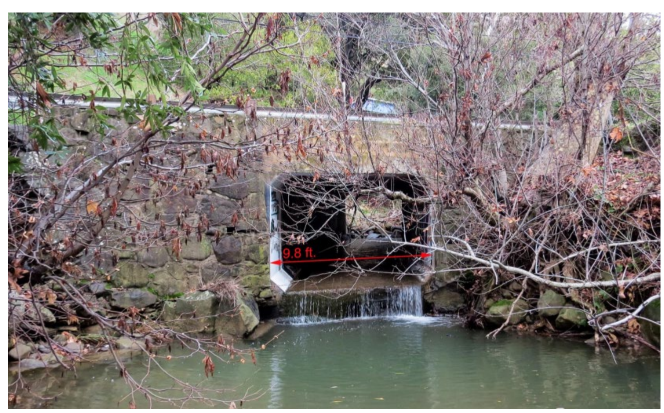
Stonybrook Creek Culvert Replacement Bridge Design Report

Niles Canyon Safety Improvements Project (04-2A332)

The California Department of Transportation (Caltrans) approved the Niles Canyon Safety Improvements Project to improve safety along State Route (SR) 84 within the Niles Canyon corridor in Alameda County. Improvements will include replacement of the reinforced box culvert at Stonybrook Creek with a single-span bridge and associated creek channel improvements.

The existing culvert is located on SR 84, just upstream of Stonybrook Creek's confluence with Alameda Creek. The culvert is approximately 10 feet wide and is undersized for the amount of water flow that occurs during most winters. During moderate and high flows, water moves through the culvert at such high velocities that it has created a scour hole at the downstream end that can be up to five feet deep. With the scour hole, the downstream water level typically sits at a lower elevation than the culvert bottom, creating a physical fish passage barrier that blocks fish from traveling upstream. When water submerges the culvert bottom during winter, the high flow velocities through the culvert continue to make upstream fish passage impossible.



View upstream showing fish passage barrier at culvert outlet

Fish Passage Background

Anadromous fish are species that require freshwater and ocean environments to complete their lifecycle. Suitable freshwater habitat is particularly important because it provides breeding and rearing habitat. Manmade structures, like culverts or dams, act as fish passage barriers and have historically blocked steelhead, an anadromous fish, from reaching suitable breeding habitat in Alameda and Stonybrook creeks. The non-anadromous form of steelhead, rainbow trout, is known to occur upstream of fish passage barriers within Alameda and Stonybrook creeks. Several fish passage improvement projects have been completed upstream of the culvert within Stonybrook Creek and downstream within Alameda Creek. With the completion of the BART Weir Fish Ladder Project in 2021, anadromous fish will be able to once again migrate between Alameda Creek and the San Francisco Bay. Removing the Stonybrook Creek culvert fish passage barrier is key to connecting the work being done on the numerous fish passage improvement projects in upper Stonybrook Creek and in lower Alameda Creek.

Bridge Design

The existing Stonybrook Creek culvert that drains Stonybrook Creek into Alameda Creek will be replaced with a new, single-span bridge, removing the fish passage barrier and the main source of scour. The bridge abutments will be skewed to be more in line with the creek, and the vertical bridge abutments will be spaced wider than the active channel width to allow unimpeded bed-load transport under the bridge. This will allow the creek to flow at a more natural rate that would allow fish to swim upstream during high flows.

The new Stonybrook Creek Bridge will span approximately 50 feet over Stonybrook Creek in order to facilitate the installation of the abutments while staying outside of the creek (previous technical studies indicated the measured creek channel width was 20.5 feet). The length of the new bridge will be approximately 55 feet. The bridge will sit on diaphragm or seat-type abutments founded on 24-inch diameter cast-in-drilled-hole piles. The total width of the bridge, measured perpendicular to roadway alignment, will be 50.25 feet, consisting of a 2-foot wide median rumble strip, two 12-foot wide travel lanes, two 8-foot shoulders, and 2 feet on either side of the bridge for installation of the bridge railing. The bridge railing will be a California ST-75, which consists of metal posts and three horizontal cross beams. Additionally, a rock-textured façade will be installed on the outside portions of the bridge (Appendix A).

The bridge was designed to the maximum possible height, with the underside of the downstream portion of the bridge slightly under the 100-year flood level. The bridge height could not be further increased due to constraints of an existing driveway to the west and, the railroad undercrossing and SR-84/Palomares Road intersection to the east. The bridge height is not expected to negatively impact fish passage or channel scour.

Fish Passage Design

After removal of the existing culvert, the creek channel will be restored to generally match existing conditions upstream. The goal of the channel restoration is to improve fish passage conditions and stabilize the reconstructed portion of the channel. To improve fish passage conditions, the channel design will include boulder steps and rock clusters spaced throughout the reconstructed channel that will create pools of slower water where fish can rest as they make their way upstream (Appendix B).

To prevent bank erosion and protect trees on the outer bend of the creek upstream of the bridge, a portion of the bank will be armored with rock. Below the elevation of the streambed, the channel design will also consist of a foundation of base rock that is designed to remain in place and prevent erosion of the main channel. The middle and upper layers of the channel restoration, including fish passage elements, are not designed to be permanent and are expected to be transported at relatively high flow rates. This design decision was made because Stonybrook Creek is known to transport sediment and large rocks during high flows. The material that will be transported out of the restored channel is expected to be replaced with similarly sized material from upstream, as is typical in natural stream geomorphic processes.

View upstream along Alameda Creek showing old abutment (blue arrow) and large rock formation (red arrow)

In addition to the main channel work within Stonybrook Creek, three elements downstream, at the confluence of Stonybrook and Alameda creeks, will be addressed during the culvert removal and new bridge construction. The first element, a boulder weir, will be reshaped to concentrate flow over the center of the weir to match the alignment of the low-flow channel that will be created in Stonybrook Creek. This will improve fish passage conditions by increasing water depth in the channel. The other two elements consist of a concrete road remnant and old abutment wall within Stonybrook Creek near the edge of the Alameda Creek channel. The road remnant will be completely removed from the creek. The old abutment will be removed down to the point where it widens into a spread footing, which is near the Alameda Creek low-flow water level. This point sits at a similar elevation to the existing natural rock formation upstream that is expected to remain in place. Additionally, leaving a portion of the old abutment in place will continue to provide stability for the Alameda Creek channel. Work on these three elements will not require a creek diversion or the use of heavy equipment in Alameda Creek.

A fish passage engineer with qualifications agreed upon by Caltrans, National Marine Fisheries Service, California Department of Fish and Wildlife, and the San Francisco Regional Water Quality Control Board will be on-site during the crucial portions of the channel restoration work to ensure the design is being implemented correctly and to make decisions in the field regarding proper rock size and placement for fish passage design elements. The restored channel will be monitored by geomorphologists over a 10-year period to ensure fish passage barriers do not develop and the channel does not become unstable.

Regulatory Agencies Consultation

The creek channel restoration plans were developed with substantial input from National Marine Fisheries Service, California Department of Fish and Wildlife, and the San Francisco Regional Water Quality Control Board. Caltrans would like to thank these agencies for their comments, reviews, and attendance at numerous focus meetings throughout the channel restoration design process. Design changes incorporated at the request of agency personnel include, but are not limited to, addition of a robust base rock layer, removal of permanent geotextile fabric from the design, addition of rock clusters and boulder steps, removal/alteration of downstream structures, and addition of a fish passage expert during planned channel restoration work. One element that agencies suggested but was not incorporated into the fish passage design was the use of tree trunks or removed tree stumps in the channel. Caltrans considered this suggestion but determined that it was not consistent with the existing conditions of Stonybrook Creek, which features a rocky bottom.

Tree Planting and Site Restoration

After the new bridge and channel restoration are complete, revegetation of the site will occur. Temporarily impacted areas will be hydroseeded with a mix of native seeds. Replacement trees will be planted within the project footprint, including along the banks of Stonybrook Creek.

The initial estimates in the environmental document called for 260 trees to be removed. However, Caltrans was able to reduce that to approximately 62 tree removals and 17 tree trims. Caltrans will mitigate for tree removal through on- and off-site mitigation. For on-site mitigation, Caltrans will maximize tree planting within the project footprint. Off-site mitigation in satisfaction with the Alameda Creek Alliance legal settlement agreement, will consist of Caltrans' payment into a Native Tree Mitigation Fund agreed upon by both parties. Caltrans will continue to look for opportunities to plant additional trees within Niles Canyon prior to purchasing off-site mitigation.

Appendix A Select Stonybrook Creek Bridge Plans

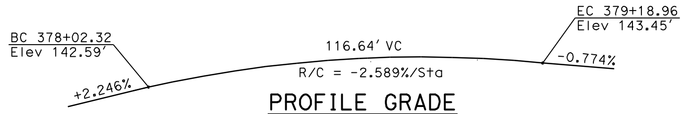
Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	10.8/18.0	356	370

Rosa M Candiotti 8-31-20
REGISTERED CIVIL ENGINEER DATE

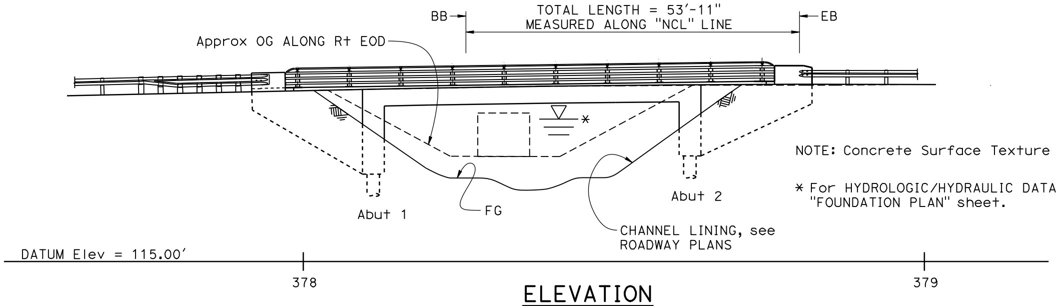
August 31, 2020
PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

REGISTERED PROFESSIONAL ENGINEER ROSA CANDIOTTI No. 64626 Exp. 6/30/21 CIVIL STATE OF CALIFORNIA



PROFILE GRADE
NO SCALE



ELEVATION
1" = 10'

NOTE: Concrete Surface Texture not shown

* For HYDROLOGIC/HYDRAULIC DATA SUMMARY, see "FOUNDATION PLAN" sheet.

NOTES:

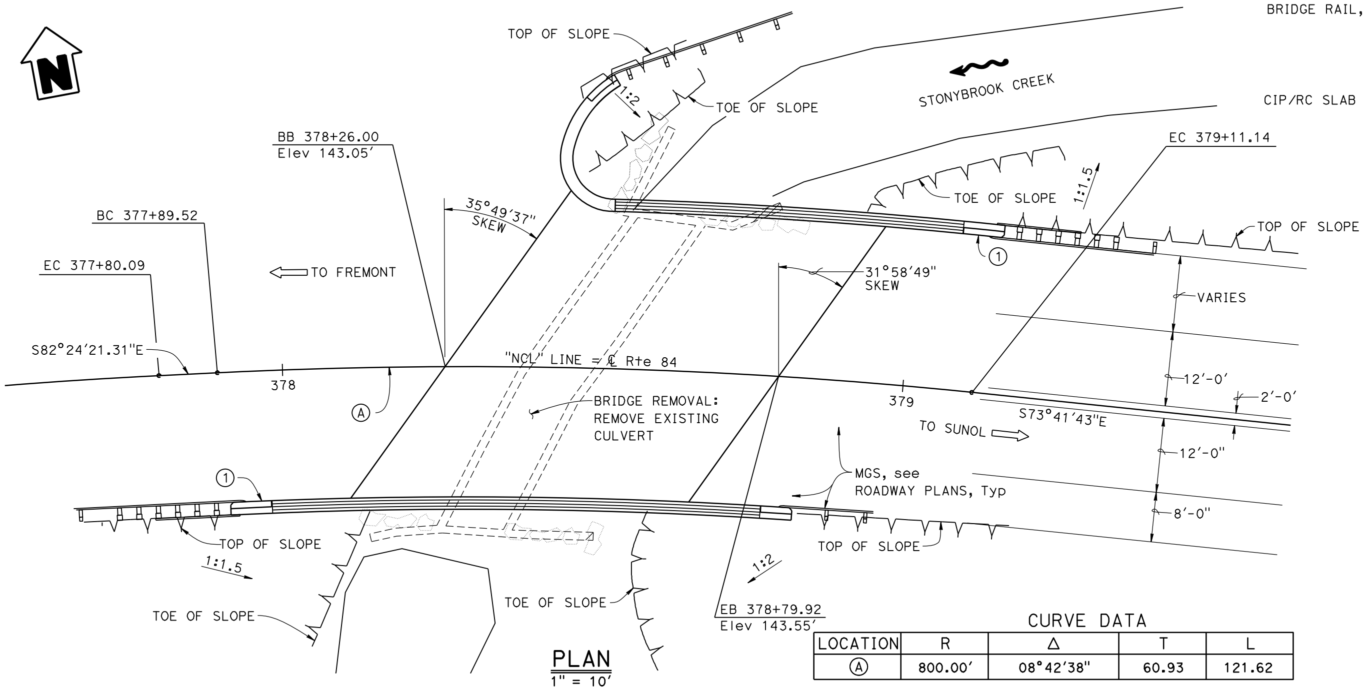
1. For "GENERAL NOTES", "INDEX TO PLANS" and "PILE DATA TABLE", see "INDEX TO PLANS" sheet.

(1) Paint "Stonybrook Creek Bridge Br. No. 33-0731" and year constructed

(2) 1-3" ø and 1-2" ø opening for future utilities

LEGEND:

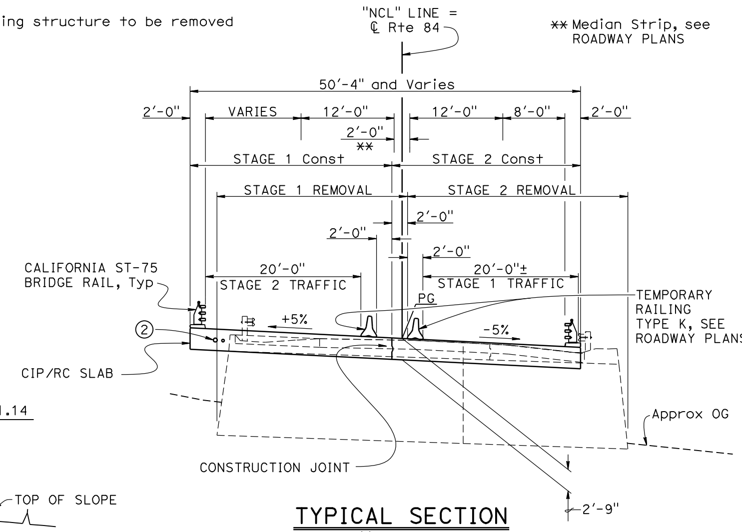
----- Existing structure to be removed



PLAN
1" = 10'

CURVE DATA

LOCATION	R	Δ	T	L
(A)	800.00'	08°42'38"	60.93	121.62



TYPICAL SECTION
1/8" = 1'-0"

QUANTITIES

STRUCTURE EXCAVATION (BRIDGE)	360	CY
STRUCTURE BACKFILL (BRIDGE)	123	CY
24" CAST-IN-DRILLED-HOLE CONCRETE PILING	550	LF
STRUCTURAL CONCRETE, BRIDGE	188	CY
STRUCTURAL CONCRETE, BRIDGE (POLYMER FIBER)	282	CY
CONCRETE SURFACE TEXTURE (ROCK)	345	SQFT
BAR REINFORCING STEEL (BRIDGE)	78,254	LB
HEADED BAR REINFORCEMENT	166	EA
BRIDGE REMOVAL	LUMP	SUM
PREPARE AND STAIN CONCRETE	345	SQFT
CALIFORNIA ST-75 BRIDGE RAIL	181	LF

RICHARD MELKO
DESIGN ENGINEER

	BY	CHECKED
DESIGN	ROSA CANDIOTTI	ADAM MENKE
DETAILS	DAVID ELLIOTT/ WEI ZHANG	ADAM MENKE
QUANTITIES	KIMBERLY MORI	ROSA CANDIOTTI

LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/"LOW-BOY"; PERMIT DESIGN VEHICLE	
LAYOUT	BY: ROSA CANDIOTTI	CHECKED: ADAM MENKE
SPECIFICATIONS	BY: JAVIER TORRES	PLANS AND SPECS COMPARED: JAVIER TORRES

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
STRUCTURE DESIGN
DESIGN BRANCH 9

BRIDGE No. 33-0731
POST MILE 12.99

STONYBROOK CREEK BRIDGE
GENERAL PLAN

STRUCTURES DESIGN GENERAL PLAN SHEET (ENGLISH) (REVISION 3/17/2017)

DATE PLOTTED => 18-NOV-2020 TIME PLOTTED => 09:09
FILE => 33-0731-a-gp.dgn USERNAME => s126849

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 3594
PROJECT NUMBER & PHASE: 0414000039-1
CONTRACT No.: 04-2A3324

DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES: 3-27-19, 09-28-20, 09-30-20
SHEET 1 OF 15

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	10.8/18.0	360	370

Rosa M Candiotti 8-31-20
REGISTERED CIVIL ENGINEER DATE

August 31, 2020
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Rosa Candiotti — No. 64626 — Exp. 6/30/21 — CIVIL — STATE OF CALIFORNIA

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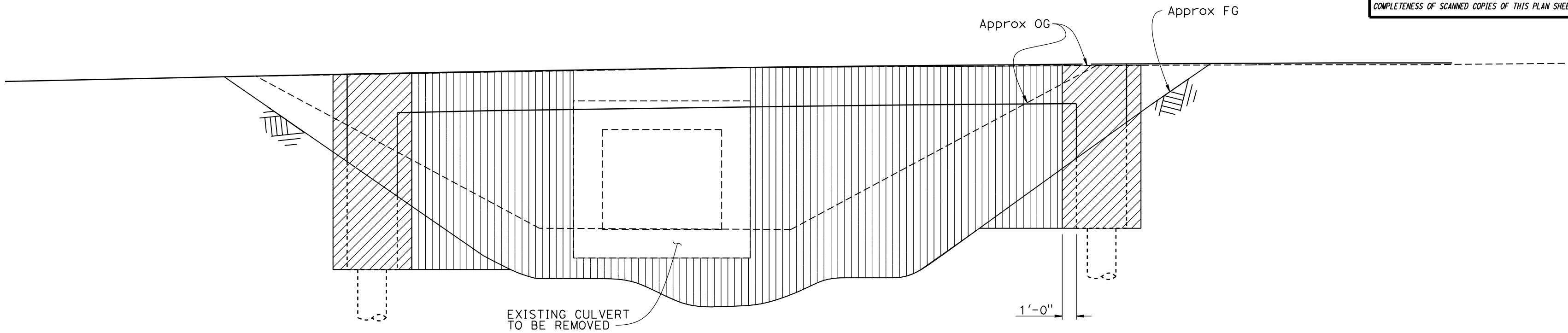
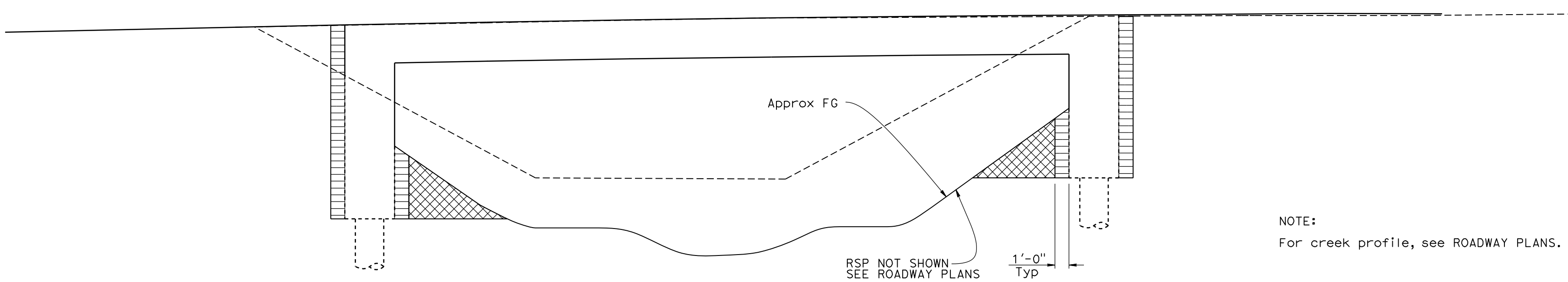


EXCAVATION



BACKFILL

NOTE:
For creek profile, see ROADWAY PLANS.

LEGEND:

- STRUCTURE EXCAVATION (Bridge)
- ROADWAY EXCAVATION
- STRUCTURE BACKFILL (Bridge)
- ROADWAY BACKFILL, see ROADWAY PLANS

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

LIMITS OF EXCAVATION AND BACKFILL (A62C)

¼" = 1'-0"

	BY	CHECKED
DESIGN	ROSA CANDIOTTI	ADAM MENKE
DETAILS	DAVID ELLIOTT	ADAM MENKE
QUANTITIES	KIMBERLY MORI	ROSA CANDIOTTI

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
STRUCTURE DESIGN
DESIGN BRANCH 9

BRIDGE No. 33-0731
POST MILE 12.99

STONYBROOK CREEK BRIDGE
EXCAVATION AND BACKFILL

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	10.8/18.0	370	370

Rosa M Candiotti 8-31-20
REGISTERED CIVIL ENGINEER DATE

August 31, 2020
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Rosa Candiotti
No. 64626
Exp. 6/30/21
CIVIL
STATE OF CALIFORNIA

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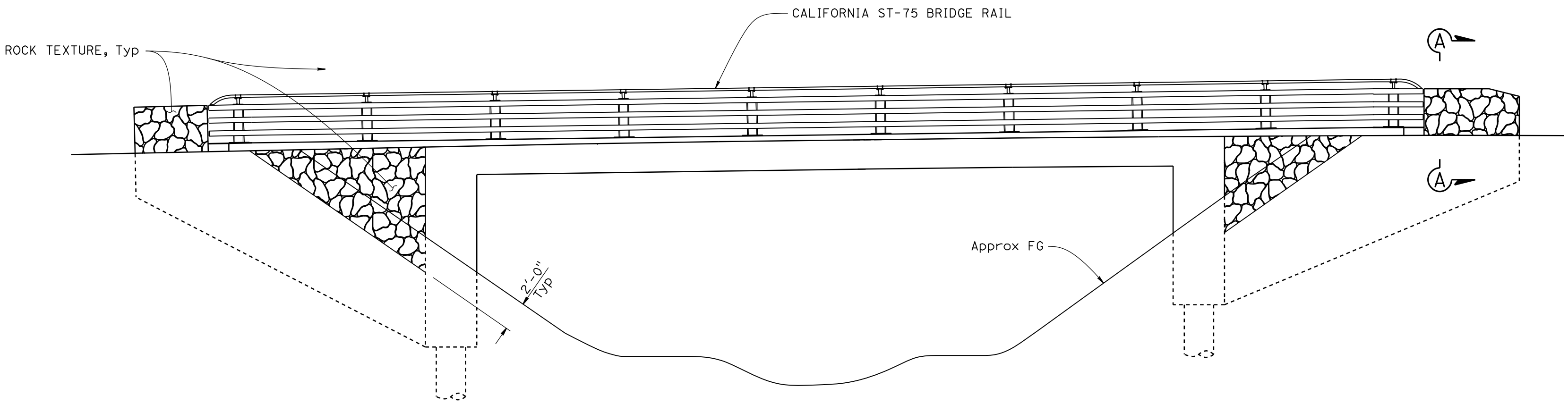
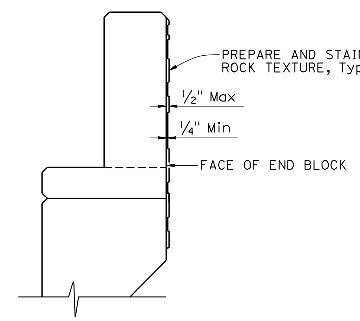


ELEVATION
1/4" = 1'-0"



SECTION A-A
1" = 1'-0"

DESIGN	BY ROSA CANDIOTTI	CHECKED ADAM MENKE	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH 9
DETAILS	BY DAVID ELLIOTT/ WEI ZHANG	CHECKED ADAM MENKE		
QUANTITIES	BY KIMBERLY MORI	CHECKED ROSA CANDIOTTI		

BRIDGE No. 33-0731
POST MILE 12.99

STONYBROOK CREEK BRIDGE
CONCRETE SURFACE TEXTURE

STRUCTURES DESIGN DETAIL SHEET (ENGLISH) (REVISION 5/8/2018)

DATE PLOTTED => 18-NOV-2020 TIME PLOTTED => 09:10
FILE => 33-0731-r-cst.dgn USERNAME => s126849

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 3594
PROJECT NUMBER & PHASE: 0414000039-1 CONTRACT No.: 04-2A3324

DISREGARD PRINTS BEARING EARLIER REVISION DATES → REVISION DATES 12-22-18 09-28-20 09-30-20

Appendix B Stonybrook Creek Channel Reconstruction Plans

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	10.8/18.0	90	370

Jennifer Abrams (signature) 8-19-20
REGISTERED CIVIL ENGINEER DATE

August 31, 2020
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — JENNIFER ABRAMS — No. 77782 — Exp. 6-30-21 — CIVIL — STATE OF CALIFORNIA

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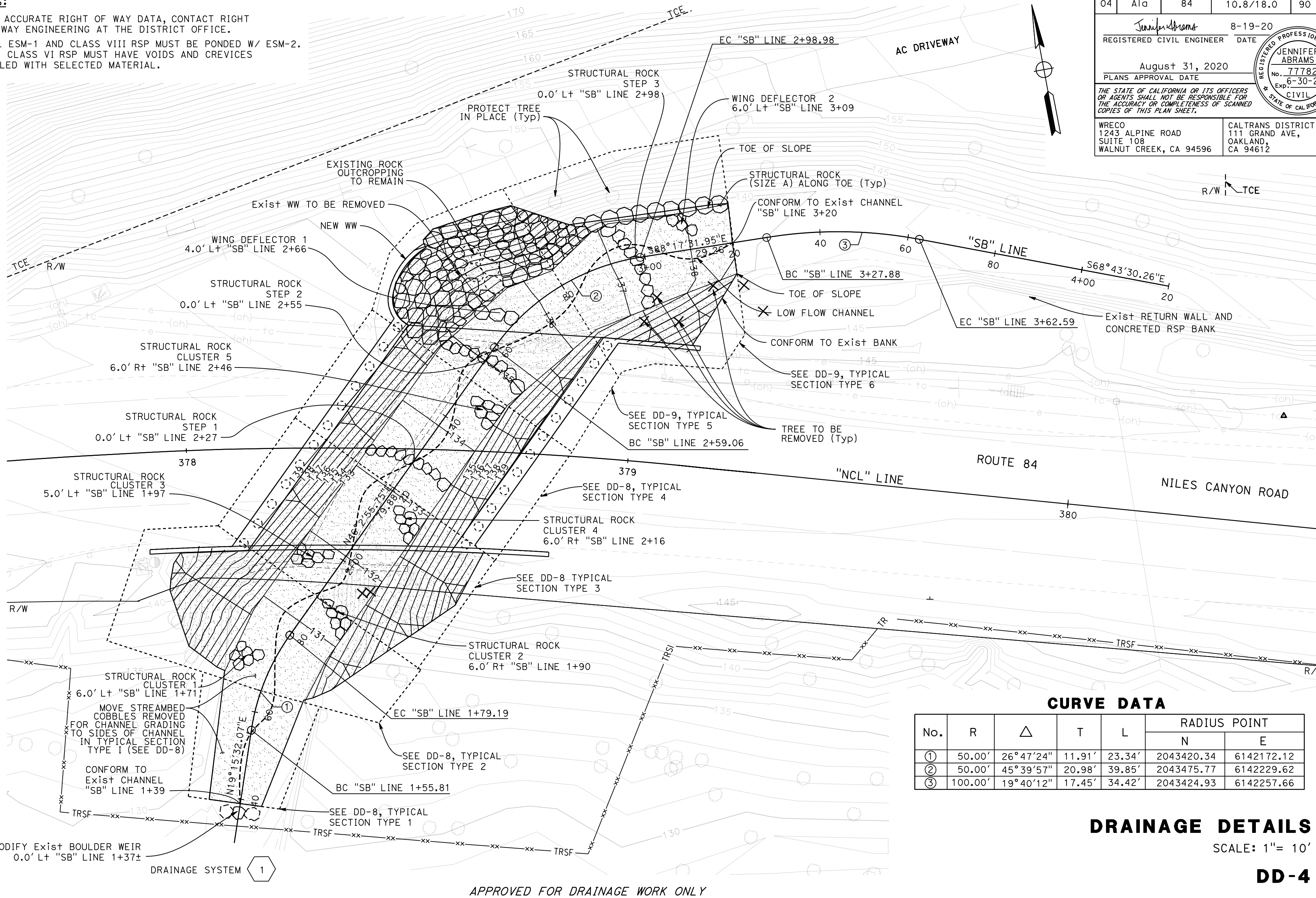
WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596

CALTRANS DISTRICT 4
111 GRAND AVE,
OAKLAND,
CA 94612

NOTES:

1. FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.
2. ALL ESM-1 AND CLASS VIII RSP MUST BE PONDED W/ ESM-2. ALL CLASS VI RSP MUST HAVE VOIDS AND CREVICES FILLED WITH SELECTED MATERIAL.



CURVE DATA

No.	R	△	T	L	RADIUS POINT N	RADIUS POINT E
①	50.00'	26°47'24"	11.91'	23.34'	2043420.34	6142172.12
②	50.00'	45°39'57"	20.98'	39.85'	2043475.77	6142229.62
③	100.00'	19°40'12"	17.45'	34.42'	2043424.93	6142257.66

DRAINAGE DETAILS

SCALE: 1"= 10'

DD-4

APPROVED FOR DRAINAGE WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: JENNIFER ABRAMS — CHECKED BY: CHRISTOPHER SEWELL
REVISED BY: JA — DATE REVISED: 4-19-19

LAST REVISION 04-19-19 — DATE PLOTTED => 16-NOV-2020 — TIME PLOTTED => 09:44

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	10.8/18.0	91	370

REGISTERED CIVIL ENGINEER DATE 8-19-20

PLANS APPROVAL DATE August 31, 2020

REGISTERED PROFESSIONAL ENGINEER JENNIFER ABRAMS No. 77782 Exp. 6-30-21 CIVIL STATE OF CALIFORNIA

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CALTRANS DISTRICT 4
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OAKLAND,
CA 94612

NOTES:

1. FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.
2. RESTORE AREAS DISTURBED OUTSIDE OF GRADING LIMITS TO EXISTING CONDITION.
3. STRUCTURAL ROCK LAYOUT TO BE APPROVED BY THE ENGINEER.
4. THE VOIDS IN STRUCTURAL ROCK, ESM-1, AND RSP MUST BE FILLED WITH ESM-2.

ABBREVIATION:

ESM ENGINEERED STREAMBED MATERIAL

LEGEND:

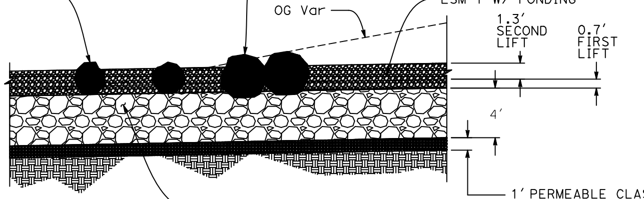
STRUCTURAL ROCK

CLASS VI RSP

ESM-1

CLASS VIII RSP

PERMEABLE CLASS II



TYPICAL DETAIL

DRAINAGE DETAILS

NO SCALE

DD-5

APPROVED FOR CHANNEL RESTORATION WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: ANALETTE OCHOA
CALCULATED-DESIGNED BY: TRAVIS BAGGETT
CHECKED BY: JENNIFER ABRAMS
REVISED BY: JA
DATE REVISED: 4-19-19

LAST REVISION 04-19-19
DATE PLOTTED => 16-NOV-2020
TIME PLOTTED => 09:44

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	10.8/18.0	92	370

REGISTERED CIVIL ENGINEER 8-19-20 DATE

REGISTERED PROFESSIONAL ENGINEER JENNIFER ABRAMS No. 77782 Exp. 6-30-21 CIVIL STATE OF CALIFORNIA

August 31, 2020
PLANS APPROVAL DATE

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111 GRAND AVE,
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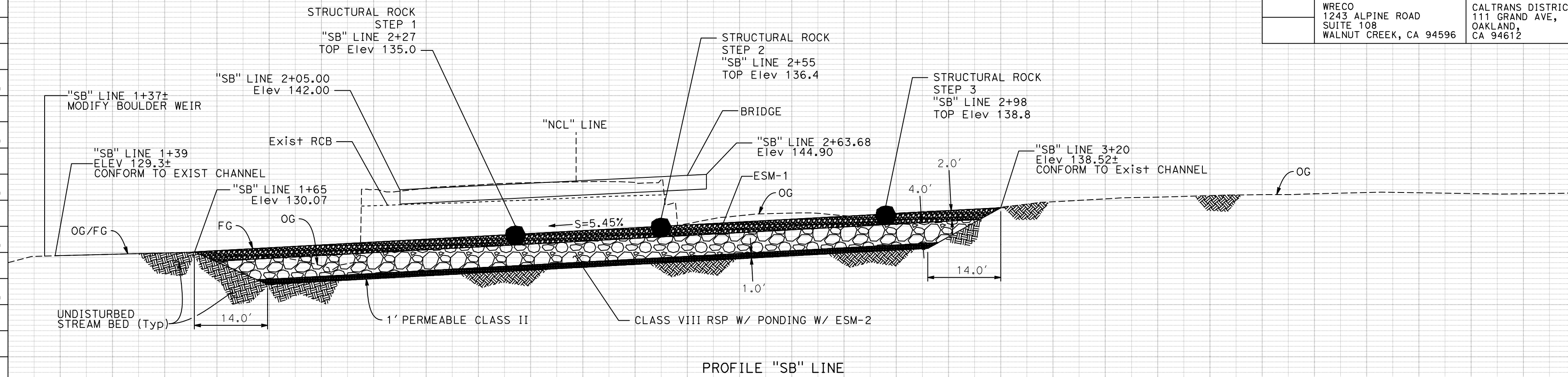
CA 94612

NOTE:

SEE DD-5 FOR NOTES AND ABBREVIATIONS.

LEGEND:

- ESM-1
- CLASS VIII RSP
- 1′ PERMEABLE CLASS II



DRAINAGE DETAILS

SCALE: Horiz 1" = 10′ Vert 1" = 10′

DD-6

APPROVED FOR DRAINAGE WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: ANALETTE OCHOA

CALCULATED-DESIGNED BY: TRAVIS BAGGETT

CHECKED BY: JENNIFER ABRAMS

REVISED BY: JA

DATE REVISED: 4-19-19

LAST REVISION: 04-19-19

DATE PLOTTED => 16-NOV-2020
TIME PLOTTED => 09:44

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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REGISTERED CIVIL ENGINEER 8-19-20 DATE

August 31, 2020
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER JENNIFER ABRAMS No. 77782 Exp. 6-30-21 CIVIL STATE OF CALIFORNIA

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SUITE 108
WALNUT CREEK, CA 94596

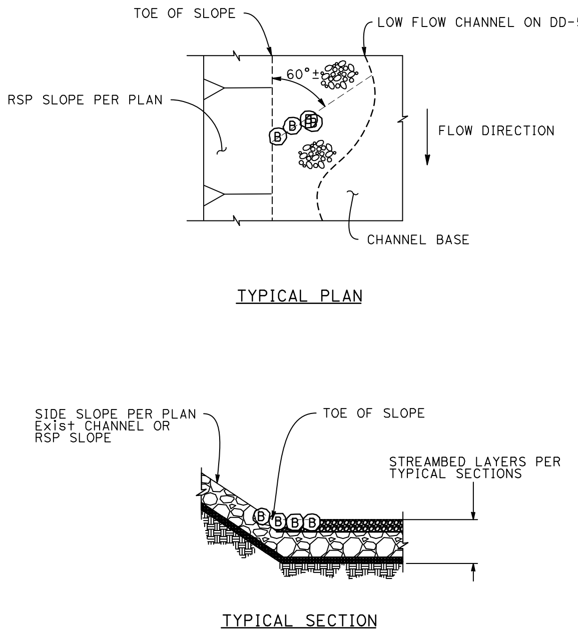
CALTRANS DISTRICT 4
111 GRAND AVE,
OAKLAND,
CA 94612

NOTE:

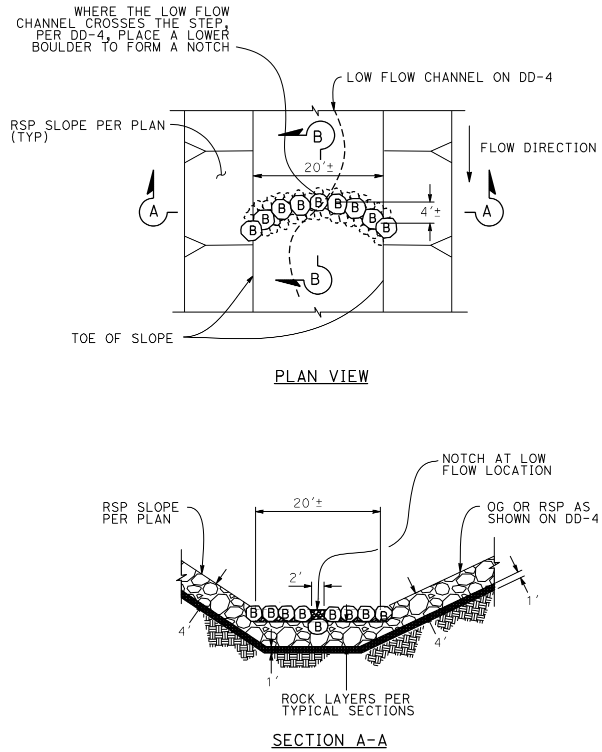
SEE DD-5 FOR NOTES AND ABBREVIATIONS.

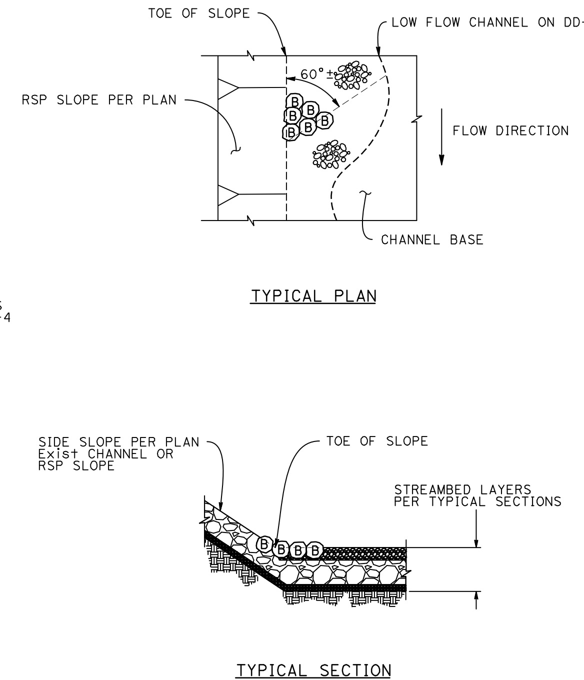
LEGEND:

- CLASS VI RSP
- ESM-1
- CLASS VIII RSP
- 1' CLASS II PERMEABLE
- (X) STRUCTURAL ROCK

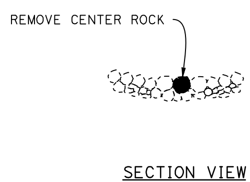


WING DEFLECTOR DETAIL

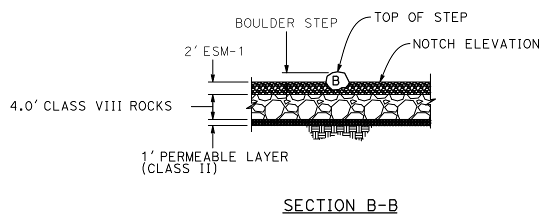




STRUCTURAL ROCK CLUSTER DETAIL



MODIFY Exist BOULDER WEIR DETAIL



STRUCTURAL ROCK STEP DETAIL

DRAINAGE DETAILS

NO SCALE

DD-7

APPROVED FOR CHANNEL RESTORATION WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: ANALETTE OCHOA

CALCULATED-DESIGNED BY: TRAVIS BAGGETT | CHECKED BY: JENNIFER ABRAMS

REVISED BY: JA | DATE REVISED: 4-19-19

LAST REVISION 04-19-19 | DATE PLOTTED => 16-NOV-2020 | TIME PLOTTED => 09:44

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	10.8/18.0	94	370

REGISTERED CIVIL ENGINEER 8-19-20 DATE

August 31, 2020
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER JENNIFER ABRAMS No. 77782 Exp. 6-30-21 CIVIL STATE OF CALIFORNIA

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WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596

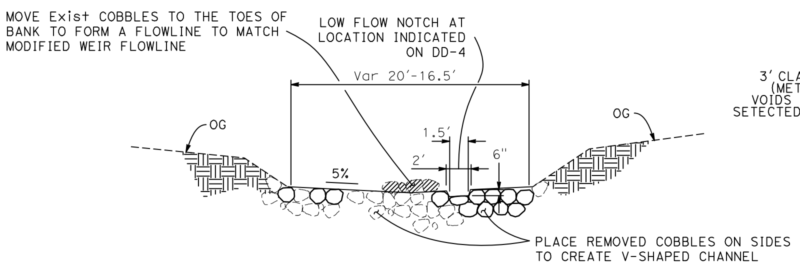
CALTRANS DISTRICT 4
111 GRAND AVE,
OAKLAND,
CA 94612

NOTES:

1. SEE DD-5 FOR NOTES AND ABBREVIATIONS.
2. BOULDERS ENCOUNTERED DURING EXCAVATION FOR STREAMBED THAT ARE GREATER THEN 3' NOMINAL DIAMETER, AND PROTRUED LESS THAN 1.5' ABOVE SUBGRADE MAY BE LEFT IN PLACE.
3. SEE PLANTING AND EROSION CONTROL PLANS FOR COMPOST SOCK AND WILLOW CUTTING DETAILS. HAND PLACE RSP AROUND THE CUTTING.

LEGEND:

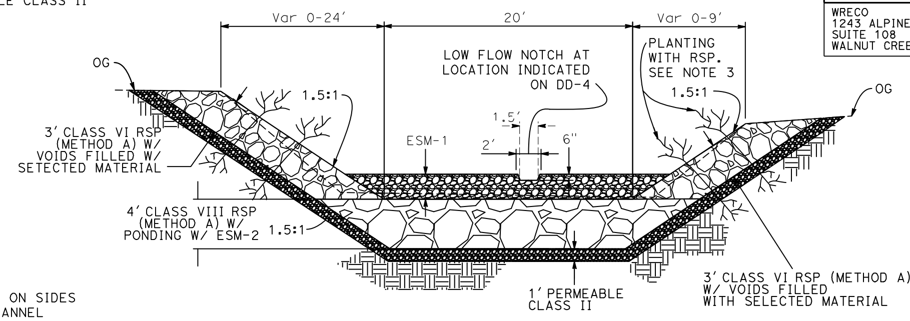
- CLASS VI RSP
- ESM-1
- CLASS VIII RSP
- 1' PERMEABLE CLASS II



TYPICAL SECTION

TYPICAL SECTION TYPE 1

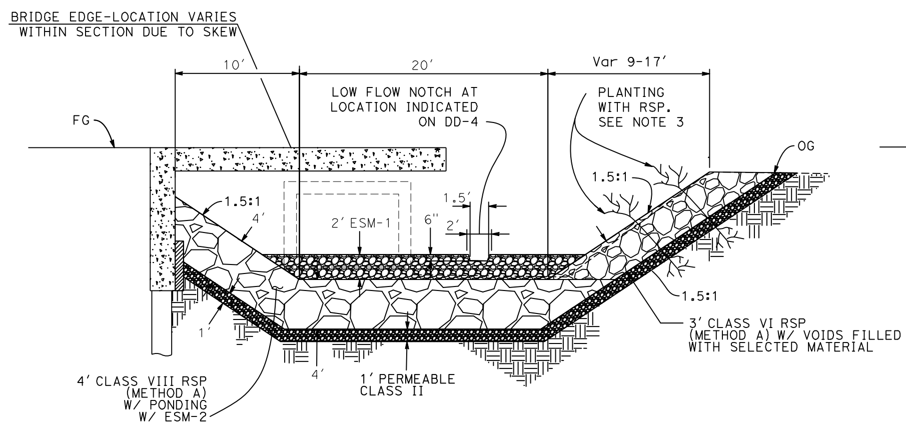
"SB" LINE 1+39 TO 1+65



TYPICAL SECTION

TYPICAL SECTION TYPE 2

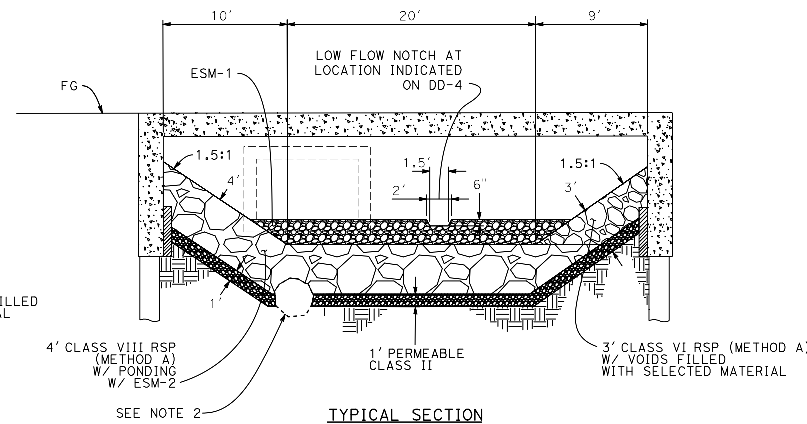
"SB" LINE 1+65 TO 1+90



TYPICAL SECTION

TYPICAL SECTION TYPE 3

"SB" LINE 1+90 TO 2+20



TYPICAL SECTION

TYPICAL SECTION TYPE 4

"SB" LINE 2+20 TO 2+50

DRAINAGE DETAILS

NO SCALE

DD-8

APPROVED FOR DRAINAGE WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: JENNIFER ABRAMS
CHECKED BY: CHRISTOPHER SEWELL
REVISED BY: JA
DATE REVISED: 4-19-19

LAST REVISION 04-19-19
DATE PLOTTED => 16-NOV-2020
TIME PLOTTED => 09:44

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	10.8/18.0	95	370

REGISTERED CIVIL ENGINEER 8-19-20 DATE

August 31, 2020
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER JENNIFER ABRAMS No. 77782 Exp. 6-30-21 CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

WRECO
1243 ALPINE ROAD
SUITE 108
WALNUT CREEK, CA 94596

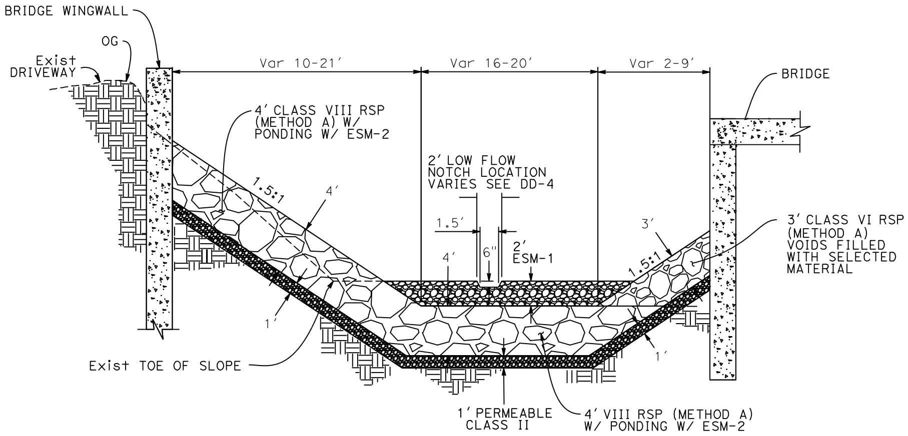
CALTRANS DISTRICT 4
111 GRAND AVE,
OAKLAND,
CA 94612

NOTE:

SEE DD-5 FOR NOTES AND ABBREVIATIONS.

LEGEND:

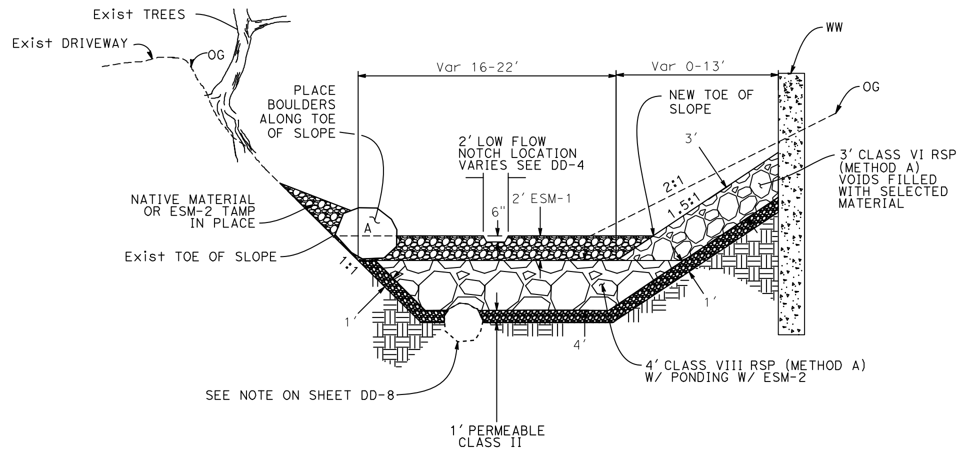
- CLASS VI RSP
- ESM-1
- CLASS VIII RSP
- 1' PERMEABLE CLASS II
- X STRUCTURAL ROCK



TYPICAL SECTION

TYPICAL SECTION TYPE 5

"SB" LINE 2+50 TO 2+80



TYPICAL SECTION

TYPICAL SECTION TYPE 6

"SB" LINE 2+80 TO 3+20

APPROVED FOR DRAINAGE WORK ONLY

DRAINAGE DETAILS

NO SCALE

DD-9

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG
CALCULATED-DESIGNED BY	JENNIFER ABRAMS
CHECKED BY	CHRISTOPHER SEWELL
REVISED BY	JA
DATE REVISED	4-19-19

LAST REVISION 04-19-19 DATE PLOTTED => 16-NOV-2020 TIME PLOTTED => 09:44

Appendix C CDFW 2005 Stonybrook Creek Memo

Interoffice Technical
MEMORANDUM

To: Marcia Grefsrud, Environmental Scientist
Central Coast Region

From: Kris Vyverberg, Senior Engineering Geologist
Fisheries Engineering Program, Headquarters

Date: 7 November 2005

Subject: State Highway 84 project at Palomares Road, Stonybrook Creek, Alameda County

Marcia,

The following comments and recommendations are based on my recent field assessment of the project area, my review of the conceptual project design, and our discussions in the field with Caltrans District 4 Hydraulic Design, Erosion Control, and Natural Resources staff and their project consultants from WRECO and CH_2MHill (M Grefsrud, DFG-CCR, K. Vyverberg, DFG-HQ; D. Breeden, A. Fowler, M. Gabil, C. Padick, C. Tomimatsu, Caltrans; H. Liang, WRECO, and A. Falzone, CH_2MHill in attendance, 2 November 2005).

Existing Conditions

The existing box culvert is sized for flow events with a recurrence interval of 25 years or less (Q_{25}). When higher flows occur the culvert capacity is exceeded and the creek overtops its bank and floods the highway at this location. The size and skewed alignment of the culvert to the creek has resulted in the impoundment of cobbles and boulders upstream of the culvert, and the excavation of a ±3 feet deep scour hole at the culvert outlet (see Attachment). The existing culvert is likely a complete physical barrier to juvenile steelhead migrating upstream, and likely a velocity barrier to adult steelhead migrating upstream during higher flow events.

Downstream of the scour hole, sediment trapped by an old grade control structure has formed an overly wide channel that is likely a barrier to fish passage during low flow conditions. The channel downstream of the grade control structure is a well-defined and fish passable boulder cascade.

At the confluence of Stonybrook Creek with Alameda Creek, a remnant of an old road and an abutment from an abandoned bridge also impede sediment movement.

Conceptual Project Design

Caltrans initially proposed to replace the existing culvert with a flat bottomed double box culvert, more or less along the same alignment but sized to pass somewhat higher Q_{50} recurrence interval flow events. Baffles were to be installed on the floor of the new culvert to establish water depths and velocities appropriate for unimpeded up- and downstream passage of juvenile and adult steelhead.

Subsequent hydraulic analyses indicated that a larger capacity structure would minimize highway flooding over a wider range of flow events, and the decision was made to replace the proposed double box culvert with a clear span bridge sized to pass the 100-year recurrence interval event. There is some indication that this reach of the creek will not contain a Q_{100} flow event due to past modifications of the channel and the backwater influence of nearby Alameda Creek on water surface elevations. However, given the work being done to remove barriers to flow and fish passage in the Alameda Creek watershed, Caltrans also recognizes the merits of increasing the size of the new structure in anticipation of future improvements in downstream and local conditions.

The current design concept calls for a clear span bridge on the same alignment as the existing culvert, and includes 19 boulder weir-type grade control structures that would begin ~20 feet downstream of the existing culvert outlet and extend upstream of the culvert inlet a distance of ~66 feet.

Comments and Recommendations

1. **A clear span bridge is the preferred alternative at this location.** I certainly agree with Caltrans that their design decisions should be informed by their knowledge of the evolving conditions in the watershed. The bridge is also the preferred alternative at this location for the following reasons:
   - The confluence of two creeks is an area where sediment will alternately be deposited and evacuated depending on runoff conditions and temporal changes in sediment supply from upstream sources. Over the long term, these cycles of aggradation and degradation are part of the natural adjustment of the channel to changes in flow and sediment supply and (viewed alone) are not necessarily indicators of channel instability. They do, however, suggest (to me) that a structure that can accommodate these cyclical changes in substrate elevation will perform more effectively from an ecosystem and engineering perspective than a channel spanning structure with a fixed substrate elevation like a box culvert. An appropriately sized clear span bridge will minimize the likelihood that the creek will detrimentally affect the structural integrity and performance of the bridge and allow the creek to naturally adjust its substrate elevation and channel form without interference from the structure.
2. **Consider adjusting the bridge alignment.** As we discussed in the field, there appears to be room to adjust the bridge alignment so that creek flows approach the new structure at less of an angle.
   - The more closely the flows parallel the new bridge abutments the less of an impediment the structure will be to the movement of sediment and woody debris. The less these natural transport processes are interfered with the less maintenance the bridge will require and the more likely habitat diversity and fish passage will be self-maintaining.
   - If the skew between the direction of flow and the new structure can be minimized, the

erosive forces on the right bank of the creek will be lessened. As we discussed in the field, the Department of Fish and Game would like to see the mature trees on the eroding right bank of the creek protected to the degree that they can be. Adjusting the alignment of the new bridge may provide more room for creative bank protection measures that can accommodate the trees.

- On an ancillary note, the left bank of the creek upstream of culvert inlet was covered at some time in the past with a generous coating of asphalt (see Attachment). It seems likely that the creek bank in this area will be reworked as part of the larger project, and that this material will be removed as part of this work. But just to be certain, Caltrans should be advised now that the asphalt must be removed at the time the project is constructed.

3. **Eliminate the proposed grade control structures.** Based on my conversation with NOAA Fisheries staff, the grade control structures incorporated into the bridge design appear to be a holdover from the initial proposal to build a box culvert. The box culvert would have required baffles to develop water depths and velocities suitable for fish passage through what would otherwise be a largely impassable flat-bottomed structure. If Caltrans proceeds with the clear span bridge we discussed in the field and the channel downstream of the new structure is regraded to match the grade upstream of the crossing, these grade control elements will not be necessary for fish passage
   - Beyond the gradient-flattening influence of the existing culvert, this reach of the creek has a naturally steep gradient defined by cobble-gravel riffle areas separated by boulder-cobble cascades. Although relatively steep, there is no reason why the channel would not be passable to juvenile and adult steelhead as long as a well-defined low flow channel is provided through the project reach.
   - As noted above, this is an area where we can expect to see regular fluctuations in sediment deposition and sediment removal. As such, it is a less than ideal location for boulder weirs with fixed elevations.
4. **Redesign or redistribute the boulders forming the boulder grade control feature downstream of the culvert outlet** (see Attachment). It seems likely that sometime in the past a high flow event evacuated sediment that had accumulated in the channel at this location, and that the grade control was built to prevent the channel degradation from migrating upstream to the culvert outlet and further deepening the scour hole and undermining the crossing. The channel downstream of the grade control is steeper, but appears to be quite stable. As noted above, this grade control structure is trapping sediment to the detriment of upstream channel form, habitat diversity and fish passage. Redistributing the boulders will allow the substrate elevation to naturally fluctuate with changes in flow and sediment supply. Alternatively, if the change in grade is too great to even out over the project reach, and it becomes necessary to keep some form of grade control at this location, then the structure should be redesigned to include a low flow channel notch consistent with the location and shape of the low flow channel immediately downstream.
   - On an ancillary note, there is an old concrete gate post buried to some unknown depth in the channel beneath and downstream of this grade control feature. As we discussed in the field, the post should be left in place unless it is apparent after the boulders are

relocated that the post can be easily removed without excessive disturbance of the creek substrate.

5. **Remove the old road remnant and the bridge abutment at the confluence of the creeks** (see Attachment). As noted above, these structures are impeding the movement of sediment from the tributary into Alameda Creek. The removal of these structures will help maintain the form of the low flow channel and fish passage through the project reach. As we discussed in the field, these structures should be broken down with a jackhammer and the concrete and asphalt debris removed from the stream corridor. Rock from the road remnant that is relatively free of asphalt and concrete may be left on site. The old bridge abutment should be broken off at ground level; the footing of the structure should be left in place and not exhumed from the substrate, and any exposed rebar should be cut off or ground down so that it poses no hazard to fish, wildlife, or human beings.

In summary, based on our discussions in the field, it is my understanding that (1) Caltrans now intends to build a clear span bridge at this location, (2) that they will revisit the alignment of the new structure to see if the angle between the creek and the structure can be improved upon, (3) that they will eliminate the proposed grade control elements and regrade the channel to match the naturally steep gradient up- and downstream of the existing culvert, and (4) that they will remove or modify the impediments to sediment movement identified downstream of the existing culvert.

Call if you have any questions, or would like to discuss any of these topics further.

Regards,

Original signed by

Kris Vyverberg
Senior Engineering Geologist
Fisheries Engineering Program
Native Anadromous Fish and Watershed Branch

Attachment

cc: Department of Fish and Game
Kristine Atkinson, CCR
Marcin Whitman, Fisheries Engineering Program

Caltrans – District 4
Dave Yam

NOAA Fisheries
Gary Stern
Steve Thomas

Cobble-boulder substrate of channel upstream of culvert inlet. Channel grade estimated to be 7-8%.

Culvert outlet and downstream scour hole.

Channel upstream of culvert showing skew of the culvert inlet to the alignment of the channel, the location of the driveway, and the bank erosion along the right bank of the creek.

Detail of bank erosion between the driveway and right bank of Stonybrook Creek.

Culvert inlet showing skew of the culvert to the alignment of the channel. Note use of asphalt on the bank at the interface between the bank and left abutment of the culvert.

Detail of asphalt bank protection used on the left bank of the creek.

Old grade control feature downstream of culvert outlet. This feature spans the channel and is trapping finer gravels. Between the scour hole at the culvert outlet and these boulders the creek bed is flat and overly wide with no defined low flow channel. Downstream of the boulders the channel is a steeper boulder cascade with a well defined, fish-passable low flow channel.

Old bridge abutment and road crossing remnant at the confluence of Stonybrook Creek with Alameda Creek.

Detail of old crossing remnant on the right bank of Stonybrook Creek at the confluence of Alameda Creek. The crossing element is composed of rock and concrete with asphalt paving on the top surface.

Appendix D Stonybrook Creek Geomorphic Assessment (2019)

Niles Canyon Safety Improvement Project
Alameda County, California
Proj ID 0414000039 EA 04-2A3321

Stonybrook Creek Geomorphic Assessment

Prepared for:

Prepared by:

WRECO

May 2019

04-ALA-84
PM 10.8/18.0
Proj ID 0414000039 EA 04-2A3321

Niles Canyon Safety Improvement Project
Alameda County, California
Proj ID 0414000039 EA 04-2A3321

Stonybrook Creek Geomorphic Assessment

Submitted to:
California Department of Transportation

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

____
Analette Ochoa, P.E.
Registered Civil Engineer

____
Date

____
Travis Baggett, M.S.
Fluvial Geomorphologist

____
Date

May 2019

Table of Contents

Figures

Photos

Executive Summary

The California Department of Transportation (Caltrans) proposes to construct safety improvements at several specific locations along the SR 84 corridor from postmile (PM) 10.8 at SR 238 (Mission Boulevard) in Fremont to PM 18.0 at Interstate 680 (I-680) near the town of Sunol (see Figure 1). The proposed project involves several components, including: installation of traffic signs and lighting, low speed curve improvements, installation of K-rail and Midwest guardrail system, installation of a rock drapery system, signalization, limited shoulder widening, and the replacement of one culvert at Stonybrook Creek with a single-span bridge.

The purpose of this report is to describe the existing fluvial geomorphic conditions and processes at the location of the crossing of State Route (SR) 84 and Stonybrook Creek. The existing box culvert at PM 12.93 on SR 84 will be replaced with a clear span bridge as part of the project to improve conditions along SR 84 in Niles Canyon.

The fluvial geomorphic processes in Stonybrook Creek transitions from one regime to another within the Stonybrook Creek culvert replacement site. Upstream of the existing culvert, Stonybrook Creek is a confined channel of moderately steep slope with bankfull geometry similar to what is observed throughout the San Francisco Bay Area. The upstream reach has step pools and runs over coarse sediment. Downstream of the culvert, the channel form appears to be influenced by high flows from Alameda Creek. The downstream reach is depositional with a cobble bar present in the middle of the channel at the time of observations.

The Caltrans project will remove a box culvert and replace it with a bridge over Stonybrook Creek. The bridge design is a clear span with the distance between abutments of approximately 45 feet measured perpendicularly to Stonybrook Creek. The distance between abutments is much wider than Stonybrook Creek upstream of the existing culvert, and therefore allows the design of the channel beneath the bridge to mimic the channel geometry upstream of the existing culvert. The design of the channel must also satisfy the Federal Highway Administration and Caltrans rules for flood conveyance capacity to the maximum extent practical. Private property along the right bank of Stonybrook Creek limits the footprint of the proposed grading. To the extent practical, while still conforming to flood conveyance rules, the design will approximate the upstream channel geometry and improve fish passage conditions in order to obtain the necessary environmental permits. Environmental permits that will be required for the project include: a biological opinion from the National Oceanic and Atmospheric Agency's National Marine Fisheries Service, a streambed alteration agreement from the California Department of Fish and Wildlife, and a water quality certification from the San Francisco Regional Water Quality Control Board.

Acronyms

ARCD	Alameda County Resource Conservation District and Natural Resources Conservation Service
Caltrans	California Department of Transportation
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
I-680	Interstate 680
NMFS	National Marine Fisheries Service
PM	Postmile
RWQCB	Regional Water Quality Control Board
SR	State Route
USGS	United States Geological Survey

1 INTRODUCTION

The purpose of this report is to describe the existing fluvial geomorphic conditions and processes at the location of the crossing of State Route (SR) 84 and Stonybrook Creek. The existing box culvert at postmile (PM) 12.93 on SR 84 will be replaced with a clear span bridge as part of a larger project to improve conditions along SR 84 in Niles Canyon.

1.1 Project Description and Scope of Report

The California Department of Transportation (Caltrans) proposes to construct safety improvements at several specific locations along the SR 84 corridor from PM 10.8 at SR 238 (Mission Boulevard) in Fremont to PM 18.0 at Interstate 680 (I-680) near the town of Sunol (see Figure 1). The proposed project involves several components, including: installation of traffic signs and lighting, low speed curve improvements, installation of K-rail and Midwest guardrail system, installation of a rock drapery system, signalization, limited shoulder widening, and the replacement of one culvert at Stonybrook Creek with a single-span bridge. The scope of this report is limited to the conditions of Stonybrook Creek at the proposed crossing (see Figure 2).

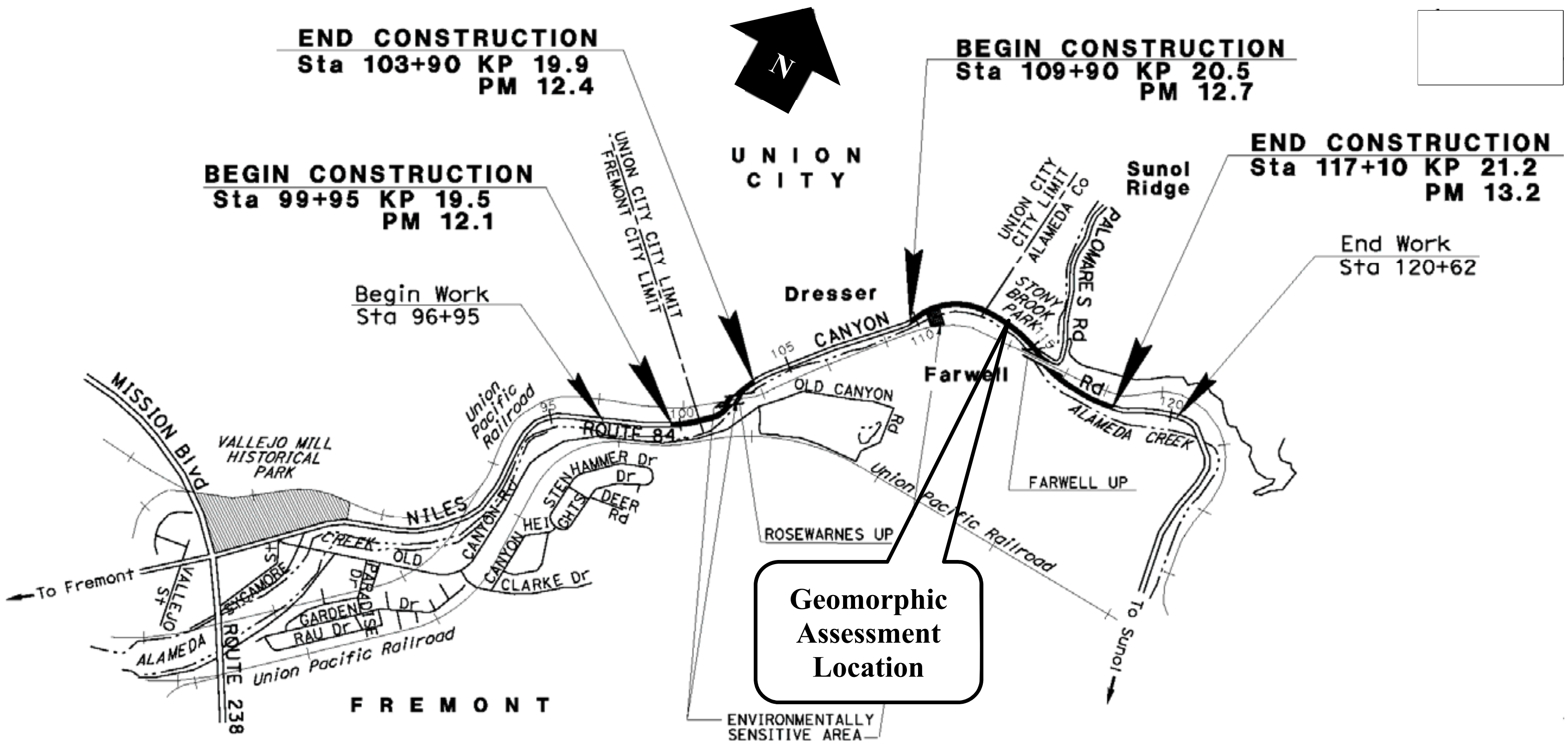


Figure 1. Project Limits and Geomorphic Assessment Location

Source: Caltrans

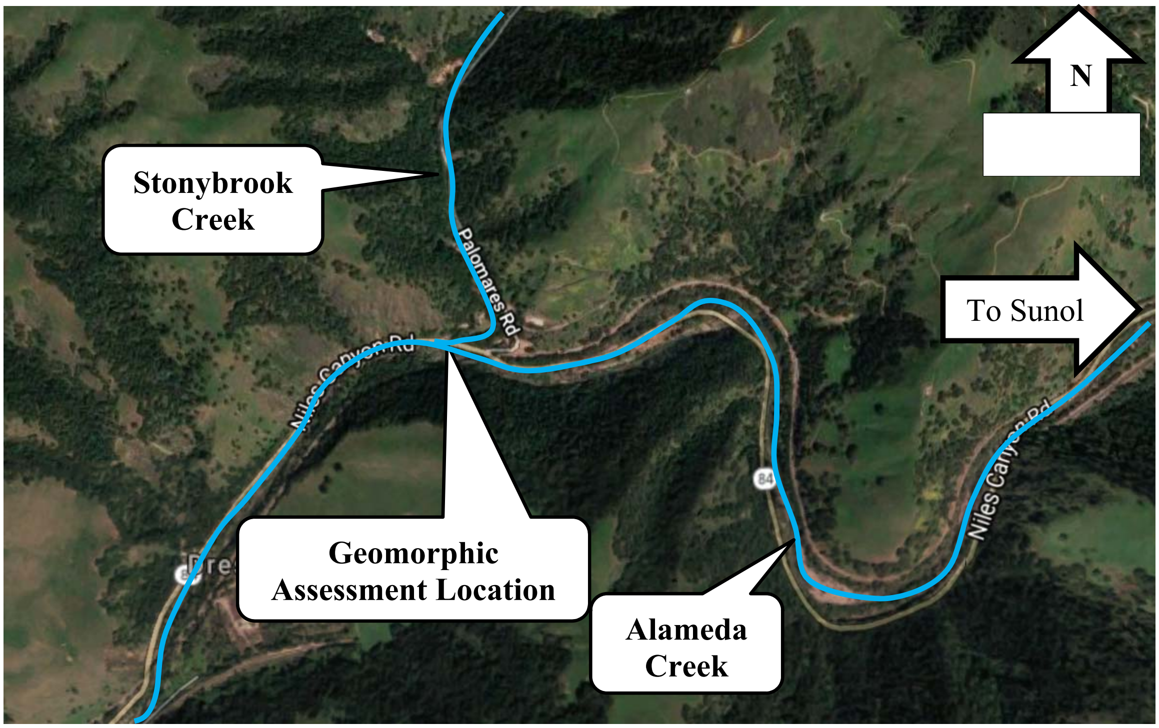


Figure 2. Aerial Photo in the Vicinity of the Geomorphic Assessment

Source: Google

1.2 Stonybrook Creek Proposed Improvements

The new Stonybrook Creek Bridge will span approximately 50 feet over Stonybrook Creek in order to facilitate the installation of the abutments while staying outside of the creek. The length of the new bridge will be approximately 55 feet measured along the road surface. The proposed bridge is clear span, and it will consist of a cast-in-place slab or precast I girders which will sit on diaphragm or seat-type abutments founded on 24-inch diameter cast-in-drilled-hole piles. The total width of the bridge, measured perpendicular to roadway alignment, will be 50 feet and 4 inches (see Figure 3), consisting of a 2-foot-wide median rumble strip, two 12-foot-wide travel lanes, two 8-foot-wide shoulders, and 2 feet on either side of the bridge for installation of the bridge railing.

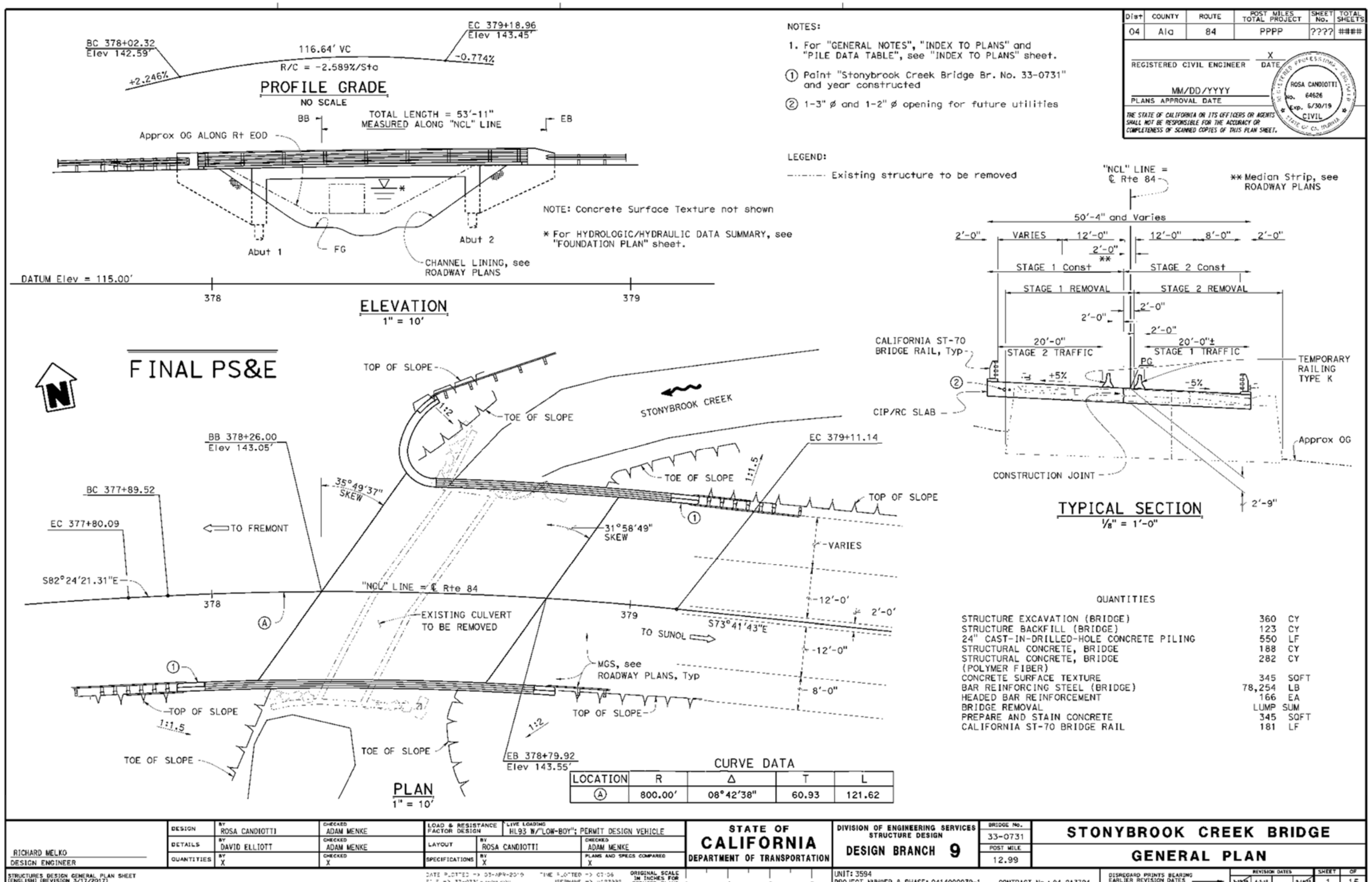


Figure 3. Proposed Stonybrook Creek Bridge General Plan

Source: Caltrans

1.3 Habitat Value in the Vicinity of the Stonybrook Creek Culvert Replacement

The Alameda County Resource Conservation District and Natural Resources Conservation Service (ARCD) prepared the *Natural Habitats, Species and Vegetation at the Stonybrook Creek Fish Passage Improvement Upgrades (*ARCD, 2013) for a fish passage improvement project approximately 1 mile upstream of the SR 84 crossing. This environmental assessment found that although anadromous populations of Central California Coast Steelhead (*Oncorhynchus mykiss*) are not known within the stream due to existing downstream barriers, resident rainbow trout have been observed.

The environmental assessment also lists Alameda whipsnake (*Masticophis lateralis euryxanthus*) as having moderate potential to be present, California red-legged frog (*Rana draytonii*) as having high potential to be present, and Western pond turtle (*Emys marmorata*) as having moderate potential to be present. For these species, the reach of Stonybrook Creek near the SR 84 crossing is not ideal habitat but is adjacent to better habitat, and therefore, the reach of Stonybrook Creek near the SR 84 crossing may serve as a movement corridor between better habitat areas.

2 FLUVIAL GEOMORPHIC PROCESSES

2.1 Field Observation Methods

WRECO staff made observations of Stonybrook Creek in the vicinity of the SR 84 crossing on two occasions: April 16 and April 24, 2019. Observations included visual assessment of the channel during a low-flow period and basic fluvial geomorphic surveying. No benchmarks were found that were close enough to be surveyed safely, and therefore, the survey was adjusted to the Project datum by adjustment to the upstream edge of the invert of the existing culvert. Access for observations and surveying was limited by private property, and the survey was performed from approximately 140 feet upstream of the existing culvert to 75 feet downstream of the existing culvert.

Sediment particle size-distribution analysis was performed visually due to many of the particles being of boulder class embedded in fines in a pavement layer.

2.2 Existing Conditions in the Vicinity of the SR 84 Crossing

The crossing of SR 84 over Stonybrook Creek is located about 100-feet upstream of the confluence of Stonybrook Creek and Alameda Creek. Alameda Creek at the confluence has a watershed of 624 square miles of which approximately 15% is urbanized (StreamStats). Stonybrook Creek at the crossing has a watershed of 6.9 square miles and is 4.1% urbanized. The close proximity of Alameda Creek to the crossing is significant, because Alameda Creek experiences peak flows which cause backwater influences to the flow of Stonybrook Creek at the crossing.

The watershed of Stonybrook Creek is located between Walpert Ridge and Sunol Peak. The hillsides are steep relative to other watersheds in Alameda County. Geologic mapping of the watershed identifies the bedrock formations as primarily an unnamed sandstone and shale. Because the channel is in a narrow canyon with steep slopes, and the canyon walls are composed of the erodible material (sandstone and shale), a portion of the bed material is formed of colluvium (material delivered via hillslope erosion processes). As a result, the sediment size range includes boulders and material larger than what is expected to be transported by flowing waters. Sediment observed near the crossing includes boulders measured as large as 36 inches in diameter. Similar conditions were observed upstream of the SR 84 crossing (see Photo 1). The report *Stonybrook Creek Fish Passage Assessment* described similar observations as typical of the majority of Stonybrook Creek (Love, 2001).

Photo 1. Stonybrook Creek Approximately 1 Mile Upstream of SR 84, Facing Upstream (April 2019)

The crossing of SR 84 over Stonybrook Creek is located where Stonybrook Creek exits a narrow canyon and discharges into Alameda Creek, which flows through the wider Niles Canyon (see Figure 4). Upstream of the SR 84 crossing, Stonybrook Creek's morphology is described as step-pools and short runs over large sediment material. Downstream of the SR 84 crossing Stonybrook Creek is no longer confined by canyon walls or manmade structures, and the geomorphic processes are also influenced by the much larger Alameda Creek. The SR 84 crossing is located at a transition zone between fluvial geomorphic regimes on Stonybrook Creek.

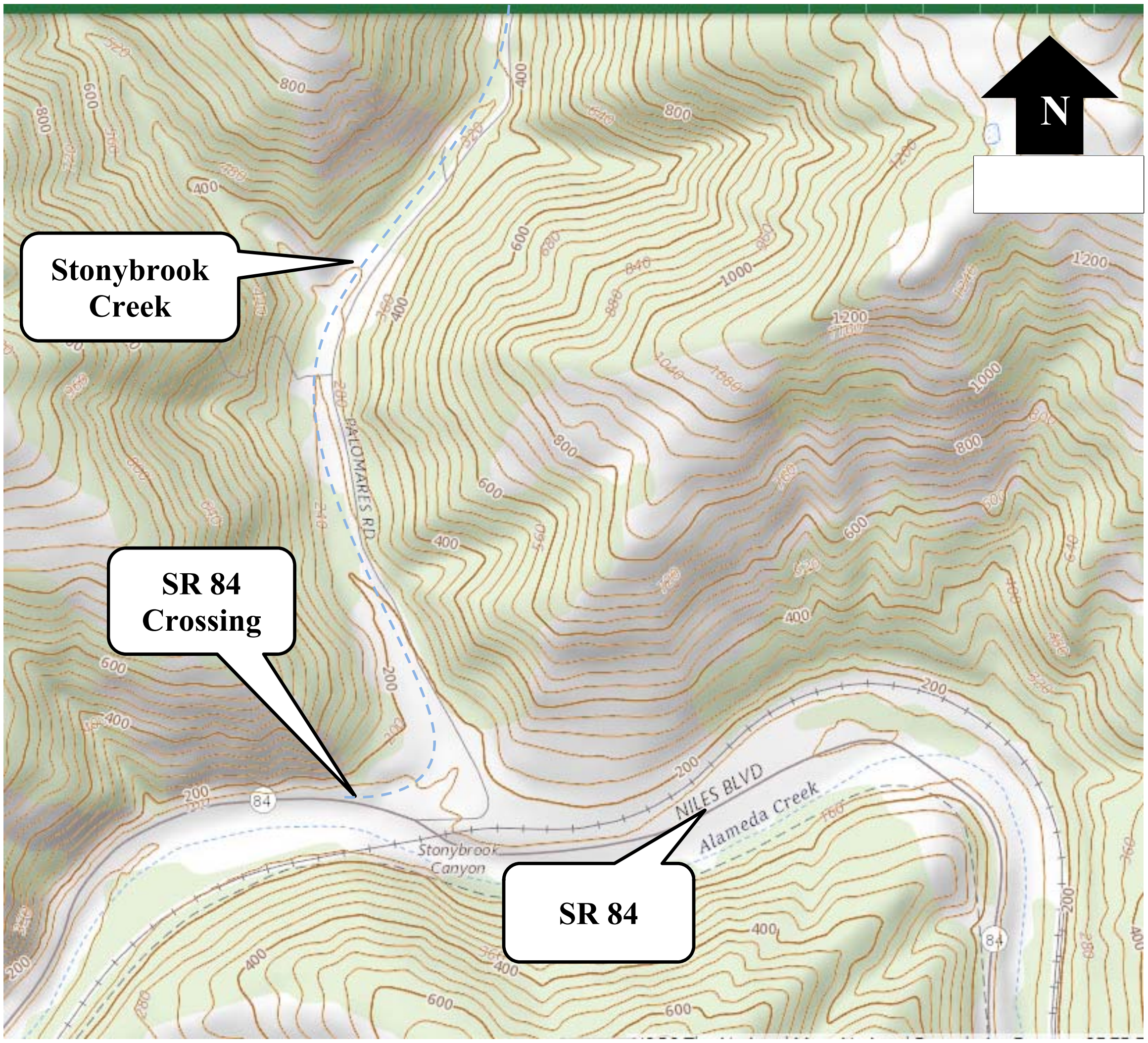


Figure 4. Topology in the Vicinity of the SR 84 Crossing

Source: USGS

Upstream of the SR 84 crossing, Stonybrook Creek is moderately steep in slope (5 to 7%). Stonybrook Creek flows from north to south for most of its length. Approximately 350-ft upstream of the crossing the creek turns to the right more than 90 degrees and flows to the west. At this location, the left bank (outside bend) is armored with a wall of grouted rock (see Photo 2) through the curve and into a relatively straight section. Along this reach, the channel form includes boulder step pools spaced 20 to 30 ft apart (see Figure 5 and Photo 3). The observed step pools do not have the typical pool depth observed in other step-pool creeks. The pools are not formed immediately downstream at the step and are instead closer to the next downstream step. This is expected to be the result of a pavement layer, which is resistant to the erosive forces of plunging flow over the step. Additionally, the reach is not strictly step-pools, and some sections are better described as runs with coarse bed material. This pattern continues to where the creek turns to the left approximately 90 degrees and flows into the existing culvert at the crossing of SR 84 over Stonybrook Creek. This sinuosity appears to be man-made, or at the least is maintained by the presence of the grouted wall, the culvert, and the SR 84 road prism.

The sediment particles observed in the reference reach ranged from fines to large boulders, many around 12 inches and the largest up to 36 inches in diameter.

Photo 2. Grouted Rock Wall on Left Bank, Facing Downstream (April, 2019)

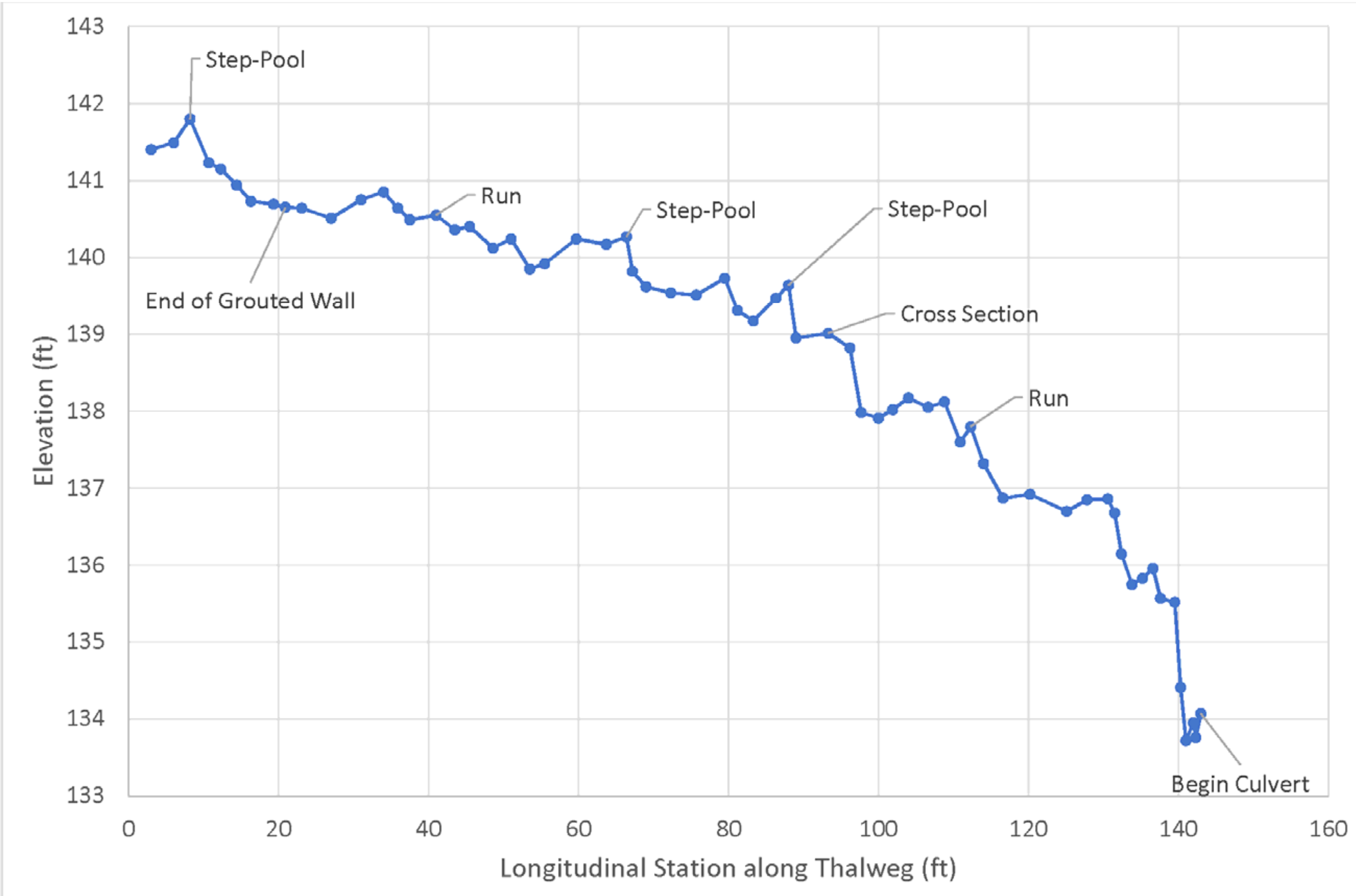


Figure 5. Longitudinal Profile of Stonybrook Creek Upstream of the Existing Culvert, Geomorphic Survey, April 2019

Photo 3. Boulder Step Pools Upstream of the Existing Culvert, Facing Upstream, (April 2019)

A cross section of Stonybrook Creek was surveyed at a hydraulic constriction where a riffle crest corresponded with trees on both banks. This location is approximately 50 feet upstream of the existing culvert (see Figure 5). The bankfull depth was about 2 feet and width was about 20 feet (see Figure 6). Comparing those data to the original Leopold Regional Curves for the San Francisco Bay Area, the bankfull geometry is smaller than typical (Leopold and Maddux, 1953). A thorough dataset of streams in the East Bay Area is not available, so the natural range of variability from a North Bay Area study was used (Collins and Leventhal, 2013). Based on that study, the surveyed cross section on Stonybrook Creek is within the range of natural variability of different stream geometry. Therefore, this cross section is believed to be a suitable geometry representing stable conditions for Stonybrook Creek upstream of the existing culvert.

The flood-prone geometry is not used as extensively as the bankfull geometry but can provide insight to the channel. The flood-prone geometry is the portion of the channel above the bankfull geometry and is formed by less common peak flow events. The shape of the cross section does not include any flat areas above the bankfull level. The absence of these floodplains or benches wetted during high flows is typical of what was visually observed along this reach.

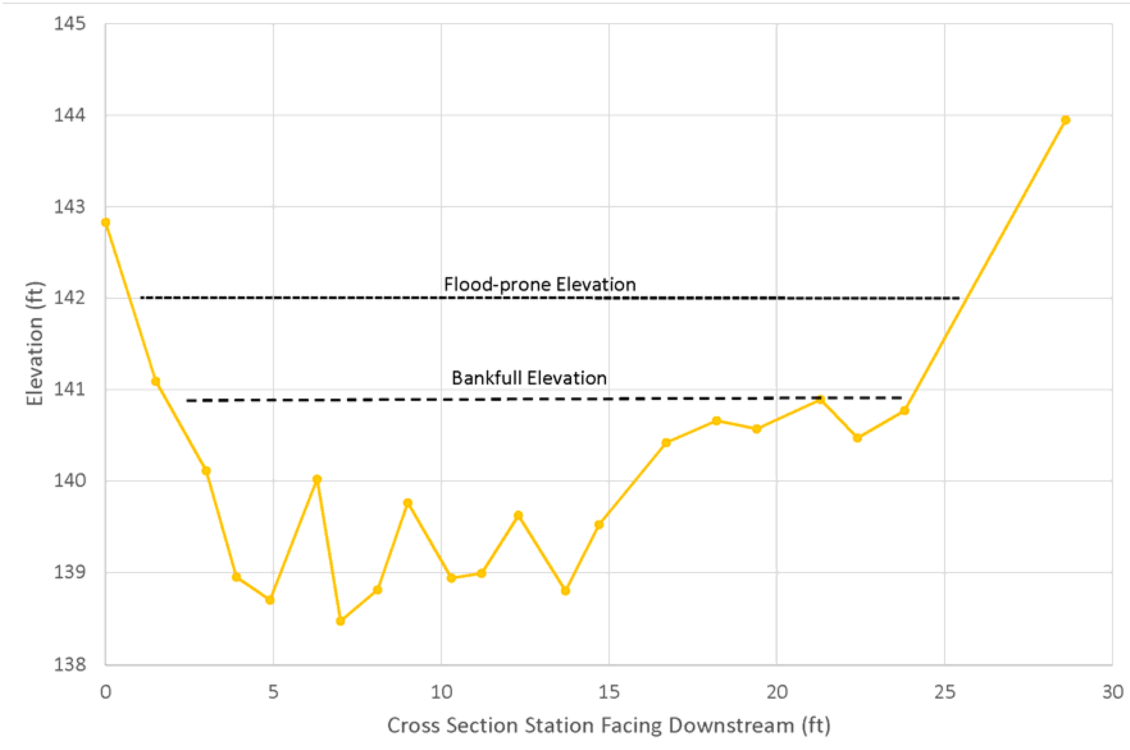


Figure 6. Cross Section of Stonybrook Approximately 50 feet Upstream of the Existing Culvert, Geomorphic Survey, April 2019

The bankfull width is approximately 21 feet, and depth is approximately 1.2 feet, which calculates out to a bankfull area of 25.2 square feet and a width to depth ratio of 17.4. The flood-prone width is estimated to be 28.6 feet, giving the channel an entrenchment ratio of 1.3, which is considered entrenched.

The final hydraulic report for the proposed bridge over Stonybrook Creek found that the existing culvert capacity is limited to flows less than the 5-year return interval peak-flow (Caltrans, 2018). The Stonybrook Creek Fish Passage Assessment reports that the restriction of flow at the many existing culverts in Stonybrook Creek also restrict bedload sediment transport, resulting in a depositional environment immediately upstream of road crossing culverts over Stonybrook Creek (Love, 2001).

The channel immediately upstream of the SR 84 crossing is dominated by boulders ranging in size from 12 inches in diameter up to 36 inches in diameter. There are finer materials deposited in lower energy environments such as on the banks, behind large boulders, and in the spaces between the larger sediment particles. These deposits are no more than a few inches deep and are not common. In other, higher energy environments within the channel, the finer material is less mobile and is a component of the pavement layer. Absent are sediment bars of either sand, gravel, or other mobile material which typically deposit as high flows recede and can no longer transport sediment. These observations indicate that this reach of Stonybrook Creek transports most of the bedload material than is supplied from upstream.

After exiting the culvert, the creek flows south for approximately 100 feet before discharging to Alameda Creek. This portion of Stonybrook Creek is a different geomorphic regime where Stonybrook Creek is not confined by canyon walls or manmade structures, and the geomorphic processes are also influenced by the much larger Alameda Creek. The reach is dominated by large cobbles (6 to 8-inches).

There is no exact boundary between Stonybrook Creek and Alameda Creek. Observations made in April 2019 indicated that at low flows, Stonybrook Creek has a direct flow path and enters Alameda Creek perpendicularly (see Photo 4). This flow path includes a step pool complex that appears to be at the bankfull elevation of Alameda Creek (see Figure 7). Located at the step pools and running perpendicular to Stonybrook Creek but parallel to Alameda Creek, there are well-established willows running at least 50 feet along the length of Alameda Creek upstream and downstream of Stonybrook Creek. From the perspective of Alameda Creek, these willows are part of the riparian habitat near the bankfull level of Alameda Creek. It is believed that during high flows, when Alameda Creek flows are elevated, Stonybrook Creek flows are prevented from discharging to Alameda Creek along the low flow channel. It is believed that high flows from Stonybrook Creek flow parallel to Alameda Creek in the downstream direction for at least 50 feet. This theory is supported by observations of a cobble-lined channel located above the well-established willows of Alameda Creek that appears to be the flow path of Stonybrook Creek when Alameda Creek has high flows.

The nearest streamflow gaging station to the crossing is the United States Geological Survey (USGS) station on Alameda Creek near Niles, approximately 1.2 miles downstream of where Stonybrook Creek discharges into Alameda Creek (USGS, 2019). The peak flow at that station for the past winter was 6,680 cubic feet per second (cfs), which is equivalent to a 3- to 5-year return period flow. Based on high water marks observed on April 16, 2019, the peak flows in between the culvert outfall and Alameda Creek during the winter of 2018/2019 appear to have reached as high as the outfall of the culvert at the crossing. This is believed to be the result of a combination of elevated flows in Alameda Creek, elevated flows in Stonybrook Creek, and a backwater effect of Alameda Creek on Stonybrook Creek.

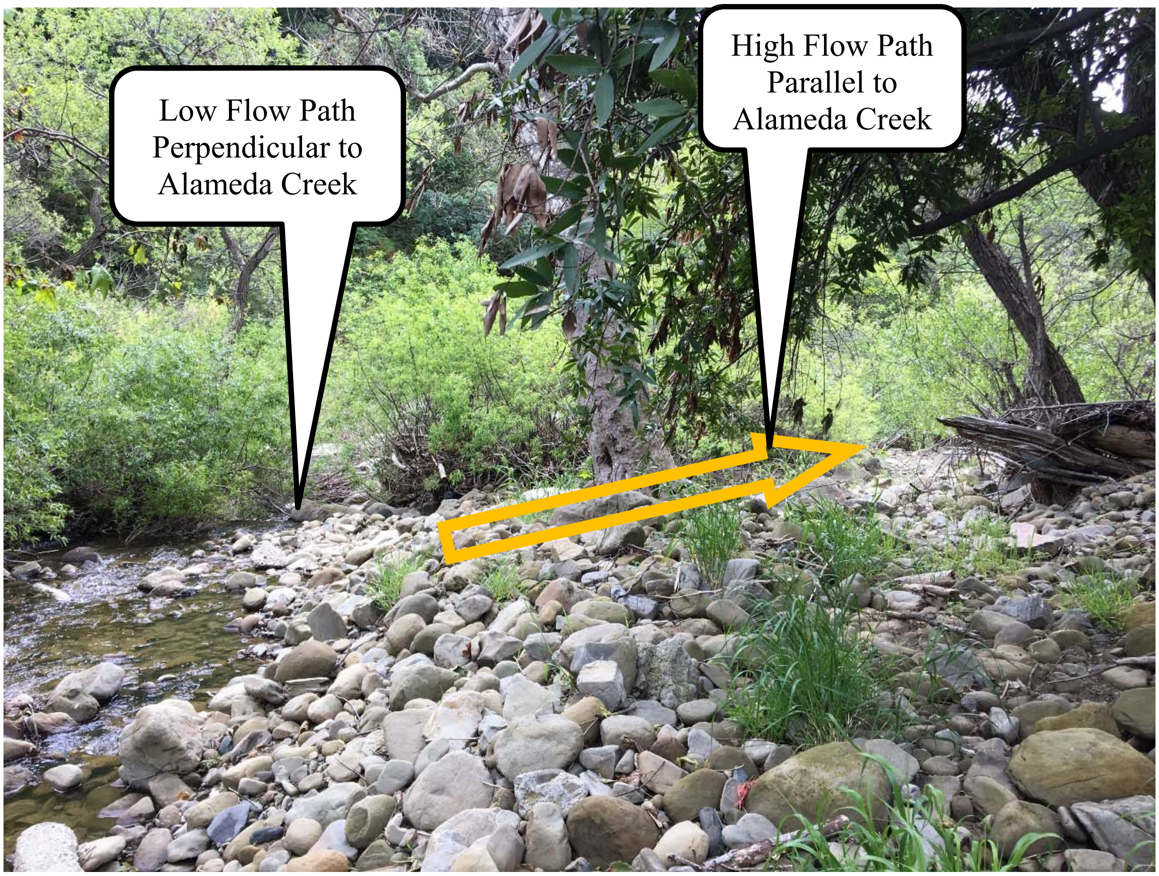


Photo 4. Facing Downstream of the Existing Culvert, Stonybrook Creek (April 2019)

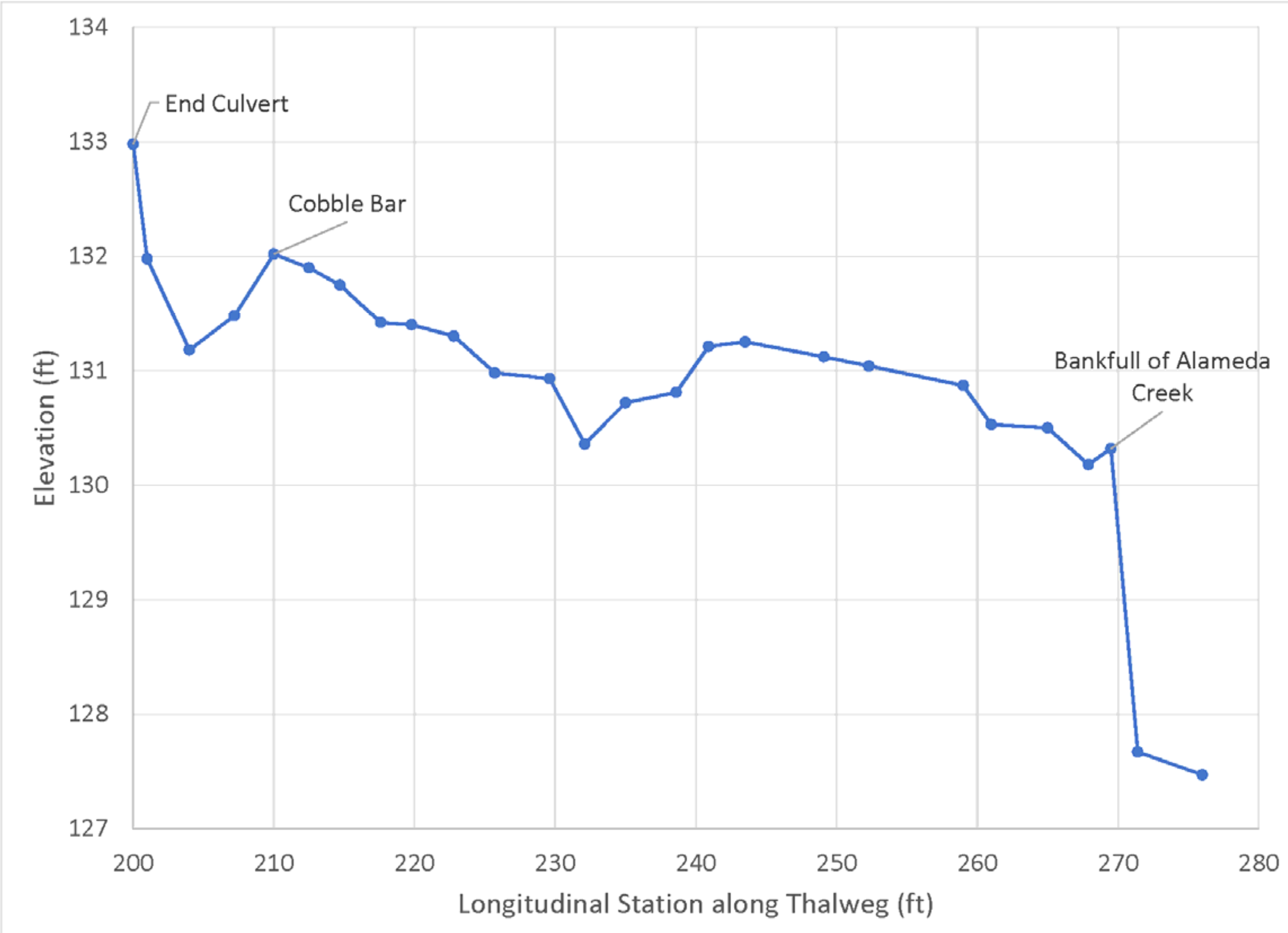


Figure 7. Longitudinal Profile of Stonybrook Creek Downstream of the Existing Culvert, Geomorphic Survey, April 2019

Because of the influence of Alameda Creek, a representative cross section of Stonybrook Creek was not located downstream of the crossing. The channel cross section at the existing culvert outfall has a vertical left bank formed by sycamore and other riparian trees and a low-slope right bank influenced by the SR 84 road prism. Moving in the downstream direction, the right bank moves further away from the channel to the point that the right bank runs perpendicular to the Stonybrook low-flow channel and parallel to Alameda Creek. Because of these conditions, the geometry downstream of the culvert could not be quantified.

Flow discharging from the existing culvert has formed a scour pool which was about 2 feet deeper than the culvert outfall (see Figure 7). This pool is lined with cobbles (see Photo 5), and a cobble bar has formed a short distance (about 10 feet to the crest of the bar) downstream of the culvert outfall. The cobble bar extends across the channel and in the downstream direction. The right bank is composed of cobbles as well, and the channel Stonybrook Creek follows when Alameda Creek flows are high is composed of well-sorted cobbles and is clear of vegetation.

Photo 5. Downstream Face of Culvert, April 2019

This condition was compared to observations made in 2018 and 2004 (see Photo 6 and Photo 7). The observations made in 2004 found the area immediately downstream of the culvert was lower than the culvert outfall by several feet. These observations show that the geometry of Stonybrook Creek in the vicinity of SR 84 is variable. These observations also show that Stonybrook Creek transports sediment in the size range of large cobbles.

Photo 6. Downstream Face of Culvert, May 2018

Source: Garcia and Associates

Photo 7. Downstream Face of Culvert, October 2004

The change in channel geometry at the downstream face of the culvert is believed to be due, at least in part, to variability in the timing of peak flows in Alameda Creek and Stonybrook Creek. The two watersheds are very different sizes, and therefore, the conditions which lead to peak flows in one are not the same conditions which lead to peak flows in the other. Whether Alameda Creek has high flows or low flows when Stonybrook Creek has high flows will lead to different sediment deposition patterns.

2.3 Summary of Existing Fluvial Geomorphic Processes

The fluvial geomorphic processes in Stonybrook Creek transition from one regime to another at the SR 84 crossing over Stonybrook Creek. Upstream of the culvert Stonybrook Creek is a confined channel of moderately steep slope with bankfull geometry similar to what is observed throughout the San Francisco Bay Area. The upstream reach has step pools and runs over coarse sediment. Downstream of the culvert the channel form appears to be controlled by high flows from Alameda Creek, and no areas suitable for measuring cross sections were found. The upstream reach and the culvert both appear to transport the majority of the sediment supply. However, the downstream reach is sometimes depositional and sometimes transports sediment. A cobble bar present in the middle of the channel in April 2019, but absent during observations made in 2004.

3 DESIGN GOALS

The Caltrans project will remove the box culvert and replace it with a bridge over Stonybrook Creek. The bridge design is a clear span with the distance between abutments of approximately 45 feet measured perpendicularly to Stonybrook Creek. The distance between abutments is much wider than Stonybrook Creek upstream of the existing culvert and therefore allows the design of the channel beneath the bridge to mimic the channel geometry upstream of the existing culvert. The design of the channel must also satisfy the Federal Highway Administration and Caltrans rules for flood conveyance capacity to the maximum extent practical. Private property along the right bank of Stonybrook Creek limits the footprint of the design. To the extent practical, while still conforming to flood conveyance rules, the design will mimic the upstream channel geometry and improve fish passage conditions.

The design proposes to reconstruct the channel where the existing culvert will be removed. The channel geometry will mimic the geometry observed upstream of the existing culvert. The wider channel will have a greater flow capacity than the existing culvert and will convey higher flows before creating a backwater effect upstream of the crossing.

The stream simulation design (SSD) will mimic the conditions observed at the reference reach. The selection of a reference reach is limited by private property along Stonybrook Creek. The chosen reference reach is the reach upstream of the crossing described in Section 2.2. That reach is observed to have a slope of approximately 5%. The bankfull width is approximately 21 feet, and depth is approximately 1.2 feet, which calculates out to a bankfull area of 25.2 square feet and a width to depth ratio of 17.4. The flood-prone width is estimated to be 28.6 feet, giving the channel an entrenchment ratio of 1.3, which is considered entrenched. The sediment particles observed in the reference reach ranged from fines to large boulders. A visual estimate of the dominant sediment size estimated a particle size that is greater than 10 inches, which is defined by CDFW as boulders.

The design proposes to reconstruct the channel to include complexity formed by rock steps, boulders, and rock clusters along the banks that act as "wing deflectors" as described by CDFW. Together, these features mimic the reference reach in that they result in a decrease in streamflow velocity in the downstream direction by increasing channel roughness. Because the existing sediment consists of a range of sediment including particles too large to be transported during high flows, the large rocks proposed are similar to the existing range of sediment particle sizes. The design will include filling the interstitial space between the large rocks with finer material to minimize the flow lost to flow through the bed. This is similar to the existing conditions of the reference reach that was observed to include a pavement layer of fines.

The reconstructed reach will be designed such that the channel profile will conform to the channel upstream and downstream of the reach beneath the proposed bridge, creating a slope which is resistant to erosion. The design of the reconstructed reach will improve fish passage conditions over the existing culvert to the extent practical while maintaining flood conveyance. The design will also include features that will result in a channel profile resistant to headcut erosion.

3.1 Proposed Improvements

The impact of the reconstructed reach on the channel upstream and downstream is considered. The design is intended to maintain the existing dynamic stability of the channel and to improve fish passage through the reconstructed reach.

The proposed SSD will extend upstream of the SR 84 crossing over Stonybrook Creek in order to create a longitudinal channel slope of approximately 4.5%. In the existing condition, the channel is relatively stable to headcut erosion due to the presence of large colluvium particles not transported by most high flows. These large particles assist in the creation of stable rock steps by obstructing flow and interlocking with smaller particles. The proposed SSD includes large rock, mimics this natural step pool formation, and is expected to be resistant to headcut erosion.

The existing culvert creates a backwater effect on the upstream side of the culvert during flows greater than the 5-year return period. The backwater effect slows the flow velocity resulting in decreased sediment transport. The design of the reconstructed reach will have a greater flow capacity than the existing culvert and will result in less hydraulic change where Stonybrook Creek crosses SR 84.

The existing culvert has a flat, concrete bottom which has a low resistance to flow. The culvert is also narrower than the upstream and downstream reaches. Combined, these factors lead to a reach of high velocity flow, corresponding transport of the full sediment supply. When this reach is reconstructed, it will be wider, and the wetted surface will be rougher, resulting in lower streamflow velocity. The lower velocity will result in a corresponding decrease in the sediment transport, especially of the largest particles transported by Stonybrook Creek. Observations have shown that Stonybrook Creek transports material up to the size large cobbles in the existing condition. Sediment deposition is expected to occur through the reconstructed reach until a balance is achieved through natural processes. The increase of sediment deposition is closer to what is expected in an unaltered reach of Stonybrook Creek. Predicting the pattern of sediment deposition, especially for sediment particles larger than gravel, is beyond the state of the science. It is expected that sediment deposition patterns along the reconstructed reach will be no more likely to result in fish passage barriers than what is expected upstream of the reconstructed reach.

At flows higher than the 5-year return period, the recreated channel will convey the flows more freely and the downstream reach will experience higher discharge from Stonybrook Creek than in the existing condition. As a result, larger sediment particles may be transported to the downstream reach, which is closer to the sediment transport occurring upstream of the reconstructed reach. High flow in Alameda Creek is believed to cause Stonybrook Creek flows to experience backwater effects, and therefore, sediment deposition patterns are variable.

4 REFERENCES

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Appendix E Amendment to Stonybrook Creek Geomorphic Assessment (2019)

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Memorandum

Date: June 17, 2019

To: Caltrans District 4

From: Analette Ochoa and Travis Baggett - WRECO

Subject: Niles Canyon Safety Improvement Project, Project ID 0414000039 EA 04-2A3321 Amendment to the Geomorphic Assessment

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INTRODUCTION

This memorandum is an amendment to the Geomorphic Assessment of Stonybrook Creek authored by WRECO (May 2019). This amendment serves to perform a geomorphic and fish passage assessment of the remnant structures at the confluence of Stonybrook Creek and Alameda Creek, located beyond the limit of observations of the Geomorphic Assessment report.

Project Description

In a memorandum dated November 7, 2005, Kris Vyerberg of the California Department of Fish and Wildlife (CDFW) identified structures downstream of the culvert replacement project. These structures were identified as fish passage and sediment transport impediments. This memorandum provides the observations made by WRECO on June 11, 2019 and describes the observed structures in the context of fish passage and sediment transport.

The observations made during the June 11, 2019 visit are located downstream of where Stonybrook Creek crosses under Highway 84 through the existing box culvert crossing (see Figure 1). Observations were made of the following remnant structures described by CDFW in 2005: the boulder grade-control feature (BGCF), the old road, and the abutment (see Figure 2). During the site visit, the streamflow in Stonybrook Creek was estimated to be approximately 1 cubic foot per second (cfs), the weather was unusually hot, and the bed of Stonybrook Creek was observed to have string algae attached to the cobbles. These observations were made during summer low flows and the assessment was focused on flow conditions ranging from summer low-flows to winter bankfull flows in Stonybrook Creek and Alameda Creek. It is expected that high flows in Alameda Creek have a water surface elevation as high as the outfall of the existing culvert. During those conditions, the fluvial geomorphic processes in Stonybrook Creek are expected to be influenced in a large part by Alameda Creek.

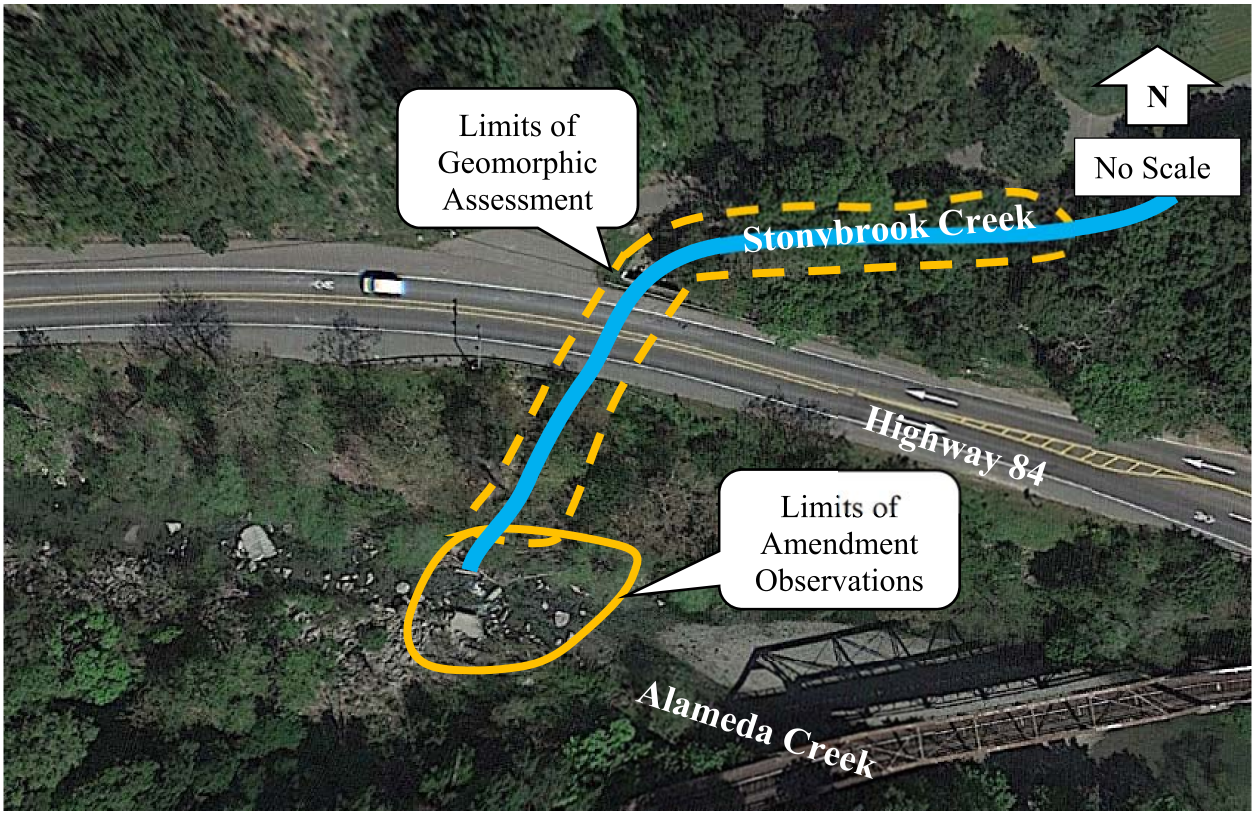

Figure 1. Approximate Limits of Geomorphic Assessment and the Subsequent Amendment

Source: Google

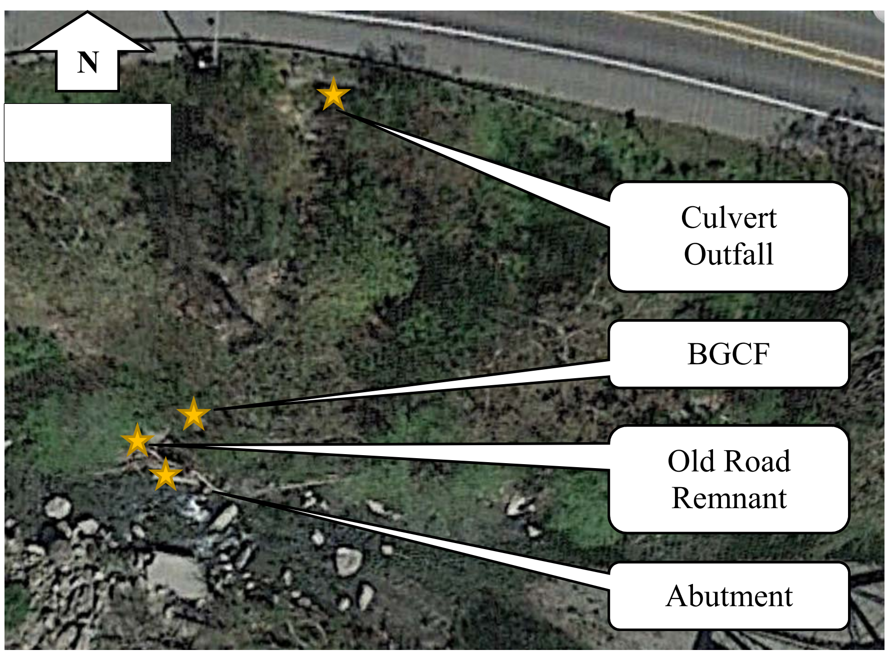

Figure 2. Approximate Location of Existing Features

Source: Google

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Boulder Grade Control Feature

CDFW described the BGCF as being constructed of boulders, and provided a photograph showing the existing boulders sitting on top of the bed of the creek (see Photo 1) with cobbles on the bed of the creek downstream. CDFW reported the BGCF is, "trapping sediment to the detriment of upstream channel form, habitat diversity, and fish passage" and that downstream of the BGCF, "is a well-defined and fish passable boulder cascade." CDFW previously recommended the boulders to be relocated, as shown in the comment added to the photograph reproduced below.

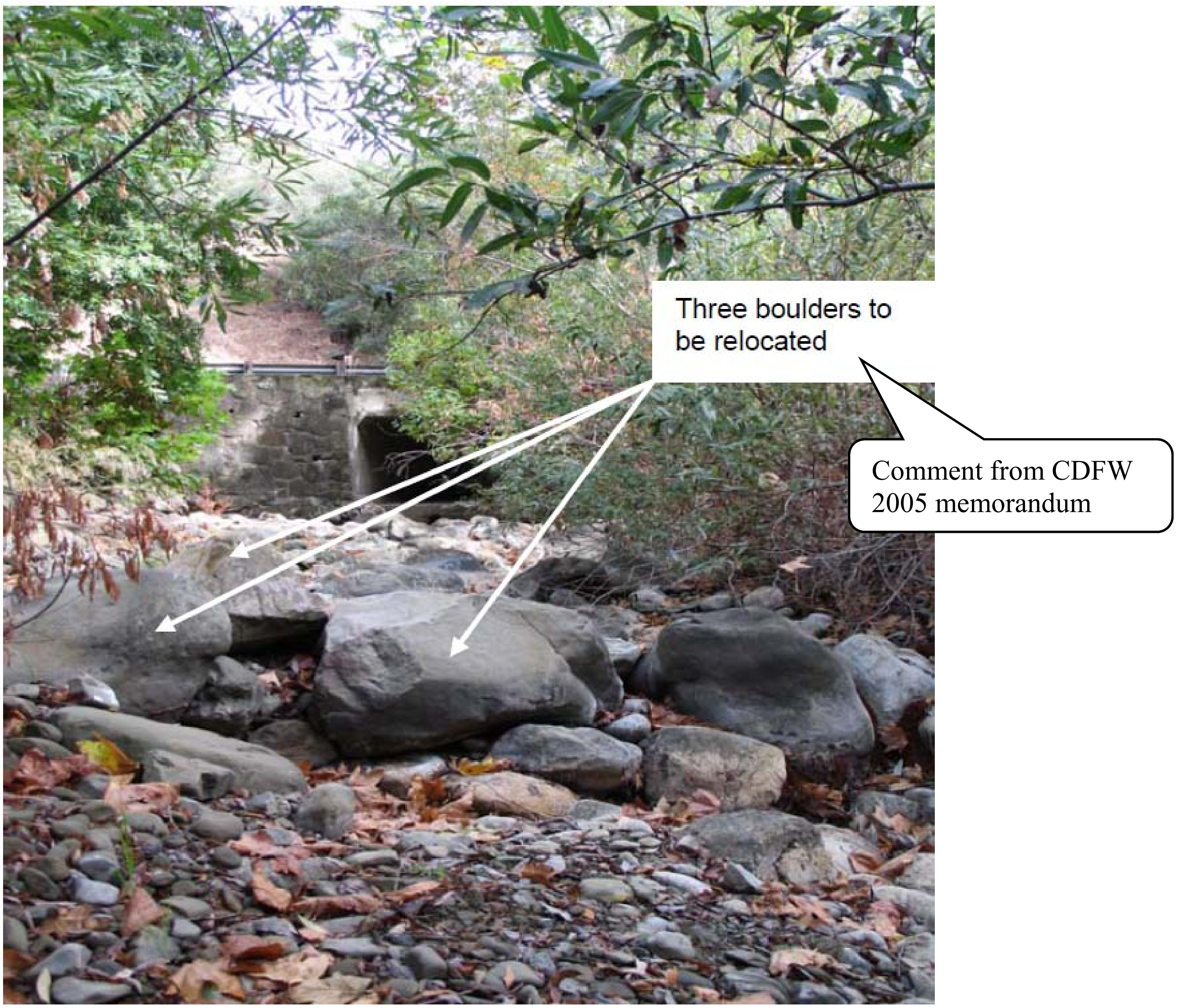

Photo 1. Photo and Comments of the Boulder Grade Control Feature from CDFW Memorandum (2005)

Photo and Comment Source: CDFW

Observations made by WRECO in 2019 found that the boulders of the BGCF were more embedded and interlocked than they appear in the photo from 2005, and that the streambed downstream of the feature was lower in elevation where a plunge pool had formed (see Photo 2). The plunge pool did not contain the cobbles shown in the photo from 2005 (see Photo 3).

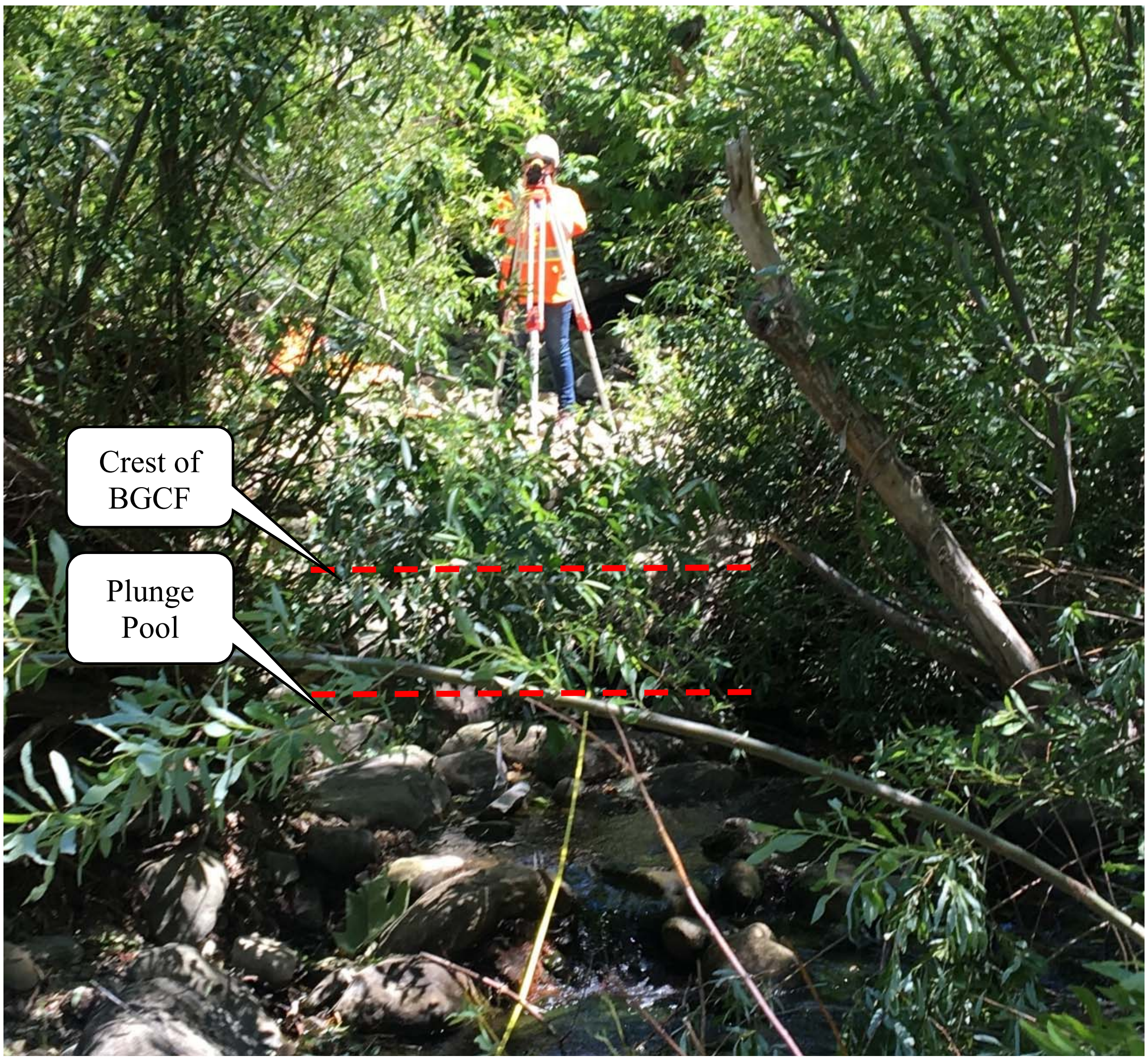

Photo 2. Showing Elevation Change at BGCF (June 2019)

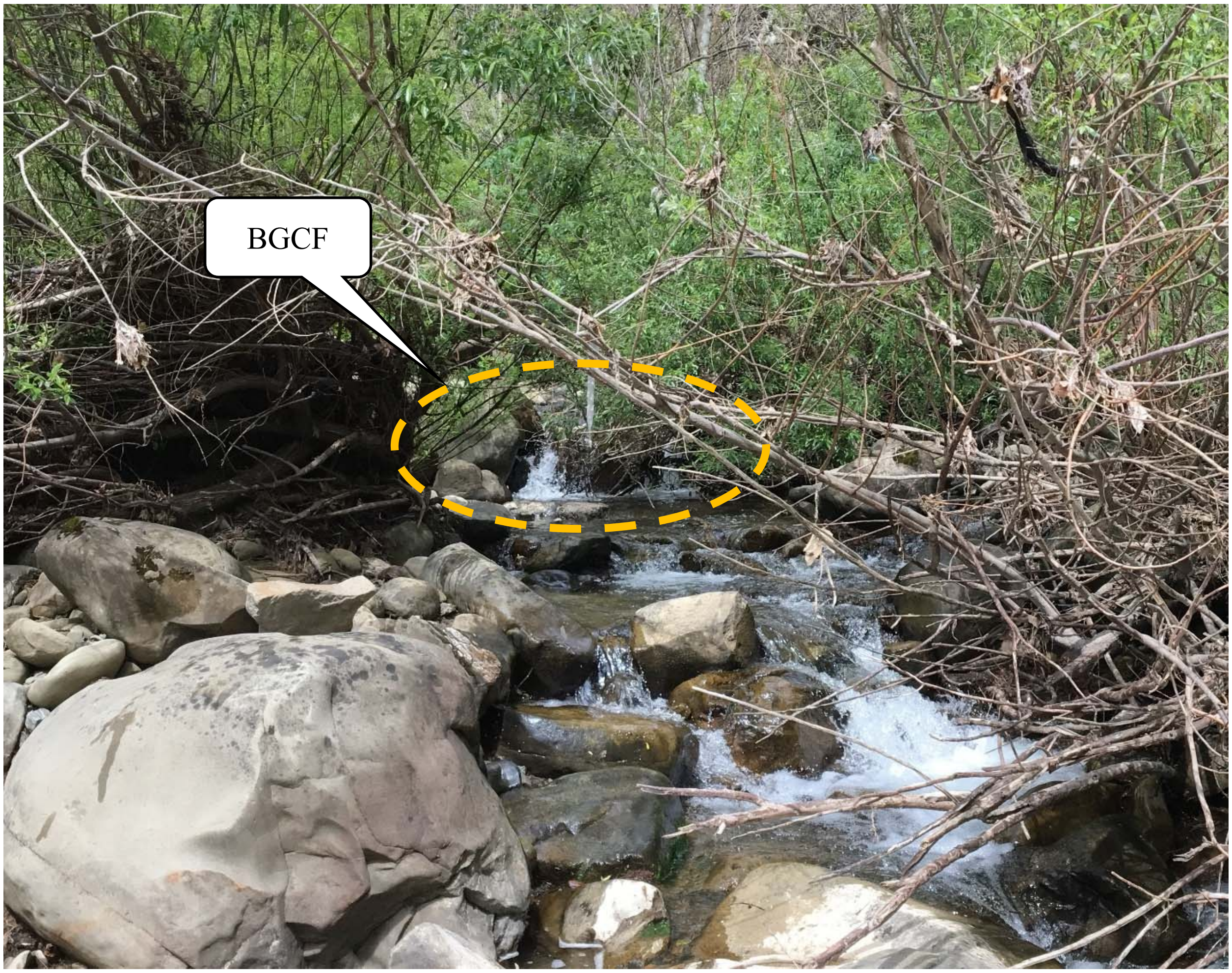

Photo 3. Facing Upstream Towards BGCF (April 2019)

Upstream of the BGCF, the bed of Stonybrook Creek is composed of cobbles. Approximately 10 feet upstream of the BGCF, the flow splits with a smaller portion flowing directly to Alameda Creek over the BGCF and the larger portion flowing towards the left bank of Stonybrook Creek. This split flow pattern is similar to what is observed on a larger scale at deltas and alluvial fans, both of which are formed by sediment deposition. It is expected the BGCF has increased the sediment deposition, and caused the flow to split. Observations were made of the two flow paths.

To the left, the flow widened before flowing beneath a fallen willow. The willow had new growth as well as debris, which are expected to have been deposited during high flows of the 2018-19 winter (see Photo 4). At the time of the site visit, the low flows passed beneath the willow and debris, but it is expected that higher flows would not pass easily through the debris and instead a greater portion would be forced to flow over the BGCF.

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Photo 4. Living Willow and Debris (June 2019)

Downstream of the willow and debris, the channel flowed along a bench of Alameda Creek parallel and opposite to the flow of Alameda Creek. The bench is approximately at the elevation of bankfull flows in Alameda Creek. The flow from Stonybrook Creek along the bench was about 2 feet wide, flat, with a bed composed of fine sediments, fine roots, and few large cobbles (see Photo 5). About 15 feet downstream of the willow and debris, the flow split again with about half flowing off the bench and down the bank directly into Alameda Creek and half continuing along the bench further before dispersing through vegetation along the bench before flowing into Alameda Creek (see Photo 6). Flow along the bench appeared suitable for juvenile fish passage, but where the flow went down the banks of Alameda Creek, it appeared to be too shallow and steep to allow upstream migration of juvenile fish.

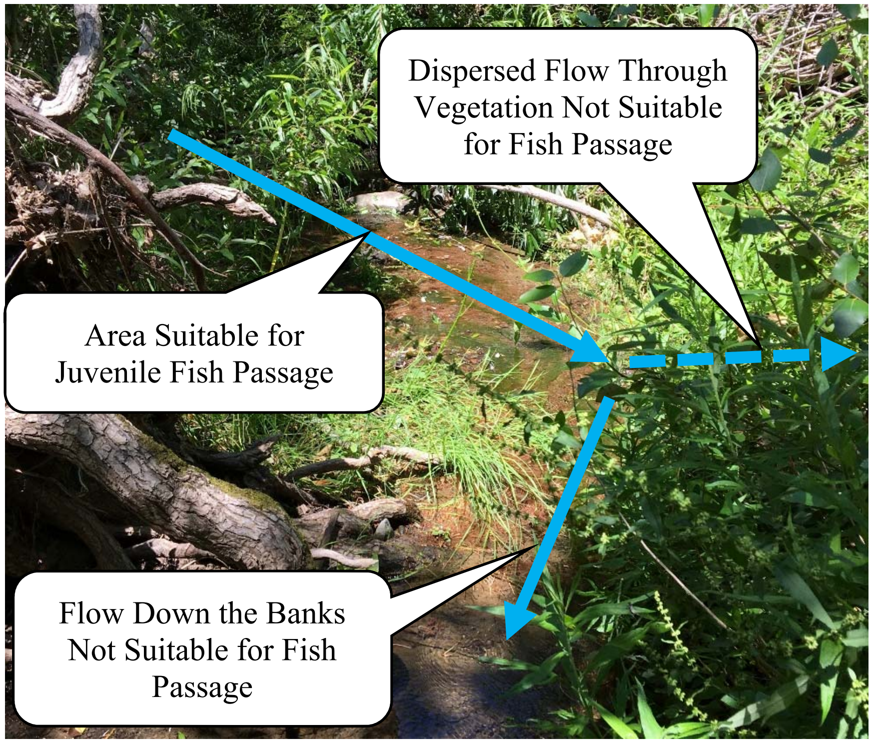

Photo 5. Low Slope Flow Path (June 2019)

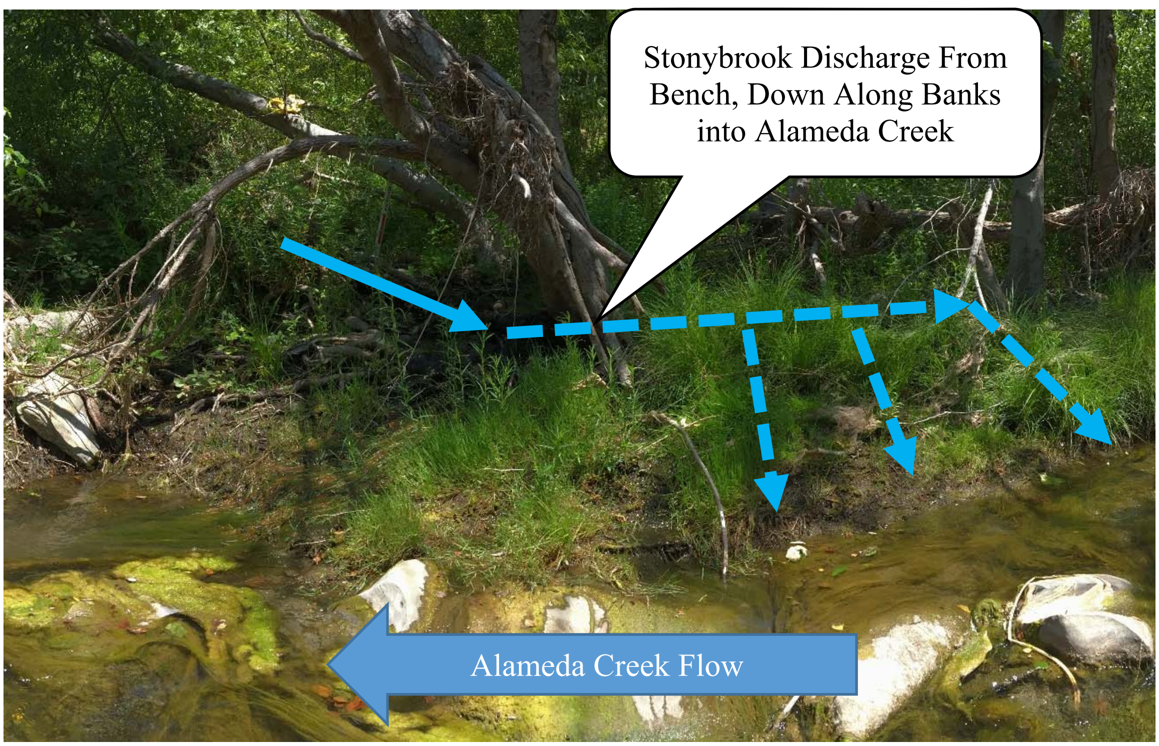

Photo 6. Right Bank of Alameda Creek Showing Stonybrook Creek Discharge (June 2019)

The more direct flow path of Stonybrook Creek to Alameda Creek is over the BGCF. Observations of the low flows downstream from the BGCF to the Abutment in April and June 2019 found conditions similar to the "boulder cascade" described by CDFW (see Photo 3). For the flow conditions during the June 2019 observations, the plunge pool of the BGCF appeared to inhibit upstream juvenile fish passage. The direct-flow path ends at the abutment at Alameda Creek.

A geomorphic survey was taken of the two flow paths to compare the slope of the flow paths (see Figure 3). The geomorphic survey found that the more direct flow path over the BGCF was steeper than the other flow path.

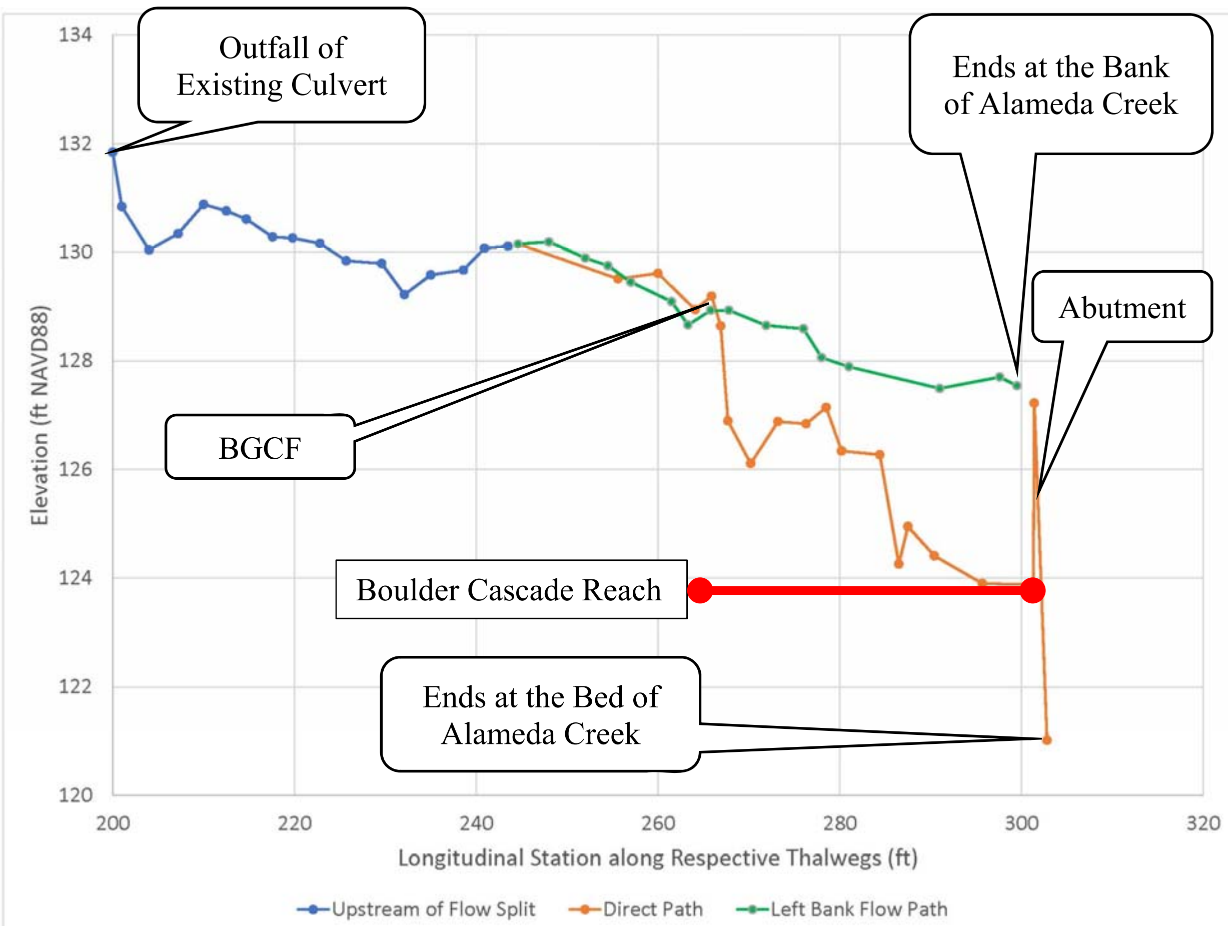

Figure 3. Longitudinal Survey of Stonybrook Creek

In summary, Stonybrook Creek appears to have adjusted to the presence of the BGCF since the CDFW observations made in 2005. The BGCF appears to have decreased sediment transport, and low flows in Stonybrook Creek are divided with a smaller portion flowing over the BGCF and a larger portion following a longer flow path to Alameda Creek. Neither low-flow path appeared to be ideal for fish passage. In the 2005 memorandum, CDFW recommended alteration of the BGCF, which should be considered advice from a fish passage perspective. Alteration of the BGCF, lowering the crest elevation in a small area, could make the BGCF the primary (and possibly sole) flow path. It is expected consolidating flow over the BGCF and through the boulder cascade would represent an improvement in juvenile fish passage conditions.

From a channel stability perspective, the BGCF is acting to control the grade of Stonybrook Creek by increasing sediment deposition upstream, and increasing the stability in that direction. The proposed reconstruction of Stonybrook Creek following the removal of the box culvert conforms to Stonybrook Channel a short distance (approximately 50 feet) upstream of the BGCF. Alteration to the BGCF should be made with consideration of the impacts to the stability of Stonybrook Creek and to the upstream grade in order to avoid lowering the grade of Stonybrook Creek at the design conform. Complete removal of the BGCF would be expected to destabilize this reach of Stonybrook Creek and result in a lower thalweg elevation between the BGCF and the existing culvert.

Old Road Remnant

In the 2005 memorandum, CDFW describes the old road remnant as an “impediment to sediment movement” to Stonybrook Creek (see Photo 7). Observations made by WRECO during April 2019 found the old road remnant to be away from the thalweg of Stonybrook Creek (see Photo 8). The old road remnant appears to be at or below the elevation of the bankfull of Alameda Creek and therefore, could impact the sediment transport of Alameda Creek, which in turn could impact the sediment transport of Stonybrook Creek. The extent of the old road remnant is not known.

Photo 7. Photo of the Old Road Remnant from the CDFW Memo (2005)

Source: CDFW

Photo 8. Old Road Remnant, Facing Upstream from Alameda Creek (April 2019)

In summary, the old road remnant could be impacting the sediment transport of Stonybrook Creek indirectly. Its removal is believed to be a low priority.

Abutment

CDFW describes the abutment as an "impediment to sediment movement" for Stonybrook Creek (see Photo 9). Observations made by WRECO in 2019 found the abutment to be located at the end of Stonybrook Creek and within the banks of Alameda Creek (see Photo 10). Comparing the photos from 2005 and 2019, there were more cobbles on the Stonybrook side of the abutment during 2005. In 2019, a very large boulder (or bedrock outcrop) limits the downward erosion of Stonybrook Creek at its confluence with Alameda Creek. A large boulder observed to be resting against the Stonybrook Creek side of the abutment in 2019 was not visible in the 2005 photographs and is an indication of the sediment transport potential of Alameda Creek.

Figure 3 shows the elevation of the base and top of the abutment as compared to the thalweg of Stonybrook Creek. The profile does not appear to show an accumulation of sediment upstream of the abutment. However, most of the reach from the BGCF to the abutment is within the bankfull elevation of Alameda Creek. It is possible that high flows in Alameda Creek have scoured away sediment that had been deposited by Stonybrook Creek. The survey shows that sediment on the Stonybrook side of the abutment sits about 2.5 feet higher than on the Alameda Creek side of the abutment. It is expected that the abutment is influencing sediment deposition of Alameda Creek which in turn, could influence sediment deposition in Stonybrook Creek.

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Photo 9. Photo and Comments of the Old Road Remnant and Abutment from the CDFW Memo (2005) (facing upstream)

Photograph and Comments Source: CDFW

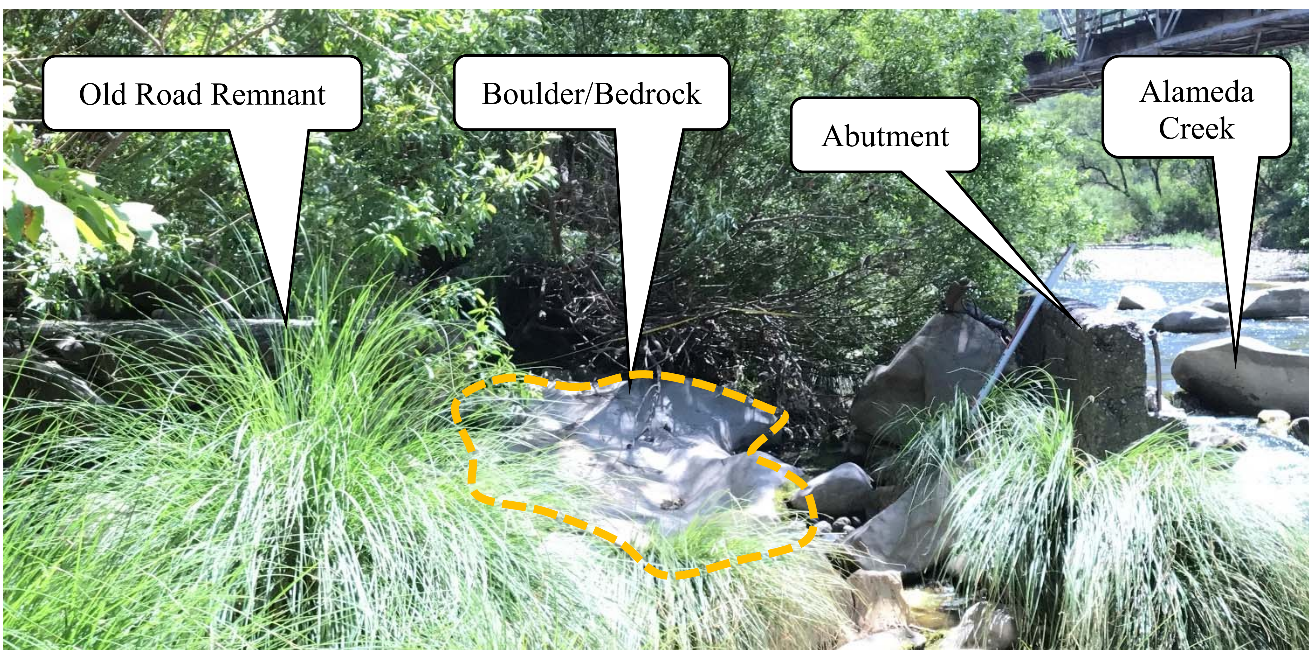

Photo 10. Facing Upstream Towards the Abutment (June 2019)

In summary, the abutment could be impacting the sediment transport of Stonybrook Creek indirectly. Its removal is believed to be a low priority.

Summary and Recommendations

From a fluvial geomorphic perspective, the BGCF has the greatest influence on the sediment transport and stability of Stonybrook Creek. The old road remnant and abutment do not appear to directly influence Stonybrook Creek, but could indirectly influence Stonybrook Creek by increasing sediment deposition of Alameda Creek at the confluence with Stonybrook Creek. Based on observations made in 2019, it appears that all three of the features (BGCF, old road remnant, and abutment) act to increase the stability of Stonybrook Creek by decreasing sediment transport. From this perspective, removal or alteration of the features is not recommended.

From a fish passage perspective, the BGCF should be altered to improve fish passage. At the low flow conditions observed, the BGCF appears to have caused the flow to split, and the resulting flow paths are not ideal for juvenile fish passage. If the low flow were not split and the flow from Stonybrook Creek was focused over the BGCF along the direct path to Alameda Creek, then this condition is expected to be better for juvenile fish passage. At the higher winter flows associated with adult fish passage, the majority of flow from Stonybrook Creek is expected to flow over the BGCF and in its existing configuration is not believed to be a major impediment to adult fish passage.

From a fish passage perspective, the old road remnant and abutment do not appear to be impediments to fish passage. These features are expected to indirectly impact sediment transport in Stonybrook Creek via the impacts on sediment transport of Alameda Creek. Based on the photographs from the 2005 CDFW memo and observations made in 2019, the sediment deposition patterns do not appear to be responsible for preventing fish passage. Therefore, no action for alteration or removal of these features is recommended. However, this reach of Stonybrook Creek has been observed to be highly variable and dynamic, and it is possible that conditions could develop which are impediments to fish passage. Therefore, it is recommended that five years of visual monitoring of this reach of Stonybrook be performed in order to gather data of the range of variability of sediment deposition patterns. Monitoring should also seek to identify the extent to which the sediment deposition patterns impact fish passage and to what extent the sediment deposition pattern is influenced by the old road remnant and abutment. If monitoring gathers evidence that the old road remnant and abutment features negatively impact fish passage, then alteration or removal of these features would be recommended.

These features were recommended for removal by CDFW in the 2005 memorandum, and therefore *how* they could be removed with minimal impact to the stability of Stonybrook Creek is discussed. The longitudinal survey shows that the lowest flow path over the BGCF is less than 0.5 feet higher than the lower (left bank) flow path of Stonybrook Creek. If the crest of the BGCF could be lowered by 0.6 to 1.0 feet in a single location, this is expected to make it the preferred flow path, concentrating flow along the direct flow path and improving conditions for fish passage. The goal would be to only lower the crest elevation in a small location (notch) which could potentially be accomplished by removing a single boulder and not substantially impacting the stability of the feature as a whole. Removal of the old road remnant and abutment is expected to require the use of heavy-equipment and other actions which would have temporary negative impacts which may exceed the benefits. The proposed monitoring would help to understand the benefit of removing these features.

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