APPENDIX B – CONCEPTUAL ALTERNATIVES

Technical Memorandum

Upper Penitencia Creek Planning Study

Conceptual Alternative Screening Report

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1. Purpose of Report

The purpose of this report is to describe the conceptual alternatives developed for the Upper Penitencia Flood Risk Reduction Project (Project) and to screen the conceptual alternatives against the project objectives, technical feasibility, right-of-way availability, costs constraints and other constraints. This screening process is documented in this report and satisfies the project's level 1 screening and the subsequent decision-making process. Conceptual alternatives that pass the level 1 screening will be identified as feasible alternatives that will undergo further analysis.

2. Problem Definition

The Problem Definition and Refined Objective Report (PDR) showed potential flooding along Upper Penitencia Creek presents a long-term hazard to public safety, property values, and economic stability in the Cities of San Jose and Milpitas. Hydraulic models of the creek have identified more than 9,000 parcels that would likely be subject to flooding in a one-percent event (see Figure 2: Flood Map).

The key problems identified in the PDR are:

- Potential flooding damages.
- Maintain and improve geomorphic stability to maintain conveyance and reduce maintenance activities.
- Maintain and improve continuity and quality of the aquatic habitat and floodplain habitat within the creek corridor.
- Maintain water supply potential.
- Mabury Meander has significant issues:
    - Lowest capacity in project area – historical flooding
    - Significant sediment deposition
    - Tree's dying and falling
    - Farm levee's failing
    - Main channel and bypass connection does not function properly

In determining the key constraints, an important consideration is that Upper Penitencia Creek is a tributary to Coyote Creek and any project that is completed cannot induce flooding in Coyote Creek. That becomes an important factor to consider when screening the alternatives.

3. Project Objectives

Per the SCW Report, the primary goal of the Project (Local funding only) is to acquire all necessary rights-of-way and construct a 1 percent flood protection project from Coyote Creek confluence to King Road. Other project objectives include:

- Secure required property for the full project reach (to Dorel Drive), in anticipation of future federal funding that would allow for construction of the full project.
- Maximize water supply potential.
- Preserve and enhance existing stream natural habitat and fisheries potential.
- Reduce sedimentation and maintenance requirements.
- Identify opportunities to integrate recreation improvements consistent with the City of San Jose and Santa Clara County Parks Master Plan.

It is understood that the planning project must address the flooding problem of the entire watershed (problem reach being from the Coyote Confluence up to Dorel Drive); however, design and construction may be limited to providing protection for the portion downstream of King Road with the understanding that future projects may construct the remaining improvements.

4. Land Ownership (Tri-Party Agreement)

In July 1981, City, District, and County entered into a 25-year joint use agreement for the lands of the Upper Penitencia Creek Park chain, which generally defined the roles of each agency in developing the park chain. In 2006, the County, District, and City renewed the agreement (Tri-Party Agreement) for another 25 years. The Tri-Party Agreement permits the use of lands along Upper Penitencia Creek, from Alum Rock Park to Coyote Creek, for flood management, water conservation, open space, and recreational purposes. The Tri-Party Agreement specifies the follow responsibilities along Upper Penitencia Creek for each jurisdiction:

- County, City, and District agree to cooperate in providing such exchanges or conveyances of real property or easements as will permit the joint use of public-owned lands for parks, recreation, open space, flood management, and water conservation.
- Each jurisdiction shall submit proposed recreational improvement plans on County-, City-, or District owned land to the respective property owner for review and approval.
- The County and City agree to cooperate in the use of County-owned land for flood protection purposes. The District agrees to cooperate in the use of District owned land along for recreational purposes.

- The District shall maintain the natural and constructed channel between the tops of banks of the creek and the recharge facilities for flood control and water conservation purposes in accordance with the applicable property interests.
- The District shall be guided by the plans and principles of the 1977 Master Plan in constructing aesthetically pleasing flood control improvements on District property and minimizing disturbance of the natural stream.

5. Landscape Vision Process

The Project had previously been a joint project with the United States Army Corps of Engineers (USACE). USACE conducted a feasibility study and presented the preferred alternative to the public in 2014. The public rejected the preferred alternative due to the significant impacts of floodwalls and in-channel work. Therefore, the District chose to look into a multi-beneficial project that would include riparian restoration, water supply enhancement, and recreational opportunities in addition to flood risk reduction as the main objectives. After consideration, the USACE decided that the project no longer aligned with its flood protection objective and it was removed from their workplan. The District decided to move forward with local only funding and joined with the San Francisco Estuary Institute (SFEI) to develop a new multi-benefit approach to flood management along Upper Penitencia Creek.

This approach is called the Landscape Vision Process (Vision). The Vision recognizes the creek's complex history, land use, and challenges, and explores a suite of actions that could help meet the flood management objectives while improving ecosystem functions, expanding recreational opportunities, and supporting water supply needs.

The Vision concepts fall into two major types of landscape measures, riparian enhancements and off-channel detention, with opportunities to pursue some of them in multiple places along the creek corridor. The riparian enhancement measures include various new configurations for the creek channel, including levee and berm setbacks, excavation of flood benches, and vegetation management to benefit wildlife. Off-channel detention would expand the flood storage capacity and reduce the peak flows by temporarily storing flood waters in flood basins. The majority of the time the basins will not be inundated and can serve as natural parks or recreational sports fields, depending on the public need.

The Vision Process helped narrow down the conceptual alternatives to a reasonable level. Since many of the alternatives are combinations of the same Vision concepts, the main differences are dependent on the level of protection it provides and whether it includes flood detention or not.

6. Conceptual Alternatives Approach

Due to the Vision, the conceptual alternatives were approached a bit differently than the way it has usually been done in the planning process. The Vision Process already developed multi-objective concepts and therefore there was no need to go through an exhaustive approach in including every possible alternative for the project. The conceptual alternatives rely on a combination of the Vision concepts with some additional concepts included in some. In following the approach of the Vision process, the following are descriptions of the conceptual designs based on the project reaches. The alternatives are described after.

The aim of the conceptual alternative analyses was to investigate all reasonable ideas for meeting the project objectives. With the results of the USACE Feasibility Study and the Vision, the conceptual alternatives were focused on the concepts developed during the Vision and how to combine those to meet the project objectives. Sufficient broad-scale detail has been provided so that the alternative's benefits, impacts, and costs could roughly be determined.

Each conceptual alternative is composed of one or more concepts from the Vision. The alternatives are described as to which concepts makes up the alternative, a short description of how the alternative would work, and descriptions of any environmental benefits and concerns. The conceptual alternatives and how they would function are described in Chapter 10 Conceptual Alternative Descriptions and the alternatives costs are detailed in Appendix A.

Several concepts that were not discussed in the Vision Report but included in the alternative analysis were floodwalls and bypasses (with the exception of using the existing Mabury Bypass as the main channel). Although floodwalls are costly and not welcomed by the community, as was shown by the USACE Feasibility Study, they are very useful where space is limited. There are certain short reaches where floodwalls are being considered due to this limited space. The lengths and heights are being minimized for safety and aesthetic concerns. Bypasses can be very costly as well, but are useful to prevent major impacts to the existing channels. That is why a bypass is being considered in the upper reaches where there are many sycamores and oaks.

The Vision basically eliminated the conceptual idea of upstream storage. The steep and narrow canyons in the upper watershed provide limited opportunities for building reservoirs large enough to provide sufficient storage and, thus, sufficient flood protection. Because large reservoirs cannot be built, several small reservoirs would be required. Access road construction and slope stability would be significant issues associated with any reservoir construction in the study area. Special design requirements as a result of locating a reservoir near the Hayward Fault would add to the level of complexity and increase costs significantly. These construction requirements would likely have significant adverse impacts to the environment, such as loss of habitat and wildlife migration routes. Therefore, this structural measure is not considered viable because of it likely low relative cost-effectiveness and is eliminated. Existing cherry dam – location will not have a significant flow reduction since it is on the Upper Penitencia Creek upper arm, not Arroyo Aguague which is where the majority of the flows come from. There is still issues such as access, impacts, loss of habitat, and costs.

7. Screening Methodology

Screening during the conceptual alternatives phase of the project is defined as Level 1 screening. Level 1 screening focuses on the project objectives, costs, technical feasibility, and right-of-way availability. The Level 1 screening criteria are described below.

Conceptual alternatives must satisfy the following project objectives to be carried forward to the feasible analysis stage:

<u>Flood Protection</u>

Construct a 1 percent flood protection project from Coyote Creek confluence to King Road, at a minimum with the Local only funding. The Planning Project will still include analysis of providing protection for the whole project reach.

<u>Secure Right-of-Way for full Project Reach</u>

Secure required property for the full project reach (to Dorel Drive), in anticipation of future federal funding that would allow for construction of the full project. Right-of-way availability refers to whether the non-District owned right-of-way required by the alternative is at least likely to be available.

<u>Preserve waters supply</u>

Protect current environmental resources, and provide opportunities for environmental enhancements such as stream restoration, trails, parks, and open space.

<u>Does not induce flooding downstream</u>

A typical constraint to almost any flood protection project is that it cannot induce flooding downstream. Even though this is not an objective, it is important to include in the screening criterion especially since Upper Penitencia Creek is a major tributary of Coyote Creek, which currently does not have 100-year protection. Designing the Upper Penitencia Project for a design flow that is greater than the current existing condition flow that is allowed into Coyote Creek during a design event (i.e. 100 year) would potentially induce flooding. During a 100-year event, the project hydraulic modeling shows that the existing capacity of the creek would only allow approximately a 20-year event flow, therefore the project design flow cannot be greater than that. This really complicates the design if we do not include flood detention, which reduces the peak design flows.

Minimize long-term maintenance costs

After screening the alternatives through the project objectives, there was a second tier of screening for: financial feasibility, technical feasibility, and logistical feasibility.

Financial Feasibility

The financial feasibility criterion was used to evaluate whether cost would create an unreasonable barrier to the implementation of the project. Overall, in order to meet the basic project purposes, alternatives must be cost effective to be considered practical.

In November 2012, the voters of Santa Clara County approved the 15-year Safe, Clean Water and Natural Flood Protection Program. This program, which created a countywide special parcel tax, provides $41.9 million (2012 dollars) for the Upper Penitencia Creek Flood Protection Project. Since the cost estimates are not very detailed at the conceptual level, the cut off cost considered for alternative elimination was 1.5 times the budget of $48 million (2018 dollars), which is $72 million.

Technical Feasibility

Technical feasibility indicates if all project elements can be actually built using widely available construction materials and know-how. The technology employed to construct, operate, or maintain an alternative must be adequate to ensure that the basic project purposes can be reasonably met. Reliance on questionable or untested technology would expose the project to substantial risk related to achieving the basic project purposes. To be considered practicable, an alternative must be technically feasible (i.e. whether it would be possible to construct and operate with current engineering technology) and have no significant and unreasonable geotechnical or engineering problems.

Logistical Feasibility

Logistical considerations must be taken into account to ensure that the basic project purposes can be reasonably achieved. Alternatives that involve unreasonable logistical constraints could expose the project to substantial risk related to its ability to achieve the project purposes. Logistical barriers associated with construction, operation, or maintenance could include maintenance costs, timing, legal issues, access, reliability, unreasonable property acquisition, or operation constraints. Overall, an alternative must be logistically feasible considering financial, temporal, and environmental constraints. For the purposes of this analysis, the following logistical feasibility criteria were used for screening purposes:

- No unreasonable constraints relative to acquiring property
- Project is consistent with local land use policies
- No unacceptable community impacts.
- No unacceptable environmental impacts.
- Consistent with the Valley Water Safe, Clean Water Plan and Ends Polices

8. Screening Results

Results of the Level 1 screening analysis concluded that alternatives C, D, F and G do not meet the minimum criteria for further analysis in the feasible alternative phase. The remaining conceptual alternatives (A, B, E, H, and I) will be studied in further detail in the feasible alternatives phase of the Permanente Creek planning study. Table 1 lists the approved alternatives and the rejected alternatives with the basis for their rejection:

Table 1

Alternative Screening Summary

Approved for feasible analysis	Rejected for feasible analysis	Basis for rejection
Alternative A		
Alternative B		
	Alternative C	Does not meet technical/logistical feasibility
	Alternative D	Does not meet technical feasibility and cost criterion
Alternative E		
	Alternative F	Would induce flooding downstream. Does not meet technical feasibility and cost criterion
	Alternative G	Would induce flooding D/S in Coyote Creek
Alternative H		
	Alternative I	Does not meet project objectives (will be included in environmental review for CEQA)

A detailed summary of Level 1 screening results is included in Table 2 below. Note: With the exception of Alternative I, the No Project, all the alternatives meet the main project objectives since the Vision tailored them to meet the objectives. The criteria used for moving the alternatives on to Feasible was cost, technical/logistical feasibility, and whether or not it induces flooding downstream.

Table 2: Conceptual Alternatives Summary Matrix

	provide 1% flood protection from coyote confluence up to king rd an up to 1% for whole project reach?	Secure right of way for full project reach?	Perserve water supply potential?	Enhance/restore existing stream natural habitat and fisheries?	reduce sedimentation and maintenance requirements?	Provide recreational opportunities	alternative meets specific project objectives?	Does it NOT induce flooding downstream - including Coyote creek?	Capital Cost (millions)?	Alternative meets project cost criteria? ($70 million)	Technical Feasability?	Logistical Feasibility?	Continue to Feasibility Phase
A: 100 year with Detention	yes, 1% for whole project reach	yes	yes	yes	yes,	yes, trails and sports fields	yes	yes	$53-60	yes	yes	yes	YES
B: 50 year with Detention	yes, 1% for R1 and 2% for R2 thru R7	yes	yes	yes	yes	yes, trails and sports fields	yes	yes	$43-48	yes	yes	yes	YES
C: 25 year with Detention	yes, 1% for R1 and 4% for R2 thru R7	yes	yes	yes	yes	yes, trails and sports fields	yes	yes	$ 28	yes	no	no	no
D: 100 year with Dam	yes, 1% for whole project reach	yes	yes	yes	yes	yes, trails and sports fields	yes	yes	$ 80	no	yes	no	no
E: 100 year for Reach 1 only	yes, 1% for R1 only	yes	yes	yes	yes	yes, trails	yes	yes	$ 10	yes	yes	yes	YES
F: 100 year with NO Detention	yes, 1% for whole project reach	yes	yes	yes, but the most environmentally impactful alt	yes	yes, trails	yes	no	$ 120	no	no	yes	no
G: 50 year with NO Detention	yes, 1% for R1 and 2% for R2 thru R7	yes	yes	yes	yes	yes, trails	yes	no	$ 90	yes	yes	yes	no
H: 25 Year with NO Detention	yes, 1% for R1 and 4% for R2 thru R7	yes	yes	yes	yes	yes, trails	yes	yes	$ 29	yes	yes	yes	YES
I: No Project	no	no	yes	no	no	no	no	no	$ 5	yes	yes	yes	no

9. Supplemental Information

All of the proposed conceptual alternatives would require, at a minimum, review and approval from the following agencies:

- U.S. Army Corps of Engineers (USACE) – Federal Clean Water Act Section 404 permit.
  Section 404 of the Clean Water Act (CWA) requires USACE authorization for work involving intentional or unintentional placement of fill or discharge of dredged materials into any "waters of the United States."
- Regional Water Quality Control Board – Federal Clean Water Act Section 401 Water Quality Certification (Porter Cologne Act).
  This certificate is required for every federal permit or license for any activity that may result in a discharge into any waters in the United States. Activities include flood control channelization, channel clearing, and placement of fill. Federal CWA Section 401 requires that every applicant for a U.S. Army Corps of Engineers CWA Section 404 permit or Rivers and Harbors Act Section 10 permit must request state certification from the Regional Board that the proposed activity will not violate State and Federal water quality standards. The Regional Board reviews the request for certification and may waive certification, or may recommend either certification or denial of certification to the State Board Executive Director.
- U.S. Fish and Wildlife Service (USFWS) – Federal Endangered Species Act of 1973 (as amended) and Migratory Bird Treaty Act (16 U.S.C. 703 et seq).
  If a project may result in "incidental take" of a listed species, an incidental take permit is required. An incidental take permit allows a non-Federal landowner to proceed with an activity that is legal in all other respects, but that results in "incidental taking" of a listed species (Section 7 consultation if USACE assumes jurisdiction over water body or is involved with funding).
- California Department of Fish and Game (DFG) – California Fish and Game Code Section 1602 Streambed Alternation Agreement
  Fish and Game Code section 1602 requires any person, state or local governmental agency, or public utility to notify the Department before beginning any activity that will do one or more of the following: 1) substantially obstruct or divert the natural flow of a river, stream, or lake; 2) substantially change or use any material from the bed, channel, or bank of a river, stream, or lake; or 3) deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into a river, stream, or lake.
- State Water Resources Control Board (SWRCB) – National Pollutant Discharge Elimination System (NPDES) Construction Permit Notice of Intent
  An NPDES Construction Permit Notice of Intent would be required from SWRCB for any project over 1-acre in size.
- Santa Clara Valley Water District – Stream Maintenance Program
  Operation and maintenance activities would need to be acceptable for incorporation in the Stream Maintenance Program.
- Other construction/building/grading permits required for earthwork, storm water pollution prevention plans, and encroachment on existing rights-of-way would also be required from

various State/local agencies (e.g., Caltrans, City of Mountain View, Santa Clara County Parks and Recreation Department, etc.)

Additionally, depending on proposed designs, the proposed conceptual alternatives may require review and approval from the following agencies:

- California Department of Fish and Game – California Endangered Species Act (Section 2081[b] permit)
  Review regarding State listed threatened and endangered species may be required under California Fish and Game Code 2050.
- State Water Resources Control Board (SWRCB) – Water Rights Permit
  A Water Rights Permit is required when there is intention to take water from a creek for storage or for direct use on non-riparian land. State Board staff will coordinate with the appropriate Regional Water Board to prepare the certification action.
- Santa Clara Valley Water District – Well Construction/Exploratory Boring Permit
  Borings and wells for geotechnical studies would need a permit.

Preliminary environmental review of the conceptual alternatives concluded that there would be no significant environmental impacts that would preclude alternatives from moving forward into the feasible alternative analysis phase. Therefore, potential environmental impacts were not used to screen conceptual alternatives. Results of the preliminary environmental review are included in the descriptions of the conceptual alternatives.

10. Conceptual Alternative Descriptions

As mentioned in chapter 6, the alternatives consist of combinations of concepts developed mainly during the Vision. The following are descriptions of each alternative detailing the conceptual design, in a reach by reach basis, followed by further descriptions of how the alternatives will work and environmental benefits and concerns. For each alternative, there is a layout map summarizing the design work through the project reaches plus a flow schematic detailing the flows through the riverine system. There are also general cross sections and plan views of the concepts.

Table 3 summarizes the work needed for each alternative in a reach by reach basis. As noted in chapter 6, much of the work is similar or the same for many alternatives. Such as in the detention alternatives, A through D, the design flow would be reduced to the 20-year event (approximately 2000cfs) and the design would be the same for reaches 1 through 6 for those alternatives.

Figure 1 shows how the project is broken into the following reaches:

Reach 1- Coyote Creek confluence up to King Road

Reach 2 – King Road up to Jackson Avenue

Reach 3 – Jackson Avenue up Capitol Avenue

Reach 4 – Capitol Avenue up to Viceroy Way/Penitencia Creek Road

Reach 5 – Viceroy Way/Penitencia Creek Road up to Piedmont Road

Reach 6 – Piedmont Road up to Noble Avenue

Reach 7 – Noble Avenue up to Dorel Drive

Conceptual Alternative A

<u>Alternative Description</u>

Figures 3 and 4 lay out Alternative A along each reach. This alternative combines off stream flow detention, channel widening with riparian restoration and bypass(es) concepts to increase capacity such that existing and restored channel reaches can convey 100 year flows safely downstream. Figure 5 is a flow schematic detailing the design peak flows through the system.

For Alternative A, there are three options included for Reaches 6 and 7:
Option A1 – channel widening with riparian restoration (Figure 34)
Option A2 – Bypass under Penitencia Creek Road (Figure 34)
Option A3 – No work: allow reaches to flood (collect flood flows along Toyon Rd)

The following descriptions summarize the concepts reach by reach:

Reach 1

The conceptual design involves channel widening with riparian enhancements. Figures 27 & 28 show the potential designs for segment 1A.

1A – Coyote confluence up to the BART/VTA track bridge (Length: 2000 ft)

The existing channel is approximately 10 feet deep and the width varies from 60 to 90 feet bank to bank. Figures 27 and 28 show the three different designs being considered for this segment. Design 1 would widen the existing channel to the south by excavating the south bank and adjacent ground to create a lowered "flood bench" at approximately the bankfull elevation. The meandering low flow channel would be designed for optimal sediment transportation and the flood benches would be planted with native vegetation and designed with passive recreational use. Design 2 is similar except the flood benches would be terraced to allow flooding on terraces only at and above specific flow events. Design 3 would leave the south bank in place and create a bypass along the south side of the existing channel. The bypass would be a trapezoidal earth channel planted with native vegetation and the existing creek would be allowed to "naturally" merge with the bypass to create its own floodway and floodplain.

1B – BART/VTA track bridge up 500ft downstream of King Road (Length: 1000 ft)

This segment along the BART/VTA station will be left as is.

1C – 500ft downstream of King Road up to King Road (Length: 500 feet)

Upstream of the BART station, the existing channel would be widened to the south bank with a flood bench about 30feet. Impacts would include existing vegetation and maintenance road removal, but a new maintenance road and trail would be added plus native vegetation would be planted.

King Road would be expanded to contain the design flow, either through constructing wider bridge or boring culverts adjacent to existing culvert (details will be determined in Feasibility stage).

Reach 2

King Road to the Downstream end of the Mabury Bypass

As mentioned above, King Road would have to be widened to increase the capacity the design flow. Some minor levees along this section may be necessary to contain the design flow, depending on the design of King Road (details will be determined in Feasibility stage).

Mabury Bypass

The most significant aspect of the alternative in Reach 2 is converting the Mabury Bypass to the main channel. The lower flows will be diverted into the Mabury Bypass (diversion will be in Reach 3) while the existing main channel will be used for higher flows. The capacity of the Mabury Bypass will be increased to 1200 cfs with 2 to 3-foot berms along the south bank adjacent to Mabury Road and north bank adjacent to Cape Horn Drive (see Figure 29).

Downstream end of Mabury bypass up to Jackson Road

The existing channel will be kept as is, for the most part. Some minor work such as existing levee enhancements, repairing the existing Mabury Bypass connection and erosion repairs will be completed in order to sustain a capacity of 900 cfs in the main reach for the higher flow events.

Reach 3

Jackson Avenue up to Highway 680

Optimization of the Mabury bypass will be done in this reach – just upstream of the Jackson Road culvert. There are three extra box culverts at Jackson currently not in use, these will connect the upstream and downstream Mabury Bypass reaches. As mentioned in the Reach 2 description, the Mabury bypass will be used as the primary channel with low flows, while the existing main channel will be used to increase capacity during high flow events. More details will be developed during the feasibility phase.

Downstream of Highway 680, the existing riparian corridor consist of low flow meandering channel with floodplains along the existing public right of way. This configuration would be optimized with some excavation along the floodplain and setback levees to contain the design flow and allow the floodplain to inundate under design flows; decreasing downstream flood impacts and increasing refuge habitat for fish during flood events. The diversion of the flows to the Mabury Bypass would occur here, just upstream of Jackson Avenue. The flow split structure would be optimized to allow the lower flows to the bypass and during large events higher flows would be conveyed through the main channel in Reach 2 to prevent flooding.

At Highway 680, large woody debris and cobble/boulder features would be placed within the channel near Highway 680 underpass to increase velocity refuge and cover habitat for steelhead and other fish as well as increasing sediment deposition and overall habitat complexity.

Highway 680 up to Capitol Avenue

Upstream of Highway 680, the existing channel would be left as is and set back levees would be placed at the ends of the existing public right of way to contain higher flow. Some excavation of the floodplain in the public right of way would be done to optimize flow capacity but there will be minimal impacts to the natural vegetation. The setback levees would be approximately 2 to 3 feet high. See figure 30.

Reach 4

Only minor in channel work would be needed to contain the design flow, which would be minimal levees mainly just upstream of Capitol Avenue and approximately 500 feet of levees along both banks around the middle of the reach. See Figure 31.

An off-stream detention facility would be created on a parcel of land owned by the County of Santa Clara. The detention facility would provide temporary storage during high intensity flood events. The average depth of the 13-acre detention site would be 10 feet, producing approximately 130 ac-ft of storage volume. The site would only get flooded during high flow events, so the site would be designed with recreational sports fields to be used by the public most of the time as well as park land with native trees and shrubs. Figure 39 shows the conceptual layout of the detention facility and Figure 35 shows a typical section along the proposed basin and creek.

Reach 5

Channel work includes a floodwall on the south bank along Penitencia Creek Road, approximately 4 feet high. It would be for approximately 700 linear feet from the Penitencia Creek Road Culvert up to Kyle Street. See Figure 32 for a typical section.

A small pedestrian bridge would have to be expanded/replaced.

An off-stream detention facility would be created at the Penitencia Creek City Park, located on property owned by both the City of San Jose and the County of Santa Clara. The average depth of the 20-acre detention facility would be 10 feet, producing approximately 200 ac-ft of storage volume. The site would be designed with recreational sports fields for the public use as well park land with native trees. Figure 40 shows the conceptual layout of the detention facility and Figure 36 shows a typical section along the creek and proposed basin.

Reach 6

Channel work would be required through out most of the reach, this is even with reduction of flows with detention. This would be a combination of levees on the south bank along Penitencia Creek Road and channel widening and channel widening on the north side of the channel. The levees would be up to 3 feet high and widening up to 20 feet wide. The widening would include excavation for a flood bench, which means there would be some removal of vegetation but there would also be native vegetation planted along the flood bench. See figure 33 for a typical section.

An off-stream detention facility would be created at the District's Water Supply Gross Ponds, located on District land. The average depth of the 8-acre detention facility would be 10 feet, producing approximately 80 ac-ft of storage volume. In order to build the detention facility, there would be some loss to the existing water supply ponds. To mitigate for that loss, the water supply ponds would be expanded to the north at the site but on City land. Figure 41 shows the conceptual layout of the detention facility and Figure 37 shows a typical section along the creek and proposed basin.

Reach 7

Reach 7 is a 1500-foot-long natural channel with many sycamore and oak trees from Noble Avenue up to Dorel Drive. The Noble Diversion is along the north bank about 200 feet upstream of Noble Bridge, the design would include modifying the Diversion to act as an overflow spill that will lead the higher flows to the Gross Ponds detention facility. There are three options considered for the rest of the reach (See Figure 34):

1. Channel widening with riparian restoration: The channel would be widened towards the north side by creating a flood bench (approximately 80ft wide) at about the 2-year event depth, the lower flows would flow through the low flow channel while the higher flows would flow over onto the flood bench. The flood bench would be fully vegetated with native plants and trees such as sycamores, willows, and oaks. The impacts would include the excavation of the existing channel with vegetation removal.
2. Underground Bypass: The 2nd option would be to construct a 10-foot bypass underneath Upper Penitencia Creek Road to carry the higher flows. There would still be some minor levees/floodwalls needed for short stretches of the creek but overall there would not be much impact to the creek itself.
3. No Work: The 3rd option is to not do any work along Reach 7. The current capacity is between 10- and 25-year event, so it would flood above these events. A flow interceptor/collector could be built further downstream along Toyon Road to intercept the flood flows to prevent flooding further west on the south side of the creek. On the north side, flood would be collected at the Noble Bridge and directed to the detention facilities.

The alternative includes extending the Penitencia Creek trail from Dorel Drive up to Alum Rock park to connect the existing trails.

Operation and Maintenance (O&M)

Existing O&M activities are expected to continue in the existing channel where the District has right of way. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance of the bypasses would be minimal. The bypass culverts would be designed to have adequate slope for sediment control.

Operation and maintenance of the widened channels with riparian restoration would be minimal. Vegetation and sediment would be expected to be self-maintaining after the vegetation establishment period. Hazard tree falls and bank failures would still need to be repaired.

Technical and Logistical Feasibility

All the alternative concepts are technically and logistically feasible. Some specialized design assistance may be necessary for the detailed design of the widened creek with the meandering low flow channel and flood benches for higher flows. Although the detention basins are technically and logistically feasible, they will be developed in further details in the feasibility phase to determine the best inlet, outlet, and basin design.

Land Ownership and Access

As mentioned in chapter 4, there is the Tri-Party agreement that helps facilitate working with the District partners, the County and the City, to use the public lands for the Project. This is especially useful for the detention facilities since the majority of that work will be on City or County property. The project team has been coordinating and meeting with the partners throughout the planning phase.

The channel expansion in Reach 1 will be on private property, what use to be the Flea Market. The project team has been working with the City and the land developer to get a fee and easement for a portion of land along the riparian corridor to use for flood protection purposes.

The Reach 7 bypass would be constructed within the existing Penitencia Creek Road right-of-way. Construction of the bypass would require right-of-way easements from the City of San Jose. This would be the same for the flood flow collection system along Toyon Road.

Costs

Capital cost for the entire alternative would be $49,000,000.

Yearly maintenance cost would be $140,000.

Preliminary Environmental Review

- **Biological Resources:**
  The new riparian corridor created under the channel widening with riparian restoration concept would provide roosting, nesting, and foraging habitat for riparian-dependent birds, and could facilitate wildlife movement from Coyote Creek up to Alum Rock Park.

Native amphibian species could also be more successful in the lower reaches of the watershed.
Construction activities may result in temporary disturbance or direct mortality of wildlife. Construction for channel widening and inlet/outlet structures of the detention basins and bypasses may result in habitat loss or degradation of small areas of wetland and riparian habitat that could support special-status species, migratory birds, and common wildlife species. The construction of the inlets/outlets removal may result in the permanent loss of roosting, nesting, and foraging habitat for migratory birds and common wildlife species. However, the channel widening will include riparian enhancements to restore these resources. Construction activities may also result in temporary disturbance of nesting raptors and other birds that use adjacent habitat for roosting or nesting.

- **Geology and Soils:**
  Principal concerns would relate to the need for appropriate earthwork design to ensure slope stability during construction and stabilization of newly contoured and constructed surfaces until vegetation establishes. Appropriate site-specific engineering geologic and geotechnical studies would address both these concerns.
  Another concern would relate to sediment load as a factor in hydraulic/geomorphic function in the modified creek. The landscape management and channel restoration concepts will help with the movement of the sediment load through the riverine system.

- **Recreation:**
  The Penitencia Creek trail would be restored anywhere the project impacts it. Plus, the existing trail would be extended from King Road down to the Coyote Creek confluence to connect to the Coyote Creek trail. At the upstream end, the Penitencia Creek Trail would be extended from Dorel Drive up to connect to the Alum Rock Park trail system. This will create a continuous trail system from Coyote creek up to Alum Rock Park. The detention facility at the County property in reach 4 would provide recreational opportunities for the surrounding communities with the construction of athletic fields. The detention facility at the City park along reach 5 would also include construction of athletic fields to provide additional recreation opportunities for the public.

- **Traffic:**
  Construction activities (such as equipment operation, staging, materials transport, spoils disposal, and similar or related activities) and construction-related traffic would temporarily affect traffic on streets in and adjacent to construction areas during the construction period. The alternative would result in large amounts of spoils materials due to excavation of existing soil in the channels, adjacent ground, and detention sites. Additionally, construction of new underground culverts could limit use of affected

roadways, sidewalks, and bike lanes during construction. Traffic using bridges in the project area could be affected by construction activities.

- **Note:**
  The following will be described in the feasibility stage: aesthetics, hazardous material, land use, public services and utilities, and cultural resources.

<u>Screening Analysis</u>

Design, construction, operation, and maintenance of this alternative would be technically feasible and availability of public land for the proposed alternative would be sufficient to move into the feasible alternative stage of the Project. The estimated capital cost of the alternative is within the acceptable limit for further consideration and review as a feasible alternative.

Conceptual Alternative B

Figures 6 and 7 lay out Alternative B along each reach. This alternative combines off stream flow detention, channel widening with riparian restoration and bypass(es) concepts to increase capacity such that existing and restored channel reaches can convey 50-year flows safely downstream. Figure 8 is a flow schematic detailing the design peak flows through the system.

For Alternative B, there are three options included for Reaches 6 and 7:
Option B1 – channel widening with riparian restoration (Figure 34)
Option B2 – Bypass under Penitencia Creek Road (Figure 34)
Option B3 – No work: allow reaches to flood (collect flood flows along Toyon Rd

The following descriptions summarize the concepts reach by reach:

Reach 1

The conceptual design involves channel widening with riparian enhancements. Figures 27 & 28 show the potential designs for segment 1A.

<u>1A – Coyote confluence up to the BART/VTA track bridge (Length: 2000 ft)</u>

The existing channel is approximately 10 feet deep and the width varies from 60 to 90 feet bank to bank. Figures 27 and 28 show the three different designs being considered for this segment. Design 1 would widen the existing channel to the south by excavating the south bank and adjacent ground to create a lowered “flood bench” at approximately the bankfull elevation. The meandering low flow channel would be designed for optimal sediment transportation and the flood benches would be planted with native vegetation and designed with passive recreational use. Design 2 is similar except the flood benches would be terraced to allow flooding on terraces only at and above specific flow events. Design 3 would leave the south bank in place and create a bypass along the south side of the existing channel. The bypass would be a trapezoidal earth channel planted with native vegetation and the existing creek would be allowed to "naturally" merge with the bypass to create its own floodway and floodplain.

<u>1B – BART/VTA track bridge up 500ft downstream of King Road (Length: 1000 ft)</u>

This segment along the BART/VTA station will be left as is.

<u>1C – 500ft downstream of King Road up to King Road (Length: 500 feet)</u>

Upstream of the BART station, the existing channel would be widened to the south bank with a flood bench about 30 feet. Impacts would include existing vegetation and maintenance road removal, but a new maintenance road and trail would be added plus native vegetation would be planted.

King Road would be expanded to contain the design flow, either through constructing wider bridge or boring culverts adjacent to existing culvert (details will be determined in Feasibility stage).

Reach 2

<u>King Road to the Downstream end of the Mabury Bypass</u>

As mentioned above, King Road would have to be widened to increase the capacity the design flow. Some minor levees along this section may be necessary to contain the design flow, depending on the design of King Road (details will be determined in Feasibility stage).

<u>Mabury Bypass</u>

The most significant aspect of the alternative in Reach 2 is converting the Mabury Bypass to the main channel. The lower flows will be diverted into the Mabury Bypass (diversion will be in Reach 3) while the existing main channel will be used for higher flows. The capacity of the Mabury Bypass will be increased to 1200 cfs with 2 to 3-foot berms along the south bank adjacent to Mabury Road and north bank adjacent to Cape Horn Drive (see Figure 29).

<u>Downstream end of Mabury bypass up to Jackson Road</u>

The existing channel will be kept as is, for the most part. Some minor work such as existing levee enhancements, repairing the existing Mabury Bypass connection and erosion repairs will be completed in order to sustain a capacity of 900 cfs in the main reach for the higher flow events.

Reach 3

Jackson Avenue up to Highway 680

Optimization of the Mabury bypass will be done in this reach – just upstream of the Jackson Road culvert. There are three extra box culverts at Jackson currently not in use, these will connect the upstream and downstream Mabury Bypass reaches. As mentioned in the Reach 2 description, the Mabury bypass will be used as the primary channel with low flows, while the existing main channel will be used to increase capacity during high flow events. More details will be developed during the feasibility phase.

Downstream of Highway 680, the existing riparian corridor consist of low flow meandering channel with floodplains along the existing public right of way. This configuration would be optimized with some excavation along the floodplain and setback levees to contain the design flow and allow the floodplain to inundate under design flows; decreasing downstream flood impacts and increasing refuge habitat for fish during flood events. The diversion of the flows to the Mabury Bypass would occur here, just upstream of Jackson Avenue. The flow split structure would be optimized to allow the lower flows to the bypass and during large events higher flows would be conveyed through the main channel in Reach 2 to prevent flooding.

At Highway 680, large woody debris and cobble/boulder features would be placed within the channel near Highway 680 underpass to increase velocity refuge and cover habitat for steelhead and other fish as well as increasing sediment deposition and overall habitat complexity.

Highway 680 up to Capitol Avenue

Upstream of Highway 680, the existing channel would be left as is and set back levees would be placed at the ends of the existing public right of way to contain higher flow. Some excavation of the floodplain in the public right of way would be done to optimize flow capacity but there will be minimal impacts to the natural vegetation. The setback levees would be approximately 2 to 3 feet high. See figure 30.

Reach 4

Only minor in channel work would be needed to contain the design flow, which would be minimal levees mainly just upstream of Capitol Avenue and approximately 500 feet of levees along both banks around the middle of the reach. See Figure 31.

An off-stream detention facility would be created on a parcel of land owned by the County of Santa Clara. The detention facility would provide temporary storage during high intensity flood events. The average depth of the 13-acre detention site would be 10 feet, producing approximately 130 ac-ft of storage volume. The site would only get flooded during high flow events, so the site would be designed with recreational sports fields to be used by the public most of the time as well as park land with native trees and shrubs. Figure 39 shows the conceptual layout of the detention facility and Figure 35 shows a typical section along the proposed basin and creek.

Reach 5

Channel work includes a floodwall on the south bank along Penitencia Creek Road, approximately 4 feet high. It would be for approximately 700 linear feet from the Penitencia Creek Road Culvert up to Kyle Street. See Figure 32 for a typical section.

A small pedestrian bridge would have to be expanded/replaced.

An off-stream detention facility would be created at the Penitencia Creek City Park, located on property owned by both the City of San Jose and the County of Santa Clara. The average depth of the 20-acre detention facility would be 10 feet, producing approximately 200 ac-ft of storage volume. The site would be designed with recreational sports fields for the public use as well park land with native trees. Figure 40 shows the conceptual layout of the detention facility and Figure 36 shows a typical section along the creek and proposed basin.

Reach 6

Channel work would be required throughout most of the reach, this is even with reduction of flows with detention. This would be a combination of levees on the south bank along Penitencia Creek Road and channel widening and channel widening on the north side of the channel. The levees would be up to 3 feet high and widening up to 20 feet wide. The widening would include excavation for a flood bench, which means there would be some removal of vegetation but there would also be native vegetation planted along the flood bench. See figure 33 for a typical section.

An off-stream detention facility would be created at the District's Water Supply Gross Ponds, located on District land. The average depth of the 8-acre detention facility would be 10 feet, producing approximately 80 ac-ft of storage volume. In order to build the detention facility, there would be some loss to the existing water supply ponds. To mitigate for that loss, the water supply ponds would be expanded to the north at the site but on City land. Figure 41 shows the conceptual layout of the detention facility and Figure 37 shows a typical section along the creek and proposed basin.

Reach 7

Reach 7 is a 1500-foot-long natural channel with many sycamore and oak trees from Noble Avenue up to Dorel Drive. The Noble Diversion is along the north bank about 200 feet upstream of Noble Bridge, the design would include modifying the Diversion to act as an overflow spill that will lead the higher flows to the Gross Ponds detention facility. There are three options considered for the rest of the reach (See Figure 34):

1. Channel widening with riparian restoration: The channel would be widened towards the north side by creating a flood bench (approximately 65ft wide) at about the 2-year event depth, the lower flows would flow through the low flow channel while the higher flows would flow over onto the flood bench. The flood bench would be fully vegetated with native plants and trees such as sycamores, willows, and oaks. The impacts would include the excavation of the existing channel with vegetation removal.
2. Underground Bypass: The 2nd option would be to construct a 8-foot bypass underneath Upper Penitencia Creek Road to carry the higher flows. There would still be some minor levees/floodwalls needed for short stretches of the creek but overall there would not be much impact to the creek itself.
3. No Work: The 3rd option is to not do any work along Reach 7. The current capacity is between 10- and 25-year event, so it would flood above these events. A flow interceptor/collector could be built further downstream along Toyon Road to intercept the flood flows to prevent flooding further west on the south side of the creek. On the north side, flood would be collected at the Noble Bridge and directed to the detention facilities.

The alternative includes extending the Penitencia Creek trail from Dorel Drive up to Alum Rock park to connect the existing trails.

Operation and Maintenance (O&M)

Existing O&M activities are expected to continue in the existing channel where the District has right of way. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance of the bypasses would be minimal. The bypass culverts would be designed to have adequate slope for sediment control.

Operation and maintenance of the widened channels with riparian restoration would be minimal. Vegetation and sediment would be expected to be self-maintaining after the vegetation establishment period. Hazard tree falls and bank failures would still need to be repaired.

Technical and Logistical Feasibility

All the alternative concepts are technically and logistically feasible. Some specialized design assistance may be necessary for the detailed design of the widened creek with the meandering low flow channel and flood benches for higher flows. Although the detention basins are technically and logistically feasible, they will be developed in further details in the feasibility phase to determine the best inlet, outlet, and basin design.

Land Ownership and Access

As mentioned in chapter 4, there is the Tri-Party agreement that helps facilitate working with the District partners, the County and the City, to use the public lands for the Project. This is especially useful for the detention facilities since the majority of that work will be on City or County property. The project team has been coordinating and meeting with the partners throughout the planning phase.

The channel expansion in Reach 1 will be on private property, what use to be the Flea Market. The project team has been working with the City and the land developer to get a fee and easement for a portion of land along the riparian corridor to use for flood protection purposes.

The Reach 7 bypass would be constructed within the existing Penitencia Creek Road right-of-way. Construction of the bypass would require right-of-way easements from the City of San Jose. This would be the same for the flood flow collection system along Toyon Road.

Costs

Capital cost for the entire alternative would be $40,000,000.

Yearly maintenance cost would be $90,000.

Preliminary Environmental Review

- **Biological Resources:**
  The new riparian corridor created under the channel widening with riparian restoration concept would provide roosting, nesting, and foraging habitat for riparian-dependent birds, and could facilitate wildlife movement from Coyote Creek up to Alum Rock Park. Native amphibian species could also be more successful in the lower reaches of the watershed.
  Construction activities may result in temporary disturbance or direct mortality of wildlife. Construction for channel widening and inlet/outlet structures of the detention basins and bypasses may result in habitat loss or degradation of small areas of wetland and riparian habitat that could support special-status species, migratory birds, and common wildlife species. The construction of the inlets/outlets removal may result in the permanent loss of roosting, nesting, and foraging habitat for migratory birds and common wildlife species. However, the channel widening will include riparian enhancements to restore these resources. Construction activities may also result in temporary disturbance of nesting raptors and other birds that use adjacent habitat for roosting or nesting.

- **Geology and Soils:**
  Principal concerns would relate to the need for appropriate earthwork design to ensure slope stability during construction and stabilization of newly contoured and constructed surfaces until vegetation establishes. Appropriate site-specific engineering geologic and geotechnical studies would address both these concerns.

Another concern would relate to sediment load as a factor in hydraulic/geomorphic function in the modified creek. The landscape management and channel restoration concepts will help with the movement of the sediment load through the riverine system.

- **Recreation:**
  The Penitencia Creek trail would be restored anywhere the project impacts it. Plus, the existing trail would be extended from King Road down to the Coyote Creek confluence to connect to the Coyote Creek trail. At the upstream end, the Penitencia Creek Trail would be extended from Dorel Drive up to connect to the Alum Rock Park trail system. This will create a continuous trail system from Coyote creek up to Alum Rock Park. The detention facility at the County property in reach 4 would provide recreational opportunities for the surrounding communities with the construction of athletic fields. The detention facility at the City park along reach 5 would also include construction of athletic fields to provide additional recreation opportunities for the public.

- **Traffic:**
  Construction activities (such as equipment operation, staging, materials transport, spoils disposal, and similar or related activities) and construction-related traffic would temporarily affect traffic on streets in and adjacent to construction areas during the construction period. The alternative would result in large amounts of spoils materials due to excavation of existing soil in the channels, adjacent ground, and detention sites. Additionally, construction of new underground culverts could limit use of affected roadways, sidewalks, and bike lanes during construction. Traffic using bridges in the project area could be affected by construction activities.

- **Note:**
  The following will be described in the feasibility stage: aesthetics, hazardous material, land use, public services and utilities, and cultural resources.

Screening Analysis

Design, construction, operation, and maintenance of this alternative would be technically feasible and availability of public land for the proposed alternative would be sufficient to move into the feasible alternative stage of the Project. The estimated capital cost of the alternative is within the acceptable limit for further consideration and review as a feasible alternative.

Conceptual Alternative C

Figures 9 and 10 lay out Alternative C along each reach. This alternative combines off stream flow detention, channel widening with riparian restoration and bypass(es) concepts to increase capacity such that existing and restored channel reaches can convey 25-year flows safely downstream. Figure 11 is a flow schematic detailing the design peak flows through the system.

For Alternative C, there are three options included for Reaches 6 and 7:
Option A1 – channel widening with riparian restoration (Figure 34)
Option A2 – Bypass under Penitencia Creek Road (Figure 34)
Option A3 – No work: allow reaches to flood (collect flood flows along Toyon Rd

The following descriptions summarize the concepts reach by reach:

Reach 1

The conceptual design involves channel widening with riparian enhancements. Figure 27 & 28 show the potential designs for segment 1A.

<u>1A – Coyote confluence up to the BART/VTA track bridge (Length: 2000 ft)</u>

The existing channel is approximately 10 feet deep and the width varies from 60 to 90 feet bank to bank. Figures 27 and 28 show the three different designs being considered for this segment. Design 1 would widen the existing channel to the south by excavating the south bank and adjacent ground to create a lowered "flood bench" at approximately the bankfull elevation. The meandering low flow channel would be designed for optimal sediment transportation and the flood benches would be planted with native vegetation and designed with passive recreational use. Design 2 is similar except the flood benches would be terraced to allow flooding on terraces only at and above specific flow events. Design 3 would leave the south bank in place and create a bypass along the south side of the existing channel. The bypass would be a trapezoidal earth channel planted with native vegetation and the existing creek would be allowed to "naturally" merge with the bypass to create its own floodway and floodplain.

<u>1B – BART/VTA track bridge up 500ft downstream of King Road (Length: 1000 ft)</u>

This segment along the BART/VTA station will be left as is.

<u>1C – 500ft downstream of King Road up to King Road (Length: 500 feet)</u>

Upstream of the BART station, the existing channel would be widened to the south bank with a flood bench about 30feet. Impacts would include existing vegetation and maintenance road removal, but a new maintenance road and trail would be added plus native vegetation would be planted.

King Road would be expanded to contain the design flow, either through constructing wider bridge or boring culverts adjacent to existing culvert (details will be determined in Feasibility stage).

Reach 2

King Road to the Downstream end of the Mabury Bypass

As mentioned above, King Road would have to be widened to increase the capacity the design flow. Some minor levees along this section may be necessary to contain the design flow, depending on the design of King Road (details will be determined in Feasibility stage).

Mabury Bypass

The most significant aspect of the alternative in Reach 2 is converting the Mabury Bypass to the main channel. The lower flows will be diverted into the Mabury Bypass (diversion will be in Reach 3) while the existing main channel will be used for higher flows. The capacity of the Mabury Bypass will increase to 1200 cfs with 2 to 3 foot berms along the south bank adjacent to Mabury Road and north bank adjacent to Cape Horn Drive (see Figure 29).

Downstream end of Mabury bypass up to Jackson Road

The existing channel will be kept as is, for the most part. Some minor work such as existing levee enhancements, repairing the existing Mabury Bypass connection and erosion repairs will be completed in order to sustain a capacity of 900 cfs in the main reach for the higher flow events.

Reach 3

Jackson Avenue up to Highway 680

Optimization of the Mabury bypass will be done in this reach – just upstream of the Jackson Road culvert. There are three extra box culverts at Jackson currently not in use, these will connect the upstream and downstream Mabury Bypass reaches. As mentioned in the Reach 2 description, the Mabury bypass will be used as the primary channel with low flows, while the existing main channel will be used to increase capacity during high flow events. More details will be developed during the feasibility phase.

Downstream of Highway 680, the existing riparian corridor consist of low flow meandering channel with floodplains along the existing public right of way. This configuration would be optimized with some excavation along the floodplain and setback levees to contain the design flow and allow the floodplain to inundate under design flows; decreasing downstream flood impacts and increasing refuge habitat for fish during flood events. The diversion of the flows to the Mabury Bypass would occur here, just upstream of Jackson Avenue. The flow split structure would be optimized to allow the lower flows to the bypass and during large events higher flows would be conveyed through the main channel in Reach 2 to prevent flooding.

At Highway 680, large woody debris and cobble/boulder features would be placed within the channel near Highway 680 underpass to increase velocity refuge and cover habitat for steelhead and other fish as well as increasing sediment deposition and overall habitat complexity.

Highway 680 up to Capitol Avenue

Upstream of Highway 680, the existing channel would be left as is and set back levees would be placed at the ends of the existing public right of way to contain higher flow. Some excavation of the floodplain in the public right of way would be done to optimize flow capacity but there will be minimal impacts to the natural vegetation. The setback levees would be approximately 2 to 3 feet high. See figure 30.

Reach 4

Only minor in channel work would be needed to contain the design flow, which would be minimal levees mainly just upstream of Capitol Avenue and approximately 500 feet of levees along both banks around the middle of the reach. See Figure 31.

An off-stream detention facility would be created on a parcel of land owned by the County of Santa Clara. The detention facility would provide temporary storage during high intensity flood events. The average depth of the 13-acre detention site would be 10 feet, producing approximately 130 ac-ft of storage volume. The site would only get flooded during high flow events, so the site would be designed with recreational sports fields to be used by the public most of the time as well as park land with native trees and shrubs. Figure 39 shows the conceptual layout of the detention facility and Figure 35 shows a typical section along the proposed basin and creek.

Reach 5

Channel work includes a floodwall on the south bank along Penitencia Creek Road, approximately 4 feet high. It would be for approximately 700 linear feet from the Penitencia Creek Road Culvert up to Kyle Street. See Figure 32 for a typical section.

A small pedestrian bridge would have to be expanded/replaced.

An off-stream detention facility would be created at the Penitencia Creek City Park, located on property owned by both the City of San Jose and the County of Santa Clara. The average depth of the 20-acre detention facility would be 10 feet, producing approximately 200 ac-ft of storage volume. The site would be designed with recreational sports fields for the public use as well park land with native trees. Figure 40 shows the conceptual layout of the detention facility and Figure 36 shows a typical section along the creek and proposed basin.

Reach 6

Channel work would be required throughout most of the reach, this is even with reduction of flows with detention. This would be a combination of levees on the south bank along Penitencia Creek Road and channel widening and channel widening on the north side of the channel. The levees would be up to 3 feet high and widening up to 20 feet wide. The widening would include excavation for a flood bench, which means there would be some removal of vegetation but there would also be native vegetation planted along the flood bench. See figure 33 for a typical section.

An off-stream detention facility would be created at the District's Water Supply Gross Ponds, located on District land. The average depth of the 8-acre detention facility would be 10 feet, producing approximately 80 ac-ft of storage volume. In order to build the detention facility, there would be some loss to the existing water supply ponds. To mitigate for that loss, the water supply ponds would be expanded to the north at the site but on City land. Figure 41 shows the conceptual layout of the detention facility and Figure 37 shows a typical section along the creek and proposed basin.

Reach 7

Reach 7 is a 1500-foot-long natural channel with many sycamore and oak trees from Noble Avenue up to Dorel Drive. The Noble Diversion is along the north bank about 200 feet upstream of Noble Bridge, the design would include modifying the Diversion to act as an overflow spill that will lead the higher flows to the Gross Ponds detention facility. There are three options considered for the rest of the reach (See Figure 34):

1. Channel widening with riparian restoration: The channel would be widened towards the north side by creating a flood bench (approximately 50ft wide) at about the 2-year event depth, the lower flows would flow through the low flow channel while the higher flows would flow over onto the flood bench. The flood bench would be fully vegetated with native plants and trees such as sycamores, willows, and oaks. The impacts would include the excavation of the existing channel with vegetation removal.
2. Underground Bypass: The 2nd option would be to construct a 6-foot bypass underneath Upper Penitencia Creek Road to carry the higher flows. There would still be some minor levees/floodwalls needed for short stretches of the creek but overall there would not be much impact to the creek itself.
3. No Work: The 3rd option is to not do any work along Reach 7. The current capacity is between 10- and 25-year event, so it would flood above these events. A flow interceptor/collector could be built further downstream along Toyon Road to intercept the flood flows to prevent flooding further west on the south side of the creek. On the north side, flood would be collected at the Noble Bridge and directed to the detention facilities.

The alternative includes extending the Penitencia Creek trail from Dorel Drive up to Alum Rock park to connect the existing trails.

Operation and Maintenance (O&M)

Existing O&M activities are expected to continue in the existing channel where the District has right of way. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance of the bypasses would be minimal. The bypass culverts would be designed to have adequate slope for sediment control.

Operation and maintenance of the widened channels with riparian restoration would be minimal. Vegetation and sediment would be expected to be self-maintaining after the vegetation establishment period. Hazard tree falls and bank failures would still need to be repaired.

Technical and Logistical Feasibility

Although the alternative is technically feasible, there would be significant amount of work needed for the detention facilities for very limited flow reduction since it is only looking at 25-year protection.

Land Ownership and Access

As mentioned in chapter 4, there is the Tri-Party agreement that helps facilitate working with the District partners, the County and the City, to use the public lands for the Project. This is especially useful for the detention facilities since the majority of that work will be on City or County property. The project team has been coordinating and meeting with the partners throughout the planning phase.

The channel expansion in Reach 1 will be on private property, what use to be the Flea Market. The project team has been working with the City and the land developer to get a fee and easement for a portion of land along the riparian corridor to use for flood protection purposes.

The Reach 7 bypass would be constructed within the existing Penitencia Creek Road right-of-way. Construction of the bypass would require right-of-way easements from the City of San Jose. This would be the same for the flood flow collection system along Toyon Road.

Costs

Capital cost for the entire alternative would be $23,000,000.

Yearly maintenance cost would be $35,000.

Preliminary Environmental Review

- **Biological Resources:**
  The new riparian corridor created under the channel widening with riparian restoration concept would provide roosting, nesting, and foraging habitat for riparian-dependent birds, and could facilitate wildlife movement from Coyote Creek up to Alum Rock Park. Native amphibian species could also be more successful in the lower reaches of the watershed.
  Construction activities may result in temporary disturbance or direct mortality of wildlife. Construction for channel widening and inlet/outlet structures of the detention basins and bypasses may result in habitat loss or degradation of small areas of wetland and riparian habitat that could support special-status species, migratory birds, and common wildlife species. The construction of the inlets/outlets removal may result in the permanent loss of roosting, nesting, and foraging habitat for migratory birds and common wildlife species. However, the channel widening will include riparian enhancements to restore these resources. Construction activities may also result in temporary disturbance of nesting raptors and other birds that use adjacent habitat for roosting or nesting.

- **Geology and Soils:**
  Principal concerns would relate to the need for appropriate earthwork design to ensure slope stability during construction and stabilization of newly contoured and constructed surfaces until vegetation establishes. Appropriate site-specific engineering geologic and geotechnical studies would address both these concerns.
  Another concern would relate to sediment load as a factor in hydraulic/geomorphic function in the modified creek. The landscape management and channel restoration concepts will help with the movement of the sediment load through the riverine system.

- **Recreation:**
  The Penitencia Creek trail would be restored anywhere the project impacts it. Plus the existing trail would be extended from King Road down to the Coyote Creek confluence to connect to the Coyote Creek trail. At the upstream end, the Penitencia Creek Trail would be extended from Dorel Drive up to connect to the Alum Rock Park trail system. This will create a continuous trail system from Coyote creek up to Alum Rock Park. The detention facility at the County property in reach 4 would provide recreational opportunities for the surrounding communities with the construction of athletic fields. The detention facility at the City park along reach 5 would also include construction of athletic fields to provide additional recreation opportunities for the public.

- **Traffic:**
  Construction activities (such as equipment operation, staging, materials transport, spoils disposal, and similar or related activities) and construction-related traffic would

temporarily affect traffic on streets in and adjacent to construction areas during the construction period. The alternative would result in large amounts of spoils materials due to excavation of existing soil in the channels, adjacent ground, and detention sites. Additionally, construction of new underground culverts could limit use of affected roadways, sidewalks, and bike lanes during construction. Traffic using bridges in the project area could be affected by construction activities.

- **Note:**
  The following will be described in the feasibility stage: aesthetics, hazardous material, land use, public services and utilities, and cultural resources.

<u>Screening Analysis</u>

Design, construction, operation, and maintenance of this alternative would be technically feasible and availability of public land for the proposed alternative would be sufficient to move into the feasible alternative stage of the Project. The estimated capital cost of the alternative is within the acceptable limit for further consideration and review as a feasible alternative. This alternative is NOT moving on to the Feasible stage due to it would technically take significant amount of work needed for the detention basins for very minimal flow reduction.

Conceptual Alternative D

Figure 12 and 13 lay out Alternative D along each reach. This alternative combines off stream flow detention, channel widening with riparian restoration and bypass(es) concepts to increase capacity such that existing and restored channel reaches can convey 100 year flows safely downstream. Figure 14 is a flow schematic detailing the design peak flows through the system.

For Alternative D, there are three options included for Reaches 6 and 7:
Option D1 – channel widening with riparian restoration (Figure 34)
Option D2 – Bypass under Penitencia Creek Road (Figure 34)
Option D3 – No work: allow reaches to flood (collect flood flows along Toyon Rd

The following descriptions summarize the concepts reach by reach:

Reach 1

The conceptual design involves channel widening with riparian enhancements. Figure 27 & 28 show the potential designs for segment 1A.

<u>1A – Coyote confluence up to the BART/VTA track bridge (Length: 2000 ft)</u>

The existing channel is approximately 10 feet deep and the width varies from 60 to 90 feet bank to bank. Figures 27 and 28 show the three different designs being considered for this segment. Design 1 would widen the existing channel to the south by excavating the south bank and adjacent ground to create a lowered "flood bench" at approximately the bankfull elevation. The meandering low flow channel would be designed for optimal sediment transportation and the flood benches would be planted with native vegetation and designed with passive recreational use. Design 2 is similar except the flood benches would be terraced to allow flooding on terraces only at and above specific flow events. Design 3 would leave the south bank in place and create a bypass along the south side of the existing channel. The bypass would be a trapezoidal earth channel planted with native vegetation and the existing creek would be allowed to "naturally" merge with the bypass to create its own floodway and floodplain.

<u>1B – BART/VTA track bridge up 500ft downstream of King Road (Length: 1000 ft)</u>

This segment along the BART/VTA station will be left as is.

<u>1C – 500ft downstream of King Road up to King Road (Length: 500 feet)</u>

Upstream of the BART station, the existing channel would be widened to the south bank with a flood bench about 30feet. Impacts would include existing vegetation and maintenance road removal, but a new maintenance road and trail would be added plus native vegetation would be planted.

King Road would be expanded to contain the design flow, either through constructing wider bridge or boring culverts adjacent to existing culvert (details will be determined in Feasibility stage).

Reach 2

<u>King Road to the Downstream end of the Mabury Bypass</u>

As mentioned above, King Road would have to be widened to increase the capacity the design flow. Some minor levees along this section may be necessary to contain the design flow, depending on the design of King Road (details will be determined in Feasibility stage).

<u>Mabury Bypass</u>

The most significant aspect of the alternative in Reach 2 is converting the Mabury Bypass to the main channel. The lower flows will be diverted into the Mabury Bypass (diversion will be in Reach 3) while the existing main channel will be used for higher flows. The capacity of the Mabury Bypass will be increased to 1200 cfs with 2- to 3-foot berms along the south bank adjacent to Mabury Road and north bank adjacent to Cape Horn Drive (see Figure 29).

<u>Downstream end of Mabury bypass up to Jackson Road</u>

The existing channel will be kept as is, for the most part. Some minor work such as existing levee enhancements, repairing the existing Mabury Bypass connection and erosion repairs will be completed in order to sustain a capacity of 900 cfs in the main reach for the higher flow events.

Reach 3

Jackson Avenue up to Highway 680

Optimization of the Mabury bypass will be done in this reach – just upstream of the Jackson Road culvert. There are three extra box culverts at Jackson currently not in use, these will connect the upstream and downstream Mabury Bypass reaches. As mentioned in the Reach 2 description, the Mabury bypass will be used as the primary channel with low flows, while the existing main channel will be used to increase capacity during high flow events. More details will be developed during the feasibility phase.

Downstream of Highway 680, the existing riparian corridor consist of low flow meandering channel with floodplains along the existing public right of way. This configuration would be optimized with some excavation along the floodplain and setback levees to contain the design flow and allow the floodplain to inundate under design flows; decreasing downstream flood impacts and increasing refuge habitat for fish during flood events. The diversion of the flows to the Mabury Bypass would occur here, just upstream of Jackson Avenue. The flow split structure would be optimized to allow the lower flows to the bypass and during large events higher flows would be conveyed through the main channel in Reach 2 to prevent flooding.

At Highway 680, large woody debris and cobble/boulder features would be placed within the channel near Highway 680 underpass to increase velocity refuge and cover habitat for steelhead and other fish as well as increasing sediment deposition and overall habitat complexity.

Highway 680 up to Capitol Avenue

Upstream of Highway 680, the existing channel would be left as is and set back levees would be placed at the ends of the existing public right of way to contain higher flow. Some excavation of the floodplain in the public right of way would be done to optimize flow capacity but there will be minimal impacts to the natural vegetation. The setback levees would be approximately 2 to 3 feet high. See figure 30.

Reach 4

Only minor in channel work would be needed to contain the design flow, which would be minimal levees mainly just upstream of Capitol Avenue and approximately 500 feet of levees along both banks around the middle of the reach. See Figure 31.

An off-stream detention facility would be created on a parcel of land owned by the County of Santa Clara. The detention facility would provide temporary storage during high intensity flood events. The average depth of the 13-acre detention site would be 10 feet, producing approximately 130 ac-ft of storage volume. The site would only get flooded during high flow events, so the site would be designed with recreational sports fields to be used by the public most of the time as well as park land with native trees and shrubs. Figure 39 shows the conceptual layout of the detention facility and Figure 35 shows a typical section along the proposed basin and creek.

Reach 5

Channel work includes a floodwall on the south bank along Penitencia Creek Road, approximately 4 feet high. It would be for approximately 700 linear feet from the Penitencia Creek Road Culvert up to Kyle Street. See Figure 32 for a typical section.

A small pedestrian bridge would have to be expanded/replaced.

An off-stream detention facility would be created at the Penitencia Creek City Park, located on property owned by both the City of San Jose and the County of Santa Clara. The average depth of the 20-acre detention facility would be 10 feet, producing approximately 200 ac-ft of storage volume. The site would be designed with recreational sports fields for the public use as well park land with native trees. Figure 40 shows the conceptual layout of the detention facility and Figure 36 shows a typical section along the creek and proposed basin.

Reach 6

Channel work would be required throughout most of the reach, this is even with reduction of flows with detention. This would be a combination of levees on the south bank along Penitencia Creek Road and channel widening and channel widening on the north side of the channel. The levees would be up to 3 feet high and widening up to 20 feet wide. The widening would include excavation for a flood bench, which means there would be some removal of vegetation but there would also be native vegetation planted along the flood bench. See figure 33 for a typical section.

An off-stream detention facility would be created at the District's Water Supply Gross Ponds, located on District land. The average depth of the 8-acre detention facility would be 10 feet, producing approximately 80 ac-ft of storage volume. In order to build the detention facility, there would be some loss to the existing water supply ponds. To mitigate for that loss, the water supply ponds would be expanded to the north at the site but on City land. Figure 41 shows the conceptual layout of the detention facility and Figure 37 shows a typical section along the creek and proposed basin.

Reach 7

Reach 7 is a 1500-foot-long natural channel with many sycamore and oak trees from Noble Avenue up to Dorel Drive. The Noble Diversion is along the north bank about 200 feet upstream of Noble Bridge, the design would include modifying the Diversion to act as an overflow spill that will lead the higher flows to the Gross Ponds detention facility. There are three options considered for the rest of the reach (See Figure 34):

1. Channel widening with riparian restoration: The channel would be widened towards the north side by creating a flood bench (approximately 60ft wide) at about the 2-year event depth, the lower flows would flow through the low flow channel while the higher flows would flow over onto the flood bench. The flood bench would be fully vegetated with native plants and trees such as sycamores, willows, and oaks. The impacts would include the excavation of the existing channel with vegetation removal.
2. Underground Bypass: The 2nd option would be to construct a 6-foot bypass underneath Upper Penitencia Creek Road to carry the higher flows. There would still be some minor levees/floodwalls needed for short stretches of the creek but overall there would not be much impact to the creek itself.
3. No Work: The 3rd option is to not do any work along Reach 7. The current capacity is between 10- and 25-year event, so it would flood above these events. A flow interceptor/collector could be built further downstream along Toyon Road to intercept the flood flows to prevent flooding further west on the south side of the creek. On the north side, flood would be collected at the Noble Bridge and directed to the detention facilities.

The alternative includes extending the Penitencia Creek trail from Dorel Drive up to Alum Rock park to connect the existing trails.

Operation and Maintenance (O&M)

Existing O&M activities are expected to continue in the existing channel where the District has right of way. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance of the bypasses would be minimal. The bypass culverts would be designed to have adequate slope for sediment control.

Operation and maintenance of the widened channels with riparian restoration would be minimal. Vegetation and sediment would be expected to be self-maintaining after the vegetation establishment period. Hazard tree falls and bank failures would still need to be repaired.

Technical and Logistical Feasibility

All the alternative concepts are technically and logistically feasible. Some specialized design assistance may be necessary for the detailed design of the widened creek with the meandering low flow channel and flood benches for higher flows. Although the detention basins are technically and logistically feasible, they will be developed in further details in the feasibility phase to determine the best inlet, outlet, and basin design.

Land Ownership and Access

As mentioned in chapter 4, there is the Tri-Party agreement that helps facilitate working with the District partners, the County and the City, to use the public lands for the Project. This is especially useful for the detention facilities since the majority of that work will be on City or County property. The project team has been coordinating and meeting with the partners throughout the planning phase.

The channel expansion in Reach 1 will be on private property, what use to be the Flea Market. The project team has been working with the City and the land developer to get a fee and easement for a portion of land along the riparian corridor to use for flood protection purposes.

The Reach 7 bypass would be constructed within the existing Penitencia Creek Road right-of-way. Construction of the bypass would require right-of-way easements from the City of San Jose. This would be the same for the flood flow collection system along Toyon Road.

Costs

Capital cost for the entire alternative would be $23,000,000.

Yearly maintenance cost would be $35,000.

Preliminary Environmental Review

- **Biological Resources:**
  The new riparian corridor created under the channel widening with riparian restoration concept would provide roosting, nesting, and foraging habitat for riparian-dependent birds, and could facilitate wildlife movement from Coyote Creek up to Alum Rock Park. Native amphibian species could also be more successful in the lower reaches of the watershed.
  Construction activities may result in temporary disturbance or direct mortality of wildlife. Construction for channel widening and inlet/outlet structures of the detention basins and bypasses may result in habitat loss or degradation of small areas of wetland and riparian habitat that could support special-status species, migratory birds, and common wildlife species. The construction of the inlets/outlets removal may result in the permanent loss of roosting, nesting, and foraging habitat for migratory birds and common wildlife species. However, the channel widening will include riparian enhancements to restore these resources. Construction activities may also result in temporary disturbance of nesting raptors and other birds that use adjacent habitat for roosting or nesting.

- **Geology and Soils:**
  Principal concerns would relate to the need for appropriate earthwork design to ensure slope stability during construction and stabilization of newly contoured and constructed surfaces until vegetation establishes. Appropriate site-specific engineering geologic and geotechnical studies would address both these concerns.
  Another concern would relate to sediment load as a factor in hydraulic/geomorphic function in the modified creek. The landscape management and channel restoration concepts will help with the movement of the sediment load through the riverine system.

- **Recreation:**
  The Penitencia Creek trail would be restored anywhere the project impacts it. Plus, the existing trail would be extended from King Road down to the Coyote Creek confluence to connect to the Coyote Creek trail. At the upstream end, the Penitencia Creek Trail would be extended from Dorel Drive up to connect to the Alum Rock Park trail system. This will create a continuous trail system from Coyote creek up to Alum Rock Park. The detention facility at the County property in reach 4 would provide recreational opportunities for the surrounding communities with the construction of athletic fields. The detention facility at the City park along reach 5 would also include construction of athletic fields to provide additional recreation opportunities for the public.

- **Traffic:**
  Construction activities (such as equipment operation, staging, materials transport, spoils disposal, and similar or related activities) and construction-related traffic would temporarily affect traffic on streets in and adjacent to construction areas during the construction period. The alternative would result in large amounts of spoils materials due to excavation of existing soil in the channels, adjacent ground, and detention sites. Additionally, construction of new underground culverts could limit use of affected roadways, sidewalks, and bike lanes during construction. Traffic using bridges in the project area could be affected by construction activities.

- **Note:**
  The following will be described in the feasibility stage: aesthetics, hazardous material, land use, public services and utilities, and cultural resources.

<u>Screening Analysis</u>

Due to the preliminary analysis and determination of an adequate location for the dam, it appears that access to the sites would be extremely difficult. Potentially, a new road would have to be created to access the site significantly increasing the impacts and costs. Logistically, this makes it very difficult.

Design, construction, operation, and maintenance of this alternative would not be technically feasible and therefore it is not sufficient to move on to the feasible alternative stage of the Project. The estimated capital cost of the alternative is not within the acceptable limit for further consideration and review as a feasible alternative.

Conceptual Alternative E

Figures 15 lays out Alternative E along each reach. This alternative focuses on meeting the minimum flood protection requirement of only constructing flood protection for Reach 1, Coyote Creek up to King Road. Figure 16 is a flow schematic detailing the design peak flows through the system.

Reach 1

The conceptual design involves channel widening with riparian enhancements. Figures 27 & 28 show the potential designs for segment 1A.

<u>1A – Coyote confluence up to the BART/VTA track bridge (Length: 2000 ft)</u>

The existing channel is approximately 10 feet deep and the width varies from 60 to 90 feet bank to bank. Figures 27 and 28 show the three different designs being considered for this segment. Design 1 would widen the existing channel to the south by excavating the south bank and adjacent ground to create a lowered “flood bench” at approximately the bankfull elevation. The meandering low flow channel would be designed for optimal sediment transportation and the flood benches would be planted with native vegetation and designed with passive recreational use. Design 2 is similar except the flood benches would be terraced to allow flooding on terraces only at and above specific flow events. Design 3 would leave the south bank in place and create a bypass along the south side of the existing channel. The bypass would be a trapezoidal earth channel planted with native vegetation and the existing creek would be allowed to “naturally” merge with the bypass to create its own floodway and floodplain.

<u>1B – BART/VTA track bridge up 500ft downstream of King Road (Length: 1000 ft)</u>

This segment along the BART/VTA station will be left as is.

<u>1C – 500ft downstream of King Road up to King Road (Length: 500 feet)</u>

Upstream of the BART station, the existing channel would be widened to the south bank with a flood bench about 30feet. Impacts would include existing vegetation and maintenance road removal, but a new maintenance road and trail would be added plus native vegetation would be planted.

King Road would be expanded to contain the design flow, either through constructing wider bridge or boring culverts adjacent to existing culvert (details will be determined in Feasibility stage).

Reaches 2 through 7

No work is planned for reach 2 through 7 for Alternative E with the exception of extending the Penitencia Creek trail from Dorel Drive up to Alum Rock park to connect the existing trails.

Operation and Maintenance (O&M)

Existing O&M activities are expected to continue in the existing channel where the District has right of way. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance of the widened channels with riparian restoration would be minimal. Vegetation and sediment would be expected to be self-maintaining after the vegetation establishment period. Hazard tree falls and bank failures would still need to be repaired.

Technical and Logistical Feasibility

All the alternative concepts are technically and logistically feasible. Some specialized design assistance may be necessary for the detailed design of the widened creek with the meandering low flow channel and flood benches for higher flows. Although the detention basins are technically and logistically feasible, they will be developed in further details in the feasibility phase to determine the best inlet, outlet, and basin design.

Land Ownership and Access

As mentioned in chapter 4, there is the Tri-Party agreement that helps facilitate working with the District partners, the County and the City, to use the public lands for the Project. This is especially useful for the detention facilities since the majority of that work will be on City or County property. The project team has been coordinating and meeting with the partners throughout the planning phase.

The channel expansion in Reach 1 will be on private property, what use to be the Flea Market. The project team has been working with the City and the land developer to get a fee and easement for a portion of land along the riparian corridor to use for flood protection purposes.

The Reach 7 bypass would be constructed within the existing Penitencia Creek Road right-of-way. Construction of the bypass would require right-of-way easements from the City of San Jose. This would be the same for the flood flow collection system along Toyon Road.

Costs

Capital cost for the entire alternative would be $70,000,000.

Yearly maintenance cost would be $170,000.

Preliminary Environmental Review

- **Biological Resources:**
  The new riparian corridor created under the channel widening with riparian restoration concept would provide roosting, nesting, and foraging habitat for riparian-dependent birds, and could facilitate wildlife movement from Coyote Creek up to Alum Rock Park. Native amphibian species could also be more successful in the lower reaches of the watershed.
  Construction activities may result in temporary disturbance or direct mortality of wildlife. Construction for channel widening and inlet/outlet structures of the detention basins and bypasses may result in habitat loss or degradation of small areas of wetland and riparian habitat that could support special-status species, migratory birds, and common wildlife species. The construction of the inlets/outlets removal may result in the permanent loss of roosting, nesting, and foraging habitat for migratory birds and common wildlife species. However, the channel widening will include riparian enhancements to restore these resources. Construction activities may also result in temporary disturbance of nesting raptors and other birds that use adjacent habitat for roosting or nesting.

- **Geology and Soils:**
  Principal concerns would relate to the need for appropriate earthwork design to ensure slope stability during construction and stabilization of newly contoured and constructed surfaces until vegetation establishes. Appropriate site-specific engineering geologic and geotechnical studies would address both these concerns.
  Another concern would relate to sediment load as a factor in hydraulic/geomorphic function in the modified creek. The landscape management and channel restoration concepts will help with the movement of the sediment load through the riverine system.

- **Recreation:**
  The Penitencia Creek trail would be restored anywhere the project impacts it. Plus, the existing trail would be extended from King Road down to the Coyote Creek confluence to connect to the Coyote Creek trail. At the upstream end, the Penitencia Creek Trail would be extended from Dorel Drive up to connect to the Alum Rock Park trail system. This will create a continuous trail system from Coyote creek up to Alum Rock Park.

- **Traffic:**
  Construction activities (such as equipment operation, staging, materials transport, spoils disposal, and similar or related activities) and construction-related traffic would temporarily affect traffic on streets in and adjacent to construction areas during the construction period. The alternative would result in large amounts of spoils materials due

to excavation of existing soil in the channels, adjacent ground, and detention sites. Additionally, construction of new underground culverts could limit use of affected roadways, sidewalks, and bike lanes during construction. Traffic using bridges in the project area could be affected by construction activities.

- **Note:**
  The following will be described in the feasibility stage: aesthetics, hazardous material, land use, public services and utilities, and cultural resources.

Screening Analysis

Design, construction, operation, and maintenance of this alternative would be technically feasible and therefore it is sufficient to move on to the feasible alternative stage of the Project. The estimated capital cost of the alternative is within the acceptable limit for further consideration and review as a feasible alternative.

Conceptual Alternative F

Figure 17 and 18 lay out Alternative F along each reach. This alternative combines levees, floodwalls, channel widening with riparian restoration and bypass(es) concepts to increase capacity such that existing and restored channel reaches can convey 100 year flows safely downstream. Figure 19 is a flow schematic detailing the design peak flows through the system.

For Alternative F, there are three options included for Reaches 6 and 7:
Option F1 – channel widening with riparian restoration (Figure 34)
Option F2 – Bypass under Penitencia Creek Road (Figure 34)
Option F3 – No work: allow reaches to flood (collect flood flows along Toyon Rd

The following descriptions summarize the concepts reach by reach:

Reach 1

The conceptual design involves channel widening with riparian enhancements. Figure 27 & 28 shows the potential designs for segment 1A.

1A – Coyote confluence up to the BART/VTA track bridge (Length: 2000 ft)

The existing channel is approximately 10 feet deep and the width varies from 60 to 90 feet bank to bank. Figures 27 and 28 show the three different designs being considered for this segment. Design 1 would widen the existing channel to the south by excavating the south bank and adjacent ground to create a lowered "flood bench" at approximately the bankfull elevation. The meandering low flow channel would be designed for optimal sediment transportation and the flood benches would be planted with native vegetation and designed with passive recreational use. Design 2 is similar except the flood benches would be terraced to allow flooding on terraces only at and above specific flow events. Design 3 would leave the south bank in place and create a bypass along the south side of the existing channel. The bypass would be a trapezoidal earth channel planted with native vegetation and the existing creek would be allowed to "naturally" merge with the bypass to create its own floodway and floodplain.

1B – BART/VTA track bridge up 500ft downstream of King Road (Length: 1000 ft)

This segment along the BART/VTA station will be left as is.

1C – 500ft downstream of King Road up to King Road (Length: 500 feet)

Upstream of the BART station, the existing channel would be widened to the south bank with a flood bench about 30feet. Impacts would include existing vegetation and maintenance road removal, but a new maintenance road and trail would be added plus native vegetation would be planted.

King Road would be expanded to contain the design flow, either through constructing wider bridge or boring culverts adjacent to existing culvert (details will be determined in Feasibility stage).

Reach 2

King Road to the Downstream end of the Mabury Bypass

As mentioned above, King Road would have to be widened to increase the capacity the design flow. Some minor levees along this section may be necessary to contain the design flow, depending on the design of King Road (details will be determined in Feasibility stage).

Mabury Bypass

The most significant aspect of the alternative in Reach 2 is converting the Mabury Bypass to the main channel. The lower flows will be diverted into the Mabury Bypass (diversion will be in Reach 3) while the existing main channel will be used for higher flows. The capacity of the Mabury Bypass will be increased to 1200 cfs with 2- to 3-foot berms along the south bank adjacent to Mabury Road and north bank adjacent to Cape Horn Drive (see Figure 29).

Downstream end of Mabury bypass up to Jackson Road

The existing channel will be kept as is, for the most part. Some minor work such as existing levee enhancements, repairing the existing Mabury Bypass connection and erosion repairs will be completed in order to sustain a capacity of 900 cfs in the main reach for the higher flow events.

Reach 3

Jackson Avenue up to Highway 680

Optimization of the Mabury bypass will be done in this reach – just upstream of the Jackson Road culvert. There are three extra box culverts at Jackson currently not in use, these will connect the upstream and downstream Mabury Bypass reaches. As mentioned in the Reach 2 description, the Mabury bypass will be used as the primary channel with low flows, while the existing main channel will be used to increase capacity during high flow events. More details will be developed during the feasibility phase.

Downstream of Highway 680, the existing riparian corridor consist of low flow meandering channel with floodplains along the existing public right of way. This configuration would be optimized with some excavation along the floodplain and setback levees to contain the design flow and allow the floodplain to inundate under design flows; decreasing downstream flood impacts and increasing refuge habitat for fish during flood events. The diversion of the flows to the Mabury Bypass would occur here, just upstream of Jackson Avenue. The flow split structure would be optimized to allow the lower flows to the bypass and during large events higher flows would be conveyed through the main channel in Reach 2 to prevent flooding.

At Highway 680, large woody debris and cobble/boulder features would be placed within the channel near Highway 680 underpass to increase velocity refuge and cover habitat for steelhead and other fish as well as increasing sediment deposition and overall habitat complexity.

Highway 680 up to Capitol Avenue

Upstream of Highway 680, the existing channel would be left as is and set back levees would be placed at the ends of the existing public right of way to contain higher flow. Some excavation of the floodplain in the public right of way would be done to optimize flow capacity but there will be minimal impacts to the natural vegetation. The setback levees would be approximately 2 to 3 feet high. See figure 30.

Reach 4

Only minor in channel work would be needed to contain the design flow, which would be minimal levees mainly just upstream of Capitol Avenue and approximately 500 feet of levees along both banks around the middle of the reach. See Figure 31.

Reach 5

Channel work includes a floodwall on the south bank along Penitencia Creek Road, approximately 4 feet high. It would be for approximately 700 linear feet from the Penitencia Creek Road Culvert up to Kyle Street. See Figure 32 for a typical section.

A small pedestrian bridge would have to be expanded/replaced.

Reach 6

Channel work would be required throughout most of the reach, this is even with reduction of flows with detention. This would be a combination of levees on the south bank along Penitencia Creek Road and channel widening and channel widening on the north side of the channel. The levees would be up to 3 feet high and widening up to 20 feet wide. The widening would include excavation for a flood bench, which means there would be some removal of vegetation but there would also be native vegetation planted along the flood bench. See figure 33 for a typical section.

Reach 7

Reach 7 is a 1500-foot-long natural channel with many sycamore and oak trees from Noble Avenue up to Dorel Drive. The Noble Diversion is along the north bank about 200 feet upstream of Noble Bridge, the design would include modifying the Diversion to act as an overflow spill that will lead the higher flows to the Gross Ponds detention facility. There are three options considered for the rest of the reach (See Figure 34):

1. Channel widening with riparian restoration: The channel would be widened towards the north side by creating a flood bench (approximately 80ft wide) at about the 2-year event depth, the lower flows would flow through the low flow channel while the higher flows would flow over onto the flood bench. The flood bench would be fully vegetated with native plants and trees such as sycamores, willows, and oaks. The impacts would include the excavation of the existing channel with vegetation removal.
2. Underground Bypass: The 2nd option would be to construct a 10-foot bypass underneath Upper Penitencia Creek Road to carry the higher flows. There would still be some minor levees/floodwalls needed for short stretches of the creek but overall there would not be much impact to the creek itself.
3. No Work: The 3rd option is to not do any work along Reach 7. The current capacity is between 10- and 25-year event, so it would flood above these events. A flow interceptor/collector could be built further downstream along Toyon Road to intercept the flood flows to prevent flooding further west on the south side of the creek. On the north side, flood would be collected at the Noble Bridge and directed to the detention facilities.

The alternative includes extending the Penitencia Creek trail from Dorel Drive up to Alum Rock park to connect the existing trails.

Operation and Maintenance (O&M)

Existing O&M activities are expected to continue in the existing channel where the District has right of way. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance of the bypasses would be minimal. The bypass culverts would be designed to have adequate slope for sediment control.

Operation and maintenance of the widened channels with riparian restoration would be minimal. Vegetation and sediment would be expected to be self-maintaining after the vegetation establishment period. Hazard tree falls and bank failures would still need to be repaired.

Technical and Logistical Feasibility

All the alternative concepts are technically and logistically feasible. Some specialized design assistance may be necessary for the detailed design of the widened creek with the meandering low flow channel and flood benches for higher flows. Although the detention basins are technically and logistically feasible, they will be developed in further details in the feasibility phase to determine the best inlet, outlet, and basin design.

Land Ownership and Access

As mentioned in chapter 4, there is the Tri-Party agreement that helps facilitate working with the District partners, the County and the City, to use the public lands for the Project. This is especially useful for the detention facilities since the majority of that work will be on City or County property. The project team has been coordinating and meeting with the partners throughout the planning phase.

The channel expansion in Reach 1 will be on private property, what use to be the Flea Market. The project team has been working with the City and the land developer to get a fee and easement for a portion of land along the riparian corridor to use for flood protection purposes.

The Reach 7 bypass would be constructed within the existing Penitencia Creek Road right-of-way. Construction of the bypass would require right-of-way easements from the City of San Jose. This would be the same for the flood flow collection system along Toyon Road.

Costs

Capital cost for the entire alternative would be $120,000,000.

Yearly maintenance cost would be $200,000.

Preliminary Environmental Review

- **Biological Resources:**
  The new riparian corridor created under the channel widening with riparian restoration concept would provide roosting, nesting, and foraging habitat for riparian-dependent birds, and could facilitate wildlife movement from Coyote Creek up to Alum Rock Park. Native amphibian species could also be more successful in the lower reaches of the watershed.
  Construction activities may result in temporary disturbance or direct mortality of wildlife. Construction for channel widening and inlet/outlet structures of the detention basins and bypasses may result in habitat loss or degradation of small areas of wetland and riparian habitat that could support special-status species, migratory birds, and common wildlife species. The construction of the inlets/outlets removal may result in the permanent loss of roosting, nesting, and foraging habitat for migratory birds and common wildlife species. However, the channel widening will include riparian enhancements to restore these resources. Construction activities may also result in temporary disturbance of nesting raptors and other birds that use adjacent habitat for roosting or nesting.

- **Geology and Soils:**
  Principal concerns would relate to the need for appropriate earthwork design to ensure slope stability during construction and stabilization of newly contoured and constructed surfaces until vegetation establishes. Appropriate site-specific engineering geologic and geotechnical studies would address both these concerns.
  Another concern would relate to sediment load as a factor in hydraulic/geomorphic function in the modified creek. The landscape management and channel restoration concepts will help with the movement of the sediment load through the riverine system.

- **Recreation:**
  The Penitencia Creek trail would be restored anywhere the project impacts it. Plus, the existing trail would be extended from King Road down to the Coyote Creek confluence to connect to the Coyote Creek trail. At the upstream end, the Penitencia Creek Trail would be extended from Dorel Drive up to connect to the Alum Rock Park trail system. This will create a continuous trail system from Coyote creek up to Alum Rock Park. The detention facility at the County property in reach 4 would provide recreational opportunities for the surrounding communities with the construction of athletic fields. The detention facility at the City park along reach 5 would also include construction of athletic fields to provide additional recreation opportunities for the public.

- **Traffic:**
  Construction activities (such as equipment operation, staging, materials transport, spoils disposal, and similar or related activities) and construction-related traffic would temporarily affect traffic on streets in and adjacent to construction areas during the

construction period. The alternative would result in large amounts of spoils materials due to excavation of existing soil in the channels, adjacent ground, and detention sites. Additionally, construction of new underground culverts could limit use of affected roadways, sidewalks, and bike lanes during construction. Traffic using bridges in the project area could be affected by construction activities.

- **Note:**
  The following will be described in the feasibility stage: aesthetics, hazardous material, land use, public services and utilities, and cultural resources.

Screening Analysis

Design, construction, operation, and maintenance of this alternative would not be technically feasible and therefore it is not sufficient to move on to the feasible alternative stage of the Project. The estimated capital cost of the alternative is not within the acceptable limit for further consideration and review as a feasible alternative. This alternative would potentially induce flooding downstream in Coyote Creek and therefore does not meet all the project objectives and will not move on to the feasible alternative stage of the Project.

Conceptual Alternative G

Figure 20 and 21 lay out Alternative F along each reach. This alternative combines levees, floodwalls, channel widening with riparian restoration and bypass(es) concepts to increase capacity such that existing and restored channel reaches can convey 100 year flows safely downstream. Figure 22 is a flow schematic detailing the design peak flows through the system.

For Alternative G, there are three options included for Reaches 6 and 7:
Option G1 – channel widening with riparian restoration (Figure 34)
Option G2 – Bypass under Penitencia Creek Road (Figure 34)
Option G3 – No work: allow reaches to flood (collect flood flows along Toyon Rd

The following descriptions summarize the concepts reach by reach:

Reach 1

The conceptual design involves channel widening with riparian enhancements. Figure 27 & 28 show the potential designs for segment 1A.

1A – Coyote confluence up to the BART/VTA track bridge (Length: 2000 ft)

The existing channel is approximately 10 feet deep and the width varies from 60 to 90 feet bank to bank. Figures 27 and 28 show the three different designs being considered for this segment. Design 1 would widen the existing channel to the south by excavating the south bank and adjacent ground to create a lowered “flood bench” at approximately the bankfull elevation. The meandering low flow channel would be designed for optimal sediment transportation and the flood benches would be planted with native vegetation and designed with passive recreational use. Design 2 is similar except the flood benches would be terraced to allow flooding on terraces only at and above specific flow events. Design 3 would leave the south bank in place and create a bypass along the south side of the existing channel. The bypass would be a trapezoidal earth channel planted with native vegetation and the existing creek would be allowed to “naturally” merge with the bypass to create its own floodway and floodplain.

<u>1B – BART/VTA track bridge up 500ft downstream of King Road (Length: 1000 ft)</u>

This segment along the BART/VTA station will be left as is.

<u>1C – 500ft downstream of King Road up to King Road (Length: 500 feet)</u>

Upstream of the BART station, the existing channel would be widened to the south bank with a flood bench about 30feet. Impacts would include existing vegetation and maintenance road removal, but a new maintenance road and trail would be added plus native vegetation would be planted.

King Road would be expanded to contain the design flow, either through constructing wider bridge or boring culverts adjacent to existing culvert (details will be determined in Feasibility stage).

Reach 2

<u>King Road to the Downstream end of the Mabury Bypass</u>

As mentioned above, King Road would have to be widened to increase the capacity the design flow. Some minor levees along this section may be necessary to contain the design flow, depending on the design of King Road (details will be determined in Feasibility stage).

<u>Mabury Bypass</u>

The most significant aspect of the alternative in Reach 2 is converting the Mabury Bypass to the main channel. The lower flows will be diverted into the Mabury Bypass (diversion will be in Reach 3) while the existing main channel will be used for higher flows. The capacity of the Mabury Bypass will be increased to 1200 cfs with 2 to 3 foot berms along the south bank adjacent to Mabury Road and north bank adjacent to Cape Horn Drive (see Figure 29).

<u>Downstream end of Mabury bypass up to Jackson Road</u>

The existing channel will be kept as is, for the most part. Some minor work such as existing levee enhancements, repairing the existing Mabury Bypass connection and erosion repairs will be completed in order to sustain a capacity of 900 cfs in the main reach for the higher flow events.

Reach 3

Jackson Avenue up to Highway 680

Optimization of the Mabury bypass will be done in this reach – just upstream of the Jackson Road culvert. There are three extra box culverts at Jackson currently not in use, these will connect the upstream and downstream Mabury Bypass reaches. As mentioned in the Reach 2 description, the Mabury bypass will be used as the primary channel with low flows, while the existing main channel will be used to increase capacity during high flow events. More details will be developed during the feasibility phase.

Downstream of Highway 680, the existing riparian corridor consist of low flow meandering channel with floodplains along the existing public right of way. This configuration would be optimized with some excavation along the floodplain and setback levees to contain the design flow and allow the floodplain to inundate under design flows; decreasing downstream flood impacts and increasing refuge habitat for fish during flood events. The diversion of the flows to the Mabury Bypass would occur here, just upstream of Jackson Avenue. The flow split structure would be optimized to allow the lower flows to the bypass and during large events higher flows would be conveyed through the main channel in Reach 2 to prevent flooding.

At Highway 680, large woody debris and cobble/boulder features would be placed within the channel near Highway 680 underpass to increase velocity refuge and cover habitat for steelhead and other fish as well as increasing sediment deposition and overall habitat complexity.

Highway 680 up to Capitol Avenue

Upstream of Highway 680, the existing channel would be left as is and set back levees would be placed at the ends of the existing public right of way to contain higher flow. Some excavation of the floodplain in the public right of way would be done to optimize flow capacity but there will be minimal impacts to the natural vegetation. The setback levees would be approximately 2 to 3 feet high. See figure 30.

Reach 4

Only minor in channel work would be needed to contain the design flow, which would be minimal levees mainly just upstream of Capitol Avenue and approximately 500 feet of levees along both banks around the middle of the reach. See Figure 31.

Reach 5

Channel work includes a floodwall on the south bank along Penitencia Creek Road, approximately 4 feet high. It would be for approximately 700 linear feet from the Penitencia Creek Road Culvert up to Kyle Street. See Figure 32 for a typical section.

A small pedestrian bridge would have to be expanded/replaced.

Reach 6

Channel work would be required throughout most of the reach, this is even with reduction of flows with detention. This would be a combination of levees on the south bank along Penitencia Creek Road and channel widening and channel widening on the north side of the channel. The levees would be up to 3 feet high and widening up to 20 feet wide. The widening would include excavation for a flood bench, which means there would be some removal of vegetation but there would also be native vegetation planted along the flood bench. See figure 33 for a typical section.

Reach 7

Reach 7 is a 1500-foot-long natural channel with many sycamore and oak trees from Noble Avenue up to Dorel Drive. The Noble Diversion is along the north bank about 200 feet upstream of Noble Bridge, the design would include modifying the Diversion to act as an overflow spill that will lead the higher flows to the Gross Ponds detention facility. There are three options considered for the rest of the reach (See Figure 34):

1. Channel widening with riparian restoration: The channel would be widened towards the north side by creating a flood bench (approximately 65ft wide) at about the 2-year event depth, the lower flows would flow through the low flow channel while the higher flows would flow over onto the flood bench. The flood bench would be fully vegetated with native plants and trees such as sycamores, willows, and oaks. The impacts would include the excavation of the existing channel with vegetation removal.
2. Underground Bypass: The 2nd option would be to construct a 8-foot bypass underneath Upper Penitencia Creek Road to carry the higher flows. There would still be some minor levees/floodwalls needed for short stretches of the creek but overall there would not be much impact to the creek itself.
3. No Work: The 3rd option is to not do any work along Reach 7. The current capacity is between 10- and 25-year event, so it would flood above these events. A flow interceptor/collector could be built further downstream along Toyon Road to intercept the flood flows to prevent flooding further west on the south side of the creek. On the north side, flood would be collected at the Noble Bridge and directed to the detention facilities.

The alternative includes extending the Penitencia Creek trail from Dorel Drive up to Alum Rock park to connect the existing trails.

Operation and Maintenance (O&M)

Existing O&M activities are expected to continue in the existing channel where the District has right of way. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance of the bypasses would be minimal. The bypass culverts would be designed to have adequate slope for sediment control.

Operation and maintenance of the widened channels with riparian restoration would be minimal. Vegetation and sediment would be expected to be self-maintaining after the vegetation establishment period. Hazard tree falls and bank failures would still need to be repaired.

Technical and Logistical Feasibility

All the alternative concepts are technically and logistically feasible. Some specialized design assistance may be necessary for the detailed design of the widened creek with the meandering low flow channel and flood benches for higher flows. Although the detention basins are technically and logistically feasible, they will be developed in further details in the feasibility phase to determine the best inlet, outlet, and basin design.

Land Ownership and Access

As mentioned in chapter 4, there is the Tri-Party agreement that helps facilitate working with the District partners, the County and the City, to use the public lands for the Project. This is especially useful for the detention facilities since the majority of that work will be on City or County property. The project team has been coordinating and meeting with the partners throughout the planning phase.

The channel expansion in Reach 1 will be on private property, what use to be the Flea Market. The project team has been working with the City and the land developer to get a fee and easement for a portion of land along the riparian corridor to use for flood protection purposes.

The Reach 7 bypass would be constructed within the existing Penitencia Creek Road right-of-way. Construction of the bypass would require right-of-way easements from the City of San Jose. This would be the same for the flood flow collection system along Toyon Road.

Costs

Capital cost for the entire alternative would be $90,000,000.

Yearly maintenance cost would be $180,000.

Preliminary Environmental Review

- **Biological Resources:**
  The new riparian corridor created under the channel widening with riparian restoration concept would provide roosting, nesting, and foraging habitat for riparian-dependent birds, and could facilitate wildlife movement from Coyote Creek up to Alum Rock Park. Native amphibian species could also be more successful in the lower reaches of the watershed.
  Construction activities may result in temporary disturbance or direct mortality of wildlife. Construction for channel widening and inlet/outlet structures of the detention basins and bypasses may result in habitat loss or degradation of small areas of wetland and riparian habitat that could support special-status species, migratory birds, and common wildlife species. The construction of the inlets/outlets removal may result in the permanent loss of roosting, nesting, and foraging habitat for migratory birds and common wildlife species. However, the channel widening will include riparian enhancements to restore these resources. Construction activities may also result in temporary disturbance of nesting raptors and other birds that use adjacent habitat for roosting or nesting.

- **Geology and Soils:**
  Principal concerns would relate to the need for appropriate earthwork design to ensure slope stability during construction and stabilization of newly contoured and constructed surfaces until vegetation establishes. Appropriate site-specific engineering geologic and geotechnical studies would address both these concerns.
  Another concern would relate to sediment load as a factor in hydraulic/geomorphic function in the modified creek. The landscape management and channel restoration concepts will help with the movement of the sediment load through the riverine system.

- **Recreation:**
  The Penitencia Creek trail would be restored anywhere the project impacts it. Plus the existing trail would be extended from King Road down to the Coyote Creek confluence to connect to the Coyote Creek trail. At the upstream end, the Penitencia Creek Trail would be extended from Dorel Drive up to connect to the Alum Rock Park trail system. This will create a continuous trail system from Coyote creek up to Alum Rock Park. The detention facility at the County property in reach 4 would provide recreational opportunities for the surrounding communities with the construction of athletic fields. The detention facility at the City park along reach 5 would also include construction of athletic fields to provide additional recreation opportunities for the public.

- **Traffic:**
  Construction activities (such as equipment operation, staging, materials transport, spoils disposal, and similar or related activities) and construction-related traffic would

temporarily affect traffic on streets in and adjacent to construction areas during the construction period. The alternative would result in large amounts of spoils materials due to excavation of existing soil in the channels, adjacent ground, and detention sites. Additionally, construction of new underground culverts could limit use of affected roadways, sidewalks, and bike lanes during construction. Traffic using bridges in the project area could be affected by construction activities.

- **Note:**
  The following will be described in the feasibility stage: aesthetics, hazardous material, land use, public services and utilities, and cultural resources.

Screening Analysis

Design, construction, operation, and maintenance of this alternative would be technically feasible and the estimated capital cost of the alternative is within the acceptable limit. This alternative would potentially induce flooding downstream in Coyote Creek and therefore does not meet all the project objectives and will not move on to the feasible alternative stage of the Project.

Conceptual Alternative H

Figure 23 and 24 lay out Alternative F along each reach. This alternative combines levees, floodwalls, channel widening with riparian restoration and bypass(es) concepts to increase capacity such that existing and restored channel reaches can convey 100 year flows safely downstream. Figure 25 is a flow schematic detailing the design peak flows through the system.

For Alternative H, there are three options included for Reaches 6 and 7:
Option A1 – channel widening with riparian restoration (Figure 34)
Option A2 – Bypass under Penitencia Creek Road (Figure 34)
Option A3 – No work: allow reaches to flood (collect flood flows along Toyon Rd

The following descriptions summarize the concepts reach by reach:

Reach 1

The conceptual design involves channel widening with riparian enhancements. Figure 27 & 28 shows the potential designs for segment 1A.

1A – Coyote confluence up to the BART/VTA track bridge (Length: 2000 ft)

The existing channel is approximately 10 feet deep and the width varies from 60 to 90 feet bank to bank. Figures 27 and 28 show the three different designs being considered for this segment. Design 1 would widen the existing channel to the south by excavating the south bank and adjacent ground to create a lowered "flood bench" at approximately the bankfull elevation. The meandering low flow channel would be designed for optimal sediment transportation and the flood benches would be planted with native vegetation and designed with passive recreational use. Design 2 is similar except the flood benches would be terraced to allow flooding on terraces only at and above specific flow events. Design 3 would leave the south bank in place and create a bypass along the south side of the existing channel. The bypass would be a trapezoidal earth channel planted with native vegetation and the existing creek would be allowed to "naturally" merge with the bypass to create its own floodway and floodplain.

<u>1B – BART/VTA track bridge up 500ft downstream of King Road (Length: 1000 ft)</u>

This segment along the BART/VTA station will be left as is.

<u>1C – 500ft downstream of King Road up to King Road (Length: 500 feet)</u>

Upstream of the BART station, the existing channel would be widened to the south bank with a flood bench about 30feet. Impacts would include existing vegetation and maintenance road removal, but a new maintenance road and trail would be added plus native vegetation would be planted.

King Road would be expanded to contain the design flow, either through constructing wider bridge or boring culverts adjacent to existing culvert (details will be determined in Feasibility stage).

Reach 2

<u>King Road to the Downstream end of the Mabury Bypass</u>

As mentioned above, King Road would have to be widened to increase the capacity the design flow. Some minor levees along this section may be necessary to contain the design flow, depending on the design of King Road (details will be determined in Feasibility stage).

<u>Mabury Bypass</u>

The most significant aspect of the alternative in Reach 2 is converting the Mabury Bypass to the main channel. The lower flows will be diverted into the Mabury Bypass (diversion will be in Reach 3) while the existing main channel will be used for higher flows. The capacity of the Mabury Bypass will increased to 1200 cfs with 2 to 3 foot berms along the south bank adjacent to Mabury Road and north bank adjacent to Cape Horn Drive (see Figure 29).

<u>Downstream end of Mabury bypass up to Jackson Road</u>

The existing channel will be kept as is, for the most part. Some minor work such as existing levee enhancements, repairing the existing Mabury Bypass connection and erosion repairs will be completed in order to sustain a capacity of 900 cfs in the main reach for the higher flow events.

Reach 3

Jackson Avenue up to Highway 680

Optimization of the Mabury bypass will be done in this reach – just upstream of the Jackson Road culvert. There are three extra box culverts at Jackson currently not in use, these will connect the upstream and downstream Mabury Bypass reaches. As mentioned in the Reach 2 description, the Mabury bypass will be used as the primary channel with low flows, while the existing main channel will be used to increase capacity during high flow events. More details will be developed during the feasibility phase.

Downstream of Highway 680, the existing riparian corridor consist of low flow meandering channel with floodplains along the existing public right of way. This configuration would be optimized with some excavation along the floodplain and setback levees to contain the design flow and allow the floodplain to inundate under design flows; decreasing downstream flood impacts and increasing refuge habitat for fish during flood events. The diversion of the flows to the Mabury Bypass would occur here, just upstream of Jackson Avenue. The flow split structure would be optimized to allow the lower flows to the bypass and during large events higher flows would be conveyed through the main channel in Reach 2 to prevent flooding.

At Highway 680, large woody debris and cobble/boulder features would be placed within the channel near Highway 680 underpass to increase velocity refuge and cover habitat for steelhead and other fish as well as increasing sediment deposition and overall habitat complexity.

Highway 680 up to Capitol Avenue

Upstream of Highway 680, the existing channel would be left as is and set back levees would be placed at the ends of the existing public right of way to contain higher flow. Some excavation of the floodplain in the public right of way would be done to optimize flow capacity but there will be minimal impacts to the natural vegetation. The setback levees would be approximately 2 to 3 feet high. See figure 30.

Reach 4

Only minor in channel work would be needed to contain the design flow, which would be minimal levees mainly just upstream of Capitol Avenue and approximately 500 feet of levees along both banks around the middle of the reach. See Figure 31.

Reach 5

Channel work includes a floodwall on the south bank along Penitencia Creek Road, approximately 4 feet high. It would be for approximately 700 linear feet from the Penitencia Creek Road Culvert up to Kyle Street. See Figure 32 for a typical section.

A small pedestrian bridge would have to be expanded/replaced.

Reach 6

Channel work would be required throughout most of the reach, this is even with reduction of flows with detention. This would be a combination of levees on the south bank along Penitencia Creek Road and channel widening and channel widening on the north side of the channel. The levees would be up to 3 feet high and widening up to 20 feet wide. The widening would include excavation for a flood bench, which means there would be some removal of vegetation but there would also be native vegetation planted along the flood bench. See figure 33 for a typical section.

Reach 7

Reach 7 is a 1500-foot-long natural channel with many sycamore and oak trees from Noble Avenue up to Dorel Drive. The Noble Diversion is along the north bank about 200 feet upstream of Noble Bridge, the design would include modifying the Diversion to act as an overflow spill that will lead the higher flows to the Gross Ponds detention facility. There are three options considered for the rest of the reach (See Figure 34):

1. Channel widening with riparian restoration: The channel would be widened towards the north side by creating a flood bench (approximately 50ft wide) at about the 2-year event depth, the lower flows would flow through the low flow channel while the higher flows would flow over onto the flood bench. The flood bench would be fully vegetated with native plants and trees such as sycamores, willows, and oaks. The impacts would include the excavation of the existing channel with vegetation removal.
2. Underground Bypass: The 2nd option would be to construct a 6-foot bypass underneath Upper Penitencia Creek Road to carry the higher flows. There would still be some minor levees/floodwalls needed for short stretches of the creek but overall there would not be much impact to the creek itself.
3. No Work: The 3rd option is to not do any work along Reach 7. The current capacity is between 10- and 25-year event, so it would flood above these events. A flow interceptor/collector could be built further downstream along Toyon Road to intercept the flood flows to prevent flooding further west on the south side of the creek. On the north side, flood would be collected at the Noble Bridge and directed to the detention facilities.

The alternative includes extending the Penitencia Creek trail from Dorel Drive up to Alum Rock park to connect the existing trails.

<u>Operation and Maintenance (O&M)</u>

Existing O&M activities are expected to continue in the existing channel where the District has right of way. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance of the bypasses would be minimal. The bypass culverts would be designed to have adequate slope for sediment control.

Operation and maintenance of the widened channels with riparian restoration would be minimal. Vegetation and sediment would be expected to be self-maintaining after the vegetation establishment period. Hazard tree falls and bank failures would still need to be repaired.

Technical and Logistical Feasibility

All the alternative concepts are technically and logistically feasible. Some specialized design assistance may be necessary for the detailed design of the widened creek with the meandering low flow channel and flood benches for higher flows. Although the detention basins are technically and logistically feasible, they will be developed in further details in the feasibility phase to determine the best inlet, outlet, and basin design.

Land Ownership and Access

As mentioned in chapter 4, there is the Tri-Party agreement that helps facilitate working with the District partners, the County and the City, to use the public lands for the Project. This is especially useful for the detention facilities since the majority of that work will be on City or County property. The project team has been coordinating and meeting with the partners throughout the planning phase.

The channel expansion in Reach 1 will be on private property, what use to be the Flea Market. The project team has been working with the City and the land developer to get a fee and easement for a portion of land along the riparian corridor to use for flood protection purposes.

The Reach 7 bypass would be constructed within the existing Penitencia Creek Road right-of-way. Construction of the bypass would require right-of-way easements from the City of San Jose. This would be the same for the flood flow collection system along Toyon Road.

Costs

Capital cost for the entire alternative would be $20,000,000.

Yearly maintenance cost would be $80,000.

Preliminary Environmental Review

- **Biological Resources:**
  The new riparian corridor created under the channel widening with riparian restoration concept would provide roosting, nesting, and foraging habitat for riparian-dependent birds, and could facilitate wildlife movement from Coyote Creek up to Alum Rock Park. Native amphibian species could also be more successful in the lower reaches of the watershed.
  Construction activities may result in temporary disturbance or direct mortality of wildlife. Construction for channel widening and inlet/outlet structures of the detention basins and bypasses may result in habitat loss or degradation of small areas of wetland and riparian habitat that could support special-status species, migratory birds, and common wildlife species. The construction of the inlets/outlets removal may result in the permanent loss of roosting, nesting, and foraging habitat for migratory birds and common wildlife species. However, the channel widening will include riparian enhancements to restore these resources. Construction activities may also result in temporary disturbance of nesting raptors and other birds that use adjacent habitat for roosting or nesting.

- **Geology and Soils:**
  Principal concerns would relate to the need for appropriate earthwork design to ensure slope stability during construction and stabilization of newly contoured and constructed surfaces until vegetation establishes. Appropriate site-specific engineering geologic and geotechnical studies would address both these concerns.
  Another concern would relate to sediment load as a factor in hydraulic/geomorphic function in the modified creek. The landscape management and channel restoration concepts will help with the movement of the sediment load through the riverine system.

- **Recreation:**
  The Penitencia Creek trail would be restored anywhere the project impacts it. Plus, the existing trail would be extended from King Road down to the Coyote Creek confluence to connect to the Coyote Creek trail. At the upstream end, the Penitencia Creek Trail would be extended from Dorel Drive up to connect to the Alum Rock Park trail system. This will create a continuous trail system from Coyote creek up to Alum Rock Park. The detention facility at the County property in reach 4 would provide recreational opportunities for the surrounding communities with the construction of athletic fields. The detention facility at the City park along reach 5 would also include construction of athletic fields to provide additional recreation opportunities for the public.

- **Traffic:**
  Construction activities (such as equipment operation, staging, materials transport, spoils disposal, and similar or related activities) and construction-related traffic would temporarily affect traffic on streets in and adjacent to construction areas during the

construction period. The alternative would result in large amounts of spoils materials due to excavation of existing soil in the channels, adjacent ground, and detention sites. Additionally, construction of new underground culverts could limit use of affected roadways, sidewalks, and bike lanes during construction. Traffic using bridges in the project area could be affected by construction activities.

- **Note:**
  The following will be described in the feasibility stage: aesthetics, hazardous material, land use, public services and utilities, and cultural resources.

<u>Screening Analysis</u>

Design, construction, operation, and maintenance of this alternative would be technically feasible and availability of public land for the proposed alternative would be sufficient to move into the feasible alternative stage of the Project. The estimated capital cost of the alternative is within the acceptable limit for further consideration and review as a feasible alternative.

Conceptual Alternative I

Alternative Description

No Project - Under Conceptual Alternative I, no new project elements would be implemented in the study area. Flood flows would continue to overtop channel banks and inundate adjacent properties, resulting in flood-related damages to residences and businesses. Figure 26 shows the existing condition flood flows through the riverine system.

Operation and Maintenance

Current operations and maintenance practices would continue. Typical maintenance activities include trash and debris removal, vegetation (overgrowth) removal, tree removal, erosion repair in natural sections, and sediment removal.

Technical Feasibility

All project elements are technically feasible with current construction techniques.

Land Ownership / Access

No issues expected.

Costs

Capital costs would be $0.

Maintenance costs would be $100,000 annually.

Preliminary Environmental Review

No new impacts are expected.

Conceptual Alternative Screening Analysis

This alternative does not meet all of the Project objectives but will be considered as part of the environmental analysis.

11. Next Step - Feasible Analysis

The next step of the planning phase is to analyze the feasible alternatives using the Natural Flood Protection approach to determine a preferred alternative. In moving forward with the alternatives chosen through the conceptual screening process, it is important to mention that some details might change as the alternatives are developed in further detail. This is especially true with the off-stream detention concepts. The size and depths may change when looking deeper into the hydraulic analysis and technical feasibility.

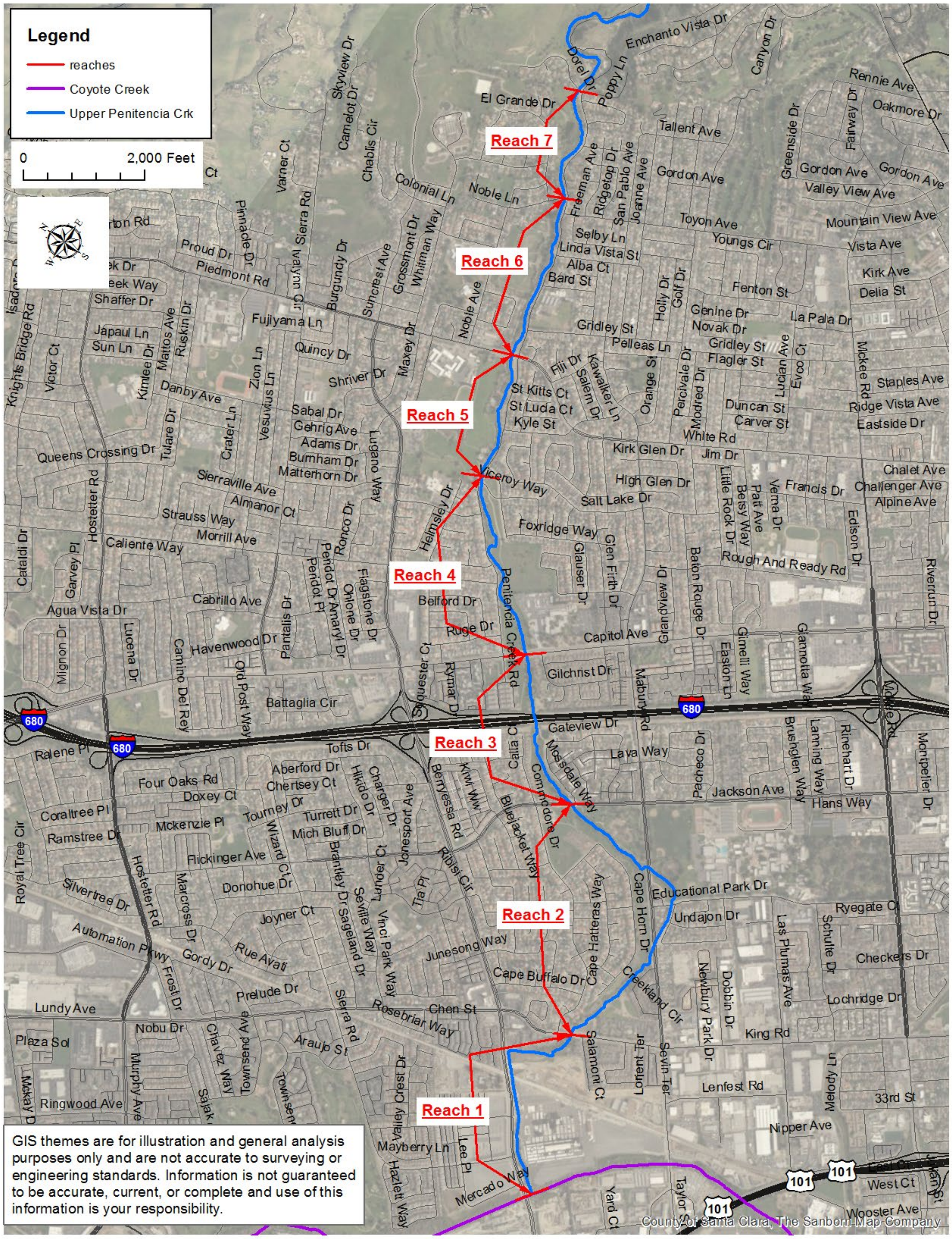


Figure 1. Project Reach Map

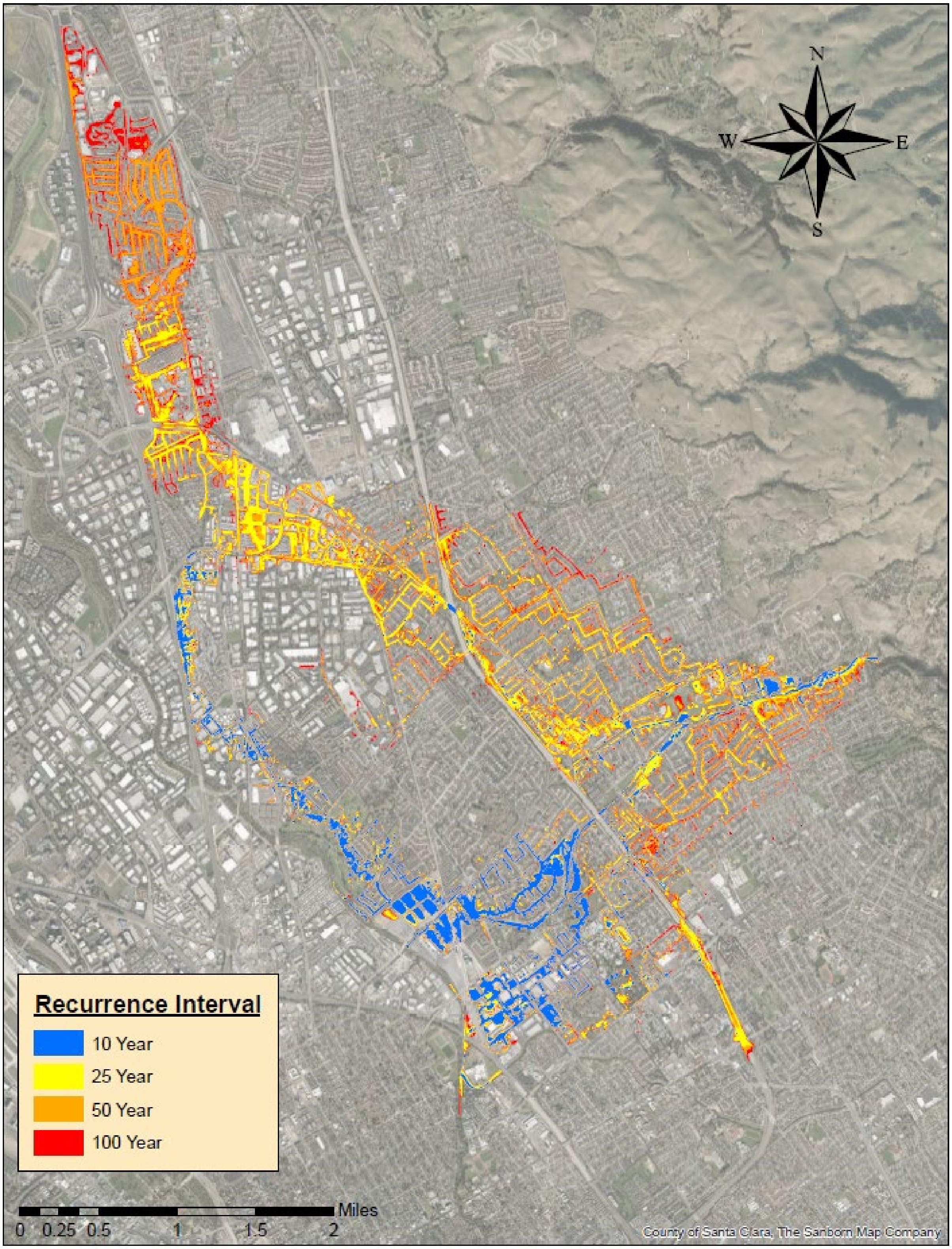


Figure 2. Flood Events Extents

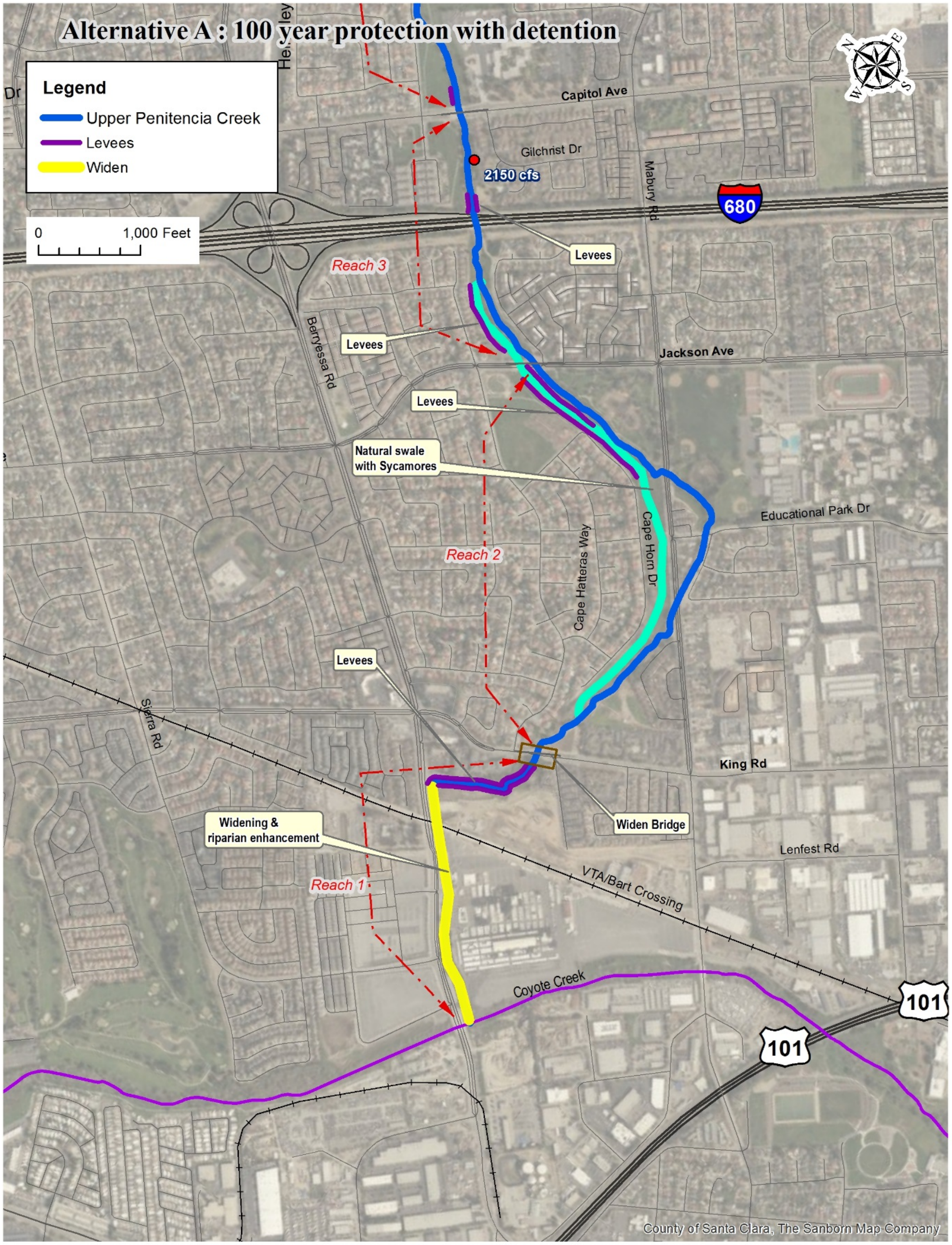


Figure 3. Alternative A Downstream Reaches

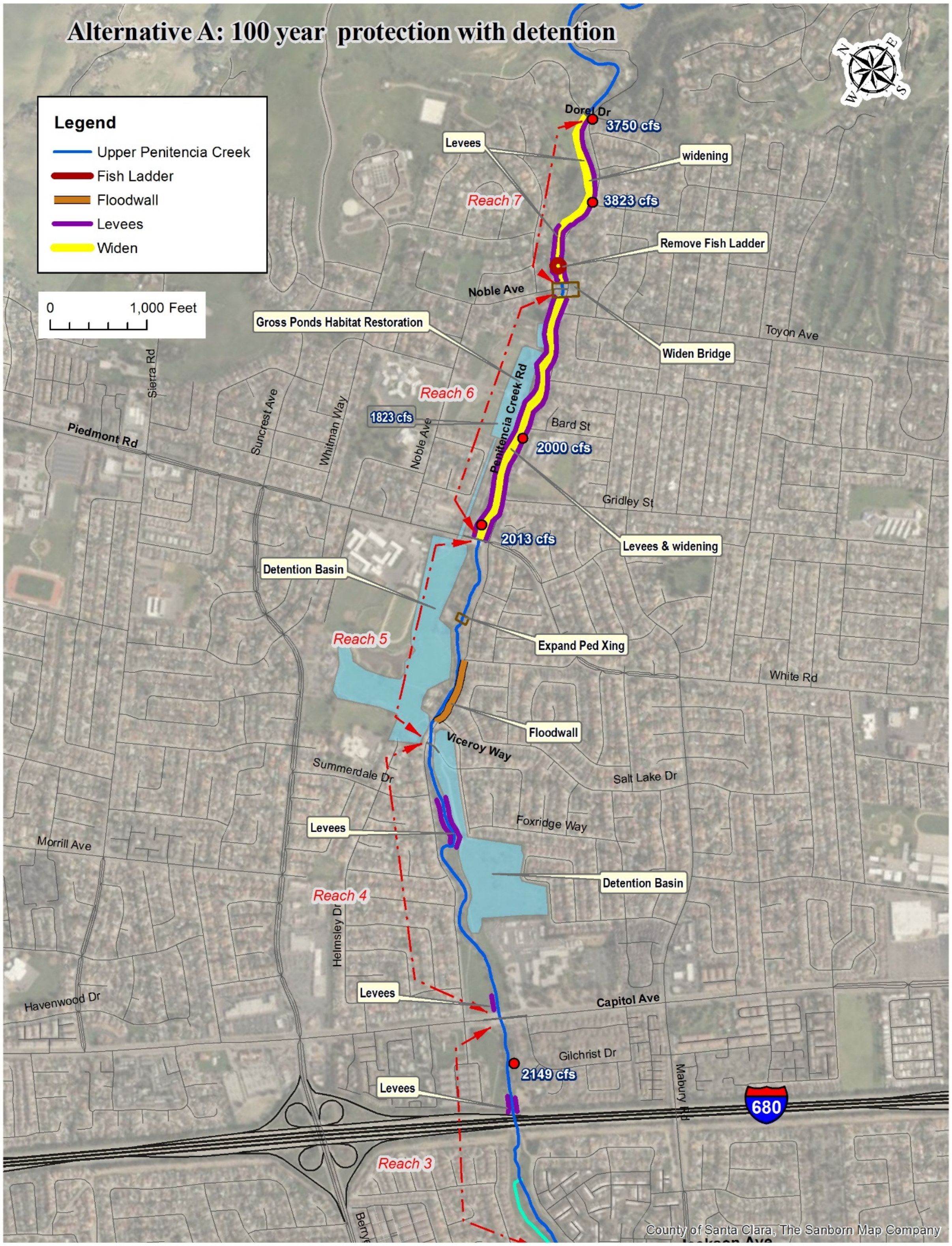


Figure 4. Alternative A Upstream Reaches

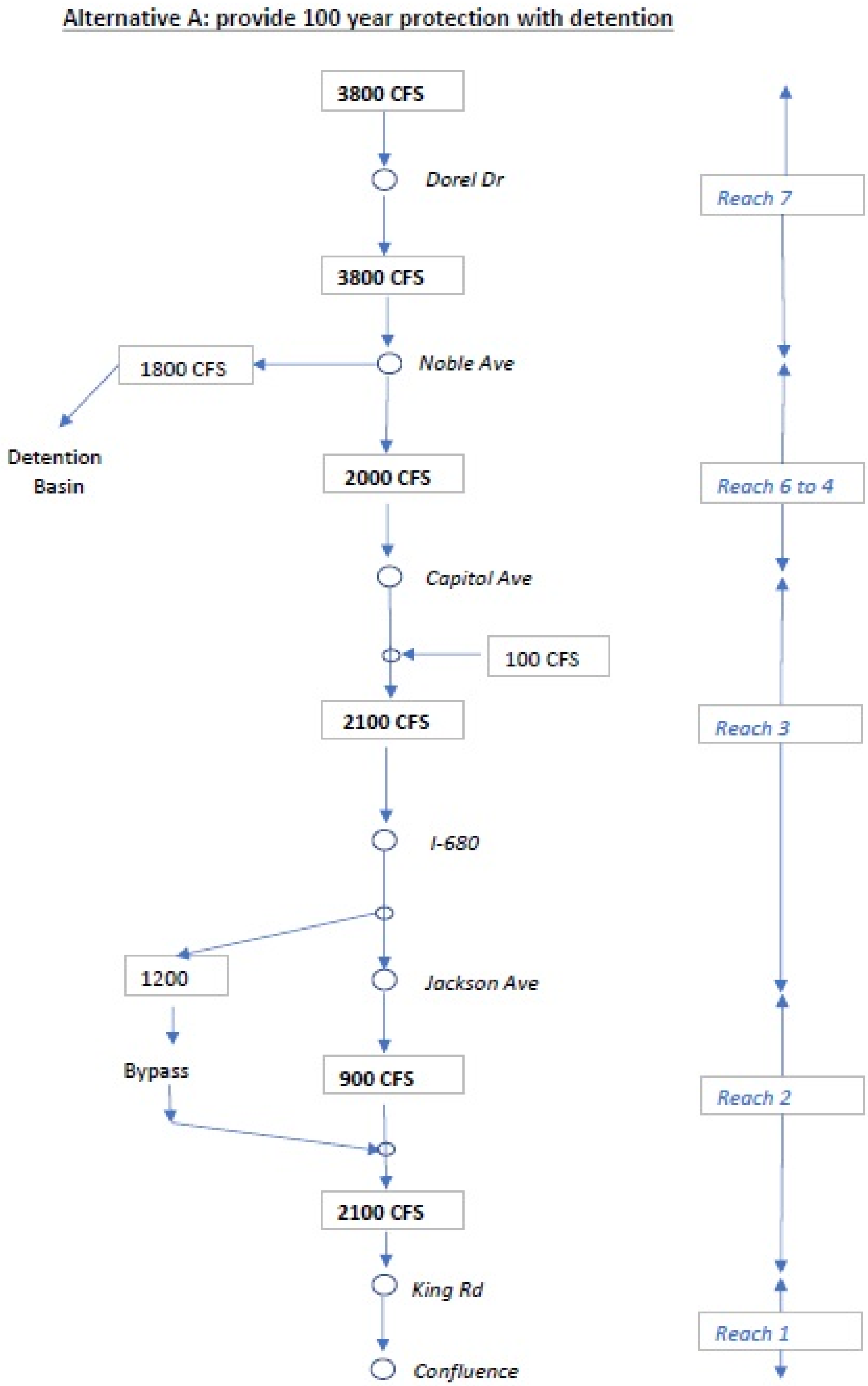


Figure 5. Alternative A Flow Diagram

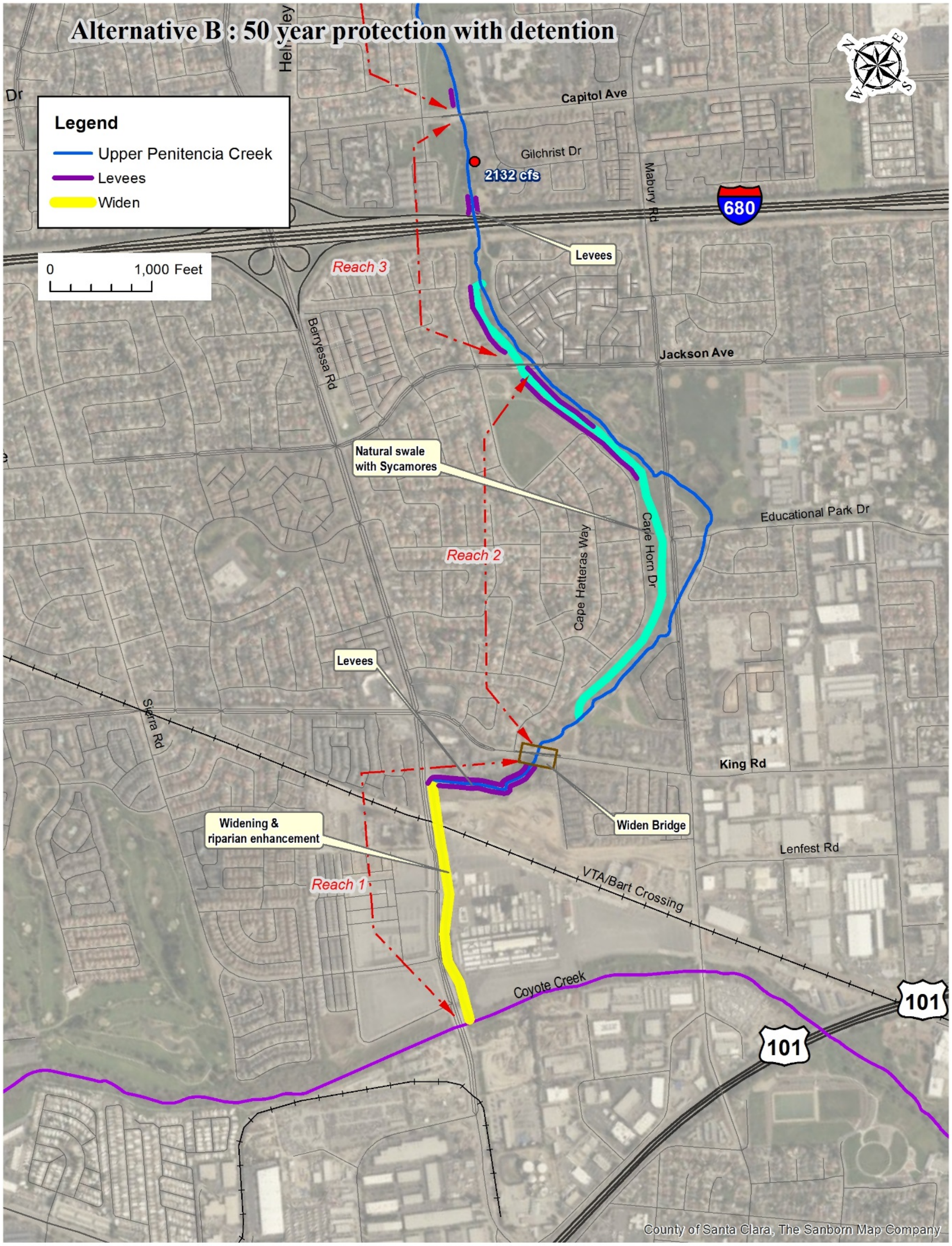


Figure 6. Alternative B Downstream Reaches

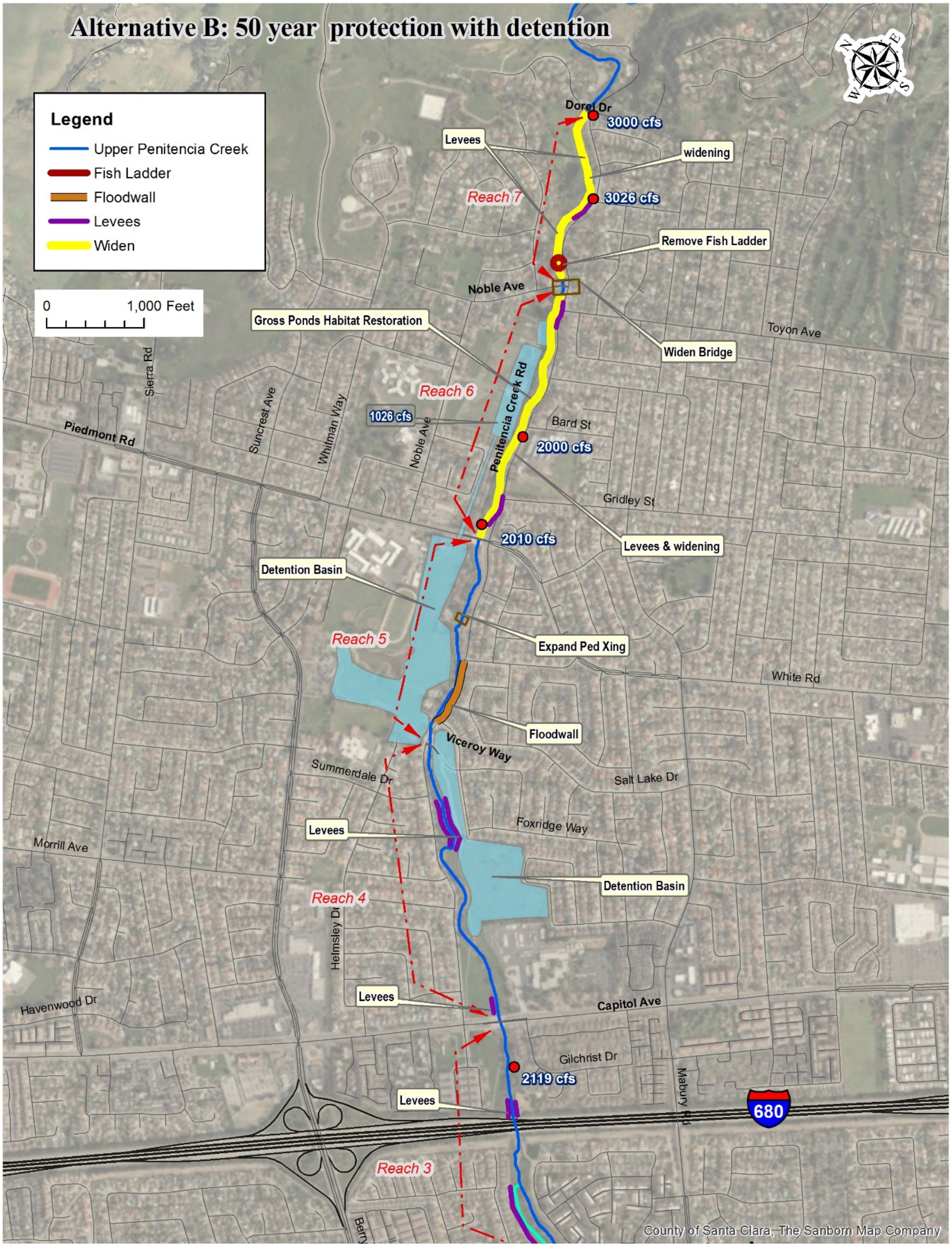


Figure 7. Alternative B Upstream Reaches

Alternative B: provide 50 year protection with detention

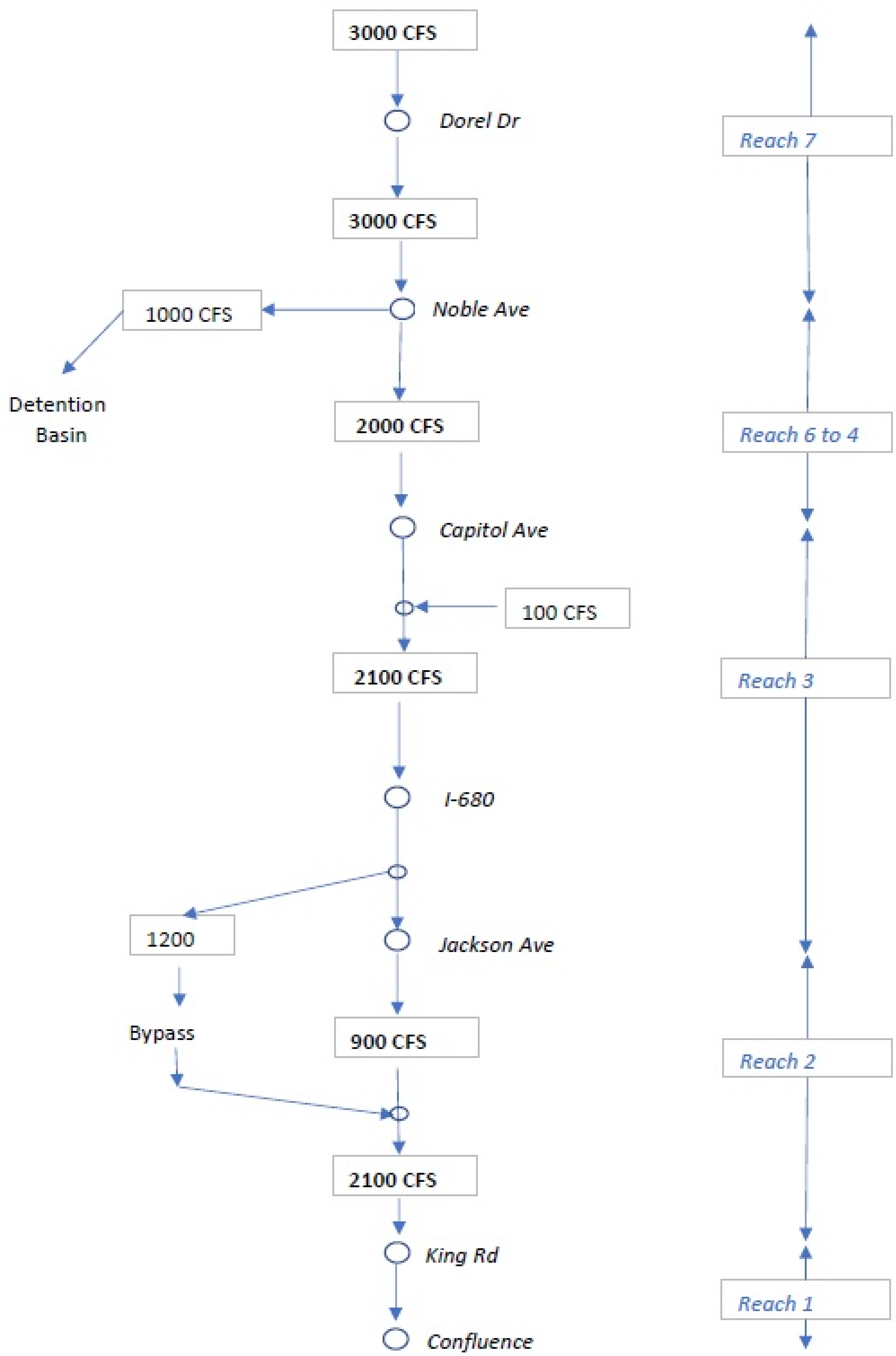


Figure 8. Alternative B Flow Diagram

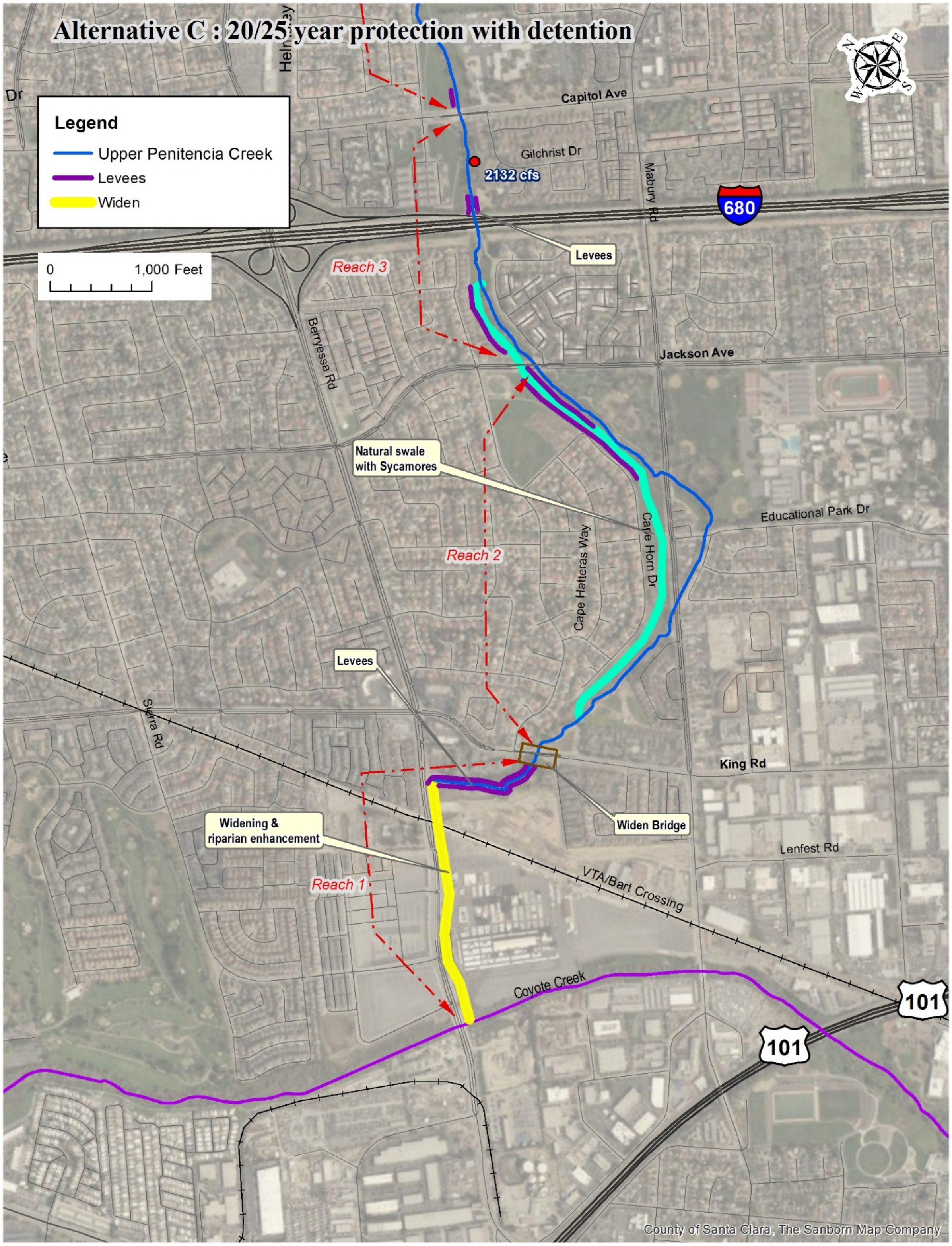


Figure 9. Alternative C Downstream Reaches

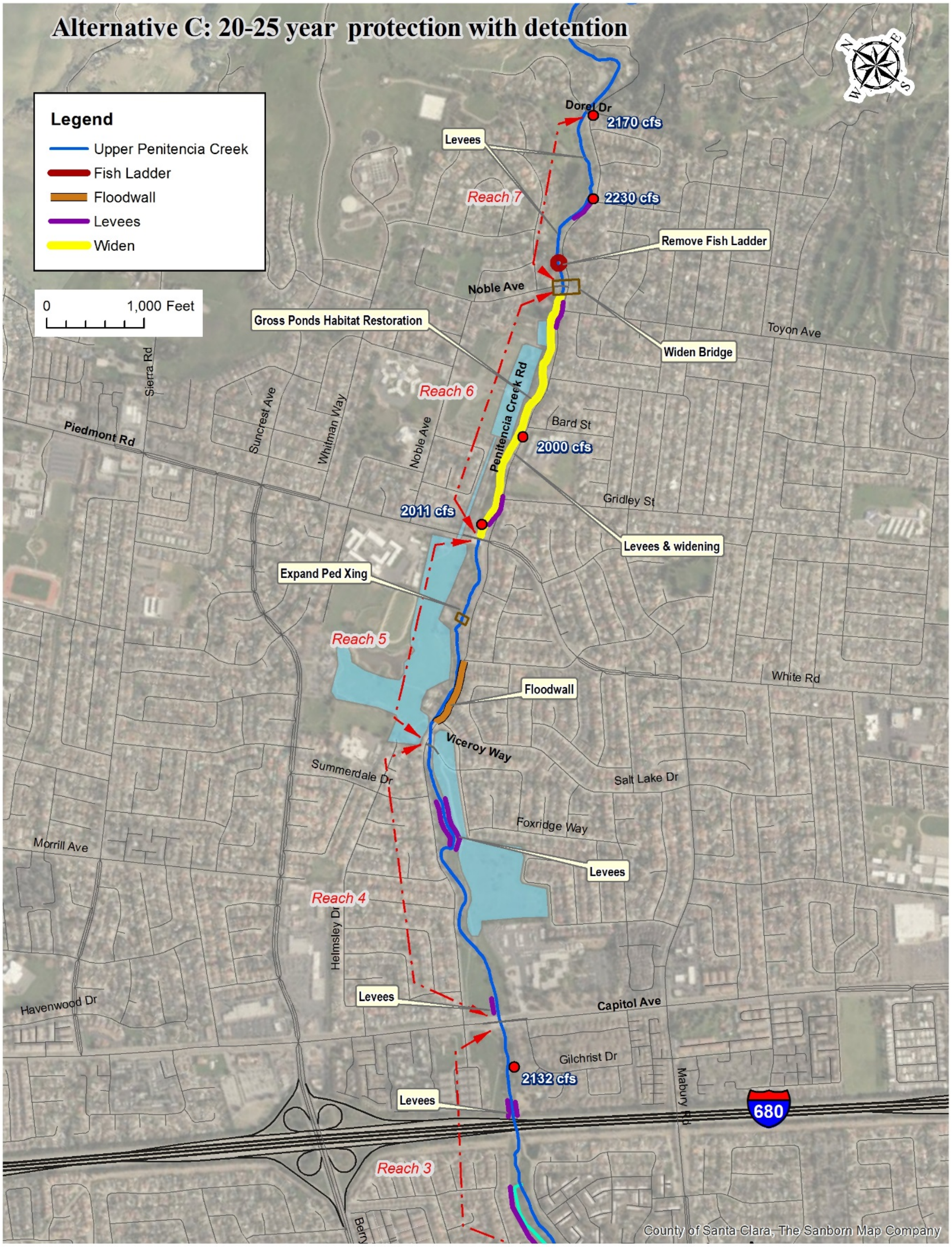


Figure 10. Alternative C Upstream Reaches

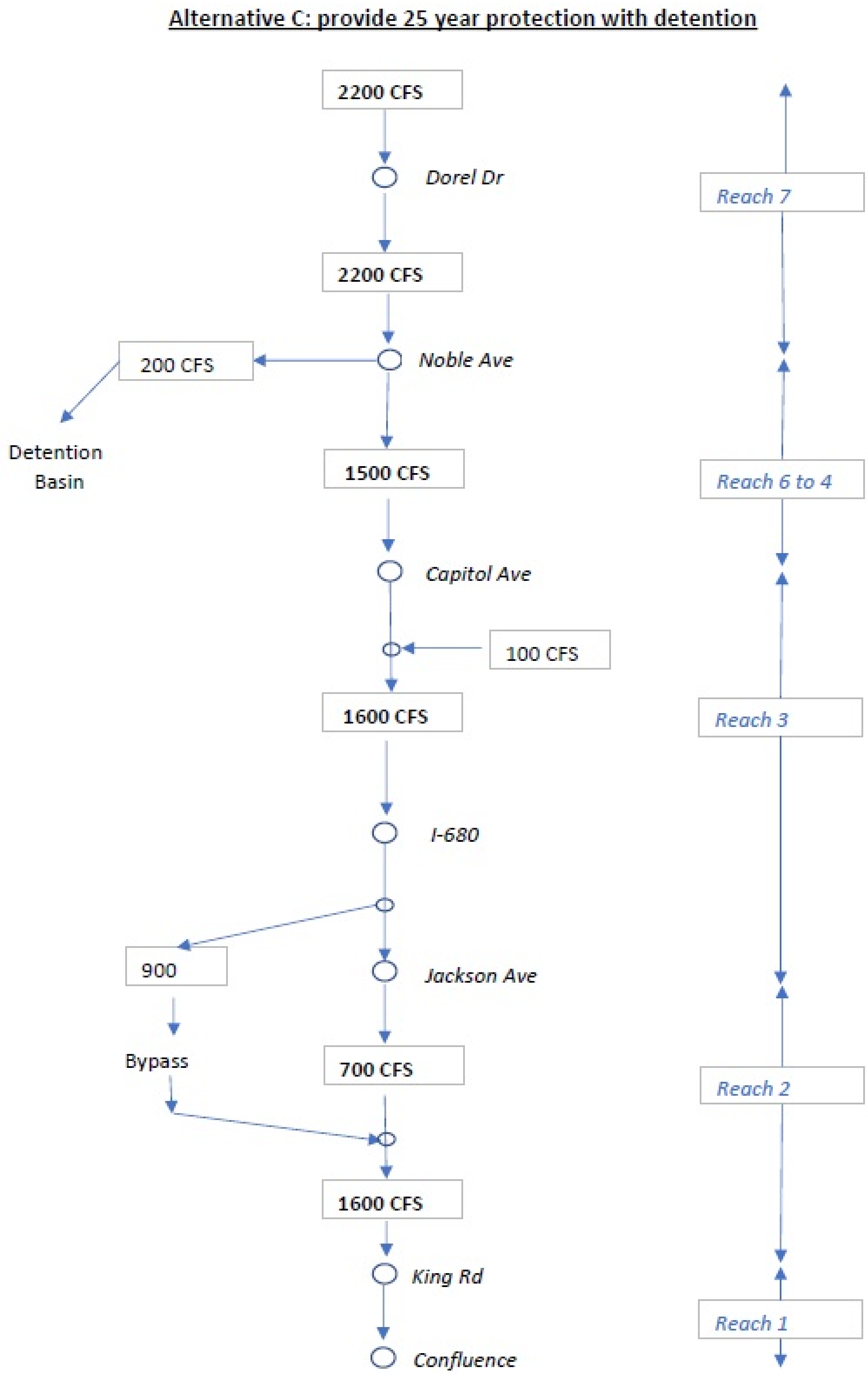


Figure 11. Alternative C Flow Diagram

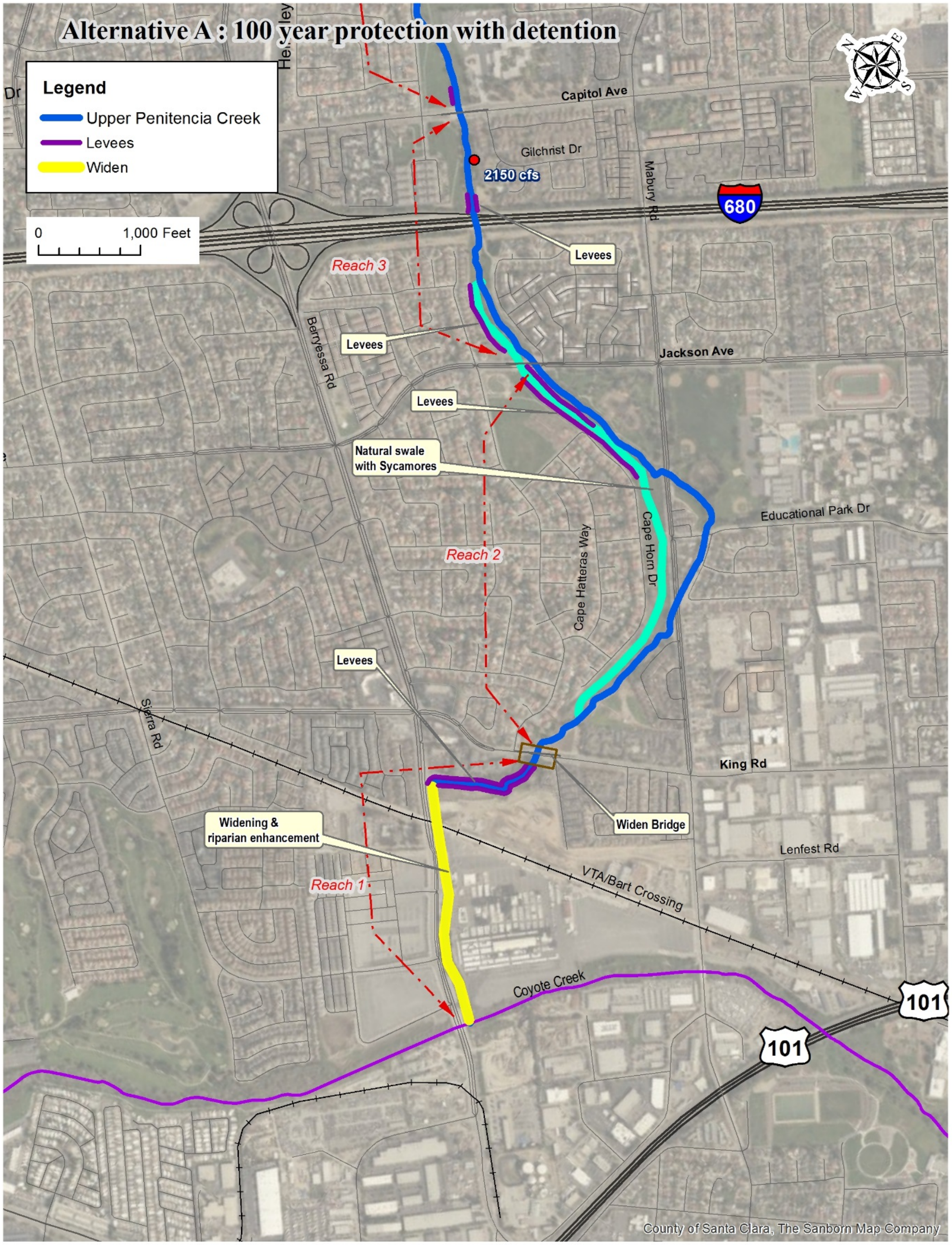


Figure 12. Alternative D Downstream Reaches

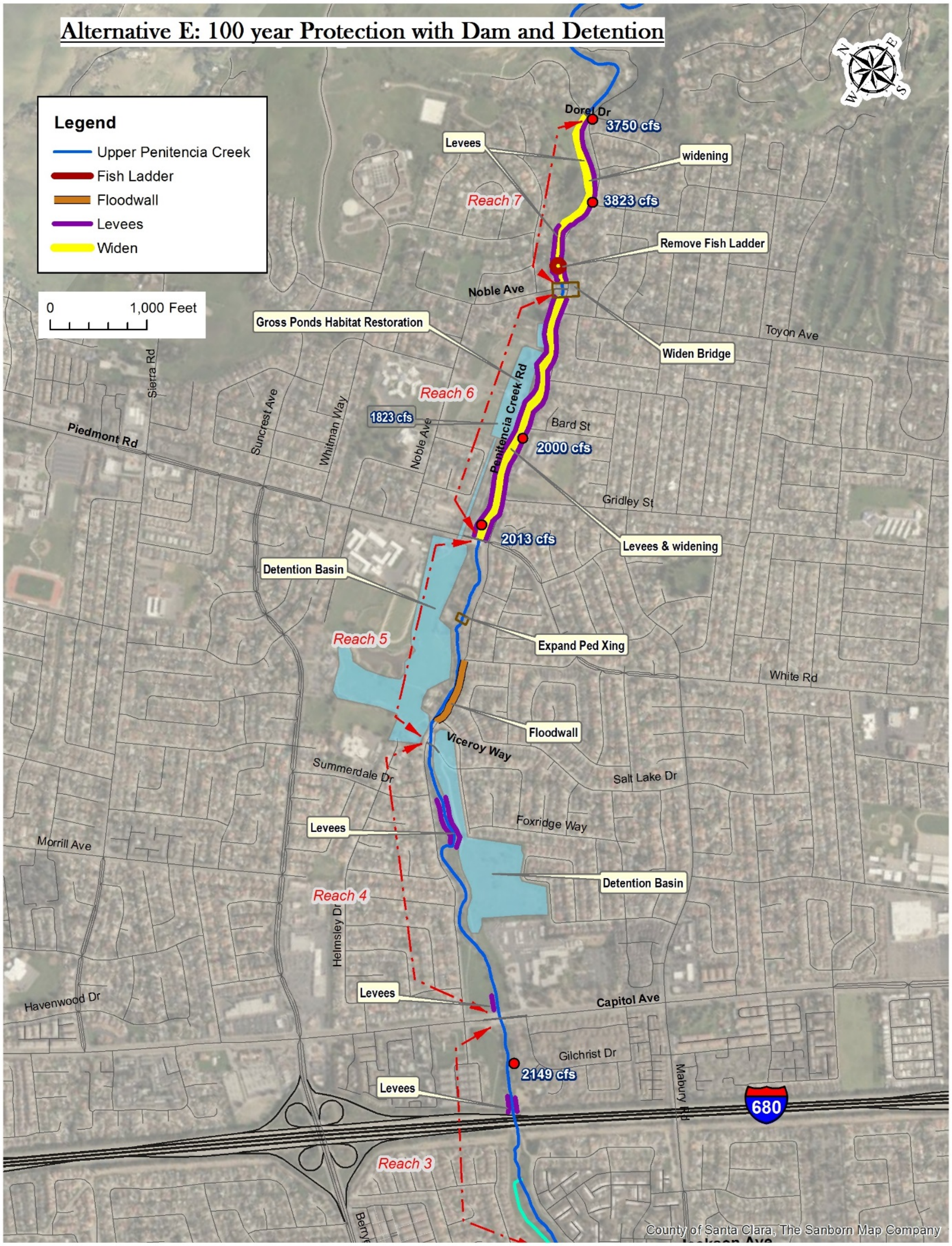


Figure 13. Alternative D Upstream Reaches

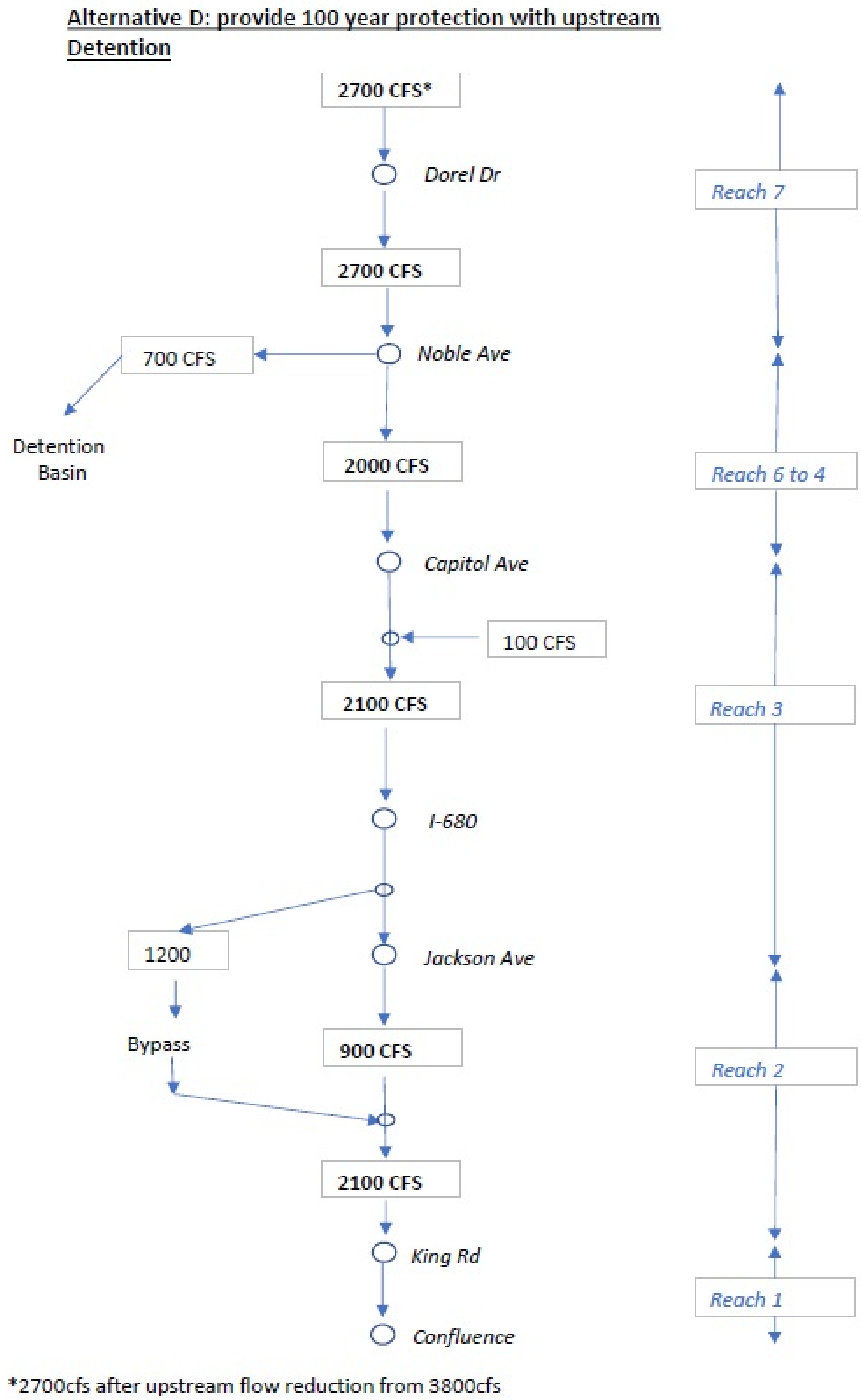


Figure 14. Alternative D Flow Diagram

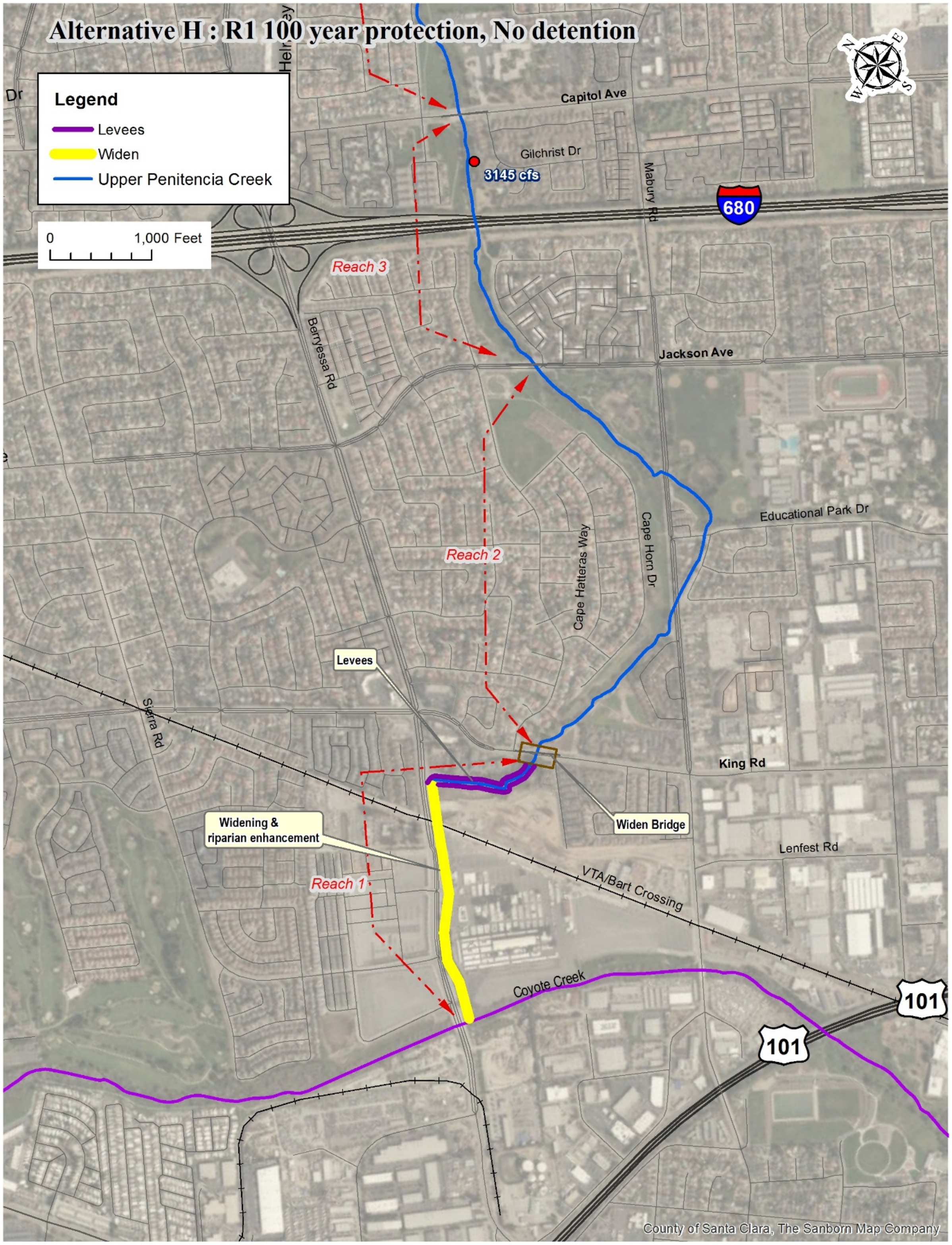


Figure 15. Alternative E

Alternative E: Reach 1 100 year Protection

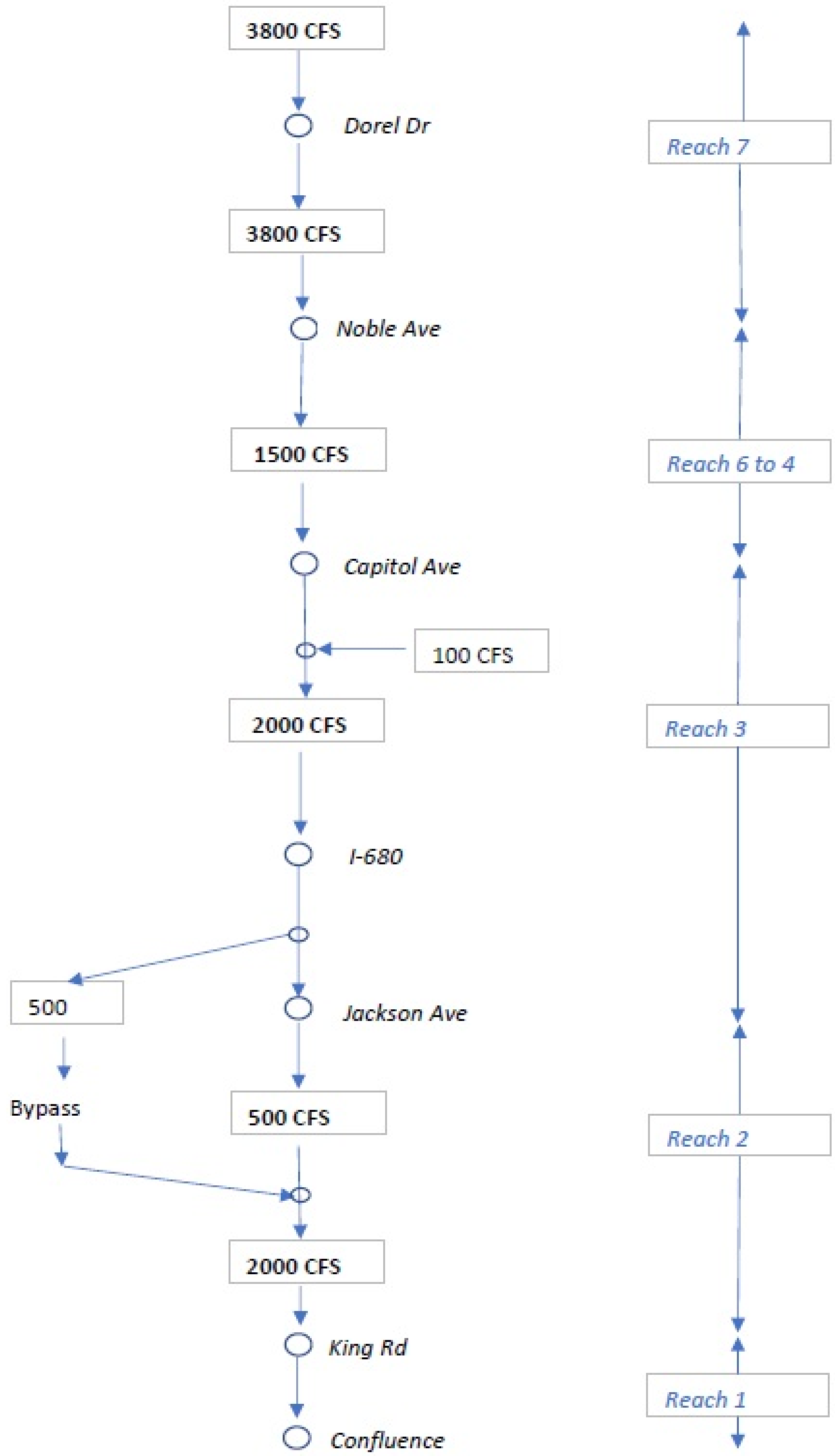


Figure 16. Alternative E Flow Diagram

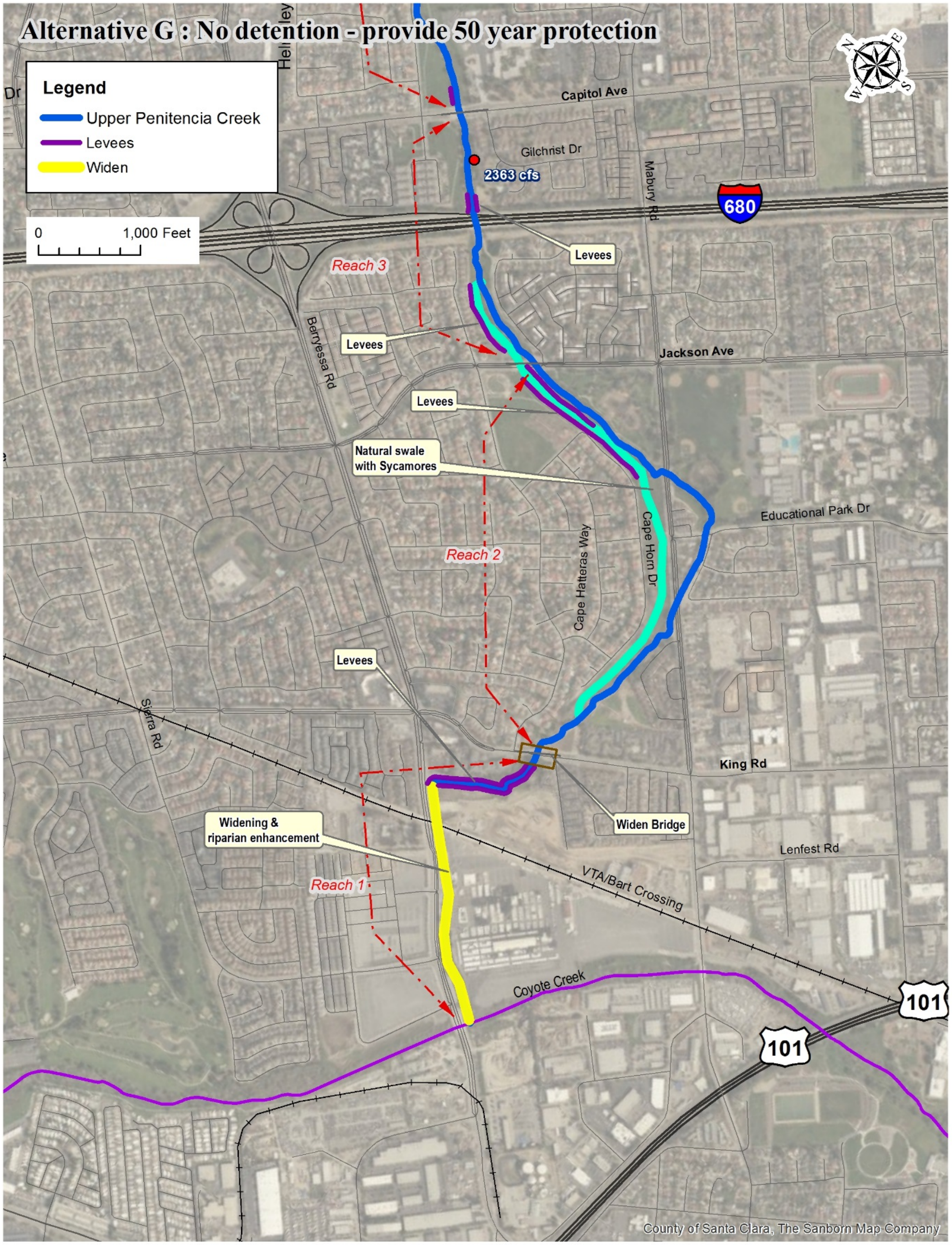


Figure 17. Alternative F Downstream Reaches

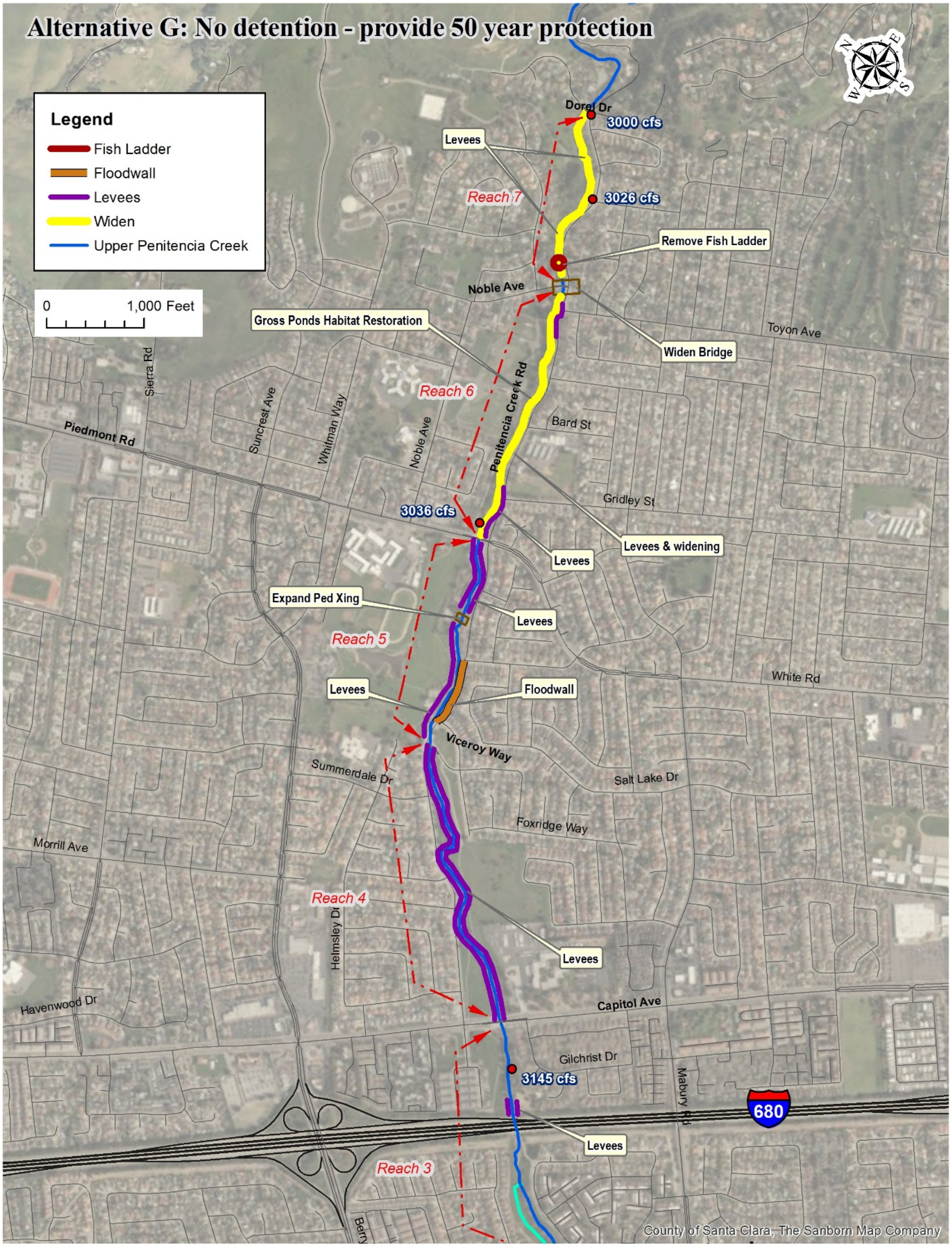


Figure 18. Alternative F Upstream Reaches

Alternative F: provide 100 year protection with no detention

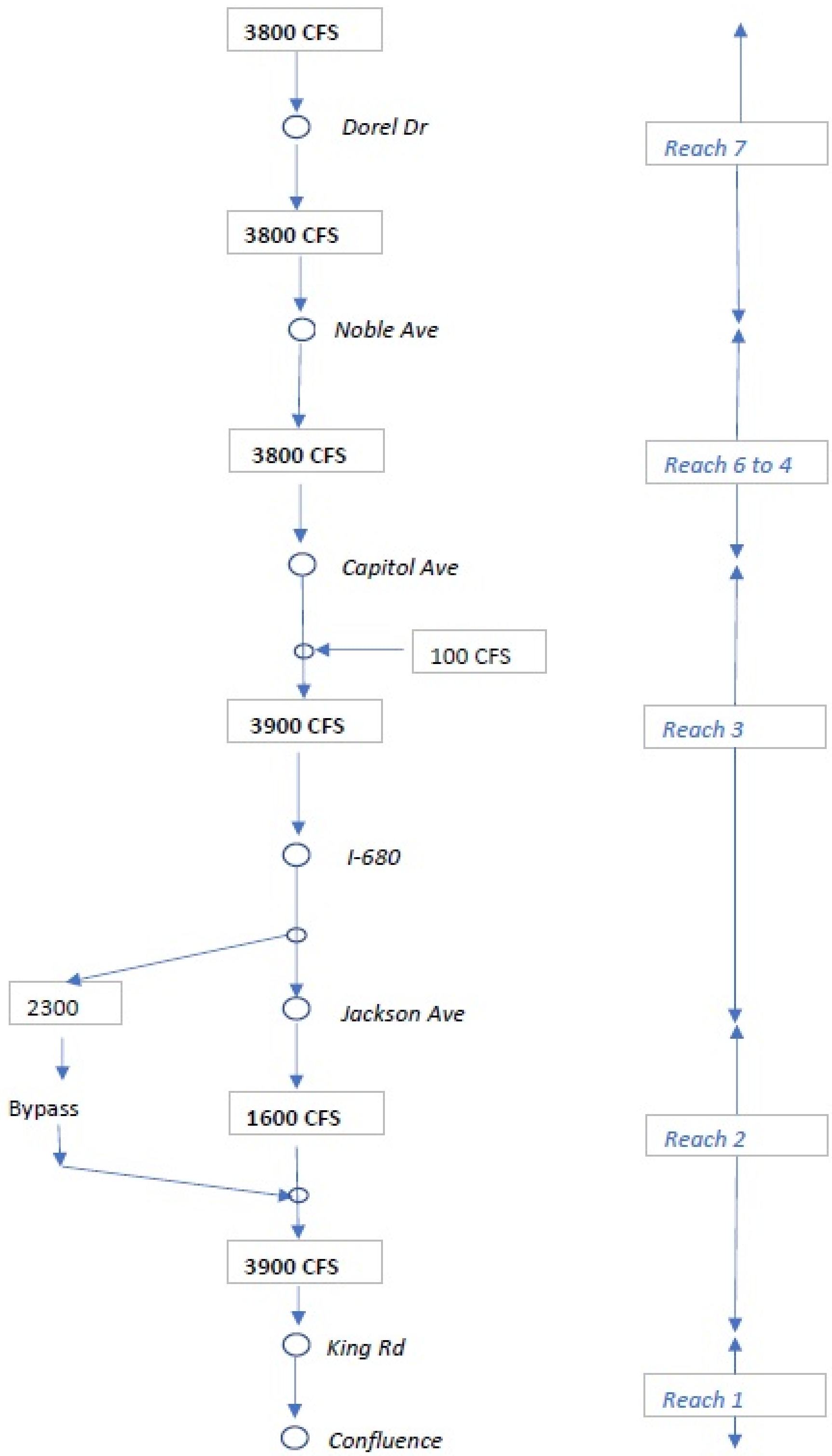


Figure 19. Alternative F Flow Diagram

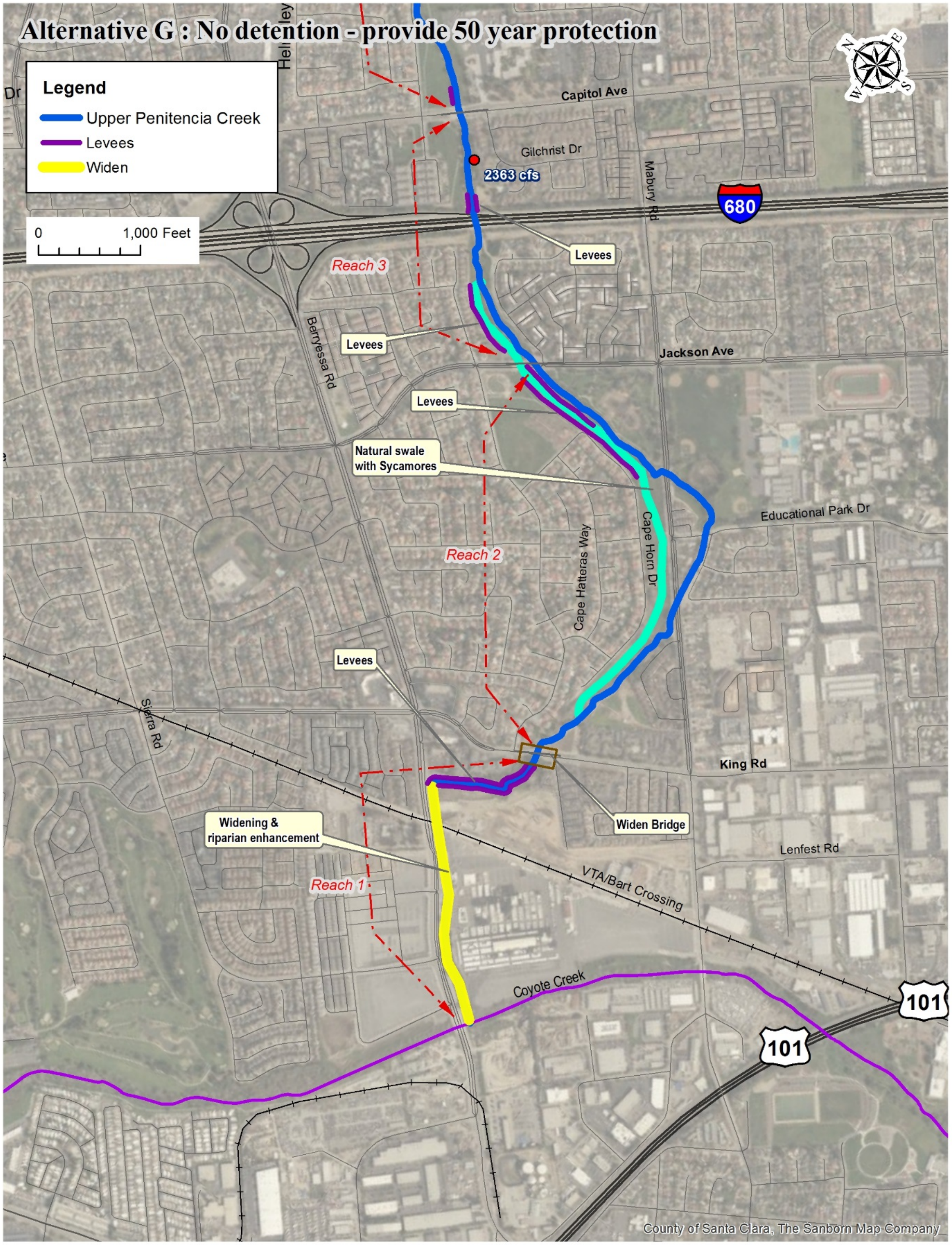


Figure 20. Alternative G Downstream Reaches

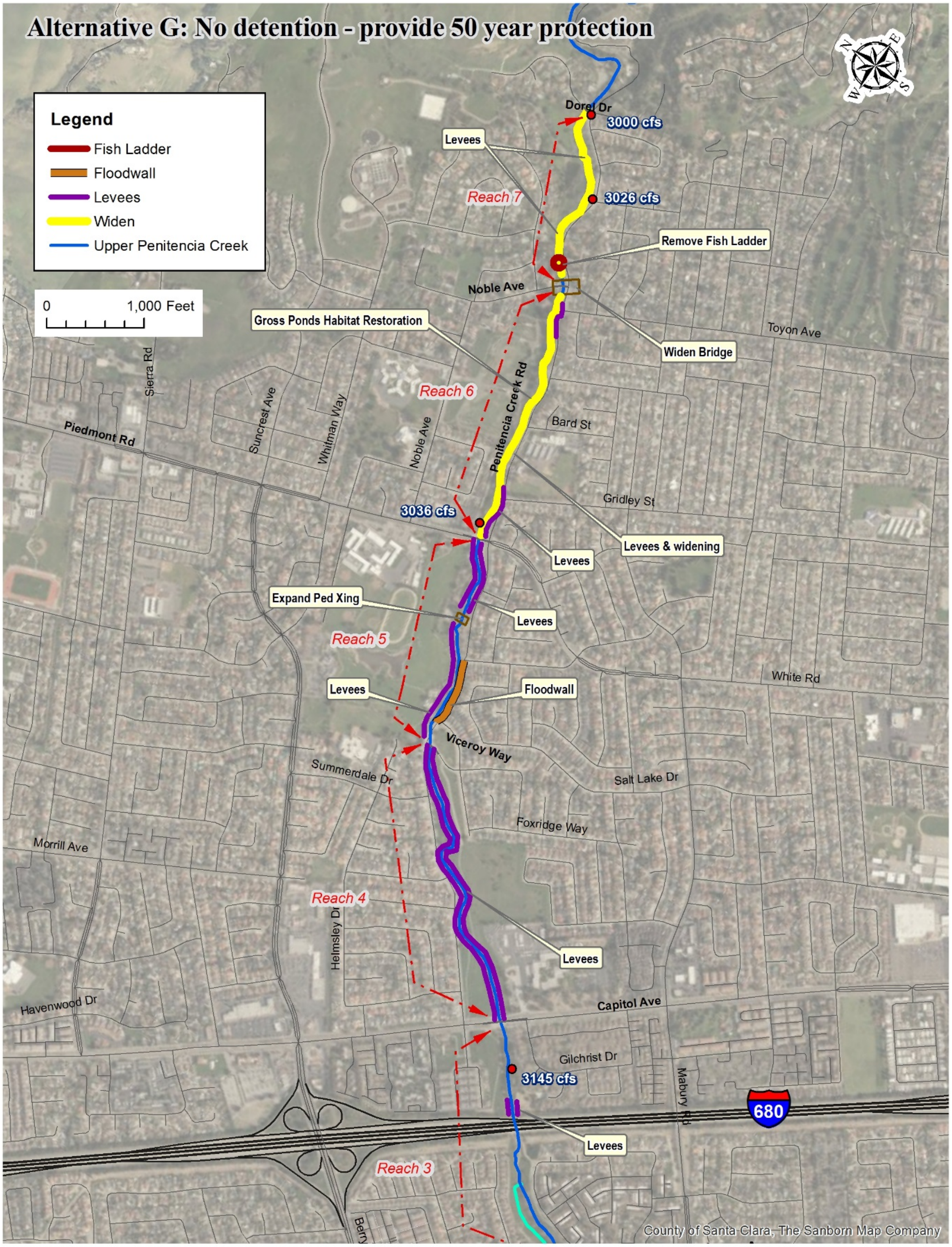


Figure 21. Alternative G Upstream Reaches

Alternative G: No detention -provide 50 year protection

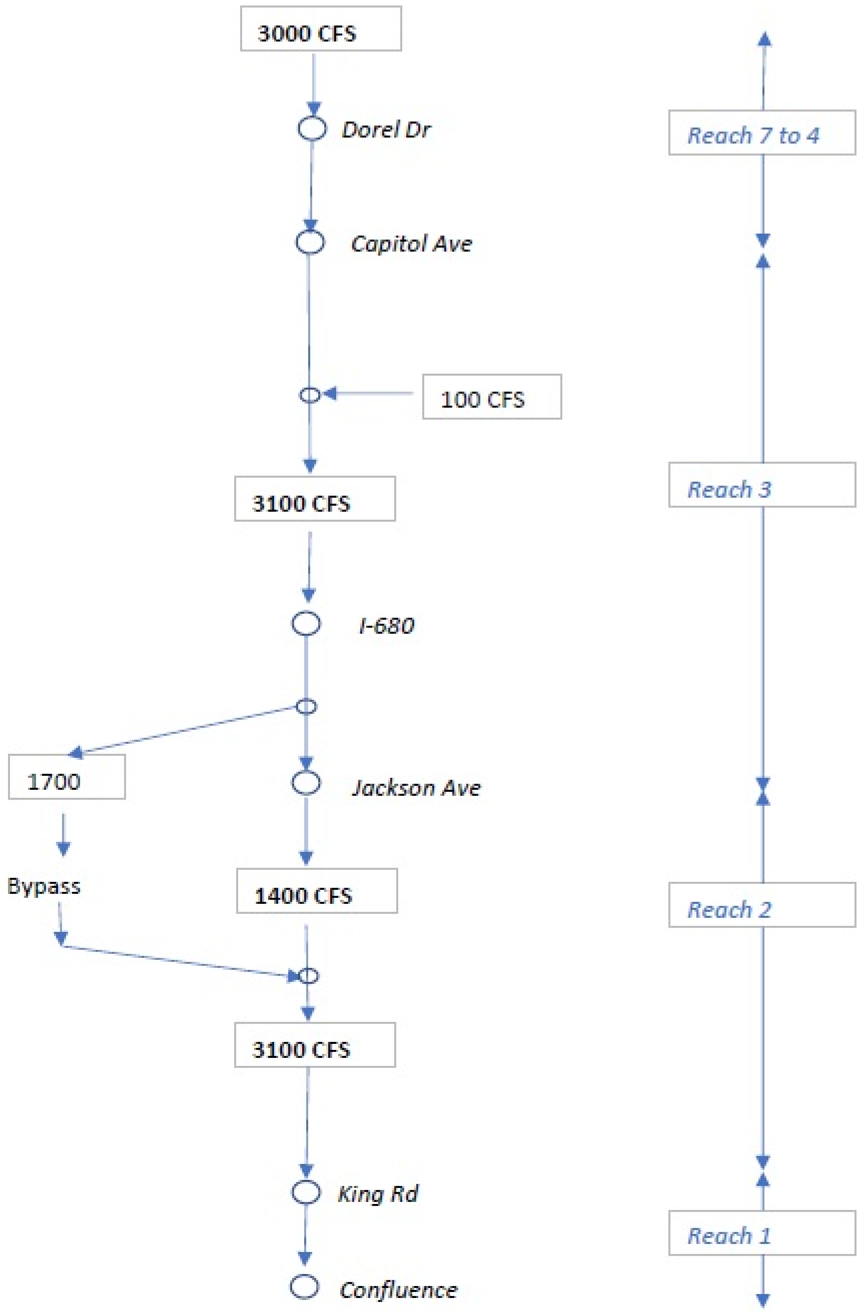


Figure 22. Alternative G Flow Diagram

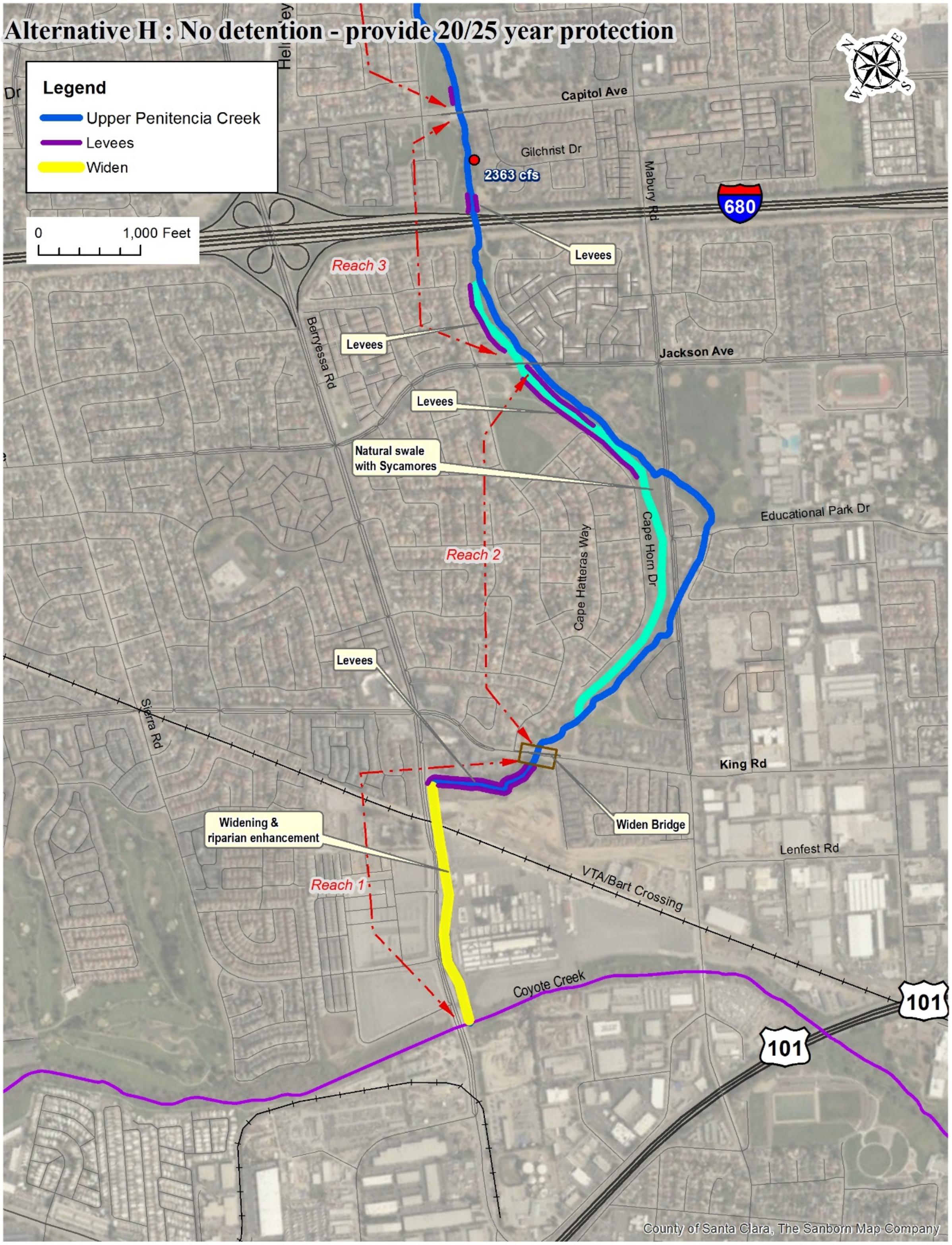


Figure 23. Alternative H Downstream Reaches

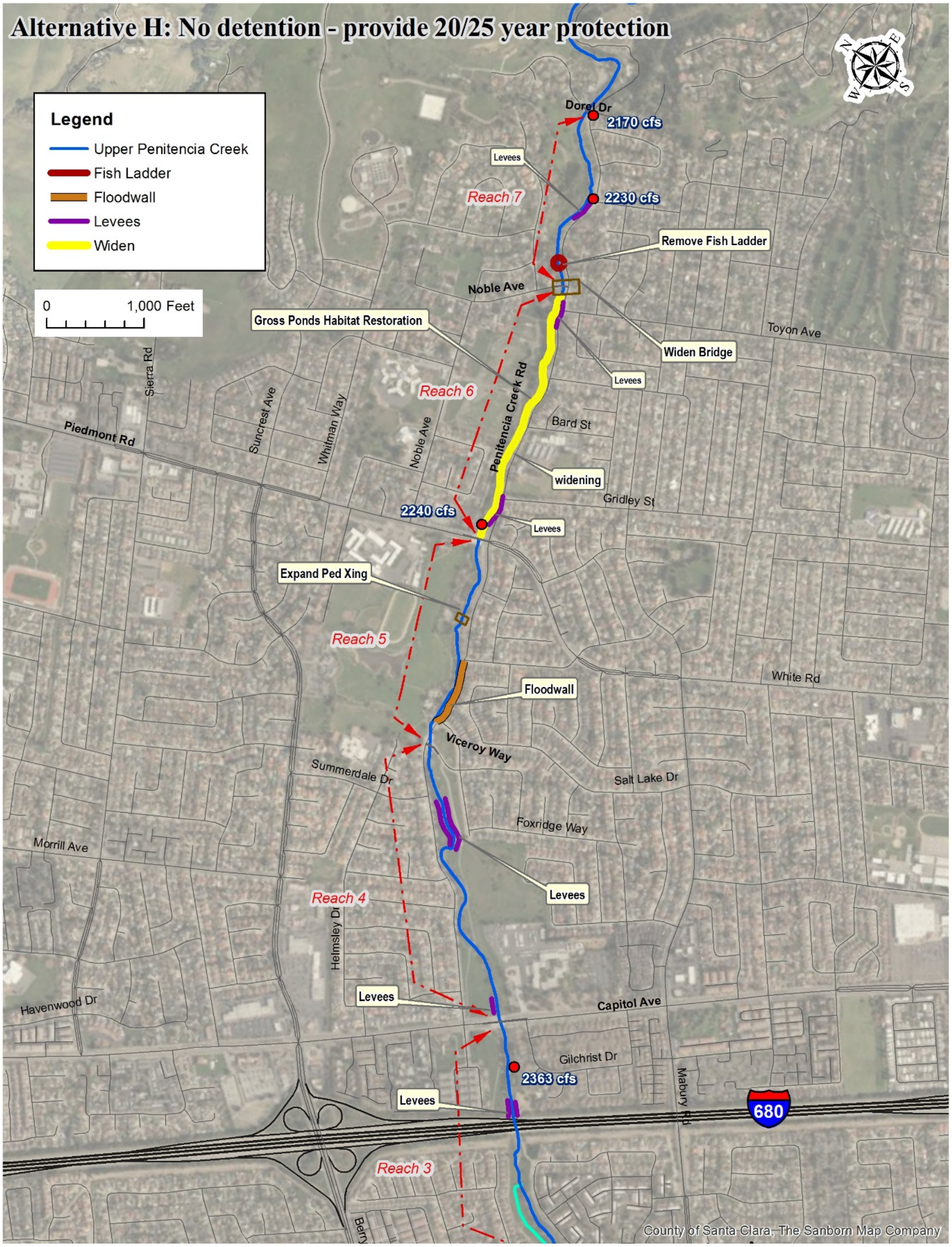
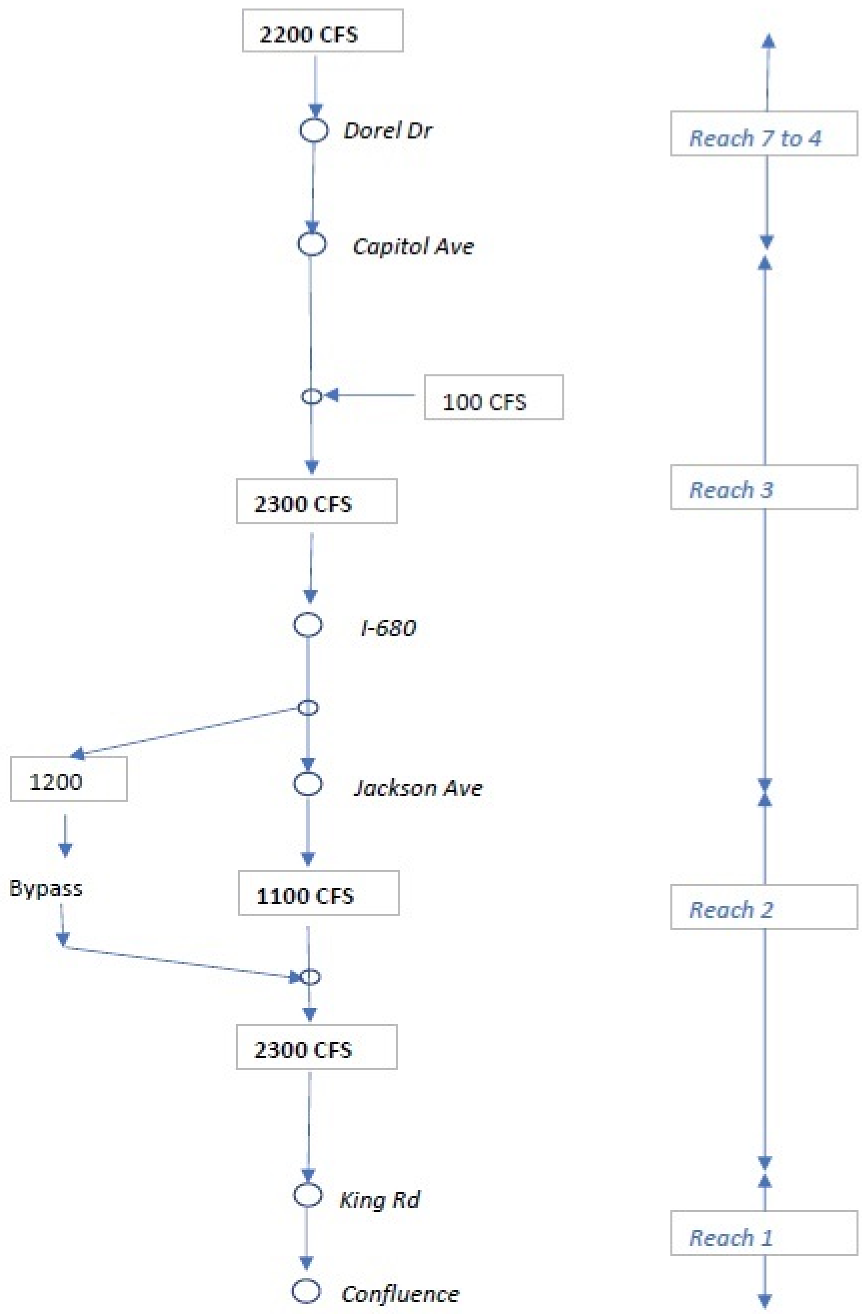


Figure 24. Alternative H Upstream Reaches

Alternative H: No detention -provide 25 year protection



Fiugre 25. Alternative H Flow Diagram

Alternative I: No Project

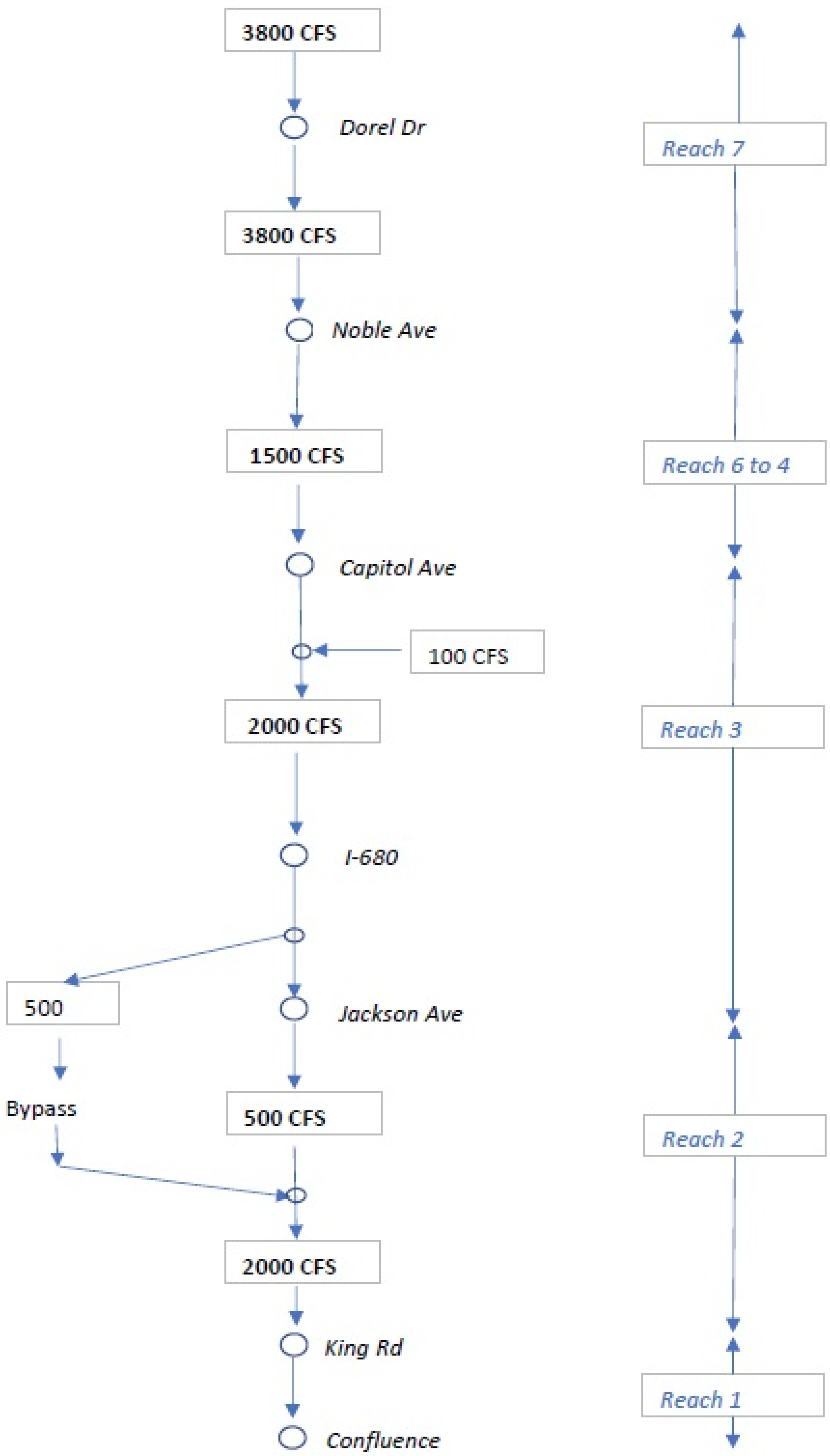


Figure 26. Alternative I Flow Diagram

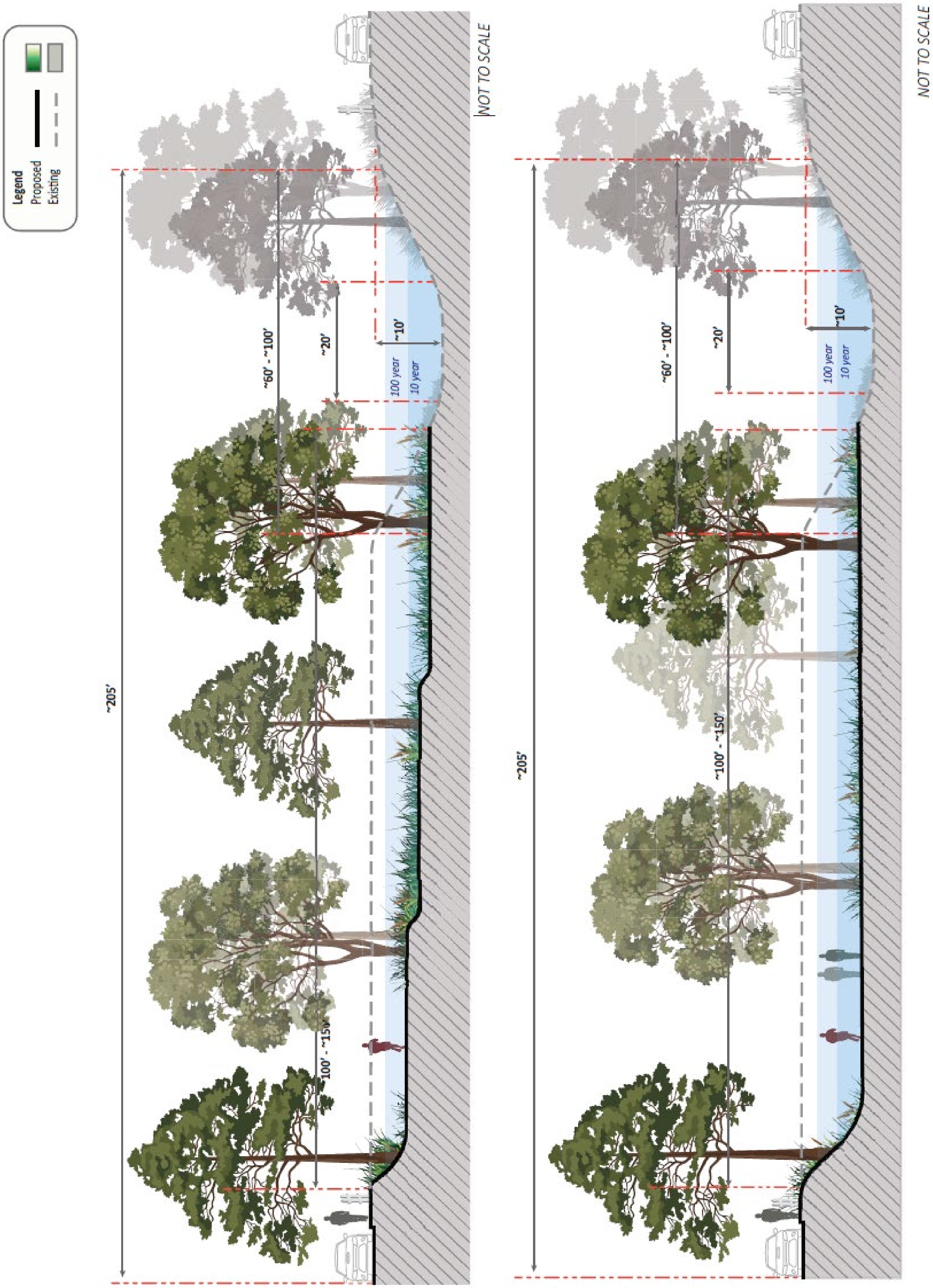


Figure 27: Reach 1 Cross Sections - Options 1A and 1B

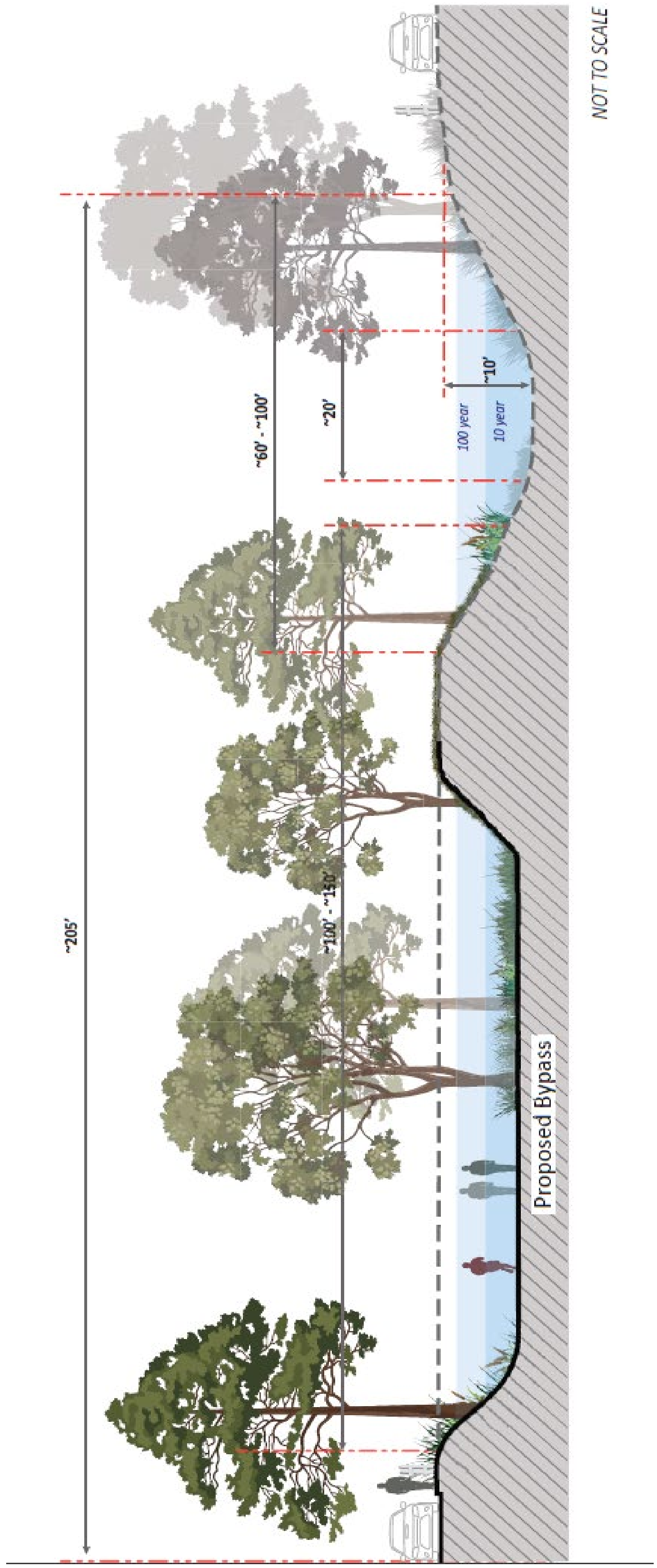


Figure 28: Reach 1 Cross Section - Options 1C

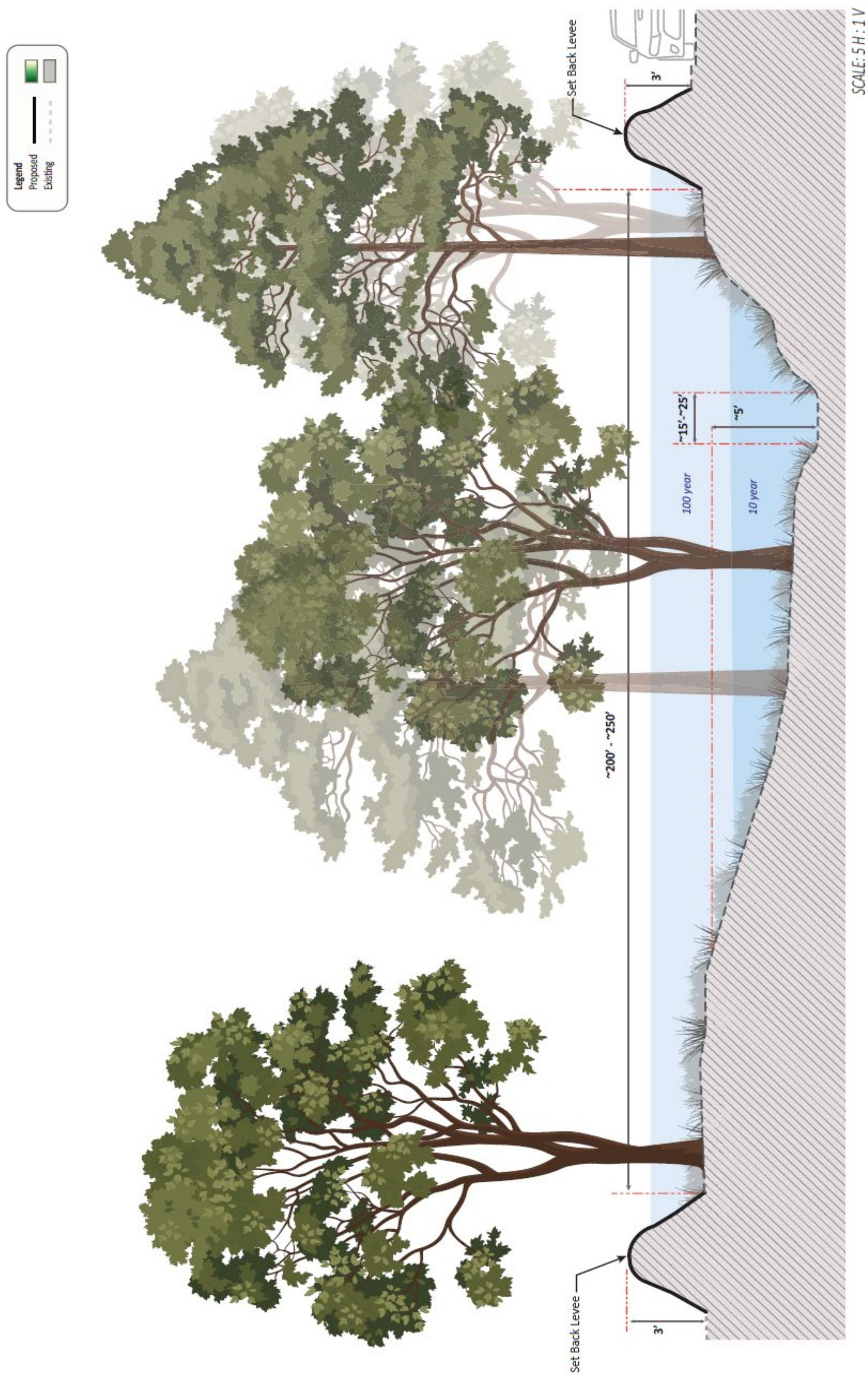


Figure 29: Reach 2 Mabury Bypass Cross Section

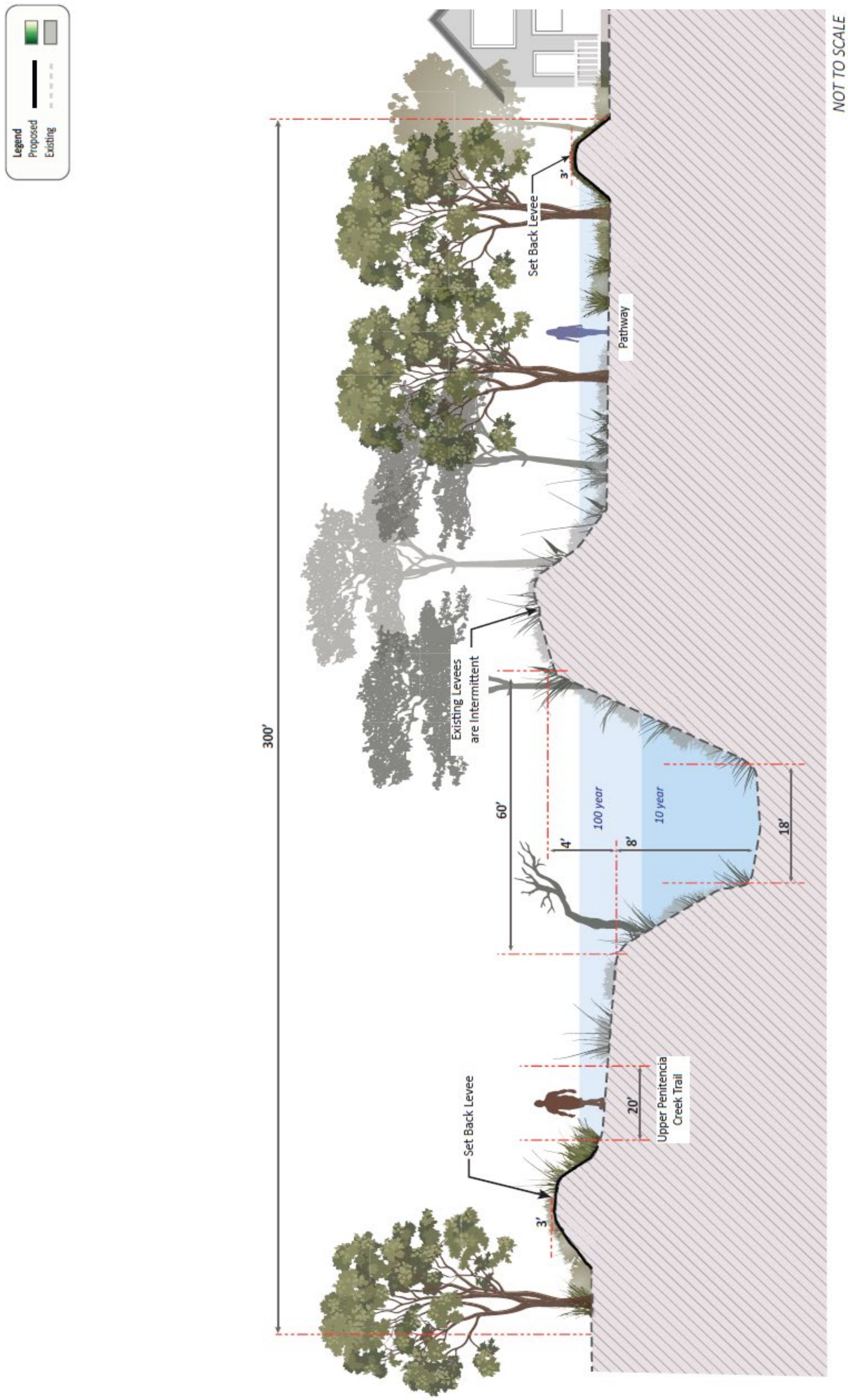


Figure 30: Reach 3 Cross Section (Upstream of Hwy 680)

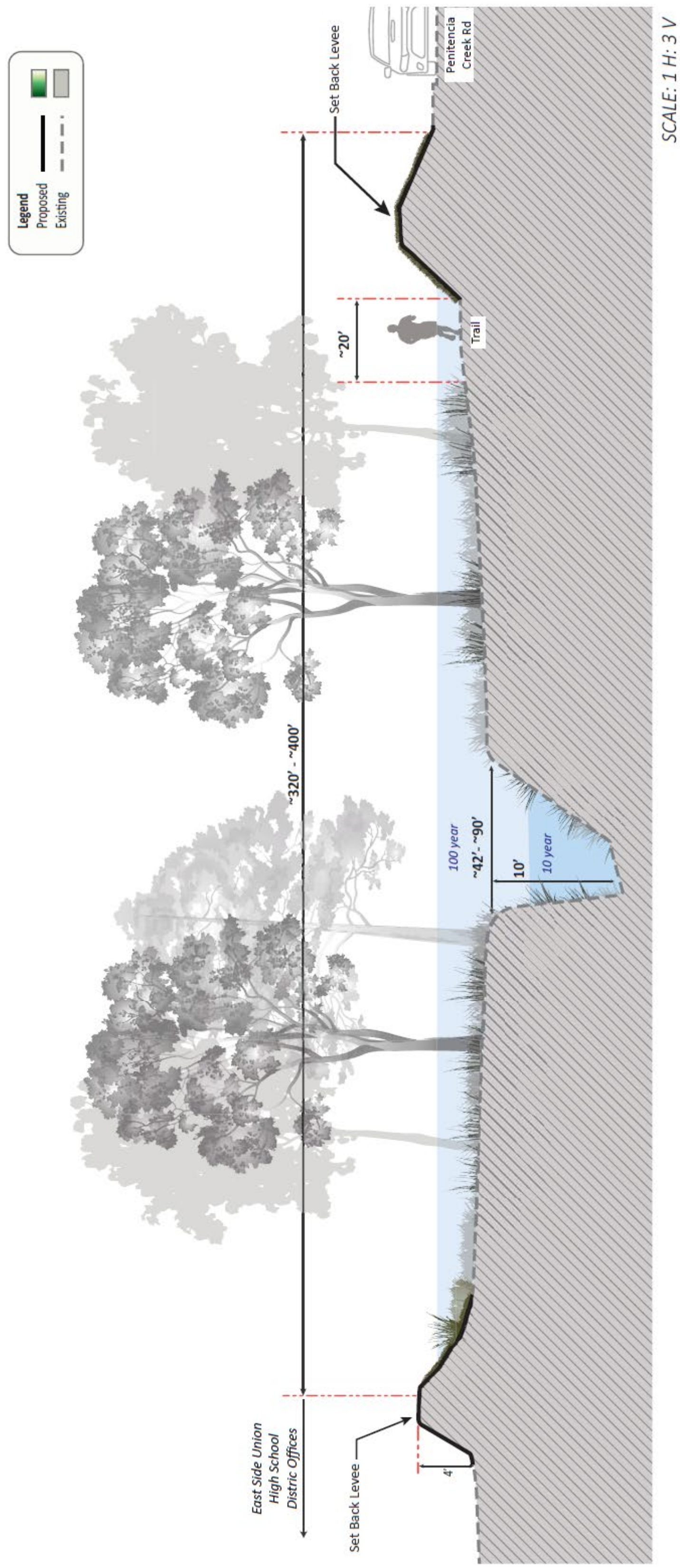


Figure 31: Reach 4 Cross Section

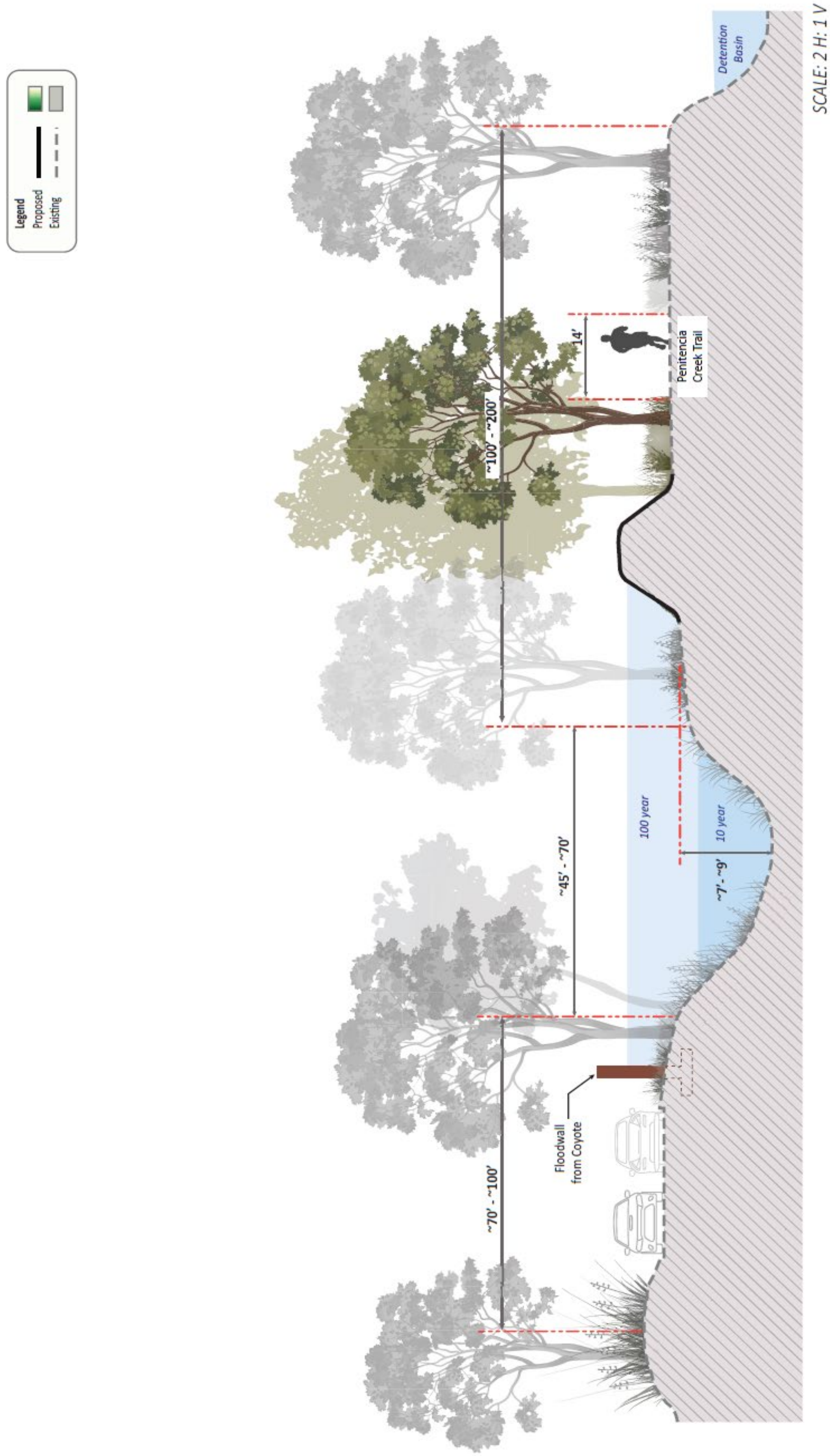


Figure 32: Reach 5 Cross Section

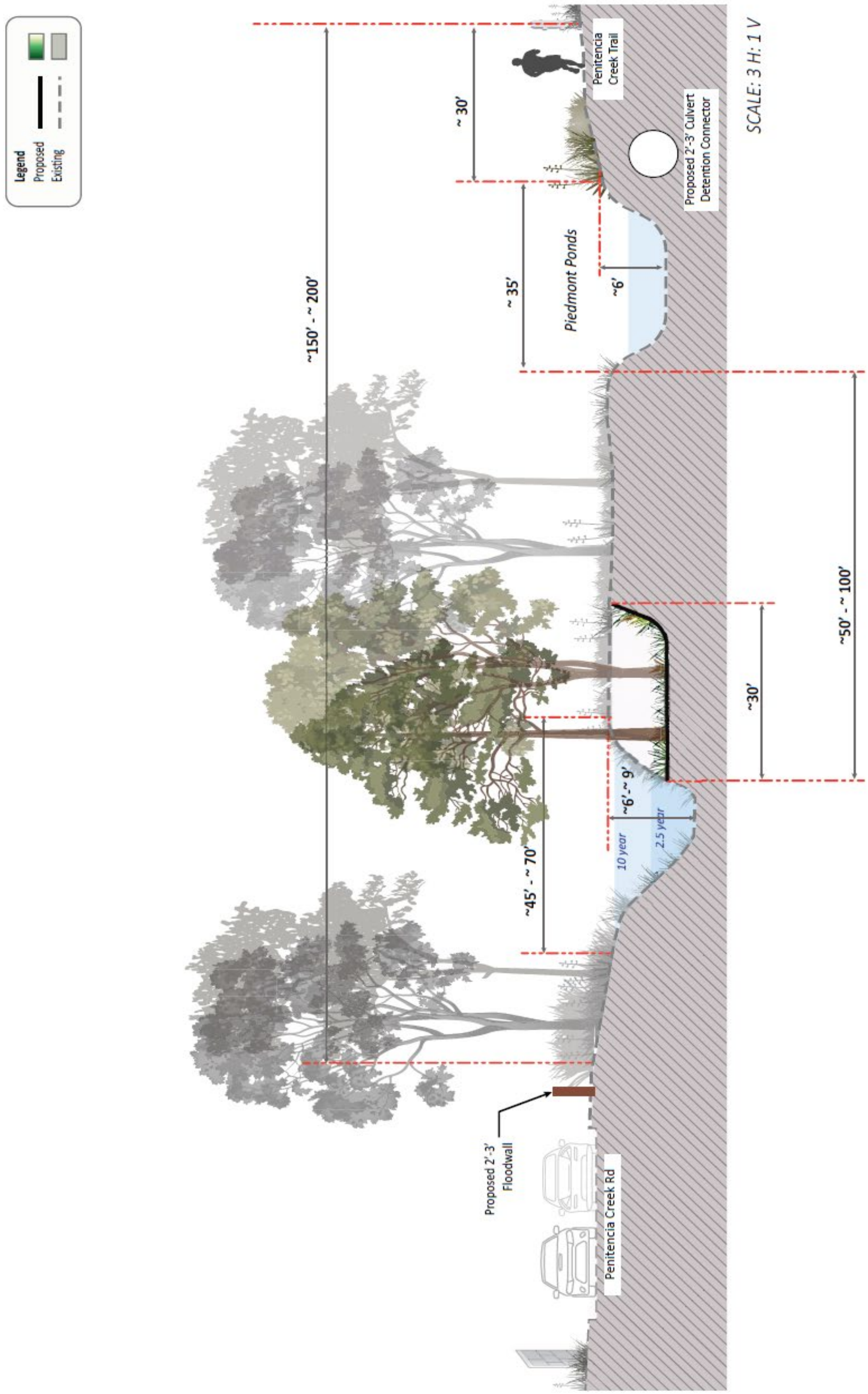


Figure 33: Reach 6 Cross Section

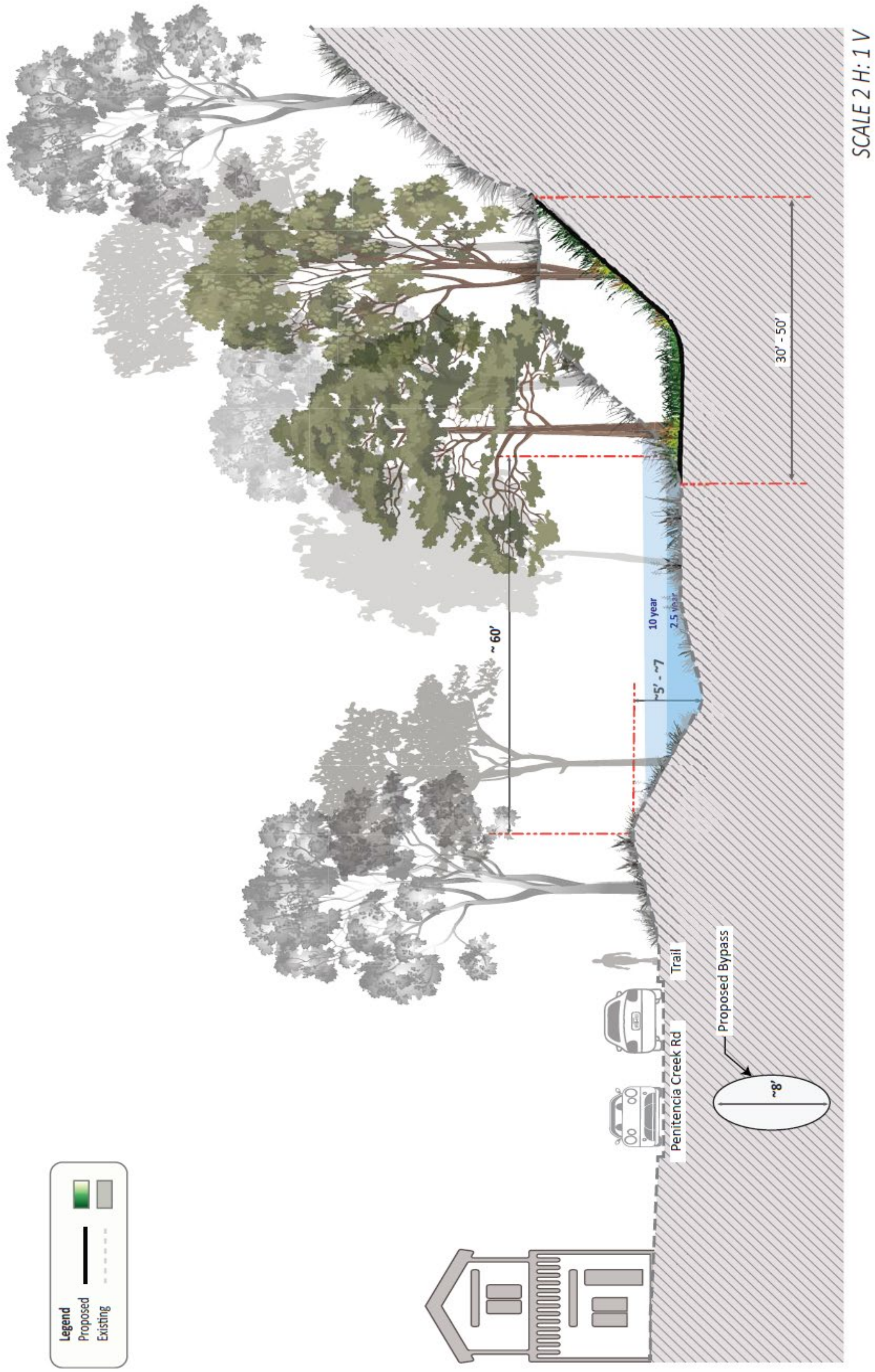


Figure 34: Reach 7 Cross Section (Channel Widening <u>OR</u> Bypass)

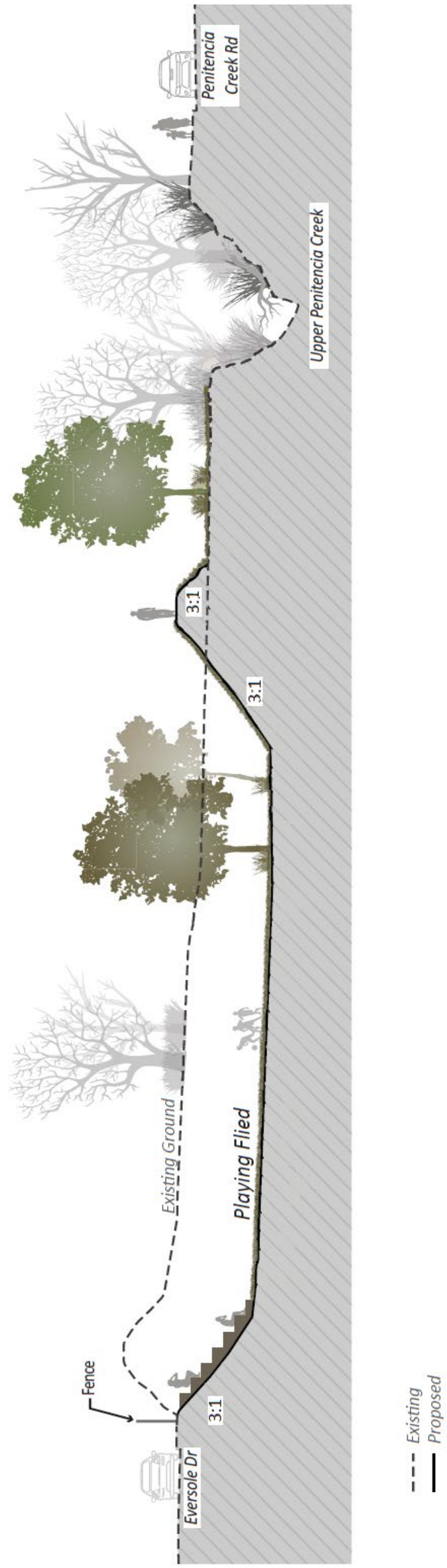


Figure 35: County Property Detention Cross Section (Reach 4)

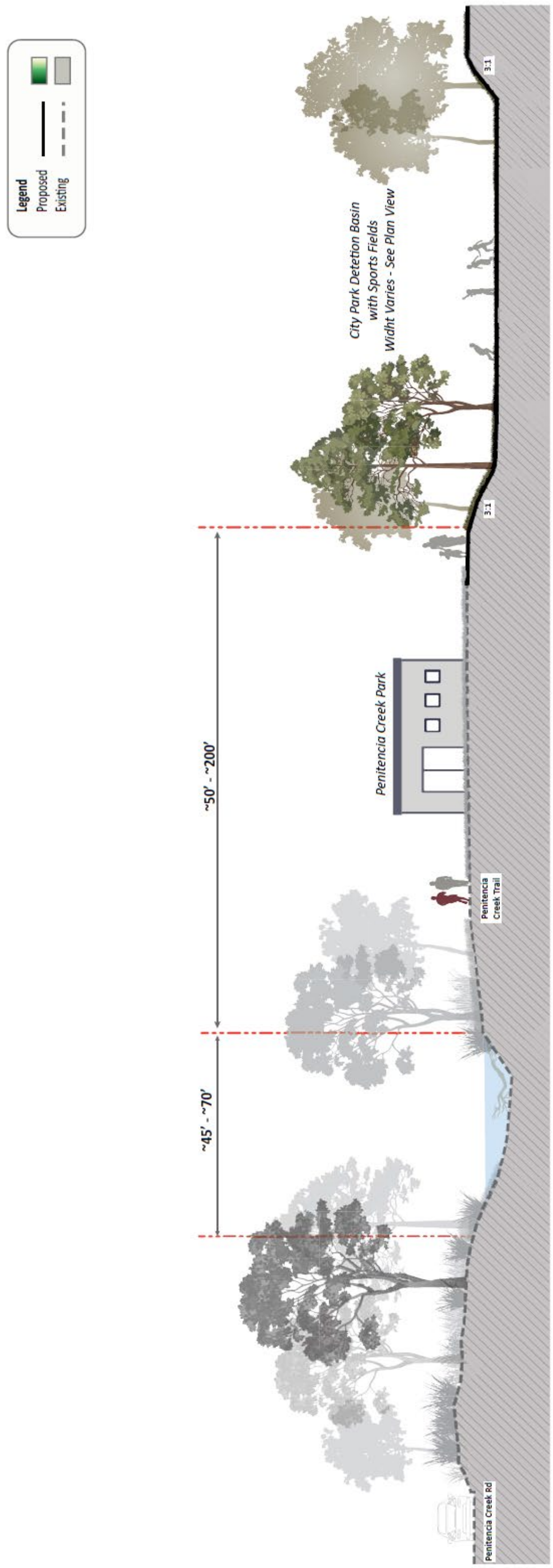


Figure 36: City Park Detention Cross Section (Reach 5)

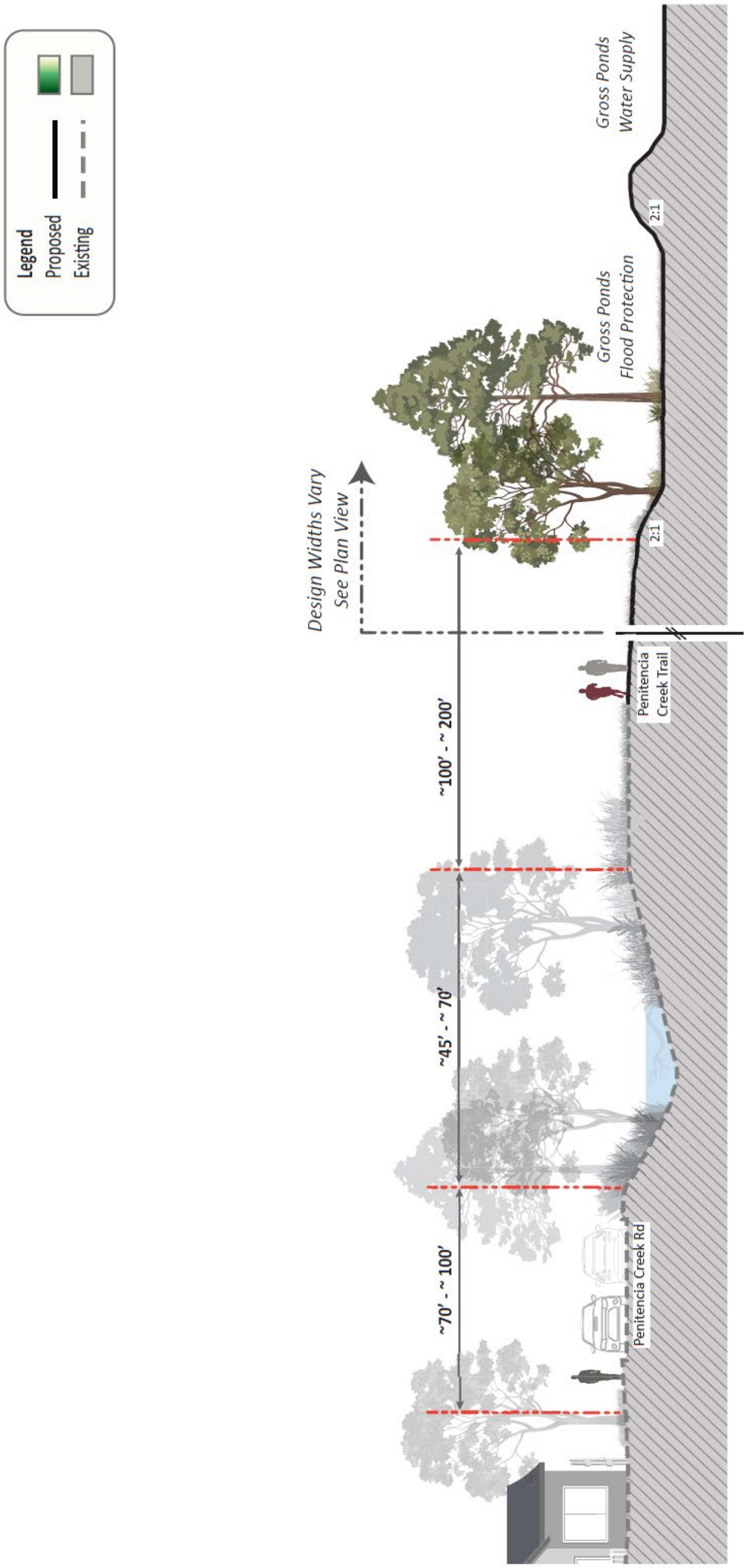


Figure 37: Gross Ponds Detention Cross Section (Reach 6)

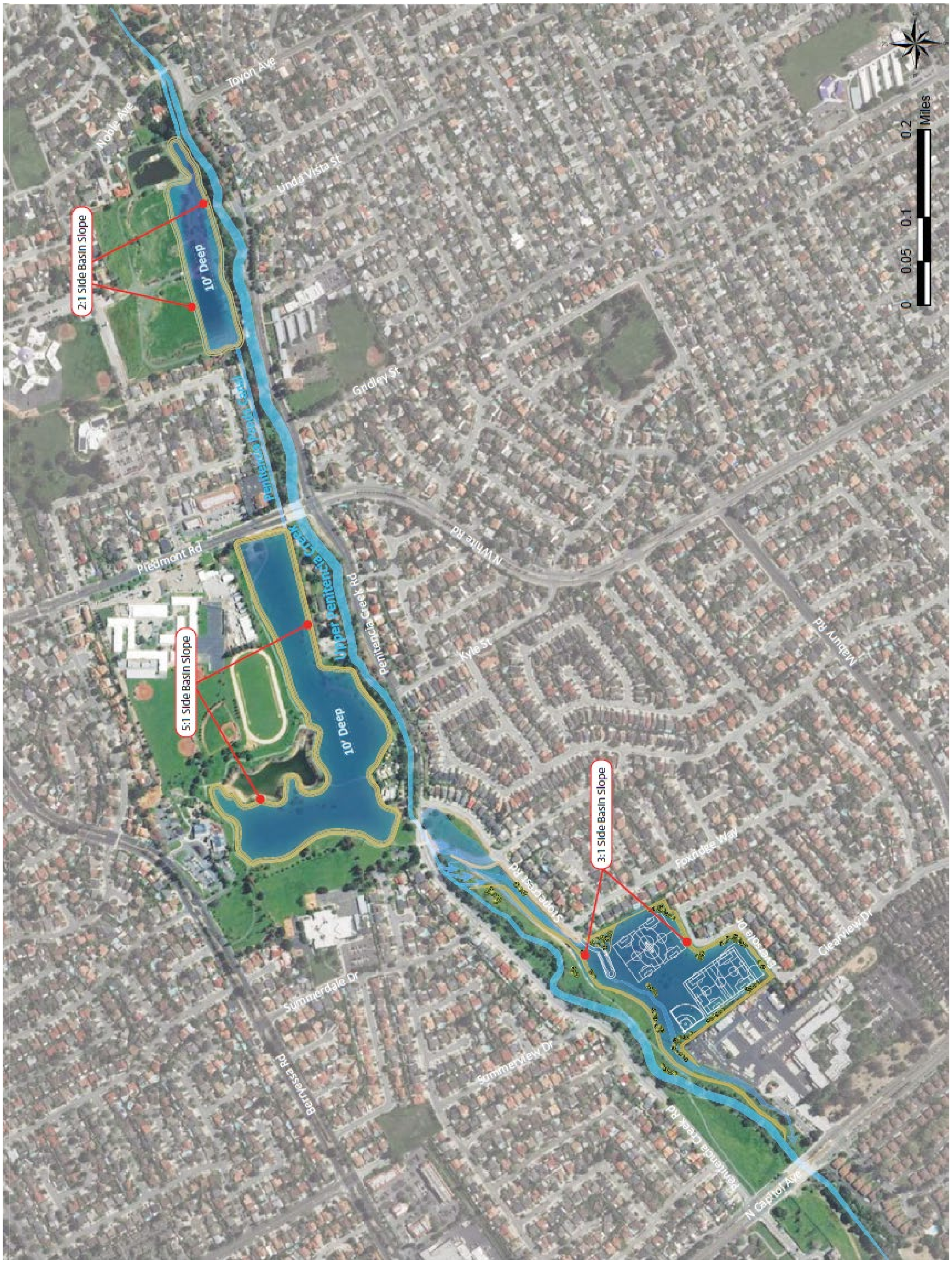


Figure 38: Detention Facilities Overall Layout of 3 Sites

Figure 39: County Property Detention Site Layout

Figure 40: City Park Detention Site Layout

Figure 41: Gross Ponds Detention Site Layout

APPENDIX C – COST CALCULATIONS

Project Reach: / Feasible Alt:	R4-R6 Detention(3ponds): Reduce peak from 100 year to 20-year flow from R1-R5. R1: widening w/ restoration. R2/R3: Mabury bypass reconfiguration w/ restoration (syc. Alluv. Wdlnd), plus short levees. R4-R5: Moderate channel work w/ widening and some levees/floodwalls. R6-R7: Channel widening w/ restoration.	R1-R6: Same as A1. R7: bypass under Penitencia Crk Rd.	R1-R6: Same as A1. R7: Passive Floodwall along Penitencia Crk Rd.	No Project: no new construction
	Alt. A1	**Alt. A2**	**Alt. A3**	**Alt. I**
Reach 1	*$17.1*	*$17.1*	*$17.1*	*$0.0*
Reach 2 and 3	*$6.7*	*$6.7*	*$6.7*	*$0.0*
Reach 4	*$12.3*	*$12.3*	*$12.3*	*$0.0*
Reach 5	*$15.7*	*$15.7*	*$15.7*	*$0.0*
Reach 6	*$9.1*	*$9.1*	*$9.1*	*$0.0*
Reach 7	*$5.6*	*$6.4*	*$17.1*	*$0.0*
Total	**$66.5**	**$67.3**	**$78.0**	*$0.0*
Phase I: SCW - Reach 1	**$17.1**	**$17.1**	**$17.1**	**$0.0**
50-year maintenance cost:	**$7.1**	**$7.1**	**$7.1**	**$0.0**
Phase II: Reach 2 & 3	**$6.7**	**$6.7**	**$6.7**	**$0.0**
50-year maintenance cost:	**$8.3**	**$8.3**	**$8.3**	**$0.0**
Phase III: Reach 4 to 7	**$42.7**	**$43.5**	**$43.5**	**$0.0**
50-year maintenance cost:	**$16.2**	**$11.0**	**$11.0**	**$0.0**
Total Capital Cost:	**$66.5**	**$67.3**	**$78.0**	**$0.0**
50-year maintenance cost:	**$31.6**	**$26.4**	**$26.4**	**$5.0**
total 50-year cost:	**$98.1**	**$93.7**	**$104.4**	**$5.0**

Parcel Counts for 100-YR Event*	# of Parcels Protected	# of Parcels left in Floodplain	% of Parcels protected
No-Project	0	7,933	0%
estimated parcels protected	7,933.0	0.0	100%
Phase I parcels protected:	442	7,491.0	6%
Phase II parcels protected:	807	7,126.0	10%
Phase III parcels protected:	6,684	1,249.0	84%
Only build R1-R6	4,969	2,964.0	63%

*NOTE: this is for the 100yr event, the percent of parcels protected for PhaseI/II during the 10yr and 25 yr events would be much greater.

Upper Penitencia Creek Feasible Alternatives
Unit Costs Table

Item	Unit	Cost
Excavation and Demo		
Excavaton	CY	$50
Clearing and grubbing	CY	$6,875
tree removal, congested area, 8" dia	Each	$420
tree removal, congested area \, 24" dia	Each	$730
Hydroseeding/ landscaping	SF	$5
Deciduous trees, weeping willow, 24"box	Each	$180
Oak trees - Planting	Each	$200
Planting - Miscelaneous	Each	$50
Sycamore trees - Planting	LS	$500,000
Offsite-soil disposal non-hazardous	CY	$25
Offsite-soil disposal hazardous	CY	$270
Burial ground	LS	$100,000
split rail fence	LF	$40
Armoring Aggregates	CY	$120
Remove small bridges	LS	$100,000
Levees	CY	$75
Bridges and Concrete Structures		
Concrete floodwall	CY	$1,200
Lateral Structure/ overflow weir	CY	$1,000
New Pedestrian Bridge at confluence	LS	$500,000
R3 - Dam to divert flow to Mabury Diversion	LS	$200,000
Bridge (small)	LS	$500,000
Bridge (large - King Rd)	LS	$3,000,000
UV Sierra Rd Br (50% share with Developer)	LS	$1,500,000

Items	Unit	Unit Cost	Quantity	Cost
Reach1				
Reach 1				
Urban Village Segment - Coyote Crk Confluence up to BART Track Bridge				
Pedestrian crossing bridge at confluence	LS	$500,000	1	$500,000
Excavation at the confluence	CY	$50	315	$15,750
Channel excavation D/S of VTA benched section	CY	$50	46390	$2,300,000
Clearing and grubbing	AC	$6,875	5.1	$34,833
Planting herbaceous trees/hydroseeding/landscaping	SF	$5	220704	$1,103,520
Deciduous trees, weeping willow, 24"box	Each	$200	150	$30,000
Planting: Oak trees	Each	$200	270	$54,000
Tree removal based on diameter				
tree removal, congested area, 24" dia	Each	$730	100	$73,000
tree removal, congested area, 8" dia	Each	$420	100	$42,000
Soil Disposal				
offsite soil disposal non-hazardous (90%)	CY	$25	41751	$1,043,775
offsite soil disposal hazardous (10%)	CY	$154	4639	$714,406
Burial ground	LS	$100,000	1	$100,000
Wooden Fences (Split Rail)	LF	$40	2066	$82,640
Maintenance ramp on either side 18 ft wide				
Ramp: Armorning aggregates	CY	$120	187	$22,440
Trail & Maintenance Road Improvements				
Armoring trail	CY	$120	765	$91,800
Bridge				
Remove two small flea market bridge	Each	$100,000	2	$200,000
Reconstruct new bridge	Each	$1,500,000	1	$1,500,000
Floodwalls along BART Bridges Segment				
Floodwalls at bart bridge 2ft high	CY	$1,200	39	$46,800
Floodwall connecting bart track crossing to bart bridge 2ft high	CY	$1,200	24	$28,800
Footing for floodwall	CY	$1,200	37	$44,400
Soil excavation for floodwall	CY	$50	74	$3,700
BART/VTA Site up to King Road				
Clearing and grubbing	AC	$6,875	5.1	$34,833
Armoring Aggregate	CY	$120	1.0133333	$122
Channel excavation 30 ft right D/S of King Rd	CY	$50	5807	$290,350
offsite soil disposal non-hazardous (90%)	CY	$25	5226	$130,650
offsite soil disposal hazardous (10%)	CY	$154	581	$89,474
need revegetation				
King Road Expansion				
King Road Culvert expansion	Each	$3,000,000	1	$3,000,000

traffic control	LS	$200,000	1	$200,000
				$11,777,293
Mobilization (10%)				$1,177,729
Contingency (10%)				$1,177,729
			subtotal	**$14,132,752**
Design (10%)				$1,413,275.19
Geotech (5%)				$706,637.60
Inspection (10%)				$1,413,275
			Total	**$17,665,940**

Items	Unit	Unit Cost	Quantity	Cost
Reaches 2 & 3				
Main Channel				
Cleaning	AC	$6,875	6	$41,250
Widening D/S of conf b/w Mabury bypass & King	CY	$50	3081	$154,050
Sediment removal/excavation	CY	$50	9750	$487,500
offsite soil disposal non-harardous (90%)	CY	$25	4388	$109,696
offsite soil disposal hazardous (10%)	CY	$154	975	$150,150
Traffic control	LS	$100,000	1	$100,000
Mabury Bypass				
Levees along bypass	CY	$75	1993	$149,475
Armoring Aggregate	CY	$120	398.6	$47,832
Sediment removal/ excavation	CY	$50	19228	$961,400
offsite soil disposal non-hazardous (90%)	CY	$25	8653	$216,325
offsite soil disposal hazardous (10%)	CY	$154	1923	$296,142
Cleaning and Grubbing	AC	$6,875	24	$165,000
Planting	Each	$50	200	$10,000
Planting sycamore trees	Each	$200	200	$40,000
Planting herbaceous trees/hydroseeding/landscaping	SF	$5	209088	$1,045,440
Jackson culvert excavation	CY	$50	5744	$287,200
offsite soil disposal non -hazardous (90%)	CY	$25	5170	$129,250
offsite soil disposal hazardous (10%)	CY	$154	575	$88,550
Lateral structure/overflow weir	CY	$1,000	130	$130,000
Dam to control flow to water supply main	LS	$200,000	1	$200,000
Cleaning under I-680 bridge	AC	$5,500	1	$5,500
				$4,814,760
Mobilization (10%)				$481,476
Contingency (10%)				$481,476
			subtotal	**$5,777,713**
Design (10%)				$577,771
Geotech (5%)				$288,886
Inspection (10%)				$577,771.25
			Total	**$7,222,141**

CIP project name:

Upper Penitencia Creek Phase I Maintenance Costs: Coyote Crk to King Road

Activity	Corresponding operations project name	Corresponding operations project number	Quantity	Unit of measure	Unit rate (per unit of measure)	Frequency, once every ____ year(s)	Annual cost (estimated)	Eligible for funding from SCW E1.3?	When was or will CIP be turned over to O&M?	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35
									FY25	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11
Vegetation management																				
- Mitigation site maintenance (Y4-8)	Mgmt of Revegetation Projects	00761075	3	acre	$ 30,000	1	$ 102,000	No		$ -	$ -	$ -	$ 102,000	$ 102,000	$ 102,000	$ 102,000	$ 102,000	$ -	$ -	$ -
- Mitigation site maintenance (Y9+)	Mgmt of Revegetation Projects	00761075	3	acre	$ 4,578	1	$ 15,565	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 15,565	$ 15,565	$ 15,565
- See note 5 below.	Vegetation Mangmnt for Access	00761078	0	acre	$ 1,373	1	$ 82	No		$ 82	$ 82	$ 82	$ 82	$ 82	$ 82	$ 82	$ 82	$ 82	$ 82	$ 82
- See note 6 below.	Stream Capacity Vegetation Con	26771067	7	acre	$ 1,836	1	$ 13,219	No		$ 13,219	$ 13,219	$ 13,219	$ 13,219	$ 13,219	$ 13,219	$ 13,219	$ 13,219	$ 13,219	$ 13,219	$ 13,219
Sediment removal	Watershed Sediment Removal	00761023	500	cy	$ 110	1	$ 55,000	No		$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000
Bank protection	Watershed Erosion Protection	62761027	200	lf	$ 2.54	1	$ 507	No		$ 507	$ 507	$ 507	$ 507	$ 507	$ 507	$ 507	$ 507	$ 507	$ 507	$ 507
Rodent abatement	Watershed Levee Maintenance	62761028	-	lf	$ 0.55	1	$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Debris removal	Watershed Debris Removal	62761026	200	lf	$ 0.98	1	$ 197	No		$ 197	$ 197	$ 197	$ 197	$ 197	$ 197	$ 197	$ 197	$ 197	$ 197	$ 197
Good neighbor maintenance	Watershed Good Neighbor Maint	00761022	200	lf	$ 1.02	1	$ 203	No		$ 203	$ 203	$ 203	$ 203	$ 203	$ 203	$ 203	$ 203	$ 203	$ 203	$ 203
Encampment cleanup	Encampment Cleanup Program	26771027	1	day	$ 11,334	0.5	$ 22,667	No		$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667
Other maintenance							$ -													
- [Other]							$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
- [Other]							$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
- [Other]							$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Creek inspections (non-USACE)	Wtrshd Facility Condition Assmnt	62761024	200	lf	$ 1.52	1	$ 304	No		$ 304	$ 304	$ 304	$ 304	$ 304	$ 304	$ 304	$ 304	$ 304	$ 304	$ 304
Creek inspections (USACE)	Corps Local Sponsor O&M	62761074	-	lf	$ 1.52	0.5	$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Totals							**$ 142,789**			$ 92,180	$ 92,180	$ 92,180	$ 194,180	$ 194,180	$ 194,180	$ 194,180	$ 194,180	$ 107,745	$ 107,745	$ 107,745

Notes/assumptions:

1. Expected life of flood protection project is 50 years.
2. Unless otherwise noted, timeframes for acceptance of maintenance responsibilities are as follow: Mitigation site maintenance (years 4 through 8, and year 9 and beyond); vegetation management for access (year 1 and beyond); stream capacity vegetation control (year 1 and beyond); all else (year 1 and beyond).
3. Unit rates obtained as follows:
   a. 00761075 estimated at $30,000/acre for years 4-8, and $4,578/acre for year 9 and beyond (per J. Codianne, 07/22/2019).
   b. 00761078 estimated at $1,373/acre for year 1 and beyond (per J. Codianne, 07/22/2019).
   c. 26771067 estimated at $1,836/acre for year 1 and beyond (per J. Codianne, 07/22/2019).
   d. 00761023 estimated at $110/cy based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities) for the costs, and the "2002-2018_sed-bank-actuals" spreadsheet for the sediment quantities. From FY15 through FY19 (FY19 data was preliminary), Valley Water spent $18,933,759 removing 179,374 cubic yards of sediment, resulting in a unit cost of $105.55/cy, say $110/cy.
   e. 62761027 estimated at $2.54/lf based on $1,200/lf over 275 miles of creek countywide, w/annual average of 3,070 lf of bank protection conducted from FY03-FY19. The $1,200/lf unit rate is based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities) for the dollar amount and based on the "2002-2018_sed-bank-actuals" spreadsheet for the linear footage estimate. From FY15 through FY19 (FY19 data was preliminary), Valley Water spent $9,778,077 protecting 8,115 linear feet of bank, resulting in a unit cost of $1,204.94/lf, say $1,200/lf.
   f. 62761028 estimated at $0.55/lf based on estimated costs of rodent trapping by Valley Water's contractor at $550/day and 1,000 lf/day (per C. Houston, 07/22/2019).
   g. 62761026 estimated at $0.98/lf based on annual average of $1,426,802 (from FY02-FY19) over 275 miles of creek countywide. This annual average is based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities).
   h. 00761022 estimated at $1.02/lf based on annual average of $1,475,718 (from FY02-FY19) over 275 miles of creek countywide. This annual average is based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities).
   i. 26771027 estimated at $11,334/day (based on average of "small crew" costs of $9,294/day and "large crew" costs of $13,373/day, per T. Peña, 07/23/2019).
   j. 62761024 estimated at $1.52/lf based on FY15-FY19 expenditures of $6,068,656 for 3,986,543 lf. These dollar and linear footage amounts are based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities).
   k. 62761074 estimated at $1.52/lf based on 62761024 (used same unit rate for simplicity).
4. Above amounts are in FY20 dollars.
5. "Management of Revegetation Projects" includes site surveys, irrigation, new plant installation, mechanical weed abatement, and herbicide application.
6. "Vegetation Management for Access" includes pruning/overhanging growth removal along ROW, mechancial mowing, hand weed abatement, and herbicide application.
7. "Stream Capacity Vegetation Control" includes mechanical mowing, hand removal, and herbicide application (aquatic).
8. "Watershed Good Neighbor Maintenance" includes trash removal, repairs of fences, gates, and signage, graffiti removal, and support for the adopt-a-creek program.

CIP project name:

Upper Penitencia Creek Phase II Maintenance Cost: King Road to Capitol Ave

Activity	Corresponding operations project name	Corresponding operations project number	Quantity	Unit of measure	Unit rate (per unit of measure)	Frequency, once every ____ year(s)	Annual cost (estimated)	Eligible for funding from SCW E1.3?	When was or will CIP be turned over to O&M?	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35
									FY25	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11
Vegetation management																				
- Mitigation site maintenance (Y4-8)	Mgmt of Revegetation Projects	00761075	4	acre	$ 30,000	1	$ 120,000	No		$ -	$ -	$ -	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ -	$ -	$ -
- Mitigation site maintenance (Y9+)	Mgmt of Revegetation Projects	00761075	4	acre	$ 4,578	1	$ 18,312	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 18,312	$ 18,312	$ 18,312
- See note 5 below.	Vegetation Mangmnt for Access	00761078	2	acre	$ 1,373	1	$ 2,952	No		$ 2,952	$ 2,952	$ 2,952	$ 2,952	$ 2,952	$ 2,952	$ 2,952	$ 2,952	$ 2,952	$ 2,952	$ 2,952
- See note 6 below.	Stream Capacity Vegetation Con	26771067	12	acre	$ 1,836	1	$ 22,032	No		$ 22,032	$ 22,032	$ 22,032	$ 22,032	$ 22,032	$ 22,032	$ 22,032	$ 22,032	$ 22,032	$ 22,032	$ 22,032
Sediment removal	Watershed Sediment Removal	00761023	500	cy	$ 110	1	$ 55,000	No		$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000
Bank protection	Watershed Erosion Protection	62761027	520	lf	$ 2.54	1	$ 1,319	No		$ 1,319	$ 1,319	$ 1,319	$ 1,319	$ 1,319	$ 1,319	$ 1,319	$ 1,319	$ 1,319	$ 1,319	$ 1,319
Rodent abatement	Watershed Levee Maintenance	62761028	334	lf	$ 0.55	1	$ 184	No		$ 184	$ 184	$ 184	$ 184	$ 184	$ 184	$ 184	$ 184	$ 184	$ 184	$ 184
Debris removal	Watershed Debris Removal	62761026	520	lf	$ 0.98	1	$ 511	No		$ 511	$ 511	$ 511	$ 511	$ 511	$ 511	$ 511	$ 511	$ 511	$ 511	$ 511
Good neighbor maintenance	Watershed Good Neighbor Maint	00761022	520	lf	$ 1.02	1	$ 528	No		$ 528	$ 528	$ 528	$ 528	$ 528	$ 528	$ 528	$ 528	$ 528	$ 528	$ 528
Encampment cleanup	Encampment Cleanup Program	26771027	1	day	$ 11,334	0.5	$ 22,667	No		$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667
Other maintenance							$ -													
- [Other]							$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
- [Other]							$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
- [Other]							$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Creek inspections (non-USACE)	Wtrshd Facility Condition Assmnt	62761024	520	lf	$ 1.52	1	$ 792	No		$ 792	$ 792	$ 792	$ 792	$ 792	$ 792	$ 792	$ 792	$ 792	$ 792	$ 792
Creek inspections (USACE)	Corps Local Sponsor O&M	62761074	-	lf	$ 1.52	0.5	$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Totals							$ 165,525			$ 105,985	$ 105,985	$ 105,985	$ 225,985	$ 225,985	$ 225,985	$ 225,985	$ 225,985	$ 124,297	$ 124,297	$ 124,297

Notes/assumptions:

1. Expected life of flood protection project is 50 years.
2. Unless otherwise noted, timeframes for acceptance of maintenance responsibilities are as follow: Mitigation site maintenance (years 4 through 8, and year 9 and beyond); vegetation management for access (year 1 and beyond); stream capacity vegetation control (year 1 and beyond); all else (year 1 and beyond).
3. Unit rates obtained as follows:
   a. 00761075 estimated at $30,000/acre for years 4-8, and $4,578/acre for year 9 and beyond (per J. Codianne, 07/22/2019).
   b. 00761078 estimated at $1,373/acre for year 1 and beyond (per J. Codianne, 07/22/2019).
   c. 26771067 estimated at $1,836/acre for year 1 and beyond (per J. Codianne, 07/22/2019).
   d. 00761023 estimated at $110/cy based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities) for the costs, and the "2002-2018_sed-bank-actuals" spreadsheet for the sediment quantities. From FY15 through FY19 (FY19 data was preliminary), Valley Water spent $18,933,759 removing 179,374 cubic yards of sediment, resulting in a unit cost of $105.55/cy, say $110/cy.
   e. 62761027 estimated at $2.54/lf based on $1,200/lf over 275 miles of creek countywide, w/annual average of 3,070 lf of bank protection conducted from FY03-FY19. The $1,200/lf unit rate is based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities) for the dollar amount and based on the "2002-2018_sed-bank-actuals" spreadsheet for the linear footage estimate. From FY15 through FY19 (FY19 data was preliminary), Valley Water spent $9,778,077 protecting 8,115 linear feet of bank, resulting in a unit cost of $1,204.94/lf, say $1,200/lf.
   f. 62761028 estimated at $0.55/lf based on estimated costs of rodent trapping by Valley Water's contractor at $550/day and 1,000 lf/day (per C. Houston, 07/22/2019).
   g. 62761026 estimated at $0.98/lf based on annual average of $1,426,802 (from FY02-FY19) over 275 miles of creek countywide. This annual average is based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities).
   h. 00761022 estimated at $1.02/lf based on annual average of $1,475,718 (from FY02-FY19) over 275 miles of creek countywide. This annual average is based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities).
   i. 26771027 estimated at $11,334/day (based on average of "small crew" costs of $9,294/day and "large crew" costs of $13,373/day, per T. Peña, 07/23/2019).
   j. 62761024 estimated at $1.52/lf based on FY15-FY19 expenditures of $6,068,656 for 3,986,543 lf. These dollar and linear footage amounts are based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities).
   k. 62761074 estimated at $1.52/lf based on 62761024 (used same unit rate for simplicity).
4. Above amounts are in FY20 dollars.
5. "Management of Revegetation Projects" includes site surveys, irrigation, new plant installation, mechanical weed abatement, and herbicide application.
6. "Vegetation Management for Access" includes pruning/overhanging growth removal along ROW, mechancial mowing, hand weed abatement, and herbicide application.
7. "Stream Capacity Vegetation Control" includes mechanical mowing, hand removal, and herbicide application (aquatic).
8. "Watershed Good Neighbor Maintenance" includes trash removal, repairs of fences, gates, and signage, graffiti removal, and support for the adopt-a-creek program.

CIP project name:

Upper Penitencia Creek Phase III Maintenance Costs: Capitol Ave to Dorel Drive

Activity	Corresponding operations project name	Corresponding operations project number	Quantity	Unit of measure	Unit rate (per unit of measure)	Frequency, once every ____ year(s)	Annual cost (estimated)	Eligible for funding from SCW E1.3?	When was or will CIP be turned over to O&M?	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35
									FY25	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11
Vegetation management																				
- Mitigation site maintenance (Y4-8)	Mgmt of Revegetation Projects	00761075	14	acre	$ 30,000	1	$ 414,000	No		$ -	$ -	$ -	$ 414,000	$ 414,000	$ 414,000	$ 414,000	$ 414,000	$ -	$ -	$ -
- Mitigation site maintenance (Y9+)	Mgmt of Revegetation Projects	00761075	14	acre	$ 4,578	1	$ 63,176	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 63,176	$ 63,176	$ 63,176
- See note 5 below.	Vegetation Mangmnt for Access	00761078	4	acre	$ 1,373	1	$ 5,492	No		$ 5,492	$ 5,492	$ 5,492	$ 5,492	$ 5,492	$ 5,492	$ 5,492	$ 5,492	$ 5,492	$ 5,492	$ 5,492
- See note 6 below.	Stream Capacity Vegetation Con	26771067	5	acre	$ 1,836	1	$ 9,804	No		$ 9,804	$ 9,804	$ 9,804	$ 9,804	$ 9,804	$ 9,804	$ 9,804	$ 9,804	$ 9,804	$ 9,804	$ 9,804
Sediment removal	Watershed Sediment Removal	00761023	-	cy	$ 110	1	$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Bank protection	Watershed Erosion Protection	62761027	950	lf	$ 2.54	1	$ 2,410	No		$ 2,410	$ 2,410	$ 2,410	$ 2,410	$ 2,410	$ 2,410	$ 2,410	$ 2,410	$ 2,410	$ 2,410	$ 2,410
Rodent abatement	Watershed Levee Maintenance	62761028	270	lf	$ 0.55	1	$ 149	No		$ 149	$ 149	$ 149	$ 149	$ 149	$ 149	$ 149	$ 149	$ 149	$ 149	$ 149
Debris removal	Watershed Debris Removal	62761026	950	lf	$ 0.98	1	$ 934	No		$ 934	$ 934	$ 934	$ 934	$ 934	$ 934	$ 934	$ 934	$ 934	$ 934	$ 934
Good neighbor maintenance	Watershed Good Neighbor Maint	00761022	950	lf	$ 1.02	1	$ 966	No		$ 966	$ 966	$ 966	$ 966	$ 966	$ 966	$ 966	$ 966	$ 966	$ 966	$ 966
Encampment cleanup	Encampment Cleanup Program	26771027	1	day	$ 11,334	0.5	$ 22,667	No		$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667	$ 22,667
Other maintenance							$ -													
- [Other]							$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
- [Other]							$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
- [Other]							$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Creek inspections (non-USACE)	Wtrshd Facility Condition Assmnt	62761024	950	lf	$ 1.52	1	$ 1,446	No		$ 1,446	$ 1,446	$ 1,446	$ 1,446	$ 1,446	$ 1,446	$ 1,446	$ 1,446	$ 1,446	$ 1,446	$ 1,446
Creek inspections (USACE)	Corps Local Sponsor O&M	62761074	-	lf	$ 1.52	0.5	$ -	No		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Totals							**$ 249,279**			$ 43,867	$ 43,867	$ 43,867	$ 457,867	$ 457,867	$ 457,867	$ 457,867	$ 457,867	$ 107,044	$ 107,044	$ 107,044

Notes/assumptions:

1. Expected life of flood protection project is 50 years.
2. Unless otherwise noted, timeframes for acceptance of maintenance responsibilities are as follow: Mitigation site maintenance (years 4 through 8, and year 9 and beyond); vegetation management for access (year 1 and beyond); stream capacity vegetation control (year 1 and beyond); all else (year 1 and beyond).
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   b. 00761078 estimated at $1,373/acre for year 1 and beyond (per J. Codianne, 07/22/2019).
   c. 26771067 estimated at $1,836/acre for year 1 and beyond (per J. Codianne, 07/22/2019).
   d. 00761023 estimated at $110/cy based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities) for the costs, and the "2002-2018_sed-bank-actuals" spreadsheet for the sediment quantities. From FY15 through FY19 (FY19 data was preliminary), Valley Water spent $18,933,759 removing 179,374 cubic yards of sediment, resulting in a unit cost of $105.55/cy, say $110/cy.
   e. 62761027 estimated at $2.54/lf based on $1,200/lf over 275 miles of creek countywide, w/annual average of 3,070 lf of bank protection conducted from FY03-FY19. The $1,200/lf unit rate is based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities) for the dollar amount and based on the "2002-2018_sed-bank-actuals" spreadsheet for the linear footage estimate. From FY15 through FY19 (FY19 data was preliminary), Valley Water spent $9,778,077 protecting 8,115 linear feet of bank, resulting in a unit cost of $1,204.94/lf, say $1,200/lf.
   f. 62761028 estimated at $0.55/lf based on estimated costs of rodent trapping by Valley Water's contractor at $550/day and 1,000 lf/day (per C. Houston, 07/22/2019).
   g. 62761026 estimated at $0.98/lf based on annual average of $1,426,802 (from FY02-FY19) over 275 miles of creek countywide. This annual average is based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities).
   h. 00761022 estimated at $1.02/lf based on annual average of $1,475,718 (from FY02-FY19) over 275 miles of creek countywide. This annual average is based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities).
   i. 26771027 estimated at $11,334/day (based on average of "small crew" costs of $9,294/day and "large crew" costs of $13,373/day, per T. Peña, 07/23/2019).
   j. 62761024 estimated at $1.52/lf based on FY15-FY19 expenditures of $6,068,656 for 3,986,543 lf. These dollar and linear footage amounts are based on "Copy of Watershed Activity Summary 1219_downloaded_2019-07-17" spreadsheet (originally obtained from Valley Water's budget page on aqua.gov, under Budget Status Report, then Watershed Field Operations Activities).
   k. 62761074 estimated at $1.52/lf based on 62761024 (used same unit rate for simplicity).
4. Above amounts are in FY20 dollars.
5. "Management of Revegetation Projects" includes site surveys, irrigation, new plant installation, mechanical weed abatement, and herbicide application.
6. "Vegetation Management for Access" includes pruning/overhanging growth removal along ROW, mechancial mowing, hand weed abatement, and herbicide application.
7. "Stream Capacity Vegetation Control" includes mechanical mowing, hand removal, and herbicide application (aquatic).
8. "Watershed Good Neighbor Maintenance" includes trash removal, repairs of fences, gates, and signage, graffiti removal, and support for the adopt-a-creek program.

APPENDIX D: NATURAL FLOOD PROTECTION PROCESS

Objective 1—Provide Protection from Flood Damage			
Criterion 1.1: Safety – Public safety if conditions exceed design assumptions			
Alternative		**Rating Score**	**Comments**
100-year Protection			
A		3	R1 – 3 – Safety rates very good with channel widening since it will slow down velocities/energy. Does not induce flooding downstream in Coyote Creek. R2 – 2 – bypass as primary channel, flood risk bit higher along Cape Horn neighborhood (assessment unknown). R3 – 3 – sending flow through wider culverts at Jackson instead of arched CMP, better capacity through Bridge.
No Project			
I		1	No reduction in existing flood risk.

Objective 1—Provide Protection from Flood Damage			
Criterion 1.2: Economic Protection – homes, schools, businesses, infrastructure			
Alternative		**Rating Score**	**Comments**
100-year Protection			
A		3	Floodwalls and levees will meet FEMA and federal structural standards except for freeboard requirement. But design flows will be contained within project area and would not enter buildings or disrupt transportation. Instream features will be subject to minimal damage (easily repairable) and would not impact community.
No Project			
I		x	Flood damages could be excessive with large flow events (high depths, velocities, building impacts, transportation disruption, etc).

Objective 1—Provide Protection from Flood Damage			
Criterion 1.3: Durability – Future effort required to maintain design level			
Alternative		**Rating Score**	**Comments**
100-year Protection			

A		4	Some operation is needed for water supply purposes, minimal and not very complex and does not interfere with flood protection. Reach 2 will need some design level of vegetation but designing as sycamore woodland to be self-sustaining. Design will be for a geomorphically stable channel – the low flow channel may change over time, but overall capacity will be maintained. Erosion and deposition will be part of the process and not require maintenance.
No Project			
I		1	Poor: Most of channel has less than 10-year capacity – there is sediment issues that reduces capacity. Structurally questionable levees through Reach 2. Coyote Confluence has big sediment deposition issues and currently Upper Pen enters Coyote Creek at a 90-degree angle.

Objective 1—Provide Protection from Flood Damage

Criterion 1.4: Resiliency – Adaptability to future non-District changes

Alternative		Rating Score	Comments
100-year Protection			
A		4	Reach 1 will be designed to fully vegetated channel with minimal maintenance. Reach 2 will be designed to self-sustaining sycamore woodlands with some vegetated removal expected. Design levees and floodwall footings for future enlargement.
No Project			
I		0	Channel cannot carry design flows.

Objective 1—Provide Protection from Flood Damage

Criterion 1.5: Local Drainage – Support local storm drain systems

Alternative		Rating Score	Comments
100-year Protection			
A		4	Not many storm drains into the system. Reach 1 will have local storm drainage from the new Urban Village at the Flea Market property.
No Project			
I		2	Current SD system.

Objective 1—Provide Protection from Flood Damage			
Criterion 1.6: Time to Implementation			
Alternative		**Rating Score**	**Comments**
100-year Protection			
A		1	High chance of running into cultural resources – burial grounds. This can cause some major delays. Even though there is much riparian restoration and enhancement, there will still be some impacts and regulatory issues might cause some delays.
No Project			
I		5	NO project so no time for implementation.
Objective 2 – Integrate Within the Watershed			
Criterion 2.1: Meets Local Watershed Goals – accounts for opportunities & constraints			
Alternative		**Rating Score**	**Comments**
100-year Protection			
A		4	Alternative integrates well within the watershed. The landscape process helped us develop alternatives that would provide flood protection from a watershed-wide perspective. This includes riparian restoration, fish passage improvements, sediment transport improvements, and ecological enhancements such as sycamore and oak woodlands.
No Project			
I		2	The creek is one of the most undisturbed creeks in the county – has very few manmade structures.
Objective 3 – Support Ecologic Functions and Processes			
Criterion 3.1: Meets local habitat goals – as defined from examining watershed as a whole and accounting for opportunities and constraints			
Alternative		**Rating Score**	**Comments**
100-year Protection			

A		4	Ecological restoration/enhancements provide habitat diversity – vegetation will moderate temperatures for fish. Vegetation provide habitat for wildlife. Fish coves will provide protection from high velocities. Boulder and gravel placement for fish habitat opportunities.
No Project			
I		2	No project does not improve habitat diversity, but the natural current conditions is okay.

Objective 3 – Support Ecologic Functions and Processes

Criterion 3.2: Habitat Provided – Quality of habitat provided by alternative

Alternative		Rating Score	Comments
100-year Protection			
A		4	High quality of habitat provided with: removal of invasive species, planting native species (sycamores, oaks, willows), widening channel and restoring floodplain with native species. Varying width of channel and floodplain helps provide hydraulic diversity.
No Project			
I		2	Current conditions provide fair quality of habitat.

Objective 3 – Support Ecologic Functions and Processes

Criterion 3.3: Sustainability of habitat – intensity of human intervention required to maintain target habitat quality, opportunity for self-adjustment to future change

Alternative		Rating Score	Comments
100-year Protection			
A		3	Will work with biologist and maintenance to develop the best vegetation palette for the system.
No Project			
I		2	Current conditions provide fair sustainability of habitat.

Objective 3 – Support Ecologic Functions and Processes

Criterion 3.4: Connectivity of habitat – integration into surrounding landscape

Alternative		Rating Score	Comments

100-year Protection			
A		3	Overall, riparian restoration would supply localized habitat and provide connectivity up to Capitol Avenue. Some issues might be at King Rd.
No Project			
I		2	Connectivity is currently fair.

Objective 4 – Integrate Geomorphic Physical Stream Functions & Processes

Criterion 4.1: Floodplain - Assesses inclusion of an appropriately sized overflow area (adjacent floodplain) within the flood conveyance corridor that conveys high flows and dissipates erosive energy (multi-stage channel)

Alternative		Rating Score	Comments
100-year Protection			
A		4	Channel expansion allows for low flow meandering channel (active channel) with flood “benches” to convey the higher flows. These conveyance benches will be at multi-stage elevations and will alleviate high velocities. Some setback levees needed in some areas.
No Project			
I		2	Overall a pretty good natural channel with typical physical functions. There are some sediment deposition areas that are troublesome, but it behaves as it should (alluvial fan).

Objective 4 – Integrate Geomorphic Physical Stream Functions & Processes

Criterion 4.2: Active Channel - Assesses appropriateness of size and configuration of the active channel relative to watershed inputs and reach characteristics

Alternative		Rating Score	Comments
100-year Protection			
A		4	The alternative includes channel designs in reaches 1 through 3 with a low flow meandering active channel.
No Project			
I		2	Current conditions are fair.

Objective 4 – Integrate Geomorphic Physical Stream Functions & Processes

Criterion 4.3: Stable Side Slopes - Assesses stability of side slopes using geotechnical and biotechnical methods			
Alternative		**Rating Score**	**Comments**
100-year Protection			
A		4	The channel restoration will provide stable side slopes and a stable overall riparian corridor.
No Project			
I		2	Current conditions are fair.
Objective 4 – Integrate Geomorphic Physical Stream Functions & Processes			
Criterion 4.4: Transitions - Stability of channel's integration with upstream and downstream reaches			
Alternative		**Rating Score**	**Comments**
100-year Protection			
A		4	We will be modifying the Coyote Confluence into a more natural curved channel instead of the 90-degree angle it currently has. The channel will be expanded with a low flow meandering active channel and flood benches for higher flows. It will transition into coyote naturally. The energy will be dissipated naturally without grade control structures.
No Project			
I		1	Downstream 90-degree confluence with constricted "ditch" is bad, has major sediment deposition issues. Upstream, Dorel Drive and Private bridge create constriction in transition.
Objective 5 – Minimize Maintenance Requirements			
Criterion 5.1: Structural Features - Assesses maintenance requirements associated with structural features within project corridor			
Alternative		**Rating Score**	**Comments**
100-year Protection			
A		2	There should be not much more operation requirements than existing – few extra for water supply maintenance. Extra gate for the Mabury Diversion may be required to maintain Overfelt ponds water. Levees and floodwalls will require some minimal maintenance (vegetation control, weed agatement, graffiti removal, etc)

No Project			
I		2	Current maintenance requirements for structures is fair.

Objective 5 – Minimize Maintenance Requirements

Criterion 5.2: Natural Processes - Assesses maintenance requirements associated with vegetation growth, erosion and sediment processes

Alternative		Rating Score	Comments
100-year Protection			
A		1	Some of channel will be designed to full vegetation growth with full 100-year capacity. Some of channel reaches will need to have some limited vegetation control to have 100-year capacity. There may be some erosion issues in reaches where no work is being done. Compared to existing conditions, more vegetation maintenance due to the riparian enhancements.
No Project			
I		0	We do not do much maintenance due to much of the riparian corridor not out right of way. But for capacity restoration, much maintenance would be required to have adequate capacity.

Objective 5 – Minimize Maintenance Requirements

Criterion 5.3: Urban Flows - Assesses maintenance requirements resulting from smaller, high-frequency storm events and outfall flows

Alternative		Rating Score	Comments
100-year Protection			
A		3	Somewhat reduce sediment removal along reaches 2 and 3 and at the confluence. Reach 2 will have low flow meandering channel through Mabury Bypass.
No Project			
I		1	Maintenance kept the same.

Objective 5 – Minimize Maintenance Requirements

Criterion 5.4: Access – Incorporation of adequate access for maintenance crews and equipment

Alternative		Rating Score	Comments

100-year Protection			
A		4	Access to creek currently is really good. Access to design areas will be built (ramps, maintenance roads, etc)
No Project			
I		3	Current access is good.
Objective 6 – Protect the Quality and Availability of Water			
Criterion 6.1: Water Availability - Assesses impact on groundwater recharge			
Alternative		**Rating Score**	**Comments**
100-year Protection			
A		3	After much discussion with water supply, there isn't much potential to increase the recharge therefore the focus was on maintaining the existing recharge.
No Project			
I		3	Kept as is.
Objective 6 – Protect the Quality and Availability of Water			
Criterion 6.2: Groundwater Quality – assesses GW quality protection from contamination and threat of contamination by preventing entry into GW			
Alternative		**Rating Score**	**Comments**
100-year Protection			
A		3	R1 – GW high near the creek, so separation thickness but soil conditions may prevent pollution infiltration. Vegetation and meanders will help keep water quality in creek healthy.
No Project			
I		4	Does not have much potential of contaminant infiltration.
Objective 6 – Protect the Quality and Availability of Water			
Criterion 6.3: Instream Water Quality – Assesses water quality protection through vegetation and instream hydraulic complexity			
Alternative		**Rating Score**	**Comments**

100-year Protection			
A		4	Alternative would provide substantial new vegetation and hydraulic complexity.
No Project			
I		3	Maintain current water quality conditions.
Objective 6 – Protect the Quality and Availability of Water			
Criterion 6.4: Offstream Water Management - Assesses ability to enhance water supply & quality and reduce peak flows through local retention of rainfall and pollution prevention programs			
Alternative		**Rating Score**	**Comments**
100-year Protection			
A		4	Alternative provides opportunity for significant offstream water management in the future.
No Project			
I		1	No changes to existing.
Objective 6 – Protect the Quality and Availability of Water			
Criterion 6.5: Flow Regime – assesses ability to maintain geomorphically and biologically appropriate range of flows – quantity and timing			
Alternative		**Rating Score**	**Comments**
100-year Protection			
A		3	The lower flow events will be maintained through the meandering active channel. Flood benches will be designed for various flow ranges.
No Project			
I		2	Maintain existing conditions, no modifications.
Objective 7 – Cooperate with Other Local Agencies (Mutually Beneficial Goals)			
Criterion 7.1: Mutual Local Goals – Assesses ability to achieve the project-specific goals and objectives developed by District and agencies			
Alternative		**Rating Score**	**Comments**

100-year Protection			
A		3	There is the Tri-Party Agreement which is similar to a Memorandum of Consensus. Through out the planning phase project team met with partners, City of San Jose and Santa Clara County, to meet their recreational needs for the community. Trail extension, riparian enhancement, natural open space all provide recreational benefits. Main benefit provided for the County and City is the trail extension from King Road down to and connecting to the Coyote Creek trail system.
No Project			
I		1	No project will not provide mutual benefits.

Objective 7 – Cooperate with Other Local Agencies (Mutually Beneficial Goals)

Criterion 7.2: Supports General Plan – Assesses ability to support goals and policies as stated in general plan of partner agencies

Alternative		Rating Score	Comments
100-year Protection			
A		3	Will be supporting the City's Master Trail Plan.
No Project			
I		1	No project will not support mutual goals.

Objective 8 – Community Benefits Beyond Flood Protection

Criterion 8.1: Community Safety - Assesses overall safety for appropriate access and recreation

Alternative		Rating Score	Comments
100-year Protection			
A		0	Floodwall heights – they are short floodwalls for only 300-feet, so wouldn't be safety issue (police and others can easily see over wall). Not reviewed by public safety officials at this point.
No Project			
I		0	Not reviewed by public safety officials at this point.

Objective 8 – Community Benefits Beyond Flood Protection

Criterion 8.2: Recreation - Assesses quality of recreation experience provided by alternative

Alternative		Rating Score	Comments

100-year Protection			
A		4	Provides recreational benefits with the trail extensions, improvements, and educational kiosks.
No Project			
I		2	Few recreational facilities – existing parks along riparian corridor and trail extends most of the project reach. Easily accessible.

Objective 8 – Community Benefits Beyond Flood Protection

Criterion 8.3: Aesthetics - Assesses quality of aesthetic form provided by alternative

Alternative		Rating Score	Comments
100-year Protection			
A		4	Floodwalls will have texture to blend in with natural setting and reduce potential of graffiti. Can have art depending on public preference. Concrete will be sculpted to look like natural rock. Benches through out trail. Channel restoration provides harmonization of the natural landscape (sounds, smell, visual). Big improvement from existing is reach 1 restoration.
No Project			
I		3	Very natural creek as is.

Objective 8 – Community Benefits Beyond Flood Protection

Criterion 8.4: Open Space - Assesses incorporation of open space in alternative design

Alternative		Rating Score	Comments
100-year Protection			
A		4	R1 expansion – riparian corridor widened, used for flood protection, ecological restoration and public recreation, not for development.
No Project			
I		2	Keep existing conditions.

Objective 8 – Community Benefits Beyond Flood Protection

Criterion 8.5: Assesses alternative reflection on community-developed objectives/ideas

Alternative		Rating Score	Comments
100-year Protection			
A		3	Overall the community feedback was positive to the alternative. There was some concern on the height of the floodwalls, making sure we don't build higher than the short walls we're proposing.
No Project			
I		3	Community are happy with existing creek.

Objective 9 – Minimize Life-Cycle Costs

Criterion 9.1: Capital Cost

Alternative		Rating Score	Comments
100-year Protection			
A			Not used – looked at total lifetime costs.
No Project			
I			Not used – looked at total lifetime costs.

Objective 9 – Minimize Life-Cycle Costs

Criterion 9.2: Maintenance Cost – over the life of the project (50-years)

Alternative		Rating Score	Comments
100-year Protection			
A		4	Channel will be designed to be self-sustaining which will minimize maintenance costs.
No Project			
I		5	No capital costs, so outstanding.

Objective 9 – Minimize Life-Cycle Costs

Criterion 9.3: Grant or Cost-Sharing Opportunities

Alternative		Rating Score	Comments
100-year Protection			

A		3	There are some opportunities for cost sharing.
No Project			
I		0	No project so no cost sharing opportunity.
Objective 10 – Impacts are Avoided, Minimized or Mitigated			
Criterion 10.1: Water Quality Effects – Assesses potential effects of each alternative on water quality via regulatory standards (Basin Plan)			
Alternative		**Rating Score**	**Comments**
100-year Protection			
A		4	Implement vegetation in phases: trees for canopy first, then underbrush. Riparian restoration aspects will improve all aspects of Basin Plan (see notes)
No Project			
I		3	Adequate as is.
Objective 10 – Impacts are Avoided, Minimized or Mitigated			
Criterion 10.2: LEDPA– Determines the preliminary Least Environmentally Damaging Practicable Alternative and ensures it is carried forward			
Alternative		**Rating Score**	**Comments**
100-year Protection			
A		2	Channel widening will result in some environmental impacts. Significant impacts but will mitigate 3 to 1 ration, project is self-mitigating.
No Project			
I		5	No project so no impacts.

NFP Objective Ratings Calculation Table

Upper Penitencia Feasible Alternatives NFP Screening

	Factor	Alt A	Alt I
Objective 1: Flood Protection			
1.1 Safety	**0.30**	3.00	1.00
1.2 Economic Protection	**0.30**	3.00	0.00
1.3 Durability	**0.10**	4.00	1.00
1.4 Resiliency	**0.10**	4.00	0.00
1.5 Local Drainage	**0.10**	4.00	2.00
1.6 Time to Implementation	**0.10**	1.00	5.00
Objective Score:		**3.10**	**1.10**
Objective 2: Integrate Within Watershed			
2.1 Meets Local Watershed Goals	**1.00**	4.00	2.00
Objective Score:		**4.00**	**2.00**
Objective 3: Ecological Functions			
3.1 Meets Local Habitat Goals	**0.25**	4.00	2.00
3.2 Quality of Habitat	**0.25**	4.00	2.00
3.3 Sustainability of Habitat	**0.25**	3.00	2.00
3.4 Connectivity of Habitat	**0.25**	3.00	2.00
Objective Score:		**3.50**	**2.00**
Objective 4: Geomorphic Physical Stream Functions			
4.1 Floodplain	**0.35**	4.00	2.00
4.2 Active Channel	**0.30**	4.00	2.00
4.3 Stable Side Slopes	**0.20**	4.00	2.00
4.4 Transitions	**0.15**	4.00	1.00
Objective Score:		**4.00**	**1.85**
Objective 5: Minimize Maintenance Requirements			
5.1 Structural Features	**0.25**	2.00	2.00
5.2 Natural Processes	**0.25**	1.00	0.00
5.3 Urban Flows	**0.25**	3.00	1.00
5.4 Access	**0.25**	4.00	3.00
Objective Score:		**2.50**	**1.50**
Objective 6: Water Quality & Availability			
6.1 Water Availability (GW Recharge)	**0.30**	3.00	3.00
6.2 Groundwater Quality	**0.25**	3.00	4.00
6.3 Instream Water Quality (Channel, Veg)	**0.30**	4.00	3.00
6.4 Offstream Water Mgmt (Runoff, Pollution)	**0.10**	4.00	1.00
6.5 Flow Regime	**0.05**	3.00	2.00
Objective Score:		**3.40**	**3.00**
Objective 7: Local Agency Cooperation			
7.1 Mutual Local Goals	**0.50**	3.00	1.00
7.2 Supports General Plan	**0.50**	3.00	1.00
Objective Score:		**3.00**	**1.00**
Objective 8: Community Benefits Beyond Flood			
8.1 Community Safety (for Access and Rec)	**0.20**	0.00	0.00
8.2 Recreation	**0.20**	4.00	2.00
8.3 Aesthetics	**0.20**	4.00	3.00
8.4 Open Space	**0.20**	4.00	2.00
8.5 Community Input	**0.20**	3.00	3.00
Objective Score:		**3.00**	**2.00**
Objective 9: Minimize Life-Cycle Costs			
9.1 Capital Cost	**0.00**	0.00	0.00
9.2 Maintenance Cost (50-yr) - Total Lifetime Cost	**0.75**	4.00	5.00
9.3 Grant or Cost Sharing Opportunities	**0.25**	3.00	0.00
Objective Score:		**3.75**	**3.75**
Objective 10: Impacts are Avoided, Minimized or Mitigated			
10.1 Compliance with S.F. Bay or Central Coast Basin Plan	**0.50**	4.00	3.00
10.2 Identify LEDPA	**0.50**	2.00	5.00
Objective Score:		**3.00**	**4.00**

Ratings Key: 5.0 = Outstanding; 4.0 = Very good; 3.0 = Adequate; 2.0 = Fair; 1.0 = Poor; 0.0 = Unacceptable
Objective Score Key: 4.5 to 5 = Outstanding; 3.5 to 4.49 = Very good; 2.5 to 3.49 = Adequate;
1.5 to 2.49 = Fair; 0.5 to 1.49 = Poor; 0 to 0.49 = Unacceptable

APPENDIX E: TRI-PARTY AGREEMENT

Santa Clara Valley Water District

Meeting Date:	12/12/06
Agenda Item No.:	9
Manager:	M. Klemencic
Extension:	2084
Directors:	R. Santos T. Estremera

BOARD AGENDA MEMO

☐ Discussion ☒ Action ☐ Consent ☐ Information

SUBJECT: Renewal of Tri-Party Agreement for the Joint-Use of Lands Along Upper Penitencia Creek by and Among the Santa Clara Valley Water District, County of Santa Clara, and the City of San Jose

RECOMMENDATION:

Authorize the Chief Executive Officer to sign a Tri-Party Agreement for the Joint-Use of Lands along Upper Penitencia Creek (Agreement) by and among the Santa Clara Valley Water District (District), County of Santa Clara (County), and the City of San Jose (City).

Denial of this request will result in closure of trails along Upper Penitencia Creek on District lands until a formal Agreement can be executed.

Denial of this request would also jeopardize the ownership of lands needed by the District for the planned Upper Penitencia Creek flood protection project. Without the Agreement in place, the County and City would be free to sell these lands. The cost associated with recovering lands for the proposed flood improvements would be significant.

RATIONALE:

Board Governance Process GP-3.1 states that the Board will produce the link between the District and the public.

In accordance with the Board's Executive Limitation 5.9, the CEO shall not, "Acquire, encumber or dispose of real property, except for acquisition of lands, easements, rights of way, or other property interests offered by dedication or required to be purchased to meet District obligations to provide such interests under a contract eligible for federal cost-sharing, provided that such acquisitions otherwise meet the requirements of state law. Therefore, Board authorization must be received before the CEO can sign the Agreement.

EL-3.7 COMPLIANCE:

Not applicable for this request.

AUTHORIZED
DEC 12 2006

SUBJECT: Renewal of Tri-Party Agreement for the Joint-Use of Lands Along Upper Penitencia Creek by and Among the Santa Clara Valley Water District, County of Santa Clara, and the City of San Jose

(12/12/06)

SUMMARY:

In 1977, the County prepared a Master Plan for Penitencia Creek Park from Alum Rock Park to Coyote Creek. The Master Plan envisioned a cooperative joint-use of lands owned by the District, County, and City for the development of a regional park along Penitencia Creek. Both the District Board and City Council fully endorsed this Master Plan.

The District first entered into the Agreement with the County and City on July 6, 1981 for a period of 25 years. Under the Agreement, the parties agreed to cooperate to permit joint-use of specified public lands for parks, recreation, open space, flood management, and water conservation purposes. In 1987, all parties adopted an addendum to this Agreement titled *Specific Plan Agreement for Joint Use and Development of a Portion of the Penitencia Creek Park Chain* (Addendum). The Addendum specified development obligations and outlined improvement project responsibilities, maintenance responsibilities, funding contributions, and fee establishment and collection for each entity. Over the years since the Agreement was executed, the City and County have constructed a number of trail segments across District lands consistent with the Master Plan.

At the beginning of this year, District staff began working with County and City staffs to update the Agreement. The update to the Agreement was close to being finalized when County staff proposed to include a provision that would commit the District to construct a continuous trail from near Alum Rock Park to Coyote Creek as part of the flood protection project, if either the County or City had not implemented the Master Plan. District staff was unable to fully evaluate the cost implications for this additional provision prior to the deadline for the last County Board hearing before its summer break. As a result, the existing Agreement expired on July 6, 2006. District staff has determined that no other agreements or permits for the County's existing trail segments are in place and, consequently, the County continues to operate trails along Upper Penitencia Creek on District lands without a formal agreement.

On October 2, 2006, District staff met with County and City staff to discuss: 1) the potential implications of not having the Agreement in place; 2) what language the parties want to include in the Agreement; and 3) the steps required to renew the Agreement. All parties agreed to move forward with renewing the Agreement as it currently exists rather than negotiate more detailed provisions that can be handled better during specific project planning in the future. County staff withdrew their proposal to include a provision that would commit the District to construct a continuous trail from near Alum Rock Park to Coyote Creek as part of the flood protection project if either the County or City had not implemented the Master Plan. District staff agreed to work closely with County staff on future flood protection improvements to help minimize impacts to leased facilities on their lands. The new Agreement is for a period of 25 years.

Attachments:
1. Project location map
2. Proposed 2006 Tri-Party Agreement
3. Original 1981 Tri-Party Agreement
4. 1987 Addendum to Tri-Party Agreement

SUBJECT: Renewal of Tri-Party Agreement for the Joint-Use of Lands Along Upper Penitencia Creek by and Among the Santa Clara Valley Water District, County of Santa Clara, and the City of San Jose

(12/12/06)

NEXT STEPS:

City staff is submitting the Agreement to City Council for approval in January 2007. County staff is submitting the Agreement to the Housing, Land Use, Environment and Transportation (HLUET) Committee for approval in December 2006 and to the County Board of Supervisors for approval in January 2007.

CEQA REQUIREMENTS:

CEQA documents will be prepared separately for flood and trail projects.

ADVISORY COMMITTEE INPUT:

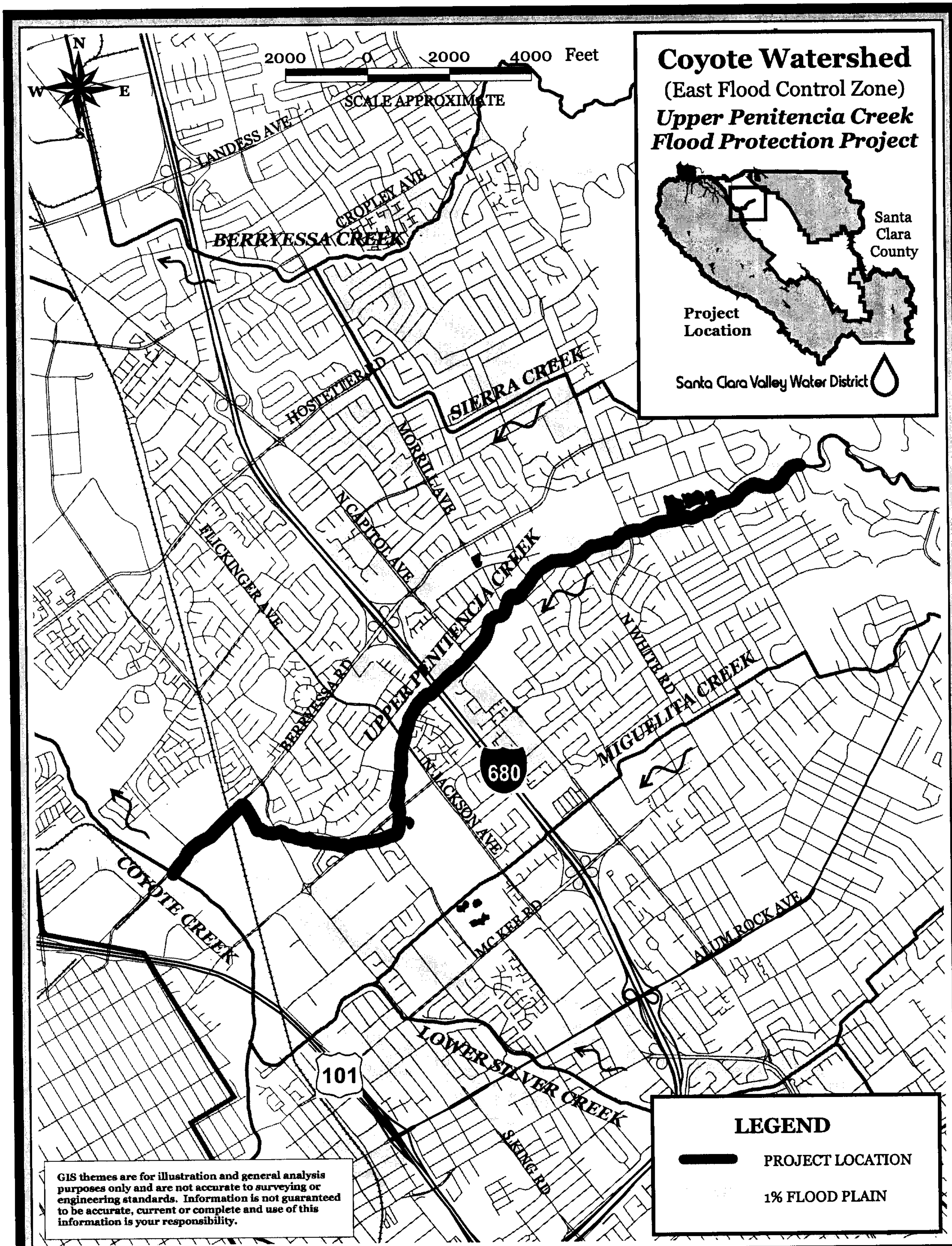
The Coyote Flood Control and Watershed Advisory Committee (CFCWAC) has been briefed on the status of the Agreement at the November 16, 2006 committee meeting. The CFCWAC passed a motion recommending that the Board approve renewal of the Agreement.

PUBLIC OUTREACH:

Not applicable for this request.

FINANCIAL IMPACT:

There are no new financial impacts to this Board action.



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AGREEMENT FOR THE JOINT USE OF LANDS OF THE UPPER PENITENCIA CREEK PARK CHAIN BY AND AMONG SANTA CLARA VALLEY WATER DISTRICT COUNTY OF SANTA CLARA AND CITY OF SAN JOSE

This Agreement ("Agreement") is made and entered into on this 20th day of March 2007 ("Effective Date") by and between the COUNTY OF SANTA CLARA, a political subdivision of the State of California (hereinafter designated "County"), the CITY OF SAN JOSE, a municipal corporation of the State of California (hereinafter designated "City"), and the SANTA CLARA VALLEY WATER DISTRICT, a public entity of the State of California (hereinafter designated "District"), concerning the joint use of certain designated properties along Upper Penitencia Creek for public park, recreational and flood control purposes from Alum Rock Park to Coyote Creek.

RECITALS

1. WHEREAS, the County prepared a Master Plan for Penitencia Creek Park, from Alum Rock Park to Coyote Creek, dated July 18, 1977, hereinafter called "1977 Master Plan", which contemplates the joint use of County, District, and City-owned land on and adjacent to Upper Penitencia Creek, said land being that shown on the attached "Exhibit 1", which by this reference is made a part of this agreement. This Master Plan was reviewed and approved by the County Board of Supervisors, and formally endorsed by the District Board of Directors, and the City Council; and

2. WHEREAS, consistent with approval of the 1977 Master Plan, the County, City, and District entered into an "Agreement for Joint Use of Lands for the Upper Penitencia Creek Park Chain By and Among Santa Clara Valley Water District, County of Santa Clara and City of San Jose" dated July 6, 1981 that expired on July 6, 2006("the Agreement"); and

3. WHEREAS, the County, City, and District entered into a 1987 agreement entitled "Specific Plan Agreement for Joint Use and Development of a Portion of the Penitencia Creek Park Chain", which provided for the development of a portion of the park; and

4. WHEREAS, the City Council adopted a master plan in June 2002 for the Penitencia Creek Trail Reach 2 and construction is underway for a trail between Noble Avenue to Piedmont Road; and

5. WHEREAS, the County adopted the 1995 Countywide Trails Master Plan as part of its General Plan and a portion designates the Penitencia Creek Trail as a Multi-Use Bay Area Ridge Trail alignment; and

6. WHEREAS, the County and City have invested considerable public funds into recreational improvements consistent with the Agreement and have performed operation and maintenance of these improvements for the benefit of the public; and

7. WHEREAS, the District is working on a joint study with the U.S. Army Corps of Engineers (Corps), hereinafter called "Flood Protection Project", to evaluate existing Upper Penitencia Creek conditions and develop flood protection alternatives that meet the Flood Protection Project objectives, which include providing 100-year flood protection, enhancing riparian and fisheries habitat, improving creek water quality and maintenance, and providing recreational access to the public in cooperation with the City and County.

NOW, THEREFORE, in consideration of the mutual promises, covenants and conditions contained herein, the parties agree as follows:

1. <u>Conveyance of Property</u>

   County, City and District agree to cooperate in providing such exchanges or conveyances of real property or easements on Upper Penitencia Creek as will permit the joint use of public-owned lands for parks, recreation, open space, flood management, and water conservation purposes. Each such exchange or conveyance of real property or interests therein shall be formally approved and consummated by the governing boards of the parties affected.

2. Term and Option to Renew

This agreement shall be for a period of twenty-five (25) years beginning on the Effective Date. County, City, and District may renew this agreement for another twenty-five (25) years either upon the same terms or conditions, or upon any other written terms or conditions mutually acceptable to the parties.

3. Joint Responsibility for Implementation and Operation and Maintenance

a. County and City agree to jointly implement the 1977 Master Plan, and subject to availability and appropriation of funds, will design and construct recreational elements consistent with the Master Plan.
b. County, City and District will maintain their respectively owned lands unless and until another party expressly assumes such maintenance by separate agreement and will maintain to the extent stated in that agreement.
c. County and District are evaluating the use and compatibility of County lands for the District's flood control easements, specifically where the 1977 Master Plan calls for a continuous paved trail from Coyote Creek to Alum Rock Park to be designed and constructed to Countywide Trails Master Plan guidelines.

4. County-Specific Responsibilities

a. County agrees to cooperate in the use of County-owned land along Upper Penitencia Creek for flood protection purposes.
b. County will develop lands adjacent to Upper Penitencia Creek as a linear regional park consistent with the 1977 Master Plan, as feasible in the opinion of the County and subject to appropriation of funds by County's governing body.
c. County shall maintain and operate all park facilities that County constructs unless otherwise provided by written agreement with another party.
d. County shall submit proposed recreational improvement plans on City or District-owned land to the respective property owner for review and approval.

5. District-Specific Responsibilities

a. District agrees to cooperate in the use of District owned land along Upper Penitencia Creek for recreational purposes.

b. District shall maintain the natural and constructed channel between the tops of banks of Upper Penitencia Creek and the recharge facilities for flood control and water conservation purposes in accordance with the applicable property interests.

c. Subject to the future needs of the District and as is permitted by separate agreement of the parties, the District will construct and maintain recharge ponds on County or City owned lands where feasible in the opinion of District, in accordance with the 1977 Master Plan. Such construction shall be subject to the availability of existing or future water supplies. The District has constructed a portion of a recharge pond on City property in accordance with the 1977 Master Plan.

d. District shall be guided by the plans and principles of the 1977 Master Plan in constructing aesthetically pleasing flood control improvements on District property and minimizing disturbance of the natural stream.

e. District will implement the Flood Protection Project consistent with the joint District and Corps planning study or agreements made pursuant to the study.

f. District shall submit proposed flood improvement plans located on City or County-owned land to the respective owner for review and approval.

6. City-Specific Responsibilities

a. City agrees to cooperate in the use of City-owned land along Upper Penitencia Creek for flood protection purposes.

b. City will develop lands adjacent to Upper Penitencia Creek as a linear regional park consistent with the 1977 Master Plan, as feasible in the opinion of the City and subject to appropriation of funds by City's governing body.

c. City shall maintain and operate all park facilities City constructs unless otherwise provided by written agreement with another party.

d. City shall submit proposed recreational improvement plans on County or District-owned land to the respective property owner for review and approval.

7. Permits

For any flood control or recreational elements constructed in the area depicted in the 1977 Master Plan, the County, City, and District shall assist each other and cooperate in identifying applicable permits, coordinate permit applications to the extent feasible, and streamline permitting processes. Each party is responsible for obtaining regulatory permits for their respective projects, as necessary.

8. Indemnification and Hold Harmless

a. County shall assume the defense of, indemnify, and hold harmless District, City, and their officers, agents and employees from all claims, liability, loss, damage and injury of any kind, nature or description directly or indirectly arising during the initial term of this agreement, or any renewal thereof, and resulting from the public use of premises under control of the County pursuant hereto or from acts, omissions, or activities of County's officers, agents, employees, or independent contractors employed by County. This agreement, to defend, indemnify, and hold harmless, shall operate irrespective of whether negligence is the basis of the claim, liability, loss, damage or injury, and irrespective of whether the act, omission or activity is merely a condition rather than a cause.

b. District shall assume the defense of, indemnify and hold harmless County, City and their officers, agents and employees from all claims, liability, loss, damage and injury of any kind, nature or description directly or indirectly arising during the initial term of this agreement or any renewal thereof and resulting from District's exercise of flood management or water conservation purposes on the premises pursuant hereto or from acts, omissions, or activities of District's officers, agents, employees or independent contractors employed by District. This agreement to defend, indemnify and hold harmless shall operate irrespective of whether negligence is the basis of the claim, liability, loss, damage or injury, and irrespective of where the act, omission or activity is merely a condition rather than a cause.

c. City shall assume the defense of, indemnify, and hold harmless County, District and their officers, agents, and employees from all claims, liability, loss, damage or injury of any kind, nature, or description directly or indirectly arising during the initial term of this agreement, or any renewal thereof and resulting from the public use of premises under control of the City pursuant hereto or from acts, omissions, or activities of City's officers, agents, employees, or independent contractors employed by City. This agreement to defend, indemnify and hold harmless shall operate irrespective of whether the act, omission or activity is merely a condition rather that a cause.

9. Notices

Any and all notices required to be given hereunder shall be in writing and may be delivered personally or shall be deemed to have been delivered upon deposit in the United States mail, postage prepaid, addressed to either of the parties at the address hereinafter specified or as later amended by either party in writing.

County: Clerk of the Board of Supervisors
County of Santa Clara
70 West Hedding Street, East Wing
San Jose, California 95110

City: City Clerk
City of San Jose
200 East Santa Clara Street
San Jose, California 95113

District: Clerk of the Board of Directors
Santa Clara Valley water District
5750 Almaden Expressway
San Jose, California 95118

10. Amendments

This Agreement may only be amended by the written agreement of the parties.

11. Exhibits

Exhibit A – Property Ownership Map

12. Successors and Assigns

This agreement, and all the terms, covenants, and conditions hereof, shall apply to and bind the successors and assigns of the respective parties hereto.

WITNESS THE EXECUTION HEREOF the day and year first hereinabove set forth.

"County"
COUNTY OF SANTA CLARA

By: ______________________
Donald F. Gage, Chairperson
Board of Supervisors

"City"
CITY OF SAN JOSE

By: ______________________
Deanna Santana
Deputy City Manager

"District"
SANTA CLARA VALLEY WATER DISTRICT

By: ______________________
Stanley M. Williams
Chief Executive Officer

ATTEST:

____
Phyllis Perez
Clerk, Board of Supervisors

ATTEST:

____
Lauren Keller
Clerk/Board of Directors

APPROVED AS TO FORM:

____
Katherine Harasz
Deputy County Counsel

APPROVED AS TO FORM:

____
Barbara Jordan
Deputy City Attorney

APPROVED AS TO FORM:

______________________ 12-22-06
Debra L. Cauble
District Counsel

Exhibit A

Page 1 of 3

Property Ownership Map
Upper Penitencia Creek
Coyote Creek to Jackson Avenue

November 27, 2006

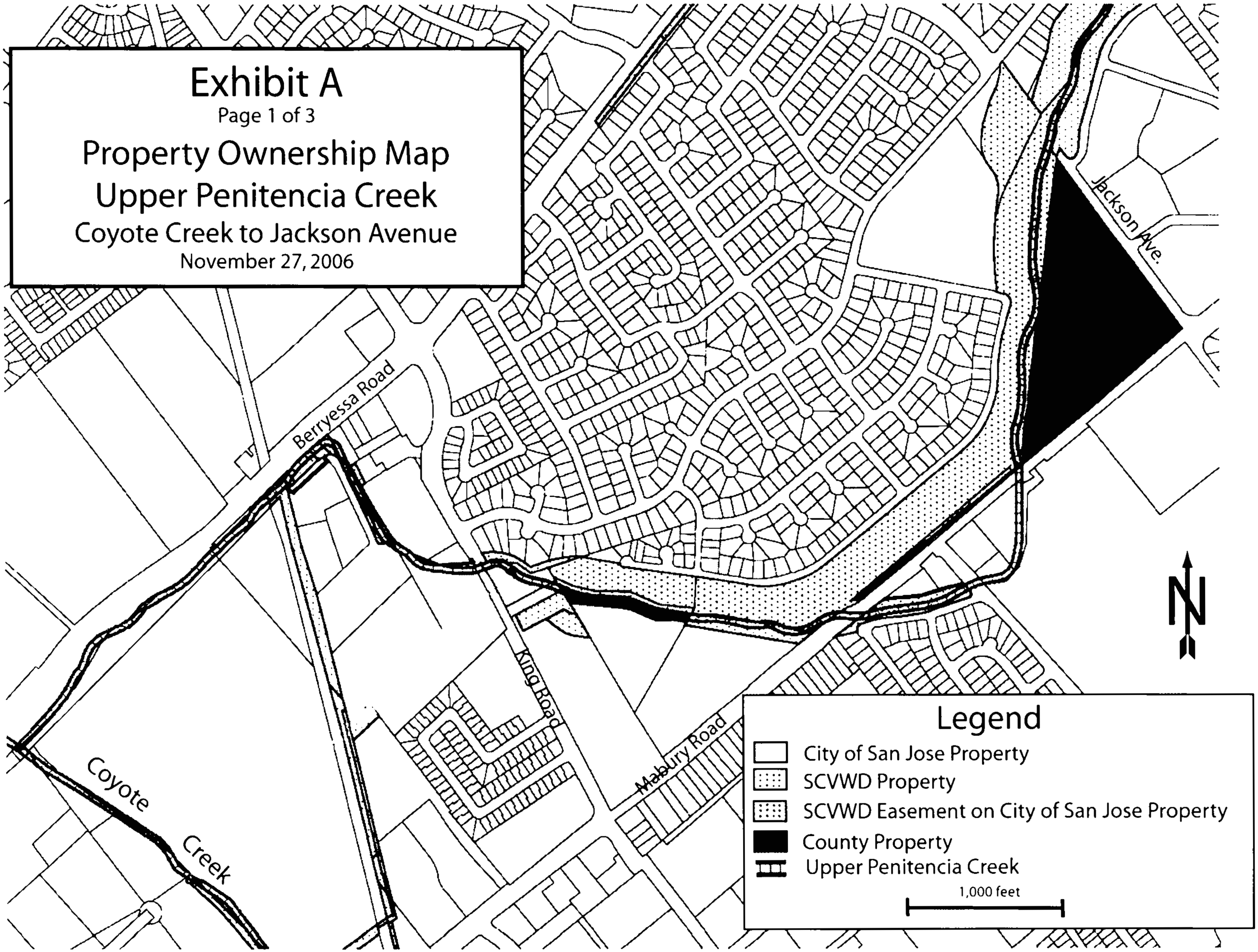


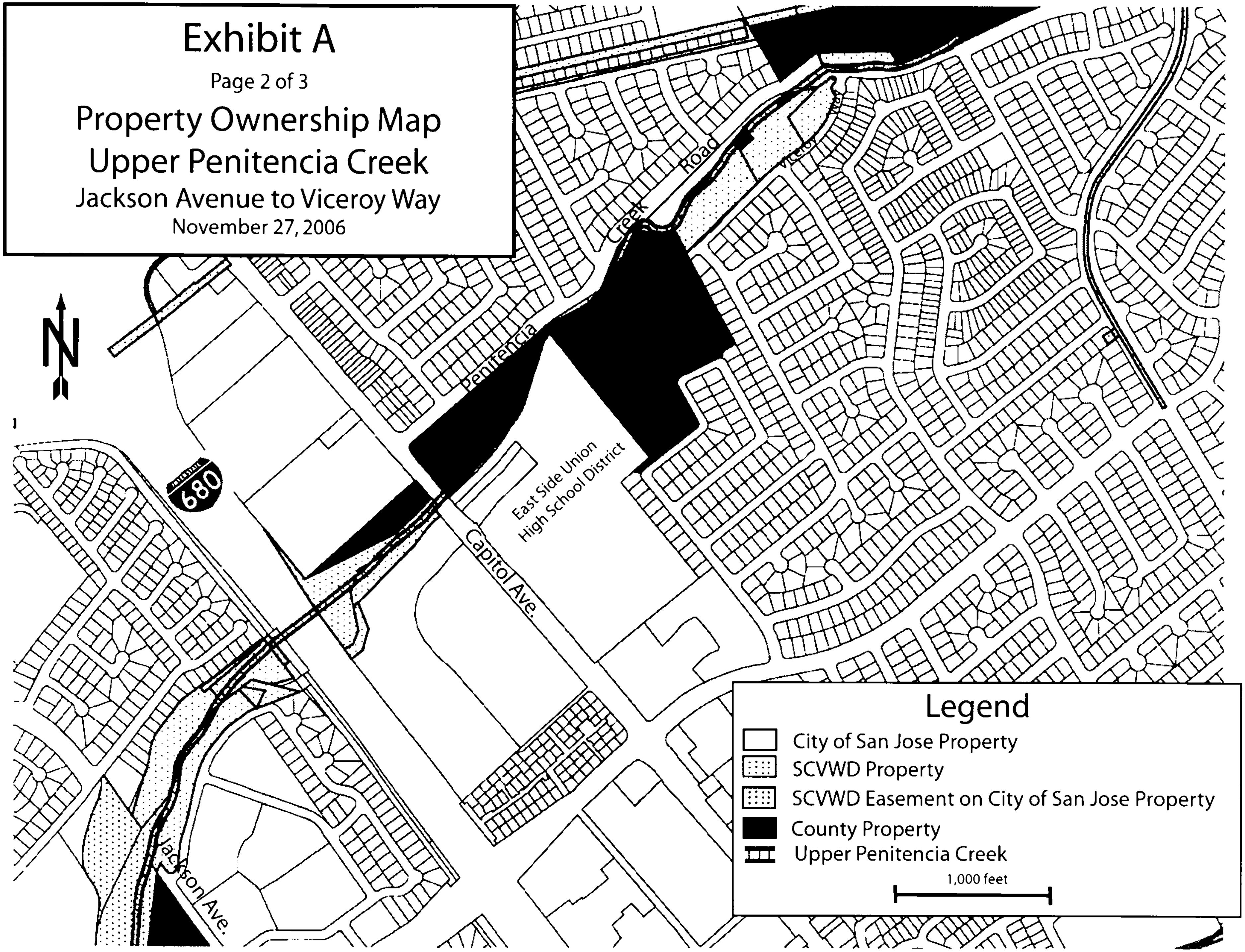
Exhibit A

Page 2 of 3

Property Ownership Map
Upper Penitencia Creek

Jackson Avenue to Viceroy Way

November 27, 2006



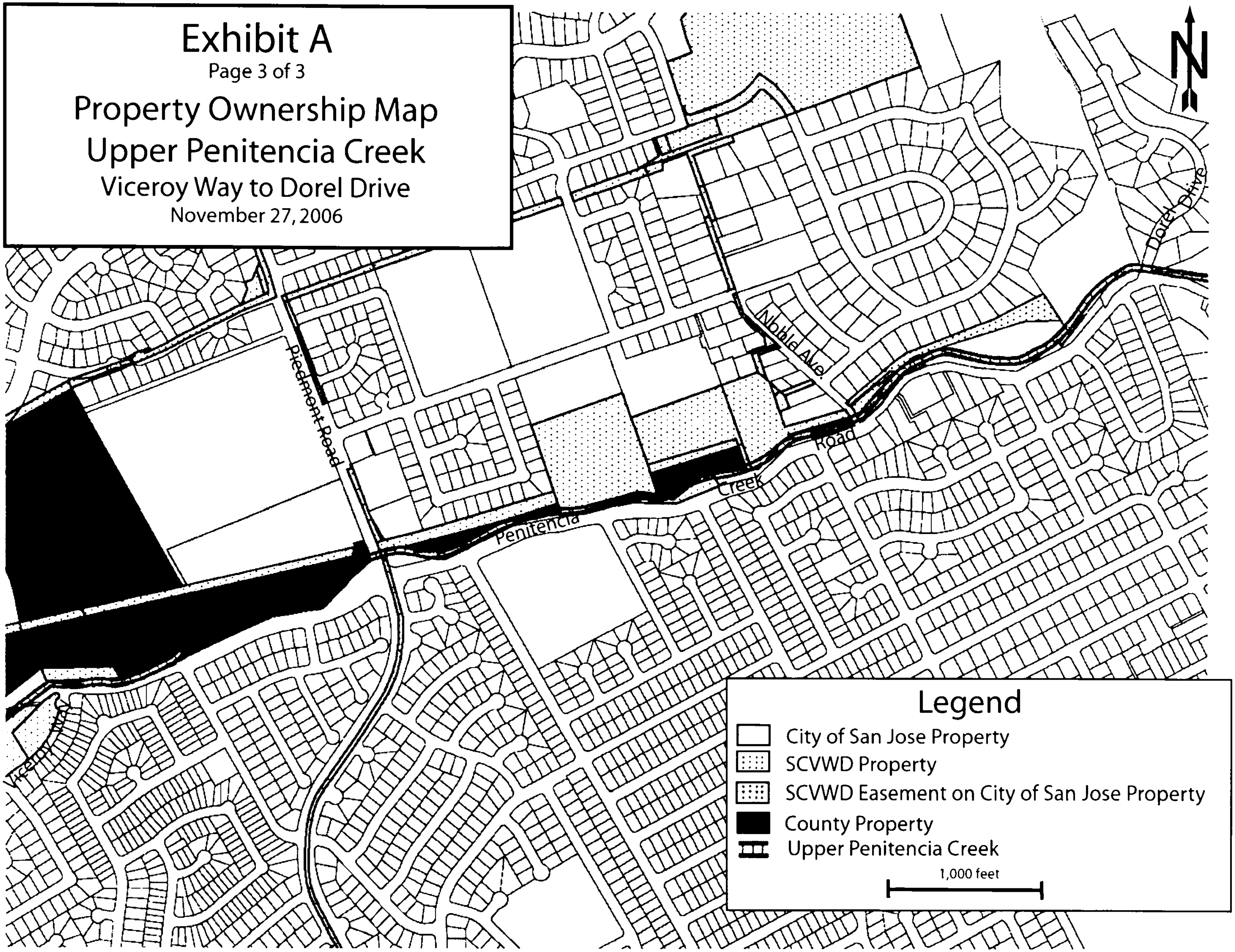


Exhibit A
Page 3 of 3
Property Ownership Map
Upper Penitencia Creek
Viceroy Way to Dorel Drive
November 27, 2006
N
Dorel Drive
Noble Ave.
Piedmont Road
Penitencia
Creek
Road
Viceroy Way
Legend
City of San Jose Property
SCVWD Property
SCVWD Easement on City of San Jose Property
County Property
Upper Penitencia Creek
1,000 feet

RESOLUTION NO. 73660

A RESOLUTION OF THE COUNCIL OF THE CITY OF SAN JOSE AUTHORIZING THE CITY MANAGER TO NEGOTIATE AND EXECUTE AN AGREEMENT WITH THE SANTA CLARA VALLEY WATER DISTRICT AND THE COUNTY OF SANTA CLARA FOR JOINT USE OF LANDS ALONG UPPER PENITENCIA CREEK, FOR FLOOD MANAGEMENT, WATER CONSERVATION, OPEN SPACE AND RECREATIONAL PURPOSES

WHEREAS, in 1977, the County of Santa Clara ("County") prepared a master plan for Penitencia Creek Park, from Alum Rock Park to Coyote Creek, which contemplated the joint use of lands owned by the County, the Santa Clara Valley Water District ("District") and the City of San José ("City"); and

WHEREAS, in July, 1981, the City, District and County entered into a joint use agreement for the lands of the Upper Penitencia Creek Park Chain, which generally defined the roles of each agency in developing the park chain, and expired in July, 2006; and

WHEREAS, City, County and District desire to enter into a new agreement for joint use of the lands along the Upper Penitencia Creek, that more specifically defines work, roles and responsibilities within each reach of the Upper Penitencia Creek system; and

WHEREAS, the City desires to negotiate and execute an agreement with the County and the District for the above purpose;

NOW, THEREFORE, BE IT RESOLVED BY THE COUNCIL OF THE CITY OF SAN JOSE THAT:

The City Manager is hereby authorized to negotiate and execute an agreement with the County of Santa Clara and the Santa Clara Valley Water District for joint use of lands along Upper Penitencia Creek, from Alum Rock Park to Coyote Creek, for flood management, water conservation, open space, and recreational purposes.

ADOPTED this 27th day of February, 2007, by the following vote:

AYES:	CAMPOS, CHIRCO, CONSTANT, CORTESE, LICCARDO, NGUYEN, PYLE, WILLIAMS; REED
NOES:	NONE
ABSENT:	NONE
DISQUALIFIED:	NONE
VACANT:	DISTRICT 4, DISTRICT 6

CHUCK REED
Mayor

ATTEST:

LEE PRICE, MMC
City Clerk

AGREEMENT FOR THE JOINT USE OF LANDS OF THE UPPER PENITENCIA CREEK PARK CHAIN BY AND AMONG SANTA CLARA VALLEY WATER DISTRICT, COUNTY OF SANTA CLARA AND CITY OF SAN JOSE

This is an agreement among the COUNTY OF SANTA CLARA, a political subdivision of the State of California (hereinafter designated "County"), the CITY OF SAN JOSE, a municipal corporation of the State of California (hereinafter designated "City"), and the SANTA CLARA VALLEY WATER DISTRICT, a body corporate and politic of the State of California (hereinafter designated "District"), concerning the joint use of certain designated property for public park and recreational purposes.

RECITALS

WHEREAS, the County has prepared a Master Plan for Penitencia Creek Park, dated July 18, 1977, hereinafter called "Master Plan", which contemplates the joint use of County, District, and City-owned land on and adjacent to Upper Penitencia Creek, said land being that shown on the attached "Exhibit A", which by this reference is made a part of this agreement; and

WHEREAS, the District and City have reviewed the Master Plan and District's Board of Directors and the City Council have adopted formal resolutions endorsing the Master Plan and stating District's and City's intentions to cooperate with County and any other interested public agencies in carrying out the Master Plan proposals, all of which is found to be in the best public interest.

NOW, THEREFORE, in consideration of the mutual promises, covenants and conditions contained herein, the parties agree as follows:

1. Term and Option to Renew

This agreement shall be for a period of twenty-five (25) years beginning on the date of execution hereof by the parties. County may, upon written notice to City and District, renew this agreement for another twenty-five (25) years either upon the same terms or conditions, or upon any other written terms or conditions mutually acceptable to the parties.

0163R/004R
1-13-81

2. Joint Use and Conveyance of Property

a. County, City and District agree to cooperate in providing such exchanges or conveyances of real property or easements on Upper Penitencia Creek as will permit the joint use of public-owned lands for parks, recreation, open space, flood management, and water conservation purposes. Each such exchange or conveyance of real property or interests therein shall be formally approved and consummated by the governing boards of the parties affected.

b. County, City and District agree to provide weed eradication and weed control on their respective owned lands until discontinuance because of impending development or inception of public use.

3. County's Responsibilities for Park Development

a. County shall assume overall responsibility for the development of a regional park on Upper Penitencia Creek.

b. County shall develop lands adjacent to Upper Penitencia Creek as a linear regional park in accordance with the Master Plan.

c. County shall exercise full control and authority for beautification and recreational purposes over the lands currently owned by County or subsequently leased from City or District.

d. County shall obtain all necessary rights and permits along the creek for trails and other facilities under Interstate Freeway 680 and any other area not in the ownership of City or District.

e. County shall obtain prior approval from the District before constructing any permanent structures or installing landscape materials within the leased areas.

f. County shall pay all costs associated with the replacement of the District's linear pond system with pipe if such replacement is deemed necessary as park development proceeds. Replacement is subject to District approval.

g. County shall maintain and operate all park facilities normally associated with regional park recreational activities--to include visiting, hiking, biking, picnicking, fishing and low intensity use of open space areas.

h. Primary law enforcement responsibility will be borne by the County by means of park ranger patrol.

4. District's Responsibilities for Flood Control and Water Conservation

a. District shall maintain the channel of Penitencia Creek and the adjacent recharge facilities for flood control and water conservation purposes.

b. District shall construct and maintain recharge ponds and gravel dams on County or City owned lands where feasible in the opinion of District, in accordance with the Master Plan. Such construction shall be subject to the availability of existing or future water supplies.

c. District shall regrade existing offstream percolation ponds to provide an aesthetically pleasing contour in accordance with the Master Plan. Grading may be carried on over a period of several years.

d. District shall be guided by the plans and principles of the Master Plan in constructing an aesthetically pleasing flood control works on its property to minimize disturbance of the natural stream.

e. District shall assist County with the removal and replacement with pipe of District's linear pond system from a point about 500 feet east of Piedmont Road to Summerdale School. Replacement cost is to be borne by County.

f. District shall, where possible, obtain fee title to privately-owned lands in the designated floodway where such lands can be obtained by dedication or district funds are available for their purchase.

5. City's Responsibilities for Public Safety Services and Recreational Development

a. City shall provide fire protection services to the Park.

b. City shall provide back-up and extraordinary police service to the Park.

c. City shall, subject to approval of the County or District and appropriation of funds by City, develop for recreational purposes those portions of the Park on City, County, or District lands where, because of the type of public recreational need, a higher degree of development is desired by the City than that normally provided on the Master Plan or normally found in Regional County parks.

d. City shall maintain and operate the intensively-developed recreational areas referred to in 5c above.

6. Indemnification and Hold Harmless

a. County shall assume the defense of, indemnify, and hold harmless District, City, and their officers, agents and employees from all claims, liability, loss, damage and injury of any kind, nature or description directly or indirectly arising during the initial term of this agreement, or any renewal thereof, and resulting from the public use of premises under control of the County pursuant hereto or from acts, omissions, or activities of County's officers, agents, employees, or independent contractors employed by County. This agreement, to defend, indemnify, and hold harmless, shall operate irrespective of whether negligence is the basis of the claim, liability, loss, damage or injury, and irrespective of whether the act, omission or activity is merely a condition rather than a cause.

b. District shall assume the defense of, indemnify and hold harmless County, City and their officers, agents and employees from all claims, liability, loss, damage and injury of any kind, nature or description directly or indirectly arising during the initial term of this agreement or any renewal thereof and resulting from District's exercise of flood management or water conservation purposes on the premises pursuant hereto or from acts, omissions, or activities of District's officers, agents, employees or independent contractors employed by District. This agreement to defend, indemnify and hold harmless shall operate irrespective of whether negligence is the basis of the claim, liability, loss, damage or injury, and irrespective of whether the act, omission or activity is merely a condition rather than a cause.

c. City shall assume the defense of, indemnify, and hold harmless County, District and their officers, agents, and employees from all claims, liability, loss, damage or injury of any kind, nature, or description directly or indirectly arising during the initial term of this agreement, or any renewal thereof and resulting from acts, omissions or activities of City's officers, agents, employees, or independent contractors employed by City pursuant to this agreement or any of the premises included in the scope of this agreement. This agreement to defend, indemnify and hold harmless shall operate irrespective of whether the act, omission or activity is merely a condition rather than a cause.

7. Notices

Any and all notices required to be given hereunder shall be in writing and may be delivered personally or shall be deemed to have been delivered upon deposit in the United States mail, postage prepaid, addressed to either of the parties at the address hereinafter specified or as later amended by either party in writing.

County: Clerk of the Board of Supervisors
County of Santa Clara
70 West Hedding Street, East Wing
San Jose, California 95110

City: City Clerk
City of San Jose
801 North First Street
San Jose, California 95110

District: Clerk of the Board of Directors
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118

8. Successors and Assigns

This agreement, and all the terms, covenants, and conditions hereof, shall apply to and bind the successors and assigns of the respective parties hereto; provided, that County shall neither assign nor sublet any leasehold or other interest conveyed without prior written consent of the party which owns the premises affected thereby.

IN WITNESS WHEREOF, the parties hereto have executed this agreement as of JUL 6 1981.

ATTEST: Helen M. Jackson

City Clerk

CITY OF SAN JOSE, a Municipal Corporation of the State of California

By: [signature]

Helen E. Jackson
CITY CLERK

ATTEST: Donald M. Rains

[signature]
Clerk, Board of Supervisors

SANTA CLARA COUNTY, a Political Subdivision of the State of California

By: [signature]
Chairperson, Board of Supervisors
Rod Diridon

ATTEST: Sue Ekstrand

[signature]
Clerk, Board of Directors

SANTA CLARA VALLEY WATER DISTRICT, a Body Corporate and Politic of the State of California

By: [signature] MAR 10 1981
Chairman, Board of Directors

APPROVED AS TO FORM:

[signature]
City Attorney

APPROVED AS TO FORM:

[signature]
General Counsel, Santa Clara Valley Water District

APPROVED AS TO FORM:

[signature]
DONALD J. BAKER
Assistant County Counsel

0163R/004R
11-13-81

KJL:JRS:se
6/6/79

RESOLUTION NO. 51799

A RESOLUTION OF THE COUNCIL OF THE CITY OF SAN JOSE AUTHORIZING THE CITY CLERK TO EXECUTE FOR AND ON BEHALF OF THE CITY OF SAN JOSE ALL CONTRACTS PREVIOUSLY APPROVED BY THE CITY COUNCIL.

BE IT RESOLVED BY THE COUNCIL OF THE CITY OF SAN JOSE:

Notwithstanding any action heretofore taken by the City Council to the contrary, unless hereinafter otherwise provided by the City Council, the City Clerk, or in the absence of the City Clerk, the Assistant City Clerk, is hereby authorized to execute for and on behalf of the City of San Jose, all contracts previously approved by the City Council.

ADOPTED this 3rd day of July, 1979, by the following vote:

AYES: ESTRUTH, GARZA, McENERY, PEGRAM, SELF, WILLIAMS AND HAYES

NOES: NONE

ABSENT: NONE

JANET GRAY HAYES, Mayor

ATTEST: FRANCIS L. GREINER

City Clerk

JRG:WHH:el/lem
1/16/87
D-10

SPECIFIC PLAN AGREEMENT FOR JOINT USE AND DEVELOPMENT OF A PORTION OF THE PENITENCIA CREEK PARK CHAIN

AGREEMENT between the CITY of SAN JOSE, a municipal corporation of the State of California (hereinafter "CITY"), COUNTY OF SANTA CLARA, a political subdivision of the State of California (hereinafter "COUNTY") and the SANTA CLARA VALLEY WATER DISTRICT, a body corporate and politic of the State of California (hereinafter "DISTRICT") concerning the joint use and development of a portion of the Penitencia Creek Park Chain bounded by Piedmont Road, Berryessa Road, and Penitencia Creek.

R E C I T A L S:

WHEREAS, CITY, COUNTY, and DISTRICT entered into an Agreement for Joint Use on July 6, 1981, in which the parties agreed to cooperate to permit joint use of certain public-owned lands described as the Penitencia Creek Park Chain for parks, recreation, open space, flood management and water conservation purpose; and

WHEREAS, the parties desire to further agree and specify specific development obligations for a portion of the Penitencia Creek Park Chain bounded by Piedmont Road, Berryessa Road, and Penitencia Creek which is more specifically described in Exhibit "A" attached hereto and made a part hereof; and

WHEREAS, the parties desire and CITY has agreed to act as lead agency to implement this portion of the development with funding provided by CITY, COUNTY and DISTRICT.

NOW, THEREFORE, in consideration of the mutual promises, covenants and conditions contained herein, the parties agree as follows:

1. CITY shall act as lead agency in the development of the above-described portion of the Penitencia Creek Park Chain, said portion of the Penitencia Creek Park Chain is more particularly described in Exhibit "A", attached hereto.

2. CITY shall coordinate the development with a steering committee comprised of representatives of CITY, DISTRICT, COUNTY, local residents, Berryessa School District, Eastside School District and other involved and interested agencies.

3. CITY shall contract with appropriate consultants to prepare a specific design and master plan, necessary environmental reports and subsequent construction documents for this development. The cost of consultant services will be apportioned between the parties as indicated on Exhibit "B". The master plan and specific design improvements will be subject to approval by all parties prior to implementation.

4. CITY shall contribute the funding necessary to construct the improvements within the intensively developed recreational areas as indicated in Exhibit "B". CITY's contribution is not to exceed $1,356,000.

5. DISTRICT shall contribute the funding necessary to construct a flood control water percolation pond and related flood control improvements as indicated on Exhibit "B". DISTRICT'S contribution is not to exceed $200,000 and will be paid to CITY within fifteen (15) days of written notice by CITY to DISTRICT that the contract for the flood control improvements has been awarded to the successful bidder. DISTRICT shall have the right of approval of the plans and specifications for the flood control improvements. CITY shall advertise and award construction contracts based on the plans and specifications approved by DISTRICT.

6. COUNTY shall contribute a sum of money not to exceed Seven Hundred Fifty Thousand Dollars ($750,000) to be used for construction of these improvements. Said sum shall be set aside by COUNTY out of available appropriated funds in the 1986-1987 fiscal year and shall be available for distribution to the CITY. CITY will periodically invoice COUNTY for reimbursement of CITY's costs incurred in constructing these improvements. CITY's invoice shall be submitted to the COUNTY Director of Parks and Recreation, along with copies of CITY's partial payment vouchers indicating the amount of CITY's

payment and payletters indicating amount of construction work completed. COUNTY shall provide payment to CITY within thirty (30) days of receiving CITY's invoice.

7. COUNTY's contribution will be expended exclusively for improvements as designated on Exhibit "B". The plans and specifications for said improvements will be subject to approval by COUNTY. CITY shall advertise and award construction contracts based on the approved plans and specifications.

8. Fees. CITY and COUNTY will be responsible for the establishment and collection of fees and charges in their respective areas of responsibility. All fees or charges collected by either party will be used for the operation, maintenance or improvement of the Penitencia Creek Park Chain. The fees charged shall be comparable with fees charged by other public entities in the Bay Area for similar park uses and services. Higher fees may be charged upon prior written approval of the CITY and COUNTY Directors of Park and Recreation, and such approval may not be denied if higher fees are needed to cover anticipated costs of improvements, maintenance, and operation of said park.

In the event that fees received by any party exceed the costs incurred by the party at the end of any fiscal year, the fees being charged shall be promptly adjusted so that the sum of such surplus and the anticipated fees will not exceed the anticipated costs for such year. Surplus funds which are being accumulated to pay for improvements necessary to implement the master plan agreed upon by the parties shall not be considered to be surplus funds for the purpose of adjusting fees.

Upon written request by one party to another party to this Agreement, said party shall promptly provide the requesting party with detailed records and information in accordance with accepted accounting principles relating to the costs incurred in improving, maintaining, and operating the park and the fees received by the party for park use and services. The party shall also provide the requesting party with information relating to anticipated costs and anticipated fees for the subsequent fiscal year.

At the termination of this AGREEMENT, any surplus fees held by any party shall be divided equally between CITY and COUNTY.

9. All parties to this Agreement understand and agree that the subject property and improvements are to be open to all members of the public for public park purpose regardless of the underlying ownership of the property.

10. Each party is responsible for the operation and maintenance of the property within their respective areas of responsibility as indicated in Exhibit "C" attached hereto and made a part hereof. COUNTY shall have exclusive use and control of the old Kiperash buildings (three [3] structures, one [1] house, and two [2] out-buildings) located in the 3100 block of Penitencia Creek Road, and the Bumb Building located in the 3200 block of Penitencia Creek Road and a reasonable area around said buildings in order that the buildings may be used for special recreational uses without being affected by persons using the adjacent park land.

11. Funds contributed by any party which are not expended to construct the improvements designated to be constructed with that party's contribution will be returned to said party upon completion of the project.

12. All provisions of the Agreement for joint use entered into by the parties on July 6, 1981, which are not inconsistent with the provisions of this Addendum shall remain in full force and effect. In the event that any provisions of the July 6, 1981 Agreement and this

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Agreement are deemed to conflict, the provisions of this Agreement shall control.

IN WITNESS WHEREOF the parties hereto have executed this agreement as of FEB 3 1987, 1987.

CITY OF SAN JOSE, a municipal corporation of the State of California

By: ANDREA M. PAVONE, City Clerk

APPROVED AS TO FORM:

WILLIAM H. HUGHES
Deputy City Attorney

SANTA CLARA COUNTY, a political subdivision of the State of California

By: Chairperson, Board of Supervisors Dianne McKenna

ATTEST: DONALD M. RAINS
Clerk of the Board of Supervisors

APPROVED AS TO FORM:

County Counsel

SANTA CLARA VALLEY WATER DISTRICT, a body corporate and politic of the State of California

By: Chairman, Board of Directors ~~Supervisors~~

ATTEST:
Clerk/Board of Directors

APPROVED AS TO FORM:

General Counsel

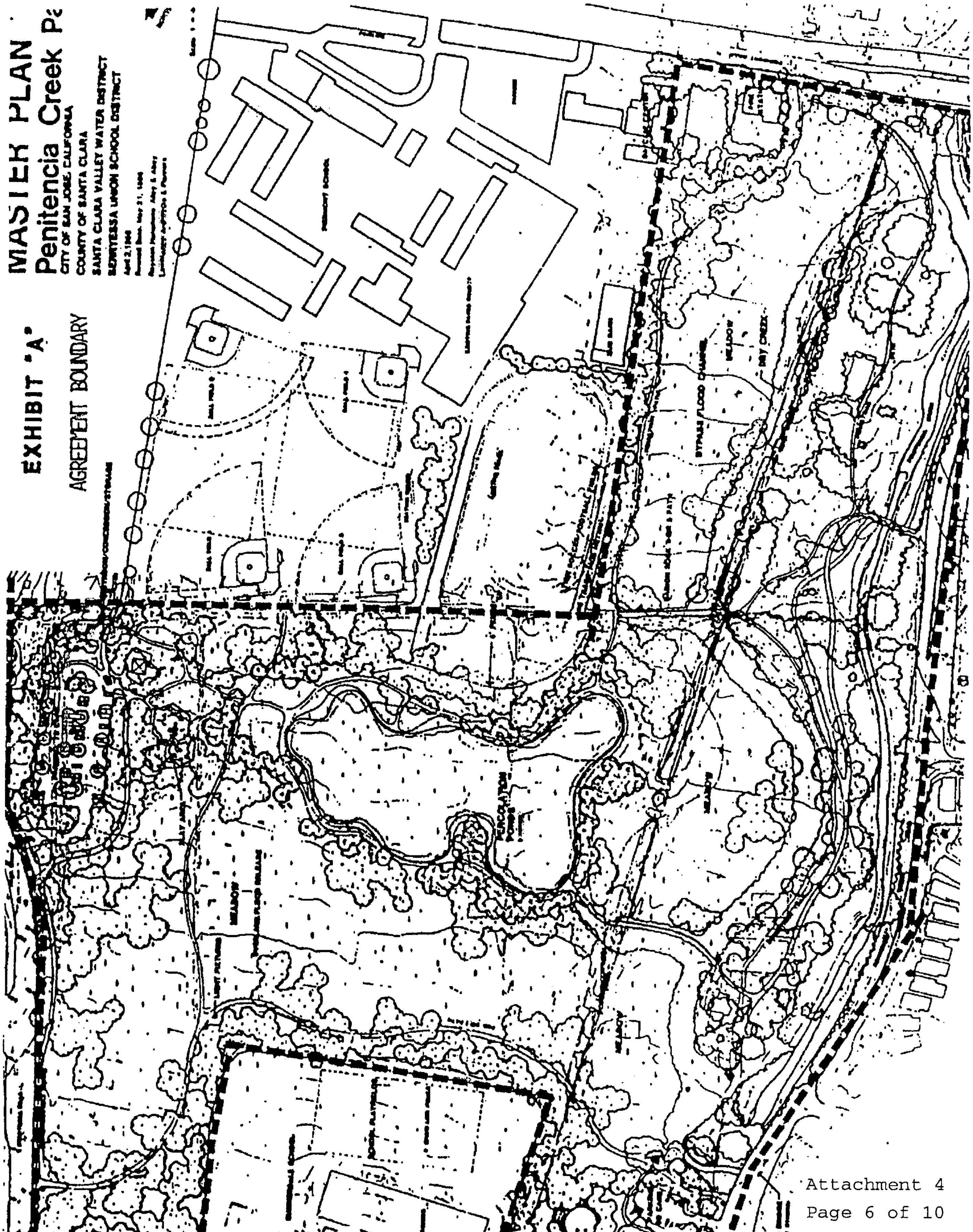

MASTER PLAN
Penitencia Creek Pa
CITY OF SAN JOSE, CALIFORNIA
COUNTY OF SANTA CLARA
SANTA CLARA VALLEY WATER DISTRICT
BERRYESSA UNION SCHOOL DISTRICT
EXHIBIT "A"
AGREEMENT BOUNDARY
PERCOLATION PONDS
MEADOW
BYPASS FLOOD CHANNEL
DRY CREEK

EXHIBIT "B"

September 5, 1986

PENITENCIA CREEK PARK
PHASE I - COST ESTIMATE

	Item	City	County	S.C.V.W.C.	Total
1.	Demo & Grading	$ 30,000	$ 30,000	$	$ 60,000
2.	Rough Grading				
	a) Perc. Pond			116,000	116,000
	b) Channel (bypass)		140,000	46,000	186,000
	c) Park Site	86,000			86,000
3.	Site Utilities	30,000			30,000
4.	Perc. Pond Pipeline		110,000		110,000
5.	Fine Grading	50,000	50,000		100,000
6.	Perc. Pond Fence	24,100			24,100
7.	Construction Items				
	a) Street Work	35,000			35,000
	b) Play Area	70,000			70,000
	c) Restroom/Conc.	180,000			180,000
	d) Parking Lot	54,000			54,000
	e) Pathways	70,000	40,000		110,000
	f) Site Furniture (tables/benches)	20,000	25,000		45,000
8.	Site Lighting	80,000			80,000
9.	Irrigation	126,000	150,000		276,000
10.	Tree Plantings		50,000		50,000
11.	Turf Plantings	78,000	40,000		118,000
12.	Shrubs	10,000			10,000
13.	Maintenance Period (60 days)	10,000			10,000
14.	School Site Improvements	143,600			143,600
15.	Gas Tank Removals	14,000			14,000
	Construction Cost	$1,110,700	$635,000	$162,000	$1,907,700
	Contingency (10%)	101,000	55,000	18,000	174,000
	Air Topography	20,000			20,000
	Arch & Construction Fees	124,300	60,000	20,000	204,300
	Total Project	$1,356,000	$750,000	$200,000	$2,306,000

7302X/0107X

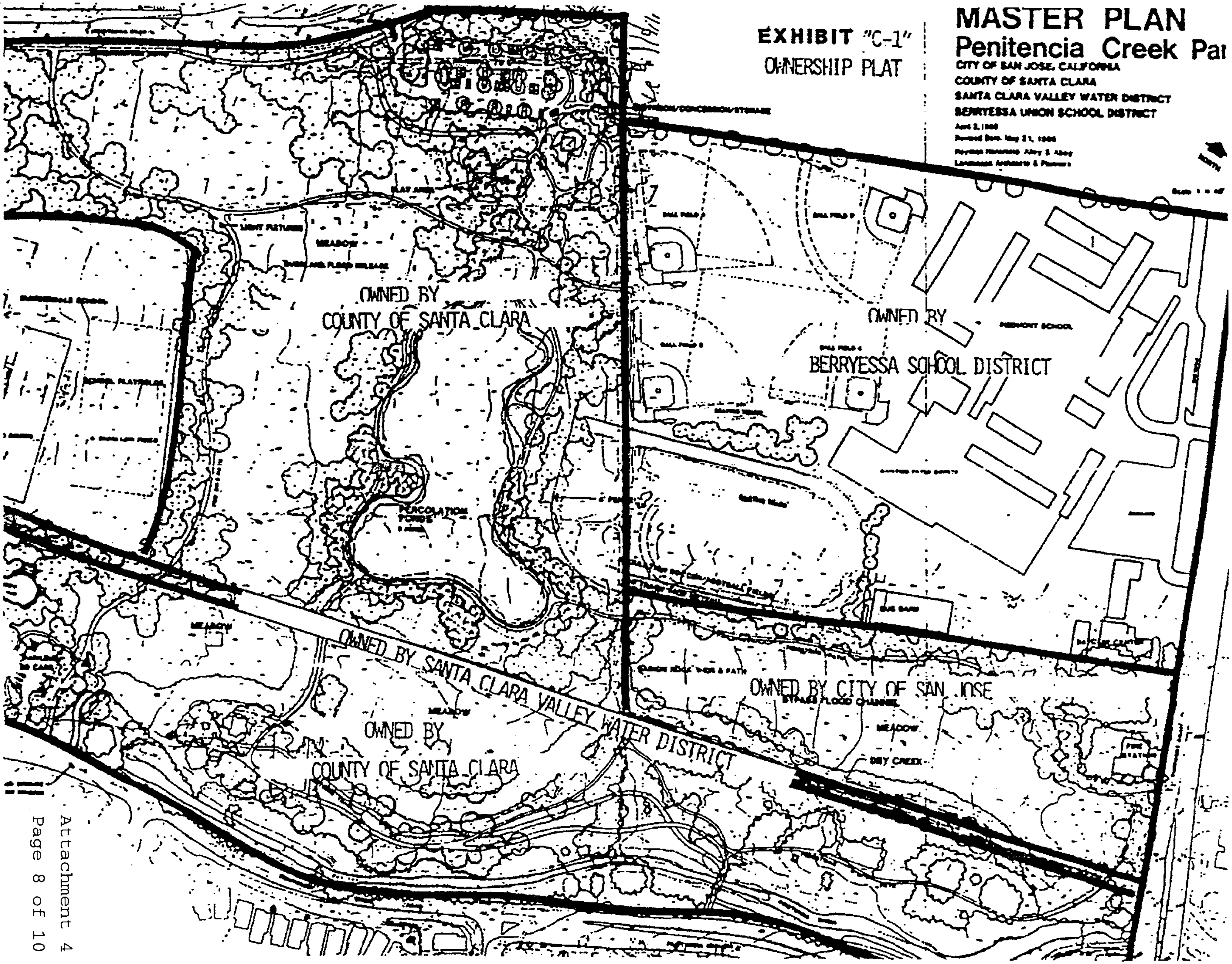


EXHIBIT "C-1"
OWNERSHIP PLAT
MASTER PLAN
Penitencia Creek Pa
CITY OF SAN JOSE, CALIFORNIA
COUNTY OF SANTA CLARA
SANTA CLARA VALLEY WATER DISTRICT
BERRYESSA UNION SCHOOL DISTRICT
OWNED BY
COUNTY OF SANTA CLARA
OWNED BY
BERRYESSA SCHOOL DISTRICT
PIEDMONT SCHOOL
PERCOLATION PONDS
MEADOW
OWNED BY SANTA CLARA VALLEY WATER DISTRICT
OWNED BY CITY OF SAN JOSE
BYPASS FLOOD CHANNEL
DRY CREEK
OWNED BY
COUNTY OF SANTA CLARA

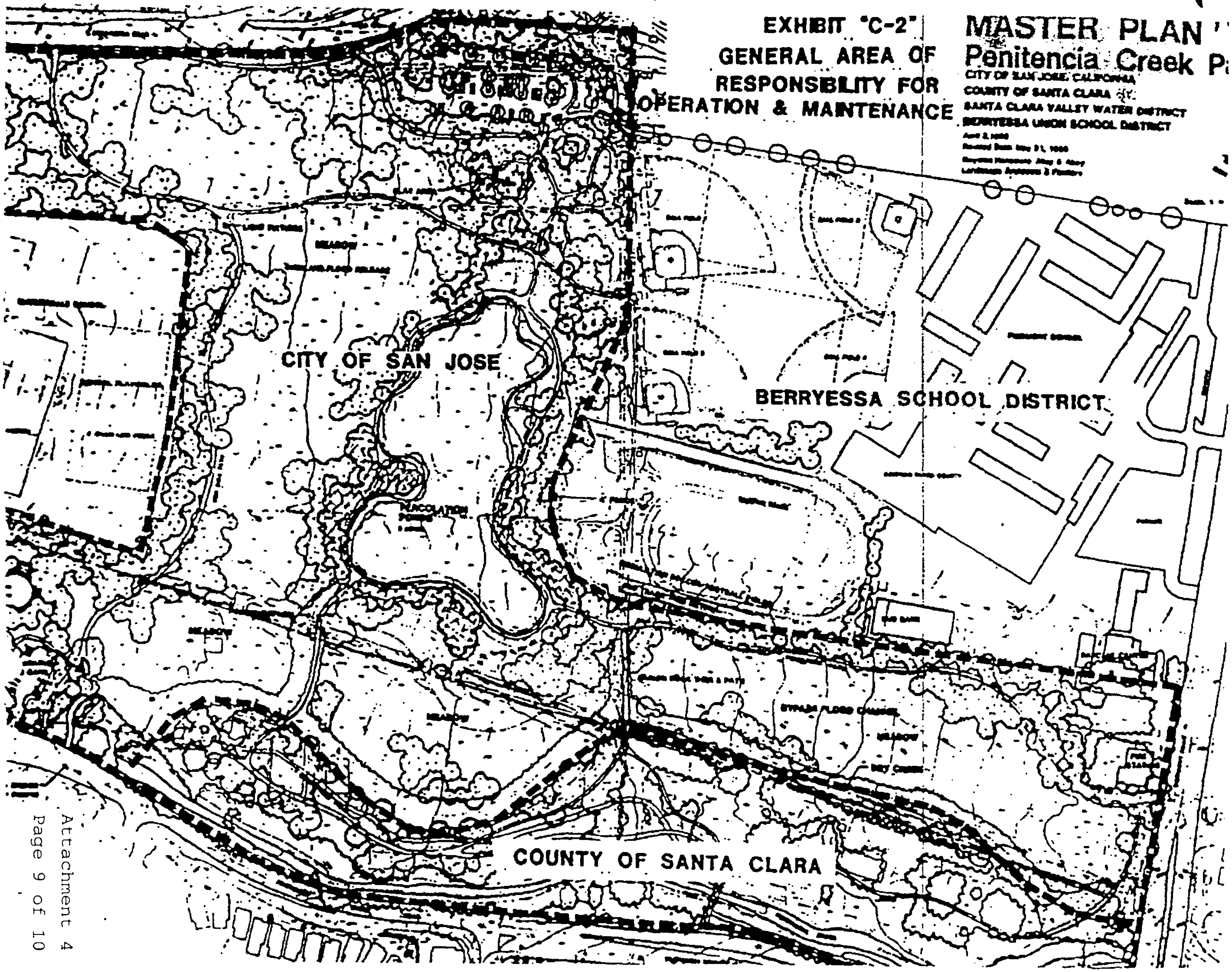
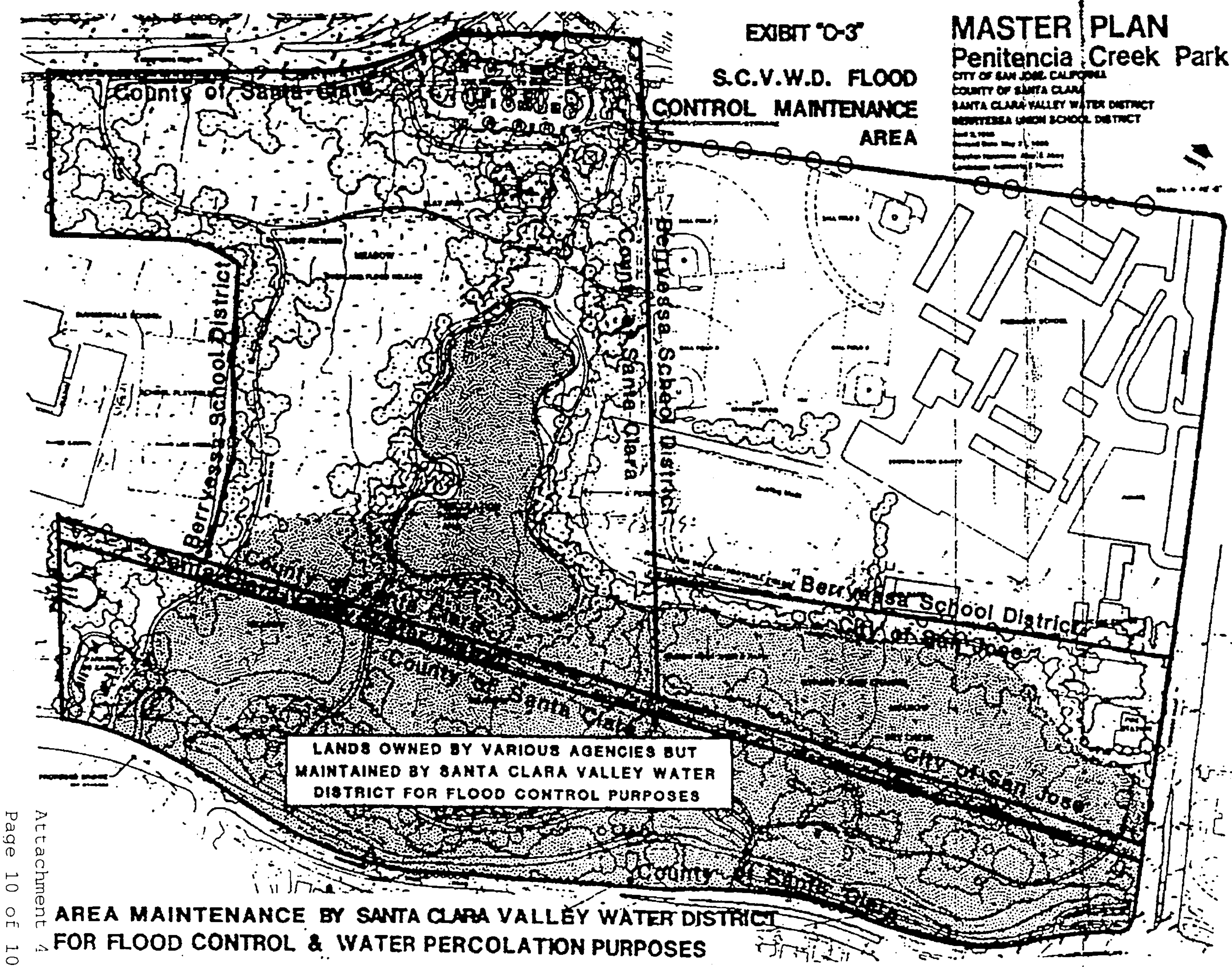


EXHIBIT "C-2"
GENERAL AREA OF
RESPONSBILITY FOR
OPERATION & MAINTENANCE
MASTER PLAN
Penitencia Creek P
CITY OF SAN JOSE, CALIFORNIA
COUNTY OF SANTA CLARA
SANTA CLARA VALLEY WATER DISTRICT
BERRYESSA UNION SCHOOL DISTRICT
CITY OF SAN JOSE
BERRYESSA SCHOOL DISTRICT
COUNTY OF SANTA CLARA


EXIBIT "O-3"
S.C.V.W.D. FLOOD
CONTROL MAINTENANCE
AREA
MASTER PLAN
Penitencia Creek Park
CITY OF SAN JOSE, CALIFORNIA
COUNTY OF SANTA CLARA
SANTA CLARA VALLEY WATER DISTRICT
BERRYESSA UNION SCHOOL DISTRICT
County of Santa Clara
Berryessa School District
City of San Jose
LANDS OWNED BY VARIOUS AGENCIES BUT
MAINTAINED BY SANTA CLARA VALLEY WATER
DISTRICT FOR FLOOD CONTROL PURPOSES
AREA MAINTENANCE BY SANTA CLARA VALLEY WATER DISTRICT
FOR FLOOD CONTROL & WATER PERCOLATION PURPOSES

Santa Clara Valley
Water District

5750 ALMADEN EXPWY
SAN JOSE, CA 95118-3686
TELEPHONE (408) 265-2600
FACSIMILE (408) 266-0271
www.valleywater.org
AN EQUAL OPPORTUNITY EMPLOYER

December 18, 2006

Mark Frederick
Planning & Real Estate Division Manager
SCCO – Parks Administration Division
298 Garden Hill Drive
Los Gatos, CA 95032

Dear Mr. Frederick:

Subject: Agreement for Joint Use of Lands of the Upper Penitencia Creek Park Chain by and among Santa Clara Valley Water District, County of Santa Clara and City of San Jose (SCVWD Board Meeting: 9/12/06, Item 9)

Enclosed please find three signed originals of the above referenced agreement approved by the Santa Clara Valley Water District Board of Directors on September 12, 2006.

Please sign where indicated and return one fully executed original agreements to me in the enclosed self-addressed, prepaid envelope as soon as possible to complete processing of District records. A copy of the agenda item is also enclosed for your information.

Should you have any questions regarding the enclosed materials, please feel free to contact me at (408)265-2607, ext. 2659.

Your assistance to expedite the enclosed documents will be greatly appreciated.

Sincerely,

Natalie F. Dominguez
Board Administrative Assistant
Office of the Clerk of the Board

Enclosures

cc: L. Keller
Accounting
Contracts
Staff

1. ORIGINAL

8-26-97
6e (8)

May 27, 1997

SCVWD AGMT. NO. A2103

AGREEMENT BETWEEN THE CITY OF SAN JOSE AND THE SANTA CLARA VALLEY WATER DISTRICT RELATING TO THE USE OF VICEROY WAY

THIS AGREEMENT is made and entered into this 26th day of August, 1997, by and between the City of San Jose, a California municipal corporation, (herein, "CITY") and the Santa Clara Valley Water District, a public corporation (herein, "DISTRICT").

RECITALS

A. District is the owner of certain property located within the Upper Penitencia Creek floodplain within the City of San Jose which is more particularly described in Exhibit "A" attached to and made a part of this Agreement. In the 1970's, DISTRICT permitted the construction of a two-lane road known as Viceroy Way, on its property within the Upper Penitencia Creek floodplain, to provide temporary vehicular access to a nearby residential development. Viceroy Way is depicted on the map attached as Exhibit "B" attached to and made a part of this Agreement.

B. Viceroy Way has not officially been accepted as part of the roadway system under the jurisdiction of the CITY.

C. Although the residential development has subsequently received permanent vehicular access by way of a CITY street, Viceroy Way has continued to be used for vehicular travel by the public.

D. In 1990, the Upper Penitencia Creek Watershed Final Watershed Plan and Environmental Impact Statement ("PLAN") was approved and adopted by DISTRICT. The PLAN provides for DISTRICT to undertake certain activities including the removal of Viceroy Way to provide for flood protection within the Upper Penitencia Creek floodplain.

E. DISTRICT and CITY each support the PLAN requirements for flood protection within the Upper Penitencia Creek floodplain. However, DISTRICT does not presently have the funding necessary to initiate the flood protection activities contemplated by the PLAN.

F. DISTRICT would in the absence of this Agreement immediately close and remove Viceroy Way from public use.

G. As an alternative to the immediate closure of Viceroy Way, CITY desires to provide for the interim use of Viceroy Way by the public, until such time as Viceroy Way is removed on the terms and conditions set forth herein.

H. The DISTRICT, does not wish to assume liability for the interim use of the road on DISTRICT property.

NOW, THEREFORE, for and in consideration of their mutual promises and agreements, and subject to the terms, conditions and provisions hereinafter set forth, the CITY and DISTRICT agree as follows:

AGREEMENT

1. DISTRICT agrees to allow the public use of Viceroy Way to continue until the date DISTRICT commences activities to remove the road pursuant to the PLAN. DISTRICT shall provide CITY at least 30 days prior written notice of the

7. Notices required under this Agreement may be delivered by first class mail addressed to the appropriate party at the following addresses:

To CITY:

Department of Public Works
801 North First Street
San Jose, Ca. 95110
Attn: Director of Public Works

and to

Office of the City Attorney
151 W. Mission Street
San Jose, Ca. 95110

To DISTRICT:

Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, Ca. 95118-3686
Attn: ________________

Notice shall be deemed effective on the third day after deposit in the mail.

9. This Agreement contains the entire Agreement between CITY and DISTRICT with respect to the use and maintenance of Viceroy Way. Any prior agreements, promises, negotiations or representations not expressly set forth in this Agreement are of no force or effect. All changes or modifications to this Agreement must be in writing in the form of an amendment and approved by both parties.

EXECUTED and EFFECTIVE on the date first written above.

APPROVED AS TO FORM

Nellie Ancel
Deputy City Attorney

"CITY"
CITY OF SAN JOSE, a municipal corporation

By Patricia L. O'Hearn
Patricia L. O'Hearn
City Clerk

ATTEST:

Clerk/Board of Directors

"DISTRICT"
SANTA CLARA VALLEY WATER DISTRICT, a public corporation

By________________

APPROVED AS TO FORM

By:________________
General Counsel

W:\Legal\AGREEMNT\VICERY.fin.wpd

11

APPENDIX F: HYDRAULIC ANALYSIS

TECHNICAL MEMORANDUM

PROJECT: Upper Penitencia Creek Flood Protection **DATE**: May 17, 2022

SUBJECT: HEC RAS Model – Proposed Project

PREPARED: Gabriel Vallin

Introduction

A steady state HEC-RAS model for Upper Penitencia Creek Flood Protection Project was developed to model the hydraulic conditions of the proposed project for the Planning Phase. This is the final planning level model. The model was updated with proposed design details from the Upper Penitencia Creek Geomorphology Study as well as with boundary condition details at the Coyote Creek Confluence. This memorandum discusses the development of the HEC-RAS model for the proposed project conditions.

Background

A HEC-RAS model of Upper Penitencia was previously developed by Schaaf and Wheeler (S&W) for a floodplain analysis of the area surrounding the proposed Silicon Valley Bart Extension (SVBX) project. A report detailing this analysis was released in December 2013. This model analyzed both existing and post-project SVBX conditions; the latter of which accounted for the channel realignment that took place immediately upstream of the proposed BART station. S&W coupled these HEC-RAS models with Flo 2D to analyze any changes to the floodplain that may occur due to the proposed project. All cross sections used for the models were surveyed by BKF in 2012. Intermediate cross sections between surveyed cross sections were created from 2006 LiDAR data. These cross sections could not capture the thalweg geometry so portions of the cross sections below water had to be interpolated.

The Upper Penitencia Creek Project team started with the S&W as the base model and updated it with additional survey and hydrology information to create a 2D hydraulic model for the existing conditions. The project team finished this model in 2018. In 2020, Valley Water went out and conducted additional field surveys along reaches 1, 2, and 3. The HEC-RAS model geometry was updated with this survey which showed some deposition along reach 1A; and then the proposed project conditions were incorporated.

HEC-RAS Model Details

Model type: HEC-RAS, Steady State
Horizontal Datum: North American Datum (NAD) 1983
Vertical Datum: NAVD (1988)

<u>Top of Banks and Adjacent Ground</u>

The top of banks (LOBs and ROBs) in the model were left as the bankfull channel banks; which is the way they were modeled for the Geomorphology Study. The capacity of the channel is based on the top of the full channel section. This is the adjacent ground elevations at the border of the riparian corridor. Along the north bank the channel is bounded by Berryessa Road and those ground elevations were used as the top of bank elevations. Along the south bank, the channel is bordered by the existing Flea

Market which will be getting redeveloped into an Urban Village. The south bank elevations reflect the post-project conditions of the Urban Village and were approximated from the draft plan sheets (Grading and Drainage Plan Sheets) for the "Master Planned Development Permit for Market Park South Village (the Berryessa BART Transit Village Development)" that were developed by HMH.

Boundary Condition

For detailed discussion on the downstream boundary condition, please see attachment 2. The following table are the 2 scenarios considered for the Coyote Creek confluence boundary condition.

There were two scenarios considered for the downstream boundary condition which reflect the timing of the Upper Penitencia Creek and Coyote Creek peak flows. 1. Upper Penitencia Creek peak flow with the coinciding Coyote Creek water surface elevation at the confluence. 2. Coyote Creek peak flow water surface elevation at the confluence with the coinciding Upper Penitencia Creek flow. The worst-case scenario needs to be considered for capacity. the following table summarizes the boundary condition scenarios:

Scenario	Upper Penitencia Crk Flow (cfs)	SWSEL at the confluence (ft)
1	2000	77.34
2	510	79.8

N Values

The Manning's roughness values (n values) selected for the proposed project model were based on post-project vegetation conditions anticipated to develop within the project reaches and not immediately post construction. This was estimated to be 0.06 for the overbank areas (flood benches). The bankfull channel n value was estimated to be 0.03; but since the bankfull channel width is relatively small compared to the overall channel width, an n value of 0.06 was used across the whole cross section to be conservative.

Bridges

The existing bridges along Reach 1A (along the Flea Market) have been removed from the model since they will be replaced as part of the Urban Village project. The assumption is that the Urban Village bridges will be built to capacity and not obstruct the design flow.

Conclusion

In consideration of the worst-case scenario, the water surface along reach 1A is controlled by the Coyote Creek confluence boundary condition. The proposed widening of the channel will greatly increase the carrying capacity of the channel, but the backwater effect of the confluence creates a "pond" with a WSEL of approximately 79.8ft from the confluence up to the BART Tracks overcrossing.

Attachment 1: Downstream Boundary Condition at Coyote Creek Confluence:

TECHNICAL MEMORANDUM

PROJECT:	Upper Penitencia Creek Flood Protection Project	**DATE**:	May 16, 2022
SUBJECT:	Downstream Boundary Condition for Upper Penitencia Creek		
PREPARED BY:	Melissa Reardon		

1. INTRODUCTION

The Upper Penitencia Creek Flood Protection Project (Project) team has requested updated downstream boundary conditions for the Upper Penitencia HEC-RAS model post-construction of the Coyote Creek Flood Mitigation Measures and Flood Protection Projects (CCFMMP and CCFPP). These updated boundary conditions will help inform the design of the Upper Penitencia Creek Flood Protection Project as well as two bridges near the confluence with Upper Penitencia Creek proposed as part of the Urban Village Development. This memorandum documents the development of the updated downstream boundary conditions for Upper Penitencia Creek for the 100-year event based on the most up to date models at the time of writing.

2. COYOTE AND UPPER PENITENCIA CREEKS HYDROLOGY

Upper Penitencia is a major tributary to Coyote Creek downstream of Anderson Dam. During a large storm event (e.g., the 100-year event), Coyote Creek has two peak flows: the first is due to local inflow from tributaries downstream of Anderson Dam, including Upper Penitencia Creek, and the second is due to spills from Anderson Dam. Based on previous (pre-Anderson Dam Seismic Retrofit Project [ADSRP]) hydrologic models, the second peak is larger than the first peak. The peak flow on Upper Penitencia Creek occurs closer in time to the first peak than to the second peak on Coyote Creek.

It should be noted that flows on Upper Penitencia Creek are limited by spills upstream of I-680 under existing conditions. Based on the Project's draft Planning Study Report[1], detention basins will likely be required upstream of I-680 as part of a future project to not induce flooding in Coyote Creek. As a result, the maximum flow along Upper Penitencia Creek is 2,000 cfs; 2,000 cfs is also the design flow for the Project.

[1] Santa Clara Valley Water District. Upper Penitencia Creek Flood Protection Project, Project No. 26324001, Coyote Creek Confluence to Dorel Drive: Planning Study Report. Prepared by Gabriel Vallin. April 2022 – DRAFT.

Because flooding on Upper Penitencia Creek can occur from either high flows on Upper Penitencia Creek or due to backwater from Coyote Creek, two scenarios should be evaluated by the Project team. The first scenario (Peak Upper Penitencia scenario) includes Project design flows (2,000 cfs) on Upper Penitencia Creek with a downstream boundary condition reflective of the conditions on Coyote at the Project design flows. The second scenario (Peak Coyote Scenario) includes flows on Upper Penitencia Creek that occur at the time of the second peak of Coyote Creek and the water surface elevation (WSEL) on Coyote Creek at the second peak. The development of downstream boundary conditions for each scenario is described in Sections 3 and 4, respectively.

3. PEAK UPPER PENITENCIA SCENARIO

As mentioned in Section 2, the peak on Coyote Creek that is closest in timing to the peak on Upper Penitencia Creek is the first peak, which is due to local inflow. Valley Water has two HEC-HMS events that could reasonably be used to evaluate the first peak: a 24-hr storm event with the storm centered on the lower watershed (i.e., downstream of Anderson Dam) or a 72-hr storm event with the storm centered on the upper watershed (i.e., upstream of Anderson Dam)[2]. For the 24-hr event, there are two models that are pertinent to this analysis: one where the storm is centered on Upper Penitencia Creek and one where the storm is centered on Lower Silver and Thompson Creeks. The 24-hr Upper Penitencia Creek-centered storm event results in the highest flows on Upper Penitencia Creek, but the 24-hr Lower Silver/Thompson Creek-centered storm event results in the highest flows on Coyote Creek at the confluence of Upper Penitencia and Coyote Creeks.

The time between the peak flow on Upper Penitencia Creek and Coyote Creek in the 24-hr models and the time between the peak flow on Upper Penitencia Creek and the first peak on Coyote Creek in the 72-hr model are almost identical, suggesting the hydrologic relationship between Upper Penitencia Creek and the first peak on Coyote Creek is well represented with the 24-hr event. However, the peak flows on Upper Penitencia Creek and Coyote Creek in the 24-hr models are higher than the respective peak flows in the 72-hr model. To be conservative, the results from the 24-hr event were used for this analysis.

In both 24-hr models, the peak flow on Upper Penitencia Creek occurs before the peak flow on Coyote Creek, but the flow on Upper Penitencia Creek at the time of the peak flow of Coyote Creek is greater than 2,000 cfs. Because the HEC-HMS model does not account for spills, it is assumed that any modeled flow above 2,000 cfs on Upper Penitencia Creek would be reduced to 2,000 cfs at the confluence due to spilling upstream. Since 2,000 cfs is also the design flow for the Project, it is reasonable to assume that the first peak on Coyote Creek could occur at the same time as the design flow.

Based on an analysis of the flows on Coyote Creek resulting from local inflow (i.e., no spills from Anderson Dam) and taking into account spilling on Fisher Creek and attenuation from the storm

[2] Santa Clara Valley Water District. Coyote Creek Hydrology Study: Final (Addendum #1). Prepared by Jack Xu. May 2017.

drain network on Lower Silver Creek, the maximum flow for the local 100-year event on Coyote Creek downstream of Upper Penitencia Creek is assumed to be 7,760 cfs[3] for this analysis.

To determine the WSEL associated with a flow of 7,760 cfs, the 24-hr Local Design Storms 100-yr profile[2] was run in the Valley Water (VW) 1D steady state HEC-RAS model for Coyote Creek from Anderson Dam to San Francisco Bay calibrated to the 2017 flood event[4]. The CCFMMP and CCFPP elements were added to the 1D model to account for the impacts of the CCFMMP and CCFPP on WSELs in Coyote Creek; the elevations of CCFMMP and CCFPP elements were set to include the additional freeboard required for potential future FEMA certification. A steady state 1D model was deemed reasonable for the local 100-year storm since most of the water would be contained within the creek.

The modeled WSEL downstream of Upper Penitencia Creek is 77.34 ft NAVD. Therefore, for the Peak Upper Penitencia Scenario, the recommended downstream boundary condition for a steady state model with the Project design flows (i.e., 2,000 cfs) on Upper Penitencia Creek is 77.34 ft NAVD.

4. PEAK COYOTE SCENARIO

As described in Section 2, the second peak on Coyote Creek results from spills from Anderson Dam. While the second peak occurs almost a full day after the peak on Upper Penitencia Creek in the 72-hr HEC-HMS model, there may be backwater effects resulting from the second peak. Although the exact flow value of the second peak is subject to change with ADSRP, it is conservatively assumed that the second peak spills under a 100-year event will be similar to those under pre-ADSRP conditions.

The most up-to-date hydraulic model for the 100-year event near Upper Penitencia Creek is a 1D-2D model for Coyote Creek between Edenvale gage and Hwy 237. A 1D-2D model is used for the second peak because the 100-year peak flow on Coyote Creek is not anticipated to be contained within the channel, and a 1D-2D model allows flow to spill away from the creek onto the floodplain. Input flows to the 1D-2D model are based on the results from the 72-hr HEC-HMS model at Edenvale gage, Upper Penitencia Creek, Lower Silver Creek, and Upper Silver Creek; the 72-hr HEC-HMS model conservatively assumes that flows on Fisher Creek are contained. The CCFMMP and CCFPP elements are included in the model assuming the elements are designed with the additional freeboard for potential future FEMA certification.

The modeled WSEL from the 1D-2D model is 79.8 ft NAVD at the confluence of Coyote Creek and Upper Penitencia Creek. This is nearly 5 ft higher than the FEMA effective WSEL at the confluence for the 100-year event. The higher modeled WSEL is likely the result of higher roughness values assumed for the 1D-2D model compared to the FEMA effective model and

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[3] Santa Clara Valley Water District. “Coyote Design Flows: Design Flows for Mid-Coyote Project Team (Addendum #3)” Technical Memorandum. Prepared by Jack Xu. Table 3. May 2022.
[4] Santa Clara Valley Water District. “Coyote Creek Anderson Reservoir to SF Bay: Combined HEC-Ras 1D Model” Technical Memorandum. Prepared by Melissa Reardon. August 2021.

presence of the CCFMMP/CCFPP floodwalls that do not allow spills to the western bank of Coyote Creek.

For the Peak Coyote Scenario, it is recommended that the peak flow on Upper Penitencia Creek from the 72-hr HEC-HMS model (510 cfs) be run with a downstream boundary condition of 79.8 ft NAVD in a steady state HEC-RAS model.

Santa Clara Valley Water District

TECHNICAL MEMORANDUM

PROJECT: Upper Penitencia Creek **DATE**: April 10th, 2018

SUBJECT: Upper Penitencia Creek Unsteady, Two-Dimensional Model

PREPARED: Benjamin Hwang

Purpose

This report summarizes the modifications that were made to an existing model of Upper Penitencia Creek. The existing model was used by Schaaf and Wheeler (S&W) for the Silicon Valley Berryessa Extension (SVBX) project. This work was done on behalf of the Valley Transportation Authority (VTA).

The purpose of the updated model is to:

- Update creek geometry using new survey data collected in August 2016
- Provide a baseline conditions model to help develop a problem definition report
- Update the flood inundation map developed by S&W using HEC-RAS 5.0.3
- Develop a flood inundation map with greater resolution than FEMA's Flood Hazard Map (100-year inundation map)
- Provide an estimate of spills from Upper Penitencia when subjected to variable storm events

Background

The existing Upper Penitencia Creek model was first developed by the Army Corps of Engineers (ACOE) using HEC-RAS 4.1. S&W modified this model and coupled it with Flo 2D to analyze the floodplain surrounding the SVBX project. The procedures and findings from this analysis are summarized in a 2013 report[1] released prior to construction. Results for both existing and post-project conditions are detailed in the report; the latter accounted for the channel modifications (mitigation measures) that took place immediately upstream of the SVBX project. S&W updated the original Upper Penitencia Creek model using additional cross sections surveyed by BKF in 2012. Intermediate cross sections between surveyed cross sections were created using 2006 LiDAR data. The non-surveyed, intermediate cross sections could not capture the thalweg geometry so portions of the cross sections which were below water had to be interpolated. S&W's post-project conditions model was used as the basis to develop the model that is discussed in this memorandum.

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1 Schaaf and Wheeler Consulting Civil Engineers, Santa Clara Valley Transportation Authority (VTA) Silicon Valley Berryessa Extension Floodplain Analysis, December 2013.

Dataset

Geometry

The following structures and features were added to S&W's post project conditions model using data collected in August 2016 by District survey crews[2]:

- Penitencia Park pedestrian bridge
- Dorel residential driveway bridge
- Capitol Avenue bridge
- BART station bridge piers*
- Noble fish ladder and adjacent grade control structure/weir

*It was assumed that the soffit for the BART railroad crossing was at an elevation that was high enough where the deck could be omitted and not included in the model as a bridge. The bridge piers were modeled as block obstructions through these cross sections

Terrain Data

The 2D floodplain for this model is a Digital Elevation Model (DEM) consisting of 10' by 10' cells. The DEM was constructed using 2006 County LiDAR data. Some current features were not captured in the 2006 dataset and modifications had to be made to the terrain. To reflect existing floodplain conditions, the following additional features were incorporated into the DEM:

- Ditch conveying flow through bypass channel
- Noble diversion culvert through Noble Ave. – 36" corrugated metal pipe
- Piedmont ponds immediately downstream of Bob Gross Ponds
- New parking lot at the Berryessa BART station
- Sound walls along I-880, I-680, BART track
- Man-made berms along Viceroy Ave and Penitencia Creek Road

Model Parameters

Terrain Roughness

The following datasets were used to assign roughness coefficients for the floodplain:

- Streets (District ArcGIS data)
- Building footprint (District ArcGIS data)
- 2011 National Land Cover Data (USGS)

The following coefficients were used as prescribed by District guidance for defining Floodplain roughness[3]

Land Use	n Value
barren land rock/sand/clay	0.01
buildings	1
Bypass area	0.035
cultivated crops	0.05

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[2] SCVWD Survey Request #2016_188

[3] SCVWD, J. Xu., Hydraulic modeling – 2D HEC-RAS 5.0 Floodplain Roughness (2016)

deciduous forest	0.36
developed, high intensity	0.035
developed, low intensity	0.035
developed, medium intensity	0.035
developed, open space	0.03
emergent herbaceous wetlands	0.05
evergreen forest	0.1
grassland/herbaceous	0.03
highways	0.015
streets - larger arterials	0.015
mixed forest	0.1
open water	0.02
shrub/scrub	0.1
streets - surface	0.015
woody wetlands	0.05

Figure 1 – Table of n values used for floodplain

<u>1D Channel Roughness</u>

Manning's n values initially assigned by S&W were generally kept throughout the model. A summary of the n values and reach descriptions can be found in Appendix A. The n values were changed from 0.04 to 0.05 to the reach immediately downstream of Piedmont Avenue. A slightly higher n value was deemed appropriate due to the presence of larger boulders in the channel bed. The Manning's n was changed from 0.04 to 0.05 for some of the cross sections downstream of the Piedmont Avenue bridge crossing.

<u>Weir Coefficients</u>

Weir coefficients were assigned using the values prescribed in the HEC-RAS User's Manual.[4] Most of the lateral structures represented non-elevated overbank terrain. As a result, a weir coefficient of 0.5 was assigned to most of the lateral structures. An exception is made around the Mabury bend, which consists of constructed levees through the reach. This feature justified a weir coefficient of 1.5 for the left bank, and 1.0 for the right bank.

Boundary Conditions

[4] HEC-RAS 5.0 2D Modeling User's Manual – "Lateral Structure Weir Coefficients" (pg. 3-50)

Upstream boundary conditions were assigned corresponding hydrographs based on the event that was being analyzed. The hydrographs used for the model were taken from the SCVWD design flood flow manual.[5] The following table summarizes the peak flow, as well as the catch points that contribute runoff (i.e. lateral inflows) to the creek at specific locations. Normal depth based on a slope of 0.7% was assumed for the downstream boundary conditions. This slope was calculated from the general stream bed elevation from approximately the flea market to the Coyote confluence. For lateral inflows, flows from the corresponding sub-basins were inputted as lateral inflows. A map of the contributing sub-basins that accounted for lateral inflows is provided in Appendix XXX. Additional boundary conditions were specified for the edges of the 2D mesh in which flow of the floodwaters terminate. These were set along the alignment of Coyote Creek to the west and Berryessa Creek to the north. For both areas, normal depth was assumed with a slope of 1%.

	72 Hour Storm Peak Flows in CFS Event (Exceedance Probability)						
Location	**Catch Point**	**2.33 Year (43%)**	**5 Year (20%)**	**10 Year (10%)**	**25 Year (4%)**	**50 Year (2%)**	**100 Year (1%)**
Upper Pen @ Dorel Dr	4	410	900	1420	2200	2840	3550
Upper Pen @ Piedmont	5	430	920	1450	2230	2880	3590
Upper Pen @ I-680	6	430	920	1450	2230	2880	3590

Figure 2 – Table of peak flow values (CFS) for storm events

Calibration

High Water Marks

The existing n values initially determined by S&W provided reasonably close water surface elevations compared to observed high water marks (HWM) for reaches upstream of Jackson Ave. HWMs were staked by District staff after a January 2017 storm event. Locations for the HWMs are shown on a map in Appendix D. The stream gage immediately downstream of Piedmont Ave. was the only reliable gage for high flows. Logged WISKI data at this gage showed a maximum flow of roughly 568 CFS on January 10th, 2017 at 11:00 P.M. Lateral inflow values were subtracted going upstream from this location and added going downstream from this location.

WSEL's calculated by HEC-RAS were generally close to the HWMs upstream of Jackson Ave. The calculated WSELs around the bend through Mabury Road had larger discrepancies. This is most likely due to greater amounts of flow entering the bypass channel than modeled. Flows into the bypass channel initially take place over a concrete lateral weir situated along the right bank of the creek. Immediately upstream of this weir, a berm had been breached – ultimately inducing additional flows into the bypass channel. Due to additional flows leaving through this breach, lower velocities through the channel caused settling of particles, which in turn aggraded the channel bed. This has resulted in the channel invert aggrading to nearly the same elevation as the top of the concrete weir. With the aggraded stream bed, spilling into the bypass channel begins to occur at relatively low flows. This breach as well as the channel aggradation is not accounted for in the current model.

[5] SCVWD J. Xu., R. Chan., Design Flood Flow Manual (2018)

Further analysis will need to be taken to properly to understand the creek behavior and flow split at this specific location.

Stake	Location	HEC-RAS Sta	Observed HWM Elevation (Feet)	HEC-RAS Elevation(Feet)	Difference with Repect to Observed Elevation
Stake 2	DS of Noble Ave. X-ing	198+99	241	241.41	-0.41
Stake 5	DS of Piedmont Ave. X-ing	169+60.3	204.98	204.57	0.41
Stake 6	DS of Pen Crk Rd Culvert	146+95.60	180	180.16	-0.16
Stake 7	Capitol Ave X-ing	115+51.78	148.87	149.08	-0.21
Stake 8	Mabury Stream Gage (Next to Mabury Pond)	71+48.24	113.62	114.33	-0.71
Stake 10	Mabury Rd DS (DS Face)	58+94.47	104.5	106.98	-2.48
Stake 11	Mabury Rd DS (DS Face)	55+83.650	102.35	102.07	0.28
Stake 12	King Rd X-ing	37+37.59	90.11	91.95	-1.84

*Stakes 1,3, & 4 were washed away by high flows

Figure 3 - Table of observed WSEL (January 2017) vs. calculated WSEL

Actual vs. Modeled Flooding

The January 2017 storm event which was used for the calibration of the model fell between a 2 and 5-year event. As aforementioned, flow readings from the Piedmont gage measured a peak flow rate of roughly 568 CFS. A larger storm occurred in the region during February 2017 over President's Day weekend. Spills from this storm event were delineated based on observations and is shown in Figure4. This The 2.33-year model was compared to the actual flooding that took place in February. All flooding occurred in the reaches between Jackson Avenue and King Road. A majority of the flooding took place in the bypass channel. It should be noted that spills from the creek flowed through this area like a creek rather than ponding. Some debris remnants along Cape Horn Drive, as well as minor ponding in a low spot along Mabury had also occurred. Modeling results from the 2.33-year event shows that a fair amount of additional flooding in the neighborhood north of the bypass channel, as well as some flooding near the BART station and Flea Market areas. This is most likely due to leakages in the 2D mesh. Additional measures were taken to limit such leakages by adding break lines along Mabury Road, Cape Horn Drive, Cape Colony Drive, and Berryessa Road. While the break lines were able to generally reduce leakages in the computational mesh, it did not completely resolve the issue. This is unfortunately due to limitations with the model and the computational mesh. Additionally, the use of a bare earth model for the terrain will have limitations in modeling a densely urbanized area.

Figure 4 – Comparison of February 2017 storm vs. HEC-RAS output for 2.33-year Storm

Uncertainties within Floodplain

Two specific areas within the floodplain had some uncertainties in terms of the propagation of floodwaters. These areas will need further investigation as well as refinement with the collection of more data.

<u>Flea Market Development</u>

The first location was the Flea Market parking lot which lies directly north of Upper Penitencia, along Berryessa Road. The 2006 LiDAR data was collected when this area was still largely undeveloped (Figure 5). Present day conditions (Figure 6) show more residential housing, which may impede the flow of floodwaters due north. Accounting for this development may reduce the flow towards Milpitas. With more development slated for the future, inundation for this area may continue to change with respect to current model outputs.

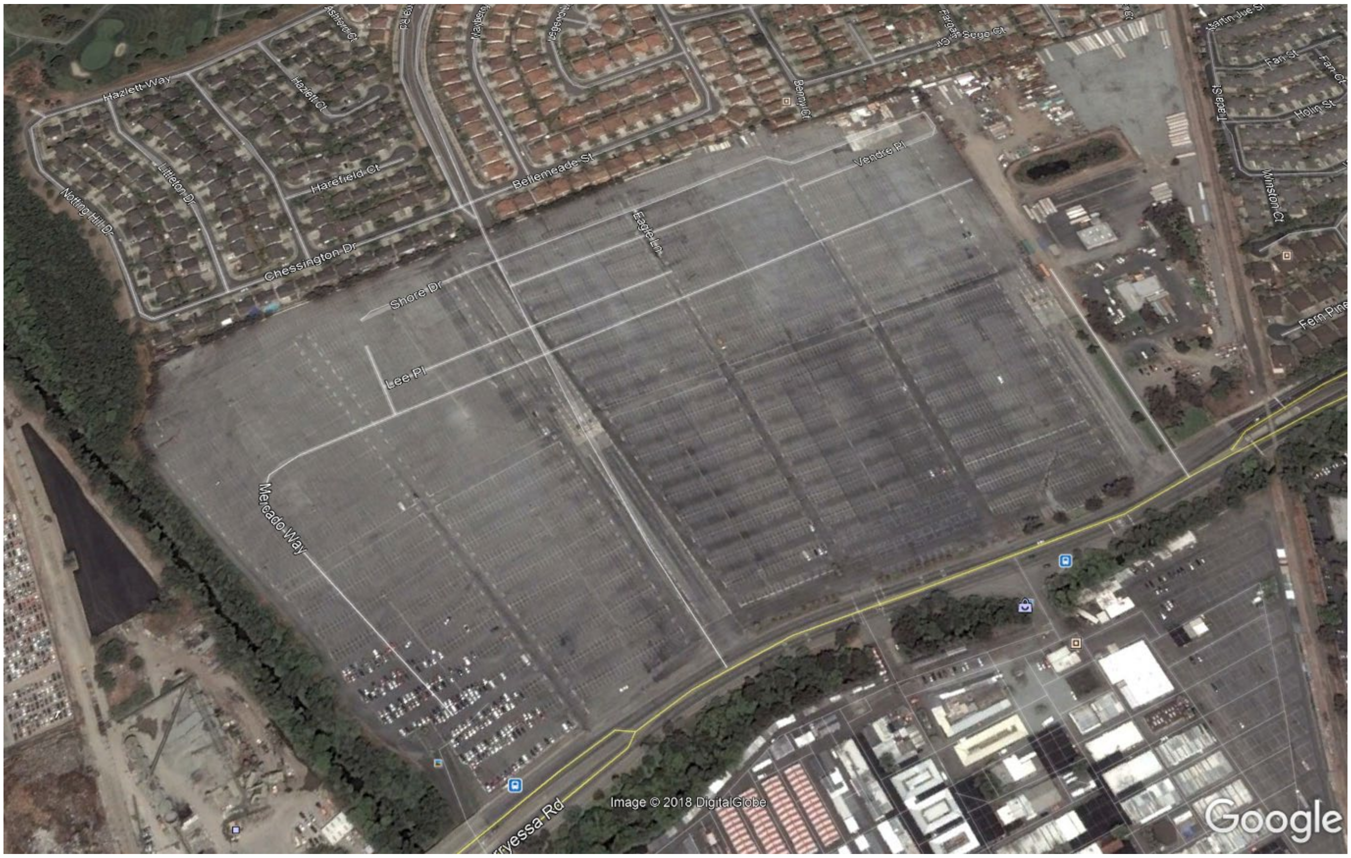


Figure 5 – Flea Market Parking lot around the time when 2006 County LiDAR data was collected

Figure 6 – Present Day Flea Market with development

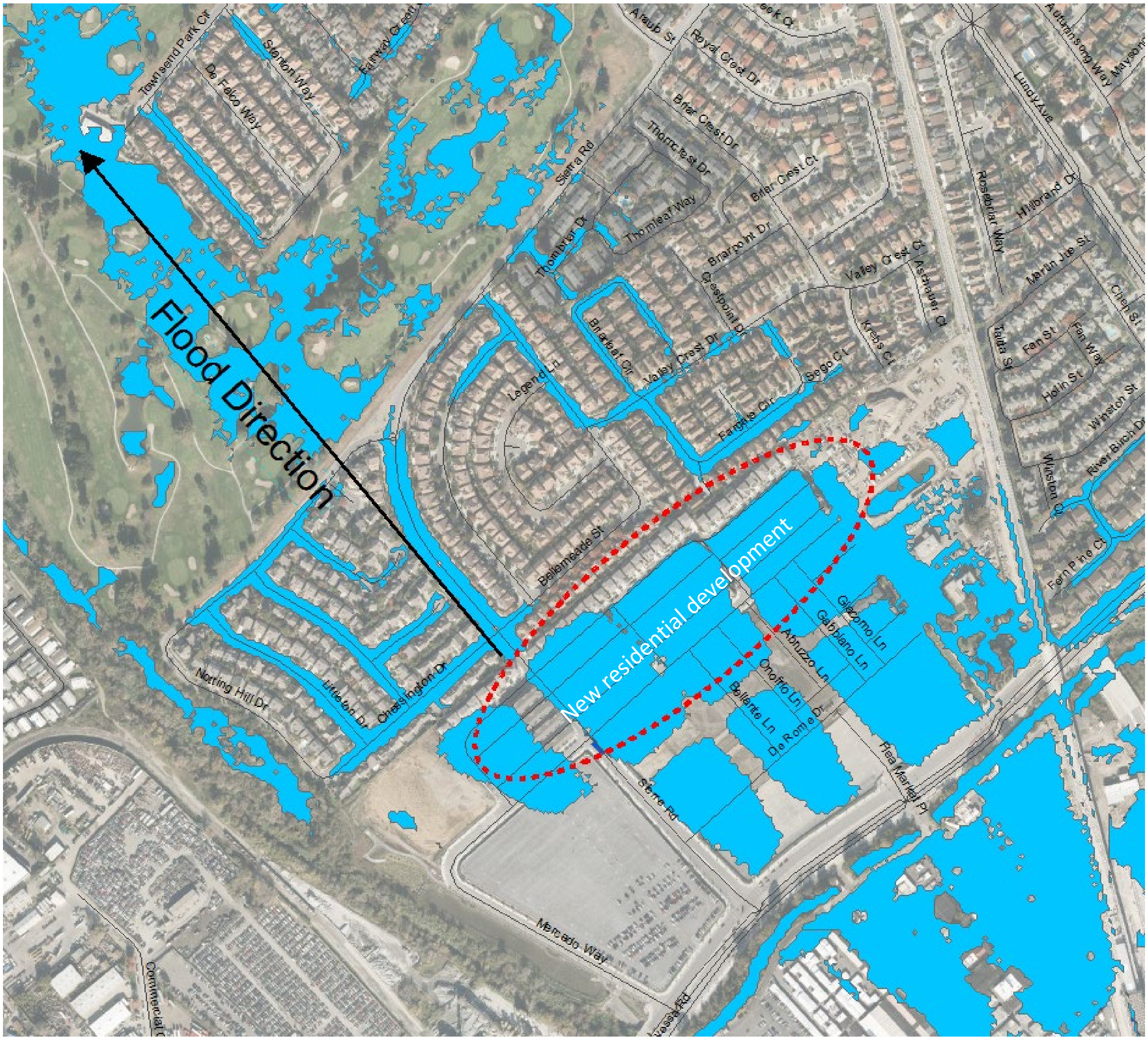


Figure 7 – Current model output with new development not being considered

<u>BART Track Sound Walls</u>

The newly constructed BART track is also an area in which the terrain is in question. Complications to flood inundation is added by the fact that a portion of the track goes underground, which may effectively curtail flows from traveling further west of the track. A sound wall that is adjacent to the track was captured using break lines within the computational mesh. The end of this sound wall, marks the beginning of the underground portion of the track. Two flood scenarios were analyzed to see the difference in terms of inundation for a 100-year storm: one in which the break line simply ends at the end of the sound wall, and another in which the break line is extended to prevent flows from crossing the underground portion of the track. Flooding west of the track was reduced with an extended break line and was deemed to be more representative of predicted flood conditions. This geometry was chosen as the final geometry file for all other storm events.

Figure 8 – Location of BART Track

Figure 9- BART track goes through subterranean tunnel at intersection with Trade Zone Boulevard.

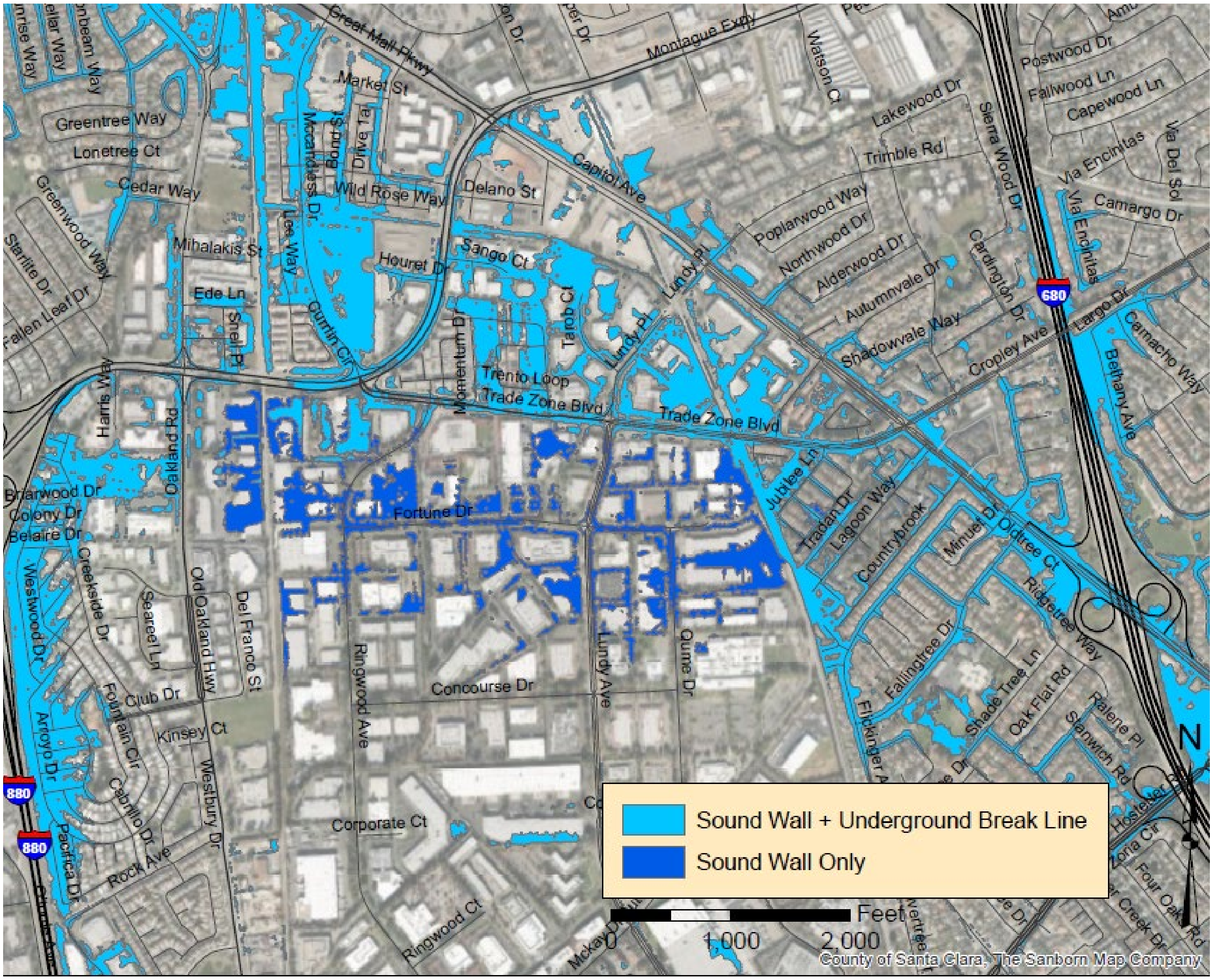


Figure 10- Comparison of flood inundation (100 year) along BART track

Floodplain Discussion

Model outputs for the 100-year event were compared to inundation maps from SCVWD's Limited Flood Studies as well as FEMA's flood hazard map. Flooding upstream of I-680 was consistent between all maps and displayed characteristics of a typical alluvial fan system. Flows for Upper Penitencia exit Mount Diablo canyon at generally high velocities due to the steep grade. As it moves downstream through the more urbanized valley floor, flows spread out laterally. Most of the spills from the creek flow northwest toward, Milpitas. A significant number of parcels were found to be affected by Upper Penitencia outside the City of San Jose. A major discrepancy that can be seen is the presence of spills immediately upstream of the confluence with Coyote Creek. Spills from this area cross Berryessa Road, and flow north, running parallel with Coyote Creek before being impeded by sound walls along I-880. As aforementioned, LiDAR data with present Flea Market development conditions will be needed to further investigate whether spills propagate through this area.

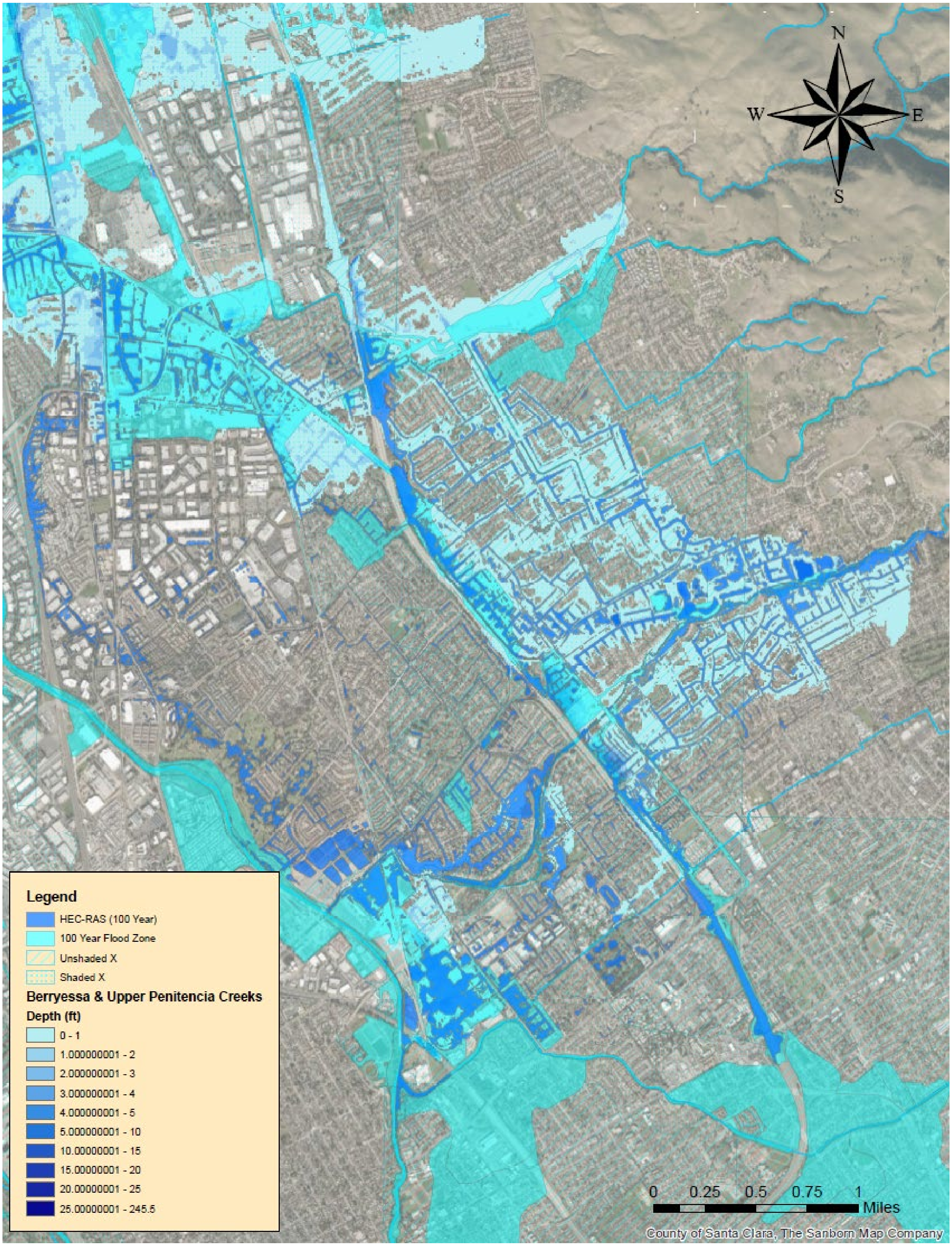
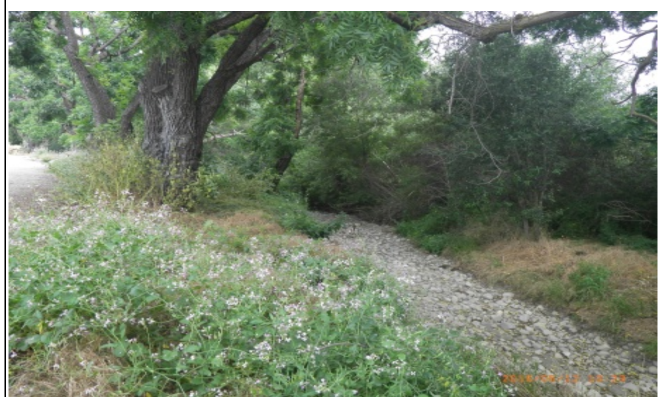


Figure 11 – Comparison of HEC-RAS output vs. FEMA & SCVWD Limited Flood Studies

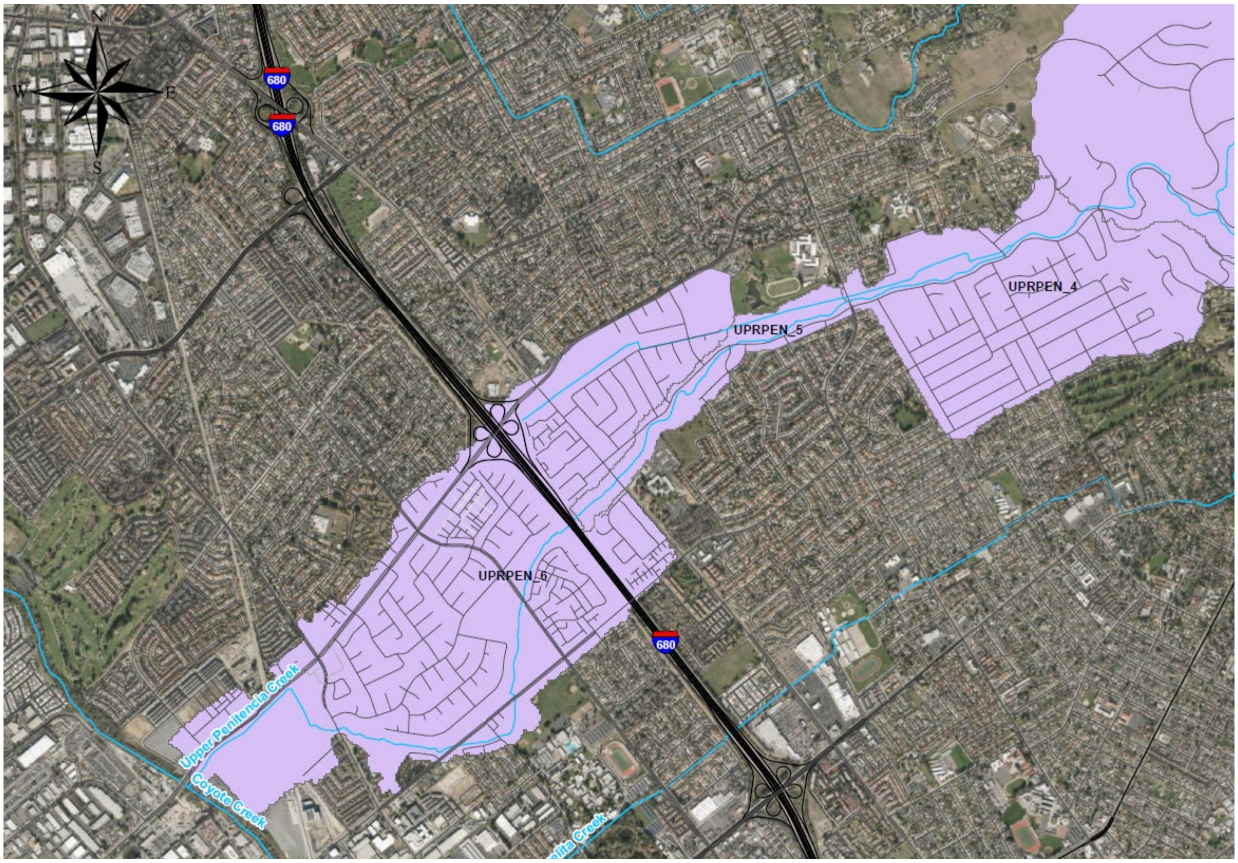
Future Improvements

To further refine this model, additional LiDAR data will need to be collected for the new Flea Market development, as well as the BART station tracks. Furthermore, flow measurements will need to be collected near the Mabury Road crossing to better calibrate the flow split between the main channel and the bypass channel. Currently, the model overestimates the flows going through the bend, as indicated by the large discrepancy between the observed and modeled WSEL.

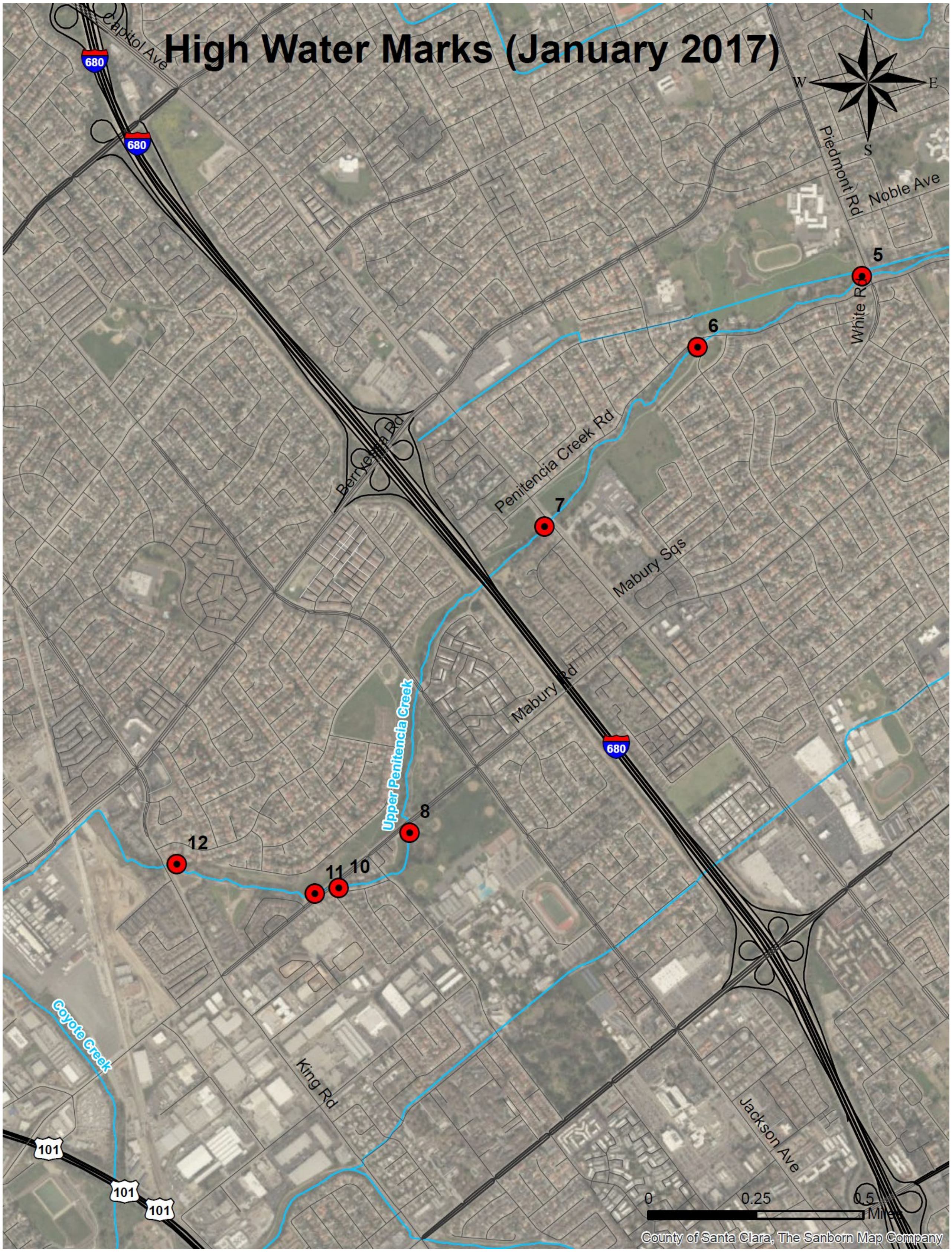
The model may also benefit from re-surveying the cross sections immediately upstream of the BART station driveway, which were modified as part of the mitigation efforts for this project. These include XS 3040, XS 2918, XS 2806, XS 2486, XS 2400, XS 2320, and XS 2220. According to notes left in the description box by S&W, these were based on "As Built" drawings. If resources permit, these cross sections would be worth an additional survey to ensure that these are in fact the existing conditions at this location.

		Roughness			
Location	**Description**	**Left Bank**	**Main Channel**	**Right Bank**	**Cross Section**
Coyote Creek to King Road	Densely vegetated with arundo along both banks by flea market area.	0.060	0.040	0.060	
King Road to Jackson Ave.	Cobble stream bed along with some sand through County Creek Park. Larger cobbles before W. Mabury crossing. Dense vegetation along the banks immediately upstream of King Ave.	0.060	0.040	0.060	
Jackson Ave. to Capitol Ave.	Stream bed with some cobbles. Some tall grass and large trees along the banks. Some trees in the middle of the channel immediately downstream of Jackson Ave.	0.050	0.050	0.060	
Capitol Ave. to Upper Penitencia Creek Rd. (Culvert)	Cobble stream bed with finer sediment, with some large boulders. Some tall grass along both left and right banks. Banks lined with sacrete where reach begins.	0.050	0.050	0.060	

Location	Description	Roughness Left Bank	Roughness Main Channel	Roughness Right Bank	Cross Section
Upper Penitencia Creek Rd. (Culvert) to Piedmont Ave.	Larger cobble and some boulders along stream bed. Tall grass and vegetation along both banks. Portion of banks lined with sacrete near culvert.	0.050	0.050	0.050	
Piedmont Ave. to Noble Ave.	Larger cobble along stream bed. Densely vegetated left and right banks with large sycamores.	0.060	0.040	0.060	
Nobel Ave. to Dorel Dr.	Larger cobble along stream bed, wide channel with a bench along some portions of the reach. Densely vegetated banks with large trees	0.060	0.040	0.060	



Subbasins from Coyote Hydrology study used for lateral inflow for Upper Penitencia Creek in HEC-RAS



High water mark locations used for the calibration of HEC-RAS model (Refer to Figure 3 for elevations)

TECHNICAL MEMORANDUM

Santa Clara Valley Water District

PROJECT: Upper Penitencia Creek **DATE**: July 7, 2017

SUBJECT: Upper Penitencia Creek HEC-RAS Calibration

PREPARED: Benjamin Hwang & Gabriel Vallin

Introduction and Purpose

A storm event in January of 2017 allowed SCVWD staff to stake high water marks (HWM) along Upper Penitencia Creek. These areas were marked shortly after peak flows from the event receded to lower elevations. Based on these HWMs, calibration efforts were made to improve the general accuracy of Upper Penitencia's HEC-RAS model (i.e. adjust Manning's n values to better match actual water surface elevations (WSE) along the creek). The purpose of this memo is to document the calibration efforts that were made to date for this model.

Background

Upper Penitencia Creek's HEC-RAS model was originally developed by the US Army Corps of Engineers (ACOE). The original model was later modified by Schaaf and Wheeler (S&W) for a study of the floodplain surrounding the proposed Berryessa BART Extension. S&W kept the same Manning's n values from the ACOE's model. District staff inherited the S&W model and further modified it for a floodplain management planning study report. The model has undergone a total of two calibration efforts since modifications began for the planning study report.

Initial Calibration Efforts

As aforementioned, HWM stakes were placed at various embankment locations along Upper Penitencia Creek. The locations of these stakes were georeferenced and assigned to the closest corresponding cross section in HEC-RAS. Flow measurements and stage information were also recorded by SCVWD's ALERT system at the Piedmont Avenue gage. A peak flow of 257 CFS was recorded during the January storm event. This flow value corresponded closest to the design flow from a 2.33-year event (roughly 371 CFS). Design flows for the 2.33-year event were taken from a previous SCVWD study of Coyote watershed (J. Xu, 2015).

Lateral inflow values in the model had to be appropriately scaled in relation to the two peaks to properly account for flow change locations. This was resolved by taking the design peak flow and adding all lateral inflows until reaching Piedmont Avenue; this resulted in a peak flow value of 388 CFS. A ratio of 2:3 was determined for recorded versus design flow values. Subsequently, this ratio was used to scale all lateral inflows both upstream and downstream of Piedmont Avenue.

Initial calibration efforts consisted of separating the creek into individual reaches with bridge crossings serving as the boundary limits. Manning's *n* values were then adjusted through the reaches to have computed WSE's match the observed WSE's. A table summarizing the Manning's n coefficients before and after the initial calibration efforts can be viewed in Table 1 of the appendix. A root mean square (RMS) analysis was performed to measure the error between the observed HWM's and predicted WSEs from the hydraulic model. The uncalibrated model resulted in a RMS of 1.10 feet. Initial calibration efforts showed improvements in terms of RMS with a value of 0.53 feet.

Field Calibration Efforts

Initial attempts to calibrate the model yielded WSE elevations reasonably close to the observed WSE's. All WSE's elevations at the examined cross sections were within 0.56' feet of the observed HWM's. Despite being reasonably close, the "calibrated" Manning's *n* values did not reflect the vegetation existing along the creek. It was determined that a second iteration of *'n'* value adjustments had to be made. Manning's *n* values were adjusted once more and a new steady state analysis was performed. The field calibrated values can also be referred to in Table 1 of the appendix. The field calibrated n values resulted in greater differences between the observed and computed WSE's. A comparison of the WSE's from each calibration effort is summarized in Table 2 of the appendix. The RMS for the second iteration of calibrations resulted in a RMS of 0.68 feet.

Capacity

Based on the "calibrated" model, a capacity analysis was also conducted to determine flooding thresholds. A summary of these capacities can also be referred to in the appendix.

Conclusion

The Manning's *n* coefficients for the Upper Penitencia Creek hydraulic model has undergone two series of changes. The first was to have calculated WSE's from the model match the observed HWM's from the January 2017 storm. A second round of changes were made to resolve the discrepancies between the "calibrated" Manning's *n* values, with the actual vegetation existing out in the field. Although the second iteration resulted in a larger RMS value, it was determined that it was still an improvement from the uncalibrated model; additionally, it was also more reflective of the existing vegetation. It was decided that the Manning's *n* values from the second iteration of calibrations will be kept in the model going forward.

Appendix

Upper Penitencia Creek High Water Marks
Storm: January 10 2017

Requestor Provided Information				Field Data				
stake	station*	bank	location	Northing	Easting	Elevation	Description	GPS point ID
1	20100	north	just downstream of Noble Fish ladder weir					
2	19900	north	just upstream of Noble Ave Bridge	1968342.67	6174300.16	241.02	GS HWM 2	1
3	19500	south	just downstream of Toyon Ave					
4	18400	south	at Bard St; just upstream of Toyon Elementry School					
5	16950	north	Just downstream of Piedmont Rd Bridge	1967533.49	6171583.34	204.98	GS HWM 5	2
6	14700	south	just downstream of Penitencia Crk Rd Culvert	1966658.81	6169565.09	180.00	GS HWM 6	5
7	11600	north	just downstream of Capitol Ave Bridge	1964460.24	6167687.33	148.87	GS HWM 7	6
8	7100	south	downstream of Mabury (north) Rd Culv near gage	1960709.12	6166031.34	113.62	GS HWM 8A	7
				1960708.41	6166032.97	114.13	GS HWM 8B	8
9	5950	north	upstream of Mabury (south) Rd Culvert					
10	5850	south	Just upstream of Mabury (south) Rd Culvert	1960025.31	6165167.76	104.50	GS HWM 10	12
11	5550	south	just downstream of Mabury (south) Rd Culvert	1959958.15	6164870.12	102.35	GS HWM 11	11
12	3700	north	upstream of King Rd Culvert	1960323.17	6163179.95	90.11	GS HWM 12	14

*stationing is approximate and based on Hec ras, the shapefile is given in folder
**See attached pdf map for georeferenced locations of stakes

Table 1 – HWM stake locations

							Δ with respect to HWM elevations			
Stake	**Location**	**HEC-RAS Sta**	**HWM WSE El.**	**Uncalibrated WSE El.**	**Calibrated WSE El.**	**Field Recon Adjust WSE El.**	**Uncalibrated Δ**	**Calibrated Δ**	**Field Adjust Δ**	**Notes**
Stake 2	DS of Noble Ave. X-ing	198+99	241	240.14	240.55	240.55	0.86	-0.45	-0.45	Model under-predicts WSE
Stake 5	DS of Piedmont Ave. X-ing	169+60.3	204.98	203.53	204.42	203.96	1.45	-0.56	-1.02	Model under-predicts WSE
Stake 6	DS of Pen Crk Rd Culvert	146+95.60	180	179.12	179.01	179.3	0.88	-0.99	-0.7	Model under-predicts WSE
Stake 7	Capitol Ave X-ing	115+51.78	148.87	147.28	148.53	148.52	1.59	-0.34	-0.35	Model under-predicts WSE
Stake 8	Mabury Stream Gage (Next to Mabury Pond)	71+48.24	113.62	113.74	113.43	114.26	-0.12	-0.19	0.64	Model over-predicts WSE
Stake 10	Mabury Rd DS (DS Face)	58+94.47	104.5	105.97	105.01	105.58	-1.47	0.51	1.08	Model over-predicts WSE
Stake 11	Mabury Rd DS (DS Face)	55+83.650	102.35	102.85	102.82	102.82	-0.5	0.47	0.47	Model over-predicts WSE
Stake 12	King Rd X-ing	37+37.59	90.11	89.06	89.8	89.8	1.05	-0.31	-0.31	Model under-predicts WSE
						RMS	1.10	0.53	0.68	

Table 2 – Comparison of WSE after initial calibration and field reconnaissance

TECHNICAL MEMORANDUM

PROJECT: Upper Penitencia Creek **DATE**: June 16, 2016

SUBJECT: Upper Penitencia Creek Steady-State Capacity Model

PREPARED: Benjamin Hwang

Introduction

A steady state HEC-RAS model for Upper Penitencia Creek project was developed to determine the current flood conveyance capacity. In turn, this will help identify areas along the creek that do not provide an adequate level of flood protection (i.e. contain a 100-year storm event). Additionally, it will help determine the maximum quantity of flow that is spilled out of the creek once capacity is exceeded. To identify these areas and their respective spills, a steady-state capacity model was developed using HEC-RAS. Furthermore, this model was created to serve as the basis for an unsteady-state 2-D floodplain model. This technical memorandum discusses the development of the capacity model, the resulting capacities, and a general summary of the spills that can potentially occur along the creek.

Background

A HEC-RAS model of Upper Penitencia was previously developed by Schaaf and Wheeler (S&W) for a floodplain analysis of the area surrounding the proposed Silicon Valley Bart Extension (SVBX) project. A report detailing this analysis was released in December 2013. This model analyzed both existing and post-project conditions; the latter of which accounted for the channel realignment that took place immediately upstream of the proposed BART station. S&W coupled these HEC-RAS models with Flo 2D to analyze any changes to the floodplain that may occur due to the proposed project. All cross sections used for the models were surveyed by BKF in 2012. Intermediate cross sections between surveyed cross sections were created from 2006 LiDAR data. These cross sections could not capture the thalweg geometry so portions of the cross sections below water had to be interpolated. Flow hydrographs taken from Santa Clara Valley Water District's (SCVWD) 100-year HEC-1 model were used by S&W for the analysis.

Development of Reach Capacity Models

Model type: HEC-RAS, Steady State
Horizontal Datum: North American Datum (NAD) 1983
Vertical Datum: NAVD (1988)

A steady-state capacity model was developed by modifying the post-project conditions model that was developed by S&W for the SVBX project. In order to determine capacity, the project reach was divided into subreaches with bridge crossings serving as the limits. The extent of each subreach started at the upstream face of the bridge downstream, to the downstream face of the bridge upstream. A separate model was created for each subreach in order to analyze capacity without any backwater effects from downstream conditions. This allowed capacity to be determined with the assumption that all cross sections downstream did not need any modifications made to improve conveyance.

To model each subreach independently, all cross sections outside the extent of the limits were deleted. All bridges and lateral weirs were also completely removed. Additionally, all bridge faces (i.e. cross sections at both faces of the bridge) were omitted because they reflected the geometry of the bridge crossing rather than being representative of a typical cross section within a subreach. A total of 15 subreaches were established through the entire project reach. The upstream and downstream boundary conditions for all subreaches were subjected to normal depth water surface elevations (WSE). The slopes used for the boundary conditions were determined from the first two (and in some cases several), non-interpolated cross sections both at the upstream and downstream end of each subreach. Manning's *n* values for the channel invert, as well as the left and right banks were determined after several field visits to Upper Penitencia. Ultimately, existing *n* values from S&W's model were verified, and modified in some areas to provide a more accurate representation of the current condition of the creek. A separate technical memorandum discusses how these *n* values were determined.

The capacity for each subreach was determined by running various flow values under steady state conditions in increments of 100 cubic feet per second (CFS). Capacity for each cross section was determined as the maximum flow value that provided a WSE that did not exceed the elevation of the left or right bank of the channel. Elevations for left and right banks were verified by importing the cross sections into GIS and using LiDAR data.

Development of Bridge Capacity Models

Model type: HEC-RAS, Steady State
Horizontal Datum: North American Datum (NAD) 1983
Vertical Datum: NAVD (1988)

Capacities for each bridge within the project reach were determined in the same manner as the subreaches. All cross sections, with the exception of the first two cross sections immediately upstream and downstream of each bridge face were deleted. Boundary conditions for each bridge were once again subjected to normal depth elevations. These conditions were determined by finding the slope of the channel invert both upstream and downstream of each bridge.

Determining the capacity for each bridge within the project reach was more straightforward. In a manner similar to the subreaches, various flow values were analyzed in increments of 100 CFS. Capacity was determined as the maximum flow value that provided a WSE that did not exceed the soffit of the bridge crossing.

Development of Bypass Channel Capacity Models

Model type: HEC-RAS, Steady State
Horizontal Datum: North American Datum (NAD) 1983
Vertical Datum: NAVD (1988)

The bypass channel for Upper Penitencia begins immediately downstream of Highway 680. This channel traverses through the Penitencia Creek County Park until its eventual confluence with the main (natural) channel, which occurs upstream of the N. King Road crossing. Capacity for this channel was determined by modeling the entire channel as a system (i.e. the bypass channel was modeled in its entirety rather than segmenting the channel into subreaches). The following scenarios were modeled to determine capacity for the bypass channel:

- Bypass channel only
- Main (natural) channel only
- Bypass and main channel together

Modeling the bypass channel by itself was the first scenario that was analyzed. This meant that the entire main channel was omitted from the model. Additionally, all bridges, bridge faces, and lateral structures were omitted from the model.

The second scenario to analyze capacity for the bypass channel was to model the natural channel by itself. The natural channel was modeled by removing all cross sections upstream of Jackson Avenue and downstream of N. King Road. As with modeling the bypass channel by itself, all bridges, bridge faces, and lateral structures were completely removed from the model. Although this area was already modeled as separate subreaches, an analysis of the natural channel alongside the bypass was modeled in its entirety. This determined the capacity that is available for the natural channel as a system. Implicitly, this determined the capacity that is required for the bypass, assuming the natural channel is left untouched.

The third and final scenario for analyzing bypass capacity was to model both the bypass and natural channel as one system. This once again required removing all cross sections outside the extent of N. King Rd. and Jackson Avenue. As with the other scenarios, all bridges, bridge faces, and lateral structures were completely removed from the model. Three cross sections above the channel diversion were kept in the model to run various flows through the natural channel. The bypass channel required a minimum flow of 1 CFS to be entered in order for the model to run. Any overflow that resulted from the main channel's right bank was diverted to the bypass channel through a lateral weir.

Subreach Capacity Results

As a result of Upper Penitencia being a natural channel, geometries for cross sections showed great variation even within the same subreach. Capacities even within the same subreach exhibited a wide range of capacities. It was deemed that the absolute minimum flow values within each subreach should be the capacities that are representative of the entire subreach. For each subreach, the cross section with the minimum flow value was first determined. Once this was determined, all cross sections upstream and downstream of this minimum was assigned the same flow value as long as it did not fall below this minimum, or exceed 50% of the flow (e.g. if 1000 CFS is the minimum, all cross sections upstream and downstream of the minimum cross section are assigned this value until capacity exceeds 1500 CFS, or falls below 1000 CFS). Once a cross section exceeded this 50% threshold or fell below the minimum, a new minimum was determined. The new minimum was then assigned to all cross sections upstream and downstream of it until the aforementioned thresholds were exceeded. This procedure was repeated until each cross section within a subreach was assigned a flow value.

A map summarizing the resulting capacities through Upper Penitencia's main channel is shown in Figure 1. Capacity values are summarized in detail in Figure 2. Generally, the subreaches upstream of Highway 680 showed greater capacities compared to those downstream of Highway 680 (with the exception of the Berryessa Flea market area). S&W's existing unsteady state model has shown a significant amount of flow being diverted to a bypass channel immediately upstream of Jackson Avenue. This diversion is facilitated by a concrete weir (Figure 3) in the main channel, but is also compounded by low right bank elevations for a number of cross sections between Jackson Avenue and E. Mabury Road. The capacity that was determined for the main channel between these crossings used the left bank as the capacity constraint rather than the right bank. It was assumed that even with flow spilling over the right bank into the bypass, the channel was still containing flow until the left bank was breached.

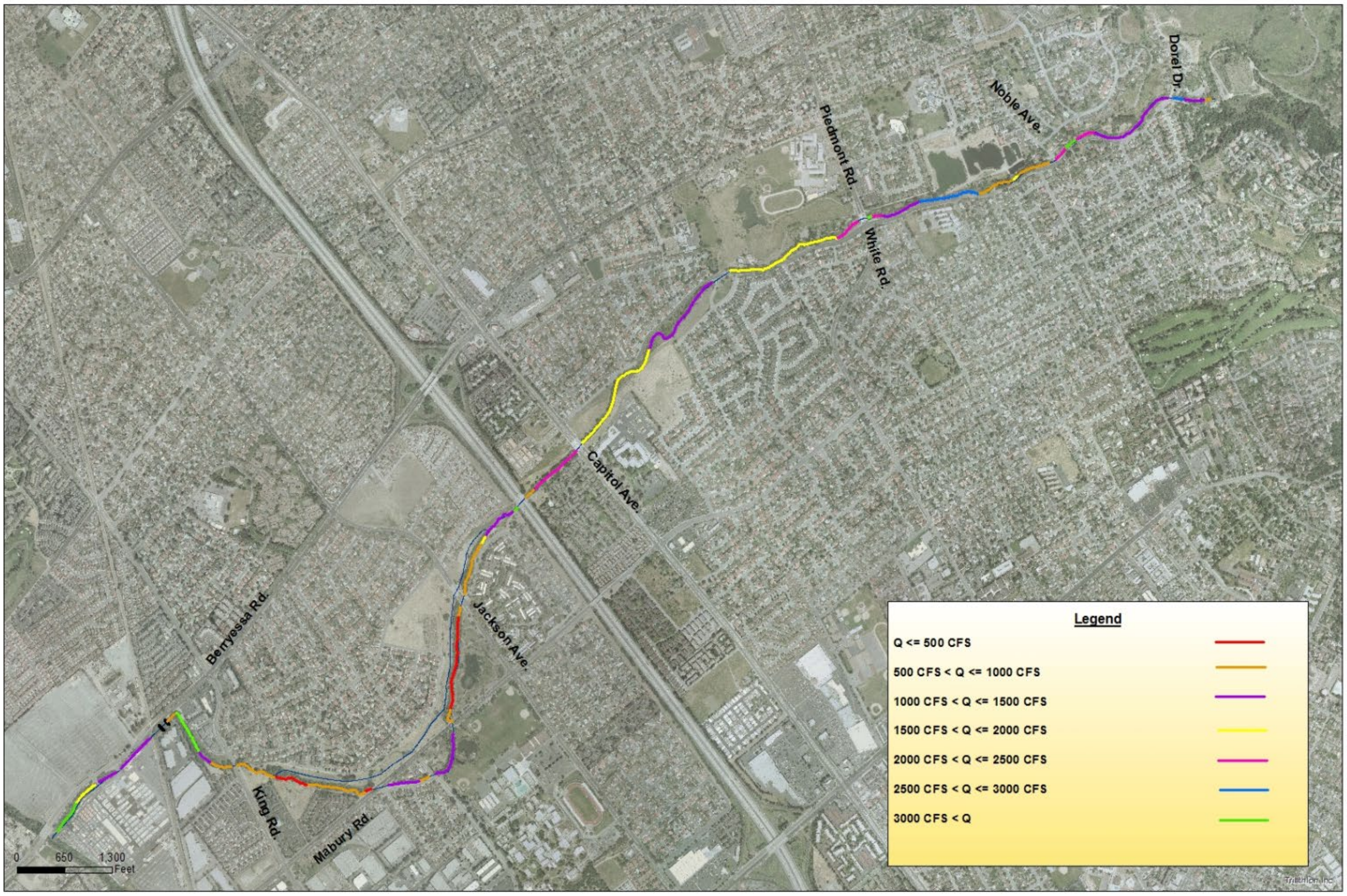


Figure 1 – Summary of capacities through Upper Penitencia (Main Channel)

Valley to Dorel	
River Sta.	Determined Q (CFS)
22406.66-22358.5	700
22310.48-22060.4	1500
22014.3-21922	2600
Dorel to Noble	
21807.9-21684	1300
21642.71-20614.3	1500
20547.43-20352.1	2200
20270.6-20189	4500
20147.49-19966.67	2400
Noble to White	
19786.98-19464.60	800
19320.14	1700
19223.07-19044.11	800
18709.41-18453.28	2600
17879.71-17502.12	1200
17307.44-17224.18	2400
17188.4	6900
White to UPC Road Culvert	
16960.3-16694.6	2200
16620.16-15074	1900
UPC Road Culvert to Capitol	
14698.9-13740.51	1300
13355.82-11937.02	1700
Capitol Ave to Hwy 680	
11613.62-11197.46	2300
10838.29-10701.34	1000
Hwy 680 to Jackson	
10494.64	5300
10437.22-9939.09	1100
9900.61-9823.666	1600
9785.23-9177.55	1200

Jackson to E. Mabury	
River Sta.	Determined Q (CFS)
8883.965-8818.62	1100
8753.28-7555.59	500
7510.485-7354.469	1000
E. Mabury to Ed. Park Dr.	
7148.24-6789.09	800
6741.159-6526.38	1000
Ed. Park Dr. To W. Mabury	
6385.433-6302.77	800
6207.995-5894.47	1400
W. Mabury to King	
5553.71-5399.222	1400
5284.265-45055.875	800
4906.277-4269.751	400
4217.358-3671.89	1000
King to Railroad X-ing	
3557.53-3321.714	900
3243.13-3164.54	1500
3040-2806	3500
2486-2400	700
Railroad X-ing to Flea Market U/S	
1949.61-1371.07	1300
Flea Market U/S to Flea Market Mid	
1275.16-1083.388	1300
1064.96-1046.54	1000
Flea Market Mid to Flea Market D/S	
948.186-682.422	2100
607.26-203.635	4700
179.269	10000
Coyote Creek Confluence	

Figure 2- Capacity values for subreaches

Figure 3 – Concrete bypass weir upstream of Jackson Ave.

Bypass Capacity Results

As previously stated, three different analyses were undertaken for the bypass channel including: bypass only, natural channel only, and bypass and natural channel combined. Results for each of these scenarios are summarized in the proceeding sections.

Bypass Channel Only

Model type: HEC-RAS, Steady State
Horizontal Datum: North American Datum (NAD) 1983
Vertical Datum: NAVD (1988)
Georeferenced: All cross sections are georeferenced

The bypass channel is within an area that features tall grass, weeds, and very fine sediment. The bypass channel itself is not well defined and a discernible left or right bank is not readily apparent (Figure 4). Additionally, there is a vast amount of open space surrounding the bypass channel, essentially functioning as a floodplain. This open space is bordered to the north by a residential area (Figure 5) with similar elevations, indicating a relatively flat area. These elevations were verified with LiDAR data on GIS.

Figure 4 – Bypass channel looking downstream

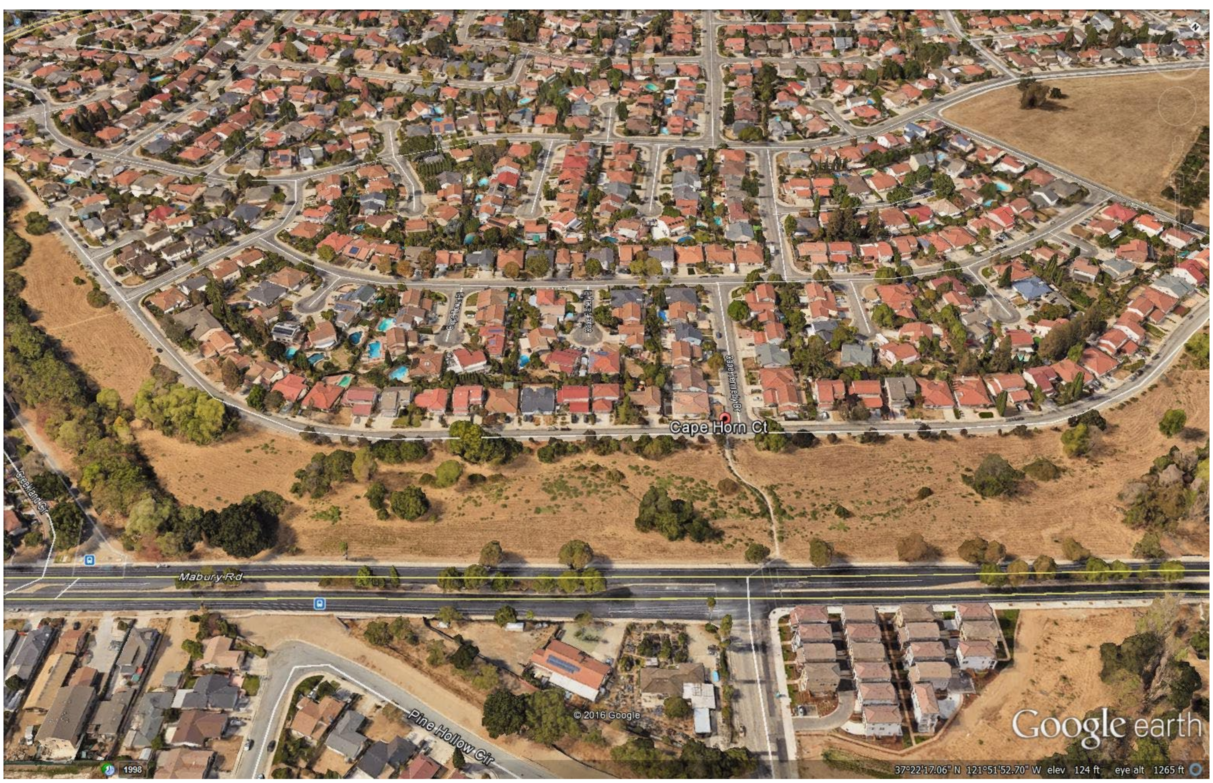


Figure 5 – Residential area along bypass channel

A few cross sections downstream of Jackson Avenue showed significantly limited capacities due to a low lying right bank. Right bank elevations for these cross sections were verified using LiDAR and were consistent with elevations shown in the HEC-RAS model. Several cross sections upstream of the Jackson Avenue crossing also showed limited capacities, however these were due to low lying left bank elevations. For these cross sections, the right bank elevation was the constraint in terms of capacity. This was based on the assumption that all spills over the left bank would enter the main channel, while spills over the right bank would begin to induce flooding in the residential area along Cape Horn Court.

Several cross sections immediately upstream of Jackson Avenue bypass crossing showed enormous capacity in the magnitude of 10,000-20,000 CFS. This bridge crosses the bypass channel and is right next to the Jackson Avenue culvert, which is part of the main channel. The significantly larger capacity through this area is noteworthy because most of the flow leaves the main channel and into the bypass channel. Figure 6 shows a detailed table of the capacities that were determined when modeling the bypass channel only.

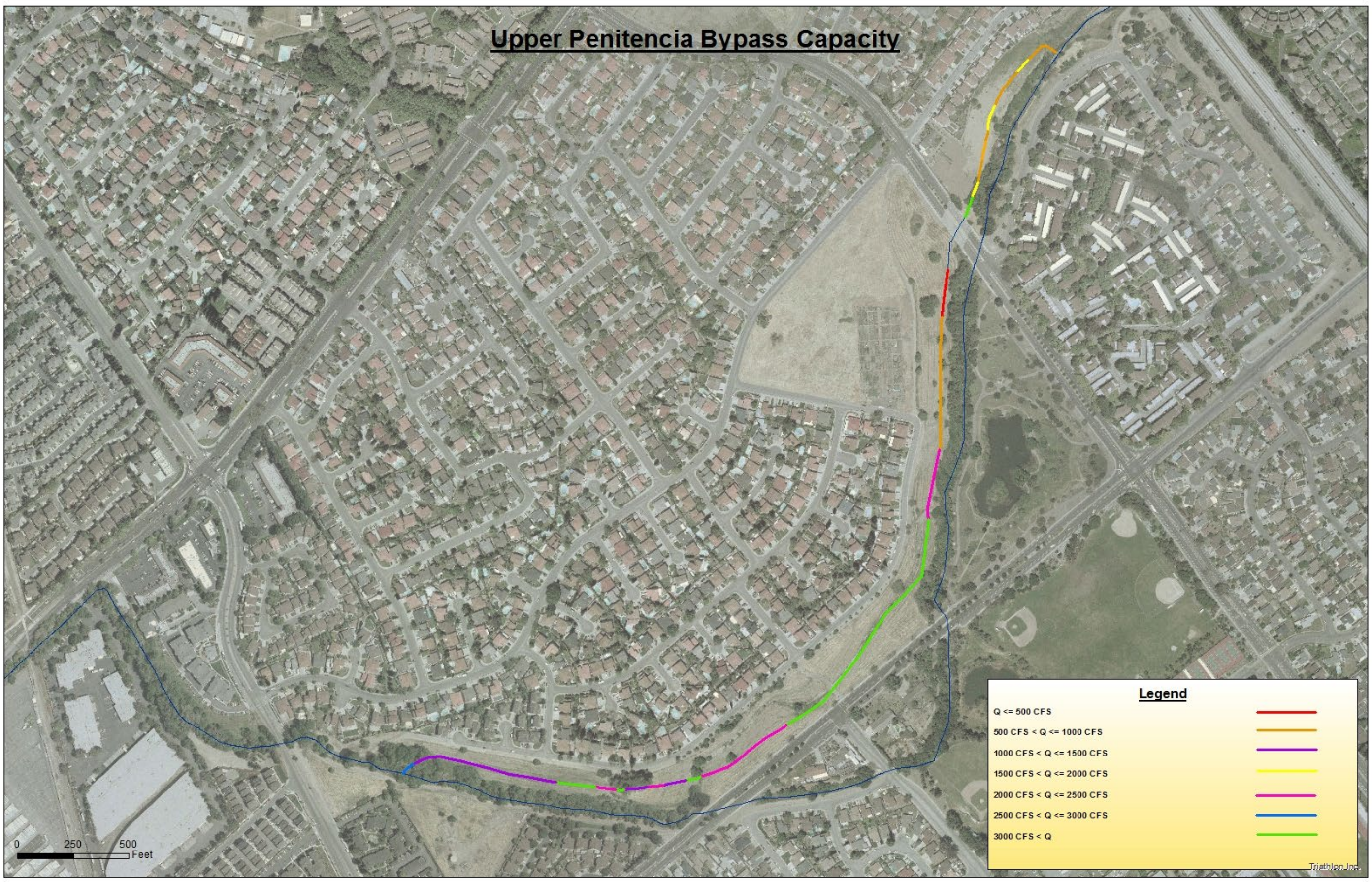


Figure 6 – Summary of bypass channel capacity

Bypass Channel Only	
River Sta.	Capacity Q (CFS)
5236.619-5198.56	1000
5160.51-5122.46	2000
5084.419-4896.29	1000
4859.905-4819.05	2100
4778.2	1000
4737.36-4693.73	300
4650.113-4601.55	700
4522.99-4504.435	2000
4484.37-4464.31	8800
4444.25-4424.19	16400
4130.13-4039.556	200
3917.046-3416.847	1100
3321.575-3090.49	2300
3002.786-2603.24	5000
2462.948	12800
2344.865-2021.479	3400
1903.87-1449.984	2400
1366.886	5800
1310.429-1250.589	1200
1206.193	2500
1134.14-1081.449	1100
1031.445	4900
990.914	2100
909.588-768.462	3800
721.826-106.271	1600
61.682	3300

Figure 7 – Summary of capacities for bypass channel only

Natural Channel Only

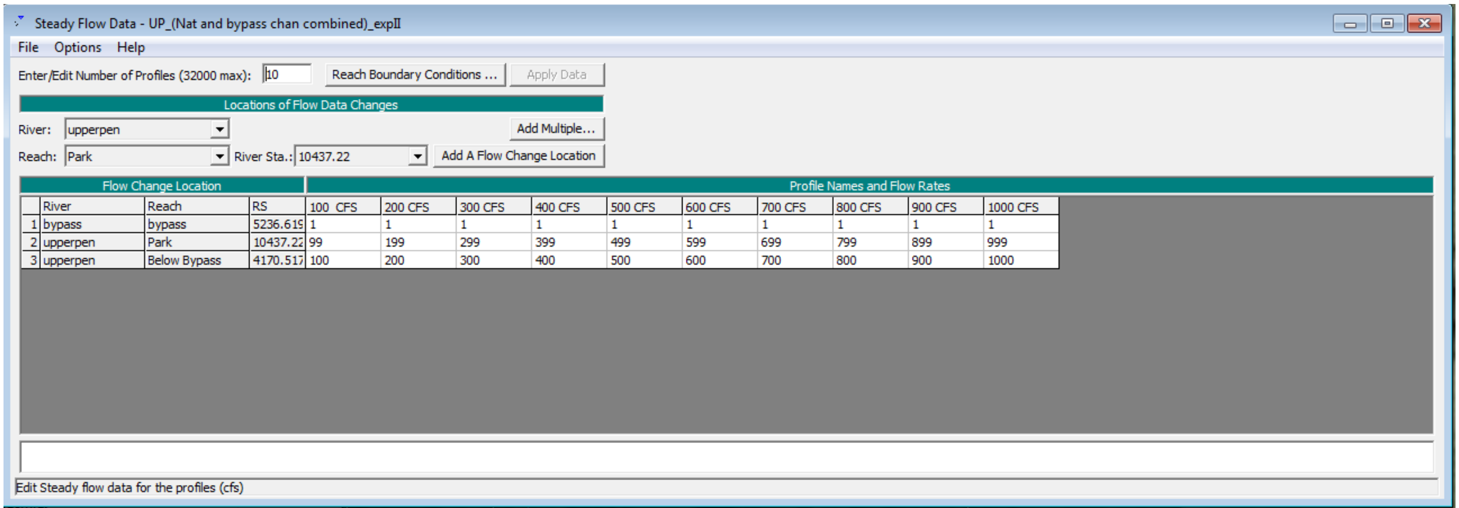
The second scenario modeled the natural channel (Jackson Ave. to N. King Rd.) in its entirety. A summary of the resulting capacities from the second scenario is summarized in Figure 8.To determine the required capacity of the bypass channel, the resulting natural channel capacities were subtracted from the design flows (Q) determined from SCVWD's Coyote Watershed Hydrology Report. With the natural channel at full capacity, and with the assumption that it remains unmodified, it can be concluded that the bypass channel will need to be able to contain anywhere from 2600-3400 CFS.

Natural Channel Only		
River Sta.	Capacity Q (CFS)	Required Bypass Capacity (Design Q - Nat. Chan. Q)
8883.965-8818.62	1100	2690
8753.28-7555.59	500	3290
7510.485-7354.469	1100	2690
Mabury Rd. (U/S)		
7148.24-6789.09	800	2990
6741.1596526.38	1000	2790
Educational Park Dr.		
6385.433-6302.777	900	2890
6207.995-5894.47	1400	2390
Mabury Rd. (D/S)		
5553.71-5055.875	1000	2790
4906.277-4269.751	400	3390
4217.358-3698.474	1000	2790
3671.89	600	3190
North King Ave.		
3557.53-3515.062	700	3090

Figure 8- Summary of capacities for natural channel only

Bypass and Natural Channel Combined

The final scenario that was analyzed for the bypass was to model both the bypass and natural channel as one system. By modeling both channels, HEC-RAS was allowed to perform a flow split provided a steady state flow value. Three cross sections upstream of the flow split were kept in the model to perform this flow split. S&W had modeled the bypass channel as a separate reach from the main channel. Any spilling from the natural channel into the bypass channel was handled by a lateral weir that was placed at the beginning of the diversion. Since the bypass channel was modeled as a separate reach, it required a minimum flow of 1 CFS to allow the model to run. For this reason, an artificial flow split was implemented (Figure 9). For an example, if a flow value of 200 CFS was modeled through the system, the bypass would take 1 CFS and the main channel would take 199 CFS. It was important to verify that cross sections below the confluence ultimately have a flow of 200 CFS (i.e. continuity conditions were being satisfied).



	River	Reach	RS	100 CFS	200 CFS	300 CFS	400 CFS	500 CFS	600 CFS	700 CFS	800 CFS	900 CFS	1000 CFS
1	bypass	bypass	5236.619	1	1	1	1	1	1	1	1	1	1
2	upperpen	Park	10437.22	99	199	299	399	499	599	699	799	899	999
3	upperpen	Below Bypass	4170.517	100	200	300	400	500	600	700	800	900	1000

Figure 9 – Flow conditions to model both bypass and main channel

Rather than analyzing capacity for each cross section, incremental flow values were specified and examined to see when the first instance of overtopping would occur in either the bypass or natural channel. It was assumed that any overtopping over the left bank of the bypass channel would spill over into the main channel; conversely, any spill over the right bank in the natural channel would spill into the bypass. The constraint in terms of capacity was the left bank for the natural channel and the right bank for the bypass channel. For a given flow value, if the WSE exceeded either of these banks, the system was considered to be above capacity. At 700 CFS, it was determined that the main channel will begin to see the left bank overtopping. Additionally, it appears that spilling from this area of the creek would affect the Penitencia Creek trail, which runs through the County Park. Generally, the combined model also shows the main channel will always reach capacity before the bypass channel.

Bridge Capacity Results

Bridge crossings that showed significantly limited capacities (<500 CFS) included Mabury Rd (U/S & D/S bridges), as well as Educational Park Drive. This can be attributed to sediment accretion that has been taking place, particularly at the Mabury Road (D/S) crossing. In spite of this, recent flooding has not occurred in this area. This can be attributed to the significant amount of flow leaving the main channel at Jackson Avenue. Another noteworthy area is the culvert leading to Coyote Creek. Although this culvert showed extremely limited capacity, the channel up to the Flea Market D/S bridge has substantial capacity. The large capacity through this area most likely offsets any flooding that may potentially occur. A summary of the bridge capacities is summarized in the table shown in Figure 10.

Bridge Capacities			
Bridge	**HEC-RAS Sta. (U/S Face)**	**HEC-RAS Sta. (D/S Face)**	**Q (CFS)**
Dorel Dr.	21875.91	21828.5	2900
Noble Ln.	19899	19871	1600
Piedmont/White Rd.	17152.78	17004.5	4500
Upper Penitencia Creek Rd. Culvert	15000	14700	1100
Highway 680	10700	10500	3000
N. Jackson Ave. (Culvert)	9093.757	8908.965	800
Mabury Rd. (U/S)	7295	7200	600
Educational Park Dr.	6482.939	6400	500
Mabury Rd. (D/S)	5842.217	5583.65	300
King Rd.	3645.314	3600	400
Berryessa Rd	2348.25	2304.86	900
Old Railroad Crossing	2018.68	1994.193	600
Flea Market Driveway U/S	1355.358	1291.7	1000
Flea Market Driveway Mid	1028.118	968.325	1400
Flea Market Driveway D/S (Culvert to Coyote Creek)	154.903	88.504	10

Figure 10 – Summary of bridge capacities

Maximum Spills

With capacities determined for all subreaches, the next step was to determine breakout locations and quantify spills. In order to do so, S&W's post-project conditions model was subjected to 100 year storm hydrographs determined from SCVWD's Coyote Watershed Hydrology report. Each subreach was subjected to the appropriate subbasin hydrograph from the report. The resulting flows from these hydrographs were compared with the capacities that were determined from this analysis. Figure 11 shows a map that summarizes the general breakout points as well as the maximum spills that can potentially occur. Generally, the map shows that most spills occur in the upper reaches of the creek as Upper Penitencia Creek begins to traverse through the valley floor. It is interesting to note that the upper reaches of the creek is also where capacities are the largest. Significant spills also occur near the Piedmont Road and Jackson Avenue crossing. The lower reaches of Upper Penitencia experiences some spilling but of a much smaller magnitude.

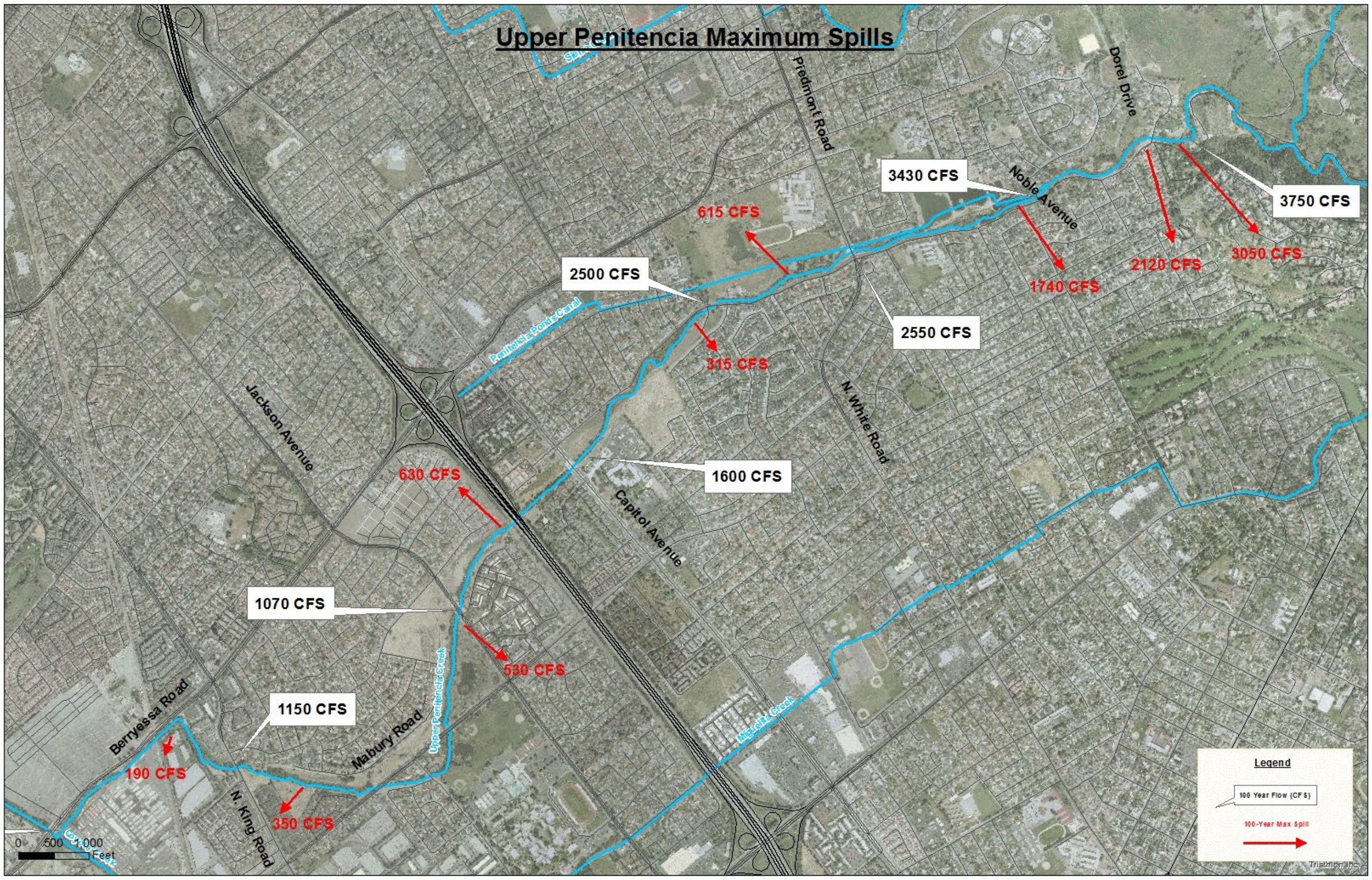


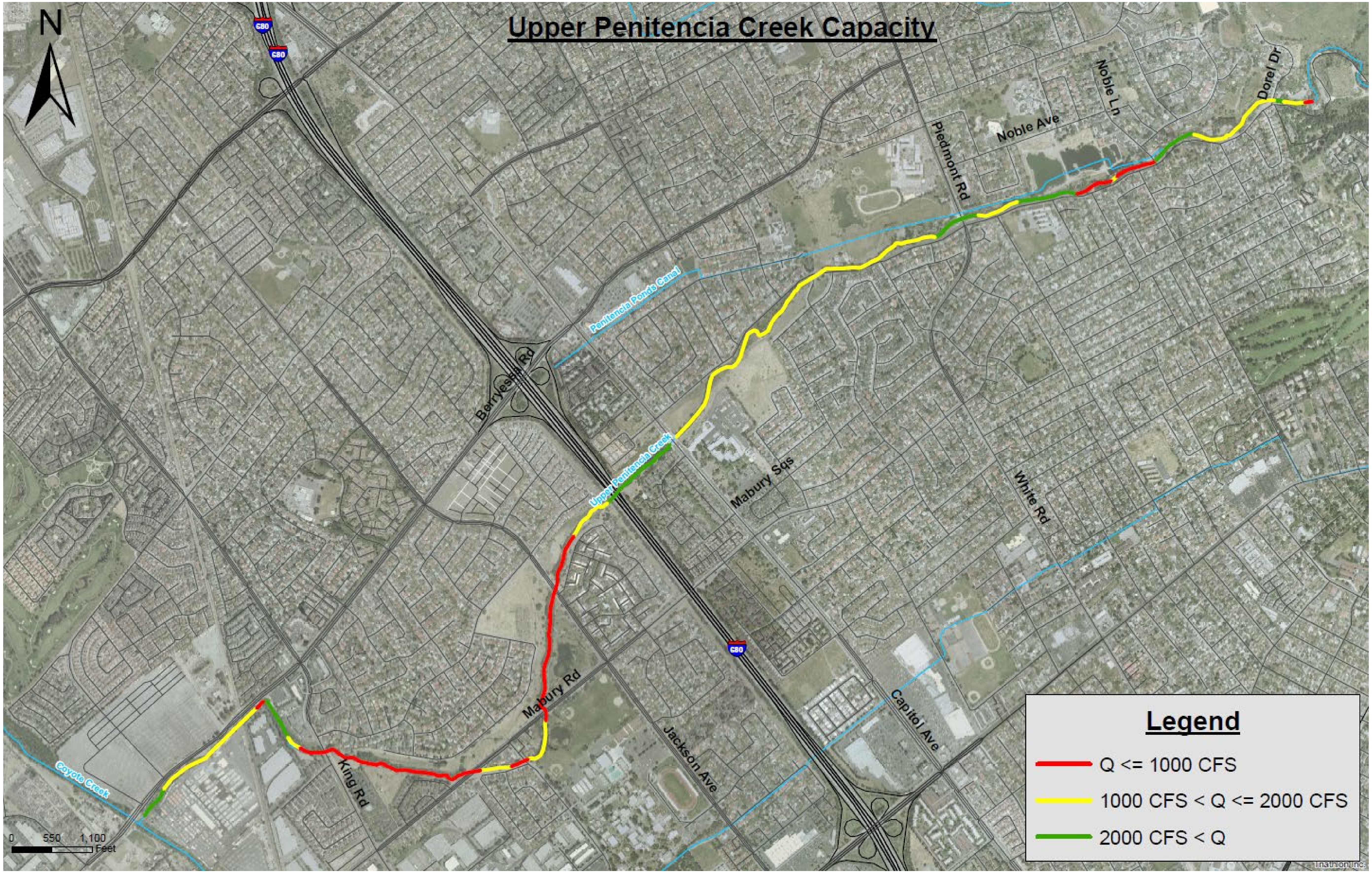
Figure 11 – Breakout points and maximum spills

Conclusion

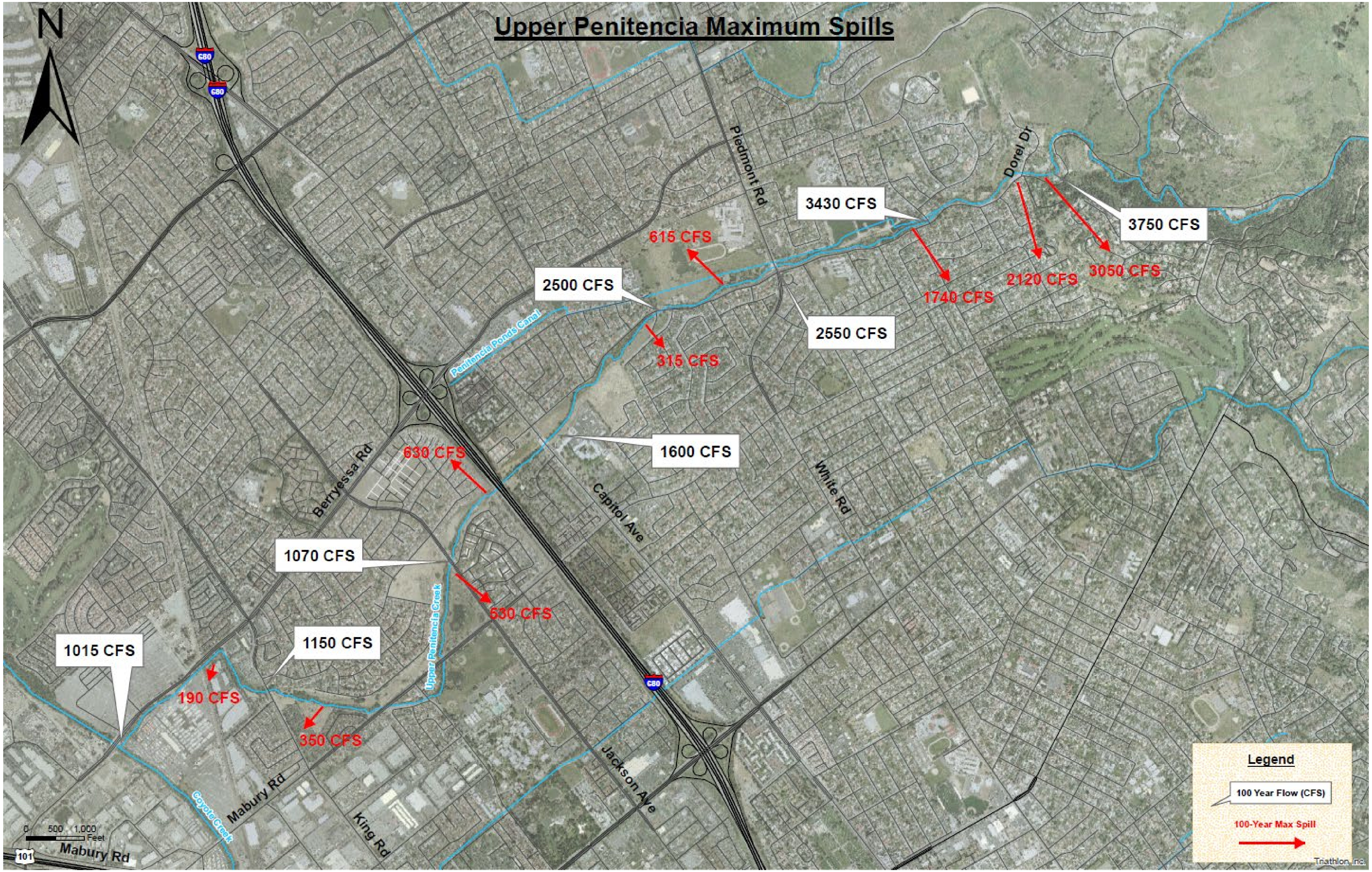
The ultimate goal of the capacity model for this project was to shed light on the existing flood conveyance capacity of the creek. Due to Upper Penitencia being primarily a natural channel, there was great variation in terms of flood conveyance capacity through the creek. Generally, the upper reaches of the creek showed greater capacity than the lower reaches (with the exception of the Berryessa Flea Market area). Interestingly, although this was case, most of the spilling (in terms of quantities and locations) occurred in the upper reaches.

Noteworthy breakout areas include portions of the creek between Noble to Dorel; these areas are a short distance downstream from Alum Rock Park, where the creek first enters the valley floor. Another noteworthy area, in which a significant amount of flow leaves the creek, is near the Piedmont/White Road crossing. Approximately 600 CFS is shown to be leaving the creek and into Penitencia Creek Park (City of San Jose). Finally, Jackson Avenue is another major breakout point that was determined. The significant amount of flow leaving this area is assisted by the bypass channel. Flow downstream of Jackson Ave. seems to be attenuated due to the breakout that occurs in this area. This is also consistent with the fact that the area around W. Mabury Road has not experienced any recent flooding despite significant sediment accretion under this bridge.

In light of these conclusions, the Upper Reaches of Upper Penitencia, specifically the areas upstream of Highway 680, should be examined more closely to address capacity issues. Additionally, the bypass channel provides a significant amount of capacity that provides the project with more options to improve hydraulic and geomorphic conditions along the main channel.



Upper Penitencia Creek Capacity
N
Legend
Q <= 1000 CFS
1000 CFS < Q <= 2000 CFS
2000 CFS < Q
0 550 1,100 Feet
Berryessa Rd
Mabury Rd
King Rd
Jackson Ave
Capitol Ave
White Rd
Piedmont Rd
Noble Ave
Noble Ln
Dorel Dr
Mabury Sqs
Penitencia Ponds Canal
Upper Penitencia Creek
Coyote Creek
680


Upper Penitencia Maximum Spills
N
680
Piedmont Rd
Dorel Dr
3430 CFS
3750 CFS
615 CFS
1740 CFS
2120 CFS
3050 CFS
2500 CFS
2550 CFS
315 CFS
1600 CFS
630 CFS
Berryessa Rd
Capitol Ave
White Rd
1070 CFS
530 CFS
1015 CFS
1150 CFS
190 CFS
350 CFS
Mabury Rd
King Rd
Jackson Ave
101
0 500 1,000 Feet
Legend
100 Year Flow (CFS)
100-Year Max Spill
Triathlon, Inc.

References

1. *Santa Clara Valley transportation Authority Silicon Valley Berryessa Extension Floodplain Analysis,* Schaaf and Wheeler (December 2013).
2. *Coyote Creek Hydrology Study,* Santa Clara Valley Water District (December 2015).

APPENDIX G: GEOMORPHOLOGY STUDY

Final

UPPER PENITENCIA CREEK
GEOMORPHIC BASIS OF DESIGN REPORT

Prepared for
Valley Water

March 2022

ESA

Final

UPPER PENITENCIA CREEK GEOMORPHIC BASIS OF DESIGN REPORT

Prepared for
Valley Water

March 2022

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CHAPTER 1
Introduction

The Santa Clara Valley Water District (Valley Water) seeks to develop process-based channel restoration and enhancement designs on Upper Penitencia Creek as part of a multi-benefit flood risk reduction project by better understanding the geomorphic processes operating along the creek and how best to work with these processes. Ecosystem enhancement is a major project objective in addition to flood management, and restoring natural geomorphic processes where feasible is expected to significantly influence how both objectives can be achieved. Consequently, a geomorphic study was needed including specific study questions to frame the investigation and guide development of the channel restoration and enhancement design. The sections below present the project location, objectives, historical and existing conditions, and design basis. A separate sediment transport modeling report (ESA, 2022) contains the details of the modeling analyses, the results of which are referenced in this report to answer the study questions, evaluate the design alternatives, and document the design basis.

1.1 Location

The project is located on Upper Penitencia Creek in the South Bay of the San Francisco Bay Area in a highly developed area of East San Jose extending from the confluence with Coyote Creek upstream to the Capitol Avenue crossing (**Figure 1**). Reaches 1A, 2, and 3 include the creek between the Coyote Creek confluence and the BART crossing, the King Road and Jackson Avenue crossings, and the Jackson Avenue and Capitol Avenue crossings, respectively.

1.2 Problem Definition and Constraints

The threat of significant flooding is the primary problem identified on Upper Penitencia Creek. Areas within the City of San Jose and the City of Milpitas have the potential to be subjected to widespread flooding from Upper Penitencia Creek. Other problems include sediment deposition along the lower reaches, water quality concerns, and geomorphic stability issues.

1.2.1 Flooding

With the capacity to convey less than a 10-year flow event, recurrent flooding along Upper Penitencia Creek presents a long-term hazard to public safety, property values, and economic stability in the cities of San Jose and Milpitas. Since Valley Water started preparing flood reports in 1967, damaging flood events occurred in 1978, 1980, 1982, 1983, 1986, 1995, and 1998, impacting many homes, businesses and streets. Other flood events throughout the years did not

SOURCE: ESA 2022

Upper Penitencia Creek

Figure 1. Project Reaches

ESA

have significant impacts, such as in 2017 when the creek spilled its banks in several locations but did not cause any damage. Hydraulic models of Upper Penitencia Creek have shown that flooding begins at a ten-year flood level and approximately eight thousand parcels are likely subject to flooding in a 1% event. Also, farm levees built in the early 1900s in the lower reaches of the creek are in poor condition and could potentially exacerbate flooding during high flow events.

1.2.2 Water Quality

Creeks in urban areas can suffer from degraded water quality due to stormwater runoff, trash, pesticides, and fertilizers. Most of the floodplain around Upper Penitencia Creek slopes away from the creek, therefore the majority of stormwater runoff flows away from the creek, and there are not many stormwater conduits that drain into the creek. This has reduced pollution compared to other urban creeks in Santa Clara County. There is some impact to the water quality due to fertilizers used in the upper reaches above Alum Rock Park.

In more recent years, water quality impairment due to homeless encampments has become more of an issue. Encampments are associated with accumulation of litter and trash in the creek as well as human waste. Upper Penitencia Creek has not been impacted by encampments as much as Coyote Creek and Guadalupe River, and most encampment impacts are limited to the lower reaches.

1.2.3 Sediment Deposition

Significant sedimentation has occurred in the downstream portion of the creek, from I-680 down to the confluence with Coyote Creek. In some areas sediment deposition has raised the creek invert by estimates of up to 3 feet. The most significant deposition problem is at the confluence with Coyote Creek where Upper Penitencia Creek enters Coyote Creek at a 90-degree angle.

The Mabury meander is a bend in Upper Penitencia Creek that crosses Mabury Road **(Figure 1**). Due to sediment deposition, flows in this natural meander will likely abandon the main channel and begin to use the Mabury bypass as its low flow channel. There have been breaches along the farm berm separating the main channel and the Mabury bypass allowing flows into the bypass. Sediment deposition has raised the invert of the main channel two to three feet causing even low flows to break into the bypass.

1.2.4 Limitations Due to Downstream Flooding Potential

A significant constraint discovered through the planning process was inherent in the current watershed floodplain hydrology and hydraulics. Because of current creek capacities upstream, only a limited amount of flow coming downstream out of the upper watershed can work through the channel and floodplain to reach Coyote Creek. Thus, flows exceeding 2,000 cfs break out into the urbanized floodplain and do not get to Coyote Creek directly. Since Coyote Creek has capacity limitations at locations downstream of the confluence with Upper Penitencia, the current hydrology should not be altered as Valley Water cannot induce more flooding downstream in Coyote Creek. This restricts channel improvement alternatives for Upper Penitencia Creek to match existing inflows to Coyote Creek—any higher level of flood protection would require construction of a flood detention project element along Upper Penitencia Creek and/or further flood protection elements on Coyote Creek.

1.2.5 Fish Passage

Steelhead trout in Coyote Creek and Upper Penitencia Creek belong to the Central California Coast Distinct Population Segment (CCC steelhead), which was listed as threatened under the federal Endangered Species Act in 1997. Upper Penitencia Creek, including within the project area, is listed by NMFS as critical habitat for CCC steelhead. Maintaining or improving the ability of steelhead to migrate through the project reaches will be an important consideration in the design and maintenance of reach-specific actions.

The Mabury meander, mentioned above, has been partially channelized as a result of urbanization and is part of the migration route of CCC steelhead. NMFS has expressed concern over fish-stranding risks associated with bifurcated or multi-channel designs. The bypassing of flows from the Mabury meander through the Mabury bypass may increase the risk of fish stranding—any bypass design must minimize such risks.

1.2.6 Water Supply

Valley Water’s managed aquifer recharge program uses both runoff captured in local reservoirs and imported water. The Penitencia Recharge System is a small system predominately served by imported water from the State Water Project with some contribution from local water. Other facilities in the system, which exclusively recharge State Water Project water, include the Penitencia, Piedmont, Helmsley, and County Park ponds. Recharge operations have been conducted in this system since 1934. The system recharges the Santa Clara Plain with a capacity of about 7,000 acre-ft per year.

The project needs to minimize any impacts to the recharge system and mitigate for any loss of recharge. The major water supply consideration is the Mabury diversion located just downstream of the eastern Mabury Road crossing, which diverts water to the Mabury and Overfelt ponds. Unless Valley Water decides to abandon these recharge facilities, the function of these recharge facilities will need to be maintained.

1.3 Project Objectives

The objectives of this project are to reduce the risk of flooding, maintain or enhance water supply, protect and enhance natural creek habitat, and improve recreation for the community along Upper Penitencia Creek. This is to be accomplished through a multi-objective planning effort that strategically considers actions that support these multiple benefits.

One way these objectives may be achieved is by enhancing the creek's ability to accommodate natural processes such as lateral hydrologic connectivity, sediment transport, and deposition. It is with the understanding that restoring natural geomorphic processes will lead to improved ecological function that results in enhanced habitat potential for native species. This project aims to work with natural geomorphic processes through following process-based design criteria where possible. Project objectives are listed in **Table 1** along with design criteria (discussed in Section 3.2). Recreation has not been included as a design criterion at this stage because it does not differentiate between any of the alternatives under consideration.

TABLE 1
PROJECT OBJECTIVES AND DESIGN CRITERIA

Objective	Criteria
1. Reduce Flood Risk	Channel corridor conveys higher design flow (1% flow event)
2. Reduce Maintenance Requirement	Channel capacity can be met with reduced frequency of maintenance/sediment removal
	Existing infrastructure is protected from erosion
3. Enhance Ecological Function/Stewardship	Channel meets fish passage needs
	Channel and floodplain provides high-flow refuge for fish
	Riparian corridor enhances native riparian plant communities
	Riparian corridor improves wildlife connectivity
	Riparian corridor improves water quality (temp, DO, turbidity)
4. Support Water Supply	Project allows ease of maintaining water supply conveyance
5. Geomorphic Processes	Riparian corridor provides space for typical channel lateral dynamism
6. Impacts	Balance cut and fill or minimizes earth movement
	Minimizes the duration of construction impacts (temporary impacts)

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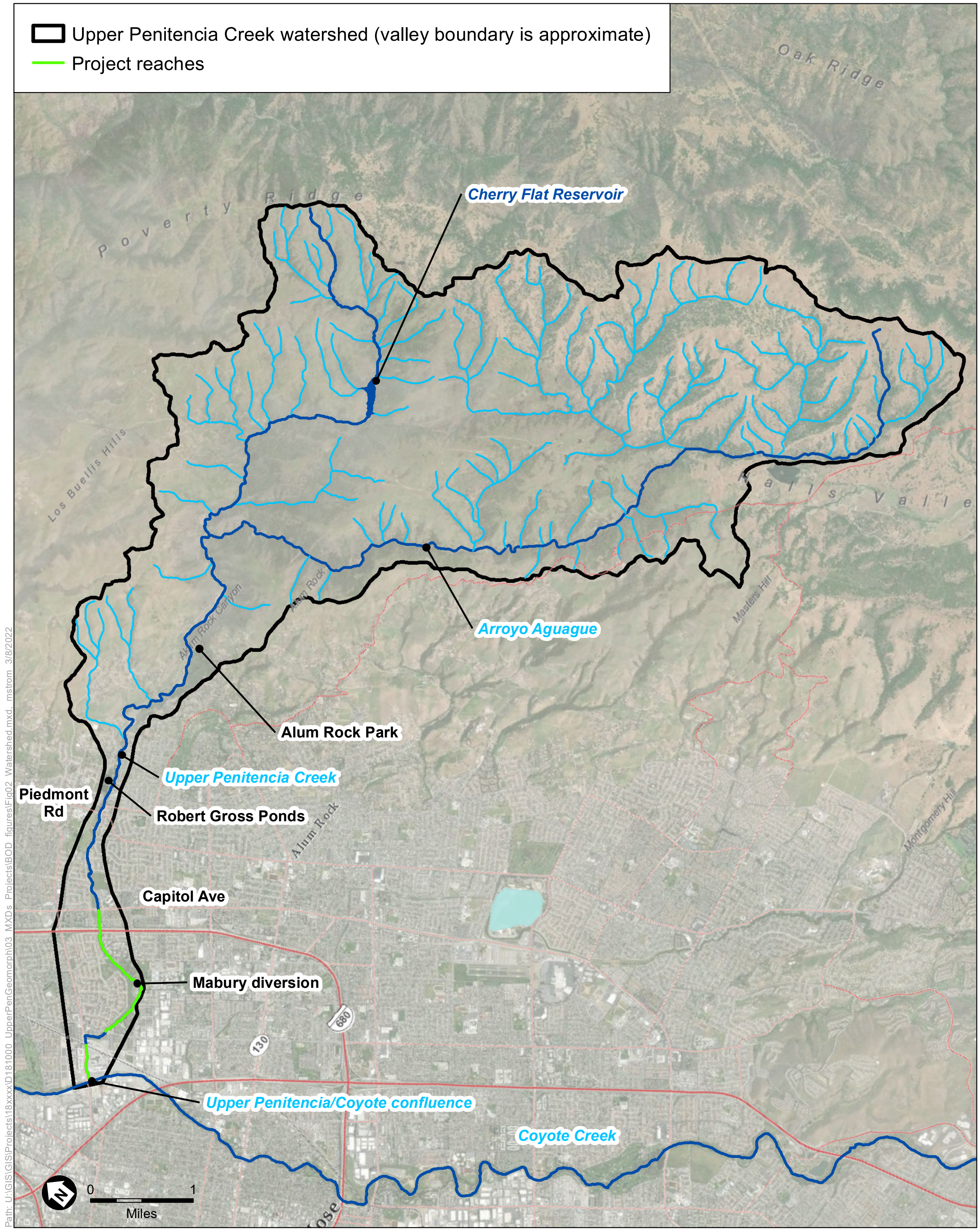
CHAPTER 2
Existing and Historical Conditions

The below sections summarize the existing and historical hydrologic, geomorphic, and vegetation conditions of the creek as investigated thoroughly by Jordan (2009) and Beller et al. (2012) and introduce potential implications of these conditions for the restoration and enhancement project.

2.1 Upper Penitencia Creek Overview

Upper Penitencia is a tributary to Coyote Creek in Santa Clara County. The relatively steep, confined headwaters, with the perennial Arroyo Aguague as the main tributary **(Figure 2**), drain the northwestern slopes of Mount Hamilton in the Diablo Range before exiting through a canyon reach at Alum Rock Park. The 22 square mile upper watershed is mostly preserved open space and is relatively undisturbed with 5.5% developed, 0.5% impervious, and a small dam at Cherry Flat Reservoir that impounds 2.4 square miles of the watershed (USGS, 2022). Downstream of Alum Rock Park, the creek and watershed changes character for the remaining four miles to its confluence with Coyote Creek at the Berryessa Road Bridge. In the downstream two square miles of watershed, the creek becomes less confined and spreads out over its historic alluvial fan, which has been extensively developed (72% developed, 56% impervious (USGS, 2022)) with a mixture of suburban and urban neighborhoods. Despite the surrounding urbanization, Upper Penitencia Creek retains many natural features compared to other creeks in the Bay Area, such as a soft bottom and a relatively wide native riparian corridor in most reaches. However, major alterations have been made to the creek since the mid-19th century including a constructed channelized connection from around the lower Mabury Road crossing down to Coyote Creek for flood flow drainage (Beller et al., 2012). While prior conditions cannot be restored due to modern flood risk constraints, there is opportunity for enhancing the natural features of this channelized connection. Other changes to the creek include the construction of informal agricultural berms along the banks that have created artificial channel confinement, the Mabury diversion of imported water to a nearby park, and channel constrictions at numerous road crossings. The Mabury bypass is a major feature that receives high flows that overtop the main channel just upstream of the upper Mabury Road crossing (**Figure 1**). The bypass and agricultural berms present a restoration opportunity as moving the main channel into the bypass and lowering the berms can restore ecologically functional channel-floodplain connectivity.



SOURCE: ESA 2022

Upper Penitencia Creek

Figure 2. Watershed

ESA

2.2 Hydrology

Upper Penitencia Creek experiences a Mediterranean climate with wet winters and dry summers. Hydromodification in the watershed since the mid-19th century includes construction of the Cherry Flat Reservoir in the headwaters above the confluence with Arroyo Aguague, creation of extensive impervious surfaces in urbanized San Jose, construction of a storm drain network that has increased the density of the drainage network while changing flow paths and reducing the effective catchment area, flow diversion to off-channel percolation ponds, imported water from the South Bay Aqueduct, and conversion of a diffuse wetland terminus to a channelized connection with Coyote Creek (Jordan, 2009; Beller et al., 2012).

Historical analysis suggests that the creek was perennial upstream of the canyon mouth, intermittent from the canyon mouth downstream to at least Capitol Avenue where flow infiltrates deep alluvial deposits, and an indistinct wetland complex downstream of around King Road where flow reemerges at the toe of the alluvial fan. Due to imported water and summer flow releases, the creek is more perennial than it was historically in the reaches across the valley floor (Beller et al., 2012). In recent years since the 2014 drought, imported water releases during the summer dry season have not been in operation.

Despite hydromodification in the watershed, a substantial fraction of the watershed is still unregulated and therefore storm events still produce high flows along the valley reaches of the creek. Episodic high flows are characteristic of Mediterranean climate rivers (Kondolf et al., 2013), and therefore the continued periodic occurrence of high flows, as compatible with flood risk reduction objectives, lends itself to engaging the natural geomorphic processes.

2.3 Geomorphology

The Upper Penitencia Creek watershed experiences a large supply of coarse sediment due to highly erodible Franciscan Complex lithology in the headwaters as common throughout much of the Bay Area (Kondolf, 2001) and high landslide activity due to the Hayward Fault (Jordan, 2009). Channel bed surface sediment sampling downstream of the canyon mouth by Jordan (2009) indicates a median particle size in the cobble range with some downstream fining toward the Coyote Creek confluence. Channel slope also decreases in the downstream direction from about 1.6% at the canyon mouth to about 0.7% near the Coyote Creek confluence. Measures of channel sinuosity for multiple reaches between the canyon mouth and the Coyote confluence indicate a range of 1.02-1.11 (Jordan, 2009).

Historical analysis reveals that the existing single-threaded, relatively straight Upper Penitencia Creek alignment along the valley floor is broadly similar to that of the mid-19th century with some notable exceptions. As mentioned above, the creek's historical terminus around King Road was a distributary wetland complex, which has been converted to a direct channelized connection with Coyote Creek. Multiple side channels shown in historic maps have also been eliminated, and unmapped smaller scale features such as bars, islands, and small meanders have likely been lost as well (Beller et al., 2012).

While some geomorphic complexity along the creek has been lost due to human development, the valley reaches still experience a large supply of coarse sediment. This, in combination with a dynamic Mediterranean climate flow regime, translates to increased potential for engaging the natural geomorphic processes along this creek.

2.4 Biological Considerations

In the early 1800s, the upper reaches of the project area supported an abundance of California sycamore trees, which can be indicative of intermittent hydrology, changing to an oak-dominated canopy near Reach 2 (Mabury Road), then to willow groves and freshwater marsh adjacent to Coyote Creek. These historical habitats supported wildlife (both aquatic and terrestrial) connectivity from the upper reaches, down through the marsh lands and Lower Penitencia Creek, and eventually to south San Francisco Bay.

Today, the riparian corridor of Upper Penitencia Creek is one of the highest quality remaining habitat areas in the Santa Clara Valley. Most of the riparian vegetation along Upper Penitencia Creek is predominately cottonwood- and/or red willow-dominated riparian forest, with box elder, coast live oak, and western sycamore as other commonly occurring native trees, and walnut and eucalyptus as common nonnative trees. Beginning in Reach 2, coast live oak, blue elderberry, toyon, and other more xeric trees and shrubs are common in the riparian corridor and along the riparian/upland boundary. These habitats have high value and are used by an abundant and diverse group of wildlife species. Riparian vegetation also filters sediment and other pollutants from runoff before it enters the creek, reduces water temperatures by shading the creek channel, provides food sources for the aquatic food web, and enhances recreational experiences by shading trails and improving aesthetics. Western sycamore trees and sycamore alluvial woodland, one of its associated vegetation types, are increasingly rare in California. Non-hybridized sycamore trees have substantial biological value and sycamore alluvial woodland is considered a sensitive natural community by CDFW and is a restoration priority for the Santa Clara Valley Habitat Agency.

Relatively small patches of ruderal grassland and unvegetated area are present along the creek and many of the Project areas are unvegetated or consist of ruderal grassland or ornamental plantings/parkland. These areas have relatively low biological resource value and offer opportunities for riparian and/or oak woodland habitat creation and enhancement.

Nonnative invasive eucalyptus trees are commonly found in the riparian corridor of Upper Penitencia Creek. Eucalyptus can spread rapidly and densely, displace native vegetation, increase fire and hazard tree risks, and offer lower quality habitat for wildlife compared with native trees. Additional nonnative invasive species found along the riparian corridor are giant reed (Arundo), tree-of-heaven, weeping willow, fan palm, and black locust.

Habitat in the Upper Penitencia Creek watershed could support several special-status species that are protected under federal and/or state laws. The presence of suitable habitat in the Project area and the life-history timing of these species will still have important ramifications on what and when Project activities may occur. Steelhead trout is the most important special-status species that needs to be considered, and fish passage through the lower reaches needs to be maintained or improved for the steelhead to reach their spawning grounds in the upper watershed. Tricolored blackbird is another important species found in the lower reaches. Found in the upper watershed of the creek, the following species could be supported by enhanced habitat conditions in the lower reaches: California red-legged frog, Foothill yellow-legged frog, California tiger salamander, and Western pond turtle.

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CHAPTER 3
Geomorphic Restoration and Enhancement Design Basis

This section includes an overview of the geomorphic restoration and enhancement design approach, the set of criteria used to evaluate whether the design alternatives meet the project objectives, the geomorphic study questions prompted by the design criteria, the sediment transport modeling and empirical analyses used to evaluate the alternatives against the criteria and answer the geomorphic study questions, and the alternatives developed for each project reach including the preferred alternative.

3.1 Design Approach

This project will include both restoration and enhancement designs. Restoration designs aim to return the system closer to its historical state with the assumption that doing so will support associated desirable ecological functions, while enhancement aims to achieve certain ecological functions of the watershed regardless of whether these occurred historically in every reach. For example, actions in the constructed flood control channel adjacent to the Flea Market are likely to be enhancements since it appears that there was not a well-defined creek channel in this location historically. Approaches to river restoration and enhancement can be categorized in terms of process versus form based and active versus passive. Process based restoration works with and is dynamically sustained by the geomorphic processes, while form based restoration constructs a channel that will provide the required ecological attributes and assumes that it will remain relatively unchanged by geomorphic processes. Active restoration involves a prescriptive intervention through detailed design of the river morphology that is expected to be sustained over time either by the geomorphic processes or by human maintenance, while passive restoration involves a non-prescriptive intervention in which the river morphology is allowed to self-develop. As described by Kondolf (2011), the appropriate approach to river restoration depends on characteristics of the river's flow and sediment regimes as well as encroachment of development within the river corridor floodplain. In settings where stream power and sediment supply are high and there is close proximity of the river to high value development, there may not be space to accommodate the river's geomorphic dynamism, and highly engineered active and form-based restoration and enhancement with regular maintenance may be needed to protect infrastructure from erosion and/or maintain flood capacity given deposition. In contrast, with sufficient room for the river, high stream power and sediment supply can enable a more passive and process-based restoration and enhancement approach in which the river has the capacity to "heal itself" (Kondolf, 2011) and develop its own morphology by eroding and depositing sediment in dynamic equilibrium with the watershed.

Mediterranean climate rivers typically exhibit natural flow and sediment regimes that facilitate more passive and process-based restoration and enhancement approaches where the surrounding constraints permit. Rivers in this climate often have highly variable hydrology with infrequent large events that erode and deposit significant volumes of sediment, dramatically alter the river corridor, and often result in braided planforms that benefit from the provision of sufficient space for the river's geomorphic processes to operate and develop the channel morphology (Kondolf, 2013). Therefore, precise design of a highly meandering bankfull channel in a Mediterranean climate may correspond to more of an active and form based approach given the geomorphic processes that operate under the flow and sediment regimes often found with this climate setting. For example, a meandering channel design implemented on Uvas Creek washed out in a large flood and reverted to a braided planform in accordance with the highly dynamic flow and sediment regimes typical of Mediterranean climate rivers (Kondolf, 2001).

Located relatively close to Uvas Creek, Upper Penitencia Creek also exhibits a highly variable flow regime that is characteristic of Mediterranean climate rivers. When compared to other creeks in the area, the flow and sediment regimes of Upper Penitencia Creek are relatively intact (SFEI, 2019) and the lateral space for the creek is relatively wide such that a more passive and process-based restoration and enhancement approach can be pursued. Instead of a highly prescriptive design of a channel that is expected to maintain precisely constructed dimensions and planform position, the design approach is intended to be more passive and process-based in which increased lateral connectivity works with the flow and sediment regimes to engage the natural geomorphic processes and further develop the initially constructed channel morphology over time.

3.2 Design Evaluation Criteria

With a passive and process based restoration approach targeted for this Mediterranean climate creek, Valley Water developed a set of criteria for evaluating whether the Reach 2 and 3 design alternatives meet the project objectives (**Table 1**). Some criteria were evaluated in consultation with other Valley Water staff, while criteria related to geomorphic processes and maintenance due to sediment deposition and erosion were evaluated with input from ESA through the development of geomorphic study questions and the use of empirical and sediment transport modeling analyses as described in the following sections.

3.3 Geomorphic Study Questions

The evaluation of the objectives and criteria related to geomorphic processes and maintenance due to sediment deposition and erosion required the development of more specific geomorphic study questions. For this study, geomorphic processes refer to the mechanisms that shape the planform, bed profile, and cross section of Upper Penitencia Creek and therefore have consequences for achieving the project objectives. Working with creek geomorphic processes to achieve project objectives implies developing a design that is sustained by processes rather than degraded by them through either significant net deposition or erosion. Net change is operative as certain channel planforms inherently exhibit high channel mobility in which a shifting channel position is associated with both deposition and erosion while the overall channel form remains relatively stable (Kondolf, 2001). **Table 2** poses key study questions to inform development of a design that works with geomorphic processes, and includes brief references to how these questions can be answered, which are described in more detail in the below modeling and empirical analyses section.

TABLE 2
GEOMORPHIC STUDY QUESTIONS

Domain	Geomorphic Study Question	Relevant Geomorphic Principle	How to Answer the Question
All Reaches	What channel cross section, bed profile, and planform will minimize significant net erosion or deposition?	Quasi-equilibrium: approximate balance between sediment supply and transport capacity over many years of the full hydrograph	At-a-station sediment transport capacity/sediment supply balancing, sediment transport modeling, historical analysis, empirical geomorphic relationships
	What are the bankfull and effective discharges?	Estimates for the channel forming, or dominant, discharge: steady flow that over time results in the same channel form as that produced by the full hydrograph	Flow gage data, sediment rating curve, bankfull field measurements
Reach 1A	What configuration of the Upper Penitencia and Coyote Creek confluence will minimize unwanted net sediment deposition in this reach and at the confluence?	Confluence dynamics: confluence configuration may influence sediment transport capacity around this feature	Sediment transport modeling

3.4 Sediment Transport Modeling and Empirical Analyses

This section reviews the modeling and empirical analyses used to answer the geomorphic study questions. See the modeling report (ESA, 2022) for more details on the other possible modeling analyses considered and how the selected modeling analyses were performed. Based on the nature of the geomorphic study questions, a combination of empirical geomorphic analyses, at-a-station sediment transport capacity/sediment supply balancing, 1D, and 2D sediment transport modeling was employed.

Empiricism has the advantage of incorporating all the geomorphic processes at work, including those not captured by 1D and 2D models, though the trends in the observations may not be completely transferrable to the current or future state of the project site. The first study question can be addressed through empirical analyses. Regression relations for large river datasets (Leopold and Wolman, 1957) and historical analysis of Upper Penitencia Creek (Jordan, 2009; Beller et al., 2012) can reveal planform attributes, such as braided vs. meandering and sinuosity, that may be expected to naturally occur. Based on extensive empirical analysis of river planforms as a function of average slope and bankfull discharge by Leopold and Wolman (1957), the planform morphology that is anticipated to develop along Upper Penitencia Creek is more transitional braided/meandering than highly meandering. This planform designation is supported by historical analyses of Upper Penitencia Creek by Beller et al. (2012) and Jordan (2009) that suggest the historic presence of a relatively low sinuosity creek with occasional side channels without extensive and prominent meanders.

Estimating the channel forming flow provides a basis for the channel design that is independent from the 1D modeling but that can also be tested with the model. The effective discharge, or the flow that moves the most sediment over time and a common surrogate for the channel forming flow, was estimated to be 350 cfs using the 2001-2020 flow series from the gage at Piedmont Road and the sediment rating curve developed for this location by Jordan (2009). The iSURF spreadsheet tool (DeTemple and Wilcock, 2006) was used to develop a representative cross section that approximately balances sediment supply and transport capacity at the effective discharge. Additionally, field measurements of the current bankfull channel such as those collected by Jordan (2009) may reveal the approximate channel dimensions that could persist into the future. Both approaches suggest that a bankfull width of about 25 ft and a bankfull depth of about 1.5-3 ft may be expected to develop naturally over time within the project reaches.

Instead of exclusively relying on the channel forming flow concept, which can be less relevant for Mediterranean climate rivers experiencing highly variable flow regimes (Kondolf, 2001), the design was tested and iterated with a HEC-RAS 1D sediment transport model using 19 years of real flow data to answer the first study question. This model was used to explicitly simulate erosion and deposition along the creek through time with results aggregated at the reach scale to avoid noise and to predict the overall long-term trajectory of the system. The 1D modeling results suggest that net deposition magnitudes may be on the order of a couple feet averaged over the Reach 2 and 3 corridor area over the course of two decades while Reach 1A and the area around the Coyote Creek confluence are predicted to experience negligible deposition over this timeframe, which may be due to the sediment trapping potential of the restored Reach 2 and 3 corridors.

Lastly, the high spatial resolution of HEC-RAS 2D sediment transport modeling is helpful for addressing the third study question given the complex multidimensional flow patterns that likely occur at the Upper Penitencia and Coyote confluence. The effect of the confluence angle on deposition in Coyote Creek at the confluence was evaluated with the 2D model, and results suggest that a less abrupt confluence instead of the current 90-degree angle would not significantly change the magnitude of deposition around the confluence. Once sediment enters Coyote Creek, the transport capacity of Coyote Creek and not the confluence angle appears to dictate whether the sediment deposits around the confluence.

3.5 Reaches 2 and 3 Design Alternatives

The Upper Penitencia main channel in Reaches 2 and 3 is separated from the adjacent 200+ ft wide creek corridor by a high berm and is completely separated from the corridor in the bypass area between the Mabury Road crossings. The design pursued upstream of the lower Mabury Road crossing is considered more “restoration” than “enhancement” given the historic presence of a less confined channel here that the design is intended to emulate as much as possible given modern constraints such as surrounding development. Downstream of the lower Mabury Road crossing, the design is considered to be "enhancement" given the lack of a defined natural channel here historically (Beller et al., 2012). Lowering of the berm and any high floodplain as well as shifting the main channel into the bypass are high priorities to allow the creek to more frequently access the floodplain to erode and deposit sediment and shape its own morphology. The stage to which the existing berm and high floodplain can be lowered is based on estimates for the size of the bankfull channel developed from the previously referenced analytical and empirical analyses.

Table 3 lists five alternatives evaluated for the Reach 2 bypass between the Mabury Road crossings including a designation of whether each qualifies as more of an active or passive restoration approach. **Figure 3** shows typical sections for these alternatives, and **Figure 4** shows a plan view of the wide low bench alternative with the location of the typical sections. The range of possible bankfull depths prompted the evaluation of alternatives with 1.5 and 3 ft bankfull depth end members. The existing conditions and no-project alternatives are clearly the most passive approaches given little to no intervention while the 1.5 and 3 ft bankfull depth alternatives are more active given the more prescriptive intervention. However, these channel dimensions are still expected to adjust over time, and therefore these alternatives are considered to be more intermediate between passive and active rather than a strict active design that's intended to persist indefinitely. The wide low bench alternative is more passive given that the shallow low flow channel is very likely undersized and therefore more of a pilot feature that the geomorphic processes can develop into more of a bankfull channel. The bench at 3 ft stage for this alternative offers a surface with lower inundation frequency that could favor different native vegetation colonization than that of the low bench. Excavated side slopes are 3:1 for all alternatives as a general guide for bank stability, and approximately 20 ft wide buffers are included on either side of the corridor relative to where the excavated side slopes begin for infrastructure protection.

Table 4 lists three alternatives evaluated for Reaches 2 and 3 outside of the Reach 2 bypass, and **Figure 5** through **Figure 7** show typical sections for these alternatives. As with the Reach 2 bypass, a primary design component is the depth of the bankfull channel. The selection of this depth controls the frequency of overtopping onto the floodplain and therefore the frequency of associated channel-floodplain geomorphic processes inherent to Mediterranean climate creeks like Upper Penitencia, which can include deposition on the floodplain as well as erosion and the formation of new channel paths through the floodplain. A design depth of 3 ft still significantly restores channel-floodplain connectivity relative to existing conditions, though it may be desirable to select 1.5 ft depth to further jump-start this lateral connectivity. As mentioned above, this depth is not expected to be static over time, and given the relatively intact flow and sediment regimes of Upper Penitencia, the creek has the capacity to self-adjust. Implications of the design depth on other project objectives such as flood capacity and fish passage are discussed further below.

Also note that the bankfull width is less of a primary design variable outside of the Reach 2 bypass where a bankfull channel already exists albeit confined between berms above the bankfull stage. The selection of a bankfull depth and associated berm lowering will set the bankfull width given the existing channel width at that stage.

TABLE 3
COMPONENTS OF THE REACH 2 BYPASS ALTERNATIVES

Alternative	Components
No project (passive)	Bankfull flow remains in existing main channel between the Mabury Road crossings
Existing conditions (passive)	Bankfull flow shifted into bypass with diversion structure at upstream Mabury Road crossing, existing bypass topography
3 ft bankfull (passive/active)	Bankfull flow shifted into bypass with diversion structure at upstream Mabury Road crossing, 3 ft deep bankfull channel
1.5 ft bankfull (passive/active)	Bankfull flow shifted into bypass with diversion structure at upstream Mabury Road crossing, 1.5 ft deep bankfull channel
Wide low bench (passive)	Bankfull flow shifted into bypass with diversion structure at upstream Mabury Road crossing, 1 ft deep low flow channel within 100 ft wide low bench

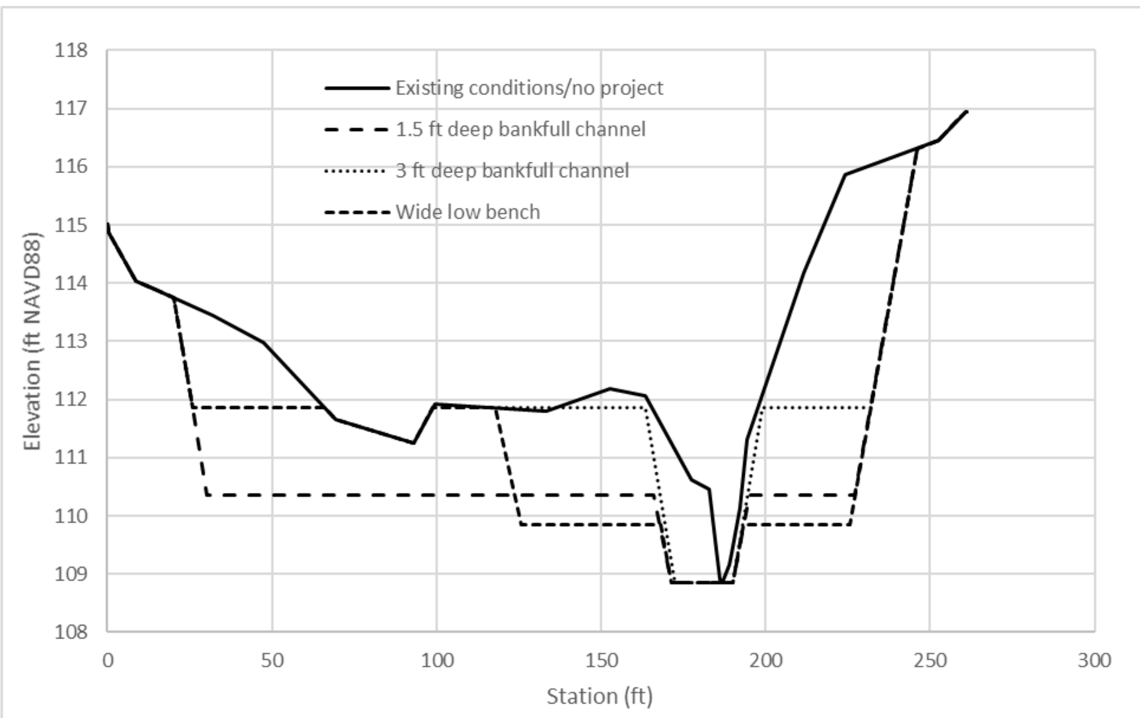


Figure 3
Typical sections for Reach 2 bypass alternatives (section 2 in Figure 4)

SOURCE: ESA 2022

Upper Penitencia Creek

Figure 4. Reaches 2 and 3 Design Concept

ESA

TABLE 4
COMPONENTS OF THE REACH 2 AND 3 ALTERNATIVES OUTSIDE OF THE REACH 2 BYPASS

Alternative	Components
Existing conditions (passive)	Existing creek corridor topography except expansion around the King Road crossing
3 ft bankfull (passive/active)	3 ft deep bankfull channel, berm lowering around high value tree preservation, expansion around the King Road crossing
1.5 ft bankfull (passive/active)	1.5 ft deep bankfull channel, berm lowering around high value tree preservation, expansion around the King Road crossing

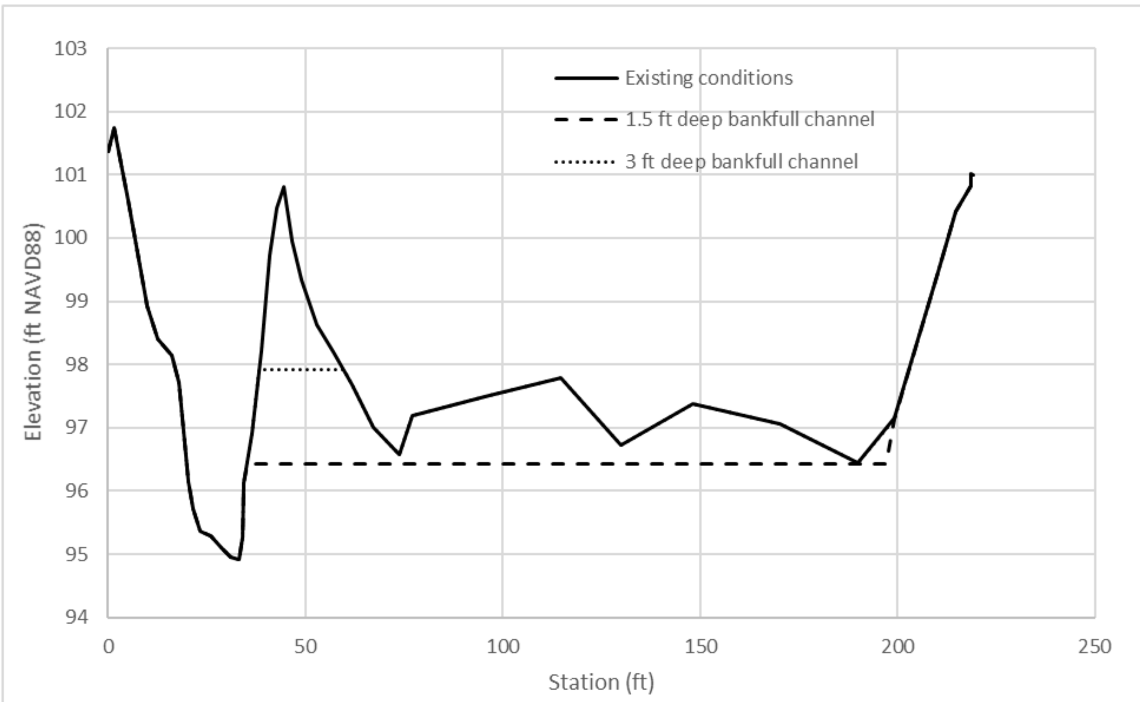


Figure 5
Typical sections for Reach 2 King Road to Mabury Road alternatives (section 1 in Figure 4)

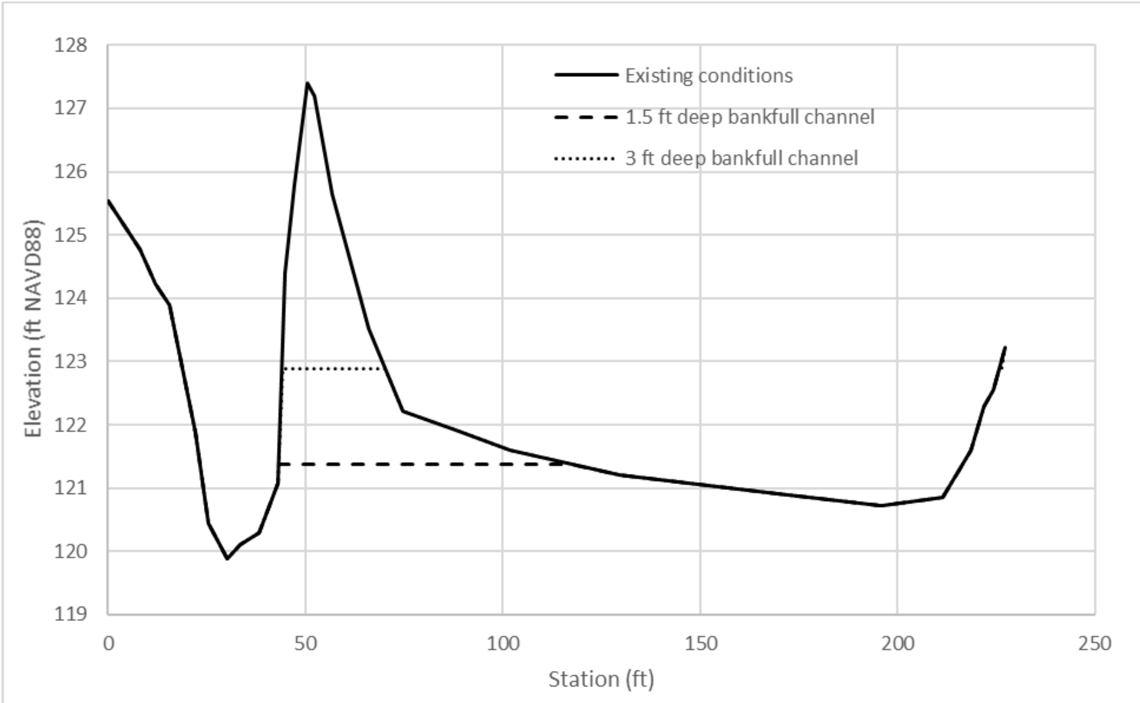


Figure 6
Typical sections for Reach 2 Mabury Road to Jackson Avenue alternatives (section 3 in Figure 4)

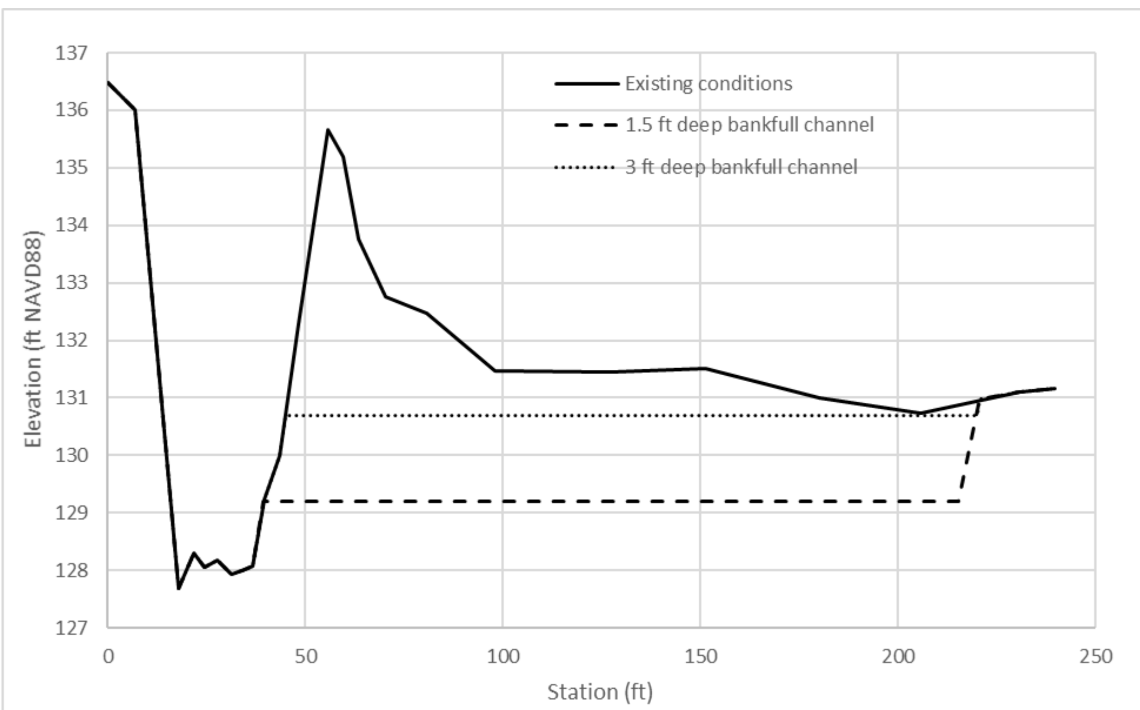


Figure 7
Typical sections for Reach 3 Jackson Avenue to I-680 alternatives (section 4 in Figure 4)

All alternatives except for the no-project and existing conditions include lowering of the berm, the longitudinal extent of which will depend on the presence of high value native trees that will be preserved in tree islands where feasible. The berm would be lowered to the top of the bankfull channel to decrease the artificially imposed channel confinement and facilitate channel-floodplain connectivity. Berm lowering also has the advantage of increasing conveyance of flood flows through both the channel and floodplain. Multiple priority berm lowering locations are also recommended at outer bends of the current main channel, as feasible allowing for tree preservation, to work with the inertia of the flow and promote avulsion of the creek into the floodplain or at least the formation of sediment splays that may be colonized by native vegetation. All alternatives including existing conditions also include left bank expansion of the creek corridor upstream of King Road to convey floodwaters through additional openings proposed for the King Road crossing.

One-dimensional sediment transport modeling was performed for all alternatives except for the no-project alternative, as the complex split flow configuration with lower flows remaining in the current main channel and higher flows passing down the Reach 2 bypass was not amenable to comparison of 1D model results with the other alternatives. Results for the other alternatives suggest that net deposition magnitudes in Reaches 2 and 3 may be on the order of a couple feet averaged over the corridor area over the course of two decades, which may satisfy the reduced flood risk and reduced sediment removal maintenance objectives (**Table 5**). The no-project alternative would likely also experience this same overall depositional trend, which would be consistent with observations from Valley Water staff of deposition occurring within the current main channel. The reduced flow conveyance from deposition occurring in the current main channel could cause the main flow path to avulse into the Reach 2 bypass. While shifting of the bankfull channel into the bypass could therefore occur without intervention, it is unclear when this would occur, and it may be desirable to jump-start this process and the associated benefits of direct channel-floodplain connectivity within the bypass.

Regarding erosion risk, the existing conditions alternative is thought to provide a relatively high level of infrastructure protection by leaving the creek corridor in its current state that in many locations does not exhibit significant erosion issues near infrastructure. However, there are areas where stabilizing bank vegetation is absent and bank erosion is currently occurring near infrastructure along the confined main channel, such that berm lowering could help decrease erosion by allowing flood flows to spread across the floodplain and reduce flow energy. On the other hand, by lowering the berm and the floodplain as part of the other alternatives to engage the geomorphic processes, channel avulsion may occur and result in a channel position that starts to erode the side slope of the creek corridor, hence the medium rating for this criterion. This channel behavior can be monitored and adaptively managed to protect the adjacent infrastructure. The sediment transport model results suggest that the corridor should experience net aggradation over the long term for all alternatives, as consistent with the alluvial fan setting of the project reaches, and therefore any erosion that does occur is likely to be localized. The 3 ft bankfull alternative is rated as medium/high in contrast to medium for the 1.5 ft bankfull and wide low bench alternatives since the higher floodplain may decrease the probability of channel avulsion and possible subsequent side slope erosion. It should also be noted that in addition to the process of channel avulsion that could result in a new main channel position adjacent to a corridor side slope, lateral migration of the current main channel through cut bank erosion and point bar deposition is another process by which the channel position can approach a side slope and pose a potential erosion risk.

The geomorphic processes objective that is perhaps best articulated as the availability of space for lateral dynamism was scored as medium for existing conditions given that the creek does currently exhibit some dynamism in the areas with less prominent berms and high floodplain. Aerial imagery from before and after the 2017 flood event for the bypass (**Figure 8**) and the locally unconfined area just downstream of the I-680 crossing (**Figure 9**) demonstrates how large flow events can dramatically alter the channel morphology in the absence of artificial channel confinement and well established woody vegetation in the bypass. This behavior is consistent with geomorphic processes operating along a creek in a Mediterranean climate with highly variable hydrology, and the other alternatives rank higher than existing conditions for this criterion since they are intended to further engage these processes by decreasing channel confinement throughout the reaches. The 3 ft bankfull channel is rated medium/high as opposed to high since flows would less frequently escape this deeper channel to access and shape the laterally extensive floodplain compared to the 1.5 ft bankfull and wide low bench alternatives.

Figure 8
Google earth imagery from before and after the January-February 2017 storm events in the Reach 2 bypass between the Mabury Road crossings

Figure 9
Google Earth imagery from before and after the January-February 2017 storm events just downstream of the I-680 crossing in Reach 3

Maintaining fish passage in the short term is likely best achieved by the existing conditions given that the current main channel is relatively narrow and deep with a geometry that appears to be stabilized by the riparian vegetation that lines the adjacent berms. Lowering the berms and floodplain to decrease channel confinement will create a shallower low flow channel that may frequently change position and exhibit variable depth. Therefore, a shallower channel and the associated lateral dynamism are rated lower for fish passage than more confined and laterally static channel conditions in the short term. It is however possible that over the longer term the alternatives that involve shifting bankfull flow into the bypass may provide equivalent or superior passage if a self-sustaining channel forms with well-established bank vegetation that prevents a very wide, shallow channel from developing. The no project alternative may provide the most optimal passage conditions in the short term while low flows still pass through the current confined channel, but passage could become uncertain if the main flow path were to avulse into the bypass and exhibit high geomorphic dynamism.

Given the above considerations, the wide low bench (**Figure 4**) is recommended as the alternative that satisfies the geomorphic criterion for the Reach 2 bypass (**Table 5**) with a more passive design approach that gives the creek ample opportunity to further develop its own morphology over time. The large 100 ft width of the low bench in the bypass subreach between the Mabury Road crossings encourages lateral dynamism and the development of bars across the channel as can be found in transitional braided/meandering systems. While likely undersized, the 25 ft top width and 1 ft deep low flow channel serves as a pilot feature that allows the creek to develop its own bankfull channel amidst benches and bars that may form and provide surfaces of different elevation for vegetation colonization. The mid bench at 3 ft stage provides an area of lower inundation frequency that could favor different native vegetation colonization from that of the low bench. However, relative to Reach 1, Reaches 2 and 3 exhibit less dense vegetation that is likely due to drier conditions from a deeper water table. Given the stabilizing influence that vegetation can have on channel morphology by resisting erosion and the development of new flow paths, the sparser vegetation in Reaches 2 and 3 may result in more dynamic channel behavior once the creek has access to more of the corridor. Fish passage conditions through these reaches can be monitored and adaptively managed in light of potentially high geomorphic dynamism.

Outside of the Reach 2 bypass in Reaches 2 and 3, the 1.5 ft depth bankfull channel alternative is recommended for engaging the natural geomorphic processes and increasing lateral dynamism. As explained above, the depth of the bankfull channel controls the frequency of overtopping onto the floodplain and therefore the frequency of associated channel-floodplain geomorphic processes. Lowering the berm to the 1.5 ft stage as much as possible can jump-start this lateral connectivity, though high priority berm lowering locations at outer bends have also been identified due to the need to balance floodplain reconnection with the preservation of high value trees. The width of the bankfull channel will be determined by the width of the existing main channel at the 1.5 ft stage.

TABLE 5
PROJECT OBJECTIVE AND CRITERIA EVALUATION FOR THE REACH 2 BYPASS ALTERNATIVES

Objective	Criteria	Alternatives				
		Existing conditions	3 ft bankfull	1.5 ft bankfull	Wide low bench	No project (bankfull in current main channel)
1. Reduce Flood Risk	Design flow conveyance	Ok	Ok	Ok	Ok	Ok
2. Reduce Maintenance Requirement	Reduce sediment removal required (flood capacity)	Ok	Ok	Ok	Ok	Ok
	Protect infrastructure from erosion	Medium/High	Medium/High	Medium	Medium	Medium/High
3. Enhance Ecological Function/Stewardship	Meets fish passage needs	Medium	Medium	Medium/Low	Low/Medium	High
	Provides high-flow refuge for fish	Low	Medium	Medium	High	Low
	Enhances native riparian plant communities	Low	Medium	High	High	Low
	Improves wildlife connectivity	Medium	Medium	High	High	Low
	Improves water quality (temp, DO, turbidity)	Medium	Medium	Medium	Medium	No change
4. Support Water Supply	Ease of maintaining water supply conveyance	Low	Medium	Medium	Medium	High
5. Geomorphic Processes	Space for lateral dynamism	Medium	Medium/High	High	High	Low
6. Impacts	Minimizes earth movement	High	Medium	Medium/Low	Medium/High	High
	Minimizes the duration of construction impacts (temporary impacts)	High	Medium	Low	Medium/High	High

3.6 Reach 1A and Confluence Design Alternatives

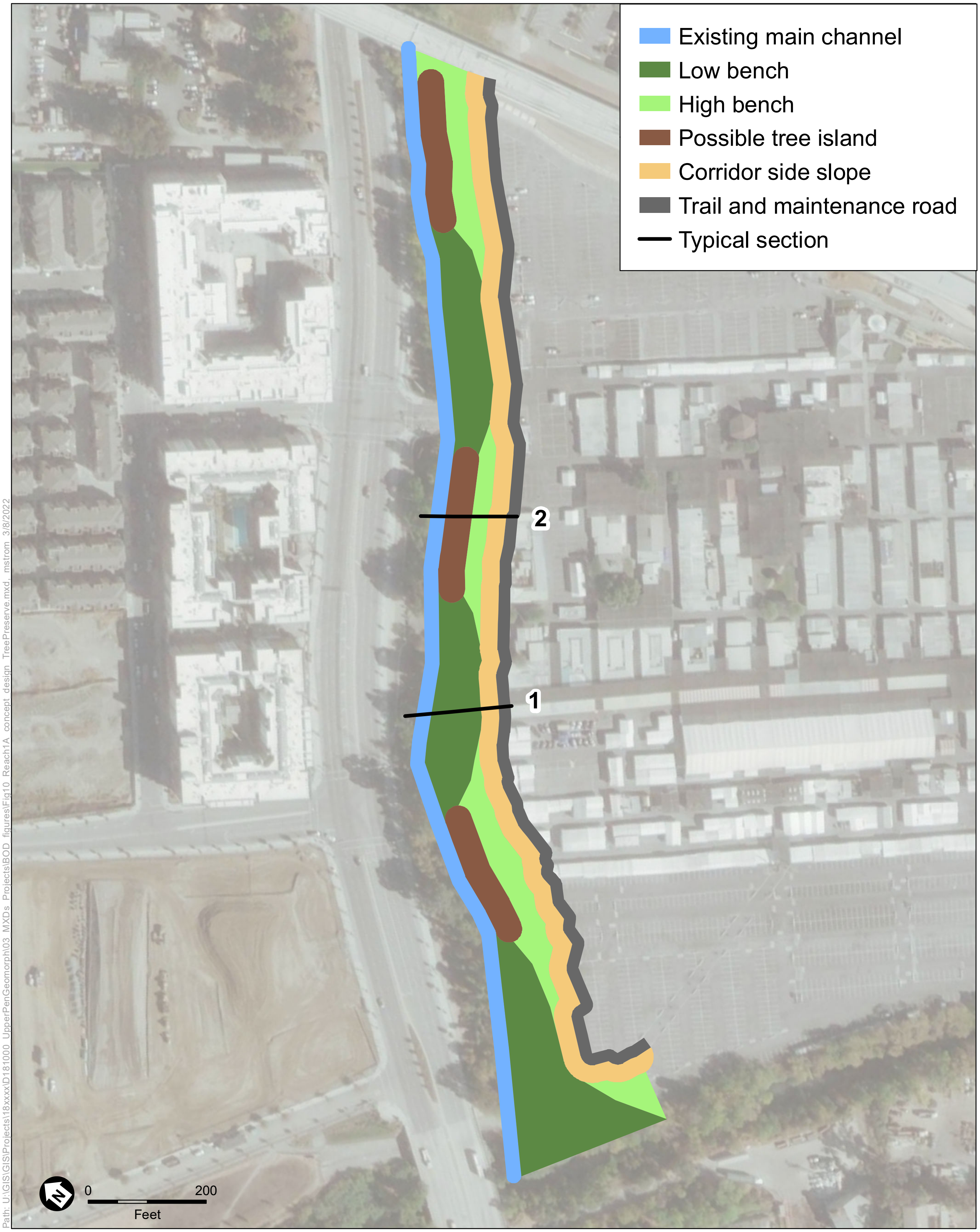
The Upper Penitencia main channel in Reach 1A is highly confined and straight owing to its constructed origin, and the major component of all design alternatives is the widening of the corridor to approximately 200 ft along with measures to allow the creek to evolve to a more sinuous course over time. The design pursued for this reach is more enhancement than restoration given that historically there was no channelized connection here between Upper Penitencia and Coyote (Beller et al., 2012). The design therefore seeks to achieve ecologically functional, albeit novel, channel-floodplain connectivity that is also compatible with other modern objectives including flood risk reduction and high velocity flow refugia for native fisheries. The bankfull channel depth and associated floodplain stage was informed by the analyses performed for Reaches 2 and 3 but also by field observations of the VTA enhancement site just upstream of Reach 1A, which was constructed in 2013 and also involved widening of the corridor. Conditions here are similar to those in Reach 1A including what appears to be a shallow water table that has supported dense riparian vegetation establishment. Several deep pools were constructed as part of this restoration design, but these have mostly filled in with sediment delivered from upstream, and riparian vegetation has colonized areas above the active or bankfull channel. The depth of this channel where sediment is actively transported and where vegetation is unable to colonize was estimated in the field to be a couple of feet, such that end member alternatives of 1.5 and 3 ft bankfull depth (**Table 6**) were also tested in the 1D sediment transport model for this reach. Additionally, 90 and 45 degree confluence angles between Upper Penitencia and Coyote were tested in these alternatives. The 2D sediment transport model was used to investigate the 90 and 45 degree confluence angles in more detail but not the different bankfull depths that were more amenable to 1D modeling analysis. See the modeling report (ESA, 2022) for more details on these modeling analyses.

TABLE 6
COMPONENTS OF THE REACH 1A AND CONFLUENCE ALTERNATIVES EVALUATED WITH THE 1D MODEL

Alternative	Components
Existing conditions	Existing conditions topography
3 ft bankfull, 90 degree confluence	3 ft deep bankfull channel, widening of creek corridor to about 200 ft, 90 degree confluence angle with Coyote
3 ft bankfull, 45 degree confluence	3 ft deep bankfull channel, widening of creek corridor to about 200 ft, 45 degree confluence angle with Coyote
1.5 ft bankfull, 90 degree confluence	1.5 ft deep bankfull channel, widening of creek corridor to about 200 ft, 90 degree confluence angle with Coyote
1.5 ft bankfull, 45 degree confluence	1.5 ft deep bankfull channel, widening of creek corridor to about 200 ft, 45 degree confluence angle with Coyote

The 2D model results, which provide a more physically realistic rendering of the confluence dynamics, suggest that creating a smoother transition by adding a meander bend to the Upper Penitencia channel would not significantly change the magnitude of sediment deposition. This is because once sediment enters Coyote Creek, the transport capacity of Coyote Creek and not the confluence angle appears to dictate whether the sediment deposits in this confluence area. The 1D modeling also indicated relatively minor net deposition (less than 1 ft) averaged across the corridor area of Reach 1A for all alternatives over two decades, though any deposition in Reach 1A has the potential benefit of capturing sediment before it enters Coyote Creek. The limited predicted net deposition here may be the result of the sediment trapping potential of Reaches 2 and 3 such that a smaller sediment load is delivered to Reach 1A and therefore less sediment is available for deposition here. While the 1D model predicts minimal net deposition, it is conceivable that removal of the small culvert at the downstream end of Reach 1A and exposure of loose alluvium during construction of the expanded creek corridor could in reality create conditions favorable to sediment delivery to and deposition within Coyote as Reach 1A adjusts to a new quasi-equilibrium. Given how the VTA site rapidly vegetated likely due to a shallow water table, a similar response may occur in Reach 1A that stabilizes bare sediment surfaces and reduces sediment delivery to Coyote over time. These feedbacks are challenging to capture with 1D or 2D modeling, but the VTA site offers a possible conceptual model for how the site may evolve.

Following the evaluation of the initial set of alternatives with the sediment transport models that suggested significant sediment deposition over the long term may not be an issue, two more refined alternatives were developed in relation to how existing trees could be preserved (**Table 7**). The first alternative shown in plan view in **Figure 10** and section view in **Figure 11** and **Figure 12** assumes the presence of many high value trees along creek left including ones high up on the banks that would be preserved within several long and vertically prominent tree islands, which are clumps of existing mature trees that are preserved by grading any new creek or floodplain features around them. The position and size of the tree islands control the location of low bench between the islands and high bench on the backside of the islands. In contrast, the second alternative shown in plan view in **Figure 13** and section view in **Figure 14** and **Figure 15** assumes that high value trees on creek left are located lower down on the bank and therefore do not require prominent islands for preservation. A field visit and initial review of the trees suggested that the second alternative may be possible, such that the tree preservation would not drive the rest of the design.



SOURCE: ESA 2022

Upper Penitencia Creek

Figure 10.
Reach 1A Tree Preservation Islands Design Concept

ESA

TABLE 7
COMPONENTS OF THE MORE REFINED REACH 1A AND CONFLUENCE ALTERNATIVES

Alternative	Components
Tree preservation islands	1.5 ft deep bankfull channel, low and high benches at 1.5 ft and 5 ft stage respectively, islands for tree preservation, 90 degree confluence angle with Coyote
No tree preservation islands	1.5 ft deep bankfull channel, low, mid, and high benches at 1.5 ft, 3 ft, and 5 ft stage respectively, right bank either filled or cut to a stable side slope, 90 degree confluence angle with Coyote

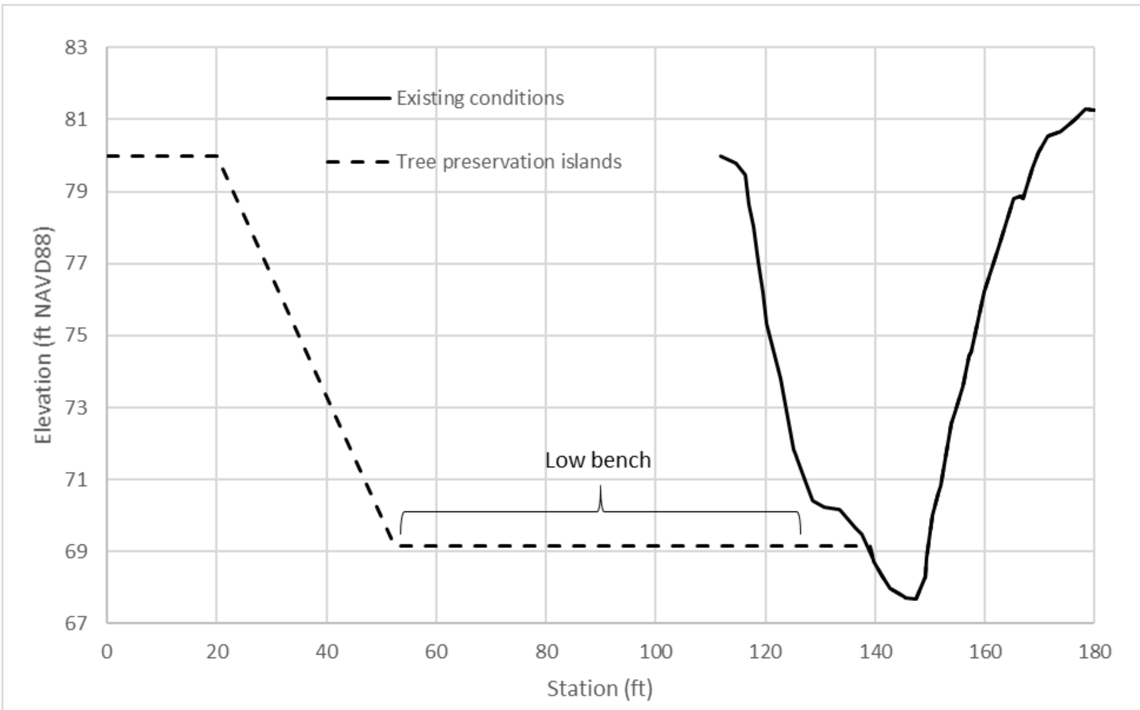


Figure 11
Typical section for Reach 1A tree preservation islands alternative (section 1 in Figure 10)

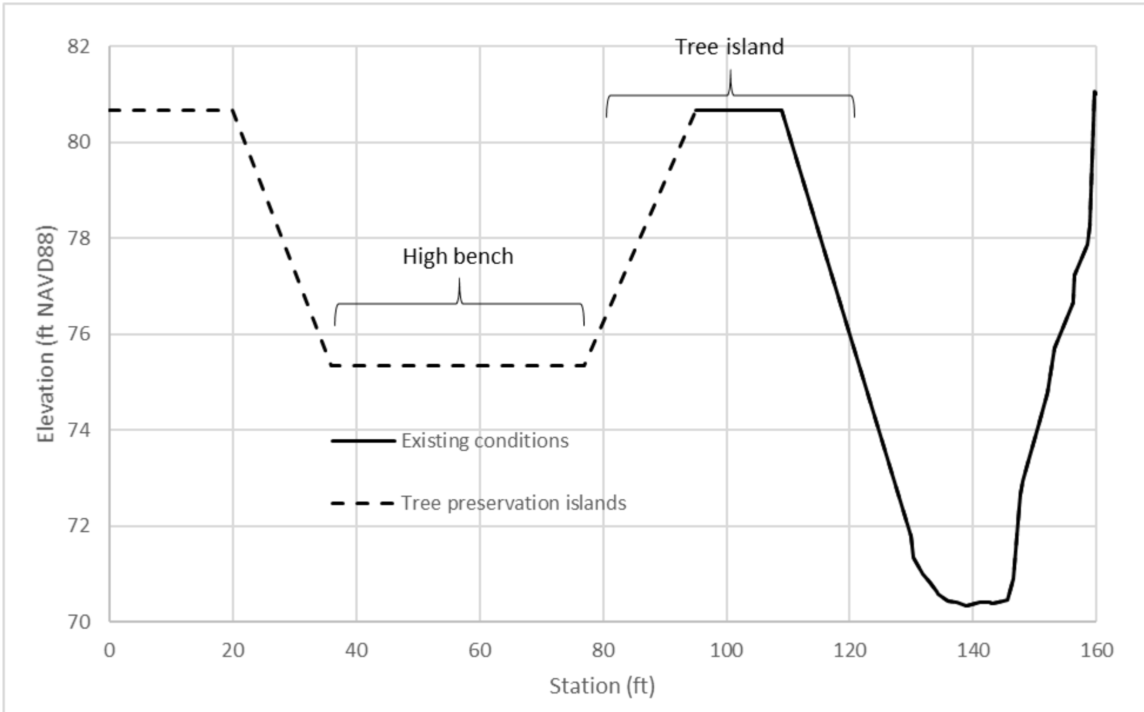
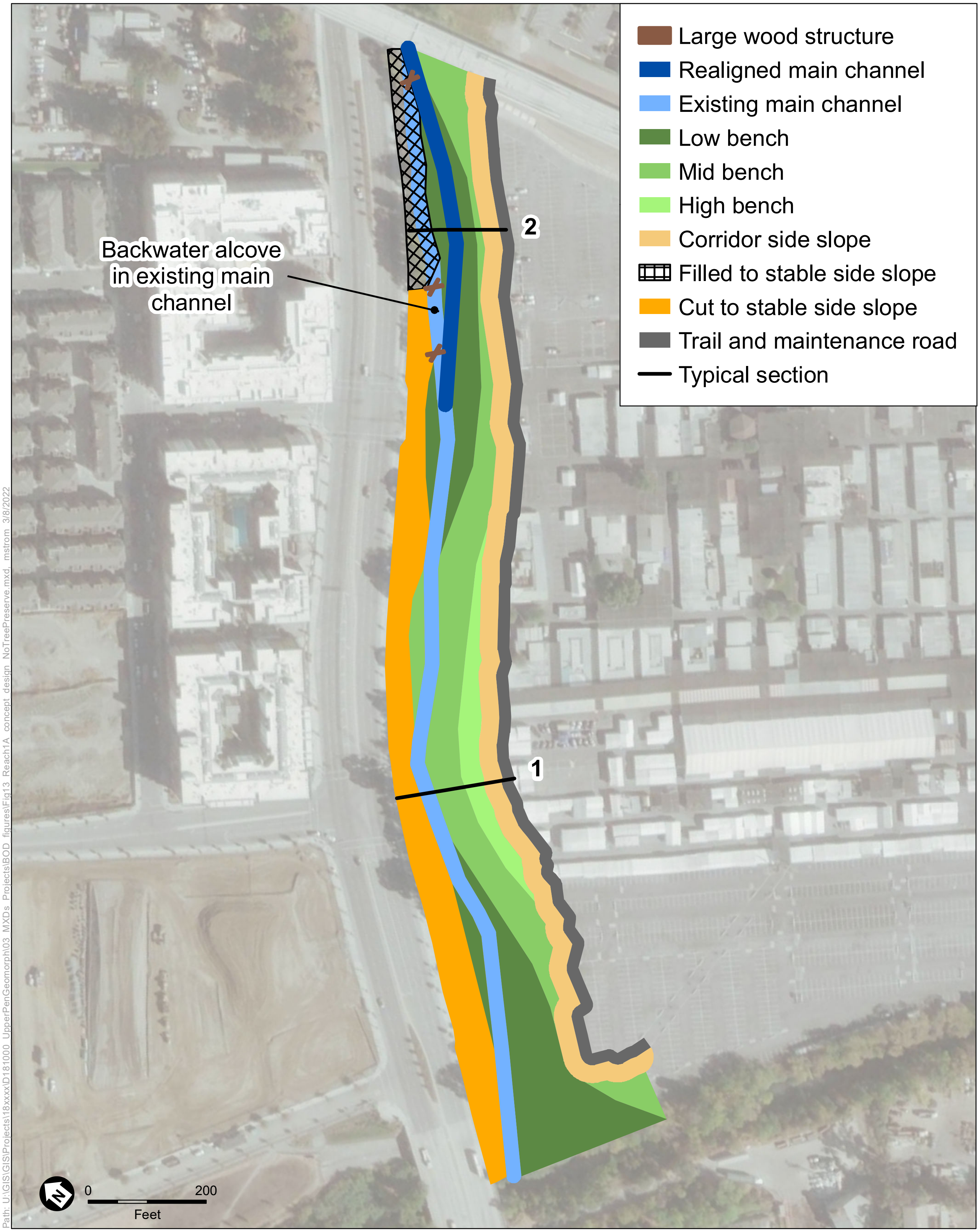


Figure 12
Typical section for Reach 1A tree preservation islands alternative (section 2 in Figure 10)



SOURCE: ESA 2022

Upper Penitencia Creek

Figure 13.
Reach 1A No Tree Preservation Islands Design Concept

ESA

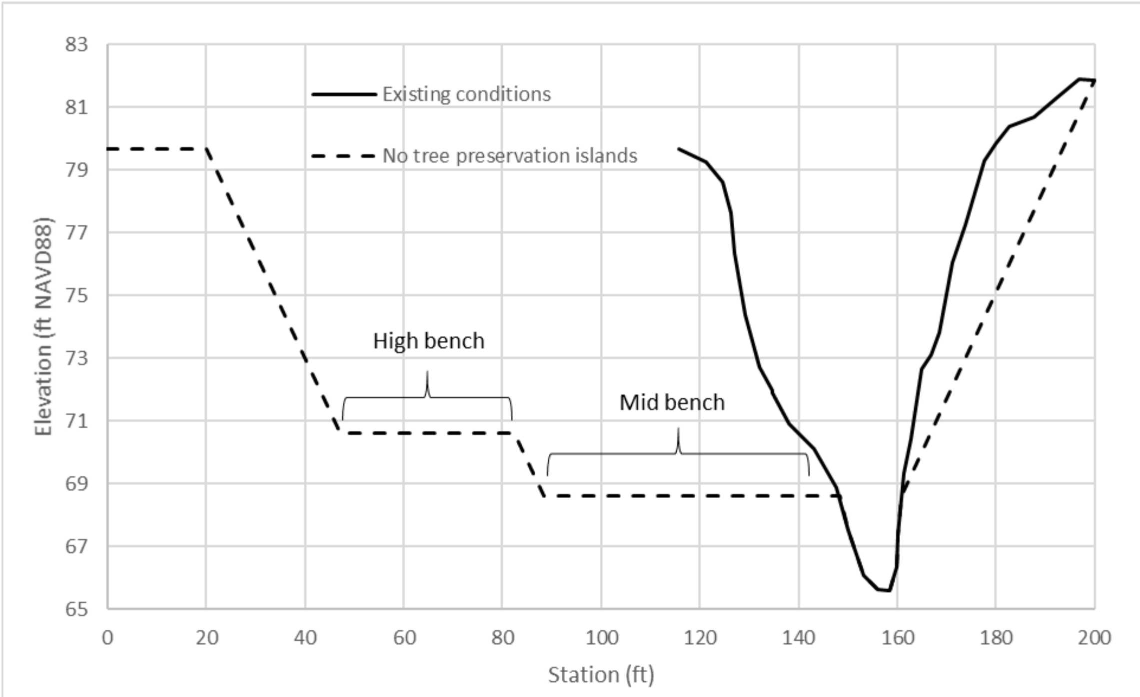


Figure 14
Typical section for Reach 1A no tree preservation islands alternative (section 1 in Figure 13)

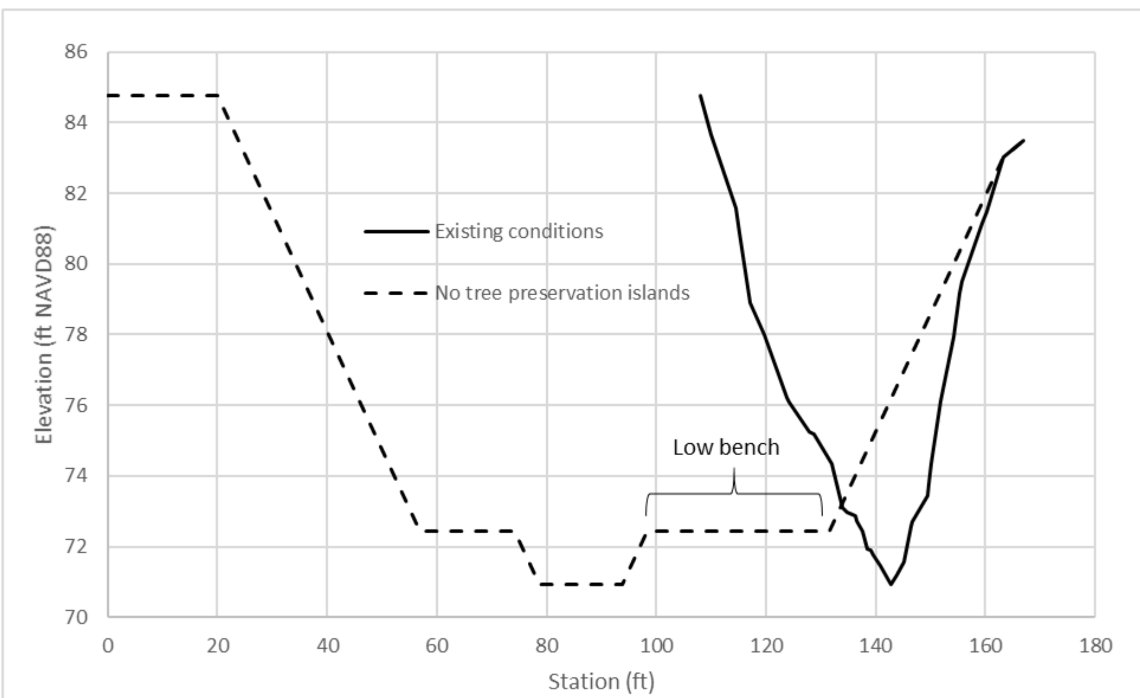


Figure 15
Typical section for Reach 1A no tree preservation islands alternative (section 2 in Figure 13)

Given the model results, field observations at the VTA site, and review of the existing trees in Reach 1A, the second alternative (**Figure 13**) is the recommended enhancement design for engaging the natural geomorphic processes and consists of a low bench at 1.5 ft stage, a mid bench at 3 ft stage, and a high bench at 5 ft stage to encourage a gradient of riparian to more upland vegetation. The alternating planform distribution of the benches is intended to encourage more planform variability and increased sinuosity within a range that's appropriate for this creek system. Jordan (2009) measured a sinuosity of 1.04-1.06 for his most downstream study reach around Mabury Road for the period 1939-2004, and the creek would reach a sinuosity of 1.04 if it were to occupy the apex positions of the low bench expansion areas, up from an existing sinuosity of 1.01. Several distinct meander bends just downstream of the mouth of the canyon along Penitencia Creek Road informed a wavelength of about 1000 ft for the meandering planform distribution of the benches for Reach 1A. The channel may need to be shifted toward creek left at the upstream end of the reach to enable filling of the right bank to a more stable side slope. The realigned channel shouldn't be considered the exact flow path that will be maintained but rather a pilot channel with 25 ft top width and 1.5 ft depth that the geomorphic processes will further develop over time as part of a more passive restoration approach. Similarly, the meandering planform distribution of the benches is intended to provide the opportunity for increased sinuosity as opposed to strictly prescribing a meandering bankfull channel alignment. Large wood structures could be added to the leftover existing main channel as a backwater alcove habitat feature where the adjacent realigned channel transitions back to the existing main channel just downstream. There is also space along creek right further downstream to lay back the bank to a more stable side slope and create additional floodplain. The confluence with Coyote Creek can be allowed to evolve on its own given the extra space set to a low bench stage. There is no historical channel confluence condition to emulate as Upper Penitencia historically terminated in a marsh before reaching Coyote Creek and has been artificially connected (Beller et al., 2012). However, Valley Water may add a meander bend anyway for a smoother confluence angle to experiment with this configuration while not necessarily expecting it to persist, which may depend on how soon after construction a large flow occurs. If there's time for dense vegetation to grow in as facilitated by the shallow water table before a flood hits, the meander bend could be stabilized.

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CHAPTER 4
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Final

UPPER PENITENCIA CREEK SEDIMENT TRANSPORT MODELING REPORT

Prepared for
Valley Water

April 2022

Final

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CHAPTER 1
Introduction

This report presents the methods and results of the sediment transport modeling analyses performed as part of the Upper Penitencia Creek multi-benefit flood risk reduction project. The overall goal of this task was to provide guidance to Valley Water on designing a project that works with natural geomorphic processes including the estimation of channel dimensions for reaches where restoration was proposed to best engage these processes in a self-sustaining fashion. A common goal when designing a channel to be self-sustaining is for it to be in sediment transport quasi-equilibrium, if that is possible given watershed and reach conditions. Sediment transport quasi-equilibrium means that the channel should be able to transport the incoming watershed sediment load without significant erosion or deposition over the long term and over the reach scale, recognizing that there may be short-term or localized erosion and deposition. It is also recognized and highly relevant to this project that the setting is a historic alluvial fan (SFEI, 2006) and that some reaches are inherently out of equilibrium (e.g. depositional in the long term). Where that is the case, the project goal becomes to design the channel to be as close to quasi-equilibrium as feasible, so as to minimize the need for channel maintenance (e.g. periodic sediment removal).

As described in more detail in the Geomorphic Basis of Design Report (ESA, 2022), achieving the project objectives required the development of specific geomorphic study questions. **Table 1** poses key study questions to inform development of a design that works with geomorphic processes and includes brief references to how these questions can be answered.

TABLE 1
GEOMORPHIC STUDY QUESTIONS

Domain	Geomorphic Study Question	Relevant Geomorphic Principle	How to Answer the Question
All Reaches	What channel cross section, bed profile, and planform will minimize significant net erosion or deposition?	Quasi-equilibrium: approximate balance between sediment supply and transport capacity over many years of the full hydrograph	At-a-station sediment transport capacity/sediment supply balancing, sediment transport modeling, historical analysis, empirical geomorphic relationships
	What are the bankfull and effective discharges?	Estimates for the channel forming, or dominant, discharge: steady flow that over time results in the same channel form as that produced by the full hydrograph	Flow gage data, sediment rating curve, bankfull field measurements
Reach 1A	What configuration of the Upper Penitencia and Coyote Creek confluence will minimize unwanted net sediment deposition in this reach and at the confluence?	Confluence dynamics: confluence configuration may influence sediment transport capacity around this feature	Sediment transport modeling

The sections below include sediment transport modeling approaches evaluated for answering the study questions followed by descriptions of the selected analyses that were performed. The selected analyses are described in order of increasing complexity beginning with at-a-station analyses that informed the development of project conditions alternatives, which were then evaluated more rigorously in a HEC-RAS 1D sediment transport model, and lastly an evaluation of alternatives for the Upper Penitencia and Coyote confluence using the beta HEC-RAS 2D sediment transport model.

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CHAPTER 2
Sediment Transport Modeling Approach Evaluation

This section reviews four modeling approaches of increasing complexity and recommends an approach that is appropriate for answering the study questions.

2.1 At-a-station Cross Section Modeling (Manual or iSURF)

This modeling approach involves the selection of a representative cross section for each project reach and the use of sediment and long-term flow data to compute the sediment transport capacity through time (PWA, 2003). Given the relatively simple computations, this approach can be manually set up and performed in a spreadsheet. Results are reported as annualized transport rates for each reach, which are then compared to the rates of adjacent reaches to identify sediment surpluses or deficits that may translate to deposition or erosion within a given reach. Adjustments to the cross section geometries can then be explored to reduce the sediment transport capacity imbalance among reaches if quasi-equilibrium conditions are a project objective. This approach is the simplest of the four considered as it assumes uniform flow conditions for each representative cross section, which can be highly inaccurate in reaches with significant backwater effects from nearby structures. Additionally, this approach is only appropriate for estimating general reach-scale sediment budgets as it assumes that sediment is neither eroded nor deposited within each cross section. Feedbacks between erosion and deposition can change the actual annual sediment surplus or deficit for each reach. Ideally, water surface elevations and sediment transport would be measured for a handful of flows and locations for calibration to ensure that, despite simplifications, the model can simulate the general hydraulic patterns and associated sediment transport capacity.

iSURF is a spreadsheet tool (DeTemple and Wilcock, 2006) for designing simple trapezoidal channel cross sections that balance sediment supply and transport capacity. This at-a-station cross section tool assumes uniform flow and uses a single design discharge to generate a suite of combinations of channel slope, depth, and width that transport the user input sediment supply. While this tool assumes uniform flow and only uses a single discharge instead of a historical flow record, this tool can still be useful for developing an initial channel design, which can then be refined through more detailed modeling.

2.2 Reach-scale Modeling (SIAM)

The Sediment Impact Analysis Method (SIAM), which is available in HEC-RAS, adds another layer of complexity relative to at-a-station cross section modeling by using the hydraulics from a one-dimensional (1D) model to compute the sediment transport capacity for each project reach (Jordan, 2009). The hydraulics are averaged across each reach, but backwater effects are accounted for in the 1D model unlike the at-a-station approach that assumes uniform flow. However, averaging 1D model results can still overlook important local variations in the balance between sediment supply and transport capacity. Similar to the at-a-station approach, SIAM can only be used for estimating reach-scale sediment budgets. Additionally, water surface elevations and sediment transport would ideally be measured for a handful of flows and locations for calibration to ensure that, despite simplifications, the model can simulate the general hydraulic patterns and associated sediment transport capacity.

2.3 1D Sediment Transport Modeling (HEC-RAS)

1D sediment transport modeling is significantly more complex than the first two modeling approaches as sediment is routed through the 1D model by simulating erosion or deposition within each cross section. The advantage of this approach compared to the prior two approaches is that changes to the channel boundary are explicitly simulated as a function of cross section to cross section imbalances between sediment supply and transport capacity. This captures feedbacks between erosion and deposition that are not resolved by reach-scale sediment budgeting. For example, an annual sediment surplus within a reach may not be deposited evenly in all areas. Additionally, the reach may aggrade until a critical bed slope is reached that is able to transport the additional sediment load, forming a feedback loop.

While a 1D sediment transport model captures geomorphic processes more effectively than the first two methods, simplifications still remain with this modeling approach. Most notably, flow patterns at channel confluences can be highly multi-dimensional, bank erosion processes such as mass failure are not simulated, and planform changes such as channel avulsion and bend migration are not simulated.

2.4 2D Sediment Transport Modeling (HEC-RAS)

The most complex modeling approach that was considered for this study is 2D sediment transport modeling, which is similar to the 1D modeling approach in which sediment is routed through the channel and erosion and deposition are simulated, but these processes are modeled in two dimensions across a model grid instead of among cross sections. This approach can more realistically predict channel change compared to the 1D model in areas of highly multi-dimensional flow such as at confluences. However, due to long run times associated with the more computationally intensive 2D model, it is not practical to run the 2D model for longer than individual storm events. Therefore, it may be challenging to extrapolate the high spatial resolution results of the 2D model over long time periods in contrast to the 1D model that can be run over long time periods but with less spatial resolution.

2.5 Recommended Sediment Transport Modeling Approach

Based on the geomorphic study questions and the aspects of the four modeling approaches, at-a-station analyses followed by 1D and 2D sediment transport modeling were used. These modeling analyses were complemented by empirical geomorphic analyses, but the focus of this report is on the modeling analyses with more information on the empirical analyses in the Geomorphic Basis of Design Report (ESA, 2022). Bankfull channel field measurements were however directly relevant to the at-a-station modeling analyses and are therefore referenced in this report.

Answering the first geomorphic study question requires explicitly simulating sediment erosion and deposition. While sediment budgeting with the at-a-station or reach-scale modeling approaches may reveal which reaches are likely to be more erosional or depositional than other reaches, these approaches do not translate imbalances in sediment supply and transport capacity to specific volumes of eroded or deposited sediment. Given that flood management is a primary project objective, the ability to predict actual channel change is required for analysis of loss of channel capacity and potential flood impacts, and only 1D and 2D modeling offer this capability. While the high temporal resolution of the 1D modeling enables erosion and deposition feedbacks to play out across storm events, the results will still be aggregated across nearly two decades and at the reach scale to avoid noise and to predict the long-term trajectory of the system. The high spatial resolution of the 2D modeling is helpful for addressing the third study question given the complex multidimensional flow patterns that likely occur at the Upper Penitencia and Coyote confluence.

Answering the second study question to estimate the channel forming flow provides a basis for the channel design that is independent from the 1D modeling but that can also be tested with the 1D model. Using an at-a-station iSURF analysis to develop a representative cross section that approximately balances sediment supply and transport capacity at the channel forming flow is useful for initiating the design iteration process. However, instead of exclusively relying on the channel forming flow concept, the design can be tested and iterated with the 1D model using 19 years of real flow data.

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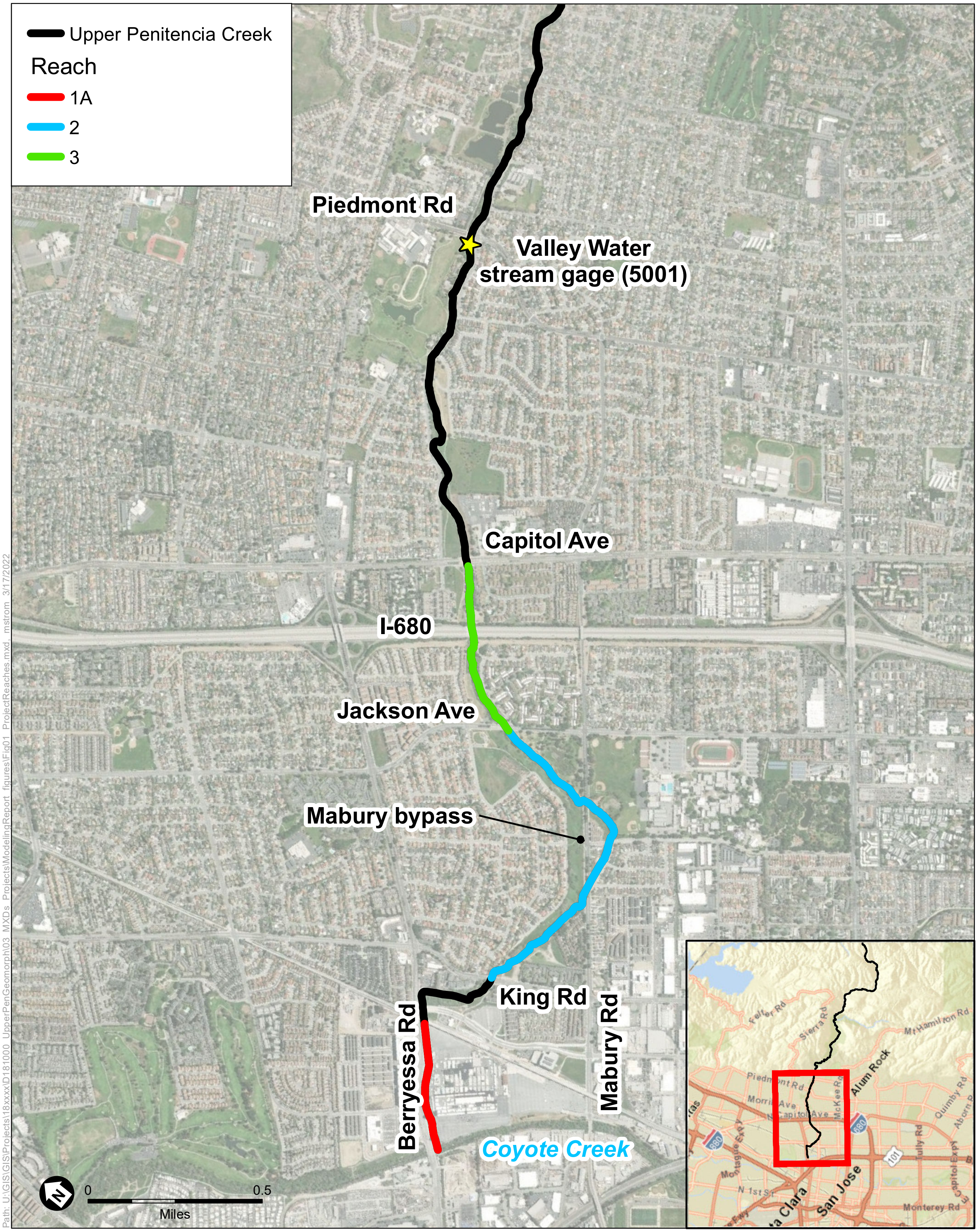
CHAPTER 3
At-a-station Analyses

At-a-station analyses address hydraulic and sediment transport processes at an individual station along the creek which is chosen to be representative of typical conditions within a reach that has the same approximate channel gradient throughout. The below at-a-station analyses were all performed for the Valley Water Piedmont Road gage location (stream sensor 5001) (**Figure 1**) with an average reach gradient of 1.2% and that can be considered a sediment supply reach for the downstream lower gradient (0.7%) project reaches. A long-term flow record plus sediment transport field measurements are available for this location and invaluable to sediment transport analysis. Based on review of the Valley Water Upper Penitencia Creek model (planning study report model dated August 2020), minimal inflows occur along the creek downstream of Piedmont Road, and therefore the flow record at this gage was considered representative of the flows occurring down to the Coyote confluence. The below sections describe the estimation of the effective discharge, bankfull channel cross section field measurements by Jordan (2009), and a sediment supply versus transport capacity analysis that were all used to estimate quasi-equilibrium channel dimensions for the project reaches.

3.1 Effective Discharge

The first step in the sediment transport analysis involved the estimation of the effective discharge[1] to inform the size of the bankfull channel needed to pass the supplied sediment load. The effective discharge can be estimated if a long-term flow series and a sediment rating curve are available for a channel station location. The Valley Water Piedmont Road gage 15-minute flow time series for 2001-2020 was used along with a sediment rating curve developed for this location by Jordan (2009). Per Valley Water staff, flow data for this gage post 2001 are considered to be good quality (Ken Stumpf, personal communication, August, 26, 2020), and the relatively long duration of the time series improves the effective discharge estimation. Jordan collected both bedload and suspended load measurements at the Piedmont Road bridge crossing and developed both bedload and suspended load rating curves. The effective discharge calculation was performed using a sediment rating curve that includes both the bedload and the sand-only suspended load from Jordan's field measurements. These sand and coarser particles

[1] The effective discharge is a geomorphic concept representing the flow, or range of flows, that transports the most sediment over the long term. The effective discharge has been equated with the bankfull discharge, and both are used in stream-restoration strategies (USDA, 2001). Rhoads (2020) summarized studies comparing effective and bankfull discharges and found that while there is variability in the two discharges, the effective and bankfull discharges are closest when effective discharge is computed using bedload or total load sediment data as opposed to just suspended load data.



SOURCE: ESA 2022

Upper Penitencia Creek

Figure 1. Project reaches

ESA

comprise the bed-material load, or the load that consists of sediment sourced from the bed which can travel as both bedload and suspended load, which is typically used in effective discharge calculations (Biedenharn et al., 2000). Silt and smaller sediment is usually supply-limited and therefore the channel dimensions are less relevant to the transport of these size fractions. The sediment rating curve was used to estimate the total sediment transported by multiple discharge ranges, i.e. discharge bins, across the 2001-2020 period of record as shown in **Figure 2**. For example, flows between 324 and 378 cfs are estimated to transport about 30,500 tons of sediment for 2001-2020, and 350 cfs is therefore estimated to be the effective discharge as the midpoint of this discharge range that transports the most sediment over the period of record. The effective discharge calculation can be sensitive to how many bins are used to group the flows, and therefore multiple bin sizes were tested. **Figure 2** shows the results using 14 discharge bins, and **Table 2** shows results for multiple discharge bin sizes.

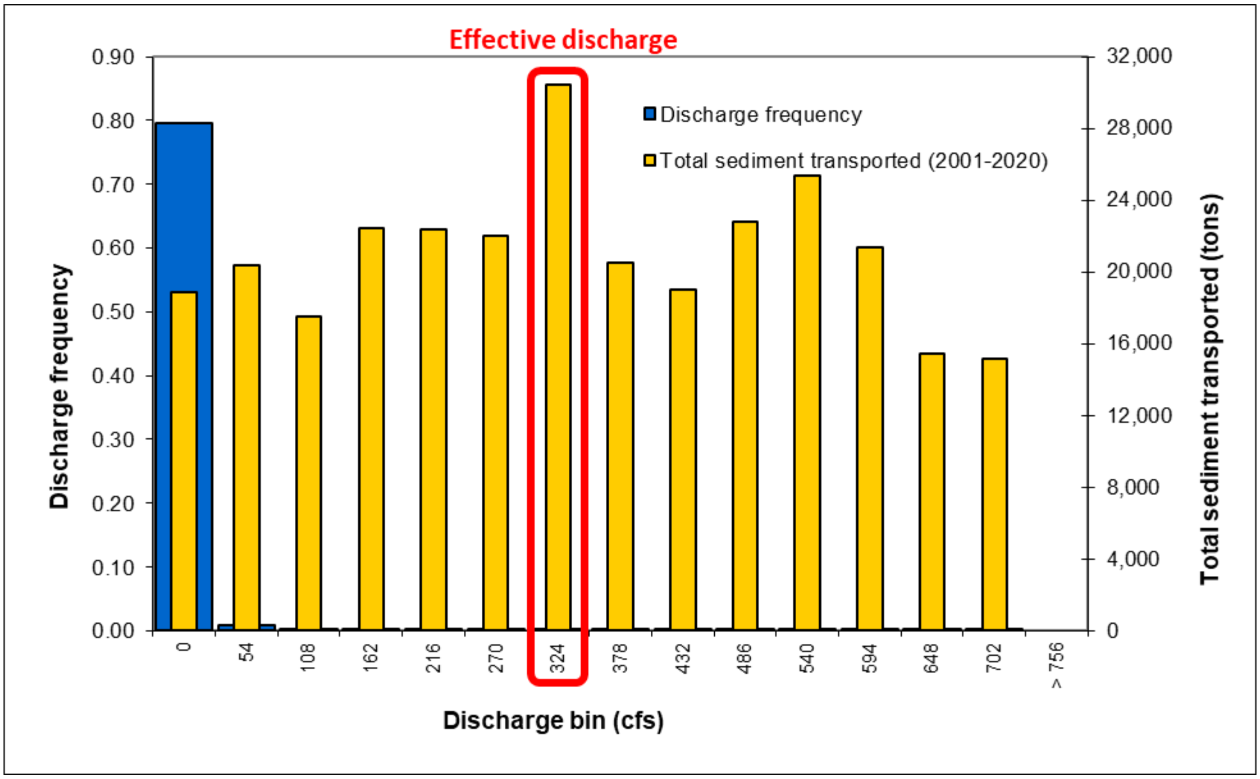


Figure 2
Graphical representation of effective discharge as the flow that moves the most sediment over time

TABLE 2
EFFECTIVE DISCHARGE AS A FUNCTION OF THE NUMBER OF DISCHARGE BINS USED IN THE CALCULATION

# of discharge bins	Effective discharge (cfs)
7	378
14	351
28	365

Table 2 suggests that the effective discharge is insensitive to the number of discharge bins used in the calculation, with an estimated effective discharge of about 350 cfs. This discharge is slightly larger than the bankfull discharge of 270 cfs that Jordan (2009) estimated from field measurements but nearly identical to the 360 cfs bankfull discharge obtained from a regression relation for bankfull discharge as a function of watershed area that Valley Water developed for Santa Clara County creeks (2020). Based on a flood frequency analysis by Jordan (2009), these flows have a recurrence interval of slightly less than two years.

3.2 Bankfull Channel Cross Section Field Measurements

Jordan (2009) measured bankfull width, mean depth, and maximum depth for 43 cross sections throughout his study area (**Figure 3**), which are useful for contextualizing the sediment supply versus transport capacity analysis described in section 3.3. No strong downstream trends are apparent for any of these dimensions, and the average bankfull width, mean depth, and maximum depth are approximately 25 ft, 1.5 ft, and 3 ft, respectively. These results alone are useful for estimating the quasi-equilibrium channel dimensions, but given the availability of flow and sediment transport data at the Piedmont Road gage, it was useful to also perform the supply versus capacity analysis described below to compare the dimensions predicted by these two analyses.

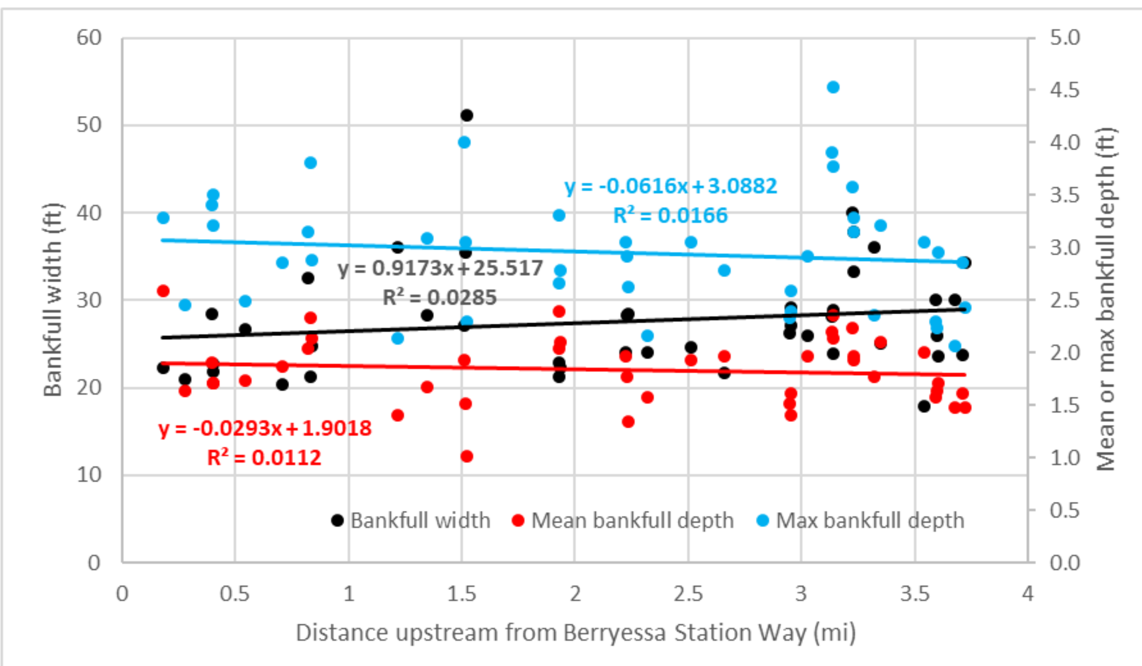


Figure 3
Bankfull channel dimensions measured by Jordan (2009)

3.3 Sediment Supply Versus Transport Capacity

With an estimated effective discharge and measured bankfull channel dimensions for reference, an a-at-station sediment supply versus sediment transport capacity analysis was next performed to estimate the quasi-equilibrium bankfull channel cross section dimensions, i.e. those associated with an approximate balance between sediment supply and transport capacity such that significant deposition or erosion is unlikely to occur over time. The spreadsheet tool iSURF (DeTemple and Wilcock, 2006) automates this analysis and was used to develop possible dimensions that could achieve a quasi-equilibrium condition. Input to the tool included the effective discharge and the associated sediment supply rate and grain size distribution obtained from the Piedmont Road sediment load measurements and rating curve. Two sediment supply scenarios were tested including bedload only and bedload plus sand only suspended load. Using the sediment rating curve, the bedload only sediment supply rate for 350 cfs was computed to be 1095 tons/day, and the bedload plus sand only suspended load supply rate was computed to be 3244 tons/day. The closest flow to the effective discharge for which sediment transport field measurements were made by Jordan was 230 cfs, so the grain size distribution of the sediment samples taken at this flow were used as input to iSURF as a rough approximation of conditions at the effective discharge given the absence of additional data (**Figure 4**).

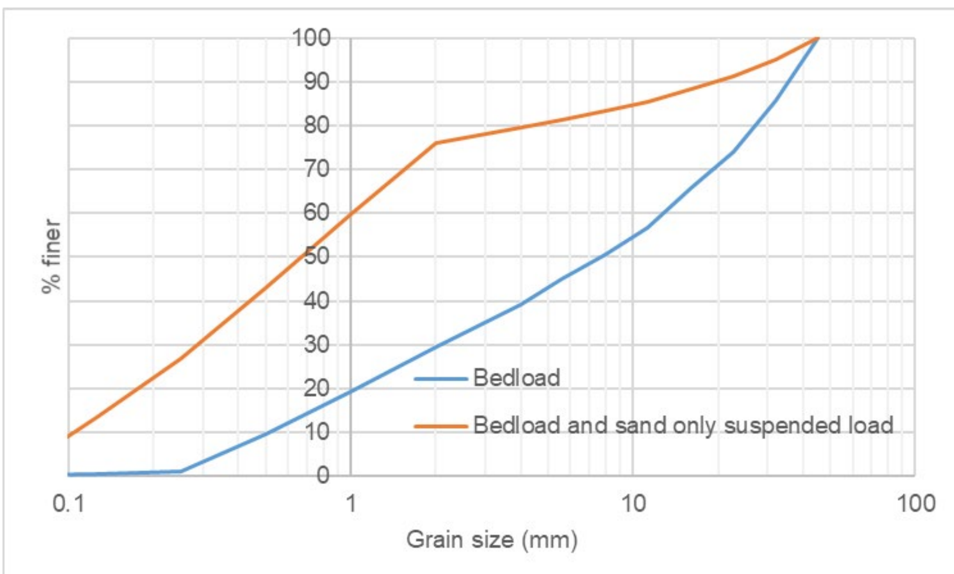


Figure 4
Grain size distributions used as input for the iSURF analysis

The tool returned a suite of combinations of channel depth, width, and gradient that may transport the supplied sediment with the available discharge (**Figure 5**) while remaining in quasi-equilibrium (neither significant erosion nor deposition over the long term). The slope curves represent the predicted quasi-equilibrium slope as a function of channel width, and the depth curves represent the predicted quasi-equilibrium depth as a function of channel width. Channel dimensions that plot below the curves represent the potential for deposition, while those above the curves represent potential erosion, and the curves themselves represent a potential balance between sediment supply and transport capacity, i.e. quasi-equilibrium. It is interesting to note the minimum reach gradient of 0.9-1.3% that the tool estimated is capable of transporting the supplied sediment, which bounds the average reach gradient of 1.2% at Piedmont Road, but that is steeper than the average reach gradient of 0.7% through the project reaches, meaning that even a perfectly straight channel would have too little gradient to transport all the sediment supplied by the watershed, and would experience deposition. This may reflect the intrinsically depositional alluvial fan environment of the project reaches such that deposition is unavoidable over time. With that said, this analysis along with Jordan's bankfull channel width and depth field measurements provided a basis for what is likely to be the most geomorphically sustainable channel dimensions achievable given these constraints. This finding also highlights the value of performing 1D sediment transport modeling rather than just an at-a-station analysis to investigate whether the lower gradient of the project reaches translates to a magnitude of long-term deposition that is incompatible with project objectives.

Using the approximate average bankfull width measured by Jordan of 25 ft, the iSURF plot suggests a depth of about 1.1-1.6 ft is associated with quasi-equilibrium. This range is consistent with the approximate average of the mean channel depths measured by Jordan of 1.5 ft, which was selected for further modeling analysis. The approximate average of the maximum channel depths measured by Jordan was 3 ft, and this was also selected for further analysis as a realistic maximum value that would help evaluate the sensitivity of the results to the channel depth. These two lines of evidence, including the iSURF results and Jordan's field measurements, were used to select a bankfull top width of approximately 25 ft and a bankfull depth of approximately 1.5-3 ft for more rigorous testing with a 1D sediment transport model.

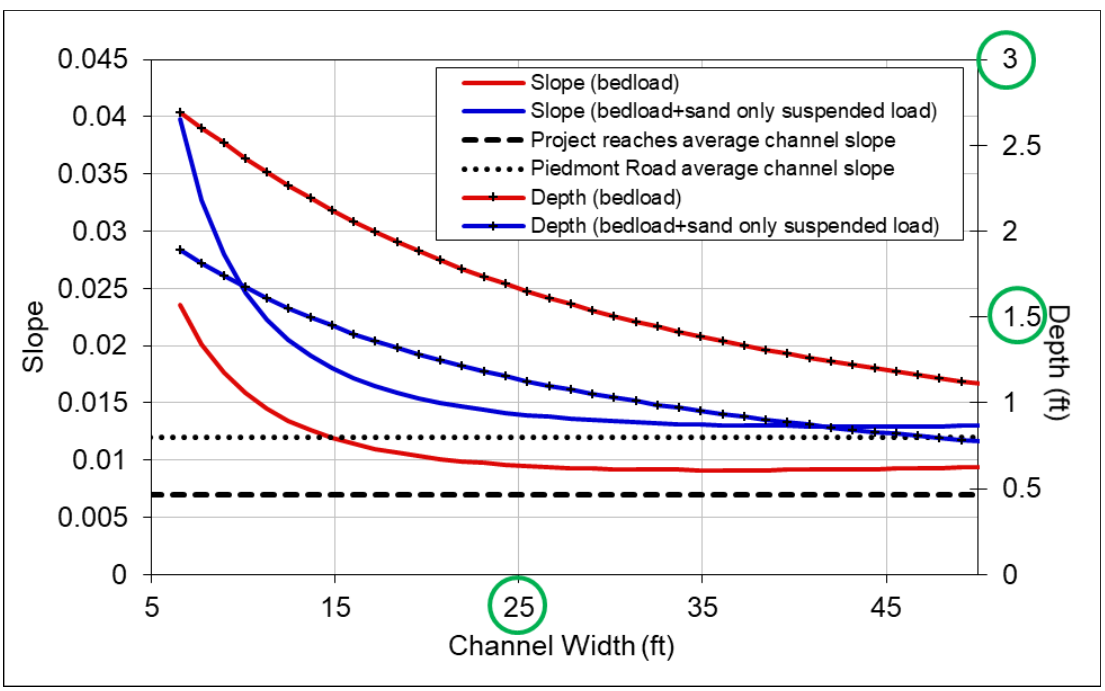


Figure 5
iSURF output for two sediment supply scenarios 1) bedload only and 2) bedload plus sand only suspended load. Depth and width values selected for further evaluation are circled in green.

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CHAPTER 4
Design Alternatives

Below is a brief summary of the design alternatives that were initially developed with reference to the above at-a-station analyses and subsequently tested with 1D and 2D modeling as described in sections 5 and 6. A major objective was to restore or enhance the ecological functionality of the creek by decreasing channel confinement and allowing lateral channel dynamism within the creek corridor. See the Geomorphic Basis of Design Report (ESA, 2022) for more details on the alternatives development.

4.1 Reaches 2 and 3

Alternatives for Reaches 2 and 3 included a set for the Reach 2 bypass (**Table 3**) and a set for these reaches outside of the Reach 2 bypass (**Table 4**). The distinction was made because the current main channel does not pass through the Reach 2 bypass such that increasing floodplain connectivity involved shifting the main channel into the bypass in contrast to elsewhere in the reaches where increasing lateral connectivity involved lowering artificial berms but not moving the channel to a new location. The berms were lowered to 1.5 ft and 3 ft stage, corresponding to the depth of the new less confined bankfull channel, to facilitate more frequent overtopping of the bankfull channel and connectivity with the adjacent floodplain.

TABLE 3
COMPONENTS OF THE REACH 2 BYPASS ALTERNATIVES

Alternative	Components
No project	Bankfull flow remains in existing main channel between the Mabury Road crossings
Existing conditions	Bankfull flow shifted into bypass with diversion structure at upstream Mabury Road crossing, existing bypass topography
3 ft bankfull	Bankfull flow shifted into bypass with diversion structure at upstream Mabury Road crossing, 3 ft deep bankfull channel
1.5 ft bankfull	Bankfull flow shifted into bypass with diversion structure at upstream Mabury Road crossing, 1.5 ft deep bankfull channel
Wide low bench	Bankfull flow shifted into bypass with diversion structure at upstream Mabury Road crossing, 1 ft deep low flow channel within 100 ft wide low bench

TABLE 4
COMPONENTS OF THE REACH 2 AND 3 ALTERNATIVES OUTSIDE OF THE REACH 2 BYPASS

Alternative	Components
Existing conditions	Existing creek corridor topography except expansion around the King Road crossing
3 ft bankfull	3 ft deep bankfull channel, berm lowering around high value tree preservation, expansion around the King Road crossing
1.5 ft bankfull	1.5 ft deep bankfull channel, berm lowering around high value tree preservation, expansion around the King Road crossing

Table 5 lists the scenarios evaluated with the 1D model which included a Reach 2 bypass alternative paired with an alternative for Reach 2 and 3 outside of the bypass. All were run for the 2001-2020 simulation period except 1.5 ft bankfull that was run for a hypothetical 2001-2038 period for sensitivity testing. See section 5 for more details on the 1D model setup.

Note that after preliminary testing in the 1D model, the no-project alternative was not modeled further as the complex split flow configuration with lower flows remaining in the current main channel and higher flows passing down the Reach 2 bypass was not amenable to comparison of 1D model results with the other alternatives. No model results will be presented for this alternative.

TABLE 5
REACH 2 AND 3 ALTERNATIVE SCENARIOS EVALUATED WITH THE 1D MODEL

Modeled scenario	Reach 2 bypass alternative	Reach 2 and 3 alternative outside the Reach 2 bypass
Existing conditions (2001-2020)	Existing conditions	Existing conditions
3 ft bankfull (2001-2020)	3 ft bankfull	3 ft bankfull
1.5 ft bankfull (2001-2020)	1.5 ft bankfull	1.5 ft bankfull
Wide low bench (2001-2020)	Wide low bench	3 ft bankfull
1.5 ft bankfull (2001-2038)	1.5 ft bankfull	1.5 ft bankfull

4.2 Reach 1A and Confluence

Alternatives evaluated in the 1D model for Reach 1A and the confluence included widening the creek corridor and testing different bankfull depths and confluence angles (**Table 6**). Bankfull depths of 1.5 and 3 ft were tested, and the existing 90 degree confluence angle was modeled plus a 45 degree angle corresponding to the addition of a new meander bend and smoother confluence configuration. The beta HEC-RAS 2D sediment transport model was used to investigate the 90 and 45 degree confluence angles in more detail (**Table 7**) but not the different bankfull depths that were more amenable to 1D modeling analysis.

TABLE 6
COMPONENTS OF THE REACH 1A AND CONFLUENCE ALTERNATIVES EVALUATED WITH THE 1D MODEL

Alternative and modeled scenario	Components
Existing conditions (2001-2020)	Existing conditions topography
3 ft bankfull, 90 degree confluence (2001-2020)	3 ft deep bankfull channel, widening of creek corridor to about 200 ft, 90 degree confluence angle with Coyote
3 ft bankfull, 45 degree confluence (2001-2020)	3 ft deep bankfull channel, widening of creek corridor to about 200 ft, 45 degree confluence angle with Coyote
1.5 ft bankfull, 90 degree confluence (2001-2020)	1.5 ft deep bankfull channel, widening of creek corridor to about 200 ft, 90 degree confluence angle with Coyote
1.5 ft bankfull, 45 degree confluence (2001-2020)	1.5 ft deep bankfull channel, widening of creek corridor to about 200 ft, 45 degree confluence angle with Coyote

TABLE 7
COMPONENTS OF THE REACH 1A AND CONFLUENCE ALTERNATIVES EVALUATED WITH THE 2D MODEL

Alternative and modeled scenario	Components
3 ft bankfull, 90 degree confluence (2001-2020)	3 ft deep bankfull channel, widening of creek corridor to about 200 ft, 90 degree confluence angle with Coyote
3 ft bankfull, 45 degree confluence (2001-2020)	3 ft deep bankfull channel, widening of creek corridor to about 200 ft, 45 degree confluence angle with Coyote

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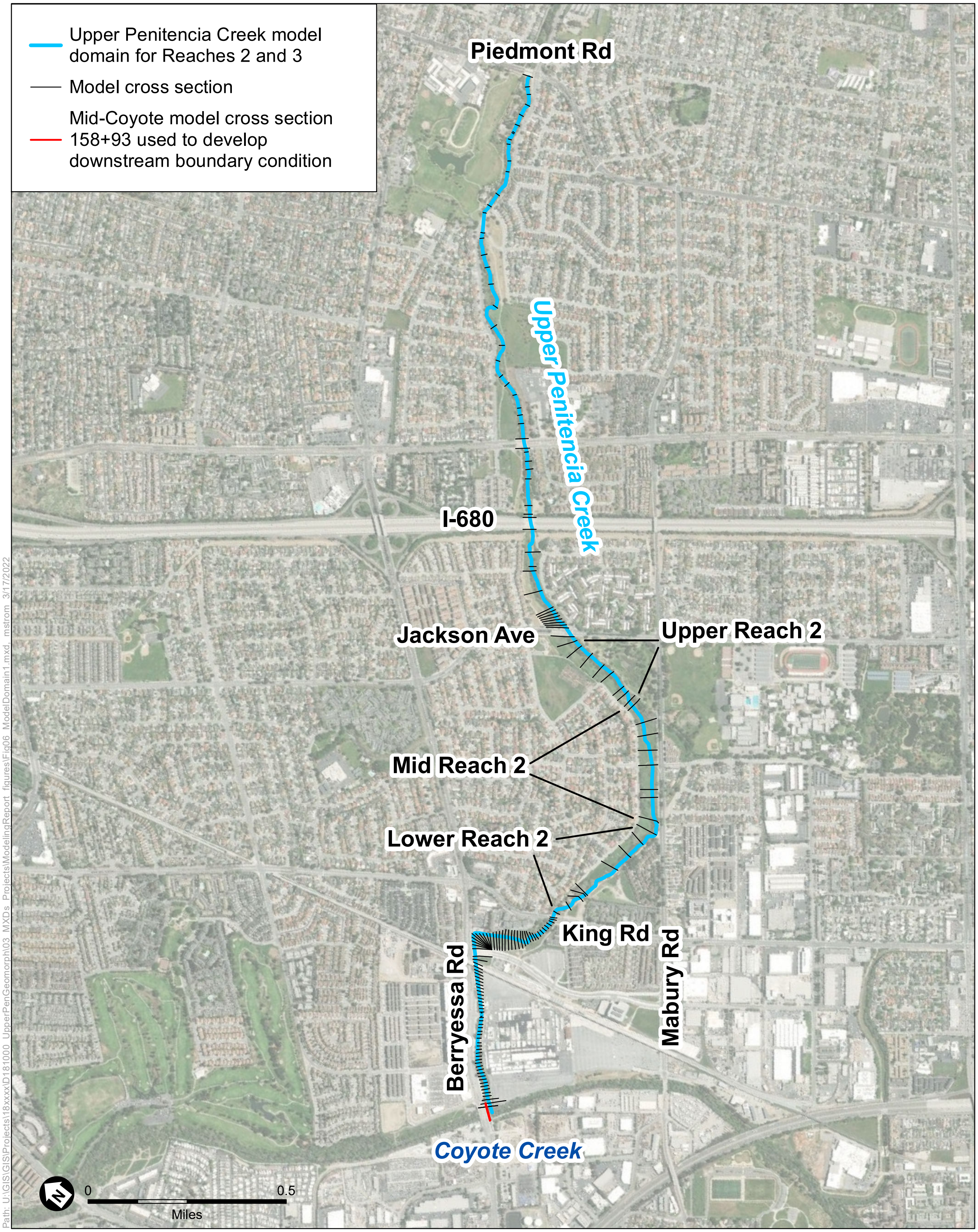
CHAPTER 5
HEC-RAS 1D Model

The next step was to develop a HEC-RAS (version 5.0.7) 1D quasi-unsteady sediment transport model to evaluate the above alternatives in a long term simulation. Unlike the at-a-station analysis which approximates reach scale geometry and gradients, HEC-RAS analyzes conditions at many individual cross sections based on measured topographic data, allowing variations in sediment transport due to changing channel dimensions and gradient to be analyzed.

5.1 Model Domain

Two domains were used for modeling the alternatives with the domain for Reach 2 and Reach 3 alternatives extending from the Piedmont Road crossing down to the Coyote Creek confluence (**Figure 6**). Piedmont Road was used as the upstream extent because of the flow gage and sediment rating curve available for this location, which assisted in model calibration. Additionally, this location afforded a generous spatial buffer to minimize the effect of any modeling artifacts associated with the upstream model boundary condition on results for the project reaches downstream of I-680. Coyote Creek itself was not included in the Reach 2 and 3 model since the focus was on the Upper Penitencia alternatives well upstream of Coyote. For the Reach 1A and confluence alternatives, the domain extended from the Piedmont Road crossing down to the Coyote Creek confluence as well as included Coyote Creek from the Mabury Road crossing down to Shore Drive (**Figure 7**). Given the proximity of Coyote Creek to Reach 1A, Coyote Creek was included in the modeling of the Reach 1A and confluence alternatives to account for its influence. Mabury Road to Shore Drive along Coyote Creek represented a relatively sizeable and homogenous extent that spans the confluence to account for the influence of Coyote Creek without including significantly more creek length that would increase model run times. Any feedbacks between sediment transport in Coyote and in Reach 1A were intended to be captured by including Coyote itself in the Reach 1A and confluence alternatives model, e.g. deposition in Coyote around the confluence could change the backwater imposed on Upper Penitencia with a possible effect on the sediment transport capacity.

Boundary conditions required for these model domains included flows (section 5.3) and sediment loads (section 5.4) at the upstream model boundaries and stages (section 5.3) at the downstream model boundaries. **Table 8** lists the cross section stations of these boundaries for the two model domains.



SOURCE: ESA 2022

Upper Penitencia Creek

Figure 6
Reaches 2 and 3 model domain

SOURCE: ESA 2022

Upper Penitencia Creek

Figure 7
Reach 1A and confluence model domain

ESA

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TABLE 8
MODEL DOMAIN BOUNDARY CONDITION CROSS SECTION STATIONS

	Model domain	
	Reaches 2 and 3	**Reach 1A and confluence**
Upstream boundary	Piedmont Rd (Upper Penitencia 164+42)	Piedmont Rd (Upper Penitencia 164+42)
		Mabury Rd (Coyote 182+63)
Downstream boundary	Coyote confluence (Upper Penitencia 0+88)	Shore Dr (Coyote 146+15)

5.2 Topographic and Structure Data

The cross sections and structures in the HEC-RAS model geometries “UpperpenExistingSteady” from the Valley Water Upper Penitencia Creek model (planning study report model dated August 2020) and “Existing_Calib_Geom” from the Santa Clara Valley Water District Mid-Coyote model (SCVWD, 2007) were used as the initial topographic and structure datasets. Valley Water survey staff performed ground topographic and hydraulic structure surveys from September through December 2020 for Reaches 1 through 3 plus around the Coyote confluence such that the model cross section and structure data could be updated for these areas. **Table 9** lists station ranges spanning the existing conditions model cross sections and structures along with the data source for each. Note that for Coyote Creek station range 160+96 – 157+61, the cross sections were updated to reflect the Valley Water 2020 survey data collected for the channel bed, while higher up on the banks still reflected the original SCVWD 2003 survey data.

TABLE 9
DATA SOURCES FOR EXISTING CONDITIONS MODEL CROSS SECTIONS AND STRUCTURES

Creek	Station range	Data source
Upper Penitencia	170+04 – 107+01	2012 BKF survey and 2006 County LiDAR
	106+55 – 6+88	2020 Valley Water survey
	2+28 – 0+88	2012 BKF survey and 2006 County LiDAR
Coyote	182+63 – 162+76	2003 SCVWD survey
	160+96 – 157+61	2003 SCVWD survey and Valley Water 2020 survey
	155+04 – 146+15	2003 SCVWD survey

Adjustments to the existing conditions cross section topographic data were made to reflect each design alternative as summarized in section 4.

5.3 Hydrologic Data

HEC-RAS offers both quasi-unsteady and unsteady sediment transport modeling, and quasi-unsteady was selected due to the much longer run times and stability issues associated with unsteady. Quasi-unsteady modeling involves discretizing a flow time series into a series of flow durations and computation increments (**Figure 8**). The flow duration time interval can simply match the frequency of gage discharge recordings, e.g. 15 minute, but can also vary through time and be much longer, with the computation increment as some fraction of the flow duration.

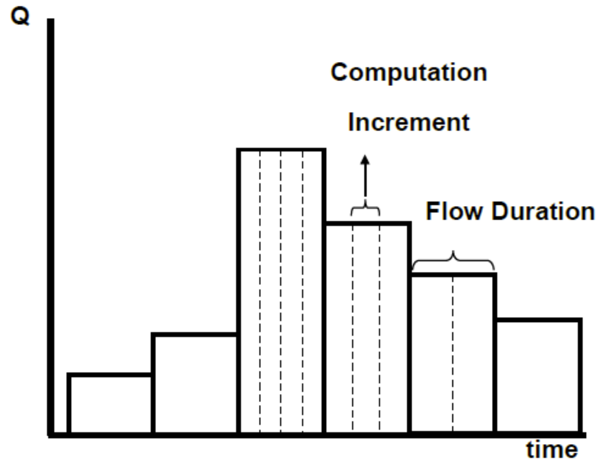


Figure 8
Quasi-unsteady flow time series example (HEC, 2022)

Upper Penitencia Creek inflows were obtained from the same Valley Water Piedmont Road gage 2001-2020 15-minute flow series that was used in the above effective discharge estimation. To reduce model run time, the 15-minute flow data were condensed into a new time series in which the flow duration and computation increment were longer than 15 minutes during low flow periods when relatively minimal sediment transport occurs and high temporal modeling resolution is unnecessary. A threshold flow was sought below which the flow duration and computation increment could be increased, and in reviewing the above effective discharge calculations, 30 cfs appeared to be a reasonable threshold below which the flows transport relatively minor amounts of sediment. The flow series was therefore condensed such that for a given time period with flow less than 30 cfs, the flow duration was set to be the length of the time period, the computation increment was set to be one tenth of the flow duration, and the flow was set to be the average flow during the time period. **Figure 9** shows the result of this condensing with long durations of constant low flow typically during the summer months.

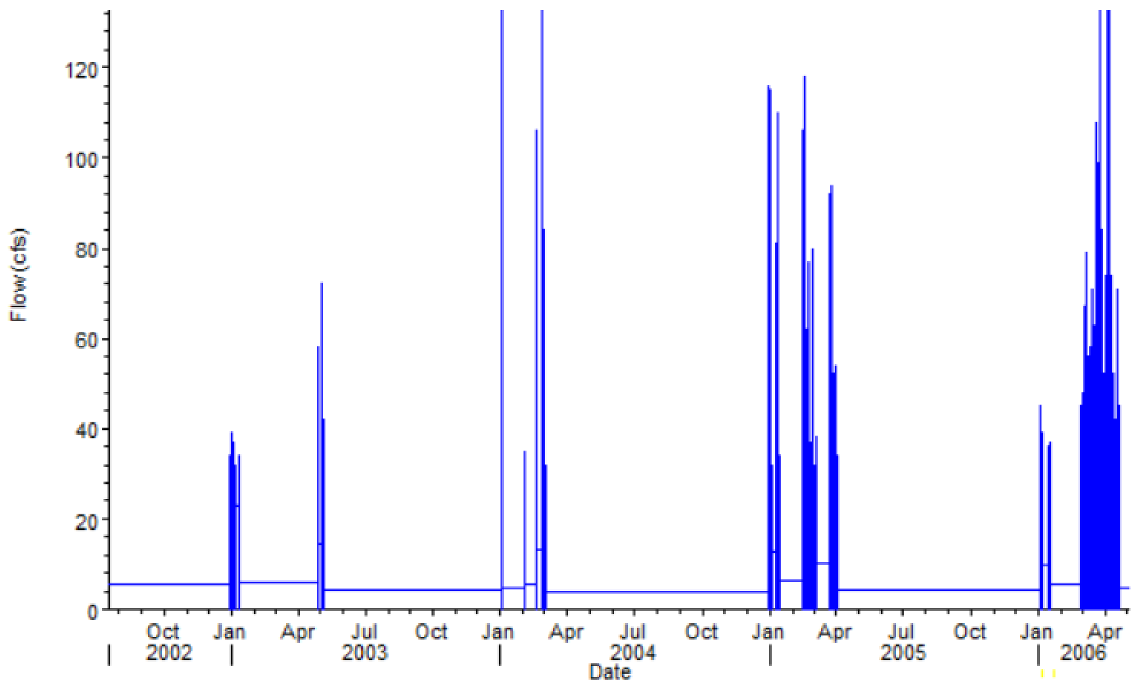


Figure 9
Example of condensed flow time series zoomed in to show long durations of low flow

The next step was to develop 2001-2020 stage time series for the downstream boundaries of the two model domains. For the Reaches 2 and 3 model with a downstream boundary at the confluence at cross section 0+88, this boundary condition was developed from cross section 158+93 in the SCVWD Mid-Coyote hydraulic model to account for the backwater imposed by Coyote on Upper Penitencia (**Figure 6**). For the Reach 1A and confluence model with a downstream boundary near Shore Drive at cross section 146+15, this boundary condition was developed from this same section in the Mid-Coyote hydraulic model (**Figure 7**). Stage-discharge relationships for both of these locations were obtained from the Mid-Coyote hydraulic model such that developing the stage time series required flow time series data for these locations. The Coyote Creek at Highway 237 USGS gage (11172175) was used for this purpose given no major tributary inputs between the confluence and the gage, but time shifting of the flow data had to be performed given that this gage is located 5 miles downstream of the confluence. In other words, to obtain the flow time series around the Upper Penitencia confluence, the flow time series at the USGS gage had to be time shifted to account for the flow travel time between these two locations. The travel time was estimated to be about 3 hr by comparing the 2018-2020 Coyote stage series for a recently installed Valley Water gage at the Berryessa Road bridge to the Coyote flow series for this time period at the USGS gage. However, an additional time shift was needed as a result of the quasi-unsteady nature of the model. Since quasi-unsteady modeling involves a series of steady flow runs to approximate an unsteady hydrograph, each flow entering Upper Penitencia occurs everywhere simultaneously through this creek. Therefore, to ensure relatively accurate timing of Upper Penitencia flows relative to Coyote stages around the confluence where this relationship could affect channel change, another time shift was applied to the USGS Coyote gage flow series to account for the travel time of Upper Penitencia flow from the Piedmont Road gage down to the confluence. This travel time was estimated to be 1 hr by running a single event hydrograph with an effective discharge peak in a 1D fully unsteady model. With the USGS Coyote gage flow series time shifted, stage series could be constructed from the rating curves for the downstream boundaries of the two model domains.

Figure 10 shows an example of the above time shifting of the Coyote flow time series for a February 2019 storm event. The original Highway 237 gage time series was first shifted backward in time by 3 hr to account for the 3 hr travel time from the Coyote confluence to the gage. This shifted time series was then shifted backward in time by an additional 1 hr to account for the Upper Penitencia travel time from the Piedmont Road gage to the Coyote confluence. The resulting time series represented the estimated Coyote flow at the confluence that coincided with the Upper Penitencia flow reaching the confluence.

Lastly, the Coyote Creek 2001-2020 inflows at Mabury Road were obtained by subtracting the Upper Penitencia flows from the time shifted USGS Coyote gage flows.

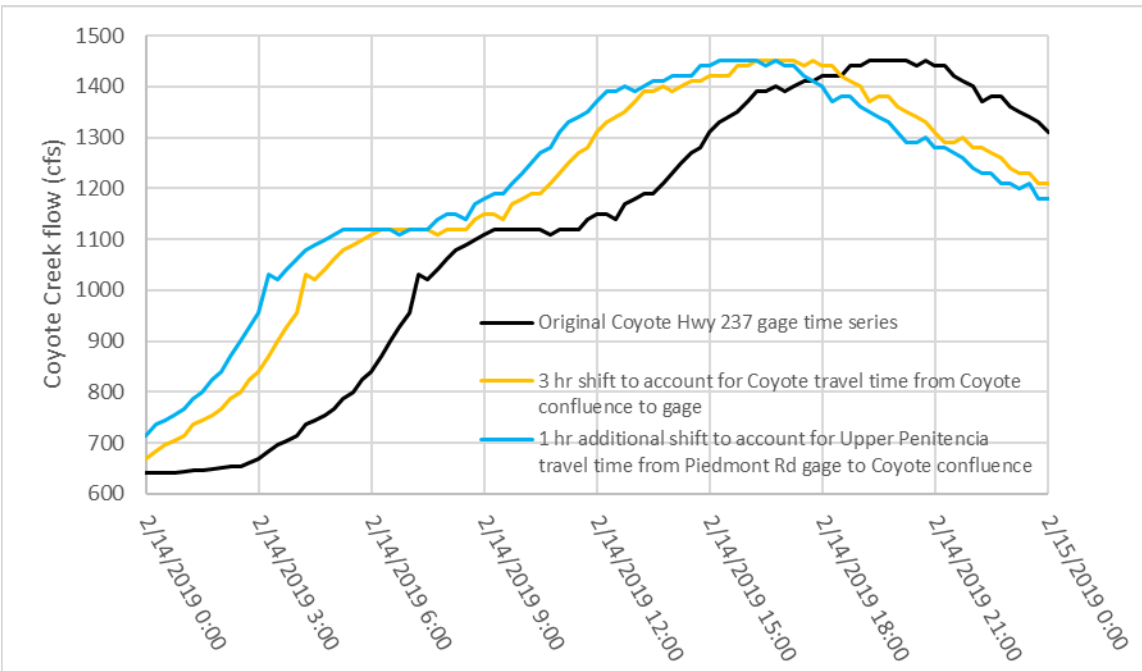


Figure 10
Example of time shifting the Coyote Creek Hwy 237 gage flow time series to yield the time series at the confluence

One of the Reach 2 and 3 modeled scenarios involved a hypothetical 2001-2038 simulation period to test sensitivity of the results, and the flow and stage data used for this simulation were the 2001-2020 time series followed by the same time series a second time.

5.4 Sediment Data

Sediment data needed for the modeling included bed grain size distributions across the model domains and inlet sediment loads at Piedmont Road for Upper Penitencia and Mabury Road for Coyote. Jordan (2009) collected bed sediment samples from King Road upstream to the mouth of the canyon. ESA reviewed these gradations in the field within the project reaches against current conditions and deemed these to still be representative (**Figure 11**). For Reach 1 downstream of King Road where Jordan did not sample, ESA collected bed sediment samples on October 20, 2020 (**Figure 12**). Coyote Creek sediment gradations were available from the SCVWD Mid-Coyote Creek modeling report (2007) including at station 208+00 which is the closest sample to the area just upstream of the confluence where the bed is much finer than downstream of the confluence at 155+80 (**Figure 13**). **Figure 14** shows the sampling locations for all sediment gradations used during calibration, and these samples do not represent the final gradations used in the model as adjustments were made during the calibration stage (see section 5.12). Both pavement and subpavement bed sediment data were available from most of the above sources, and the use of either was determined during calibration. The gradations were assigned to the nearest cross sections to the sample locations, and HEC-RAS then interpolates gradations for cross sections between these locations.

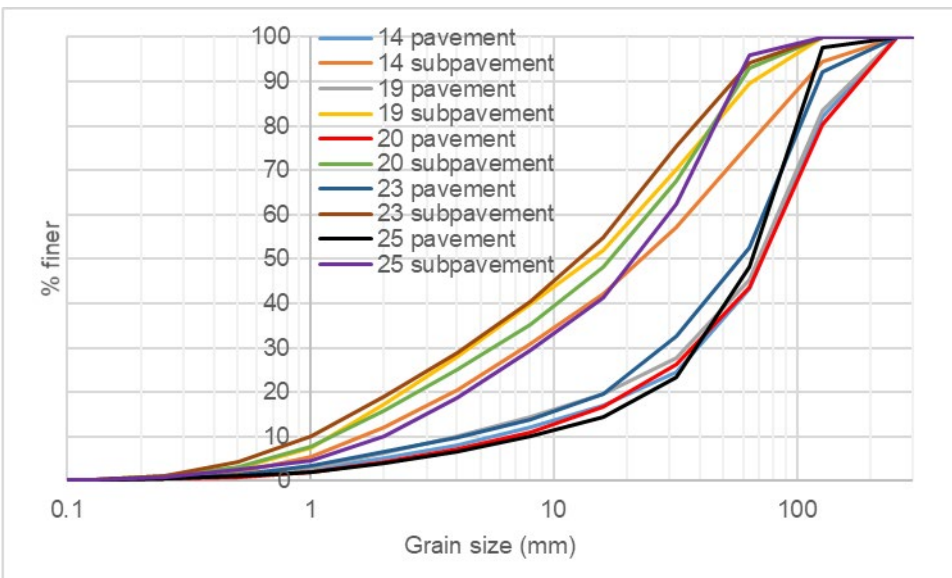


Figure 11
Grain size distributions of the Jordan (2009) sediment samples

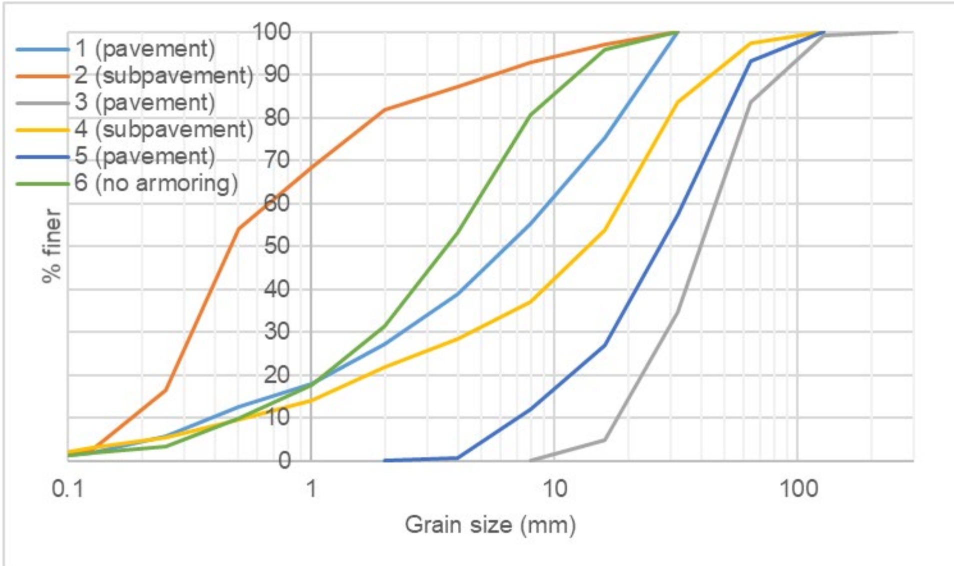


Figure 12
Grain size distributions of the 2020 ESA sediment samples

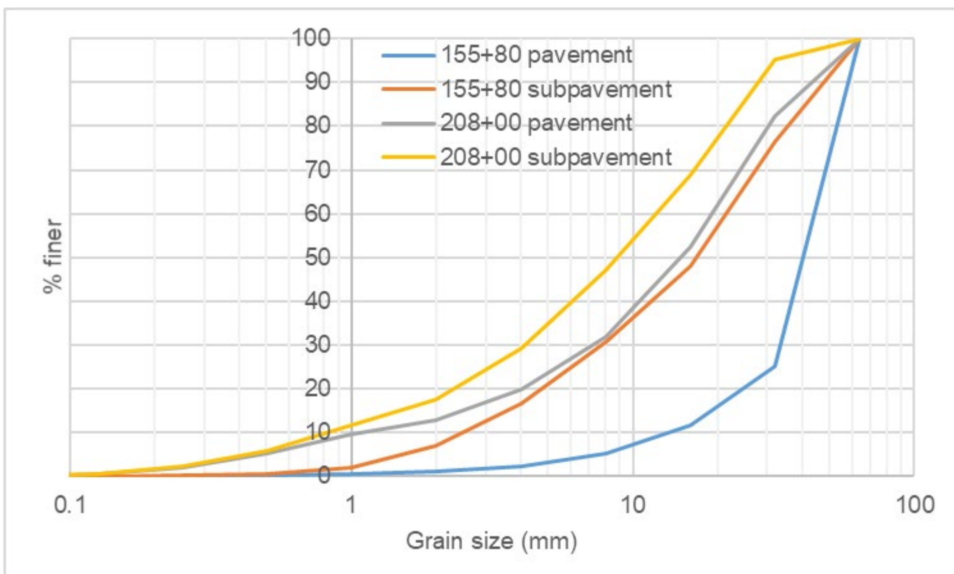
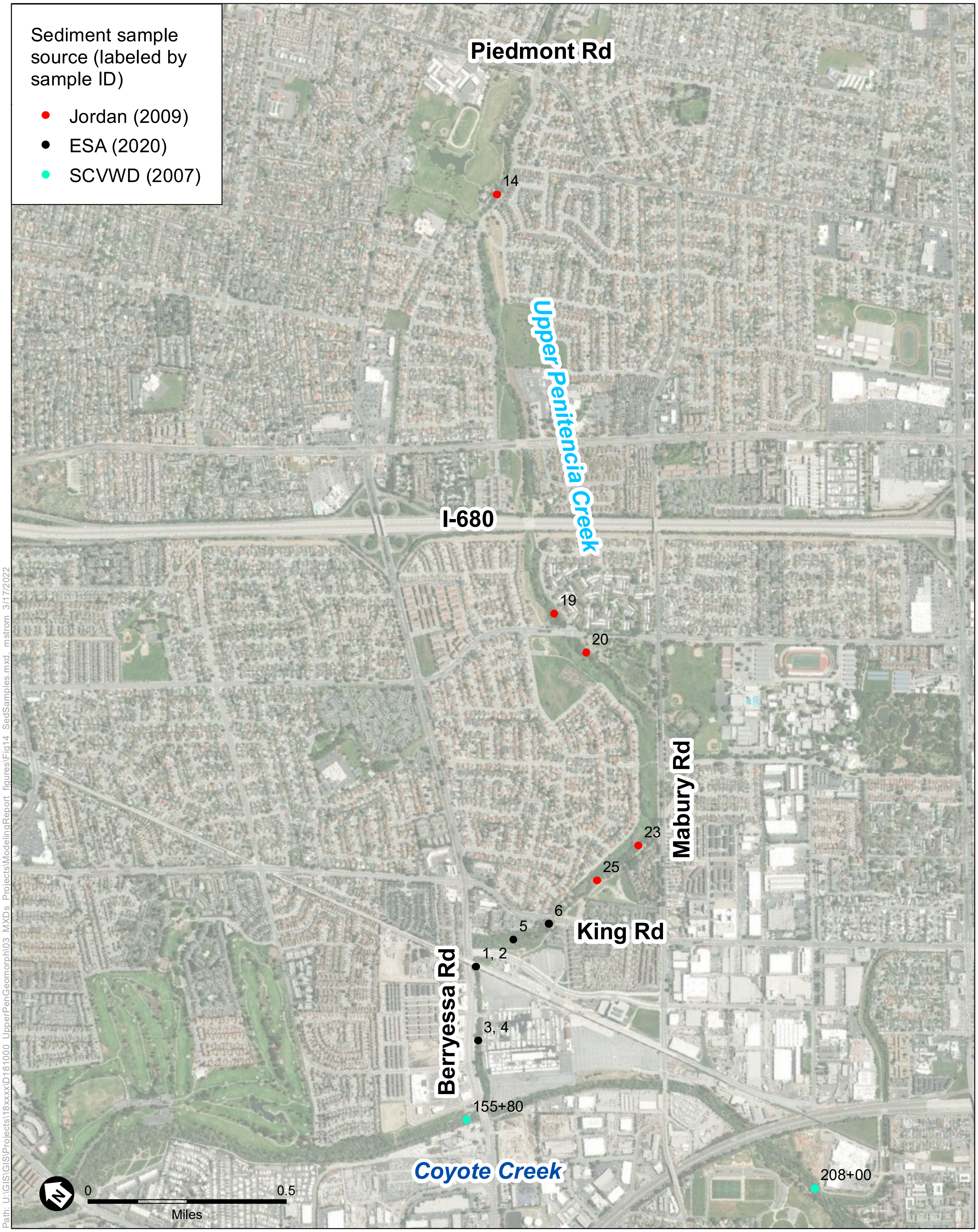


Figure 13
Grain size distributions of the SCVWD (2007) sediment samples



SOURCE: ESA 2022

Upper Penitencia Creek

Figure 14
Sediment samples tested during model calibration

ESA

Some bank sediment data were available from Jordan (2009), but explicitly modeling bank erosion was not feasible because while HEC-RAS 1D models bed erosion and deposition, it does not incorporate bank erosion processes.

The inlet sediment loads for Upper Penitencia and Coyote were initially set to equilibrium load, which assumes that the transport capacity is equal to the sediment supply here and the channel is neither eroding nor aggrading. A comparison of longitudinal bed elevation profiles upstream of King Road from 1985 and 2004 (Jordan, 2009) suggests that this is a reasonable assumption at Piedmont Road, and as described more in section 5.12, this was a useful assumption to make because it provided another opportunity for model calibration through comparison of the modeled equilibrium load to the measured sediment rating curve. No sediment rating curve was available for the Coyote inlet location, so the equilibrium load assumption was tested during calibration by assessing whether the downstream bed change was realistic.

5.5 Hydraulic Roughness

The selection of appropriate Manning's roughness values was informed by the values used in the calibrated existing conditions Valley Water hydraulic model, and by modeling judgment for the project alternatives. Vegetation is a dominant component of roughness in the overbank regions with overbank roughness values ranging from 0.04-0.06, while grain size and bedforms can dominate roughness in the channel although vegetation may be present as well with overall channel roughness values ranging from 0.025-0.06. Figure 15 shows an example roughness distribution for a cross section in the Reach 2 bypass with a roughness value of 0.03 for the channel region and 0.06 for the overbank where brush and scattered trees occur. Note that the roughness values selected for the project alternatives reflect vegetation conditions anticipated to develop within the project reaches and not immediate post construction that may exhibit less vegetation.

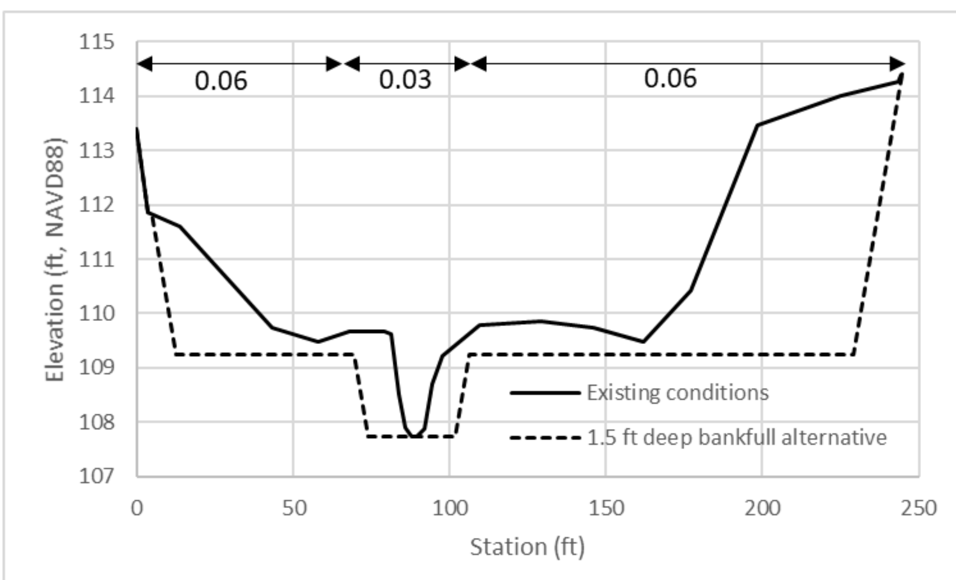


Figure 15
Example roughness distribution for Reach 2 bypass cross section 64+33

5.6 Sediment Transport Equation and Bed Mixing Method

Given the mostly coarse bed material present across the project reaches, several available transport equations that are appropriate for gravel were tested including the Meyer-Peter-Muller bedload equation and the Wilcock-Crowe and Yang bed material load equations. Jordan (2009) found the Yang equation to work well in his sediment transport modeling of Upper Penitencia. See HEC (2022) for documentation on these equations and how they're implemented in the model. The Thomas and active layer mixing methods were tested, though only the active layer method was used with Wilcock-Crowe since this is a bed surface-based equation that implicitly accounts for armoring. See section 5.12 for the results of testing the above transport equations during model calibration.

5.7 Movable Bed Limits

The movable bed limits for each cross section determine the lateral limit of erosion that is allowed to occur within each section during the model run and are set based on where active sediment entrainment appears to occur. Field observations suggest that this zone is mostly confined to the area between the main channel banks, and therefore these limits were approximated with the bank stations for cross sections upstream of the project reaches, and set to the bank stations or down to the bank toes for cross sections within the project reaches.

5.8 Maximum Erosion Depth

The maximum erosion depth determines how deep the model can erode sediment within the movable bed limits of each section. In the absence of geotechnical data this was set to 5 ft for all sections, a typical value based on best professional judgement for Bay Area creeks.

5.9 Bed Change Method

The bed change method of deposition allowed outside the movable limits was selected as erosion is often focused within the bankfull channel while deposition can occur both within the bankfull channel as well as on the floodplain by more placid overbank flows that deposit sediment and lack sufficient energy to erode (HEC, 2022). Floodplain scour with channel avulsion can still occur in reality, but the 1D model does not simulate these processes and was therefore unable to explicitly model more complex planform change.

5.10 Pass-through Nodes

Cross sections can be assigned as pass-through in which the model sets sediment transport capacity equal to the sediment supply such that the sections experience no deposition or erosion throughout the model run. The bounding sections up and downstream of bridges were set to pass-through to avoid sediment transport artifacts of either extreme erosion or deposition that can occur as the model is not suited to resolving sediment dynamics in the immediate vicinity of structures (HEC, 2022).

5.11 Confluence Method

In addition to the default energy equation solution method for confluences, HEC-RAS 1D has the option of modeling confluences with the momentum equation that factors in the angles of the combining reaches. The momentum solution was therefore used to account for any effects that the confluence angle has on the hydraulics and sediment transport with an existing 90-degree confluence angle that Upper Penitencia forms with Coyote and a 45-degree angle tested to represent the addition of a meander bend to smooth the confluence configuration.

5.12 Calibration

Model calibration was performed using the Piedmont Road crossing sediment transport rating curve and comparison of model results with channel change estimates from repeat cross section surveys (Jordan, 2009). The first calibration step (section 5.12.1) involved experimenting with the transport equation and related parameters to match the modeled equilibrium load to the observed rating curve. The second step (section 5.12.2) involved testing these transport equations in simulating the observed channel changes as well as adjusting sediment gradations as appropriate to improve the modeled changes.

5.12.1Piedmont Road Sediment Transport Rating Curve

The Jordan (2009) sediment transport rating curve for Piedmont Road afforded the first opportunity for calibration. Assuming that the channel is not significantly eroding nor aggrading at Piedmont Road, the measured rating curve could be compared to the modeled equilibrium load using different sets of model parameters. This assumption of equilibrium conditions at Piedmont Road is supported by a comparison of longitudinal bed elevation profiles upstream of King Road from 1985 and 2004 (Jordan, 2009) showing minimal change here.

Different combinations of transport equation, bed mixing method, and pavement and subpavement sediment gradations were run for flows spanning the range sampled for the rating curve (**Table 10**). Wilcock-Crowe and Meyer-Peter-Muller performed comparably and better than Yang against sediment load estimates from the Jordan rating curve. Note that Meyer-Peter-Muller was only compared to the bedload estimate from the rating curve given this is a bedload equation, and Wilcock-Crowe and Yang were only compared to the bed material load estimate from the rating curve given these are bed material load equations. Inclusion of the subpavement gradations in addition to the pavement gradations with Meyer-Peter-Muller did not improve the model performance, and note that Wilcock-Crowe is a surface based equation that is only appropriate for use with pavement gradations.

TABLE 10
COMPARISON OF MEASURED SEDIMENT TRANSPORT RATING CURVE TO MODELED TRANSPORT EQUATIONS WITH GREEN COLUMNS REFLECTING BEDLOAD CONDITIONS AND BLUE COLUMNS REFLECTING BED MATERIAL LOAD CONDITIONS

	Sediment transport rate (tons/day)					
Flow (cfs)	Jordan rating curve (bedload)	Jordan rating curve (bedload + sand only suspended load)	Yang, Thomas mixing method, pavement and subpavement gradations	Wilcock-Crowe, active layer mixing method, pavement gradations	Meyer-Peter-Muller, Thomas mixing method, pavement and subpavement gradations	Meyer-Peter-Muller, active layer mixing method, pavement gradations
38	6	19	313	60	260	222
137	116	367	2503	933	849	685
235	399	1286	4924	1276	1415	1179
		RMSE	2442	327	738	571

5.12.2 Repeat Cross Section Surveys

Cross section surveys by Jordan (2009) and Valley Water offered another opportunity for model calibration. Jordan performed repeated channel surveys upstream of King Road from 2004 through 2006 and reported changes in sediment volume normalized by channel area for multiple survey reaches. While the HEC-RAS model geometry developed for this study is not identical to the cross sections that Jordan surveyed in 2004, it was still valuable to run the current HEC-RAS model with the flow series from 2004-2006 for an order of magnitude comparison of topographic change predicted by the model to that documented by Jordan for this time period. Wilcock-Crowe and Meyer-Peter-Muller were tested and performed similarly, and both performed better than Jordan's 1D model (**Table 11**).

TABLE 11
COMPARISON OF MEASURED AND MODELED NORMALIZED CHANNEL CHANGE

	Normalized channel change (ft/yr)			
Station range	Jordan measured	Jordan's 1D model	Wilcock-Crowe, active layer mixing method, pavement gradations	Meyer-Peter-Muller, active layer mixing method, pavement gradations
17004-13900	0.20	-0.27	0.32	-0.05
13820-10700	0.16	0.58	0.02	0.01
10500-9069	-0.05	0.40	-0.04	-0.01
8924-5842	0.03	-0.18	0.06	0.01
5583-4711	0.05	-0.53	-0.03	-0.05
4185-3645	0.08	-0.26	0.11	0.05
	RMSE	0.42	0.08	0.13

More formal repeat cross section survey data and volumetric change analysis were not available downstream of King Road, but the 2020 Valley Water cross sections were compared to the 2012 BKF sections to get a sense for approximately decade scale channel change here. This comparison suggested change on the order of ±0.5 ft since 2012. However, 1D modeling using Wilcock-Crowe showed extensive erosion of multiple feet downstream of King Road to the confluence over a similar timescale. The results upstream of King Road were not sensitive to this downstream erosion, so Wilcock-Crowe was used for the Reach 2 and 3 model given the good calibration performance upstream of King Road.

For the Reach 1A and confluence model, the unrealistically high erosion downstream of King Road to the confluence was not acceptable for modeling the alternatives here. Further testing was done, and Meyer-Peter-Muller in combination with a coarser sediment gradation that Jordan sampled upstream of King Road produced bed changes mostly within the observed ±0.5 ft in this downstream reach for 2012-2020 (**Figure 16**). Modifying the sediment gradations from those sampled in the field in order to produce realistic model results was considered to be justified in light of field observations of bank erosion just upstream of King Road. This finer eroded bank material appears to have deposited downstream of King Road, with significant quantities immediately below the crossing. Using gradations in the model that reflected this finer sediment produced heavy erosion given that the model does not simulate bank erosion that could otherwise replace this material. In other words, in order to model the observed bed elevation changes in these lower reaches without simultaneously modeling bank erosion processes due to the model limitations, a coarser bed grain size distribution had to be used. While the fate of this finer eroded bank material observed just downstream of King Road was therefore not a focus of the modeling, the fate of coarser sediment was of greater interest given that the existing deposit at the Coyote confluence consists of coarse material. Finer sediment, including material that may be sourced from upstream bank erosion in Upper Penitencia, may be more easily flushed downstream on Coyote and therefore not as relevant to the magnitude of the deposit at the confluence.

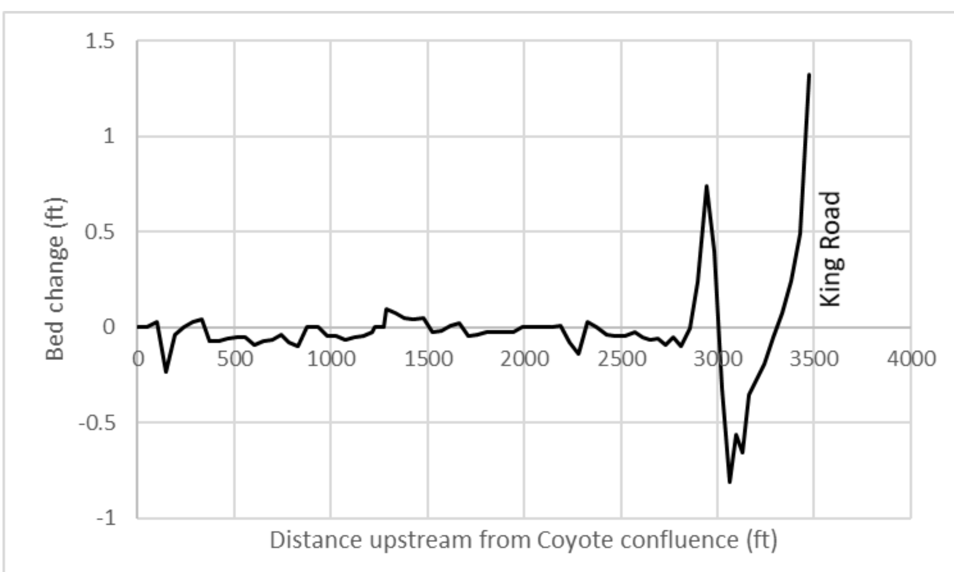


Figure 16
Modeled bed change downstream of King Road 2012-2020

The Coyote Creek sediment gradation was also modified in the Reach 1A and confluence model to avoid possible modeling artifacts that would confound interpretation of the results since initial testing with gradations from the SCVWD Mid-Coyote Model produced unrealistic results. The coarse sediment size of the existing deposit at the confluence suggests that Upper Penitencia is likely the main source, and therefore the fate of sediment originating from Upper Penitencia was of primary interest for the modeling. Therefore, all of Coyote was set to nonerodible with no incoming sediment load to avoid possible confounding model artifacts while still allowing sediment sourced from Upper Penitencia to deposit or redistribute at and downstream of the confluence.

5.13 Results

The net volume changes predicted to occur at the model cross sections over the simulation period were summed and divided by the creek corridor area to compute an average creek corridor net vertical change. **Table 12** and **Table 13** list these predicted average net vertical changes for the project reaches including subreaches of Reach 2 with the Upper from Jackson Avenue to just above the upstream Mabury Road crossing, Mid from just above to just below the two Mabury Road crossings, and Lower from the downstream Mabury Road crossing to King Road (**Figure 6**).

All project scenarios show overall greater deposition than existing conditions, which is consistent with more frequent floodplain inundation and deposition resulting from lowering of the existing channel berms and overbank region and reducing the overall level of channel confinement. This effect is especially pronounced in Reach 3 where the 1.5 ft deep bankfull channel scenario is predicted to yield more deposition than the 3 ft deep bankfull channel, and both scenarios are predicted to yield more deposition than existing conditions. Deposition may be more focused in Reach 3 than in Reach 2 under project conditions as this is where the flow first encounters the less confined geometry that traps a sizeable fraction of the sediment delivered from upstream confined reaches followed by progressively less deposition in the downstream direction through Reach 2. **Figure 17** shows an example in Reach 3 of this transition from existing confined channel to much less confined downstream channel given berm lowering.

While increased deposition may be unavoidable given decreased channel confinement under project conditions and the alluvial fan setting, none of the project alternatives shows a magnitude of deposition that is clearly incompatible with the project objectives, even for the longer term 2001-2038 scenario. Additionally, the decreased confinement can facilitate other natural geomorphic processes to occur in response to the deposition, such as avulsion of the bankfull channel within the creek corridor and the spreading of deposition over a wider area, as part of a more dynamic fluvial system in contrast to deposition occurring primarily within the existing confined and static channel. The 1D HEC-RAS model is not capable of simulating avulsion and planform change, but this behavior could occur given patterns observed on other Mediterranean climate rivers.

TABLE 12
MODEL RESULTS FOR REACH 2 AND REACH 3 SCENARIOS FOR 2001-2020 AND A LONGER TERM 2001-2038 SCENARIO (POSITIVE VALUES CORRESPOND TO NET DEPOSITION)

	Creek corridor net volume change (cy)				Average creek corridor net vertical change (ft)			
Scenario	Reach 3	Upper Reach 2	Mid Reach 2	Lower Reach 2	Reach 3	Upper Reach 2	Mid Reach 2	Lower Reach 2
Existing conditions (2001-2020)	2871	6385	2986	630	0.39	0.58	0.20	0.06
3 ft bankfull (2001-2020)	7810	5007	2312	715	1.06	0.45	0.16	0.06
1.5 ft bankfull (2001-2020)	10613	5369	449	137	1.44	0.49	0.03	0.01
Wide low bench (2001-2020)	8577	5758	5554	663	1.17	0.52	0.38	0.06
1.5 ft bankfull (2001-2038)	14165	9770	1917	93	1.92	0.88	0.13	0.01

TABLE 13
MODEL RESULTS FOR REACH 1A AND COYOTE CREEK SCENARIOS FOR 2001-2020 (POSITIVE VALUES CORRESPOND TO NET DEPOSITION)

	Upper Penitencia Reach 1A		Coyote		
Scenario	Creek corridor net volume change (cy)	Average creek corridor net vertical change (ft)	Creek corridor net volume change (cy)	Average creek corridor net vertical change (ft)	Max channel net vertical change (ft)
Existing conditions (2001-2020)	26	0.007	2	0.000	0.359
3 ft bankfull, 90 degree confluence (2001-2020)	91	0.008	6	0.001	0.459
3 ft bankfull, 45 degree confluence (2001-2020)	91	0.008	6	0.001	0.459
1.5 ft bankfull, 90 degree confluence (2001-2020)	182	0.016	2	0.000	0.015
1.5 ft bankfull, 45 degree confluence (2001-2020)	182	0.016	2	0.000	0.015

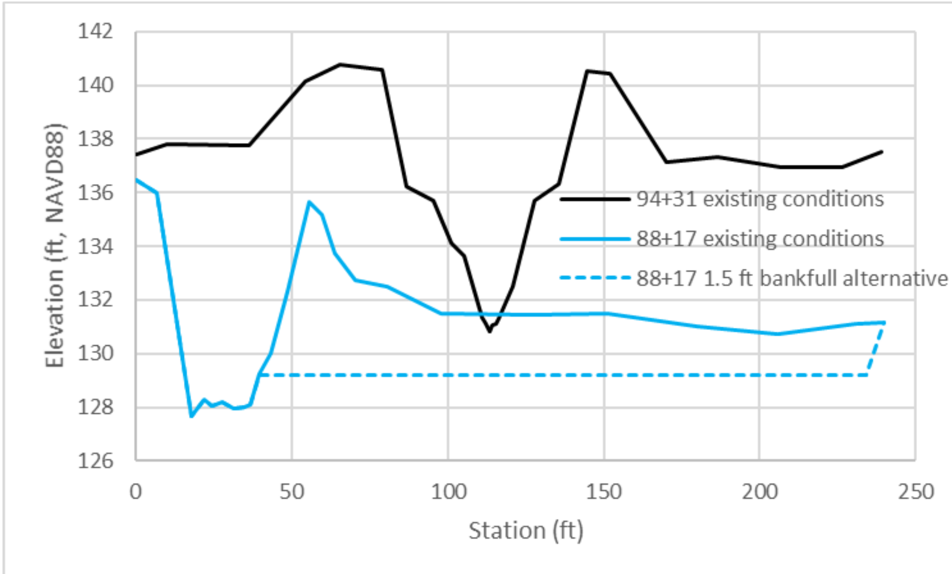


Figure 17
Reach 3 transition from upstream existing confined conditions to downstream unconfined project alternative conditions given berm lowering

Compared to Reaches 2 and 3, very minimal deposition is predicted to occur in Reach 1A and Coyote Creek (**Table 13**), which may be in part due to the sediment trapping potential of the upstream bypass reaches that limits the sediment load delivered to the downstream reaches. Any deposition that does occur in Reach 1A before reaching Coyote could be beneficial if avoiding Coyote deposition is a high priority. In contrast to Reaches 2 and 3, Reach 1A project conditions may also exhibit less planform change over time due to a shallower water table that could support more rapid and denser vegetation colonization of the creek corridor that stabilizes the channel position.

The HEC-RAS 1D model does not predict a different result for the 45 degree versus 90 degree Coyote confluence angle, though the effect of the confluence angle on channel change is better investigated with 2D modeling as described in the following section.

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CHAPTER 6
HEC-RAS 2D Model

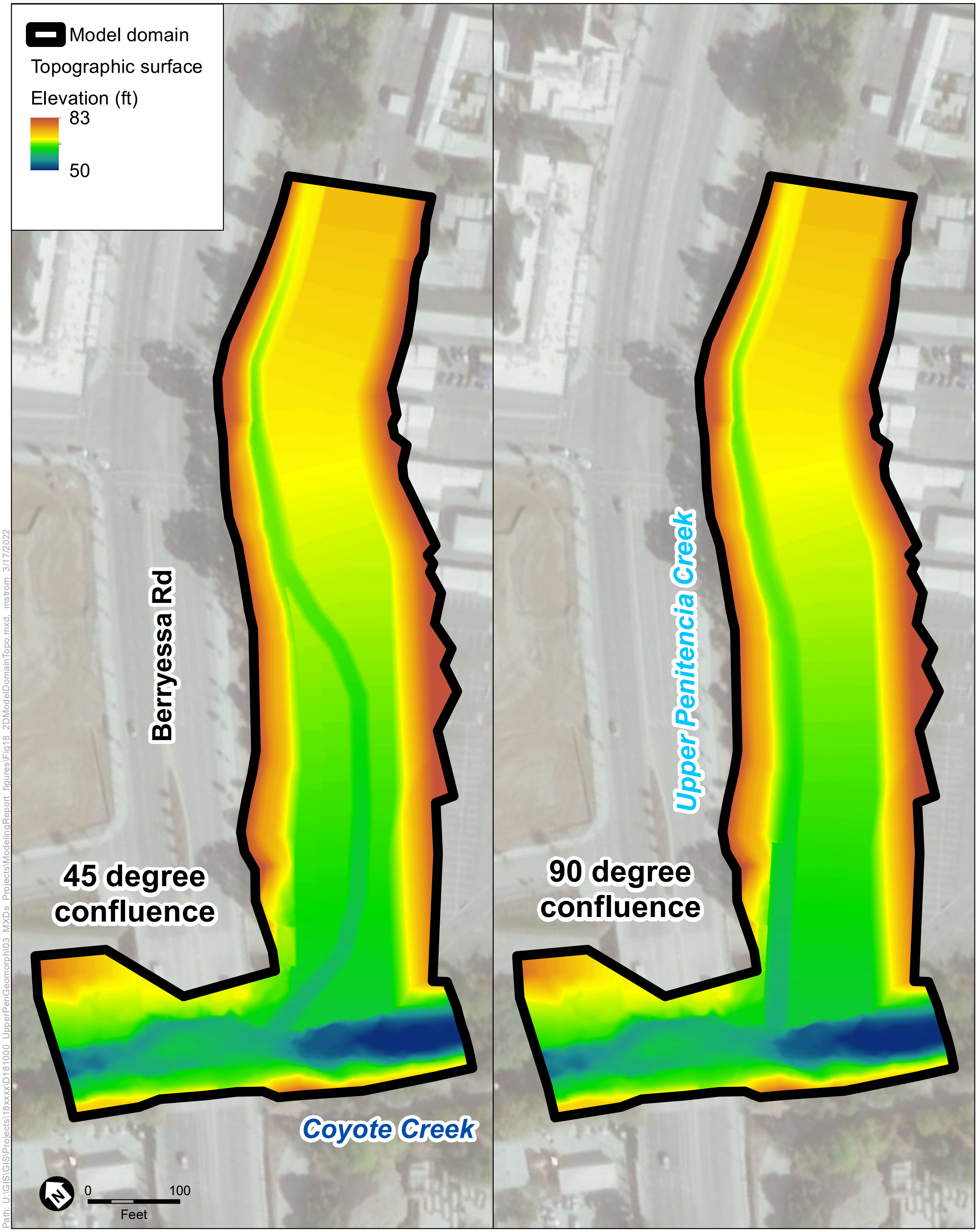
Due to the limitations of the HEC-RAS 1D model when simulating channel change associated with multi-dimensional flow patterns at a confluence, the HEC-RAS 6.0 2D sediment transport model beta was tested to investigate the effect of confluence angle on channel change and to inform whether the confluence angle could be modified to reduce sediment deposition here.

6.1 Model Domain

The model domain for the 2D model was restricted to a limited area of Upper Penitencia and Coyote Creek around the confluence since the confluence itself was the main focus and due to much longer run times compared to the 1D model (**Figure 18**). The upstream extent on Upper Penitencia was also set to provide some spatial buffer relative to the meander bend that could be graded as part of the 45 degree confluence scenario that is under consideration.

6.2 Topographic Data

The topographic data sources for the surfaces shown in **Figure 18** were 2020 Valley Water surveys of cross sections on Upper Penitencia and detailed breaklines on Coyote around the confluence. The Upper Penitencia cross sections were interpolated into a continuous surface, and project conditions features were graded including an expanded floodplain on creek left, a meander bend for the 45 degree confluence scenario, and removal of the culvert at the downstream end of Upper Penitencia. While structure data were available for this existing culvert, no existing conditions scenario was simulated due to high uncertainty about the ability of the beta 2D sediment transport model to also handle structures within the mesh. The high span of Berryessa Road meant that the surface adequately represented conditions here without the need for a structure given that open channel flow occurs over most discharges.



SOURCE: ESA 2022

Upper Penitencia Creek

Figure 18
2D model domain and topographic surfaces

ESA

6.3 Hydrologic Data

In contrast to the long term simulation that was performed with the 1D model, the long run time of the 2D model required event based simulation. While different combinations of Upper Penitencia and Coyote hydrograph timings are possible depending on the storm centering, peak Coyote flow appears to typically lag behind peak Upper Penitencia flow due to the larger watershed area of Coyote Creek. Therefore, a synthetic hydrograph was generated for the model to investigate the effect of this typical hydrologic relationship on channel change at the confluence (**Figure 19**). In this synthetic hydrograph, Upper Penitencia peaks at the maximum flow recorded for 2001-2020, which is less than a 10-year flood, and the flood wave is allowed to completely pass before the Coyote flood wave arrives and also peaks at less than a 10-year flood. In reality, the two hydrographs would overlap to some degree, but for this exercise the end member of no overlap was simulated to see how Coyote flows interact with the sediment once the Upper Penitencia flood wave has fully delivered the sediment load. A normal depth downstream boundary condition was set for Coyote.

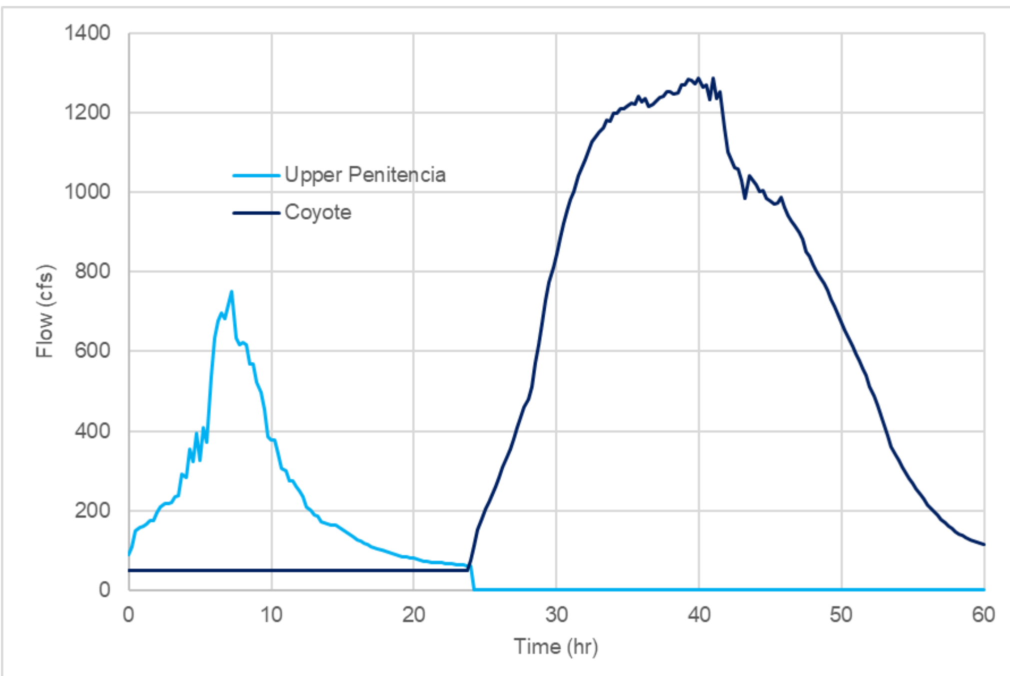


Figure 19
Upper Penitencia and Coyote hydrographs

6.4 Sediment Data

The coarse sediment size of the existing deposit at the confluence suggests that Upper Penitencia is likely the main source, and therefore the fate of sediment originating from Upper Penitencia was of primary interest for the modeling. Therefore, all of Coyote was set to nonerodible with no incoming sediment load to avoid possible confounding model artifacts associated with the simulated transport of sediment sourced from Coyote while still allowing sediment sourced from Upper Penitencia to deposit or redistribute at and downstream of the confluence. The same Jordan (2009) Upper Penitencia pavement gradation as that used in this area of the 1D model was used for Upper Penitencia in the 2D model, i.e. the 25 pavement gradation shown in **Figure 11**. An equilibrium load boundary condition was set at the upstream end of Upper Penitencia.

6.5 Maximum Erosion Depth

As with the 1D model, a maximum erosion depth of 5 ft was set for Upper Penitencia, while as referenced above, all of Coyote was set to nonerodible to avoid introducing Coyote sediment that may confound the interpretation of how Upper Penitencia sediment deposits around the confluence.

6.6 Roughness

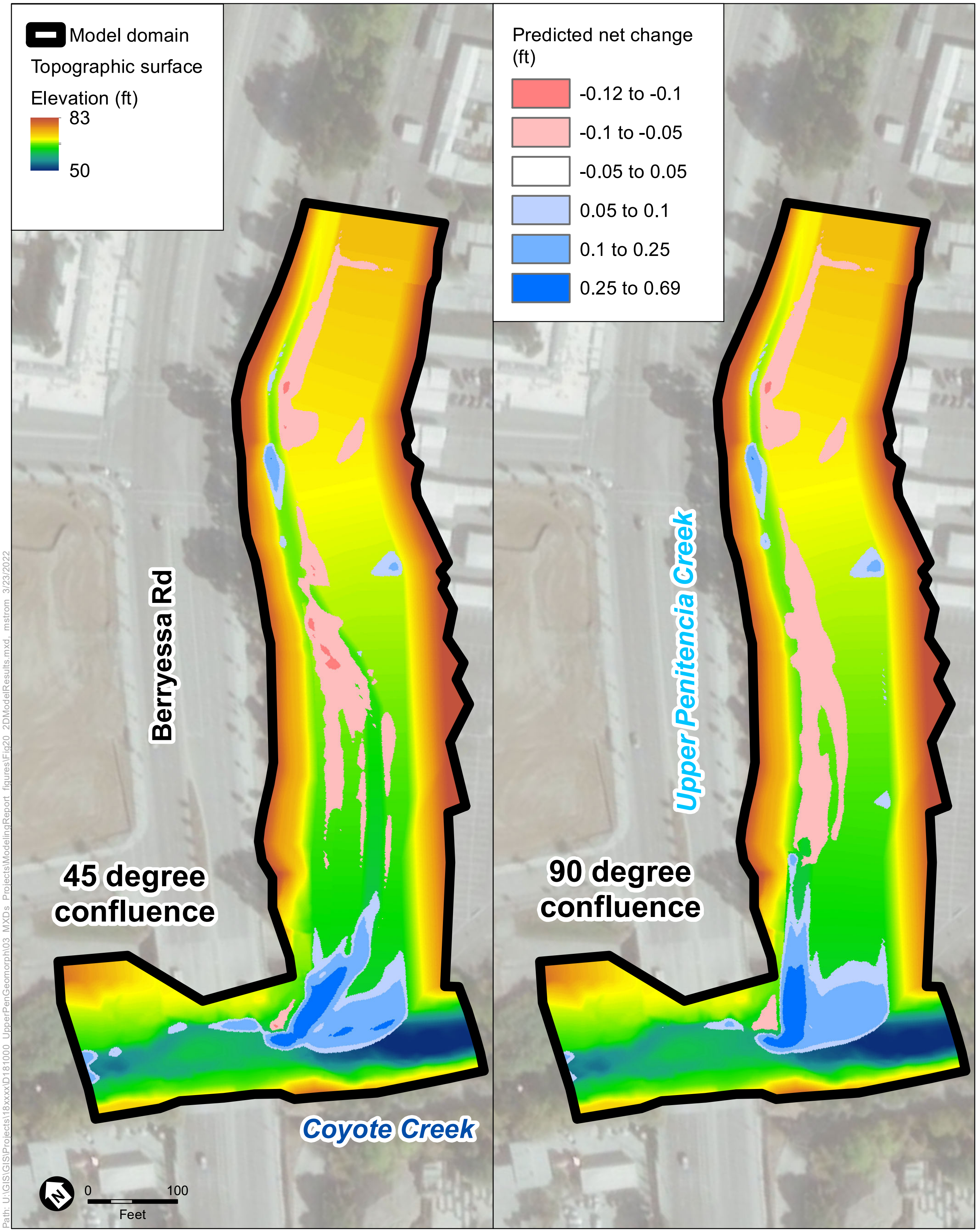
A simple binary roughness distribution was used for this exploratory model testing with a uniform 0.06 across Upper Penitencia in reference to that used in the 1D model and a uniform 0.1 across Coyote. While dense vegetation is present along the banks of Coyote, 0.1 is likely an overestimate; however, due to model bugs and instability noted in relation to the Coyote downstream boundary, the higher roughness was needed to maintain realistic Coyote stage and velocities.

6.7 Results

The use of event based rather than long term simulation with the 2D model creates some uncertainty with the interpretation of the results as far as a possible long term trend. Nevertheless, the 2D modeling is still useful given the much greater spatial resolution of the hydraulics and sediment transport compared to the 1D model.

Figure 20 shows the predicted net channel change associated with the synthetic flood event for the 45 and 90 degree confluence angle scenarios. In both scenarios, sediment sourced from Upper Penitencia deposits along the right bank of Coyote Creek around the confluence as well as within the Upper Penitencia bankfull channel where much of the sediment is being transported from upstream. A longer simulation spanning many events of different magnitude could show more deposition within Coyote as is evident in the field.

The abrupt decrease in channel slope associated with the transition from the steeper Upper Penitencia to the flatter Coyote appears responsible for the deposition of coarse sediment around the confluence. The confluence angle is predicted to just slightly shift the position of the deposit but not significantly affect the size and magnitude of the deposit. This result is consistent with Coyote sediment transport capacity as likely being the main driver of confluence deposition as once Upper Penitencia sediment enters the confluence region, regardless of confluence angle, finer material may wash downstream but much of the cobble load will deposit due to predicted insufficient transport capacity.



SOURCE: ESA 2022

Upper Penitencia Creek

Figure 20
2D model predicted net topographic change

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CHAPTER 7
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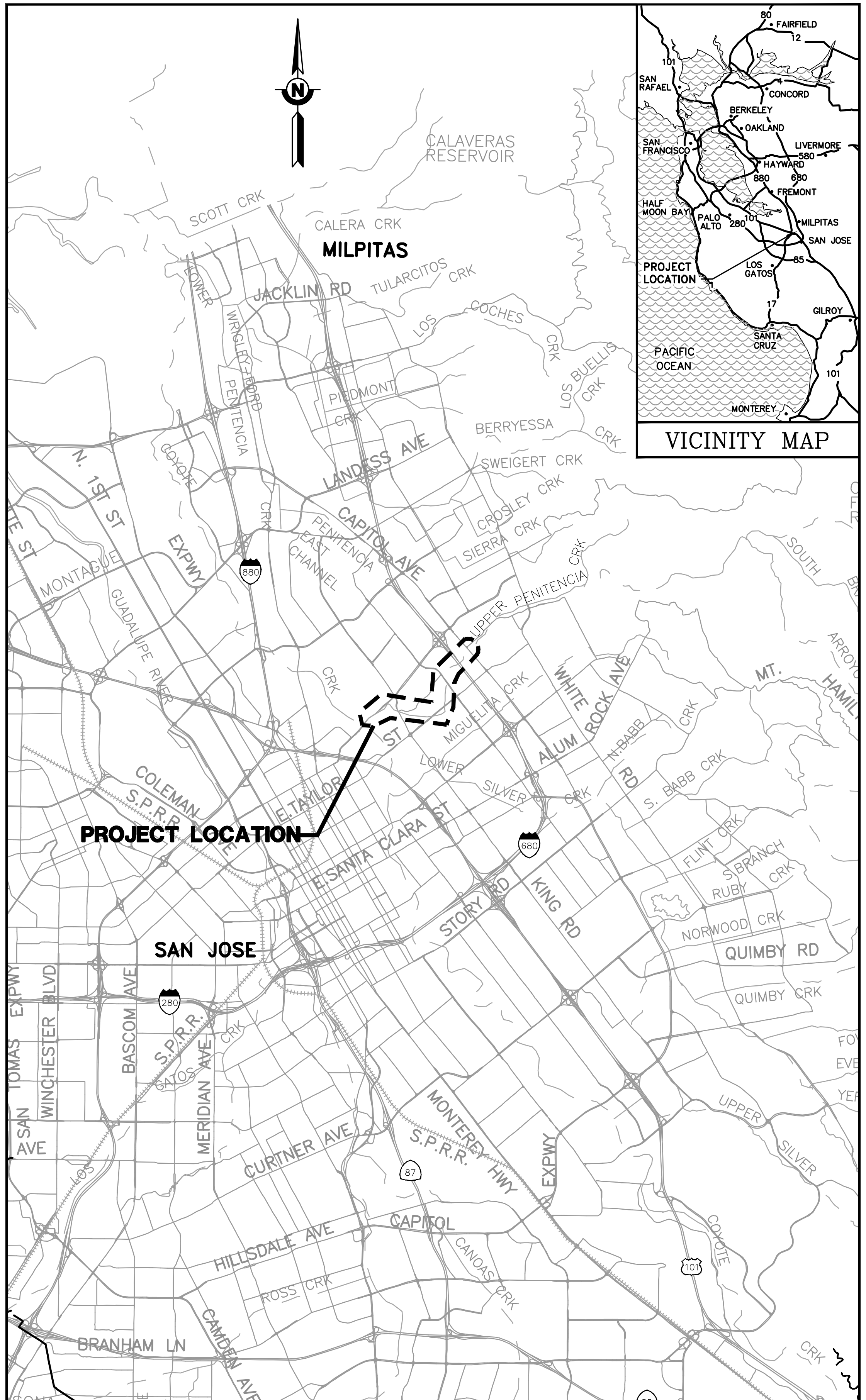


LOCATION MAP
SCALE: 1" = 5,000'

MAP AND CONSTRUCTION PLAN

FOR

UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT

COYOTE CREEK CONFLUENCE TO CAPITOL AVE

SAN JOSE, CALIFORNIA

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

APPROVED BY:

NAME DATE
TITLE – DIVISION
SANTA CLARA VALLEY WATER DISTRICT

NAME
TITLE – DIVISION
SANTA CLARA VALLEY WATER DISTRICT

REGISTERED PROFESSIONAL ENGINEER
Engineers Name
No. PE Lic No
Exp. Expiration Date
CIVIL
STATE OF CALIFORNIA

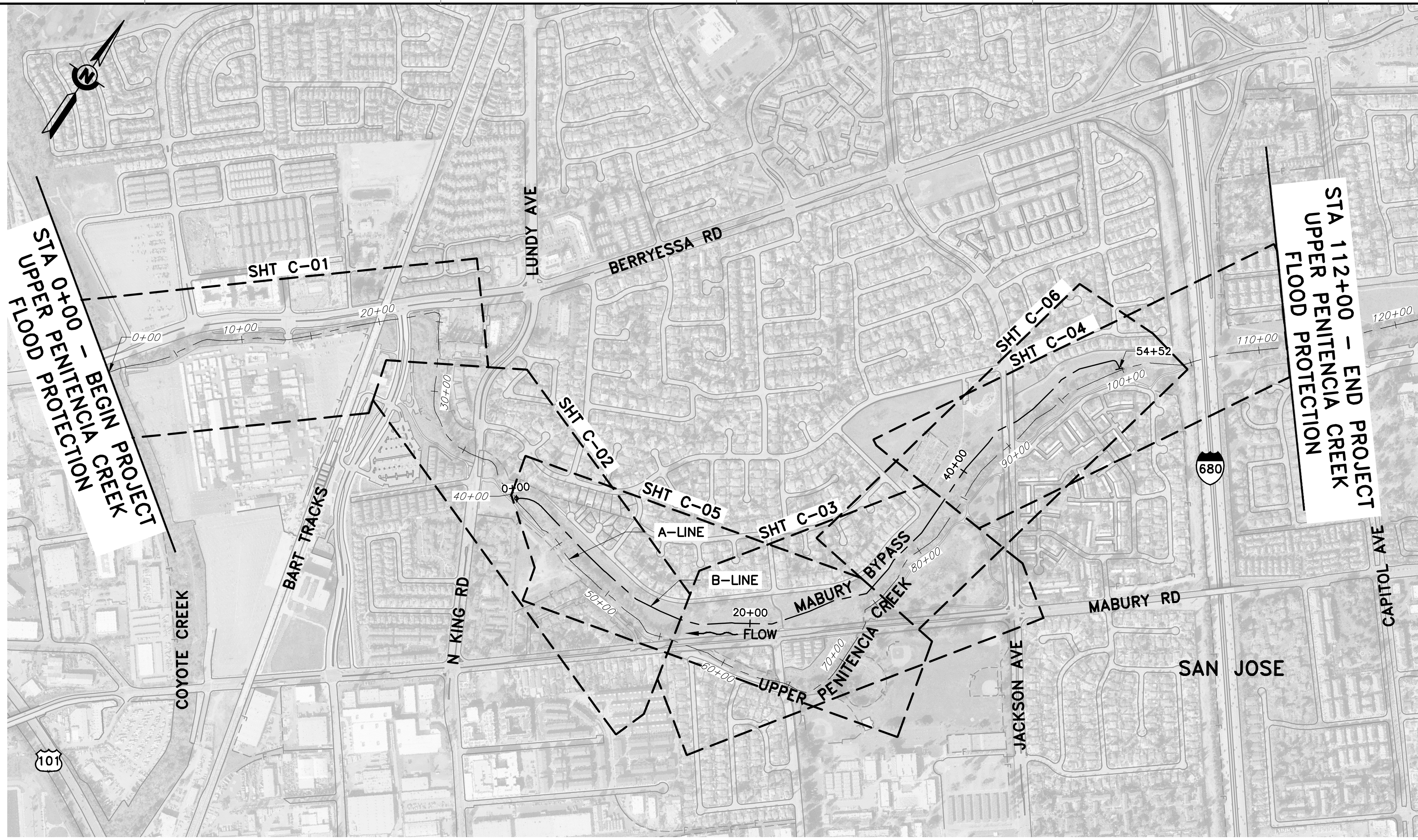
ACCEPTED BY:

NAME
TITLE – DIVISION
SANTA CLARA VALLEY WATER DISTRICT

PRELIMINARY
OCTOBER 2021

CONTRACT NUMBER	C-XXXXX
PROJECT NUMBER	26324001
SHEET CODE:	G-01
SHEET NUMBER:	1 OF 16

DOCUMENT NUMBER: PEL_CY-G-4032-XXXXX



INDEX MAP

SCALE: 1" = 500'

DRAWING INDEX

SHEET CODE	DESCRIPTION	SHEET NUMBER
	GENERAL	
G-01	LOCATION MAP AND TITLE SHEET	1 OF 16
G-02	DRAWING INDEX, INDEX MAP AND GENERAL NOTES	2 OF 16
G-03	ABBREVIATIONS, LEGEND AND SYMBOLS	3 OF 16
	DEMOLITION	
D-01	A-LINE DEMOLITION STA 0+00 TO 28+00	4 OF 16
D-02	A-LINE DEMOLITION STA 28+00 TO 84+00	5 OF 16
D-03	A-LINE DEMOLITION STA 84+00 TO 112+00	6 OF 16
	CIVIL	
C-01	A-LINE PLAN AND PROFILE STA 0+00 TO 28+00	7 OF 16
C-02	A-LINE PLAN AND PROFILE STA 28+00 TO 56+00	8 OF 16
C-03	A-LINE PLAN AND PROFILE STA 56+00 TO 84+00	9 OF 16
C-04	A-LINE PLAN AND PROFILE STA 84+00 TO 112+00	10 OF 16
C-05	B-LINE PLAN AND PROFILE STA 0+00 TO 28+00	11 OF 16
C-06	B-LINE PLAN AND PROFILE STA 28+00 TO 53+34	12 OF 16
C-07	TYPICAL CROSS SECTIONS	13 OF 16
C-08	TYPICAL CROSS SECTIONS	14 OF 16
C-09	TYPICAL CROSS SECTIONS	15 OF 16
C-10	TYPICAL CROSS SECTIONS	16 OF 16

GENERAL NOTES

DESIGN NOTES

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DOCUMENT NUMBER: PEL_CY-G-4032-XXXXX

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY OCTOBER 2021		

REFERENCE INFORMATION AND NOTES
1. AERIAL IMAGE PROVIDED BY 2020 COUNTY OF SANTA CLARA; THE SANBORN MAP CO.

DATE	JUN 2020
DESIGN	G. VALLIN
DRAWN	J. CORDOVA
CHECKED	X.X.X.

ENGINEERING CERTIFICATION

ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT

DRAWING INDEX, INDEX MAP AND GENERAL NOTES

SCALE: AS SHOWN

VERIFY SCALES
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PROJECT NUMBER: 26324001

SHEET CODE: G-02

SHEET NUMBER: 2 OF 16

ABBREVIATIONS

ABM – AIR BLOWN MORTAR
ABS – ACRYLONITRILE–BUTADIENCE–STYRENE
AC – ASPHALT CONCRETE
ACP – ASBESTOS CEMENT PIPE
AISI – AMERICAN IRON & STEEL INSTITUTE
ALIGN – ALIGNMENT
AMP – AMPERES
ANSI – AMERICAN NATIONAL STANDARDS INSTITUTE
APPROX – APPROXIMATE
ARV – AIR RELEASE VALVE
ASA – AMERICAN STANDARD ASSOCIATION
ASTM – AMERICAN SOCIETY FOR TESTING MATERIALS
AWG – AMERICAN WIRE GAGE
AWWA – AMERICAN WATER WORKS ASSOCIATION

BC – BEGIN CURVE
BM – BENCH MARK
BT – BACKHOE TRENCH
BRG – BRIDGE
BW – BOTH WAYS

℄ – CENTERLINE
CB – CATCH BASIN (INLET)
CCCL – CEMENT MORTAR COATED & LINED STEEL PIPE
CCEM – CEMENT CONDUIT
CCTL – CORROSION CONTROL TEST LEADS
CCP – CONCRETE CYLINDER PIPE
CFM – CUBIC FEET PER MINUTE
CI – CAST IRON
CIP – CAST IRON PIPE
CL – CLEARANCE
CLR – CLEAR
CMC – CEMENT MORTAR COAT
CML – CEMENT MORTAR LINE
CMP – CORRUGATED METAL PIPE
CO – CLEAN OUT
CONC – CONCRETE
CONT – CONTINUOUS
CP – CEMENT PIPE
CPC – PLASTIC CONDUIT
CSP – CORRUGATED STEEL PIPE
CTP – CABLE TELEVISION POLE
CTV – CABLE TV
CU FT – CUBIC FEET
CYL – CYLINDER
CIPP – CAST–IN–PLACE PIPE

DET – DETAIL
DH – DRILL HOLES
DIA – DIAMETER
DICL – DUCTILE IRON CEMENT LINED
DIP – DUCTILE IRON PIPE
DPDT – DOUBLE POLE DOUBLE THROW
D/S – DOWNSTREAM
DWR – DEPARTMENT OF WATER RESOURCES

EC – END CURVE
ELEC – ELECTRICAL
EL – ELEVATION
ELEV – ELEVATION
EP – EDGE OF PAVEMENT
EXIST – EXISTING

FF – FULL FORCE
FH – FIRE HYDRANT
FKCL – FIBERGLASS–KRAFT WRAP CEMENT LINED
FLG – FLANGE
FP – FEEDER PRESSURE
FT – FEET

GA – GAGE
GALV – GALVANIZED
GFI – GROUND FAULT INTERRUPTER

HC – HOUSE CONNECTION (SANITARY)
HMW/PE – HIGH MOLECULAR WEIGHT POLYETHYLENE
HORIZ – HORIZONTAL
HP – HORSEPOWER

ID – INSIDE DIAMETER
IF – INSIDE FACE
IL – INDUCTIVE LOOP
IN – INCH
INSUL – INSULATION
INV – INVERT
IP – IRON PIPE
IPS – IRON PIPE SIZE

JT – JOINT TRENCH

KV – KILO VOLT

LB – CONDUIT FITTING ELBOW
LG – LONG
LLV – LONG LEG VERTICAL
LT – LEFT

MAINT – MAINTENANCE
MAX – MAXIMUM
MCD – MULTIPLE CONDUITS
MCI – MCI TELECOMMUNICATION CORP.
MH – MANHOLE
MIN – MINIMUM
MON – MONUMENT
MW – MONITORING WELL

N – NITROGEN
N/A – NOT APPLICABLE
NE – NORTHEAST
NEMA – NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NO – NUMBER
NTS – NOT TO SCALE
NW – NORTHWEST

OC – ON CENTER
OD – OUTSIDE DIAMETER
OF – OUTSIDE FACE
OH – OVERHEAD
OW – OBSERVATION WELL

℘ – PROPERTY LINE
PCC – PORTLAND CEMENT CONCRETE
PCCP – PRESTRESSED CONCRETE CYLINDER PIPE
PE – PLAIN END
PG&E – PACIFIC GAS AND ELECTRIC
PI – POINT OF INTERSECTION
PK – PARKER–KALON SURVEY NAIL
PL – PLASTIC LINE
POT – POINT ON TANGENT
PP – POWER POLE
PRC – POINT OF REVERSE CURVE
PSI – POUND PER SQUARE INCH
PT&T – PACIFIC TELEPHONE AND TELEGRAPH
PUE – PUBLIC UTILITY EASEMENT
PV – PRECAST VAULT
PVC – POLYVINYL CHLORIDE
PVMT – PAVEMENT
PW – PUMPING WELL

R – RADIUS
RCB – REINFORCED CONCRETE BOX
RCP – REINFORCED CONCRETE PIPE
RE – REFERENCE ELECTRODE
REBAR – REINFORCING BAR
REINF – REINFORCED
REQ'D – REQUIRED
RR – RAILROAD
RT – RIGHT
RTU – REMOTE TERMINAL UNIT
R/W – RIGHT OF WAY

S – SLOPE
SCHED – SCHEDULE
SCVWD – SANTA CLARA VALLEY WATER DISTRICT
SD – STORM DRAIN
SE – SOUTHEAST
SEC – SECTION
SHT – SHEET

SJMW – SAN JOSE MUNICIPAL WATER
SJWC – SAN JOSE WATER COMPANY
SOMCL – STANDARD OIL MASTIC CEMENT LINED
SPECS – SPECIFICATIONS
SPRR – SOUTHERN PACIFIC RAILROAD
SQ – SQUARE
SS – SANITARY SEWER
SSTL – STAINLESS STEEL
ST – STREET
STA – STATION
STD – STANDARD
STL – STEEL
STRD – STRANDED
SW – SOUTHWEST
SYM – SYMMETRICAL

T – TELEPHONE
t – THICKNESS OF PLATE OR DIMENSION OF WELD
TBM – TEMPORARY BENCH MARK
TC – TELEMETRY CABLE
TCA – TEMPORARY CONSTRUCTION AREA
TCE – TEMPORARY CONSTRUCTION EASEMENT
TCS – TELEMETRY CABLE SPLICE
TEL – TELEPHONE
THW – THERMAL PLASTIC MOISTURE AND HEAT RESISTANT
THWN – THERMAL PLASTIC WITH NYLON COATING MOISTURE AND HEAT RESISTANT
TOB – TOP OF BANK
TP – TEST PIT LOCATION
TR – TAPE WRAPPED
TS – TRAFFIC SIGNAL
TYP – TYPICAL

UG – UNDERGROUND
UPRR – UNION PACIFIC RAILROAD
U/S – UPSTREAM
USGS – UNITED STATES GEOLOGICAL SURVEY

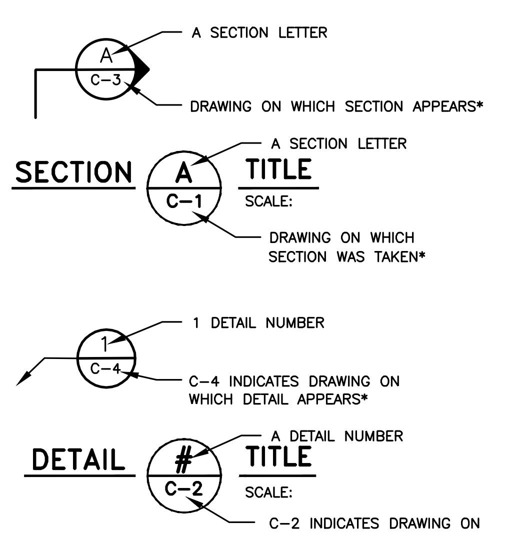
V – VOLTAGE
VAC – VOLTAGE ALTERNATING CURRENT
VCD – VACANT CONDUIT
VCP – VITRIFIED CLAY PIPE
VERT – VERTICAL

W – WATER
WP – WORK POINT
WSE – WATER SURFACE ELEVATION
WSP – WELDED STEEL PIPE
WSCL – WRAPPED STEEL CEMENT LINED
WV – WATER VALVE
WWF – WELDED WIRE FABRIC
W/ – WITH

& – AND
@ – AT
℄ – CENTERLINE
Ø – DIAMETER
℘ – PROPERTY LINE

DETAIL AND SECTION DESIGNATION

* IF SECTION OR DETAIL APPEARS ON THE SAME DRAWING AS THE CALLOUT, THE DRAWING REFERENCE IS REPLACED WITH A DASH (–)



LINE TYPE LEGEND

EXISTING / PROPOSED

℄ CABLE TELEVISION
℄ ELECTRICAL LINE
℄ ELECTRICAL & TELEPHONE LINE
℄ ELECTRICAL LINE – OVERHEAD
℄ GAS LINE
℄ IRRIGATION LINE
℄ STORM DRAIN LINE
℄ SANITARY SEWER LINE
℄ TELEPHONE LINE
℄ TELEPHONE LINE – OVERHEAD
℄ TRAFFIC SIGNAL LINE
℄ TELEMETRY LINE
℄ WATER LINE
℄ RECYCLED WATER LINE
℄ BARBED WIRE FENCE LINE
℄ CHAIN LINK FENCE LINE
℄ WOODEN FENCE LINE
CUT OR FILL SLOPE (TOP / TOE)
CENTER LINE
CENTER LINE
GROUND
TOP OF NORTH BANK
TOP OF SOUTH BANK
LOWER FLOODBENCH
FLOODWALL
PROPERTY–LINE
ROW–TRACT
ROW–FEE
TCE
LOT LINE
BOUNDARY LINE

SURVEY

HORIZONTAL CONTROL
VERTICAL CONTROL
HORIZONTAL VERTICAL CONTROL
TEMPORARY BENCH MARK

TRAFFIC CONTROL

SIGN–1
SIGN–2
BUS STOP
TRAFFIC DIRECTION
TRAFFIC CONE
CONSTRUCTION SIGN
FLASHING ARROW SIGN
TYPE I – TRAFFIC BARRICADE
TYPE III – TRAFFIC BARRICADE
K–RAIL BARRIER

MISCELLANEOUS

ELECTROLIER
ELECTROLIER
GUY WIRE
STORM DRAIN OUTFALL

SYMBOLS LEGEND

EXISTING	PROPOSED
EXISTING JOINT POLE	PROPOSED JOINT POLE
EXISTING POWER POLE	PROPOSED POWER POLE
EXISTING TELEPHONE POLE	PROPOSED TELEPHONE POLE
EXISTING ELECTRICAL MANHOLE	PROPOSED ELECTRICAL MANHOLE
EXISTING ELECTRIC METER	PROPOSED ELECTRIC METER
EXISTING STORM DRAIN MANHOLE	PROPOSED STORM DRAIN MANHOLE
EXISTING CATCH BASIN / SD INLET	PROPOSED CATCH BASIN / SD INLET
EXISTING SANITARY CLEANOUT	PROPOSED SANITARY CLEANOUT
EXISTING SANITARY MANHOLE	PROPOSED SANITARY MANHOLE
EXISTING TELEPHONE MANHOLE	PROPOSED TELEPHONE MANHOLE
EXISTING WATER VALVE	PROPOSED WATER VALVE
EXISTING WATER METER	PROPOSED WATER METER
EXISTING BLOWOFF	PROPOSED BLOWOFF
EXISTING FIRE HYDRANT	PROPOSED FIRE HYDRANT
EXISTING GAS VALVE	PROPOSED GAS VALVE
EXISTING GAS METER	PROPOSED GAS METER
EXISTING DEEP ANODE BED	PROPOSED DEEP ANODE BED
EXISTING REFERENCE ELECTRODE TEST STATION	PROPOSED REFERENCE ELECTRODE TEST STATION
EXISTING INSULATION JOINT	PROPOSED INSULATION JOINT
EXISTING PRECAST VAULT	PROPOSED PRECAST VAULT
EXISTING TELEMETRY CABLE PULLBOX	PROPOSED TELEMETRY CABLE PULLBOX
EXISTING VENTILATION STRUCTURE	PROPOSED VENTILATION STRUCTURE
EXISTING TREE	PROPOSED TREE

SHAPE HATCH LEGEND

PROPOSED HIGH FLOOD BENCH
PROPOSED MID FLOOD BENCH
PROPOSED LOW FLOOD BENCH
PROPOSED PEDESTRIAN BRIDGE
REMOVAL
PROPOSED MAINTENANCE ROADS
PROPOSED TRAIL AND MAINTENANCE ROAD
PROPOSED TRAIL
REMOVAL

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DOCUMENT NUMBER: PEL_CY–G–4032–XXXXX

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY OCTOBER 2021		

REFERENCE INFORMATION AND NOTES

DATE: JUN 2020
DESIGN: G. VALLIN
DRAWN: J. CORDOVA
CHECKED: X.X.X.

ENGINEERING CERTIFICATION
ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT
Valley Water

PROJECT NAME AND SHEET DESCRIPTION:
UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT
ABBREVIATIONS, LEGEND AND SYMBOLS

SCALE: AS SHOWN
VERIFY SCALES: 0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26324001
SHEET CODE: G–03
SHEET NUMBER: 3 OF 16

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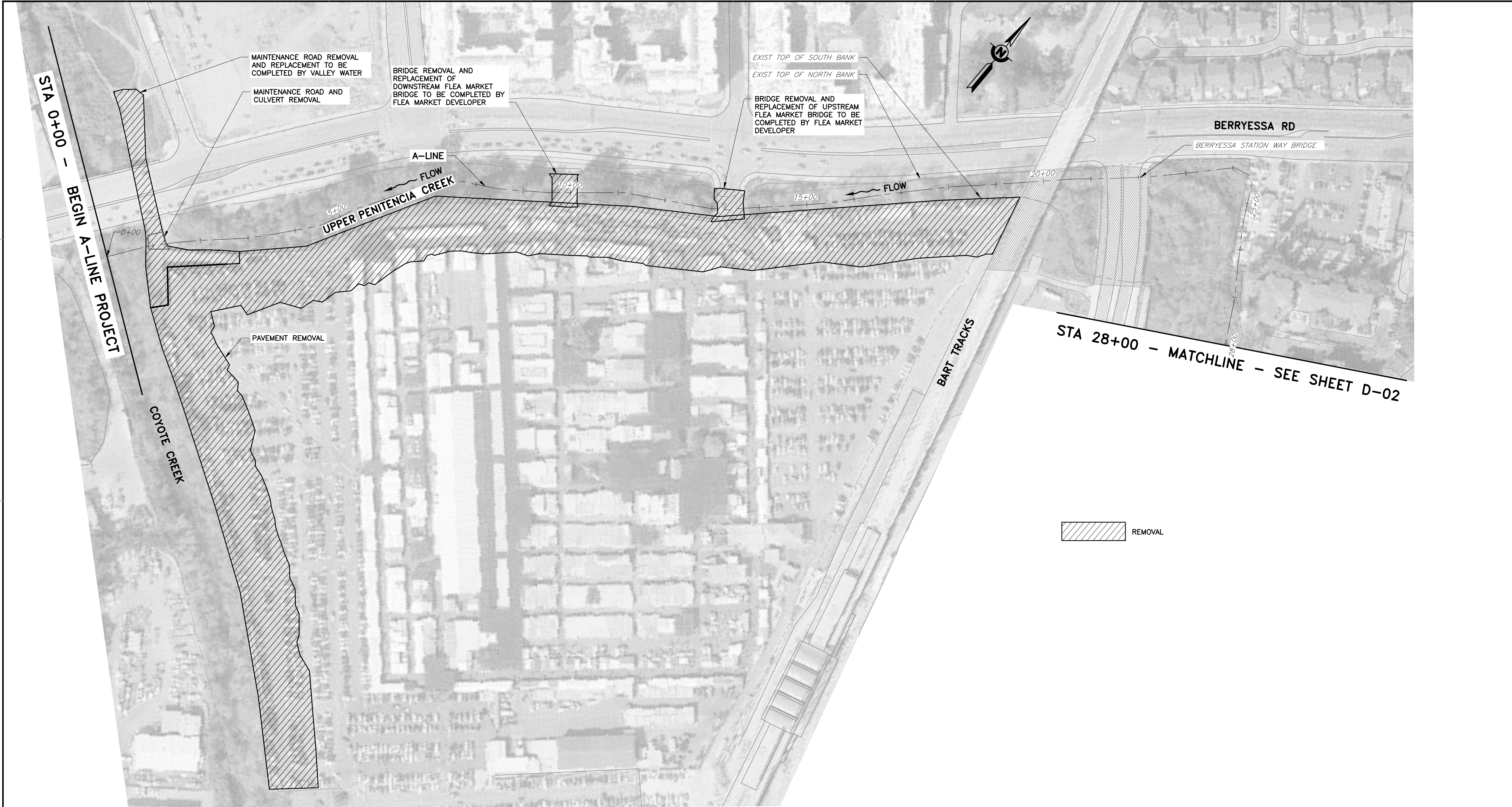

PLAN

SCALE: 1" = 100'

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY OCTOBER 2021		

REFERENCE INFORMATION AND NOTES

1. AERIAL IMAGE PROVIDED BY 2020 COUNTY OF SANTA CLARA; THE SANBORN MAP CO.

DATE: JUN 2020
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DRAWN: J. CORDOVA
CHECKED: X.X.X.

ENGINEERING CERTIFICATION

ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT

A-LINE DEMOLITION PLAN STA 0+00 TO 28+00

SCALE: AS SHOWN

VERIFY SCALES: 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26324001

SHEET CODE: D-01

SHEET NUMBER: 4 OF 16

DOCUMENT NUMBER: PEL_CY-C-4032-XXXXX

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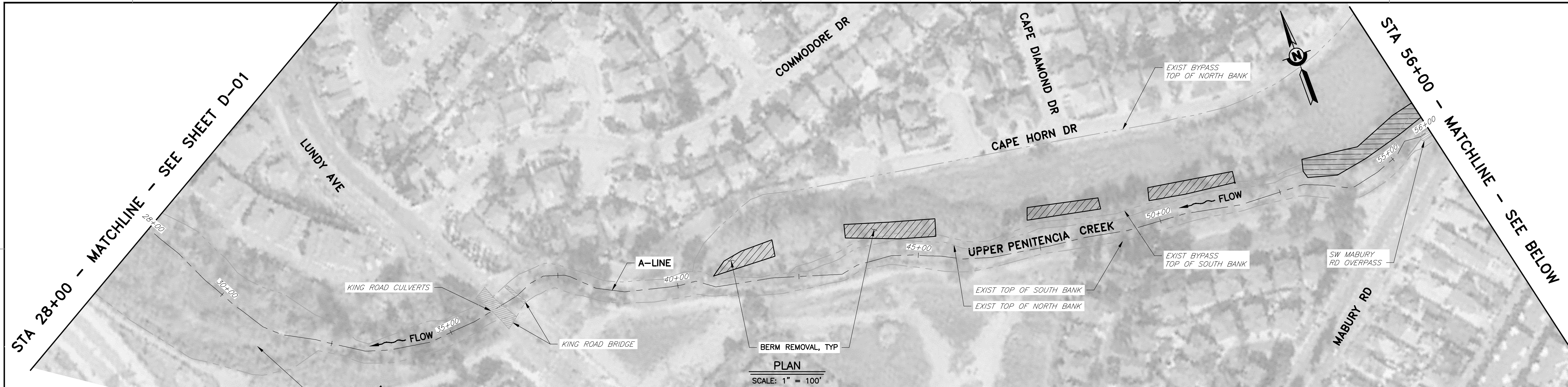

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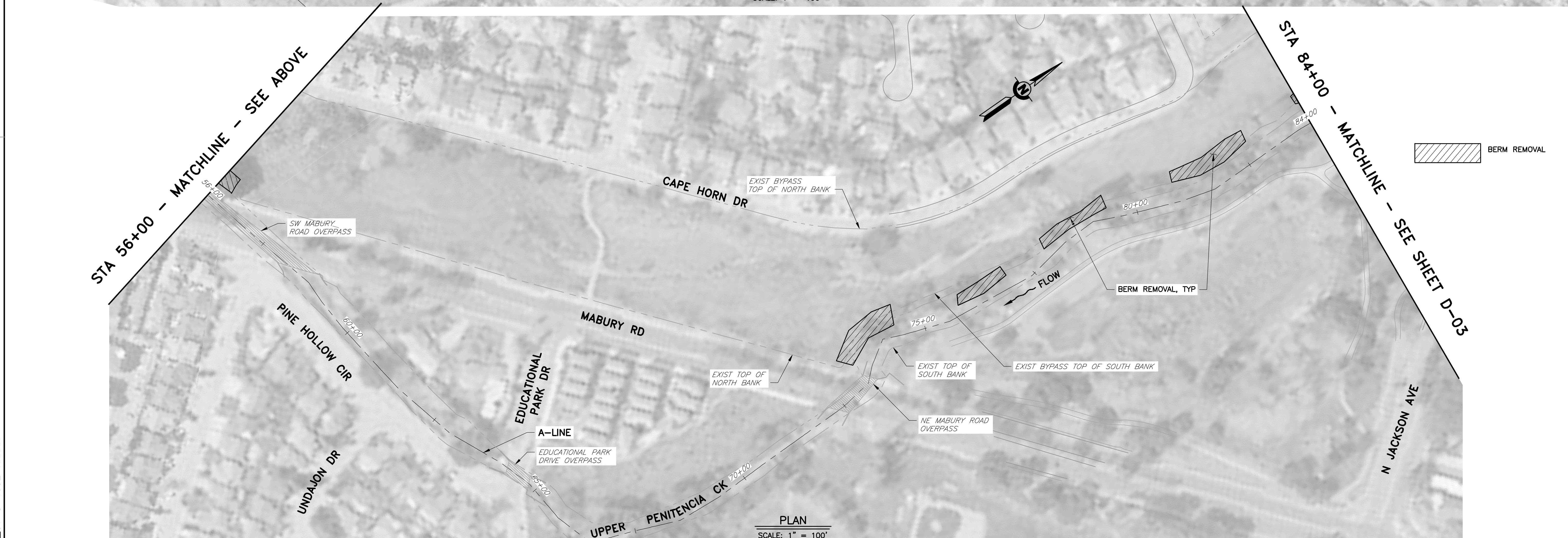

PLAN
SCALE: 1" = 100'

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY OCTOBER 2021		

REFERENCE INFORMATION AND NOTES

1. AERIAL IMAGE PROVIDED BY 2020 COUNTY OF SANTA CLARA; THE SANBORN MAP CO.

DATE	
JUN 2020	
DESIGN	G. VALLIN
DRAWN	J. CORDOVA
CHECKED	X.X.X.

ENGINEERING CERTIFICATION

ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT

A-LINE DEMOLITION PLAN STA 28+00 TO 84+00

SCALE: AS SHOWN

VERIFY SCALES
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26324001

SHEET CODE: D-02

SHEET NUMBER: 5 OF 16

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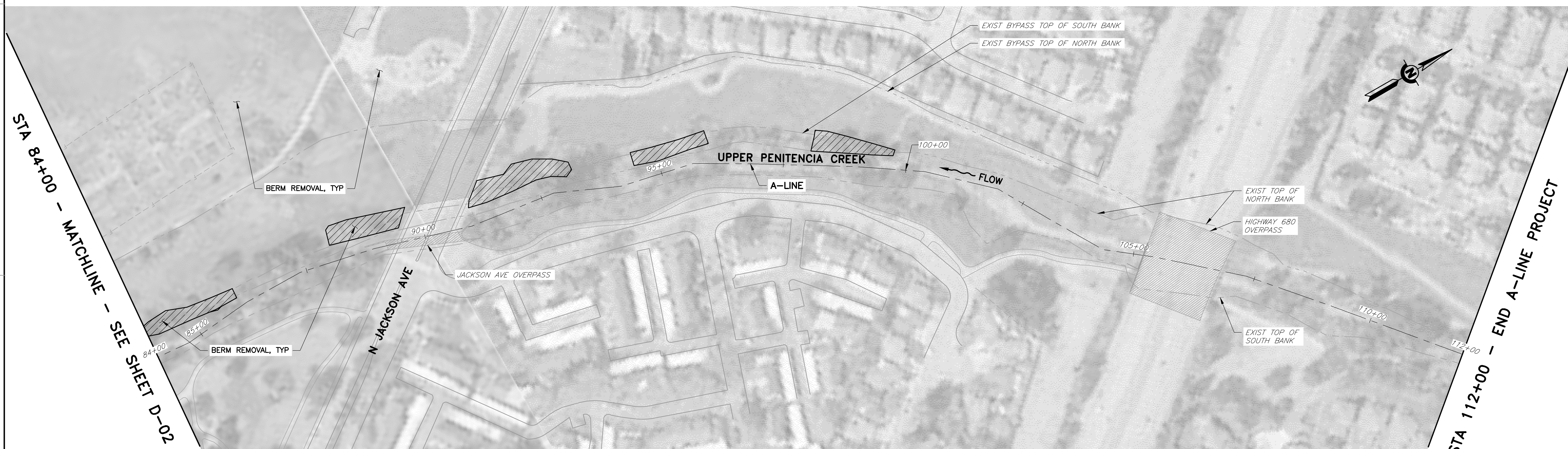

BERM REMOVAL

PLAN

SCALE: 1" = 100'

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY OCTOBER 2021		

REFERENCE INFORMATION AND NOTES

1. AERIAL IMAGE PROVIDED BY 2020 COUNTY OF SANTA CLARA; THE SANBORN MAP CO.

DATE	JUN 2020
DESIGN	G. VALLIN
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CHECKED	X.X.X.

ENGINEERING CERTIFICATION

ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT

A–LINE DEMOLITION PLAN STA 84+00 TO 112+00

SCALE: AS SHOWN

VERIFY SCALES 0 1"

BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26324001

SHEET CODE: D–03

SHEET NUMBER: 6 OF 16

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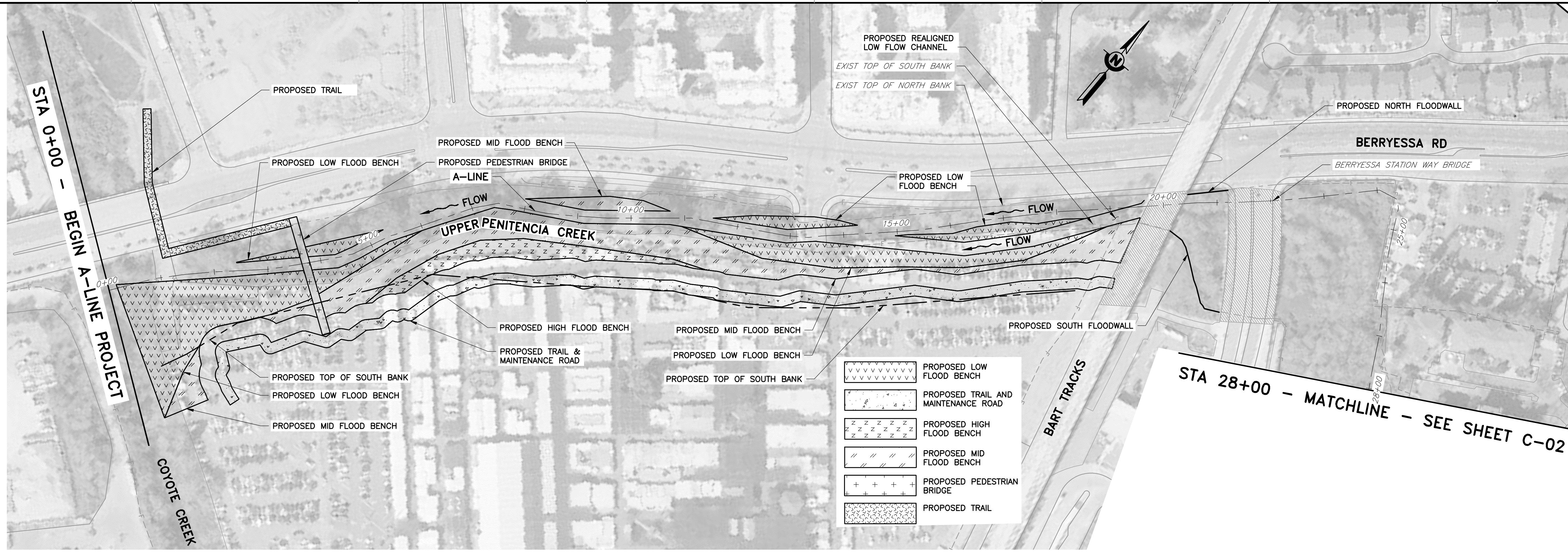

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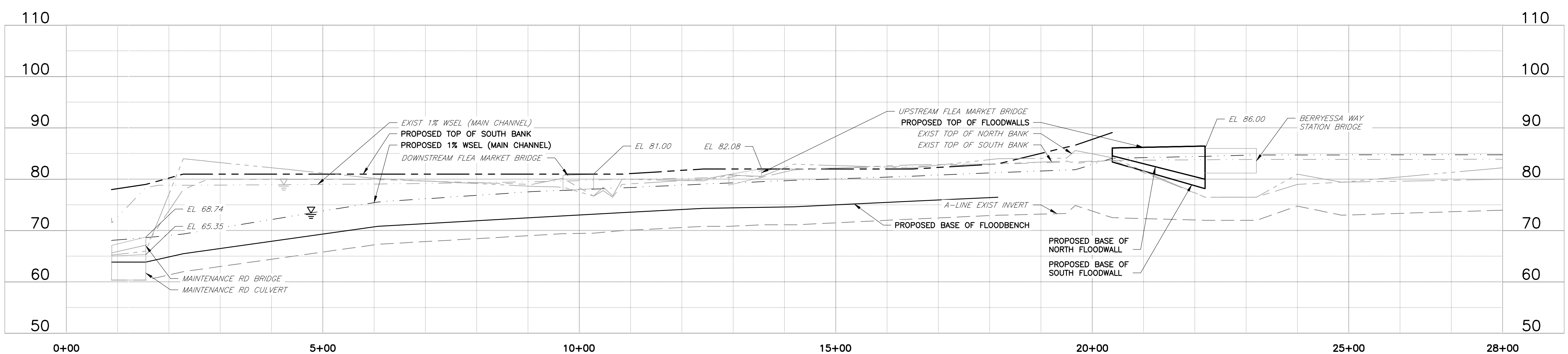

PROFILE
HORIZ: 1" = 100'
VERT: 1" = 10'

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY OCTOBER 2021		

REFERENCE INFORMATION AND NOTES
1. A-LINE DESIGN FLOW RATE IS 2000 CFS.
2. PROFILES WERE GENERATED USING HEC-RAS.
3. AERIAL IMAGE PROVIDED BY 2020 COUNTY OF SANTA CLARA; THE SANBORN MAP CO.

DATE: JUN 2020
DESIGN: G. VALLIN
DRAWN: J. CORDOVA
CHECKED: X.X.X.

ENGINEERING CERTIFICATION
ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT
Valley Water

PROJECT NAME AND SHEET DESCRIPTION:
UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT
A-LINE PLAN AND PROFILE
STA 0+00 TO 28+00

SCALE: AS SHOWN
VERIFY SCALES: 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
PROJECT NUMBER: 26324001
SHEET CODE: C-01
SHEET NUMBER: 7 OF 16

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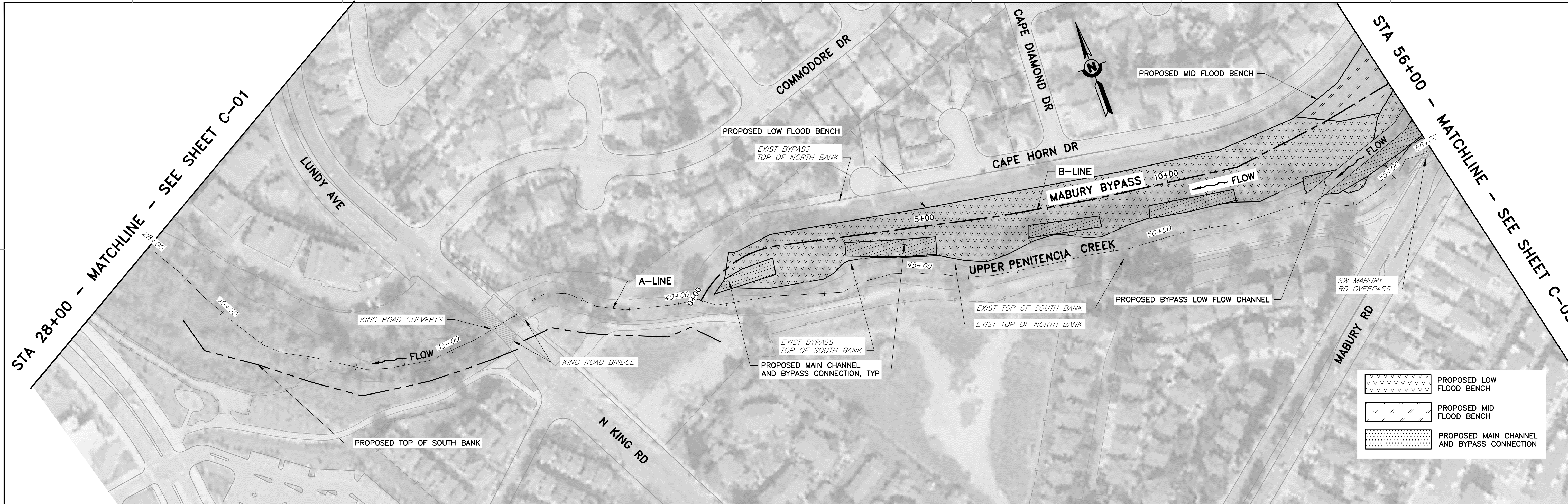

PLAN
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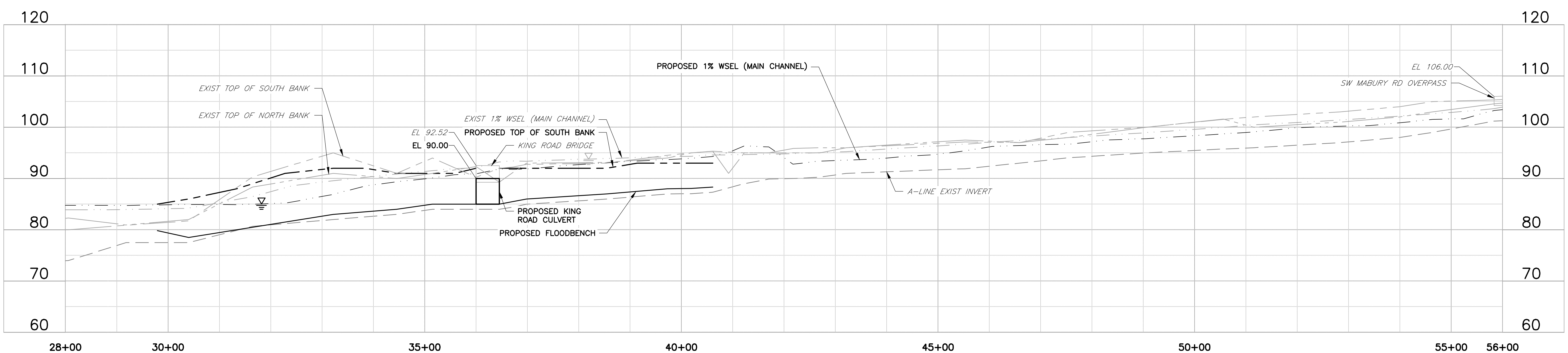

PROFILE
HORIZ: 1" = 100'
VERT: 1" = 10'

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY OCTOBER 2021		

REFERENCE INFORMATION AND NOTES

1. FULL MAIN STEM FLOW:
   A-LINE DESIGN FLOW RATE IS 2000 CFS.
2. FLOW SPLIT BETWEEN MAIN STEM AND BYBASS:
   A-LINE DESIGN FLOW RATE IS 400 CFS.
   B-LINE DESIGN FLOW RATE IS 1600 CFS.
2. PROFILES WERE GENERATED USING HEC-RAS.
3. AERIAL IMAGE PROVIDED BY 2020 COUNTY OF SANTA CLARA; THE SANBORN MAP CO.

DATE	JUN 2020
DESIGN	G. VALLIN
DRAWN	J. CORDOVA
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SANTA CLARA VALLEY WATER DISTRICT
Valley Water

PROJECT NAME AND SHEET DESCRIPTION:
UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT
A-LINE PLAN AND PROFILE STA 28+00 TO 56+00

SCALE: AS SHOWN
VERIFY SCALES: 0 1" — BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26324001
SHEET CODE: C-02
SHEET NUMBER: 8 OF 16

DOCUMENT NUMBER: PEL_CY-C-4032-XXXXX

USERNAME: Josecord 10/25/2021 3:18 PM
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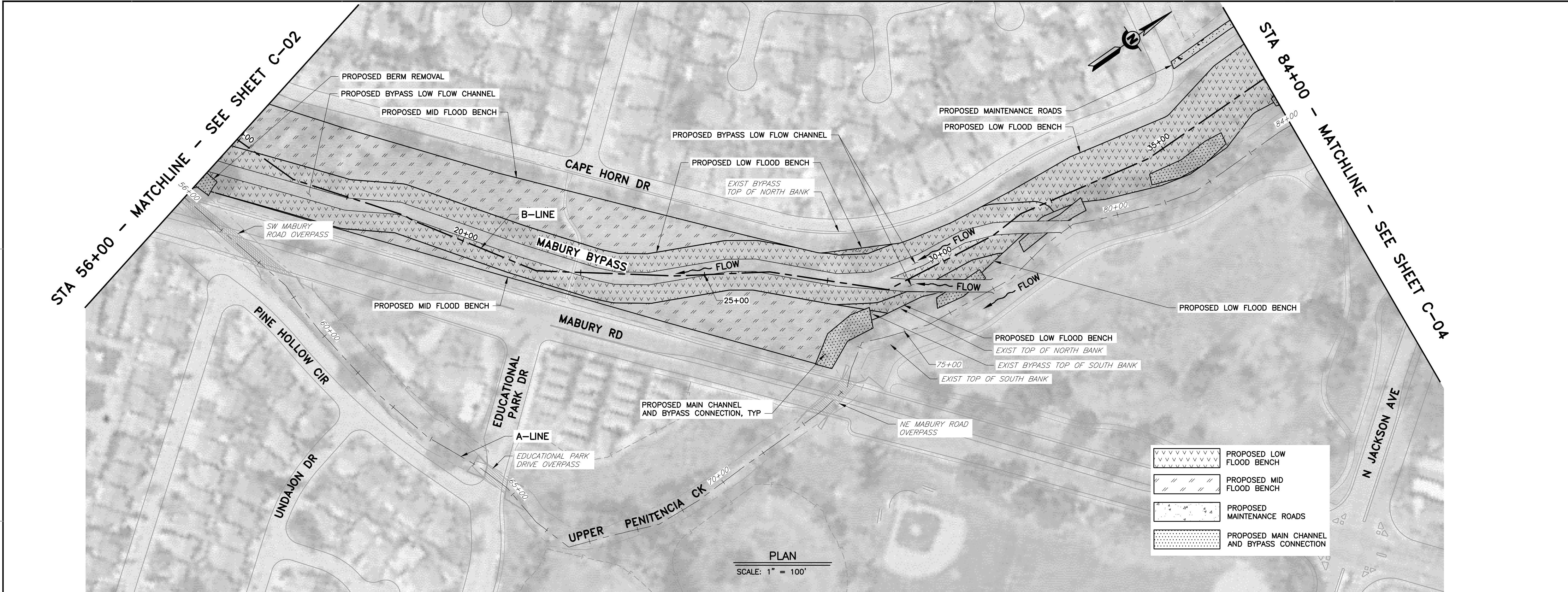
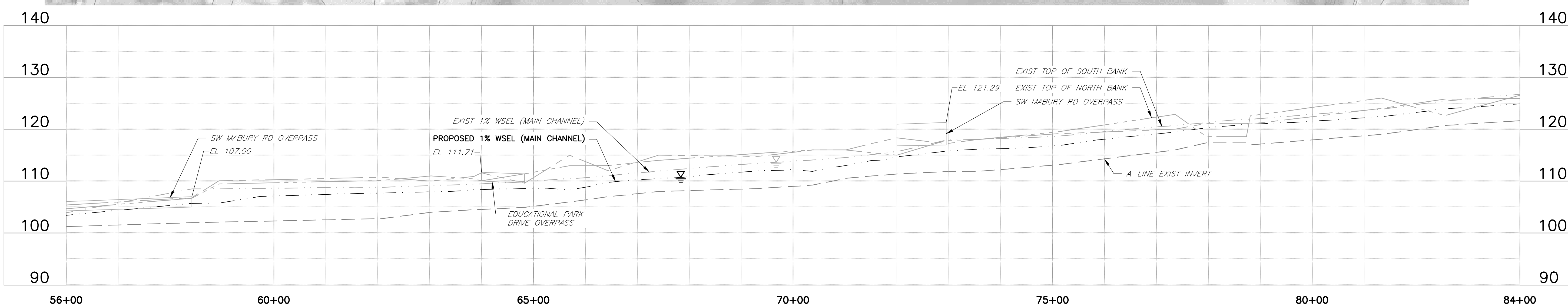




PROFILE
HORIZ: 1" = 100'
VERT: 1" = 10'

DOCUMENT NUMBER: PEL_CY-C-4032-XXXXX

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY OCTOBER 2021		

REFERENCE INFORMATION AND NOTES

1. A-LINE DESIGN FLOW RATE IS 400 CFS.
2. B-LINE DESIGN FLOW RATE IS 1600 CFS.
2. PROFILES WERE GENERATED USING HEC-RAS.
3. AERIAL IMAGE PROVIDED BY 2020 COUNTY OF SANTA CLARA; THE SANBORN MAP CO.

DATE	
JUN 2020	
DESIGN	G. VALLIN
DRAWN	J. CORDOVA
CHECKED	X.X.X.

ENGINEERING CERTIFICATION

ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT

A-LINE PLAN AND PROFILE STA 56+00 TO 84+00

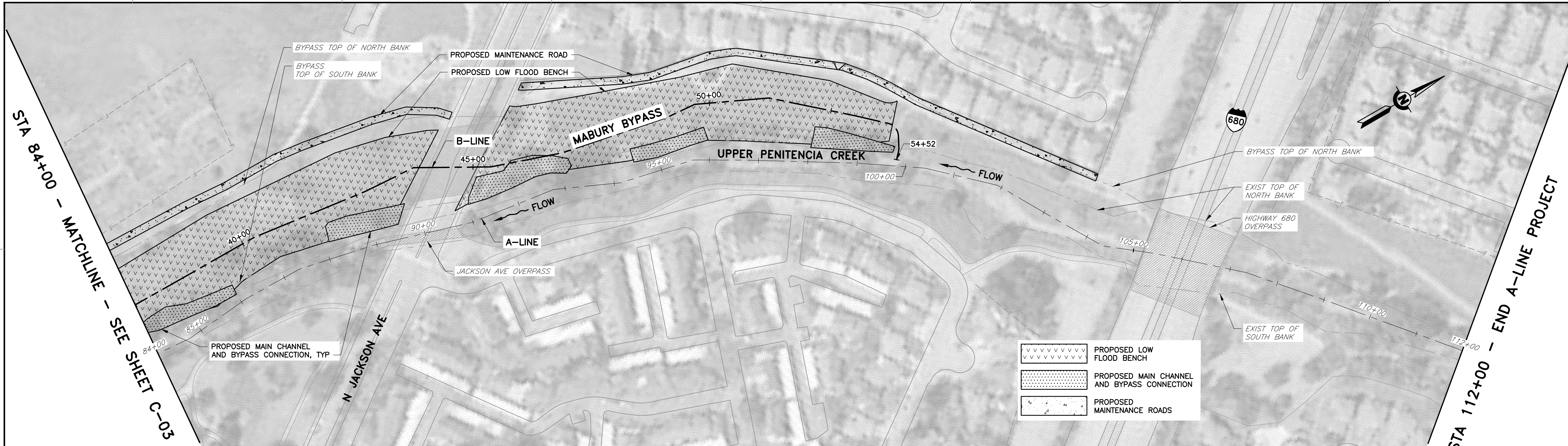
SCALE: AS SHOWN

VERIFY SCALES: 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

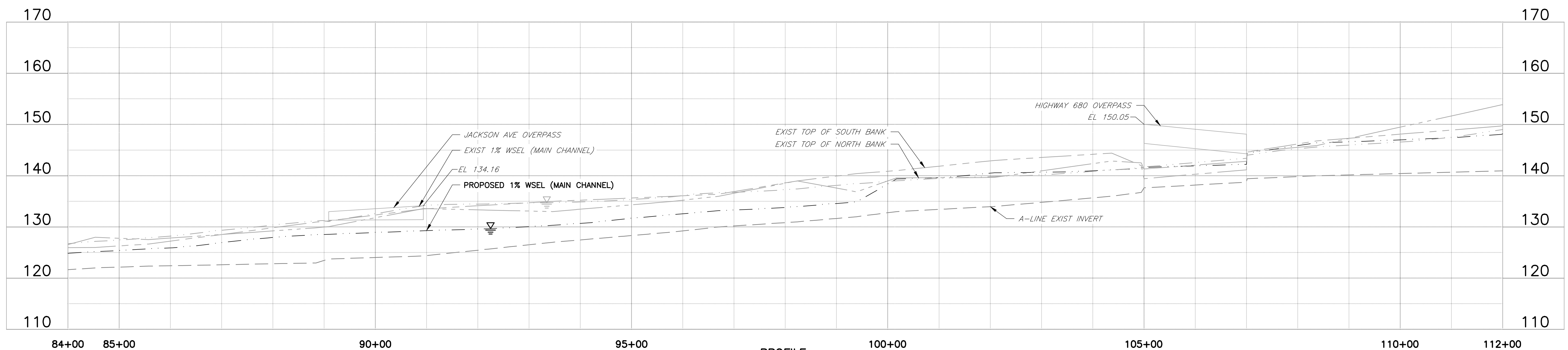
PROJECT NUMBER: 26324001

SHEET CODE: C-03

SHEET NUMBER: 9 OF 16



PLAN
SCALE: 1" = 100'



PROFILE
HORIZ: 1" = 100'
VERT: 1" = 10'

USERNAME: Josecord 10/25/2021 3:25 PM
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DOCUMENT NUMBER: PEL_CY-C-4032-XXXXX

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY June 2022		

REFERENCE INFORMATION AND NOTES
1. FULL MAIN STEM FLOW:
   A-LINE DESIGN FLOW RATE IS 2000 CFS.
2. FLOW SPLIT BETWEEN MAIN STEM AND BYPASS:
   A-LINE DESIGN FLOW RATE IS 400 CFS.
   B-LINE DESIGN FLOW RATE IS 1600 CFS.
3. PROFILES WERE GENERATED USING HEC-RAS.
4. AERIAL IMAGE PROVIDED BY 2020 COUNTY OF SANTA CLARA; THE SANBORN MAP CO.

DATE: JUN 2020
DESIGN: G. VALLIN
DRAWN: J. CORDOVA
CHECKED: X.X.X.

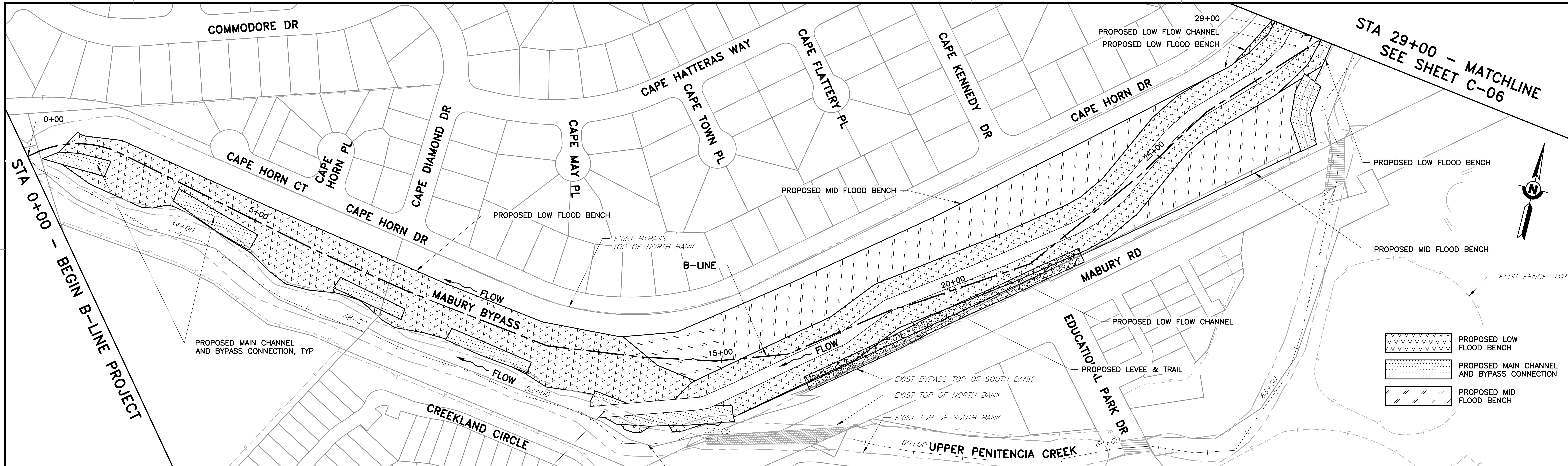
ENGINEERING CERTIFICATION
ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT
Valley Water

PROJECT NAME AND SHEET DESCRIPTION:
UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT
A-LINE PLAN AND PROFILE STA 84+00 TO 112+00

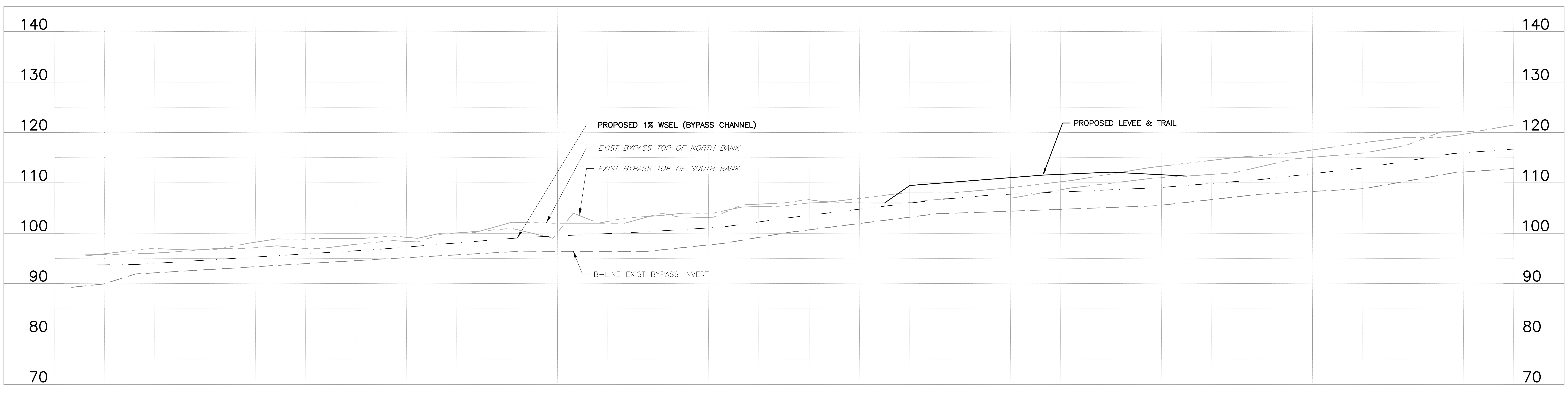
SCALE: AS SHOWN
VERIFY SCALES: 0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26324001
SHEET CODE: C-04
SHEET NUMBER: 10 OF 16



PLAN

SCALE: 1" = 100'



PROFILE

HORIZ: 1" = 100'
VERT: 1" = 10'

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY JANUARY 2022		

REFERENCE INFORMATION AND NOTES
1. A-LINE DESIGN FLOW RATE IS 400 CFS.
2. B-LINE DESIGN FLOW RATE IS 1600 CFS.
3. PROFILES WERE GENERATED USING HEC-RAS.
4. SANTA CLARA COUNTY PARCEL MAP SEPTEMBER 2021.

DATE: JAN 2022
DESIGN: G. VALLIN
DRAWN: J. ARIANI
CHECKED: X.X.X.

ENGINEERING CERTIFICATION
ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT
Valley Water

PROJECT NAME AND SHEET DESCRIPTION:
UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT
B-LINE PLAN AND PROFILE STA 0+00 TO 28+00

SCALE: AS SHOWN
VERIFY SCALES: 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26324001
SHEET CODE: C-05
SHEET NUMBER: 11 OF 16

USERNAME: GabrVall 9/7/2022 2:14 AM
FILENAME: C:\Users\gabrvall\Documents\upper pen\Recommended Prj\PP sheets\Drawing Files\C-05.dwg

DOCUMENT NUMBER: PEL_CY-C-4032-XXXXX

USERNAME: GabrVall 9/7/2022 1:04 AM
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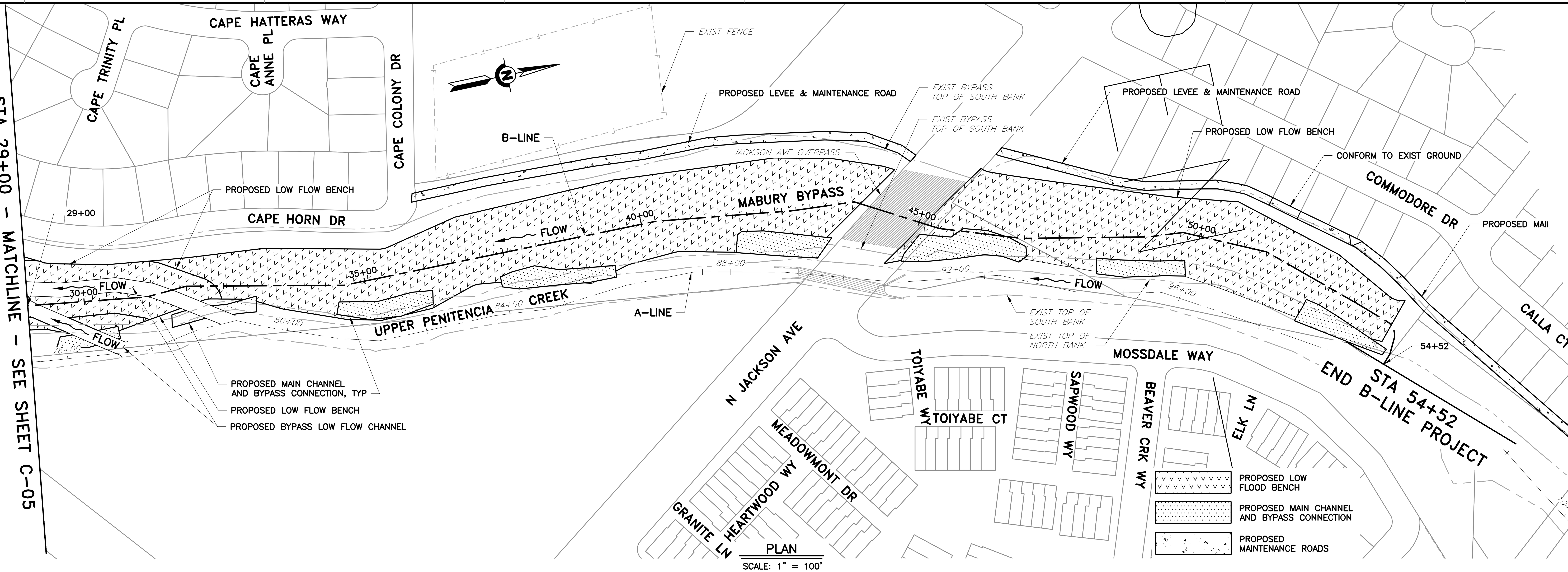
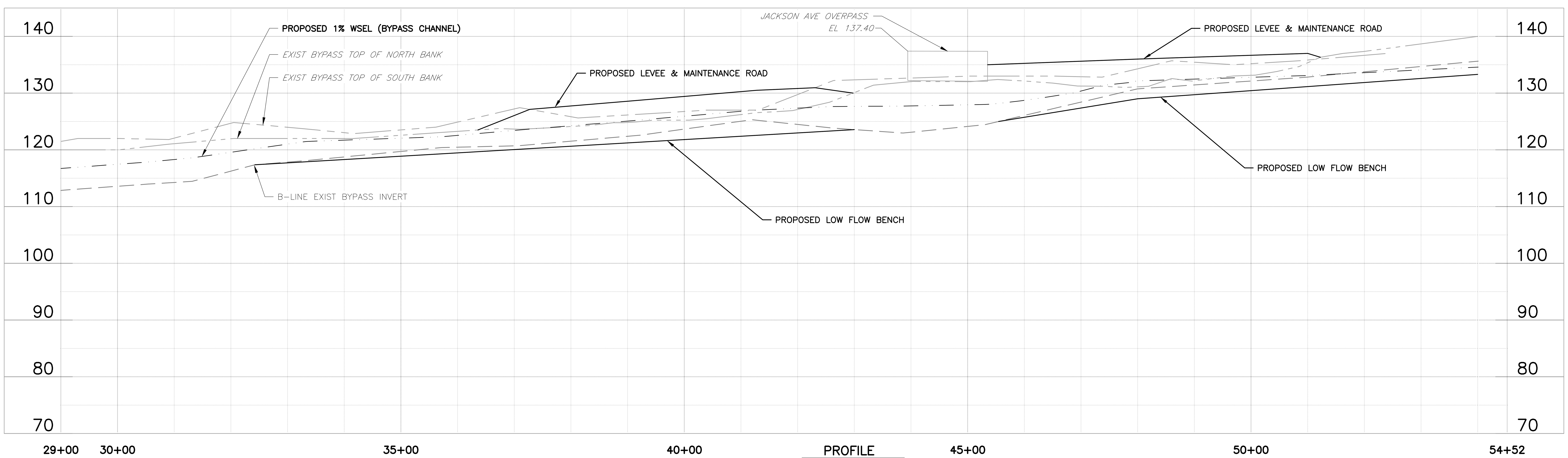




REV	DESCRIPTION	DATE	APPR
	PRELIMINARY JANUARY 2022		

REFERENCE INFORMATION AND NOTES

1. FULL MAIN STEM FLOW:
   A-LINE DESIGN FLOW RATE IS 2000 CFS.
2. FLOW SPLIT BETWEEN MAIN STEM AND BYBASS:
   A-LINE DESIGN FLOW RATE IS 400 CFS.
   B-LINE DESIGN FLOW RATE IS 1600 CFS.
3. PROFILES WERE GENERATED USING HEC-RAS.
4. SANTA CLARA COUNTY PARCEL MAP SEPTEMBER 2021.

DATE: JAN 2022
DESIGN: G. VALLIN
DRAWN: J. ARIANI
CHECKED: X.X.X.

ENGINEERING CERTIFICATION

ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT

B-LINE PLAN AND PROFILE STA 28+00 TO 53+34

SCALE: AS SHOWN

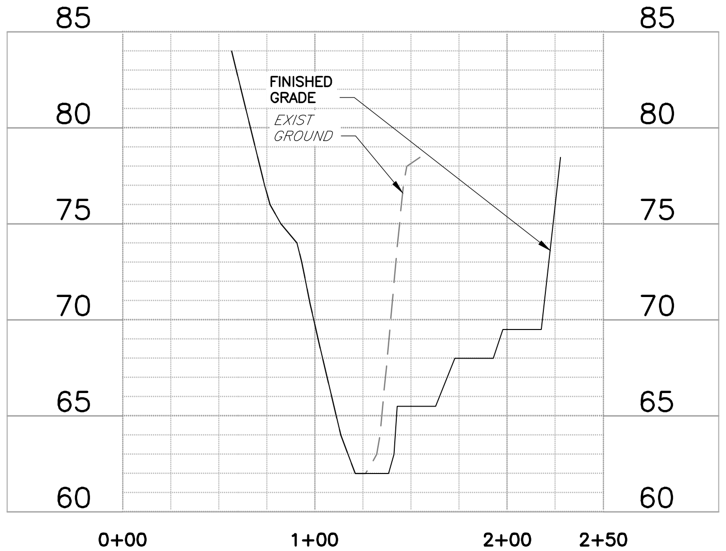
VERIFY SCALES: 0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26324001

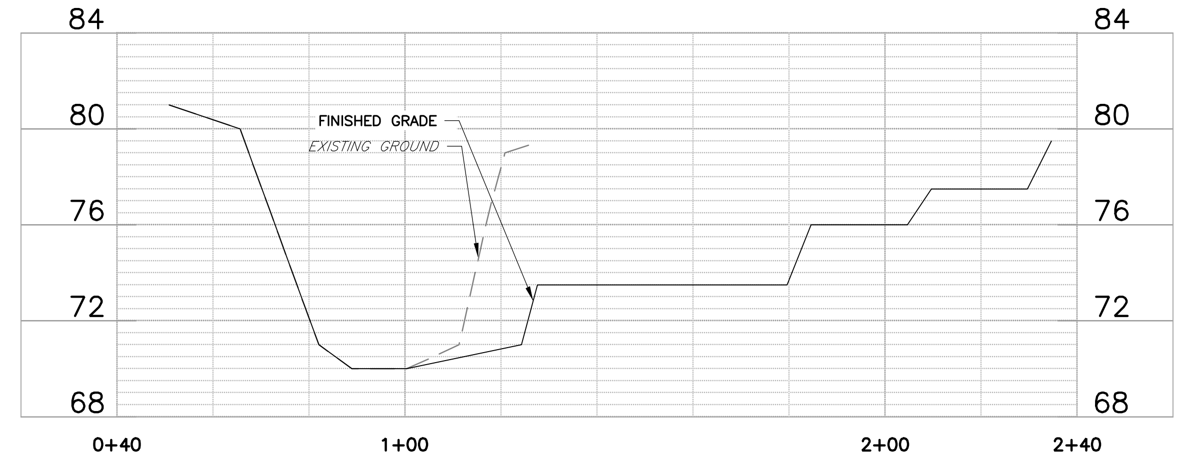
SHEET CODE: C-06

SHEET NUMBER: 12 OF 16

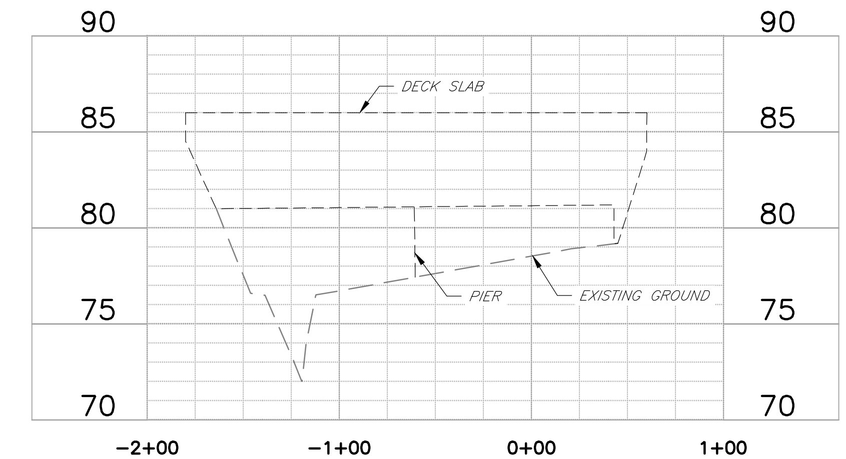
DOCUMENT NUMBER: PEI_CY-C-4032-XXXXX



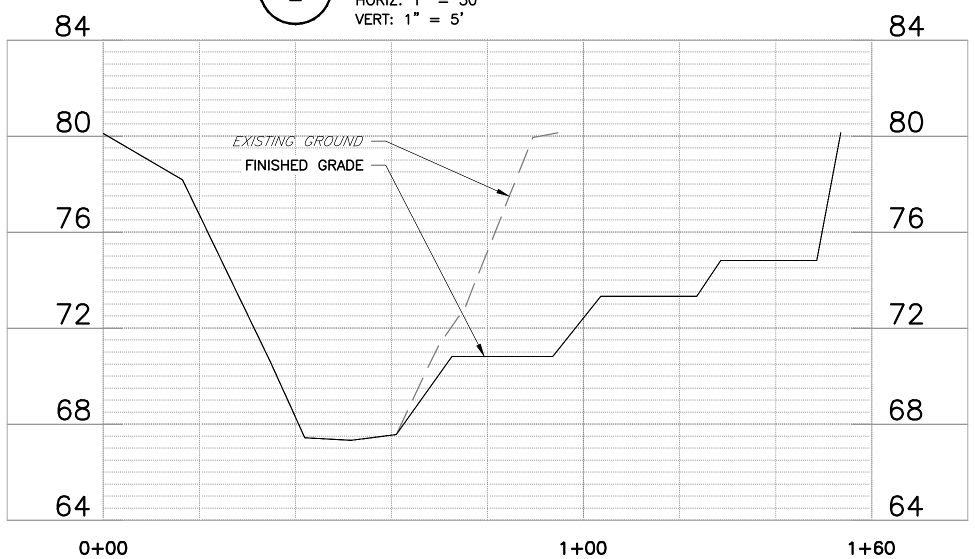
TYPICAL SECTION (A / –) STA ±0+88 TO ±2+28
HORIZ: 1" = 50'
VERT: 1" = 5'



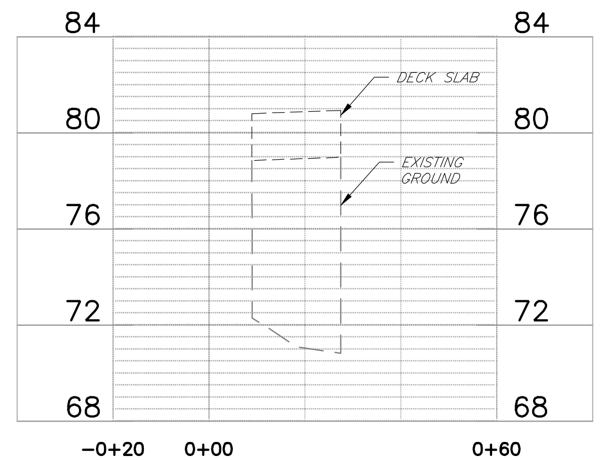
TYPICAL SECTION (D / –) STA ±10+28.1 TO ±12+91.7
HORIZ: 1" = 20'
VERT: 1" = 4'



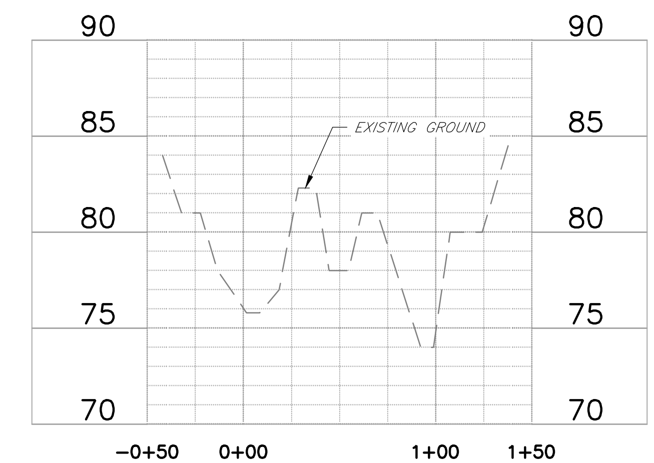
TYPICAL SECTION (G / –) STA ±22+20 TO ±23+20
HORIZ: 1" = 50'
VERT: 1" = 5'



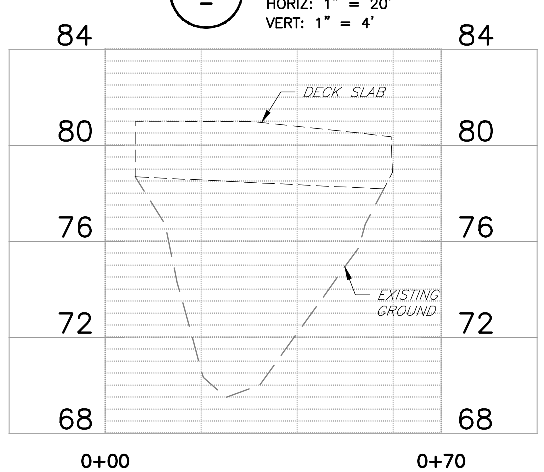
TYPICAL SECTION (B / –) STA ±2+28 TO ±9+68.3
HORIZ: 1" = 20'
VERT: 1" = 4'



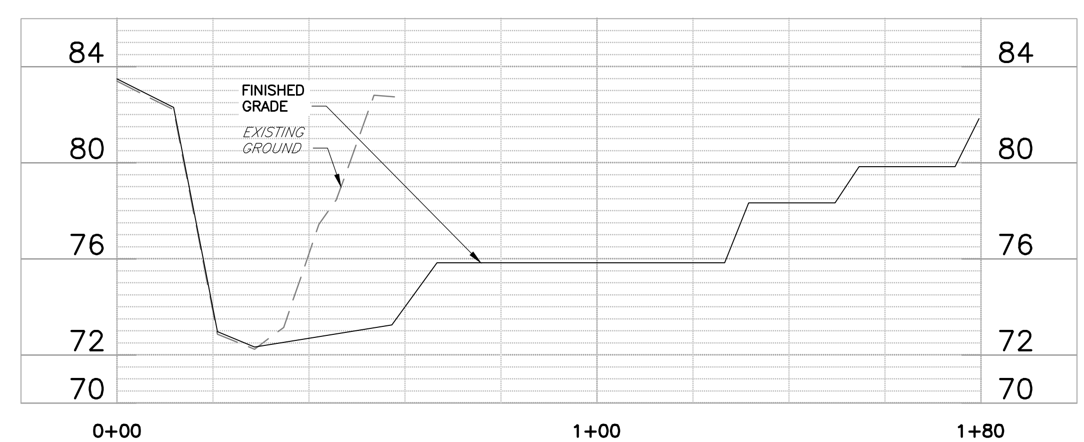
TYPICAL SECTION (E / –) STA ±12+91.7 TO ±13+55.4
U/S FLEA MARKET BRIDGE
HORIZ: 1" = 20'
VERT: 1" = 4'



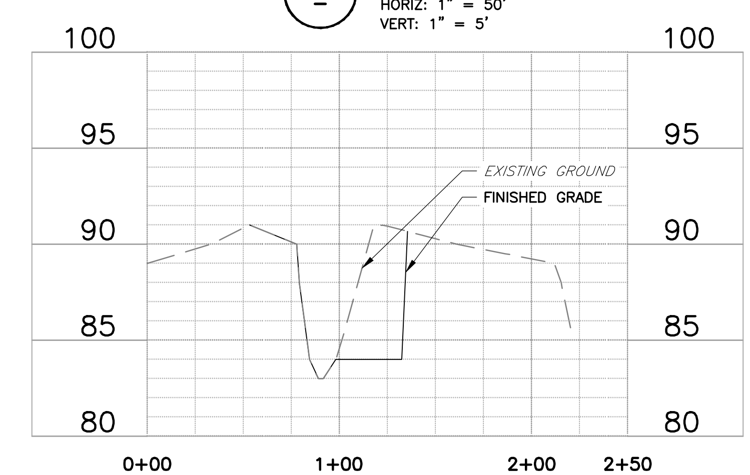
TYPICAL SECTION (H / –) STA ±23+20 TO ±29+18
HORIZ: 1" = 50'
VERT: 1" = 5'



TYPICAL SECTION (C / –) STA ±9+68.3 TO ±10+28.1
D/S FLEA MARKET BRIDGE
HORIZ: 1" = 20'
VERT: 1" = 4'



TYPICAL SECTION (F / –) STA ±13+55.4 TO ±22+20
HORIZ: 1" = 20'
VERT: 1" = 4'



TYPICAL SECTION (I / –) STA ±29+18 TO ±36+00
HORIZ: 1" = 50'
VERT: 1" = 5'

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY OCTOBER 2021		

REFERENCE INFORMATION AND NOTES
1. ALL TYPICAL CROSS SECTIONS ARE LOOKING UPSTREAM.

DATE: JUN 2020
DESIGN: G. VALLIN
DRAWN: J. CORDOVA
CHECKED: X.X.X.

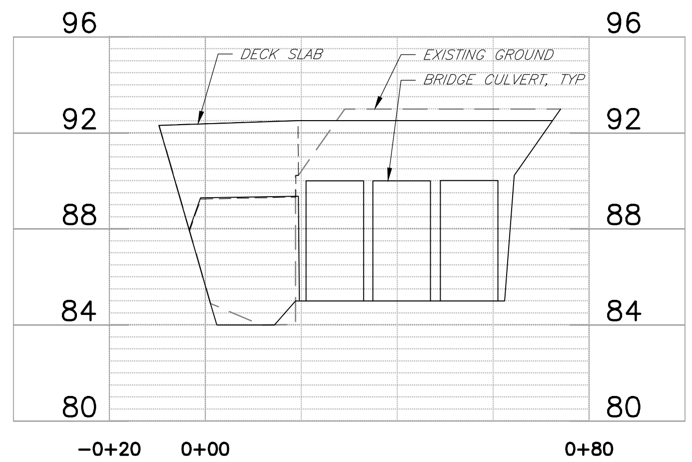
ENGINEERING CERTIFICATION
ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT
Valley Water

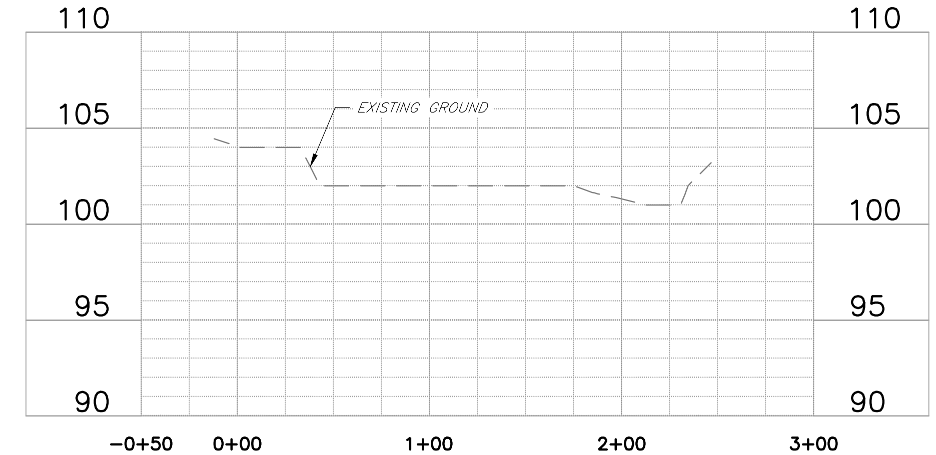
PROJECT NAME AND SHEET DESCRIPTION:
UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT
TYPICAL CROSS SECTIONS

SCALE: AS SHOWN
VERIFY SCALES: 0 1" — BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
PROJECT NUMBER: 26324001
SHEET CODE: C-07
SHEET NUMBER: 13 OF 16

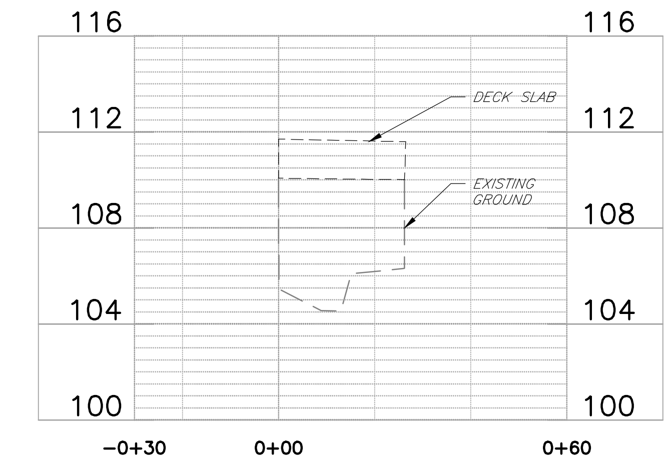
DOCUMENT NUMBER: PEL_CY-C-4032-XXXXX



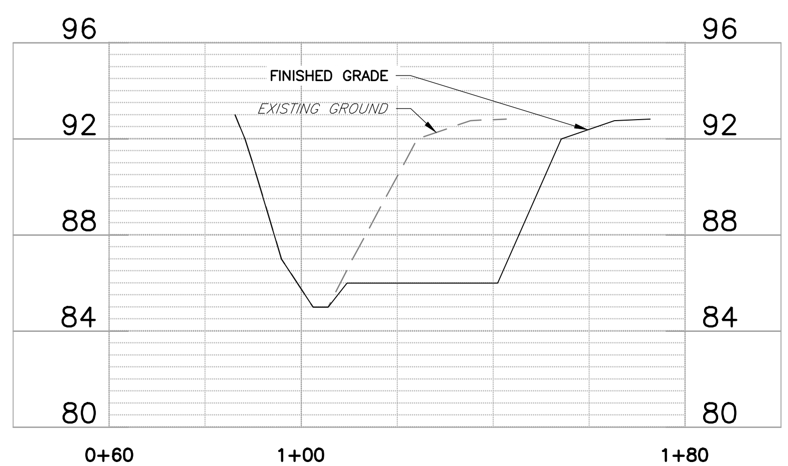
TYPICAL SECTION KING ROAD (J / –) STA ±36+00 TO ±36+45.3
HORIZ: 1" = 20'
VERT: 1" = 4'



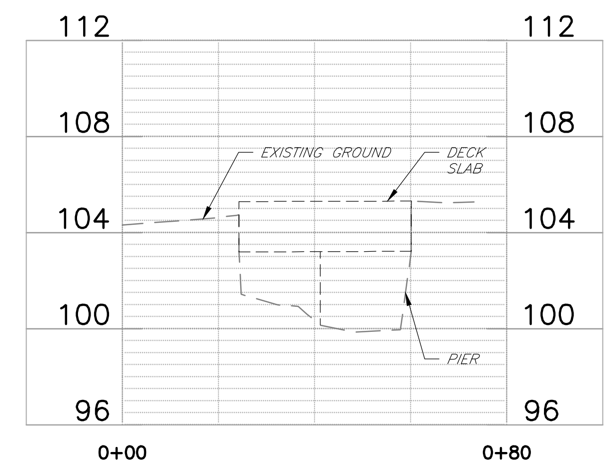
TYPICAL SECTION (M / –) (B-LINE STA ±10+81.5 TO ±16+88.2)
HORIZ: 1" = 50'
VERT: 1" = 5'



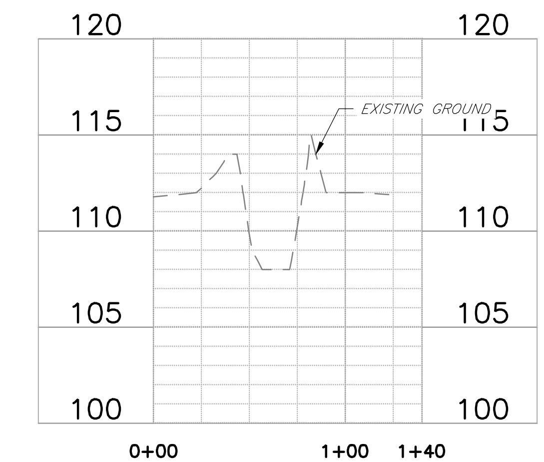
TYPICAL SECTION EDUCATION PARK BRIDGE (P / –) STA ±64+00 TO ±64+82.9
HORIZ: 1" = 20'
VERT: 1" = 4'



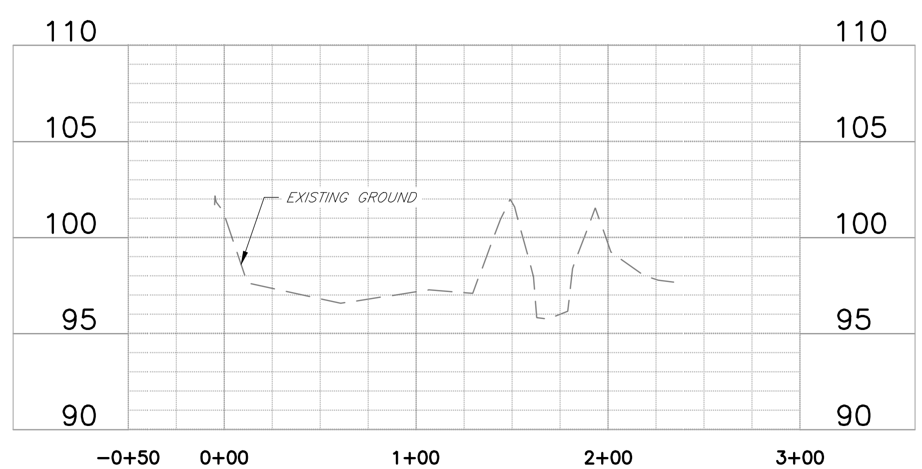
TYPICAL SECTION (K / –) STA ±36+45.3 TO ±40+61.5
HORIZ: 1" = 20'
VERT: 1" = 4'



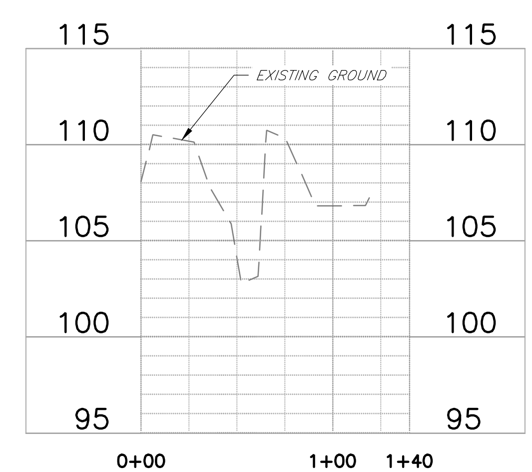
TYPICAL SECTION D/S MABURY BRG (N / –) STA ±55+83.7 TO ±58+42.2
HORIZ: 1" = 20'
VERT: 1" = 4'



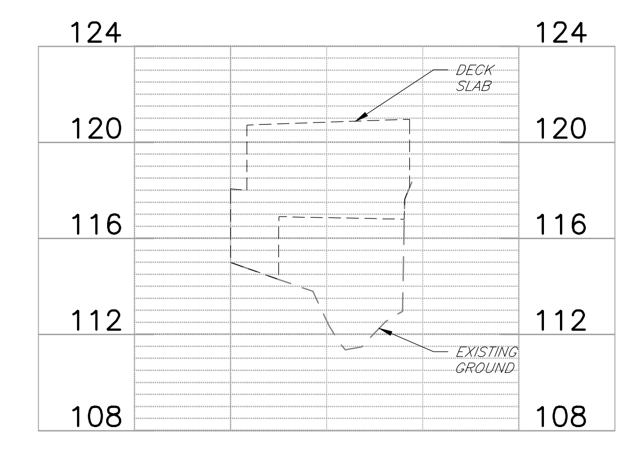
TYPICAL SECTION (Q / –) STA +64+82.9 TO +72+00
HORIZ: 1" = 50'
VERT: 1" = 5'



TYPICAL SECTION (L / –) STA +40+61.5 TO +55+83.7 (B-LINE STA ±00+61.7 TO ±10+81.5)
HORIZ: 1" = 50'
VERT: 1" = 5'



TYPICAL SECTION (O / –) STA ±58+42.2 TO ±64+00
HORIZ: 1" = 50'
VERT: 1" = 5'



TYPICAL SECTION U/S MABURY BRG (R / –) STA ±72+00 TO ±72+95
HORIZ: 1" = 20'
VERT: 1" = 4'

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY OCTOBER 2021		

REFERENCE INFORMATION AND NOTES
1. ALL TYPICAL CROSS SECTIONS ARE LOOKING UPSTREAM.

DATE: JUN 2020
DESIGN: G. VALLIN
DRAWN: J. CORDOVA
CHECKED: X.X.X.

ENGINEERING CERTIFICATION
ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT
Valley Water

PROJECT NAME AND SHEET DESCRIPTION:
UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT
TYPICAL CROSS SECTIONS

SCALE: AS SHOWN
VERIFY SCALES: 0 1" BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
PROJECT NUMBER: 26324001
SHEET CODE: C-08
SHEET NUMBER: 14 OF 16

DOCUMENT NUMBER: PEL_CY-C-4032-XXXXX

USERNAME: Josecord 10/25/2021 3:37 PM
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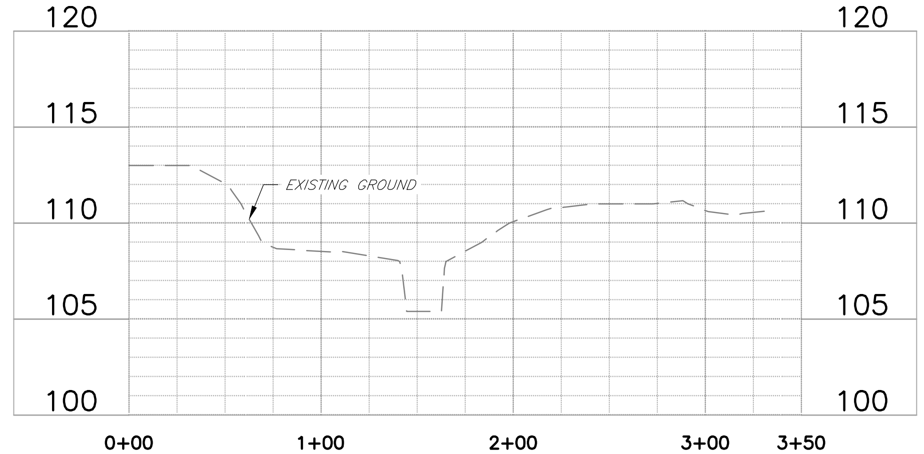
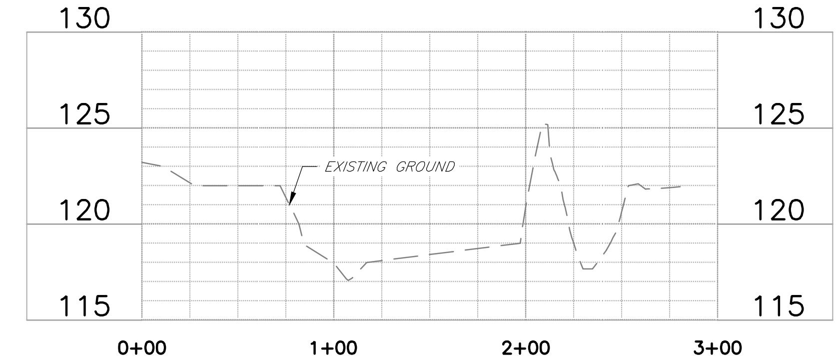
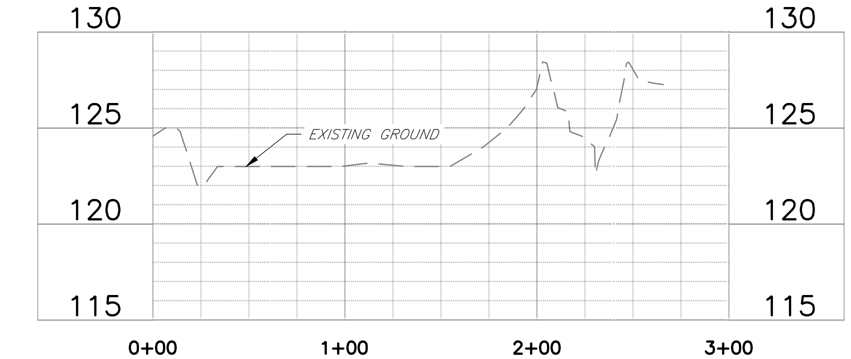


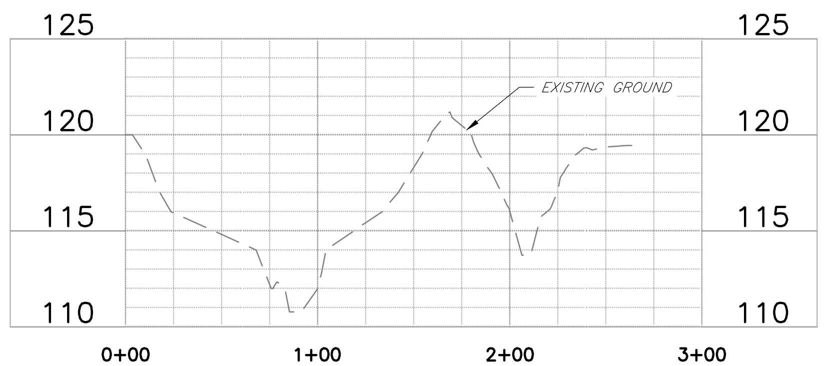
TYPICAL SECTION (S / –) (B–LINE STA ±16+88.2 TO ±23+44.9)
HORIZ: 1" = 50'
VERT: 1" = 5'



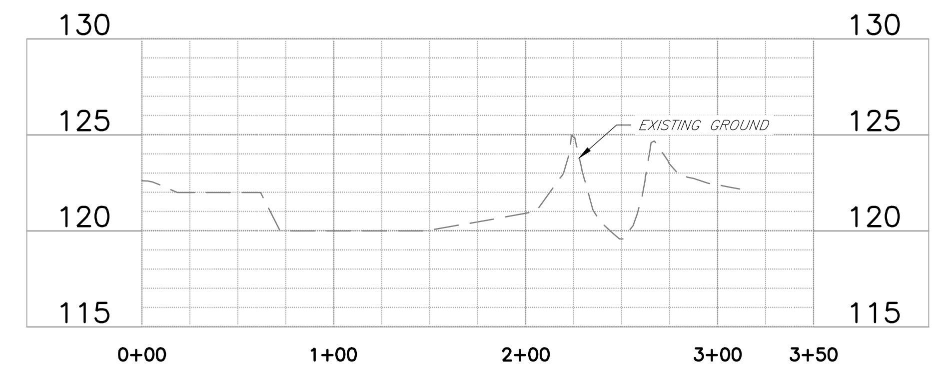
TYPICAL SECTION (V / –) STA ±78+80.7 TO ±81+33.4
(B–LINE STA ±30+90.5 TO ±33+21.6)
HORIZ: 1" = 50'
VERT: 1" = 5'



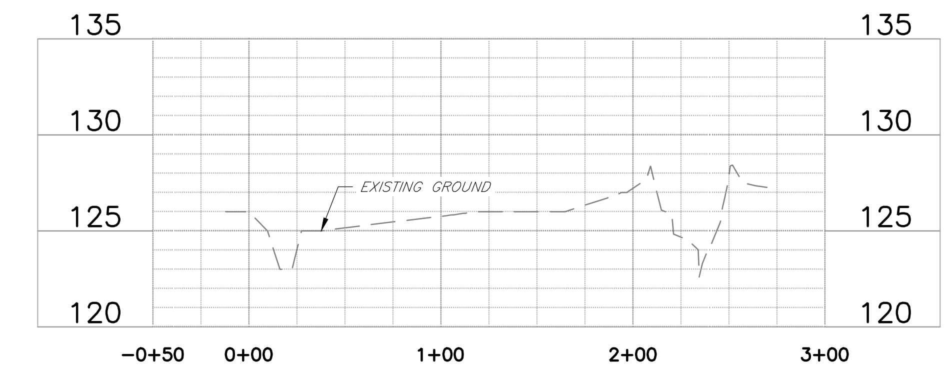
TYPICAL SECTION (Y / –) STA ±84+53.4 TO ±86+87.9
(B–LINE STA ±37+09.7 TO ±39+17.1)
HORIZ: 1" = 50'
VERT: 1" = 5'



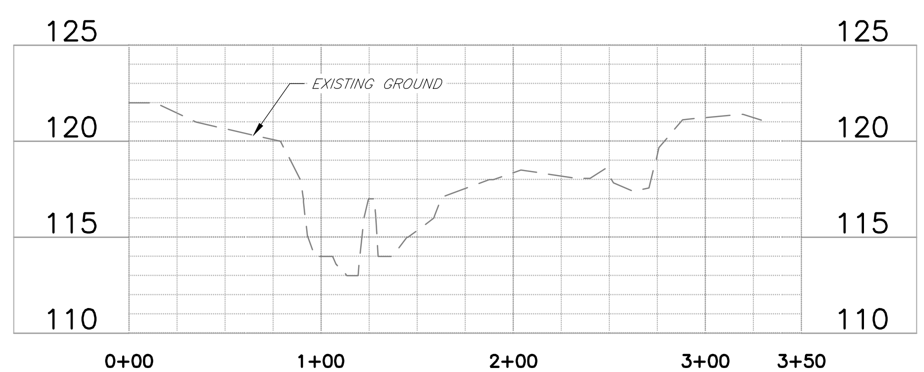
TYPICAL SECTION (T / –) STA ±72+95 TO ±77+96.3
(B–LINE STA ±23+44.9 TO ±30+02.8)
HORIZ: 1" = 50'
VERT: 1" = 5'



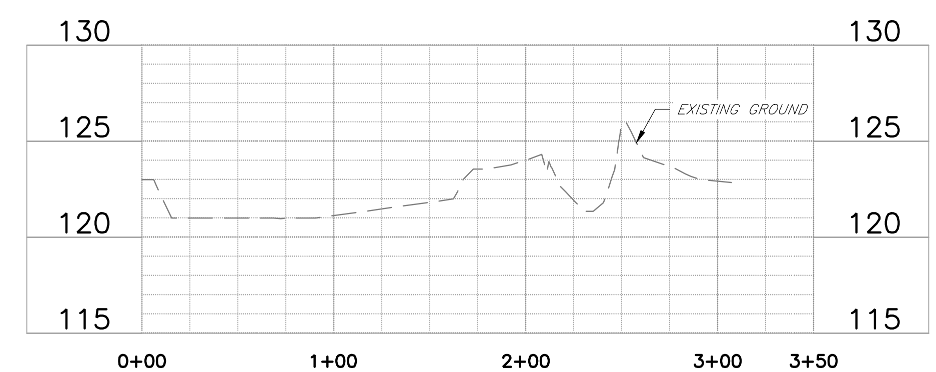
TYPICAL SECTION (W / –) STA ±81+33.4 TO ±82+55.73
(B–LINE STA ±33+21.6 TO ±35+61.8)
HORIZ: 1" = 50'
VERT: 1" = 5'



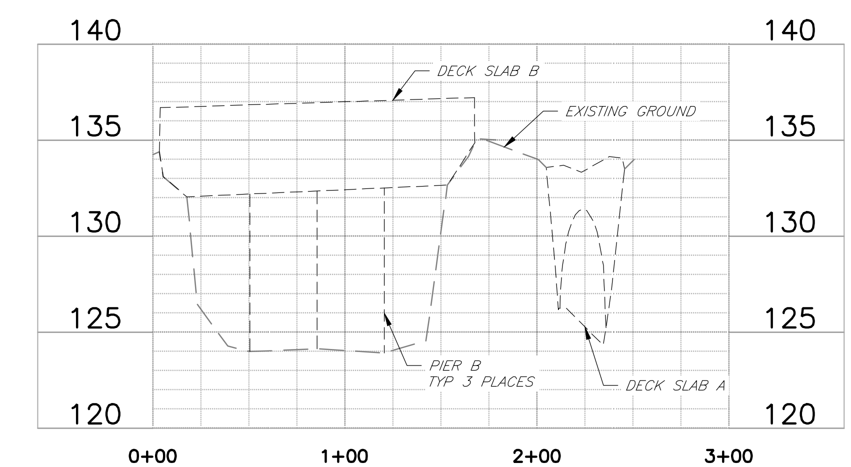
TYPICAL SECTION (Z / –) STA ±86+87.9 TO ±89+09
(B–LINE STA ±39+17.1 TO ±42+63.3)
HORIZ: 1" = 50'
VERT: 1" = 5'



TYPICAL SECTION (U / –) STA ±77+96.3 TO ±78+80.7
(B–LINE STA ±30+02.8 TO ±30+90.5)
HORIZ: 1" = 50'
VERT: 1" = 5'



TYPICAL SECTION (X / –) STA ±82+55.7 TO ±84+53.4
(B–LINE STA ±35+61.8 TO ±37+09.7)
HORIZ: 1" = 50'
VERT: 1" = 5'



TYPICAL SECTION (AA / –) STA ±89+09 TO ±90+93.8
JACKSON BRIDGE
(B–LINE STA ±42+63.3 TO ±44+04.1)
HORIZ: 1" = 50'
VERT: 1" = 5'

REV	DESCRIPTION	DATE	APPR
	PRELIMINARY OCTOBER 2021		

REFERENCE INFORMATION AND NOTES
1. ALL TYPICAL CROSS SECTIONS ARE LOOKING UPSTREAM.

DATE	JUN 2020
DESIGN	G. VALLIN
DRAWN	J. CORDOVA
CHECKED	X.X.X.

ENGINEERING CERTIFICATION
ENGINEER DATE

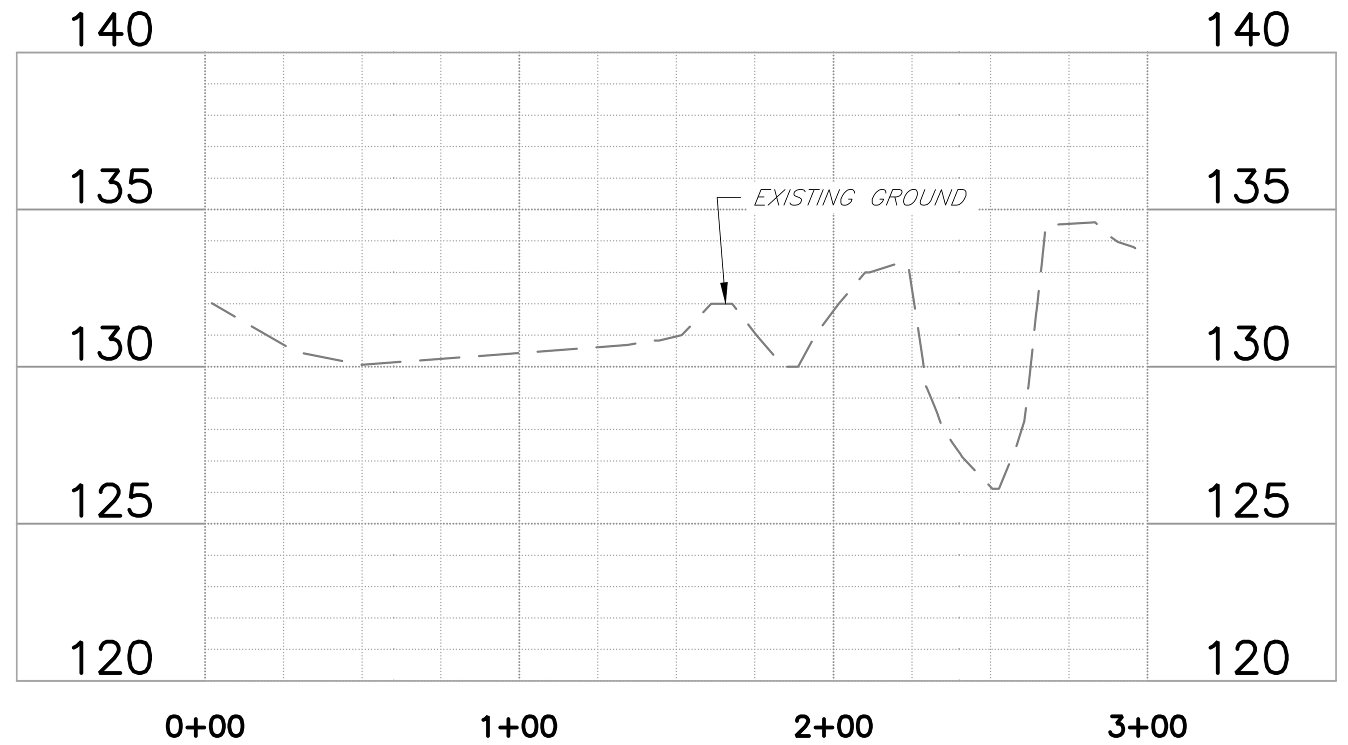
SANTA CLARA VALLEY WATER DISTRICT
Valley Water

PROJECT NAME AND SHEET DESCRIPTION:
UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT
TYPICAL CROSS SECTIONS

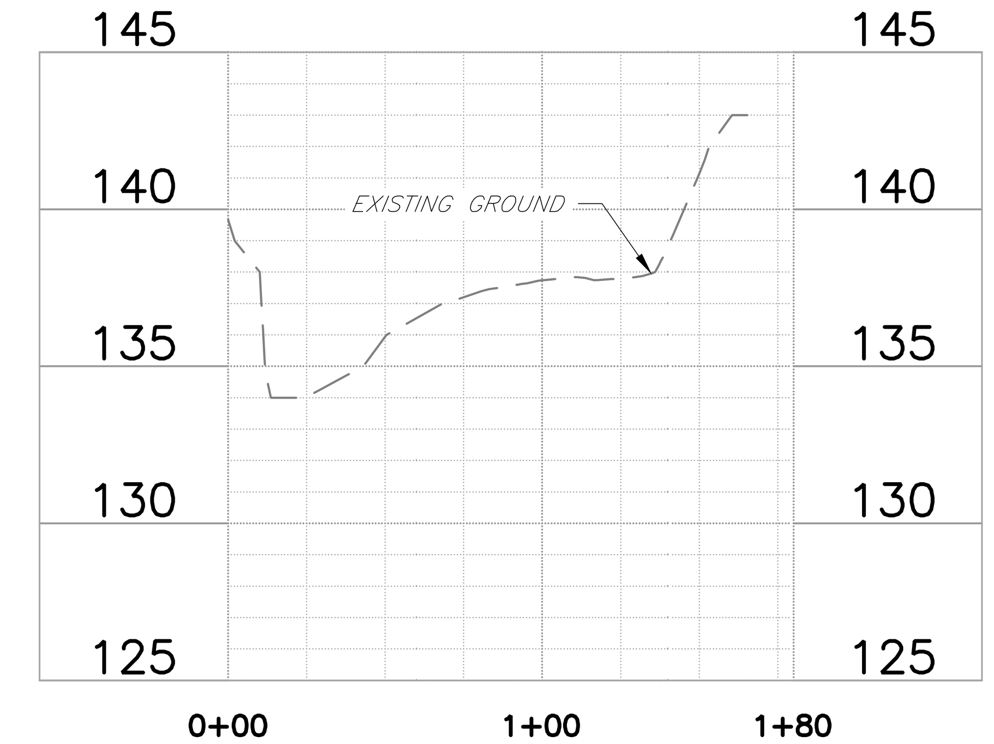
SCALE: AS SHOWN
VERIFY SCALES: 0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26324001
SHEET CODE: C–09
SHEET NUMBER: 15 OF 16

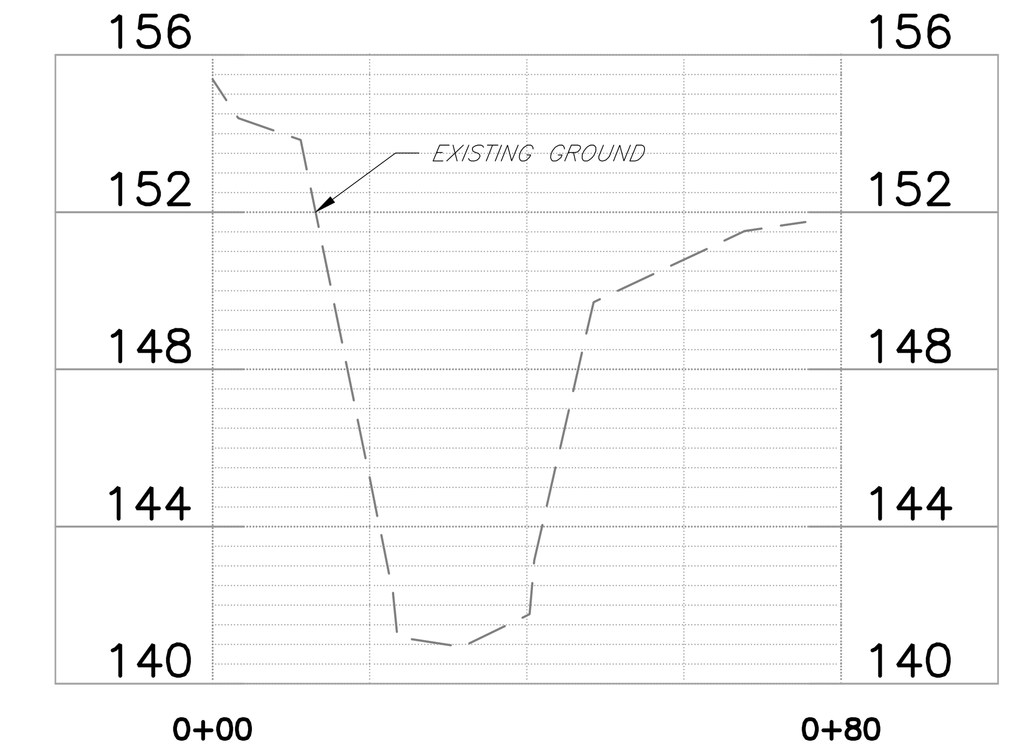
USERNAME: Josecord 10/25/2021 3:38 PM
FILENAME: K:\Active Projects\MP-26324001\UPPER PEN – Coyote to Capitol\SHEETS\C-09.dwg
DOCUMENT NUMBER: PEL_CY-C-4032-XXXXX



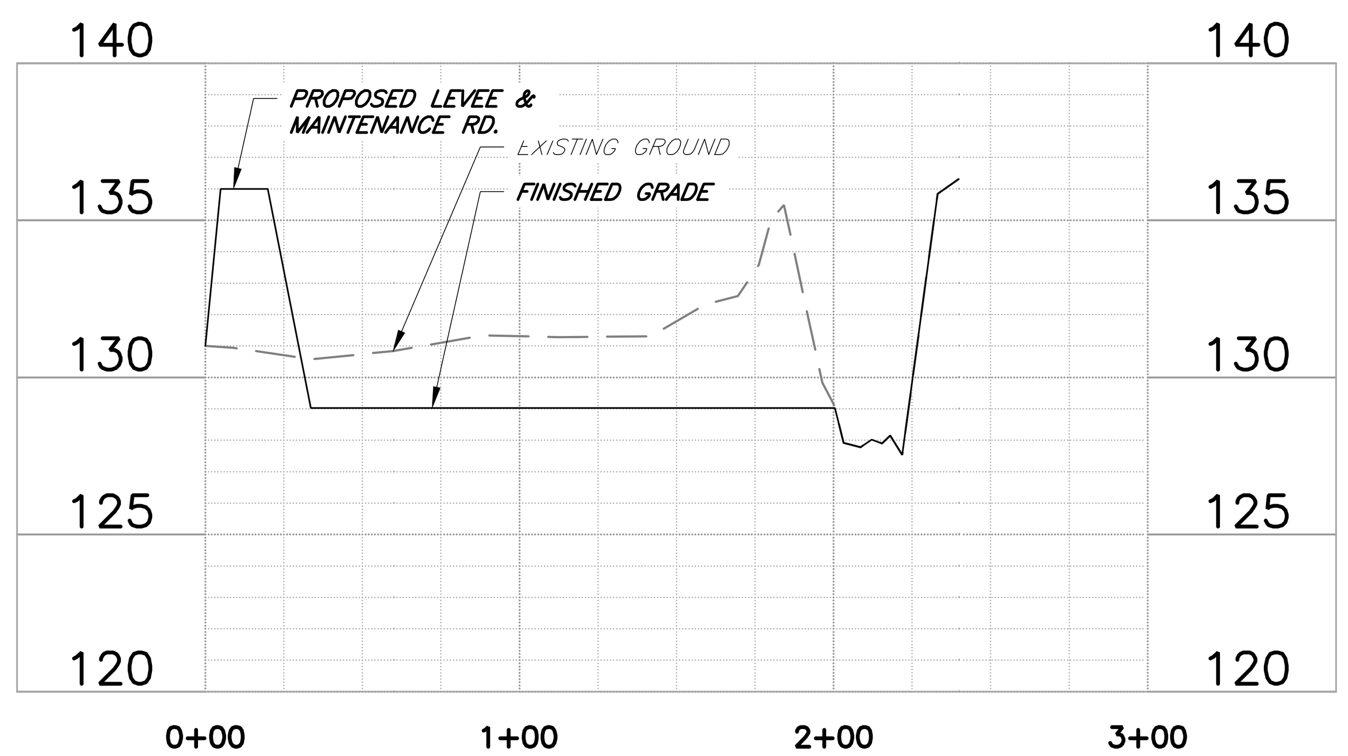
TYPICAL SECTION BB –
STA ±90+93.8 TO ±93+45.1
(B–LINE STA ±44+04.1 TO ±45+04.4)
HORIZ: 1" = 50'
VERT: 1" = 5'



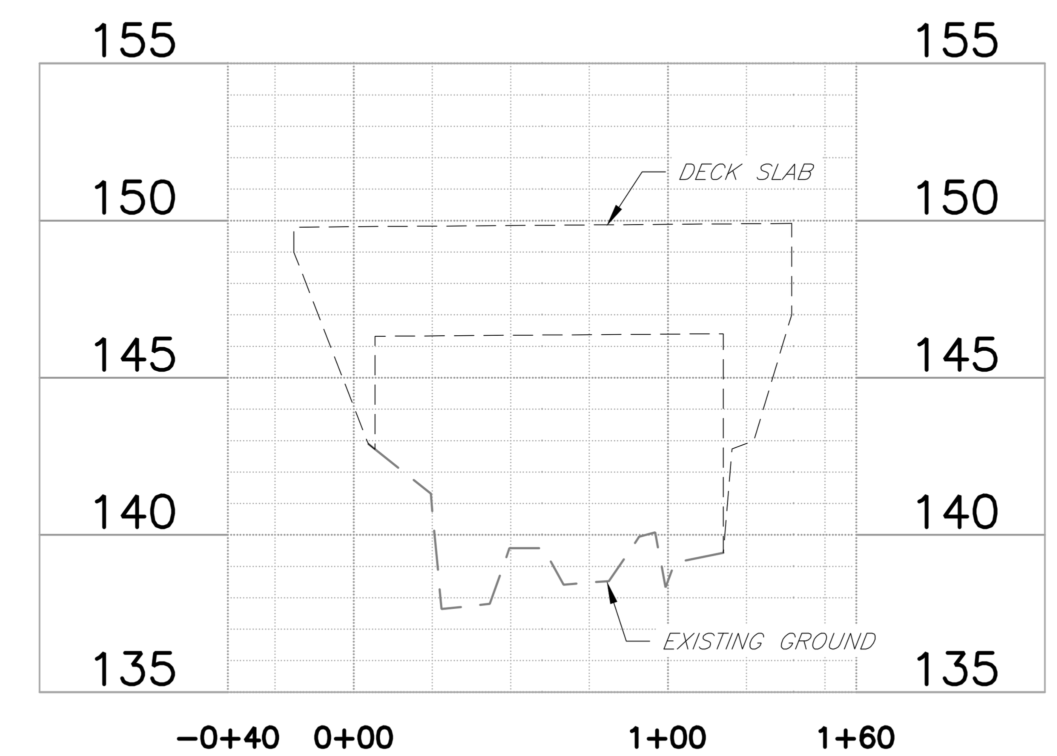
TYPICAL SECTION EE –
STA ±100+17.1 TO ±105+00
HORIZ: 1" = 50'
VERT: 1" = 5'



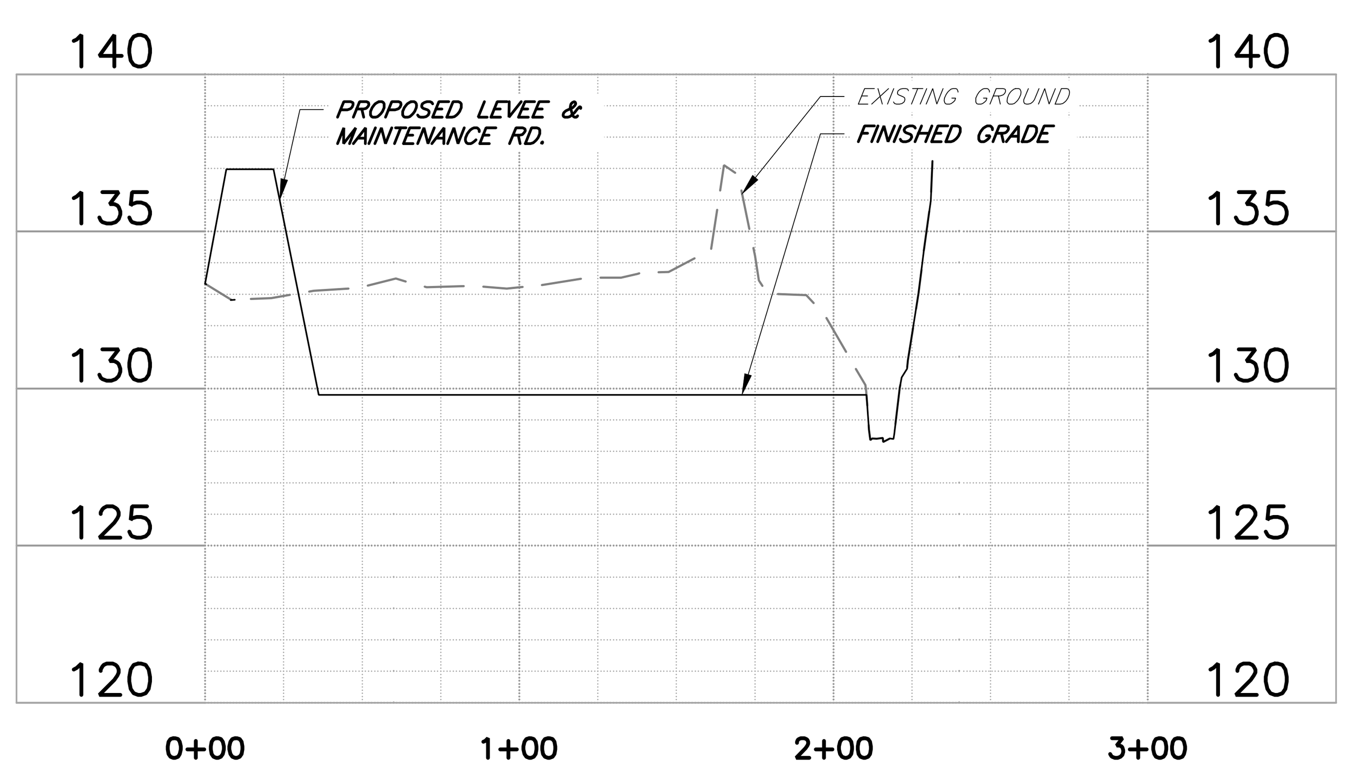
TYPICAL SECTION GG –
STA ±107+00 TO ±116+13.6
HORIZ: 1" = 20'
VERT: 1" = 4'



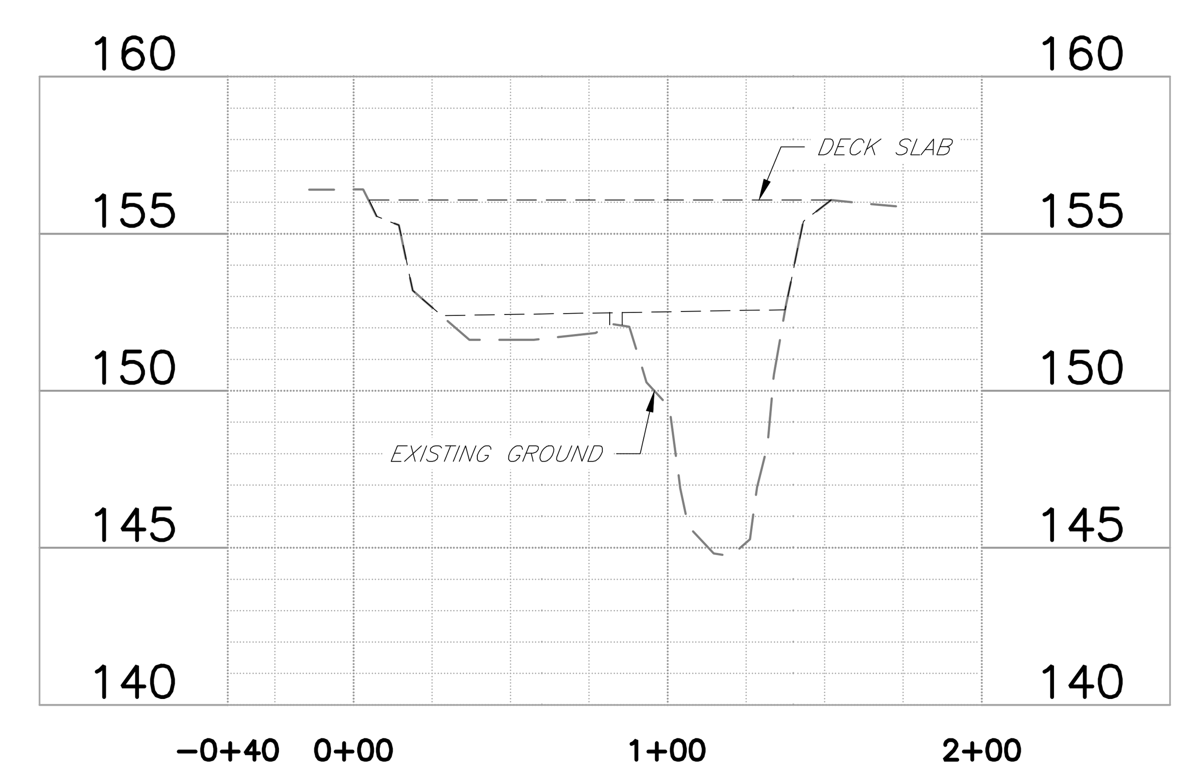
TYPICAL SECTION CC –
STA ±93+45.1 TO ±96+69.9
(B–LINE STA ±45+04.4 TO ±48+59.9)
HORIZ: 1" = 50'
VERT: 1" = 5'



TYPICAL SECTION FF –
FREEWAY I–680
STA ±105+00 TO ±107+00
HORIZ: 1" = 50'
VERT: 1" = 5'



TYPICAL SECTION DD –
STA ±96+69.9 TO ±100+17.1
(B–LINE STA ±48+59.9 TO ±52+36.6)
HORIZ: 1" = 50'
VERT: 1" = 5'



TYPICAL SECTION HH –
CAPITOL BRIDGE
STA ±116+13.6 TO ±117+27
HORIZ: 1" = 50'
VERT: 1" = 5'

REV	DESCRIPTION	DATE	APPR	REFERENCE INFORMATION AND NOTES
	PRELIMINARY JANUARY 2022			1. ALL TYPICAL CROSS SECTIONS ARE LOOKING UPSTREAM.

DATE	JAN 2022
DESIGN	G. VALLIN
DRAWN	J. ARIANI
CHECKED	X.X.X.

ENGINEERING CERTIFICATION

ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

UPPER PENITENCIA CREEK FLOOD PROTECTION PROJECT

TYPICAL CROSS SECTIONS

SCALE: AS SHOWN

VERIFY SCALES: 0 1" — BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 26324001

SHEET CODE: C–10

SHEET NUMBER: 16 OF 16

USERNAME: GabrVall 9/7/2022 2:59 AM
FILENAME: C:\Users\gabrvall\Documents\upper pen\Recommended Proj\PP sheets\Drawing Files\C-10.dwg

DOCUMENT NUMBER: PEL_CY–C–4032–XXXXX