselmo and a portion of Ross. This request also covers improvements to pedestrian and park features that comprise the ReImagine Park project as proposed by the Town of San Anselmo. ReImagine Park is adjacent to and overlaps with the BB2 parcel. The Town's ReImagine Park and the District's BB2 projects have been designed and would be constructed in a coordinated fashion.

BB2 refers to the concrete structure that spans over San Anselmo Creek in downtown San Anselmo at 634-636 San Anselmo Ave and Marin County Assessor's Parcel (APN) 106-102-28 (Figure 1). BB2 is a concrete structure with abutment walls, piers, and footings in the creek that support an overlying concrete deck that completely spans over San Anselmo Creek. The deck previously supported small, wood-frame and concrete block commercial buildings. Those buildings have been removed and today only the concrete structure and downstream ancillary building on the property remain. BB2 spans over San Anselmo Creek and hydraulically functions as a culvert for conveying creek flows (see photos below).

BB2 is a dilapidated structure and is structurally deficient based on a structural analysis commissioned by the District.

(a) Downstream opening (exit) of BB3 and upstream opening (entrance) of BB2

(b) San Anselmo Creek under BB2 (left side looking downstream)

(c) San Anselmo Creek under BB2 (right side looking downstream)

(d) Downstream opening (exit) of BB2 ((looking upstream)

(e) BB2 and Vicinity

BB2 passes flood discharges in San Anselmo Creek channel that are less than approximately 3,200 cfs at BB2, approximately the 6-year recurrence flood, without contributing to flooding. At discharges exceeding 3,200 cfs, BB2 obstructs flow in the channel to the degree that the "backwater effect" causes floodwater to overtop the bank and escape from the channel upstream of the Center Avenue Bridge (about 500 ft upstream of BB2). This escaping floodwater flows as a separate side-stream in the floodplain following an "overland flow path" which generally flows along San Anselmo Ave. During a Base Flood, the overland flow path in the floodplain is generally separate and apart from the channel flow, and it also exhibits a higher water surface elevation. The overland flow path extends from the Center Avenue Bridge for a distance of about 4,000 feet where it joins floodwaters in Ross Creek in Ross (Figure 2). The photo below shows floodwaters about 800 feet downstream of BB2, which had escaped from the channel upstream of BB2, flowing in the overland flow path along San Anselmo Ave. during the December 31, 2005 flood which was an approximate 100-year flood (i.e., a Base Flood).

Flood waters rage through downtown San Anselmo during December 31, 2005 flood.

Both hydraulic modeling and observations during the December 31, 2005 flood demonstrate that BB2 obstructs flow in San Anselmo Creek and contributes significantly to flooding and flood damage to other properties in the Ross Valley floodplain.

The BB2 removal project has the following major elements:

- Removal of BB2;
- Construction of a retaining wall along the right side of the channel; and
- Minor channel grading.

The ReImagine Park project has the following major elements:

  - Construction of a pedestrian bridge spanning the creek at the interface of BB3 and the existing BB2 (photos (a) and (e) above);
  - "Plaza area" sidewalk improvements along the San Anselmo Avenue side of the BB2 reach including a pedestrian sitting wall; and
  - Park area improvements along the park side of the BB2 reach (left side looking downstream).

The purpose of removing BB2 is to reduce flooding in downtown San Anselmo and a portion of Ross. With BB2 removed, during a Base Flood flooding in downtown San Anselmo and a portion of Ross would still occur but at a lessened amount. BB2 removal reduces flooding in downtown San Anselmo and a portion of Ross by eliminating its backwater effect during large floods. This backwater effect contributes to floodwaters overtopping the banks of San Anselmo Creek upstream and escaping into the floodplain. Reducing overtopping upstream of BB2 keeps more floodwater in the channel downstream of the overtopping location. While keeping more floodwater in the channel lowers the BFE in the floodplain it raises the BFE in the channel downstream of BB2. This rise in BFE in the channel occurs along a reach where commercial and residential structures have been constructed adjacent to the creek channel.

ReImagine Creek Park project is intended for public recreation and enjoyment. ReImagine Creek Park includes construction of a new pedestrian bridge at the current BB3-BB2 interface (Design sheet L-101 for the landscape plan in Appendix A in the Proposed Plans Section). This bridge connects and integrates the Plaza area on the San Anselmo Ave side of the creek with the park area on the opposite site of the creek. The concrete pedestrian sitting wall was designed as a pedestrian feature and serves as the Plaza's border along San Anselmo Ave. It has the incidental effect of maintaining the status quo hydraulic separation between the overland flow path and the channel that is currently produced by the existing BB2 structure and other existing structures that line the creek along San Anselmo Ave. This effect prevents floodwater in the overland flow path from returning back to the channel which, in turn, limits the rise in the BFE downstream resulting from BB2 removal.

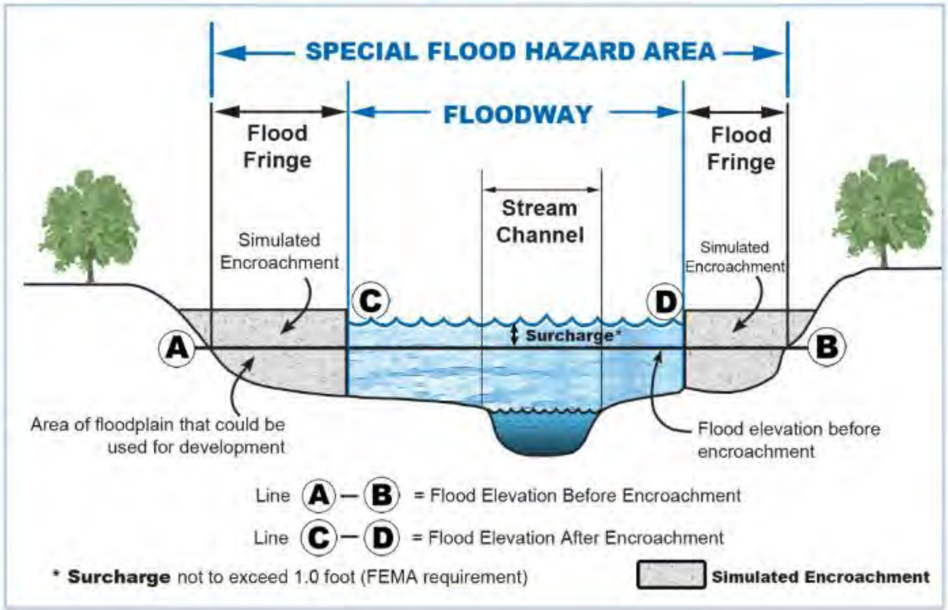
The Town of San Anselmo is proceeding with its Reimagine Creek Park Project. The two projects have been designed in concert with each other and would be constructed in a coordinated fashion; therefore, both are covered in this request for CLOMR. Hereafter the combined project is called "BB2 removal project" or simply "project."

This MT-2 application provides the design and analysis documentation and other documents required for a request for CLOMR.

1.2 Purpose of MT-2 Application

Because the BB2 removal project would be constructed within the established regulatory floodway in the channel (Figure 3) and, based on hydraulic modeling, the project would result in a BFE rise in the channel downstream of BB2, the District is required to prepare submittals and other technical documents to support compliance with FEMA floodplain management regulations spelled out in 44CFR §65.12, including a request for CLOMR. The MT-2 application is the format which is required by FEMA for requesting a CLOMR, according to the FEMA Instructions for MT-2 Forms.

The regulatory floodway is defined as the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the Base Flood (i.e., 100-year flood) without cumulatively increasing the water surface elevation more than a designated height (normally 1 ft; see the regulatory floodway schematic below) through completed development in the remainder of the floodplain (i.e., flood fringe). The regulatory floodway is a hypothetical feature which assumes the flood fringes on both sides are completely developed (i.e., completely filled-in or encroached upon). The floodway width can only be determined through hydraulic modeling. The floodway width and its boundary are important features of the FEMA Flood Insurance Rate Map (FIRM).



Regulatory Floodway Schematic (Source: FEMA)

According to FEMA regulations, construction of a project within the regulatory floodway requires either demonstration of "no-rise" in the regulatory floodway or, if there is a "rise", submittal of a CLOMR to conditionally revise the FIRM, including the mapping of the regulatory floodway. In either case, the demonstration requires use of the FEMA "effective model" or another method approved by FEMA. FEMA has an effective model for Ross Valley which is a HEC-RAS 1D (one-dimensional) steady-state model that was developed in 2009. The FEMA effective model establishes two regulatory floodways for the BB2 project area; one in the creek channel and the other in the overland floodplain.

1.3 Summary of Method Used to Analyze the Project Effects

Below is a summary of steps followed to analyze the BB2 removal project effects, i.e., post-project conditions:

1) The FEMA effective model was acquired from the FEMA Engineering Library, then tested and verified to create a "Duplicate Effective Model".

2) A "Corrected Effective Model" was developed for the purposes of enabling simulation/evaluation of project effects and post-project conditions on BFEs. Developing the "Corrected Effective Model" involved (a) establishing new cross sections to enable simulation/evaluation of project effects on BFE; and (b) utilizing new, updated topography within the project reach:

    a. New cross sections were needed to enable proper simulation of both existing conditions and post-project conditions. Post-project conditions could not be properly simulated by the “Duplicate Effective Model”. The reasons are that the “Duplicate Effective Model” (1) has a cross section that passes through the new pedestrian bridge which is not allowed in the modeling procedures, and (2) lacks a cross section through the park stage which is a prominent feature of ReImagine Park with potential hydraulic effects that should be accounted for.

b. New updated topographic survey data (2017) within the project reach became available.

c. The existing cross section that passes through the proposed pedestrian bridge was eliminated and a new cross section was added immediately upstream of the proposed pedestrian bridge to simulate the hydraulic effect of the bridge based on the new updated topographic survey (2017).

d. A new cross section was added at the park stage to capture the hydraulic effect of the park stage deck and pier based on new updated topographic survey (2017).

e. The modeling approach of the Sir Francis Drake (SFD) Ave downstream bridge in the FEMA Duplicate Effective Model was modified from “Pressure and Weir” to “Energy Only” to produce a reasonable revised floodway water surface elevation (WSE) profile.

3) Simulations were performed using the Corrected Effective Model to analyze the existing conditions and post-project conditions. The Corrected Effective Model modified to reflect the project features is called “Post-Project Conditions Model”.

The resulting hydraulic difference between the existing conditions simulated by the Corrected Effective Model (i.e., “Existing Conditions Model” or “Pre-Project Conditions Model”)[1] and the post-project conditions simulated by the Corrected Effective Model modified to reflect the project features (i.e., “Post-Project Conditions Model”) represents the project’s isolated (i.e., incremental) impact, which will be used to assess mitigation and compliance with 44CFR §65.12 (Appendix B).

The resulting hydraulic difference between the existing conditions simulated by the Duplicate Effective Model and the post-project conditions simulated by the Post-Project Conditions Model represents the combined effects of the project and the model’s “correction”, which will be used to determine the revisions to the FEMA FIRM and FIS (Flood Insurance Study).

[1] In FEMA terminology, the Existing or Pre-Project Conditions Model is the Duplicate Effective Model or Corrected Effective Model modified to reflect any man-made modifications that have occurred within the floodplain since the date of the current Effective Model. Since no hydraulically significant man-made modifications have occurred within the floodplain of this study since the date of the current Effective Model, the Corrected Effective Model becomes the Existing or Pre-Project Conditions Model.

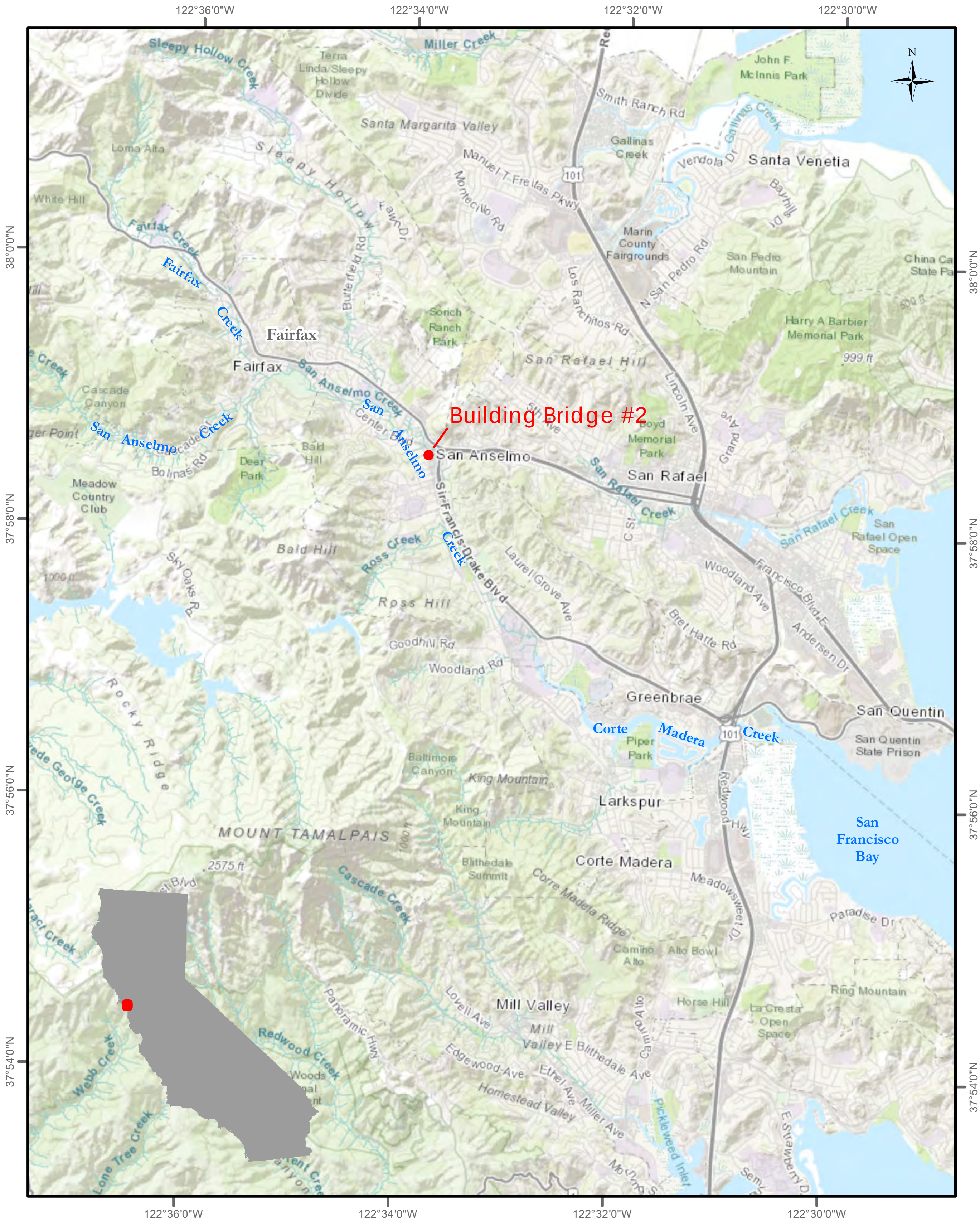


FIGURE 1 PROJECT LOCATION

0 0.75 1.5 Miles

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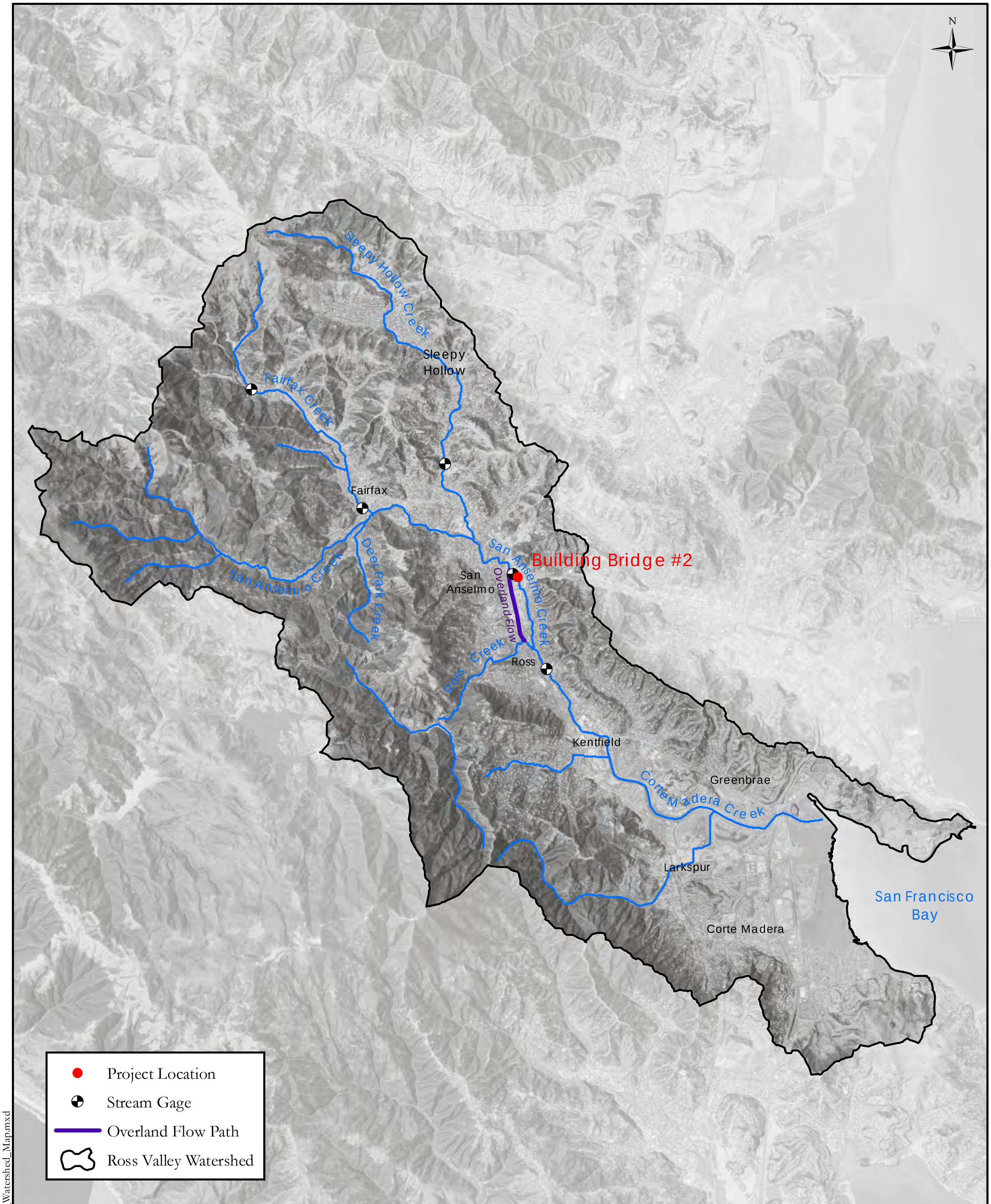

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FIGURE 2 PROJECT AND STREAM GAGE LOCATIONS AND SAN ANSELO OVERLAND FLOW PATH

ROSS VALLEY WATERSHED

0 0.75 1.5 Miles

Figure 3 FEMA FIRM Panels and BB2

2.0 MT-2 Application Forms

Applicable MT-2 Forms

- Form 1: Overview & Concurrence Form (Town of San Anselmo)
    - Town of San Anselmo Submitted Letter in-lieu of Signing Form 1
- Form 1: Overview & Concurrence Form (Town of Ross)
    - Town of Ross Submitted Letter in-lieu of Signing Form 1
- Form 2: Riverine Hydrology & Hydraulics Form (San Anselmo Creek)
- Form 2: Riverine Hydrology & Hydraulics Form (San Anselmo Creek Overflow)
- Form 3: Riverine Structures Form
- Review Fee Payment Information Form

Refer to the separate filled MT-2 Forms and the letters submitted by the Towns in-lieu of signing the MT-2 Form 1.

Explanations on Sediment Transport [per MT-2 Form 3 Section C(4)]

Sediment transport was not considered in the analysis of this project. In general, the creek channel at the BB2 site has been heavily disturbed by the surrounding development and much of the channel and banks are obscured by vegetation, concrete, rip-rap, or other man-made "improvements". Local outcrops of sandstone/shale bedrock were observed in the channel bottom directly downstream of BB2. The bedrock is not continuously exposed and much of the channel bottom exposes young alluvial deposits. There has been no indication from field reconnaissance and historical channel bed records that the project would significantly affect sediment transport with an effect on the BFE's for the San Anselmo Creek at this location. Figure 4 below compares the channel bed profiles between 1976 shown in the FEMA's 1977 Flood Insurance Study and the 2006 cross sections survey that was used in the development of the FEMA effective model. As shown in Figure 4, the channel bed degraded by about 4 - 5 ft at BB2 over the 30-year period of 1976-2006. Based on geomorphic reasoning, it would be expected that the channel bed would degrade at a slower rate in the future and eventually reach "equilibrium". This is demonstrated by the 2017 topographic survey for the BB2 project which shows that there has been little further degradation over the 10-year period of 2006-2017. The channel bed at the BB3-BB2 interface may have already reached equilibrium. In addition, the project has a hydraulic effect only on large infrequent floods that exceed 3,200 cfs (i.e., the 6-year recurrence level). The large majority of sediment that is transported in a typical creek channel over time is cumulatively transported by the smaller, more frequent floods, and those smaller floods, along with the sediment loads transported therein, would be unaffected by the project. For these reasons, impacts to BFE's resulting from changes to sediment transport caused by this project would not be significant.

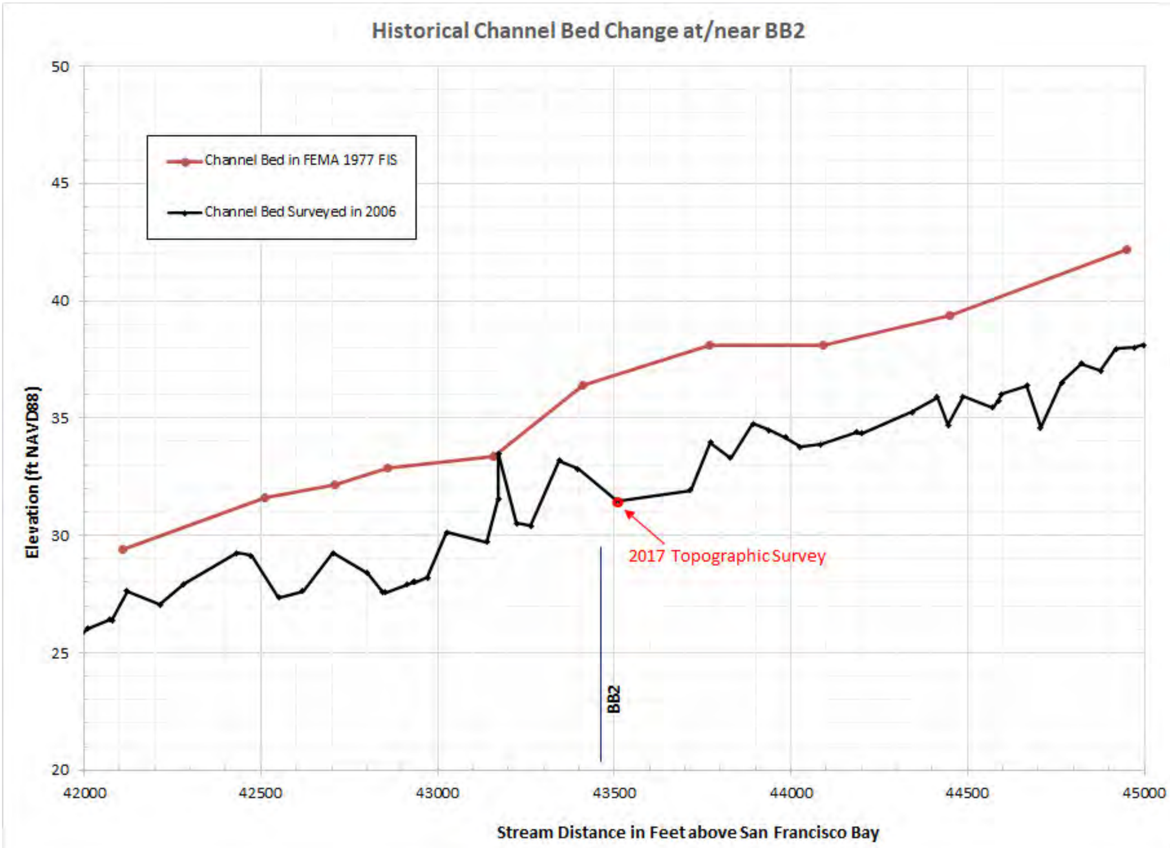

Figure 4 Historical Channel Bed Change at/near BB2

3.0 State Approval

There is no requirement in California for state approval prior to the submittal of MT-2 application to FEMA.

4.0 Hydrologic Analysis (not applicable)

This requirement is not applicable. There is no revised or new hydrologic analysis included in this MT-2 application because the project does not have a significant effect on hydrology. The flow data used in FEMA's currently effective HEC-RAS hydraulic model was used for the analysis of project effects.

Based on the FEMA effective HEC-RAS model, the 100-year peak flows in the creek channel and the overland flow path in the vicinity of BB2 are estimated at about 4,000 cfs and 1,660 cfs, respectively.

5.0 Hydraulic Analysis

The current FEMA effective HEC-RAS 1D steady-flow model and associated hydrological and topographical data were obtained from the FEMA Engineering Library. The following three models in digital format are included in this submittal:

- Duplicate Effective Model
- Corrected Effective Model (or Existing Conditions Model or Pre-Project Conditions Model)
- Post-Project Conditions Model

<u>Overview of the FEMA Effective Model</u>

Figure 5 shows how the Effective Model has been configured by FEMA to represent the hydraulics of the Base Flood. Figure 6 shows the FEMA Effective Model configuration overlaid with the BB2 Project.

As shown in Figure 5, the model has been configured by FEMA to represent San Anselmo Creek floodwaters as flowing in two water bodies from the Center Ave Bridge down to Ross Creek -- the creek channel and the overland flow path. Ross Creek is a tributary of San Anselmo Creek. Four lateral structures at/near the Center Ave Bridge simulate how the floodwater, which escapes from the channel upstream, separates through a hydraulic process known as "split flow" into the overland flow path and the creek channel. In this split flow process, floodwater spills over the topographic ridge at the headwater point of the overland flow path and the creek channel located at the Center Ave Bridge. The amount of floodwater that spills over this topographic ridge is controlled by the height of the water surface in San Anselmo Creek above the ridge – the higher the water surface the more floodwater spills over into the overland flow path. Using this process enables simulating the effect that BB2 removal has on reducing flooding in the floodplain because BB2 removal lowers the height of the water surface in San Anselmo Creek above the ridge which, in turn, reduces the amount of floodwater spilling over into the overland flow path. In doing so, BB2 removal also keeps more water in the creek channel which raises the water level in the channel downstream of BB2.

The FEMA Effective Model's overall configuration of the main channel cross sections and the overland flow path cross sections implicitly indicates that under existing conditions there is no flow exchange between the main channel and overland flow path in the floodplain from the Center Ave Bridge down to Ross Creek. In modeling terms, this configuration means that there is a "height-unlimited glass wall" along the junction points between the main channel cross sections and the overland flow path cross sections which functions to hydraulically separate the flows of the main channel and overland flow path. This configuration represents the hydraulic effect of the BB2 structure and the other existing buildings that line the creek side of San Anselmo Ave. This configuration was maintained in the Corrected Effective Model and in the Post-Project Conditions Model by not setting any new lateral structures that would allow for flow exchange. This configuration also reflects the incidental hydraulic effect of the concrete pedestrian seating wall which maintains the status quo separation between the overland flow path and the channel that is currently produced by the existing BB2 structure.

Duplicate Effective Model

After acquiring the current FEMA effective HEC-RAS 1D steady-flow model (version 4.1) from the FEMA Engineering Library, the model was run and verified to reproduce the same Effective Model output and results as reported in the FIS and shown in the effective FIRM (both in terms of the BFE profile and the floodway WSE/encroachment stations). This process was necessary to ensure that all input data of the effective model had been transferred correctly so that later the model could be trusted to provide reliable results that reflect "post-project" conditions over the affected reach. This section describes the verification process.

The FEMA current effective model package has the following five simulation scenarios:

1) Calibration – with optimization on split flow analysis (for the calibration flow event)
    a. 19 flow input locations
    b. Optimization turned ON[2]

2) Multiple Profile Run – without optimization (for Q10, Q50, Q100, and Q500)
    a. 31 flow input locations
    b. Optimization turned OFF

3) Multiple Profile Run – with optimization (for Q10, Q50, Q100, and Q500)
    a. 19 flow input locations
    b. Optimization turned ON

4) Floodway Model Run – without optimization (for Q100)
    a. 31 flow input locations
    b. Optimization turned OFF

5) Floodway Model Run – with optimization (for Q100)
    a. 19 flow input locations
    b. Optimization turned ON

Simulation runs for the scenarios listed above were carried out to verify the results reproduced those in the Effective Model output and those reported in the FIS and shown in the effective FIRM (both in terms of the BFE profile and the floodway WSE/encroachment stations).

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[2] The HEC-RAS program has two methods for split flow analysis at lateral structures: (1) the model "optimizes" the flow splits by automatic iterative computations (optimization turned ON), and (2) a user specifies the flow splits (optimization turned OFF). When the split flow optimization is turned ON, the program will calculate a water surface profile with the initially assumed flows. From the computed profile, new flows are calculated for the hydraulic structures and junctions and the profile is re-run. This process continues until the calculated and assumed flows match within a given tolerance.

The split flow optimization approach (i.e., with optimization ON) is the most appropriate modeling method to analyze the hydraulic effect of the BB2 removal project.

The BFE and floodway water surface elevation (WSE) results of all the above simulation scenarios were verified for the Base Flood (i.e., the 100-year flood or Q100; see Figures 7a and 7b for the main channel BFE and floodway WSE). The simulated channel BFEs (without the floodway) produced by the FEMA effective model are the same for the with and without optimizations (see Figure 7c). The model-simulated channel floodway WSEs have minor discrepancies upstream of BB#3 between the with and without optimizations (see Figure 7d). The reason for these discrepancies is that the flow inputs in the without optimization run had minor modifications to the flow results simulated from the optimization run at the locations with lateral structures that are located upstream of BB3. Figure 7d also shows that the FEMA FIS used the without optimization run for the floodway WSE.

The WSE results for Scenario 3 above (with optimization ON) were also verified for Q10 and Q50 (see Figures 8a and 8b), but not for Q500 (see Figure 8c). Q10, Q50, Q100, and Q500 are the four flood events documented in the FEMA FIS. The reason that the WSE result for Q500 could not be duplicated is not known for certain, but it could be related to the instability issue that exists in the FEMA Effective Model for Q500.

For the floodway analysis, the FEMA effective model first used "Method 4" (equal conveyance reduction from both sides of overbanks) to preliminarily determine the encroachment stations and then used "Method 1" to refine the encroachment stations (Method 1 specifies the exact locations of the encroachment stations for each individual cross section)[3]. By comparing the floodway WSEs in the FEMA FIS and the those in the FEMA Effective Model it was found that the FEMA FIS used the "without optimization" results (Scenario 4 results instead of Scenario 5 results). Based on this finding, it became apparent that FEMA's modeling procedure was to first run the model with optimization, then to reconstruct the flow inputs based on the optimization run with minor flow modifications at certain locations in the floodway analysis. To be consistent with FEMA, this procedure was also used in the revised floodway analysis for the post-project conditions.

In summary, the FEMA Effective Model was able to duplicate the Q10, Q50, Q100, and floodway WSEs, but not the Q500 (Scenario 3 listed above). The reason for non-duplication of the Q500 is not known for certain, but it could be related to the instability issue that exists in the FEMA Effective Model for Q500[4]. Resolving this particular model instability is not essential to this CLOMR analysis. Considering the non-duplication of the modeled WSE for Q500, the 500-year floodplain in the FIRMs will not be revised.

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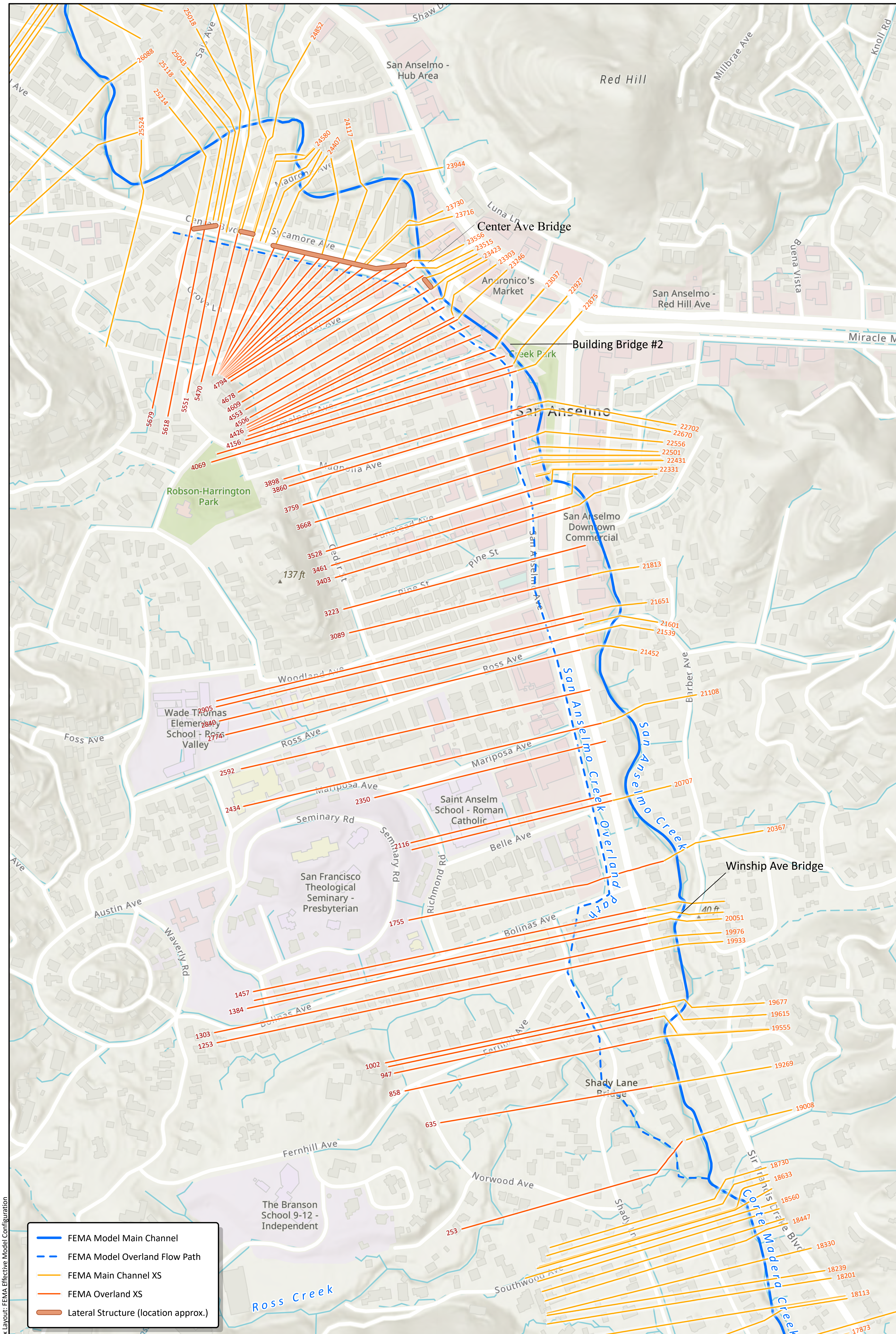
[3] In HEC-RAS, there are five optional methods for specifying/computing floodway encroachment stations. Method 1 specifies the exact locations of the encroachment stations for each individual cross section. Method 2 utilizes a fixed top width, and the left and right encroachment stations are made equal distance from the centerline of channel, which is halfway between left and right bank stations. Method 3 calculates encroachment stations for a specified percent reduction in the conveyance of the natural profile for each cross section. Method 4 computes encroachment stations so that conveyance within the encroached cross section (at some higher elevation) is equal to the conveyance of the natural cross section at the natural water level. This higher elevation is specified as a fixed amount (target increase) above the natural (e.g., 100-year) profile. The encroachment stations are determined so that the equal loss of conveyance (at the higher elevation) occurs on each overbank, if possible. Method 5 operates much like Method 4 except that an optimization scheme is used to obtain the target difference in water surface elevation between natural and encroached conditions.

[4] Used herein, instability issue means that when running the Duplicate Effective Model for Q500 a waring message appears that states "Flow Optimization Fails to Converge".

Figure 5



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FEMA EFFECTIVE MODEL CONFIGURATION

N

0 250 500

Feet

FIGURE 6

FEMA Effective Model Configuration And Proposed Structures

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C:\DATA\2431\2431-21-01\GIS\FIG 1 FEMA Effective Model Configuration.mxd 11/30/2021

Figure 7a Duplicate Effective Model Verification for the Main Channel BFE and Floodway WSE with Optimization ON

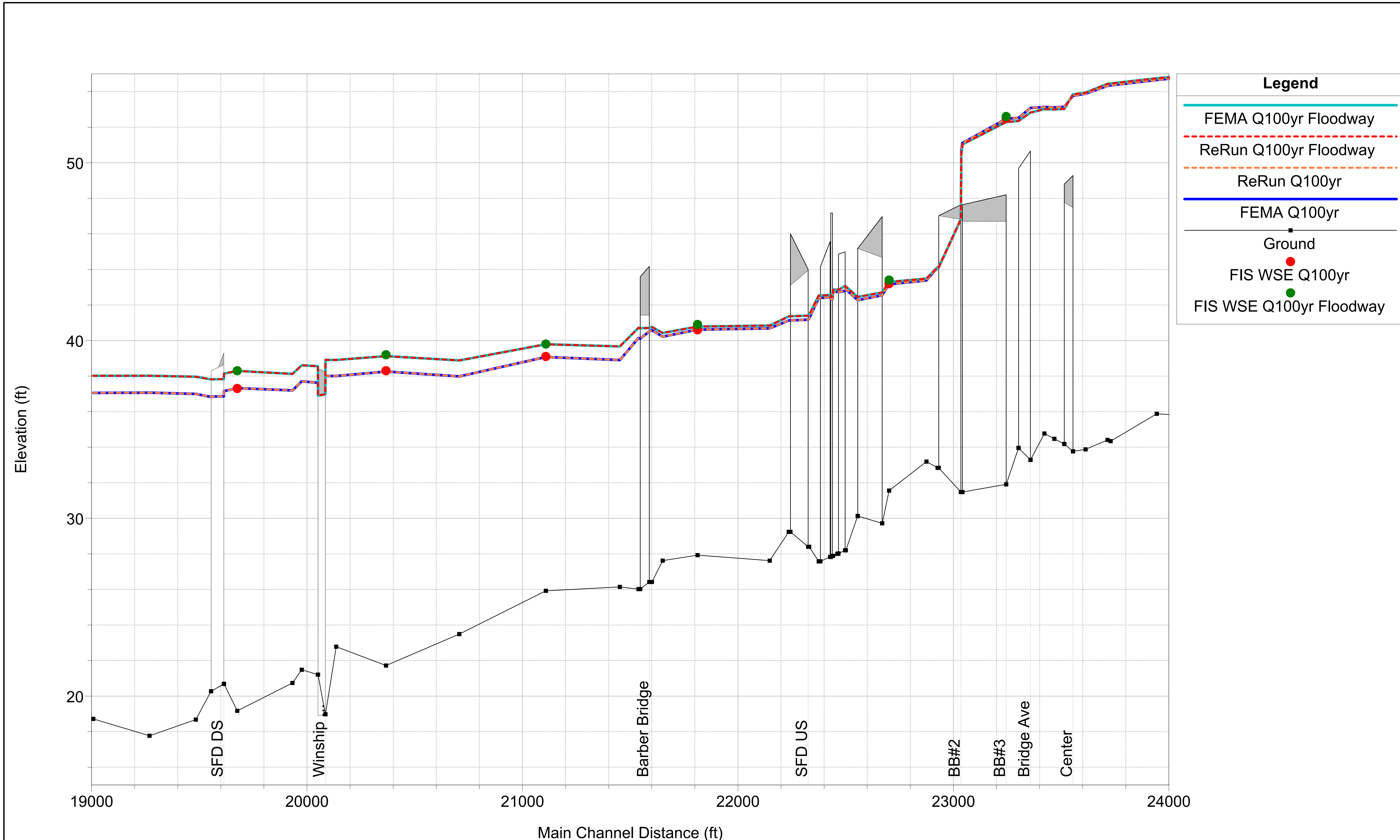


Figure 7b Duplicate Effective Model Verification for the Main Channel BFE and Floodway WSE with Optimization OFF

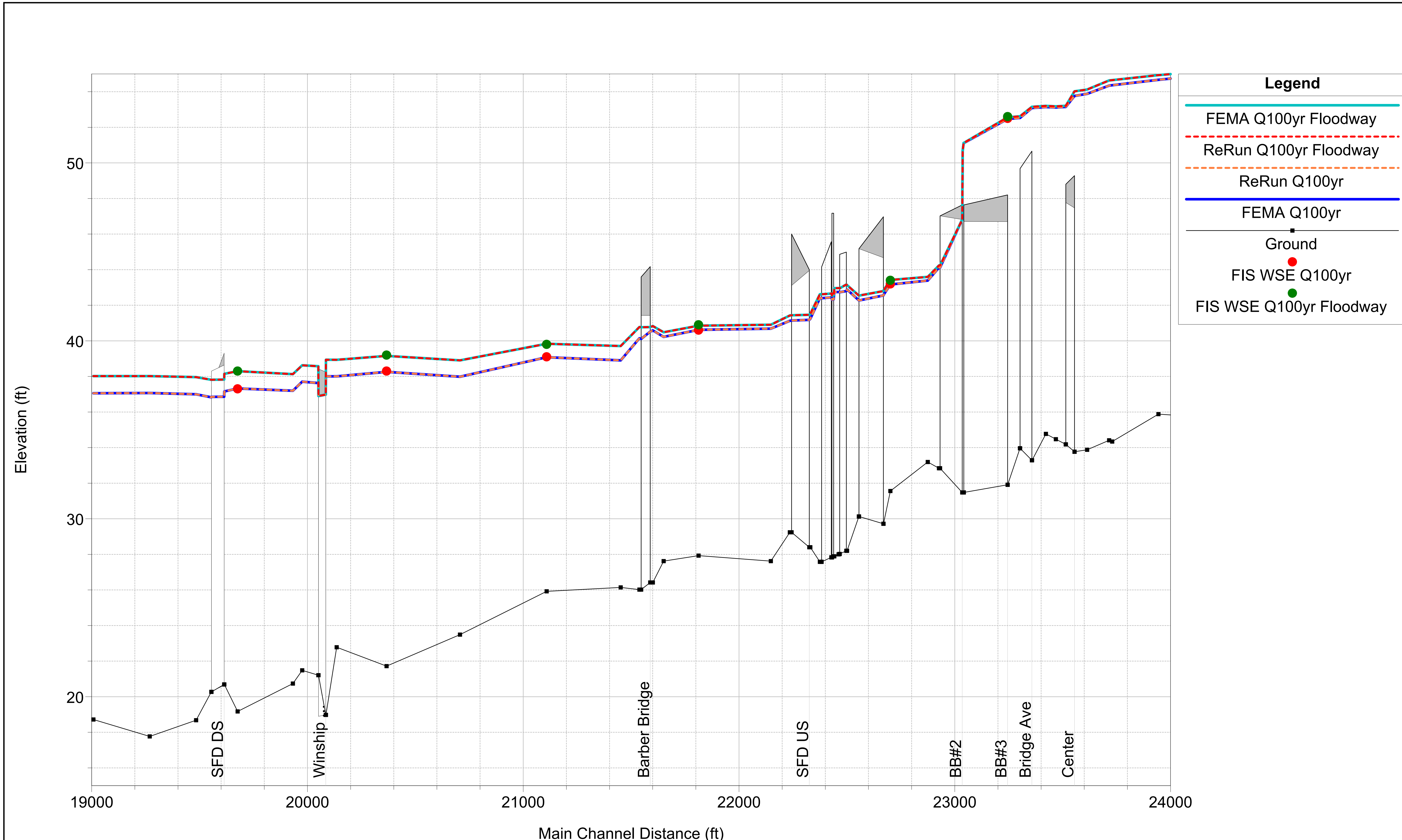


Figure 7c Comparison of the FEMA Effective Model-Simulated Main Channel BFEs between Optimization and Without Optimization

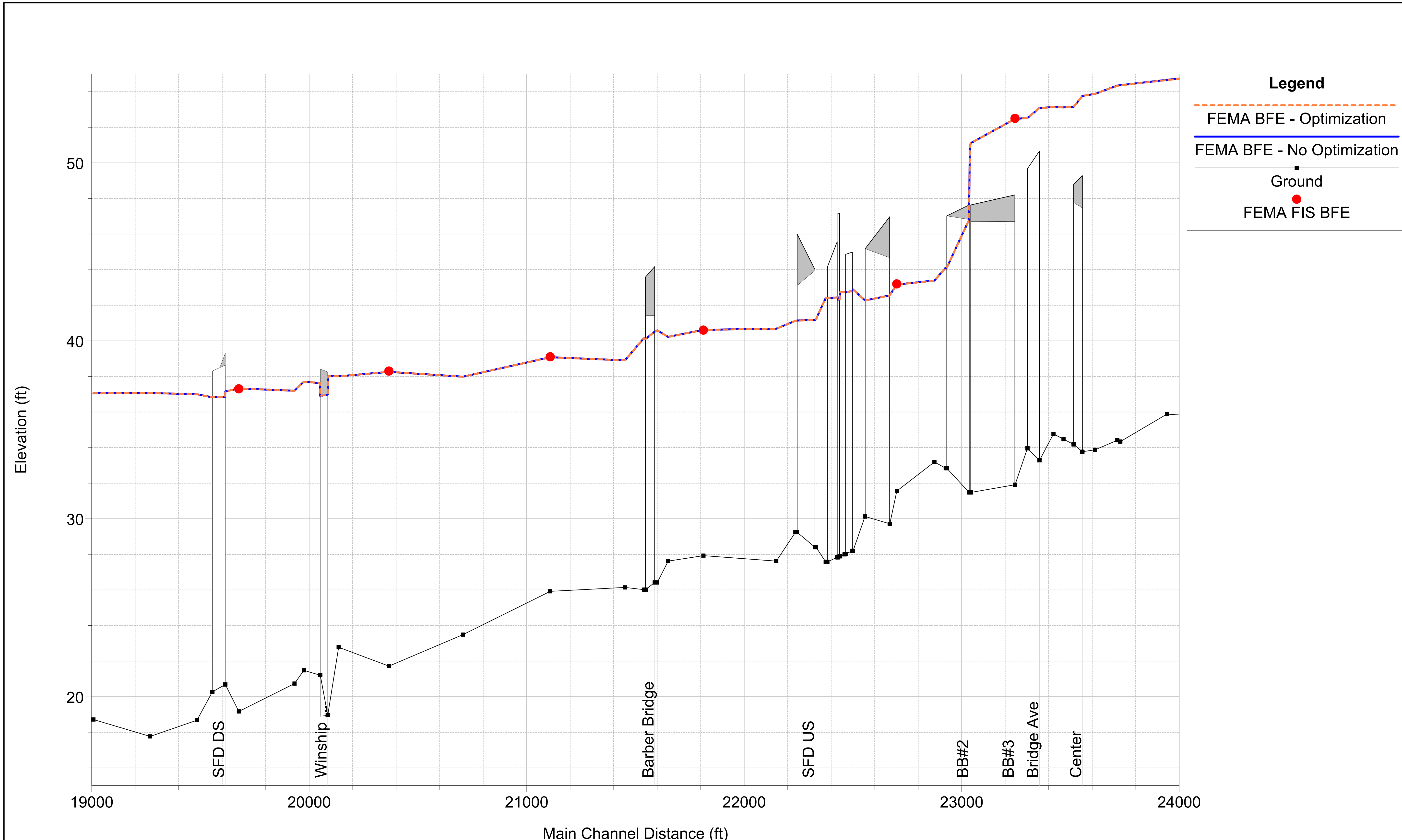


Figure 7d Comparison of the FEMA Effective Model-Simulated Main Channel Floodway WSE between Optimization and Without Optimization

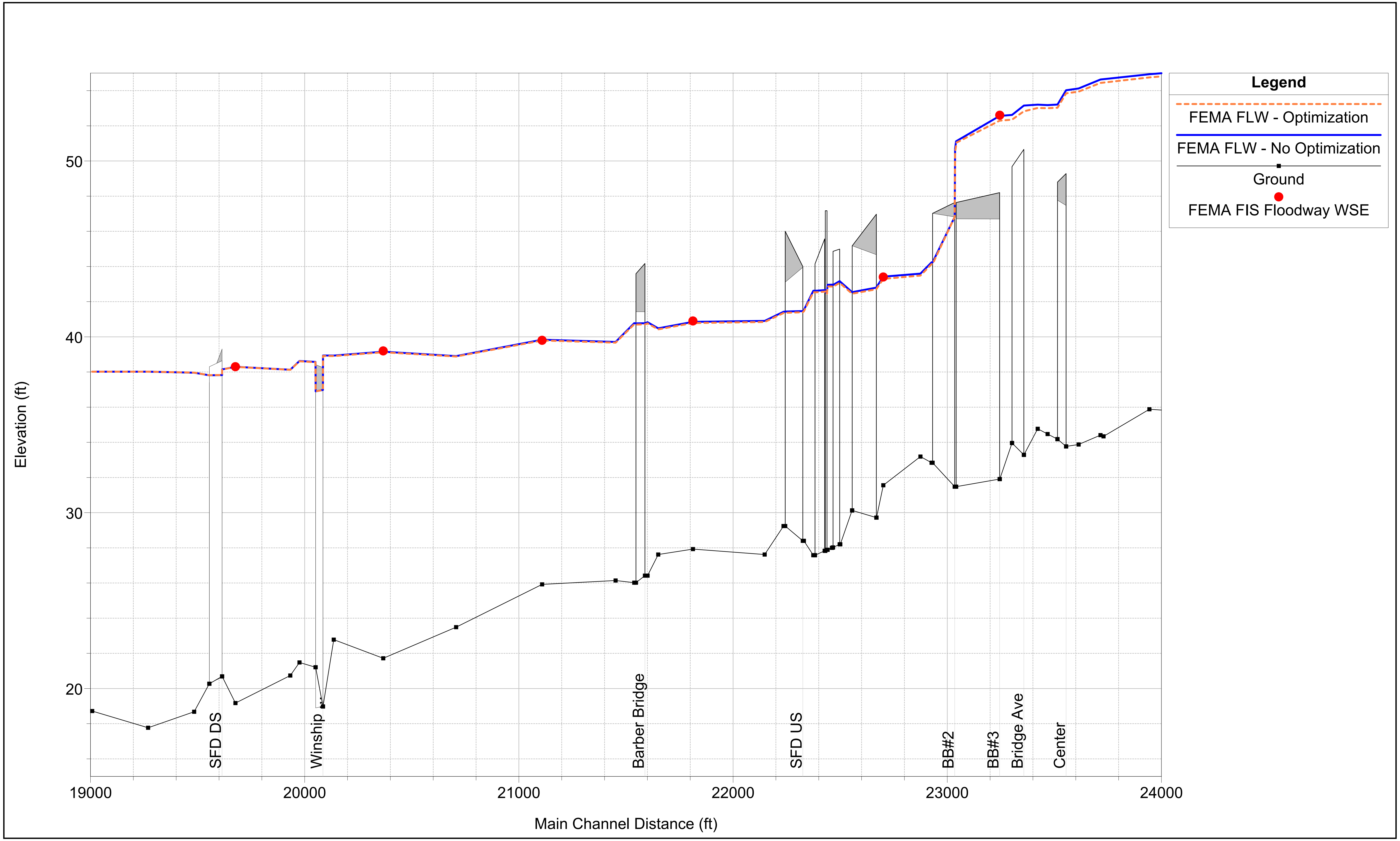


Figure 8a Comparison of Simulated Creek Channel WSE for Q10 between FEMA Effective Model and FEMA Duplicate Model

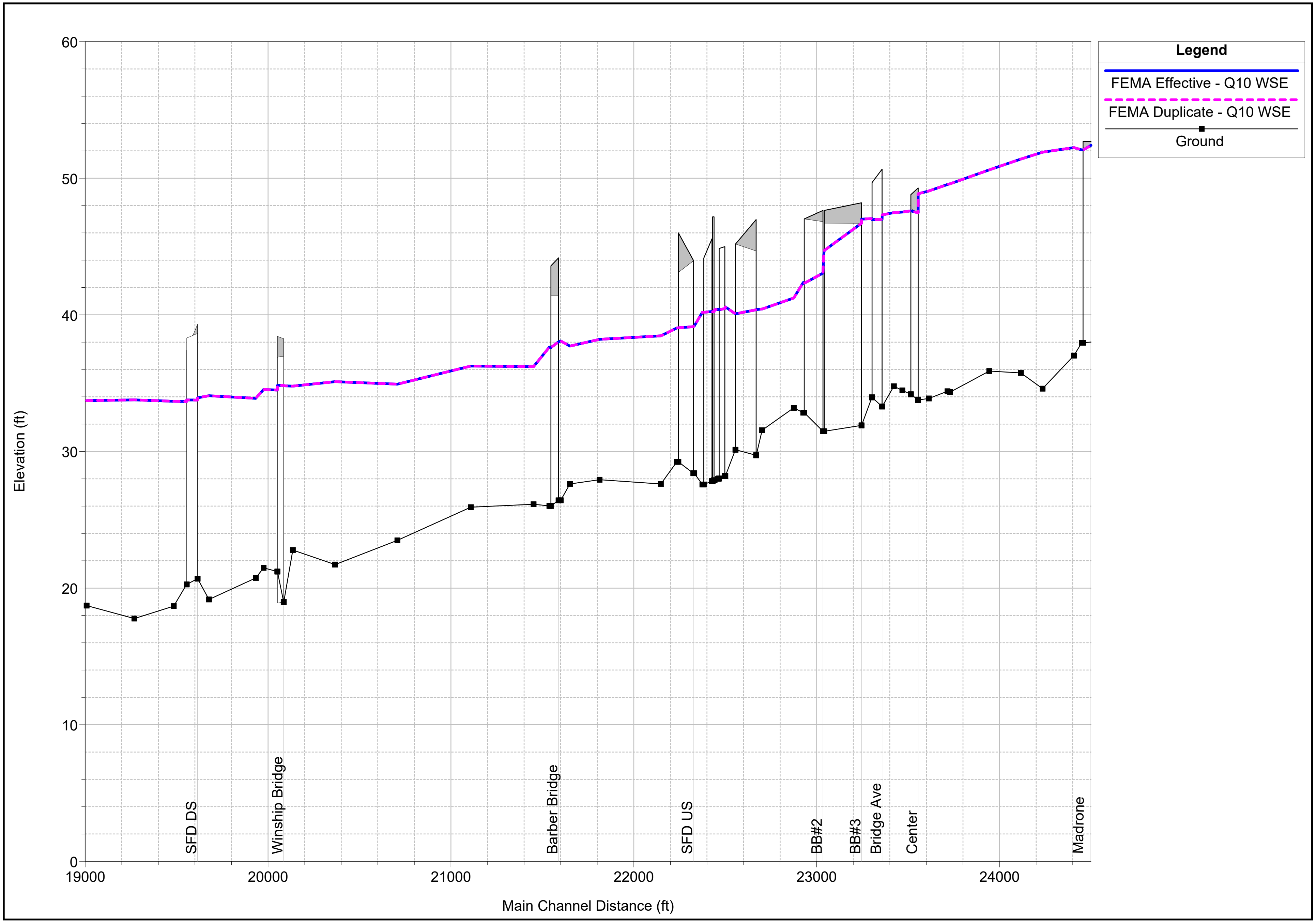


Figure 8b Comparison of Simulated Creek Channel WSE for Q50 between FEMA Effective Model and FEMA Duplicate Model

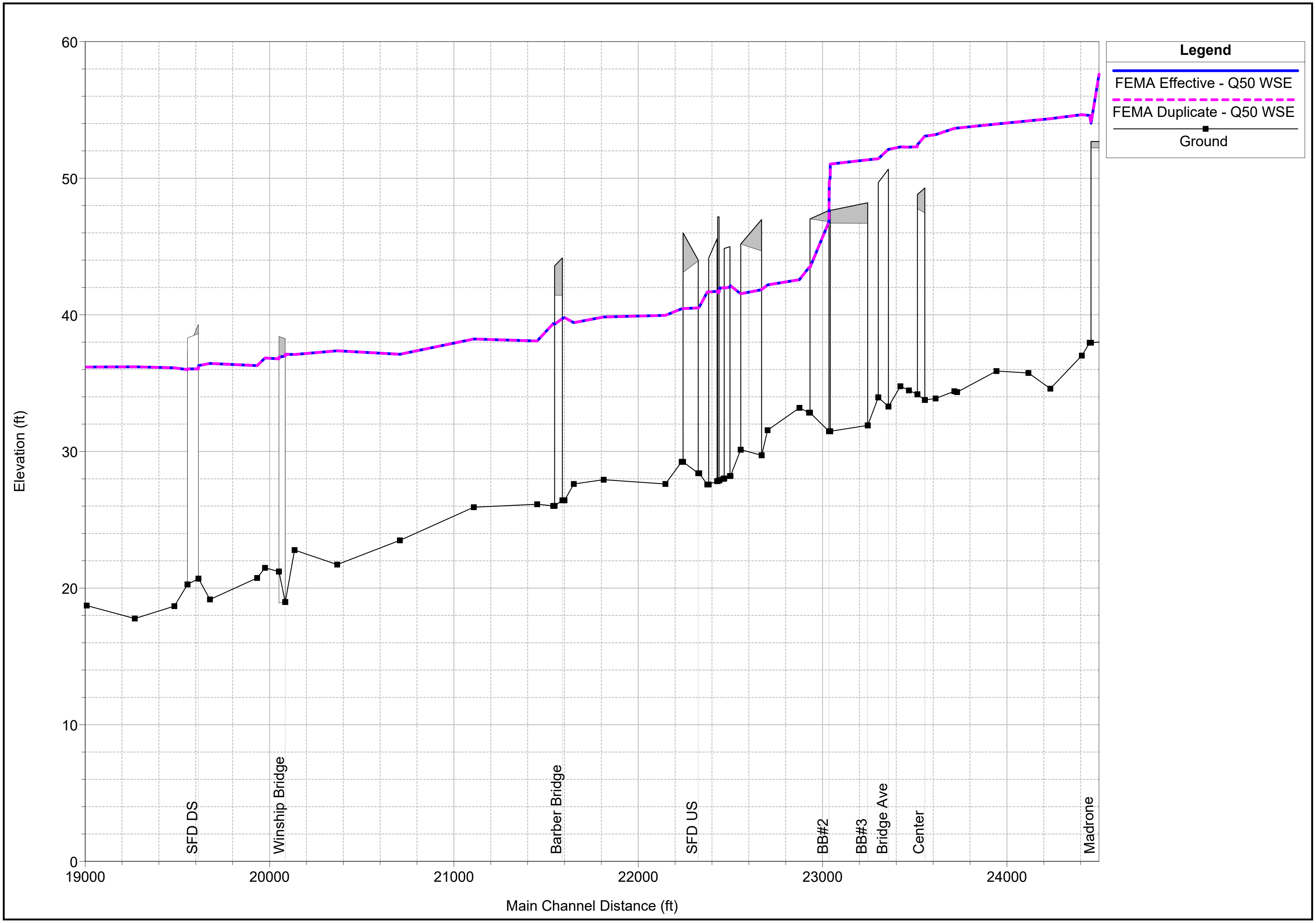
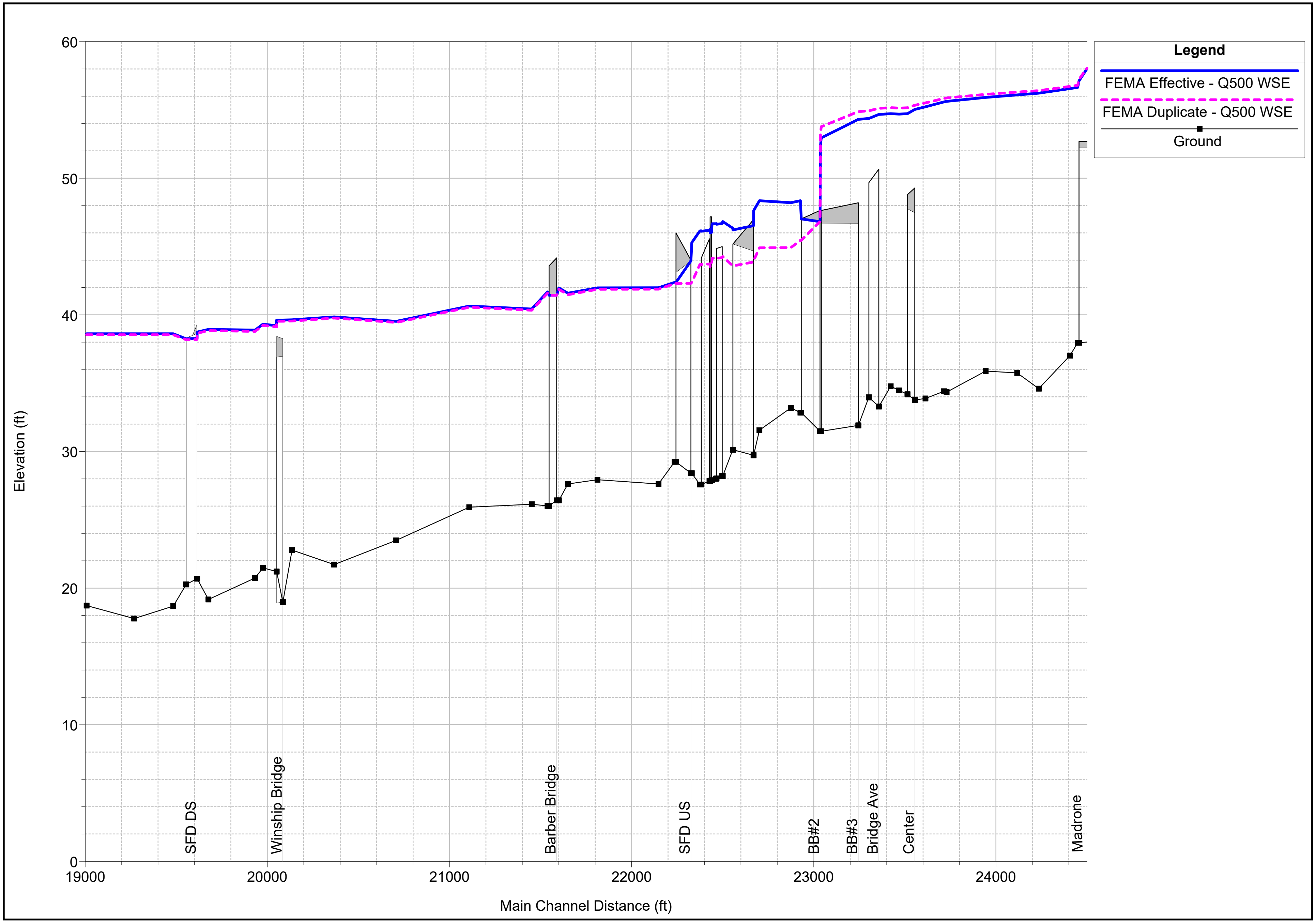


Figure 8c Comparison of Simulated Creek Channel WSE for Q500 between FEMA Effective Model and FEMA Duplicate Model



Corrected Effective Model or Pre-Project Conditions Model

As defined by FEMA, the Corrected Effective Model is the model that corrects any errors that occur in the Duplicate Effective Model, adds any additional cross sections to the Duplicate Effective Model, or incorporates more detailed topographic information than that used in the current effective model.

The following steps were taken to create the Corrected Effective Model:

1) Overlaid the Duplicate Effective Model cross sections with the footprints of the existing BB2 and BB3 structures and the footprint of the proposed pedestrian bridge.

2) Development of the Corrected Effective Model was determined necessary in order to (1) enable simulation/evaluation of project effects on BFE; and (2) utilize new, updated topography within the project reach:
    a. Identified Corrected Effective Model cross section locations that most appropriately allow simulating both existing conditions and post-project conditions. Since there was an overlap between certain effective model cross sections and the footprint of the proposed pedestrian bridge, adding new cross sections and deleting certain existing cross sections was necessary.
    b. Updated the geometry of the corrected effective model cross sections using the most recent topographic survey (2017) within the project reach.

3) Modified the modeling approach of the SFD Ave downstream bridge in the Duplicate Effective Model from "Pressure and Weir" to "Energy Only" to produce a reasonable revised floodway WSE profile.

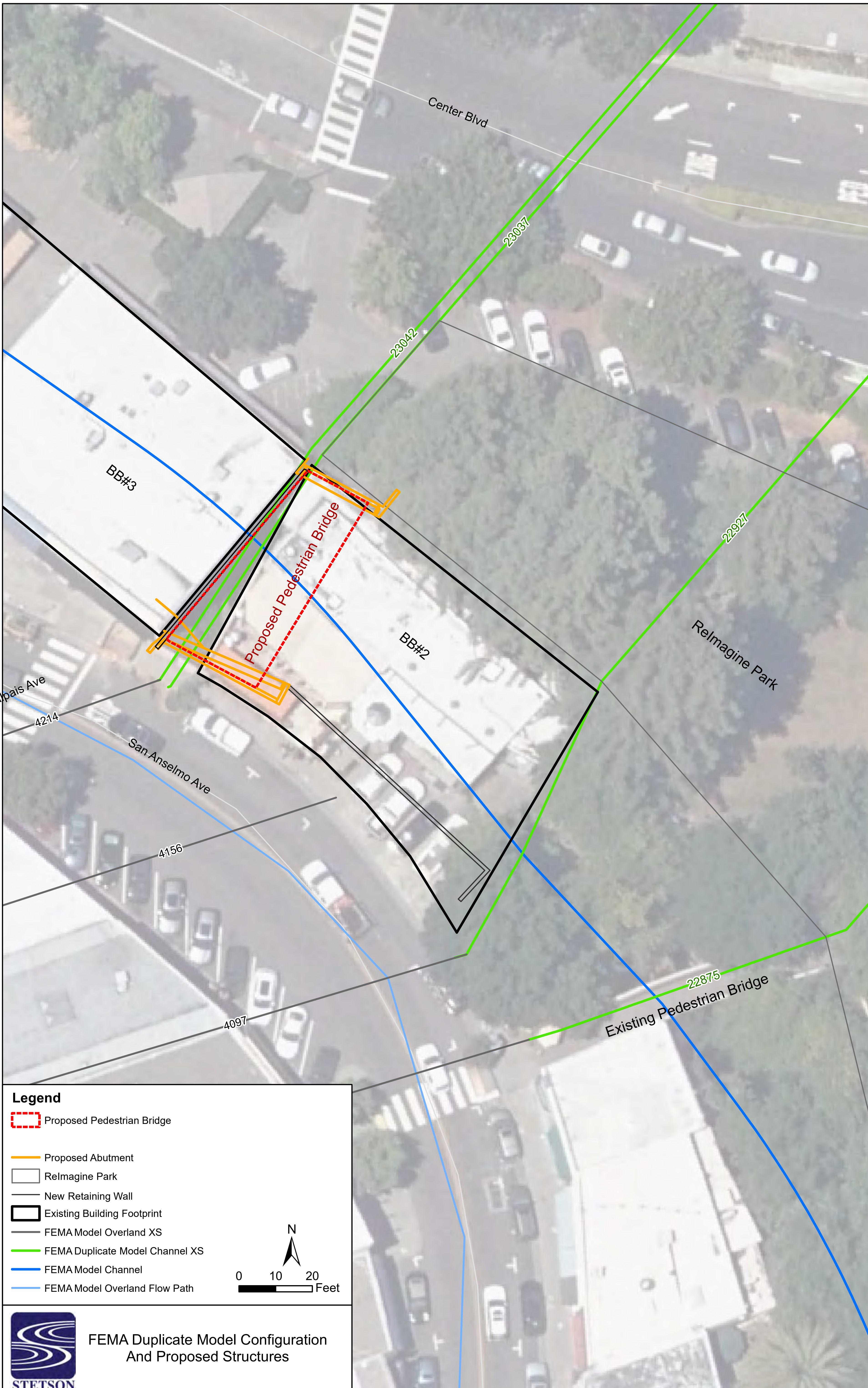
Model procedures require a minimum of one cross section at the upstream face and one at the downstream face of a structure. As shown in Figure 6 and Figure 9 (zoom in of Figure 6 in the project area), the existing cross sections overlap the middle of the proposed pedestrian bridge and there are no cross sections upstream of the proposed pedestrian bridge. This requires "correction" to conform with the modeling procedures. Figure 10 shows the cross sections in the Corrected Effective Model and the following describes the cross section changes to create the Corrected Effective Model (compare Figures 9 and 10).

- Added a new cross section between XS 22927 and XS 22875 to simulate and account for the hydraulic effect of the existing stage deck in the ReImagine Creek Park. The deck's exposure to flow was configured in HEC-RAS with "obstruction" for the pier and "lid" for the deck as shown in Figure 11.

- Added a new cross section at the upstream face of the proposed pedestrian bridge. This cross section is needed to simulate the effect of the pedestrian bridge.

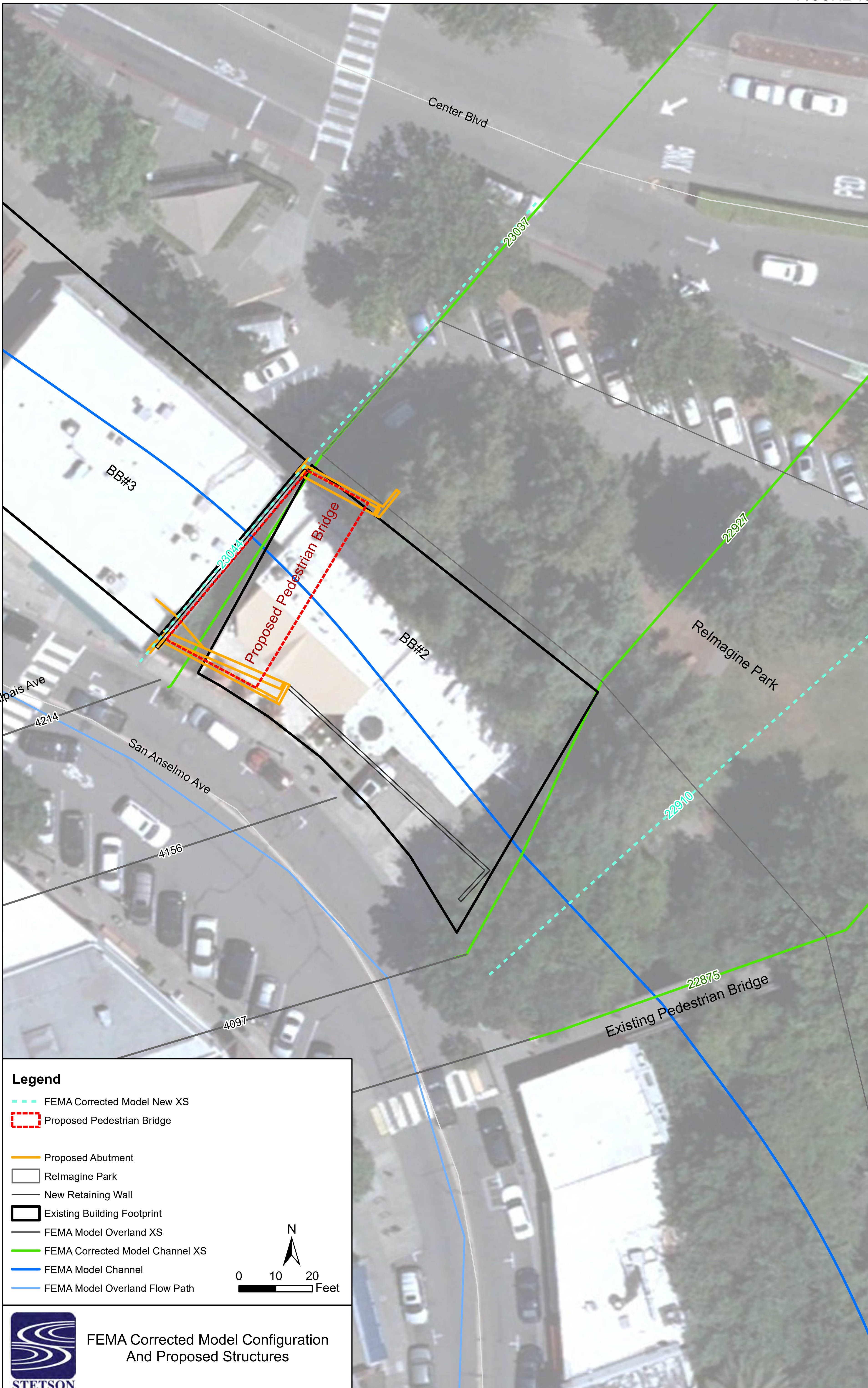
- Deleted the existing XS 23042 that overlaps with the proposed pedestrian bridge. Existing XS 23037, which is close to the upstream face of the existing BB2, is kept in the Corrected Effective Model to simulate existing conditions even though it overlaps with the proposed pedestrian bridge. The reason for this is that, according to modeling guidelines, two cross sections upstream of existing BB2 (the existing XS 23037 and the added new cross section at the upstream of the proposed pedestrian bridge) are theoretically needed to simulate the hydraulics of the existing BB2. Theoretically two cross sections upstream of a structure and two cross sections downstream of the structure are needed to simulate the hydraulics of the structure.

The Corrected Effective Model also changed the default number of computational iterations used in the Duplicate Effective Model to the maximum allowable number of computational iterations, with the intention to avoid/minimize the instability issue.



FEMA Duplicate Model Configuration And Proposed Structures

C:\DATA\2431\2431-21-01\GIS\FIG 2 FEMA Duplicate Model Configuration.mxd 11/30/2021



FEMA Corrected Model Configuration And Proposed Structures

STETSON ENGINEERS INC.

C:\DATA\2431\2431-21-01\GIS\FIG 3 FEMA Corrected Model Configuration.mxd 7/21/2022

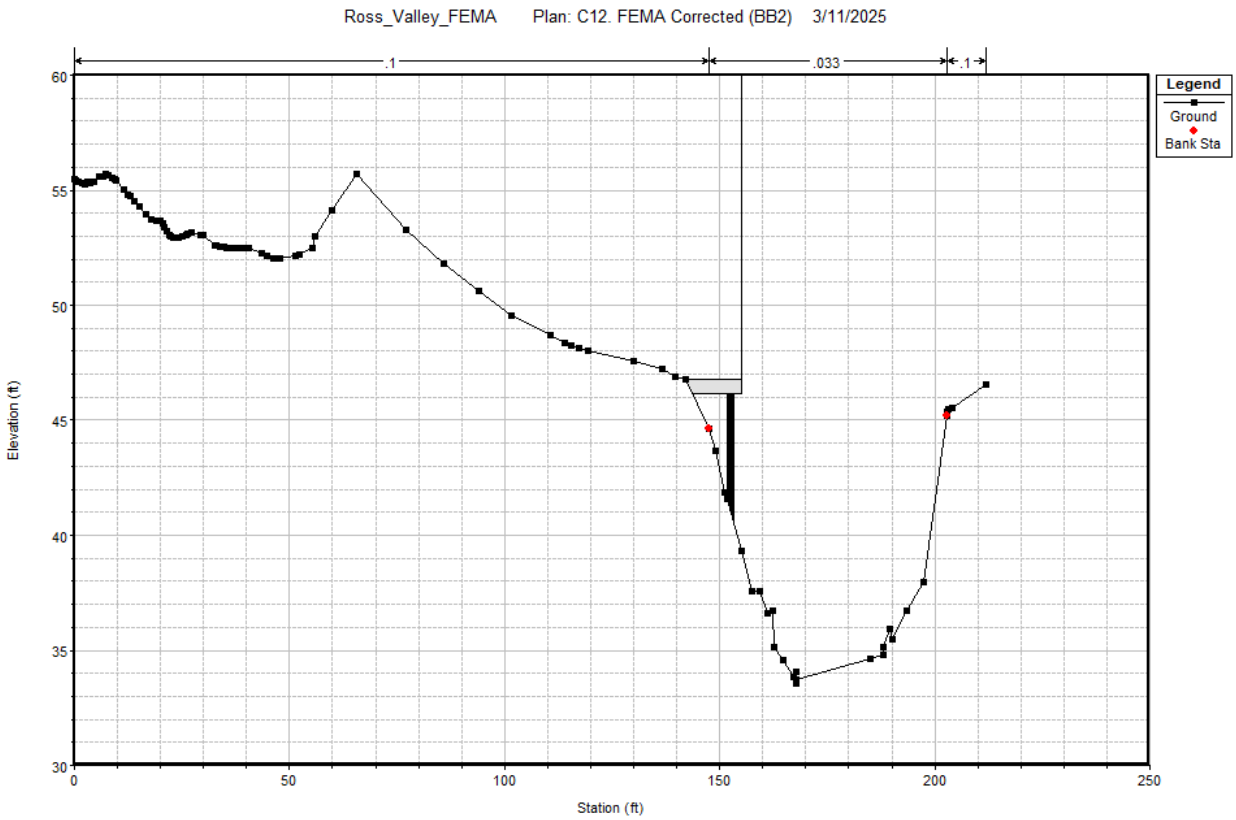


Figure 11 Configuration of the Existing Stage Deck in the ReImagine Creek Park

Post-Project Conditions Model

Figure 12 shows the cross sections of the Revised or Post-Project Conditions Model. The Post-Project Model included the following changes to the cross sections of the Corrected Effective Model to simulate project conditions (compare Figures 10 and 12)[5]:

- Added three new cross sections; two at the downstream end of the proposed pedestrian bridge and one farther downstream at the end of the proposed new retaining wall. The two new cross sections at the downstream of the proposed pedestrian bridge are theoretically needed for simulating the hydraulics of the proposed pedestrian bridge according to modeling guidelines. The new cross section farther downstream at the end of the proposed new retaining wall is intended to simulate the transition from the retaining wall to natural channel condition. There is only one cross section at the upstream end of the proposed pedestrian bridge although two cross sections are theoretically needed according to modeling guidelines. This is because the gap between BB3 and the proposed pedestrian bridge is small, spanning only several feet. Model testing showed that an additional cross section at the upstream end of the proposed pedestrian bridge would have little effect on the hydraulic result.
- Deleted the XS 23037 that overlaps with the proposed pedestrian bridge.

Note that the Post-Project Conditions Model did not include any changes to the overall configuration of the FEMA Effective Model with respect to channel cross sections, overland flow path cross sections, or the lateral structures at/near the Center Ave Bridge. This configuration reflects the incidental hydraulic effect of the proposed pedestrian sitting wall on the right bank parallel to San Anselmo Ave which prevents flow exchange between the overland flow path and the channel.

During the revised floodway modeling for the creek channel under project conditions, it was discovered that the project conditions floodway WSE at the SFD Ave upstream bridge is unreasonable. As shown in Figure 13, there was a significant backwater effect at the SFD Ave upstream bridge even though the floodway WSE was below the bridge soffit. Modifying the bridge modeling approach from “Pressure and Weir” to “Energy Only” resulted in a reasonable floodway WSE (see Figure 14). This modification was judged reasonable since the bridge is not overtopped by the floodway WSE. Accordingly, the modification of the bridge modeling approach for the SFD Ave upstream bridge was also included in the “Corrected Effective Model”. This modification does not affect the WSE modeling results for Q10, Q50, and Q100.

As mentioned earlier, the FEMA Effective Model has instability issues for Q500. The table below summarizes the instability issues encountered during the further modeling process. All four instability issues occur in the 500-year flood (i.e., Q500) scenario. For the post-project conditions model, the model would have also been unstable for the Q50 and Q100 scenarios if

[5] In general, same cross sections should be used for both pre- and post-project conditions in order to show changes in water surface elevations. However, for this case, because the removed BB2 and the added new pedestrian bridge/ are not at the same location or within the same footprint, the model configuration used the same cross sections to the extent possible, but with three different cross sections to better simulate the pre- and post- project hydraulic conditions.

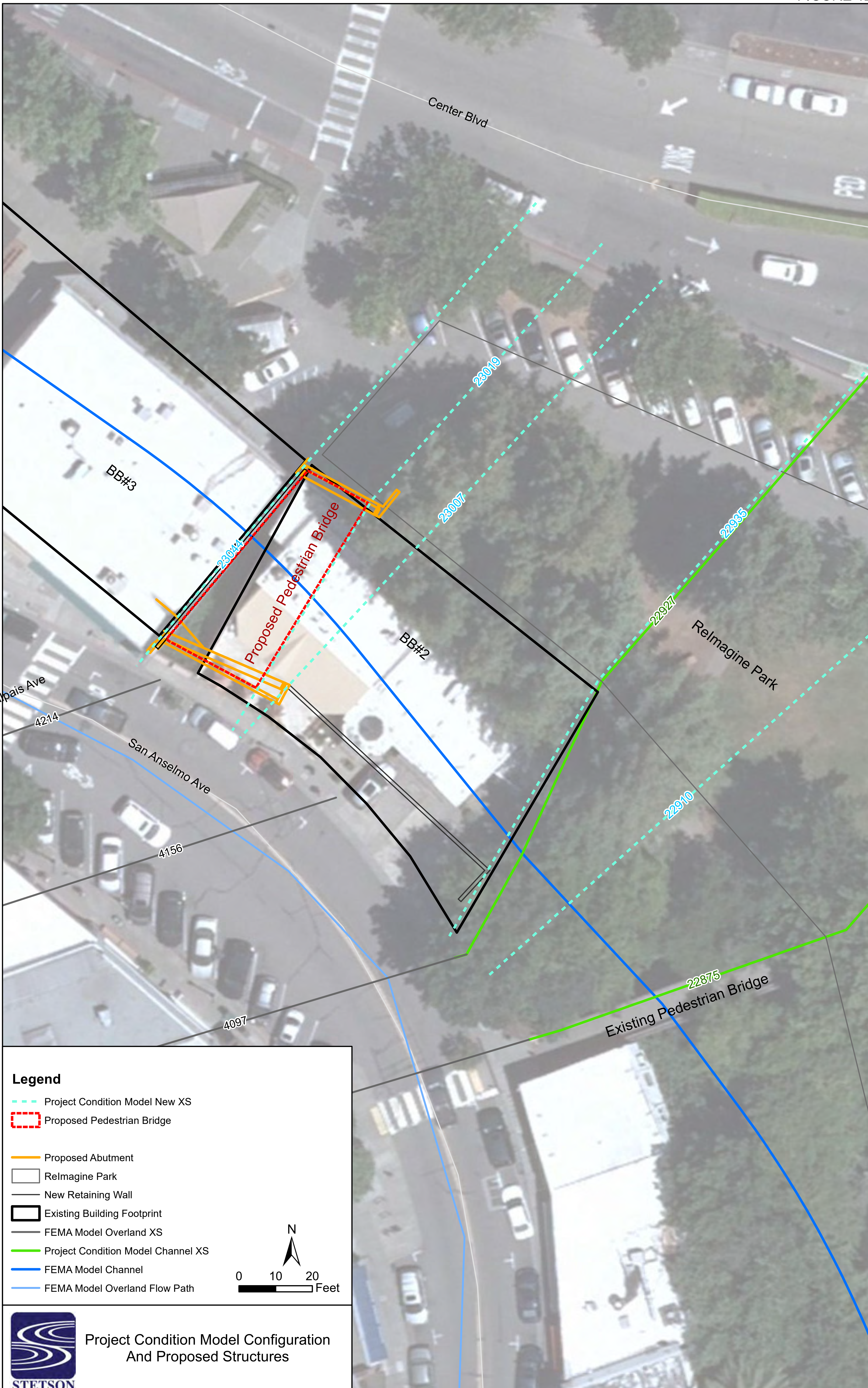
the project-raised stage deck, along with the stage pier, had been represented in the model (scenario 3 in the table below; see graph (b) in Figure 15). However, the Post-Project Conditions Model for Q100 is stable if only the project-raised stage pier is represented in the model (scenario 4 in the table below; see graph (c) in Figure 15). Q100 is the most relevant flood for the project impact assessment and this request for CLOMR. The model representation of the raised stage in scenario 4 was adopted in the Post-Project Conditions Model to ensure stable result for Q100. Because the project-raised stage deck (designed at elevation 50 ft NAVD88) is above all WSEs, it would have no effect on hydraulics and, as such, it does not need to be explicitly represented in the model. Model instabilities for other flood events are not essential to this CLOMR analysis. In addition, the reasonability check for the modeled WSE profiles for Q10, Q50, Q100, and Q500 in the next section demonstrates that the simulated WSE profiles have a reasonable pattern and are therefore acceptable for the purposes of this CLOMR analysis.

Summary of Different Model Scenarios and Instability Flow Events (x = instability)

	Q10	Q50	Q100	Q500
1. Duplicate Effective Model				×
2. Corrected Effective Model (existing stage deck and pier represented)				×
3. Post-Project Conditions Model (project-raised stage pier and deck represented)		×	×	×
4. Post-Project Conditions Model (project-raised stage pier represented, but raised stage deck not represented)*		×		×

*Finding: Without the project-raised stage deck represented in the Post-Project Conditions Model, the model is stable for Q100. Since the project-raised stage deck (designed at elevation 50 ft NAVD88) is above all WSEs, it does not affect hydraulics and, as such, does not need to be explicitly represented. This instability becomes mute.

FIGURE 12



Project Condition Model Configuration And Proposed Structures

C:\DATA\2431\2431-21-01\GIS\FIG 9a Project Condition Model Configuration.mxd 7/21/2022

Figure 13 Unreasonable Post-Project Floodway WSE vs. BFE
(Modeling Approach for the Upstream SFD Bridge: Pressure and Weir)

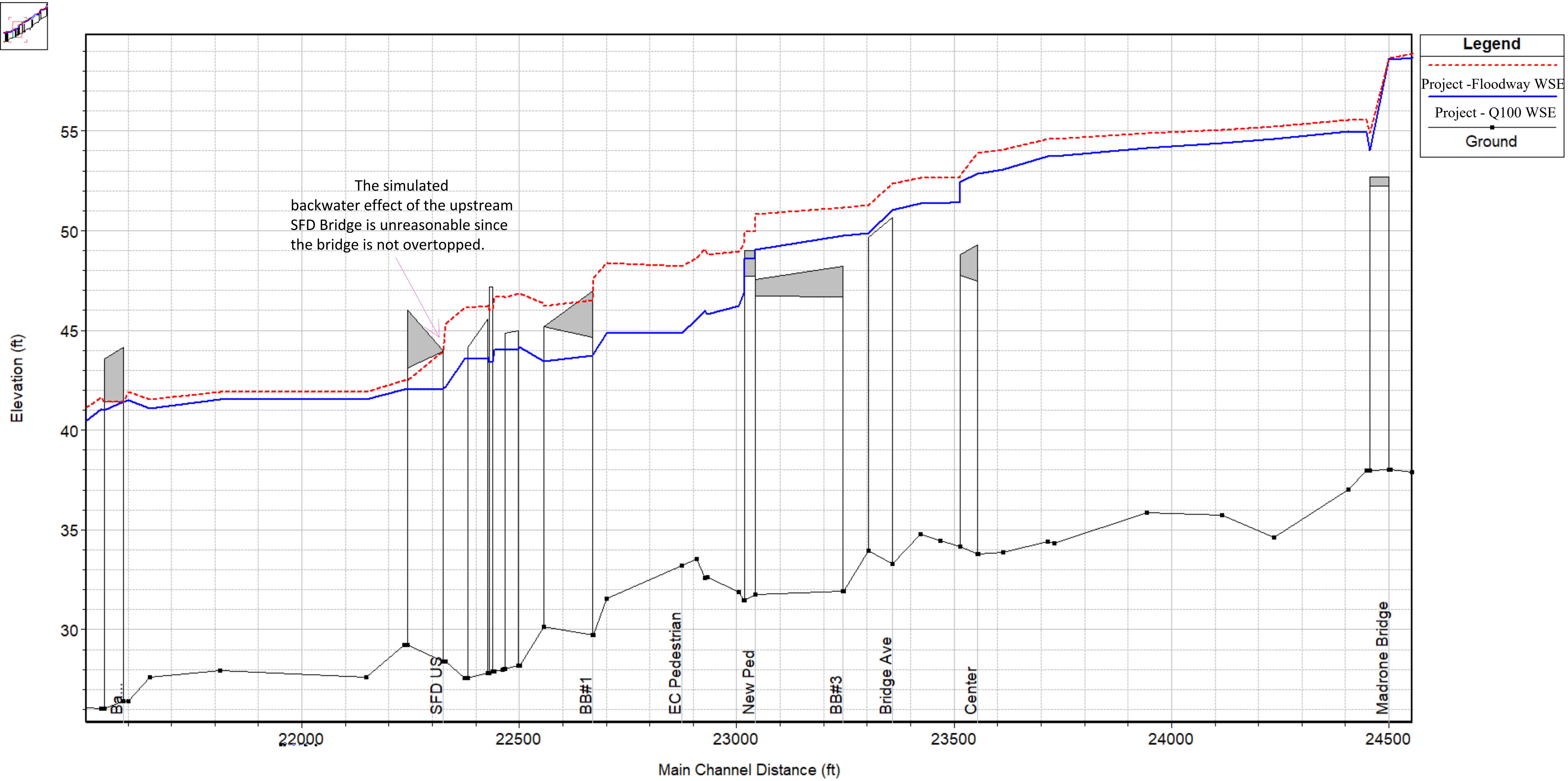
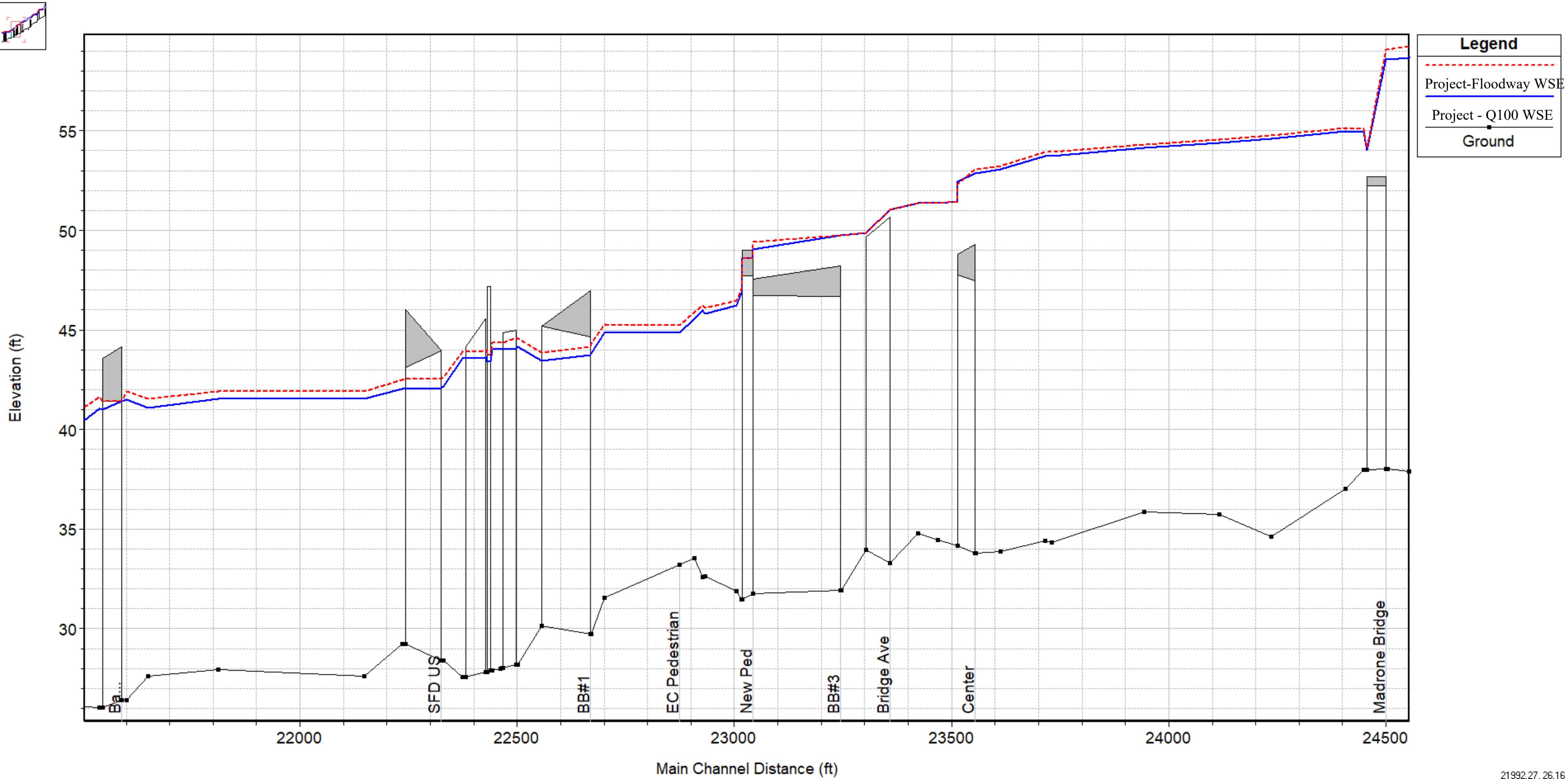
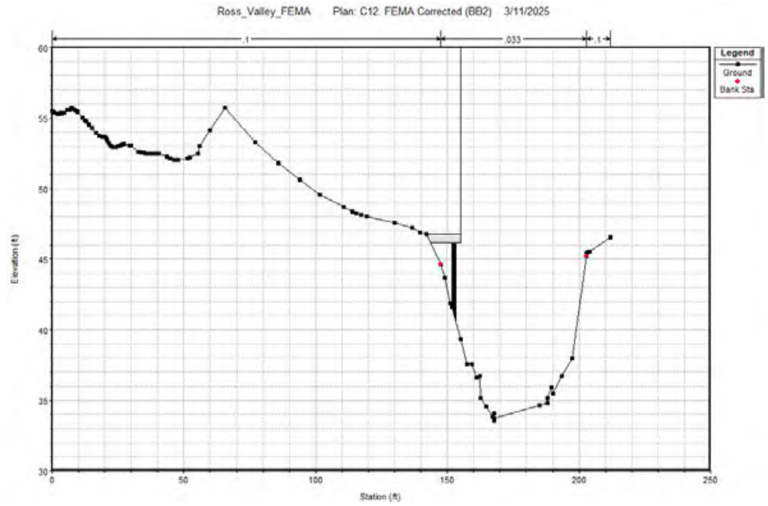


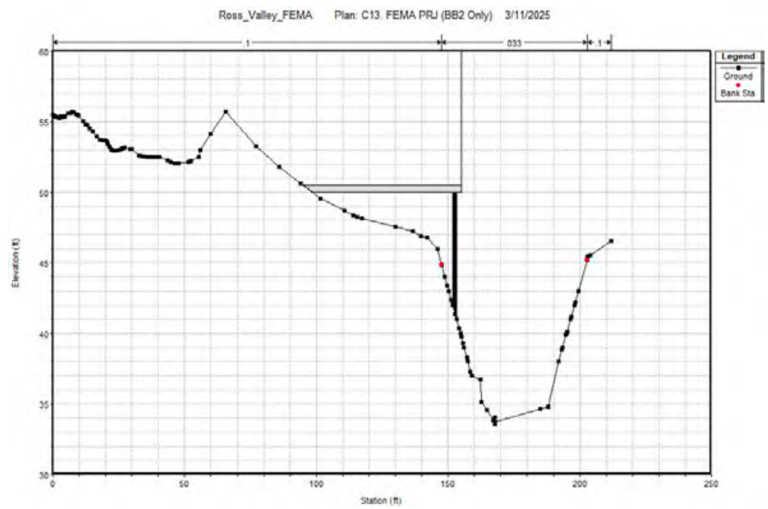
Figure 14 Reasonable Post-Project Floodway WSE vs. BFE
(Modified Modeling Approach for the Upstream SFD Bridge: Energy Only)



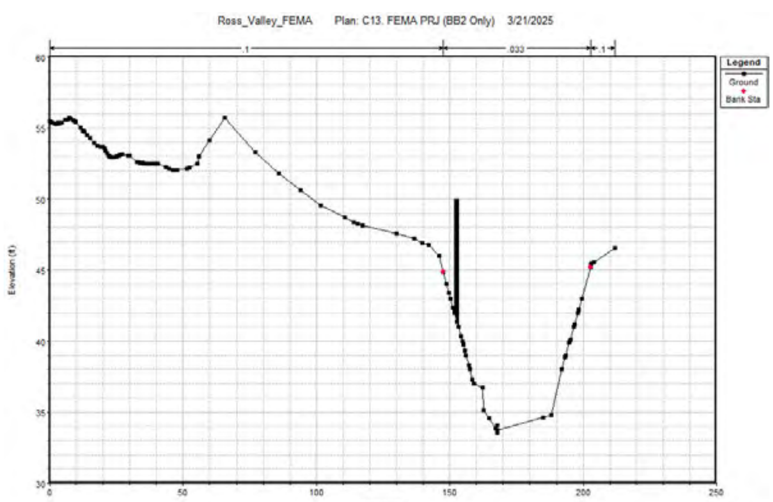
21992.27, 26.16



(a) **Existing Condition Stage Deck**
(Representation in the Corrected Effective Model; **Scenario 2**)



(b) Post-Project Condition Stage Deck
(Representation in the Post-Project Conditions Model; **Scenario 3**)



(c) Post-Project Conditions Stage Deck
(Representation in the Post-Project Conditions Model; **Scenario 4**)

Figure 15 Model Representation of the ReImagine Creek Park Stage Deck
(Representation (c) was selected for the Post-Project Conditions Model to avoid computational instability for Q100)

Reasonability Check of Q10, Q50, Q100, and Q500 WSE Profiles

Given the instability issues that exist in the models, the patterns of WSE profiles for Q10, Q50, Q100, and Q500 were checked for reasonableness and acceptability.

Figures 16a and 16b present the simulated Q10, Q50, Q100, and Q500 WSE profiles by the Duplicate Effective Model for the creek channel and the overland flow path, respectively.

Figures 17a and 17b present the simulated Q10, Q50, Q100, and Q500 WSE profiles by the Corrected Effective Model for the creek channel and the overland flow path, respectively.

Figures 18a and 18b present the simulated Q10, Q50, Q100, and Q500 WSE profiles by the Post-Project Conditions Model for the creek channel and the overland flow path, respectively.

All these figures show higher WSE profiles for higher flood events, indicating the model-simulated WSE profiles have a reasonable pattern and, as such, are acceptable.

The simulated WSE profile results for Q10, Q50, Q100, and Q500 under the post-project conditions will be used to prepare the annotated FIS profiles in Section 7.0.

Note that Figures 16b, 17b, and 18b show that the simulated water surface elevations in the overland flow path under Q10 were lower than the channel invert (ground) in certain reaches. This is due to the arbitrary selection of the top of bank locations by the modeler for the overland flow path in the FEMA effective model (In reality there is no defined “channel” in the overland flow path). The ground elevation in these figures represents the “channel” invert within the modeler-selected “channel” banks at each cross section along the overland flow path. The flood water could flow outside of the channel banks where have lower ground elevations than the “channel invert”, causing the water level lower than the arbitrary channel invert at certain reaches. A better way to avoid this confusion is to redefine the top of bank locations by careful examination of the floodplain topography so that the lowest point (channel invert) is within both banks at each cross section.

Figure 16a FEMA Duplicate Effective Model-Simulated Creek Channel WSE Profiles for Q10, Q50, Q100, and Q500

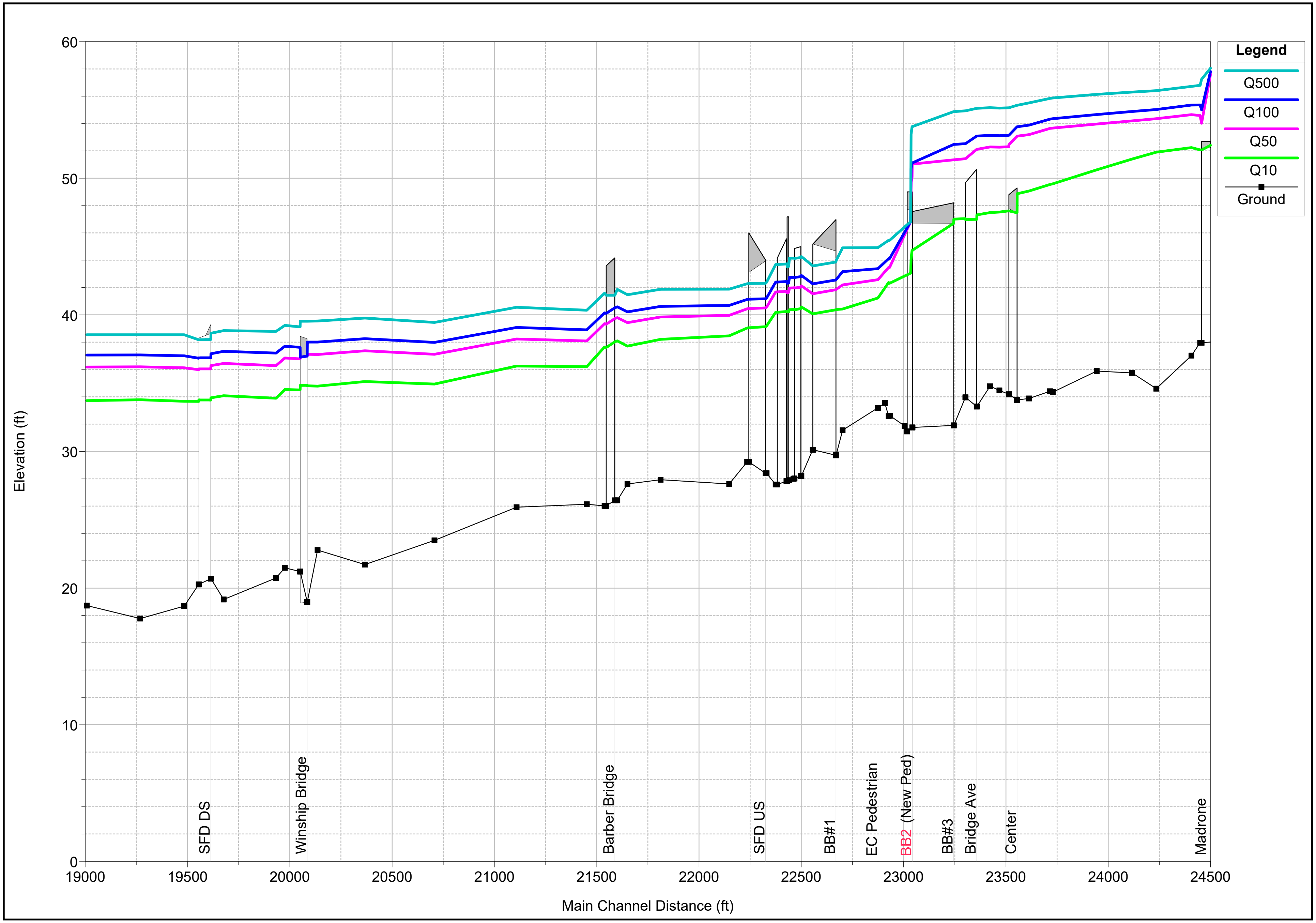


Figure 16b FEMA Duplicate Effective Model-Simulated Overland WSE Profiles for Q10, Q50, Q100, and Q500

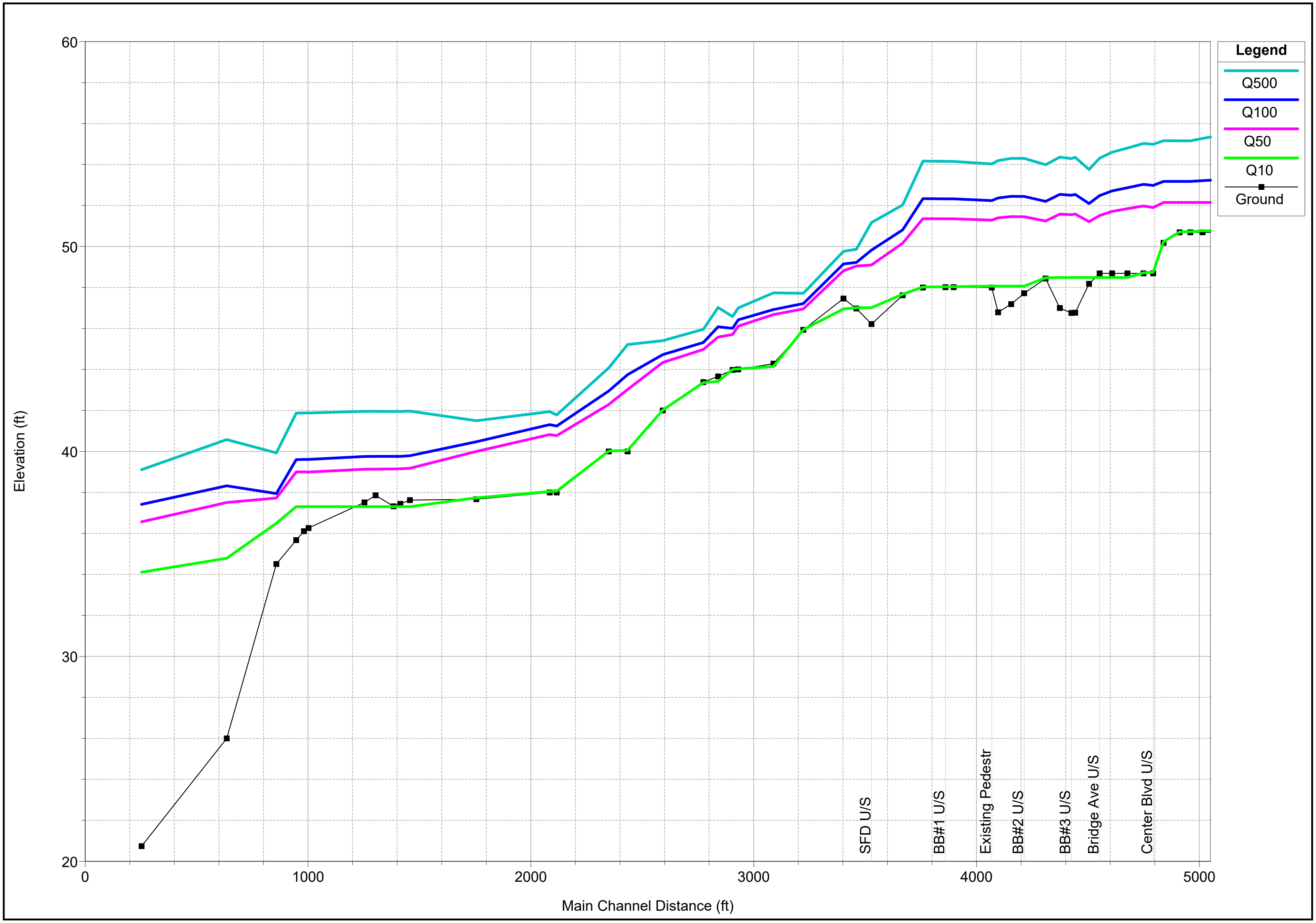


Figure 17a Corrected Effective Model-Simulated Creek Channel WSE Profiles for Q10, Q50, Q100, and Q500

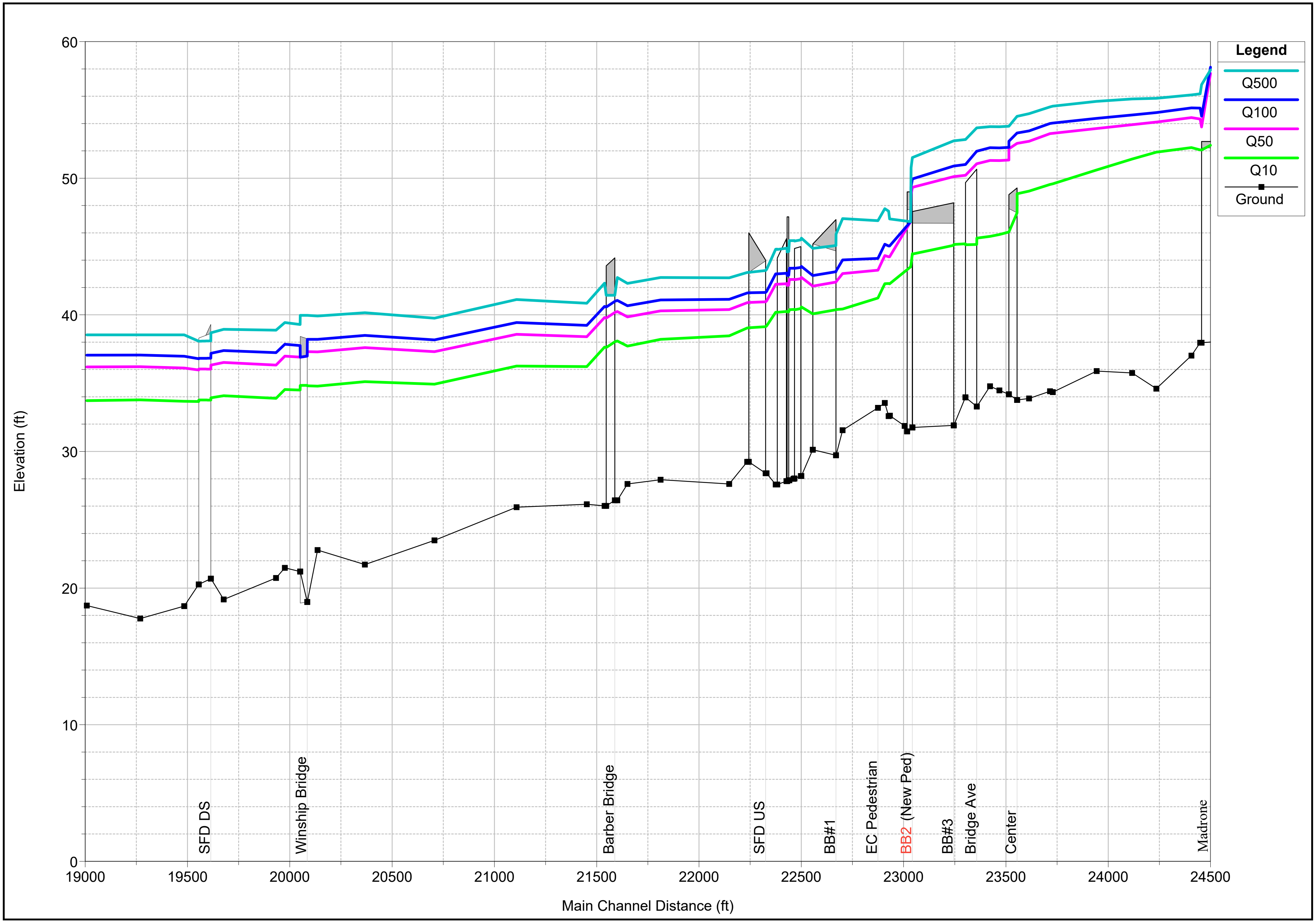


Figure 17b Corrected Effective Model-Simulated Overland WSE Profiles for Q10, Q50, Q100, and Q500

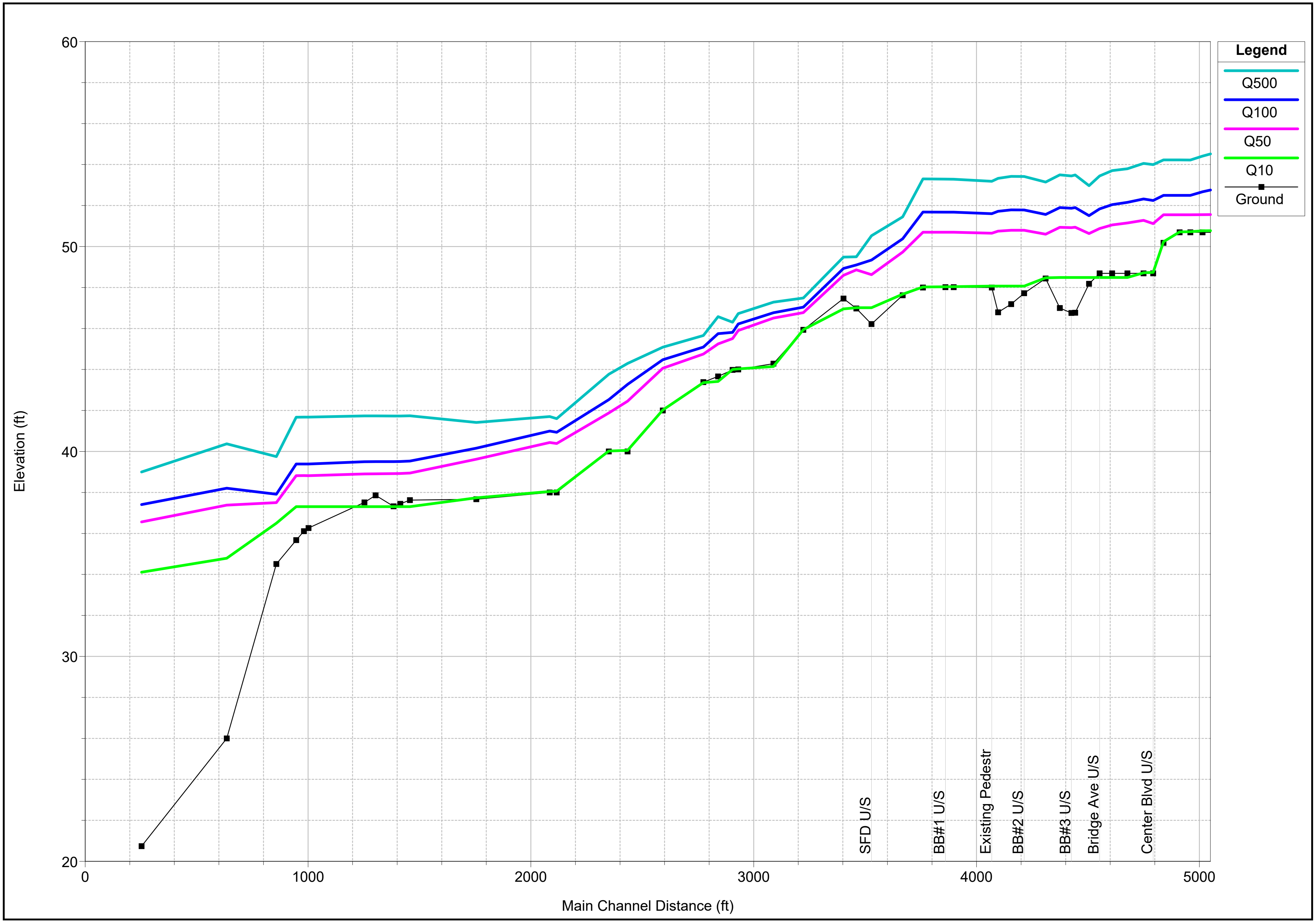


Figure 18a Post-Project Conditions Model-Simulated Creek Channel WSE Profiles for Q10, Q50, Q100, and Q500

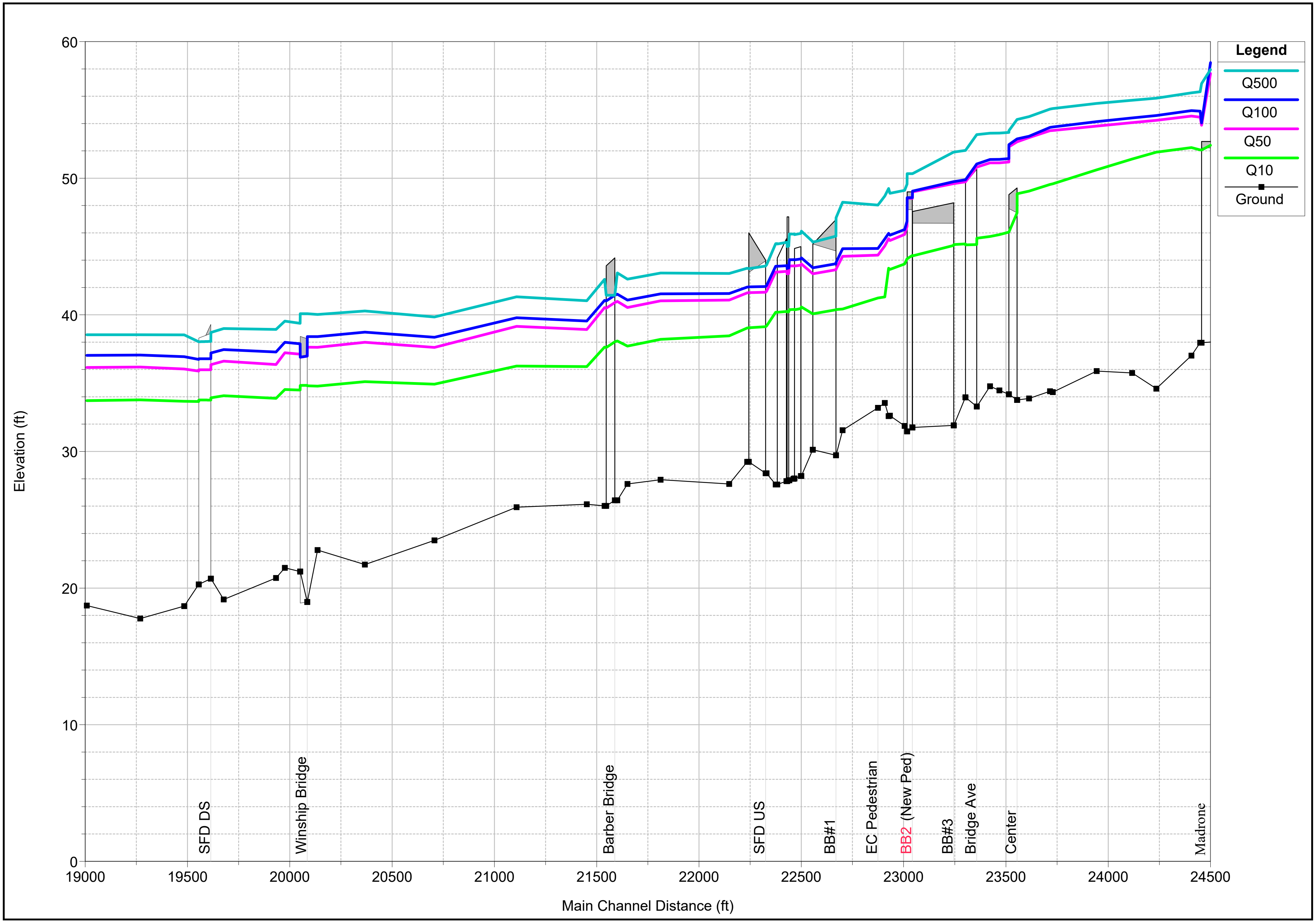
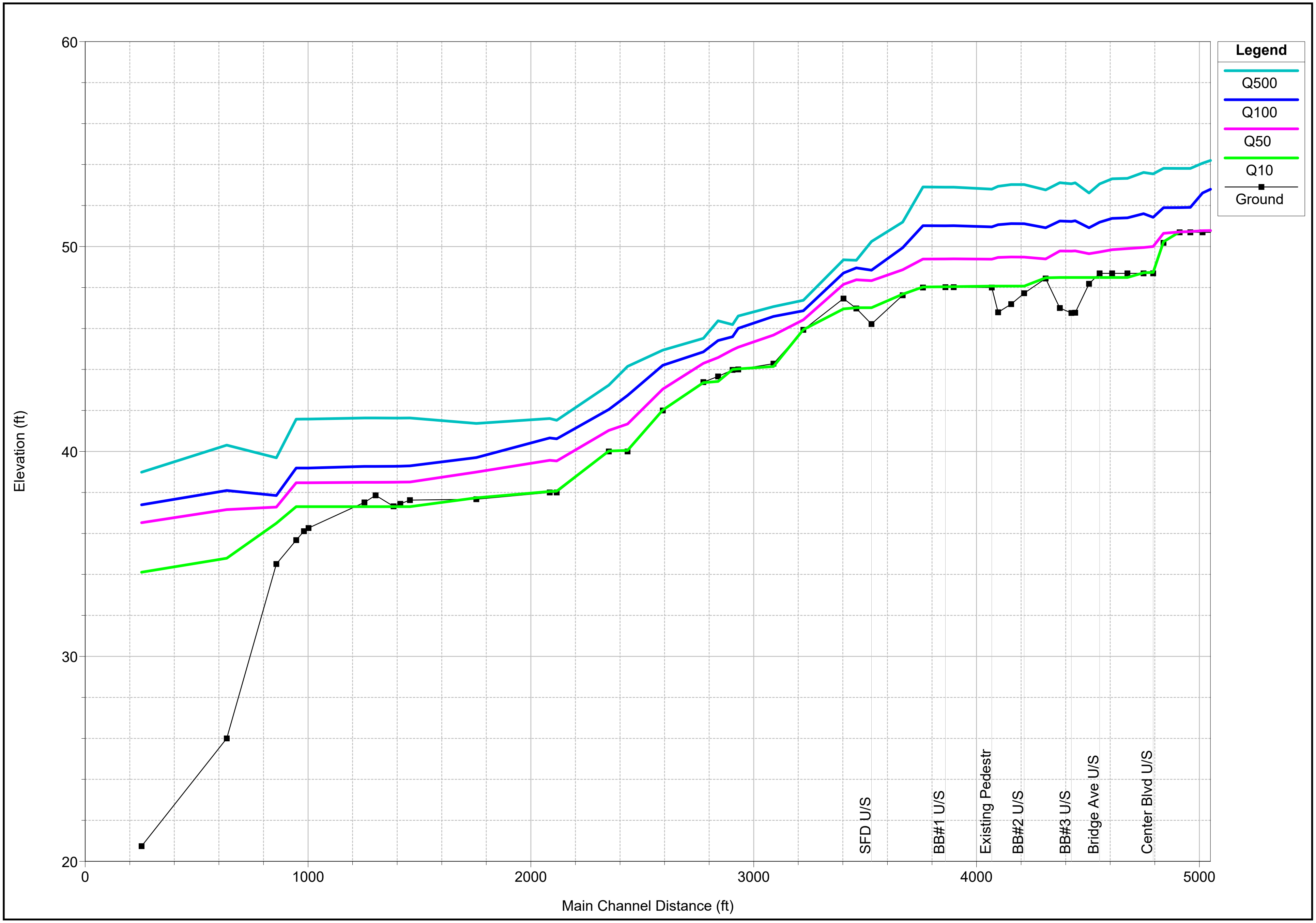


Figure 18b Post-Project Conditions Model-Simulated Overland WSE Profiles for Q10, Q50, Q100, and Q500



Modeling Results of Project Effects under Q100 and Determination of CLOMR Reach

Figure 19a presents the simulated BFE (Q100) profiles from the Duplicate Effective Model, the Corrected Effective Model, and the Post-Project Conditions Model for the creek channel. Similarly, Figure 19b shows the simulated BFE profiles for the overland flow path.

The simulated BFE difference between the Corrected Effective Model (i.e., "Existing Conditions Model" or "Pre-Project Conditions Model") and Post-Project Conditions Model (see Figures 20a and 20b) represents the project impact, which will be used for compliance with 44CFR §65.12 (Appendix B). In general, the BB2 project will lower the creek channel BFE upstream of BB2 (between BB2 and Madrone Ave Bridge) by up to 1.37 ft with an average of about 0.60 ft, and raise the creek channel BFE downstream of BB2 (between BB2 and the SFD downstream bridge) by up to 0.82 ft with an average of about 0.40 ft (see Figure 20a). The BB2 project will reduce the overland flow path BFE by up to 0.81 ft with an average of about 0.42 ft (see Figure 20b) and reduce the spatial extent of flooding in the floodplain (i.e., FEMA flood hazard Zone AE).

The simulated BFE difference between the Duplicate Effective Model and the Post-Project Conditions Model (see Figures 21a and 21b) represents the combined effects of the project and the model's "correction", which will be used to determine the revisions to the FEMA FIRM.

According to FEMA Instructions for MT-2 Forms, "for streams that have a detailed study, an effective tie-in is obtained when the revised BFEs are within 0.5 foot of the effective elevations, and the revised floodway encroachment stations match the effective floodway stations at both the upstream and downstream limits." Figures 21a and 21b also show the identified "CLOMR Reach" defined by the upstream and downstream tie-in locations in accordance with the FEMA instructions.

As shown in Figure 21a, the difference between the revised BFEs and the effective BFEs is more than 0.5 ft for a certain length of the creek channel, demonstrating the need for flood map revisions. After examining the FEMA effective FIRM, the channel Cross-Section H (RS 24117) on the effective FIRM was selected as the upstream tie-in location for the flood map revision under the post-project condition, and the channel Cross-Section C (RS 20367) on the effective FIRM was selected as the downstream tie-in location (see the annotated FIRM in Section 7.0). The BFE differences at the selected upstream and downstream tie-in locations are 0.47 ft and 0.48 ft, respectively, which are within 0.5 ft and meet the FEMA tie-in criterion[6].

As shown in Figure 21b, the difference between the revised BFEs and the effective BFEs is more than 0.5 ft for a certain length of the overland flow path, demonstrating the need for flood map revisions. After examining the FEMA effective FIRM, it was found that the upstream tie-in location needs to be upstream of the overflow Cross-Section G (RS 4840) on the effective FIRM; however, no other cross sections were available upstream on the FIRM (see the annotated FIRM

[6] Note that the impact and mitigation analysis (Appendix B) considers rises in BFE throughout the project impacted reach, not only within the upstream and downstream tie-ins. This is consistent with the FEMA 2020 Guidance for MT-2 Requests which states that the no impact structure certification is not limited to areas within the revised (CLOMR) reach.

in Section 7.0). In this case, the Effective Model cross section location at RS 5061 (BFE line 53 ft), which is 221 ft upstream of the overflow Cross-Section G, was selected as the upstream tie-in location for the flood map revision under the post-project condition. The overland flow path Cross-Section B (RS 1002) on the effective FIRM was selected as the downstream tie-in location. The BFE differences at the selected upstream and downstream tie-in locations are 0.40 ft and 0.42 ft, respectively, which are within 0.5 ft and meet the FEMA tie-in criterion.

Figure 19a Comparison of Simulated Creek Channel 100-Year WSE Profiles from the Duplicate Effective Model, the Corrected Effective Model, and the Post-Project Conditions Model

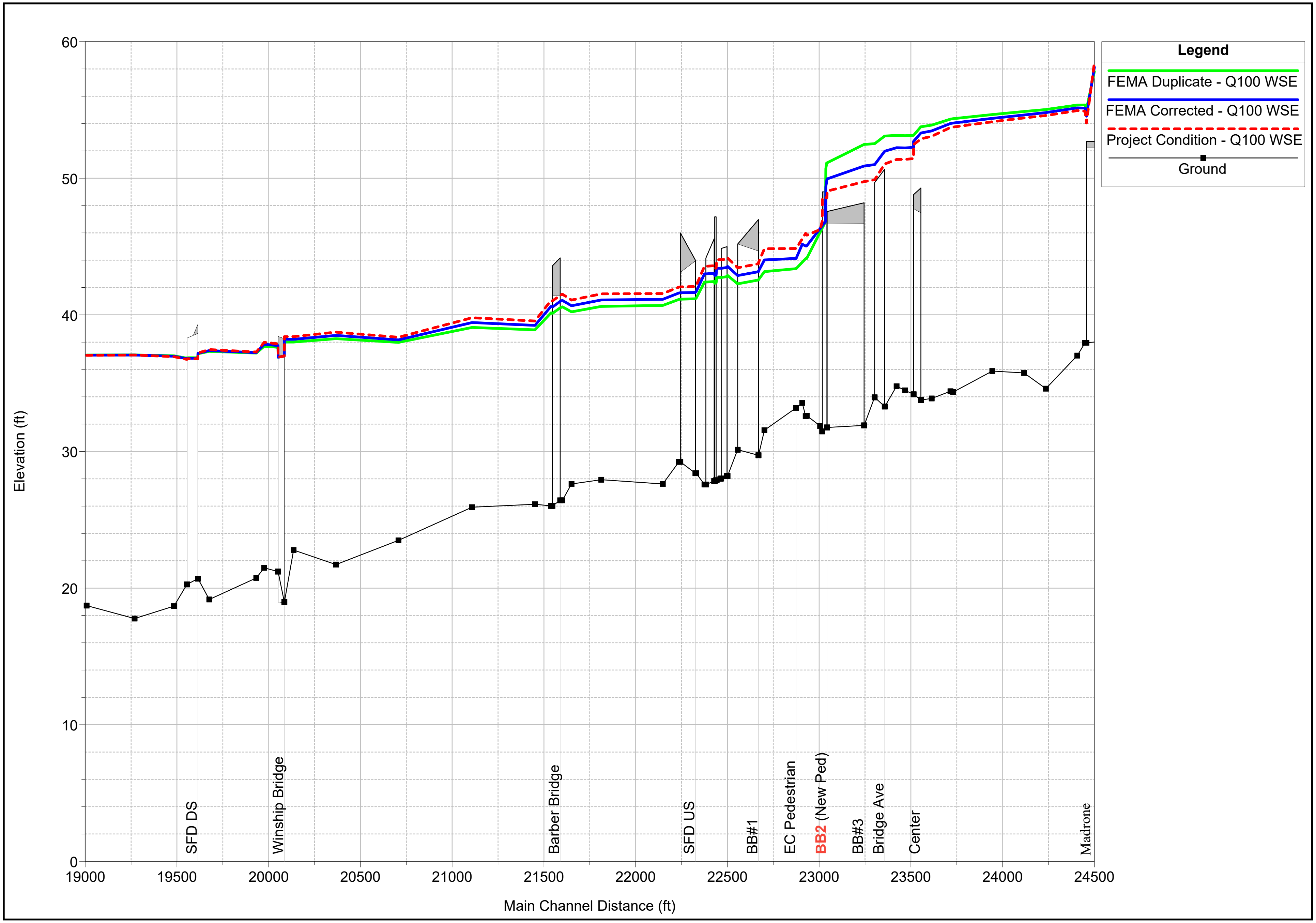


Figure 19b Comparison of Simulated Overland 100-Year WSE Profiles from the Duplicate Effective Model, the Corrected Effective Model, and the Post-Project Conditions Model

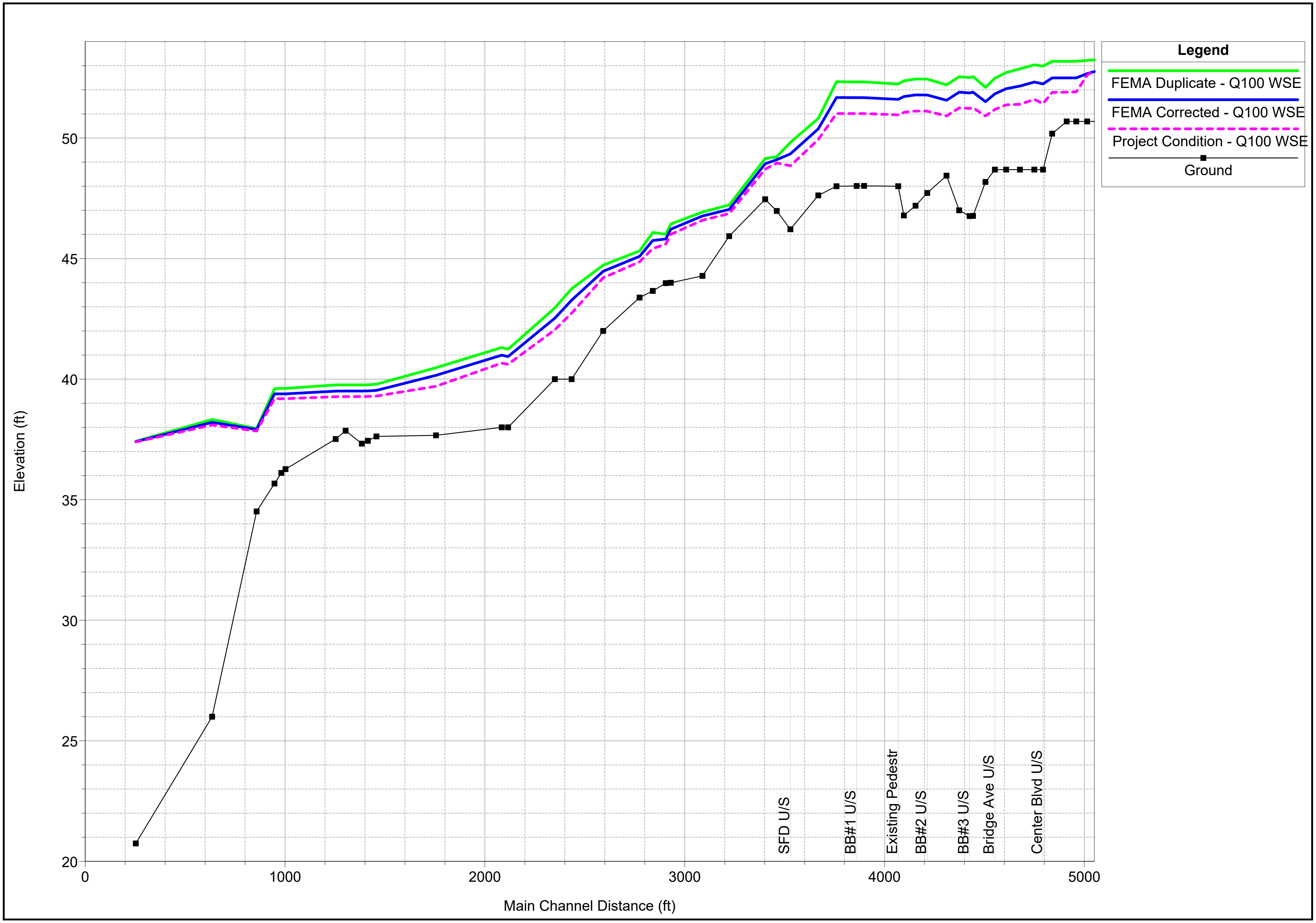


Figure 20a Comparison of Simulated Creek Channel 100-Year WSE Profiles from the Corrected Effective Model and the Post-Project Conditions Model

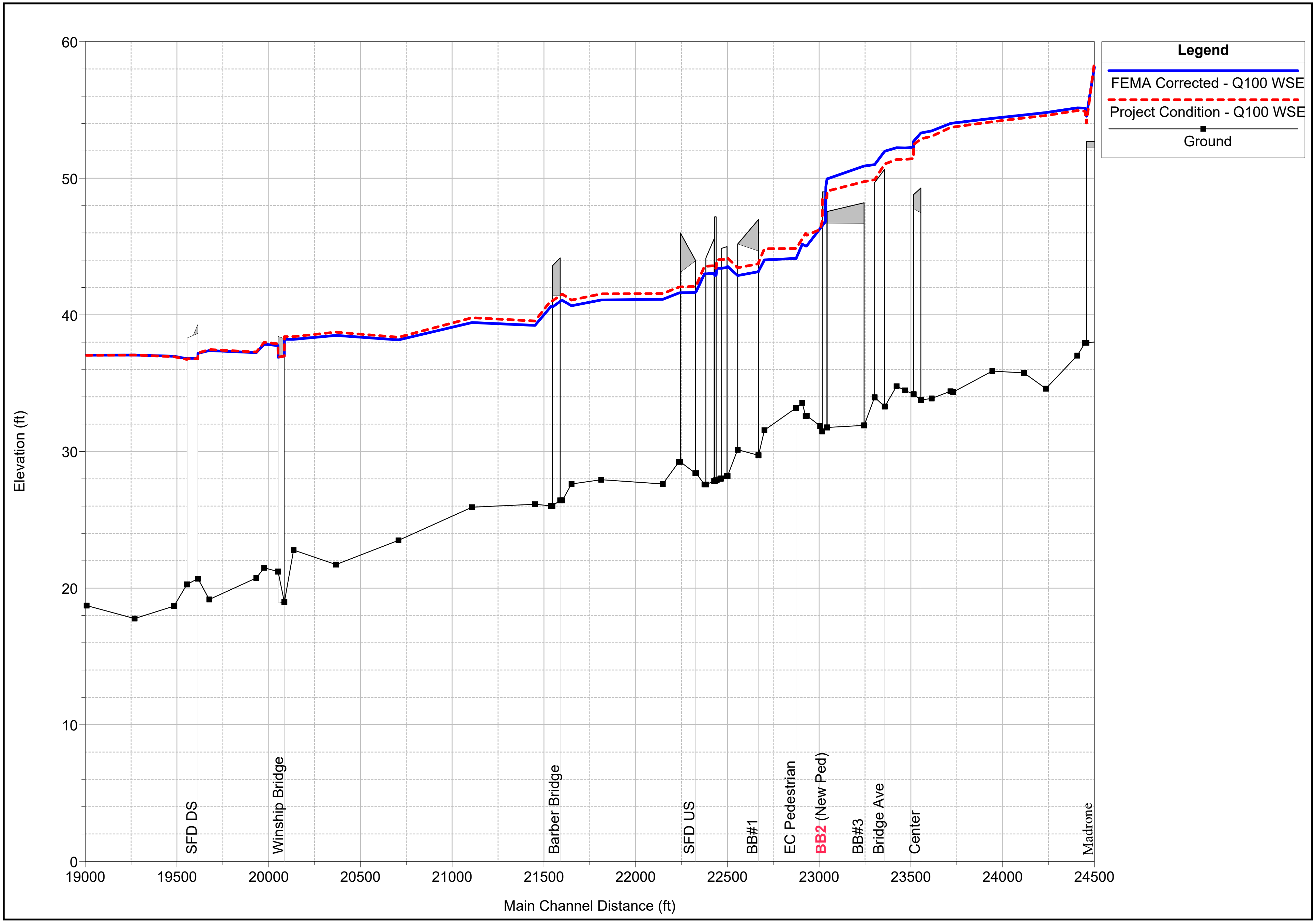


Figure 20b Comparison of Simulated Overland 100-Year WSE Profiles from the Corrected Effective Model and the Post-Project Conditions Model

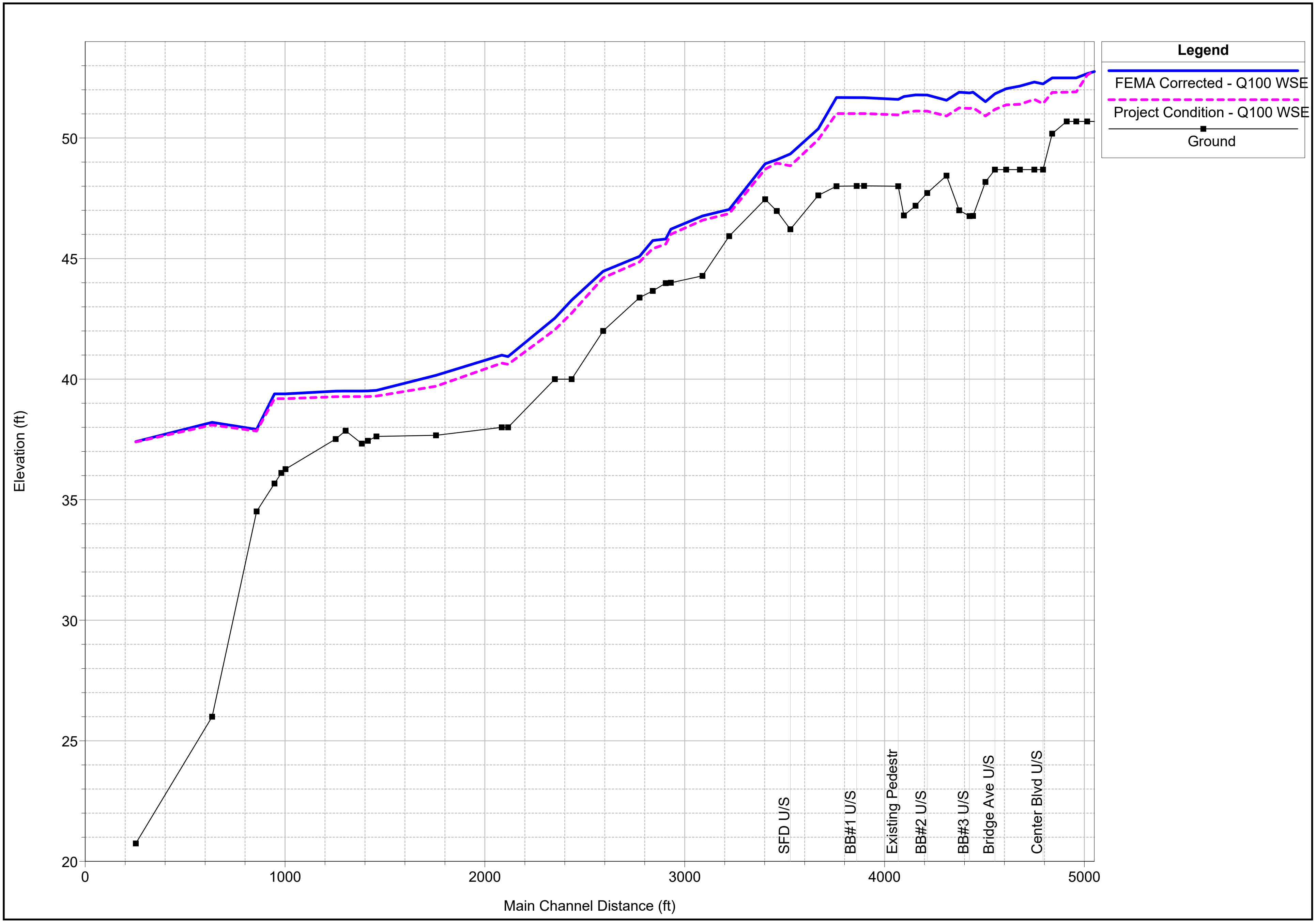


Figure 21a Comparison of Simulated Creek Channel 100-Year WSE Profiles for the Duplicate Effective Model and the Post-Project Conditions Model

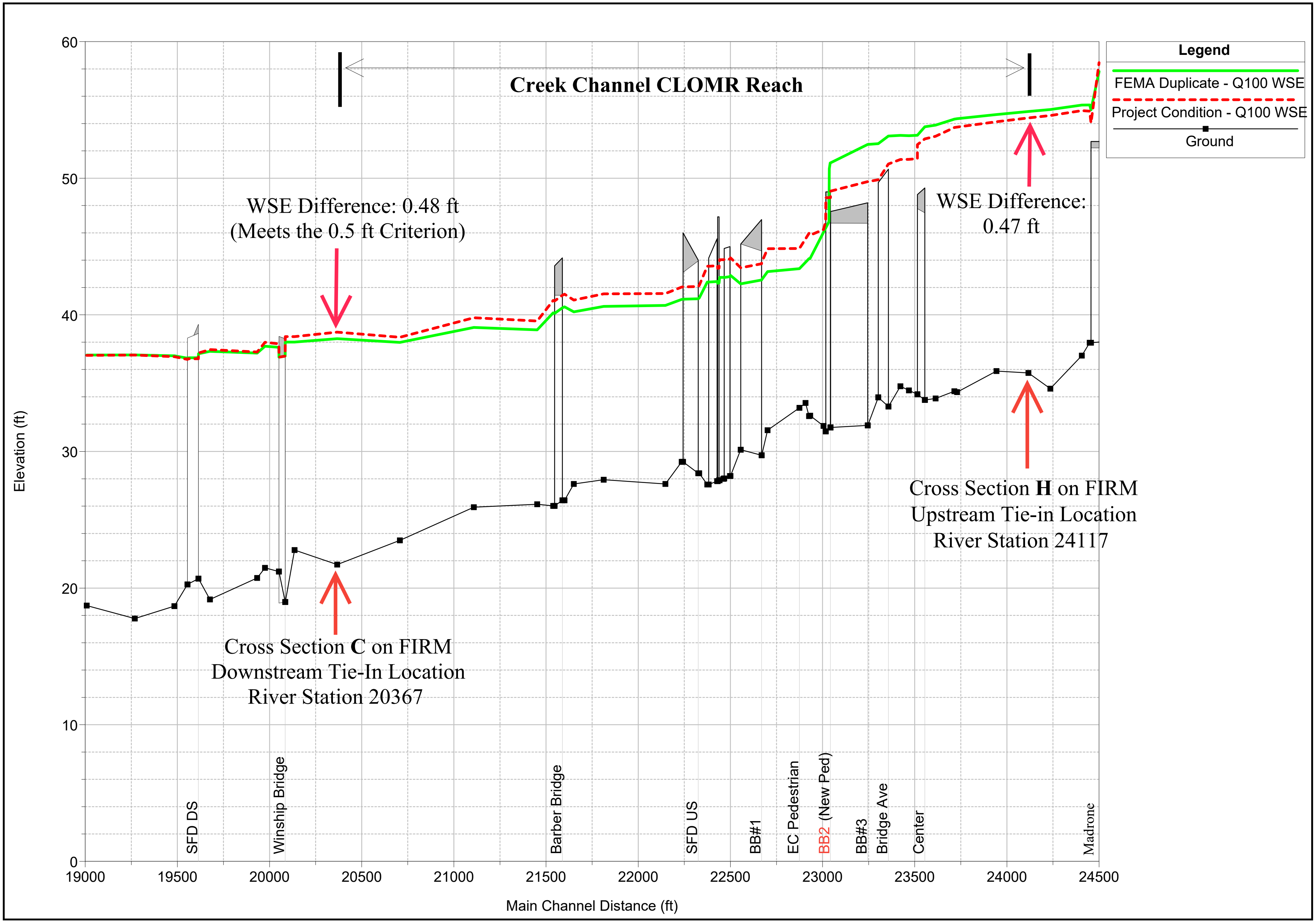
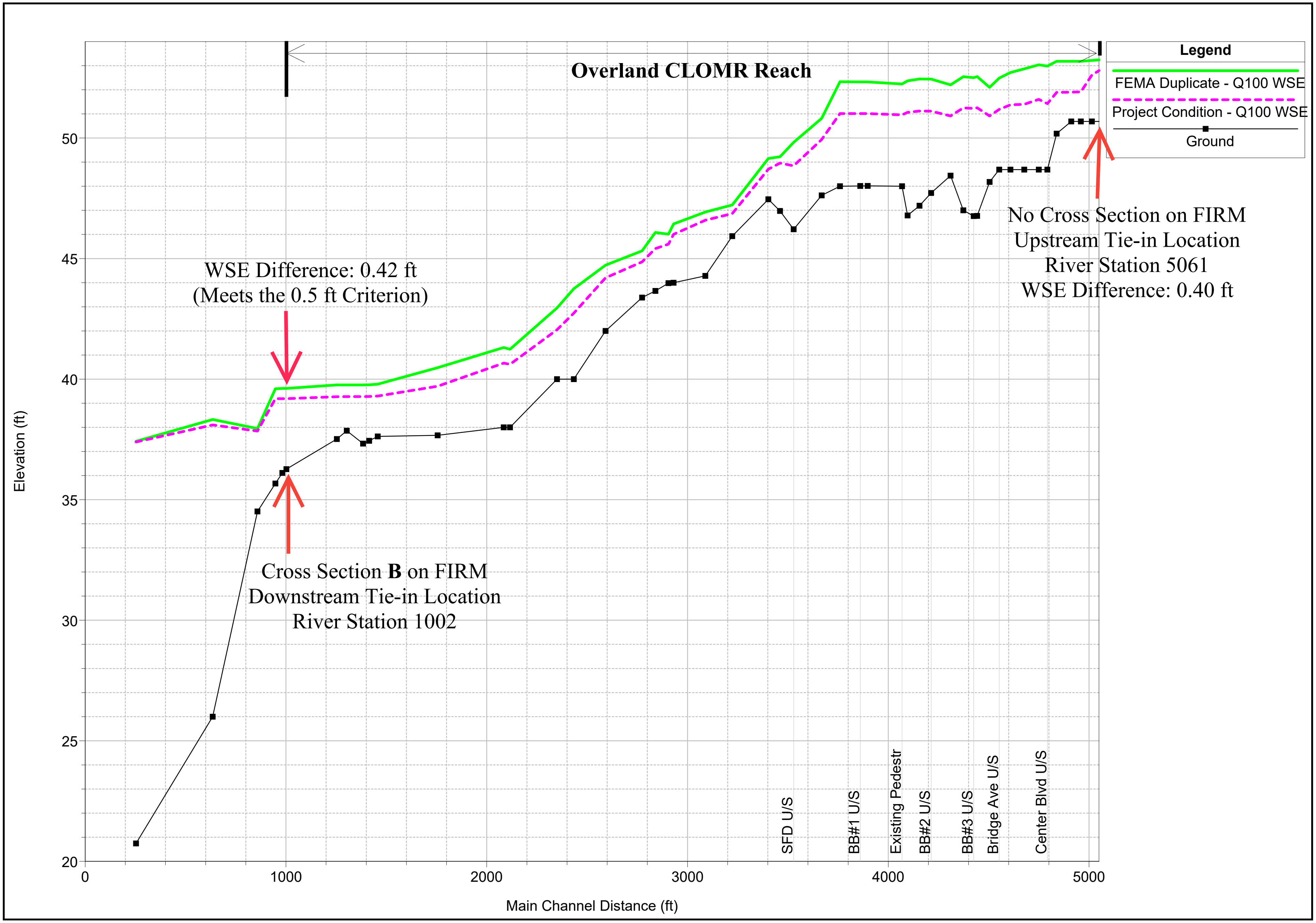


Figure 21b Comparison of Simulated Overland 100-Year WSE Profiles for the Duplicate Effective Model and the Post-Project Conditions Model



Revised Floodway Analysis under Post-Project Conditions

As described previously, the procedure FEMA used for the split flow floodway analysis was first to run the model with optimization, then to reconstruct the flow inputs based on the optimization run. To be consistent with FEMA, this procedure was also used for the revised floodway analysis.

To preliminarily determine the encroachment stations for the effective floodway, “Method 4” (equal conveyance reduction from both sides of overbanks) was used first by FEMA, then “Method 1” was used to refine the encroachment stations. For the revised floodway analysis, only “Method 1” was used to revise the encroachment stations.

Table 1 shows the results of the revised main channel floodway analysis for the post-project conditions. The last column in Table 1 shows that the WSE surcharges between the with- and without-floodway conditions are all within 1.0 ft at all cross sections within the revised main channel reach (between the Cross Sections H and C on the FEMA FIRM), indicating the revised floodway encroachment stations along the main channel are acceptable.

Similarly, Table 2 shows the results of the revised overflow floodway analysis for the post-project conditions. The last column in Table 2 shows that the WSE surcharges between the with- and without-floodway conditions are all within 1.0 ft at all cross sections within the revised overflow reach (between the model cross section 5061 and the Cross Section B on the FEMA FIRM), indicating the revised floodway encroachment stations along the overflow path are acceptable.

The results shown in Tables 1 and 2 will be used to prepare the annotated FIS tables in Section 7.0.

Table 1 Results of Revised Main Channel Floodway Analysis under Post-Project Conditions

Model River Station/ Cross Section on FIRM		Main Channel Floodway			1-Percent-Annual-Chance Flood Water Surface Elevation			
Model River Station	Cross Section on FIRM	Width	Section Area	Mean Velocity	Main Channel BFE	Without Floodway	With Floodway	Surcharge
		(ft)	(ft^2)	(fps)	(ft NAVD 88)	(ft NAVD 88)	(ft NAVD 88)	(ft)
24117	H	408	1,913	3.0	54.4	54.4	54.6	0.2
23944		426	2,195	2.6	54.1	54.1	54.3	0.2
23730		314	1,785	3.2	53.7	53.7	54.0	0.3
23716		300	1,745	3.2	53.7	53.7	53.9	0.2
23614		211	1,117	5.1	53.1	53.1	53.2	0.1
23556		71	755	6.2	52.9	52.9	53.1	0.2
23515		78	789	5.9	51.4	51.4	51.4	0.0
23469		94	859	5.4	51.4	51.4	51.4	0.0
23423		99	959	4.9	51.4	51.4	51.4	0.0
23358		101	761	6.2	51.0	51.0	51.0	0.0
23303		94	900	5.2	49.9	49.9	49.9	0.0
23246	G	80	816	5.7	49.8	49.8	49.8	0.0
23044		70	692	6.8	48.6	48.6	48.6	0.0
23019		55	565	8.3	46.9	46.9	47.0	0.1
23007		49	480	9.8	46.3	46.3	46.5	0.2
22935		48	461	10.2	45.8	45.8	46.1	0.3
22927		66	494	9.5	46.0	46.0	46.2	0.2
22910		55	462	10.2	45.6	45.6	45.9	0.3
22875		78	405	11.6	44.9	44.9	45.3	0.4
22702	F	63	494	9.5	44.8	44.8	45.3	0.5
22670		68	405	11.6	43.8	43.8	44.3	0.5
22556		81	413	11.3	43.5	43.5	43.9	0.4
22501		92	816	5.7	44.2	44.2	44.6	0.4
22466		90	824	5.7	44.1	44.1	44.4	0.3
22462		88	819	5.7	44.0	44.0	44.4	0.4
22442		90	833	5.6	44.0	44.0	44.4	0.4
22431		92	813	5.8	43.6	43.6	44.0	0.4
22382		91	819	5.7	43.6	43.6	43.9	0.3
22375		91	818	5.7	43.6	43.6	43.9	0.3
22331		43	481	9.7	42.2	42.2	42.6	0.4
22236		84	520	9.0	42.0	42.0	42.5	0.5
22148		40	462	10.2	41.6	41.6	41.9	0.3
21813	E	58	604	7.8	41.5	41.5	41.9	0.4
21651		67	560	8.4	41.1	41.1	41.5	0.4
21601		91	1,023	4.6	41.5	41.5	41.9	0.4
21539		91	1,033	4.5	41.1	41.1	41.6	0.5
21452		44	507	9.2	39.6	39.6	40.3	0.7
21108	D	60	724	6.5	39.8	39.8	40.5	0.7
20707		50	526	8.9	38.4	38.4	39.3	0.9
20367	C	74	788	6.0	38.7	38.7	39.6	0.9

Note: The creek channel Cross Sections H and C on the FEMA FIRM were selected as the upstream and downstream tie-in locations.

Table 2 Results of Revised Overflow Floodway Analysis under Post-Project Conditions

Model River Station/ Cross Section on FIRM		Overflow Floodway			1-Percent-Annual-Chance Flood Water Surface Elevation			
Model River Station	Cross Section on FIRM	Width	Section Area	Mean Velocity	Overflow BFE	Without Floodway	With Floodway	Surcharge
		(ft)	(ft^2)	(fps)	(ft NAVD 88)	(ft NAVD 88)	(ft NAVD 88)	(ft)
5061	U/S Limit	0	0	0.0	52.8	52.8	52.9	0.1
5015		0	0	0.0	52.6	52.6	52.9	0.3
4960		0	0	0.0	51.9	51.9	52.9	1.0
4912		0	0	0.0	51.9	51.9	52.9	1.0
4840	G	0	0	0.0	51.9	51.9	52.9	1.0
4794		94	231	4.3	51.4	51.4	52.4	1.0
4750		85	255	4.0	51.6	51.6	52.4	0.8
4678		100	365	2.8	51.4	51.4	52.3	0.9
4609		62	222	4.4	51.4	51.4	52.2	0.8
4553		62	228	4.3	51.2	51.2	52.0	0.8
4506		53	183	5.3	50.9	50.9	51.8	0.9
4444		60	316	3.1	51.3	51.3	52.2	0.9
4426		60	302	3.2	51.2	51.2	52.1	0.9
4375		60	285	3.4	51.3	51.3	52.1	0.8
4311		58	187	5.2	50.9	50.9	51.8	0.9
4214		60	234	4.1	51.1	51.1	51.9	0.8
4156		60	267	3.6	51.1	51.1	51.9	0.8
4097		65	316	3.1	51.1	51.1	52.0	0.9
4069		65	246	4.0	51.0	51.0	51.9	0.9
3898	F	85	149	6.5	51.0	51.0	51.3	0.3
3860		85	147	6.6	51.0	51.0	51.3	0.3
3759		75	161	6.0	51.0	51.0	51.3	0.3
3668		69	134	7.2	50.0	50.0	50.9	0.9
3528		72	101	9.6	48.9	48.9	49.8	0.9
3461		65	164	5.9	49.0	49.0	49.9	0.9
3403		75	130	7.5	48.7	48.7	49.5	0.8
3223		75	130	7.5	46.9	46.9	47.8	0.9
3089	E	90	138	7.0	46.6	46.6	47.4	0.8
2931		75	130	7.5	46.0	46.0	46.9	0.9
2905		80	132	7.3	45.6	45.6	46.3	0.7
2840		65	124	7.8	45.4	45.4	45.8	0.4
2774		80	133	7.3	44.9	44.9	45.5	0.6
2592		80	135	7.2	44.2	44.2	45.1	0.9
2434	D	70	130	7.5	42.7	42.7	43.5	0.8
2350		56	121	8.0	42.1	42.1	42.6	0.5
2116		58	170	5.7	40.6	40.6	41.6	1.0
2084		63	168	5.8	40.7	40.7	41.5	0.8
1755	C	53	116	8.4	39.7	39.7	40.6	0.9
1457		110	275	3.5	39.3	39.3	40.1	0.8
1414		127	344	2.8	39.3	39.3	40.1	0.8
1384		127	356	2.7	39.3	39.3	40.1	0.8
1303		128	309	3.1	39.3	39.3	40.3	1.0
1253		118	328	3.0	39.3	39.3	40.3	1.0
1002	B	190	744	1.3	39.2	39.2	40.2	1.0

Notes: The overflow Cross Section B on the FEMA FIRM was selected as the downstream tie-in location. There are no cross sections available upstream of the overflow Cross Section G on the FEMA FIRM. In this case RS 5061 was selected as the upstream tie-in location for the flood map revision under the post-project condition.

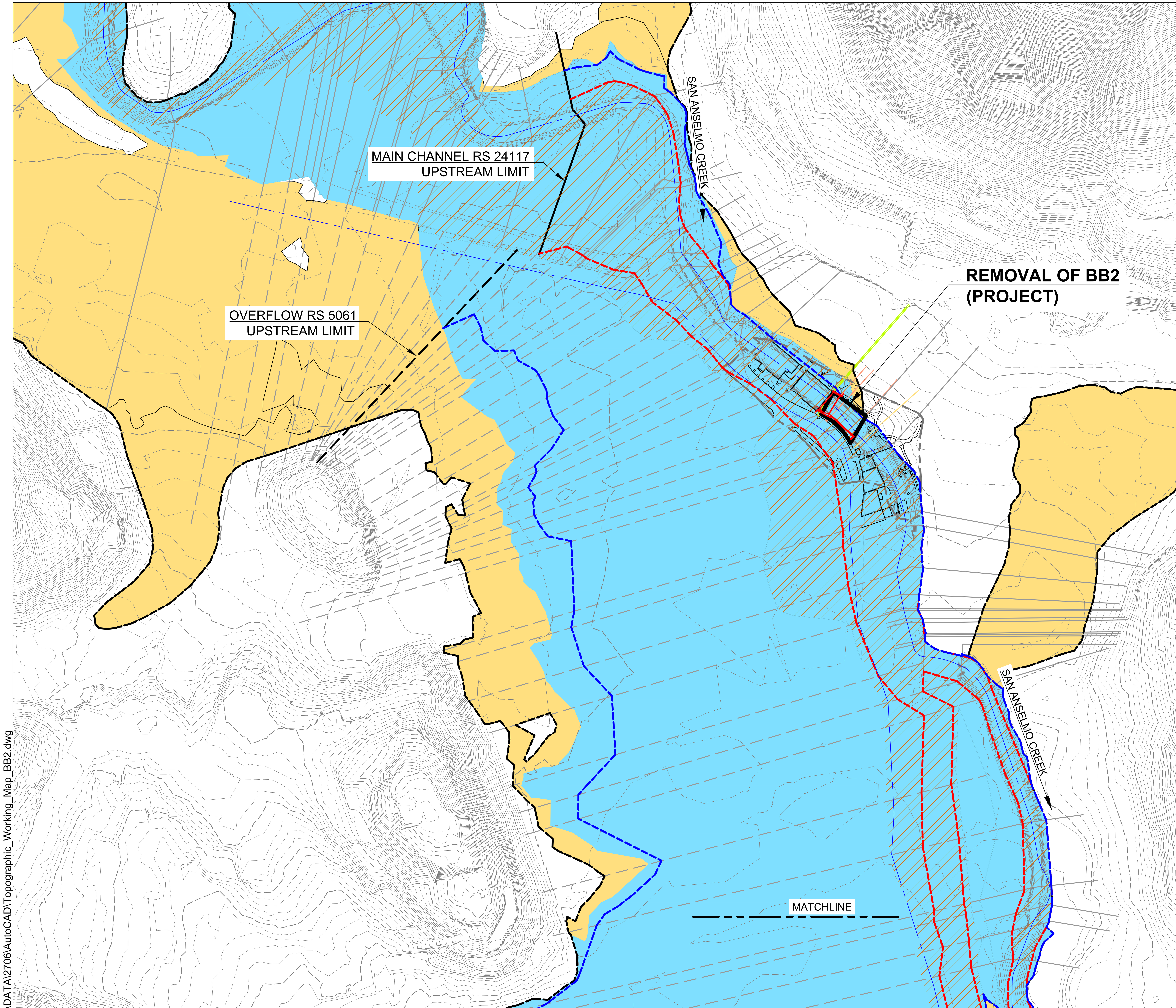
6.0 Certified Topographic Work Map

A certified topographic work map is presented in the next page which shows the project area and the area with flood map revisions. The topographic work map includes the following:

- Boundary delineations of the effective base floodplain, the floodway, and the 0.2-percent annual-chance floodplain;
- Boundary delineations of the revised base floodplain, the floodway, and the 0.2-percent annual-chance floodplain;
- Graphical tie-in between the revised and effective boundary delineations;
- Topographic contour information used for the floodplain boundary delineations, with elevation labels;
- Vertical datum used on the map (which matches the vertical datum of the hydraulic analysis);
- Locations and alignment of all cross sections in the hydraulic modeling within the revised reach; and
- Flow line used in the revised hydraulic model.

The floodplain and floodway delineations on the topographic work map are consistent with the output from the hydraulic modeling analysis. The cross section top widths and reach lengths shown on topographic work map match the hydraulic modeling.

The topographic work map in AutoCAD format is included in this submittal.



LEGEND

- 2 FT CONTOUR LINES SURVEYED FOR THE PROJECT
- 2 FT CONTOUR LINES RECEIVED FROM FEMA
- LIMIT OF TOPOGRAPHIC SURVEY FOR THE PROJECT
- PROJECT ELEMENTS (PEDESTRIAN BRIDGE, ABUTMENTS, AND RETAINING WALL)
- STREAM CENTER LINE
- FEMA EFFECTIVE MODEL CROSS SECTION - MAIN CHANNEL
- FEMA EFFECTIVE MODEL CROSS SECTION - OVERFLOW
- NEW / ADDED CROSS SECTION IN CORRECTED MODEL
- DELETED FEMA CROSS SECTION IN CORRECTED MODEL
- NEW / ADDED CROSS SECTION IN POST-PROJECT CONDITION MODEL
- TIE IN CROSS SECTION FOR THE REVISED REACH
- EXISTING FEMA 100-YEAR BOUNDARY
- EXISTING FEMA 500-YEAR BOUNDARY
- EXISTING FEMA FLOODWAY BOUNDARY
- REVISED 100-YEAR BOUNDARY
- REVISED 500-YEAR BOUNDARY
- REVISED FLOODWAY BOUNDARY

SOURCE:

1. SURVEY DATA IS BASED ON SURVEY PERFORMED BY MERIDIAN SURVEY ENGINEERING, INC., DATED JUNE 2017.
2. BASIS OF COORDINATES: (CCS83) CALIFORNIA COORDINATES SYSTEM 83 ZONE 3.
3. BASIS OF ELEVATION: NORTH AMERICA VERTICAL DATUM OF 1988 (NAVD88) GEIOD12B BASED ON A OPUS SOLUTION.

REGISTERED PROFESSIONAL ENGINEER
JAIME G. TRINIDAD
No. C 68371
Exp. 09/30/25
CIVIL
STATE OF CALIFORNIA

N
W E
S

SCALE (Feet)
0 60 120 240

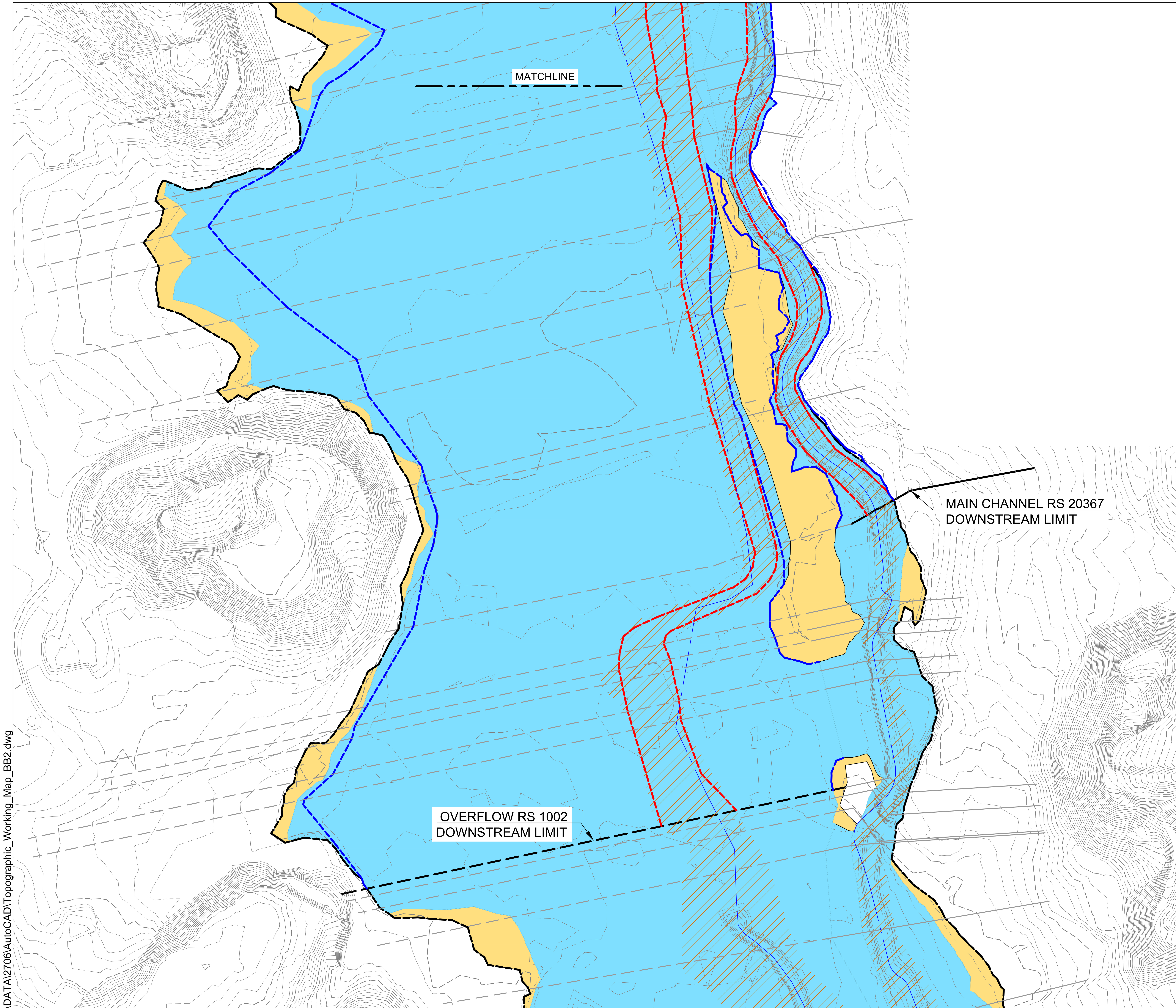
STETSON ENGINEERS INC.

DATE: JUNE 12, 2025

JN: 2706-04-007

TOPOGRAPHIC WORKING MAP BB2 CLOMR, NORTH AREA

F:\DATA\2706\AutoCAD\Topographic_Working_Map_BB2.dwg



LEGEND

- 2 FT CONTOUR LINES SURVEYED FOR THE PROJECT
- 2 FT CONTOUR LINES RECEIVED FROM FEMA
- LIMIT OF TOPOGRAPHIC SURVEY FOR THE PROJECT
- PROJECT ELEMENTS (PEDESTRIAN BRIDGE, ABUTMENTS, AND RETAINING WALL)
- STREAM CENTER LINE
- FEMA EFFECTIVE MODEL CROSS SECTION - MAIN CHANNEL
- FEMA EFFECTIVE MODEL CROSS SECTION - OVERFLOW
- NEW / ADDED CROSS SECTION IN CORRECTED MODEL
- DELETED FEMA CROSS SECTION IN CORRECTED MODEL
- NEW / ADDED CROSS SECTION IN POST-PROJECT CONDITION MODEL
- TIE IN CROSS SECTION FOR THE REVISED REACH
- EXISTING FEMA 100-YEAR BOUNDARY
- EXISTING FEMA 500-YEAR BOUNDARY
- EXISTING FEMA FLOODWAY BOUNDARY
- REVISED 100-YEAR BOUNDARY
- REVISED 500-YEAR BOUNDARY
- REVISED FLOODWAY BOUNDARY

SOURCE:

1. SURVEY DATA IS BASED ON SURVEY PERFORMED BY MERIDIAN SURVEY ENGINEERING, INC., DATED JUNE 2017.
2. BASIS OF COORDINATES: (CCS83) CALIFORNIA COORDINATES SYSTEM 83 ZONE 3.
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REGISTERED PROFESSIONAL ENGINEER
JAIME G TRINIDAD
No. C 68371
Exp. 09/30/25
CIVIL
STATE OF CALIFORNIA

N W E S

SCALE (Feet)
0 60 120 240

STETSON ENGINEERS INC.

DATE: JUNE 12, 2025 | JN: 2706-04-007

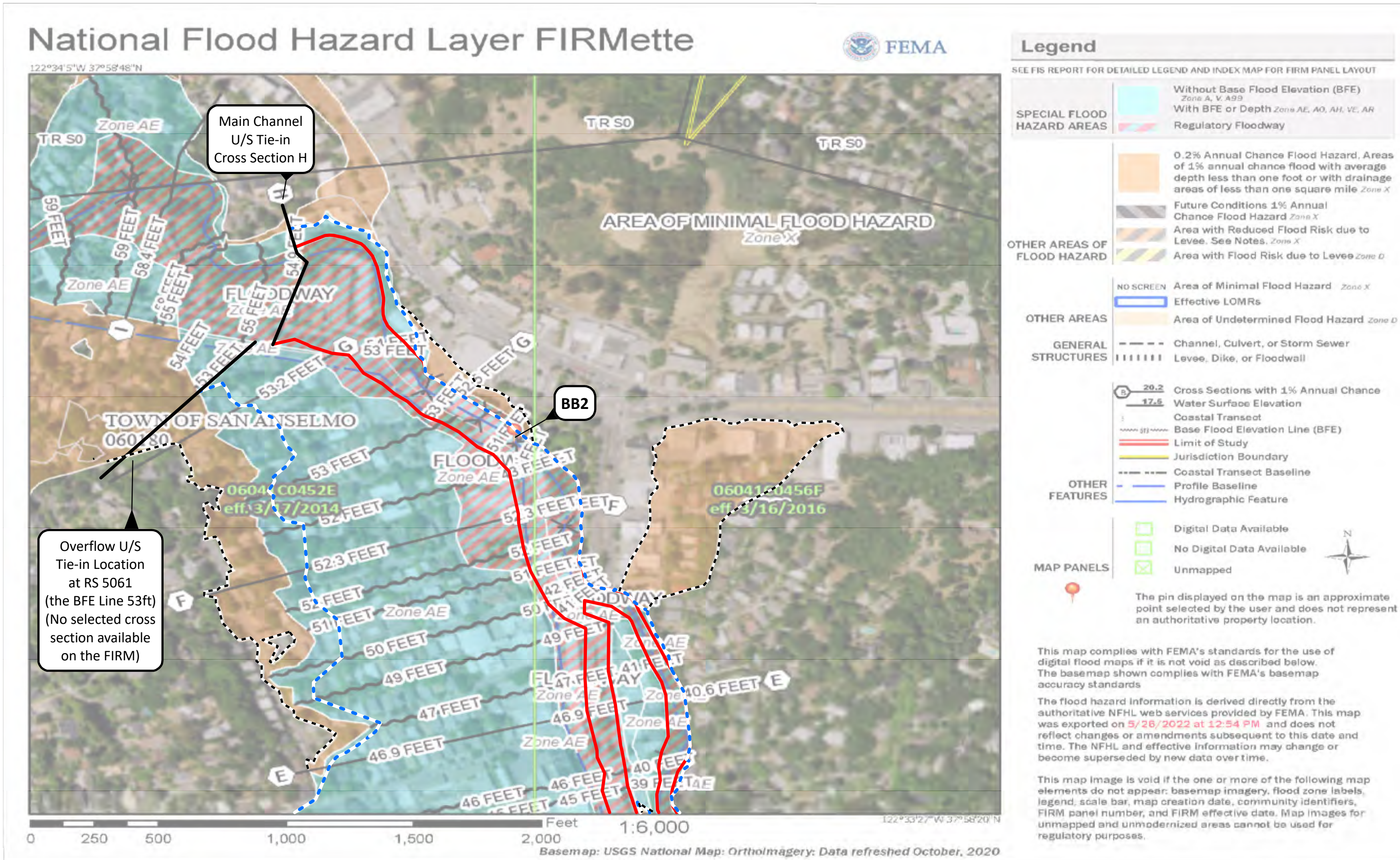
TOPOGRAPHIC WORKING MAP
BB2 CLOMR
SOUTH AREA

F:\DATA\2706\AutoCAD\Topographic_Working_Map_BB2.dwg

7.0 Annotated FIRM/FIS Data

- Annotated FIRM (panels 0452E, 0454E, 0456F, and 0458F)
- Annotated FIS Data Tables (San Anselmo Creek and San Anselmo Creek Overflow)
- Annotated FIS WSE Profiles (San Anselmo Creek and San Anselmo Creek Overflow)

Path: J:\jn2706\BB2_CLOMR2025.aprx Layout: BB2CLOMR25_FIRMette1



Tie-in Cross Section

500-Year Boundary

Revised 100-Year Boundary

Revised Floodway Boundary

BB2 PROJECT CLOMR

ANNOTATED FIRM

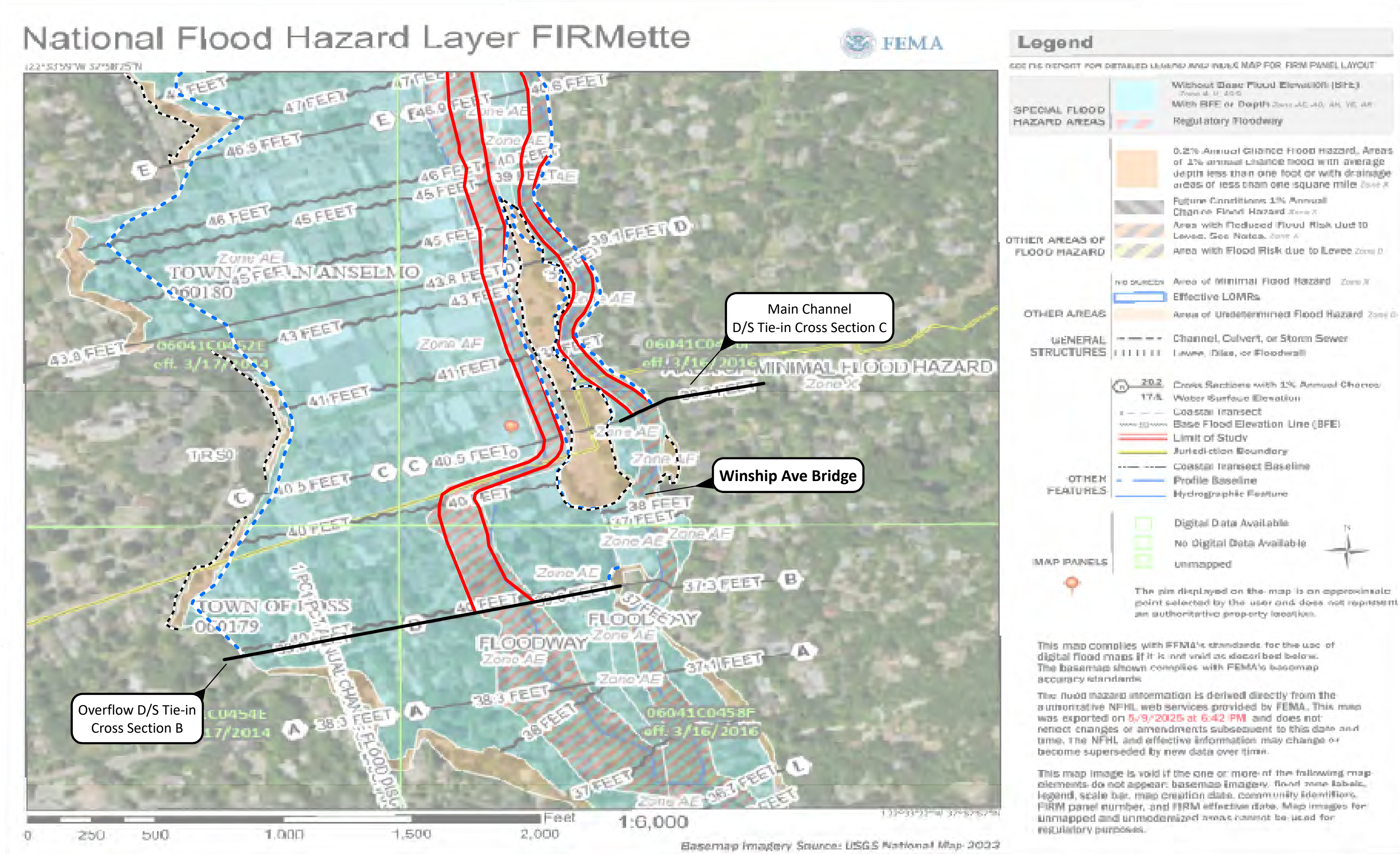
5/12/2025

STETSON ENGINEERS INC.

N

0 300 600

Feet



STETSON ENGINEERS INC.	

Legend

- Tie-in Cross Section
- 500-Year Boundary
- Revised 100-Year Boundary
- Revised Floodway Boundary

BB2 PROJECT CLOMR

ANNOTATED FIRM

6/11/2025

N

0 300 600

Feet

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD 88)	WITHOUT FLOODWAY (FEET NAVD 88)	WITH FLOODWAY (FEET NAVD 88)	INCREASE (FEET)
San Anselmo Creek								
A	19,269	81	1,060	2.3	37.1	37.1	38.0	0.9
B	19,677	77	791	5.1	37.3	37.3	38.3	1.0
C	20,367	74	757	5.3	38.3	38.3	39.2	0.9
D	21,108	60	~~686~~ 724	~~5.8~~ 6.5	~~39.1~~ 39.8	~~39.1~~ 39.8	~~39.8~~ 40.5	0.7
E	21,813	58	~~545~~ 604	~~7.3~~ 7.8	~~40.6~~ 41.5	~~40.6~~ 41.5	~~40.9~~ 41.9	~~0.3~~ 0.4
F	22,702	63	~~398~~ 494	~~10.1~~ 9.5	~~43.2~~ 44.8	~~43.2~~ 44.8	~~43.4~~ 45.3	~~0.2~~ 0.5
G	23,246	80	~~1,048~~ 816	~~3.8~~ 5.7	~~52.5~~ 49.8	~~52.5~~ 49.8	~~52.6~~ 49.8	~~0.1~~ 0.0
H	24,117	408	2,133	2.7	54.9	54.9	55.1	0.2
I	24,852	362	2,433	2.3	58.4	58.4	59.3	0.9
J	25,802	98	943	5.4	62.6	62.6	63.1	0.5
K	27,102	110	928	3.9	66.6	66.6	67.3	0.7
L	27,981	72	680	5.3	72.1	72.1	73.0	0.9
M	29,014	85	809	4.5	76.0	76.0	76.9	0.9
N	29,816	52	899	4.0	84.9	84.9	85.7	0.8
O	31,653	49	510	7.1	93.5	93.5	93.5	0.0
P	32,703	56	476	7.4	97.5	97.5	97.7	0.2
Q	33,388	52	332	8.7	102.4	102.4	102.4	0.0

[1] Feet above U.S. Highway 101

REACH TO BE REVISED;
Cross-sections C and H are
downstream and upstream tie-in locations.

TABLE 16

FEDERAL EMERGENCY MANAGEMENT AGENCY
MARIN COUNTY, CA
AND INCORPORATED AREAS

ANNOTATED **FLOODWAY DATA** (5-12-2025)

BB#2 CLOMR **SAN ANSELMO CREEK**

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD 88)	WITHOUT FLOODWAY (FEET NAVD 88)	WITH FLOODWAY (FEET NAVD 88)	INCREASE (FEET)
San Anselmo Creek Overflow								
A	635	297	1,543	3.0	38.3	38.3	39.2	0.9
B	1,002	190	819	2.0	39.6	39.6	40.6	1.0
C	1,755	~~105~~ 53	~~280~~ 116	~~5.9~~ 8.4	~~40.5~~ 39.7	~~40.5~~ 39.7	~~41.4~~ 40.6	0.9
D	2,434	~~140~~ 70	~~358~~ 130	~~4.6~~ 7.5	~~43.8~~ 42.7	~~43.8~~ 42.7	~~44.1~~ 43.5	~~0.3~~ 0.8
E	3,089	~~217~~ 90	~~267~~ 138	~~6.2~~ 7.0	~~46.9~~ 46.6	~~46.9~~ 46.6	~~47.1~~ 47.4	~~0.2~~ 0.8
F	3,898	~~295~~ 85	~~506~~ 149	~~3.3~~ 6.5	~~52.3~~ 51.0	~~52.3~~ 51.0	~~52.3~~ 51.3	~~0.0~~ 0.3
G	4,840	~~45~~ 0	~~101~~ 0	0.0	~~53.2~~ 51.9	~~53.2~~ 51.9	~~53.2~~ 52.9	~~0.0~~ 1.0

[1] Feet above confluence with San Anselmo Creek

U/S Limit	5,061	0	0	0.0	52.8	52.8	52.9	0.1

REACH TO BE REVISED;
Cross-sections B and RS 5061 are
downstream and upstream tie-in locations.

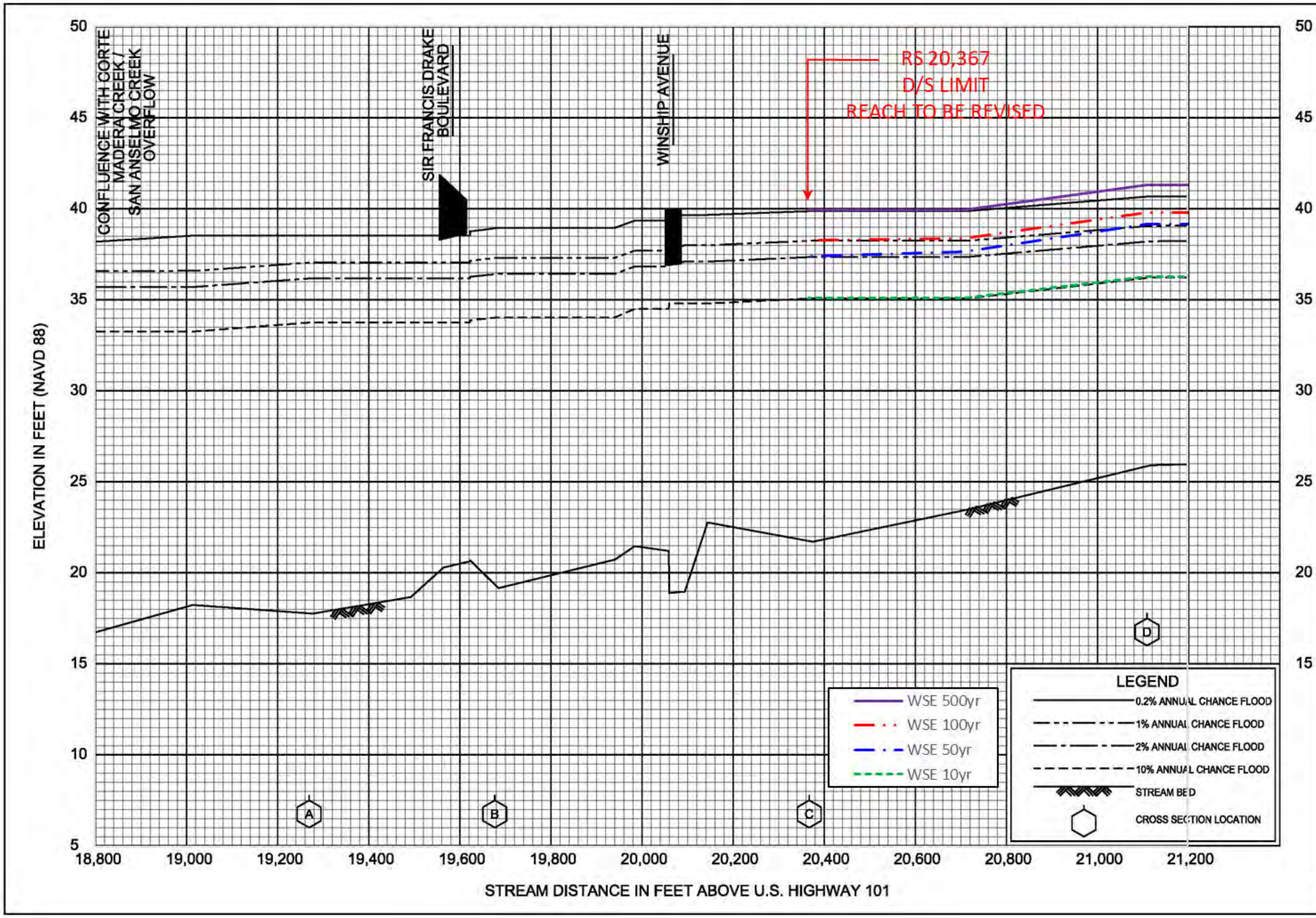
TABLE 16

FEDERAL EMERGENCY MANAGEMENT AGENCY
MARIN COUNTY, CA
AND INCORPORATED AREAS

ANNOTATED FLOODWAY DATA (5-12-2025)

BB#2
CLOMR

SAN ANSELMO CREEK OVERFLOW

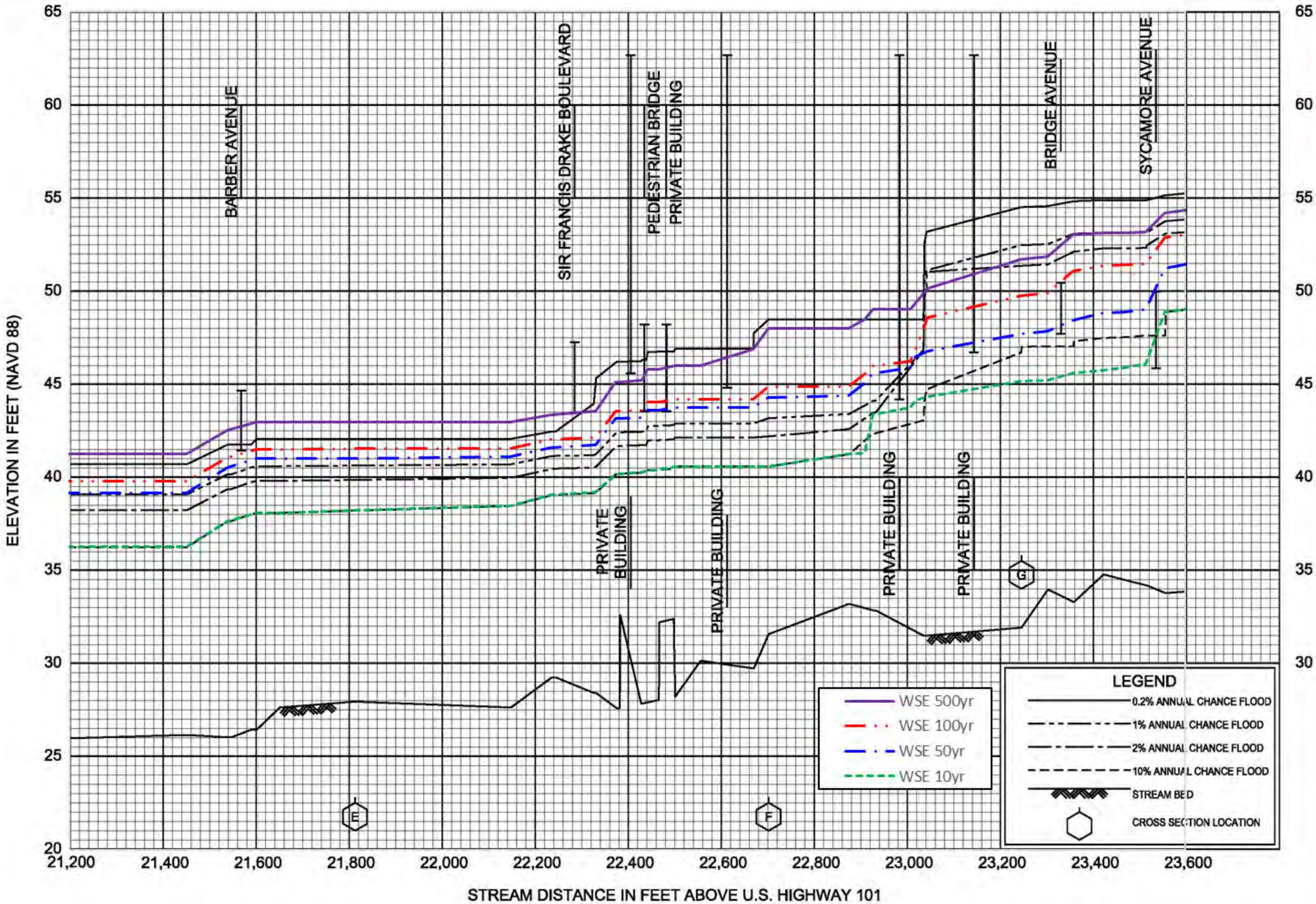


ANNOTATED FLOOD PROFILES (5-12-2025)

BB#2 CLOMR SAN ANSELMO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARIN COUNTY, CA
AND INCORPORATED AREAS



ANNOTATED FLOOD PROFILES (5-12-2025)

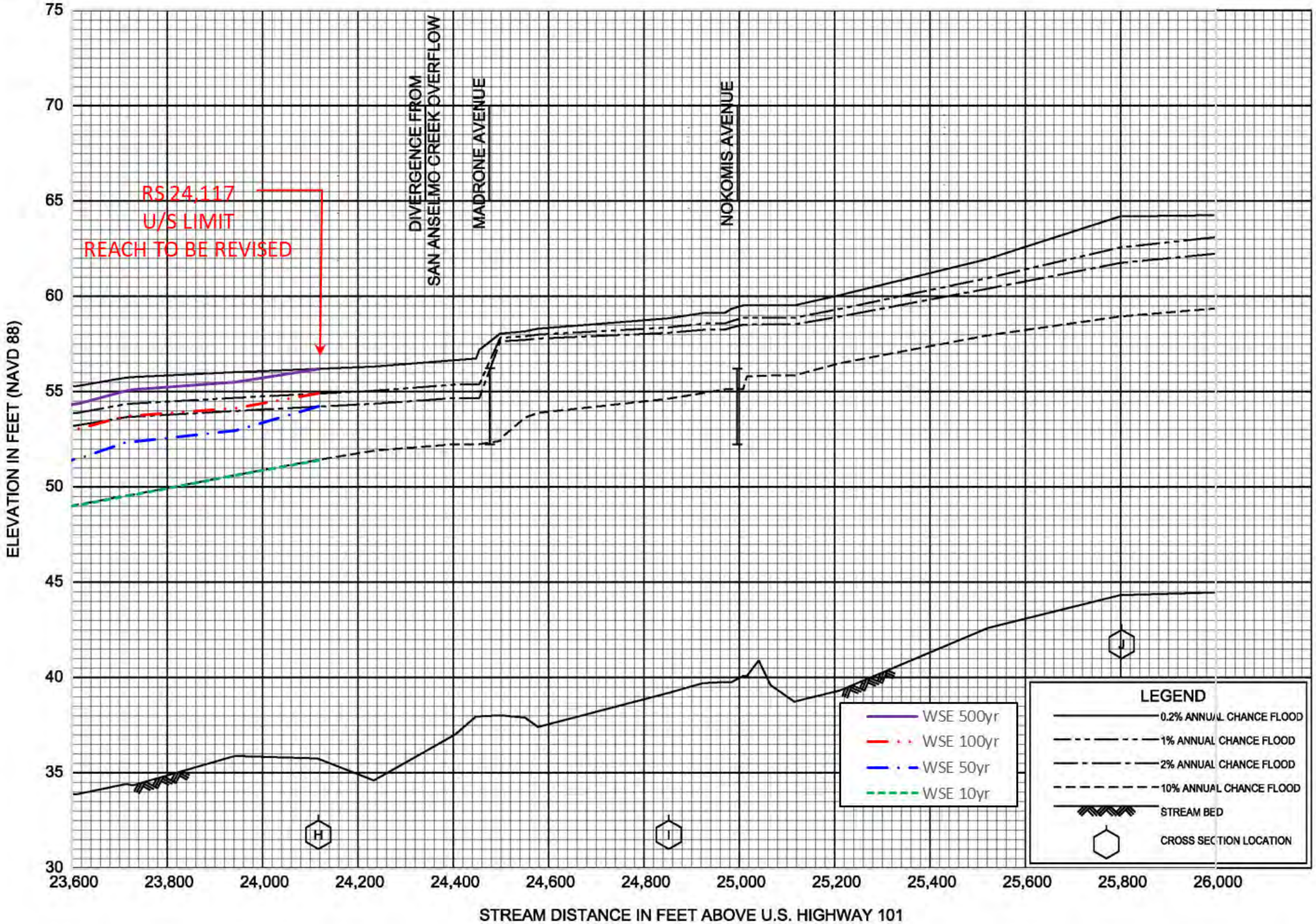
BB#2 CLOMR SAN ANSELMO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARIN COUNTY, CA

AND INCORPORATED AREAS

76P



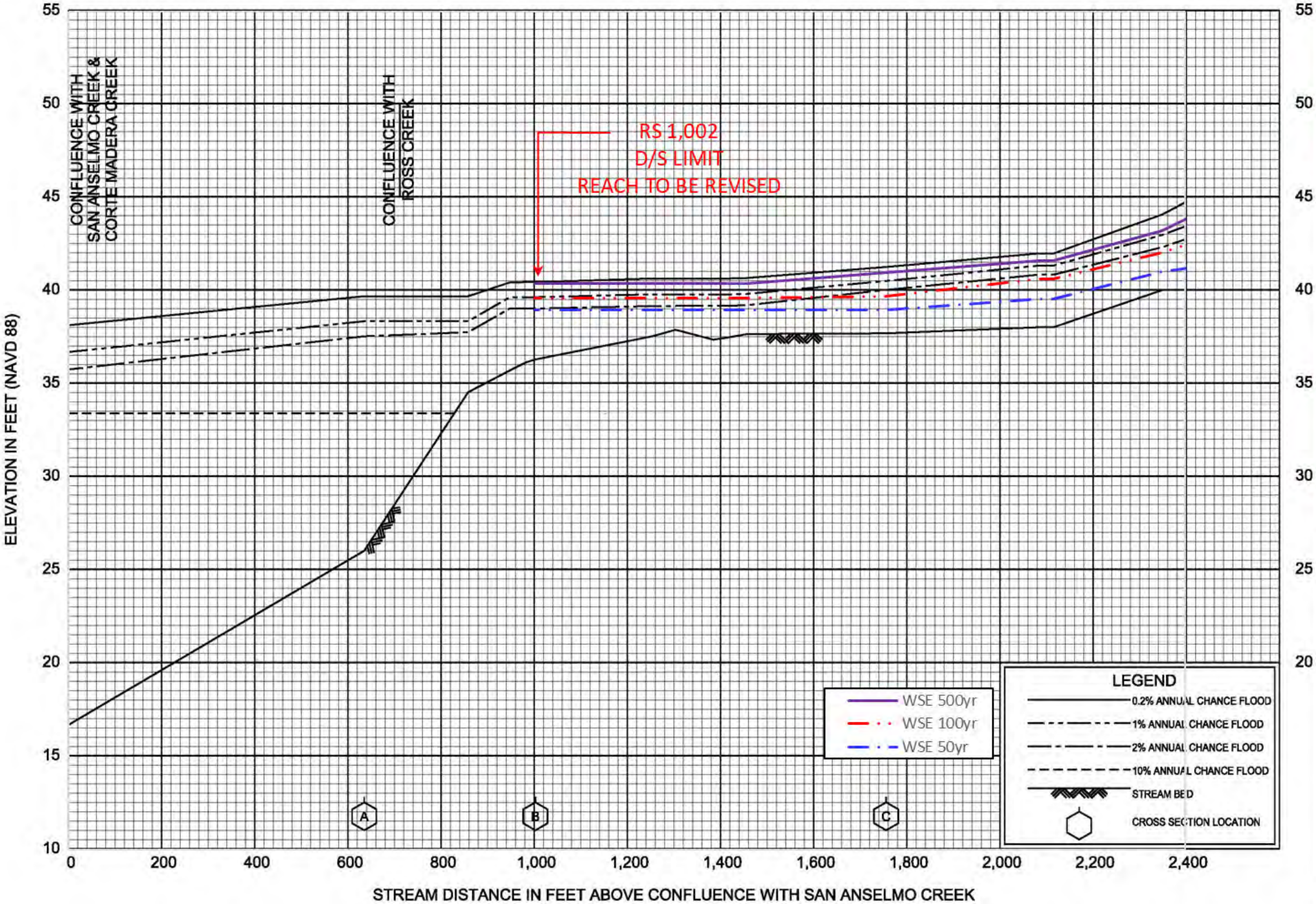
ANNOTATED FLOOD PROFILES (5-12-2025)

BB#2 CLOMR SAN ANSELMO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARIN COUNTY, CA AND INCORPORATED AREAS

77P



ANNOTATED FLOOD PROFILES (5-12-2025)

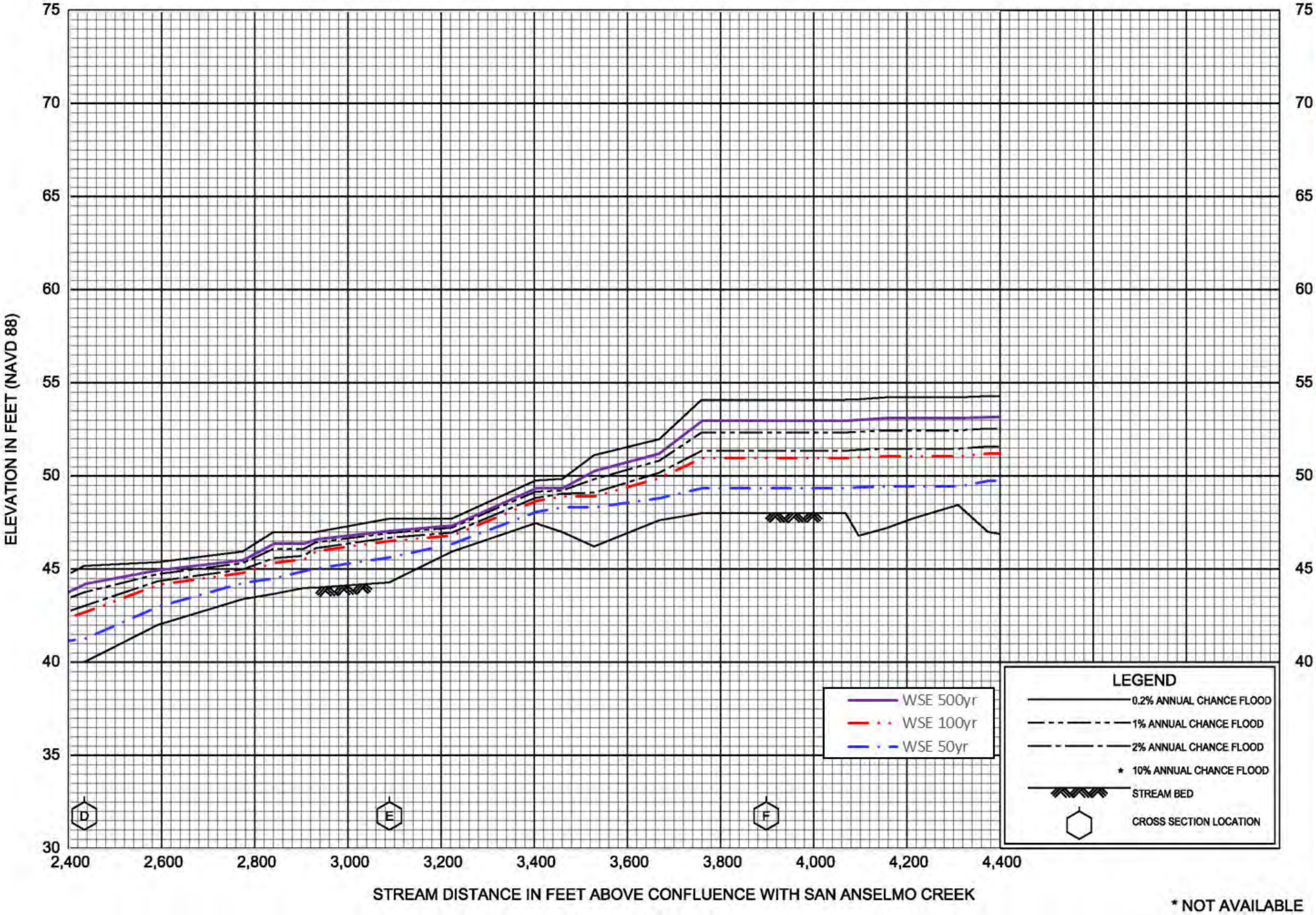
SAN ANSELMO CREEK OVERFLOW

BB#2 CLOMR

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARIN COUNTY, CA AND INCORPORATED AREAS

81P(e)



ANNOTATED FLOOD PROFILES (5-12-2025)

SAN ANSELMO CREEK OVERFLOW

BB#2

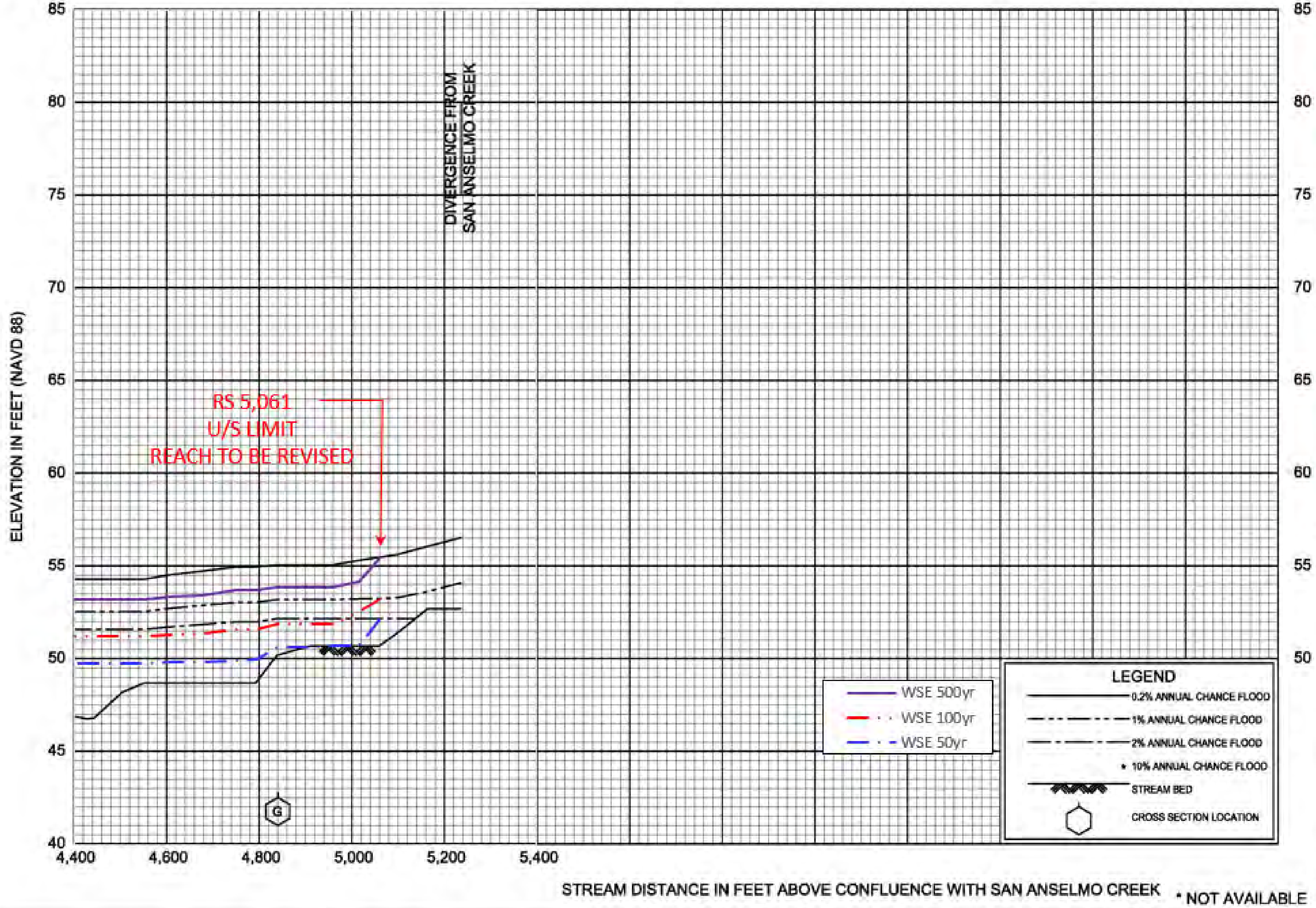
CLOMR

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARIN COUNTY, CA

AND INCORPORATED AREAS

81P(f)



* NOT AVAILABLE

ANNOTATED FLOOD PROFILES (5-12-2025)

BB#2 CLOMR

SAN ANSELMO CREEK OVERFLOW

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARIN COUNTY, CA AND INCORPORATED AREAS

81P(g)

8.0 Proposed Plans

The design plan sheets are included in Appendix A of this MT-2 application. Features in the design plans that may affect the hydraulics are represented in the hydraulic model to analyze the project effects.

NOT included in the design plans is the plan sheet for the new pedestrian bridge – the reason is that the Town of San Anselmo has not yet selected the pre-fab bridge. While the pre-fab pedestrian bridge has not been selected by the Town, it has been represented in the Post-Project Conditions Model with a top elevation at 49.0 ft NAVD88[7] and a soffit elevation at 47.7 ft NAVD88. The soffit elevation of the proposed pedestrian bridge is designed to be 1 ft higher than the bottom elevation of the upstream BB3 (46.7 ft NAVD88) with the intention that the bridge will not become a new hydraulic obstruction after removal of BB2 (which has an existing bottom elevation at about 44.8 ft NAVD88).

[7] The most recent design by RHAA (60% design) showed the bridge deck top elevation at 48.7 ft NAVD88. The Post-Project Conditions Model (reasonably) added an allowance of 0.3' to account for camber and foot curbs commonly placed along the sides of the deck.

9.0 Compliance with 44CFR §65.12 Regulatory Requirements

Hydraulic modeling in Section 5.0 has demonstrated that the proposed project would result in modeled BFE increases in San Anselmo Creek between the pre-project (existing) conditions and the post-project conditions downstream of BB2 along the creek channel reach from BB2 to the SFD downstream bridge. The BFE increases are more than 0.00 foot as a result of encroachment within a regulatory floodway, which triggers the following additional requirements under the 44CFR §65.12:

- Certification that no structures are located in areas which would be impacted by the increased BFEs;
- Documentation of individual legal notice to all impacted property owners within and outside of the community, explaining the impact of the proposed action on their property;
- An evaluation of alternatives which would not result in a BFE increase above that permitted under paragraphs (c)(10) or (d)(3) of § 60.3 of this subchapter demonstrating why these alternatives are not feasible; and
- Concurrence of the Chief Executive Officers of any other communities impacted by the proposed actions.

Other requirements under the 44CFR §65.12 include a request for conditional approval of map change, a request for revision of base flood elevation determination, and a request for floodway revision. Documentation of satisfying these requirements is already covered in the previous sections of this MT-2 documentation.

Structure No-Impact Certification Statement

See the next page for the structure no-impact certification statement.

Documentation of Individual Legal Notices Sent to Impacted Property Owners

Appendix E contains documentation of individual legal notices to all property owners within and outside of the community which could potentially be impacted, explaining the potential impact of the proposed action on their property. For the purpose of complying with this requirement, potentially impacted properties were identified as those properties with structures that would experience a modeled rise in BFE under post-project conditions, compared to pre-project conditions.

Engineering staff from the District examined all properties adjacent to the creek channel with a modeled rise in BFE due to the removal of BB2. For all structures where the modeled rise in BFE had potential to be above the lowest adjacent grade (LAG), the District surveyed structure elevations (LAG and first finished floor (FFF)), using the services of a licensed land surveyor. Then the LAG and FFF elevations were compared to the modeled BFEs (between pre-project and post-project models). The survey data was collected by Meridian Surveying Engineering, Inc between July 2022 and April 2025

Appendix B contains a report, entitled *Proposed Removal of Building Bridge No. 2 on San Anselmo Creek Town of San Anselmo, Marin County, California/ IMPACT ASSESSMENT AND*

MITIGATION, prepared by the District. The report presents the survey and photo-documentation of properties with structures that would experience a rise in BFE under post-project conditions, relative to pre-project conditions. The report describes the District's assessment of the effect of the rise on each structure and mitigation measures. The modeled BFE rise occurs on a total of 58 parcels adjacent to the creek channel, 38 in the Town of San Anselmo and 20 in the Town of Ross. Most structures in these parcels were already elevated above the modeled BFE for existing and post-BB2 scenarios. A total of 22 structures would be affected by the BFE rise, 7 of them commercial structures and 15 residential, with 9 affected structures in San Anselmo and 13 in Ross. For structures where the effect has no impact, no mitigation is prescribed. For parcels where the effect does have impact on structures, appropriate measures are prescribed to mitigate the impact. A total of 12 structures in 10 parcels were found to require mitigation with 2 structures in San Anselmo and 10 structures in Ross proposed for mitigation. Refer to Appendix B for more detailed information. Based on the District's assessments and prescribed mitigations, there will be no structures impacted by the proposed actions (i.e., BB2 removal) after prescribed mitigations.

Evaluation of Alternatives That Would Not Result in a BFE Increase

As explained in Section 1.1, the purpose of removing BB2 is to reduce flooding in downtown San Anselmo and a portion of Ross. One alternative would be to convey floodwaters by way of a closed "bypass" conduit buried beneath San Anselmo Ave. The bypass conduit would discharge to the area of the Ross Creek confluence with San Anselmo Creek in Ross, which is where floodwaters in the overland flow path discharge under existing conditions. This alternative is not feasible because it would be prohibitively costly and would likely face major obstacles during implementation, particularly with regard to constructability, environmental impacts, disturbance to residents and businesses, and public acceptance.

The District has evaluated other alternatives that would meet the same purpose of BB2 removal and would not result in a BFE increase. The District's evaluation is documented in Appendix C which contains the report entitled, "Ross Valley Flow Reduction Study Report, (CH2M Hill, 2015). The report describes the evaluation of nine sites for constructing flood detention basins. Detention basins function to attenuate floodwater which in turn reduces flooding downstream. Eight of the nine sites are located upstream of San Anselmo. At one site -- "Former Nursery Site" – a detention basin has been constructed. This detention basin, referred to as the "Sunnyside Detention Basin," has an off-stream storage capacity of 13 acre-feet at the spillway crest. While it effectively reduces flooding in Fairfax and San Anselmo during more frequent floods less than the 15-year flood, its storage capacity is filled during larger floods and, as such, it is not sufficient to measurably reduce the Base Flood (i.e., 100-year flood) in San Anselmo. The Memorial Park detention basin was rejected by the voters of the Town of San Anselmo in 2015. The Lefty Gomez Field detention basin was rejected by the voters of the Town of Fairfax in 2016. The other five sites (Camp Bothin Youth Center, Loma Alta Open Space, Deer Park, San Domenico School, Red Hill Park) are not feasible because they are owned by private or public entities who have expressed unwillingness to use their properties for a flood detention basin.

For the reasons explained above, there are no practical alternatives that would not result in a BFE increase.

Concurrence of the Chief Executive Officers of Communities Affected by the Proposed Actions

The affected communities are the Town of San Anselmo and the Town of Ross. The towns submitted letters in-lieu of signing the MT-2 Form 1 (community concurrence form) – see Section 2.0.

Structure No-Impact Certification

This is to certify that I am duly qualified engineer licensed to practice in the State of California. This further certifies that no structures* are located in the areas that would be impacted by base flood elevation increases for the San Anselmo Creek in Marin County, California, associated with the proposed project which mainly includes removal of the existing Building Bridge #2 (BB2) with proposed mitigations.

*A structure, as defined by FEMA 44 CFR 59.1, is a walled and roofed building, including a gas a liquid storage tank, that is principally above ground, as well as a manufactured home.

Structure, for insurance purpose, means:

(1) A building with two or more outside rigid walls and a fully secured roof that is affixed to a permanent site;

(2) A manufactured home ("a manufactured home," also known as a mobile home, is a structure: built on a permanent chassis, transported to its site in one or more sections, and affixed to a permanent foundation); or

(3) A travel trailer without wheels, built on a chassis and affixed to a permanent foundation, that is regulated under the community's floodplain management and building ordinances or laws.

CLOMR R5514739020939
(Case Number)

Berenice Davidson
(Certifier's Name)

7/21/2025
(Date)

Dept. of Public Works, Assistant Director
(Title)

Seal:

10.0 Endangered Species Act (ESA) Compliance

Nationwide Permit (NWP) General Condition 18, Endangered Species, stipulates that project authorization under an NWP does not allow for the incidental take of any federally-listed species in the absence of a biological opinion with incidental take provisions. As the principal federal lead agency for the San Anselmo Flood Risk Reduction Project[8], the U.S. Army Corps of Engineers, San Francisco District, initiated consultation with the United States Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) to address project related impacts to listed species, pursuant to Section 7(a) of the Endangered Species Act of 1973, as amended, 16 U.S.C. § 1531 et seq. By letter of January 6, 2021, USFWS concurred with the determination that the project was not likely to adversely affect California red-legged frog (Rana draytonii), northern spotted owl (Strix occidentalis caurina), and their designated critical habitat (see the attached letter in Appendix D from USFWS). By electronic message of August 12, 2021, the NOAA Restoration Center (RC) determined that the San Anselmo Flood Risk Reduction Project (2018-00240) fits within the Biological Opinion titled, "Program to fund, and/or permit restoration projects within the NOAA Restoration Center's Central Coastal California Office jurisdictional area in California" (WCR-2015-3755), dated June 14, 2016.

[8] Removal of BB2 is one of the two elements of the San Anselmo Flood Risk Reduction Project. The other element is to construct a flood diversion storage (FDS) basin at the former Sunnyside Nursery in unincorporated Marin County, adjacent to the western border of the Town of Fairfax.

11.0 Property Owner Notification

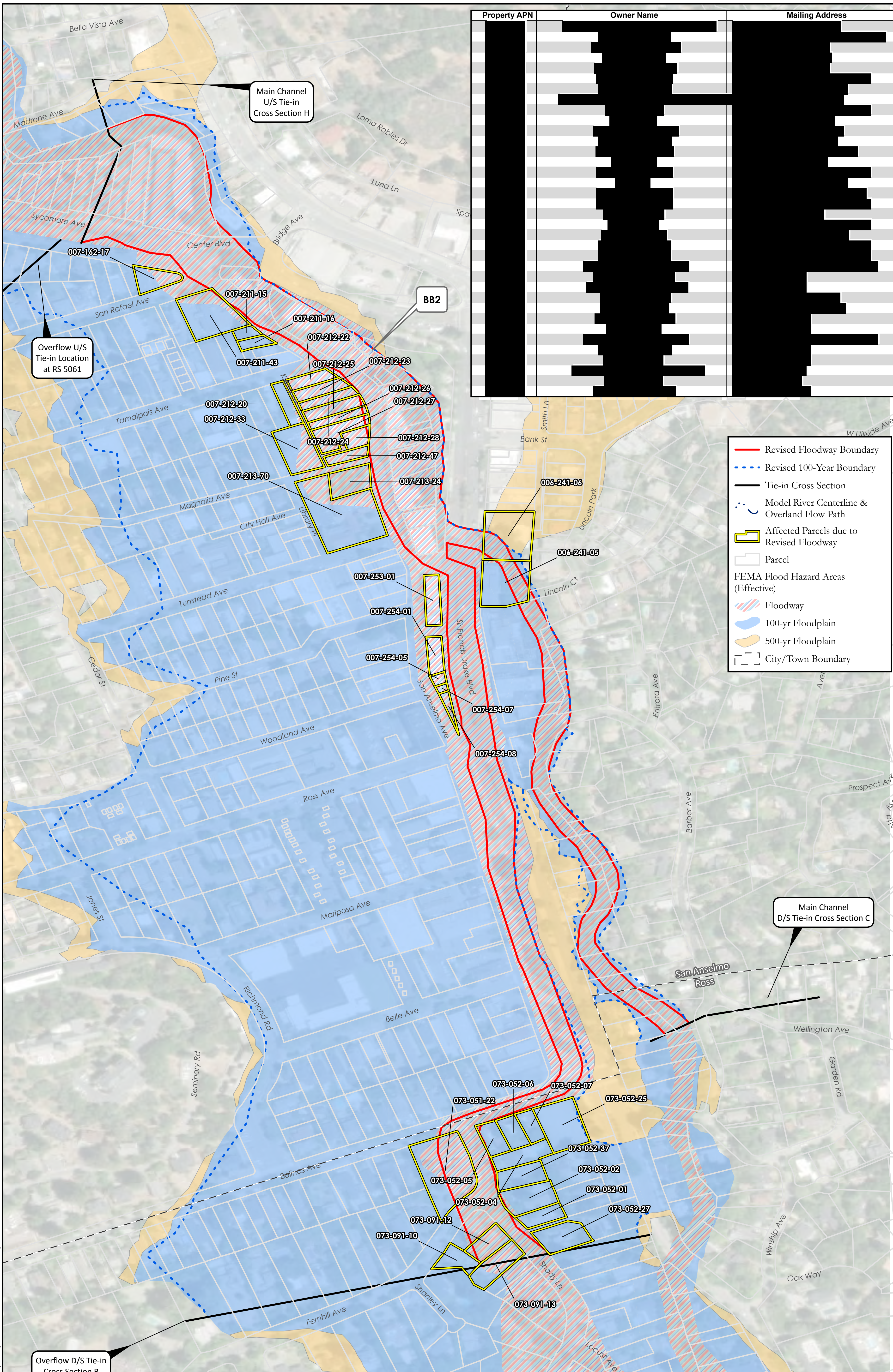
- Notification on Floodway Boundary Change

  See the map on the next page showing the floodway boundary change and the affected property owners. These property owners have been notified, as documented in Appendix E. In general, the project will have little effect on the creek channel floodway boundary and reduce the extent of the overland floodway.

- Notification on BFE Increases

  As shown in Figure 21a under Section 5.0, the properties adjacent to the main channel downstream of BB2 down to the SFD downstream bridge are modeled to have a BFE increase. These property owners have been notified, as documented in Appendix E.

Property APN	Owner Name	Mailing Address
[redacted]	[redacted]	[redacted]

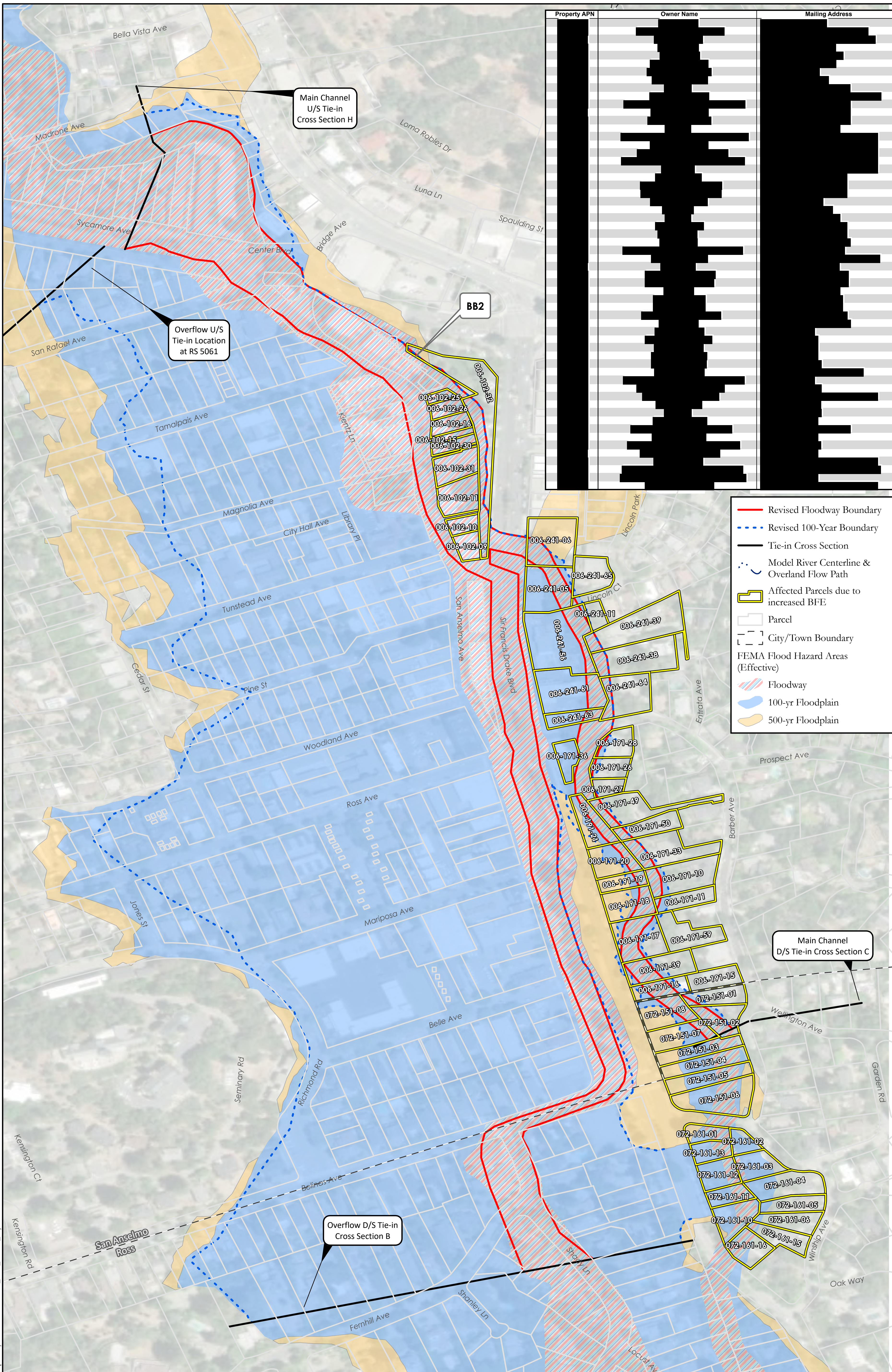


Path: J:\jn2706\BB2_CLOMR2025.aprx Layout: BB2CLOMR25_Parcels_citybound

STETSON ENGINEERS INC.

FOR REFERENCE ONLY
BB2 PROJECT CLOMR
PROPERTY OWNER NOTIFICATION MAP
DUE TO REVISED FLOODWAY
6/26/2025

N
0 200 400
Feet



Property APN	Owner Name	Mailing Address
[redacted]	[redacted]	[redacted]

Path: J:\jn2706\BB2_CLOMR2025.aprx Layout: BB2CLOMR25_BFE_Parcels_citybound

STETSON ENGINEERS INC.

FOR REFERENCE ONLY

BB2 PROJECT CLOMR

PROPERTY OWNER NOTIFICATION MAP

DUE TO INCREASED BFE

6/26/2025

12.0 Environmental Permitting

Removal of BB2 is one of the two elements of the San Anselmo Flood Risk Reduction Project (SAFRR). The other element is a flood diversion storage (FDS) basin at the former Sunnyside Nursery in unincorporated Marin County, adjacent to the western border of the Town of Fairfax. The FDS Basin was constructed in 2022 and 2023.

The SAFRR Final EIR was certified in October 2018 by the Marin County Board of Supervisors. The Final EIR lists the following project permits:

- Federal: USACE 404, USFWS and NOAA Fisheries comment to USACE permits.
- State: CEQA & CDFW Incidental Take Permit/1600 Lake and Streambed Authorization.
- Regional & Federal CWA: NPDES Permit SWMPPP and Federal CWA Section 401 through RWQCB.

All permits have been obtained.

MT-2 Application for BB2

Appendices A, B, C, D, and E