SANTA CLARA VALLEY WATER DISTRICT

LOWER PENITENCIA CREEK IMPROVEMENTS PROJECT
Coyote Creek to Berryessa Creek

PROBLEM DEFINITION AND REFINED OBJECTIVES REPORT

Project No. 40334005

Report Prepared by:

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Coyote Watershed Projects

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July 2013

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1. PROBLEM DEFINITION AND PURPOSE

The Coyote Watershed Division initiated the Lower Penitencia Creek capital project in October of 2008. During the process of re-certifying the levees on Lower Penitencia Creek, the District found that Lower Penitencia Creek may not have the capacity to convey the 1 percent flow when the Upper and Lower Berryessa Creek flood improvement projects are completed. The current project limits begins at the downstream end with Coyote Creek and ends at the upstream end with Berryessa Creek (Figure 1, page 3).

The Upper Berryessa Creek project hydrology[1] showed that upon completion of the Lower and Upper Berryessa Creek projects, Berryessa Creek will deliver additional flows downstream to Lower Penitencia Creek. In its current condition, Lower Penitencia Creek does not have the capacity to convey that future 1 percent flow. Preliminary hydraulic findings, based on current sedimented channel conditions, show overtopping of levees within the project limit with the future 1 percent flow.

This project will address the improvements required to accommodate the future 1 percent flow from the completed Berryessa Creek Flood Protection Projects. This project, although not a part of the Clean, Safe Creeks Program, is necessary to provide continuous flood protection for Berryessa Creek; the Upper Berryessa Creek Project is a Clean, Safe Creeks Program project.

2. OBJECTIVES

- Restore capacity to Lower Penitencia Creek and provide improvements if needed in the project reach to accommodate the future 1 percent flow.
- Provide freeboard as required by FEMA standards.
- Complete construction of Lower Penitencia Creek improvements, prior to the completion of Upper Berryessa Creek construction.
- Minimize future maintenance needs.
- Provide maintenance guidelines for the creek in the project reach.
- Minimize impacts to environmental resources.
- Provide maintenance access that is complementary to the City of Milpitas Trail Master Plan (as much as possible).
- Project objectives are consistent with the following Board Ends Policies:
    - Ends Policy E3.1 – Provide natural flood protection for residents, businesses, and visitors.

[1] Lower Berryessa Creek Project Planning Study Report, Winzler & Kelly, March 2010 (Table 4-1)

- Ends Policy E3.2 – Reduce potential for flood damages.
- Ends Policy E4.2 – Improved quality of life in Santa Clara County through trails and open space.

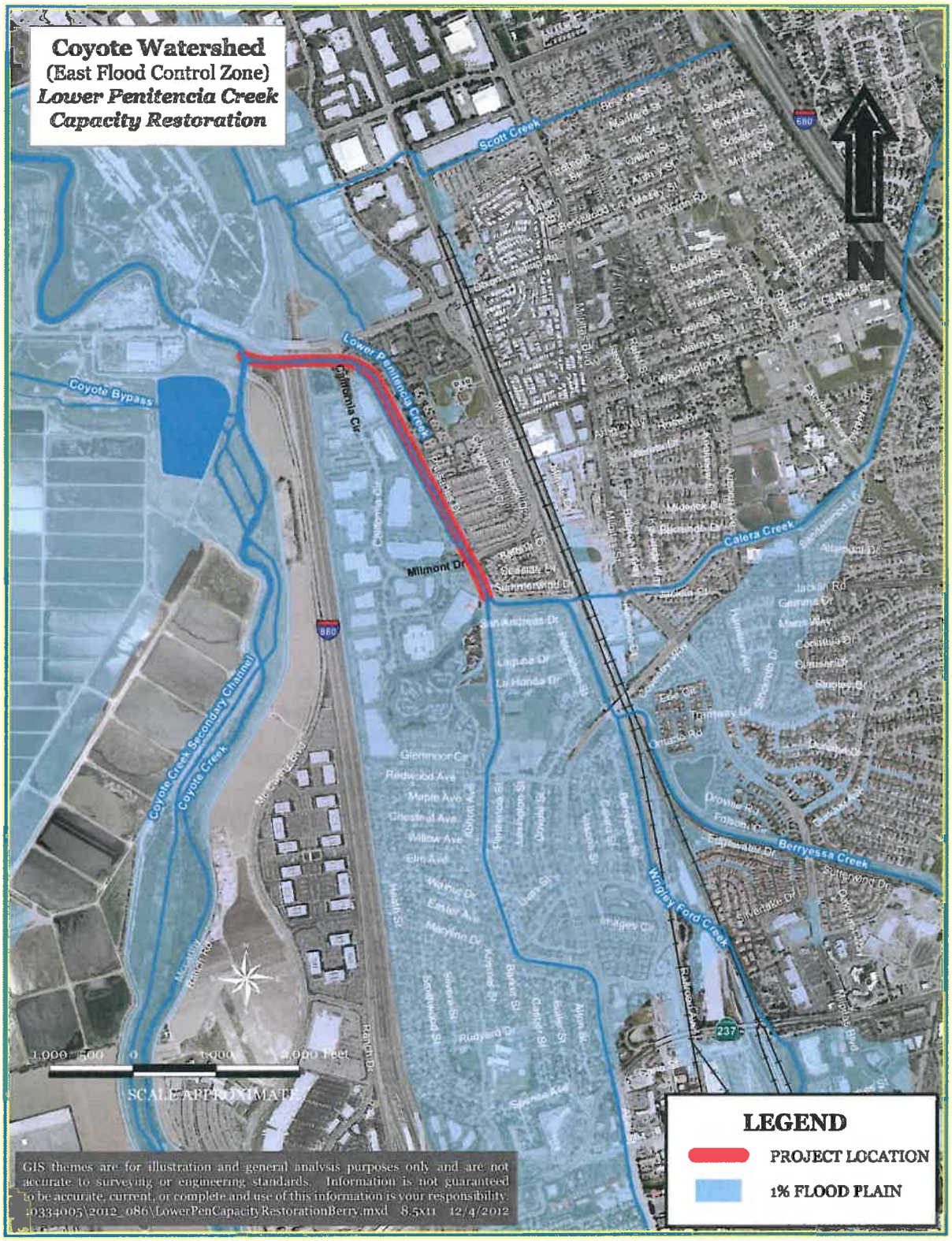

Figure 1: Location Map and Project Limits

3. BACKGROUND AND EXISTING CONDITION

3.1 Project Watershed Description

Lower Penitencia Creek is located in the northeasterly portion of Santa Clara County within the City of Milpitas. In its entirety, it is about four miles long and flows northerly from two large outfalls at Montague Expressway to its confluence with Coyote Creek near the intersection of Interstate 880 and Dixon Landing Road.

Its watershed lies in the unincorporated area of the county and in the Cities of Milpitas and San Jose. The total watershed area is about 29 sq miles[2] with about 16 square miles lying on the valley floor and the remainder in the hills of the Diablo Range.[3]

Two tributaries, Berryessa Creek and East Penitencia Creek, flow into Lower Penitencia Creek. Lower Penitencia Creek itself flows into Coyote Creek. Berryessa Creek is the major drainage channel for the mountainous portion of the Lower Penitencia Creek Watershed.

3.2 History

Up until the mid 1800's, Lower Penitencia Creek was seasonally connected to Upper Penitencia Creek[4]. The two creeks were separated by a substantial complex of willow groves, seasonally flooded wetlands, and freshwater marsh, stretching along the east side of Coyote Creek from today's Murphy Ave southward past Mabury Road. As Upper Penitencia Creek sunk into this marsh, it lost definition as a creek but then came out as a creek again as Lower Penitencia Creek. During summer months, there would have been no surface connection between the two creeks. During winter months, they would be connected from high flows through this marsh complex.

Around 1851, a local landowner dug a ditch from the mouth of Upper Penitencia Creek through the willow groves to Coyote Creek to reduce wintertime flooding at the mouth of the creek, but it had the added effect of connecting Upper Penitencia Creek to Coyote Creek for the first time. Over time, this connection became the sole flow pathway and the two Penitencia Creeks became permanently separated.

The District improved the portion of Lower Penitencia Creek from the confluence with Coyote Creek to State Route 237 in 1955, the portion from State Route 237 to Sylvia Ave. in 1962, the portion from Sylvia Ave. to South Main Street in 1965.

A Lower Penitencia Creek Planning Study and Engineer's Report was prepared in 1982. (See Section 3.3 below) The current existing channel in the project reach was improved

[2] Berryessa Creek Watershed Hydrology Report, Berryessa Creek Levees Project, Northwest Hydraulic Consultants, April 2003

[3] Lower Penitencia Creek Planning Study Report/Engineers Report/Negative Declaration, Nov 1982

[4] Upper Penitencia Creek Historical Ecology Assessment, San Francisco Estuary Institute, June 2012

at multiple locations in the 1980's. The channel improvements consisted of various modifications to the creek to increase capacity for the 1 percent flood flows at the time, which according the report was 7000 cfs.

In 1983, property west of the creek and south of Dixon Landing Road was developed, becoming Dixon Landing Business Park.[5] The development included improving the channel between Interstate 880 and Berryessa Creek confluence. Levees were built on both sides of the creek between Interstate 880 and California Circle. A secondary channel and a depressed center island topped with a maintenance road were constructed between California Circle and Milmont Drive. A west levee was constructed between California Circle and Berryessa Creek confluence.

In 1984, the District reconstructed the channel with concrete under Interstate 880.

In 1988, property east of the creek and south of Dixon Landing Road was developed, becoming Californing Landing.[6] The development included improving the channel between California Circle and Berryessa Creek confluence, and constructing Milmont Drive bridge[7]. The main channel was widened and a depressed maintenance road (along the east levee) was constructed between California Circle and Milmont Dr. At the same time, east levees were constructed between California Circle and Berryessa Creek confluence.

In 1989, the channel downstream of Interstate 880 was widened and a south levee was constructed as part of the Coyote Creek Reach 1 improvements. In the same year, the City of Milpitas constructed the Milmont Drive bridge.

In 2001, Caltrans reconstructed the interchange at Dixon Landing Road and Interstate 880 within the Cities of Milpitas and Fremont. The project consisted of constructing a new Dixon Landing Road, a newly widened Interstate 880 freeway structure, and new freeway access ramps. Both the new freeway bridge and the new southbound on-ramp bridge crosses over the creek.

3.3 Previous Studies

Lower Penitencia Creek Planning Study, Engineer's Report, and Negative Declaration (1982)

This study was the basis of the improvements that were constructed in the 1980's. The study covered the full length of the creek from the downstream limit at Coyote Creek confluence to the upstream limit at Montague Expressway. For the reach downstream of Berryessa Creek confluence, it proposed channel modifications to increase capacity, specifically that the channel be widened and levees be constructed to provide adequate capacity and freeboard. It also proposed that portions of the channel be concrete lined. Adjacent property owners were required to construct these measures as conditions of

[5] Dixon Landing Business Park, Plans for Improvement of Lower Penitencia Creek, Reimer Associates, 4/15/1983

[6] Plans for the Improvement of Easterly Levee of Lower Penitencia Creek, Reimer Associates, Sept., 1988.

[7] California Landing, Plans for the Improvement of California Circle and Milmont Drive Bridge, Reimer Associates, December 1988.

development. Only the concrete lined section crossing under Interstate 880 was constructed by the district in this reach.

A copy of the report's summary section can be found in Appendix E.

Recertification of Provisionally Accredited Levee P52 on Lower Penitencia Creek (2009)

In 2007, the district began recertification efforts under FEMA's Map Modernization Program. The program identified and included the east levee on Lower Penitencia Creek from the California Circle bridge to confluence with Berryessa Creek. Schaaf & Wheeler assisted the District to undertake the effort.

As part of the recertification effort, AMEC Geomatrix Inc was hired to undertake the geotechnical investigation. AMEC produced a report in 2009 documenting the investigation, which concluded that there were no geotechnical issues that would prevent a recertification.

The recertification was completed in 2009 and FEMA updated the Flood Insurance Rate Map to reflect the results. For more detailed information, see section 3.8. For relevant memorandums associated with this recertification, see Appendix D.

3.4 Project Reach Description

The project reach is entirely tidally influenced and is approximately 4700 feet long from the downstream limit at the confluence with Coyote Creek to the upstream limit at the confluence with Berryessa Creek. The location and project limits are shown in Figure 1.

There are 4 bridges that cross over the creek in the project limits. They are, from downstream to upstream, south bound on-ramp to Interstate 880, Interstate 880, California Circle, and Milmont Drive.

Lower Penitencia Creek is for the most part, a trapezoidal channel that is both earth-lined and concrete lined, with a portion of it splitting into dual channels. There are two pump stations located within the project reach and one pump station located just upstream of the confluence with Berryessa Creek, as shown in Figure 10.

Photo 1: standing on south levee looking downstream at confluence with Coyote Creek

At the confluence with Coyote Creek, the channel bottom is rock lined with 3 feet deep of ¼ ton boulders overlaid on geotextile fabric. From the confluence to approximately 200 feet downstream of Interstate 880, the creek is an earthen trapezoidal channel with a levee on the south bank and an embankment on the north banks that daylight at Dixon Landing Road. The top of the south levee width is 18 feet. Since the levee was constructed as part of Coyote Creek to the standards of U.S. Army Corp of Engineers, it is inspected and maintained as part of Coyote Creek. Channel bottom width varies approximately between 55 feet and 70 feet. See photos 1 and 2.

Photo 2: standing on south levee looking upstream at Interstate 880 and on-ramp

From approximately 200 feet downstream of Interstate 880 to Interstate 880, the creek is a concrete lined trapezoidal channel. Channel bottom width varies approximately from 68 feet to 82 feet. There is a concrete ramp on the south bank.

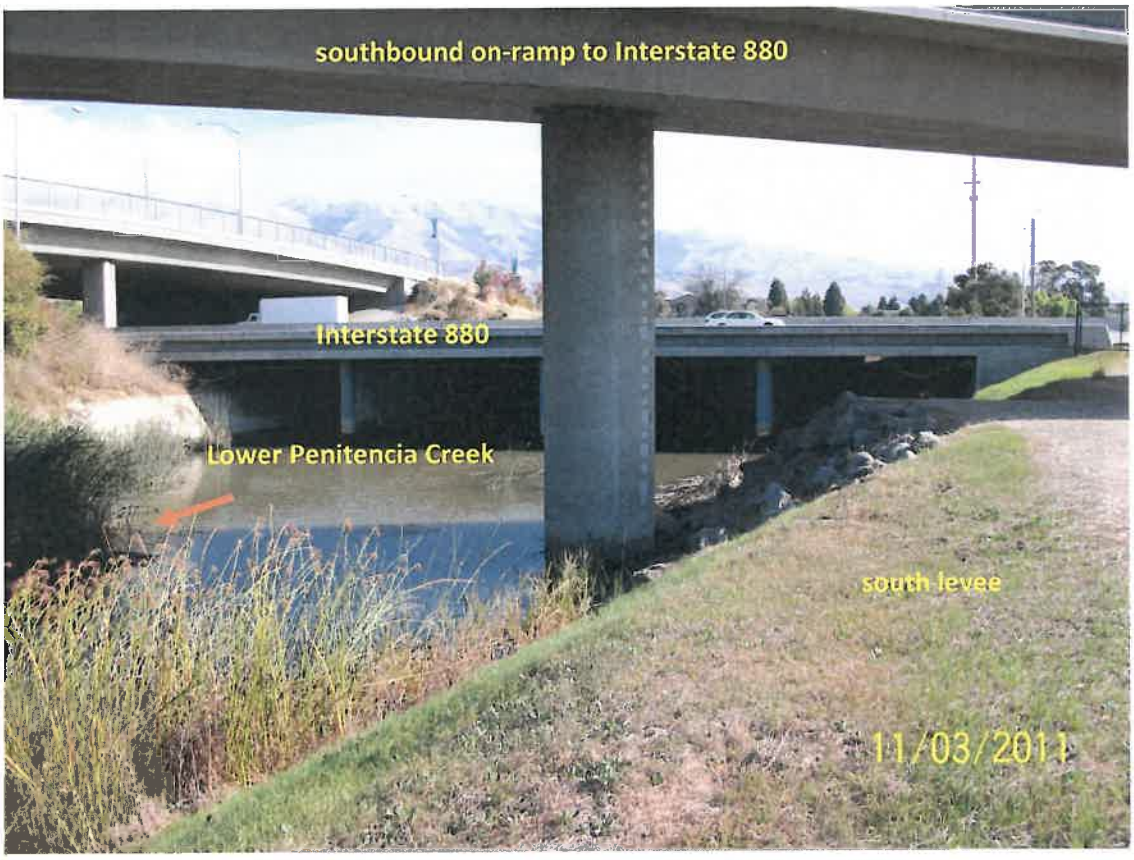

Photo 3: standing on south levee looking upstream at Interstate 880 and on-ramp

Under the Interstate 880 bridge, the creek is a concrete lined channel with a bottom width of approximately 68 feet.

Photo 4: standing on California Circle bridge looking downstream at Interstate 880

From Interstate 880 to California Circle, the creek is a 55 feet wide concrete lined trapezoid channel with levees on both banks. Both the north bank and south levee are 18 feet wide at top. Just downstream of California Circle, there is an outfall consisting of three 36-inch polyethylene pipes at the south levee originating from the California Circle pump station, which is privately owned.[8] The location is shown on Figure 3.

Under the California Circle bridge, the creek is a concrete lined trapezoidal channel with a bottom width of 55 feet.

[8] Dixon Landing Business Park Plans for the Improvement of Lower Penitencia Creek, design plans, Reimer Associates, March 1983

Photo 5: standing on California Circle looking upstream at the start of the dual channel

From California Circle to the start of the dual channels, approximately 165 feet upstream, the creek is a concrete lined trapezoidal channel with bottoms varying from approximately 55 feet to 70 feet wide. There are levees on both banks with the top of the east levee paved with asphalt concrete for the city's trail. Both levees are 12 feet wide at top. There is an 18 feet wide depressed maintenance road along the inboard east levee.

At the start of the dual channels, the creek is concrete lined for approximately 90 feet before transitioning to earth. The dual channel consists of a main channel, a secondary channel, and an 18 feet wide depressed maintenance road island in between. The main channel bottom varies approximately from 38 to 41 feet wide and the secondary channel bottom is approximately 22 feet wide. Levees continue to flank both sides of the channel and the east levee top continue to be paved for the city's trail. Both levees continue to be 12 feet wide at top and the east levee continues the 18 feet wide depressed maintenance road.

Photo 6: Standing on Milmont Drive looking downstream at the dual channel and transition to single channel.

The creek is an earthen dual trapezoidal channel for approximately 2365 feet. The main channel bottom is approximately 41 feet wide and the secondary channel bottom is approximately 22 feet wide. The west levee maintains a top width of 12 feet while the east levee is narrowed to 11 feet. The depressed maintenance road on the east bank is narrowed to 16 feet wide. Within this reach is a 72 inch diameter outfall on the east bank. The outfall discharges storm water runoff from Jurgens pump station, which is owned and operated by the City and located in the Dixon Landing Park. The location is shown on Figure 3.

At approximately 240 feet downstream of the Milmont Drive bridge, the creek starts to transition back to a single trapezoidal concrete lined channel.

Photo 7: standing at Milmont Drive looking upstream at Berryessa Creek confluence

From the Milmont Drive bridge to the Berryessa Creek confluence, approximately 450 feet, the creek is a single concrete lined trapezoidal channel with a bottom width of approximately 60 feet. Both levees are 18 feet wide at top and have paved roadways.

Just upstream of the Berryessa Creek confluence are two outfalls on the west bank. These two 18 inch diameter polyethylene pipes discharge storm water runoff from the Abbott Ave pump station. The location is shown on Figure 3.

3.5 Property Ownership of Creek

As shown on Figure 2:

From Coyote Creek to Interstate 880, the district owns the creek, including the south levee. Under Interstate 880, Caltrans owns the creek and the district have an easement. Between Interstate 880 and California Circle, the creek is privately owned but the district have an easement. Between California Circle and Milmont Drive, the district owns the main channel and east levee, but both the secondary channel and west levee is in private ownership and the district have an easement over them. From Milmont Drive to Berryessa Creek confluence, the District owns the channel, east levee and east top of bank landscaping strip. The west levee is privately owned and the district have an easement. All property rights will be confirmed during design phase.

Lower Penitencia Creek

Coyote Creek confluence to Berryessa Creek confluence

Land Rights

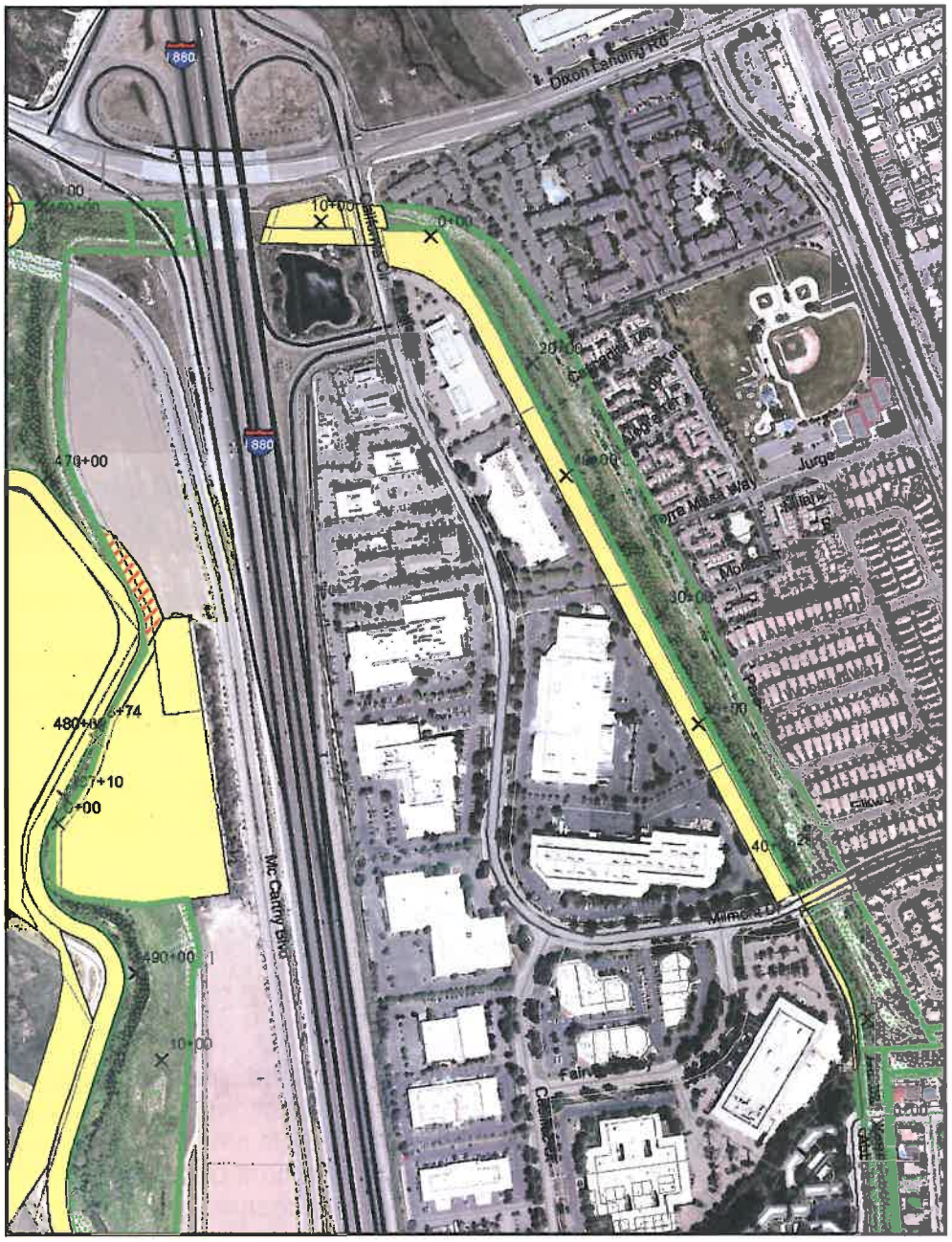

Figure 2: Creek Fee and Easement

Lower Penitencia Creek

Coyote Creek confluence to Berryessa Creek confluence

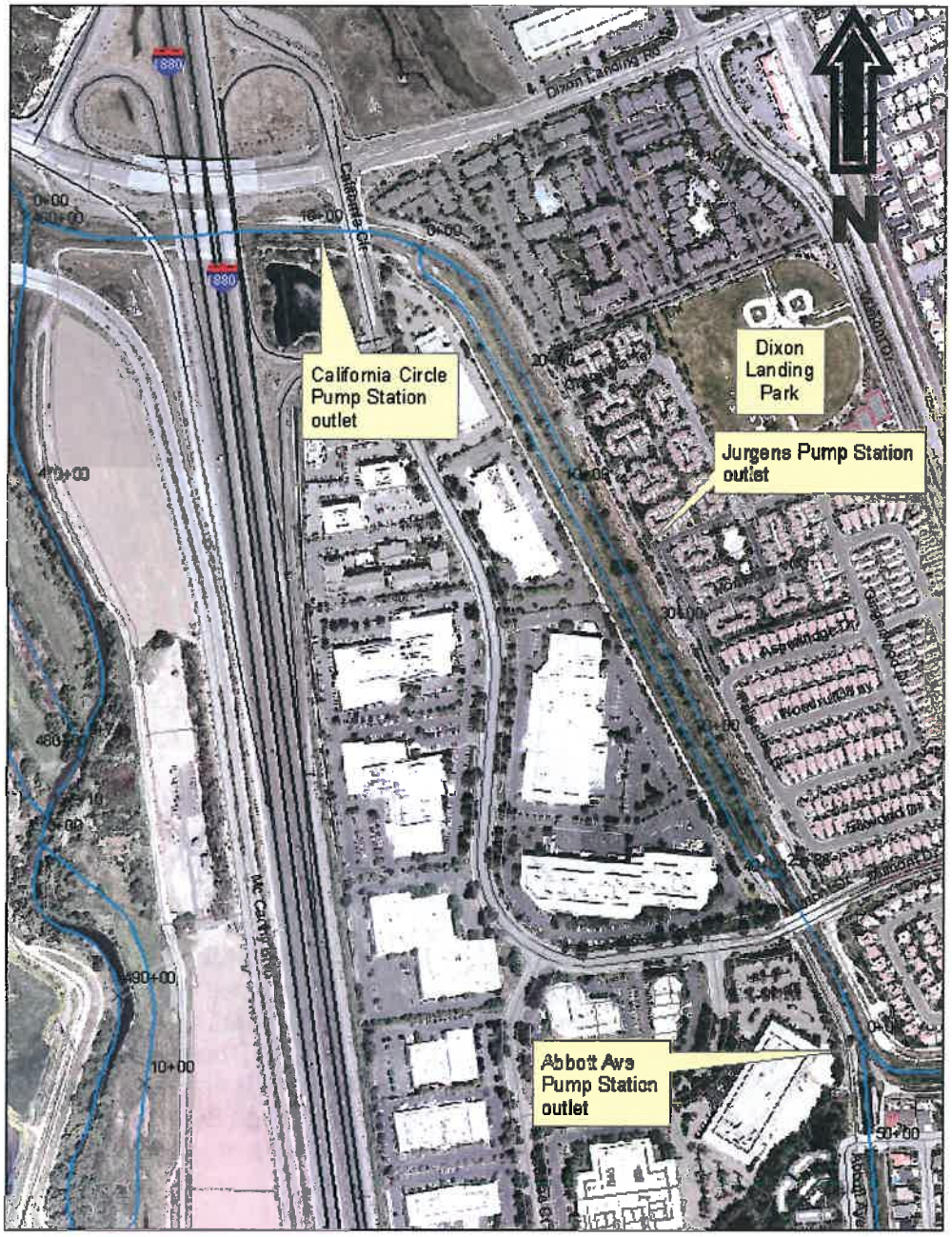

Figure 3: Pump Station Outlets

3.6 Watershed Hydrology

This project will use the design flows, as shown below, from the Lower Berryessa Creek Project Planning Study Report.[9] The design flows were based on a detailed hydrology study (and addendum)[9] and modified by subsequent analysis by the Corp of Engineers[10]. Therefore, these flows supersede the flows shown in the hydrology study and its addendum.

Table 1: New Future 1% Flow Rates (With Improved Berryessa Creek)
(Corp of Engineers Design Flood Quantities)

Location	1% Flow (cfs)
Lower Penitencia Creek d/s Berryessa Creek confluence	8850
Lower Penitencia Creek u/s Coyote Creek confluence	9050

3.7 Hydraulics

FEMA Levee Recertification in 2009

Following Hurricane Katrina in 2005, FEMA embarked on an effort to reevaluate all accredited levees. The east levee on Lower Penitencia Creek, between California Circle and confluence with Berryessa Creek, was then put under the category of 'provisionally accredited levee and the district was asked to provide additional data and documentation to show that the levee still provides protection from the 1% flood. The District obtained the services of Schaaf and Wheeler to re-evaluate and reaccredit the east levee.[11] In 2009, the study was completed and the levee was accredited.

The approximate length of the reaccreditation reach was 3400 feet or 0.65 mile. In general, the area protected from the 1% flooding by the levee extends from Lower Penitencia Creek and eastward to the Union Pacific Railroad, and between Dixon Landing Road and southward nearly to Berryessa Creek. The reaccreditation included a study on a 72 inch diameter outfall on the east bank, which discharges storm water runoff from the Jurgens pump station. Located in the Dixon Landing Park (See Figure 3), this pump station drains mixed residential areas between Lower Penitencia Creek and Hwy 680. The system is undersized for large runoff events and was designed to

[9] Lower Berryessa Creek Project Planning Study Report, March 2010, Winzler & Kelly and Santa Clara Valley Water District

[10] Lower Berryessa Creek Project-Lower Berryessa Creek Final Hydraulic Model Technical Memorandum, Winzler & Kelly, April 16, 2010.

[11] 1% flow used was 3500 cfs base flow plus coincident pump station discharges. Recertification of Provisionally Accredited Levee P52 on Lower Penitencia Creek in Milpitas, California, Schaaf & Wheeler, July 2009.

function in tandem with the detention storage available in the park itself. Analysis showed that water can be stored to an approximate elevation of 12.7 feet NAVD before being released across Dixon Landing Road north into the City of Fremont. Therefore, an area of residual ponding is shown at the park and this also is reflected in the most updated Flood Insurance Rate Map dated 5/18/2009.[12]

A geotechnical study was done as part of the recertification. The study concluded that the levees meet geotechnical criteria as set by FEMA for reaccreditation.[13]

The west levee was not evaluated nor FEMA accredited since there is flooding in areas west of the channel.[14] As shown in Figure 4, the latest Flood Insurance Rate Map shows flooding between 1 and 3 feet west of the project reach.

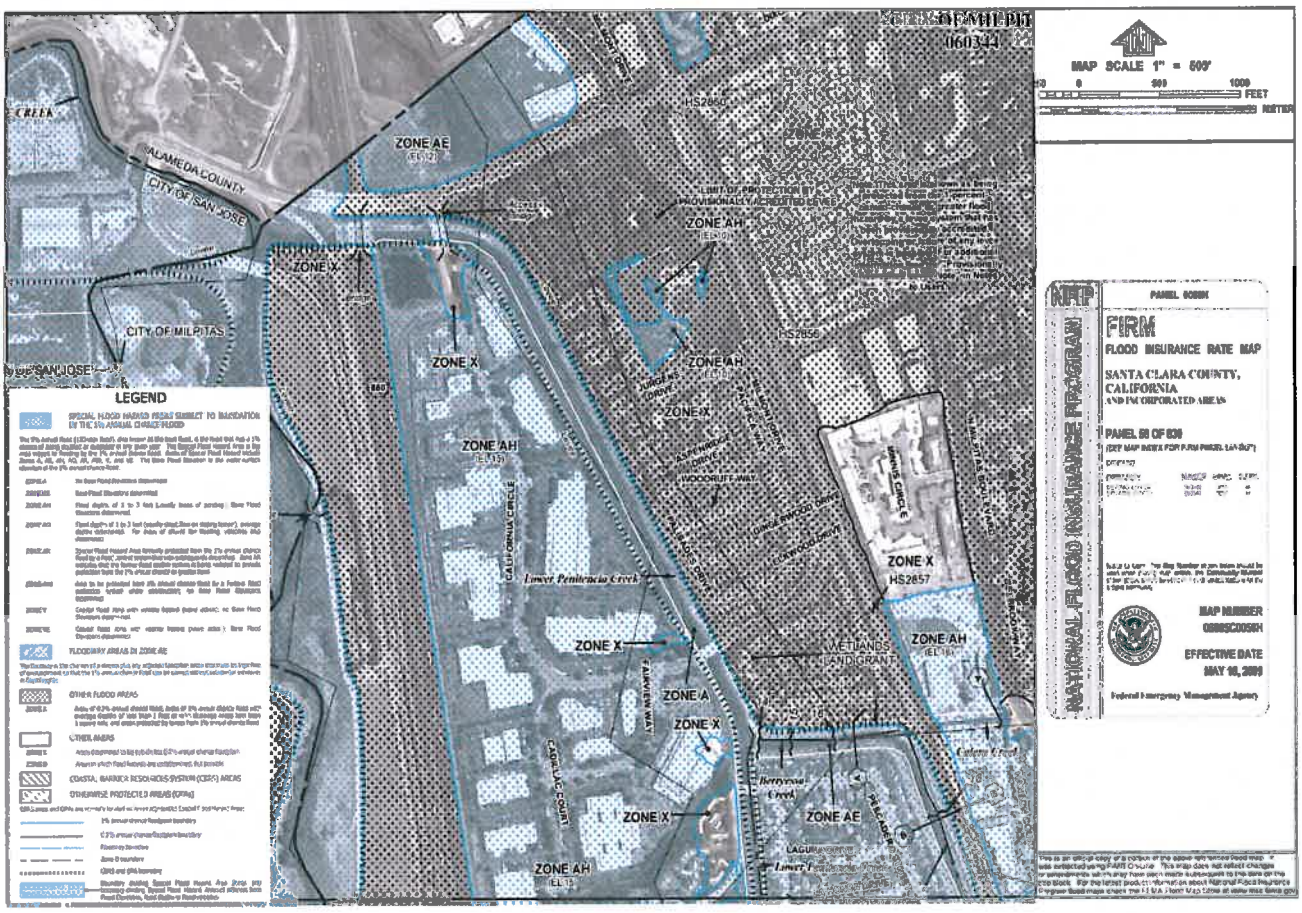

Figure 4: Flood Insurance Rate Map

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[12] Recertification of Provisionally Accredited Levee P52 on Lower Penitencia Creek in Milpitas, CA, Schaaf and Wheeler, July 2009.

[13] Geotechnical Investigation Lower Penitencia Creek Levee Recertification, AMEC Geomatrix, July 2009.

[14] The specific source of flooding is to be clarified in the PSR. However, it is generally believed that the flooding is due to breakouts from Berryessa Creek and possibly from Upper Penitencia Creek.

Preliminary Hydraulic Analysis

Two separate preliminary hydraulic analyses were performed on Lower Penitencia Creek. The first analysis was performed in 2010 to reevaluate the downstream starting water surface elevation for Lower Berryessa Creek project.[15] This covered Lower Penitencia Creek downstream of the Berryessa Creek confluence in conjunction with future 1% flows (see Table 1). The second analysis was completed in early 2012 as part of an effort to understand the likely situation in the non-project reach from Berryessa Creek confluence to Montague Expressway.

The first analysis consisted of reanalyzing the Lower Berryessa Creek hydraulic model with existing 2009-2010 conditions in Lower Penitencia Creek. Then current Lower Berryessa Creek model was based on mostly clean conditions on Lower Penitencia Creek and did not evaluate the impacts of a more sedimented and vegetated Lower Penitencia Creek. Field surveys performed in 2009 and 2010 show that sedimentation and vegetation growth has resulted in a reduced channel cross-section area and increased channel roughness. When the future 1% flood flows were applied to the existing condition, the downstream starting water surface elevation for Lower Berryessa Creek, located at Lower Penitencia Creek downstream of Milmont Drive bridge, would increase roughly by 3 to 4 feet. This showed that if the Lower Berryessa Creek project was to increase the starting water surface elevation (based on a more sedimented and vegetated Lower Penitencia Creek), then modifications would need to be made to the Lower Berryessa Creek design to accommodate the higher water surface. If the Lower Berryessa Creek project was to maintain its original starting water surface elevation, then Lower Penitencia Creek would need to be highly maintained and maybe even its channel features modified to provide the lower starting water surface elevation to Lower Berryessa Creek.

Below is an excerpt from the November 2010 Memo on the findings and recommendations :

Main Findings:

> *The main results of the downstream boundary condition investigation are described here.*
>
> 1. *The 100-year water surface elevation will increase by 3 to 4 feet at the location of the downstream boundary of the Lower Berryessa Creek HEC-RAS model. This increase could be substantially reversed through sediment and vegetation maintenance.*
>
> 2. *The Lower Berryessa Creek design flow (7200 cfs @ one percent at the Lower Berryessa Creek-Lower Penitencia Creek confluence) is based on anticipated future completion of capacity improvement projects on Upper Berryessa Creek and other tributaries. Under current hydraulic conditions, the one percent event is estimated at approximately 3600 cfs, which can be safely conveyed by the existing unmaintained channel.*

[15] Memorandum, Lower Berryessa Flood Protection Project-Downstream Boundary Condition for the 100-year Water Surface Profile, Emily Zedler, November 22, 2010.

3. *An increase of 3 to 4 feet of the downstream boundary condition of the 60 percent Lower Berryessa Creek design hydraulic model would increase the one percent water surface elevations along the entire project reach. If improvements are not made to Lower Penitencia Creek, increases to the one percent water surface elevation would vary between about 3 to 4 feet at the Lower Penitencia Creek-Lower Berryessa Creek confluence and 0.8 feet at Lower Berryessa Creek (just upstream of Hillview Dr. bridge). Under the scenario where maintenance of Lower Penitencia Creek is not performed, the 60 percent design of the Lower Berryessa Creek Project would need to be adjusted by raising floodwall heights accordingly.*

4. *Alternatively, the water surface elevation could be reduced with various modifications to the geometry of Lower Penitencia Creek, such as the construction of a floodplain. There is a future capital flood protection project on Lower Penitencia Creek which will address these issues.*

Recommendations in the memo:

Based on this study, the following recommendations are provided.

1. *The current 60% design of the Lower Berryessa project will convey the future one percent flow (7200 cfs at the Lower Berryessa Creek-Lower Penitencia Creek confluence) and will meet one percent FEMA freeboard standards, provided that maintenance is performed to restore the Lower Penitencia Creek to its 1980s as-built conditions. Because Lower Penitencia Creek is subject to sedimentation, an on-going maintenance plan should also be developed for Lower Penitencia Creek.*

2. *Vegetation and sediment maintenance on Lower Penitencia Creek must be performed prior to the future planned capacity improvement project on Upper Berryessa Creek. Otherwise, there will be a risk of flooding to Lower Berryessa Creek during a one percent flood event.*

3. *As part of their future work, the Lower Penitencia Creek capital project team should develop and evaluate alternatives to the vegetation and sediment maintenance plan in order to achieve the lower one percent water surface profile. Alternatives might include widening the channel, increasing the hydraulic gradient, or reducing the roughness factor. These alternatives could be performed instead of or in concert with the maintenance plan for Lower Penitencia Creek, and could potentially result in further reductions to the one percent water surface elevations.*

The second preliminary analysis compared the results of 3 scenarios. The first scenario combined existing channel conditions with existing one percent FEMA flows. The resulting water surface profile showed that most of the creek had capacity with less than 3 feet freeboard, upstream and downstream of the Lower Berryessa Creek confluence.

The second scenario combined existing channel conditions with new future 1% flows.[16] [17] The resulting water surface profile showed overtopping of the levees upstream of Interstate 880 with most bridges under pressure flow condition. It also showed that the water would continue to spill out of channel until just upstream of the Elmwood Correctional Facility entrance, about 2 miles upstream of the Lower Berryessa Creek confluence. The third scenario combined a clean channel condition with new future 1% flows. The resulting profile showed that downstream of Berryessa Creek confluence, the creek had capacity but with less than 3 feet of freeboard. Upstream of the confluence, it showed overtopping with some bridges under pressure flow conditions. This situation continues upstream to Calaveras Blvd, after which the flows are contained within the floodwalls, but still without 3 feet of freeboard. See Appendix B for future 1% flow rates for upstream of the confluence and from the Berryessa Creek Watershed Hydrology Report Addendum 1. See Appendix C for water surface profiles of these three scenarios. These results are very preliminary and would need to be confirmed during the analyses for feasible alternatives.

Starting Water Surface Elevation

A memorandum dated 9/27/1990 discussed the starting water surface elevation at Lower Penitencia Creek's confluence with Coyote Creek.[18] According to the memo, a 2-D model that was performed prior had shown that the water surface elevation at that location to be 11.2 NGVD (approximately 14 NAVD88). See Appendix D for the entire text of the memo.

3.8 Environmental Setting

Biological Assessments were not conducted at this time, but will be carried out at a later time. Assumptions in the Lower Berryessa Creek Program Final Environmental Impact Report (December, 2011), which was prepared for the Lower Berryessa Creek project and included Lower Penitencia Creek on a programmatic level[19], will be verified in the later biological assessments.

Lower Berryessa Creek Program Final EIR

As stated in the report,

> *"Lower Penitencia Creek was discussed at the program level in this EIR. As currently proposed, improvements to this element include removing sediment and vegetation to return the channel to design capacity. The bench within the channel would be lowered and a new, widened floodplain would be constructed near INTERSTATE 880."*

[16] Lower Berryessa Creek Project Planning Study Report, March 2010, Winzler & Kelly and Santa Clara Valley Water District, Appendix B- Hydrology Study Addendum 1: October 2006 (NHC).

[17] At the time when these hydraulic analyses were performed, it was assumed that the addendum provided the appropriate 1% design flows. It is now known that these flows are superseded by the flows in Table 1.

[18] Per direction given by Liang Xu, Hydraulics Unit Manager, this elevation should be used as the downstream starting water surface elevation.

[19] Lower Berryessa Creek Program FEIR, ESA, Dec 2011

This is an assumption within the report that will be revisited and analyzed as part of identifying alternatives for the project. The report stated that preliminary wetland delineation was not conducted for the Lower Penitencia Creek, but was visually evaluated. The estimate described:

> *"Wetland vegetation, either freshwater or brackish marsh species, also occurs in thick patches within the low-flow channels and adjacent to open water areas throughout the creek. A few large trees occur in some locations at the toe of the levee. Downstream of Interstate 880, the creek is more tidally influenced and vegetation communities transition to brackish marsh vegetation."*

Additional assumptions in the report include:

Sensitive Habitats:

It was assumed that no sensitive natural communities are found in Lower Penitencia Creek – that there are no high potential for any special status species of amphibians, reptiles, fish, birds and mammals to occur in the project reach.

Riparian Vegetation:

Grasses and low shrubs are typical riparian vegetation along the banks with a scattering of some trees within the channel along the project reach.

No special status plant species are anticipated to occur within the program area.

Wetlands:

There are approximately 7.20 acres of potentially jurisdictional waters of the U.S. within Lower Penitencia Creek in the project area. This quantity is roughly estimated to include approximately 5.5 acres of wetlands and 1.7 acres of open water areas.

Cultural Resource:

A cultural resource survey at this project area was not performed at the time of the FEIR.

Temporary and Long Term Impacts:

Specific construction (temporary) and long term impacts will be evaluated at a later date in the planning phase when alternatives are being developed.

3.9 Maintenance

Current maintenance needs include sediment removal, vegetation management, and maintaining both maintenance roads. For many years, sediment removal activities were deferred upon finding that the channel could pass FEMA flows with then current sediment deposition. This project will look into incorporating reduced maintenance activities as part of the solution.

Maintenance History and Stream Maintenance Program (SMP)

The Stream Maintenance Program (SMP) began in 2002 and was granted permits to undertake maintenance activities for 10 years. The program covers routine activities such as sediment removal, bank protection, vegetation management, and minor maintenance activities. It is currently in the process of being renewed.

Under the SMP, sediment was removed from the project reach in two occasions, once in 2004 and once in 2005. Prior sediment removals, which required individual permits from regulatory agencies, were conducted in years 1983, 1984, 1985, 1986, 1988, 1989, and 1997. See Table 2 below.

Table 2: Sediment Removal Maintenance History

Calendar Year	Location	Length (ft)	Vol (CY)
1984	D/S Interstate 880 to Coyote Creek	600	2460
1984	U/S California Cr to Berryessa Crk	3100	4000
1985	U/S California Cr to Berryessa Crk	3100	15000[20]
1986	U/S California Cr to Berryessa Crk	3100	9600[20]
1988	U/S California Cr to Berryessa Crk	3200	4000
1989	D/S San Andreas Dr	3800	4215
1997	Milmont Dr to California Cr	3600	17790[20]

[20] Volume is high - number may be researched further at a later date.

2004	Milmont Dr to San Andreas Dr	1000	3630[21]
2005	California Cr to Milmont Dr (secondary channel only)	2800	3656[22]

In 2004, the reconstruction of the Interstate 880 and Dixon Landing Road interchange project was completed. Sediment was removed from the channel as part of the project.[23]

4. OPPORTUNITIES AND CONSTRAINTS

Opportunities

Land Development

There are two properties between California Circle and the creek, both currently commercial, that is being developed into residential housing. Depending on the details and timeline, there may be opportunity to improve land conditions outside the current outboard toe of the creek levee.

Maintenance

Potential additional opportunities can include improved maintenance access, dewatering system, and landscape cleanup to reduce future sediment removal by emulating marsh floodplain elevations instead of a widened bottom invert width that is not sustainable.

Constraints

Hydraulics

Future alternatives will need to ensure that the water surface elevations in this creek do not increase the already established water surface elevations in Lower Berryessa Creek project.

Right of Way

There is limited Right of Way. Most of the creek is adjoined to the west by commercial properties and to the east by residential properties.

Schedule

Construction of improvements will need to be completed prior to completion of Upper Berryessa Creek project, which is currently scheduled for FY2016.

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[21] According to maintenance records, sediment removal were performed for $178,000 ($49/cy)
[22] According to maintenance records, sediment removal were performed for $175,000 ($48/cy)
[23] Sediment removal quantity will be researched at a later date as needed.

Joint Use Agreement for City of Milpitas Trail

Future alternatives will need to take into consideration impacts to the existing City trail.

Under a joint use agreement with the District, the City of Milpitas owns a paved trail in the project reach. The paved trail is located within District right of way, on the east levee from California Circle to about 700 feet downstream California Cr, where the trail then diverges off the levee and continues along the foot of the PG&E towers and at the outboard toe of the east levee to Milmont Drive. The City has also installed in a joint use area within District right of way, landscaping and drainage, which runs along the east levee between Milmont Drive and Berryessa Creek confluence.

There is a paved pedestrian and emergency vehicle access on the west levee between Milmont Drive, which is downstream of the confluence with Berryessa Creek, and San Andreas Drive, which is upstream of this confluence. It appears to be both in District right of way and on private land.

The trail is identified in a joint use agreement with City of Milpitas for a period of 25 years, set to expire in 2022.[24]

5. COMMUNITY OUTREACH

Since this project is a capacity restoration project, there is no public meetings planned for the Draft Problem Definition Report. During the Feasible Alternatives Analysis phase, a public meeting will be scheduled to solicit input from the public and stakeholders.

6. POTENTIAL CHANGES TO PROJECT OBJECTIVES AND SCOPES

The current project objectives and scopes remain the same. During a preliminary hydraulic analysis of the creek (see Appendix C), the resulting profiles showed various losses of freeboard upstream of the project limit. The preliminary findings were presented to the project owner in January, 2012 and it was determined by the project owner that the reaches upstream of the confluence with Berryessa Creek will be addressed in a future Capital project.

7. NEXT STEPS

The next immediate steps will focus on developing feasible alternatives, preparing an outreach strategy plan, planning and conducting appropriate public outreach, identifying a staff recommended alternative, preparing the Planning Study Report, and starting the CEQA process.

[24] Lease Agreement (Joint Use) No. A2001, File 4033-49 (CPRU), January 7, 1997.

Appendix A

Memorandum on Lower Berryessa Creek Hydraulic Analysis

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Santa Clara Valley Water District

MEMORANDUM

TO: Dennis Cheong, Liang Lee

FROM: Emily Zedler

SUBJECT: Lower Berryessa Flood Protection Project- Downstream Boundary Condition for the 100-year Water Surface Profile

DATE: November 22, 2010

INTRODUCTION

This memo summarizes the main findings of a hydraulic analysis of the downstream boundary condition used for the 60% design of the Lower Berryessa Creek Project. The purpose of this analysis was to determine whether the 60% design of the Berryessa Creek project needs to be adjusted to accommodate changed conditions in Lower Penitencia Creek. Based on this analyses, it provides recommendations for the Lower Berryessa Creek and Lower Penitencia Flood Protection capital projects.

BACKGROUND

The downstream boundary condition for the 60% design of Lower Berryessa Creek was originally computed by Winzler and Kelly in 2003 by extracting the water surface elevation from a Lower Penitencia 1% hydraulic model at the location of the downstream boundary of the Lower Berryessa HEC-RAS model . The Lower Penitencia Hydraulic model was based on 1980s as-built channel geometry; since then, Lower Penitencia Creek has experienced both sedimentation (primarily of bay mud) and the establishment of vegetation (mostly tulies). Although Winzler and Kelly did update upstream portions of the model with more recent survey data, the most critical geometry changes to Lower Penitencia Creek have occurred in the downstream part of the channel between the confluence of Lower Penitencia and Coyote Creek and the bridge crossing at Milmont Dr. The District collected new geometry data in 2009 and 2010 which indicates that sedimentation and the establishment of vegetation has occurred in Lower Penitencia, resulting in reduced channel cross-section and increased channel roughness. These geometry changes have increased the downstream boundary condition for Lower Berryessa Creek under existing 2010 conditions.

MAIN FINDINGS

The main results of the downstream boundary condition investigation are described here. Details of these findings can be found in the attached report (see enclosures below).

1. The 100-year water surface elevation will increase by 3 to 4 feet at the location of the downstream boundary of the Lower Berryessa Creek HEC-RAS model. This increase could be substantially reversed through sediment and vegetation maintenance.

2. The Lower Berryessa Creek design flow (7200 cfs @ 1% at the Lower Berryessa Creek-Lower Penitencia Creek confluence) is based on anticipated future completion of capacity improvement projects on Upper Berryessa Creek and other tributaries. Under current hydraulic conditions, the 1% event is estimated at approximately 3600 cfs, which can be safely conveyed by the existing unmaintained channel.

3. An increase of 3 to 4 feet of the downstream boundary condition of the 60% Lower Berryessa Creek design hydraulic model would increase the 1% water surface elevations along the entire project reach. If improvements are not made to Lower Penitencia Creek, increases to the 1% water surface elevation would vary between about 3 to 4 feet at the Lower Penitencia Creek-Lower Berryessa Creek confluence and 0.8 feet at Lower Berryessa Creek. Under the scenario where maintenance of Lower Penitencia

Creek is not performed, the 60% design of the Lower Berryessa Creek Project would need to be adjusted by raising floodwall heights accordingly.

4. Alternatively, the water surface elevation could be reduced with various modifications to the geometry of Lower Penitencia Creek, such as the construction of a floodplain. There is a future capital flood protection project on Lower Penitencia Creek which will address these issues.

RECOMMENDATIONS

Based on this study, the following recommendations are provided.

1. The current 60% design of the Lower Berryessa project will convey the future 1% flow (7200 cfs at the Lower Berryessa Creek-Lower Penitencia Creek confluence) and will meet 1% FEMA freeboard standards, provided that maintenance is performed to restore the Lower Penitencia Creek to its 1980s as-built conditions. Because Lower Penitencia Creek is subject to sedimentation, an on-going maintenance plan should also be developed for Lower Penitencia Creek.

2. Vegetation and sediment maintenance on Lower Penitencia Creek must be performed prior to the future planned capacity improvement project on Upper Berryessa Creek. Otherwise, there will be a risk of flooding to Lower Berryessa Creek during a 1% flood event.

3. As part of their future work, the Lower Penitencia Creek capital project team should develop and evaluate alternatives to the vegetation and sediment maintenance plan in order to achieve the lower 1% water surface profile. Alternatives might include widening the channel, increasing the hydraulic gradient, or reducing the roughness factor. These alternatives could be performed instead of or in concert with the maintenance plan for Lower Penitencia Creek, and could potentially result in further reductions to the 1% water surface elevations.

Emily Zedler, P.E.
Assistant Civil Engineer
Capital Program Services Division

Enclosures

1. Report on the Starting Water Surface Elevation for Lower Berryessa Creek Based on Updated Geometry at Lower Penitencia Creek

CC: Tony Ndah, Stacey Lee, Al Gurevich, Liang Xu

Appendix B

Design Flow Rates for Upstream of Berryessa Creek Confluence

and

Berryessa Creek Watershed Hydrology Report

Addendum 1: October 2006

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Hydrology Hydraulics and Geomorphology Unit Service Request Form

Brief Description of Request:

Requested by: **Stacey Lee**	**Extension:** **X3078**	**Email:** **slee@valleywater.org**
Job/Project Title: **Asc Civil Engr**	**Job/Project No:** **40334005**	**Date of Request:** **11/16/11**
Unit No: **327**	**Task No:** **1213**	**Date Required:** **Tues 11/22/11**

Nahm, let me know if you're too busy and can't make that date. I don't have a good idea of how long these things take. We can talk.

I would like to obtain flow rates for Lower Penitencia Creek:

From approx Sta 40+00 (just d/s Milmont) to upstream end of creek, approx sta 216+94

Please also let me know if your flows are obtained from a Corp model or District model. If Corp model, let me know which one and year. Can you also let me know if your numbers include any pump stations and if so, which ones?

Thanks!!

Deliverable(s):

- flow rates for Lower Penitencia Creek

Location	Drainage Area(mi^2)	100 yr Flow (cfs)
Lower Penitencia Creek (LP1) at Trimble	2.98	820
Lower Penitencia CreekLP3(Guessed location at at Spence Ave)	4.44	1,400
Lower Penitencia Creek at LP5 (Guessed location at Spangler School	4.63	1,500
Lower Penitencia Creek U/S Berryessa Creek	5.09	1,600

From NHC, 2006. *Addendum to Berryessa Creek Watershed Hydrology Report.* Northwest Hydraulics Consultants, Inc

- Corp or District model. If Corp model, which one and year
    1. All values are From NHC, 2006. *Addendum to Berryessa Creek Watershed Hydrology Report.* Northwest Hydraulics Consultants, Inc.
    2. Unit doesn't have any information about Corp model.

- Any pump stations included in Q (which ones)
    - Yes

Data Provided by: Nahm Lee	**Date: Nov. 21 2011**
Reviewed by: Jen-Men Lo	**Date: Nov. 22 2011**

Appendix C

Preliminary Hydraulic Profiles
(Dec 2011 & Jan 2012)

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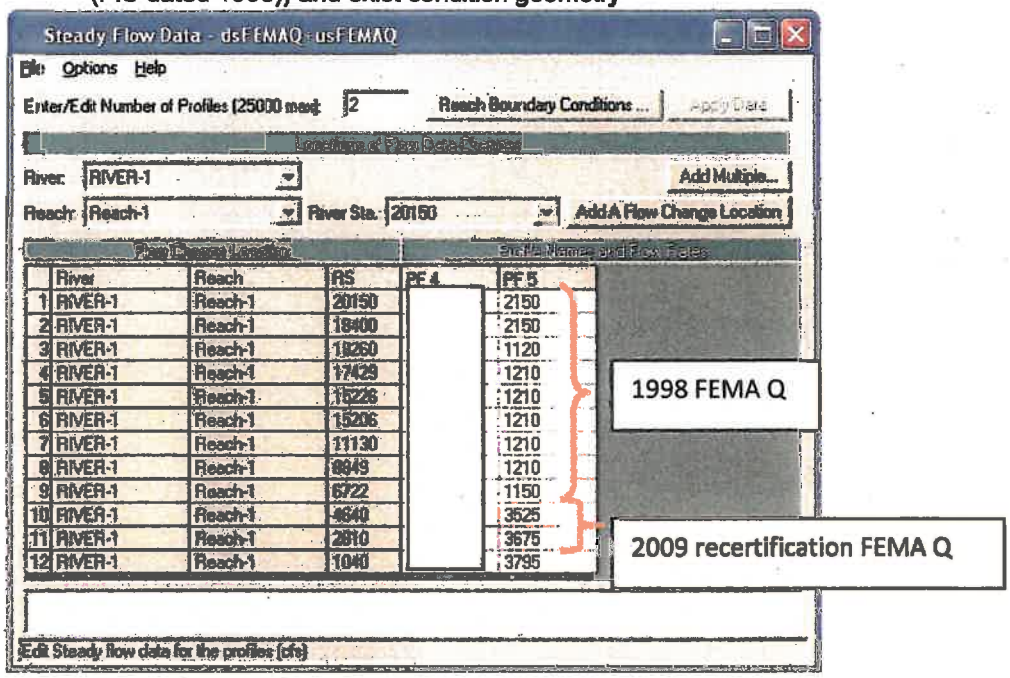
File: Lpen_existdsQ+existusQNAVD88
Plan: 2010-1990NAVDGeom+existds+existusQ

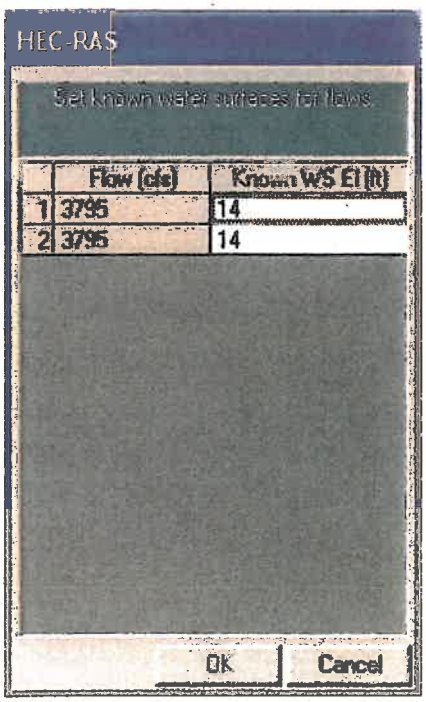
FEMA Q= exist Q

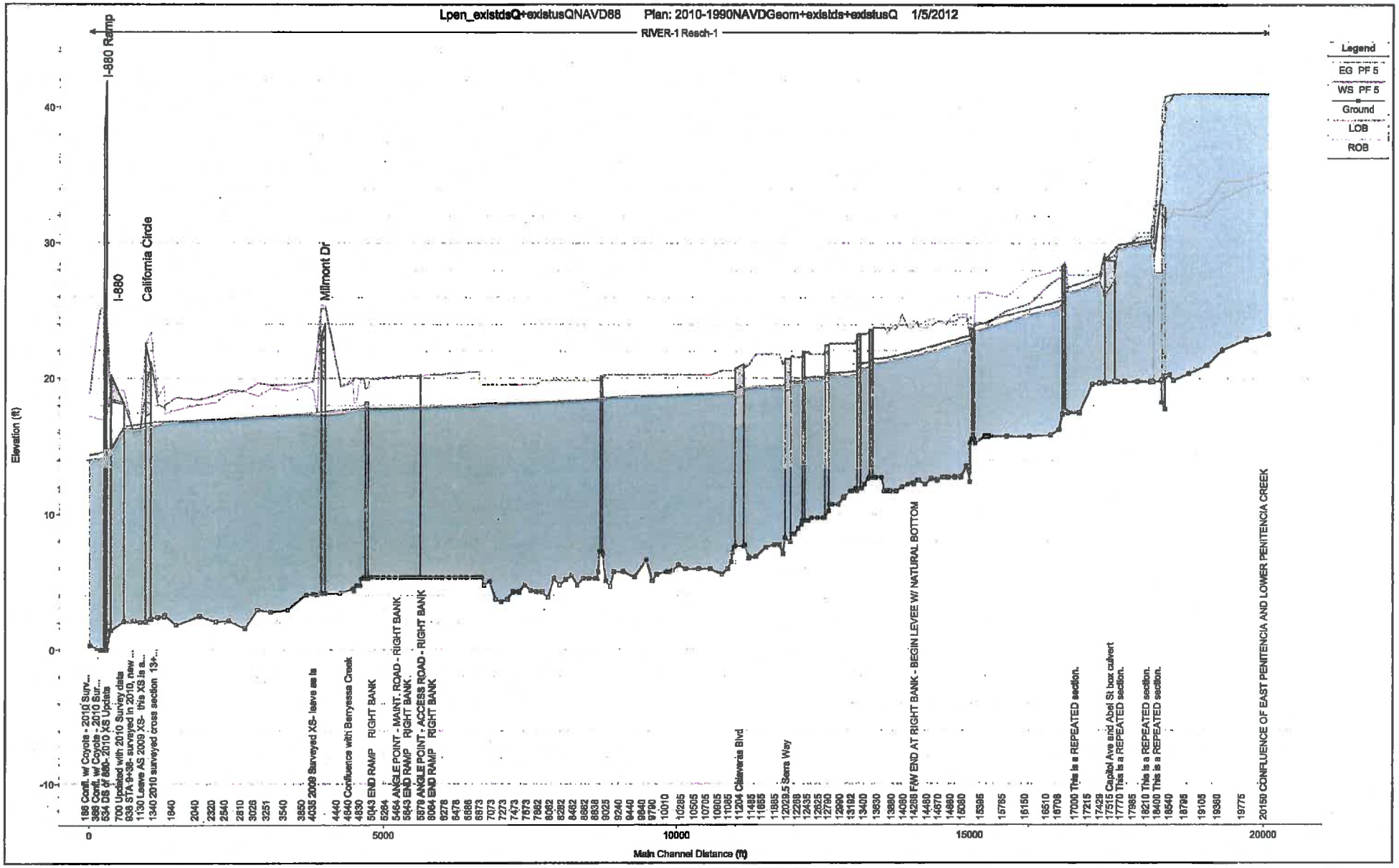
Run reflects exist Q (including overflow from non-improved Berryessa (FIS dated 1998)) and exist condition geometry



1998 FEMA Q

2009 recertification FEMA Q




Lpen_existdsQ+existusQNAVD88 Plan: 2010-1990NAVDGeom+existds+existusQ 1/5/2012
RIVER-1 Reach-1
Legend
EG PF 5
WS PF 5
Ground
LOB
ROB
Elevation (ft)
Main Channel Distance (ft)
I-880 Ramp
I-880
California Circle
Milmont Dr
186 Confl. w/ Coyote - 2010 Surv...
388 Confl. w/ Coyote - 2010 Sur...
534 DS of 880- 2010 XS Update
700 Updated with 2010 Survey data
838 STA 9+38- surveyed in 2010, new ...
1130 Leave AS 2009 XS- this XS is a...
1340 2010 surveyed cross section 13+...
1840
2040
2320
2540
2810
3028
3251
3540
3850
4035 2009 Surveyed XS- leave as is
4440
4840 Confluence with Berryessa Creek
4830
5043 END RAMP RIGHT BANK
5284
5464 ANGLE POINT - MAINT. ROAD - RIGHT BANK.
5843 END RAMP RIGHT BANK.
5879 ANGLE POINT - ACCESS ROAD - RIGHT BANK
6064 END RAMP RIGHT BANK
6278
6478
6686
6873
7073
7273
7473
7673
7882
8062
8282
8462
8662
8838
9025
9240
9440
9640
9790
10010
10285
10505
10705
10905
11085
11204 Calaveras Blvd
11485
11665
11865
12029.5 Sierra Way
12268
12435
12625
12790
12990
13192
13400
13630
13860
14060
14288 F/W END AT RIGHT BANK - BEGIN LEVEE W/ NATURAL BOTTOM
14480
14670
14880
15080
15395
15765
16150
16510
16708
17000 This is a REPEATED section.
17215
17429
17515 Capitol Ave and Abel St box culvert
17770 This is a REPEATED section.
17985
18210 This is a REPEATED section.
18400 This is a REPEATED section.
18540
18795
19105
19360
19775
20150 CONFLUENCE OF EAST PENITENCIA AND LOWER PENITENCIA CREEK

File: Lpen_w_dslookingxsec
Plan: ex2010+1990&2006CorpEPen

Run reflects future Q with Berryessa Creek improved and exist condition geometry

Steady Flow Data - 2006 CORPS Addendum to E.Pen

File Options Help

Enter/Edit Number of Profiles (25000 max): 4 Reach Boundary Conditions ... Apply Data

Locations of Flow Data Changes

River: RIVER-1 Add Multiple...

Reach: Reach-1 River Sta.: 20150 Add A Flow Change Location

	River	Reach	RS	PF 4
1	RIVER-1	Reach-1	20150	820
2	RIVER-1	Reach-1	15226	820
3	RIVER-1	Reach-1	11130	1400
4	RIVER-1	Reach-1	10905	1500
5	RIVER-1	Reach-1	9849	1500
6	RIVER-1	Reach-1	4654	1600
7	RIVER-1	Reach-1	4640	8400
8	RIVER-1	Reach-1	1040	8720

2006 Corp Q

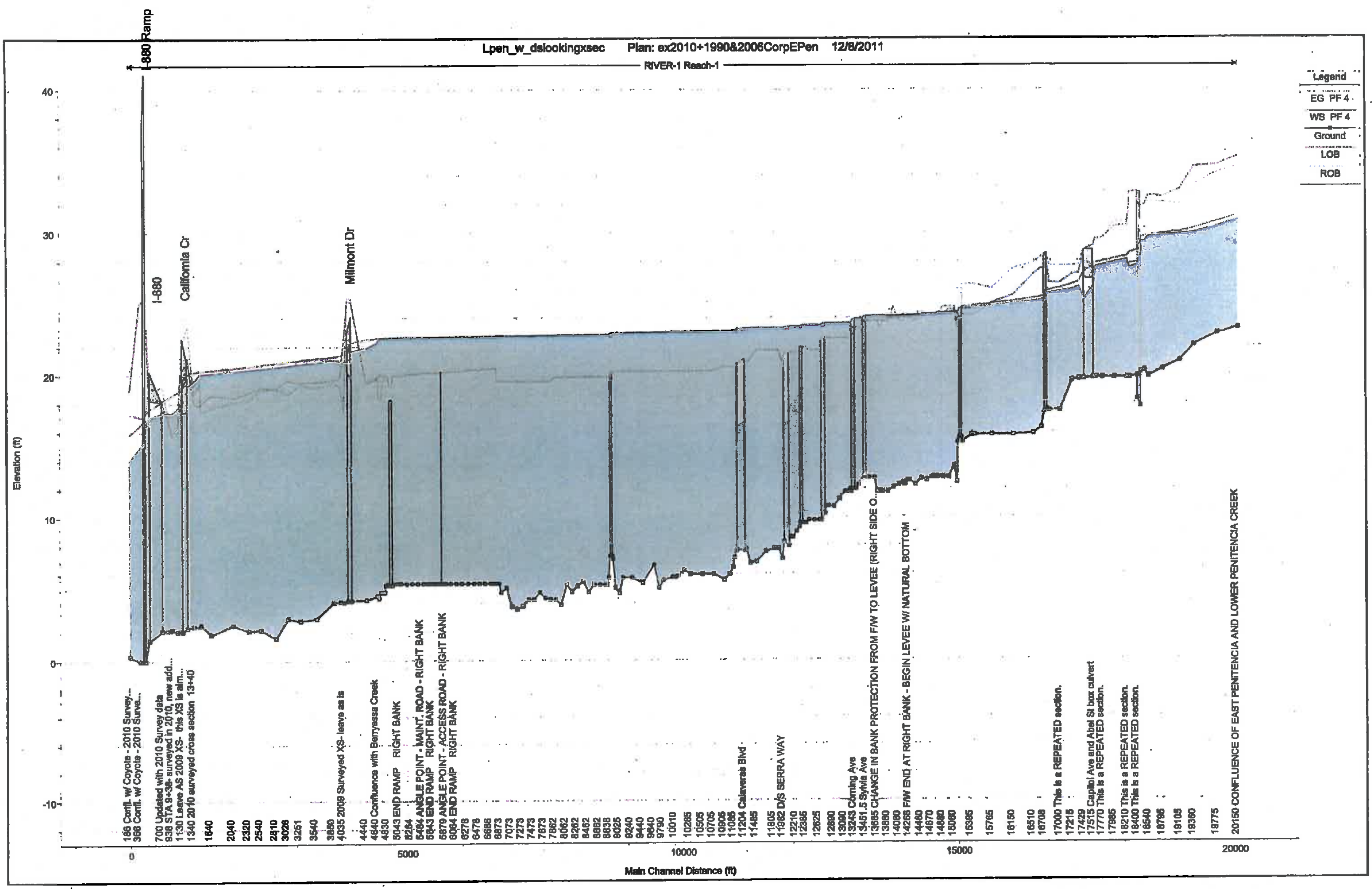
Edit Steady flow data for the profiles (cfs)

HEC-RAS

Set known water surfaces for flows

	Flow (cfs)	Known WS El (ft)
1	3795	14
2	3795	14

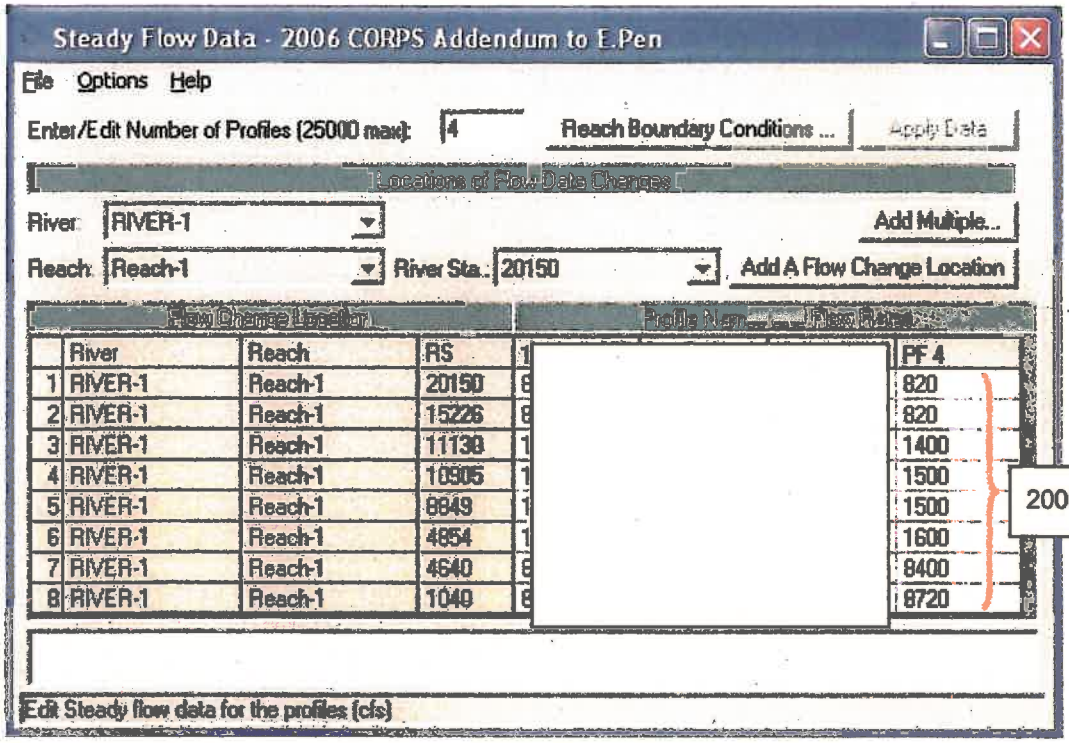
OK Cancel

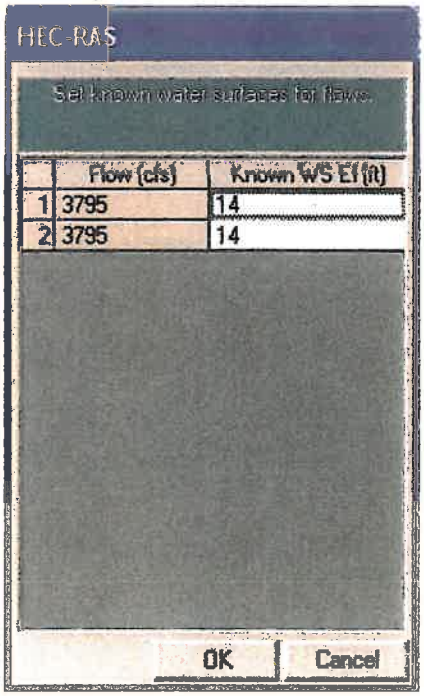


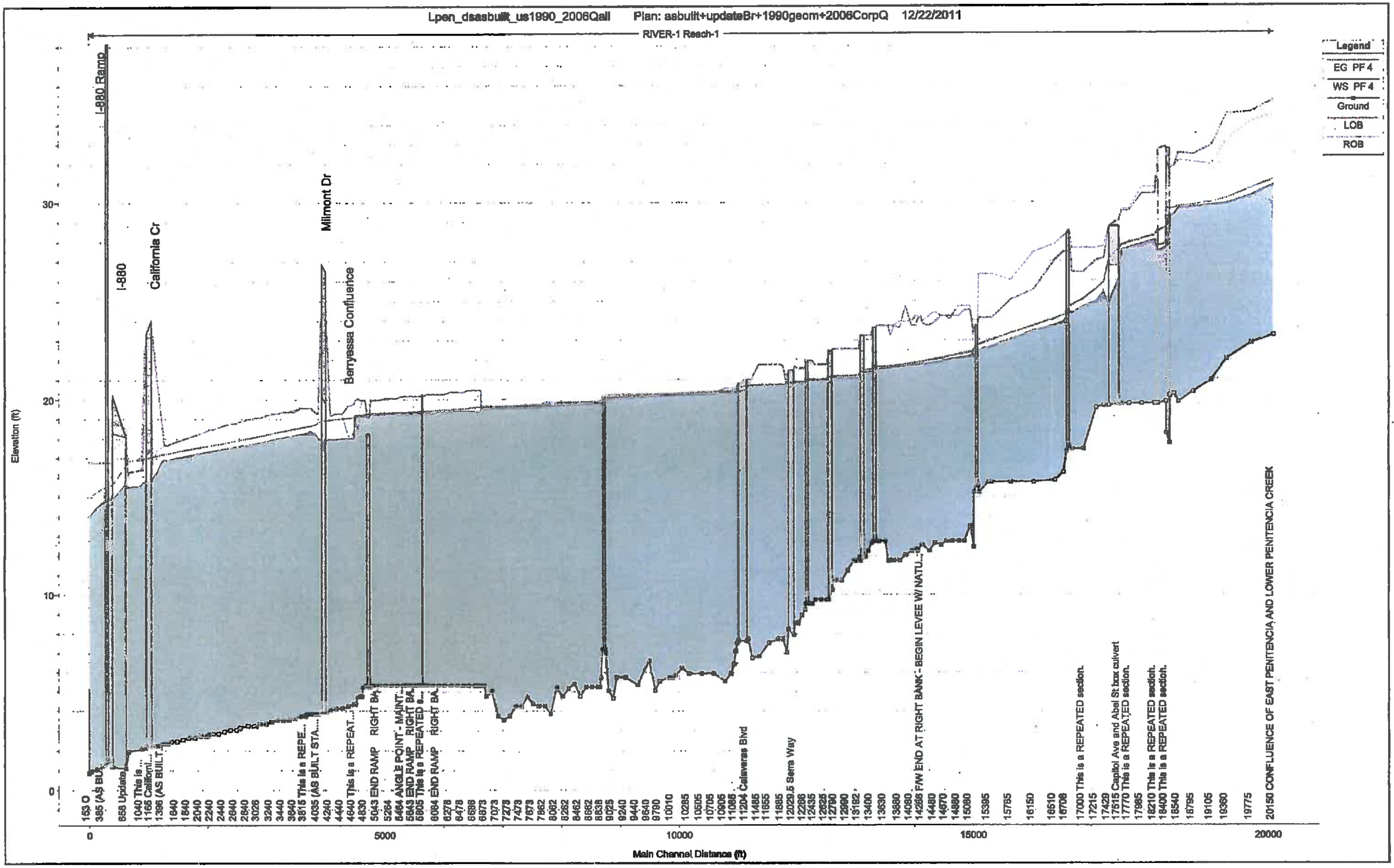
Lpen_w_dslookingxsec Plan: ex2010+1990&2006CorpEPen 12/8/2011
RIVER-1 Reach-1
Legend
EG PF 4
WS PF 4
Ground
LOB
ROB
I-880 Ramp
I-880
California Cr
Milmont Dr
Elevation (ft)
Main Channel Distance (ft)
186 Confl. w/ Coyote - 2010 Survey...
366 Confl. w/ Coyote - 2010 Surve...
700 Updated with 2010 Survey data
938 STA 9+38- surveyed in 2010, new add...
1130 Leave AS 2009 XS- this XS is sim...
1340 2010 surveyed cross section 13+40
4035 2009 Surveyed XS- leave as is
4640 Confluence with Berryessa Creek
5043 END RAMP RIGHT BANK
5464 ANGLE POINT - MAINT. ROAD - RIGHT BANK
5643 END RAMP RIGHT BANK
5879 ANGLE POINT - ACCESS ROAD - RIGHT BANK
6064 END RAMP RIGHT BANK
11204 Calaveras Blvd
11982 D/S SERRA WAY
13243 Corning Ave
13451.5 Sylvia Ave
13665 CHANGE IN BANK PROTECTION FROM F/W TO LEVEE (RIGHT SIDE O...
14266 F/W END AT RIGHT BANK - BEGIN LEVEE W/ NATURAL BOTTOM
17000 This is a REPEATED section.
17515 Capitol Ave and Abel St box culvert
17770 This is a REPEATED section.
18210 This is a REPEATED section.
18400 This is a REPEATED section.
20150 CONFLUENCE OF EAST PENITENCIA AND LOWER PENITENCIA CREEK

File: Lpen_dsasbuilt_us1990_2006Qall
Plan: asbuilt+updateBr+1990geom+2006CorpQ

Run reflects future Q with Berryessa Creek improved and clean as-built geometry







Lpen_dsasbuilt_us1990_2006Qall Plan: asbuilt+updateBr+1990geom+2006CorpQ 12/22/2011
RIVER-1 Reach-1
Legend
EG PF 4
WS PF 4
Ground
LOB
ROB
I-880 Ramp
I-880
California Cr
Milmont Dr
Berryessa Confluence
Elevation (ft)
Main Channel Distance (ft)
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20000
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385 (AS BU
658 Update
1040 This is...
1165 Californi...
1396 (AS BUILT...
3815 This is a REPE...
4035 (AS BUILT STA...
4640 This is a REPEAT...
5043 END RAMP RIGHT BA
5464 ANGLE POINT - MAINT...
5643 END RAMP RIGHT BA
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11204 Calaveras Blvd
12029.5 Serra Way
14266 F/W END AT RIGHT BANK - BEGIN LEVEE W/ NATU...
17000 This is a REPEATED section.
17515 Capitol Ave and Abel St box culvert
17770 This is a REPEATED section.
18210 This is a REPEATED section.
18400 This is a REPEATED section.
20150 CONFLUENCE OF EAST PENITENCIA AND LOWER PENITENCIA CREEK

Appendix D

Memorandum
On
Starting Water Surface Elevation

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From Emily

Santa Clara Valley Water District

MEMORANDUM

FC 14A (04-11-88)

TO: Stan N. Wolfe

FROM: Randall R. Talley

SUBJECT: Coyote Creek at Lower Penitencia Creek

DATE: September 27, 1990

The Corps staff in Sacramento have requested additional information on the design and operation of the Coyote Creek - Lower Penitencia - Coyote Bypass area as part of their analysis for the GDM. Because of the complexity of this area, we took the opportunity to calibrate our new 2-dimensional finite element model which could more accurately reflect the flow distributions, velocities, and water surface elevations.

The results of the 2-D model are reasonably accurate and shown on the attached drawings.

1) The flow used for design in 1984 was 14,500 cfs, but did not include contributions from Lower Penitencia. The flowrate downstream of Newby Island should be 18,600 cfs based on recent hydrology studies. In 1984 the combination of 1% flow and MHHW became the design conditions beginning at Station 96+00 in the bypass. With the new flowrates, the 1% flow with the MHHW becomes the design condition at Station 35+00 in the bypass. At Station 96+00, the new condition produces a water surface elevation of approximately 10.8 which is 0.8 higher than in 1984.

2) The flow distribution is 4,000 cfs in the natural Coyote Creek and 14,600 cfs in the bypass. The 1984 design was for 2,000 cfs and 12,500 cfs respectively. The x-section of the Dixon Landing Road bridge is the control.

3) The water surface elevation at the haul road/weir is approximately 11.1 NGVD. The original design required elevation 10.0 at the weir to control the water surface in Lower Penitencia. The water surface elevation at the confluence with Lower Penitencia Creek is 11.2 NGVD. 11.2 + 2.8 = 14

All the water surface elevations are higher than the 1984 basis of design. The Coyote Creek levees continue to have the three feet minimum freeboard required by FEMA but Lower Penitencia Creek from Highway 880 up to the confluence with Berryessa Creek (approximately 4500 feet) now has 2-3 feet of freeboard. The higher Coyote Creek water surface elevation does not affect Lower Penitencia Creek beyond the confluence with Berryessa Creek.

ORIGINAL SIGNED BY

Division Engineer
Flood Control Planning Division

Enclosures

cc: (All w/attachments)
J. Fiedler, R. Talley, K. Reiller, A. Saah, S. Williams, J. Chen, W. Carlsen

RT:lvm:MM0630.CA

118

Appendix E

2009 Levee Recertification Memorandum

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Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

James R. Schaaf, PE
Kirk R. Wheeler, PE
David A. Foote, PE
Peder C. Jorgensen, PE
Charles D. Anderson, PE

100 N. Winchester Blvd., Suite 200
Santa Clara, CA 95050-6566
(408) 246-4848
FAX (408) 246-5624
s&w@swsv.com

Offices in
Monterey Bay Area
Sacramento
San Francisco

July 7, 2009

Mr. Eric Simmons, CFM
National Flood Insurance Program
FEMA Region IX
1111 Broadway, Suite 1200
Oakland, CA 94609
(510) 627-7029

Subject: **Recertification of Provisionally Accredited Levee P52 on Lower Penitencia Creek in Milpitas, California**

Dear Mr. Simmons:

On behalf of the Santa Clara Valley Water District and City of Milpitas, I hereby submit the documentation and engineering analyses necessary to obtain full accreditation for Levee P52 from its downstream end just east of Interstate 880 to its upstream end at the confluence with Berryessa Creek in Milpitas. It is my professional opinion that the subject levees meet the requirements of 44 CFR §65.10.

Enclosed is an application for the recertification of the levee on the east bank of Lower Penitencia Creek. Our submittal is organized as follows:

Tab 1	MT-2 Forms 1, 2, and 3
Tab 2	Annotated FIRM and FIS Profile
Tab 3	Survey Report and LiDAR Metadata
Tab 4	Topographic Work Maps
Tab 5	Record Drawings
Tab 6	Freeboard Evaluation
Tab 7	Engineering Analyses
Tab 8	Interior Drainage
Tab 9	Operation and Maintenance

The following documentation and analyses are bound separately and enclosed with this application:

Geotechnical Investigation (AMEC Geomatrix, 2009)

Digital HEC-RAS model on CD (Schaaf & Wheeler, 2009)

Levee Safety Technical Guidance Manual (URS, 2002)

Thank you very much for accepting our levee recertification package for Lower Penitencia Creek in Milpitas. Please direct technical questions regarding this application to Liza McNulty or me.

Very truly yours,
SCHAAF & WHEELER

Charles D. Anderson, PE
President

Enclosures

cc: Robert van den Berg, Santa Clara Valley Water District
Robert Wang, City of Milpitas

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

100 N. Winchester Blvd., Suite 200
Santa Clara, CA 95050
(408) 246-4848
FAX (408) 246-5624
canderson@swsv.com

TECHNICAL MEMORANDUM

PROJECT: Lower Penitencia Creek Levee Recertification DATE: April 30, 2009

PREPARED: Charles D. Anderson, PE and M. Eliza McNulty, PE JOB #: SCVW.18.08-003-C4

SUBJECT: Freeboard Evaluation for Lower Penitencia Creek Levee in Milpitas, California (Task C4)

The Santa Clara Valley Water District (District) has co-signed a PAL agreement to re-certify the levee on the eastern side of Lower Penitencia Creek within the City of Milpitas (City). The District and City are participating in FEMA's Map Modernization Program (MapMod) to reflect the current reality of the natural and man-made environments as they relate to flood hazards. The ultimate goal is to provide updated maps that support a flood insurance program properly aligned with actual risk. Access to accurate maps enhances community-based floodplain decisions, provides jurisdictional agencies with the proper tools for floodplain management and provides local property owners with meaningful flood risk data so they may make informed decisions.

District and City participation in MapMod includes the accreditation of District levees that provide protection from the base flood, that is, the one percent (1%) annual chance flood also referred to as the "100-year flood." Certain levees believed to meet federal standards for levee performance – as listed in the Code of Federal Regulations, Title 44, Section 65 (44 CFR §65) – are thought to be eligible as Provisionally Accredited Levees (PAL) and are currently shown as providing one-percent flood protection on Flood Insurance Rate Maps (FIRMs).

To receive FEMA accreditation, the levee must be shown to conform to the requirements of 44 CFR §65.10 as indicated by the terms of the Provisionally Accredited Levee Program (PAL):

> "To the best of [the District's and City's] knowledge the [subject] levee...meets the requirements of 44 CFR 65.10 and has been maintained in accordance with an adopted operation and maintenance plan and records of levee maintenance and operation, as well as tests of the mechanized interior drainage system if applicable....."

The purpose of this memorandum is to provide documentation that ***the subject levee meets federal standards for levee performance relative to freeboard*** as described in 44 CFR 65.10. This documentation will eventually be provided to FEMA and their Technical Evaluation Contractor if the Lower Penitencia Creek levee is shown to meet all other NFIP standards for levee certification.

Limits of Levee Freeboard Evaluation

The District intends to evaluate and certify the Lower Penitencia Creek levee located on the eastern bank of Lower Penitencia Creek in Milpitas, which was constructed by a private developer in 1988. The levee extends from the Berryessa Creek Levee at its upstream limit to the upstream face of California Circle. The limit of this levee re-certification study is between the confluence of Lower Penitencia Creek with Berryessa Creek and the upstream face of California Circle. The approximate total length of the levee re-certification reach is 3,400 feet or 0.65 mile.

Limits of Hydraulic Evaluation

To compute levee freeboard and ascertain whether NFIP standards for freeboard are met, a one-percent water surface profile for Lower Penitencia Creek has been calculated from the creek's confluence with Coyote Creek to its confluence with Berryessa Creek. A water surface profile downstream of the levee is necessary to establish backwater conditions at the levee.

Sources of Data Used to Evaluate Levee Freeboard

The primary source of data used in this evaluation is a field survey of the Lower Penitencia Creek channel and levees from the Berryessa Creek confluence to the Coyote Creek confluence. This certified survey was undertaken in September 2008 by Ruggeri Jensen Azar & Associates (RJA), after verifying that the effective hydraulic model no longer accurately represented current creek channel conditions. This field survey is the basis for the cross sections in the HEC-RAS model used for freeboard evaluation.

Freeboard Requirements

44 CFR 65.10 mandates that riverine levees provide a minimum freeboard of three feet above the water surface level of the base (one-percent) flood. An additional foot of freeboard (i.e. 4 feet of freeboard) is required within 100 feet of either side of structures such as bridges or wherever the flow is constricted. An additional one-half foot of freeboard above the minimum is required at the upstream end of the levee (i.e. 3.5 feet freeboard), tapering to not less than the minimum at the downstream end (i.e. 3 feet freeboard). Since the Lower Penitencia Creek levee ties directly into the previously certified Berryessa Creek levee without ending per se, the additional one half foot freeboard criterion has not been applied. Nonetheless, if the additional half-foot criterion were applied, the determination of adequate freeboard for the Lower Penitencia Creek East Levee would not change.

Methodology

To evaluate whether required freeboard above the base flood elevation is provided by the existing levee, an HEC-RAS model was prepared to reflect current conditions within the creek channel and our evaluation of relevant hydraulic parameters including channel roughness, bridge modeling, transition losses and boundary conditions. Subcritical flow computations have been made since there are no reach locations exhibiting supercritical flow during a base flood discharge. A levee must be certified to at least the base flow (i.e. 1% or 100-year discharge). This study analyzes whether the Lower Penitencia Creek levee meets the freeboard NFIP standards at the published base flow discharge.

Channel Roughness

In one-dimensional open channel flow analysis as performed using HEC-RAS, a single parameter known as "Manning's n" is used to represent the retarding forces to flow imposed by the channel bed and banks. Values for "n" are published in various literature – and in the absence of high water marks with which to calibrate stream reaches with known discharge (as is the case for Lower Penitencia Creek in the leveed condition) – are often relied upon for hydraulic modeling. When selecting roughness values, it is important to remember that in one-dimensional flow analysis, Manning's "n" accounts for the flow resistance due to a host of hydraulic phenomena beyond boundary shear.

Several sources have been used to estimate roughness factors for water surface profile determination within Lower Penitencia Creek. These include "n" values published by Henderson (1966) and Chow (1959), engineering judgment, and procedures outlined by the USACE (EM 1110-2-1601, July 1991). Channel roughness considers the channel as if maintained in no worse than its present condition, evaluated as if it were the rainy season.

Roughness elements along the wetted perimeter of Lower Penitencia Creek can vary across an individual cross section. For instance the channel cross section might contain elements of grassed banks, mature trees, an island, shrubs or brush, access areas and/or bare earth. To compute water surface elevations in a channel with variable roughness using a one-dimensional model (i.e. with a mean velocity), it is necessary to estimate an effective (composite) roughness value for each cross section. Flow velocities vary across the channel due to variation in both the flow depth and roughness from one channel element to the next. To calculate mean flow velocity without actually subdividing each channel section, several methods are suggested in the literature for estimating a composite roughness value within non-uniform channels.

HEC-RAS calculates a composite "n" value based (apparently) on an assumption that average velocities within each channel element are equal and equivalent to the mean channel velocity as a whole. (HEC, 1998) Since this may not necessarily be the case when there is a wide variation in roughness elements, several other methods for weighting "n" are considered and used to select roughness values based on judgment. Composite weighting generally involves breaking a representative reach cross section into elements that reflect cross sectional geometry and the various roughness characteristics, such as bed material, channel sinuosity, vegetation and obstructions. Roughness values for each element are estimated, and a weighting equation is used to obtain the equivalent roughness coefficient for that reach.

Lotter assumed that the total discharge in each section is equal to the sum of the discharges of individual areas subdivided by roughness (i.e. conservation of mass). The resultant equivalent roughness coefficient formula, consistent with US Army Corps of Engineers engineer manual EM 1110-2-1601, is provided by Chow as Equation 6-19:

$$\bar{n} = \frac{P R^{5/3}}{\sum_{1}^{N}\left(\frac{P_N R_N^{5/3}}{n_N}\right)} = \frac{P R^{5/3}}{\frac{P_1 R_1^{5/3}}{n_1} + \frac{P_2 R_2^{5/3}}{n_2} + \ldots + \frac{P_N R_N^{5/3}}{n_N}}$$

where $\overline{n}$ = composite roughness coefficient for cross section
P = total wetted perimeter of cross section (feet)
R = total hydraulic radius of cross section (feet)
P_i = wetted perimeter of cross section element i (feet)
R_i = hydraulic radius of cross section element i (feet)
N_i = Manning's roughness coefficient for cross section element i

It could be assumed that the total force resisting the flow is equal to the sum of the forces resisting the flow developed in the subdivided areas (Pavlovskii, Muhlhofer, Einstein and Banks). The resultant equivalent roughness coefficient formula is provided by Chow (1959) as Equation 6-18:

$$\overline{n} = \frac{\left[\sum_{1}^{N} P_N n_N\right]^{1/2}}{P^{1/2}} = \frac{\left(P_1 n_1^{\,2} + P_2 n_2^{\,2} + \ldots + P_N n_N^{\,2}\right)^{1/2}}{P^{1/2}}$$

where $\overline{n}$ = composite roughness coefficient for cross section
P = total wetted perimeter of cross section (feet)
P_i = wetted perimeter of cross section element i (feet)
n_i = Manning's roughness coefficient for cross section element i

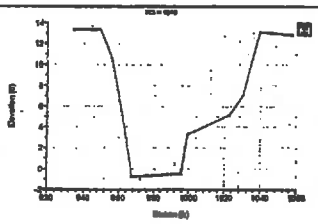
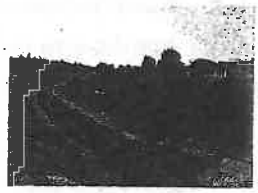
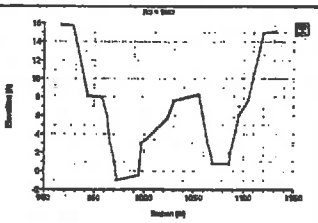
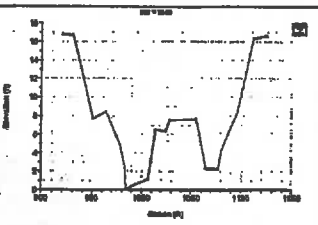
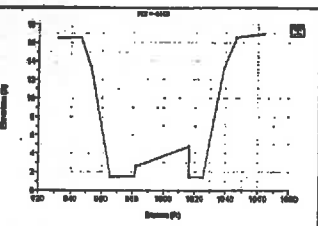
In USACE EM 1110-2-2601 the Colbatch method, which weights roughness based on subdivided cross sectional area is said to be more accurate than an assumption of equal velocity. The resultant equivalent roughness coefficient formula from EM 1110-2-1601 (5-22) is:

$$\overline{n} = \frac{\left[\sum_{1}^{N} A_N n_N^{\,1.5}\right]^{2/3}}{A^{2/3}} = \frac{\left(A_1 n_1^{\,1.5} + A_2 n_2^{\,1.5} + \ldots + A_N n_N^{\,1.5}\right)^{2/3}}{A^{2/3}}$$

where n = composite roughness coefficient for cross section
$\overline{A}$ = total area of cross section (square feet)
A_i = area of cross section element i (square feet)
n_i = Manning's roughness coefficient for cross section element i

Table 1 presents the selection of channel roughness by reach, from the Berryessa Creek Confluence to the Coyote Creek confluence. Detailed spread sheets are attached for each reach that show the breakdown of roughness elements and composite roughness calculations. Reach descriptions are based on channel stationing that begins at 1+86 at the Coyote Creek confluence. This stationing was chosen in an effort to match the stationing from the District's HEC-2 model from 1990. The selected roughness coefficient is generally derived as an average of the roughness estimated using the sum of forces method and the Colbatch method. Using the conveyance method produces unrealistically low composite roughness characteristics in those reaches with heavy vegetation within the channel.

Table 1
Channel Roughness Coefficients Used for Freeboard Evaluation

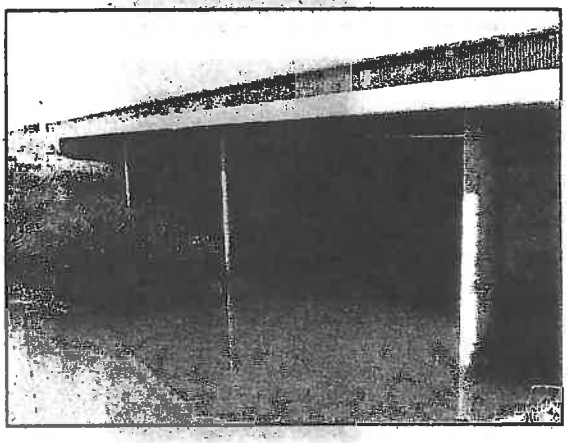
Station		Photo	Representative Section	Composite Roughness Coefficient (Manning's "n")			
From	To			Conveyance	ΣForce	Colbatch	Selected
1+86	14+50			0.027	0.030	0.032	0.030
14+50	20+40			0.032	0.039	0.038	0.038
20+40	38+50			0.034	0.040	0.039	0.038
38+50	46+40			0.027	0.031	0.031	0.030

Bridge Modeling

In addition to the energy required to overcome channel resistance, structures such as bridges and culverts also cause energy losses, which can result in a raised water surface profile. Methods provided by HEC-RAS for analyzing bridges and culverts under low flow and pressurized conditions are employed in the computations for Lower Penitencia Creek.

Several methods are available through HEC-RAS to compute energy losses through a bridge. The "energy only" or standard step method handles a bridge section without piers in the same manner as a natural river section, except that the area between the low chord of the bridge (soffit) and the top of road is subtracted from the total cross-sectional area, and the wetted perimeter is increased where water is in contact with the bridge. Increased frictional resistance due to the added wetted perimeter is included in the energy loss through the structure. This method is appropriate where there are no piers and the base flood elevation does not touch the bridge soffit, which is the case for the California Circle Bridge and the Milmont Avenue Bridge.

When bridge piers are present as is the case for the I-880 bridge and the South I-880 approach ramp bridge, in addition to the "energy only" method, conservation of momentum is applied by using a coefficient of drag (1.33 for a semicircular nose and tail), as is Yarnell's method for subcritical "Class A" low flow through the bridge (with a pier coefficient of 0.90 for a semicircular nose and tail). HEC-RAS calculates losses through the bridge using all three methods and applies the answer with the highest calculated upstream energy grade.



HEC-RAS results indicate that all bridges within the reach function under Class A (subcritical) low flow conditions with the certifiable discharge in Lower Penitencia Creek. The lowest part of the bridge superstructures are above the energy grade line at all locations. For three of the bridges (I-880 approach ramp, California Circle, and Milmont Avenue), the "energy only" method provides the highest bridge losses. At the I-880 Bridge, the conservation of momentum method provides the highest bridge losses.

Transition Losses

An energy loss also takes place just upstream and downstream from each structure as flow contracts at a ratio of 1:1 into a flow constriction and expands at a ratio of 1:4 out of a flow constriction such as bridge abutments. A flow contraction coefficient of 0.1 is used for gradual cross sectional transitions, which characterize the majority of Lower Penitencia Creek. Similarly a flow expansion coefficient of 0.3 is used for gradual transitions. (Reference: USACE, Hydrologic Engineering Center) Contraction and expansion coefficients are increased to 0.3 and 0.5 respectively wherever turbulent conditions create the potential for energy loss, such as at a bridge (or culvert), channel bend, pool, or maintenance access ramp.

Boundary Conditions

For subcritical backwater computations, the upstream boundary condition is discharge and the downstream boundary condition is water surface elevation (stage). As directed by the District, Schaaf & Wheeler used the effective 1% (base flood) discharge and flood profile published in the June 22, 1998 Flood Insurance Study (FIS) for the City of Milpitas to determine whether the levee provides sufficient freeboard. The starting coincident water surface elevation is 7.5 feet NGVD29, or 10.28 feet NAVD.

The Summary of Discharges table in the effective FIS shows a one-percent discharge of 2,600 cfs downstream of the confluence with Berryessa Creek, and a one-percent discharge of 3,500 cfs at Nimitz Freeway (Interstate 880). Subsequent to the calculation of the base flood discharge that is published in the effective FIS, the City of Milpitas constructed a number of stormwater pumping facilities that discharge to Lower Penitencia Creek within the study reach. Table 2 summarizes the base flood discharge used in the present analysis, which conservatively assumes a coincident discharge of local interior runoff at each pump station's rated capacity and the maximum effective base discharge listed for the recertification reach.

Table 2
Effective Base Flood Flow with Coincident Pump Station Discharge

River Station	Pumping Facility	Total Pump Capacity (gpm)	Pump Station Capacity (cfs)	Base Flood Discharge (cfs)
				3,500
46+40	Abbott Pump Station	10,700	25	3,525
28+10	Jurgens Pump Station	67,000	150	3,675
10+40	California Circle Pump Station	51,000	120	3,795

FREEBOARD

Freeboard provides a measure of safety that compensates for the many unknown and difficult-to-quantify parameters that affect the calculation of flood elevations. These factors include uncertainty in rainfall data, soil loss parameters, watershed urbanization, wave action, debris at bridge openings, and general uncertainties in hydrologic and hydraulic procedures. Freeboard is usually expressed in terms of feet above the design base flood elevation. To meet FEMA standards, freeboard is necessary whenever a levee system, including structural floodwalls, is used to provide flood protection.

When mapping flood-prone areas, FEMA only recognizes those levee systems meeting their criteria, which includes a minimum three feet of freeboard whenever the design one-percent water surface elevation is carried above the natural ground elevation. An additional six inches of freeboard (3.5 feet above the water surface) are required at the upstream end of the levee system, tapering to the minimum freeboard of 3.0 feet at the downstream end of the levee. An additional foot of freeboard (4.0 feet above the water surface) must be provided within 100 feet of each side of any structure, such as a bridge or culvert. This additional freeboard criterion is applied at all bridges within the levee reach in question.

Freeboard Evaluation

Attached tables and profiles provide the following information:

1. HEC-RAS hydraulic model output information including main channel invert, water surface elevation, energy grade elevation, average channel velocity and Froude Number.
2. Water surface profiles for the published base flood (1%) discharge of 3,500 cfs with additional coincident pumped interior drainage from Table 2.
3. Required levee elevation to meet NFIP freeboard criteria.
4. Surveyed levee elevations.
5. Determination of whether the NFIP freeboard criterion is met for the effective base flood discharge.

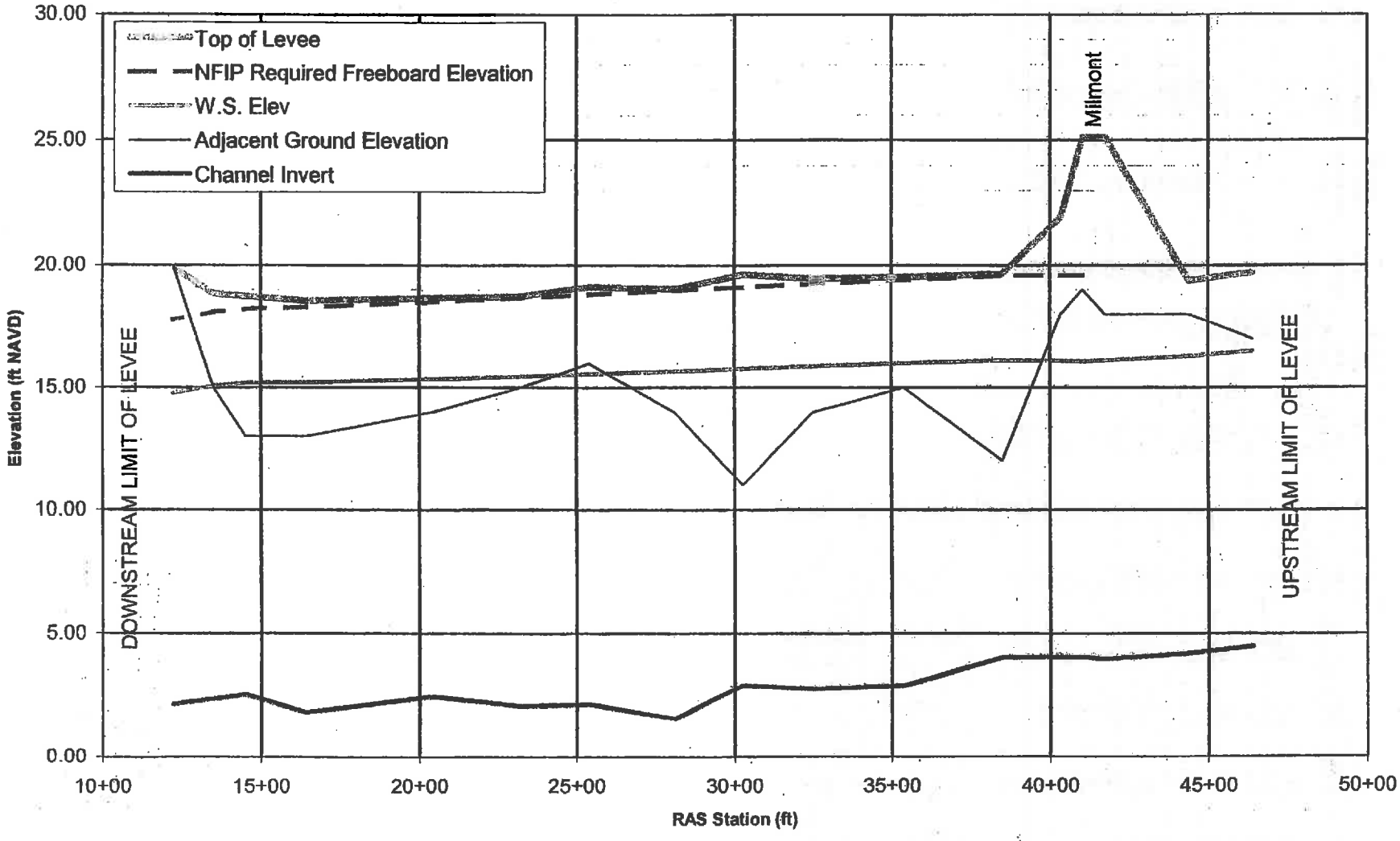
Conclusion

The levee along the eastern side of Lower Penitencia Creek can be certified to meet NFIP freeboard criteria at the published base flood discharge of 3,500 cfs with additional flow from City pumping facilities. Existing field conditions as of September 2008 have been used as the basis for this conclusion. For this conclusion to remain valid, the District must maintain Lower Penitencia Creek in accordance with its adopted stream maintenance plan for vegetation growth and sediment management. The next phases of work will be the completion an interior drainage study and geotechnical evaluation using USACE stability and seepage requirements for certification.

Summary of Freeboard Evaluation for Lower Penitencia Creek Levee on Eastern Bank in Milpitas

River Station	Q Total	Channel Invert	W.S. Elev	EGL	Avg. Channel Velocity	Froude No.	Top of Levee	Natural Ground Elev.	Levee Condition?	Freeboard Reqd. for Certification	Reqd. Freeboard Elevation	Freeboard Provided	Certifiable?
	(cfs)	(ft NAVD)	(ft NAVD)	(ft NAVD)	(ft/sec)		(ft NAVD)	(ft NAVD)		(feet)	(ft NAVD)	(feet)	
UPSTREAM LIMIT OF LEVEE RE-CERTIFICATION													
46+40	3525	4.50	16.51	16.67	3.22	0.19	19.71	17.0	NO	—	N/A	3.20	N/A
44+40	3525	4.21	16.29	16.59	4.41	0.26	19.36	18.0	NO	—	N/A	3.09	N/A
41+75	3525	3.98	16.12	16.45	4.56	0.27	26.14	18.0	NO	—	N/A	9.02	N/A
41+42	Milmont Drive Bridge												
41+04	3525	4.06	16.08	16.41	4.59	0.27	25.14	19.0	NO	3.50	19.58	9.06	N/A
40+35	3525	4.07	16.10	16.34	3.97	0.23	21.95	16.0	NO	3.49	19.59	5.85	N/A
38+50	3525	4.05	16.12	16.24	2.75	0.18	19.65	12.0	YES	3.46	19.58	3.53	YES
35+40	3525	2.92	16.00	16.13	2.87	0.19	19.52	15.0	YES	3.40	19.40	3.52	YES
32+51	3525	2.77	15.89	16.01	2.87	0.19	19.46	14.0	YES	3.35	19.24	3.57	YES
30+26	3525	2.93	15.79	15.92	2.86	0.19	19.63	11.0	YES	3.31	19.10	3.84	YES
28+10	3675	1.56	15.69	15.82	2.94	0.19	19.04	14.0	YES	3.28	18.97	3.35	YES
25+40	3675	2.15	15.58	15.71	2.88	0.19	19.12	16.0	NO	3.23	18.81	3.54	YES
23+20	3675	2.06	15.48	15.61	2.93	0.19	18.74	15.0	YES	3.19	18.67	3.26	YES
20+40	3675	2.47	15.36	15.48	2.82	0.18	18.67	14.0	YES	3.14	18.50	3.31	YES
18+40	3675	1.84	15.22	15.33	2.70	0.17	18.56	13.0	YES	3.07	18.29	3.34	YES
14+50	3675	2.54	15.18	15.27	2.46	0.15	18.75	13.0	YES	3.04	18.22	3.57	YES
13+50	3675	2.37	15.07	15.24	3.32	0.20	18.86	15.0	YES	3.02	18.09	3.76	YES
12+23	3675	2.16	14.77	15.13	4.84	0.29	19.93	20.0	NO	3.00	17.77	5.16	YES
DOWNSTREAM LIMIT OF LEVEE													
11+80	California Circle Bridge												
11+30	3675	2.07	14.71	15.08	4.86	0.29							
10+40	3795	2.05	14.53	14.99	5.44	0.33							
8+58	3795	1.43	14.53	14.82	4.32	0.27							
7+68	3795	1.13	14.53	14.74	3.71	0.22							
7+00	I-880 Bridge												
5+34	3795	1.68	13.40	13.59	3.47	0.20							
4+67	3795	1.68	13.33	13.56	3.86	0.21							
4+34	I-880 Approach Ramp Bridge												
4+28.06	3795	4.89	12.21	13.25	8.19	0.64							
3+66	3795	4.89	11.47	12.89	9.57	0.79							
1+86	3795	3.52	10.28	11.86	10.10	0.85							

Lower Penitencia Creek East Levee Freeboard Evaluation
Q(1%) = 3,500 cfs at I-880 + Local Pump Station Discharges



SCVWD Levee Recertification
Lower Penitencia Creek
Composite Roughness Calculations
*Elevations in ft NAVD
Reach 1
Station 46+40 to 38+50 (rep. xsec 44+40)

Channel Element	Elev	b	SS	n
Left Bank			1	0.020
Left Channel	1.5	15.74		0.025
Island	3.0	35.52		0.040
Right Channel	1.5	8.59		0.025
Right bank			1	0.020

Total Discharge	3,525	cfs
WSEL	12.0	feet

Element	n_i	A_i	P_i	R_i	$P_i R_i^{5/3}/n_i$	$P_i n_i^2$	$A_i n_i^{1.5}$	Q_i	V_i	$V_i^3 A_i$
Left Bank	0.020	55.13	14.85	3.71	6,608	0.006	0.156	252	4.58	5,289
Left Channel	0.025	165.27	15.74	10.50	31,699	0.010	0.653	1,211	7.32	64,949
Island	0.040	293.04	35.52	8.25	29,911	0.057	2.344	1,142	3.90	17,357
Right Channel	0.025	90.54	8.59	10.54	17,410	0.005	0.358	665	7.34	35,852
Right bank	0.020	55.55	14.91	3.73	6,676	0.008	0.157	255	4.59	5,370
		659.52	89.61	7.36	92,304	0.084	3.669	3,525		128,817

Average Velocity	5.34	fps
Composite n (Conveyance)	0.027	
Composite n (Force)	0.031	
Composite n (Colbatch)	0.031	
α	1.28	

n used for freeboard eval.	0.030

SCVWD Levee Recertification
Lower Penitencia Creek
Composite Roughness Calculations
*Elevations in ft NAVD
Reach 2
Station 38+50 to 20+40 (rep. xsec 35+40)

Channel Element	Elev	b	SS	n
Upper Left Bank			2.3	0.035
Left Maint Rd	8	12.79		0.025
Lower Left Bank			2.5	0.035
Left Channel	0.65	21.79		0.035
Island	7.0	58.4		0.050
Right Channel	2.3	12.61		0.035
Lower Right Bank	8.2		3	0.035
Upper Right Bank			2	0.035

Total Discharge	3,525	cfs
WSEL	13.0	feet

Element	n_i	A_i	P_i	R_i	$P_i R_i^{5/3}/n_i$	$P_i n_i^2$	$A_i n_i^{1.5}$	Q_i	V_i	$V_i^3 A_i$
Upper Left Bank	0.035	28.75	12.54	2.29	1,428	0.015	0.188	40	1.39	77
Left Maint Rd	0.025	63.95	12.79	5.00	7,480	0.008	0.253	209	3.27	2,237
Lower Left Bank	0.035	159.40	19.79	8.05	18,300	0.024	1.044	512	3.21	5,274
Left Channel	0.035	269.11	21.79	12.35	41,080	0.027	1.762	1,149	4.27	20,932
Island	0.050	350.40	58.40	6.00	23,140	0.146	3.918	647	1.85	2,207
Right Channel	0.035	134.93	12.61	10.70	18,719	0.015	0.883	523	3.88	7,878
Lower Right Bank	0.035	137.03	18.63	7.36	14,810	0.023	0.897	414	3.02	3,782
Upper Right Bank	0.035	23.14	10.76	2.15	1,102	0.013	0.151	31	1.33	55
		1,166.70	167.30	6.97	126,059	0.272	9.097	3,525		42,442

Average Velocity	3.02 fps
Composite n (Conveyance)	0.034
Composite n (Force)	0.040
Composite n (Colbatch)	0.039
α	1.32

n used for freeboard eval.	0.038

SCVWD Levee Recertification
Lower Penitencia Creek
Composite Roughness Calculations
*Elevations in ft NAVD
Reach 3
Station 20+40 to 14+50 (rep. xsec 16+40)

Channel Element	Elev	b	SS	n
Upper Left Bank			2	0.030
Left Maint Rd	8.1	14.76		0.025
Lower Left Bank			2	0.035
Left Channel	0.7	22.6		0.030
Island	5.7	74.06		0.050
Right Channel	0.8	17.89		0.030
Lower Right Bank			1.5	0.035
Right Maint Rd	6.9	9.83		0.025
Upper Right Bank			2	0.020

Total Discharge	3,675	cfs
WSEL	13.5	feet

Element	n_i	A_i	P_i	R_i	$P_i R_i^{2/3}/n_i$	$P_i n_i^2$	$A_i n_i^{1.5}$	Q_i	V_i	$V_i^3 A_i$
Upper Left Bank	0.030	29.16	12.07	2.41	1,750	0.011	0.152	34	1.17	46
Left Maint Rd	0.025	79.70	14.76	5.40	9,813	0.009	0.315	191	2.39	1,093
Lower Left Bank	0.035	134.68	16.55	8.14	15,570	0.020	0.882	303	2.25	1,529
Left Channel	0.030	289.28	22.60	12.80	52,764	0.020	1.503	1,026	3.55	12,899
Island	0.050	576.93	74.06	7.79	45,343	0.185	6.450	882	1.53	2,058
Right Channel	0.030	220.68	17.39	12.69	40,020	0.016	1.147	778	3.53	9,672
Lower Right Bank	0.035	87.91	10.94	8.03	10,075	0.013	0.576	196	2.23	972
Right Maint Rd	0.025	65.07	9.83	6.62	9,177	0.006	0.257	178	2.74	1,341
Upper Right Bank	0.020	43.82	14.80	2.96	4,518	0.006	0.124	88	2.00	353
		1,527.24	193.01	7.91	189,030	0.287	11.405	3,675		29,964

Average Velocity	2.41	fps
Composite n (Conveyance)	0.032	
Composite n (Force)	0.039	
Composite n (Colbatch)	0.038	
α	1.41	

n used for freeboard eval.	0.038

SCVWD Levee Recertification
Lower Penitencia Creek
Composite Roughness Calculations
*Elevations in ft NAVD
Reach 4
Station 14+50 to 1+86 (rep. xsec 10+40)

Channel Element	Elev	b	SS	n
Left Bank			:1	0.02
Left Channel	-0.58	27.99		0.03
Right Channel	4.3	27.28		0.04
Right Bank			1.5	0.02

Total Discharge	3,795	cfs
WSEL	12.5	feet

Element	n_i	A_i	P_i	R_i	$P_i R_i^{5/3}/n_i$	$P_i n_i^2$	$A_i n_i^{1.5}$	Q_i	V_i	$V_i^3 A_i$
Left Bank	0.020	85.54	18.50	4.62	11,872	0.007	0.242	417	4.87	9,901
Left Channel	0.030	366.11	27.99	13.08	67,748	0.025	1.902	2,379	6.50	100,444
Right Channel	0.040	223.70	27.28	8.20	22,741	0.044	1.790	799	3.57	10,176
Right Bank	0.020	50.43	14.78	3.41	5,714	0.006	0.143	201	3.98	3,176
		725.78	88.55	8.20	108,075	0.082	4.077	3,795		123,697

Average Velocity	5.23 fps
Composite n (Conveyance)	0.027
Composite n (Force)	0.030
Composite n (Colbatch)	0.032
α	1.19

n used for freeboard eval.	0.030

Appendix F

Lower Penitencia Creek Planning Study
Coyote Creek to Montague Expressway
Planning Study, Engineer's Report, Negative Declaration
1982

Summary

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SANTA CLARA VALLEY WATER DISTRICT

LOWER PENITENCIA CREEK PLANNING STUDY

CONFLUENCE WITH COYOTE CREEK TO MONTAGUE EXPRESSWAY

Engineer's Report Prepared by Predesign Division

Jose L. Ortiz, P.E. — Associate Civil Engineer
Shaikh E. Buksh — Assistant Civil Engineer
Randall R. Talley, P.E. — Division Engineer

Negative Declaration Prepared by

Dr. Bernard H. Goldner — Environmental Specialist

Robert R. Smith, P. E.
Head, Project Development Branch

John T. O'Halloran
General Manager

George S. Korbay, P. E.
Flood Control Manager

November 1982

SUMMARY

Flooding, erosion, sedimentation and channel maintenance problems requiring solutions have been identified in this study of Lower Penitencia Creek between Coyote Creek and Montague Expressway.

Areas of the City of Milpitas have flooded periodically from Lower Penitencia Creek; most recently in March 1982. During the one percent flood the area bounded by Highway 17, Lower Penitencia Creek and Calaveras Boulevard would be flooded to depths of up to three feet. Areas west of the creek, north of Berryessa Creek and south of Redwood Avenue would also receive floodwaters.

Lower Penitencia Creek would flood approximately 380 acres and 700 structures, nearly all residential, during the one percent event causing $14.0 million in damages.

Alternative solutions to the flooding problems were investigated. These included: 1) channel modifications, 2) flood forecasting system, 3) floodproofing, 4) flood insurance and 5) no project. The costs, advantages, and disadvantages of these alternatives were examined. The recommended alternative consists of constructing channel modifications.

The proposed project consists of various channel modifications to the creek to increase its capacity. In the reaches downstream of the confluence with Berryessa Creek, it is proposed that the existing channel be widened and levees be constructed to provide adequate capacity and freeboard. It is also proposed that portions of the channel be concrete lined. Adjacent property owners would be required to construct these measures as conditions of development. Only the concrete lined section through Highway 17 would be constructed by the District in these reaches.

Upstream of Berryessa Creek, flood control measures are proposed to extend to the entrance of Elmwood Rehabilitation Center. These measures consist of a combination of earth levees, floodwalls, culvert enlargement and concrete lining. The existing channel upstream of the entrance to Elmwood Center is adequate to convey the

one percent flows from Lower Penitencia Creek, except for an 84-inch culvert immediately downstream of Montague Expressway which must be enlarged.

The proposed project is estimated to cost $5.4 million in 1982 dollars. This estimate includes all costs for engineering, construction, inspection, administration and overhead. District costs for constructing the section through Highway 17 and the measures upstream of Berryessa Creek are estimated to be $3.6 million. The routine maintenance of the creek is projected at $43,000 per year.

Table 1 summarizes the proposed measures and the estimated costs.

Sources for funding the project include developers and the District's East Zone ad valorem tax and benefit assessment. The District's share of the proposed channel modifications could be constructed by 1985.

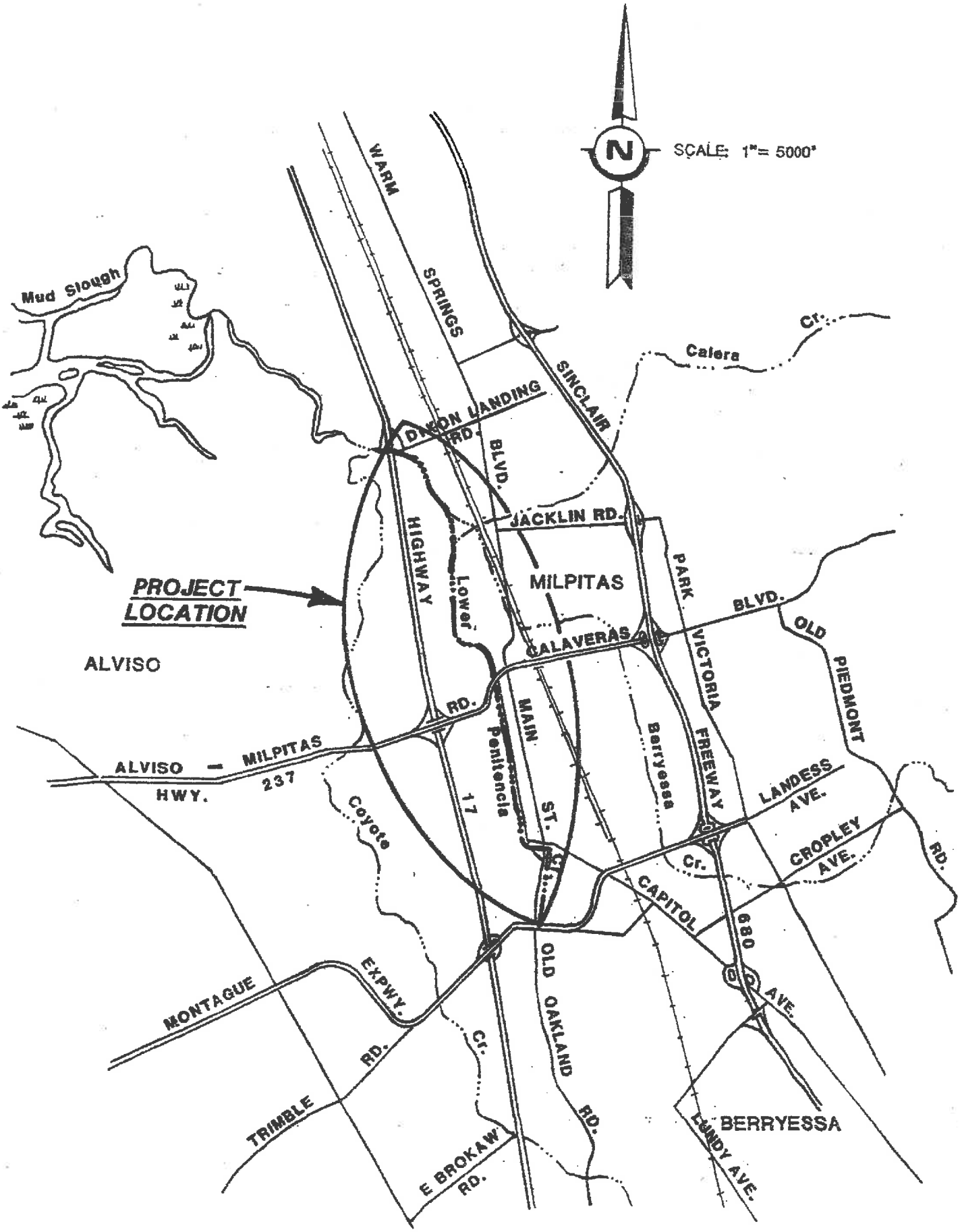

FIGURE 1

PROJECT LOCATION MAP

Appendix G

Typical Cross Sections

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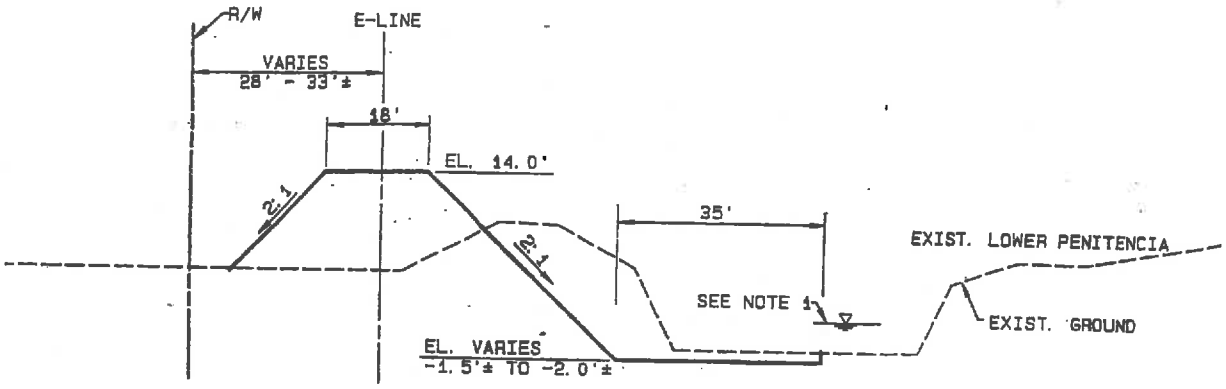
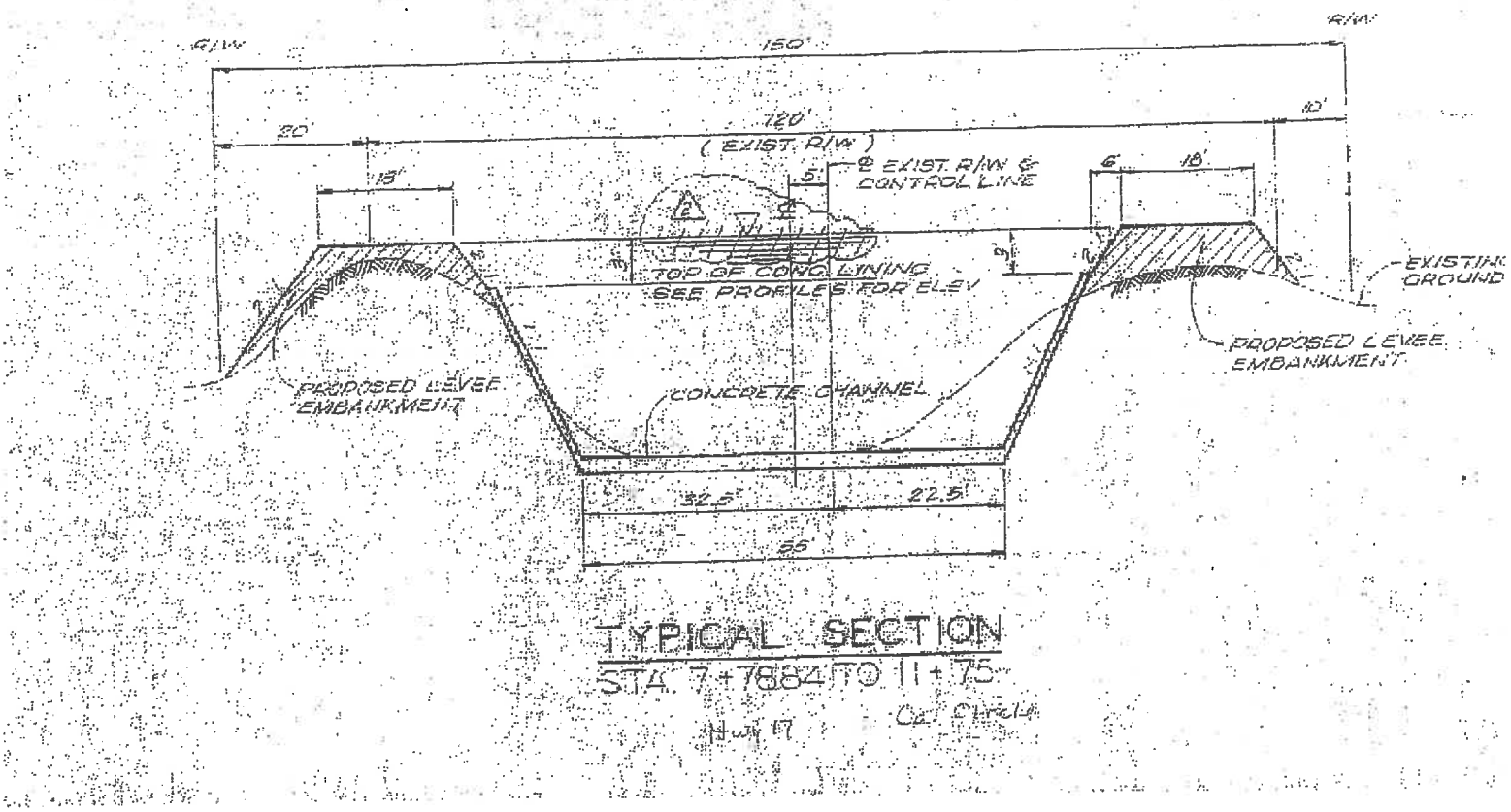
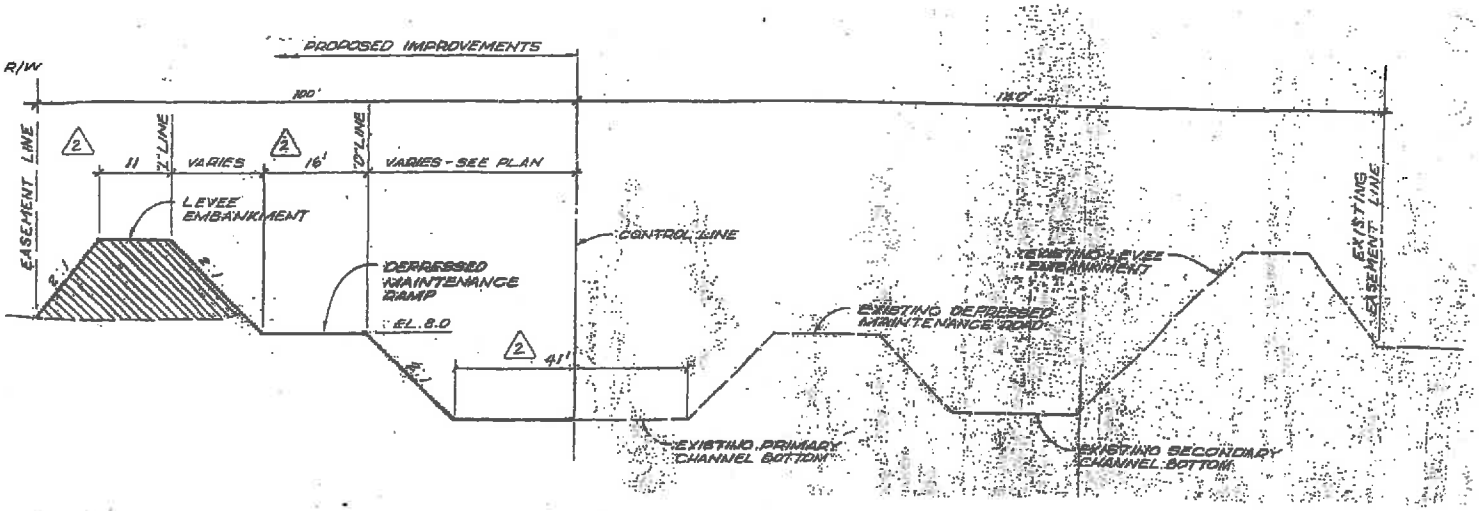
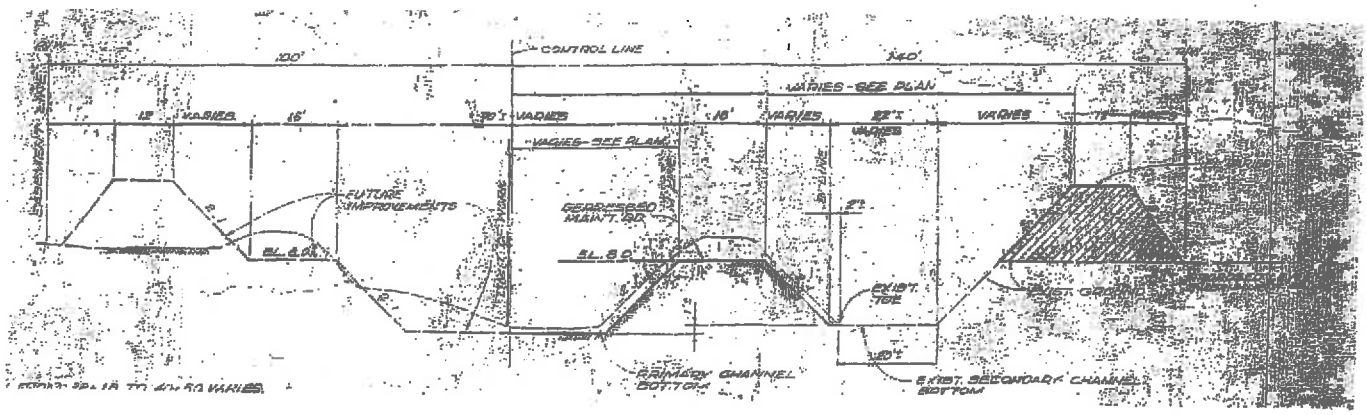


Typical Section
Coyote Creek Confluence to I-880

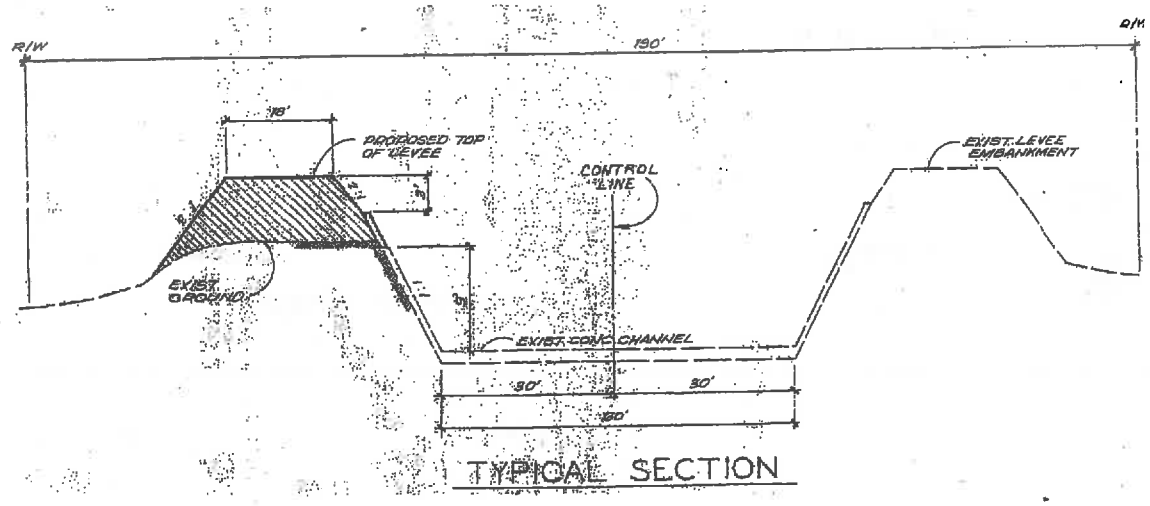


Typical Section
Hwy I-880 to California Circle

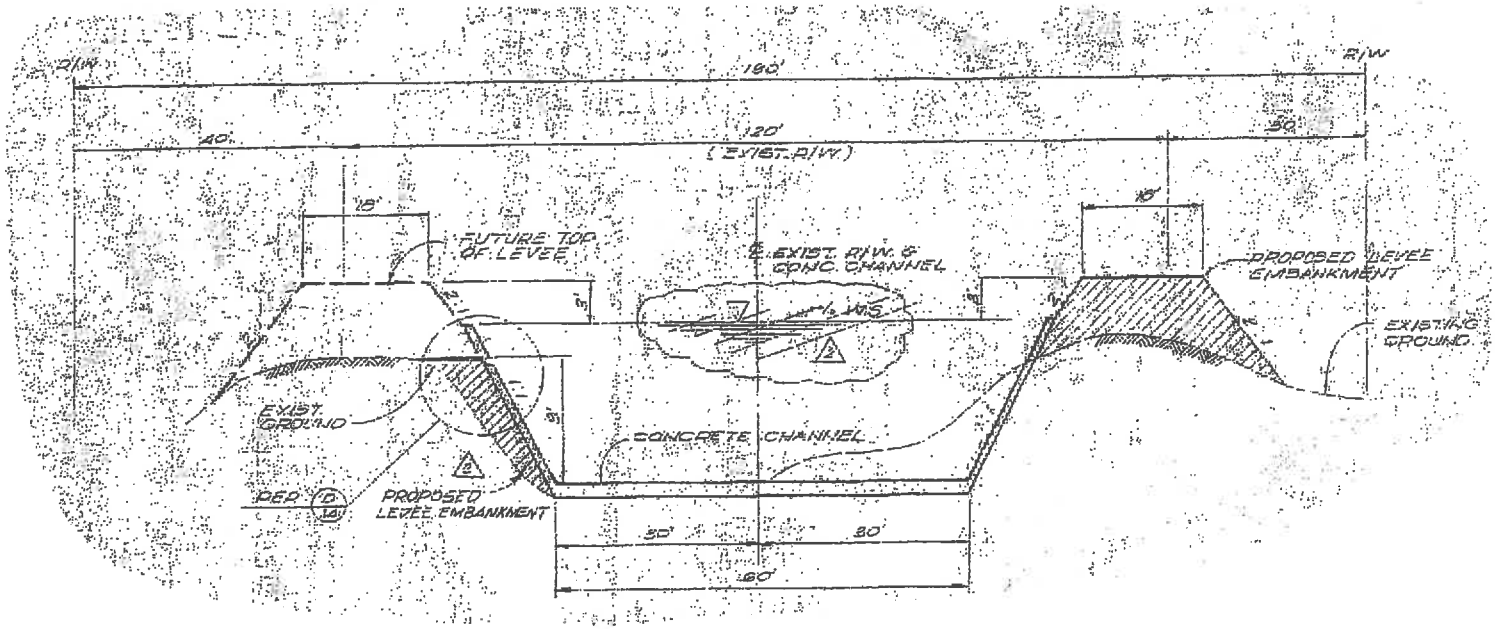




Typical Sections
California Circle to Milmont Drive



TYPICAL SECTION



Typical Sections
Milmont Drive to Berryessa Creek confluence