City of SACRAMENTO Community Development

Two Rivers Trail Phase II: Project Comments

January 13, 2020

The following written comments regarding the Two Rivers Trail Phase II project and the review of the project pursuant to the California Environmental Quality Act (CEQA) were received after the close of public comment period for the Draft EIR. The City, as the CEQA lead agency, is not required to respond to issues raised in the comments. The comments are part of the project administrative record, and will be provided to the decision-making body for consideration.

Date	Commenter
10/28/2019	Amanda Morrow (Save Don't Pave)
11/3/2019	Kate Riley
11/21/2019	Osha Meserve (Save Don't Pave)
12/18/2019	Nancy MacKenzie
1/8/2020	Allyssa Mader (Save Don't Pave)

October 28, 2019

Ron Bess, Assistant Planner
City of Sacramento
Community Development Department
300 Richards Boulevard
Sacramento, CA 95811

RE: Supplemental Comments on the Draft Environmental Impact Report for the Two Rivers Trail - Phase II Project

Dear Mr. Bess;

These comments on the Draft Environmental Impact Report (DEIR) for the Two Rivers Trail - Phase II project are submitted on behalf of Save Don't Pave (SDP). These comments are offered in addition to our previous comment letter on September 16, 2019 in response to new information received after the end of the formal public comment period.

The formal public comment period for the Two Rivers Trail DEIR closed on September 16, 2019 and the following day, at the meeting of the Lower American River Task Force on September 17, 2019 the U.S. Army Corps of Engineers (Army Corps) provided updated designs for the planned levee armoring along the American River.

The designs presented by the Army Corps at the September 17, 2019 meeting indicated that the Army Corps is planning to construct levee armoring along the levee on the south bank of the American River from the H Street bridge to Paradise Beach (Site 2-1). The Army Corps project involves excavation and construction along the levee toe, including that portion of the levee toe that would be paved to construct a bike trail as proposed in the Two Rivers Trail - Phase II project; the Army Corps project is scheduled to begin in 2020, concurrent with, or directly following, the construction of the Two Rivers Trail - Phase II project, and will necessitate excavating the levee toe and the paved trail that would be constructed in the Two Rivers Trail - Phase II project.

The Army Corps project is mentioned in the Two Rivers Trail DEIR cumulative impacts section as the American River Common Features Erosion Control Project (including Bank Protection Conceptual Design Process) DEIR Table 5-2 and page 5-5. However, the DEIR contains no details about the Army Corps project and does not analyze the biological impacts of the Two Rivers Trail project in conjunction with the impacts to trees and wildlife habitat from the Army Corps project. Nor does the DEIR acknowledge either the operational complications of two projects occurring on the same location at the same time, or the implications of the Army Corps excavating the levee toe at the same time, or directly after, a paved bike trail is constructed on the same stretch of levee toe.

Now that the design of the Army Corps project is available to the City, it should be fully disclosed and analyzed in the EIR of the Two Rivers Trail. Furthermore, the City should reconsider the construction plans for the Two Rivers Trail, both in terms of timing and area to be affected.

At the September 17, 2019 meeting of the Lower American River Task Force, the City was represented by Adam Randolph, project manager for the Two Rivers Trail – Phase II project. Upon learning of the Army Corp's designs for the levee armoring project, Mr. Randolph noted that additional coordination with the Army Corps will be required in order to determine how the levee armoring would impact the Two Rivers Trail Phase – II project Mr. Randolph further indicated that the City will look at possibly phasing the construction of Two Rivers Trail – Phase II to coordinate with the Army Corps project.

The City could conceivably construct the paved bike trail only to have it destroyed immediately afterward by the Army Corps project and subsequently reconstructed as part of site mitigation for that project. Such a scenario would constitute a substantial waste of public funds. Furthermore, building the same trail twice would involve closing the same area to public use twice, in addition to closing that area for the duration of the levee armoring project. Finally, the overlap in timing of these two projects means that visitors to the American River, wildlife along that stretch of river, and homeowners adjacent to the project area will be subjected to the noise and disturbance of construction for what may be a very long and continuous period, potentially several years. This is a significant cumulative impact that should be described in the EIR for the Two Rivers Trail – Phase II project.

SDP is concerned that the Two Rivers Trail - Phase II project is being rushed through final approval despite the development of these substantial complications and without consideration of the associated impacts to the trees and wildlife habitat, recreational access, and adjacent homeowners. The Two Rivers Trail - Phase II project is being considered at a time that the City should be carefully weighing its priorities. Flood protection and addressing increased impacts from the current homelessness crisis should take precedence over paving a section of trail, especially when that trail is going to be excavated immediately by a levee armoring project. SDP recommends that the Two Rivers Trail - Phase Two project be suspended until these higher priority issues have been addressed.

Thank you for your consideration of these comments.

Amanda Morrow
President, Save Don't Pave

November 3, 2019

Ron Bess, Assistant Planner
City of Sacramento
Community Development Department
300 Richards Boulevard
Sacramento, CA 95811

Supplemental Comments on the Draft Environmental Impact Report (DEIR) for the Two Rivers Trail - Phase II Project

Dear Mr. Bess:

This letter and the accompanying photos are submitted to be included in the public record for the DEIR described above. The trees proposed for removal have been identified in DEIR Appendix H, Tree Survey Datasheets, pp. H-1 to H-4. No photographs of trees proposed for removal were included in the DEIR itself; this is an attempt to partially correct that failure.

According to the Survey, <u>22 trees are proposed for removal. Seventy-two trees are proposed for some form of "trimming" (pruning)</u>. The extent of proposed pruning is not specified. Removing so many trees will damage the natural environment. Furthermore, the US Army Corps of Engineers erosion control project planned for the Paradise Bend to below the Fair Oaks Blvd. Bridge includes removal of trees – number not yet specified. The cumulative effect of this tree loss will be devastating for both people and wildlife.

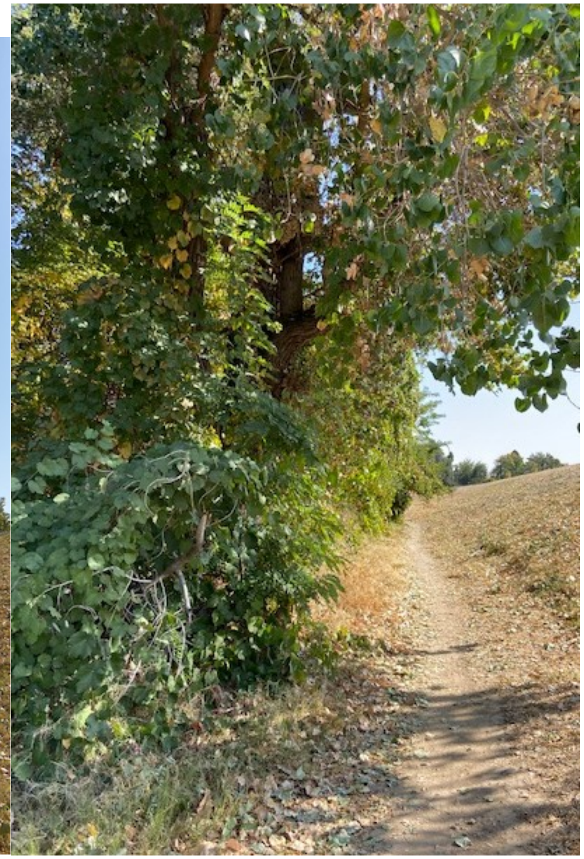
It was impossible to take pictures of all 22 trees the City proposes to remove. Instead, I have photographed those trees greater than 30" in diameter proposed for removal in order to build the Two Rivers Trail – Phase II Project. Using the Latitude and Longitude listings from the Survey, I located those trees and took photographs of them. I believe it is important that the public record include photographs of the major trees proposed to be removed.

Thank you for including this document in the public record of the environmental review of this proposed project.

Sincerely,

Kate Riley
5601 Monalee Avenue

LARGE TREES PROPOSED FOR REMOVAL
TWO RIVERS TRAIL PHASE II – DEIR Appendix H, Tree Survey Datasheets, pp. H-1 to H-4

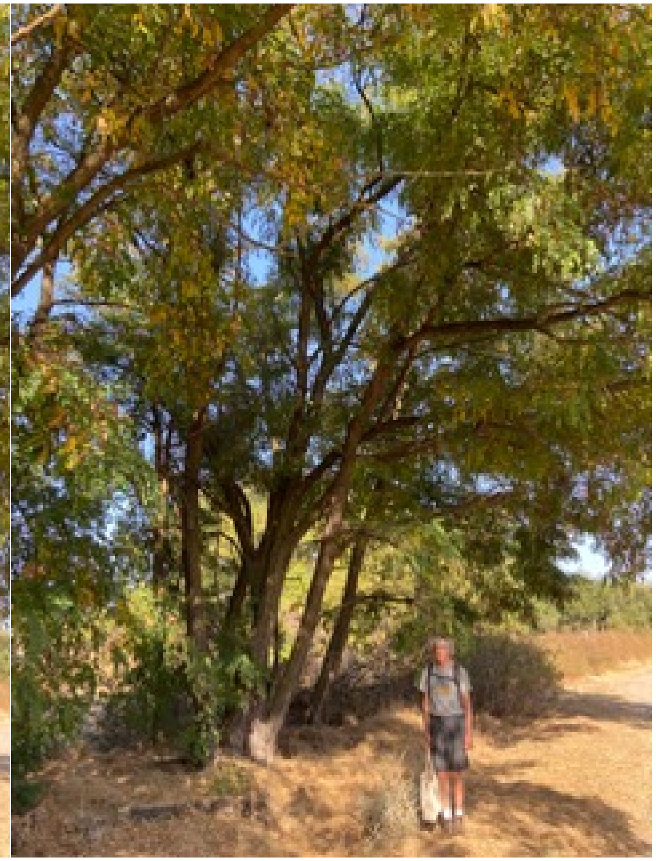


Fremont Cottonwood	50 inch Diameter	38.582268,-121.440891

LARGE TREES PROPOSED FOR REMOVAL
TWO RIVERS TRAIL PHASE II – DEIR Appendix H, Tree Survey Datasheets, pp. H-1 to H-4

Black Locust	30	38.582467, -121.441414

LARGE TREES PROPOSED FOR REMOVAL
TWO RIVERS TRAIL PHASE II – DEIR Appendix H, Tree Survey Datasheets, pp. H-1 to H-4

Black Locust	50 Inch Diameter	38.581043, -121.430109

LARGE TREES PROPOSED FOR REMOVAL
TWO RIVERS TRAIL PHASE II – DEIR Appendix H, Tree Survey Datasheets, pp. H-1 to H-4


Northern California Black Walnut	40 Inch Diameter	38.574792, -121.422997

Holly Oak (not Cork Oak)	40 Inches Diameter	38.574362, -121,423132

LARGE TREES PROPOSED FOR REMOVAL

TWO RIVERS TRAIL PHASE II – DEIR Appendix H, Tree Survey Datasheets, pp. H-1 to H-4

SOLURI MESERVE
a law corporation

tel: 916.455.7300 · fax: 916.244.7300
510 8th Street · Sacramento, CA 95814

November 21, 2019

SENT VIA EMAIL (rbess@cityofsacramento.org)

Ron Bess, Assistant Planner
Community Development Department
City of Sacramento
300 Richards Boulevard
Sacramento, CA 95811

RE: Request for Stay of Environmental Review for Two Rivers Trail Phase II Project Due to United States Army Corp of Engineers Project

Dear Mr. Bess:

This letter regarding the Environmental Impact Report ("EIR") for the Two Rivers Trail Phase II Project, K15125000 ("TRTP2 Project") is submitted on behalf of Save Don't Pave. Save Don't Pave requests that the City of Sacramento's ("City") delay certifying a final EIR until completion of an ongoing joint effort between Sacramento Area Flood Control Agency ("SAFCA") and United States Army Corp of Engineers ("USACE") on the Lower American River Subreach 2 Bank Protection Project ("LAR Project"). The LAR Project is a project under the American River Common Features General Reevaluation Report. (See attached Exhibit A, Draft Final Lower American River Subreach 2: Summary of Bank Protection Conceptual Design Process, p. 1; see also Draft EIR ("DEIR"), p. 5-5.) The DEIR recognized the LAR Project as a cumulative project with "direct physical overlap with" the TRTP2 Project. (DEIR, p. 5-10.) Construction for LAR Project would occur in the TRTP2 Project area in 2021, approximately along segments 5 and 6. (DEIR, pp. ES-5, 5-12; Exhibit B, Lower American River Task Force, Technical Presentation Subreach 2 Design Updates (September 17, 1019), p. 3.) However, the DEIR erroneously assumes that LAR Project activities will occur after TRTP2 Project construction and therefore doesn't address cumulative construction impacts. (See DEIR, pp. 5-10, 5-15.)

The City should delay certification of the final EIR and approval of the TRTP2 Project until after the LAR Project activities are complete, or, at the very least, until the design process is complete in 2020. (See attached Exhibit B, p. 2.) The LAR Project would involve significant construction activity along the river bank in the TRTP2 Project area. (See Exhibit A, pp. 43-53; Exhibit B, pp. 17-27.) As more specific designs for the

LAR Project evolve, new cumulative impacts of the TRTP2 Project may become evident and require further environmental review. (Pub. Resources Code, § 21166.) The DEIR assumes TRTP2 construction ending in November 2020 (DEIR, p. 2-7), while elderberry transplanting for the LAR Project will begin in November 2020 (Exhibit B, p. 3). Overlapping construction windows could cause potentially significant new impacts and place undue stress on the biological resources in the TRTP2 Project area. Additionally, LAR Project activities could be completed prior to TRTP2 Project construction, which would change the baseline environmental setting for the TRTP2 Project. (CEQA Guidelines, § 15125.)

The City should not certify a final EIR and approve the TRTP2 Project given the amount of uncertainty raised by the TRTP2 Project's overlap with SAFCA and USACE LAR Project activities. Please feel free to contact this office regarding any questions about these comments and potential means to address the concerns stated herein.

Very truly yours,

SOLURI MESERVE
A Law Corporation

By: Osha R. Meserve

ORM/mre

cc (via email): Save Don't Pave

Attachments:

Exhibit A	Draft Final Lower American River Subreach 2: Summary of Bank Protection Conceptual Design Process
Exhibit B	Lower American River Task Force, Technical Presentation Subreach 2 Design Updates (September 17, 1019)

EXHIBIT A

DRAFT FINAL

Lower American River Subreach 2: Summary of Bank Protection Conceptual Design Process

PREPARED FOR THE TECHNICAL RESOURCE ADVISORY COMMITTEE, ON BEHALF OF:

Gary Bardini, Director of Planning
Sacramento Area Flood Control Agency
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Contact: Gregg Ellis
916.737.3000

WITH ASSISTANCE FROM:

Northwest Hydraulic Consultants, David Ford Consulting Engineers, and ESA

November 2018

ICF. 2018. *Lower American River Subreach 2: Summary of Bank Protection Conceptual Design Process*. Draft Final. November. (ICF 00637.18.) Sacramento, CA. Prepared for the Technical Resource Advisory Committee, on behalf of Sacramento Area Flood Control Agency, Sacramento, CA.

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Acronyms and Abbreviations

ARCF	American River Common Features
BiOp	Biological Opinion
BPWG	Bank Protection Working Group
cfs	cubic feet per second
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
Ford Engineers	David Ford Consulting Engineers
DWR	Department of Water Resources
EOE	Expert Opinion Elicitation
GRR	General Reevaluation Report
LAR	Lower American River
LARTF	Lower American River Task Force’s
NCIC	North Central Information Center
NHC	Northwest Hydraulic Consultants
NMFS	National Marine Fisheries Service
NPS	National Park Service
RAC	Resource Advisory Committee
RM	River Mile
SAM	Standard Assessment Methodology
SRA	shaded riverine aquatic habitat
SRBPP	Sacramento River Bank Protection Project
TAC	Technical Advisory Committee
TRAC	Technical and Resource Advisory Committee
USACE	Unites States Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	United States Fish & Wildlife Service
VELB	Valley Elderberry Longhorn Beetle
WRDA	Water Resources Development Act
WSRA	Wild and Scenic Rivers Act

Lower American River Subreach 2: Summary of Bank Protection Conceptual Design Process

1.0 Introduction

1.1 Purpose and Intended Use and Audience

The Technical and Resource Advisory Committee (TRAC), as part of the Lower American River Task Force's (LARTF) Bank Protection Working Group (BPWG), presents this summary report and its attachments to document for the United States Army Corps of Engineers (USACE) the process, considerations, deliberations, and recommendations for Tier 1 and Tier 2 bank protection sites identified in Subreach 2 of the Lower American River (LAR). The comprehensive and collaborative process has resulted in recommended bank protection conceptual designs for a total of ten segments in Subreach 2. The 10% conceptual designs presented later in this document have been substantially vetted and considered through extensive discussion, analysis, and refinement. The TRAC members support the conceptual designs presented herein as a means to achieve the intended goals of managing flood risk along LAR, while adhering to key regulations influencing bank protection design (e.g. Endangered Species Act, Wild and Scenic Rivers Act, American River Parkway Plan, etc.) as well as design guidance and justification processes utilized by USACE.

In addition to USACE, this report is intended to be a resource for other involved parties (i.e. LAR stakeholders and regulators) who have demonstrated interest in the process. The intention of this report is to clearly and transparently document how the process evolved, explain the parties involved and their intended roles, explain how decisions were made, points of agreement, and the conceptual designs being put forward at this time.

1.1.1 Nexus to ARCF GRR/WRDA 16

The American River Common Features (ARCF) General Reevaluation Report (GRR), authorized by Congress in the Water Resources Development Act (WRDA) of 2016, included up to 11 miles of bank stabilization being implemented along LAR in order to help safely convey flows up to 160,000 cubic feet per second (cfs). A commitment was included in the GRR, and further reinforced through an associated Biological Opinion, to work with local entities in implementation of bank protection. Specifically, this commitment reads,

> An initial assessment with regards to the method of bank stabilization has been made for this document. During detailed design, the Corps will coordinate closely with county, state, and federal agencies responsible for managing the resources of the parkway in selecting which method of bank stabilization should be deployed. In carrying out this effort, the Corps will coordinate through the formal and informal processes that have been created to facilitate management of the parkway in application of the above criteria. Where erosion protection is needed to meet established flood risk reduction objectives, the selection of the method of protection will be based on a determination of which method would do the most to protect valuable parkway land, fish and wildlife resources, and recreational facilities considering both the short-term impacts of construction and the long-term effects of any mitigation measures included in the design of the project.

The commitment was made directly in response to comments received during the NEPA/CEQA public review process. The driving entities that led to USACE making this commitment were Friends of the River, Save the American River Association, and the Environmental Council of Sacramento.

1.2 Background on BPWG/TRAC

In the mid-1990's, LARTF members called for the formation of a BPWG to help plan, design, and implement bank protection features along the LAR. A primary goal of the BPWG is to support federal, state, and local efforts to provide the highest level of flood protection for the surrounding community and the conservation of irreplaceable resources along the American River Parkway. Together with USACE, Central Valley Flood Protection Board (CVFPB), Department of Water Resources (DWR), and SAFCA, BPWG successfully helped to design and implement five bank protection sites along LAR that integrated bank protection and habitat. Construction of these sites, referred to as LAR Sites 1-5, were authorized under the Sacramento River Bank Protection Project.

During that same era, the American River Common Features and the Folsom Dam Modifications projects, which were a part of the *1996 American River Watershed Project*, were authorized by Congress in the 1996 Water Resources Development Act (WRDA), with the goal of providing a higher level of flood protection to the Sacramento area. These projects were intended to improve LAR levees to control seepage and increase stability, enlarge the outlet capacity of Folsom Dam, and raise Folsom Dam. As a result, the City and County of Sacramento will have an increased level of flood protection.

Now, with both the Folsom Dam Joint Federal Project and the levee improvements of the American River Common Features WRDA 96/99 projects completed, the ability to manage large flood events has been improved along LAR by allowing more water to be safely released from Folsom Dam/Reservoir earlier in a major storm event. There is more flood storage capacity in Folsom Reservoir to control peak inflows and better manage releases, up to 160,000 cfs into LAR. However, at the time the above referenced projects were studied, the extent of erosion impacts was not well understood and as such none of these projects implemented bank protection to address the increased erosion potential due to the higher and longer releases the spillway modification projects would deliver. As a result, in 2015, LARTF members called for the re-formation of BPWG to help advise, plan, design, and implement bank protection features along LAR. The intent was to better understand how the river channel may respond under an extended 160,000 cfs release from Folsom Dam during an extreme flow event. A flow event of this magnitude could have the potential to induce substantial erosion and impact valuable resources in the American River Parkway. Due to the highly technical issues facing BPWG under this scenario, a multi-disciplinary committee composed of various agency and interested party stakeholders was developed. The committee initially consisted of flood control technical experts and was referred to as the Technical Advisory Committee (TAC). The need for additional expertise, specifically natural resource experts, was identified and formed as the Resource Advisory Committee (RAC). Together, TAC and RAC form the larger TRAC to help consider both existing condition resource impacts as well as potential short-term and long-term impacts.

TRAC members include:

Name/Organization/Expertise	TAC	RAC
Jennifer Hobbs (USFWS - Environmental)		X
Annalisa Tuel-Batanides (NMFS - Environmental)		X
Anne Baker (Corps - Environmental)		X
Todd Rivas (USACE - Hydraulics)	X	
David Martasian (DWR - Environmental)		X
Steve Mahnke (DWR - Geotechnical)	X	
Liz Bellas (Sac County Parks – Parkway Resources)		X
Sharon Kramer (H.T. Harvey and Associates - Fisheries)		X
Chuck Watson (WRC Environmental - Geomorphology)	X	X
Steve Chainey (GEI - Environmental)	X	X
Ray Costa (Kleinfelder - Geotechnical)	X	
Mike Kynett (MBK - Geotechnical)	X	
Tom Smith (RiverSmith Engineering – hydraulics/geotechnical)	X	

1.3 Regulatory Background

There are numerous federal, state, and local laws and regulations that projects within the LAR floodway must comply with. Following are highlights of a few key regulatory drivers discussed by TRAC.

1.3.1 American River Parkway Plan

American River Parkway Plan goals include:

- To provide, protect, and enhance for public use a continuous open space greenbelt along the American River extending from the Sacramento River to Folsom Dam.
- To provide appropriate access and facilities in order that present and future generations can enjoy the amenities and resources of the Parkway which enhance the enjoyment of leisure activities.
- To preserve, protect, interpret, and improve the natural, archeological, historical, and recreational resources of the Parkway, including an adequate flow of high quality water, anadromous and resident fishes, migratory and resident wildlife, and diverse natural vegetation.

The Plan also speaks to balancing the management needs of the Parkway stating "The American River Parkway is a unique regional asset that shall be managed to balance the goals of controlling flooding; preserving and enhancing native vegetation, native fish species, the naturalistic open space and environmental quality within the urban environment; maintaining and improving water flow and quality; providing adequate habitat connectivity and travel corridors to support migratory and resident wildlife; providing recreational opportunities; and ensuring public safety."

1.3.2 Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act (WSRA) established the National Wild and Scenic Rivers System, administered jointly by the National Park Service (NPS) and the United States Forest Service (USFS), to protect the environmental values of free-flowing streams from degradation resulting from effects of activities, including those associated with water resource projects. Proposed actions on streams in the system are subject as appropriate to consultation, review of plans and environmental impact assessments, and approval by either agency.

The Lower American River Parkway (23 miles) from below Nimbus Dam to the confluence with the Sacramento River was designated through both the State WSRA (in 1972) and the Federal WSRA (in 1981) as "Recreational." LAR is a state managed federal 2(a)(ii) wild and scenic river. LAR was included in the original State Wild and Scenic Rivers Act in 1972 and was designated a Federal Wild and Scenic River in 1981. The State Wild and Scenic River Management Plan was completed in 1977, and incorporated the American River Parkway Plan. The Plan establishes boundaries for the Parkway, including for the purposes of WSRA. Its recreational and anadromous fishery resources were recognized as "extraordinary values" and "outstandingly remarkable values" in the State and Federal designations, respectively.

Under its obligations to manage the LAR as a 2(a)(ii) Federal WSRA, the State, through the ARPP, has a non-degradation obligation. This includes limiting resource management actions that degrade the resource values for which the river was originally designated, as well as those conditions that support those resource values, and developing strategies for returning degraded resource conditions to their status at the time of federal designation (1981) where practical. The WSR values to be addressed include free-flowing characteristics (i.e., as existing or flowing in natural conditions without impoundments, diversion, straightening and other modification of the waterway), water quality, cultural resources, and recreation and anadromous fisheries (along with those resource attributes that support those values, such as visual, aquatic habitat needs, and bankline structure and riparian vegetation as may be needed for fish habitat, wildlife habitat, and recreational uses and access.

1.3.3 Central Valley Flood Protection Plan's Conservation Strategy

The Central Valley Flood Protection Plan (CVFPP) is a long-term planning document that provides a framework for prioritizing investment in the State Plan of Flood Control. A component of the CVFPP is a Conservation Strategy that is a non-regulatory approach for improving riverine/floodplain ecosystems. The Conservation Strategy advocates for the integration of ecosystem restoration into flood risk reduction projects. The goals of the Conservation Strategy include increasing floodplain inundation and connectivity, increasing abundance of shaded riverine aquatic (SRA) habitat cover and riparian habitat, increasing abundance of marsh and other wetland habitats, reducing fish passage stressors, and reducing invasive plant stressors.

In order to accomplish these goals, the Conservation Strategy recommends biotechnical bank protection along levees and adjacent eroding banks, incorporation of the vegetation component of SRA habitat cover, application of levee designs that create compatibility with existing and potential floodway habitats, and prioritizes investments into multi-benefit projects.

1.3.4 Biological Opinions for American River Common Features GRR

As previously described, there is a nexus between the current efforts of TRAC and the ARCF GRR/WRDA 16 project. The United States Fish & Wildlife Service (USFWS) issued a Biological Opinion (BiOp) for the American River Common Features project including Incidental Take for the Valley Elderberry Longhorn Beetle and the Western Yellow-billed Cuckoo, compensation for 69.91 acres of riparian habitat that supports elderberry shrubs, and long-term maintenance compensation of 40 acres of riparian habitat that supports elderberry shrubs or 40 credits at a mitigation bank. While these amounts are subject to change based on refinement of the project, they provide an indication of the types and level of effects. The BiOp also established Conservation Measures and Terms and Conditions for the project, as well as made a Conservation Recommendation to develop and implement projects that support DWR's Central Valley Flood System Conservation Strategy, specifically to "consider the goals, measurable objectives, and potential projects which could be implemented in a manner that while improving the riverine ecosystem also will improve the flood system."

Similarly, the National Marine Fisheries Service (NMFS) BiOp issued Incidental Take for Chinook Salmon, Green Sturgeon, and Steelhead based primarily on Standard Assessment Methodology (SAM) outputs. The compensation rate for SRA habitat was set at a 1:1 ratio (e.g., 1 new unit/acre created for 1 existing unit/acre impacted) prior to construction, a 2:1 ratio during construction, or a 3:1 ratio if mitigation actions occur after construction based on updated outputs from SAM or other approved models. A Draft Jeopardy Opinion for Sturgeon resulted in a commitment from USACE to coordinate with NMFS to develop a Habitat Mitigation and Monitoring Plan, which is underway. The BiOp also established numerous Conservation and Avoidance Actions, Reasonable and Prudent Measures, Terms and Conditions, and Conservation Recommendations including integrating the 2017 California CVFPP's Conservation Strategy into the project.

The USACE's *Riparian Corridor Improvement Plan* is designed to "maximize the ecological function and value" in the leveed system of the Sacramento metropolitan area (USFWS, BiOp, p22). The USACE's intent for, and interpretation of, its *Riparian Corridor Improvement Plan* is to assess the baseline condition of the overall riparian corridor in the Sacramento Area and establish areas of potential improvement, with a particular focus on connectivity of habitats including habitat for the Valley Elderberry Longhorn Beetle. The plan is currently under development and will be incorporated into the ARCF 2016 Comprehensive Mitigation Plan, which will guide mitigation implementation for the overall program upon its completion in 2019. …

TRAC has considered these regulatory drivers, among others, during the conceptual design development process.

1.4 Definitions and Nomenclature

1.4.1 River Mileage

River mileage is measured from the mouth of the American River along its centerline, with zero miles at the junction with the Sacramento River (Figure 1). The reference river mile (RM) markers used in this study are from the USACE Comprehensive Study UNET model. They have also been used in studies recently prepared for the USACE (i.e., Fugro 2012, URS 2012) and were considered the most consistent set of markers for this study. River mileage is used to name sites and generally refer to their locations but the references are not intended to be precise. RM references in older reports do not always refer to the current USACE mile markers and care is required when using mileage references in older documents to locate sites relative to the current USACE markers. The RM tenths used in this report were positioned by NHC by simple interpolation between the foregoing RM locations as first used in NHC's LAR Geomorphology Assessment report (2016).

The levees and banks are referred to as *left* (south) and *right* (north) based on an observer looking downstream. Figure 2 shows the terms used to describe the various components of the levee, overbank bench or berm, and river bank along a cross section of LAR. The levee template noted on the drawing refers to the minimum levee section or geometry geometry specified by USACE (2008). On LAR, the design top of levee is determined by the 192,000 cfs water profile (USACE, 2007), the minimum crown width is 20 feet, the minimum waterside slope is 3H:1V, and the landside slope is 2H:1V.

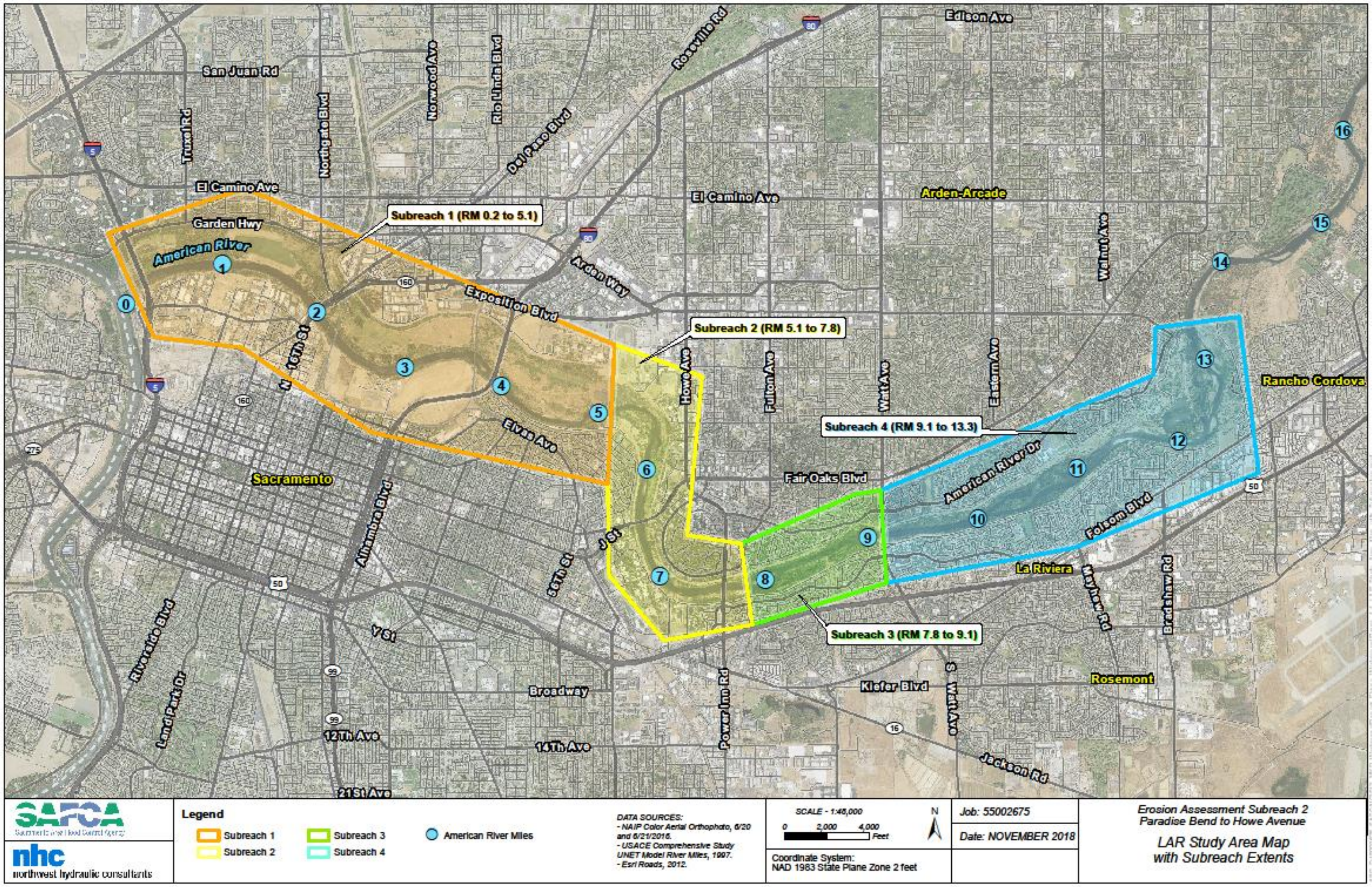


Figure 1. LAR Study Area Map with Subreach Extents

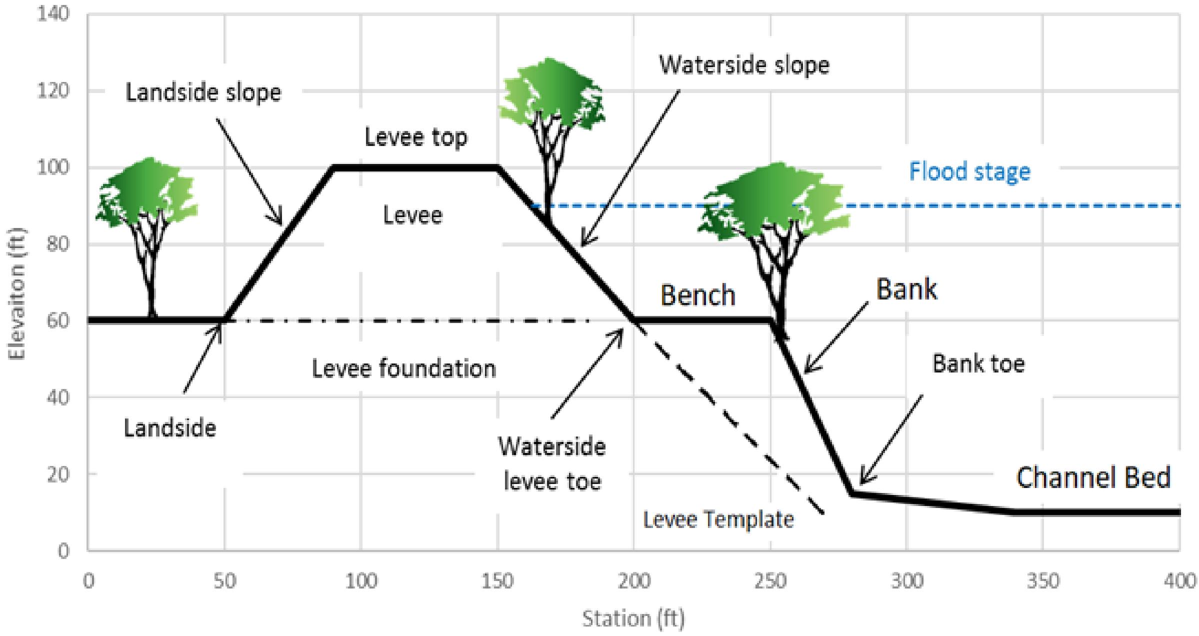


Figure 2. Nomenclature for Lower American River Banks and Levees

1.4.2 Subreaches

Subreaches refer to the four study areas of the leveed reach in the LAR. The subreaches were subdivided to facilitate evaluating the entire 14-mile leveed reach as an integrated dynamic riverine system on the one hand, while also allowing for segment-specific project assessments and proposals on the other. The subreaches are therefore not indicative of geomorphic conditions but rather considering potential design sites, resource impacts, and overall planning and implementation.

1.4.3 Segments

Segments refer to sections of levee and bank with similar bench width, bank stratigraphy, existing revetment, and hydraulics. The left bank and right bank of each subreach is discretized into individual segments for evaluating erosion potential, risk of levee failure due to erosion, resource assessment, and conceptual design evaluation. NHC discretized Subreach 2 into eight right bank segments and eight left bank segments in the Subreach 2 Erosion Assessment (Section 4.2).

2.0 BPWG/TRAC Process

LARTF relies on BPWG to assist with, through coordination and technical input, bank erosion and protection along LAR. As mentioned above, TRAC was formed to provide an independent multidiscipline review of and contribution of technical assistance to BPWG's efforts. The work of TRAC and its consultant team has focused on technical issues, including use of a more risk based approach. The goal of TRAC is that erosion site identification and evaluation processes utilized be consistent with USACE and State (DWR, CVFPB, and Urban Levee Design Criteria) requirements.

After consideration, BPWG/TRAC decided to address bank and levee risk assessments and the development of conceptual bank protection designs at a "subreach" level. The subreach approach allowed for evaluating the entire 14-mile leveed reach as an integrated dynamic riverine system on the one hand, while also allowing for segment-specific project assessments and proposals on the other. It was determined that at the subreach scale, segment-specific risk issues could be reasonably addressed within the context of inter-project consequences and mutual benefits based on LAR channel dynamics, while avoiding having to address in detail consequences at the leveed reach scale so long as present and foreseeable boundary conditions at the subreach interfaces were considered.

BPWG/TRAC, based on review of existing documents and findings in the Erosion Screening Process and Geomorphic Assessment, both undertaken by Northwest Hydraulic Consultants (NHC), identified Subreach 2 (extending from Paradise Bend upstream to Howe Avenue) as one of the most serious risk-potential portions of the leveed reach and determined it was appropriate to address this subreach first. The intent was to undertake this subreach in a deliberate manner in order to develop appropriate assessment tools and methods that could be used when later addressing the three remaining subreaches within the leveed portion of LAR.

To broaden the geotechnical and levee performance experience-base of the BPWG process, TAC was formed to assist NHC in determining relative levee risk at the "segment" scale. Through an Expert Opinion Elicitation (EOE) process facilitated by David Ford Consulting Engineers, TAC used the background geotechnical and channel information provided by NHC to rank the segments by relative risk of levee breach from hydraulic and erosional processes. TAC categorized the ranked relative levee safety risk segment conclusions into three tiers of treatment priority at the segment scale based on projected risk to levees over a 50 year project planning horizon.

As mentioned above, RAC was formed to broaden the BPWG baseline expertise in LAR/American River Parkway natural and cultural resource conditions, values, and potential project impacts, and to integrate the concerns of allied resource agencies. With RAC incorporated into the process, the overarching goal of TRAC is to assist BPWG in developing resource friendly proposed conceptual bank and/or levee protection design alternatives and to develop suites of design approaches in the various segments of Subreach 2 so as to maximize resulting resource values within the overall objectives of public safety and levee performance. A planning horizon of 50 years was adopted for characterizing resource conditions and potential project consequences, with a provision for looking further into the future should particular conditions warrant.

Through their resource assessment, Environmental Sciences Associates (ESA) documented and developed a database of natural/parkway resources in the subreach that could be impacted by a wide range of bank and/or levee protection project design approaches which could be proposed in segments subject to erosion. This resource assessment also has the value of identifying areas and or habitat values that could be improved through project implementation.

In order to bring this vast amount of information together in a manner that could be readily utilized by TRAC, NHC, working with ESA, developed a "Dashboard" as a tool for assessing the possible resource and hydraulic consequences of a range of generic and unrefined possible conceptual design approaches for high risk segments (4 alternative design approaches) and moderate risk segments (3 alternative design approaches). Individual members of TRAC used the Dashboard tool to assign a suite of potential generic treatment approaches in high and moderate risk segments to both evaluate the possible resource consequences and the in-subreach and upstream subreach hydraulic consequences of suites of possible actions, and to select a preferred suite of design approaches for Subreach 2 based on individual preferences.

A collaboration between engineering concerns (NHC engineering staff) and resource concerns (SAFCA staff and consulting team) used the Dashboard responses by individual TRAC members to develop a proposed final overall flood risk reduction strategy for Subreach 2 (the type, distribution, and extent of bank and levee treatments) and conceptual project site designs. For some segments, there was nearly unanimous agreement on recommended approaches among the individual TRAC member responses, while for others there were divergent views. The engineering and resource collaboration effort used the self-reported objectives and concerns that individual TRAC members considered when framing their individually preferred dashboard results to resolve the areas of disagreement within the context of the flood risk reduction strategy. The proposed final overall flood risk reduction strategy and conceptual project site designs for Subreach 2 developed by that process were reviewed and agreed to by TRAC and the BPWG.

The following sections expand on this process by describing in summary format the assessment methods and tools utilized and the reports generated that document these processes and information. Also included is the composite suite of conceptual designs for Subreach 2 that TRAC/BPWG recommend to USACE and its Project Delivery Team for use in their planning and implementation process associated with bank protection implementation under the recent Supplemental Authorization.

3.0 Introduction to Assessment Methods/Tools Considered

The BPWG began its current effort in 2015 with a review of available information and analytical tools. As the process continued, and more recently with the addition of the TRAC, a primary goal has been to conduct appropriate analyses in a manner that is technically sound and defensible. As a result, numerous assessment methods and analytical tools have been used. Following is a list of key methods and tools. Each one is described more fully in the supporting technical documents that are summarized in Section 4 and included as attachments to this summary document.

- DWR's Levee Erosion Screening Process
- USACE's Stratigraphic Model
- HEC-6T Sediment Transport Model to predict sediment transport and deposition and bed profile adjustments
- Sedimentation and River Hydraulics – 2-Dimensional (SRH2D) software: two-dimensional depth-averaged numerical hydraulic model
- 2006 USACE bathymetric survey information
- 2008 LiDAR survey information (topographic data)
- USACE (2018) synthetic hydrology representative of the updated Water Control Manual for Folsom Dam
- USACE Standard Assessment Methodology to evaluate the effects of projects on aquatic habitat
- Excel-based dashboard using Visual Basic for Applications and ActiveX controls to process and visualize data

4.0 Key Supporting Documents and Outputs

This document, which summarizes the conceptual design process utilized for Subreach 2, relies entirely on several documents that are included as attachments and outputs from the TRAC process. Following are summaries of key aspects of these supporting documents and processes. The supporting documents should be referred to by the reader, as they contain substantial detail beyond what is provided in this summary document.

The key supporting documents and process outputs are:

- Lower American River Geomorphology Assessment (Attachment 1) (document, addressing the leveed reach of LAR)
- Erosion Assessment – Subreach 2 Paradise Bend to Howe Avenue (Attachment 2) (document, addressing Subreach 2 only)
- David Ford Consulting Engineers Erosion Risk Assessment and Expert Opinion Elicitation (Attachment 3) (document, addressing Subreach 2 only)
- Designation of Tier 1, 2, and 3 Segments (output generated by TRAC, building on information from geomorphology, erosion assessment, and expert opinion elicitation documents)
- Lower American River Subreach 2 Resource Assessment (Attachment 4) (document, addressing Subreach 2 only)
- Comprehensive Subreach Approach Dashboard Tool Development and Application (Attachment 5) (document and output generated by TRAC, both addressing Subreach 2 only with exception of hydraulic consideration of upstream Subreach also considered)
- Subreach 2 10 Percent Basis of Design Report (document, addressing Subreach 2 only)

4.1 Lower American River Geomorphology Assessment

4.1.1 Authors and Purpose

NHC prepared two geomorphic assessments in 2016 and 2018 focusing on the portion of the LAR with Federal project levees, from the mouth at the Sacramento River (River Mile 0) to about River Mile (RM 14). The portion of the LAR from RM 14 upstream to Nimbus Dam (RM 23) is discussed when it is important to understanding the history or behavior of the river channel in the leveed portion.

The geomorphic assessment provides a broad, long-term perspective on fluvial geomorphic processes in the LAR and identify any future channel adjustments that might affect erosion of the channel bed and banks and levees. The assessment is intended to identify future channel adjustments up to 50 years in the future and provides the basis for the Erosion Assessment (Section 4.2), an in-depth evaluation of Subreach 2 levee erosion risks.

4.1.2 Methods

The first geomorphic assessment was completed in late 2016 then supplemented in the 2018 Subreach 2 Erosion Assessment. These relied on previous reports prepared for the USACE since 1991, theses, topographic and bathymetric surveys, geologic maps, and historic and current aerial imagery. The key materials used included:

- Geologic reports and geotechnical investigations of LAR including recent work completed for the USACE (GRR 2015 Appendix E for summary),
- Field inspections,
- Documentation of human impacts on the LAR including changes in sediment supply from hydraulic, dredging and gravel mining and closure of Folsom Dam, hydromodification,

channelization, historical development of floodplain lands and construction of levees, and bank protection structures, and

- Data and accounts of historic adjustments of the LAR channel bed profile.

4.1.3 Results

Levee erosion hazards along the LAR result from recent geologic history dating back 2.0 million+ years, and the effects of recent human land use over the past 150 years. It has long been understood that the geomorphic processes forming a river channel and adjacent floodplain areas are driven by fluvial erosion, sediment transport and deposition working over time. The resultant channel form generally reflects the underlying geology and the balance of streamflow and sediment supply (volume and sizes) which creates the observed channel form: geometry in cross section (width and depth) and flow path or planform as viewed from above (e.g. meandering, straight or braided). These features are subject to change due to climate change and geologic forces, but also due to human modifications such as construction of dams and levees, which are extensive in the LAR and highly consequential for erosion processes. The LAR is still responding to hydraulic mining of the mid to late 1800s, instream gravel mining from the 1940s to 1970s, Folsom Dam closure and concurrent loss of sediment supply and hydromodification in the 1950s, confinement and loss of large floodplain overflow areas due to levee construction and urbanization.

4.1.4 Geologic Influences

The present Lower American River below Nimbus Dam is a semi-confined, alluvial river flowing within older erosion resistant geologic units (ERM) that date back before the Pleistocene ice age epoch (1.8+ million years before present [mybp]). During this time, the American River drained a relatively large area of the western Sierra Nevada and delivered sediment loads into the Central Valley Basin forming a large alluvial fan that extends from Sierra Nevada foothills near Folsom westward to Sacramento and southward towards the south Sacramento County line (Figure 3). Presently, the LAR flows within a small corridor along the northern edge of the fan. Over repeated glacial cycles, the LAR channel migrated northward and made successive cuts into the older alluvial fan deposits creating a set of three nested terraces with each glacial period’s river channel / floodplain incised within the next oldest (Figure 3). Each glacial cycle began with sea level lowering (up to 400 feet lower due to worldwide glacial ice formation) resulting in a steeper and longer river channel that eroded a trench into the older fan deposits leaving an eroded surface or strath terrace. During the mid and late glacial periods, sediment and streamflow increased to partially fill the trench and extend sediment transport and the fan farther west into the valley floor. When glaciers had fully melted, and sea level rose back to near present-day levels, the channel and floodplain became graded to the higher base level near present day topography. Simultaneously, streamflow and sediment supply decreased and a low energy and “stabilized” interglacial condition occurred, such as today. After the last glacial cycle and over the past 8,000 years +/-, the LAR geomorphic floodplain formed to the present-day base level with the Sacramento River.

The present entrenchment and confinement of the LAR is controlled by older ERM geologic units: the Fair Oaks, Riverbank and Modesto Formations. These are exposed along the channel bed, banks, floodplain and terraces as shown in a cross section at Watt Ave RM 9 (Figure 4). The sand and silt deposits of Holocene Alluvium (Ha) consists of semi consolidated layers of gravels and sand deposited before 1850. After Euro American settlement and the Gold Rush of the mid to late 1800s, hydraulic mining produced a distinct overlying unit of unconsolidated silty sands or Recent Alluvium (Ra) which reportedly covered 15 square miles of the LAR corridor and by 1900 reached depths of over 20 feet in lower LAR channel.

The youngest alluvial units of Ra and Ha form most of the channel bank materials downstream of RM 12 and in all of Subreach 2. These unconsolidated fine units form steep high banks and are highly erodible with only woody vegetation providing protection. Once vegetation is removed by erosion, decay by aging or windthrow, the banks can erode rapidly. Where the bench area is narrow, abrupt lateral erosion can suddenly create a significant hazard to levees (such as the banks eroded in 1986 flood at RM 4.0 and RM 7.2 (Figures 5 and 6).

As a result of confinement by ERM geologic units, lateral erosion and meandering of the LAR channel is restricted. The width, alignment and planform has remained remarkably constant with very limited lateral movement since earliest detailed maps were rendered in late 1800s (with the notable exception of the lower 2 miles which was artificially moved northward in the late 1800s to protect Sacramento). In this regard, the LAR does not demonstrate the behavior of a fully alluvial meandering river as there is no evidence of prograding point bars, floodplain creation and erosive destruction, progressive erosion on outer bends and an active meander belt zone.

4.1.5 Historical Influences

The LAR has been subject to significant alteration due to human activities over the past 160 years since Euro American settlement which began in the 1840s (Table 1). These changes not only affected the physical features of the channel and floodplain, but also sediment transport and geomorphic processes.

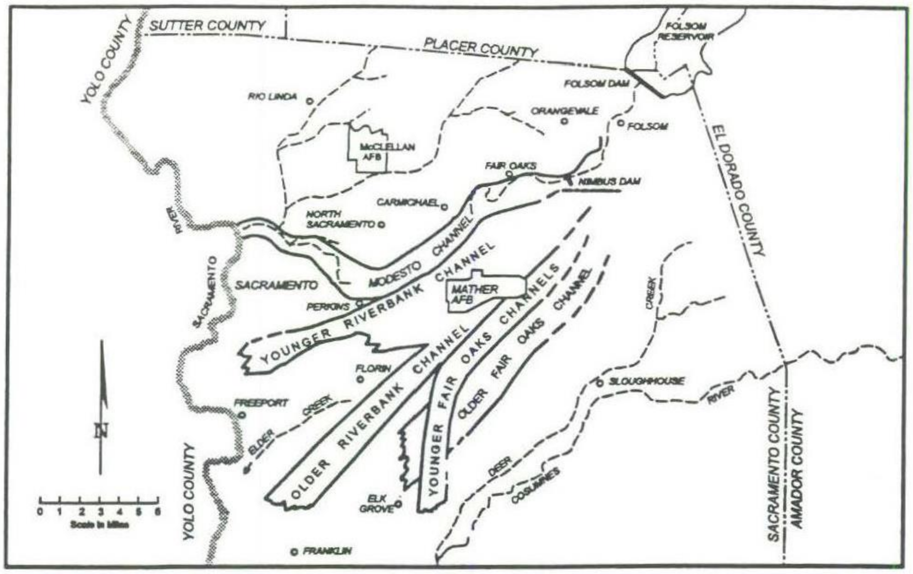


Fig. 1: Pleistocene channels of the lower American River (after Shlemon, 1972).

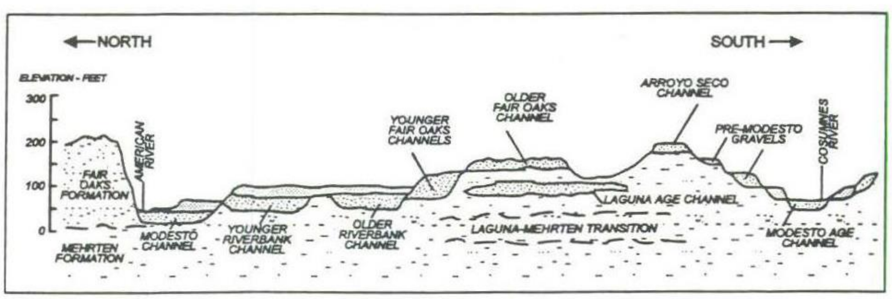


Fig. 2: Generalized composite cross section from the American River near Fair Oaks to the Cosumnes River showing Quaternary formations and the surface and buried channels. Vertical scale exaggerated (after Shlemon, 1972).

Figure 3. Upper Panel Shows Map of Lower American River Pleistocene Channels Showing a South to North Progression and the Modern River Contained within the Modesto Channel, Lower Panel Shows North to South Cross Section Crossing the LAR at Approximately RM 23.0 (Shlemon 1972)

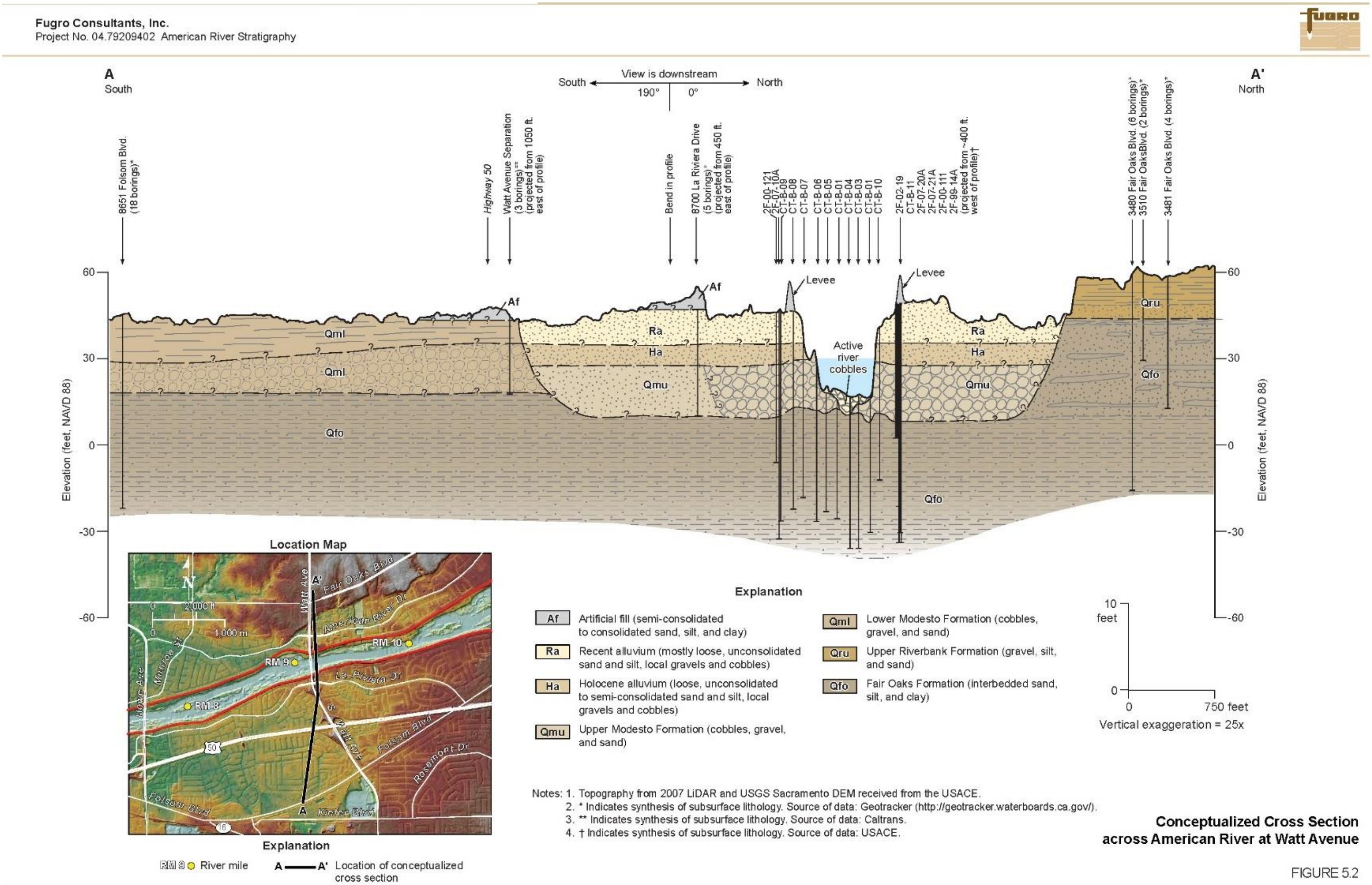


Figure 4. Geologic Cross Section at Watt Ave, Lower American River RM 9.2 (Fugro 2012)

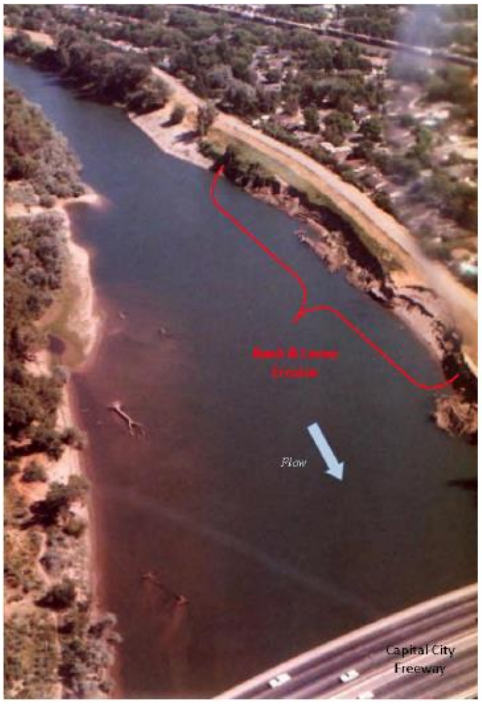


Figure 5. Lateral Erosion Failure of 100+ Feet Occurred at RM 4.0 during the February 1986 Flood Event That Included Mass Failure of Levee Structure during Peak Flood Conditions

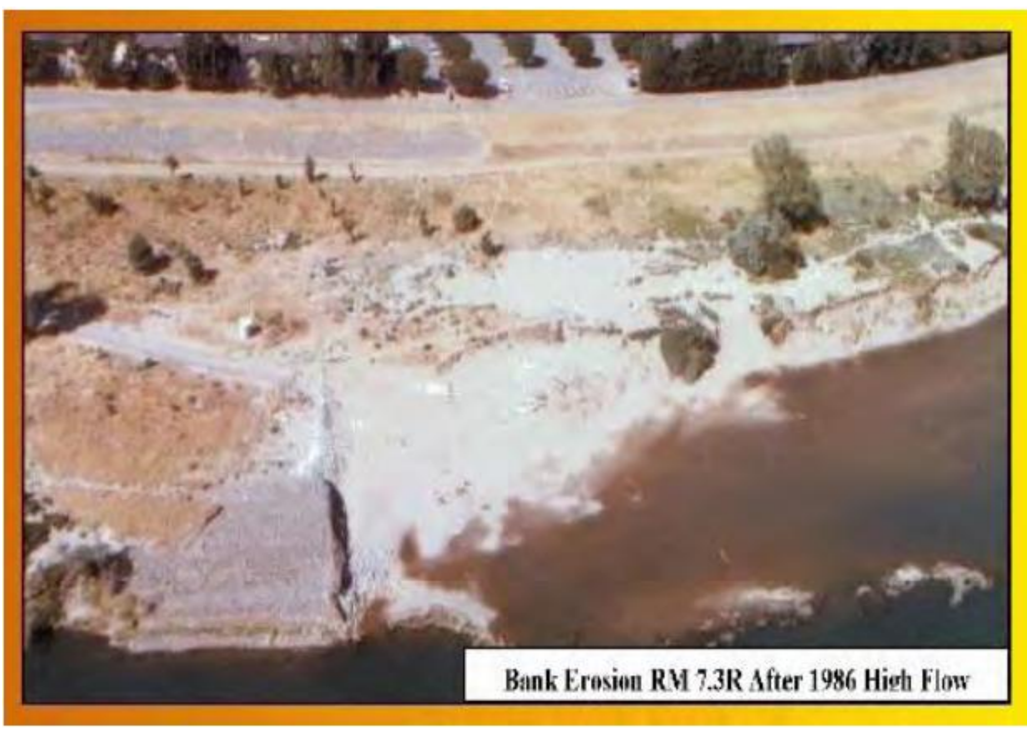


Figure 6. Example of Rapid Bank Erosion (100+ Feet) from the February 1986 Flood within Subreach 2 at Sewer Force Main Crossing

Table 1. Summary of Historical Events Affecting Channel Stability of the Lower American River

Time period	Land Use Event	Consequences	Ongoing Effects
1850-1900	Hydraulic Mining and release of sediments to LAR	Increased sedimentation and filling of LAR up to 20+ feet	LAR channel bed has generally recovered, but high steep banks of erodible hydraulic mining sands remain
1850 – 1900s	Agricultural Development and early urbanization; inflow of hydraulic mining sediments; early water resources development; in channel placer gold mining; channelization of the lower 2 miles of LAR north of original path.	First generation of levees constructed from approximately RM 12 to Sacramento River; construction of railroad causeways and bridges; after 1862 flood raising urban areas with fill and higher levees.	Clearing riparian lands for agriculture, then urbanization of floodplain lands and reduction of natural overbank areas.
1900s – 1950s	Federal flood control and levee system installed; continued expansion and encroachment of urban areas into floodplain including levees closer to LAR channel. Aggregate mining in LAR begins. Closure of Lake Clementine to control sedimentation.	Reduced floodplain areas for overbank flood flows; flushing of hydraulic mining sediments and channel entrenchment. Further levee construction encroachment. Installation of bank protection works	Episodic large flood events threaten the expanding Sacramento urban areas. Continued levee upgrades, raising and encroachment confining hydraulic force during floods, and erosion protection.
1950s to 1980s	Closure of Folsom Dam; additional levee construction; new bridges and peak period for instream aggregate mining, continued urbanization. New bridge and water intake construction. Installation of bank protection. Creation of LAR Parkway and protections.	Elimination of watershed sediment supply; reduction of flood flows and increased summer flows irrigates floodplain. expansion of channel area by mining creating sediment supply discontinuities. Large levee confined floods force and accelerate bank erosion necessitating bank protection works; physical encroachments disrupt channel hydraulics and erosion patterns.	Highly confined levee system concentrating floods and erosive force. Ongoing episodic bank erosion. Channel bed erosion and significant bed lowering ends. Ongoing episodic bank erosion during large floods threaten levees. Vegetation in floodplain areas increases due to irrigation.

Time period	Land Use Event	Consequences	Ongoing Effects
1990s to 2018	Levee structural upgrades; upgrades to Folsom Dam flood operations; installation of bank protection works at numerous locations. Consideration of natural resources for activities.	Level of flood protection increased with higher peak flood design for LAR. Increase hardened bank protection structures; aging and gradual loss of large trees on banks. Habitat restoration in bank protection structures and in other areas.	Ongoing episodic bank erosion influenced by the summation of past land use effects and dependent upon vegetation cover for stability

The response of the LAR channel to is ongoing, which has implications for the future stability of the channel, banks and levees that provide essential protection for urban areas of Sacramento.

Numerous reports discuss the repercussions of land use impact on the LAR. The following presents the most important and salient points:

1. **Overall Lateral and Planform Channel Stability:** The LAR channel in the levee reach below RM 14.0 has maintained a stable planform and channel width over time despite periods of significant vertical instability and large fluctuations in sediment supply that occurred during the filling and flushing hydraulic mining sediments between 1880s and 1950s. The LAR exhibits lateral stability primarily due to confinement within ERM, woody bank vegetation, and more recently, bank protection structures.
2. **Channel stability with depleted sediment supply** The LAR channel bed has been relatively stable since the 1950s after hydraulic mining sediments were flushed out. Channel incision left an entrenched channel that concentrates greater hydraulic force further increased by constricting levees. This combined with a depleted supply of bed material sized sediments (gravels and coarse sand) below RM 12.0. This has created a "sediment hungry water" condition in Subreach 2 and excessive hydraulic force that favors channel widening.
3. **Steep Erodible Sandy Banks.** As a result of hydraulic mining sediments filling the channel and covering floodplain areas in the late 1800s followed by channel incision after 1900, the banks of the LAR are steep and composed of highly erodible sands (Ra and Ha). Vegetation became established on banks during this period and was able to survive channel bed lowering and deepening groundwater. This history resulted in the bank vegetation observed today that protects the sandy soils and helps to maintain channel width. However, soil moisture conditions are not favorable for recruitment and sustenance of new vegetation and in many locations, trees are decaying with age or have been eroded away (Figure 7). Without vegetation cover and root structures, the banks would erode rapidly during floods perhaps as low as 40,000 cfs and greatly increase local channel width. The eroded sands would be flushed immediately downstream due to the excessive hydraulic forces concentrated by levees. Where erosion has progressed and threatened levees, bank protection has been installed along much of the left bank of Subreach 2 and at the 1986 right bank erosion location at RM 7.2.
4. **Increased hydraulic force due to levee encroachment:** The current LAR flood conveyance corridor between the levees is as narrow as 800 feet in Subreach 2 and contains an excess of hydraulic force with projected flow velocities above 12 feet per second which is capable is transporting small boulder size sediments. This reach also includes the armored constriction of the Arden sewer force main crossing where rapid erosion occurred in 1986. Since the north levee protecting Campus Commons was constructed in the early 1950s, the leveed reach has experienced three floods of about 115,000 cfs (water years 1965 and 1997), and one flood of 135,000 cfs (1986). During the 1965 event, emergency erosion repair work was required to mitigate erosion on the left bank downstream of H Street. In the 1986 event, over 100 feet of lateral erosion of the right bank berm along about 1,000 feet of bank between Howe Ave and the Fairbairn intake (Figure 5) occurred. Additional bank repair was required on the left bank upstream of H street after the 1986 event due to erosion at the bank toe. After the 1997 event, the left bank was again repaired between H Street and the Fairbairn intake due to ongoing erosion. Other locations of erosion were also noted in the American Flood Control District's log books along the levee toe.

Figure 7. Example of Recent Bank Erosion and Limited Tree Cover Protecting Steep Erodible Banks on LAR at RM 6.0 Right Bank on Campus Commons Golf Course

4.1.6 Summary and Long-Term Trends

Examination of historical information indicates that the LAR channel in Subreach 2 has been very stable over the past 60 years since Folsom Dam was closed. The channel bed profile has remained stable since the 1960s and channel width has remained consistent. However, the excess of hydraulic force, especially within the narrow channel of Subreach 2, due to levee encroachment and historic bed incision combined with sandy bank materials protected only by vegetation cover presents a hazardous condition, especially where the bench width is narrow.

The present geomorphic trends in Subreach 2 indicate that localized lateral bank erosion will be an ongoing response to excessive hydraulic force and steep banks of erodible soils. Where hardened bank protection has not already been installed, only well-rooted woody riparian vegetation prevents bank retreat. Visual observation suggests that bank vegetation consists of aging trees and recruitment of replacements may not be occurring. Due to lack of data on bank tree ages and recruitment dynamics, it is unknown whether loss of bank tree stock could accelerate in the future and in turn increase erosion as well.

Another factor that could affect channel processes is future sea level rise and hydrologic and sediment transport changes associated with climate change. Sea level rise would affect the Sacramento River and possibly the base level for the Lower American River, especially in the lower 6 miles including part of Subreach 2. Recent analyses conducted for DWR's Central Valley Flood Protection Project 2017 Update (DWR 2017) assume a moderate sea level rise of 1.5 feet which would have little effect on flooding in the LAR. However, this appears to be at the median range of possible scenarios which include upwards of 5+ feet by 2100 (National Research Council 2012). It is unknown what effect the higher range estimates would have on the LAR as such a scenario has not been examined through hydraulic modeling.

4.2 Erosion Assessment – Subreach 2 Paradise Bend to Howe Avenue

NHC completed both a screening level analyses of the potential for event based erosion to impact levee stability and a geomorphic assessment of LAR. Both studies indicate Subreach 2, extending from Paradise Bend to Howe Avenue (RM 5 to RM 7.8), was likely most vulnerable to erosion due to increased discharges from Folsom Dam. Application of the DWR Levee Erosion Screening Process (NHC, 2016a) identified the left bank and levee as having a high erosion risk between RM 6.0 and 6.7. Subreach 2 also includes high risk areas identified in the Geomorphic Assessment (NHC 2016b) as likely to experience significant channel adjustments due to excess hydraulic force acting on weak, less erosion resistant soil materials. The objective of this erosion assessment was to further assess high risk areas and identify specific locations within Subreach 2 that are likely to erode and estimate the potential extents of erosion that could threaten project levees either in the immediate future or long term.

For the erosion assessment, NHC completed a thorough review of background information needed to estimate the erosion potential. This information included compiling the latest soils and stratigraphic information, evaluating the (as of spring 2018) most current topographic and bathymetric information, identifying flows of interest to evaluate for erosion considering the updated Water Control Manual at Folsom Dam, developing a two-dimensional hydraulic model to quantify hydraulic forces for each identified flow of interest, updating and revising existing revetment inventories to understand the level of existing erosion protection in the subreach, and completing field investigations. NHC also considered the potential for erosion during individual 3-day events for identified flows of interest of 40,000 cfs, 80,000 cfs, 115,000 cfs, and 160,000 cfs. By comparing the erosive forces against resistance factors, the potential for erosion was qualified as low (unlikely to occur), moderate (may occur), and high (likely to occur).

A single flood event based analysis of erosion discretized the left and right banks into 16 individual segments based on the extent of existing revetments, stratigraphic profiles, and bench widths (distance from channel bank to levee toe). The potential for erosion was evaluated considering the ability of the various flows to erode bank or levee embankment materials, and the resistance of existing vegetation cover and revetments to erosion. The analysis considered both fluvial erosion and scour processes at both the river bank and on the levee face. The analysis did not include any assessment of potential wind/wave generated erosion.

The objective of this study was to identify the potential for erosion to occur, and to quantify the extent of erosion progression towards/into the levees. The study did not include an evaluation of consequences if levee breach were to occur and, therefore, does not include a flood damage risk assessment.

Four flows of interest were selected to evaluate erosion potential throughout the study area. The flows were selected to represent a range of lower magnitude and more frequent flows, as well as higher magnitude design flows which occur less frequently. USACE (2015) notes that the critical duration- or the storm duration that produces the maximum downstream discharge for Folsom Reservoir is a 3-day event. Investigation of the peak outflow hydrographs show the peak outflows typically last a period between 2 and 3 days. The four flows events considered were:

- A flow of 160,000 cfs is the maximum flow which can be released under control from Folsom Dam under proposed operating scenarios. The 160,000 cfs event brings flows to within several feet of the top of levee. 160,000 cfs sustained for 3 days is considered the design event.
- A flow of 115,000 cfs is the maximum flow in the synthetic period of record and is representative of peak flows with an approximate 50-year return period. The 115,000 cfs event

is also representative of a flow where the bench conveys significant flow which occurs with relative regularity. The 1997 event had a peak flow of about 117,000 cfs.

- A flow of 80,000 fills the main channel and shallow water flow spreads onto the overbank bench throughout the study area The 80,000 cfs event has an approximate 10-year return period under the proposed updates to the Folsom Dam Water Control Manual. The winter 2017 peak flow on the Lower American River was about 80,000 cfs.
- A flow of 40,000 cfs is representative of a large in-channel flow which occurs under existing conditions at about a 10-year return period but would occur more frequently (about 3.5-year recurrence) under proposed new operations.

4.2.1 Hydraulic Model

NHC used the "Sedimentation and River Hydraulics – 2-Dimensional" (SRH2D) (USBR version 4.0) software to model the LAR reach from RM 3.7 to RM 9.1. The intent of this two-dimensional depth-averaged numerical hydraulic model was to evaluate the distribution of velocities and applied shear stresses throughout the project subreach for the four flows of interest. The downstream boundary was set at the Business Interstate-80 bridge about 1.2 miles downstream of Paradise Bend. The upstream boundary was set at the Watt Avenue bridge about 1.55 miles upstream of Howe Avenue. The model results include velocity and shear stress maps as well as cross-section plots of depth-averaged velocity and shear stress.

Figure 8 shows the model results for velocity and shear stress throughout Subreach 2 at a flow of 160,000 cfs. In-channel velocities exceed 10 feet per second (ft/s) from the Fairbairn intake downstream to Paradise Bend. Peak shear stresses are about 1.1 pounds per square foot (psf), with typical values between 0.5 and 1.0 psf instream, and less than 0.1 psf in the overbank area.

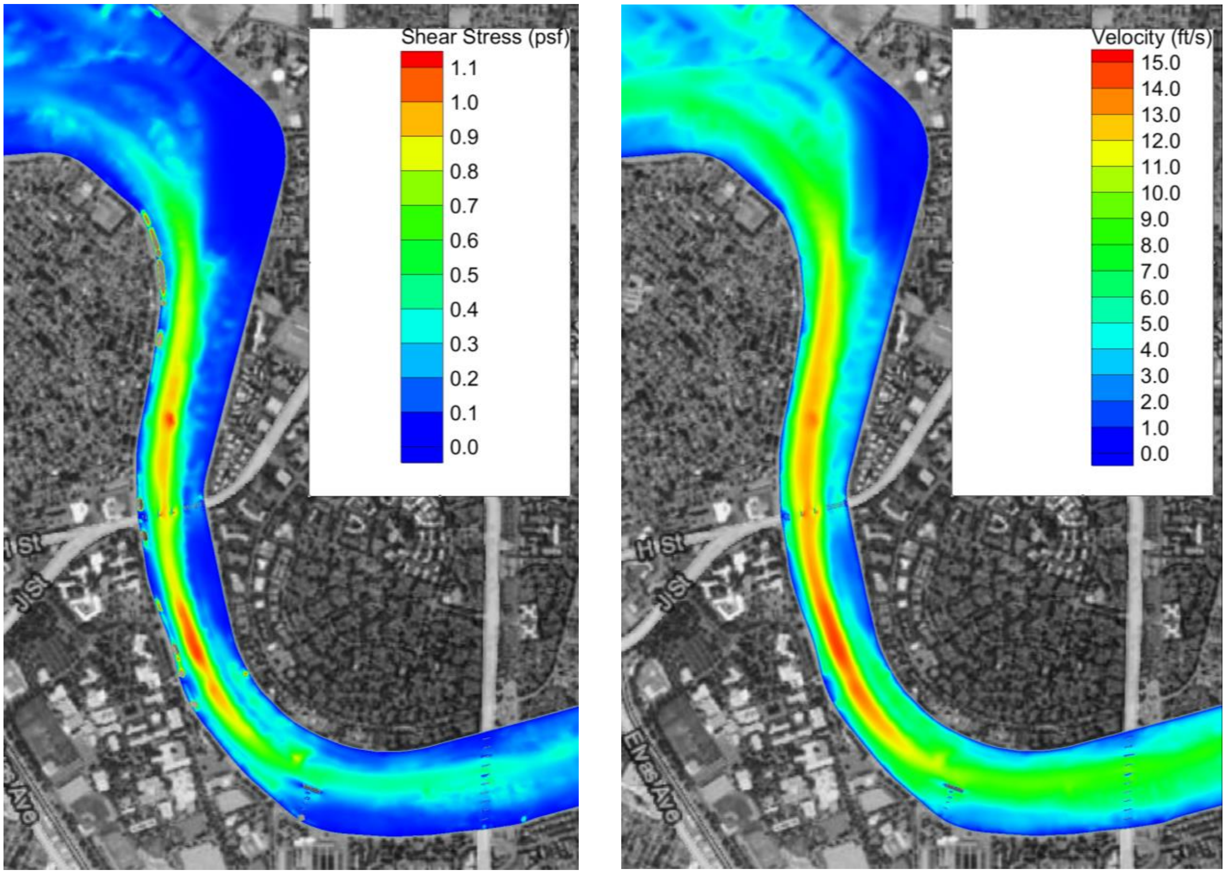


Figure 8. Subreach 2 Model Results for Shear Stress (left) and Velocity (right) during a Constant Discharge of 160,000 cfs

4.2.2 Event Based Erosion

An event based erosion assessment methodology was used, which breaks the left bank and right bank of the river into discrete segments. The segments were discretized into sections of the bank and levee with similar hydraulic conditions, revetment design, vegetation, and bank and overbank bench geometry. Each segment was analyzed for its potential for slope failure of the bank due to scour at the bank toe, erosion of the bank, slope failure of the levee due to scour, and erosion of the levee.

The potential erosion extents were quantified for each flow rate at each segment as a function of the underlying soil types and applied hydraulic shear stresses. The vertical extents of scour are estimated at both the bank and levee toe. Fluvial erosion is quantified as a lateral extent into the bank or levee face.

4.2.2.1 Segment Discretization

Bank erosion evaluation segments were discretized based on lengths of riverbank with similar hydraulic conditions, soil properties, revetment designs, and vegetation as well as similar bank, levee, and overbank geometry. Hydraulic conditions were evaluated using results from the two-dimensional hydraulic modeling of the site (summarized above). Hydraulic characteristics used to identify segments included velocities, depths, and flow direction at the bank toe and levee toe. Soil properties were taken from the URS-GEI (2013) stratigraphic model of LAR and from visual observations in the field. Existing revetment designs were taken from the Revetment Inventory, also prepared by NHC. Vegetation was qualitatively classified through observation in the field. Bank and overbank bench geometry was evaluated through a combination of the 2008 LiDAR and 2006 bathymetric surveys, as well as field investigation. Discretization of the study reach based on these variables resulted in 16 segments being identified. Eight segments are located on the right bank, and 8 segments on the left bank. Segments vary in length from 0.1 to 0.6 miles. Figure 9 shows the segments. Table 2 provides a summary of the key characteristics of each segment. (It should be noted Table 2 shows the location of Segment 9 as adjacent to the channel. In fact, the segment limits are representative of the levee location along this segment).

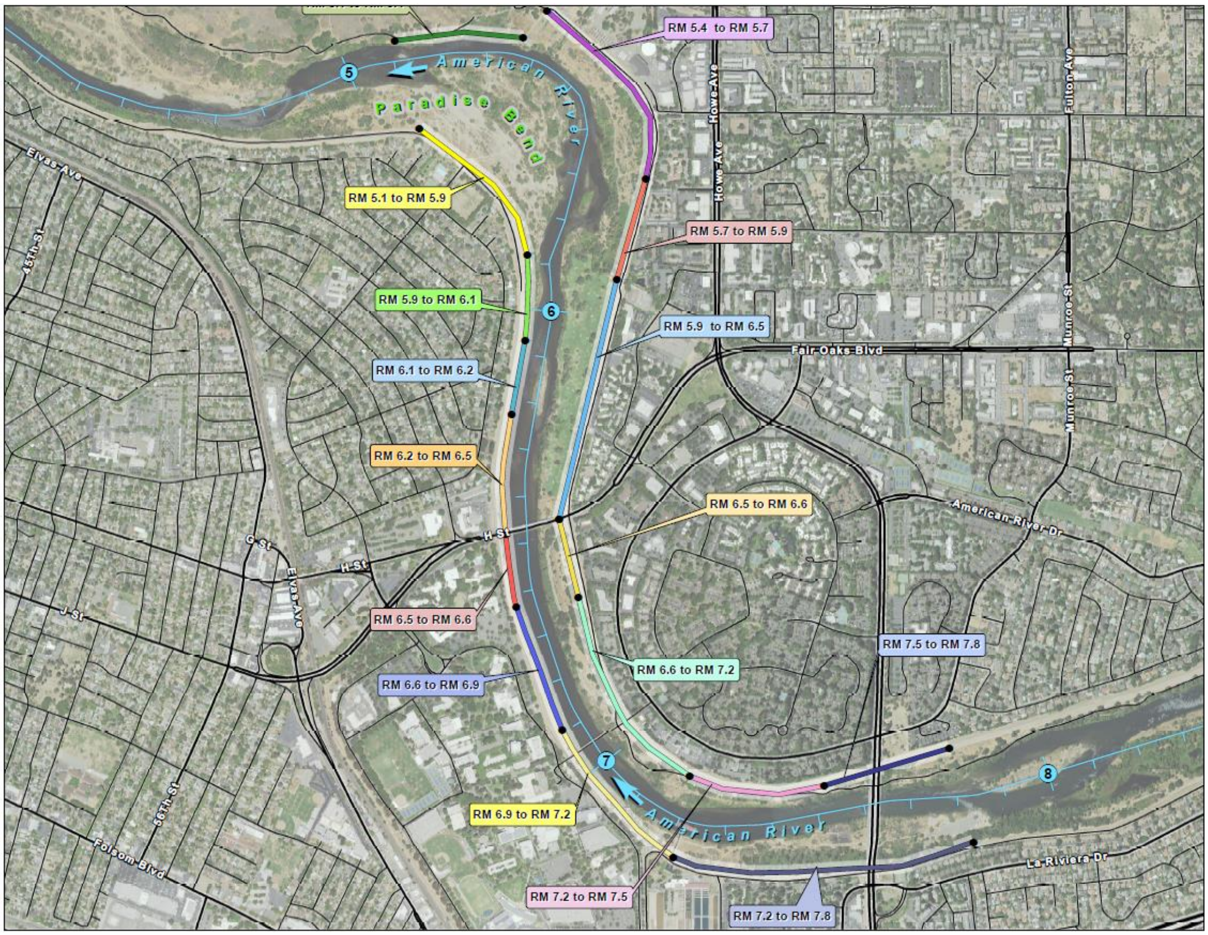


Figure 9. Erosion Assessment Segments

Table 2. Summary of Segments

Segment	Soil Type	Bench Width (ft)	160 kcfs Velocity at Bank Toe (ft/s)	160 kcfs Depth at Bank Toe (ft)	Existing revetment Plan Name (year installed)
Segment 1 Left Bank RM 5.1-5.9	Mining deposits	200-2000	5.5	22.0	None
Segment 2 Left Bank RM 5.9-6.1	Mining deposits with boulder, cobble, and gravel layer	20-200	11.4	29.5	None
Segment 3 Left Bank RM 6.1-6.2	Silty-sand	~20	11.4	31.5	Riprap bank protection (no toe) American River Common Features Project American River Erosion Control Site 6.4 L (2004)
Segment 4 Left Bank RM 6.2-6.5	Silty-sand extending down to a boulder, cobble, gravel layer	~20	10.3	35.0	Cobble toe and bank protection American River Erosion Control Project American River Lt. Bank Vicinity – "H" St. Bridge. (1967)
Segment 5 Left Bank RM 6.5-6.6	Silty-sand extending down to a boulder, cobble, gravel layer	0	9.6	46.0	Riprap toe and cobble bank protection American River Erosion Control Project American River Lt. Bank Vicinity – "H" St. Bridge. (1967)
Segment 6 Left Bank RM 6.6-6.9	Silty-sand extending down to a boulder, cobble, gravel layer	0	12.5	40.0	Riprap toe protection Sacramento River Bank Projection Project Site 4 (2001) Riprap bank protection American River Common Features Project American River Erosion Control Site 6.9L (2004)
Segment 7 Left Bank RM 6.9-7.2	Silty-sand extending down to a boulder, cobble, gravel layer	20-100	12.0	38.6	Riprap toe protection Sacramento River Bank Projection Project Site 4 (2001)
Segment 8 Left Bank RM 7.2-7.8	Both the silty sand and mining deposits extend down to a boulder, cobble, gravel layer	100-300	7.6	33.8	Cobble toe and bank protection American River Erosion Control Project American River Lt. Bank Vicinity – "H" St. Bridge. (1967)

Segment	Soil Type	Bench Width (ft)	160 kcfs Velocity at Bank Toe (ft/s)	160 kcfs Depth at Bank Toe (ft)	Existing revetment Plan Name (year installed)
Segment 9 Right Bank RM 5.1-5.4	Silty-sand on sandy-clay/ clay deposits	500+	6.3	38.4	None
Segment 10 Right Bank RM 5.4-5.7	Mining deposits abuting silty-sands under the levee, deposited on sand laid upon a boulder/cobbles/gravel layer	300-500	4.2	31.9	Cobble bank protection (design/year unknown)
Segment 11 Right Bank RM 5.7-5.9	Mining deposits on layer of sand laid upon a boulder/cobbles/gravel layer	300-600	7.7	36.5	None
Segment 12 Right Bank RM 5.9-6.5	Mining deposits on layer of sand laid upon boulder/cobbles/gravel layer	250-600	8.1	29.5	None
Segment 13 Right Bank RM 6.5-6.6	Mining deposits on layer of sand laid upon boulder/cobbles/gravel layer	275-350	8.2	41.5	None
Segment 14 Right Bank RM 6.6-7.2	Mining deposits on layer of sand laid upon boulder/cobbles/gravel layer	300-400	10.3	41.5	Riprap levee and levee toe protection American River Common Features Project American River Erosion Control Site 7.0R (2004)
Segment 15 Right Bank RM 7.2-7.5	Mining deposits on layer of sand laid upon boulder/cobbles/gravel layer	150-350	8.5	35.0	Riprap levee and levee toe protection American River Common Features Project American River Erosion Control Site 7.0R (2004) Riprap bank protection (1986)
Segment 16 Right Bank RM 7.5-7.8	Mining deposits on layer of sand laid upon boulder/cobbles/gravel layer	150-330	6.7	38.5	None

4.2.3 Overall Erosion Potential

The following descriptions review the key findings from the review of geomorphic processes and expected long-term changes in channel planform, as well as, the evaluation of the potential for the existing channel to erode during individual events of various flow magnitudes under existing conditions.

4.2.3.1 Left Bank

Segment 1 (Left Bank RM 5.1-5.8)

This area which includes Paradise Bend is backwatered by the Sacramento River during high water events and shows evidence of erosion into ERM and areas accumulating deposition. The impacts of the developing chute on Paradise Bend are unlikely to significantly change hydraulics near the levee. The levee is constructed on Post-1850 alluvium. Although there is no revetment along this segment, erosion of the levee and/or levee foundation material is unlikely to occur. If erosion were to occur, it is unlikely to impinge into the minimum levee template.

Segment 2 (Left Bank RM 5.8-6.1)

The levee in this segment is constructed on the Post-1850 alluvium and does not have any modern revetment. The bench is an extension of Paradise Bend and its width reduces from about 200 feet on the downstream end to about 20 feet on at the upstream boundary. Although Segment 2 is situated in a hydraulically depositional zone, the lack of coarse sediment supply means scour may develop locally. Scour depths may impinge on the minimum levee template during the 160,000 cfs event but is unlikely to impinge the levee template at lower magnitude flows. Although vegetation is generally thick and established over much of the segment, large unvegetated areas do exist on the bench increasing the potential for erosion. The bank toe is unprotected and it is uncertain how erodible the materials underlying this segment are. The channel along this segment is relatively narrow and is likely to experience velocities in excess of 11 ft/s during the 160,000 cfs event and the potential for erosion increases from a moderate potential during 40,000 cfs and 80,000cfs events, to a high potential during the 115,000 cfs and 160,000 cfs events. The progress of erosion during the 40,000 cfs and 80,000 cfs would be unlikely to reach the levee template, but 115,000 cfs or 160,000 cfs events could.

Segment 3 (Left Bank RM 6.1-6.2)

The levee is constructed on natural deposits of silty sands with a bench width of about 20 feet. A relatively large mid channel bar opposite Segment 3 has been slowly growing over the past 50+ years causing erosion and retreat of the opposite right bank within Segment 12. Bar growth appears to be away from the left bank and may force more erosion on the right bank. The depth of the minimum levee template at the existing river bank toe is at about the location of the erosionally resistant material. Scour may reach this depth during 160,000 cfs events, but is unlikely to reach this depth at lower flows. The 1965 115,000 cfs event caused erosion through this segment, and large rock bars exist in the bankline from the emergency fix. USACE also constructed the RM 6.4L riprap design in 2004. Neither design included bank toe scour protection. Although velocities in channel are likely to exceed 11 ft/s during the 160,000 cfs event, the existing riprap is likely to resist bank erosion during all the flows of interest. However if the riprap were to fail erosion could extend into the minimum levee template during events of 80,000 cfs or larger.

Segment 4 (Left Bank RM 6.2-6.5)

The levee in this segment is constructed on natural deposits of silty sands with a bench width of about 20 feet and no modern revetment. Scour is unlikely to impinge into the levee template during the flows of interest. The bank is well covered with trees along the bank toe and grasses along the upper bank slope which is expected to resist erosion. However, if the vegetation were to fail, erosion could impinge into the levee template during the 160,000 cfs event.

Segment 5 (Left Bank RM 6.5-6.6)

The levee is constructed on natural deposits of silty sands with no discernable bench. Angular rock riprap was installed along the toe in 1967 with cobble bank paving above. Scour may impinge into the levee template during a 160,000 cfs event, but is unlikely to encroach into the template at lesser flows. The existing rock toe is likely not adequate to resist this scour. Noticeable gaps in the vegetation coverage on the bank surface increases the likelihood of erosion. The segment is considered as having a high potential to erode at events of 40,000 cfs and larger.

Segment 6 (Left Bank RM 6.6-6.9)

The levee is constructed on natural deposits of silty sands with no discernable bench beyond the constructed rock toe bench. Angular rock riprap was installed along the toe in 2001 and along the bank above the toe in 2004. The toe of the levee template is about 20 feet below the expected top elevation of erosion resistant material (ERM). Scour may impinge into the levee template at flows of 80,000 cfs and above, however both the existing revetment design and ERM are likely to resist the scour. The existing revetment designs are likely adequate to resist erosion during all flows of interest.

Segment 7 (Left Bank RM 6.9-7.2)

The levee along Segment 7 is constructed on natural deposits of silty sands with a bench width of about 20 feet at the downstream end widening to 100 feet upstream. Due to levee constriction and alignment along the outside of the bend, Segment 7 favors erosion. Angular rock riprap was installed along the toe in 2001. The toe of the levee template is about 20 feet below the expected top elevation of the erosionally resistant material. Scour may impinge into the levee template at flows of 160,000 cfs but is unlikely to at lower flows. The existing revetment design and erosionally resistant material are both likely to resist the scour and prevent it from impinging the levee template. The existing revetment designs are likely adequate to resist erosion during all flows of interest, however if it were to fail erosion could extend into the levee template at the flows of 80,000 cfs and above.

Segment 8 (Left Bank RM 7.2-7.8)

The Segment 8 levee is constructed on natural deposits of silty sands with a bench width of about 100 feet on the downstream end expanding to 300 feet upstream. The levee template is about 70 feet below the expected elevation of the erosionally resistant material. Scour is unlikely to impinge into the levee template at any of the flows of interest. The existing river bank is covered with vegetation, however large unvegetated areas are noticeable. The vegetation is likely to resist erosion where it is established, however erosion may occur where gaps in vegetation exist. This erosion may further compromise the existing vegetation. If erosion does occur, it is unlikely to impinge into the levee template.

4.2.3.2 Right Bank

Segment 9 (Right Bank RM 5.1-5.4)

The levee is constructed on natural deposits of silty and clayey sands. The bench is about 500 feet wide. The riverbanks are near vertical and poorly vegetated without modern bank protection.

Erosion may occur during any of the flows of interest however the bench width is wide enough that an individual event is unlikely to impinge into the levee template.

Segment 10 (Right Bank RM 5.4-5.7)

The levee is constructed on natural deposits of silty and clayey sands. The bench is about 500 feet wide. No modern bank revetment is currently installed in this segment. The riverbanks are at a stable slope and well-vegetated. Scour and lateral erosion is unlikely to reach to the levee template.

Segment 11 (Right Bank RM 5.7-5.9)

The Segment 11 levee is constructed on loosely consolidated post-1850 alluvium. The bench is about 300 feet wide. No modern bank revetment is currently installed in this segment. The riverbanks are at a stable slope and well-vegetated. Scour is unlikely to reach to the levee template. The vegetation should be adequate to resist erosion along the river bank and if any occurred it would still be unlikely to impinge into the levee at any of the flows of interest.

Segment 12 (Right Bank RM 5.9-6.5)

The Segment 12 levee is constructed on loosely consolidated post-1850 alluvium. The bench is generally about 300 feet wide and is situated within the Campus Commons Golf Course. Channel widths may increase near the existing depositional bar. The downstream end of Segment 12 has ERM along the toe which appears to have limited lateral erosion in the recent past. Much of the bank is well vegetated, however the are significant lengths which are thin or lack coverage. Erosion of these areas may compromise adjacent vegetated areas. The segment has a moderate potential for erosion during all four flows of interest, however erosion is unlikely to impinge into the levee template during an individual event. Similarly, scour is unlikely to reach the levee template during any of the four flows of interest.

Segment 13 (Right Bank RM 6.5-6.6)

The Segment 13 levee is constructed on loosely consolidated post-1850 alluvium. The bench is generally about 300 feet wide and no rock revetment on banks. Overall the bank is well vegetated, however localized areas along the bank toe appear to lack adequate vegetation to resist erosion. The bank is steep and composed loosely consolidated silty sands which appear to not allow large vegetation to firmly anchor and establish. Although the existing vegetation where it exists could likely resist erosion, the lack of established vegetation near the toe suggests the bank would be likely to erode during all of the flows of interest. If erosion does occur, it is unlikely that erosion would impinge into the levee template during a single event. Similarly, scour may occur at the toe but would be unlikely that scour could impinge into the levee template.

Segment 14 (Right Bank RM 6.6-7.2)

The Segment 14 levee is constructed on loosely consolidated post-1850 alluvium. The bench is generally about 300 feet to 400 feet wide. No rock revetment exists along bank, however riprap was installed along the waterside levee face and levee toe in 2004. Overall the bank is well vegetated, however sections along the bank toe appear to lack adequate vegetation to resist erosion. The bank is steep and composed loosely consolidated silty sands that do not allow vegetation recruitment. Although the existing vegetation would likely resist erosion, the lack of established vegetation near the toe suggests the bank would be likely to erode during all of the flows of interest. If erosion does occur, it is unlikely that erosion would impinge into the levee template during a single event. Similarly, scour may occur at the toe, however it is unlikely that scour could impinge into the levee template.

Segment 15 (Right Bank RM 7.2-7.5)

The Segment 15 levee is constructed on loosely consolidated post-1850 alluvium and the bench is 150 feet to 300 feet wide. This segment includes the armored sewer line crossing where significant erosion occurred in 1986 and rip rap was installed on the banks shortly after. Riprap was also installed in a trench from the right bank at the sewer line to the levee toe; a sheet pile wall was installed where the buried rip rap meets the levee toe. Riprap was also installed along the waterside levee slope and in a toe trench in 2004. The bench is wide enough that scour is unlikely to impinge into the levee template during a single event. The existing revetment and vegetation appear to be adequate to resist erosion during all four flows of interest. If erosion of the riverbank does occur, it is unlikely to impinge into the levee template. However, the armored sewer line and constriction remain a concern for local channel stability and should be investigated for modification.

Segment 16 (Right Bank RM 7.5-7.8)

The Segment 16 levee is constructed on loosely consolidated post-1850 alluvium. The bench is 150 feet to 300 feet wide and no bank protection occurs in this segment. The bench is wide enough that scour is unlikely to impinge into the levee template, however the existing bank is relatively steep and likely prone to slope failure. The bank has numerous large trees however some have undercut root systems along the top edge of bank increasing the potential for slope failure. Tension cracks appeared along the top of bank after the high flows of 2017 indicating ongoing slope instabilities. If bank erosion were to occur, it is unlikely to impinge into the levee template in a single event.

The results of the erosion assessment were provided to TRAC and utilized throughout their process and in particular for the expert opinion elicitation described below.

4.3 David Ford Consulting Engineers Erosion Risk Assessment and Expert Opinion Elicitation

4.3.1 Authors and Purpose

David Ford Consulting Engineers (Ford Engineers) conducted an expert opinion elicitation (EOE) to estimate the probability of levee failure as a result of erosion in the 16 segments of Reach 2. Ford Engineers used this information for a semi-quantitative risk assessment. For the EOE and risk assessment, Ford Engineers used methods consistent with USACE practice. Ford Engineers used the risk assessment results to rank the segments to inform prioritization of repair.

4.3.2 Methods

For the semi-quantitative risk assessment, Ford Engineers computed conditional annual exceedance probability (C-AEP). (A typical risk assessment considers economic consequences, loss of life, or other consequences.) For this assessment, C-AEP is the annual probability that flooding will occur to any depth due to levee failure under these conditions:

- The levee failure is caused by erosion.
- In-channel flows are between 40,000 and 160,000 cfs.

The C-AEP metric used here differs from commonly reported AEP values. A typical AEP value would be computed considering additional levee failure modes (e.g., underseepage, through seepage, landside stability, etc.) and the full range of flows. Here, the C-AEP value provides a metric for relative comparison of the segments and does not indicate a "level of protection."

Ford Engineers first held the EOE, interviewing six experts. The experts provided opinions based on existing conditions (e.g., physical and hydraulic model data developed by NHC through their erosion assessment process) for a range of in-channel flows (between 40,000 and 160,000 cfs). Next, Ford Engineers used the information from the EOE to develop levee performance curves, which, in combination with a USACE flow-frequency curve, were used to compute a C-AEP value for each segment.

Ford Engineers planned and implemented the EOE generally following three USACE guidance documents:

- Technical Guide for Use of Expert Opinion Elicitation for U.S. Army Corps of Engineers Risk Assessments, USACE Dam Safety Risk Management Center (2009).
- A Practical Guide on Conducting Expert-opinion Elicitation of Probabilities and Consequences for Corps Facilities, IWR Report 01-R-01 (2001).
- Methods for Expert-opinion Elicitation of Probabilities and Consequences for Corps Facilities, IWR Report 00-R-10 (2000).

The ballot used for EOE is shown in Figure 10.

Ballot for expert opinion elicitation on LAR erosion risk assessment

Segment: Site 3 - Left bank - RM 6.1-6.2

Panel member: ___________________________

In each cell of the ballot below, answer the question shown in col. 1 by entering your opinion of the probability, given the flow rate shown in the heading for each column. Indicate also your confidence in your estimate by circling **H** (high confidence, unlikely additional information would change); **L** (low confidence; additional information likely to change this); **M** (moderately confident, additional information might change the estimate).

	Question[1, 2, 3] (1)	LAR flow rate							
		40K cfs (2)		80K cfs (3)		115K cfs (4)		160K cfs (5)	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final
1	GIVEN the flow rate shown (and the associated velocity and shear loading), along with your knowledge of the current geotechnical and geomorphic conditions, existing mitigating features (revetment, vegetation, etc.), WHAT IS THE PROBABILITY erosion is initiated?	H M L	H M L	H M L	H M L	H M L	H M L	H M L	H M L
2	GIVEN erosion is initiated, WHAT IS THE PROBABILITY erosion progresses (mass wasting) to such a magnitude that it extends into the levee template?	H M L	H M L	H M L	H M L	H M L	H M L	H M L	H M L
3	GIVEN erosion progresses, WHAT IS THE PROBABILITY intervention is successful?	H M L	H M L	H M L	H M L	H M L	H M L	H M L	H M L
4	GIVEN lack of success of intervention, WHAT IS THE PROBABILITY erosion into the levee template is sufficient to cause freeboard loss, slope instability, and/or seepage piping that results in levee breach?	H M L	H M L	H M L	H M L	H M L	H M L	H M L	H M L

Notes:
1. Probability values are between 0.00 and 1.00.
2. Consider only the current condition of the site, without any additional mitigation, etc.
3. Probability estimates are for a single occurrence; cumulative impacts are not considered at present.

Figure 10. Ballot Used for Expert Opinion Elicitation

For each segment, Ford Engineers computed C-AEP using the Folsom Dam outflow-frequency curve from USACE and the levee performance curve from each expert. Ford Engineers followed USACE procedure and combined the likelihood of a given flow in the channel and the likelihood of levee failure due to erosion given that flow to compute C-AEP (i.e., combined the flow-frequency curve and levee performance curve to produce a probability of failure-probability of flow curve) and then integrated the curve to find the C-AEP of flooding.

4.3.3 Results

The results indicate the top six segments (i.e., those with the highest C-AEP) are mostly on the downstream end of the left bank (Table 3). All other segments had relatively low C-AEP values that were difficult to differentiate and were, therefore, all ranked as seventh priority.

Table 3. Risk Assessment Results of Expert Opinion Elicitation

Rank	Segment Number	Segment	Median C-AEP[1]
1	2	L - RM 5.8-6.1	23.5[2]
2	5	L - RM 6.5-6.6	6.1
3	1	L - RM 5.1-5.8	2.6
4	4	L - RM 6.2-6.5	2.5
5	3	L - RM 6.1-6.2	0.8
6	16	R - RM 7.5-7.8	0.7
7	6	L - RM 6.6-6.9	Less than 0.1
7	7	L - RM 6.9-7.2	Less than 0.1
7	8	L - RM 7.2-7.8	Less than 0.1
7	9	R - RM 5.1-5.4	Less than 0.1
7	10	R - RM 5.4-5.7	Less than 0.1
7	11	R - RM 5.7-5.9	Less than 0.1
7	12	R - RM 5.9-6.5	Less than 0.1
7	13	R - RM 6.5-6.6	Less than 0.1
7	14	R - RM 6.6-7.2	Less than 0.1
7	15	R - RM 7.2-7.5	Less than 0.1

1. The median C-AEP among the experts. The C-AEP is computed based on levee failure due to erosion at flows between 40,000 and 160,000 cfs.
2. Here, we show the median C-AEP value multiplied by 10,000 for ease of comparison. For example, for segment 2, the C-AEP actually is 0.00235. This indicates that there is a 0.235% annual chance that flooding will occur to any depth due to levee failure under these conditions: the levee failure is caused by erosion and in-channel flows are between 40,000 and 160,000 cfs.

The results of this erosion risk assessment were a key driver for the subsequent process led by the TRAC to further prioritize each of the 16 segments in Subreach 2, described below.

4.4 Designation of Tier 1, 2, and 3 Segments

Consistent with an original objective of the BPWG/TRAC process, to identify areas that likely require bank protection and those that do not, the TRAC devised a three-tier approach to prioritize bank protection needs of the 16 segments in Subreach 2. The TRAC agreed to designate each of the 16 segments as either Tier 1, Tier 2, or Tier 3:

- Tier 1—The segments that have the highest risk of erosion and are subject to an immediate threat to the levees during high flows were classified as Tier 1.

- Tier 2—The segments that are not subject to an immediate threat to the levee but are anticipated to reach that condition after one or more high flow events were classified as Tier 2.
- Tier 3—The remaining segments that were not considered subject to an erosion threat that could lead to levee breach were classified as Tier 3.

The TRAC relied primarily on information from and discussion of NHC's *Erosion Assessment – Subreach 2 Paradise Bend to Howe Avenue*, and Ford Engineers's *Erosion Risk Assessment and Expert Opinion Elicitation*, to make tier designations.

As previously described, NHC's Erosion Assessment developed parameters that affect erosion potential including basic channel condition and evolutionary trends, potential local scour depths, existing levee and bank revetment features, bank and berm materials, water velocity, depth, and shear stress values, channel bed material, land surface cover conditions, and susceptibility to erosion given water velocities at four identified significant flow magnitudes (40,000; 80,000; 115,000; and 160,000 cfs) for each of the 16 segments in Subreach 2.

The TAC used this erosion-risk information at the segment-scale to engage in the EOE process for establishing estimates of relative erosion-risks and potential public safety concerns among the segments in order to prioritize them by relative safety risks. The basic assessment assumptions were to estimate erosion-risks at the segment-scale based on the channel, bank, berm, and levee conditions as they presently exist given a single occurrence of each of the four flow magnitudes over a 3-day duration. The process evaluated these independent flow events and did not directly consider the cumulative risk of multiple high flow events over time, and therefore ignores long-term channel and bank changes that may occur over a planning horizon such as may be induced by a series of floodflow events of varying magnitudes and durations, and channel evolutionary trends. The consideration of these planning horizon parameters could result in a different erosion-risk prioritization at the segment scale, and likely with more extensive rates of erosion.

The Ford Engineers Expert Opinion Elicitation process prioritized the 16 segments in Subreach 2. Although the EOE process employed for this effort results in numerical values of potential risks at apparent high level of precision, the identification of <u>relative risks</u> among the segments, and the identification of <u>priority segments</u>, within the constraints and limitations of the assumptions, are the actual objectives of this effort.

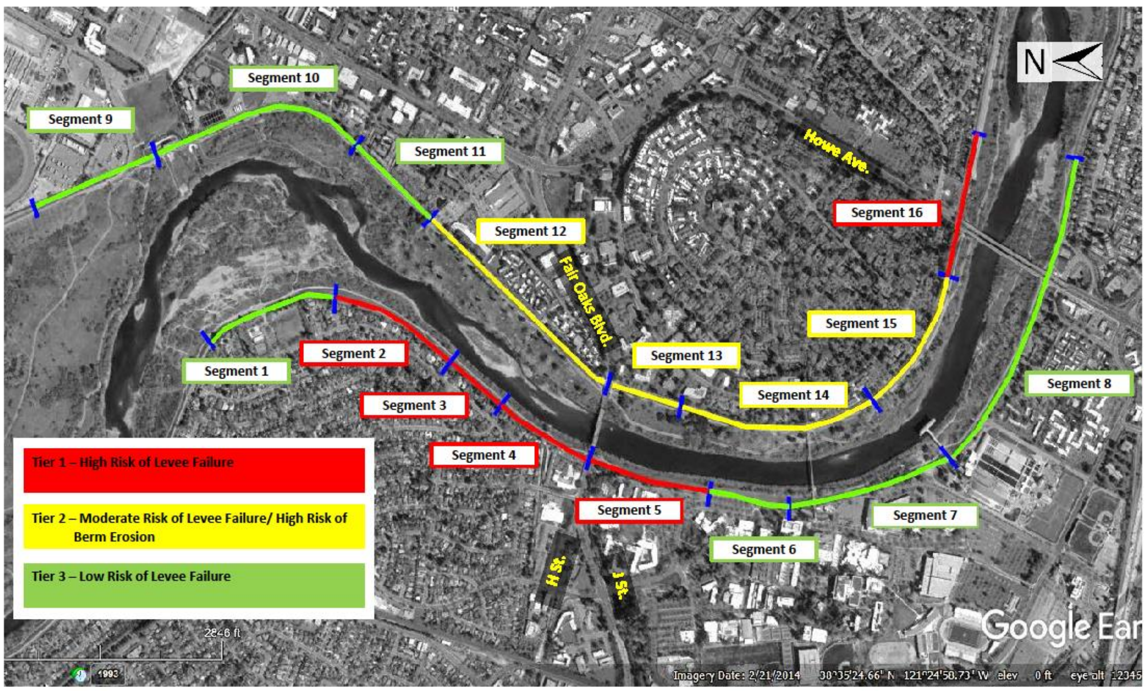
The TAC used that information as a starting place to make tier designations. The segments ranked 1 through 6 in the EOE process were further discussed by the TAC, and all but one of those six segments were ultimately identified as Tier 1 segments due to their high likelihood to erode and encroach into the adjacent levee. Segment 1 was the exception and was not designated a Tier 1 segment. For Segment 1, the TAC recognized that the voting in the EOE process resulted in a relatively high ranking, but after further discussion and review of the erosion assessment data, they determined that the risk of erosion reaching and compromising the levee was low. More specifically, the TAC determined that the combination of the wide berm, the relatively low velocities expected at the bank and levee toe, and the large size of the cobble in the cutoff chute would keep substantial erosion from affecting this segment. As a result, Segments 2, 3, 4, 5, and 16 were agreed to be Tier 1 segments and in need of bank protection.

The TAC then conducted further study and deliberation and designated several segments as Tier 3 based on either 1) the presence of modern bank protection that was deemed to be adequate to withstand flow events of 160,000 cfs or 2) a combination of factors including the presence of erosion resistant material, substantial berm width, and/or hydraulic conditions resulting in low velocities and shear stress, all of which made the threat of erosion reaching the levee extremely low. As a result, Segments 1, 6, 7, 8, 9, 10, and 11 were agreed to be Tier 3 and not in need of bank protection.

The remaining segments were considered likely to erode to some extent and likely to be designated as Tier 2 segments. Figure 11 depicts the status of the tier designations at that point in the process. The TRAC recognized that additional study and deliberation, including collection and analysis of Parkway resource information, was needed to make final decisions regarding Tier 2 designations. As a result, the TRAC considered the Tier 2 designations as interim in the following manner:

- Tier 2a: continued erosion in the long-term and berm/resources should be protected
- Tier 2b: continued erosion in the long-term but protection is not warranted and therefore is treated as if it were a Tier 3 Segment

This approach to the Tier 2 segments was a result of knowing that allowing natural processes to occur can be beneficial, as long as levees and substantial and/or highly valuable Parkway resources (e.g., habitat, recreation resources, infrastructure) are not at risk.



Source: SAFCA Lower American Resource Assessment / 160092.05

Figure 11. Lower American River Subreach 2 Segments and Tier Designations

The TRAC conducted further study and discussion, associated with the Resource Assessment and Dashboard Tool efforts summarized below, and determined that three of the Tier 2 segments warranted treatment and one did not. This work took into account site-specific considerations, such as soil/geotechnical conditions, velocities, and habitat/Parkway resources. It also took into account cumulative considerations, including subreach hydraulics and water surface elevations, site transitions, and potential mitigation requirements and opportunities. As a result, Segments 12, 13, and 14 were agreed to be Tier 2a segments and in need of action to protect against erosion, and Segment 15 was agreed to be a Tier 2b segment and not in need bank protection. Specific to Segment 15, its future upstream transition with the Segment 16 conceptual design, its existing downstream transition with Segment 14 (e.g., prior erosion, rock protection, revegetation), and existing resource values on the upper berm were the primary reasons for recommending no action. With regard to all segments identified for protection, bank protection project sites could be a portion of a particular segment, could be all of a segment, or could extend over several segments. Those details will be resolved during the more detailed design process.

4.5 Lower American River Subreach 2 Resource Assessment

4.5.1 Author and Purpose

ESA conducted a resource assessment for the Tier 1 and 2 segments (i.e., high and moderate risk of levee failure) of Subreach 2 to determine which resources are susceptible to loss from erosion and possibly from implementation of proposed remediation. The results of the resource assessment are being used by the TRAC as a baseline for the evaluation of conceptual bank treatment designs. The resources assessed in this study were fisheries habitat, vegetation, elderberries, cultural resources, and recreational resources. This section provides a summary of the resource assessment; more detail can be found in Attachment 4.

4.5.2 Methods

Fisheries Resources Assessment - Standard Assessment Methodology (SAM): The Standard Assessment Methodology (SAM) is a tool specifically developed to evaluate the response of threatened and endangered fish to habitat changes from bank protection projects in the Sacramento River watershed. ESA collected data for the six SAM habitat variables – bank slope, floodplain inundation ratio, bank substrate size, instream structure, aquatic vegetation, and overhanging shade – according to the SAM documentation (USACE 2012) and the application of SAM for the 2015 National Marine Fisheries Service (NMFS) Biological Opinion of the American River Common Features General Reevaluation Report (ARCF GRR; NMFS 2015). Bank slope, floodplain inundation ratio, and overhanging shade data were collected using GIS analysis. Bank substrate size, instream structure, and aquatic vegetation were collected using field surveys conducted from September 10, 2018, to September 24, 2018. SAM habitat variables were characterized at two seasonal shorelines (average Summer/Fall and average Winter/Spring) for all Tier 1 segments (2, 3, 4, 5, 16), all Tier 2 segments (12, 13, 14, 15), and one Tier 3 segment (11).

Fisheries Resources Assessment – Shaded Riverine Aquatic (SRA) Cover: Shaded Riverine Aquatic (SRA) cover is the near-bank cover that benefits fish species, including (a) the adjacent bank being composed of natural, eroding substrates, (b) supporting riparian vegetation that either hangs over the water or protrudes into the water, and (c) the water containing variable amounts of woody debris as well as variable depths, velocities, and currents. ESA collected SRA cover data using three variables: vegetation properties, bank properties, and structure. SRA cover field surveys were conducted from September 10, 2018, to September 24, 2018. SRA cover variables were characterized at two seasonal shorelines (average Summer/Fall and average Winter/Spring) for all Tier 1 segments (2, 3, 4, 5, 16), all Tier 2 segments (12, 13, 14, 15), and one Tier 3 segment (11). SRA cover was sub-sampled by surveying 20-foot long sections spaced every 200 feet along each the seasonal shorelines.

Vegetation Resources: ESA surveyed vegetation in the field from August 17, 2018, to August 30, 2018 between the levee crests. Four habitat components were mapped: overstory vegetation, understory vegetation, unvegetated areas, and invasive plants. Vegetation was mapped onto an orthorectified true-color mosaic image, with a native pixel resolution of 0.25 feet, flown in October 2017. Vegetation types were identified to the association level based on their plant species composition, according to Sawyer et al. (2009), with a minimum mapping unit of 0.2 acre. Three approximate density categories were identified for overstory and understory vegetation. The acreage of vegetation types was tabulated according to its elevation, i.e., whether it occurred below or above the average 2-year flood elevation (the 18,500 cfs water surface elevation), and according to segment.

Valley Elderberry Longhorn Beetle Habitat: Occurrences of the blue elderberry (*Sambucus nigra* ssp. *caerulea*) were mapped, because this species is the host plant for the federally-listed threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*). ESA surveyed elderberry shrubs in the field from August 22, 2018, to August 30, 2018, within levee segments with Tier 1 and 2 risk ratings, with the exception of Segment 11, which is rated as Tier 3 but was still surveyed. Survey methods followed both the USFWS's "1999 Conservation Guidelines" and the 2017 "Framework for Assessing Impacts to the Valley Elderberry Longhorn Beetle." Submeter accuracy GPS point locations and data were taken for shrubs with stems greater than 1" diameter at ground level. One GPS point was taken for stems that were less than 6" apart from each other. This prevented double counting by easily allowing surveyors to keep track of which elderberries had been surveyed, especially in high density areas. Stem counts were taken for different stem diameter classes, and the presence of exit holes in the stems made by valley elderberry longhorn beetles.

Cultural Resources: ESA requested a records search of the leveed portion of the American River Parkway from the North Central Information Center (NCIC) of the California Historical Resources Information System at Sacramento State University (File No. SAC-18-166). Included in the review were the *California Inventory of Historical Resources* (California Department of Parks and Recreation, 1976) and the *Historic Properties Directory Listing* (Office of Historic Preservation, 2012). ESA also conducted an archival review of ESA's past project files to identify any additional resources in the project footprint that were not included in the results of the records search. Cultural resource sites mapped using the GIS system.

Recreation Resources: Spatial data (as GIS shapefiles) for recreation resources (e.g., trails, access points, rest rooms, parking lots, golf course) were provided to ESA by Sacramento County Regional Parks. Maps were created that showed the location of these resources that will be used to determine if these facilities would be affected by erosion or designed bank protection structures.

4.5.3 Results

Fisheries Resources Assessment - Standard Assessment Methodology (SAM): The SAM habitat variables were summarized on a per-segment basis to describe the existing baseline conditions and allow for future evaluation of habitat changes. The list below provides the range across all assessed segments in Subreach 2 for each habitat variable, along with a description of how to interpret values in terms of suitability for juvenile salmonid rearing.

- Bank slope ranged from 1.3 to 4.5. Higher values (more gradual slopes) are better for juvenile salmonid rearing, with an optimal value of 10.
- Floodplain inundation ratio ranged from 1.0 to 1.94. Higher values (more floodplain available) are better for juvenile salmonid rearing, with an optimal value of 12.
- Bank substrate size ranged from 0.04 to 4.5 inches. Values are optimal between 4 and 8 inches, being worse for juvenile salmonid rearing both below and above the optimal range.
- Instream structure ranged from 5% to 73% shoreline cover. Higher values (more shoreline length covered by instream structure) are better for juvenile salmonid rearing, with an optimal range of 60-100%.
- Aquatic vegetation ranged from 19% to 100% shoreline cover. Higher values (more shoreline length covered by aquatic vegetation) are better for juvenile salmonid rearing, with an optimal range of 40-100%.
- Overhanging shade ranged from 68% to 100% Summer/Fall shoreline cover. Higher values (more shoreline length covered by overhanging shade) are better for juvenile salmonid rearing, with an optimal range of 80-100%.

Fisheries Resources Assessment – Shaded Riverine Aquatic (SRA) Cover: The SRA cover variables were summarized on a per-segment basis to describe the existing baseline conditions and allow for future evaluation of habitat changes. The list below provides the range across all assessed segments in Subreach 2 for each habitat variable.

- Vegetation properties
  - Tree cover ranged from 13% to 93% shoreline cover.
  - Shrub cover ranged from 1% to 60% shoreline cover.
  - Herbaceous cover ranged from 2% to 75% shoreline cover.
- Bank properties
  - Bank shape was dominated by smooth slopes.
  - Sediment type was dominated by sand and cobble.
- Structure
  - Organic structure was dominated by branches.
  - Variable depth was largely absent.

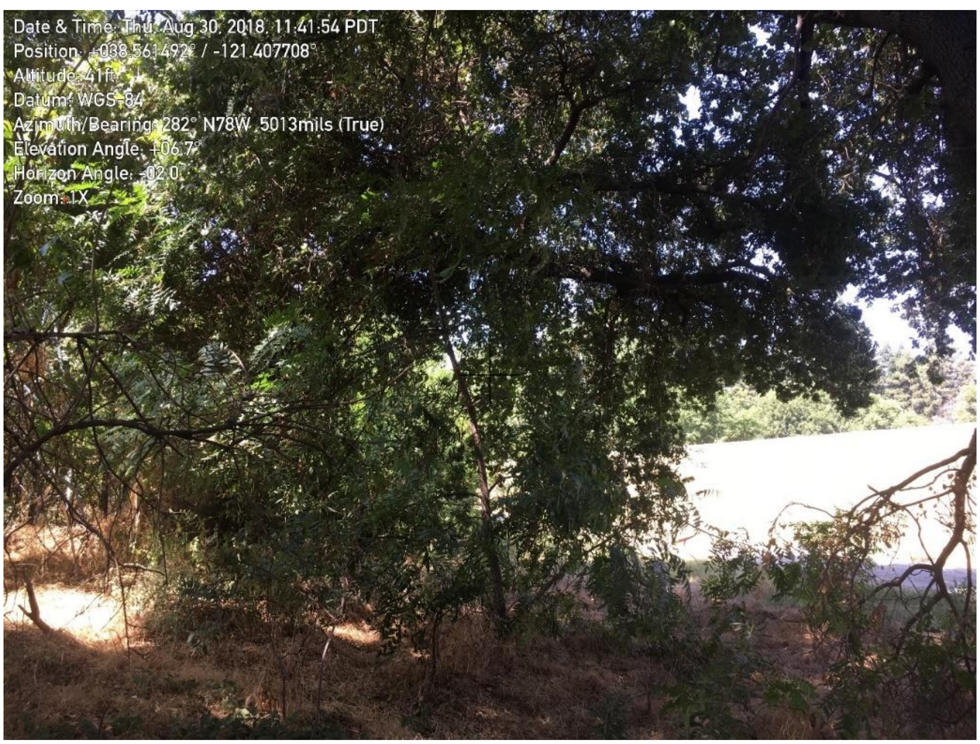
Vegetation Resources: ESA created a geodatabase containing all vegetation information recorded, which can be used in further evaluations going forward. Overstory and understory vegetation are included as separate layers since there is substantial overlap. Photo documentation of examples of low, medium, and high densities of both the overstory and understory layers are provided in Figures 12 through 15. Included in this report are tabular summaries of the vegetation data for overstory vegetation (Table 4) and understory vegetation (Table 5).

Source: ESA 2018 Lower American Resource Assessment / 160092.05

Figure 12. Low Density Fremont Cottonwood (*Populus fremontii*) Overstory with a High Density Himalayan Blackberry (*Rubus armeniacus*) Understory

Source: ESA 2018   Lower American Resource Assessment / 160092.05

Figure 13. Medium Density Northern California Black Walnut (*Juglans hindsii*) Overstory with a High Density California Blackberry (*Rubus ursinus*) Understory



Source: ESA 2018   Lower American Resource Assessment / 160092.05

Figure 14. High Density Valley Oak (*Quercus lobata*) Overstory with a Low California Walnut (*Juglans hindsii*) Understory

Source: ESA 2018 Lower American Resource Assessment / 160092.05

Figure 15. Medium Density Narrowleaf Willow (*Salix exigua)*

Table 4. Subreach 2 Overstory Vegetated and Unvegetated Area and Density By Flood Frequency

Native/Non-native/ Unvegetated	Vegetation Type	Density	Area (acres)	
			Below 18,500 cfs	Above 18,500 cfs
Native	Woodland	low	12.0	16.4
		medium	22.9	22.0
		high	3.2	15.0
		Subtotal	**38.2**	**53.3**
		Total	**91.5**	
	Scrub	low	7.3	6.1
		medium	8.0	7.4
		high	6.3	5.2
		Subtotal	**21.6**	**18.7**
		Total	**40.4**	
Total Native Overstory Vegetation				**131.9**
Non-native	Woodland	low	0.3	3.0
		medium	0.9	2.8
		high	0.5	5.9
		Subtotal	**1.7**	**11.7**
		Total		**13.4**
	Scrub	low	0.0	0.0
		medium	0.1	0.2
		high	0.1	1.5
		Subtotal	**0.2**	**1.8**
		Total		**2.0**
	Grassland	**Subtotal**	**1.5**	**69.1**
		Total		**70.6**
	Irrigated turf	**Subtotal**	**0.0**	**13.5**
		Total		**13.5**
Total Non-native Overstory Vegetation				**99.5**
Unvegetated land		**Subtotal**	**13.2**	**17.0**
		Total		**30.3**
Open water				**96.3**

Source: ESA 2018

Table 5. Subreach 2 Understory Vegetation Area and Density, and Unvegetated Area

Native/Non-native/ Unvegetated	Vegetation Type	Density	Area (acres) Below 18,500 cfs	Area (acres) Above 18,500 cfs
Native	Scrub	low	7.9	11.0
		medium	12.0	7.3
		high	6.2	21.2
		Subtotal	**26.1**	**39.5**
Total native understory vegetation				**65.6**
Non-native	Scrub	low	0.3	0.6
		medium	0.8	4.2
		high	1.7	4.8
		Subtotal	**2.8**	**9.6**
		Total		**12.5**
	Grassland		0.7	15.1
		Total		**15.9**
	Irrigated Turf		0.0	3.1
		Total		**3.1**
Total Non-native Understory Vegetation				**31.5**
Open water				**5.3**

Source: ESA 2018

Valley Elderberry Longhorn Beetle Habitat: Elderberries were only found within surveyed segments on the right bank, no elderberries were found on the left bank. Many elderberry shrubs were not accessible because they were overgrown by grape, blackberry, or other dense vegetation. The number of stems or exit holes were not determined for those plants, and the number of shrubs was estimated for those plants. The total number of shrubs in the survey area was estimated at 1,166, and about half of those (estimated at 576 shrubs) were not accessible (Table 6). A total of 237 stems were found that had beetle exit holes.

Table 6. Subreach 2 Elderberry Stems and Shrubs

	Accessible Plants						Inaccessible Plants	
	Stems with Exit Holes		Total Stem Count		Total Shrub Count		Estimated Shrubs	
Segment	Riparian habitat	Upland habitat	Riparian habitat	Upland habitat	Riparian habitat	Upland habitat	Riparian habitat	Upland habitat
11	7	10	50	36	33	26	59	170
12	19	0	66	0	34	0	50	0
13	20	1	63	17	37	12	85	0
14	26	14	212	103	115	37	127	0
15	3	61	4	147	3	77	0	16
16	25	51	187	113	120	96	11	58
Total	100	137	582	416	342	248	332	244

Source: ESA 2018

Cultural Resources: The results of the records search conducted at the NCIC indicate several cultural surveys previously conducted in both Subreach 2 and larger leveed reach, covering approximately 32% of the footprint of Subreach 2, and approximately 55% of the 12.5-mile larger project area. The NCIC identified 126 cultural resource surveys previously conducted within 1/8 mile of the larger project area, with 22 of those within or intersecting the Subreach 2 footprint. These efforts identified 86 previously documented cultural resource sites within 1/8 mile of the project footprint, including 6 sites identified within or adjacent to Subreach 2. Known sites also include the Guy West Bridge, which was identified through review of ESA's files. Table 7 details these resources.

Table 7. Previously Identified Cultural Resources within Subreach 2

P#/Trinomial	Name	Eligibility Determination	Within or Adjacent
34-000060 / SAC-000033	Historic period burial/ habitation mound	Unevaluated	Within
34-000508 / SAC-000481	American River Levee	Ineligible for National Register	Within
34-000509 / SAC-000482	South Bank Levee - American River	Ineligible for National Register	Within
34-003893	Five Mile House - Overland Pony Express Route in CA	Listed in California Register	Adjacent
34-004298	H Street Bridge (Bridge No. 24C0076)	Ineligible for National Register	Within
n/a	Guy West Bridge	Eligible for listing in the California and Sacramento registers	Within

Source: NCIC, 2018

Recreation Resources: Recreational resources in the County's GIS occurring in Subreach 2 include: a golf course (in Segments 11 and 12), an entry kiosk (in Segment 14), bicycle and pedestrian access (in Segments 5, 8, 9, 10, 12, 14, and 16), pedestrian access (in Segment 1), and horse trails and bike trails. No recreational resources were mapped in Segments 2, 3, and 4. Paved bike trails are continuous on both sides of the river for the majority of Subreach 2. There are no boat launch facilities within Subreach 2, but one is located just south of this subreach on the left bank (Segment 8). The assessment documents a range or recreational resources susceptible to loss from erosion and possibly from implementation of proposed remediation and the collected GIS data are being used to inform the design process and potentially locations for remediation.

4.6 Comprehensive Subreach Approach Dashboard Tool Development and Application

NHC developed a suite of conceptual design alternatives and a dashboard to assist TRAC in comparing and evaluating the conceptual design alternatives throughout the subreach. The dashboard provided TRAC with a comprehensive subreach assessment tool and aided in the development of the design approach for bank protection within the subreach.

The previously described efforts, the NHC Erosion Assessment in particular, provide a detailed summary of bank erosion processes in the subreach, qualified the likelihood of erosion, and quantified potential erosion extents and resources at risk. TRAC was tasked to provide input for a design approach for the individual subreaches which addressed bank erosion concerns, hydraulic capacity, and aquatic, riparian, and recreational resources. The intent of the dashboard tool was to improve TRAC's understanding of the project site, quantify potential impacts of various design options, and support communication between stakeholders of different disciplines.

NHC developed conceptual bank protection treatment designs which would address the bank erosion processes of concern and modeled the impacts the designs would have on the flow hydraulics and water surface elevation. Resource surveys on riparian vegetation were provided by ESA (2018) to inform the habitat area map of the dashboard. ESA also used habitat parameters in a SAM model and provided scores to evaluate suitability for Fall-run Chinook and Central Valley Steelhead at critical life stages. NHC developed and delivered the dashboard tool to TRAC while receiving iterative feedback from the intended users. TRAC utilized multiple versions during the tool's development.

Although the underlying components of the dashboard are complex and could be evaluated in significant detail, the dashboard was intentionally kept simple to better facilitate discussion at a conceptual level. This tool did not include details beyond about a 10% design level. Rather, several bookend design concepts were available for selection at Tier 1 and Tier 2 segments. TRAC utilized this tool to observe the expected effects the designs have on water surface elevation, riparian vegetation, SAM evaluations, and erosion potential.

The dashboard is an Excel based, interactive tool that links five different bank protection treatment actions and their effect on three parameters: water surface elevation (effect on flood capacity and freeboard), erosion risk (rated low, medium, and high) and ecosystem resource value (rated by area of SRA habitat created over existing conditions after 5 years). The dashboard consists of an interactive interface where a user chooses a treatment for each segment location and the resulting three parameters are displayed in colorized ratings on a map and in summary tables. The parameters were refined through a review process. The revised dashboard was distributed to TRAC members to develop their own overall treatment plans for Subreach 2.

By allowing each member to view the large-scale (e.g., cumulative) impacts that various designs have on water surface elevation and dynamically displaying the effects of design choices on vegetation, fish, and erosion potential, the dashboard facilitates big-picture discussions and helps communication between experts of various disciplines. The dashboard is intended as a simple tool to aid a conceptual planning level of decision-making to define a preferred overall plan of treatments for each of the 16 segments in Subreach 2. The resulting conceptual plan produced by the TRAC, presented in the following section, is intended to be used as guidance for development of engineering plans that will be more detailed and site specific.

4.6.1 Design Constraints

Three key design constraints were addressed in the dashboard and in the development of the comprehensive dashboard approach. The following sections define these considerations.

4.6.1.1 Erosion Potential

Due to the risk of levee instability from erosion, Tier 1 sites required repair to reduce erosion potential. Each of the concepts developed for Tier 1 sites address scour and erosion processes identified in the Erosion Assessment. Tier 2 sites were provided with an alternative to maintain existing conditions. The dashboard used results from the Erosion Assessment for potential for erosion to occur, and for the maximum potential erosion extents.

4.6.1.2 Hydraulic Capacity

The design top of levee (DTOL) for this reach is based on the 192,000 cfs water surface profile (USACE, 2007). The levees in Subreach 2 and upstream in Subreach 3 have minimal, if any, excess freeboard above the DTOL. Any raise in water surface elevation would require raising levee profiles. The USACE (2007) HEC-RAS model also showed the 160,000 cfs water surface touches the bottom of the Howe Avenue bridge. Increases in the 160,000 cfs water surface profile would likely start to induce pressure flow under Howe Avenue and rapidly increase water levels upstream. The final suite of bank protection measures proposed for Subreach 2 were therefore limited to combinations which would not reduce hydraulic capacity of the reach and raise the water surface elevation during the design event.

The SRH2D model developed as part of the Erosion Assessment was updated for changes in geometry and roughness for each alternative and run for the 160,000 cfs event. Changes in water surface elevation relative to existing conditions were computed for each segment. This allowed an approximation of impacts to hydraulic capacity that a given concept would have at each segment. The intent of this approach was to approximate impacts for concepts which could later be refined for the selected alternative through the design process.

4.6.1.3 Resource Impacts

As discussed in Section 1.3, the regulatory requirements of bank protection design require compensation for impacts to existing fisheries, riparian, and other existing resources. The dashboard provided a comparison between existing condition SAM scores and SAM scores for each conceptual alternative by segment. The existing condition SAM scores were provided by ESA based on the Subreach 2 Resource Assessment. The dashboard also included impacts to riparian habitat as mapped in the Resource Assessment. This allowed comparison between net long-term gains or losses in riparian habitat due to implementation of various concept designs.

4.6.2 Tier 1 Design Concepts

Tier 1 designs include toe scour and bank erosion protection. These designs will utilize rock revetments for levee safety and reliability. All designs will be varied in width horizontally along the shoreline to provide variations in flow velocities as well as varied vertically to give a diverse range of habitat.

4.6.2.1 Base Design

The base design was the initial concept presented- consisting of a rocked upper bank sloping down to a planting bench with an instream woody material bench on a launchable toe (Figure 16). This design addresses toe erosion as well as fluvial erosion of the upper bank. The planting bench will be varied in elevation and horizontal distance out into the water to provide diverse conditions of habitat. The design has a planting bench width of about 25 feet which is consistent with the planting bench width of modern revetment designs in Subreach 2.

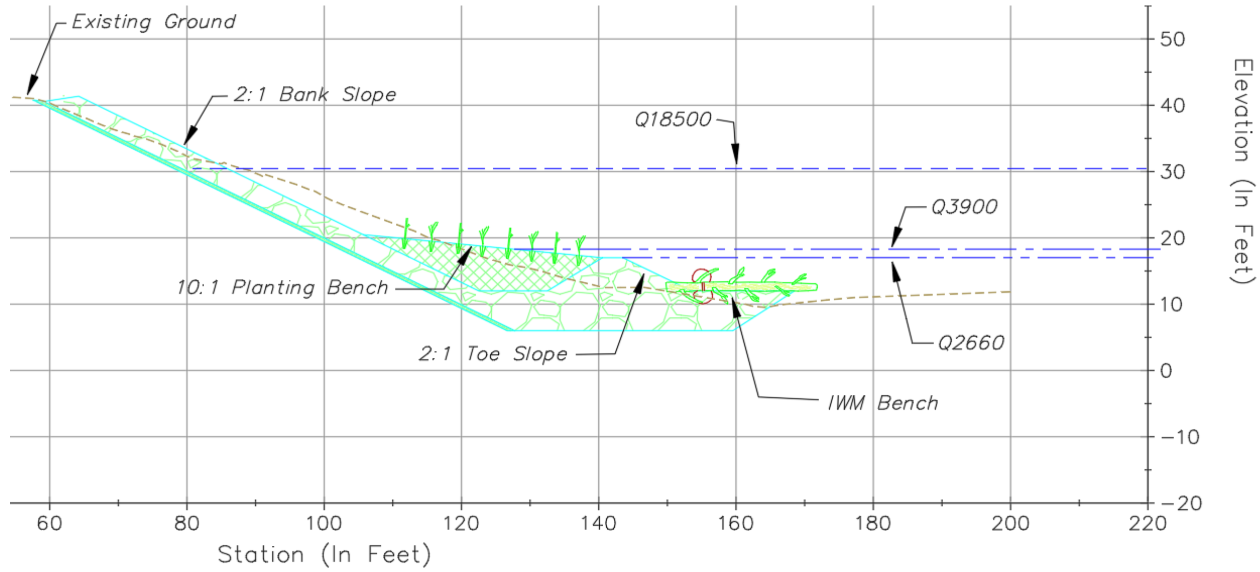


Figure 16. Typical Cross Section of the Tier 1 Base Design with Labels Showing Average Summer/Fall (2,660 cfs), Average Winter/Spring (3,900 cfs), and 2-Year Storm Event (18,500 cfs) Water Levels

Advantages:

- Toe and bank protection with rock
- Revegetation area in planting bench
- Launchable rock toe

Disadvantages:

- Possible hydraulic impact
- Cut and fill construction
- Removal of existing vegetation and resources

4.6.2.2 Wide Design

The wide design concept is intended to explore the effects of having a larger planting bench than the base design. Specifically, the addition of this concept allows the user to see how much of a hydraulic impact is too much while maximizing revegetation. The only difference is that the wide design has a planting bench twice the width of that of the base design (Figure 17).

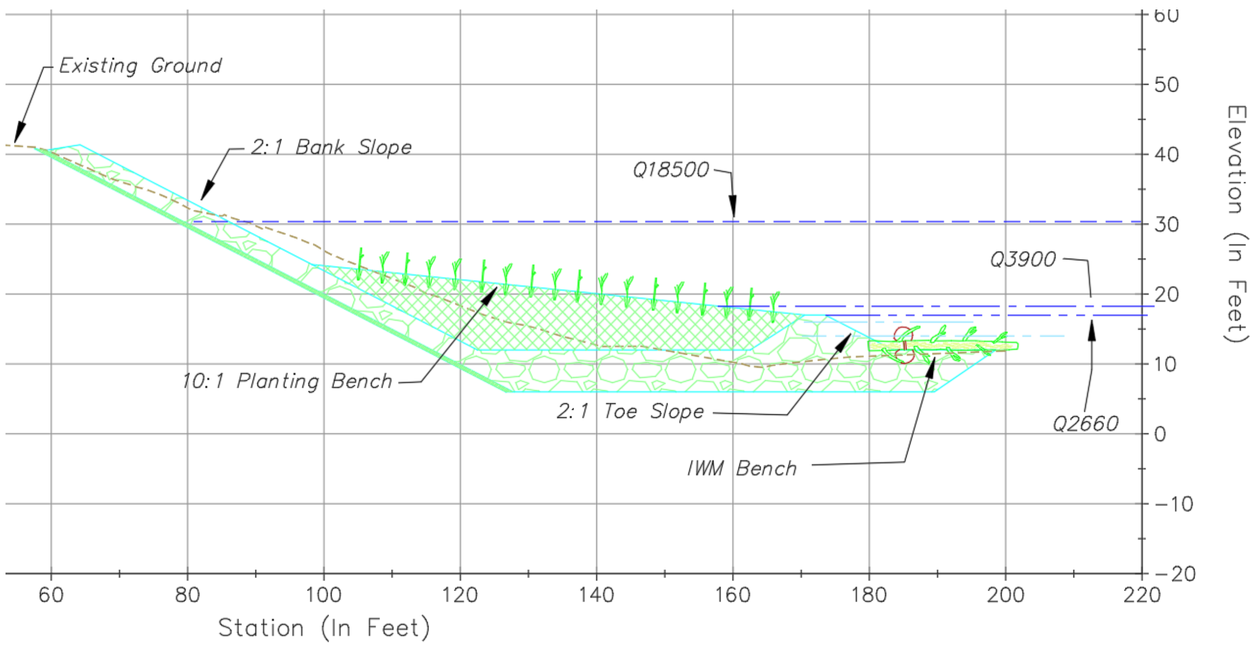


Figure 17. Typical Cross Section of the Tier 1 Wide design With Labels Showing Average Summer/Fall (2,660 cfs), Average Winter/Spring (3,900 cfs), and 2-Year Storm Event (18,500 cfs) Water Levels

Advantages:

- Larger riparian revegetation area relative to the base design

Disadvantages:

- Greater hydraulic impact relative to the base design
- Greater cost of construction and materials relative to the base design

4.6.2.3 Full Fill Design

Concerns were raised regarding cutting into the existing bank for the Base design. This excavation into the bank was intended to reduce hydraulic impacts. The Full Fill design explores the effects of building the design on top of the existing bank. The design consists of a rocked upper bank sloping down to a planting bench with an instream woody material bench on a launchable toe (Figure 18).

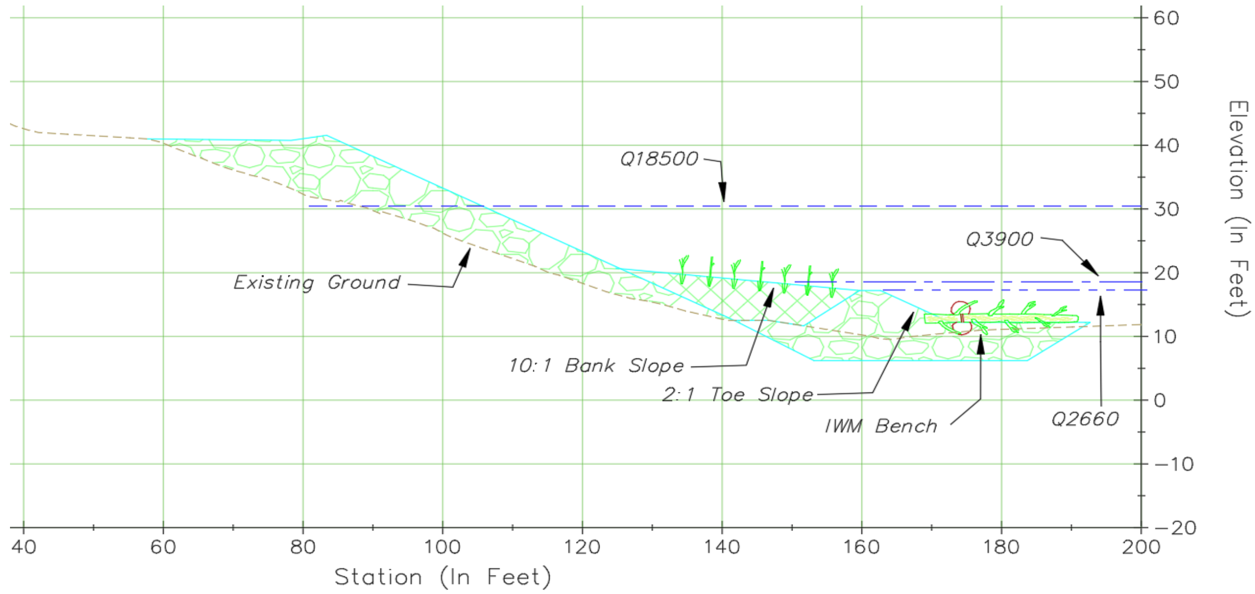


Figure 18. Typical Cross Section of the Tier 1 Full Fill Design with Labels Showing Average Summer/Fall (2,660 cfs), Average Winter/Spring (3,900 cfs), and 2-Year Storm Event (18,500 cfs) Water Levels

Advantages:

- Easier construction relative to the base design
- Can keep existing features relative to the base design
- Lower mitigation requirements relative to the base design

Disadvantages:

- Greater hydraulic impact relative to the base design
- Lower SAM scores at certain segments relative to the base design

4.6.2.4 Smooth Design

The Smooth design is a minimalist concept, minimizing hydraulic impact with a rocked upper bank sloping down to an instream woody material bench on a launchable toe with no planting bench. While this protects against toe erosion and fluvial erosion of the upper bank, there is no revegetation (Figure 19).

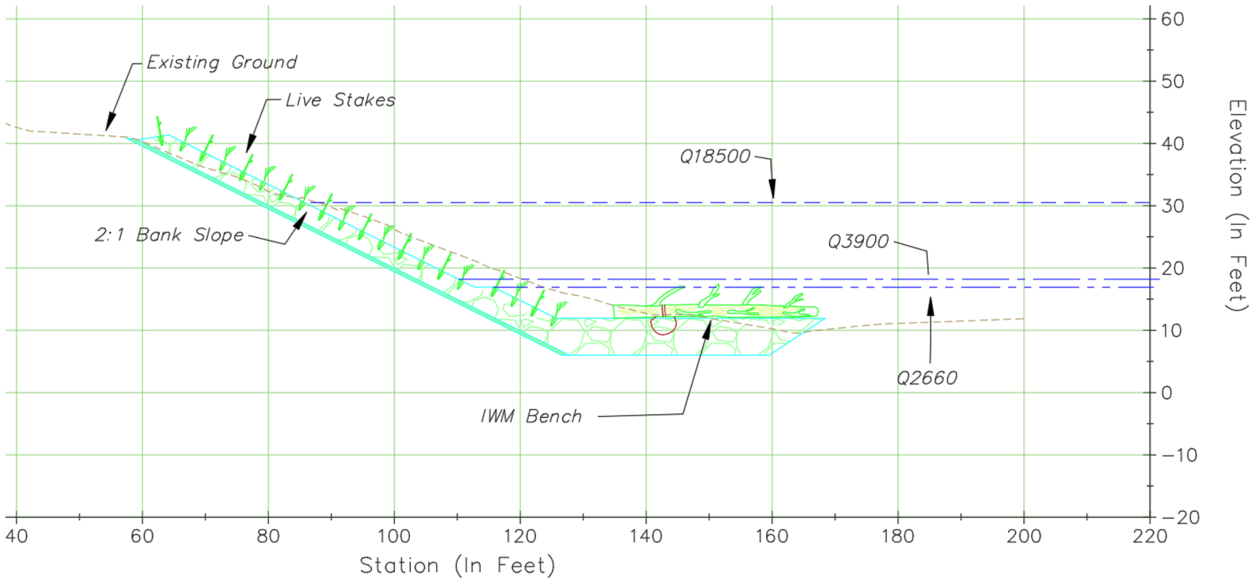


Figure 19. Typical Cross Section of the Tier 1 Smooth Design with Labels Showing Average Summer/Fall (2,660 cfs), Average Winter/Spring (3,900 cfs), and 2-Year Storm Event (18,500 cfs) Water Levels

Advantages:

- Less hydraulic impact relative to the base design
- Simpler construction relative to the base design

Disadvantages:

- Less riparian revegetation relative to the base design

4.6.2.5 Buried Toe Design

This design minimizes impacts to existing vegetation along the existing bank. The design consists of a rocked upper levee slope transitioning to a buried rock launchable toe (Figure 20). Although the design does not provide protection for the existing berm, the design will protect the levee if the channel erodes through the existing berm.

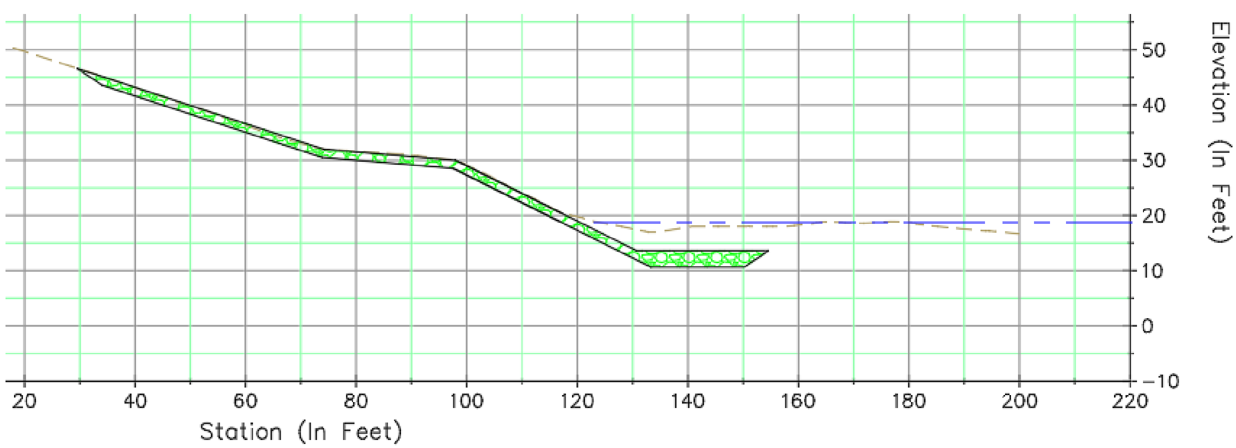


Figure 20. Typical Cross Section of the Tier 1 Buried Toe Design

Advantages:

- Less hydraulic impact
- Less SAM score impact
- Minimal disturbance of existing area

Disadvantages:

- No planting bench
- No toe protection
- Potential loss of river bank to erosion

4.6.3 Tier 2 Design Concepts

Tier 2 designs address the Tier 2 erosion sites. Erosion at these sites is not an immediate threat to levee stability, but it is anticipated these sites could become Tier 1 sites after one or more high flow events.

4.6.3.1 Small Bench With Toe Design

This design protects the bank toe while keeping the upper bank natural. A planting bench with an instream woody material bench on a launchable rock toe prevents toe erosion (Figure 21).

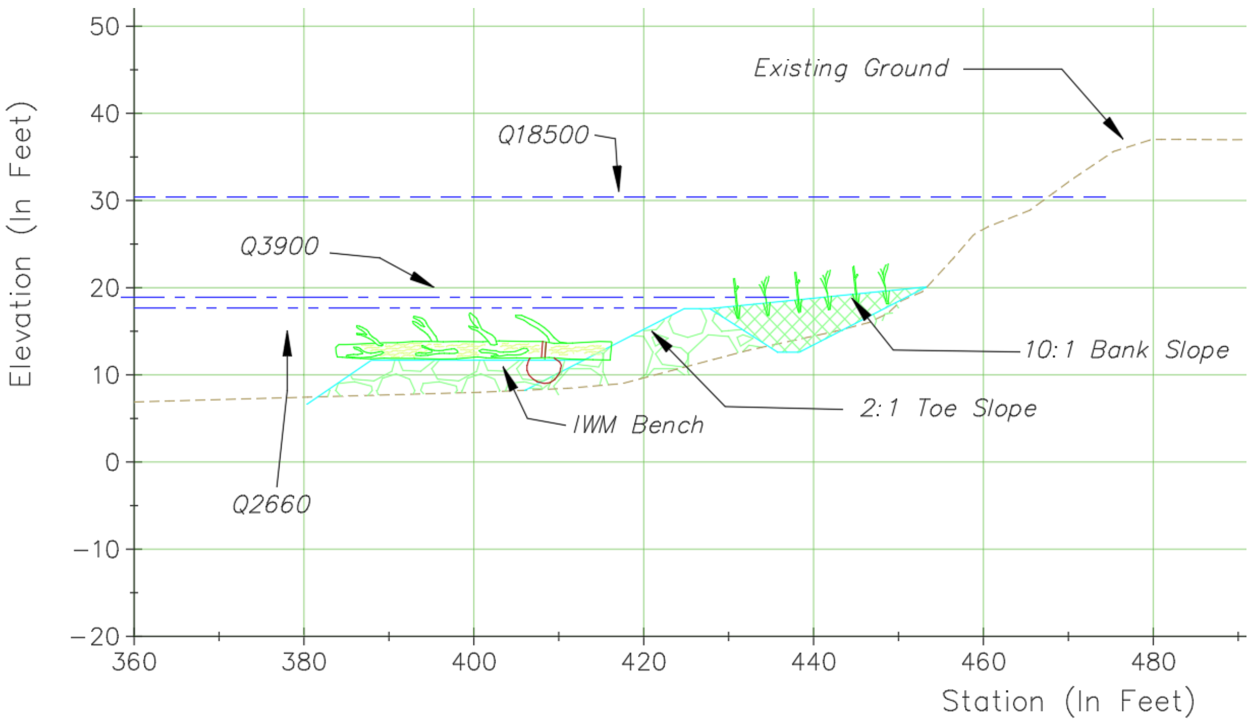


Figure 21. Typical Cross Section of the Tier 2 Small Bench With Toe Design With Labels Showing Average Summer/Fall (2,660 cfs), Average Winter/Spring (3,900 cfs), and 2-Year Storm Event (18,500 cfs) Water Levels

Advantages:

- Moderate hydraulic impact
- Can preserve existing vegetation higher on the bank

Disadvantages:

- Higher bank still exposed to erosion

4.6.3.2 Full Fill Design

This is the maximum design concept, fully protecting the bank toe and upper bank. There is a rocked upper bank sloping down to a planting bench with an instream woody material bench on a launchable toe. This design, like the Tier 1 Full Fill design, does not cut into the existing bank (Figure 22).

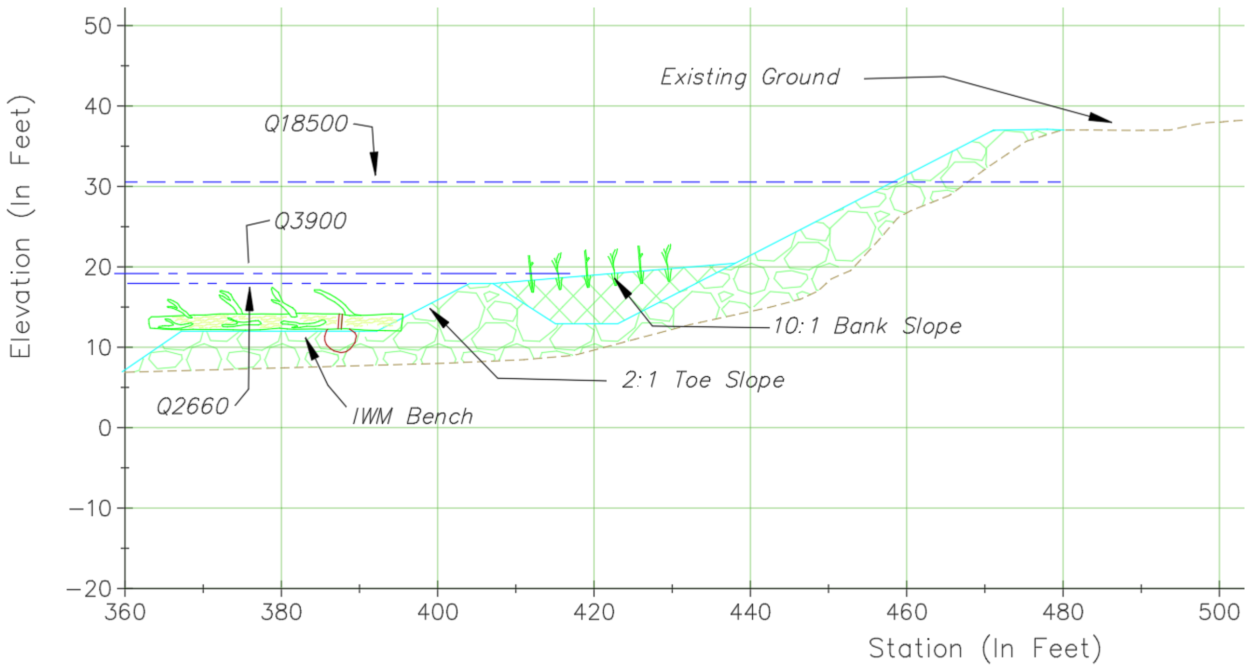


Figure 22. Typical Cross Section of the Tier 2 Full Fill Design with Labels Showing Average Summer/Fall (2,660 cfs), Average Winter/Spring (3,900 cfs), and 2-Year Storm Event (18,500 cfs) Water Levels

Advantages:

- Better erosion protection
- Easier construction
- Can keep existing features

Disadvantages:

- Greater hydraulic impact
- More rock

4.6.3.3 Cut Bank Design

This design treats the process instead of the symptoms by sloping back the bank to prevent larger bank failures. The existing ground is cut back at two different slopes to facilitate vegetation growth (Figure 23). By accelerating the natural channel adjustment processes, this conceptual design shapes the bank to a more stable geometry.

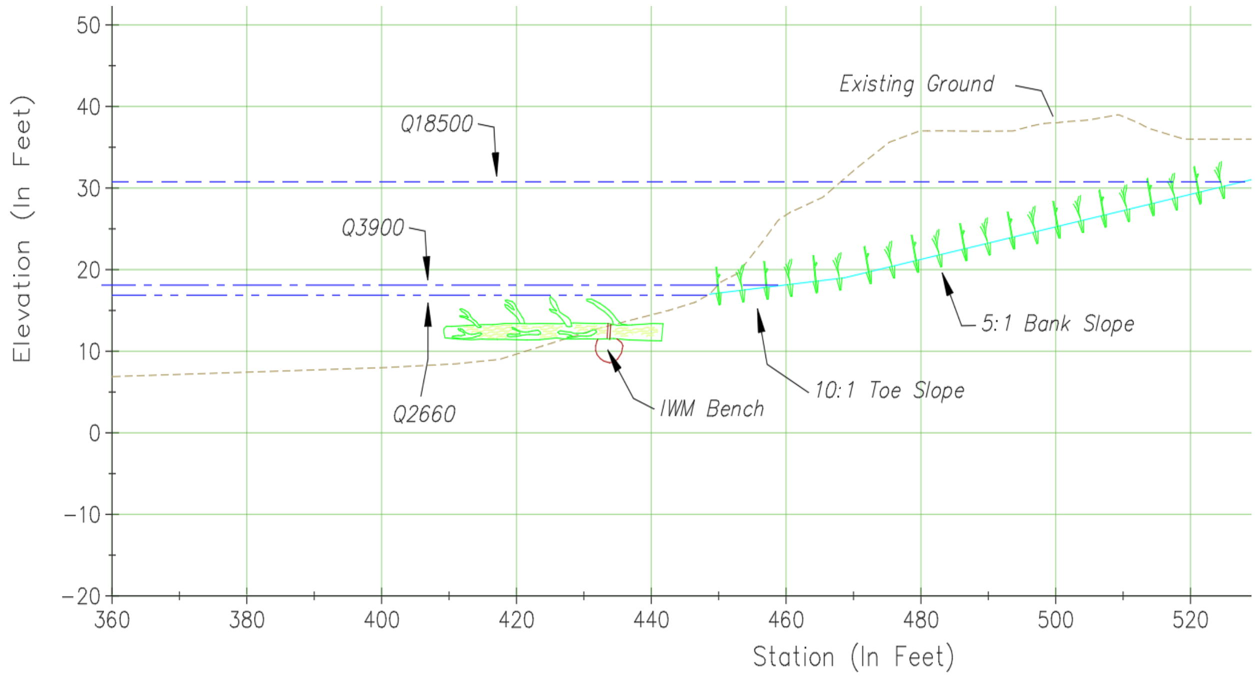


Figure 23. Typical Cross Section of the Tier 2 Cut Bank Design with Labels Showing Average Summer/Fall (2,660 cfs), Average Winter/Spring (3,900 cfs), and 2-Year Storm Event (18,500 cfs) Water Levels

Advantages:

- Adds hydraulic capacity
- Greater revegetation area
- Less rock

Disadvantages:

- Less toe and bank erosion protection
- Lose vegetation on upper banks
- Greater area of project impact

4.6.4 TRAC Dashboard Application

The TRAC utilized the dashboard tool to develop a comprehensive approach to the Subreach 2 study area. The TRAC members individually applied the dashboard to develop preferred approaches to the reach and document approaches, assumptions, and concerns. NHC compiled the results of the TRAC effort and used the information to develop the comprehensive subreach approach. Overall, the TRAC preferred alternatives that would 1) not impair hydraulic capacity in the reach, and 2) provide improved resource conditions over the long-term. The TRAC advised temporary resource impacts would be tolerable for a net improvement long-term.

The results from the final round of the TRAC utilizing the comprehensive subreach assessment tool were used to decide the final conceptual designs and inform design considerations in furthering the designs toward implementation. The TRAC is divided into the Resource Advisory Sub-committee (RAC) and the Technical Advisory Committee (TAC). There are six RAC members, five TAC members, and two dual committee members that are on both committees for a total of 12 TRAC members. The results are discretized between these three groups. The following sections group results by tier and location.

4.6.4.1 Left Bank Tier 1 Results (Segments 2, 3, 4, 5-River Mile 5.8 to 6.6)

The left bank Tier 1 Segments 2, 3, 4, and 5 together continuously extend along bank from RM 6.6 downstream to RM 5.8. As these sites cover a continuous bank line, the final concept design for each segment must consider transitions to upstream and downstream segment design choices as well. Table 8 provides the number of TRAC members who chose a concept at each segment. Overall, the base design most chosen by the majority for all of the Tier 1 sites, with the exception of a buried toe design at Segment 2. Segment 2 has a wide vegetated bench at the toe under existing conditions, and the buried toe would limit the impacts to this area. The majority of the TRAC members chose options which included a planting bench. In general, the TRAC pushed for maximizing potential recreation and riparian resource values, providing adequate erosion protection for the levee, not exceeding hydraulic capacity, and supporting vegetation growth. Concerns included having too much encroachment into the river, using too much rock, and cutting into the existing bank.

Table 8. Results of TRAC dashboard application to Segments 2, 3, 4, and 5

Segment	Concept	RAC members	TAC members	Dual TAC and RAC members	Total TRAC
2	Base	2	2	0	4
	Buried Toe	4	1	1	6
	Smooth	0	1	0	1
	Wide	0	1	1	2
3	Base	4	1	1	6
	Full Fill	0	3	0	3
	Smooth	1	1	0	2
	Wide	1	0	1	2
4	Base	5	1	1	7
	Full Fill	0	2	0	2
	Smooth	1	2	1	4
	Wide	0	0	0	
5	Base	4	1	1	6
	Full Fill	0	2	0	2
	Smooth	1	1	1	3
	Wide	1	1	0	2

4.6.4.2 Right Bank Tier 1 (Segment 16- River Mile 7.5 to 7.8)

Table 9 provides a summary of the concept designs chosen by the TRAC for Segment 16. Overall, the TRAC preferred stabilizing the toe of the bank with a vegetated bench. The TRAC generally preferred a bench width which could maximize improved riparian area without hydraulic impacts and minimizing impacts into the channel. The buried toe design - which at this location would allow the bank to erode but would protect the levee- did receive four votes. This design would tie into the downstream buried toe design (RM 7.0R) and provide uniformity in the reach.

Table 9. Results of TRAC dashboard application to Segment 16

Segment	Concept	RAC members	TAC members	Dual TAC and RAC members	Total TRAC
16	Base	2	3	0	5
	Buried Toe	2	1	1	4
	Smooth	1	0	0	1
	Wide	1	1	1	3

4.6.4.3 Right Bank Tier 2

Table 10 provides a summary of the concept designs chosen by the TRAC for Segments 12-15. For segments 12, 13, and 14 the TRAC chose the Cut Bank design for the Tier 2 sites. Reasons for the cut bank design include maximizing hydraulic capacity, providing opportunity for resource habitat enhancement, and minimizing rock use. Concerns include being too invasive of a measure (cutting into the parkway and removing existing resources), and potential future erosion due to failure of the vegetation to resist erosion. Segment 15 was a split decision between the cut bank and leaving the site as existing. Since the segment has riprap at the bank toe and at the levee toe, has a significant number of elderberry shrubs, and has an already narrow berm, it is proposed to leave this site in its existing condition.

Table 10. Results of TRAC dashboard application to Segments 12, 13, 14, and 15

Segment	Concept	RAC members	TAC members	Dual TAC and RAC members	Total TRAC
12	Cut Bank	5	3	0	8
	Small Bench	1	1	0	2
	No Fix	0	1	2	3
13	Cut Bank	4		2	6
	Small Bench	2	2	0	4
	No Fix	0	3	0	3
14	Cut Bank	5	1	2	8
	Small Bench	0	1	0	1
	No Fix	1	3	0	4
15	Cut Bank	3	1	1	5
	Small Bench	2	1	0	3
	No Fix	1	3	1	5

4.6.4.4 Overall Subreach Approach

The results above have been combined into three separate repair sites. Repair Site 2-1 will include the left bank Tier 1 segments and be addressed. Repair Site 2-2 will include the Tier 1 segment on the right bank, and Repair Site 2-3 will include repairs to segments 12, 13, and 14. The TRAC did not utilize an approach which compromised improvements in one segment (or design site) en lieu of improvements in another. Instead, the overall subreach plan will work to develop designs which maximize erosion protection and riparian resources, minimize project footprint into the channel, minimize impacts to existing resources, and which do not negatively impact the hydraulic capacity in the reach. Figure 24 provides the final overall subreach approach showing conceptual plans for each of the segments.

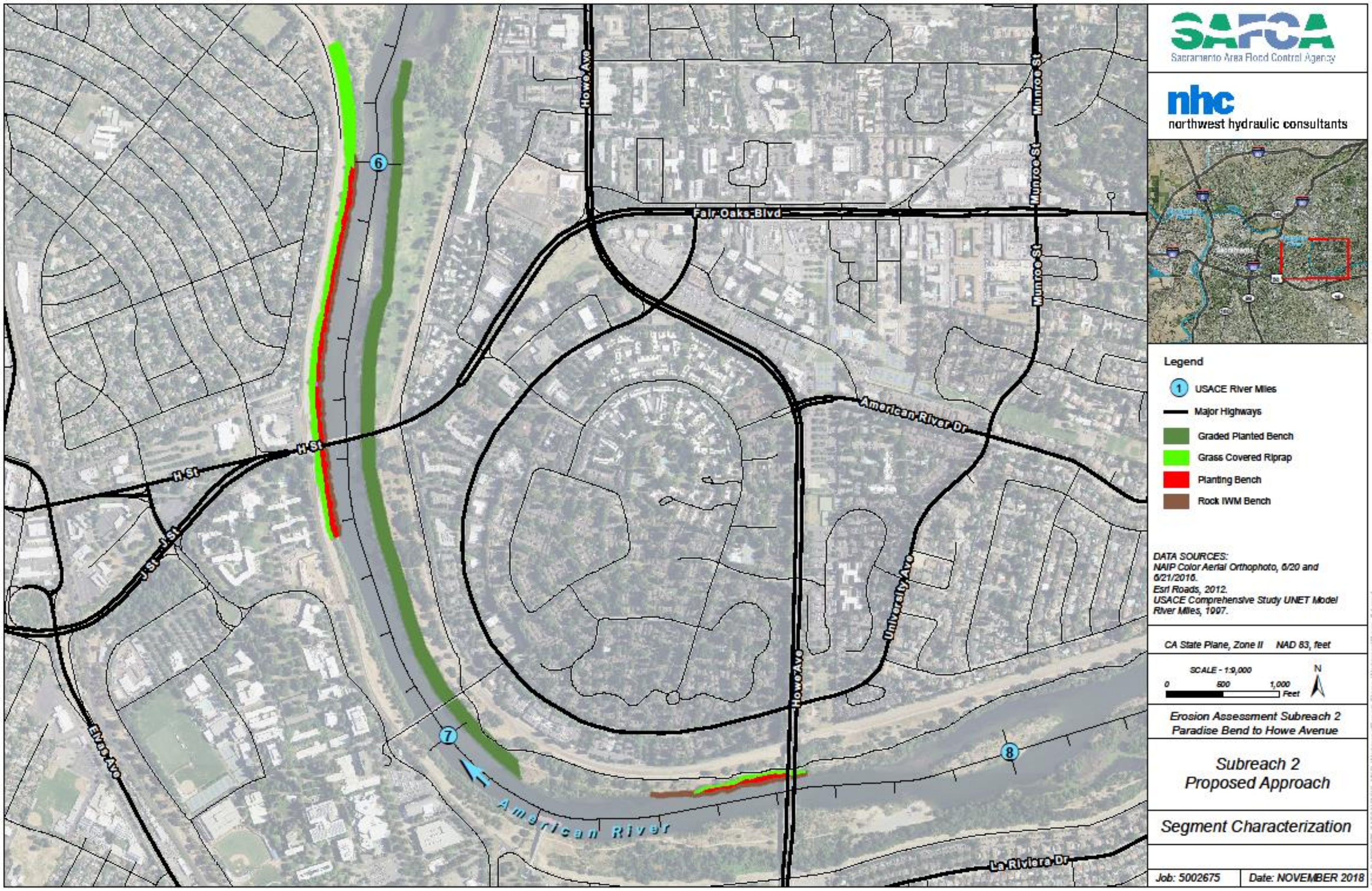


Figure 24. Subreach 2 Proposed Approach

Preliminary results from the dashboard exercise suggest the approach will reduce water levels by 0.3 feet at the upstream extents of the subreach. The cut bank design in Segment 12 and the base design at Segment 4 both does result in an increase of 0.1 feet. The small increases at these sites are expected to be within tolerances which can be reduced in further levels of design. Over the entire subreach, the cut bank reduces water levels by 0.5 feet which provides the net reduction in water surface elevation at the upstream of the subreach. Reducing the water level at the downstream extent of Subreach 3 is expected to help facilitate future erosion designs in this subreach.

Although the preferred subreach approach will impact 11.5 acres of existing riparian habitat, the project will add an additional 6 acres of riparian habitat. The gain in riparian habitat area will also result in improved habitat quality in Repair Site 2-3 where the lowered bench elevations will improve natural recruitment. With the exception of Segment 12, the proposed repair designs all produce a slight reduction in SAM scores. The slight reduction is expected to be within tolerances that can likely be mitigated with design adjustments while furthering the designs from concepts to final designs.

5.0 Subreach 2 Application of Conceptual Designs (Based on NHC Basis of Design Report)

This NHC Basis of Design Report provides the 10% design submittal for the three repair sites identified by the TRAC in the comprehensive subreach approach.

Each repair site has a conceptual design intended to protect the existing bank from fluvial erosion and scour during a 160,000 cfs flow event. The preliminary designs were developed using applicable USACE design standards and methods. The designs are intended to be consistent with the manuals and reports shown in Table 11.

Table 11. USACE Engineering Manuals and Reports

Manual No	Date	Title
EM 1110-2-1601	June 30, 1994	Hydraulic Design of Flood Control Channels
EM 1110-2-1418	October 31, 1994	Channel Stability Assessment for Flood Control Projects
EM 1110-2-1913	April 30, 2000	Design and Construction of Levees
EM 1110-2-1614	June 30, 1995	Design of Coastal Revetments, Seawalls and Bulkheads
EM 1110-2-2302	October 24, 1990	Construction with Large Stone
ETL 1110-2-583	April 20, 2007	Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures

Table 12 provides state and local design manuals and reports referred to in developing the designs in addition to the references shown in Table 11 and those listed in Section 1.4 of this document.

Table 12. Other Manuals and Documents

Source	Date	Title
California Department of Water Resources	2012	Urban Levee Design Criteria
Sacramento Area Flood Control Agency	2010	Instream Woody Material Installation and Monitoring Guidance Manual
Transportation Association of Canada	2001, reprinted 2004	Guide to Bridge Hydraulics (Second Edition)
US Fish and Wildlife Service	2015	American River Common Features Project Biological Opinion
USACE, Sacramento District	2007	American River Common Features American River Levee Raising Sacramento County, California Top of Levee Profile and Design Documentation Report

5.1 Design Approach

5.1.1 Design Objectives and Considerations

The references listed in the previous section identify design constraints and considerations in developing the comprehensive plan for the Subreach and development of the designs. The overarching objective of the designs is to reduce erosion risk, and therefore risk to public safety, in Subreach 2 to minimize risk of levee erosion and significant loss of parkway land and resources during the 160,000 cfs flow event. This strategy section addresses the hydraulic and resource considerations applied in developing the recommended approach and feature configuration for bank and levee protection designs. It presents the objectives developed by the BPWG and TRAC during the assessment process, a short review of the relevant considerations, and basis for the recommended overall project configuration. Overall, the design considerations for each repair site included:

Erosion Risk: The sites are intended to ensure erosion during a design flow of 160,000 cfs will not compromise levee stability nor will it cause mass erosion or significant loss of parkway. Minimizing erosion risk is key to meeting the primary objective of providing a high level of public safety.

Hydraulic Capacity: USACE (2007) identified the 192,000 cfs water surface elevation as the design top of levee profile in the LAR. The existing top of levee in Subreach 2 and upstream in Subreach 3 has little to no freeboard above the minimum design top of levee elevation, and the Howe Avenue bridge low chord is at the USACE (2007) 160,000 cfs water surface elevation. No net increase in water surface elevation relative to existing conditions was considered acceptable in the designs.

Compatibility with Channel Processes and Evolutionary Trends: The suite of recommended conceptual designs should be compatible with the present understanding of channel conditions, dynamics, and evolutionary trends of LAR as a whole and the Subreach in particular.

Resource Impacts: The TRAC discussions, specifically the Resource Advisory Subcommittee, stressed an approach of long-term resource benefits over short-term resource impacts. Although impacts to resources should be avoided where possible, short-term impacts due to construction are considered tolerable if demonstrated that the project would improve the overall resource conditions over 10 to 50 years. It was also an objective to maximize on-site mitigation opportunities, while recognizing that off-site mitigation will be required and can provide substantial opportunities to improve overall habitat values.

Aesthetics and Recreation: The *American River Parkway Plan,* consistent with the state and federal Wild and Scenic Rivers Acts, specifies that erosion control projects should include a revegetation program that screens the project from public view, provides for a naturalistic appearance to the site, and restores affected habitat values.

Infrastructure: Options that entail impacts to roadway and major utility infrastructure should be minimized to the extent practicable. Impacts to Parkway infrastructure (e.g., trails) should also be minimized, but recognizing that those features may sometimes be relocated or modified in order to accommodate project work, particularly where project work would contribute to long-term Parkway resource values.

Biological Opinion Requirements: Both NOAA NMFS and USFWS provided Biological Opinions (BiOps) for the American River Common Features Project General Reevaluation Report. Both BiOps include a number of Conservation Measures and Terms and Conditions, however key design considerations included the NOAA NMFS Conservation Measure of at least 40% coverage of shoreline with instream woody material (IWM).

5.1.2 Design Flow Event

The American River Common Features Project has a peak design release of 160,000 cfs. Although initially expected to have an Annual Exceedance Probability (AEP) of 0.5%, ongoing refinements in development of the WCM have shown this flow may be less frequent than expected. Nonetheless, the design flow for the levee system is kept at 160,000 cfs to be consistent with the maximum controlled outflow from Folsom Dam. The flow event is assumed to have a duration of 3-days, consistent with the critical duration storm events identified in the Hydrology Appendix of the GRR.

5.1.3 Hydraulic Design

NHC evaluated results from three existing two-dimensional models of 160,000 cfs through Subreach 2. The SRH-2D model developed for the Subreach 2 Erosion Assessment provided reasonably conservative model results and was used for computing scour, computing stable rock sizes, and determining limits of rock repair. Stable rock size, minimum rock thicknesses, design slopes, and launchable rock volumes were determined using methods outlined in the USACE EM 1110-2-1601 design manual. As noted in the Erosion Assessment, channel incision is not expected to occur in this reach. However, toe scour due to general scour may occur along the bank toes and cause instability. Scour estimates computed in the erosion assessment at the bank toe were used to determine maximum toe scour depths.

5.1.4 Typical Design Features

The following sections cover standard design components that were included in the repair site 10% designs. The designs are discussed in the following section.

5.1.4.1 Grass-Covered Riprap

Subreach 2 includes three successful applications of grass-covered riprap by the USACE. (Revetment design 7.0R, 6.4L, and 6.9L). The grass covered riprap meets the aesthetic requirements of the Wild and Scenic Rivers Act and American River Parkway Plan. The grass covered riprap will maintain existing roughness values in the hydraulic models and should not impair hydraulic capacity in the reach. The grass-covered riprap design details will utilize similar approaches as near-by designs. The grass covered riprap is proposed for locations above typical daily flows. Details of these designs will be refined in further levels of design.

5.1.4.2 Planting Bench

The preferred repair site designs recommended by the TRAC include planting benches. The intent of the planting benches is to provide on-site mitigation for resource impacts and maximize habitat values. The water side elevation of the planting bench will be variable in elevation to provide natural aesthetic and ecological function. The water side elevation of the planting bench will extend from about the median summer water level to an elevation about 3 feet above the median summer level. The lower elevation at the median summer water level will ensure the planting bench can be constructed during the summer construction season and at an elevation appropriate to establish riparian growth. The upper elevation will match the "Site 4" planting bench design (relative to median summer water levels) as this design has been shown to provide adequate conditions for riparian growth.

The bottom of the planting bench trench will be placed below the stage associated with the 95% exceedance flow during the spring, summer, and fall months. This will ensure adequate soil moisture to sustain riparian vegetation during long periods of low flow. The soil mix will be specified at further levels of design. As a planting plan and pallet are developed for the planting bench, further erosion protection features-such as a cobble surface on the planting bench- will be considered.

5.1.4.3 Instream Woody Material (IWM)

Instream woody material (IWM) will be placed below the summer water level to provide structure below the planting bench. IWM material selection and installation will be concurrent with recommendations outlined in the Installation and Monitoring Guidance Manual (SAFCA, 2010). The IWM will be placed to cover up to at least 40% of the length of the shoreline in accordance with the NMFS BiOp for the GRR. Anchoring for the IWM will be adequate to resist transport of the IWM downstream in the design flood event, and also be installed to ensure the added force of the IWM does not impair the revetment design. The details for the anchoring will be refined in further levels of design.

5.2 Repair Site 2-1: RM 5.8 to 6.6 Left Bank

Repair Site 2-1 extends along the left bank from about RM 5.8 upstream to RM 6.6. The upstream of the site will tie into the existing "Site 4" revetment design. The downstream extents of the design can be extended to tie into the levee behind the "Site 3" design if kept as a buried toe design. The design passes under the H-Street bridge, and will also encompass an existing pump outfall near 6.4. The design will incorporate the existing revetment design at 6.4L. The 6.4L design installed grass covered riprap between RM 6.1 and 6.2, but did not include toe scour protection. Repair Site 2-1 will augment the existing site with toe scour protection.

The key recommendations for the TRAC at Repair Site 2-1 were to 1) minimize impacts to hydraulic capacity, 2) maximize the width of the planting bench without impacting hydraulic capacity, 3) minimize excavation into the existing berm and preserved existing resources where possible, and 4) minimize the footprint into the existing channel.

The downstream 900 feet of the site has a well vegetated 100 foot wide berm separating the levee from the channel. Figure 25 shows the typical cross-section of this design. The proposed design will bury rock landward of this bench to preserve the existing riparian vegetation. The rock will extend from about two-thirds up the levee slope down to a launchable rock at the waterside levee toe. The top elevation is located at an elevation where velocities are predicted to be less than 2 ft/s during the design event and the native grass and soil is unlikely to erode. The launchable rock toe at the base of the slope includes volume to provide scour protection down to maximum expected scour depths. The launchable rock toe will be keyed into the exiting ground deep enough to allow backfill and planting over the top. The riprap on the levee slope will be soil and grass covered. The design will deconstruct and rebuild the existing lower maintenance road in this area. The lower maintenance road is identified as the future alignment for the City of Sacramento's Twin Rivers trail, and further design will be needed to ensure adequate base for a paved bike trail can be provided.

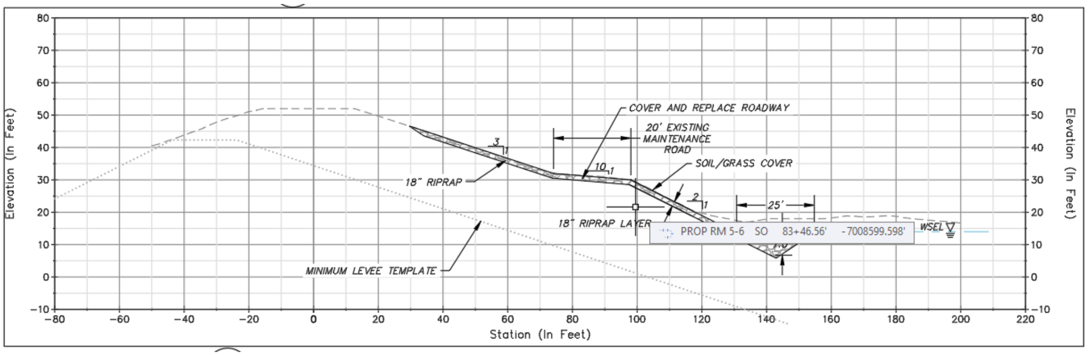


Figure 25. Typical Section of downstream buried rock in Repair Site 2-1

The remaining upstream 4,400 feet of the repair site is located at an area with about a 20 foot lower maintenance road as the only bench. From the waterside edge of the maintenance road, the bank slopes down at a variable slope between about 2H:1V to 3H:1V to the river. A row of established trees have established just above the summer water level. The road is identified as a potential alignment for City of Sacramento's proposed Two River paved bicycle trail and will be maintained in its current elevation and alignment.

The 6.4L Revetment site is an 800 foot long site constructed by the USACE in 2004 between RM 6.1 and RM 6.2 in about the middle of the 2-1 repair site. The 6.4L includes an 18" thick layer of soil covered riprap from the edge of the lower maintenance road down (~elevation 41) down to elevation 22 feet. A rock toe is located between elevation 22 feet and the summer water surface elevation (~elevation 18 feet.) The existing rock size is suitable for the design event. Figure 26 shows the typical cross-section of this design. The typical section through this location will tie into the existing rock near elevation 18 feet, and provide rock protection to the toe of the river. The typical section includes a planting bench, and launchable rock toe. The launchable rock toe will provide scour protection to maximum expected scour depths. The existing riparian vegetation in this area is well established and can be protected during construction. IWM will be anchored along the launchable toe.

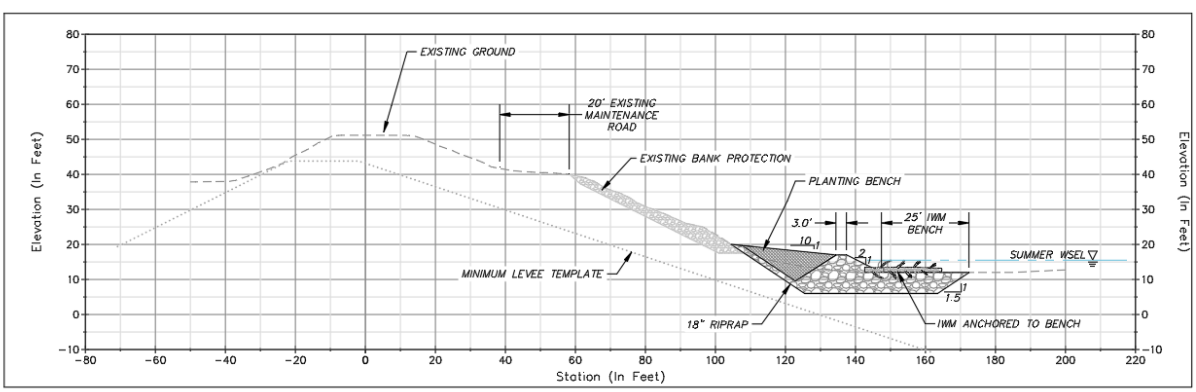


Figure 26. Typical Section Repair Site 2-1 through the existing 6.4L Revetment Site

The remaining 2,600 feet of the repair site is represented by a single typical design. Rock riprap will extend from the edge of the existing lower levee maintenance road down to the channel bed, and extend out into the channel approximately 40 feet. Figure 27 shows the typical cross-section of this design. The design will include a planting bench about 40 feet wide. The rock above the planting bench will be soil and grass covered. The rock toe of the design includes adequate volume to provide toe scour protection for scour extending down to the maximum expected scour elevation. The launchable rock toe will be keyed into the streambed to minimize visibility and aesthetic impacts. The IWM will be anchored into the launchable rock toe.

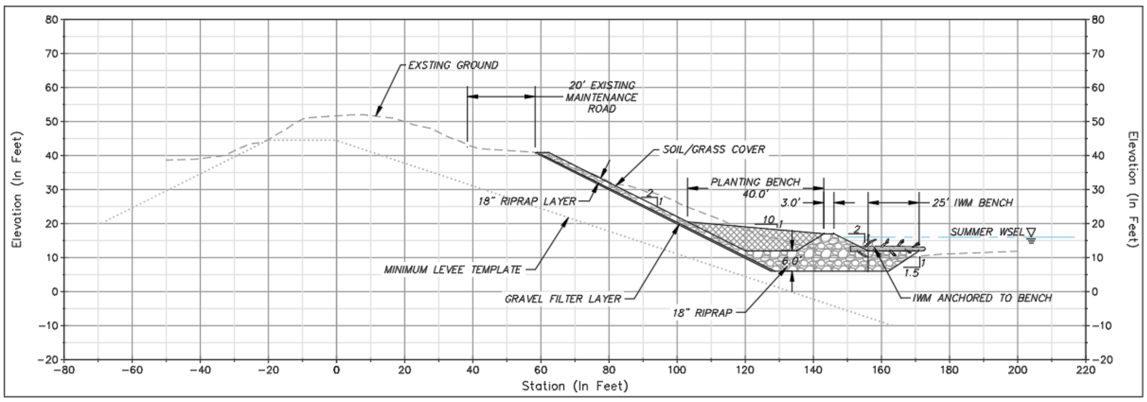


Figure 27. Typical section of Repair Site 2-1 upstream of buried toe and outside of existing RM 6.4L Repair Site

The overall design will protect approximately 5,300 feet of levee. The design will require about 126,000 tons of rock riprap to be installed. The design will temporarily impact about 2.5 acres of existing riparian vegetation, but will add an additional 0.5 acres of riparian vegetation to the bank. The design will require about 200 trees to be installed as IWM along the bank toe. No elderberry bushes were identified in the footprint of this work. The proposed planting bench is outside the 15 foot vegetation free zone and will not require a variance from ETL 1110-2-583.

5.3 Repair Site 2-2: RM 7.45 to 7.65 Right Bank

Repair Site 2-2 will include a rock toe, planting bench, and soil covered riprap along the toe of the bench from Howe Avenue and extending downstream about 1,000 feet. The design will provide protection to the toe of the bank against maximum scour depths of up to 10 feet as identified in the Erosion Assessment, as well as erosion protection against expected velocities and shear stresses at the site. The rock toe will tie into existing revetment at the downstream terminus of the site.

Figure 28 shows the typical cross-section of this design. The planting bench will vary in width up to 40 feet throughout the design with variable elevations between 1 and 3 feet above the summer water level. The planting bench will be planted with native riparian plants. The planting bench will be located outside of the ETL-1110-2-583 vegetation free zone and will not require a variance. The waterside toe of the design will have instream woody material placed at or below the summer water level along 40% or more of the bank toe.

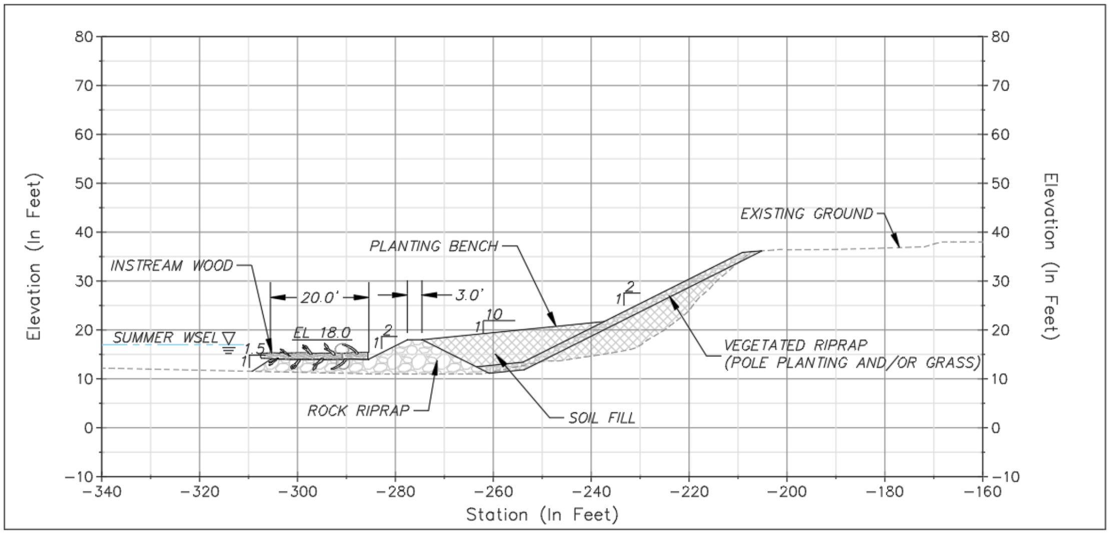


Figure 28. Typical section with planting bench as Repair Site 2-2

The key recommendations for the TRAC at Repair Site 2-2 were to 1) minimize impacts to hydraulic capacity, 2) minimize impacts to existing elderberry bushes, 3) maximize the width of the planting bench without impacting hydraulic capacity, and 4) minimize the project footprint into the existing channel. The Erosion Assessment showed the hydraulic conditions along the levee toe in the existing conditions would not create erosion conditions which could impair levee stability. The proposed repair site focuses on bank erosion and does not include rock installed on the bench or levee face. The American River Bike Trail and a restroom are located near the top of the bank and the bank protection will help protect these features.

The design will impact approximately 1,000 feet of bank. It will require the installation of about 10,500 tons of rock riprap. It will temporarily impact less than 0.2 acres of riparian habitat, but will add an additional 0.2 acres after construction. The design will require about 55 trees to be installed along the toe of the bank to meet instream wood requirements. The design should be able to be installed without disturbing identified elderberry bushes on the nearby bench and bank.

5.4 Repair Site 2-3: RM 5.8 to 7.15 Right Bank

Repair Site 2-3 extends along the right bank from about RM 5.8 upstream to RM 7.15. The USACE installed the RM 7.0R revetment site behind the bench on the levee toe to protect the levee from RM 6.6 to RM 7.5 in 2004.The proposed repair is located along the bankline and is intended to protect the bench from mass erosion during large events. The upstream extent of the repair site is the location where Sacramento Regional Sanitation's force mains pass under the American River. The transition to existing bank protection and working with this existing infrastructure will be addressed in further design. The downstream extents will transition back to the existing bankline near RM 5.8. The downstream extents may be adjusted depending on further investigation of soil properties in this area.

The repair site has significant infrastructure within in it. Sacramento Regional Sanitation has two pressure flow sewer main pipes buried in the bench. The distance to the closest pipe alignment is variable, but is about 130 feet from the top of bank and buried about 14 feet deep at its closest location to the bankline. The pipe is outside the area of the preliminary 10% design footprint. A paved bike trail runs along the length of the site and about 2,000 lineal feet falls within the design footprint and will require either adjustment to the alignment or slight adjustments to the project footprint in further levels of design. The repair site also passes under the Guy West Pedestrian Bridge at about RM 6.95, and the H Street Bridge at about RM 6.45. Campus Commons Golf Course is located between about RM 5.9 to RM 6.4. Two pump outfalls are located near RM 6.2 and RM 6.4. The pump outfall at RM 6.2 is behind the project footprint, while the pump outfall at RM 6.4 will be addressed in further design.

The key recommendations for the TRAC at Repair Site 2-3 were to 1) provide long-term resource improvements and erosion protection to the parkway relative to existing and future eroded conditions, 2) minimize impacts to existing elderberry bushes, and 3) minimize impacts to hydraulic capacity.

The Erosion Assessment identified this section of bankline as having a high potential for erosion due to the erodible material, moderate to poor vegetation, and steep banklines susceptible to mass failure due to toe erosion. The cut-bank design will cut the slopes back to stable slopes which are unlikely to suffer from mass failure due to toe scour. The cut-bank designs will establish planting benches at appropriate elevations to establish natural and regenerating vegetation growth. The lower 20 foot wide area with 10H:1V slope will allow for an establishment of dense riparian vegetation at the toe of the slope. This area will be dressed with cobble to provide erosion protection below elevations where riparian plants establish and surficial erosion protection near the plants. The flatter upper banks will also provide better coverage and growth for establishing vegetation. These slopes will likely be protected with biodegradable erosion control netting until vegetation can be established. Existing vegetation within the project footprint may be transplanted back into project footprint after excavation, or incorporated as instream woody material.

The typical designs included in the 10% drawings provide a general footprint and layout for the design. The elevations and width of the lower planting bench will be variable through the subreach to provide natural variability to the shoreline. The variation in elevation will be within a few feet of elevations shown on the plans, and variability in the width of the lower planting bench may entail narrowing it by up to 10 feet. The 5H:1V upper slope may be steepened to as much as 3H:1V in areas to avoid impacts in the parkway above. Steepened slopes will likely be designed with vegetation reinforced soil stabilization (VRSS) methods. Figure 29 shows the typical cross-section of this design. Elevations and widths of planting benches will be further optimized based on resource agency input on planting pallet, further evaluation of seasonal water levels, and other resource considerations.

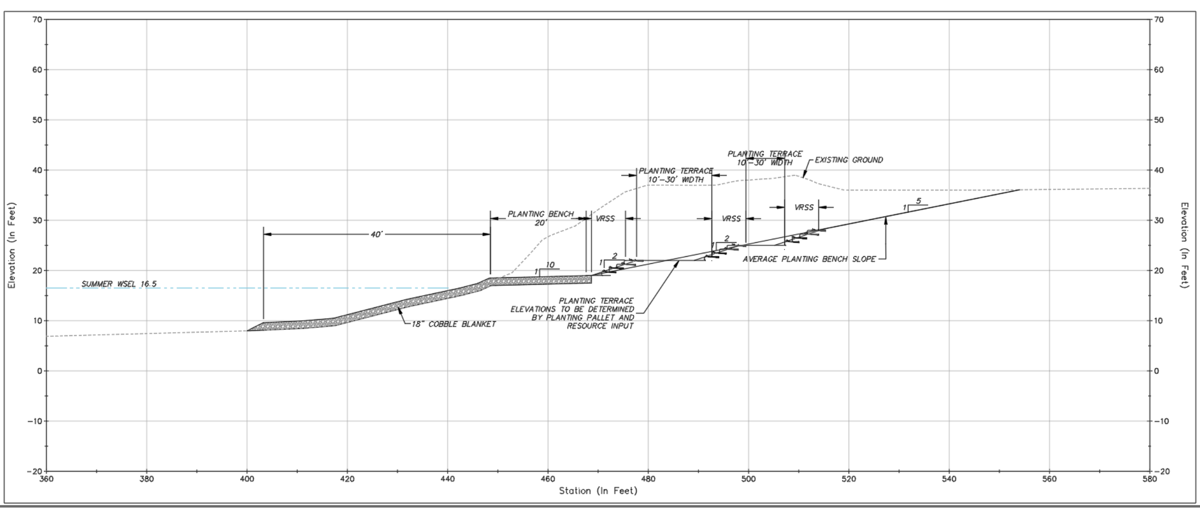


Figure 29. Typical section in Repair Site 2-3

The overall design will protect about 6,000 lineal feet of bankline. Approximately 135,000 cubic yards of material will require off-haul. The design will impact about 14.3 acres of riparian habitat and likely require transplanting over 300 elderberry bushes. The elderberry bushes could be transplanted back into the existing project footprint. The temporary impacts will also be offset by creating benches at lower elevations than currently exist which will better facilitate natural regeneration of native riparian species and improve habitat over the long term. The design will also require about 36,500 tons of cobble and result in a net gain of about 1.4 acres of riparian habitat.

6.0 Long-Term Operations and Maintenance

Regular operation and maintenance (O&M) of the levee system is presently executed by the local maintaining agencies (American River Flood Control District in Subreach 2) in accordance with the existing governing O&M manuals. Regular O&M activities along the levees typically include mowing, vegetation management, rodent control, inspections, and minor levee slope repair.

With regard to newly constructed bank protection sites, the Corps conducts maintenance during the site establishment period. Vegetation establishment and monitoring would be necessary to ensure that the vegetation and species habitat required for mitigation is successfully establishing and that the vegetation is functioning consistent with the site design and being managed as required by environmental permits.

Vegetation establishment and monitoring would be necessary to ensure that the mitigation vegetation is successfully establishing and that the instream woody material (IWM) is functioning as intended. Following completion of construction at an individual site, the Corps would submit a detailed maintenance and monitoring plan (MMP) for the resource agencies to review. The MMP would include 1) success criteria to provide a standard to assess whether mitigation efforts successfully replace lost habitat value, 2) a program to monitor the development of SRA cover and riparian habitat, 3) a protocol for implementing remedial actions should any success criteria not be met, and 4) the required duration of the monitoring efforts. Monitoring reports that evaluate the progress of each constructed erosion site in meeting the success criteria would be submitted to the resource agencies by December 31 of each monitoring year.

Vegetation establishment activities for on-site mitigation will typically be performed by the Corps for a minimum of 3 years and until mitigation success criteria have been met following the completion of bank protection. After this time, it is anticipated that the vegetation would be established and self-sustaining. Anticipated activities during the 3-year establishment period include removal of problematic invasive species, irrigation of vegetation to promote optimal growth, replacement of any dead or declining vegetation, and maintenance of beaver barrier fencing.

Establishment activities also may include monitoring the vegetation and IWM to ensure that hazards to navigation are not present, assessing the status of the rock revetment and soil fill during high-flow events, and monitoring the sites for vandalism. Any in-water maintenance work would be conducted in coordination with the applicable federal and state resource agencies to avoid adverse effects on sensitive fish species.

Following the establishment period, long-term maintenance is the responsibility of the project sponsor, which is the CVFPB. In most cases and as previously described, the CVFPB delegates long-term maintenance to a local maintaining agency. Maintenance is to be carried out consistent with the Sacramento Flood Control Project Operations and Maintenance manual.

7.0 Next Steps/Continuing Efforts

The content of this summary report includes 10% conceptual designs for Tier 1 and Tier 2 sites in Phase 2. The submittal intends to satisfy the functional, special, technical, and aesthetic needs for the sites. The submittal also defines the approach, identifies any relevant technical studies, and includes a parametric cost estimate for the designs submitted. TRAC considers the submitted designs as the most appropriate and economical for the sites under assessment. The conceptual designs were developed to meet USACE guidance, comments received, and site criteria through the ongoing interaction with LARTF, and they are being submitted following USACE Architectural & Engineering Design submittal guidance.

7.1 Iterative Planning Process with PDT (e.g., conceptual designs are first major step in iterative process)

The submittal of the 10% conceptual designs is the first major step in what is intended to be a collaborative, iterative process for LARTF, BPWG, TRAC, and USACE's PDT. The next milestone will be developing 35% designs that will include refined transitions (pump outfall, typical sections, upstream/downstream), station lines and offsets, planting elevations, mitigated impacts, etc. The designs will also outline sections for the specifications, include Value Engineering, and outline initial operations and maintenance requirements and anticipated project impacts.

Following the 35% designs will be a 65% submittal that will add in planting pallets, details on construction staging and access, marked-up specifications, Engineering Considerations and Instructions for Field Personnel, Value Engineering, responses to comments from prior submittal, and finalized operations and maintenance and mitigation requirements.

The final submittal will be the complete 100% designs or final set of plans which will be bidable, constructable, operable, and conforming to all project requirements. The final plans will not contain any significant changes from the 65% designs and will address any comments or concerns raised at that milestone.

Throughout each stage of design preparation and refinement, LARTF, BPWG, TRAC and USACE PDT will engage to ensure bank protection solutions meet the technical requirements established by USACE while also successfully meeting key regulations influencing design considerations.

7.2 Additional Reaches (e.g., 1, 3, and 4)

Following closely behind Subreach 2, TRAC will begin the process of evaluating, documenting, and coordinating on the three other subreaches. Subreach 1 (Sacramento River Confluence to Paradise Bend), Subreach 3 (Howe Avenue to Watt Avenue), and Subreach 4 (Watt Avenue upstream to top of leveed reach) will all go through the same bank protection assessment and recommendation development process as Subreach 2. Analysis of these subsequent subreaches will have the benefit of tools like the Dashboard already in place to improve the efficiency of the effort. It should also be noted that aspects of other subreaches (e.g. Subreach 3 hydraulics) were taken into account during evaluation of Subreach 2 sites, so the team will not necessarily be starting from a data void on the other three subreaches. Outcomes of the conceptual design process will be staggered into early 2019 for Subreaches 1, 3, and 4 with the goal of 100% designs by the end of 2020.

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<u>EXHIBIT B</u>

LARTF
Technical Presentation

Subreach 2 Design Updates

September 17, 2019




nhc
northwest hydraulic consultants

water resource specialists

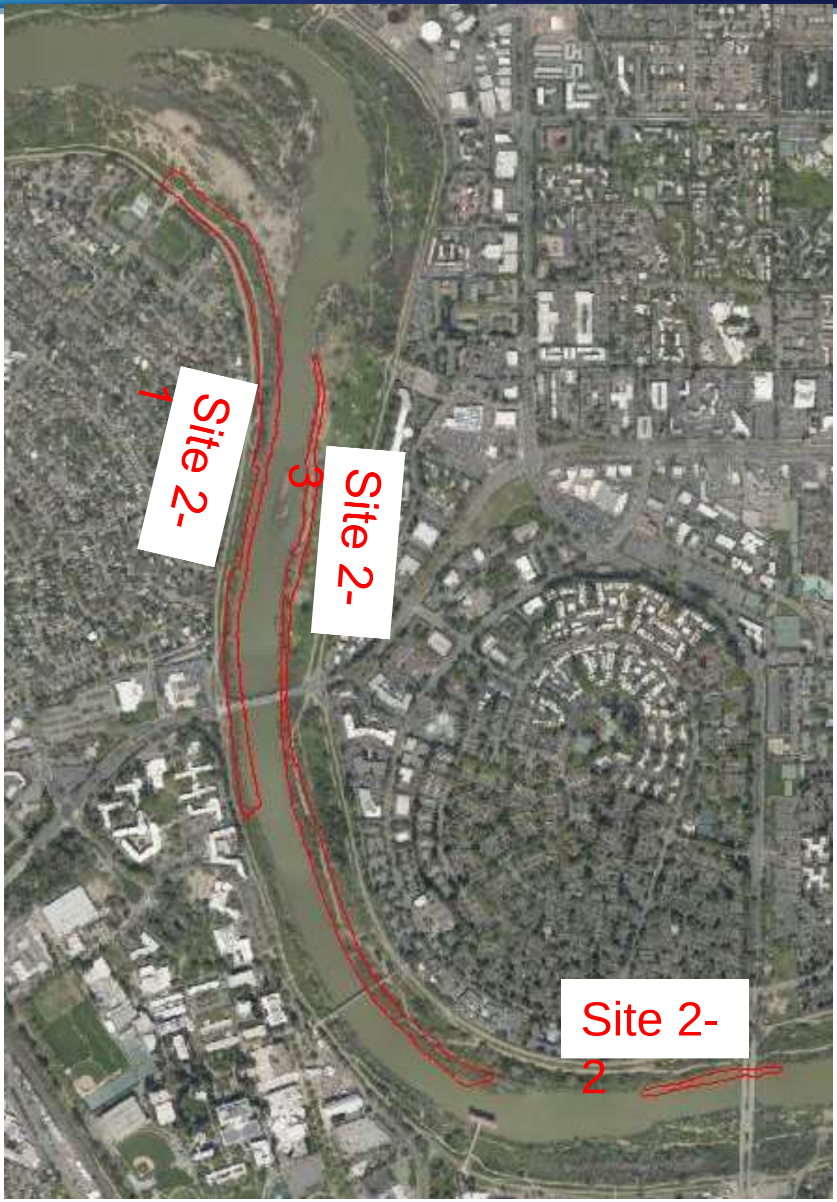
Overview

- Design Process
  - 10% Designs Submitted to USACE 30 Nov. 2018
  - 35% Design Review Conference 4-5 June.
  - 35% Value Engineering Submittal 19 Aug 2019
  - 65% Submittal <u>16 September 2019</u>
  - 65% USACE Review(s) November 2019
  - Permitting Consultation starts October/November 2019
  - 90% Submittal March 2020
  - Final Submittal May 2020
  - Fall 2020 Contract Award

DRAFT Construction Timeline

- Nov. 2020-Jan. 2021 Tree Removal and Elderberry Transplant
  - Elderberry Transplant Window (1 Nov.-15 Feb.)
  - Nesting Bird Season (1 Feb.-15 Aug.)
- May 2021 Contractor Mobilization and Out of Water Work
- 1 Aug 2021-30 Nov. 2021 In-water Work Window
- 30 Nov. 2021-15 Dec. 2021 Site Cleanup/Winterization
- July 2022 Planting
- 2022-2025? Planting Maintenance

Design Sites



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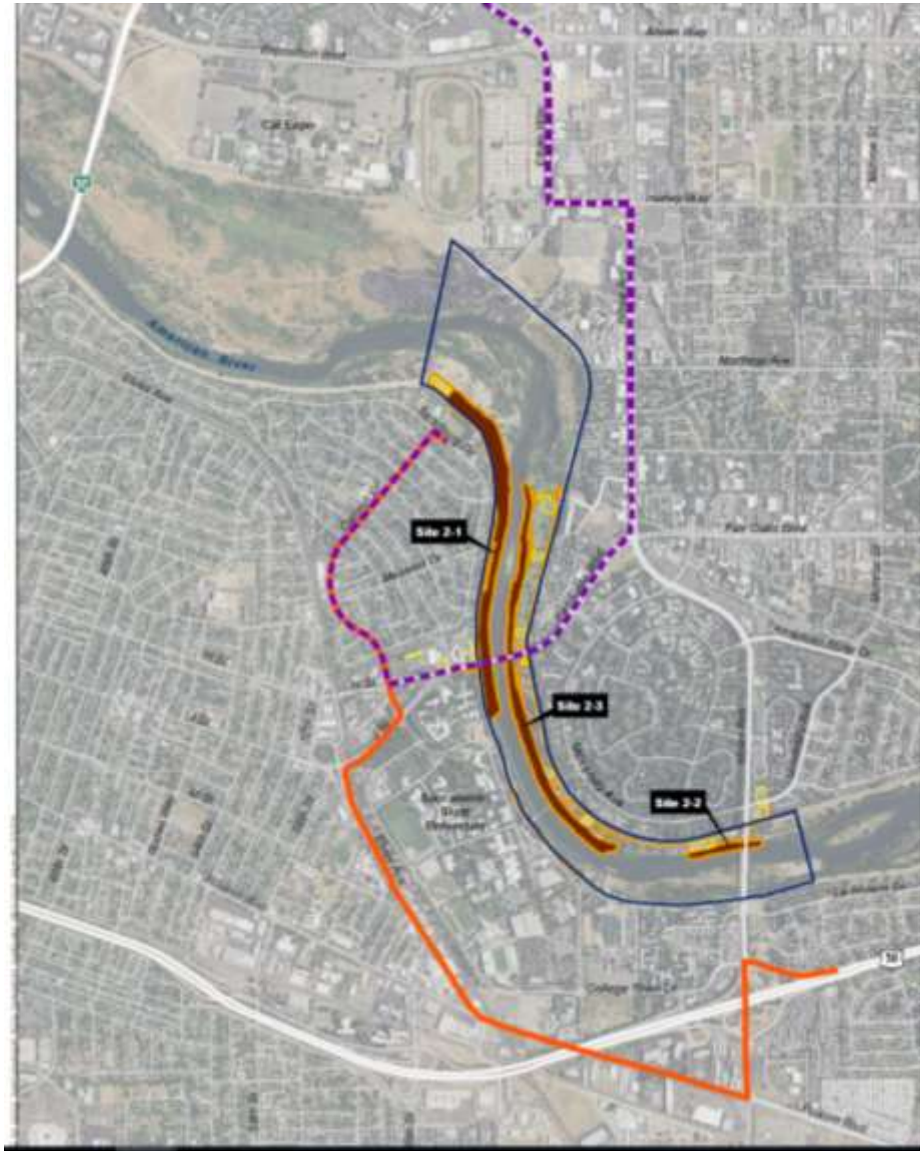
water resource specialists

Site 2-1 Access



Site 2-1 Design Updates

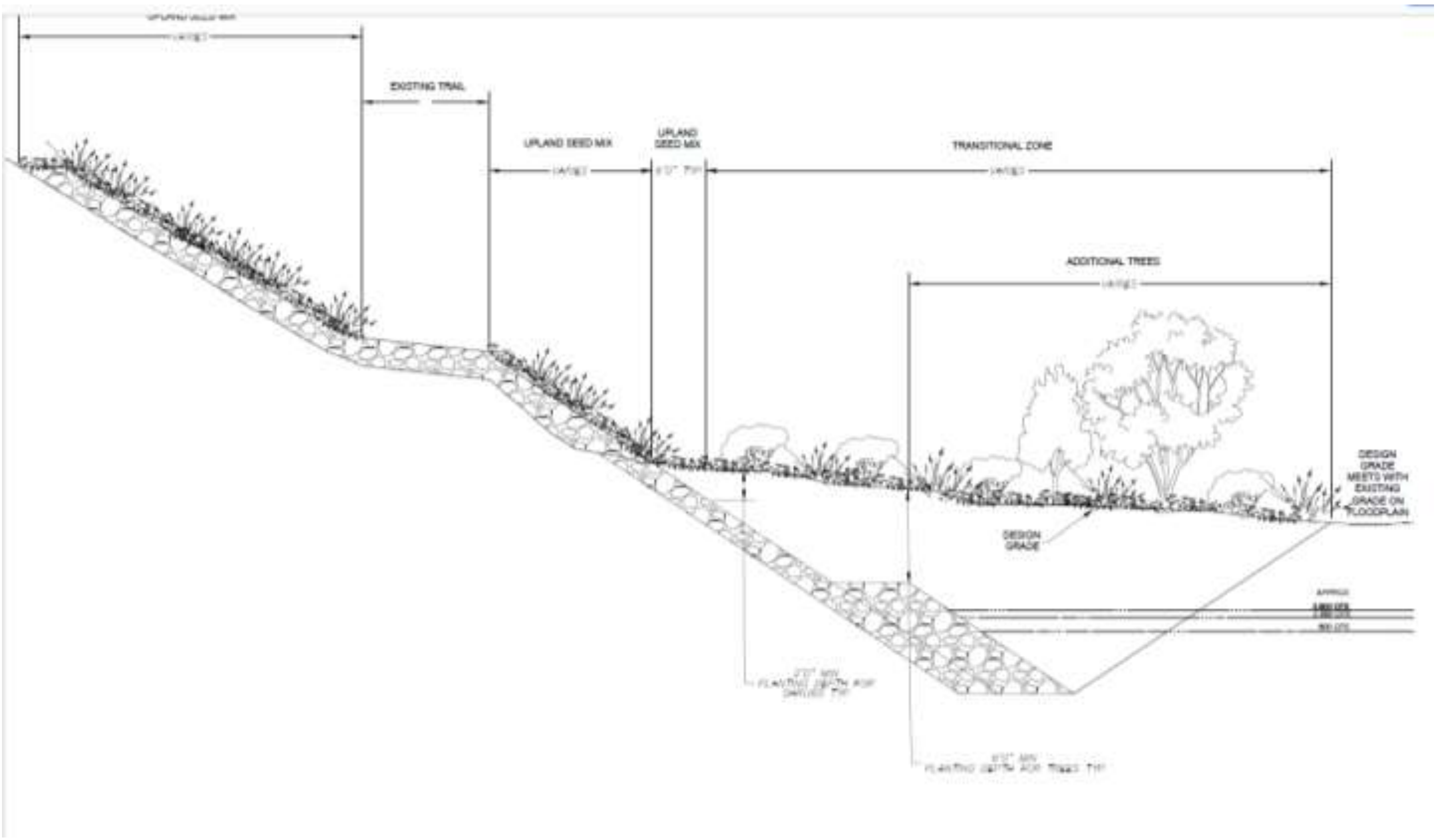
- Transitions
  - Bridges, pump outfalls, existing revetment
- Planting Plans
  - ESA in development
  - Back and forth dialogue establishing soil volumes/planting area, IWM details,

Site 2-1

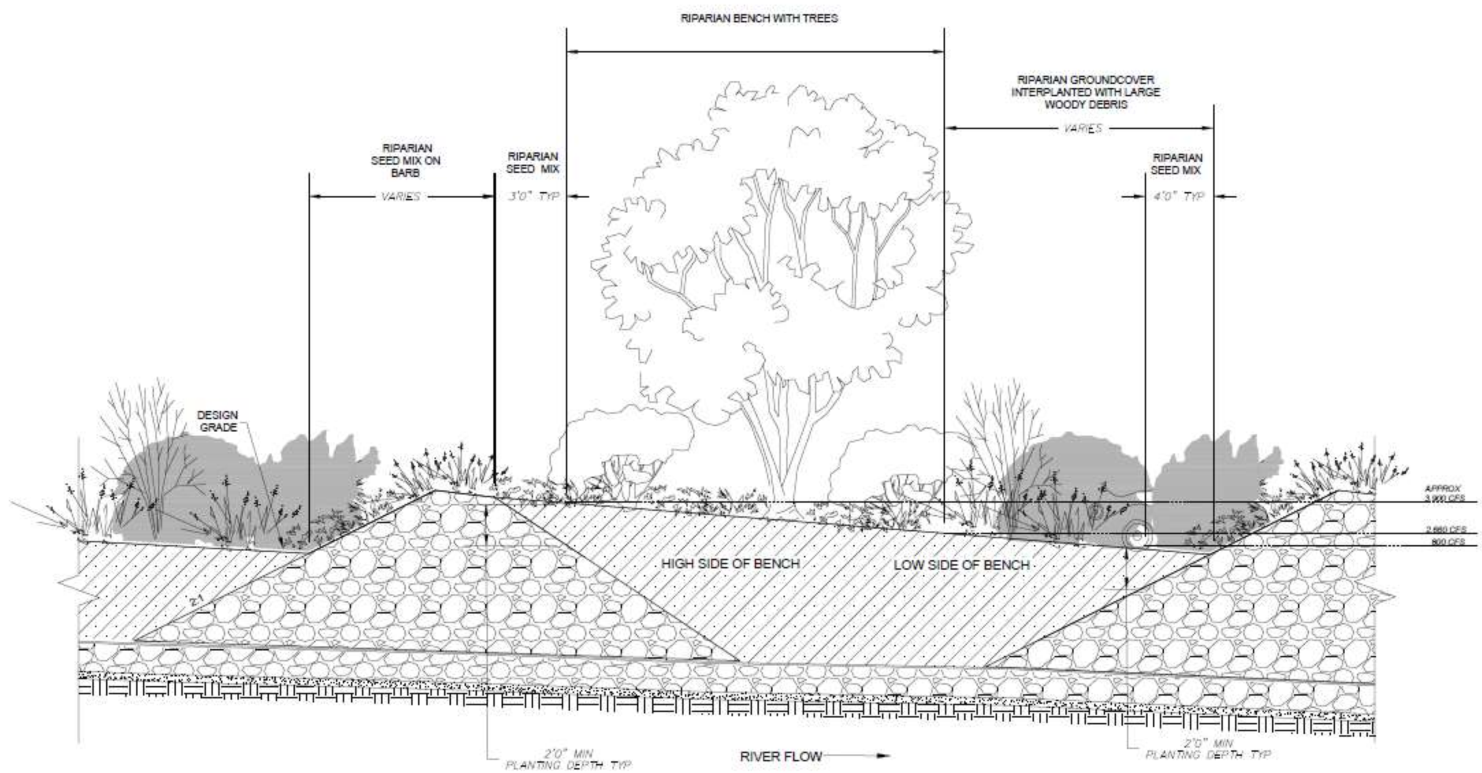
Project

Existing

Site 2-1 Paradise Bend

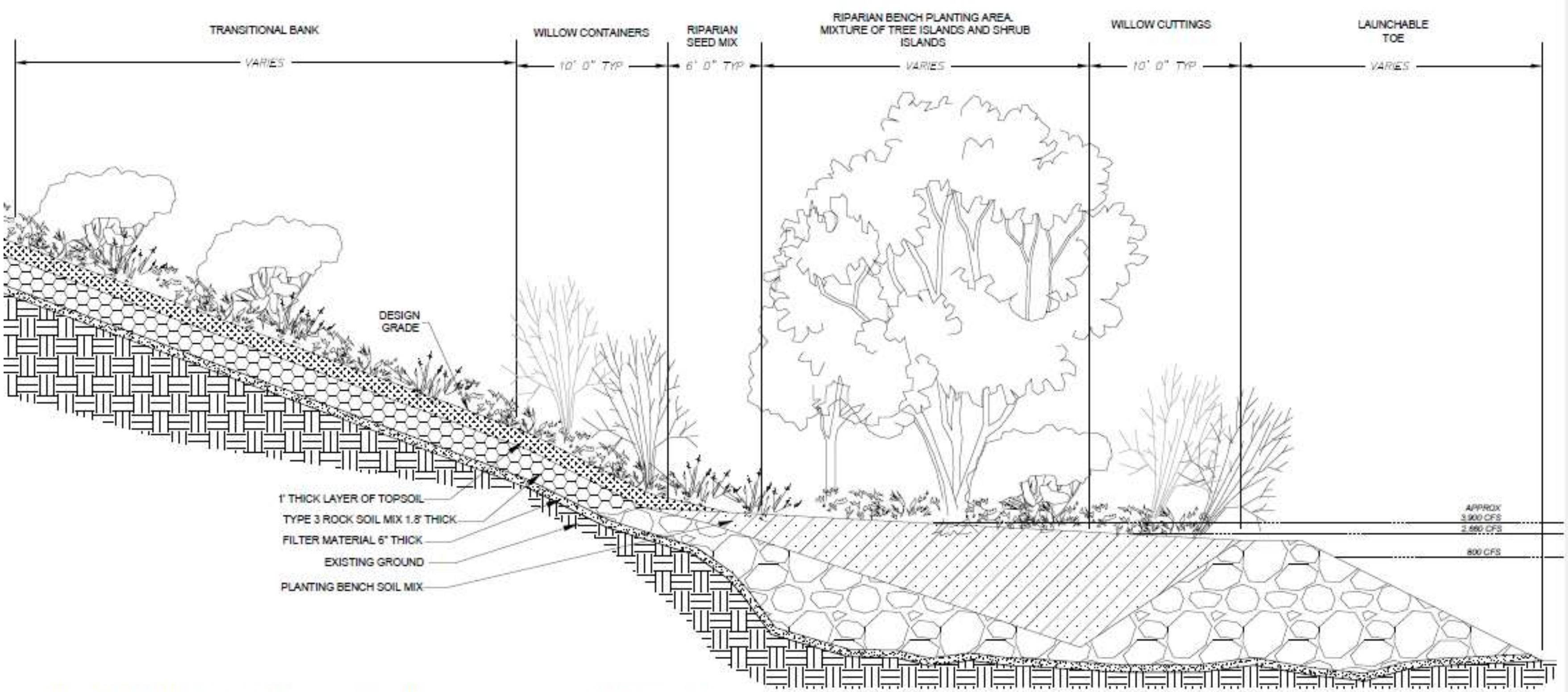


Site 2-1 Paddler's View



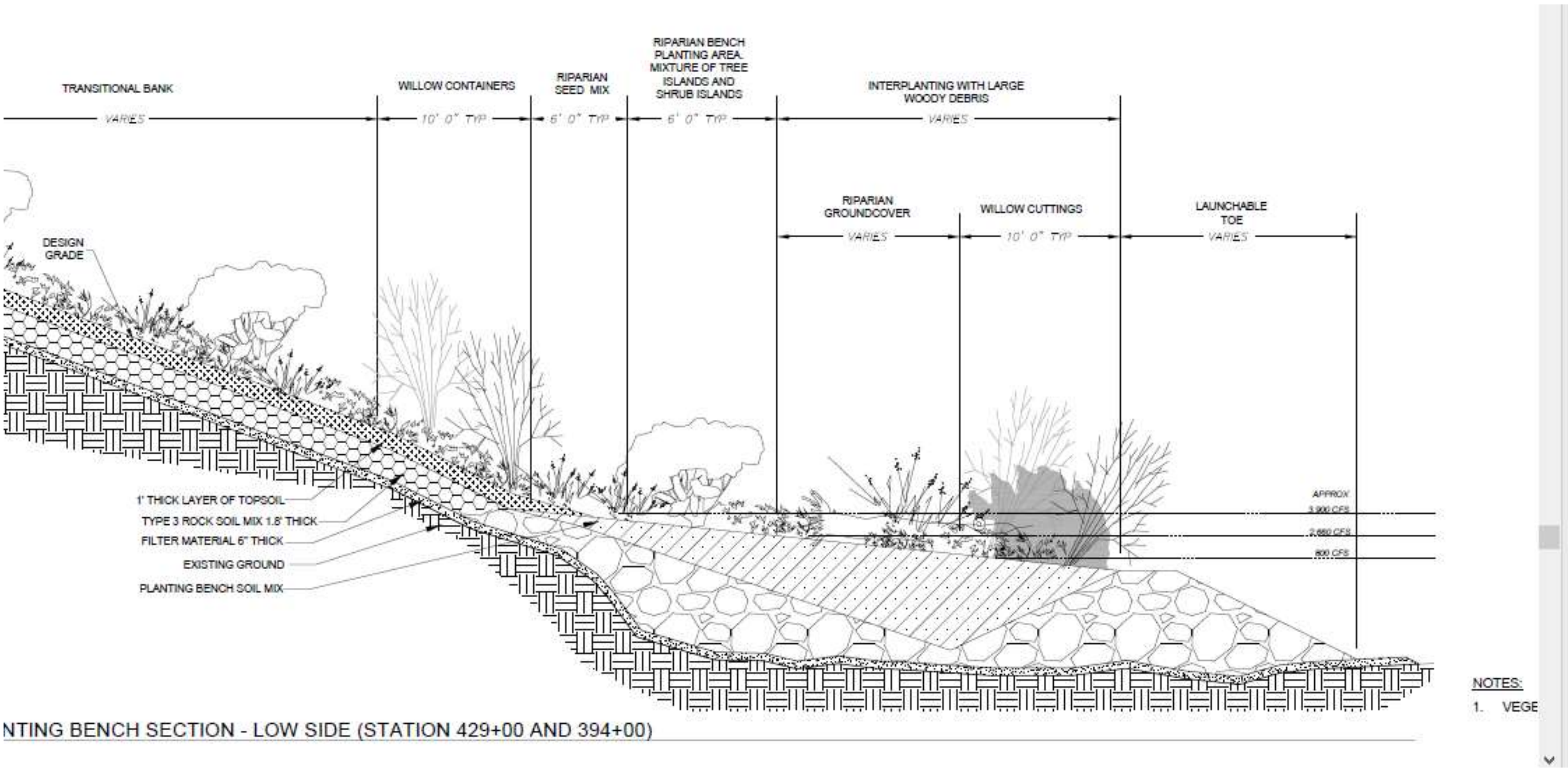
BENCH PROFILE / ELEVATION (STATION 394+00 to 429+00)

Site 2-1 Cross-Section



TYPICAL PLANTING BENCH SECTION - HIGH SIDE (STATION 429+00 AND 394+00)
NTS

Site 2-1 Cross-Section



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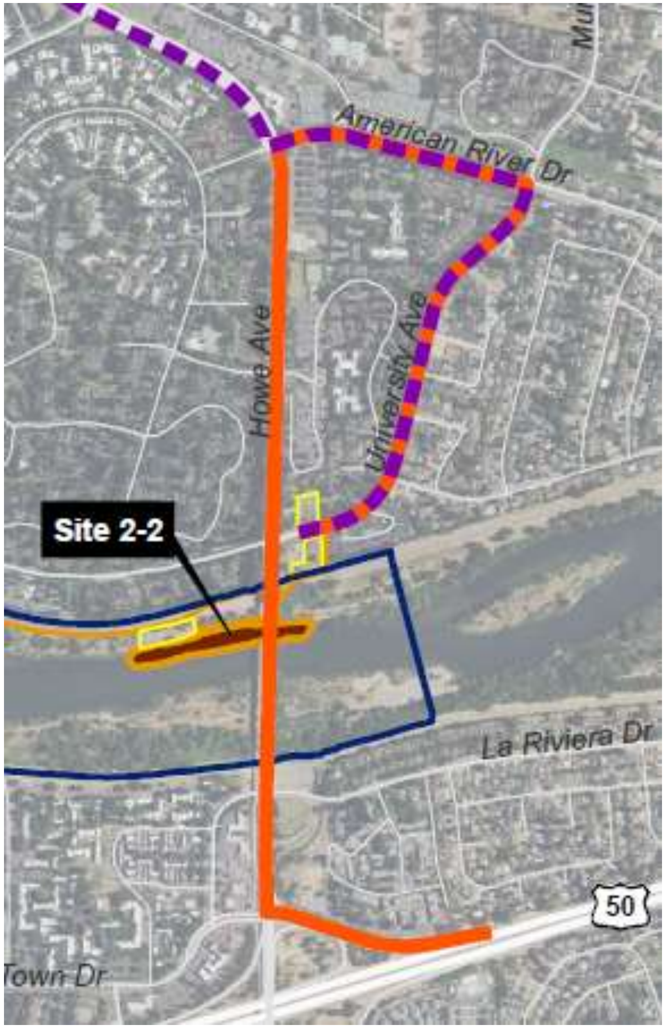
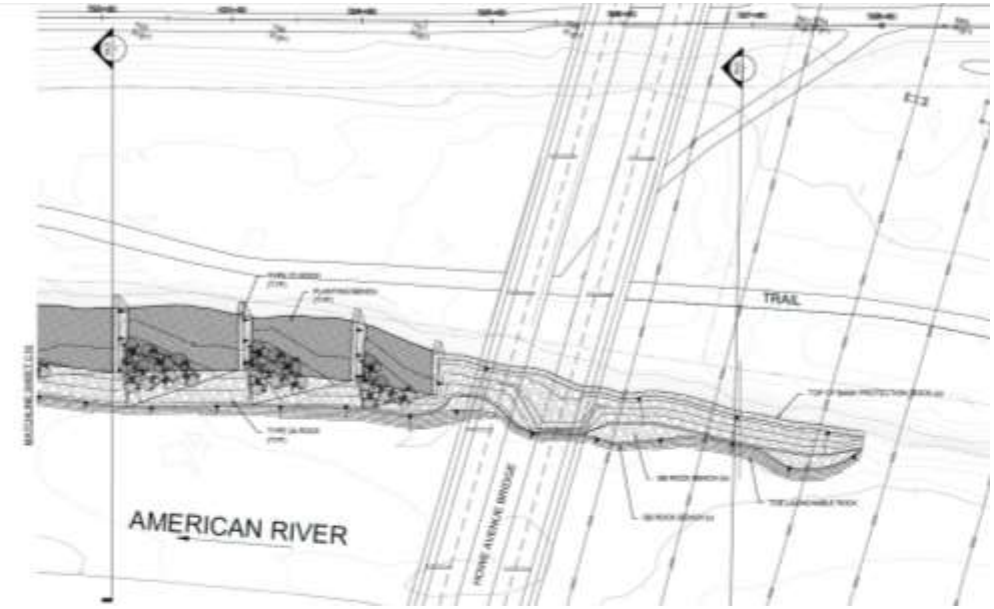
Site 2-2 Access

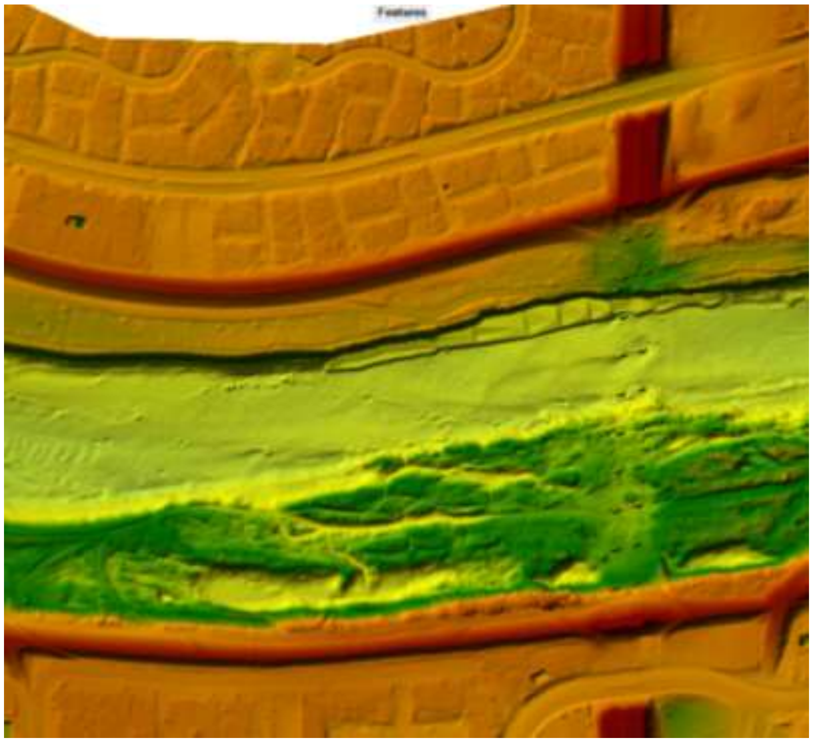


Site 2-2 Design Updates

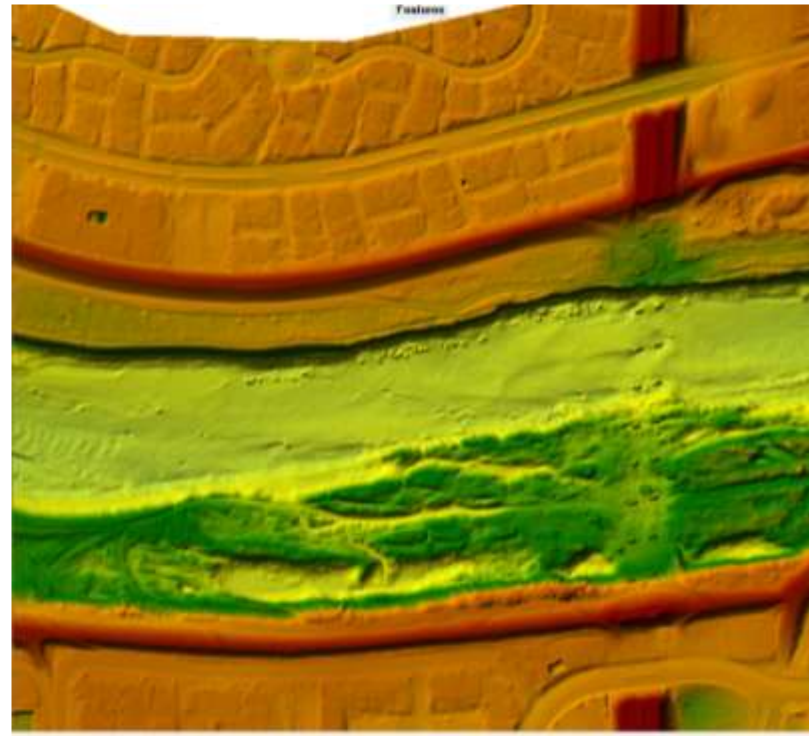
- Transitions
  - Bridges, Elderberries, construction approach
- Planting Plans
  - ESA in development
  - Back and forth dialogue establishing soil volumes/planting area, IWM details,



2-2 Design

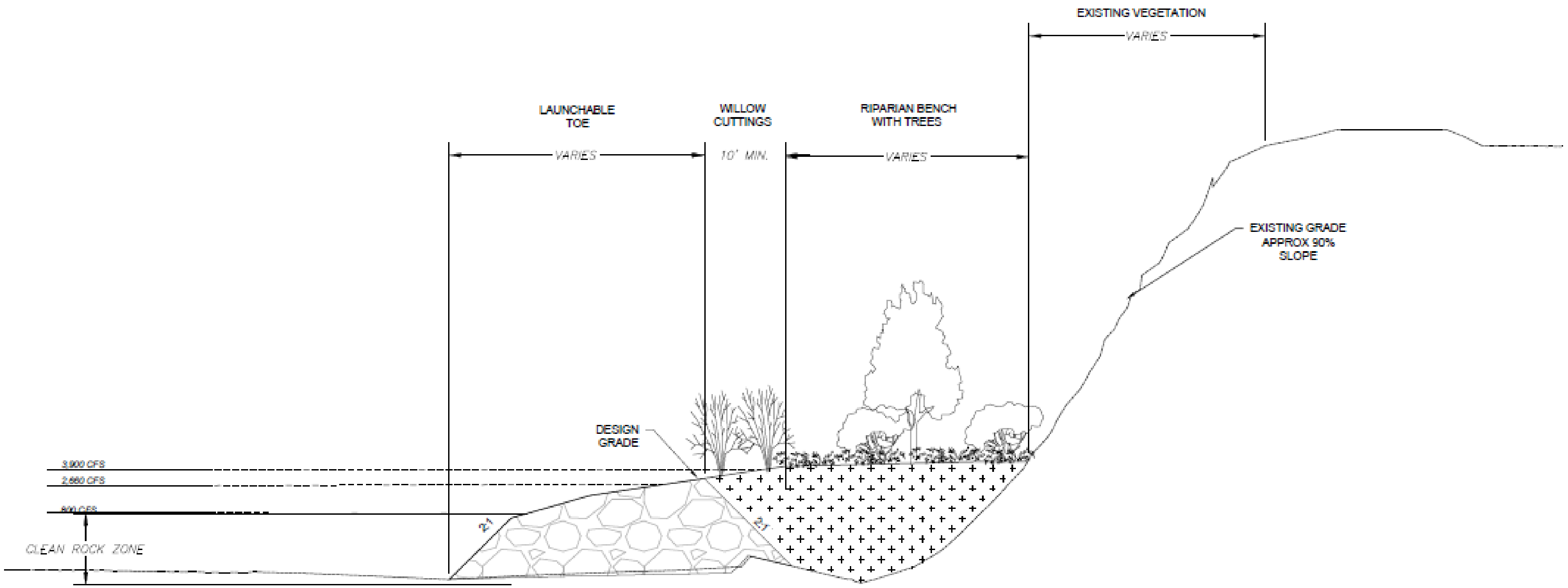


Project

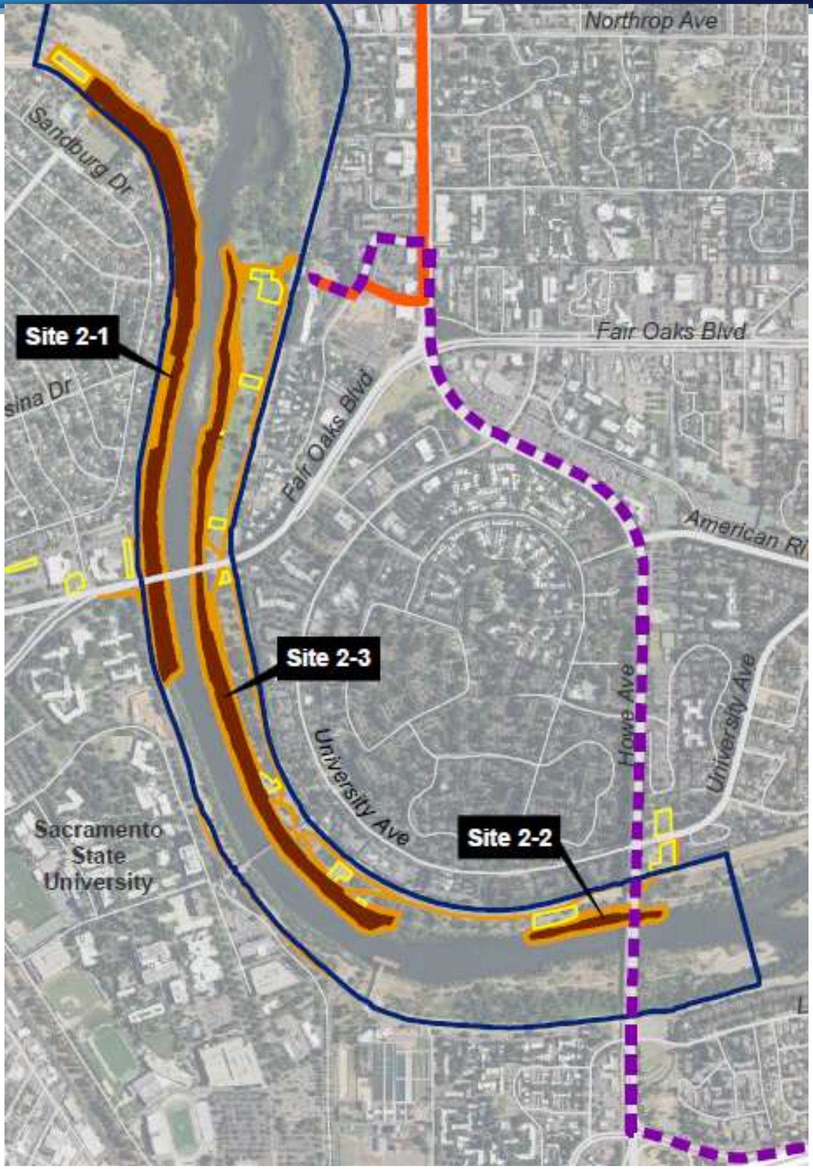


Existing

Site 2-2 Cross-Section



Site 2-3 Access



2-3 Design Discussions

- Hard Toe
  - Protects from toe erosion below vegetation
  - Maintain low bench
  - Typical Site 1-5 approach
- Soft Toe
  - Allow natural erosion processes
  - Natural bank material/habitat
  - Provide 15ft -25 ft buffer of allowable erosion
  - Previous Design

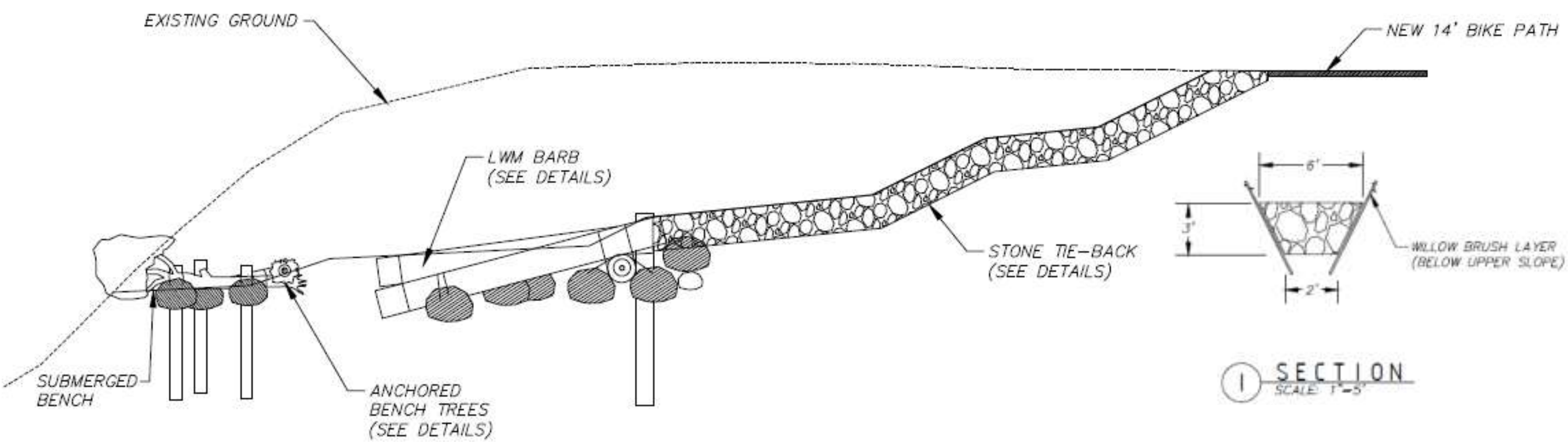
Site 2-3 Design Updates

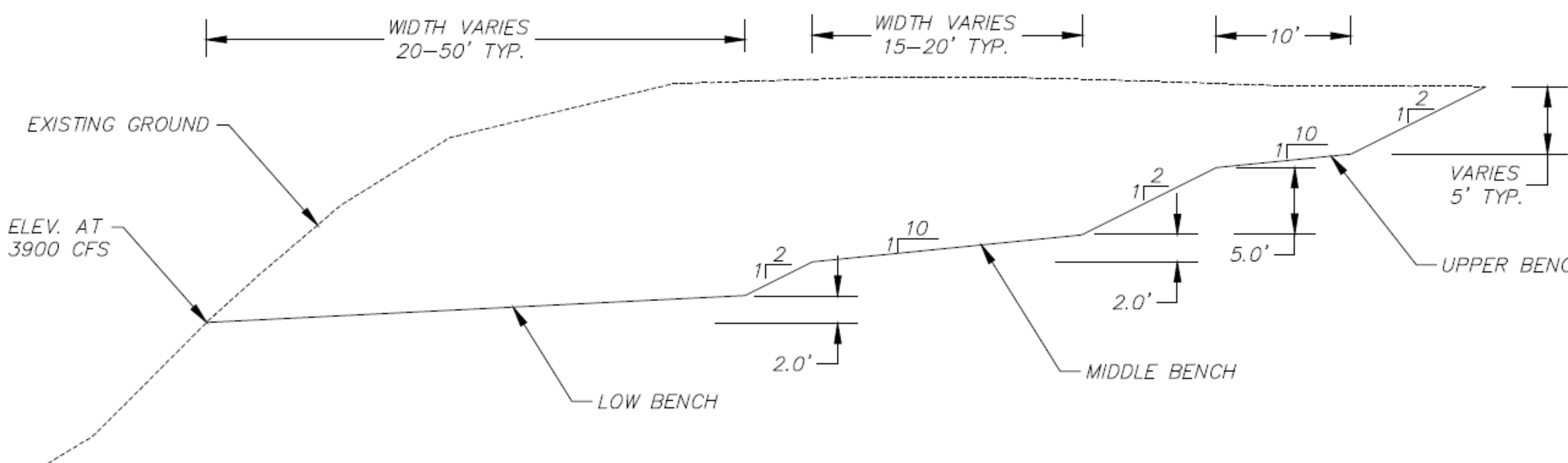
- Materials, Maintenance, and Performance Considerations
- Buried rock trench performance

Site 2-3 Design Updates

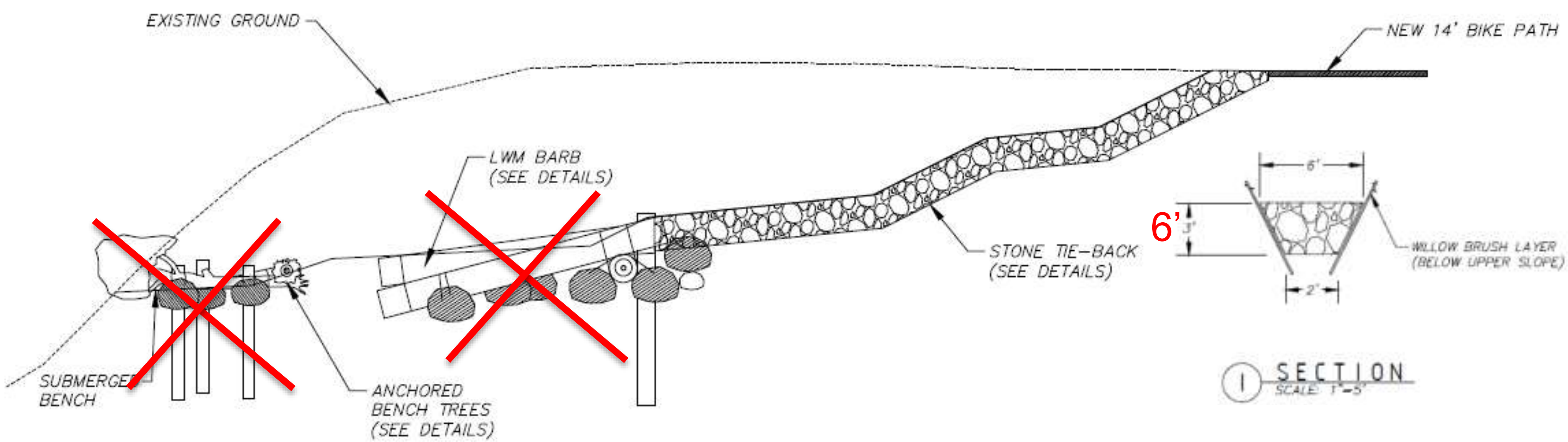
- Removed Large Wood Structures
  - Cost, Performance
- Bigger rock groynes
  - Performance, Replace Wood structures
- Focused lower bench height for vegetation recruitment

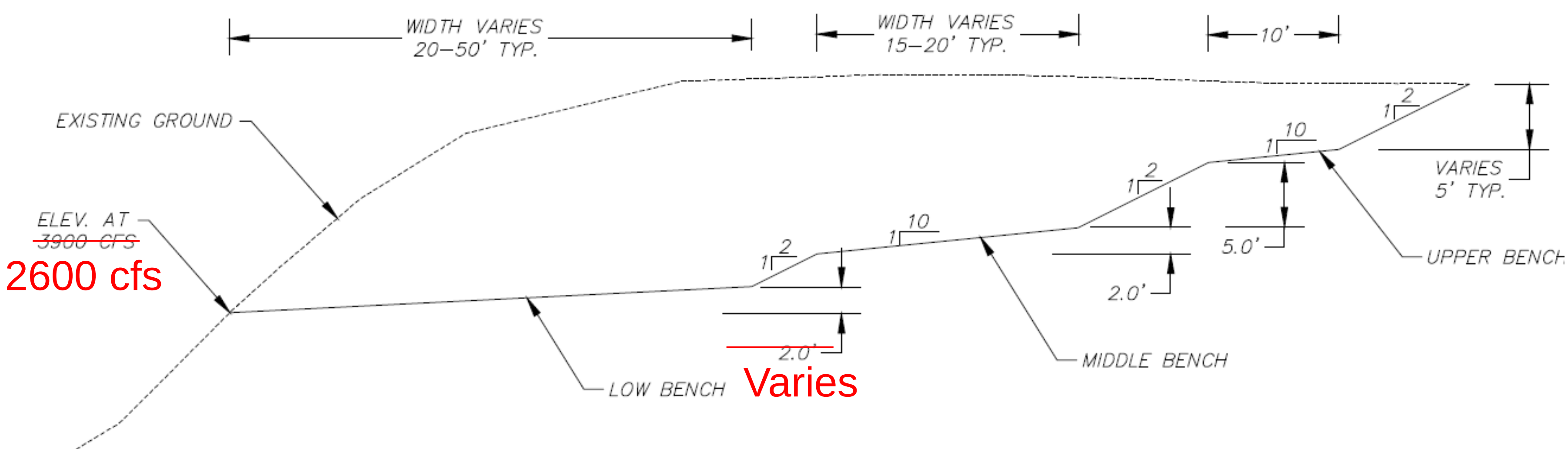
2-3 Previous Design



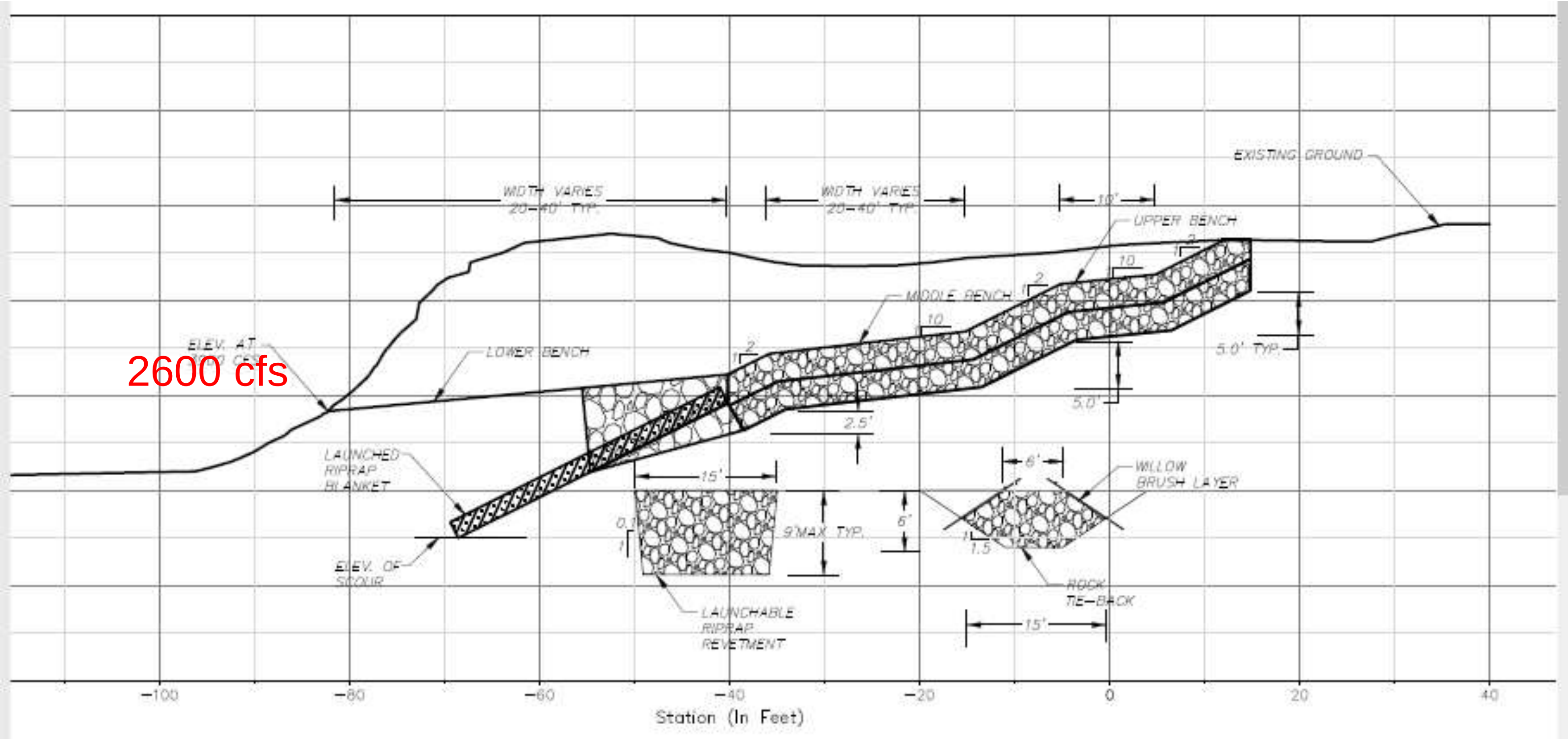


2-3 Previous Design





2-3 Current Design

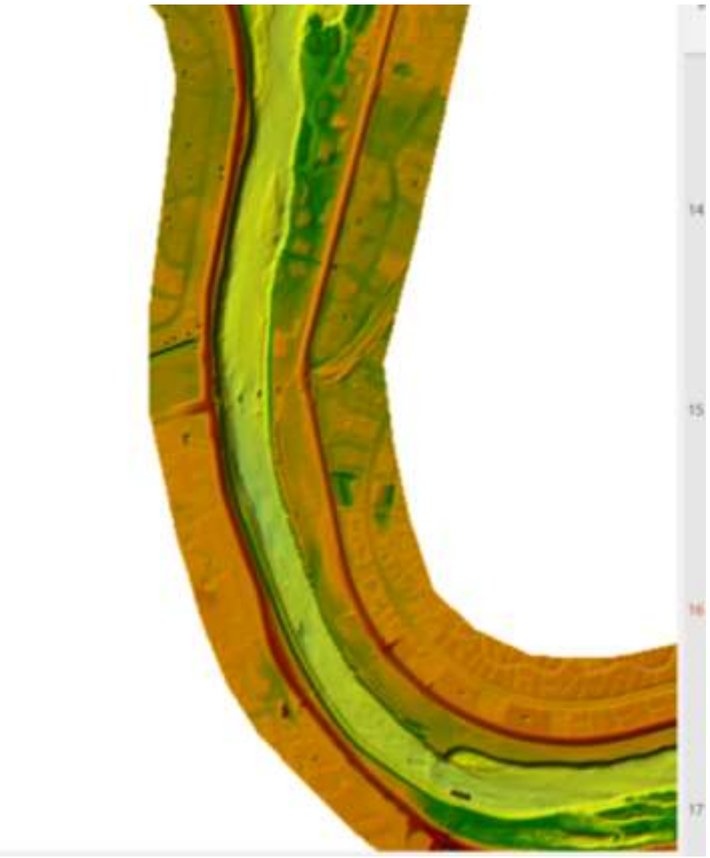


nhc

2-3 Current Design

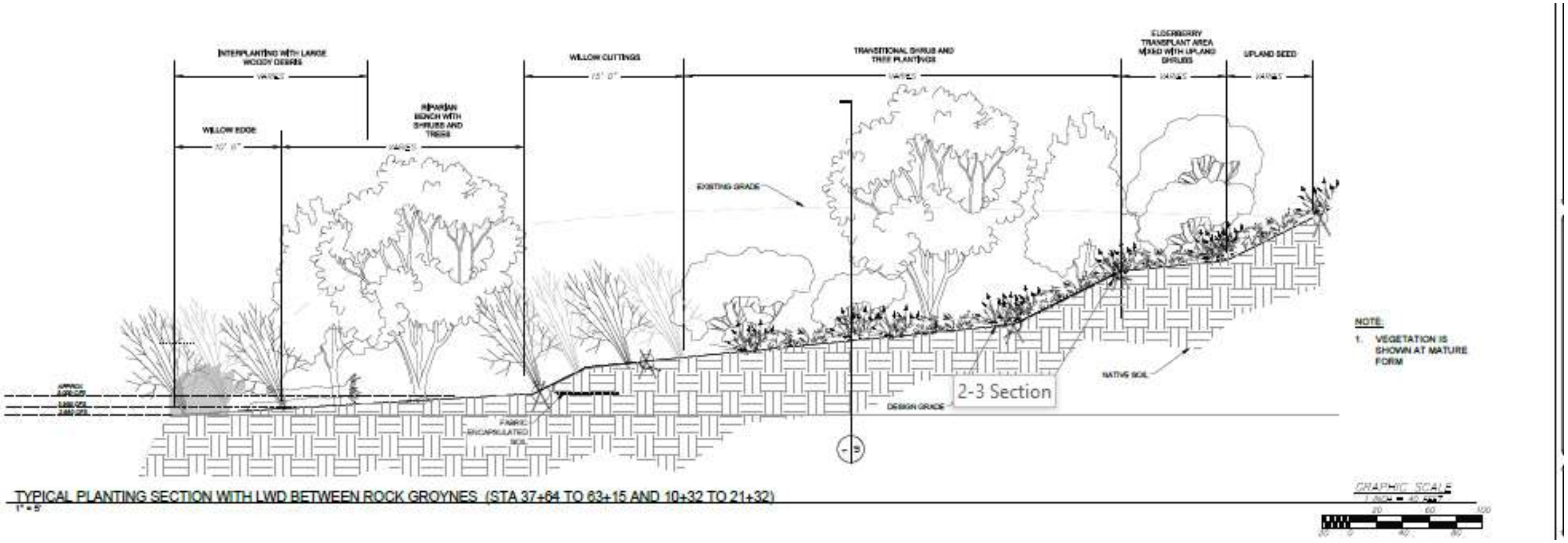
Site 2-3

Project



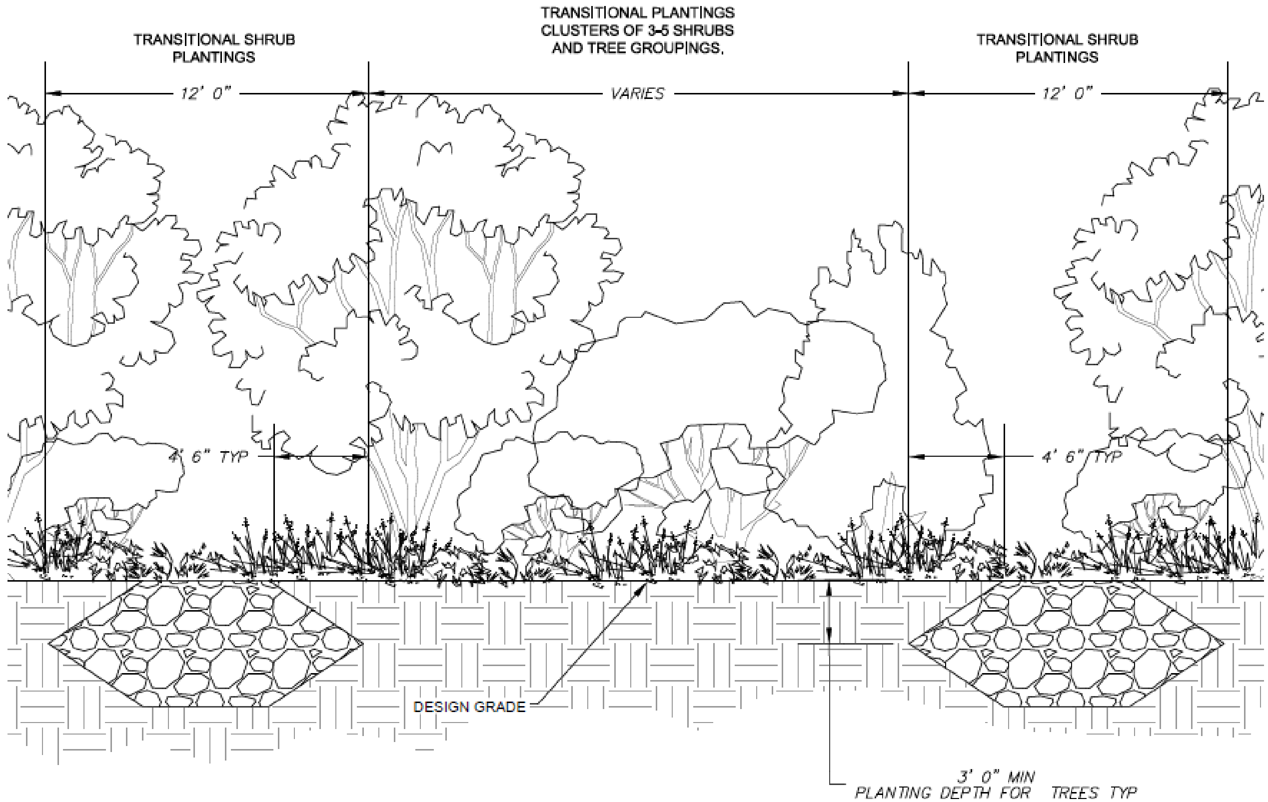
Existing

2-3 Section



INTERPLANTING WITH LARGE WOODY DEBRIS
VARIES
WILLOW CUTTINGS
15' 0"
TRANSITIONAL SHRUB AND TREE PLANTINGS
VARIES
ELDERBERRY TRANSPLANT AREA MIXED WITH UPLAND SHRUBS
VARIES
UPLAND SEED
VARIES
RIPARIAN BENCH WITH SHRUBS AND TREES
WILLOW EDGE
VARIES
EXISTING GRADE
FABRIC ENCAPSULATED SOIL
NATIVE SOIL
DESIGN GRADE
2-3 Section
NOTE:
1. VEGETATION IS SHOWN AT MATURE FORM
TYPICAL PLANTING SECTION WITH LWD BETWEEN ROCK GROYNES (STA 37+64 TO 63+15 AND 10+32 TO 21+32)
1" = 5'
GRAPHIC SCALE

Site 2-3 Paddler's View



1 PLANTING ELEVATION BETWEEN GROYNES AT TRANSITIONAL PLANTING ZONE
1" = 5'

Questions?

Butte City, Ca

nhc

water resource specialists

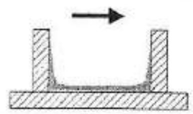
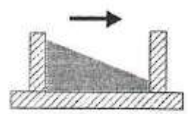
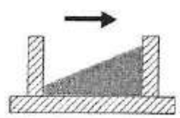
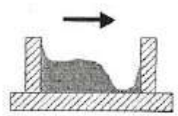
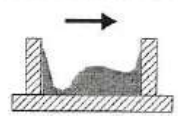
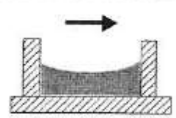
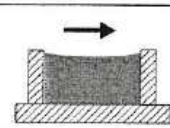
Hard Points (example)

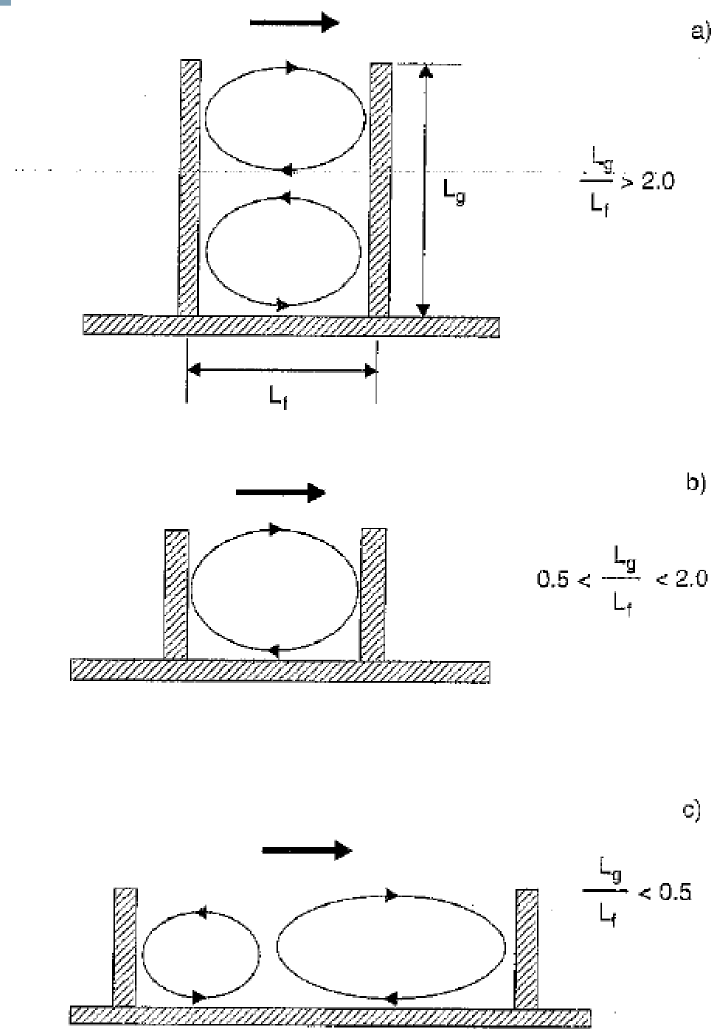
nhc

water resource specialists


2006 Post-Construction


2018

Class	Definition	Pattern
1	weak deposition	
2	downstream triangle-shaped deposition	
3	upstream triangle-shaped deposition	
4	downstream wave-shaped deposition	
5	upstream wave-shaped deposition	
6	uniform partial deposition	
7	uniform complete deposition	



December 18, 2019

To:
Mayor Darrell Steinburg,
Councilmembers of Sacramento City Council, and
Tom Buford, Manager, Environmental Planning Services

Subject: Two Rivers Trail Phase II, Final Environmental Impact Report (FEIR)

I just learned from a third party that the City plans to release the FEIR for this project on Friday, December 20, and that it is scheduled for Council decision on certification and project approval on January 7.

If this schedule is accurate, I am writing to request that you direct City staff to provide sufficient time for the public to review the proposed FEIR for the project. Given the holiday season, the schedule noted above (less than three weeks) does not provide enough time for meaningful public review.

Also, given that the major Army Corps erosion control project in the bike trail project area, whose construction schedule requires the bike trail project to be pushed further out than originally planned, there is no urgency to certify the bike trail project FEIR.

Please postpone consideration of the document by City Council until February, when the holidays have passed.

I would like to note that when I worked as an environmental planner and manager in the private sector and for the State, my office scheduled project reviews *around* the holidays, not during them. The CEQA Guidelines have minimum requirements for public involvement, but the spirit of CEQA is allowing meaningful public involvement.

We appreciate the improvement the City has made in communicating with the community and in being responsive to our requests to provide input on the project. We hope you will continue to keep us involved and allow us sufficient time to review the FEIR before it is brought before the City Council for consideration.

Thank you for your consideration.

Sincerely,

Nancy MacKenzie

Nancy MacKenzie
5747 State Avenue
Sacramento, CA 95819
916-402-7289
Cumby54@yahoo.com

January 8, 2020

Ron Bess, Assistant Planner
City of Sacramento
Community Development Department
300 Richards Boulevard
Sacramento, CA 95811

RE: Supplemental Information Relevant to the Environmental Impact Report for the Two Rivers Trail - Phase II Project

Dear Mr. Bess,

Save Don't Pave is an unincorporated association comprised of community members working to save the section of the American River Parkway (Parkway) between Sutter's Landing and the H Street Bridge as a natural recreation option for all to enjoy in its current unpaved state. Save Don't Pave submitted a comment letter on September 16, identifying various concerns regarding the Two Rivers Trail - Phase II project and deficiencies in the Draft EIR. This letter and attached photos and video files are submitted to supplement the concerns raised in that letter.

The EIR indicates that the City does not expect any increase in the level of maintenance, trash collection, or crime prevention needs[1] as a result of constructing a paved bike trail, and that no mitigation is required[2], despite the fact that a stated purpose of the project is to increase traffic through the area,[3] and the number of users and bicycles is expected to increase as a result of the project.[4] The EIR's assertion that it does not expect impacts to increase as a result of the project does not appear to be based on an analysis of the kinds of impacts that occur consistently along the existing segments of paved bike trail along the American River Parkway, which offers the best available indicator for what to expect along the proposed bike trail.

The attached exhibits are photos and videos taken along the existing paved bike trail of the Two Rivers Trail - Phase I, the Two Rivers Trail – Phase II at Sutter's Landing Regional Park, the Sacramento Northern Bikeway Trail, and the American River Bike Trail (Jedidiah Smith Memorial Trail). All of these images were captured in the past year as the Two Rivers Trail – Phase II project has been under development.

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1 DEIR at 3.9-8

2 DEIR at 3.9-8, 3.9-9

3 DEIR at ES-2

4 DEIR at 3.9-8, 3.10-5

The videos focus on the Two Rivers Trail - Phase I and the Sacramento Northern Bikeway Trail, which are directly relevant to the proposed project.[5] The Sacramento Northern Bikeway Trail is located at the western end of the proposed project and is intended to connect directly to the Two Rivers Trail – Phase II. The Two Rivers Trail – Phase I is the first segment of the trail that the proposed project will continue. The trail beginning at Sutter's Landing is the second constructed segment of the trail, and will connect directly to the proposed project. All of these areas show substantial, ongoing impacts to the trail, the riparian natural area, and the properties directly adjacent to the paved bike trail in the form of extensive litter, uncollected trash, and encampments.

These exhibits show examples of maintenance, trash collection, and crime prevention needs that are currently going unmet along the existing paved bike trail:

- Extensive litter and apparent dumping;
- Piles of trash left uncollected for extended periods;
- Graffiti that persists for months;
- Traffic signs, maps, and interpretive signs in extreme disrepair;
- Areas burned by illicit ignition;
- Recreation facilities overgrown with weeds;
- A vegetation restoration project now overgrown with invasive weeds;
- Encampments along the bike trail and within obvious view of the trail; and
- A person defecating along the paved bike trail.

When we read in the EIR that the City does not expect any increase in the need for maintenance, trash collection, or crime prevention as a result of constructing a paved bike trail, and is not planning to commit additional resources to address these needs, we interpret this to mean that the City believes that these needs are currently being adequately met along the existing paved portions of the bike trail. The attached exhibits demonstrate that they are not. We are therefore concerned that the City will find itself unable to address additional impacts as they occur along this stretch of river—currently an unpaved footpath where none of these issues are common—as it appears it has found itself overwhelmed by impacts throughout the Parkway.

Unlike other sections of the Parkway within Sacramento city boundaries where the Parkway borders commercial and industrial areas, the project area for the Two Rivers Trail – Phase II is directly adjacent to a residential neighborhood. The proposed project runs more than two miles along the River Park neighborhood, tens of feet from the houses bordering the levee, and through an area heavily used by Sacramento families. The impacts and issues described above will essentially be brought, as a result of the proposed project, along the entire length of this neighborhood.

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[5] A video of the Two Rivers Trail-Phase I and a video of the Sacramento Northern Bikeway are included as attachments to this letter, and are also available at https://drive.google.com/open?id=1-JdxA3AfNffcXwEl2Cfh-SIdEY2Hxv65 and https://drive.google.com/open?id=1fr_sHVfzUPNUZwbtdcjREM0_Bc3yF6Lr, respectively.
See also the video posted by the Sacramento Bee showing the state of the Two Rivers Trail – Phase I. "Sacramento doesn't want to face its homeless. But this is what the local nightmare looks like" by Marcos Bretón, *Sacramento Bee*, July 25, 2019, available at https://www.sacbee.com/news/local/news-columns-blogs/marcos-breton/article232838467.html

We urge the City to ensure that the EIR accurately reflects the current state of the existing Two Rivers Trail – Phase I and Sutter's Landing paved bike trail and the needs for maintenance, trash collection, and crime prevention that are likely to result from the Two Rivers Trail – Phase II project, as well as the mitigation measures and additional resources necessary to address such impacts. Furthermore, we urge the City to delay adoption of the EIR until the City can demonstrate that the pressing needs for maintenance, trash collection, and crime prevention along already paved sections of the City's bike trail are being adequately addressed, and can ensure that any increased maintenance, trash collection, and crime prevention needs that arise as a result of the project will be given the priority and funding to fully address those needs.

Thank you for your consideration of these comments.

Sincerely,

Allyssa Mader
Treasurer
Save Don't Pave
savedontpave@gmail.com

cc. Mayor Darrell Steinberg, Supervisor Phil Serna, CM Jeff Harris, and Adam Randolph

Overgrown weeds at Sutter's Landing regional park.

Overgrown weeds at Sutter's Landing regional park.

Trash can overgrown with weeds at Sutter's Landing regional park.

Trash surrounding a trash can along the bike trail at Sutter's Landing regional park.

Broken bench at Sutter's Landing regional park.

Burnt and broken irrigation pipe at vegetation restoration site at Sutter's Landing regional park, following an unplanned fire.

Burned trees after an unplanned fire along the bike trail at Sutter's Landing regional park.

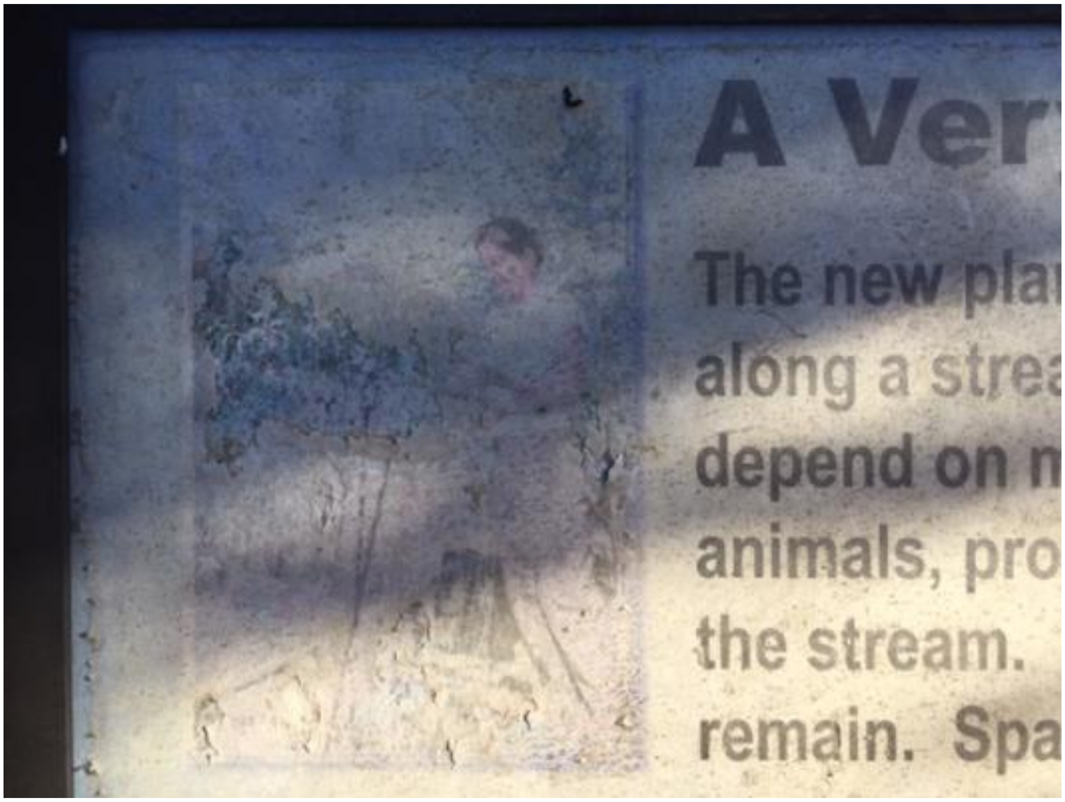
Invasive star-thistle along the bike trail at Sutter's Landing regional park.

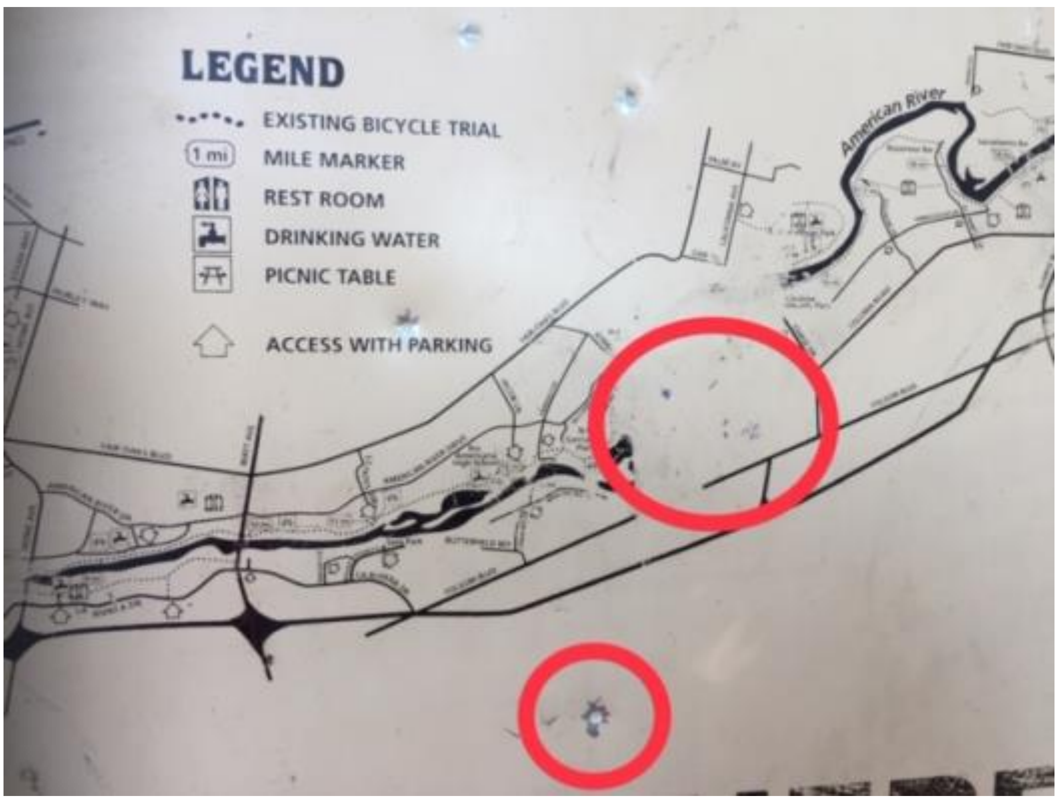
Invasive star-thistle growing in a vegetation restoration site at Sutter's Landing regional park.

Graffiti along the bike trail at Sutter's Landing regional park.

Interpretive signs in extreme disrepair along the bike trail.

Interpretive signs in extreme disrepair along the bike trail.





Interpretive signs in extreme disrepair along the bike trail.

Traffic sign in extreme disrepair along the bike trail.

Vegetation burned in an unplanned fire along the bike trail.

Trash along the bike trail.

Used hypodermic needle on the ground along the bike trail at Sutter's Landing regional park.

Vegetation cleared and trampled along the bike trail.

Campsite along the bike trail at Sutter' Landing regional park.

Campsite along the bike trail at Sacramento Northern Bikeway Trail.

Campsites along the bike trail at Sacramento Northern Bikeway Trail.

Campsite along the bike trail at Sacramento Northern Bikeway Trail.

Campsites along the Two Rivers Trail – Phase I.

Campsites along the Two Rivers Trail – Phase I.

Person defecating along the American River Parkway.