Marin County Flood Control and Water Conservation District

FLOOD CONTROL ZONE 4

ADVISORY BOARD

PUBLIC MEETING

Tuesday, July 25, 2023

6:30 P.M. – 8:00 P.M.

Findlay Hall, Westminster Presbyterian Church
240 Tiburon Blvd, Tiburon CA 94920

The Marin County Flood Control & Water Conservation District Board of Supervisors encourages a respectful dialogue that supports freedom of speech and values diversity of opinion. Advisory Board members, staff and the public are expected to be polite and courteous, and refrain from questioning the character or motives of others. Please help create an atmosphere of respect by not booing, whistling or clapping; by adhering to speaking time limits; and by silencing your cell phone.

The Advisory Board may elect to take formal action on any of the items listed below.

AGENDA

Item	Description
1.	Approval of Meeting Minutes: April 25, 2023 ***Recommended Action**: Approve minutes*
2.	Evaluation of Channel Capacity Improvement Options at East and West Creek *See attached Draft Tech Memo: Task 2 and Task 3 Flood Risk Reduction Alternative Development. Geomorph Design will provide a presentation at the meeting. The presentation will include diagrams and preliminary cost estimates. These documents will be finalized based on feedback from the advisory board and brought back at the October 2023 Zone 4 Advisory Board meeting.*
3.	Greenwood Bay Condominiums Seawall Project *The Greenwood Bay HOA will have an opportunity to share information about this project with the Advisory Board.*
4.	Open Time for Items Not on the Agenda *While members of the public are welcome to address the Advisory Board, under the Brown Act Board members may not deliberate or take action on items not on the agenda, and generally may only listen.*
5.	Next Meeting *October 24, 2023*

GUIDELINES FOR TIME LIMITS ON PRESENTATION AND PUBLIC TESTIMONY

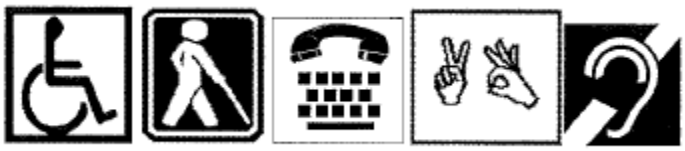
The Flood Control Zone Advisory Board meeting procedure and time limit guidelines are as follows:

1. Flood Control District staff report. — 10 minutes per item
2. Advisory Board questions to staff. — No defined limit
3. Public Testimony. — 3 minutes per speaker

How to Provide Public Comment *(All comments will be entered into the public record.)***:**
Before the Meeting: Email comments to floodinquiry@marincounty.org no later than 2pm on January 25 including a name and the agenda item number being responded to; if the comment is general include "Agenda Item 2 – Open Time for Items Not on the Agenda".

4. Deliberation by the Advisory Board. — No defined limit
5. Decision by Board. — No defined limit

Agendas and related material can be viewed at the office of the Marin County Department of Public Works (Marin County Civic Center, Room 304, located at 3501 Civic Center Drive, San Rafael) Monday through Friday, between the hours of 8:00 a.m. and 4:30 p.m. A copy of the agenda can be faxed or emailed upon request by calling (415) 473-6528. Agendas and related material are also available online at http://www.marinflooddistrict.org**.**



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Marin County Flood Control and Water Conservation District

DRAFT MINUTES OF THE FLOOD CONTROL ZONE 4 ADVISORY BOARD MEETING HELD WEDNESDAY APRIL 25, 2023 HELD AT THE STRAWBERRY RECREATION DISTRICT

Advisory Board (AB) Members Present	**District Staff (Staff) Present**
Kathryn Oliver (KO) – Chairperson	Hannah Lee, Senior Civil Engineer
Sheldon Dorph (SD)	Jennifer Imbimbo, District 3 Supervisor's Aide
Timothy Barteau (TB) – Vice Chairperson	Tracy Clay, Principal Civil Engineer
Liza Bass (LB)	Berenice Davidson, Assistant Director
Carolyn Shadan (CS)	**Dignitaries Present**
	Stephanie Moulton-Peters, District 3 Supervisor
	Jack Ryan, Mayor, Town of Tiburon

Item 1. Approval of Meeting Minutes: October 25, 2022 and January 25, 2023

Action by Board: Approve minutes.

M/S: TB/SD; **Ayes:** All

Item 2. Open Time for Items Not on the Agenda

Comments from two people were received. The AB asked that a discussion on Greenwood Cove be placed on a future agenda.

Item 3. Storm Report

See staff report. Staff added that even in the absence of a storm, high tides can come up between Greenwood Cove Drive and Tiburon Blvd. Staff is coordinating with Caltrans regarding potential options to reduce this "sunny day" flooding. If Zone 4 would provide wetland enhancement as mitigation for loss of the poor-quality wetland vegetation between the two roads it may open up an opportunity for Caltrans to implement an option that would help Greenwood Cove Drive. The AB was supportive of this idea.

AB asked for Roger Leventhal to come to a future meeting to present on sea level rise barrier options from the Richardson's Bay Shoreline Study and answer questions they have about his project at Aramburu Island.

AB asked to put on a future agenda a discussion of a watershed plan. The work of Item 4 below, which focuses above Tiburon Blvd, can be expanded for the development of such a plan. All the problems in the watersheds should be described and prioritized.

Item 4. Evaluation of Channel Capacity Improvement Options at East and West Creek

See staff report. Additionally, staff provided a short preview of very preliminary findings of this evaluation. A full report will be provided at the July 25, 2023 meeting.

There was a brief presentation by Zone 4 resident John Leszczynski on East Creek, including a graphic of East Creek and the Cove pump station (attached). He shared an idea to reconfigure

the discharge pipes from Cove Pump Station to help flush sediment out of the culverts under Tiburon Blvd. Though sedimentation within the pipes is not known, there is some visible sediment in and around their 52" diameter outfalls in the bay.

Item 5. Annual and Preventive Maintenance Work Program

There was no presentation or discussion on this item. See staff report.

Item 6. Zone 4 and 4A FY 2023-24 Proposed Baseline Budgets

There was a question regarding whether there was funding available for the Greenwood Cove seawall currently being designed and permitted by the HOA. A discussion on that topic will be part of a future agenda.

Action by Board: Recommend the Board of Supervisors approve the FY 23-24 baseline budgets for Flood Zone 4 and Flood Zone 4A.

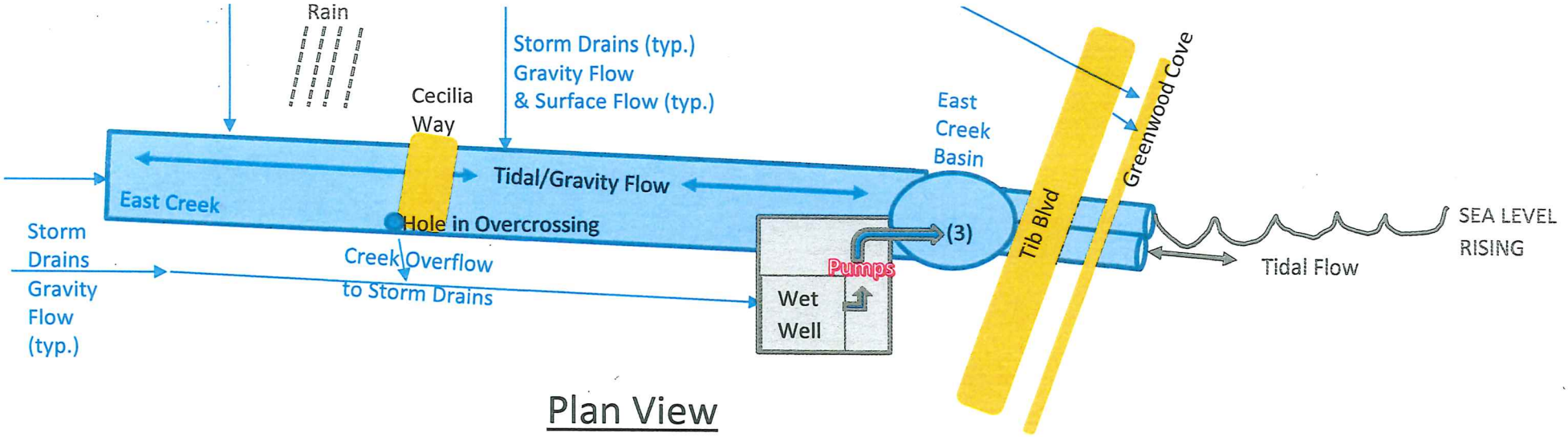
M/S: CS/TB; **Ayes:** All

Item 7. Potential Boundary Adjustment(s)

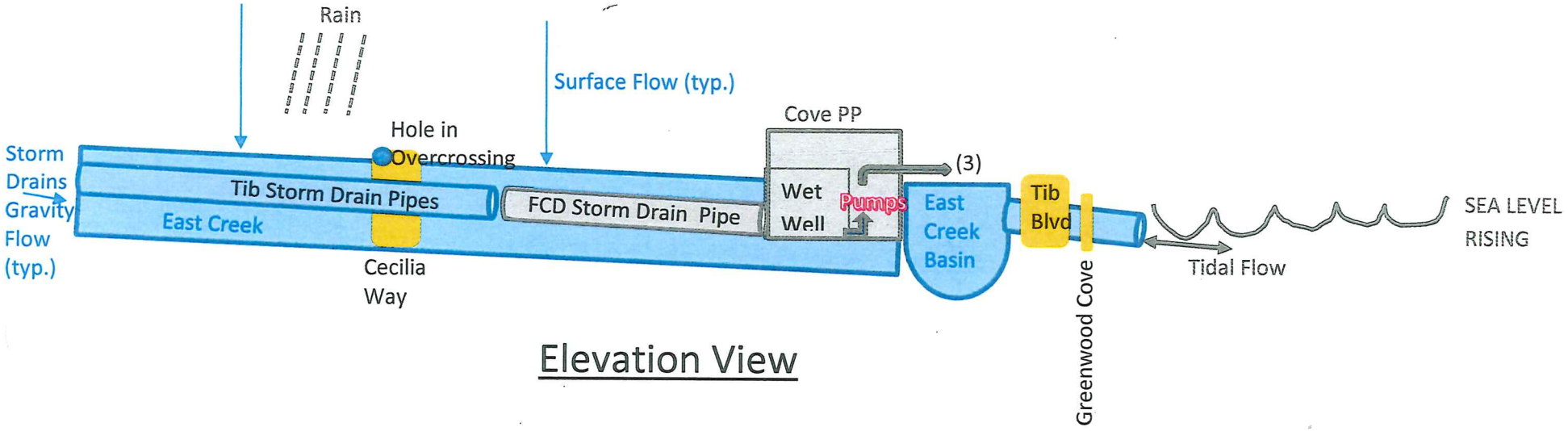
See staff report. AB members emphasized that parcels, even high in the watershed, should not be removed from the zone.

Item 8. Schedule Next Meeting

The next advisory board meeting is July 25th. Advisory Board members asked to consider Westminster Presbyterian Church and Bel Aire School as potential venues.



Plan View



Elevation View

Looking upstream to East Creek from near STA 1+50' to RBSD sanitary sewer pipe crossing (December 16, 2022).

Preliminary Flood Risk Reduction Alternatives

Marin County Flood Control & Water Conservation District Zone 4
East Creek & West Creek
Tiburon, California
July 18, 2023

geomorph DESIGN

Prepared by:
Matt Smeltzer, P.E.
Engineer/Geomorphologist
CA Civil Engineer #71671

1. Introduction

This preliminary Tech Memo report documents Geomorph Design Group's (GDG's) Task 2 and Task 3 work re. flood risk reduction design alternatives for East Creek and West Creek in Tiburon, CA (Marin County Flood Control & Water Conservation District Flood Zone 4).

In Task 2, GDG used the new existing conditions hydraulic models developed in Task 1, to evaluate potential flood risk reduction benefits of implementing certain sets of roadway and utility crossing infrastructure modification or replacement projects.

In Task 3, GDG built upon the Task 2 findings to assemble sets of flood risk reduction measures as preliminary recommended "Minimum", "Medium", and "Maximum" flood risk reduction alternatives for each creek. Planning-level implementation cost estimates are presented for each alternative to facilitate alternatives analysis by the Flood Zone 4 Advisory Board, beginning with a presentation of these materials at the scheduled July 25 Advisory Board meeting.

1.1 Background

In Summer 2022, the Marin County Flood Control & Water Conservation District (District) furnished the original HEC-RAS models prepared by Kamman Hydrology & Engineering, Inc. for East Creek and West Creek. According to the available model documentation, the original East Creek model was produced using March 2017 survey data, and the West Creek model was produced with a combination of 2006 and 2008 survey data. GDG used the original models with minor adaptations in August 2022 to generally evaluate effectiveness of potential flood risk reduction measures for presenting findings and recommendations to the Zone 4 Advisory Board in September 2022. Simulations with those original models indicated that the effectiveness and sustainability of potential in-channel flood flow capacity improvements depends substantially on the configuration of roadway and utility crossing infrastructure features owned and operated by key stakeholders, including Town of Tiburon, Cal-Trans, and Richardson Bay Sanitary District (RBSD).

The Advisory Board directed District staff to develop "design alternatives" for each creek, ranging from Minimum Plan (i.e., repeat channel clearing and other maintenance measures similar to *status quo*) to Maximum Plan (e.g., heavy-equipment implemented channel enlargement combined with modification or replacement of certain key roadway and utility crossing infrastructure features).

To develop these design alternatives for Advisory Board consideration, GDG began with Task 1 work in December 2022 to survey new channel cross-sections at key locations for updating

the original existing conditions hydraulic models. See the Task 1 Tech Memo and Task 1 Survey Maps documenting the new updated existing conditions models.

Task 2 work used the updated existing conditions hydraulic models to evaluate the effectiveness of modifying or replacing certain of the roadway and utility crossing infrastructure features (culverts, bridges, sanitary sewer pipeline crossings) as a first design alternatives screening step, in coordination with stakeholders.

Task 3 work used detailed hydraulic model plan simulations to develop preliminary recommended "Minimum", "Medium", and "Maximum" Plans for both creeks. In July 2023, these will be presented to the Advisory Board in a customized "cost-benefit" framework for the Board's evaluation and decision-making to guide future Zone 4 flood risk reduction work.

Task 2 Existing Conditions East Creek Crossing Infrastructure

Crossing	Stakeholder	Description
Greenwood Cove Dr	County of Marin	Two 60" CMP culverts slip-lined with 52" HDPE plastic pipes all or part of the approx. 280-ft-long distance from the north edge of Greenwood Cove Drive to outfall in Richardson Bay (Photo 1)
SR 131 (Tiburon Blvd)	CalTrans	Two approx. 120-ft-long 66" RCP culverts extending from the vertical concrete headwall at north edge of Tiburon Blvd to two 36" RCP risers between Tiburon Blvd and Greenwood Cove Drive (Photo 2)
Grouted Rock Channel	RBSD	Approx. 180-ft-long grouted rock rip-rap lined channel transitioning from the grouted section at the overhead sewer crossing downstream to the Tiburon Blvd culvert headwall (Photo 3)
Sanitary Sewer Crossing	RBSD	Overhead sewer pipeline crossing with narrow, elevated grouted rock channel section (4.7' invert) (Cover Photo, Photo 4)
Cecilia Way	Town of Tiburon	Approx. 30-ft-long 5'x10' concrete box culvert (6.9' culvert invert) with approx. 25-ft-long 10-ft-wide open concrete rectangular channel transition upstream and overhead sanitary sewer pipe crossing (Photo 5) (Photo 9

Photo 1. East Creek. Looking downstream to the original double-barrel 60" CMPs outfalling in Richardson Bay near Station -3+95' (January 19, 2023).

Photo 2. East Creek. Looking downstream from right bank of the grouted rock channel to the vertical concrete headwall inlet to the State Route 131 66" RCP "double-barrel" at Station 0+00' (December 16, 2022).

Photo 3. East Creek. Looking downstream from Control Point 1 near Station 1+55' to Lower East Creek. The grouted rock-lined channel extends from the sanitary sewer crossing near Station 1+80' to the State Route 131 "double-barrel" culverts headwall seen in background of view at Station 0+00' (December 16, 2022).

Photo 4. East Creek. Looking from left bank to right bank along the sanitary sewer crossing near Station 1+80' and narrow grouted rock channel with 4.7' invert on the pipeline section (December 16, 2022). See also cover photo.

Photo 5. East Creek. Looking downstream from inlet to the 10-ft-wide open concrete box culvert and overhead sanitary sewer pipe crossing to 5'x10' Cecilia Way concrete box culvert downstream in background of view (August 3, 2022).

Task 2 Existing Conditions West Creek Crossing Infrastructure

Crossing	Stakeholder	Description
SR 131 (Tiburon Blvd)	Cal-Trans	Two approx. 180-ft-long 60" CMP culverts extending from the vertical concrete headwall at north edge of Tiburon Blvd to constructed natural open channel downstream from Tiburon Blvd (Photo 6)
Cecilia Way	Town of Tiburon	Approx. 50-ft-long 5.3'x11.4' concrete box culvert (5.4' culvert invert) with narrow natural channel transitioning into culvert inlet (Photo 7)

Photo 6. West Creek. Looking from left bank to outlet of two 60" CMP culverts (in foreground) outfalling to open natural channel downstream from Tiburon Boulevard (August 3, 2022).

Photo 7. West Creek. Looking upstream to outlet of the Cecilia Way 5.3'x11.4' concrete box culvert (August 17, 2022). Note there is about 2-3 ft of fine sediment deposited within the downstream part of the culvert but much less sediment deposited in the upstream part of the culvert. This is the natural, unmaintained condition.

Photo 8. East Creek. Looking upstream to the outlet of culverts originating at or upstream from Karen Way (December 16, 2022). This is the maintained condition following channel maintenance dredging completed in October 2022. Note sedimentation near the culvert outfalls that occurred during November and December rainstorms.

Photo 9. East Creek. Looking upstream to the outlet of Cecilia Way culvert (December 16, 2022). This is the maintained condition following channel maintenance dredging completed in October 2022. None or negligible sedimentation occurred downstream form Cecilia Way culvert during November and December rainstorms.

Photo 10. East Creek. View of the East Creek culvert outfalls in Richardson Bay near Station -3+95' (see also Photo 1). The original double-barrel 60" CMPs appear to have been slip-lined with 52" HDPE plastic pipe culverts (January 19, 2023).

2. Task 2 East Creek Crossing Infrastructure Survey Notes

On December 16, 2022, GDG surveyed East Creek crossing infrastructure from the State Route 131 culvert headwall (at Station 0+00') (Photo 2) to the upstream end of Upper East Creek at the culvert outfalls downstream from Karen Way (near Station 15+00') (Photo 8).

On January 19, 2023, during a low, low tide, GDG surveyed the East Creek culvert outfalls in Richardson Bay (Photo 1) (near Station minus 3+95') about 400 feet downstream from the culvert inlets at Station 0+00'. According to Cal-Trans as-built design plans furnished by the District, the State Route 131 "double-barrel" culverts were originally 60"-diameter corrugated metal pipes (CMPs) that were later upgraded to the current existing 66"-diameter reinforced concrete pipes (RCPs). Near Station -1+20' the 66" RCPs join with separate culverts run the approximately 275-foot remainder of the distance under Greenwood Cove Drive right-of-way and the easement to the Richardson Bay outfalls (Photo 2).

These downstream culverts were also originally 60"-diameter CMPs. At the outfall they were measured to be 52" thick-smooth-walled HDPE plastic pipes (PPs) (Photo 10). It has not been confirmed if the 60" CMPs were slip-lined with the 52" PPs all the way upstream to the junction with the 66" RCPs, or if there are remainder segments of the original 60" CMPs downstream from the Cal-Trans Right-of-Way.

Photo 11. Looking downstream to the grade-controlling channel-spanning concrete stormwater outfall forming a headcut-step on Upper West Creek near Station 11+60' (January 19, 2023).

Cecilia Way East Creek culvert was surveyed by Kamman Hydrology & Engineering (KHE) in March 2017 for producing culvert geometry contained in the original East Creek existing conditions HEC-RAS model. GDG used these culvert geometry data for the new updated existing conditions model.

3. Task 2 West Creek Crossing Infrastructure Survey Notes

On January 19, 2023, GDG GPS-surveyed Lower West Creek culvert inlet and outlet invert elevations of the approx. 180-ft-long double-barrel 60"-diameter CMP State Route 131 culverts (Photo 6), including the inverts and limits of the sackrete-lined 90-degree bending transition structure upstream from the culvert inlets.

Cecilia Way West Creek culvert was surveyed by Kamman Hydrology & Engineering (KHE) in March 2006 or 2008 for producing culvert geometry contained in the original West Creek existing conditions HEC-RAS model. GDG used these culvert geometry data for the new updated existing conditions model, after adjusting the elevations up approximately 2.3 feet to best-fit adjust the original models to NAVD88 elevation datum (see Task 1 Memo for more information).

GDG GPS-surveyed the bed elevations from the downstream end of the Tiburon Boulevard culverts (near Station minus 1+80') to the upstream end of Lower West Creek (near Station 5+80'), and Total Station-surveyed new channel cross-sections and channel bed and bank features in Upper West Creek including multiple flow-blocking in-channel trees, and the channel-spanning concrete stormwater outfall apron forming a headcut-step near Station 11+60' (Photo 11).

See Tech Memo 1 and Task 1 survey data maps for more complete information about the December 2022 – January 2023 surveys and development of the adapted original and updated new existing conditions models.

4. Task 3 Hydraulic Model Evaluation – East Creek

To evaluate flood risk reduction measures for East Creek, the model-computed 50-year flood water surface elevations (WSEs) are compared to the in-model designated "levee" flood elevations at selected floodprone locations (model cross-sections). The selected floodprone locations for East Creek are upstream from Cecilia Way Culvert:

- Cross-Section 17 (Station 8+16') near the property line between 100 and 106 Leland Way. The designated "levee" elevation indicating the initiation of potential damaging flooding set in the model at the surveyed 12.28-ft (NAVD88) top of bank elevation formed by the redwood tree burl.

- Cross-Section 18 (Station 8+81') near the property line between 106 and 112 Leland Way. The designated "levee" elevation indicating the initiation of potential backyard

flooding set in the model at the surveyed 12.01-ft (NAVD88) top of bank elevation formed by the natural ground elevation at this location.

- Cross-Section 19 (Station 9+40') near the property line between 112 and 118 Leland Way. The designated "levee" elevation indicating the initiation of potential backyard flooding set in the model at the surveyed 12.07-ft (NAVD88) top of bank elevation formed by the natural ground elevation at this location.

- Cross-Section 23 (Station 11+86') near the property line between 136 and 142 Leland Way. The designated "levee" elevation indicating the initiation of potential backyard flooding set in the model 20' landward of the top of bank fence line at Cross-Section 23 is 13.02 feet (NAVD88).

Finished floor elevations and crawlspace utilities elevations and rear yard ground elevations were not surveyed for Harriet Way, Cecilia Way, or Leland Way residential buildings for evaluating potential for structure flooding of primary and accessory buildings.

4.1. East Creek Minimum Plan. *Status Quo*. District continues current program of periodic as needed vegetation and sediment removal from accessible reaches and according to the current permitted extents downstream and upstream from Cecilia Way culvert. The implementation cost of the Minimum Plan is similar to the current ongoing channel maintenance and permit management cost.

At Cross-Sections 17-19:

- The Minimum Plan produces model-computed 50-year WSEs ranging from 12.49 ft to 12.55 ft for the recently maintained condition, same as the updated new existing conditions model (Plan 28).
    - *The Minimum Plan 50-year WSEs are about 0.2-0.6 feet higher than the estimated ground elevation at the initiation of backyard flooding at 100, 106, and 112 Leland Way.*

- After vegetation naturally reestablishes and sediment deposits in the channel, cyclically, and immediately prior to implementing repeat channel maintenance, the Minimum Plan "Pre-Maintenance" Condition (Plan 35) produces model-computed 50-year WSEs ranging 12.83 ft to 12.94.
    - *The Minimum Plan Pre-Maintenance Condition 50-year WSEs are about 0.6-0.9 ft higher than the estimated ground elevation at initiation of backyard flooding at 100, 106, and 112 Leland Way.*

At Cross-Section 23:

- The Minimum Plan produces a model-computed 12.89-ft 50-year WSE for the recently maintained condition, same as the updated new existing conditions model (Plan 28).
  - *The Minimum Plan 50-year WSE is about 0.1 feet less than the estimated ground elevation at the initiation of backyard flooding at 136 Leland Way.*

- After vegetation naturally reestablishes and sediment deposits in the channel, cyclically, and immediately prior to implementing repeat channel maintenance, the Minimum Plan "Pre-Maintenance" Condition (Plan 35) produces a model-computed 13.38-ft 50-year WSE.
  - *The Minimum Plan Pre-Maintenance Condition 50-year WSE is about 0.4 higher than the estimated ground elevation at the initiation of backyard flooding at 136 Leland Way.*

Task 3 Flood Risk Reduction Alternatives for East Creek
Model-Computed 50-Year Water Surface Elevations at Floodprone Locations
(Red numbers indicate potential inundation.)

Plan	Scenario	#1 Replace 52" Culverts	#2 Modify SS Xing & Channel Inlet	#3 Replace Cecilia Way Culvert	50-yr WSE at Station 8+16' (CS 17) (ft) "Levee" 12.28	50-yr WSE at Station 8+81' (CS 18) (ft) "Levee" 12.01	50-yr WSE at Station 9+40' (CS 19) (ft) "Levee" 12.07	50-yr WSE at Station 11+86' (CS 23) (ft) "Levee" 13.02
29	Orig. Exist Cond				13.37	13.39	13.40	13.51
28	New Exist Cond [1]				12.49	12.54	12.55	12.89
35	"Pre-Maintenance"				12.83	12.89	12.94	13.38
28	Minimum Plan [1]				12.49	12.54	12.55	12.89
32	Medium Plan				11.89	11.96	12.00	12.51
37	Medium+1				11.84	11.91	11.95	12.48
33	Medium+3				11.68	11.76	11.82	12.41
34	Medium+1+3				11.64	11.72	11.78	12.41
38	Medium+2				11.72	11.80	11.85	12.42
39	Medium+1+2				11.63	11.72	11.77	12.38
41	Medium+2+3				11.34	11.40	11.48	12.25
40	Medium+1+2+3				11.20	11.28	11.37	12.21

[1] Post-Maintenance Condition.

4.1.1 East Creek Minimum Plan Summary

In the first season after channel maintenance activities are completed, the *status quo* Minimum Plan produces 50-year WSEs that appear to be less than the ground elevations around the perimeter of the primary residential structures along Leland Way but may exceed ground elevations in the rear-yard area of certain Leland Way properties nearer to Cecilia Way, such as 100, 106, and 112 Leland Way, potentially producing shallow inundation as may marginally affect accessory structures.

As vegetation reestablishes and sediment redeposits in the channel after each maintenance event, the WSE-reducing benefits of maintenance dissipate. Model-simulations of "no maintenance" conditions reestablished immediately prior to implementing channel maintenance work, show that computed 50-year WSEs may cause shallow backyard inundation at 136 Leland Way and inundation depths exceeding 0.5 feet at 100, 106, and 112 Leland Way. Presumably shallow nuisance backyard flooding may occur at the intervening Leland Way properties.

These East Creek flood water surface elevations also temporarily prevent gravity runoff of on-site stormwater from these affected properties, increasing reliance on direction of stormwater runoff to the Leland Way – Cecilia Way stormwater drainage system, and mechanical pumped drains and sumps to reduce surface inundation and high groundwater levels.

For the Minimum Plan, for both the post-maintenance and pre-maintenance conditions, the computed 100-year WSEs are about 0.5 feet higher than the computed 50-year WSEs.

4.2. East Creek Medium Plan. Flood risk reduction would be improved over the *status quo* Minimum Plan, and the cycling between its "post-maintenance" and "pre-maintenance" conditions described in Section 4.1, if natural vegetation establishment and sediment deposition after channel maintenance would be delayed and/or reduced in extent.

For the Medium Plan, the District optimizes efficacy of channel maintenance by obtaining new individual project environmental permits to one-time extend the normal channel maintenance sediment removal an additional approximately 220-250 feet downstream from its current permitted limit. The one-time "dredging" work – the "East Creek Restoration Project" – would extend through the 50 and 80 Harriet Way properties to "restore" an adequate width and depth channel sloped 0.3% over the 510 feet from the Cecilia Way culvert concrete floor elevation to the grouted channel bed invert at the RBSD sanitary sewer crossing. The restored channel would not be severely deepened and widened so as to require engineered retaining walls or rip-rap slope protection. Rather, the restored channel would have natural bedrock banks and moderately sloped alluvial soil banks suitable for vegetated biotechnical bank erosion protection.

The Medium Plan would also implement one-time removal of sediment from within the Cecilia Way concrete box culvert and the open concrete box culvert transition upstream from the culvert, and from within the tree-covered natural channel reach upstream from the concrete channel to produce "completely dredged" conditions and the maximum feasible 0.3%-sloped channel over the 1,320-foot-long reach from the Karen Way culverts, through the concrete-bottom Cecilia Way culvert, to the RBSD sewer crossing grouted rock channel section.

District would monitor vegetation establishment and sediment deposition following restoration of the "completely dredged" condition to determine if and what ongoing channel maintenance sediment and vegetation removal activities would be required to maintain plan effectiveness over time.

At Cross-Sections 17-19:

- The Medium Plan produces model-computed 50-year WSEs ranging from 12.89 ft to 12.00 ft (Plan 32).
    - *The Medium Plan 50-year WSEs are about 0.1-0.3 lower than the estimated ground elevation at the initiation of backyard flooding at 100, 106, and 112 Leland Way.*

At Cross-Section 23:

- The Medium Plan produces a model-computed 12.51-ft 50-year WSE (Plan 32).
    - *The Medium Plan 50-year WSE is about 0.5 feet less than the estimated ground elevation at the initiation of backyard flooding at 136 Leland Way.*

4.2.1 East Creek Medium Plan Summary

The Medium Plan produces 50-year WSEs less than the model-designated ground elevations at the initiation of backyard flooding along the entire length of East Creek.

The Medium Plan restores a "completely dredged" 1,320-ft-long adequate width-and-depth channel at the maximum 0.3% slope from the Karen Way culvert outfalls, through the 6.9-ft elevation concrete floor of the Cecilia Way box culvert, to the 4.7-ft elevation grouted concrete channel invert at the RBSD SS crossing.

The model-simulated Medium Plan WSEs are for completely dredged conditions immediately following the channel restoration work. If monitoring shows excessive in-channel vegetation establishment and channel sedimentation reduces the Medium Plan flood risk reduction

below an acceptable level, the District would then consider routine periodic channel maintenance, or obtaining separate environmental permits to establish an in-channel "sediment basin" immediately downstream from the Karen Way culvert outfalls accessed via the east side access road ramp. The excavator-maintained basin would intercept the majority of the coarser fraction of sediment delivered to the reach through the Karen Way culverts to help maintain the 0.3%-sloped channel condition downstream. A sedimentation basin may have a lower average annual maintenance cost and produce less environmental disruption than reach-scale vegetation and sediment removal.

Another option for buffering the potential effects of vegetation in-channel vegetation establishment and channel sedimentation on Medium Plan performance would be installing a permanent top of bank flood barrier along the rear of 100, 106, and 112 Leland Way (see discussion in Section 4.2.2. below).

For the Medium Plan, the computed 100-year WSEs are about 0.5 feet higher than the computed 50-year WSEs.

4.2.2 Option to Restore the Top of Bank Barrier

There is an existing 345-ft-long 24"-high wood wall "flood barrier" extending along the top of bank of East Creek along the rear of 100, 106, 112, 118, 124, and 130 Leland Way. The wall appears to be more than about 20 years old. It is constructed from two horizontal courses of treated 2"x12" timber planks fixed to vertical treated 4"x4" pier posts. The pier depth and foundation type is unknown, but generally appears shallow, hand-dug. The wall may have been subsequently backfilled with soil at Cross-Sections 20, 21, and 22 (118, 124, and 130 Leland Way). The wall is in failed condition and, being discontinuous, with variable top wall elevations, it does not appear to prevent creek bank overflows. Therefore, any potential residual "flood barrier" effect of the wall was neglected in the hydraulic model computations.

However, the Minimum Plan 50-year and 100-year WSEs and the Medium Plan 100-year WSEs are higher than the top of bank elevations near the base of the wall along 100, 106, and 112 Leland Way. It appears to be feasible to restore the downstream 200-240 lineal feet of the top of bank flood barrier to provide added flood risk reduction for these properties. A potential preliminary schematic design for a more permanently stable and effective version of the restored barrier would be a "waterproof fence" similar to the existing failed wood wall: two courses of double horizontal PTDF 2"x12" planks sandwiching heavy-mil waterproof membrane fixed to PTDF 4"x4" piers on 8-ft centers, set in 8" diameter drilled pier holes to minimum 6-ft below finished grade and backfilled with concrete. Actual design of an engineered District-implemented top of bank flood barrier would require topographic surveying on landward of the top of bank fencing and site-scale design evaluation. Construction of the flood barrier would require District to acquire new easements donated by the property owners for construction and maintenance as flood control infrastructure. There

may be construction conflicts with existing trees and accessory buildings/foundations requiring customized construction or selected tree removals.

One potential advantage of adding the permanent top of bank flood barrier to the East Creek Medium Plan is the added protection buffers against effects of vegetation establishment and sediment deposition should it be determined that the Medium Plan depends on repeat channel maintenance and/or maintaining a sedimentation basin near the Karen Way culvert outfalls. Theoretically, the permanent top of bank flood barrier could replace or eliminate the potential need for repeat channel maintenance on East Creek for maintaining the lowest possible flood flow water surface elevations.

The surcharges could also likely be mitigated with relatively low-cost residential scale work to replace the existing failed 24" high wood wall flood barrier with a similar residential-scale constructed barrier, such as a similar wall, a landscape berm, seeded rope-staked coir, or waterproofing the bottom of existing accessory buildings and fencing with waterproof membrane and row of sandbags, etc.

4.3. East Creek Maximum Plan. Add to the Medium Plan one or more of the following three potential channel roadway/utility crossing infrastructure modification/replacement projects:

#1. Replace the approximately 275-ft-long 52"-diameter culverts in the County Right-of-Way and easement between State Route 131 (Tiburon Boulevard) and the Richardson Bay outfall with 66"-diameter culverts (matching the diameter of the culverts under Tiburon Blvd).

#2. Modify Richardson Bay Sanitary District's grouted rock-lined channel inlet at the Sanitary Sewer overhead crossing to widen and lower the channel bed, as would likely require new replacement steel-reinforced concrete abutments and foundations for the sewer pipe. Extend the "Lower East Creek Restoration Project" downstream to smoothly conform channel bed elevations with the lower channel inlet.

#3. Replace Cecilia Way Culvert and concrete transition channel with a wider natural bottom channel formed by new pier-supported vertical concrete retaining walls clear-spanned by a new roadway bridge deck. The natural creek bottom would presumably self-set at a lower bed elevation than the existing box culvert concrete floor.

4.3.1 East Creek Maximum Plan Summary

Hydraulic model simulations show that adding any combination of the three infrastructure upgrade projects would not substantially reduce the flood water surface elevations in the most floodprone parts of East Creek.

First, simulations show that adding any of the three infrastructure upgrade projects alone to the Medium Plan (e.g., Plan 37, Plan 33, Plan 38) would not reduce the 50-year WSE at:

- Cross-Section 23 by more than about 0.1 feet;
- Cross-Sections 17-19 by more than about 0.2 feet.

Upgrading the 52"-diameter outfall culverts to 66"-diameter culverts (Plan 37) would reduce the 50-yr WSE by about 2.3 ft immediately upstream from the culvert inlet headwall on the north side of Tiburon Boulevard. But the WSE reduction would not be substantial upstream from the elevated narrow grouted rock-lined channel inlet at RBSD sewer crossing, and diminishes to just 0.03 ft at Cross-Section 23 and just 0.04-0.05 ft at Cross-Sections 17-19.

Simulations show that the WSE reduction caused by upgrading the 52"-diameter outfall culverts to 66"-diameter culverts would extend farther upstream if the RBSD sanitary sewer crossing were also modified to lower and widen the grouted rock-lined channel inlet (Plan 39). The reduction would be improved as much as 1.7' upstream from the sewer crossing bordering 50 Harriet Way, but the reduction diminishes upstream to be unsubstantial upstream from Cecilia Way culvert, and only about 0.1 ft (0.13 ft) at Cross-Section 23 and about 0.23-0.26 ft at Cross-Sections 17-19.

Plan 40 ("Medium+1+2+3") would also replace the Cecilia Way box culvert with a wider clear-span bridge over a natural bottom channel with a lower self-setting bed elevation (i.e., implementing all three potential crossing infrastructure upgrade projects). Plan 40 includes simulation of lower bed elevations naturally establishing through upper and lower East Creek at 0.4% bed slope (increased from 0.3%) resulting from eliminating the elevated grouted channel bed at the sewer crossing and the concrete channel bed at Cecilia Way. The Plan 40 computed 50-year WSE would be reduced by about 0.3 ft at Cross-Section 23 compared to the Medium Plan (from the 12.51-ft Plan 37 Medium Plan WSE to 12.21-ft Plan 40 WSE). Plan 40 would reduce the 50-year WSE about 0.62-0.69 ft at Cross-Sections 17-19. The computed 100-year WSE would be reduced at Cross-Section 23 by about 0.4 ft at Cross-Section 23 compared to the Medium Plan (from the 12.88-ft Plan 37 Medium Plan WSE to 12.49-ft Plan 40 WSE).

5. Task 3 Hydraulic Model Evaluation – West Creek

To evaluate flood risk reduction measures for West Creek, the hydraulic model-computed 50-year flood water surface elevations (WSEs) are compared to the in-model designated "levee" ground elevation at initiation of flooding at selected floodprone locations (model cross-sections). Preliminary hydraulic model analysis of existing conditions shows that there may be nearly floodprone locations along the left bank at upstream end of Lower West Creek, and several potentially floodprone locations along the left bank of Upper West Creek.

Model-Identified West Creek Floodprone Backyard Locations

Cross-Section	Station	Location	"Levee" Gd Elev (ft)
"X-Section 23"	Station 5+54'	Lower West Creek 10-ft landward from LB fence line at 242 Cecilia Way	9.98
Cross-Section 59	Station 8+19'	Upper West Creek Top of left bank at 113 Blackfield Drive	12.28
Cross-Section 66	Station 10+40'	Upper West Creek 10-ft landward from LB fence line at P/L btwn 137 & 131 Blackfield Drive	13.37
Cross-Section 68	Station 11+03'	Upper West Creek Top of left bank at P/L btwn 143 & 137 Blackfield Drive	13.08
Cross-Section 72	Station 12+23'	Upper West Creek 10-ft landward from LB fence line at P/L btwn 155 & 149 Blackfield Drive	14.90
"X-Section 6"	Station 13+28'	Upper West Creek Top of left bank at 161 Blackfield Drive	15.86

Lower West Creek. 50-year WSEs may exceed the ground elevations at the fence line along the rear of 242 Cecilia Way, 75 Pamela Ct, and 85 Pamela Ct, but do not appear to exceed the ground elevations at the mid-yard area or along the perimeter of the primary residential structures on those properties. According to anecdotal reports, Pamela Court residents may

experience stormwater entering properties from Pamela Court frontage rather than Lower West Creek. Excessive stormwater on Pamela Court could result from Upper West Creek overflowing through Blackfield Drive residences onto Blackfield Drive, if the flows exceed the inlet capacity of storm drain inlets near the Blackfield-Cecilia intersection, or those inlets are blocked by debris or otherwise surcharged. Performance of the street network stormwater drainage systems was not evaluated by this study.

Upper West Creek. 50-year WSEs may exceed the ground elevations at the top of bank or fence line along the rear of several Blackfield Drive properties. Blackfield Drive property land typically slopes down from the rear yard fence line at the top of creek bank to the front yard on Blackfield Drive. Therefore, overbank flows would tend to pass through the properties onto Blackfield Drive thence be captured in storm drain inlets along the curb near the Blackfield-Cecilia intersection, if those inlets are not blocked by debris or otherwise surcharged.

West of the creek, 50-year WSEs may exceed the ground elevations at the rear of 150 Rancho Drive by about 0.1′ at Cross-Section 66 (Station 10+40′), but do not appear to exceed the ground elevations at the perimeter of the residential structure. Otherwise, the ground elevations in the rear yards of Rancho Drive properties appear to have been built-up high enough above the existing grade on the utility easement access roadway to not be floodprone.

Finished floor elevations and crawlspace utilities elevations were not surveyed for Pamela Court, Blackfield Drive, or Rancho Drive residential buildings for evaluating potential for primarily residential or rear-yard accessory building structure flooding.

To evaluate flood risk reduction measures, the model-computed 50-year WSEs at selected floodprone backyard locations are compared to the designated "levee" flood elevations set in the model to represent the initiation of creek overflow at those locations.

5.1. West Creek Minimum Plan. Historically, the District has periodically removed fine gravelly-sand channel bed material from the downstream side of Cecilia Way culvert using an excavator operated from the roadway. The natural self-setting channel bed elevation on the downstream side of the culvert is about 6 ft (NAVD88), which is about 2 feet higher than the 4.1-ft concrete floor elevation of the Cecilia Way box culvert outlet (Photo 7). About 10 cubic yards (1 standard dump truck load) of gravelly sand bed material can be removed from the 12-ft-wide channel bed to produce a 2-ft-deep excavation within the 10-ft reach of the excavator bucket.

However, hydraulic model simulations show that the flood risk reduction benefits of sediment removal are more perceived than real. The model-computed 50-year WSEs are unchanged by

the 10-CY excavation and assuming clear conditions within the culvert (Minimum Plan 0, Plan 50). This is because the conveyance capacity of the very narrow Upper West Creek is much less than the 5.3'x11.4 box culvert. Creek flow accelerates through the narrow natural channel as its falls steeply into the culvert inlet, scouring all sediment and larger debris off of the concrete channel floor to where it naturally deposits within the culvert outlet as the flow decelerates within the relatively wide culvert. The near-critical velocity flows immediately upstream from the culvert inlet prevent any culvert capacity improvements from reducing flood water surface elevations along Upper West Creek.

Moreover, the 10-CY excavation would be refilled by sediment before a 25-year or larger flood peak occurs. According to regional averages, the average annual natural supply of gravelly-sand bedload sediment delivered by the approximately 0.25-square mile West Creek watershed exceeds 100 CY/year. It may be as low as 10-20 CY in years with lower-than-average winter storm flows, but it likely exceeds 500 CY in years with 25-year or larger peak flows. Therefore, the excavation would be refilled by natural sediment transported to the culvert by the first few to several small winter storms, collectively, or by the first moderate or average annual sized storm. Certainly, it would be refilled completely during the beginning and before the peak of any flood flow that would may overbank flooding.

To reduce 50-year flood water surface elevations at floodprone locations along West Creek, channel maintenance work needs to remove blockages and produce lower bed elevations on a long reach-scale:

#2. Remove Rubble from Lower West Creek. Remove foreign rock and broken concrete rubble pieces blanketing the Lower West Creek channel to reduce reach-scale bed elevations with hand-work and without grading the channel bed and banks or reducing stability of channel banks on private properties (see Minimum Plan 1 below).

#4. Remove Rubble from Upper West Creek. Remove foreign rock and broken concrete rubble pieces jammed along the narrow Upper West Creek channel bed to reduce reach-scale bed elevations with hand-work facilitated by heavy equipment on the access road and erosion protection repairs with 100% biodegradable fabrics and rolls (see Minimum Plan 2 below).

No trees would be removed by the West Creek Minimum Plan 1 or Minimum Plan 2.

5.1.1 West Creek Minimum Plan 1. Remove Rubble from Lower West Creek (#2). Theoretically, the 6-ft self-setting channel bed elevation downstream from Cecilia Way culvert is artificially high due to the prevalence of loose broken concrete rubble and foreign rock rip-rap pieces covering the width of the channel bed downstream from Cecilia Way culvert (Photo 12). Rubble and rock pieces issued out of failed bank erosion protection structures over decades has been transported by high peak flows (such as the December 31, 2005 flood)

and deposited on the channel bed upstream from the sackrete-lined 90-degree bend, generally forming a 9-12" thick armor from Station 1+10' to Station 3+80'. If the District were to amend the current channel maintenance permit or obtain a new individual project permit to implement a one-time measure to remove all of the loose rock and rubble materials exposed on the channel bed in this reach, it would reduce the bed elevations by about 8-10" in the reach, and potentially lead to a 6" lower self-setting bed elevation at the culvert outlet.

Photo 12. Lower West Creek. Looking upstream from Lower West Creek channel bed near Station 3+00' to the broken concrete rubble covered channel bed (August 17, 2022).

Photo 13. Lower West Creek. Looking downstream from the Lower West Creek channel bed near Station 4+10' to the lightweight foreign rubble deposited upstream from the rubble covered channel bed downstream, and evidence of recent natural tendency channel bed downcutting limited by coarse foreign material on the bed (August 17, 2022).

Minimum Plan 1 simulates removal of loose concrete rubble and foreign rock rip-rap pieces from Lower West Creek between sackrete transition structure (Station 1+04') to upstream end of rubble dominated reach (Station 3+96'), specifically hand-work to remove 8-10" thickness of material from the 6-ft average width channel bed over this 300-ft-long reach (50 CY). The

self-setting bed elevation upstream from the rubble covered reach between Station 4+00' (Photo 13) and the downstream face of Cecilia Way culvert is reduced from about 6 ft to about 5.5 ft, and the culvert depth-block is reduced from 2 ft to 1.5 ft.

Hydraulic model simulations of Minimum Plan 1 (Plan 46) indicate that the 50-year WSE would be reduced by up to about 0.25 feet along the length of Lower West Creek, diminishing to about 0.2 ft (0.18 ft) at Station 5+54', about 60 feet downstream from the Cecilia Way culvert. Minimum Plan 1 does not change the computed water surface elevations in Upper West Creek due to the narrow channel accelerated flows immediately upstream from the culvert inlet, as discussed above.

5.1.2 West Creek Minimum Plan 2. Also Remove Rubble from Upper West Creek (#4) There are numerous smaller deposits of loose foreign rock and broken concrete rubble jammed in the narrow Upper West Creek channel bed. Theoretically, if District were to remove those rubble deposits, combined with the 50 CY of rubble removal on Lower West Creek, the flood WSE reduction realized by Minimum Plan 1 would extend upstream through the narrow channel upstream from the culvert.

Minimum Plan 2 simulates hand-work-only removal of rubble from Upper West Creek channel bed and minor local hand-work bed and bank erosion protection to repair bank surfaces disturbed by the rubble removal. Specifically, removing an 8-12" thickness of rubble and foreign rock on the channel bed where it occurs, and assumes the channel bed elevation with self-set about 6-8" lower in intervening areas. Ground disturbance caused by removing tightly jammed rubble deposits may require removal of 0.5-1.5-ft thicknesses of bank material 3-4-ft high above the channel bed, to reshaped the lower bank in places, as would be restored by placement of 100% biodegradable erosion protection fabric and rope-staked *carex*-seeded coir logs.

Work may be expedited using an excavator operated from the top of bank access road to bucket materials out of the creek. Hand-workers would place the materials by hand into the bucket, and the excavator would place them in trucks on the access road for off-haul and disposal. The plan simulates minor channel restoration work extending about 400 ft from Cecilia Way culvert inlet area upstream to Station 11+03' (Cross-Section 68). Hand-work to remove average 9" average thickness of material from 3-ft average width channel bed and 9" average thickness over 3-ft-high bank segments comprising approximately 125 lineal ft of the total 400-ft-long reach (45 CY).

Hydraulic model simulations of Minimum Plan 2 (Plan 47) indicate that the 50-year WSE would be reduced by up to about 0.2 feet along the length of Upper West Creek, increasing locally to about 0.4 feet at Cross-Section 68 (Station 11+03'). However, the improvements would not reduce the WSE upstream from the existing channel-spanning concrete

stormwater outfall apron near Station 11+39', because the weir crest type grade-control formed by that outfall controls the WSE profile upstream.

Task 3 Flood Risk Reduction Alternatives for West Creek
Model-Computed 50-Year Water Surface Elevations at Floodprone Locations
(Red numbers indicate potential inundation.)

Plan	Scenario	50-yr WSE at Station 5+54' (XS-23) (ft) Left Levee 9.98 ft	50-yr WSE at Station 8+19' (CS 59) (ft) Left Levee 12.28 ft	50-yr WSE at Station 10+40' (CS 66) (ft) Left Levee 13.08 ft	50-yr WSE at Station 11+03' (CS 68) (ft) Left Levee 13.85 ft	50-yr WSE at Station 12+23' (CS 72) (ft) Left Levee 14.90 ft	50-yr WSE at Station 13+28' (XS-6) (ft) Left Levee 15.86 ft
44	**Orig. Exist Cond**	9.99	11.85	13.16	13.43	14.52	15.84
45	**New Exist Cond**	9.92	12.77	13.49	14.20	15.26	16.54
50	**Minimum Plan 0**	9.92	"	"	"	"	"
46	**Minimum Plan 1**	9.74	"	"	"	"	"
47	**Minimum Plan 2**	9.74	12.56	13.32	13.80	"	"
49	**Maximum Plan Min-1**	9.72	"	"	"	"	"
51	**Maximum Plan Min-2**	9.73	"	"	"	"	"
52	**Maximum Plan Min-3**	"	"	"	"	"	"
48	**Medium Plan 1**	9.74	"	"	13.55	14.07	15.78
53	**Medium Plan 2-1**	"	"	"	"	"	"
54	**Medium Plan 2-2**	"	12.47	13.29	13.54	14.06	"
55	**Medium Plan 2-3**	"	12.41	13.27	13.52	"	"
56	**Medium Plan 2-4**	"	12.16	13.21	13.49	14.04	"
57	**Medium Plan 2-5**	"	"	13.17	13.47	14.03	"
58	**Medium Plan 2-6**	"	"	"	"	"	"
62	**Medium Plan 3-1**	"	11.81	13.11	13.44	14.02	"
63	**Medium Plan 3-2**	"	11.70	13.10	"	"	"
64	**Maximum Plan Med-1**	9.71	"	"	"	"	"
65	**Maximum Plan Med-2**	9.74	11.67	13.10	"	"	"
66	**Maximum Plan Med-3**	9.71	"	13.09	"	"	"

5.1.3 West Creek Minimum Plan Summary

Minimum Plan 0 is not recommended because the flood risk reduction benefits are insignificant.

Minimum Plan 1 is not recommended because the benefits do not extend upstream from Cecilia Way where most of the floodprone locations occur.

Under Minimum Plan 2, District would obtain new individual environmental permits and implement one-time hand-work to remove about 100 CY of foreign rock and concrete materials accumulated in places along the length of the channel bed in an approximately 300-ft long of Lower West Creek and an approximately 400-ft-long reach of Upper West Creek. Minimum Plan 2 would achieve a modest flood risk reduction benefit, generally reducing the 50-year flood flow water surface elevation by about 0.25 ft. The relatively inexpensive maintenance work would also naturalize West Creek. No tree removals are part of Minimum Plan 2.

Minimum Plan 2 would lower the 50-year WSE at 3 of the 5 floodprone locations identified along Upper West Creek, but the computed WSE at 4 of the 5 locations would remain higher than the surveyed ground elevation at the top of bank, indicating overflow from the channel left bank onto Blackfield Drive properties.

5.2. West Creek Medium Plan.

To further reduce computed 50-year WSEs at all of the 5 identified floodprone locations, District would need to implement additional, more expensive channel conveyance capacity measures along Upper West Creek. District would obtain new individual environmental permits to implement certain of these additional measures along with the Minimum Plan 2 measures, as a single, stand-alone creek restoration project:

#5. Remove Concrete Stormwater Outfall. Removing the existing grade-controlling channel-spanning concrete stormwater outfall apron near Station and replacing it with an adequate width and depth rock-lined channel and associated biotechnical bank erosion protection upstream and downstream would reduce 50-year WSEs upstream from Station 11+39' including floodprone locations near Station 12+23' and Station 13+28'.

#6. Remove In-Channel Trees. Removing certain in-channel trees that detailed hydraulic modeling shows would reduce 50-year WSEs at floodprone locations throughout the reach by reducing blockage of creek flows.

#7. Stabilize Creek Banks to Enlarge Channel at Removed In-Channel Trees. Removing stumps of removed channel bank rooted trees will destabilize the channel bank. Repairing the bank with more steeply sloped, possibly physically stabilized bank materials such as rock rip-rap placed by an excavator in certain places where hydraulic

modeling shows enlarging the channel would reduce 50-year WSEs at remaining floodprone locations.

Inventory In-Channel Trees Upper West Creek

#	Station	Cross-Section	Bank	Species	Diam	Notes
1	6+91′	54	LB	poplar	40″	Non-native tree
2	7+17′	56	RB	poplar	2 x 24″	Non-native tree
3	7+31′	57	LB	poplar	30″	Non-native tree
4	7+77′	58	LB	eucalyptus	46″	Non-native tree
5	8+53′	60	LB	poplar	28″	Non-native tree
6	10+40′	66	RB	redwood	60″	Cluster at top of bank
7	10+63′	67	LB	willow	30″	Native tree
8	11+34′	69	RB	willow	48″	Native tree

Task 3 Flood Risk Reduction Alternatives for West Creek

Plan	Scenario	#1 Upgrade SR 131 Culverts	#2 Remove Rubble Lower Ck	#3 Replace Cecilia Way Culvert	#4 Remove Rubble Upper Ck	#5 Remove Concrete Outfall	#6 Remove In-Ch Trees
44	**Adapted Original Exist Cond**						
45	**Updated New Exist Cond**						
50	**Minimum Plan 0**						
46	**Minimum Plan 1**						
47	**Minimum Plan 2**						
49	**Maximum Plan Min-1**						
51	**Maximum Plan Min-2**						
52	**Maximum Plan Min-3**						
48	**Medium Plan 1**						
53	**Medium Plan 2-1**						**#1**
54	**Medium Plan 2-2**						**#2**
55	**Medium Plan 2-3**						**#2-#3**
56	**Medium Plan 2-4**						**#2-#4**
57	**Medium Plan 2-5**						**#2-#5**
58	**Medium Plan 2-6**						**#2-#6**
62	**Medium Plan 3-1**						**#2-#4**
63	**Medium Plan 3-2**						**#1-#4**
64	**Maximum Plan Med-1**						**#1-#4**
65	**Maximum Plan Med-2**						**#1-#4**
66	**Maximum Plan Med-3**						**#1-#4**

Photo 14. West Creek. Looking upstream from the channel bed near Station 7+60' to the left bank in-channel tree, Tree #4 (46"-diameter eucalyptus), surveyed on Cross-Section 58 at Station 7+77'. Tree #4 was topped approximately 10 years ago. Model simulations show that removal of Tree #4 reduces the computed 50-year flood water surface elevation by 0.4' upstream near Station 8+19' (August 17, 2022).

5.2.1 West Creek Medium Plan 1. Remove Concrete Stormwater Outfall (#5). Medium Plan 1 (Plan 48) simulates (adding to Minimum Plan 2) removal of the existing grade-controlled channel-spanning concrete stormwater outfall with an adequate width and depth rock-lined channel with a lower bed elevation.

Model simulations suggest that the length of the constructed channel should extend about 160 feet from near Station 10+63' to near Station 12+23' in order to adjust to the elimination of the concrete grade control structure formed by the outfall. The portion of the constructed channel near the outfall would need to be rock-lined to handle the turbulent mixing of flows, but the remainder of the constructed reach may be erosion-protected with seeded 100% biodegradable erosion control fabrics and rolls. The existing 24" RCP stormwater outfall would be retrofitted to discharge nearer the direction of West Creek flow rather than perpendicular to West Creek flow. Eliminating the concrete-reinforced headcut and plunge pool would reduce turbulence, energy losses, and bank erosion at this location. Plan 48 simulates assumed natural channel bed level adjustment upstream from removed outfall. Model simulations show that additional bank grading and may be needed extending upstream form Station 12+23' to near Station 13+19' (or 260 linear feet in total) in order to complete the channel conveyance improvements far enough upstream to substantially reduce flood WSEs near Station 13+28'. Medium Plan 1 completes naturalization of Upper West Creek up to near Station 13+20'.

Hydraulic model simulations of Medium Plan 1 (Plan 48) indicate that the 50-year WSE would be reduced by up to 1.2 feet near Station 12+23 about 85 feet upstream from the removed concrete outfall. Medium Plan 1 produces 50-year WSEs below the bank overflow thresholds everywhere in Upper West Creek except near Station 8+19' and Station 10+40' downstream

from the concrete outfall. Plan 48 produces 50-year WSEs about 0.25 ft higher than the top of bank at Station 8+19' (Cross-Section 59) and Station 10+40' (Cross-Section 66).

Further reducing WSEs at Cross-Sections 59 & 66 would require, at a minimum, removing selected in-channel trees downstream from those cross-sections (#6), and possibly additional work to enlarge the channel near the removed trees by stabilization of the bank where the tree stumps are removed (#7).

5.2.2 West Creek Medium Plan 2. Also Remove In-Channel Selected Trees (#6). Medium Plan 2 simulates (adding to Medium Plan 1) removal of in-channel trees in different combinations determined by hydraulic modeling to reduce the computed 50-year WSE at floodprone locations along Upper West Creek. Site inspection and surveying indicated there were eight in-channel trees with the potential to obstruct flood flows and increase flood water surface elevation. These trees were precisely surveyed and built into the hydraulic model as dimensional flow obstructions where they occur on model cross-sections:

Model evaluation procedure for tree removals:

- Medium Plan 2-1 (Plan 53). Simulates removal of Tree #1 only. Simulations indicated that removing Tree #1 produced a negligible reduction in the 50-year flood WSE. Therefore, removal of Tree #1 was not included in the remaining simulations.

- Medium Plan 2-2 (Plan 54). Simulates removal of Tree #2 only. Simulations indicated that removing Tree #2 reduced the 50-year WSE by about 0.1 feet near Station 8+19'. Removal of Tree #2 was retained in the remaining simulations.

- Medium Plan 2-3 (Plan 55). Simulates removal of Tree #2 and Tree #3 (2 trees, all non-native), indicating an additional 50-year WSE reduction of 0.06' near Station 8+19'. Removal of Tree #3 was retained in remaining simulations.

- Medium Plan 2-4 (Plan 56). Simulates removal of Tree #2, Tree #3, and Tree #4 (Photo 14) (3 trees, all non-native). Plan 56 produces a total 50-year WSE reduction of 0.4' near Station 8+19', reducing the computed 50-year WSE to less than the overbank flow threshold. Removal of Tree #4 was retained in remaining simulations.

- Medium Plan 2-5 (Plan 57). Simulates removal of Tree #2, Tree #3, Tree #4, and Tree #5 (4 trees, all non-native). Plan 57 produces a total 50-year WSE reduction of 0.15' near Station 10+40', and does not reducing the computed 50-year WSE to less than the overbank flow threshold there. Removal of Tree #5 was retained in remaining simulations.

- Medium Plan 2-6 (Plan 58). Simulates removal of Tree #2, Tree #3, Tree #4, Tree #5, and Tree #6 (5 trees, 4 non-native). Tree #6 is a redwood tree cluster rooted on the top of the right creek bank. Simulations show that removal of Tree #6 would not reduce model-computed 50-year WSEs.

Hydraulic model simulations of selected grouped tree removals show that removal of Trees #1, #5, and #6 would not produce a substantial flood risk reduction, but removal of Trees #2, #3, and #4 (Medium Plan 2-4) would produce a substantial reduction in the computed 50-year WSEs along Upper West Creek, up to about 0.4 feet at Station 8+19'. Medium Plan 2-4 would produce 50-year WSEs below the top of bank everywhere except Station 10+40' (Cross-Section 66).

5.2.3 West Creek Medium Plan 3-1. Also Stabilize Creek Banks to Enlarge Channel at Removed In-Channel Trees (#7). Medium Plan 3-1 (Plan 62) simulates (adding to Medium Plan 2) excavator-implemented rock rip-rap bank stabilization work in the vicinity of removed stumps of Trees #2, #3, and #4 (three trees located 60 ft apart at the rear of 101 and 107 Blackfield Dr) to repair bank damage caused by tree stump removal and at the same time enlarge the channel to improve flood flow conveyance through the narrow channel leading into the Cecilia Way culvert. Model simulation of Plan 62 shows that compared to removal of Trees #2, #3, and #4 alone, additional rock bank stabilization work to build a steep 1.25H:1V rock-lined slope in the approx. 90-ft-long reach (3 tree/stump removals spaced 60 ft apart, with 15-ft-long grading transitions on both ends), would reduce computed 50-year WSEs by up to 0.4 feet in Upper West Creek. However, Plan 62 would reduce computed 50-year WSE only 0.06 ft at Station 10+40' (Cross-Section 66). The computed 50-year WSE at Cross-Section 66 (13.11 ft) would still be 0.03 higher than the 13.08-ft surveyed top of bank elevation there.

5.2.4 West Creek Medium Plan 3-2. Also Remove Tree #1 and Stabilize Bank in Vicinity of Remove Tree #1 Stump. Medium Plan 3-2 (Plan 63) simulates (adding to Medium Plan 3-1) also removing Tree #1 at Station 7+01' (20 ft downstream of removed Tree #2) and excavator-implemented rock rip-rap bank stabilization work in the vicinity of removed stumps of Trees #1. The Plan 63 computed 50-year WSE at Cross-Section 66 (13.10 ft) would still be 0.02 higher than the 13.08-ft surveyed top of bank elevation there. Compared to Medium Plan 3-1, the flood risk reduction benefits of Medium Plan 3-2 are not substantially improved. However, combining Tree #1 and bank grading repair with the Medium Plan 3-1 work is sensible and probably practically necessary for preventing Tree #1 bank area being subject to increased bank erosion pressure. Therefore, Medium Plan 3-2 is recommended.

5.2.3 West Creek Medium Plan Summary:

Under the recommended Medium Plan 3-2, District would implement the hand-work channel maintenance work of recommended Minimum Plan 2:

#2. Remove Rubble from Lower West Creek.

#4. Remove Rubble from Upper West Creek.

And these other in-channel flood flow capacity improvements:

#5. Remove Concrete Stormwater Outfall. Replace outfall with rock-lined channel, and light grading and minor biotechnical bank erosion protection work in places over approx. 260-ft channel length downstream and upstream from the outfall to correct the channel geometry altered by the outfall grade control.

#6. Remove In-Channel Trees. Removing Trees #2, #3, and #4 (3 trees, all non-native).

#7. Stabilize Creek Banks to Enlarge Channel at Removed In-Channel Trees. Stabilizing creek banks at removed stumps of Trees #2, #3, and #4 with steeply-sloped rock rip-rap placed with an excavator to widen the channel. Considering the work required to stabilize the bank near removed Tree #2 stump (Station 7+17′), it appears it would also be necessary, practically, to also remove Tree #1 (Station 6+91′), its stump, and stabilize the bank uniformly leading into the Cecilia Way culvert inlet.

Medium Plan 3-2 is a thorough creek naturalization project that restores adequate width, depth, and slope channel for reasonably optimizing creek flow conveyance in West Creek. Medium Plan 3-2 pre-empts future work requirements for removing the concrete outfall as it continues to degrade, and emergency maintenance work to clear debris blockages and repair bank erosion when large in-channel trees are wind-thrown.

Other measures, such as top of bank flood barrier walls or landscape berms may be needed to increase the floodprone top of bank elevation near Station 10+40′ (Cross-Section 66) to produce equivalent 50-year flood protection level throughout Upper West Creek. According to the spatial resolution of the hydraulic model, the Medium Plan 3-2 computed 50-year flood would overflow an approximately 5-ft-long top of bank segment between Station 10+35′ and Station 10+40′ with a maximum flow depth of 0.02 ft (1/4-inch). This may be considered di minimis and equivalent to 50-year level flood protection.

The Medium Plan 3-2 computed 100-year flood would overflow an approximately 60-ft-long top of bank segment between Station 9+90′ and Station 10+50′ (primarily along the rear of 131 Blackfield Dr) with a maximum flow depth of 0.26 ft (3 inches).

Both the 50-year and 100-year surcharges could be mitigated with a minor top of bank flood barrier such as an approximately 85-ft-long waterproof fence installed and maintained by District with top elevation uniformly sloped from the 13.99-ft surveyed top of bank elevation at Station 10+63' (Cross-Section 67) to the 13.23-ft elevation at Station 9+78 (Cross-Section 64), or extending 67 more feet downstream (152-ft-long total) to the 13.38-ft surveyed top of bank (existing sandbag levee) at Station 9+11' (Cross-Section 62).

Actual design of an engineered District-implemented top of bank flood barriers would require topographic surveying on landward of the top of bank fencing and site-scale design evaluation. Construction of an engineered flood barrier would require District to acquire new easements donated by the property owners for construction and maintenance as flood control infrastructure. There may be construction conflicts with existing trees and accessory buildings/foundations requiring customized construction or selected tree removals.

Both surcharges could also likely be mitigated with relatively low-cost residential scale work undertaken by the Owners, such as a landscape berm, seeded rope-staked coir-log, or waterproofing the bottom of existing fencing with waterproof membrane or row of sandbags, etc.

The potential for the surcharges to be mitigated by capital improvement projects to replace/upgrade the Cecilia Way and Tiburon Blvd culverts is evaluated in Section 5.3 West Creek Maximum Plan.

5.3. West Creek Maximum Plan.

Six potential Maximum Plans for West Creek were evaluated by model-simulating the potential flood risk reduction benefits of adding capital improvement projects to replace/upgrade existing West Creek roadway and utility crossing infrastructure to the recommended Minimum and Medium plans. There are three potential combinations of the two infrastructure upgrades projects on West Creek:

1. (Only) Upgrade SR 131 Tiburon Boulevard Culverts. Upgrading the Tiburon Blvd culverts from 60" CMP to 66" RCP culverts.

2. (Only) Replace Cecilia Way Culvert. Replacing Cecilia Way culvert with a wider or same-width channel formed by new pier-supported vertical concrete retaining walls clear-spanned by a new, thinner profile roadway bridge deck and same roadway elevation.

3. (Both) Upgrade Tiburon Blvd Culverts and Replace Cecilia Way Culvert. Upgrading the Tiburon Blvd culverts from 60" CMP to 66" RCP culverts and replacing Cecilia Way culvert with a wider or same-width channel formed by new pier-supported vertical concrete retaining walls clear-spanned by a new, thinner profile roadway bridge deck and same roadway elevation.

Each of these three potential combinations were combined with the recommended West Creek Minimum Plan (Minimum Plan 2) and the recommended West Creek Medium Plan (Medium Plan 3-2), producing 6 potential Maximum Plans for model evaluation:

1. Maximum Plan Min-1: Maximum Plan Min-1 (Plan 49) combines upgrading Tiburon Boulevard culverts (only) with Minimum Plan 2. Plan 49 produce a 0.3' WSE reduction immediately upstream from Tiburon Boulevard. The reduction dissipates to 0.2 ft about 250 ft upstream, then diminishes rapidly. The reduction at Station 5+54' 60 ft downstream from Cecilia Way culvert is only 0.02 ft. Maximum Plan Min-1 (Plan 49) would reduce the 50-yr WSE immediately upstream from Cecilia Way culvert by about 0.01 ft, but not in the floodprone Upper West Creek locations upstream from the culvert. Maximum Plan Min-1 is not recommended.

2. Maximum Plan Med-1: Maximum Plan Med-1 (Plan 64) combines upgrading Tiburon Boulevard culverts (only) with Medium Plan 3-2. Plan 64 would produce would produce the same 0.3' WSE reduction immediately upstream from Tiburon Boulevard that dissipates to 0.2 ft about 250 ft upstream. The local WSE reduction does not appear to substantially affect flood risk reduction to the properties in that vicinity. Maximum Plan Med-1 is not recommended.

3. Maximum Plan Min-2: Maximum Plan Min-2 (Plan 51) combines replacing Cecilia Way culvert (only) with Minimum Plan 2. Plan 51 would reduce the computed 50-year WSE as much as 0.5 ft immediately upstream from and within 40-50 feet from the Cecilia Way culvert inlet, but there would be no reduction in the floodprone Upper West Creek locations. Maximum Plan Min-2 is not recommended.

4. Maximum Plan Med-2: Maximum Plan Med-2 (Plan 65) combines replacing Cecilia Way culvert (only) with Medium Plan 3-2. Plan 65 would not substantially reduce model-computed 50-year WSEs at floodprone locations along Upper West Creek. Maximum Plan Med-2 is not recommended.

5. Maximum Plan Min-3: Maximum Plan Min-3 (Plan 52) combines both infrastructure upgrade capital improvement projects with Minimum Plan 2. Plan 52 produces the same relatively large WSE reductions immediately upstream from both culvert inlets as the individual crossing upgrades would. These reductions only occur over a short distance upstream from the inlets and do not appear to produce meaningful WSE

reductions in floodprone locations along West Creek. Maximum Plan Min-3 is not recommended.

6. Maximum Plan Med-3: Maximum Plan Med-3 (Plan 66) combines both infrastructure upgrade capital improvement projects with Medium Plan 3-2. Plan 66 produces relatively large WSE reductions immediately upstream from both culvert inlets, but does not produce meaningful WSE reductions in floodprone locations along West Creek. Maximum Plan Med-3 is not recommended.

Model simulations show that upgrading the Tiburon Blvd and/or Cecilia Way culverts would not achieve meaningful flood risk reduction on West Creek, in combination with either the recommended Minimum Plan 2 or Medium Plan 3-2 channel improvements.

Although none of the six potential West Creek Maximum Plans are recommended, Maximum Plan Med-3 is cost estimated for the purposes of the alternatives analysis.

Although modeling simulations show that improvements to the existing Cecilia Way and Tiburon Blvd culverts are not necessary, any future work required to upgrade those culverts at the end of their engineering lifespan should be undertaken with an up-to-date evaluation of then-existing conditions and hydraulic design to optimize flood risk reduction on West Creek.

Notably the existing West Creek 60"-diameter CMP culverts appear to be in poor condition due to corrosion and may be nearing their engineering lifespan. Presumably they were installed by Cal-Trans at the same time as the original East Creek 60"-diameter CMP culverts. Cal-Trans replaced the East Creek CMP culverts with upgraded 66"-diameter RCP culverts in [year]. Should Cal-Trans elect to repair the West Creek 60"-diameter CMP culverts by slip-lining with smaller diameter plastic pipes, this should be carefully evaluated to ensure the smaller diameter culverts do not cause increased flood water surface elevations at floodprone locations along Lower and Upper West Creek.

6. Task 2 Conclusions

Model simulations of combining capital improvement projects to upgrade existing roadway and utility crossing infrastructure to otherwise maintenance-optimized flood risk minimized conditions on East and West Creek shows that none of the existing infrastructure substantially increases flood risk:

1. East Creek Tiburon Boulevard Culverts. Model simulations show that upgrading the 66"-diameter RCP East Creek Tiburon Blvd culverts would not achieve meaningful flood risk

reduction. The 66" RCP culverts join to existing 52" HDPE plastic culverts running under Greenwood Cove Drive to the Richardson Bay outfall.

2. East Creek Greenwood Cove Drive Culverts. Model simulations show that upgrading the 52" HDPE plastic culverts to 66" RCP culverts matching the existing Tiburon Boulevard Culverts would reduce the 50-year flood water surface elevation immediately upstream from the culvert inlet headwall north from Tiburon Boulevard adjacent to the pump station by about 2.3 feet. The WSE reduction diminishes rapidly upstream within the length of the existing grouted rock-lined channel due to the acceleration of Lower East Creek flows into the narrow, elevated grouted channel inlet at the RBSD sewer crossing section.

3. East Creek RBSD Sanitary Sewer Crossing. Model simulations show that the potential benefits of culvert upgrading would extend farther upstream if the RBSD sanitary sewer crossing were also replaced to lower and widen the grouted rock-lined channel inlet, in combination with reconstructing the downstream grouted rock-lined channel, the WSE reduction would be substantial in Lower East Creek but not at the floodprone locations along Upper East Creek.

4. East Creek Cecilia Way Culvert. Model simulations show that also replacing or upgrading the Cecilia Way culvert in combination with the Medium Plan, Greenwood Cove Drive culvert upgrading, and sewer crossing replacement, and rock-lined channel reconstruction (Medium Plan +1+2+3), would reduce flood WSEs at floodprone locations on Upper East Creek by as much as 0.3 feet. However, it is not clear that the WSE reduction would substantially reduce potential flood damages in the rear-yard areas of the affected Leland Way properties.

5. West Creek Tiburon Boulevard Culverts. Model simulations show that upgrading the 60"-diameter CMP West Creek Tiburon Blvd culverts would not achieve meaningful flood risk reduction. The WSE reductions occur within 200-250 feet upstream from the culvert inlet and do not appear to reduce risk of flood damage at floodprone locations on Lower or Upper West Creek.

Photo 14. Upper East Creek. Looking from Cecilia Way to the upstream end of the right bank concrete transition channel wall about 30 feet upstream from the Cecilia Way culvert road crossing (August 17, 2022). The stormwater drain hole in the wall discharges creek flow onto the street during routine or average annual high creek flows. Blocking the drain hole combined with surface drainage improvements for directing the concrete swale flows to existing storm drain inlets near the Cecilia-Leland Way intersection should be considered.

6. West Creek Cecilia Way culvert. Model simulations show that replacing or upgrading the West Creek Cecilia Way culvert, alone, or in combination with upgrading the Tiburon Blvd culverts would not achieve meaningful flood risk reduction on Upper West Creek, either in combination with Minimum Plan 2 or Medium Plan 3-2 channel improvements. The WSE reductions occur within 40-60 feet upstream from the culvert inlet and do not appear to reduce risk of flood damage at floodprone locations along Upper West Creek.

Still, for review and consideration by the Advisory Board, preliminary planning-level implementation cost estimates are developed for "Maximum Plans" that would combine replacement of the existing crossing infrastructure with the recommended Medium Plans for each creek.

7. Task 3 Preliminary Recommended Flood Risk Reduction Alternatives

According to the detailed hydraulic modeling evaluations documented in Section 4 and Section 5, a "Minimum", "Medium", and "Maximum" flood risk reduction design alternative is recommended for each creek:

	Minimum Plan	Medium Plan	Maximum Plan
East Creek	"Minimum Plan"	"Medium Plan"	"Medium Plan +1+2+3"
West Creek	"Minimum Plan 2"	"Medium Plan 3-2"	"Maximum Plan Med-3"

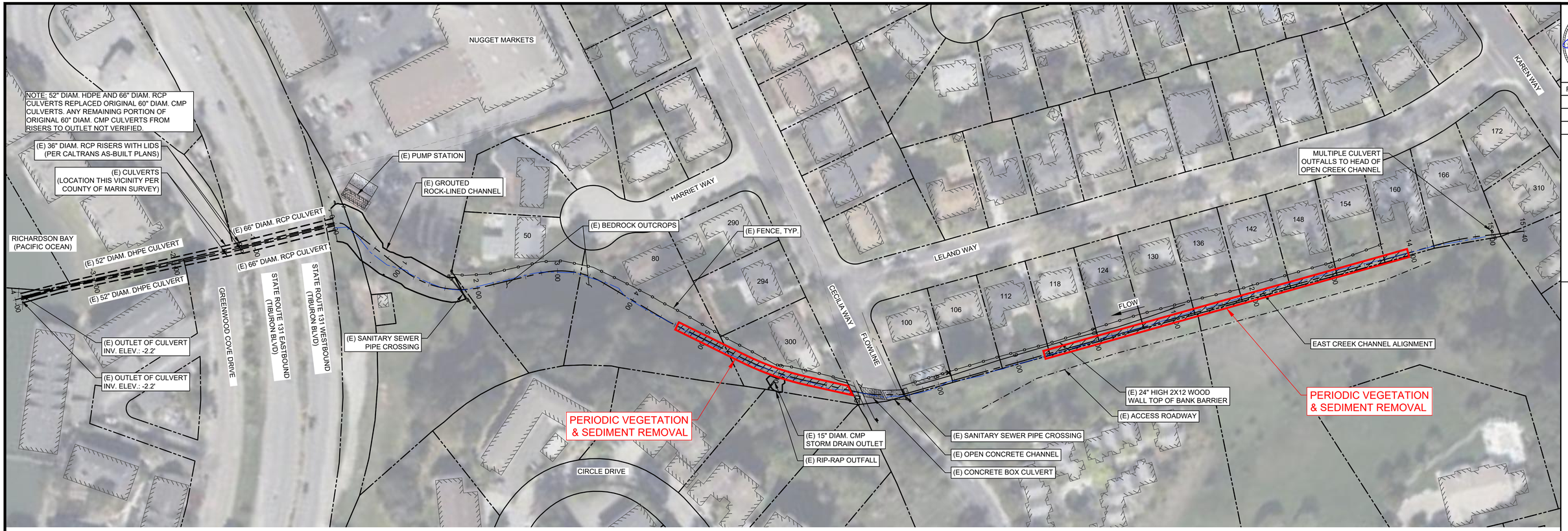
Summaries of each alternative are on the following pages. Also see Figures 1-6.

EAST CREEK
Preliminary Recommended Flood Risk Reduction Alternatives

Minimum Plan	Medium Plan	Maximum Plan
"Minimum Plan" (Plan 28) Figure 1	**"Medium Plan" (Plan 32) Figure 2**	**"Medium Plan +1+2+3" (Plan 40) Figure 3**
Status Quo. District continues current program of periodic as needed vegetation and sediment removal from accessible reaches and according to the current permitted extents downstream and upstream from Cecilia Way culvert.	District obtains new permits to one-time extend channel maintenance 220-250 feet downstream from its current permitted limit. The one-time project would "restore" an adequate width and depth channel sloped 0.3% from the Cecilia Way culvert concrete floor to the grouted channel bed invert at the RBSD sanitary sewer crossing.	Same as Medium Plan.
	One-time sediment removal from within Cecilia Way concrete box culvert, open concrete box culvert transition upstream and from within the tree-covered natural channel reach bordering 100, 106, and 112 Leland Way.	Same as Medium Plan.
	Plan Option: Also restore the downstream 200 lineal feet of the top of bank flood barrier to provide added flood risk reduction for 100, 106, and 112 Leland Way.	Same as Medium Plan.
		Also: (1) District upgrades the 52"-diam. outfall culverts to 66"-diam. culverts; (2) RBSD modifies the sanitary sewer crossing to lower and widen the grouted rock-lined channel inlet; and, (3) Town replaces the Cecilia Way box culvert with a wider clear-span bridge or open bottom culvert with natural self-setting bed elevation.

WEST CREEK
Preliminary Recommended Flood Risk Reduction Alternatives

Minimum Plan	Medium Plan	Maximum Plan
"Minimum Plan 2" (Plan 47) Figure 4	**"Medium Plan 3-2" (Plan 63) Figure 5**	**"Maximum Plan Med-3" (Plan 66) Figure 6**
District would obtain new permits and implement one-time hand-work to remove about 100 CY of foreign rock and concrete materials accumulated in places along the length of the channel bed in an approximately 300-ft long of Lower West Creek and an approximately 400-ft-long reach of Upper West Creek, including minor bank shaping and biotechnical erosion protection in Upper West Creek.	Same as Minimum Plan 2.	Same as Medium Plan 3-2.
No tree removals.	Remove 4 Trees (#1, 2, 3, 4)	Same as Medium Plan 3-2.
	District would also remove the existing channel-spanning concrete storm drain outfall and restore adequate width-and-depth channel upstream and downstream from the replaced outfall with minimized rock lining and biotechnical bank erosion protection measures.	Same as Medium Plan 3-2.
	District would also remove the tree stumps from Trees #1,2,3,4 and repair the affected creek bank with combination vegetated rock slope protection to improve channel conveyance and bank stability.	Same as Medium Plan 3-2.
	Plan Option: Owners or District also install approximately 150 lineal feet minor top of bank flood barrier between Station 10+63' and 9+11'.	Same as Medium Plan 3-2.
		Also: (1) Caltrans upgrades the 60"-diam. Tiburon Blvd culverts to 66"-diam. culverts; and, (2) Town replaces the Cecilia Way box culvert with a wider or same-width natural with a natural, self-setting bed elevation.



LEGEND

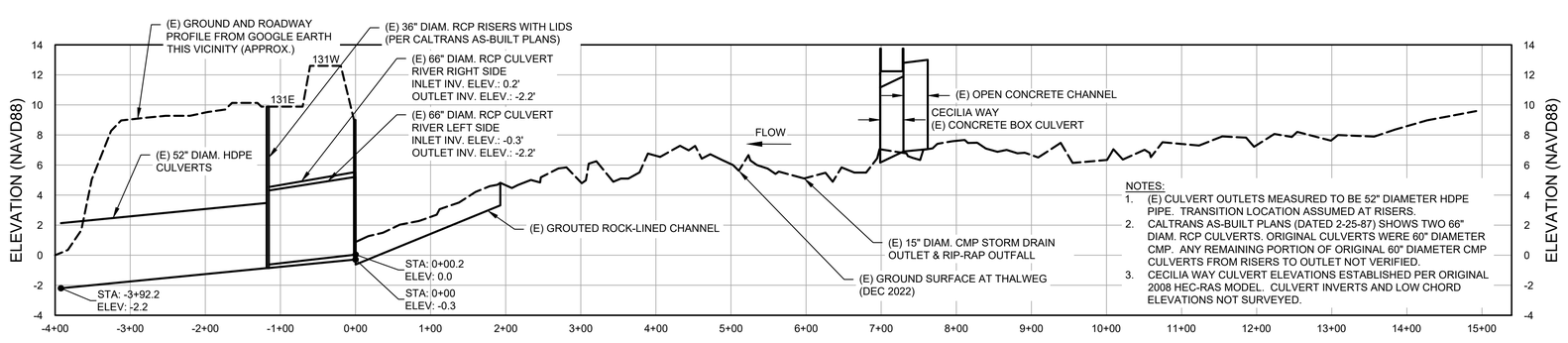
- EXISTING PROPERTY BOUNDARY LINE (FROM MARINMAP GIS, APPROX.)
- EXISTING BUILDING LINE (FROM MARINMAP GIS, APPROX.)
- EXISTING THALWEG LINE

EAST CREEK MINIMUM PLAN "MINIMUM PLAN" (PLAN 28)

SCALE: 1" = 60'

0 30 60 120

SCALE: 1" = 60'



NOTES:
1. (E) CULVERT OUTLETS MEASURED TO BE 52" DIAMETER HDPE PIPE. TRANSITION LOCATION ASSUMED AT RISERS.
2. CALTRANS AS-BUILT PLANS (DATED 2-25-87) SHOWS TWO 66" DIAM. RCP CULVERTS. ORIGINAL CULVERTS WERE 60" DIAMETER CMP. ANY REMAINING PORTION OF ORIGINAL 60" DIAMETER CMP CULVERTS FROM RISERS TO OUTLET NOT VERIFIED.
3. CECILIA WAY CULVERT ELEVATIONS ESTABLISHED PER ORIGINAL 2008 HEC-RAS MODEL. CULVERT INVERTS AND LOW CHORD ELEVATIONS NOT SURVEYED.

POTENTIAL EAST CREEK FLOOD RISK REDUCTION MEASURES - PROFILE

SCALE: H:1" = 100', V:1" = 5' (20X EXAGGERATION)

REGISTERED PROFESSIONAL ENGINEER
MATT SMELTZER
No. 71671
Exp. 12-31-23
CIVIL
STATE OF CALIFORNIA

Revisions:

MARIN COUNTY WATER CONSERVATION AND FLOOD CONTROL DISTRICT ZONE 4
TIBURON, CALIFORNIA 94920

TASK 3 FLOOD RISK REDUCTION ALTERNATIVES

EAST & WEST CREEKS

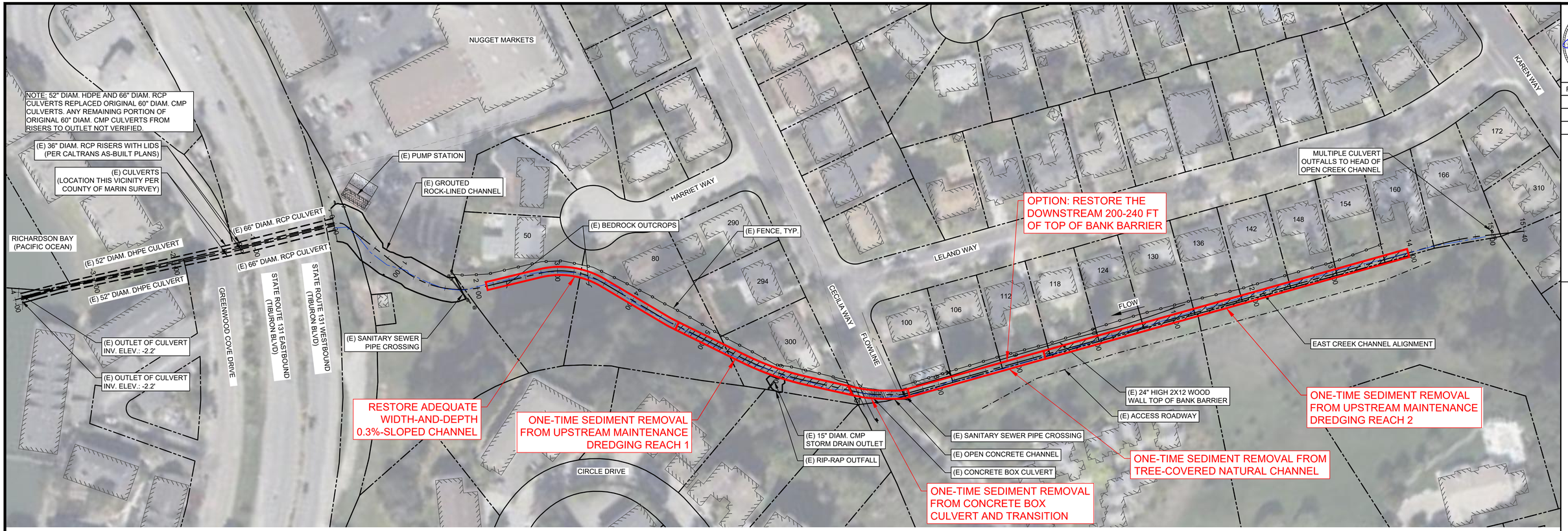
HYDRAULIC MODEL ANALYSIS FOR FLOOD RISK REDUCTION

Geomorph DESIGN
2100 Fourth Street, No. 154
San Rafael, CA 94901
(510) 219-1064
www.geomorphdesign.com

geomorphDESIGN

Date: 17 JUL 2023
Design by: MS
Drawn by: BRS
Checked by: MS
Scale: 1" = 60', 1" = 100'

FIG.1



LEGEND

- EXISTING PROPERTY BOUNDARY LINE (FROM MARINMAP GIS, APPROX.)
- EXISTING BUILDING LINE (FROM MARINMAP GIS, APPROX.)
- EXISTING THALWEG LINE

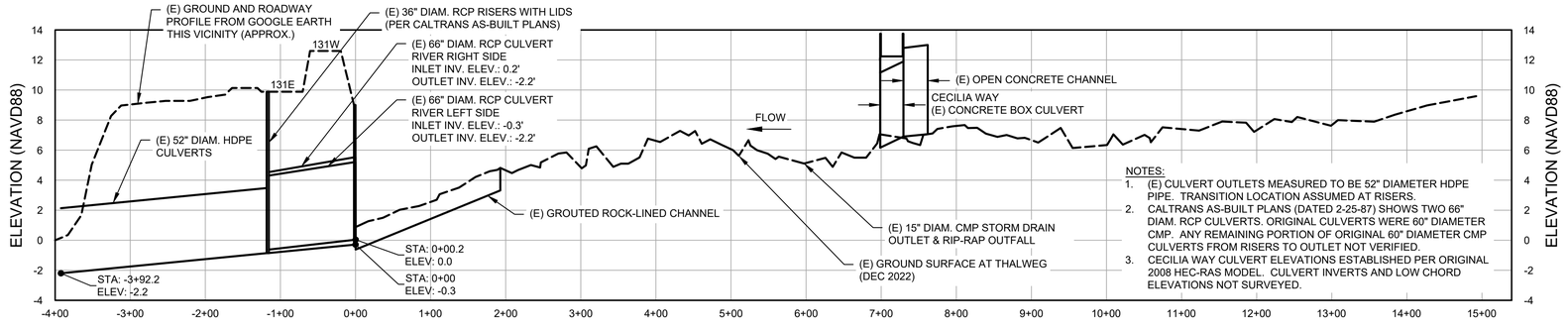
EAST CREEK MEDIUM PLAN

"MEDIUM PLAN" (PLAN 32)

SCALE: 1" = 60'

0 30 60 120

SCALE: 1" = 60'



NOTES:

1. (E) CULVERT OUTLETS MEASURED TO BE 52" DIAMETER HDPE PIPE. TRANSITION LOCATION ASSUMED AT RISERS.
2. CALTRANS AS-BUILT PLANS (DATED 2-25-87) SHOWS TWO 66" DIAM. RCP CULVERTS. ORIGINAL CULVERTS WERE 60" DIAMETER CMP. ANY REMAINING PORTION OF ORIGINAL 60" DIAMETER CMP CULVERTS FROM RISERS TO OUTLET NOT VERIFIED.
3. CECILIA WAY CULVERT ELEVATIONS ESTABLISHED PER ORIGINAL 2008 HEC-RAS MODEL. CULVERT INVERTS AND LOW CHORD ELEVATIONS NOT SURVEYED.

POTENTIAL EAST CREEK FLOOD RISK REDUCTION MEASURES - PROFILE

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REGISTERED PROFESSIONAL ENGINEER — JAMES M. SMELTZER — No. 71671 — Exp. 12-31-23 — CIVIL — STATE OF CALIFORNIA

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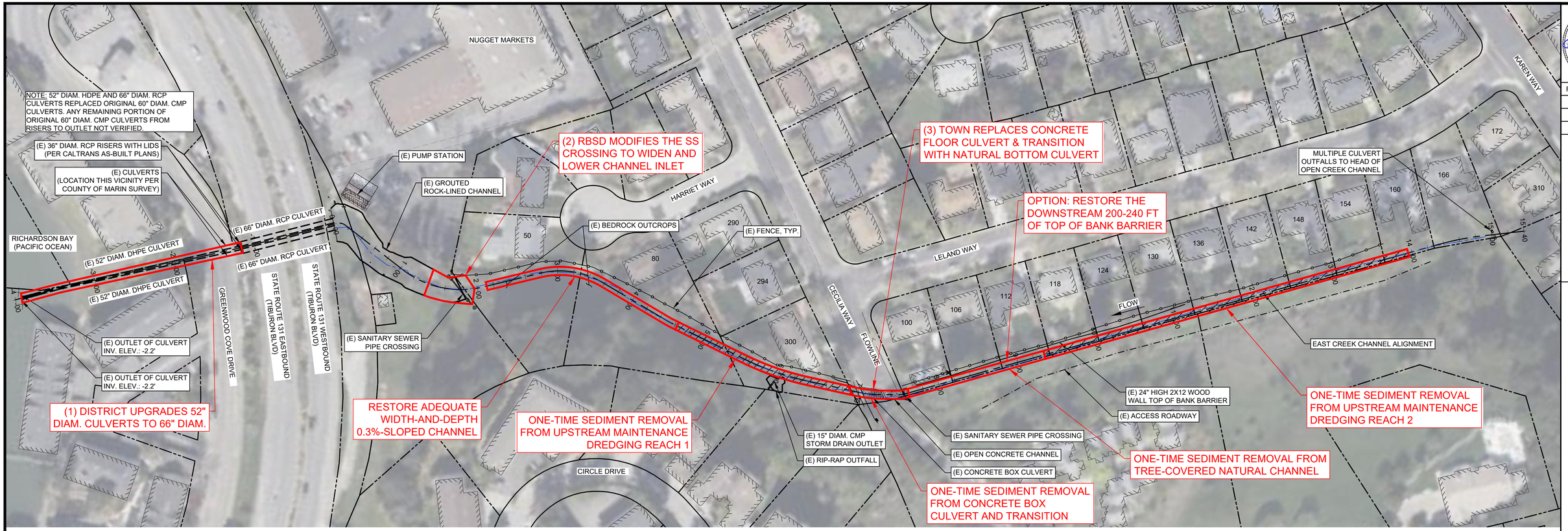
FIG.2



LEGEND

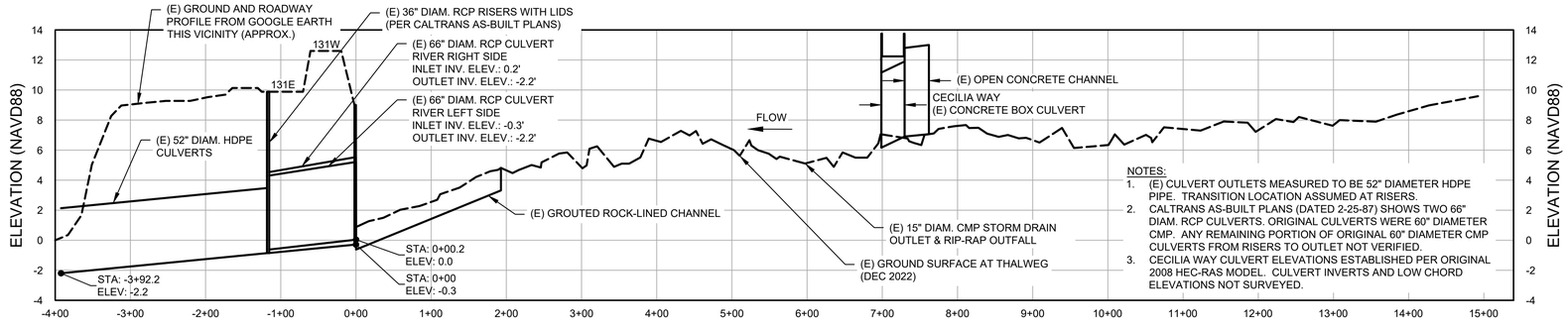
- EXISTING PROPERTY BOUNDARY LINE (FROM MARINMAP GIS, APPROX.)
- EXISTING BUILDING LINE (FROM MARINMAP GIS, APPROX.)
- EXISTING THALWEG LINE

EAST CREEK MAXIMUM PLAN "MEDIUM PLAN + 1 + 2 + 3" (PLAN 40)

SCALE: 1" = 60'

0 30 60 120

SCALE: 1" = 60'



NOTES:
1. (E) CULVERT OUTLETS MEASURED TO BE 52" DIAMETER HDPE PIPE. TRANSITION LOCATION ASSUMED AT RISERS.
2. CALTRANS AS-BUILT PLANS (DATED 2-25-87) SHOWS TWO 66" DIAM. RCP CULVERTS. ORIGINAL CULVERTS WERE 60" DIAMETER CMP. ANY REMAINING PORTION OF ORIGINAL 60" DIAMETER CMP CULVERTS FROM RISERS TO OUTLET NOT VERIFIED.
3. CECILIA WAY CULVERT ELEVATIONS ESTABLISHED PER ORIGINAL 2008 HEC-RAS MODEL. CULVERT INVERTS AND LOW CHORD ELEVATIONS NOT SURVEYED.

POTENTIAL EAST CREEK FLOOD RISK REDUCTION MEASURES - PROFILE

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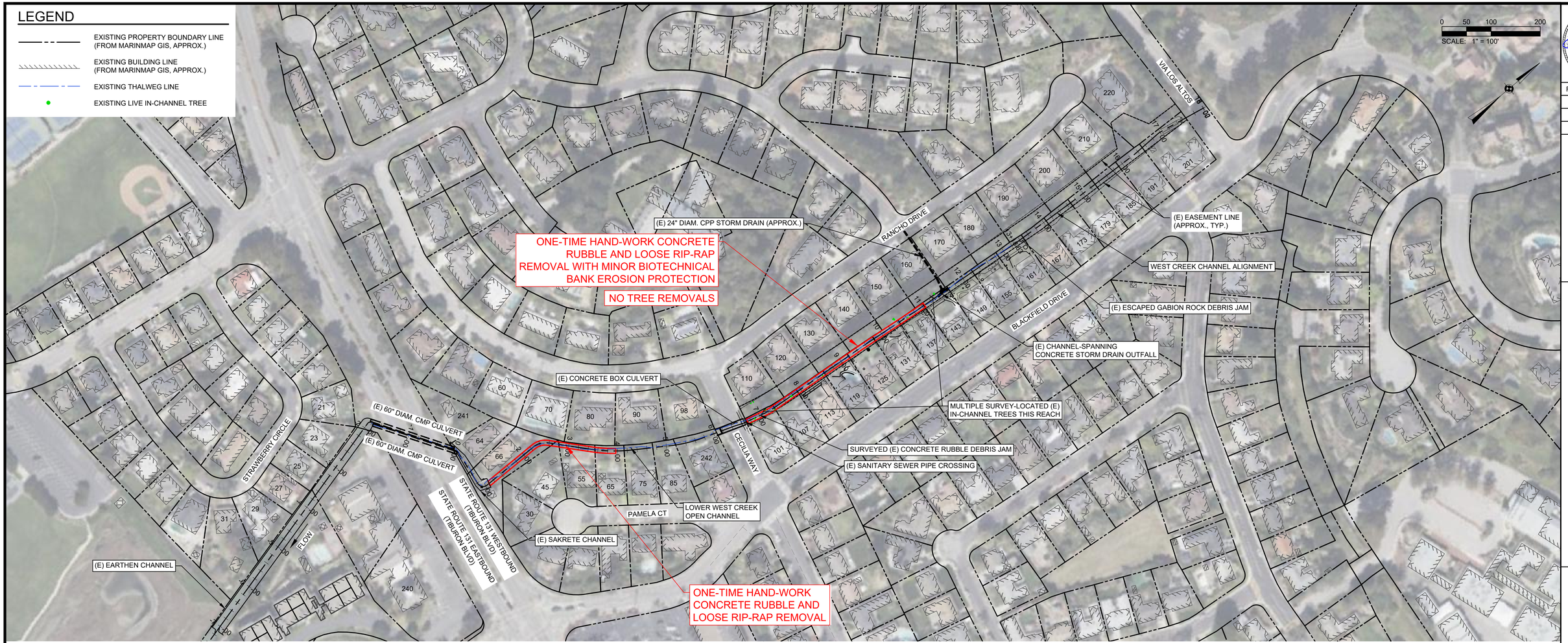
FIG.3

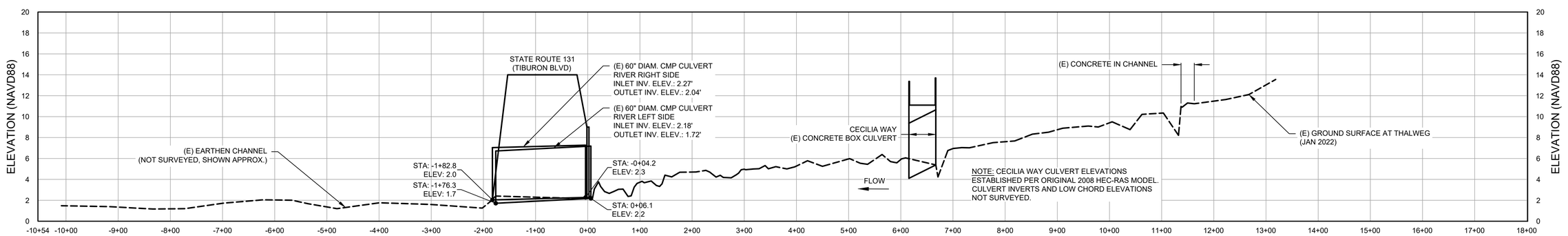
LEGEND

- EXISTING PROPERTY BOUNDARY LINE (FROM MARINMAP GIS, APPROX.)
- EXISTING BUILDING LINE (FROM MARINMAP GIS, APPROX.)
- EXISTING THALWEG LINE
- EXISTING LIVE IN-CHANNEL TREE



WEST CREEK MINIMUM PLAN "MINIMUM PLAN 2" (PLAN 47)

SCALE: 1" = 100'



POTENTIAL WEST CREEK FLOOD RISK REDUCTION MEASURES - PROFILE

SCALE: H:1" = 100', V:1" = 5' (20X EXAGGERATION)

REGISTERED PROFESSIONAL ENGINEER
JAMES M. SMELTZER
No. 71617
Exp. 12-31-23
CIVIL
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FIG.4

LEGEND

- EXISTING PROPERTY BOUNDARY LINE (FROM MARINMAP GIS, APPROX.)
- EXISTING BUILDING LINE (FROM MARINMAP GIS, APPROX.)
- EXISTING THALWEG LINE
- EXISTING LIVE IN-CHANNEL TREE

REMOVE CONCRETE OUTFALL AND RESTORE ADEQUATE WIDTH-AND-DEPTH CHANNEL UPSTREAM AND DOWNSTREAM FROM REPLACED OUTFALL USING PRIMARILY BIOTECHNICAL EROSION PROTECTION

OPTION: OWNERS OR DISTRICT ALSO INSTALL 105-FT-LONG MINOR TOP OF BANK BARRIER

ONE-TIME HAND-WORK CONCRETE RUBBLE AND LOOSE RIP-RAP REMOVAL WITH MINOR BIOTECHNICAL BANK EROSION PROTECTION

REMOVE TREES #1, 2, 3, 4. ALSO REMOVE TREE STUMPS AND REPAIR LEFT BANK WITH VEGETATED ROCK SLOPE PROTECTION.

ONE-TIME HAND-WORK CONCRETE RUBBLE AND LOOSE RIP-RAP REMOVAL

(E) 24" DIAM. CPP STORM DRAIN (APPROX.)

(E) CONCRETE BOX CULVERT

(E) 60" DIAM. CMP CULVERT

(E) 60" DIAM. CMP CULVERT

(E) EARTHEN CHANNEL

(E) SAKRETE CHANNEL

LOWER WEST CREEK OPEN CHANNEL

PAMELA CT

STRAWBERRY CIRCLE

CECILIA WAY

RANCHO DRIVE

BLACKFIELD DRIVE

VIA LOS ALTOS

STATE ROUTE 131 WESTBOUND (TIBURON BLVD)

STATE ROUTE 131 EASTBOUND (TIBURON BLVD)

FLOW

(E) EASEMENT LINE (APPROX., TYP.)

WEST CREEK CHANNEL ALIGNMENT

(E) ESCAPED GABION ROCK DEBRIS JAM

(E) CHANNEL-SPANNING CONCRETE STORM DRAIN OUTFALL

MULTIPLE SURVEY-LOCATED (E) IN-CHANNEL TREES THIS REACH

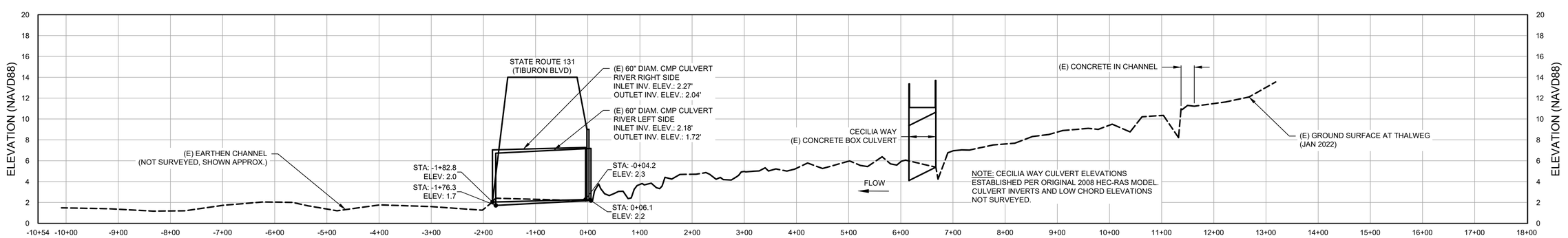
SURVEYED (E) CONCRETE RUBBLE DEBRIS JAM

(E) SANITARY SEWER PIPE CROSSING

SCALE: 1" = 100'

WEST CREEK MEDIUM PLAN "MEDIUM PLAN 2" (PLAN 63)

SCALE: 1" = 100'



POTENTIAL WEST CREEK FLOOD RISK REDUCTION MEASURES - PROFILE

SCALE: H:1" = 100', V:1" = 5' (20X EXAGGERATION)

REGISTERED PROFESSIONAL ENGINEER JAMES T. SMELTZER No. 71617 Exp. 12-31-23 CIVIL STATE OF CALIFORNIA

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EAST & WEST CREEKS

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San Rafael, CA 94901
(510) 219-1064
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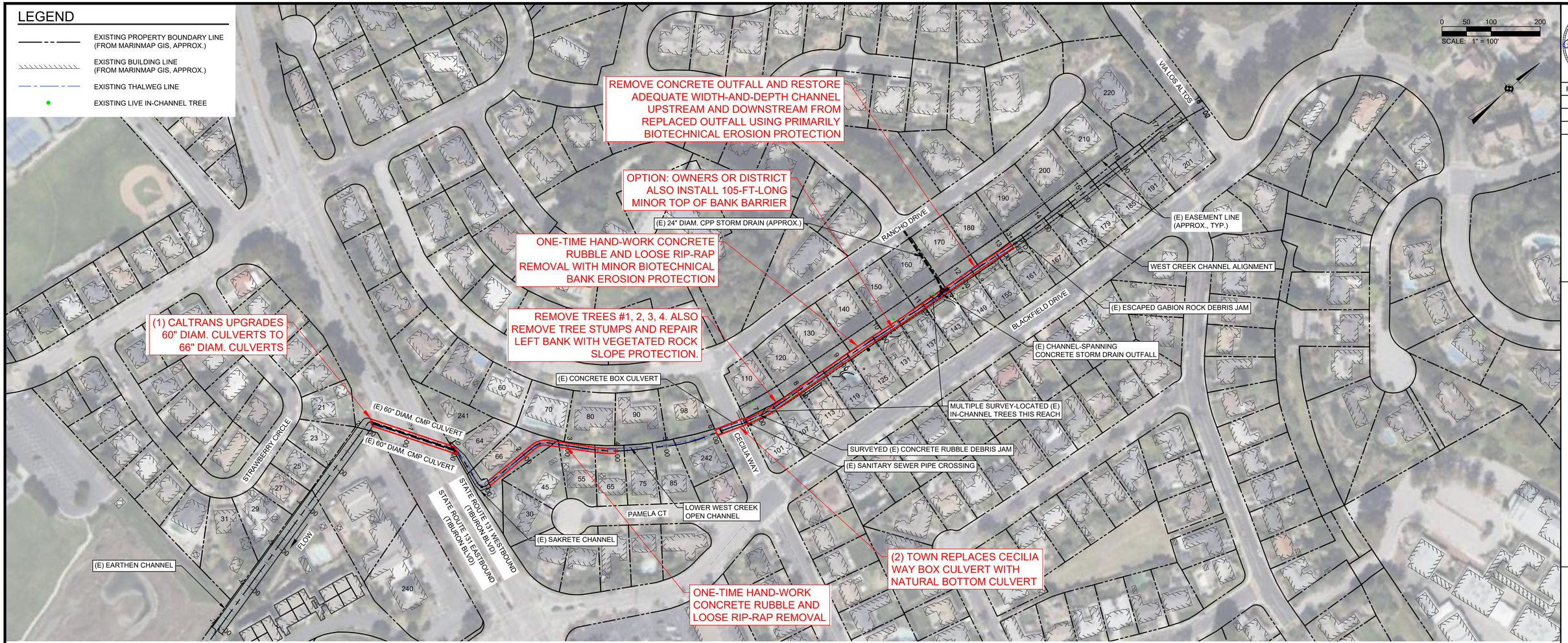
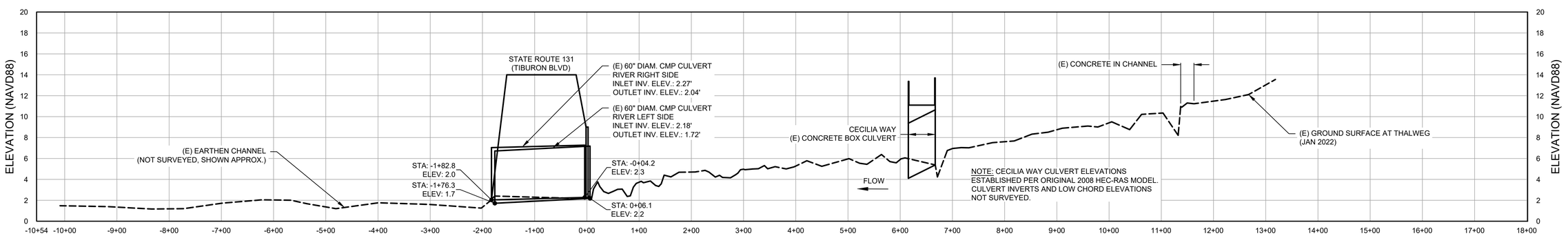
Scale: 1" = 100'

FIG.5



WEST CREEK MAXIMUM PLAN "MAXIMUM PLAN MED-3" (PLAN 66)

SCALE: 1" = 100'



POTENTIAL WEST CREEK FLOOD RISK REDUCTION MEASURES - PROFILE

SCALE: H:1" = 100', V:1" = 5' (20X EXAGGERATION)

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FIG.6