Meeting of the Central Valley Flood Protection Board
October 26, 2012

Staff Report – 33 USC Section 408 Request

Sutter Butte Flood Control Agency
Feather River West Levee Project (FRWLP)
Thermalito Afterbay, Butte County to Approximately four (4) miles north of the Feather River Confluence with the Sutter Bypass, Sutter County

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1.0 –REQUESTED ITEM

Consider approval of a letter (Attachment A) to the U.S. Army Corps of Engineers (USACE) requesting 33 U.S. Code Section 408 (Section 408) approval to alter approximately 41 miles of federal flood control project levee on the west side (right bank looking downstream) of the Feather River from Thermalito Afterbay in Butte County at the northern end of the project (Station 2368+00) to a point approximately four (4) miles north of the Feather River's confluence with the Sutter Bypass in Sutter County at the southern end of the project (Station 202+50).

The Central Valley Flood Projection Board (Board) is not being asked to approve the Project or issue an encroachment permit with today's action, which is based on a Project design at the 65 percent level.

It is typical to request Section 408 approval at the 65% design stage so the applicant's design finalization and USACE processing can occur concurrently. As Project designs advance towards the 100 percent level, and after a favorable USACE Section 408 decision is reached, the Board will be asked to consider future requests submitted by the applicant in the form of encroachment permit applications to approve individual construction phases.

2.0 - APPLICANT

Sutter Butte Flood Control Agency (SBFCA) is the applicant. SBFCA is a joint powers agency formed in 2007 by Butte and Sutter Counties, the cities of Biggs, Gridley, Live Oak and Yuba City, and Levee Districts 1 and 9. The agency has the authority to finance and construct regional levee improvements, and is governed by

a 13-member Board comprised of elected officials from the cities, counties and levee districts.

3.0 – PROJECT LOCATION

The proposed Feather River West Levee Project (FRWLP) extends from Thermalito Afterbay in Butte County at downstream in a southerly directly approximately 41 miles to a point approximately four (4) miles north of the Feather River's confluence with Sutter Bypass in Sutter County. The Feather River west levee is maintained by several Department of Water Resources (DWR) Maintenance Areas (MAs) out of the DWR Sutter Maintenance Yard and Levee Districts (LDs), including MA 7, MA 16, LD 9, LD 1, and MA 3 in order from north to south (See Attachment B1 for site location).

4.0 – AUTHORITY OF THE BOARD

- California Code of Regulations, Title 23 (CCR 23), § 106, Existing Encroachments within an Adopted Plan of Flood Control
- CCR 23, § 116, Borrow and Excavation Activities – Land and Channel
- CCR 23, § 120, Levees
- CCR 23, § 121, Erosion Control
- CCR 23, § 123, Pipelines, Conduits and Utility Lines
- CCR 23, § 124, Abandonment of Pipelines
- CCR 23, § 128, Bridges
- Rivers and Harbors Act of 1899, Title 33 United States Code, § 408 (33 USC 408), hereafter referred to as Section 408

5.0 – PROJECT BACKGROUND

The Feather River West Levee (FRWL) was originally constructed in the 19th century by local interests. Construction was driven by frequent flooding in the 1860s due to mining debris raising the river beds. The original levee was generally constructed on the Holocene and late-Pleistocene alluvial and fluvial materials deposited by the ancient and modern Feather River and its tributaries.

The FRWL was subjected to several high water and flood events that led to repeated performance problems including levee breaks in 1909, 1914, and 1955. In the 1955

flood the water level was approximately 21 feet high on the levee at the southern end of Yuba City. The flood of 1986 nearly failed the FRWL, and the Yuba River south levee did fail resulting in rapid drawdown of water levels in the Feather River. Widespread flood fighting was necessary from the 5th Street Bridge in Yuba City downstream during the 1997 New Years flood.

During these floods the FRWL experienced repeated performance problems at many locations, including under-seepage problems causing boils, piping of soil material, and sinkholes. Some locations along the FRWL also experienced other geotechnical problems associated with through-seepage, under-seepage, landside and waterside instabilities and erosion.

In addition to upgrades completed by the early 1960s various improvements to the FRWL have been made at multiple locations, primarily in response to the performance issues observed during large flood events. These improvements have included construction of stability berms, drainage trenches, relief wells, slurry cutoff walls, and other measures.

Various geotechnical studies have been performed to investigate the performance of the FRWL. Between 2007 and 2010 the DWR Urban Levee Evaluation (ULE) Program investigated nearly the entire length of the FRWL with extensive subsurface exploration and laboratory testing, geotechnical analyses, and information compiled from previous geotechnical studies. The ULE Program focused on evaluating levee seepage and slope stability and identifying the potential levee deficiencies. SBFCA has used some of the ULE Program date with DWR's permission to evaluate and design proposed project.

After forming in 2007 as a joint powers agency SBFCA embarked on a comprehensive evaluation of the FRWL protecting their member jurisdictions in collaboration with DWR and Board. This evaluation was necessary to identify the deficiencies of the FRWL, their magnitude and severity, and the remedial measures required to address them.

The results of SBFCA's comprehensive evaluation determined that the existing FRWL does suffer from through- and under-seepage, landside and waterside instabilities, and erosion deficiencies, and that a substantial number of geotechnical and other improvements are necessary to bring the FRWL up to current federal and State flood protection standards.

6.0 – PROJECT DESCRIPTION

SBFCA is proposing the FRWLP to reduce flood risk in the Sutter Basin, which includes portions of Sutter and Butte Counties in the Sacramento Valley of California. The Feather River west levee is a component of the Sacramento River Flood Control Project and State Plan of Flood Control under USACE and Board jurisdictions. Conceived prior to adoption of the Central Valley Flood Protection Plan (CVFPP) in June 2012, the FRWLP has been proposed by SBFCA to be a "no regrets" Early Implementation Project. The FRWLP is consistent with the adopted CVFPP.

In light of the flood risk to the area, SBFCA is pursuing the FRWLP in parallel and coordinated with a separate effort by USACE, SBFCA, DWR, and Board to determine the federal interest in the Sutter Basin Project initiated in 2000. The Sutter Basin Project is being evaluated under a Feasibility Study and was selected as a national pilot project to incorporate more efficient, relevant and cost effective practices in the traditional feasibility study process.

SBFCA's project goals are to achieve a minimum 200-year level of flood protection for urbanized and urbanizing areas, and a 100-year level of protection for the remaining rural agricultural portions of the planning area. A 200-year flood is a flood having a 0.5 percent chance of occurring in any given year, and is also referred to having a 0.5 percent annual exceedance probability (AEP). A 100- year flood has a 1 percent chance of occurring in any given year, also referred to as a 1 percent AEP.

SBFCA's project proposes to achieve a 200-year level of protection from Thermalito Afterbay in Butte County (Station 2368+00, Reach 41) downstream to a point below Star Bend south of Yuba City (Station 461+00, Reach 5). The balance of Reaches 5 through 2 (Station 202+50) are proposed to achieve a 100-year level of protection.

6.1 Project-Wide Section 408 Request

To construct the FRWLP, SBFCA is requesting Section 408 permission from USACE for the alteration of a levee which is a part of the Sacramento River Flood Control Project (SRFCP), a federal work. USACE's authority to grant permission for the FRWLP under Section 408 triggers the requirement for USACE to comply with the National Environmental Policy Act (NEPA). The project is also subject to Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act; for which the USACE also exercises regulatory authority.

The Section 408 request seeks project-wide approval for all but Reach 1 of the Feather River west levee downstream of Station 202+50 to Station 10+00 at the Sutter Bypass (Attachment B2). This lower section may be improved as part of a future Section 408 or USACE project along with improvements to the Sutter Bypass. Unlike prior Early Implementation Project Section 408 requests, this proposal will be the sole Section 408 request made by the Board on behalf of SBFCA for the FRWLP.

6.2 Phased Plan of Construction

SBFCA is proposing a phased plan of construction beginning in 2013. Attachment I is a map of the proposed project "areas". SBFCA plans to submit the 90 percent design documents for construction of Project Area "C" to Board staff in late October / early November, followed by an encroachment permit application in December 2012. Subsequent construction phases will be submitted in a similar manner. Board staff will assign -1, -2, -3, etc. suffix numbers to the 18793 permit number as these projects are submitted by SBFCA for staff review and Board approval.

6.3 Summary of Repair Measures

Attachment C1 shows typical levee cross sections while Attachment C2, Table 1 provides a summary of levee deficiencies (through-seepage, under-seepage, and slope stability) by reach.

For each deficiency listed in Table 1 a combination of measures is proposed to reduce or mitigate the flood risk. These measures include the construction of slurry cutoff walls, seepage berms, stability berms, relief wells, slope flattening, landside depression / ditch infilling, levee reconstruction and encroachment removal. Attachment C3, Table 2 summarizes the proposed levee modifications by reach.

Slurry cutoff walls are proposed to address through-seepage and under-seepage. Seepage berms and relief wells are also proposed to address under-seepage. In reaches where there are deficiencies of slope stability and levee geometry, SBFCA proposes to construct either stability berms or flatten the levee slope.

In cases where cutoff walls are proposed the existing levee will be degraded to 50 percent of its height, and levee reconstruction in such areas will be necessary. Substantial numbers of encroachments will also have to be removed from within the

levee prism. In these cases the levee will need to be reconstructed with materials and methods that meet current engineering standards.

Landside depressions and ditches may also contribute to levee failures if a seepage pathway forms under the levee and water flows through the pathway and surfaces within the depression or ditch exploiting its less resistive nature as compared to the surrounding soil mass. In addition to other seepage measures such as cutoff walls and berms, SBFCA may place fill material in these depressions and ditches to eliminate localized seepage problems.

Structural encroachments, certain vegetation, and levee penetrations by pipes, conduits, cables, power poles, pump stations, retaining walls, or similar features may require removal from the levee prism to meet levee safety requirements. Removal may require demolition of such features and relocation or reconstruction as appropriate on a case-by-case basis (or retrofitting to comply with current policy, regulations, or standards).

7.0 - PROJECT DESIGN REVIEW

The Board's Project Section staff completed a preliminary technical review of the following documents:

- Feather River West Levee Project - 65% Design Submittal – Design Documentation Report, compiled by HDR Engineering, Inc., April 2012 (including the Geotechnical Design Recommendations Report).

- Feather River West Levee Project – Basis of Design Report, Segments 1 through 7, prepared by HDR, Wood Rogers, URS, and MHM, March 2012.

- Feather River West Levee Project - Design Water Surface Profiles for the Feather River West Levee Project, prepared by Peterson Brustad, Inc. (PBI), March 2012.

The Project has been undergoing technical review by an Independent Panel of Experts to satisfy the USACE's Safety Assurance Review (SAR) requirements. In addition, since DWR is a Project funding partner through the EIP program, they have been conducting their own technical review of the project design.

Staff's preliminary technical review concluded that the majority of designs are in accordance with CCR 23 and USACE standards. There are some areas which will need to conform to CCR 23 which are discussed in Section 8 of this report. Board staff will continue to work with the SBFCA project design team to work through specific technical comments and resolve any remaining issues through review of the 90 percent level design submittals and encroachment permit applications for each planned phase of construction.

8.0 – PROJECT ANALYSES

Project analyses included review of hydrology/hydraulic analysis, geotechnical analysis, encroachments issues, and environmental update, discussed as follows:

8.1 - Hydraulic Analysis

Board staff has reviewed the hydraulic analysis submitted by SBFCA. The analysis computed various design water surface profiles and evaluated the incremental hydraulic impacts resulting from levee improvement measures designed to achieve a 200-year level of flood protection for the urban and urbanizing northern portion of the Sutter-Yuba City Basin, and 100-year protection south of Star Bend downstream of Yuba City. The analysis modeled the entire 44 miles of the Feather River from Thermalito Afterbay to the Sutter Bypass to include proper boundary conditions.

Board staff reviewed: (1) Design Water Surface Profile for the Feather River West Levee Project, prepared by Peterson Brustad, Inc. (PBI) dated March, 2012, and (2) Addendum #1, prepared by PBI dated July, 2012.

PBI applied the USACE HEC-RAS model also being used by the USACE as part of the Sutter Basin Feasibility Study (SBFS). The SBFS is a separate collaborative effort between the USACE, DWR and SBFCA to evaluate flood damage reduction, ecosystem restoration, and recreation projects within the Sutter-Yuba City basin.

The HEC-RAS model has undergone Independent Technical Review (ITR) by the USACE Sacramento District, as well as an independent peer review by MBK Engineers, Inc. of Sacramento.

8.1.1 Channel Cross Section Data Sources

The HEC-RAS model has undergone several recent updates and improvements to incorporate new or updated data. All horizontal datum are based on NAD83 and all

vertical datum are based on NAVD88 in U.S. Survey feet. Ground topography data is based on the USACE Sacramento and San Joaquin River Basins Comprehensive Study (Comp Study, 2002) mapping at a contour interval of 2 feet, with vertical datum converted from NGVD 29 to NAVD 88 based upon a conversion surface provided by the USACE.

Recent top of levee elevation data deemed more accurate were added to the model from the USACE National Levee Database (NLDB, 2008) with elevations input every 100 feet along the levee based on ground surveys in NAVD 88.

8.1.2 Water Surface Elevation Profile Results

The results indicate that the 100-year plus 3 feet water surface profile (from Station 461+00 downstream to Station 202+50) and the 200-year plus 3 feet water surface profile (from Station 461+00 upstream) are contained within the channel, with one exception occurring at the Union Pacific Railroad Bridge Station 1131+00 in Project Area “C”.

The model results predict that this location will be submerged at the 200-year flood discharge. SBFCA is proposing a closure structure where the railroad tracks intersect the levee. Board staff will work with SBFCA over the next few months on this physical solution.

Attachment D2 provides a table of cross section, water surface elevation, channel velocity data and other HEC-RAS data and results. Attachment D3 tabulates freeboard above the 100-, 200-, and 500-year water surfaces.

8.1.3 Freeboard Analysis based on Urban Levee Design Criteria

Freeboard is the vertical distance between the physical top of levee (TOL) and the design water surface elevation (DWSE), and serves as a factor of safety for containing water in a channel without overtopping the levee. The FRWLP used two sources of data to estimate the freeboard. Starting with the USACE Comp Study and NLDB data, additional TOL data developed for DWR’s Central Valley Floodplain Evaluation and Delineation program (CVFED, 2010), and field survey data from 2001 were added to the model. This was deemed necessary because: (a) the CVFED has not yet released updated HEC-RAS cross sectional data; and (b) the TOL data from Comp Study (2002), while suitable for computing water surface

elevations, is not as accurate in certain levee reaches as compared to TOL data from other sources (CVFED, 2010 and NLDB, 2008).
DWR's Urban Levee Design Criteria, May 2012 (ULDC) requires that projects be designed to provide at least three feet of freeboard above the 200-year water surface profile. The ULDC further suggests, but does not require, that based on the potential for underestimating the design water surface elevation (DWSE), the civil engineer should consider increasing the DWSE to account for the potential increases in WSE associated with future uncertainties such as climate change, updated hydrology, and updated hydraulic models.

SBFCA's freeboard analysis is based on a 200-year DWSE plus three (3) feet of freeboard for the portion of the Project protecting urban and urbanizing areas from Station 461+00 upstream, and on a 100-year DWSE plus three (3) feet for the portion of the Project protecting non-urban areas downstream of Station 461+00.

The hydraulic modeling results, when compared to Top of Levee LiDAR topographic data and supplemental field surveys indicate that the project meets the ULDC freeboard requirement.

Attachment D1 provides water surface elevation profile plots of the 200-year plus three (3) feet (required by ULDC), 200-year plus four (4) feet (suggested but not required by ULDC), and 100-year plus (3) feet profiles against the Comp Study (2002), FRWL Field Survey (2011) and CVFED (2010) TOL profiles.

Attachment D2 tabulates selected HEC-RAS input data and results and uses blue shading to highlight those stations where computed velocities were greater than 10 feet per second (fps).

Attachment D3 tabulates the freeboard analysis for both 100- and 200- year water surfaces, and indicates that sufficient freeboard is available for all but only 800 feet (less than 4/10 of one percent) of the entire project. Freeboard at those locations is all within 0.15 feet of the 3-foot requirement. Pink shading highlights stations with less than 3 feet of freeboard while yellow shading highlights stations with more than 3 feet but less than 4 feet of freeboard. Freeboard computations for both the 2011 field data and CVFED LiDAR data also appear to be in general agreement with one another.

8.1.4 Review of Final CVFED Data

It appears that the approach to hydraulic analysis used by the SBFCA design team is sufficient and appropriate for the 65 percent design based on the availability of the existing data. However the uncertainties (either random and/or systematic) associated with merging data from two different sources to calculate freeboard are unclear at this stage. When the full set of CVFED data is released by DWR it will be appropriate to use only the CVFED data for both cross section and top of levee elevations to estimate freeboard. Board staff will continue to work closely with the SBFCA team to further evaluate the hydraulic modeling data and results to be informed with as much certainty as possible with respect to water surface elevations and freeboard.

8.1.5 Super-elevation Considerations

There are several river bends along the FRWL alignment where water surface elevations would be expected to rise along the outer bank and fall along the inner bank due to centrifugal forces resulting in the condition known as super-elevation. As phased construction project designs move to the 90 percent level it may be necessary to analyze the impacts of super-elevation using a two-dimensional model in these critical areas as recommended in the ULDC. Board staff will continue to work with the SBFCA team to address this potential and to determine its significance.

8.1.6 Channel Velocities

Based on Board staff review the HEC-RAS model indicates that 33 cross-sections have channel velocities greater than 10 fps which is normally considered erodible. However due to the use of heavy quarry stone lining the river banks and bottom, the 200-year velocities are not anticipated to present significant problems. HEC-RAS cross sections at the upper end of the project near the Thermalito Afterbay release structure indicate channel velocities as high as 18.49 fps (highlighted in light blue on Attachment D2). These high velocities are a result of Thermalito Afterbay Dam outlet waters merging with the Feather River at lower water surface elevations. Measures to protect this area from advanced erosion are already in place.

Board staff will work with SBFCA to consider additional protection for this area if it is deemed necessary. Attachment D5 lists suggested maximum permissible mean channel velocities published by USACE. Board staff also compared and confirmed

the consistency of overbank velocities computed by the HEC-RAS model with the overbank velocities from the erosion report.

8.1.7 Roughness Coefficients

SBFCA engineers applied a maximum Manning's "n" roughness coefficient in the HEC-RAS model of 0.1 for vegetated areas. The HEC-RAS Hydraulic Reference Manual suggests use of a roughness coefficient for trees in the flood plain with flows into the branches (vegetated areas) ranging from 0.1 to 0.16.

The Manual also states that Manning's "n" roughness coefficients should be calibrated whenever observed water surface profile information is available. The SBFCA model was calibrated to two different flood events (2006 and 1997) and the final roughness coefficients used in the model reproduce those events very well.

Increases in the roughness coefficient due to vegetated area are proportionally related to increases in water surface elevation (WSE). Staff will continue to work with the SBFCA team to confirm that the current analysis does not underestimate the impact to WSE caused by vegetation. Attachment D6 shows Roughness Coefficients from HEC-RAS Hydraulic Reference Manual.

8.1.8 Hydraulic Conclusions

Based on the 65 percent design submittal and hydraulic analysis Board staff concludes that if constructed the FRWLP would result in no incremental adverse hydraulic impacts to the Feather River West Levee and Sacramento River Flood Control Project.

Board staff will work closely with the SBFCA team over the next several months to refine the hydraulic modeling analysis and results discussed herein to ensure continuing confidence in the predicted results and impacts.

8.2 - Geotechnical Analysis

The scope of geotechnical analyses for the 65 percent design included:

- performing steady-state seepage analyses to evaluate under- and through-seepage;
- performing steady-state stability analyses to evaluate landside stability;

- performing rapid drawdown stability analyses to evaluate waterside stability conditions; and
- performing seismic vulnerability analyses using liquefaction analyses and simplified deformation analyses.

In designing the proposed geotechnical measures such as slurry walls, seepage berms, etc., SBFCA used the 200-year DWSE plus four (4) feet for the portion of the Project protecting urban and urbanizing areas (from Station 461+00 upstream to Thermalito Afterbay), and used the 100-year DWSE plus four (4) feet for the portion of the Project protecting non-urban areas downstream of Station 461+00.

Board staff has made the following observations related to the geotechnical review of 65 percent design and analysis:

8.2.1 Levee Slopes

According to the USACE Engineering and Design Manual on the Design and Construction of Levees (EM 1110-2-1913, April 2000) a 1V on 2H slope is generally accepted as the steepest slope that can be easily constructed. However, taking maintenance into consideration a 1V on 3H slope is the steepest slope that can be conveniently traversed with conventional mowing equipment and walked on during inspections. Certain locations in the project have existing levee landside slopes that are steeper than USACE maximum slope requirements. These sites will be restored to existing conditions after slurry walls are installed. For the FRWLP these reaches include Reach 19, 20, 22, 23, 24, 25, 26, 27, 28, 30, 31, 33, 34, 38, and 40, and Reaches 27 and 28 have side slopes as steep as 1V on 1.3H.

The ULDC allows, for new levees and for extensive reconstruction of existing levees along major waterways, waterside and landside slopes of 1V on 3H. Exceptions may be allowed for reconstruction of existing levees when: (1) where the authorized geometry provides for steeper slopes; (2) the levee has a history of good performance; and (3) it meets stability and seepage criteria. Additionally levees with crown widths wider than minimum ULDC requirements may have steeper slopes if the theoretical levee prism can fit entirely within the dimensions of the existing levee, and if seepage and slope stability criteria are met.

In comparison, both the USACE (Geotechnical Levee Practice, 2008) and CCR 23 require a minimum landside levee slope of 1V on 2H, and the USACE further requires the levee to have a good history of performance.

8.2.2 Seismic Assessment

The FRWL Project evaluated seismic performance of levees using the higher of mean winter or summer water surface elevations for the liquefaction triggering and seismic slope stability analyses. Liquefaction analyses were performed at the crown and landside toe for each analysis section. Liquefaction analyses results were then used to evaluate whether the analysis sections covered the variability in liquefaction potential for the levee segments. The horizontal peak accelerations (PGA) of 0.11g to 0.125g were obtained for analysis from DWR's development of a 200-year return period seismic hazard map for the Urban Levee Evaluations Program Region (DWR, 2011).

The results of liquefaction triggering analyses, as presented in Table 8-3 of the Geotechnical Design Recommendation Report (GDRR, 2012), show that a liquefiable zone exists in the foundations of all of the FRWL reaches from Reach 7 to 41 excluding Reaches 20, 27, 28, 32, 38, 39, and 41. In addition, the results of seismic vulnerability (see Table 8-4 of the GDRR; and Table D-13 of Appendix D) (See Attachment E) indicate that post-seismic flood protection ability will be "compromised" and significant damage to internal structures (i.e., cutoff walls) will occur at Reaches 8, 10, 13, and 15, based on the evaluation criteria discussed in Table 6-2 of the GDRR. In addition, the results of deformation analysis indicate that several levee sections will have potential for large deformation to occur during seismic events. For example the estimated maximum seismic deformation for Reach 7 at Station 539+30 is about 6.5 feet; and for Reach 19 at Station 1224+00 is about 10 feet. Furthermore, the post earthquake stability analysis results with mitigation measures (Appendix D) indicate factor of safety of less than 1 for Reaches 8, 10, 13, and 15. The results of the seismic analyses may require further review at critical locations prior to final design of each construction project. SBFCA does not plan to mitigate for seismic issues, but rather will identify areas of concern and will develop an Emergency Action Plan.

8.2.3 Exit Gradient for Critical Locations

A goal of the 65 percent design seepage analysis was to achieve exit gradients of 0.5 of less. The GDRR recognizes that the USACE Geotechnical Levee Practice, 2008 suggests that the maximum allowable exit gradient be lowered to as low as 0.3 at critical locations such as pump stations and swimming pools, or in areas where flood fight operations are difficult. The seepage analyses at the Sunset Pump Station (Reach 21, Station 1430+00) shows an exit gradient for the 200-year plus 4 feet WSE at the bottom of the ditch to be lower than the 200-year plus 1 foot WSE.

This appears to be an oversight and will be corrected as the project design advances to ensure compliance with the USACE suggestion.

8.2.4 Relief Wells

USACE (EM 1110-2-1913) requires that the relief wells be designed so that the maximum exit gradient midway between the wells or landward from the well line does not exceed 0.5. Board staff will work with the applicant to ensure appropriate relief well design.

8.2.5 Adjacent Canals

There are three irrigation canals and one drainage canal located adjacent to the FRWL. One of these canals, the Sutter Butte Main Canal, is located adjacent to the levee toe from Station 1674+37 to 1769+31 (Reaches 26 through 28). Along certain portions of the canal the landside slope of the FRWL also serves as the east bank of the canal. Canal bank / landside levee slope erosion has occurred along the canal at some locations, and the division of responsibility for operations and maintenance of the canal bank / landside levee slope has been an issue between the canal company and State and local levee maintaining agencies. SBFCA is working with the irrigation district to develop a joint use agreement that would delineate this division of responsibility for operations and maintenance.

The 65 percent design includes sections of canal bank armoring to address erosion in the canal, and flattening of waterside levee slopes to achieve an expanded levee cross section to improve slope-stability performance at selected locations.

SBFCA's GDRR does not include steady state seepage analysis or landside slope stability analysis from Station 1615+62 in Reach 24 to 1820+80 in Reach 30. There is a concern for seepage in this stretch of the levee when the canal is empty and the river is at elevated flood stages. The steep slopes may also cause difficulties for maintenance of these levees. SBFCA plans additional geotechnical explorations and analyses to finalize the design at these locations.

The ULDC requires more stringent criteria for "frequently loaded levees" experiencing water surface elevations one (1) foot or higher above the elevation of the landside levee toe at least once a day for more than 36 days per year on average. While the "frequently loaded levees" criterion was developed to address Delta levees subjected to daily tidal influence, the ULDC does not explicitly state this. Staff will confer with DWR staff and the ULDC work group to determine if it is

appropriate to apply the “frequently loaded levees” criteria to the final design and analysis of the existing slopes that are adjacent to canals (for example, Reach 21, Station 1430+00).

8.2.6 Bank Erosion

At some locations the waterside slope has been undercut due to bank erosion such that the standard riverine levee prism geometry has not been maintained. While these undercuts are outside the levee prism, these locations should be monitored and maintained as necessary to protect the levee prism. In addition at some locations (see, for example, Station 656+00) the factor of safety does not meet the minimum requirements of the ULDC and USACE for rapid drawdown analysis of the waterside slope with mitigation measures.

At some locations the waterside slope has been undercut due to bank erosion such that the standard riverine levee prism geometry has not been maintained. Such a condition exists, for example, in the vicinity of Stations 1907+00 to 1910+00. In addition at some other locations (see, for example, Station 656+00) the factor of safety does not meet the minimum requirements of the ULDC and USACE for rapid drawdown analysis of the waterside slope with mitigation measures. Remedial measures are needed for the final design.

8.2.7 Railroad Crossing

At Station 1131+00 the Union Pacific Railroad crosses the FRWL in Project Area “C”. More detailed information is needed for this section of the levee including cross sections. The closest seepage/stability analysis presented in the GDRR is at Station 1138+86 upstream and 1125+00 downstream.

8.2.8 Levee Bends

The levee system along FRWL project has a number of bends, including 90 degree levee bends. A bend in the channel may cause super elevation along the outside of the bend. In other than straight sections of a channel, super elevation is to be checked with velocity consistent with the 200-year discharge. The ULDC and USACE (EM 1110-2-1601) describe the importance of considering super elevation when performing seepage and stability analyses. On the outside of a bend, the super elevation needs to be added to the DWSE. While super elevation may not be a major issue for the FRWL project levee system, the final designs need to be checked against the requirements of the ULDC and USACE. In addition, it is

reasonable to use the principle of superposition for seepage analysis at the 90-degree bends to confirm the adequacy of the cutoff walls.

8.2.9 Cutoff Walls

USACE (EM 1110-2-1913) recommends a maximum exit gradient of 0.5 at the levee toe with seepage control measures such as cutoff wall. The design of the cutoff walls (for example, Reach 33, Station 2076+90) should comply with the USACE design requirements.

8.2.10 Site Characterization

The Geotechnical Data Report (GDR, 2012) prepared for FRWLP includes field investigations and collected geotechnical information to supplement existing data and support the FRWLP 65 percent design of rehabilitation measures. In addition to existing information and pertinent geotechnical data, the GDR includes completing exploratory borings, cone penetrometer tests and laboratory testing on selected samples from the explorations. The design team is engaged in further site characterization. Compliance with USACE (Geotechnical Levee Practice, 2008) for final design will be aimed primarily to confirm the landward extent/continuity of the aquiclude layer for the seepage cutoff walls.

8.2.11 Reuse of Levee Degrade Materials

Construction of the levee sections with a soil-bentonite wall includes degrading the existing levee and rebuilding the levee's upper section with an 8-foot-wide clay core and shells on both the landside and waterside. The URS Technical Memorandum on "Geotechnical considerations for clay core and shell materials" dated January 23, 2012, and 65 percent design, Addendum No.1, Specification, dated August 16, 2012, Section 2.2.2, have recommended fine contents lower than the requirement in CCR 23. Accordingly, shell materials comprised of coarse-grained soils should have fine contents (i.e., passing #200 sieve) consistent with CCR 23, § 120; or alternatively to design some measures to minimize erosion without increasing levee maintenance.

Board staff will continue to work closely with the SBFCA design team to evaluate and resolve the issues summarized here.

8.3 – Encroachments and Public Law 84-99 Rehabilitation Eligibility

The FRWLP will favorably contribute to the re-instatement of the Feather River Right Bank – Sutter Bypass East Bank levee system into the Public Law (PL) 84-99 Rehabilitation and Inspections Program. The Periodic Inspection (PI) Report released by the USACE on September 10, 2010 for this system identified over 50 encroachments and bank caving & erosion issues that the USACE considers "Unacceptable – Likely to Prevent Performance in the Next Flood Event". These findings resulted in the levee system being deemed ineligible for PL 84-99 Rehabilitation Assistance.

While Board staff has begun enforcement proceedings, and has enlisted Local Maintaining Agencies' (LMA) help in addressing the numerous PI issues on this and other levee systems in the SRFCP, the nature of the process can be lengthy due to numerous stakeholders and regulatory interests. To date compliance on PI issues is only approximately ten (10) percent.

Implementation of SBFCA's FRWLP will address at least fifty (50) percent of the PI issues in the Feather River Right Bank – Sutter Bypass East Bank system, and the FRWLP's detailed encroachment research is helping Board staff to clearly define the steps that LMAs and Board Enforcement Section staff need to take to address the remaining PI issues.

The methods and plans that the FRWLP proposes to address encroachments in the project area will help restore the levee system in the PL 84-99 program more quickly, efficiently, and effectively than if the LMAs and Board Enforcement Staff were to address each issue separately.

8.3.1 Permit Status of Encroachments

The encroachment limits include 15 feet from the waterside toe, up and over the levee, to 30 feet from the landside toe. There are 432 total encroachments. About 55 percent have permits, 15 percent are listed in the Operations and Maintenance (O&M) Manual, and 30 percent are neither permitted nor in the O&M Manual (Attachment F1). Of the permitted encroachments about 80 percent contain the condition holding the permittee as the responsible party for necessary encroachment relocation, while about 20 percent do not specify this condition. Three of the pipes are currently permitted and CCR 23 compliant.

This levee improvement project plans to modify 322 of the 432 encroachments by bringing all 322 into CCR 23 compliance. The remaining 110 encroachments were observed during the encroachment survey, but will not need to be modified as part of the project.

8.3.2 Types of Encroachments

Of the 322 encroachments (see Attachment F2) to be modified:

- about 38 percent are pipelines to be modified as described below;
- about 25 percent are structures or retaining walls which will be removed or relocated off the levee and outside of a right-of-way zone extending 15 feet waterward of the waterside toe and 20 feet landward of the landside toe. The right-of-way zone may be reduced for structures that do not create levee safety or constructability issues;
- about 25 percent are dry utilities consisting of power and communications lines and utility poles which will be relocated outside of the right-of-way limits if they could be potentially damaged during construction. An easement may be granted to the owner if the utility may be left in place;
- about 7 percent are water wells, of which only about 40 percent are within the proposed right-of-way;
- about 3 percent are roadway crossings including city streets and boat launch access roads, but not farm roads;
- about 2 percent are canals and ditches (excluding the Sutter Buttes Main Canal) where the right of way will be adjusted to avoid those features.

There are 121 pipelines that will be modified. Four of them are gravity lines running parallel to the levee that will be relocated outside the right-of-way. The remaining 117 lines penetrate the levee prism. About 23 percent of the penetrations are no longer in use and will be properly abandoned per in CCR 23. About 26 percent are gravity lines that cross perpendicular to the levee, and 44 percent are pressurized lines that cross up and over the levee above the design water surface elevation. The 7 percent of pipes that cross the levee and are pressurized, but located below the design water surface elevation, will be rebuilt to cross above the design water surface elevation. Pipelines constructed before 1985 will be completely replaced, and all penetrations will receive positive closure and flap gate fixtures if missing them.

Board staff will work closely with the SBFCA team to address encroachments that are included in the SBFCA levee improvement project and are described in the

USACE's Periodic Inspection. Some encroachments not part of the FRWLP and will handled in coordination with local maintaining agencies directly.

8.4 – Right-Of-Way Issues

The SBFCA team has worked jointly with DWR to propose the following actions regarding the Right-of-Way (ROW) for the FRWL Project:

8.4.1 Undeveloped Areas

For undeveloped areas the general approach is to maintain a clear zone 15 feet waterward of the waterside levee toe. Landside levee ROW acquisition is proposed to be a permanent 30-foot landside ROW with the first 20-feet from the levee toe owned in fee and maintained as a clear zone. Rights for the remaining 10 feet would be held in easement. Agricultural land use will be allowed beyond 20 feet landward of landside levee toe. For levees with landside berms or relief wells in undeveloped areas the same ROW will apply from the berm toe or relief well, respectively. SBFCA's overall goal is to reduce ROW at encroachments which do not create levee safety or constructability issues.

8.4.2 Developed Areas

For developed areas the general approach is to maintain a 15 foot waterside clear zone. Landside levee ROW for "structures" to conform to available area (0 to 10 ft) on the landside. For "penetrations" the plan is to assure that existing encroachments: (a) do not create levee safety issues; (b) conform to ULDC); (c) do not create levee operation and maintenance issues; and (d) conform to levee certification and accreditation requirements. The "non-penetration" encroachments will be removed for (a) levee integrity; (b) constructability; (c) access and; (d) visibility. The remaining encroachments will be conformed over time.

This proposal includes keeping encroachments at locations within the minimum ROW in the CCR 23. Compliance with the regulations will be reviewed by Board staff on case by case basis during the CVFPB permit application process. In summary Board staff will continue to work with the SBFCA team to address existing encroachments in the ROW.

8.5 – Environmental Review

The environmental analysis of the project is underway and a joint Environmental Impact Report / Environmental Impact Statement (EIR/EIS) is expected to be available for public review in December 2012.

9.0 - PROJECT SUMMARY

Based on our review and evaluation, the following benefits and issues have been identified which have been outlined below.

9.1 - Project Benefits

This project is expected to provide the following benefits:

- To protect existing populations and minimize the exposure to flooding for agricultural commodities, infrastructure use, and other properties.

- To reduce the flood risk from the Feather River toward a targeted 200-year level of protection for Yuba City and communities north, and toward a targeted 100-year level of protection south of Yuba City, consistent with the CVFPP, and with State of California Senate Bill 5 mandates for 200-year flood protection for urban and urbanized areas.

- To bring the encroachments surveyed by SBFCA into CCR 23 compliance while addressing about 50 percent of the encroachment issues noted by the USACE in 2010 levee inspections as “Unacceptable – likely to prevent performance in the next flood event.”

- To address known deficiencies and observed performance issues.

- To construct a flood risk reduction project as quickly as possible utilizing available local and State cost-shared funding.

- To preserve and enhance riparian and other native habitats (such as ecosystem restoration).

- To facilitate consistency with the CVFPP and the Sutter Basin Project Feasibility Study such that proposed activities would be “no regrets” and not inconsistent with any future plans.

- To the extent feasible, adhere to federal standards, thereby ensuring eligibility for federal assistance for levee repairs and maintenance (e.g., federal assistance programs such as Public Law (PL) 84-99).

- To facilitate compatibility with recreation and restoration goals in the planning area.

9.2 – Other Issues that May Need Additional Evaluation

The following are issues identified by Board or DWR staff which will require ongoing evaluation and coordination with SBFCA to evaluate and resolve. Board staff expects that these issues will be resolved prior to the Section 408 approval if possible, or before approval of future permit applications to the Board for specific construction projects.

- There are erodible slopes at the upstream end of the East Gridley Road Bridge (Station 1910+00, Reach 31). Board staff will require additional information whether the slopes will be stabilized as part of the project, or if it will be done under another program, possibly needing a separate encroachment permit from the Board.

- The Irrigation Canal upstream of the Sunset Pump Station (Station 1430+00. Reach 22) where the canal slope and the existing levee landside slope are one and the same. SBFCA is working with the irrigation district to develop a joint use agreement which would delineate the division of maintenance responsibilities between the irrigation district and levee maintaining agencies.

- The three large diameter pipes at Sunset Pump Station (Station 1430+00, Reach 22) do not meet the CCR 23 criteria. SBFCA will request a construction variance for this item.

- The Union Pacific Railroad crossing at the boundary between LD1 and LD9 (Station 1131+00, Reach 17) needs work on the crossing. Board staff has concerns regarding the 100-foot cutoff wall overlapping from the south and north of the crossing which is within the Union Pacific Railroad right of way. The SBFCA team is working on this item.

- In Reach 16 the State Route 20 / Colusa Avenue / 10th Street bridge (Station 1026+00) and the Twin Cities Memorial Bridge / Bridge Street / 5th Street (Station 1007+00) cross the Feather River. SBFCA is working with the cities of Yuba City and Marysville on pedestrian / equestrian access issues under the soffit at the State Route 20 Bridge. The levee has also experienced severe erosion and has overly steep waterside banks in this vicinity. Constructability of proposed cutoff wall and seepage berms may be challenging in this area.

- An existing parking structure at the Sutter County Courthouse is embedded within the levee prism just downstream from the 5th Street Bridge (Station 995+00, Reach 16). The structure is proposed to be removed, and additional geotechnical analysis may be needed to assess levee stability and proper backfill design to rebuild the levee prism after the garage is removed.

- There are multiple existing relief wells (Station 846+50, Reach 13) just upstream of Shanghai Bend. The exact determination of which wells will be abandoned and which will remain is needed.

10.0 - FUTURE VARIANCES

To construct the cutoff walls, and relief wells at several locations some existing pipelines may require temporary removal and reinstallation. While Board staff are normally bound to the current standards of CCR 23 § 123 for pipelines, conduits, and utility lines, CCR 23 § 11 allows the Board to approve variances to the standards when the standards are found to be infeasible or not appropriate. Any necessary variance proposals will be brought to the Board for their approval as part of future construction permit applications.

SBFCA has submitted a list of twenty five (25) existing gravity or pressurized pipelines to be replaced that will fail to meet the standards of CCR 23 § 123 as per their designs, and has planned to request variances during future construction permit applications. A majority of these pipelines were previously permitted by the Board.

The nature of these variances includes the need for positive closure devices, the use of steel pipes below the design water surface elevation, and other deviations. SBFCA plans to provide detailed variance justification and proposals during future applications for construction projects permits. Some of the variances expected to be received from SBFCA in the future are displayed in Attachment G.

11.0 - STAFF CONCLUSIONS AND RECOMMENDATIONS

Staff concludes that the proposed Feather River West Levee Project, if constructed as described by the 65 percent level design documents submitted by the Sutter Butte Flood Control Agency, would result in an overall betterment to the Sacramento River Flood Control Project and State Plan of Flood Control, and would be consistent with the adopted Central Valley Flood Protection Plan.

Staff further concludes that the proposed alterations, subject to finalization of designs to address the remaining issues, can be constructed in a manner that will not be injurious to the public interest and will not impair the usefulness of the Sacramento River Flood Control Project.

Staff therefore recommends that the Board approve the letter to the U.S. Army Corps of Engineers (Attachment A) requesting Section 408 approval to alter approximately 41 miles of federal flood control project levee on the west side (right bank) of the Feather River in Butte and Sutter Counties.

Staff also recommends that the Board direct the Executive Officer to finalize and send the letter and SBFCA's Feather River West Levee Project Summary Report (Attachment H) to the U.S. Army Corps of Engineers Sacramento District Engineer.

Subject to USACE Section 408 approval in 2013 SBFCA will submit individual encroachment permit applications to seek Board approval for each phase of construction within the project.

12.0 - LIST OF ATTACHMENTS

A. Draft 33 U.S.C Section 408 Request Letter

B. Maps
   - B1. Site Location Map
   - B2. Project Alignment Maps

C. Project Details
   - C1. Typical Cross-Sections
   - C2. Table 1: Summary of Levee Deficiencies by Reach
   - C3. Table 2: Summary of Proposed Levee Modifications by Reach

D. Hydraulic Outputs and Criterion
   D1. Comparison of TOL from Different Data Sources
   D2. Typical Results from HEC-RAS
   D3. Freeboard Analysis
   D4. Water Surface Profiles
   D5. Maximum Allowable Channel Velocity (USACE)
   D6. Roughness Coefficients, Manning “n” Values from HEC-RAS Manual

E. Geotechnical Design Recommendation Report, 2012
   E1. GDRR-Table 8-3
   E2. GDRR-Table 8-4
   E3. GDRR-Table D-13
   E4. GDRR-Table 6-2
   E5. GDRR-Appendix D

F. Permit Status and Encroachments
   F1. Permit Status pie-chart
   F2. Types of encroachments pie-chart

G. List of Title 23 Variances

H. FRWL Project Summary Report, Section 408 Application

I. FRWL Construction Phasing Map

Coordinated by:	Deb Biswas, Engineer, Projects Section
Hydraulics Review:	Sungho Lee, Engineer, Projects Section
Encroachment Review:	Alison Tang, Engineer, Encroachment Section
Geotechnical Review:	Ali Porbaha, Senior Engineer, Projects and Environmental Branch
Document Review:	Ali Porbaha, Senior Engineer, Projects and Environmental Branch
	David Williams, Senior Engineer, Projects Section
	Eric R. Butler, Projects and Environmental Branch Chief
	Len Marino, Chief Engineer

Attachment A - Draft 408 Request Letter

STATE OF CALIFORNIA – THE RESOURCES AGENCY **EDMUND G. BROWN JR.,** GOVERNOR

CENTRAL VALLEY FLOOD PROTECTION BOARD
3310 El Camino Ave., Rm. 151SACRAMENTO, CA 95821
(916) 574-0609 FAX: (916) 574-0682
PERMITS: (916) 574-0685 FAX: (916) 574-0682

October 26, 2012

Colonel William J. Leady
District Engineer
U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814

Subject: Feather River West Levee Project, Sutter Butte Flood Control Agency

Dear Colonel Leady:

Based on the Policy and Procedural Guidance for the Approval of Modification and Alteration of Corps of Engineers Projects dated October 23, 2006, and the Clarification Guidance dated November 17, 2008, and on behalf of Sutter Butte Flood Control Agency (SBFCA) of Sutter and Butte Counties, the Central Valley Flood Protection Board (Board) is requesting permission from the U.S. Army Corps of Engineers (USACE) to alter a portion of the Sacramento River Flood Control Project (SRFCP). The Board is making this request pursuant to 33 U.S.C. Section 408.

The Board has conducted a preliminary review of the 65% project plans and specifications, geotechnical and hydraulic analyses, and other reports submitted by SBFCA for the alteration of 41 miles of federal flood control project levee on the west side (right bank) of the Feather River from Thermalito Afterbay in Butte County at the northern end of the project (Station 2368+00) to a point approximately four (4) miles north of the Feather River's confluence with Sutter Bypass in Sutter County at the southern end of the project (Station 202+50). The Board has determined that SBFCA will accomplish this alteration in a manner that will not be injurious to the public interest and will not impair the usefulness of the SRFCP. Attached is the information you require to accompany this request as outlined in your October 23, 2006 and November 17, 2008 guidance documents.

If the proposed project, upon completion, is formally incorporated within the federal SRFCP by the USACE, the State of California, acting through the Board, will accept the altered project for operation and maintenance and hold and save the United States free from damage due to the constructed works.

Within 180 days of completion of the project alteration, the Board will provide both information to the USACE for the purposes of preparing a revised Operation and Maintenance Manual for this portion of the SRFCP, and as-built Plans and Specifications for the alteration.

In order to achieve the flood control benefits of this work beginning with the 2013-2014 flood season, the Board is requesting that the USACE make any necessary determination so that SBFCA may proceed with this alteration by June 2013.

If you have any questions, please feel free to contact me at (916) 574-0609, or your staff may contact David R. Williams, Senior Engineer of the Board Projects Section, at (916) 574-2379.

Sincerely,

Jay S. Punia
Executive Officer

Enclosures

cc: Mr. Michael Inamine
Sutter Butte Flood Control Agency
1227 Bridge Street, Suite C
Yuba City, California 95991

Mr. Bill Hampton, General Manager
Levee District No. 1 of Sutter County
243 Second Street
Yuba City, California 95991

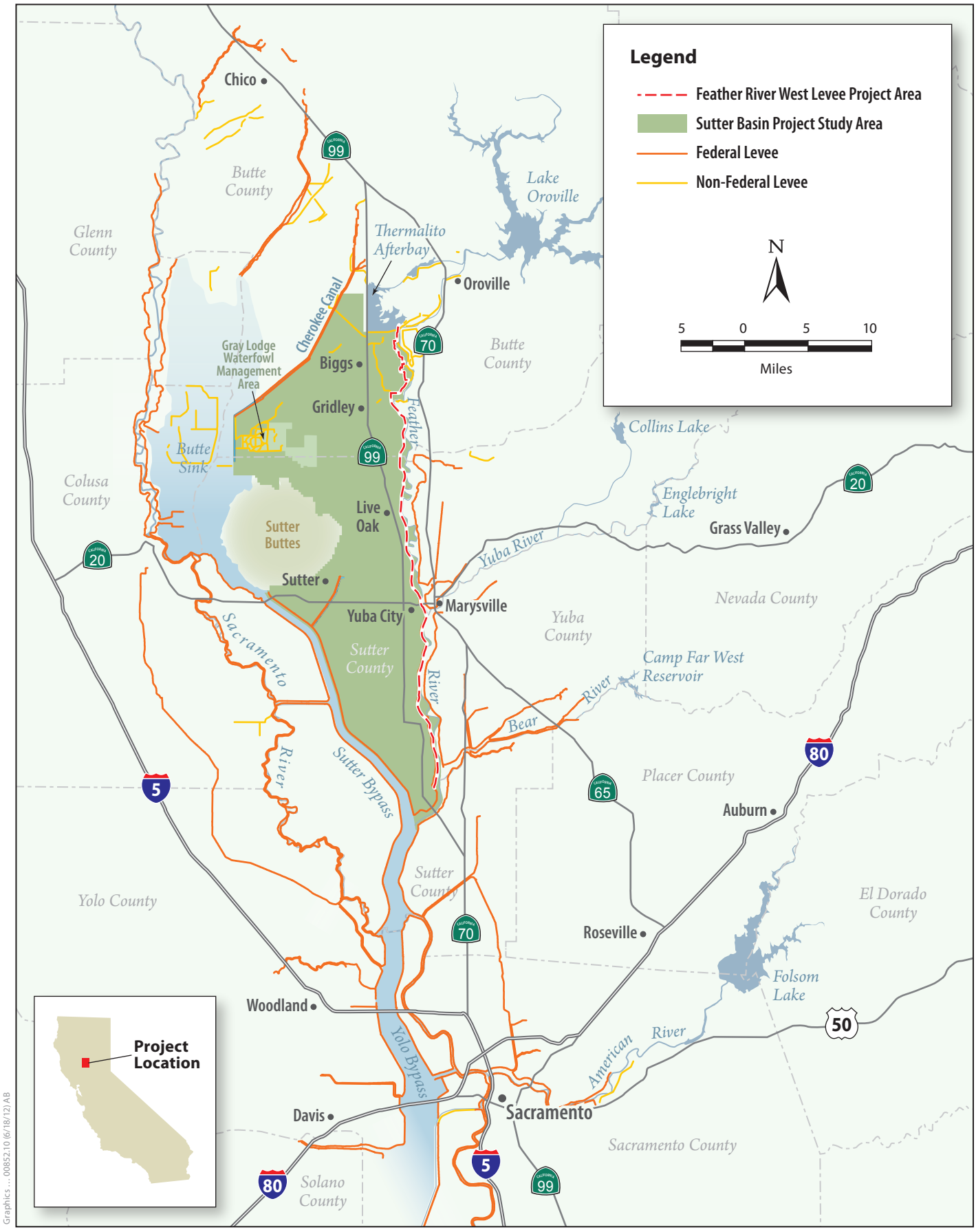
Mr. David Lamon, Chairman
Levee District No. 9 of Sutter County
1471 Coats Drive
Yuba City, California 95993

Mr. Mark List, DWR Chief Maintenance Support Branch
Maintenance Areas 3, 7, & 16
3310 el Camino Ave.
Sacramento, California 95821

Ms. Karen Hull, DWR Superintendent
Sutter maintenance Yard
PO Box 40
State Hwy 20
Sutter, California 95982

DRAFT

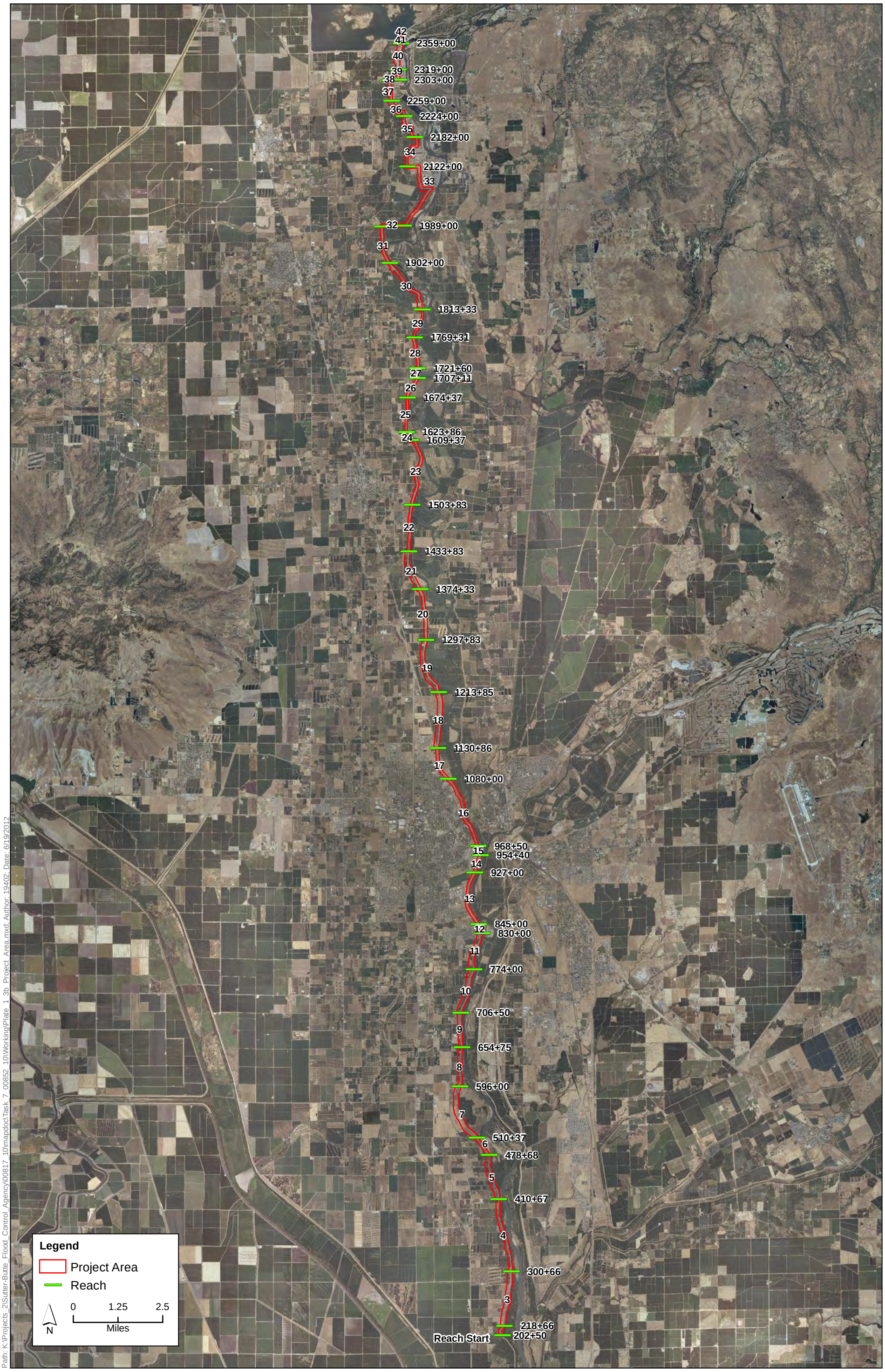
Attachment B1 - Site Location Map



Graphics ... 00852.10 (6/18/12) AB

Plate 1-1
Regional Setting

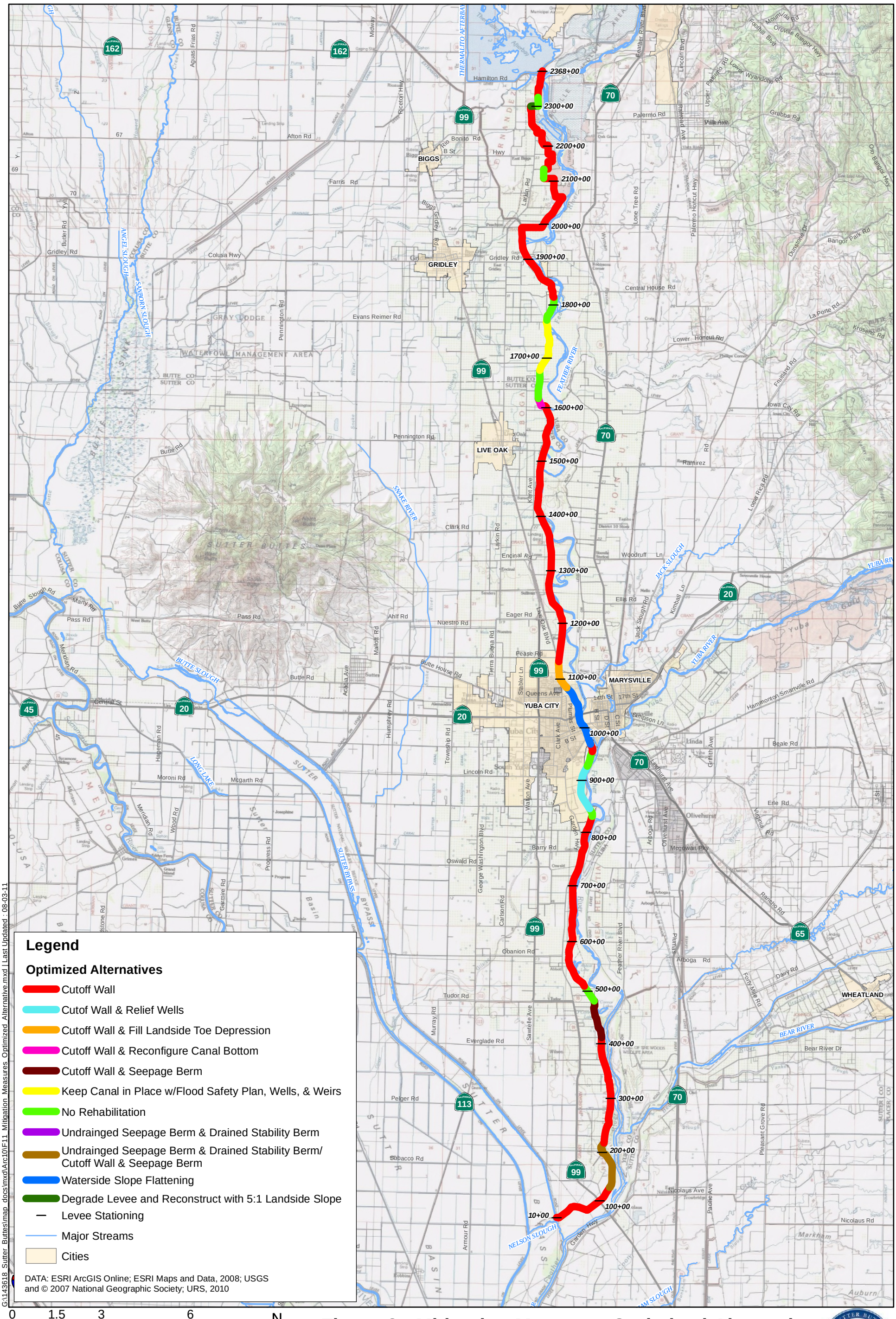
Attachment B2 - Project Alignment Maps



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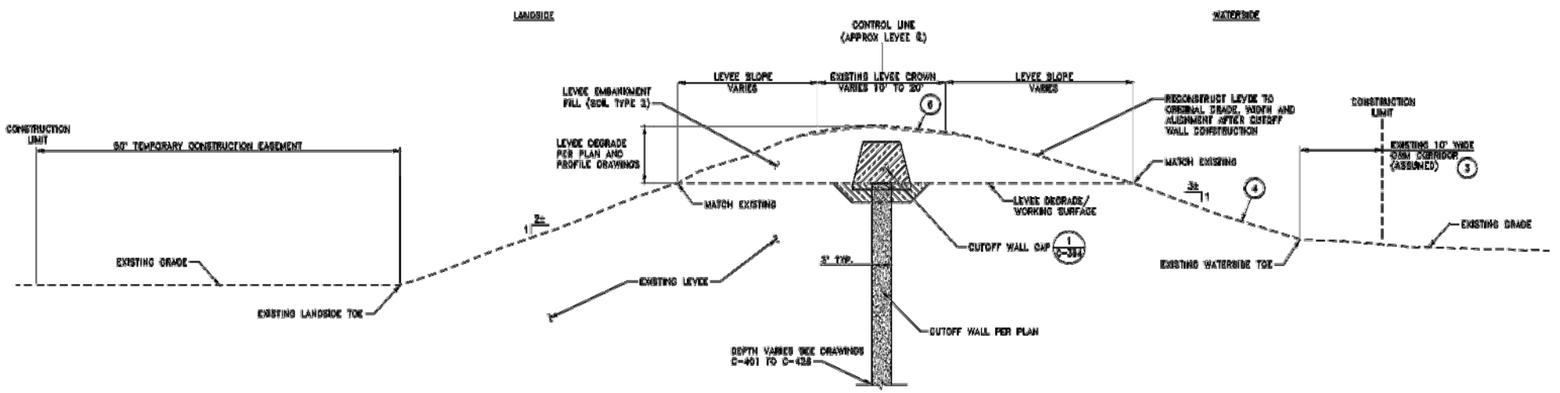
Plate 1-3b
Project Area

Attachment B2 - Project Alignment Maps


2368+00
2300+00
2200+00
2100+00
2000+00
1900+00
1800+00
1700+00
1600+00
1500+00
1400+00
1300+00
1200+00
1100+00
1000+00
900+00
800+00
700+00
600+00
500+00
400+00
300+00
200+00
100+00
10+00
BIGGS
GRIDLEY
LIVE OAK
YUBA CITY
MARYSVILLE
WHEATLAND
Hamilton Rd
Afton Rd
Rio Bonito Rd
Farris Rd
Gridley Rd
Colusa Hwy
Evans Reimer Rd
Pennington Rd
Butte Rd
Palermo Rd
Central House Rd
Lower Honcut Rd
Clark Rd
Encinal Rd
Woodruff Ln
Ellis Rd
Eager Rd
Nuestro Rd
Pease Rd
Butte House Rd
Queens Ave
14th St
17th St
Lincoln Rd
Barry Rd
Oswald Rd
Tudor Rd
Everglade Rd
Pelger Rd
Tobacco Rd
Nicolaus Ave
Obanion Rd
Arboga Rd
Dairy Rd
Bear River Dr
Nicolaus Rd
Beale Rd
Erle Rd
Olivehurst
Ramirez
Moroni Rd
Mcgarth Rd
Oro Bangor Hwy
Bangor Park Rd
Hammonton Smartville Rd
Lone Tree Rd
Grubbs Rd
Villa Ave
Lower Wyandotte Rd
Upper Palermo Rd
Mountain Rd
Oroville Bangor Hwy
Foothill Blvd
Lincoln Blvd
Feather River Blvd
Railroad Ave
Dunstone Dr
Central St
Butler Rd
Gridley Rd
Afton Rd
Aguas Frias Rd
Midway
Riceton Hwy
Hwy
B St
Larkin Rd
Biggs Gridley Rd
Peaches
Wyman
Robinson Corner
Phillips Corner
Krosens Rd
La Porte Rd
Frutland Rd
Iowa City Rd
Ramirez Rd
Lone Rice Rd
Woodruff Ln
Kimball Ln
Jack Slough Rd
Ellis Rd
Olivehurst Ave
Ramirez
Rancho Rd
Forty Mile Rd
Pleasant Grove Rd
Simpson Ln
Linda
Griffith Ave
Lindhurst Ave
Virginia Rd
Mcgowan Pky
Nicolaus Ave
Pacific Ave
Markham
Auburn
Garden Hwy
Plumas St
B St
C St
D St
Clark Ave
Walton Ave
Larkin Rd
Stabler Ln
Acacia Ave
Humphrey Rd
Township Rd
Maloff Rd
Ahlf Rd
Tierra Buena Rd
Live Oak Blvd
Sawtelle Ave
Murray Rd
Carlson Rd
George Washington Blvd
Kent Ave
Larkin Rd
Meridian Rd
Hagenan Rd
Wood Rd
Progress Rd
Garmire Rd
Armour Rd
Butte Slough Rd
Marty Rd
Pass Rd
Central St
Lone Tree Rd
Palermo Honcut Hwy
Railroad Ave
Feather River Blvd
Lincoln Blvd
Oro Bangor Hwy
Foothill Blvd
Mountain Rd
Oroville
Municipal Airport
Thermalito Afterbay
Thermalito Forebay
Riceton Hwy
Midway
Aguas Frias Rd
Afton Rd
Rio Bonito Rd
B St
Hwy
Farris Rd
Biggs Gridley Rd
Gridley Rd
Colusa Hwy
Butler Rd

Attachment C1 - Typical Cross-sections

30% DESIGN

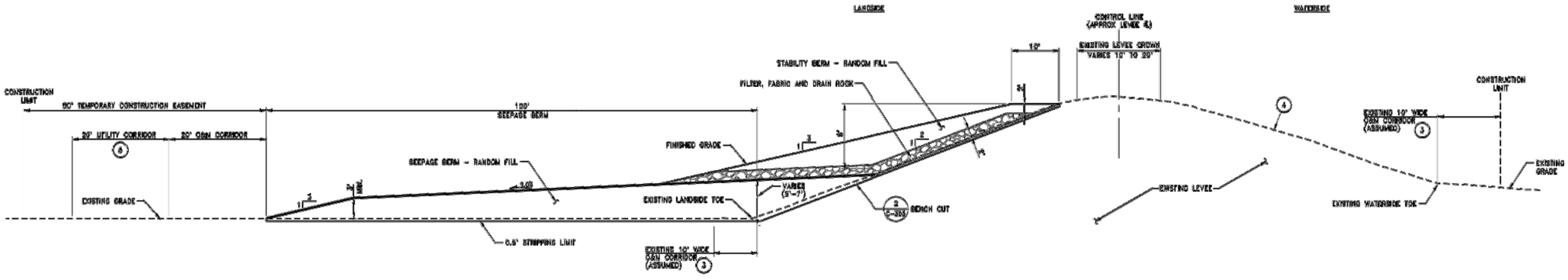


TYPICAL LEVEE SECTION WITH CUTOFF WALL (1)
SCALE: 1"=10'

STA. 10+00 TO 129+55
STA. 218+86 TO 456+00
STA. 513+96 TO 830+35
STA. 954+40 TO 968+50
STA. 1080+00 TO 1213+85

NOTES:
1. LEVEE EMBANKMENT FILL MATERIALS SHALL CONSIST OF IMPORT MATERIAL AND EXCAVATED LEVEE MATERIAL BLENDED AS REQUIRED TO MEET THE REQUIREMENTS OF SPECIFICATION 31 00 00.
2. FINISH GRADE LINES SHOWN ARE PRIOR TO PLACEMENT OF TOPSOIL.
3. EXISTING O&M CORRIDOR TO BE USED BY THE CONTRACTOR DURING CONSTRUCTION.
4. EXISTING VEGETATION ON WATERSIDE SHALL NOT BE DISTURBED.
5. NEW 20' UTILITY CORRIDOR ONLY WHERE POWER POLE RELOCATION IS REQUIRED.
6. SALVAGE EXISTING AGGREGATE BASE. RECONSTRUCT LEVEE CROWN ROADWAY IN ACCORDANCE WITH DETAIL ON DRAWING C-305.

BEGIN STATION	END STATION	DETAIL	SHEET	REHABILITATION MEASURE
10+00	129+66	1	C-301	CUTOFF WALL
129+66	181+00	2	C-301	SEEPAGE BERM AND STABILITY BERM
181+00	218+66	3	C-302	CUTOFF WALL AND SEEPAGE BERM
218+66	456+00	1	C-301	CUTOFF WALL
456+00	475+88	3	C-302	CUTOFF WALL AND SEEPAGE BERM
475+88	513+95	–	–	NONE
513+96	830+35	1	C-301	CUTOFF WALL
830+35	844+75	–	–	NONE
844+75	923+73	4	C-302	CUTOFF WALL AND RELIEF WELLS
923+73	954+40	–	–	NONE
954+40	968+50	1	C-301	CUTOFF WALL
968+50	1080+00	A-0	C-303	LEVEE GEOMETRY ADJUSTMENTS
1080+00	1213+85	1	C-301	CUTOFF WALL



TYPICAL LEVEE SECTION WITH SEEPAGE BERM AND STABILITY BERM (2)
SCALE: 1"=10'

STA. 129+66 TO 181+00

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION	REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

DESIGNED BY: C. CONTRERAS
DRAWN BY: L. SMILEY, J. PRIEST
CHECKED BY: P. TOBIA
IN CHARGE: J. KORB
DATE: 08/15/2011

PRELIMINARY

WOOD RODGERS
DEVELOPING • INNOVATIVE • DESIGN • SOLUTIONS
2591 C STREET, SUITE 110-A, SACRAMENTO, CA 95816
PHONE: (916) 341-7760 FAX: (916) 341-7767

SUBMITTED | APPROVED

SUTTER BUTTE FLOOD CONTROL AGENCY

VOLUME 3: FRWL IMPROVEMENT PLANS
TYPICAL LEVEE SECTIONS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING. ADJUST SCALES FOR REDUCED PLOTS
0 1"

DRAWING NO. C-301 | SHEET 137

Figure 3

ONE COMPANY | *Many Solutions*

Typical Levee Sections (Wood Rodgers)
Plan Sheet 137

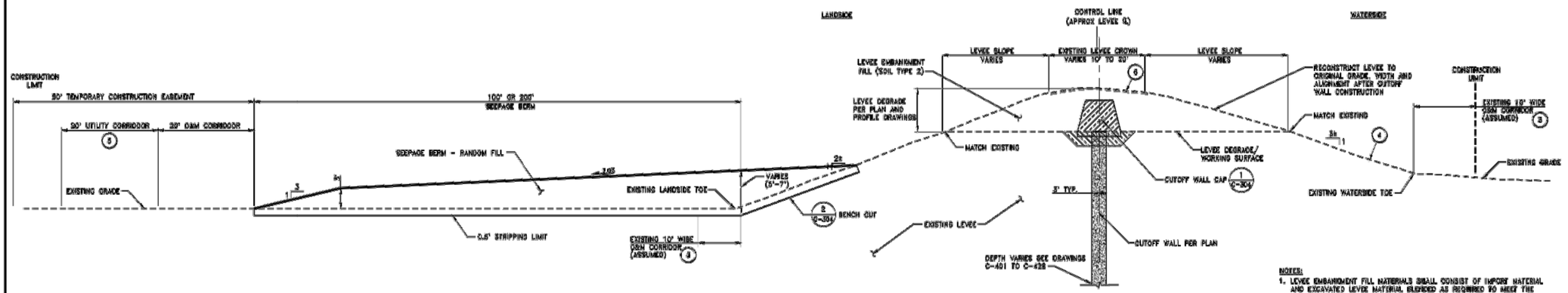
Feather River West Levee Project
Sutter and Butte Counties, CA

Date
AUG 2011

Figure
3

Attachment C1 - Typical Cross-sections

30% DESIGN

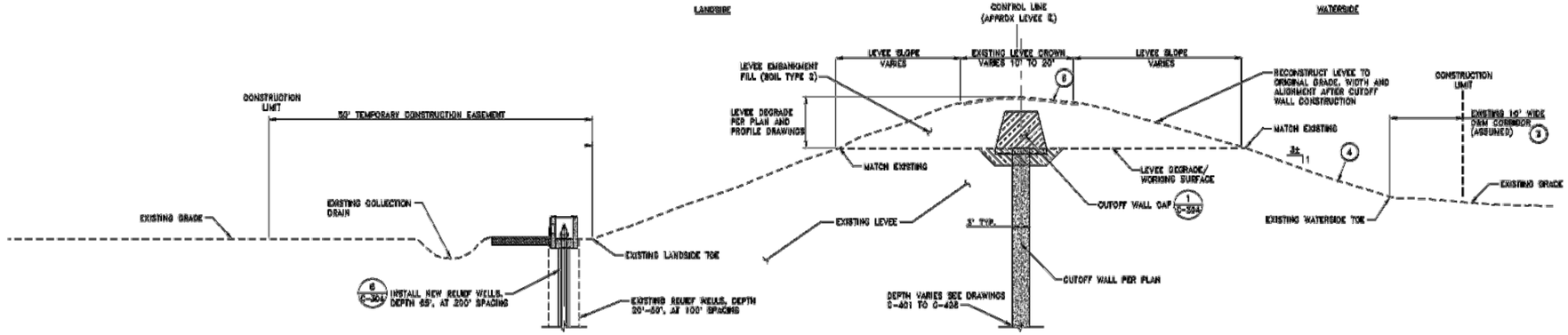


TYPICAL LEVEE SECTION WITH CUTOFF WALL AND SEEPAGE BERM

SCALE: 1"=10'

STA. 181+00 TO 218+86
STA. 436+00 TO 475+86

NOTES:
1. LEVEE EMBANKMENT FILL MATERIALS SHALL CONSIST OF IMPORT MATERIAL AND EXCAVATED LEVEE MATERIAL BLENDED AS REQUIRED TO MEET THE REQUIREMENTS OF SPECIFICATION 31 00 00.
2. FINISH GRADE LINES SHOWN ARE PRIOR TO PLACEMENT OF TOPSOIL.
3. EXISTING O&M CORRIDOR TO BE USED BY THE CONTRACTOR DURING CONSTRUCTION.
4. EXISTING VEGETATION ON WATERSIDE SHALL NOT BE DISTURBED.
5. NEW 20' UTILITY CORRIDOR ONLY WHERE POWER POLE RELOCATION IS REQUIRED.
6. SALVAGE EXISTING AGGREGATE BASE. RECONSTRUCT LEVEE CROWN ROADWAY IN ACCORDANCE WITH DETAIL ON DRAWING C-305.



TYPICAL LEVEE SECTION WITH CUTOFF WALL AND RELIEF WELLS

SCALE: 1"=10'

STA. 844+75 TO 923+73

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

DESIGNED BY: C. CONTRERAS
DRAWN BY: L. BAILEY, J. PRIEST
CHECKED BY: P. TOSIA
IN CHARGE: J. KORE
DATE: 08/18/2011

PRELIMINARY

WOOD RODGERS
DEVELOPING • INNOVATIVE • DESIGN • SOLUTIONS
3301 C STREET, BLDG. 100-B, SACRAMENTO, CA 95816
PHONE: (916) 341-7760 FAX: (916) 341-7767

SUBMITTED | APPROVED

SUTTER BUTTE FLOOD CONTROL AGENCY

VOLUME 3: FRWL IMPROVEMENT PLANS
TYPICAL LEVEE SECTIONS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING. ADJUST SCALES FOR REDUCED PLOTS
0" 1"

DRAWING NO. C-302 | SHEET 138

Figure 4

ONE COMPANY | *Many Solutions*

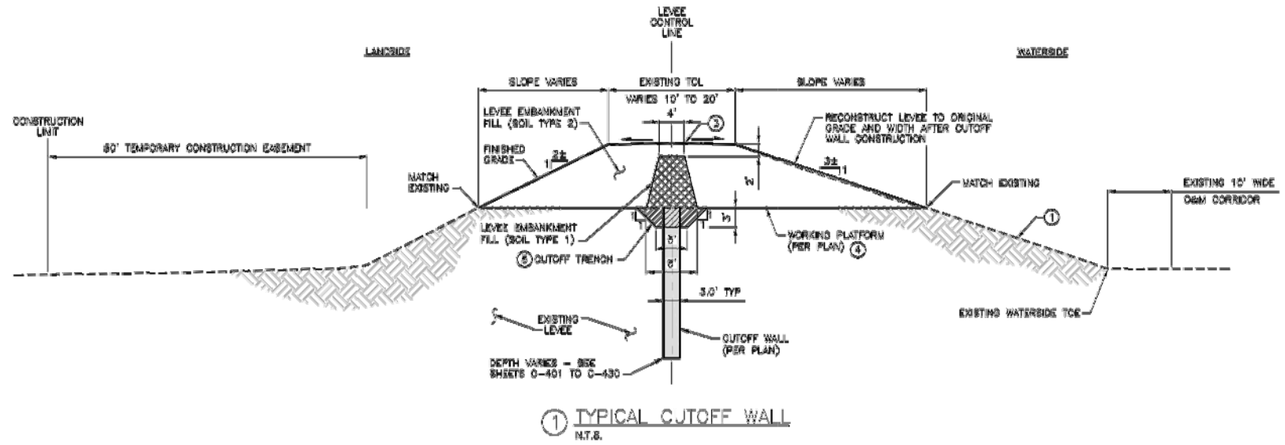
Typical Levee Sections (Wood Rodgers)
Plan Sheet 138

Feather River West Levee Project
Sutter and Butte Counties, CA

Date
AUG 2011

Figure
4

Attachment C1 - Typical Cross-sections



① TYPICAL CUTOFF WALL
N.T.S.

NOTES:

① EXISTING VEGETATION ON THE WATERSIDE SHALL NOT BE DISTURBED.

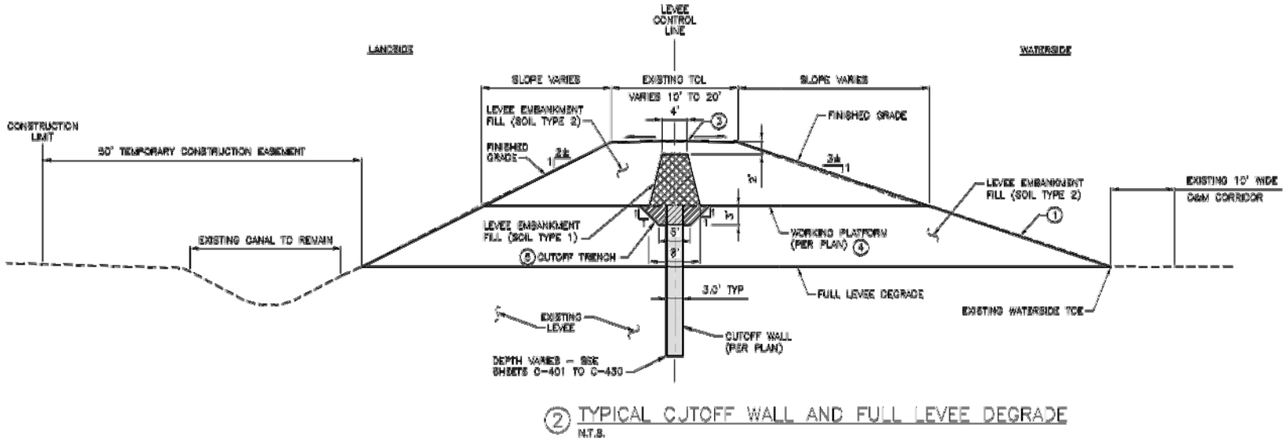
② SEE SHEET C-303 FOR BENCHING DETAILS.

③ SALVAGE EXISTING AGGREGATE BASE. CROWN RESURFACING PER DETAIL ON SHEET C-303.

④ SEE LEVEE DEGRADE DETAIL ON SHEET C-303.

⑤ EXCAVATE CUTOFF TRENCH AND FILL WITH TYPE 1 SOIL PRIOR TO EXCAVATING CUTOFF WALL TRENCH.

LEVEE SECTION SCHEDULE				
BEGIN	END	SECTION DESIGNATION	REHABILITATION MEASURE	DRAWING NO.
1213+35	1433+83	1	CUTOFFWALL	C-301
1433+83	1439+77	2	CUTOFF WALL & FULL LEVEE DEGRADE	C-301
1439+77	1609+37	1	CUTOFF WALL	C-301
1609+37	1823+88	3	CUTOFF WALL & LINE CANAL	C-302
1823+88	1847+37	–	NONE	–
1874+37	1789+31	–	NONE	–
1789+31	1813+33	–	NONE	–
1813+33	2128+00	1	CUTOFF WALL	C-301
2128+00	2182+00	–	NONE	–
2182+00	2290+00	1	CUTOFF WALL	C-301
2290+00	2303+00	4	FULL DEGRADE & RECONSTRUCT LEVEE W/3:1 LANDSIDE SLOPE	C-302
2303+00	2313+00	–	NONE	–
2313+00	2368+00	1	CUTOFF WALL	C-301



② TYPICAL CUTOFF WALL AND FULL LEVEE DEGRADE
N.T.S.

30% DESIGN

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

DESIGNED BY: D. JASBOUR
DRAWN BY: A. JACKSON
IN CHARGE: D. JASBOUR
PROJECT MANAGER: C. KRIVANEC
DATE: 8/18/11

HDR Engineering Inc. 2365 Iron Point Rd. Suite 300 Folsom, CA 95630

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SUTTER BUTTE FLOOD CONTROL AGENCY

VOLUME 4: FEATHER RIVER WEST LEVEE IMPROVEMENT PLANS

TYPICAL LEVEE SECTIONS

VERIFY SCALES BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET ADJUST SCALES FOR REDUCED PLOTS

DRAWING NO. C-301 | SHEET 138

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Figure 5

ONE COMPANY | *Many Solutions*

Typical Levee Sections (HDR)
Plan Sheet 138

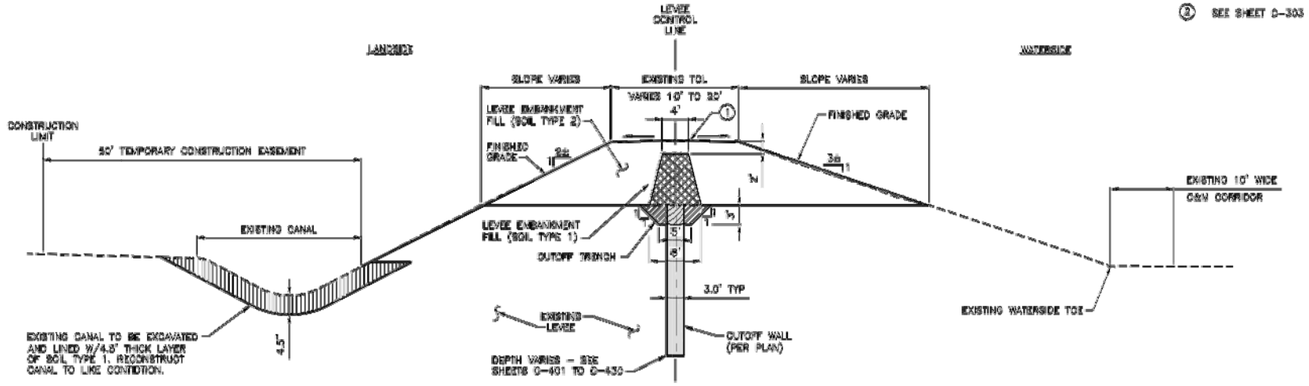
Feather River West Levee Project
Sutter and Butte Counties, CA

Date
AUG 2011

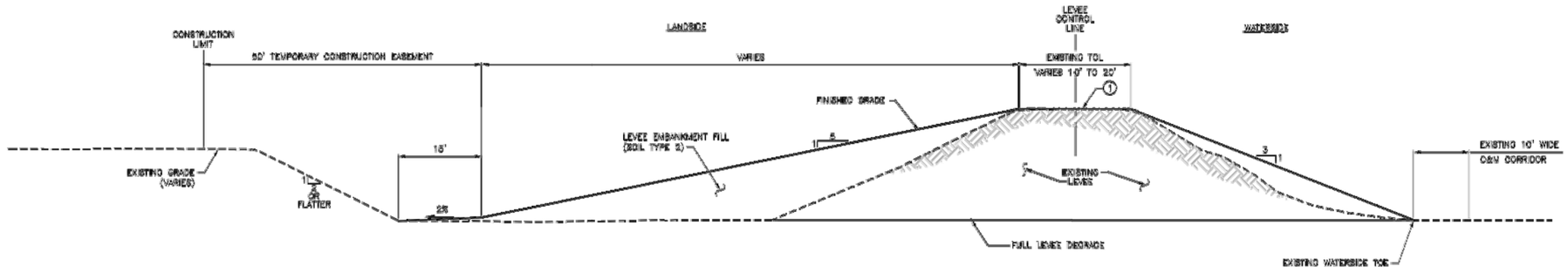
Figure
5

NOTES:

1. SALVAGE EXISTING AGGREGATE BASE. CROWN RESURFACING PER DETAIL ON SHEET C-303.
2. SEE SHEET C-303 FOR BENCHING DETAILS.



③ CANAL EXCAVATION DETAIL
N.T.S.



④ TYPICAL FULL LEVEE DEGRADE AND 5:1 LANDSIDE SLOPE FLATTENING
N.T.S.

30% DESIGN

REV.	DATE	BY	CHK.	APPR.	DESCRIPTION

DESIGNED BY: D. JASBOUR
DRAWN BY: A. JACKSON
IN CHARGE: D. JASBOUR
PROJECT MANAGER: C. KRAVANES
DATE: 8/18/11

HDR Engineering Inc. 2365 Iron Point Rd. Suite 300 Folsom, CA 95630

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VOLUME 4: FEATHER RIVER WEST LEVEE IMPROVEMENT PLANS

TYPICAL LEVEE SECTIONS

VERIFY SCALES BAR IS ONE INCH ON ORIGINAL DRAWING. ADJUST SCALES FOR REDUCED PLOTS 0 1"

DRAWING NO. C-302 | SHEET 139

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Figure 6

ONE COMPANY | *Many Solutions*

Typical Levee Sections (HDR)
Plan Sheet 139

Feather River West Levee Project
Sutter and Butte Counties, CA

Date
AUG 2011

Figure
6

Attachment C2 -Table 1: Summary of Levee Deficiencies by Reach

Table 1 Summary of Levee Deficiencies by Reach

Study Reach	Through Seepage	Under Seepage	Slope Stability
1	*Not part of the project proposed at this time*		
2	X	X	*
3	X	X	*
4	X	X	*
5	X	X	*
6			
7	X	X	*
8	X	X	*
9	X	X	*
10	X	X	*
11	X	X	*
12			
13	X	X	*
14			
15	X	X	*
16			X
17	X	X	*
18	X	X	*
19	X	X	*
20		X	*
21		X	*
22	X	X	*
23		X	*
24		X	*
25			
26	X	X	*
27	X	X	*
28		X	X
29			
30	X	X	*
31		X	X
32	X	X	*
33	X	X	*
34	X	X	*
35	X	X	*
36	X	X	*
37	X	X	*
38	X	X	*
39			
40	X	X	*
41	X	X	*

X=Levee deficiency

*= Reaches where both through seepage and under seepage issues exist and slope stability was not independently verified.

Attachment C3 - Table 2: Summary of Proposed Levee Modifications by Reach

Table 2 Summary of Proposed Levee Modifications by Reach

Reach	Length (ft)	Proposed Modification/ Flood Management Measure
2	1,616	202+50 to 218+66, cutoff wall extending to an elevation of 25' with 100'-wide undrained seepage berm. Seepage berm 5' thick at berm toe.
3	8,200	218+66 to 230+00 cutoff wall extending to an elevation of 25' with 100'-wide undrained seepage berm. Seepage berm 5' thick at berm toe.
		230+00 to 250+00 cutoff wall tip elevation 35';
		250+00 to 289+00 cutoff wall tip elevation 20';
		289+00 to 300+66 cutoff wall tip elevation 12'
4	11,001	300+66 to 312+00 cutoff wall tip elevation 15';
		312+00 to 349+00 cutoff wall tip elevation 15';
		349+00 to 368+00 cutoff wall tip elevation 10';
		368+00 to 410+67 cutoff wall tip elevation 20'
5	6,801	410+67 to 417+00, cutoff wall tip elevation 20';
		417+00 to 425+00, cutoff wall tip elevation 10';
		425+00 to 456+00, cutoff wall tip elevation 15';
		456+00 to 475+35, cutoff wall tip elevation 15' with 300-ft-wide undrained seepage berm. Seepage berm 5 ft. thick at berm toe;
		475+35 to 478+68 no rehabilitation required
6	3,169	No Rehabilitation Required
7	8,563	514+00 to 526+00, cutoff wall tip elevation 15';
		526+00 to 570+00, cutoff wall tip elevation 5';
		545+00 to 570+00, Relief wells with 60' spacing and 50-foot depth over one half of the length, distributed at various locations over this stretch of levee
		570+00 to 575+00, cutoff wall tip elevation 5';
		575+00 to 595+00, cutoff wall tip elevation 10';
		595+00 to 596+00, cutoff wall tip elevation 15'
8	5,875	596+00 to 654+75, cutoff wall tip elevation 15'
9	5,175	654+75 to 670+00, cutoff wall tip elevation 15';
		670+00 to 697+00, cutoff wall tip elevation 20';
		697+00 to 706+50: cutoff wall tip elevation 10';
10	6,750	706+50 to 726+00, cutoff wall tip elevation 10';
		726+00 to 746+00, cutoff wall tip elevation 5';
		746+00 to 754+50, cutoff wall tip elevation 5';

Table 2 Summary of Proposed Levee Modifications by Reach (Contd.)

Reach	Length (ft)	Proposed Modification/ Flood Management Measure
		754+50 to 774+00, cutoff wall tip elevation 25’
11	5,600	774+00 to 784+50, cutoff wall tip elevation 25’;
		784+50 to 827+50, cutoff wall tip elevation 5’;
		827+50 to 830+00, cutoff wall tip elevation 25’
12	1,500	No Rehabilitation Required
13	8,200	844+50 to 923+75: cutoff wall tip elevation 35’ and relief well with 200-foot spacing and 65’ deep
14	2,740	No Rehabilitation Required
15	1,410	No rehabilitation required
16	11,150	992+80 to 1001+80, waterside slope flattening or other remedial measures Closure of gap in cutoff wall at 5th Street bridge crossing around Station 1007+00, cutoff wall tip elevation 40’;
		Closure of gap in cutoff wall at 10th Street bridge crossing around Station 1026+00, cutoff wall tip elevation 35’;
		1077+85 to 1080+00, cutoff wall tip elevation 30’ and backfill landside toe depression
17	5,086	1080+00 to 1089+00, cutoff wall tip elevation 30’ and backfill landside toe depression;
		1089+00 to 1125+00, cutoff wall tip elevation 35’ and backfill landside toe depression;
		1125+00 to 1130+86, cutoff wall tip elevation 0’
18	8,299	1130+86 to 1151+50, cutoff wall tip elevation 0’;
		1151+50 to 1159+50: cutoff wall tip elevation 30’;
		1159+50 to 1169+50: cutoff wall tip elevation 25’;
		1169+50 to 1189+50: cutoff wall tip elevation 30’;
		1189+50 to 1209+50: cutoff wall tip elevation 40’;
		1209+50 to 1213+85: cutoff wall tip elevation 35’
19	8,398	1213+85 to 1219+75, cutoff wall tip elevation 35’;
		1219+75 to 1224+00, cutoff wall tip elevation 5’;
		1224+00 to 1238+00, cutoff wall tip elevation 28’;
		1238+00 to 1248+00, cutoff wall tip elevation 42’;
		1248+00 to 1268+75, cutoff wall tip elevation 3’;
		1268+75 to 1297+83, cutoff wall tip elevation 35’
20	7,650	1297+83 to 1298+75, cutoff wall tip elevation 35’;
		1298+75 to 1359+00, cutoff wall tip elevation 50’;

Table 2 Summary of Proposed Levee Modifications by Reach (Contd.)

Reach	Length (ft)	Proposed Modification/ Flood Management Measure
		1359+00 to 1369+00: cutoff wall tip elevation 40’;
		1369+00 to 1374+33: cutoff wall tip elevation 32‘
21	5,950	1297+83 to 1298+75: cutoff wall tip elevation 35’;
		1298+75 to 1359+00: cutoff wall tip elevation 50’;
		1359+00 to 1369+00: cutoff wall tip elevation 40’;
		1369+00 to 1374+33: cutoff wall tip elevation 32’
22	7,000	1433+83 to 1448+75, cutoff wall tip elevation 40’;
		1448+75 to 1468+83, cutoff wall tip elevation 50’;
		1455+00 to 1461+00, full levee degrade and reconstruction;
		1468+83 to 1503+83, cutoff wall tip elevation 55’
23	10,554	1503+83 to 1508+50, cutoff wall tip elevation 55’;
		1508+50 to 1528+75, cutoff wall tip elevation 60’;
		1528+75 to 1566+50, cutoff wall tip elevation 55’;
		1566+50 to 1608+75, cutoff wall tip elevation 60’
24	1,449	1608+75 to 1623+86, cutoff wall tip elevation 28’
25	5,051	1623+86 to 1625+00, cutoff wall tip elevation 28’;
		1673+00 to 1674+37, cutoff wall tip elevation 65’
26	3,274	1674+37 to 1707+11, cutoff wall tip elevation 65’;
		reconstruction of landside slope extends down to elevation of bottom of canal, with
		armoring on canal portion of slope
27	1,449	1707+11 to 1721+60: cutoff wall tip elevation 65’; reconstruction of landside slope extends down to elevation of bottom of canal, with armoring on canal portion of slope
28	4,771	1721+60 to 1727+75, cutoff wall tip elevation 65’;
		1727+ 75 to 1748+50, cutoff wall tip elevation 70’;
		1748+50 to 1769+31, cutoff wall tip elevation 45’
		Reconstruction of landside slope extends down to elevation of bottom of canal, with armoring on canal portion of slope
29	4,402	No Rehabilitation Required
30	8,867	1813+33 to 1816+50, cutoff wall tip elevation 80’ with full levee degrade and reconstruction;
		1816+50 to 1848+25, cutoff wall tip elevation 30’;

Table 2 Summary of Proposed Levee Modifications by Reach (Contd.)

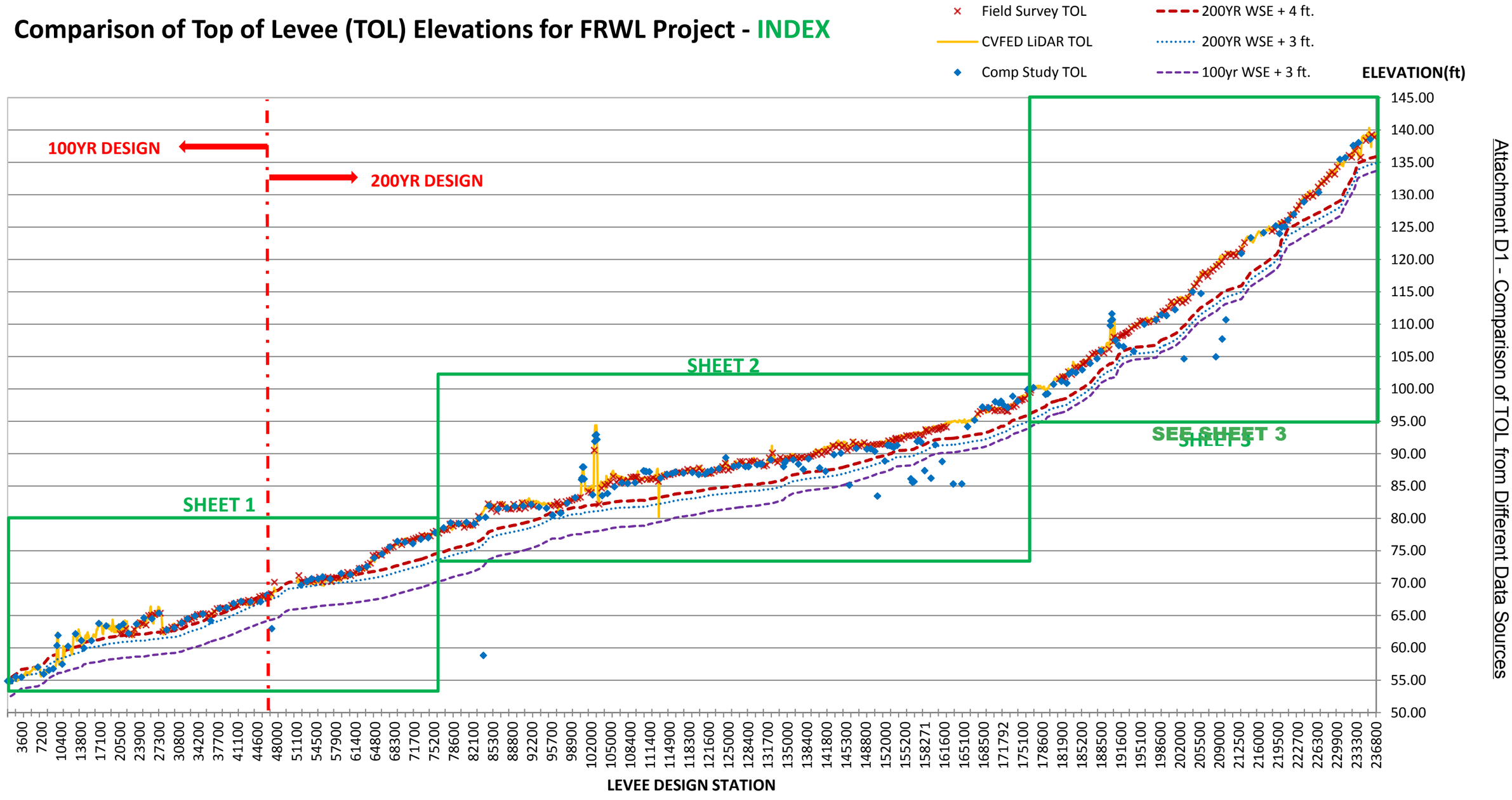
Reach	Length (ft)	Proposed Modification/ Flood Management Measure
		1848+25 to 1866+00, cutoff wall tip elevation 70’;
		1866+00 to 1877+75, cutoff wall tip elevation 47’;
		1877+75 to 1883+00, cutoff wall tip elevation 40’;
		1883+00 to 1902+00, cutoff wall tip elevation 27’;
		1897+05 to 1898+35 and 1900+20 to 1901+40, waterside slope flattening or other remedial measures
31	5,600	1902+00 to 1907+50, cutoff wall tip elevation 27’;
		1907+50 to 1917+50, cutoff wall tip elevation 44’;
		1907+92 to 1909+42, waterside slope flattening or other remedial measure;
		1917+50 to 1927+50, cutoff wall tip elevation 75’;
		1927+50 to 1937+00, cutoff wall tip elevation 50’;
		1937+00 to 1958+00, cutoff wall tip elevation 40‘
32	3,100	1958+00 to 1971+80, cutoff wall tip elevation 40’;
		1971+80 to 1987+25, cutoff wall tip elevation 48’;
		1987+25 to 1989+00, cutoff wall tip elevation 10’
33	13,300	1989+00 to 2002+00, cutoff wall tip elevation 10’;
		2002+00 to 2016+75, cutoff wall tip elevation 90’;
		2016+75 to 2036+75, cutoff wall tip elevation 20’;
		2036+75 to 2041+00, cutoff wall tip elevation 53’;
		2041+00 to 2067+00, cutoff wall tip elevation 38’;
		2067+00 to 2088+00, cutoff wall tip elevation 33’;
		2088+00 to 2122+00, cutoff wall tip elevation 90’
34	6,000	2122+00 to 2137+00, cutoff wall tip elevation 90’;
		2137+00 to 2148+00, cutoff wall tip elevation 20’;
		2148+00 to 2164+00, cutoff wall tip elevation 90’;
		2164+00 to 2182+00, cutoff wall tip elevation 50’
35	4,200	2182+00 to 2196+50, cutoff wall tip elevation 40’;
		2196+50 to 2212+00, cutoff wall tip elevation 45’;
		2212+00 to 2218+25, cutoff wall tip elevation 50’;
		2218+25 to 2224+00, cutoff wall tip elevation 55’
36	3,500	2224+00 to 2233+50, cutoff wall tip elevation 55’;
		2233+50 to 2245+75, cutoff wall tip elevation 70’;
		2245+75 to 2259+00, cutoff wall tip elevation 42’
37	3,100	2259+00 to 2277+00, cutoff wall tip elevation 42’;
		2277+00 to 2290+00, cutoff wall tip elevation 45’

Attachment C3 - Table 2: Summary of Proposed Levee Modifications by Reach

Table 2 Summary of Proposed Levee Modifications by Reach (Contd.)

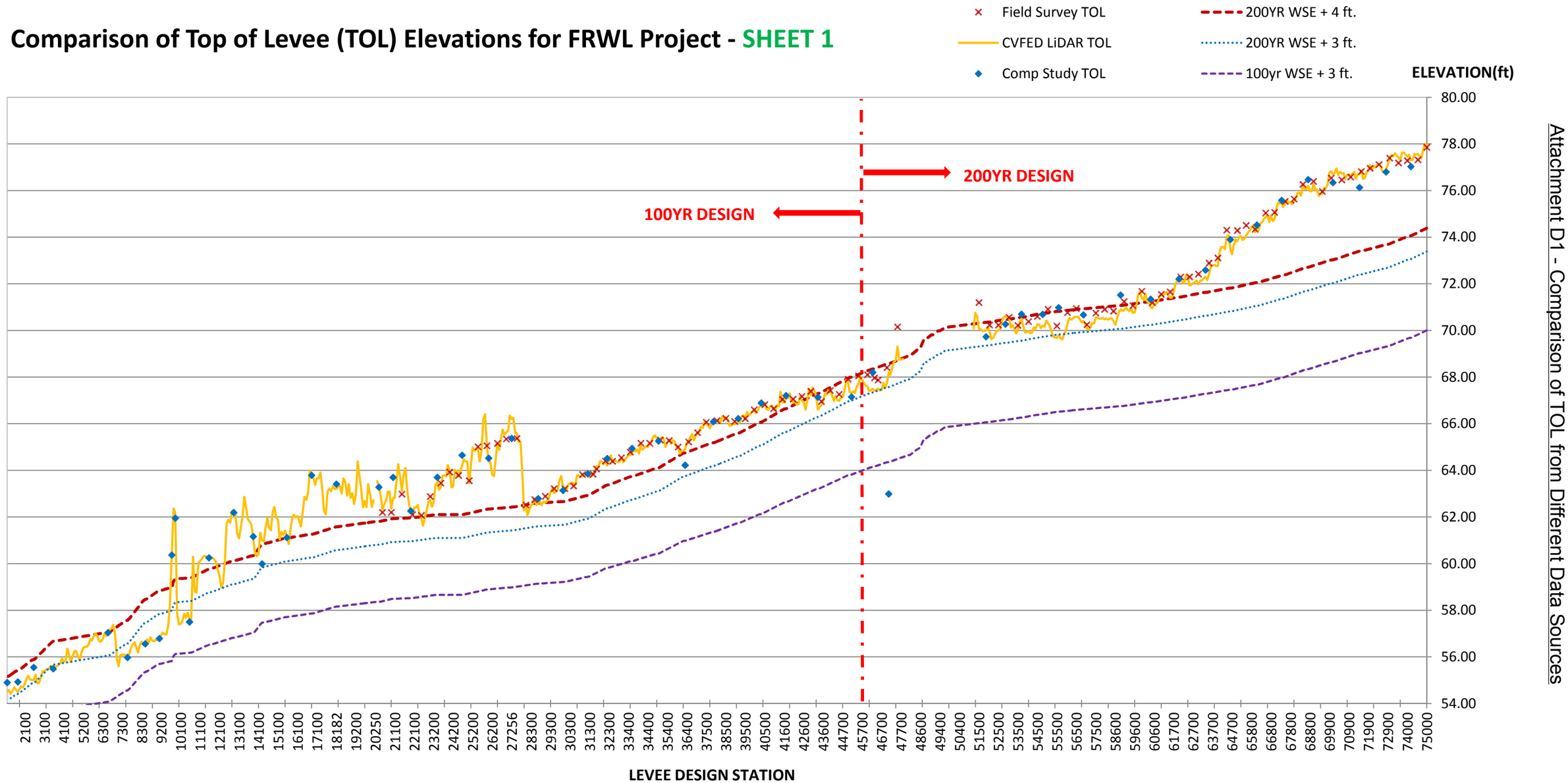
Reach	Length (ft)	Proposed Modification/ Flood Management Measure
38	1,300	2290+00 to 2303+00, adjacent levee with 20-ft wide crown and 5:1 landside slope
39	1,600	No Rehabilitation Required
40	4,000	2321+00 to 2332+00 Fill Landside Pit (up to Elevation 120');
		2321+00 to 2329+00, 7' tall Drained Stability Berm on 65' wide Undrained
		Berm (5' thick at levee toe);
		2331+00 to 2346+00, 10' tall Drained Stability Berm on 120' wide Undrained Seepage
		Berm (5' thick at levee toe); 2346+00 to 2359+00, 4' tall Drained Stability Berm on
		300' wide undrained Seepage Berm (5' thick at levee toe)
41	900	2359+00 to 2368+00, construct 150-ft wide drained seepage berm

Comparison of Top of Levee (TOL) Elevations for FRWL Project - INDEX



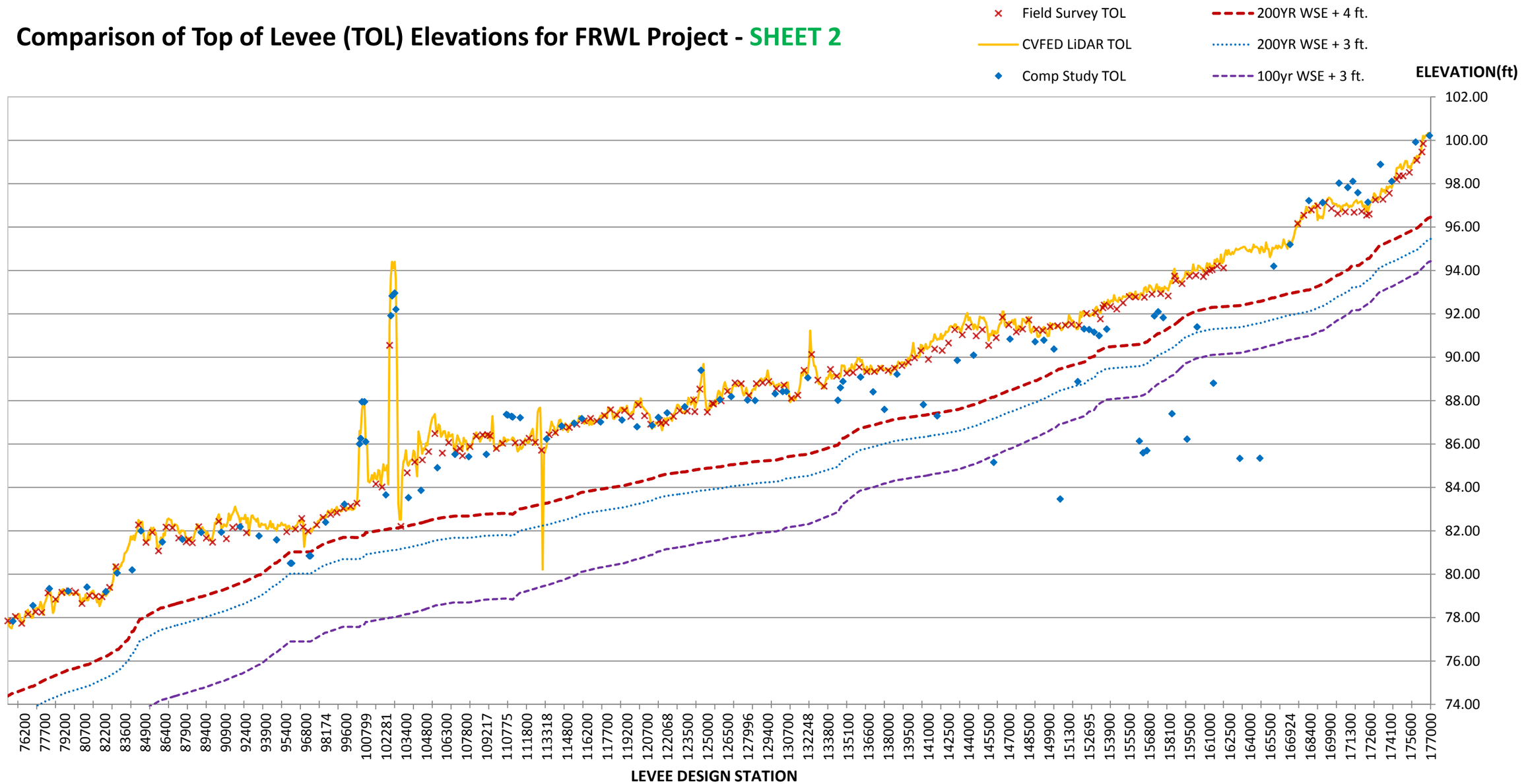
Attachment D1 - Comparison of TOL from Different Data Sources

Comparison of Top of Levee (TOL) Elevations for FRWL Project - SHEET 1



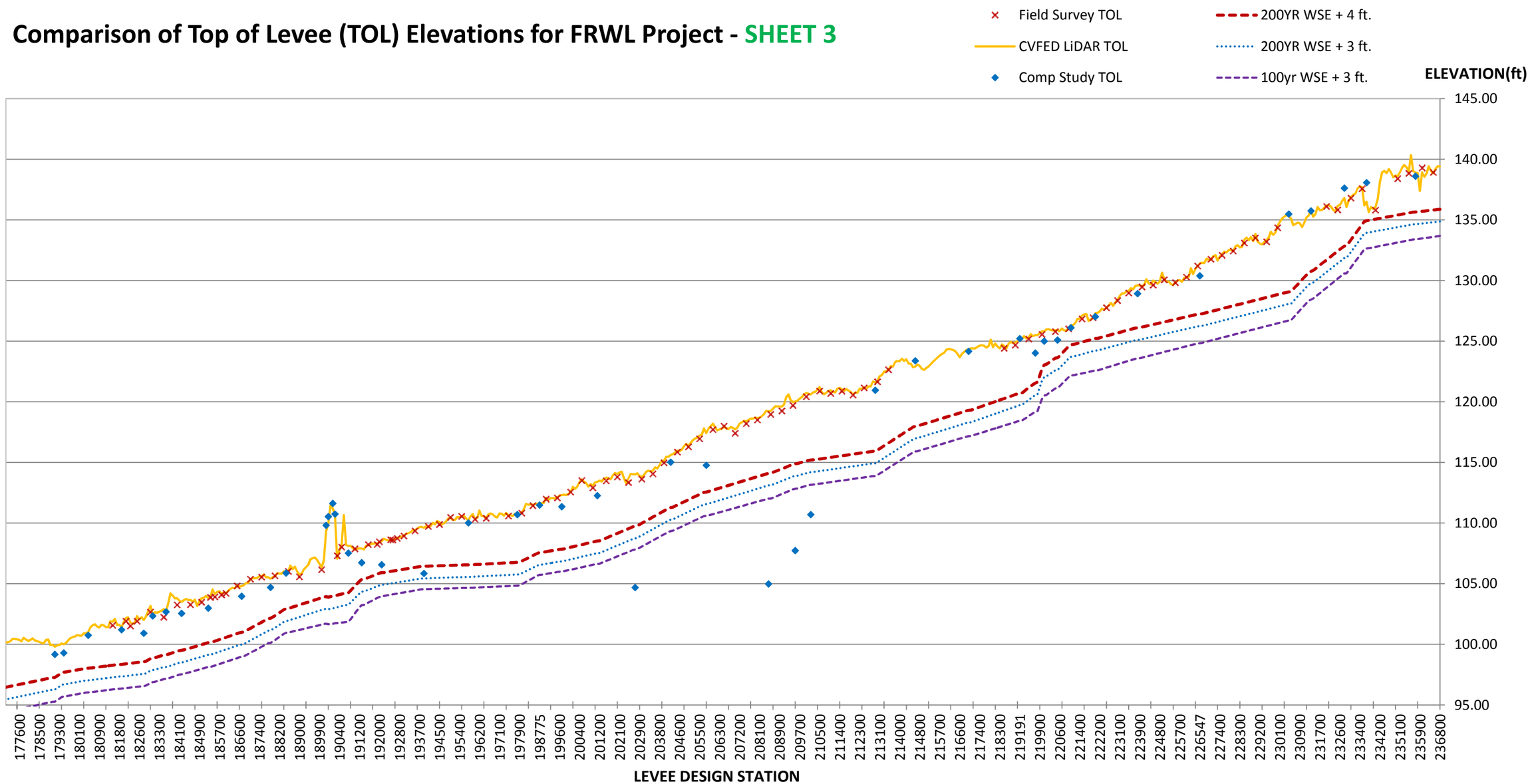
Attachment D1 - Comparison of TOL from Different Data Sources

Comparison of Top of Levee (TOL) Elevations for FRWL Project - SHEET 2



Attachment D1 - Comparison of TOL from Different Data Sources

Comparison of Top of Levee (TOL) Elevations for FRWL Project - SHEET 3



Attachment D1 - Comparison of TOL from Different Data Sources

Attachment D2 - Typical Results from HEC-RAS

Feather River 200 yr HEC-RAS model result

: velocity higher than 10 ft/s

Reach	River Sta	Profile	Q Total (cfs)	Length Ch (ft)	Min Ch El (ft)	Levee St Left (ft)	(A) Levee Elev Left (ft)	(A - W) Left differ (ft)	(W) W.S. Elev (ft)	(B - W) Right differ (ft)	Embankment (ft)	Levee St Right (ft)	(B) Levee Elev Right (ft)	Vel Chnl (ft/s)
Upper	71.45	Max WS	174050.5	284	227.48	295.21			260.91					**18.49**
Upper	71.4	Max WS	174050.5	1604	228.08	159.6			260.35					**14.97**
Upper	71.09	Max WS	174050.5	778	194.44	265.46			247.23					**18.23**
Upper	70.95	Max WS	174050.5	1076	188.52	178.11			243.26					**15.87**
Upper	70.74	Max WS	174050.5	507	174.09	267.84			233.69					**17.75**
Upper	70.65	Max WS	174050.5	632	186.56	15.35			234					**10.07**
Upper	70.53	Max WS	174050.5	815	183.5	11.19			233.77					9.2
Upper	70.38	Max WS	174050.5	1452	188.04	109.33			228.01					**18.8**
Upper	70.1	Max WS	174050.5	1927	176.01	14.97			227.77					**10.2**
Upper	69.73	Max WS	174050.5	1918	164.62	24.69			225.31					**11.73**
Upper	69.37	Max WS	174050.5	914	142.51	7.74			224.73					8.4
Upper	69.2	Max WS	174050.5	833	170.61	3.41			224.93					6.23
Upper	69.04	Max WS	174050.4	477	157.86	19.6			223.24					**11.23**
Upper	68.95	Max WS	174050.5	1468	141.59	58.74			220.65					**16**
Upper	68.67	Max WS	174050.5	1120	141.76	13.43			221.14					9.96
Upper	68.46	Max WS	174050.5	884	166.51	10.27			220.79					9.07
Upper	68.29	Max WS	174050.4	648	163.32	6.01			220.79					7.6
Upper	68.17	Max WS	174050.5	1204	162.7	3.19			220.91					6.16
Upper	67.94	Max WS	174050.4	1280	173.97	2.64			220.71					5.76
Upper	67.7	Max WS	174050.4	821	156.14	2.24			220.52					5.52
Upper	67.54	Max WS	174050.3	2446	148.88	2.38			220.36					5.64
Upper	67.08	Max WS	174050.4	266	141.9	0.22			220.46					2.71
Upper	67.07		Inl Struct					0		0				
Upper	67.03	Max WS	174050.6	417	138.54	11.53			182.77					9.16
Upper	66.95	Max WS	174050.5	1805	135.76	91.78			178.56					**17.59**
Upper	66.61	Max WS	174050.5	520	115.54	13.27			177.11					9.79
Upper	66.4889	Max WS	174050.5	100	115.54	15.63			176.6			1.18		**10.6**
Upper	66.472	Max WS	174050.4	43	120	18.54			176.54			3.92		**11.06**
Upper	66.469		Inl Struct					0		0				
Upper	66.4637	Max WS	174050.3	100	120	44.59			168.91			6.35		**14.46**
Upper	66.4448	Max WS	174050.4	1218.72	115.54	30.77			169.12			0.79		**13.01**
Upper	66.2317	Max WS	174050.3	50	125.48	14.39			168.97					9.86
Upper	66.2162	Max WS	174050.2	7	125.48	14.47	200.2	31.28	168.92	33.58			202.5	9.87
Upper	66.2149		Bridge					0		0				
Upper	66.212	Max WS	174049.9	190	125.48	15.15			168.53					**10.01**
Upper	66.19	Max WS	174050.2	1628	125.5	15.32			168.34					**10.07**
Upper	65.88	Max WS	174049.7	1583	128.92	21.07			166.39					**11.17**
Upper	65.58	Max WS	174048.8	1568	126.1	22.99			164.48					**11.47**
Upper	65.28	Max WS	174047.9	1711	125.78	22.15			162.63					**11.3**
Upper	64.954	Max WS	174046.1	10	119.88	26.04			160.34					**12.07**
Upper	64.952	Max WS	174046.1	5	119.89	30.23			160.1					**12.71**
Upper	64.95		Bridge					0		0				
Upper	64.916	Max WS	174046.1	11	119.92	29.87			159.9					**12.55**
Upper	64.914	Max WS	174044.9	932	119.93	25.5			160.08					**11.97**
Upper	64.76	Max WS	174044.3	1622	119.89	3.9			160.57					6.16
Upper	64.46	Max WS	174041.5	617	121.5	10.47			158.86					8.46
Upper	64.34	Max WS	174041.2	745	120.89	9.38			158.2					8.03
Upper	64.2	Max WS	174040.5	1305	120.12	9.58			157.33					8.02
Upper	63.95	Max WS	174038.1	667	119.98	7.68			155.83					7.58
Upper	63.826	Max WS	174035.6	10	119.11	26.47			153.77			0.08		**11.78**
Upper	63.824	Max WS	174033.8	7	119.21	26.15			153.76					**11.74**
Upper	63.82		Bridge					0		0				
Upper	63.816	Max WS	174033.8	10	119.66	26.32			153.52					**11.76**
Upper	63.814	Max WS	174033.7	444	119.76	26.25			153.51					**11.75**
Upper	63.73	Max WS	174035.4	3155.92	124.61	3.08	171.14	16.65	154.49	6.75			161.24	5.74
Upper	63.43	Max WS	174027.6	2640	124.24	3.31	156.83	3.75	153.08	9.65			162.73	5.79
Upper	62.93	Max WS	174015.2	1478.57	111.1	14.33	154.27	4.06	150.21	12.6			162.81	9.59
Upper	62.65	Max WS	174002.2	2791.32	116.99	20.41	152.14	4.25	147.89	9.87			157.76	**10.61**
Upper	62.38	Max WS	173967	1386	115.7	4.02	150.58	4.79	145.79	9.18		0.23	154.97	6.24
Upper	62.12	Max WS	173941.5	1372	115.3	20.34	148.53	4.86	143.67	7.49		2.83	151.16	**10.57**
Upper	61.86	Max WS	173913.3	1003.2	112.49	18.71	166.15	24.6	141.55	10.65		2.5	152.2	**10.22**
Upper	61.67	Max WS	173889.3	1108.8	112.18	16.89			139.64	14.67		4.13	154.31	9.62
Upper	61.46	Max WS	173848.4	950.4	114.34	12.84			137.93	8.27		1.94	146.2	8.94
Upper	61.28	Max WS	173824.3	1478.41	105.2	4.78			137.34	8.64		1.18	145.98	6.38
Upper	61	Max WS	173808.6	1003.21	95.29	0.68			136.91	9.41			146.32	3.52
Upper	60.81	Max WS	173806.9	1689.4	98.96	0.89			136.73	12.03			148.76	3.81
Upper	60.7678		Lat Struct					0		0				
Upper	60.49	Max WS	143266.7	1267	106.39	5.04			135.92	15.57		2.62	151.49	6.55
Upper	60.25	Max WS	142438.5	1071	106.5	2.52			135.32	13.98		1.15	149.3	5.28
Upper	60.04	Max WS	127754.3	1592	102.16	0.86			135.2	12.64		0.43	147.84	3.74
Upper	59.8175		Lat Struct					0		0				
Upper	59.74	Max WS	136644.3	2052	97.83	1.14			134.89	12.4		0.49	147.29	4.15
Upper	59.35	Max WS	136636.5	3202	104.05	3.32			134.06	9.67		1.38	143.73	5.83
Upper	58.7854		Lat Struct					0		0				
Upper	58.75	Max WS	136271.5	1254	91.53	7.03			132.06	11.3			143.36	7.7
Upper	58.51	Max WS	135195.9	1336	93.61	4			131.65	6.95			138.6	6.09
Upper	58.45		Lat Struct					0		0				
Upper	58.26	Max WS	134607.8	1636.8	99.07	3.73			130.93	7.24			138.17	5.54
Upper	57.95	Max WS	133739.6	1349	96.13	14.23			128.84	8.78			137.62	8.5
Upper	57.7	Max WS	132921	1319	92.92	18.86			126.75	8.99			135.74	9.25
Upper	57.45	Max WS	132272.3	1461	97.28	13.37			125.06	10.42		0.01	135.48	7.86
Upper	57.3		Lat Struct					0		0				
Upper	57.17	Max WS	131846.1	1307	89.8	10.11			123.23	8.97			132.2	7.26

Attachment D2 - Typical Results from HEC-RAS

Reach	River Sta	Profile	Q Total (cfs)	Length Ch (ft)	Min Ch El (ft)	Levee St Left (ft)	(A) Levee Elev Left (ft)	(A - W) Left differ (ft)	(W) W.S. Elev (ft)	(B - W) Right differ (ft)	Embankment (ft)	Levee St Right (ft)	(B) Levee Elev Right (ft)	Vel Chnl (ft/s)
Upper	56.99		Lat Struct					0		0				
Upper	56.94	Max WS	131713.9	1646	94.21	5.75			122.09	10.11			132.2	6.99
Upper	56.61	Max WS	131674.9	947	93.74	4.3			121.22	8.98			130.2	6.39
Upper	56.5755		Lat Struct					0		0				
Upper	56.43	Max WS	135831.6	1219	89.78	4.14			120.7	7.5			128.2	6.27
Upper	56.42		Lat Struct					0		0				
Upper	56.2	Max WS	135793.6	921	88.87	7.2			119.62	12.58			132.2	7.54
Upper	56.1938		Lat Struct					0		0				
Upper	56.02	Max WS	172469.8	1168	81.02	4.77			119.03	13.17			132.2	6.66
Upper	55.8	Max WS	172420.3	1380	87.94	11.06			117.54	12.66			130.2	8.68
Upper	55.55	Max WS	172397.2	1015	85.67	6.42			116.71	16.49			133.2	7.41
Upper	55.4		Lat Struct					0		0				
Upper	55.35	Max WS	172371.4	1707	83.4	14.08			115.29	16.91			132.2	9.46
Upper	55.03	Max WS	172340.1	3063	84.56	9			113.98	16.32		0.21	130.3	8.2
Upper	54.45	Max WS	172263.2	1291	66.18	6.43			111.92	8.38		0.05	120.3	7.21
Upper	54.2	Max WS	172242.3	853	76.57	4.82			111.19	9.11		0.14	120.3	6.6
Upper	54.04	Max WS	172230	1042	74.9	3.04			110.88	5.91		0.07	116.79	5.6
Upper	54.039		Lat Struct					0		0				
Upper	53.84	Max WS	172218.8	1710	75.18	6.83			110.1	6.87		0.23	116.97	7.58
Upper	53.56		Lat Struct					0		0				
Upper	53.52	Max WS	172201.4	1604	76.26	10.41			108.55	7.89		1.46	116.44	8.58
Upper	53.22	Max WS	172175.7	1703	75.51	7.91			107.27	7.75		0.83	115.02	7.77
Upper	52.89	Max WS	172120.1	1567	73.01	8.94			105.73	6.85		0.5	112.58	8.1
Upper	52.6	Max WS	172040.1	2013	72.32	8.03			104.51	7.76		0.8	112.27	7.22
Upper	52.21	Max WS	171969	1417	71.92	1.24			103.83	7.52		0.11	111.35	3.94
Upper	51.95	Max WS	171941.5	3125	70.4	1.13			103.56	7.92		0.08	111.48	3.81
Upper	51.35	Max WS	171861.5	897.6	67.53	4.61			102.75	7.96		0.25	110.71	6.6
Upper	51.2		Lat Struct					0		0				
Upper	51.1777	Max WS	171851.5	739.2	64.2	1.2			102.55	9.65		0.13	112.2	4.38
Upper	51.04	Max WS	171835.8	1063.04	62.73	0.82			102.43	6.48		0.01	108.91	3.83
Upper	50.84	Max WS	171815.6	733	59.43	4.44			101.91	5.68			107.59	6.72
Upper	50.7	Max WS	171797.3	550	55.6	7.56			101.34	5.74			107.08	7.69
Upper	50.59	Max WS	171761.6	435	58.53	20.99	99.46	-0.78	100.24	7.28			107.52	**11.35**
Upper	50.498	Max WS	171755.5	10	58.15	13.65			100.01	10.73		0.04	110.74	9.66
Upper	50.496	Max WS	171755.5	6	57.99	13.61			99.96	11.68			111.64	9.56
Upper	50.493		Bridge					0		0				
Upper	50.489	Max WS	171750.3	11	57.45	12.72			99.88	10.65			110.53	9.38
Upper	50.487	Max WS	171750.3	1574	57.32	11.85			99.93	9.88		0	109.81	9.24
Upper	50.486		Lat Struct					0		0				
Upper	50.48		Lat Struct					0		0				
Upper	50.31		Lat Struct					0		0				
Upper	50.2	Max WS	171735.1	693	62.78	9.98			98.93	6.95		0.12	105.88	8.91
Upper	50.06	Max WS	171716.9	1504	64.74	10.45			98.14	6.55		0.15	104.69	8.89
Upper	49.78	Max WS	171669	1067	59.92	9.06			96.98	6.98		0.76	103.96	8.48
Upper	49.58	Max WS	171623.9	1022	56.57	8.42			96.13	6.85		0.34	102.98	8.25
Upper	49.38	Max WS	171572.5	910	57.77	5.94			95.5	7.05		0.1	102.55	7.29
Upper	49.21	Max WS	171540.2	1121	65.14	4			95.12	7.56		0.19	102.68	6.39
Upper	48.99	Max WS	171507.6	803	64.73	2.09			94.87	7.47		0.12	102.34	4.99
Upper	48.85	Max WS	171490.9	1000	61	2.45			94.55	6.36		0.15	100.91	5.3
Upper	48.66	Max WS	171467.8	1397	66.09	0.82			94.34	6.86		0.27	101.2	3.63
Upper	48.55		Lat Struct					0		0				
Upper	48.47		Lat Struct					0		0				
Upper	48.39	Max WS	171446.6	988	59.53	0.9			94.03	6.71			100.74	3.69
Upper	48.21	Max WS	171419.6	704	59.78	1.83			93.7	5.59		0.21	99.29	4.86
Upper	48.07	Max WS	171398.9	1964	51.53	6.01			93.26	5.91		0.53	99.17	7.38
Upper	47.7	Max WS	171304.3	798	49.03	5.8			92.43	7.79			100.22	7.11
Upper	47.55	Max WS	171197.4	1836	48.43	7.07			91.92	8		0.04	99.92	7.62
Upper	47.25		Lat Struct					0		0				
Upper	47.2	Max WS	171044	847	54.92	1.71			91.37	6.74		0.1	98.11	4.68
Upper	47.04	Max WS	170950.3	1810	54.43	1.64			91.15	7.74		0.12	98.89	4.62
Upper	46.69	Max WS	170617.4	865	52.96	4.38			90.55	6.6		0.16	97.15	6.66
Upper	46.53	Max WS	170475.4	500	54.58	3.4			90.23	7.36		0.18	97.59	6.02
Honcut to J	46.45	Max WS	182408.4	1	58.17	1.51	96.88	6.65	90.23	7.88		0.1	98.11	4.55
Honcut to J	46.449	Max WS	182408.4	1286	58.17	1.51	96.88	6.65	90.23	7.88		0.1	98.11	4.55
Honcut to J	46.44		Lat Struct					0		0				
Honcut to J	46.43		Lat Struct					0		0				
Honcut to J	46.2	Max WS	182401.9	1175	57.09	0.77	96.53	6.51	90.02	7.81		0.06	97.83	3.63
Honcut to J	45.98	Max WS	182396.5	1412	56.79	1.56	96.5	6.7	89.8	8.23		0.13	98.03	4.67
Honcut to J	45.71	Max WS	182386	692	50.64	3.57	96.56	7.21	89.35	7.78		0.43	97.13	6.08
Honcut to J	45.58	Max WS	182376.3	717	52.89	3.14	96.41	7.31	89.1	8.12		0.32	97.22	5.98
Honcut to J	45.55		Lat Struct					0		0				
Honcut to J	45.44	Max WS	182371.5	954	56.17	2.18	96.1	7.16	88.94	6.26		0.32	95.2	5.28
Honcut to J	45.26	Max WS	182367	1207.73	51.57	1.75	96.72	7.98	88.74	5.46		0.29	94.2	4.84
Honcut to J	45.14		Lat Struct					0		0				
Honcut to J	45.1		Lat Struct					0		0				
Honcut to J	45.03	Max WS	182366	1461	53.04	0.7	91.95	3.38	88.57	-3.22	7.22	0.08	85.35	3.57
Honcut to J	44.76	Max WS	182361.8	686.4	50.79	1.18	95.84	7.46	88.38	-3.04	7.04	0.17	85.34	4.27
Honcut to J	44.71		Lat Struct					0		0				
Honcut to J	44.6326	Max WS	182360.8	686.4	50.36	1.04	96.16	7.86	88.3	0.51	3.49	0.2	88.81	4.1
Honcut to J	44.6		Lat Struct					0		0				
Honcut to J	44.5	Max WS	182358.3	1445	48.65	1.34	94.06	5.91	88.15	3.25	0.75	0.25	91.4	4.36
Honcut to J	44.24		Lat Struct					0		0				
Honcut to J	44.23	Max WS	182355.7	4023	49.35	0.98	94.41	6.47	87.94	-1.71	5.71	0.28	86.23	3.46
Honcut to J	44.2		Lat Struct					0		0				
Honcut to J	43.46	Max WS	182353.7	675	40.32	2.42	94.16	6.73	87.43	-0.03	4.03	0	87.4	4.68
Honcut to J	43.34	Max WS	182352.7	316.8	43.14	1.99	93.55	6.36	87.19	4.64		0.06	91.83	4.45
Honcut to J	43.28	Max WS	182352.3	264	44.28	2.09	93.97	6.88	87.09	5.01		0.04	92.1	4.49

Attachment D2 - Typical Results from HEC-RAS

Reach	River Sta	Profile	Q Total (cfs)	Length Ch (ft)	Min Ch El (ft)	Levee St Left (ft)	(A) Levee Elev Left (ft)	(A - W) Left differ (ft)	(W) W.S. Elev (ft)	(B - W) Right differ (ft)	Embankment (ft)	Levee St Right (ft)	(B) Levee Elev Right (ft)	Vel Chnl (ft/s)
Honcut to J	43.27		Lat Struct					0		0				
Honcut to J	43.23	Max WS	182351.7	1179	45.99	2.18	93.03	6.07	86.96	4.95		0.08	91.91	4.57
Honcut to J	43.12	Max WS	182349	316.8	46.49	2.16	91.21	4.51	86.7	-1	5	0.16	85.7	4.56
Honcut to J	43.06	Max WS	182351	264	45.23	2	91.7	5.06	86.64	-1.04	5.04	0.19	85.6	4.39
Honcut to J	43.01	Max WS	182346	1900	46.38	1.65	91.73	5.14	86.59	-0.45	4.45	0.13	86.14	4.17
Honcut to J	42.65	Max WS	182348.4	951	46.16	1.11	91.11	4.64	86.47	4.83		0.18	91.3	3.67
Honcut to J	42.62		Lat Struct					0		0				
Honcut to J	42.47	Max WS	182344.9	1490	45.24	1.41	90.92	4.63	86.29	4.71		0.24	91	3.9
Honcut to J	42.19	Max WS	182337.2	950.4	42.76	1.88	89.72	3.69	86.03	5.13		0.26	91.16	4.34
Honcut to J	42.01	Max WS	182332.7	2112	44.52	0.61	91.23	5.25	85.98	5.3		0.23	91.28	2.93
Honcut to J	41.61	Max WS	182306.5	316.8	35.21	2.18	90.61	4.84	85.77	5.54		0.12	91.31	4.6
Honcut to J	41.6		Lat Struct					0		0				
Honcut to J	41.59		Lat Struct					0		0				
Honcut to J	41.55	Max WS	182306.3	1855	34.55	2.48	90.5	4.81	85.69	3.19	0.81	0.15	88.88	4.79
Honcut to J	41.2	Max WS	182268.7	2623	43.04	1.27	90.27	4.81	85.46	-1.99	5.99	0.17	83.47	3.8
Honcut to J	40.7	Max WS	182247.4	1101	40.72	1.02	89.44	4.12	85.32	5.06		0.19	90.38	3.5
Honcut to J	40.49	Max WS	182192.4	1567	43.91	1.22	91.27	6.17	85.1	5.69		0.2	90.79	3.76
Honcut to J	40.19	Max WS	182130.8	3940	39.13	1.36	89.78	4.86	84.92	5.8		0.26	90.72	3.95
Honcut to J	39.45	Max WS	181903.8	1188	39.67	3.08	90.5	6.04	84.46	6.38		0.25	90.84	5.17
Honcut to J	39.35		Lat Struct					0		0				
Honcut to J	39.3		Lat Struct					0		0				
Honcut to J	39.23	Max WS	181658.6	1509	36.55	3.17	90.08	5.92	84.16	1	3	0.17	85.16	5.24
Honcut to J	38.94	Max WS	180991.3	1221	40.4	1.7	90.32	6.51	83.81	6.29		0.15	90.1	4.2
Honcut to J	38.75		Lat Struct					0		0				
Honcut to J	38.73		Lat Struct					0		0				
Honcut to J	38.71	Max WS	179939.2	1352	41.16	1.52	87.81	4.23	83.58	6.28		0.03	89.86	4.12
Honcut to J	38.45	Max WS	177953	953	38.64	0.74	90.12	6.69	83.43	3.87	0.13	0.1	87.3	3.23
Honcut to J	38.27	Max WS	176957.5	1694	38.55	0.67	89.61	6.29	83.32	4.5		0.07	87.82	3.11
Honcut to J	38.2		Lat Struct					0		0				
Honcut to J	38.1		Lat Struct					0		0				
Honcut to J	37.95	Max WS	175715.5	1430	38.73	0.47	90.29	7.13	83.16	6.06		0.14	89.22	2.69
Honcut to J	37.68	Max WS	175125	1201	36.69	0.79	90.45	7.43	83.02	4.58		0.15	87.6	3.3
Honcut to J	37.45	Max WS	174411.4	849	34.47	1.35	89.07	6.2	82.87	5.54		0.2	88.41	4
Honcut to J	37.29	Max WS	172966.1	4424	37.42	1.03	87.9	5.17	82.73	6.36		0.12	89.09	3.57
Honcut to J	36.45	Max WS	170755.1	528	28.54	2.13	88.47	6.2	82.27	6.62		0.3	88.89	4.59
Honcut to J	36.35	Max WS	170493.6	580.8	28.48	2.54	88.1	5.98	82.12	6.48		0.43	88.6	4.79
Honcut to J	36.24	Max WS	170158.1	2415	36.9	3.75	87.98	6.03	81.95	6.07		0.45	88.02	5.53
Honcut to J	35.78	Max WS	169493	1482	30.09	0.84	88.08	6.55	81.53	7.53		0.2	89.06	3.39
Honcut to J	35.5	Max WS	169274.3	1339	36.92	0.44	87.31	5.9	81.41	7.01		0.12	88.42	2.74
Honcut to J	35.25	Max WS	169180.8	2385	35.29	0.44	87.23	5.9	81.33	7.09		0.12	88.42	2.53
Honcut to J	34.8	Max WS	169124.2	1581	38.91	0.35	87.58	6.32	81.26	7.06		0.1	88.32	2.34
Honcut to J	34.7		Lat Struct					0		0				
Honcut to J	34.6		Lat Struct					0		0				
Honcut to J	34.5	Max WS	169009.8	2244	41.03	0.2	87.93	6.74	81.19	6.82		0.1	88.01	1.92
Honcut to J	34.07	Max WS	168911.6	2996	31.52	0.14	87.56	6.43	81.13	6.9		0.07	88.03	1.7
Honcut to J	33.5	Max WS	168831.7	1348	36.43	0.31	86.75	5.7	81.05	7.14		0.12	88.19	2.23
Honcut to J	33.25	Max WS	168683.2	1298	28.75	0.69	87.05	6.1	80.95	7.1		0.07	88.05	2.98
Honcut to J	33	Max WS	168556.3	1338	33.58	0.77	86.31	5.46	80.85	8.55		0.13	89.4	3.09
Honcut to J	32.75	Max WS	168320.9	1296	33.15	0.57	86.73	6.01	80.72	7		0.07	87.72	2.8
Honcut to J	32.5	Max WS	168164.9	1340	33.31	0.78	86.96	6.34	80.62	6.82		0.11	87.44	3.12
Honcut to J	32.25	Max WS	168051.5	1317	31.15	0.65	87.06	6.53	80.53	6.7		0.15	87.23	2.9
Honcut to J	32.23		Lat Struct					0		0				
Honcut to J	32.2		Lat Struct					0		0				
Honcut to J	32	Max WS	167775	1311	23.65	1.13	87.04	6.64	80.4	6.46		0.28	86.86	3.53
Honcut to J	31.75	Max WS	167440.4	1329	26.61	1.16	87.15	6.92	80.23	6.57		0.34	86.8	3.56
Honcut to J	31.5	Max WS	167167.5	1307	33.79	0.84	86.98	6.91	80.07	7.04		0.2	87.11	3.16
Honcut to J	31.25	Max WS	166839.7	1339	32.78	1.09	87.01	7.09	79.92	7.1		0.25	87.02	3.45
Honcut to J	31.1		Lat Struct					0		0				
Honcut to J	31.05		Lat Struct					0		0				
Honcut to J	31	Max WS	166498.5	1352	28.39	1.07	86.72	6.95	79.77	7.41		0.22	87.18	3.46
Honcut to J	30.75	Max WS	166226.8	1256	20.87	1.4	85.51	5.89	79.62	7.34		0.32	86.96	3.78
Honcut to J	30.5	Max WS	165741.7	1371	30.08	1.46	85.93	6.48	79.45	7.38		0.36	86.83	3.83
Honcut to J	30.25	Max WS	165343.2	1295	31.86	0.79	85.79	6.52	79.27	6.97		0.24	86.24	3.05
Honcut to J	30.21		Lat Struct					0		0				
Honcut to J	30.2		Lat Struct					0		0				
Honcut to J	30	Max WS	164928.7	920	22.29	2.13	86.04	7.03	79.01	8.21		0.56	87.22	4.33
Honcut to J	29.828	Max WS	164586.3	10	29.01	3.55	86.12	7.36	78.76	8.49		0.82	87.25	5.14
Honcut to J	29.826	Max WS	164616.9	1	29.04	3.1	86.12	7.34	78.78	8.5		0.71	87.28	4.92
Honcut to J	29.824	Railroad	Bridge					0		0				
Honcut to J	29.822	Max WS	164616.9	11	28.81	2.37	86.11	7.32	78.79	8.55		0.65	87.34	4.5
Honcut to J	29.821	Max WS	164647.6	344	28.59	2.03	86.11	7.3	78.81	8.56		0.54	87.37	4.27
Honcut to J	29.82		Lat Struct					0		0				
Honcut to J	29.75	Max WS	164616.4	1364	29.23	0.9	86.28	7.51	78.77	6.76		0.24	85.53	3.52
Honcut to J	29.741		Lat Struct					0		0				
Honcut to J	29.501	Max WS	164461.5	5	30.04	0.38	85.27	6.59	78.68	6.74		0.18	85.42	2.76
Honcut to J	29.5	Max WS	164430.5	200	30.04	0.38	85.27	6.59	78.68	6.74		0.18	85.42	2.76
Jack Sl - Yul	29.25 LB	Max WS	170812.6	5	27.1	0.89	86.7	8.02	78.68	6.85		0.32	85.53	3.77
Jack Sl - Yul	29.249	Max WS	170812.6	1333	27.1	0.89	86.71	8.03	78.68	6.85		0.32	85.53	3.77
Jack Sl - Yul	29.241		Lat Struct					0		0				
Jack Sl - Yul	29.2		Lat Struct					0		0				
Jack Sl - Yul	29.00 LB	Max WS	170541.8	1318	29.96	1.01	86.84	8.27	78.57	6.34		0.39	84.91	3.89
Jack Sl - Yul	28.75 LB	Max WS	170052.4	1338	29.43	1.62	85.87	7.51	78.36	5.51		0.46	83.87	4.6
Jack Sl - Yul	28.74		Lat Struct					0		0				
Jack Sl - Yul	28.50 LB	Max WS	169901	910	25.24	0.91	87.12	8.89	78.23	5.3		0.36	83.53	3.79
Jack Sl - Yul	28.324 LB	Max WS	169699.5	11	25.34	1.1	93.5	15.38	78.12	14.09		0.21	92.21	3.94
Jack Sl - Yul	28.322 LB	Max WS	169699.5	2	25.28	1.11	101.7	23.58	78.12	14.84		0.22	92.96	3.95
Jack Sl - Yul	28.321		Bridge					0		0				

Attachment D2 - Typical Results from HEC-RAS

Reach	River Sta	Profile	Q Total (cfs)	Length Ch (ft)	Min Ch El (ft)	Levee St Left (ft)	(A) Levee Elev Left (ft)	(A - W) Left differ (ft)	(W) W.S. Elev (ft)	(B - W) Right differ (ft)	Embankment (ft)	Levee St Right (ft)	(B) Levee Elev Right (ft)	Vel Chnl (ft/s)
Jack Sl - Yul	28.309 LB	Max WS	169670.7	11	19.94	1.03	105.44	27.34	78.1	14.73		0.19	92.83	3.86
Jack Sl - Yul	28.307 LB	Max WS	169699.5	302	19.12	1.05	105.54	27.44	78.1	13.82		0.19	91.92	3.88
Jack Sl - Yul	28.3		Lat Struct					0		0				
Jack Sl - Yul	28.255		Lat Struct					0		0				
Jack Sl - Yul	28.25 LB	Max WS	169642.4	1318	20.16	1.01	87.88	9.82	78.06	5.6		0.13	83.66	4.21
Jack Sl - Yul	28.00 LB	Max WS	169416.2	155	27.52	1.43	87.31	9.39	77.92	8.19		0.1	86.11	4.78
Jack Sl - Yul	27.971 LB	Max WS	169250.5	2	24.65	1.93	83.89	6.07	77.82	10.13		0.16	87.95	5.29
Jack Sl - Yul	27.97		Bridge					0		0				
Jack Sl - Yul	27.963 LB	Max WS	169250.5	37	24.65	1.93	83.89	6.1	77.79	10.16		0.16	87.95	5.29
Jack Sl - Yul	27.956 LB	Max WS	169196	2	20.93	2.2	86.16	8.4	77.76	8.5		0.16	86.26	5.52
Jack Sl - Yul	27.955		Bridge					0		0				
Jack Sl - Yul	27.952 LB	Max WS	169141.6	1045	20.36	2.25	86.18	8.49	77.69	8.32		0.15	86.01	5.57
Jack Sl - Yul	27.95		Lat Struct					0		0				
Jack Sl - Yul	27.94		Lat Struct					0		0				
Jack Sl - Yul	27.75 LB	Max WS	169141.5	1321	31.49	0.65	86.77	9.07	77.7	5.53		0.08	83.23	3.69
Jack Sl - Yul	27.50 LB	Max WS	168738.8	1309	31.79	1.3	87.14	9.7	77.44	4.96		0.06	82.4	4.52
Jack Sl - Yul	27.251	Max WS	168261.7	5	28.9	3.34	87.46	10.43	77.03	3.82	0.18	0.46	80.85	5.75
Jack Sl - Yul	27.25 LB	Max WS	168233.9	700	28.9	3.34	87.46	10.43	77.03	3.82	0.18	0.46	80.85	5.75
Yuba R - Be	27	Max WS	363616.8	5	30.82	7.34	81.47	4.44	77.03	3.48	0.52	0.16	80.51	6.63
Yuba R - Be	26.999	Max WS	363616.8	1289.58	30.82	7.34	81.47	4.44	77.03	3.48	0.52	0.16	80.51	6.64
Yuba R - Be	26.95		Lat Struct					0		0				
Yuba R - Be	26.9		Lat Struct					0		0				
Yuba R - Be	26.75 LB	Max WS	363495.7	1344	30.97	6.14	82.49	5.97	76.52	5.07		0.14	81.59	6.21
Yuba R - Be	26.5	Max WS	363367.9	1346	26.12	6.4	83.49	7.52	75.97	5.79		0.08	81.76	6.31
Yuba R - Be	26.4		Lat Struct					0		0				
Yuba R - Be	26.3		Lat Struct					0		0				
Yuba R - Be	26.25	Max WS	363254.4	1315	26.64	4.23	82.92	7.34	75.58	6.61		0.58	82.19	5.48
Yuba R - Be	26	Max WS	363164.6	1310	25.18	2.49	82.42	7.17	75.25	6.69		0.66	81.94	4.53
Yuba R - Be	25.75	Max WS	363109	1343	21.62	2.06	82.11	7.15	74.96	6.96		0.72	81.92	4.23
Yuba R - Be	25.5	Max WS	363035.2	1284	30.88	1.77	81.33	6.62	74.71	6.9		0.75	81.61	4.14
Yuba R - Be	25.25	Max WS	362980.7	1312	29.97	2.12	84.47	10.02	74.45	7.05		0.37	81.5	4.32
Yuba R - Be	25	Max WS	362834.3	1301	15.61	5	82.11	8.18	73.93	8.07		1.24	82	5.73
Yuba R - Be	24.99		Lat Struct					0		0				
Yuba R - Be	24.95		Lat Struct					0		0				
Yuba R - Be	24.75	Max WS	362699.7	1371	26.56	5.6	81.5	8.14	73.36	6.83		1.25	80.19	5.99
Yuba R - Be	24.5	Max WS	362598.9	1296	22.22	3.32	79.77	6.83	72.94	7.76		0.91	80.7	4.93
Yuba R - Be	24.25	Max WS	362474.1	1324	22.93	2.48	81.93	9.41	72.52	7.55		0.52	80.07	4.49
Yuba R - Be	24.12		Lat Struct					0		0				
Yuba R - Be	24	Max WS	362409.6	1317	38.08	2.53	82.2	9.98	72.22	7		0.51	79.22	5.59
Yuba R - Be	23.75	Max WS	362297.2	1302	17.06	3.53	81.74	9.91	71.83	7.58		0.09	79.41	6.44
Yuba R - Be	23.5	Max WS	362207.7	1356	23.4	2.32	81.71	10.13	71.58	8.35		0.05	79.93	5.54
Yuba R - Be	23.25	Max WS	362074.9	1309	19.36	4.7	81.36	10.14	71.22	8.23		1.23	79.45	7.09
Yuba R - Be	23	Max WS	361986.8	1334	19.67	5.13	81.73	10.9	70.83	7.77		0.33	78.6	7.43
Yuba R - Be	22.75	Max WS	361895.8	1303	14.22	5.15	81.18	10.67	70.51	7.46		0.41	77.97	7.49
Yuba R - Be	22.5	Max WS	361752.8	1322	17.07	7.15	81.36	11.3	70.06	7.05		0.65	77.11	8.3
Yuba R - Be	22.25	Max WS	361630	1309	20.49	5.83	81.73	12.06	69.67	7.23		0.57	76.9	7.79
Yuba R - Be	22	Max WS	361506.2	1361	22.91	2.89	79.12	9.72	69.4	7.41		0.37	76.81	6.05
Yuba R - Be	21.89		Lat Struct					0		0				
Yuba R - Be	21.75	Max WS	361381	1279	16.83	5.19	79.34	10.31	69.03	7.37		0.61	76.4	7.46
Yuba R - Be	21.5	Max WS	361254.7	1352	17.89	3.41	81.27	12.56	68.71	7.89		0.08	76.6	6.3
Yuba R - Be	21.25	Max WS	361101.9	1298	19.27	4.01	77.41	9.07	68.34	7.23		0.16	75.57	6.74
Yuba R - Be	21	Max WS	361025.2	1334	22.17	3.49	78.63	10.58	68.05	6.45		0.06	74.5	6.5
Yuba R - Be	20.85		Lat Struct					0		0				
Yuba R - Be	20.75	Max WS	360923.5	1329	21.15	2.76	77.13	9.31	67.82	6.08		0.38	73.9	6
Yuba R - Be	20.5	Max WS	360848.9	1295	21.67	1.93	76.67	9.04	67.63	4.85		0.25	72.48	5.33
Yuba R - Be	20.25	Max WS	360799.7	1306	23.01	1.89	74.52	7.09	67.43	4.78		0.35	72.21	5.27
Yuba R - Be	20	Max WS	360727.5	1337	21.43	1.59	74.09	6.85	67.24	4.09		0.34	71.33	4.95
Yuba R - Be	19.91		Lat Struct					0		0				
Yuba R - Be	19.9		Lat Struct					0		0				
Yuba R - Be	19.75	Max WS	360656.8	1348	16.13	1.49	71.92	4.85	67.07	4.55		0.27	71.62	4.9
Yuba R - Be	19.5	Max WS	360611.8	1334	21.1	1.33	71.2	4.27	66.93	3.91	0.09	0.29	70.84	4.74
Yuba R - Be	19.25	Max WS	360568.5	1271	21.52	0.76	72.16	5.34	66.82	4.18		0.24	71	3.87
Yuba R - Be	19	Max WS	360567.3	1331	18.78	0.6	71.71	4.99	66.72	4		0.23	70.72	3.55
Yuba R - Be	18.75	Max WS	360508.1	1318	15.08	1.49	71.72	5.16	66.56	4.15		0.31	70.71	4.86
Yuba R - Be	18.5	Max WS	360506.4	1298	19.48	1.32	71.92	5.45	66.47	3.8	0.2	0.26	70.27	4.68
Yuba R - Be	18.3		Lat Struct					0		0				
Yuba R - Be	18.25	Max WS	360471.7	1312	20.61	1.75	71.34	4.99	66.35	3.38	0.62	0.35	69.73	5.18
Yuba R - Be	18	Max WS	360420.2	1349.21	12.08	2.37	71.27	5.13	66.14	3.92	0.08	0.34	70.06	5.72
Yuba R - Be	17.75	Max WS	360387.4	1305	21.63	2	70.52	4.54	65.98	3.96	0.04	0.31	69.94	5.41
Yuba R - Be	17.5	Max WS	360371.2	1292	21.4	2.27	70.01	4.2	65.81	4.05		0.31	69.86	5.63
Yuba R - Be	17.25	Max WS	360325.3	1353	20.36	3.33	68.47	2.85	65.62	4.05		0.42	69.67	6.12
Yuba R - Be	17.2		Lat Struct					0		0				
Yuba R - Be	17	Max WS	360265.9	1330	5.55	6.72	69.03	3.84	65.19	4.24		0.91	69.43	7.67
Yuba R - Be	16.75	Max WS	360207.1	1375	12.53	4.03	68.49	3.59	64.9	3.56	0.44	0.89	68.46	6.44
Yuba R - Be	16.7		Lat Struct					0		0				
Yuba R - Be	16.69		Lat Struct					0		0				
Yuba R - Be	16.5	Max WS	360163.9	1274	16.69	3.69	68.08	3.51	64.57	-1.56	5.56	0.79	63.01	6.33
Yuba R - Be	16.25	Max WS	360135.2	1311	18.06	3.51	67.15	2.81	64.34	3.86	0.14	0.75	68.2	6.26
Yuba R - Be	16	Max WS	360079.3	1317	19.02	4.57	67.04	3.05	63.99	3.17	0.83	0.94	67.16	6.79
Yuba R - Be	15.75	Max WS	359951.1	1297	16.91	9.82	67.34	4.05	63.29	3.65	0.35	1.3	66.94	8.74
Yuba R - Be	15.61		Lat Struct					0		0				
Yuba R - Be	15.6		Lat Struct					0		0				
Yuba R - Be	15.5	Max WS	359832.1	1328	17.22	11.21	66.94	4.3	62.64	4.56		1.8	67.2	9.11
Yuba R - Be	15.25	Max WS	359673.9	1314	18.27	8.34	67.23	5.17	62.06	4.83		1.31	66.89	9.33
Yuba R - Be	15	Max WS	359540.5	1371	21.88	6.35	65.94	4.36	61.58	4.64		1.04	66.22	8.48
Yuba R - Be	14.75	Max WS	359437.8	1290	16.31	6.64	66.13	4.95	61.18	4.93		1.47	66.11	8.59
Yuba R - Be	14.68		Lat Struct					0		0				

Attachment D2 - Typical Results from HEC-RAS

Reach	River Sta	Profile	Q Total (cfs)	Length Ch (ft)	Min Ch El (ft)	Levee St Left (ft)	(A) Levee Elev Left (ft)	(A - W) Left differ (ft)	(W) W.S. Elev (ft)	(B - W) Right differ (ft)	Embankment (ft)	Levee St Right (ft)	(B) Levee Elev Right (ft)	Vel Chnl (ft/s)
Yuba R - Be	14.67		Lat Struct					0		0				
Yuba R - Be	14.5	Max WS	359297.3	1323	19.4	6.28	65.3	4.55	60.75	3.48	0.52	1.35	64.23	8.48
Yuba R - Be	14.25	Max WS	359018.5	1330	13.93	8.54	65.07	4.97	60.1	5.18		1.04	65.28	9.35
Yuba R - Be	14	Max WS	358880.1	1321	13.13	7.5	64.79	5.06	59.73	5.21		1.71	64.94	9.77
Yuba R - Be	13.95		Lat Struct					0		0				
Yuba R - Be	13.9		Lat Struct					0		0				
Yuba R - Be	13.75	Max WS	358697.5	1308	18.51	5.1	64.55	5.18	59.37	5.14		0.8	64.51	8.55
Yuba R - Be	13.5	Max WS	358463.8	1323	11.58	6.27	63.64	4.72	58.92	4.94		1.02	63.86	9.08
Yuba R - Be	13.25	Max WS	358308.6	1307	15.72	5.08	63.5	4.84	58.66	4.47		1.04	63.13	8.5
Yuba R - Be	13.24		Lat Struct					0		0				
Yuba R - Be	13	Max WS	358240.7	1301	18.73	2.42			58.6	4.19		0.48	62.79	6.06
Yuba R - Be	12.75	Max WS	358149.8	1338	19.08	2.08			58.42	6.96		0.43	65.38	5.79
Yuba R - Be	12.74		Lat Struct					0		0				
Yuba R - Be	12.5	Max WS	304061.3	1317	16.77	1.38			58.34	6.19		0.24	64.53	5.06
Yuba R - Be	12.25	Max WS	335142.4	100	18.61	1.93			58.1	6.57		0.29	64.67	5.7
Reach 35	12	Max WS	407176.3	1	15.83	1.25	60.75	2.65	58.1	5.6		0.32	63.7	5.21
Reach 35	11.999	Max WS	407200.4	1324	15.83	1.25	60.75	2.65	58.1	5.6		0.32	63.7	5.21
Reach 35	11.95		Lat Struct					0		0				
Reach 35	11.93		Lat Struct					0		0				
Reach 35	11.75	Max WS	407106.6	1	15.72	1.05	62.61	4.65	57.96	4.3		0.3	62.26	4.9
Reach 35	11.599	Max WS	407084.1	1324	15.83	1.29	60.75	2.82	57.93	5.77		0.33	63.7	5.26
Comment										**28 Cr-sec-Freeboard Issue**				**33 Cr-sec> 10 ft/s**
Reach 35	11.59	**Laurel Ave**	Lat Struct					0		0				
Reach 35	11.57		Lat Struct					0		0				
Reach 35	11.5	Max WS	407015.1	1315	14.77	1.1	63.56	5.75	57.81	5.47		0.24	63.28	5.04
Reach 35	11.25	Max WS	406899.7	1347	17.34	1.51	63.35	5.77	57.58	5.83		0.38	63.41	5.63
Reach 35	11	Max WS	406711.5	1346	14.59	2.82	63.52	6.26	57.26	6.53		0.56	63.79	6.93
Reach 35	10.75	Max WS	406613.3	1301	17.83	2.07	64.28	7.18	57.1	4.02		0.63	61.12	6.27
Reach 35	10.5	Max WS	406441.8	1322	16.19	2.42	63.35	6.51	56.84	3.15	0.85	0.6	59.99	6.61
Reach 35	10.25	Max WS	406080.1	1316	16.77	4.14	61.09	4.75	56.34	4.82		1	61.16	7.87
Reach 35	10.07		Lat Struct					0		0				
Reach 35	10.05		Lat Struct					0		0				
Reach 35	10	Max WS	405890.1	1334	14.34	3.67	60.36	4.24	56.12	6.07		1.07	62.19	7.57
Reach 35	9.75	Max WS	405550.6	1297	14.79	2.67	58.04	2.27	55.77	4.48		0.92	60.25	6.67
Reach 35	9.5	Max WS	405099.3	1193	12.34	4.9	61.35	5.96	55.39	2.11	1.89	1.03	57.5	8.46
Reach 35	9.278	Max WS	405036.7	10	14.45	1.39	63.31	7.97	55.34	6.61			61.95	5.29
Reach 35	9.27		Bridge					0		0				
Reach 35	9.265	Max WS	404583.6	297	14.36	2.89	61.69	6.71	54.98	5.39		0.7	60.37	6.98
Reach 35	9.261		Lat Struct					0		0				
Reach 35	9.22		Lat Struct					0		0				
Reach 35	9.2	Max WS	404379.5	1064	15.21	3.53	60.54	5.7	54.84	1.95	2.05	0.7	56.79	7.45
Reach 35	9	Max WS	403734.6	1334	13.22	5.96	59.97	5.51	54.46	2.1	1.9	1.25	56.56	8.2
Reach 35	8.75	Max WS	401577.7	1321	9.5	12.28	59.4	5.83	53.57	2.4	1.6	2.38	55.97	**10.42**
Reach 35	8.5	Max WS	399528.3	1271	9.95	10.02	58.33	5.28	53.05	3.99	0.01	2.03	57.04	9.73
Reach 35	8.25	Max WS	397628.2	1357	12.83	6.08	58.73	6.06	52.67	2.82	1.18	1.22	55.49	8.24
Reach 35	8	Max WS	390957.2	1322	11.53	10.93	58.48	6.6	51.88	3.67	0.33	1.55	55.55	**10.08**
Reach 35	7.75	Max WS	386318.9	1070	5.06	8.61	57.42	6.01	51.41	3.52	0.48	1.28	54.93	9.38
Reach 35	7.55	Max WS	383500.5	748.69	2.7	6.13	57.97	6.81	51.16	3.74	0.26	0.96	54.9	8.4
Reach 35	7.52		Lat Struct					0		0				
Reach 35	7.41	Max WS	181160.3	1240	-21.72	2.48	53.84	2.36	51.48	10.82		0.09	62.3	6.3
Reach 35	7.17	Max WS	173691.5	1559	-3.34	4.15	53.65	2.54	51.11	11.19		0.22	62.3	7.43
Reach 35	6.88	Max WS	159776.2	1539	-7.21	6.26	55.76	5.24	50.52	11.78		0.36	62.3	8.56
Reach 35	6.59	Max WS	152960.3	1045	6.27	5.63	54.39	4.11	50.28	12.02		0.57	62.3	8.17
Reach 35	6.39	Max WS	140771.2	955	13.72	5.61	54.25	4.12	50.13	12.17		0.45	62.3	7.96
Reach 35	6.21	Max WS	135236.1	1009	15.75	5.89	53.99	4.2	49.79	12.51		0.26	62.3	8.04
Reach 35	6.02	Max WS	127173.6	977	16.74	4.39	53.3	3.6	49.7	12.6		0.21	62.3	7.28
Reach 35	5.83	Max WS	115326.8	1008	15.78	4.33	54.02	4.48	49.54	12.76		0.2	62.3	7.27
Reach 35	5.64	Max WS	106690.2	1016	14.31	4.49	53.18	3.88	49.3	13		0.19	62.3	7.36
Reach 35	5.45	Max WS	104431.8	958	15.03	3.35	52.52	3.35	49.17	13.03		0.16	62.2	6.7
Reach 35	5.27	Max WS	102428.4	513	13.22	3.08	52.72	3.74	48.98	13.22		0.16	62.2	6.47
Reach 35	5.17	Max WS	103288.2	980	12.8	3.36	53.15	4.35	48.8	13.4		0.17	62.2	6.64
Reach 35	4.98	Max WS	100640.6	984	13.09	2.8	53.58	4.94	48.64	13.56		0.25	62.2	6.28
Reach 35	4.95		Lat Struct					0		0				
Reach 35	4.8	Max WS	96410.57	943	12.34	3.14	53.84	5.36	48.48	13.72		0.23	62.2	6.01
Reach 35	4.62	Max WS	94941.04	1016	12.83	2.64	54.38	6.08	48.3	13.9		0.23	62.2	5.66
Reach 35	4.42	Max WS	90473.76	1009	15	2.01	53.49	5.31	48.18	14.02		0.1	62.2	5.16
Reach 35	4.23	Max WS	84492.48	973	14.11	1.81	54.11	6.06	48.05	14.15		0.08	62.2	4.99
Reach 35	4.05	Max WS	81624.82	976	13.49	1.61	55.01	7.08	47.93	14.27		0.1	62.2	4.79
Reach 35	3.87	Max WS	77336.2	1006	13.75	1.24	52.32	4.47	47.85	14.35		0.07	62.2	4.4
Reach 35	3.67	Max WS	72922.3	1057	11.98	1.17	51.53	3.79	47.74	14.46		0.04	62.2	4.32
Reach 35	3.47	Max WS	70797.53	994	10.04	1.02	53.33	5.69	47.64	14.56		0.04	62.2	4.14
Reach 35	3.29	Max WS	70210.29	963	13.03	0.94	51.57	4.04	47.53	14.67		0.02	62.2	4.03
Reach 35	3.1	Max WS	70583.78	817	13.29	0.92	52.51	5.09	47.42	14.78		0.08	62.2	3.98
Reach 35	2.95	Max WS	71120.79	705	10.93	1.01	54.57	7.28	47.29	14.81		0.07	62.1	4.12
Reach 35	2.82	Max WS	71681.17	394	1.77	1.05	51.5	4.31	47.19	14.91		0.09	62.1	4.2
Reach 35	2.74	Max WS	70323.61	335	0.49	1.43	51.11	4.02	47.09	15.01			62.1	4.65
Reach 35	2.68	Max WS	76382.32	582	1.35	1.68	51.43	4.49	46.94	15.16		0.06	62.1	4.93
Reach 35	2.57	Max WS	78701.74	1041	2.63	1.36	51.53	4.65	46.88	15.22		0.05	62.1	4.6
Reach 35	2.55		Lat Struct					0		0				
Reach 35	2.37	Max WS	75518.57	950	-6.36	1.49	51.66	4.93	46.73	15.37		0.01	62.1	4.77
Reach 35	2.19	Max WS	78340.71	1003	11.19	1.29	50.34	3.72	46.62	15.48		0.1	62.1	4.47
Reach 35	2	Max WS	77259.16	1384	10.07	1.06	49.27	2.75	46.52	15.58		0.09	62.1	4.17
Reach 35	1.74	Max WS	71869.45	1060	9.68	0.92	49.4	3	46.4	15.7		0.07	62.1	3.99
Reach 35	1.54	Max WS	71007.85	934	10.73	1.22	49.22	3.01	46.21	15.89		0.04	62.1	4.39
Reach 35	1.36	Max WS	75800.91	1005	9.94	1.27	50.42	4.39	46.03	16.07		0.06	62.1	4.46

Attachment D2 - Typical Results from HEC-RAS

Reach	River Sta	Profile	Q Total (cfs)	Length Ch (ft)	Min Ch El (ft)	Levee St Left (ft)	(A) Levee Elev Left (ft)	(A - W) Left differ (ft)	(W) W.S. Elev (ft)	(B - W) Right differ (ft)	Embankment (ft)	Levee St Right (ft)	(B) Levee Elev Right (ft)	Vel Chnl (ft/s)
Reach 35	1.17	Max WS	79896.76	1012	8.66	1.3	49.83	3.98	45.85	16.25		0.09	62.1	4.5
Reach 35	0.98	Max WS	79340.76	1298	1.97	1.26	49.87	4.16	45.71	16.39		0.07	62.1	4.44
Reach 35	0.73	Max WS	80819.89	901	7.68	0.94	50.59	5.01	45.58	16.52		0.07	62.1	4.02
Reach 35	0.56	Max WS	81200.45	1218	9.61	0.76	51.57	6.06	45.51	16.59		0.08	62.1	3.75
Reach 35	0.33	Max WS	87397.05	1071	5.55	0.68	47.57	2.2	45.37	16.73		0.04	62.1	3.62
Reach 35	0.13	Max WS	87393.47	2270	9.06	0.51	48.28	2.97	45.31	16.79		0.03	62.1	3.31

Attachment D3 - Freeboard Analysis

SUTTER BUTTE FLOOD CONTROL AGENCY
FEATHER RIVER WEST LEVEE PROJECT
FREEBOARD ANALYSIS
October 23, 2012 (for Staff Report)

: < 3 ft Freeboard
: >3 but < 4 ft fFreeboard

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	236800			139.41	130.67	131.87	134.02				8.74	7.54	5.39
	236700			139.43	130.64	131.85	134.01				8.78	7.58	5.41
	236600			139.21	130.62	131.83	134.00				8.59	7.39	5.21
	236500	138.91		138.82	130.59	131.81	133.99	8.32	7.10	4.92	8.23	7.02	4.83
	236400			139.05	130.57	131.79	133.99				8.48	7.26	5.06
	236300			139.42	130.54	131.77	133.98				8.88	7.65	5.44
	236200			138.85	130.52	131.74	133.97				8.33	7.10	4.88
	236100			138.53	130.49	131.72	133.96				8.04	6.81	4.57
	236000	139.28		138.92	130.46	131.70	133.95	8.82	7.58	5.33	8.45	7.21	4.97
	235900			137.38	130.44	131.68	133.94				6.94	5.70	3.44
	235800			138.85	130.41	131.66	133.93				8.44	7.19	4.92
58.51	235749		138.60	138.90	130.40	131.65	133.93				8.50	7.25	4.97
	235700			139.01	130.38	131.63	133.91				8.63	7.38	5.10
	235600			140.34	130.35	131.60	133.88				10.00	8.74	6.46
	235500	138.84		138.98	130.31	131.57	133.85	8.53	7.27	4.98	8.67	7.41	5.13
	235400			139.32	130.27	131.53	133.82				9.05	7.79	5.50
	235300			139.52	130.24	131.50	133.79				9.28	8.02	5.73
	235200			139.30	130.20	131.46	133.76				9.09	7.83	5.54
	235100			138.91	130.16	131.43	133.73				8.74	7.48	5.18
	235000	138.40		138.61	130.13	131.40	133.70	8.27	7.00	4.70	8.49	7.22	4.92
	234900			138.64	130.09	131.36	133.67				8.55	7.28	4.97
	234800			138.51	130.06	131.33	133.64				8.46	7.18	4.88
	234700			138.91	130.02	131.29	133.60				8.89	7.61	5.30
	234600			139.18	129.98	131.26	133.57				9.20	7.92	5.61
	234500			138.85	129.95	131.23	133.54				8.90	7.62	5.31
	234400			139.04	129.91	131.19	133.51				9.13	7.85	5.53
	234300			138.93	129.87	131.16	133.48				9.05	7.77	5.45
	234200			138.12	129.84	131.12	133.45				8.28	6.99	4.67
	234100			136.70	129.80	131.09	133.42				6.90	5.61	3.28
	234000	135.80		136.03	129.77	131.06	133.39	6.04	4.75	2.42	6.27	4.98	2.65
	233900			135.89	129.73	131.02	133.36				6.16	4.87	2.53
	233800			136.06	129.69	130.99	133.32				6.36	5.07	2.73
	233700			135.63	129.66	130.96	133.29				5.98	4.68	2.34
58.26	233625		138.07	136.50	129.63	130.93	133.27				6.87	5.57	3.23
	233600			136.18	129.57	130.87	133.21				6.61	5.31	2.97
	233500	137.57		137.70	129.32	130.61	132.95	8.25	6.96	4.62	8.38	7.08	4.74
	233400			137.74	129.07	130.36	132.70				8.67	7.38	5.04
	233300			137.61	128.83	130.11	132.45				8.78	7.50	5.16
	233200			137.16	128.58	129.86	132.20				8.58	7.30	4.96
	233100			137.07	128.33	129.61	131.95				8.73	7.46	5.12
	233000	136.79		136.88	128.08	129.35	131.69	8.71	7.44	5.10	8.80	7.53	5.19
	232900			136.62	127.84	129.10	131.44				8.79	7.52	5.18
	232800			136.05	127.59	128.85	131.19				8.46	7.20	4.86
57.95	232796		137.62	136.80	127.58	128.84	131.18				9.22	7.96	5.62
	232700			136.55	127.44	128.70	131.09				9.11	7.85	5.46
	232600			136.22	127.29	128.56	130.99				8.93	7.67	5.23
	232500	135.82		136.14	127.14	128.41	130.89	8.68	7.41	4.92	9.00	7.73	5.25
	232400			135.68	126.99	128.27	130.80				8.69	7.41	4.89
	232300			135.82	126.84	128.12	130.70				8.98	7.70	5.12
	232200			136.08	126.70	127.98	130.60				9.39	8.10	5.48
	232100			136.22	126.55	127.84	130.51				9.67	8.38	5.71
	232000	136.11		136.17	126.40	127.69	130.41	9.71	8.42	5.70	9.78	8.48	5.76
	231900			136.01	126.25	127.55	130.31				9.76	8.46	5.70
	231800			135.82	126.10	127.40	130.22				9.72	8.42	5.60
	231700			135.80	125.95	127.26	130.12				9.85	8.54	5.68
	231600			136.06	125.80	127.11	130.02				10.26	8.95	6.04
	231500			135.45	125.66	126.97	129.93				9.80	8.48	5.53
	231400			135.26	125.51	126.83	129.83				9.75	8.43	5.43
57.7	231347		135.74	135.80	125.43	126.75	129.78				10.37	9.05	6.02
	231300			135.35	125.33	126.66	129.75				10.02	8.70	5.60
	231200			135.20	125.13	126.46	129.70				10.07	8.74	5.50
	231100			134.76	124.93	126.26	129.65				9.83	8.50	5.11
	231000			134.39	124.73	126.06	129.59				9.67	8.33	4.80
	230900			134.71	124.53	125.87	129.54				10.19	8.85	5.17
	230800			134.76	124.32	125.67	129.49				10.44	9.10	5.28
	230700			134.66	124.12	125.47	129.43				10.53	9.18	5.22
	230600			134.57	123.92	125.27	129.38				10.65	9.29	5.19
	230500			135.11	123.72	125.08	129.32				11.39	10.03	5.78
57.45	230492		135.48	135.30	123.70	125.06	129.32				11.60	10.24	5.98
	230400			135.43	123.66	125.02	129.31				11.77	10.41	6.11
	230300			135.25	123.61	124.97	129.30				11.64	10.28	5.95
	230200			135.12	123.56	124.92	129.29				11.56	10.20	5.83
	230100			134.82	123.51	124.88	129.28				11.31	9.94	5.54
	230000	134.36		134.50	123.47	124.83	129.27	10.89	9.52	5.08	11.04	9.67	5.23
	229900			133.96	123.42	124.79	129.26				10.54	9.17	4.70
	229800			133.75	123.37	124.74	129.25				10.38	9.01	4.50
	229700			134.02	123.32	124.69	129.24				10.69	9.32	4.78
	229600			133.54	123.28	124.65	129.23				10.26	8.89	4.31
	229500	133.20		133.32	123.23	124.60	129.22	9.97	8.60	3.98	10.09	8.72	4.10
	229400			133.19	123.18	124.55	129.21				10.01	8.64	3.98
	229300			132.97	123.13	124.51	129.20				9.84	8.47	3.77
	229200			133.05	123.09	124.46	129.19				9.97	8.59	3.86
	229100			133.21	123.04	124.41	129.18				10.17	8.79	4.03
	229000	133.52		133.85	122.99	124.37	129.17	10.52	9.15	4.35	10.85	9.48	4.68
	228900			133.24	122.95	124.32	129.16				10.30	8.92	4.08
	228800			133.58	122.90	124.28	129.15				10.68	9.30	4.43

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	228700			133.33	122.85	124.23	129.14				10.48	9.10	4.19
	228600			133.54	122.80	124.18	129.13				10.73	9.35	4.41
	228500	133.09		133.37	122.76	124.14	129.12	10.34	8.96	3.97	10.62	9.24	4.25
	228400			132.76	122.71	124.09	129.11				10.05	8.67	3.65
	228300			132.73	122.66	124.04	129.10				10.07	8.69	3.63
	228200			132.91	122.61	124.00	129.09				10.30	8.92	3.83
	228100			132.82	122.57	123.95	129.08				10.25	8.87	3.74
	228000	132.44		132.41	122.52	123.90	129.07	9.92	8.53	3.37	9.89	8.50	3.34
	227900			132.52	122.47	123.86	129.06				10.05	8.67	3.47
	227800			132.51	122.42	123.81	129.05				10.08	8.70	3.46
	227700			132.32	122.38	123.76	129.04				9.95	8.56	3.29
	227600			132.37	122.33	123.72	129.03				10.05	8.66	3.35
	227500	132.08		132.16	122.28	123.67	129.02	9.80	8.41	3.06	9.88	8.49	3.14
	227400			131.97	122.23	123.63	129.01				9.74	8.34	2.96
	227300			131.64	122.19	123.58	129.00				9.45	8.06	2.64
	227200			132.10	122.14	123.53	128.99				9.96	8.56	3.11
	227100			131.98	122.09	123.49	128.98				9.89	8.49	3.00
	227000	131.75		131.71	122.04	123.44	128.97	9.71	8.31	2.79	9.66	8.27	2.74
	226900			131.72	122.00	123.39	128.96				9.72	8.32	2.76
	226800			131.80	121.95	123.35	128.95				9.85	8.45	2.85
	226700			131.42	121.90	123.30	128.94				9.52	8.12	2.49
	226600			131.46	121.85	123.25	128.93				9.60	8.20	2.53
57.17	226547		130.39	131.40	121.83	123.23	128.92				9.57	8.17	2.48
	226500	131.20		131.20	121.81	123.21	128.91	9.39	7.99	2.29	9.40	7.99	2.29
	226400			130.93	121.76	123.17	128.89				9.17	7.76	2.04
	226300			130.52	121.71	123.13	128.88				8.81	7.40	1.65
	226200			131.00	121.67	123.08	128.86				9.33	7.91	2.14
	226100			130.30	121.62	123.04	128.84				8.68	7.26	1.46
	226000	130.28		130.25	121.57	123.00	128.82	8.70	7.28	1.46	8.68	7.25	1.43
	225900			130.21	121.53	122.96	128.80				8.68	7.25	1.41
	225800			129.89	121.48	122.92	128.78				8.41	6.98	1.11
	225700			130.02	121.43	122.87	128.77				8.58	7.14	1.25
	225600			129.99	121.39	122.83	128.75				8.60	7.16	1.24
	225500	129.82		129.85	121.34	122.79	128.73	8.48	7.03	1.09	8.51	7.06	1.12
	225400			129.61	121.29	122.75	128.71				8.32	6.87	0.90
	225300			129.70	121.25	122.71	128.69				8.46	7.00	1.01
	225200			129.90	121.20	122.66	128.68				8.70	7.24	1.23
	225100			129.89	121.15	122.62	128.66				8.74	7.27	1.23
	225000	130.06		130.13	121.10	122.58	128.64	8.95	7.48	1.42	9.03	7.55	1.49
	224900			130.64	121.06	122.54	128.62				9.58	8.10	2.02
	224800			129.92	121.01	122.50	128.60				8.91	7.43	1.32
	224700			129.72	120.96	122.45	128.59				8.76	7.27	1.13
	224600			129.89	120.92	122.41	128.57				8.97	7.48	1.32
	224500	129.62		129.99	120.87	122.37	128.55	8.75	7.25	1.07	9.12	7.62	1.44
	224400			129.67	120.82	122.33	128.53				8.85	7.34	1.14
	224300			129.75	120.78	122.28	128.51				8.97	7.47	1.24
	224200			130.09	120.73	122.24	128.50				9.36	7.85	1.60
	224100			129.61	120.68	122.20	128.48				8.93	7.41	1.13
	224000	129.46		129.55	120.64	122.16	128.46	8.82	7.30	1.00	8.92	7.40	1.09
	223900			129.58	120.59	122.12	128.44				8.99	7.46	1.14
56.94	223837		128.92	129.60	120.56	122.09	128.43				9.04	7.51	1.17
	223800			129.54	120.54	122.07	128.42				9.00	7.47	1.12
	223700			129.28	120.48	122.02	128.41				8.79	7.25	0.87
	223600			129.37	120.43	121.97	128.39				8.94	7.39	0.98
	223500	128.97		129.15	120.37	121.92	128.37	8.60	7.05	0.60	8.78	7.23	0.78
	223400			129.09	120.31	121.87	128.35				8.78	7.22	0.74
	223300			128.93	120.26	121.82	128.33				8.67	7.11	0.60
	223200			128.93	120.20	121.77	128.32				8.73	7.16	0.62
	223100			128.72	120.15	121.72	128.30				8.58	7.00	0.42
	223000	128.34		128.41	120.09	121.67	128.28	8.25	6.67	0.06	8.32	6.74	0.13
	222900			128.20	120.03	121.62	128.26				8.17	6.58	-0.06
	222800			127.90	119.98	121.57	128.25				7.92	6.32	-0.35
	222700			128.15	119.92	121.52	128.23				8.22	6.62	-0.08
	222600			127.92	119.87	121.47	128.21				8.05	6.44	-0.29
	222500	127.76		127.74	119.81	121.42	128.19	7.95	6.33	-0.44	7.94	6.32	-0.45
	222400			127.59	119.75	121.37	128.17				7.84	6.22	-0.58
	222300			127.68	119.70	121.32	128.16				7.99	6.36	-0.47
	222200			127.43	119.64	121.27	128.14				7.79	6.16	-0.70
	222100			127.33	119.58	121.22	128.12				7.75	6.11	-0.79
56.61	222093		127.02	127.30	119.58	121.22	128.12				7.72	6.08	-0.82
	222000	126.93		126.92	119.54	121.17	128.04	7.39	5.76	-1.12	7.38	5.75	-1.12
	221900			126.77	119.50	121.12	127.96				7.27	5.65	-1.19
	221800			126.66	119.46	121.07	127.88				7.20	5.59	-1.22
	221700			127.22	119.42	121.02	127.80				7.80	6.20	-0.58
	221600			127.20	119.38	120.97	127.72				7.83	6.23	-0.52
	221500	126.83		127.10	119.34	120.92	127.64	7.49	5.91	-0.81	7.76	6.18	-0.54
	221400			126.85	119.30	120.87	127.56				7.56	5.98	-0.71
	221300			126.83	119.26	120.82	127.48				7.58	6.02	-0.64
	221200			126.51	119.21	120.77	127.40				7.29	5.74	-0.89
	221100			126.32	119.17	120.72	127.32				7.14	5.60	-1.00
56.43	221068		126.11	126.30	119.16	120.70	127.29				7.14	5.60	-0.99
	221000	126.02		126.10	119.03	120.57	127.13	6.99	5.45	-1.12	7.07	5.53	-1.03
	220900			125.86	118.84	120.37	126.91				7.02	5.49	-1.05
	220800			125.87	118.65	120.18	126.68				7.22	5.70	-0.80
	220700			126.04	118.47	119.98	126.45				7.58	6.06	-0.41
	220600			125.84	118.28	119.78	126.22				7.56	6.05	-0.38
56.2	220516		125.09	125.90	118.12	119.62	126.03				7.78	6.28	-0.13
	220500	125.78		125.89	118.10	119.60	126.00	7.68	6.18	-0.22	7.80	6.29	-0.11
	220400			125.88	117.96	119.47	125.83				7.92	6.41	0.05
	220300			125.90	117.83	119.34	125.65				8.07	6.56	0.25

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	220200			125.98	117.69	119.21	125.48				8.29	6.77	0.50
	220100			125.97	117.56	119.08	125.30				8.41	6.88	0.66
56.02	220058		125.00	125.80	117.50	119.03	125.23				8.30	6.77	0.57
	220000	125.55		125.80	117.21	118.71	124.81	8.34	6.84	0.74	8.59	7.09	0.99
	219900			125.65	116.72	118.16	124.08				8.93	7.49	1.57
	219800			125.49	116.23	117.61	123.36				9.26	7.87	2.13
55.8	219787		124.02	125.50	116.16	117.54	123.26				9.34	7.96	2.24
	219700			125.40	116.05	117.42	123.07				9.35	7.98	2.33
	219600			125.57	115.93	117.28	122.85				9.64	8.29	2.73
	219500	125.18		125.32	115.81	117.14	122.62	9.37	8.03	2.55	9.51	8.18	2.69
	219400			125.21	115.69	117.00	122.40				9.52	8.21	2.81
	219300			125.41	115.56	116.86	122.18				9.84	8.55	3.23
	219200			125.19	115.44	116.72	121.96				9.75	8.46	3.23
55.55	219191		125.21	125.20	115.43	116.71	121.94				9.77	8.49	3.26
	219100			124.99	115.38	116.65	121.84				9.61	8.34	3.15
	219000	124.67		124.90	115.32	116.59	121.73	9.35	8.08	2.94	9.58	8.31	3.17
	218900			124.84	115.26	116.52	121.62				9.57	8.31	3.22
	218800			124.94	115.20	116.46	121.51				9.73	8.48	3.43
	218700			124.80	115.15	116.39	121.39				9.65	8.41	3.41
	218600			124.40	115.09	116.33	121.28				9.31	8.07	3.11
	218500	124.41		124.62	115.03	116.27	121.17	9.38	8.14	3.24	9.58	8.35	3.44
	218400			124.73	114.97	116.20	121.06				9.76	8.53	3.67
	218300			124.39	114.92	116.14	120.95				9.48	8.26	3.44
	218200			124.55	114.86	116.07	120.84				9.69	8.48	3.71
	218100			124.79	114.80	116.01	120.73				9.99	8.78	4.06
	218000			124.49	114.74	115.94	120.62				9.75	8.55	3.87
	217900			125.12	114.69	115.88	120.51				10.43	9.24	4.61
	217800			124.58	114.63	115.81	120.40				9.95	8.77	4.19
	217700			124.46	114.57	115.75	120.28				9.89	8.71	4.18
	217600			124.62	114.51	115.69	120.17				10.10	8.93	4.44
	217500			124.66	114.46	115.62	120.06				10.20	9.03	4.59
	217400			124.63	114.40	115.56	119.95				10.23	9.07	4.68
	217300			124.53	114.34	115.49	119.84				10.19	9.04	4.69
	217200			124.39	114.28	115.43	119.73				10.11	8.97	4.67
	217100			124.40	114.23	115.36	119.62				10.17	9.04	4.78
	217000			124.40	114.17	115.30	119.51				10.23	9.10	4.90
55.35	216984		124.16	124.30	114.16	115.29	119.49				10.14	9.01	4.81
	216900			124.27	114.11	115.24	119.44				10.15	9.03	4.83
	216800			124.11	114.06	115.19	119.37				10.05	8.92	4.74
	216700			123.95	114.01	115.13	119.31				9.94	8.82	4.64
	216600			123.66	113.95	115.07	119.25				9.71	8.59	4.42
	216500			123.96	113.90	115.02	119.19				10.07	8.95	4.78
	216400			124.17	113.84	114.96	119.12				10.33	9.21	5.05
	216300			124.27	113.79	114.90	119.06				10.49	9.37	5.21
	216200			124.33	113.73	114.85	119.00				10.59	9.48	5.33
	216100			124.35	113.68	114.79	118.93				10.67	9.56	5.42
	216000			124.28	113.63	114.73	118.87				10.66	9.55	5.41
	215900			124.03	113.57	114.68	118.81				10.46	9.35	5.22
	215800			123.94	113.52	114.62	118.74				10.42	9.31	5.19
	215700			123.82	113.46	114.56	118.68				10.35	9.25	5.13
	215600			123.63	113.41	114.51	118.62				10.22	9.12	5.01
	215500			123.46	113.35	114.45	118.56				10.11	9.01	4.91
	215400			123.30	113.30	114.40	118.49				10.00	8.91	4.81
	215300			123.10	113.25	114.34	118.43				9.86	8.76	4.67
	215200			122.89	113.19	114.28	118.37				9.70	8.61	4.53
	215100			122.78	113.14	114.23	118.30				9.65	8.56	4.48
	215000			122.63	113.08	114.17	118.24				9.55	8.46	4.39
	214900			122.71	113.03	114.11	118.18				9.68	8.59	4.53
	214800			122.97	112.97	114.06	118.12				10.00	8.91	4.85
	214700			123.06	112.92	114.00	118.05				10.14	9.06	5.01
55.03	214664		123.38	122.90	112.90	113.98	118.03				10.00	8.92	4.87
	214600			122.84	112.82	113.90	117.96				10.02	8.94	4.88
	214500			123.14	112.71	113.79	117.84				10.43	9.35	5.30
	214400			123.15	112.59	113.67	117.73				10.56	9.49	5.43
	214300			123.51	112.47	113.55	117.61				11.03	9.96	5.90
	214200			123.35	112.36	113.43	117.50				11.00	9.92	5.86
	214100			123.55	112.24	113.31	117.38				11.31	10.24	6.17
	214000			123.34	112.12	113.19	117.27				11.21	10.15	6.07
	213900			123.36	112.01	113.07	117.15				11.35	10.28	6.20
	213800			123.29	111.89	112.96	117.04				11.40	10.34	6.26
	213700			122.90	111.77	112.84	116.92				11.13	10.07	5.98
	213600			122.94	111.66	112.72	116.81				11.28	10.22	6.14
	213500	122.63		122.65	111.54	112.60	116.69	11.09	10.03	5.94	11.11	10.05	5.96
	213400			122.52	111.42	112.48	116.58				11.09	10.03	5.94
	213300			122.48	111.31	112.36	116.46				11.17	10.12	6.02
	213200			122.21	111.19	112.25	116.35				11.02	9.96	5.86
	213100			122.09	111.07	112.13	116.23				11.02	9.96	5.86
	213000	121.65		121.65	110.96	112.01	116.12	10.70	9.64	5.54	10.69	9.64	5.54
54.45	212926		120.95	121.60	110.87	111.92	116.03				10.73	9.68	5.57
	212900			121.68	110.86	111.91	116.02				10.82	9.77	5.66
	212800			121.26	110.84	111.89	115.99				10.42	9.38	5.27
	212700			121.26	110.81	111.86	115.96				10.45	9.40	5.30
	212600			121.07	110.79	111.83	115.93				10.28	9.23	5.14
	212500	121.14		121.18	110.76	111.81	115.90	10.38	9.33	5.24	10.42	9.38	5.28
	212400			121.09	110.73	111.78	115.87				10.35	9.31	5.22
	212300			121.07	110.71	111.75	115.84				10.36	9.32	5.23
	212200			120.74	110.68	111.73	115.81				10.06	9.01	4.93
	212100			120.76	110.66	111.70	115.78				10.11	9.06	4.98
	212000	120.56		120.59	110.63	111.68	115.75	9.93	8.88	4.81	9.96	8.92	4.84
	211900			120.81	110.60	111.65	115.72				10.21	9.16	5.09

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	211800			120.92	110.58	111.62	115.69				10.35	9.30	5.23
	211700			121.04	110.55	111.60	115.66				10.48	9.44	5.38
	211600			120.89	110.53	111.57	115.63				10.36	9.32	5.26
	211500	120.88		121.04	110.50	111.54	115.60	10.38	9.33	5.28	10.54	9.50	5.44
	211400			121.14	110.47	111.52	115.57				10.66	9.62	5.57
	211300			121.09	110.45	111.49	115.54				10.64	9.59	5.55
	211200			120.77	110.42	111.46	115.51				10.35	9.31	5.26
	211100			120.79	110.39	111.44	115.48				10.40	9.36	5.32
	211000	120.69		120.95	110.37	111.41	115.45	10.32	9.28	5.24	10.58	9.54	5.51
	210900			120.90	110.34	111.39	115.42				10.55	9.51	5.48
	210800			120.75	110.32	111.36	115.38				10.43	9.39	5.37
	210700			120.61	110.29	111.33	115.35				10.32	9.28	5.26
	210600			120.79	110.26	111.31	115.32				10.52	9.48	5.46
	210500	120.88		121.21	110.24	111.28	115.29	10.64	9.60	5.59	10.97	9.93	5.92
	210400			121.00	110.21	111.25	115.26				10.78	9.74	5.73
	210300			120.81	110.19	111.23	115.23				10.62	9.58	5.57
	210200			120.77	110.16	111.20	115.20				10.61	9.57	5.57
54.2	210158		110.70	120.60	110.15	111.19	115.19				10.45	9.41	5.41
	210100			120.65	110.12	111.16	115.16				10.53	9.49	5.49
	210000	120.42		120.72	110.06	111.11	115.12	10.36	9.31	5.30	10.66	9.61	5.60
	209900			120.60	110.01	111.06	115.07				10.59	9.54	5.53
	209800			120.38	109.95	111.00	115.02				10.43	9.38	5.36
	209700			120.25	109.90	110.95	114.97				10.35	9.30	5.27
	209600			120.08	109.84	110.90	114.93				10.24	9.18	5.15
54.04	209563		107.73	120.00	109.82	110.88	114.91				10.18	9.12	5.09
	209500	119.70		119.98	109.77	110.83	114.87	9.92	8.86	4.83	10.21	9.15	5.11
	209400			120.12	109.70	110.76	114.80				10.42	9.35	5.32
	209300			120.60	109.62	110.69	114.73				10.98	9.91	5.87
	209200			120.37	109.54	110.61	114.66				10.82	9.75	5.71
	209100			119.76	109.47	110.54	114.59				10.30	9.22	5.18
	209000	119.24		119.60	109.39	110.47	114.52	9.85	8.77	4.72	10.21	9.13	5.08
	208900			119.60	109.32	110.39	114.45				10.29	9.21	5.15
	208800			119.62	109.24	110.32	114.38				10.38	9.30	5.24
	208700			119.61	109.16	110.25	114.31				10.45	9.37	5.30
	208600			119.42	109.09	110.17	114.24				10.33	9.24	5.18
	208500	118.97		119.24	109.01	110.10	114.17	9.96	8.87	4.80	10.23	9.14	5.07
53.84	208500		104.98	119.20	109.01	110.10	114.17				10.19	9.10	5.03
	208400			119.25	108.96	110.04	114.11				10.29	9.21	5.14
	208300			118.98	108.91	109.99	114.05				10.07	8.99	4.93
	208200			118.81	108.86	109.93	113.99				9.96	8.88	4.83
	208100			118.69	108.80	109.88	113.93				9.88	8.81	4.76
	208000	118.50		118.65	108.75	109.82	113.87	9.75	8.68	4.63	9.90	8.83	4.78
	207900			118.69	108.70	109.77	113.81				9.98	8.92	4.88
	207800			118.60	108.65	109.71	113.75				9.95	8.89	4.86
	207700			118.60	108.60	109.66	113.69				10.00	8.94	4.91
	207600			118.51	108.55	109.60	113.63				9.96	8.91	4.89
	207500	118.20		118.37	108.50	109.54	113.57	9.70	8.65	4.63	9.87	8.83	4.80
	207400			118.42	108.45	109.49	113.51				9.98	8.93	4.91
	207300			118.30	108.39	109.43	113.45				9.90	8.87	4.85
	207200			118.20	108.34	109.38	113.39				9.85	8.82	4.81
	207100			117.86	108.29	109.32	113.33				9.56	8.54	4.53
	207000	117.40		117.71	108.24	109.27	113.27	9.16	8.14	4.14	9.47	8.45	4.45
	206900			117.85	108.19	109.21	113.21				9.66	8.64	4.64
	206800			117.92	108.14	109.15	113.14				9.78	8.76	4.77
	206700			117.75	108.09	109.10	113.08				9.66	8.65	4.66
	206600			117.82	108.03	109.04	113.02				9.79	8.78	4.80
	206500	117.99		117.95	107.98	108.99	112.96	10.01	9.00	5.03	9.96	8.96	4.98
	206400			117.77	107.93	108.93	112.90				9.84	8.84	4.86
	206300			117.72	107.88	108.88	112.84				9.84	8.84	4.88
	206200			117.63	107.83	108.82	112.78				9.80	8.81	4.85
	206100			117.88	107.78	108.76	112.72				10.10	9.11	5.16
	206000	117.71		118.20	107.73	108.71	112.66	9.98	9.00	5.04	10.47	9.49	5.53
	205900			118.00	107.68	108.65	112.60				10.32	9.34	5.40
	205800			117.76	107.62	108.60	112.54				10.14	9.17	5.22
53.52	205714		114.76	117.40	107.58	108.55	112.49				9.82	8.85	4.91
	205700			117.81	107.57	108.54	112.48				10.24	9.27	5.33
	205600			117.30	107.48	108.45	112.37				9.82	8.85	4.93
	205500	116.95		117.20	107.40	108.36	112.26	9.56	8.59	4.69	9.80	8.84	4.94
	205400			117.03	107.31	108.27	112.16				9.73	8.76	4.88
	205300			116.97	107.22	108.18	112.05				9.75	8.79	4.92
	205200			116.83	107.14	108.10	111.95				9.70	8.74	4.89
	205100			116.59	107.05	108.01	111.84				9.54	8.58	4.74
	205000	116.29		116.34	106.96	107.92	111.74	9.32	8.37	4.55	9.38	8.43	4.61
	204900			116.53	106.88	107.83	111.63				9.65	8.70	4.90
	204800			116.33	106.79	107.74	111.52				9.54	8.59	4.81
	204700			116.04	106.70	107.65	111.42				9.34	8.39	4.63
	204600			115.92	106.62	107.57	111.31				9.30	8.35	4.61
	204500	115.85		115.97	106.53	107.48	111.21	9.32	8.38	4.65	9.44	8.50	4.77
	204400			115.83	106.45	107.39	111.10				9.38	8.44	4.72
	204300			115.68	106.36	107.30	111.00				9.32	8.38	4.68
53.22	204266		115.02	115.60	106.33	107.27	110.96				9.27	8.33	4.64
	204200			115.46	106.26	107.20	110.89				9.19	8.25	4.57
	204100			115.46	106.16	107.10	110.78				9.30	8.36	4.68
	204000	114.96		115.14	106.06	107.00	110.67	8.90	7.97	4.29	9.08	8.14	4.47
	203900			115.12	105.96	106.90	110.57				9.16	8.23	4.56
	203800			114.76	105.86	106.79	110.46				8.90	7.97	4.30
	203700			114.48	105.76	106.69	110.35				8.72	7.79	4.13
	203600			114.58	105.66	106.59	110.25				8.92	7.99	4.34
	203500	114.06		114.30	105.56	106.49	110.14	8.50	7.57	3.92	8.75	7.82	4.17
	203400			114.24	105.46	106.39	110.03				8.78	7.85	4.21

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	203300			114.33	105.36	106.28	109.92				8.97	8.05	4.41
	203200			114.23	105.26	106.18	109.82				8.97	8.04	4.41
	203100			113.96	105.16	106.08	109.71				8.80	7.88	4.25
	203000	113.62		113.80	105.05	105.98	109.60	8.57	7.64	4.02	8.75	7.83	4.20
	202900			113.87	104.95	105.88	109.49				8.91	7.99	4.37
	202800			114.10	104.85	105.77	109.39				9.25	8.33	4.72
52.89	202757		104.68	114.00	104.81	105.73	109.34				9.19	8.27	4.66
	202700			114.02	104.77	105.69	109.29				9.25	8.33	4.73
	202600			114.05	104.69	105.61	109.20				9.36	8.45	4.85
	202500	113.34		113.68	104.62	105.53	109.12	8.72	7.81	4.22	9.06	8.15	4.56
	202400			113.26	104.54	105.45	109.03				8.72	7.81	4.23
	202300			113.73	104.47	105.38	108.94				9.27	8.36	4.79
	202200			114.23	104.39	105.30	108.86				9.83	8.93	5.37
	202100			114.18	104.32	105.22	108.77				9.86	8.96	5.41
	202000	113.80		114.03	104.24	105.14	108.69	9.55	8.65	5.11	9.79	8.88	5.34
	201900			114.13	104.17	105.07	108.60				9.97	9.07	5.53
	201800			113.93	104.09	104.99	108.51				9.83	8.94	5.41
	201700			113.60	104.02	104.91	108.43				9.58	8.69	5.17
	201600			113.68	103.94	104.83	108.34				9.74	8.85	5.34
	201500	113.48		113.74	103.87	104.76	108.25	9.61	8.72	5.22	9.88	8.99	5.49
	201400			113.64	103.79	104.68	108.17				9.85	8.97	5.48
	201300			113.43	103.72	104.60	108.08				9.71	8.83	5.35
	201200			113.49	103.64	104.52	107.99				9.85	8.97	5.49
52.6	201184		112.26	113.40	103.63	104.51	107.98				9.77	8.89	5.42
	201100			113.34	103.60	104.47	107.94				9.75	8.87	5.40
	201000	112.90		113.09	103.55	104.43	107.89	9.35	8.47	5.02	9.53	8.66	5.20
	200900			113.20	103.51	104.39	107.83				9.68	8.81	5.36
	200800			112.99	103.47	104.34	107.78				9.52	8.65	5.20
	200700			113.30	103.43	104.30	107.73				9.87	9.00	5.57
	200600			113.42	103.39	104.26	107.68				10.03	9.16	5.74
	200500	113.50		113.61	103.35	104.21	107.63	10.15	9.29	5.87	10.26	9.40	5.98
	200400			113.36	103.31	104.17	107.58				10.06	9.20	5.79
	200300			112.99	103.27	104.13	107.53				9.72	8.86	5.46
	200200			112.81	103.23	104.08	107.48				9.58	8.73	5.33
	200100			112.98	103.19	104.04	107.43				9.79	8.94	5.55
	200000	112.55		112.60	103.15	104.00	107.37	9.41	8.56	5.18	9.45	8.60	5.22
	199900			112.38	103.10	103.95	107.32				9.27	8.43	5.06
	199800			112.31	103.06	103.91	107.27				9.24	8.40	5.03
	199700			112.33	103.02	103.87	107.22				9.31	8.47	5.11
52.21	199619		111.35	112.30	102.99	103.83	107.18				9.31	8.47	5.12
	199600			112.26	102.98	103.82	107.17				9.28	8.44	5.09
	199500	112.07		112.12	102.95	103.79	107.13	9.11	8.27	4.93	9.17	8.33	4.99
	199400			112.01	102.92	103.76	107.09				9.09	8.25	4.92
	199300			112.05	102.89	103.73	107.05				9.15	8.32	4.99
	199200			112.04	102.86	103.70	107.01				9.18	8.34	5.03
	199100			111.92	102.83	103.66	106.97				9.09	8.25	4.95
	199000	111.97		112.08	102.80	103.63	106.93	9.17	8.34	5.04	9.29	8.45	5.15
	198900			111.67	102.77	103.60	106.89				8.90	8.07	4.78
	198800			111.64	102.74	103.57	106.85				8.90	8.07	4.79
51.95	198775		111.48	111.60	102.73	103.56	106.84				8.87	8.04	4.76
	198700			111.60	102.65	103.49	106.79				8.94	8.11	4.81
	198600			111.54	102.55	103.40	106.71				8.99	8.14	4.83
	198500	111.43		111.51	102.45	103.31	106.64	8.98	8.12	4.79	9.06	8.20	4.87
	198400			111.52	102.35	103.22	106.57				9.17	8.30	4.95
	198300			111.50	102.25	103.13	106.49				9.25	8.38	5.01
	198200			111.58	102.15	103.04	106.42				9.43	8.54	5.16
	198100			111.13	102.05	102.95	106.35				9.08	8.19	4.79
	198000	110.82		110.87	101.95	102.86	106.28	8.87	7.96	4.54	8.92	8.02	4.60
	197900			110.74	101.85	102.77	106.20				8.90	7.98	4.54
51.35	197883		110.70	110.70	101.83	102.75	106.19				8.87	7.95	4.51
	197800			110.76	101.82	102.74	106.18				8.94	8.02	4.58
	197700			110.59	101.81	102.73	106.17				8.78	7.86	4.42
	197600			110.64	101.81	102.72	106.16				8.83	7.91	4.47
	197500	110.58		110.66	101.80	102.71	106.15	8.78	7.86	4.43	8.86	7.94	4.50
	197400			110.83	101.79	102.71	106.14				9.04	8.13	4.69
	197300			110.60	101.78	102.70	106.13				8.82	7.90	4.47
	197200			110.76	101.77	102.69	106.12				8.99	8.08	4.64
	197100			110.78	101.76	102.68	106.11				9.02	8.11	4.67
	197000			110.46	101.76	102.67	106.10				8.70	7.79	4.36
	196900			110.53	101.75	102.66	106.09				8.79	7.88	4.44
	196800			110.69	101.74	102.65	106.08				8.95	8.04	4.62
	196700			110.78	101.73	102.64	106.07				9.04	8.14	4.71
	196600			110.71	101.72	102.63	106.06				8.99	8.08	4.65
	196500	110.39		110.39	101.71	102.62	106.05	8.67	7.77	4.34	8.68	7.77	4.34
	196400			110.55	101.71	102.61	106.04				8.84	7.93	4.51
	196300			110.58	101.70	102.60	106.03				8.89	7.98	4.56
	196200			111.03	101.69	102.59	106.02				9.34	8.44	5.01
	196100			110.40	101.68	102.58	106.01				8.72	7.82	4.40
	196000	110.31		110.32	101.67	102.57	106.00	8.64	7.74	4.32	8.65	7.75	4.33
	195900			110.74	101.66	102.57	105.99				9.07	8.17	4.75
	195800			110.56	101.66	102.56	105.98				8.90	8.00	4.58
51.1777	195737		110.01	110.20	101.65	102.55	105.97				8.55	7.65	4.23
	195700			110.37	101.65	102.55	105.97				8.72	7.82	4.40
	195600			110.59	101.64	102.54	105.96				8.95	8.05	4.63
	195500	110.55		110.55	101.64	102.54	105.95	8.92	8.02	4.60	8.91	8.01	4.60
	195400			110.47	101.63	102.53	105.94				8.84	7.95	4.53
	195300			110.49	101.62	102.52	105.94				8.87	7.97	4.55
	195200			110.27	101.62	102.52	105.93				8.65	7.76	4.34
	195100			110.23	101.61	102.51	105.92				8.62	7.72	4.31
	195000	110.47		110.44	101.61	102.50	105.91	8.86	7.97	4.56	8.83	7.93	4.53

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	194900			110.38	101.60	102.50	105.90				8.78	7.88	4.47
	194800			110.14	101.60	102.49	105.90				8.54	7.65	4.24
	194700			109.96	101.59	102.49	105.89				8.37	7.48	4.07
	194600			109.87	101.58	102.48	105.88				8.29	7.39	3.99
	194500	109.88		110.07	101.58	102.47	105.87	8.30	7.41	4.01	8.49	7.60	4.20
	194400			110.17	101.57	102.47	105.87				8.60	7.70	4.30
	194300			109.89	101.57	102.46	105.86				8.32	7.43	4.03
	194200			110.02	101.56	102.45	105.85				8.46	7.57	4.17
	194100			109.75	101.56	102.45	105.84				8.19	7.30	3.90
	194000	109.72		109.65	101.55	102.44	105.83	8.17	7.28	3.88	8.10	7.21	3.82
	193900			109.72	101.54	102.44	105.83				8.18	7.29	3.90
51.04	193817		105.84	109.60	101.54	102.43	105.82				8.06	7.17	3.78
	193800			109.69	101.53	102.42	105.82				8.15	7.26	3.87
	193700			109.65	101.50	102.39	105.79				8.15	7.26	3.86
	193600			109.54	101.47	102.36	105.76				8.07	7.17	3.78
	193500	109.36		109.41	101.44	102.33	105.73	7.92	7.02	3.62	7.98	7.08	3.68
	193400			109.40	101.41	102.30	105.71				8.00	7.10	3.70
	193300			109.25	101.37	102.27	105.68				7.87	6.97	3.57
	193200			109.16	101.34	102.24	105.65				7.82	6.92	3.51
	193100			109.10	101.31	102.21	105.63				7.79	6.88	3.47
	193000	108.93		108.98	101.28	102.18	105.60	7.66	6.75	3.33	7.71	6.80	3.38
	192900			108.86	101.24	102.15	105.57				7.62	6.71	3.29
	192800			108.80	101.21	102.12	105.54				7.59	6.67	3.25
	192700	108.73		108.79	101.18	102.09	105.52	7.55	6.64	3.22	7.61	6.69	3.27
	192600			108.68	101.15	102.06	105.49				7.53	6.61	3.19
	192500	108.60		108.61	101.11	102.03	105.46	7.49	6.57	3.14	7.49	6.57	3.15
	192400	108.63		108.57	101.08	102.00	105.44	7.54	6.62	3.19	7.49	6.57	3.14
	192300			108.56	101.05	101.97	105.41				7.51	6.59	3.15
	192200			108.62	101.02	101.94	105.38				7.60	6.67	3.24
	192100			108.70	100.98	101.91	105.35				7.72	6.79	3.35
50.84	192086		106.56	108.50	100.98	101.91	105.35				7.52	6.59	3.15
	192000	108.45		108.41	100.90	101.85	105.31	7.55	6.60	3.14	7.51	6.56	3.10
	191900	108.24		108.33	100.81	101.78	105.26	7.43	6.46	2.97	7.52	6.55	3.07
	191800			108.30	100.71	101.71	105.22				7.58	6.59	3.08
	191700			108.31	100.62	101.64	105.17				7.68	6.67	3.14
	191600			108.25	100.53	101.57	105.12				7.72	6.68	3.13
	191500	108.22		108.17	100.44	101.50	105.07	7.78	6.72	3.14	7.73	6.67	3.09
	191400			108.11	100.34	101.43	105.03				7.77	6.69	3.09
	191300			107.81	100.25	101.35	104.98				7.56	6.46	2.83
50.7	191279		106.73	107.90	100.23	101.34	104.97				7.67	6.56	2.93
	191200			107.91	100.04	101.19	104.88				7.87	6.72	3.02
	191100			107.87	99.79	101.00	104.78				8.08	6.88	3.10
	191000	107.87		107.81	99.55	100.80	104.67	8.32	7.07	3.20	8.27	7.01	3.15
	190900			107.91	99.30	100.61	104.56				8.61	7.30	3.35
	190800			108.12	99.06	100.42	104.45				9.06	7.70	3.67
50.59	190706		107.52	108.10	98.83	100.24	104.35				9.27	7.86	3.75
	190700			108.18	98.83	100.24	104.35				9.35	7.95	3.83
	190600			110.66	98.81	100.19	104.31				11.85	10.47	6.35
	190500	108.02		108.25	98.79	100.14	104.26	9.23	7.88	3.76	9.46	8.11	3.99
	190400			107.73	98.77	100.09	104.22				8.96	7.64	3.51
	190300	107.30		107.05	98.74	100.04	104.18	8.56	7.26	3.12	8.31	7.01	2.88
50.498	190231		110.74	110.70	98.73	100.01	104.15				11.97	10.69	6.55
50.496	190219		111.62	111.20	98.68	99.96	104.08				12.52	11.24	7.12
	190200			111.48	98.67	99.92	104.01				12.81	11.56	7.47
50.489	190177		110.53	109.90	98.65	99.88	103.93				11.25	10.02	5.97
50.487	190167		109.81	109.30	98.69	99.93	103.95				10.61	9.37	5.35
	190100			106.90	98.66	99.89	103.91				8.24	7.01	2.99
	190000	106.15		106.35	98.62	99.83	103.85	7.53	6.32	2.30	7.74	6.52	2.50
	189900			106.66	98.57	99.77	103.79				8.08	6.88	2.87
	189800			106.94	98.53	99.71	103.73				8.41	7.23	3.21
	189700			107.16	98.49	99.65	103.67				8.67	7.50	3.49
	189600			107.09	98.44	99.60	103.61				8.65	7.49	3.48
	189500			107.01	98.40	99.54	103.55				8.61	7.47	3.46
	189400			106.54	98.36	99.48	103.49				8.18	7.06	3.05
	189300			106.36	98.31	99.42	103.43				8.05	6.94	2.93
	189200			106.17	98.27	99.36	103.37				7.90	6.81	2.80
	189100			105.81	98.22	99.30	103.31				7.59	6.51	2.51
	189000	105.56		105.74	98.18	99.24	103.25	7.38	6.32	2.32	7.55	6.49	2.49
	188900			106.00	98.14	99.18	103.19				7.87	6.82	2.82
	188800			106.40	98.09	99.12	103.13				8.31	7.27	3.27
	188700			106.20	98.05	99.07	103.07				8.15	7.13	3.13
	188600			106.49	98.01	99.01	103.01				8.48	7.48	3.48
	188500	106.01		105.98	97.96	98.95	102.95	8.05	7.06	3.06	8.02	7.03	3.03
50.2	188471		105.88	105.90	97.95	98.93	102.93				7.95	6.97	2.97
	188400			106.02	97.86	98.84	102.85				8.16	7.17	3.17
	188300			105.82	97.73	98.72	102.74				8.09	7.10	3.08
	188200			105.83	97.60	98.60	102.63				8.23	7.23	3.20
	188100			105.86	97.47	98.48	102.52				8.39	7.38	3.34
	188000	105.65		105.60	97.34	98.36	102.41	8.31	7.29	3.24	8.26	7.25	3.20
	187900			105.52	97.21	98.23	102.30				8.31	7.29	3.22
50.06	187823		104.69	105.40	97.11	98.14	102.21				8.29	7.26	3.19
	187800			105.52	97.09	98.12	102.19				8.44	7.41	3.34
	187700			105.52	96.99	98.02	102.09				8.53	7.50	3.43
	187600			105.75	96.89	97.92	102.00				8.86	7.83	3.75
	187500	105.55		105.59	96.79	97.82	101.91	8.75	7.73	3.64	8.80	7.78	3.69
	187400			105.61	96.69	97.72	101.81				8.92	7.89	3.80
	187300			105.46	96.59	97.62	101.72				8.86	7.84	3.74
	187200			105.45	96.49	97.52	101.62				8.95	7.93	3.82
	187100			105.45	96.39	97.42	101.53				9.05	8.03	3.92
	187000	105.37		105.36	96.29	97.32	101.44	9.08	8.05	3.93	9.07	8.04	3.92

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	186900			105.07	96.20	97.22	101.34				8.87	7.85	3.72
	186800			105.04	96.10	97.12	101.25				8.95	7.92	3.79
	186700			104.86	96.00	97.02	101.16				8.86	7.84	3.71
49.78	186663		103.96	104.80	95.96	96.98	101.12				8.84	7.82	3.68
	186600			104.73	95.92	96.94	101.08				8.81	7.79	3.65
	186500	104.81		104.86	95.86	96.88	101.03	8.95	7.93	3.78	9.00	7.98	3.83
	186400			104.62	95.80	96.82	100.97				8.82	7.81	3.65
	186300			104.66	95.74	96.75	100.92				8.92	7.91	3.74
	186200			104.57	95.68	96.69	100.86				8.89	7.88	3.71
	186100			104.41	95.61	96.63	100.80				8.80	7.78	3.61
	186000	104.20		104.22	95.55	96.57	100.75	8.65	7.63	3.45	8.67	7.65	3.47
	185900			104.27	95.49	96.51	100.69				8.78	7.77	3.58
	185800	104.07		104.15	95.43	96.44	100.63	8.64	7.63	3.44	8.72	7.71	3.52
	185700			104.36	95.37	96.38	100.58				8.99	7.98	3.78
	185600			104.32	95.31	96.32	100.52				9.02	8.00	3.80
	185500	103.91		104.13	95.25	96.26	100.47	8.66	7.65	3.44	8.89	7.87	3.67
	185400			104.53	95.19	96.20	100.41				9.35	8.34	4.12
	185300	103.87		103.93	95.12	96.13	100.35	8.74	7.73	3.51	8.80	7.79	3.57
49.58	185294		102.98	103.80	95.12	96.13	100.35				8.68	7.67	3.45
	185200			103.99	95.07	96.08	100.30				8.92	7.91	3.69
	185100			103.82	95.02	96.02	100.24				8.80	7.80	3.58
	185000	103.46		103.79	94.97	95.97	100.18	8.50	7.49	3.28	8.82	7.82	3.60
	184900			103.56	94.92	95.92	100.13				8.65	7.65	3.43
	184800			103.15	94.86	95.86	100.07				8.29	7.29	3.08
	184700			103.68	94.81	95.81	100.02				8.86	7.87	3.66
	184600			103.52	94.76	95.75	99.96				8.76	7.77	3.56
	184500	103.26		103.66	94.71	95.70	99.90	8.56	7.57	3.36	8.95	7.96	3.76
	184400			103.65	94.66	95.64	99.85				9.00	8.01	3.80
	184300			103.72	94.60	95.59	99.79				9.12	8.13	3.93
	184200			103.64	94.55	95.53	99.73				9.09	8.10	3.90
49.38	184139		102.55	103.50	94.52	95.50	99.70				8.98	8.00	3.80
	184100			103.59	94.50	95.48	99.68				9.09	8.11	3.91
	184000	103.25		103.80	94.43	95.42	99.63	8.82	7.84	3.62	9.36	8.38	4.17
	183900			103.79	94.37	95.35	99.58				9.42	8.44	4.21
	183800			104.02	94.31	95.29	99.53				9.71	8.72	4.48
	183700			104.20	94.25	95.23	99.48				9.96	8.97	4.72
	183600			103.34	94.18	95.17	99.43				9.15	8.17	3.91
49.21	183514		102.68	102.70	94.13	95.12	99.39				8.57	7.58	3.31
	183500	102.23		102.90	94.12	95.11	99.38	8.11	7.12	2.85	8.78	7.79	3.52
	183400			102.78	94.07	95.06	99.34				8.71	7.72	3.44
	183300			102.67	94.01	95.00	99.29				8.66	7.67	3.38
	183200			102.61	93.95	94.95	99.25				8.66	7.66	3.36
	183100			102.63	93.89	94.89	99.20				8.74	7.74	3.43
48.99	183056		102.34	102.50	93.87	94.87	99.18				8.63	7.63	3.32
	183000	102.66		103.16	93.81	94.81	99.13	8.85	7.84	3.53	9.35	8.35	4.03
	182900			102.75	93.70	94.70	99.04				9.05	8.05	3.71
	182800			102.29	93.59	94.60	98.95				8.70	7.69	3.34
48.85	182754		100.91	102.00	93.54	94.55	98.91				8.46	7.45	3.09
	182700			102.23	93.53	94.54	98.90				8.70	7.69	3.33
	182600			102.04	93.51	94.52	98.88				8.53	7.52	3.16
	182500	101.91		102.31	93.49	94.49	98.85	8.42	7.41	3.05	8.83	7.82	3.46
	182400			101.80	93.47	94.47	98.83				8.33	7.32	2.96
	182300			101.69	93.44	94.45	98.81				8.24	7.24	2.88
	182200	101.51		101.78	93.42	94.43	98.79	8.09	7.08	2.72	8.36	7.35	2.99
	182100			102.22	93.40	94.41	98.77				8.81	7.81	3.45
	182000	101.91		102.16	93.38	94.38	98.74	8.53	7.52	3.16	8.78	7.78	3.42
	181900			101.83	93.36	94.36	98.72				8.47	7.47	3.11
48.66	181802		101.20	101.40	93.34	94.34	98.70				8.06	7.06	2.70
	181800			101.61	93.34	94.34	98.70				8.27	7.27	2.91
	181700			101.59	93.32	94.32	98.68				8.28	7.28	2.92
	181600			102.09	93.29	94.29	98.66				8.79	7.79	3.43
	181500	101.57		101.85	93.27	94.27	98.63	8.30	7.30	2.93	8.58	7.58	3.22
	181400			101.88	93.25	94.25	98.61				8.63	7.63	3.27
	181300			101.40	93.22	94.22	98.59				8.17	7.17	2.81
	181200			101.41	93.20	94.20	98.57				8.21	7.21	2.85
	181100			101.55	93.18	94.18	98.54				8.37	7.37	3.01
	181000			101.61	93.16	94.16	98.52				8.46	7.46	3.09
	180900			101.37	93.13	94.13	98.50				8.24	7.24	2.87
	180800			101.47	93.11	94.11	98.48				8.36	7.36	3.00
	180700			101.65	93.09	94.09	98.45				8.56	7.56	3.19
	180600			101.57	93.06	94.06	98.43				8.51	7.51	3.14
	180500			101.39	93.04	94.04	98.41				8.35	7.35	2.98
48.39	180454		100.74	101.00	93.03	94.03	98.40				7.97	6.97	2.60
	180400			100.91	93.01	94.01	98.38				7.90	6.90	2.52
	180300			100.91	92.98	93.98	98.35				7.93	6.93	2.55
	180200			100.70	92.95	93.95	98.32				7.75	6.75	2.38
	180100			100.72	92.91	93.91	98.29				7.81	6.81	2.43
	180000			100.75	92.88	93.88	98.26				7.87	6.87	2.49
	179900			100.64	92.85	93.85	98.23				7.80	6.80	2.42
	179800			100.59	92.81	93.81	98.20				7.78	6.78	2.39
	179700			100.51	92.78	93.78	98.16				7.73	6.73	2.34
	179600			100.32	92.75	93.75	98.13				7.58	6.58	2.19
	179500			100.10	92.71	93.71	98.10				7.39	6.39	2.00
48.21	179460		99.29	100.00	92.70	93.70	98.09				7.30	6.30	1.91
	179400			100.06	92.62	93.62	98.04				7.44	6.44	2.03
	179300			99.93	92.50	93.50	97.95				7.43	6.43	1.98
	179200			99.90	92.37	93.37	97.86				7.53	6.53	2.04
48.07	179109		99.17	99.80	92.26	93.26	97.78				7.54	6.54	2.02
	179100			99.96	92.26	93.26	97.78				7.70	6.70	2.18
	179000			99.93	92.22	93.22	97.75				7.72	6.71	2.18

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	178900			100.38	92.18	93.18	97.73				8.21	7.20	2.66
	178800			100.35	92.14	93.14	97.70				8.21	7.21	2.65
	178700			100.08	92.10	93.10	97.67				7.98	6.97	2.41
	178600			100.12	92.06	93.07	97.65				8.06	7.05	2.47
	178500			100.20	92.02	93.03	97.62				8.18	7.17	2.58
	178400			100.25	91.98	92.99	97.59				8.27	7.26	2.66
	178300			100.32	91.94	92.95	97.57				8.38	7.37	2.75
	178200			100.48	91.90	92.91	97.54				8.58	7.57	2.94
	178100			100.35	91.86	92.87	97.52				8.49	7.47	2.83
	178000			100.28	91.82	92.84	97.49				8.46	7.44	2.79
	177900			100.39	91.78	92.80	97.46				8.60	7.59	2.92
	177800			100.53	91.74	92.76	97.44				8.78	7.76	3.09
	177700			100.24	91.70	92.72	97.41				8.54	7.52	2.83
	177600			100.36	91.66	92.68	97.38				8.70	7.68	2.98
	177500			100.40	91.62	92.65	97.36				8.78	7.76	3.04
	177400			100.44	91.58	92.61	97.33				8.86	7.83	3.11
	177300			100.45	91.54	92.57	97.31				8.90	7.88	3.14
	177200			100.25	91.51	92.53	97.28				8.75	7.72	2.97
	177100			100.16	91.47	92.49	97.25				8.70	7.67	2.91
	177000			100.15	91.43	92.46	97.23				8.73	7.70	2.93
47.7	176934		100.22	100.20	91.40	92.43	97.21				8.80	7.77	2.99
	176900			100.33	91.38	92.41	97.20				8.95	7.92	3.13
	176800			100.24	91.32	92.36	97.17				8.92	7.88	3.07
	176700			100.22	91.26	92.31	97.14				8.96	7.92	3.08
	176600			100.10	91.21	92.25	97.11				8.90	7.85	2.99
	176500	99.85		100.21	91.15	92.20	97.08	8.70	7.65	2.76	9.06	8.01	3.12
	176400	99.46		99.85	91.09	92.15	97.06	8.37	7.32	2.41	8.76	7.70	2.80
	176300			99.38	91.03	92.10	97.03				8.35	7.28	2.35
	176200			99.30	90.97	92.04	97.00				8.33	7.26	2.30
	176100			99.21	90.92	91.99	96.97				8.29	7.22	2.24
	176000	99.09		99.28	90.86	91.94	96.94	8.23	7.15	2.15	8.42	7.34	2.34
47.55	175968		99.92	99.10	90.84	91.92	96.93				8.26	7.18	2.17
	175900			99.15	90.82	91.90	96.92				8.33	7.25	2.23
	175800			98.95	90.79	91.87	96.89				8.16	7.08	2.05
	175700			98.92	90.76	91.84	96.87				8.16	7.08	2.05
	175600			98.68	90.72	91.81	96.85				7.96	6.87	1.83
	175500	98.52		98.80	90.69	91.78	96.83	7.83	6.74	1.69	8.11	7.02	1.97
	175400			98.74	90.66	91.75	96.81				8.08	6.99	1.94
	175300			99.04	90.63	91.72	96.79				8.41	7.32	2.25
	175200			99.05	90.60	91.69	96.77				8.45	7.35	2.28
	175100			98.91	90.57	91.66	96.74				8.35	7.25	2.17
	175000	98.36		98.70	90.53	91.63	96.72	7.82	6.72	1.64	8.17	7.06	1.98
	174900			98.67	90.50	91.61	96.70				8.16	7.06	1.97
	174800			98.89	90.47	91.58	96.68				8.42	7.32	2.21
	174700	98.37		98.75	90.44	91.55	96.66	7.93	6.83	1.71	8.31	7.20	2.09
	174600			98.73	90.41	91.52	96.64				8.33	7.22	2.10
	174500	98.19		98.72	90.38	91.49	96.62	7.81	6.70	1.57	8.34	7.23	2.10
	174400			98.25	90.34	91.46	96.59				7.91	6.79	1.66
	174300			98.22	90.31	91.43	96.57				7.90	6.79	1.64
	174200			98.02	90.28	91.40	96.55				7.74	6.62	1.47
47.2	174103		98.11	97.80	90.25	91.37	96.53				7.55	6.43	1.27
	174100			97.88	90.25	91.37	96.53				7.63	6.51	1.35
	174000	97.57		97.87	90.22	91.34	96.51	7.35	6.23	1.06	7.65	6.53	1.36
	173900			97.76	90.19	91.31	96.49				7.58	6.45	1.27
	173800			97.86	90.16	91.28	96.47				7.71	6.58	1.39
	173700			97.57	90.13	91.25	96.45				7.44	6.32	1.12
	173600			97.71	90.10	91.22	96.43				7.62	6.49	1.28
	173500	97.28		97.65	90.07	91.19	96.41	7.22	6.09	0.87	7.58	6.45	1.23
	173400			97.77	90.04	91.17	96.39				7.73	6.60	1.38
47.04	173346		98.89	97.50	90.02	91.15	96.38				7.48	6.35	1.12
	173300			97.30	89.99	91.12	96.36				7.31	6.18	0.94
	173200			97.24	89.92	91.05	96.33				7.32	6.19	0.91
	173100			97.30	89.86	90.98	96.29				7.44	6.32	1.01
	173000	97.26		97.48	89.79	90.90	96.25	7.46	6.35	1.00	7.69	6.57	1.22
	172900			97.56	89.73	90.83	96.22				7.83	6.72	1.34
	172800			97.27	89.66	90.76	96.18				7.61	6.51	1.09
	172700			97.23	89.59	90.69	96.14				7.63	6.53	1.08
	172600			97.13	89.53	90.62	96.11				7.60	6.51	1.02
	172500	96.60		96.92	89.46	90.55	96.07	7.14	6.05	0.53	7.46	6.37	0.85
46.69	172499		97.15	96.70	89.46	90.55	96.07				7.24	6.15	0.63
	172400	96.55		97.01	89.42	90.51	96.05	7.13	6.05	0.50	7.60	6.51	0.97
	172300			96.71	89.38	90.46	96.02				7.34	6.25	0.69
	172200			97.00	89.34	90.41	96.00				7.66	6.58	1.00
	172100			96.94	89.30	90.37	95.97				7.65	6.57	0.97
	172000	96.72		97.19	89.26	90.32	95.95	7.47	6.40	0.77	7.94	6.87	1.24
	171900			97.16	89.21	90.28	95.93				7.95	6.88	1.24
	171800			97.14	89.17	90.23	95.90				7.96	6.90	1.23
46.53	171792		97.59	97.10	89.17	90.23	95.90				7.93	6.87	1.20
	171700			97.24	89.17	90.23	95.90				8.07	7.01	1.34
	171600			97.20	89.17	90.23	95.90				8.03	6.97	1.30
	171500	96.68		97.13	89.17	90.23	95.90	7.51	6.45	0.78	7.96	6.90	1.23
46.45	171455		98.11	97.00	89.17	90.23	95.90				7.83	6.77	1.10
	171400			96.95	89.13	90.19	95.87				7.81	6.75	1.08
	171300			96.99	89.07	90.13	95.81				7.92	6.86	1.18
	171200			96.90	89.01	90.07	95.74				7.90	6.84	1.16
46.2	171128		97.83	97.00	88.96	90.02	95.70				8.04	6.98	1.30
	171100			97.09	88.95	90.01	95.69				8.14	7.08	1.40
	171000	96.70		97.00	88.91	89.97	95.65	7.79	6.73	1.05	8.10	7.03	1.35
	170900			97.01	88.87	89.94	95.61				8.14	7.07	1.39
	170800			96.98	88.83	89.90	95.58				8.15	7.08	1.40

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	170700			96.72	88.79	89.86	95.54				7.93	6.85	1.18
	170600			96.95	88.75	89.83	95.50				8.20	7.12	1.45
45.98	170521		98.03	97.00	88.72	89.80	95.47				8.28	7.20	1.53
	170500	96.63		96.94	88.71	89.79	95.46	7.92	6.84	1.16	8.23	7.15	1.48
	170400			97.05	88.67	89.75	95.43				8.38	7.29	1.61
	170300			97.05	88.63	89.72	95.40				8.42	7.33	1.65
	170200			97.09	88.59	89.68	95.36				8.50	7.41	1.73
	170100			97.08	88.55	89.64	95.33				8.53	7.43	1.74
	170000	96.86		97.26	88.51	89.60	95.30	8.36	7.26	1.56	8.75	7.66	1.96
	169900			97.31	88.46	89.57	95.27				8.85	7.74	2.04
	169800			97.36	88.42	89.53	95.23				8.93	7.83	2.12
	169700			97.30	88.38	89.49	95.20				8.92	7.81	2.10
	169600			97.16	88.34	89.45	95.17				8.82	7.71	1.99
	169500	97.14		97.11	88.30	89.41	95.14	8.84	7.73	2.00	8.81	7.69	1.97
	169400			96.63	88.26	89.38	95.10				8.37	7.26	1.53
45.71	169331		97.13	96.40	88.23	89.35	95.08				8.17	7.05	1.32
	169300			96.48	88.22	89.34	95.07				8.26	7.14	1.41
	169200			96.42	88.20	89.32	95.05				8.22	7.10	1.37
	169100			96.54	88.17	89.29	95.03				8.37	7.25	1.51
	169000	96.98		96.32	88.15	89.27	95.01	8.84	7.71	1.97	8.17	7.05	1.31
	168900			97.09	88.12	89.24	94.99				8.97	7.84	2.10
	168800			96.92	88.09	89.22	94.97				8.83	7.70	1.96
	168700			96.97	88.07	89.20	94.94				8.90	7.78	2.03
	168600			96.96	88.04	89.17	94.92				8.91	7.78	2.03
	168500	96.80		96.84	88.02	89.15	94.90	8.78	7.65	1.90	8.82	7.69	1.94
	168400			96.65	87.99	89.12	94.88				8.66	7.53	1.77
45.58	168312		97.22	96.70	87.97	89.10	94.86				8.73	7.60	1.84
	168300			96.77	87.97	89.10	94.86				8.80	7.67	1.91
	168200			96.94	87.96	89.09	94.85				8.98	7.85	2.09
	168100			96.64	87.94	89.08	94.84				8.69	7.56	1.80
	168000	96.55		96.59	87.93	89.06	94.82	8.62	7.49	1.73	8.65	7.52	1.76
	167900			96.36	87.92	89.05	94.81				8.44	7.31	1.55
	167800			96.54	87.91	89.04	94.80				8.63	7.49	1.73
	167700			96.23	87.90	89.03	94.79				8.34	7.20	1.44
	167600			96.04	87.88	89.02	94.78				8.16	7.03	1.27
	167500	96.17		96.24	87.87	89.01	94.77	8.30	7.16	1.40	8.37	7.24	1.48
	167400			96.00	87.86	88.99	94.75				8.14	7.01	1.25
	167300			95.82	87.85	88.98	94.74				7.97	6.83	1.07
	167200			95.55	87.83	88.97	94.73				7.72	6.58	0.82
	167100			95.38	87.82	88.96	94.72				7.56	6.42	0.66
	167000			95.21	87.81	88.95	94.71				7.40	6.26	0.50
45.44	166924		95.20	95.20	87.80	88.94	94.70				7.40	6.26	0.50
	166900			95.37	87.80	88.94	94.70				7.57	6.43	0.67
	166800			95.00	87.78	88.92	94.68				7.23	6.08	0.32
	166700			95.14	87.76	88.90	94.66				7.38	6.24	0.48
	166600			95.25	87.74	88.89	94.65				7.52	6.37	0.61
	166500			95.43	87.72	88.87	94.63				7.71	6.56	0.80
	166400			95.14	87.70	88.85	94.61				7.44	6.28	0.52
	166300			95.03	87.68	88.84	94.60				7.35	6.19	0.43
	166200			95.08	87.66	88.82	94.58				7.42	6.26	0.50
	166100			95.15	87.64	88.80	94.56				7.51	6.35	0.59
	166000			95.01	87.62	88.79	94.55				7.39	6.22	0.46
	165900			95.14	87.60	88.77	94.53				7.54	6.37	0.61
	165800			95.04	87.58	88.75	94.51				7.46	6.29	0.53
45.26	165726		94.20	95.00	87.57	88.74	94.50				7.43	6.26	0.50
	165700			95.05	87.57	88.74	94.50				7.48	6.31	0.55
	165600			94.74	87.55	88.72	94.48				7.19	6.02	0.26
	165500			94.62	87.53	88.70	94.46				7.09	5.92	0.16
	165400			94.98	87.51	88.68	94.44				7.47	6.30	0.54
	165300			95.00	87.50	88.67	94.43				7.50	6.33	0.57
	165200			95.29	87.48	88.65	94.41				7.81	6.64	0.88
	165100			94.88	87.46	88.63	94.39				7.42	6.25	0.49
	165000			94.85	87.45	88.62	94.38				7.40	6.23	0.47
	164900			95.06	87.43	88.60	94.36				7.63	6.46	0.70
	164800			95.09	87.41	88.58	94.34				7.68	6.51	0.75
45.03	164733		85.35	94.80	87.40	88.57	94.33				7.40	6.23	0.47
	164700			95.00	87.40	88.57	94.33				7.61	6.44	0.68
	164600			95.05	87.38	88.55	94.31				7.67	6.50	0.74
	164500			95.10	87.37	88.54	94.30				7.73	6.56	0.80
	164400			95.07	87.36	88.53	94.29				7.71	6.54	0.78
	164300			95.19	87.34	88.51	94.27				7.85	6.68	0.92
	164200			94.97	87.33	88.50	94.26				7.64	6.47	0.71
	164100			94.85	87.31	88.49	94.25				7.53	6.36	0.60
	164000			94.96	87.30	88.48	94.24				7.66	6.48	0.72
	163900			94.89	87.29	88.46	94.22				7.60	6.42	0.66
	163800			94.91	87.27	88.45	94.21				7.64	6.46	0.70
	163700			94.98	87.26	88.44	94.20				7.72	6.55	0.79
	163600			95.08	87.25	88.42	94.18				7.83	6.66	0.90
	163500			95.09	87.23	88.41	94.17				7.86	6.68	0.92
	163400			95.05	87.22	88.40	94.16				7.83	6.65	0.89
	163300			95.04	87.21	88.39	94.15				7.83	6.65	0.89
44.76	163251		85.34	95.00	87.20	88.38	94.14				7.80	6.62	0.86
	163200			94.96	87.20	88.38	94.14				7.76	6.58	0.82
	163100			94.95	87.19	88.37	94.13				7.76	6.58	0.82
	163000			95.00	87.19	88.37	94.13				7.82	6.63	0.88
	162900			94.89	87.18	88.37	94.12				7.71	6.53	0.77
	162800			94.76	87.18	88.36	94.12				7.58	6.40	0.64
	162700			94.85	87.18	88.36	94.12				7.67	6.49	0.73
	162600			94.73	87.17	88.35	94.11				7.56	6.37	0.62
	162500			94.77	87.17	88.35	94.11				7.60	6.42	0.66

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	162400			94.94	87.16	88.35	94.10				7.77	6.59	0.83
	162300			94.72	87.16	88.34	94.10				7.56	6.38	0.62
	162200			94.93	87.15	88.34	94.09				7.78	6.59	0.84
	162100			94.72	87.15	88.33	94.09				7.57	6.39	0.63
	162000	94.12		94.43	87.14	88.33	94.08	6.98	5.79	0.04	7.28	6.09	0.34
	161900			94.33	87.14	88.33	94.08				7.19	6.00	0.25
	161800			94.73	87.14	88.32	94.08				7.60	6.41	0.66
	161700			94.28	87.13	88.32	94.07				7.15	5.96	0.21
	161600			94.40	87.13	88.32	94.07				7.28	6.09	0.34
	161500	94.21		94.54	87.12	88.31	94.06	7.09	5.90	0.15	7.42	6.23	0.48
	161400			94.38	87.12	88.31	94.06				7.26	6.07	0.32
	161300			94.49	87.11	88.30	94.05				7.37	6.18	0.43
44.6326	161214		88.81	94.10	87.11	88.30	94.05				6.99	5.80	0.05
	161200	94.05		94.21	87.11	88.30	94.05	6.94	5.75	0.00	7.10	5.91	0.16
	161100			94.10	87.09	88.28	94.03				7.01	5.82	0.07
	161000	94.00		94.32	87.08	88.27	94.02	6.92	5.73	-0.02	7.23	6.04	0.29
	160900			94.14	87.07	88.26	94.01				7.07	5.88	0.13
	160800			94.34	87.05	88.24	93.99				7.28	6.09	0.34
	160700	93.90		94.09	87.04	88.23	93.98	6.86	5.67	-0.08	7.05	5.86	0.11
	160600			93.99	87.03	88.22	93.97				6.96	5.77	0.02
	160500	93.72		93.93	87.01	88.20	93.95	6.70	5.51	-0.24	6.91	5.72	-0.03
	160400			94.10	87.00	88.19	93.94				7.09	5.90	0.15
	160300			94.10	86.99	88.18	93.93				7.11	5.92	0.17
	160200			94.18	86.97	88.16	93.91				7.21	6.02	0.27
	160100			94.22	86.96	88.15	93.90				7.26	6.07	0.32
44.5	160088		91.40	94.00	86.96	88.15	93.90				7.04	5.85	0.10
	160000	93.79		94.00	86.94	88.13	93.88	6.85	5.66	-0.09	7.07	5.88	0.13
	159900			93.99	86.91	88.10	93.85				7.09	5.89	0.14
	159800			94.28	86.88	88.07	93.82				7.40	6.21	0.46
	159700			93.93	86.85	88.05	93.80				7.08	5.88	0.13
	159600			93.88	86.82	88.02	93.77				7.06	5.86	0.11
	159500	93.74		93.81	86.79	87.99	93.74	6.95	5.75	0.00	7.02	5.82	0.07
	159400			93.93	86.77	87.96	93.71				7.17	5.97	0.22
44.23	159311		86.23	93.80	86.74	87.94	93.69				7.06	5.86	0.11
	159300			93.96	86.73	87.93	93.69				7.22	6.02	0.27
	159200			93.67	86.68	87.89	93.64				7.00	5.79	0.03
	159100			93.63	86.62	87.84	93.60				7.01	5.79	0.02
	159000	93.40		93.53	86.56	87.79	93.56	6.83	5.61	-0.16	6.97	5.75	-0.03
	158900			93.44	86.51	87.74	93.52				6.94	5.71	-0.08
	158800			93.45	86.45	87.69	93.48				7.00	5.76	-0.03
	158700			93.47	86.39	87.64	93.44				7.08	5.83	0.03
	158600			93.77	86.34	87.59	93.40				7.43	6.18	0.37
	158500	93.54		93.76	86.28	87.54	93.35	7.26	6.00	0.18	7.48	6.22	0.40
	158400	93.75		94.08	86.22	87.49	93.31	7.52	6.25	0.43	7.86	6.59	0.77
	158300			93.89	86.17	87.44	93.27				7.73	6.45	0.62
43.46	158271		87.40	93.40	86.15	87.43	93.26				7.25	5.97	0.14
	158200			93.51	86.12	87.40	93.24				7.39	6.11	0.27
	158100			93.32	86.08	87.37	93.21				7.23	5.95	0.11
	158000	92.83		93.08	86.04	87.33	93.18	6.79	5.50	-0.35	7.04	5.75	-0.10
	157900			93.17	86.00	87.29	93.15				7.17	5.88	0.02
	157800			93.19	85.96	87.25	93.12				7.23	5.93	0.07
	157700			93.26	85.92	87.22	93.09				7.34	6.04	0.17
43.34	157628		91.83	93.00	85.89	87.19	93.07				7.11	5.81	-0.07
	157600			93.19	85.88	87.18	93.07				7.32	6.01	0.13
	157500	92.94		93.06	85.83	87.14	93.05	7.11	5.80	-0.12	7.23	5.92	0.01
	157400			93.23	85.78	87.10	93.04				7.45	6.13	0.19
43.28	157374		92.10	93.10	85.77	87.09	93.04				7.33	6.01	0.06
	157300			93.36	85.73	87.05	93.02				7.63	6.31	0.34
	157200			93.19	85.67	87.01	92.99				7.52	6.19	0.20
43.23	157105		91.91	93.00	85.62	86.96	92.97				7.38	6.04	0.03
	157100			93.07	85.62	86.96	92.97				7.45	6.11	0.10
	157000	92.91		93.17	85.56	86.90	92.94	7.36	6.01	-0.03	7.62	6.27	0.23
	156900			93.28	85.50	86.85	92.92				7.79	6.43	0.36
	156800			93.31	85.43	86.80	92.90				7.88	6.51	0.42
	156700			93.10	85.37	86.75	92.87				7.73	6.35	0.23
43.12	156613		85.70	93.00	85.32	86.70	92.85				7.68	6.30	0.15
	156600			93.23	85.31	86.69	92.85				7.92	6.54	0.39
	156500	92.77		93.18	85.27	86.66	92.83	7.50	6.11	-0.06	7.92	6.53	0.36
43.06	156460		85.60	92.90	85.25	86.64	92.82				7.65	6.26	0.08
	156400			92.94	85.23	86.63	92.80				7.70	6.31	0.13
	156300			92.94	85.20	86.60	92.77				7.74	6.34	0.17
43.01	156249		86.14	92.70	85.19	86.59	92.76				7.51	6.11	-0.06
	156200			92.72	85.19	86.59	92.76				7.54	6.14	-0.03
	156100			92.75	85.18	86.58	92.75				7.57	6.16	-0.01
	156000	92.78		93.03	85.18	86.58	92.75	7.60	6.20	0.03	7.86	6.46	0.28
	155900			92.78	85.17	86.57	92.75				7.61	6.21	0.04
	155800			92.68	85.16	86.57	92.74				7.52	6.11	-0.06
	155700			92.94	85.16	86.56	92.74				7.78	6.38	0.20
	155600			92.95	85.15	86.56	92.74				7.80	6.39	0.22
	155500	92.80		92.97	85.15	86.55	92.73	7.65	6.25	0.07	7.82	6.41	0.23
	155400			92.84	85.14	86.55	92.73				7.70	6.29	0.11
	155300			92.86	85.14	86.54	92.73				7.73	6.32	0.14
	155200			92.77	85.13	86.54	92.72				7.64	6.23	0.05
	155100			92.79	85.13	86.53	92.72				7.66	6.25	0.07
	155000	92.51		92.81	85.12	86.53	92.71	7.39	5.98	-0.20	7.69	6.28	0.09
	154900			92.69	85.11	86.52	92.71				7.58	6.17	-0.02
	154800			92.68	85.11	86.52	92.71				7.57	6.16	-0.03
	154700			92.74	85.10	86.52	92.70				7.64	6.23	0.04
	154600			92.55	85.10	86.51	92.70				7.45	6.04	-0.15
	154500	92.22		92.61	85.09	86.51	92.70	7.13	5.72	-0.47	7.52	6.11	-0.08

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	154400			92.64	85.09	86.50	92.69				7.56	6.14	-0.05
	154300			92.86	85.08	86.50	92.69				7.78	6.37	0.18
	154200			92.56	85.07	86.49	92.69				7.48	6.07	-0.13
	154100			92.62	85.07	86.49	92.68				7.55	6.14	-0.06
	154000	92.34		92.58	85.06	86.48	92.68	7.28	5.86	-0.34	7.51	6.09	-0.10
	153900			92.43	85.06	86.48	92.67				7.37	5.95	-0.24
	153800			92.65	85.05	86.47	92.67				7.59	6.17	-0.03
42.65	153766		91.30	92.40	85.05	86.47	92.67				7.35	5.93	-0.27
	153700			92.44	85.03	86.45	92.65				7.42	6.00	-0.21
	153600	92.40		92.55	84.99	86.42	92.62	7.41	5.99	-0.22	7.56	6.14	-0.07
	153500	92.28		92.38	84.96	86.39	92.59	7.32	5.89	-0.31	7.43	6.00	-0.21
	153400			92.29	84.92	86.35	92.56				7.37	5.94	-0.27
	153300	91.77		92.03	84.88	86.32	92.53	6.88	5.44	-0.76	7.14	5.71	-0.50
42.47	153203		91.00	92.10	84.85	86.29	92.50				7.25	5.81	-0.40
	153200			92.20	84.85	86.29	92.50				7.35	5.91	-0.30
	153100			92.33	84.75	86.20	92.43				7.58	6.13	-0.10
	153000	92.06		92.25	84.65	86.11	92.35	7.42	5.96	-0.29	7.60	6.14	-0.10
42.19	152912		91.16	91.90	84.56	86.03	92.29				7.34	5.87	-0.39
	152900			92.03	84.56	86.03	92.29				7.48	6.00	-0.26
	152800			91.99	84.53	86.00	92.27				7.46	5.98	-0.29
	152700			91.89	84.50	85.98	92.26				7.39	5.91	-0.37
42.01	152695		91.28	91.90	84.50	85.98	92.26				7.40	5.92	-0.36
	152600			92.01	84.44	85.92	92.22				7.57	6.09	-0.21
	152500	92.02		92.01	84.37	85.86	92.17	7.65	6.16	-0.15	7.64	6.15	-0.16
	152400			91.97	84.31	85.80	92.13				7.66	6.17	-0.16
41.61	152341		91.31	92.10	84.27	85.77	92.10				7.83	6.33	0.00
	152300			92.12	84.26	85.76	92.09				7.86	6.36	0.02
	152200			91.85	84.24	85.74	92.08				7.61	6.10	-0.23
	152100			92.08	84.21	85.73	92.06				7.87	6.35	0.02
	152000	91.48		91.51	84.19	85.71	92.04	7.28	5.77	-0.57	7.32	5.80	-0.54
41.55	151908		88.88	91.30	84.17	85.69	92.03				7.13	5.61	-0.73
	151900			91.30	84.17	85.69	92.03				7.13	5.61	-0.73
	151800			91.40	84.15	85.67	92.02				7.25	5.73	-0.62
	151700			91.58	84.13	85.65	92.00				7.45	5.92	-0.43
	151600			91.70	84.11	85.64	91.99				7.59	6.06	-0.29
	151500	91.52		91.65	84.09	85.62	91.98	7.43	5.90	-0.46	7.57	6.04	-0.33
	151400			91.81	84.07	85.60	91.97				7.75	6.21	-0.16
	151300			91.94	84.04	85.58	91.96				7.90	6.36	-0.01
	151200			91.57	84.02	85.57	91.94				7.54	6.00	-0.38
	151100			91.49	84.00	85.55	91.93				7.49	5.94	-0.44
	151000	91.48		91.56	83.98	85.53	91.92	7.50	5.95	-0.44	7.58	6.03	-0.36
	150900			91.42	83.96	85.51	91.91				7.46	5.91	-0.48
	150800			91.29	83.94	85.50	91.89				7.35	5.80	-0.60
	150700			91.24	83.92	85.48	91.88				7.32	5.76	-0.64
41.2	150601		83.47	91.40	83.90	85.46	91.87				7.50	5.94	-0.47
	150600			91.48	83.90	85.46	91.87				7.58	6.02	-0.39
	150500	91.45		91.45	83.85	85.42	91.84	7.60	6.03	-0.39	7.60	6.03	-0.38
	150400			91.34	83.80	85.37	91.80				7.54	5.97	-0.46
	150300			91.54	83.74	85.33	91.77				7.80	6.21	-0.23
40.7	150272		90.38	91.50	83.73	85.32	91.76				7.77	6.18	-0.26
	150200			91.54	83.70	85.30	91.74				7.83	6.24	-0.20
	150100			91.29	83.67	85.26	91.72				7.62	6.03	-0.42
	150000	91.41		91.58	83.63	85.23	91.69	7.78	6.18	-0.28	7.95	6.35	-0.11
	149900			90.98	83.60	85.20	91.67				7.39	5.78	-0.68
	149800			90.97	83.56	85.17	91.64				7.41	5.80	-0.67
	149700			91.11	83.53	85.14	91.62				7.59	5.98	-0.50
	149600			91.35	83.49	85.10	91.59				7.85	6.25	-0.24
40.49	149590		90.79	91.40	83.49	85.10	91.59				7.91	6.30	-0.19
	149500	91.24		91.29	83.46	85.07	91.57	7.78	6.16	-0.33	7.83	6.22	-0.28
	149400			91.30	83.43	85.04	91.55				7.87	6.26	-0.25
	149300			91.02	83.39	85.01	91.52				7.62	6.00	-0.50
	149200			90.95	83.36	84.98	91.50				7.59	5.96	-0.55
	149100			90.95	83.33	84.95	91.47				7.62	5.99	-0.53
	149000	91.30		91.24	83.29	84.92	91.45	8.01	6.38	-0.15	7.95	6.32	-0.21
40.19	148995		90.72	91.30	83.29	84.92	91.45				8.01	6.38	-0.15
	148900			91.40	83.27	84.90	91.43				8.14	6.50	-0.03
	148800			91.33	83.24	84.87	91.41				8.09	6.45	-0.09
	148700			91.13	83.21	84.85	91.40				7.92	6.28	-0.27
	148600			91.22	83.19	84.83	91.38				8.04	6.39	-0.16
	148500	91.72		91.85	83.16	84.81	91.36	8.56	6.92	0.36	8.69	7.05	0.49
	148400			91.82	83.13	84.78	91.34				8.69	7.04	0.48
	148300			91.54	83.11	84.76	91.32				8.43	6.78	0.22
	148200			91.63	83.08	84.74	91.31				8.55	6.90	0.33
	148100			91.74	83.06	84.71	91.29				8.69	7.03	0.46
	148000	91.30		91.77	83.03	84.69	91.27	8.27	6.61	0.03	8.74	7.08	0.50
	147900			91.30	83.00	84.67	91.25				8.30	6.63	0.05
	147800			91.28	82.98	84.64	91.23				8.30	6.63	0.04
	147700			91.45	82.95	84.62	91.22				8.50	6.83	0.24
	147600			91.26	82.93	84.60	91.20				8.34	6.67	0.07
	147500	91.17		91.31	82.90	84.58	91.18	8.27	6.60	-0.01	8.41	6.73	0.13
	147400			91.75	82.87	84.55	91.16				8.88	7.20	0.59
	147300			91.52	82.85	84.53	91.14				8.67	6.99	0.38
	147200			91.71	82.82	84.51	91.13				8.89	7.21	0.59
	147100			91.63	82.80	84.48	91.11				8.83	7.15	0.52
39.45	147001		90.84	91.60	82.77	84.46	91.09				8.83	7.14	0.51
	147000	91.50		91.63	82.77	84.46	91.09	8.73	7.04	0.41	8.86	7.17	0.54
	146900			91.52	82.74	84.43	91.07				8.78	7.09	0.46
	146800			91.43	82.71	84.41	91.05				8.72	7.02	0.39
	146700			91.45	82.69	84.38	91.03				8.76	7.07	0.42
	146600			92.10	82.66	84.36	91.01				9.44	7.74	1.09

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	146500	91.85		92.11	82.63	84.33	90.99	9.22	7.51	0.86	9.47	7.77	1.12
	146400			91.57	82.60	84.31	90.96				8.97	7.26	0.61
	146300			91.55	82.58	84.28	90.94				8.98	7.27	0.61
	146200			91.38	82.55	84.26	90.92				8.83	7.12	0.46
	146100			91.12	82.52	84.23	90.90				8.60	6.89	0.22
	146000	90.90		91.10	82.49	84.21	90.88	8.41	6.70	0.02	8.61	6.89	0.22
	145900			91.20	82.47	84.18	90.86				8.74	7.02	0.34
39.23	145808		85.16	91.00	82.44	84.16	90.84				8.56	6.84	0.16
	145800			91.23	82.44	84.16	90.84				8.79	7.07	0.39
	145700			91.01	82.41	84.13	90.82				8.60	6.88	0.20
	145600			91.06	82.39	84.11	90.80				8.68	6.95	0.27
	145500	90.55		90.76	82.36	84.09	90.78	8.19	6.47	-0.23	8.41	6.68	-0.01
	145400			91.29	82.33	84.06	90.76				8.96	7.23	0.54
	145300			91.60	82.31	84.04	90.74				9.29	7.56	0.86
	145200			91.69	82.28	84.01	90.72				9.41	7.68	0.97
	145100			91.83	82.25	83.99	90.70				9.58	7.84	1.13
	145000	91.27		91.80	82.23	83.96	90.68	9.05	7.31	0.60	9.57	7.83	1.12
	144900			91.82	82.20	83.94	90.66				9.62	7.89	1.17
	144800			91.87	82.17	83.91	90.64				9.69	7.95	1.23
	144700			91.54	82.15	83.89	90.62				9.39	7.65	0.92
	144600			91.28	82.12	83.87	90.60				9.15	7.41	0.68
	144500	90.99		91.39	82.09	83.84	90.58	8.89	7.14	0.41	9.30	7.55	0.82
	144400			91.51	82.07	83.82	90.56				9.44	7.69	0.95
38.94	144368		90.10	91.30	82.06	83.81	90.55				9.24	7.49	0.75
	144300			91.54	82.05	83.80	90.54				9.49	7.74	1.00
	144200			91.64	82.03	83.78	90.52				9.61	7.86	1.12
	144100			91.83	82.01	83.76	90.51				9.83	8.07	1.32
	144000	91.40		91.70	81.99	83.74	90.49	9.41	7.66	0.90	9.71	7.96	1.21
	143900			92.04	81.97	83.72	90.48				10.07	8.31	1.56
	143800			91.92	81.95	83.71	90.46				9.97	8.22	1.46
	143700			91.70	81.93	83.69	90.45				9.77	8.01	1.25
	143600			91.54	81.91	83.67	90.43				9.63	7.87	1.10
	143500	91.04		91.42	81.89	83.65	90.42	9.15	7.39	0.62	9.53	7.77	1.00
	143400			91.11	81.87	83.63	90.40				9.24	7.47	0.70
	143300			91.28	81.85	83.62	90.39				9.43	7.66	0.89
	143200			91.40	81.83	83.60	90.37				9.57	7.80	1.02
38.71	143106		89.86	91.30	81.81	83.58	90.36				9.49	7.72	0.94
	143100			91.50	81.81	83.58	90.36				9.69	7.92	1.14
	143000	91.28		91.52	81.80	83.57	90.35	9.48	7.71	0.93	9.72	7.95	1.17
	142900			91.36	81.79	83.56	90.34				9.58	7.80	1.02
	142800			91.40	81.77	83.55	90.33				9.63	7.86	1.07
	142700			91.45	81.76	83.54	90.32				9.68	7.91	1.12
	142600			91.39	81.75	83.53	90.31				9.64	7.87	1.08
	142500	90.66		91.21	81.74	83.52	90.31	8.92	7.14	0.35	9.47	7.69	0.90
	142400			91.15	81.73	83.51	90.30				9.42	7.64	0.85
	142300			91.19	81.71	83.50	90.29				9.47	7.69	0.90
	142200			91.01	81.70	83.49	90.28				9.31	7.52	0.73
	142100			90.99	81.69	83.48	90.27				9.30	7.52	0.72
	142000	90.32		90.84	81.68	83.46	90.26	8.64	6.85	0.05	9.16	7.37	0.58
	141900			91.08	81.67	83.45	90.25				9.41	7.63	0.83
	141800			90.83	81.66	83.44	90.24				9.17	7.39	0.59
	141700			90.86	81.64	83.43	90.23				9.21	7.42	0.62
38.45	141664		87.30	90.80	81.64	83.43	90.23				9.16	7.37	0.57
	141600			90.89	81.63	83.42	90.22				9.26	7.47	0.67
	141500	90.38		91.06	81.62	83.41	90.21	8.76	6.97	0.17	9.44	7.65	0.85
	141400			90.78	81.61	83.40	90.20				9.17	7.37	0.57
	141300			90.72	81.60	83.39	90.19				9.13	7.33	0.53
	141200			90.73	81.59	83.38	90.18				9.14	7.35	0.55
	141100			90.47	81.57	83.37	90.17				8.90	7.10	0.30
	141000	89.91		90.45	81.56	83.36	90.16	8.34	6.55	-0.25	8.89	7.09	0.29
	140900			90.38	81.55	83.35	90.15				8.83	7.04	0.24
	140800			90.61	81.54	83.34	90.14				9.08	7.28	0.48
	140700			90.39	81.53	83.33	90.13				8.86	7.06	0.26
38.27	140631		87.82	90.30	81.52	83.32	90.12				8.78	6.98	0.18
	140600			90.55	81.52	83.32	90.12				9.03	7.23	0.43
	140500	90.30		90.57	81.51	83.31	90.11	8.79	6.99	0.19	9.06	7.26	0.46
	140400			90.07	81.50	83.30	90.10				8.57	6.77	-0.03
	140300			89.98	81.49	83.29	90.09				8.49	6.69	-0.12
	140200			90.03	81.48	83.28	90.09				8.55	6.75	-0.06
	140100			90.02	81.47	83.28	90.08				8.54	6.74	-0.06
	140000	89.97		90.27	81.46	83.27	90.07	8.51	6.71	-0.10	8.81	7.00	0.20
	139900			90.66	81.45	83.26	90.06				9.21	7.40	0.59
	139800			90.22	81.44	83.25	90.06				8.77	6.96	0.16
	139700			90.06	81.43	83.24	90.05				8.62	6.81	0.01
	139600			89.87	81.43	83.24	90.04				8.44	6.63	-0.17
	139500	89.77		89.96	81.42	83.23	90.03	8.36	6.55	-0.26	8.55	6.74	-0.07
	139400			89.73	81.41	83.22	90.03				8.32	6.51	-0.30
	139300			89.59	81.40	83.21	90.02				8.19	6.38	-0.43
	139200			89.78	81.39	83.20	90.01				8.39	6.58	-0.23
	139100			89.73	81.38	83.20	90.00				8.35	6.53	-0.28
	139000	89.62		89.78	81.37	83.19	90.00	8.25	6.43	-0.38	8.40	6.59	-0.22
	138900			89.73	81.36	83.18	89.99				8.37	6.55	-0.26
	138800			89.70	81.35	83.17	89.98				8.35	6.53	-0.28
	138700			89.80	81.34	83.16	89.97				8.45	6.63	-0.18
37.95	138662		89.22	89.50	81.34	83.16	89.97				8.16	6.34	-0.47
	138600			89.58	81.33	83.15	89.96				8.25	6.43	-0.38
	138500	89.50		89.58	81.31	83.13	89.94	8.19	6.36	-0.45	8.27	6.45	-0.36
	138400			89.38	81.29	83.12	89.93				8.09	6.26	-0.55
	138300			89.39	81.27	83.10	89.91				8.12	6.29	-0.52
	138200			89.20	81.26	83.09	89.90				7.95	6.12	-0.69

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	138100			89.46	81.24	83.07	89.88				8.22	6.39	-0.42
	138000	89.39		89.38	81.22	83.05	89.86	8.17	6.34	-0.47	8.16	6.33	-0.48
	137900			89.47	81.20	83.04	89.85				8.27	6.43	-0.38
	137800			89.42	81.18	83.02	89.83				8.24	6.40	-0.41
37.68	137780		87.60	89.40	81.18	83.02	89.83				8.22	6.38	-0.43
	137700			89.43	81.16	83.01	89.82				8.27	6.43	-0.38
	137600			89.61	81.14	82.99	89.80				8.47	6.63	-0.18
	137500	89.49		89.55	81.12	82.97	89.78	8.37	6.53	-0.28	8.43	6.58	-0.23
	137400			89.56	81.10	82.95	89.76				8.46	6.61	-0.20
	137300			89.35	81.08	82.93	89.74				8.27	6.42	-0.39
	137200			89.27	81.06	82.91	89.72				8.21	6.36	-0.45
	137100			89.41	81.04	82.89	89.70				8.38	6.52	-0.29
	137000	89.34		89.38	81.02	82.87	89.68	8.33	6.47	-0.34	8.36	6.50	-0.31
37.45	136974		88.41	89.30	81.01	82.87	89.68				8.29	6.43	-0.38
	136900			89.53	81.00	82.86	89.67				8.54	6.68	-0.13
	136800			89.62	80.98	82.84	89.65				8.64	6.78	-0.03
	136700			89.27	80.97	82.83	89.63				8.30	6.44	-0.37
	136600			89.37	80.95	82.81	89.61				8.42	6.56	-0.24
	136500	89.34		89.57	80.93	82.80	89.60	8.40	6.54	-0.26	8.64	6.77	-0.03
	136400			89.36	80.92	82.78	89.58				8.44	6.58	-0.22
	136300			89.30	80.90	82.77	89.56				8.40	6.54	-0.26
	136200			89.63	80.88	82.75	89.54				8.75	6.88	0.09
	136100			89.87	80.87	82.74	89.53				9.01	7.14	0.35
37.29	136058		89.09	89.80	80.86	82.73	89.52				8.94	7.07	0.28
	136000	89.55		89.96	80.83	82.71	89.50	8.72	6.84	0.05	9.12	7.25	0.46
	135900			89.97	80.79	82.67	89.47				9.18	7.29	0.50
	135800			89.80	80.74	82.64	89.43				9.06	7.16	0.37
	135700			89.71	80.69	82.60	89.40				9.02	7.11	0.32
	135600			89.44	80.65	82.56	89.36				8.79	6.87	0.08
	135500	89.30		89.54	80.60	82.53	89.33	8.70	6.77	-0.03	8.94	7.02	0.22
	135400			89.67	80.56	82.49	89.29				9.12	7.18	0.38
	135300			89.36	80.51	82.46	89.26				8.85	6.91	0.10
	135200			89.49	80.46	82.42	89.22				9.02	7.07	0.26
	135100			89.31	80.42	82.38	89.19				8.89	6.93	0.12
	135000	89.27		89.34	80.37	82.35	89.15	8.89	6.92	0.11	8.97	6.99	0.19
	134900			89.36	80.32	82.31	89.12				9.03	7.04	0.24
	134800			89.61	80.28	82.28	89.09				9.33	7.34	0.53
36.45	134783		88.89	89.60	80.27	82.27	89.08				9.33	7.33	0.52
	134700			89.63	80.15	82.18	89.00				9.48	7.45	0.63
36.35	134646		88.60	89.10	80.08	82.12	88.95				9.02	6.98	0.15
	134600			89.10	79.96	82.03	88.87				9.14	7.07	0.23
36.24	134561		88.02	89.10	79.85	81.95	88.80				9.25	7.15	0.30
	134500	89.14		89.14	79.84	81.94	88.79	9.30	7.20	0.35	9.31	7.21	0.35
	134400			89.17	79.81	81.92	88.77				9.36	7.25	0.39
	134300			89.16	79.79	81.90	88.76				9.37	7.26	0.41
	134200			89.19	79.76	81.88	88.74				9.42	7.30	0.45
	134100			89.00	79.74	81.87	88.72				9.26	7.14	0.28
	134000	89.45		89.34	79.72	81.85	88.71	9.73	7.60	0.74	9.63	7.50	0.64
	133900			89.19	79.69	81.83	88.69				9.49	7.36	0.50
	133800			89.01	79.67	81.81	88.67				9.35	7.20	0.34
	133700			89.05	79.65	81.79	88.66				9.41	7.26	0.39
	133600			88.85	79.62	81.78	88.64				9.23	7.08	0.21
	133500	88.67		88.57	79.60	81.76	88.63	9.07	6.91	0.04	8.97	6.81	-0.06
	133400			88.58	79.57	81.74	88.61				9.01	6.85	-0.02
	133300			88.73	79.55	81.72	88.59				9.18	7.01	0.13
	133200			88.81	79.53	81.70	88.58				9.28	7.11	0.23
	133100			88.76	79.50	81.68	88.56				9.26	7.08	0.20
	133000	88.95		88.95	79.48	81.67	88.54	9.47	7.28	0.41	9.47	7.28	0.40
	132900			89.32	79.46	81.65	88.53				9.87	7.67	0.80
	132800			89.59	79.43	81.63	88.51				10.16	7.96	1.08
	132700			89.61	79.41	81.61	88.49				10.20	7.99	1.11
	132600			90.02	79.38	81.59	88.48				10.64	8.43	1.54
	132500	90.13		90.07	79.36	81.58	88.46	10.77	8.56	1.67	10.71	8.49	1.61
	132400			91.23	79.34	81.56	88.45				11.89	9.67	2.79
	132300			89.82	79.31	81.54	88.43				10.51	8.28	1.39
35.78	132248		89.06	89.30	79.30	81.53	88.42				10.00	7.77	0.88
	132200			89.09	79.30	81.53	88.42				9.79	7.56	0.67
	132100			89.39	79.29	81.52	88.41				10.10	7.87	0.98
	132000	89.40		89.45	79.28	81.51	88.40	10.12	7.89	1.00	10.17	7.94	1.05
	131900			89.16	79.27	81.50	88.39				9.89	7.65	0.77
	131800			89.29	79.26	81.50	88.38				10.03	7.79	0.91
	131700			88.74	79.25	81.49	88.37				9.49	7.25	0.37
	131600			88.46	79.24	81.48	88.36				9.22	6.98	0.10
	131500	88.26		88.26	79.23	81.47	88.35	9.03	6.78	-0.10	9.03	6.79	-0.09
	131400			88.26	79.22	81.47	88.35				9.04	6.80	-0.08
	131300			88.03	79.21	81.46	88.34				8.82	6.57	-0.31
	131200			88.16	79.20	81.45	88.33				8.96	6.71	-0.16
	131100			88.03	79.19	81.44	88.32				8.84	6.59	-0.29
	131000	88.11		88.10	79.18	81.44	88.31	8.92	6.67	-0.20	8.92	6.67	-0.21
	130900			87.93	79.17	81.43	88.30				8.75	6.50	-0.38
	130800			88.31	79.16	81.42	88.29				9.14	6.89	0.01
	130700			88.84	79.15	81.41	88.28				9.69	7.43	0.56
35.5	130647		88.42	88.70	79.15	81.41	88.28				9.55	7.29	0.42
	130600			88.79	79.13	81.39	88.26				9.67	7.40	0.53
	130500	88.72		88.72	79.08	81.36	88.23	9.63	7.36	0.49	9.64	7.37	0.50
35.25	130422		88.42	88.60	79.05	81.33	88.20				9.55	7.27	0.40
	130400			88.71	79.05	81.33	88.20				9.66	7.38	0.51
	130300			88.72	79.03	81.31	88.18				9.69	7.41	0.54
	130200			88.78	79.01	81.29	88.16				9.77	7.48	0.61
	130100			88.68	78.99	81.28	88.15				9.69	7.40	0.53

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	130000	88.56		88.73	78.97	81.26	88.13	9.58	7.29	0.42	9.76	7.47	0.60
34.8	129991		88.32	88.60	78.97	81.26	88.13				9.63	7.34	0.47
	129900			88.72	78.96	81.26	88.13				9.75	7.46	0.59
	129800			88.87	78.96	81.25	88.12				9.91	7.62	0.75
	129700			88.78	78.95	81.25	88.12				9.83	7.53	0.66
	129600			88.72	78.95	81.24	88.11				9.77	7.47	0.61
	129500	88.89		89.06	78.94	81.24	88.11	9.95	7.65	0.78	10.12	7.82	0.95
	129400			89.39	78.94	81.23	88.10				10.45	8.15	1.29
	129300			89.01	78.93	81.23	88.10				10.08	7.78	0.91
	129200			89.04	78.93	81.23	88.09				10.12	7.82	0.95
	129100			88.93	78.92	81.22	88.08				10.02	7.71	0.85
	129000	88.83		88.92	78.91	81.22	88.08	9.91	7.61	0.75	10.00	7.70	0.84
	128900			89.02	78.91	81.21	88.07				10.11	7.81	0.94
	128800			88.97	78.90	81.21	88.07				10.07	7.77	0.90
	128700			88.84	78.90	81.20	88.06				9.94	7.64	0.78
	128600			88.73	78.89	81.20	88.06				9.84	7.53	0.67
	128500	88.79		88.73	78.89	81.19	88.05	9.90	7.59	0.73	9.84	7.53	0.67
34.5	128407		88.01	88.50	78.88	81.19	88.05				9.62	7.31	0.45
	128400			88.55	78.88	81.19	88.05				9.67	7.36	0.50
	128300			88.50	78.86	81.17	88.03				9.64	7.33	0.47
	128200			88.34	78.84	81.16	88.01				9.50	7.18	0.32
	128100			88.18	78.82	81.15	88.00				9.36	7.04	0.19
	128000	88.24		88.27	78.80	81.13	87.98	9.44	7.11	0.26	9.47	7.14	0.29
34.07	127996		88.03	88.30	78.80	81.13	87.98				9.50	7.17	0.32
	127900			88.59	78.79	81.12	87.97				9.80	7.47	0.62
	127800			88.31	78.79	81.12	87.97				9.52	7.19	0.34
	127700			88.24	78.78	81.11	87.96				9.46	7.13	0.28
	127600			88.44	78.77	81.10	87.95				9.67	7.34	0.49
	127500	88.79		88.73	78.76	81.10	87.95	10.02	7.69	0.84	9.96	7.63	0.78
	127400			88.77	78.76	81.09	87.94				10.02	7.68	0.83
	127300			88.87	78.75	81.08	87.93				10.12	7.79	0.94
	127200			88.78	78.74	81.08	87.93				10.04	7.70	0.85
	127100			88.66	78.73	81.07	87.92				9.93	7.59	0.74
	127000	88.83		88.76	78.73	81.06	87.91	10.10	7.76	0.91	10.04	7.70	0.85
	126900			88.68	78.72	81.06	87.91				9.96	7.62	0.77
	126800			88.61	78.71	81.05	87.90				9.90	7.56	0.71
33.5	126795		88.19	88.30	78.71	81.05	87.90				9.59	7.25	0.40
	126700			88.37	78.70	81.04	87.89				9.68	7.34	0.49
	126600			88.38	78.68	81.03	87.88				9.70	7.35	0.50
	126500	88.43		88.55	78.67	81.02	87.86	9.77	7.42	0.57	9.88	7.53	0.69
	126400			88.64	78.65	81.00	87.85				9.99	7.63	0.79
	126300			88.86	78.64	80.99	87.84				10.22	7.86	1.02
	126200			88.64	78.62	80.98	87.82				10.02	7.66	0.82
	126100			88.28	78.61	80.97	87.81				9.68	7.31	0.47
	126000	87.99		87.99	78.59	80.96	87.80	9.40	7.03	0.19	9.40	7.03	0.19
33.25	125934		88.05	88.40	78.58	80.95	87.79				9.82	7.45	0.61
	125900			88.45	78.58	80.95	87.79				9.88	7.51	0.67
	125800			88.25	78.57	80.94	87.78				9.68	7.31	0.47
	125700			87.83	78.56	80.93	87.77				9.27	6.89	0.05
	125600			88.03	78.55	80.93	87.76				9.48	7.10	0.26
	125500	87.85		87.83	78.54	80.92	87.76	9.31	6.93	0.09	9.29	6.91	0.07
	125400	87.88		87.82	78.53	80.91	87.75	9.35	6.96	0.13	9.29	6.90	0.07
	125300			87.67	78.52	80.90	87.74				9.15	6.77	-0.07
	125200			87.89	78.51	80.90	87.73				9.37	6.99	0.15
	125100			87.56	78.50	80.89	87.72				9.05	6.67	-0.17
	125000	87.48		87.50	78.49	80.88	87.72	8.98	6.59	-0.24	9.01	6.62	-0.22
	124900			87.80	78.48	80.88	87.71				9.31	6.92	0.09
	124800			88.34	78.47	80.87	87.70				9.87	7.48	0.64
	124700			89.69	78.46	80.86	87.69				11.23	8.83	2.00
	124600			89.35	78.45	80.85	87.68				10.90	8.50	1.67
33	124547		89.40	88.90	78.45	80.85	87.68				10.45	8.05	1.22
	124500	88.54		88.62	78.44	80.84	87.67	10.09	7.69	0.86	10.18	7.78	0.95
	124400			88.24	78.43	80.83	87.66				9.81	7.40	0.58
	124300			87.98	78.42	80.82	87.65				9.57	7.16	0.33
	124200			87.85	78.40	80.81	87.64				9.45	7.04	0.21
	124100	87.50		87.65	78.39	80.80	87.62	9.11	6.69	-0.13	9.27	6.85	0.03
	124000	88.04		88.16	78.37	80.79	87.61	9.66	7.24	0.42	9.78	7.36	0.54
	123900			87.95	78.36	80.78	87.60				9.59	7.16	0.35
	123800			87.82	78.35	80.77	87.59				9.47	7.05	0.23
	123700			88.01	78.33	80.76	87.58				9.68	7.25	0.44
	123600			88.13	78.32	80.75	87.56				9.81	7.38	0.57
	123500	87.52		87.78	78.30	80.74	87.55	9.22	6.79	-0.03	9.47	7.04	0.23
	123400			87.74	78.29	80.73	87.54				9.45	7.01	0.20
32.75	123336		87.72	87.40	78.28	80.72	87.53				9.12	6.68	-0.13
	123300			87.47	78.28	80.72	87.53				9.19	6.75	-0.06
	123200			87.45	78.27	80.71	87.52				9.18	6.74	-0.07
	123100			87.55	78.26	80.70	87.51				9.29	6.85	0.04
	123000	87.55		87.70	78.25	80.69	87.50	9.30	6.85	0.05	9.45	7.00	0.20
	122900			87.80	78.24	80.69	87.49				9.57	7.12	0.32
	122800			87.81	78.23	80.68	87.48				9.58	7.13	0.33
	122700			87.60	78.22	80.67	87.47				9.38	6.93	0.13
	122600			87.44	78.21	80.66	87.46				9.23	6.78	-0.02
	122500	87.28		87.38	78.20	80.65	87.45	9.08	6.63	-0.17	9.18	6.73	-0.07
	122400			87.06	78.19	80.65	87.44				8.87	6.42	-0.38
	122300			87.22	78.18	80.64	87.43				9.04	6.58	-0.21
	122200			87.21	78.17	80.63	87.42				9.04	6.58	-0.21
	122100			87.14	78.16	80.62	87.41				8.97	6.51	-0.28
32.5	122068		87.44	87.20	78.16	80.62	87.41				9.04	6.58	-0.21
	122000	86.99		87.08	78.15	80.61	87.40	8.85	6.38	-0.41	8.94	6.47	-0.32
	121900			87.18	78.13	80.60	87.39				9.05	6.58	-0.21

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	121800			86.91	78.11	80.58	87.37				8.80	6.33	-0.46
	121700			86.63	78.09	80.57	87.36				8.54	6.06	-0.73
	121600	86.96		86.88	78.07	80.55	87.34	8.88	6.41	-0.38	8.80	6.33	-0.46
	121500	87.09		87.14	78.06	80.54	87.33	9.04	6.56	-0.23	9.08	6.60	-0.19
32.25	121463		87.23	87.00	78.05	80.53	87.32				8.95	6.47	-0.32
	121400			86.92	78.03	80.51	87.30				8.90	6.41	-0.37
	121300			86.99	77.99	80.48	87.26				9.00	6.51	-0.27
	121200			86.78	77.95	80.45	87.22				8.82	6.33	-0.45
	121100			86.81	77.92	80.42	87.19				8.89	6.38	-0.38
32	121024		86.86	86.70	77.89	80.40	87.16				8.81	6.30	-0.46
	121000	86.92		86.99	77.89	80.40	87.16	9.03	6.52	-0.24	9.11	6.60	-0.16
	120900			87.34	77.87	80.38	87.14				9.47	6.96	0.20
	120800			87.40	77.85	80.36	87.12				9.55	7.03	0.28
	120700			87.45	77.83	80.35	87.10				9.62	7.10	0.35
	120600			87.56	77.81	80.33	87.08				9.74	7.22	0.47
	120500	87.31		87.59	77.79	80.32	87.06	9.51	6.99	0.24	9.80	7.27	0.53
	120400			87.69	77.77	80.30	87.04				9.92	7.39	0.65
	120300			87.72	77.76	80.29	87.03				9.96	7.43	0.69
	120200			88.11	77.74	80.27	87.01				10.37	7.84	1.10
	120100			87.82	77.72	80.25	86.99				10.10	7.57	0.83
	120000	87.81		87.95	77.70	80.24	86.97	10.11	7.57	0.84	10.25	7.71	0.98
31.75	119946		86.80	87.80	77.69	80.23	86.96				10.11	7.57	0.84
	119900			87.98	77.68	80.22	86.95				10.30	7.75	1.03
	119800			87.74	77.66	80.21	86.93				10.07	7.53	0.80
	119700			87.45	77.64	80.19	86.91				9.81	7.26	0.54
	119600			87.48	77.62	80.18	86.89				9.86	7.30	0.59
	119500	87.27		87.40	77.61	80.16	86.88	9.66	7.11	0.39	9.79	7.23	0.52
	119400			87.38	77.59	80.15	86.86				9.79	7.23	0.52
	119300			87.39	77.57	80.13	86.84				9.82	7.25	0.55
	119200			87.76	77.55	80.12	86.82				10.21	7.64	0.94
	119100			87.51	77.53	80.10	86.80				9.98	7.41	0.71
	119000	87.55		87.58	77.51	80.09	86.78	10.04	7.47	0.77	10.07	7.49	0.80
	118900			87.67	77.49	80.07	86.76				10.18	7.60	0.91
31.5	118882		87.11	87.50	77.49	80.07	86.76				10.01	7.43	0.74
	118800			87.69	77.48	80.06	86.75				10.21	7.63	0.94
	118700			87.50	77.47	80.05	86.74				10.03	7.45	0.76
	118600			87.53	77.46	80.04	86.73				10.07	7.49	0.80
	118500	87.35		87.26	77.45	80.04	86.72	9.90	7.32	0.64	9.81	7.22	0.54
	118400			87.39	77.44	80.03	86.70				9.95	7.36	0.68
	118300			87.16	77.43	80.02	86.69				9.73	7.14	0.46
	118200			87.18	77.42	80.01	86.68				9.77	7.17	0.50
	118100			87.56	77.40	80.00	86.67				10.16	7.56	0.89
	118000	87.59		87.55	77.39	79.99	86.66	10.19	7.60	0.93	10.16	7.56	0.89
	117900			87.67	77.38	79.98	86.65				10.29	7.69	1.02
	117800			87.65	77.37	79.97	86.64				10.28	7.68	1.01
	117700			87.19	77.36	79.96	86.62				9.83	7.23	0.57
	117600			87.35	77.35	79.95	86.61				10.00	7.39	0.73
	117500	87.32		87.38	77.34	79.94	86.60	9.98	7.37	0.72	10.04	7.44	0.78
	117400			87.22	77.33	79.94	86.59				9.89	7.29	0.63
	117300			87.33	77.32	79.93	86.58				10.01	7.40	0.75
31.25	117232		87.02	87.30	77.31	79.92	86.57				9.99	7.38	0.73
	117200			87.20	77.31	79.92	86.57				9.89	7.28	0.63
	117100			87.09	77.29	79.91	86.55				9.80	7.18	0.54
	117000	87.05		87.07	77.28	79.90	86.54	9.78	7.16	0.52	9.79	7.17	0.53
	116900			87.06	77.26	79.88	86.52				9.79	7.17	0.53
	116800			87.07	77.25	79.87	86.51				9.82	7.20	0.56
	116700			86.94	77.23	79.86	86.50				9.71	7.08	0.44
	116600			86.90	77.22	79.85	86.48				9.68	7.04	0.41
	116500	87.19		87.19	77.21	79.84	86.47	9.98	7.35	0.72	9.98	7.35	0.72
	116400			86.88	77.19	79.83	86.46				9.69	7.05	0.42
	116300			87.07	77.18	79.82	86.44				9.89	7.25	0.63
	116200			87.10	77.16	79.81	86.43				9.94	7.29	0.67
	116100			86.96	77.15	79.80	86.42				9.82	7.17	0.55
	116000	87.08		86.94	77.13	79.79	86.40	9.94	7.29	0.67	9.80	7.15	0.53
	115900			87.10	77.12	79.78	86.39				9.98	7.32	0.71
31	115836		87.18	87.10	77.11	79.77	86.38				9.99	7.33	0.72
	115800			87.25	77.10	79.76	86.37				10.16	7.50	0.89
	115700			87.28	77.06	79.73	86.33				10.22	7.55	0.95
	115600			86.99	77.02	79.69	86.29				9.97	7.30	0.70
	115500	86.91		86.97	76.98	79.66	86.25	9.93	7.25	0.66	9.99	7.30	0.72
	115400			87.01	76.94	79.63	86.21				10.07	7.38	0.80
30.75	115369		86.96	87.00	76.93	79.62	86.20				10.07	7.38	0.80
	115300			87.06	76.91	79.61	86.19				10.14	7.45	0.87
	115200			86.88	76.89	79.59	86.16				9.99	7.29	0.72
	115100			86.91	76.87	79.57	86.14				10.04	7.34	0.77
	115000	86.77		86.77	76.84	79.55	86.12	9.93	7.22	0.65	9.93	7.22	0.65
	114900			86.56	76.82	79.54	86.10				9.74	7.02	0.46
	114800			86.83	76.79	79.52	86.08				10.04	7.31	0.75
	114700			86.96	76.77	79.50	86.06				10.19	7.46	0.90
	114600			86.85	76.75	79.48	86.04				10.11	7.37	0.81
	114500	86.80		86.64	76.72	79.47	86.02	10.08	7.33	0.78	9.92	7.17	0.62
30.5	114411		86.83	86.90	76.70	79.45	86.00				10.20	7.45	0.90
	114400			87.13	76.70	79.45	86.00				10.43	7.68	1.13
	114300			87.08	76.68	79.43	85.98				10.40	7.65	1.10
	114200			86.80	76.66	79.42	85.96				10.14	7.39	0.84
	114100			86.55	76.64	79.40	85.94				9.91	7.15	0.61
	114000	86.53		86.45	76.62	79.38	85.92	9.91	7.15	0.61	9.83	7.07	0.53
	113900			86.80	76.60	79.37	85.90				10.20	7.43	0.90
	113800			86.84	76.58	79.35	85.88				10.26	7.49	0.96
	113700			87.03	76.56	79.33	85.86				10.48	7.70	1.18

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	113600			86.73	76.54	79.32	85.84				10.19	7.41	0.89
	113500	86.43		86.48	76.52	79.30	85.82	9.92	7.13	0.62	9.96	7.18	0.66
	113400			86.40	76.50	79.28	85.80				9.90	7.11	0.60
30.25	113318		86.24	85.90	76.48	79.27	85.78				9.42	6.63	0.12
	113300			85.74	76.48	79.27	85.78				9.26	6.47	-0.04
	113200			85.52	76.46	79.25	85.76				9.06	6.26	-0.24
	113100	UPRR	Railroad	80.21	76.44	79.24	85.74				3.77	**0.97**	-5.53
	113000	85.72		85.49	76.42	79.23	85.72	9.29	6.49	-0.01	9.07	6.26	-0.23
	112900			87.68	76.41	79.21	85.71				11.27	8.47	1.97
	112800			87.64	76.39	79.20	85.69				11.25	8.44	1.95
	112700			87.46	76.37	79.19	85.67				11.09	8.27	1.79
	112600			86.27	76.36	79.17	85.66				9.92	7.10	0.62
	112500	86.08		85.97	76.34	79.16	85.64	9.74	6.92	0.44	9.63	6.81	0.33
	112400			86.16	76.32	79.15	85.62				9.84	7.01	0.54
	112300			86.70	76.30	79.14	85.60				10.39	7.56	1.09
	112200			86.55	76.29	79.12	85.59				10.27	7.43	0.97
	112100			86.40	76.27	79.11	85.57				10.13	7.29	0.83
	112000	86.27		86.08	76.25	79.10	85.55	10.02	7.18	0.72	9.83	6.99	0.53
	111900			86.04	76.23	79.08	85.53				9.81	6.96	0.51
	111800			86.11	76.22	79.07	85.52				9.89	7.04	0.59
	111700			86.25	76.20	79.06	85.50				10.05	7.20	0.75
	111600			86.09	76.18	79.04	85.48				9.91	7.05	0.61
	111500	86.08		85.86	76.16	79.03	85.46	9.91	7.05	0.61	9.70	6.83	0.40
	111400			85.77	76.15	79.02	85.45				9.63	6.76	0.33
30	111357		87.22	85.90	76.14	79.01	85.44				9.76	6.89	0.46
	111300			85.73	76.11	78.98	85.43				9.62	6.74	0.30
	111200			85.65	76.05	78.94	85.41				9.60	6.72	0.24
	111100			85.93	75.99	78.89	85.40				9.94	7.04	0.53
	111000	86.06		86.11	75.94	78.85	85.38	10.12	7.21	0.68	10.18	7.27	0.73
	110900			86.26	75.88	78.80	85.36				10.38	7.46	0.90
29.828	110813		87.25	86.30	75.83	78.76	85.35				10.47	7.54	0.95
29.826	110802		87.28	86.20	75.85	78.78	85.35				10.35	7.42	0.85
29.824	110801				75.85	78.78							
	110800			86.18	75.85	78.78	85.35				10.33	7.40	0.83
29.822	110785		87.34	86.20	75.86	78.79	85.34				10.34	7.41	0.86
29.821	110775		87.37	86.10	75.88	78.81	85.34				10.22	7.29	0.76
	110700			86.25	75.88	78.81	85.34				10.37	7.44	0.91
	110600			86.30	75.87	78.81	85.33				10.43	7.50	0.97
	110500	86.04		85.95	75.87	78.80	85.32	10.16	7.23	0.71	10.07	7.14	0.62
	110400			85.97	75.87	78.80	85.32				10.11	7.17	0.66
	110300			86.15	75.86	78.80	85.31				10.29	7.35	0.84
	110200			85.92	75.86	78.80	85.30				10.06	7.13	0.62
	110100			85.81	75.86	78.79	85.30				9.95	7.01	0.51
	110000	85.80		85.76	75.86	78.79	85.29	9.95	7.01	0.51	9.91	6.97	0.47
	109900			85.73	75.85	78.79	85.28				9.88	6.95	0.45
	109800			85.98	75.85	78.78	85.28				10.13	7.19	0.70
	109700			87.29	75.85	78.78	85.27				11.44	8.50	2.01
	109600			86.52	75.84	78.78	85.26				10.68	7.74	1.26
	109500	86.38		86.15	75.84	78.78	85.26	10.54	7.61	1.13	10.31	7.37	0.89
	109400			86.45	75.84	78.77	85.25				10.61	7.67	1.20
	109300	86.44		86.30	75.83	78.77	85.25	10.60	7.66	1.19	10.46	7.52	1.05
29.75	109217		85.53	86.40	75.83	78.77	85.24				10.57	7.63	1.16
	109200			86.49	75.83	78.77	85.24				10.66	7.72	1.25
	109100			86.47	75.82	78.76	85.23				10.65	7.70	1.24
	109000	86.43		86.35	75.81	78.75	85.22	10.62	7.67	1.20	10.54	7.59	1.12
	108900			86.23	75.80	78.75	85.21				10.43	7.48	1.01
	108800			86.10	75.79	78.74	85.21				10.31	7.36	0.89
	108700			86.34	75.78	78.73	85.20				10.56	7.61	1.14
	108600			86.32	75.77	78.73	85.19				10.55	7.59	1.13
	108500	86.36		86.54	75.76	78.72	85.18	10.61	7.64	1.18	10.78	7.82	1.35
	108400			86.37	75.75	78.71	85.17				10.62	7.66	1.19
	108300			86.34	75.73	78.70	85.17				10.60	7.63	1.17
	108200			86.09	75.72	78.70	85.16				10.36	7.39	0.93
	108100			85.84	75.71	78.69	85.15				10.13	7.15	0.69
	108000	85.89		85.90	75.70	78.68	85.14	10.18	7.20	0.74	10.20	7.22	0.76
29.5	107965		85.42	85.90	75.70	78.68	85.14				10.20	7.22	0.76
	107900			85.71	75.70	78.68	85.14				10.01	7.03	0.57
	107800			86.16	75.70	78.68	85.14				10.46	7.48	1.02
	107700			86.10	75.70	78.68	85.14				10.40	7.42	0.96
	107600			86.29	75.70	78.68	85.14				10.59	7.61	1.15
	107500	85.46		85.67	75.70	78.68	85.14	9.76	6.78	0.32	9.97	6.99	0.53
	107400			85.98	75.70	78.68	85.14				10.28	7.30	0.84
	107300	85.79		86.09	75.70	78.68	85.14	10.09	7.11	0.65	10.39	7.41	0.95
	107200			86.24	75.70	78.68	85.14				10.54	7.56	1.10
	107100			86.40	75.70	78.68	85.14				10.70	7.72	1.26
	107000	85.69		86.02	75.70	78.68	85.14	9.99	7.01	0.55	10.32	7.34	0.88
29.25	106938		85.53	85.60	75.70	78.68	85.14				9.90	6.92	0.46
	106900			85.85	75.70	78.68	85.14				10.15	7.17	0.71
	106800			86.45	75.69	78.67	85.12				10.76	7.78	1.32
	106700			86.40	75.68	78.66	85.11				10.72	7.74	1.29
	106600			86.34	75.67	78.65	85.10				10.67	7.69	1.24
	106500	86.07		86.54	75.66	78.64	85.08	10.41	7.43	0.99	10.88	7.89	1.45
	106400			86.18	75.65	78.63	85.07				10.53	7.54	1.11
	106300			86.32	75.64	78.63	85.06				10.68	7.69	1.26
	106200			86.60	75.63	78.62	85.04				10.97	7.98	1.55
	106100			86.59	75.62	78.61	85.03				10.97	7.98	1.56
	106000	85.59		86.43	75.61	78.60	85.02	9.98	6.99	0.57	10.82	7.83	1.41
	105900			86.34	75.60	78.59	85.01				10.74	7.74	1.33
	105800			86.83	75.59	78.58	84.99				11.25	8.25	1.84
	105700			86.90	75.58	78.58	84.98				11.32	8.32	1.92

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
29	105628		84.91	86.50	75.57	78.57	84.97				10.93	7.93	1.53
	105600			86.66	75.56	78.57	84.96				11.09	8.09	1.69
	105500	86.49		87.37	75.54	78.55	84.94	10.94	7.94	1.55	11.83	8.83	2.44
	105400			87.26	75.52	78.53	84.91				11.74	8.73	2.35
	105300			87.19	75.50	78.51	84.89				11.69	8.68	2.31
	105200			86.96	75.48	78.50	84.86				11.48	8.47	2.10
	105100			86.60	75.46	78.48	84.83				11.13	8.12	1.76
	105000	85.65		86.33	75.44	78.46	84.81	10.21	7.19	0.84	10.89	7.87	1.52
	104900			85.94	75.42	78.44	84.78				10.52	7.49	1.15
	104800			86.04	75.40	78.43	84.76				10.64	7.61	1.28
	104700			85.73	75.38	78.41	84.73				10.35	7.32	1.00
	104600			85.79	75.36	78.39	84.71				10.44	7.40	1.09
	104500	85.27		85.55	75.34	78.37	84.68	9.93	6.90	0.59	10.22	7.18	0.87
28.75	104418		83.87	86.00	75.32	78.36	84.66				10.68	7.64	1.34
	104400			86.28	75.32	78.36	84.66				10.96	7.92	1.63
	104300			86.58	75.30	78.34	84.63				11.28	8.24	1.95
	104200			84.51	75.28	78.33	84.61				9.23	6.18	-0.10
	104100			85.02	75.27	78.31	84.59				9.76	6.71	0.44
	104000	85.18		85.62	75.25	78.30	84.56	9.93	6.88	0.61	10.37	7.32	1.06
	103900			85.70	75.23	78.28	84.54				10.46	7.41	1.16
	103800			85.24	75.22	78.27	84.52				10.02	6.97	0.72
	103700			85.25	75.20	78.26	84.49				10.05	7.00	0.76
	103600			85.19	75.18	78.24	84.47				10.01	6.95	0.72
28.5	103522		83.53	85.00	75.17	78.23	84.45				9.83	6.77	0.55
	103500	84.68		85.14	75.17	78.23	84.45	9.51	6.45	0.23	9.97	6.91	0.69
	103400			85.71	75.15	78.22	84.43				10.56	7.50	1.28
	103300			85.31	75.14	78.20	84.41				10.17	7.11	0.90
	103200			85.15	75.12	78.19	84.39				10.03	6.96	0.76
	103100			84.53	75.10	78.18	84.37				9.43	6.35	0.16
	103000	82.21		82.50	75.09	78.17	84.35	7.12	4.04	-2.14	7.42	4.34	-1.85
	102900			82.52	75.07	78.15	84.33				7.45	4.36	-1.81
	102800			83.24	75.06	78.14	84.31				8.18	5.10	-1.08
	102700			88.83	75.04	78.13	84.29				13.79	10.70	4.53
28.324	102627		92.21	93.60	75.03	78.12	84.28				18.57	15.48	9.32
28.322	102616		92.96	94.40	75.02	78.12	84.28				19.38	16.28	10.12
	102600			94.10	75.02	78.12	84.28				19.08	15.99	9.83
28.309	102538		92.83	94.40	75.01	78.10	84.26				19.39	16.30	10.14
28.307	102527		91.92	93.70	75.00	78.10	84.26				18.70	15.60	9.44
	102500	90.55		91.42	75.00	78.10	84.25	15.56	12.46	6.30	16.43	13.33	7.17
	102400			84.14	74.98	78.08	84.23				9.16	6.06	-0.09
	102300			85.02	74.96	78.06	84.20				10.06	6.96	0.82
28.25	102281		83.66	84.80	74.96	78.06	84.20				9.84	6.74	0.60
	102200			84.79	74.95	78.05	84.19				9.84	6.74	0.60
	102100			85.07	74.94	78.04	84.17				10.13	7.02	0.90
	102000	84.02		84.49	74.93	78.03	84.15	9.09	5.99	-0.13	9.56	6.46	0.33
	101900			84.08	74.92	78.02	84.14				9.16	6.06	-0.05
	101800			84.76	74.91	78.01	84.12				9.85	6.74	0.63
	101700			84.80	74.90	78.01	84.11				9.90	6.79	0.69
	101600			84.36	74.89	78.00	84.09				9.47	6.36	0.27
	101500	84.16		84.41	74.88	77.99	84.07	9.29	6.18	0.09	9.54	6.43	0.34
	101400			84.67	74.86	77.98	84.06				9.80	6.69	0.61
	101300			84.36	74.85	77.97	84.04				9.50	6.39	0.31
	101200			84.57	74.84	77.96	84.02				9.72	6.61	0.54
	101100			84.32	74.83	77.95	84.01				9.49	6.37	0.31
	101000			84.23	74.82	77.94	83.99				9.40	6.29	0.23
	100900			84.29	74.81	77.93	83.98				9.47	6.36	0.31
	100800			86.18	74.80	77.92	83.96				11.38	8.26	2.22
28	100799		86.11	86.10	74.80	77.92	83.96				11.30	8.18	2.14
27.971	100749		87.95	87.80	74.69	77.82	83.77				13.11	9.98	4.03
	100700			87.83	74.67	77.79	83.72				13.15	10.03	4.10
27.963	100696		87.95	87.60	74.67	77.79	83.72				12.93	9.81	3.88
27.956	100684		86.26	86.50	74.64	77.76	83.67				11.86	8.74	2.83
27.952	100652		86.01	86.60	74.57	77.69	83.49				12.03	8.91	3.11
	100600			84.19	74.57	77.69	83.49				9.62	6.50	0.70
	100500	83.28		83.26	74.57	77.69	83.49	8.71	5.59	-0.22	8.69	5.57	-0.23
	100400			83.30	74.57	77.69	83.49				8.73	5.61	-0.20
	100300			83.02	74.57	77.69	83.50				8.45	5.33	-0.48
	100200			82.97	74.57	77.69	83.50				8.39	5.27	-0.53
	100100			82.97	74.57	77.69	83.50				8.39	5.27	-0.53
	100000	83.14		83.05	74.58	77.70	83.50	8.56	5.44	-0.36	8.48	5.36	-0.45
	99900			82.99	74.58	77.70	83.50				8.41	5.29	-0.52
	99800			83.06	74.58	77.70	83.50				8.48	5.36	-0.45
	99700			82.95	74.58	77.70	83.51				8.37	5.25	-0.56
	99600			83.13	74.58	77.70	83.51				8.55	5.43	-0.38
27.75	99512		83.23	83.00	74.58	77.70	83.51				8.42	5.30	-0.51
	99500	83.04		83.06	74.58	77.70	83.51	8.46	5.34	-0.47	8.48	5.36	-0.45
	99400			82.91	74.56	77.68	83.47				8.35	5.23	-0.56
	99300			82.89	74.54	77.66	83.44				8.36	5.23	-0.54
	99200			82.95	74.52	77.64	83.41				8.43	5.31	-0.45
	99100			82.90	74.50	77.62	83.37				8.40	5.28	-0.47
	99000	82.85		83.10	74.48	77.60	83.34	8.37	5.24	-0.49	8.62	5.50	-0.24
	98900			82.98	74.46	77.58	83.30				8.53	5.40	-0.32
	98800			82.78	74.44	77.56	83.27				8.34	5.22	-0.49
	98700			82.90	74.42	77.54	83.24				8.49	5.36	-0.33
	98600			83.00	74.40	77.52	83.20				8.60	5.48	-0.20
	98500	82.76		82.86	74.38	77.50	83.17	8.39	5.26	-0.41	8.49	5.36	-0.31
	98400			82.86	74.36	77.48	83.14				8.51	5.38	-0.27
	98300			82.93	74.34	77.46	83.10				8.59	5.46	-0.17
	98200			82.75	74.32	77.44	83.07				8.43	5.30	-0.32
27.5	98174		82.40	82.60	74.31	77.44	83.06				8.29	5.16	-0.46

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	98100			82.61	74.28	77.41	83.01				8.33	5.20	-0.40
	98000	82.62		82.65	74.25	77.38	82.95	8.37	5.24	-0.33	8.40	5.27	-0.30
	97900			82.63	74.21	77.34	82.89				8.41	5.28	-0.26
	97800			82.58	74.18	77.31	82.82				8.40	5.27	-0.24
	97700			82.45	74.14	77.27	82.76				8.31	5.18	-0.31
	97600			82.46	74.11	77.24	82.70				8.35	5.22	-0.24
	97500	82.28		82.24	74.07	77.20	82.63	8.20	5.07	-0.36	8.16	5.03	-0.40
	97400			82.20	74.04	77.17	82.57				8.17	5.04	-0.37
	97300			82.19	74.00	77.13	82.51				8.19	5.06	-0.32
	97200			82.13	73.97	77.10	82.45				8.16	5.03	-0.32
	97100			81.96	73.93	77.06	82.38				8.03	4.90	-0.43
27.251	97016		80.85	82.00	73.90	77.03	82.33				8.10	4.97	-0.33
27.25	97011		80.85	82.00	73.90	77.03	82.32				8.10	4.97	-0.32
	97000	81.99		81.99	73.90	77.03	82.32	8.09	4.96	-0.33	8.09	4.96	-0.33
	96900			81.86	73.90	77.03	82.32				7.96	4.83	-0.46
	96800			81.80	73.90	77.03	82.32				7.90	4.77	-0.52
	96700			81.27	73.90	77.03	82.32				7.37	4.24	-1.05
	96600	82.17		82.42	73.90	77.03	82.32	8.27	5.14	-0.15	8.52	5.39	0.10
	96500	82.57		82.53	73.90	77.03	82.32	8.67	5.54	0.25	8.63	5.50	0.21
	96400			82.37	73.90	77.03	82.32				8.47	5.34	0.05
	96300			82.48	73.90	77.03	82.32				8.58	5.45	0.16
	96200			82.37	73.90	77.03	82.32				8.47	5.34	0.05
	96100			82.25	73.90	77.03	82.32				8.35	5.22	-0.07
	96000	82.08		82.21	73.90	77.03	82.32	8.18	5.05	-0.24	8.31	5.18	-0.11
	95900			82.07	73.90	77.03	82.32				8.17	5.04	-0.25
	95800			82.11	73.90	77.03	82.32				8.21	5.08	-0.21
27	95788		80.51	82.10	73.90	77.03	82.32				8.20	5.07	-0.22
26.999	95783		80.51	82.10	73.90	77.03	82.32				8.20	5.07	-0.22
	95700			82.23	73.86	76.99	82.28				8.37	5.24	-0.05
	95600			82.22	73.82	76.94	82.23				8.40	5.27	-0.01
	95500	81.96		82.08	73.77	76.90	82.18	8.19	5.06	-0.22	8.31	5.18	-0.10
	95400			82.29	73.72	76.85	82.13				8.56	5.44	0.16
	95300			82.26	73.68	76.80	82.08				8.59	5.46	0.18
	95200			82.26	73.63	76.75	82.03				8.63	5.51	0.23
	95100			82.37	73.58	76.71	81.98				8.79	5.67	0.40
	95000			82.24	73.54	76.66	81.93				8.70	5.58	0.31
	94900			82.22	73.49	76.61	81.88				8.73	5.61	0.34
	94800			82.28	73.44	76.56	81.83				8.84	5.72	0.45
26.75	94706		81.59	82.00	73.40	76.52	81.78				8.60	5.48	0.22
	94700			82.11	73.40	76.52	81.78				8.71	5.59	0.33
	94600			82.12	73.35	76.47	81.74				8.77	5.65	0.38
	94500			82.32	73.30	76.43	81.69				9.01	5.89	0.62
	94400			82.16	73.26	76.38	81.65				8.91	5.78	0.51
	94300			82.45	73.21	76.34	81.61				9.24	6.11	0.84
	94200			82.20	73.16	76.29	81.57				9.03	5.91	0.63
	94100			82.08	73.11	76.24	81.52				8.97	5.84	0.56
	94000			82.11	73.07	76.20	81.48				9.04	5.91	0.63
	93900			82.30	73.02	76.15	81.44				9.28	6.14	0.86
	93800			82.28	72.97	76.11	81.40				9.30	6.17	0.88
	93700			82.27	72.93	76.06	81.36				9.35	6.21	0.92
	93600			82.34	72.88	76.02	81.31				9.46	6.32	1.02
	93500			82.19	72.83	75.97	81.27				9.36	6.22	0.92
26.5	93495		81.77	82.20	72.83	75.97	81.27				9.37	6.23	0.93
	93400			82.57	72.80	75.94	81.25				9.77	6.63	1.32
	93300			82.43	72.77	75.92	81.22				9.65	6.51	1.21
	93200			82.52	72.74	75.89	81.19				9.78	6.64	1.33
	93100			82.57	72.71	75.86	81.17				9.86	6.71	1.40
	93000			82.71	72.68	75.83	81.14				10.03	6.88	1.57
	92900			82.68	72.65	75.80	81.12				10.03	6.88	1.57
	92800			82.33	72.62	75.78	81.09				9.71	6.55	1.24
	92700			81.80	72.59	75.75	81.07				9.21	6.05	0.73
	92600			82.59	72.55	75.72	81.04				10.04	6.87	1.56
	92500	81.91		82.37	72.52	75.69	81.01	9.39	6.22	0.90	9.85	6.68	1.36
	92400			82.74	72.49	75.66	80.99				10.25	7.08	1.75
	92300			82.54	72.46	75.64	80.96				10.08	6.90	1.58
	92200			82.57	72.43	75.61	80.94				10.13	6.96	1.63
	92100			82.59	72.40	75.58	80.91				10.19	7.01	1.68
26.25	92096		82.19	82.40	72.40	75.58	80.91				10.00	6.82	1.49
	92000	82.20		82.65	72.38	75.56	80.89	9.82	6.64	1.31	10.27	7.09	1.75
	91900			82.78	72.35	75.54	80.87				10.43	7.25	1.91
	91800			82.93	72.33	75.51	80.85				10.61	7.42	2.08
	91700			83.12	72.30	75.49	80.83				10.81	7.63	2.29
	91600			82.92	72.28	75.47	80.81				10.64	7.45	2.11
	91500	82.15		82.80	72.25	75.45	80.79	9.90	6.71	1.36	10.54	7.35	2.01
	91400			82.69	72.23	75.42	80.77				10.46	7.27	1.92
	91300			82.49	72.20	75.40	80.75				10.29	7.09	1.74
	91200			82.79	72.18	75.38	80.73				10.62	7.42	2.07
	91100			82.39	72.15	75.36	80.71				10.24	7.04	1.69
	91000	81.64		82.20	72.13	75.33	80.69	9.51	6.30	0.95	10.07	6.87	1.52
	90900			82.24	72.11	75.31	80.66				10.13	6.93	1.57
	90800			82.30	72.08	75.29	80.64				10.22	7.02	1.66
	90700			82.14	72.06	75.26	80.62				10.09	6.88	1.52
26	90634		81.94	82.10	72.04	75.25	80.61				10.06	6.85	1.49
	90600			82.53	72.03	75.24	80.60				10.50	7.29	1.92
	90500	82.44		82.76	72.01	75.22	80.58	10.43	7.21	1.85	10.75	7.54	2.18
	90400			82.60	71.99	75.20	80.57				10.61	7.39	2.03
	90300			82.39	71.97	75.19	80.55				10.42	7.20	1.84
	90200			82.36	71.95	75.17	80.53				10.41	7.19	1.83
	90100			81.99	71.93	75.15	80.51				10.06	6.85	1.48
	90000	81.48		81.69	71.91	75.13	80.49	9.57	6.35	0.99	9.78	6.56	1.20

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	89900			81.52	71.89	75.11	80.47				9.63	6.41	1.04
	89800			81.64	71.87	75.09	80.45				9.77	6.55	1.18
	89700			81.68	71.85	75.07	80.44				9.84	6.61	1.25
	89600			81.93	71.83	75.05	80.42				10.11	6.88	1.52
	89500	81.67		81.82	71.81	75.03	80.40	9.87	6.64	1.27	10.01	6.79	1.42
	89400			82.01	71.78	75.01	80.38				10.23	7.00	1.63
	89300			81.98	71.76	74.99	80.36				10.22	6.99	1.62
	89200			82.17	71.74	74.97	80.34				10.43	7.20	1.83
25.75	89137		81.93	82.10	71.73	74.96	80.33				10.37	7.14	1.77
	89100			82.07	71.72	74.95	80.32				10.34	7.11	1.74
	89000	82.20		82.13	71.70	74.94	80.31	10.49	7.26	1.89	10.43	7.20	1.83
	88900			82.30	71.69	74.92	80.29				10.62	7.39	2.02
	88800			82.09	71.67	74.90	80.27				10.42	7.19	1.82
	88700			81.94	71.65	74.88	80.25				10.29	7.06	1.69
	88600			81.68	71.63	74.86	80.23				10.05	6.82	1.45
	88500	81.45		81.59	71.61	74.85	80.22	9.84	6.61	1.24	9.98	6.74	1.37
	88400			81.54	71.59	74.83	80.20				9.94	6.71	1.34
	88300			81.65	71.58	74.81	80.18				10.07	6.84	1.47
	88200	81.60		81.67	71.56	74.79	80.16	10.04	6.80	1.43	10.11	6.88	1.51
	88100			81.52	71.54	74.78	80.15				9.98	6.74	1.37
	88000	81.50		81.55	71.52	74.76	80.13	9.98	6.74	1.37	10.03	6.79	1.42
	87900			81.94	71.50	74.74	80.11				10.43	7.20	1.83
	87800			82.00	71.48	74.72	80.09				10.52	7.28	1.91
25.5	87728		81.61	82.00	71.47	74.71	80.08				10.53	7.29	1.92
	87700			82.02	71.47	74.71	80.07				10.55	7.31	1.94
	87600			81.86	71.45	74.69	80.06				10.41	7.17	1.80
	87500	81.67		81.95	71.43	74.67	80.04	10.24	7.00	1.63	10.52	7.28	1.92
	87400			82.23	71.41	74.65	80.02				10.81	7.57	2.21
	87300			82.27	71.40	74.64	80.00				10.88	7.64	2.28
	87200			82.31	71.38	74.62	79.98				10.93	7.69	2.33
	87100			82.18	71.36	74.60	79.96				10.82	7.58	2.22
	87000	82.15		82.27	71.35	74.59	79.94	10.80	7.56	2.20	10.92	7.68	2.33
	86900			82.49	71.33	74.57	79.92				11.16	7.92	2.57
	86800			82.51	71.31	74.55	79.90				11.20	7.96	2.61
	86700			82.57	71.29	74.53	79.88				11.27	8.03	2.68
	86600			82.52	71.28	74.52	79.86				11.24	8.00	2.65
	86500	82.18		82.24	71.26	74.50	79.85	10.92	7.68	2.33	10.98	7.74	2.40
	86400			81.80	71.24	74.48	79.83				10.55	7.31	1.97
	86300			81.87	71.23	74.47	79.81				10.64	7.40	2.06
25.25	86208		81.49	81.40	71.21	74.45	79.79				10.19	6.95	1.61
	86200			81.70	71.21	74.45	79.79				10.49	7.25	1.91
	86100			81.36	71.17	74.41	79.76				10.19	6.95	1.61
	86000	81.08		81.23	71.14	74.38	79.72	9.94	6.70	1.36	10.09	6.84	1.50
	85900			81.22	71.10	74.35	79.69				10.12	6.87	1.53
	85800			81.89	71.07	74.32	79.66				10.82	7.57	2.23
	85700			81.92	71.03	74.28	79.63				10.89	7.64	2.30
	85600			82.14	71.00	74.25	79.60				11.14	7.89	2.55
	85500	81.94		82.00	70.97	74.22	79.56	10.97	7.72	2.37	11.04	7.79	2.44
	85400			82.14	70.93	74.19	79.53				11.20	7.95	2.60
	85300			81.59	70.90	74.15	79.50				10.69	7.44	2.09
	85200			81.92	70.86	74.12	79.47				11.05	7.80	2.45
	85100			81.51	70.83	74.09	79.44				10.68	7.42	2.08
	85000	81.47		81.51	70.79	74.06	79.40	10.68	7.41	2.07	10.72	7.46	2.11
	84900			81.53	70.76	74.02	79.37				10.77	7.51	2.16
	84800			81.86	70.72	73.99	79.34				11.14	7.87	2.52
	84700			82.43	70.69	73.96	79.31				11.74	8.47	3.12
25	84613		82.00	82.30	70.66	73.93	79.28				11.64	8.37	3.02
	84600			82.42	70.65	73.92	79.27				11.78	8.51	3.16
	84500	82.28		82.50	70.53	73.81	79.16	11.75	8.47	3.12	11.97	8.69	3.34
	84400			81.97	70.42	73.70	79.05				11.56	8.27	2.92
	84300			81.88	70.30	73.59	78.94				11.57	8.29	2.94
	84200			81.57	70.19	73.48	78.83				11.38	8.08	2.73
	84100			81.78	70.08	73.38	78.73				11.70	8.40	3.05
24.75	84085		80.20	81.60	70.06	73.36	78.71				11.54	8.24	2.89
	84000			81.75	69.95	73.26	78.60				11.80	8.49	3.15
	83900			81.44	69.82	73.13	78.48				11.62	8.31	2.96
	83800			81.27	69.69	73.01	78.35				11.57	8.26	2.92
24.5	83744		58.85	81.10	69.62	72.94	78.28				11.48	8.16	2.82
	83700			81.00	69.59	72.91	78.25				11.41	8.09	2.75
	83600			80.96	69.53	72.85	78.18				11.43	8.11	2.78
	83500			80.58	69.47	72.79	78.12				11.12	7.80	2.47
	83400			80.54	69.40	72.72	78.05				11.14	7.82	2.49
	83300			80.36	69.34	72.66	77.99				11.02	7.70	2.38
	83200			80.34	69.28	72.60	77.92				11.06	7.74	2.42
	83100			80.17	69.21	72.53	77.86				10.95	7.63	2.31
24.25	83076		80.06	80.20	69.20	72.52	77.84				11.00	7.68	2.36
	83000	80.35		80.19	69.17	72.49	77.81	11.18	7.86	2.54	11.02	7.70	2.38
	82900			80.45	69.13	72.45	77.77				11.32	8.00	2.68
	82800			79.77	69.09	72.42	77.74				10.68	7.35	2.03
	82700			79.49	69.05	72.38	77.70				10.44	7.11	1.79
	82600			79.31	69.01	72.34	77.66				10.31	6.97	1.65
	82500	79.40		79.23	68.96	72.31	77.63	10.43	7.09	1.77	10.26	6.92	1.60
	82400			79.16	68.92	72.27	77.59				10.24	6.89	1.57
	82300			79.07	68.88	72.23	77.55				10.19	6.84	1.52
24	82269		79.20	79.00	68.87	72.22	77.54				10.13	6.78	1.46
	82200			79.11	68.85	72.20	77.52				10.26	6.91	1.59
	82100			79.18	68.82	72.17	77.49				10.36	7.01	1.69
	82000	78.97		78.92	68.79	72.14	77.46	10.17	6.82	1.50	10.13	6.78	1.46
	81900			78.69	68.76	72.12	77.43				9.92	6.57	1.25
	81800			78.53	68.73	72.09	77.40				9.80	6.44	1.13

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	81700			78.83	68.70	72.06	77.37				10.12	6.77	1.45
	81600			78.70	68.68	72.03	77.35				10.03	6.67	1.36
	81500	78.99		79.00	68.65	72.00	77.32	10.34	6.99	1.67	10.36	7.00	1.69
	81400			79.03	68.62	71.97	77.29				10.41	7.06	1.74
	81300			79.24	68.59	71.95	77.26				10.65	7.30	1.98
	81200			79.21	68.56	71.92	77.23				10.65	7.29	1.98
	81100			79.15	68.53	71.89	77.20				10.62	7.26	1.95
	81000	79.02		79.00	68.50	71.86	77.17	10.52	7.16	1.85	10.49	7.14	1.82
	80900			78.80	68.47	71.83	77.14				10.33	6.97	1.66
23.75	80892		79.41	78.80	68.47	71.83	77.14				10.33	6.97	1.66
	80800			79.06	68.45	71.81	77.12				10.61	7.25	1.94
	80700			78.79	68.43	71.80	77.10				10.36	7.00	1.69
	80600			78.90	68.42	71.78	77.09				10.48	7.12	1.81
	80500	78.66		78.68	68.40	71.76	77.07	10.26	6.90	1.59	10.28	6.92	1.61
	80400			78.62	68.38	71.74	77.05				10.24	6.87	1.57
	80300			79.07	68.36	71.72	77.03				10.71	7.34	2.04
	80200			79.05	68.34	71.71	77.01				10.71	7.35	2.04
	80100			79.19	68.32	71.69	76.99				10.86	7.50	2.19
	80000	79.16		79.16	68.30	71.67	76.97	10.86	7.49	2.19	10.85	7.49	2.18
	79900			79.04	68.29	71.65	76.96				10.76	7.39	2.09
	79800			79.11	68.27	71.63	76.94				10.84	7.48	2.17
	79700			79.12	68.25	71.62	76.92				10.87	7.51	2.20
	79600			79.12	68.23	71.60	76.90				10.89	7.52	2.22
	79500	79.24		79.04	68.21	71.58	76.88	11.03	7.66	2.36	10.83	7.46	2.16
23.5	79495		79.23	79.10	68.21	71.58	76.88				10.89	7.52	2.22
	79400			79.21	68.19	71.56	76.86				11.02	7.65	2.35
	79300			79.24	68.16	71.53	76.83				11.08	7.71	2.41
	79200			79.04	68.13	71.51	76.80				10.91	7.53	2.24
	79100			79.31	68.11	71.48	76.78				11.20	7.83	2.53
	79000	79.16		79.26	68.08	71.46	76.75	11.08	7.71	2.41	11.18	7.80	2.51
	78900			79.16	68.06	71.43	76.73				11.11	7.73	2.44
	78800			79.16	68.03	71.41	76.70				11.13	7.75	2.46
	78700			78.83	68.00	71.38	76.67				10.83	7.45	2.16
	78600			78.73	67.98	71.36	76.65				10.76	7.37	2.09
	78500	78.85		78.87	67.95	71.34	76.62	10.90	7.51	2.23	10.92	7.53	2.25
	78400			78.38	67.93	71.31	76.60				10.45	7.07	1.78
	78300			78.22	67.90	71.29	76.57				10.32	6.93	1.65
	78200			78.69	67.87	71.26	76.54				10.81	7.43	2.14
	78100			79.21	67.85	71.24	76.52				11.36	7.97	2.69
23.25	78033		79.34	79.20	67.83	71.22	76.50				11.37	7.98	2.70
	78000	79.14		79.17	67.82	71.21	76.49	11.32	7.93	2.65	11.36	7.97	2.69
	77900			78.93	67.79	71.18	76.45				11.14	7.75	2.47
	77800			78.74	67.76	71.15	76.42				10.98	7.59	2.32
	77700			78.61	67.72	71.11	76.38				10.89	7.50	2.23
	77600			78.13	67.69	71.08	76.35				10.44	7.05	1.78
	77500	78.24		78.56	67.66	71.05	76.31	10.58	7.19	1.93	10.90	7.51	2.24
	77400			78.72	67.63	71.02	76.28				11.09	7.70	2.45
	77300			78.41	67.60	70.99	76.24				10.81	7.42	2.17
	77200			78.45	67.56	70.95	76.21				10.89	7.50	2.24
	77100			78.45	67.53	70.92	76.17				10.92	7.53	2.28
	77000	78.27		78.40	67.50	70.89	76.14	10.77	7.38	2.14	10.90	7.51	2.26
	76900			78.36	67.47	70.86	76.10				10.89	7.50	2.26
23	76810		78.56	78.00	67.44	70.83	76.07				10.56	7.17	1.93
	76800			77.99	67.44	70.83	76.07				10.55	7.16	1.92
	76700			78.15	67.42	70.81	76.04				10.74	7.35	2.11
	76600			78.16	67.40	70.78	76.02				10.76	7.37	2.14
	76500	78.16		78.36	67.37	70.76	76.00	10.79	7.40	2.17	10.98	7.60	2.36
	76400			78.30	67.35	70.74	75.97				10.95	7.56	2.33
	76300			78.18	67.33	70.72	75.95				10.85	7.46	2.23
	76200			77.93	67.31	70.70	75.92				10.62	7.23	2.00
	76100			77.73	67.29	70.67	75.90				10.44	7.05	1.83
	76000	77.74		77.78	67.27	70.65	75.88	10.47	7.09	1.86	10.51	7.13	1.90
	75900			77.94	67.25	70.63	75.85				10.69	7.31	2.09
	75800			78.17	67.23	70.61	75.83				10.95	7.56	2.34
	75700			77.96	67.20	70.59	75.80				10.76	7.37	2.16
	75600			77.99	67.18	70.57	75.78				10.81	7.43	2.21
	75500	78.05		78.11	67.16	70.54	75.76	10.89	7.51	2.30	10.94	7.56	2.35
	75400			77.90	67.14	70.52	75.73				10.75	7.37	2.16
22.75	75346		77.84	77.70	67.13	70.51	75.72				10.57	7.19	1.98
	75300			77.51	67.11	70.49	75.70				10.39	7.01	1.80
	75200			77.55	67.08	70.46	75.66				10.47	7.09	1.89
	75100			77.61	67.04	70.42	75.62				10.57	7.19	1.99
	75000	77.85		77.95	67.00	70.38	75.58	10.85	7.47	2.27	10.95	7.57	2.37
	74900			78.00	66.97	70.35	75.54				11.03	7.65	2.47
	74800			77.77	66.93	70.31	75.50				10.83	7.45	2.27
	74700			77.39	66.90	70.28	75.45				10.50	7.12	1.94
	74600			77.48	66.86	70.24	75.41				10.62	7.24	2.07
	74500	77.32		77.57	66.82	70.20	75.37	10.50	7.12	1.95	10.74	7.36	2.19
	74400			77.54	66.79	70.17	75.33				10.75	7.37	2.21
	74300			77.56	66.75	70.13	75.29				10.81	7.43	2.27
	74200			77.31	66.71	70.09	75.25				10.60	7.22	2.07
22.5	74107		77.03	77.30	66.68	70.06	75.21				10.62	7.24	2.09
	74100			77.54	66.68	70.06	75.21				10.86	7.48	2.33
	74000	77.29		77.46	66.65	70.03	75.17	10.64	7.26	2.11	10.81	7.44	2.29
	73900			77.56	66.62	70.00	75.14				10.94	7.56	2.42
	73800			77.62	66.59	69.96	75.10				11.03	7.65	2.52
	73700			77.62	66.56	69.93	75.06				11.06	7.68	2.55
	73600			77.30	66.53	69.90	75.03				10.78	7.40	2.27
	73500	77.19		77.43	66.50	69.87	74.99	10.69	7.31	2.19	10.93	7.56	2.44
	73400			77.50	66.47	69.84	74.96				11.03	7.65	2.54

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	73300			77.60	66.44	69.81	74.92				11.16	7.79	2.68
	73200			77.46	66.41	69.78	74.88				11.06	7.68	2.58
	73100			77.51	66.37	69.75	74.85				11.14	7.77	2.67
	73000	77.39		77.43	66.34	69.72	74.81	11.05	7.68	2.58	11.09	7.71	2.62
	72900			77.11	66.31	69.68	74.78				10.79	7.42	2.33
22.25	72852		76.80	76.90	66.30	69.67	74.76				10.60	7.23	2.14
	72800			76.75	66.29	69.66	74.75				10.46	7.09	2.01
	72700			76.81	66.27	69.64	74.73				10.54	7.17	2.09
	72600			77.04	66.25	69.62	74.70				10.79	7.42	2.33
	72500	77.12		77.13	66.23	69.60	74.68	10.89	7.52	2.44	10.90	7.53	2.45
	72400			77.09	66.21	69.58	74.66				10.88	7.51	2.43
	72300			76.99	66.19	69.56	74.63				10.80	7.43	2.35
	72200			77.05	66.17	69.54	74.61				10.88	7.51	2.44
	72100			76.88	66.15	69.52	74.59				10.73	7.36	2.30
	72000	76.96		77.10	66.13	69.50	74.56	10.83	7.46	2.39	10.97	7.60	2.53
	71900			76.86	66.11	69.48	74.54				10.75	7.38	2.32
	71800			76.76	66.09	69.46	74.52				10.67	7.30	2.24
	71700			76.54	66.07	69.44	74.50				10.47	7.10	2.04
	71600			76.49	66.05	69.42	74.47				10.44	7.07	2.02
	71500	76.82		76.85	66.03	69.40	74.45	10.79	7.42	2.37	10.82	7.45	2.40
22	71498		76.13	76.70	66.03	69.40	74.45				10.67	7.30	2.25
	71400			76.69	66.00	69.38	74.42				10.69	7.32	2.27
	71300			76.50	65.98	69.35	74.40				10.52	7.15	2.11
	71200			76.81	65.95	69.33	74.37				10.85	7.48	2.44
	71100			76.72	65.93	69.30	74.34				10.79	7.42	2.38
	71000	76.58		76.64	65.90	69.28	74.31	10.68	7.30	2.27	10.74	7.37	2.33
	70900			76.68	65.88	69.25	74.28				10.81	7.43	2.40
	70800			76.66	65.85	69.23	74.26				10.81	7.44	2.41
	70700			76.49	65.83	69.20	74.23				10.66	7.29	2.26
	70600			76.76	65.80	69.18	74.20				10.96	7.58	2.56
	70500	76.46		76.72	65.77	69.15	74.17	10.68	7.31	2.28	10.94	7.57	2.54
	70400			76.80	65.75	69.13	74.15				11.05	7.67	2.65
	70300			76.66	65.72	69.10	74.12				10.94	7.56	2.54
	70200			76.95	65.70	69.08	74.09				11.25	7.88	2.86
	70100			76.74	65.67	69.05	74.06				11.07	7.69	2.68
21.75	70018		76.34	76.70	65.65	69.03	74.04				11.05	7.67	2.66
	70000	76.54		76.82	65.65	69.03	74.03	10.89	7.51	2.50	11.18	7.80	2.79
	69900			76.76	65.62	69.00	74.01				11.14	7.76	2.75
	69800			76.26	65.60	68.98	73.98				10.66	7.28	2.28
	69700			76.11	65.57	68.95	73.95				10.53	7.16	2.16
	69600			76.10	65.55	68.93	73.92				10.55	7.18	2.18
	69500	75.96		75.87	65.53	68.90	73.90	10.43	7.06	2.06	10.35	6.97	1.98
	69400			75.85	65.50	68.88	73.87				10.35	6.97	1.98
	69300			75.76	65.48	68.85	73.84				10.28	6.91	1.92
	69200			76.05	65.46	68.83	73.81				10.59	7.22	2.24
	69100			76.03	65.43	68.80	73.79				10.60	7.22	2.24
	69000	76.39		76.27	65.41	68.78	73.76	10.98	7.61	2.63	10.86	7.49	2.51
	68900			75.97	65.38	68.76	73.73				10.59	7.22	2.24
	68800			75.97	65.36	68.73	73.70				10.61	7.24	2.26
21.5	68712		76.47	76.20	65.34	68.71	73.68				10.86	7.49	2.52
	68700			76.07	65.34	68.71	73.68				10.73	7.36	2.39
	68600			76.06	65.31	68.68	73.65				10.75	7.38	2.42
	68500	76.26		76.19	65.28	68.65	73.62	10.98	7.61	2.65	10.91	7.54	2.57
	68400			75.78	65.25	68.63	73.59				10.52	7.15	2.19
	68300			75.91	65.23	68.60	73.56				10.68	7.31	2.35
	68200			75.89	65.20	68.57	73.53				10.70	7.32	2.36
	68100			75.67	65.17	68.55	73.50				10.50	7.12	2.17
	68000	75.64		75.53	65.14	68.52	73.47	10.50	7.12	2.17	10.38	7.01	2.05
	67900			75.43	65.12	68.49	73.44				10.31	6.94	1.98
	67800			75.50	65.09	68.47	73.42				10.41	7.03	2.08
	67700			75.47	65.06	68.44	73.39				10.41	7.03	2.09
	67600			75.58	65.03	68.41	73.36				10.55	7.17	2.22
	67500	75.54		75.48	65.01	68.39	73.33	10.53	7.15	2.21	10.47	7.10	2.15
	67400			75.29	64.98	68.36	73.30				10.31	6.93	1.99
21.25	67330		75.58	75.50	64.96	68.34	73.28				10.54	7.16	2.22
	67300			75.45	64.95	68.33	73.27				10.49	7.11	2.18
	67200			75.48	64.93	68.31	73.25				10.55	7.17	2.24
	67100			75.21	64.91	68.29	73.22				10.30	6.92	1.99
	67000	75.07		74.78	64.89	68.27	73.19	10.18	6.80	1.87	9.89	6.51	1.58
	66900			74.69	64.86	68.24	73.17				9.83	6.45	1.52
	66800			74.92	64.84	68.22	73.14				10.08	6.70	1.78
	66700			74.65	64.82	68.20	73.11				9.83	6.45	1.54
	66600			74.92	64.79	68.17	73.09				10.12	6.74	1.83
	66500	75.04		74.85	64.77	68.15	73.06	10.27	6.89	1.98	10.08	6.70	1.79
	66400			74.78	64.75	68.13	73.03				10.03	6.65	1.74
	66300			74.64	64.73	68.11	73.01				9.91	6.53	1.63
	66200			74.59	64.70	68.08	72.98				9.89	6.51	1.61
	66100			74.28	64.68	68.06	72.95				9.60	6.22	1.33
21	66047		74.52	74.40	64.67	68.05	72.94				9.73	6.35	1.46
	66000	74.34		74.21	64.66	68.04	72.93	9.68	6.30	1.41	9.54	6.16	1.28
	65900			74.52	64.65	68.03	72.91				9.87	6.49	1.60
	65800			74.42	64.63	68.01	72.89				9.79	6.41	1.53
	65700			74.28	64.62	67.99	72.87				9.66	6.29	1.41
	65600			74.19	64.60	67.98	72.85				9.59	6.22	1.34
	65500	74.51		74.06	64.59	67.96	72.83	9.92	6.55	1.67	9.48	6.10	1.23
	65400			73.94	64.57	67.94	72.81				9.37	5.99	1.12
	65300			73.87	64.56	67.92	72.79				9.32	5.95	1.08
	65200			74.05	64.54	67.91	72.77				9.51	6.14	1.28
	65100			74.00	64.52	67.89	72.75				9.47	6.11	1.24
	65000	74.29		73.83	64.51	67.87	72.73	9.78	6.41	1.55	9.32	5.95	1.09

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	64900			73.91	64.49	67.86	72.71				9.42	6.05	1.20
	64800			73.68	64.48	67.84	72.69				9.20	5.83	0.98
	64700			73.28	64.46	67.82	72.67				8.81	5.45	0.60
20.75	64676		73.90	73.50	64.46	67.82	72.67				9.04	5.68	0.83
	64600			74.08	64.45	67.81	72.66				9.63	6.27	1.43
	64500	74.31		74.02	64.44	67.80	72.64	9.87	6.51	1.67	9.58	6.22	1.38
	64400			73.49	64.42	67.78	72.62				9.07	5.71	0.87
	64300			73.58	64.41	67.77	72.60				9.17	5.81	0.98
	64200			73.57	64.40	67.75	72.58				9.18	5.82	0.99
	64100			73.40	64.38	67.74	72.56				9.01	5.66	0.83
	64000	73.11		72.77	64.37	67.72	72.54	8.74	5.39	0.57	8.40	5.05	0.23
	63900			72.76	64.36	67.71	72.53				8.41	5.05	0.24
	63800			72.82	64.34	67.70	72.51				8.48	5.12	0.31
	63700			72.78	64.33	67.68	72.49				8.45	5.10	0.29
	63600			72.74	64.32	67.67	72.47				8.42	5.07	0.27
	63500	72.89		72.41	64.30	67.65	72.45	8.59	5.24	0.44	8.10	4.75	-0.05
	63400			72.15	64.29	67.64	72.43				7.86	4.51	-0.28
20.5	63332		72.59	72.30	64.28	67.63	72.42				8.02	4.67	-0.12
	63300			72.24	64.28	67.63	72.41				7.96	4.61	-0.18
	63200			72.15	64.26	67.61	72.40				7.89	4.54	-0.25
	63100			72.13	64.25	67.60	72.38				7.88	4.54	-0.24
	63000	72.42		71.98	64.23	67.58	72.36	8.19	4.84	0.06	7.74	4.40	-0.38
	62900			72.14	64.22	67.57	72.34				7.92	4.57	-0.20
	62800			72.08	64.21	67.55	72.32				7.87	4.53	-0.24
	62700			72.02	64.19	67.54	72.30				7.83	4.49	-0.28
	62600			71.96	64.18	67.52	72.28				7.78	4.44	-0.32
	62500	72.30		71.92	64.16	67.51	72.27	8.13	4.79	0.03	7.76	4.41	-0.35
	62400			72.32	64.15	67.49	72.25				8.17	4.82	0.07
	62300			72.39	64.14	67.48	72.23				8.25	4.91	0.16
	62200			72.03	64.12	67.46	72.21				7.91	4.57	-0.18
	62100			72.08	64.11	67.45	72.19				7.98	4.64	-0.11
	62000	72.29		72.11	64.09	67.43	72.17	8.20	4.86	0.12	8.02	4.68	-0.06
20.25	61977		72.21	72.10	64.09	67.43	72.17				8.01	4.67	-0.07
	61900			72.15	64.08	67.42	72.16				8.07	4.73	-0.01
	61800			71.99	64.07	67.41	72.14				7.92	4.58	-0.16
	61700			71.65	64.06	67.40	72.13				7.59	4.25	-0.48
	61600			71.41	64.05	67.38	72.11				7.36	4.03	-0.70
	61500	71.66		71.40	64.04	67.37	72.10	7.62	4.28	-0.44	7.36	4.03	-0.70
	61400			71.49	64.03	67.36	72.08				7.47	4.14	-0.59
	61300			71.65	64.01	67.35	72.07				7.63	4.30	-0.42
	61200			71.56	64.00	67.33	72.05				7.56	4.23	-0.49
	61100			71.49	63.99	67.32	72.04				7.50	4.17	-0.55
	61000	71.55		71.53	63.98	67.31	72.02	7.57	4.24	-0.47	7.55	4.22	-0.49
	60900			71.47	63.97	67.30	72.01				7.50	4.18	-0.54
	60800			71.18	63.96	67.28	71.99				7.23	**3.90**	-0.81
	60700			71.14	63.95	67.27	71.98				7.19	**3.87**	-0.84
	60600			71.13	63.94	67.26	71.96				7.19	**3.87**	-0.83
	60500	71.19		70.95	63.92	67.25	71.95	7.27	**3.95**	-0.75	7.02	**3.70**	-1.00
20	60460		71.34	71.00	63.92	67.24	71.94				7.08	**3.76**	-0.94
	60400			71.20	63.91	67.23	71.93				7.29	**3.97**	-0.73
	60300			71.24	63.90	67.22	71.92				7.34	4.02	-0.68
	60200			71.58	63.89	67.21	71.91				7.69	4.37	-0.32
	60100			71.30	63.88	67.20	71.90				7.42	4.10	-0.59
	60000	71.68		71.40	63.87	67.19	71.88	7.81	4.49	-0.20	7.53	4.21	-0.48
	59900			71.65	63.86	67.18	71.87				7.79	4.47	-0.22
	59800			71.54	63.85	67.17	71.86				7.69	4.37	-0.32
	59700			71.13	63.84	67.16	71.85				7.29	**3.97**	-0.71
	59600			70.78	63.83	67.15	71.83				6.95	**3.63**	-1.05
	59500	71.06		70.75	63.82	67.14	71.82	7.24	**3.92**	-0.76	6.93	**3.61**	-1.07
	59400			70.93	63.81	67.13	71.81				7.13	**3.81**	-0.87
	59300			70.83	63.80	67.12	71.80				7.03	**3.71**	-0.97
	59200			70.88	63.79	67.11	71.78				7.09	**3.77**	-0.91
	59100			70.99	63.78	67.10	71.77				7.21	**3.89**	-0.79
	59000	71.24		70.86	63.77	67.09	71.76	7.47	4.15	-0.52	7.10	**3.78**	-0.89
	58900			70.84	63.76	67.08	71.75				7.09	**3.77**	-0.90
19.75	58852		71.52	70.90	63.75	67.07	71.74				7.15	**3.83**	-0.84
	58800			70.78	63.75	67.07	71.74				7.03	**3.72**	-0.95
	58700			70.47	63.74	67.06	71.73				6.73	**3.41**	-1.26
	58600			70.24	63.73	67.05	71.72				6.51	**3.19**	-1.48
	58500	70.83		70.41	63.73	67.05	71.71	7.10	**3.78**	-0.89	6.68	**3.36**	-1.31
	58400			70.52	63.72	67.04	71.71				6.80	**3.48**	-1.19
	58300			70.51	63.71	67.03	71.70				6.80	**3.48**	-1.18
	58200			70.46	63.71	67.02	71.69				6.76	**3.44**	-1.23
	58100			70.51	63.70	67.02	71.68				6.81	**3.49**	-1.18
	58000	70.91		70.48	63.69	67.01	71.68	7.21	**3.90**	-0.77	6.79	**3.47**	-1.20
	57900			70.53	63.69	67.00	71.67				6.84	**3.52**	-1.14
	57800			70.50	63.68	67.00	71.66				6.82	**3.51**	-1.16
	57700			70.50	63.67	66.99	71.65				6.83	**3.52**	-1.15
	57600			70.54	63.67	66.98	71.65				6.87	**3.56**	-1.11
	57500	70.75		70.55	63.66	66.97	71.64	7.08	**3.77**	-0.89	6.89	**3.57**	-1.09
	57400			70.30	63.66	66.97	71.63				6.64	**3.33**	-1.33
	57300			70.32	63.65	66.96	71.62				6.67	**3.36**	-1.30
	57200			70.13	63.64	66.95	71.62				6.48	**3.17**	-1.49
	57100			70.02	63.64	66.95	71.61				6.38	**3.07**	-1.59
	57000	70.25		70.08	63.63	66.94	71.60	6.62	**3.31**	-1.35	6.45	**3.14**	-1.53
	56900			70.27	63.62	66.93	71.59				6.65	**3.34**	-1.32
19.5	56863		70.67	70.40	63.62	66.93	71.59				6.78	**3.47**	-1.19
	56800			70.34	63.61	66.92	71.58				6.73	**3.42**	-1.24
	56700			70.48	63.61	66.92	71.57				6.87	**3.56**	-1.10
	56600			70.60	63.60	66.91	71.56				7.00	**3.69**	-0.97

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	56500	70.94		70.57	63.59	66.90	71.55	7.35	4.04	-0.61	6.98	**3.67**	-0.98
	56400			70.58	63.58	66.89	71.55				6.99	**3.68**	-0.97
	56300			70.50	63.57	66.88	71.54				6.93	**3.62**	-1.03
	56200			70.47	63.57	66.88	71.53				6.91	**3.60**	-1.05
	56100			70.53	63.56	66.87	71.52				6.97	**3.66**	-0.99
	56000	70.77		70.27	63.55	66.86	71.51	7.22	**3.91**	-0.74	6.72	**3.41**	-1.24
	55900			69.95	63.54	66.85	71.50				6.41	**3.10**	-1.55
	55800			69.83	63.53	66.84	71.49				6.29	**2.98**	-1.66
	55700			69.61	63.52	66.83	71.48				6.08	**2.77**	-1.87
	55600			69.67	63.52	66.83	71.47				6.16	**2.85**	-1.79
19.25	55517		70.98	69.80	63.51	66.82	71.46				6.29	**2.98**	-1.66
	55500	70.19		69.68	63.51	66.82	71.46	6.68	**3.37**	-1.27	6.17	**2.86**	-1.78
	55400			69.70	63.50	66.81	71.44				6.21	**2.90**	-1.74
	55300			69.73	63.48	66.79	71.43				6.25	**2.94**	-1.70
	55200			69.94	63.47	66.78	71.42				6.47	**3.16**	-1.47
	55100			70.20	63.46	66.77	71.40				6.74	**3.43**	-1.20
	55000	70.91		70.32	63.45	66.76	71.39	7.46	4.15	-0.48	6.88	**3.57**	-1.07
	54900			70.42	63.43	66.74	71.38				6.98	**3.67**	-0.96
	54800			70.16	63.42	66.73	71.36				6.74	**3.43**	-1.20
19	54713		70.69	70.20	63.41	66.72	71.35				6.79	**3.48**	-1.15
	54700			70.10	63.41	66.72	71.35				6.69	**3.38**	-1.25
	54600			70.25	63.39	66.70	71.33				6.86	**3.55**	-1.08
	54500	70.60		70.26	63.38	66.69	71.31	7.22	**3.91**	-0.71	6.88	**3.57**	-1.05
	54400			70.07	63.37	66.67	71.30				6.70	**3.40**	-1.22
	54300			70.13	63.35	66.66	71.28				6.78	**3.47**	-1.15
	54200			69.90	63.34	66.64	71.26				6.56	**3.26**	-1.36
	54100			69.88	63.33	66.63	71.24				6.55	**3.25**	-1.37
	54000	70.38		69.97	63.31	66.62	71.23	7.07	**3.77**	-0.84	6.65	**3.35**	-1.26
	53900			69.94	63.30	66.60	71.21				6.64	**3.33**	-1.27
	53800			69.92	63.28	66.59	71.19				6.63	**3.33**	-1.27
	53700			70.22	63.27	66.57	71.17				6.95	**3.65**	-0.95
18.75	53623		70.70	70.50	63.26	66.56	71.16				7.24	**3.94**	-0.66
	53600			70.31	63.26	66.56	71.16				7.06	**3.76**	-0.84
	53500	70.22		69.99	63.24	66.54	71.14	6.97	**3.67**	-0.93	6.75	**3.45**	-1.15
	53400			69.87	63.23	66.53	71.13				6.64	**3.34**	-1.26
	53300			70.08	63.22	66.52	71.11				6.86	**3.56**	-1.03
	53200			70.23	63.21	66.51	71.10				7.02	**3.72**	-0.87
	53100			70.12	63.20	66.50	71.08				6.93	**3.63**	-0.96
	53000	70.56		70.58	63.18	66.48	71.07	7.38	4.08	-0.50	7.40	4.10	-0.48
	52900			70.54	63.17	66.47	71.05				7.37	4.07	-0.51
18.5	52898		70.27	70.60	63.17	66.47	71.05				7.43	4.13	-0.45
	52800			70.57	63.16	66.46	71.04				7.42	4.12	-0.46
	52700			70.39	63.15	66.45	71.02				7.24	**3.95**	-0.63
	52600			70.07	63.14	66.43	71.01				6.93	**3.63**	-0.95
	52500	70.23		69.99	63.13	66.42	71.00	7.11	**3.81**	-0.77	6.87	**3.57**	-1.01
	52400			69.97	63.12	66.41	70.99				6.85	**3.56**	-1.02
	52300			69.83	63.10	66.40	70.97				6.72	**3.43**	-1.15
	52200			69.69	63.09	66.39	70.96				6.59	**3.30**	-1.27
	52100			69.63	63.08	66.37	70.95				6.54	**3.25**	-1.32
	52000	70.24		69.97	63.07	66.36	70.93	7.16	**3.87**	-0.70	6.90	**3.60**	-0.97
	51900			70.14	63.06	66.35	70.92				7.08	**3.79**	-0.78
18.25	51890		69.73	70.00	63.06	66.35	70.92				6.94	**3.65**	-0.92
	51800			69.99	63.05	66.34	70.91				6.94	**3.65**	-0.92
	51700			69.98	63.04	66.33	70.90				6.94	**3.65**	-0.92
	51600			70.05	63.03	66.32	70.89				7.01	**3.72**	-0.84
	51500	71.20		70.07	63.02	66.31	70.88	8.17	4.89	0.32	7.05	**3.76**	-0.80
	51400			70.59	63.02	66.30	70.86				7.58	4.29	-0.27
	51300			70.76	63.01	66.29	70.85				7.75	4.46	-0.10
	51200			70.09	63.00	66.28	70.84				7.09	**3.81**	-0.75
	51100				62.99	66.27	70.83						
	51000				62.98	66.26	70.82						
	50900				62.97	66.25	70.81						
	50800				62.96	66.25	70.80						
	50700				62.95	66.24	70.78						
	50600				62.94	66.23	70.77						
	50500				62.93	66.22	70.76						
	50400				62.92	66.21	70.75						
	50300				62.91	66.20	70.74						
	50200				62.91	66.19	70.73						
	50100				62.90	66.18	70.72						
	50000				62.89	66.17	70.70						
	49900				62.88	66.16	70.69						
	49800				62.87	66.15	70.68						
18	49704				62.86	66.14	70.67						
	49700				62.86	66.14	70.67						
	49600				62.81	66.09	70.61						
	49500				62.76	66.03	70.55						
	49400				62.71	65.98	70.49						
17.75	49400				62.71	65.98	70.49						
	49300				62.65	65.92	70.42						
	49200				62.60	65.86	70.35						
17.5	49114				62.55	65.81	70.29						
	49100				62.54	65.80	70.28						
	49000				62.48	65.74	70.21						
	48900				62.42	65.68	70.14						
	48800				62.36	65.62	70.07						
17.25	48795				62.36	65.62	70.07						
	48700				62.19	65.45	69.88						
	48600				62.01	65.27	69.69						
17	48556				61.93	65.19	69.60						

STAR

BEND

SETBACK

AREA

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	48500				61.90	65.15	69.56						
	48400				61.84	65.09	69.49						
	48300				61.77	65.03	69.42						
	48200				61.71	64.97	69.35						
	48100				61.65	64.90	69.28						
16.75	48094				61.65	64.90	69.28						
	48000				61.62	64.87	69.25						
	47900				61.60	64.84	69.21						
	47800			68.78	61.57	64.81	69.18				7.21	**3.97**	-0.40
	47700			68.75	61.54	64.78	69.15				7.21	**3.97**	-0.39
	47600			68.74	61.51	64.75	69.11				7.23	3.99	-0.37
	47500	70.15		69.31	61.49	64.72	69.08	8.67	5.44	1.08	7.83	4.59	0.24
	47400			68.72	61.46	64.69	69.04				7.26	4.03	-0.32
	47300			68.64	61.43	64.66	69.01				7.21	**3.98**	-0.37
	47200			68.39	61.40	64.63	68.97				6.99	**3.77**	-0.58
	47100			68.09	61.37	64.60	68.94				6.72	**3.50**	-0.85
16.5	47013		62.99	68.20	61.35	64.57	68.91				6.85	**3.63**	-0.71
	47000	68.41		67.75	61.35	64.57	68.91	7.06	**3.84**	-0.50	6.40	**3.18**	-1.16
	46900			67.53	61.32	64.54	68.87				6.21	**2.99**	-1.34
	46800			67.76	61.29	64.51	68.84				6.46	**3.25**	-1.08
	46700			67.45	61.27	64.48	68.80				6.18	**2.97**	-1.35
	46600			67.43	61.24	64.45	68.77				6.19	**2.98**	-1.34
	46500	67.87		67.50	61.21	64.42	68.73	6.66	**3.45**	-0.86	6.29	**3.08**	-1.23
	46400			67.46	61.19	64.39	68.70				6.27	**3.07**	-1.24
	46300	67.97		67.41	61.16	64.36	68.66	6.81	**3.61**	-0.69	6.25	**3.05**	-1.26
16.25	46228		68.20	67.50	61.14	64.34	68.64				6.36	**3.16**	-1.14
	46200			67.43	61.13	64.33	68.63				6.30	**3.10**	-1.20
	46100			67.41	61.10	64.30	68.60				6.30	**3.11**	-1.19
	46000	68.11		67.60	61.08	64.27	68.56	7.03	3.84	-0.45	6.52	3.33	-0.96
	45900			67.63	61.05	64.24	68.53				6.59	3.40	-0.89
	45800			67.75	61.02	64.21	68.49				6.73	3.54	-0.74
	45700			67.89	60.99	64.18	68.46				6.90	3.71	-0.57
	45600			68.07	60.96	64.14	68.42				7.11	3.92	-0.36
	45500	68.05		67.71	60.93	64.11	68.39	7.12	3.94	-0.33	6.78	3.60	-0.67
	45400			67.61	60.90	64.08	68.35				6.70	3.52	-0.75
	45300			67.31	60.88	64.05	68.32				6.43	3.26	-1.01
	45200			67.39	60.85	64.02	68.28				6.55	3.37	-0.89
16	45101		67.15	67.30	60.82	63.99	68.25				6.48	3.31	-0.95
	45100			67.36	60.82	63.99	68.25				6.54	3.37	-0.89
	45000	67.91		67.78	60.78	63.95	68.20	7.13	3.96	-0.29	6.99	3.83	-0.42
	44900			67.87	60.75	63.91	68.16				7.12	3.96	-0.29
	44800			67.37	60.71	63.87	68.11				6.66	3.50	-0.74
	44700			67.13	60.68	63.83	68.07				6.45	3.30	-0.93
	44600			67.11	60.64	63.79	68.02				6.46	3.32	-0.91
	44500	67.26		66.98	60.61	63.75	67.97	6.65	3.51	-0.71	6.37	3.23	-1.00
	44400			67.02	60.57	63.71	67.93				6.44	3.31	-0.91
	44300			67.19	60.54	63.67	67.88				6.65	3.52	-0.70
	44200			66.97	60.50	63.63	67.84				6.47	3.35	-0.86
	44100			67.23	60.47	63.59	67.79				6.76	3.65	-0.56
	44000	67.43		67.38	60.43	63.55	67.75	6.99	3.88	-0.32	6.94	3.83	-0.37
	43900			67.47	60.40	63.51	67.70				7.07	3.97	-0.23
	43800			67.25	60.37	63.47	67.65				6.89	3.78	-0.40
	43700			67.29	60.33	63.43	67.61				6.96	3.86	-0.32
	43600			66.96	60.30	63.39	67.56				6.66	3.57	-0.60
	43500	66.95		66.79	60.26	63.35	67.52	6.69	3.61	-0.56	6.53	3.44	-0.72
	43400			66.71	60.23	63.31	67.47				6.48	3.40	-0.76
15.75	43356		67.14	66.60	60.21	63.29	67.45				6.39	3.31	-0.85
	43300			67.21	60.19	63.27	67.43				7.02	3.94	-0.21
	43200			67.41	60.16	63.23	67.38				7.25	4.18	0.03
	43100			67.55	60.12	63.19	67.34				7.42	4.35	0.21
	43000	67.39		67.22	60.09	63.16	67.29	7.30	4.23	0.10	7.12	4.06	-0.08
	42900			67.49	60.06	63.12	67.25				7.43	4.37	0.24
	42800			66.99	60.02	63.08	67.20				6.96	3.90	-0.22
	42700			66.60	59.99	63.05	67.16				6.61	3.56	-0.56
	42600			66.93	59.96	63.01	67.12				6.97	3.92	-0.19
	42500	67.17		66.98	59.93	62.97	67.07	7.25	4.20	0.10	7.06	4.01	-0.09
	42400			67.15	59.89	62.93	67.03				7.25	4.21	0.12
	42300			66.84	59.86	62.90	66.98				6.98	3.94	-0.15
	42200			66.82	59.83	62.86	66.94				7.00	3.97	-0.11
	42100			66.95	59.79	62.82	66.90				7.16	4.13	0.06
	42000	67.06		66.90	59.76	62.78	66.85	7.30	4.27	0.20	7.14	4.11	0.05
	41900			67.00	59.73	62.75	66.81				7.28	4.25	0.19
	41800			67.30	59.69	62.71	66.76				7.61	4.59	0.54
	41700			67.09	59.66	62.67	66.72				7.43	4.41	0.37
15.5	41613		67.21	67.10	59.63	62.64	66.68				7.47	4.46	0.42
	41600			66.90	59.62	62.63	66.67				7.28	4.27	0.23
	41500	67.05		66.92	59.59	62.59	66.62	7.46	4.46	0.42	7.33	4.33	0.30
	41400			67.37	59.55	62.55	66.57				7.82	4.82	0.80
	41300			66.75	59.51	62.50	66.52				7.25	4.25	0.23
	41200			66.80	59.47	62.46	66.47				7.33	4.34	0.33
	41100			66.57	59.43	62.41	66.42				7.14	4.15	0.15
	41000	66.65		66.63	59.39	62.37	66.37	7.26	4.28	0.28	7.23	4.26	0.26
	40900			66.77	59.35	62.32	66.31				7.42	4.45	0.46
	40800			66.74	59.31	62.28	66.26				7.43	4.46	0.48
	40700			66.59	59.27	62.24	66.21				7.31	4.35	0.38
	40600			66.62	59.23	62.19	66.16				7.39	4.43	0.46
	40500	66.82		66.90	59.20	62.15	66.11	7.62	4.67	0.71	7.71	4.76	0.79
	40400			66.77	59.16	62.10	66.06				7.61	4.67	0.71
15.25	40305		66.89	66.80	59.12	62.06	66.01				7.68	4.74	0.79
	40300			66.73	59.12	62.06	66.01				7.61	4.67	0.72

200YR Design
100YR Design

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	40200			66.56	59.08	62.02	65.96				7.47	4.54	0.60
	40100			66.46	59.05	61.98	65.91				7.41	4.48	0.55
	40000	66.60		66.58	59.02	61.94	65.86	7.58	4.66	0.74	7.56	4.64	0.72
	39900			66.52	58.99	61.90	65.81				7.53	4.62	0.71
	39800			66.42	58.95	61.86	65.76				7.47	4.57	0.66
	39700			66.36	58.92	61.82	65.71				7.44	4.54	0.65
	39600			66.51	58.89	61.78	65.66				7.62	4.73	0.84
	39500	66.22		66.19	58.85	61.74	65.61	7.37	4.48	0.61	7.33	4.45	0.57
	39400			66.35	58.82	61.70	65.57				7.53	4.65	0.79
	39300			66.31	58.79	61.66	65.52				7.53	4.66	0.80
	39200			66.10	58.75	61.62	65.47				7.35	4.48	0.63
15	39103		66.22	66.00	58.72	61.58	65.42				7.28	4.42	0.58
	39100			66.03	58.72	61.58	65.42				7.31	4.45	0.61
	39000	66.10		65.97	58.69	61.55	65.39	7.41	4.55	0.71	7.28	4.43	0.59
	38900			65.99	58.66	61.52	65.35				7.33	4.47	0.64
	38800			65.92	58.63	61.49	65.32				7.28	4.43	0.60
	38700			65.92	58.60	61.45	65.29				7.32	4.47	0.64
	38600			66.20	58.58	61.42	65.25				7.62	4.77	0.94
	38500	66.23		66.27	58.55	61.39	65.22	7.68	4.84	1.01	7.73	4.88	1.05
	38400			66.22	58.52	61.36	65.18				7.70	4.86	1.03
	38300			66.32	58.49	61.33	65.15				7.83	4.99	1.16
	38200			66.06	58.46	61.30	65.12				7.60	4.76	0.94
	38100			66.12	58.43	61.27	65.08				7.69	4.86	1.04
	38000	66.13		66.13	58.40	61.24	65.05	7.73	4.90	1.08	7.73	4.89	1.08
	37900			66.12	58.37	61.21	65.02				7.75	4.92	1.10
14.75	37817		66.09	66.00	58.35	61.18	64.99				7.65	4.82	1.01
	37800			65.95	58.35	61.18	64.98				7.61	4.78	0.97
	37700			65.81	58.32	61.15	64.95				7.49	4.66	0.86
	37600			65.91	58.30	61.12	64.92				7.61	4.79	0.99
	37500	66.07		66.03	58.27	61.09	64.88	7.80	4.98	1.18	7.76	4.94	1.15
	37400			66.07	58.25	61.06	64.85				7.83	5.01	1.22
	37300			65.82	58.22	61.03	64.82				7.60	4.79	1.00
	37200			65.87	58.20	61.00	64.78				7.67	4.86	1.08
	37100			65.64	58.17	60.97	64.75				7.47	4.67	0.89
	37000	65.62		65.56	58.15	60.95	64.72	7.47	4.67	0.90	7.41	4.62	0.84
	36900			65.49	58.12	60.92	64.68				7.37	4.57	0.80
	36800			65.29	58.10	60.89	64.65				7.19	4.40	0.64
	36700			65.56	58.07	60.86	64.62				7.48	4.70	0.94
	36600			65.42	58.05	60.83	64.58				7.37	4.59	0.83
	36500	65.22		65.22	58.02	60.80	64.55	7.20	4.42	0.67	7.20	4.42	0.67
	36400			65.18	58.00	60.77	64.52				7.18	4.40	0.66
14.5	36319		64.22	64.90	57.98	60.75	64.49				6.92	4.15	0.41
	36300			64.85	57.97	60.74	64.48				6.88	4.11	0.37
	36200			64.82	57.93	60.70	64.43				6.89	4.12	0.39
	36100			64.72	57.89	60.65	64.37				6.82	4.07	0.35
	36000	65.00		65.00	57.86	60.60	64.32	7.14	4.39	0.68	7.15	4.40	0.69
	35900			65.03	57.82	60.56	64.26				7.21	4.47	0.77
	35800			65.24	57.78	60.51	64.21				7.47	4.73	1.04
	35700			65.29	57.74	60.47	64.15				7.55	4.83	1.14
	35600			65.15	57.70	60.42	64.10				7.45	4.73	1.05
	35500	65.28		65.30	57.66	60.37	64.04	7.62	4.90	1.23	7.64	4.93	1.26
	35400			65.19	57.62	60.33	63.99				7.57	4.86	1.20
	35300			65.01	57.58	60.28	63.94				7.42	4.72	1.07
	35200			65.32	57.54	60.24	63.88				7.77	5.08	1.44
	35100			65.42	57.51	60.19	63.83				7.91	5.23	1.59
	35000	65.30		65.37	57.47	60.14	63.77	7.83	5.15	1.53	7.91	5.23	1.60
14.25	34904		65.26	65.30	57.43	60.10	63.72				7.87	5.20	1.58
	34900			65.36	57.43	60.10	63.72				7.93	5.26	1.64
	34800			65.50	57.41	60.07	63.69				8.10	5.43	1.81
	34700			65.44	57.38	60.05	63.66				8.06	5.39	1.78
	34600			65.20	57.36	60.02	63.62				7.84	5.18	1.57
	34500	65.16		65.16	57.33	59.99	63.59	7.83	5.17	1.57	7.83	5.17	1.57
	34400			64.99	57.31	59.97	63.56				7.68	5.02	1.43
	34300			65.02	57.29	59.94	63.53				7.74	5.08	1.49
	34200			64.97	57.26	59.91	63.50				7.71	5.06	1.47
	34100			64.89	57.24	59.89	63.47				7.65	5.00	1.42
	34000	65.17		65.07	57.22	59.86	63.44	7.95	5.30	1.73	7.85	5.21	1.63
	33900			64.72	57.19	59.83	63.40				7.52	4.88	1.31
	33800			64.90	57.17	59.81	63.37				7.73	5.09	1.53
	33700			64.81	57.15	59.78	63.34				7.67	5.03	1.47
	33600			64.89	57.12	59.75	63.31				7.76	5.13	1.58
14	33508		64.94	64.70	57.10	59.73	63.28				7.60	4.97	1.42
	33500	64.79		64.66	57.10	59.73	63.28	7.69	5.06	1.51	7.57	4.94	1.39
	33400			64.64	57.08	59.70	63.24				7.57	4.95	1.40
	33300			64.55	57.05	59.67	63.21				7.49	4.88	1.34
	33200			64.45	57.03	59.64	63.17				7.42	4.81	1.28
	33100			64.35	57.01	59.61	63.14				7.34	4.73	1.21
	33000	64.54		64.52	56.99	59.58	63.10	7.55	4.96	1.44	7.54	4.94	1.42
	32900			64.38	56.96	59.55	63.06				7.42	4.83	1.32
	32800			64.35	56.94	59.52	63.03				7.41	4.83	1.32
	32700			64.39	56.92	59.50	62.99				7.47	4.89	1.39
	32600			64.44	56.89	59.47	62.96				7.55	4.97	1.48
	32500	64.39		64.35	56.87	59.44	62.92	7.52	4.95	1.47	7.48	4.91	1.43
	32400			64.64	56.85	59.41	62.89				7.79	5.23	1.75
	32300			64.41	56.83	59.38	62.85				7.59	5.03	1.56
13.75	32270		64.51	64.20	56.82	59.37	62.84				7.38	4.83	1.36
	32200	64.40		64.40	56.79	59.34	62.80	7.60	5.06	1.59	7.60	5.06	1.59
	32100			64.26	56.76	59.30	62.75				7.51	4.97	1.52
	32000			64.37	56.72	59.25	62.70				7.65	5.12	1.67
	31900			64.39	56.68	59.21	62.64				7.71	5.18	1.75

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	31800			64.15	56.64	59.16	62.59				7.51	4.99	1.57
	31700	64.06		64.18	56.60	59.12	62.54	7.45	4.94	1.52	7.58	5.06	1.64
	31600			63.91	56.57	59.08	62.48				7.35	4.83	1.43
	31500	63.84		63.85	56.53	59.03	62.43	7.31	4.80	1.41	7.33	4.82	1.42
	31400			63.73	56.49	58.99	62.38				7.24	4.74	1.35
	31300			63.69	56.45	58.95	62.32				7.24	4.75	1.37
13.5	31239		63.85	63.80	56.43	58.92	62.29				7.37	4.88	1.51
	31200			63.83	56.42	58.91	62.28				7.41	4.92	1.55
	31100			63.77	56.41	58.89	62.26				7.36	4.87	1.51
	31000	63.82		63.75	56.39	58.87	62.24	7.43	4.95	1.58	7.36	4.88	1.51
	30900			63.72	56.37	58.85	62.21				7.35	4.87	1.50
	30800			63.77	56.35	58.83	62.19				7.42	4.94	1.58
	30700			63.79	56.34	58.81	62.17				7.45	4.98	1.62
	30600			63.37	56.32	58.79	62.15				7.05	4.58	1.23
	30500	63.33		63.45	56.30	58.77	62.13	7.03	4.56	1.21	7.15	4.68	1.32
	30400			63.47	56.28	58.75	62.10				7.19	4.73	1.37
	30300			63.44	56.27	58.73	62.08				7.17	4.71	1.36
	30200			63.39	56.25	58.71	62.06				7.14	4.69	1.33
	30100			63.14	56.23	58.69	62.04				6.91	4.45	1.10
	30000	63.21		63.24	56.21	58.66	62.02	7.00	4.55	1.20	7.03	4.58	1.23
13.25	29977		63.14	63.30	56.21	58.66	62.01				7.09	4.64	1.29
	29900			63.75	56.21	58.66	62.01				7.55	5.10	1.74
	29800			63.57	56.20	58.65	62.00				7.37	4.92	1.57
	29700			63.14	56.20	58.65	62.00				6.94	4.49	1.13
	29600			63.09	56.19	58.64	62.00				6.90	4.44	1.09
	29500	63.22		63.03	56.18	58.64	62.00	7.03	4.58	1.22	6.85	4.39	1.04
	29400			63.22	56.18	58.63	61.99				7.04	4.59	1.23
	29300			63.08	56.17	58.63	61.99				6.91	4.45	1.09
	29200			62.80	56.17	58.63	61.99				6.63	4.18	0.82
	29100			62.67	56.16	58.62	61.98				6.51	4.05	0.69
	29000	62.89		62.62	56.16	58.62	61.98	6.73	4.27	0.91	6.46	4.01	0.64
	28900			62.66	56.15	58.61	61.98				6.50	4.04	0.68
	28800			62.49	56.15	58.61	61.97				6.35	3.89	0.52
	28700			62.66	56.14	58.60	61.97				6.51	4.05	0.69
13	28644		62.79	62.60	56.14	58.60	61.97				6.46	4.00	0.63
	28600			62.51	56.13	58.59	61.96				6.38	3.92	0.55
	28500	62.75		62.80	56.12	58.58	61.95	6.62	4.17	0.80	6.67	4.22	0.85
	28400			62.55	56.11	58.57	61.93				6.44	3.98	0.62
	28300			62.51	56.10	58.56	61.92				6.41	3.96	0.60
	28200			62.31	56.09	58.54	61.90				6.22	3.77	0.41
	28100			62.09	56.08	58.53	61.89				6.01	3.56	0.20
	28000	62.52		62.49	56.07	58.52	61.87	6.45	4.00	0.64	6.43	3.98	0.62
	27900			62.28	56.05	58.50	61.86				6.23	3.78	0.42
	27800			64.02	56.04	58.49	61.84				7.98	5.53	2.18
	27700			65.23	56.03	58.48	61.83				9.20	6.75	3.40
	27600			65.22	56.02	58.46	61.81				9.20	6.75	3.40
	27500	65.37		65.59	56.01	58.45	61.80	9.36	6.92	3.57	9.58	7.14	3.79
	27400			65.61	56.00	58.44	61.78				9.62	7.18	3.83
	27300			66.25	55.99	58.43	61.77				10.27	7.83	4.48
12.75	27256		65.37	66.20	55.98	58.42	61.76				10.22	7.78	4.44
	27200			66.35	55.98	58.42	61.76				10.37	7.93	4.59
	27100			65.69	55.97	58.41	61.75				9.72	7.28	3.94
	27000	65.35		65.63	55.96	58.40	61.74	9.38	6.94	3.60	9.67	7.23	3.88
	26900			65.53	55.96	58.40	61.74				9.58	7.14	3.79
	26800			65.74	55.95	58.39	61.73				9.79	7.35	4.01
	26700			65.37	55.94	58.38	61.73				9.43	6.99	3.65
	26600			64.88	55.94	58.38	61.72				8.95	6.51	3.16
	26500	65.16		65.13	55.93	58.37	61.72	9.23	6.79	3.44	9.20	6.76	3.42
	26400			64.48	55.92	58.36	61.71				8.56	6.12	2.77
	26300			63.75	55.92	58.36	61.70				7.83	5.39	2.05
	26200			63.82	55.91	58.35	61.70				7.91	5.47	2.13
	26100			64.34	55.90	58.34	61.69				8.44	6.00	2.65
12.5	26065		64.52	64.40	55.90	58.34	61.69				8.50	6.06	2.71
	26000	65.06		65.03	55.89	58.33	61.68	9.17	6.73	3.38	9.14	6.70	3.35
	25900			66.41	55.87	58.31	61.66				10.54	8.10	4.75
	25800			66.16	55.86	58.30	61.64				10.31	7.87	4.52
	25700			64.85	55.84	58.28	61.62				9.01	6.57	3.22
	25600			64.38	55.82	58.26	61.60				8.56	6.12	2.77
	25500	65.01		64.93	55.80	58.24	61.59	9.21	6.77	3.42	9.12	6.68	3.34
	25400			64.90	55.79	58.23	61.57				9.12	6.68	3.33
	25300			64.83	55.77	58.21	61.55				9.06	6.62	3.28
	25200			64.98	55.75	58.19	61.53				9.22	6.78	3.45
	25100			64.19	55.74	58.18	61.51				8.46	6.02	2.68
	25000	63.56		63.45	55.72	58.16	61.50	7.84	5.40	2.06	7.73	5.29	1.96
	24900			64.37	55.70	58.14	61.48				8.67	6.23	2.90
	24800			64.38	55.69	58.13	61.46				8.69	6.25	2.92
	24700			64.47	55.67	58.11	61.44				8.80	6.36	3.03
12.25	24642		64.65	64.20	55.66	58.10	61.43				8.54	6.10	2.77
	24600			63.98	55.66	58.10	61.43				8.32	5.88	2.55
	24500	63.79		63.73	55.66	58.10	61.43	8.13	5.69	2.36	8.07	5.63	2.30
	24400			63.98	55.66	58.10	61.43				8.32	5.88	2.55
	24300			64.02	55.66	58.10	61.43				8.36	5.92	2.59
	24200			63.31	55.66	58.10	61.43				7.65	5.21	1.88
	24100			63.27	55.66	58.10	61.43				7.61	5.17	1.84
	24000	63.93		63.96	55.66	58.10	61.43	8.27	5.83	2.50	8.30	5.86	2.53
	23900			64.23	55.66	58.10	61.43				8.57	6.13	2.80
	23800			63.75	55.66	58.10	61.43				8.09	5.65	2.32
	23700			63.78	55.66	58.10	61.43				8.12	5.68	2.35
	23600			63.77	55.66	58.10	61.43				8.11	5.67	2.34
	23500	63.46		63.27	55.66	58.10	61.43	7.80	5.36	2.03	7.61	5.17	1.84

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	23400			63.17	55.66	58.10	61.43				7.51	5.07	1.74
12	23313		63.70	63.50	55.66	58.10	61.43				7.84	5.40	2.07
	23300			63.35	55.66	58.10	61.43				7.69	5.25	1.92
	23200			62.65	55.65	58.09	61.42				7.00	4.56	1.23
	23100			62.45	55.64	58.08	61.41				6.81	4.37	1.04
	23000	62.88		62.73	55.63	58.07	61.40	7.25	4.81	1.48	7.10	4.66	1.33
	22900			62.63	55.62	58.06	61.39				7.01	4.57	1.24
	22800			62.28	55.61	58.05	61.38				6.67	4.23	0.90
	22700			61.98	55.59	58.03	61.37				6.39	3.95	0.61
	22600			61.63	55.58	58.02	61.36				6.04	3.60	0.27
	22500	62.07		61.92	55.57	58.01	61.35	6.50	4.06	0.72	6.34	3.90	0.57
	22400			62.10	55.56	58.00	61.34				6.54	4.10	0.76
	22300			62.52	55.55	57.99	61.33				6.97	4.53	1.19
	22200			62.41	55.54	57.98	61.32				6.87	4.43	1.09
	22100			62.40	55.53	57.97	61.31				6.87	4.43	1.09
	22000	62.10		62.14	55.52	57.96	61.30	6.58	4.14	0.80	6.62	4.18	0.84
11.75	21994		62.26	62.20	55.52	57.96	61.30				6.68	4.24	0.90
	21900			62.59	55.52	57.96	61.29				7.07	4.63	1.30
	21800			63.15	55.51	57.95	61.29				7.64	5.20	1.86
	21700			64.11	55.51	57.95	61.28				8.59	6.15	2.82
	21600			63.80	55.51	57.95	61.28				8.29	5.85	2.52
	21500	62.98		63.12	55.50	57.94	61.27	7.48	5.04	1.71	7.62	5.18	1.85
	21400			63.72	55.50	57.94	61.27				8.21	5.77	2.45
	21300			64.26	55.50	57.94	61.26				8.76	6.32	2.99
	21200			63.58	55.49	57.93	61.26				8.09	5.65	2.33
	21100			62.82	55.49	57.93	61.25				7.33	4.89	1.57
11.599	21070		63.70	62.80	55.49	57.93	61.25				7.31	4.87	1.55
	21000	62.20		62.37	55.48	57.92	61.24	6.72	4.28	0.96	6.89	4.45	1.13
	20900			63.10	55.46	57.90	61.22				7.64	5.19	1.87
	20800			63.07	55.44	57.88	61.20				7.62	5.18	1.86
	20700			62.70	55.42	57.87	61.19				7.27	4.83	1.51
	20600			62.51	55.40	57.85	61.17				7.11	4.66	1.34
	20500	62.20		62.31	55.39	57.83	61.15	6.81	4.36	1.04	6.92	4.47	1.15
	20400			62.94	55.37	57.82	61.14				7.58	5.13	1.81
11.5	20355		63.28	63.30	55.36	57.81	61.13				7.94	5.49	2.17
	20300			63.54	55.35	57.80	61.12				8.19	5.74	2.42
	20250	Laurel Avenue											
	20200			62.72	55.35	57.79	61.11				7.38	4.93	1.61
	20100			62.43	55.34	57.78	61.10				7.09	4.65	1.33
	20000			63.01	55.33	57.77	61.09				7.68	5.24	1.92
	19900			63.40	55.32	57.76	61.08				8.08	5.64	2.32
	19800			62.42	55.31	57.75	61.06				7.11	4.67	1.36
	19700			62.68	55.30	57.74	61.05				7.38	4.94	1.63
	19600			62.42	55.29	57.73	61.04				7.13	4.69	1.38
	19500			63.21	55.28	57.72	61.03				7.93	5.49	2.18
	19400			63.81	55.27	57.71	61.02				8.54	6.10	2.80
	19300			64.38	55.26	57.70	61.00				9.12	6.68	3.38
	19200			62.94	55.25	57.69	60.99				7.69	5.26	1.95
	19100			62.56	55.24	57.68	60.98				7.32	4.88	1.58
	19000			63.02	55.24	57.67	60.97				7.78	5.35	2.05
	18900			62.82	55.23	57.66	60.96				7.59	5.16	1.86
	18800			63.41	55.22	57.65	60.94				8.19	5.76	2.47
	18700			62.92	55.21	57.63	60.93				7.71	5.29	1.99
	18600			63.52	55.20	57.62	60.92				8.32	5.90	2.60
	18500			63.65	55.19	57.61	60.91				8.46	6.04	2.74
	18400			63.00	55.18	57.60	60.90				7.82	5.40	2.11
	18300			63.34	55.17	57.59	60.88				8.17	5.75	2.46
	18200			63.30	55.16	57.58	60.87				8.14	5.72	2.43
11.25	18182		63.41	63.20	55.16	57.58	60.87				8.04	5.62	2.33
	18100			63.20	55.14	57.56	60.85				8.06	5.64	2.36
	18000			63.32	55.12	57.54	60.82				8.20	5.78	2.50
	17900			63.10	55.10	57.51	60.79				8.01	5.59	2.31
	17800			63.22	55.07	57.49	60.76				8.15	5.73	2.46
	17700			63.07	55.05	57.46	60.73				8.03	5.61	2.34
	17600			62.11	55.03	57.44	60.71				7.09	4.67	1.41
	17500			62.27	55.00	57.41	60.68				7.26	4.85	1.59
	17400			63.22	54.98	57.39	60.65				8.24	5.83	2.57
	17300			63.90	54.96	57.36	60.62				8.95	6.54	3.28
	17200			63.65	54.94	57.34	60.59				8.72	6.31	3.06
	17100			63.66	54.91	57.32	60.56				8.75	6.35	3.10
	17000			63.37	54.89	57.29	60.54				8.48	6.08	2.84
	16900			63.66	54.87	57.27	60.51				8.79	6.39	3.15
11	16871		63.79	63.90	54.86	57.26	60.50				9.04	6.64	3.40
	16800			63.99	54.85	57.25	60.49				9.13	6.73	3.49
	16700			63.07	54.84	57.24	60.48				8.23	5.83	2.59
	16600			62.73	54.83	57.23	60.47				7.90	5.50	2.26
	16500			62.86	54.82	57.22	60.45				8.04	5.64	2.41
	16400			62.25	54.81	57.20	60.44				7.45	5.05	1.81
	16300			61.60	54.80	57.19	60.43				6.81	4.41	1.18
	16200			61.85	54.78	57.18	60.41				7.07	4.67	1.44
	16100			62.03	54.77	57.17	60.40				7.26	4.86	1.63
	16000			61.99	54.76	57.15	60.39				7.23	4.84	1.60
	15900			62.10	54.75	57.14	60.38				7.35	4.96	1.73
	15800			61.93	54.74	57.13	60.36				7.19	4.80	1.56
	15700			61.41	54.73	57.12	60.35				6.68	4.29	1.06
	15600			60.84	54.72	57.11	60.34				6.13	3.74	0.51
10.75	15548		61.12	61.20	54.71	57.10	60.33				6.49	4.10	0.87
	15500			61.40	54.70	57.09	60.32				6.70	4.31	1.08
	15400			61.23	54.68	57.07	60.29				6.55	4.16	0.94
	15300			61.35	54.66	57.05	60.27				6.69	4.31	1.09

Attachment D3 - Freeboard Analysis

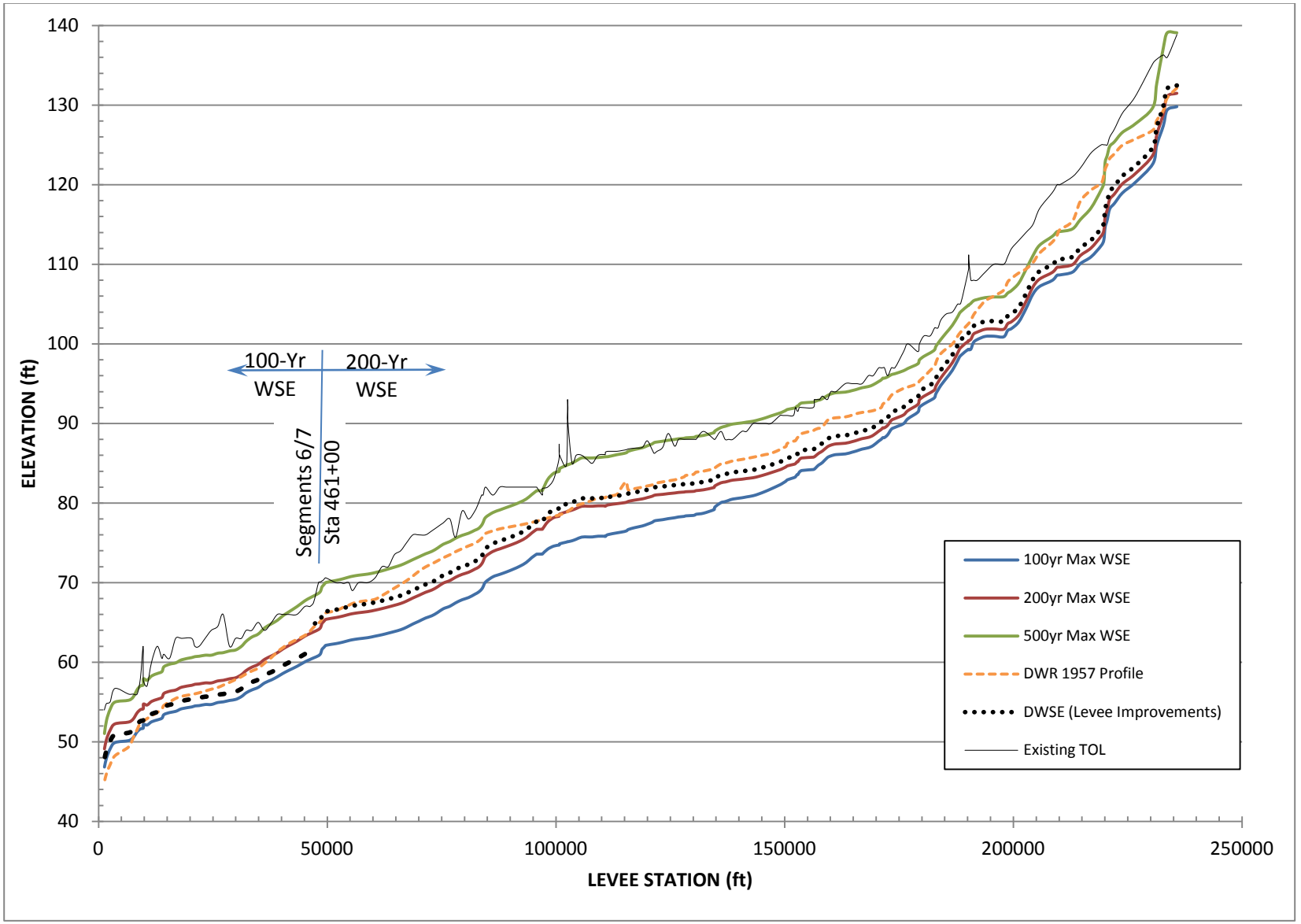
								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	15200			61.04	54.64	57.03	60.25				6.39	4.01	0.79
	15100			61.87	54.63	57.01	60.22				7.25	4.87	1.65
	15000			61.98	54.61	56.99	60.20				7.37	4.99	1.78
	14900			62.42	54.59	56.97	60.17				7.83	5.46	2.25
	14800			62.21	54.57	56.95	60.15				7.64	5.27	2.07
	14700			61.42	54.55	56.93	60.12				6.87	4.50	1.30
	14600			61.55	54.53	56.91	60.10				7.02	4.64	1.45
	14500			61.95	54.51	56.89	60.07				7.44	5.07	1.88
	14400			61.52	54.49	56.86	60.05				7.03	4.65	1.47
	14300			60.95	54.47	56.84	60.03				6.48	4.11	0.92
10.5	14278		59.99	61.00	54.47	56.84	60.02				6.53	4.16	0.98
	14200			61.32	54.39	56.75	59.91				6.93	4.57	1.41
	14100			60.39	54.29	56.63	59.76				6.11	3.76	0.63
	14000			60.31	54.18	56.51	59.62				6.12	3.79	0.69
	13900			60.48	54.08	56.40	59.47				6.40	4.08	1.00
10.25	13850		61.16	61.10	54.03	56.34	59.40				7.07	4.76	1.70
	13800			61.67	54.02	56.33	59.39				7.65	5.34	2.29
	13700			61.80	54.00	56.31	59.36				7.80	5.49	2.43
	13600			61.90	53.98	56.29	59.34				7.93	5.62	2.57
	13500			62.40	53.96	56.26	59.31				8.44	6.13	3.08
	13400			62.86	53.94	56.24	59.29				8.92	6.62	3.57
	13300			62.03	53.91	56.22	59.26				8.12	5.81	2.77
	13200			61.54	53.89	56.20	59.24				7.65	5.35	2.31
	13100			61.09	53.87	56.18	59.21				7.21	4.91	1.87
	13000			61.28	53.85	56.15	59.19				7.43	5.13	2.09
	12900			62.08	53.83	56.13	59.16				8.25	5.95	2.92
10	12847		62.19	62.30	53.82	56.12	59.15				8.48	6.18	3.15
	12800			62.25	53.81	56.11	59.13				8.44	6.14	3.11
	12700			61.75	53.78	56.08	59.10				7.97	5.67	2.65
	12600			61.88	53.76	56.05	59.07				8.12	5.83	2.81
	12500			61.72	53.74	56.02	59.03				7.99	5.70	2.69
	12400			60.02	53.71	55.99	59.00				6.31	4.02	1.02
	12300			59.19	53.69	55.97	58.97				5.51	3.23	0.23
	12200			58.98	53.66	55.94	58.93				5.32	3.04	0.05
	12100			59.47	53.64	55.91	58.90				5.83	3.56	0.57
	12000			59.74	53.62	55.88	58.87				6.12	3.85	0.87
	11900			60.07	53.59	55.85	58.83				6.48	4.22	1.24
	11800			60.18	53.57	55.83	58.80				6.61	4.35	1.38
	11700			60.25	53.54	55.80	58.76				6.71	4.45	1.49
	11600			60.22	53.52	55.77	58.73				6.70	4.45	1.49
9.75	11598		60.25	60.30	53.52	55.77	58.73				6.78	4.53	1.57
	11500			60.23	53.49	55.73	58.69				6.74	4.49	1.54
	11400			60.33	53.45	55.70	58.64				6.88	4.63	1.69
	11300			60.32	53.42	55.66	58.60				6.90	4.66	1.72
	11200			60.20	53.39	55.62	58.55				6.81	4.58	1.65
	11100			60.11	53.35	55.58	58.51				6.75	4.52	1.60
	11000			60.02	53.32	55.54	58.46				6.70	4.48	1.56
	10900			58.74	53.28	55.51	58.42				5.46	3.24	0.33
	10800			58.81	53.25	55.47	58.37				5.56	3.34	0.44
	10700			60.29	53.22	55.43	58.33				7.08	4.86	1.97
	10600			57.60	53.18	55.39	58.28				4.42	2.21	-0.68
9.5	10596		57.50	57.60	53.18	55.39	58.28				4.42	2.21	-0.68
	10500			57.90	53.17	55.38	58.27				4.72	2.51	-0.38
	10400			57.68	53.16	55.38	58.27				4.52	2.31	-0.58
	10300			57.85	53.16	55.37	58.26				4.70	2.48	-0.41
	10200			57.54	53.15	55.36	58.25				4.39	2.17	-0.72
	10100			57.41	53.14	55.36	58.25				4.27	2.05	-0.84
	10000			57.40	53.13	55.35	58.24				4.27	2.05	-0.84
	9900			57.87	53.13	55.35	58.24				4.75	2.53	-0.36
9.278	9814		61.95	62.20	53.12	55.34	58.23				9.08	6.86	3.97
	9800			62.36	53.04	55.25	58.11				9.32	7.12	4.25
9.265	9759		60.37	60.40	52.82	54.98	57.76				7.58	5.42	2.64
	9700			58.26	52.81	54.97	57.74				5.45	3.30	0.52
	9600			57.35	52.79	54.94	57.71				4.56	2.41	-0.37
	9500			56.96	52.77	54.92	57.69				4.19	2.04	-0.73
	9400			56.97	52.75	54.90	57.66				4.23	2.08	-0.68
	9300			57.03	52.73	54.87	57.63				4.30	2.16	-0.60
	9200			56.94	52.71	54.85	57.60				4.23	2.09	-0.66
9.2	9164		56.79	56.80	52.70	54.84	57.59				4.10	1.96	-0.79
	9100			56.73	52.67	54.81	57.55				4.06	1.92	-0.82
	9000			56.73	52.62	54.75	57.48				4.11	1.97	-0.76
	8900			56.67	52.57	54.70	57.42				4.10	1.97	-0.75
	8800			56.69	52.52	54.65	57.36				4.17	2.05	-0.66
	8700			56.84	52.47	54.59	57.29				4.37	2.25	-0.45
	8600			56.61	52.43	54.54	57.23				4.18	2.06	-0.62
	8500			56.75	52.38	54.49	57.16				4.37	2.26	-0.42
9	8446		56.56	56.50	52.35	54.46	57.13				4.15	2.04	-0.63
	8400			56.53	52.31	54.42	57.08				4.22	2.12	-0.54
	8300			56.65	52.22	54.32	56.96				4.42	2.33	-0.31
	8200			56.52	52.14	54.22	56.84				4.38	2.30	-0.32
	8100			56.18	52.05	54.12	56.72				4.13	2.06	-0.54
	8000			56.40	51.96	54.03	56.60				4.43	2.37	-0.20
	7900			56.63	51.88	53.93	56.48				4.75	2.70	0.15
	7800			56.54	51.79	53.83	56.36				4.75	2.71	0.18
	7700			56.38	51.71	53.73	56.24				4.67	2.64	0.14
	7600			56.12	51.62	53.64	56.12				4.50	2.49	0.00
8.75	7532		55.97	56.10	51.56	53.57	56.04				4.54	2.53	0.06
	7500			56.07	51.54	53.55	56.02				4.53	2.52	0.05
	7400			56.10	51.49	53.50	55.96				4.60	2.60	0.14
	7300			56.10	51.44	53.45	55.90				4.65	2.65	0.20

Attachment D3 - Freeboard Analysis

								FRWL 2011 Field Survey Elevations			CVFED LiDAR Elevations		
HEC-RAS CROSS SECTION	LEVEE DESIGN STATION	FRWL 2011 Field Survey TOL (ft-NAVD88)	Comp Study TOL (ft-NAVD88)	CVFED LiDAR TOL (ft-NAVD88)	100YR Interpolated WSE	200YR Interpolated WSE	500 Interpolated WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
	7200			56.07	51.39	53.39	55.84				4.68	2.68	0.24
	7100			55.60	51.34	53.34	55.78				4.25	2.26	-0.18
	7000			55.93	51.29	53.29	55.72				4.63	2.64	0.21
	6900			56.92	51.25	53.24	55.65				5.68	3.68	1.27
	6800			57.37	51.20	53.18	55.59				6.17	4.18	1.77
	6700			57.22	51.15	53.13	55.53				6.08	4.09	1.69
	6600			57.17	51.10	53.08	55.47				6.07	4.09	1.70
8.5	6549		57.04	57.00	51.07	53.05	55.44				5.93	3.95	1.56
	6500			56.90	51.06	53.04	55.43				5.83	3.85	1.47
	6400			57.00	51.05	53.03	55.42				5.95	3.97	1.58
	6300			56.75	51.04	53.02	55.40				5.71	3.74	1.35
	6200			56.66	51.03	53.01	55.39				5.63	3.65	1.27
	6100			56.67	51.02	52.99	55.38				5.66	3.68	1.30
	6000			56.89	51.00	52.98	55.36				5.89	3.91	1.53
	5900			57.00	50.99	52.97	55.35				6.01	4.03	1.66
	5800			56.89	50.98	52.95	55.33				5.91	3.93	1.56
	5700			56.70	50.97	52.94	55.32				5.74	3.76	1.39
	5600			56.76	50.96	52.93	55.30				5.80	3.83	1.46
	5500			56.53	50.94	52.92	55.29				5.59	3.62	1.24
	5400			56.43	50.93	52.90	55.27				5.50	3.52	1.15
	5300			56.43	50.92	52.89	55.26				5.51	3.54	1.17
	5200			56.38	50.91	52.88	55.25				5.47	3.50	1.14
	5100			56.18	50.89	52.86	55.23				5.29	3.32	0.95
	5000			55.86	50.88	52.85	55.22				4.98	3.01	0.64
	4900			56.04	50.87	52.84	55.20				5.17	3.20	0.84
	4800			56.26	50.86	52.83	55.19				5.40	3.43	1.07
	4700			56.23	50.85	52.81	55.17				5.39	3.42	1.06
	4600			56.03	50.83	52.80	55.16				5.20	3.23	0.87
	4500			55.78	50.82	52.79	55.14				4.96	2.99	0.64
	4400			56.09	50.81	52.78	55.13				5.28	3.32	0.96
	4300			56.35	50.80	52.76	55.12				5.56	3.59	1.24
	4200			55.82	50.79	52.75	55.10				5.04	3.07	0.72
	4100			55.79	50.77	52.74	55.09				5.01	3.05	0.70
	4000			55.92	50.76	52.72	55.07				5.16	3.20	0.85
	3900			55.73	50.75	52.71	55.06				4.98	3.01	0.67
	3800			55.64	50.74	52.70	55.04				4.91	2.94	0.60
	3700			55.60	50.73	52.69	55.03				4.87	2.91	0.57
	3600			55.57	50.71	52.67	55.01				4.85	2.89	0.55
8.25	3573		55.49	55.60	50.71	52.67	55.01				4.89	2.93	0.59
	3500			55.61	50.66	52.61	54.94				4.95	2.99	0.66
	3400			55.52	50.59	52.54	54.85				4.93	2.98	0.67
	3300			55.48	50.52	52.46	54.75				4.96	3.01	0.72
	3200			55.46	50.45	52.39	54.66				5.01	3.07	0.80
	3100			55.38	50.38	52.31	54.57				5.00	3.07	0.82
	3000			55.38	50.31	52.24	54.47				5.07	3.15	0.91
	2900			55.13	50.24	52.16	54.38				4.89	2.96	0.75
	2800			54.88	50.17	52.09	54.28				4.71	2.80	0.60
	2700			54.87	50.10	52.01	54.19				4.77	2.86	0.68
	2600			55.23	50.03	51.93	54.10				5.20	3.29	1.13
8	2528		55.55	55.00	49.98	51.88	54.03				5.02	3.12	0.97
	2500			55.01	49.96	51.86	54.01				5.05	3.15	1.00
	2400			55.02	49.91	51.80	53.93				5.11	3.21	1.09
	2300			55.19	49.86	51.74	53.85				5.33	3.44	1.34
	2200			55.06	49.80	51.69	53.77				5.26	3.38	1.30
	2100			54.84	49.75	51.63	53.69				5.10	3.22	1.16
	2000			54.69	49.69	51.57	53.60				5.00	3.12	1.09
	1900			54.74	49.64	51.51	53.52				5.10	3.23	1.21
	1800			54.61	49.59	51.45	53.44				5.03	3.16	1.17
7.75	1733		54.93	54.50	49.55	51.41	53.39				4.95	3.09	1.11
	1700			54.58	49.53	51.39	53.37				5.04	3.19	1.21
	1600			54.70	49.49	51.34	53.29				5.21	3.36	1.41
	1500			54.53	49.44	51.28	53.22				5.09	3.25	1.31
	1400			54.42	49.39	51.23	53.14				5.03	3.19	1.27
	1300			54.58	49.34	51.17	53.07				5.24	3.41	1.51
7.55	1275		54.90	54.50	49.33	51.16	53.05				5.17	3.34	1.45

Attachment D4 - Water Surface Profiles

Figure 4-1. Water Surface and Existing Top of Levee Elevations



Attachment D5 - Maximum Allowable Channel Velocity (USACE)

Table 2-5
Suggested Maximum Permissible Mean Channel Velocities

Channel Material	Mean Channel Velocity, fps
Fine Sand	2.0
Coarse Sand	4.0
Fine Gravel[1]	6.0
Earth	
Sandy Silt	2.0
Silt Clay	3.5
Clay	6.0
Grass-lined Earth (slopes less than 5%)[2]	
Bermuda Grass	
Sandy Silt	6.0
Silt Clay	8.0
Kentucky Blue Grass	
Sandy Silt	5.0
Silt Clay	7.0
Poor Rock (usually sedimentary)	10.0
Soft Sandstone	8.0
Soft Shale	3.5
Good Rock (usually igneous or hard metamorphic)	20.0

Notes:

1. For particles larger than fine gravel (about 20 millimetres (mm) = 3/4 in.), see Plates 29 and 30.
2. Keep velocities less than 5.0 fps unless good cover and proper maintenance can be obtained.

Hydraulic Design of Flood Control Channels, US Army Corps of Engineers, EM1110-2-1601, 1 July, 1991, p 2-16

Attachment D6 - Roughness Coefficients, Manning “n” Values from HEC-RAS

HEC-RAS River Analysis System (Hydraulic Reference Manual), Version 4.1, Jan., 2010, Page 3-14

Table 3-1 Manning's 'n' Values

Type of Channel and Description	Minimum	Normal	Maximum
A. *Natural Streams*			
1. **Main Channels**			
a. Clean, straight, full, no rifts or deep pools	0.025	0.030	0.033
b. Same as above, but more stones and weeds	0.030	0.035	0.040
c. Clean, winding, some pools and shoals	0.033	0.040	0.045
d. Same as above, but some weeds and stones	0.035	0.045	0.050
e. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
f. Same as "d" but more stones	0.045	0.050	0.060
g. Sluggish reaches, weedy. deep pools	0.050	0.070	0.080
h. Very weedy reaches, deep pools, or floodways with heavy stands of timber and brush	0.070	0.100	0.150
2. **Flood Plains**			
a. Pasture no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
2. Same as above, but heavy sprouts	0.050	0.060	0.080
3. Heavy stand of timber, few down trees, little undergrowth, flow below branches	0.080	0.100	0.120
4. Same as above, but with flow into branches	0.100	0.120	0.160
5. Dense willows, summer, straight	0.110	0.150	0.200
3. **Mountain Streams, no vegetation in channel, banks usually steep, with trees and brush on banks submerged**			
a. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
b. Bottom: cobbles with large boulders	0.040	0.050	0.070

Table 8-3. Liquefaction Triggering Analyses Results.

Reach	Section	Explorations for Analysis	PHA (g)	Levee Height (feet)	Landside Slope (xH:1V)	Waterside Slope (xH:1V)	Approximate Waterside Bench Width (feet)	Approximate Waterside Bench Elevation (feet, MSL)	Bank Slope	Crown Elevation (feet, MSL)	Analyzed WSE (feet)	Freeboard at Analyzed WSE (feet)	Liquefiable Zone in Foundation? (yes/no)[1]	Approximate Thickness of Liquefiable Zone (feet)	Soil Types in Liquefiable Zone	N_{60}	$(N_1)_{60\text{-}cs}$	Foundation Liquefiable Zone Location	Section Selected for Analysis? (yes/no)
7	539+30	WL0001_089C	0.125	24	4	3.3	15	46	3.5	70	30	40	Yes	20-25	SP,SP-SM	3-16	-	Within 1 levee height	Yes
7	545+50	WL0001_043C	0.125	25	3.4	3.6	15	48	1.9	70	30	40	Yes	25-30	SP,SP-SM	N/A	N/A	Within 1 levee height	No
7	565+50	WM0001_044C	0.125	23	3	3.3	10	47	0.45	70	30	40	Yes	25	SP,SP-SM	N/A	N/A	Within 2 levee heights	No
8	623+86	SL0001_005C WL0001_049B	0.125	24	3.2	4.5	>100	-	-	72	31	41	Yes	20-25	SP,SM	7-22	4-17	Within 2 levee heights	Yes
8	636+00	WL0001_050C	0.125	25	3	5.2	>100	-	-	73	31	42	Yes	20-25	SP,SM	20-35	-	Within 2 levee heights	No
9	705+84	WL0001_004B WL0001_055C	0.125	25	3.8	4.2	>100	-	-	76	32	44	Yes	5-10	ML	18	20	Within 1 levee height	No
9	683+00	SL0001_038C WL0001_053B	0.125	25	3.2	3.6	70	55	1.0	75	32	43	Yes	10-15	SP,SP-SM	28-30	16-18, 13	Within 2 levee heights	Yes
10	733+84	SL0001_001B WL0001_059B	0.125	27	3.5	4.1	100	50	1.3	77	33	44	Yes	10-15	SM,SP-SM, ML	4-19, 3	4-17	Within 1 levee height	Yes
10	721+00	WL0001_0057C	0.125	28	3.2	4.4	>100	-	-	77	33	44	Yes	10-15	SM,SP-SM	N/A	N/A	Within 1 levee height	No
11	808+85	SL0001_008C 2F-07-01	0.125	23	2.6	3.5	25	59	3.1	79	35	44	Yes	0-5	SP	24	18	Within 1 levee height	No
11	810+00	SL0001_008C 2F-07-01	0.125	23	2.4	3.8	20	59	4.2	79	35	44	Yes	0-5	SP	24	18	Within 1 levee height	No
12	830+59	WL0001_064B SL0001_009C	0.125	24	2.7	3.3	>100	-	-	80	36	44	Yes	20-30 (Toe Only)	ML/SM	N/A	N/A	Within 2 levee heights	No
13	861+33	WL0001_067B	0.125	26	2.7	3	>100	-	-	81	37	44	Yes	20-30	SM	11-19	8-15	Within 1 levee height	No
13	871+00	SL0001_002B	0.125	27	2.6	3	>100	-	-	82	37	45	Yes	20-30	SP, SP-SC	4-27	4-20	Within 1 levee height	Yes
13	907+00	_	0.125	24	2.5	3	>100	-	-	82	38	44	Yes	15-20	ML	7-8	-	Within 1 levee height	No
14	939+33	2F-07-02 SL0001_011C	0.125	23	3	7.4	>100	-	-	82	39	43	Yes	20	SM	2-12	2-8	Within 1 levee height	No
15	958+83	WL0001_074B WL0001_105C	0.125	18	3.1	6.1	>100	-	-	82	40	42	Yes	20-30	SM/ML	8-21	4-13	Within 2 levee heights	Yes
16	993+80	2F-07-03 SL0001_012C	0.125	22	2.5	2	90	55	1.6	83	41	42	Yes	5-10	SM	20	18-19	Within 2 levee heights	No
16	1043+88	WL0001_081C	0.125	28	3.6	3.3	>100	-	-	86	42	44	Yes	0-5	CL/ML	N/A	N/A	Within 1 levee height	No
16	1005+00	_	0.125	22	2.5	2.7	0	-	-	84	41	43	No	-	N/A	N/A	N/A	-	No
16	1006+20	WL0001_078C	0.125	20	1.7	3.5	25	57	1.4	84	41	43	No	-	N/A	N/A	N/A	-	No
16	1025+00	_	0.125	29	2.1	2.9	20	76	2.7	91	41	50	Yes	0-5	SM	N/A	N/A	Within 2 levee heights	No
16	1026+00	SL0001_040C	0.125	23	5	2.7	10	77	1.7	94	41	53	Yes	0-5	SM	N/A	N/A	Within 2 levee heights	No
16	1031+00	_	0.125	20	4.25	4.3	20	61	1.4	84	41	43	Yes	0-5	SM	N/A	N/A	Within 2 levee heights	No

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Table 8-3. Liquefaction Triggering Analyses Results.

Reach	Section	Explorations for Analysis	PHA (g)	Levee Height (feet)	Landside Slope (xH:1V)	Waterside Slope (xH:1V)	Approximate Waterside Bench Width (feet)	Approximate Waterside Bench Elevation (feet, MSL)	Bank Slope	Crown Elevation (feet, MSL)	Analyzed WSE (feet)	Freeboard at Analyzed WSE (feet)	Liquefiable Zone in Foundation? (yes/no)[1]	Approximate Thickness of Liquefiable Zone (feet)	Soil Types in Liquefiable Zone	N_{60}	$(N_1)_{60\text{-}cs}$	Foundation Liquefiable Zone Location	Section Selected for Analysis? (yes/no)
16	997+00	2F-07-03 SL0001_012C	0.125	21	1.9	2.8	0	67	2	83	40	43	Yes	5-10	SM	20	18-19	Within 2 levee heights	No
17	1108+86	WL0001_002C 2F-07-05	0.125	22	2.3	2.9	>100	-	-	86	43	43	Yes	5-10	ML, SM	20-25	11-15	Within 2 levee heights	No
17	1116+00	2F-07-06	0.125	21	2.6	3.2	>100	-	-	86	44	42	Yes	30-40	SM, ML, SP-SM	5-19	6-17	Within 2 levee heights	Yes
17	1125+00	WL0001_001B	0.125	21	2.9	3.3	>100	-	-	86	44	42	Yes	5-10	SC, SM	20	16-19	Within 2 levee heights	No
18	1138+86	WL0009_007A WL0009_008C	0.125	21	1.9	3.4	>100	-	-	87	44	43	Yes	10-15	SP- SM	22	21	Within 2 levee heights	No
18	1145+00	_	0.125	19	2.4	3.3	>100	-	-	86	44	42	Yes	15-25	SP- SM	N/A	N/A	Within 2 levee heights	No
18	1163+75	WL0009_002C SL0009_001B	0.125	20	2	3.1	>100	-	-	86	45	41	Yes	20	ML, SP-SM	10-15	8-19	Within 2 levee heights	No
19	1224+00	SL0009_007C (Crown) 2F-07-8 (Crown)	0.125	19	2.1	3.7	>100	-	-	87	47	40	Yes	20-30	ML, SM	11-19	10-16	Within 2 levee heights	Yes
19	1244+00	WL0009_014C WL0009_016C	0.125	19	2.4	2.8	>100	-	-	88	48	40	Yes	10-15	SP-SC SP-SM	17-22	-	Within 2 levee heights	No
19	1270+00	2F-07-9	0.125	20	2	3.2	15	67	1.9	89	49	40	Yes	0-5	SP	20	19	Below 2 levee heights	No
20	1338+83	WL0009_025C WL0009_003A	0.125	15	2.3	3.5	20	78	2.1	89	53	36	No	-	N/A	N/A	N/A	-	No
20	1339+00	WL0009_023C	0.125	15	2.3	3.5	20	78	2.1	89	53	36	No	-	N/A	N/A	N/A	-	No
21	1378+83	WL0009_006A WL0009_028C	0.125	11	2.3	3.4	35	73	6.1	89	55	34	Yes	5-10	ML	10	12	Below 2 levee heights	Yes
21	1427+00	WL0009_007C SL0009_003B	0.125	11	2.7	3	>100	-	-	91	56	35	Yes	10-15	SC-SM	N/A	N/A	Below 2 levee heights	No
22	1468+83	WM0016_008C WM0016_011C	0.125	12	2.1	2.9	45	73	3.9	91	57	34	Yes	0-5	CL,SC	N/A	N/A	Within 2 levee heights	No
22	1470+00	WM0016_008C WM0016_011C	0.125	10	2.5	2.4	45	73	2.1	92	57	35	Yes	0-5	CL,SC	N/A	N/A	Below 2 levee heights	No
22	1499+00	WM0016_010C	0.125	9	3.3	4.2	>100	-	-	91	60	31	Yes	0-5	CL/ML	N/A	N/A	Below 2 levee heights	No
23	1508+33	WM0016_011B	0.110	10	2.5	3.5	>100	-	-	91	60	31	Yes	0-5	SP-SM	20	14	Below 2 levee heights	No
23	1536+00	SM0016_006C WM0016_002C	0.110	7	2.9	2.5	>100	-	-	93	62	31	Yes	0-5	SC/SM	N/A	N/A	Below 2 levee heights	No
24	1615+62	WM0016_006C WM0016_020B	0.110	14	3.2	2.9	35	76	3.8	94	64	30	Yes	0-5	ML	20	21	Within 2 levee heights	No
25	1645+86	WL00016_021B	0.110	9	2.8	3.2	>100	-	-	95	65	30	Yes	0-5	SM	N/A	N/A	Below 2 levee heights	No
26	1698+85	WM0007_018C	0.110	7	2.1	2.5	>100	-	-	97	66	31	Yes	0-5	SM	N/A	N/A	Below 2 levee heights	No

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Table 8-3. Liquefaction Triggering Analyses Results.

Reach	Section	Explorations for Analysis	PHA (g)	Levee Height (feet)	Landside Slope (xH:1V)	Waterside Slope (xH:1V)	Approximate Waterside Bench Width (feet)	Approximate Waterside Bench Elevation (feet, MSL)	Bank Slope	Crown Elevation (feet, MSL)	Analyzed WSE (feet)	Freeboard at Analyzed WSE (feet)	Liquefiable Zone in Foundation? (yes/no)[1]	Approximate Thickness of Liquefiable Zone (feet)	Soil Types in Liquefiable Zone	N_{60}	$(N_1)_{60\text{-}cs}$	Foundation Liquefiable Zone Location	Section Selected for Analysis? (yes/no)
27	1708+87	WM0007_019B	0.110	12	1.7	3.1	>100	-	-	97	67	30	No	-	N/A	N/A	N/A	-	No
27	1710+00	WM0007_019B	0.110	12	2.1	2.1	>100	-	-	97	67	30	No	-	N/A	N/A	N/A	-	No
28	1760+87	WM0007_024B	0.110	13	1.9	2.5	80	91	1.9	99	69	30	No	-	N/A	N/A	N/A	-	No
28	1764+00	WM0007_024B	0.110	13	1.9	2.5	95	92	1.5	100	69	31	No	-	N/A	N/A	N/A	-	No
29	1788+81	WM0007_028B	0.110	4	3.8	3.2	>100	-	-	100	70	30	Yes	0-5	SM	18-20	17-18	Below 2 levee heights	No
29	1811+00	_	0.110	5	3	2.5	>100	-	-	101	70	31	No	-	N/A	N/A	N/A	-	No
30	1826+94	2F88-4A	0.110	13	2.3	3.6	>100	-	-	102	71	31	Yes	10-15	SM, ML SP	7-12	-	Within 2 levee heights	No
30	1902+00	_	0.110	10	5.8	2.1	0	-	1.4	107	73	34	Yes	0-5	SP-SM	N/A	N/A	Below 2 levee heights	No
31	1907+91	_	0.110	6	2.5	4.3	0	-	1.6	108	73	35	Yes	0-5	SP-SM	N/A	N/A	Below 2 levee heights	No
31	1924+00	_	0.110	14	3.6	4.4	10	100	2.8	108	75	33	Yes	5	ML	14	-	Within 2 levee heights	No
31	1933+00	SM0007_013B (Crown)	0.110	6	3.3	3.9	50	99	2.9	109	75	34	Yes	5	SP	17	17	Below 2 levee heights	No
32	1965+80	SM0007_002B	0.110	22	2.7	2.9	>100	-	-	111	75	36	No	-	N/A	N/A	N/A	-	No
32	1980+00	SM0007_015B	0.110	13	2.7	2.5	>100	-	-	111	77	34	No	-	N/A	N/A	N/A	-	No
32	1981+50	SM0007_015B	0.110	12	2.9	2.7	>100	-	-	111	77	34	No	-	N/A	N/A	N/A	-	No
33	2047+50	WM0007_048B	0.110	16	2.5	3.5	>100	-	-	116	86	30	Yes	10-15	SM,SP-SM	17-18	13-14	Within 2 levee heights	Yes*
33	2076+90	_	0.110	15	2.3	3.3	>100	-	-	119	88	31	No	-	N/A	N/A	N/A	-	No
34	2141+00	_	0.110	13	2.3	3.5	>100	-	-	123	94	29	Yes	0-5	ML, SP	N/A	N/A	Within 2 levee heights	No
35	2211+30	SM0007_004B	0.110	16	2.5	3.1	>100	-	-	126	99	27	Yes	5	SM	5-10	7-12	Within 2 levee heights	No
36	2246+00	WM0007_065B WM0007_0003 SM0007_005B	0.110	13	2.3	2.9	>100	-	-	129	102	27	Yes	5-10	SM	12-15	13-17	Within 2 levee heights	No
36	2250+78	SM0007_005B	0.110	17	2.9	3.2	>100	-	-	130	102	28	No	-	N/A	N/A	N/A	-	No
37	2276+76	SM0007_005A	0.110	16	2.8	3	>100	-	-	132	104	29	Yes	5	SP, SM	9-15	11	Within 1 levee height	Yes
37	2280+00	_	0.110	16	2.5	3.3	>100	-	-	132	104	29	Yes	5	SP, SM	9-16	-	Within 1 levee height	No
38	2293+30	_	0.110	14	2.5	3	>100	-	-	133	104	29	No	-	N/A	N/A	N/A	-	No
39	2314+91	_	0.110	12	3.75	3.3	>100	-	-	135	105	30	No	-	N/A	N/A	N/A	-	No
40	2332+91	SM0007_008B	0.110	17	3.2	2.7	15	115	2.5	137	107	30	Yes	10	SP-SM, SC	14,11	18,10	Within 1 levee height	Yes
41	2362+70	_	0.110	16	2.2	2.6	>100	-	-	139	108	31	No	-	N/A	N/A	N/A	-	No

[1]Levee geometry at Station 2076+90 was used.

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Table 8-4. Seismic Vulnerability Evaluation Results.

Reach	PHA (g)	Beginning Station	Ending Station	Seismic Vulnerability Class	Rationale for Seismic Vulnerability Class Selection
7	0.125	510+37	526+00	Possibly Compromised	Judged based on the subsurface soil conditions (presence of thin layers of no to low plasticity shallow foundation materials) and the results of the seismic analysis performed at Station 539+30.
7	0.125	526+00	598+87	Likely Compromised	The liquefiable zone (very loose to medium dense) is up to 25 feet thick, and located within 1 levee height; the estimated maximum seismic deformation for the seismic analysis section at Station 539+30 is about 6.5 feet (Newmark-type).
8	0.125	598+87	654+75	Compromised	The liquefiable zone (very loose to medium dense) is up to 25 feet in thickness, and located within 2 levee height; the post-earthquake factor of safety at Station 623+86 is less than 1.0.
9	0.125	654+75	674+00	Compromised	The liquefiable zone (very loose to medium dense) is up to 25 feet in thickness, and located within 2 levee height; judged based on the results of the seismic analysis performed at Station 623+86.
9	0.125	674+00	695+00	Probably Uncompromised	The liquefiable zone (medium dense) is up to 10 feet in thickness and located within 2 levee height; the estimated maximum seismic deformation for the seismic analysis section at Station 683+00 is about 0.8 feet (Newmark-type).
9	0.125	695+00	706+50	Possibly Compromised	The liquefiable zone (medium dense) is up to 10 feet in thickness and located within 1 levee height; judged based on the results of the seismic analysis performed at Station 683+00.
10	0.125	706+50	722+00	Possibly Compromised	The liquefiable zone is up to 15 feet in thickness and located within 1 levee height; judged based on the results of the seismic analysis performed at Station 683+00.

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Table 8-4. Seismic Vulnerability Evaluation Results.

Reach	PHA (g)	Beginning Station	Ending Station	Seismic Vulnerability Class	Rationale for Seismic Vulnerability Class Selection
10	0.125	722+00	754+00	Compromised	The liquefiable zone (loose to medium dense) is up to 15 feet in thickness and located within 1 levee height; the post-earthquake factor of safety at Station 733+84 is less than 1.0.
10	0.125	754+00	774+00	Possibly Compromised	The liquefiable zone (loose to medium dense) is up to 15 feet in thickness and located within 1 levee height; judged based on the subsurface soil conditions and available CPT and blow count data.
11	0.125	774+00	831+00	Possibly Compromised	
12	0.125	831+00	845+00	Possibly Compromised	The localized liquefiable zones of up to 30 feet exist within 2 levee height; judged based on the subsurface soil conditions and available CPT and blow count data.
13	0.125	845+00	927+00	Compromised	The liquefiable zone (very loose to medium dense) is up to 30 feet in thickness and located within 2 levee height; the post-earthquake factor of safety at Station 871+00 is less than 1.0.
14	0.125	927+00	954+00	Compromised	The liquefiable zone (very loose to medium dense) is up to 20 feet in thickness and located within 1 levee height; judged based on the results of the seismic analyses performed at Stations 871+00 and 958+83.
15	0.125	954+00	968+00	Compromised	The liquefiable zone (loose to medium dense) is up to 30 feet in thickness and located within 2 levee height; the post-earthquake factor of safety at Station 958+83 is less than 1.0.
16	0.125	968+00	993+00	Compromised	The liquefiable zone (medium dense) is up to 10 feet in thickness and located within 2 levee height; judged based on the results of the seismic analysis performed at Station 958+83.

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Table 8-4. Seismic Vulnerability Evaluation Results.

Reach	PHA (g)	Beginning Station	Ending Station	Seismic Vulnerability Class	Rationale for Seismic Vulnerability Class Selection
16	0.125	993+00	1080+00	Possibly Compromised	The localized liquefiable zones (medium dense) of up to 10 feet in thickness exist within 2 levee height; judged based on the results of the seismic analysis performed at Station 1116+00.
17	0.125	1080+00	1130+86	Possibly Compromised	The liquefiable zone (loose to medium dense) is up to 40 feet in thickness and located within 2 levee height; the estimated maximum seismic deformation for the seismic analysis section at Station 1116+00 is about 1.5 feet (Newmark-type).
18	0.125	1130+86	1136+00	Possibly Compromised	The liquefiable zone (medium dense) is up to 15 feet in thickness and located within 1 levee height; judged based on the results of the seismic analysis performed at Station 1116+00.
18	0.125	1136+00	1170+00	Likely Compromised	The liquefiable zone (loose to medium dense) is up to 25 feet in thickness and located within 2 levee height; judged based on the results of the seismic analysis performed at Station 1224+00.
18	0.125	1170+00	1213+85	Possibly Compromised	The liquefiable zone (medium dense) is up to 10 feet in thickness; judged based on the results of the seismic analysis performed at Station 1116+00, and CPT and blow count data.
19	0.125	1213+85	1243+00	Likely Compromised	The liquefiable zone (loose to medium dense) is up to 30 feet in thickness and located within 2 levee height; the estimated maximum seismic deformation for the seismic analysis section at Station 1224+00 is about 10 feet (Newmark-type).
19	0.125	1243+00	1297+83	Probably Uncompromised	The liquefiable zone is up to 15 feet in thickness and located below 2 levee height; judged based on the results of the seismic analysis performed at Station 1378+83.
20	0.125	1297+83	1374+33	Probably Uncompromised	No liquefiable zones identified

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Table 8-4. Seismic Vulnerability Evaluation Results.

Reach	PHA (g)	Beginning Station	Ending Station	Seismic Vulnerability Class	Rationale for Seismic Vulnerability Class Selection
21	0.125	1374+33	1433+83	Probably Uncompromised	The liquefiable zone (loose to medium dense) is up to 15 feet in thickness and located below 2 levee height; the minimum factor of safety calculated for Pseudo-static stability analysis at Station 1378+83 is greater than 1.0.
22	0.125	1433+83	1503+83	Probably Uncompromised	The localized liquefiable zones of up to 5 feet in thickness exist below 2 levee height; judged based on the results of the seismic analyses performed at Stations 2047+50 and 1378+83.
23	0.11	1503+83	1609+37	Probably Uncompromised	
24	0.11	1609+37	1623+86	Probably Uncompromised	The localized liquefiable zones (medium dense) of up to 5 feet in thickness exist within 2 levee height; judged based on the results of the seismic analyses performed at Stations 2047+50 and 1378+83.
25	0.11	1623+86	1674+37	Probably Uncompromised	The localized liquefiable zones of up to 5 feet in thickness exist below 2 levee height; judged based on the results of the seismic analyses performed at Stations 2047+50 and 1378+83.
26	0.11	1674+37	1707+11	Probably Uncompromised	
27	0.11	1707+11	1721+60	Probably Uncompromised	No liquefiable zones identified
28	0.11	1721+60	1769+31	Probably Uncompromised	No liquefiable zones identified
29	0.11	1769+31	1813+33	Probably Uncompromised	The localized liquefiable zones (medium dense) of up to 5 feet in thickness exist below 2 levee height; judged based on the results of the seismic analysis performed at Station 2047+50.
30	0.11	1813+33	1902+00	Probably Uncompromised	The liquefiable zone (loose to medium dense) is up to 15 feet in thickness and located within 2 and/or below 2 levee height; judged based on the results of the seismic analysis performed at Station 2047+50.
31	0.11	1902+00	1958+00	Probably Uncompromised	The liquefiable zone (medium dense) is up to 5 feet in thickness and located below 1 levee height; judged based on the results of the seismic analysis performed at Station 2047+50.
32	0.11	1958+00	1989+00	Probably Uncompromised	No liquefiable zones identified

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Table 8-4. Seismic Vulnerability Evaluation Results.

Reach	PHA (g)	Beginning Station	Ending Station	Seismic Vulnerability Class	Rationale for Seismic Vulnerability Class Selection
33	0.11	1989+00	2122+00	Probably Uncompromised	The liquefiable zone (medium dense) is up to 15 feet in thickness and located within 2 levee height; the minimum factor of safety calculated for Pseudo-static stability analysis at Station 2047+50 is greater than 1.0.
34	0.11	2122+00	2182+00	Probably Uncompromised	The liquefiable zone is up to 5 feet in thickness and located within 2 levee height; judged based on the results of the seismic analysis performed at Station 2276+76.
35	0.11	2182+00	2224+00	Probably Uncompromised	The liquefiable zone (loose) is up to 5 feet in thickness and located within 2 levee height; judged based on the results of the seismic analysis performed at Station 2276+76.
36	0.11	2224+00	2259+00	Probably Uncompromised	The localized liquefiable zones (medium dense) of up to 10 feet in thickness exist within 2 levee height; judged based on the results of the seismic analysis performed at Station 2276+76.
37	0.11	2259+00	2290+00	Probably Uncompromised	The liquefiable zone (loose to medium dense) is up to 5 feet in thickness and located within 1 levee height; the estimated maximum seismic deformation for the seismic analysis section at Station 2276+76 is about 0.9 feet (Newmark-type).
38	0.11	2290+00	2303+00	Probably Uncompromised	No liquefiable zones identified
39	0.11	2303+00	2319+00	Probably Uncompromised	No liquefiable zones identified
40	0.11	2319+00	2359+00	Probably Uncompromised	The liquefiable zone (loose to medium dense) is up to 10 feet in thickness and located within 1 levee height; the minimum factor of safety calculated for Pseudo-static stability analysis at Station 2332+91 is greater than 1.0.
41	0.11	2359+00	2368+00	Probably Uncompromised	No liquefiable zones identified

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Table D-13 Summary of $N_{160,cs}$ and selected strength parameters for liquefiable layers

Reach	section	Layer No.	Soil Type	Thickness (ft)	$N_{160,cs}$	Avg $N_{160,cs}$	Used $N_{160,cs}$	S_{ur} (psf)	Seismic Vulnerability
7	539+30	4B	SP-SM	20	-	-	12*	360	Likely compromised
8	623+86	6	SP	17	8, 7, 12	9	8	160	Compromised
		8A	SC/SM	10	11,13	12	11	290	
9	683+00	6	SP	15	16,18	17	16	720	Probably uncompromised
		8	SP	24	13, 13, 14, 15, 15	14	13	430	
10	733+84	4B	SP-SM	7	17, 7, 4, 13	10	7	130	Compromised
		5B	ML	7	17, 19, 3	13	3	70	
13	871+00	5B	SP-SM	5	9,4	6.5	6	100	Compromised
		5C	SP-SM	22	12,13,14	13	12	360	
15	958+83	4B	CL	8	9	9	9	190	Compromised
		5A	SM	10	7,9	8	8	160	
		5B	SM	7	13,13	13	13	430	
17	1116+00	2B	ML	13	6,12,13,16,15	12.4	12	360	Possibly compromised
		3	SM	3	14	14	14	520	
		4B	ML	17	12,13, 12,12	12	12	360	
19	1224+00	2B	SM	25	14,13,10,16,14,15,13	13.6	12	360	Likely compromised
21	1378+87	5B	ML	5	12	12	12	360	Probably uncompromised
33	2047+50	4	SP-SM	16	14,13,13	13	13	430	Probably uncompromised
37	2276+76	3	SP	5	11	11	11	290	Probably uncompromised
40	2332+91	4B	GW	3	18	18	18	940	Probably uncompromised
		6B	GP	5	10	10	10	240	

Note:

* Based on CPT data (qc,1 mod = 50 to 80 tsf)

Table 6-2. Seismic Vulnerability Evaluation Criteria.

Amount of Vertical Deformation Relative to Landside Levee Height (percent)	Significant Damage to Internal Structures (e.g., Cutoff Walls)	Remaining Freeboard for Post-Seismic Evaluation (10-Year Flood Water Surface Elevation)	Post-Seismic Flood[1] Protection Ability (Vulnerability Class)
< 5	No	>1 foot	Probably Uncompromised
<10	Possibly	>1 foot	Possibly Compromised
<20	Likely if Existing	None	Likely Compromised
Unlimited, > 10 feet (Flow Slide Condition)	Yes	None	Compromised

[1]The section must pass each of the three criteria at a given level, or it should be rated at the next poorer post seismic flood protection ability classification (i.e. vulnerability class).

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APPENDIX D

Results of Seismic Assessment

Attachment E5

Table D-1 Feather River West Levee Project
Strength Parameters for Seismic Stability Analysis

Reach: 7
Station: 539+30
Explorations: WL0001_084C, WL0001_089C

By: S. Orgill 12/29/2011
Checked: C. Tsai 1/4/2011

A	B	C	D	E	F	G	H	I	J	K
Material Description	**Layer Number**	**Liquefiable Layer (Y/N)**	**$N_{160,cs}$**	**Strength Type**	**Parameter**	**From Static Stability Analysis**	**From $N_{1,60\ cs}$**	**Selection**	**Unit Weight**	**Rationale**
CL (Fill)	1	N	-	**Drained**	c' (psf) =	100		100	120	
					φ' (°) =	31		31		Above water table. Use drained strength.
CL	2	N	-	**Drained**	c' (psf) =	100		100	120	
					φ' (°) =	31		31		Above water table. Use drained strength.
SM	3	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	33		33		Above water table. Use drained strength.
SP-SM	4A	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	36		36		Above water table. Use drained strength.
SP-SM	4B	Y	12	**Drained**	c' (psf) =	0		0	125	$N_{160,CS}$ for liquefiable layer are Interpreted by CPT given $q_{c,1\ mod}$ between 50 to 80 tsf .Use composite envelope with lower of drained strength and Sur envelopes.
					φ' (°) =	36		36		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =			-		
					s_{ur} (psf) =		360	360		
SP-SM	4C	N	-	**Drained**	c' (psf) =	0		0	125	Not liquefied, use drained strength
					φ' (°) =	36		36		
ML	5	N	-	**Undrained**	OCR =	3		3	125	Below water table, use undrained strength.
					s_u/σ'_{vc} =	0.55		0.55		
CL	6	N	-	**Undrained**	OCR =	9		9	125	Below water table, use undrained strength.
					s_u/σ'_{vc} =	1		1		
SP	7	N	-	**Drained**	c' (psf) =	0		0	125	Not liquefied, use drained strength
					φ' (°) =	36		36		
SP-SM (Regraded)	8	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	35		35		Above water table. Use drained strength.
CL Core (Regraded)	9	N	-	**Drained**	c' (psf) =	100		100	125	
					φ' (°) =	31		31		Above water table. Use drained strength.
Cutoff Wall	10	N	-	**Drained**	c' (psf) =	300		300	100	
					φ' (°) =	0		0		

Note: N_{160cs} values for Residual Strength were taken from SPT liquefaction analyses or correlated with q_{c1mod} from CPT liquefaction analyses

Attachment E5

Table D-2 Feather River West Levee Project
Strength Parameters for Seismic Stability Analysis

Reach: 8
Station: 623+86
Explorations: WL0001_049B, SL0001_050C

By: S. Orgill 12/29/2011
Checked: C. Tsai 1/4/2012

A	B	C	D	E	F	G	H	I	J	K
Material Description	**Layer Number**	**Liquefiable Layer (Y/N)**	**$N_{160,cs}$**	**Strength Type**	**Parameter**	**From Static Stability Analysis**	**From $N_{1,60\ cs}$**	**Selection**	**Unit Weight**	**Rationale**
SM (Fill)	1	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	35		35		Above water table. Use drained strength.
SP	2	N	-	**Drained**	c' (psf) =	0		0	115	
					φ' (°) =	30		30		Above water table. Use drained strength.
CL	3	N	-	**Drained**	c' (psf) =	100		100	125	
					φ' (°) =	31		31		Above water table. Use drained strength.
SP-SM	4	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	35		35		Above water table. Use drained strength.
CL	5A	N	-	**Undrained**	OCR =	1		1	125	Below water table, use undrained strength.
					s_u/σ'_{vc} =	0.23		0.23		
CL	5B	Y	-	**Undrained - Post Liquefaction**	OCR =	1		1	125	Sur/p'=0.8*Su/p=0.18
					s_{ur}/σ'_{vc} =	0.18		0.18		
SP	6	Y	8	**Drained**	c' (psf) =	0		0	125	Use composite envelope with lower of drained strength and Sur envelopes.
					φ' (°) =	30		30		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-		-		
					s_{ur} (psf) =		160	160		
CL	7A	Y	-	**Undrained - Post Liquefaction**	OCR =	1		1	120	Sur/p'=0.8*Su/p=0.18
					s_{ur}/σ'_{vc} =	0.18		0.18		
CL	7B	N	-	**Undrained**	OCR =	1		1	120	Below water table, use undrained strength.
					s_u/σ'_{vc} =	0.23		0.23		
SM/SC	8A	Y	11	**Drained**	c' (psf) =	0		0	125	Use composite envelope with lower of drained strength and Sur envelopes.
					φ' (°) =	32		32		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =			-		
					s_{ur} (psf) =		290	290		
SM/SC	8B	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	32		32		
GP	9	N	-	**Drained**	c' (psf) =	0		0	130	
					φ' (°) =	36		36		
SP-SM (Regraded)	10	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	35		35		Above water table. Use drained strength.
CL Core (Regraded)	11	N	-	**Drained**	c' (psf) =	100		100	125	
					φ' (°) =	31		31		Above water table. Use drained strength.
Cutoff Wall	12	N	-	**Drained**	c' (psf) =	300	-	300	100	
					φ' (°) =	0	-	0		

Note: N_{160cs} values for Residual Strength were taken from SPT liquefaction analyses or correlated with q_{c1mod} from CPT liquefaction analyses

Attachment E5

Table D-3 Feather River West Levee Project
Strength Parameters for Seismic Stability Analysis

Reach: 9
Station: 683+00
Explorations: WL0001_053B, SL0001_038C

By: S. Orgill 12/29/2011
Checked: C. Tsai 1/4/2012

A	B	C	D	E	F	G	H	I	J	K
Material Description	**Layer Number**	**Liquefiable Layer (Y/N)**	**$N_{160,cs}$**	**Strength Type**	**Parameter**	**From Static Stability Analysis**	**From $N_{1,60\ cs}$**	**Selection**	**Unit Weight**	**Rationale**
SM (Fill)	1	N	-	**Drained**	c' (psf) =	0		0	125	Above water table. Use drained strength.
					φ' (°) =	35		35		
SP-SM	2	N	-	**Undrained**	OCR =	0		0	125	Above water table. Use drained strength.
					s_u/σ'_{vc} =	36		36		
ML	3	N	-	**Drained**	c' (psf) =	0		0	125	Above water table. Use drained strength.
					φ' (°) =	30		30		
SM	4	N	-	**Drained**	c' (psf) =	0		0	130	Above water table. Use drained strength.
					φ' (°) =	35		35		
ML	5	N	-	**Undrained**	OCR =	1.5		1.5	125	Below water table, use undrained strength.
					s_u/σ'_{vc} =	0.32		0.32		
SP	6	Y	16	**Drained**	c' (psf) =	0		0	125	Use composite envelope with lower of drained strength and Sur envelopes.
					φ' (°) =	35		35		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =			-		
					s_{ur} (psf) =		720	720		
CL	7	N	-	**Undrained - Post Liquefaction**	OCR =	1		1	120	Below water table, use undrained strength.
					s_u/σ'_{vc} =	0.23		0.23		
SP	8	Y	13	**Drained**	c' (psf) =	0		0	125	Use composite envelope with lower of drained strength and Sur envelopes.
					φ' (°) =	35		35		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =			-		
					s_{ur} (psf) =		430	430		
SP-SM (Regraded)	9	N	-	**Drained**	c' (psf) =	0		0	125	Above water table. Use drained strength.
					φ' (°) =	35		35		
CL Core (Regraded)	10	N	-	**Drained**	c' (psf) =	100		100	125	Above water table. Use drained strength.
					φ' (°) =	31		31		
Cutoff Wall	11	N	-	**Drained**	c' (psf) =	300	-	300	100	
					φ' (°) =	0	-	0		

Note: N_{160cs} values for Residual Strength were taken from SPT liquefaction analyses or correlated with q_{c1mod} from CPT liquefaction analyses

Attachment E5

Table D-4 Feather River West Levee Project
Strength Parameters for Seismic Stability Analysis

Reach: 10
Station: 733+84
Explorations: SL0001_001B, WL0001_057C

By: S. Orgill 12/29/2011
Checked: C. Tsai 1/4/2012

A	B	C	D	E	F	G	H	I	J	K
Material Description	**Layer Number**	**Liquefiable Layer (Y/N)**	**$N_{160,cs}$**	**Strength Type**	**Parameter**	**From Static Stability Analysis**	**From $N_{1,60\ cs}$**	**Selection**	**Unit Weight**	**Rationale**
SM (Fill)	2	N	-	**Drained**	c' (psf) =	0		0	120	
					φ' (°) =	33		33		Above water table. Use drained strength.
CL	3	N	-	**Undrained**	OCR =	3		-	125	
					s_u/σ'_{vc} =	0.5		0.5		
SP-SM	4A	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	30		30		Not liquefied. Use drained strength.
SP-SM	4B	Y	7	**Drained**	c' (psf) =	0		0	125	Use composite envelope with lower of drained strength and Sur envelopes.
					φ' (°) =	30		30		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	130	130		
SP-SM	4C	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	30		30		
CL	5A	N	-	**Undrained**	OCR =	5	-	5	125	
					s_u/σ'_{vc} =	0.8	-	0.8		
ML	5B	Y	3	**Drained**	c' (psf) =	0		0	125	Liquefiable Silt sublayer within layer 5 (modeled as CL for steady state analysis). No PI data available for this layer, so assume non-plastic.
					φ' (°) =	30		30		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	70	70		
SP-SM	6	N	-	**Drained**	c' (psf) =	0		0	130	
					φ' (°) =	30		30		
GW	7	N	-	**Drained**	c' (psf) =	0		0	130	
					φ' (°) =	33		33		
SP-SM (Regraded)	8	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	35		35		Above water table. Use drained strength.
CL Core (Regraded)	9	N	-	**Drained**	c' (psf) =	100		100	125	
					φ' (°) =	31		31		Above water table. Use drained strength.
Cutoff Wall	10	N	-	**Drained**	c' (psf) =	300	-	300	100	
					φ' (°) =	0	-	0		

Note: N_{160cs} values for Residual Strength were taken from SPT liquefaction analyses or correlated with q_{c1mod} from CPT liquefaction analyses

Attachment E5

Table D-5 Feather River West Levee Project
Strength Parameters for Seismic Stability Analysis

Reach: 13
Station: 871+00
Explorations: SL0001_002B (Toe), WL0001_068C (crown), B-41 (crown), B-31 (LS Toe)

By: C. Tsai 12/29/2011
Checked: Kanax 1/5/2012

A	B	C	D	E	F	G	H	I	J	K
Material Description	**Layer Number**	**Liquefiable Layer (Y/N)**	**$N_{160,cs}$**	**Strength Type**	**Parameter**	**From Static Stability Analysis**	**From $N_{1,60\ cs}$**	**Selection**	**Unit Weight**	**Rationale**
SP-SM	1	N	-	**Drained**	c' (psf) =	0		0	110	
					φ' (°) =	35		35		Above water table; use drained strength
SM	2	N	-	**Drained**	c' (psf) =	0		0	115	
					φ' (°) =	30		30		Above water table; use drained strength
ML	3	N	-	**Drained**	c' (psf) =	50		50	120	
					φ' (°) =	31		31		Above water table; use drained strength
ML	4	N	-	**Drained**	c' (psf) =	50		50	124	
					φ' (°) =	31		31		Above water table; use drained strength
SP-SM	5A	N	-	**Drained**	c' (psf) =	0		0	115	
					φ' (°) =	30		30		Above water table; use drained strength
SP-SM	5B	Y	4-9	**Drained**	c' (psf) =	0		0	115	Liquefiable SP-SM layer. $N_{1,60cs}$ approximately 6. Used composite envelope of drained strength and $S_{u,r}$
					φ' (°) =	30		30		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	100	100		
SP-SM	5C	Y	12-13	**Drained**	c' (psf) =	0		0	115	Liquefiable SP-SM layer. $N_{1,60cs}$ approximately 12. Used composite envelope of drained strength and $S_{u,r}$
					φ' (°) =	30		30		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	360	360		
GW	6	N	-	**Drained**	c' (psf) =	0		0	130	
					φ' (°) =	32		32		Non-liquefiable; use drained strength
CL	7	N	-	**Undrained**	OCR =	1		1	120	
					s_u/σ'_{vc} =	0.25		0.25		Below water table; use undrained strength
SP	8	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	34		34		Non-liquefiable; use drained strength
CL	9	N	-	**Undrained**	OCR =	1		1	120	
					s_u/σ'_{vc} =	0.25		0.25		Below water table; use undrained strength
SP-SM (Regraded)	10	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	35		35		
CL Core (Regraded)	11	N	-	**Drained**	c' (psf) =	100		100	125	
					φ' (°) =	31		31		
Cutoff Wall	12	N	-	**Drained**	c' (psf) =	300	-	300	100	
					φ' (°) =	0	-	0		

Note: N_{160cs} values for Residual Strength were taken from SPT liquefaction analyses or correlated with q_{c1mod} from CPT liquefaction analyses

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Table D-6 Feather River West Levee Project
Strength Parameters for Seismic Stability Analysis

Reach: 15
Station: 958+83
Explorations: WL0001_003B (LS Toe), WL0001_074B (crown)

By: C. Tsai 12/29/2011
Checked: Kanax 1/5/2012

A	B	C	D	E	F	G	H	I	J	K
Material Description	**Layer Number**	**Liquefiable Layer (Y/N)**	**$N_{160,cs}$**	**Strength Type**	**Parameter**	**From Static Stability Analysis**	**From $N_{1,60\ cs}$**	**Selection**	**Unit Weight**	**Rationale**
ML	1	N	-	**Drained**	c' (psf) =	50		50	125	
					φ' (°) =	31		31		Above water table; use drained strength
SM	2	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	30		30		Above water table; use drained strength
ML	3	N	-	**Drained**	c' (psf) =	0		0	120	
					φ' (°) =	28		28		Above water table; use drained strength
CL	4A	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	35		35		Above water table; use drained strength
CL	4B	Y	9	**Drained**	c' (psf) =	0		0	125	WL0001_074B show silty layer and judge to be liquefiable. N1,60cs approximately 9. Used composite envelope of drained strength and Su,r
					φ' (°) =	35		35		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	190	190		
SM	5A	Y	7-9	**Drained**	c' (psf) =	0		0	125	Liquefiable SM layer. $N_{1,60cs}$ approximately 8. Used composite envelope of drained strength and $S_{u,r}$
					φ' (°) =	28		28		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	160	160		
SM	5B	Y	13	**Drained**	c' (psf) =	0		0	125	Liquefiable SM layer. $N_{1,60cs}$ approximately 13. Used composite envelope of drained strength and $S_{u,r}$
					φ' (°) =	28		28		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	430	430		
CL	6	N	-	**Undrained**	OCR =	1		1	125	
					s_u/σ'_{vc} =	0.25		0.25		Below water table; use undrained strength
SM	7	N	-	**Drained**	c' (psf) =	0		0	130	Non-liquefiable; use drained strength
					φ' (°) =	35		35		
CL	8	N	-	**Undrained**	OCR =	5		5	120	
					s_u/σ'_{vc} =	0.9		0.9		Below water table; use undrained strength
SP-SM (Regraded)	9	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	35		35		
CL Core (Regraded)	10	N	-	**Drained**	c' (psf) =	100		100	125	
					φ' (°) =	31		31		
Cutoff Wall	11	N	-	**Drained**	c' (psf) =	300	-	300	100	
					φ' (°) =	0	-	0		

Note: N_{160cs} values for Residual Strength were taken from SPT liquefaction analyses or correlated with q_{c1mod} from CPT liquefaction analyses

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Table D-7 Feather River West Levee Project
Strength Parameters for Seismic Stability Analysis

Reach: 17
Station: 1116+00
Explorations: 2F-07-06 (Crown)

By: C. Tsai 12/29/2011
Checked: Kanax 1/5/2012

A	B	C	D	E	F	G	H	I	J	K
Material Description	**Layer Number**	**Liquefiable Layer (Y/N)**	**$N_{160,cs}$**	**Strength Type**	**Parameter**	**From Static Stability Analysis**	**From $N_{1,60\ cs}$**	**Selection**	**Unit Weight**	**Rationale**
ML	1	N	-	**Drained**	c' (psf) =	50		50	120	
					φ' (°) =	31		31		Above water table; use drained strength
ML	2A	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	30		30		Above water table; use drained strength
ML	2B	Y	12-15	**Drained**	c' (psf) =	0		0	125	Liquefiable ML layer. $N_{1,60cs}$ approximately 12. Used composite envelope of drained strength and $S_{u,r}$
					φ' (°) =	30		30		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	360	360		
ML	2C	N	-	**Undrained**	OCR =				125	
					sur/σ'vc =	0.2		0.2		Below water table; use undrained strength
SM	3	Y	14	**Drained**	c' (psf) =	0		0	125	Liquefiable SM layer. $N_{1,60cs}$ approximately 14. Used composite envelope of drained strength and $S_{u,r}$
					φ' (°) =	32		32		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	520	520		
ML	4A	N	-	**Undrained**	OCR =				125	
					sur/σ'vc =	0.3		0.3		Below water table; use undrained strength
ML	4B	Y	12-13	**Drained**	c' (psf) =	50		50	125	Liquefiable ML layer. $N_{1,60cs}$ approximately 12. Used composite envelope of drained strength and $S_{u,r}$
					φ' (°) =	31		31		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	360	360		
SP-SM (Regraded)	5	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	35		35		
CL Core (Regraded)	6	N	-	**Drained**	c' (psf) =	100		100	125	
					φ' (°) =	31		31		
Cutoff Wall	7	N	-	**Drained**	c' (psf) =	300	-	300	100	
					φ' (°) =	0	-	0		

Note: N_{160cs} values for Residual Strength were taken from SPT liquefaction analyses or correlated with q_{c1mod} from CPT liquefaction analyses

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Table D-8 Feather River West Levee Project
Strength Parameters for Seismic Stability Analysis

Reach: 19
Station: 1224+00
Explorations: 2F-07-8 (crown), SL0009_007C (crown), WL0009_019c (landside)

By: C. Tsai 12/29/2011
Checked: Kanax 1/5/2012

A	B	C	D	E	F	G	H	I	J	K
Material Description	**Layer Number**	**Liquefiable Layer (Y/N)**	**$N_{160,cs}$**	**Strength Type**	**Parameter**	**From Static Stability Analysis**	**From $N_{1,60\ cs}$**	**Selection**	**Unit Weight**	**Rationale**
CL-ML	1	N	-	**Drained**	c' (psf) =	50		50	125	
					φ' (°) =	31		31		Above water table; use drained strength
CL	2	N	-	**Drained**	c' (psf) =	100		100	125	
					φ' (°) =	31		31		Above water table; use drained strength
SM	3A	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	31		31		Above water table; use drained strength
SM	3B	Y	10-16	**Drained**	c' (psf) =	0		0	125	Liquefiable SM layer. $N_{1,60cs}$ approximately 12. Used composite envelope of drained strength and $S_{u,r}$
					φ' (°) =	31		31		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	360	360		
GW-GM	4	N	-	**Drained**	c' (psf) =	0		0	130	Non-liquefiable; use drained strength
					φ' (°) =	36		36		
ML	5	N	-	**Undrained**	OCR =				125	
					s_u/σ'_{vc} =	1		1		Below water table; use undrained strength
SM	6	N	-	**Drained**	c' (psf) =	0		0	130	Non-liquefiable; use drained strength
					φ' (°) =	36		36		
CL	7	N	-	**Undrained**	OCR =	1		1	125	
					s_u/σ'_{vc} =	0.25		0.25		Below water table; use undrained strength
SP-SM (Regraded)	8	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	35		35		
CL Core (Regraded)	9	N	-	**Drained**	c' (psf) =	100		100	125	
					φ' (°) =	31		31		
Cutoff Wall	10	N	-	**Drained**	c' (psf) =	300	-	300	100	
					φ' (°) =	0	-	0		

Note: N_{160cs} values for Residual Strength were taken from SPT liquefaction analyses or correlated with q_{c1mod} from CPT liquefaction analyses

Table D-9 Feather River West Levee Project
Strength Parameters for Seismic Stability Analysis

Reach: 21
Station: 1378+83
Explorations: WL0001_028C(crown), WL0009_006A (LS Toe)

By: C. Tsai 12/29/2011
Checked: Kanax 12/5/2012

A	B	C	D	E	F	G	H	I	J	K
Material Description	**Layer Number**	**Liquefiable Layer (Y/N)**	**$N_{160,cs}$**	**Strength Type**	**Parameter**	**From Static Stability Analysis**	**From $N_{1,60\ cs}$**	**Selection**	**Unit Weight**	**Rationale**
CL/ML	1	N	-	**Drained**	c' (psf) =	50		50	115	
					φ' (°) =	31		31		Above water table; use drained strength
CL/ML	2	N	-	**Drained**	c' (psf) =	75		75	115	
					φ' (°) =	31		31		Above water table; use drained strength
SM	3	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	33		33		Above water table; use drained strength
SP-SM	4	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	34		34		Above water table; use drained strength
ML	5A	N	-	**Drained**	c' (psf) =	0		0	120	
					φ' (°) =	30		30		Above water table; use drained strength
ML	5B	Y	10-16	**Drained**	c' (psf) =	0		0	120	Liquefiable ML layer. $N_{1,60cs}$ approximately 12. Used composite envelope of drained strength and $S_{u,r}$
					φ' (°) =	30		30		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	360	360		
SP-SM	6	N	-	**Drained**	c' (psf) =	0		0	130	Non-liquefiable; use drained strength
					φ' (°) =	36		36		
ML	7	N	-	**Undrained**	OCR =				125	
					s_u/σ'_{vc} =	1		1		Below water table; use undrained strength
CL	8	N	-	**Undrained**	OCR =				125	
					s_u/σ'_{vc} =	0.75		0.75		Below water table; use undrained strength
SP-SM (Regraded)	8	N	-	**Drained**	c' (psf) =	0		0	125	
					φ' (°) =	35		35		
CL Core (Regraded)	9	N	-	**Drained**	c' (psf) =	100		100	125	
					φ' (°) =	31		31		
Cutoff Wall	10	N	-	**Drained**	c' (psf) =	300	-	300	100	
					φ' (°) =	0	-	0		

Note: N_{160cs} values for Residual Strength were taken from SPT liquefaction analyses or correlated with q_{c1mod} from CPT liquefaction analyses

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Table D-10 Feather River West Levee Project
Strength Parameters for Seismic Stability Analysis

Reach: 33
Station: 2047+50 (based on 2076+90)
Explorations: WM0007_048B (WM0007_009S, WM0007_002C)

By: M. Weil 1/3/2012
Checked: C. Tsai 1/4/2012

A	B	C	D	E	F	G	H	I	J	K
Material Description	**Layer Number**	**Liquefiable Layer (Y/N)**	**$N_{1,60cs}$**	**Strength Type**	**Parameter**	**From Static Stability Analysis**	**from $N_{1,60\ cs}$**	**Selection**	**Unit Weight**	**Rationale**
ML	1	N	-	**Drained**	c' (psf) =	0	-	0	115	
					φ' (°) =	30	-	30		Above water table; use drained strength
ML	2	N	-	**Drained**	c' (psf) =	75	-	75	115	
					φ' (°) =	31	-	31		Above water table; use drained strength
SP-SM	3	N	-	**Drained**	c' (psf) =	0	-	0	115	
					φ' (°) =	32	-	32		Non-liquefiable; use drained strength
SP-SM	4	Y	13	**Drained**	c' (psf) =	0	-	0	115	Liquefiable SP layer. $N_{1,60cs}$ approximately 13. Used composite envelope of drained strength and $S_{u,r}$
					φ' (°) =	32	-	32		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	430	430		
GP	5	N	-	**Drained**	c' (psf) =	0	-	0	121	
					φ' (°) =	36	-	36		Non-liquefiable; use drained strength
SW-SM	6	N	-	**Drained**	c' (psf) =	0	-	0	130	
					φ' (°) =	36	-	36		Non-liquefiable; use drained strength
GP	7	N	-	**Drained**	c' (psf) =	0	-	0	130	
					φ' (°) =	36	-	36		Non-liquefiable; use drained strength
CL	8	N	-	**Undrained**	OCR =	1	-	1	125	
					s_u/σ'_{vc} =	0.23	-	0.23		Not critical to the analysis
ML	9	N	-	**Undrained**	OCR =	1	-	1	125	
					s_u/σ'_{vc} =	0.23	-	0.23		Not critical to the analysis
SP-SM (Regraded)	10	N	-	**Drained**	c' (psf) =	0	-	0	130	
					φ' (°) =	35	-	35		
CL Core (Regraded)	11	N	-	**Drained**	c' (psf) =	100	-	100	125	
					φ' (°) =	31	-	31		
Cutoff Wall	12	N	-	**Drained**	c' (psf) =	300	-	300	100	
					φ' (°) =	0	-	0		

Note: N_{160cs} values for Residual Strength were taken from SPT liquefaction analyses or correlated with q_{c1mod} from CPT liquefaction analyses

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Table D-11 Feather River West Levee Project
Strength Parameters for Seismic Stability Analysis

Reach: 37
Station: 2276+76
Explorations: SM0007_006A (crown), SM0007_006B (LS toe), SM0007_013S (crown)

By: M. Weil 12/29/2011
Checked: C. Tsai 1/4/2012

A	B	C	D	E	F	G	H	I	J	K
Material Description	**Layer Number**	**Liquefiable Layer (Y/N)**	**$N_{1,60cs}$**	**Strength Type**	**Parameter**	**From Static Stability Analysis**	**from $N_{1,60\ cs}$**	**Selection**	**Unit Weight**	**Rationale**
ML	1	N	-	**Drained**	c' (psf) =	50	-	50	115	
					φ' (°) =	31	-	31		Above water table; use drained strength
ML	2	N	-	**Drained**	c' (psf) =	75	-	75	115	
					φ' (°) =	31	-	31		Above water table; use drained strength
SP	3	Y	11	**Drained**	c' (psf) =	0	-	0	115	Liquefiable SP layer. $N_{1,60cs}$ approximately 11. Used composite envelope of drained strength and $S_{u,r}$
					φ' (°) =	32	-	32		
				Undrained - Post Liquefaction	s_{ur}/σ'_{vc} =	-	-	-		
					s_{ur} (psf) =	-	290	290		
GW	4	N	-	**Drained**	c' (psf) =	0	-	0	130	Non-liquefiable; use drained strength
					φ' (°) =	36	-	36		
GC	5	N	-	**Drained**	c' (psf) =	0	-	0	130	Non-liquefiable; use drained strength
					φ' (°) =	32	-	32		
SM	6	N	-	**Drained**	OCR =	0	-	0	115	Non-liquefiable; use drained strength
					s_u/σ'_{vc} =	32	-	32		
GC	7	N	-	**Drained**	c' (psf) =	0	-	0	130	Non-liquefiable; use drained strength
					φ' (°) =	32	-	32		
SM	8	N	-	**Drained**	OCR =	0	-	0	115	Non-liquefiable; use drained strength
					s_u/σ'_{vc} =	32	-	32		
GP	9	N	-	**Drained**	c' (psf) =	0	-	0	130	Non-liquefiable; use drained strength
					φ' (°) =	36	-	36		
SP-SM (Regraded)	10	N	-	**Drained**	c' (psf) =	0	-	0	125	
					φ' (°) =	35	-	35		
CL Core (Regraded)	11	N	-	**Drained**	c' (psf) =	100	-	100	125	
					φ' (°) =	31	-	31		
Cutoff Wall	12	N	-	**Drained**	c' (psf) =	300	-	300	100	
					φ' (°) =	0	-	0		

Note: N_{160cs} values for Residual Strength were taken from SPT liquefaction analyses or correlated with q_{c1mod} from CPT liquefaction analyses

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Table D-12 Feather River West Levee Project
Strength Parameters for Seismic Stability Analysis

Reach: 40
Station: 2332+91
Explorations: WM0007_072S, SM0007_008B

By: M. Weil 12/29/2011
Checked: C. Tsai 1/4/2012

A	B	C	D	E	F	G	H	I	J	K
Material Description	**Layer Number**	**Liquefiable Layer (Y/N)**	**$N_{1,60cs}$**	**Strength Type**	**Parameter**	**From Static Stability Analysis**	**from $N_{1,60\ cs}$**	**Selection**	**Unit Weight**	**Rationale**
GP-GM	1	N	-	**Drained**	c' (psf) =	0	-	0	130	
					φ' (°) =	35	-			Above water table; use drained strength
GC	2	N	-	**Drained**	c' (psf) =	0	-	0	130	
					φ' (°) =	35	-	35		Above water table; use drained strength
CL	3	N	-	**Drained**	c' (psf) =	100	-	100	120	
					φ' (°) =	31	-	31		Above water table; use drained strength
GW	4A	N	-	**Drained**	c' (psf) =	0	-	0	130	
					φ' (°) =	35	-	35		Above water table; use drained strength
GW	4B	Y	18	**Drained**	c' (psf) =	0	-	0	130	Liquefiable SW-SC sublayer within GW (4). $N_{1,60cs}$ approximately 18. Used composite envelope of drained strength and $S_{u,r}$
					φ' (°) =	35	-	35		
				Undrained - Post Liquefaction	**s_{ur}/σ'_{vc} =**	**-**	**-**	**-**		
					s_{ur} (psf) =	-	940	940		
SW-SC	5	N	-	**Drained**	OCR =	0	-	0	130	
					s_u/σ'_{vc} =	36	-	36		
GP	6A	N	-	**Drained**	c' (psf) =	0	-	0	130	
					φ' (°) =	36	-	36		Non-liquefiable; use drained strength
GP	6B	Y	10	**Drained**	c' (psf) =	0	-	0	130	Liquefiable SC sublayer within GP (6). $N_{1,60cs}$ approximately 10. Used composite envelope of drained strength and $S_{u,r}$
					φ' (°) =	36	-	36		
				Undrained - Post Liquefaction	**s_{ur}/σ'_{vc} =**	**-**	**-**	**-**		
					s_{ur} (psf) =	-	240	240		
GP	6C	N	-	**Drained**	c' (psf) =	0	-	0	130	
					φ' (°) =	36	-	36		Non-liquefiable; use drained strength
GC	7	N	-	**Drained**	c' (psf) =	0	-	0	130	
					φ' (°) =	32	-	32		Non-liquefiable; use drained strength
ML	8	N	-	**Undrained**	OCR =	1.2	-	1.2	125	
					s_u/σ'_{vc} =	0.27	-	0.27		Non-liquefiable; use undrained strength
SP-SM	9	N	-	**Drained**	c' (psf) =	0	-	0	125	
					φ' (°) =	32	-	32		Non-liquefiable; use drained strength
SP-SM (Regraded)	10	N	-	**Drained**	c' (psf) =	0	-	0	125	
					φ' (°) =	35	-	35		
CL Core (Regraded)	11	N	-	**Drained**	c' (psf) =	100	-	100	125	
					φ' (°) =	31	-	31		
Cutoff Wall	12	N	-	**Drained**	c' (psf) =	300	-	300	100	
					φ' (°) =	0	-	0		

Note: N_{160cs} values for Residual Strength were taken from SPT liquefaction analyses or correlated with q_{c1mod} from CPT liquefaction analyses

Attachment E5

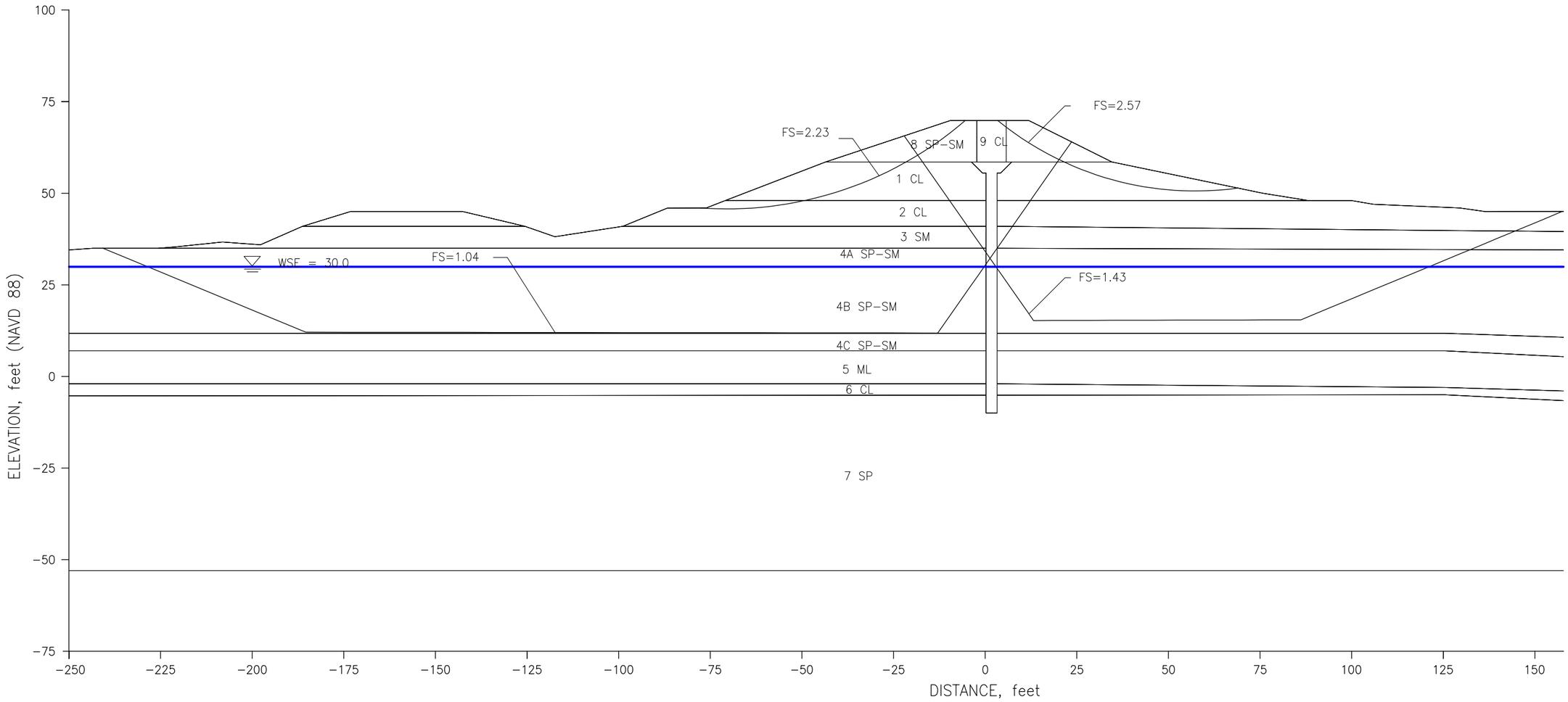
Table D-13 Summary of $N_{160,cs}$ and selected strength parameters for liquefiable layers

Reach	section	Layer No.	Soil Type	Thickness (ft)	$N_{160,cs}$	Avg $N_{160,cs}$	Used $N_{160,cs}$	S_{ur} (psf)	Seismic Vulnerability
7	539+30	4B	SP-SM	20	-	-	12*	360	Likely compromised
8	623+86	6	SP	17	8, 7, 12	9	8	160	Compromised
		8A	SC/SM	10	11,13	12	11	290	
9	683+00	6	SP	15	16,18	17	16	720	Probably uncompromised
		8	SP	24	13, 13, 14, 15, 15	14	13	430	
10	733+84	4B	SP-SM	7	17, 7, 4, 13	10	7	130	Compromised
		5B	ML	7	17, 19, 3	13	3	70	
13	871+00	5B	SP-SM	5	9,4	6.5	6	100	Compromised
		5C	SP-SM	22	12,13,14	13	12	360	
15	958+83	4B	CL	8	9	9	9	190	Compromised
		5A	SM	10	7,9	8	8	160	
		5B	SM	7	13,13	13	13	430	
17	1116+00	2B	ML	13	6,12,13,16,15	12.4	12	360	Possibly compromised
		3	SM	3	14	14	14	520	
		4B	ML	17	12,13, 12,12	12	12	360	
19	1224+00	2B	SM	25	14,13,10,16,14,15,13	13.6	12	360	Likely compromised
21	1378+87	5B	ML	5	12	12	12	360	Probably uncompromised
33	2047+50	4	SP-SM	16	14,13,13	13	13	430	Probably uncompromised
37	2276+76	3	SP	5	11	11	11	290	Probably uncompromised
40	2332+91	4B	GW	3	18	18	18	940	Probably uncompromised
		6B	GP	5	10	10	10	240	

Note:

* Based on CPT data (qc,1 mod = 50 to 80 tsf)

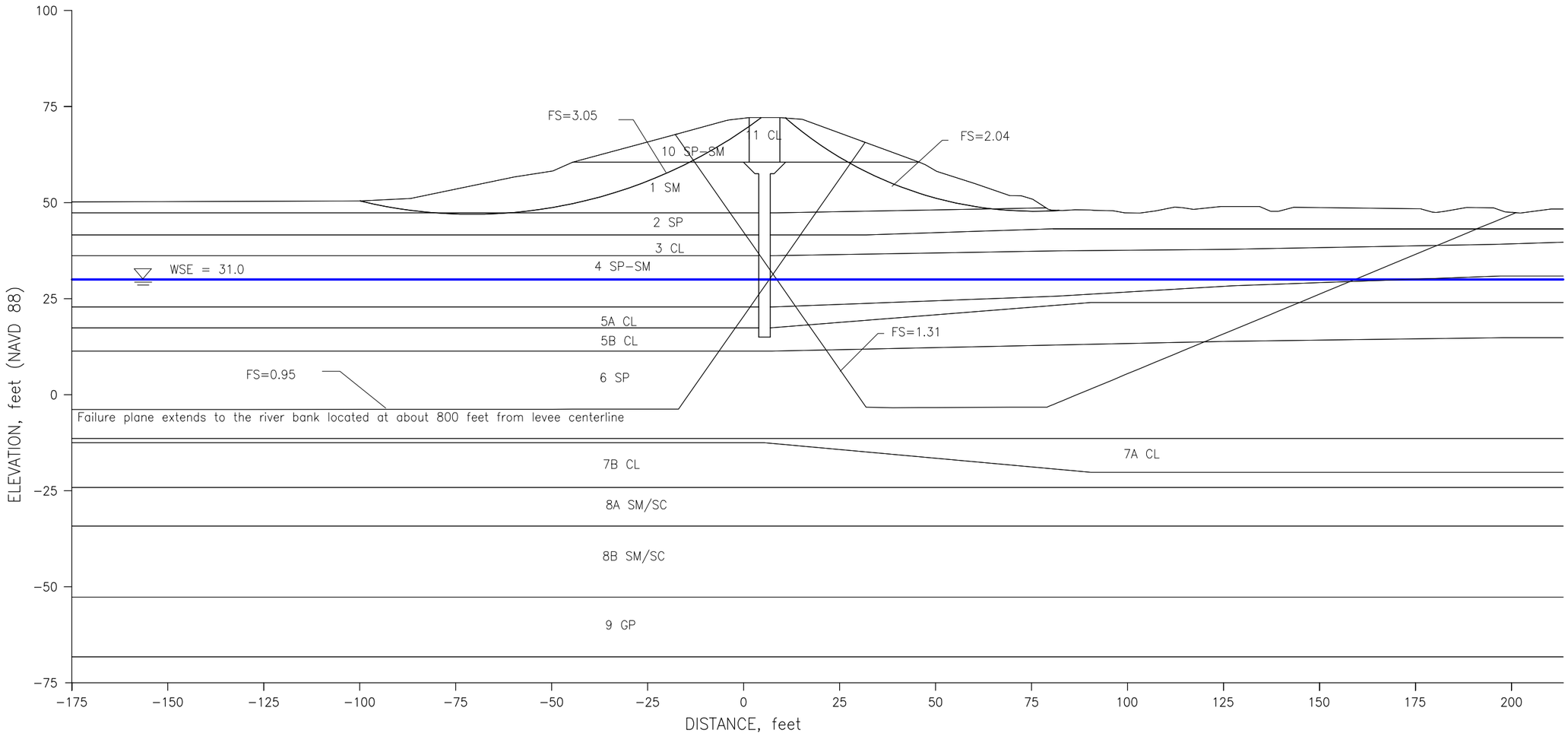
Attachment E5



Sutter Butte Flood Control Agency	in association with: blackburn consulting	PROJECT NUMBER 17326712 TASK ORDER T04 DATE February 2012	PREPARED BY C. Tsai CHECKED BY Kanax	FEATHER RIVER WEST LEVEE PROJECT GEOTECHNICAL RECOMMENDATIONS REPORT FOR 65% DESIGN	Post Earthquake Slope Stability Analysis Results with Mitigation Measures Station 539+30 Reach 7	FIGURE D-R07-1

PLOT BY: SHAWN_ORGILL - Feb 23, 2012 - 2:22:25pm
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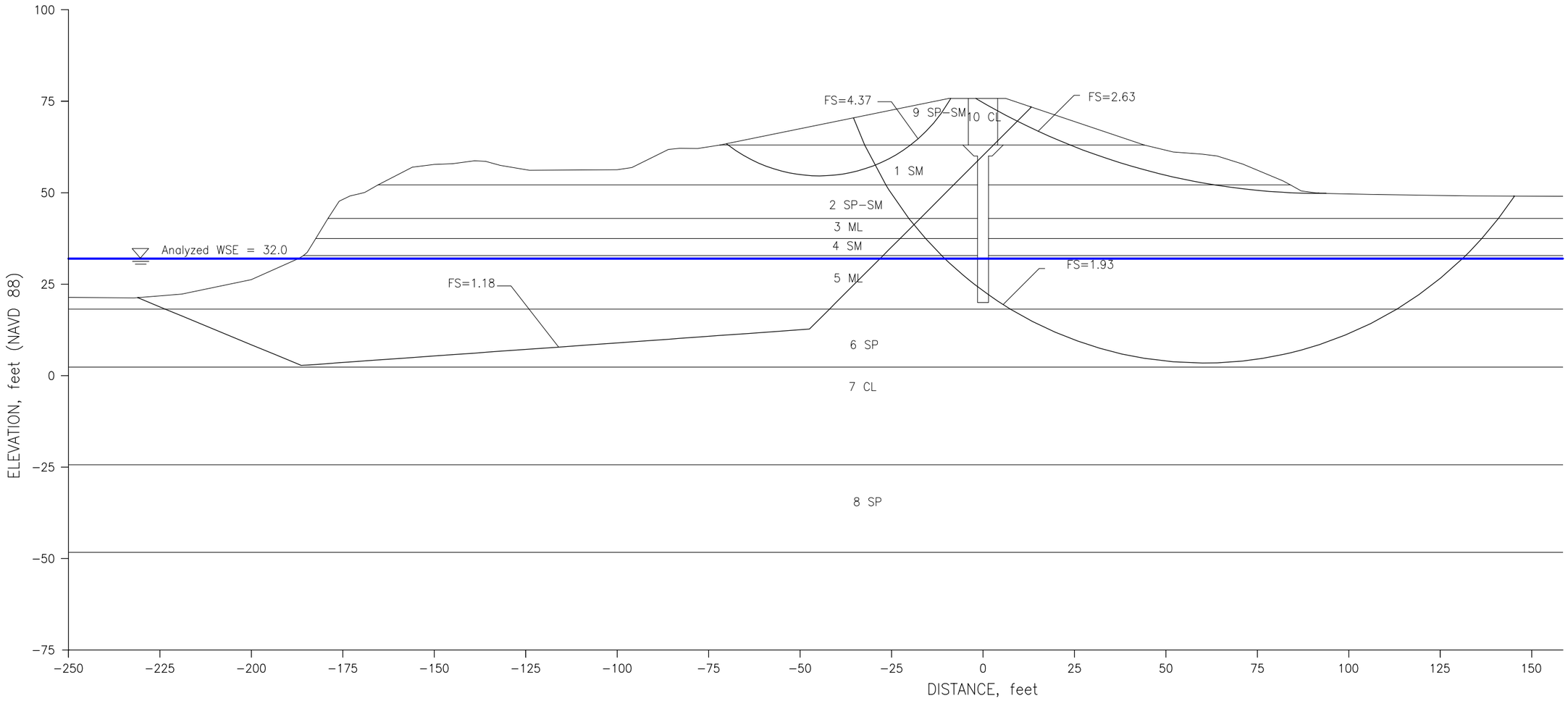
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Sutter Butte Flood Control Agency	URS in association with: blackburn consulting	PROJECT NUMBER 17326712 TASK ORDER TO4 DATE February 2012	PREPARED BY C. Tsai CHECKED BY Kanax	FEATHER RIVER WEST LEVEE PROJECT GEOTECHNICAL RECOMMENDATIONS REPORT FOR 65% DESIGN	Post Earthquake Slope Stability Analysis Results with Mitigation Measures Station 623+86 Reach 8	FIGURE D-R09-1

PLOT BY: SHAWN_ORGILL - Feb 23, 2012 - 2:22:29pm
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Attachment E5



Sutter Butte Flood Control Agency

in association with: URS / blackburn consulting

PROJECT NUMBER	17326712
TASK ORDER	T04
DATE	February 2012
PREPARED BY	C. Tsai
CHECKED BY	Kanax

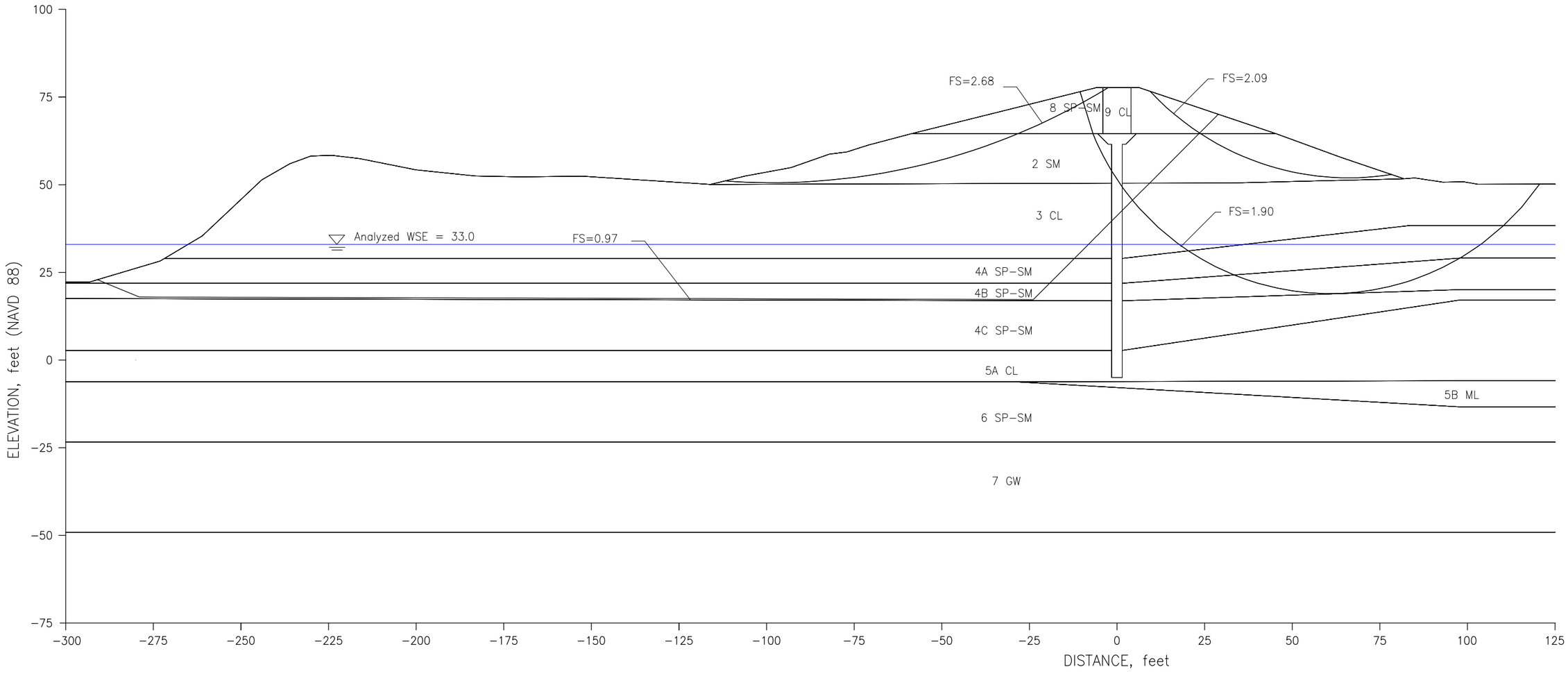
FEATHER RIVER WEST LEVEE PROJECT
GEOTECHNICAL RECOMMENDATIONS REPORT
FOR 65% DESIGN

Post Earthquake Slope Stability
Analysis Results with Mitigation Measures
Station 683+00
Reach 9

FIGURE
D−R09−2

PLOT BY: SHAWN_ORGILL - Feb 23, 2012 - 2:22:34pm
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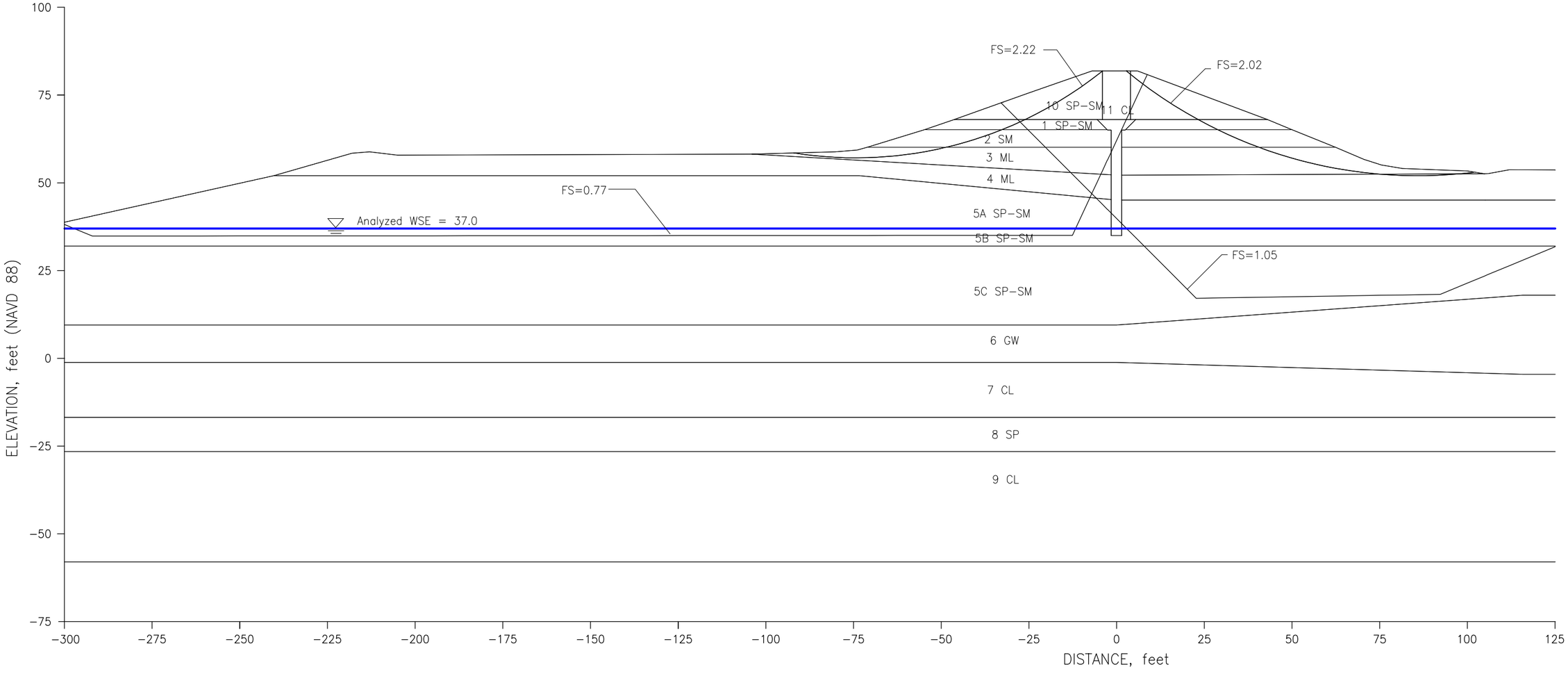
Attachment E5



Sutter Butte Flood Control Agency	in association with: blackburn consulting	PROJECT NUMBER 17326712 TASK ORDER T04 DATE February 2012	PREPARED BY C. Tsai CHECKED BY Kanax	FEATHER RIVER WEST LEVEE PROJECT GEOTECHNICAL RECOMMENDATIONS REPORT FOR 65% DESIGN	Post Earthquake Slope Stability Analysis Results with Mitigation Measures Station 733+84 Reach 10	FIGURE D−R10−1

PLOT BY: SHAWN_ORGILL - Feb 23, 2012 - 2:22:39pm
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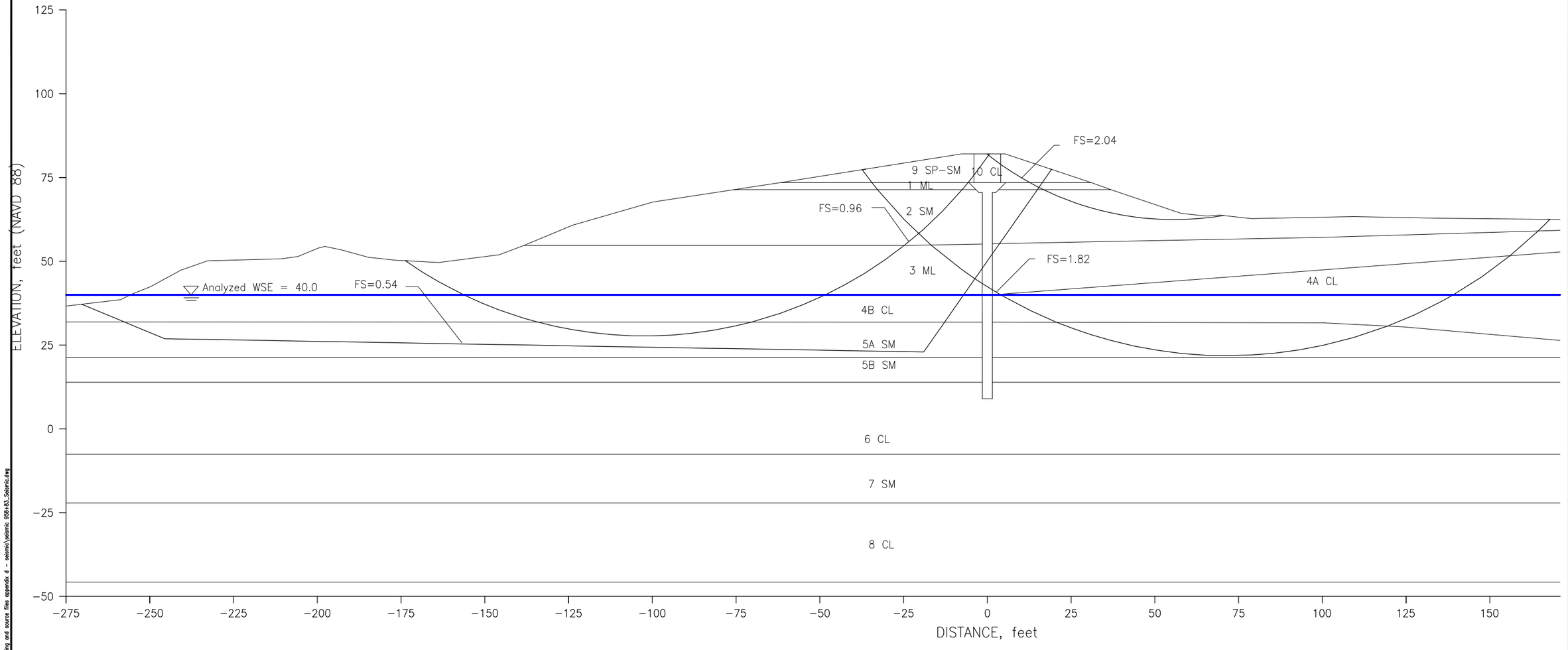
Attachment E5



Sutter Butte Flood Control Agency	in association with: URS / blackburn consulting	PROJECT NUMBER 17326712 TASK ORDER T04 DATE February 2012	PREPARED BY C. Tsai CHECKED BY Kanax	FEATHER RIVER WEST LEVEE PROJECT GEOTECHNICAL RECOMMENDATIONS REPORT FOR 65% DESIGN	Post Earthquake Slope Stability Analysis Results with Mitigation Measures Station 871+00 Reach 13	FIGURE D-R13-1

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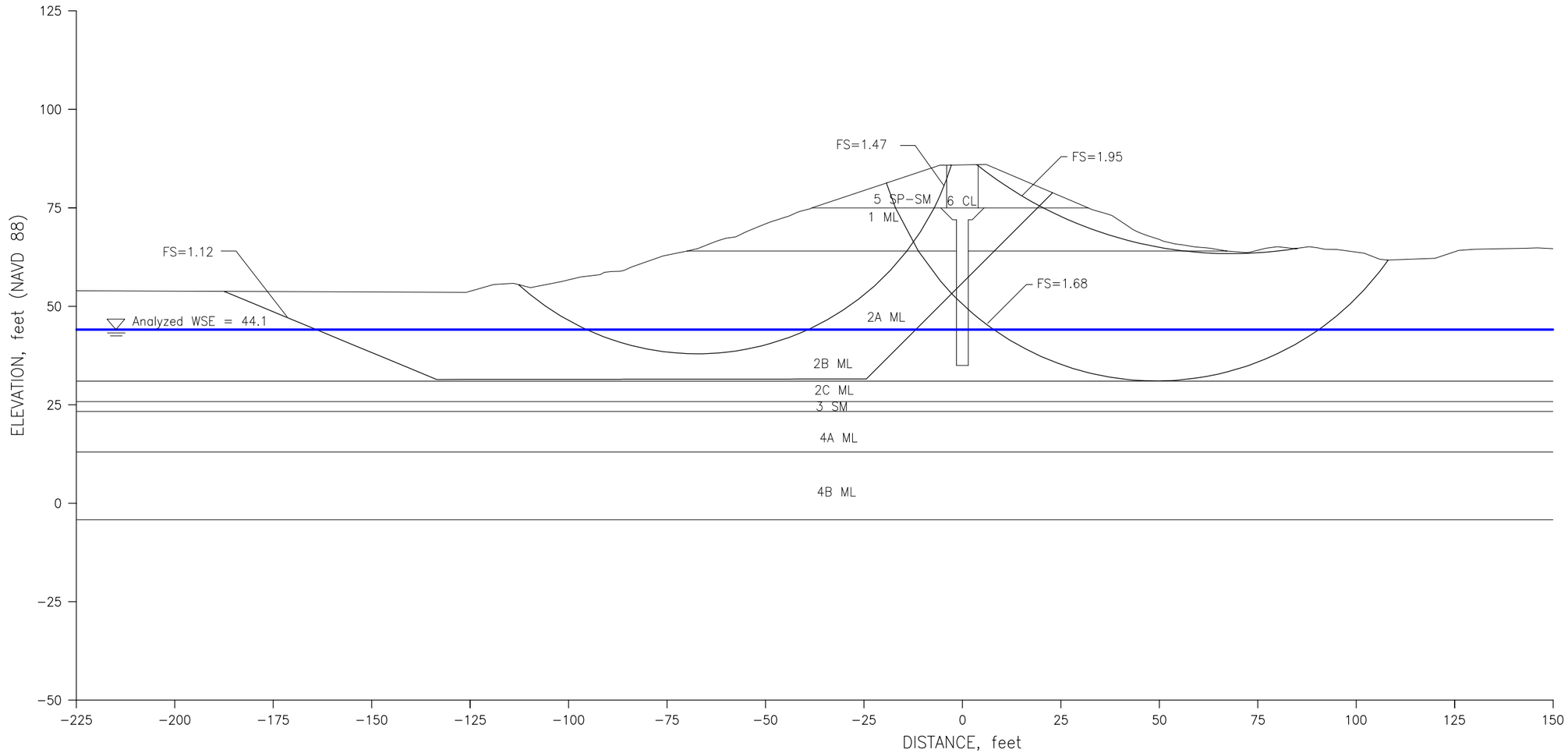
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Sutter Butte Flood Control Agency	URS in association with: blackburn consulting	PROJECT NUMBER 17326712 TASK ORDER TO4 DATE February 2012	PREPARED BY C. Tsai CHECKED BY Kanax	FEATHER RIVER WEST LEVEE PROJECT GEOTECHNICAL RECOMMENDATIONS REPORT FOR 65% DESIGN	Post Earthquake Slope Stability Analysis Results with Mitigation Measures Station 958+83 Reach 15	FIGURE D-R15-1

PLOT BY: SHAWN_ORGILL - Feb 23, 2012 - 2:22:49pm
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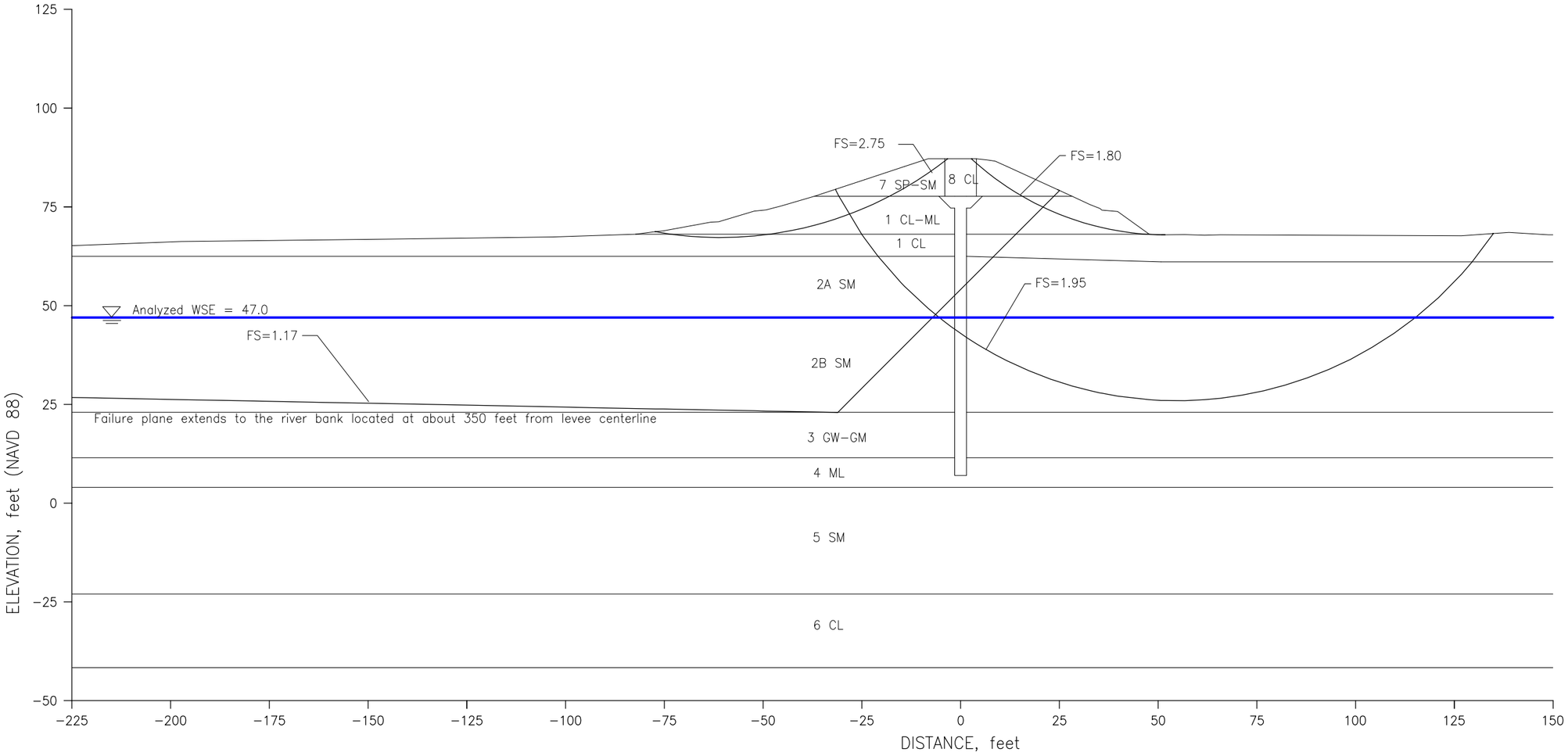
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Sutter Butte Flood Control Agency	in association with: URS / blackburn consulting	PROJECT NUMBER 17326712 TASK ORDER T04 DATE February 2012	PREPARED BY C. Tsai CHECKED BY Kanax	FEATHER RIVER WEST LEVEE PROJECT GEOTECHNICAL RECOMMENDATIONS REPORT FOR 65% DESIGN	Post Earthquake Slope Stability Analysis Results with Mitigation Measures Station 1116+00 Reach 17	FIGURE D−R17−1

PLOT BY: SHAWN_ORGILL - Feb 23, 2012 - 2:22:54pm
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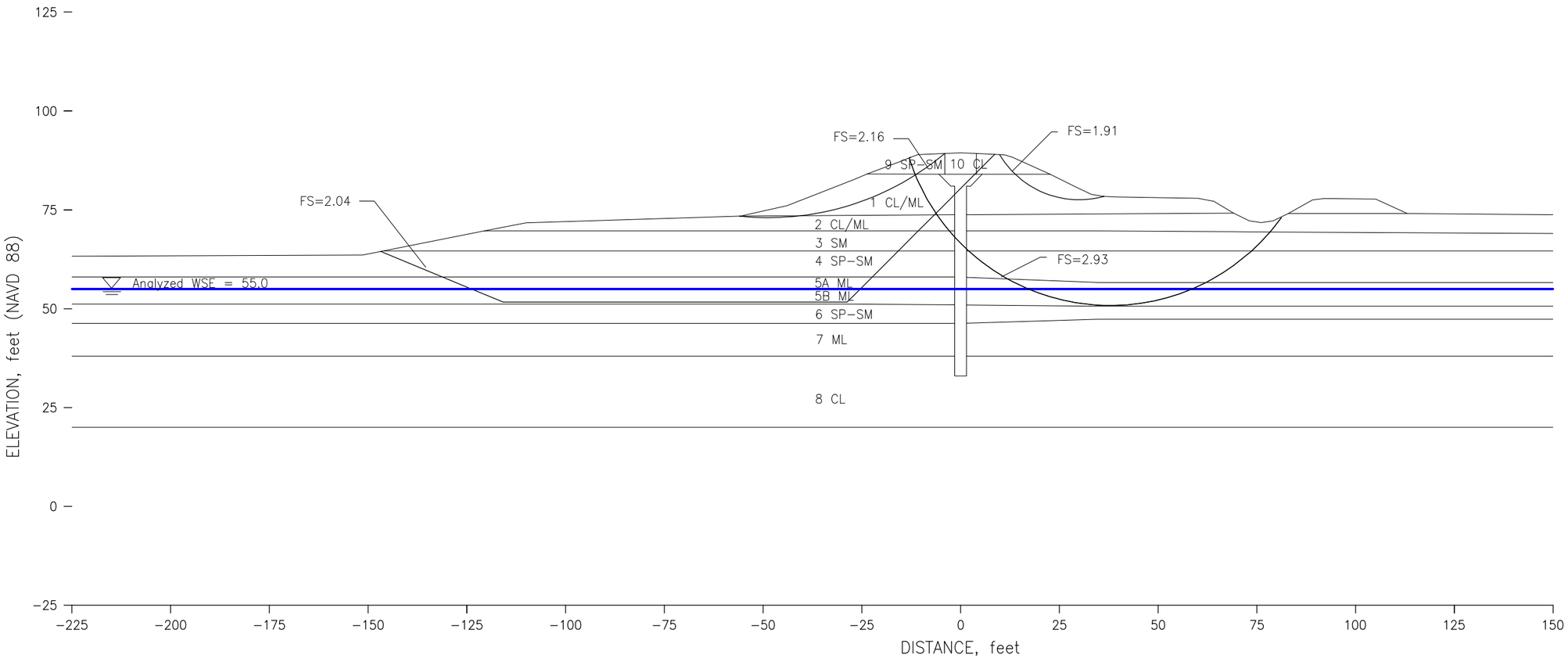
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Sutter Butte Flood Control Agency	in association with: URS / blackburn consulting	PROJECT NUMBER 17326712 TASK ORDER T04 DATE February 2012	PREPARED BY C. Tsai CHECKED BY Kanax	FEATHER RIVER WEST LEVEE PROJECT GEOTECHNICAL RECOMMENDATIONS REPORT FOR 65% DESIGN	Post Earthquake Slope Stability Analysis Results with Mitigation Measures Station 1224+00 Reach 19	FIGURE D-R19-1

PLOT BY: SHAWN_ORGILL - Feb 23, 2012 - 2:23:00pm
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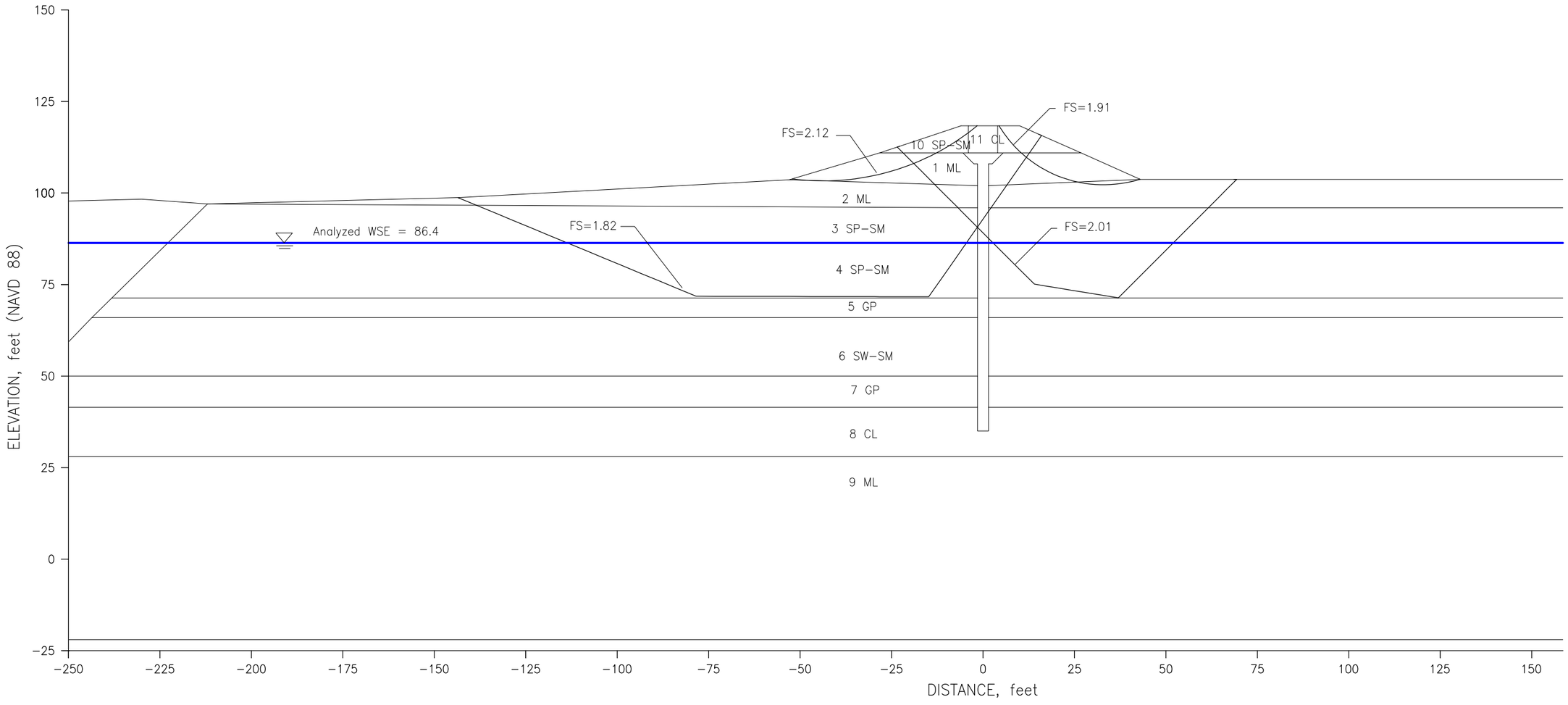
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Sutter Butte Flood Control Agency	in association with: blackburn consulting	PROJECT NUMBER 17326712 TASK ORDER TO4 DATE February 2012	PREPARED BY C. Tsai CHECKED BY Kanax	FEATHER RIVER WEST LEVEE PROJECT GEOTECHNICAL RECOMMENDATIONS REPORT FOR 65% DESIGN	Post Earthquake Slope Stability Analysis Results with Mitigation Measures Station 1378+83 Reach 21	FIGURE D-R21-1

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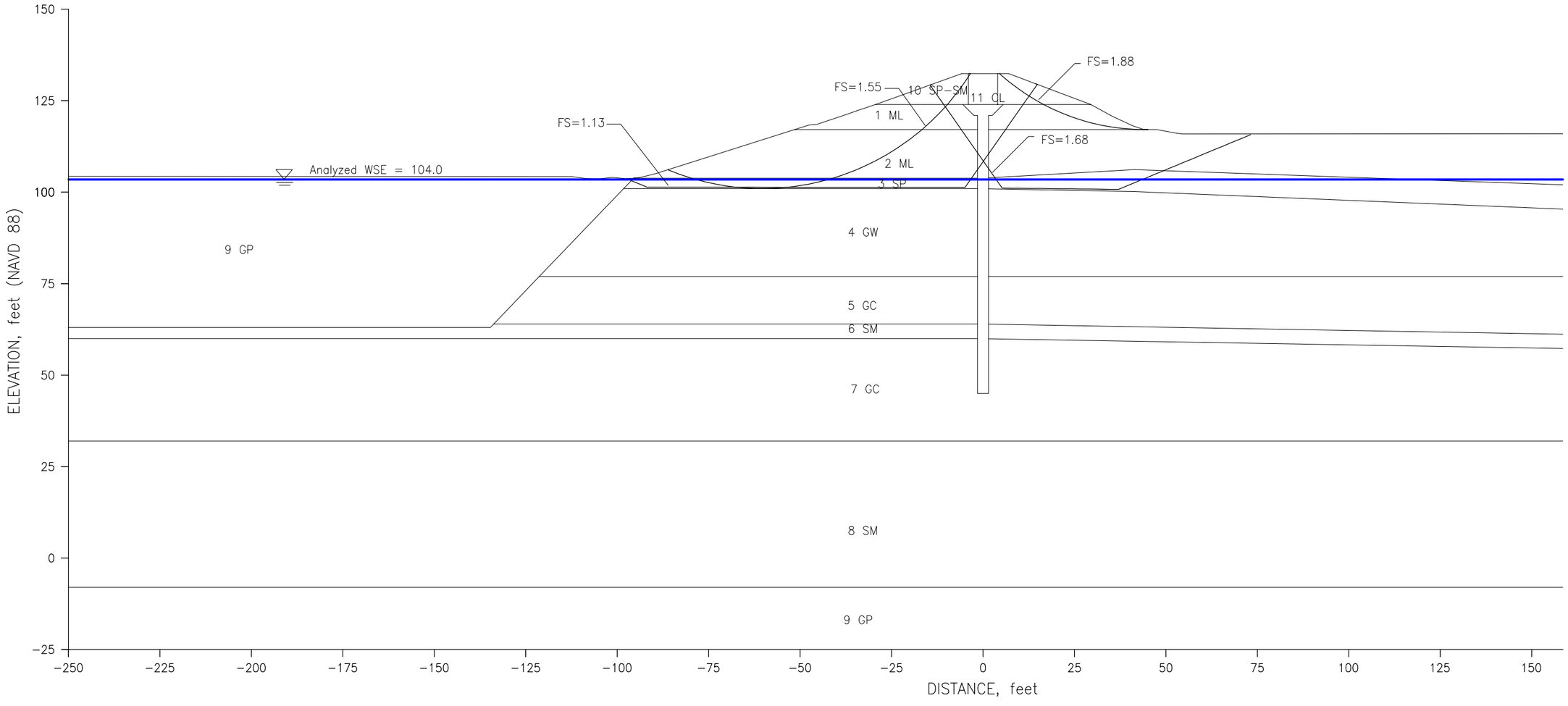
Attachment E5



Sutter Butte Flood Control Agency	URS in association with: blackburn consulting	PROJECT NUMBER 17326712 TASK ORDER TO4 DATE February 2012	PREPARED BY C. Tsai CHECKED BY Kanax	FEATHER RIVER WEST LEVEE PROJECT GEOTECHNICAL RECOMMENDATIONS REPORT FOR 65% DESIGN	Post Earthquake Slope Stability Analysis Results with Mitigation Measures Station 2047+50 Reach 33	FIGURE D−R33−1

PLOT BY: SHAWN_ORGILL – Feb 23, 2012 – 2:23:10pm
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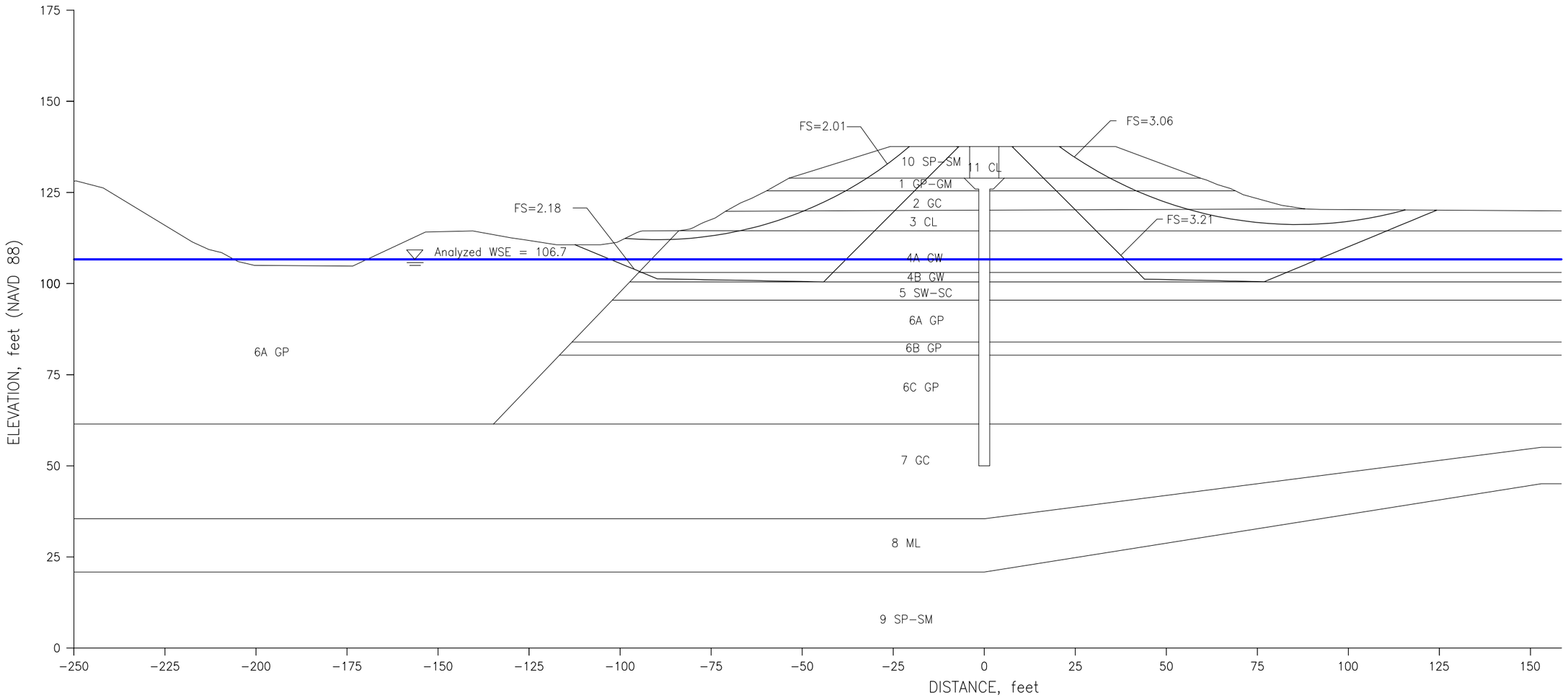
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Sutter Butte Flood Control Agency	in association with: URS / blackburn consulting	PROJECT NUMBER 17326712 TASK ORDER TO4 DATE February 2012	PREPARED BY C. Tsai CHECKED BY Kanax	FEATHER RIVER WEST LEVEE PROJECT GEOTECHNICAL RECOMMENDATIONS REPORT FOR 65% DESIGN	Post Earthquake Slope Stability Analysis Results with Mitigation Measures Station 2276+76 Reach 37	FIGURE D−R37−1

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Attachment E5



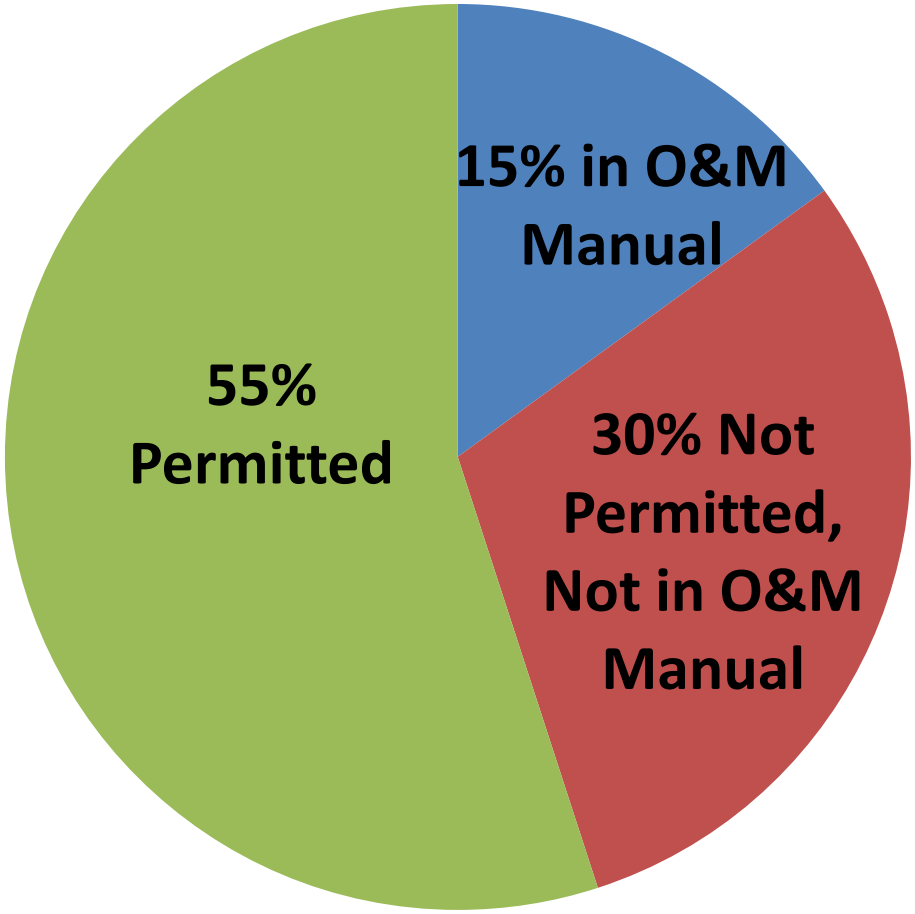
Sutter Butte Flood Control Agency	in association with: URS / blackburn consulting	PROJECT NUMBER 17326712 TASK ORDER T04 DATE February 2012	PREPARED BY C. Tsai CHECKED BY Kanax	FEATHER RIVER WEST LEVEE PROJECT GEOTECHNICAL RECOMMENDATIONS REPORT FOR 65% DESIGN	Post Earthquake Slope Stability Analysis Results with Mitigation Measures Station 2332+91 Reach 40	FIGURE D-R40-1

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Attachment F1

Sutter Butte Flood Control Agency
Feather River West Levee Encroachments
October 2012
Prepared by CVFPB – A.T.

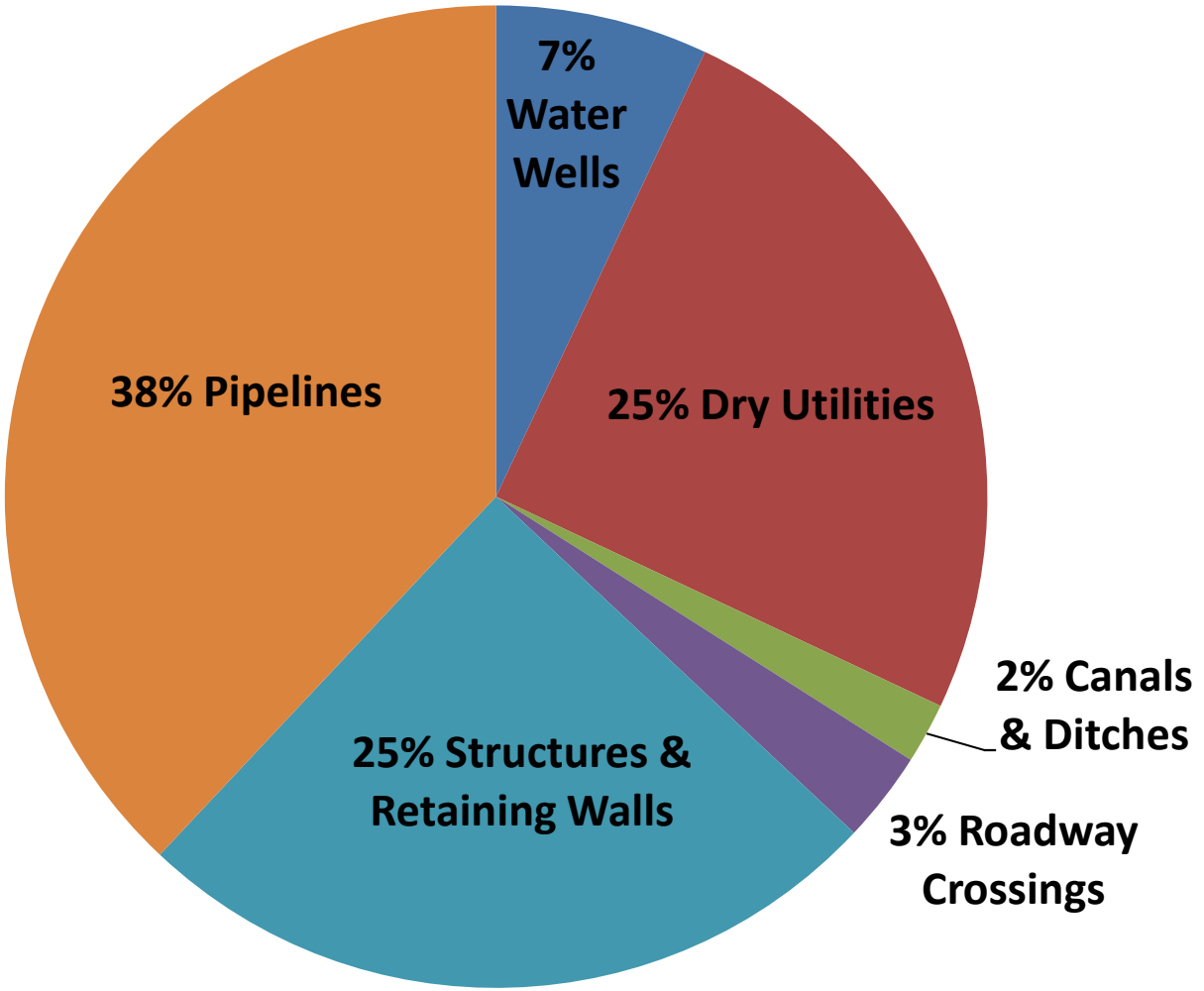
Current Permitting Status of Encroachments



Sutter Butte Flood Control Agency
Feather River West Levee Encroachments
October 2012
Prepared by CVFPB – A.T.

Attachment F2

Types of Encroachments



LIST OF TITLE 23 VARIANCES
PHASE C - SBFCA FRWL IMPROVEMENT PROJECT

Attachment G

						Location (NAD 83)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988) - July 2012 WSEL				CVFPB Permit Information				Owner Information		
		Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Encroachment	Title 23 Variances	Proposed Levee Improvement	Required Improvement Work	Type	cover	Invert of Pipe	Top of Pipe	Top of Levee	100 Yr	200 Yr	500 Yr	DWR 1957	NoV Notice by CVFPB	Permit No.	Require Permittee to Relocate	Year	Name	Address	Phone
			C1	24/25	1623+86			Reach 24/25 Transition		1623+86 to 1625+00 Cutoff Wall																	
152	12	2.87	C1	24	1610+92	2,233,196.84	6,664,513.54	RD 777 Lateral 12. An 18 inch CM pipe through levee. Automatic drainage gate on waterside end of pipe. The CVFPB sent an encroachment violation notice on July 26, 2011 to Theodore Bill. The violation was regarding the heavy vegetation on the waterside outfall pipe.	123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23. 123(g)(7). Title 23 states that steel pipe shall be used for installations above the DWSE only. We propose to allow the contractor to use Concrete Cylinder Pipe and Precast RCP C76 (both are allowed in 123(g)(6)) along with Cement Mortar Lined Steel Pipe and Cement Mortar Lined and Cement Mortar Coating Steel Pipe. This would require a variance for use of steel pipe below DWSE. We feel the Cement Mortar Lined Steel Pipe with the CLSM backfill will be the most cost effective and provide a design life greater than 50 years.	Cutoff Wall (adjacent to Main Canal)	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and automatic drainage gate on waterside of levee. **Replace in accordance with Title 23**	SD(G)	17.3	76.50	78.00	93.80	87.09	88.28	94.03	90.69	NoV Mailed by CVFPB - 2011-222	pre-1955		part of orig O&M 1955	Reclamation District No. 777	P.O. Box 876, Gridley, CA 95948	1-530-846-2270
		2.83	C1	23/24	1609+37			Reach 23/24 Transition																			
161	21	1.45	C1	23	1536+12	2,226,796.70	6,665,666.06	RD 777 Lateral 7. There is a 36 inch CM pipe through levee. Automatic drainage gate on waterside end of pipe. The CVFPB sent an encroachment violation notice on August 16, 2011 to Hatamiya Trust.	123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23. 123(g)(7). Title 23 states that steel pipe shall be used for installations above the DWSE only. We propose to allow the contractor to use Concrete Cylinder Pipe and Precast RCP C76 (both are allowed in 123(g)(6)) along with Cement Mortar Lined Steel Pipe and Cement Mortar Lined and Cement Mortar Coating Steel Pipe. This would require a variance for use of steel pipe below DWSE. We feel the Cement Mortar Lined Steel Pipe with the CLSM backfill will be the most cost effective and provide a design life greater than 50 years.	Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and automatic drainage gate on waterside of levee. **Replace in accordance with Title 23**	SD(G)	13.7	75.65	78.65	92.32	85.00	86.42	92.62	88.68	NoV Mailed by CVFPB - 2011-220	pre-1955		part of orig O&M 1955	Reclamation District No. 777	P.O. Box 876, Gridley, CA 95948	1-530-846-2270
		0.75	C1	22/23	1503+83			Reach 22/23 Transition																			
			C1	22	1460+00			Levee District No. 9 Levees /Maintenance Area 16 Transition																			
		5.73	C1	21/22	1433+83			Reach 21/22 Transition		1433+83 to 1455+00 Cutoff Wall with Full Levee Degrade and Reconstruction (1433+83 to 1450+00 adjacent to Main Canal)																	
183	43	5.67	C1	21	1430+55	2,216,425.27	6,664,383.06	Sunset Pump Station owned an operated by Sutter Extension Main Pump Station. There is a 60 Inch steel pipe through the levee. Pump end has gate valves on structure. Automatic drainage gates on the landside end.	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23. The pipeline is a very low pressure installation at about 6 psi. The common practice is for pressure pipes to be above design water surface elevation when feasible. USACE EM 1110-2-1913 states above DWSE "in general" but is not a requirement and provides criteria for installation below DWSE. No variance will be required but extra care will be taken. The Tier II Title 23 does make it a requirement so we listed this as something that should be addressed. 123(g)(7). Title 23 states that steel pipe shall be used for installations above the DWSE only. We propose to allow the contractor to use Concrete Cylinder Pipe (which is allowed in 123(g)(6)) along with Cement Mortar Lined Steel Pipe and Cement Mortar Lined and Cement Mortar Coating Steel Pipe. This would require a variance to use steel pipe below DWSE. We feel the Cement Mortar Lined Steel Pipe with the CLSM backfill will be the most cost effective and provide a design life greater than 50 years.	1429+00 to 1433+83 Cutoff Wall (adjacent to Main Canal)	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and automatic drainage gate on waterside of levee. **Replace in accordance with Title 23**	IR(P)	15.6	80.61	85.61	91.16	81.80	83.57	90.36	85.74		pre-1955 and 3610	yes, cond 5 (for pumps)	part of orig O&M 1955 and 1961	Sutter Extension Water District c/o Lynn Phillips	4525 Franklin Road, Yuba City, CA 95993-9316	1-530-673-7138
184	44	5.67	C1	21	1430+47	2,216,417.64	6,664,382.64	Sunset Pump Station owned an operated by Sutter Extension Main Pump Station. There is a 60 Inch steel pipe through the levee. Pump end has gate valves on structure. Automatic drainage gates on the landside end.	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23. The pipeline is a very low pressure installation at about 6 psi. The common practice is for pressure pipes to be above design water surface elevation when feasible. USACE EM 1110-2-1913 states above DWSE "in general" but is not a requirement and provides criteria for installation below DWSE. No variance will be required but extra care will be taken. The Tier II Title 23 does make it a requirement so we listed this as something that should be addressed. 123(g)(7). Title 23 states that steel pipe shall be used for installations above the DWSE only. We propose to allow the contractor to use Concrete Cylinder Pipe (which is allowed in 123(g)(6)) along with Cement Mortar Lined Steel Pipe and Cement Mortar Lined and Cement Mortar Coating Steel Pipe. This would require a variance to use steel pipe below DWSE. We feel the Cement Mortar Lined Steel Pipe with the CLSM backfill will be the most cost effective and provide a design life greater than 50 years.	1429+00 to 1433+83 Cutoff Wall (adjacent to Main Canal)	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and automatic drainage gate on waterside of levee. **Replace in accordance with Title 23**	IR(P)	15.6	80.42	85.42	91.13	81.80		90.35	85.74		pre-1955 and 3610	yes, cond 5 (for pumps)	part of orig O&M 1955 and 1961	Sutter Extension Water District c/o Lynn Phillips	4525 Franklin Road, Yuba City, CA 95993-9316	1-530-673-7138

LIST OF TITLE 23 VARIANCES
PHASE C - SBFCA FRWL IMPROVEMENT PROJECT

Attachment G

					Location (NAD 83)						Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988) - July 2012 WSEL				CVFPB Permit Information				Owner Information		
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Encroachment	Title 23 Variances	Proposed Levee Improvement	Required Improvement Work	Type	cover	Invert of Pipe	Top of Pipe	Top of Levee	100 Yr	200 Yr	500 Yr	DWR 1957	NoV Notice by CVFPB	Permit No.	Require Permittee to Relocate	Year	Name	Address	Phone
185	45	5.67	C1	21	1430+40	2,216,410.86	6,664,382.27	Sunset Pump Station owned an operated by Sutter Extension Main Pump Station. There is a 36 Inch steel pipe through the levee. Pump end has gate valves on structure. Automatic drainage gates on the landside end.	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23. The pipeline is a very low pressure installation at about 6 psi. The common practice is for pressure pipes to be above design water surface elevation when feasible. USACE EM 1110-2-1913 states above DWSE "in general" but is not a requirement and provides criteria for installation below DWSE. No variance will be required but extra care will be taken. The Tier II Title 23 does make it a requirement so we listed this as something that should be addressed. 123(g)(7). Title 23 states that steel pipe shall be used for installations above the DWSE only. We propose to allow the contractor to use Concrete Cylinder Pipe (which is allowed in 123(g)(6)) along with Cement Mortar Lined Steel Pipe and Cement Mortar Lined and Cement Mortar Coating Steel Pipe. This would require a variance to use steel pipe below DWSE. We feel the Cement Mortar Lined Steel Pipe with the CLSM backfill will be the most cost effective and provide a design life greater than 50 years.	1429+00 to 1433+83 Cutoff Wall (adjacent to Main Canal)	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and automatic drainage gate on waterside of levee. **Replace in accordance with Title 23**	IR(P)	15.6	82.92	85.92	91.18	81.80	83.57	90.35	85.74		pre-1955 and 3610	yes, cond 5 (for pumps)	part of orig O&M 1955 and 1961	Sutter Extension Water District c/o Lynn Phillips	4525 Franklin Road, Yuba City, CA 95993-9316	1-530-673-7138
		4.47	C1	20/21	1374+33			Reach 20/21 Transition																		
216	76	3.48	C1	20	1314+80	2,205,375.80	6,666,944.25	Micheli Storm Drainage Pump Station. To install a pump with 20 Inch steel discharge pipe through the right bank of the Feather River for the removal of stormwater.	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23. 123(e)(1). The pipeline is not owned by public agency and levee height is greater than 15 feet. - This will require a variance if issued new permit.	Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and automatic drainage gate on waterside of levee. **Replace in accordance with Title 23**	SD(P)	2.0	84.73	86.40	88.20	79.23	81.47	88.35	83.94		13657	yes, cond 13	1983	Micheli	6005 Highway 99, Live Oak, CA 95993	1-530-695-3487
		3.18	C1	19/20	1297+83			Reach 19/20 Transition																		
225	84	2.54	C1	19	1265+59	2,200,487.69	6,666,648.86	Sullivan Pump Station. 18 inch steel pipe through the levee. Pump and Gate valve in pump house on the channel bank. Concrete well on the bank. Siphon breaker in CMP riser on landside slope. (Sullivan Pump Station)	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23. 123(e)(1). The pipeline is not owned by public agency and levee height is greater than 15 feet. - This will require a variance if issued new permit.	Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and anti-siphon device on waterside hinge of levee. The pipe line is pressurized and need to be installed above the design water surface. The current installation is at-grade. **Replace in accordance with Title 23**	IR(P)	18.3	70.05	71.55	88.30	78.67	81.02	87.87	82.99		pre-1955		part of orig O&M 1955	Richland Enterprises c/o Balbir Sohal, Amarjit Sohal	P.O. Box 1383, Yuba City, CA 95992 or 1859 Alyssa Drive, Yuba City, CA 95993-8301	1-530-755-2136
226	85	1.86	C1	19	1229+41	2,197,325.05	6,668,184.53	Kewall Singh IR PS. A 16 inch steel pipe through levee. Pump in pump house on channel bank. Gate valve on the waterside end. Concrete standpipe.	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23. 123(e)(1). The pipeline is not owned by public agency and levee height is greater than 15 feet. - This will require a variance if issued new permit.	Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and anti-siphon device on waterside hinge of levee. The pipeline is pressurized and will need to be installed about the design water surface. **Replace in accordance with Title 23**	IR(P)	3.0 or deeper through levee?			87.52	78.24	80.69	87.49	82.61		pre-1955		part of orig O&M 1955	Kewal & Resham K. Singh	876 Oxford Ct., Yuba City, CA 95991-3479	
		1.57	C1	18/19	1213+85			Reach 18/19 Transition																		
			C1	18	1132+61			Levee District No. 1 Levees /Levee District No. 9 Transition																		
			C1	17/18	1130+86			Reach 17/18 Transition																		
249	5	16.60	C1	17	1127+48	2,187,405.84	6,668,629.29	Village Green Trailer Park - To install a 10 inch outfall pipe through the right bank levee of the Feather River to provide storm drainage for a mobile home park.	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23. 123(e)(1). The pipeline is not owned by public agency and levee height is greater than 15 feet. - This will require a variance if issued new permit.	1125+00 to 1130+86 Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	SD(P)				87.90	76.38	79.19	85.68	81.01		13754	yes, cond 13	1984	Village Green Mobile Homes Park c/o Sargent and Morton	1155 Pease Road, Yuba City, CA 95991-8814	1-530-671-2544

LIST OF TITLE 23 VARIANCES
PHASE C - SBFCA FRWL IMPROVEMENT PROJECT

Attachment G

						Location (NAD 83)						Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988) - July 2012 WSEL				CVFPB Permit Information				Owner Information		
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Encroachment	Title 23 Variances	Proposed Levee Improvement	Required Improvement Work	Type	cover	Invert of Pipe	Top of Pipe	Top of Levee	100 Yr	200 Yr	500 Yr	DWR 1957	NoV Notice by CVFPB	Permit No.	Require Permittee to Relocate	Year	Name	Address	Phone
251	7	16.29	C1	17	1111+46	2,185,808.02	6,668,723.59	West Onstott Frontage Road Pump Station and Clark Avenue Pump Station Drainage Area. 16 Inch welded steel 7 GA asphalt coated storm drain discharge pipe over levee connected to 24 inch pipe in overflow area, outfall ditch, and pipes in floodway (Source: City of Yuba City Pump Station No. 4 and City of Yuba City Pump Station No. 2)	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23.	1080+00 to 1125+00 Cutoff Wall and backfill landside toe depression	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	SD(P)	1.1	83.17	84.50	85.60	76.02	78.91	85.41	80.77		14420	no	1986	City of Yuba City c/o George Musallam	1201 Civic Center Blvd., Yuba City, CA 95991	1-530-822-4632
254	10	16.01	C1	17	1096+81	2,184,421.28	6,669,119.50	Yuba City Water Treatment Plant 28" (29 25/32" OD) 7 GA welded steel waterline pipe crossing of levee. New permit included installation of automatic drainage gates on pipelines. (copy of record drawings)	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23.	1080+00 to 1125+00 Cutoff Wall and backfill landside toe depression	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	RW(P)	5.0	81.05 rd	83.6 est	87.70	75.84	78.78	85.27	80.62		5758 & 6016 & 13957 & 13593 & 15330	yes, cond 13	1967 & 1968 & 1984 & 1983 & 1989	City of Yuba City c/o George Musallam	1201 Civic Center Blvd., Yuba City, CA 95991	1-530-822-4632
255	11	16.01	C1	17	1096+71	2,184,412.72	6,669,124.71	Yuba City Water Treatment Plant 24" 7 GA welded steel waterline pipe crossing of levee. New permit included installation of automatic drainage gates on pipelines. (copy of record drawings)	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23.	1080+00 to 1125+00 Cutoff Wall and backfill landside toe depression	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	RW(P)	4.7	81.80 rd	83.8 est	87.80	75.84	78.78	85.27	80.62		5758 & 6016 & 13957 & 13593 & 15330	yes, cond 13	1967 & 1968 & 1984 & 1983 & 1989	City of Yuba City c/o George Musallam	1201 Civic Center Blvd., Yuba City, CA 95991	1-530-822-4632
256	12	16.01	C1	17	1096+62	2,184,404.80	6,669,129.53	Yuba City Water Treatment Plant 42"cement mortar lined and coated welded steel pipe waterline crossing of levee (copy of record drawings)	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions.	1080+00 to 1125+00 Cutoff Wall and backfill landside toe depression	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	RW(P)	2.5	82.50 rd	86.1 est	88.40	75.84	78.78	85.27	80.61		17977	yes, cond 28	2005	City of Yuba City c/o George Musallam	1201 Civic Center Blvd., Yuba City, CA 95991	1-530-822-4632
			C1/C2	16/17	1080+00			Reach 16/17 Transition																		
266	22	14.98	C2	16	1043+45	2,180,137.11	6,672,230.51	To install a 36 Inch discharge pipe through right bank of Feather River.	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(11). The minimum cover for pipelines installed through the levee crown is twenty-four (24) inches. - This is a no geotechnical work reach and an existing permitted encroachment. Our scope or work is to provide the positive closure device. We do not propose to pothole and modify the levee crown. CVFPB should work issue a NOV to address this issue if a concern.	1042+50 to 1043+90 Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	SD(P)	5.0	80.0 rd	83.0 rd	86.40	75.31	78.35	84.64	79.62		13930	yes, cond 13	1984	Gilsizer Drainage County Drainage District c/o George Musallam	701 Bogue Road, Yuba City, CA 95991	1-530-673-0134
267	23	14.98	C2	16	1043+27	2,180,126.23	6,672,235.13	To install a 24 inch wrapped steel pipe through the right bank levee of the Feather River	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(11). The minimum cover for pipelines installed through the levee crown is twenty-four (24) inches. - This is a no geotechnical work reach and an existing permitted encroachment. Our scope or work is to provide the positive closure device. We do not propose to pothole and modify the levee crown. CVFPB should work issue a NOV to address this issue if a concern.	1042+50 to 1043+90 Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	SD(P)	2.0	81.3 rd	83.0 rd	86.30	75.30	78.35	84.64	79.62		12074	yes, cond 13	1977	Gilsizer Drainage County Drainage District c/o George Musallam	701 Bogue Road, Yuba City, CA 95991	1-530-673-0134
268	24	14.98	C2	16	1043+22	2,180,121.72	6,672,237.88	To construct a 24 inch steel pipe storm drainage discharge pipe crossing the west levee of the Feather River	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(11). The minimum cover for pipelines installed through the levee crown is twenty-four (24) inches. - This is a no geotechnical work reach and an existing permitted encroachment. Our scope or work is to provide the positive closure device. We do not propose to pothole and modify the levee crown. CVFPB should work issue a NOV to address this issue if a concern.	1042+50 to 1043+90 Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	SD(P)	4.0	81.3 rd	83.3 rd	86.20	75.30	78.35	84.64	79.61		7019	yes, cond 5	1970	Gilsizer Drainage County Drainage District	701 Bogue Road, Yuba City, CA 95991	1-530-673-0134
269	25	14.98	C2	16	1043+03	2,180,106.36	6,672,244.70	Gilsizer Slough Storm Drain Facilities. A 16 inch welded steel discharge pipe crossing of levee. (copy of record drawings)	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(11). The minimum cover for pipelines installed through the levee crown is twenty-four (24) inches. - This is a no geotechnical work reach and an existing permitted encroachment. Our scope or work is to provide the positive closure device. We do not propose to pothole and modify the levee crown. CVFPB should work issue a NOV to address this issue if a concern.	1042+50 to 1043+90 Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	SD(P)	1.3	83.30 rd	84.7 est	85.90	75.30	78.34	84.63	79.61		3112	yes, cond 4	1959	City of Yuba City c/o George Musallam	1201 Civic Center Blvd., Yuba City, CA 95991	1-530-822-4632
334	90	13.53	C2	16	972+29			2 Inch Domestic Water Line serving the Yuba City Boat Dock.	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23.	968+50 to 992+80 No Rehabilitation Required	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	W(P)					73.97	77.10	82.45	77.93					County of Sutter c/o Doug Gault	1160 Civic Center Blvd, Yuba City, CA	1-530-822-7450
			C2	15/16	968+50			Reach 15/16 Transition																		
			C2	14/15	954+40			Reach 14/15 Transition																		
			C2	13/14	927+00			Reach 13/14 Transition																		

LIST OF TITLE 23 VARIANCES
PHASE C - SBFCA FRWL IMPROVEMENT PROJECT

Attachment G

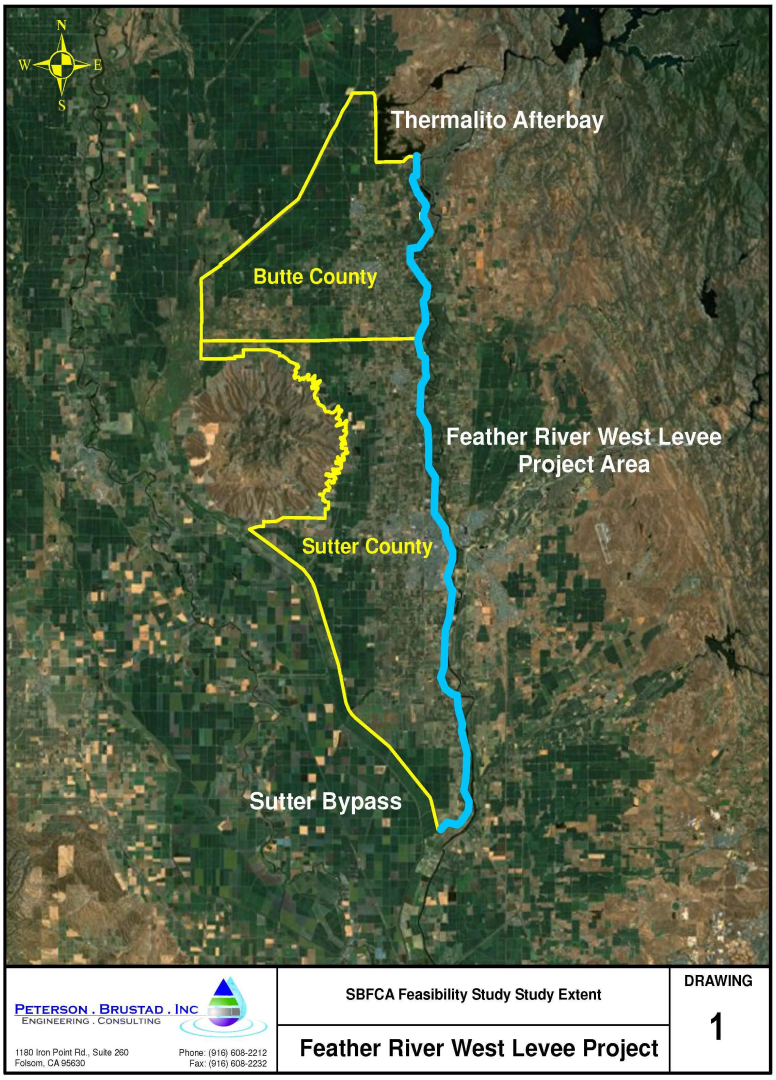
						Location (NAD 83)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988) - July 2012 WSEL				CVFPB Permit Information				Owner Information		
		Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Encroachment	Title 23 Variances	Proposed Levee Improvement	Required Improvement Work	Type	cover	Invert of Pipe	Top of Pipe	Top of Levee	100 Yr	200 Yr	500 Yr	DWR 1957	NoV Notice by CVFPB	Permit No.	Require Permittee to Relocate	Year	Name	Address	Phone
347	103	12.14	C2	13	893+84	2,166,181.41	6,673,142.43	Garden Highway Industrial Park. To install a 12 inch steel storm drain pipeline through the right bank levee of the Feather River (Source: City of Yuba City Pump Station No. 1)	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23.	844+50 to 923+75; Cutoff Wall and relief wells at 200 foot spacing and 65 feet deep	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	SD(P)	3.3	77.70	78.70	82.00	71.78	75.01	80.38	76.93		12827	yes, cond. 13	1979	City of Yuba City c/o George Musallam	1201 Civic Center Blvd., Yuba City, CA 95991	1-530-822-4632
348	104	12.12	C2	13	893+78	2,166,175.45	6,673,142.43	Burns Drive Storm Water Pump Station. 16 inch steel storm drain discharge pipe through levee. (Source: City of Yuba City Pump Station No. 1)	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23.	844+50 to 923+75; Cutoff Wall and relief wells at 200 foot spacing and 65 feet deep	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	SD(P)	2.7	77.97	79.30	82.00	71.78	75.01	80.38	76.93		15863	?	1992	City of Yuba City c/o George Musallam	1201 Civic Center Blvd., Yuba City, CA 95991	1-530-822-4632
349	105	11.90	C2	13	881+40	2,164,942.19	6,673,036.13	Levee District No. 1 Relief Well Pump Station 6" pipes located just southeast of the Waste Water Treatment Plant. The waterside outlet structure has cobbles and the flap gate is damaged or plugged. CVFPB sent a notice of encroachment violation on August 16, 2011 to Sutter County.	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23.	844+50 to 923+75; Cutoff Wall and relief wells at 200 foot spacing and 65 feet deep	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	RW(P)	5.1	75.23	76.40	81.50	71.55	74.78	80.15	76.79	NoV Mailed by CVFPB - 2011-197				Levee District No. 1 c/o Bill Hampton	243 Second Street, Yuba City, CA 95991	1-530-673-2454
350	106	11.90	C2	13	881+43	2,164,944.70	6,673,036.17	Levee District No. 1 Relief Well Pump Station 14" pipes located just southeast of the Waste Water Treatment Plant. The waterside outlet structure has cobbles and the flap gate is damaged or plugged. CVFPB sent a notice of encroachment violation on August 16, 2011 to Sutter County.	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23.	844+50 to 923+75; Cutoff Wall and relief wells at 200 foot spacing and 65 feet deep	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	RW(P)	5.1	75.23	76.40	81.50	71.55	74.78	80.15	76.79	NoV Mailed by CVFPB - 2011-197				Levee District No. 1 c/o Bill Hampton	243 Second Street, Yuba City, CA 95991	1-530-673-2454
351	107	11.43	C2	13	856+23	2,162,702.52	6,674,085.34	South Yuba City Seepage Interceptor Pump Station 24 inch 7 GA Steel Pipe asphalt coated and wrapped with asphalt saturated felt discharge pipe (Source: City of Yuba City Pump Station No. ?)	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23.	844+50 to 923+75; Cutoff Wall and relief wells at 200 foot spacing and 65 feet deep	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	SD(P)	5.2	76.80	78.80	82.00	71.01	74.26	79.60	76.38		15565	no	1992	City of Yuba City c/o George Musallam	1201 Civic Center Blvd., Yuba City, CA 95991	1-530-822-4632
352	108	11.43	C2	13	856+08	2,162,689.81	6,674,093.30	South Yuba City Storm Drainage Pump Station 24 inch 7 GA Steel Pipe asphalt coated and wrapped with asphalt saturated felt discharge pipe (Source: City of Yuba City Pump Station No. 3)	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. This variance is for the portion below the DWSE. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23.	844+50 to 923+75; Cutoff Wall and relief wells at 200 foot spacing and 65 feet deep	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	SD(P)	5.2	76.80	78.80	82.00	71.00	74.25	79.60	76.37		15565	no	1992	City of Yuba City c/o George Musallam	1201 Civic Center Blvd., Yuba City, CA 95991	1-530-822-4632
			C2	12/13	845+00			Reach 12/13 Transition																			
			B/C2	11/12	830+00			Reach 11/12 Transition																			
357	113	10.57	B	11	828+55	2,160,267.77	6,675,134.01	City of Yuba City Sewer 24 inch welded steel pipe mortar lined and coated pipe (wall thickness 0.188" min) Discharge Pipe to river diffuser - New installation moved to Station 832+20	123(d)(7). Pipelines carrying gas or fluids under pressure must have a readily accessible rapid closure device located within ten (10) of the landside levee toe - A positive closure device shall be located on the waterside edge of levee crown. This condition is proposed to be deleted in the Tier II Title 23 conditions. 123(d)(9). The side slopes of trenches excavated for the installation of pipeline, conduit, or utility lines may not be steeper than one (1) horizontal to one (1) foot vertical. - We propose to use CLSM backfill to six (6) above pipe at which time we will meet the slope requirement. No sloping is proposed below this location. 123(d)(20). We propose to use CLSM backfill from invert of pipe to six (6) inches above pipe. CLSM will meet the specification provided in Tier II Title 23.	Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed. **Replace in accordance with Title 23**	SS(P)	2.3	75.70 rd	77.8 est	79.80	69.11	72.44	77.76	75.15		7151D	yes, cond 13?	1974	City of Yuba City c/o George Musallam	1201 Civic Center Blvd., Yuba City, CA 95991	1-530-822-4632

Feather River West

Levee Project

Project Summary Report

Section 408 Application



Prepared for:
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Prepared by:
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Appendix A – Plates

1.0 Program Overview

The Sutter Butte Flood Control Agency (SBFCA) is proposing the Feather River West Levee Project (FRWLP, or project) to reduce flood risk in the Sutter Basin, which includes portions of Sutter and Butte Counties in the Sacramento Valley of California.

To protect human health and safety and prevent adverse effects on property and the regional economy, SBFCA was formed as a Joint Powers Authority in 2007 through a Joint Exercise of Powers Agreement by the Counties of Sutter and Butte; the Cities of Yuba City, Gridley, Live Oak, and Biggs; and Levee Districts 1 and 9 (LD 1, LD 9). SBFCA was established to coordinate the planning and construction of flood protection facilities and to finance the local share of flood management projects. SBFCA's member agencies as well as the State of California are responsible for the operations and maintenance of the detention basins, pump stations, and levees that protect the area.

In partnership with the State of California (through the Department of Water Resources (DWR)) and Central Valley Flood Protection Board [CVFPB], SBFCA embarked on a comprehensive evaluation of the condition of the levees protecting the area in 2007, the results of which are also being used by the U.S. Army Corps of Engineers (USACE). The evaluation was necessary to identify the magnitude and severity of deficiencies and determine measures to address the deficiencies. The results of the comprehensive evaluation revealed that substantial construction is necessary to meet current flood protection standards.

In light of the flood risk to the area, SBFCA is pursuing the FRWLP in parallel and coordinated with a separate effort by USACE, SBFCA, DWR, and CVFPB to determine the Federal interest in the Sutter Basin Project initiated in 2000. The Sutter Basin Project is being evaluated under a Feasibility Study and was selected as a national pilot project to incorporate more efficient, relevant and cost effective practices in the traditional feasibility study process.

To construct the FRWLP, SBFCA is requesting permission from USACE pursuant to Section 14 of the Rivers and Harbors Act of 1899 (Title 33 of the United States Code [USC], Section 408, [33 USC 408]), hereinafter referred to as Section 408, for the alteration of a levee which is a part of the Sacramento River Flood Control Project (SRFCP), a Federal work. USACE's authority to grant permission for the FRWLP under Section 408 triggers the requirement for USACE to comply with the National Environmental Policy Act (NEPA). The project is also subject to Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act; for which the USACE also excercises regulatory authority..

2.0 Physical and Functional Description of the Existing Project

The regional setting of the FRWLP is the SRFCP, beginning as far north as Redding, California, and extending south to the Sacramento–San Joaquin River Delta (Delta). The regional setting is important relative to other major flood risk reduction projects occurring within the SRFCP, including USACE's Sutter Basin Project, American River Common Features Project, West Sacramento Project and Yuba Basin Project, and the locally-led Natomas Levee Improvement Program as well as other projects undertaken by the Sacramento Area Flood Control Agency (SAFCA), Three Rivers Levee Improvement Authority (TRLIA), and the West Sacramento Area Flood Control Agency (WSAFCA). These and other projects are described under Section 1.5, *Related Actions, Programs, and Planning Efforts*. For the analysis of effects (direct, indirect, or cumulative), the regional context of the SRFCP is taken into consideration.

The Sutter Basin is part of the SRFCP, and is located in north-central California in Sutter and Butte Counties. The elongated, irregularly shaped basin covers about 326 square miles and is about 44 miles long, north to south and up to 14 miles wide east to west. It is roughly bounded by the Feather River on the east, and Cherokee Canal, the Sutter Buttes and Sutter Bypass on the west, listed north to south, respectively. Floodwaters potentially threatening the basin originate from the Feather River watershed or the upper Sacramento River watershed, above Colusa Weir. These waterways have drainage areas of 5,921 and 12,090 square miles, respectively. In addition to Yuba City, communities in the basin include Biggs, Gridley, Live Oak, and Sutter.

The project area for the FRWLP is focused on the corridor along the west levee of the Feather River from Thermalito Afterbay on the north to approximately 4 miles north of the Sutter Bypass on the south. This corridor is roughly 500 feet toward the land side of the existing levees and 100 feet toward the water side. This corridor was determined as the area in which levee improvements, such as seepage berms, stability berms, relief wells, erosion protection, and slurry cutoff walls, are likely to occur. The corridor is approximately 41 miles long, divided into 41 relatively homogeneous reaches for ease of describing existing conditions, proposed actions, the affected environment, and potential environmental effects (noting that this number is coincidental and one reach does not consistently correspond to a length of 1 mile, and Reach 1 is not a part of the FRWLP). The project area also includes borrow/spoil sites or project mitigation sites. The reaches are listed in Table 3 of this report and are described in detail on the following pages.

3.0 Existing Condition of the Project Levees

For evaluation and analysis purposes, the SBFCA geotechnical team divided the project levee into 41 reaches based on subsurface soil conditions. Below are brief descriptions, by reach, of the existing surface conditions located along the FRWLP. Please note that Reach 1 is not part of the project at this time and is not included in the proposed Section 408 permit action. All levee heights are measured from the landside toe.

Reach 2 (Station 202+50 to Station 218+66)

Reach 2 begins at Station 202+50 and extends to Station 218+66. The levee height through this reach is approximately 24 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 15 to 16 feet. The landside slope is approximately 2:1 and the waterside slope is approximately 3:1. In some areas, the waterside slope is approaching 2:1. The levee appears to have been originally constructed by excavating material from the area of the waterside toe and placing it in the current levee location. There is a large waterside excavation that forms a lagoon between Station 200+00 and Station 217+00. The lagoon is hydraulically connected to the river channel. There is a small irrigation pump and a 10-inch pipe crossing at Station 209+23. There appears to be a landside stability berm between Station 130+00 and Station 210+00. Orchard crops are predominately located landward of the levee throughout this reach.

Reach 3 (Station 218+66 and 300+66)

Reach 3 begins at Station 218+66 and extends to Station 300+66. The levee height through this reach is approximately 25 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width. The landside slope is approximately 2:1 and the waterside slope is approximately 3:1. In some areas, the waterside slope is as steep as 2:1. The levee appears to have been originally constructed by excavating material from the area of the waterside toe and placing it in the current levee location. There is a large landside borrow pit located between Station 254+00 and Station 258+00. Levee operation and maintenance responsibility passes from the DWR (Maintenance Area 03) to Levee District No. 1 of Sutter County (LD1) at Station 269+81. Orchard crops are predominately located landward of the levee throughout this reach. There is a residence located approximately 500 feet from the levee landside toe at Station 257+00. The Garden Highway Mutual Water Company (GHMWC) owns and operates a pumping plant located at Station 298+38. A 54-inch pipeline carries irrigation water pumped into a box at the levee waterside toe by gravity through the levee. A water well owned by GHMWC is located landward of the levee toe at Station 298+84. The well discharges into a concrete lined irrigation canal between Station 216+50 and 298+40.

Reach 4 (Station 300+66 to Station 410+67)

Reach 4 begins at Station 300+66 and extends to Station 410+67. The levee height through this reach is 25 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 15 feet. The landside slope is approximately 2:1 and the waterside slope is approximately 3:1. In some areas, the waterside slope is as steep as or steeper than 2:1. The levee appears to have been originally constructed by excavating material from the area of the waterside toe and placing it in the current levee location. An elevated waterside roadway exists between Station 308+00 and Station 324+00. Three 8-inch pipelines cross over the levee at Station 364+99, Station 386+71, and Station 396+38. At Station 409+50, a large pumping plant containing multiple pipes owned and operated by the Feather River Water District and two owned by the Taylor Brothers Farm discharges irrigation water over the levee in 14- to 18-inch pipelines. A large, elevated, regulating reservoir is located at the levee landside toe. Orchard crops are predominately located landward of the levee throughout this reach. There appears to be a 60- to 80-foot landside seepage berm between Station 424+00 and Station 478+67.

Reach 5 (Station 410+67 to Station 478+68)

Reach 5 begins at Station 410+67 and extends to Station 478+68. The levee height through this reach is 23 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 15 feet. The landside slope is approximately 2:1 and the waterside slope is approximately 3:1. In some areas, the landside slope is marginally

steeper than 2:1, and in other areas the waterside slope is as steep as 2:1. At Station 459+89, there is an abandoned 8-inch pipeline over the levee. There is a large waterside lagoon between Station 434+00 and Station 437+00. Orchard crops are predominately located landward of the levee throughout this reach. There are no structures located near the landside levee toe.

Reach 6 (Station 478+68 to Station 510+37)

Reach 6 begins at Station 478+68 and extends to Station 510+37. This reach corresponds to the newly constructed Star Bend setback levee. The levee was completed in 2009 and was built with a 20-foot crown width and 3:1 waterside and landside slopes. The height of the new levee is approximately 25 feet measured from the landside levee toe. The California Department of Fish and Game (CDFG) O'Conner Lakes Wildlife Area is located waterward of the levee. Two 30-inch pipes owned and operated by the Tudor Mutual Water Company and one 18-inch pipe owned by Volcano Vista Farms discharge over the levee into concrete structures located 50 feet landward of the levee toe. Orchards are located landward of the levee.

Reach 7 (Station 510+37 to Station 596+00)

Reach 7 begins at Station 510+37 and extends to Station 596+00. The levee height through this reach is 22 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 15 feet. The landside slope is at least 2:1 and the waterside slope is 3:1 throughout the reach. The CDFG Abbot Lake Wildlife Area is located waterward of the levee. Orchard crops are predominately located landward of the levee throughout this reach. A series of relief wells and a concrete-lined drainage collection ditch runs parallel to the landside levee toe between Station 511+70 and 543+50. A relief well pump station is located at Station 512+10.

Reach 8 (Station 596+00 to Station 654+75)

Reach 8 begins at Station 596+00 and extends to Station 654+75. The levee height through this reach is 23 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 18 feet. The landside slope is at least 2:1 and the waterside slope is at 3:1 throughout the reach. Some sections of the levee contain waterside slopes steeper than 3:1. Orchard crops are predominately located landward of the levee throughout this reach. The Feather River Water District North Pumping plant is located at Station 647+70, where a series of four 26-inch pipes cross over the levee. An elevated water regulating reservoir is located at the landside toe of the levee between Station 647+00 and Station 649+00. Fields of row crops are located landward of the levee.

Reach 9 (Station 654+75 to Station 706+50)

Reach 9 begins at Station 654+75 and extends to Station 706+50. The levee height through this reach is 25 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 18 feet. The landside slope is approximately 2:1 and the waterside slope is approximately 3:1 throughout the reach. The Boyd's Pump Boat Launching facility is located on the waterside of the levee between Station 690+00 and Station 700+00. Orchard crops are predominately located landward of the levee throughout this reach. Sierra Gold Nursery is located landward of the levee between Station 670+00 and Station 675+00 and owns an 8-inch pipe crossing at Station 664+25. The Oswald Mutual Water Company owns and operates a 24-inch pump discharge pipeline (Boyd's Pump) which crosses the levee at Station 689+13. There appears to be a landside stability berm throughout Reach 9.

Reach 10 (Station 706+50 to Station 774+00)

Reach 10 begins at Station 706+50 and extends to Station 774+00. The levee height through this reach is 25 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 18 feet. The landside slope is approximately 2:1

and the waterside slope is approximately 3:1 throughout the reach. Orchard crops are predominately located landward of the levee throughout this reach. The Garden Highway alignment is situated in close proximity to the levee landside toe between Station 750+00 and Station 763+00.

Reach 11 (Station 774+00 to Station 830+00)

Reach 11 begins at Station 774+00 and extends to Station 830+00. The levee height through this reach is 24 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 15 feet. The landside slope is approximately 2:1 and the waterside slope is approximately 3:1 throughout the reach. Fields of row crops are located landward of the levee through most of the reach through Station 821+00, where the urban area of Yuba City begins. Yuba City owns and operates a 24- and 36-inch sewer outfall pipeline that passes over the levee at Station 828+55. There appears to be a landside stability berm between Station 780+00 and Station 795+00.

Reach 12 (Station 830+00 to Station 845+00)

Reach 12 includes the Shanghai Bend Setback levee, beginning at Station 830+00 and extending to Station 845+00. The levee height through this reach is approximately 23 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 18 feet. The landside slope is approximately 2.5:1 and the waterside slope is approximately 3:1 throughout the reach. A waterside berm exists through the reach, comprised of materials wasted during the degrading of the previous levee alignment. The urban area of Yuba City is located landward of the levee.

Reach 13 (Station 845+00 to Station 927+00)

Reach 13 begins at Station 845+00 and extends to Station 927+00. The levee height through this reach is 25 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 15 feet. The landside slope is approximately 2:1 and the waterside slope is approximately 3:1. In some areas, the waterside slope is steeper than 3:1. Urban areas of Yuba City are located landward of the levee, including the City of Yuba City Wastewater Treatment Plant. Two 24-inch pressure pipelines that extend over the levee are located at Station 862+52. Relief wells, and a subsurface seepage collection system, are located along the levee landside toe. A relief well pump station is located at Station 881+41. Two pressure pipelines (12-inch and 16-inch) cross over the levee at Station 893+84. PG&E owns two 16-inch gas lines that pass over the levee at Station 912+94.

Reach 14 (Station 927+00 to Station 954+40)

Reach 14 begins at Station 927+00 and extends to Station 954+40. The levee height through this reach is 20 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 15 feet. The landside slope is approximately 2:1 and the waterside slope is approximately 3:1. The Sutter County airport is located landward of the existing levee throughout the reach. There are several relief wells located at the levee landside toe in this reach. Existing U.S. Army Corps of Engineers (USACE) information indicates a cutoff wall has been installed through this reach.

Reach 15 (Station 954+40 to Station 968+50)

Reach 15 begins at Station 954+40 and extends to Station 968+50. The levee height through this reach is approximately 17 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 15 feet. The landside slope is approximately 2:1 and the waterside slope is approximately 3:1. There is one area where the waterside slope steepens to approximately 2:1. The Sutter County airport is located landward of the existing levee throughout the reach.

Reach 16 (Station 968+50 to Station 1080+00)

Reach 16 begins at Station 968+50 and extends to Station 1080+00. The levee height through this reach is approximately 24 feet on average, as measured from the landside toe. Portions of the levee are as short as 15 feet, while other portions are as tall as 26 feet. The crown is approximately 20 feet in width with some areas as narrow as 18 feet. The landside slope is approximately 2:1 and the waterside slope is slightly steeper than 3:1. The Twin Cities Memorial Bridge (5th Street Bridge) crosses the levee at Station 1007+00. The Sacramento Northern Railroad crosses the levee at Station 1006+60. State Highway 20 (Colusa Avenue) crosses the levee at Station 1026+00. The urban area of Yuba City is located adjacent to the levee throughout the reach. Beginning at Station 983+50, and extending through Station 1016+00, there are several structures within close proximity of the levee landside toe. Approximately six structures, four of which appear to be garages, encroach within the levee prism. Several residential swimming pools are within 50 feet of the levee toe. At the Sutter County Courthouse, a parking structure behind the courthouse is embedded within the levee prism. Existing USACE information indicates that a cutoff wall has been installed through this reach. Gilsizer Slough Pump Station discharges through four pipelines (one 16-, two 24-, and one 36-inch) over the levee at Station 1043+30. PG&E owns a 16-inch pipeline that passes over the levee at Station 1073+41. There appears to be a landside stability berm between Station 1032+00 and Station 1053+00.

Reach 17 (Station 1080+00 to Station 1130+86)

Reach 17 begins at Station 1080+00 and extends to Station 1130+86. The levee height through this reach is approximately 22 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 15 feet. The landside slope is approximately 2:1 and the waterside slope is approximately 3:1. There are areas of the reach where the waterside slope is steeper than 3:1, with one location as steep as 2:1. Three pipelines (one 24-inch, one 28-inch, and one 48-inch) associated with the Yuba City Water Treatment Plant cross over the levee between Station 1096+60 and Station 1096+75. A Yuba City drainage pump station discharges through a 16-inch pipeline that crosses the levee at Station 1111+45. A 10-inch pipeline crosses the levee at Station 1127+48. Union Pacific Railroad (UPRR) owns an 8-inch fuel line that crosses the levee at station 1132+61 and PG&E owns a 16-inch gas line that crosses the levee at Station 1180+98. An electrical transmission tower is located 14 feet landward of the levee at Station 1152+25. The urban area of Yuba City is located adjacent to the levee throughout the reach. The UPRR tracks cross the levee at Station 1130+47.

Reach 18 (Station 1130+86 to Station 1213+85)

Reach 18 begins at Station 1130+86 and extends to Station 1213+85. The levee height through this reach is approximately 19 feet on average, as measured from the landside toe. The crown is approximately 20 feet in width with some areas as narrow as 15 feet. The landside slope is approximately 2:1 and the waterside slope approximately 3:1. There are areas of the reach where the waterside slope is marginally steeper than 3:1. Fields of row crops are located landward of the levee.

Reach 19 (Station 1213+85 to 1297+83)

Reach 19 begins north of Yuba City near the intersection of HWY 99 and Eager Road (Station 1213+85) and extends north 8,398 lineal feet to Station 1297+83. The levee height through this reach is approximately 18' as measured from the levee landside toe. The crown width is approximately 17'. Land and water side slopes are approximately 1.9:1 and 2.9:1 respectively. Existing structures are located along the landside of the levee from approximate Station 1290+00 to 1297+00. A seepage interceptor trench is located on the landside levee toe from Station 1285+00 to 1315+00. Morse Road intersects the levee at approximate Station 1294+50.

Orchards and open space are located along both sides of the levee. Gates are located across the levee crown at Station 1225+50, and at the landside access ramps at Stations 1219+00 and 1294+00. Culverts, pumps, and standpipes are located along both sides of the levee from approximately Station 1220+00 to 1266+50. Utility poles are located along both sides of the levee throughout the reach.

Reach 20 (Station 1297+83 to 1374+33)

Reach 20 begins just north of Morse Road (Station 1297+83) and extends north 7,650 linear feet to Station 1374+33. The levee height through this reach is approximately 17' as measured from the levee landside toe. The crown width is approximately 17'. Land and water side slopes are approximately 1.9:1 and 3:1 respectively. An existing structure is located approximately 100' away from the landside toe at approximate Station 1349+50. Koch Lane intersects the levee at approximate Station 1347+50. A seepage interceptor trench is located on the landside levee toe from Station 1374+94 to 1395+00. Orchards and open space areas are located along both sides of the levee. Gates are located across the levee crown at Stations 1307+00, 1307+50, 1346+75, and 1362+00. Gates are also located at landside levee access ramps located at Stations 1340+00, 1347+50, and at a waterside levee access ramp located at Station 1350+00.. Utility poles are located along both sides of the levee throughout the reach.

Reach 21 (Station 1374+33 to 1433+83)

Reach 21 begins at Station 1374+33 and extends north 5,950 lineal feet to Station 1433+83. The levee height through this reach is approximately 10' as measured from the levee landside toe. The crown width is approximately 16'. Land and water side slopes are approximately 2:1 and 3:1 respectively. A raised irrigation canal runs along the landside of the levee starting at approximate Station 1376+00 and runs through this reach. A small pedestrian bridge is located over the canal at Station 1431+75. Hermansen Street and Bridgeford Avenue intersect the levee at approximate Stations 1385+50 and 1399+00 respectively. Sunset Pumping Station is located along the waterside of the levee at Station 1430+00. Orchards and open space areas are located along both sides of the levee. Gates are located across the levee crown at 1392+25, 1400+00, and 1429+25 and at the access ramps, landside and waterside, at 1383+50, 1397+00, 1399+50, 1400+00, and 1428+50. Pumps, irrigation valves, and standpipes are located along both sides of the levee from approximately 1374+00 to 1431+00. Utility poles are located along both sides of the levee throughout the reach.

Reach 22 (Station 1433+83 to 1503+83)

Reach 22 begins at Station 1433+83 and extends north 7,000 lineal feet to Station 1503+83. The levee height through this reach varies between 10' and 12', as measured from the levee landside toe, depending on the location of the adjacent canal. The crown width is approximately 17'. Land and water side slopes are approximately 1.9:1 and 3:1 respectively. A canal runs along the landside of the levee veering from the landside toe to several hundred feet away. This reach has existing structures located along the landside at Stations 1440+00, 1470+00, 1483+00, 1484+50, and 1486+00. Paseo Road and Bishop Avenue intersect the levee at approximate Stations 1440+00 and 1473+50 respectively. Over the canal a pedestrian bridge is located at Station 1482+50 and a larger bridge is located at 1482+50. Orchards and open space areas are located along both sides of the levee. Gates are located across the levee crown at Stations 1492+50, 1473+20, 1480+60, and 1460+50 and at access ramps located at Stations 1473+00, 1475+00, and 1492+25. Electrical transformers, irrigation valves, and standpipes are located along both sides of the levee from approximately 1466+00 and 1480+90. Utility poles are located along both sides of the levee throughout the reach.

Reach 23 (Station 1503+83 to 1609+37)

Reach 23 begins at Station 1503+83 and extends north 10,554 lineal feet to Station 1609+37. The levee height through this reach varies between 7 and 12', as measured from the levee landside toe. The crown width is approximately 17'. Land and water side slopes are approximately 1.9:1 and 3:1 respectively. A canal runs along the landside of the levee veering from the landside toe to several hundred feet away. This reach has existing structures located along the landside at Stations 1519+50, 1555+00, and 1557+00. Structures are located along the waterside from Station 1525+00 to 1531+00 and from Station 1603+50 to 1613+00. Archer Avenue intersects the levee at approximate Station 1520+50, Pennington Road at 1535+60, and Cooley Road at 1556+50. Orchards and open space areas are located along both sides of the levee. There is also a mobile home park/parking lot on the waterside of the levee starting at approximately Station 1526+00 to 1532+00. Gates are located across the levee crown at Stations 1520+00, 1521+00, 1535+00, 1537+00, 1556+00, 1557+00, and 1580+00 and at access ramps located at Stations 1520+50 and 1535+50. Utility poles are located along both sides of the levee throughout the reach.

Reach 24 (Station 1609+37 TO 1623+86)

Reach 24 begins at Station 1609+37 and extends north 1,449 lineal feet to Station 1623+86. The levee height through this reach is approximately 10', as measured from the levee landside toe. The crown width is approximately 17'. Land and water side slopes are approximately 1.9:1 and 3:1 respectively. A canal runs along the land side toe of the levee. This reach has existing structures located along the waterside at Station 1612+00. Campbell Road intersects the levee at approximate Station 1611+00. Orchards and open space areas are located along both sides of the levee. Gates are located across the levee crown at 1610+25 and along access roads along the waterside of the levee at Station 1611+00. Utility poles are located along both sides of the levee throughout the reach.

Reach 25 (Station 1623+86 to 1674+37)

Reach 25 begins at Station 1623+86 and extends north 5,051 lineal feet to Station 1674+37. The levee height through this reach is approximately 8', as measured from the levee landside toe. The crown width is approximately 19'. Land and water side slopes are approximately 1.8:1 and 3:1 respectively. Metteer Road intersects the levee at approximate Station 1665+50. Orchards and open space areas are located along both sides of the levee. Existing structures are located along the landside of the levee at Stations 1637+00, 1662+00, 1663+50, and 1674+00. Existing structures are located along the waterside of the levee at Stations 1637+00, 1666+00, and 1673+50. Gates are located across the levee crown at Stations 1624+25 and 1639+00. Utility poles are located along both sides of the levee throughout the reach.

Reach 26 (Station 1674+37 to 1707+11)

Reach 26 begins at Station 1674+37 and extends north 3,274 lineal feet to Station 1707+11. The levee height through this reach is approximately 6', as measured from the levee landside toe. The crown width is approximately 16'. Land and water side slopes are approximately 1.9:1 and 3:1 respectively. A canal runs along the landside toe of the levee. This reach has existing structures located along the waterside at approximate Stations 1696+00 and 1699+00. Pump houses are located along the landside at approximate Stations 1676+00 and 1705+00. Chandon Avenue intersects the levee at approximate Station 1690+00. Orchards and open space areas are located along both sides of the levee. Gates are located across the levee crown at Station 1676+00 and across Chandon Avenue at approximate Station 1690+00. Irrigation valves located within the canal at approximate Stations 1676+00, 1681+50, and 1688+75. A large weir is located within the adjacent canal at Station 1704+00. Utility poles are located along both sides of the levee throughout the reach.

Reach 27 (Station 1707+11 to 1721+60)

Reach 27 begins at Station 1707+11 and extends north 1,449 lineal feet to Station 1721+60. The levee height through this reach is approximately 12', as measured from the levee landside toe. The crown width is approximately 20'. Land and water side slopes are approximately 1.3:1 and 3:1 respectively. A canal runs along the landside toe of the levee. Orchards and open space areas are located along both sides of the levee. A gate is located across the levee crown at 1721+00. A concrete weir structure is located within the adjacent canal at Station 1721+30.

Reach 28 (Station 1721+60 to 1769+31)

Reach 28 begins at Station 1721+60 and extends north 4,771 lineal feet to Station 1769+31. The levee height through this reach is approximately 8', as measured from the levee landside toe. The crown width is approximately 19'. Land and water side slopes are approximately 1.3:1 and 3:1 respectively. A canal runs along the landside toe of the levee and veers away (landward) near Station 1765+50. This reach has existing structures located along the waterside at approximate Stations 1724+00, 1725+00, 1729+00, 1730+00, 1733+00, 1739+00, 1740+00 and 1745+00. Campbell Avenue intersects the levee at Station 1721+60. East Evans Reimer Road intersects the levee near the northern end of this reach at Station 1767+50. Orchards and open space areas are located along both sides of the levee. Gates are located across the levee crown at Stations 1766+25 and 1765+00. Gates are also located at waterside access ramps at Stations 1722+00 and 1734+00. Irrigation valves are located within the adjacent irrigation canal at Station 1735+00, 1743+00, and 1765+00. A culvert passes through the levee at Station 1767+50. Utility poles are located along both sides of the levee throughout the reach.

Reach 29 (Station 1769+31 to 1813+33)

Reach 29 begins at Station 1769+31 and extends north 4,402 lineal feet to Station 1813+33. The levee height through this reach is approximately 5', as measured from the levee landside toe. The crown width is approximately 15'. Land and water side slopes are approximately 2:1 and 3:1 respectively. This reach has existing structures located along the landside at approximate Stations 1779+00, 1780+00, 1782+50, 1794+00, and 1794+50. Orchards and open space areas are located along both sides of the levee. A gate is located at a landside access ramp at approximate Station 1782+50. Gates are also located at waterside access ramps at Stations 1781+00, 1786+50, and 1806+50. Utility poles are located along both sides of the levee throughout the reach.

Reach 30 (Station 1813+33 to 1902+00)

Reach 30 begins at Station 1813+33 and extends north 8,867 lineal feet to Station 1902+00, just south of E Gridley Road. The levee height through this reach is approximately 12', as measured from the levee landside toe. The crown width is approximately 17'. Land and water side slopes are approximately 1.9:1 and 3:1 respectively. Near the northern portion of the reach, just south of E Gridley Road, is a development with a number of homes located along the landside toe of the levee from Station 1889+00 to Station 1902+00. Orchards and open space areas are located along both sides of the levee. Gates are located across the levee crown at 1823+00, 1867+75, and 1901+00. Gates are also located at landside access ramps located at approximate Stations 1823+00, 1837+50, and 1855+00 and at waterside access ramps located at approximate Stations 1823+00, 1835+00, 1848+50, and 1853+00. Utility poles, standpipes, and valves are located along both sides of the levee throughout the reach.

Reach 31 (Station 1902+00 to 1958+00)

Reach 31 begins near E Gridley Road at Station 1902+00 and extends north 5,600 lineal feet to Ord Ranch Road near Station 1958+00. The levee height through this reach is approximately 11', as measured from the levee landside toe. The crown width is approximately 19'. Land and

water side slopes are approximately 1.8:1 and 3:1 respectively. A canal runs along the landside toe of the levee. The levee turns 90 degrees and veers away from the canal near Station 1957+00. This reach has an existing structure located on the levee crown at approximate Station 1957+50. Orchards and open space areas are located along both sides of the levee. Above ground tank and silos are located along the waterside of the levee at Station 1957+00. A gate is located across the levee crown at Station 1906+50. An abandoned bridge abutment and pump Station are located on the waterside at Station 1906+00. Bridge piers are also located within the Feather River at this Station. A concrete weir structure is located within the adjacent canal at Station 1941+60. A large culvert appears to cross underneath the levee at Station 1934+50. Utility poles, standpipes, and irrigation valves are located along both sides of the levee throughout the reach.

Reach 32 (Station 1958+00 to 1989+00)

Reach 32 begins near Ord Ranch Road at Station 1958+00 and extends north 3,100 lineal feet to Station 1989+00. The levee height through this reach is approximately 17', as measured from the levee landside toe. The crown width is approximately 19'. Land and water side slopes are approximately 2:1 and 3:1 respectively. Orchards and open space areas are located along both sides of the levee. An above ground tank is located on the landside of the levee at Station 1958+00. There is a raised ditch located at Station 1961+50 on the waterside. This ditch runs toward the Feather River and there is a headwall at the levee at this same Station. No outfall structure was found on the landside of the levee at this location.

Reach 33 (Station 1989+00 to 2122+00)

Reach 33 begins at Station 1989+00 and extends north 13,300 lineal feet to Station 2122+00. The levee height through this reach is approximately 13', as measured from the levee landside toe. The crown width is approximately 18'. Land and water side slopes are approximately 1.9:1 and 3:1 respectively. This reach has an existing structure located on the landside at approximate Station 2093+50, 2097+00, 2112+00. Almond Avenue intersects the levee near Station 2092+50. This reach of the levee has several sharp bends through it. Orchards and open space areas are located along both sides of the levee. Gates are located across the levee crown at 1993+00, 2092+00 and 2093+00. Gates are also located at landside access ramps located at approximate Stations 2021+00 and 2037+00. A gate is also located at the waterside access ramps located at Station 2007+00. Utility poles and standpipes are located along both sides of the levee throughout the reach. Mounds of dirt/rock (dredge tailings) are located along the waterside of the levee from Station 2093+00 to 2122+00.

Reach 34 (Station 2122+00 to 2182+00)

Reach 34 begins at Station 2122+00 and extends north 6,000 lineal feet to Station 2182+00. The levee height through this reach is approximately 13', as measured from the levee landside toe. The crown width is approximately 18'. Land and water side slopes are approximately 1.8:1 and 3:1 respectively. The levee intersects Palm Avenue near Station 2138+50. The crown of the levee is paved with asphalt concrete from Station 2138+50 to 2145+50. This reach of the levee has several 90 degree bends through it. Orchards and open space areas are located along both sides of the levee. Gates are located across the levee crown at 2138+00, 2146+00, and 2178+00. Standpipes are located along both sides of the levee throughout the reach. Mounds of dirt/rock (dredge tailings) are located along the waterside of the levee from Station 2122+00 to 2115+00.

Reach 35 (Station 2182+00 to 2224+00)

Reach 35 begins at Station 2182+00 near Cherry Avenue, and extends north 4,200 lineal feet to Station 2224+00. The levee height through this reach is approximately 13', as measured from the levee landside toe. The crown width is approximately 19'. Land and water side slopes are

approximately 2:1 and 3:1 respectively. This reach has an existing structure located along the landside at approximate Station 2184+00. Walnut Avenue intersects the levee near Station 2217+00. This reach of the levee has several 90 degree bends through it. Orchards and open space areas are located along both sides of the levee. Gates are located across the levee crown at 2186+50, 2216+50 and 2217+50 and at landside access ramps located at Stations 2186+00 and 2217+00. Utility poles and standpipes are located along both sides of the levee throughout the reach. There is an abandoned parking lot located on the waterside of the levee from Station 2218+00 to 2223+00.

Reach 36 (Station 2224+00 to 2259+00)

Reach 36 begins at Station 2224+00 and extends north 3,500 lineal feet to Station 2259+00. The levee height through this reach is approximately 14', as measured from the levee landside toe. The crown width is approximately 18'. Land and water side slopes are approximately 2:1 and 3:1 respectively. There are several structures located along the waterside of the levee near the northern portion of this reach from Station 2239+50 to 2248+00. This reach of the levee has several 90 degree bends through it. Orchards and open space areas are located along both sides of the levee. Gates are located across the levee crown at Stations 2248+00 and 2249+50.

Reach 37 (Station 2259+00 to 2290+00)

Reach 37 begins at Station 2259+00 and extends north 3,100 lineal feet to Station 2290+00. The levee height through this reach is approximately 16', as measured from the levee landside toe. The crown width is approximately 17'. Land and water side slopes are approximately 2:1 and 3:1 respectively. This reach has existing structures located along the landside at approximate Stations 2260+00, 2279+00, and 2289+50. The levee intersects Vance Avenue at approximate Station 2290+00. This reach of the levee has several bends through it including one 90 degree bend at Station 2289+50. Orchards and open space areas are located along both sides of the levee. Gates are located across the levee crown at Stations 2275+50 and 2284+50 and on the waterside access ramp located at Station 2284+00. Utility poles and standpipes are located along both sides of the levee throughout the reach. Dredge tailings are located along the water side of the levee.

Reach 38 (Station 2290+00 to 2303+00)

Reach 38 begins at Station 2290+00, near Vance Avenue, and extends east 1,300 lineal feet to Station 2303+00. The levee height through this reach is approximately 11', as measured from the levee landside toe. The crown width is approximately 20'. Land and water side slopes are approximately 1.7:1 and 3:1 respectively. Dredge tailings are located along the water side of the levee.

Reach 39 (Station 2303+00 to 2319+00)

Reach 39 begins at Station 2303+00 and extends north 1,600 lineal feet to Station 2319+00. The levee height through this reach is approximately 9', as measured from the levee landside toe. The crown width is approximately 20'. Land and water side slopes are approximately 2:1 and 3:1 respectively. Dredge tailings are located along the water side of the levee.

Reach 40 (Station 2319+00 to 2359+00)

Reach 40 begins at Station 2319+00 and extends north 4,000 lineal feet and terminates at the south end of an outfall structure located at Station 2359+00. The levee height through this reach is approximately 16', as measured from the levee landside toe. The crown width is approximately 20'. Land and water side slopes are approximately 1.9:1 and 3:1 respectively. Orchards and open space areas are located along both sides of the levee. There is a tree located near the crown of the levee at Station 2358+50. Utility poles and standpipes are located along

both sides of the levee throughout the reach. A horse stable is located along the landside from Station 2331+00 to 2334+50. Dredge tailings are located along the water side of the levee.

Reach 41 (Station 2359+00 to 2368+00)
Reach 41 begins at Station 2359+00 and extends north 900 lineal feet to terminate at Station 2368+00, just south of the Thermalito Afterbay outlet and Larkin Road. The levee height through this reach is approximately 14', as measured from the levee landside toe. The crown width is approximately 18'. Land and water side slopes are approximately 2:1 and 3:1 respectively. Open space areas are located along both sides of the levee.

Table 1 on the following page illustrates the deficiencies in the existing project levee as the result of a detailed geotechnical analyses of the FRWLP.

Table 1. Summary of Levee Deficiencies by Reach

Study Reach	Through-Seepage[a]	Under-Seepage[b]	Slope Stability[c]
1	Not part of the project proposed at this time.		
2	X	X	*
3	X	X	*
4	X	X	*
5	X	X	*
6			
7	X	X	*
8	X	X	*
9	X	X	*
10	X	X	*
11	X	X	*
12			
13	X	X	*
14			
15	X	X	*
16			X
17	X	X	*
18	X	X	*
19	X	X	*
20		X	*
21		X	*
22	X	X	*
23		X	*
24		X	*
25			
26	X	X	*
27	X	X	*
28		X	X
29			
30	X	X	*
31		X	X
32	X	X	*
33	X	X	*
34	X	X	*
35	X	X	*
36	X	X	*
37	X	X	*
38	X	X	*
39			
40	X	X	*
41	X	X	*

Notes: (From PFR Aug-2011)

An X signifies the levee deficiency applies to the levee reach.

a. Through-seepage issues based on phreatic surface existing on the landside slope.

b. Under-seepage issues based on exit gradient greater than 0.5 at the landside levee toe.

c. An * signifies reaches where through- and under-seepage issues exist and slope stability was not independently verified.

4.0 Purpose and Need for the Modification

SBFCA's goal for the Sutter Basin is to achieve a minimum of 200-year flood protection for the more urbanized areas with population centers and 100-year protection for the remaining more rural agricultural parts of the planning area. A 200-year flood is a flood that has a 0.5% chance of occurring in any given year, also referred to as a 0.5% annual exceedance probability (AEP). A 100-year flood has a 1% AEP.

The primary purpose of the FRWLP is to reduce flood risk for the entire planning area by addressing known levee deficiencies along the Feather River West Levee from Thermalito Afterbay downstream to approximately 4 miles upstream of the confluence with the Sutter Bypass.

The following objectives provide additional detail in support of the project purpose above.

- Protect existing populations and minimize exposure to flooding for agricultural commodities, infrastructure use, and other property.
- Reduce flood risk from Feather River toward a target of 200-year protection for Yuba City and to the north of the planning area and 100-year protection south of Yuba City, in compliance with State of California SB 5 mandates for 200-year protection for urbanized areas.
- Address known deficiencies and observed performance issues.
- Construct a project as soon as possible to reduce flood risk as quickly as possible.
- Construct a project that is politically, socially, economically, and environmentally acceptable.
- Preserve and enhance riparian and other native habitats (such as through ecosystem restoration of borrow sites).
- Facilitate consistency with the Central Valley Flood Protection Plan (CVFPP) and the Sutter Basin Project Feasibility Study such that proposed activities would be "no regrets" and not inconsistent with any future plans.
- To the extent feasible, adhere to Federal standards, thereby ensuring eligibility for Federal assistance for levee repairs and maintenance (e.g., Federal assistance programs such as Public Law [PL] 84-99).
- Facilitate compatibility with recreation and restoration goals in the planning area.

Four needs have been identified for action.

- Study results from levee evaluations have shown that the Feather River West Levee needs improvements to reduce the current level of risk to human health, safety, property, and the adverse economic effect that serious flooding would cause.
- Study results have further shown that the levees in SBFCA's planning area, and, specifically, levees on the west bank of the Feather River, are deficient when compared against current Federal and State standards.
- Improvements are necessary to meet FEMA's minimum acceptable level of flood protection (commonly referred to as the 100-year flood) as specified by the National Flood Insurance Program (NFIP). Draft revised FEMA maps show that all or parts of SBFCA's planning area may

not meet 100-year flood standards. SBFCA intends to incrementally reduce risk to meet or exceed the FEMA standards.

- As mandated by SB 5, the CVFPB will require a 200-year level of flood protection for urban areas by the year 2025 and calls for building limitations after 2015 if adequate progress towards achieving this standard is not met. Improvements to the Feather River West Levee are necessary to meet that requirement.

5.0 Description of the Proposed Modification

For each deficiency noted in Table 1, a number of measures or combination of measures can be used to reduce flood risk. Table 2 outlines the major deficiencies identified in the existing project levees and the measures that will be applied to resolve each deficiency; text follows describing in detail each improvement and associated construction methods.

Table 2. Summary of Levee Measures and Deficiencies

	Deficiency				
Measure	Through-Seepage	Under-Seepage	Slope Stability and Geometry	Erosion	Encroachments
Slurry cutoff wall	✓	✓			
Slope flattening			✓		
Stability berm	✓		✓		
Levee reconstruction	✓		✓		✓
Seepage berm		✓			
Relief wells		✓			
Depression/ditch infilling		✓			
Rock slope protection				✓	
Encroachment removal					✓

Slurry Cutoff Wall

A slurry cutoff wall consists of impermeable material that is placed parallel to the levee, typically through the center of the levee crown. There are generally three methods for constructing a slurry cutoff wall: (1) conventional slot trench, (2) deep soil mixing (DSM), and (3) jet grouting. The first two methods are for application over longer areas while jet grouting is a spot application based on limiting conditions for the primary methods. A slurry cutoff wall addresses the deficiency of seepage (through- and under-seepage).

Slope Flattening

Slope flattening is a mechanical method to repair or reshape slopes that do not meet standards for geometry and stability. Levee slopes are typically subject to standards as flat as 3H:1V, but this may

vary based on site-specific conditions and supporting engineering analysis. Slope flattening addresses the deficiency of slope stability and geometry.

Stability Berm

A stability berm would be constructed against the landside slope of the existing levee with the purpose of supplying support as a buttress. The height of the stability berm is generally two-thirds the height of the levee; the structural needs of the levee determine the distance it extends along that reach. A stability berm addresses the deficiency of stability and may also incorporate drainage elements to address seepage.

Levee Reconstruction

Levee reconstruction would be necessary where a levee has been degraded to facilitate implementation of another measure (such as a slurry cutoff wall), where a substantial encroachment has been removed from within the levee prism, or otherwise where the levee is found to be deficient and needs to be replaced with materials and methods that meet current engineering standards.

Seepage Berm

Seepage berms are wide embankment structures made up of low-permeability materials that resist accumulated water pressure and safely release seeping water (Figure 2-16). A seepage berm is typically one-third the height of the levee, extending outward from the landside levee toe approximately 300 to 400 feet, and laterally along the levee as needed relative to the seepage conditions. A seepage berm addresses the deficiency of under-seepage.

Relief Wells

Relief wells are passive systems that are constructed near the levee landside toe to provide a filtered, low-resistance pathway for under-seepage to exit to the ground surface in a controlled and observable manner. A low-resistance pathway allows under-seepage to exit without creating sand boils or piping levee foundation materials. Relief wells are an option only in reaches where geotechnical analyses have identified continuous sand and gravel layers. Relief wells are used to address the levee deficiency of under-seepage.

Relief wells are constructed using soil-boring equipment to drill a hole vertically through the fine-grained blanket layer into the coarse-grained aquifer layer beneath. Pipe casings and gravel/sand filters are installed to allow water to flow freely to the ground surface, relieving the pressure beneath the blanket without transporting materials to the surface, which can undermine the levee foundation. Relief wells are designed to discharge into collector ditches, pipes, or to discharge at low velocity into adjoining areas.

Relief wells generally are spaced at 50- to 100-foot intervals, dependent upon the amount of under-seepage, and extend to depths of up to 150 feet. Areas for relief well construction are cleared, grubbed, and stripped. During relief well construction, a typical well-drilling rig is used to drill to the required depth and construct the well (including well casing, gravel pack material, and well seal) beneath the ground surface.

Depression/Ditch Infilling

Landside depressions and ditches can contribute to risk of levee failure if a seepage pathway forms under the levee and the water then surfaces through the depression or ditch, exploiting its less resistive nature compared to the surrounding soil mass. This measure involves placing fill soil in such depressions and ditches to remove localized susceptibility to seepage.

Rock Slope Protection

Portions of the levee slopes may be protected by the placement of rock slope protection. Rock is placed in a layer approximately 2.5 feet thick on the water side of the levee to protect against erosional forces that threaten levee stability, such as wind, waves, and boat wake. Rock slope protection addresses the levee deficiency of erosion.

Wherever possible, the bank protection is designed both to control erosion and to maintain existing vegetation and instream woody material as much as possible. This can be accomplished by incorporating rock benches that serve as buffers against extreme toe scour and shear stress while providing space for planting riparian vegetation and creating a platform to support aquatic habitat features. Such features would be subject to and designed in compliance with USACE levee vegetation guidance.

Encroachment Removal

Encroachments such as structures, certain vegetation, levee penetrations (e.g., pipes, conduits, and cables), power poles, pump stations, retaining walls, or similar features may require removal from the levee prism to meet levee safety requirements. This measure would include the demolition of such features and relocation or reconstruction as appropriate on a case-by-case basis (or retrofit to comply with requirements).

Table 3. Summary of Proposed Levee Modifications by Reach

Reach	Length (ft)	Proposed Modification Flood Management Measure
2	1,616	202+50 to 218+66, cutoff wall extending to an elevation of 25’ with 100’-wide undrained seepage berm. Seepage berm 5’ thick at berm toe.
3	8,200	218+66 to 230+00 cutoff wall extending to an elevation of 25’ with 100’-wide undrained seepage berm. Seepage berm 5’ thick at berm toe. 230+00 to 250+00 cutoff wall tip elevation 35’; 250+00 to 289+00 cutoff wall tip elevation 20’; 289+00 to 300+66 cutoff wall tip elevation 12’
4	11,001	300+66 to 312+00 cutoff wall tip elevation 15’; 312+00 to 349+00 cutoff wall tip elevation 15’; 349+00 to 368+00 cutoff wall tip elevation 10’; 368+00 to 410+67 cutoff wall tip elevation 20’
5	6,801	410+67 to 417+00, cutoff wall tip elevation 20’;

Reach	Length (ft)	Proposed Modification Flood Management Measure
		417+00 to 425+00, cutoff wall tip elevation 10'; 425+00 to 456+00, cutoff wall tip elevation 15'; 456+00 to 475+35, cutoff wall tip elevation 15' with 300-ft-wide undrained seepage berm. Seepage berm 5 ft. thick at berm toe; 475+35 to 478+68 no rehabilitation required
6	3,169	No Rehabilitation Required
7	8,563	514+00 to 526+00, cutoff wall tip elevation 15'; 526+00 to 570+00, cutoff wall tip elevation 5'; 545+00 to 570+00, Relief wells with 60' spacing and 50-foot depth over one half of the length, distributed at various locations over this stretch of levee 570+00 to 575+00, cutoff wall tip elevation 5'; 575+00 to 595+00, cutoff wall tip elevation 10'; 595+00 to 596+00, cutoff wall tip elevation 15'
8	5,875	596+00 to 654+75, cutoff wall tip elevation 15'
9	5,175	654+75 to 670+00, cutoff wall tip elevation 15'; 670+00 to 697+00, cutoff wall tip elevation 20'; 697+00 to 706+50: cutoff wall tip elevation 10';
10	6,750	706+50 to 726+00, cutoff wall tip elevation 10'; 726+00 to 746+00, cutoff wall tip elevation 5'; 746+00 to 754+50, cutoff wall tip elevation 5'; 754+50 to 774+00, cutoff wall tip elevation 25'
11	5,600	774+00 to 784+50, cutoff wall tip elevation 25'; 784+50 to 827+50, cutoff wall tip elevation 5'; 827+50 to 830+00, cutoff wall tip elevation 25'
12	1,500	No Rehabilitation Required
13	8,200	844+50 to 923+75: cutoff wall tip elevation 35' and relief well with 200-foot spacing and 65' deep
14	2,740	No Rehabilitation Required
15	1,410	No rehabilitation required
16	11,150	992+80 to 1001+80, waterside slope flattening or other remedial measures Closure of gap in cutoff wall at 5th Street bridge crossing around Station 1007+00, cutoff wall tip elevation 40'; Closure of gap in cutoff wall at 10th Street bridge crossing around Station 1026+00, cutoff wall tip elevation 35';

Reach	Length (ft)	Proposed Modification Flood Management Measure
		1077+85 to 1080+00, cutoff wall tip elevation 30' and backfill landside toe depression
17	5,086	1080+00 to 1089+00, cutoff wall tip elevation 30' and backfill landside toe depression; 1089+00 to 1125+00, cutoff wall tip elevation 35' and backfill landside toe depression; 1125+00 to 1130+86, cutoff wall tip elevation 0'
18	8,299	1130+86 to 1151+50, cutoff wall tip elevation 0'; 1151+50 to 1159+50: cutoff wall tip elevation 30'; 1159+50 to 1169+50: cutoff wall tip elevation 25'; 1169+50 to 1189+50: cutoff wall tip elevation 30'; 1189+50 to 1209+50: cutoff wall tip elevation 40'; 1209+50 to 1213+85: cutoff wall tip elevation 35'
19	8,398	1213+85 to 1219+75, cutoff wall tip elevation 35'; 1219+75 to 1224+00, cutoff wall tip elevation 5'; 1224+00 to 1238+00, cutoff wall tip elevation 28'; 1238+00 to 1248+00, cutoff wall tip elevation 42'; 1248+00 to 1268+75, cutoff wall tip elevation 3'; 1268+75 to 1297+83, cutoff wall tip elevation 35'
20	7,650	1297+83 to 1298+75, cutoff wall tip elevation 35'; 1298+75 to 1359+00, cutoff wall tip elevation 50'; 1359+00 to 1369+00: cutoff wall tip elevation 40'; 1369+00 to 1374+33: cutoff wall tip elevation 32'
21	5,950	1297+83 to 1298+75: cutoff wall tip elevation 35'; 1298+75 to 1359+00: cutoff wall tip elevation 50'; 1359+00 to 1369+00: cutoff wall tip elevation 40'; 1369+00 to 1374+33: cutoff wall tip elevation 32'
22	7,000	1433+83 to 1448+75, cutoff wall tip elevation 40'; 1448+75 to 1468+83, cutoff wall tip elevation 50'; 1455+00 to 1461+00, full levee degrade and reconstruction; 1468+83 to 1503+83, cutoff wall tip elevation 55'
23	10,554	1503+83 to 1508+50, cutoff wall tip elevation 55';

Reach	Length (ft)	Proposed Modification Flood Management Measure
		1508+50 to 1528+75, cutoff wall tip elevation 60'; 1528+75 to 1566+50, cutoff wall tip elevation 55'; 1566+50 to 1608+75, cutoff wall tip elevation 60'
24	1,449	1608+75 to 1623+86, cutoff wall tip elevation 28'
25	5,051	1623+86 to 1625+00, cutoff wall tip elevation 28'; 1673+00 to 1674+37, cutoff wall tip elevation 65'
26	3,274	1674+37 to 1707+11, cutoff wall tip elevation 65'; reconstruction of landside slope extends down to elevation of bottom of canal, with armoring on canal portion of slope
27	1,449	1707+11 to 1721+60: cutoff wall tip elevation 65'; reconstruction of landside slope extends down to elevation of bottom of canal, with armoring on canal portion of slope
28	4,771	1721+60 to 1727+75, cutoff wall tip elevation 65'; 1727+ 75 to 1748+50, cutoff wall tip elevation 70'; 1748+50 to 1769+31, cutoff wall tip elevation 45' Reconstruction of landside slope extends down to elevation of bottom of canal, with armoring on canal portion of slope
29	4,402	No Rehabilitation Required
30	8,867	1813+33 to 1816+50, cutoff wall tip elevation 80' with full levee degrade and reconstruction; 1816+50 to 1848+25, cutoff wall tip elevation 30'; 1848+25 to 1866+00, cutoff wall tip elevation 70'; 1866+00 to 1877+75, cutoff wall tip elevation 47'; 1877+75 to 1883+00, cutoff wall tip elevation 40'; 1883+00 to 1902+00, cutoff wall tip elevation 27'; 1897+05 to 1898+35 and 1900+20 to 1901+40, waterside slope flattening or other remedial measures
31	5,600	1902+00 to 1907+50, cutoff wall tip elevation 27'; 1907+50 to 1917+50, cutoff wall tip elevation 44'; 1907+92 to 1909+42, waterside slope flattening or other remedial measure; 1917+50 to 1927+50, cutoff wall tip elevation 75'; 1927+50 to 1937+00, cutoff wall tip elevation 50'; 1937+00 to 1958+00, cutoff wall tip elevation 40'
32	3,100	1958+00 to 1971+80, cutoff wall tip elevation 40';

Reach	Length (ft)	Proposed Modification Flood Management Measure
		1971+80 to 1987+25, cutoff wall tip elevation 48'; 1987+25 to 1989+00, cutoff wall tip elevation 10'
33	13,300	1989+00 to 2002+00, cutoff wall tip elevation 10'; 2002+00 to 2016+75, cutoff wall tip elevation 90'; 2016+75 to 2036+75, cutoff wall tip elevation 20'; 2036+75 to 2041+00, cutoff wall tip elevation 53'; 2041+00 to 2067+00, cutoff wall tip elevation 38'; 2067+00 to 2088+00, cutoff wall tip elevation 33'; 2088+00 to 2122+00, cutoff wall tip elevation 90'
34	6,000	2122+00 to 2137+00, cutoff wall tip elevation 90'; 2137+00 to 2148+00, cutoff wall tip elevation 20'; 2148+00 to 2164+00, cutoff wall tip elevation 90'; 2164+00 to 2182+00, cutoff wall tip elevation 50'
35	4,200	2182+00 to 2196+50, cutoff wall tip elevation 40'; 2196+50 to 2212+00, cutoff wall tip elevation 45'; 2212+00 to 2218+25, cutoff wall tip elevation 50'; 2218+25 to 2224+00, cutoff wall tip elevation 55'
36	3,500	2224+00 to 2233+50, cutoff wall tip elevation 55'; 2233+50 to 2245+75, cutoff wall tip elevation 70'; 2245+75 to 2259+00, cutoff wall tip elevation 42'
37	3,100	2259+00 to 2277+00, cutoff wall tip elevation 42'; 2277+00 to 2290+00, cutoff wall tip elevation 45'
38	1,300	2290+00 to 2303+00, adjacent levee with 20-ft wide crown and 5:1 landside slope
39	1,600	No Rehabilitation Required
40	4,000	2321+00 to 2332+00 Fill Landside Pit (up to Elevation 120'); 2321+00 to 2329+00, 7' tall Drained Stability Berm on 65' wide Undrained Seepage Berm (5' thick at levee toe); 2331+00 to 2346+00, 10' tall Drained Stability Berm on 120' wide Undrained Seepage Berm (5' thick at levee toe); 2346+00 to 2359+00, 4' tall Drained Stability Berm on 300' wide undrained Seepage Berm (5' thick at levee toe)
41	900	2359+00 to 2368+00, construct 150-ft wide drained seepage berm

6.0 Non-Federal Request for Project Modification

The State of California, Central Valley Flood Protection Board (**CVFPB**) has requested permission to alter the Feather River West Levee from station 202+50 to station 2368+00, all of which is a Federal Project levee. This request is formally provided to the CVFPB by means of an encroachment permit application submitted by SBFCA in May 2010. SBFCA is continuing to coordinate closely with the CVFPB and the USACE on finalizing the design and permitting of these projects.

7.0 Related Actions, Programs, and Planning Efforts

This section provides an overview of other flood management activities that comprise the regional planning context. The following section includes current and future actions which may be considered as part of the cumulative effects analysis.

System-wide Efforts

Related current and future efforts affecting the entire SRFCP (or beyond) are described below.

Central Valley Flood Protection Act

The Central Valley Flood Protection Act (CVFPA enacted in California in 2009, called for DWR to present a CVFPP by January 1, 2012 to the CVFBP. The CVFPP, which was adopted by the CVFPB in June 2012, outlines a comprehensive system-wide approach for the protection of lands currently protected from flooding by the SRFCP and the corresponding San Joaquin River watershed to the south. It also establishes a new standard of 200-year flood protection for urban areas in the Central Valley and requires this standard to be achieved by 2025.

The CVFPP presented three preliminary approaches for addressing current challenges and affordably meeting the CVFPP goals. The State assembled what it viewed as the most promising, affordable, and timely elements of the three preliminary approaches into the State Systemwide Investment Approach (SSIA), which provides guidance for future State participation in projects and programs for integrated flood management in the Central Valley. The FRWLP fits into the State Systemwide Investment Approach outlined in the CVFPP and adopted by the CVFPB in June 2012.

The people of California passed two bond measures (Propositions 84 and 1E) that provide approximately $5 billion toward flood improvements to reduce flood risk, particularly to state-Federal levees protecting urban areas in the Central Valley. These levee improvements are expected to occur over the 10 years since authorization of the bonds in 2006 with much of the bond money spent after the year 2012. However, there were urgent needs to improve inadequate flood protection in existing urban areas in advance of the overall comprehensive effort. These advance efforts are termed early implementation projects (EIPs). EIPs can be implemented ahead of and in parallel with the comprehensive effort as long as they are designed to ensure that they do not eliminate opportunity or prejudice future flood risk-management alternatives that would provide regional or system-wide benefits. Local agencies and the State are identifying and planning EIPs in a parallel process to be compatible with comprehensive, system-wide studies. Several EIPs have been implemented, such as those under the programs of SAFCA and WSAFCA.

Along with the requirement for increased flood protection by 2025, one of the objectives of the CVFPP is:

> Increasing the engagement of local agencies willing to participate in flood protection, ensuring a better connection between state flood protection decisions and local land use decisions (Draft Framework for Early Implementation Projects and Section 408 Approval).

In line with that objective, SBFCA has proposed the FRWLP as an EIP.

7.1 Sacramento River Flood Control System Evaluation

Following the flood of 1986, USACE and the State of California, along with local partners, completed a comprehensive evaluation of the Sacramento River Flood Control System and initiated a flood risk management program aimed at repairing, raising, and strengthening urban levees, among other activities. This effort, known as the Sacramento River Flood Control System Evaluation (commonly referred to as System Evaluation) resulted in the repair of more than 70 miles of deficient levees by USACE. However, to date, not all the authorized repairs have been completed. Moreover, the completed repairs were built to standards in place at the time which are no longer current.

Due to the large scale of the evaluation, the review was split into five phases. The results were published in the Sacramento River Flood Control System Evaluation, Phase II-V, Programmatic EIS/EIR, dated May 1992. Phases I and II evaluations include the Sacramento urban area and Marysville/Yuba City area. Phase III is the Mid-Valley area in and around the town of Knights Landing, approximately 27 miles northwest of Sacramento. Phase IV and V includes the lower Sacramento River area south of Sacramento and the upper Sacramento River area north of Knights Landing. According to the November 2002 SRFCP Limited Reevaluation Report (LRR), Phase VI was more recently added to evaluate additional potential sites in all phases, but its supplemental design memorandum had not been completed at that time.

Phase III is the only currently active phase and is being designed for levee slurry wall work at three sites along the right bank of the Sacramento River (River Mile [RM] 84.1 to 87.2). The work also involves dike reconstruction, with final design being recently completed, at three sites along the left bank of the Knights Landing Ridge Cut. The State of California is proposing to complete the Knights Landing work under an EIP or USACE would complete all work in 2015 to 2016.

7.2 Sacramento–San Joaquin River Basins Comprehensive Study and Central Valley Integrated Flood Management Study

Following the 1997 flood, the Sacramento-San Joaquin River Basin Comprehensive Study (Comp Study) was initiated by the State and USACE to formulate comprehensive plans for flood risk reduction and environmental restoration. This study was unable to stimulate widespread public or political interest in flood risk reduction or environmental restoration activity beyond the ongoing urban levee improvement programs. The study did result in a new set of engineering criteria for the design and evaluation of urban levees and a greatly expanded scope and cost for the ongoing urban levee improvement efforts on the Sacramento and American Rivers. In addition, the adequacy of previous repairs was reviewed.

Presently, the Central Valley Integrated Flood Management Study (CVIFMS) is a continuation of the Comp Study in which USACE and the State are defining a long-range program for the Sacramento and San Joaquin River Basins and the corresponding level of Federal participation. This program will identify opportunities to reduce flood risk by improving the flood capacity of the system while

restoring and protecting floodplain and environmental features including wetlands and other fish and wildlife habitat. The approaches and management strategies under CVIFMS include:

- Conduct a watershed study to provide long-term reduction of flood risk and environmental restoration needs.
- Coordinate closely with the CVFPP development to produce joint products for mutual benefits and use.
- Provide leadership in specific disciplinary areas to ensure consistency in national management directives and guidelines.
- Coordinate with ongoing projects and programs to incorporate relevant information and actions in the study development.

Subject to continued appropriation, USACE plans to complete the CVIFMS by 2015.

7.3 Sacramento River Bank Protection Project

USACE is responsible for implementation of the Sacramento River Bank Protection Project (SRBPP) in conjunction with its non-Federal partner, CVFPB. The SRBPP is a continuing construction project authorized by Section 203 of the Flood Control Act of 1960. The purpose of this project is to provide protection from erosion to the existing levee and flood control facilities of the SRFCP. To date, work has been carried out in two phases. Phase I consisted of 435,000 feet and Phase II's original authorization included 405,000 feet. Approximately 3,000 feet of work under the existing authorization remains to be constructed in 2012–2013; a supplemental authorization is in the planning phase. Project(s) within the SBFCA service area are being evaluated under this program.

7.4 Flood Control and Coastal Storm Emergency Act

The Flood Control and Coastal Storm Emergency Act (PL 84-99) authorizes USACE if requested by the sponsor to undertake activities including disaster preparedness, advance measures, emergency operations, rehabilitation of flood control works threatened or destroyed by flood, protection or repair of federally authorized shore protective works threatened or damaged by coastal storms, and provisions of emergency water due to drought or contaminated source. PL 84-99 establishes an emergency fund for emergency response preparations for natural disasters, for flood fighting and rescue operations, and for rehabilitation of flood control and hurricane protection structures. Under PL 84-99, an eligible flood protection system, such as the SRFCP, can be rehabilitated if damaged by a flood event.

Federal Projects Within the Region

Related current and future Federal efforts within the SRFCP are noted below.

7.5 Sutter Basin Project

SBFCA and the State of California are the non-Federal sponsors of the Sutter Basin Project, which may eventually provide the Sutter Basin with 100- to 200-year flood protection (depending upon location). The Sutter Basin is bounded roughly by the Feather River, Cherokee Canal, Sutter Buttes, and the Sutter Bypass, and contains the cities of Biggs, Gridley, Live Oak, and Yuba City, as well as a significant amount of agricultural land. Past flood events and geotechnical analysis show that the

levees surrounding the Sutter Basin (including the Feather River West Levee) have a higher probability of failure related to through-and under-seepage than levees designed to meet current standards. Additionally, the levees are at risk of overtopping from floods greater than they are designed to withstand.

The Sutter Basin Project is undergoing a Feasibility Study by USACE, Sacramento District, to determine Federal interest in implementing a flood-risk reduction project with ecosystem and recreation benefits. The Feasibility Study will evaluate structural and nonstructural flood risk management measures, including reoperation of existing reservoirs; improvements to existing levees; construction of new levees; and other storage, conveyance, and nonstructural options. Ecosystem restoration measures likely would include restoration of floodplain function and habitat. Recreation measures would include those outdoor recreation opportunities associated with sustainable water resource development. As of February 2012, USACE anticipates that the draft EIS/EIR for the Feasibility Study will be released in December 2012.

In regard to the relationship between the FRWLP and the Sutter Basin Project, it is intended that some or all of the FRWLP will be constructed prior to or concurrently with any Sutter Basin Project construction, which can only be constructed after authorization of the Sutter Basin Project by Congress following completion of the Feasibility Study. SBFCA anticipates that the non-Federal costs it and the State of California incur in implementation of the FRWLP could be credited against the remaining non-Federal share of the cost of the Sutter Basin Project studied under the Feasibility Study. Credit is only available if the flood protection improvements constructed as part of the FRWLP are found to be integral to the Sutter Basin Project recommended in the Feasibility Study.

More specifically, requests for general credit for flood control under Section 221 of the Flood Control Act of 1970 (as amended by Section 2003 of the Water Resources Development Act of 2007) may allow the work conducted by SBFCA and described in the Feasibility Study to be credited against the local cost sharing requirements of the Sutter Basin Project as long as the project features constructed are integral to the USACE project.

Because implementation of the improvements by SBFCA does not immediately use Federal funds, it would not result in a commitment of Federal resources that would prejudice selection of a Feasibility Study alternative before a final decision on the Feasibility Study alternatives is made. In addition, the project-specific improvements considered in this EIS/EIR are limited to a portion of the overall flood protection system considered in the Feasibility Study. In summary, the FRWLP is intended to be integral to the ultimate Sutter Basin Project Feasibility Study.

7.6 Yuba Basin Project

The Yuba Basin Project is an initiative to provide a 200-year level of protection and higher for communities in Yuba County. When complete, it will be the first community in California's Central Valley to achieve the State's requirement of 200-year flood protection.

To accelerate this Federally authorized project, the State and local interests (Yuba County, Yuba County Water Agency, and Three Rivers Levee Improvement Authority), began an advanced levee construction program in the southern portion of the county. Work is now complete on all of the 29.3 miles of levees, including the construction of two new setback levees: the 2-mile long Bear River setback and the 6-mile long Feather River setback. Besides providing greater regional flood protection, these setback levees resulted in the creation of nearly 2,000 acres of wildlife habitat.

All of this advanced work is being evaluated by USACE in the Yuba River Basin Project General Reevaluation Report (GRR), scheduled for completion in 2012. The scheduled work for the 7.5-mile long Marysville Ring Levee is the final piece to the entire project. In 2008, USACE approved a "separable element" for Marysville, so that work could begin while the GRR was underway. Construction in Marysville began in 2010 and several additional phases of the project are designed and ready for construction in 2013. Both the Marysville element and GRR are in need of additional appropriation for completion.

7.7 American River Common Features Project

To increase flood protection for the city of Sacramento, which is bordered by the left bank of the Sacramento River, the American River Common Features Project (Common Features) was authorized by Congress in the WRDA of 1996. This authorization called for strengthening the north and south levees of the American River and raising and strengthening the upper 12 miles of the left levee of the Sacramento River in the Natomas area, just north of the city of Sacramento. These improvements were considered *common features* of any comprehensive plan of flood protection for the Sacramento area that might ultimately be approved by Congress. In the WRDA of 1999, the scope of the Common Features authorization was expanded to include raising portions of the north and south levees of the American River (including the Mayhew Levee), additionally strengthening portions of the north levee of the American River, and raising and strengthening the north and south levees of the Natomas Cross Canal in the Natomas area.

With the goal of strengthening the American River levees to enable them to pass a flow of 160,000 cubic feet per second (cfs) the Common Features Project has installed roughly 24 miles of slurry wall up to depths of 80 feet, raised levees to provide adequate freeboard, addressed slope stability issues and corrected some erosion problems. Because of the considerable cost increase of seepage remediation on the American River, all funds appropriated by Congress throughout the late 1990s and the early part of the 2000s were used for construction activities on the American River instead of for design efforts for the Natomas Basin. In 2006, the Common Features authorization was deemed sufficient to cover improvements to the left levee of the Sacramento River near the Pioneer Reservoir and in the Pocket/Freeport area.

USACE is currently developing two post-authorization change studies. The Common Features GRR is reevaluating the previous Common Features project and identifying levee improvements needed to provide the city of Sacramento and the Natomas area to the north with at least a 200-year level of flood protection. The Common Features GRR is planned for completion in 2014. Construction associated with the report would begin approximately 1 year after adoption of the report by Congress. Much of this work was completed or is underway by SAFCA as an EIP and Section 408 action (see Section 7.11). The Natomas Post-Authorization Change Report documents the evaluation of features in the Natomas Basin portion of the Common Features project and was submitted to Congress in October 2010.

7.8 West Sacramento General Reevaluation Report

USACE and DWR published the previous Sacramento Metropolitan Area General Reevaluation Report in 1992. The purpose of that report was to recommend a program of improvements needed to remedy structural problems and limitations of the levee system that were revealed by the 1986 flood. The subsequent 1997 flood and revisions to USACE levee construction standards after the 2005 New Orleans flood shifted attention to under-seepage deficiencies that had not been

considered in the previous study. Presently, USACE and SBFCA are developing a GRR for West Sacramento levee improvements to assess the entirety of the levees protecting the city of West Sacramento in light of most recent criteria and knowledge regarding levee design, with particular attention to remediation of seepage deficiencies.

USACE uses GRRs to present the results of a reevaluation of a previously completed study, using current planning criteria and policies, due to changed conditions and/or assumptions. The results may reaffirm the previous plan, reformulate and modify it, or find that no plan is currently justified. The results are documented in a GRR which, if recommended and supported, also serves as the decision document for a Federal action (U.S. Army Corps of Engineers and Central Valley Flood Protection Board 2009).

The primary objective of the West Sacramento GRR is to determine the extent of Federal interest in additionally reducing the flood risk within the study area while concurrently exploring opportunities to increase recreation and restore the ecosystem along the Sacramento River within the study area. Much of this work was completed or is underway by WSAFCA as an EIP and Section 408 action (see Section 7.11). USACE anticipates completion of the GRR in 2014.

State and Local Projects Within the Region

Related current and future state and locally led efforts within the SRFCP are described below.

7.9 Lower Feather River Corridor Management Program

DWR is developing the Lower Feather River Corridor Management Plan (LFRCMP) as an integrated strategy for managing the 20-mile river corridor between the cities of Marysville and Yuba City and the Sutter Bypass. The lower half of the Feather River West Levee falls within the LFRCMP planning area. The LFRCMP will provide guidance and recommendations for planners, land managers and decision-makers to manage the lower Feather River in a way that accomplishes the following primary purposes: protects public safety, facilitates flood protection system management and maintenance of flood control facilities, and conserves and enhances or restores habitat and ecosystem functions. The plan also has the following secondary purposes: promoting economic sustainability, land use compatibility, and recreational opportunities. As a part of this effort, DWR is developing a comprehensive permitting approach, and hopes to obtain programmatic permits, with advance mitigation, for routine and extraordinary maintenance of the flood control system and for restoration activities in the corridor. As of publication of this EIS/EIR, a public draft of the LFRCMP has not been released. DWR anticipates publishing a draft LFRCMP in 2012.

7.10 Three Rivers Levee Improvement Program

TRLIA, a joint powers agency, was established in May 2004 by the County of Yuba and Reclamation District (RD) 784 to finance and construct levee improvements in south Yuba County. The goal of the Three Rivers Levee Improvement Program is to provide 200-year flood protection to more than 40,000 residents in Linda, Olivehurst, and Plumas Lake. Four work phases, covering 29 miles of levees, were identified to achieve this goal. All of the work identified in the four phases has been completed as of the end of 2011.

The levees affected by this project are the south levee of the Yuba River, the east levee of the Feather River, the north levee of the Bear River, and the west levee of the Western Pacific Interceptor Canal. Improvements included stability berms, slurry cutoff walls, erosion protection, corrections to levee geometry, levee height increases, relief wells, monitoring wells, and detention basins. Setback levees were constructed along a portion of the Bear River north levee and the Feather River east levee. The land within the setback areas of both levees totals 1,750 acres, and will be used for habitat restoration and agricultural purposes.

TRLIA is currently evaluating a portion of the Yuba Goldfields to determine if it is sufficient to provide 200-year flood protection. TRLIA hopes to complete this evaluation by the end of 2012 and receive 200-year certification for the Goldfields shortly thereafter.

7.11 Natomas Levee Improvements Program

As part of its long-term program to improve the Natomas Basin levee system, SAFCA proposes to continue waterside and landside levee-strengthening efforts, including levee raises, seepage remediation, increased bank protection, levee stabilization, and flattening of landside levee slopes under the NLIP, an EIP and Section 408 action.

The ultimate goal of the NLIP is to provide the Natomas Basin with a 200-year level of flood protection by improving conditions along approximately 42 miles of levees surrounding the Natomas Basin. These levees include the Natomas Cross Canal South Levee, Sacramento River East Levee, American River North Levee, Natomas East Main Drainage Canal West Levee, and the Pleasant Grove Creek Canal West Levee. The NLIP is a four-phase construction program: Phase 1 occurred in 2008, Phase 2 in 2009 and 2010, Phase 3 in 2010 and 2011, and a majority of Phase 4a work was completed in 2011 with the remainder scheduled for 2012. Phases 1 through 4a focus on the Natomas Cross Canal South Levee and a large portion of the Sacramento River East Levee.

Phase 4b includes a portion of the Sacramento River East Levee, the American River North Levee, the Natomas East Main Drainage Canal West Levee, the Pleasant Grove Creek Canal West Levee, any water supply and drainage pump station improvements which are needed but have been deferred from SAFCA's construction program, and other improvements needed to provide 200-year level of flood protection to the Natomas Basin. SAFCA staff is currently working with the USACE on an evolving plan for completing the Phase 4b work using a combination of USACE and SAFCA resources.

7.12 West Sacramento Levee Improvements Program

WSAFCA proposes to implement the Southport project along the right bank of the urbanized reach of the Sacramento River as an EIP and Section 408 action. The study reach is approximately 6 miles, beginning at the upstream limit where a SRBPP element terminates south of the barge canal connecting the Sacramento River to the Sacramento River Deep Water Ship Channel and extending downstream to West Sacramento city limit at the southern cross levee. The project would most immediately protect the part of the city known as Southport and is targeted at addressing under-seepage, through-seepage, erosion, and slope instability. This project is presently undergoing design development and an EIS/EIR is being prepared with USACE as the Federal lead agency for NEPA based on USACE's responsibilities under Section 408, Section 404, and Section 10. Similar to the relationship of the FRWLP to the Sutter Basin Project Feasibility Study, SBFCA's Southport project is being coordinated with the ongoing West Sacramento Project GRR (described previously). This project follows three others implemented by WSAFCA as EIPs and Section 408 actions, namely, the I Street Bridge project (completed in 2008) and the CHP Academy and The Rivers projects (completed in 2011).

8.0 Environmental Considerations

An EIS/EIR is being prepared in accordance with the National Environmental Policy Act and the California Environmental Quality Act for the FRWLP. The EIS/EIR will describe the existing environmental resources in the project area and will provide a project level analysis of the environmental effects of the FRWLP. The EIS will facilitate USACE planning and regulatory activities in connection with the FRWLP.

9.0 Public Interest Determination

Proposed Federal projects are to be reviewed to determine a project's probable impacts (including cumulative impacts) on the public interest (33 CFR §320.4). The public interest review is described

as a balancing of the benefits which reasonably may be expected to accrue from the proposal against its reasonably foreseeable detriments, with consideration of the national concern for both protection and utilization of important resources (33 CFR §320.4). In the case of the proposed Project, this review is being conducted in an Environmental Impact Statement (EIS) being completed for the purposes of complying with NEPA (40 CFR §1508.9). The draft EIS will analyze the potential impacts (including cumulative and growth inducing impacts) of the proposed Project and two alternatives on all relevant resource areas, including aesthetics, agriculture and land use, air quality, sensitive species and wetlands, cultural resources, hazardous waste, hydrology and water quality, noise, recreation, and transportation.

The general policies for conducting a public interest review included in 33 CFR §320.4, include three general criteria to be considered in the evaluation of every Federal project:

1) The relative extent of the public and private need for the proposed structure or work: As mentioned in Section 3 of this Project Summary Report, the deficiencies identified in the Project levees pose significant threats to public safety, property, and infrastructure during flood events. Without the proposed Project and without future improvements to other parts of the flood protection system, residents, their property and infrastructure will remain vulnerable to an unacceptable high risk of flooding;

2) Where there are unresolved conflicts as to resource use, the practicability of using reasonable alternative locations and methods to accomplish the objective of the proposed structure or work. Three alternatives to the proposed Project are being evaluated in the EIS/EIR to determine if there were more benign ways to improve flood control in the area. The No Action Alternative would not provide an adequate level of flood control for the area.

3) The extent and permanence of the beneficial and/or detrimental effects which the proposed structure or work is likely to have on the public and private uses to which the area is suited. NEPA policy is to assess and avoid, as practical, all the potential impacts of a Federal action to the environment in an effort to "foster and promote the general welfare" (42 USC 4331, Section 101). The EIS/EIR will assess short- and long-term effects of the proposed Project and its alternatives, as well as cumulative and growth-inducing effects. USACE and SBFCA have established a proactive multi-media outreach program to communicate the SBFCA program. The approach to the outreach program has been to go beyond the guidelines and requirements of NEPA and CEQA for public noticing to ensure the affected community and other interested stakeholders are informed, engaged, and involved through an accessible, open, and transparent process. Thus far, the FRWLP outreach program has included the following actions.

- Four scoping meetings for the environmental document.
- Publication of notices in local newspapers of major circulation.
- Publication in the *Federal Register*.
- Notification to the State Clearinghouse.
- Posting NEPA notices on the USACE website.
- Posting CEQA notices and project information on the SBFCA website.
- Publication in a local newsletter, distributed quarterly to all parties subject to the assessment district for updates and information about flood management activities.

- Presentation and discussion of the status of the project at various public meetings for elected boards and commissions.
- Phone calls to public agencies.
- Small-group meetings with interested stakeholders.
- Posting of notices in public places.

The FRWLP scoping effort was conducted jointly with the separate but related Sutter Basin Project as mentioned earlier. The two projects are related in their study area, purpose, potential measures and potential effects. Despite joint scoping, two separate EIS/EIRs are being developed for each project.

As the proposed improvements and FRWLP EIS/EIR are further developed, the outreach program would continue in a broad sense via the methods listed above and would expand through more targeted specific outreach to residents and businesses who might be more directly affected by construction or operation of the proposed improvements.

To date, the results of the FRWLP outreach program have been favorable, constructive, and supportive. The tone and substance of the input has been consistent with the voter-approved assessment to fund the local share of the project.

10.0 Executive Order 11988

Executive Order 11988 (May 24, 1977) requires a Federal agency, when taking an action, to avoid short- and long-term adverse effects associated with the occupancy and the modification of a floodplain, and it must avoid direct and indirect support of floodplain development whenever there is a reasonable and feasible alternative. If the only reasonable and feasible alternative involves siting in a floodplain, the agency must minimize potential harm to or in the floodplain and explain why the action is proposed in the floodplain.

In February 1978, the Water Resources Council issued Floodplain Management Guidelines for Implementing Executive Order 11988. These guidelines provide analysis of the Executive Order, definitions of key terms, and an eight-step decision-making process for carrying out the Executive Order's directives. The process contained in the Water Resources Council guidelines incorporates the basic requirements of the Executive Order. Briefly, the eight-step process is outlined below, followed by discussion of the FRWLP's application of the process to demonstrate compliance.

- **Step 1: Determine if a proposed action is in the base floodplain** (100-year floodplain or 1% chance flood or 500-year or 0.2% if the action falls under the definition of critical, discussed separately below). The FRWLP is located primarily on and adjacent to the west levee along the Feather River in Sutter and Butte counties and as such is not directly within the base 100-year floodplain but would improve the current level of protection ultimately to the goal of 200-year protection for more populated areas. The proposed action is described in EIR/S Chapter 2, including location, construction methods, and operations and maintenance activities.

  The Water Resources Council Floodplain Management Guidelines presented the concept of a critical action. While there is no precise definition of critical action, the guidelines (under Part II,

Decision-Making Process, Step 1C) outline the parameters of critical actions. To summarize, as noted in the guidelines, a critical action is "any activity for which even a slight chance of flooding is too great." This definition is intended to apply to Federal actions where that action would involve facilities or infrastructure that are sensitive to flooding, where the consequences of flooding would be severe in terms of ability to provide essential community services or to protect life and welfare. Under the FRWLP, it is the levee project itself that would reduce the chance of flooding, rather than being sensitive to or compromised by flooding; i.e., the project purpose is to manage flood risk. Therefore, the FRWLP is not considered a critical action because it is intended to withstand flood conditions, reduce flood risk, and increase flood protection.

- **Step 2: Provide public review.** The NEPA/CEQA process provides for public disclosure; this EIS/EIR is one instrument for public review of the FRWLP. As discussed in EIS/EIR Chapter 1, USACE and SBFCA have established a proactive multi-media outreach program to communicate the project and allow for public review and disclosure. The approach to the outreach program has been to go beyond the guidelines and requirements of NEPA and CEQA for public noticing to ensure the community and other interested stakeholders are informed, engaged, and involved through an accessible, open, and transparent process. Thus far, the outreach program has included the following actions:
    - Four scoping meetings for the environmental document.
    - Publication of notices in local newspapers of major circulation.
    - Publication in the *Federal Register*.
    - Notification to the State Clearinghouse.
    - Posting NEPA notices on the USACE website.
    - Posting CEQA notices and project information on the SBFCA website.
    - Periodic newsletters provided to the parcel owners in the flood improvement assessment district.
    - Presentation and discussion of the status of the project at various public meetings for elected boards.
    - Phone calls to public agencies.

    As the proposed actions and EIS/EIR are further developed, the outreach program would continue in a broad sense via the methods listed above and would expand through more targeted specific outreach to residents and businesses who might be more directly affected by construction or operation of the proposed improvements.

    To date, the results of the outreach program have been very favorable, constructive, and supportive for the FRWLP. The tone and substance of the input has been consistent with the very favorable response for the voter-approved assessment to fund the local share of flood improvements. Comments received from the public have been considered to refine the project description and the environmental analysis.

- **Step 3: Identify and evaluate reasonable and feasible alternatives to locating in the base floodplain.** Firstly, it should be noted that previously much of Sutter and Butte counties within the basin have not been mapped in the base floodplain, and land use planning decisions have been based on studies demonstrating protection from the base flood. Only recent studies (as

described in EIS/EIR Chapter 1) based on evolving levee standards now necessitate improvements to continue maintaining protection above the base floodplain. The proposed action (the FRWLP) is specifically targeted to provide such improvements and exceed the level of protection beyond the base flood to that of the 0.5% chance (200-year) flood event for more populated areas including in, around, and north of Yuba City and 100-year for the area south of Yuba City.

General engineering and environmental analyses have been performed for the FRWLP, following an identification and screening process discussed in EIS/EIR Chapter 2, *Alternatives*. Detailed analyses were performed for the alternatives and have found the proposed action to be the only practicable alternative that achieves the objectives of the project. Construction of the FRWLP would remove thousands of transportation, commercial, institutional, and residential structures and nearly 100,000 residents out of the base floodplain.

- **Step 4: Identify the effects of the proposed action.** This EIS/EIR analyzes the environmental effects potentially resulting from the FRWLP per NEPA/CEQA requirements. Review under the Endangered Species Act, Clean Water Act, Clean Air Act, and other Federal and state environmental regulations is also occurring in coordination with the EIS/EIR. Effects of the FRWLP are in EIS/EIR Chapter 3 of the EIS/EIR. In brief, the FRWLP may have temporary construction-related effects on roadways, air quality from heavy equipment use, biological resources (due to temporary disruption of or construction near habitat), temporary construction-related effects on residents due to noise generation, changes in visual quality, and interruption in utility service and property access. The project may also necessitate property acquisition, either through temporary construction easements or permanent increases in the levee footprint.
- **Step 5: Minimize threats to life and property and to natural and beneficial floodplain values.** Restore and preserve natural and beneficial floodplain values. The FRWLP would reduce flood risk for Sutter and Butte counties and increase protection for life and property within the affected area. The existing levee system was originally designed and constructed to provide a minimum level of protection from the base flood and ensure that human life and structures are out of the floodplain. The FRWLP target is to maintain and increase the level of protection beyond that of the base flood to a minimum 200-year protection (0.5% chance) for more populated areas including in, around, and north of Yuba City and 100-year for the area south of Yuba City.
- **Step 6: Reevaluate alternatives.** This EIS/EIR is part of a step-wise evaluation process to refine the alternatives through public review as well as through resource and regulatory agency input in consultation for compliance with the Clean Water Act, Endangered Species Act, and other project authorizations. The alternatives have been evaluated at the planning level for initial screening (in EIS/EIR Chapter 2) and for re-evaluation through environmental analysis (EIS/EIR Chapter 3). The alternatives are also continuously evaluated on a technical basis through independent review of the design documents (i.e., plans and specifications) at several levels of design development, including review by an Independent Panel of Experts. The recommendations and design refinements resulting from these reviews have been incorporated in the project description (EIS/EIR Chapter 2), resource analyses and findings (EIS/EIR Chapter 3), and project-level analyses and mitigation measures (EIS/EIR Chapter 3). This level of screening analysis has demonstrated that the proposed actions of the FRWLP are the most practicable alternatives.

- **Step 7: Issue findings and a public explanation.** To conclude the NEPA process, a record of decision for the FRWLP would be publically issued following the Final EIS. To conclude the CEQA process, findings would be publically issued following the Final EIR. A public workshop would be conducted during the draft document stage and a public hearing would be held to decide on project adoption by SBFCA as an action under CEQA.
- **Step 8: Implement the action.** SBFCA intends to construct the FRWLP as soon as possible based on conclusion of the project approval processes, targeted to be initiated in the 2013 construction season.

In conclusion, the FRWLP would reduce the risk of flood loss and minimize the effect of floods on human health, safety, and welfare by improving existing flood management infrastructure, and would increase protection for existing population centers. Importantly, the FRWLP would further protect farmland, agricultural commodities, and agricultural infrastructure for this crucial agricultural region. The FRWLP would also be a substantial step toward compliance with State law requiring 200-year protection for urban and urbanizing areas and would avoid development restrictions outlined under SB 5. Therefore, the FRWLP is not in conflict with Executive Order 11988 because the project would improve flood protection and because there is no reasonable and feasible alternative to the urban development already existing in the affected area. The Project EIS/EIR further complies with this Executive Order by identifying the most reasonable and feasible flood improvement alternative and disclosing the potential effects of the FRWLP that may lead to growth or other direct and indirect effects. Additionally, EIS/EIR Chapter 1, *Introduction*, and Chapter 2, *Alternatives*, explain why levee improvements are necessary for Sutter and Butte counties, regardless of how they may affect future development and growth.

11.0 Effects of the Proposed Modification

This section provides a summary of the indirect effects of the FRWLP.

11.1 Flood Control and Geomorphic Conditions

The proposed project would not significantly contribute to cumulative effects on flood control and geomorphic conditions resulting from the various seepage control and erosion treatments. Since the west bank of the Feather River in the project area does not have any significant freeboard issues, levee raises have not been proposed. Levee raises can cause slight increases in upstream or downstream water surface elevations and a transfer of flood risk to downstream reaches. Additionally, levee setbacks may cause variable localized, upstream, and downstream outcomes, dependent upon the modeling scenario, but levee setbacks are also not presently proposed in any of the project alternatives.

There is no evidence that the proposed seepage control and erosion treatments would represent an unacceptable transfer of flood risk to adjacent or downstream levee districts. Furthermore, strengthening portions of the Federal project levee system protecting the project area and implementing in-channel erosion protection measures would not result in any adverse hydraulic effects on other sub-basins protected as part of the SRFCP. Finally, these improvements would be consistent with the principles that have guided the management of the SRFCP over the past century

and with the policies adopted by the state legislature calling for an immediate and comprehensive effort to increase the level of flood protection provided to the region in the SRFCP area.

11.2 Water Quality and Groundwater Resources

There is potential for the project to have a cumulative water quality effect from the additional sedimentation from areas where construction would take place. However, it is anticipated that this cumulative increase in sedimentation would be minimal and the sediment loading would be minimized by construction-related BMPs.

No other projects presently known are expected to have potential groundwater effects cumulatively considerable with the FRWLP.

11.3 Geology, Seismicity, Soils, and Mineral Resources

The FRWLP could result in both beneficial and significant effects on geology, seismicity, and soils. Other earth-moving activities in the study area, such as development, could change the stability of soils, increase erosion and sedimentation, and expose structures to ground shaking and liquefaction. Soil stability is addressed through engineering design of structures, including levees, and ground-disturbing activities are required to stabilize soils on completion of construction or even between stages of construction. As such, no significant cumulative effects related to soil stability are anticipated. A cumulative increase in erosion and sedimentation could occur if other levee improvement projects on the Feather River occur at the same time. The potential for erosion and sedimentation resulting from the FRWLP and other projects is limited by minimization measures and implementation of a SWPPP. Any cumulative effect would be temporary and minimal and therefore less than significant. The levee improvement projects replace or upgrade existing flood control facilities (i.e., levees) and there would be no change in risks due to seismicity. However, there could be cumulative effects related to construction of structures that could be subject to seismic activity. The study area is not located in an active seismic area (i.e., no active faults and in an area of relatively low risk of strong ground shaking for California and therefore any cumulative increase in risk related to ground shaking would be less than significant.

There would be no effect on mineral resources, and therefore no cumulative effects associated with the levee improvement projects.

11.4 Transportation and Navigation

Construction activities associated with the FRWLP have the potential to result in short-term disruptions to roadways, including closures, increase in emergency response time and road hazards, effects on alternative transportation modes, disruption to navigation, temporary damage to roadway surfaces during construction, temporary increases in traffic volumes, and decreases in LOS for roads accessed or used for detours during construction. Combined with other projects in Sutter and Butte counties and along the Feather River, there could be significant cumulative effects on transportation if the FRWLP and other projects are implemented at the same time. Specifically, cumulative effects would occur if projects required closing or detours on multiple major roadways at the same time resulting in decreased access to roads within the project area. With implementation of the environmental commitment to use a traffic control and road maintenance plan to ensure minimal overlap in disturbances to traffic during project construction, these effects would be less than significant. No significant cumulative effects would occur.

11.5 Air Quality

The FRWLP would result in temporary construction-related emissions that would be partially mitigated by reducing vehicle and equipment emissions and implementing a fugitive dust plan. Regardless of the mitigation measures, the temporary construction emissions produced by the FRWLP would be significant and unavoidable on a project-level basis. Other projects occurring in the FRAQMD and BCAQMD jurisdictions at the same time as the FRWLP construction would result in cumulative effects that would be significant, particularly ROG, NO_x, and PM10. It is expected that projects generating these pollutants would also minimize emissions through dust control and vehicle emissions control. However, there could still be a significant unavoidable cumulative effect.

11.6 Climate Change

Construction activity for the FRWLP, considered on a project-only basis, would cause a temporary and less-than-significant increase in greenhouse gas emissions. However, climate change is a worldwide cumulative effect that is caused by all emission sources throughout California and the world. Therefore, the local effects of climate change in central California will be caused by worldwide GHG emissions rather than local emissions. The State of California, through the AB-32 process, has identified global climate change as a significant and unavoidable issue. Therefore, even though the FRWLP emissions would be small and mitigated to the extent practical, this cumulative effect is significant and unavoidable. Global climate change could affect the hydrology of the Feather River, including the frequency and intensity of flood events. Climate change is not expected to increase future water levels substantially, but the timing and intensity of flood events may change. However, seepage control facilities are designed to accommodate future flood intensities.

11.7 Noise

Implementation of the FRWLP would result in temporary but significant effects related to construction noise and vibration at sensitive receptors in the project area. Other projects in the vicinity of these receptors occurring at the same time could result in cumulative effects. However, because construction noise would be temporary and highly localized, implementation of project alternatives is not anticipated to make a cumulatively considerable contribution to noise effects in the project area.

11.8 Vegetation and Wetlands

Vegetation, including riparian vegetation, on levees would be permanently removed as necessary for construction of the proposed cutoff walls and seepage berms.Vegetation below the upper 20 feet of slope distance on the waterside would be allowed to remain in-place unless shown to pose a safety hazard to the levee, or removal was necessary for construction activities. If constructability or levee safety does not necessitate removal, vegetation on the remaining levee prism (outside of the lower waterside slope) shall be allowed to remain in place.

To allow placement of rock slope erosion protection vegetation would be permanently removed from the water side unless such vegetation could be safely protected in-place and does not pose a safety hazard to the levee. Additionally, waterside slope flattening, depression infill, and ditch lining may remove riparian vegetation during project construction.

Because the loss of riparian habitat as a result of the proposed project could be substantial, the disturbance and removal of riparian habitat would be considered a significant effect. These effects are considered unavoidable due to levee safety and constructability requirements.

The FRWLP would result in the fill of features that may be waters of the United States, including irrigation ditches, open water, and seasonal wetlands. Placement of fill would occur in jurisdictional features that are within the footprint of the cutoff wall and seepage berms. This analysis assumes that the ditches would not be replaced after the excavation is completed. In addition, rock slope protection would be placed within open water in the Feather River where needed for erosion control. This extent of effect on waters of the US is pending completion and verification of a delineation of waters of the United States and waters of the state in the project area.

Waters of the United States are regulated by USACE and waters of the state in California are regulated by the RWQCB. Wetlands are considered sensitive communities. The project would have a substantial adverse effect on federally protected wetlands and other waters of the United States through direct removal, filling, and hydrologic interruption; therefore, this effect would be considered significant. Implementation of the environmental commitment to develop a SWPPP and other Mitigation Measures would help offset these impacts. The table below summarizes the impact on potential habitat types.

Table 4. Effects on Habitat

Habitat Types	Project
Wildlands	
Riparian forest	15.44
Riparian scrub-shrub	0.47
Oak woodland	0.20
Open-Water Categories	
Irrigation ditch	0.01
Open water	0.09
Seasonal wetlands	0.01
Riparian forest wetland	NA
Stream	NA
Tailing ponds	NA
Orchards	97.77
Field and row crops	2.67
Developed/Disturbed Areas	
Developed	196.99
Ruderal	530.42
Total	847.52

11.9 Wildlife

Construction of the proposed improvements could result in the injury, mortality, or disturbance of special-status and common species during construction, which could impact local populations. Implementation of mitigation measures identified in this report would minimize or avoid injury,

mortality, or disturbance of special-status and common species during construction, and avoid or reduce the project's contribution to cumulative effects on local populations.

The proposed improvements would result in the permanent and temporary losses of land cover types that provide suitable habitat for special-status and common wildlife species. The loss of these habitats would cumulatively contribute to effects from other projects that remove these habitats in the project region. The Feather River corridor provides important nesting, roosting, foraging, cover, and movement habitat for numerous wildlife species, including several listed and rare species. Additional levee improvement projects along the Feather River levee system would result in losses of riparian habitat as a result of construction and/or implementation of USACE's policy regarding levee vegetation (or other future agreed upon policy). Coordination with USFWS, NMFS, DFG and appropriate local agencies would be required for such projects to ensure appropriate compensation for effects to riparian habitat. Additionally, many of the listed species affected by the proposed project would be affected by other projects along the Feather River. Because these species are protected under state and Federal laws, other projects would also be required to minimize injury and mortality, and compensate for loss of their habitats.

Loss of riparian forest would be compensated. Creation/restoration of riparian forest would occur along the Feather River corridor, within or adjacent to the biological study area and would ensure no net loss of riparian forest. Because the greatest threat to most special-status species is the loss of habitat, the permanent loss of habitat from the proposed project together with habitat loss for other projects in the region may be significant.

Construction and preconstruction mitigation measures have been established to minimize injury, mortality, disturbance, and habitat loss for special-status and common species. Mitigation measures include contractor/worker awareness training, surveys, construction barrier fencing, monitoring, and other species-specific measures. An overview list of measures intended to mitigate injury, mortality, disturbance, and habitat loss is presented below. These measures will be conducted in accordance with all appropriate wildlife agencies.

Mitigation Measure:

- Special-status beetles: Mitigation may include surveys, habitat avoidance, relocation, fenced barriers, signage, dust control measures, and other species-specific measures.

- Special-status turtles: Mitigation may include surveys, capture/relocation of entrapped turtles by biological monitors, construction monitoring, and other species-specific measures.

- Special-status snakes: Mitigation may include construction during active period (snakes can more easily escape during this period), USFWS protective measures during non-active period construction, barrier fencing, temporary construction halts until snakes identified on site are properly handled, habitat flagging, heavy equipment movement limited to designated haul routes, fee titles, conservation easements, in-lieu mitigation, and other species-specific measures.

- Special-status birds, special-status bats, and common avian species: Mitigation may include vegetation removal outside of breeding seasons, nesting surveys for vegetation removal inside of breeding season, no removal or disturbance of trees with nests or active raptors, protective measures during construction, barriers and buffer zones, off-site habitat management lands, eviction outside of nesting season, and other species-specific measures.

11.10 Fisheries and Aquatic Resources

Cumulative effects from levee repair would result in permanent loss of fish habitat. Compensation of lost riparian vegetation would help mitigate those effects with the goal of no net loss. Levee repairs on other reaches of the Feather River may also result in losses of riparian vegetation and permanent loss of fish habitat and could contribute to a significant cumulative effect.

11.11 Agriculture, Land Use, and Socioeconomics

During construction of the FRWLP, less than 0.1% of the agriculture land would be temporarily and/or permanently lost for agriculture production. This low percentage of the regions farmland would not result in any significant effects on agriculture or land use in the region. The project would include a benefit of employment for construction related workers for the duration of the project. No mitigation measures are required for agriculture, land use, or socioeconomics.

11.12 Population and Housing

Implementation of the Project may require the acquisition of up to 10 residences. Considering that 10 residences represent less than 0.05% of the total housing units in the basin the displacement of these residences would not displace a substantial number of people or existing housing units nor necessitate the construction of replacement housing elsewhere.

Acquisition of any residences for the FRWLP would comply with the policies and provisions set forth in the Uniform Act and implementing regulation, Title 49 CFR Part 24 and are in accordance with the California Government Code Section 7267, et seq.

Because implementation of the Project would neither displace a substantial number of existing housing units nor necessitate the construction of replacement housing elsewhere and would be carried out in compliance with the Uniform Act and the California Relocation Act, this effect is considered less than significant. No mitigation is required.

11.13 Visual Resources

Visual changes resulting from construction are considered short-term and temporary and would be considered less than significant. Permanent impacts are considered less than significant because most of the improvements consist of cutoff walls within existing levees. Permanent features such as new levees or seepage berms could impact visual resources. However, only a limited number of sensitive viewers have visual access to these reaches. Furthermore, permanent improvements are localized and would not obstruct scenic vista, thus the overall visual quality in these reaches would not change. Therefore, effects on scenic vistas would be less than significant for the FRWLP.

11.14 Recreation

The FRWLP would not result in any significant or beneficial effects on recreation, and consequently would not contribute to any cumulative recreation effects in the planning area.

11.15 Utilities and Public Services

Construction of the project may damage drainage and irrigation systems and public utility infrastructure, resulting in temporary disruptions to service. Coordination with drainage and

irrigation system users, consultation with service providers, and implementation of appropriate protection measures would minimize the possibility of any significant effects. Because utility and public service system effects would be isolated, temporary, and fully mitigated, the project would not result in a cumulatively considerable incremental contribution to a cumulatively significant impact.

11.16 Public Health and Environmental Hazards

The project has the potential to slightly increase risks to the public during construction through use of equipment and fuels, but the increased risk is temporary. These risks are minimized through implementation of the SWPPP and other best management practices described for mitigation measures. Because these are standard practice for construction projects, it is expected that the overall cumulative effect would not be adverse.

The FRWLP would improve flood protection for the planning area. The Sutter Basin Project is expected to propose flood management improvements that would further improve flood protection in the planning area, and other projects that reduce stress on the Sutter Basin levees could result in a beneficial cumulative effect in the planning area by reducing the overall public risk resulting from levee failure.

11.17 Cultural Resources

Because individual cultural resources consist of discrete, geographically bounded resources, they are not typically subject to cumulative effects. Individual resources may be affected by particular projects but cumulative effects do not typically accrue to individual cultural resources because such resources occur at particular locations rather than more expansive environmental resources such as air basins or river systems where individual projects may each contribute to the degradation of the resource. Accordingly, individual resources are not typically subject to cumulative effects. However, the combined set of actions that form the cumulative context are expected to result in significant and unavoidable effects on cultural resources resulting in an ongoing loss of such resources. Because the action alternatives would each result in significant and unavoidable effect on cultural resources, they would make a significant contribution to this cumulative effect. While mitigation is identified for the action alternatives, this mitigation does not reduce the contribution of the action alternatives to less than significant. For these reasons, this effect may be cumulatively significant and unavoidable.

Rural historic landscapes, however, may span large enough areas to be subject to cumulative effects. Such landscapes typically contain multiple contributing elements associated with the historic themes that give the landscape significance. For example, reclaimed agricultural landscapes may have multiple elements such as drainage systems, road systems and landscape patterns (Dames and Moore 1996). Because these landscapes span large areas, individual projects may each contribute to a loss of the resource's integrity that ultimately results in a complete loss of the ability of the resource to convey its significance. The FRWLP would alter the features of the Feather River West Levee and would also require the use and operation of borrow sites. These improvements may result in the demolition of individual structures and residences that contribute to rural historic landscapes. Other projects that form the cumulative context may contribute to these effects through plan build out, levee repair, or other actions requiring demolition of structures forming portions of rural historic landscapes also affected by the FRWLP. For these reasons, the FRWLP may contribute to cumulatively significant and unavoidable effects on rural historic landscapes.

11.18 Environmental Justice

The FRWLP would not result in environmental justice effects and, therefore, there would be no cumulative effect.

11.19 Residual Risk

Implementation of the FRWLP would substantially lessen the probability of flooding in the Sutter basin due to levee failure. However, the Basin would remain subject to risk from flooding. SBFCA recognizes that the consequences of a flood would increase over time as new development occurs within the basin. If no additional risk reduction measures are implemented, the result would be a rise in expected annual damages that would undermine the risk reduction accomplishments of the FRWLP. However, development in California is a highly regulated activity that involves a laundry list of discretionary approvals and permits, each of which is critical to development. No single approval or permit in itself will guarantee a right to develop. Rather, a developer's failure to obtain even a single discretionary approval, such as annexation, or a permit, such as an incidental take permit under the ESA or CESA, will scuttle the project. Even if a developer can persuade a city or county that local planning laws, many of which are designed to discourage development, do allow for construction, CEQA may prohibit the agency from granting approval. In addition, many potential developers will be dissuaded by the exorbitant costs attached to development in California, including development impact fees and the costs of CEQA compliance. Historic growth patterns indicate that development has been very slow in this region due to the above as well as a lack of market pressures and economic drivers that would support development.

To reduce the residual risk, SBFCA is participating in the Regional Floodplain Planning initiative which has developed out of the Central Valley Flood Protection Plan adoption process, and is evaluating existing and proposed development fee programs that could be used to finance a continuing flood risk reduction program for the basin.

11.20 Transfer of Risk

Strengthening portions of the federal project levee system protecting the basin as proposed by SBFCA would not result in any significant, adverse hydraulic impacts or induce flooding to other sub-basins protected as part of the SRFCP. Indeed, the work proposed will bring these levees cloer to the authorized level of protection. Furthermore, these improvements would be consistent with the principles that have guided the management of the SRFCP over the past century and with the policies adopted by the State Legislature calling for an immediate and comprehensive effort to increase the level of flood protection provided to urban areas within the California Central Valley.

The proposed project specific elements of the FRWLP do not include levee raising. Since the proposed action will not change water surface elevations, the USACE has concluded that a risk analysis is not necessary.

11.21 Growth Inducement

The FRWLP and proposed EIPs would reduce the risk of flood loss and minimize the impact of floods on human health, safety, and welfare by improving existing flood management infrastructure, and would increase protection for existing urban development and remove one in a series of potential obstacles to future growth. Because the improvements alone do not induce development and because there is no reasonable and feasible alternative to levee improvements to provide protection

to the existing urbanized communities, this action is not in conflict with Executive Order 11988. Further, even if these actions are deemed to be growth inducing, there are no other practical alternatives to this project for the existing urbanized areas, and therefore it is not in conflict with Executive Order 11988.

The Project EIS/EIR further complies with this Executive Order by identifying the most reasonable and feasible flood improvement alternative and disclosing the potential effects of actions under the FRWLP that may lead to growth or other direct and indirect effects.

12.0 Technical Analysis and Adequacy of Design

12.1 Geotechnical Analysis

Previously, the design team prepared a Pre-Design Formulation Report (PFR) for the FRWL Project, as well as 30% design plans (HDR, 2011). The PFR included:

- Characterization and evaluations of existing levee conditions.
- Determinations regarding the need (or lack of) to rehabilitate each reach of the FRWLP.
- Evaluation of various potential rehabilitation measures that may be used for the FRWLP.
- For each reach needing rehabilitation, analysis of two different rehabilitation alternatives to estimate rehabilitation measure dimensions and costs.
- Selection of a preferred alternative for each reach and formulation of a Project-wide optimized alternative to be carried forward in design.

Geotechnical characterization, analyses, and evaluations included in the PFR incorporated the findings of various previous investigations by others and also new data collected for the FRWL Project. Numerous previous geotechnical studies have been performed for portions of the FRWLP. Notably, from 2007 to 2010, the DWR Urban Levee Evaluations (ULE) Project investigated nearly the entire length of the FRWLP, including performing extensive subsurface explorations and laboratory testing, conducting geotechnical analyses, and compiling information from previous geotechnical studies (URS, 2010). Subsequently, additional explorations were performed for the FRWL Project during the geotechnical investigation for the Pre-Design Formulation Report (PFR).

Following preparation of the PFR and 30% design plans, additional geotechnical exploration was performed to support design confirmation and refinement. Approximately 130 additional explorations have been performed since preparation of the 30% design plans, to:

- Evaluate subsurface conditions to estimate appropriate cutoff wall depths.
- Evaluate aquiclude/composite-blanket continuity landward of the levee.
- Evaluate subsurface conditions for rapid drawdown evaluations.
- Evaluate landward continuity of stratigraphy for berm design.
- Characterize stratigraphy/characteristics at anomalous locations, such as landside ponds, headgate structures, and pump stations.
- Evaluate previous performance problem areas.

Findings of these explorations are presented in a Geotechnical Data Report for the FRWL Project (URS, 2012), which is a companion report to this GDRR. The Geotechnical Data Report provides geotechnical data collected in the FRWL Project and from previous geotechnical studies by others in the FRWLP area.

This GDRR was prepared by URS Corporation (URS), as part of the FRWL Project design team, to support 65% design of the FRWL Project. These data collectively form the basis of this GDRR and the 65% design of the FRWL Project. Geotechnical evaluations to support the 65% design included:

Updating reaches, geotechnical parameters, and cross sections for design analyses,

- Developing new analytical cross sections and corresponding parameters.
- Performing geotechnical analyses to confirm or modify design of rehabilitation measures.

Geotechnical analyses included steady-state seepage, landside stability, and waterside rapid drawdown. Approximately 80 cross sections were analyzed. Table 8-1 of this GDRR summarizes results of the steady-state seepage, landside stability, and rapid drawdown analyses. Additionally, liquefaction analyses were performed for approximately 80 locations and 12 cross sections were analyzed for seismic vulnerability.

Table 8-2 of this GDRR presents the geotechnical recommendations for design of rehabilitation measures for the FRWL Project 65% design. Recommended rehabilitation measures for the FRWL Project include, at various locations:

- Cutoff walls, to various depths.
- Shallow cutoff walls and relief wells.
- Seepage berms.
- Levee de-grade and reconstruction.

Cutoff walls are the preferred rehabilitation measure for the vast majority of FRWLP reaches that need rehabilitation. Recommended depths for the cutoff walls range from shallow (approximately 20 feet deep) to very deep (more than 100 feet deep). Most commonly, the recommended depths for the cutoff walls range from about 30 to 70 feet deep. In support of the 65% design, cutoff wall depths were refined to account for variations in geotechnical conditions, as well as hydraulic loading and topographic conditions, over the length of each reach (i.e., recommended wall depths are not constant over the length of a reach, but vary along the reach to correspond to the varying conditions). Geotechnical analyses were performed at locations identified as being the most critical for the design in order to confirm the effectiveness of the design. For some reaches, especially those with significant variations in cutoff wall depths, cross sections at multiple locations were analyzed to confirm the effectiveness of the design. Sensitivity analyses also were performed at many cross sections to support the conclusions and recommendations for design.

12.2 Hydraulics and Hydrology Analysis

For the FRWLRP, PBI utilized the HEC-RAS model that is currently being prepared for the USACE as part of the SBFS. A summary of the hydraulic modeling that was completed for the FRWLRP is provided below.

DATUM
The referenced vertical datum is the North American Vertical Datum of 1988 (NAVD88).
The referenced horizontal projection is NAD 1983 State Plane, California Zone II.

TOPOGRAPHY
Ground surface topography was based on USACE Sacramento and San Joaquin River Basins Comprehensive Study mapping (December 2002), which was provided by the USACE at a contour interval of 2 feet.

HEC-RAS RIVER CHANNEL MODELING

The Sacramento River system HEC-RAS model is an ever-changing model that is frequently updated in order to support various flood control projects throughout the region. The model was utilized in 2005 by the USACE for the *Lower Feather River Floodplain Mapping Study* and versions of this model have since been updated independently by both the USACE and MBK engineers. The USACE model was updated to support the *American River Watershed Common Features General Reevaluation Report* and the MBK model was updated to support the levee improvement projects that were constructed by the *Three Rivers Levee Improvement Authority* (TRLIA). For the SBFS, PBI obtained the USACE Common Features model and updated it to include the work that MBK performed for the TRLIA program. In addition, PBI further refined the model for the Upper Feather River and Sutter Bypass reaches. The SBFS model was then calibrated to a major flood event that occurred in January 2006 and verified to an event that occurred in 1997.

This calibration had completed the Independent Technical Review stage and just prior to the FRWLRP analysis, the model's vertical datum was updated from the National Geodetic Vertical Datum of 1929 (NGVD29) to NAVD88. Details regarding the vertical datum conversion are included in the *Draft Vertical Datum Conversion TM*. Details regarding the development of the SBFS HEC-RAS model will be provided in the Hydraulics Appendix of the SBFS Report, which is scheduled for release in 2011. It should be noted that the PBI model used to generate the water surface profiles for the FRWLRP includes the TRLIA improvements and the recently constructed Star Bend setback levee. The model developed for the SBFS includes the TRLIA improvements, but does not include the recently constructed Star Bend setback levee because per Section 104 of WRDA 1996, the Star Bend levee will be considered a "with-project" feature. For the model inflow parameters, PBI utilized 1/200 annual exceedance probability (AEP) 30- day storm event hydrographs from the SBFS. In developing these hydrographs the USACE used two different storm centering: 1) the Sacramento River storm centering and 2) the Shanghai Bend storm centering. The Shanghai Bend storm centering produces higher flows in the Feather River and the Sacramento storm centering produces higher flows in the Sutter Bypass.

The FRWLRP utilized the Shanghai storm centering (shown in Table 5) and the inflows were applied to the most upstream cross sections of the HEC-RAS model,.

Table 5 – Shanghai Storm Centering Peak Inflow Values (cfs)

Description	1/100 AEP Storm Event	1/200 AEP Storm Event	1/500 AEP Storm Event
Dry Creek	7,000	8,100	9,400
Feather River	150,000	174,000	327,000
Sacramento River	52,900	58,200	62,600
Sutter Bypass	156,000	218,000	273,000
Yuba (Englebright)	141,000	211,000	295,000
Yuba (Deer Creek)	9,500	10,700	12,400
Yuba (Dry Creek)	9,000	10,100	11,600
Honcut Creek	32,300	38,800	48,100

The HEC-RAS model results for each of the AEP events are shown in Table 4. The results are referenced to both the Wood Rodgers FRWLRP design stationing (provided to PBI from Wood Rodgers on September 27, 2010) and the USACE 1957 profile (provided to PBI by DWR on August 26, 2010). The 1957 profile was provided to PBI by DWR via excel spreadsheet . No details were provided regarding its development. It is assumed that the values were manually interpolated off of scaled drawings and then converted to NAVD88. The river stationing of the 1957 profile was compared to the river stationing of the PBI HEC-RAS model by comparing the values at bridge crossings and river confluences; these values were found to be within +/- 0.25 miles. The HEC-RAS

model files that were used in this analysis are titled "PBI Sutter Basin Model 10.15.2010" dated October 26, 2010.

The majority of the FRWLP improvements consist of cutoff walls and seepage berms, which have no effect on the existing river channel hydraulics of the Feather River. In addition, the proposed changes to the existing vegetation on the waterside of the levee are far too minor to produce any measurable effects on the hydraulics. However, the proposed improvements for reaches 26 thru 28 (STA 1674+00 thru 1770+00) include a shifting of the levee waterward by a distance of about 20-feet . A 'With-Project' hydraulics analysis was therefore completed in order to provide justification that the proposed levee shift does not alter the river channel hydraulics of the Feather River.

The 'With-Project' hydraulics analysis was completed as follows:

- The 'Existing Conditions' HEC-RAS geometry was modified for the Feather River cross sections 45.58 thru 47.7 in order to simulate the future 'With-Project' conditions. The 'With-Project' geometry incorporates the proposed 20' levee shift for reaches 26 thru 28

- The 100-year, 200-year, and 500-year events were simulated using the 'With-Project' geometry. Similar to what was done for the design (existing conditions) WSP, the 'With- Project' WSP are a composite of both the Shanghai and Sacramento storm centerings, where the higher water surface elevation is selected at each HEC-RAS cross section.

- The 100-year, 200-year, and 500-year 'With-Project' WSP were compared to the 'Existing Conditions' WSP.

It is important to note that for the 100-year and 200-year events, the Feather River water surface does not reach the waterside levee toe elevation for reaches 26 thru 28; therefore, it can be expected that the 'With-Project' and 'Existing Conditions' water surface profiles will be exactly the same for both the 100-year and 200-year events. The results of the 'With Project' analysis showed that the FRWLP has no hydraulic impacts to the Feather River.

12.3 Risk and Uncertainty Analysis

It has been concluded that a Risk and Uncertainty analysis is not necessary for the FRWLP since the project elements have no hydraulic impacts to the Feather River.

12.4 Levee Vegetation Management

The circumstances of compliance with USACE levee vegetation policy in the Sacramento Valley is complex, due to the overlays of flood management objectives, protected fish and wildlife habitat, environmental regulations, overlapping jurisdictional authorities, and recreation and other social values. In light of these circumstances, the No Action Alternative reflects multiple possible future scenarios. At this time, it is considered too speculative to adopt and consider a single one of these future scenarios as the sole or most likely outcome. Therefore, this document acknowledges and analyzes the following conditions in regard to the USACE levee vegetation policy as it relates to the No Action Alternative for the actions under consideration.

- Full application of USACE levee vegetation policy, as detailed in Engineering Technical Letter 1110-2-571, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures (ETL), meaning prohibition and

removal of woody vegetation within the levee prism or within 15 feet of the landside or waterside levee toes (the scenario described and analyzed in the Draft EIS/EIR);

- No application of the ETL; assuming the continued existence into the future of the vegetation conditions at the time of the analysis;
- Application of the Urban Levee Design Criteria http://www.water.ca.gov/floodsafe/leveedesign/ULDC_May2012.pdf produced by the California Department of Water Resources that requires life cycle management of woody vegetation, allows unmanaged vegetation below 20 feet slope distance on the waterside, and removal of vegetation anywhere on the levee that poses a levee safety hazard; and
- Application of a possible variance, such as the variance issued for the Natomas Levee Improvement Program under USACE's draft variance policy, meaning removal of trees within the levee prism on the landside slope or within the landside operations and maintenance corridor, and allowance of trees within the levee prism on the waterside slope based on demonstration of not affecting the critical levee prism.

Further complicating this matter, it should be noted that there is federal litigation that challenges USACE's levee vegetation policy. The case, *Friends of the River, et. al. v. United States Army Corps of Engineers, et. al.* was filed in the U.S. District Court for the Eastern District of California in June 2011. Plaintiffs in the case include Friends of the Rivers, Defenders of Wildlife, Center for Biological Diversity, and DFG. The existence of the ongoing legal proceedings and unknown outcome support the approach of multiple future scenarios.

12.5 Real Estate Analysis

The FRWLP involves real property interests required for its construction and subsequent operation and maintenance. SBFCA will acquire fee title to the areas required for the levee improvement facilities. Additional permanent easements will be acquired operations and maintenance activities. Temporary construction easements will be acquired for the areas required for haul routes and working areas.

SBFCA will comply with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 916456 for eligible owners and/or tenants. A comprehensive Relocation Plan will be developed to address the needs of any displaced owners and/or. As the various phases of the project progresses, the Relocation Plan will be augmented with the specific information about each displacee.

13.0 Administrative Record

SBFCA and its consultants are continuing to compile an Administrative Record as required by NEPA and CEQA. The Administrative Record includes everything the agency has considered in reaching a Federal decision regarding this proposed action. Significant contributions to this effort will be listed in the FRWLP Draft EIS/EIR. Further information can be obtained upon request.

14.0 Technical Support Documents

Kleinfelder. 2009. *Preliminary Problem Identification and Conceptual Alternatives Analysis Report Sutter Butte Flood Control Agency Feather River West Levee Evaluation Thermalito Afterbay to Yuba City Butte and Sutter Counties, California*.

Peterson Brustad Inc. 2009. *Preliminary Design Report for The Feather River West Levee Rehabilitation Project.* September.

HDR. 2010. *Design Criteria and Technical Approach Memorandum, Feather River West Levee Improvements, Sutter Butte Flood Control Agency*, Yuba City, California, November.

URS. 2010b. *Draft Interim Geotechnical Data Report, Feather River West Levee Rehabilitation Early Implementation Project*. December.

HDR. 2011. *Pre-Design Formulation Report*. Sutter Butte Flood Control Agency. Feather River West Levee Project. August.

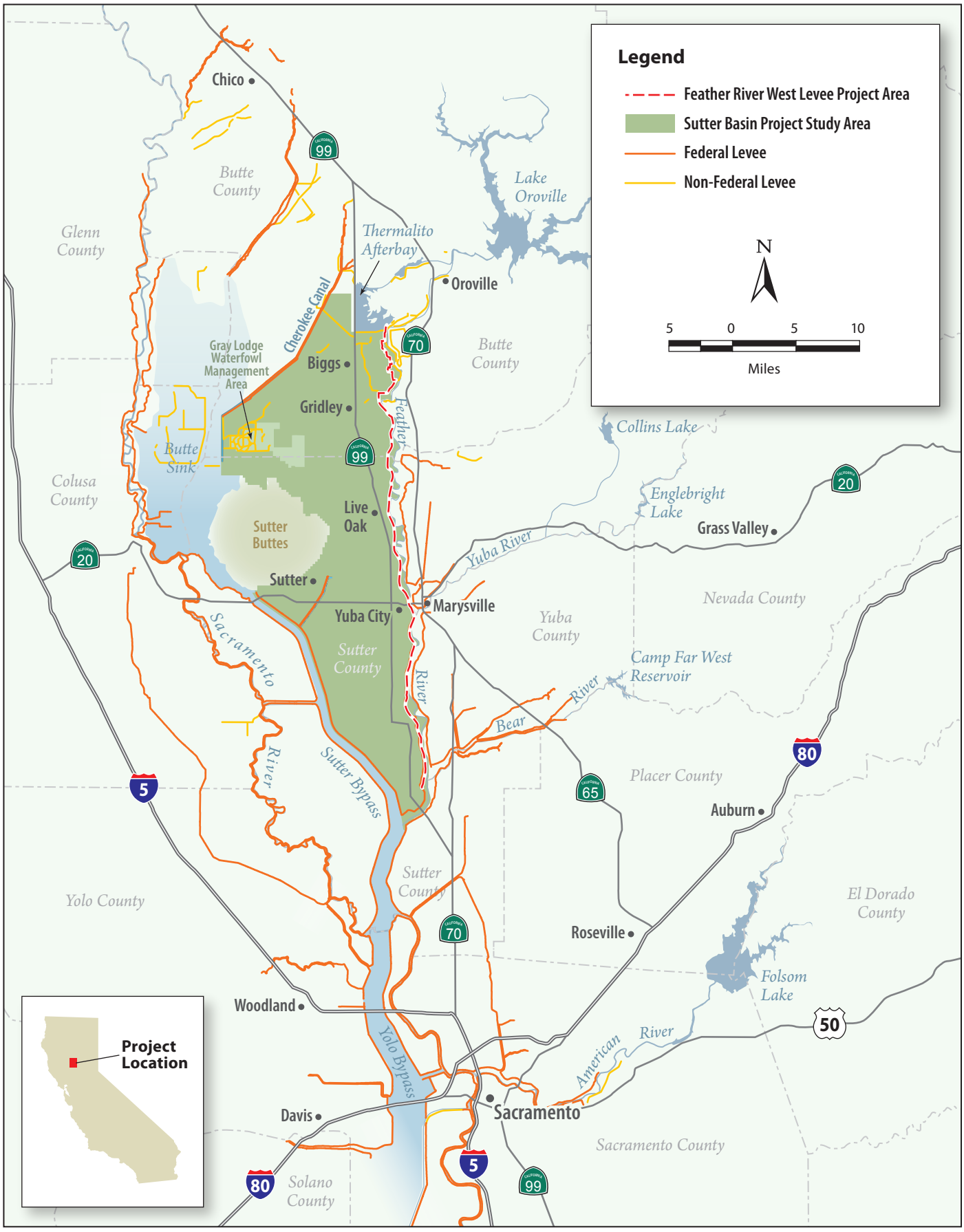
Peterson Brustad Inc. 2011. *Revised Design Water Surface Profiles for the Feather River West Levee Rehabilitation Project*. September.

URS. 2011a. *Approach for Rapid Drawdown Analysis*. Technical Memorandum. Feather River West Levee Project. December.

URS. 2012. Approach for Seismic Vulnerability Analysis. Technical Memorandum. Feather River West Levee Project. January.

URS. 2012. *Draft Geotechnical Data Report (GDR)*. Feather River West Levee Project. February.

APPENDIX A - PLATES



Graphics ... 00852.10 (6/18/12) AB

Plate 1-1
Regional Setting

State Plan of Flood Control

Lead Agency: DWR
Location: Central Valley
Goal: Guide flood management expenditures under Propositions 84 & 1E
Timeline: Complete Plan by 2014

Sacramento – San Joaquin River Basins Comprehensive Study/Central Valley Integrated Flood Management Study

Lead Agency: USACE and DWR
Location: Central Valley
Goal: Flood damage reduction and ecosystem restoration
Phase: Comp study was completed in 2002; CVIFMS is expected to be complete by 2015

Sutter Basin Project

Lead Agency: USACE and SBFCA
Location: Sutter and Butte counties
Goal: Increase flood protection for communities in Sutter and Butte counties
Phase (Timeline): Feasibility Study and EIS (2011)

Mid-Valley Project

Lead Agency: USACE and State of California
Location: Knights Landing
Goal: Flood risk reduction for Knights Landing
Timeline: Construction by 2016

Natomas Levee Improvement Program

Lead Agency: SAFCA
Location: Natomas Area, Sacramento
Goal: Achieve 200-year flood protection for the Natomas Basin
Timeline: Construction of 100 yr. protection by 2011, 200 yr. protection by 2012

West Sacramento Levee Improvements Project

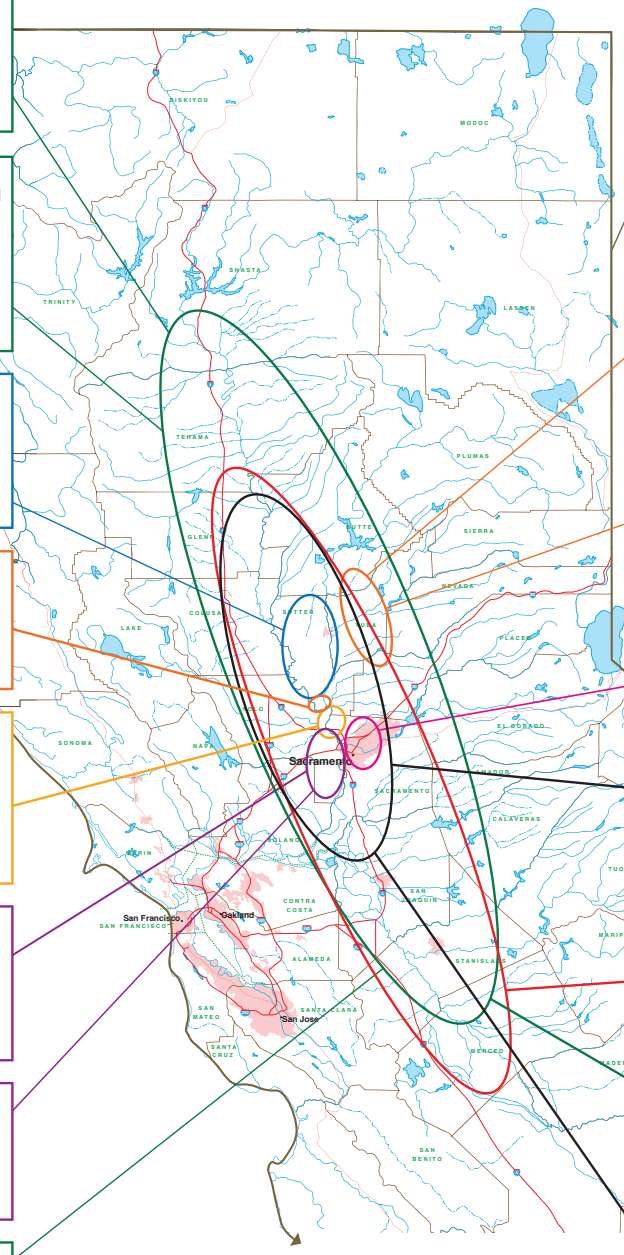
Lead Agency: USACE and WSAFCA
Location: West Sacramento
Goal: Achieve 200-year flood protection for the City of West Sacramento
Phase (Timeline): EIS/EIR (2010)

West Sacramento Project

Lead Agency: WSAFCA, USACE and DWR
Location: West Sacramento
Goal: Comprehensive analysis of the City's levee system
Phase (Timeline): GRR (2012)

Central Valley Flood Protection Plan

Lead Agency: DWR
Location: Central Valley and Sacramento-San Joaquin Delta
Goal: Develop strategies for comprehensive system-wide flood improvements
Timeline: Complete plan by 2012; complete protection measures by 2025



FloodSAFE

Lead Agency: DWR
Location: State-wide, but primarily Central Valley
Definition: Multi-faceted program to improve public safety through integrated flood management.
Timeline: Complete foundational objectives by 2025

Yuba Basin Project

Lead Agency: USACE, DWR, and YCWA
Location: Yuba, Feather, Bear rivers Watershed
Goal: Increase flood protection for communities of Linda, Olivehurst, Arboga, Marysville, and unincorporated areas of Yuba County
Phase (Timeline): GRR (2010)

Three Rivers Levee Improvement Authority Projects

Lead Agency: Three Rivers Levee Improvement Authority
Location: Southern Yuba County
Goal: Increase flood protection for communities in southern Yuba County
Phase (Timeline): Construction of 200-year protection by 2010

American River Common Features Project

Lead Agency: USACE, DWR, and SAFCA
Location: Sacramento metropolitan area
Goal: Reduce flood risks for the City of Sacramento
Phase (Timeline): GRR (2010)

Sacramento River Bank Protection Project

Lead Agency: USACE and DWR
Location: SRFCP
Goals: Federal program to correct levee erosion issues
Phase (Timeline): Ongoing Phase II EIS (2011)

PL 84-99 Rehabilitation Assistance of Flood Control Works

Lead Agency: USACE and DWR
Location: Central Valley and Sacramento-San Joaquin Delta
Goals: Federal program to provide emergency levee repairs
Timeline: Ongoing

Levee Collaborative

Lead Agency: USACE and DWR
Location: Central Valley
Goals: Develop short- and long-term plans to achieve system-wide compliance with USACE standards for the State Flood System in the Central Valley
Timeline: Ongoing

Sacramento River Flood Control System Evaluation

Lead Agency: USACE
Location: SRFCP
Goals: Repairing, raising, and strengthening urban levees
Timeline: Ongoing

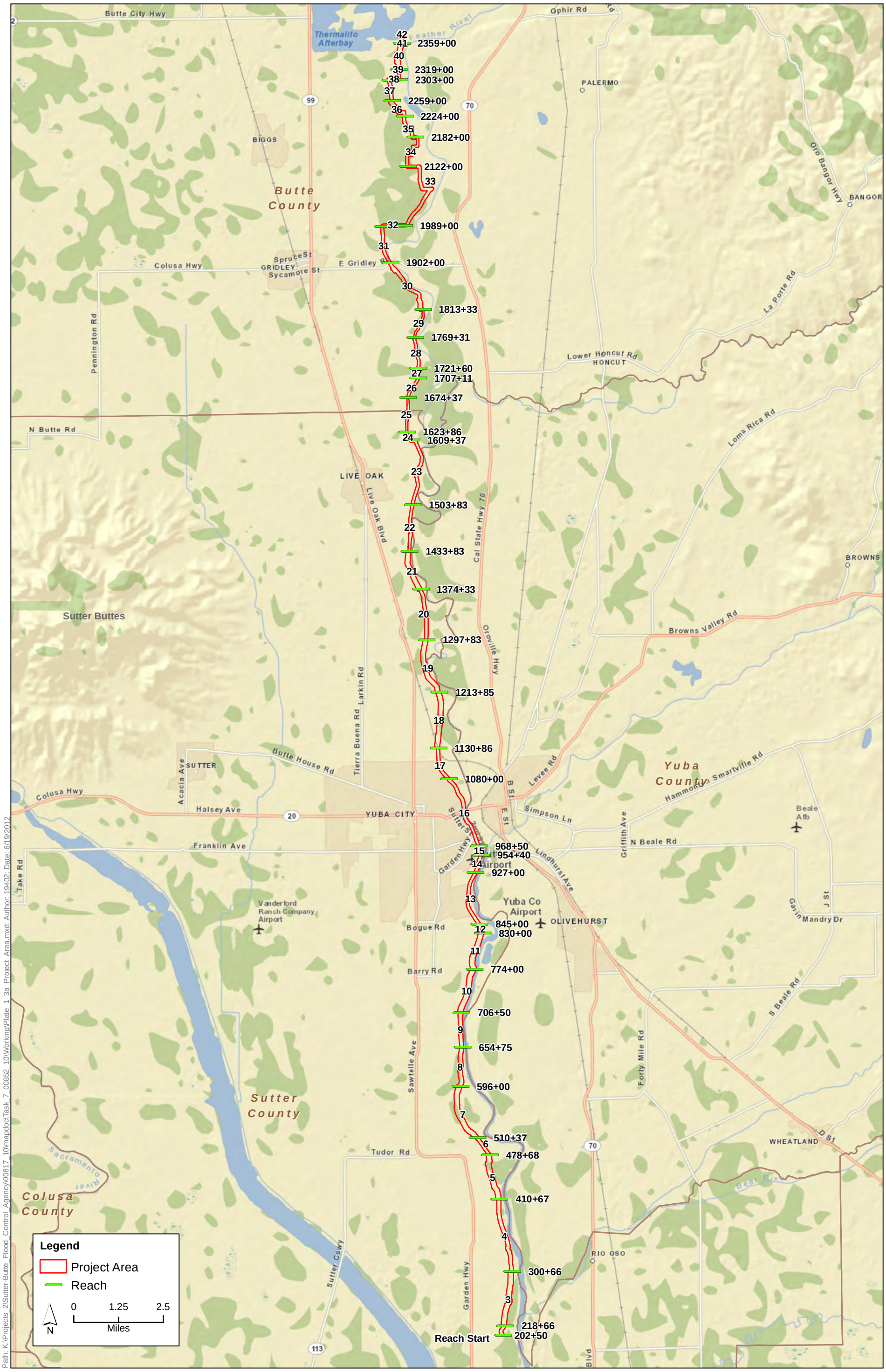
ACRONYMS

WSAFCA - West Sacramento Area Flood Control Agency
USACE - U.S. Army Corps of Engineers
SBFCA - Sutter-Butte Flood Control Agency
DWR - Department of Water Resources
SAFCA - Sacramento Area Flood Control Agency
SRFCP - Sacramento River Flood Control Project
YCWA - Yuba County Water Agency

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Plate 1-2
Major Flood Risk Reduction Efforts in the Sacramento Valley

Attachment H - FRWL Project Summary Report, Section 408 Application



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Plate 1-3a
Project Area

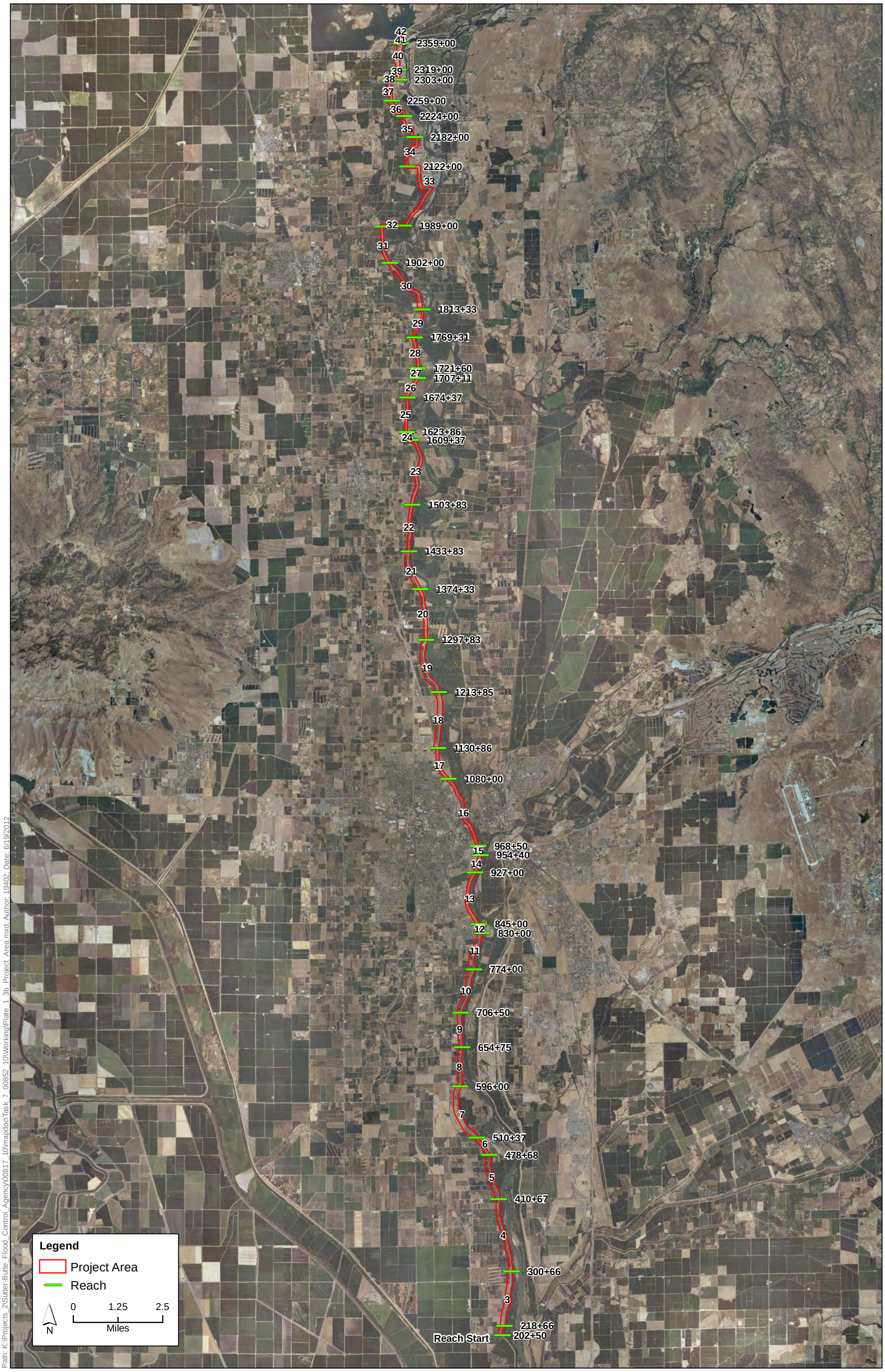


Plate 1-3b
Project Area



Reach 4. Feather River west levee looking northeast from water side of levee crown. Note mature vegetation on waterside slope. River is off the photo to the right.



Reach 4. Feather River west levee looking northwest from landside of levee crow. Note the Sutter Buttes visible on the horizon and orchards in foreground.

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Plate 1-4
Representative Photos of the Project Area



Reach 7. Feather River west levee looking northeast from landside slope. Note the Sutter Buttes to the left along the horizon and the agricultural fields in the foreground.



Reach 8. Feather River west levee looking northeast from waterside slope. Note the mature vegetation along the bank, and the Feather River in the middleground barely visible beyond the near vegetation.

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Plate 1-5
Representative Photos of the Project Area



Reach 9. Feather River west levee looking south from the levee crown at Boyd's Pump. Note the boat launching facilities.



Reach 11. Feather River west levee looking south from the crown. Note the river channel at left and the mature vegetation along the bank.

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Plate 1-6
Representative Photos of the Project Area



Reach 13. Feather River west levee looking south along the landside slope at the intersection of Shanghai Bend Road. Note the paved public access trail and the residences to the west. The river is at left off the photo.



Reach 14. Feather River west levee looking west from the landside slope at the Sutter County Airport.

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Plate 1-7
Representative Photos of the Project Area



Reach 18. Feather River west levee looking north from the levee crown. Note the utility poles at the landside toe of the levee at left with orchards beyond.



Reach 19. Feather River west levee looking west from the land side of the levee crown. Note the Sutter Buttes in the background and orchards in the foreground.

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Plate 1-8
Representative Photos of the Project Area



Reach 23. Feather River west levee looking south from the levee crown. Note the residence on the landside toe and the mature vegetation on both the land and watersides of the levee.



Reach 26. Feather River west levee looking north from land side of the crown. Note the irrigation canal, utility poles, and orchards to the left. Also note the decreased levee prism in this reach.

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Plate 1-9
Representative Photos of the Project Area



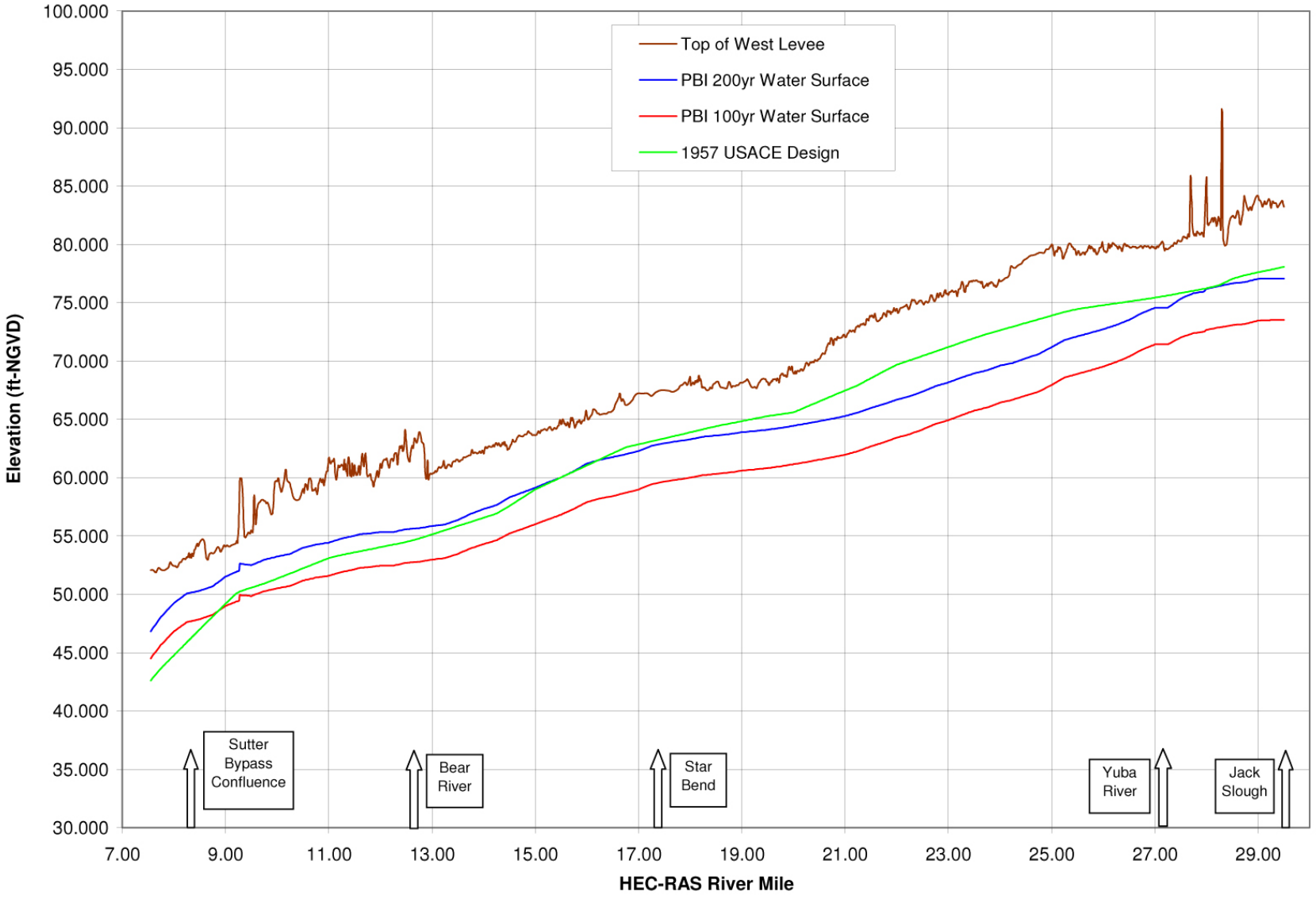
Reach 32. Feather River West levee looking north from the water side of the levee crown. Note orchards on both water side and land side of the levee.



Reach 33. Feather River west levee looking north. Note the orchards on the land side to the left and the aggregate deposits in the floodplain to the right.

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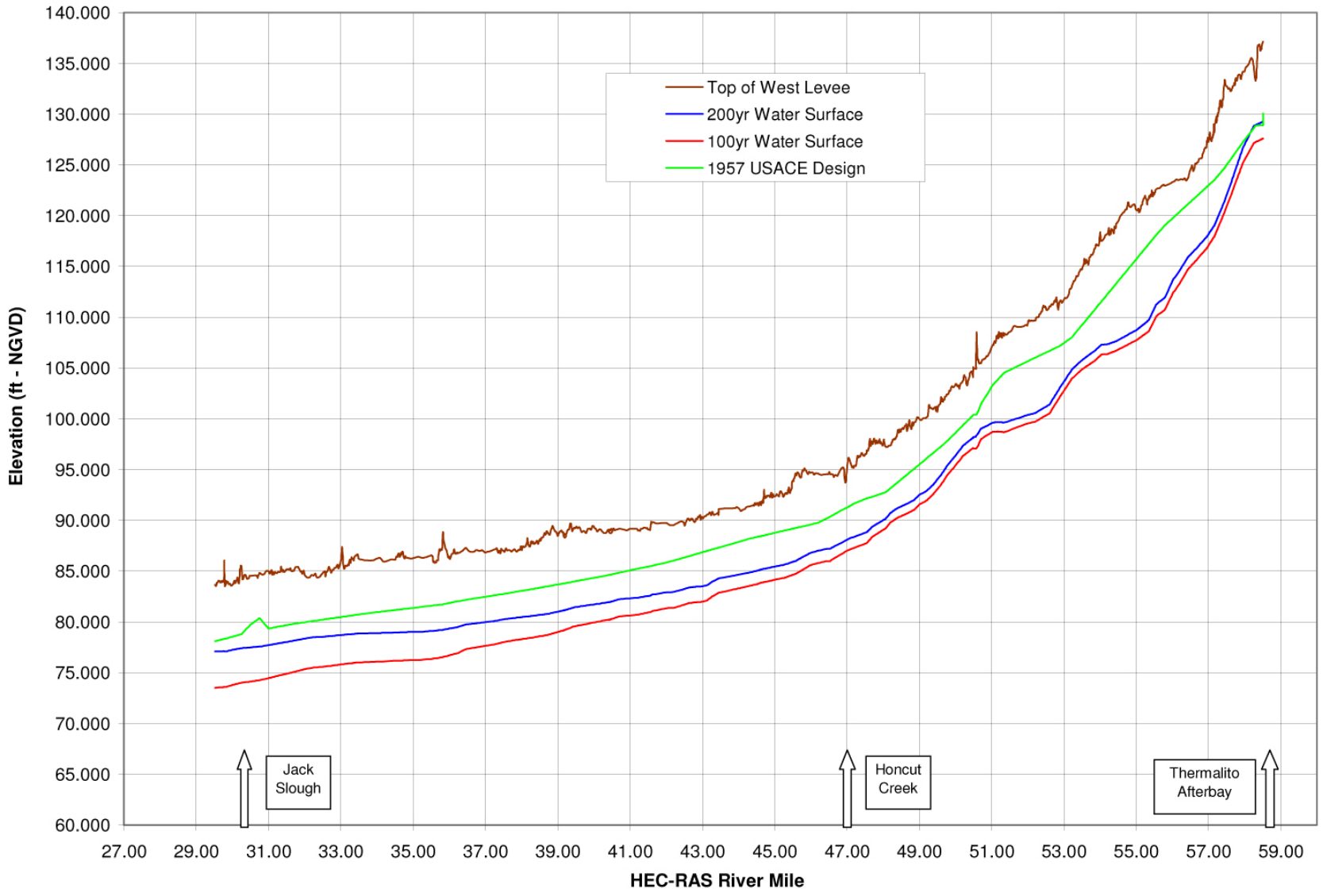
Plate 1-10
Representative Photos of the Project Area



Source: Peterson Brustad, Inc. 2010. Sutter Butte Flood Control Agency's Early Implementation Program Project Report for the Feather River West Levee Rehabilitation Project. Figure 9

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Figure 3.1-1
Lower Feather River Freeboard Profile

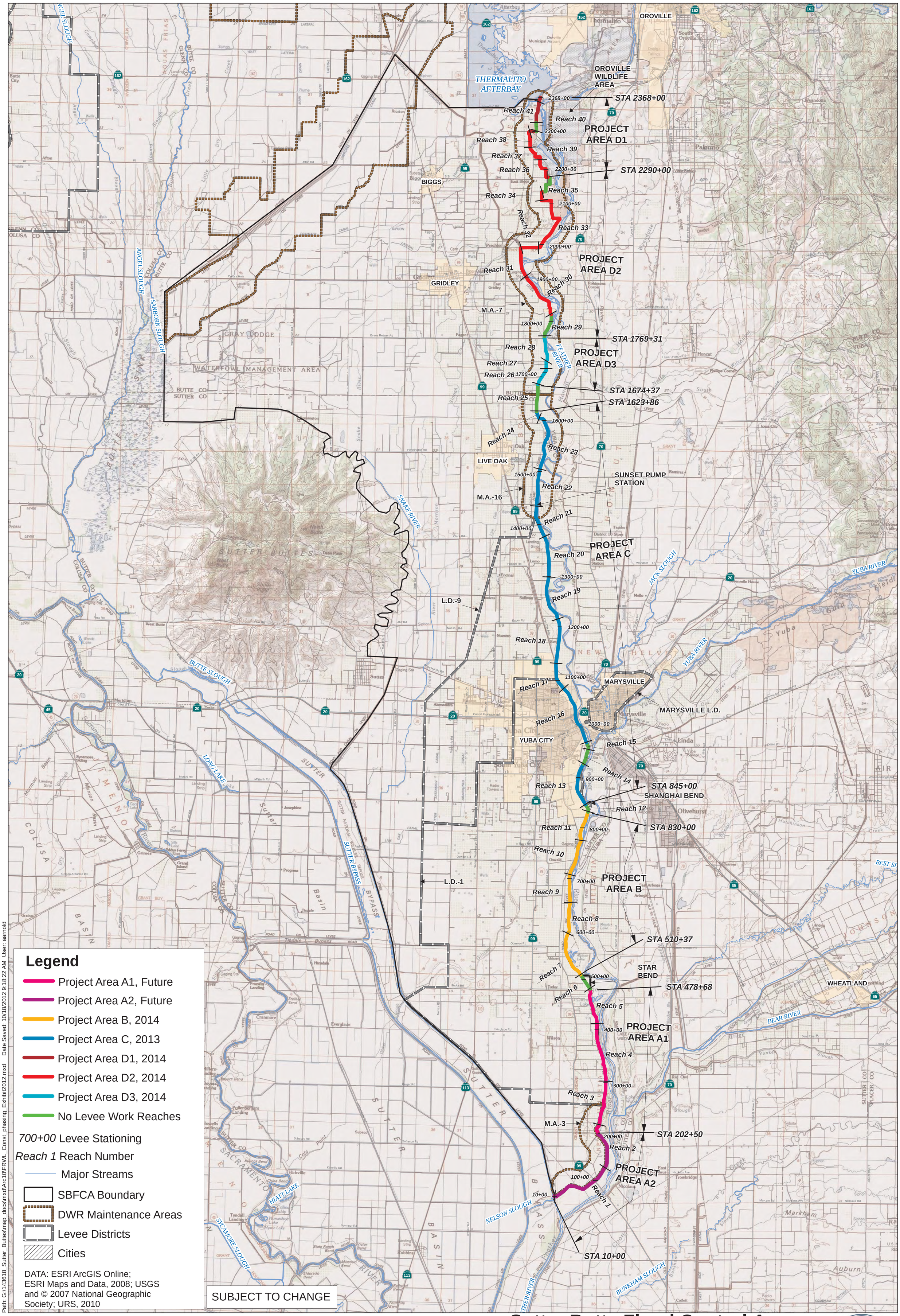


Source: Peterson Brustad, Inc. 2010. Sutter Butte Flood Control Agency's Early Implementation Program Project Report for the Feather River West Levee Rehabilitation Project. Figure 8

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Plate 3.1-2
Upper Feather River Freeboard Profile

Attachment I - Construction Phasing Map



Legend

- Project Area A1, Future
- Project Area A2, Future
- Project Area B, 2014
- Project Area C, 2013
- Project Area D1, 2014
- Project Area D2, 2014
- Project Area D3, 2014
- No Levee Work Reaches

700+00 Levee Stationing

Reach 1 Reach Number

Major Streams

SBFCA Boundary

DWR Maintenance Areas

Levee Districts

Cities

DATA: ESRI ArcGIS Online; ESRI Maps and Data, 2008; USGS and © 2007 National Geographic Society; URS, 2010

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1 in = 1.5 miles

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HDR ONE COMPANY | *Many Solutions* SM

Sutter Butte Flood Control Agency
Feather River West Levee
Construction Phasing Plan

August, 2012