October 26, 2023

TO: Derek Dittman, P.E.
RSA+ Civil Engineers

FROM: ______________________________
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O'Connor Environmental, Inc.

SUBJECT: Hydraulic Analysis of the Proposed Zinfandel Estate Subdivision

Introduction

This document supersedes the previous hydraulic analysis submitted for the project dated May 4, 2021. Detailed in-channel water surface elevation results are presented in Appendix A and responses to review comments by River Focus Water Resources Consultants received June 9, 2021, are presented in Appendix B.

RSA+ has developed several alternative design concepts for the proposed Zinfandel Estate Subdivision adjacent to Salvador Creek on APNs 038-361-009 & 038-361-010. The designs involve elevating portions of the subject properties above 100-yr flood elevations along with measures to mitigate against potential increases in flooding associated with the loss of floodplain. A MIKE FLOOD hydraulic model of the creek and floodplains was developed by DHI, Inc. and the Napa County Resource Conservation District in 2008. This model served as the basis for developing 100-yr Base Flood Elevations (BFEs) and FEMA Flood Insurance Rate Maps (FIRMs) in 2010. The 2010 BFEs and FIRMs were later revised with an effective date of February 20th, 2012 and they provide the basis for defining pre-project hydraulic conditions. The existing model was used to evaluate two alternative design concepts leading to selection of a preferred design alternative. A geomorphic assessment was also performed to evaluate the stability and likely maintenance requirements associated with the preferred design; the geomorphic assessment is presented in a separate technical memorandum. Given that the proposed preferred alternative presented here is very similar to the original preferred alternative evaluated in the May 4, 2021 geomorphic assessment, this document was not revised.

Limitations

The modeling analysis is based on an existing hydraulic model originally developed in 2008. This model uses channel cross sections that were surveyed in 2002 and 2005 and LiDAR data for the floodplain that was collected in 2002. The existing and proposed topography in the model outside of the proposed work area was retained since it was used to define the existing FEMA regulatory floodplain and thus serves as the baseline for evaluating proposed project effects. It is noted that these topographic data sources are relatively old and that a higher-resolution 2018 LiDAR dataset is now available which could be used for a revised study of the system in the future (a task beyond the scope of this parcel-specific project). In the absence of a revised study, it is important to acknowledge the uncertainty associated with the analysis due to the age of the off-site topographic information and potential changes in channel morphology or floodplain development that may have occurred since 2002. For example, field observations in early 2021 revealed the presence of a beaver dam at Lassen Street and evidence of beaver activity downstream of Lassen Street.

Design Alternatives

Both designs include removal of the Biale footbridge and retention/upgrades to the south bank pathway/access road in addition to the features discussed below.

Alternative 1: This design elevates most of the floodplain above the 100-yr BFE and allows for shallow street flooding on both sides of the creek (Figure 1).

Alternative 2: This design reduces the area of elevated floodplain and creates ~830 lineal feet of terracing on the north bank and ~450 lineal feet on the south bank. Street flooding is excluded on the north bank but retained on the south bank (Figure 2).

Figure 1: Design plans provided by RSA+ for Alternative 1.

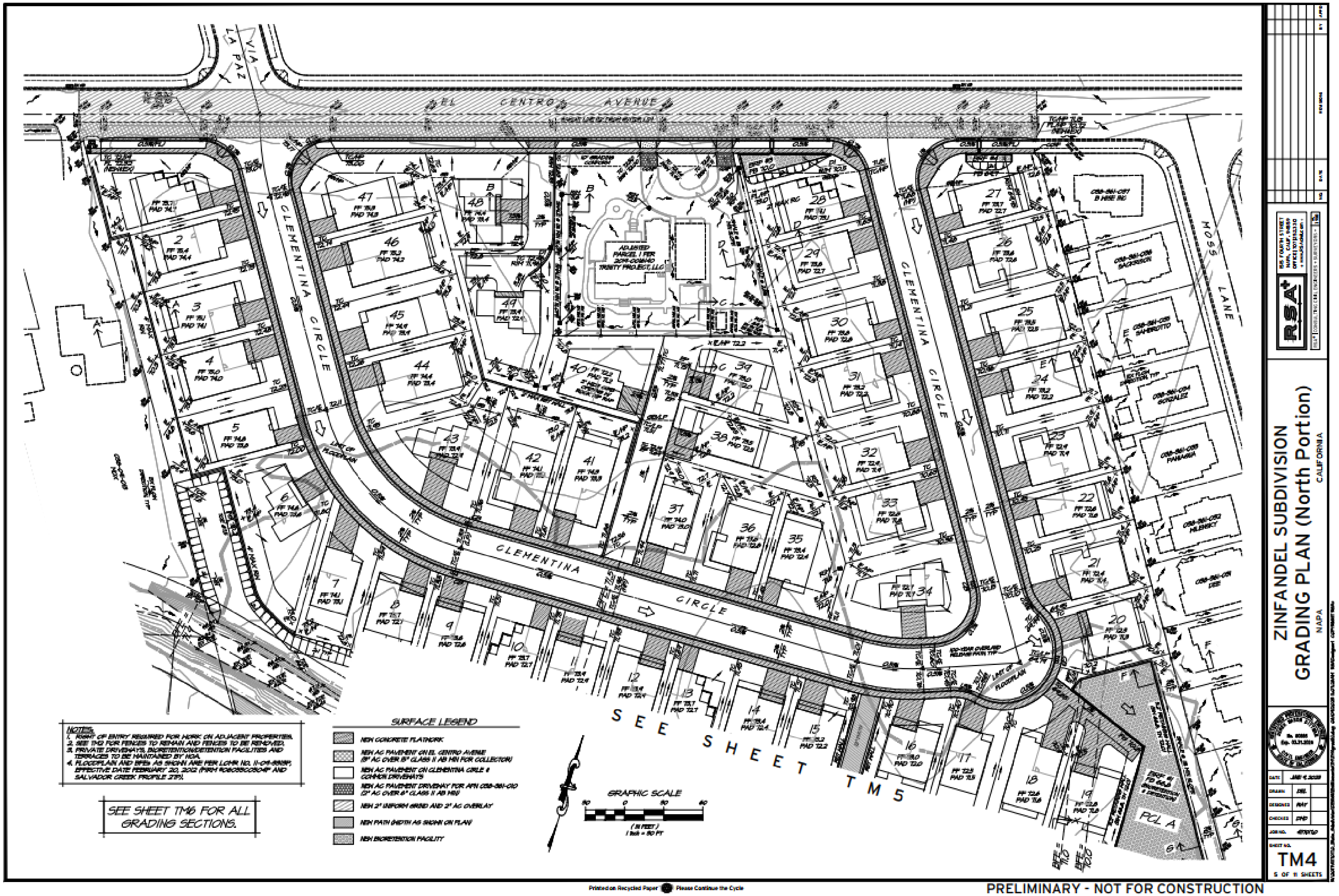

Figure 2a: Design plans provided by RSA+ for Alternative 2 (north section).

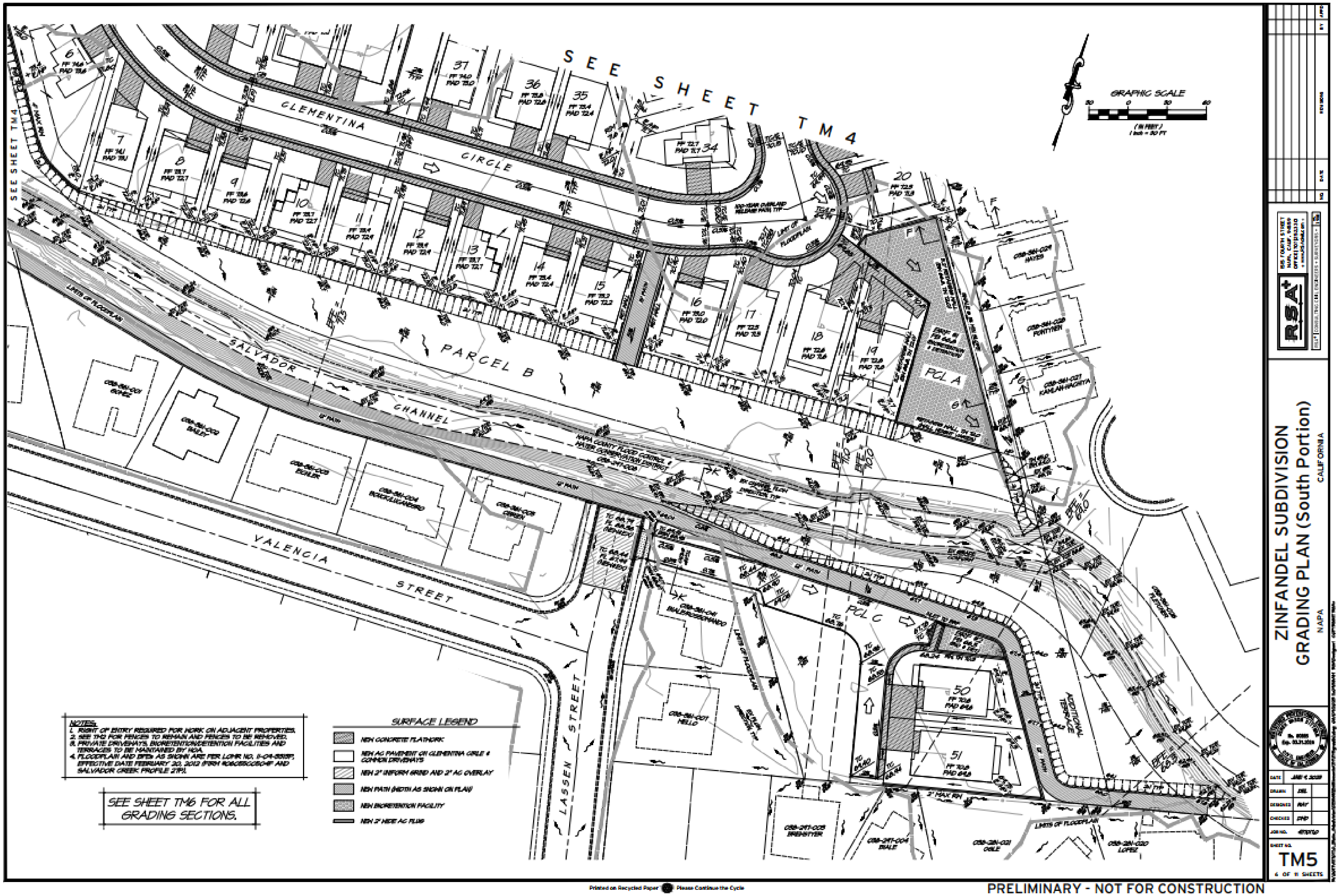

Figure 2b: Design plans provided by RSA+ for Alternative 2 (south section).

Hydrologic Model Development

Hydrologic models for the December 2005 flood and the 100-yr flood were developed previously as part of the 2008 flood study. To enable evaluation of the proposed design alternatives over a wider range of flow conditions, new hydrologic models were developed for the 2- and 10-yr floods using the hydrologic model parameters developed previously for the other flood events in combination with NOAA ATLAS 14 24-hr duration rainfall depths and an SCS Type 1A distribution (same procedure used previously to simulate the 100-yr flood). Resulting peak flows contributing to the project reach range from 1,277 cfs during the 2-yr event to 3,934 cfs for the 100-yr flood (Figure 3).

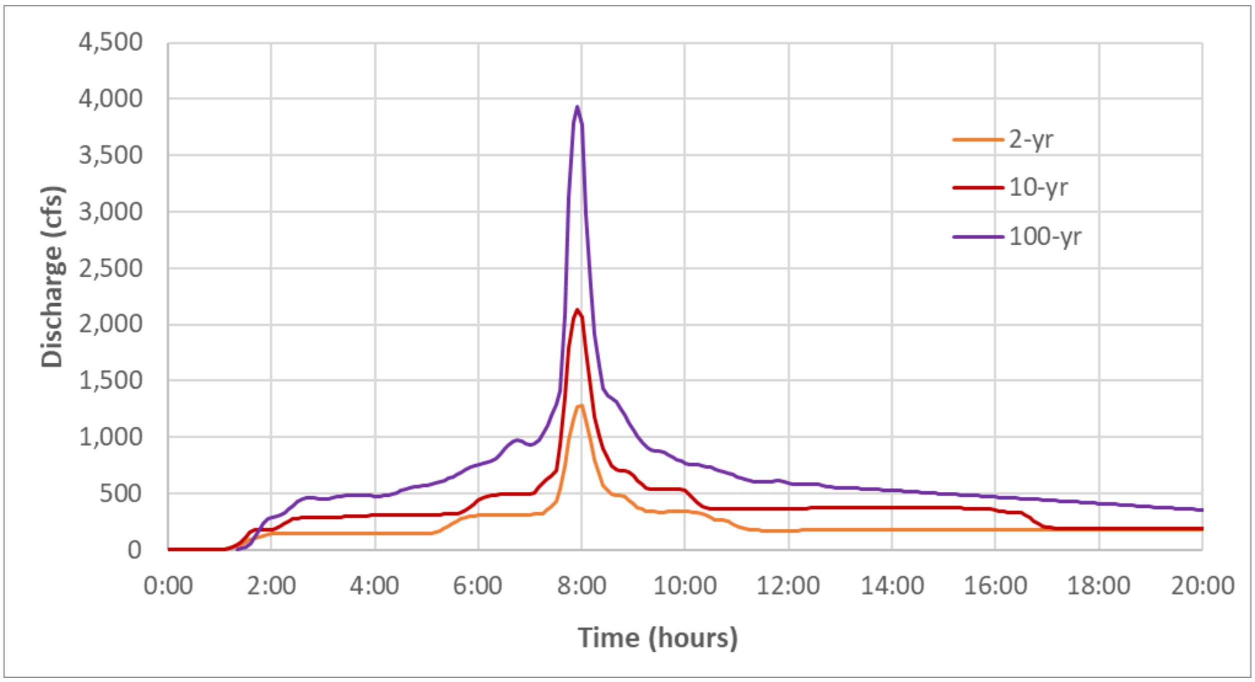

Figure 3: Simulated runoff hydrographs contributing to the project reach of Salvador Creek for the 2-, 10- and 100-yr flood events.

Hydraulic Model Development

Topographic surfaces representing the finished grade of the proposed design alternatives (Figures 4 & 5) were interpolated from points representing proposed elevations at the project site provided by RSA+. Each alternative includes placement of fill to elevate building sites above the 100-yr floodplain. Excluding the building footprints and proposed roads, finished grades in the development footprint are generally between 1- and 2-ft above existing grade on the north side of the creek and between 2- and 3-ft above existing grade on the south side of the creek. In Alternative 1, the proposed roads on both sides of the creek are designed to be below 100-yr floodplain elevations to allow for some shallow street flooding to help to mitigate offsite impacts. This feature was retained on the south side of the creek in Alternative 2, however roads were not lowered on the north side of the creek with the entirety of the building envelope on the north side of the creek excluded from the 100-yr floodplain.

In addition to elevating the site, Alternative 2 includes a 50- to 70-ft wide 830-ft long terrace along the north bank of the creek and a 15- to 75-ft wide 450-ft long terrace along the south bank of the creek. The terracing along the south bank extends downstream of the primary project parcels by ~110-ft to include portions of APNs 038-361-026 and -027. Terrace elevations were set based on a field determination of Ordinary High Water performed by RSA+. In most locations, the terrace elevations range from 2 to 4-ft below existing grade. The design also includes the removal of the bridge near the downstream edge of the project area which was referred to as the Biale Bridge in the existing 2008 flood study. Note that the proposed topography on the north side of the creek for Alternative 2 does not include the details of proposed elevated building pads.

To implement the proposed project in the model, the floodplain elevations in the 2-dimensional component of the model were modified by replacing the existing elevations with proposed elevations within the project site. The terraces were also included in the 2-dimensional component of the model. Cross section bank elevations within the 1-dimensional component of the model (which represents the channels) were lowered to correspond with the proposed terrace grades and several new cross sections were interpolated from adjacent cross sections to more accurately capture the transitions between terraced and unterraced reaches. To accommodate the new positions of the top of banks associated with the terrace design, the locations of the transition from 1- to 2-dimensional flow (known as lateral links) were adjusted accordingly. The Biale bridge was also removed from the model.

The existing condition model was re-run with the inclusion of the new interpolated cross sections to ensure that the comparisons between existing and proposed conditions reflect only the proposed changes to the creek and floodplain and not the changes resulting from the change in cross section density in the model. The changes in water surface elevations and inundation extents resulting from the cross section additions were very minor. The original existing conditions model was calibrated using a uniform floodplain roughness of 0.033 and channel roughness that varied in the project reach from 0.06 to 0.10. The terraces will be re-vegetated with native grasses, shrubs, and trees. We selected a roughness value of 0.08 for the terraces to reflect conditions following the establishment and maturation of the new vegetation. No changes are proposed within the active channel below Ordinary High Water therefore the existing in-channel roughness values were retained.

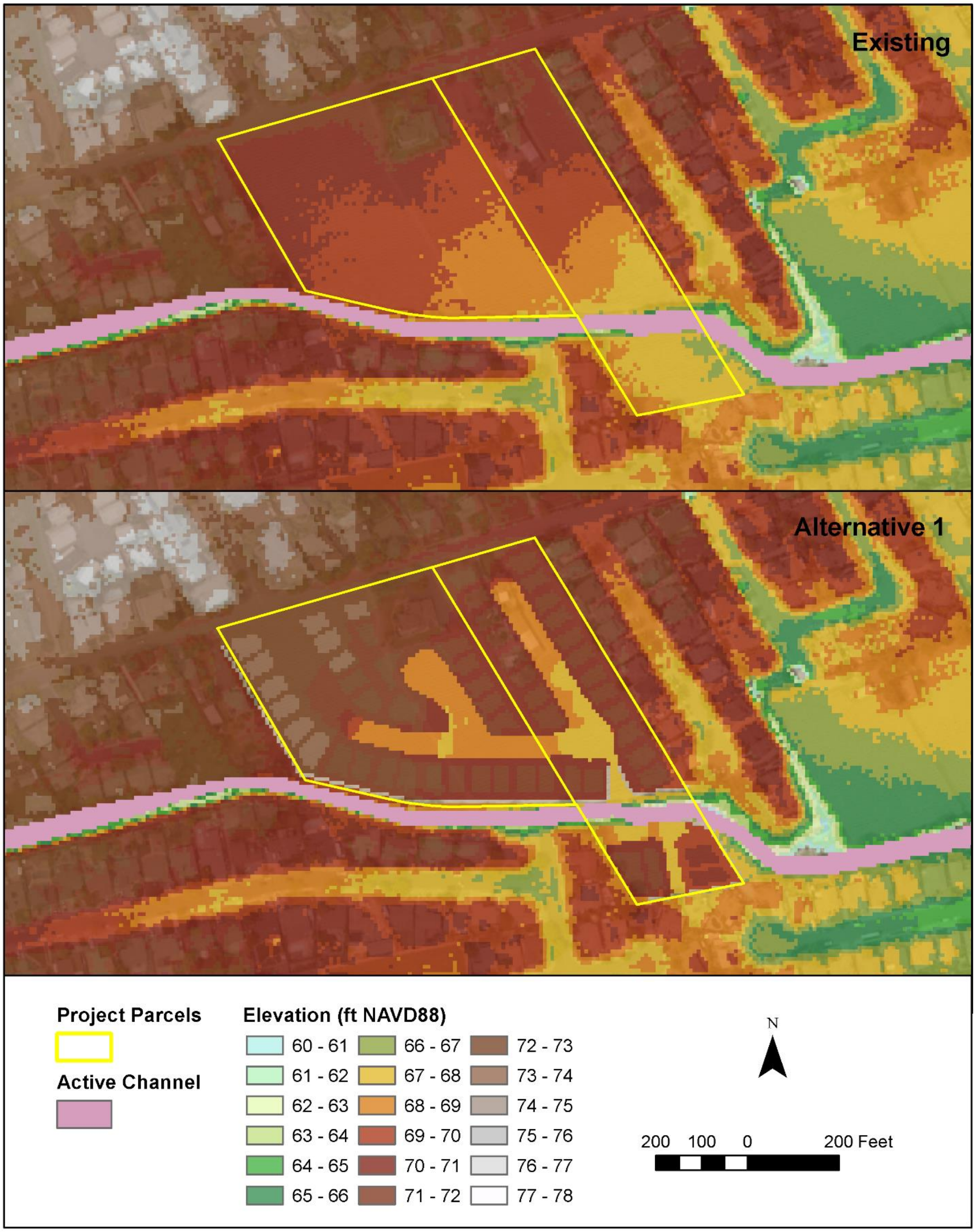

Figure 4: Comparison of existing and proposed topography used in the hydraulic model for Alternative 1.

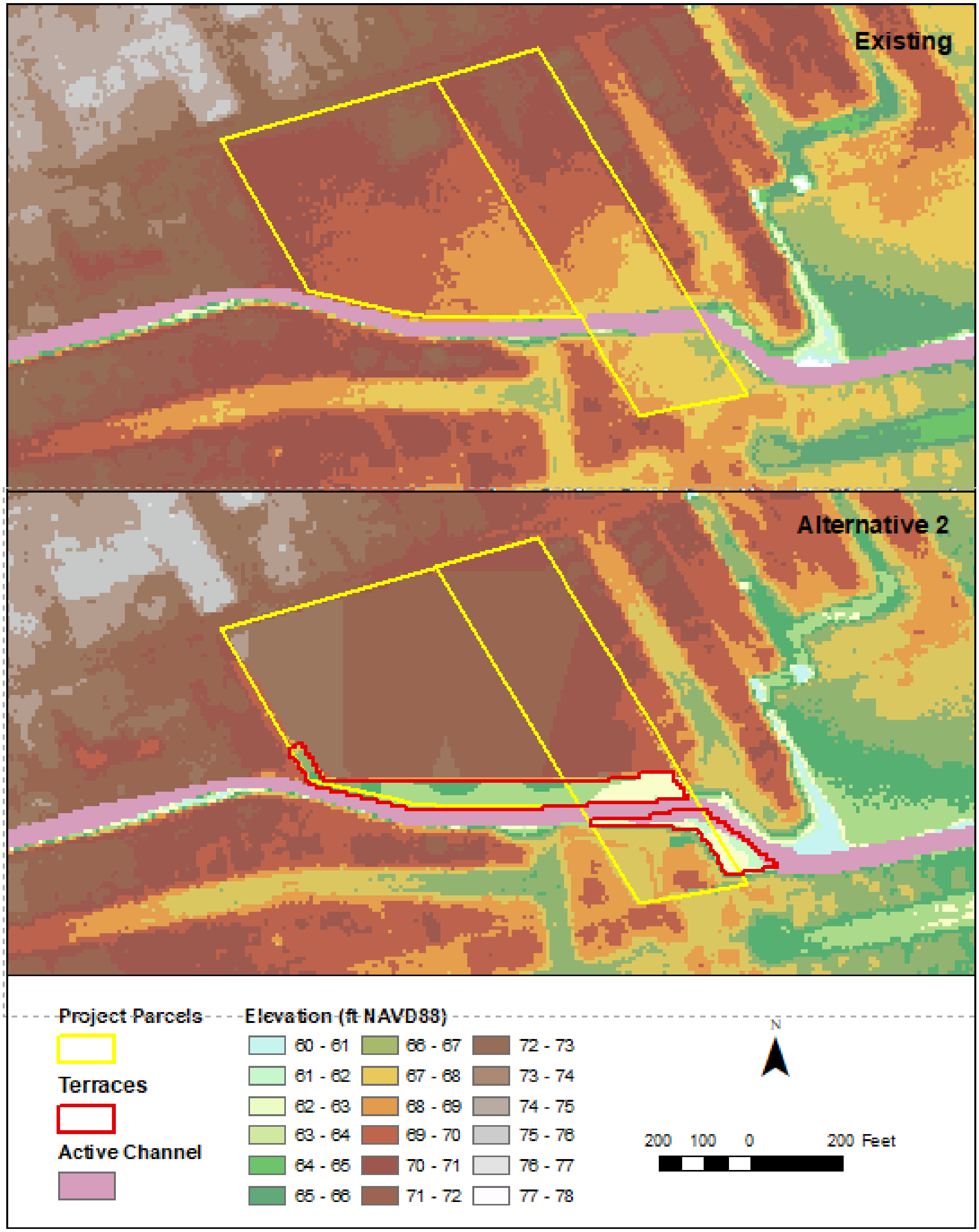

Figure 5: Comparison of existing and proposed topography used in the hydraulic model for Alternative 2. Note proposed grades do not include street and building pad details on the north side of the creek.

Results

Preface

The combination of multiple alternatives, flood events, and various ways to examine the model outputs results in the generation of a very large number of datasets. Results have been summarized for all alternative/event combinations and figures have been included for select combinations that serve to best illustrate the findings of the modeling analysis without overwhelming the reader with information.

Alternative 1

Comparison of maximum water surface elevation (WSE) profiles between the updated existing and proposed Alternative 1 conditions reveals that Alternative 1 produces increases in WSEs upstream of Lassen Street during each of the flow events (Figure 6). The maximum increases range from 0.45 to 0.64-ft (Table 1). This can be attributed to the decrease in floodplain area on the north bank which results in more water remaining in-channel through this reach. Comparison of maximum floodplain inundation extents and depths for the 2- and 100-yr floods shows how the design substantially increases flood extents on the south side of the creek throughout the range of evaluated flows (Figures 7 & 8).

In contrast, the design results in decreases in WSEs downstream of Lassen Street due to the increased overbank flows at Lassen Street which result in less water remaining in-channel to be routed to the downstream reaches (Figure 6). This effect manifests with modest reductions in flood extent downstream of the project parcels on the north side the creek (Figures 7 & 8). Overall, the mean change in WSE over the project reach plus 1,000-ft upstream and downstream is a small decrease of between 0.04 and 0.11-ft (Table 1).

Table 1: Summary of changes in channel water surface elevations for Alternative 1.

		2-yr	10-yr	100-yr
Change in WSE (ft)	Min	-0.33	-0.54	-0.37
	Max	0.45	0.52	0.64
	Mean	-0.05	-0.11	-0.04

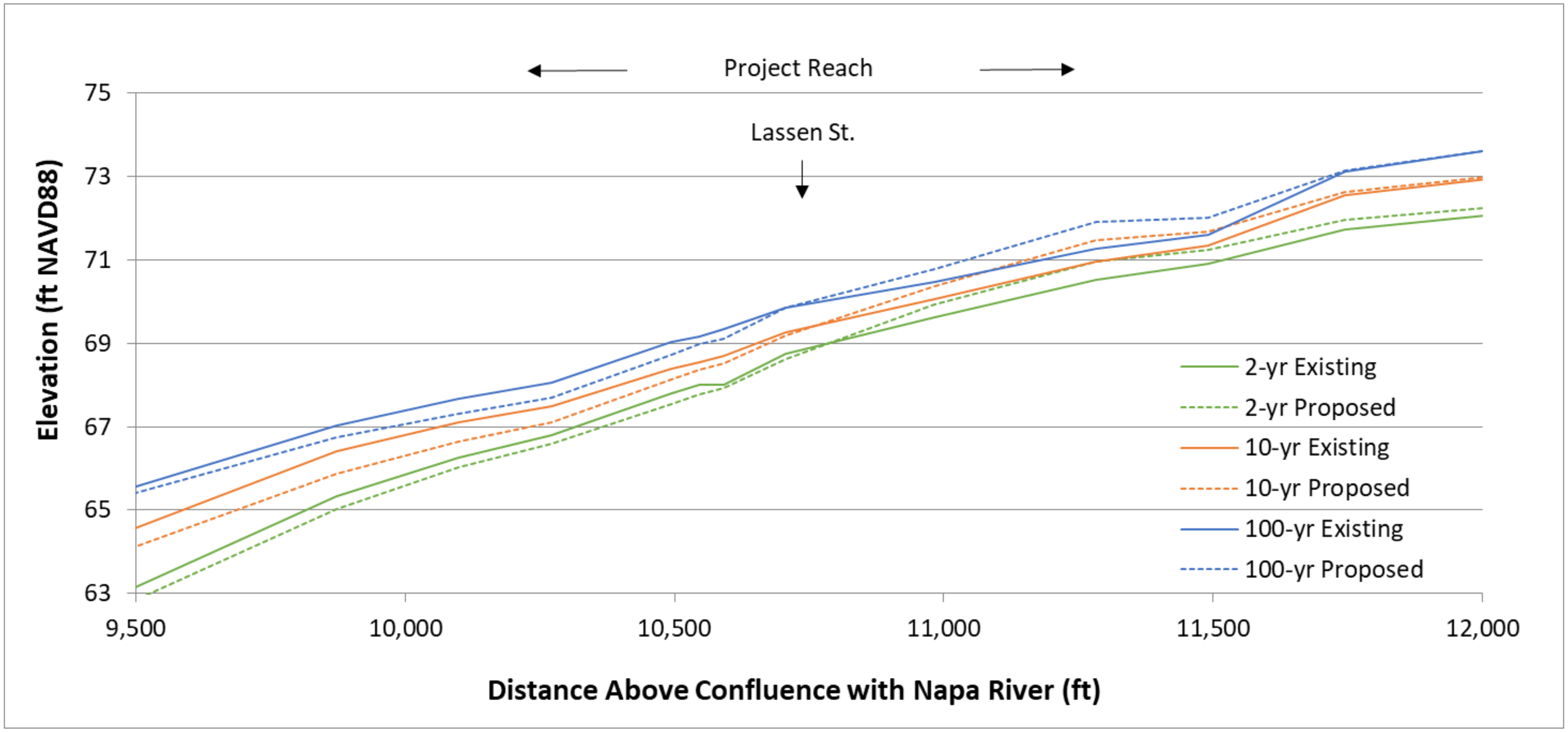

Figure 6: Comparison of existing and proposed water surface profiles for Alternative 1.

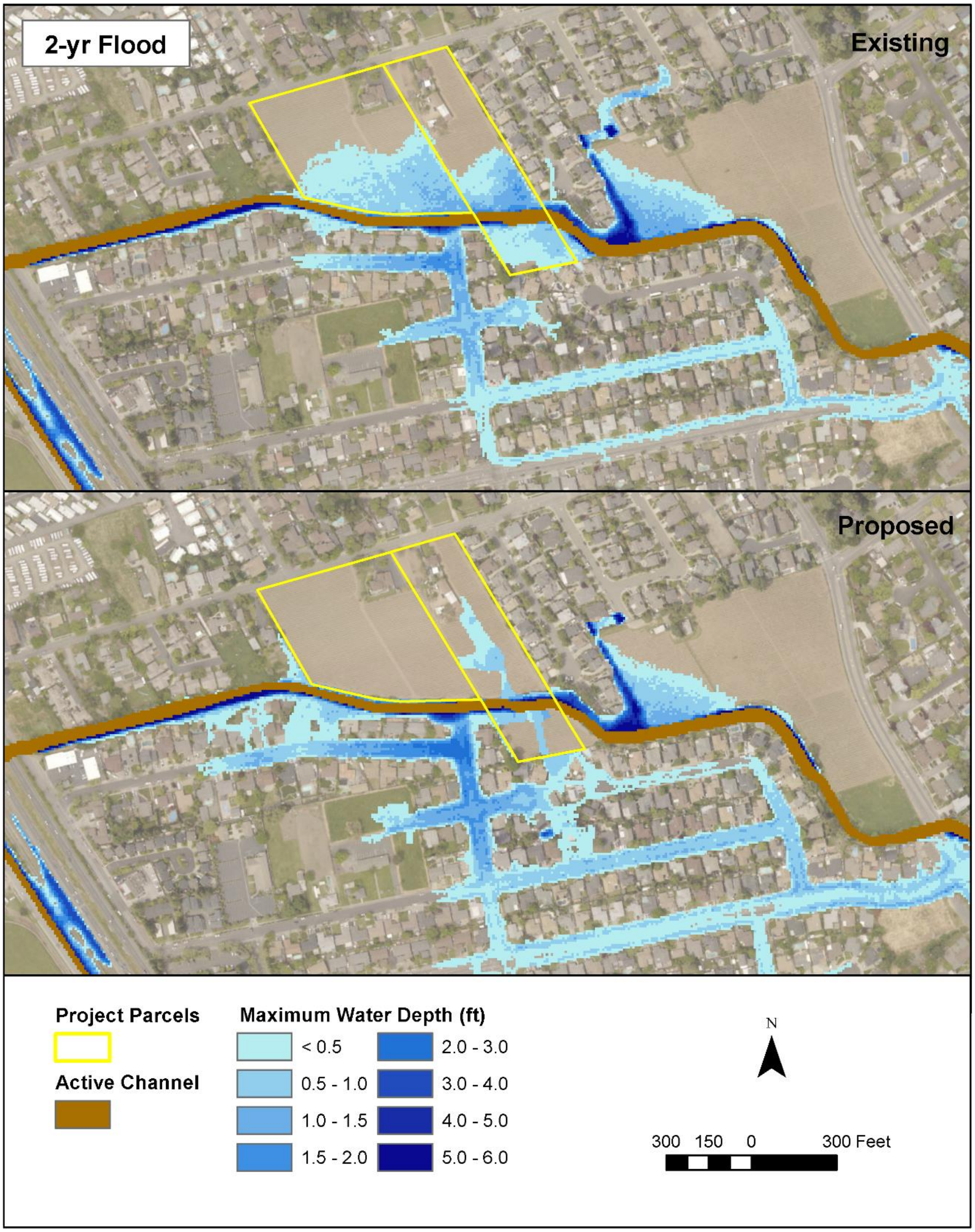

Figure 7: Comparison of existing and proposed 2-yr water depths and inundation extents for Alternative 1.

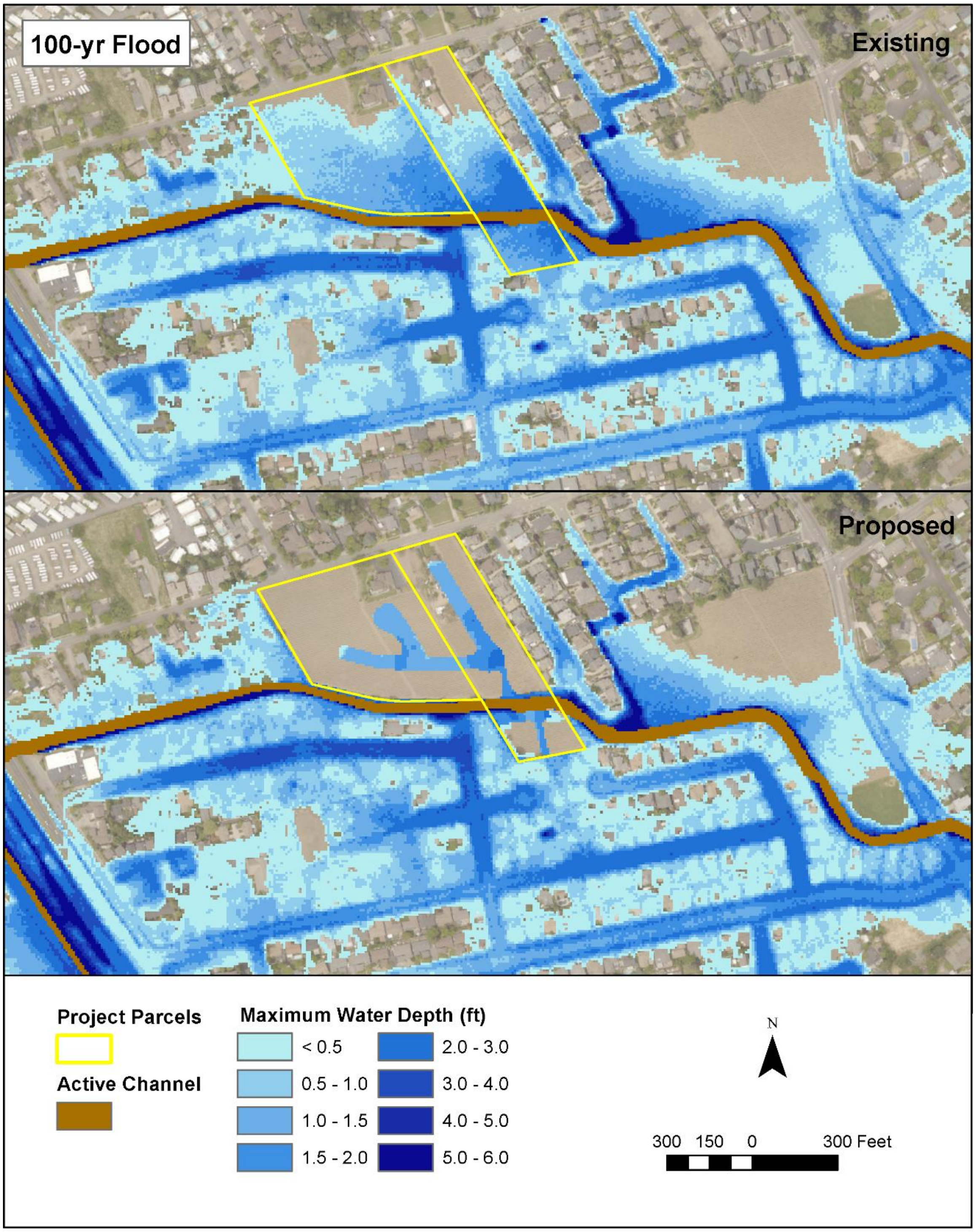

Figure 8: Comparison of existing and proposed 100-yr water depths and inundation extents for Alternative 1.

Alternative 2

Comparison of maximum WSE profiles between the updated existing and Alternative 2 conditions reveals that the design results in decreases in WSEs upstream of Lassen Street during the 2-yr and to a lesser extent during the 10-yr event, with maximum decreases of 0.57-ft during the 2-yr flood (Figure 9; Table 2). This can be attributed to the increase in channel capacity due to the addition of the terraces which, at smaller flood flows, is more than enough to compensate for the loss of floodplain associated with the proposed fill in the development footprint. The reduced WSEs result in substantially reduced overbank flows at Lassen Street and associated reductions in flood extents and depths south of the creek during the 2-yr flood and to a lesser extent during the 10- and 100-yr floods (Figures 10-12). This effect diminishes with increasing flow as changes on the floodplain become more important relative to changes in channel capacity. Except for the area along the edge of the fill prism immediately upstream of the project reach where local increases in depth of up to 0.8-ft occur during the 10- and 100-yr floods, increases in inundation extent and flood depth upstream of Lassen Street are minor (Figures 11-13). As discussed in greater detail in Appendix B, these increases do not affect structure flooding.

Downstream of Lassen Street, Alternative 2 results in increases in WSEs due to reduced overbank flows and inundation at Lassen Street (Figure 9). These overbank flow decreases result in more water remaining in-channel to be routed to downstream reaches resulting in a maximum increase in WSE of 0.28-ft during the 2-yr flood (Table 2). This effect diminishes with increasing flow, and the maximum increase in WSE during the 100-yr flood is 0.10-ft (Table 2). Increased flow in the downstream reaches results in small increases in inundation extents and depths in the vicinity of Bryce Court, along the high flow path on the north bank through the downstream Biale vineyard and crossing Jefferson Street north of Trower, and farther downstream at Vintage High School. These changes are relatively minor and primarily represent less than a 0.1-ft increase in inundation depth, except in low-lying portions of the street networks (Figures 11-13). Overall, the mean change in WSE over the project reach plus 1,000-ft upstream and downstream is near zero during all flood events (Table 2).

Table 2: Summary of changes in channel water surface elevations for Alternative 2.

		2-yr	**10-yr**	**100-yr**
Change in WSE (ft)	Min	-0.57	-0.27	-0.13
	Max	0.28	0.14	0.10
	Mean	-0.03	-0.02	-0.01

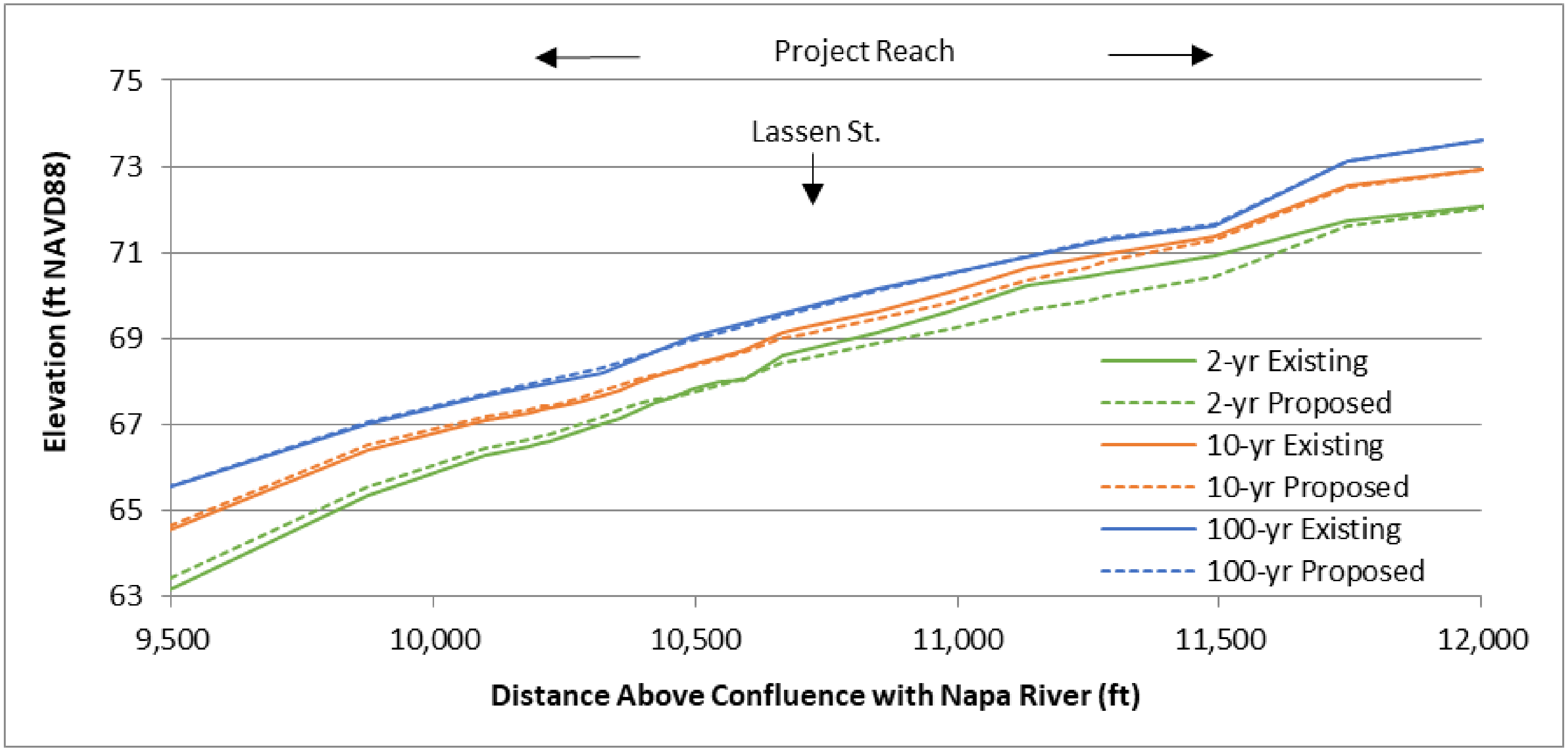

Figure 9: Comparison of existing and proposed water surface profiles for Alternative 2.

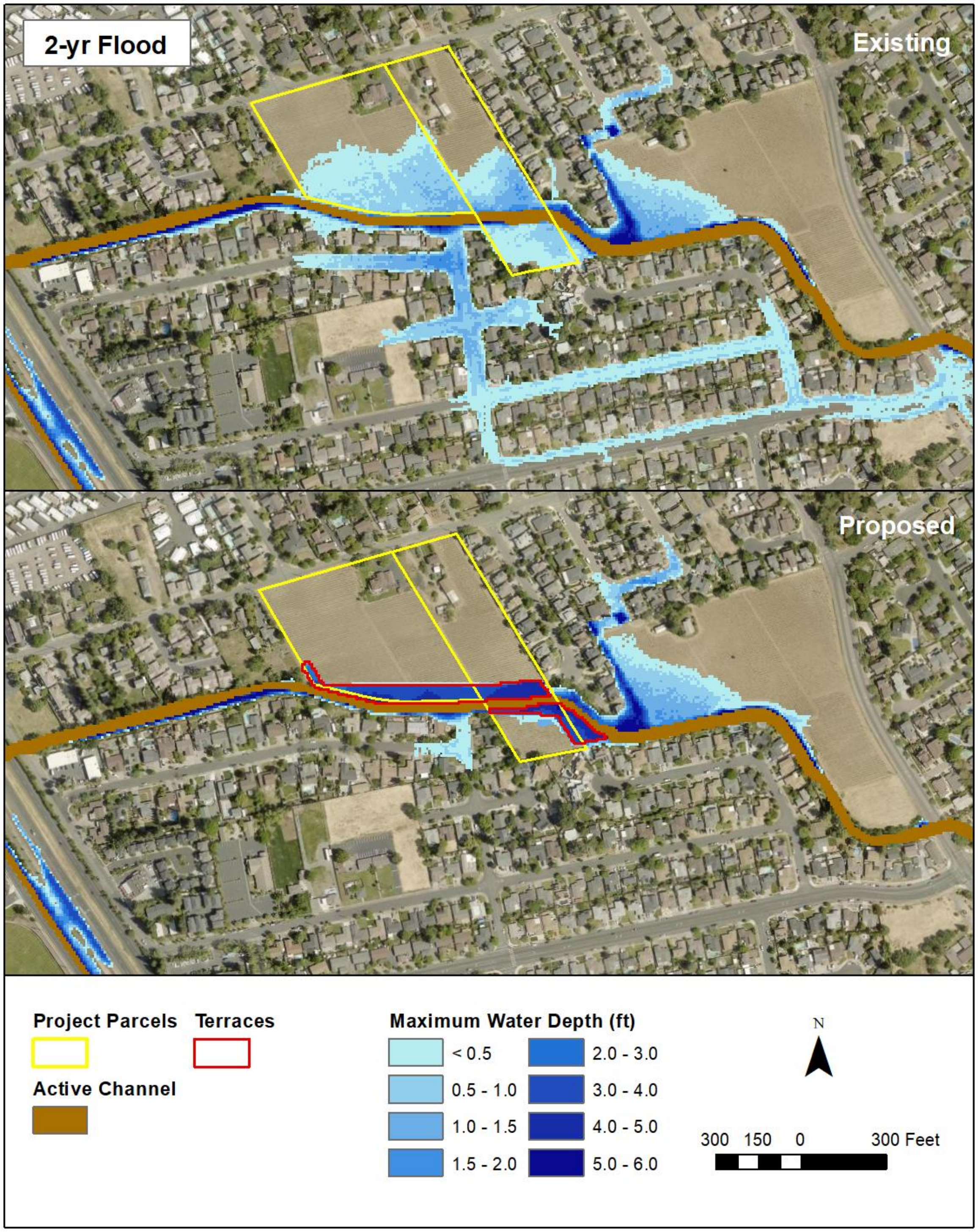

Figure 10: Comparison of existing and proposed 2-yr water depths and inundation extents for Alternative 2.

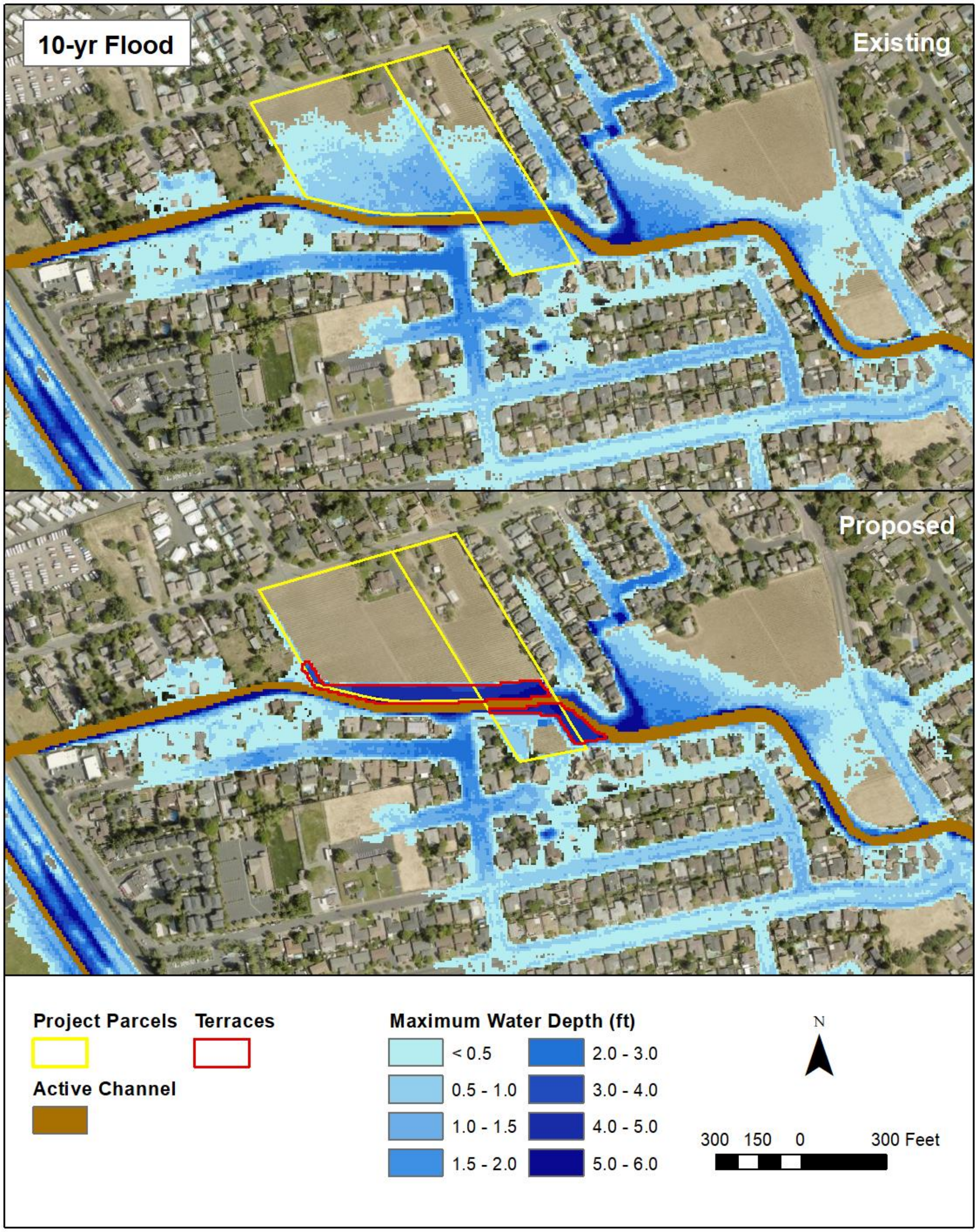

Figure 11: Comparison of existing and proposed 10-yr water depths and inundation extents for Alternative 2.

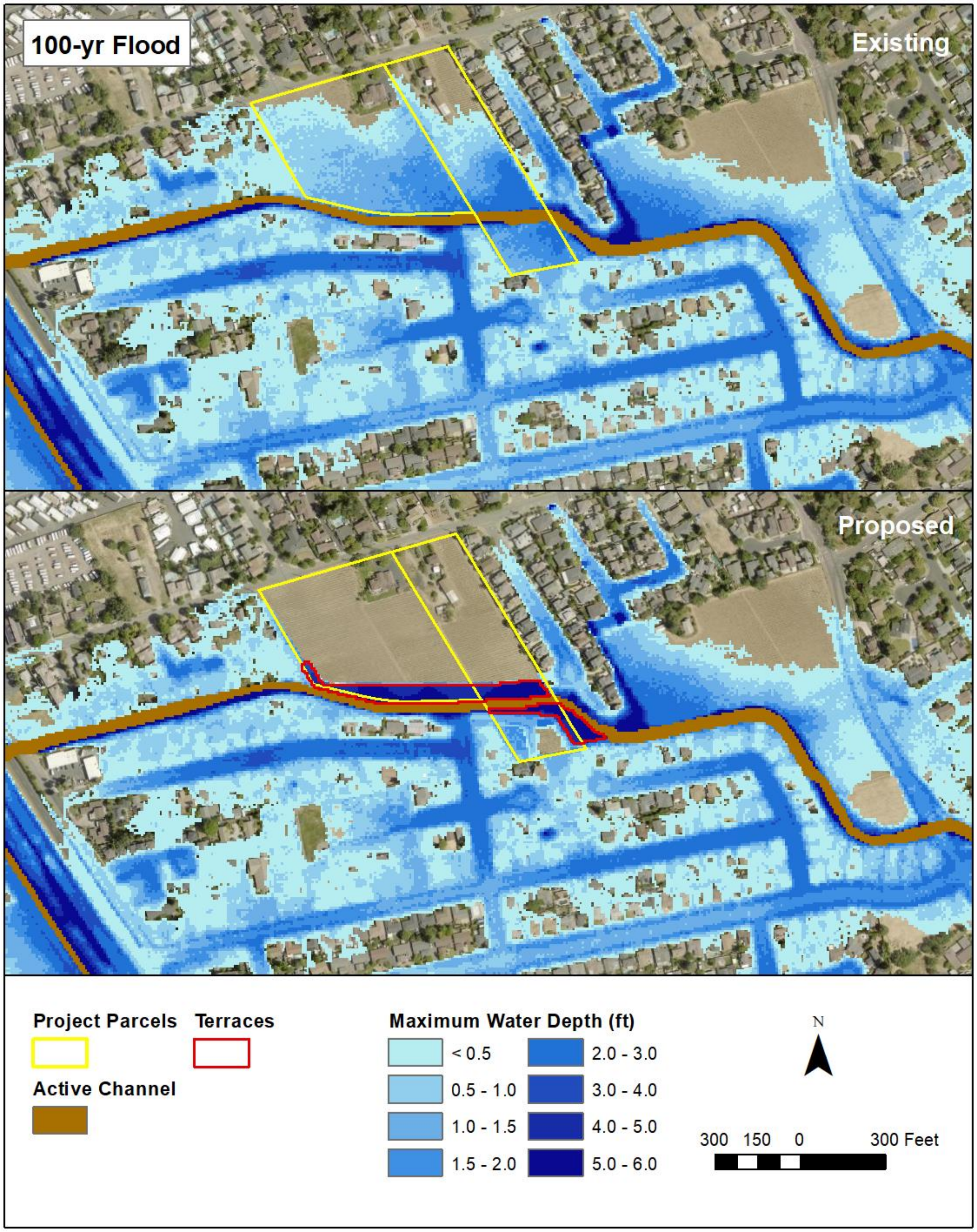

Figure 12: Comparison of existing and proposed 100-yr water depths and inundation extents for Alternative 2.

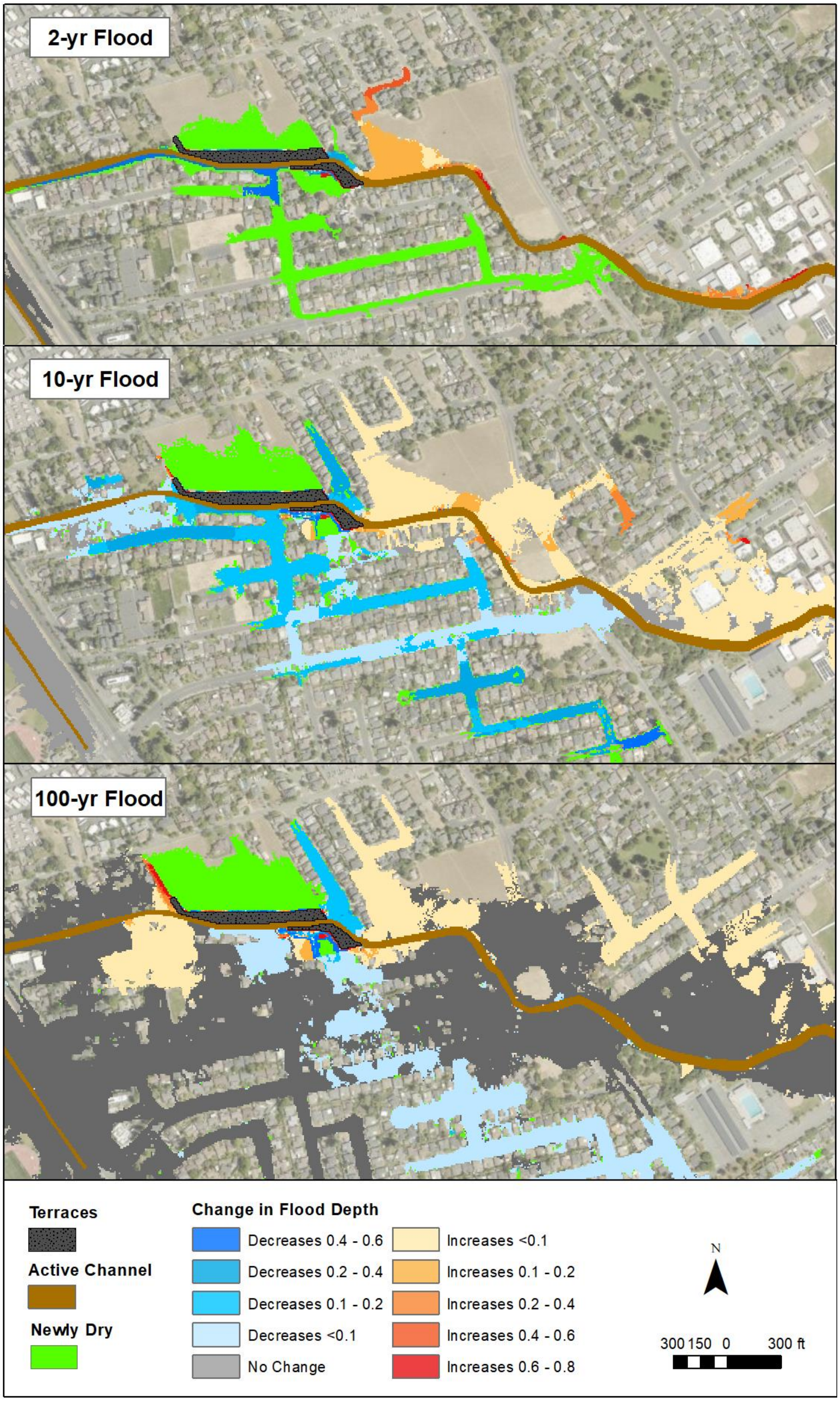

Figure 13: Change in 2-, 10- and 100-yr water depths and inundation extents for Alternative 2 relative to existing conditions.

Discussion & Selection of Preferred Alterative

The modeling analysis reveals several important aspects to the flooding situation along Salvador Creek. Overall, the analysis shows that flooding patterns are highly sensitive to changes in grade or WSEs that affect overbank flows at Lassen Street. The results indicate that these overbank flows are providing some important flood attenuation benefits to the reaches farther downstream, and that any measures that reduce overbank flows and inundation at Lassen Street will be accompanied by increases in WSEs and inundation extents downstream (or vice versa). This is because the channel downstream does not have sufficient capacity to contain increases in flow generated from reduced overbank flow at Lassen. This suggests that in the absence of a comprehensive flood mitigation strategy for the creek that addresses capacity limitations both upstream and downstream of the project reach, this site-specific project should seek to avoid significant reductions in overbank flows at Lassen Street to prevent downstream impacts.

Results for Alternative 1 indicate that filling the development footprint as a stand-alone measure results in significant increases in WSEs and inundation upstream of the project and in the Lassen Street neighborhood. Results for Alternative 2 indicate that pairing the fill with terracing can successfully mitigate these increases. As discussed above, flooding patterns are very sensitive to changes in overbank flows at Lassen Street, and the design does result in some reduction in overbank flows and inundation in the Lassen neighborhood which in turn results in minor increases in flows and inundation in the downstream reaches.

Comparison of the maximum increases in WSEs between the two alternatives reveals that Alternative 2 results in the smallest increases for each of the four simulated events (Tables 1 & 2). Comparison of the mean changes in WSEs reveals that Alternative 1 results in reductions in WSEs for all four events. This result indicates the potential pitfalls of basing decisions on WSE changes alone since the overall reductions are the result of significant increases in flooding in the Lassen neighborhood and the associated reductions in flows downstream. Alternative 2 results in near zero change to the mean WSE for all four events (Table 2).

Alternative 2 has been selected as the preferred alternative because it results in the smallest increases in WSEs for all four events as well as the smallest increases in inundation extents and depths. The degree of terracing represented by the design appears to be near optimal since less terracing would be expected to result in significant increases in WSEs and flooding upstream of the project reach and more terracing would be expected to result in less overbank flow at Lassen Street accompanied by significant increases in flooding downstream.

Though not likely to significantly affect peak riverine flooding or this analysis, it is worth noting that the City of Napa has developed a concept study for stormwater drainage system improvement for the Trower & Lassen area which it is planning to implement. The proposed improvements consist of abandoning five outfalls including one at Lassen Street and re-directing stormwater flows to an existing concrete culvert at Trower and Jefferson. The runoff from the relatively small (compared to total upstream drainage area) drainage areas served by these outfalls is not expected to significantly mitigate peak riverine flooding, however it should help alleviate the frequency of nuisance street flooding during small events and the duration of inundation associated with overtopping at Lassen during larger events.

Erosion and sedimentation considerations associated with Alternative 2, particularly potential sediment deposition on proposed terrace surfaces and potential change of in-channel sediment transport capacity are the subject of a companion geomorphic assessment.

Appendix A - Comparison of water surface elevations in Salvador Creek between existing and proposed preferred alternative (Alternative 2) conditions.

2-yr Flood

		Water Surface Elevation (ft)		
	Station (ft)	Existing	Proposed	Change (ft)
	12503.7	73.91	73.91	0.00
	12480.6	73.89	73.89	0.00
	12328.0	72.33	72.31	-0.02
	12303.7	72.28	72.26	-0.02
	12216.2	72.19	72.17	-0.02
	12025.2	72.09	72.06	-0.03
	11744.5	71.73	71.60	-0.13
Project Reach	11491.6	70.92	70.42	-0.50
	11282.1	70.53	69.99	-0.54
	11246.0	70.45	69.88	-0.57
	11131.4	70.22	69.66	-0.56
	10982.9	69.63	69.22	-0.41
	10844.7	69.13	68.88	-0.25
	10706.5	68.75	68.51	-0.24
	10665.0	68.59	68.44	-0.15
	10591.9	68.01	68.07	0.06
	10545.5	68.01	67.91	-0.10
	10494.5	67.81	67.77	-0.05
	10456.1	67.64	67.65	0.00
	10423.3	67.49	67.58	0.09
	10384.9	67.30	67.45	0.15
	10355.4	67.15	67.34	0.19
	10322.6	67.00	67.18	0.18
	10272.1	66.80	66.96	0.15
	10220.1	66.63	66.76	0.13
	10203.7	66.57	66.72	0.15
	10181.7	66.50	66.66	0.16
	10098.2	66.27	66.44	0.17
	9872.4	65.33	65.55	0.22
	9360.9	62.36	62.64	0.28
	9303.4	62.34	62.62	0.28
	9249.2	61.47	61.74	0.28
	9071.1	61.29	61.57	0.28
	9010.0	61.10	61.38	0.27
	8869.8	60.82	61.10	0.28
	8650.1	60.51	60.78	0.28
	8480.9	58.67	58.89	0.23
	8254.6	58.13	58.35	0.22
	7921.5	57.73	57.94	0.21

<u>10-yr Flood</u>

		Water Surface Elevation (ft)		
	Station (ft)	Existing	Proposed	Change (ft)
	12503.7	75.92	75.92	0.00
	12480.6	75.90	75.90	0.00
	12328.0	73.29	73.27	-0.01
	12303.7	73.22	73.21	-0.01
	12216.2	73.12	73.10	-0.02
	12025.2	72.97	72.96	-0.02
	11744.5	72.55	72.52	-0.03
Project Reach	11491.6	71.35	71.28	-0.07
Project Reach	11282.1	70.96	70.81	-0.16
Project Reach	11246.0	70.87	70.64	-0.23
Project Reach	11131.4	70.63	70.36	-0.27
Project Reach	10982.9	70.05	69.83	-0.23
Project Reach	10844.7	69.60	69.46	-0.14
Project Reach	10706.5	69.27	69.08	-0.18
Project Reach	10665.0	69.14	69.01	-0.12
Project Reach	10591.9	68.71	68.67	-0.04
Project Reach	10545.5	68.55	68.53	-0.02
Project Reach	10494.5	68.39	68.36	-0.03
Project Reach	10456.1	68.25	68.23	-0.02
Project Reach	10423.3	68.13	68.17	0.04
Project Reach	10384.9	67.97	68.03	0.06
Project Reach	10355.4	67.78	67.93	0.14
Project Reach	10322.6	67.66	67.77	0.11
Project Reach	10272.1	67.49	67.57	0.08
Project Reach	10220.1	67.37	67.43	0.05
Project Reach	10203.7	67.33	67.41	0.08
	10181.7	67.28	67.36	0.08
	10098.2	67.10	67.18	0.09
	9872.4	66.41	66.51	0.10
	9360.9	63.89	63.95	0.06
	9303.4	63.88	63.96	0.08
	9249.2	62.85	62.90	0.04
	9071.1	62.71	62.75	0.04
	9010.0	62.52	62.56	0.04
	8869.8	62.27	62.29	0.02
	8650.1	61.85	61.87	0.02
	8480.9	59.66	59.67	0.01
	8254.6	59.11	59.13	0.01
	7921.5	58.69	58.71	0.02

<u>100-yr Flood</u>

		Water Surface Elevation (ft)		
	Station (ft)	Existing	Proposed	Change (ft)
	12503.7	77.57	77.57	0.00
	12480.6	77.56	77.55	0.00
	12328.0	74.24	74.24	0.00
	12303.7	74.12	74.11	-0.01
	12216.2	73.93	73.92	-0.01
	12025.2	73.65	73.66	0.01
	11744.5	73.12	73.12	-0.01
Project Reach	11491.6	71.61	71.66	0.06
Project Reach	11282.1	71.28	71.33	0.06
Project Reach	11246.0	71.17	71.14	-0.03
Project Reach	11131.4	70.95	70.89	-0.06
Project Reach	10982.9	70.48	70.42	-0.06
Project Reach	10844.7	70.14	70.10	-0.04
Project Reach	10706.5	69.86	69.73	-0.13
Project Reach	10665.0	69.73	69.65	-0.08
Project Reach	10591.9	69.34	69.27	-0.07
Project Reach	10545.5	69.17	69.16	0.00
Project Reach	10494.5	69.03	68.98	-0.06
Project Reach	10456.1	68.92	68.84	-0.08
Project Reach	10423.3	68.80	68.78	-0.01
Project Reach	10384.9	68.60	68.62	0.02
Project Reach	10355.4	68.41	68.48	0.07
Project Reach	10322.6	68.21	68.31	0.10
Project Reach	10272.1	68.05	68.08	0.03
Project Reach	10220.1	67.96	67.94	-0.01
Project Reach	10203.7	67.92	67.93	0.01
	10181.7	67.86	67.88	0.02
	10098.2	67.69	67.70	0.01
	9872.4	67.03	67.05	0.02
	9360.9	65.02	65.03	0.01
	9303.4	65.02	65.03	0.01
	9249.2	64.20	64.21	0.01
	9071.1	64.11	64.09	-0.01
	9010.0	63.91	63.91	0.00
	8869.8	63.63	63.63	0.00
	8650.1	62.96	62.97	0.00
	8480.9	60.82	60.82	0.00
	8254.6	60.09	60.09	0.00
	7921.5	59.80	59.80	0.00

Appendix B – Response to June 9, 2021 comments received from River Focus Water Resources Consultants.

1. The preferred Alternative 2 causes a 0.2 to 0.4 ft increase in computed 100-year flood elevations on the north (left overbank) floodplain, immediately upstream of the project, as well as on the south (right overbank) floodplain (see Figure 1). These increases appear to be the result of floodplain flows being blocked by the proposed fill (Figure 2). On the north side, the proposed floodplain terracing tapers off at the upstream end of the project to the point where there is no connection between the upstream floodplain flow and the proposed terracing during the 100-year event.

   Note that the terracing was likely tapered back to the channel because this matches the effective FEMA Zone AE (100-year) floodplain in this area. However, on the upstream side of the development, the existing conditions 100-year floodplain computed by the current study is larger than the effective FEMA floodplain.

   To reduce the increase in flood elevations, some of the floodplain conveyance may have to be preserved (for example, see Figure 3). Alternatively, floodplain relief culverts through the fill, and discharging to the terracing, might be an option. Note: All figures in this review document were taken from the *Hydraulic Analysis* tech memo with annotated comments, labels, and arrows added by River Focus.

Several changes to the Alternative 2 design were made to mitigate the effects of floodplain blockage at the upstream extents of the project area on the north and south banks. On the north bank, the terrace was widened at its upstream end as suggested by River Focus. Additionally, the fill prism was set back 15-ft from the property line such that increases in inundation associated with floodplain flows interacting with the fill will largely be contained on the project parcel. We also investigated using relief culverts to mitigate the north bank increases, however this strategy was not as effective as the adopted terrace changes. On the south bank, the extent of the fill prism was reduced by eliminating the western-most lot and instead lowering the grades in this area. The proposed driveway parallel to the channel was also lowered. The changes on the north side resulted in a decreased area where inundation depth increases extend onto the neighboring parcel to the west. Additional topographic survey was collected surrounding the neighbor's house and the existing and proposed 100-yr WSEs were mapped at a finer scale than is possible using the hydraulic model alone. This exercise reveals that although Alternative 2 does result in the WSE in this area increasing from 70.9-71.9 to 71.3-71.9, neither the exiting nor proposed WSEs are high enough to result in inundation that extends to the edges of the house (Figure A1). The changes on the south side resulted in all increases in inundation depth in excess of 0.1 ft being contained on the project parcels thus fully mitigating against significant off-site impacts.

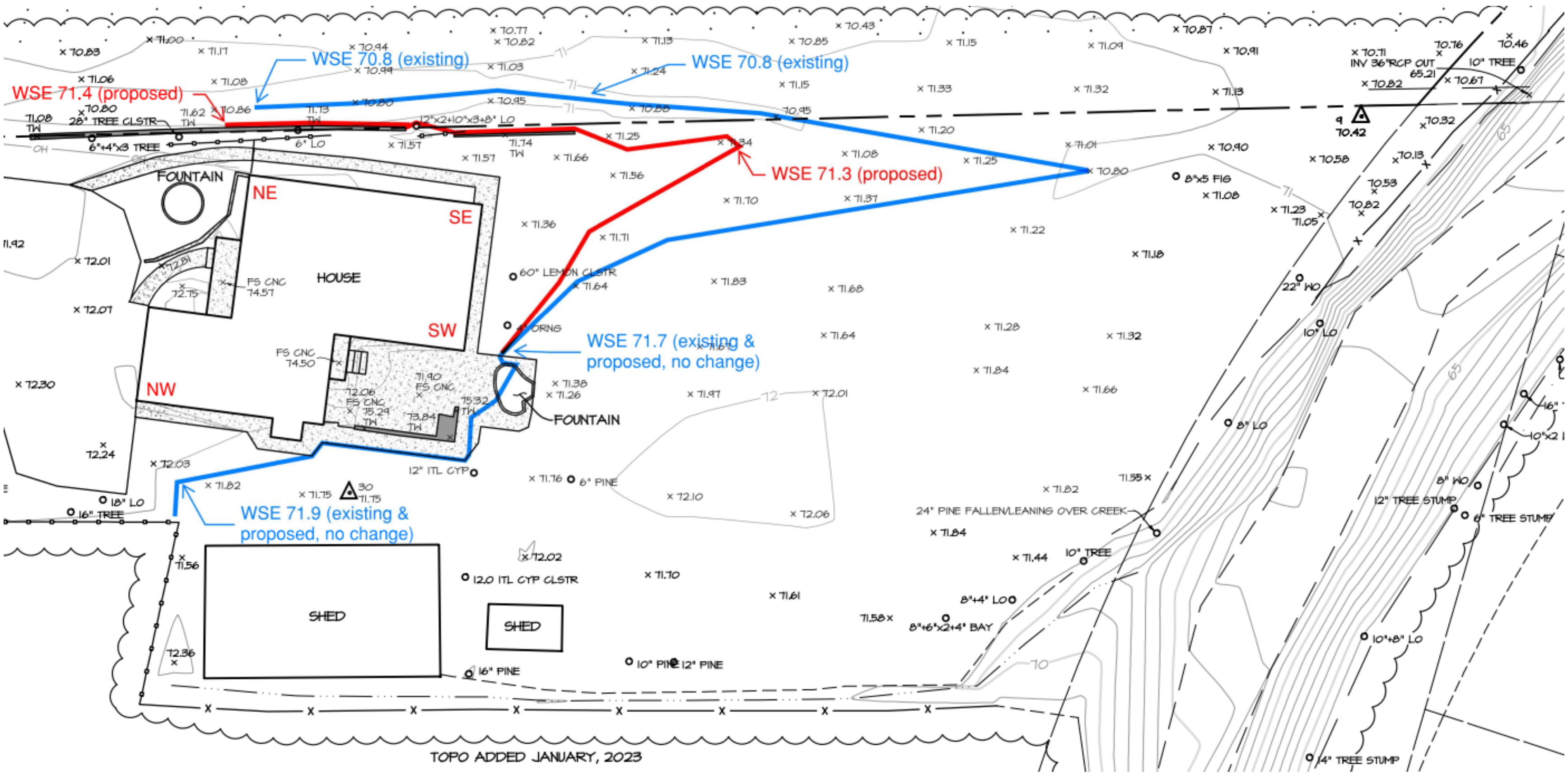

Figure A1: Detailed mapping of existing and proposed WSEs in the vicinity of the house located on the neighboring parcel west of the proposed project on the north side of Salvador Creek.

2. Alternatives 3a and 3b include an elevated pathway (0.5 ft for 3a or 0.9 ft for 3b) to block flow from leaving the channel at Lassen Street. The proposed berm keeps significantly more flow in the channel and causes increased flooding throughout the study reach. Based on a close review of the model results, we believe that Alternative 2 may be a better option for proposed conditions in terms of minimizing offsite flood impacts until a more comprehensive, regional flood reduction solution can be implemented in the future. However, in consultation with the NCFC&WCD, more information is needed to make a definitive conclusion (see comment #3).

We completely agree that Alternative 2 is the preferred option and have eliminated discussion of Alternatives 3a and 3b from the revised hydraulic report for simplicity and because those alternatives resulted in significant increases in flooding.

3. For Alternatives 2 and 3, it is difficult to determine whether the floodplain benefits outweigh the areas where flood depths are increasing. This is because not all increases (and decreases) are alike. For example, flood depth increases on undeveloped land may be more acceptable than increases affecting existing structures. For each recurrence interval event, please provide a comparison of:
    a) The number of insurable structures and the total floodplain area with WSE increases greater than 0.1 ft; and
    b) The number of insurable structures and the total floodplain area with WSE decreases less than 0.1 ft.

The table below provides the requested information for Alternative 2. As discussed above in the response to item #2, Alternative 3 has been removed from consideration due to unacceptable impacts. Changes in floodplain inundation on the proposed project parcels were excluded from the tabulation of floodplain area change to avoid skewing the results. The proposed condition results in reductions in offsite floodplain inundation area for all three flood events. The number of structures with decreases in WSE is greater than the number of structures with increases for all three flood events. The raw model outputs do indicate increases in 100-yr WSEs greater than 0.1 ft in the vicinity of two houses, however additional surveying and more detailed floodplain mapping was performed in the vicinity of the houses which revealed that the finished floor elevations are above both the existing and proposed 100-yr WSEs, therefore these structures were excluded from the table. The detailed mapping for the house upstream of the project on the north bank is discussed above under Item #1 and presented in Figure A1, and the detailed mapping for the other house downstream of the project on the south bank is presented in Figure A2. These statistics clearly show that the project results in a net reduction in flood risk to the surrounding neighborhoods.

	floodplain area (acres)			# of structures		
	increase	decrease	net change	increase	decrease	net change
2-yr	6.9	7.3	-0.4	7	15	-8
10-yr	4.4	13.6	-9.3	11	57	-46
100-yr	0.6	7.4	-6.8	0	2	-2

Figure A2: Surveyed elevations in the vicinity of the houses located downstream of the proposed project on the south side of Salvador Creek (the existing and proposed 100-yr water surface elevations in this reach are 68.1 and 68.2 ft respectively).

4. A Manning's *n* value of 0.08 was selected for the terracing. The report mentions that this value is based on mature vegetation conditions. Please provide additional information on what type of vegetation is planned or expected for the terraces and how that corresponds to the selected *n* value.

The terraces will be planted with native grasses, shrubs, and trees. A detailed riparian restoration plan will be prepared prior to construction. A Manning's *n* value of 0.08 was selected as a 'conservative' value representing the high-end of plausible roughness associated with the proposed planting strategy.

5. Figure 23 of the Hydraulic Analysis tech memo shows the maximum change in WSE for each of the alternatives for each modeled flood event. Please confirm the maximum change values. For example, for preferred Alternative 2 the 100-year max change is shown as 0.1 ft; however, the WSE difference plot (Figure 1 above) shows a max change of 0.2 to 0.4 ft.

The maximum WSE change values reported in Figure 23 of the prior report represent changes within the channel of Salvador Creek as simulated at cross sections within the 1-dimensional component of the model, whereas the changes shown in the WSE difference plots represent changes in inundation on the floodplains as simulated with the 2-dimensional component of the model. In the current report, the maximum changes in the channel and on the floodplain for Alternative 2 are shown in Table 2 and Figure 13 respectively.

6. Overall: The geomorphic analysis provides a well-reasoned analysis of potential stream sedimentation—based on the computed Rouse Number—through the project reach. We do not have any specific comments or suggested revisions on the geomorphic analysis.

No response necessary.

7. The preferred Alternative 2 has additional flow in the main channel downstream of the project, which could have an impact on stream stability. Please provide a discussion—either in the hydraulic analysis or with the geomorphic analysis—of whether any increased velocity or shear stress will adversely impact stream stability given the existing bank vegetation and/or protection. Please include figures showing computed channel velocities and shear stresses for existing and proposed conditions, as well as difference plots. Note: For the velocity and shear stress figures, please do not cover the main/active channel with a brown polygon (as in the flood elevation plots).

As requested, simulated channel velocities and shear stresses for existing and proposed conditions are shown below in Figures A3 and A4. Note, that the channel is simulated using a 1-dimensional formulation which is why the flood elevation plots show the channel as a brown polygon. The polygon is not covering up information but rather is intended to delineate where detailed 2-dimensional information is not available and where results are instead presented as longitudinal profiles.

The velocity and shear stress comparisons reveal that the increased flow in the channel downstream of the project associated with Alternative 2 results in only very minor increases in these parameters. Matt O'Connor performed an additional reconnaissance survey of the creek between Lassen Avenue and Jefferson Avenue on June 1, 2023 to assess existing channel stability and potential vulnerability to erosion. This reconnaissance revealed that much of the right lower bank is armored by a vertical rock revetment about 3 ft or less in height that appears to have been placed in a stable stacked arrangement, probably at the time of construction of the channel. Portions of the left bank are armored by plates of concrete slab that appear to be waste material. These revetments appeared stable; no areas of undermining or failure of revetment were observed.

There was little evidence of significant sediment deposition in the channel of Salvador Creek. There is one substantial gravel bar that was observed in both 2020 and 2023 formed about 200 ft downstream of the private bridge, and it was not particularly large. The sediment deposited on the bar had a median diameter estimated to be 30 mm and the largest clasts were about 100 mm in diameter. A sand deposit along the bank on the bar top had a median diameter estimated to be about 0.5 mm. The general absence of mobile gravel bars in this area reduces the potential bank erosion. The only other gravel bar observed in the survey is at the Jefferson Avenue bridge at the downstream end of the surveyed reach.

The downstream reach has relatively significant woody vegetation canopy in the narrow riparian zone between the adjacent vineyards and subdivisions. The riparian canopy is dominated by young willow and more mature oak trees; the young willow comprises a substantial understory component. The abundance of relatively mature trees is greater on the right bank. The density of shrubs, grasses, and herbaceous plants on the banks is variable. The width of the riparian zone is limited, and the overstory canopy generally extends not more than one crown diameter from either bank.

The density of riparian vegetation is sufficient to provide ground cover and some root reinforcement of soils and generally appears to prevent surface erosion. The density of woody stems and branches in the channel is substantial but not extreme. This density appears to provide some balance between excessive density that could significantly increase flow resistance and sparse or absent woody vegetation that could leave inadequate ground cover and low flow resistance along the banks that could increase the likelihood of erosion.

This reach of Salvador Creek is inhabited by beaver. Four active dams about 3 ft in height were observed during the survey. The upstream most of these is at Lassen Avenue with another active dam about 200 ft downstream near the existing private bridge; these two locations were also occupied by beaver dams in 2020. The next dam downstream is about 850 ft downstream of the private bridge, with another dam about 300 ft further downstream. The presence of beaver is indicative of a reliable food source and perennial flow. It is generally understood that impounded ponds formed upstream of dams promote the growth of willows and other woody plants utilized by beaver. The presence of this beaver population suggests that this reach of Salvador Creek is relatively stable.

Given hydraulic simulations that indicate very little change in velocity and bed shear stress in Salvador Creek with the proposed project and the observed channel conditions, the proposed project does not pose a substantial risk of destabilizing this reach of Salvador Creek.

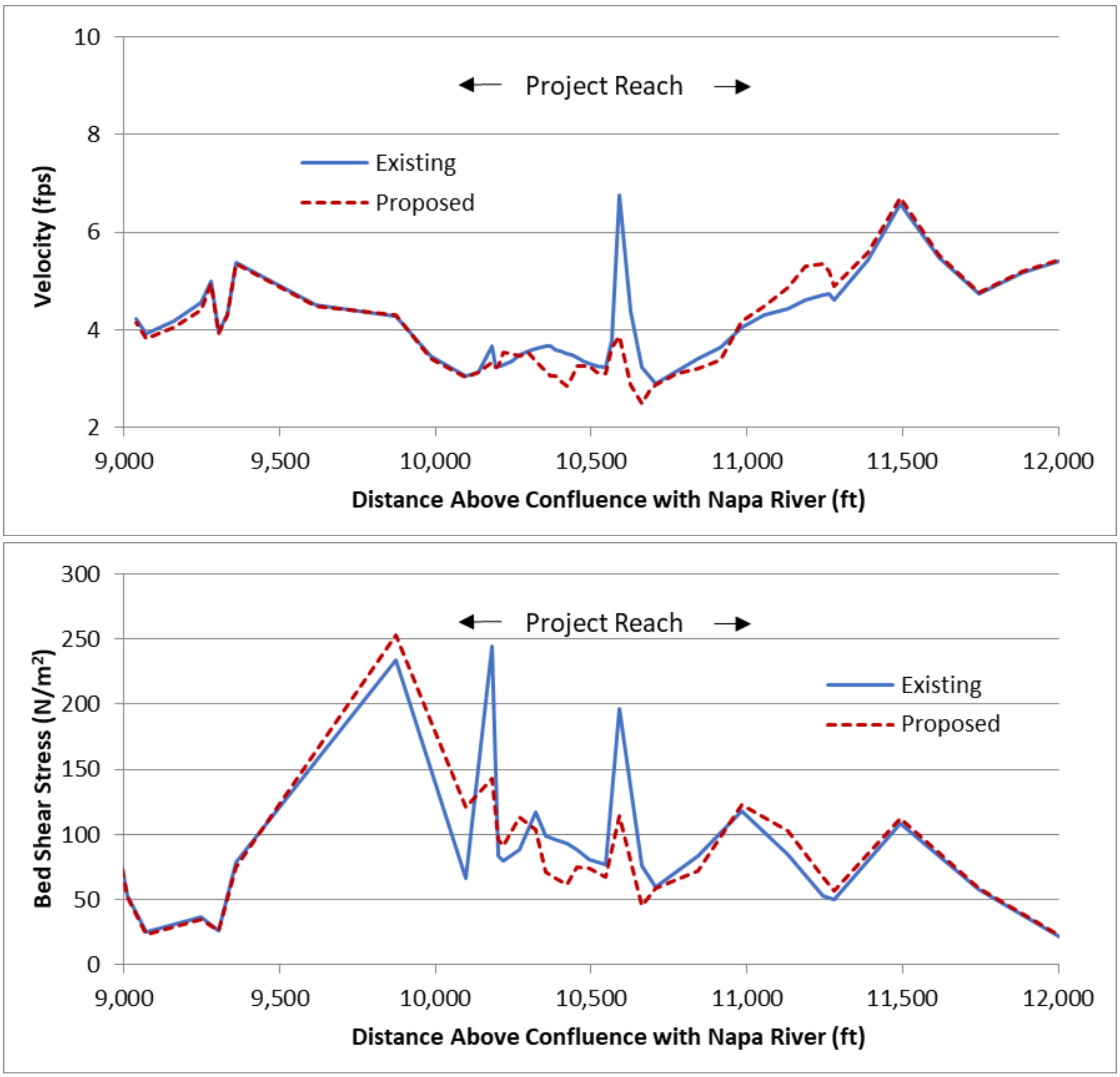

Figure A3: Comparison of existing and proposed velocities (top) and shear stresses (bottom) for the 10-yr flood.

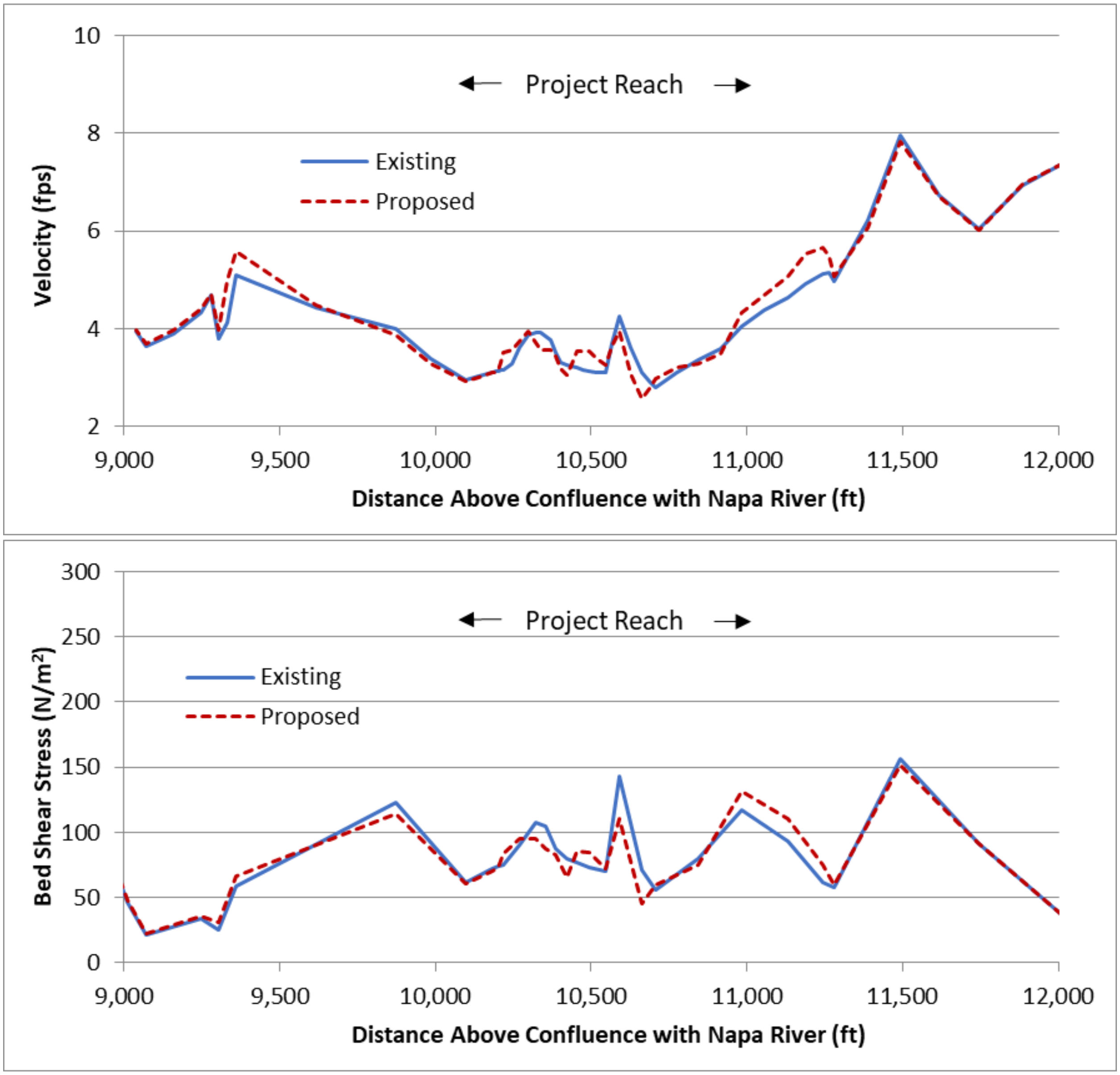

Figure A4: Comparison of existing and proposed velocities (top) and shear stresses (bottom) for the 100-yr flood.

8. Please provide velocity and shear stress results for the terraces and fill slopes along the terraces and verify that no additional protection is required.

The requested results are provided below in Figures A5 & A6. Maximum velocities and shear stresses on the terraces are ~2.3 fps and 35 N/m^2 respectively. These values indicate that additional protection beyond the planned planting of native grasses, shrubs, and trees is not necessary. Maximum velocities and shear stresses on the side slopes leading down to the terraces are ~7.2 fps and 100 N/m^2 respectively. These values indicate that these fill slopes do require additional protection in the form of 9-in d_{50} or larger rock rip-rap which will be incorporated in the final design plans.

9. Where floodplain flows are returning to the channel at the upstream end of the project (see Figure 4), the likelihood of bank erosion may increase. Please examine proposed vs. existing velocity and shear stresses specifically in this area.

Floodplain velocities and shear stresses are both quite low in the area where floodplain flows return to the channel at the upstream end of the project on the north side of the creek (Figures A5 & A6) and there aren't significant increases in channel velocities associated with the project in this area (Figures A3 & A4), therefore increases in bank erosion are not likely to occur in this area and additional bank protection is unnecessary.

10. We reviewed selected MIKE 11 and MIKE 21 models for the project and the model parameters look reasonable. The only model revisions needed will be based on design changes required by any of the previous comments.

No response necessary.

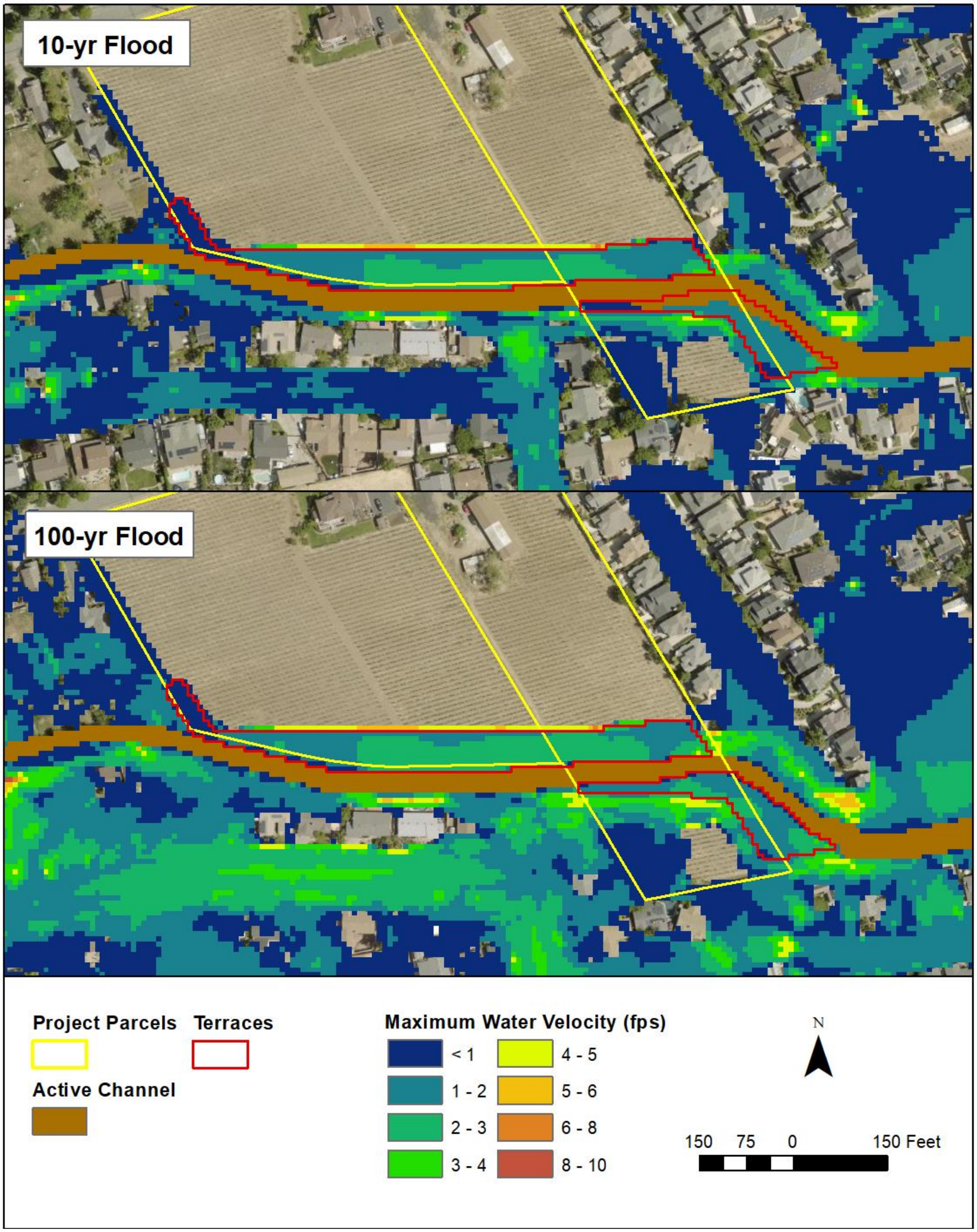

Figure A5: Proposed velocities for the 10-yr (top) and 100-yr (bottom) floods.

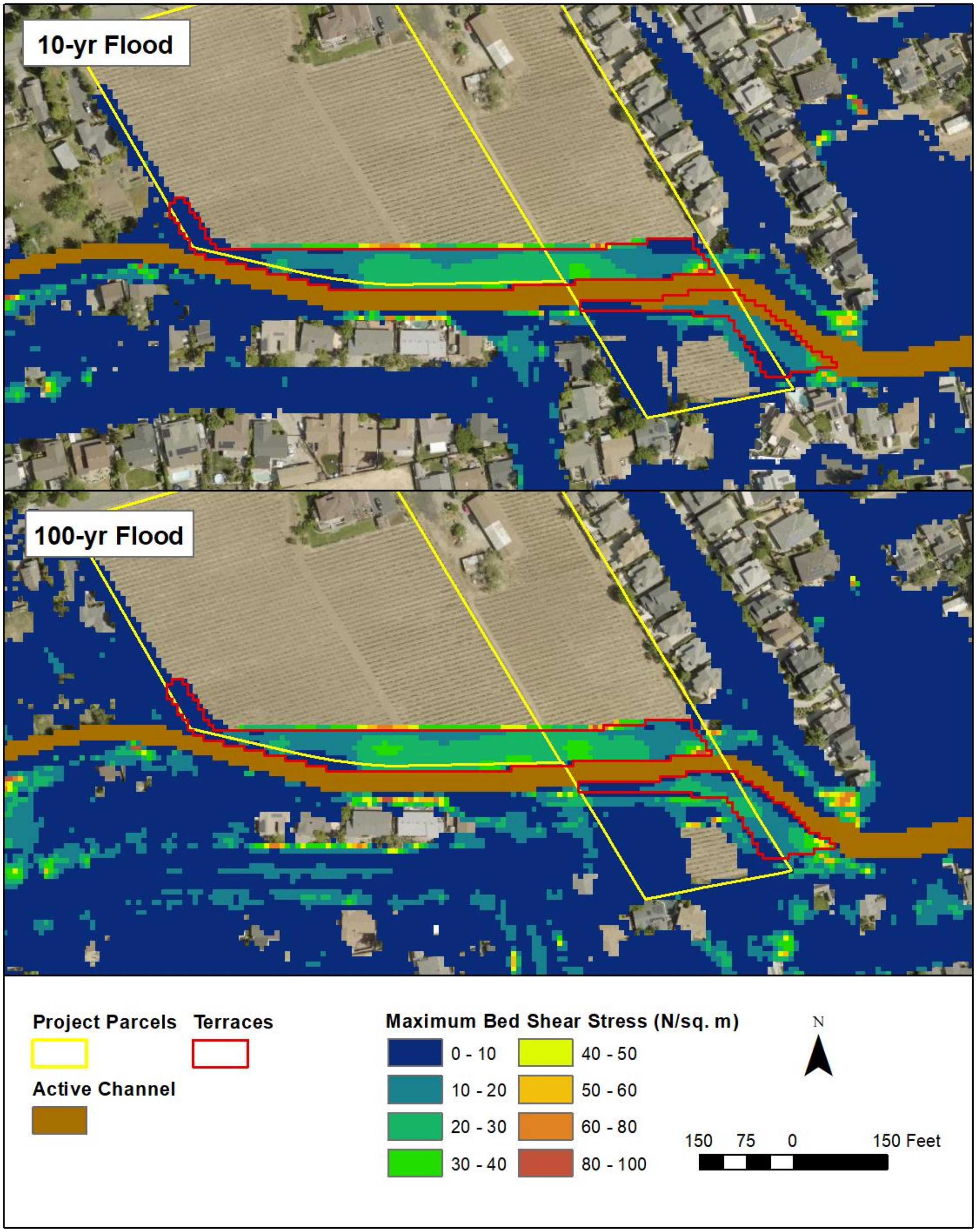

Figure A6: Proposed shear stresses for the 10-yr (top) and 100-yr (bottom) floods.